SERVICE MANUAL (Vol. 1 of 2)

LANOS

FOREWORD

This manual includes procedure for maintenance, adjustment, service operation and removal and installation of components.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of manual approval.

The right is reserved to make changes at any time without notice.

DAEWOO MOTOR CO., LTD.

INCHON, KOREA

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Performance – Manual Transaxle

Application	1.3L SOHC	1.5L SOHC	1.6L DOHC
Maximum Speed	166 km/h (103.2 mph)	172 km/h (106.9 mph)	180 km/h (111.8 mph)
Gradeability	0.43 (tan j)	0.5 (tan j)	0.5 (tan j)
Minimum Turning Radius	4.9 m (16 ft)	4.9 m (16 ft)	4.9 m (16 ft)

Performance – Automatic Transaxle

Application	1.3L SOHC	1.5L SOHC	1.6L DOHC
Maximum Speed	-	161 km/h (100.0 mph)	173 km/h (107.5 mph)
Gradeability	-	0.59 (tan j)	0.59 (tan j)
Minimum Turning Radius	-	4.9 m (16 ft)	4.9 m (16 ft)

Engine

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Engine Type	Overhead Cam L–4	Overhead Cam L–4	Overhead Cam L–4
Bore	76.5 mm (3.01 in.)	76.5 mm (3.01 in.)	79.0 mm (3.11 in.)
Stroke	73.4 mm (2.89 in.)	81.5 mm (3.21 in.)	81.5 mm (3.21 in.)
Total Displacement	1 349 cm^3 (82.3 in^3)	1 498 cm^3 (91.4 in^3)	1 598 cm^3 (97.5 in^3)
Compression Ratio	9.5:1	9.5:1	9.5:1
Maximum Power	55 kw (74 bhp) (at 5,400 rpm)	63 kw (84 bhp) (at 5,800 rpm)	77.8 kw (104 bhp) (at 6,000 rpm)
Maximum Torque	115 N·m (85 lb–ft) (at 3,400 rpm)	130 N·m (96 lb–ft) (at 3,400 rpm)	145.3 N·m (107.17 lb–ft) (at 3,400 rpm)

Ignition System

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Ignition Type	Direct Ignition System	Direct Ignition System	Direct Ignition System
Ignition Timing	10° (BTDC)	10° (BTDC)	10° (BTDC)
Ignition Sequence	1–3–4–2	1–3–4–2	1–3–4–2
Spark Plug Gap	0.70–0.80 mm (0.028–0.031 in.)	0.70–0.80 mm (0.028–0.031 in.)	1.00–1.10 mm (0.039–0.043 in.)
Spark Plug Maker	Champion / Woojin	Champion / Woojin	Woojin
Spark Plug Type	RN9YC / BPR6ES	RN9YC / BPR6ES	BKR6E–11

Clutch – Manual Transaxle

Application	1.3L SOHC	1.5L SOHC	1.6L DOHC
Type	Single Dry Plate	Single Dry Plate	Single Dry Plate
Outside Diameter	184 mm (7.2 in.)	200 mm (7.9 in.)	215 mm (8.5 in.)
Inside Diameter	127 mm (5.0 in.)	134 mm (5.3 in.)	145 mm (5.7 in.)
Thickness	7.65 mm (0.301 in.)	7.65 mm (0.301 in.)	7.65 mm (0.301 in.)
Fluid	Common Use; Brake Fluid	Common Use; Brake Fluid	Common Use; Brake Fluid

Manual Transaxle

Application	1.3L SOHC Wide Ratio	1.5L SOHC Medium Ratio	1.6L DOHC Close Ratio
Maker	DWMC	DWMC	DWMC
Type or Model	D–16	D–16	D–16
Gear Ratio:			
1st	3.545:1	3.545:1	3.545:1
2nd	1.952:1	2.048:1	2.158:1
3rd	1.276:1	1.346:1	1.478:1
4th	0.892:1	0.971:1	1.129:1
5th	0.707:1	0.763:1	0.886:1
Reverse	3.333:1	3.333:1	3.333:1
Final Drive Ratio	3.944:1	4.176:1	3.722:1
Oil Capacity	1.8L (2 qt)	1.8L (2 qt)	1.8L (2 qt)

Automatic Transaxle

Application	1.3L SOHC	1.5L SOHC	1.6L DOHC
Maker	-	General Motors	General Motors
Type or Model	-	4T40E	4T40E
Gear Ratio: 1st	-	2.957:1	2.957:1
2nd	-	1.623:1	1.623:1
3rd	-	1.000:1	1.000:1
4th	-	0.682:1	0.682:1
Reverse	-	2.143:1	2.143:1
Final Drive Ratio	-	3.91:1	3.91:1
Oil Capacity	-	11.5L (12 qt)	11.5L (12 qt)

Brake

Application	1.3L SOHC Manual Transaxle	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Booster Size	228.6 mm (9.00 in.)	228.6 mm (9.00 in.)	228.6 mm (9.00 in.)
Master Cylinder Diameter	20.64 mm (0.813 in.)	20.64 mm (0.813 in.)	22.22 mm (0.875 in.)
Booster Ratio	5.0:1	5.0:1	5.0:1
Front Brake: Disc Type	Ventilated	Ventilated	Ventilated
Rear Brake: Drum Inside Diameter	200 mm (7.9 in.)	200 mm (7.9 in.)	200 mm (7.9 in.)
Wheel Cylinder Diameter	17.46 mm (0.687 in.)	17.46 mm (0.687 in.)	19.05 mm (0.750 in.)
Fluid Capacity	0.5L (0.5 qt)	0.5L (0.5 qt)	0.5L (0.5 qt)

Tire and Wheel

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Tire Size	155/80R13 175/70R13	175/70R13	185/60R14
Standard Wheel Size	5J X 13 (Steel)	5J X 13 (Steel)	5.5J X 14 (Steel)
Optional Wheel Size	-	-	5.5J X 14 (Aluminum)
Inflation Pressure at Full Load: 155/80R13	35 psi	-	-
175/70R13	32 psi	32 psi	-
185/60R14	-	-	32 psi

Steering System

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Gear Type	Power/Manual Rack and Pinion	Power/Manual Rack and Pinion	Power/Manual Rack and Pinion
Overall Gear Ratio Manual Steering Power Steering	24.5:1 16.12:1	- 16.12:1	- 16.12:1
Wheel Diameter	380 mm (15.0 in.)	380 mm (15.0 in.)	380 mm (15.0 in.)
Wheel Alignment: Front: ToeǴn	- 10iǴ+10i (- 1Ǵ+1 mm) (- 0.04Ǵ+0.04 in.)	- 10iǴ+10i (- 1Ǵ+1 mm) (- 0.04Ǵ+0.04 in.)	- 10iǴ+10i (- 1Ǵ+1 mm) (- 0.04Ǵ+0.04 in.)
Caster: Manual Steering	30iǴ2_30i	-	-
Power Steering	1_45iǴ3_45i	1_45iǴ3_45i	1_45iǴ3_45i
Camber	- 1_10iǴ+20i	- 1_10iǴ+20i	- 1_10iǴ+20i
Rear: ToeǴn	- 10iǴ+40i (- 1Ǵ+4 mm) (- 0.04Ǵ+0.16 in.)	- 10iǴ+40i (- 1Ǵ+4 mm) (- 0.04Ǵ+0.16 in.)	- 10iǴ+40i (- 1Ǵ+4 mm) (- 0.04Ǵ+0.16 in.)
Camber	- 2_10iǴ- 1_10i	- 2_10iǴ- 1_10i	- 2_10iǴ- 1_10i
Oil Capacity	1.0L (1 qt)	1.0L (1 qt)	1.0L (1 qt)

Suspension

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Front type	MacPherson Strut	MacPherson Strut	MacPherson Strut
Rear type	Compound Link	Compound Link	Compound Link

Fuel System

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Fuel Delivery	MPI	MPI	MPI
Fuel Pump Type	Electric Motor Pump	Electric Motor Pump	Electric Motor Pump
Fuel Filter Type	Cartridge	Cartridge	Cartridge
Fuel Capacity	48L (12.7 gal)	48L (12.7 gal)	48L (12.7 gal)

Lubricating System

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Lubricating Type	Forced Feed	Forced Feed	Forced Feed
Oil Pump Type	Duocentric Rotor	Duocentric Rotor	Duocentric Rotor
Oil Filter Type	Cartridge (Full Flow)	Cartridge (Full Flow)	Cartridge (Full Flow)
Oil Pan Capacity Including Oil Filter	3.75L (4 qt)	3.75L (4 qt)	3.75L (4 qt)

Cooling System

Application	1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Cooling Type	Forced Water Circulation	Forced Water Circulation	Forced Water Circulation
Radiator Type	Cross-Flow	Cross-Flow	Cross-Flow
Water Pump Type	Centrifugal	Centrifugal	Centrifugal
Thermostat Type	Pellet Type	Pellet Type	Pellet Type
Coolant Capacity: Standard	7.0L (7 qt)	7.0L (7 qt)	7.0L (7 qt)
Heavy Duty	7.0L (7 qt)	7.0L (7 qt)	7.0L (7 qt)

Electric System

Application		1.3L SOHC Manual	1.5L SOHC Manual and Automatic	1.6L DOHC Manual and Automatic
Battery	General Area	550 Cold Cranking Amps	550 Cold Cranking Amps	550 Cold Cranking Amps
	Some Countries Only	430 Cold Cranking Amps	430 Cold Cranking Amps	430 Cold Cranking Amps
Alternator	General Area	85 Amps	85 Amps	85 Amps
	Hot Area Only	95 Amps	95 Amps	95 Amps
Starter (No-Load Test Current Draw)	0.8 (kW)	Maximum 53 (Amps) (at 11.5 Volts)	Maximum 53 (Amps) (at 11.5 Volts)	Maximum 53 (Amps) (at 11.5 Volts)
	1.4 (kW)	Minimum 40 Amps Maximum 90 (Amps) (at 12.2 Volts)	Minimum 40 Amps Maximum 90 (Amps) (at 12.2 Volts)	Minimum 40 Amps Maximum 90 (Amps) (at 12.2 Volts)

VEHICLE DIMENSIONS AND WEIGHTS

Vehicle Dimensions – Manual and Automatic

Application	1.3L SOHC	1.5L SOHC	1.6L SOHC
Overall Length: 3 Door	4 074 mm (160.4 in.)	4 074 mm (160.4 in.)	4 074 mm (160.4 in.)
4 Door	4 237 mm (166.8 in.)	4 237 mm (166.8 in.)	4 237 mm (166.8 in.)
5 Door	4 074 mm (160.4 in.)	4 074 mm (160.4 in.)	4 074 mm (160.4 in.)
Overhang: Front: – 3 Door	838 mm (33.0 in.)	838 mm (33.0 in.)	838 mm (33.0 in.)
– 4 Door	838 mm (33.0 in.)	838 mm (33.0 in.)	838 mm (33.0 in.)
– 5 Door	838 mm (33.0 in.)	838 mm (33.0 in.)	838 mm (33.0 in.)
Rear: – 3 Door	716 mm (28.2 in.)	716 mm (28.2 in.)	716 mm (28.2 in.)
– 4 Door	879 mm (34.6 in.)	879 mm (34.6 in.)	879 mm (34.6 in.)
– 5 Door	716 mm (28.2 in.)	716 mm (28.2 in.)	716 mm (28.2 in.)
Overall Width	1 678 mm (66.1 in.)	1 678 mm (66.1 in.)	1 678 mm (66.1 in.)
Overall Height	1 432 mm (56.4 in.)	1 432 mm (56.4 in.)	1 432 mm (56.4 in.)
Minimum Ground Clearance	160 mm (6.3 in.)	160 mm (6.3 in.)	160 mm (6.3 in.)
Wheel Base	2 520 mm (99.2 in.)	2 520 mm (99.2 in.)	2 520 mm (99.2 in.)
Tread: Front	1 405 mm (55.3 in.)	1 405 mm (55.3 in.)	1 405 mm (55.3 in.)
Rear	1 425 mm (56.1 in.)	1 425 mm (56.1 in.)	1 425 mm (56.1 in.)

Vehicle Weights – 3 Door

Application	1.3L SOHC	1.5L SOHC	1.6L DOHC
Manual: Curb Weight: – Standard	1 005 kg (2,216 lb)	1 011 kg (2,229 lb)	1 031 kg (2,273 lb)
– Optional	1 071 kg (2,361 lb)	1 077 kg (2,374 lb)	1 097 kg (2,418 lb)
Gross Vehicle Weight	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Automatic: Curb Weight: – Standard	-	1 047 kg (2,308 lb)	1 067 kg (2,352 lb)
– Optional	-	1 113 kg (2,454 lb)	1 133 kg (2,498 lb)
Gross Vehicle Weight	-	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Passenger Capacity	5	5	5

Vehicle Weights - 4 Door

Application	1.3L SOHC	1.5L SOHC	1.5L DOHC
Manual: Curb Weight: • Standard	1 030 kg (2,271 lb)	1 036 kg (2,284 lb)	1 056 kg (2,328 lb)
• Optional	1 096 kg (2,416 lb)	1 102 kg (2,430 lb)	1 122 kg (2,474 lb)
Gross Vehicle Weight	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Automatic: Curb Weight: • Standard	-	1 072 kg (2,363 lb)	1 092 kg (2,407 lb)
• Optional	-	1 138 kg (2,509 lb)	1 158 kg (2,553 lb)
Gross Vehicle Weight	-	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Passenger Capacity	5	5	5

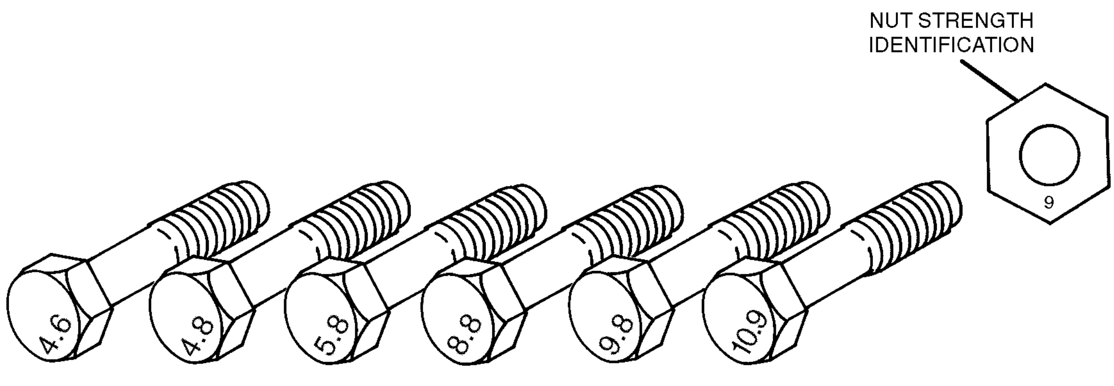
Vehicle Weights - 5 Door

Application	1.3L SOHC	1.5L SOHC	1.5L DOHC
Manual: Curb Weight: • Standard	1 015 kg (2,238 lb)	1 021 kg (2,251 lb)	1 041 kg (2,295 lb)
• Optional	1 081 kg (2,383 lb)	1 087 kg (2,396 lb)	1 107 kg (2,440 lb)
Gross Vehicle Weight	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Automatic: Curb Weight: • Standard	-	1 057 kg (2,330 lb)	1 077 kg (2,374 lb)
• Optional	-	1 123 kg (2,476 lb)	1 143 kg (2,520 lb)
Gross Vehicle Weight	-	1 595 kg (3,516 lb)	1 595 kg (3,516 lb)
Passenger Capacity	5	5	5

Optional Weight: Air Conditioner, Power Steering, ABS, Sun Roof, Airbag

STANDARD BOLT SPECIFICATIONS

Bolt*	4T - Low Carbon Steel	7T - High Carbon Steel	7T - Alloy Steel
M6 X 1.0	4.1–8.1 N·m (36–72 lb·in)	4.1–9.5 N·m (48–84 lb·in)	–
M8 X 1.25	8.1–17.6 N·m (72–156 lb·in)	12.2–23.0 N·m (108–204 lb·in)	16–30 N·m (12–22 lb·ft)
M10 X 1.25	20–34 N·m (15–25 lb·ft)	27–46 N·m (20–34 lb·ft)	37–62 N·m (27–46 lb·ft)
M10 X 1.5	19–34 N·m (14–25 lb·ft)	27–45 N·m (20–33 lb·ft)	37–60 N·m (27–44 lb·ft)
M12 X 1.25	49–73 N·m (36–54 lb·ft)	61–91 N·m (45–67 lb·ft)	76–114 N·m (56–84 lb·ft)
M12 X 1.75	45–69 N·m (33–51 lb·ft)	57–84 N·m (42–62 lb·ft)	72–107 N·m (53–79 lb·ft)
M14 X 1.5	76–115 N·m (56–85 lb·ft)	94–140 N·m (69–103 lb·ft)	114–171 N·m (84–126 lb·ft)
M14 X 2.0	72–107 N·m (53–79 lb·ft)	88–132 N·m (65–97 lb·ft)	107–160 N·m (79–118 lb·ft)
M16 X 1.5	104–157 N·m (77–116 lb·ft)	136–203 N·m (100–150 lb·ft)	160–240 N·m (118–177 lb·ft)
M16 X 2.0	100–149 N·m (74–110 lb·ft)	129–194 N·m (95–143 lb·ft)	153–229 N·m (113–169 lb·ft)
M18 X 1.5	151–225 N·m (111–166 lb·ft)	195–293 N·m (144–216 lb·ft)	229–346 N·m (169–255 lb·ft)
M20 X 1.5	206–311 N·m (152–229 lb·ft)	270–405 N·m (199–299 lb·ft)	317–476 N·m (234–351 lb·ft)
M22 X 1.5	251–414 N·m (185–305 lb·ft)	363–544 N·m (268–401 lb·ft)	424–636 N·m (313–469 lb·ft)
M24 X 2.0	359–540 N·m (265–398 lb·ft)	431–710 N·m (318–524 lb·ft)	555–831 N·m (409–613 lb·ft)
*Diameter X pitch in millimeters			



METRIC BOLTS—IDENTIFICATION CLASS NUMBERS CORRESPOND TO BOLT STRENGTH—INCRREASING NUMBERS REPRESENT INCREASING STRENGTH.

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MAINTENANCE AND REPAIR

MAINTENANCE AND LUBRICATION

NORMAL VEHICLE USE

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

- To carry passengers and cargo within the limitation indicated on the tire placard located on the edge of the driver's door.
- To be driven on reasonable road surfaces and within legal operating limits.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in the maintenance schedule are further explained below. When the following maintenance services are performed, make sure all the parts are replaced and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

Drive Belt Inspection

When a separate belt drives the power steering pump, the air conditioning compressor and the generator, inspect it for cracks, fraying, wear and proper tension. Adjust or replace the belt as needed.

Engine Oil and Oil Filter Change

Always use above the API SH grade or ACEA A1/A2/A3 engine oil. The SH designation may be shown alone or in combination with other designations such as SH/CC, SH/CD etc.

Engine Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

Cooling System Service

Drain, flush and refill the system with new coolant. Refer to "Recommended Fluids And Lubricants" in this section.

Fuel Micro-Filter Replacement

Replace the engine fuel filter every 40,000 km (24,000 miles).

The engine fuel filter is located on the center dash panel near the brake booster.

Air Cleaner Element Replacement

Replace the air cleaner element every 40,000 km (24,000 miles).

Replace the air cleaner more often under dusty conditions.

Throttle Body Mounting Bolt Torque

Check the torque of the mounting bolts.

Tighten the throttle body mounting bolts to 17 N•m (12 lb-ft) if necessary.

Spark Plug Replacement

Replace spark plugs with same type.

- Type: AC Type RN9YC (SOHC)
  BPR6ES (SOHC)
  BKR6E-11 (DOHC)
- Gap
  0.7-0.8 mm (SOHC)
  1.0-1.1 mm (DOHC)

Spark Plug Wire Replacement

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the DIS module and at the spark plugs. Replace the wires as needed.

Brake System Service

Check the disc brake pads or the drum brake linings every 10,000 km (6,000 miles) or 12 months. Check the pad and the lining thickness carefully. If the pads or the linings are not expected to last another 10,000 km (6,000 miles), replace the pads or the linings. Check the breather hole in the brake fluid reservoir cap to be sure it is free from dirt and the passage is open.

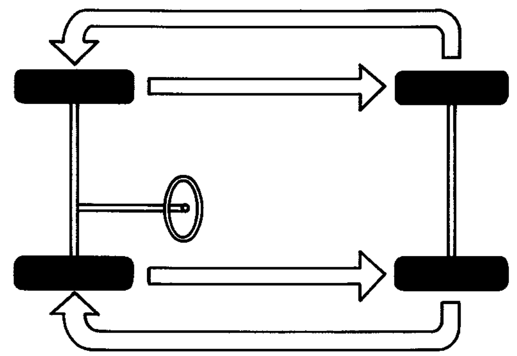
Transaxle Service

The manual transaxle fluid does not require changing. For automatic transaxles, refer to "Scheduled Maintenance Charts" in this section.

Tire and Wheel Inspection and Rotation

Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes. Refer to "Each Time The Oil Is Changed" in this section.

Tire Rotation



SCHEDULED MAINTENANCE CHARTS

Engine

Maintenance Item	Maintenance Interval										
	Kilometers (miles) or time in months, whichever comes first										
Kilometers x 1000	1	10	20	30	40	50	60	70	80	90	100
MIles x 1000	0.6	6	12	18	24	30	36	42	48	54	60
Months	—	6	12	18	24	30	36	42	48	54	60
Drive belts (alternator, power steering)	I	I	I	I	I	I	R	I	I	I	I
Engine oil and oil filter[1, 3]	I	R	R	R	R	R	R	R	R	R	R
Cooling system and hose connections		I	I	I	I	I	I	I	I	I	I
Engine coolant[3]	I	I	I	I	R	I		I	R	I	I
Fuel filter					R				R		
Fuel line and connections			I		I		I		I		I
Air cleaner element[2]		I	I	I	R	I	I	I	R	I	I
Ignition timing			I		I		I		I		I
Spark plugs		I	R	I	R	I	R	I	R	I	R
DIS Module			I		I		I		I		I
Charcoal canister and vapor lines					I				I		
PCV system				I			I			I	
Camshaft belt							I			R	

Chart Symbols:

I - Inspect and, if necessary, correct, clean, replenish or adjust.

R - Replace or change.

1 If the vehicle is operated under severe conditions, such as short distance driving, extensive idling, or driving in dusty conditions, change the engine oil and the filter every 5,000 km (3,000 miles) or 3 months, whichever comes first.

2 More frequently if driving in dusty conditions.

3 Refer to "Recommended Fluids And Lubricants" in this section.

Chassis and Body

Maintenance Item	Maintenance Interval										
	Kilometers (miles) or time in months, whichever comes first										
Kilometers x 1000	1	10	20	30	40	50	60	70	80	90	100
MIles x 1000	0.6	6	12	18	24	30	36	42	48	54	60
Months	—	6	12	18	24	30	36	42	48	54	60
Exhaust pipe and mountings		I	I	I	I	I	I	I	I	I	I
Brake/Clutch fluid[1, 5]	I	I	I	R	I	I	R	I	I	R	I
Rear brake drums and linings[3]		I	I	I	I	I	I	I	I	I	I
Front brake pads and discs[3]		I	I	I	I	I	I	I	I	I	I
Parking brake	I	I	I	I	I	I	I	I	I	I	I
Brake line and connections (including booster)		I	I	I	I	I	I	I	I	I	I
Rear hub bearing and clearance		I	I	I	I	I	I	I	I	I	I
Manual transaxle oil[1]		I	I	I	I	I	I	I	I	I	I
Clutch and brake pedal free play		I	I	I	I	I	I	I	I	I	I
Automatic transaxle fluid*[1, 4]	I	I	I	I	I	I	I	I	I	I	I
Tighten chassis and underbody bolts and nuts		I	I	I	I	I	I	I	I	I	I
Tire condition and inflation pressure	I	I	I	I	I	I	I	I	I	I	I
Wheel alignment[2]	Inspect when abnormal condition is noted										
Steering wheel and linkage		I	I	I	I	I	I	I	I	I	I
Power steering fluid and lines*[1]	I	I	I	I	I	I	I	I	I	I	I
Drive shaft boots		I	I	I	I	I	I	I	I	I	I
Seat belts, buckles and anchors		I	I	I	I	I	I	I	I	I	I
Lubricate locks, hinges and hood latch		I	I	I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect and, if necessary, correct, clean, replenish, or adjust.

R - Replace or change.

1 Refer to "Recommended Fluids And Lubricants" in this section.

2 And, if necessary, rotate and balance the wheels.

3 More frequently if operated under severe conditions which include the following: short distance driving, extensive idling, frequent low-speed operation in stop-and-go traffic, or driving in dusty conditions.

4 The automatic transaxle fluid and filter do not require changing, unless operated under any of these conditions: heavy city driving where the temperature regularly reaches 32°C (90°F) or higher, hilly terrain, frequent trailer towing, or taxi, police or delivery service driving. If operated under any of these conditions, change the fluid and the filter every 75,000 km (45,000 miles).

5 Change the brake/clutch fluid every 15,000 km (9,000 miles) if the vehicle is mainly driven under the following severe conditions: driving in hilly or mountainous terrain, or towing a trailer/caravan frequently.

OWNER INSPECTIONS AND SERVICES

WHILE OPERATING THE VEHICLE

Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes. These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or if unusual sounds are noticed when turning or parking.

Headlight Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

AT EACH FUEL FILL

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

Engine Oil Level

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the MIN line and within the area labeled "Operating Range." Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

Engine Coolant Level and Condition

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

Windshield Washer Fluid Level

Check the washer fluid level in the reservoir. Add fluid if necessary.

AT LEAST MONTHLY

Tire And Wheel Inspection and Pressure Check

Check the tires for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stowaway). Maintain the recommended pressures that are on the tire placard that is in the glove box.

Light Operation

Check the operation of the license plate light, the headlights (including the high beams), the parking lights, the fog lights, the taillight, the brake lights, the turn signals, the backup lights and the hazard warning flasher.

Fluid Leak Check

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

AT LEAST TWICE A YEAR

Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 5A, Power Steering System.

Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open passage.

Clutch Pedal Free Travel

Check clutch pedal free travel and adjust as necessary every 10,000 km (6,000 miles). Measure the distance from the center of the clutch pedal to the outer edge of the steering wheel with the clutch pedal not depressed. Then measure the distance from the center of the clutch pedal to the outer edge of the steering wheel with the clutch pedal fully depressed. The difference between the two values must be greater than 130 mm (5.19 inches).

Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

EACH TIME THE OIL IS CHANGED

Automatic Transaxle Fluid

Refer to 4T40E fluid level service procedure of Section 3A, 4T40E Automatic Transaxle.

Manual Transaxle

Check the fluid level and add fluid as required. Refer to Section 3B, Five-Speed Manual Transaxle.

Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Also inspect the drum brake linings for wear and cracks. Inspect other brake parts, including the drums, the wheels cylinders, the parking brake, etc., at the same time. Check the parking brake adjustment. Inspect the brakes more often if habit or conditions result in frequent braking.

Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-of-position parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle Linkage Inspection

Inspect the throttle linkage for interference or binding, damaged, or missing parts. Lubricate all linkage joints and throttle cable joints, the intermediate throttle shaft bearing, the return spring at throttle valve assembly, and the accelerator pedal sliding face with suitable grease. Check the throttle cable for free movements.

Engine Drive Belts

Inspect all belts for cracks, fraying, wear and proper tension. Adjust or replace the belts as needed.

Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

AT LEAST ANNUALLY

Lap and Shoulder Belts Condition and Operation

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

Movable Head Restraint Operation

On vehicles with movable head restraints, the restraints must stay in the desired position.

Spare Tire and Jack Storage

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

Key Lock Service

Lubricate the key lock cylinder.

Body Lubrication Service

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

Transaxle Neutral Switch Operation on Automatic Transaxle

Caution: Take the following precautions because the vehicle could move without warning and possibly cause personal injury or property damage:

- Firmly apply the parking brake and the regular brakes.
- Do not use the accelerator pedal.
- Be ready to promptly turn off the ignition if the vehicle starts.

On automatic transaxle vehicles, try to start the engine in each gear. The starter should crank only in P (Park) or N (Neutral).

Parking Brake and Transaxle P (Park) Mechanism Operation

Caution: In order to reduce the risk of personal injury or property damage, be prepared to apply the regular brakes promptly if the vehicle begins to move.

Park on a fairly steep hill with enough room for movement in the downhill direction. To check the parking brake, with the engine running and the transaxle in N (Neutral), slowly remove foot pressure from the regular brake pedal (until only the parking brake is holding the vehicle).

To check the automatic transaxle P (Park) mechanism's holding ability, release all brakes after shifting the transaxle to P (Park).

Underbody Flushing

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

Engine Cooling System

Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps. Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

RECOMMENDED FLUIDS AND LUBRICANTS

Usage	Capacity	Fluid/Lubricant
Engine Oil	3.75L	API SH grade or ACEA A1/A2/A3 SAE 5W-30, SAE 10W-30, SAE 10W-40, SAE 15W-40 (Cold area: SAE 5W-30 Hot area: SAE 15W-40)
Engine Coolant	M/T (1.3L and 1.5L SOHC, 1.6L DOHC) - 7.0L A/T 1.5L SOHC and 1.6L DOHC) - 7.0L	Mixture of water and good quality ethylene glycol base antifreeze (year-round coolant)
Brake Fluid and Clutch Fluid	0.5L (0.53 qt)	DOT-3 or DOT-4
Power Steering System	1.0L (1.06 qt)	DEXRON®-III
Automatic Transaxle	11.5L (12.15 qt)	DEXRON®-III
Manual Transaxle	1.8L (1.90 qt)	Manual Transaxle Fluid (B0400075, SAE80 or equivalent)
Manual Transaxle Shift Linkage	As required	Multipurpose type grease meeting requirements NLGI No. 1 or 2
Key Lock Cylinders	As required	Silicone lubricant
Automatic Transaxle Shift Linkage	As required	Engine oil
Clutch Linkage Pivot Points	As required	Engine oil
Floor Shift Linkage Points	As required	Engine oil
Hood Latch Assembly a. Pivots and Spring Anchor b. Release Pawl	As required	 a. Engine oil b. Multipurpose type grease meeting requirements NLGI No. 1 or 2
Hood and door hinges Fuel door hinge Rear compartment lid hinges	As required	Engine oil
Weatherstrips	As required	Silicone grease

GENERAL DESCRIPTION AND SYSTEM OPERATION

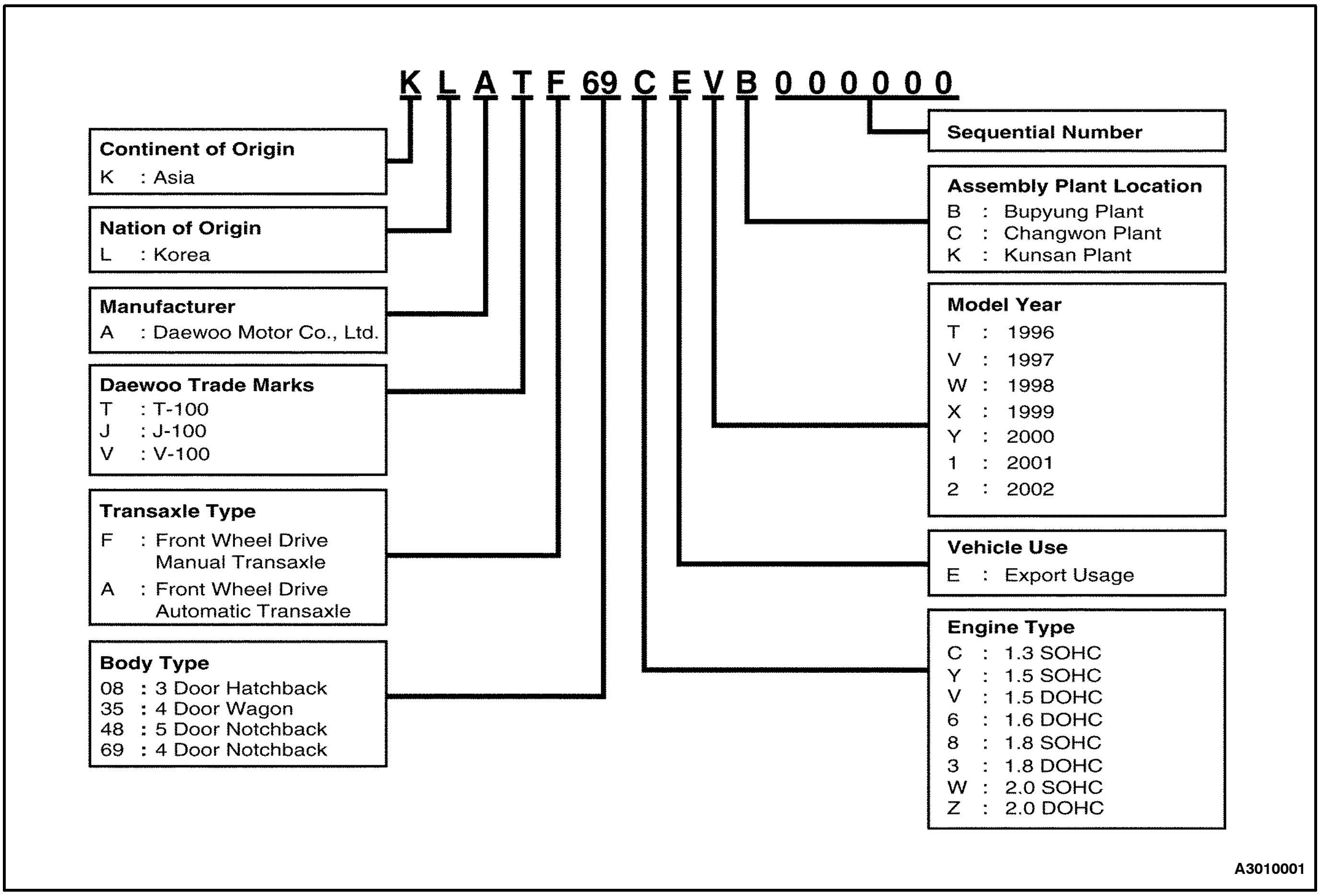
GENERAL REPAIR INSTRUCTIONS

- If a floor jack is used, the following precautions are recommended.
- Park the vehicle on level ground, "block" the front or rear wheels, set the jack against the frame, raise the vehicle and support it with chassis stands and then perform the service operation.
- Before performing the service operation, disconnect the negative battery cable in order to reduce the chance of cable damage and burning due to short-circuiting.
- Use a cover on the body, the seats and the floor to protect them against damage and contamination.
- Handle brake fluid and antifreeze solution with care as they can cause paint damage.
- The use of proper tools, and the recommended essential and available tools where specified, are important for efficient and reliable performance of the service repairs.
- Use genuine DAEWOO parts.
- Discard used cotter pins, gaskets, O-rings, oil seals, lock washers and self-locking nuts. Prepare new ones for installation. Normal function of these parts cannot be maintained if these parts are reused.
- Keep the disassembled parts neatly in groups to facilitate proper and smooth reassembly.
- Keep attaching bolts and nuts separated, as they vary in hardness and design depending on the position of the installation.
- Clean the parts before inspection or reassembly.
- Also clean the oil parts, etc. Use compressed air to make certain they are free of restrictions.
- Lubricate rotating and sliding faces of parts with oil or grease before installation.
- When necessary, use a sealer on gaskets to prevent leakage.
- Carefully observe all specifications for bolt and nut torques.
- When service operation is completed, make a final check to be sure service was done properly and the problem was corrected.

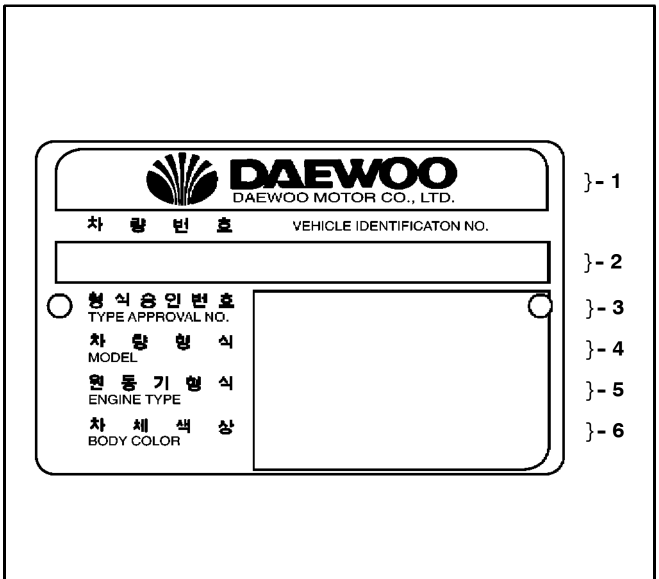
GENERAL DESCRIPTION

VEHICLE AND COMPONENT IDENTIFICATION

Passenger Car Vehicle Identification Number



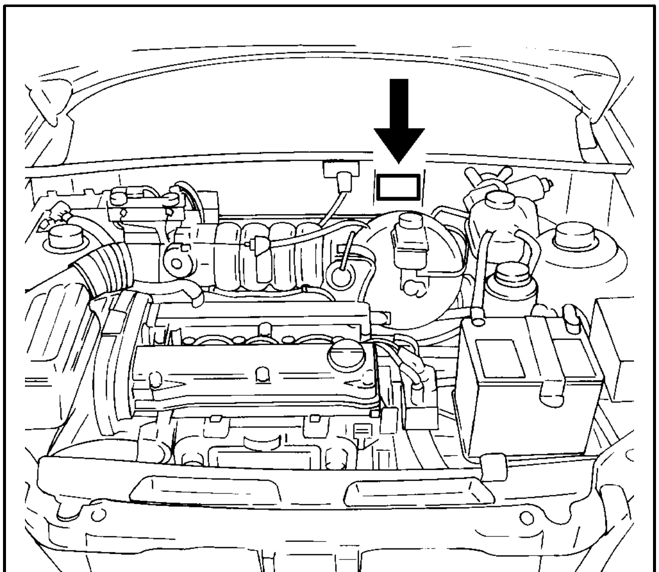
VIN Plate



A1010002

1 Manufacturer
2 Vehicle Identification Number
3 Blank
4 Vehicle Model
5 Engine Type
6 Body Color

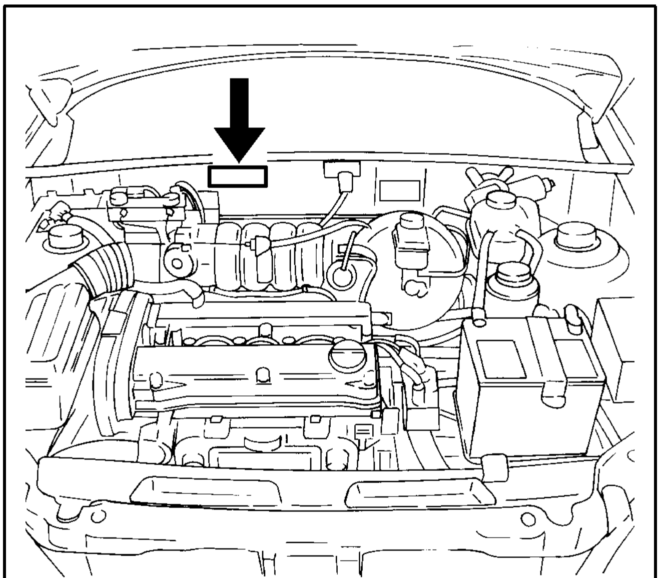
VIN Plate Location (Left-Hand Drive Shown, Right-Hand Drive Similar)



A3010005

The vehicle identification number (VIN) plate is attached to the top of the bulkhead, next to the wiper motor.

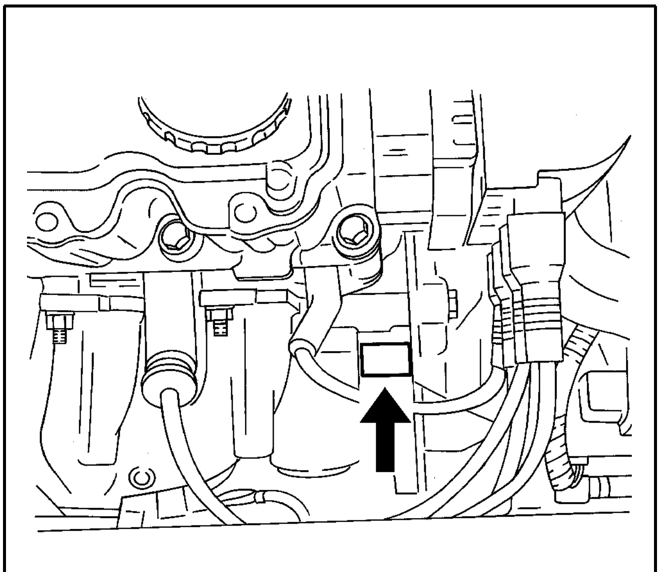
Engraved VIN Location (Left-Hand Drive Shown, Right-Hand Drive Similar)



A3010006

The vehicle identification number (VIN) is engraved in the top of the bulkhead, next to the ABS module.

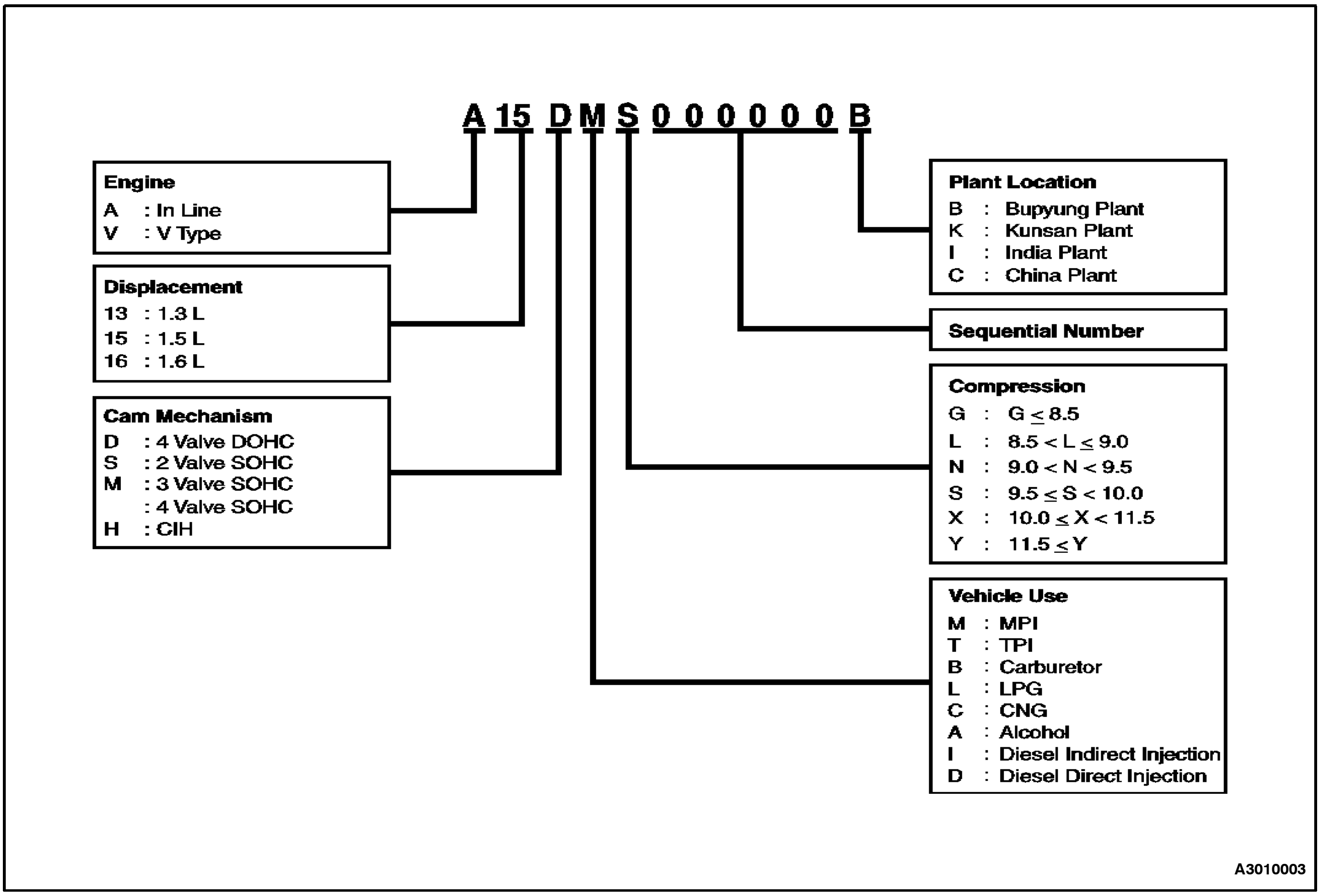
Engine Number Location - SOHC



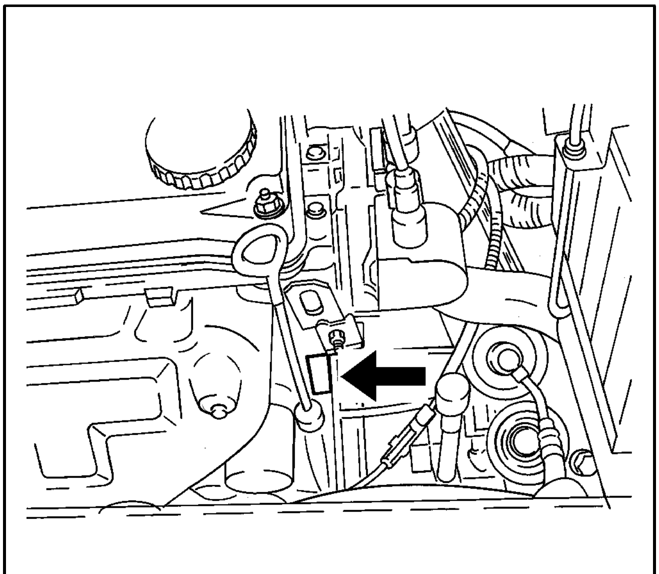
A3010007

The engine number is stamped on the cylinder block under the No. 4 exhaust manifold of the engine.

Engine Number



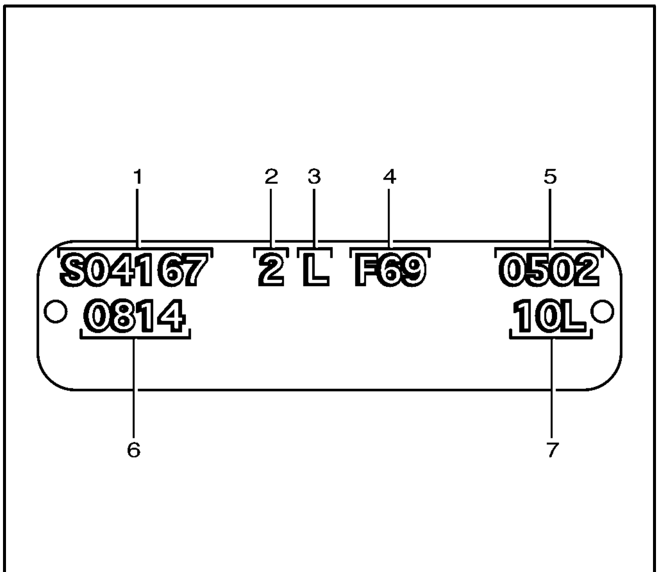
Engine Number Location - DOHC



A3010008

The engine number is stamped on the cylinder block under the No. 4 exhaust manifold of the engine.

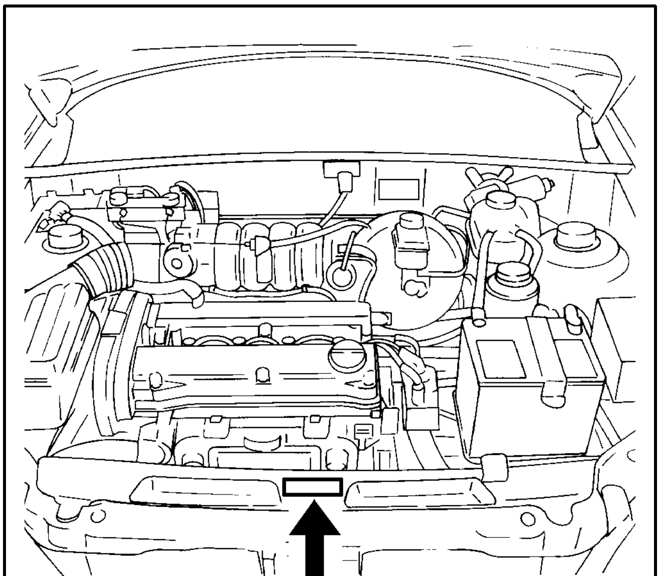
Body Identification Number Plate



A2010004

1 P/O Number
2 Check Digit
3 Drive
4 Body Type
5 P/O Date
6 Sequential Number
7 Exterior Color

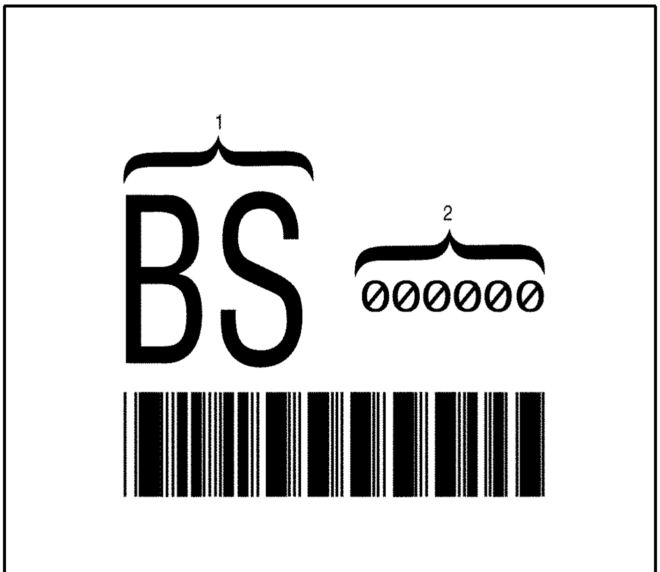
Body Identification Number Plate Location (Left-Hand Drive Shown, Right-Hand Drive Similar)



A3010009

The body identification number plate is attached to the top of the front panel support.

Manual Transmission Identification Number Plate

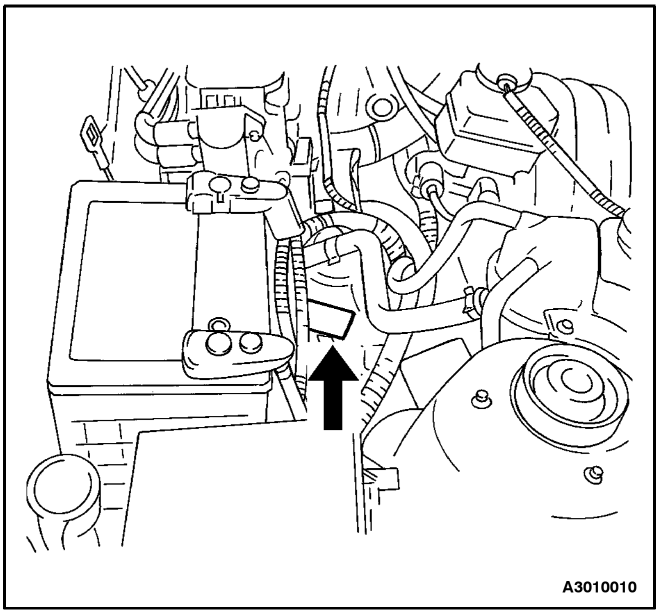


A3010004

1 Identification Code
2 Sequential Number

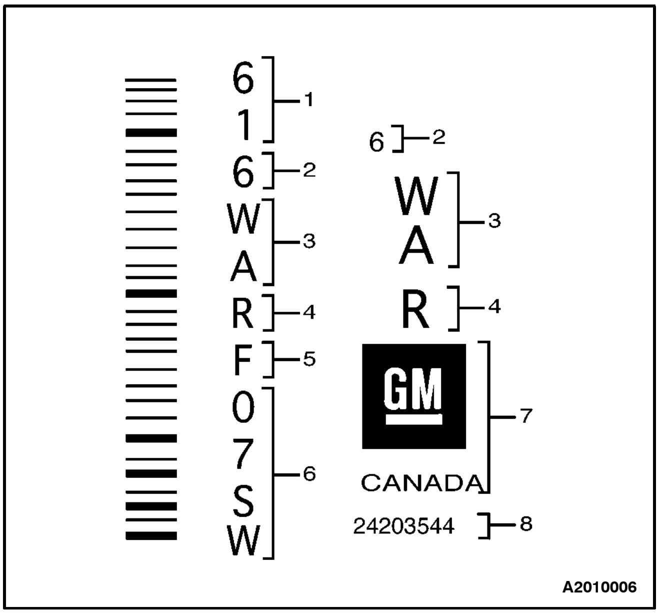
Identification Code	Engine	Gear Ratio
VG	1.3L SOHC	3.944 W/R
MA	1.5L SOHC	4.176 M/R
BS	1.6L DOHC	3.722 C/R

Manual Tranaaxle Identification Number Plate Location (Left-Hand Drive Shown, Right-Hand Drive Similar)



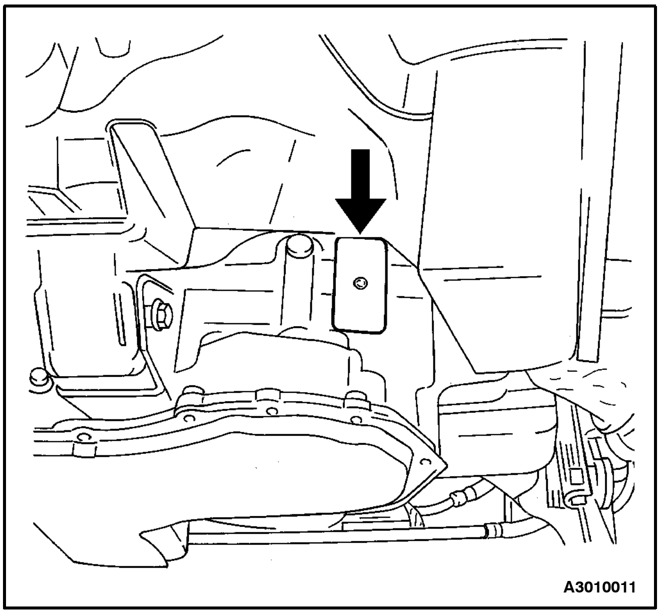
The manual transaxle identification number is attached to the top of the transmission case near the engine.

Automatic Transmission Identification Number Plate



1 Assembly Plant (Windsor, Canada)
2 Model Year (1996)
3 Broadcast Code
4 Model Name (4T40E)
5 Update Level
6 Sequential Number
7 Manufacturer
8 Part Number

Automatic Transaxle Identification Number Plate Location

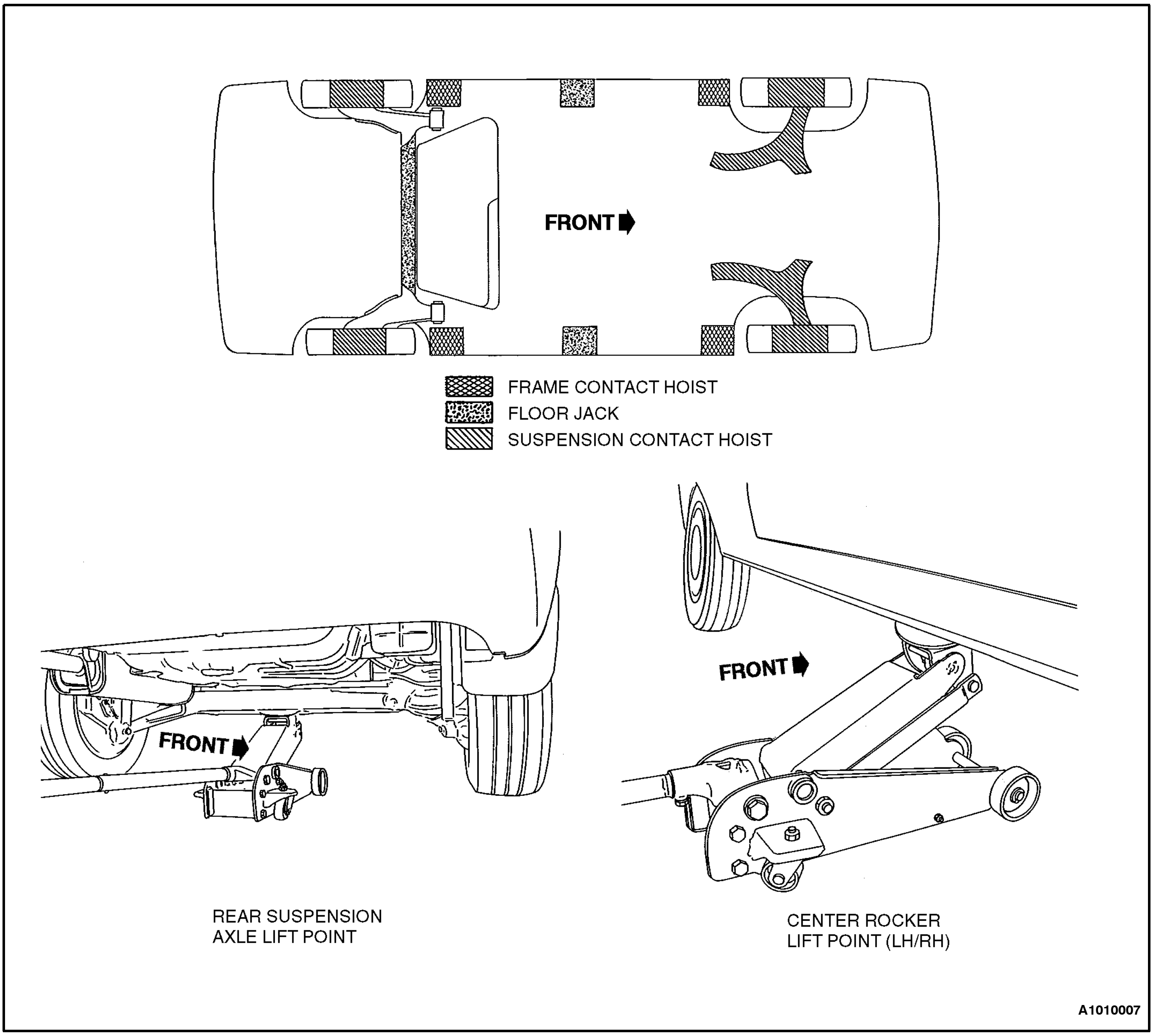


The automatic transaxle identification number plate is attached on the rear side of the transmission near the bulkhead.

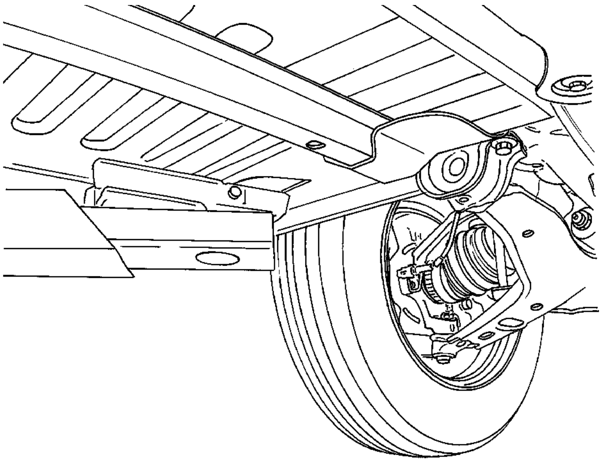
VEHICLE LIFTING PROCEDURES

Notice: To raise the vehicle, place the lifting equipment only at the points indicated. Failure to use these precise positions may result in permanent vehicle body deformation. Many dealer service facilities and service stations are equipped with automotive hoists that bear upon some parts of the frame in order to lift the vehicle. If any other hoist method is used, use special care to avoid damaging the fuel tank, the filler neck, the exhaust system, or the underbody.

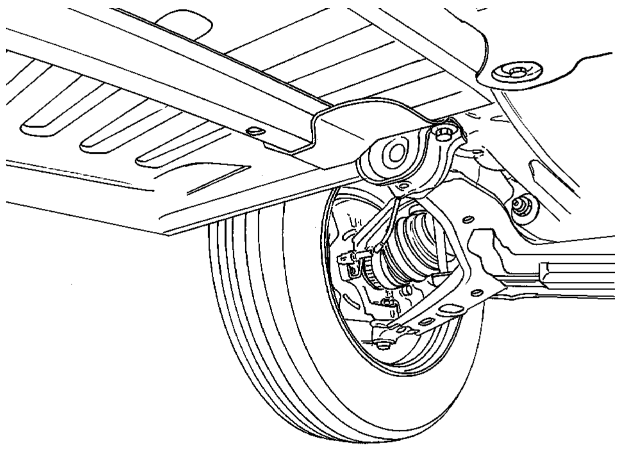
Vehicle Lifting Points



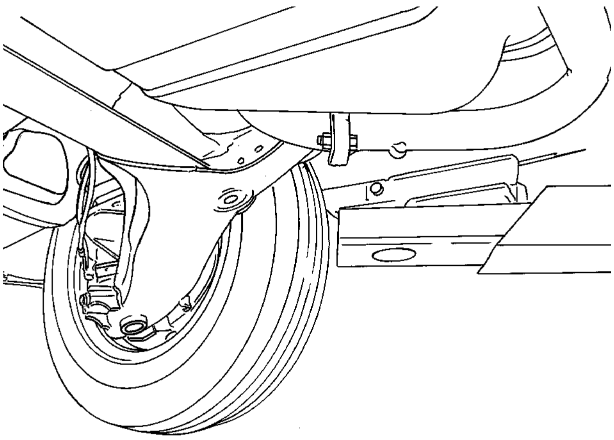
Vehicle Lifting Points



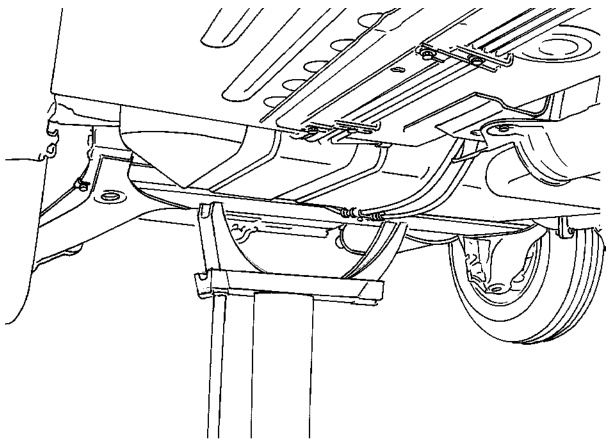
FRAME CONTACT HOIST
–REARWARD OF FRONT TIRE–



SUSPENSION CONTACT HOIST
–UNDER FRONT LOWER CONTROL ARM–



FRAME CONTACT HOIST
–FORWARD OF REAR TIRE–



SUSPENSION CONTACT HOIST
–LIFTING ON REAR AXLE–

A1010008

SECTION 1

ENGINE

SECTION 1A

GENERAL ENGINE INFORMATION

TABLE OF CONTENTS

DIAGNOSIS

COMPRESSION TEST

Important: Disconnect the Crankshaft Position Sensor (CPS) connector to disable the fuel and the ignition systems.

Test the compression pressure for each cylinder. Low compression pressure may be the fault of the valves or the pistons. The following conditions should be considered when you check the cylinder compression:

- The engine should be at normal operating temperature.
- The throttle must be wide open.
- All the spark plugs should be removed.
- The battery must be at or near full charge.

1. Place approximately three squirts of oil from a plunger type oiler into each spark plug port.
2. Insert the engine compression gauge into each spark plug port.
3. Crank test each cylinder with four to five compression strokes using the starter motor.
4. The lowest reading should not be less than 70% of the highest reading. The compression gauge reading should not be less than 689 kPa (100 psi) for any of the cylinders.
5. Examine the gauge readings obtained after the four "puffs" per cylinder are obtained from cranking the starter motor. The readings are explained in the following descriptions:

- Normal Condition - Compression builds up quickly and evenly to specified compression on each cylinder.
- Piston Rings Faulty - Compression is low on the first stroke and tends to build up on following strokes, but the compression pressure does not reach normal. The compression pressure improves considerably with the addition of oil into the cylinder.
- Valves Faulty - Low compression pressure on the first stroke. The compression pressure does not tend to build up on the following strokes. The compression pressure does not improve much with the addition of oil into the cylinder.

OIL PRESSURE TEST

Step	Action	Value(s)	Yes	No
1	Is low or no oil pressure indicated?	-	Go to Step 2	System OK
2	Check the oil level in the crankcase. Is the level low?	-	Go to Step 3	Go to Step 4
3	Add oil so that the oil level is up to the full mark on the indicator. Is the repair complete?	-	Go to Step 1	-
4	Check the idle speed. Is the idle speed below the value specified?	825 rpm	Go to Step 5	Go to Step 6
5	Increase the idle speed. Is the speed increased?	-	Go to Step 1	-
6	Inspect the oil pressure switch. Is the oil pressure switch incorrect or malfunctioning?	-	Go to Step 7	Go to Step 8
7	Install a new oil pressure switch. Is the repair complete?	-	Go to Step 1	-
8	Inspect the oil pressure gauge. Is the oil pressure gauge incorrect or malfunctioning?	-	Go to Step 9	Go to Step 10
9	Install a new oil pressure gauge. Is the repair complete?	-	Go to Step 1	-
10	Inspect the engine oil. Is the engine oil in the crankcase diluted or of the improper viscosity?	-	Go to Step 11	Go to Step 12
11	Install new engine oil of the proper viscosity for the expected temperatures. Is the repair complete?	-	Go to Step 1	-
12	Inspect the oil pump. Is the pump worn or dirty?	-	Go to Step 13	Go to Step 14
13	Replace the oil pump. Is the repair complete?	-	Go to Step 1	-
14	Inspect the oil filter. Is the oil filter plugged?	-	Go to Step 15	Go to Step 16
15	Install a new oil filter. Is the repair complete?	-	Go to Step 1	-
16	Inspect the oil pickup screen. Is the oil pickup screen loose or plugged?	-	Go to Step 17	Go to Step 18
17	Tighten or replace the oil pickup screen as necessary. Is the repair complete?	-	Go to Step 1	-
18	Inspect the oil pickup tube. Are there any holes in the oil pickup tube?	-	Go to Step 19	Go to Step 20
19	Replace the oil pickup tube. Is the repair complete?	-	Go to Step 1	-

OIL PRESSURE TEST (CONT'D)

Step	Action	Value(s)	Yes	No
20	Inspect the bearing clearances. Are the bearing clearances more than the values specified?	Crankshaft 0.005 mm (0.002 in.) Connecting Rod 0.019 X 0.070 mm (0.0007 X 0.0027 in.)	Go to Step 21	Go to Step 22
21	Replace the bearing if necessary. Is the repair complete?	-	Go to Step 1	-
22	Inspect the oil galleries. Are the oil galleries cracked, porous or plugged?	-	Go to Step 23	Go to Step 24
23	Repair or replace the engine block. Is the repair complete?	-	Go to Step 1	-
24	Inspect the gallery plugs. Are any of the gallery plugs missing or not installed properly?	-	Go to Step 25	Go to Step 26
25	Install plugs or repair as necessary. Is the repair complete?	-	Go to Step 1	-
26	Inspect the camshaft. Is the camshaft worn or is there evidence of poor machining?	-	Go to Step 27	System OK
27	Replace the camshaft. Is the repair complete?	-	Go to Step 1	-

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1. After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2. Wait a few minutes.
   - 2.3. You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1. Clean the area well.
   - 4.2. Dry the area.
   - 4.3. Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4. After operating the vehicle, visually check the suspected component.
   - 4.5. If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks. Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle under normal operating conditions as directed in the kit.

3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the component.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

KNOCK DIAGNOSIS

Definition for Knock

Engine knock refers to various types of engine noise. Heavy knock is usually very loud and the result of broken or excessively worn internal engine components. Light knock is a noticeable noise, but not as loud. Light knock can be caused by worn internal engine components. Loose or broken external engine components can also cause heavy or light knock.

Engine Knocks Cold and Continues for Two-Three Minutes and/or Knock Increases with Engine Torque

Step	Action	Value(s)	Yes	No
1	Does the engine knock when it is cold and continue for two to three minutes or does the knock increase with torque?	-	Go to Step 2	System OK
2	Inspect the flywheel. Is the flywheel contacting the splash shield?	-	Go to Step 3	Go to Step 4
3	Reposition the splash shield. Is the repair complete?	-	Go to Step 1	-
4	Inspect the balancer and the drive pulleys. Is either the balancer or the drive pulleys loose or broken?	-	Go to Step 5	Go to Step 6
5	Tighten or replace the balancer or the drive pulleys. Is the repair complete?	-	Go to Step 1	-
6	Inspect the piston-to-bore clearance. Is the clearance more than the value specified?	0.030 mm (0.001 in.)	Go to Step 7	Go to Step 8
7	1. Rebore the cylinder and hone to size. 2. Replace the piston. Is the repair complete?*	-	Go to Step 1	-
8	Inspect the connecting rod. Is the connecting rod bent?	-	Go to Step 9	System OK
9	Replace the connecting rod. Is the repair complete?	-	Go to Step 1	-

* Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock, which disappears in about 1.5 minutes, is considered acceptable.

Heavy Knock Hot with Torque Applied

Step	Action	Value(s)	Yes	No
1	Is there a heavy knock when the engine is hot and torque is applied?	-	Go to Step 2	System OK
2	Inspect the balancer and pulley hub. Is the balancer or pulley hub broken?	-	Go to Step 3	Go to Step 4
3	Replace the broken balancer or pulley hub. Is the repair complete?	-	Go to Step 1	-
4	Inspect the torque converter bolts. Are the bolts tightened to the value specified?	45 N•m (33 lb ft)	Go to Step 5	Go to Step 6
5	Tighten the torque converter bolts. Is the repair complete?	-	Go to Step 1	-
6	Inspect the accessory belts. Are the belts too tight or nicked?	-	Go to Step 7	Go to Step 8
7	Replace and/or tension the belts to specifications as necessary. Is the repair complete?	-	Go to Step 1	-
8	Inspect the exhaust system. Is the system grounded?	-	Go to Step 9	Go to Step 10
9	Reposition the system as necessary. Is the repair complete?	-	Go to Step 1	-
10	Inspect the flywheel. Is the flywheel cracked?	-	Go to Step 11	Go to Step 12
11	Replace the flywheel. Is the repair complete?	-	Go to Step 1	-
12	Inspect the main bearing clearance. Is the clearance more than the value specified?	0.050 mm (0.002 in.)	Go to Step 13	Go to Step 14
13	Replace the main bearings as necessary. Is the repair complete?	-	Go to Step 1	-
14	Inspect the rod bearing clearance. Is the clearance more than the value specified?	0.019 X 0.070 mm (0.0007 X 0.0028 in.)	Go to Step 15	System OK
15	Replace the rod bearings as necessary. Is the repair complete?	-	Go to Step 1	-

Light Knock Hot

Step	Action	Value(s)	Yes	No
1	Is there a light knock when the engine is hot?	-	Go to Step 2	System OK
2	Is detonation or spark knock evident?	-	Go to Step 3	Go to Step 4
3	Check the engine timing and the fuel quality. Was the problem found?	-	Go to Step 1	-
4	Inspect the torque converter bolts. Are the bolts tightened to the value specified?	45 NSm (33 lb ft)	Go to Step 5	Go to Step 6
5	Tighten the torque converter bolts. Is the repair complete?	-	Go to Step 1	-
6	Inspect the manifold. Is there an exhaust leak at the manifold?	-	Go to Step 7	Go to Step 8
7	Tighten the bolts or replace the gasket. Is the repair complete?	-	Go to Step 1	-
8	Check the rod bearing clearance. Is the clearance within the value specified?	0.019 X 0.070 mm (0.0007 X 0.0028 in.)	Go to Step 9	System OK
9	Replace the rod bearings as necessary. Is the repair complete?	-	Go to Step 1	-

Knocks During Initial Start-Up But Lasts Only a Few Seconds

Step	Action	Value(s)	Yes	No
1	Does the engine knock during initial start-up but last only a few seconds?	-	Go to Step 2	System OK
2	Check the engine oil. Is the proper viscosity oil used in the crankcase?	-	Go to Step 4	Go to Step 3
3	Install oil of the proper viscosity for the expected seasonal temperatures. Is the repair complete?	-	Go to Step 1	-
4	Inspect the hydraulic lifters. Is there evidence of hydraulic lifter bleed-down?	-	Go to Step 5	Go to Step 6
5	Clean, test and replace the lifters as necessary. Is the repair complete?*	-	Go to Step 1	-
6	Inspect the crankshaft end clearance. Is the clearance more than value specified?	0.1 mm (0.0039 in.)	Go to Step 7	Go to Step 8
7	Replace the crankshaft thrust bearing. Is the repair complete?	-	Go to Step 1	-
8	Inspect the front main bearing clearance. Is the clearance more than the value specified?	0.005 mm (0.0001 in.)	Go to Step 9	System OK
9	Replace the worn parts of the front main bearing. Is the repair complete?	-	Go to Step 1	-

* When the engine is stopped, some valves will be open. Spring pressure against the lifters will tend to bleed lifter down. Attempts to repair this should be made only if the problem is consistent.
An engine that is operated for only short periods between start-ups may have lifter noise that lasts for a few minutes. This is a normal condition.

Knocks at Idle Hot

Step	Action	Value(s)	Yes	No
1	Does the engine knock at idle when hot?	-	Go to Step 2	System OK
2	Inspect the drive belts. Are the belts loose or worn?	-	Go to Step 3	Go to Step 4
3	Tension or replace the belts as necessary. Is the repair complete?	-	Go to Step 1	-
4	Inspect the A/C compressor and the generator. Is either the compressor or the generator faulty?	-	Go to Step 5	Go to Step 6
5	Replace the faulty A/C compressor or the generator. Is the repair complete?	-	Go to Step 1	-
6	Inspect the valve train. Are valve train components faulty?	-	Go to Step 7	Go to Step 8
7	Replace faulty valve train components. Is the repair complete?	-	Go to Step 1	-
8	Check the engine oil. Is the proper viscosity oil used in the crankcase?	-	Go to Step 10	Go to Step 9
9	Install oil of the proper viscosity for the expected seasonal temperatures. Is the repair complete?	-	Go to Step 1	-
10	Inspect the piston pin clearance. Is the clearance more than the value specified?	0.020 mm (0.0008 in.)	Go to Step 11	Go to Step 12
11	Replace the piston and the pin. Is the repair complete?	-	Go to Step 1	-
12	Check the connecting rod alignment. Is the alignment faulty?	-	Go to Step 13	Go to Step 14
13	Check and replace rods as necessary. Is the repair complete?	-	Go to Step 1	-
14	Inspect the piston-to-bore clearance. Is the clearance within the value specified?	0.030 mm (0.0012 in.)	Go to Step 16	Go to Step 15
15	Hone the bore and fit a new piston. Is the repair complete?	-	Go to Step 1	-
16	Inspect the crankshaft balancer. Is the balancer loose?	-	Go to Step 17	Go to Step 18
17	Torque or replace worn parts. Is the repair complete?	-	Go to Step 1	-
18	Check the piston pin offset. Is the offset at the value specified?	0.5 X 0.7 mm (0.020 X 0.028 in.) Toward Thrust Side	Go to Step 19	System OK
19	Install the correct piston. Is the repair complete?	-	Go to Step 1	-

NOISE DIAGNOSIS

Main Bearing Noise

Step	Action	Value(s)	Yes	No
1	Are dull thuds or knocks heard with every engine revolution?	-	Go to Step 2	System OK
2	Check the oil pump pressure. Is the oil pump pressure low?	-	Go to Oil Pressure Test	Go to Step 3
3	Inspect the crankshaft end play. Does the crankshaft end play exceed the value specified?	0.1 mm (0.0039 in.)	Go to Crankshaft Replacement Procedure	Go to Step 4
4	Inspect the crankshaft journals. Are the crankshaft journals out-of-round?	0.004 mm (0.0002 in.) max.	Go to Crankshaft Replacement Procedure	Go to Step 5
5	Inspect the belt tension. Does the belt tension exceed the value specified?	-	Go to Timing Belt Replacement Procedure	Go to Step 6
6	Inspect the crankshaft pulley. Is the crankshaft pulley loose?	-	Go to Crankshaft Replacement Procedure	System OK

Connecting Rod Bearing Noise Symptom

Step	Action	Value(s)	Yes	No
1	Is a knock noise heard under all engine speeds?	-	Go to Step 2	System OK
2	Inspect the crankshaft connecting rod journal. Is the crankshaft connecting rod journal worn?	-	Go to Crankshaft Replacement Procedure	Go to Step 3
3	Check the oil pump pressure. Is the oil pump pressure low?	-	Go to Oil Pressure Test	Go to Step 4
4	Inspect the crankshaft connecting rod journals. Are the journals out of round?	-	Go to Crankshaft Replacement Procedure	Go to Step 5
5	Inspect the connecting rods. Is there a misaligned connecting rod?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 6
6	Inspect the connecting rod bolts. Are the connecting rod bolts torqued properly?	-	System OK	Go to Pistons and Rods Replacement Procedure

Piston Noises

Step	Action	Value(s)	Yes	No
1	Are any of the following noises heard: a sharp double knock when the engine is idling, a light ticking with no load on the engine or a “slapping” noise when the engine is cold?	-	Go to Step 2	System OK
2	Inspect the piston pin and bushing. Is the piston pin or the bushing worn or loose?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 3
3	Inspect the piston. Is the piston broken or cracked?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 4
4	Inspect the connecting rods. Is there a misaligned connecting rod?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 5
5	Inspect the piston position. Is the piston 180_ out of position?	-	Go to Pistons and Rods Replacement Procedure	System OK

Valve Mechanism or Valve Train Noises

Step	Action	Value(s)	Yes	No
1	Is a light tapping sound heard from the engine?	-	Go to Step 2	System OK
2	Inspect the valve springs. Are the springs weak or broken?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 3
3	Inspect the valves. Are the valves sticking or warped?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 4
4	Inspect the valve lifters. Are the valve lifters dirty, stuck or worn?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 5
5	Inspect the camshaft lobes. Are the camshaft lobes damaged or improperly machined?	-	Go to Camshaft Replacement Procedure	Go to Step 6
6	Check the oil supply to the valve train. Is the oil supply insufficient or poor?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 7
7	Inspect the valve guides. Are the valve guides worn?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 8
8	Inspect the valve spring seat. Is the valve spring seat incorrect?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	System OK

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or, when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

SECTION 1B

SOHC ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

ENGINE SPECIFICATIONS

Application	Description (Manual and Automatic)
General Data:	
Engine Type	4 Cylinder (In-Line)
Displacement: 1.3 SOHC	1 349 cm^3 (82.30 in^3)
1.5 SOHC	1 498 cm^3 (91.44 in^3)
Bore Stroke: 1.3 SOHC	76.5 x 73.4 mm (3.01 in. x 2.89 in.)
1.5 SOHC	76.5 X 81.5 mm (3.01 in. X 3.21 in.)
Compression Ratio	9.5 $ 0.2:1
Firing Order	1-3-4-2
Cylinder Bore:	
Diameter	76.5 mm (3.01 in.)
Out of Round (Maximum)	0.0065 mm (0.00025 in.)
Taper (Maximum): 1.3 SOHC	0
1.5 SOHC	0.0065 mm (0.00025 in.)
Piston:	
Diameter	76.470 mm (3.01 in.)
Clearance to Bore	0.030 mm (0.0012 in.)
Piston Rings:	
Ring, End Gap: Top Compression	0.3 mm (0.019 in.)
2nd Compression	0.3 mm (0.019 in.)
Groove Clearance: Top Impression	0.02 mm (0.0008 in)
2nd Impression	0.02 mm (0.0008 in.)
Piston Pin:	
Diameter	18.000 mm (0.708 in.)
Pin Off-Set	0.5X 0.7 mm (0.019X 0.027 in.)
Camshaft:	
Lift Intake: 1.3 SOHC	5.61 mm (0.220 in.)
1.5 SOHC	6.12 mm (0.240 in.)
Lift Exhaust	6.12 mm (0.240 in.)
End Play	0.09X 0.21 mm (0.0035X 0.0082 in.)
Journal OD: No. 1	39.445 mm (1.552 in.)
No. 2	39.700 mm (1.562 in.)
No. 3	39.945 mm (1.572 in.)
No. 4	40.200 mm (1.582 in.)
No. 5	40.445 mm (1.592 in.)

ENGINE SPECIFICATIONS (Cont'd)

Application	Description (Manual and Automatic)
Bearing OD: No. 1	39.500 mm (1.555 in.)
No. 2	39.750 mm (1.564 in.)
No. 3	40.000 mm (1.574 in.)
No. 4	40.250 mm (1.584 in.)
No. 5	40.500 mm (1.594 in.)
Crankshaft:	
Main Journal: Diameter (All)	54.982X 54.994 mm (2.164X 2.165 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Main Bearing Clearance (All)	0.005 mm (0.0001 in.)
Crankshaft End Play	0.1 mm (0.003 in.)
Connecting Rod Journal: Diameter (All)	42.971X 42.987 mm (1.691X 1.692 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Rod Bearing Clearance (All)	0.019X 0.070 mm (0.0007X 0.0027 in.)
Rod Side Clearance	0.070X 0.242 mm (0.0027X 0.009 in.)
Valve System:	
Valve Lash Compensators	Hydraulic
Face Angle (All)	46_
Seat Angle (All)	46_
Seat Runout (Maximum, All)	0.03 mm (0.019 in.)
Face Runout (Maximum, All)	0.03 mm (0.019 in.)
Seat Width: Intake	1.3X 1.5 mm (0.051X 0.059 in.)
Exhaust	1.6X 1.8 mm (0.063X 0.071 in.)
Valve Guide Inside Diameter (All)	7.030X 7.050 mm (0.276X 0.277 in.)
Valve Stem Diameter (All)	7 mm (0.275 in.)
Valve Diameter (All): Intake	38.0" 0.15 mm (1.49" 0.0059 in.)
Exhaust	31.0" 0.15 mm (1.22" 0.0059 in.)
Valve Spring Loads: Valve Open	625" 25 N (461" 18 lbs) @ 21.5 mm (0.846 in.)
Valve Closed	275" 15 N (202" 11 lbs) @ 31.5 mm (1.240 in.)
Oil Pump:	
Gap Between Oil Pump Body and Out Rotor	0.400X 0.484 mm (0.0157X 0.0191 in.)
Out Rotor Side Clearance	0.045X 0.100 mm (0.0018X 0.0039 in.)
Inner Rotor Side Clearance	0.035X 0.085 mm (0.0014X 0.0033 in.)
Relief Valve Spring Free Length	81 mm (3.2 in.)

FASTENER TIGHTENING SPECIFICATIONS

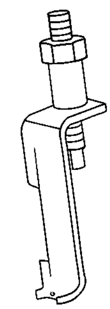
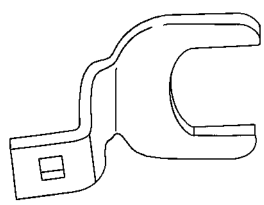
Application	NSm	Lb-Ft	Lb-In
A/C Compressor Hose Assembly Retaining Bolt	33	24	-
A/C Compressor Mounting Bolts	27	20	-
A/C Compressor Mounting Bracket Bolts	50	36	-
Air Filter Housing Bolts	12	-	106
Alternator Adjusting Bolt	20	15	-
Alternator Adjusting Bracket Retaining Bolt	20	15	-
Camshaft Gear Bolt	45	33	-
Camshaft Pressure Plate Bolts	10	-	89
Connecting Rod Bearing Cap Bolts	25 +30_ +15_	18 +30_ +15_	-
Coolant Pump Retaining Bolts	10	-	89
Coolant Temperature Sensor	20	15	-
Crankshaft Bearing Cap Bolts	50 +45_ +15_	37 +45_ +15_	-
Crankshaft Pulley Bolt	95 +30_ +15_	70 +30_ +15_	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Cylinder Head Bolts (Camshaft Support Housing & Cylinder Head Mounting Bolts)	25 +60_ +60_ +60_+10_	18 +60_ +60_ +60_+10_	-
DIS Ignition Coil Mounting Bolts	10	-	89
DIS Ignition Coil Mounting Plate Bolts	10	-	89
Engine Lift Bracket Bolt	25	18	-
Engine Mount Attaching Nuts	40	30	-
Engine Mount Bracket Retaining Bolts	60	44	-
Engine Mount Bracket-to-Engine Mount Retaining Bolts	60	44	-
Exhaust Flex Pipe Bracket Bolts	40	30	-
Exhaust Flex Pipe-to-Catalytic Converter or Connecting Pipe Retaining Nuts	30	22	-
Exhaust Flex Pipe-to-Exhaust Manifold Retaining Nuts	40	30	-
Exhaust Manifold Heat Shield Bolts	15	11	-
Exhaust Manifold Nuts	25	18	-
Flexible Plate Bolts	60	44	-
Flexible Plate Inspection Cover Bolts	10	-	89
Flywheel Bolts	35 +30_ +15_	25 +30_ +15_	-
Flywheel Inspection Cover Bolts	12	-	106
Fuel Rail Retaining Bolts	25	18	-
Intake Manifold Retaining Nuts	25	18	-
Intake Manifold Support Bracket Retaining Bolts	22	16	-
Lower Timing Belt Cover Bolts	10	-	89

FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

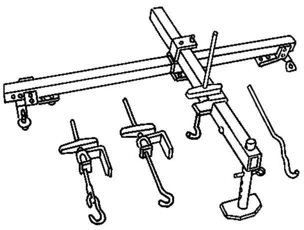
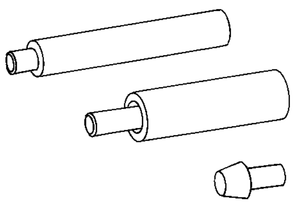
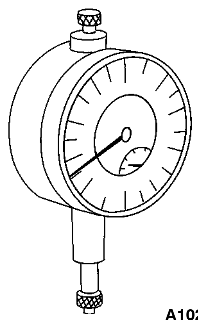
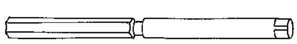
Application	N•m	Lb-Ft	Lb-In
Oil Pan Retaining Bolts	10	-	89
Oil Pan Drain Plug	55	41	-
Oil Pressure Switch	40	30	-
Oil Pump Retaining Bolts	10	-	89
Oil Pump/Pickup Tube and Support Bracket Bolts	10	-	89
Oil Pump Safety Relief Valve	30	22	-
Oil Pump Rear Cover Bolts	6	-	53
Power Steering Pump Mounting Bolts	25	18	-
Power Steering Pump Pulley Bolts	25	18	-
Rear Timing Belt Cover Bolts	10	-	89
Right Transaxle Brace Bolts	60	45	-
Spark Plugs	25	18	-
Thermostat Housing Mounting Bolts	20	15	-
Throttle Cable Bracket Bolts	8	-	71
Timing Belt Automatic Tensioner Bolt	20	15	-
Transaxle Bell Housing Bolts	75	55	-
Transaxle Torque Converter Bolts	45	33	-
Upper Timing Belt Cover Bolts	10	-	89
Valve Cover Bolts	10	-	89

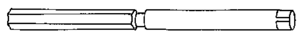
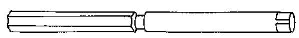
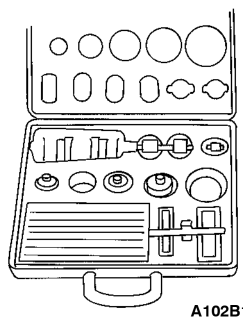
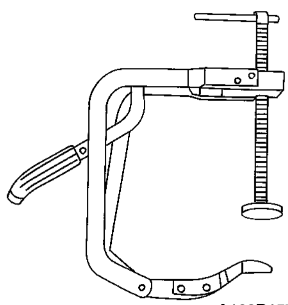
SPECIAL TOOLS

SPECIAL TOOLS TABLE

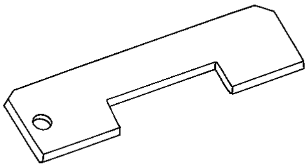
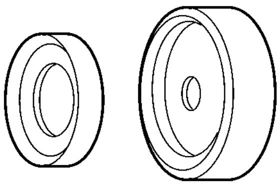
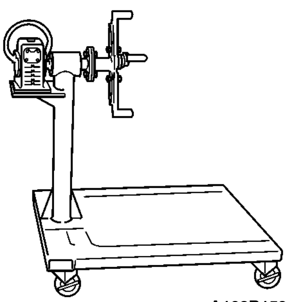
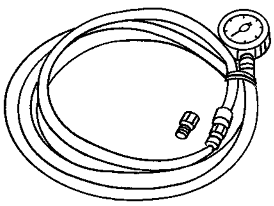
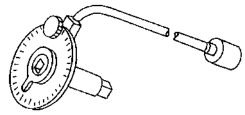
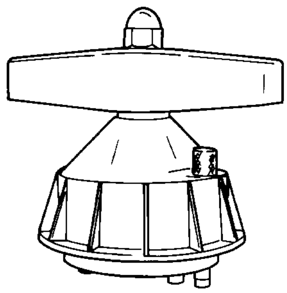
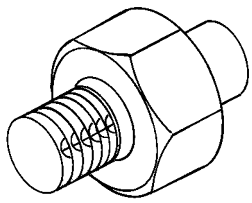
 A102B150	**KM-565-A Valve Spring Compressor**	 A102B151	**J-42492 Timing Belt Adjuster**

SPECIAL TOOLS TABLE (Cont'd)

 A102B152	**J-28467-B** **Engine Assembly** **Support Fixture**
 A102B153	**KM-427** **Piston Pin Service Set**
 A102B154	**MKM-571-B** **Gauge**
 A102B155	**KM-253** **Valve Guide Reamer**

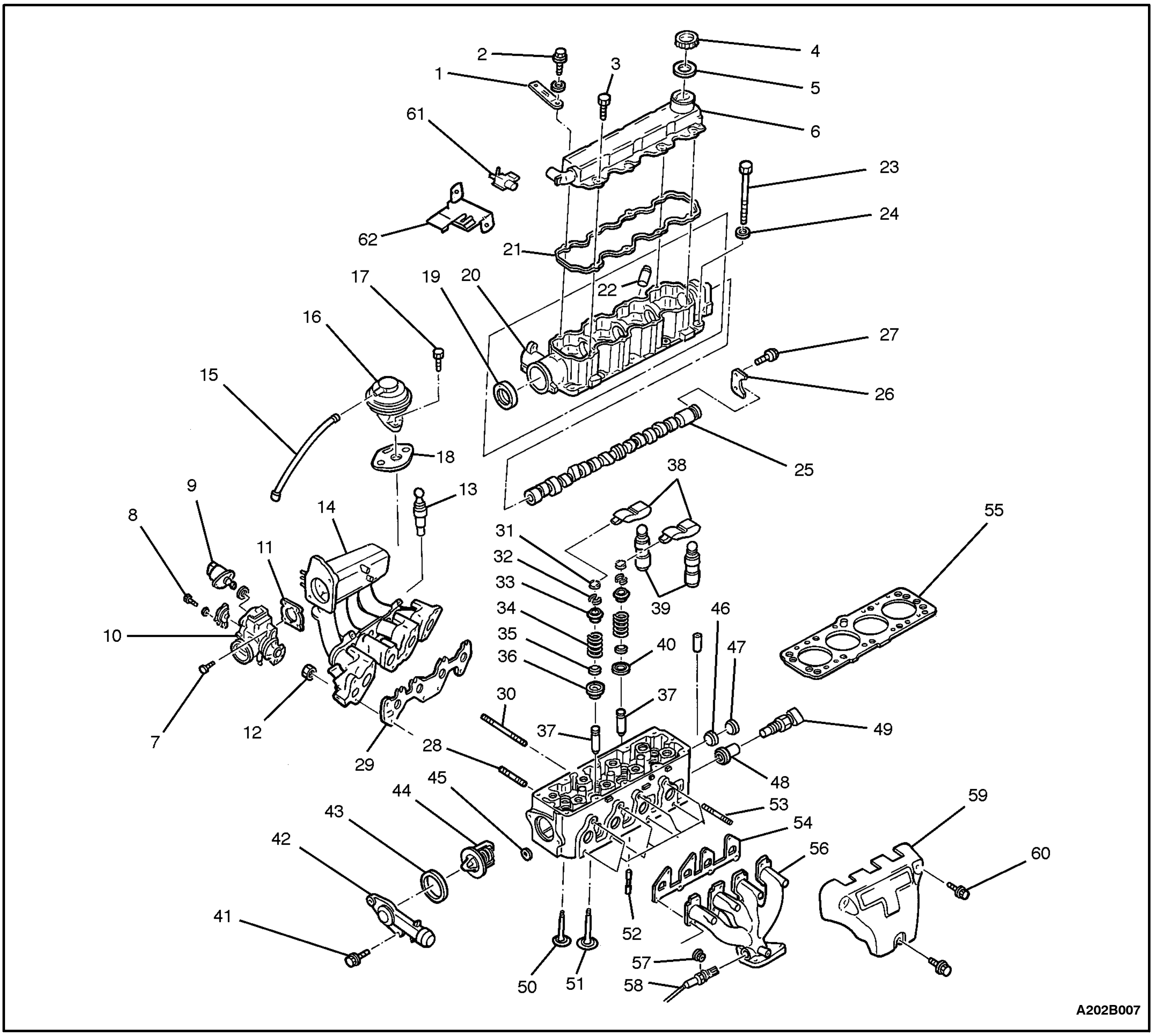
 A102B155	**KM-254** **Valve Guide Reamer**
 A102B155	**KM-255** **Valve Guide Reamer**
 A102B156	**KM-340-0** **Cutter Set** **Includes: KM-340-7** **KM-340-13** **KM-340-26**
 A102B157	**KM-348** **Valve Spring** **Compressor**

SPECIAL TOOLS TABLE (Cont'd)

 A102B158	**KM-419** **Distance Gauge**
 A102B160	**KM-635** **Crankshaft Rear Oil Seal Installer**
 A102B159	**MKM-412** **Engine Overhaul Stand**
 A202B005	**KM-498-B** **Pressure Gauge**
 A102B161	**KM-470-B** **Angular Torque Gauge**
 A102C155	**J-36972** **Crankshaft Rear Oil Seal Installer**
 B102C044	**KM-135** **Adapter**

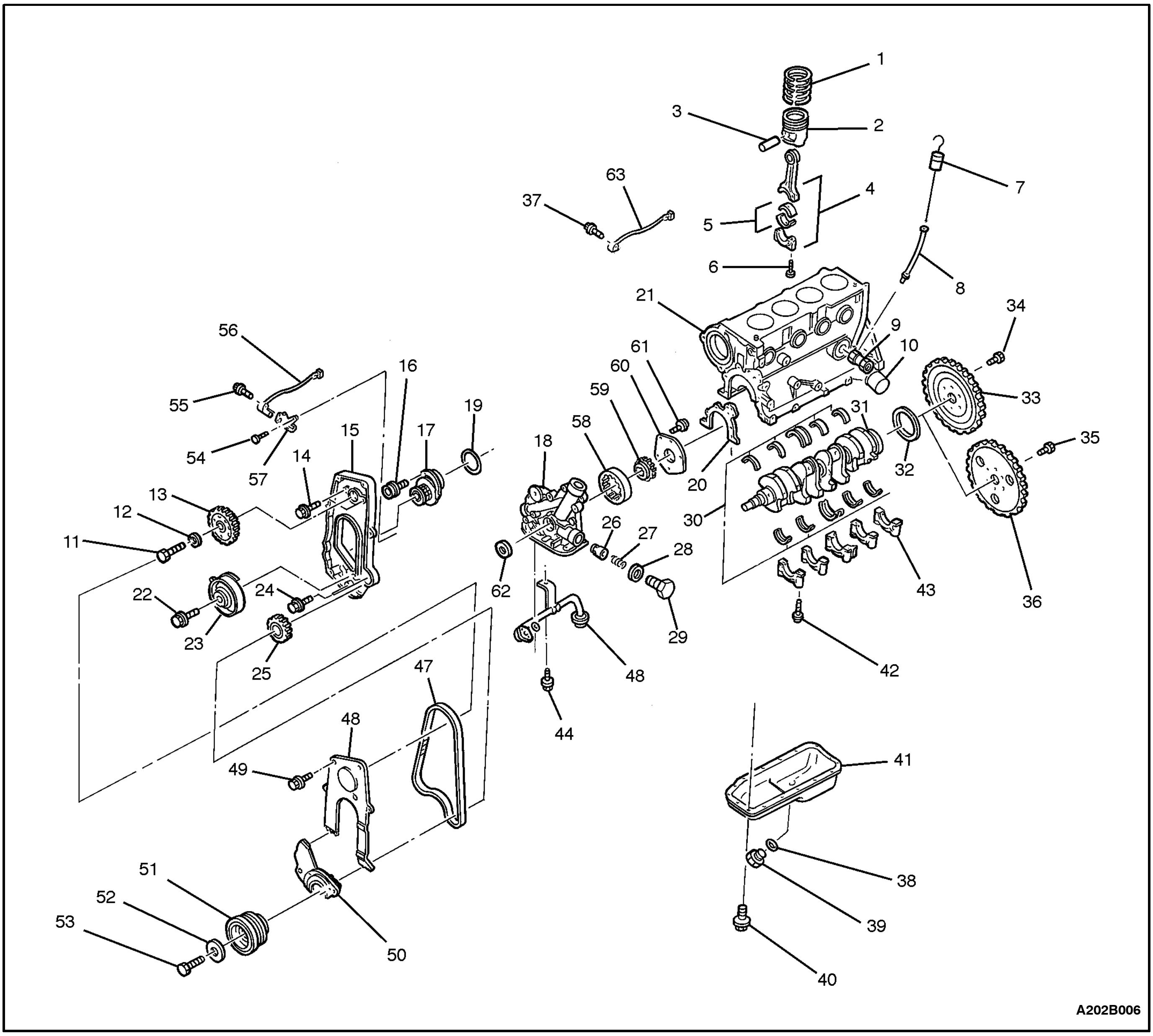
COMPONENT LOCATOR

UPPER END



1 Wiring Bracket
2 Bolt
3 Bolt
4 Cap, Bayonet Joint
5 Seal, Bayonet Cap
6 Valve Cover
7 Bolt
8 Throttle Position Sensor
9 Idle Air Control Valve
10 Throttle Body
11 Throttle Body Gasket
12 Nut
13 Engine Coolant Temperature Sensor
14 Intake Manifold
15 Vacuum Tube
16 EGR Valve
17 Bolt
18 EGR Gasket
19 Shaft Seal Ring
20 Camshaft Support
21 Valve Cover Gasket
22 Tube
23 Cylinder Head Bolt
24 Washer
25 Camshaft
26 Camshaft Pressure Plate
27 Bolt
28 Bolt-Stud
29 Intake Manifold Gasket
30 Bolt-Stud
31 Valve Thrust Piece
32 Valve Key
33 Valve Spring Plate
34 Valve Spring
35 Valve Stem Seal
36 Exhaust Valve Spring Seat
37 Valve Guide
38 Cam Follower
39 Cam Follower Lifter
40 Intake Valve Spring Seat
41 Bolt
42 Thermostat Housing
43 Thermostat Housing Seal Ring
44 Thermostat
45 Screw Plug
46 Oil Duct Cap
47 Oil Duct Cap
48 Adapter
49 Coolant Temperature Sensor
50 Exhaust Valve
51 Intake Valve
52 Cylinder Head Oil Duct Sleeve
53 Bolt-Stud
54 Exhaust Manifold Gasket
55 Cylinder Head Gasket
56 Exhaust Manifold
57 Nut
58 Exhaust Oxygen Sensor
59 Exhaust Manifold Heat Shield
60 Bolt
61 EGR Solenoid
62 Bracket

LOWER END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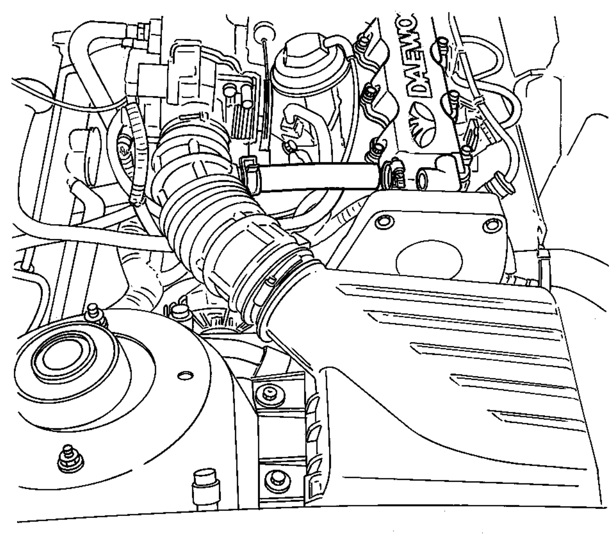
A202B006

1 Piston Ring Seat
2 Piston
3 Piston Pin
4 Connecting Rod
5 Connecting Rod Bearing Set
6 Connecting Rod Bolt
7 Oil Level Gauge Stick
8 Gauge Stick Tube
9 Connecting Piece
10 Oil Filter
11 Camshaft Pulley Bolt
12 Washer
13 Camshaft Gear
14 Rear Cover Bolt
15 Rear Timing Belt Cover
16 Bolt
17 Coolant Pump
18 Oil Pump
19 Seal Ring
20 Oil Pump Body Gasket
21 Engine Block
22 Bolt
23 Auto Tensioner
24 Bolt
25 Crankshaft Gear
26 Pressure Relief Valve Plunger
27 Spring
28 Oil Pump Seal Ring
29 Bolt Plug
30 Crankshaft Bearing Set
31 Crankshaft
32 Shaft Seal Ring
33 Flywheel (Manual Transaxle)
34 Bolt (Manual Transaxle)
35 Bolt (Automatic Transaxle)
36 Flex Plate (Automatic Transaxle)
37 Bolt
38 Threaded Ring
39 Drain Plug
40 Bolt
41 Oil Pan
42 Main Bearing Cap Bolt
43 Main Bearing
44 Bolt
45 Bracket
46 Oil Pickup Tube
47 Timing Belt
48 Upper Timing Belt Front Cover
49 Bolt
50 Lower Timing Belt Front Cover
51 Crankshaft Pulley
52 Washer
53 Bolt
54 Bolt
55 Bolt
56 Crankshaft Position Sensor
57 Bracket
58 Gear
59 Gear
60 Cover
61 Bolt
62 Seal
63 Knock Sensor



A102B011

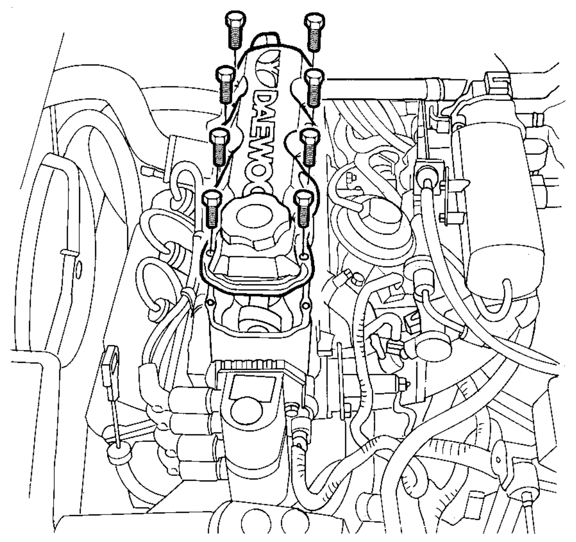
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

VALVE COVER

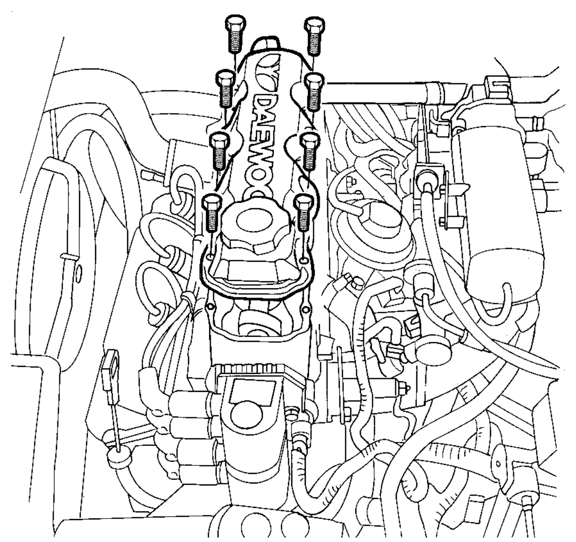
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the breather tube from the valve cover.



A102B010

3. Remove the eight bolts from the valve cover.
4. Remove the valve cover.
5. Remove the valve cover gasket.
6. Clean the sealing surfaces of the valve cover and the camshaft housing.



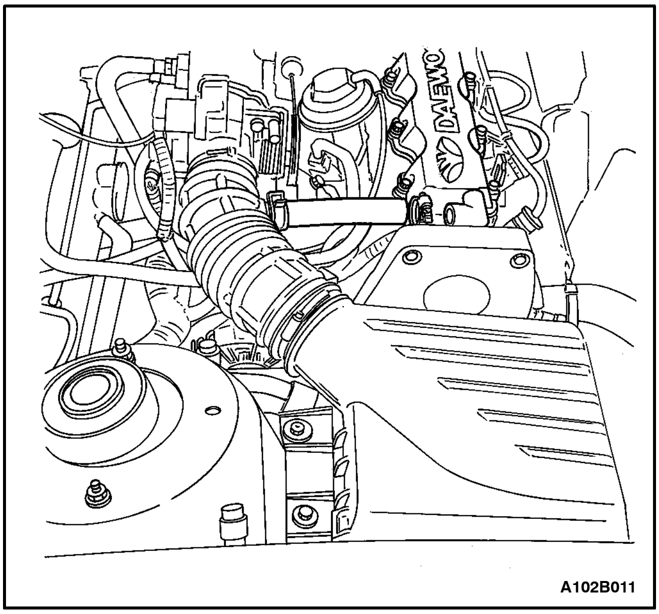
A102B010

Installation Procedure

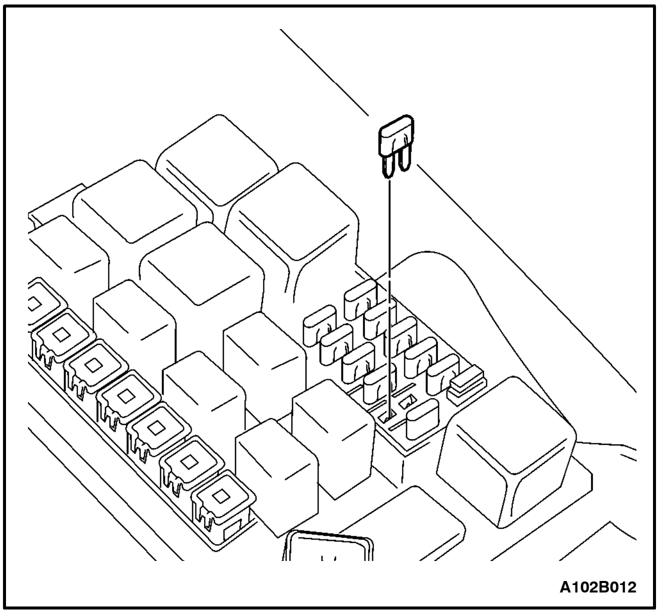
1. Install the new valve cover gasket and the valve cover.
2. Install the eight bolts to the valve cover.

   Tighten

   Tighten the valve cover bolts to 10 N·m (89 lb-in).


A102B011

3. Connect the breather tube to the valve cover.
4. Connect the negative battery cable.


A102B012

CYLINDER HEAD AND GASKET

(Left-Hand Drive Shown, Right Hand Drive Similar)

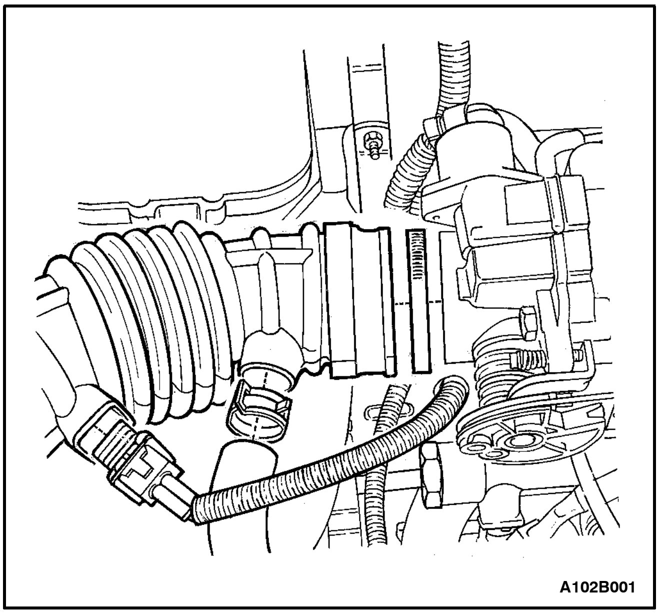
Tools Required

J-42492 Timing Belt Adjuster

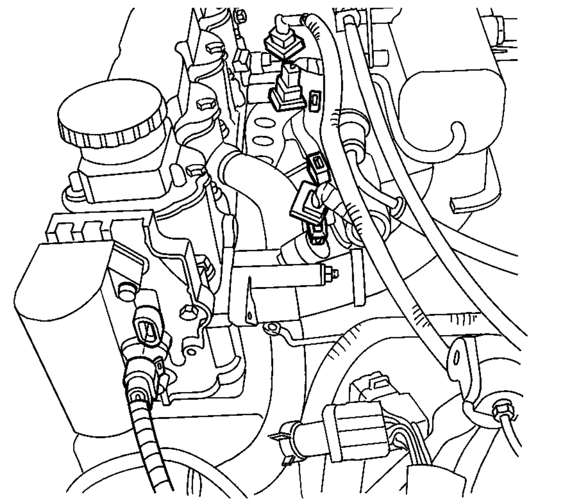
KM-470-B Angular Torque Gauge

Removal Procedure

1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the electronic control module (ECM) ground terminal from the intake manifold.

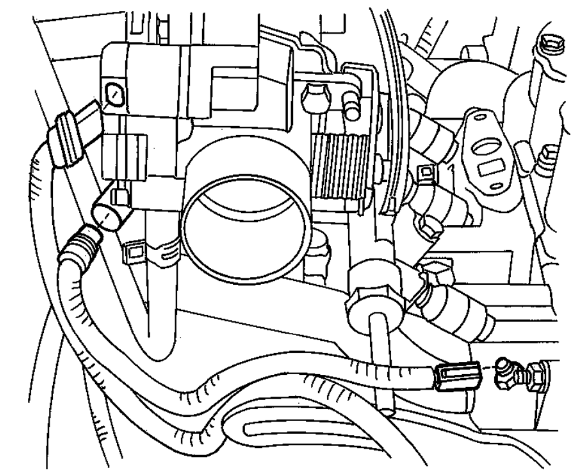

A102B001

5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the breather tube from the valve cover.
8. Disconnect the air intake tube from the throttle body.



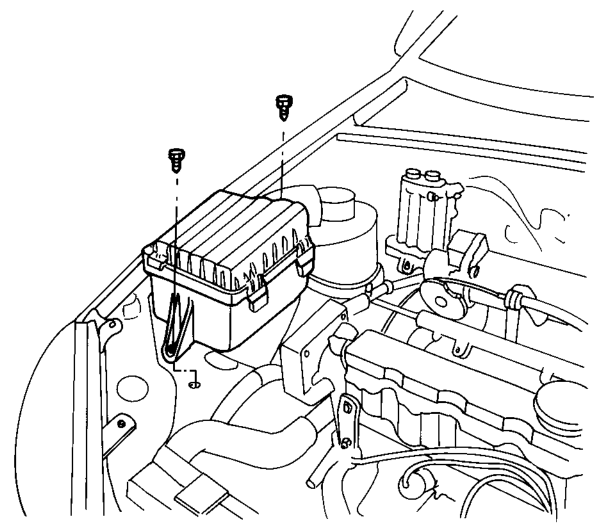
A102B092

9. Disconnect the direct ignition system (DIS) ignition coil connector.
10. Disconnect the oxygen sensor connector.
11. Disconnect the fuel injector harness connectors.



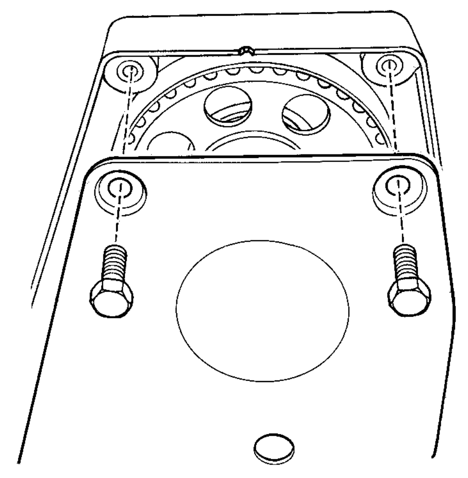
A102B016

12. Disconnect the idle air control valve connector.
13. Disconnect the throttle position sensor connector.
14. Disconnect the engine coolant temperature sensor connector.
15. Disconnect the coolant temperature sensor connector.



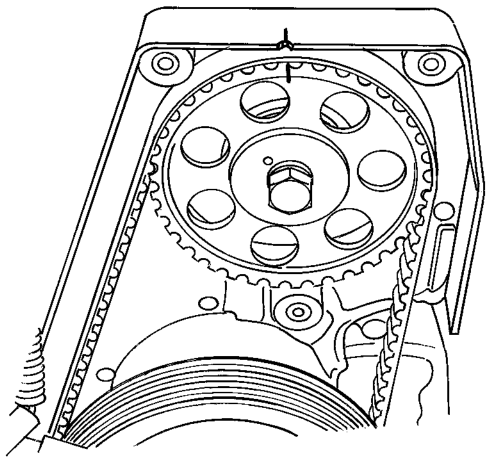
A102B002

16. Remove the air cleaner housing bolts.
17. Remove the air cleaner housing.



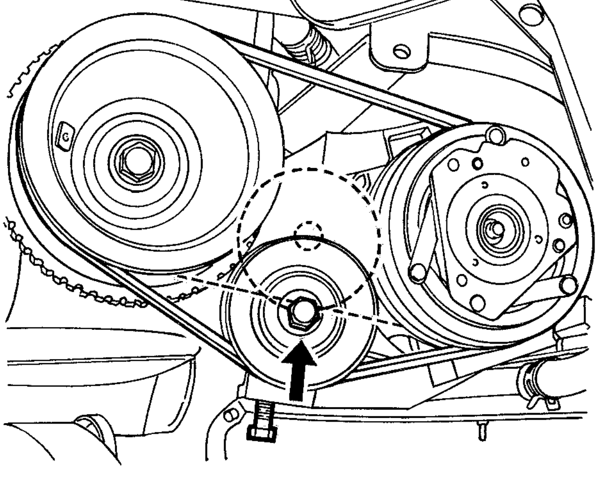
A102B003

18. Remove the upper timing belt cover bolts.
19. Remove the upper timing belt cover.



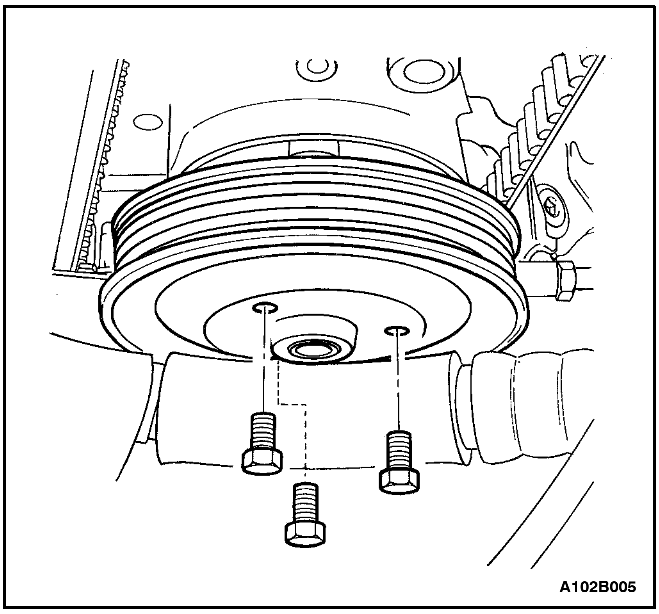
A102B004

20. Align the camshaft gear timing mark to the notch in the rear timing belt cover.

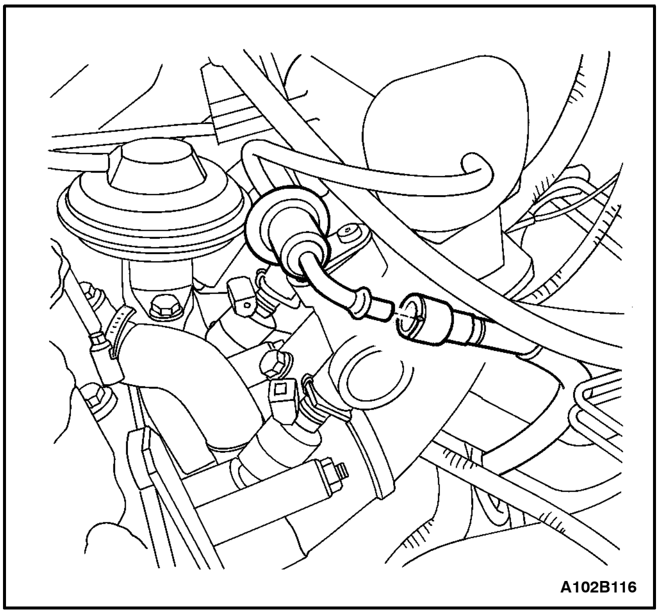


A102B006

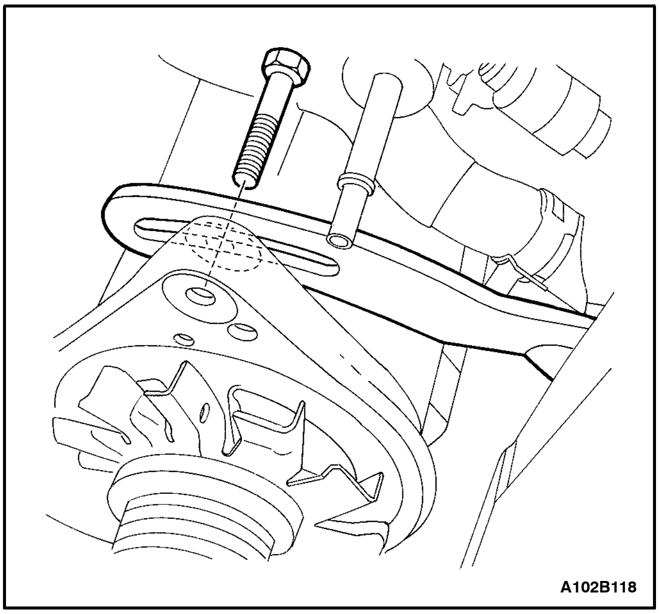
21. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
22. Remove the right front wheel well splash shield.
23. Remove the A/C compressor drive belt, if equipped.



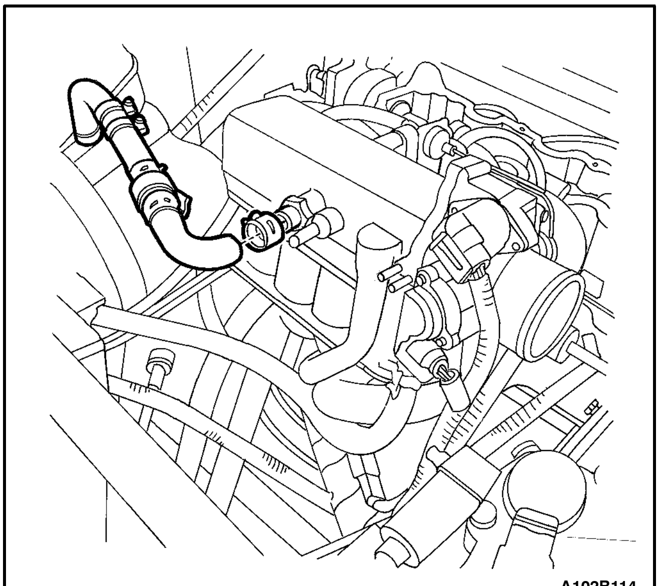
24. Remove the alternator drive belt.
25. Remove the power steering pump pulley bolts, if equipped.
26. Remove the power steering pump pulley, if equipped.



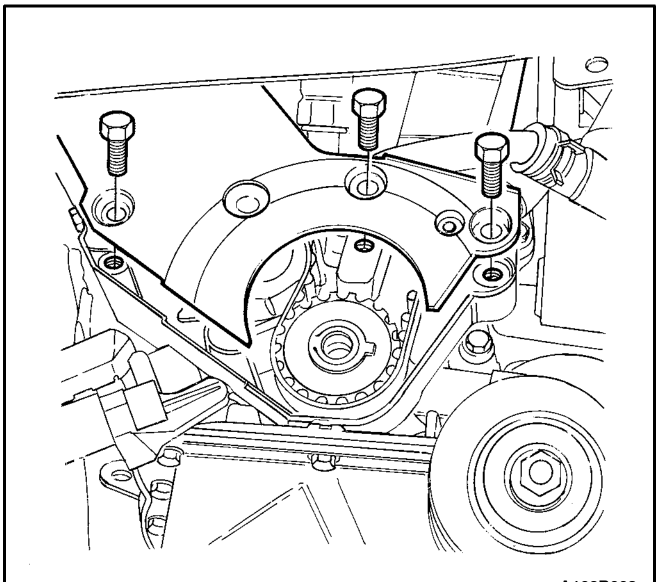
27. Disconnect the fuel return line at the fuel pressure regulator.
28. Disconnect the fuel feed line at the fuel rail.



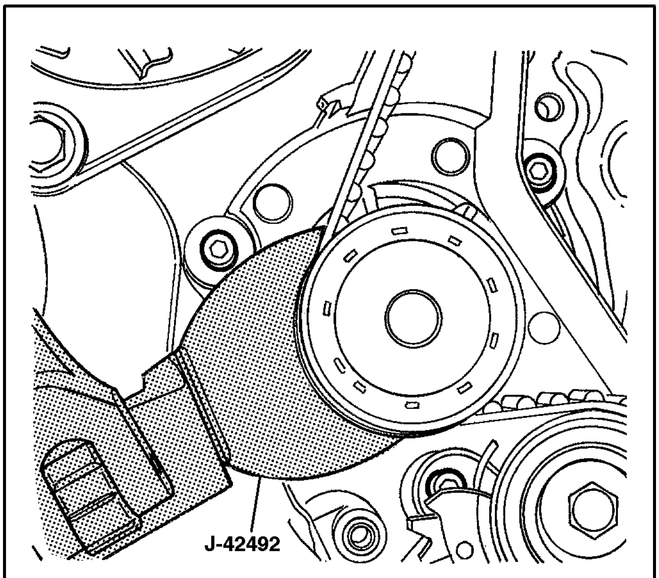
29. Remove the alternator adjusting bolt.
30. Remove the alternator adjusting bracket retaining bolt.
31. Remove the alternator adjusting bracket.


A102B114

32. Disconnect the upper radiator hose at the thermostat housing.
33. Disconnect the brake booster vacuum hose at the intake manifold.
34. Disconnect all of the necessary vacuum hoses.

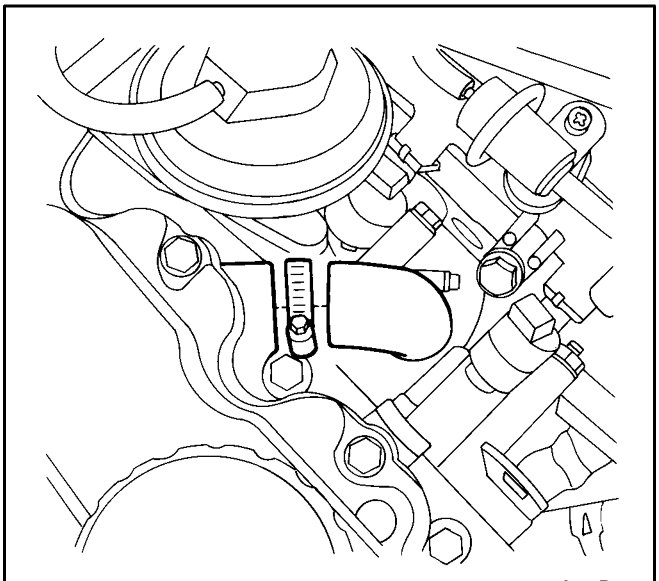

A102B008

35. Remove the crankshaft pulley bolt.
36. Remove the crankshaft pulley.
37. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
38. Install the engine mount bracket-to-engine mount retaining bolts and tighten the bolts to secure the engine, if the power steering pump was removed.
39. Remove the lower timing belt cover bolts.
40. Remove the lower timing belt cover.

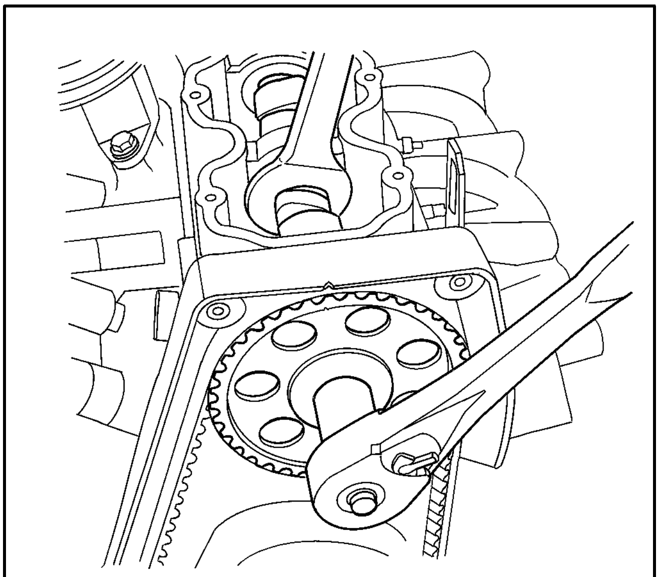


A102B040

41. Slightly loosen the coolant pump retaining bolts.
42. Rotate the coolant pump counterclockwise using the timing belt adjuster J-42492 to relieve the timing belt tension.
43. Remove the timing belt. Refer to "Timing Belt" in this section.


A102B117

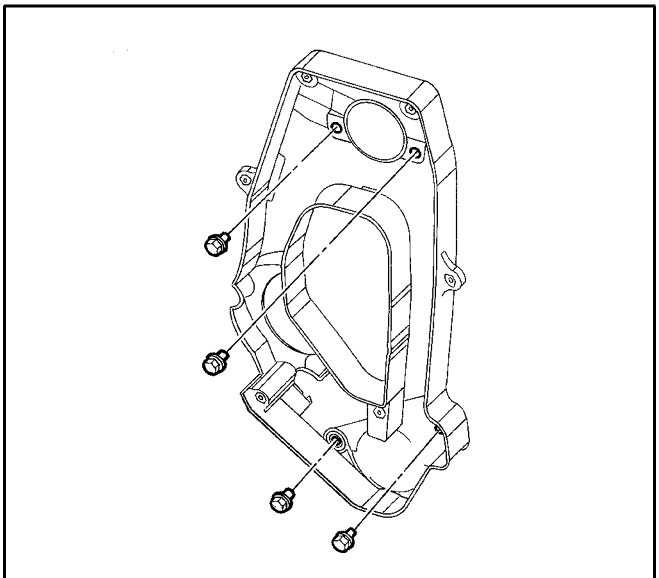
44. Disconnect the crankcase ventilation tube at the camshaft housing and the electrical connector at the exhaust gas recirculation (EGR) solenoid.


A102B111

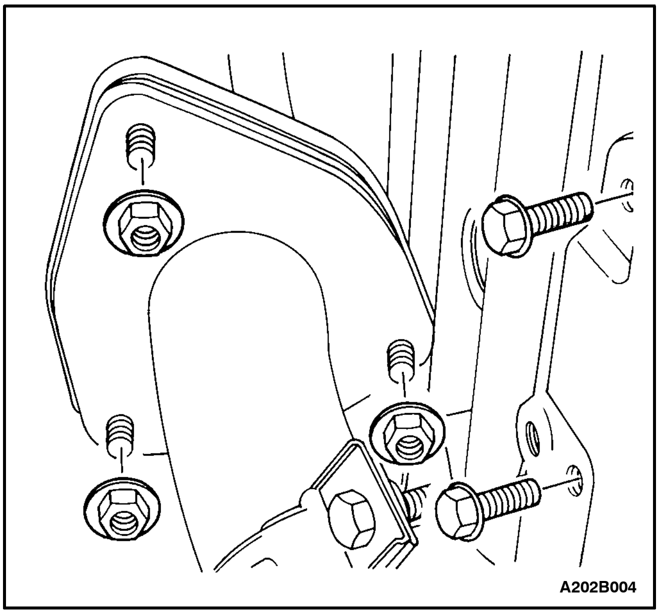
45. Remove the valve cover bolts.
46. Remove the valve cover and the valve cover gasket.

Notice: Take care to prevent any scratches, nicks or damage to the camshaft.

47. While holding the camshaft firmly in place, remove the camshaft gear bolt.
48. Remove the camshaft gear.

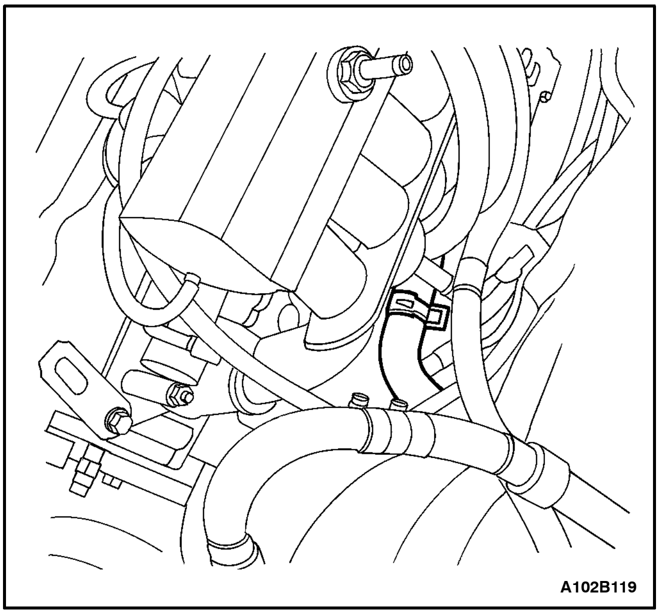

A102B046

49. Remove the timing belt automatic tensioner bolt.
50. Remove the timing belt automatic tensioner.
51. Remove the rear timing belt cover bolts.
52. Remove the rear timing belt cover.



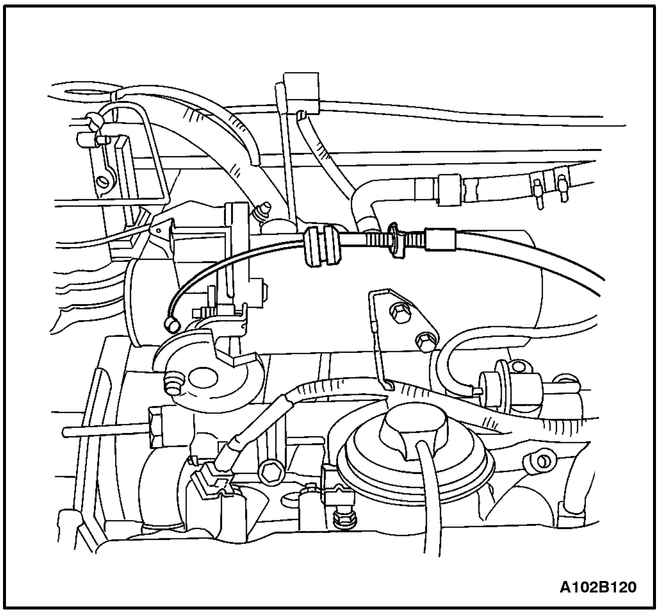
53. Disconnect the ignition wires at the spark plugs.

54. Remove the retaining nuts from the exhaust flex pipe at the exhaust manifold flange and the bolts at the bracket.



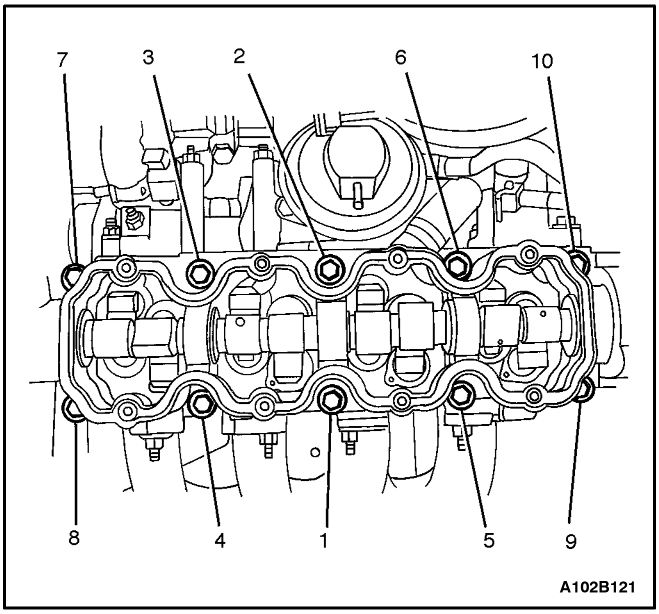
55. Disconnect the heater inlet hose at the coolant distributor.

56. Disconnect the surge tank coolant hose at the throttle body.



57. Remove the intake manifold support bracket retaining bolts from the coolant distributor.

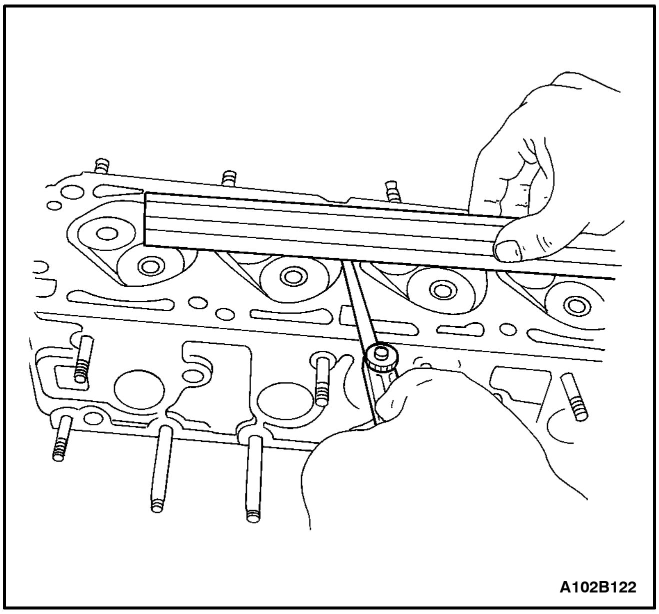
58. Disconnect the throttle cable at the throttle body and the intake manifold.



59. Gradually loosen all of the cylinder head bolts in the sequence shown.
60. Remove the cylinder head bolts.
61. Remove the camshaft carrier assembly.

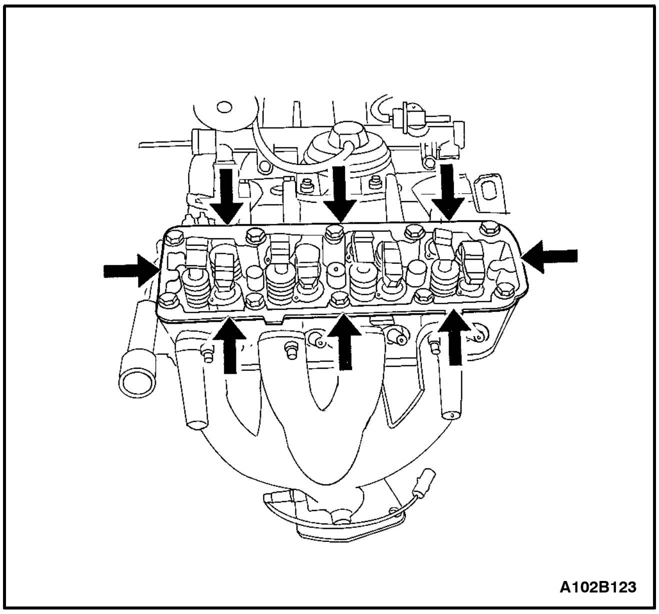
Notice: Prevent any engine oil or coolant from entering the cylinders when removing the cylinder head. Damage to the engine could result.

62. Remove the cylinder head with the intake manifold and the exhaust manifold attached.
63. Remove the cylinder head gasket.



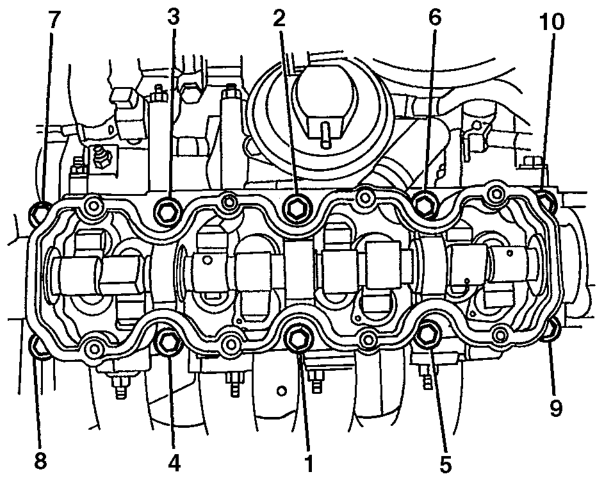
Cleaning Procedure

1. Clean the gasket surfaces of the cylinder head and the engine block.
2. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
3. Clean the cylinder head bolts.
4. Inspect the cylinder head for warpage. Refer to “Cylinder Head and Valve Train Components” in this section.



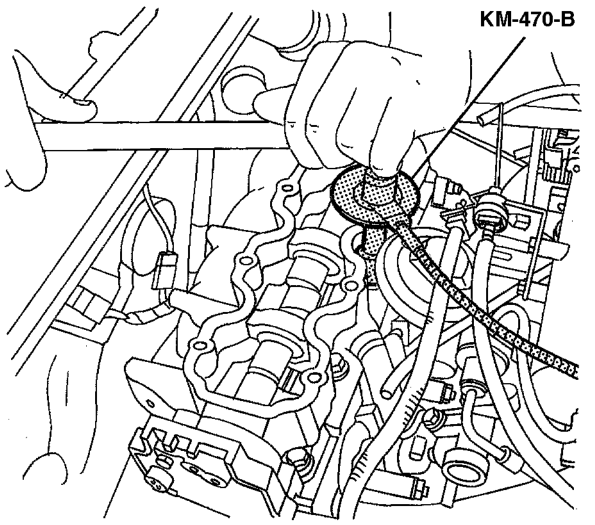
Installation Procedure

1. Apply a continuous 3 mm (0.12 inch) bead of gasket maker to the sealing surface of the camshaft carrier.
2. Install the cylinder head gasket.
3. Install the cylinder head with the intake manifold and the exhaust manifold attached.
4. Install the camshaft carrier assembly.



A102B124

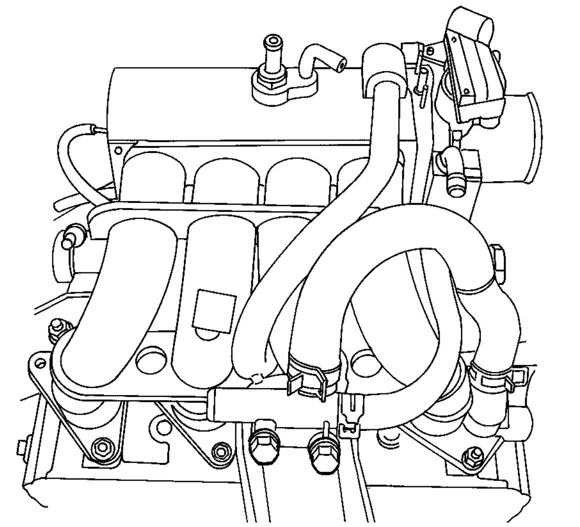
5. Install the cylinder head bolts in the sequence shown.



A102B172

Tighten

Tighten the cylinder head bolts in the sequence previously shown to 25 N•m (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the cylinder head bolts another 60 degrees plus 60 degrees plus 60 degrees plue 10 degrees.

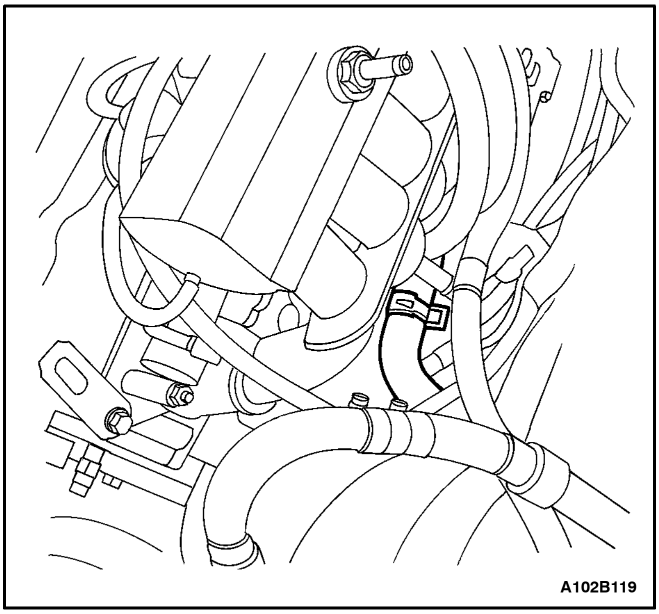


A102B029

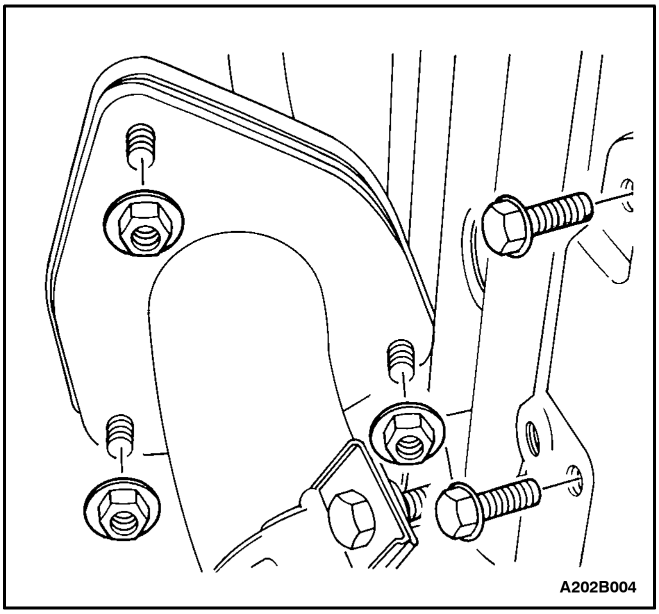
6. Connect the throttle cable at the throttle body and at the intake manifold.
7. Install the intake manifold support bracket retaining bolt to the coolant distributor.

Tighten

Tighten the intake manifold support bracket retaining bolts to 22 N•m (16 lb-ft).



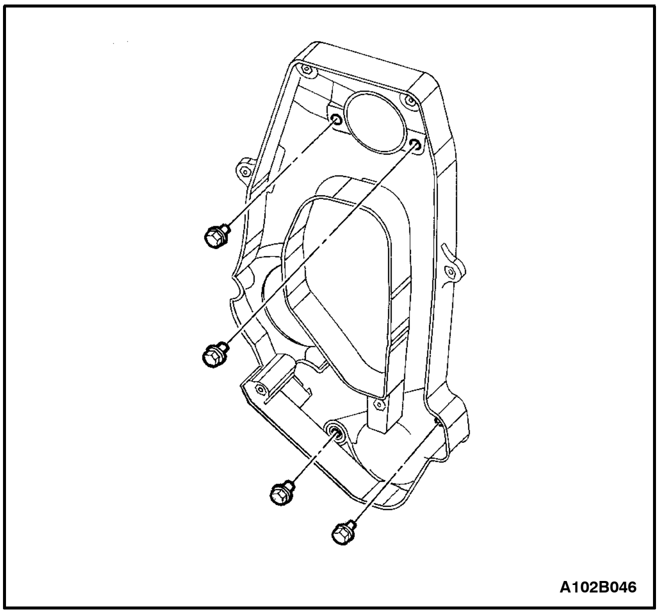
8. Connect the surge tank coolant hose at the throttle body.
9. Connect the heater inlet hose to the coolant distributor.



10. Install the exhaust flex pipe retaining nuts at the exhaust manifold flange and the bolts to the bracket.

Tighten

Tighten the exhaust flex pipe-to-exhaust manifold retaining nuts and bracket bolts to 40 NSm (30 lb-ft).



11. Connect the ignition wires at the spark plugs.
12. Install the rear timing belt cover.
13. Install the rear timing belt cover bolts.

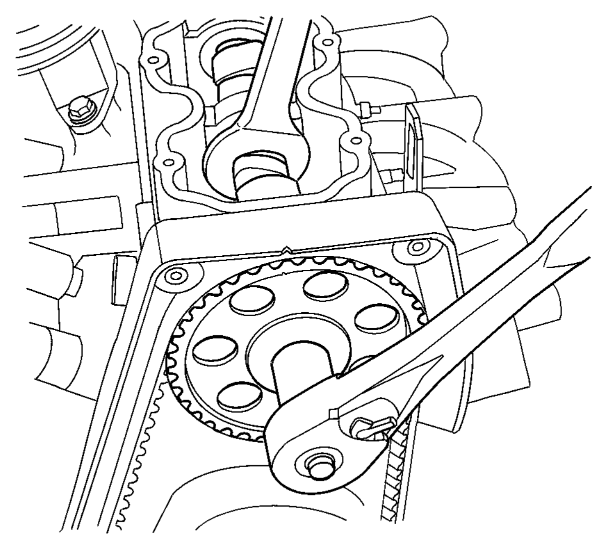
Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).

14. Install the timing belt automatic tensioner.
15. Install the timing belt automatic tensioner bolt.

Tighten

Tighten the timing belt automatic tensioner bolt to 20 NSm (15 lb-ft).



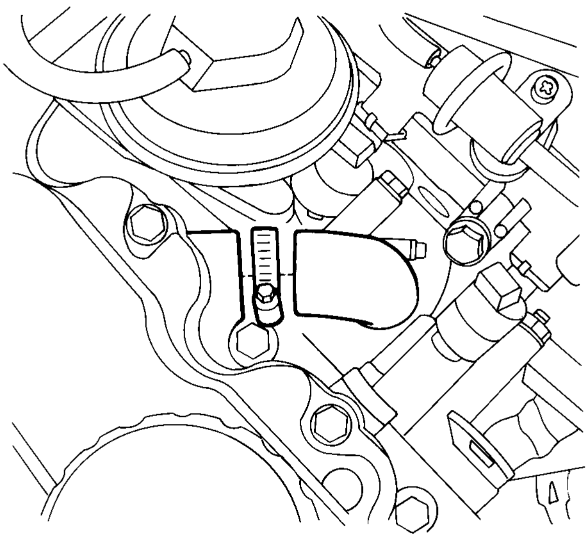
A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

16. Install the camshaft gear.
17. While holding the camshaft firmly in place, install the camshaft gear bolt.

Tighten

Tighten the camshaft gear bolt to 45 NSm (33 lb-ft).



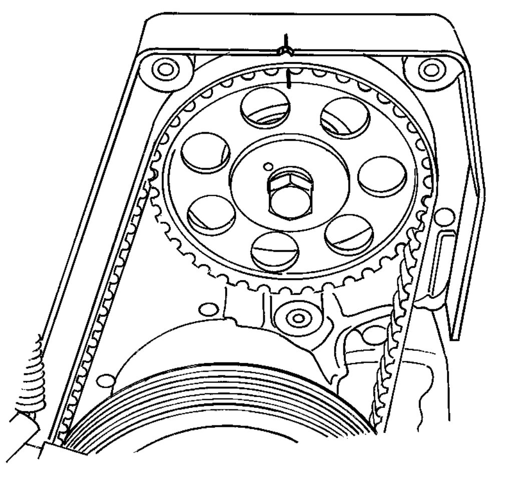
A102B117

18. Install the valve cover and the valve cover gasket.
19. Install the valve cover bolts.

Tighten

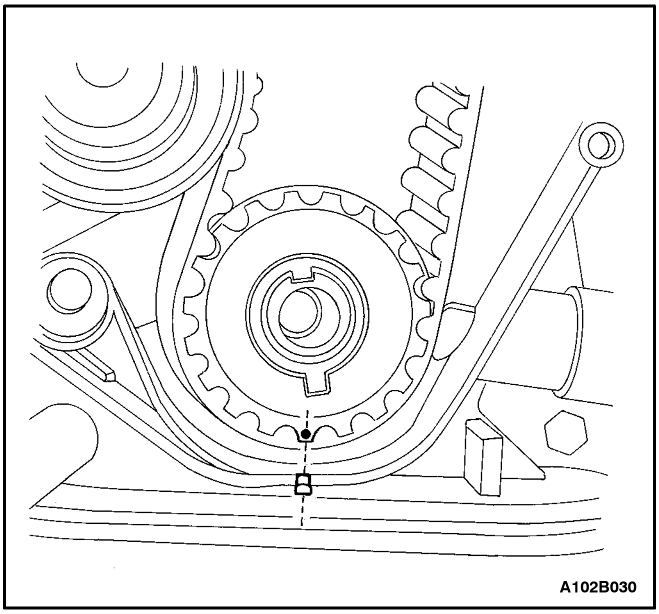
Tighten the valve cover bolts to 10 NSm (89 lb-in).

20. Connect the crankcase ventilation tube to the camshaft housing and connect the EGR solenoid connector.

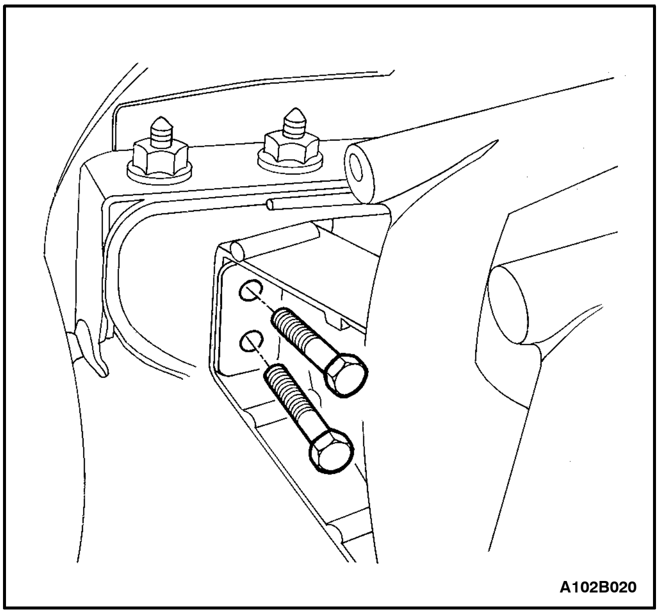


A102B004

21. Align the mark on the camshaft gear to the notch at the top of the rear timing belt cover.



22. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.



23. Install the timing belt. Refer to "Timing Belt" in this section.
24. Check the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
25. Install the lower timing belt cover.
26. Install the lower timing belt cover bolts.

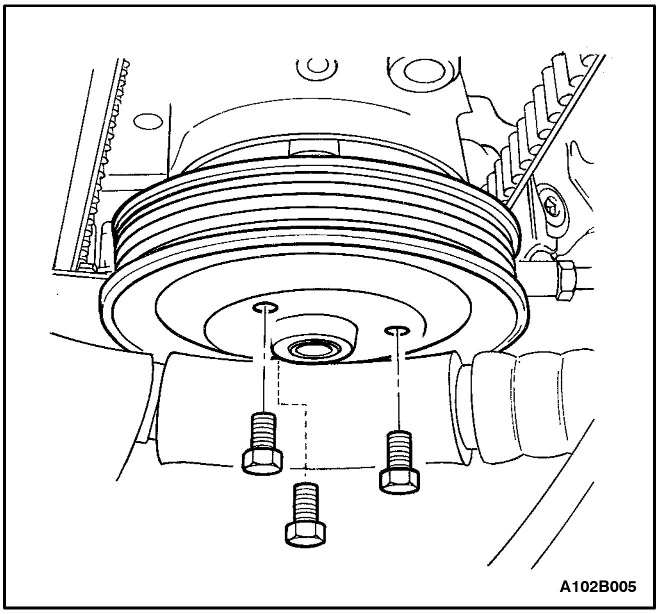
Tighten

Tighten the lower timing belt cover bolts to 10 N•m (89 lb-in).

27. Install the power steering pump and the bolts, if equipped. Refer to Section 6B, Power Steering Pump.
28. Install the engine mount bracket-to-engine mount retaining bolts if the power steering pump was installed.

Tighten

Tighten the engine mount bracket-to-engine mount retaining bolts to 60 N•m (44 lb-ft).



29. Install the crankshaft pulley.
30. Install the crankshaft pulley bolt.

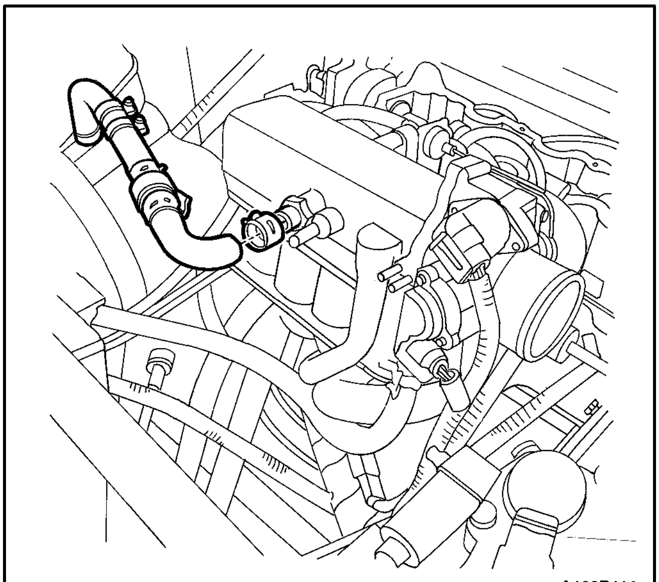
Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.

31. Install the power steering pump pulley, if equipped.
32. Install the power steering pump pulley bolts, if equipped.

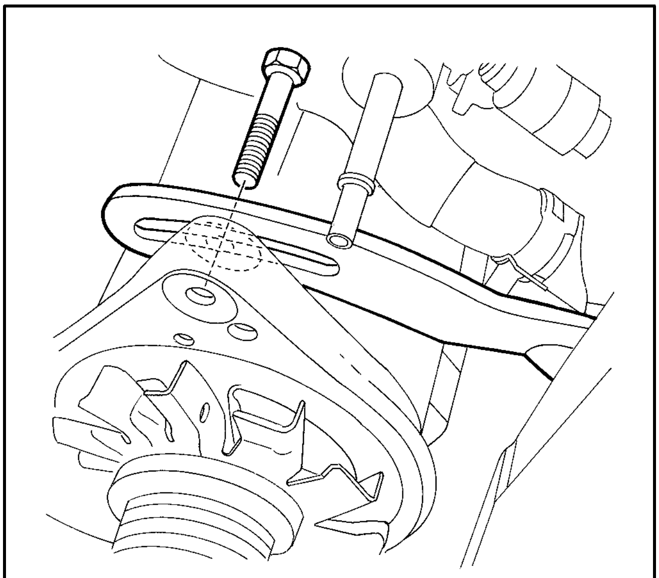
Tighten

Tighten the power steering pump pulley bolts to 25 N•m (18 lb-ft).



A102B114

33. Connect all of the vacuum hoses.
34. Connect the brake booster hose at the intake manifold.
35. Connect the upper radiator hose at the thermostat housing.



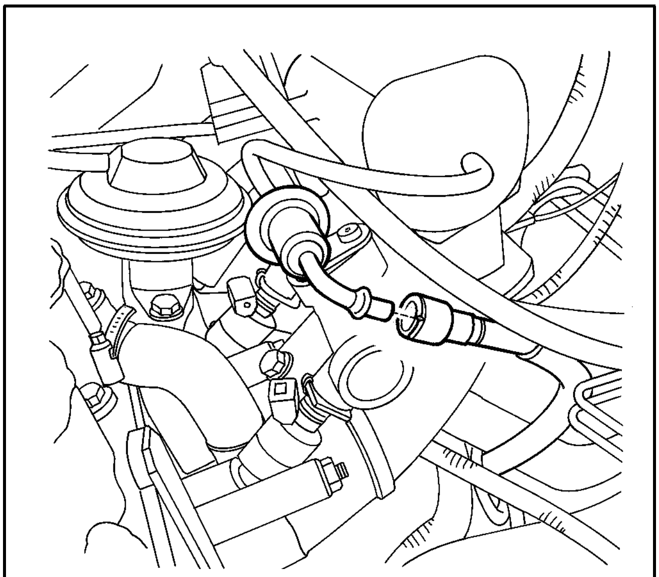
A102B118

36. Install the alternator adjusting bracket.
37. Install the alternator adjusting bracket retaining bolt.

Tighten

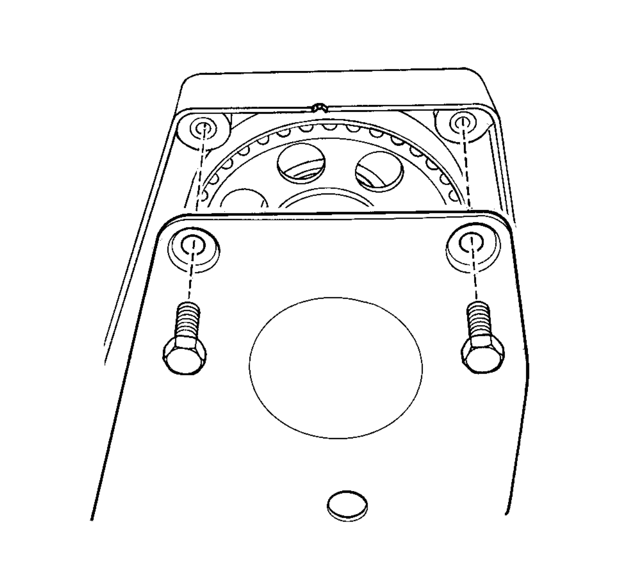
Tighten the alternator adjusting bracket retaining bolt to 20 N•m (15 lb-ft).

38. Install the alternator adjusting bolt. Do not tighten.



A102B116

39. Connect the fuel feed line at the fuel rail.
40. Connect the fuel return line at the fuel pressure regulator.



A102B003

41. Install the alternator drive belt.

Tighten

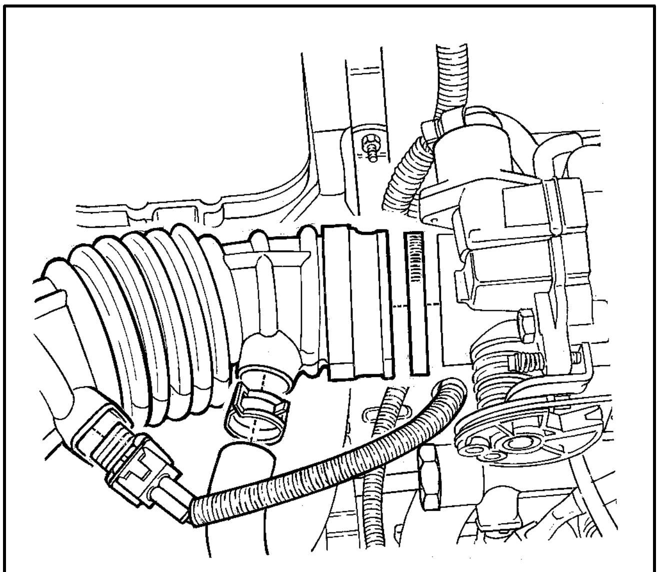
Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

42. Install the upper timing belt cover.
43. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).

44. Install the A/C compressor drive belt, as necessary.
45. Install the right front wheel well splash shield.
46. Install the right front wheel. Refer to Section 2E, Tires and Wheels.



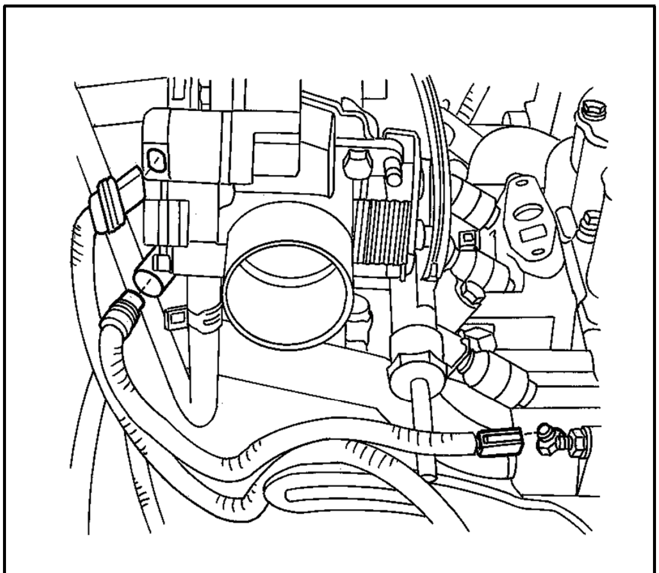
A102B001

47. Install the air filter housing.
48. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).

49. Connect the air intake tube to the throttle body.
50. Connect the breather tube to the valve cover.
51. Connect the manifold air temperature sensor connector.



A102B016

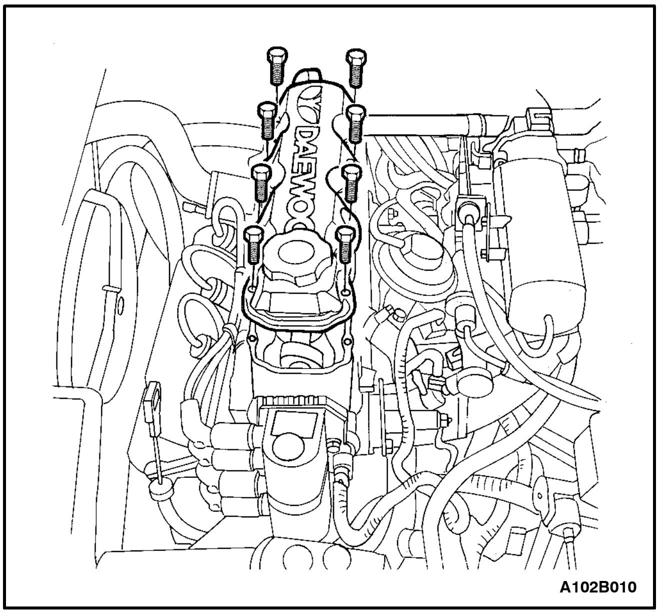
52. Connect the coolant temperature sensor connector.
53. Connect the engine coolant temperature sensor connector.
54. Connect the idle air control valve connector.
55. Connect the throttle position sensor connector.
56. Connect the DIS ignition coil connector.
57. Connect the fuel injector harness connectors.
58. Connect the oxygen sensor connector.
59. Connect the ECM ground terminal at the intake manifold.
60. Connect the negative battery cable.
61. Install the fuel pump fuse.
62. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.

CAMSHAFT

(Left-Hand Drive Shown, Right Hand Drive Similar)

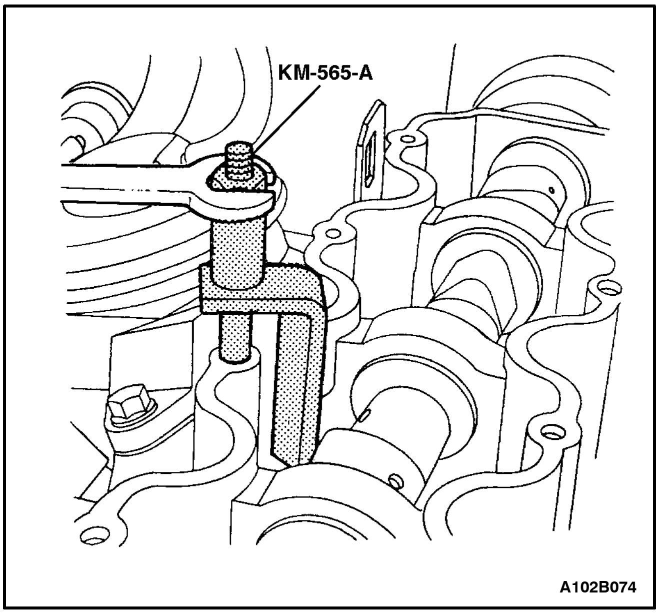
Tools Required

KM-565-A Valve Spring Compressor



Removal Procedure

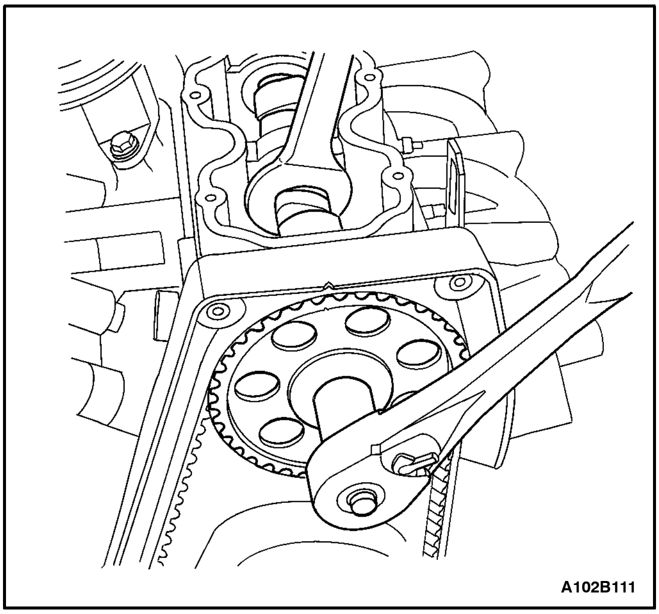
1. Remove the timing belt. Refer to "Timing Belt" in this section.
2. Disconnect the air breather tube at the valve cover.
3. Remove the valve cover bolts.
4. Remove the valve cover.
5. Remove the valve cover gasket.



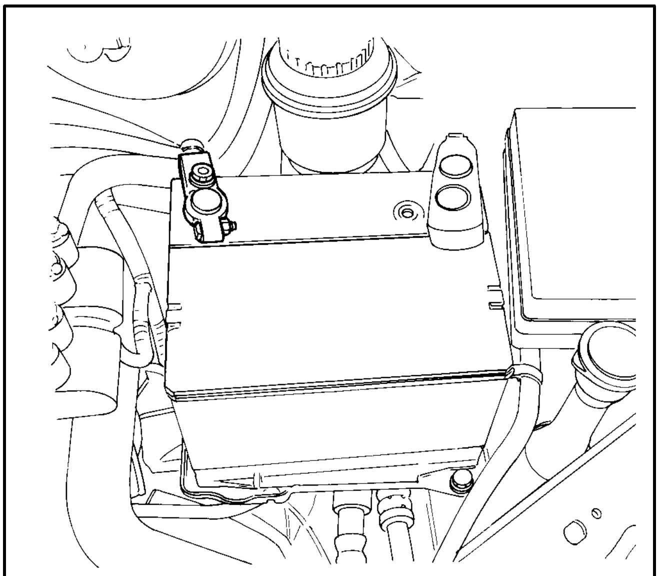
6. Install the valve spring compressor KM-565-A.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

7. Remove the camshaft followers using the valve spring compressor KM-565-A.

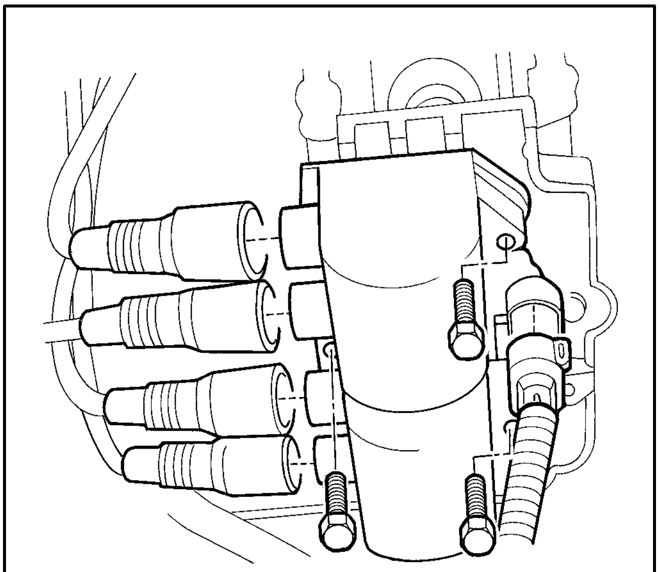


8. While holding the camshaft firmly in place, remove the camshaft gear bolt.
9. Remove the camshaft gear.



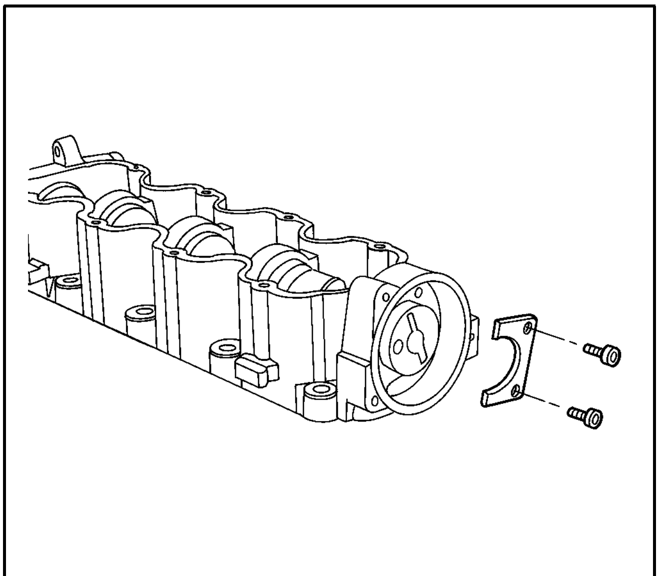
A102C034

10. Disconnect the positive battery cable from the battery.
11. Remove the battery and the battery tray. Refer to Section 1E, Engine Electrical.



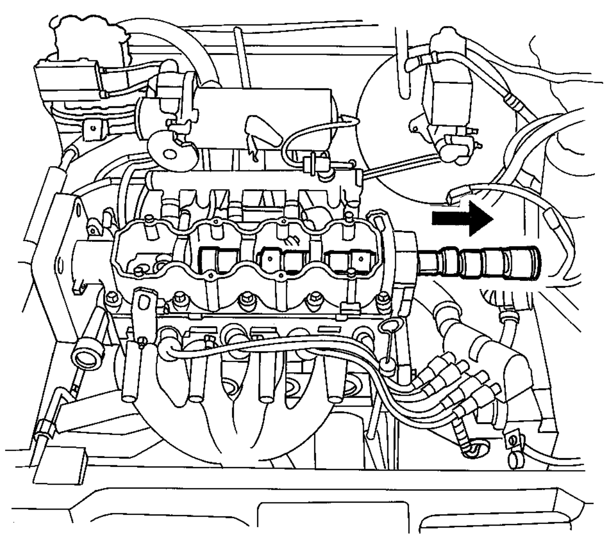
A102B075

12. Disconnect the direct ignition system (DIS) ignition coil connector.
13. Disconnect the DIS ignition wires at the ignition coil.
14. Remove the DIS ignition coil mounting bolts.
15. Remove the DIS ignition coil.



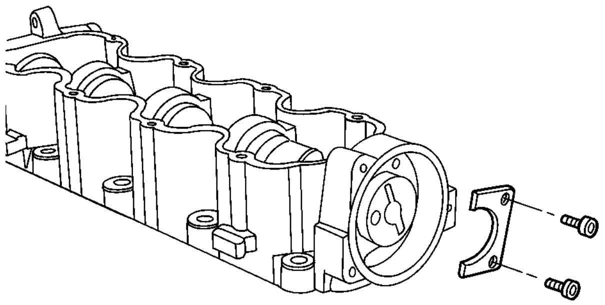
A102B076

16. Remove the DIS ignition coil mounting plate bolts.
17. Remove the DIS ignition coil mounting plate.
18. Remove the camshaft pressure plate bolts.
19. Remove the camshaft pressure plate.



A102B077

20. Remove the camshaft.



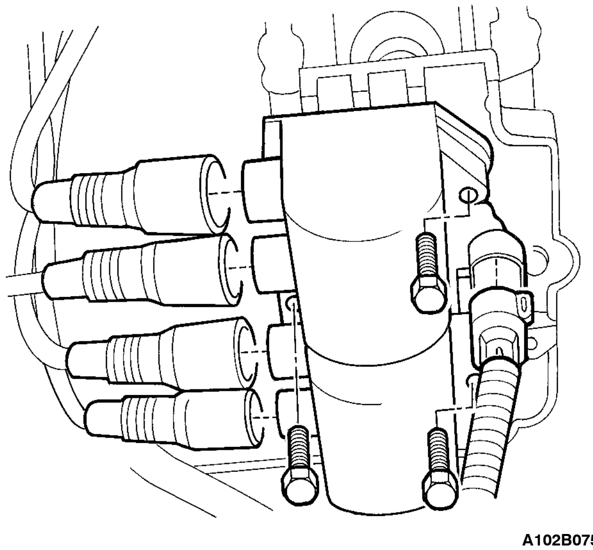
A102B076

Installation Procedure

1. Install the camshaft.
2. Install the camshaft pressure plate.
3. Install the camshaft pressure plate bolts.

Tighten

Tighten the camshaft pressure plate bolts to 10 NSm (89 lb-in).



A102B075

4. Measure camshaft end play. Camshaft end play should be 0.04 to 0.16 mm (.016 to 0.64 inch).
5. Install the DIS ignition coil mounting plate.
6. Install the DIS ignition coil mounting plate bolts.

Tighten

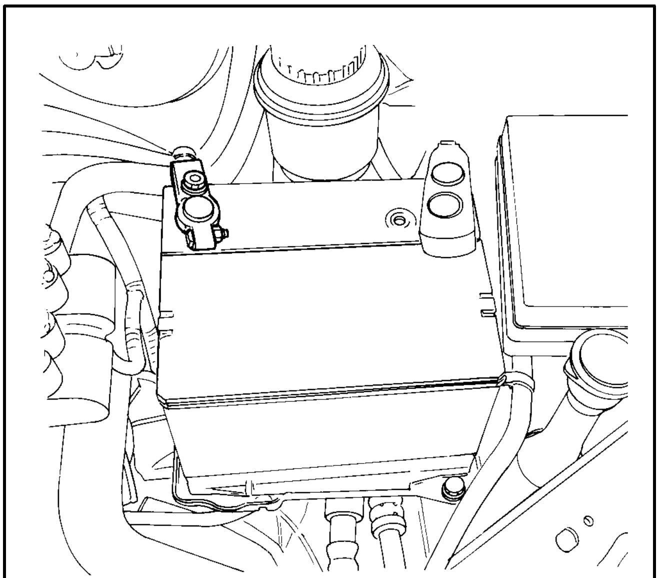
Tighten the DIS ignition coil mounting plate bolts to 10 NSm (89 lb-in).

7. Install the DIS ignition coil.
8. Install the DIS ignition coil mounting bolts.

Tighten

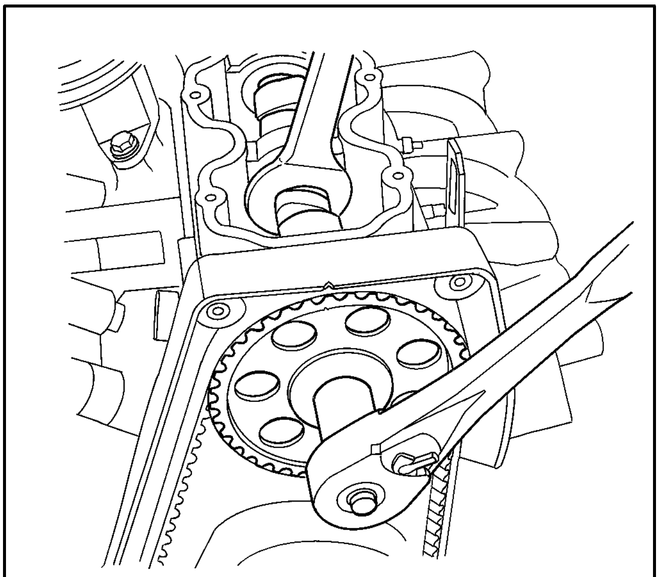
Tighten the DIS ignition coil mounting bolts to 10 NSm (89 lb-in).

9. Connect the ignition wires at the DIS ignition coil.
10. Connect the DIS ignition coil connector.



A102C034

11. Install the battery and the battery tray. Refer to Section 1E, Engine Electrical.
12. Connect the positive battery cable to the battery.



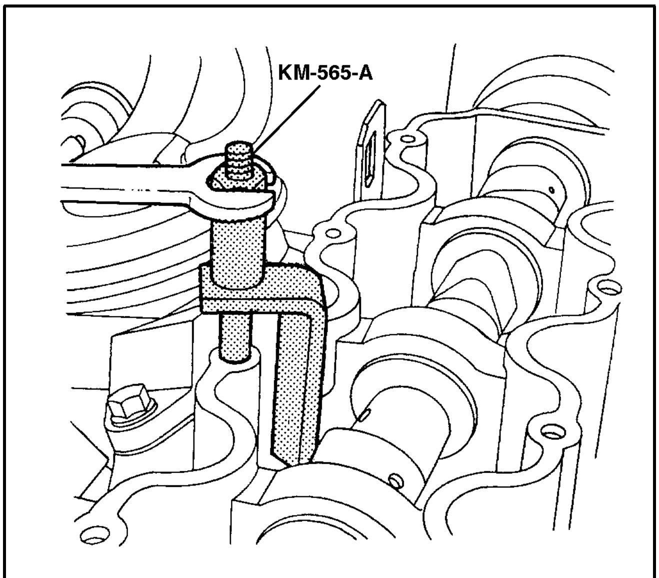
A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

13. Install the camshaft gear.
14. While holding the camshaft firmly in place, install the camshaft gear bolt.

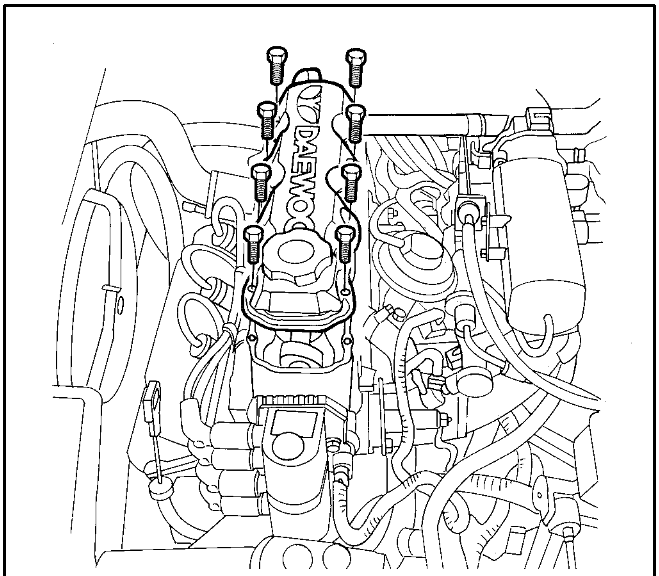
Tighten

Tighten the camshaft gear bolt to 45 N•m (33 lb-ft).



A102B074

15. Install the camshaft followers using the valve spring compressor KM-565-A.
16. Remove the tool KM-565-A.



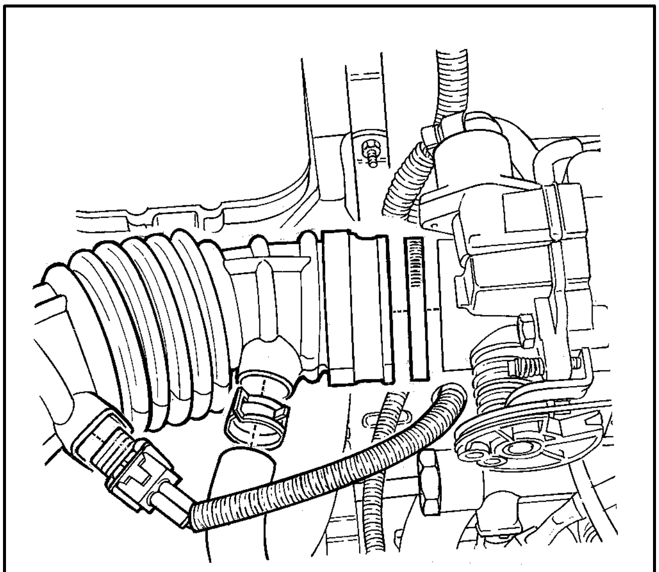
A102B010

17. Install the valve cover gasket.
18. Install the valve cover.
19. Install the valve cover bolts.

Tighten

Tighten the valve cover bolts to 10 N•m (89 lb-in).

20. Connect the air breather tube to the valve cover.
21. Install the timing belt. Refer to "Timing Belt" in this section.


A102B001

TIMING BELT CHECK AND ADJUST

(Left-Hand Drive Shown, Right Hand Drive Similar)

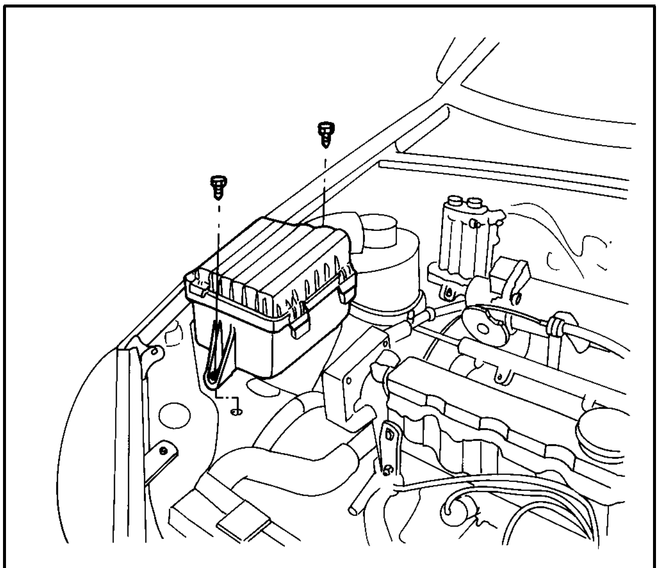
Tools Required

J-42492 Timing Belt Adjuster

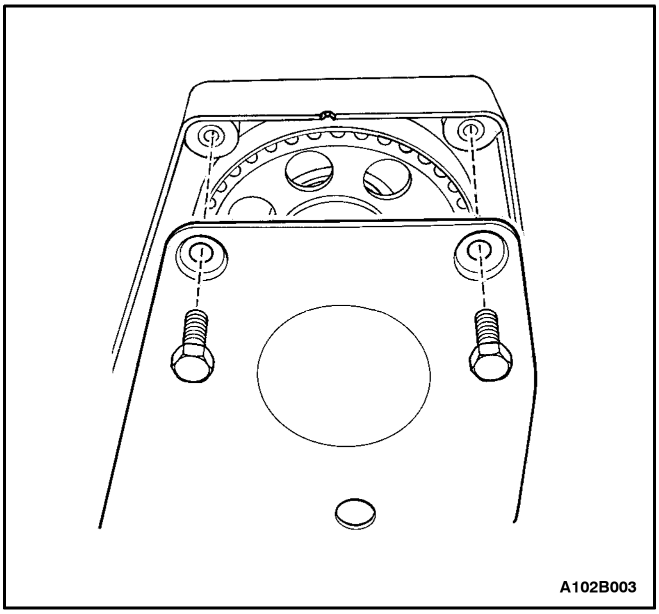
KM-470-B Angular Torque Gauge

Adjustment Procedure

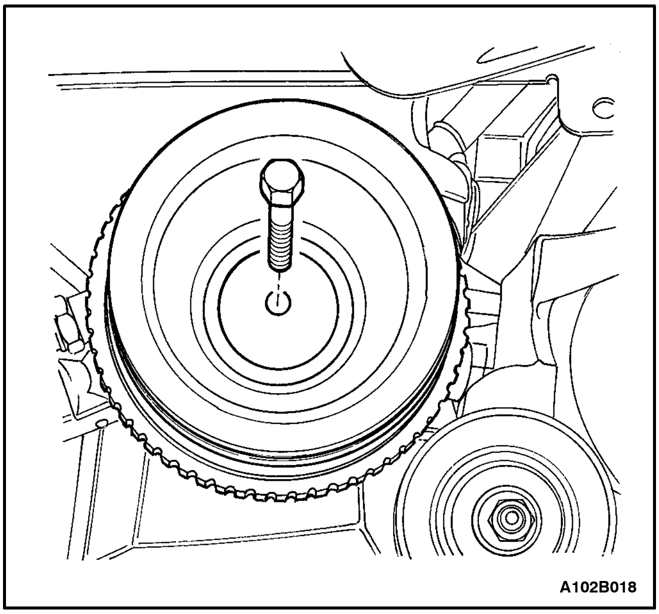
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.


A102B002

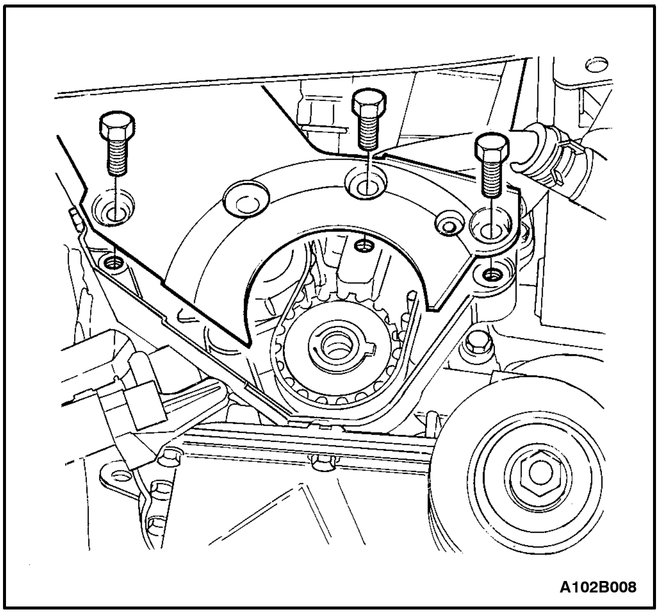
5. Remove the air cleaner housing bolts.
6. Remove the air cleaner housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front wheel well splash shield.



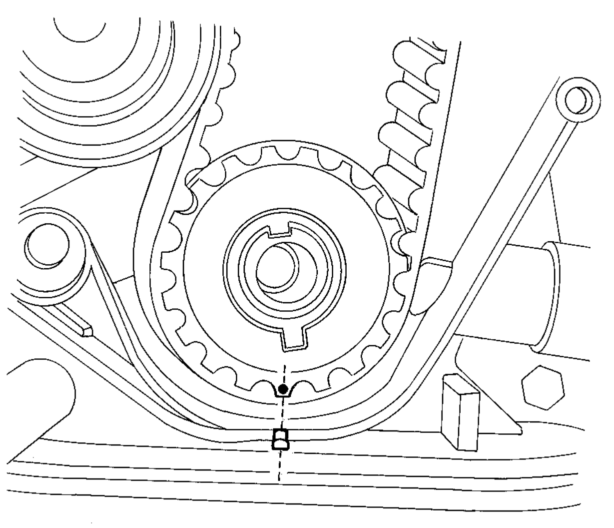
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.
12. Remove the power steering pump pulley, if equipped.
13. Remove the power steering pump mounting bolts, if equipped.
14. Remove the upper timing belt cover bolts.
15. Remove the upper timing belt cover.



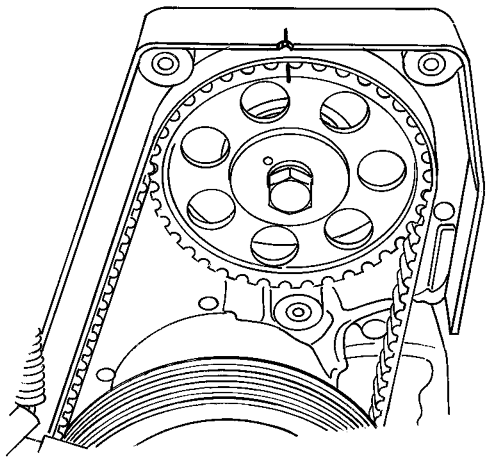
16. Remove the crankshaft pulley bolt.
17. Remove the crankshaft pulley.



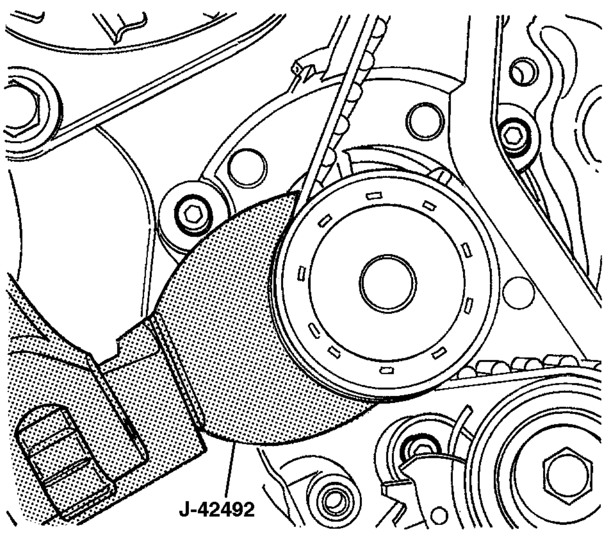
18. Remove the lower timing belt cover bolts.
19. Remove the lower timing belt cover.


A102B030

20. Install the crankshaft pulley bolt.
21. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
22. Align the dot on the crankshaft gear to the notch at the bottom of the rear timing belt cover.

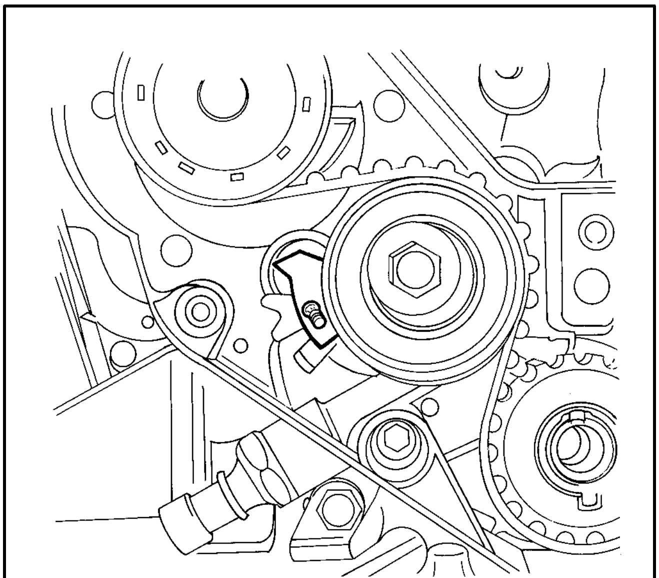

A102B004

23. Align the camshaft gear timing mark to the notch at the top of the rear timing belt cover.

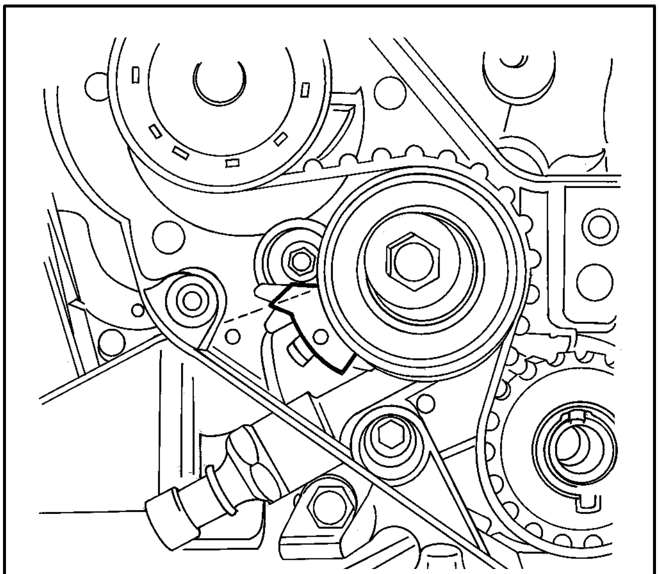


A102B040

24. Slightly loosen the three coolant pump retaining bolts.
25. Using the timing belt adjuster J-42492, rotate the coolant pump clockwise to add the highest tension to the timing belt.
26. Tighten the coolant pump retaining bolts.


A102B039

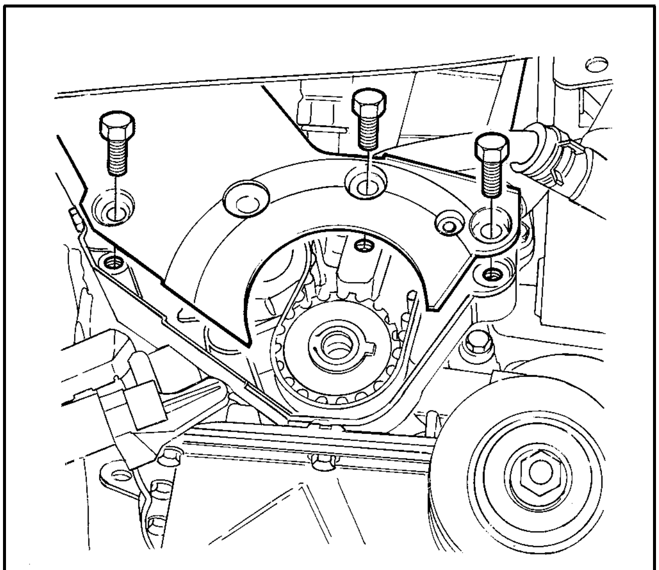
27. Align the adjust arm hole of the timing belt automatic tensioner to the hole in the timing belt automatic tensioner bracket.
28. Insert a 4.5 mm driver through the adjust arm hole and the tensioner bracket hole.
29. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
30. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
31. Remove the driver from the timing belt automatic tensioner.
32. Loosen the coolant pump retaining bolts.


A102B041

33. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.
34. Tighten the coolant pump retaining bolts.

Tighten

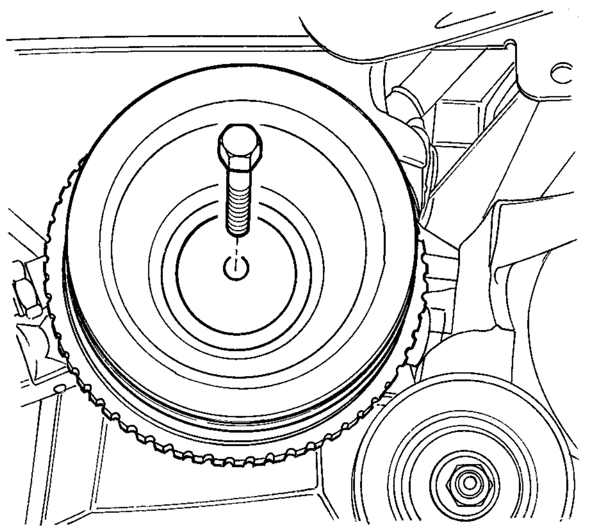
Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).


A102B008

35. Remove the crankshaft pulley bolt.
36. Install the lower timing belt cover.
37. Install the lower timing belt cover bolts.

Tighten

Tighten the lower timing belt cover bolts to 10 NSm (89 lb-in).

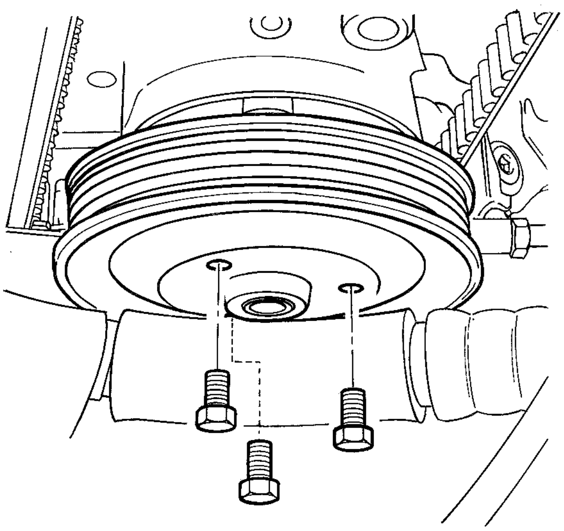


A102B018

38. Install the crankshaft pulley.
39. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.



A102B005

40. Install the upper timing belt cover.
41. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).

42. Install the power steering pump mounting bolts, if equipped.

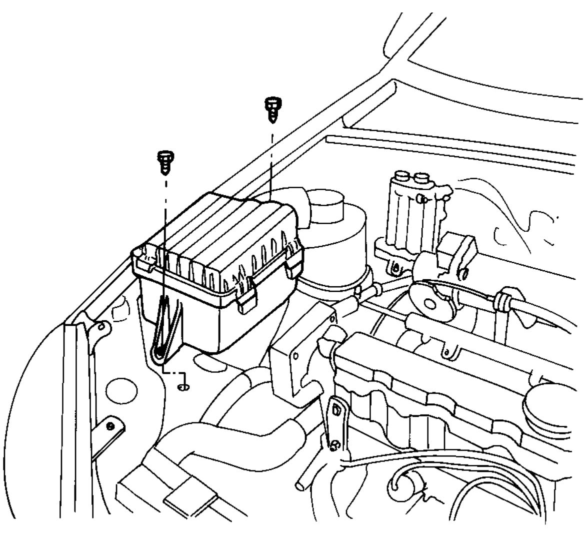
Tighten

Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).

43. Install the power steering pump pulley, if equipped.
44. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).



A102B002

45. Install the alternator drive belt.

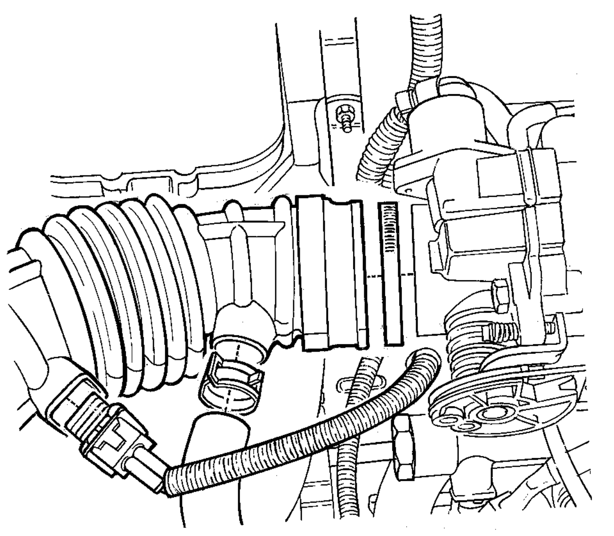
Tighten

Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

46. Install the A/C compressor drive belt, if equipped.
47. Install the right front wheel well splash shield.
48. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
49. Install the air cleaner housing.
50. Install the air cleaner housing bolts.

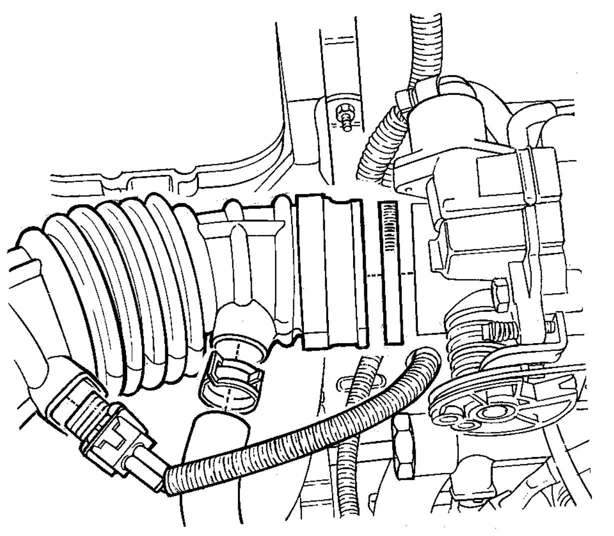
Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).



A102B001

51. Connect the air intake tube to the throttle body.
52. Connect the breather tube to the valve cover.
53. Connect the manifold air temperature sensor connector.
54. Connect the negative battery cable.



A102B001

TIMING BELT

(Left-Hand Drive Shown, Right Hand Drive Similar)

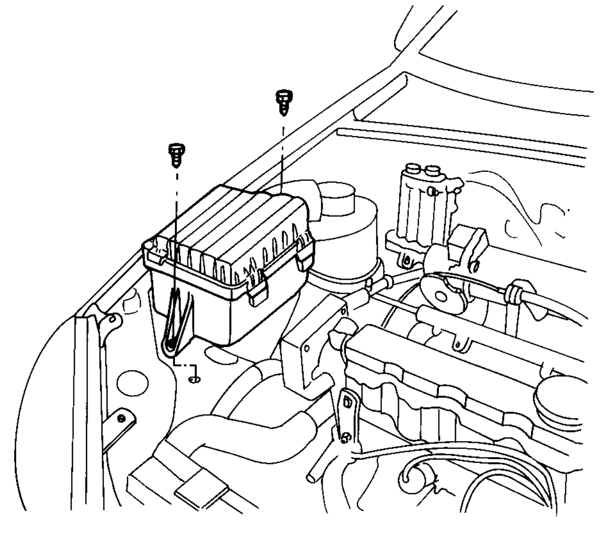
Tools Required

J-42492 Timing Belt Adjuster

KM-470-B Angular Torque Gauge

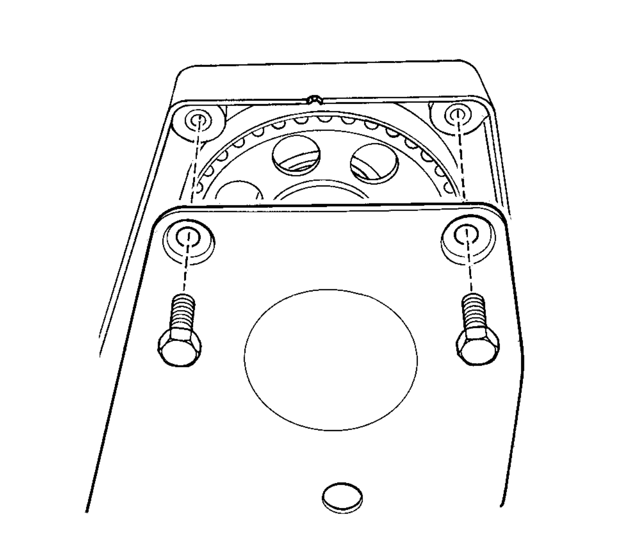
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.



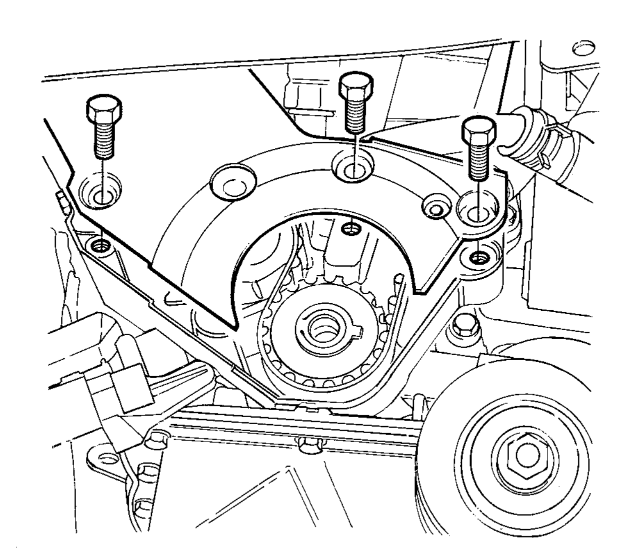
A102B002

5. Remove the air cleaner housing bolts.
6. Remove the air cleaner housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front wheel well splash shield.



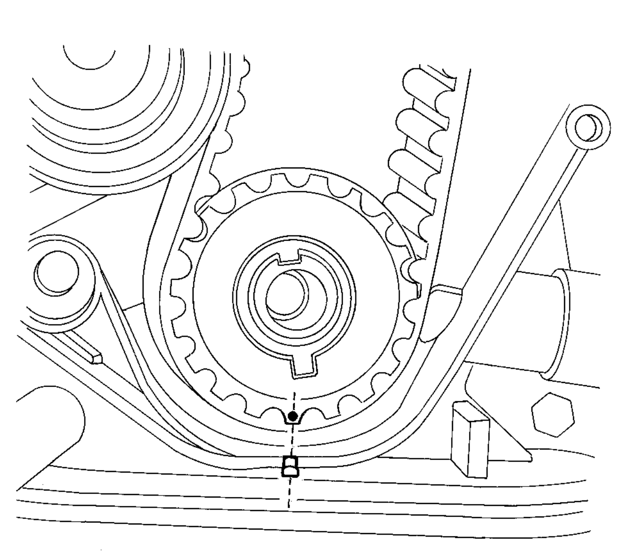
A102B003

9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
12. Remove the upper timing belt cover bolts.
13. Remove the upper timing belt cover.



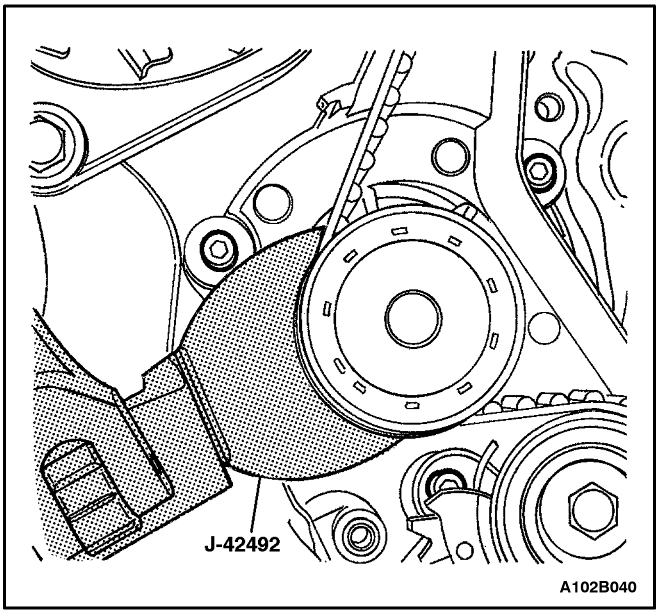
A102B008

14. Remove the crankshaft pulley bolt.
15. Remove the crankshaft pulley.
16. Remove the lower timing belt cover bolts.
17. Remove the lower timing belt cover.

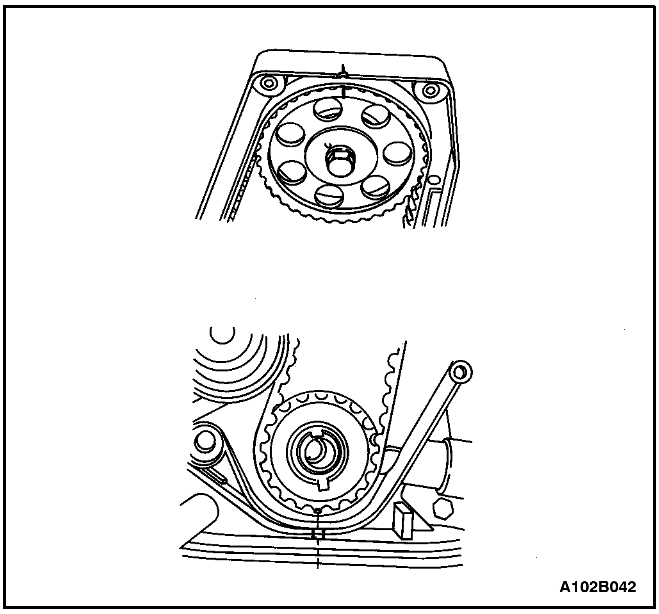


A102B030

18. Install the crankshaft pulley bolt.
19. Using the crankshaft pulley bolt, rotate the crankshaft clockwise until the mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.

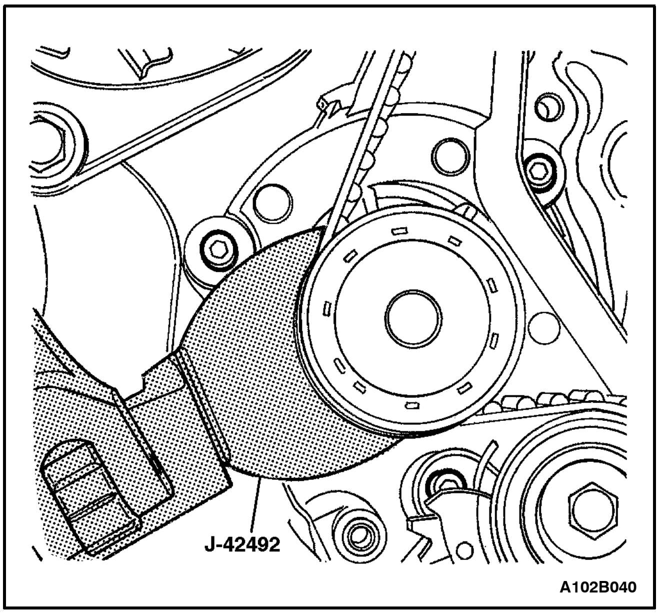


20. Slightly loosen the coolant pump retaining bolts.
21. Using the timing belt adjuster J-42492, rotate the coolant pump counterclockwise to release the tension on the timing belt.
22. Remove the timing belt.

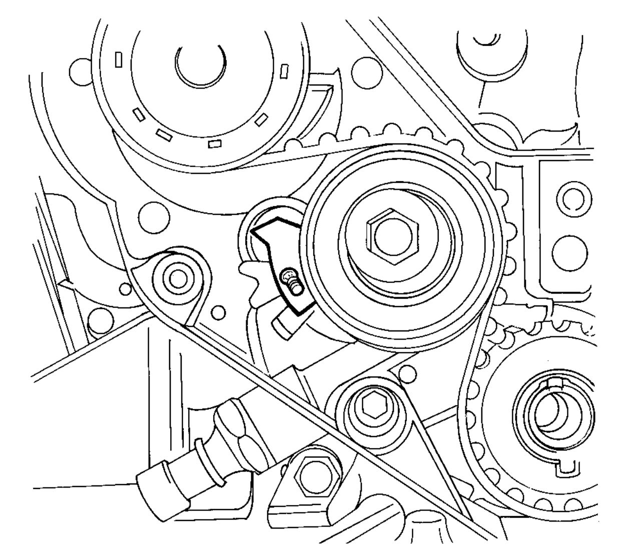


Installation Procedure

1. Align the mark on the crankshaft gear to the notch on the bottom of the rear timing belt cover.
2. Align the mark on the camshaft gear to the notch on the top of the rear timing belt cover.
3. Install the timing belt.

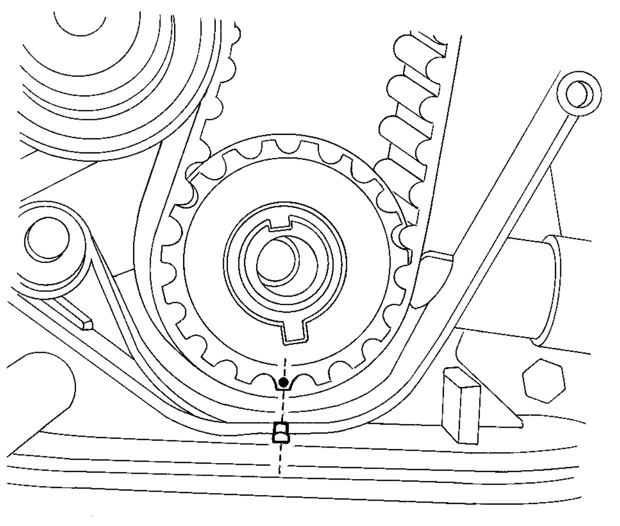


4. Using the timing belt adjuster J-42492, rotate the coolant pump clockwise to add the highest tension to the timing belt.
5. Tighten the coolant pump retaining bolts.



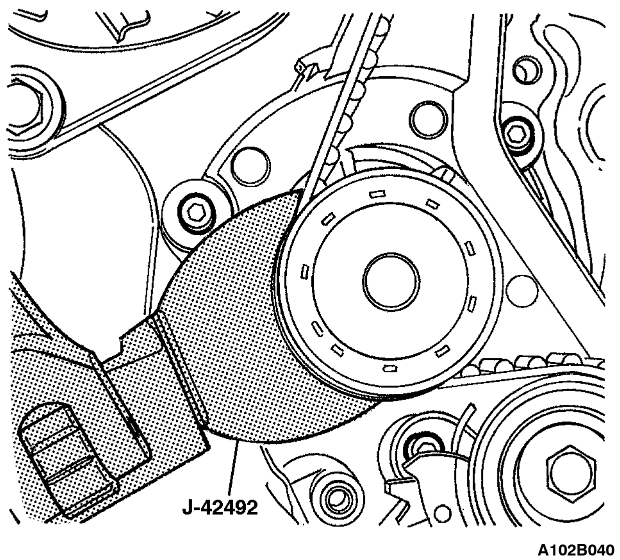
A102B039

6. Align the adjust arm hole of the timing belt automatic tensioner to the hole in the timing belt automatic tensioner bracket.
7. Insert a 4.5 mm driver through the adjust arm hole and the tensioner bracket hole.



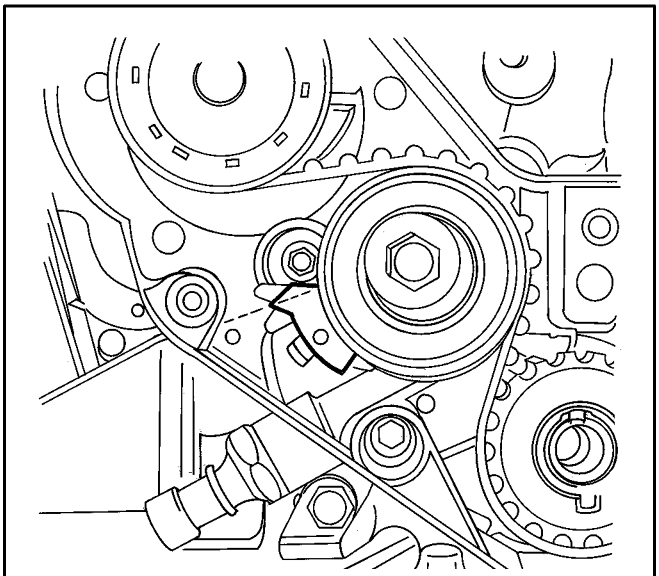
A102B030

8. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
9. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.



A102B040

10. Remove the driver from the timing belt automatic tensioner.
11. Slightly loosen the three coolant pump retaining bolts.
12. Using the timing belt adjuster J-42492, rotate the coolant pump.

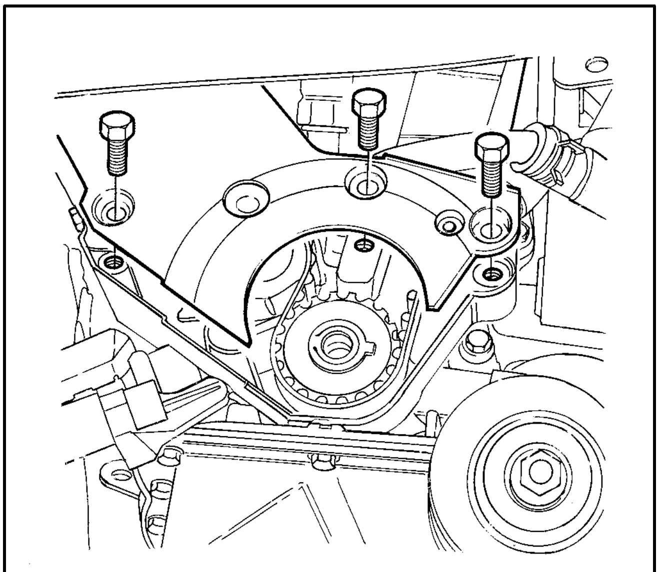


A102B041

13. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.
14. Tighten the coolant pump retaining bolts.

Tighten

Tighten the coolant pump retaining bolts to 10 N•m (89 lb-in).

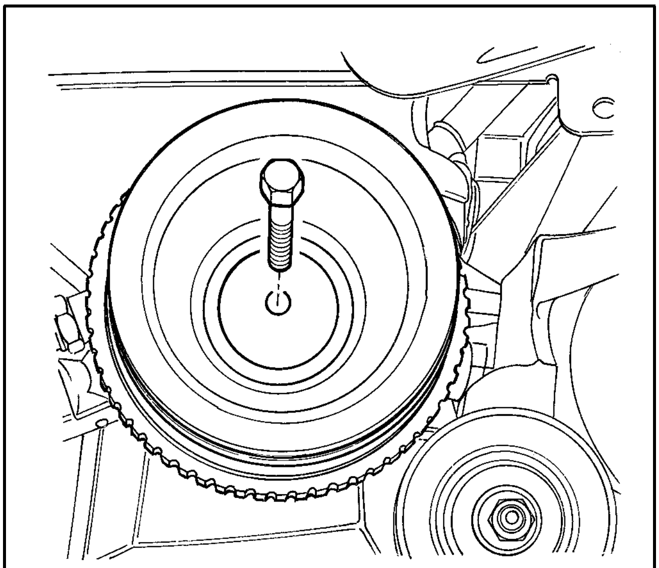


A102B008

15. Remove the crankshaft pulley bolt.
16. Install the lower timing belt cover.
17. Install the lower timing belt cover bolts.

Tighten

Tighten the lower timing belt cover bolts to 10 N•m (89 lb-in).

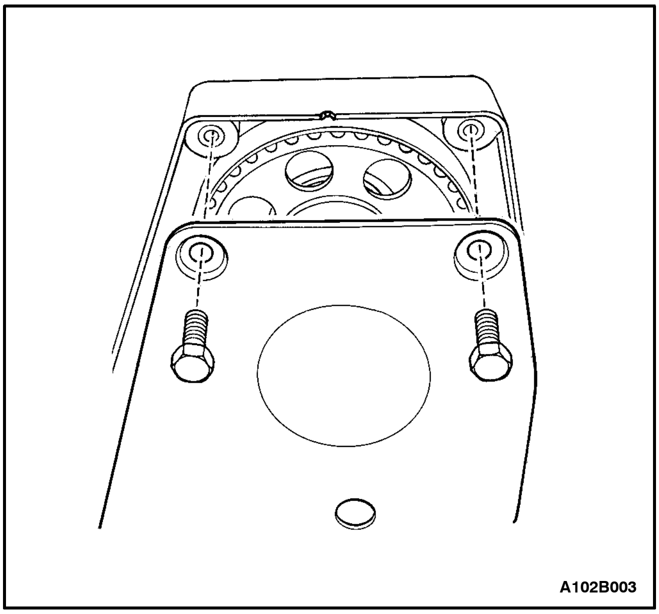


A102B018

18. Install the crankshaft pulley.
19. Install the crankshaft pulley bolt.

Tighten

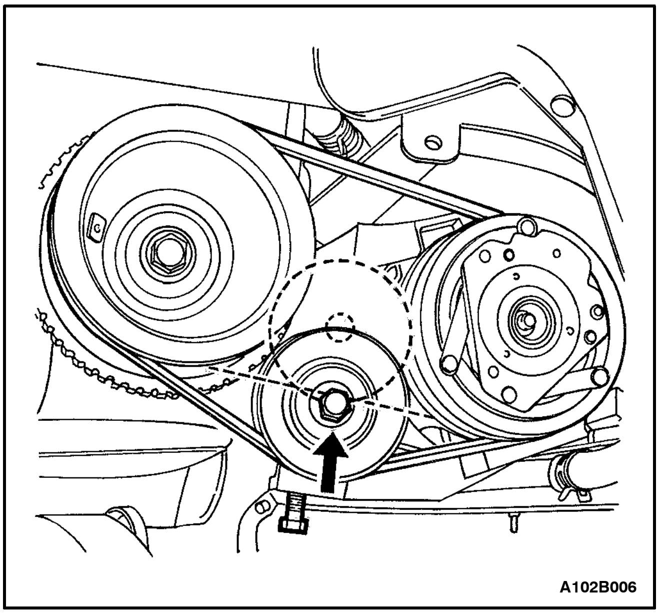
Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.



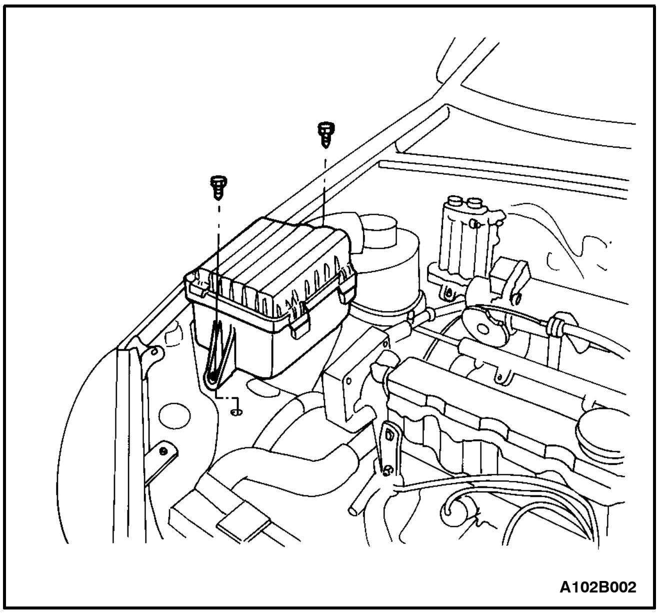
20. Install the upper timing belt cover.
21. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 N•m (89 lb-in).



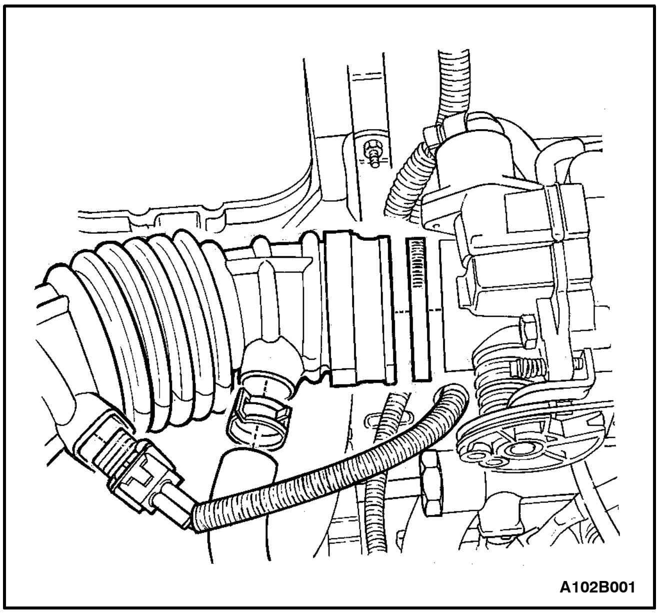
22. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
23. Install the alternator drive belt.
24. Install the A/C compressor drive belt, if equipped.



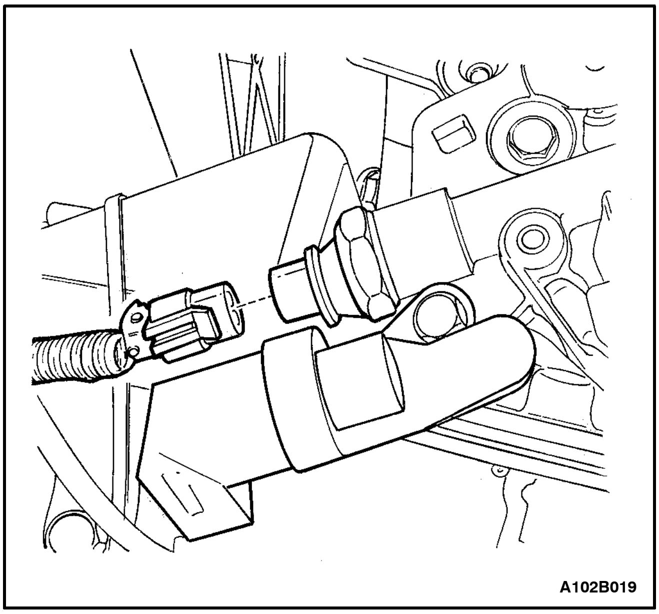
25. Install the right front wheel well splash shield.
26. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
27. Install the air filter housing.
28. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 N•m (106 lb-in).



29. Connect the air intake tube to the throttle body.
30. Connect the breather tube to the valve cover.
31. Connect the manifold air temperature sensor connector.
32. Connect the negative battery cable.



OIL PUMP

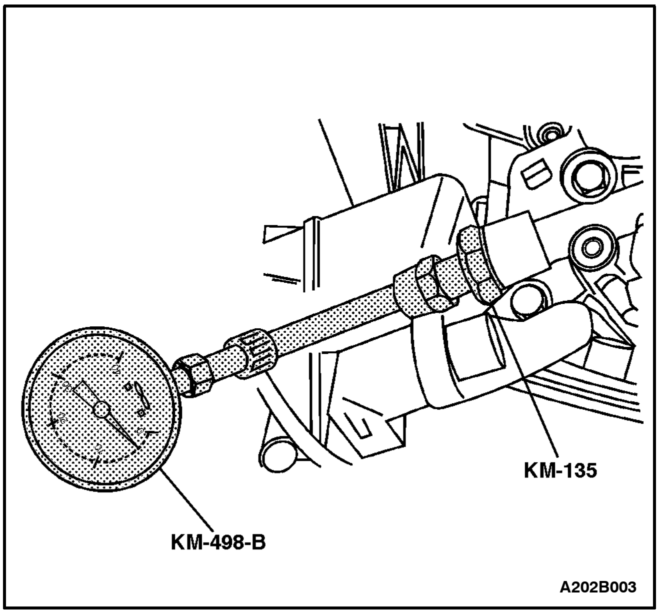
Tools Required

KM-498-B Pressure Gauge

KM-135 Adapter

Engine Oil Pressure Inspection Procedure

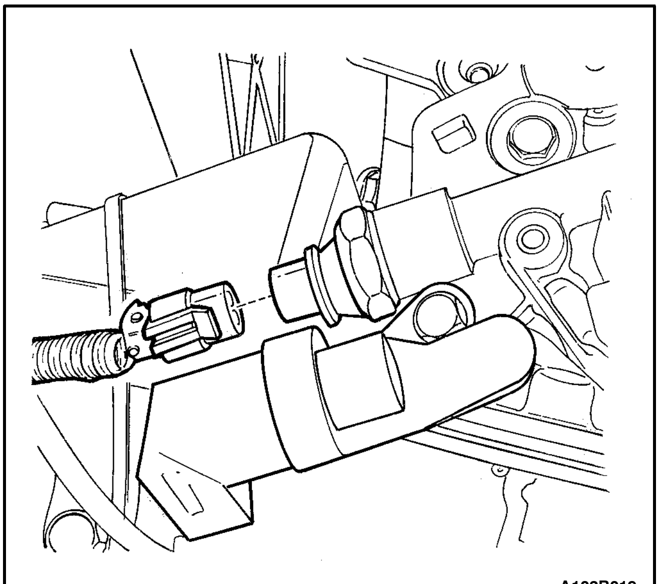
1. Remove the right-hand (RH) wheel well splash shield.
2. Remove the oil pressure switch connector.



3. Install the adapter KM-135 in place of the oil pressure switch.
4. Connect the pressure gauge KM-498-B to the adapter.
5. Start the engine and check the oil pressure at idle speed and an engine temperature of 80_C (176_ F).

Important: The minimum oil pressure should be 30 kPa (8.88 psi).

6. Stop the engine and remove the oil pressure gauge and the adapter.

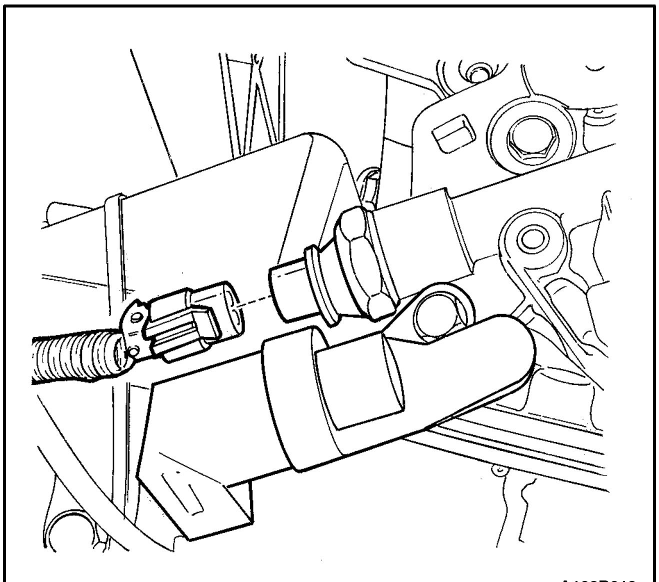

A102B019

7. Install the oil pressure switch.

Tighten

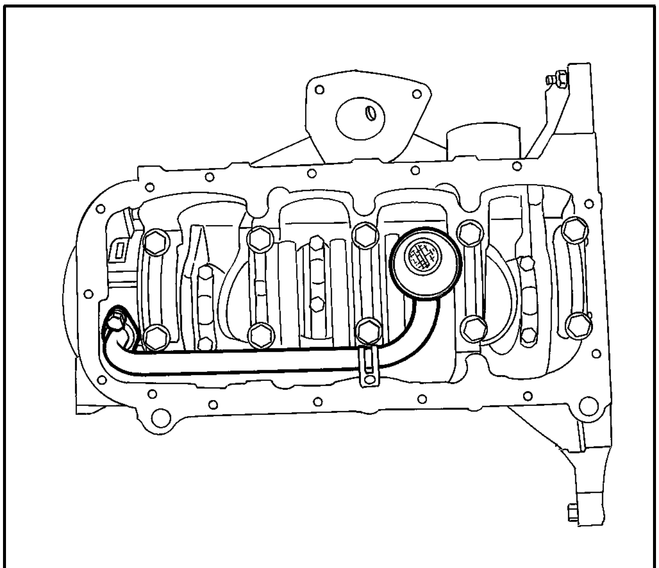
Tighten the oil pressure switch to 40 NSm (30 lb-ft).

8. Connect the electrical connector to the oil pressure switch.
9. Install the RH wheel well splash shield.
10. Check the oil level and fill the oil to the FULL mark.

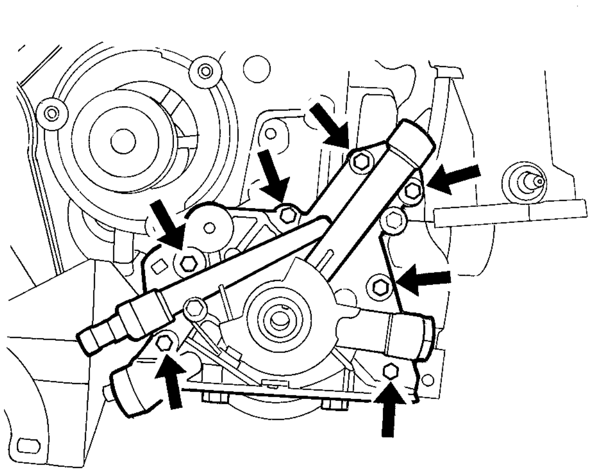

A102B019

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
3. Remove the timing belt. Refer to "Timing Belt" in this section.
4. Remove the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
5. Disconnect the oil pressure switch connector.

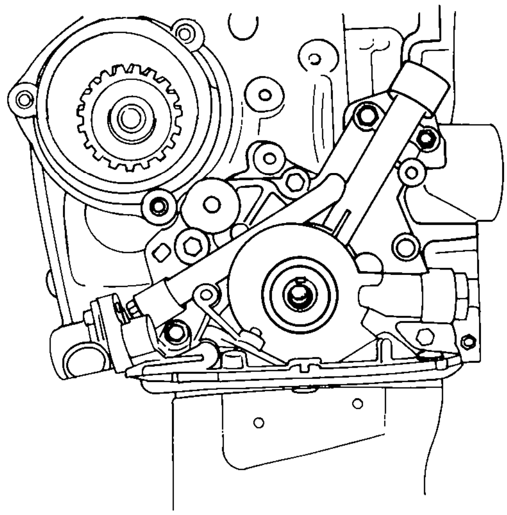

A102B064

6. Remove the crankshaft position sensor bolt.
7. Remove the crankshaft position sensor.
8. Remove the oil pan. Refer to "Oil Pan" in this section.
9. Remove the oil pump pickup tube and the support bracket bolts.
10. Remove the oil pump pickup tube.



A102B065

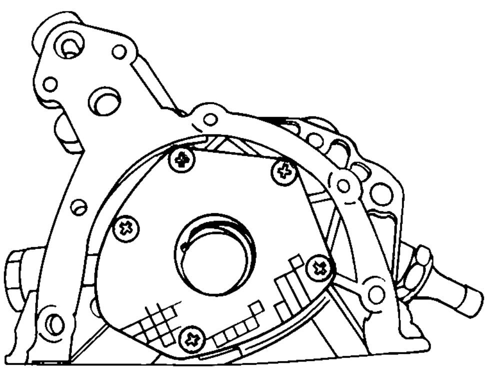
11. Remove the oil pump retaining bolts.
12. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
13. Remove the oil pump.



A202B002

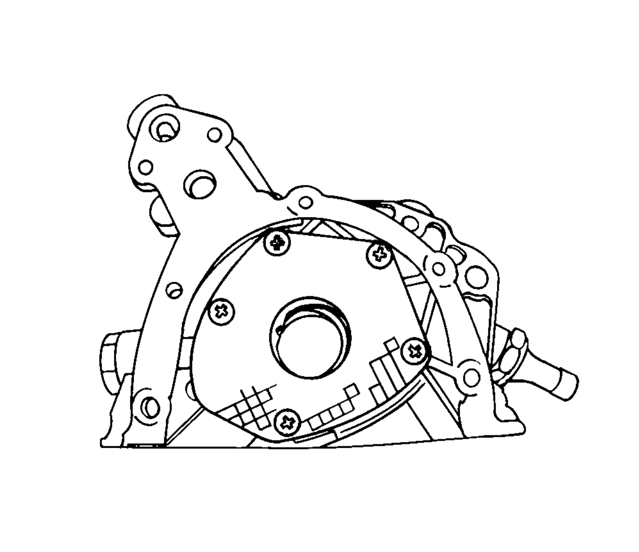
Inspection Procedure

1. Clean the oil pump and the engine block gasket mating surfaces.
2. Remove the safety relief valve bolt.
3. Remove the safety relief valve and the spring.
4. Remove the oil pump-to-crankshaft seal.



A202B001

5. Remove the oil pump rear cover bolts.
6. Remove the rear cover.


A202B001

7. Clean the oil pump housing and all of the parts.
8. Inspect all of the parts for signs of wear. Refer to "Engine Specifications" in this section.
9. Coat all of the oil pump parts with clean engine oil.
10. Reinstall all of the oil pump parts.

Notice: Pack the oil pump gear cavity with petroleum jelly to ensure an oil pump prime. Failure to do this can damage the engine.

11. Install the oil pump rear cover and the bolts.

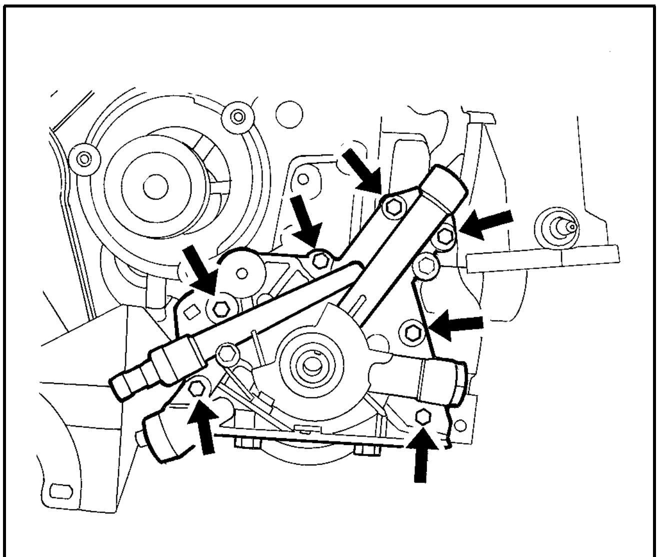
Tighten

Tighten the oil pump rear cover bolts to 6 N•m (53 lb-in).

12. Install the safety relief valve, the spring, the washer, and the bolt.

Tighten

Tighten the oil pump safety relief valve bolt to 30 N•m (22 lb-ft).

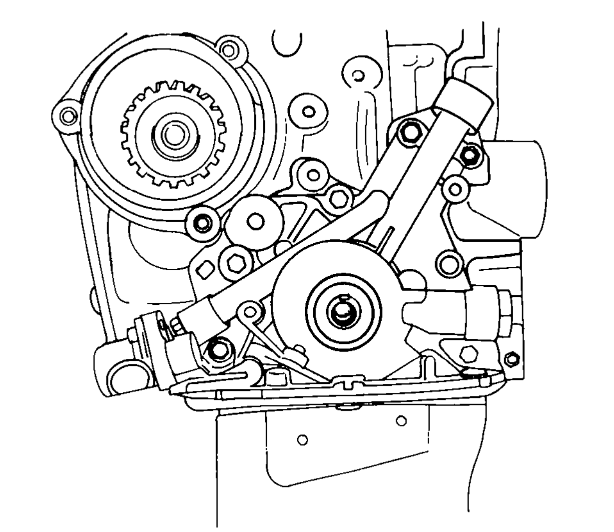

A102B065

Installation Procedure

1. Apply a bead of room temperature vulcanizing (RTV) sealer to the oil pump gasket.
2. Install a new oil pump gasket to the oil pump.
3. Coat the threads of the oil pump bolts with Loctite® 573.
4. Install the oil pump to the engine block with the bolts.

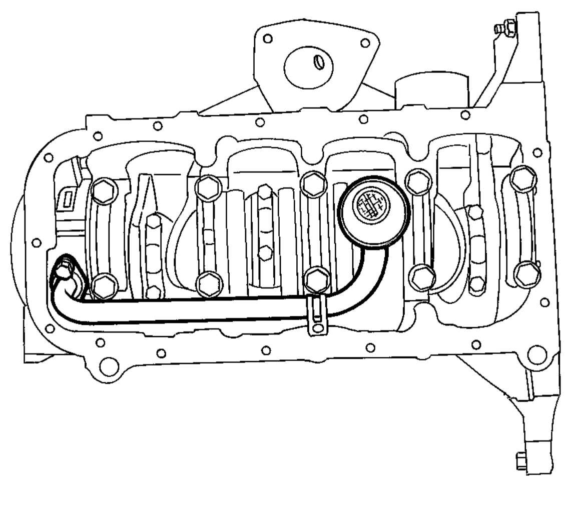
Tighten

Tighten the oil pump retaining bolts to 10 N•m (89 lb-in).



A202B002

5. Install a new oil pump to the crankshaft shaft seal.
6. Coat the lip of the seal with a thin coat of grease.

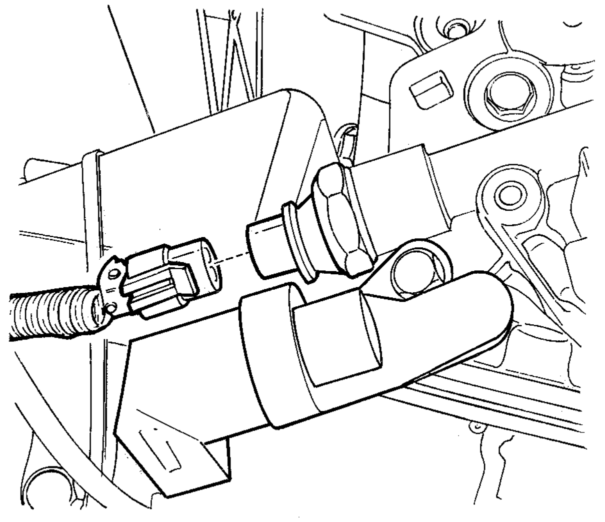


A102B064

7. Coat the threads of the oil pump pickup tube and the support bracket bolts with Loctite[573.
8. Install the oil pump pickup tube and the bolts.

Tighten

Tighten the oil pump pickup tube and the support bracket bolts to 10 NSm (89 lb-in).



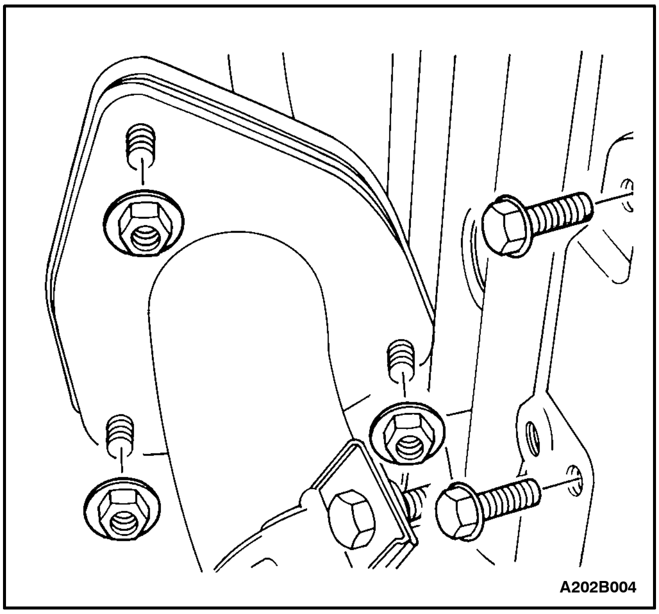
A102B019

9. Install the oil pan. Refer to "Oil Pan" in this section.
10. Install the crankshaft position sensor and the bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 NSm (89 lb-in).

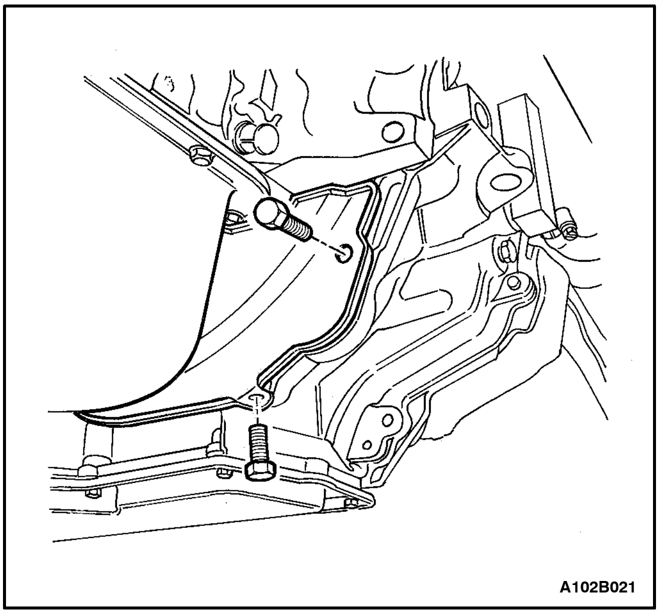
11. Connect the oil pressure switch connector.
12. Install the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
13. Install the timing belt. Refer to "Timing Belt" In this section.
14. Install the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
15. Connect the negative battery cable.



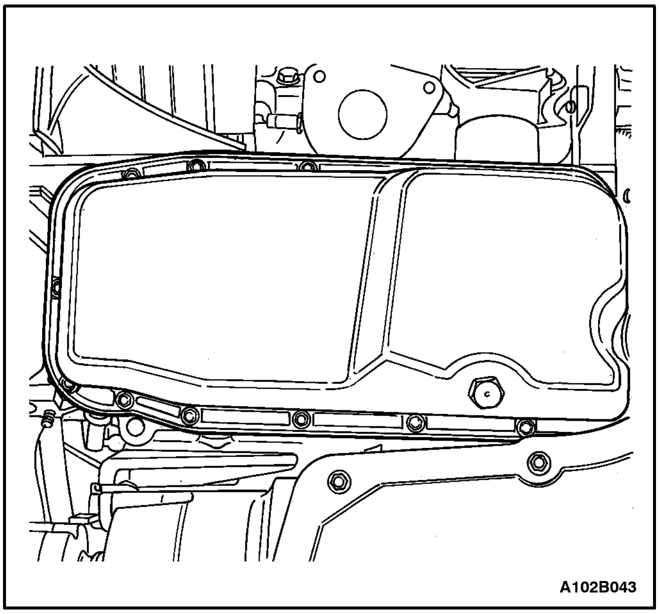
OIL PAN

Removal Procedure

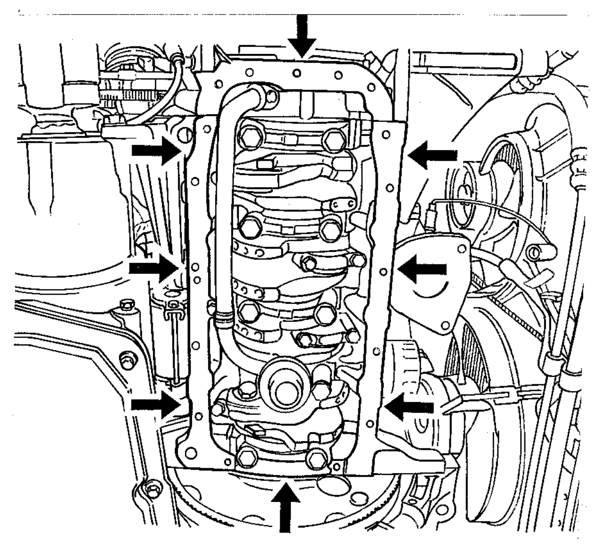
1. Disconnect the negative battery cable.
2. Drain the engine oil from the engine crankcase.
3. Remove the exhaust flex pipe retaining nuts from the exhaust manifold and the bolts from the bracket.
4. Remove the exhaust flex pipe retaining nuts from the catalytic converter or connecting pipe.
5. Remove the exhaust flex pipe.



6. Remove the flywheel or flexible plate inspection cover bolts.
7. Remove the flywheel or flexible plate inspection cover.



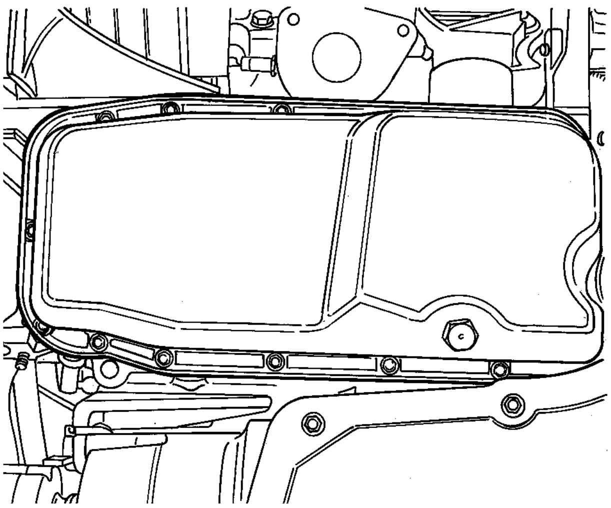
8. Remove the oil pan retaining bolts.
9. Remove the oil pan from the engine block.



A102B044

Cleaning Procedure

1. Clean the oil pan sealing surface.
2. Clean the engine block sealing surface.
3. Clean the oil pan retaining bolts.
4. Clean the oil pan retaining bolt holes in the engine block.



A102B043

Installation Procedure

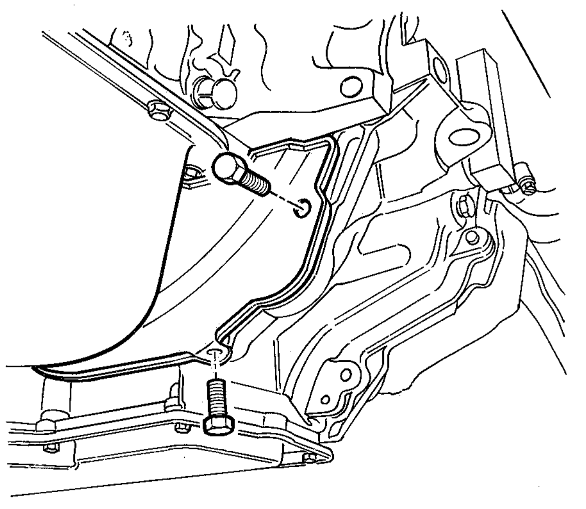
1. Install the oil pan gasket to the oil pan.
2. Install the oil pan to the engine block.

Important: Install the oil pan within 5 minutes after applying liquid gasket to the oil pan.

3. Install the oil pan retaining bolts.

Tighten

Tighten the oil pan retaining bolts to 10 N•m (89 lb-in).

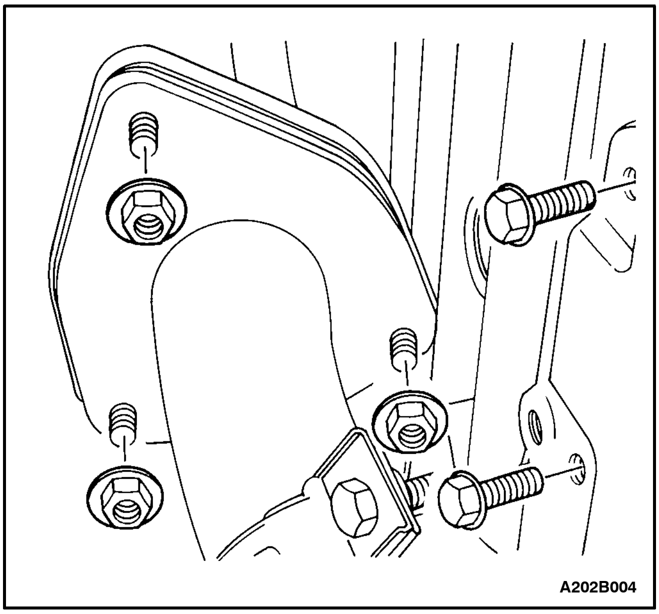


A102B021

4. Install the flywheel or flexible plate inspection cover.
5. Install the flywheel or flexible plate inspection cover bolts.

Tighten

Tighten the flywheel inspection cover bolts to 12 N•m (106 lb-in) or the flexible plate inspection cover bolts to 10 N•m (89 lb-in).



6. Install the exhaust flex pipe.
7. Install the exhaust flex pipe to the exhaust manifold retaining nuts and the bracket bolts.

Tighten

Tighten the exhaust flex pipe-to-exhaust manifold retaining nuts and bracket bolts to 40 N•m (30 lb-ft).

8. Install the exhaust flex pipe retaining nuts to the catalytic converter or connecting pipe.

Tighten

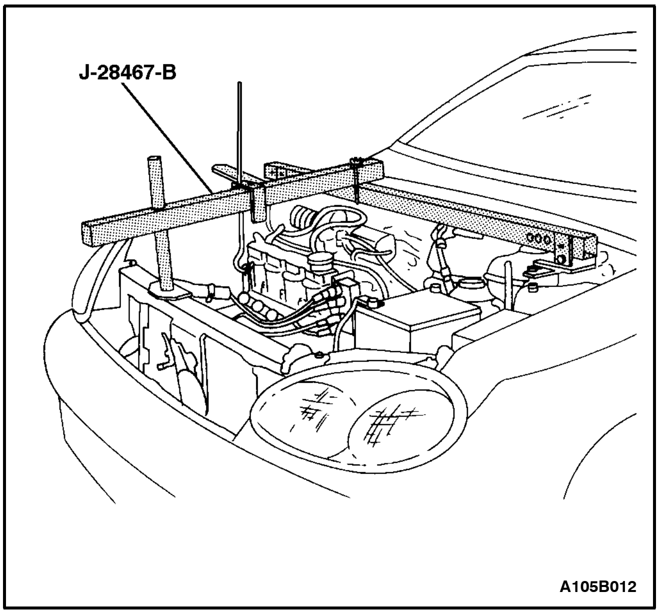
Tighten the exhaust flex pipe-to-catalytic converter or connecting pipe retaining nuts to 30 N•m (22 lb-ft).

9. Connect the negative battery cable.
10. Install the oil pan drain plug.

Tighten

Tighten the oil pan drain plug to 55 N•m (41 lb-ft).

11. Refill the engine crankcase with engine oil.



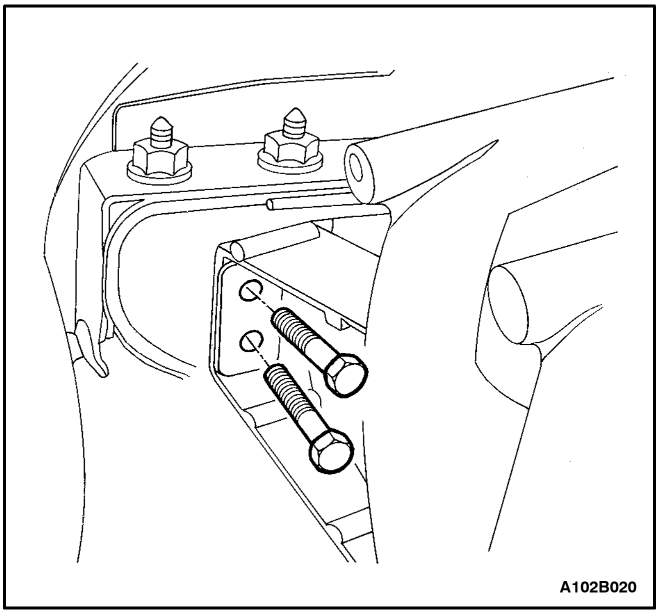
ENGINE MOUNT

Tools Required

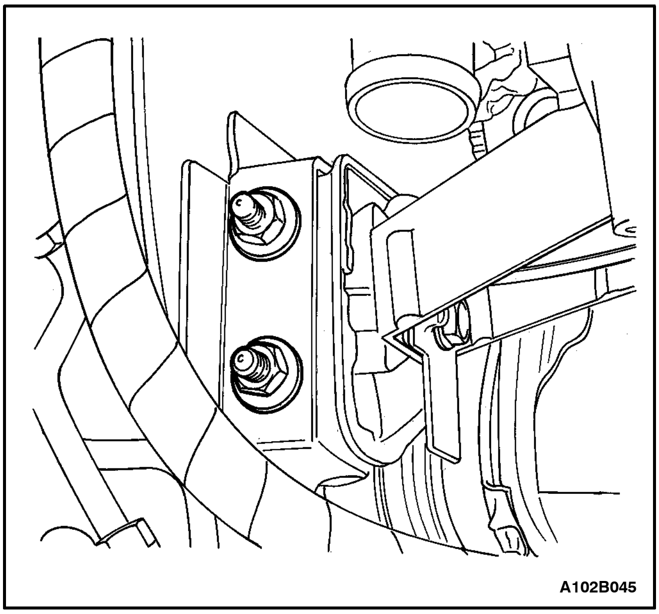
J-28467-B Engine Assembly Support Fixture

Removal Procedure

1. Disconnect the negative battery cable.
2. Support the engine assembly using the engine assembly support fixture J-28467-B.



3. Remove the engine mount bracket retaining bolts.



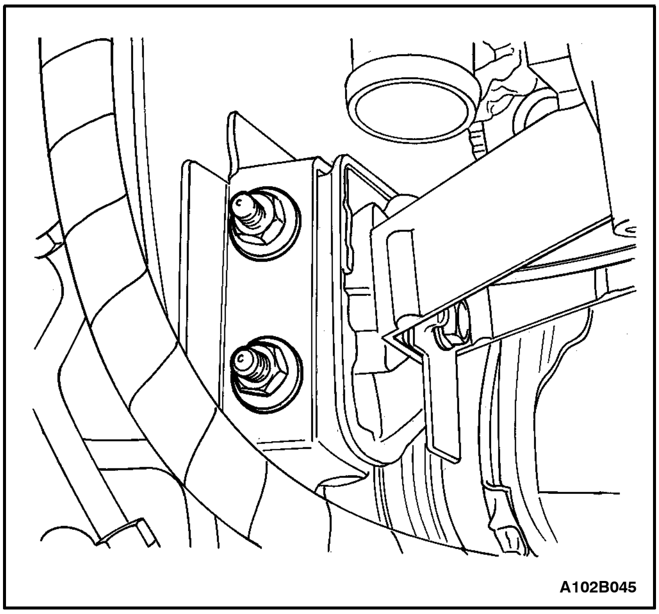
4. Remove the engine mount attaching nuts.
5. Remove the engine mount.

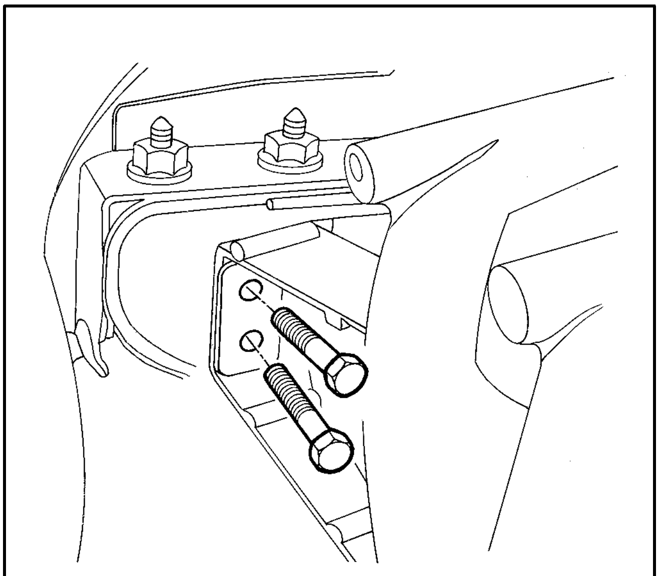
Installation Procedure

1. Install the engine mount.
2. Install the engine mount attaching nuts.

Tighten

Tighten the engine mount attaching nuts to 40 N•m (30 lb-ft).



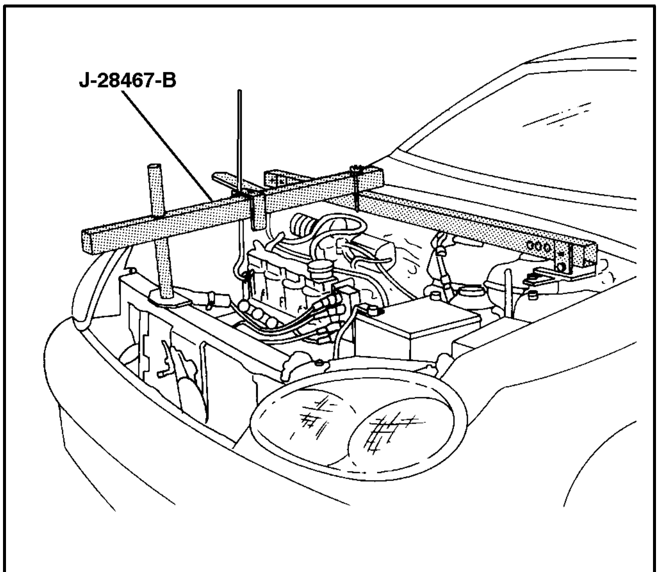


A102B020

3. Install the engine mount bracket retaining bolts.

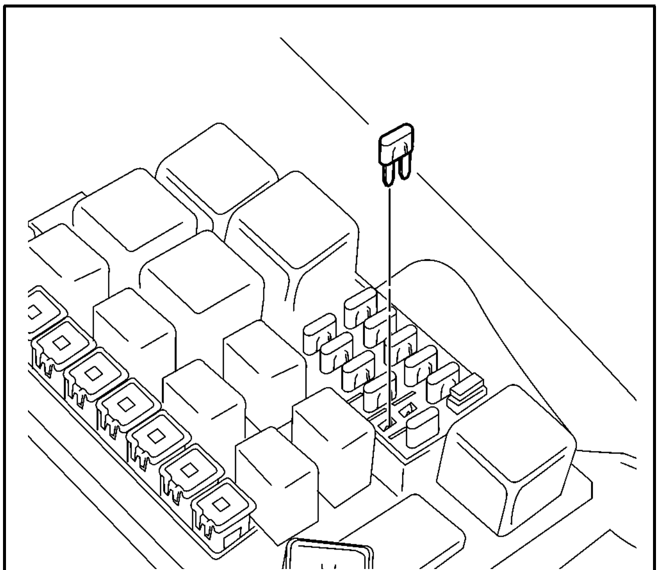
Tighten

Tighten the engine mount bracket retaining bolts to 60 N•m (44 lb-ft).



A105B012

4. Remove the engine assembly support fixture J-28467-B.
5. Connect the negative battery cable.



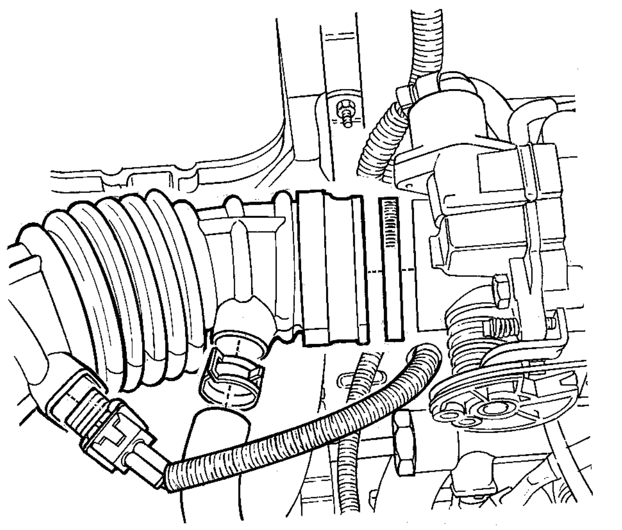
A102B012

INTAKE MANIFOLD

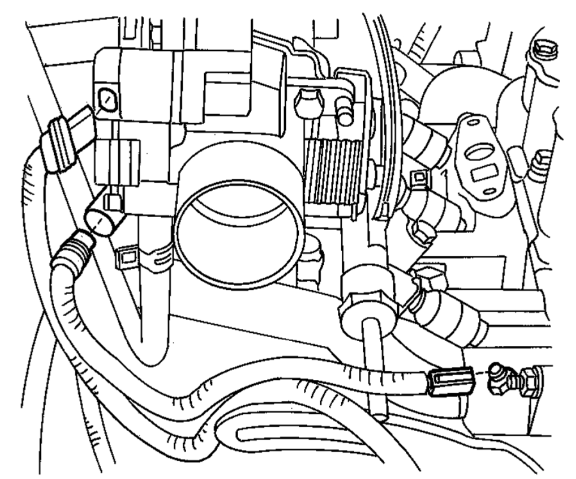
(Left-Hand Drive Shown, Right Hand Drive Similar)

Removal Procedure

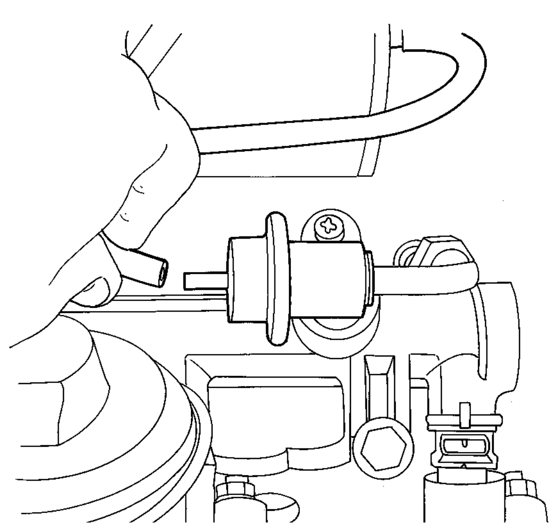
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the electronic control module (ECM) ground terminal from the intake manifold.


A102B001

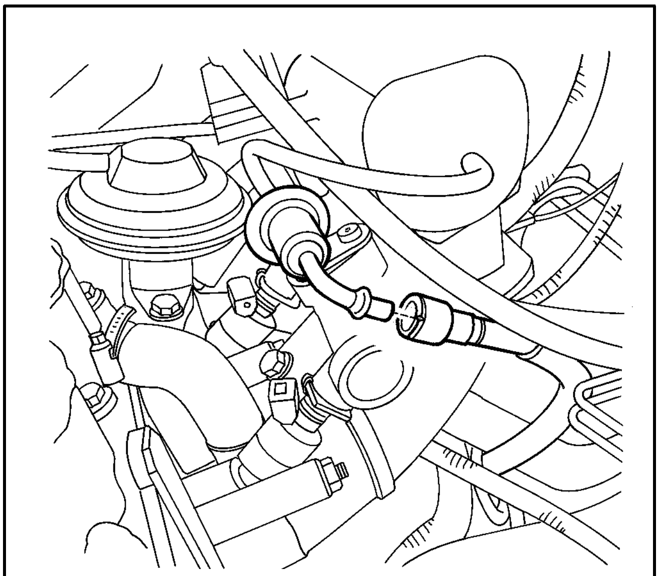
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the air intake tube from the throttle body.


A102B016

8. Disconnect the idle air control valve connector.
9. Disconnect the throttle position sensor connector.
10. Disconnect the engine coolant temperature sensor connector.

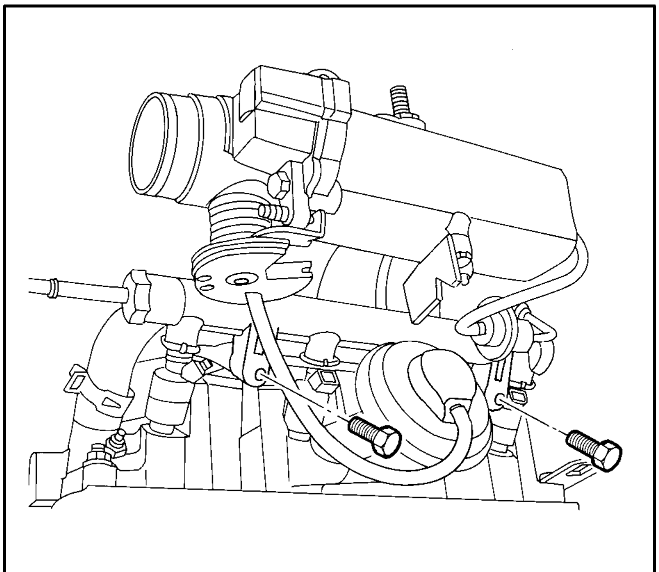

A102B031

11. Disconnect the heater inlet hose from the coolant distributor beneath the intake manifold.
12. Disconnect the surge tank coolant hose at the throttle body.
13. Disconnect all of the necessary vacuum hoses, including the vacuum hose at the fuel pressure regulator and the brake booster vacuum hose at the intake manifold.



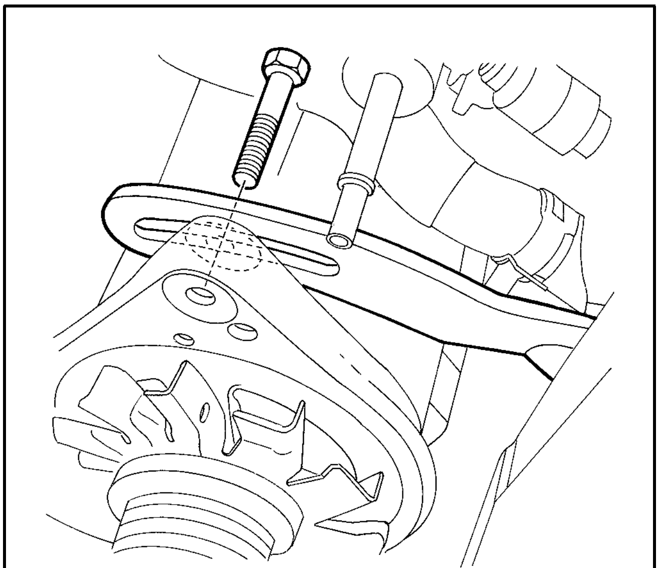
A102B116

14. Disconnect the throttle cable from the throttle body and the intake manifold.
15. Remove the two throttle cable bracket bolts and the throttle cable bracket.
16. Disconnect the fuel return line from the fuel pressure regulator.
17. Disconnect the fuel feed line from the fuel rail.



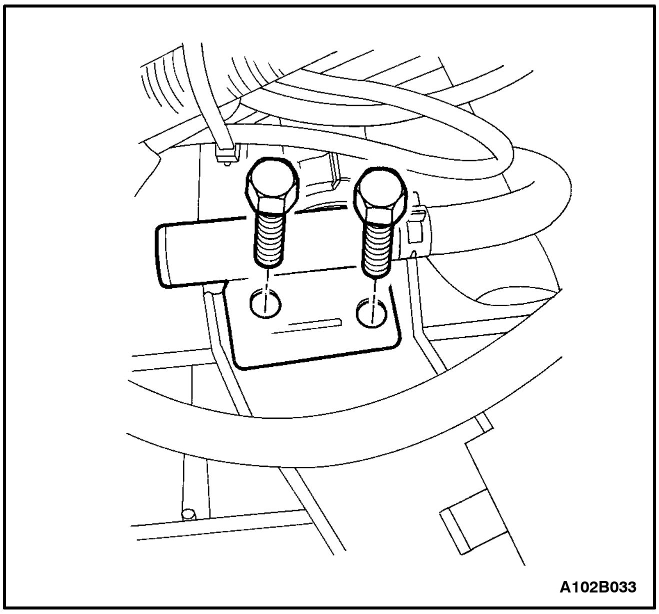
A102B032

18. Disconnect the fuel injector connectors from the fuel injectors.
19. Remove the two retaining bolts from the fuel injector rail.
20. Remove the fuel injector rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.

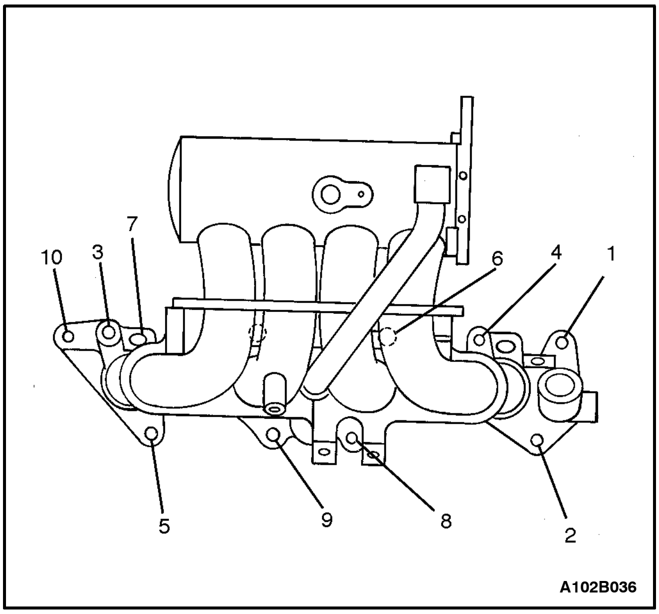


A102B118

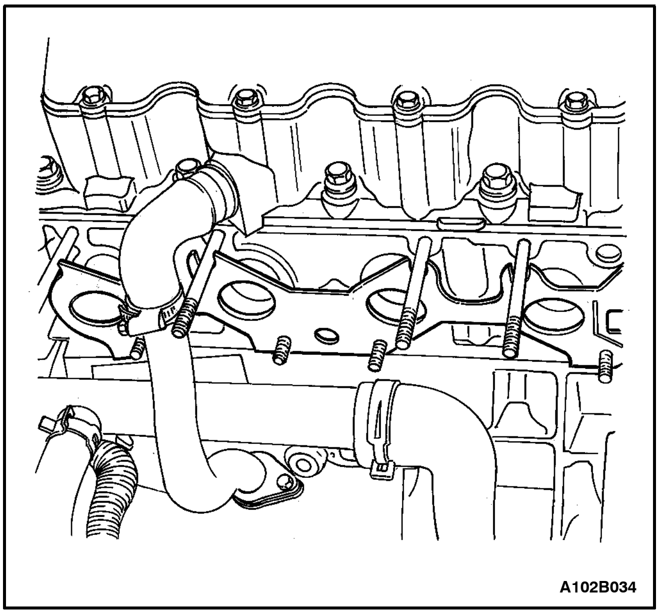
21. Remove the alternator drive belt.
22. Remove the alternator adjusting bracket and the bolts.



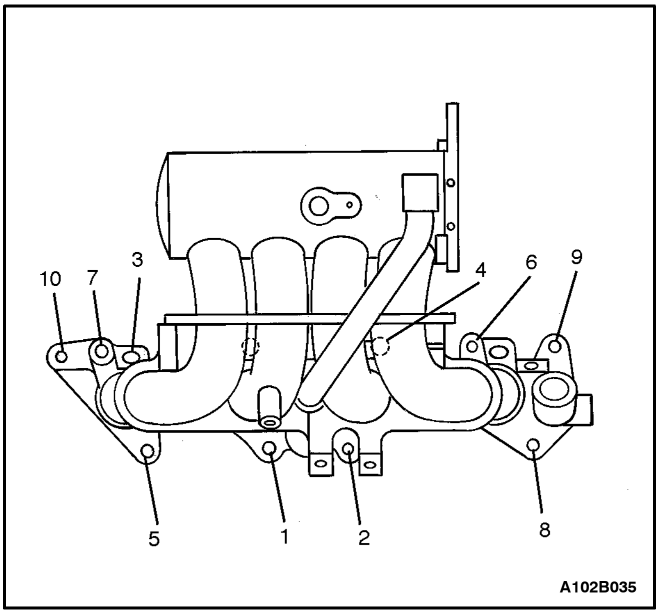
23. Remove the three intake manifold support bracket retaining bolts from the coolant distributor and the engine block.
24. Remove the intake manifold support bracket.



25. Remove the intake manifold retaining nuts and the engine lift bracket bolt in the sequence shown.



26. Remove the intake manifold.
27. Remove the intake manifold gasket.
28. Clean the sealing surfaces of the intake manifold and the cylinder head.



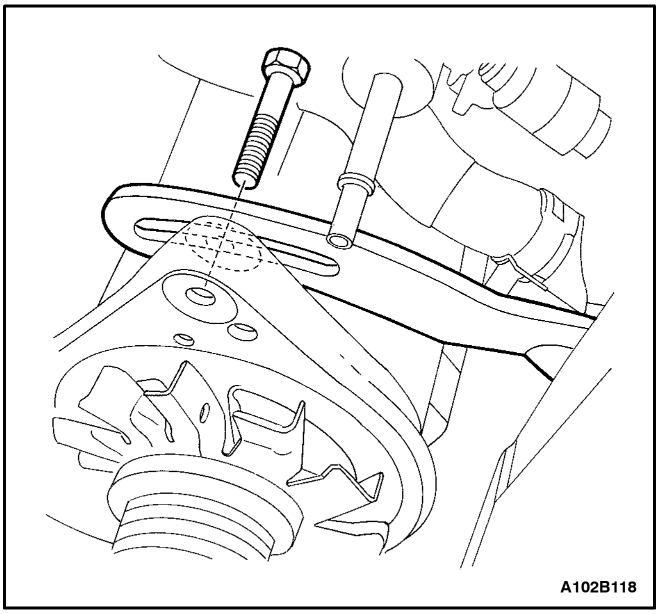
Installation Procedure

1. Install the intake manifold gasket.
2. Install the intake manifold.
3. Install the intake manifold retaining nuts and the engine lift bracket bolt in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts in the sequence shown to 25 N•m (18 lb-ft).

Tighten the engine lift bracket bolt to 25 N•m (18 lb-ft).



4. Install the intake manifold support bracket.
5. Install the intake manifold support bracket retaining bolts.

Tighten

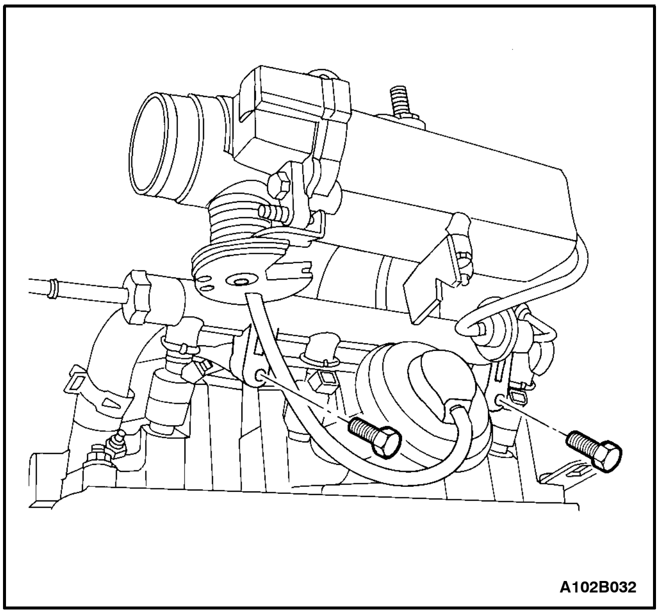
Tighten the intake manifold support bracket retaining bolts to 22 N•m (16 lb-ft).

6. Install the alternator adjusting bracket and the bolts.

Tighten

Tighten the alternator adjusting bracket retaining bolts to 20 N•m (15 lb-ft).

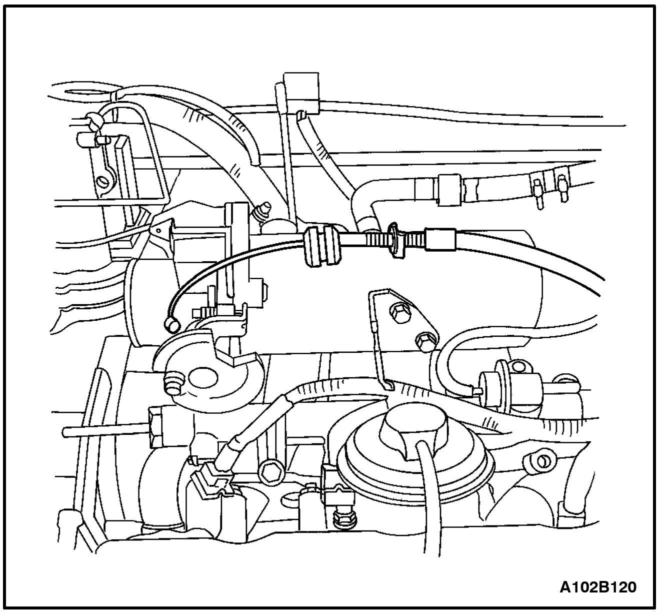
7. Install the alternator drive belt.



8. Install the fuel rail and the fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
9. Install the fuel rail retaining bolts.

Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

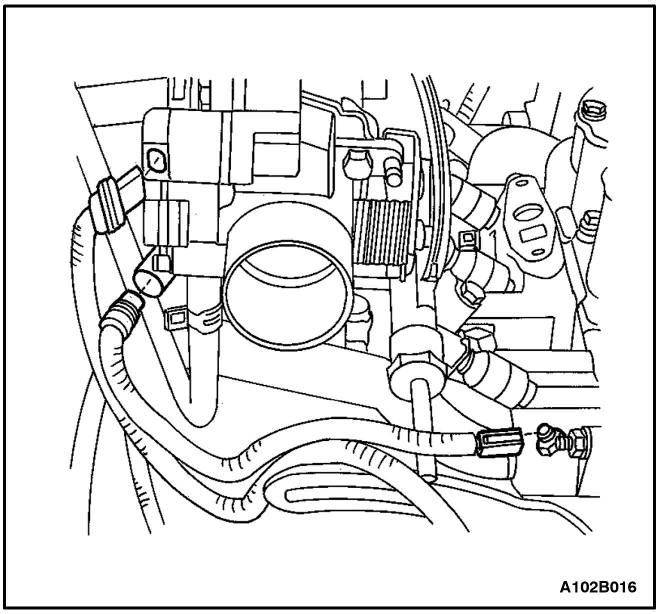

A102B120

10. Connect the fuel return line to the fuel pressure regulator.
11. Connect the fuel feed line to the fuel rail.
12. Install the throttle cable bracket and the two throttle cable bracket bolts.

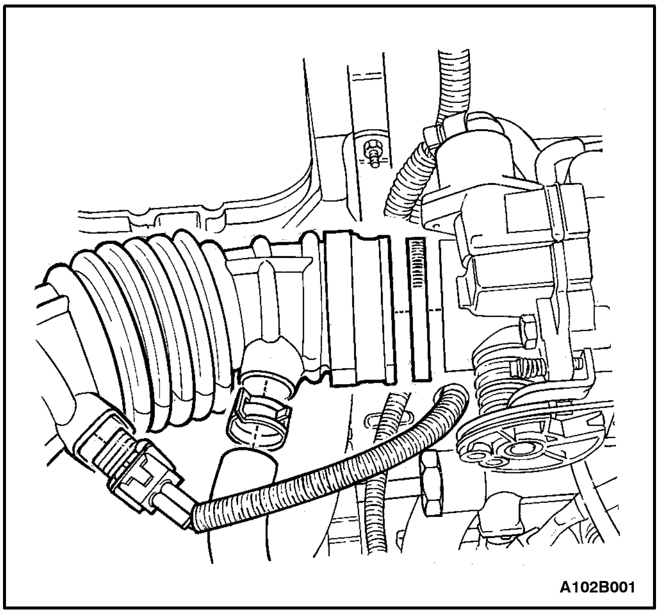
Tighten

Tighten the throttle cable bracket bolts to 8 N•m (71 lb-in).

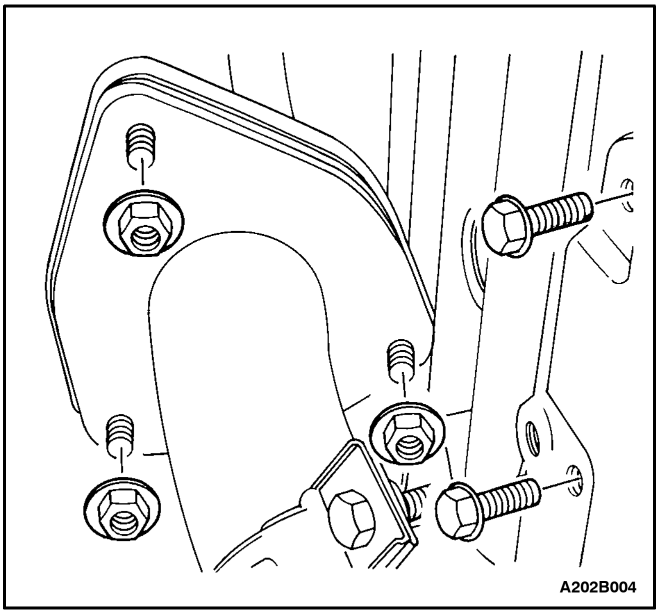
13. Connect the throttle cable to the intake manifold and the throttle body.


A102B016

14. Connect the fuel injector connectors to the fuel injectors.
15. Connect all of the vacuum lines that were previously disconnected.
16. Connect the heater inlet hose to the coolant distributor beneath the intake manifold.
17. Connect the surge tank coolant hose to the throttle body.
18. Connect the engine coolant temperature sensor connector.
19. Connect the idle air control valve connector.
20. Connect the throttle position sensor connector.


A102B001

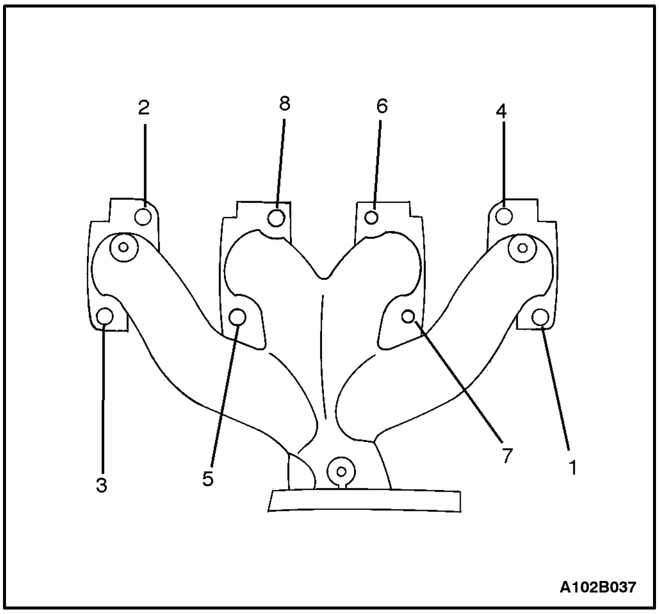
21. Connect the air intake tube to the throttle body.
22. Connect the manifold air temperature sensor connector.
23. Connect the ECM ground terminal to the intake manifold.
24. Connect the negative battery cable.
25. Install the fuel pump fuse.
26. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.



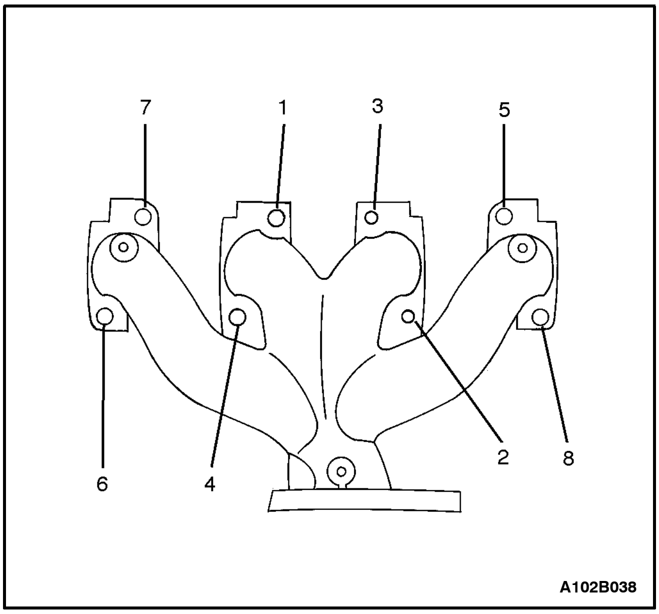
EXHAUST MANIFOLD

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition wires from the spark plugs.
3. Disconnect the oxygen sensor.
4. Remove the exhaust manifold heat shield bolts.
5. Remove the exhaust manifold heat shield.
6. Remove the nuts from the exhaust flex pipe flange and the bracket bolts.



7. Remove the eight exhaust manifold nuts in the sequence shown.
8. Remove the exhaust manifold.
9. Remove the exhaust manifold gasket.
10. Clean the sealing surfaces of the exhaust manifold and the cylinder head.

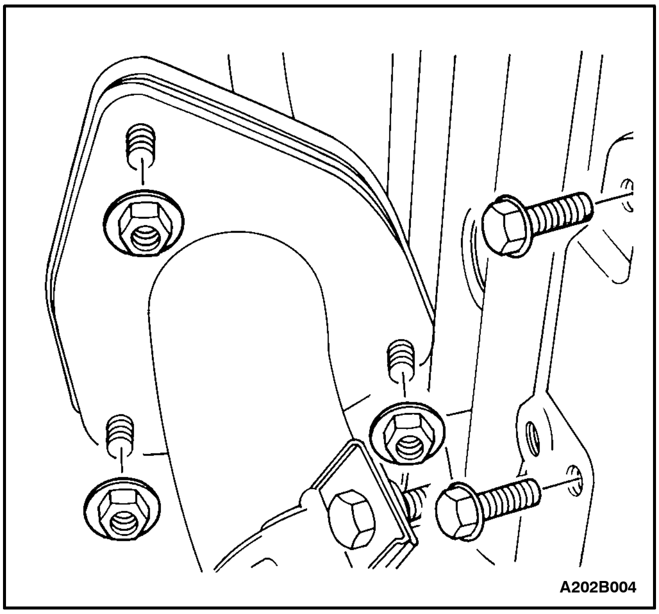


Installation Procedure

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.
3. Install the eight exhaust manifold nuts and torque in the sequence shown.

Tighten

Tighten the exhaust manifold nuts 25 N•m (18 lb-ft).



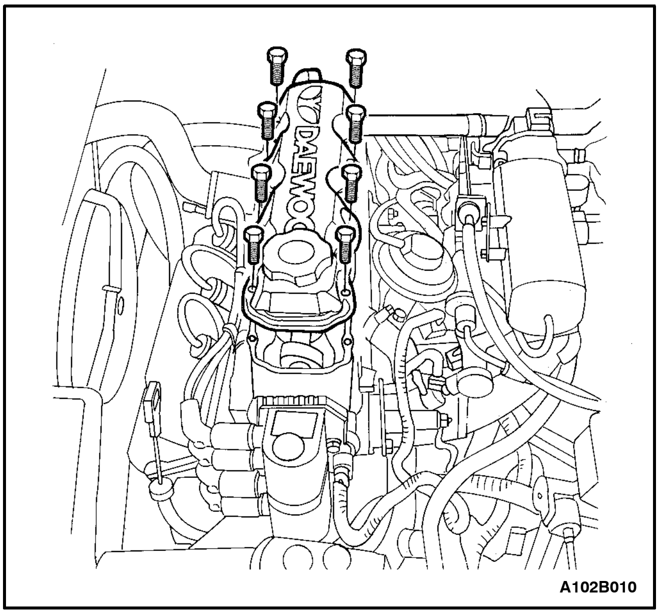
4. Install the exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts.

   Tighten

   Tighten the three exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts to 40 N•m (30 lb-ft).
5. Install the manifold heat shield.
6. Install the exhaust manifold heat shield bolts.

   Tighten

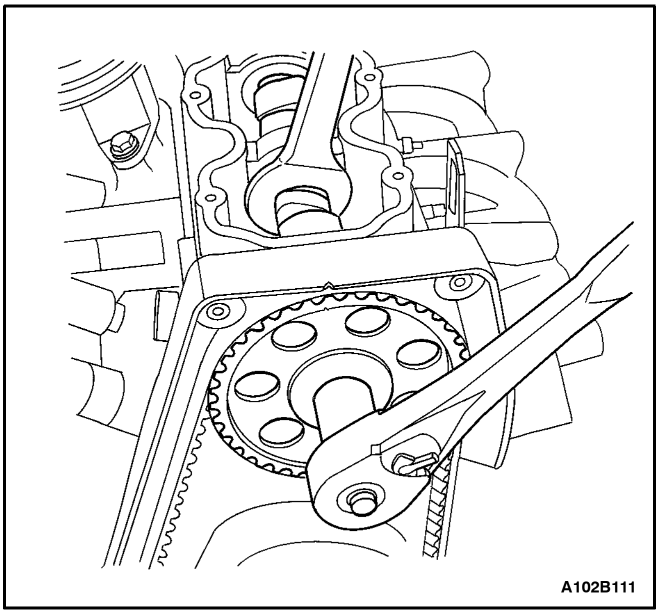
   Tighten the exhaust manifold heat shield bolts to 15 N•m (11 lb-ft).
7. Connect the oxygen sensor.
8. Connect the ignition wires to the spark plugs.
9. Connect the negative battery cable.



CAMSHAFT GEAR

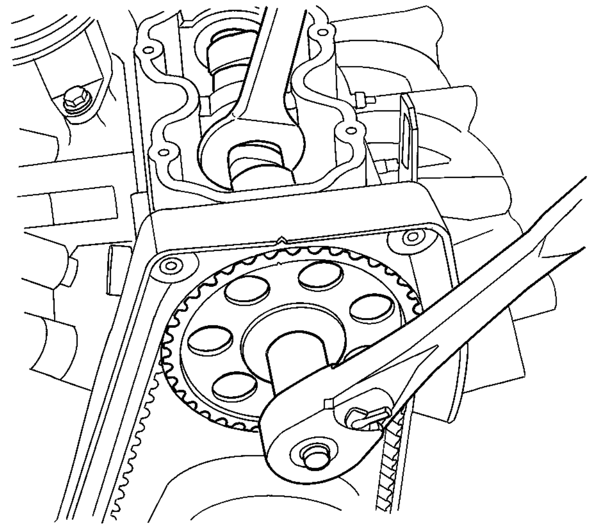
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.
3. Remove the valve cover bolts.
4. Remove the valve cover.



Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

5. While holding the camshaft firmly in place, remove the camshaft gear bolt.
6. Remove the camshaft gear.



A102B111

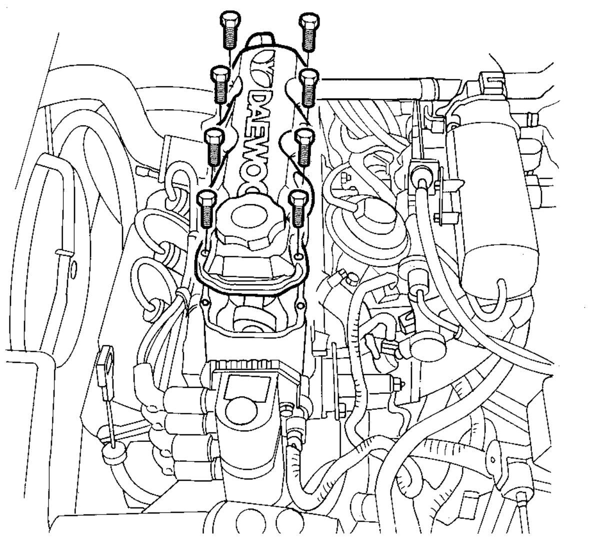
Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

1. Install the camshaft gear.
2. While holding the camshaft firmly in place, install the camshaft gear bolt.

Tighten

Tighten the camshaft gear bolt to 45 N•m (33 lb-ft).



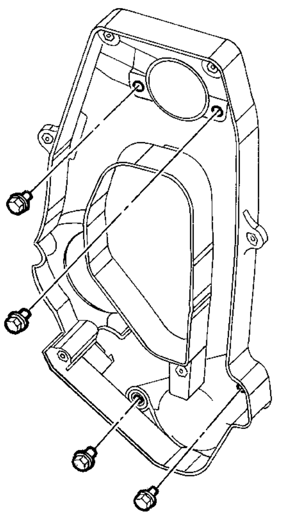
A102B010

3. Install the valve cover.
4. Install the valve cover bolts.

Tighten

Tighten the valve cover bolts to 10 N•m (89 lb-in).

5. Install the timing belt. Refer to "Timing Belt" in this section.
6. Connect the negative battery cable.



A102B046

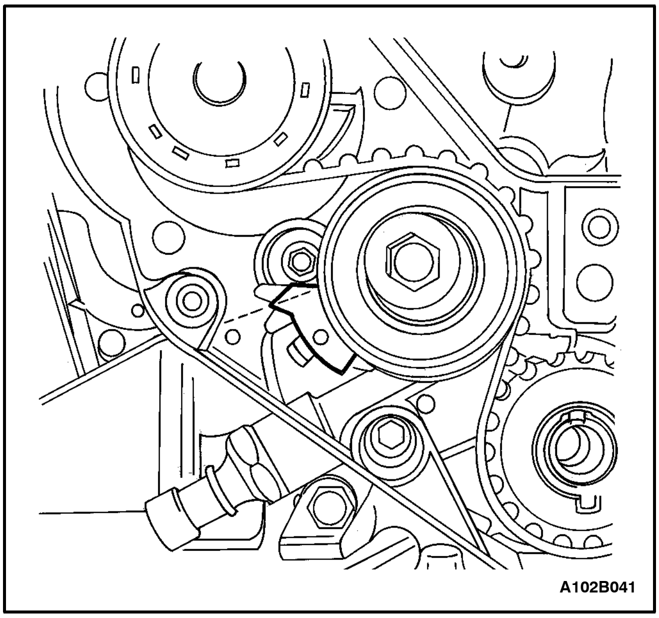
REAR TIMING BELT COVER

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

3. Remove the camshaft gear. Refer to "Camshaft Gear" in this section.
4. Remove the timing belt automatic tensioner bolt.
5. Remove the timing belt automatic tensioner.
6. Remove the rear timing belt cover bolts.
7. Remove the rear timing belt cover.



A102B041

Installation Procedure

1. Install the rear timing belt cover.
2. Install the rear timing belt cover bolts.

   Tighten

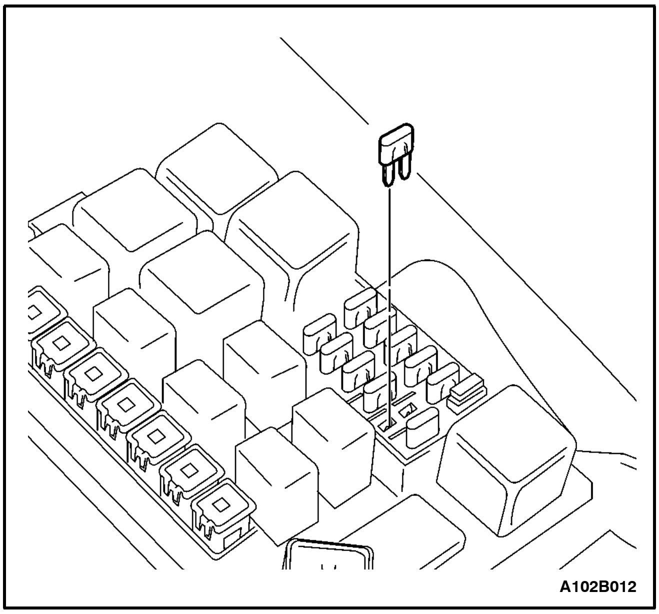
   Tighten the rear timing belt cover bolts to 10 N•m (89 lb-in).
3. Install the timing belt automatic tensioner.
4. Install the timing belt automatic tensioner bolt.

   Tighten

   Tighten the timing belt automatic tensioner bolt to 20 N•m (15 lb-ft).

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

5. Install the camshaft gear. Refer to "Camshaft Gear" in this section.
6. Install the timing belt. Refer to "Timing Belt" in this section.
7. Connect the negative battery cable.



A102B012

ENGINE

(Left-Hand Drive Shown, Right Hand Drive Similar)

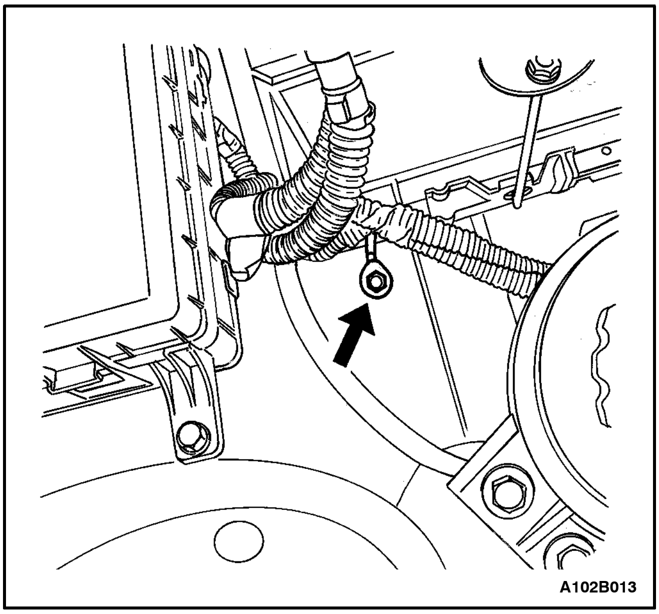
Tools Required

KM-470-B Angular Torque Gauge

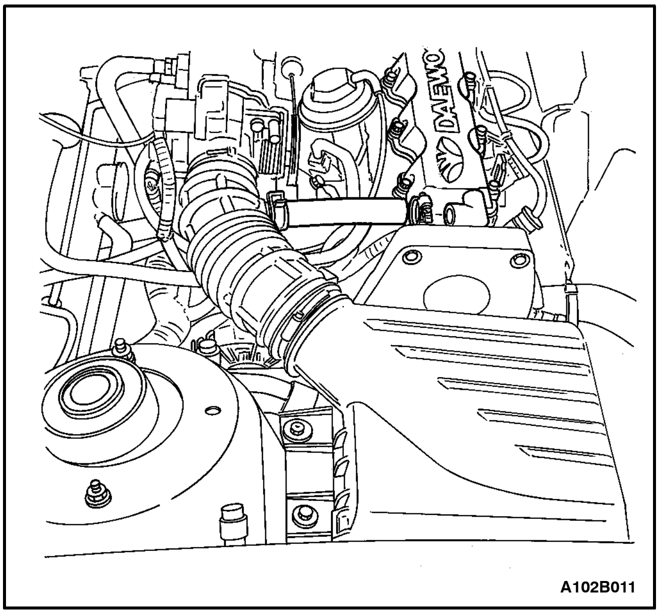
Removal Procedure

Important: On vehicles equipped with a manual transaxle, the manual transaxle must be removed before engine removal. Refer to Section 5B, Five-Speed Manual Transaxle.

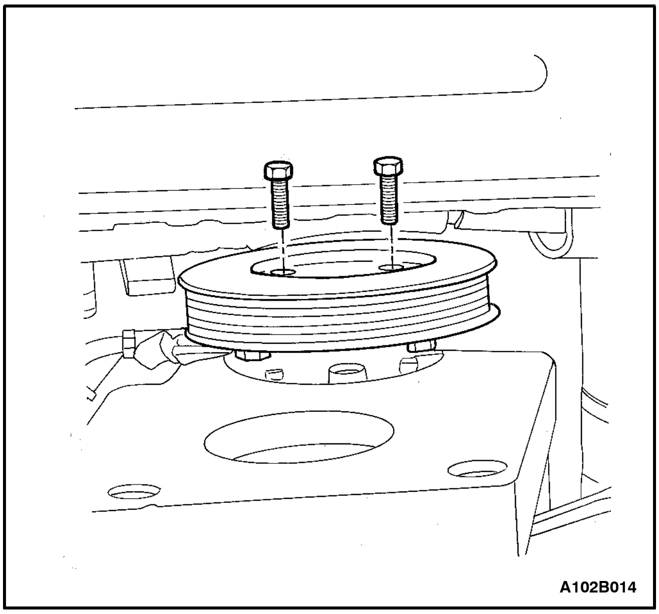
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Remove the hood. Refer to Section 9R, Body Front End.
4. Drain the engine oil.



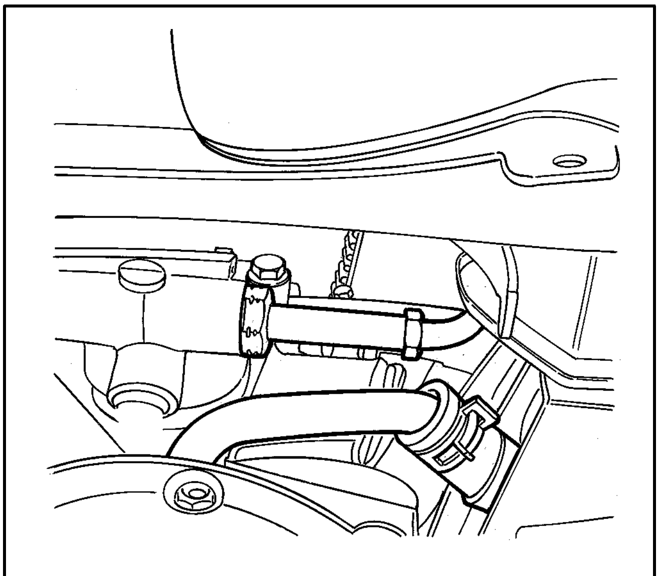
5. Disconnect the negative battery cable.
6. Disconnect and separate the battery positive cable.
7. Disconnect the negative battery cable from the vehicle frame.



8. Discharge the air conditioning (A/C) system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
9. Disconnect the manifold air temperature sensor connector.
10. Remove the air intake tube from the throttle body and the air filter housing.
11. Disconnect the breather tube from the valve cover.

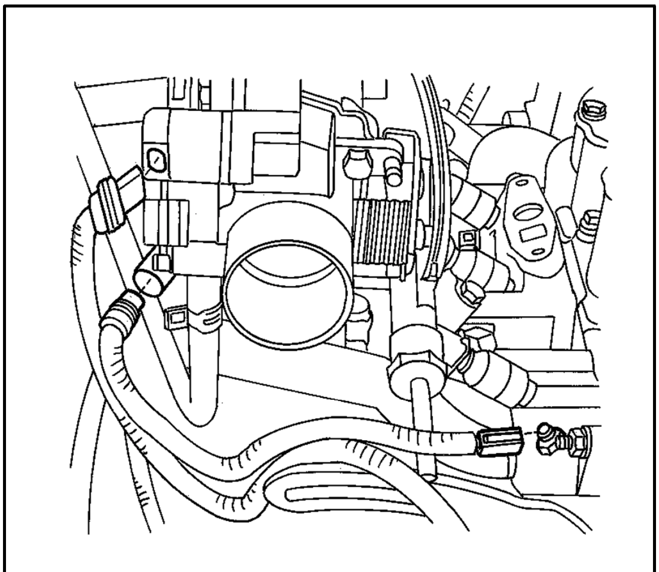


12. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
13. Remove the right front wheel well splash shield.
14. Remove the A/C compressor drive belt, if equipped.
15. Remove the alternator drive belt.
16. Remove the power steering pump pulley bolts.
17. Remove the power steering pump pulley.



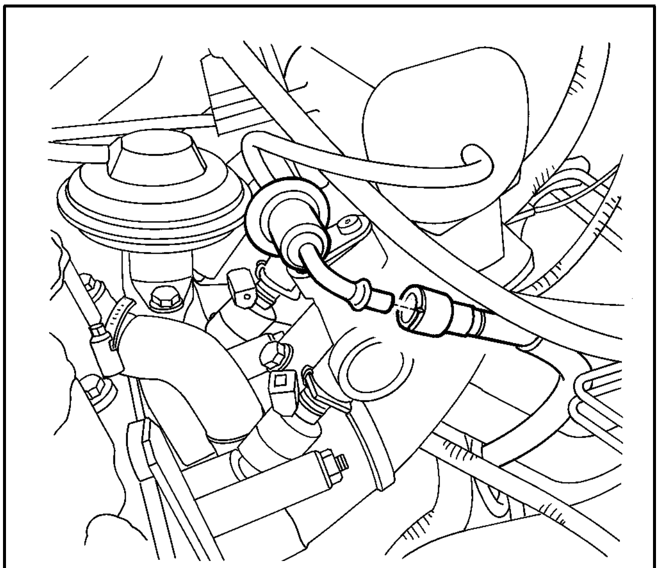
A102B015

18. Drain the engine coolant. Refer to Section 1D, EnĆ gine Cooling.
19. Remove the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
20. Disconnect the upper radiator hose from the thermostat housing.
21. Disconnect the coolant surge tank hose from the radiator.
22. Disconnect the power steering return hose from the power steering pump, if equipped.
23. Drain the power steering system, if equipped.
24. Disconnect the power steering pressure hose from the power steering pump, if equipped.



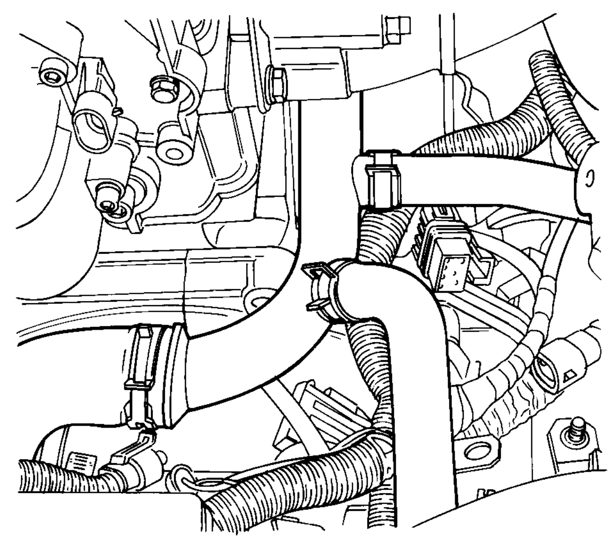
A102B016

25. Disconnect the electrical connector at the direct ignition system (DIS) ignition coil, and the engine control module (ECM) ground terminal at the intake manifold and at the starter motor.
26. Disconnect the oxygen sensor connector.
27. Disconnect the electrical connectors at the fuel injectors.
28. Disconnect the idle air control valve connector.
29. Disconnect the throttle position sensor connector.
30. Disconnect the engine coolant temperature sensor connector.
31. Disconnect the coolant temperature sensor connector and the knock sensor, if equipped.

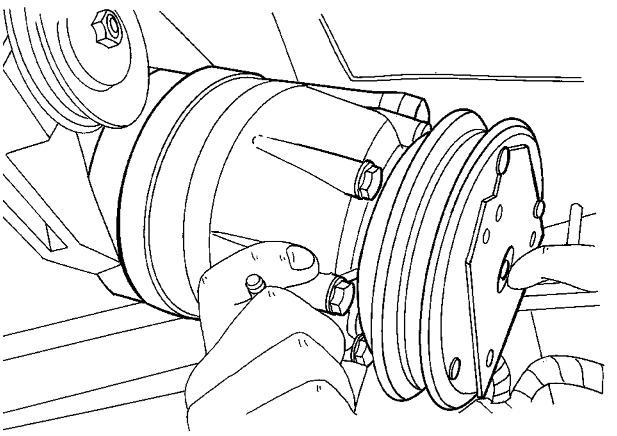


A102B116

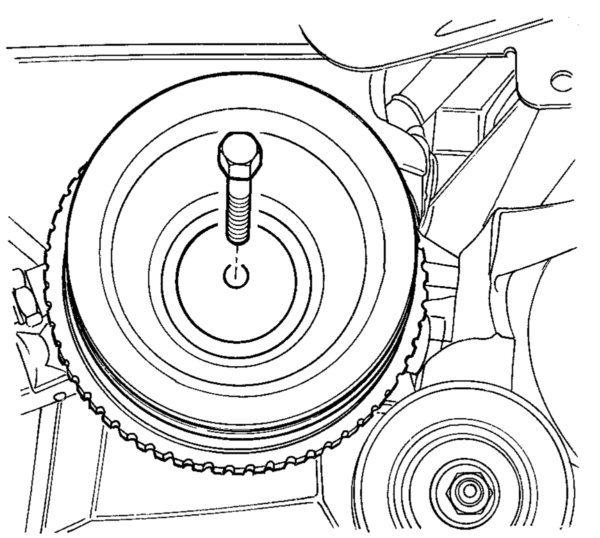
32. Disconnect the alternator voltage regulator connector.
33. Disconnect all of the necessary vacuum lines, including the brake booster vacuum hose.
34. Disconnect the fuel return line at the fuel pressure regulator.
35. Disconnect the fuel feed line at the fuel rail.
36. Disconnect the throttle cable from the throttle body and the intake manifold bracket.


A102B017

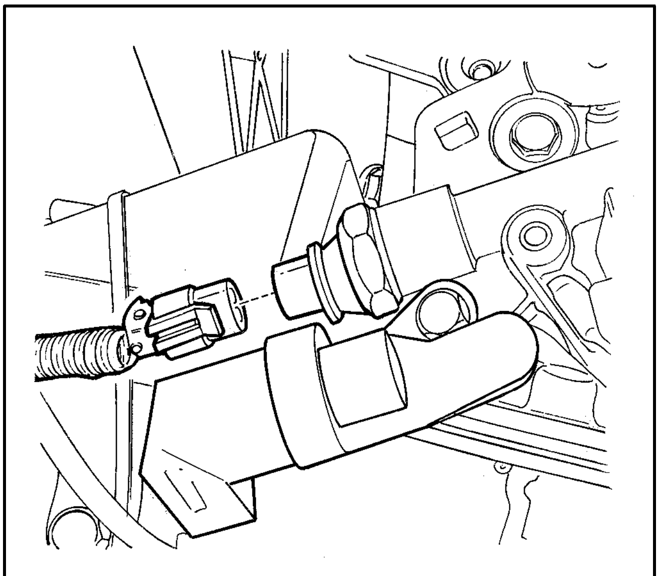
37. Disconnect the surge tank coolant hose at the throttle body.
38. Disconnect the heater inlet hose from the coolant distributor.
39. Disconnect the heater outlet hose at the coolant pipe.
40. Disconnect the surge tank coolant hose from the coolant pipe.
41. Disconnect the lower radiator hose at the coolant pipe.


A102B025

42. Disconnect the starter solenoid "S" terminal wire.
43. Remove the A/C compressor hose assembly retaining bolt.
44. Disconnect the A/C compressor hose assembly from the compressor.
45. Disconnect the A/C compressor coil connector.
46. Remove the A/C compressor mounting bolts.
47. Remove the A/C compressor.
48. Remove the A/C compressor mounting bracket bolts.
49. Remove the A/C compressor mounting bracket from the engine block.

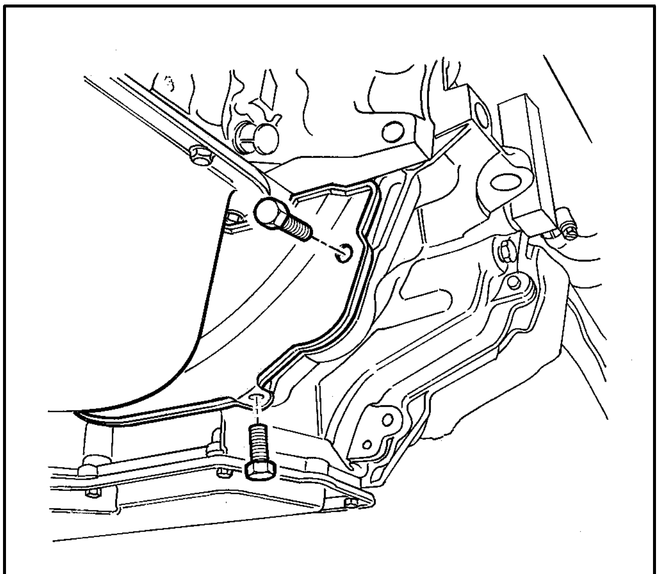

A102B018

50. Remove the exhaust flex pipe retaining nuts from the exhaust manifold.
51. Remove the exhaust flex pipe retaining nuts from the catalytic converter or connecting pipe.
52. Remove the exhaust flex pipe.
53. Remove the engine crankshaft pulley bolt.
54. Remove the engine crankshaft pulley.



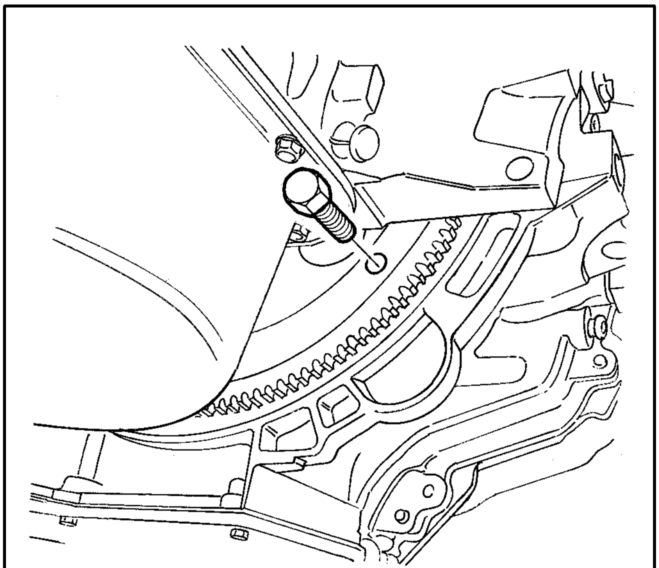
A102B019

55. Disconnect the vacuum lines at the charcoal canister purge and exhaust gas recirculation (EGR) solenoid.
56. Disconnect the electrical connector at the charcoal canister purge solenoid and the knock sensor.
57. Disconnect the electrical connector at the oil pressure switch.
58. Disconnect the crankshaft position sensor connector.
59. Remove the crankshaft position sensor retaining bolt.
60. Remove the crankshaft position sensor.
61. Remove the right transaxle brace bolts from the transmission.



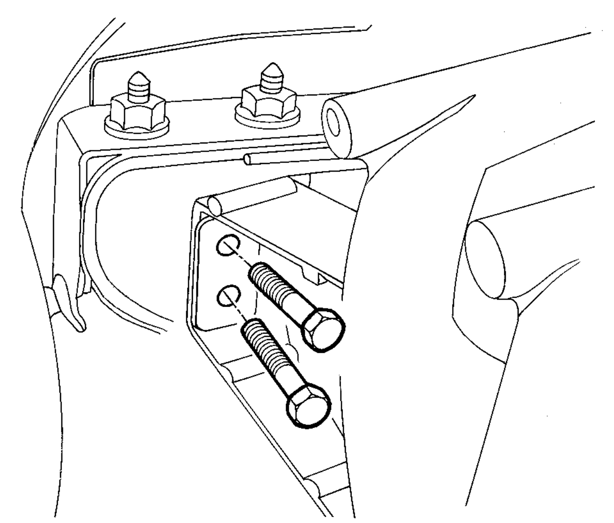
A102B021

62. Remove the flywheel or the flexible plate inspection cover bolts.
63. Remove the flywheel or the flexible plate inspection cover.

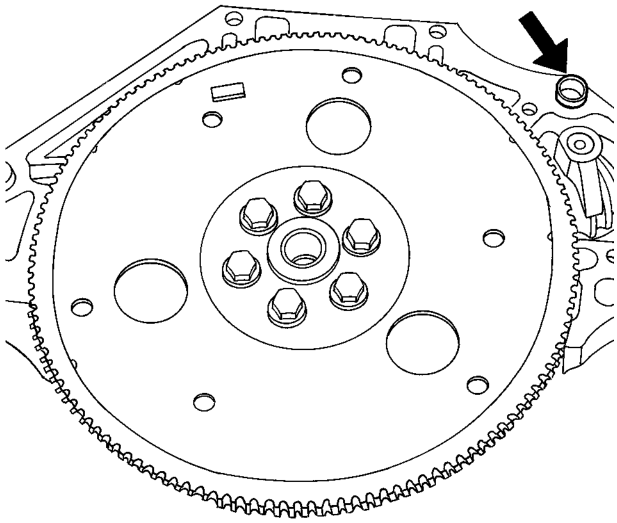


A102B022

64. Remove the transaxle torque converter bolts on vehicles with an automatic transaxle.


A102B020

65. Remove the transaxle bell housing bolts.
66. Support the transaxle with a floor jack.
67. Install the engine lifting device.
68. Disconnect the right engine mount bracket from the rubber engine mount by removing the two retaining bolts.
69. Remove the right engine mount bracket from the engine block.
70. Separate the engine block from the transaxle.
71. Remove the engine.
72. Transfer any necessary parts.

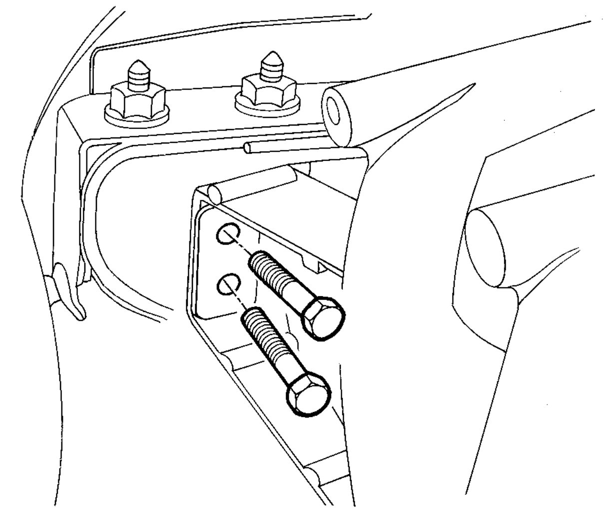

A102B063

Installation Procedure

1. Install the engine into engine compartment.
2. Align the transaxle alignment pins to the transaxle.
3. Install the transaxle bell housing bolts.

Tighten

Tighten the transaxle bell housing bolts to 75 NSm (55 lb-ft).


A102B020

4. Install the right engine mount bracket to the engine block.
5. Install the right engine mount bracket retaining bolts to the engine block.

Tighten

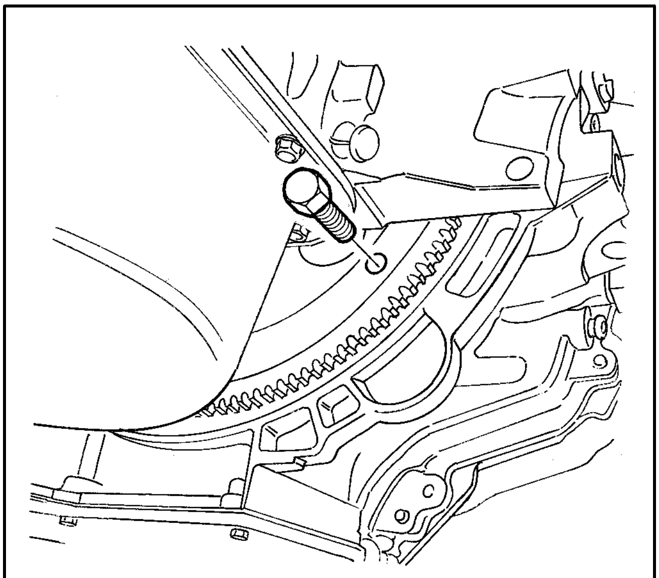
Tighten the engine mount bracket retaining bolts to 60 NSm (44 lb-ft).

6. Install the engine mount-to-bracket retaining bolts.

Tighten

Tighten the engine mount bracket-to-engine mount retaining bolts to 60 NSm (44 lb-ft).

7. Remove the floor jack used for support of the transaxle.
8. Remove the engine lifting device.

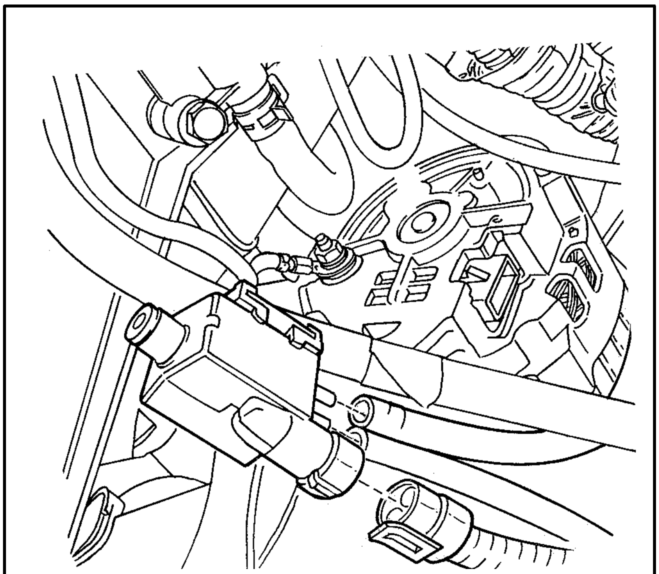


A102B022

9. Install the transaxle torque converter bolts, if the vehicle has an automatic transaxle.

Tighten

Tighten the transaxle torque converter bolts to 45 N·m (33 lb-ft).



A102B024

10. Install the flywheel or the flexible plate inspection cover.
11. Install the flywheel or the flexible plate inspection cover bolts.

Tighten

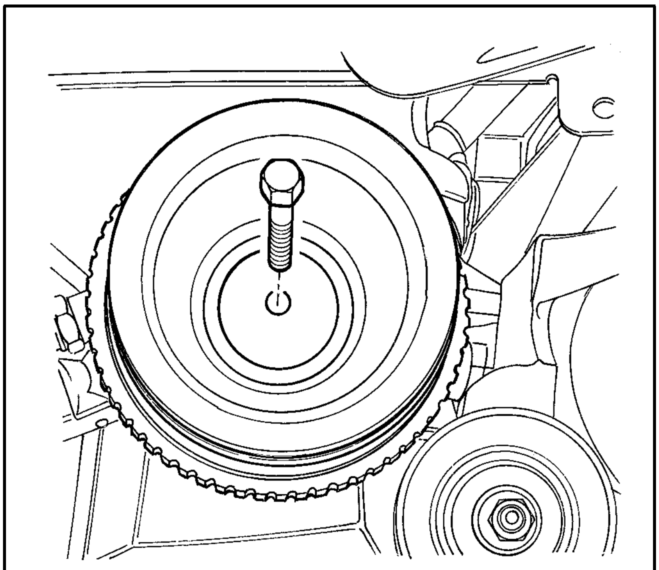
Tighten the flywheel inspection cover bolts to 12 N·m (106 lb-in) or the flexible plate inspection cover bolts to 10 N·m (89 lb-in).

12. Install the right transaxle brace bolts to the transaxle.

Tighten

Tighten the right transaxle brace bolts to 60 N·m (45 lb-ft).

13. Connect the vacuum lines at the charcoal canister purge and EGR solenoid.
14. Connect the electrical connectors at the charcoal canister purge and EGR solenoids.

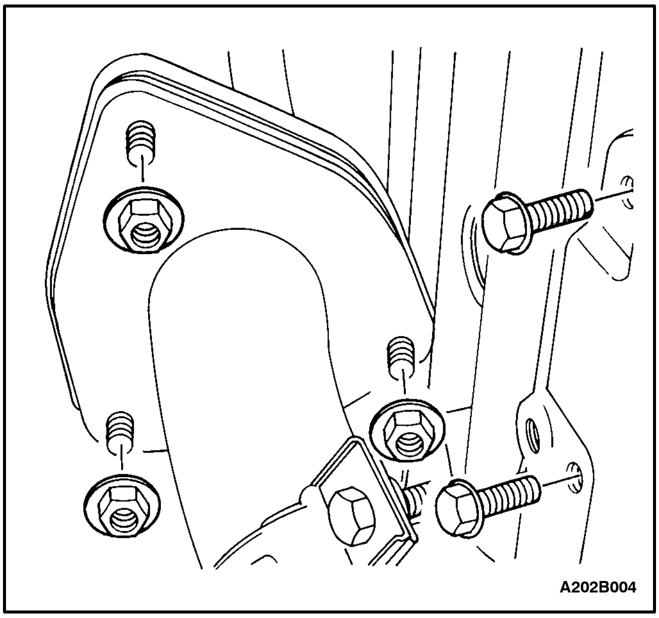


A102B018

15. Connect the oil pressure switch connector.
16. Install the crankshaft pulley.
17. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N·m (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.


A202B004

18. Install the crankshaft position sensor and the crankshaft position sensor retaining bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).

19. Connect the crankshaft position sensor connector.
20. Install the exhaust flex pipe.
21. Install the exhaust flex pipe-to-catalytic converter retaining nuts.

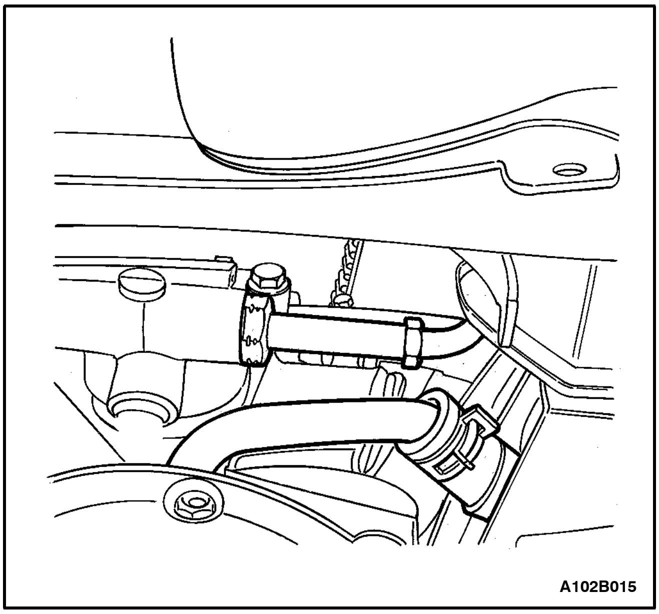
Tighten

Tighten the exhaust flex pipe-to-catalytic converter or connecting pipe retaining nuts to 30 N•m (22 lb-ft).

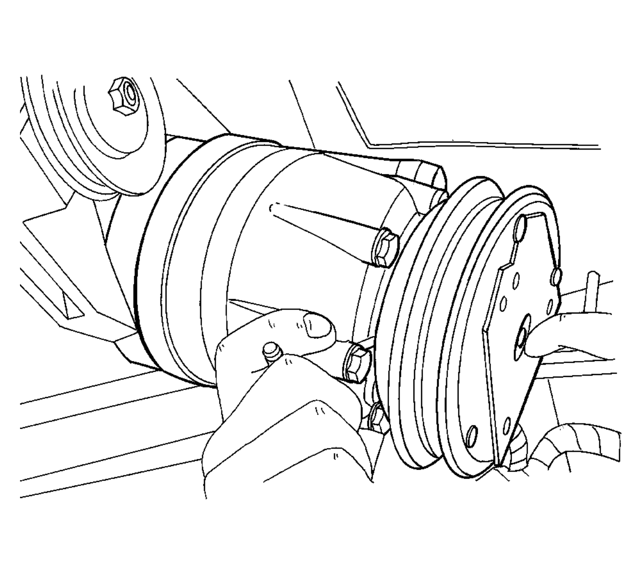
22. Install the exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts.

Tighten

Tighten the exhaust flex pipe to exhaust manifold retaining nuts and the bracket bolts to 40 N•m (30 lb-ft).


A102B015

23. Connect the power steering pressure hose, if equipped.
24. Connect the power steering return hose, if equipped.



A102B025

25. Install the A/C compressor mounting bracket, if equipped.
26. Install the A/C compressor mounting bracket bolts, if equipped.

Tighten

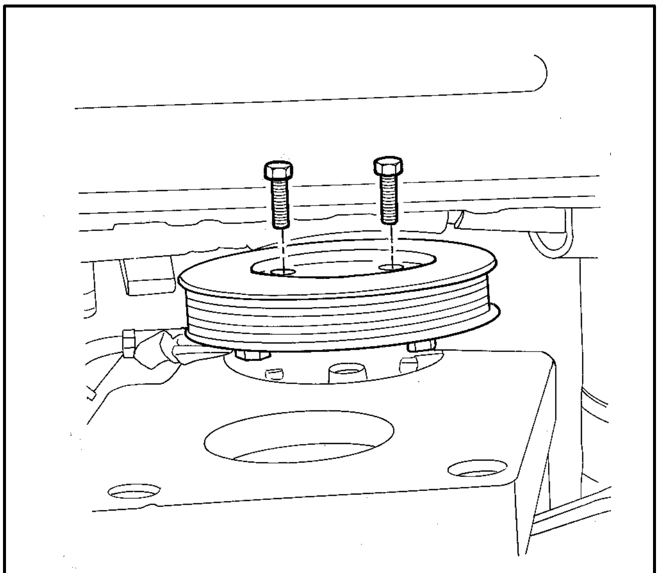
Tighten the A/C compressor mounting bracket bolts to 50 N·m (36 lb-ft).

27. Install the A/C compressor, if equipped.
28. Install the A/C compressor mounting bolts, if equipped.

Tighten

Tighten the A/C compressor mounting bolts to 27 N·m (20 lb-ft).

29. Connect the A/C compressor coil connector.
30. Install the alternator drive belt.
31. Install the A/C compressor drive belt, if equipped.



A102B014

32. Connect the A/C compressor hose assembly and the A/C compressor hose assembly retaining bolt, if equipped.

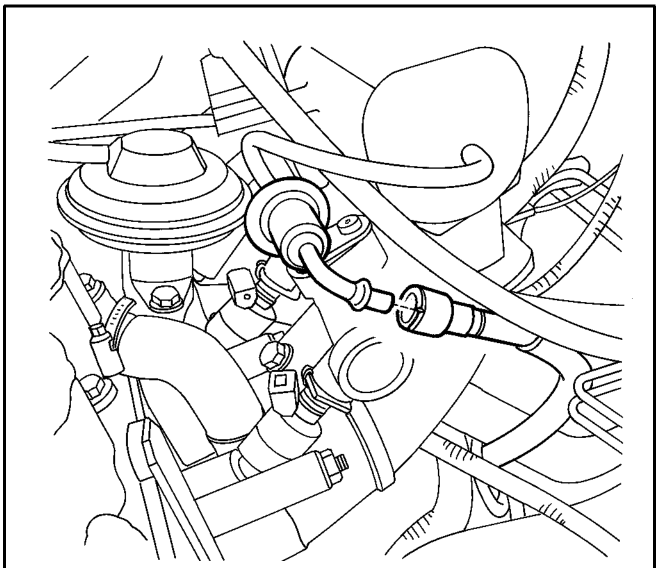
Tighten

Tighten the A/C compressor hose assembly retaining bolt to 33 N·m (24 lb-ft).

33. Install the power steering pump pulley, if equipped.
34. Install the power steering pump pulley bolts, if equipped.

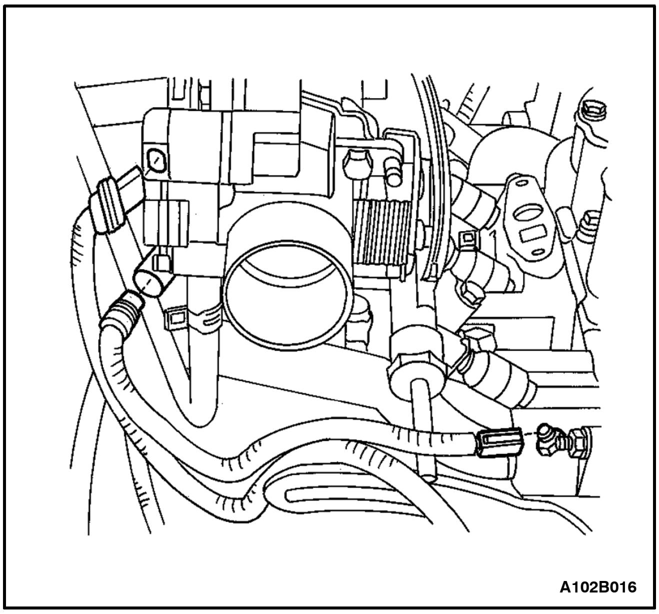
Tighten

Tighten the power steering pump pulley bolts to 25 N·m (18 lb-ft).

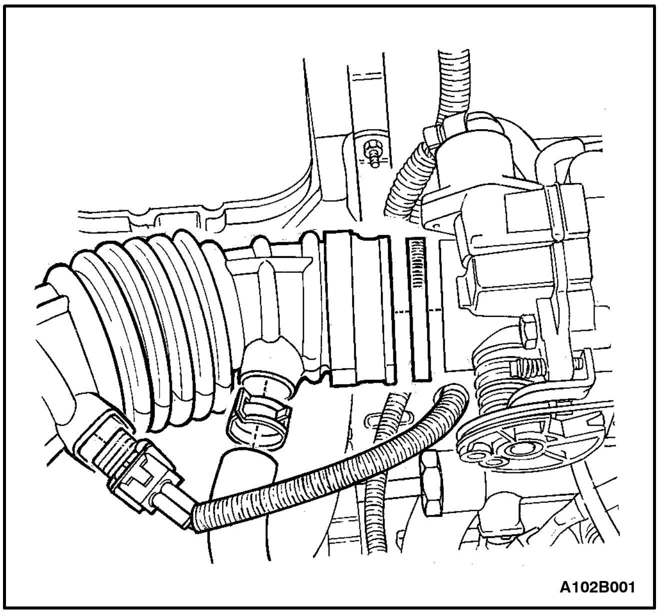


A102B116

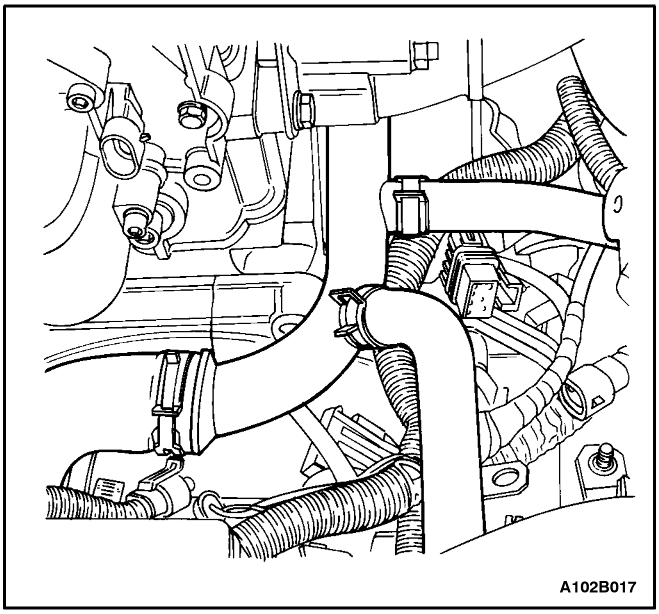
35. Install the right front wheel well splash shield.
36. Install the right front wheel. Refer to Section 2E, Tires and Wheels
37. Connect the fuel feed line to the fuel rail.
38. Connect the fuel return line to the fuel pressure regulator.
39. Connect all of the necessary vacuum lines, including the brake booster vacuum hose.



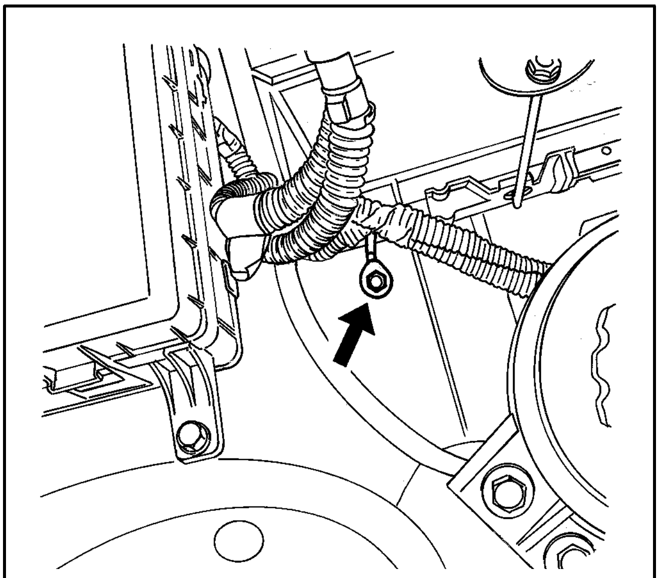
40. Connect the oxygen sensor connector.
41. Connect the starter solenoid "S" terminal wire.
42. Connect the alternator voltage regulator connector.
43. Connect the coolant temperature sensor connector.
44. Connect the engine coolant temperature sensor connector and the knock sensor connector, if equipped.
45. Connect the throttle position sensor connector.
46. Connect the idle air control valve connector.



47. Connect the electrical connectors at the fuel injectors.
48. Connect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold.
49. Install the air intake tube between the throttle body and the air filter housing.
50. Connect the breather tube to the valve cover.
51. Connect the manifold air temperature sensor connector.

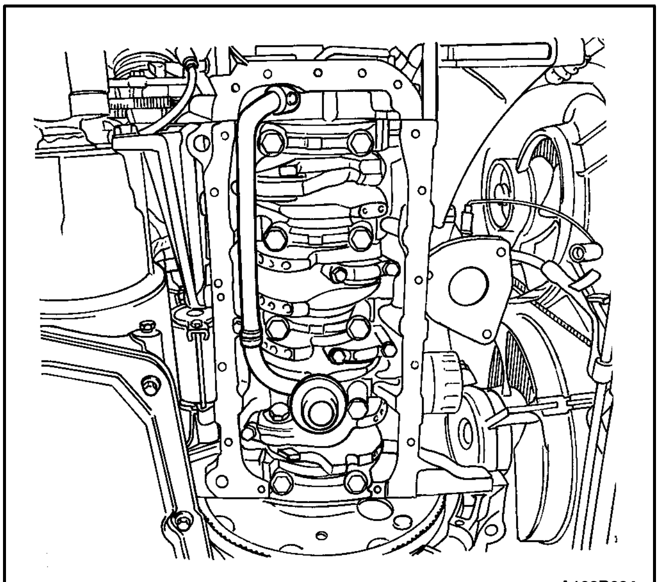


52. Install the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
53. Connect the lower radiator hose to the coolant pipe.
54. Connect the upper radiator hose to the thermostat housing.
55. Connect the coolant surge tank hose to the radiator.
56. Connect the heater outlet hose to the coolant pipe.
57. Connect the heater inlet hose to the coolant distributor.
58. Connect the coolant surge tank hose to the coolant pipe.
59. Connect the surge tank coolant hose to the throttle body.



A102B013

60. Connect the throttle cable to the throttle body and the intake manifold bracket.
61. Install the fuel pump fuse.
62. Connect the negative battery cable to the vehicle frame.
63. Connect the negative battery cable to the battery.
64. Connect and assemble the battery positive cable.
65. Refill the engine crankcase with engine oil.
66. Refill the engine coolant system. Refer to Section 1D, Engine Cooling.
67. Bleed the power steering system as necessary. Refer to Section 6A, Power Steering System.
68. Refill the A/C refrigerant system as necessary. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
69. Install the hood. Refer to Section 9R, Body Front End.



A102B094

PISTONS AND RODS

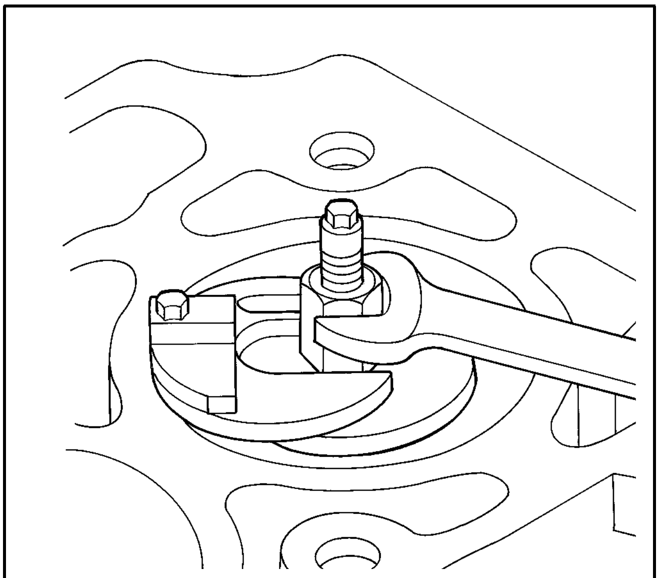
Tools Required

KM-427 Piston Pin Service Set

KM 470-B Angular Torque Gauge

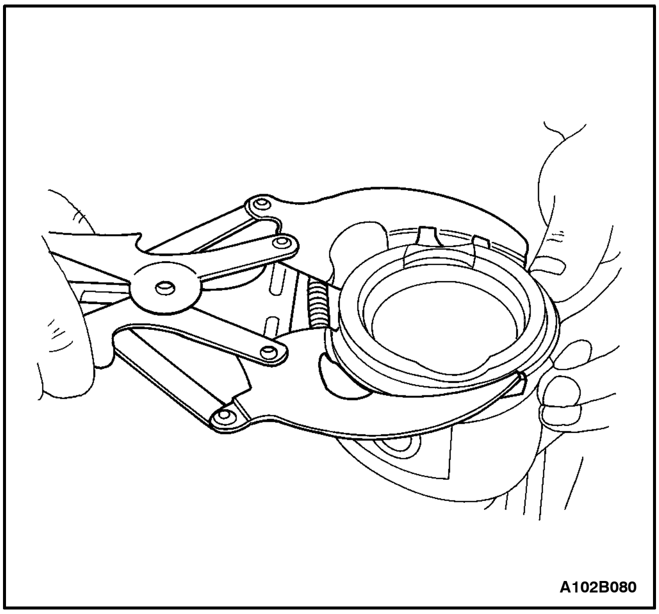
Removal Procedure

1. Remove the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the oil pan. Refer to "Oil Pan" in this section.
3. Remove the oil pump/pickup tube bolts.
4. Remove the oil pump/pickup tube.



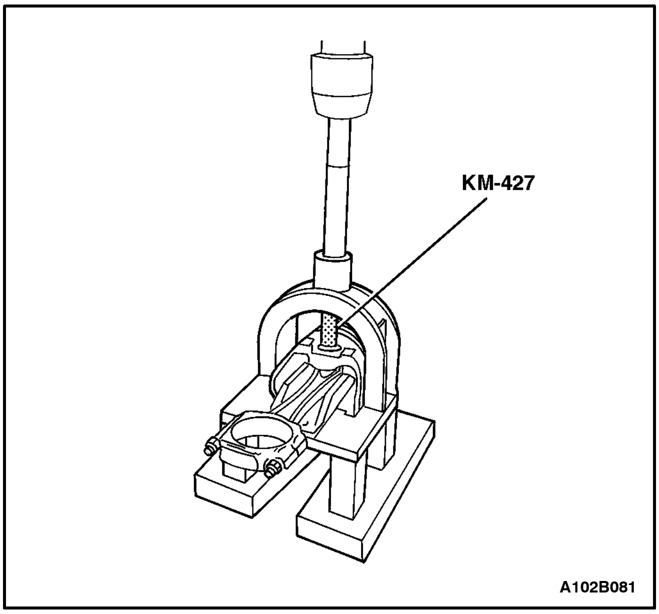
A102B079

5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.

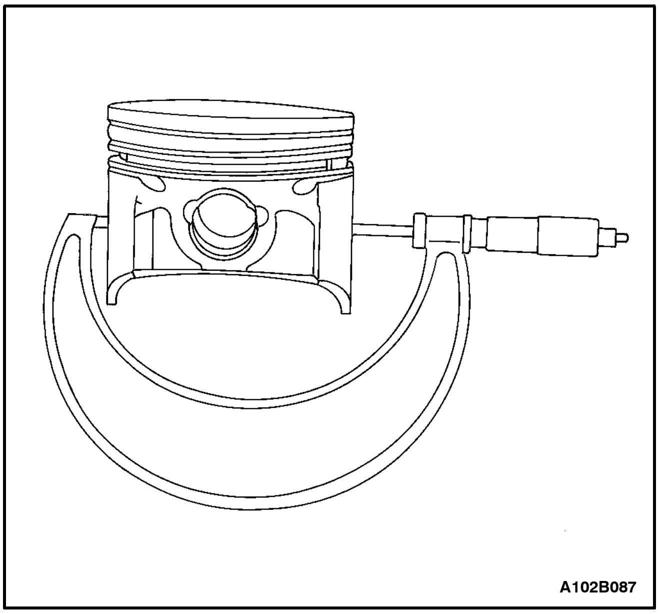


Caution: Use care when handling the piston. Worn piston rings are sharp and may cause injury.

11. Remove the piston.
12. Use a piston ring expander tool to expand the piston rings.
13. Remove the piston rings.

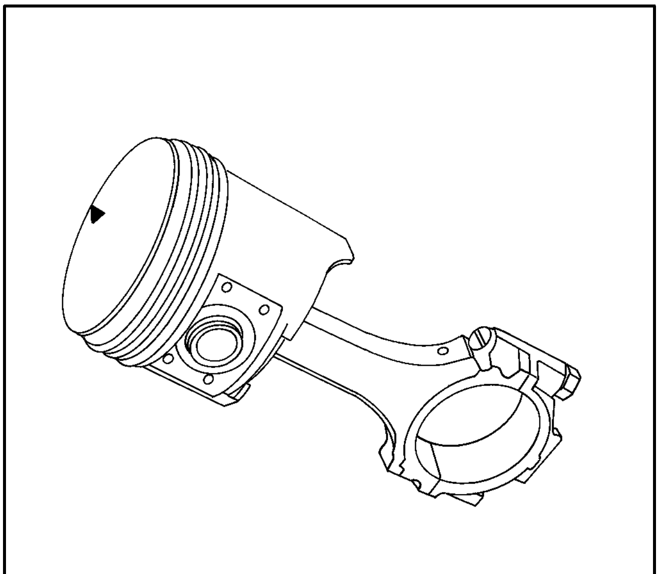


14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.



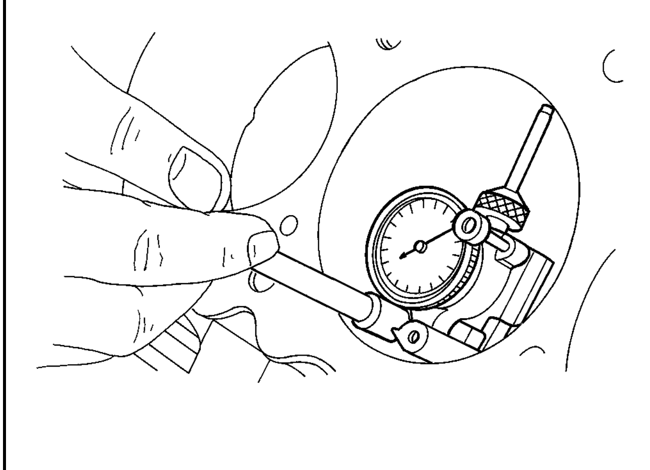
Inspection Procedure

1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the piston for scoring, cracks and wear.
6. Inspect the piston for taper using a micrometer.



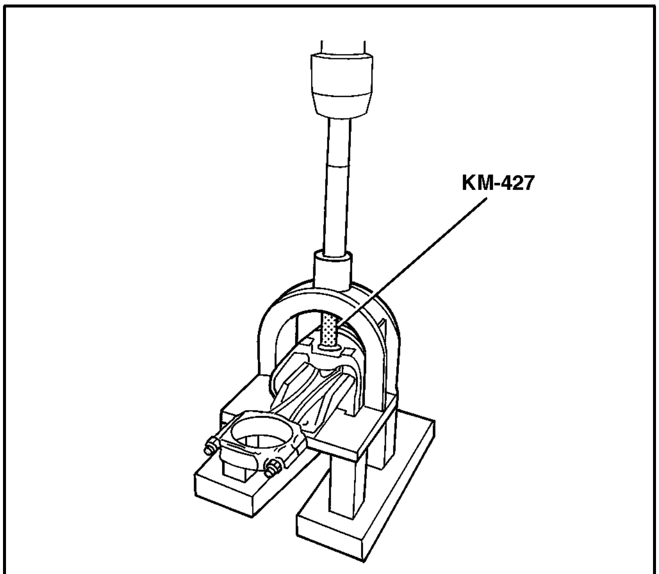
A102B082

7. Inspect the piston for fit to the connecting rod.



A102B083

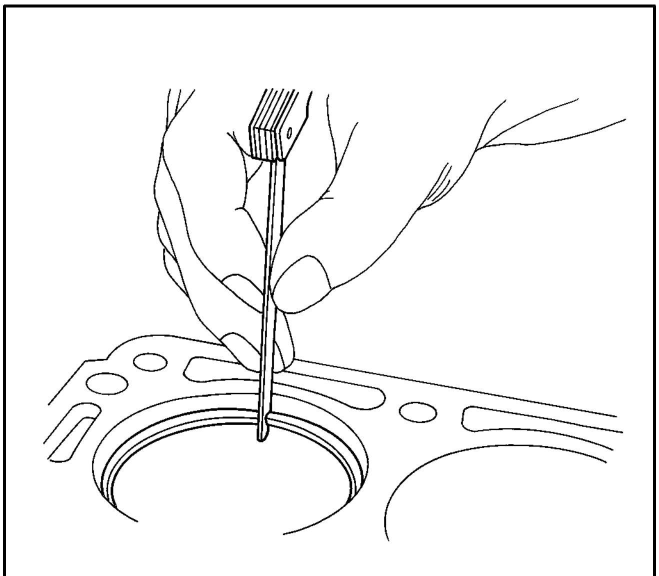
8. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to "Engine Specifications" in this section.
9. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to "Engine Specifications" in this section. If beyond specifications, replace the engine block.
10. Inspect the engine block cylinder bore for wear, runout, ridging and taper using a bore gauge. Refer to "Engine Specifications" in this section.
11. Inspect the engine block cylinder bore for glazing. Lightly hone the cylinder bore as necessary.



A102B081

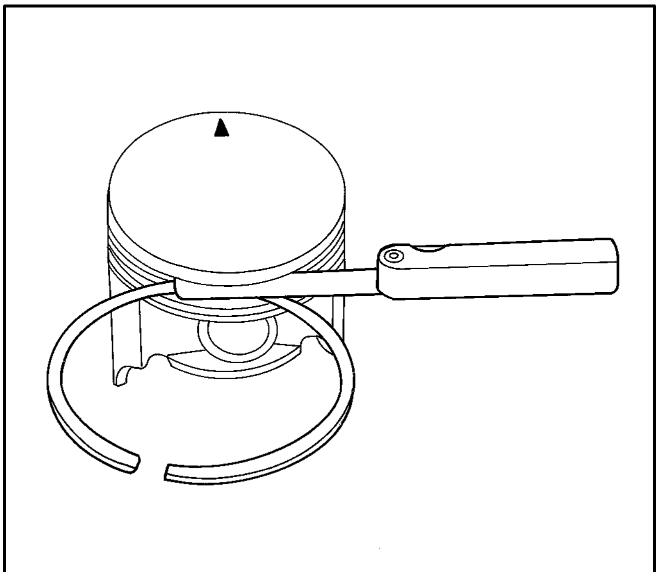
Installation Procedure

1. Align the notch on the piston and connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.
5. Install the piston pin into the piston and connecting rod assembly using the piston pin service set KM-427.



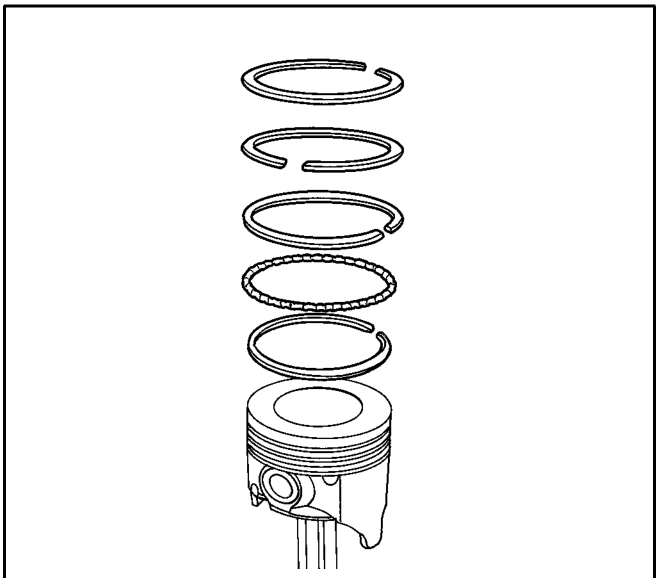
A102B084

6. Select a set of new piston rings.
7. Measure the piston ring gap using a feeler gauge. Refer to "Engine Specifications" in this section.
8. Increase the piston ring gap by carefully filing off excess material if the piston ring gap is below specifications.



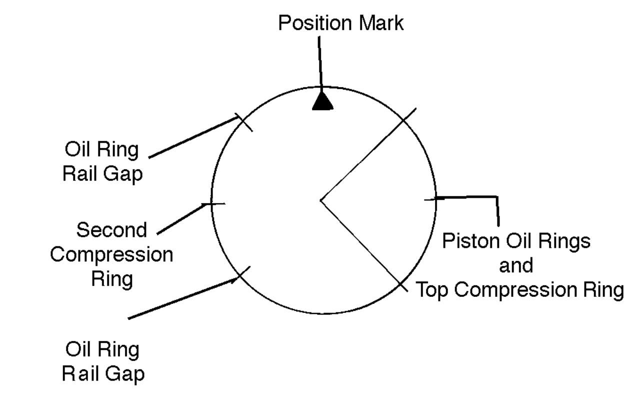
A102B085

9. Measure the piston ring side clearance using a feeler gauge. Refer to "Engine Specifications" in this section.
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed on a sheet of glass.



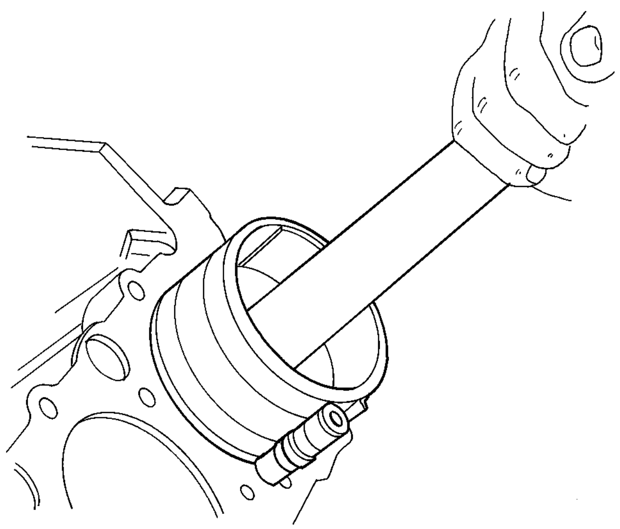
A102B086

12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.



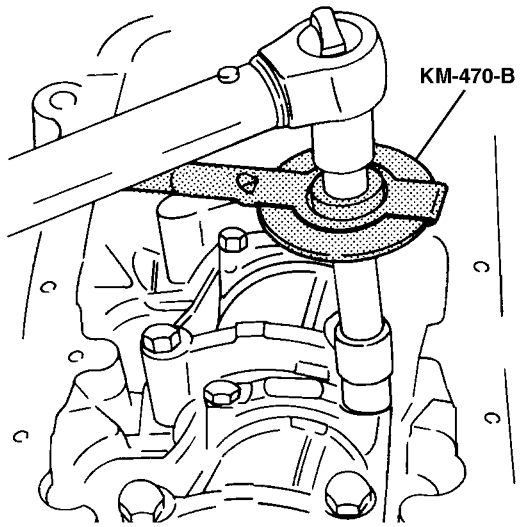
A102B089

15. Use a piston ring expander to install the piston rings. Do not expand the piston rings beyond the expansion necessary for installation.
16. Stagger the piston oil rings, the oil ring rail gaps, the second compression ring, and the top compression ring in relation to the notch on the top of the piston.



A102B088

17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using a ring compressor and a wood handle. Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and the bearings. Refer to "Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic" in this section.

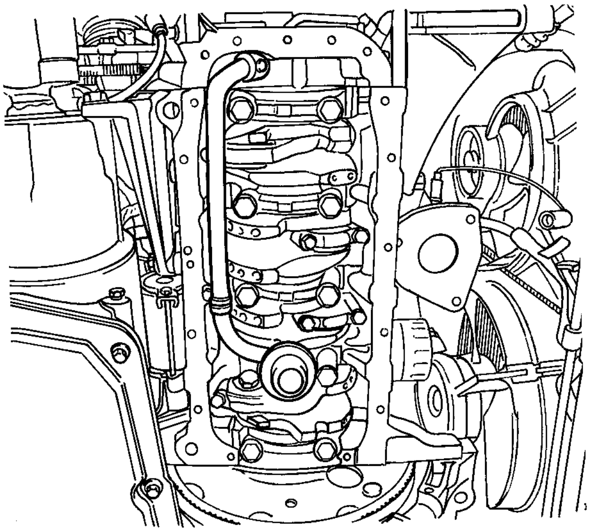


A102C151

20. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod bearing cap bolts to 25 N•m (18 lb-ft). Using the angular torque gauge KM-470-B, tighten one turn of 30 degrees plus one turn of 15 degrees.



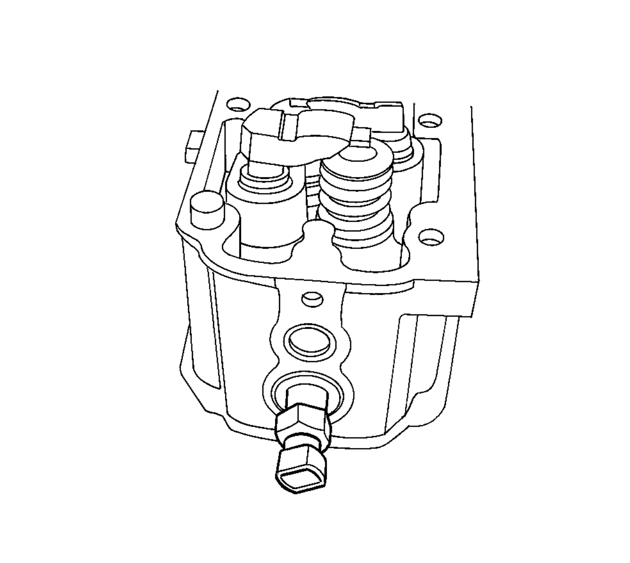
A102B094

21. Install the oil pump/pickup tube.
22. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 NSm (89 lb-in).

23. Install the oil pan. Refer to "Oil Pan" in this section.
24. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.



A102B049

UNIT REPAIR

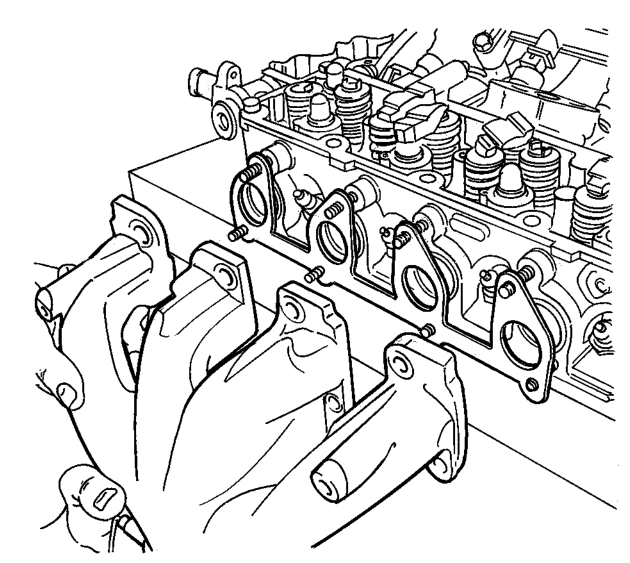
CYLINDER HEAD AND VALVE TRAIN COMPONENTS

Tools Required

MKM-571-B Gauge
KM-253 Valve Guide Reamer
KM-254 Valve Guide Reamer
KM-255 Valve Guide Reamer
KM-340-0 Cutter Set
  KM-340-7 Guide Drift
  KM-340-13 Cutter
  KM-340-26 Cutter
KM-348 Valve Spring Compressor
KM-419 Distance Gauge

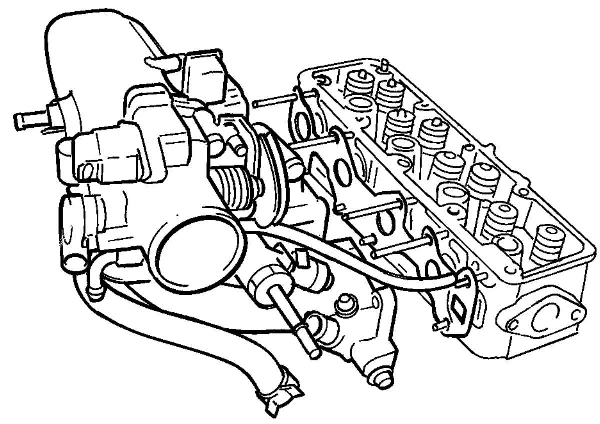
Disassembly Procedure

1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the coolant temperature sensor.

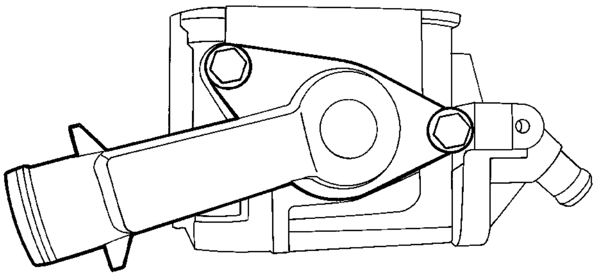


A102B047

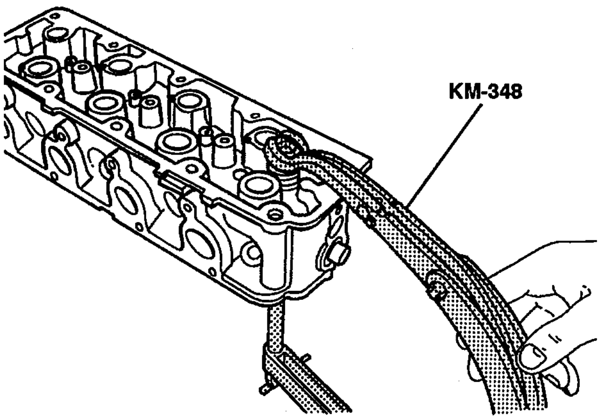
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold nuts.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.
9. Remove the spark plugs.


A102B048

10. Remove the intake manifold retaining nuts.
11. Remove the intake manifold.
12. Remove the intake manifold gasket.
13. Remove the intake manifold studs.

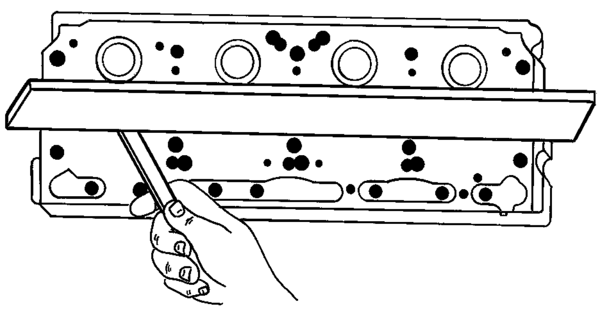

A102B050

14. Remove the thermostat housing mounting bolts.
15. Remove the thermostat housing.
16. Remove the thermostat and thermostat gasket.



A102B051

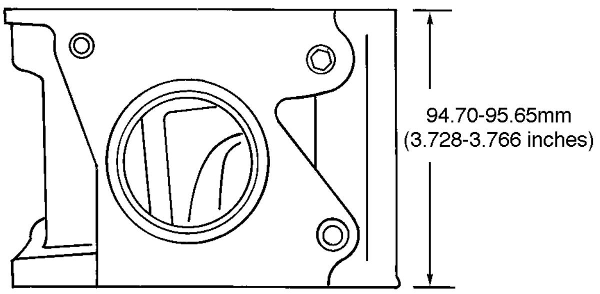
17. Using the valve spring compressor KM-348, compress the valve springs.
18. Remove the valve keepers.
19. Remove the valve spring cap.
20. Remove the valve springs.
21. Remove the valves.
22. Remove the valve stem oil seals.
23. Remove camshaft carrier alignment pins.



A102B052

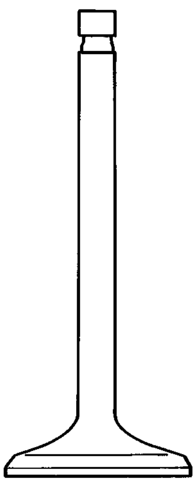
Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and the mating surfaces for leaks, corrosion, and blowby.
3. Inspect the cylinder head for cracks.
4. Inspect the length and the width of the cylinder head using a feeler gauge and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within .025 mm (.001 inch) maximum.



A102B053

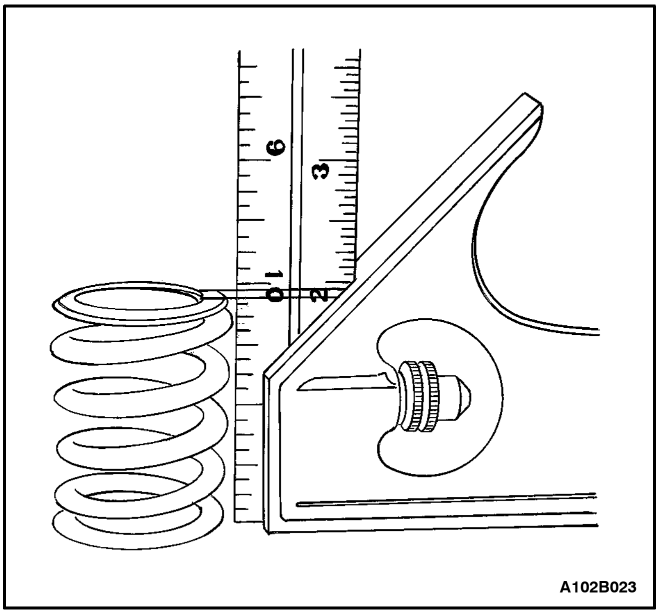
6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 94.70 to 95.65 mm (3.728 to 3.766 inches). If the cylinder head height is less than 94.70 mm (3.728 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect the valve seats for excessive wear and burned spots.



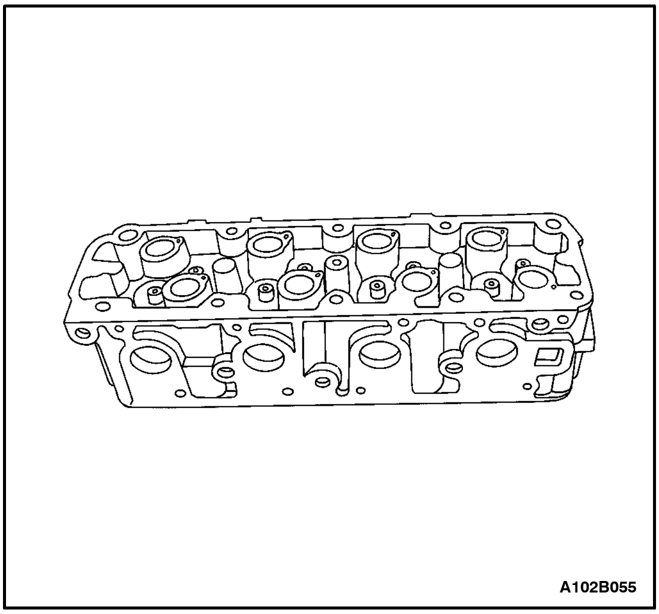
A102B054

Valve Inspection

1. Inspect valve stem tip wear.
2. Inspect the valve keeper grooves and oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.
4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep the refacing would result in a sharp edge, replace the valve.

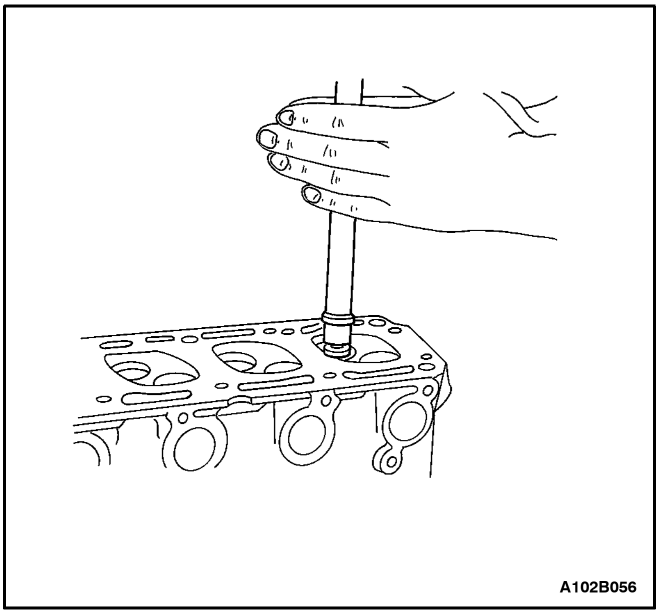


7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to "Engine Specifications" in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.



Cleaning Procedure

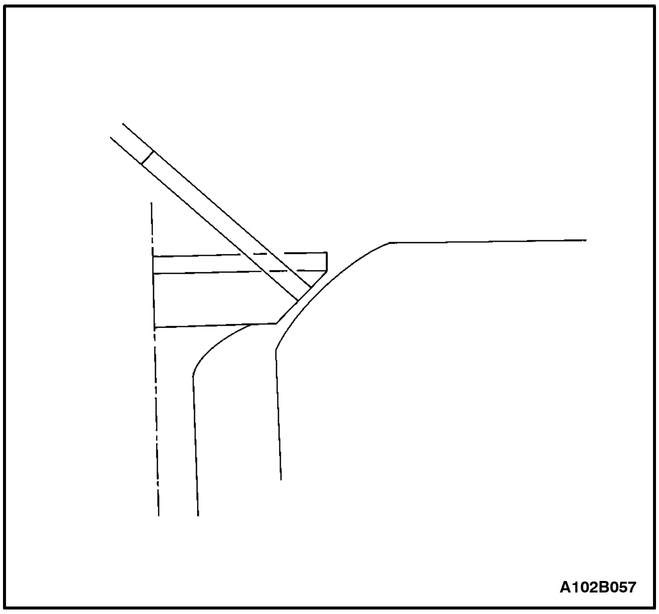
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil and varnish.



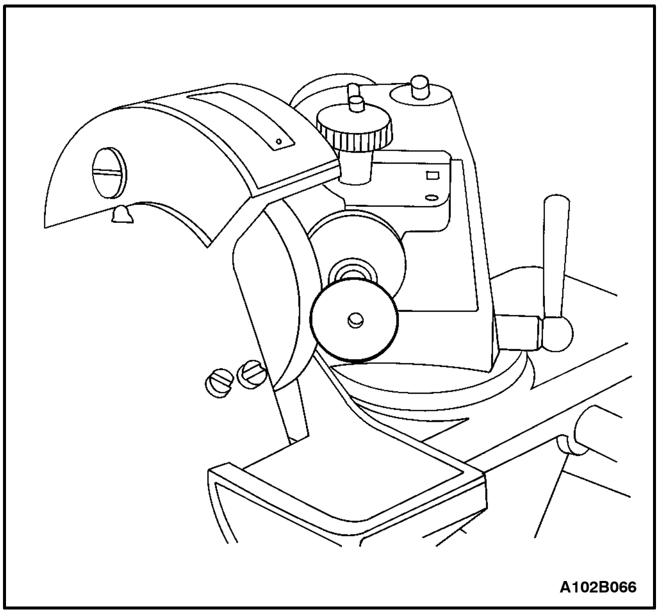
Cylinder Head Overhaul

Valve Grind-in

1. Lubricate the valve stem using a fine-grained paste.
2. Lift the valve rhythmically from the seat with a commercially available valve grinding tool in order to distribute the paste.

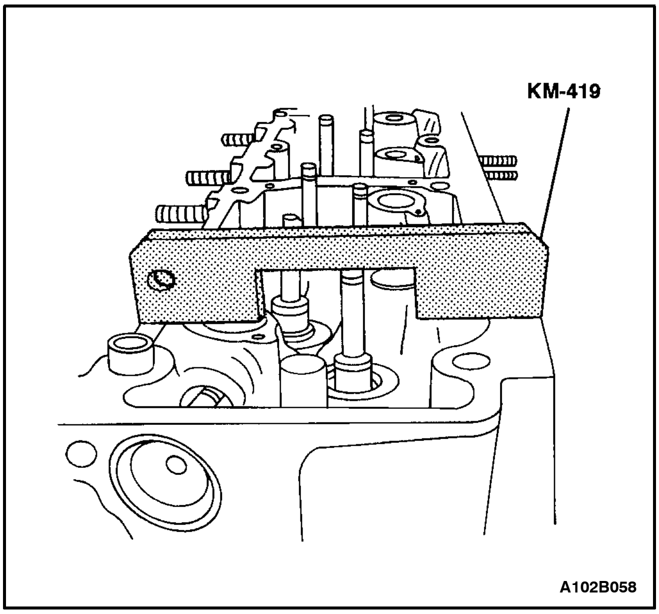


3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.

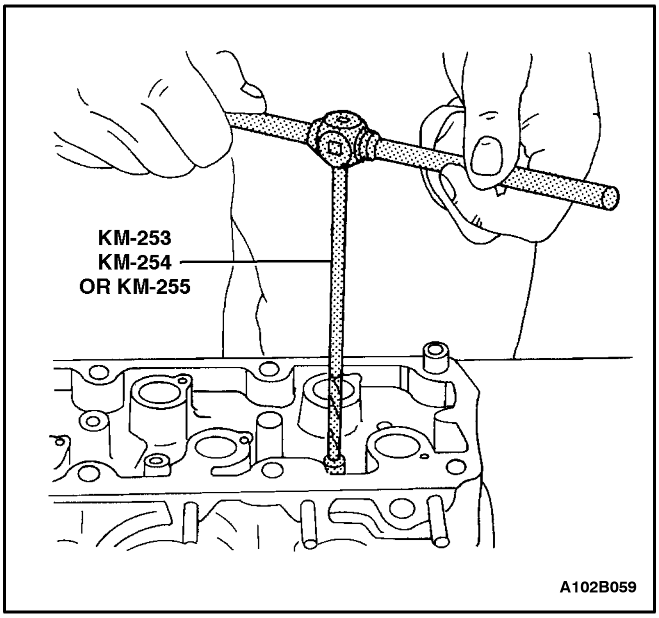


Valve Grind

1. Ensure that there are no crater line burns on the valve cone.
2. The valve may be reground only two times. Do not grind the valve stem end.
3. The angle at the valve face angle is 46 degrees.



4. Check the valve stem projection using the distance gauge KM-419.



Valve Guide Ream

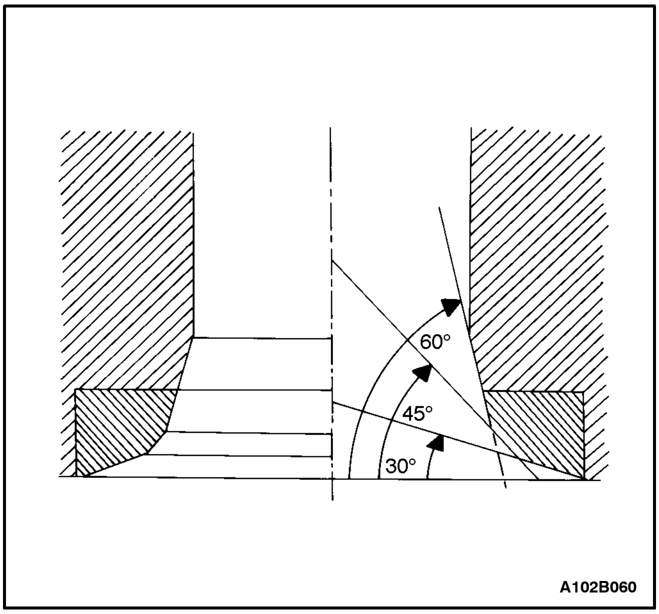
1. Measure the diameter of the valve guide using the gauge MKM-571-B and a commercially available inside micrometer.

Important: Valve oversizes may already have been fitted in production.

2. An oversize code is on the valve guide and the valve stem end. The following table gives the correct size, reamer, and production code for each service code.

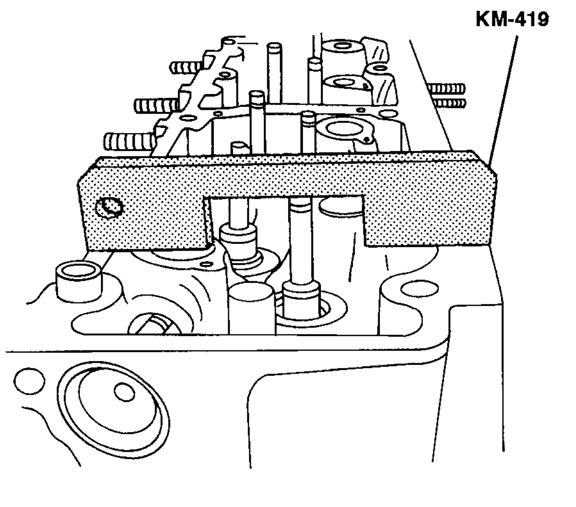
Size	Reamer	Production Code	Service Code
Normal	—	—	K
0.075	KM-253	1	K1
0.150	KM-254	2	K2
0.250	KM-255	—	A

3. Ream the valve guide from the upper side of the cylinder head to the next oversize. After reaming, cross out the code and emboss the valve guide with the new code.



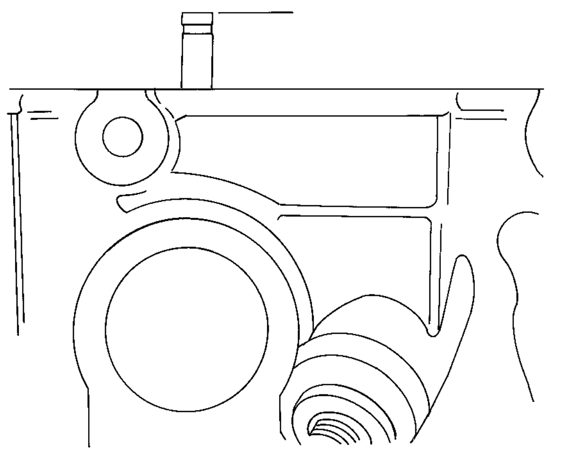
Valve Seat — Cut

1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the guide drift KM-340-7 as follows:
   - Valve seat: a 45-degree side using the cutter KM-340-13.
   - Upper correction angle: a 30-degree side using the cutter KM-340-13.
   - Lower correction angle: a 60-degree side using the cutter KM-340-26.



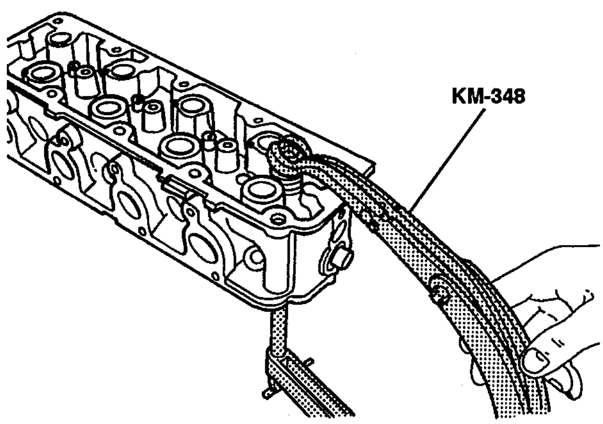
A102B058

3. Clean the chippings from the cylinder head.
4. Inspect the dimension for the proper valve seat width.
   - Intake: 1.3 to 1.5 mm (0.051 to 0.059 inch)
   - Exhaust: 1.6 to 1.8 mm (0.063 to 0.071 inch)
5. Inspect the valve stem projection using the distance gauge KM-419.



A102B061

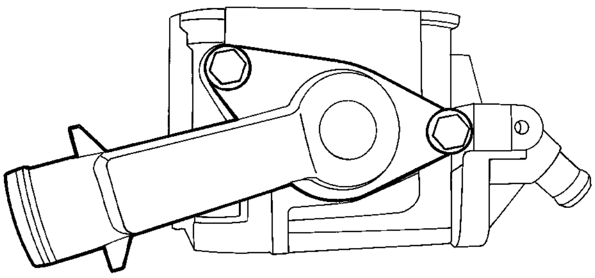
6. If the dimension is exceeded, install new valves and then check the valve stem projection again. Refer to "Valve Grind" and "Valve Grind-In" in this section.
7. If the valve stem projection is still too large despite replacing the valves, replace the cylinder head.



A102B051

Assembly Procedure

1. Install the camshaft carrier alignment pins.
2. Install the valve stem oil seals.
3. Coat the valves with engine oil.
4. Install the valves.
5. Install the valve springs.
6. Using the valve spring compressor KM-348, compress the valve springs.
7. Install the valve keeper.
8. Install the valve spring cap.

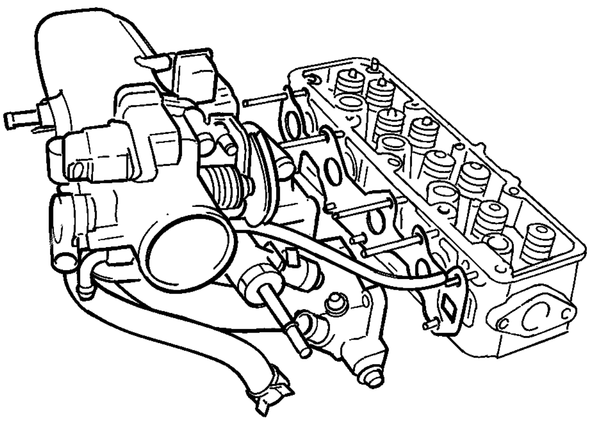


A102B050

9. Install the thermostat and the gasket.
10. Install the thermostat housing.
11. Install the thermostat housing mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 N•m (15 lb-ft).

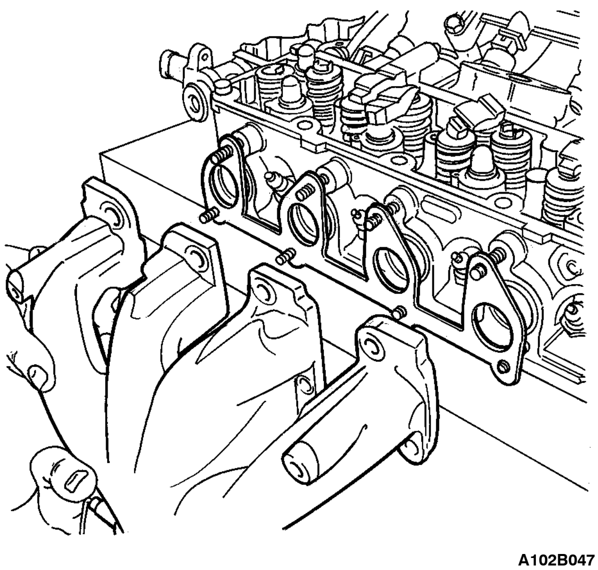


A102B048

12. Install the intake manifold studs.
13. Install the intake manifold gasket.
14. Install the intake manifold.
15. Install the intake manifold retaining nuts.

Tighten

Tighten the intake manifold retaining nuts to 25 N•m (18 lb-ft).



A102B047

16. Install the spark plugs.

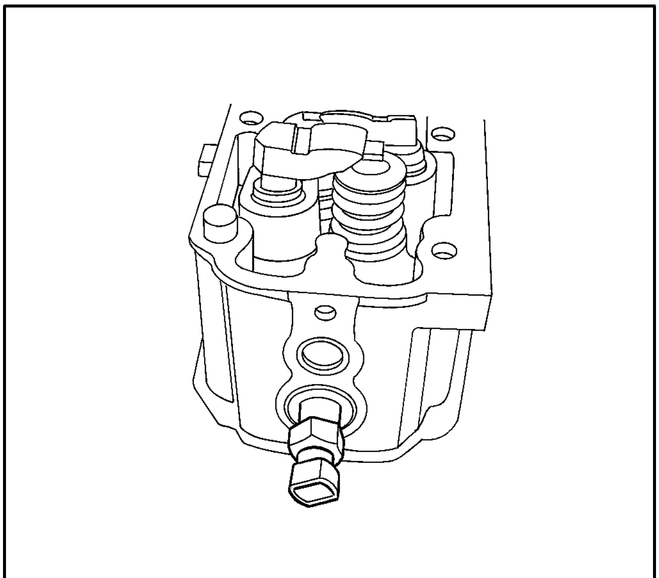
Tighten

Tighten the spark plugs to 25 N•m (18 lb-ft).

17. Install the exhaust manifold studs.
18. Install the exhaust manifold gasket.
19. Install the exhaust manifold.
20. Install the exhaust manifold nuts.

Tighten

Tighten the exhaust manifold nuts to 25 N•m (18 lb-ft).



A102B049

21. Install the exhaust manifold heat shield.
22. Install the exhaust manifold heat shield bolts.

Tighten

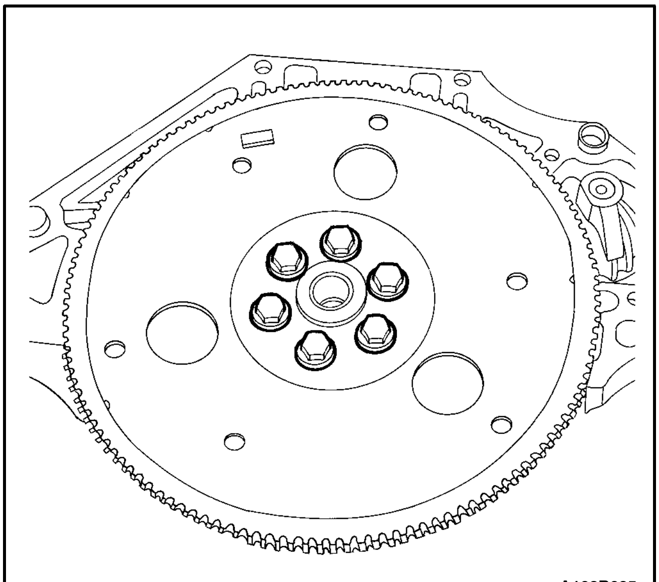
Tighten the exhaust manifold heat shield bolts to 15 N•m (11 lb-ft).

23. Install the coolant temperature sensor.

Tighten

Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).

24. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.



A102B095

CRANKSHAFT

Tools Required

MKM-412 Engine Overhaul Stand

J-42492 Timing Belt Adjuster

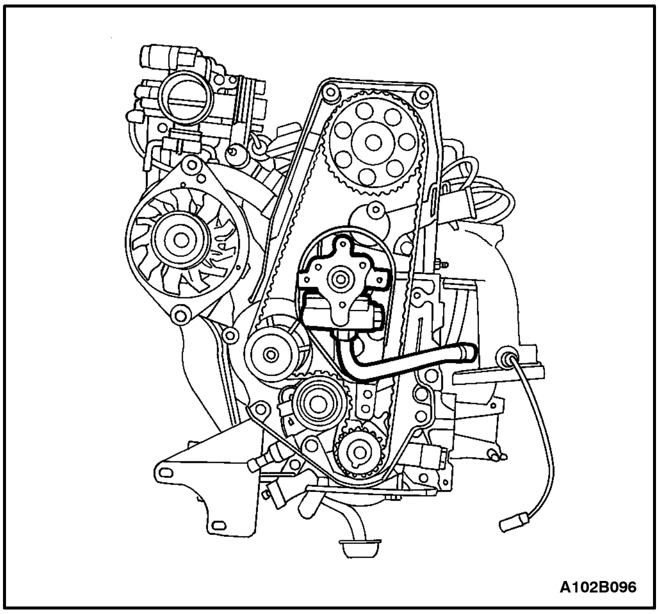
KM-470-B Angular Torque Gauge

J-36792 or KM-635 Crankshaft Rear Oil Seal Installer

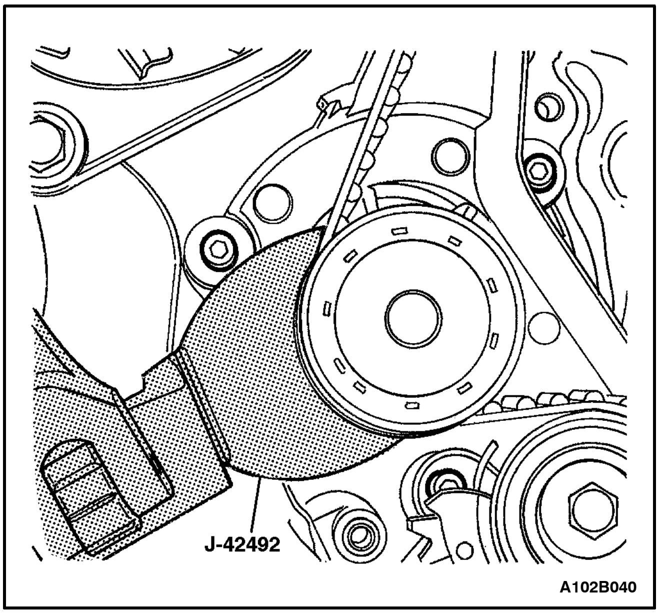
Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

Disassembly Procedure

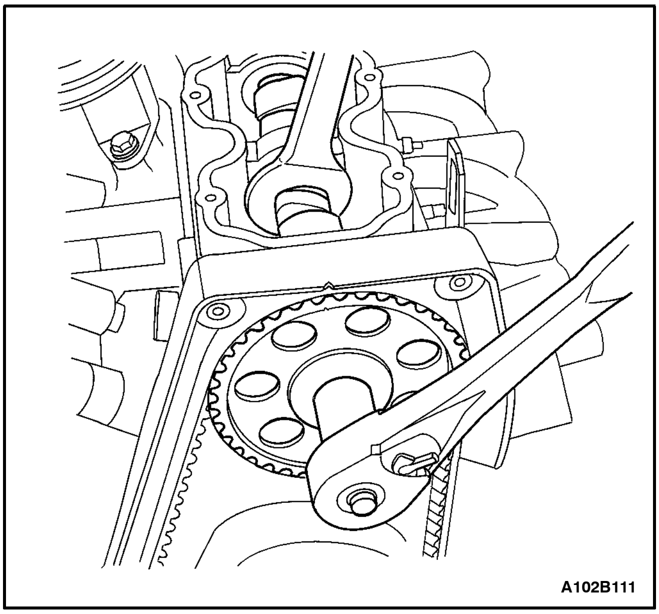
1. Remove the engine. Refer to "Engine" in this section.
2. Remove the flywheel bolts.
3. Remove the flywheel.
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand MKM-412.



6. Remove the upper timing belt cover bolts.
7. Remove the upper timing belt cover.
8. Remove the power steering pump mounting bolts.
9. Remove the power steering pump.
10. Remove the lower timing belt cover bolts.
11. Remove the lower timing belt cover.



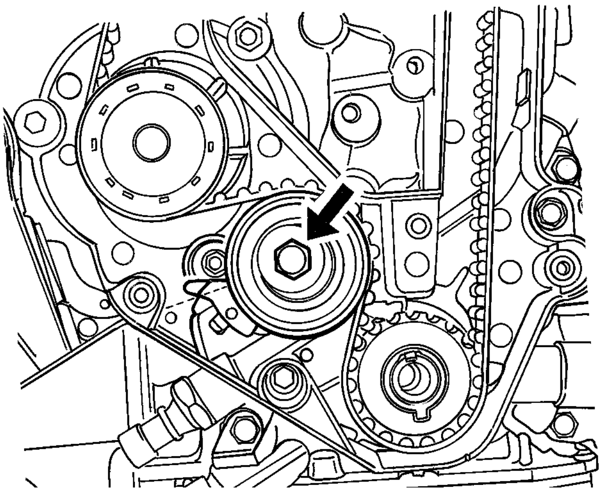
12. Slightly loosen the three coolant pump retaining bolts.
13. Rotate the coolant pump using timing belt adjuster J-42492 to remove the tension from the timing belt.
14. Remove the timing belt.



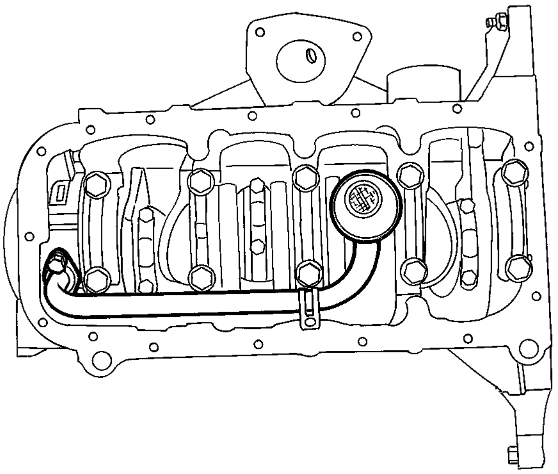
15. Remove the valve cover bolts.
16. Remove the valve cover and the valve cover gasket.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

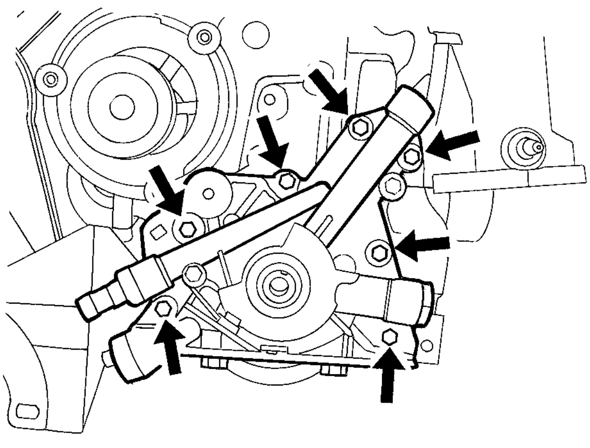
17. While holding the camshaft firmly in place, remove the camshaft gear bolt.
18. Remove the camshaft gear.


A102B093

19. Remove the timing belt automatic tensioner bolt.
20. Remove the timing belt automatic tensioner.
21. Remove the rear timing belt cover bolts.
22. Remove the rear timing belt cover.
23. Remove the crankshaft timing belt gear.


A102B064

24. Rotate the engine on the engine overhaul stand MKM-412.
25. Remove the oil pan retaining bolts.
26. Remove the oil pan.
27. Remove the oil pickup tube bolts.
28. Remove the oil pump pickup tube.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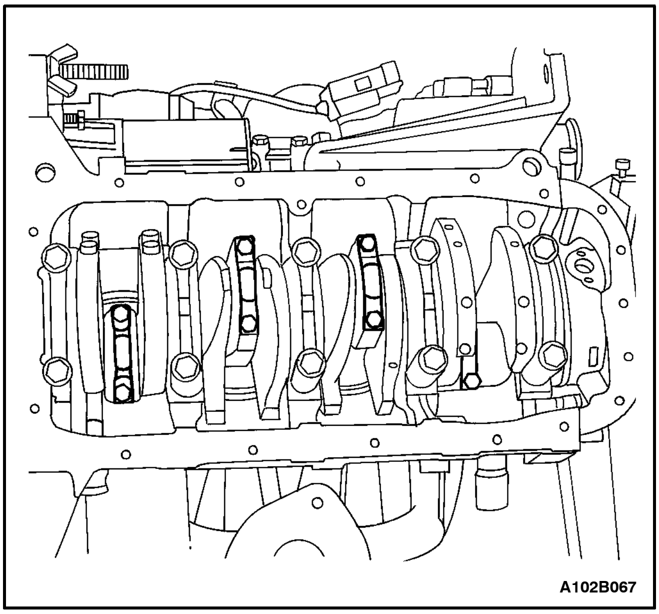
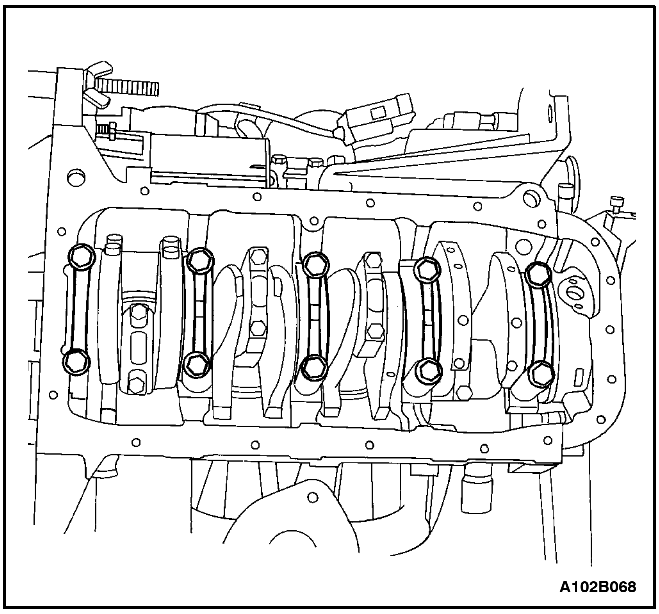
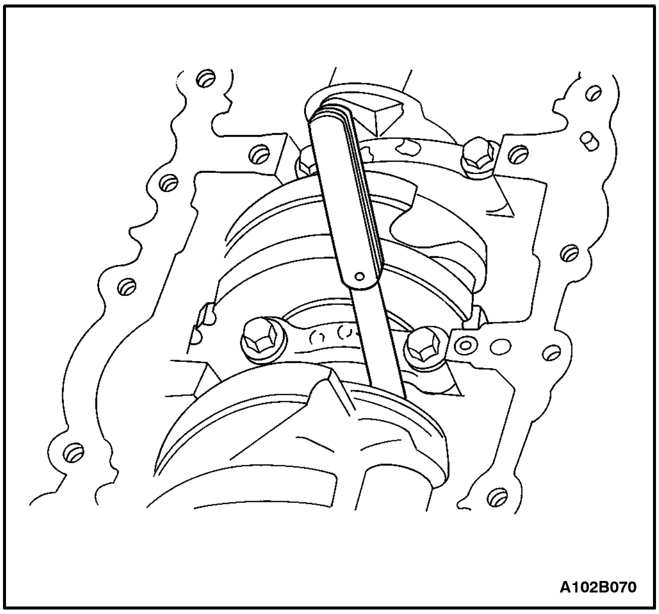
29. Remove the oil pump retaining bolts.
30. Remove the oil pump.



31. Mark the order of the rod bearing caps.
32. Remove the connecting rod cap bolts for all of the pistons.
33. Remove the connecting rod bearing caps and the lower connecting rod bearings.
34. Remove the upper connecting rod bearings.

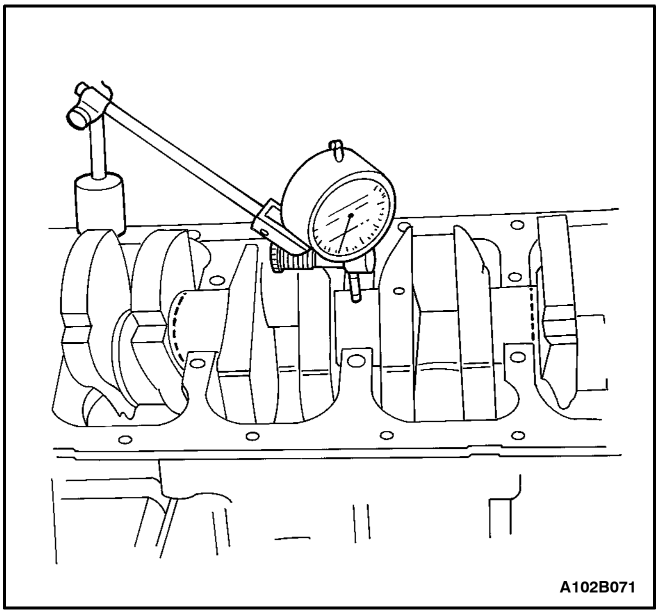


35. Mark the order of the crankshaft bearing caps.
36. Remove the crankshaft bearing cap bolts.
37. Remove the crankshaft bearing caps.
38. Remove the crankshaft bearings from the crankshaft bearing caps.
39. Remove the crankshaft.
40. Remove the crankshaft bearings from the engine block.
41. Clean the parts, as necessary.

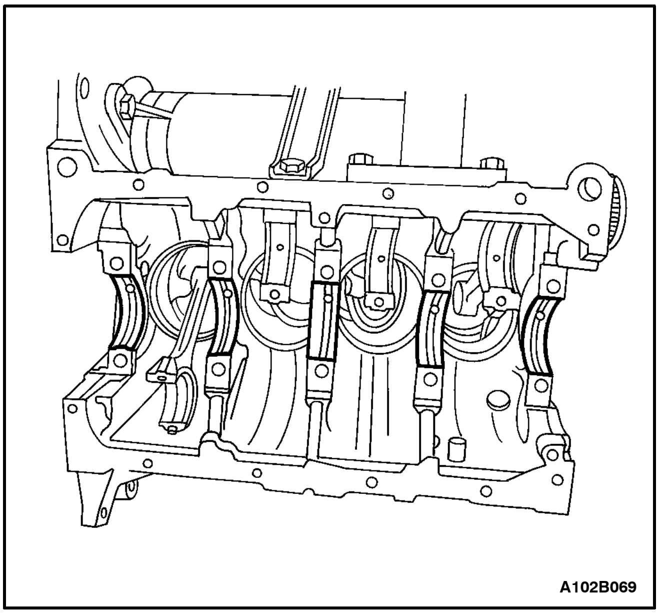


Assembly Procedure

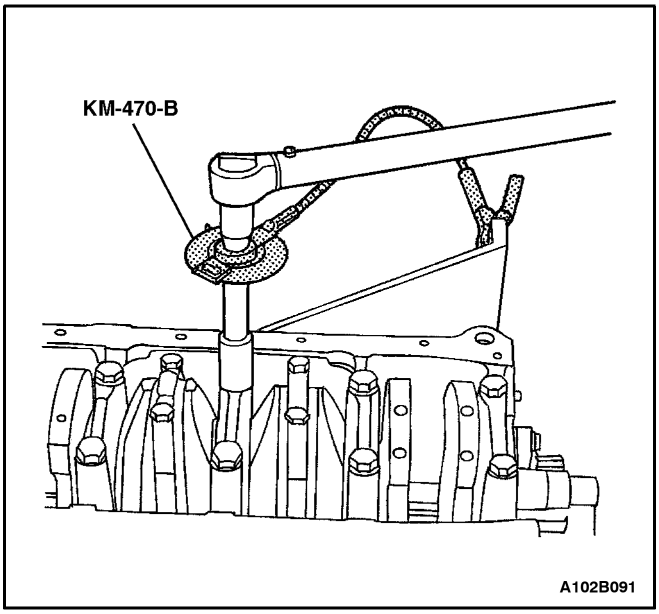
1. With crankshaft and bearings in place, plastic gauge all bearing clearances. Refer to “Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic” in this section.
2. Inspect the crankshaft end play with the crankshaft bearings installed.
3. Check for permissible crankshaft end play. Refer to “Engine Specifications” in this section.



4. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.



5. Coat the crankshaft bearings with engine oil.
6. Apply a bead of adhesive sealing compound to the grooves of the rear crankshaft bearing cap.
7. Install the crankshaft bearings in the engine block.
8. Install the crankshaft.



9. Install the crankshaft bearings to the crankshaft bearing caps.
10. Install the crankshaft bearing caps.

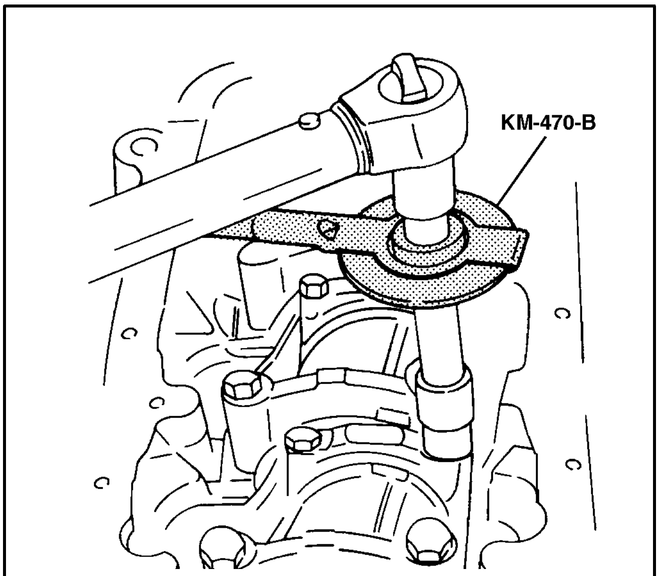
Notice: Do not reuse the old crankshaft bearing cap bolts. Damage to the engine could result.

11. Install new crankshaft bearing cap bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts another 45 degrees plus 15 degrees.

12. Install the upper connecting rod bearings to the connecting rods.
13. Install the lower connecting rod bearings to the connecting rod bearing caps



A102C151

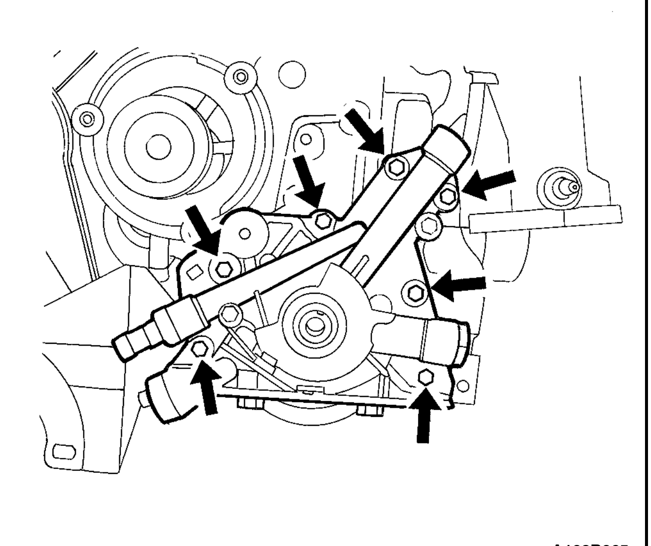
14. Install the connecting rod bearing caps to the connecting rods.

Notice: Do not reuse the old connecting rod bearing cap bolts. Damage to the engine could result.

15. Install new connecting rod bearing cap bolts.

Tighten

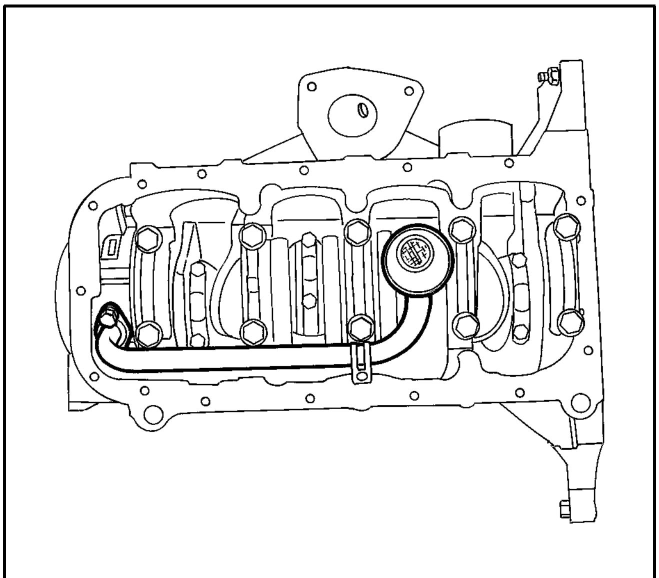
Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the connecting rod bearing cap bolts another 30 degrees plus 15 degrees.


A102B065

16. Install the oil pump.
17. Install the oil pump retaining bolts.

Tighten

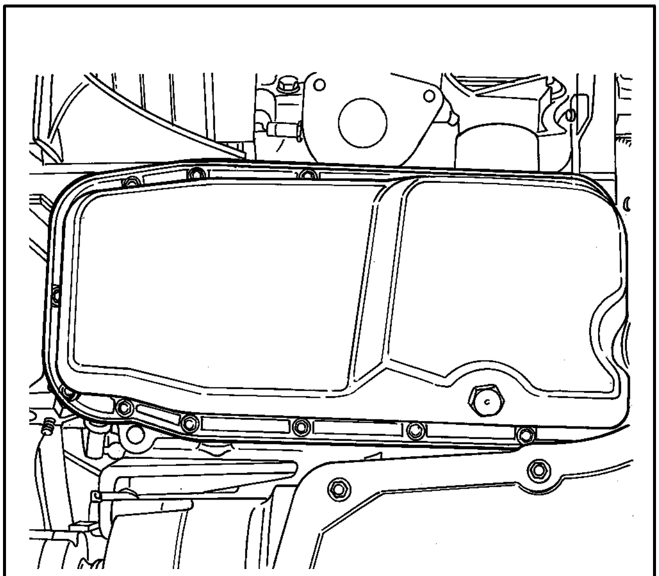
Tighten the oil pump retaining bolts to 10 NSm (89 lb-in).


A102B064

18. Install the oil pump/pickup tube.
19. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 NSm (89 lb-in).



A102B043

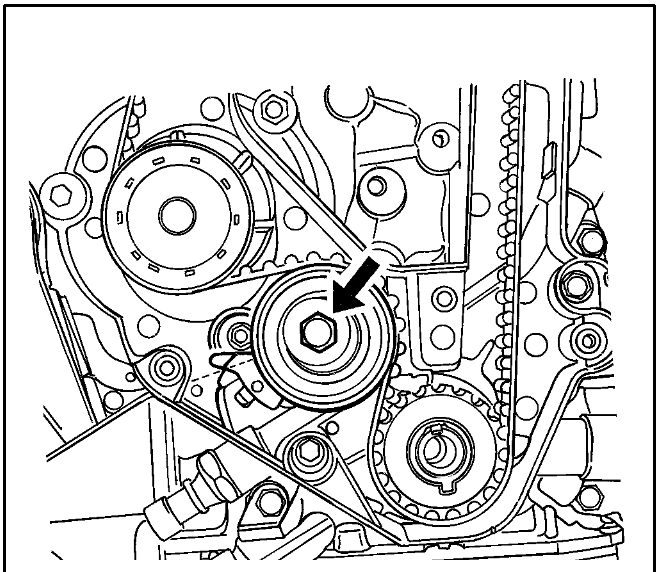
20. Install the oil pan gasket to the oil pan.
21. Install the oil pan.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

22. Install the oil pan retaining bolts.

Tighten

Tighten the oil pan retaining bolts to 10 N•m (89 lb-in).



A102B093

23. Install the crankshaft timing belt gear.
24. Install the rear timing belt cover.
25. Install the rear timing belt cover bolts.

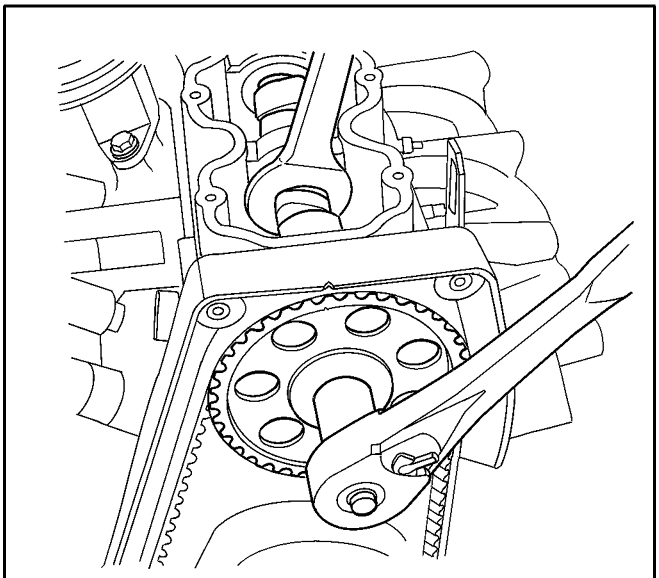
Tighten

Tighten the rear timing belt cover bolts to 10 N•m (89 lb-in).

26. Install the timing belt automatic tensioner.
27. Install the timing belt automatic tensioner bolt.

Tighten

Tighten the timing belt automatic tensioner bolt to 20 N•m (15 lb-ft).



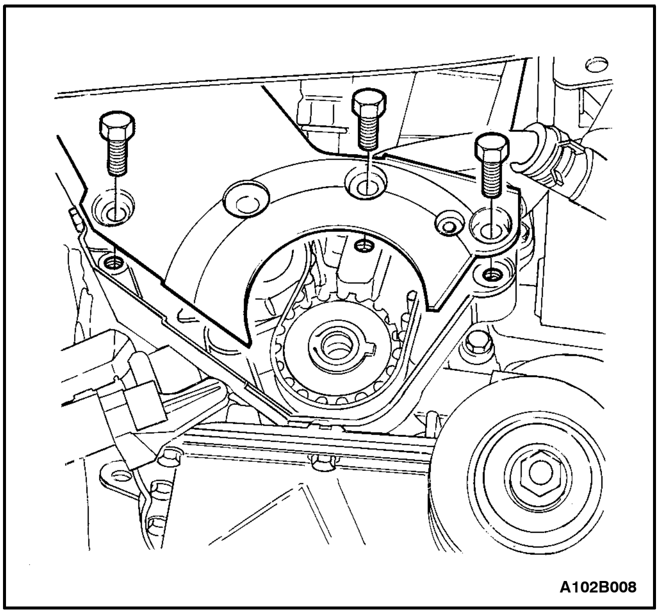
A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

28. Install the camshaft gear.
29. Install the camshaft gear bolt while holding the camshaft firmly in place.

Tighten

Tighten the camshaft gear bolt to 45 N•m (33 lb-ft).



30. Install the timing belt.
31. Adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
32. Install the valve cover gasket and the valve cover.
33. Install the valve cover bolts.

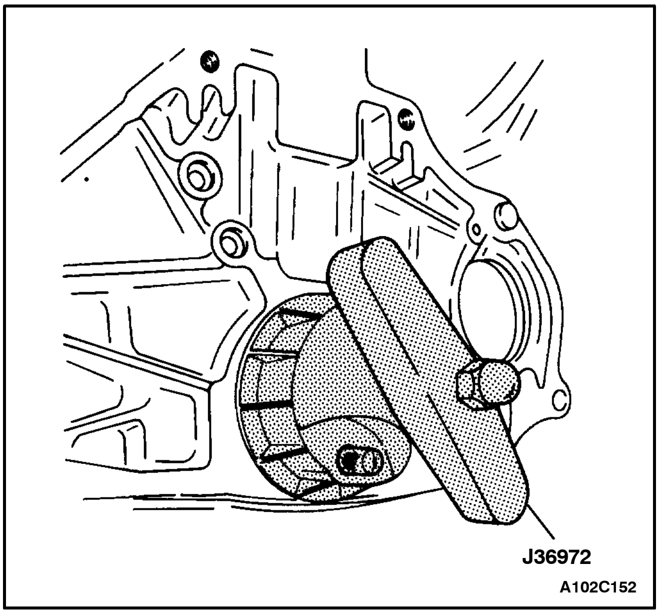
Tighten

Tighten the valve cover bolts to 10 N•m (89 lb-in).

34. Install the lower timing belt cover.
35. Install the lower timing belt cover bolts.

Tighten

Tighten the lower timing belt cover bolts to 10 N•m (89 lb-in).



36. Install the power steering pump.
37. Install the power steering pump mounting bolts.

Tighten

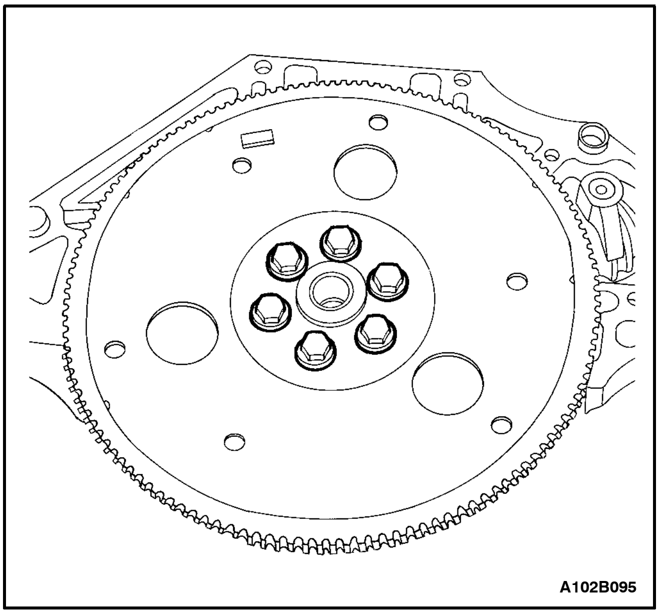
Tighten the power steering pump mounting bolts to 25 N•m (18 lb-ft).

38. Install the upper timing belt cover.
39. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 N•m (89 lb-in).

40. Install the engine lifting device.
41. Dismount the engine from the engine overhaul stand MKM-412.
42. Install the crankshaft rear oil seal using installer J-36972 or KM-635.

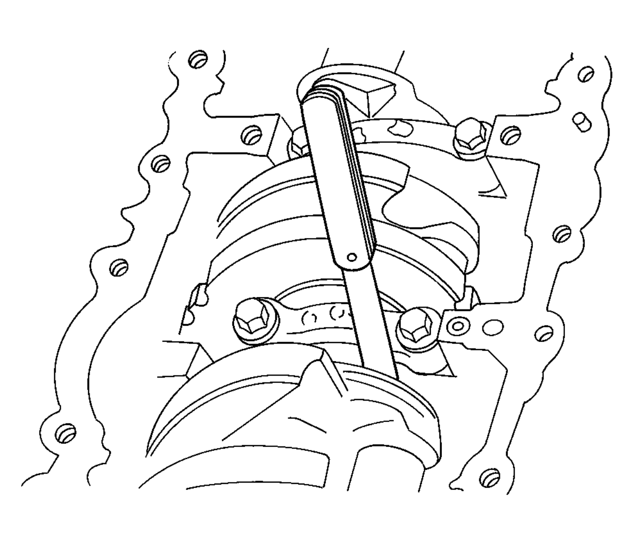


43. Install the flywheel.
44. Install the flywheel bolts.

Tighten

Tighten the flywheel bolts to 35 N•m (25 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the flywheel bolts another 30 degrees plus 15 degrees.

45. Install the engine. Refer to "Engine" in this section.


A102B070

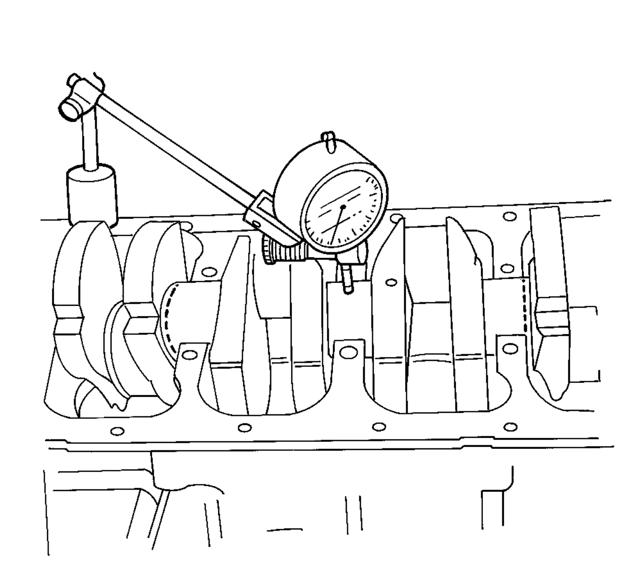
CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS — GAUGING PLASTIC

Tools Required

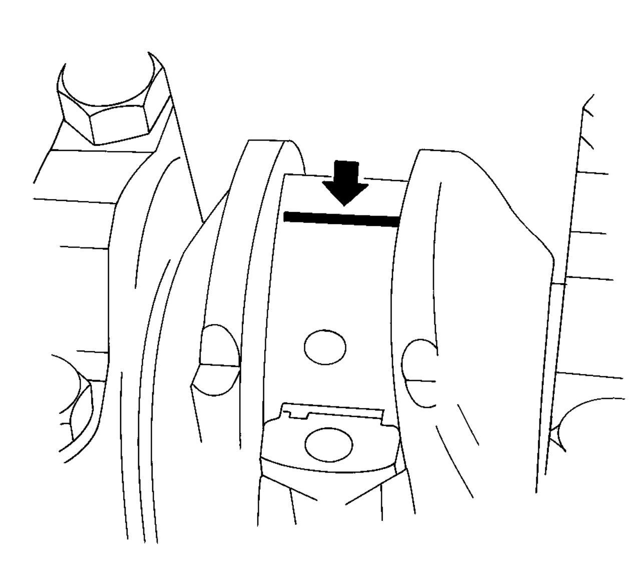
KM-470-B Angular Torque Gauge

Inspection Procedure – Crankshaft

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.
4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.

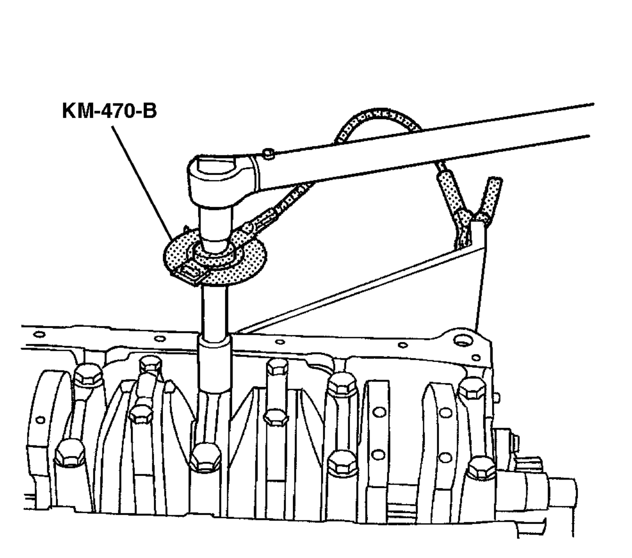

A102B071

7. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.


A102B072

Important: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.

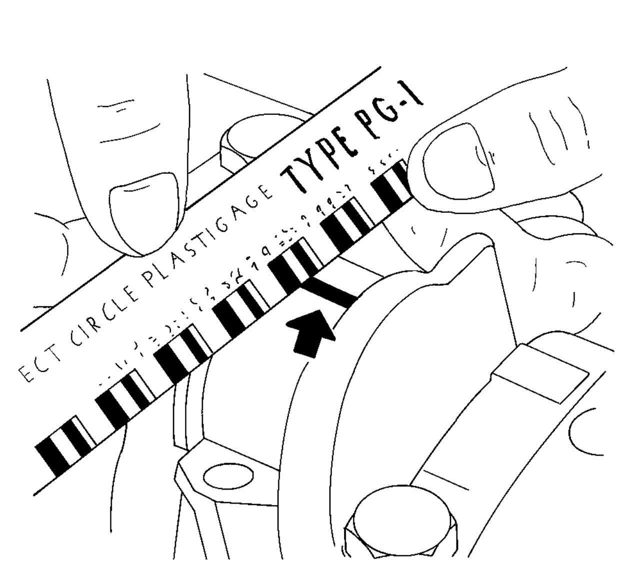


A102B091

10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

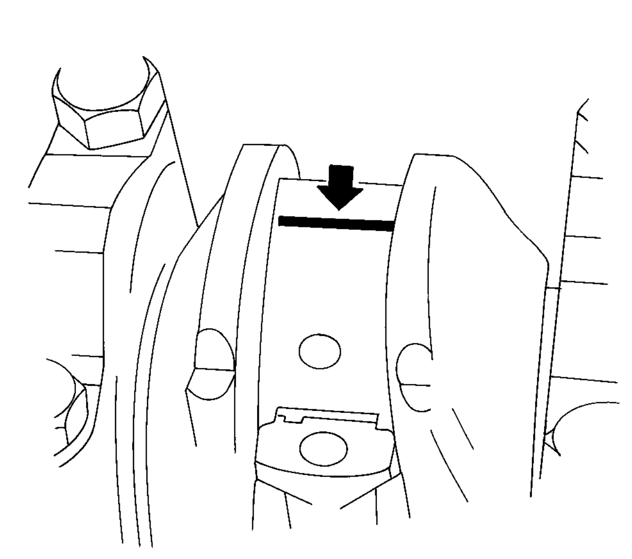
Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts another 45 degrees plus 15 degrees.



A102B073

12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
14. Inspect the bearing clearances for permissible tolerance ranges. Refer to "Engine Specifications" in this section.



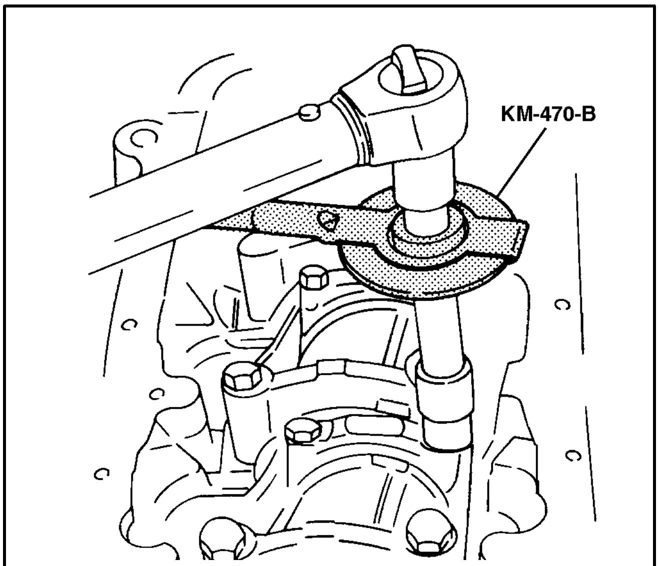
A102B072

Inspection Procedure – Connecting Rods

1. Coat the connecting rod bearings with engine oil.

Important: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.
4. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).

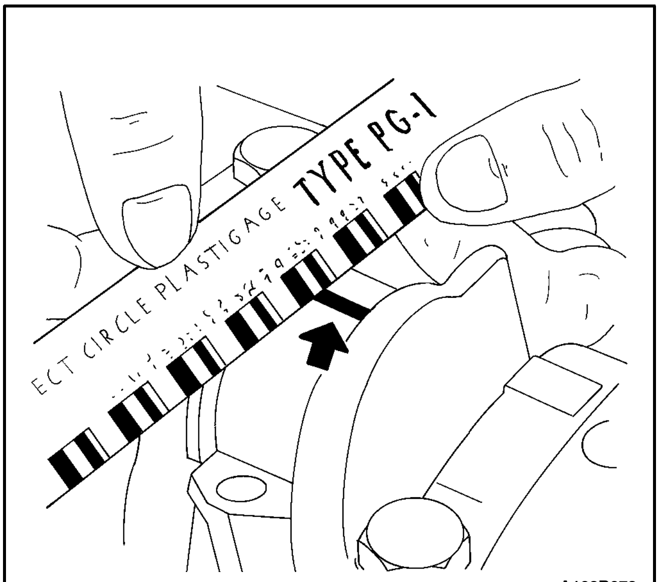


A102C151

5. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
6. Install the connecting rod bearing caps.
7. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod bearing cap bolts to 25 N•m (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft cap bolts another 30 degrees plus 15 degrees.



A102B073

8. Remove the connecting rod bearing caps.
9. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
10. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

CYLINDER HEAD AND GASKET

The cylinder head is made of an aluminum alloy. The cylinder head uses crossflow intake and exhaust ports. A spark plug is located in the center of each of the combustion chambers.

CRANKSHAFT

The crankshaft is supported by the five main bearings. The number three bearing is the end thrust bearing. The main bearings are lubricated from the oil holes which intersect the main oil gallery on the left side of the engine block.

TIMING BELT

The timing belt coordinates the crankshaft and the camshaft and keeps them synchronized. The timing belt also turns the coolant pump. The timing belt and the pulleys are toothed so that there is no slippage between them. There is a tension pulley that maintains the correct timing belt tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine drive belt. The timing belt requires no lubrication.

OIL PUMP

The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or the other engine components. When the drive gear rotates, the driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows.

At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages. During normal oil supply, a coil spring and a valve keep the bypass closed, directing all of the oil pumped to the engine. When the amount of oil being pumped increases, the pressure becomes high enough to overcome the force of the spring. This opens the valve of the oil pressure regulator, allowing the excess oil to flow through the valve and drain back to the oil pan.

OIL PAN

The oil pan is mounted to the bottom of the cylinder block. The oil pan houses the crankcase and is made of pressed sheet metal.

Engine oil is pumped from the oil pan by the oil pump. After the oil passes through the oil filter, the oil is fed through two paths to lubricate the cylinder block and the cylinder head. In one path, the oil is pumped through the oil passages in the crankshaft to the connecting rods, then to the pistons and the cylinders in the cylinder block. The oil then drains back into the oil pan. In the second path, the oil is pumped through the oil passages to the camshaft. The oil passes through the internal passageways in the camshafts to lubricate the valve assemblies in the cylinder head before draining back into the oil pan.

EXHAUST MANIFOLD

A single four-port, rear-takedown exhaust manifold is used with this engine. The exhaust manifold is designed to direct the escaping exhaust gases out of the combustion chambers with a minimum of backpressure.

INTAKE MANIFOLD

The intake manifold is made of aluminum. The intake manifold is heated by the engine coolant. An air/fuel mixture is transferred through the intake manifold to the engine cylinders for combustion.

CAMSHAFT

The cast-iron camshaft is supported by the five bearing surfaces in an aluminum camshaft carrier located on the top of the cylinder head. The camshaft gear is power driven by the crankshaft, using the timing belt.

EXHAUST GAS RECIRCULATION VALVE

The exhaust gas recirculation (EGR) system is used to lower oxides of nitrogen (NOX) emission levels caused by high combustion temperatures. The main element of the system is the EGR valve which is operated by vacuum.

The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease the combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

SECTION 1C

DOHC ENGINE MECHANICAL

[illegible]

TABLE OF CONTENTS

SPECIFICATIONS

ENGINE SPECIFICATIONS

Application	Description (1.6L DOHC)
General Data:	
Engine Type	4 Cylinder (In-line)
Displacement	1 598 cm^3 (97.51 in^3)
Bore Stroke	79.0 X 81.5 mm (3.11 in. X 3.21 in.)
Compression Ratio	9.5$ 0.02:1
Firing Order	1-3-4-2
Cylinder Bore:	
Diameter	79.0 mm (3.11 in.)
Out of Round (Maximum)	0.0065 mm (0.00025 in.)
Taper (Maximum)	0.0065 mm (0.00025 in.)
Piston:	
Diameter	78.970 mm (3.1090 in.)
Clearance to Bore	0.030 mm (0.0012 in.)
Piston Rings:	
Ring, End Gap: Top Compression	0.3 mm (0.019 in.)
2nd Compression	0.3 mm (0.019 in.)
Groove Clearance: Top Impression	0.02 mm (0.0008 in.)
2nd Impression	0.02 mm (0.0008 in.)
Piston Pin:	
Diameter	18.00 mm (0.708 in.)
Pin Off-Set	0.6X 0.8 mm (0.02X 0.03 in.)
Camshaft:	
Lift Intake	8.75 mm (0.344 in.)
Lift Exhaust	8.75 mm (0.344 in.)
End Play	0.10X 0.25 mm (0.003X 0.009 in.)
Journal OD: No. 1	30 mm (1.18 in.)
No. 2	27 mm (1.06 in.)
No. 3	27 mm (1.06 in.)
No. 4	27 mm (1.06 in.)
No. 5	27 mm (1.06 in.)
Crankshaft:	
Main Journal: Diameter (All)	54.982X 54.994 mm (2.164X 2.165 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Main Bearing Clearance (All)	0.005 mm (0.0001 in.)

ENGINE SPECIFICATIONS (Cont'd)

Application	Description (1.6L DOHC)
Crankshaft End Play	0.01 mm (0.003 in.)
Connecting Rod Journal: Diameter (All)	 42.971X 42.987 mm (1.691X 1.692 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Rod Bearing Clearance (All)	0.019X 0.070 mm (0.0007X 0.0027 in.)
Rod Side Clearance	0.070X 0.242 mm (0.0027X 0.009 in.)
Valve System:	
Valve Lash Compensators	Hydraulic
Face Angle (All)	46_
Seat Angle (All)	46_
Seat Runout (Maximum, All)	0.03 mm (0.019 in.)
Face Runout (Maximum, All)	0.03 mm (0.019 in.)
Seat Width: Intake	 1.17X 1.57 mm (0.046X 0.062 in.)
Exhaust	1.07X 1.47 mm (0.042X 0.058 in.)
Valve Guide Inside Diameter (All)	6.00X 6.02 mm (0.236X 0.237 in.)
Valve Stem Diameter (All)	6 mm (0.236 in.)
Valve Diameter (All): Intake	 30.3" 0.12 mm (1.19" 0.0047 in.)
Exhaust	26.0" 0.14 mm (1.02" 0.0055 in.)
Valve Spring Loads: Valve Open	 580" 26 N (428" 19 lbs) @ 23.0 mm (0.90 in.)
Valve Closed	260" 13 N (192" 9 lbs) @ 32.0 mm (1.25 in.)
Valve Spring Free Length	-
Cylinder Head:	
Overall Height	138.18 mm (5.440 in.)
Minimum Height after machining	138.13 mm (5.438 in.)
Distortion	0.1 mm (0.002 in.)
Oil Pump:	
Gap Between Oil Pump Body and Out Rotor	0.4X 0.484 mm (0.016X 0.019 in.)
Out Rotor Side Clearance	0.45X 0.100 mm (0.017X 0.003 in.)
Inner Rotor Side Clearance	0.035X 0.085 mm (0.001X 0.003 in.)
Relief Valve Spring Free Length	81 mm (3.188 in.)
Sealants and Adhesives:	
Rear Main Bearing Cap	GE p/n RTV 159
Camshaft Carrier to Cylinder Head	HN 1581 (Loctite^R 515)
Oil Pan Bolts	HN 1256 (Loctite^R 242)
Oil Pump Bolts	HN 1256 (Loctite^R 242)
Oil Pan Pickup Tube Bolts	HN 1256 (Loctite^R 242)
Oil Gallery Plug	HN 1256 (Loctite^R 242)
Coolant Jacket Caps and Plugs (Freeze Plugs)	HN 1756 (Loctite^R 176)
Exhaust Manifold Studs/Nuts	Anti-seize Compound (HMC Spec HN1325)

FASTENER TIGHTENING SPECIFICATIONS

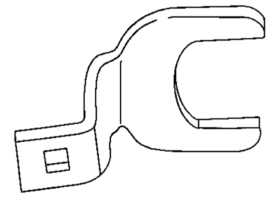
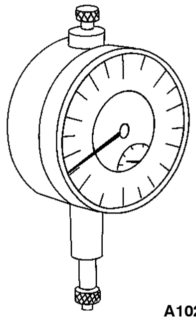
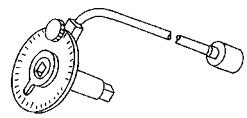
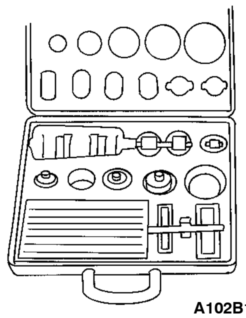
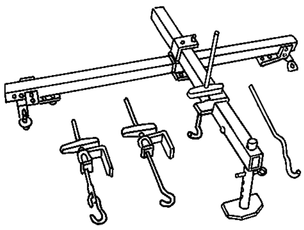
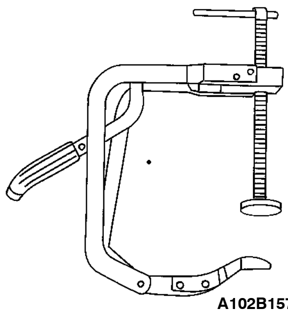
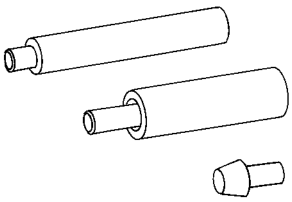
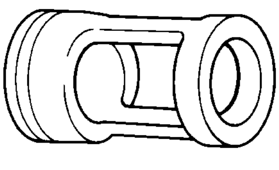
Application	NSm	Lb-Ft	Lb-In
A/C Compressor Hose Assembly Retaining Bolt	33	24	-
A/C Compressor Mounting Bolts	27	20	-
A/C Compressor Mounting Bracket Bolts	50	37	-
Air Filter Housing Bolts	12	-	106
Alternator Adjusting Bolt	20	15	-
Alternator Adjusting Bracket Retaining Bolt	20	15	-
Camshaft Cap Bolts	16	12	-
Camshaft Gear Bolt, Intake & Exhaust	67.5	49	-
Connecting Rod Cap Bolts	25 +30_+15_	18 +30_+15_	-
Coolant Pump Retaining Bolts	10	-	89
Coolant Temperature Sensor	20	15	-
Crankshaft Bearing Cap Bolts	50 +45_+15_	37 +45_+15_	-
Crankshaft Pulley Bolt	95 +30_+15_	70 +30_+15_	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Cylinder Head Bolts (Camshaft Support Housing & Cylinder Head Mounting Bolts)	25 +60_+60_ +60_+10_	18 +60_+60_ +60_+10_	-
DIS Ignition Coil Mounting Bracket Bolts	10	-	89
DIS Ignition Coil Mounting Bolts	10	-	89
Engine Mount Bracket Retaining Bolts	60	44	-
Engine Mount Retaining Nuts	40	30	-
Engine-Mount-to-Engine-Mount-Bracket Retaining Bolts	60	44	-
Exhaust Flexible Pipe Bracket Bolts	40	30	-
Exhaust Flex Pipe-to-Catalytic Converter or Connecting Pipe Retaining Nuts	30	22	-
Exhaust Flex Pipe-to-Exhaust Manifold Retaining Nuts	40	30	-
Exhaust Gas Recirculation Valve Adapter Bolts	25	18	-
Exhaust Manifold Heat Shield Bolts	15	11	-
Exhaust Manifold Retaining Nuts	25	18	-
Flexible Plate Bolts	60	44	-
Flexible Plate Inspection Cover Bolts	10	-	89
Flywheel Bolts	35 +30_+15_	25 +30_+15_	-
Flywheel Inspection Cover Bolts	12	-	106
Front Timing Belt Cover Bolts, Upper and Lower	10	-	89
Fuel Rail Retaining Bolts	25	18	-
Intake Manifold Retaining Nuts/Bolts	25	18	-
Intake Manifold Support Bracket Bolts, Upper	25	18	-

FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

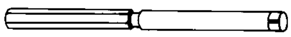
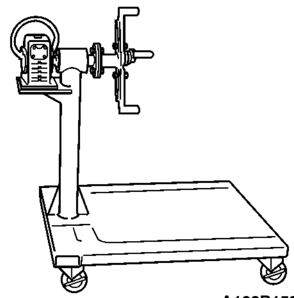
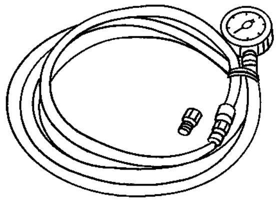
Application	N•m	Lb-Ft	Lb-In
Oil Pan Retaining Bolts	10	-	89
Oil Pressure Switch	40	30	-
Oil Pump Rear Cover Bolts	6	-	53
Oil Pump Retaining Bolts	10	-	89
Oil Pump Safety Relief Valve	30	22	-
Oil Pump/Pickup Tube Bolts	10	-	89
Power Steering Pump Mounting Bolts	25	18	-
Power Steering Pump Pulley Bolts	25	18	-
Rear Timing Belt Cover Bolts	10	-	89
Right Transaxle Brace Bolts	40	30	-
Spark Plug Cover Bolts	3	-	27
Spark Plugs	25	18	-
Support Bracket Bolt	10	-	89
Thermostat Housing Mounting Bolts	20	15	-
Throttle Cable Bracket Bolts	8	-	71
Timing Belt Automatic Tensioner Bolts	25	18	-
Timing Belt Idler Pulley Bolt	40	30	-
Transaxle Torque Converter Bolts	65	48	-
Transmission/Transaxle Bell Housing Bolts	75	55	-
Valve Cover Nuts	10	-	89

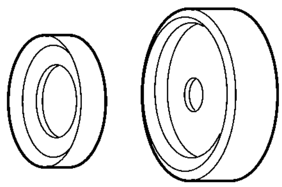
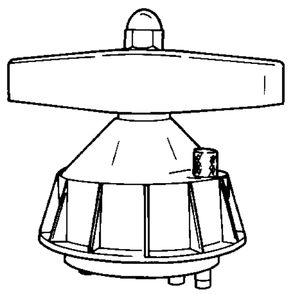
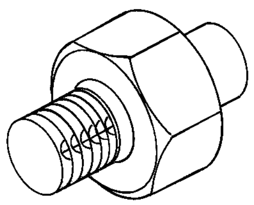
SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A102B151	**J-42492** **Timing Belt Adjuster**	 A102B154	**MKM-571-B** **Gauge**
 A102B161	**KM-470-B** **Angular Torque Gauge**	 A102B156	**KM-340-0** **Cutter Set** Includes: **KM-340-7** **KM-340-13** **KM-340-26**
 A102B152	**J-28467-B** **Engine Assembly Support Fixture**	 A102B157	**KM-348** **Valve Spring Compressor**
 A102B153	**KM-427** **Piston Pin Service Set**	 A102C153	**KM-653** **Adapter**

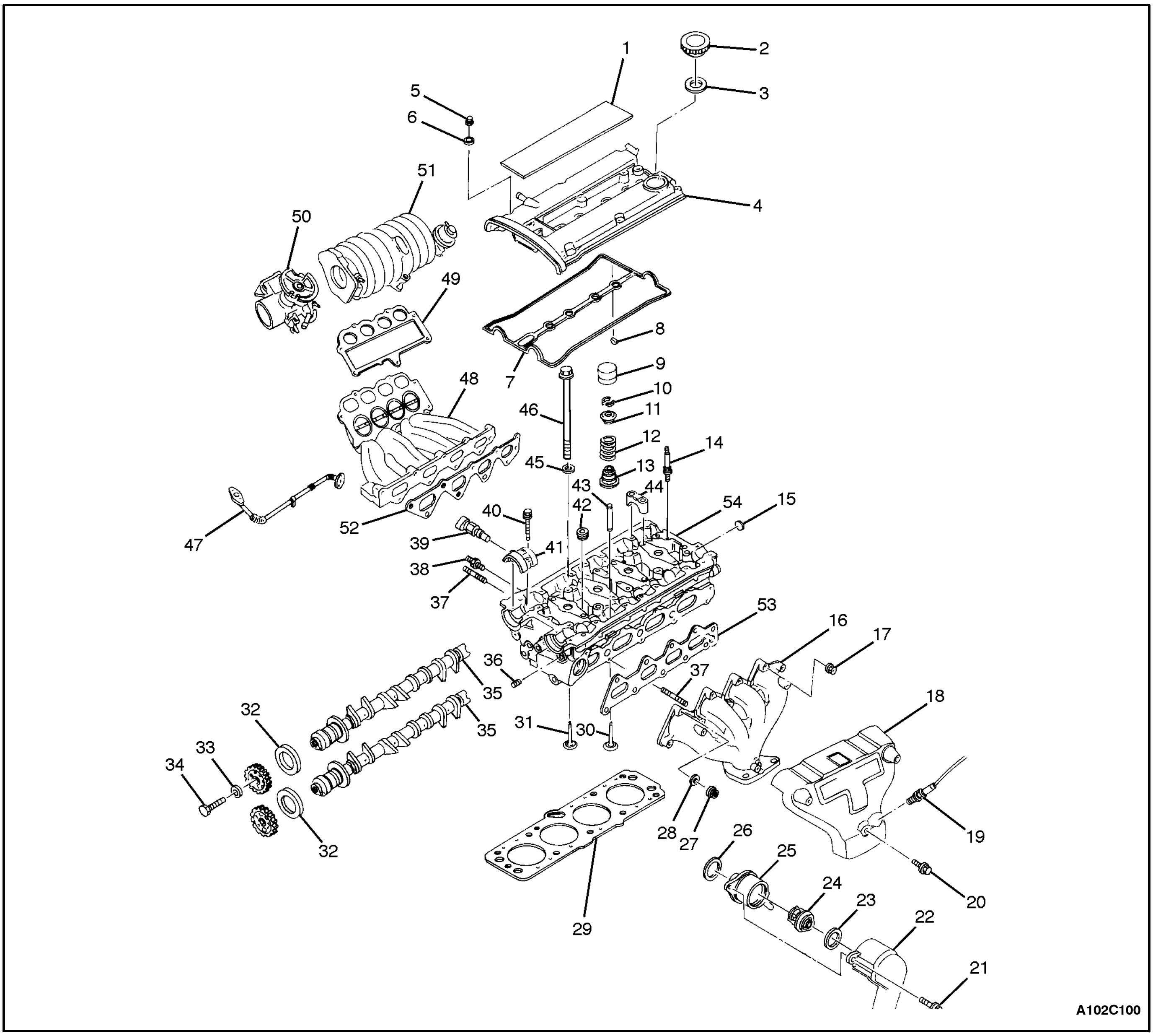
SPECIAL TOOLS TABLE (Cont'd)

 A102C154	**KM-805 Valve Guide Reamer**
 A102B159	**KM-412 Engine Overhaul Stand**
 A202B005	**KM-498-B Pressure Gauge**

 A102B160	**KM-635 Crankshaft Rear Oil Seal Installer**
 A102C155	**J-36972 Crankshaft Rear Oil Seal Installer**
 B102C044	**KM-135 Adapter**

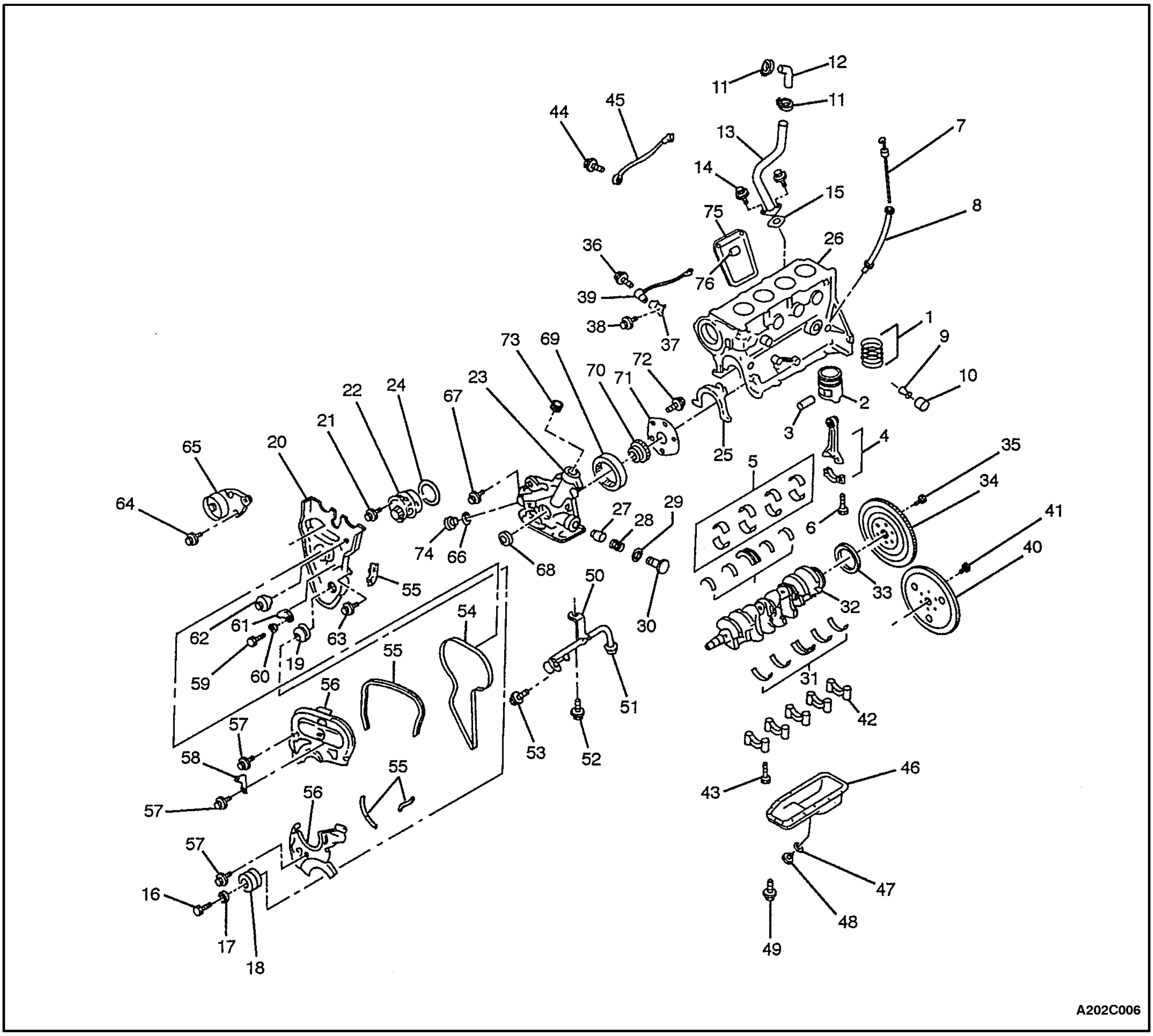
COMPONENT LOCATOR

UPPER END



1 Spark Plug Cover
2 Oil Cap
3 Oil Cap Seal
4 Valve Cover
5 Valve Cover Nut
6 Valve Cover Washer
7 Valve Cover Gasket
8 Seal
9 Hydraulic Valve Lash Adjuster
10 Valve Key
11 Valve Spring Retainer
12 Valve Spring
13 Valve Stem Oil Seal
14 Valve Cover Stud
15 Freeze Plug
16 Exhaust Manifold
17 Nut
18 Exhaust Manifold Heat Shield
19 Oxygen Sensor
20 Bolt
21 Bolt
22 Thermostat Housing
23 Thermostat Housing Seal
24 Thermostat
25 Thermostat Adapter
26 Thermostat Adapter Seal
27 Nut
28 Washer
29 Cylinder Head Gasket
30 Exhaust Valve
31 Intake Valve
32 Camshaft Seal
33 Washer
34 Camshaft Gear Bolt
35 Camshaft
36 Plug
37 Stud
38 Engine Coolant Temperature Sensor
39 Coolant Temperature Sensor
40 Bolt
41 Front Camshaft Cap
42 Plug
43 Valve Guide
44 Intermediate Camshaft Cap
45 Washer
46 Head Bolt
47 Exhaust Gas Recirculation Pipe
48 Intake Manifold
49 Plenum Gasket
50 Throttle Body
51 Plenum
52 Intake Manifold Gasket
53 Exhaust Manifold Gasket
54 Cylinder Head

LOWER END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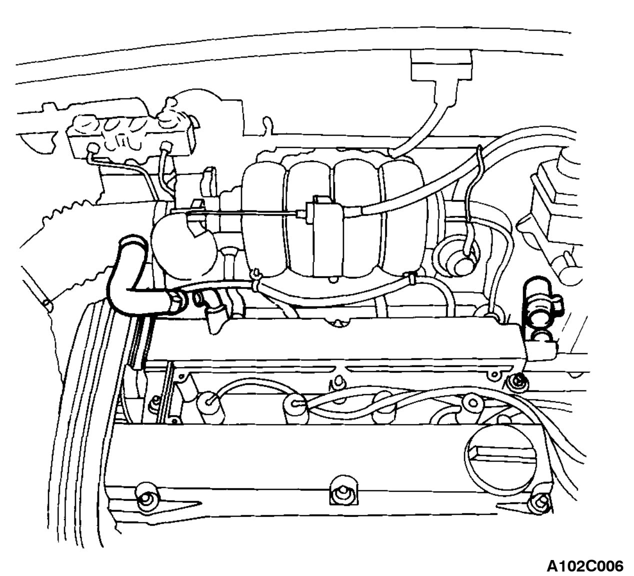
A202C006

1 Piston Ring Set
2 Piston
3 Piston Pin
4 Connecting Rod
5 Connecting Rod Bearing Set
6 Connecting Rod Bolt
7 Oil Level Gauge Stick
8 Gauge Stick Tube
9 Connecting Piece
10 Oil Filter
11 Hose Clamp
12 Engine Ventilation Hose
13 Engine Ventilation Pipe
14 Bolt
15 Oil Separator Gasket
16 Crankshaft Pulley Bolt
17 Washer
18 Crankshaft Pulley
19 Crankshaft Gear
20 Rear Timing Belt Cover
21 Bolt
22 Coolant Pump
23 Oil Pump
24 Engine Block Seal Ring
25 Oil Pump Body Gasket
26 Engine Block
27 Pressure Relief Valve Plunger
28 Spring
29 Oil Pump Seal Ring
30 Bolt Plug
31 Crankshaft Bearing Set
32 Crankshaft
33 Shaft Seal Ring
34 Flywheel (Manual Transmission)
35 Bolt (Manual Transmission)
36 Bolt
37 Bracket
38 Bolt
39 Crankshaft Position Sensor
40 Flexible Plate (Automatic Transmission)
41 Bolt (Automatic Transmission)
42 Crankshaft Main Bearing Cap
43 Bolt
44 Bolt
45 Knock Sensor
46 Oil Pan
47 Threaded Ring
48 Bolt
49 Bolt
50 Bracket
51 Oil Pickup Tube
52 Bolt
53 Bolt
54 Timing Belt
55 Cover Seal
56 Cover
57 Bolt
58 Clamp
59 Bolt
60 Washer
61 Cover Bracket
62 Idler Pulley
63 Rear Cover Bolt
64 Bolt
65 Auto Tensioner
66 Seal
67 Bolt
68 Seal
69 Gear
70 Gear
71 Cover
72 Bolt
73 Plug
74 Oil Pressure Sensor
75 Intake Manifold Support Bracket
76 EGR Solenoid



A102C006

MAINTENANCE AND REPAIR

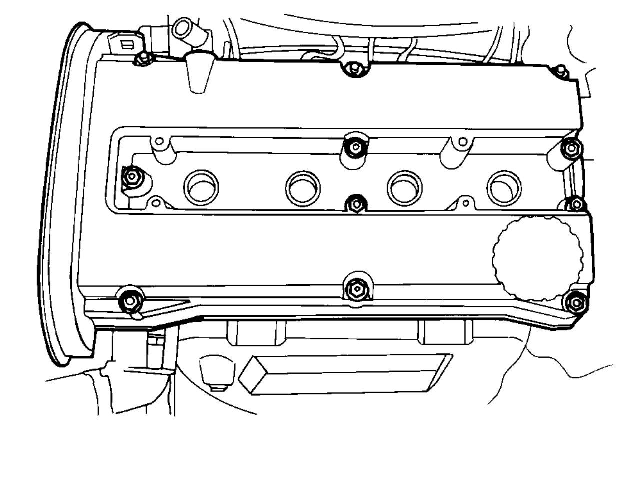
ON-VEHICLE SERVICE

VALVE COVER

(Left-Hand Drive Shown, Right-Hand Drive Similar)

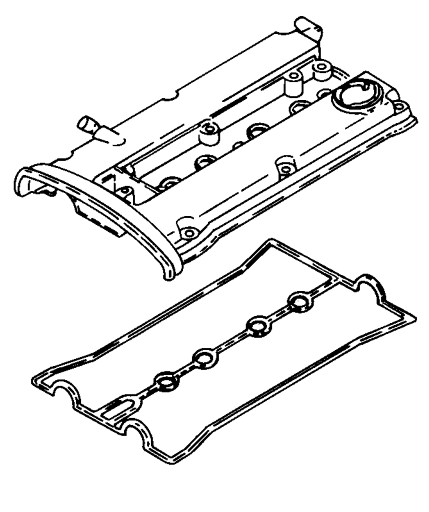
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the spark plug cover bolts and cover.
3. Disconnect the breather tube from the valve cover.
4. Disconnect the crankcase ventilation tube from the valve cover.



A102C015

5. Disconnect all of the necessary vacuum lines.
6. Disconnect the ignition wires from the spark plugs.
7. Remove the valve cover nuts.
8. Remove the valve cover washers.

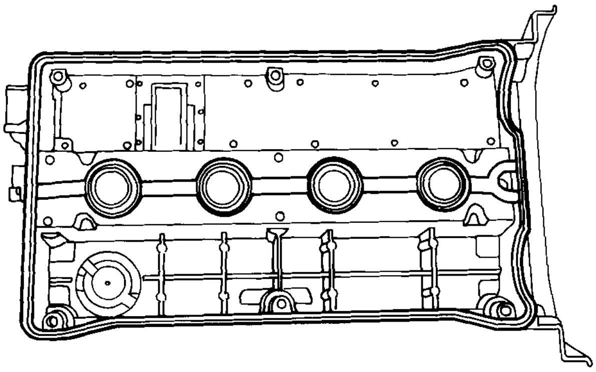


A102C160

9. Remove the valve cover.
10. Remove the valve cover gasket from the valve cover.

Installation Procedure

1. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.
2. Install the new valve cover gasket to the valve cover.
3. Install the valve cover.

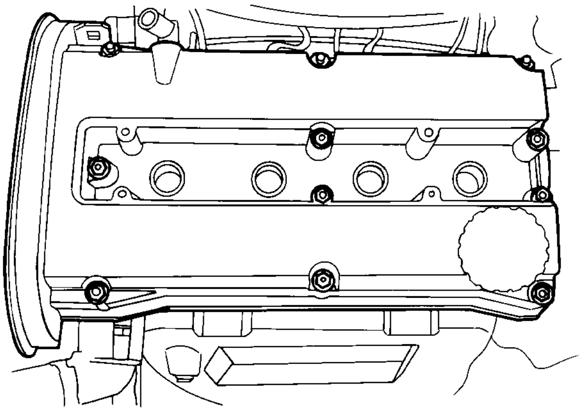


A102C001

4. Install the valve cover washers.
5. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).



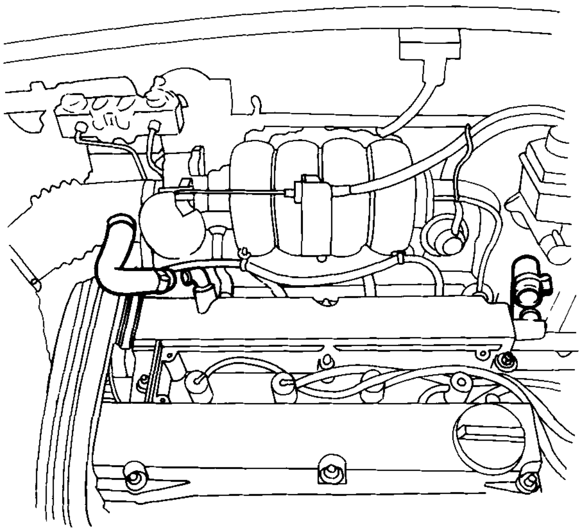
A102C015

6. Connect the ignition wires to the spark plugs.
7. Install the spark plug cover.
8. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

9. Connect all of the necessary vacuum lines.
10. Connect the crankcase ventilation tube to the valve cover.
11. Connect the breather tube to the valve cover.
12. Connect the negative battery cable.



A102C006

CYLINDER HEAD AND GASKET

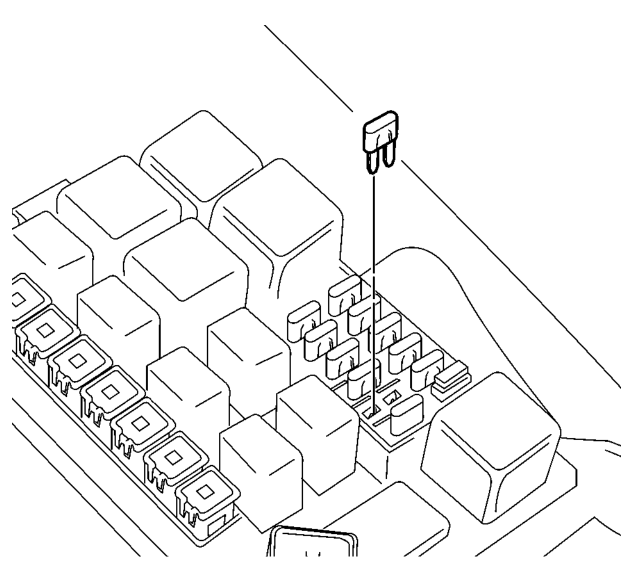
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

J-42472 Timing Belt Adjuster

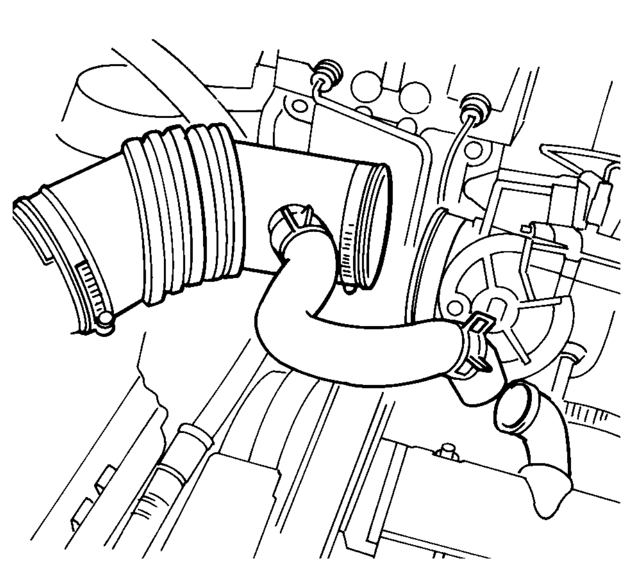
KM-470-B Angular Torque Gauge

Removal Procedure



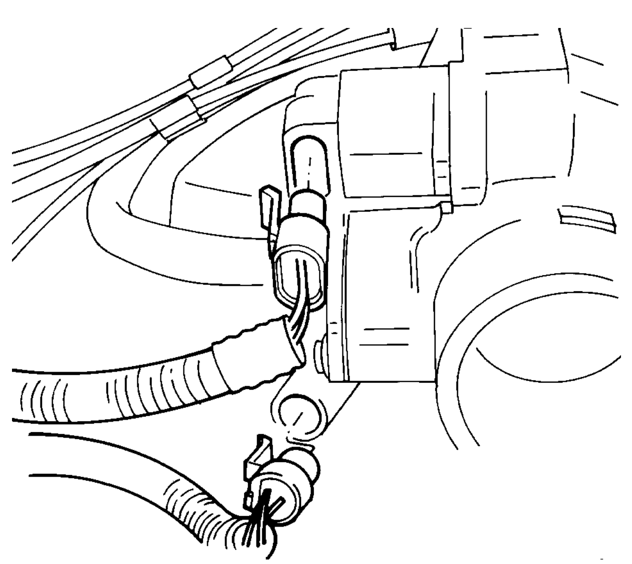
A102B012

1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the ECM ground terminal from the intake manifold.
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.



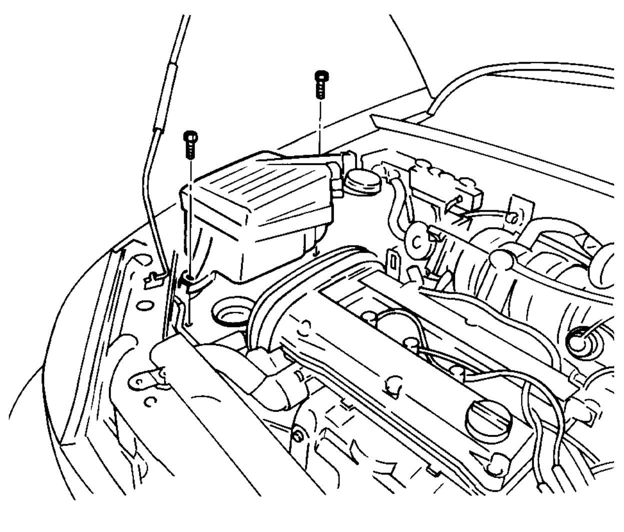
A102C002

6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the breather tube from the valve cover.
8. Disconnect the air intake tube from the throttle body.



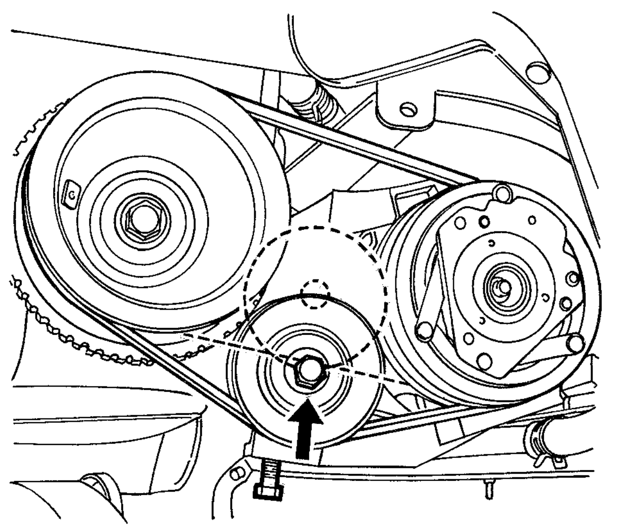
A102C016

9. Disconnect the DIS ignition coil connector.
10. Disconnect the oxygen sensor connector.
11. Disconnect the fuel injector harness connectors.
12. Disconnect the idle air control valve connector.
13. Disconnect the throttle position sensor connector.
14. Disconnect the engine coolant temperature sensor connector.
15. Disconnect the coolant temperature sensor connector.



A102C161

16. Remove the air filter housing bolts.
17. Remove the air filter housing.
18. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
19. Remove the right front splash shield.

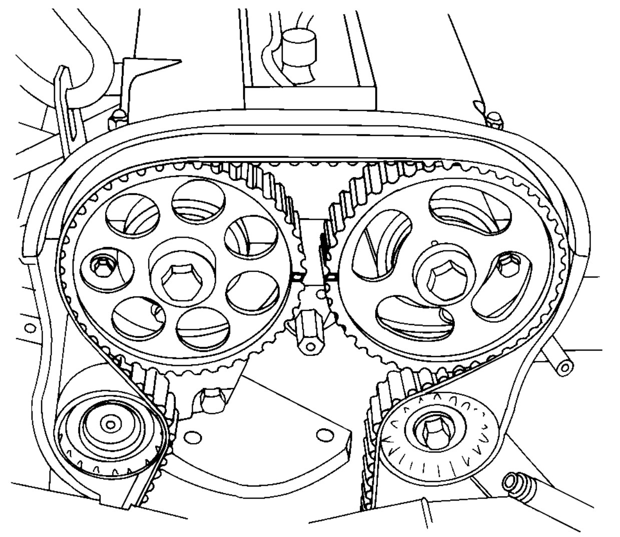


A102B006

20. Disconnect the upper radiator hose at the thermostat housing.
21. Remove the A/C compressor drive belt, if equipped.
22. Remove the alternator adjusting bolt and the alternator drive belt.
23. Remove the power steering pump pulley bolts, if equipped.

Important: Push the engine assembly toward the battery to remove the power steering pump pulley.

24. Remove the power steering pump pulley, if equipped.
25. Remove the crankshaft pulley bolt.
26. Remove the crankshaft pulley.



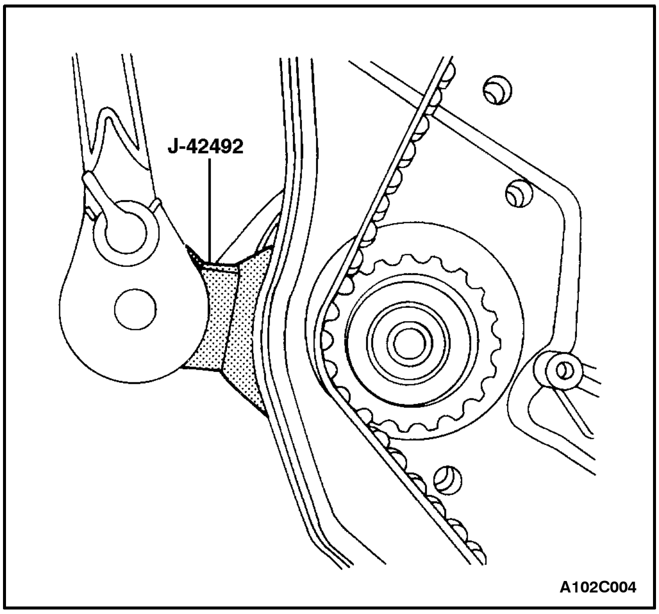
A102C003

27. Remove the upper front timing belt cover bolts.
28. Remove the upper front timing belt cover.
29. Remove the lower front timing belt cover bolts.
30. Remove the lower front timing belt cover.
31. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
32. Install the engine-mount-to-engine-mount-bracket retaining bolts and tighten the bolts to secure the engine if the power steering was removed.

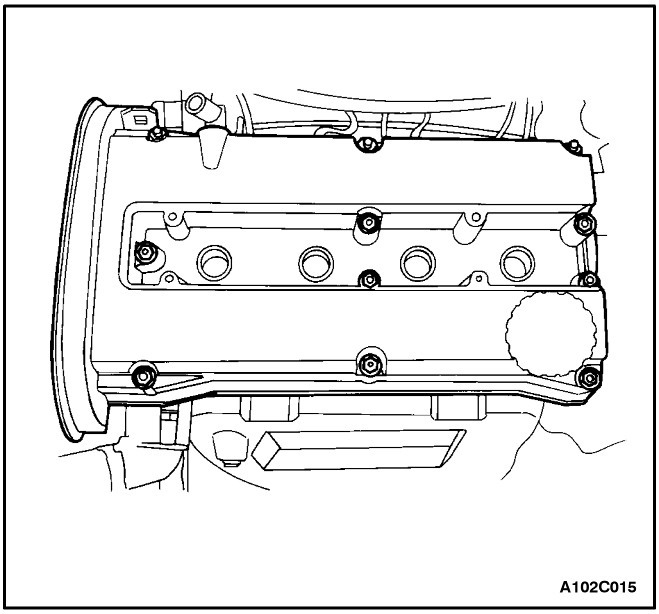
Tighten

Tighten the engine-mount-to-engine-mount-bracket retaining bolts to 60 N•m (44 lb-ft).

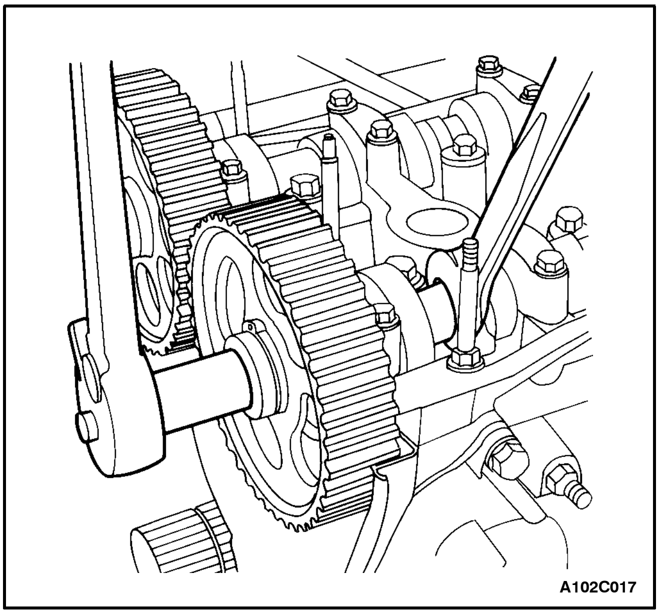
33. Align the camshaft gear timing marks.



34. Slightly loosen the coolant pump retaining bolts.
35. Rotate the coolant pump counterclockwise using the timing belt adjuster J-42492 to relieve the timing belt tension.
36. Remove the timing belt. Refer to "Timing Belt" in this section.

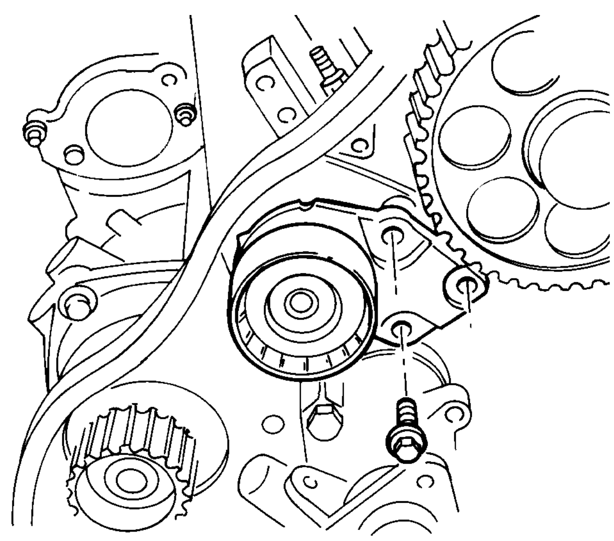


37. Disconnect the crankcase ventilation tube at the valve cover.
38. Remove the spark plug cover bolts.
39. Remove the spark plug cover.
40. Disconnect the ignition wires from the spark plugs.
41. Remove the valve cover nuts.
42. Remove the valve cover washers.
43. Remove the valve cover and the valve cover gasket.



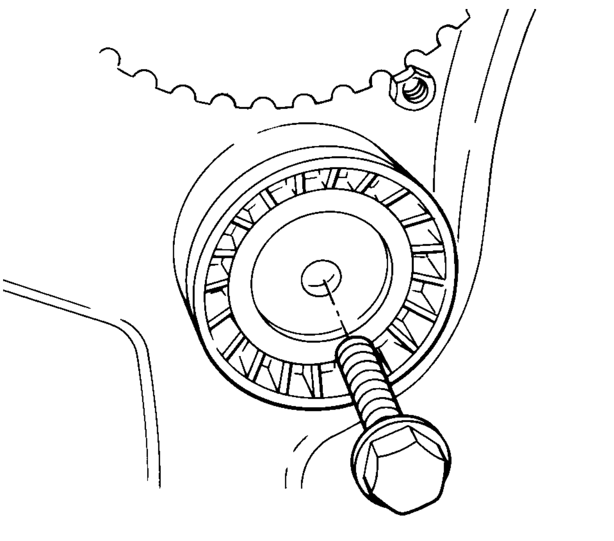
Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

44. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
45. Remove the intake camshaft gear.
46. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
47. Remove the exhaust camshaft gear.



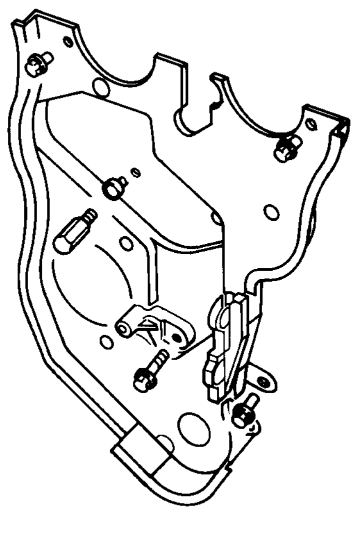
A102C018

48. Remove the timing belt automatic tensioner bolts.
49. Remove the timing belt automatic tensioner.



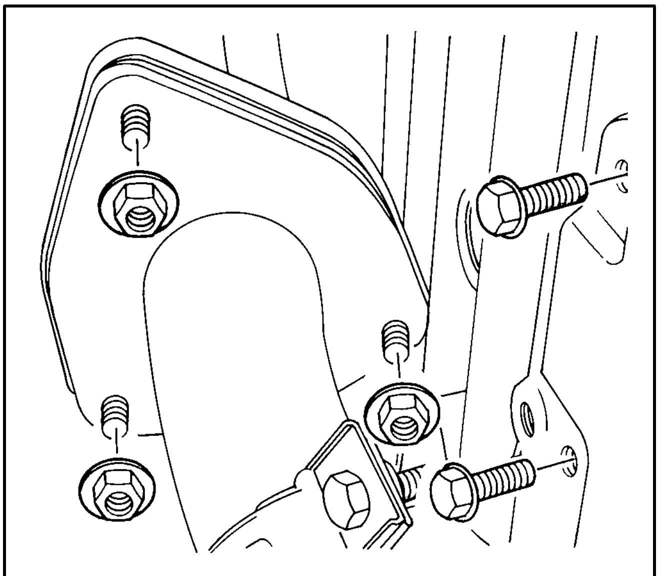
A102C019

50. Remove the timing belt idler pulley bolt.
51. Remove the timing belt idler pulley.

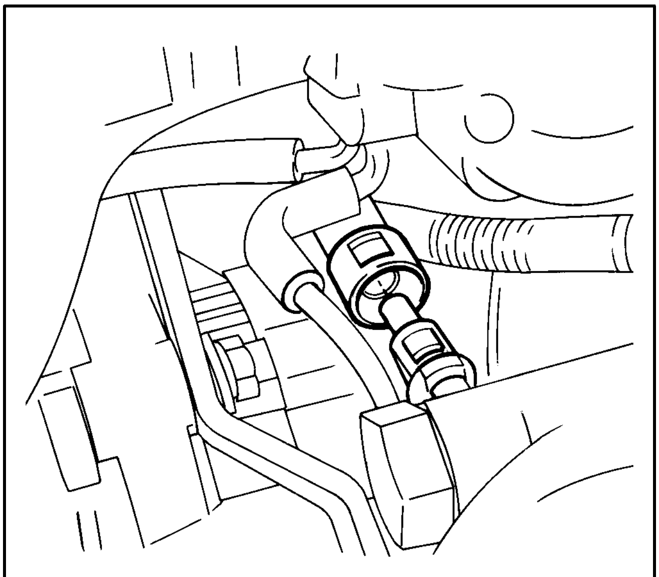


A102C005

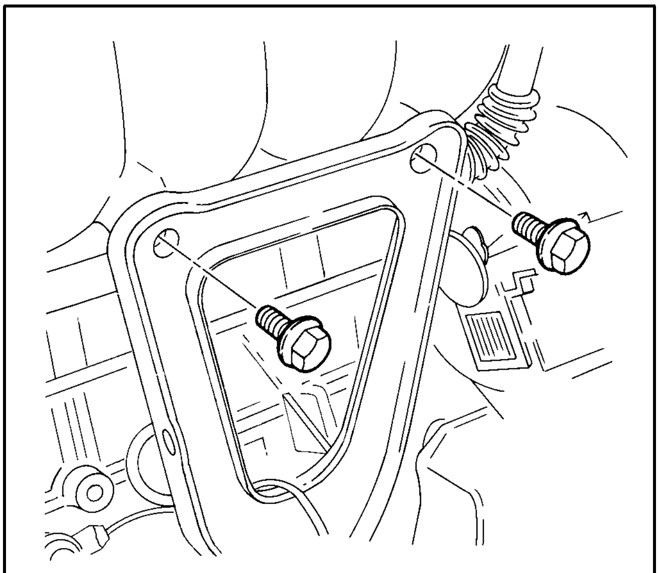
52. Remove the rear timing belt cover bolts.
53. Remove the rear timing belt cover.


A202B004

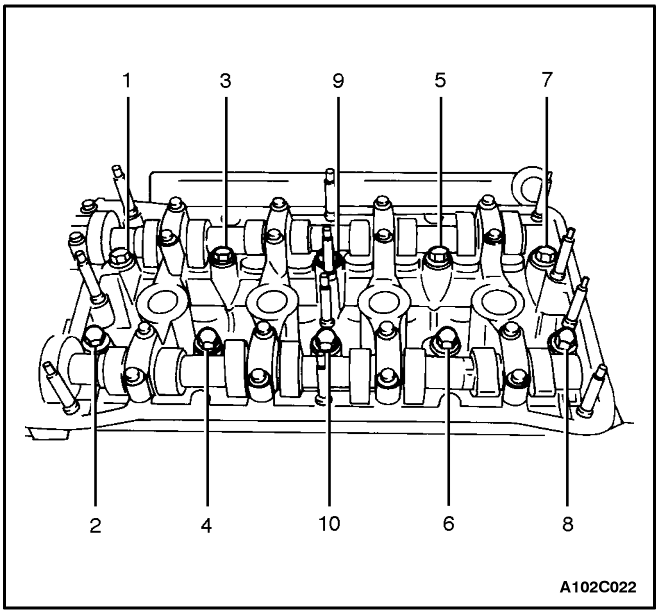
54. Remove the exhaust flex pipe retaining nuts at the exhaust manifold studs and the bolts at the bracket.
55. Disconnect all of the necessary vacuum hoses.


A102C020

56. Disconnect the fuel return line at the fuel pressure regulator.
57. Disconnect the fuel feed line at the fuel rail.
58. Remove the alternator adjusting bracket retaining bolt and the bracket.
59. Disconnect the heater inlet hose at the cylinder head.
60. Disconnect the surge tank coolant hose at the throttle body.


A102C021

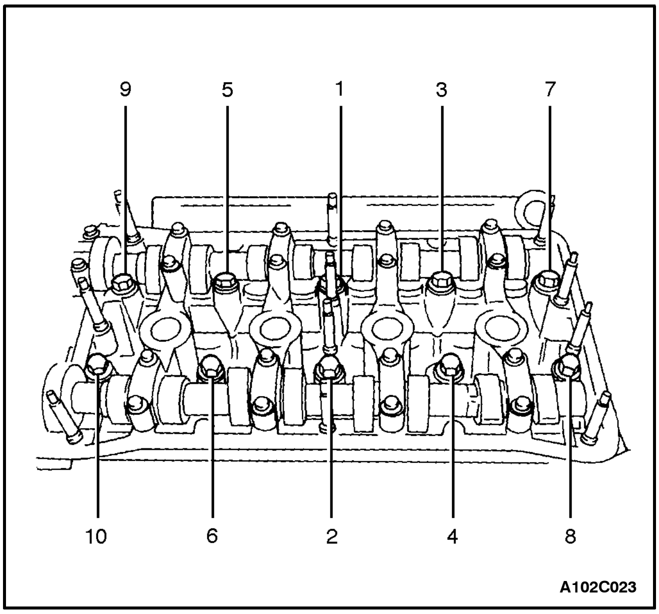
61. Remove the upper intake manifold support bracket bolts.



62. Disconnect the throttle cable at the throttle body and the intake manifold.
63. Loosen all of the cylinder head bolts gradually and in the sequence shown.
64. Remove the cylinder head bolts.
65. Remove the cylinder head with the intake manifold and the exhaust manifold attached.

Notice: Prevent any engine oil or coolant from entering the cylinders when removing the cylinder heads.

66. Remove the cylinder head gasket.

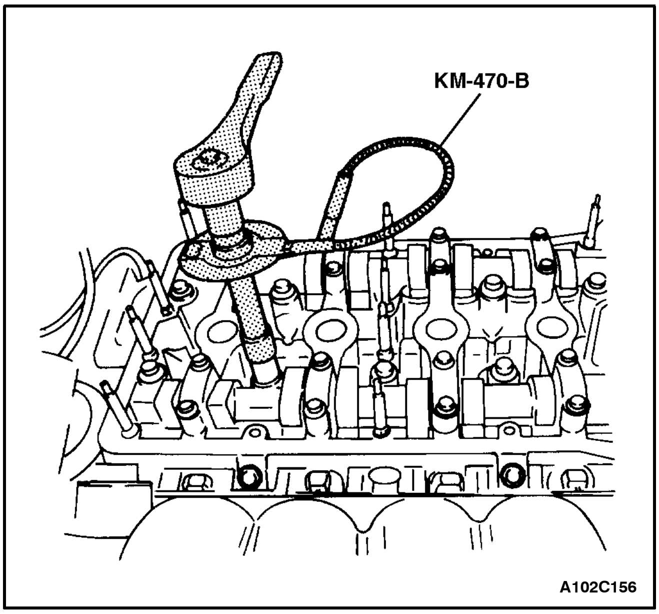


Cleaning Procedure

1. Clean the gasket surfaces of the cylinder head and the engine block.
2. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
3. Clean the cylinder head bolts.
4. Inspect the cylinder head for warpage. Refer to "Cylinder Head and Valve Train Components" in this section.

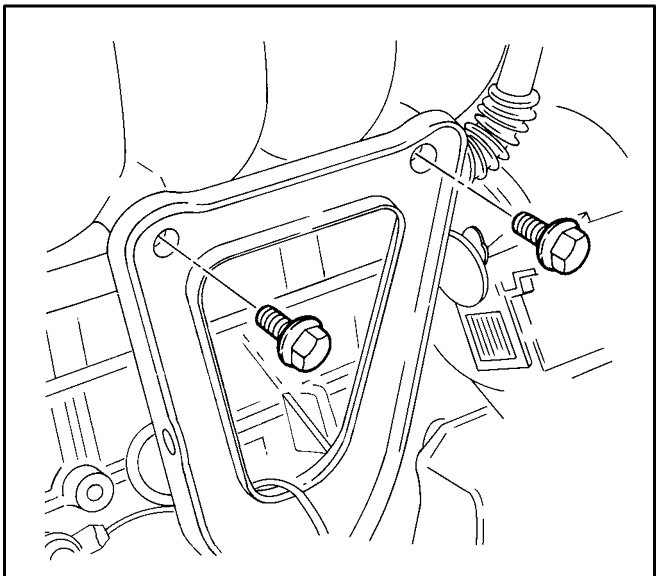
Installation Procedure

1. Install the cylinder head gasket.
2. Install the cylinder head with the intake manifold and the exhaust manifold attached.
3. Install the cylinder head bolts.
4. Tighten the cylinder head bolts gradually and in the sequence shown.



Tighten

Tighten the cylinder head bolts to 25 N•m (18 lb-ft). Adjust the bolts to 60 degrees + 60 degrees + 60 degrees + 10 degrees using the angular torque gauge KM-470-B.

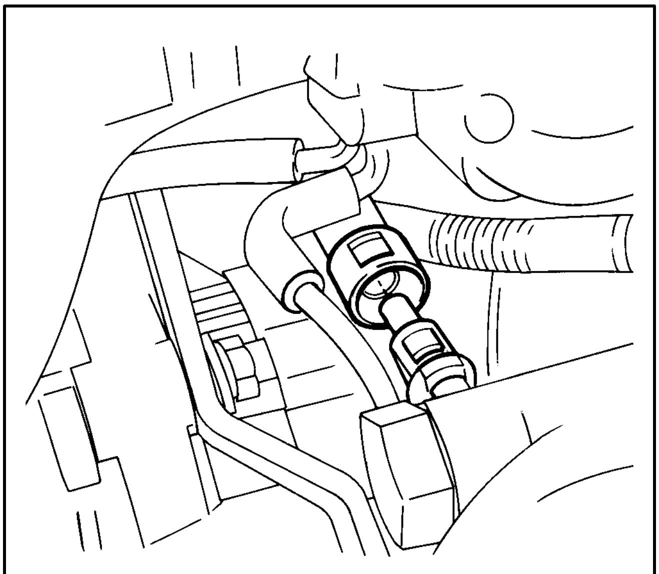

A102C021

5. Connect the throttle cable at the throttle body and the intake manifold.
6. Install the intake manifold support bracket upper bolts to the intake manifold.

Tighten

Tighten the intake manifold support bracket upper bolts to the intake manifold to 25 N•m (18 lb-ft).

7. Connect the surge tank coolant hose at the throttle body.
8. Connect the heater inlet hose to the cylinder head.

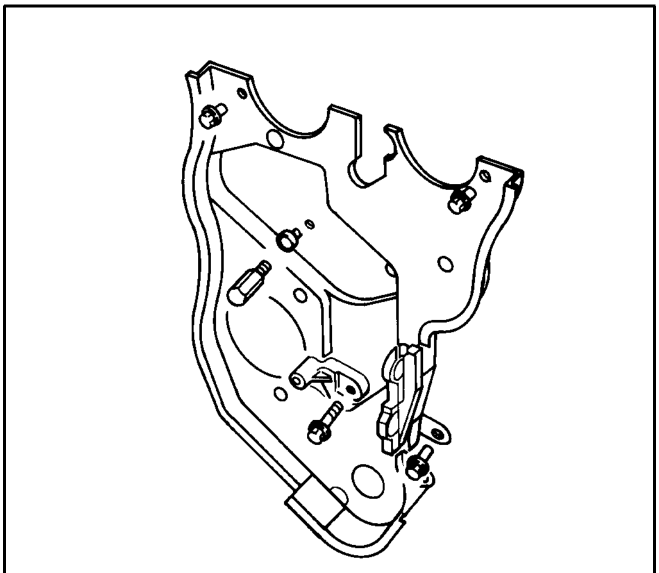

A102C020

9. Install the alternator adjusting bracket with the bolt.

Tighten

Tighten the alternator adjusting bracket retaining bolt to 20 N•m (15 lb-ft).

10. Connect the fuel feed line at the fuel rail.
11. Connect the fuel return line at the fuel rail.
12. Connect all of the necessary vacuum hoses.


A102C005

13. Install the exhaust flex pipe retaining nuts at the exhaust manifold flange and the bolts at the bracket.

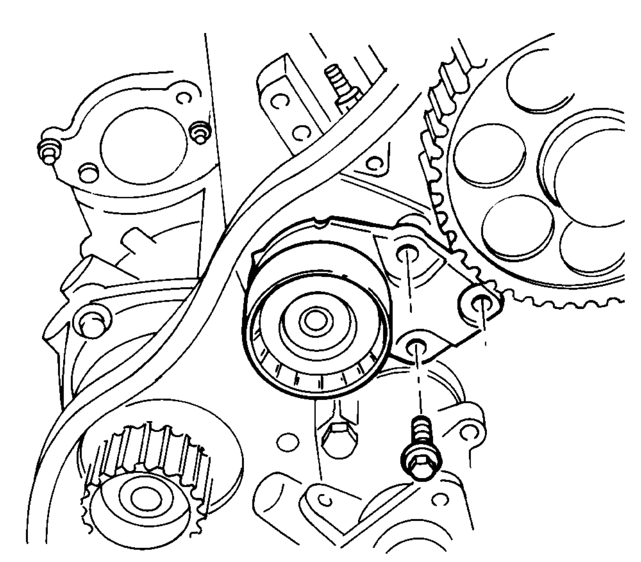
Tighten

Tighten the exhaust flex pipe retaining nuts and bracket bolts to 40 N•m (30 lb-ft).

14. Install the rear timing belt cover.
15. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 N•m (89 lb-in).



A102C018

16. Install the timing belt automatic tensioner.
17. Install the timing belt automatic tensioner bolts.

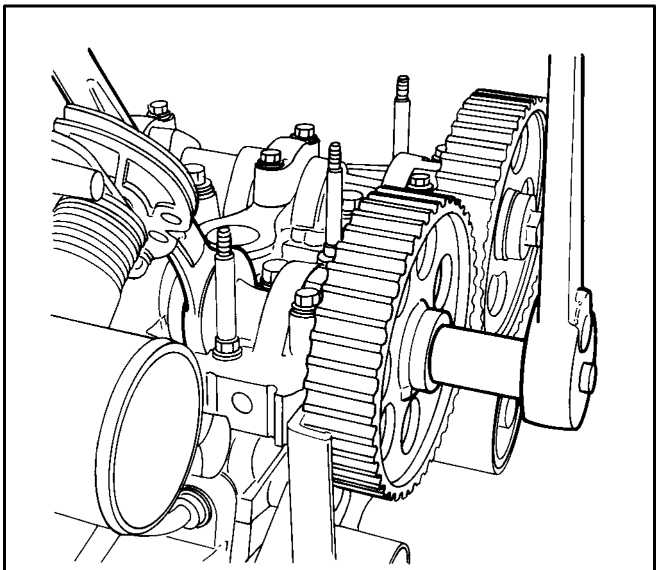
Tighten

Tighten the timing belt automatic tensioner bolts to 25 NSm (18 lb-ft).

18. Install the timing belt idler pulley.
19. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 NSm (30 lb-ft).



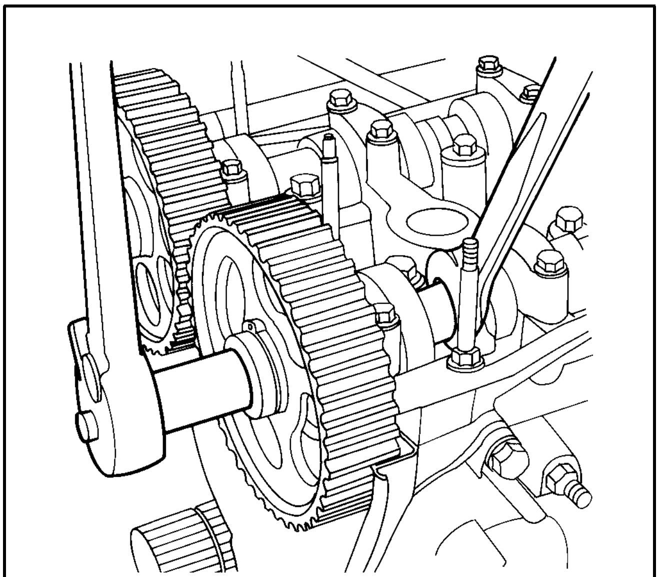
A102C024

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

20. Install the intake camshaft gear.
21. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten

Tighten the intake camshaft gear bolt to 67.5 NSm (49 lb-ft).

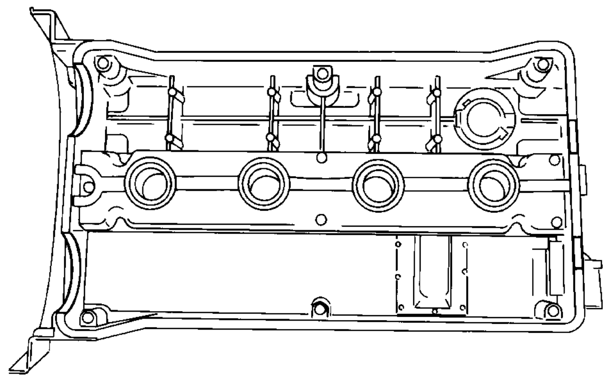


A102C017

22. Install the exhaust camshaft gear.
23. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten

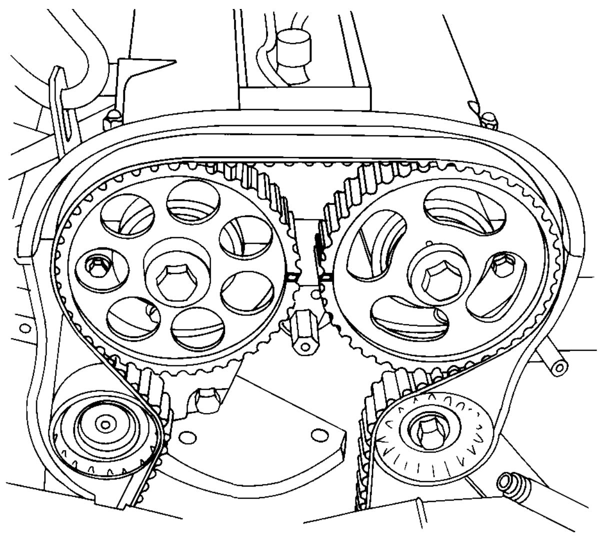
Tighten the exhaust camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C162

24. Apply a small amount of gasket sealant to the corners of the front camshaft caps, and the top of the rear valve cover to cylinder head seal.
25. Install the valve cover and the valve cover gasket.
26. Install the valve cover washers.
27. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).

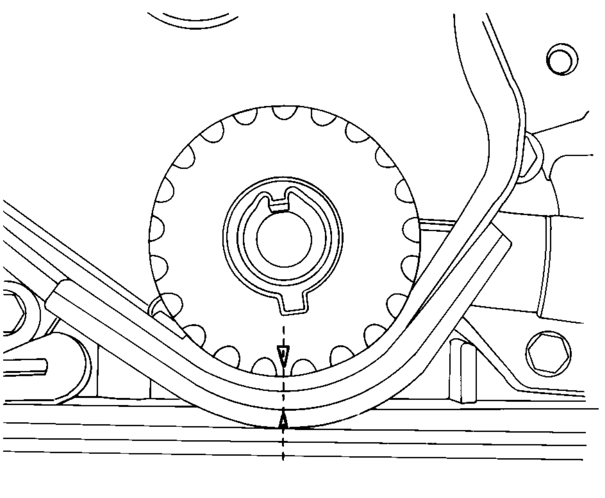

A102C003

28. Connect the ignition wires to the spark plugs.
29. Install the spark plug cover.
30. Install the spark plug cover bolts.

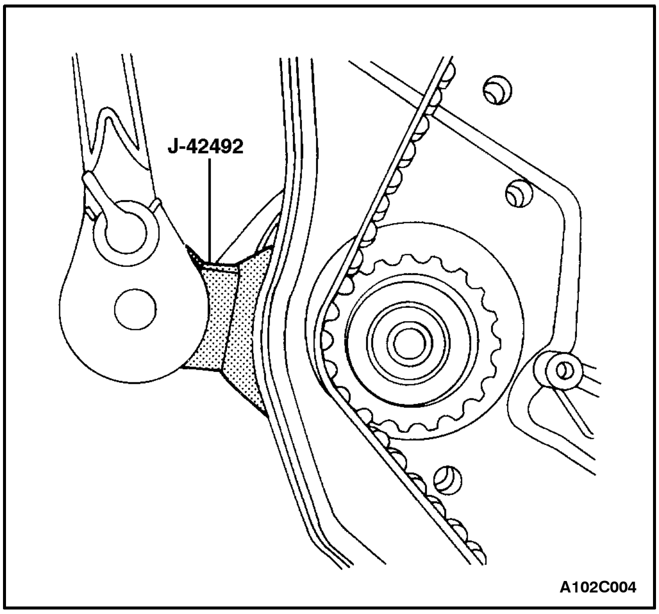
Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

31. Connect the crankcase ventilation tube to the valve cover.
32. Align the timing marks on the camshaft gears.


A102C008

33. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.

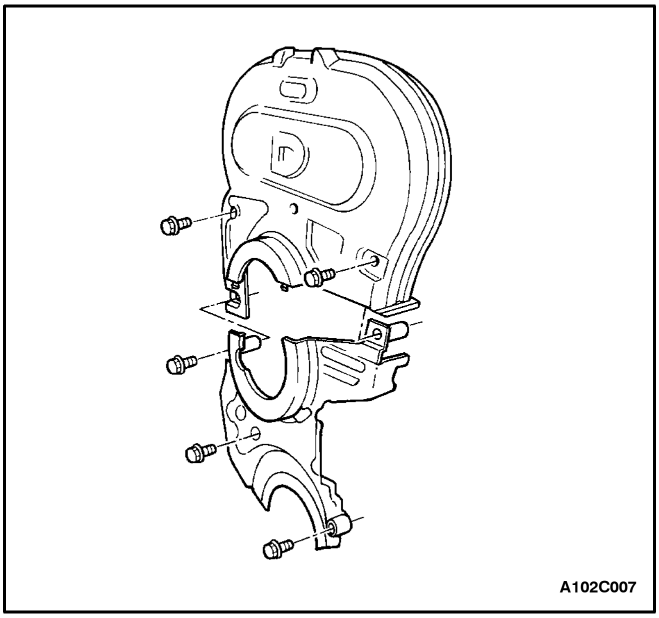


34. Install the timing belt.
35. Rotate the coolant pump clockwise using the timing belt adjuster J-42492 to apply tension to the timing belt.

Tighten

Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).

36. Check and adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.



37. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
38. Install the engine-mount-bracket-to-engine-mount retaining bolts if the power steering pump was installed.

Tighten

Tighten the engine-mount-bracket-to-engine-mount retaining bolts to 60 NSm (44 lb-ft).

39. Install the upper and lower front timing belt cover.
40. Install the upper and lower front timing belt cover bolts.

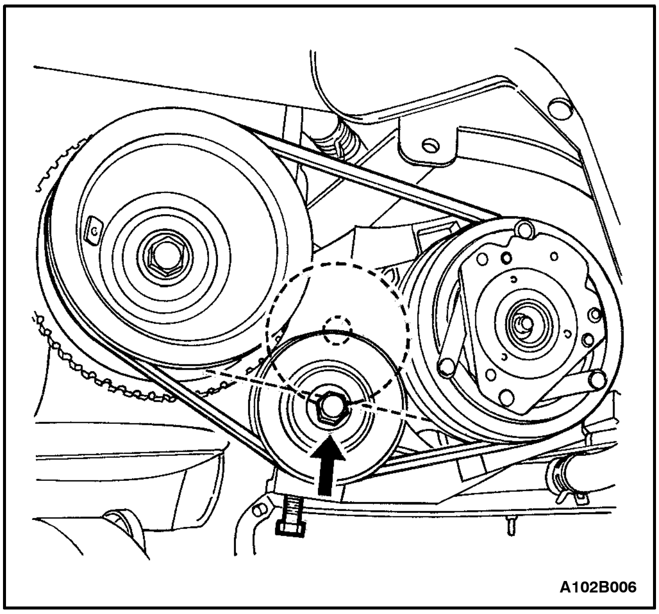
Tighten

Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).

41. Install the crankshaft pulley.
42. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.



43. Install the power steering pump pulley, if equipped.
44. Install the power steering pump pulley bolts, if equipped.

Tighten

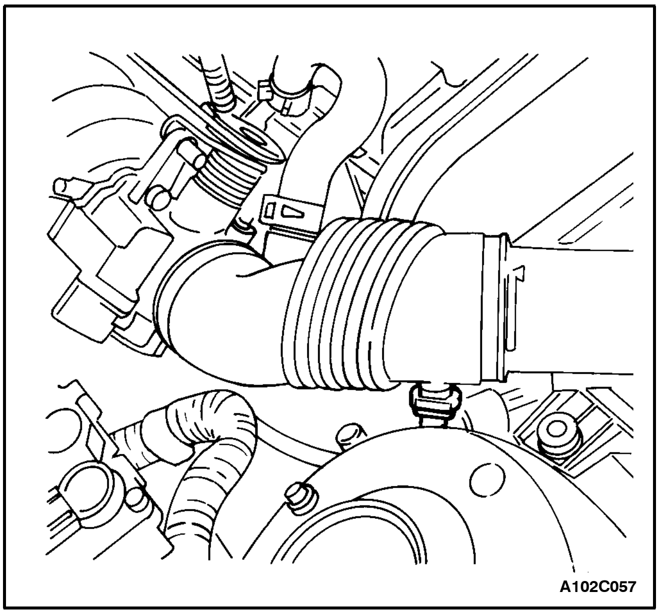
Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

45. Install the alternator drive belt.
46. Install the alternator adjusting bolt.

Tighten

Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

47. Install the A/C compressor drive belt, if equipped.
48. Connect the upper radiator hose to the thermostat housing.
49. Install the right front splash shield.
50. Install the right front wheel. Refer to Section 2E, Tires and Wheels.

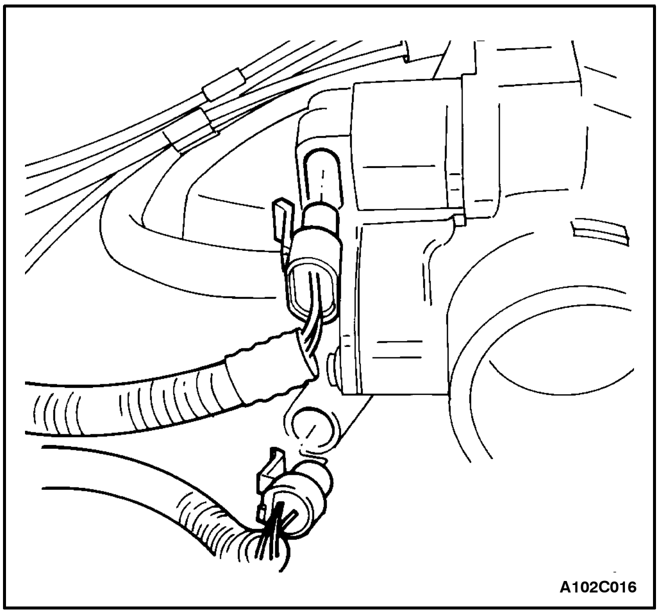


51. Install the air filter housing.
52. Install the air filter housing bolts.

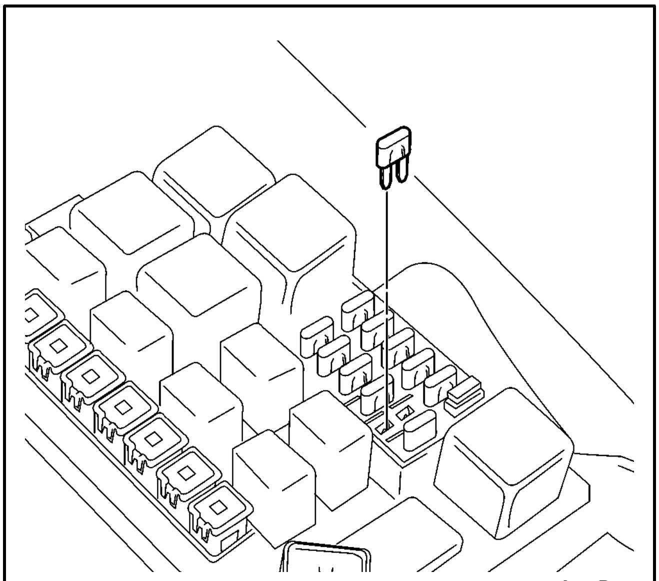
Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).

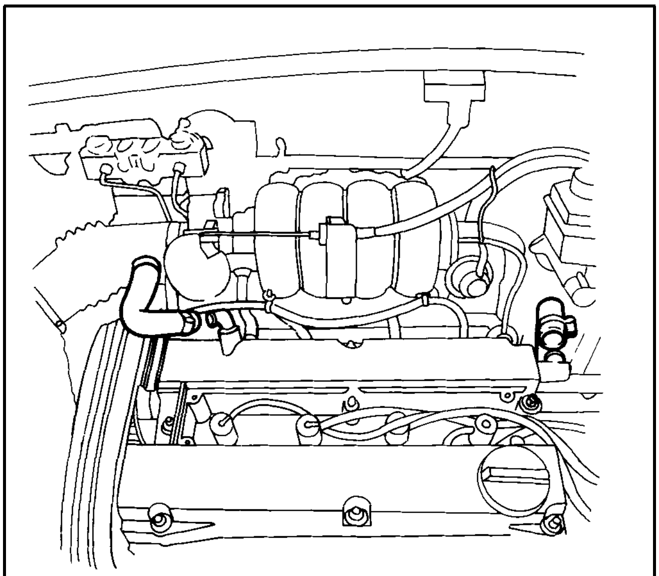
53. Connect the air intake tube to the throttle body.
54. Connect the breather tube to the valve cover.
55. Connect the manifold air temperature sensor connector.



56. Connect the coolant temperature sensor connector.
57. Connect the engine coolant temperature sensor connector.
58. Connect the idle air control valve connector.
59. Connect the throttle position sensor connector.


A102B012

60. Connect the DIS ignition coil connector.
61. Connect the fuel injector harness connectors.
62. Connect the oxygen sensor connector.
63. Connect the ECM ground terminal at the intake manifold.
64. Install the fuel pump fuse.
65. Connect the negative battery ground cable.
66. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.

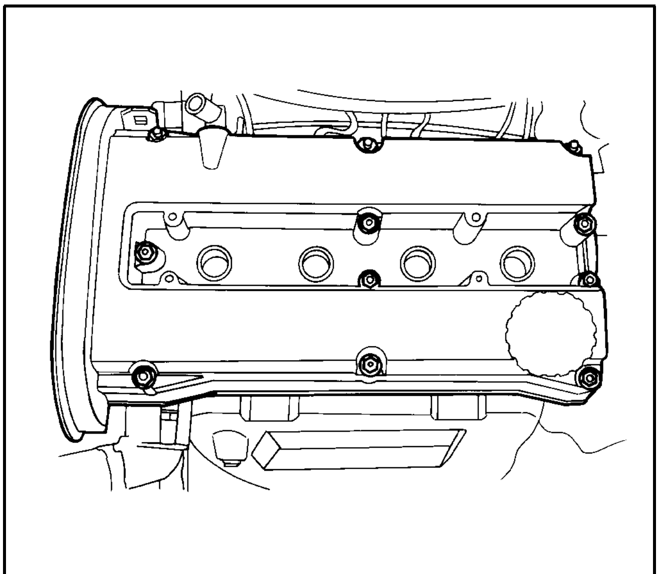

A102C006

CAMSHAFTS

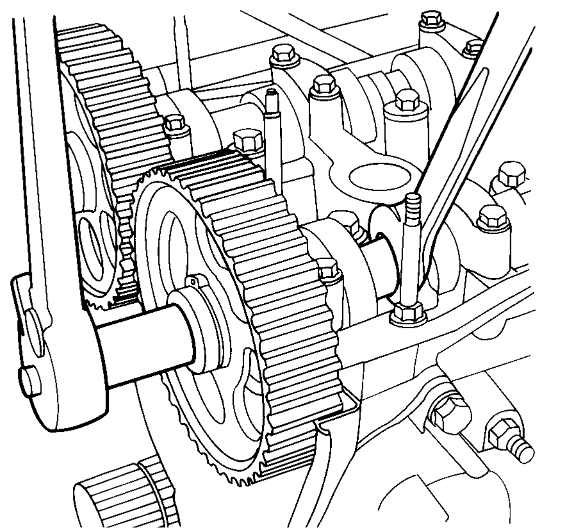
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Remove the timing belt. Refer to “Timing Belt” in this section.
2. Disconnect the air breather tube at the valve cover.
3. Disconnect the crankcase ventilation tube at the valve cover.
4. Remove the spark plug cover bolts.
5. Remove the spark plug cover.

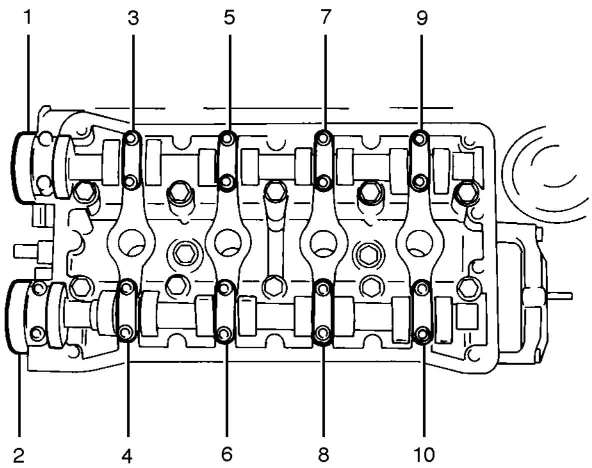

A102C015

6. Disconnect the ignition wires from the spark plugs.
7. Remove the valve cover nuts.
8. Remove the valve cover washers.
9. Remove the valve cover and the valve cover gasket.


A102C017

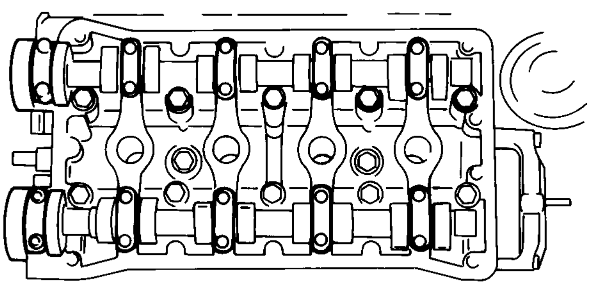
Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

10. **While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.**
11. **Remove the intake camshaft gear.**
12. **While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.**
13. **Remove the exhaust camshaft gear.**

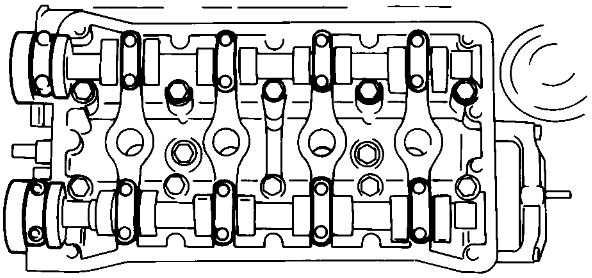


A102C026

14. **Remove the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.**


A102C025

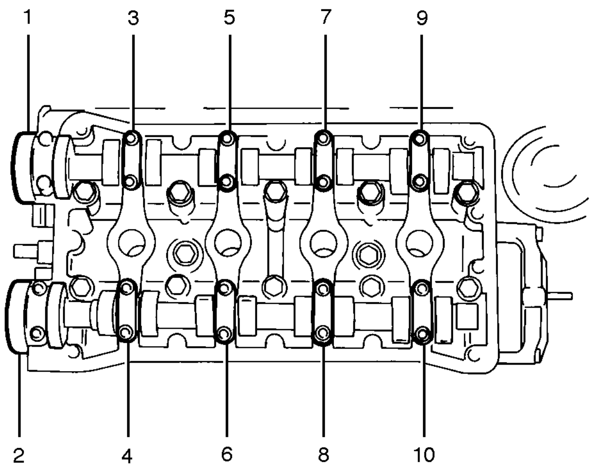
15. **Remove the intake camshaft caps. Maintain the correct positions for installation.**
16. **Remove the intake camshaft.**
17. **Remove the exhaust camshaft caps. Maintain the correct positions for installation.**
18. **Remove the exhaust camshaft.**


A102C025

Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

1. Lubricate the camshaft journals and the camshaft caps with engine oil.
2. Install the intake camshaft.
3. Install the intake camshaft caps in their original positions.
4. Install the intake camshaft cap bolts.
5. Install the exhaust camshaft.
6. Install the exhaust camshaft caps in their original positions.
7. Install the exhaust camshaft cap bolts.

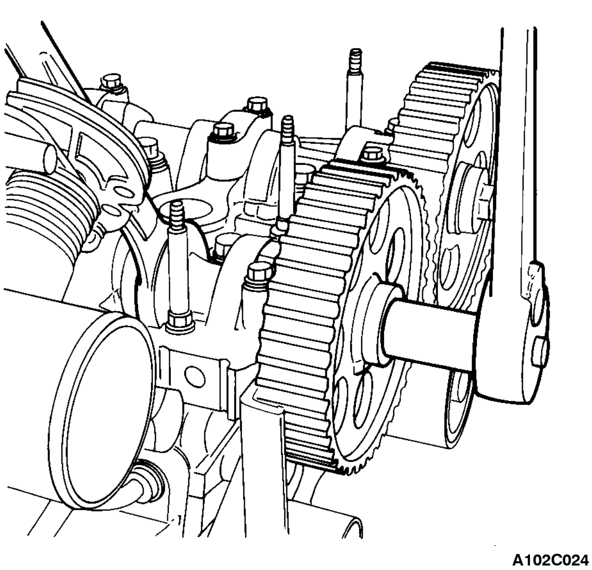


A102C026

8. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

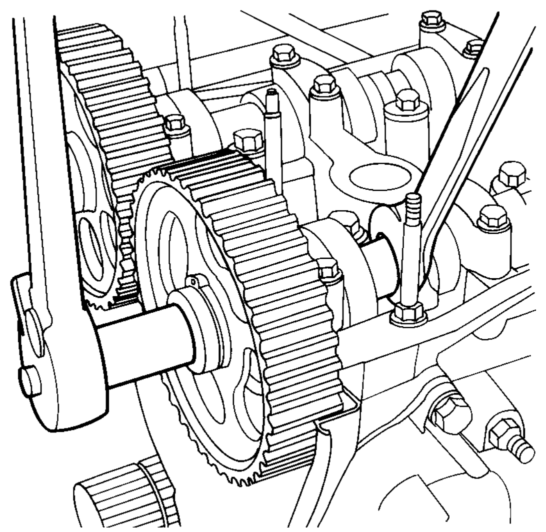
Tighten the camshaft cap bolts to 16 N•m (12 lb-ft).


A102C024

9. Measure the intake camshaft end play and the exhaust camshaft end play. Refer to "Engine Specifications" in this section.
10. Install the intake camshaft gear.
11. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten

Tighten the intake camshaft gear bolt to 67.5 N•m (49 lb-ft).

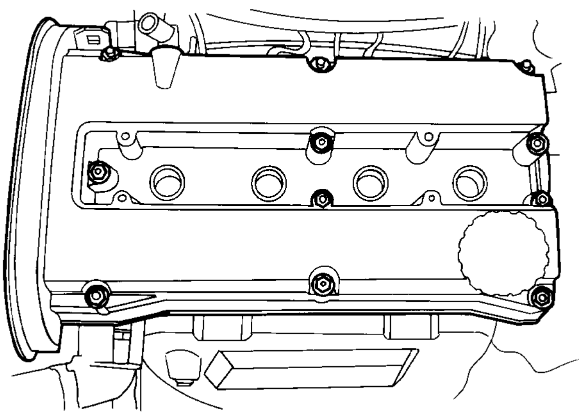


A102C017

12. Install the exhaust camshaft gear.
13. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten

Tighten the exhaust camshaft gear bolt to 67.5 N·m (49 lb-ft).

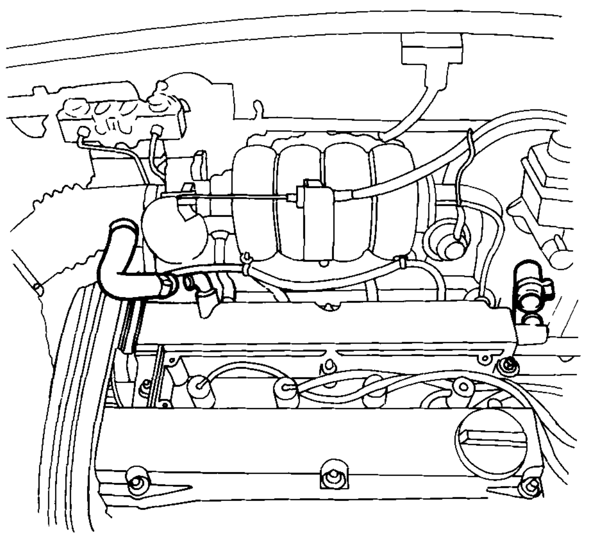


A102C015

14. Install the valve cover and the valve cover gasket.
15. Install the valve cover washers.
16. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 N·m (89 lb-in).



A102C006

17. Connect the ignition wires to the spark plugs.
18. Install the spark plug cover.
19. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 N·m (27 lb-in).

20. Connect the air breather tube to the valve cover.
21. Connect the crankcase ventilation tube to the valve cover.
22. Install the timing belt. Refer to “Timing Belt” in this section.

TIMING BELT CHECK AND ADJUST

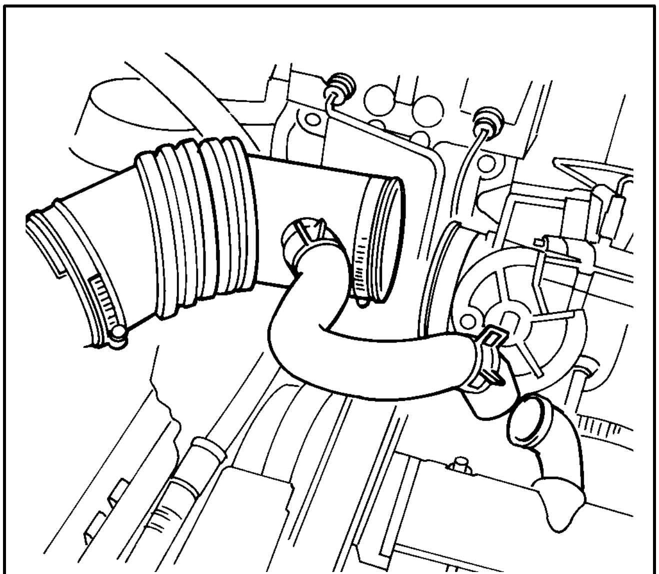
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

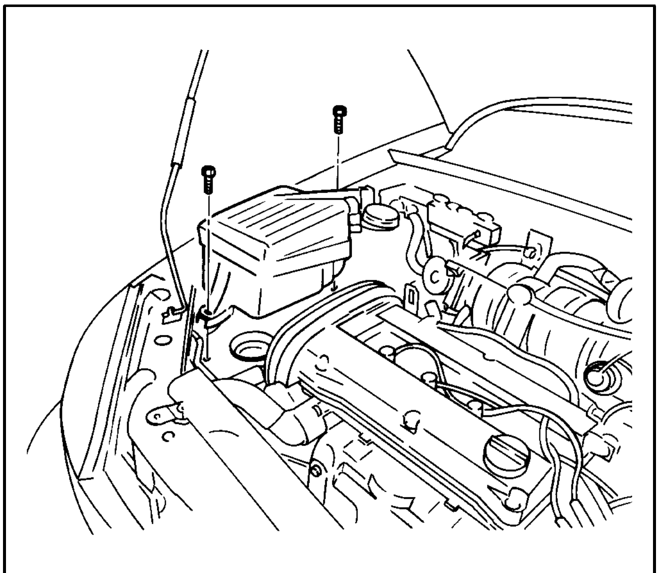
J-42492 Timing Belt Adjuster

KM-470-B Angular Torque Gauge

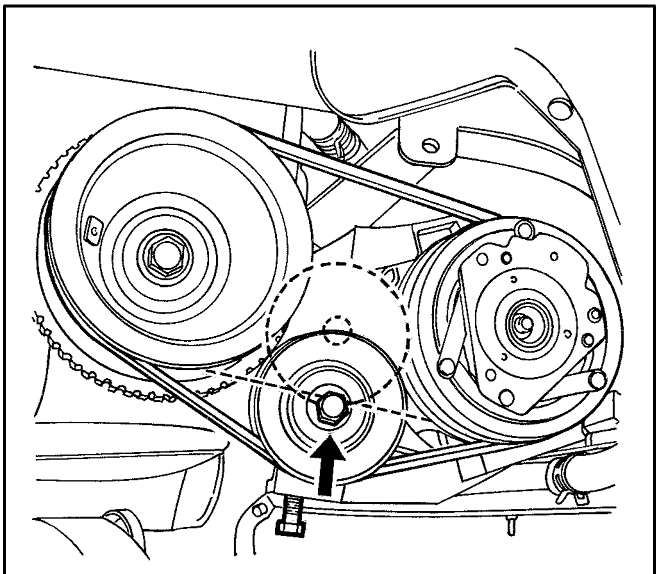
Adjustment Procedure


A102C002

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Remove the air intake tube from the throttle body.
4. Remove the breather tube from the valve cover.


A102C161

5. Remove the air filter housing bolts.
6. Remove the air filter housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front splash shield.


A102B006

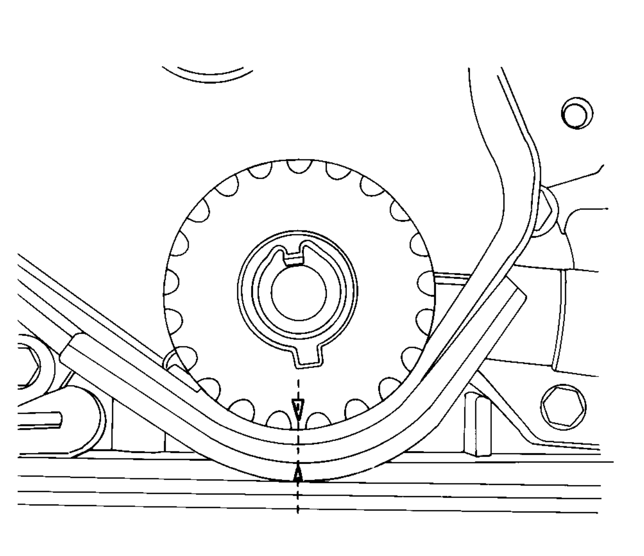
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.

Important: Push the engine assembly toward the battery to remove the power steering pump pulley.

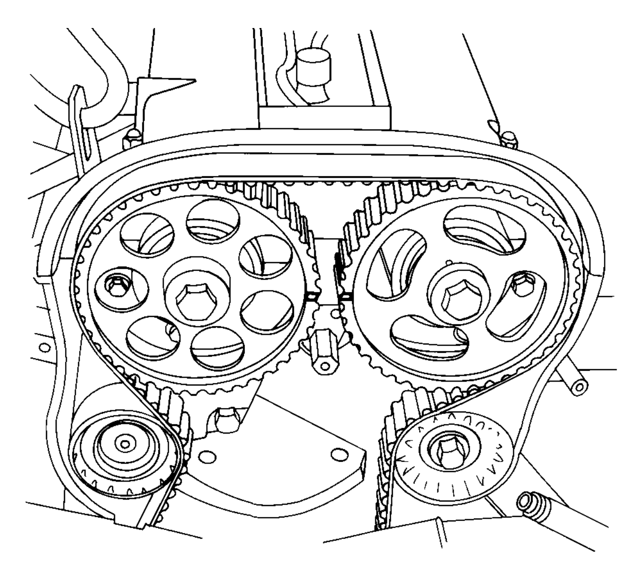
12. Remove the power steering pump pulley, if equipped.
13. Remove the crankshaft pulley bolt.
14. Remove the crankshaft pulley.


A102C007

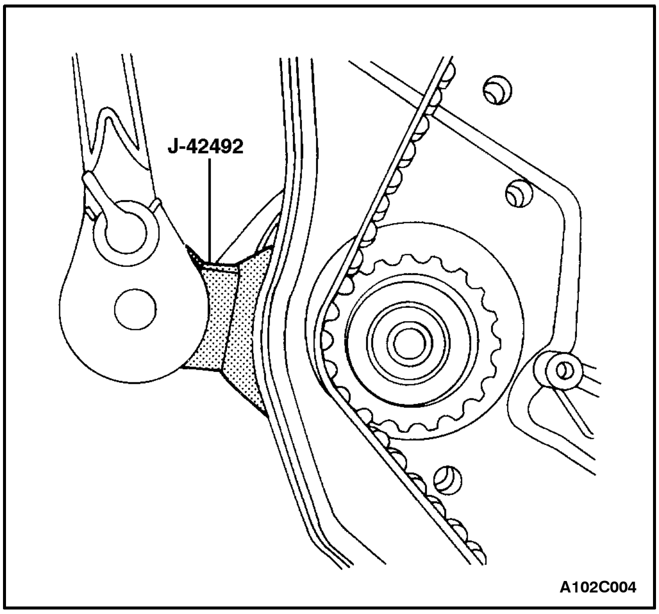
15. Remove the upper front timing belt cover bolts.
16. Remove the upper front timing belt cover.
17. Remove the lower front timing belt cover bolts.
18. Remove the lower front timing belt cover.
19. Remove the power steering pump mounting bolts, if equipped.
20. Install the crankshaft pulley bolt.


A102C008

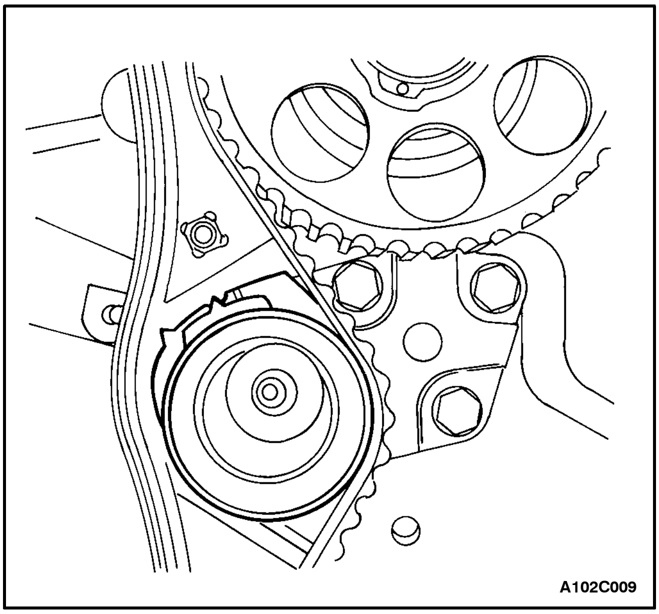
21. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
22. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.


A102C003

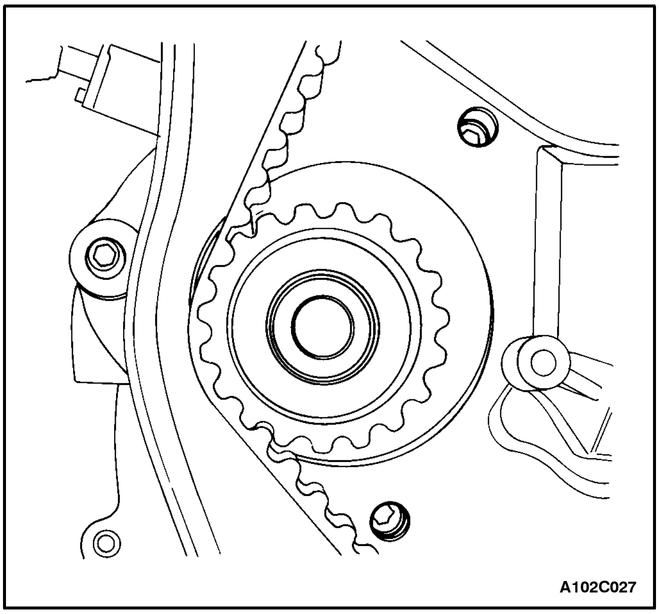
23. Align the camshaft gear timing marks.



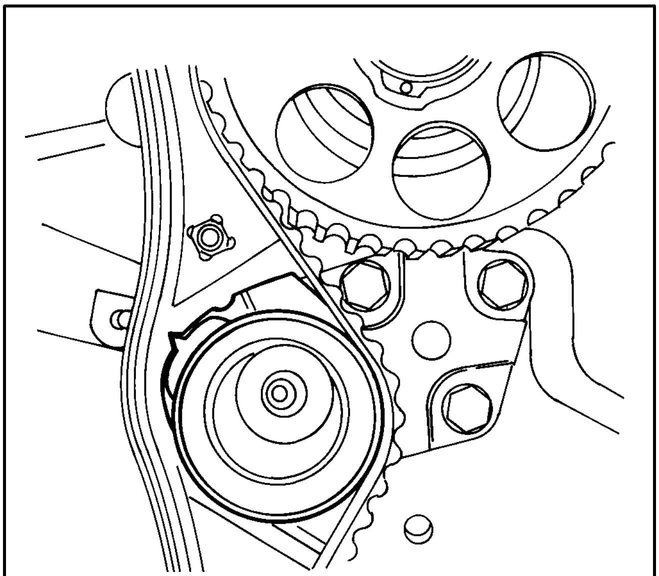
24. Slightly loosen the coolant pump retaining bolts.
25. Rotate the coolant pump clockwise using the timing belt adjuster J-42492.



26. Rotate the coolant pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned to the notch in the timing belt automatic tensioner bracket.

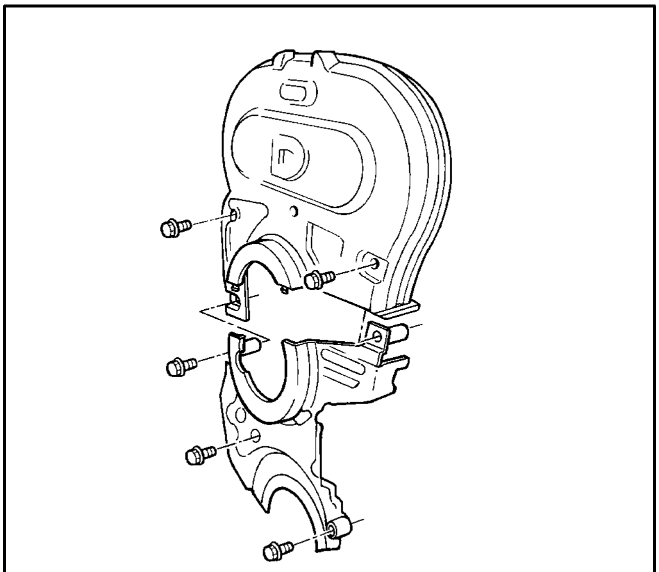


27. Tighten the coolant pump retaining bolts.
28. Rotate the crankshaft two full turns clockwise using the crankshaft pulley.
29. Loosen the coolant pump retaining bolts.



A102C010

30. Using the timing belt adjuster J-42492, rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the pointer on the timing belt automatic tensioner bracket.



A102C007

31. Tighten the coolant pump retaining bolts.

Tighten

Tighten the coolant pump retaining bolts to 10 N·m (89 lb-in).

32. Remove the crankshaft pulley bolt.
33. Install the power steering pump mounting bolts, if equipped.

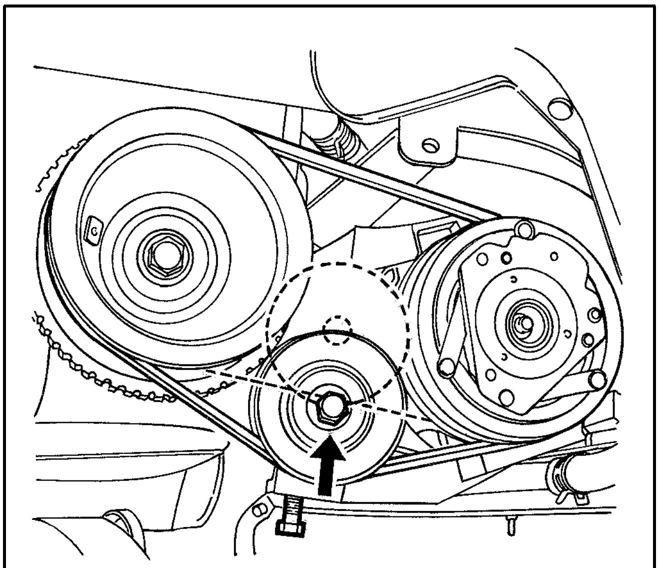
Tighten

Tighten the power steering pump mounting bolts to 25 N·m (18 lb-ft).

34. Install the upper and lower front timing belt cover.
35. Install the upper and lower front timing belt cover bolts.

Tighten

Tighten the upper and lower front timing belt cover bolts to 10 N·m (89 lb-in).



A102B006

36. Install the crankshaft pulley.
37. Install the crankshaft pulley bolt.

Tighten

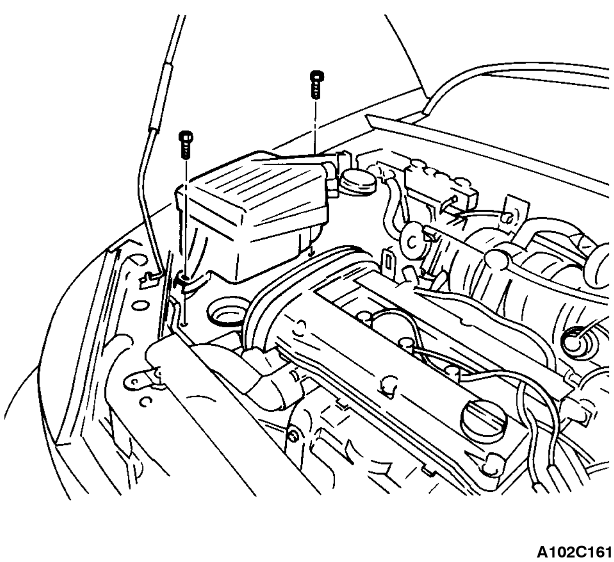
Tighten the crankshaft pulley bolt to 95 N·m (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.

38. Install the power steering pump pulley, if equipped.
39. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 N·m (18 lb-ft).

40. Install the alternator drive belt.
41. Install the A/C compressor drive belt, if equipped.

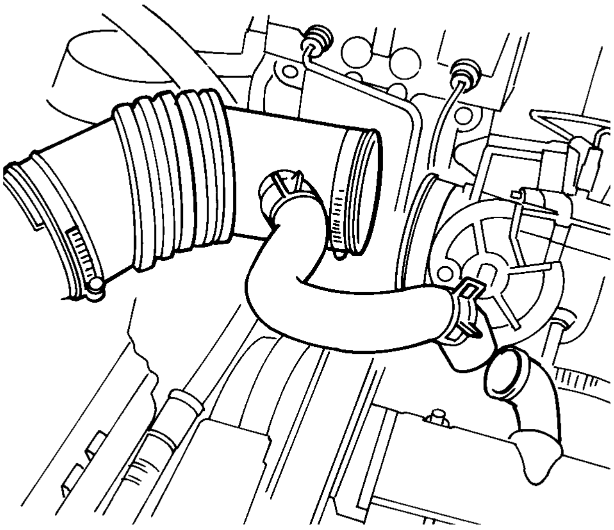


A102C161

42. Install the right front splash shield.
43. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
44. Install the air filter housing.
45. Install the air filter housing bolts.

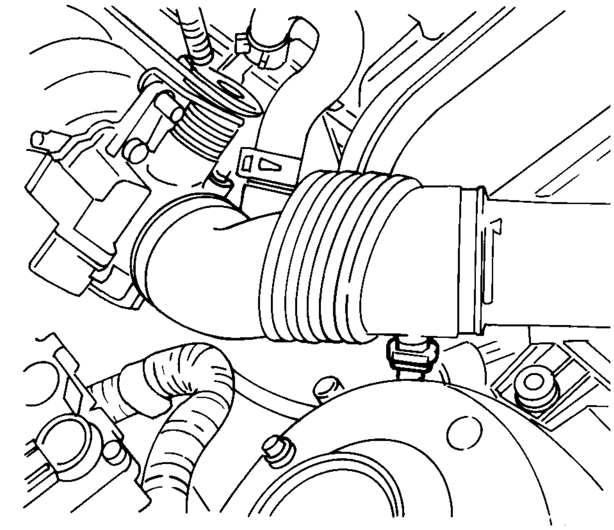
Tighten

Tighten the air filter housing bolts to 12 N•m (106 lb-in).



A102C002

46. Connect the air intake tube to the throttle body.
47. Connect the breather tube to the valve cover.
48. Connect the manifold air temperature sensor connector.
49. Connect the negative battery cable.



A102C057

TIMING BELT

(Left-Hand Drive Shown, Right-Hand Drive Similar)

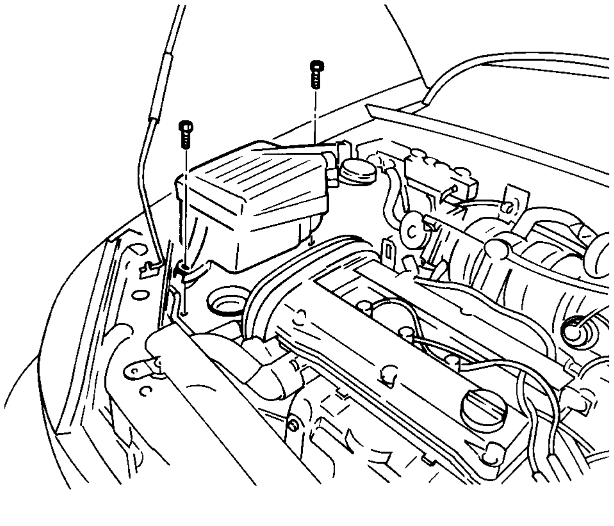
Tools Required

J-42492 Timing Belt Adjuster

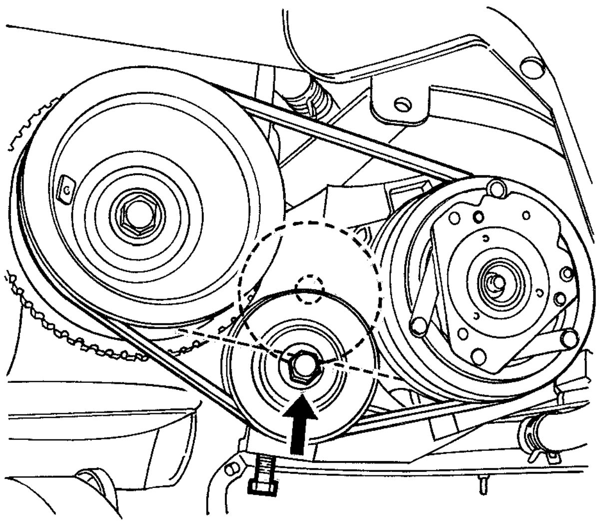
KM-470-B Angular Torque Gauge

Removal Procedure

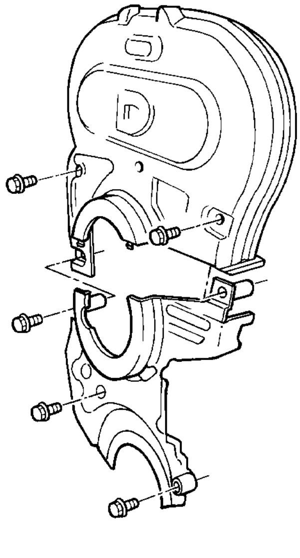
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.


A102C161

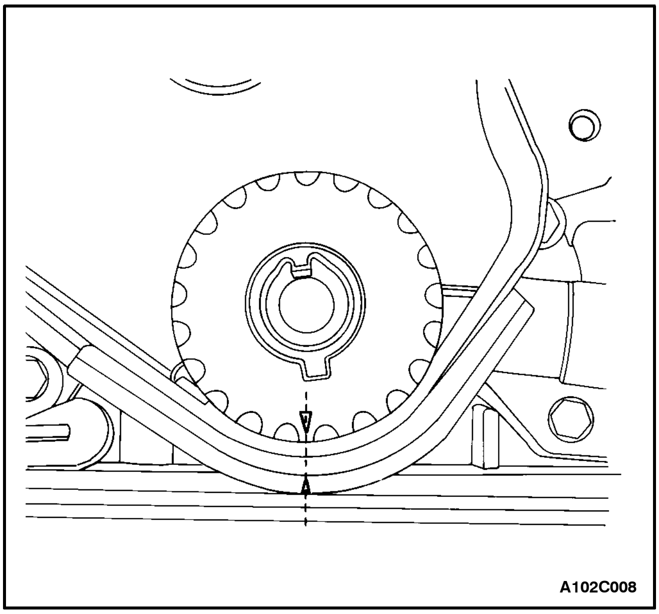
5. Remove the air filter housing bolts.
6. Remove the air filter housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front splash shield.


A102B006

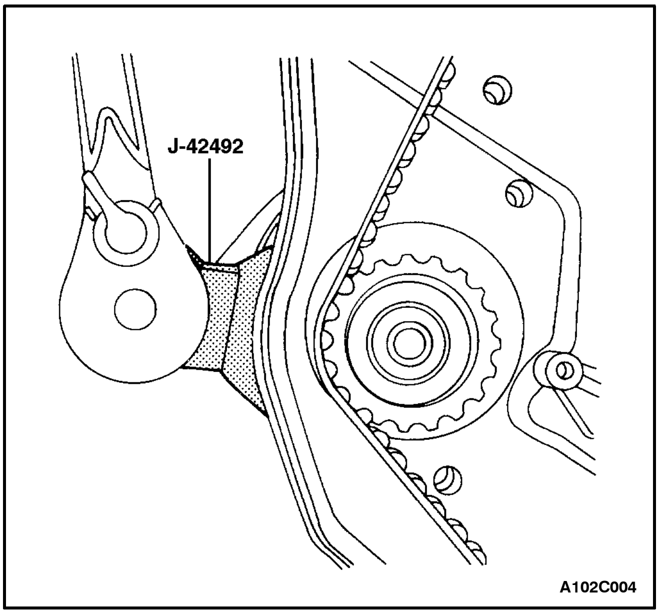
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.
12. Remove the power steering pump pulley, if equipped.
13. Remove the crankshaft pulley bolt.
14. Remove the crankshaft pulley.


A102C007

15. Remove the upper front timing belt cover bolts.
16. Remove the upper front timing belt cover.
17. Remove the lower front timing belt cover bolts.
18. Remove the lower front timing belt cover.
19. Remove the power steering pump mounting bolts, if equipped.
20. Install the crankshaft pulley bolt.

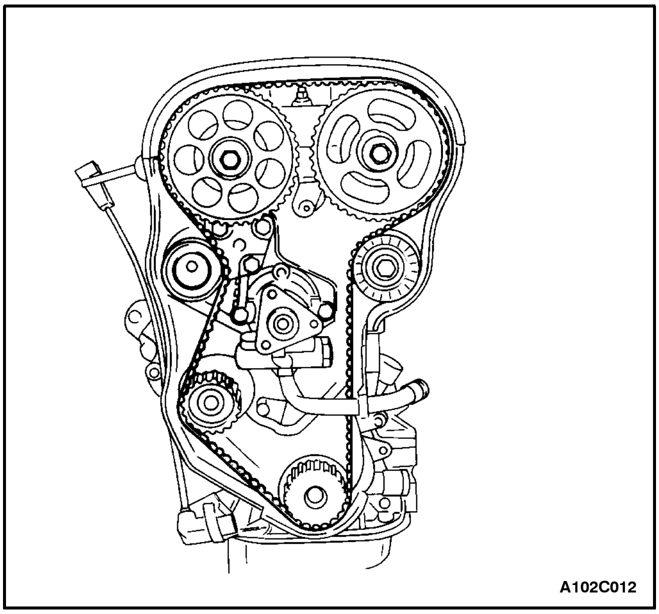


21. Using the crankshaft pulley bolt, rotate the crankshaft clockwise until the timing mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.



22. Slightly loosen the coolant pump retaining bolts.

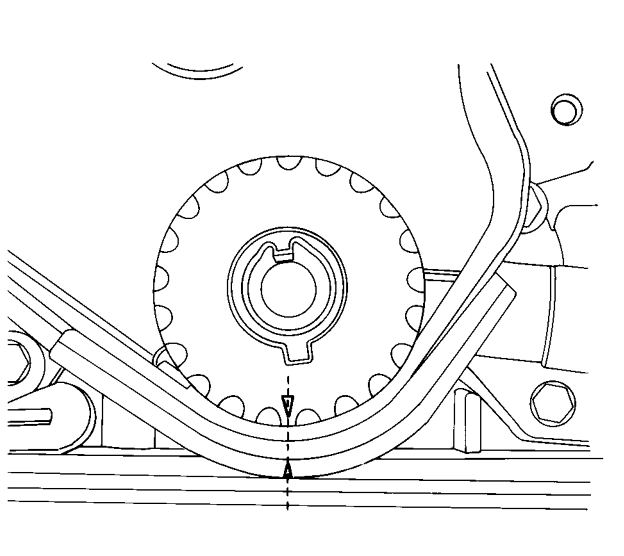
23. Using the timing belt adjuster J-42492, rotate the coolant pump counterclockwise to release the tension on the timing belt.



Important: Remove the timing belt behind the power steering pump.

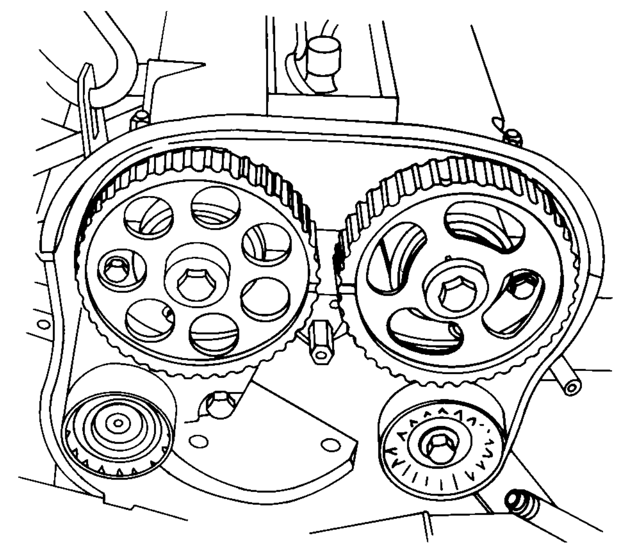
24. Remove the timing belt.

Installation Procedure



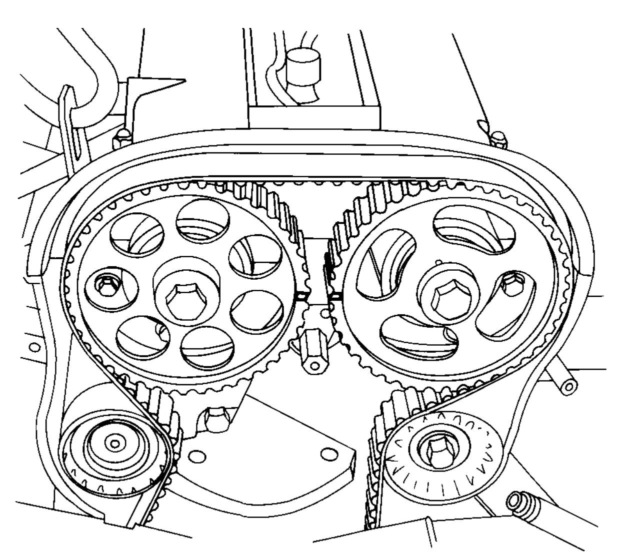
A102C008

1. Align the timing mark on the crankshaft gear to the notch on the bottom of the rear timing belt cover.



A102C163

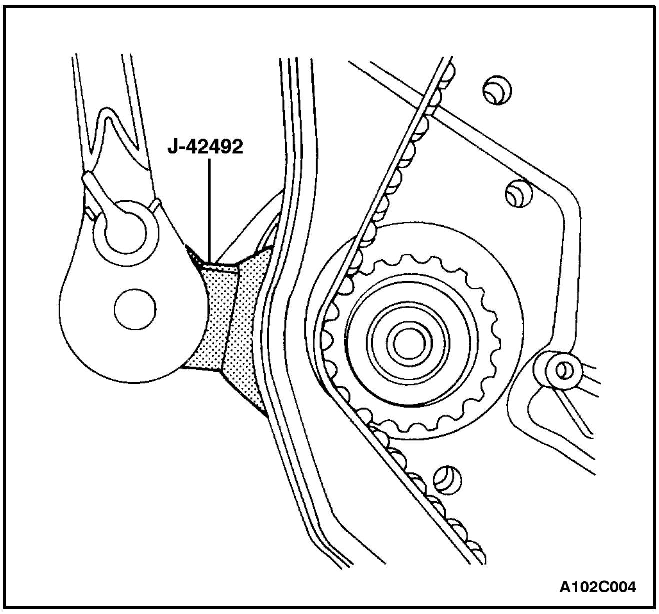
2. Align the timing marks on the camshaft gears.



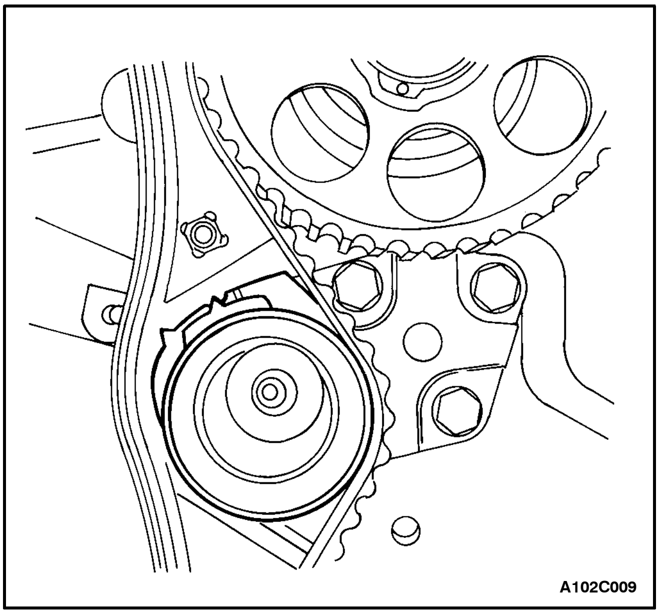
A102C003

Important: Insert the timing belt behind the power steering pump.

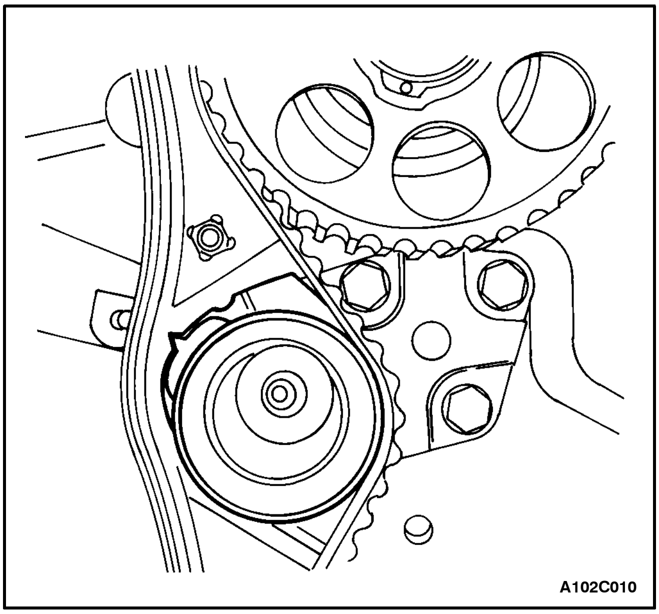
3. Install the timing belt.



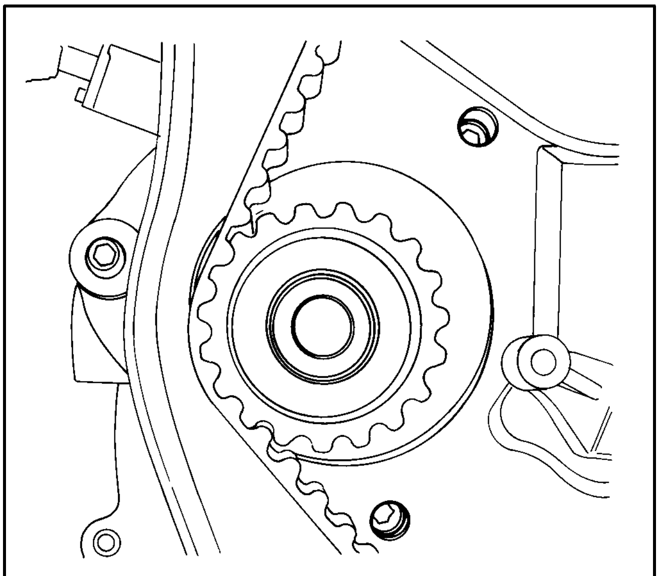
4. Rotate the coolant pump clockwise using the timing belt adjuster J-42492.



5. Rotate the coolant pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned to the notch in the timing belt automatic tensioner bracket.



6. Tighten the coolant pump retaining bolts.
7. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
8. Loosen the coolant pump retaining bolts.
9. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the pointer on the timing belt automatic tensioner bracket.

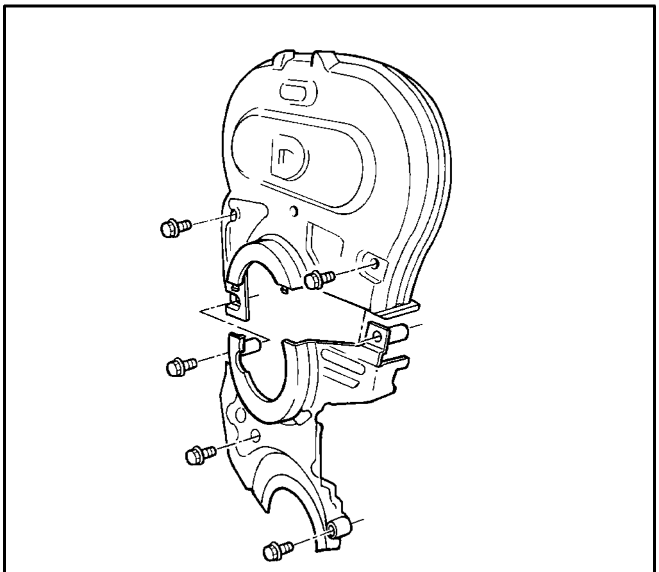


A102C027

10. Tighten the coolant pump retaining bolts.

Tighten

Tighten the coolant pump retaining bolts to 10 N•m (89 lb-in).



A102C007

11. Remove the crankshaft pulley bolt.
12. Install the power steering pump mounting bolts, if equipped.

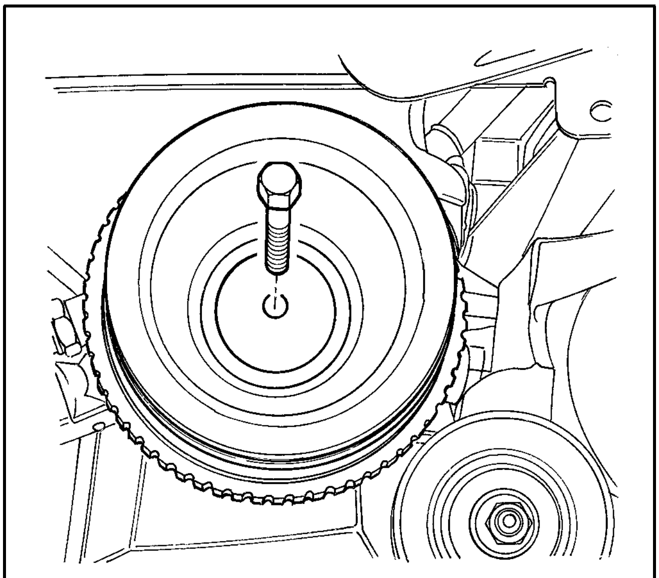
Tighten

Tighten the power steering mounting bolts to 25 N•m (18 lb-ft).

13. Install the upper and lower front timing belt cover.
14. Install the upper and lower front timing belt cover bolts.

Tighten

Tighten the upper and lower front timing belt cover bolts to 10 N•m (89 lb-in).

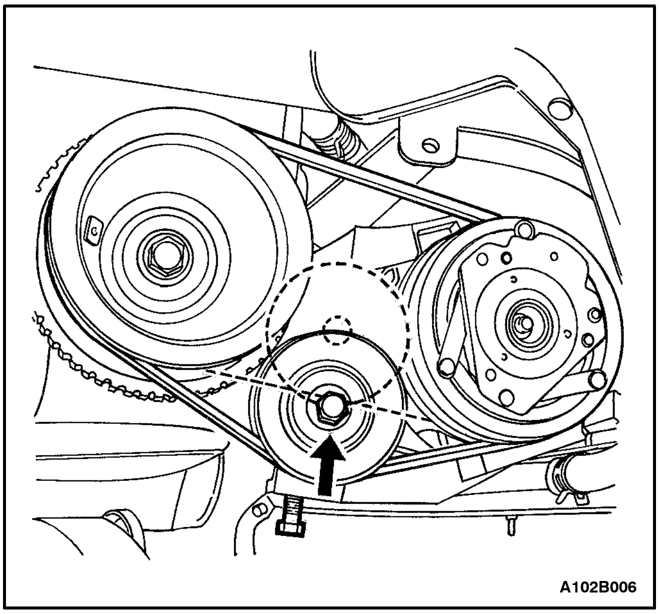


A102B018

15. Install the crankshaft pulley.
16. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.



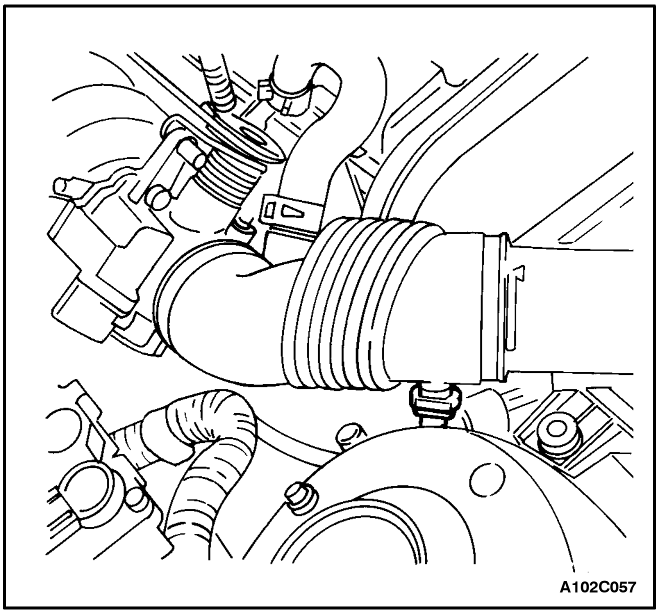
A102B006

17. Install the power steering pump pulley, if equipped.
18. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 N·m (18 lb-ft).

19. Install the alternator drive belt.
20. Install the A/C compressor drive belt, if equipped.
21. Install the right front splash shield.
22. Install the right front wheel. Refer to Section 2E, Tires and Wheels.



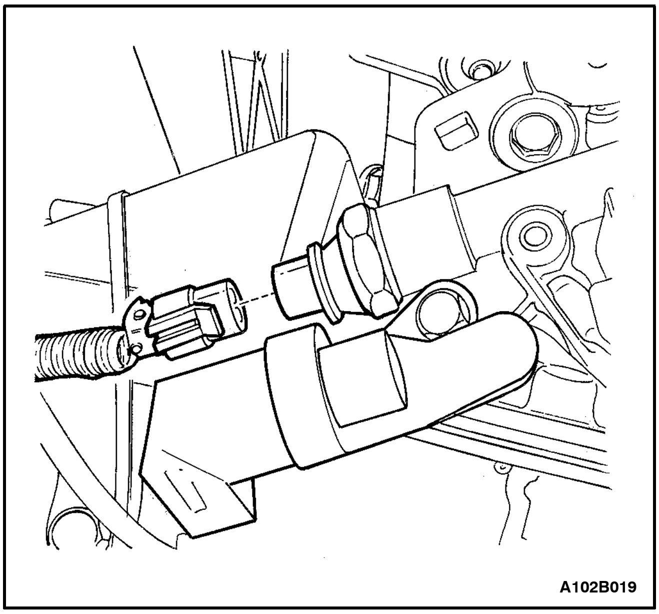
A102C057

24. Install the air filter housing.
25. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 N·m (106 lb-in).

26. Connect the air intake tube to the throttle body.
27. Connect the breather tube to the valve cover.
28. Connect the manifold air temperature sensor connector.
29. Connect the negative battery cable.



A102B019

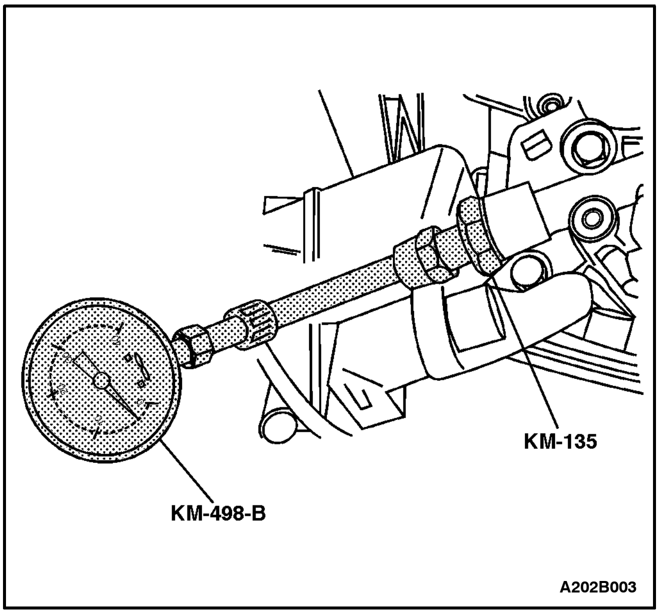
ENGINE OIL PRESSURE INSPECTION PROCEDURE

Tools Required

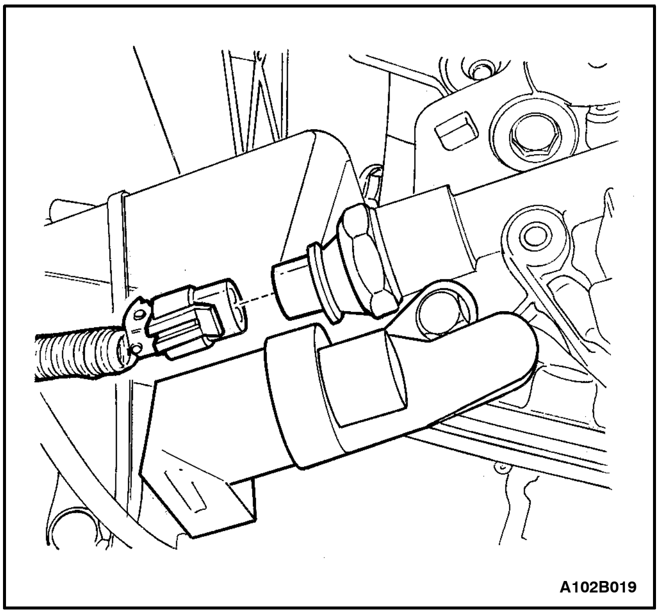
KM-498-B Pressure Gauge

KM-135 Adapter

1. Remove the front, right-hand wheel well splash shield.
2. Disconnect the oil pressure switch connector.



3. Install the adapter KM-135 in place of the oil pressure switch.
4. Connect the pressure gauge KM-498-B to the adapter.
5. Start the engine and check the oil pressure at idle speed and engine temperature of 80_C (176_F). The minimum oil pressure should be 30 kPa (8.88 psi).
6. Turn the engine OFF and remove the oil pressure gauge and adapter.

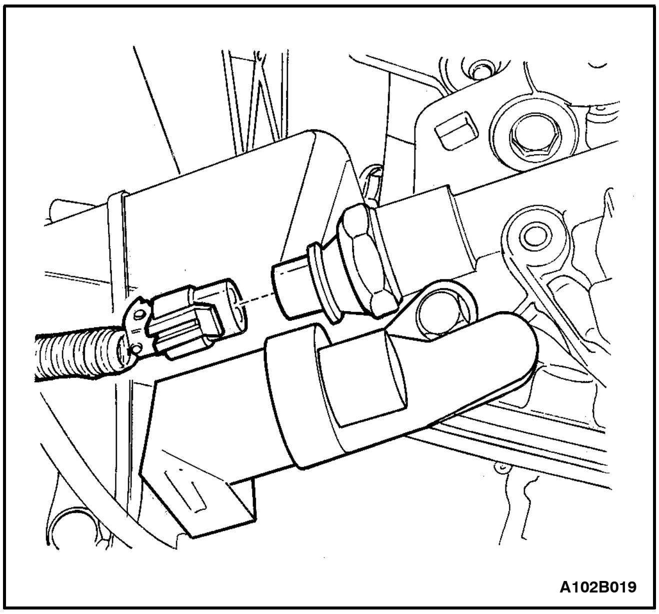


7. Install the oil pressure switch.

Tighten

Tighten the oil pressure switch to 40 N•m (30 lb-ft).

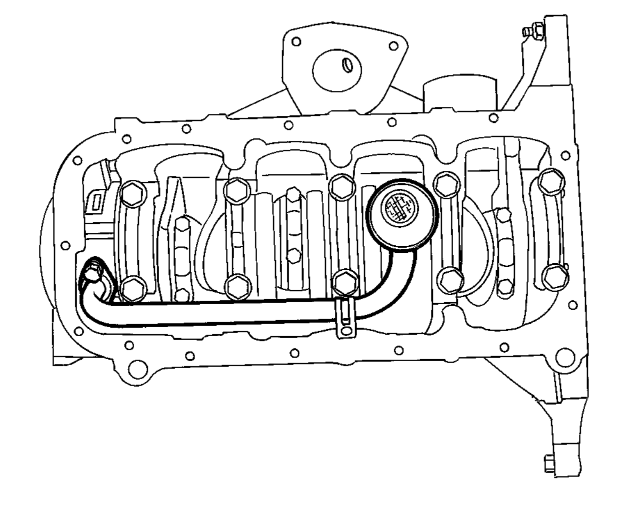
8. Connect the oil pressure switch connector.
9. Install the lower front, right-hand wheel well splash shield.
10. Check the oil level and fill to the full mark.



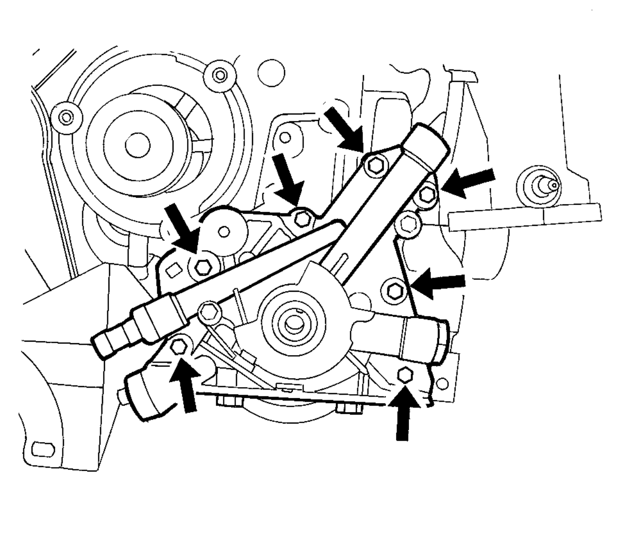
OIL PUMP

Removal Procedure

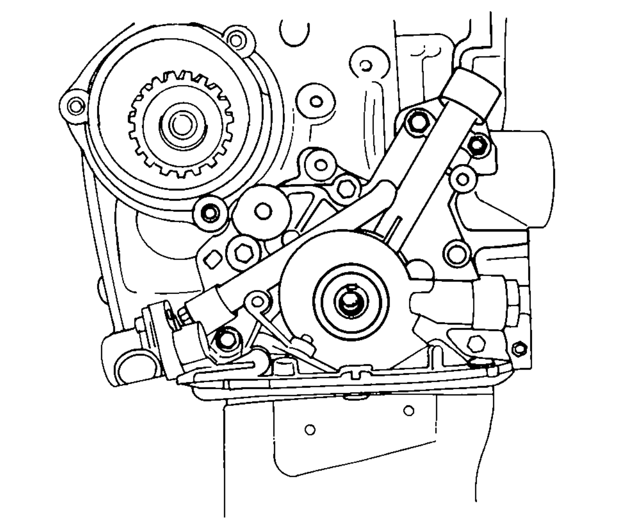
1. Disconnect the negative battery cable.
2. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
3. Remove the timing belt. Refer to “Timing Belt” in this section.
4. Remove the rear timing belt cover. Refer to “Rear Timing Belt Cover” in this section.
5. Disconnect the oil pressure switch connector.


A102B064

6. Remove the crankshaft position sensor bolt.
7. Remove the crankshaft position sensor.
8. Remove the oil pan. Refer to “Oil Pan” in this section.
9. Remove the oil pump pickup tube and the support bracket bolts.
10. Remove the oil pump pickup tube.

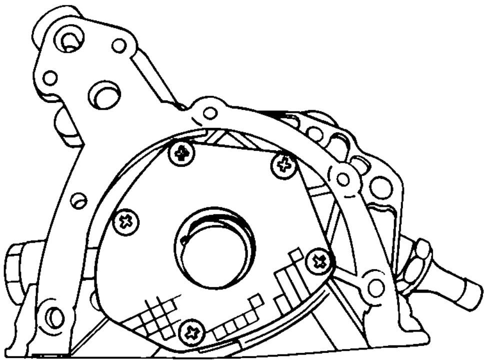

A102B065

11. Remove the oil pump retaining bolts.
12. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
13. Remove the oil pump.

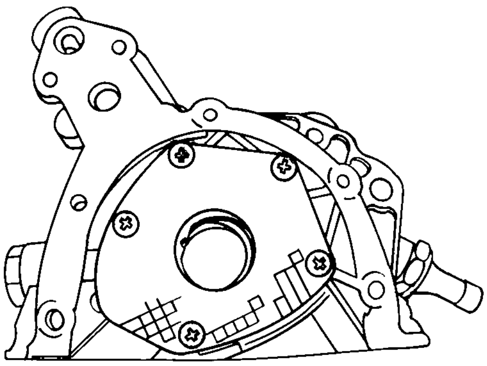

A202B002

Inspection Procedure

1. Clean the oil pump and the engine block gasket mating surfaces.
2. Remove the safety relief valve bolt.
3. Remove the safety relief valve and the spring.
4. Remove the oil pump-to-crankshaft seal.


A202B001

5. Remove the oil pump rear cover bolts.
6. Remove the rear cover.


A202B001

7. Clean the oil pump housing and all of the parts of the oil pump housing.
8. Inspect all of the parts for signs of wear. Refer to "Engine Specifications" in this section.
9. Coat all of the oil pump parts with clean engine oil and reinstall them.

Notice: Pack the oil pump gear cavity with petroleum jelly to ensure an oil pump prime, or engine damage could result.

10. Apply Loctite® 242 to the rear cover bolts and install the rear oil pump cover with the bolts.

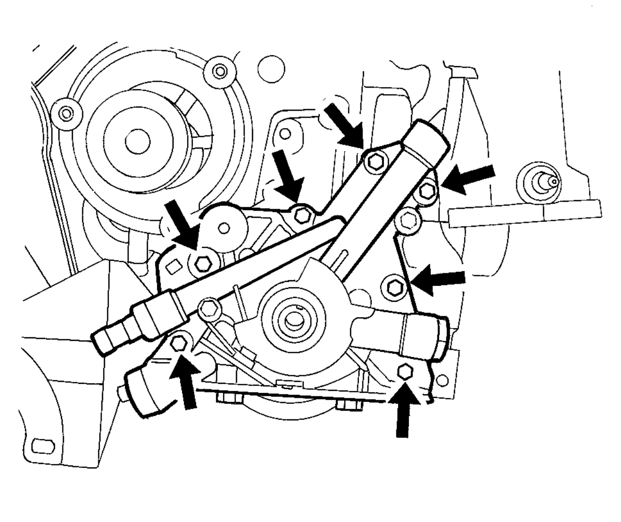
Tighten

Tighten the rear cover bolts to 6 N•m (53 lb-in).

11. Install the safety relief valve, the spring, the washer, and the bolt.

Tighten

Tighten the safety relief valve bolt to 30 N•m (22 lb-ft).



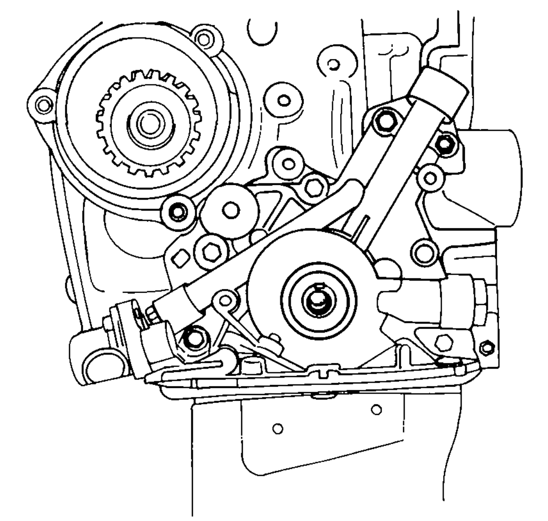
A102B065

Installation Procedure

1. Apply Loctite® 242 to the oil pump bolts and room temperature vulcanizing (RTV) (sealer) sealant to the new oil pump gasket.
2. Install the gasket to the oil pump and install the oil pump to the engine block with the retaining bolts.

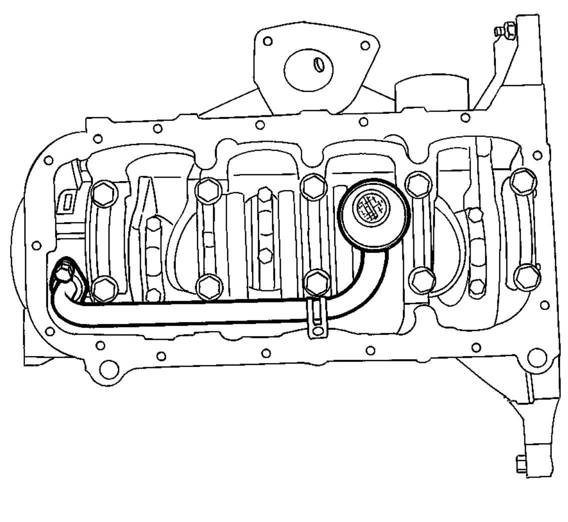
Tighten

Tighten the oil pump retaining bolts to 10 N·m (89 lb-in).



A202B002

3. Install a new oil pump-to-crankshaft seal. Coat the lip of the seal with a thin coat of grease.

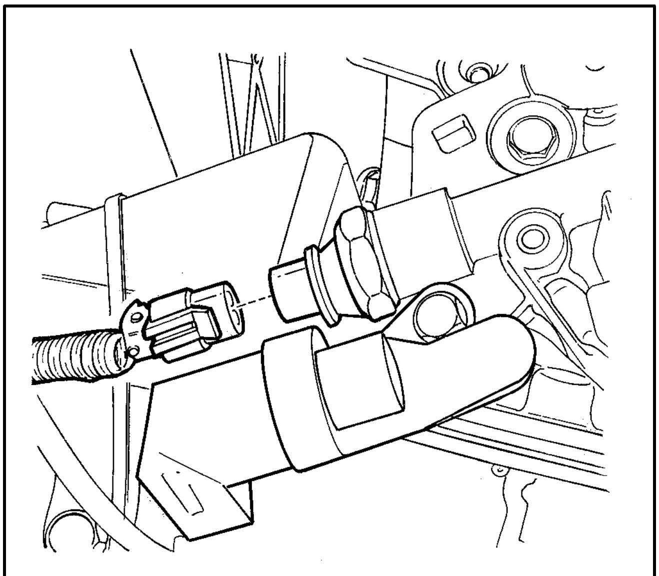


A102B064

4. Coat the threads of the oil pump pickup tube and support bracket bolts with Loctite® 242.
5. Install the oil pump pickup tube and bolts.

Tighten

Tighten the oil pump pickup tube and the support bracket bolts to 10 N·m (89 lb-in).



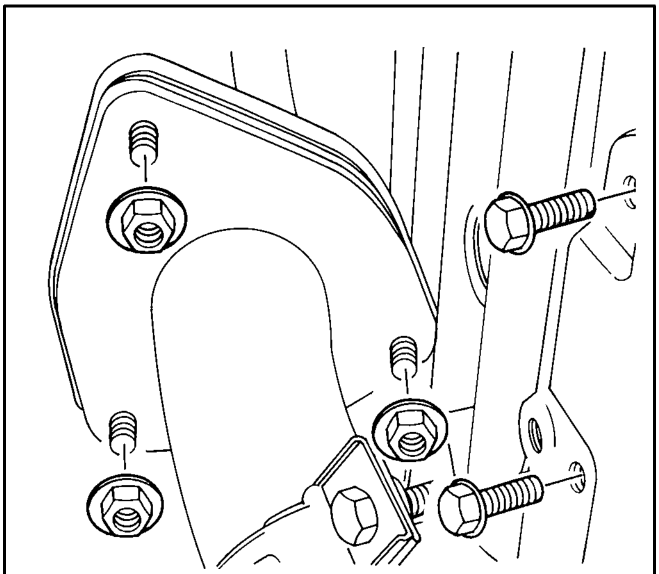
A102B019

6. Install the oil pan. Refer to "Oil Pan" in this section.
7. Install the crankshaft position sensor and the bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).

8. Connect the oil pressure switch connector.
9. Install the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
10. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
11. Install the timing belt. Refer to "Timing Belt" In this section.
12. Connect the negative battery cable.

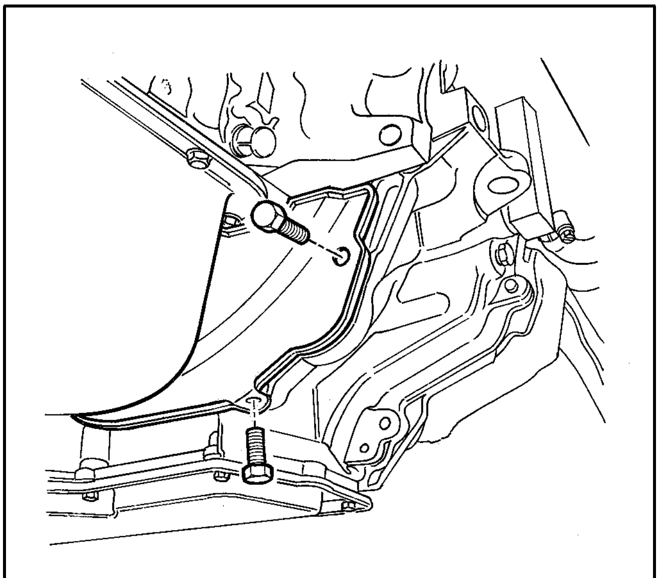


A202B004

OIL PAN

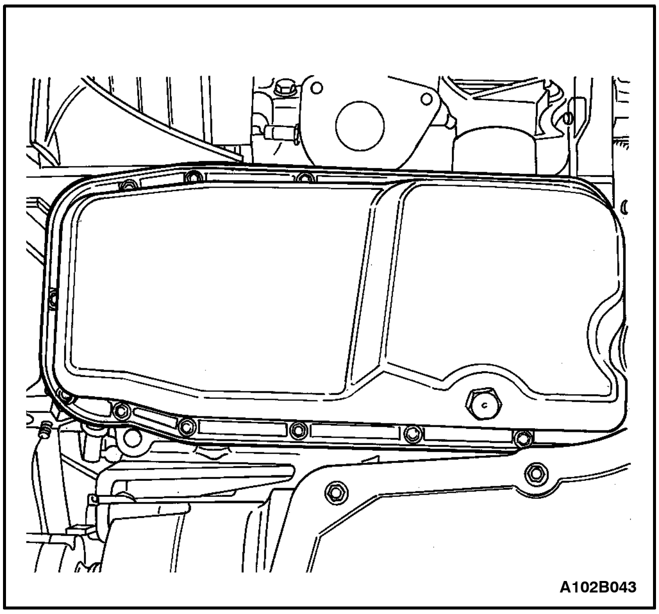
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the right front splash shield.
4. Drain the engine oil from the engine crankcase.
5. Remove the exhaust flex pipe retaining nuts from the exhaust manifold and the bolts at the bracket.
6. Remove the exhaust flex pipe retaining nuts from the catalytic converter or the connecting pipe.
7. Remove the exhaust flex pipe.

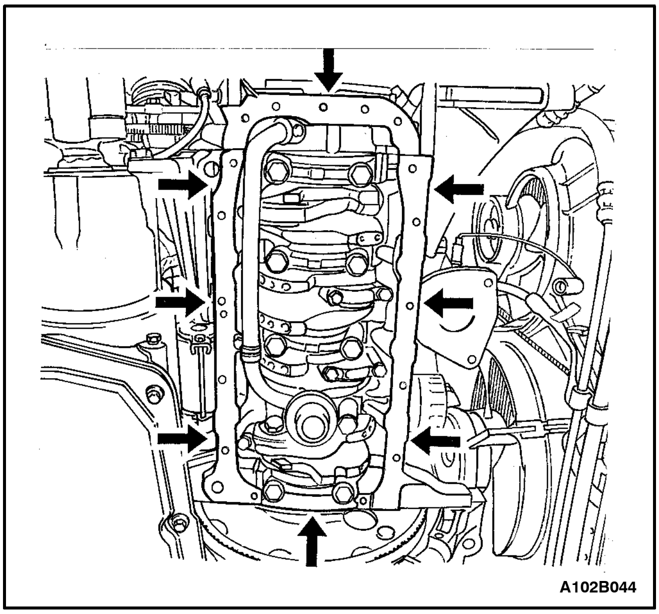


A102B021

8. Remove the flywheel or flexible plate inspection cover bolts.
9. Remove the flywheel or flexible plate inspection cover.

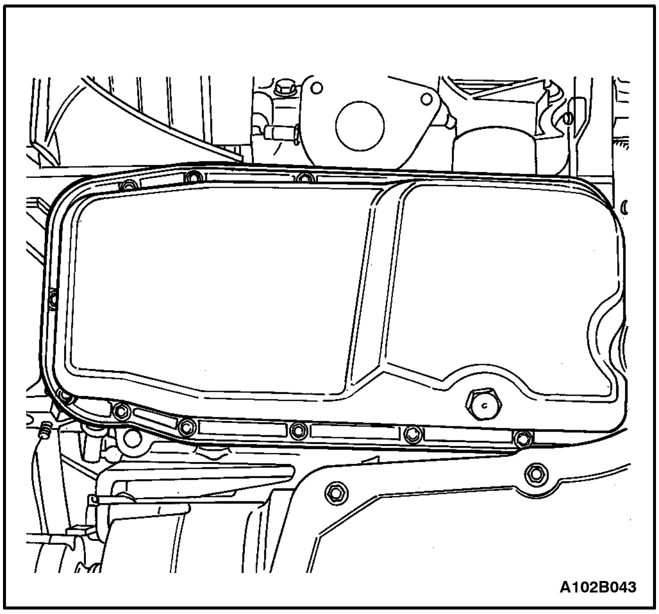


10. Remove the oil pan retaining bolts.
11. Remove the oil pan from the engine block.
12. Remove the oil pan gasket from the oil pan.



Cleaning Procedure

1. Clean the oil pan sealing surface.
2. Clean the engine block sealing surface.
3. Clean the oil pan retaining bolts.
4. Clean the oil pan attaching bolt holes in the engine block.



Installation Procedure

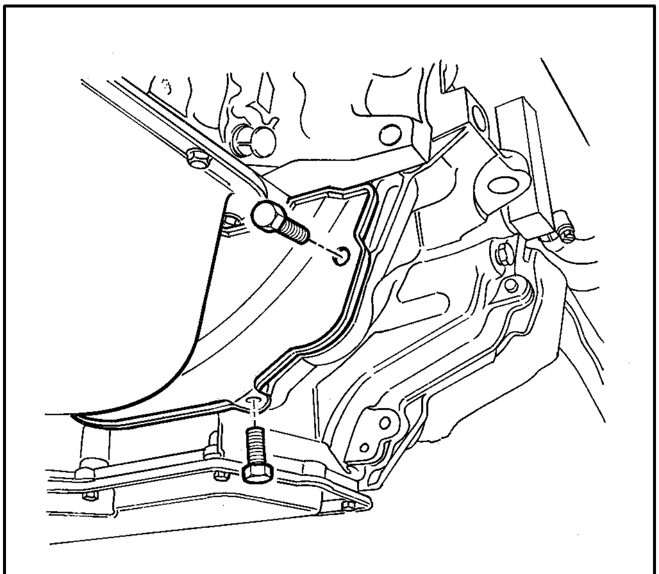
1. Install the oil pan gasket to the oil pan.
2. Install the oil pan to the engine block.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

3. Install the oil pan retaining bolts.

Tighten

Tighten the oil pan retaining bolts to 10 N•m (89 lb-in).

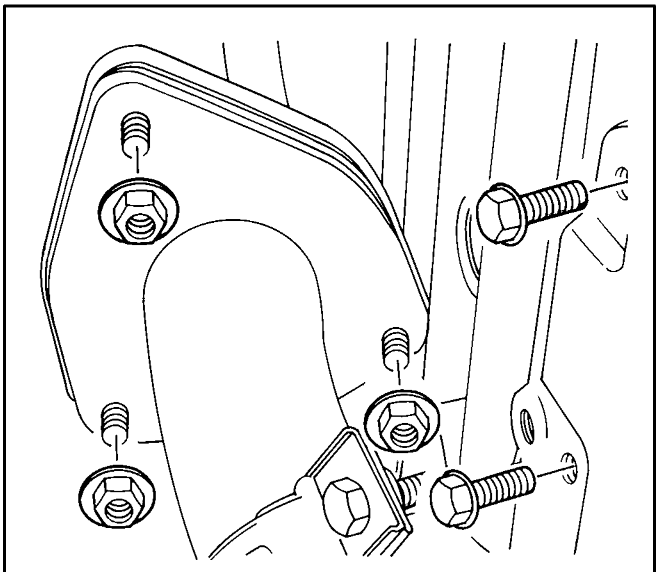


A102B021

4. Install the flywheel or flexible plate inspection cover.
5. Install the flywheel or flexible plate inspection cover bolts.

Tighten

Tighten the flywheel inspection cover bolts to 12 N·m (106 lb-in) or the flexible plate inspection cover bolts to 10 N·m (89 lb-in).



A202B004

6. Install the exhaust flex pipe.
7. Install the exhaust flex pipe retaining nuts to the exhaust manifold and the exhaust pipe bracket bolts.

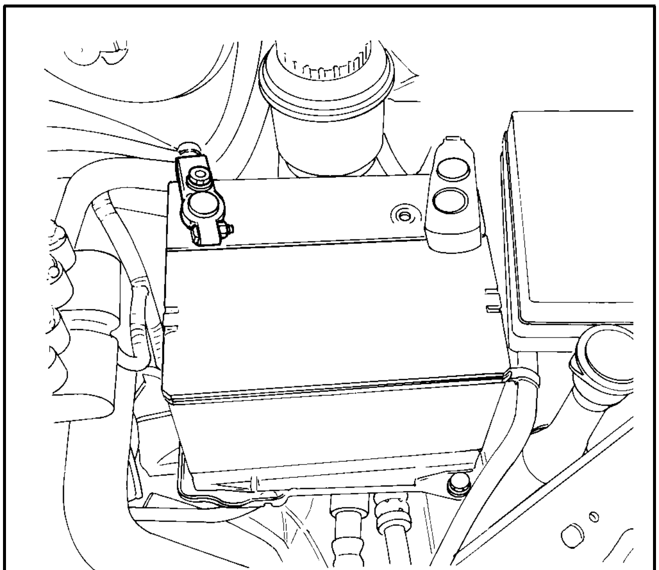
Tighten

Tighten the exhaust flex pipe retaining nuts to the exhaust manifold and the exhaust pipe bracket bolts to 40 N·m (30 lb-ft).

8. Install the exhaust flex pipe retaining nuts to the catalytic converter or the connecting pipe.

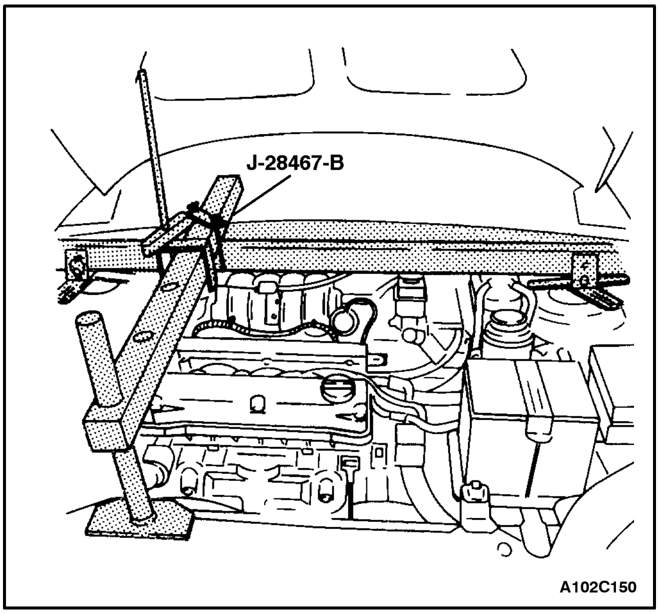
Tighten

Tighten the exhaust flex pipe retaining nuts to the catalytic converter or the connecting pipe to 30 N·m (22 lb-ft).



A102C034

9. Install the right front splash shield.
10. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
11. Connect the negative battery cable.
12. Refill the engine crankcase with engine oil.



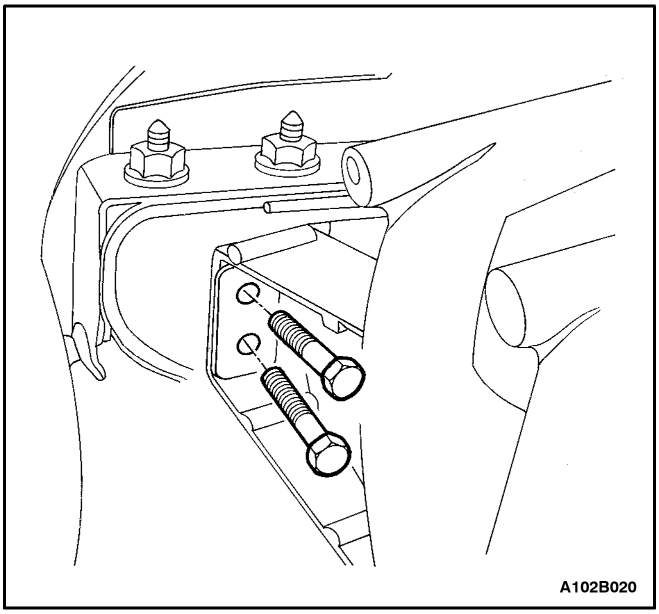
ENGINE MOUNT

Tools Required

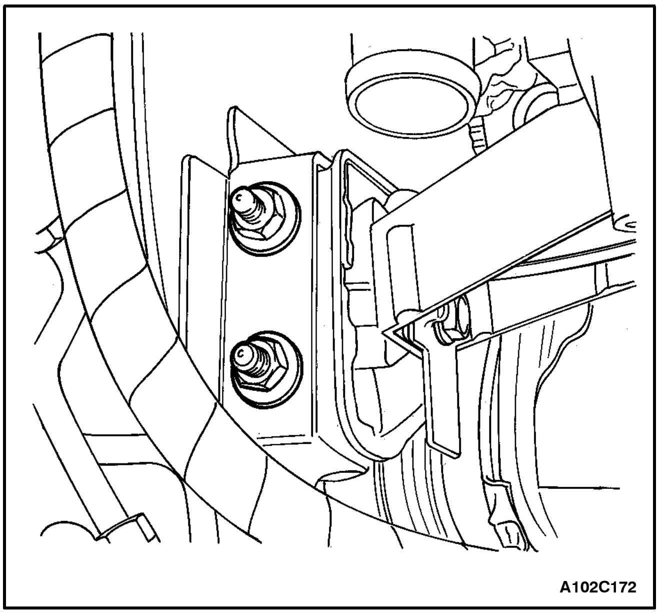
J-28467-B Engine Assembly Lift Support

Removal Procedure

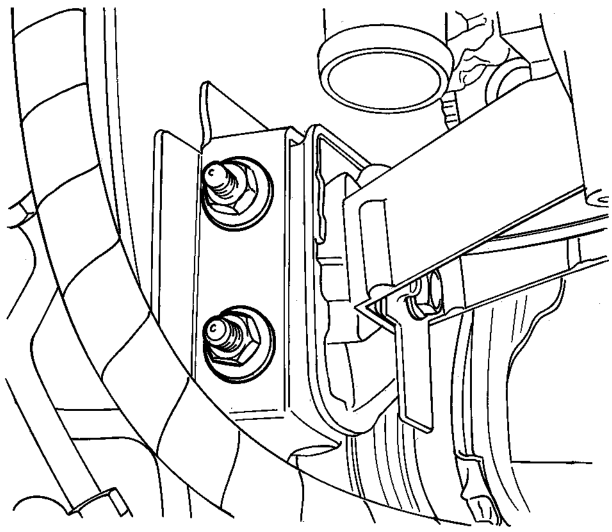
1. Disconnect the negative battery cable.
2. Remove the upper radiator cover.
3. Remove the right front splash shield.
4. Support the engine assembly using the engine assembly lift support J-28467-B.



5. Remove the engine mount bracket retaining bolts.



6. Remove the engine mount retaining nuts.
7. Lower the engine.
8. Remove the engine mount.



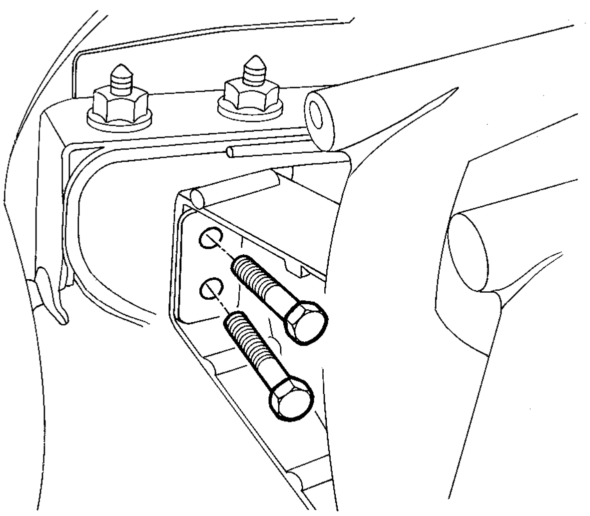
A102C172

Installation Procedure

1. Install the engine mount.
2. Raise the engine.
3. Install the engine mount retaining nuts.

Tighten

Tighten the engine mount retaining nuts to 40 NSm (30 lb-ft).

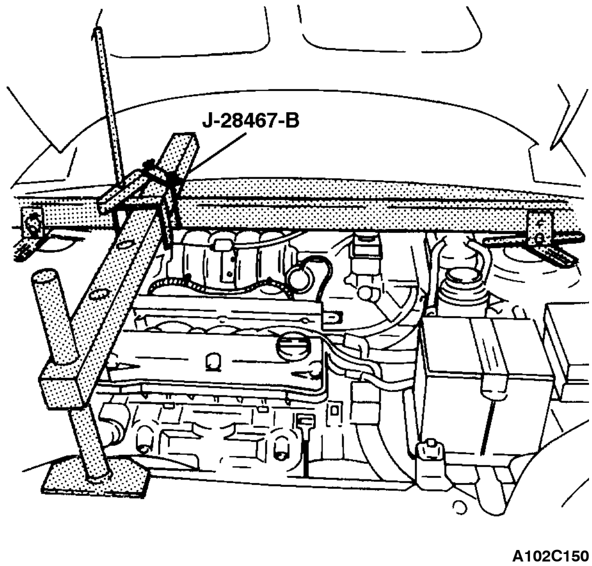


A102B020

4. Install the engine mount bracket retaining bolts.

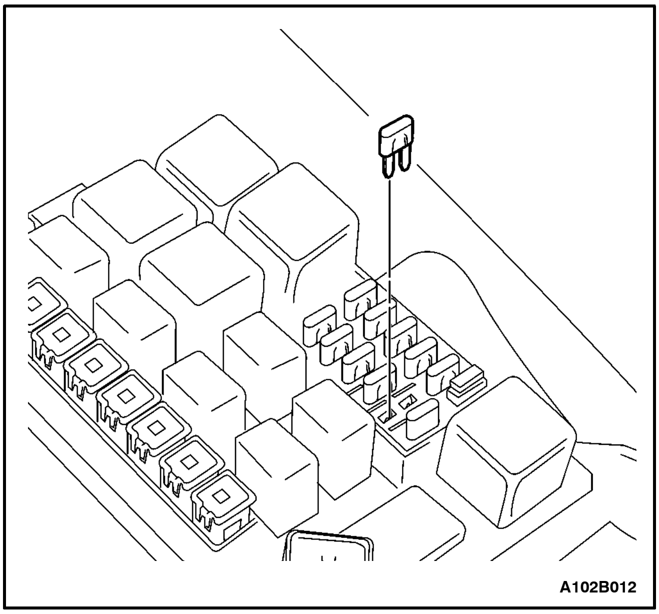
Tighten

Tighten the engine mount bracket retaining bolts to 60 NSm (44 lb-ft).



A102C150

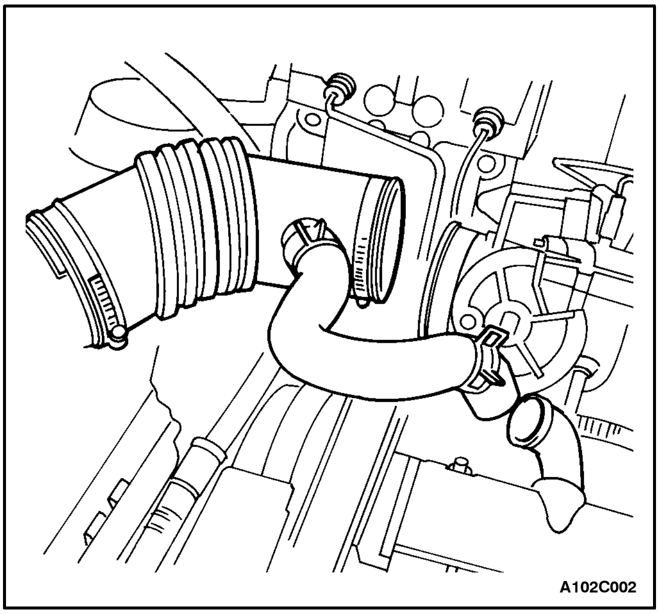
5. Remove engine assembly lift support J-28467-B.
6. Install the right front splash shield.
7. Install the upper radiator cover.
8. Connect the negative battery cable.



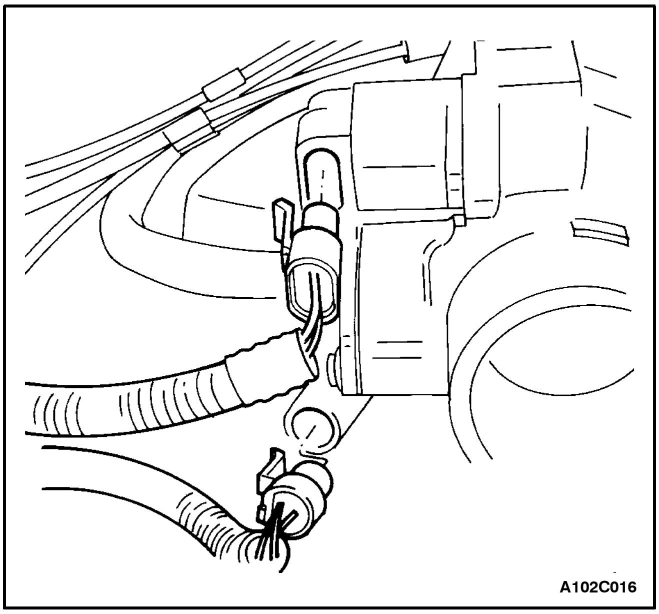
INTAKE MANIFOLD

Removal Procedure

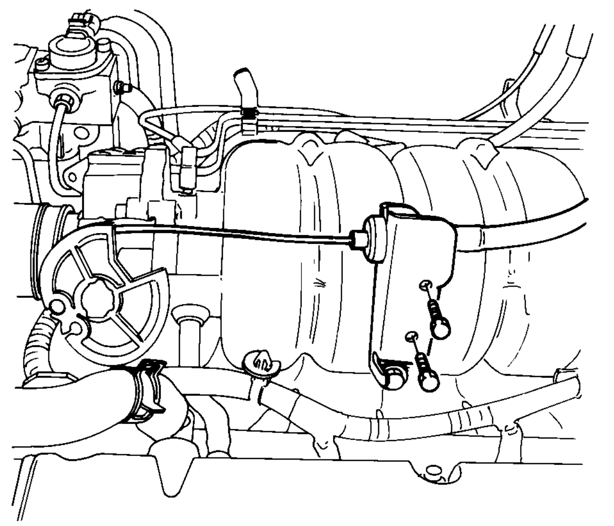
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the ECM ground terminal from the intake manifold.
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.



6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the air intake tube from the throttle body.

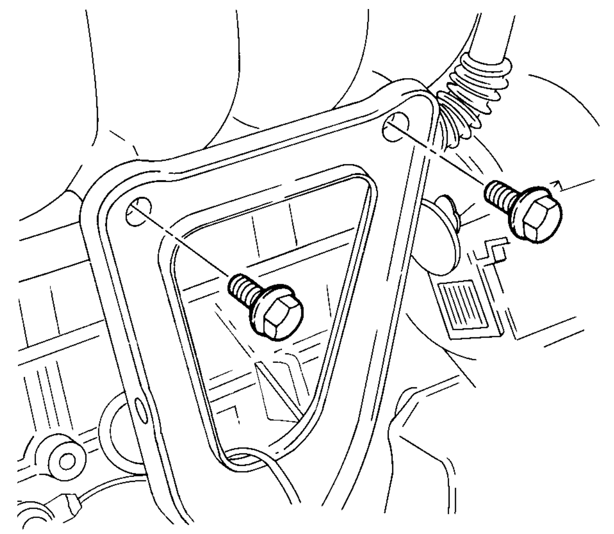


8. Disconnect the idle air control valve connector.
9. Disconnect the throttle position sensor connector.
10. Disconnect the coolant temperature sensor connector.
11. Disconnect the engine coolant temperature sensor connector.
12. Disconnect the heater inlet hose from the cylinder head.
13. Disconnect the surge tank coolant hose at the throttle body.



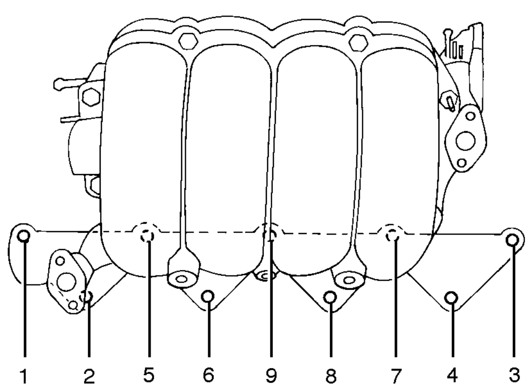
A102C032

14. Disconnect all of the necessary vacuum hoses, including the vacuum hose at the fuel pressure regulator and the brake booster vacuum hose at the intake manifold.
15. Disconnect the throttle cable from the throttle body and the intake manifold.
16. Remove the throttle cable bracket bolts from the intake manifold.
17. Remove the throttle cable bracket.



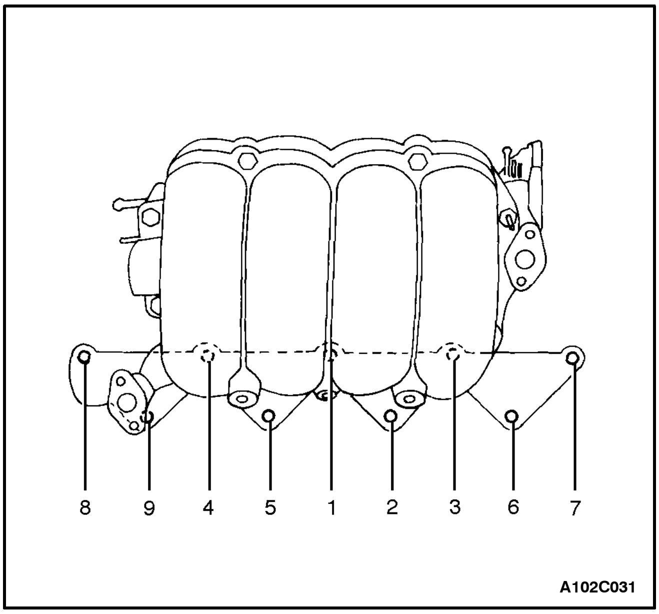
A102C021

18. Remove the fuel injector rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
19. Remove the alternator. Refer to Section 1E, Engine Electrical.
20. Remove the intake manifold support bracket bolts.
21. Remove the intake manifold support bracket.



A102C030

22. Remove the intake manifold retaining bolts/nuts in the sequence shown.
23. Remove the intake manifold.
24. Remove the intake manifold gasket.
25. Clean the sealing surfaces of the intake manifold and the cylinder head.

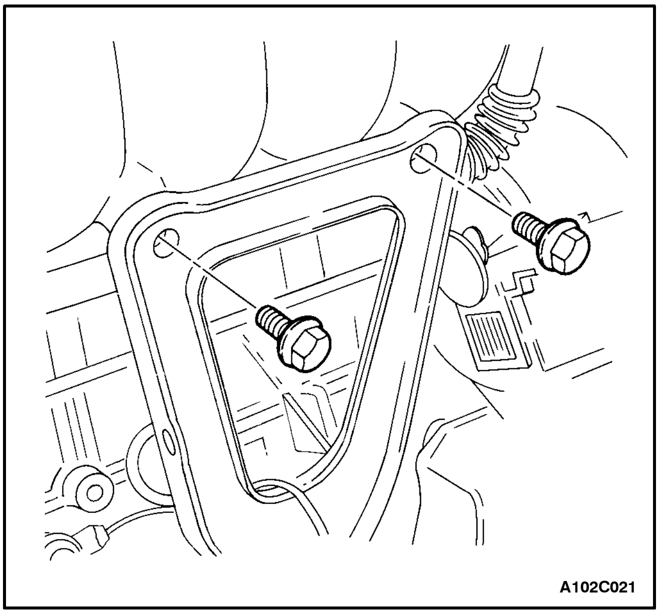


Installation Procedure

1. Install the intake manifold gasket.
2. Install the intake manifold.
3. Install the intake manifold retaining bolts/nuts in the sequence shown.

Tighten

Tighten the intake manifold retaining bolts to 25 NSm (18 lb-ft).



4. Install the intake manifold support bracket.
5. Install the intake manifold support bracket upper bolts to the intake manifold.

Tighten

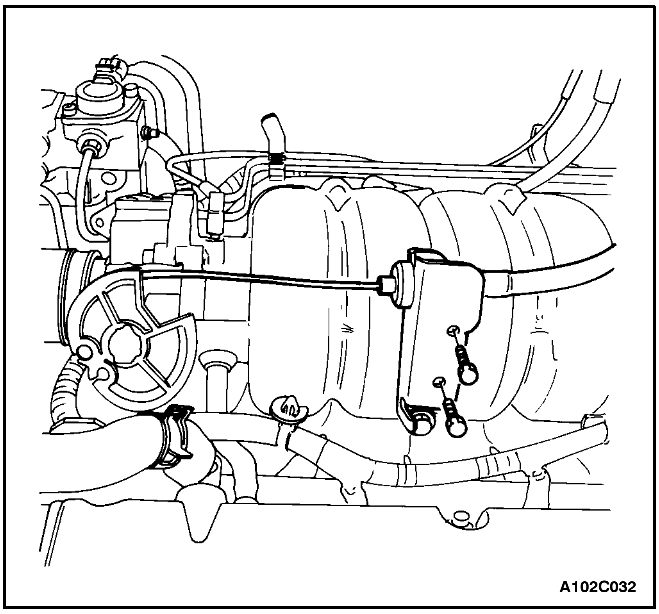
Tighten the intake manifold support bracket bolts to 25 NSm (18 lb-ft).

6. Install the intake manifold support bracket lower bolt to the engine block.

Tighten

Tighten the intake manifold support bracket lower bolt to the engine block to 40 NSm (30 lb-ft).

7. Install the alternator. Refer to Section 1E, Engine Electrical.

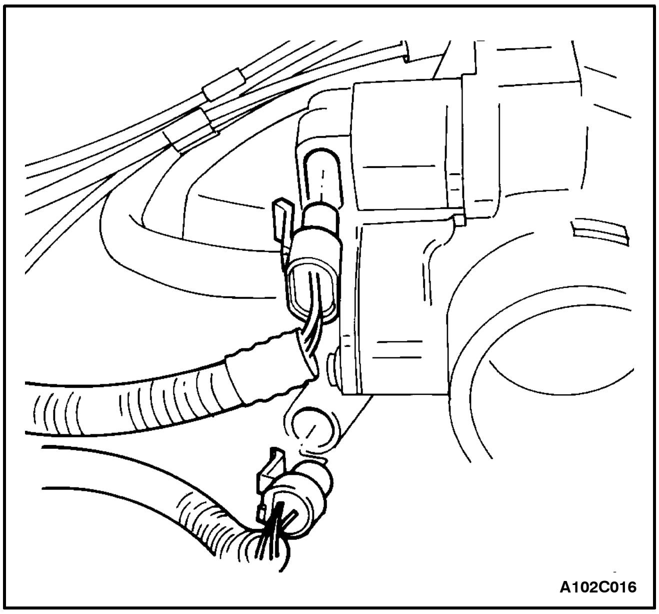


8. Install the fuel rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
9. Install the throttle cable bracket.
10. Install the throttle cable bracket bolts.

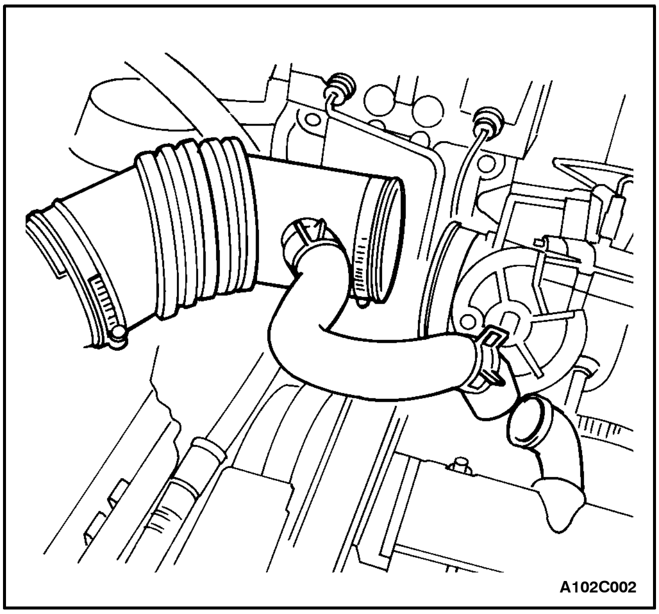
Tighten

Tighten the throttle cable bracket bolts to 8 NSm (71 lb-in).

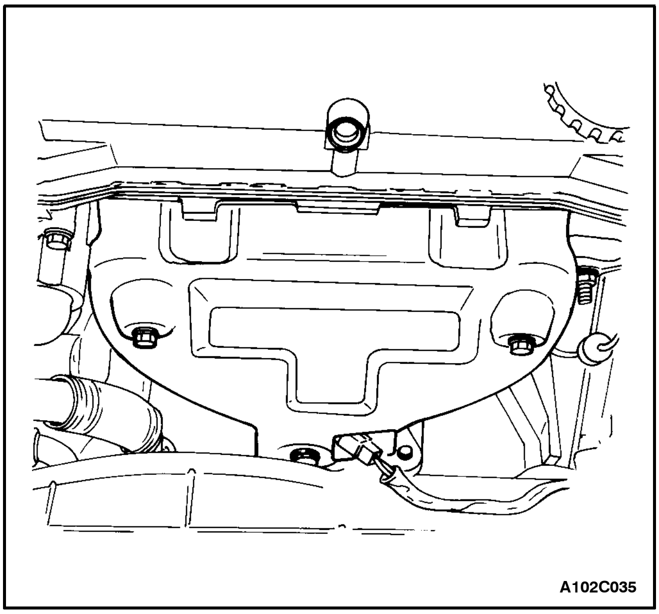
11. Connect the throttle cable to the intake manifold and the throttle body.
12. Connect all of the necessary vacuum lines that were previously disconnected.



13. Connect the heater inlet hose to the cylinder head.
14. Connect the surge tank coolant hose to the throttle body.
15. Connect the coolant temperature sensor connector.
16. Connect the engine coolant temperature sensor connector.
17. Connect the idle air control valve connector.
18. Connect the throttle position sensor connector.



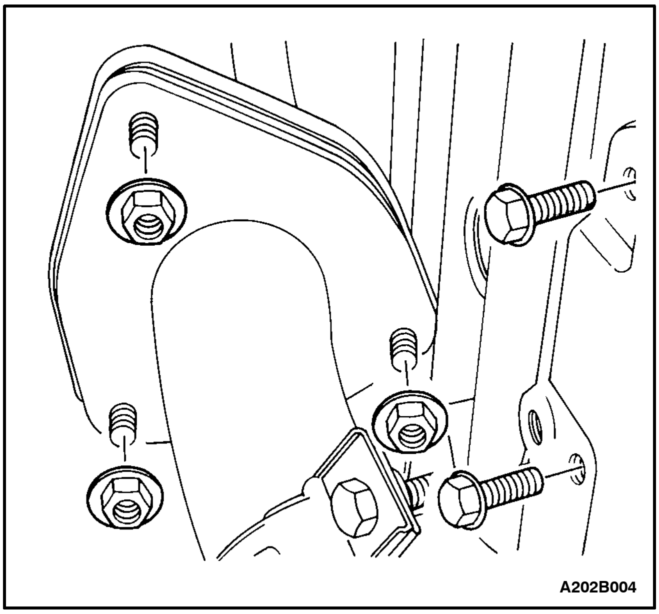
19. Connect the air intake tube to the throttle body.
20. Connect the manifold air temperature sensor connector.
21. Connect the ECM ground terminal to the intake manifold.
22. Install the fuel pump fuse.
23. Connect the negative battery cable.
24. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.



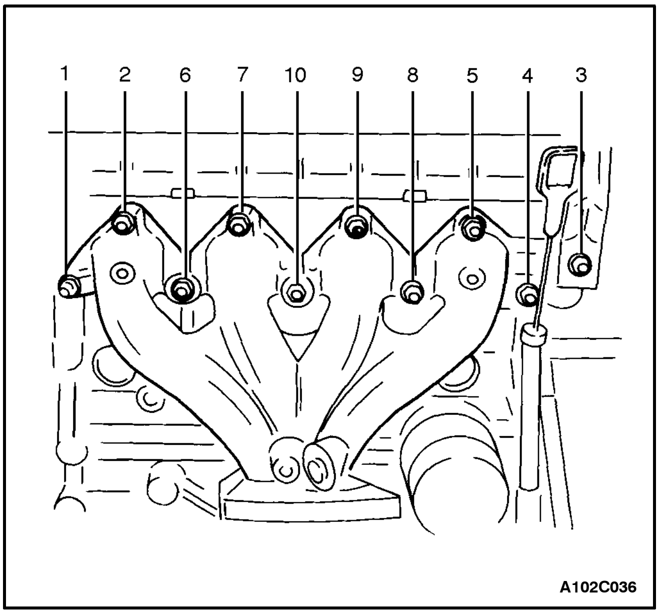
EXHAUST MANIFOLD

Removal Procedure

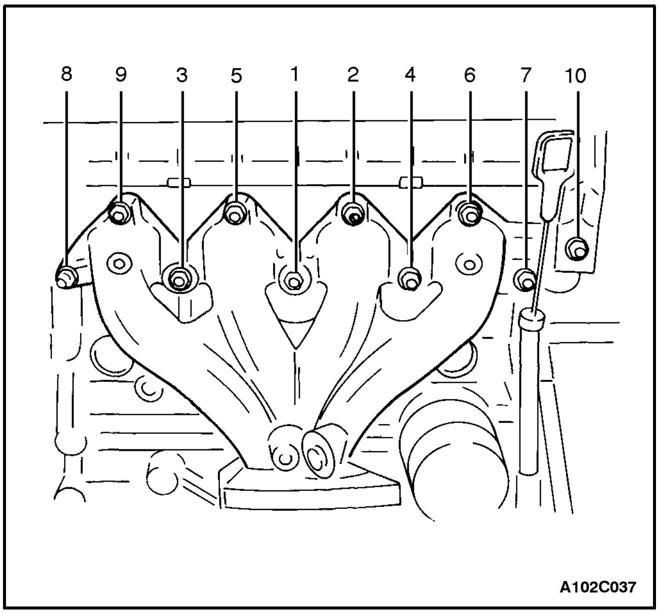
1. Disconnect the negative battery cable.
2. Disconnect the oxygen sensor connector.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.



5. **Remove the exhaust flex pipe retaining nuts from the exhaust manifold studs.**



6. **Remove the exhaust manifold retaining nuts in the sequence shown.**
7. **Remove the exhaust manifold.**
8. **Remove the exhaust manifold gasket.**
9. **Clean the sealing surfaces of the exhaust manifold and the cylinder head.**

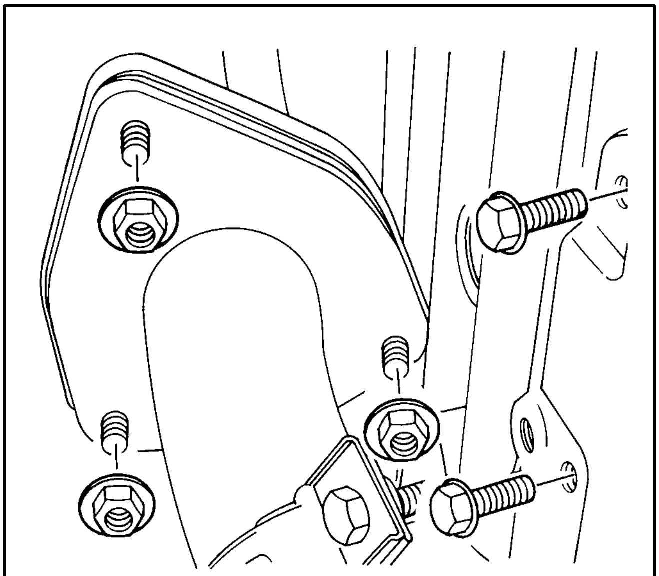


Installation Procedure

1. **Install the exhaust manifold gasket.**
2. **Install the exhaust manifold.**
3. **Install the exhaust manifold retaining nuts and tighten in the sequence shown.**

Tighten

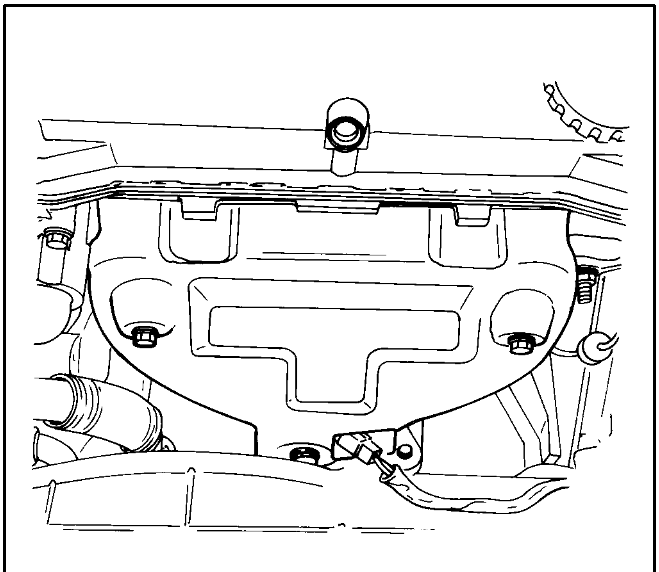
Tighten the exhaust manifold retaining nuts 25 N•m (18 lb-ft).


A202B004

4. Install the exhaust flex pipe retaining nuts to the exhaust manifold studs.

Tighten

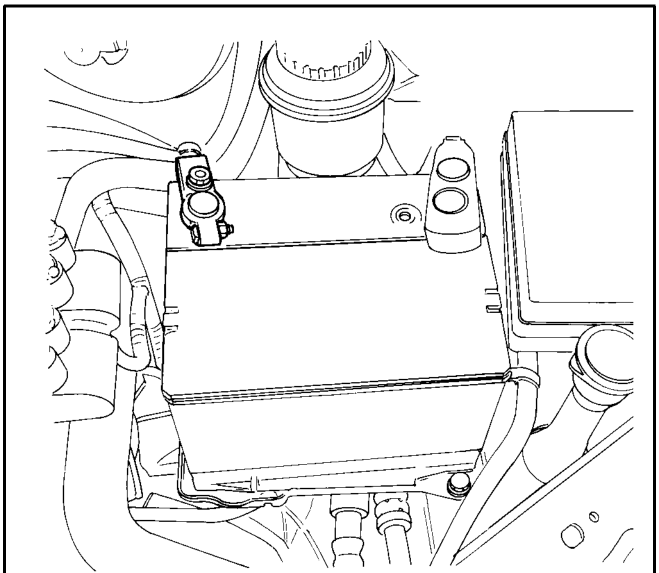
Tighten the exhaust flex pipe retaining nuts to 40 N•m (30 lb-ft).


A102C035

5. Install the exhaust manifold heat shield.
6. Install the exhaust manifold heat shield bolts.

Tighten

Tighten the exhaust manifold heat shield bolts to 15 N•m (11 lb-ft).

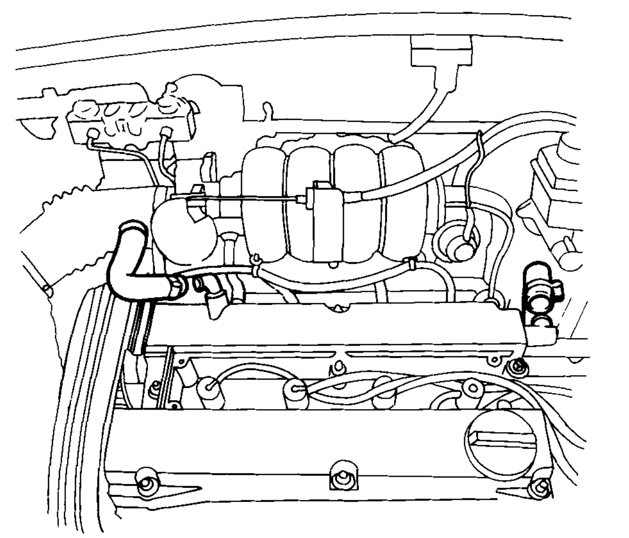

A102C034

7. Connect the oxygen sensor connector.
8. Connect the negative battery cable.

CAMSHAFT GEARS

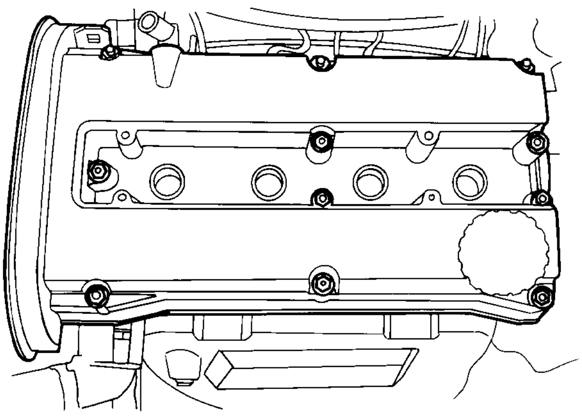
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



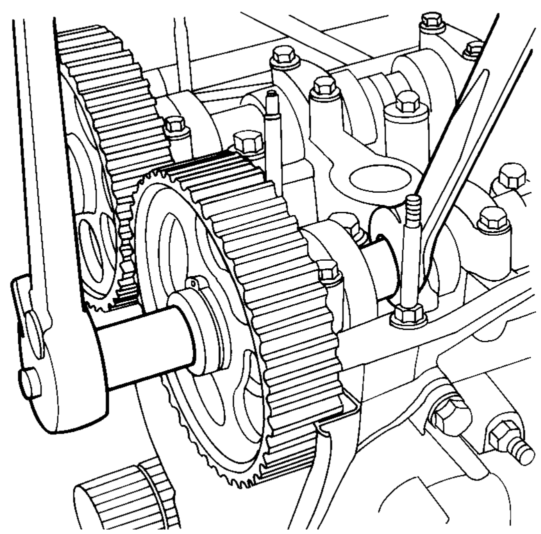
A102C006

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.
3. Remove the spark plug cover bolts.
4. Remove the spark plug cover.
5. Disconnect the ignition wires from the spark plugs.
6. Disconnect the crankcase ventilation tubes from the valve cover.



A102C015

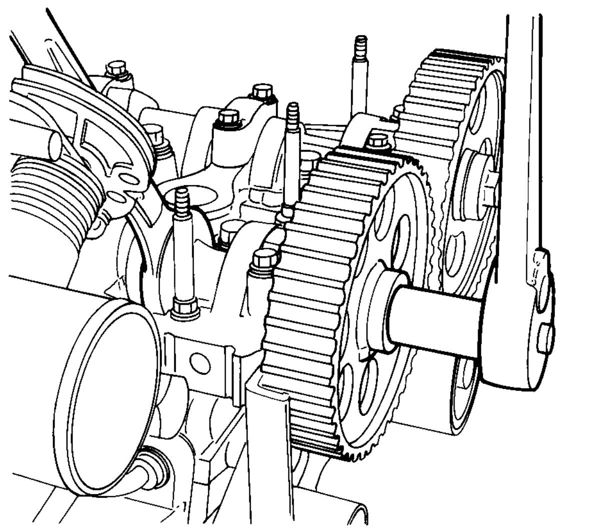
7. Remove the valve cover nuts.
8. Remove the valve cover washers.
9. Remove the valve cover and the valve cover gasket.



A102C017

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

10. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
11. Remove the intake camshaft gear.
12. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
13. Remove the exhaust camshaft gear.



A102C024

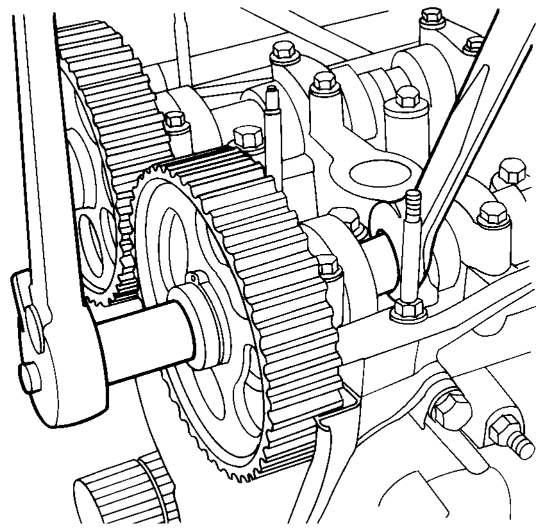
Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

1. **Install the intake camshaft gear.**
2. **While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.**

Tighten

Tighten the intake camshaft gear bolt to 67.5 N·m (49 lb-ft).

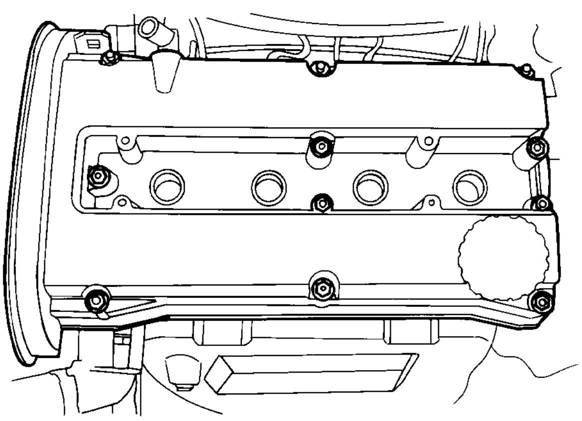


A102C017

3. **Install the exhaust camshaft gear.**
4. **While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.**

Tighten

Tighten the exhaust camshaft gear bolt to 67.5 N·m (49 lb-ft).

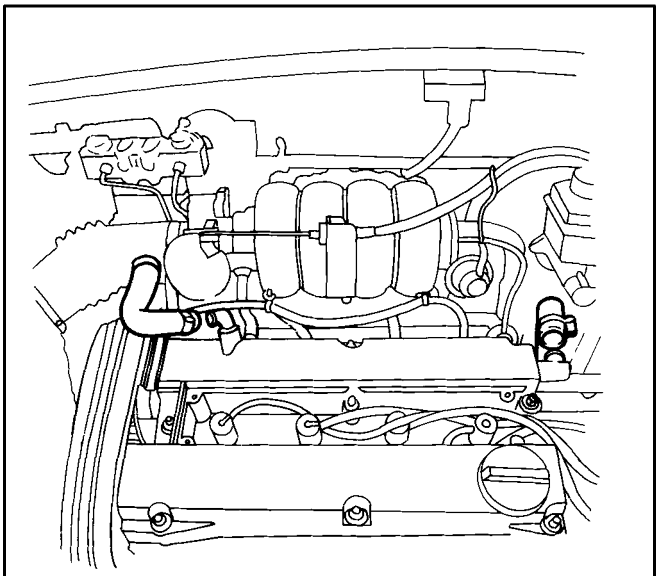


A102C015

5. **Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.**
6. **Install the valve cover and the valve cover gasket.**
7. **Install the valve cover washers.**
8. **Install the valve cover nuts.**

Tighten

Tighten the valve cover nuts to 10 N·m (89 lb-in).

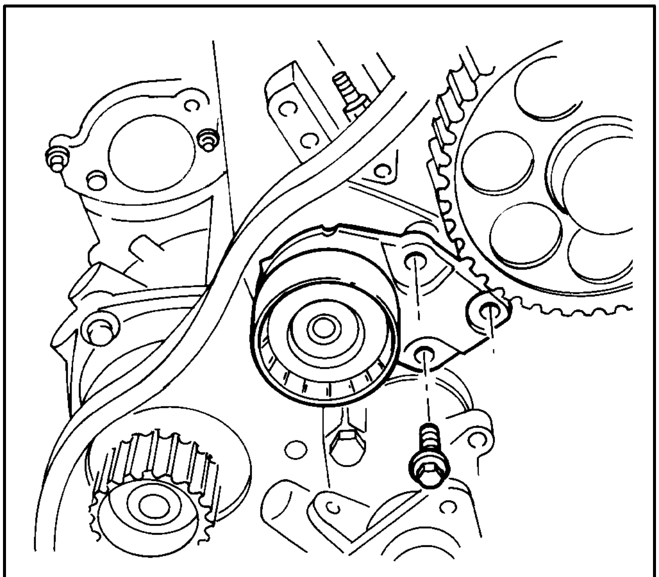

A102C006

9. Connect the crankcase ventilation tubes to the valve cover.
10. Connect the ignition wires to the spark plugs.
11. Install the spark plug cover.
12. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 N•m (27 lb-in).

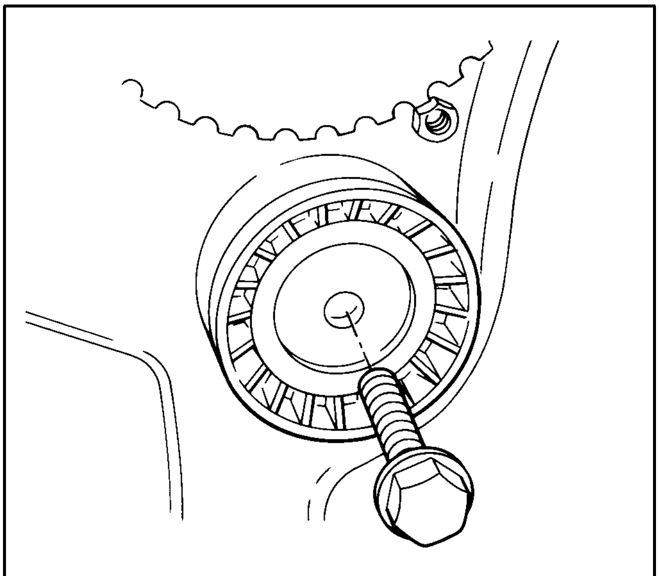
13. Install the timing belt. Refer to "Timing Belt" in this section.
14. Connect the negative battery cable.


A102C018

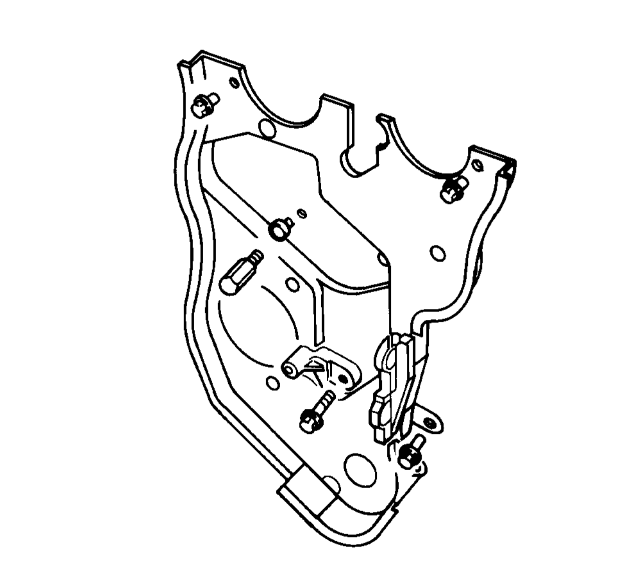
REAR TIMING BELT COVER

Removal Procedure

1. Remove the timing belt and the timing belt cover. Refer to "Timing Belt" in this section.
2. Remove the camshaft gears. Refer to "Camshaft Gears" in this section.
3. Remove the crankshaft gear.
4. Remove the timing belt automatic tensioner bolts.
5. Remove the timing belt automatic tensioner.

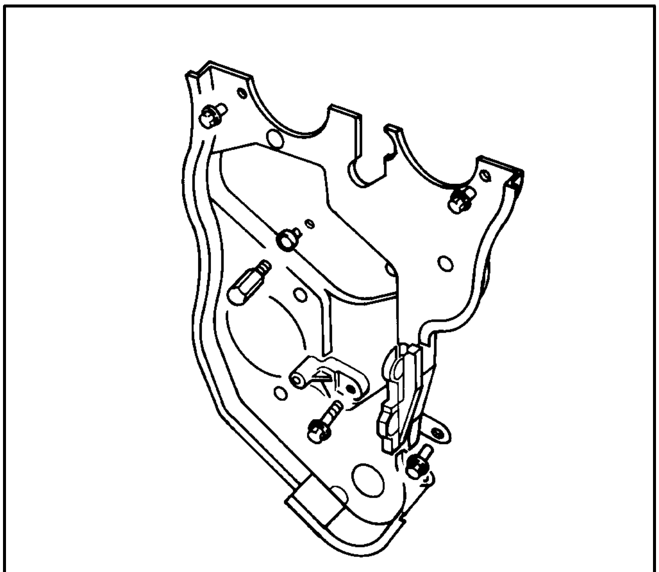

A102C019

6. Remove the timing belt idler pulley bolt.
7. Remove the timing belt idler pulley.



A102C005

8. Remove the rear timing belt cover bolts.
9. Remove the rear timing belt cover.



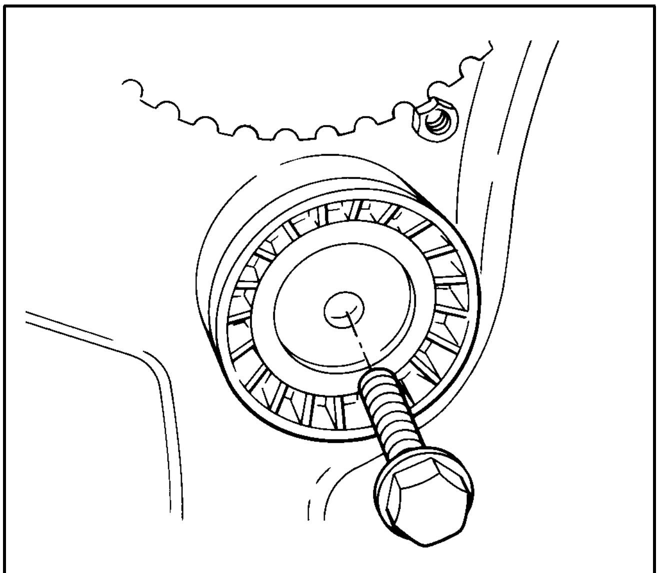
A102C005

Installation Procedure

1. Install the rear timing belt cover.
2. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).

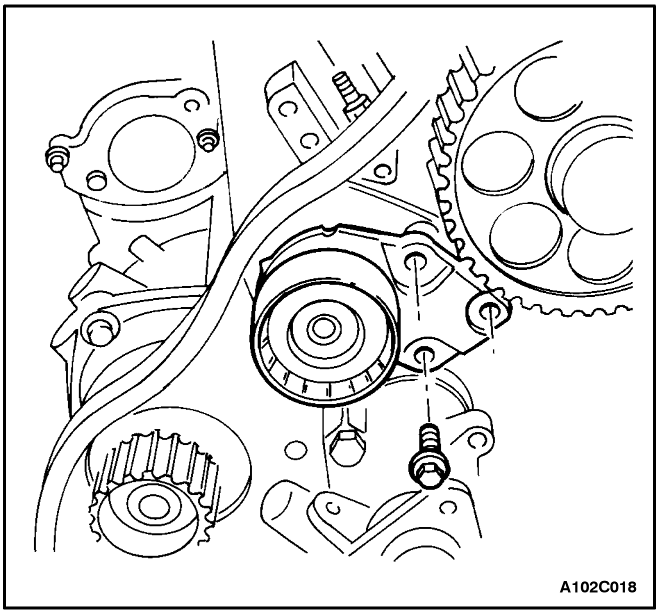


A102C019

3. Install the timing belt idler pulley.
4. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 NSm (30 lb-ft).

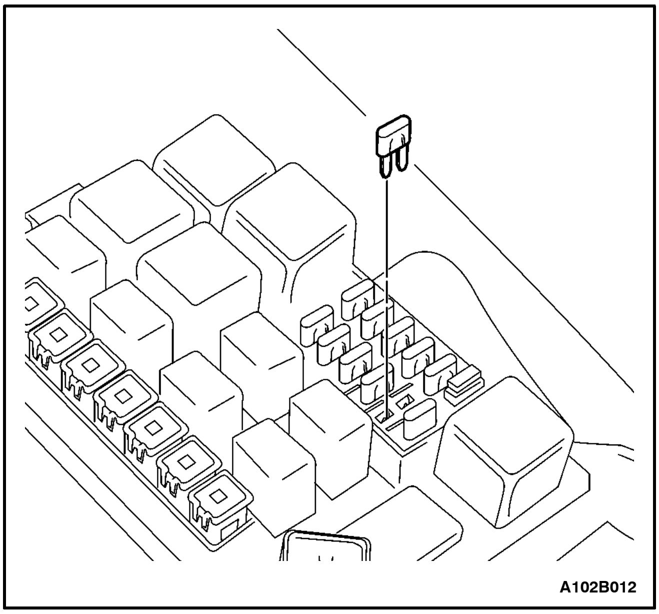


5. Install the timing belt automatic tensioner.
6. Install the timing belt automatic tensioner bolts.

Tighten

Tighten the timing belt automatic tensioner bolts to 25 N•m (18 lb-ft).

7. Install the crankshaft gear.
8. Install the camshaft gears. Refer to “Camshaft Gears” in this section.
9. Install the timing belt and timing belt cover. Refer to “Timing Belt” in this section.



ENGINE

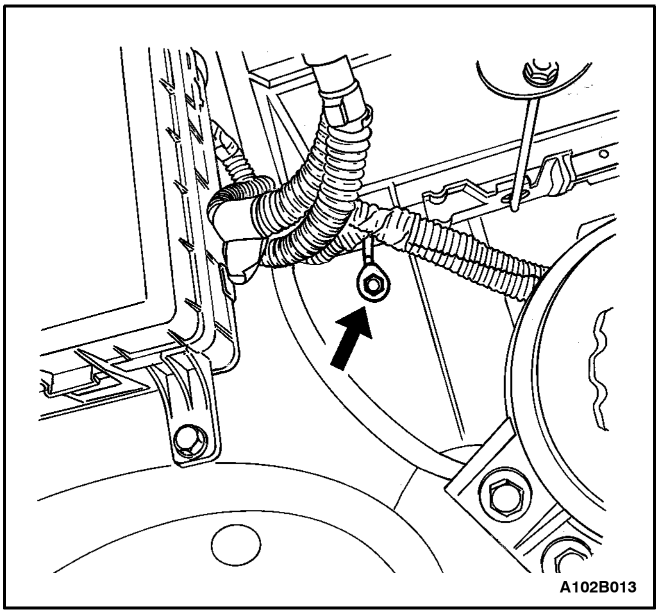
Tools Required

KM-470-B Angular Torque Gauge

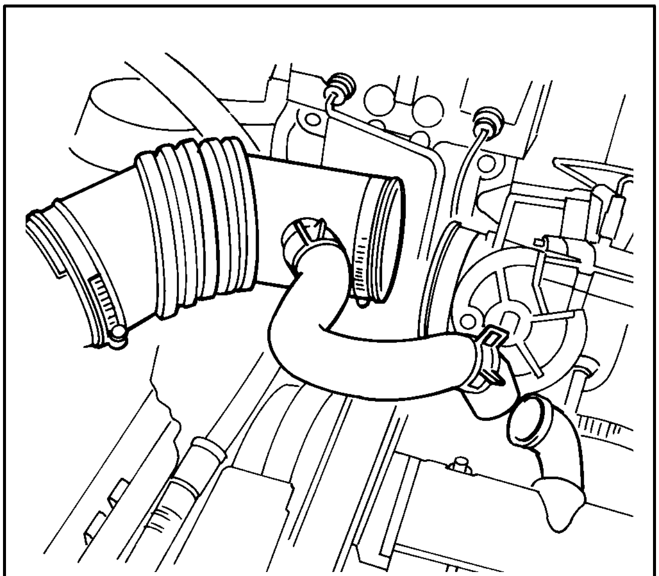
Removal Procedure

Important: On vehicles equipped with manual transaxle, the manual transaxle must be removed before the engine is removed. Refer to Section 5B, Manual Transaxle.

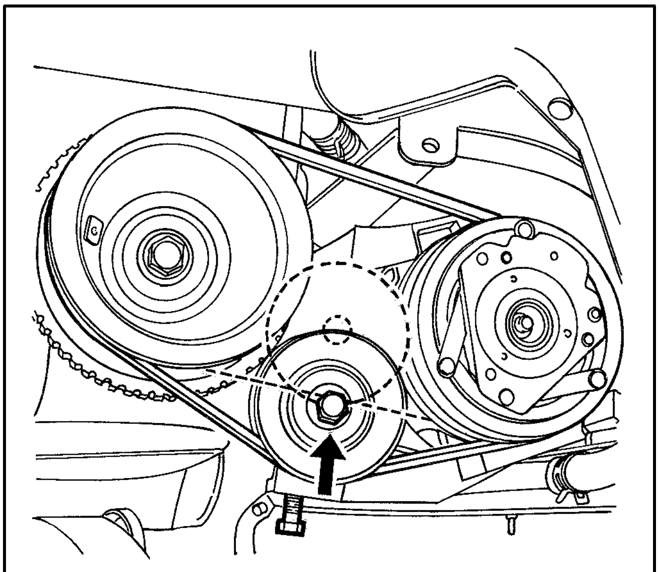
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Remove the hood. Refer to Section 9R, Body Front End.
4. Drain the engine oil.



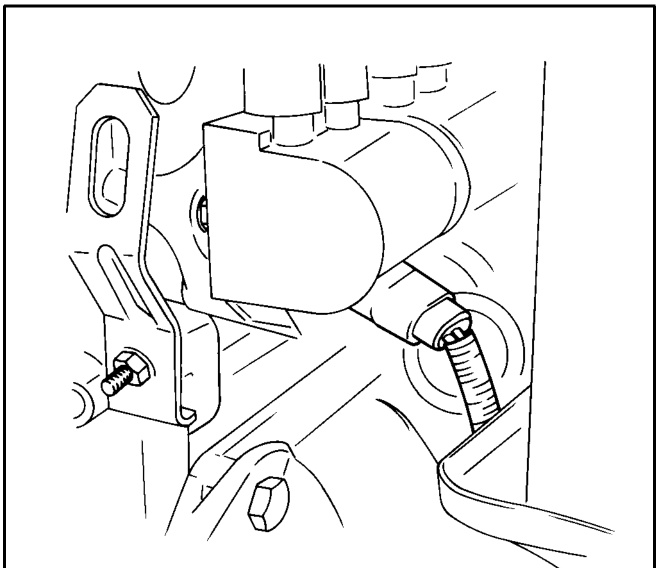
5. Disconnect the negative battery cable.
6. Disconnect and separate the positive battery cable.
7. Disconnect the negative battery cable from the vehicle frame.


A102C002

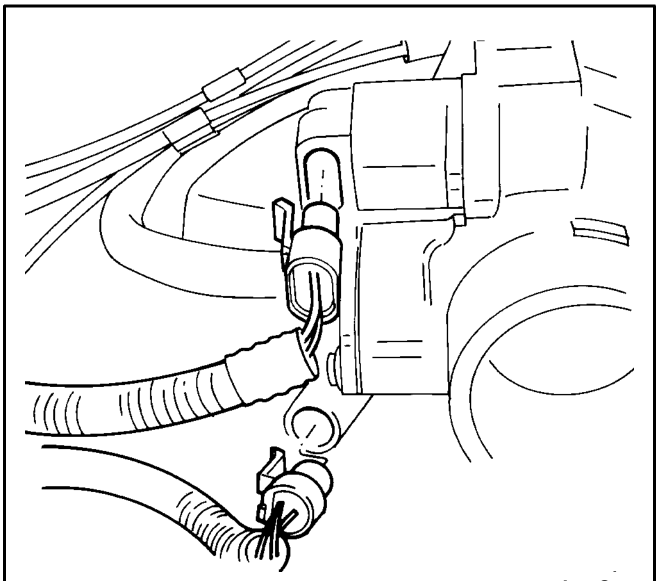
8. Discharge the air conditioning system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
9. Disconnect the manifold air temperature sensor connector.
10. Remove the air intake tube from the throttle body and air filter housing.
11. Disconnect the breather tubes from the valve cover.


A102B006

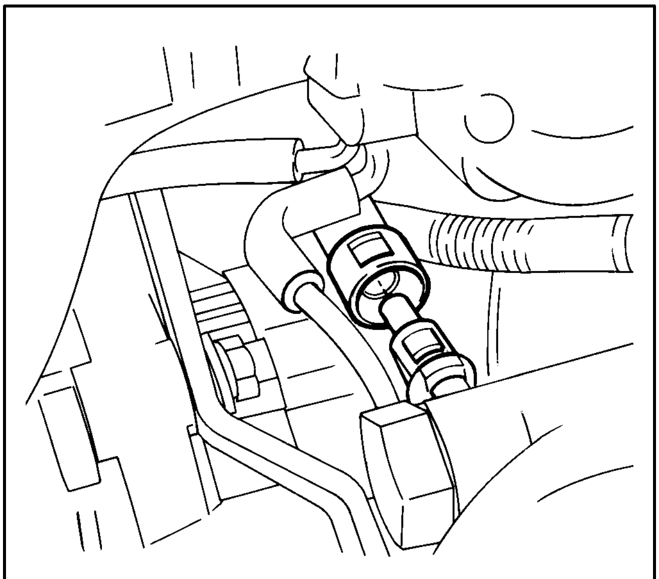
12. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
13. Remove the right front splash shield.
14. Remove the A/C compressor drive belt, if equipped.
15. Remove the alternator drive belt.
16. Remove the power steering pump pulley bolts.
17. Remove the power steering pump pulley.


A102C164

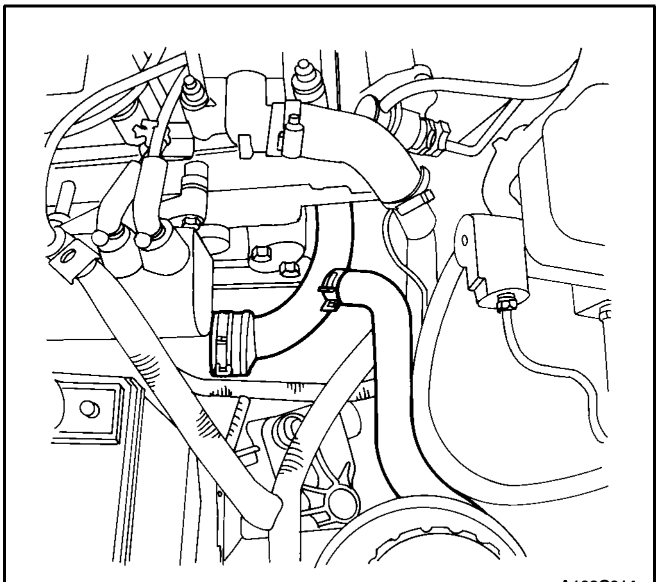
18. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
19. Remove the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
20. Disconnect the upper radiator hose from the thermostat housing.
21. Disconnect the power steering return hose from the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
22. Disconnect the power steering pressure hose from the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
23. Disconnect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold and at the starter motor.


A102C016

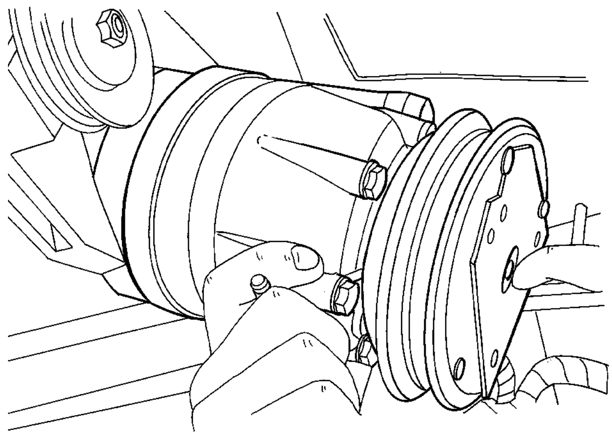
24. Disconnect the oxygen sensor connector.
25. Disconnect the fuel injector harness connectors.
26. Disconnect the idle air control valve connector.
27. Disconnect the throttle position sensor connector.
28. Disconnect the engine coolant temperature sensor connector.
29. Disconnect the coolant temperature sensor connector.
30. Disconnect the alternator voltage regulator connector.


A102C020

31. Disconnect all of the necessary vacuum lines including the brake booster vacuum hose.
32. Disconnect the fuel return line at the fuel pressure regulator.
33. Disconnect the fuel feed line at the fuel rail.

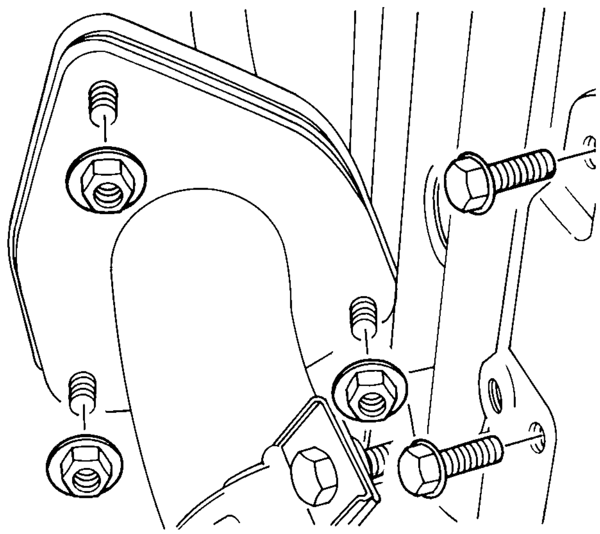

A102C014

34. Disconnect the throttle cable from the throttle body and the intake manifold bracket.
35. Disconnect the surge tank coolant hose at the throttle body.
36. Disconnect the heater outlet hose at the coolant pipe.
37. Disconnect the heater inlet hose from the cylinder head.
38. Disconnect the surge tank coolant hose from the coolant pipe.
39. Disconnect the lower radiator hose from the coolant pipe.



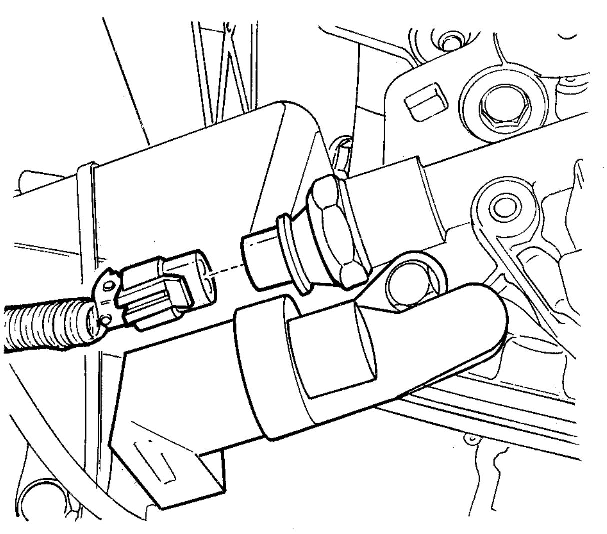
A102B025

40. Disconnect the starter solenoid "S" terminal wire.
41. Remove the A/C compressor hose assembly retaining bolt.
42. Disconnect the A/C compressor hose assembly from the compressor.
43. Disconnect the electrical connector at the A/C compressor coil.
44. Remove the A/C compressor mounting bolts.
45. Remove the A/C compressor.
46. Remove the A/C compressor mounting bracket bolts from the engine block.
47. Remove the A/C compressor mounting bracket.



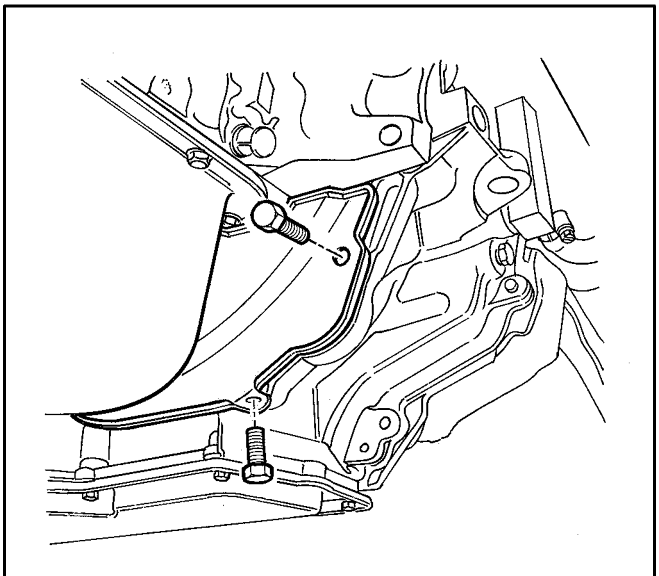
A202B004

48. Remove the exhaust flex pipe retaining nuts from the exhaust manifold studs and the bolts at the bracket.
49. Remove the exhaust flex pipe retaining nuts from the catalytic converter or the connecting pipe.
50. Remove the exhaust flex pipe.



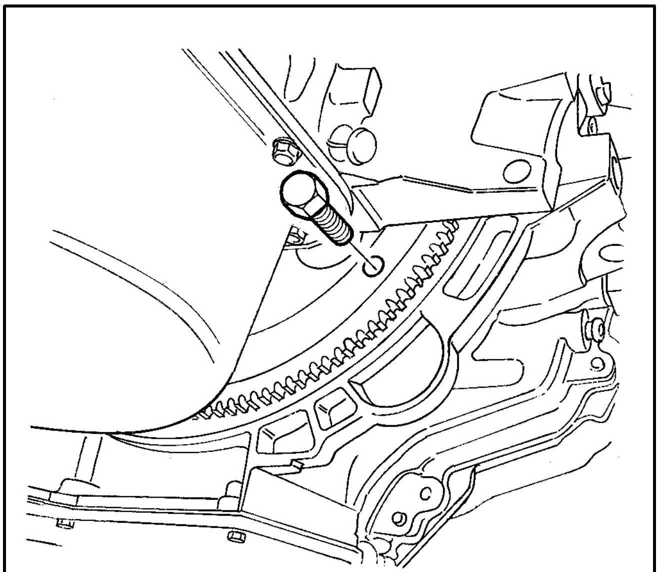
A102B019

51. Remove the crankshaft pulley bolt.
52. Remove the crankshaft pulley.
53. Disconnect the vacuum lines at the charcoal canister purge and exhaust gas recirculation (EGR) solenoid.
54. Disconnect the electrical connector at the charcoal canister purge and EGR solenoid.
55. Disconnect the electrical connector at the oil pressure switch.
56. Disconnect the crankshaft position sensor and the knock sensor connectors.
57. Remove the crankshaft position sensor retaining bolt.
58. Remove the crankshaft position sensor.



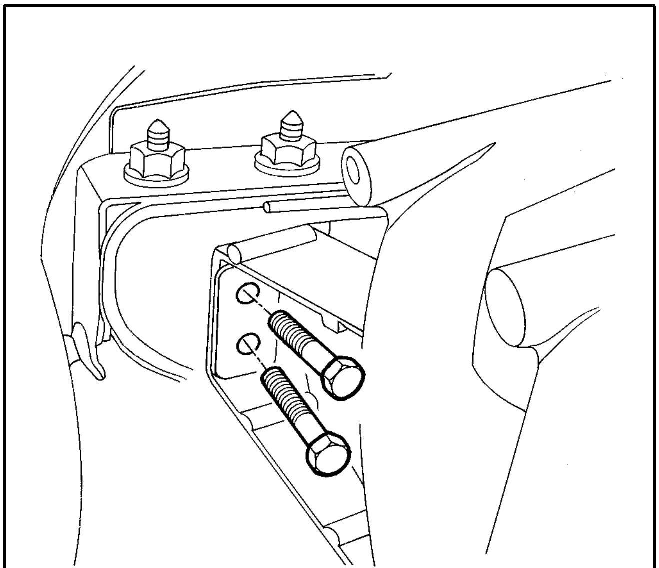
A102B021

59. Remove the right transaxle brace bolts from the transmission.
60. Remove the flywheel or flexible plate inspection cover bolts.
61. Remove the flywheel or flexible plate inspection cover.



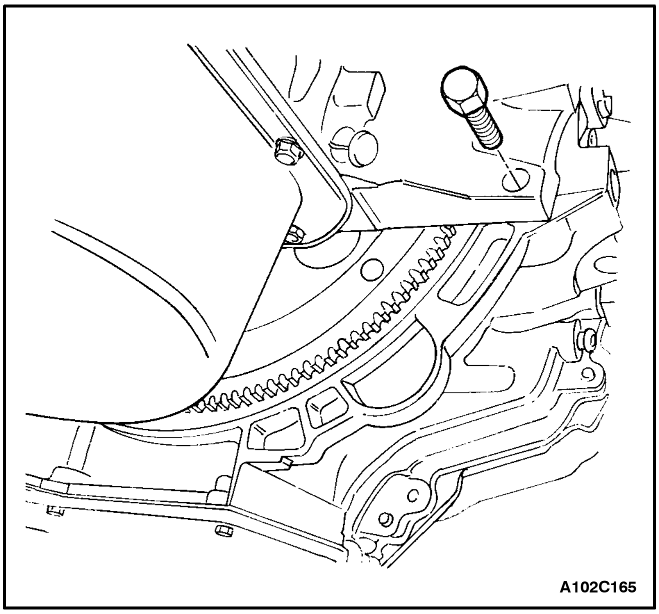
A102B022

62. Remove the transaxle torque converter bolts, if automatic transaxle equipped.
63. Remove the transmission/transaxle bell housing bolts.
64. Support the transmission with a floor jack.
65. Install the engine lifting device.



A102B020

66. Disconnect the right engine mount bracket from the engine mount by removing the retaining bolts.
67. Remove the right engine mount bracket from the engine block.
68. Separate the engine block from the transmission.
69. Remove the engine.

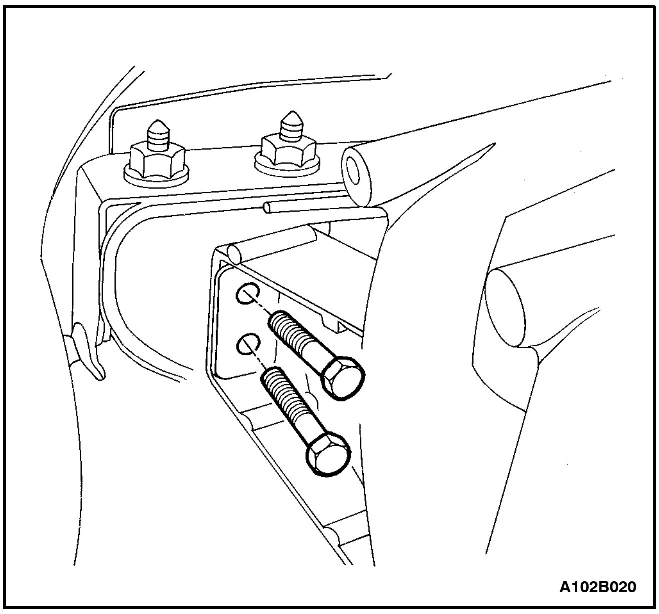


Installation Procedure

1. Install the engine into the engine compartment.
2. Align the engine alignment pins to the transmission.
3. Install the transmission/transaxle bell housing bolts.

   Tighten

   Tighten the transmission/transaxle bell housing bolts to 75 NSm (55 lb-ft).



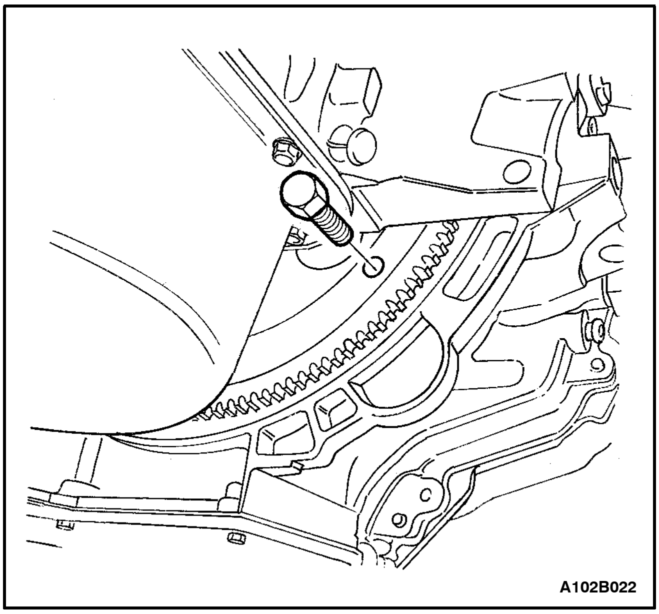
4. Install the right engine mount bracket to the engine block.
5. Install the right engine mount bracket retaining bolts.

   Tighten

   Tighten the right engine mount bracket retaining bolts to 60 NSm (44 lb-ft).
6. Connect the right engine mount bracket to the engine mount by installing the two retaining bolts.

   Tighten

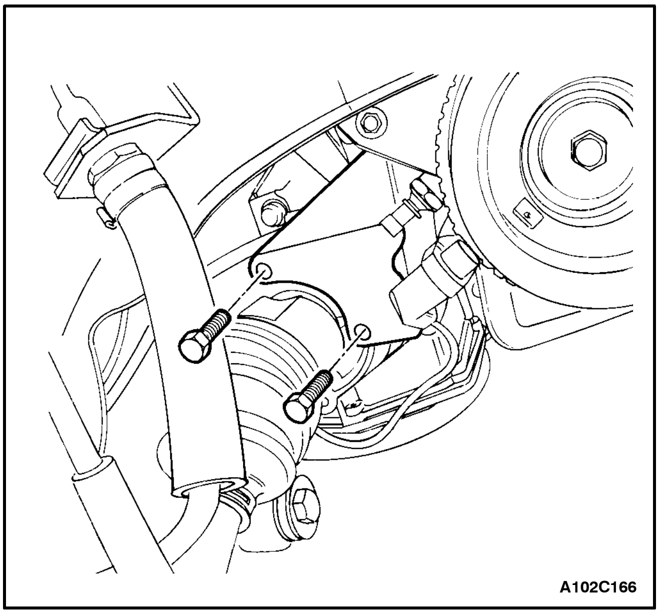
   Tighten the right engine mount-to-engine mount bracket retaining bolts to 60 NSm (44 lb-ft).



7. Remove the floor jack used for support of the transmission.
8. Remove the engine lifting device.
9. Install the transaxle torque converter bolts, if automatic transaxle equipped.

   Tighten

   Tighten the transaxle torque converter bolts to 65 NSm (48 lb-ft).



A102C166

10. Install the flywheel or flexible plate inspection cover.
11. Install the flywheel or flexible plate inspection cover bolts.

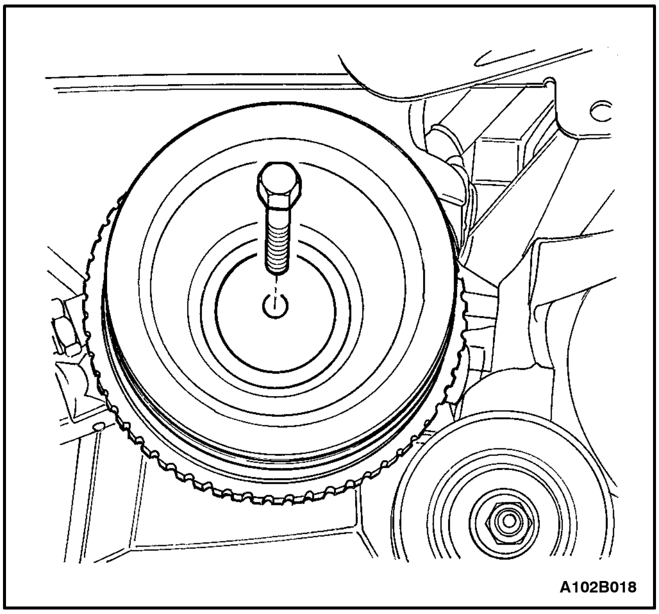
Tighten

Tighten the flywheel inspection cover bolts to 12 N•m (106 lb-in) or the flexible plate inspection cover bolts to 10 N•m (89 lb-in).

12. Install the right transaxle brace bolts to the transmission.

Tighten

Tighten the right transaxle brace bolts to 40 N•m (30 lb-ft).

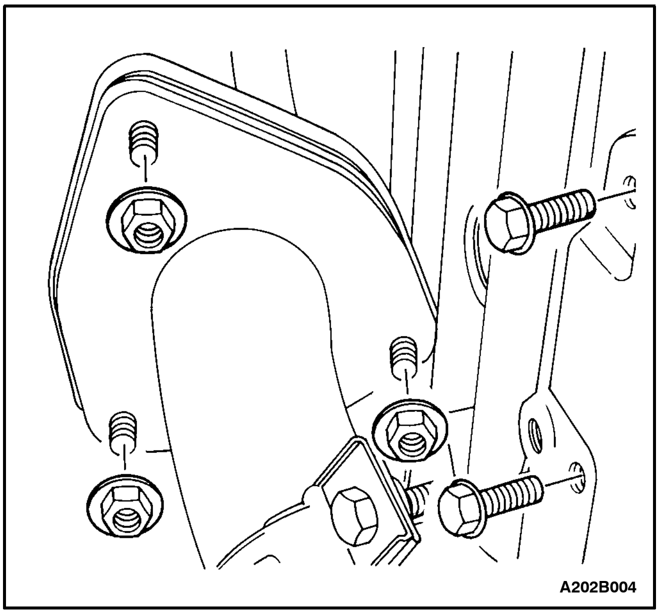


A102B018

13. Connect the vacuum lines at the charcoal canister purge and EGR solenoid.
14. Connect the electrical connector charcoal canister purge and EGR solenoid.
15. Connect the oil pressure switch connector.
16. Install the crankshaft pulley.
17. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.



A202B004

18. Install the crankshaft position sensor and the crankshaft position sensor retaining bolt.

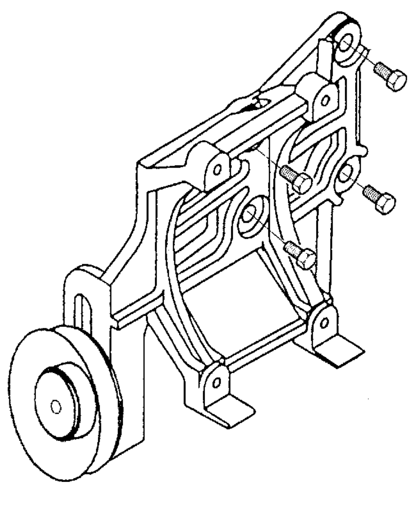
Tighten

Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).

19. Connect the crankshaft position sensor and the knock sensor connectors.
20. Install the exhaust flex pipe.
21. Install the exhaust flex pipe retaining nuts to the exhaust manifold studs and the bolts at the bracket.

Tighten

Tighten the exhaust flex pipe retaining nuts and the bolts at the bracket to 40 N•m (30 lb-ft).



A12C167A

22. Install the exhaust flex pipe retaining nuts to the catalytic converter.

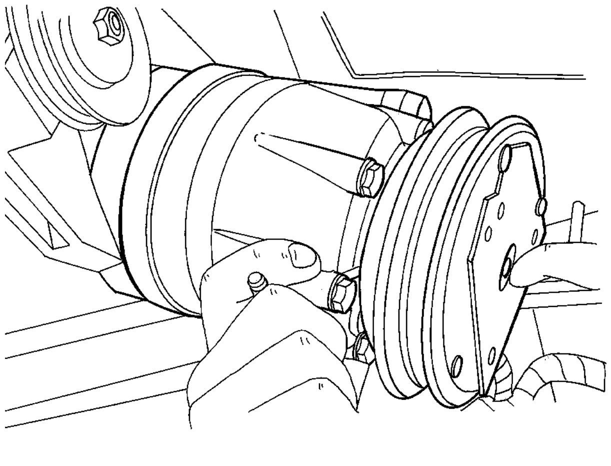
Tighten

Tighten the exhaust flex pipe retaining nuts to the catalytic converter on the connecting pipe or the connecting pipe to 30 N·m (22 lb-ft).

23. Connect the power steering pressure hose, if equipped. Refer to Section 6A, Power Steering System.
24. Connect the power steering return hose, if equipped. Refer to Section 6A, Power Steering System.
25. Install the A/C compressor mounting bracket, if equipped.
26. Install the A/C compressor mounting bracket bolts, if equipped.

Tighten

Tighten the A/C compressor mounting brackets bolts to 50 N·m (37 lb-ft).

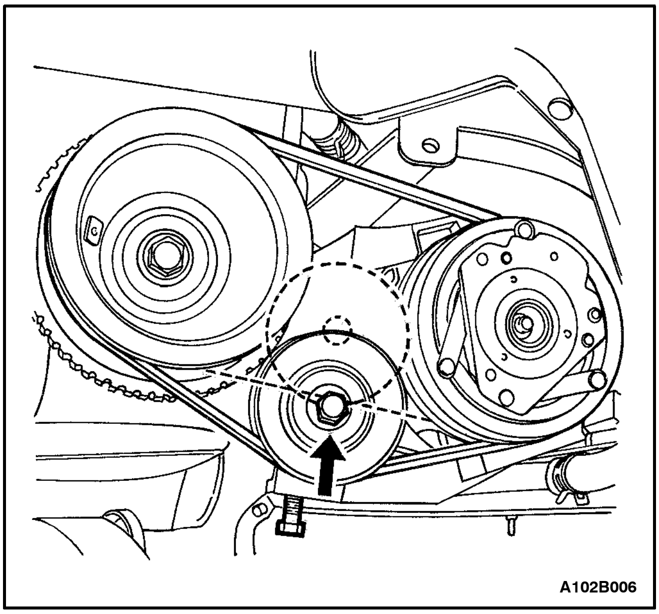


A102B025

27. Install the A/C compressor, if equipped.
28. Install the A/C compressor mounting bolts, if equipped.

Tighten

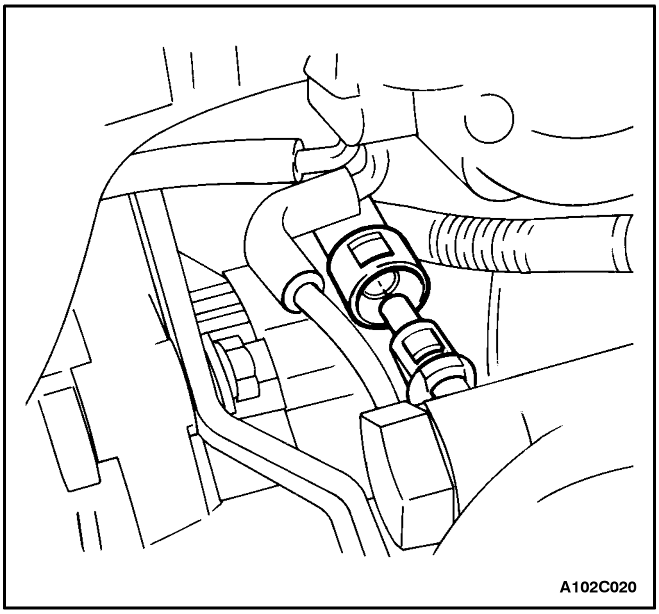
Tighten the A/C compressor mounting bolts to 27 N·m (20 lb-ft).



29. Connect the A/C compressor coil connector, if equipped.
30. Install the alternator drive belt.
31. Install the A/C compressor drive belt, if equipped.
32. Connect the A/C compressor hose assembly and the A/C compressor hose assembly retaining bolt, if equipped.

Tighten

Tighten the A/C compressor hose assembly retaining bolt to 33 NSm (24 lb-ft).

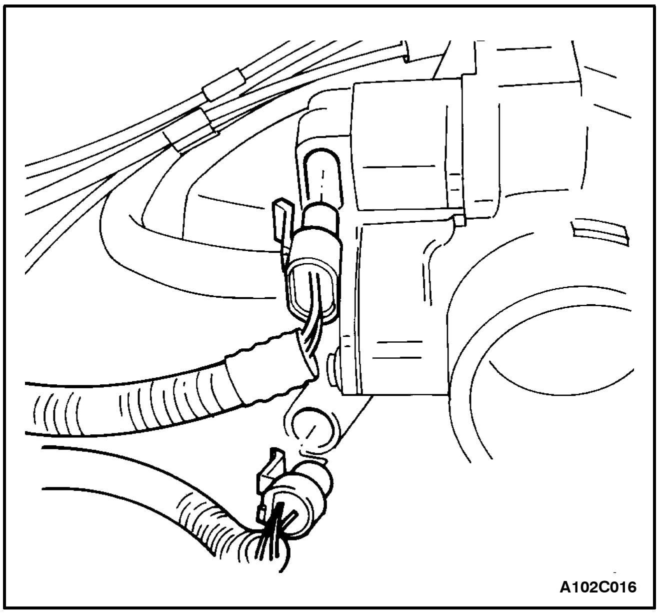


33. Install the power steering pump pulley, if equipped.
34. Install the power steering pump pulley bolts, if equipped.

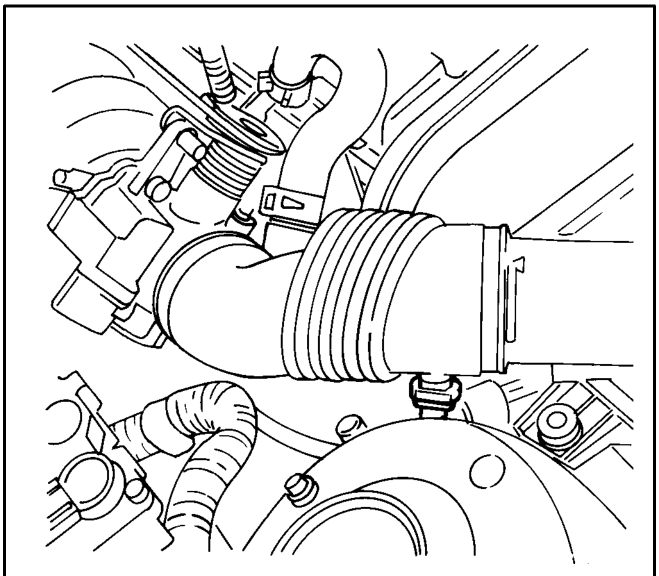
Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

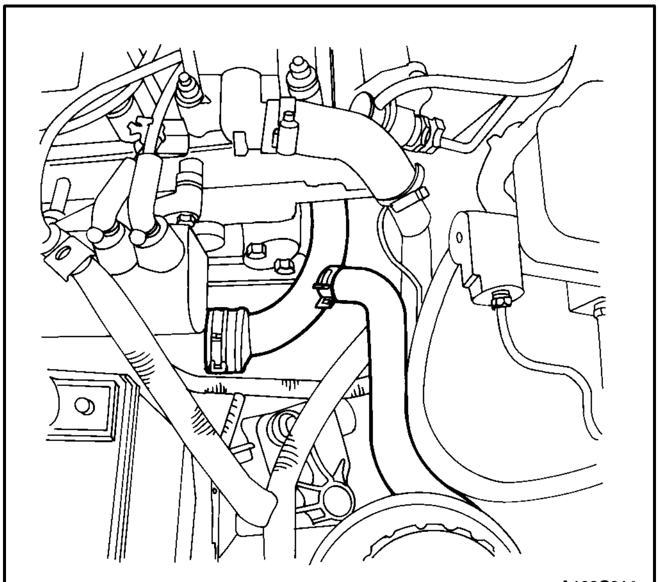
35. Install the right front splash shield.
36. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
37. Connect the fuel feed line to the fuel rail.
38. Connect the fuel return line to the fuel pressure regulator.



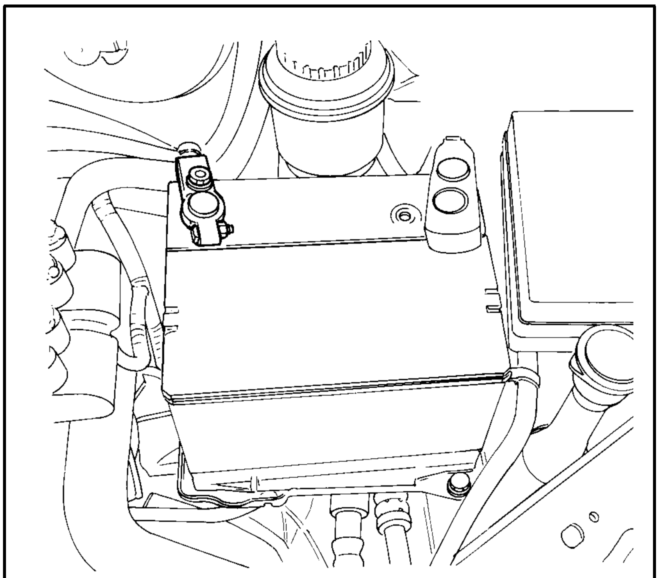
39. Connect all of the necessary vacuum lines including the brake booster vacuum hose.
40. Connect the oxygen sensor connector.
41. Connect the starter solenoid “S” terminal wire.
42. Connect the alternator voltage regulator connector.
43. Connect the coolant temperature sensor connector.
44. Connect the engine coolant temperature sensor connector.
45. Connect the throttle position sensor connector.
46. Connect the idle air control valve connector.


A102C057

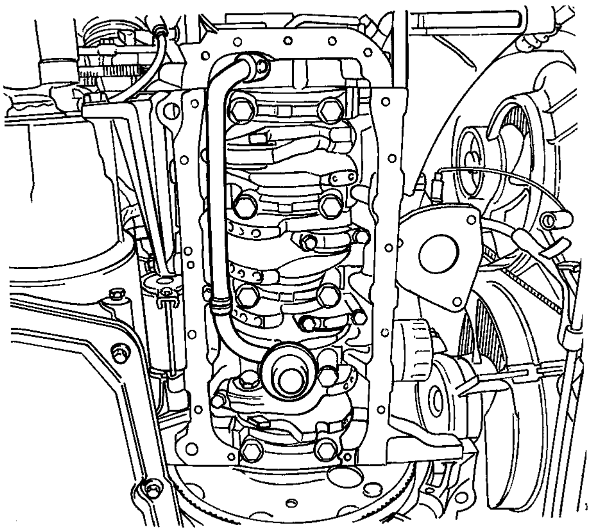
47. Connect the fuel injector harness connectors.
48. Connect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold and the starter motor.
49. Install the air intake tube between the throttle body and the air filter housing.
50. Connect the breather tubes to the valve cover.
51. Connect the manifold air temperature sensor connector.
52. Install the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.


A102C014

53. Connect the lower radiator hose to the coolant pipe.
54. Connect the upper radiator hose to the thermostat housing.
55. Connect the heater inlet hose to the cylinder head.
56. Connect the heater outlet hose to the coolant pipe.
57. Connect the coolant surge tank hose to the coolant pipe.
58. Connect the surge tank coolant hose to the throttle body.


A102C034

59. Connect the throttle cable to the throttle body and the intake manifold bracket.
60. Install the fuel pump fuse.
61. Connect the negative battery cable to the vehicle frame.
62. Connect the negative battery cable.
63. Connect and assemble the positive battery cable.
64. Refill the engine crankcase with engine oil.
65. Refill the engine coolant system. Refer to Section 1D, Engine Cooling.
66. Bleed the power steering system, if equipped. Refer to Section 6A, Power Steering System.
67. Refill the A/C refrigerant system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
68. Install the hood. Refer to Section 9R, Body Front End.



A102B094

PISTONS AND RODS

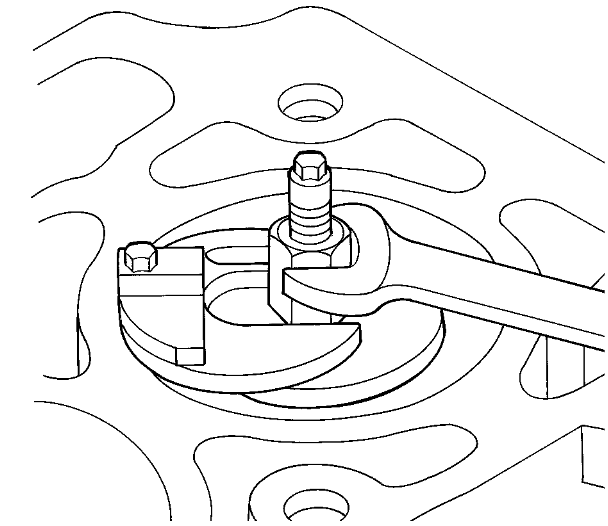
Tools Required

KM-427 Piston Pin Service Set

KM 470-B Angular Torque Gauge

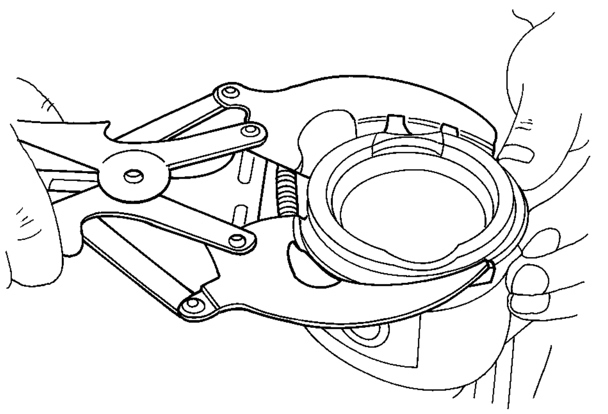
Removal Procedure

1. Remove the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the oil pan. Refer to "Oil Pan" in this section.
3. Remove the oil pump/pickup tube bolts.
4. Remove the oil pump/pickup tube.



A102B079

5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap for position.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.



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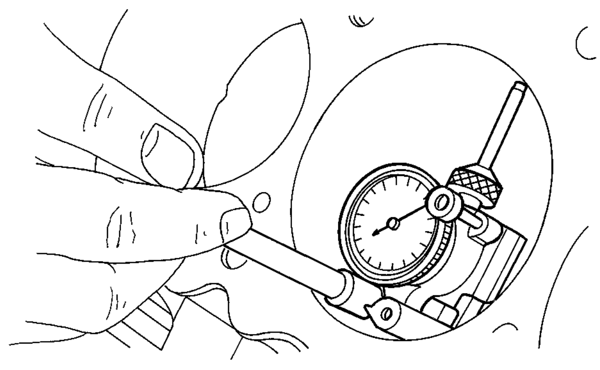
Caution: Use care when handling the piston. Worn piston rings are sharp and may cause injury.

11. Remove the piston.
12. Use a piston ring expander tool to expand the piston rings.
13. Remove the piston rings.



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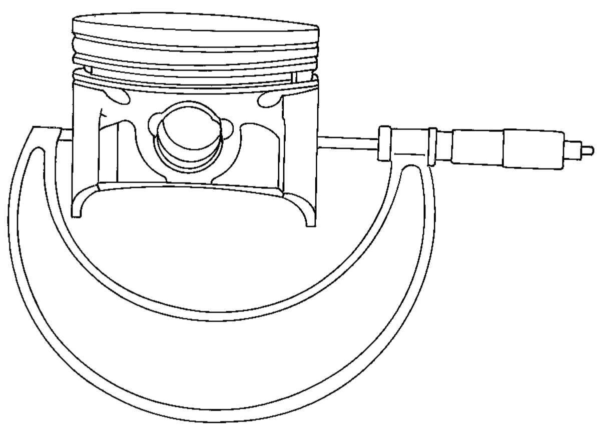
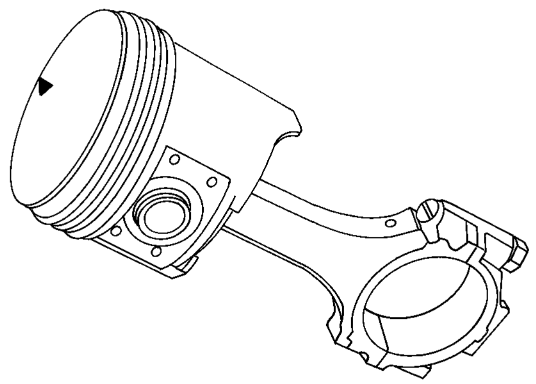
14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.



A102B087

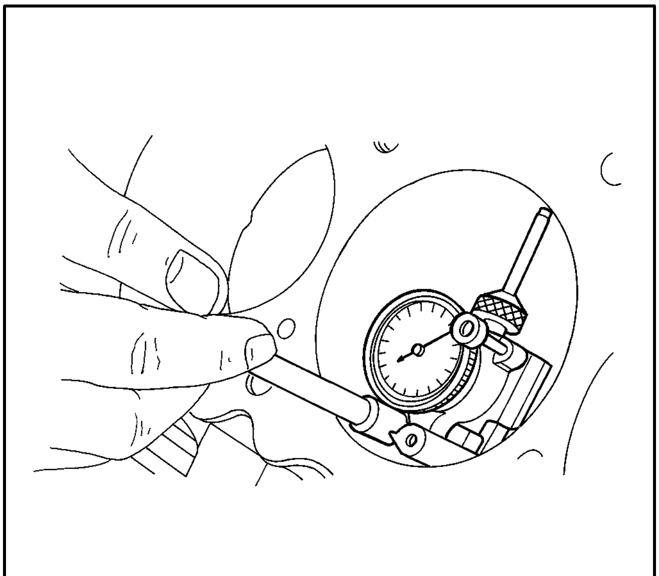
Inspection Procedure

1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the crankshaft rod bearing journal for wear. Refer to “Engine Specifications” in this section.
6. Inspect the piston for scoring, cracks, and wear.
7. Inspect the piston for taper using a micrometer.

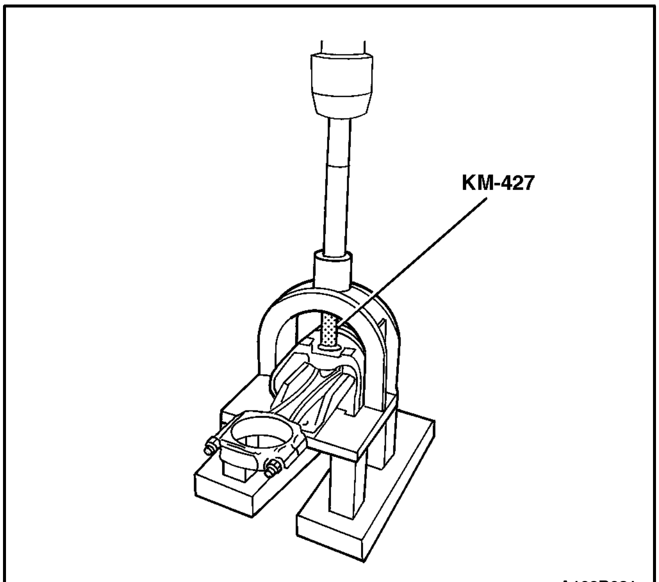


A102B082

8. Inspect the piston for fit to the connecting rod.


A102B083

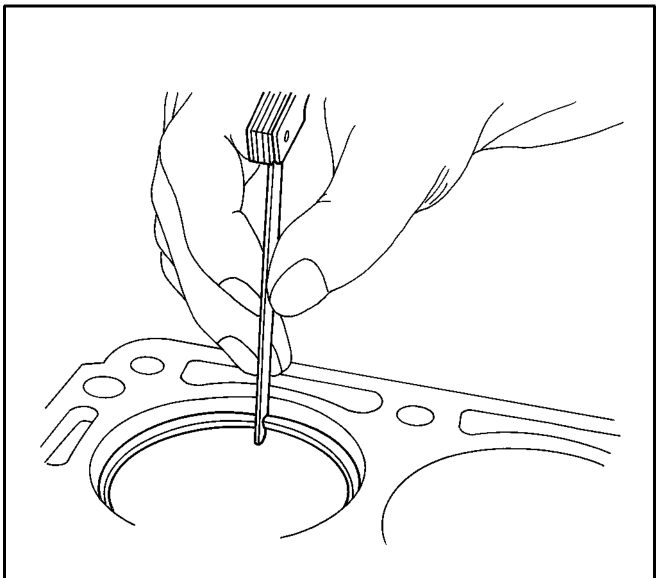
9. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to "Engine Specifications" in this section.
10. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to "Engine Specifications" in this section. If the bearing bore is beyond specifications, replace the engine block.
11. Inspect the engine block cylinder bore for wear, runout, ridging and taper using a bore gauge. Refer to "Engine Specifications" in this section.
12. Inspect the engine block cylinder bore for glazing. Lightly hone the cylinder bore as necessary.



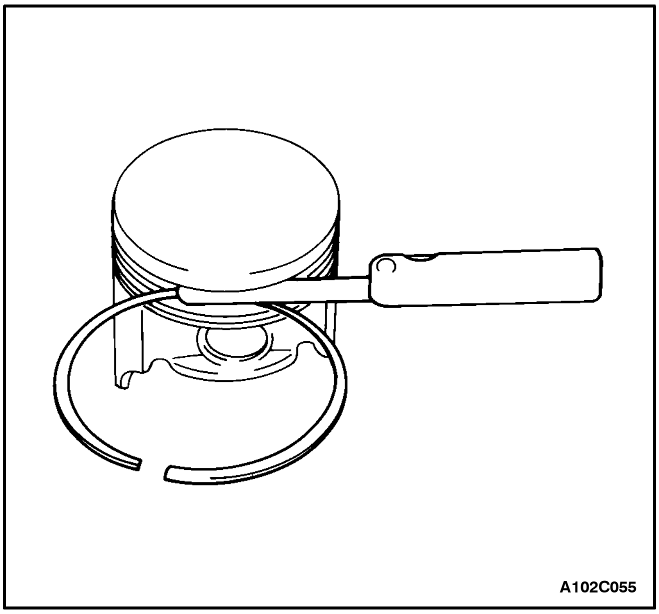
A102B081

Installation Procedure

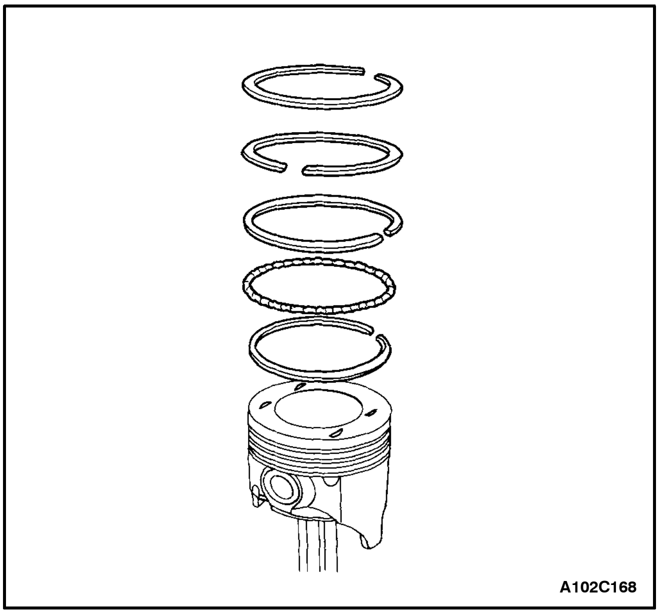
1. Align the notch on the piston and connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.
5. Install the piston pin into the piston and connecting rod assembly using the piston pin service set KM-427.


A102B084

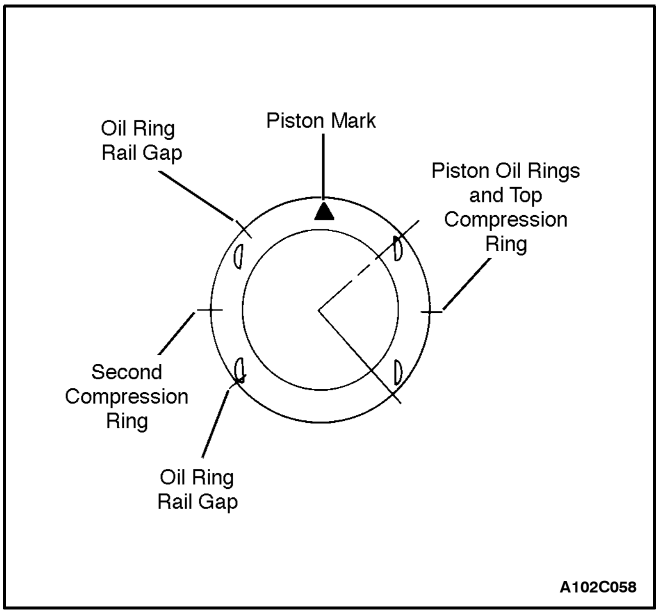
6. Select a set of new piston rings.
7. Measure the piston ring gap using a feeler gauge. Refer to "Engine Specifications" in this section.
8. Increase the piston ring gap by carefully filing off excess material if the piston ring gap is below specifications.



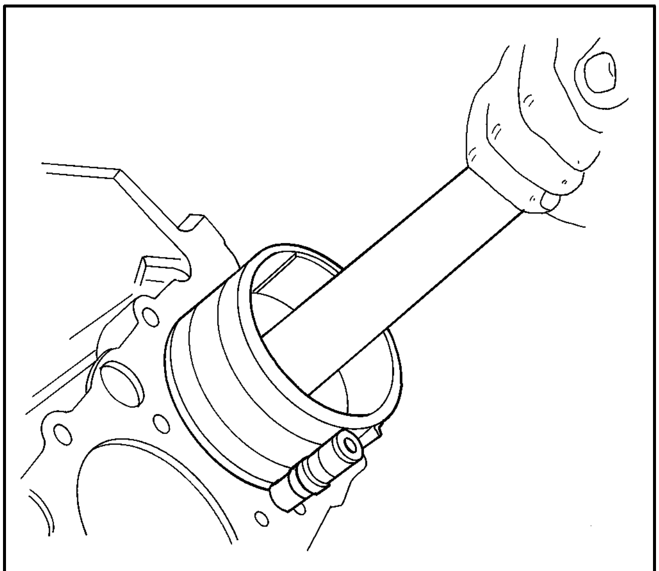
9. Measure the piston ring side clearance using a feeler gauge. Refer to "Engine Specifications" in this section.
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed on a sheet of glass.



12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.

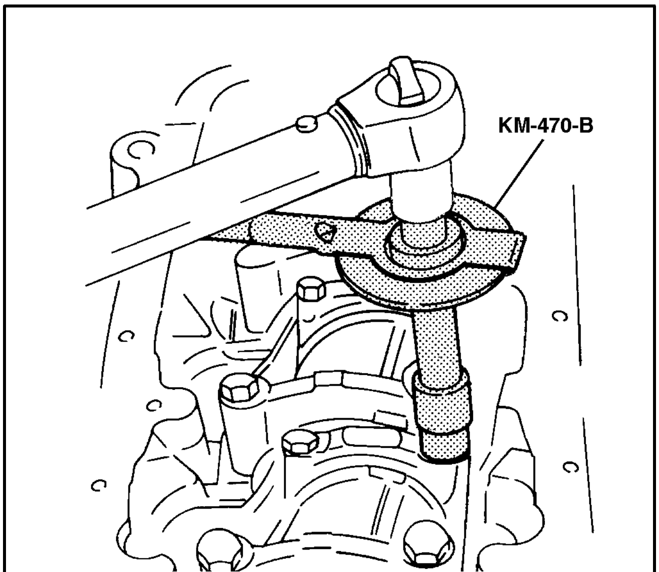


15. Use a piston ring expander to install the piston rings. Do not expand the piston rings beyond the expansion necessary for installation.
16. Stagger the piston oil rings, the oil ring rail gaps, the second compression ring, and the top compression ring in relation to the notch on the top of the piston.



A102B088

17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using a ring compressor and a wood handle. Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and bearings. Refer to "Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic" in this section.

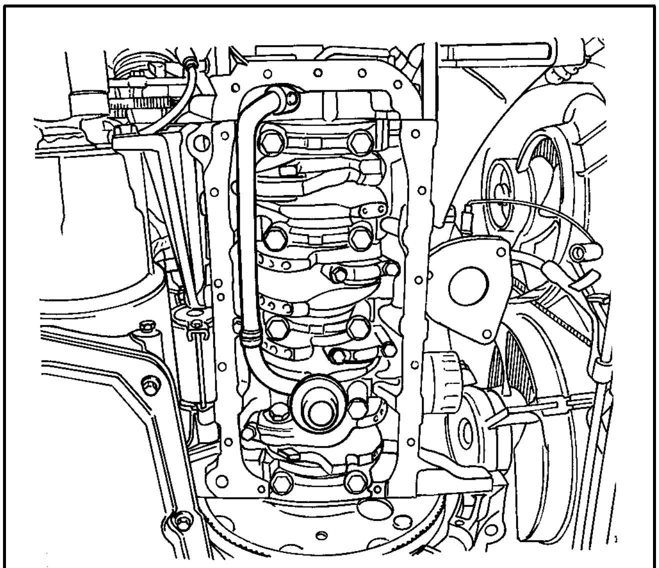


A102C151

20. Install the connecting rod cap bolts.

Tighten

Tighten the connecting rod cap bolts to 25 N•m (18 lb-ft). Using the angular torque gauge KM 470-B, tighten the bolts one turn of 30 degrees plus one turn of 15 degrees.



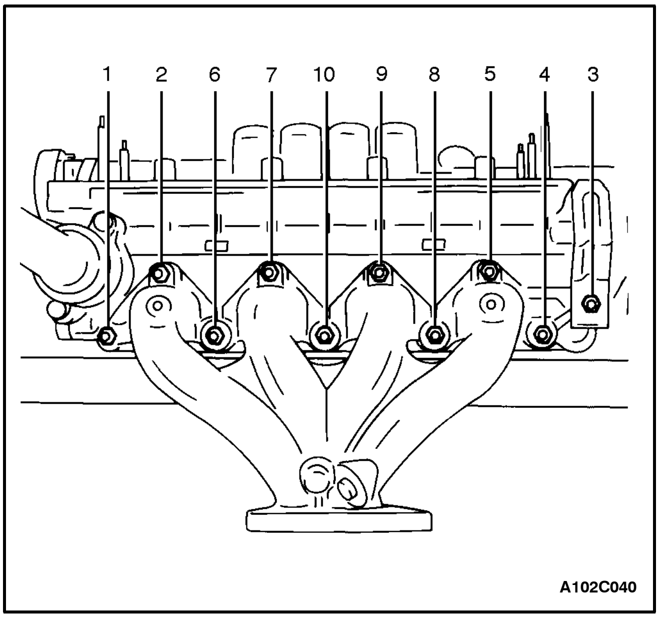
A102B094

21. Install the oil pump/pickup tube.
22. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pickup tube bolts to 10 N•m (89 lb-in).

23. Install the oil pan. Refer to "Oil Pan" in this section.
24. Install the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.



UNIT REPAIR

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

Tools Required

MKM-571-B Gauge

KM-340-0 Cutter Set

KM-340-7 Guide Drift

KM-340-13 Cutters

KM-340-26 Cutters

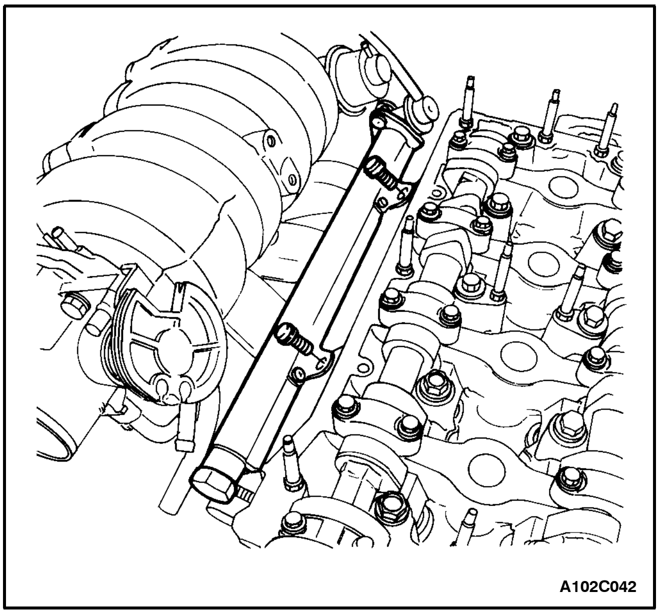
KM-348 Valve Spring Compressor

KM-653 Adapter

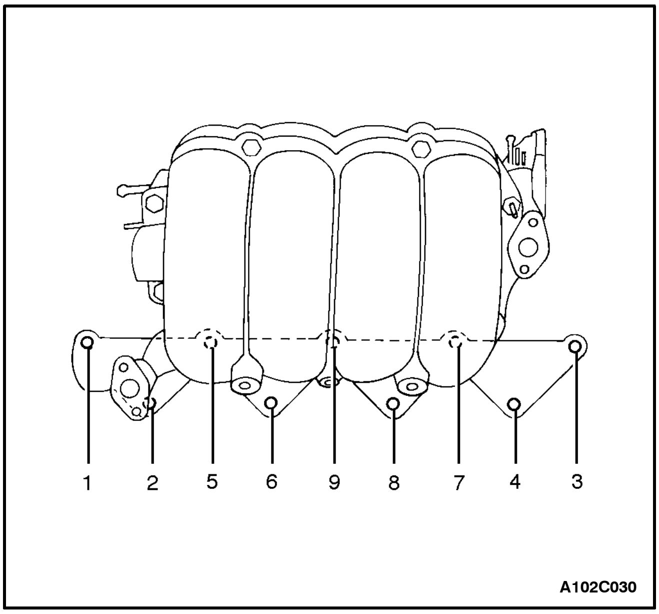
KM-805 Reamer

Disassembly Procedure

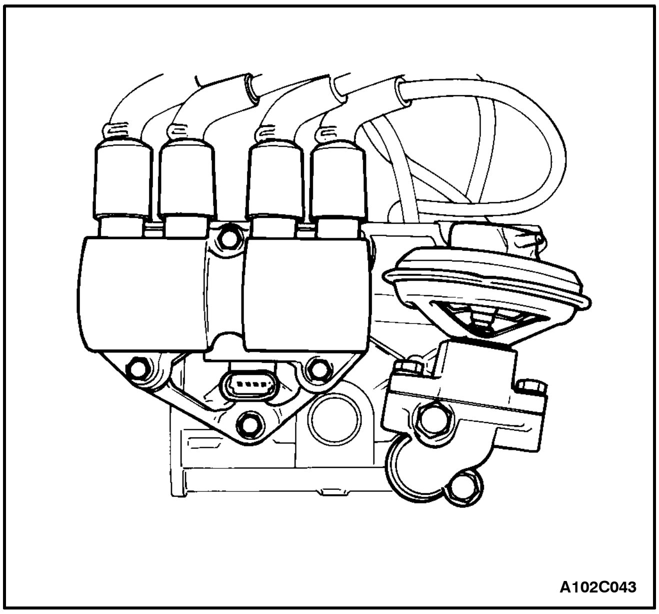
1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the coolant temperature sensor.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold retaining nuts in the sequence shown.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.



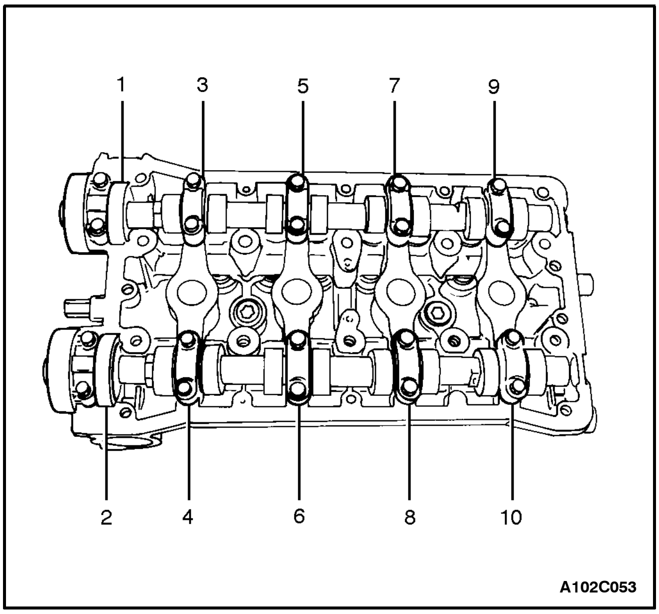
9. Remove the thermostat housing mounting bolts.
10. Remove the thermostat housing assembly.
11. Remove the fuel rail retaining bolts and the fuel rail assembly.



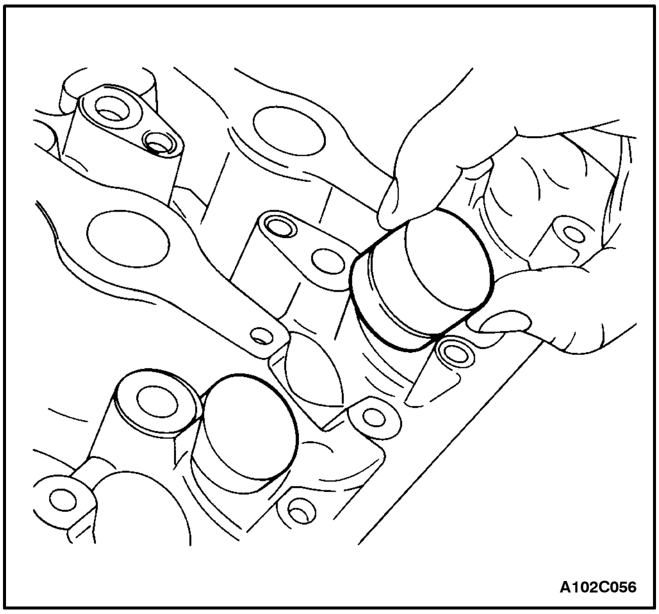
12. Remove the intake manifold retaining nuts and retaining bolts in the sequence shown.
13. Remove the intake manifold.
14. Remove the intake manifold gasket.
15. Remove the intake manifold studs.



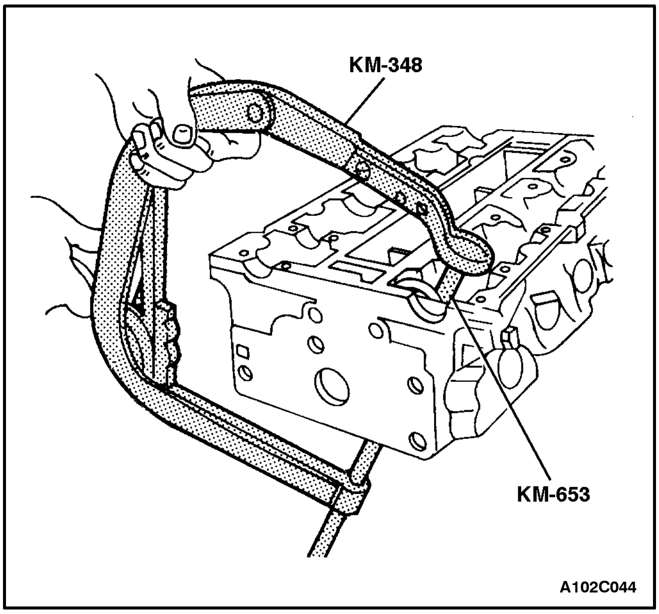
16. Remove the DIS ignition coil mounting bolts.
17. Remove the DIS ignition coil with the ignition wires attached.
18. Remove the DIS ignition coil mounting bracket bolts.
19. Remove the DIS ignition coil mounting bracket.
20. Remove the exhaust gas recirculation valve adapter bolts.
21. Remove the exhaust gas recirculation valve adapter.
22. Remove the exhaust gas recirculation valve adapter gasket.
23. Remove the spark plugs.



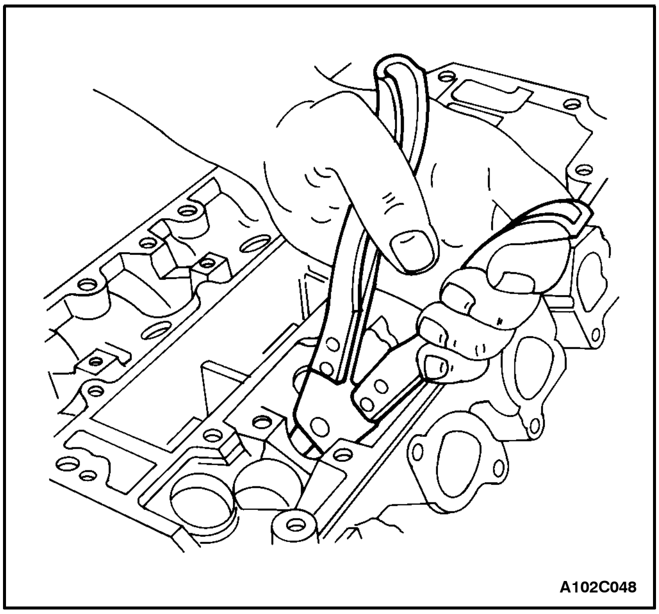
24. Remove the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.



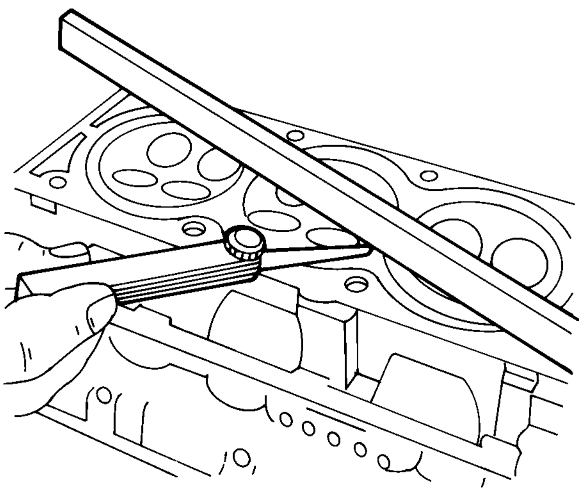
25. Remove the intake camshaft caps. Maintain the correct positions for installation.
26. Remove the intake camshaft.
27. Remove the intake valve lash adjusters.
28. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
29. Remove the exhaust camshaft.
30. Remove the exhaust valve lash adjusters.



31. Compress the valve springs with the valve spring compressor KM-348 and the adapter KM-653.
32. Remove the valve retainers.
33. Remove the valve spring compressor KM-348 and the adapter KM-653.
34. Remove the valve spring caps.
35. Remove the valve springs. Maintain the original position of the valves springs for installation.



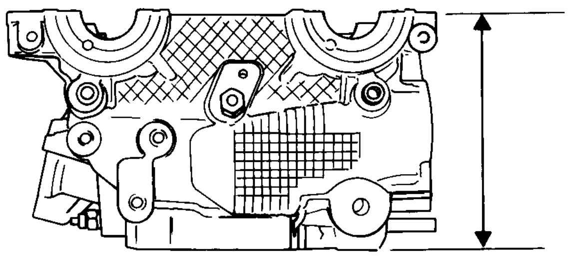
36. Remove the valves. Maintain the original position of the valves for installation.
37. Remove the valve stem seals.



A102C046

Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by.
3. Inspect the cylinder head for cracks.
4. Inspect the length and width of the cylinder head using a feeler gauge and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within 0.050 mm (0.002 inch) maximum.



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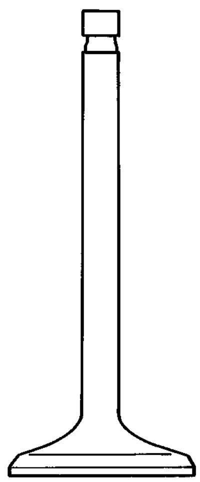
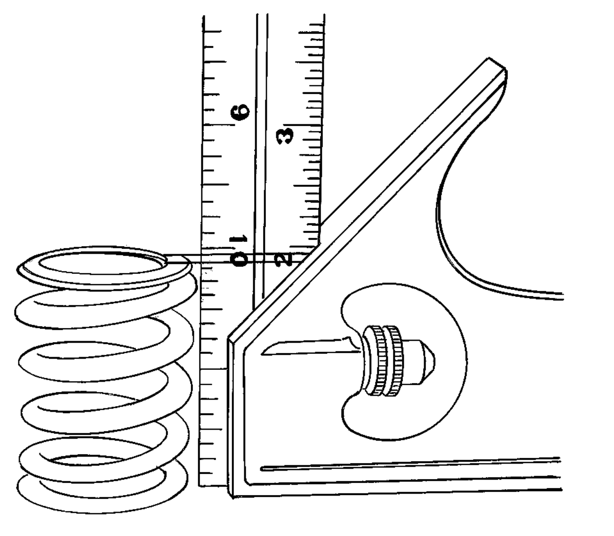
6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 138.13 to 138.18 mm (5.438 to 5.440 inches). If the cylinder head height is less than 138.13 mm (5.438 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Valve seats for excessive wear and burned spots.



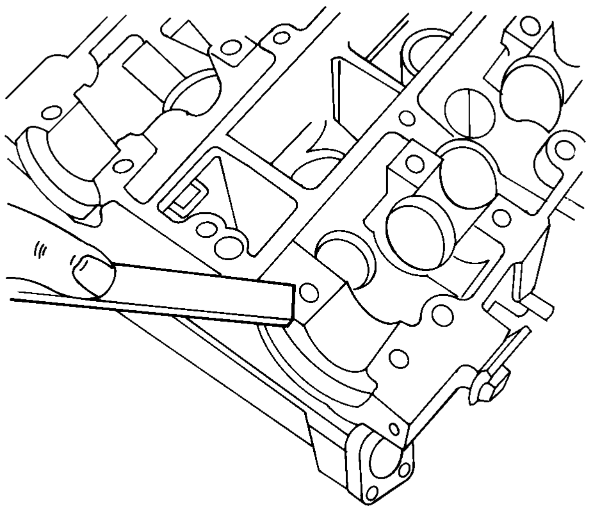
A102B054

Valve Inspection

1. Inspect the valve stem tip for wear.
2. Inspect the valve retainer grooves and the oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.
4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep that refacing the valve would result in a sharp edge, replace the valve.


A102B023

7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to "Engine Specifications" in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.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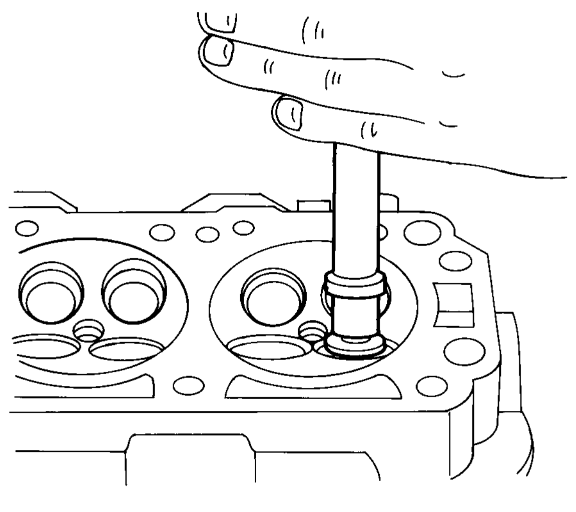
Cleaning Procedure

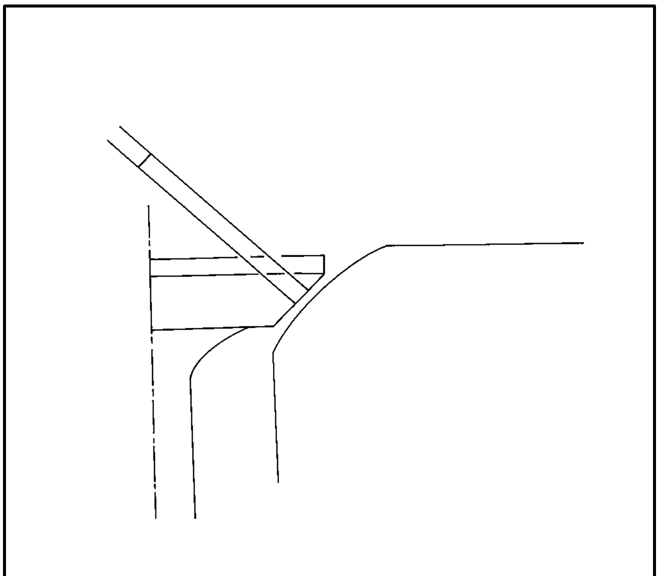
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil and varnish.


A102C049

Cylinder Head Overhaul

Valve Grind-in

1. Lubricate the valve stem using a fine-grained paste.
2. Lift the valve rhythmically from the seat with a commercially-available valve grinding tool in order to distribute the paste.



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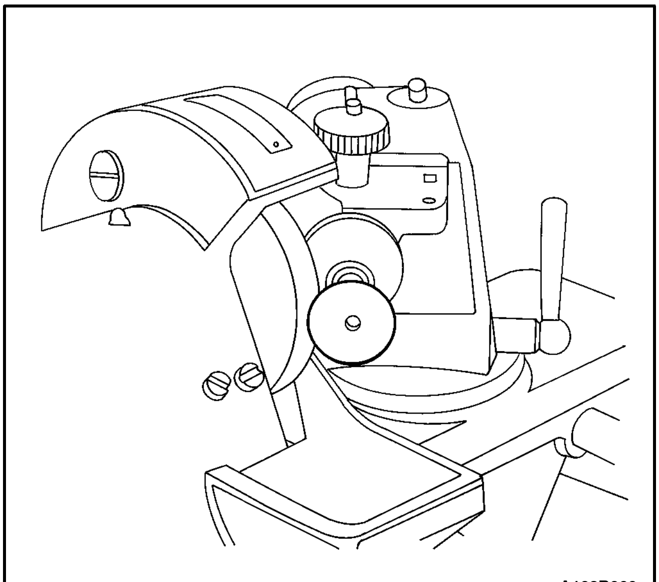
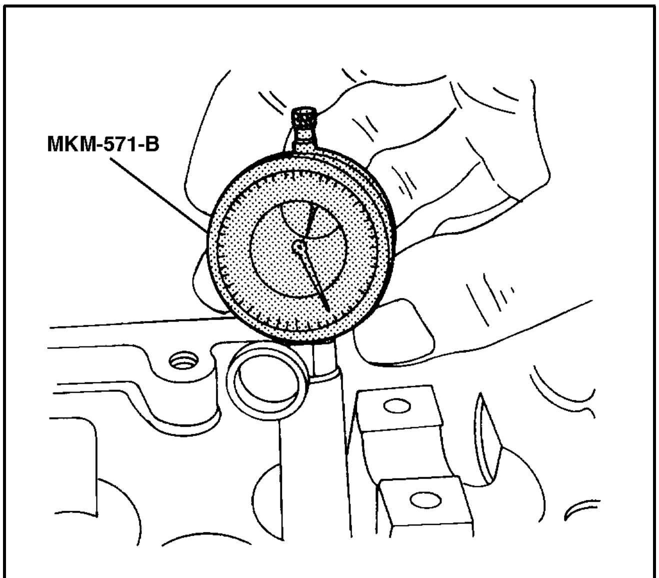
3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.



A102B066

Valve Grind

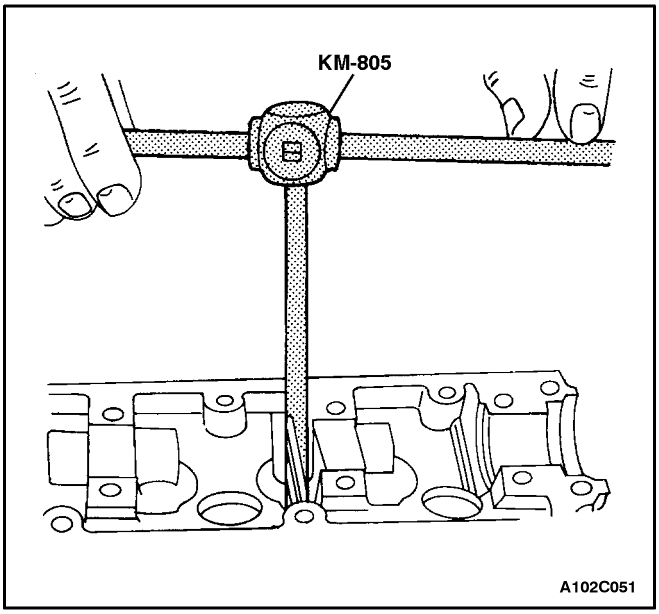
1. Ensure that there are no crater line burns on the valve cone.
2. The valve may be reground only two times. Do not grind the valve stem end.
3. The angle at the valve face is 45 degrees.
4. Inspect the assembly height of the intake valves and the exhaust valves.



A102C050

Valve Guide - Ream

1. Measure the diameter of the valve guide using gauge MKM-571-B and a commercially-available inside micrometer.

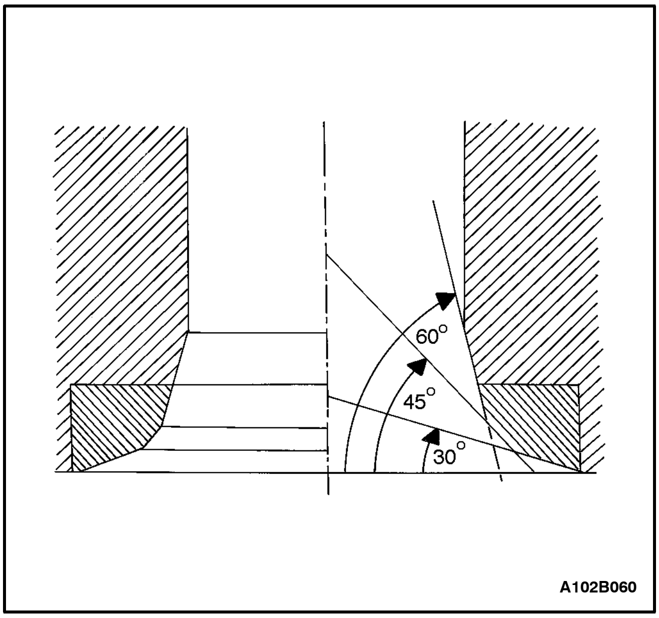


Important: Valve oversizes may already have been fitted in production.

2. An oversize service code is on the valve guide and the valve stem end. The following table gives the correct size, reamer, and production code for each service.

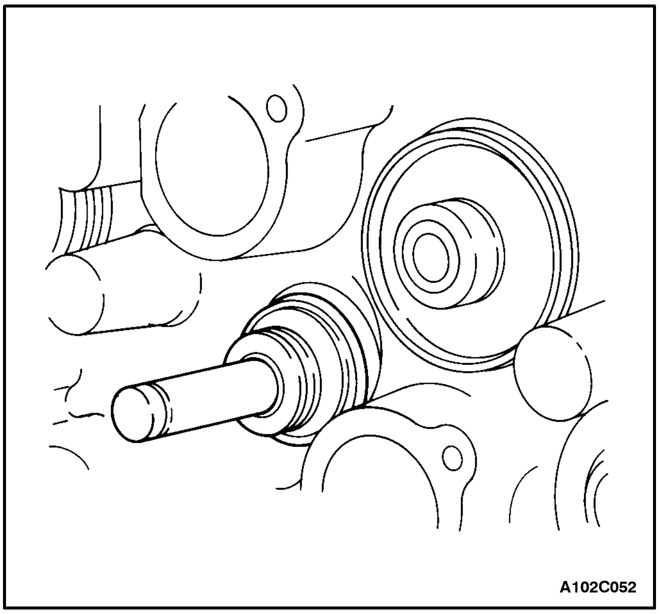
Size	Reamer	Production Code	Service Code
Normal	—	—	K
0.075	KM-805	1	K1
0.150		2	K2

3. Ream the valve guide from the upper side of the cylinder head to the next oversize.
4. After reaming, cross out the code and emboss the valve guide with the new code.



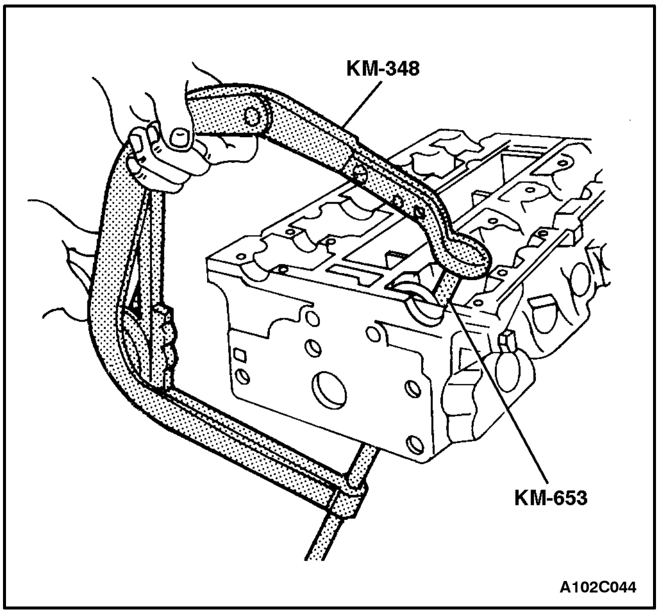
Valve Seat - Cut

1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the guide drift KM-340-7 as follows:
   - Valve seat: * 45 degrees side using the cutter KM-340-13.
   - Upper correction angle: * 30 degrees side using the cutter KM-340-13.
   - Lower Correction Angle: * 60 degrees using cutter KM-340-26.
3. Clean the chippings from the cylinder head.
4. Inspect the dimension for the valve seat width.
   - Intake: 1.17 to 1.57 mm (0.046 to 0.062 inch).
   - Exhaust: 1.07 to 1.47 mm (0.042 to 0.058 inch).
5. Inspect the assembly height of the intake valves and the exhaust valves.
6. If the dimension is exceeded, install new valves. Inspect the assembly height of the intake valves and the exhaust valves again.
7. If the valve assembly height is still too large despite replacing the valves, replace the cylinder head.

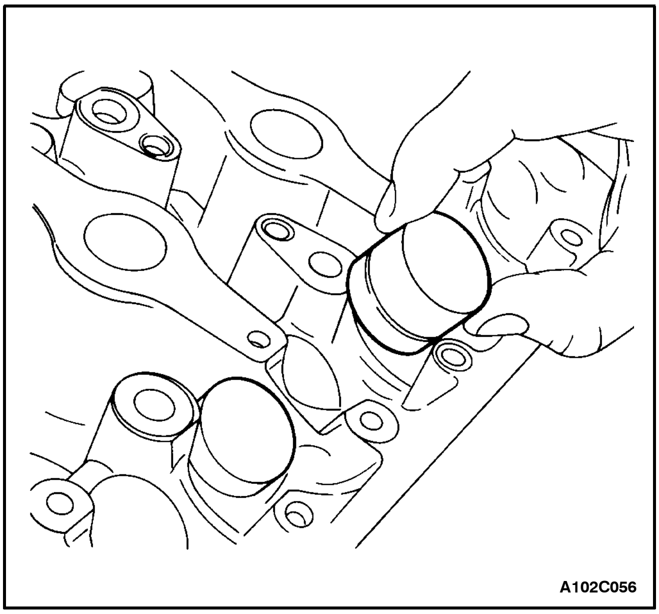


Assembly Procedure

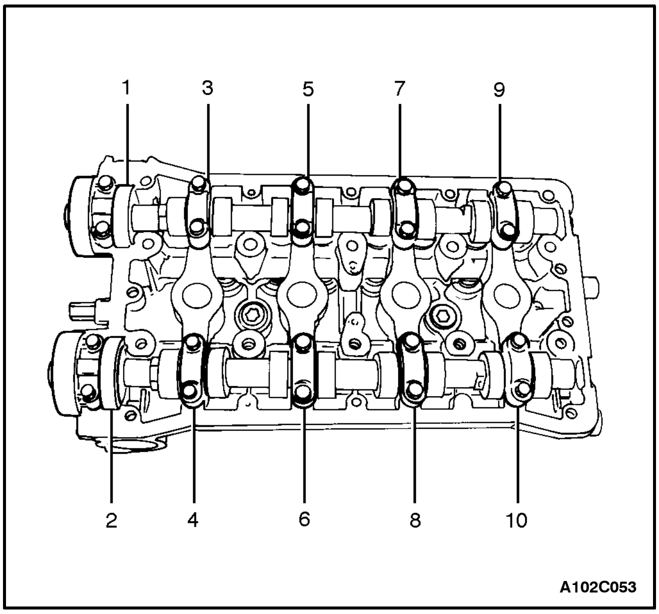
1. Install the valve stem seals.
2. Lubricate the valve stems with engine oil.
3. Carefully install the valves in their original positions. Do not damage the valve stem seals.
4. Install the valve springs in their original positions.
5. Install the valve spring caps.



6. Compress the valve springs with the valve spring compressor KM-348 and adapter KM-653.
7. Install the valve retainers.
8. Remove the valve spring compressor KM-348 and adapter KM-653.



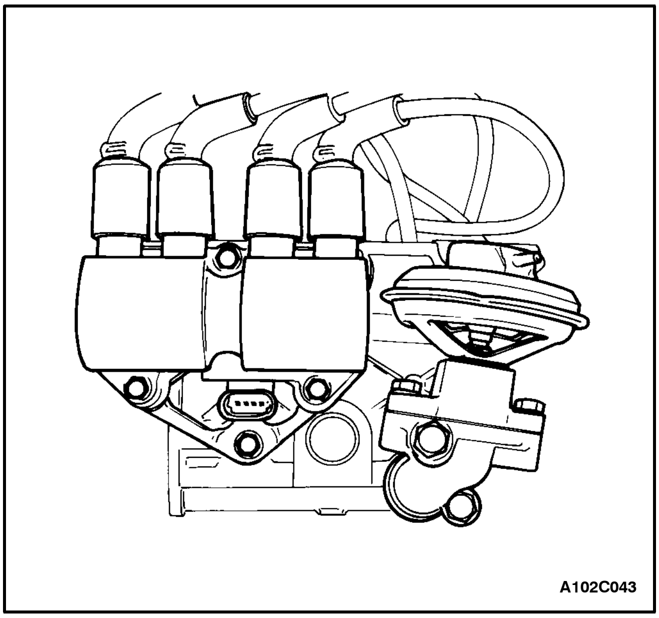
9. Lubricate the valve lash adjusters with engine oil.
10. Install the valve lash adjusters.



11. Install the intake camshaft.
12. Install the intake camshaft caps in their original positions.
13. Install the exhaust camshaft.
14. Install the exhaust camshaft caps in their original positions.
15. Install the camshaft cap bolts.
16. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

Tighten the camshaft cap bolts to 16 N•m (12 lb-ft).



17. Install the spark plugs.

Tighten

Tighten the spark plugs to 25 N•m (18 lb-ft).

18. Install the exhaust gas recirculation valve adapter gasket.
19. Install the exhaust gas recirculation valve adapter.
20. Install the exhaust gas recirculation valve adapter bolts.

Tighten

Tighten the exhaust gas recirculation valve adapter bolts to 25 N•m (18 lb-ft).

21. Install the DIS ignition coil mounting bracket.
22. Install the DIS ignition coil mounting bracket bolts.

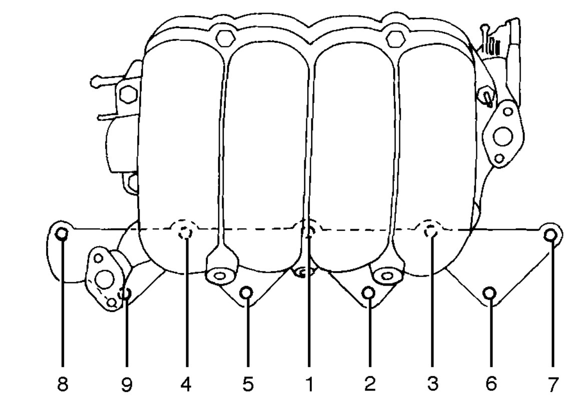
Tighten

Tighten the DIS ignition coil mounting bracket bolts to 10 N•m (89 lb-in).

23. Install the DIS ignition coil with the ignition wires attached.
24. Install the DIS ignition coil mounting bolts.

Tighten

Tighten the DIS ignition coil mounting bolts to 10 N•m (89 lb-in).

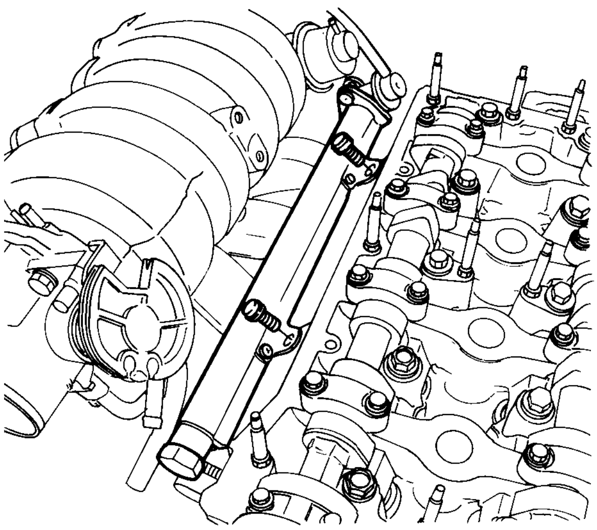


A102C031

25. Install the intake manifold studs.
26. Install the intake manifold gasket.
27. Install the intake manifold.
28. Install the intake manifold retaining nuts and retaining bolts in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts and retaining bolts to 25 N•m (18 lb-ft).


A102C042

29. Install the fuel rail assembly with the bolts.

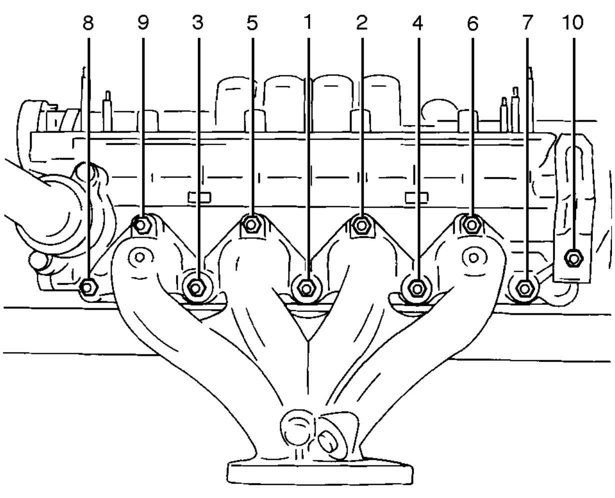
Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

30. Install the thermostat housing assembly.
31. Install the thermostat housing mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 N•m (15 lb-ft).



A102C041

32. Install the exhaust manifold studs.
33. Install the exhaust manifold gasket.
34. Install the exhaust manifold.
35. Install the exhaust manifold retaining nuts in the sequence shown.

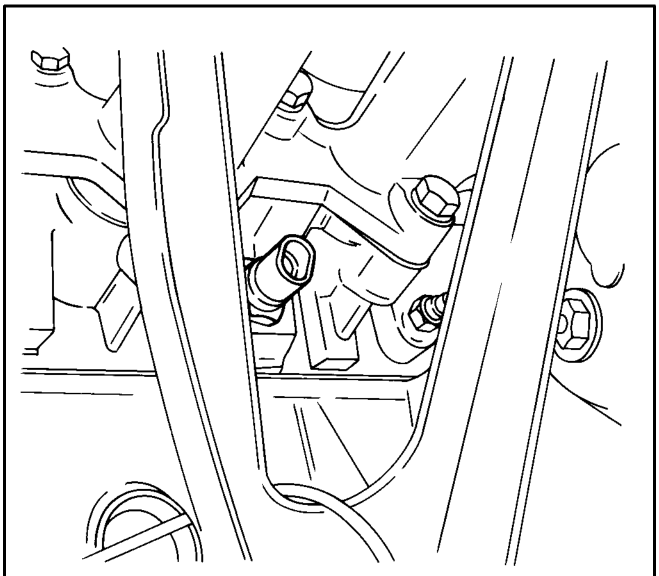
Tighten

Tighten the exhaust manifold retaining nuts to 25 N•m (18 lb-ft).

36. Install the exhaust manifold heat shield.
37. Install the exhaust manifold heat shield bolts.

Tighten

Tighten the exhaust manifold heat shield bolts to 15 N•m (11 lb-ft).

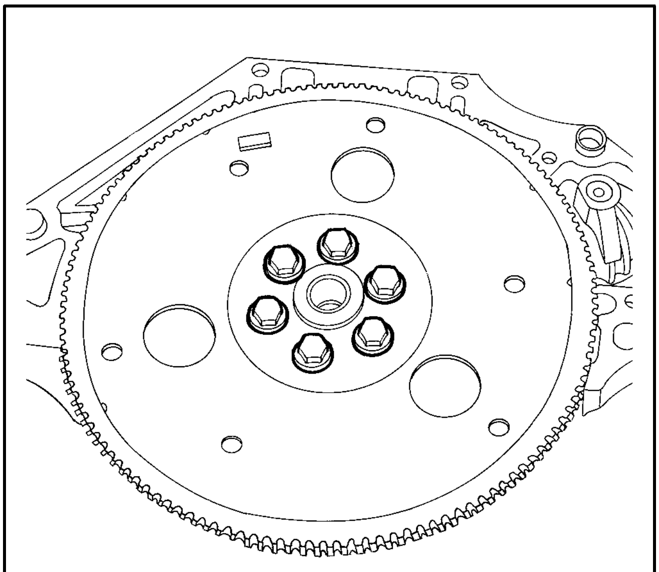

A102C169

38. Install the coolant temperature sensor.

Tighten

Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).

39. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.


A102B095

CRANKSHAFT

Tools Required

KM-412 Engine Overhaul Stand

J-42492 Timing Belt Adjuster

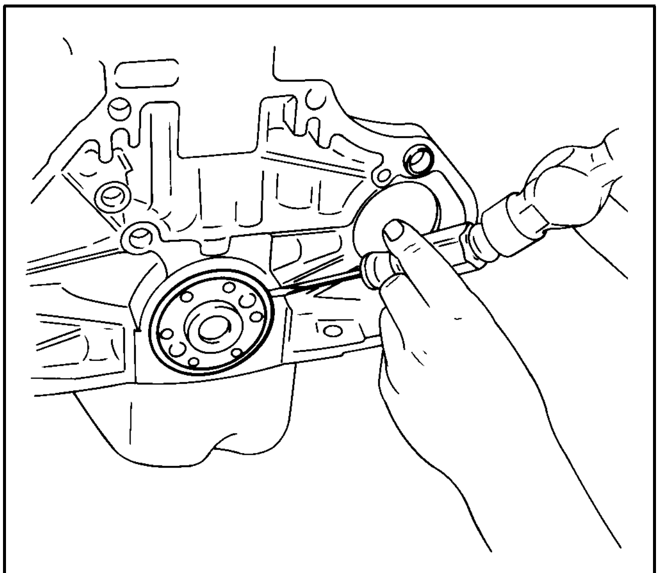
KM-470-B Angular Torque Gauge

J-36792 Crankshaft Rear Oil Seal Installer (or KM-635)

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshafts.

Disassembly Procedure

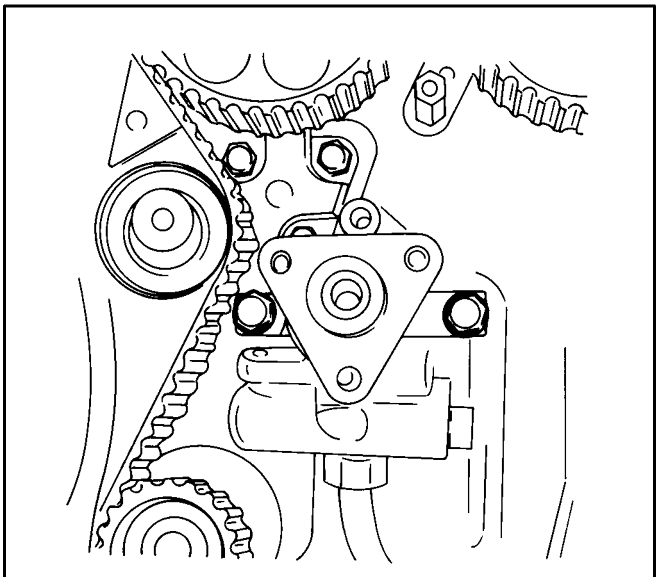
1. Remove the engine. Refer to "Engine" in this section.
2. Remove the flywheel or flexible plate bolts.
3. Remove the flywheel or the flexible plate.


A102C170

4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand KM-412.

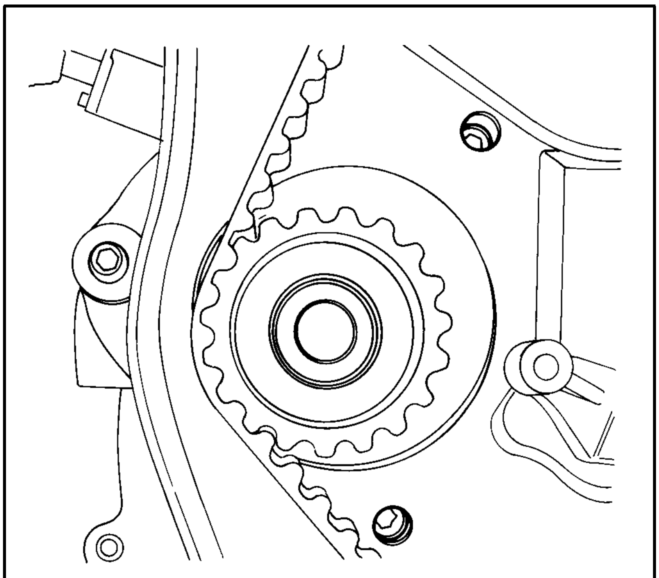
A102C007

6. Remove the upper and lower front timing belt cover bolts.
7. Remove the upper and lower front timing belt cover.



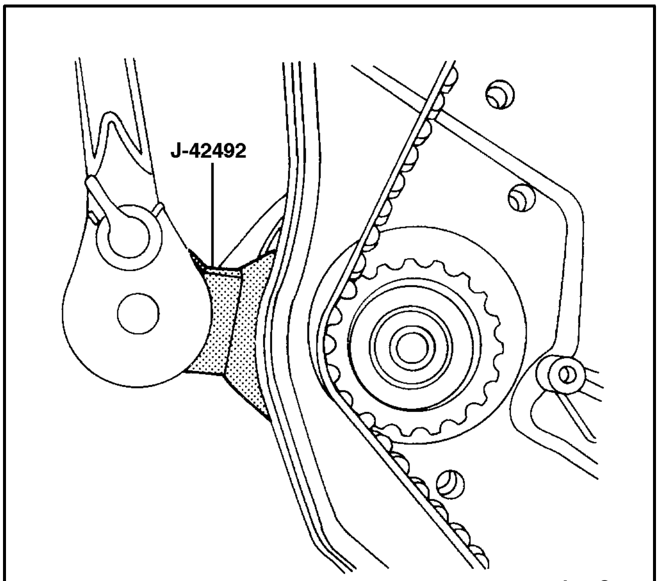
A102C157

8. Remove the power steering pump mounting bolts, if equipped.
9. Remove the power steering pump, if equipped.



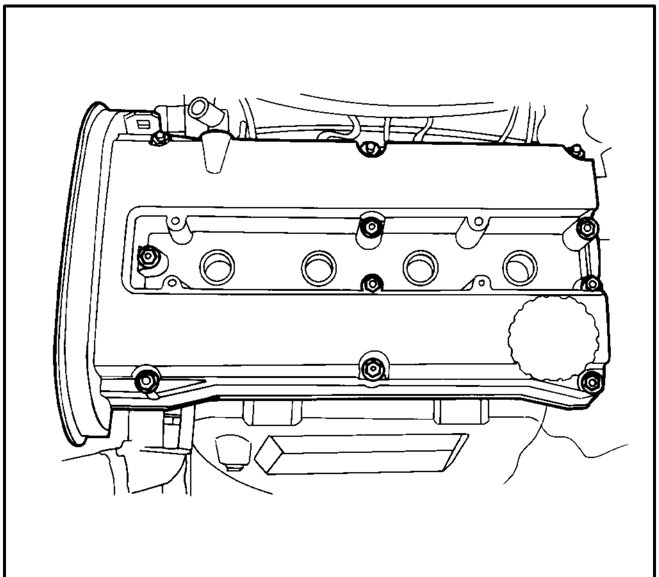
A102C027

10. Slightly loosen the coolant pump retaining bolts.



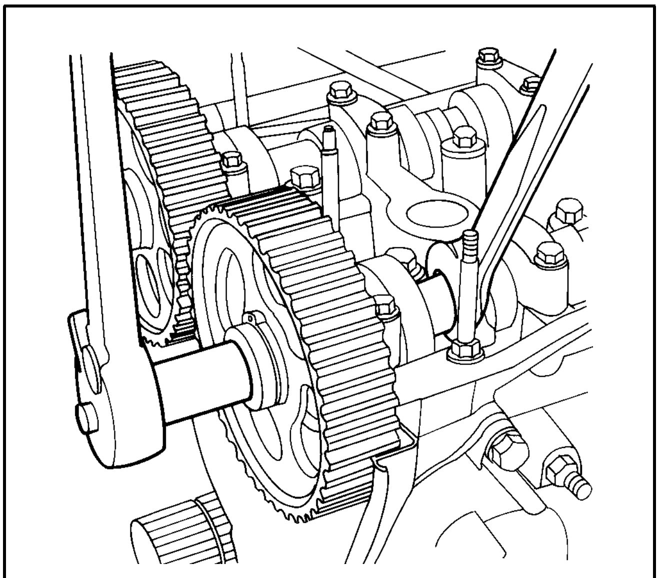
A102C004

11. Rotate the coolant pump using the timing belt adjuster J-42942 to remove the tension from the timing belt.
12. Remove the timing belt.



A102C015

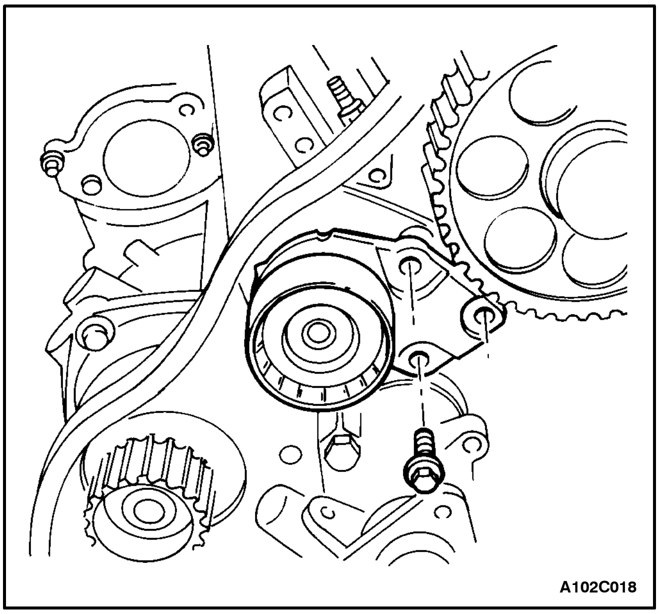
13. Disconnect the crankcase ventilation tubes from the valve cover.
14. Remove the spark plug cover bolts.
15. Remove the spark plug cover.
16. Disconnect the ignition wires from the spark plugs.
17. Remove the valve cover nuts.
18. Remove the valve cover washers.
19. Remove the valve cover and the valve cover gasket.



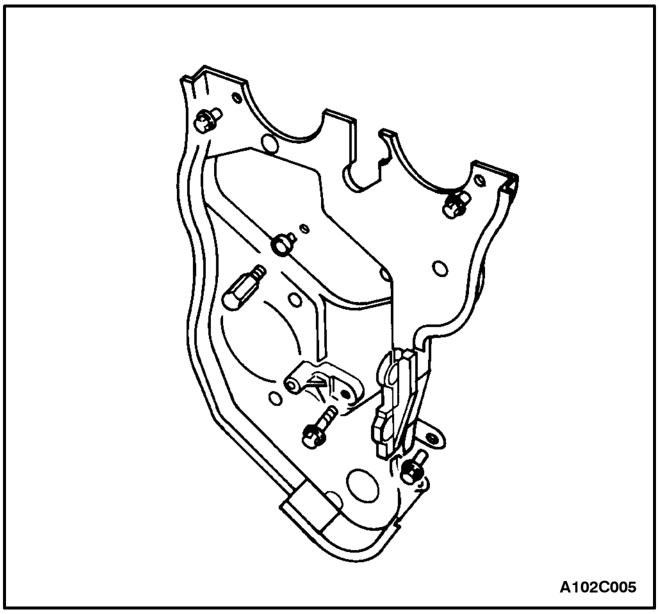
A102C017

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

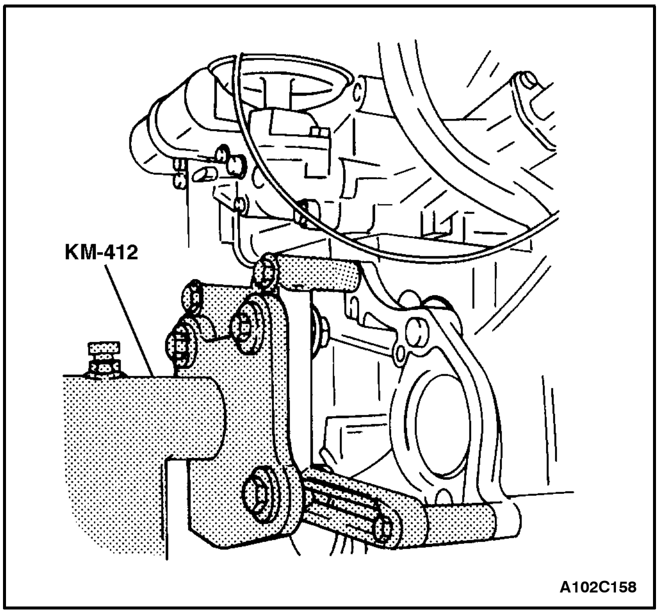
20. While holding the intake camshaft firmly in place, remove the intake camshaft bolt.
21. Remove the intake camshaft gear.
22. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft bolt.
23. Remove the exhaust camshaft gear.



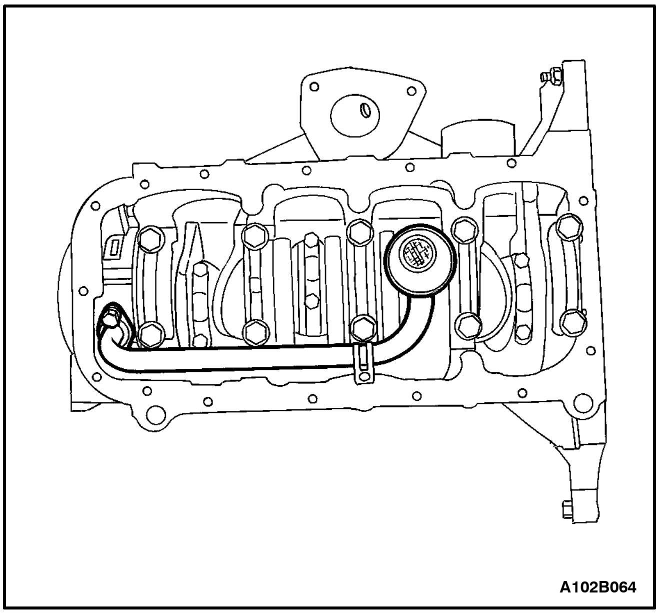
24. Remove the timing belt automatic tensioner bolts.
25. Remove the timing belt automatic tensioner.
26. Remove the timing belt idler pulley bolt.
27. Remove the timing belt idler pulley.



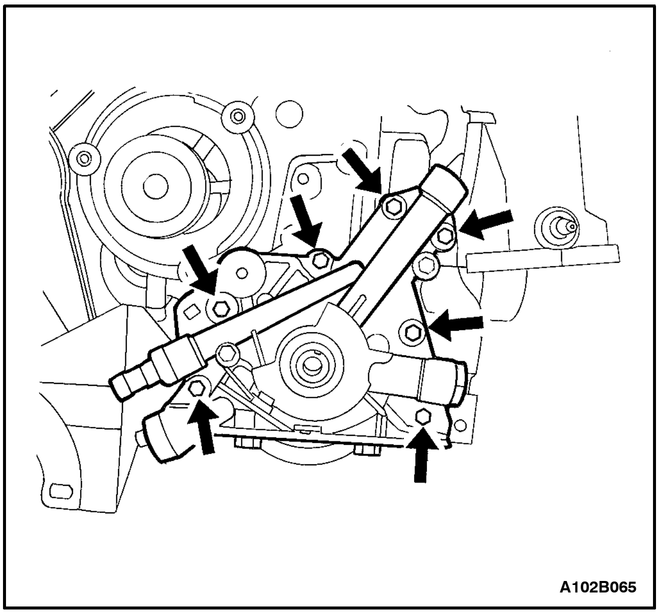
28. Remove the crankshaft timing belt gear.
29. Remove the rear timing belt cover bolts.
30. Remove the rear timing belt cover.



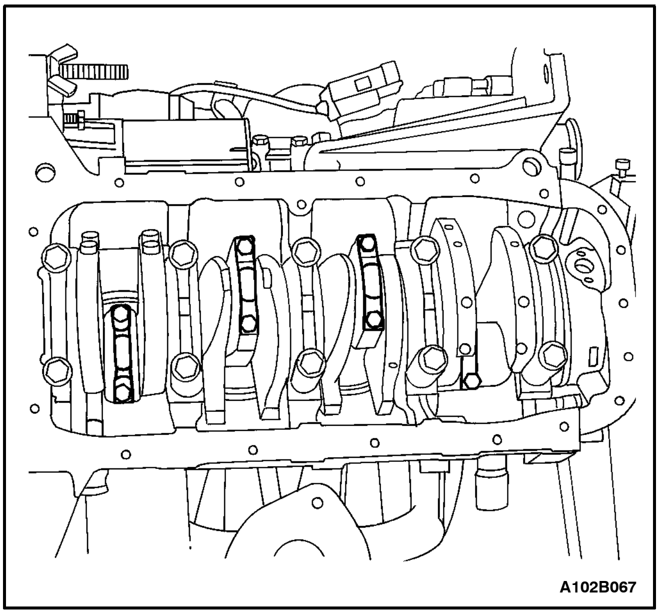
31. Rotate the engine on the engine overhaul stand KM-412.



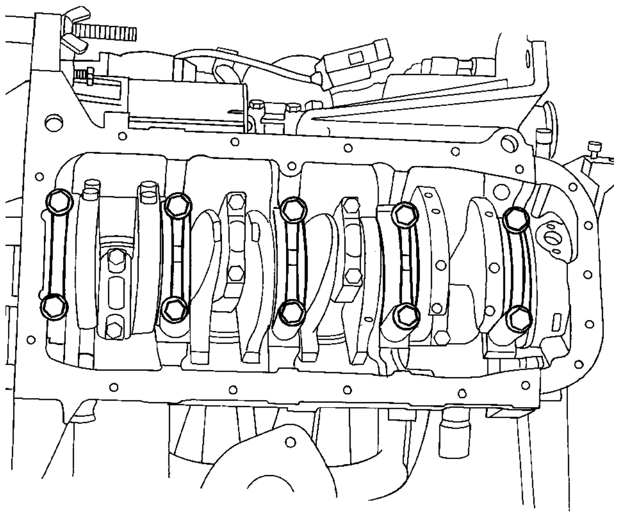
32. Remove the oil pan retaining bolts.
33. Remove the oil pan.
34. Remove the oil pickup tube bolts.
35. Remove the oil pickup tube.



36. Remove the oil pump retaining bolts.
37. Remove the oil pump.

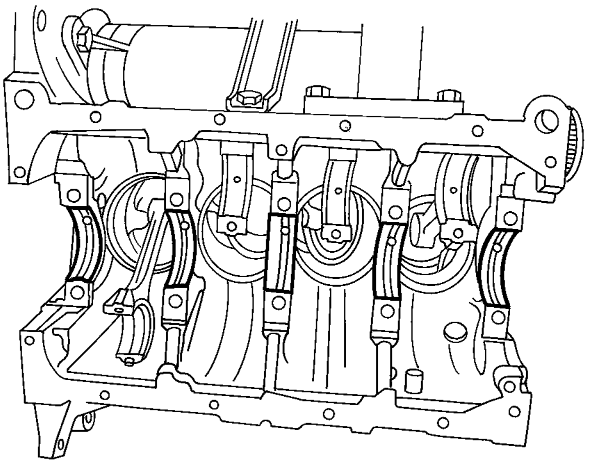


38. Mark the order of the connecting rod bearing caps.
39. Remove the connecting rod bearing cap bolts for all of the pistons.
40. Remove the connecting rod bearing caps and the lower connecting rod bearings.
41. Remove the upper connecting rod bearings.



A102B068

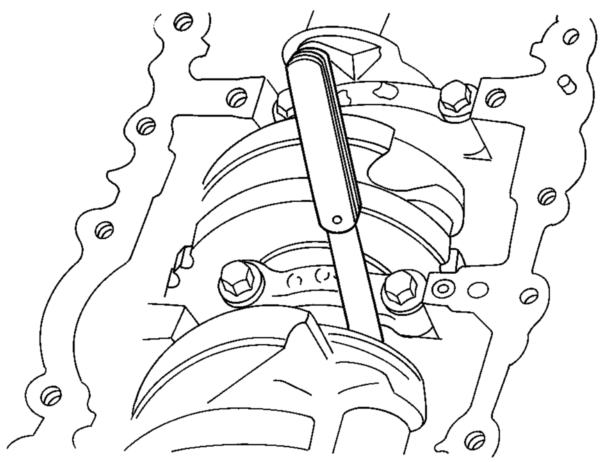
42. Mark the order of the crankshaft bearing caps.
43. Remove the crankshaft bearing cap bolts.
44. Remove the crankshaft bearing caps and the lower crankshaft bearings.
45. Remove the crankshaft.
46. Remove the upper crankshaft bearings.
47. Clean any necessary parts.



A102B069

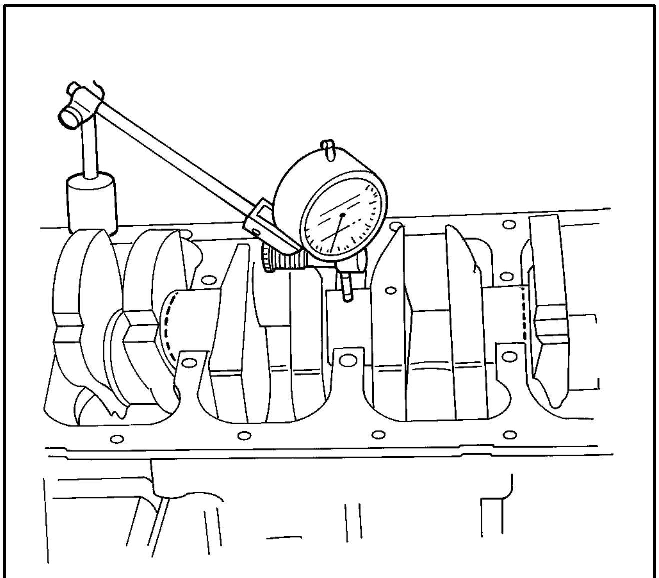
Assembly Procedure

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings in the engine block.



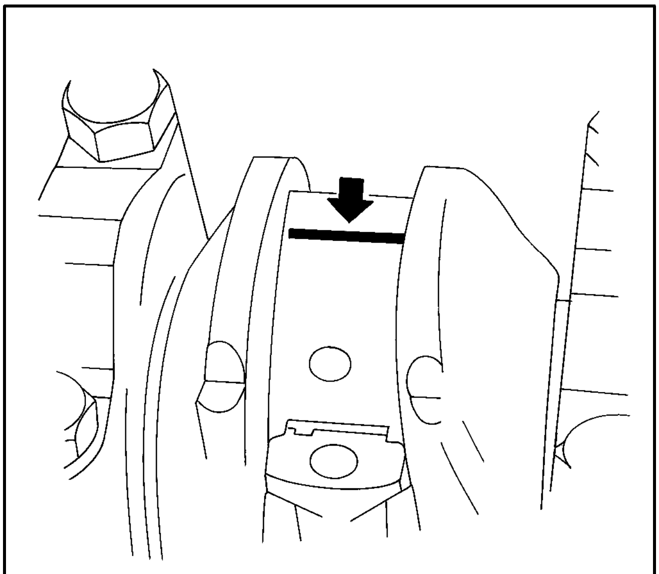
A102B070

3. Install the crankshaft.
4. Install the lower crankshaft bearings in the bearing caps.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to “Engine Specifications” in this section.



A102B071

7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.



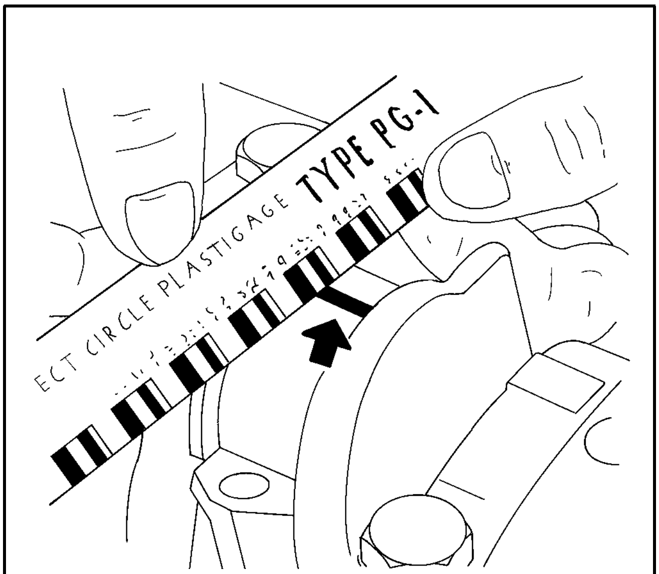
A102B072

Important: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.
10. Install the crankshaft bearing caps and the bolts.

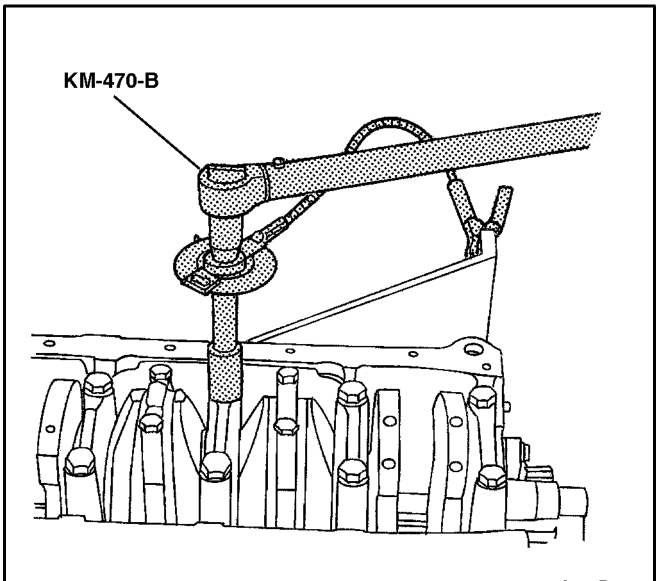
Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb-ft) 45 degrees + 15 degrees.



A102B073

11. Remove the crankshaft bearing cap bolts and the caps.
12. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
13. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

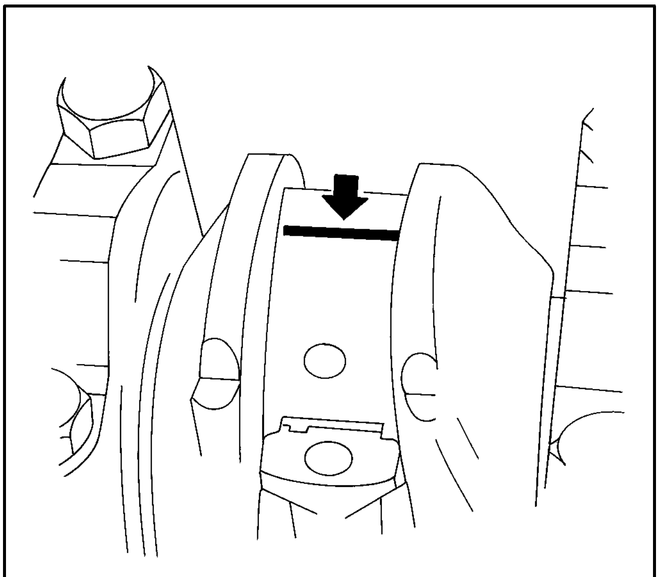


A102B091

14. Apply a bead of adhesive sealing compound to the grooves of the crankshaft bearing caps.
15. Install the crankshaft bearing caps to the engine block.
16. Tighten the crankshaft bearing caps using new bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft bearings 45 degrees + 15 degrees.



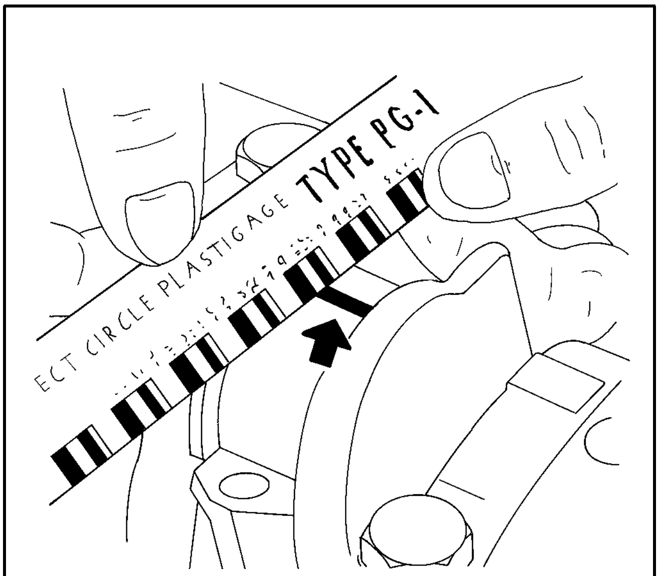
A102B072

Important: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

17. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).
18. Cut the plastic gauging threads to the length of the connecting rod bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
19. Install the connecting rod bearing caps.

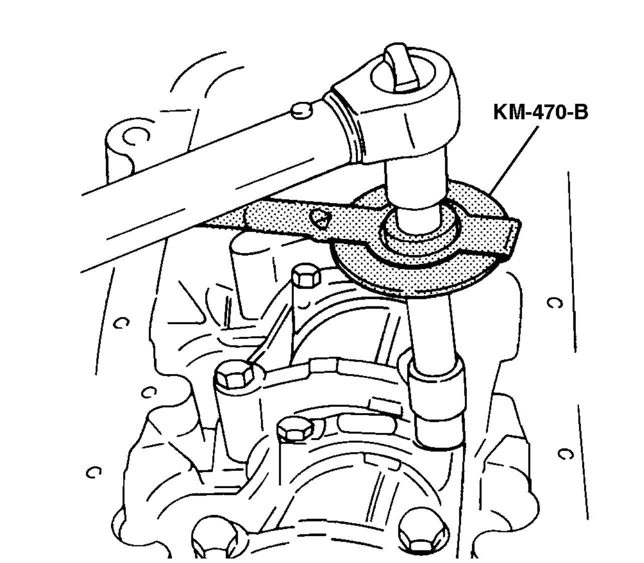
Tighten

Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod bearing cap bolts to 30 degrees + 15 degrees.



A102B073

20. Remove the connecting rod bearing caps.
21. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
22. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

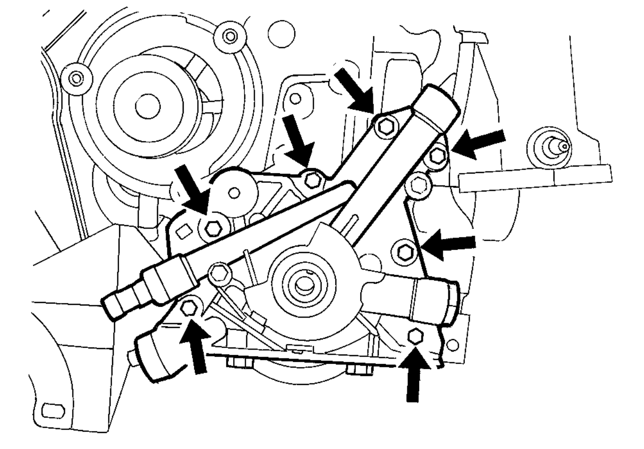


A102C151

23. Install the connecting rod bearing caps to the connecting rods.
24. Tighten the connecting rod bearing caps using new bolts.

Tighten

Tighten the connecting rod bearing cap bolts to 25 N•m (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod cap bolts to 30 degrees + 15 degrees.

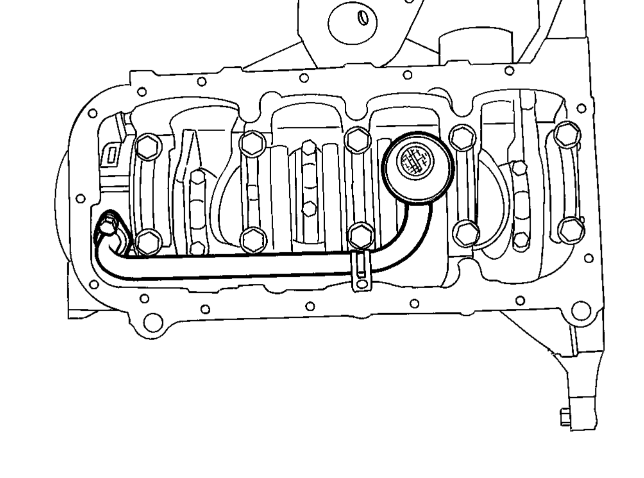


A102B065

25. Install the oil pump.
26. Install the oil pump retaining bolts.

Tighten

Tighten the oil pump retaining bolts to 10 N•m (89 lb-in).

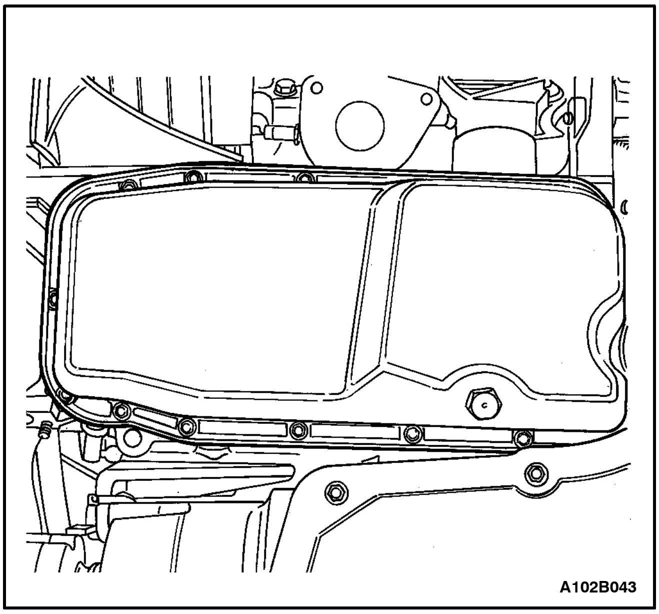


A102B064

27. Install the oil pump/pickup tube.
28. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 N•m (89 lb-in).



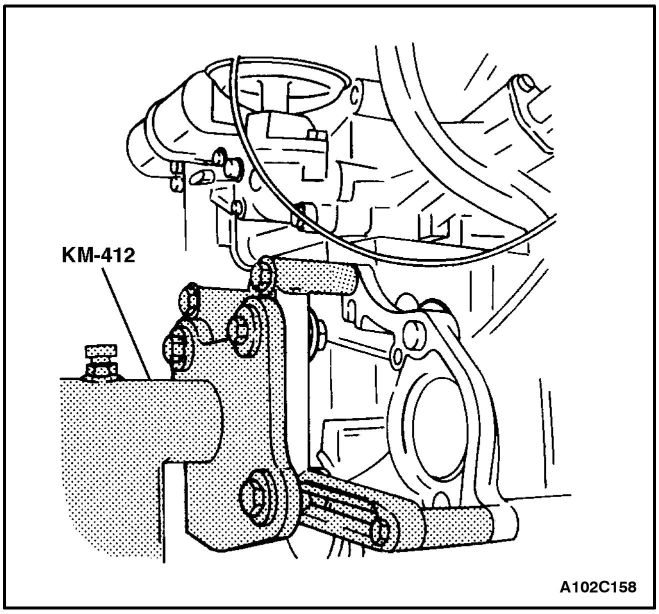
29. Install the oil pan gasket to the oil pan.
30. Install the oil pan.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

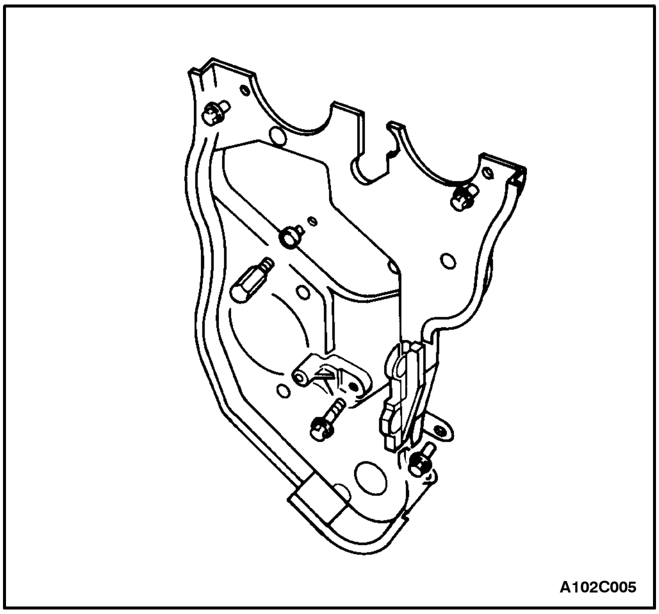
31. Install the oil pan retaining bolts.

Tighten

Tighten the oil pan retaining bolts to 10 N•m (89 lb-in).



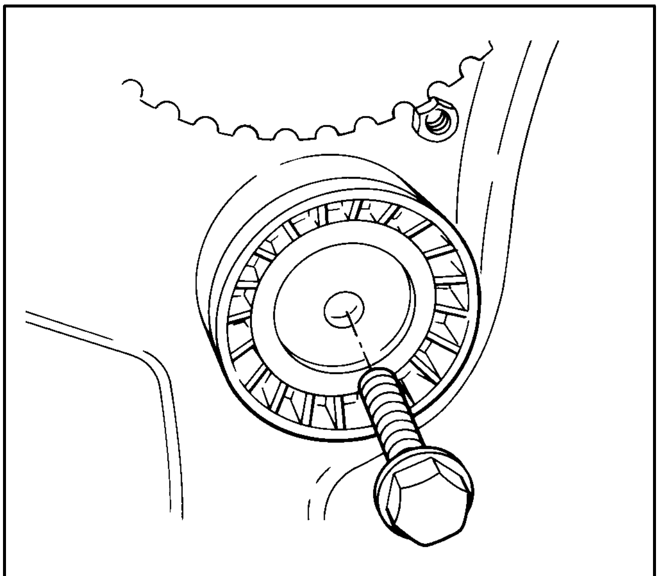
32. Rotate the engine on the engine assembly stand KM-412.



33. Install the rear timing belt cover.
34. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 N•m (89 lb-in).



A102C019

35. Install the crankshaft timing belt gear.
36. Install the timing belt automatic tensioner.
37. Install the timing belt automatic tensioner bolts.

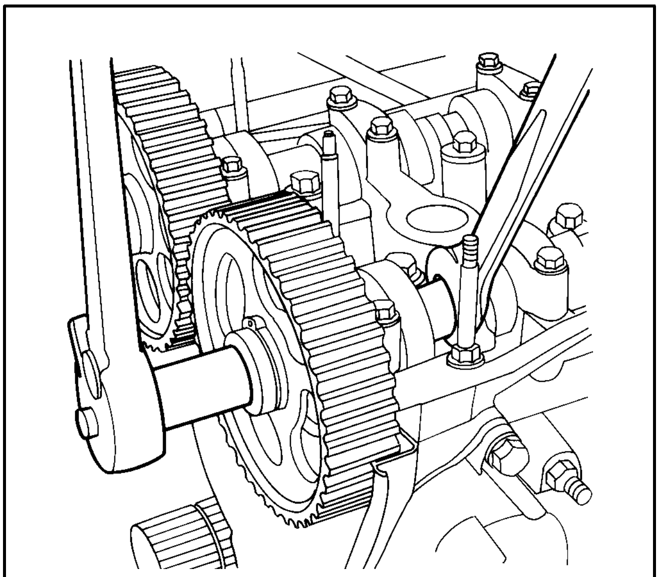
Tighten

Tighten the timing belt automatic tensioner bolts to 25 N•m (18 lb-ft).

38. Install the timing belt idler pulley.
39. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 N•m (30 lb-ft).



A102C017

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

40. Install the intake camshaft gear.
41. Install the intake camshaft gear bolt while holding the intake camshaft firmly in place.

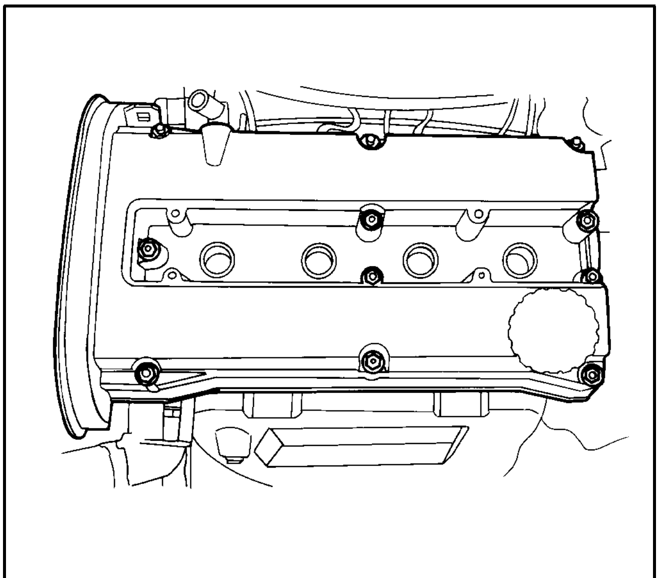
Tighten

Tighten the intake camshaft gear bolt to 67.5 N•m (49 lb-ft).

42. Install the exhaust camshaft gear.
43. Install the exhaust camshaft gear bolt while holding the exhaust camshaft firmly in place.

Tighten

Tighten the exhaust camshaft bolt to 67.5 N•m (49 lb-ft).

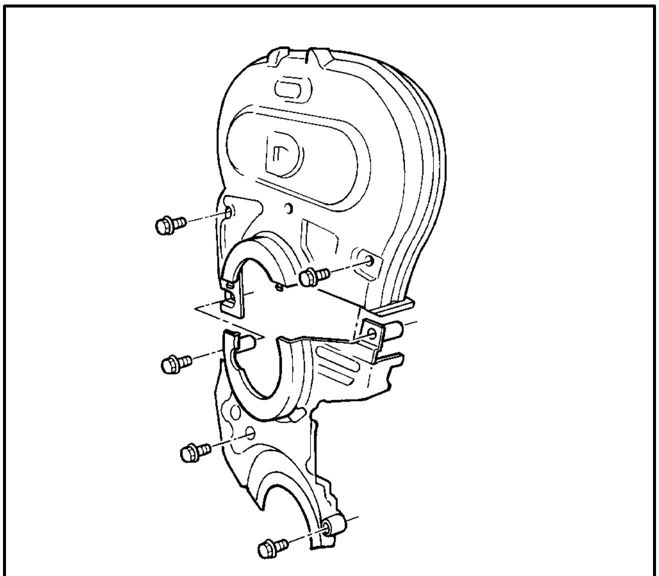


A102C015

44. Install the timing belt. Refer to “Timing Belt” in this section.
45. Adjust the timing belt tension. Refer to “Timing Belt Check and Adjust” in this section.
46. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.
47. Install the valve cover and the valve cover gasket.
48. Install the valve cover washers.
49. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 N•m (89 lb-in).



A102C007

50. Connect the ignition wires to the spark plugs.
51. Install the spark plug cover.
52. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

53. Connect the crankcase ventilation tube to the valve cover.
54. Install the upper and lower front timing belt cover.
55. Install the upper and lower front timing belt cover bolts.

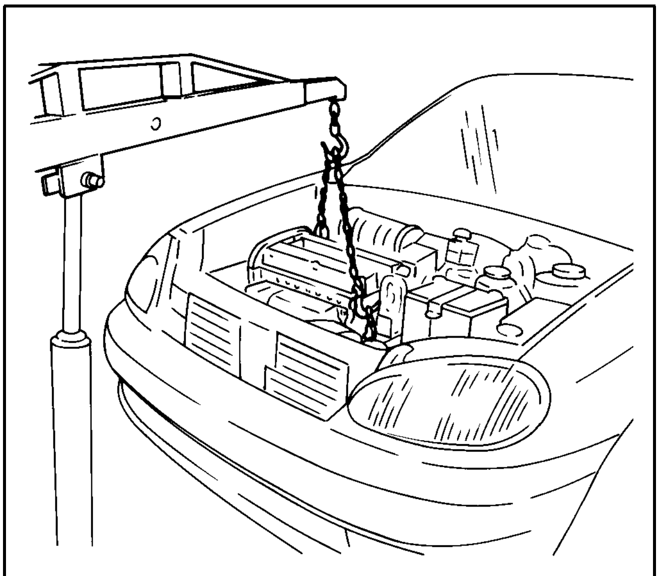
Tighten

Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).

56. Install the power steering pump, if equipped.
57. Install the power steering pump mounting bolts.

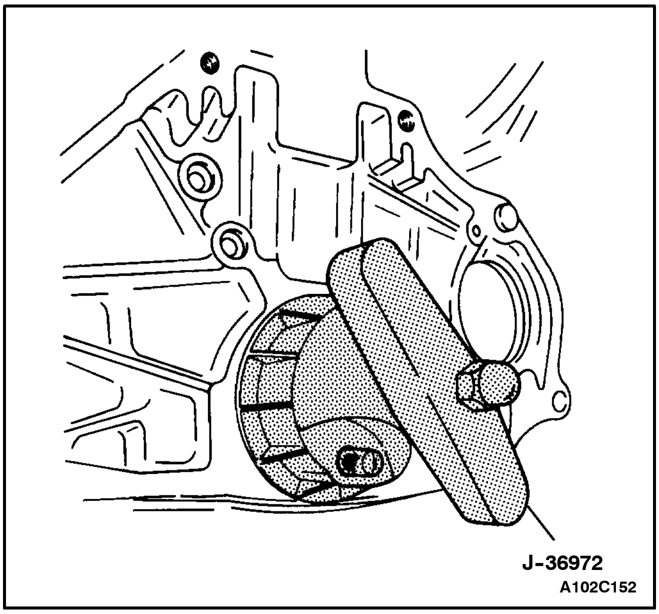
Tighten

Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).

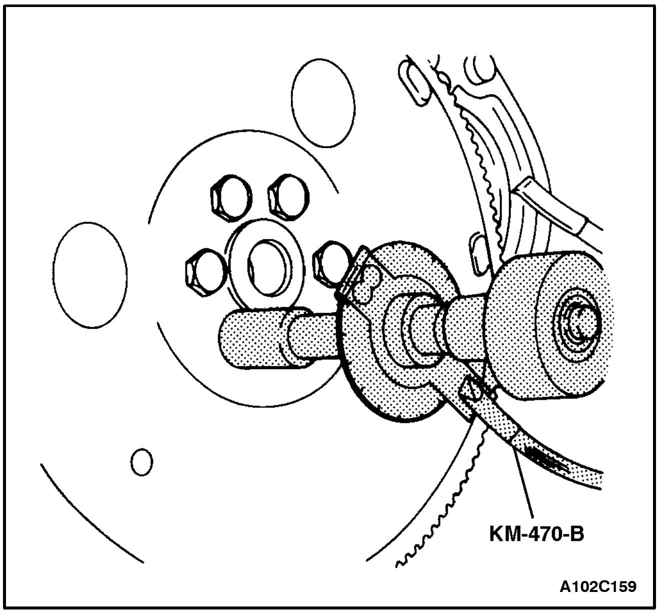


A102C171

58. Install the engine lifting device.
59. Remove the engine from the engine assembly stand KM-412.



60. Install a new crankshaft rear oil seal using installer J-36972 (or KM-635).

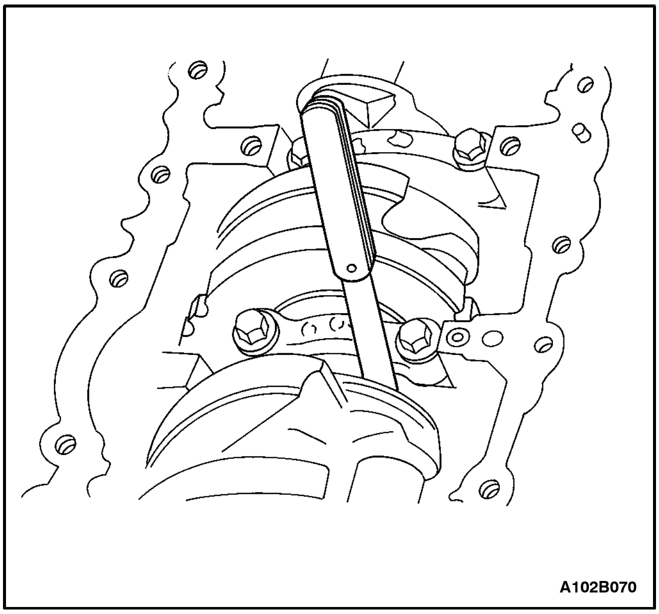


61. Install the flywheel or flexible plate.
62. Install the flywheel or the flexible plate bolts.

Tighten

Tighten the flywheel bolts to 35 NSm (25 lb-ft). Use the angular torque gauge KM-470-B to tighten the flywheel bolts to 30 degrees + 15 degrees. For the manual transmission, tighten the flexible plate bolts to 60 NSm (44 lb-ft).

63. Install the engine. Refer to "Engine" in this section.



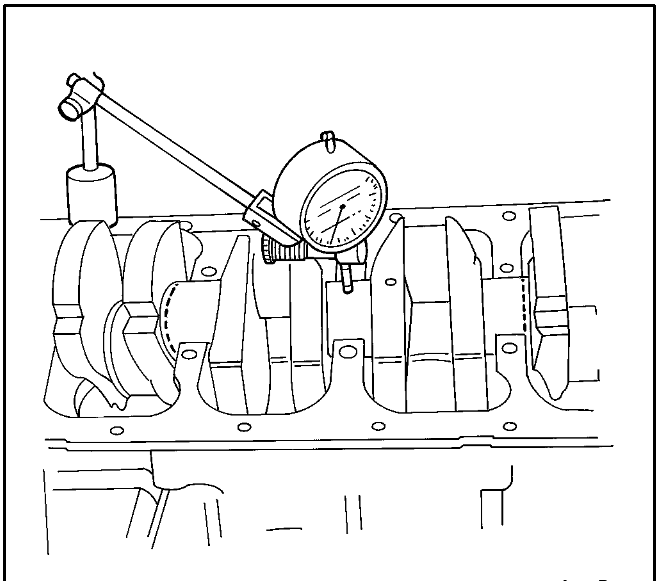
CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS — GAUGING PLASTIC

Tools Required

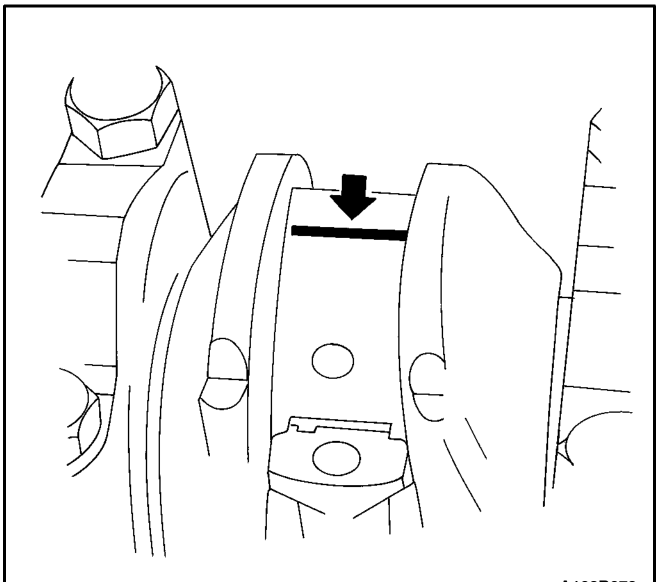
KM-470-B Angular Torque Gauge

Inspection Procedure - Crankshaft

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.
4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.

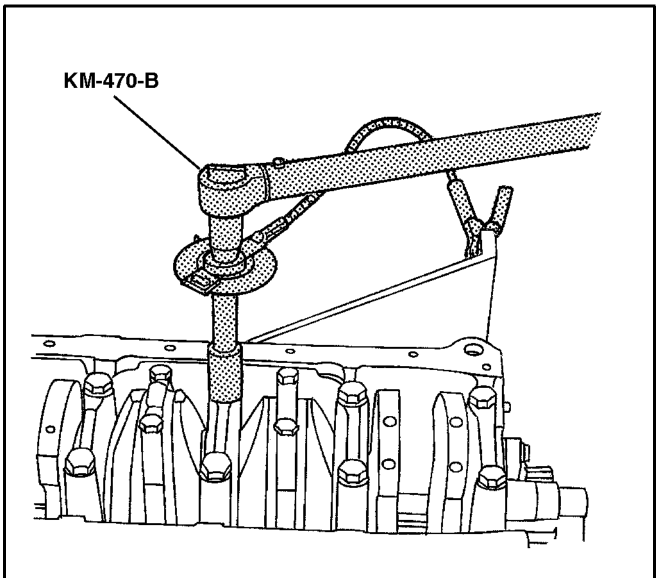

A102B071

7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.


A102B072

Notice: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.

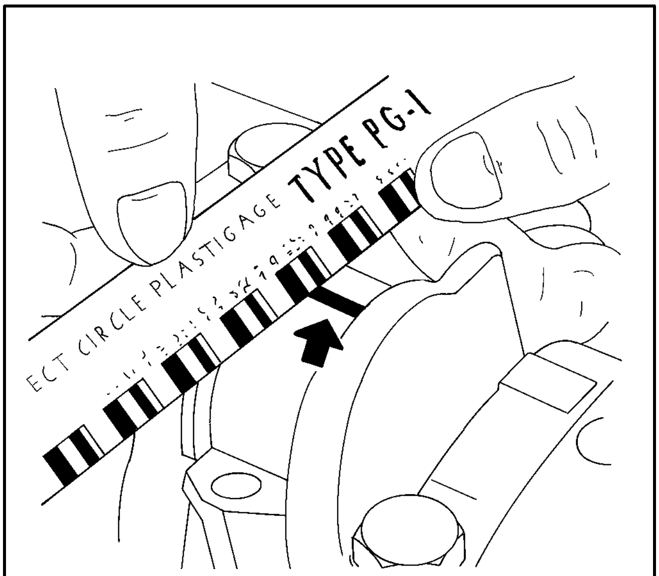


A102B091

10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

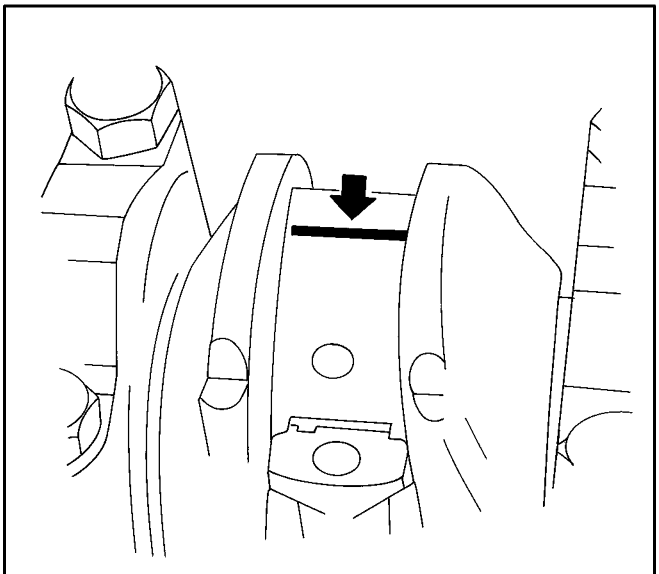
Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts to 45 degrees +15 degrees.



A102B073

12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
14. Inspect the bearing clearances for permissible tolerance ranges. Refer to "Engine Specifications" in this section.



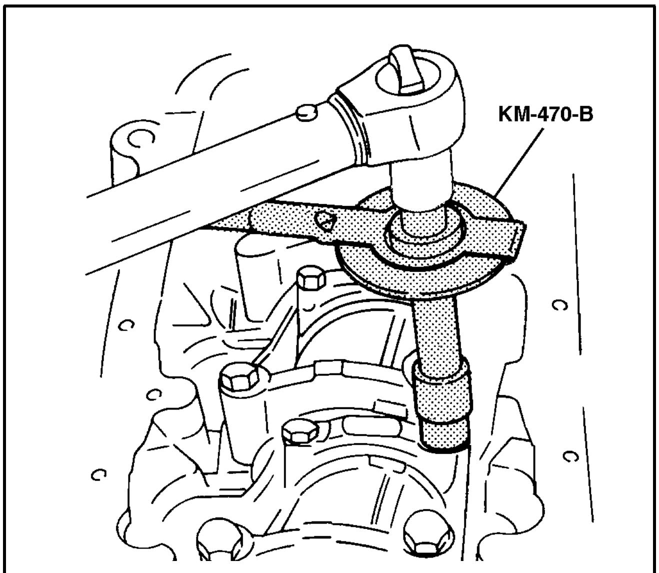
A102B072

Inspection Procedure – Connecting Rods

1. Coat the connecting rod bearings with engine oil.
2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.

Notice: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

4. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).

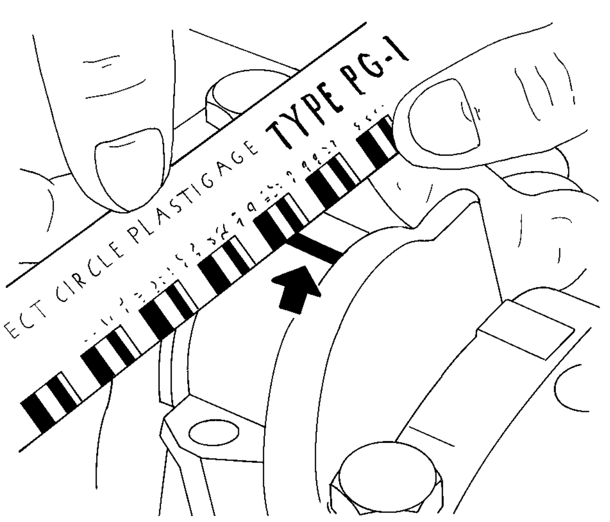


A102C151

5. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
6. Install the connecting rod bearing caps.
7. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod cap bolts to 25 N·m (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the connecting rod cap bolts to 30 degrees + 15 degrees.



A102B073

8. Remove the connecting rod bearing caps.
9. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
10. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

CYLINDER HEAD AND GASKET

The cylinder head is made of an aluminum alloy. The cylinder head uses crossflow intake and exhaust ports. A spark plug is located in the center of each combustion chamber. The cylinder head houses the dual camshafts.

CRANKSHAFT

The crankshaft has eight integral weights which are cast with it for balancing. Oil holes run through the center of the crankshaft to supply oil to the connecting rods, the bearings, the pistons, and the other components. The end thrust load is taken by the thrust washers installed at the center journal.

TIMING BELT

The timing belt coordinates the crankshaft and the dual overhead camshafts and keeps them synchronized. The timing belt also turns the coolant pump. The timing belt and the pulleys are toothed so that there is no slippage between them. There are two idler pulleys. An automatic tensioner pulley maintains the timing belt's correct tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine drive belt. The timing belt requires no lubrication.

OIL PUMP

The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or other engine components. When the drive gear rotates, the driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows.

At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages. During normal oil supply, a coil spring and valve keeps the bypass closed, directing all of the oil pumped to the engine. When the amount of oil being pumped increases, the pressure becomes high enough to overcome the force of the spring. This opens the valve of the oil pressure regulator, allowing the excess oil to flow through the valve and drain back to the oil pan.

OIL PAN

The engine oil pan is mounted to the bottom of the cylinder block. The engine oil pan houses the crankcase and is made of pressed sheet metal.

Engine oil is pumped from the oil pan by the oil pump. After it passes through the oil filter, it is fed through two paths to lubricate the cylinder block and cylinder head. In one path, the oil is pumped through oil passages in the crankshaft to the connecting rods, then to the pistons and cylinders. It then drains back to the oil pan. In the second path, the oil is pumped through passages to the camshaft. The oil passes through the internal passageways in the camshafts to lubricate the valve assemblies before draining back to the oil pan.

EXHAUST MANIFOLD

A single four-port, rear-takedown manifold is used with this engine. The manifold is designed to direct escaping exhaust gases out of the combustion chambers with a minimum of backpressure. The oxygen sensor is mounted to the exhaust manifold.

INTAKE MANIFOLD

The intake manifold has four independent long ports and utilizes an inertial supercharging effect to improve engine torque at low and moderate speeds. The plenum is attached to the intake manifold.

CAMSHAFTS

This engine is a dual over head camshaft (DOHC) type, which means there are two camshafts. One camshaft operates the intake valves, and the other camshaft operates the exhaust valves. The camshafts sit in journals on the top of the engine (in the cylinder head) and are held in place by camshaft caps. The camshaft journals of the cylinder head are drilled for oil passages. Engine oil travels to the camshafts under pressure where it lubricates each camshaft journal. The oil returns to the oil pan through drain holes in the cylinder head. The camshaft lobes are machined into the solid camshaft to precisely open and close the intake and the exhaust valves the correct amount at the correct time. The camshaft lobes are oiled by splash action from pressurized oil escaping the camshaft journals.

EXHAUST GAS RECIRCULATION VALVE

The exhaust gas recirculation (EGR) system is used to lower oxides of nitrogen (NOX) emission levels caused by high combustion temperatures. The main element of the system is the EGR valve which is operated by vacuum.

The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease the combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters, combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

SECTION 1D

ENGINE COOLING

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

CAPACITY

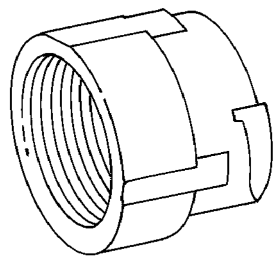
Application	Description
Coolant in the Cooling System (SOHC MPFI System)	7.0L (1.85 gal) for automatic transaxle 7.0L (1.85 gal) for manual transaxle
Coolant in the Cooling System (DOHC MPFI System)	7.1L (1.88 gal) for automatic transaxle 7.2L (1.90 gal) for manual transaxle

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Coolant Pump Mounting Bolts	10	-	89
Electric Cooling Fan (Auxiliary) Motor Retaining Nuts	3.2	-	28
Electric Cooling Fan (Auxiliary) Retaining Nut	4	-	35
Electric Cooling Fan (Main) Motor Nut	3.2	-	28
Electric Cooling Fan (Main) Motor Retaining Screws	4	-	35
Electric Cooling Fan Assembly (Auxiliary) Mounting Bolts	4	-	35
Electric Cooling Fan Assembly (Main) Mounting Bolts	4	-	35
Engine Coolant Temperature Sensor (DOHC)	20	15	-
Engine Coolant Temperature Sensor (SOHC)	20	15	-
Negative Battery Terminal Retainer Bolt	15	11	-
Radiator Retaining Bolt (Upper Left)	4	-	35
Radiator Retaining Bolt (Upper Right)	4	-	35
Surge Tank Attaching Nuts	4	-	35
Thermostat Housing Mounting Bolts (DOHC)	20	15	-
Thermostat Housing Mounting Bolts (SOHC)	20	15	-
Transmission Cooler Pipe Bolt (Lower)	12	-	106
Transmission Cooler Pipe Bolt (Upper)	12	-	106

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A102D020	KM-471 Adapter

DIAGNOSIS

THERMOSTAT TEST

1. Remove the thermostat from the vehicle. Refer to "Thermostat" in this section.
2. Make sure the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.
3. Suspend the thermostat and a thermometer in a pan of 50/50 mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan because the uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
4. Heat the pan on a burner.
5. Use the thermometer to measure the temperature of the heated solution.
6. The thermostat should begin to open at 87_C (189_F) and it should be fully open at 102_C (226_F). If it does not open at these temperatures, replace the thermostat.

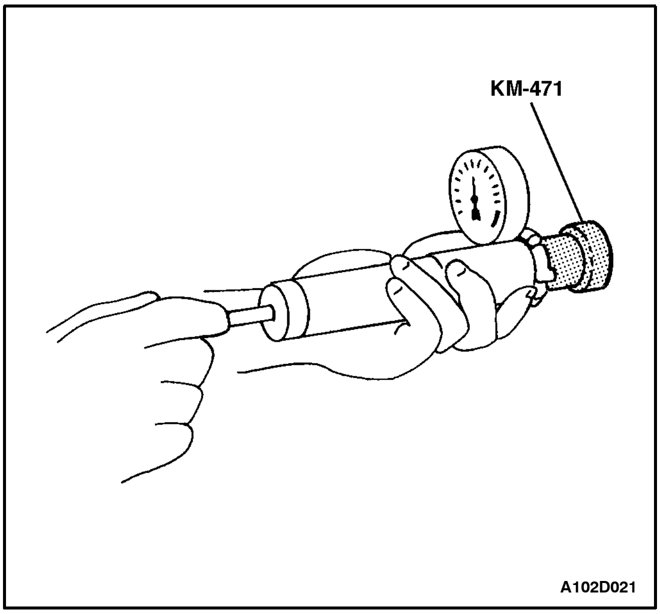
SURGE TANK CAP TEST

SPECIAL TOOLS

KM-471 Adapter

The surge tank cap maintains proper pressure, protects the system from high-pressure by opening a pressure-valve, and protects the coolant hoses from collapsing because of a vacuum.

1. Wash any sludge from the surge tank cap and the valve seat of the vacuum pressure valve for the surge tank cap.
2. Check for any damage or deformity to the vacuum pressure valve for the surge tank cap. If any damage or deformity is found, replace the cap.
3. Install a suitable cooling system pressure tester to the cap using the KM-471 Adapter.
4. Pull the vacuum pressure valve to the open position. If the surge tank cap does not seal properly, replace the surge tank cap.
5. Pressurize the cap to 90 to 120 kPa (13 to 17 psi).
6. Wait 10 seconds and check the pressure held by the tank cap tester.



7. If the pressure held by the cooling system pressure tester falls below 80 kPa (11.6 psi) replace the surge tank cap.

COOLING SYSTEM DIAGNOSIS

Engine Overheats

Checks	Action
Check for a loss of the coolant.	Add the coolant.
Check for a weak coolant solution.	Confirm that the coolant solution is a 50/50 mixture of ethylene glycol and water.
Check the front of the radiator for any dirt, any leaves, or any insects.	Clean the front of the radiator.
Check for leakage from the hoses, the coolant pump, the heater, the thermostat housing, the radiator, the core plugs, or the head gasket.	Replace any damaged components.
Check for a faulty thermostat.	Replace a damaged thermostat.
Check for retarded ignition timing.	Perform an ECM code diagnosis. Confirm the integrity of the timing belt.
Check for an improperly operating electric cooling fan.	Replace the electric cooling fan.
Check for radiator hoses that are plugged or rotted.	Replace any damaged radiator hoses.
Check for a faulty water pump.	Replace a faulty water pump.
Check for a faulty surge tank cap.	Replace a faulty surge tank cap.
Check for a cylinder head or an engine block that is cracked or plugged.	Repair the damaged cylinder head or the damaged engine block.

Loss of Coolant

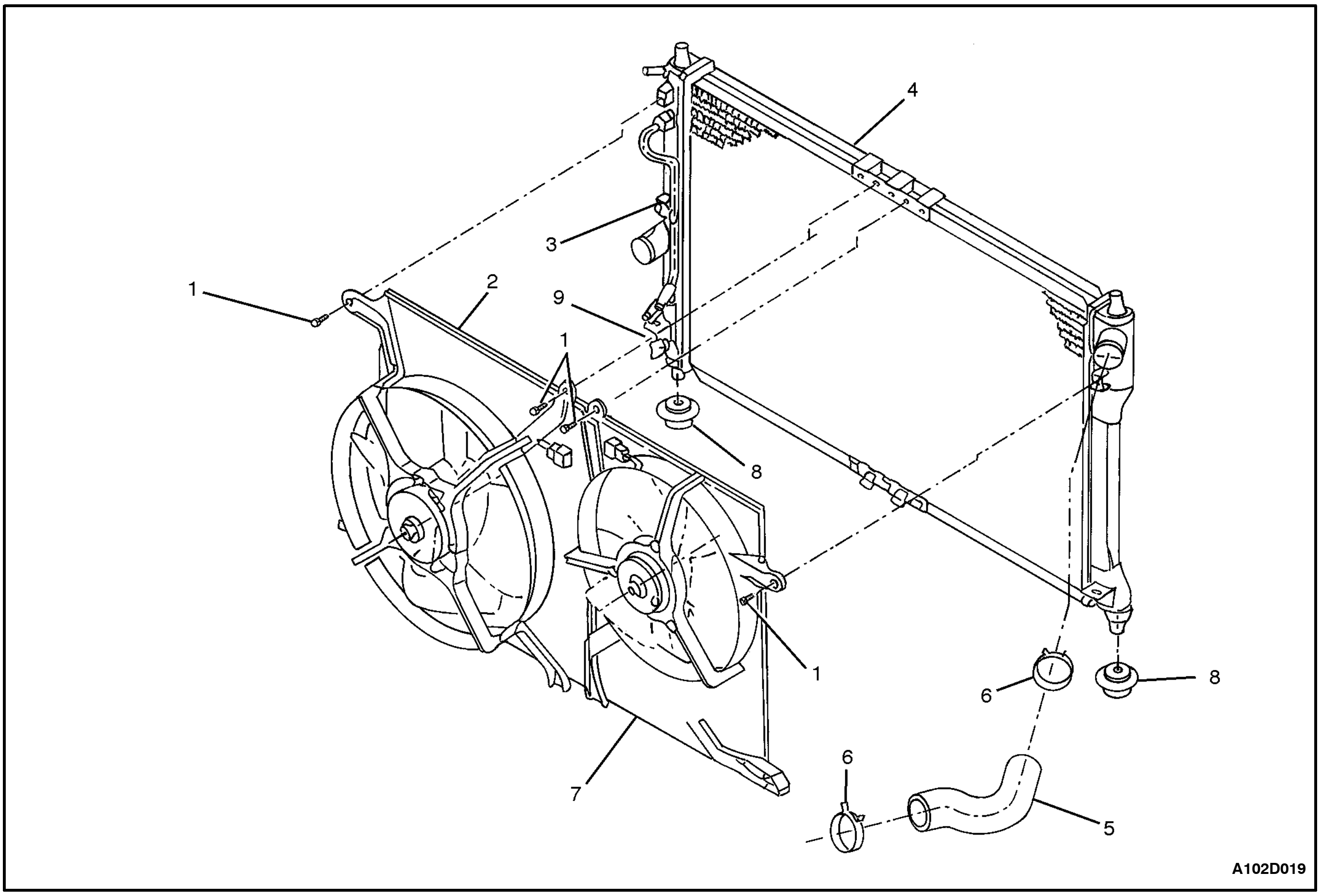
Checks	Action
Check for a leak in the radiator.	Replace a damaged radiator.
Check for a leak in the D Surge tank. D Hose.	Replace the D Surge tank. D Hose.
Check for loose or damaged D Radiator hoses. D Heater hoses. D Connections.	Reseat the hoses. Replace the hoses or the clamps.
Check for leaks in the coolant pump seal.	Replace the coolant pump seal.
Check for leaks in the coolant pump gasket.	Replace the coolant pump gasket.
Check for an improper cylinder head torque.	Tighten the cylinder head bolts to specifications. Replace the cylinder head gasket, if needed.
Check for leaks in the D Intake manifold. D Cylinder head gasket. D Cylinder block plug. D Heater core. D Radiator drain plug.	Repair or replace any components, as needed to correct the leak.

Engine Fails to Reach Normal Operating Temperature or Cool Air from the Heater

Checks	Action
Check to determine if the thermostat is D Stuck open. D The wrong type of thermostat.	Install a new thermostat of the correct type and heat range.
Check the coolant level to determine if it is below the MIN mark on the surge tank.	Add sufficient coolant to raise the fluid to the specified mark on the surge tank.

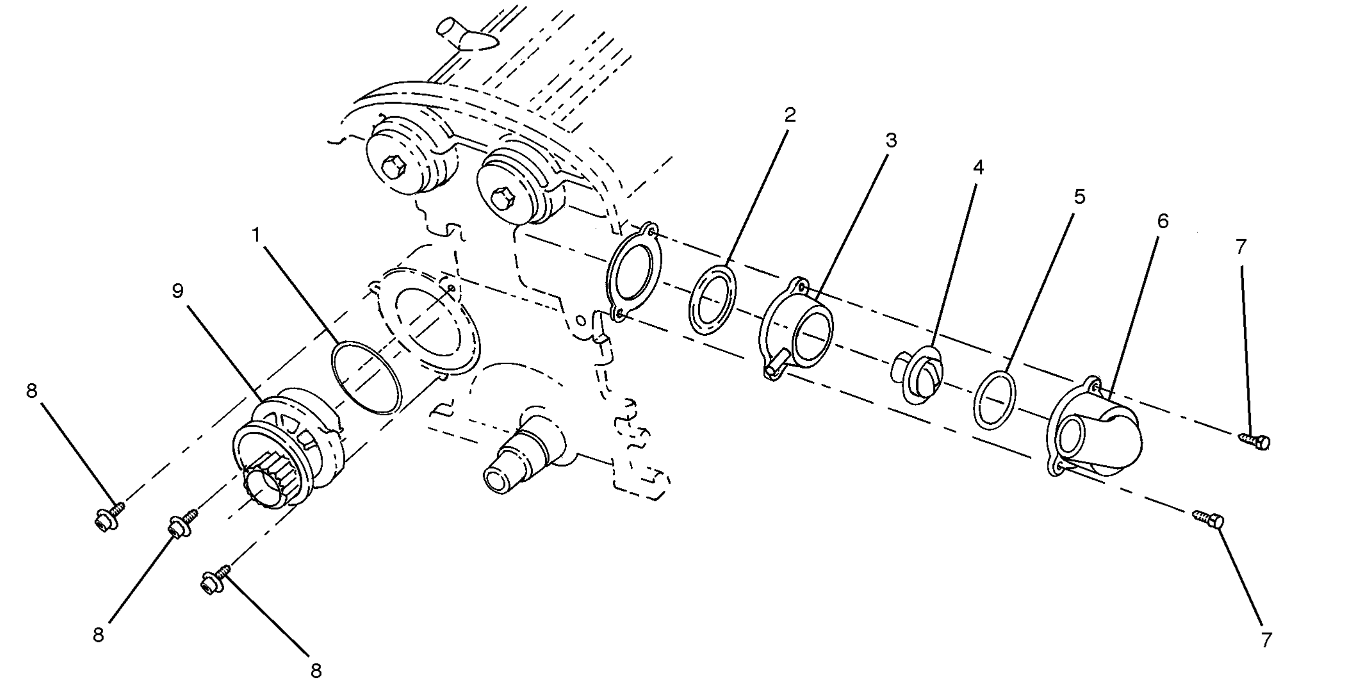
COMPONENT LOCATOR

RADIATOR/FAN



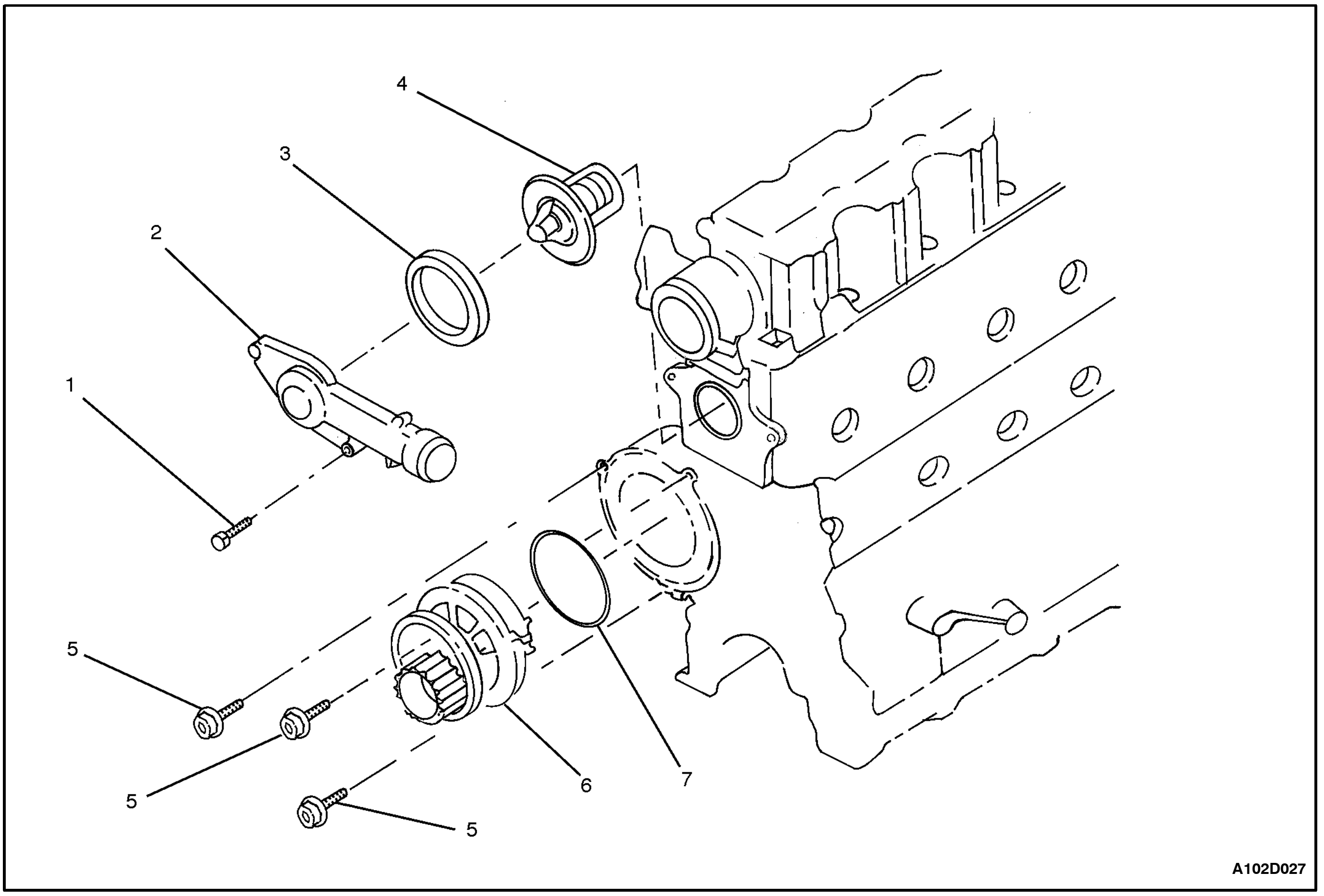
1 Bolt
2 Main Cooling Fan
3 Holder Transmission Fluid Pipe (Automatic Transmission Only)
4 Radiator
5 Upper Radiator Hose
6 Spring Clamp
7 Auxiliary Cooling Fan (Air Conditioning Only)
8 Radiator Bumper
9 Drain Cock

COOLANT PUMP/THERMOSTAT (DOHC)



1	Cylinder Block Seal Ring	6	Thermostat Housing
2	Seal Ring	7	Bolt
3	Thermostat Adapter	8	Bolt
4	Thermostat	9	Water Pump
6	Seal Ring		

COOLANT PUMP/THERMOSTAT (SOHC)

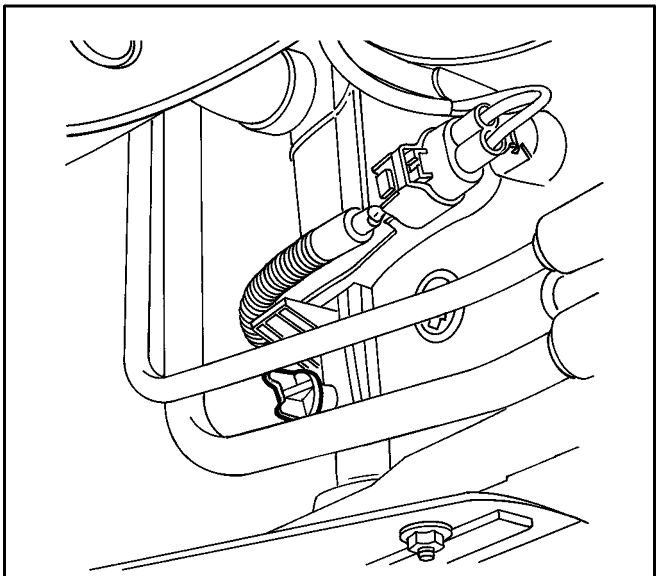


1 Thermostat Housing Bolt
2 Thermostat Housing
3 Seal Ring
4 Thermostat
5 Water Pump Mounting Bolts
6 Water Pump
7 O-Ring

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

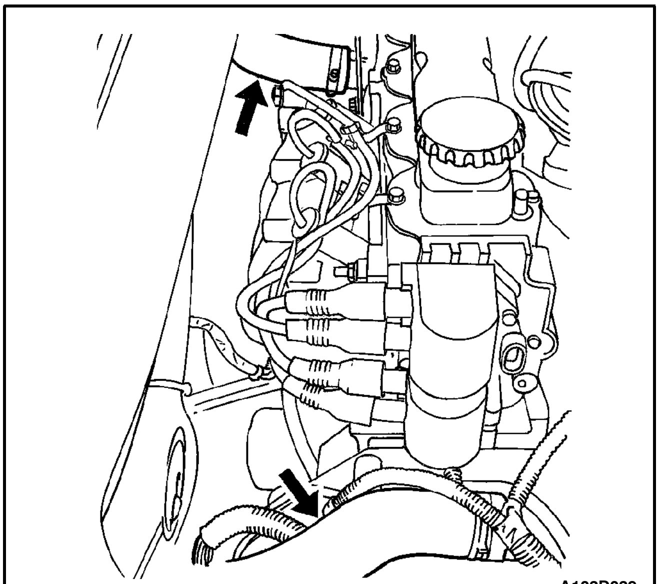
DRAINING AND REFILLING THE COOLING SYSTEM



A102D001

Caution: Do not remove the surge tank cap while the engine and the radiator are hot. Scalding fluid and steam may be blown out under pressure.

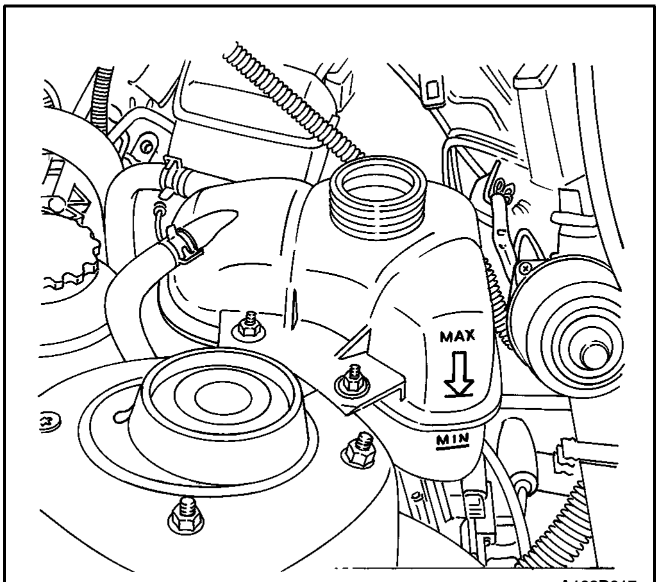
1. Place a pan below the vehicle to catch the draining coolant.
2. Remove the surge tank cap.
3. Unplug the drain cock.



A102D029

Caution: Dispose of the used coolant to a used coolant holding tank to be picked up with the used oil for disposal. Never pour the used coolant down the drain. Ethylene glycol antifreeze is an extremely toxic chemical. Disposing of it into the sewer system or the ground water can contaminate the local environment.

4. Catch the escaping fluid in a drain pan.
5. Remove all sludge and dirt from inside the surge tank. Refer to "Surge Tank" in this section.
6. Plug the drain cock.
7. Add the clean water to the surge tank.
8. Fill the tank slowly so that the upper reservoir hose remains above the water line. This allows the air inside the cooling system to escape.
9. Start the engine.
10. Run the engine until the thermostat opens. You can tell the thermostat is open when both radiator hoses are hot to the touch.

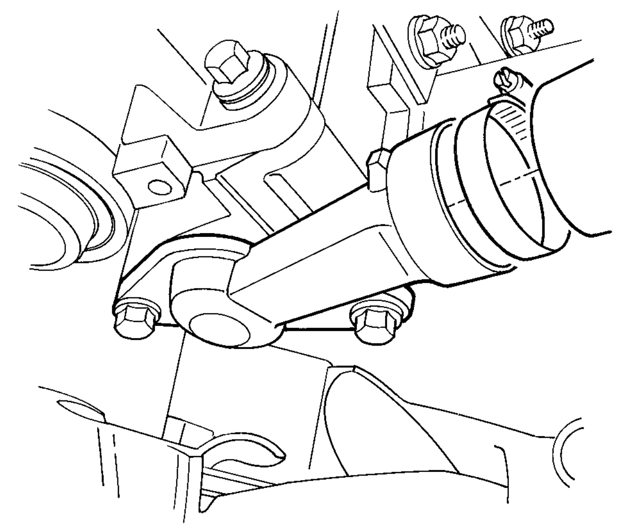


A102D017

11. Stop the engine.
12. Repeat steps 1 through 9 until the drained water is clear and free of coolant and rust.

Notice: Never use an antifreeze mixture more concentrated than 60 percent antifreeze to 40 percent water. The solution freezing point increases above this concentration.

13. Fill the cooling system through the surge tank with a mixture of ethylene glycol antifreeze and water. The mixture must be at least 50 percent antifreeze, but not more than 60 percent antifreeze for cold weather operation.
14. Fill the surge tank to the specified MAX fill mark on the outside of the tank.



A102D002

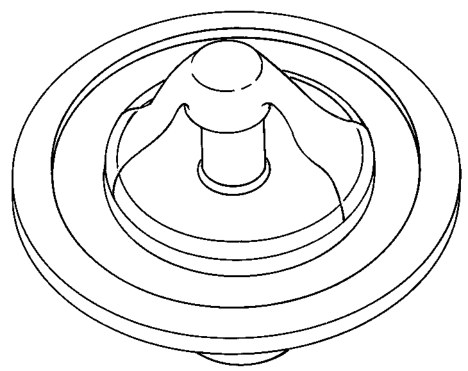
THERMOSTAT

Single Overhead Cam Engine

Removal Procedure

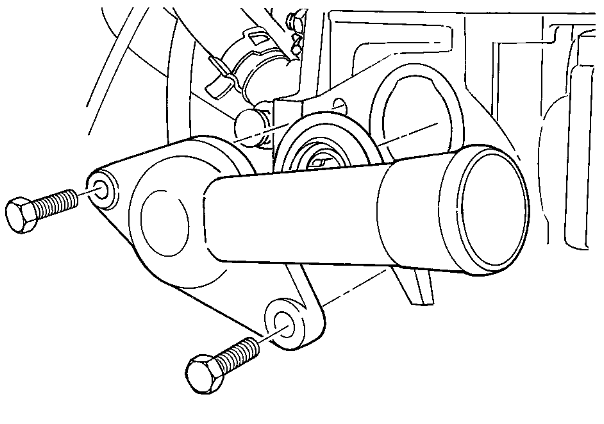
Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot because the heat causes the system to re-main under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the coolant. Refer to "Draining and Refilling the Cooling System" in this section.
2. Remove the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical.
3. Loosen the hose clamp on the upper radiator hose at the thermostat housing.
4. Disconnect the upper radiator hose from the thermostat housing.



A102D014

5. Remove the mounting bolts that hold the thermostat housing to the cylinder head.
6. Remove the thermostat housing from the head.
7. Remove the thermostat from its recess in the cylinder head.
8. Inspect the valve seat for foreign matter that could prevent the valve from seating properly.
9. Inspect the thermostat for proper operation. Refer to "Thermostat Test" in this section.
10. Clean the thermostat housing and the cylinder head mating surfaces.



A102D040

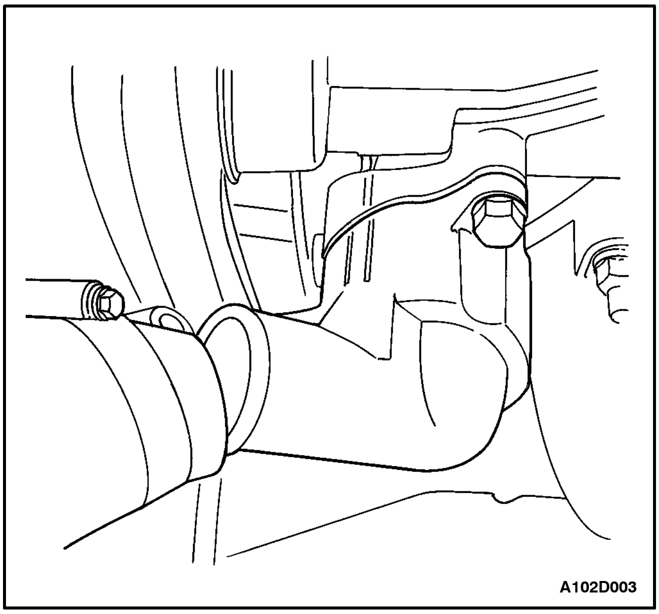
Installation Procedure

1. Install the thermostat into the cylinder head recess.
2. Install the thermostat housing.
3. Secure the thermostat housing to the cylinder head with the mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 N·m (15 lb-ft).

4. Connect the upper radiator hose to the thermostat housing.
5. Secure the upper radiator hose to the thermostat housing with a hose clamp.
6. Install the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical.
7. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.

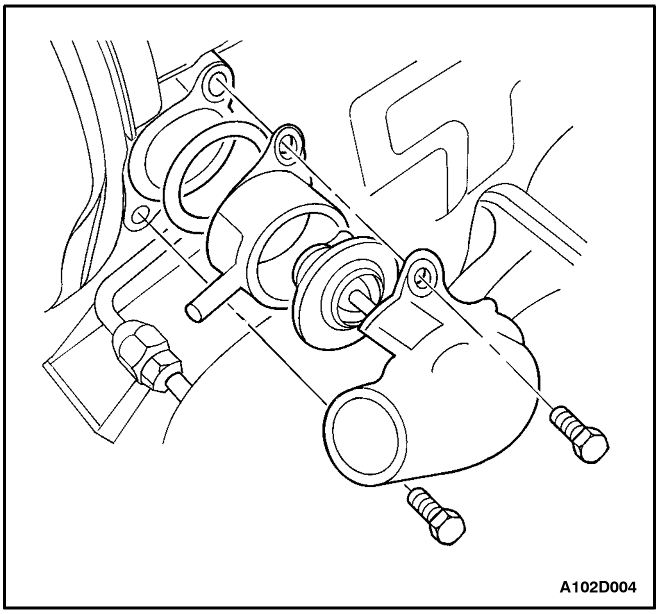


Dual Overhead Cam Engine

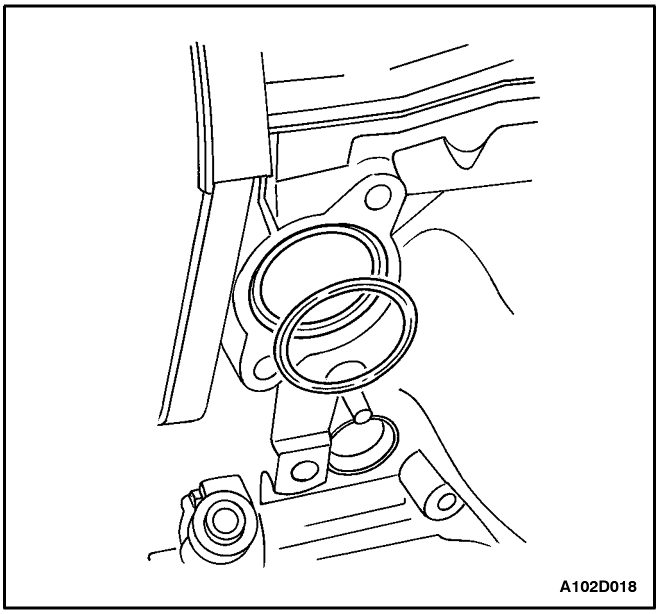
Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are still hot because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the coolant. Refer to "Draining and Refilling the Cooling System" in this section.
2. Loosen the hose clamp on the upper radiator hose at the thermostat housing.
3. Disconnect the upper radiator hose from the thermostat housing.

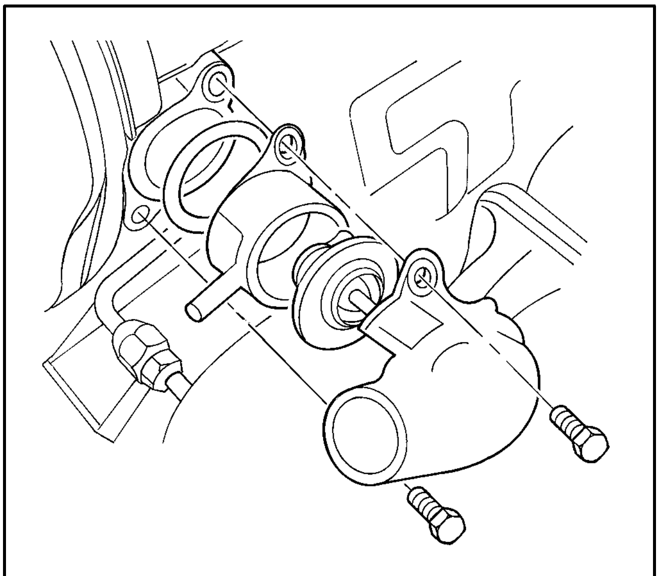


4. Loosen the clamp on the bypass hose.
5. Disconnect the bypass hose from the thermostat adapter.
6. Remove the mounting bolts holding the thermostat housing to the cylinder head.
7. Remove the thermostat housing from the head.
8. Remove the O-ring seal from the head.
9. Separate the thermostat cover from the thermostat adapter.
10. Remove the thermostat from its recess in the thermostat adapter.
11. Check the valve seat for foreign matter that could prevent the valve from seating properly.
12. Check the thermostat for proper operation. Refer to "Thermostat Test" in this section.
13. Clean the thermostat housing and cylinder head mating surfaces.



Installation Procedure

1. Install the thermostat into the thermostat adapter recess.
2. Assemble the thermostat cover over the thermostat adapter.
3. Coat the sealing surface of a new O-ring seal with Lubriplate r.



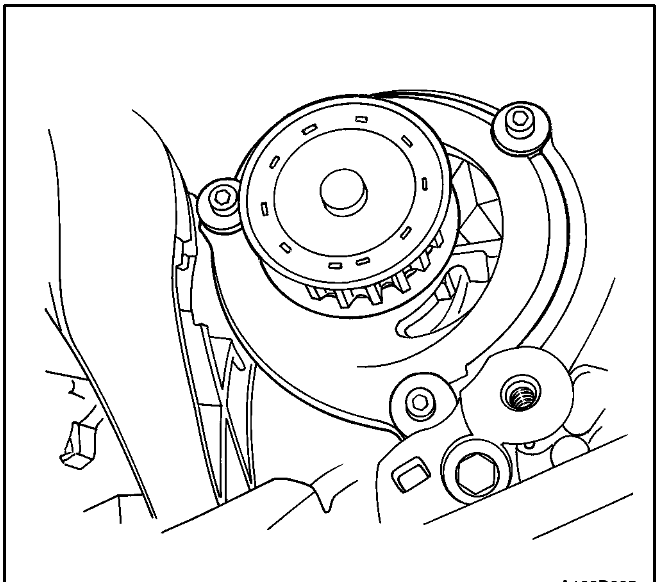
A102D004

4. Install a new O-ring seal into the recess in the cylinder head.
5. Secure the thermostat housing to the cylinder head with the mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 N•m (15 lb-ft).

6. Connect the bypass hose to the thermostat adapter.
7. Secure the bypass hose with a hose clamp.
8. Connect the upper radiator hose to the thermostat housing.
9. Secure the upper radiator hose to the thermostat housing with a hose clamp.
10. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.

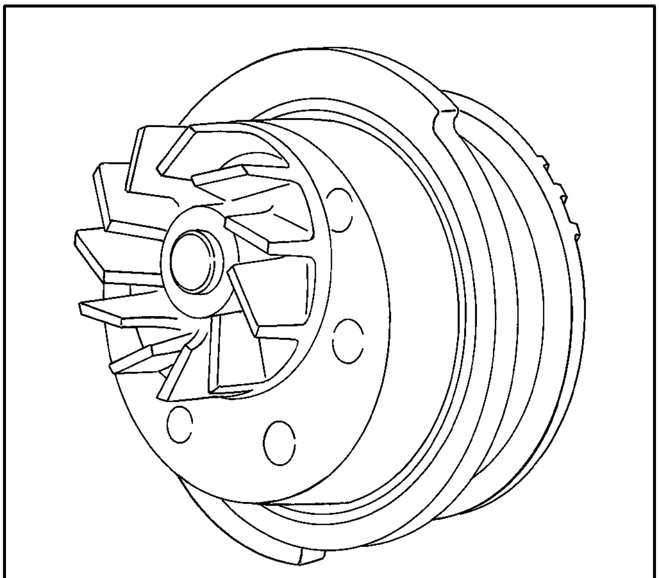


A102D005

COOLANT PUMP

Removal Procedure

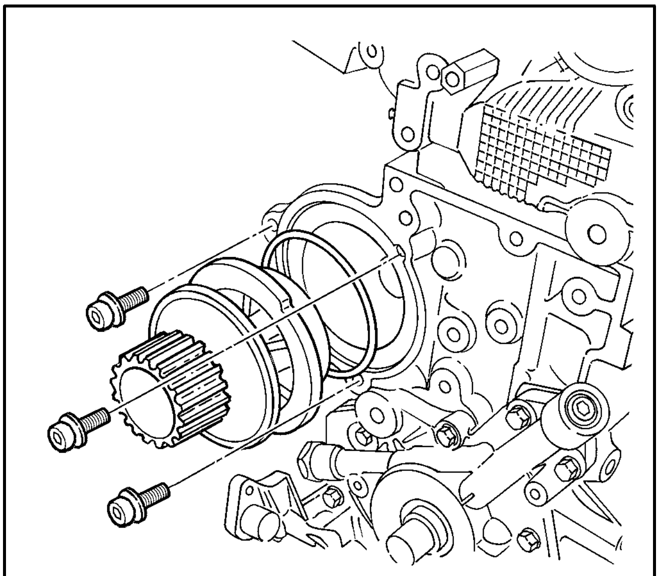
1. Drain the engine cooling system to a level below the thermostat housing. Refer to "Draining and Refilling the Cooling System" in this section.
2. Remove the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
3. Remove the coolant pump mounting bolts.
4. Remove the coolant pump from the cylinder block.
5. Remove the ring seal from coolant pump.



A102D041

Inspection and Cleaning Procedure

1. Inspect the coolant pump body for cracks and leaks.
2. Inspect the coolant pump bearing for play or abnormal noise.
3. Inspect the coolant pump pulley for excessive wear. If the coolant pump is defective, replace the coolant pump as a unit.
4. Clean the mating surfaces of the coolant pump and cylinder block.

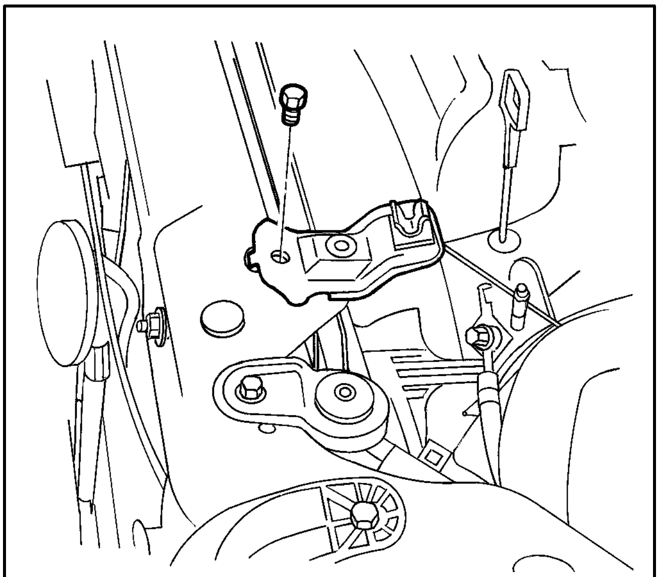

A102D042

Installation Procedure

1. Install a new ring seal to the coolant pump.
2. Coat the sealing surface of the ring seal with Lubriplate r.
3. Install the coolant pump to the engine block.
4. Secure the coolant pump to the engine block with the mounting bolts.

   Tighten

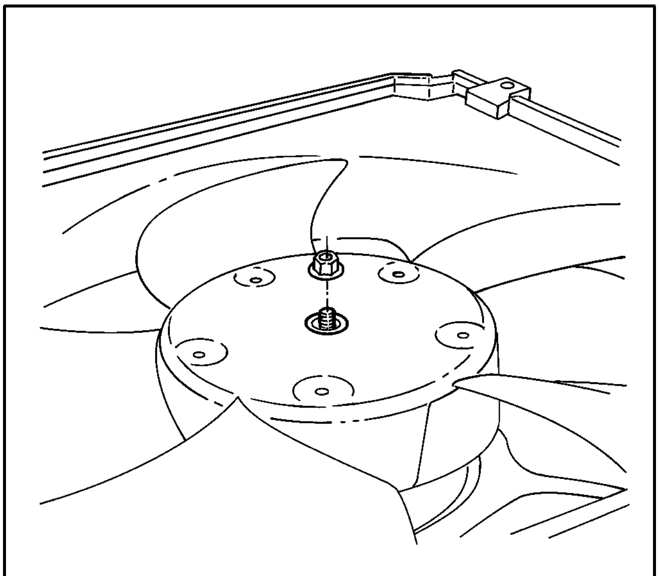
   Tighten the coolant pump mounting bolts to 10 NSm (89 lb-in).
5. Install the rear timing belt cover. Refer to Section 1B, DOHC Engine Mechanical.
6. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.


A102D023

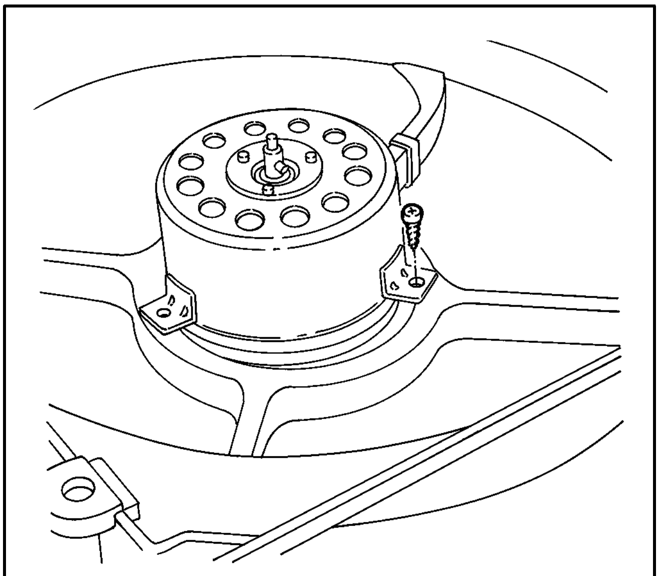
ELECTRIC COOLING FAN – MAIN

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the hood support rod bracket.

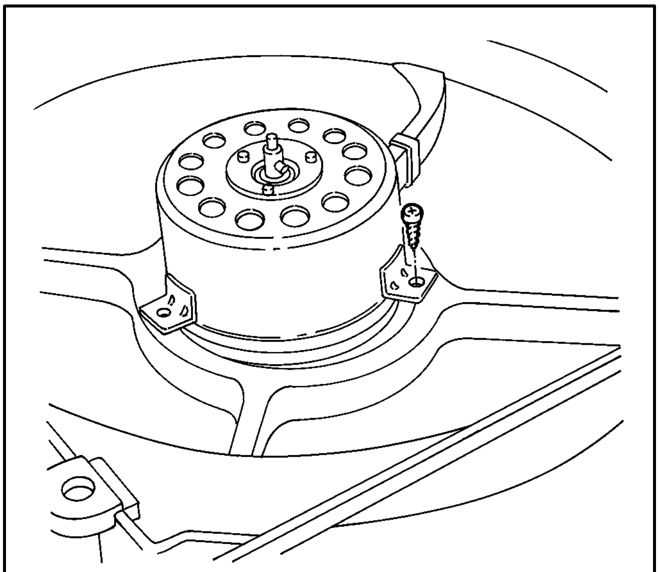

A102D006

3. Disconnect the cooling fan electrical connector.
4. Remove the fan shroud mounting bolts.
5. Lift the fan shroud assembly upward, and remove the fan shroud assembly from the vehicle.
6. Remove the fan blade from the fan motor by removing the nut at the center of the fan hub.



A102D007

7. Remove the fan motor retaining screws.
8. Remove the fan motor from the shroud.



A102D007

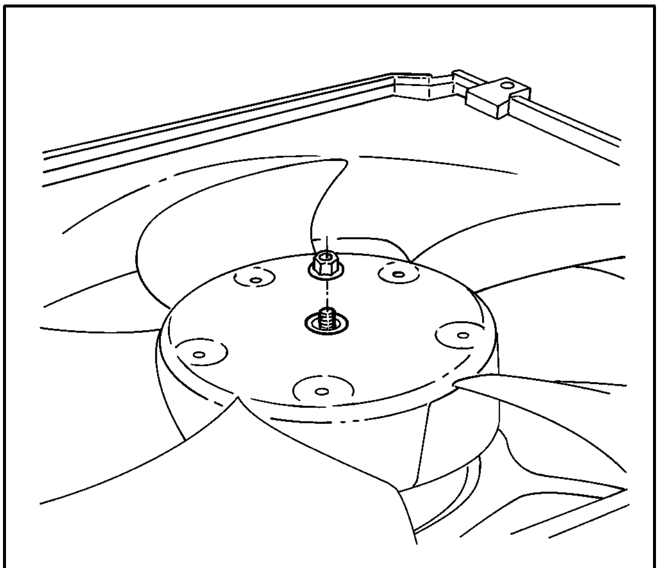
Installation Procedure

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly must be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance. A fan assembly that is not in proper balance can fail and fly apart during use, creating extreme danger. Proper balance cannot be assured on a fan assembly that has been bent or damaged.

1. Install the fan motor to the shroud.
2. Secure the motor to the shroud with the retaining screws.

Tighten

Tighten the fan motor retaining screws to 4 N·m (35 lb-in).

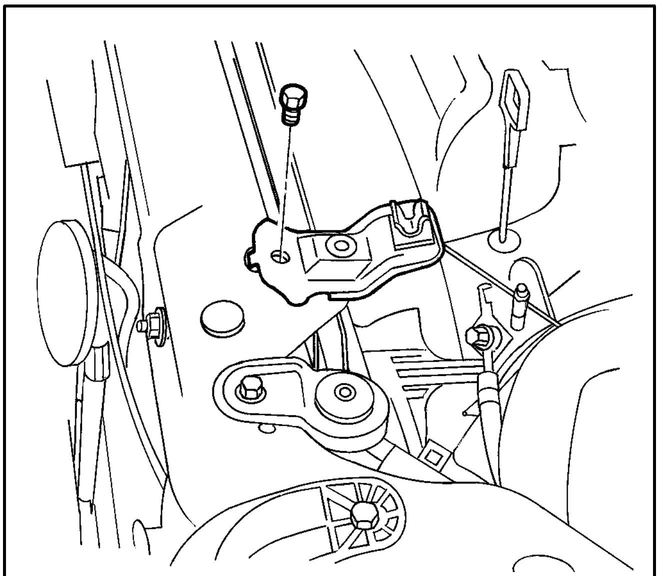


A102D006

3. Install the fan to the motor with the single nut in the center of the fan hub.

Tighten

Tighten the fan motor nut to 3.2 N·m (28 lb-in).


A102D023

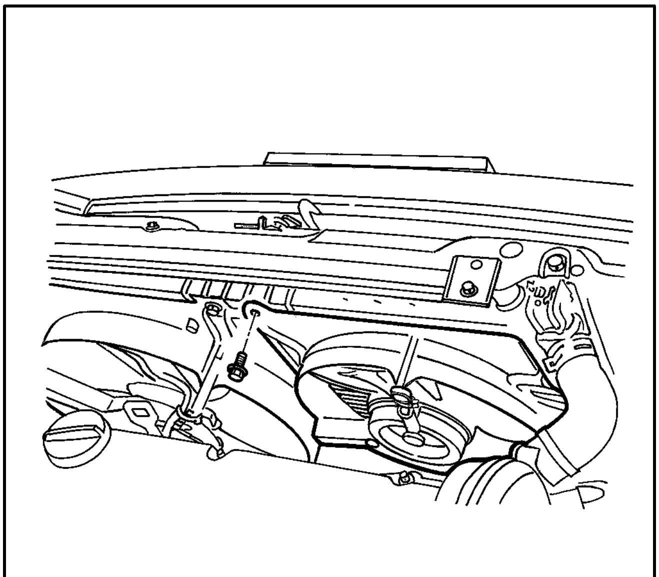
4. Install the electric cooling fan shroud assembly to the radiator.

Important: Be careful to seat the mounting post on the fan shroud into the socket at the radiator left tank. Be sure to slip the tab at the bottom edge of the shroud into the retaining clip near the center of the radiator.

5. Secure the shroud to the top of the radiator with the mounting bolts.

   Tighten

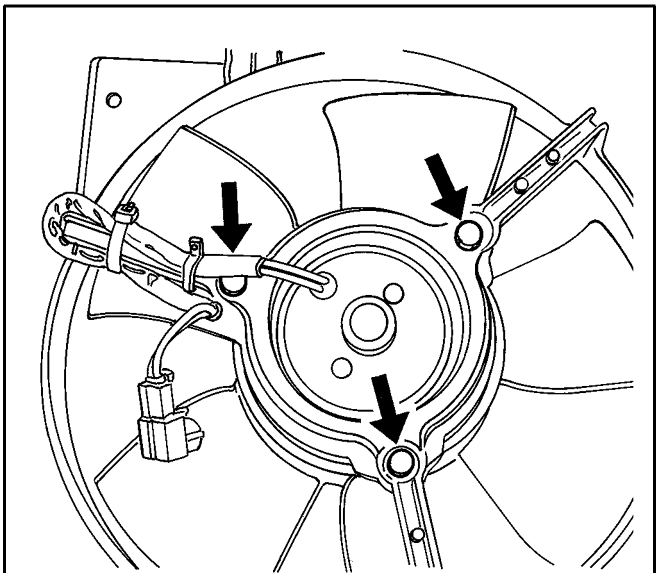
   Tighten the electric cooling fan assembly mounting bolts to 4 NSm (35 lb-in).
6. Install the electrical connector to the cooling fan.
7. Install the hood support rod bracket.
8. Connect the negative battery cable.


A102D026

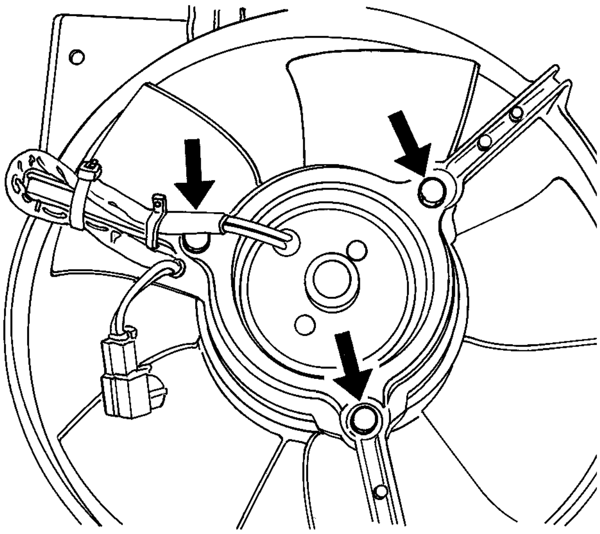
ELECTRIC COOLING FAN – AUXILIARY

Removal Procedure

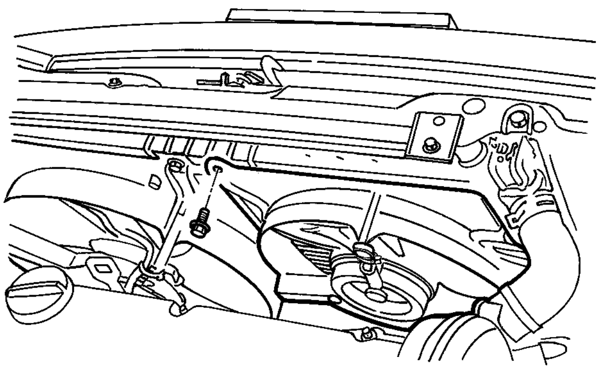
1. Disconnect the negative battery cable.
2. Disconnect the cooling fan electrical connector.
3. Remove the fan shroud mounting bolts.
4. Lift the fan shroud assembly upward, and remove the fan shroud assembly from the vehicle.
5. Remove the fan motor nuts that secure the fan motor to the shroud.


A102D008

6. Remove the fan motor from the shroud.
7. Remove the fan retaining nut which secures the fan to the motor.



A102D008



A102D026

Installation Procedure

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly must be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance. A fan assembly that is not in proper balance can fail and fly apart during use, creating an extremely dangerous condition. Proper balance cannot be assured on a fan assembly that has been bent or damaged.

1. Install the fan to the motor.
2. Attach the fan retaining nut.

Tighten

Tighten the fan retaining nut to 4 N·m (35 lb-in).

3. Attach the fan motor to the shroud.
4. Secure the fan motor to the shroud with the retaining nuts.

Tighten

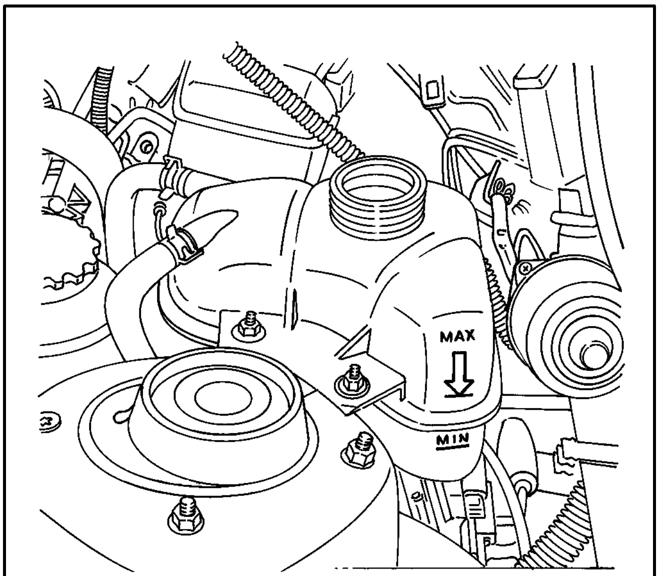
Tighten the fan motor retaining nuts to 3.2 N·m (28 lb-in).

5. Install the electric cooling fan assembly to the radiator.
6. Be careful to seat the mounting post on the fan shroud into the socket at the radiator right tank.
7. Also be sure to slip the bottom edge of the shroud into the retaining clip near the center of the radiator.
8. Secure the shroud to the top of the radiator with the mounting bolts.

Tighten

Tighten the electric cooling fan assembly mounting bolts to 4 N·m (35 lb-in).

9. Install the electrical connector to the cooling fan.
10. Connect the negative battery cable.



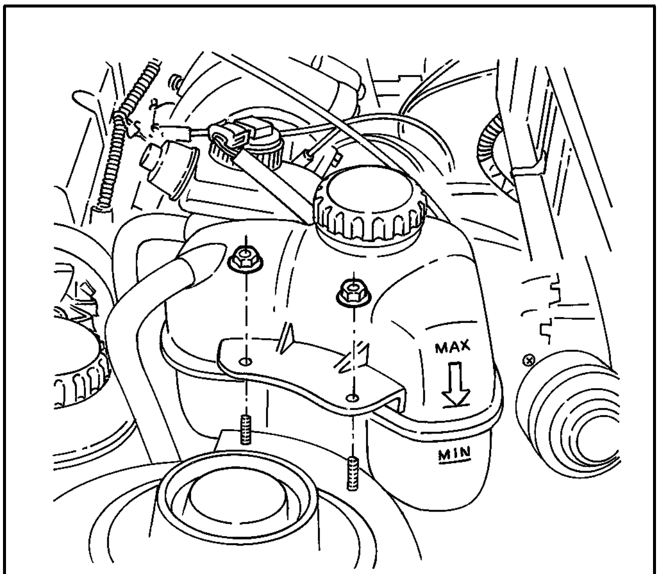
A102D017

SURGE TANK

Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot, because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the engine coolant to below the level of the surge tank.
2. Loosen the overflow hose clamps and disconnect the overflow hoses from the surge tank.
3. Remove the tank attaching nuts.
4. Remove the tank from the vehicle.
5. Clean the inside and the outside of the surge tank and the surge tank cap with soap and water.
6. Rinse the surge tank and the cap thoroughly.



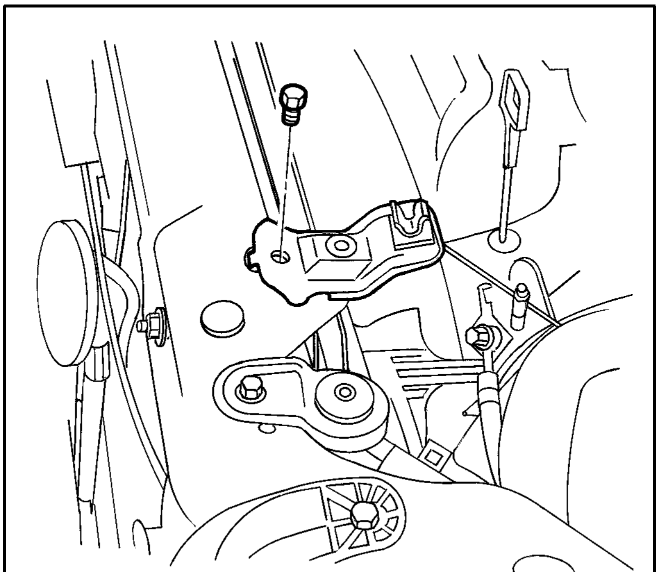
A102D043

Installation Procedure

1. Install the surge tank to the vehicle.
2. Secure the surge tank with the attaching nuts.

   Tighten

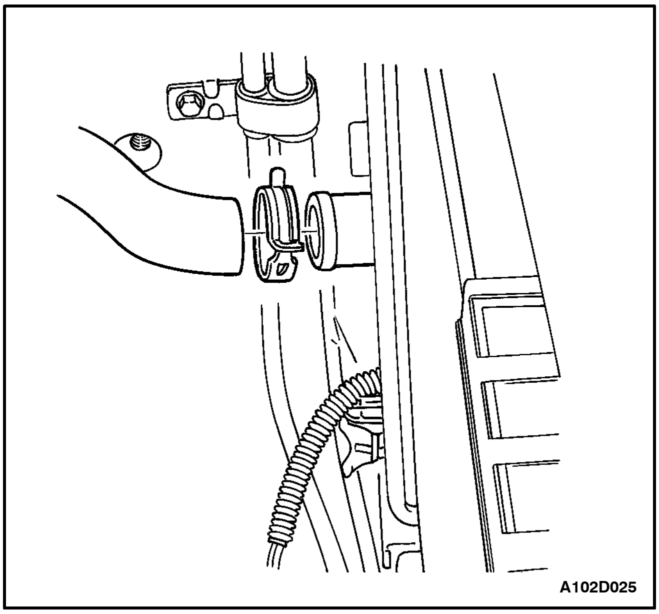
   Tighten the surge tank attaching nuts to 4 N·m (35 lb-in).
3. Connect the overflow hoses to the surge tank.
4. Secure the overflow hoses to the surge tank with the hose clamps.
5. Fill the surge tank with the coolant to the center ridge, or the MAX mark.


A102D023

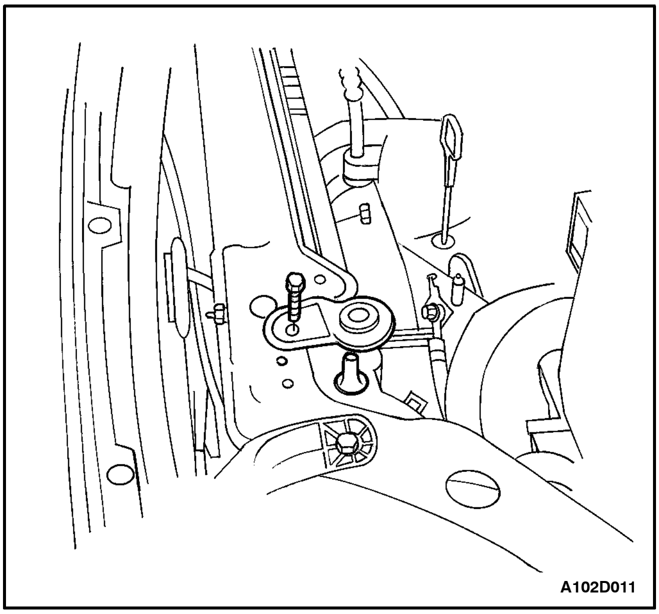
RADIATOR

Removal Procedure

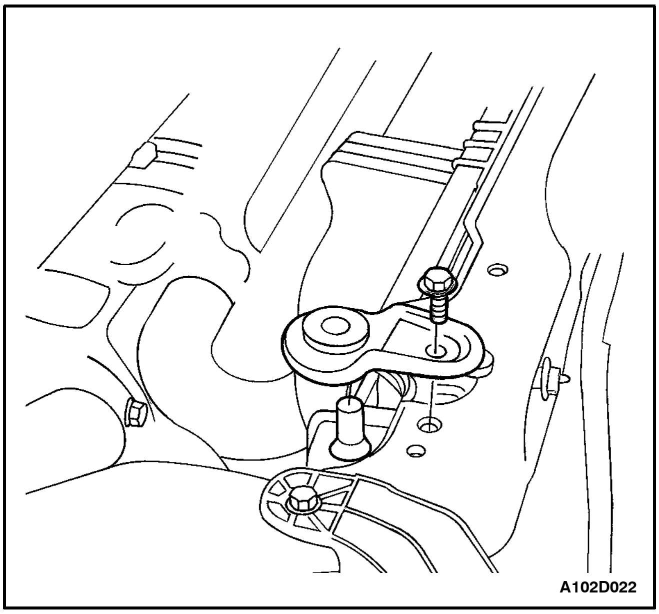
1. Disconnect the negative battery cable.
2. Drain the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
3. Remove the hood support rod bracket.



4. Remove the main cooling fan. Refer to "Electric Cooling Fan - Main" in this section.
5. Remove the auxiliary cooling fan, if equipped. Refer to "Electric Cooling Fan - Auxiliary" in this section.
6. Remove the lower radiator hose clamp.
7. Disconnect the lower radiator hose from the radiator.
8. Remove the upper radiator hose clamp.
9. Disconnect the upper radiator hose from the radiator.

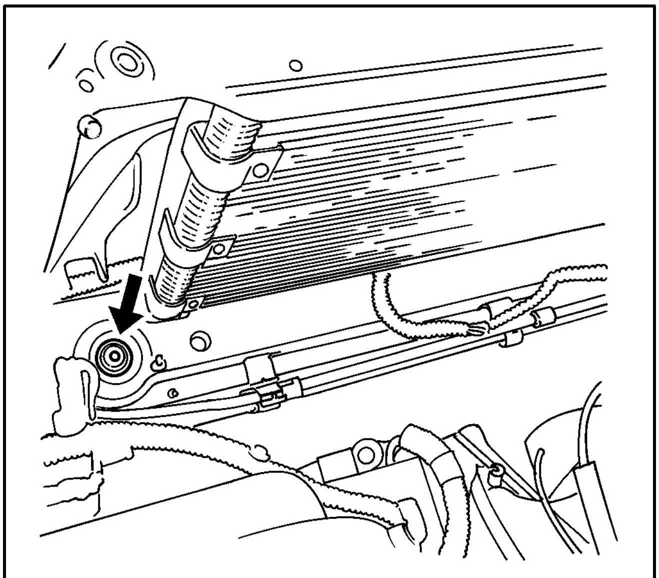


10. Remove the hose clamp from the surge tank hose at the radiator.
11. Disconnect the surge tank hose from the radiator.
12. Disconnect the upper and lower transmission cooler hoses from the pipes at the left radiator tank, if equipped.
13. Remove the left upper radiator retaining bolt.
14. Remove the left upper radiator retaining bracket.



15. Remove the right upper radiator retaining bolt.
16. Remove the right upper radiator retaining bracket.
17. Remove the radiator from the vehicle.

Important: The radiator still contains a substantial amount of coolant. Drain the remainder of the coolant from the radiator into a drain pan.


A102D012

Installation Procedure

1. If installing a new radiator, remove the transmission cooler pipes from the old radiator and install them onto the left tank of the new radiator.
2. Install the upper transmission cooler pipe to the radiator and secure the pipe with a pipe bolt.

Tighten

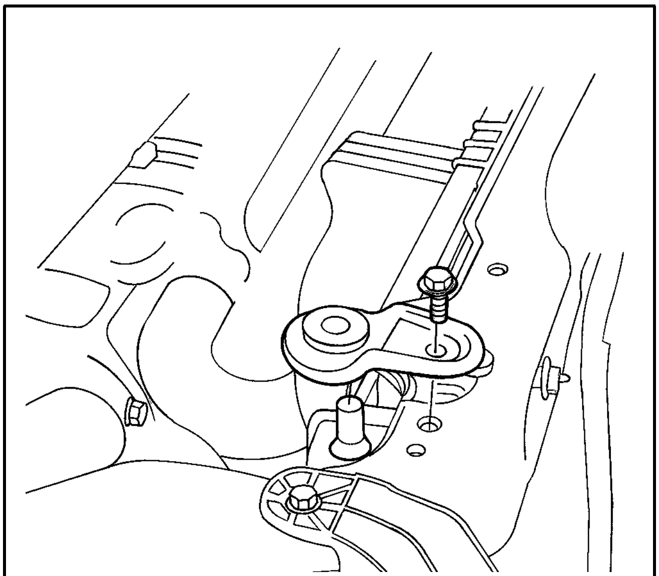
Tighten the upper transmission cooler pipe bolt to 12 N•m (106 lb-in).

3. Install the pipe holder as it was in the old radiator.
4. Install the lower transmission cooler pipe to the radiator and secure the pipe with a pipe bolt.

Tighten

Tighten the lower transmission cooler pipe bolt to 12 N•m (106 lb-in).

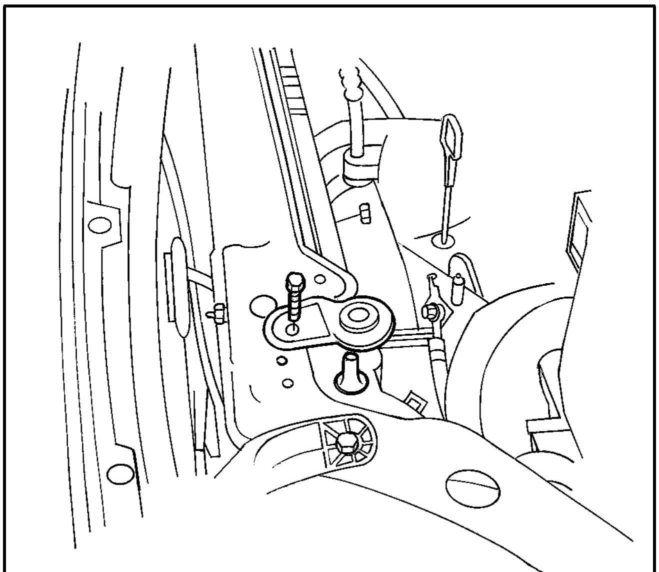
5. Set the radiator into place in the vehicle with the radiator bottom posts in the rubber shock bumpers.


A102D022

6. Position the radiator retainers in place.
7. Install the right upper radiator retainer bracket.
8. Install the right upper radiator retaining bolt.

Tighten

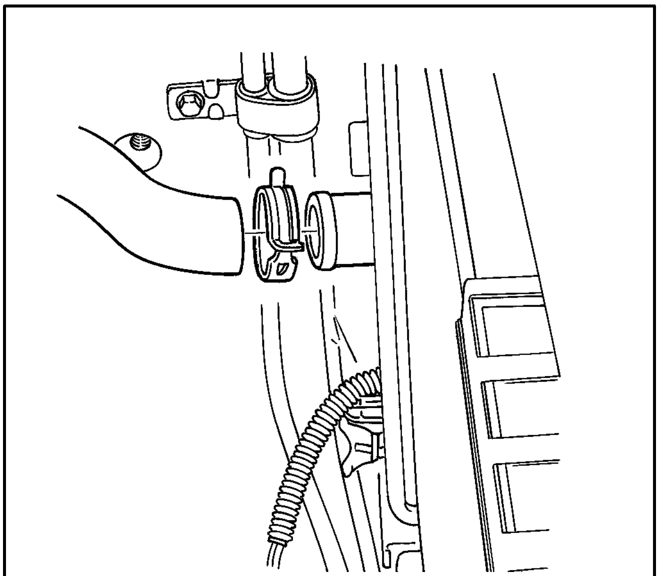
Tighten the right upper radiator retaining bolt to 4 N•m (35 lb-in).


A102D011

9. Install the left upper radiator retainer bracket.
10. Install the left upper radiator retaining bolt.

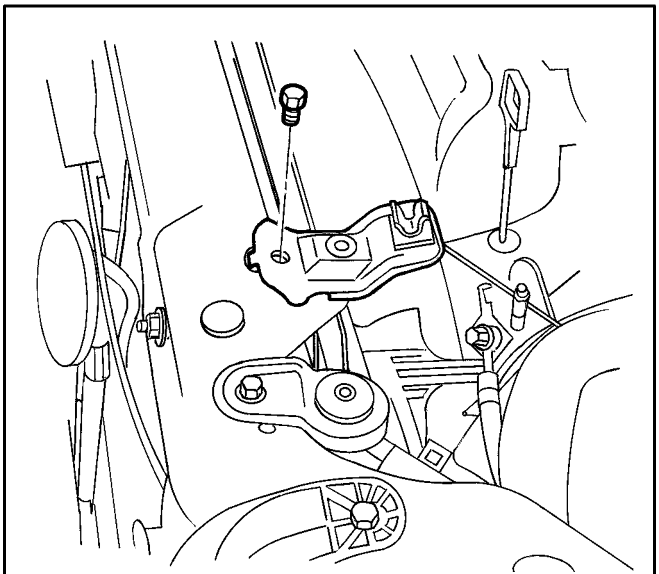
Tighten

Tighten the left upper radiator retaining bolt to 4 N•m (35 lb-in).



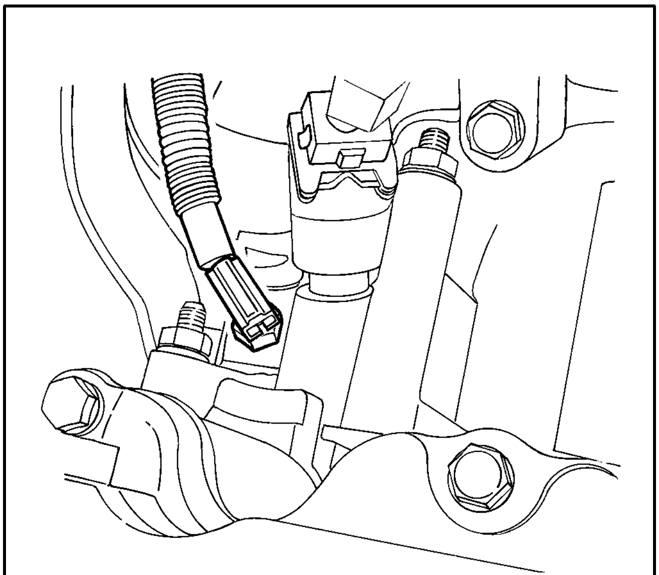
A102D025

11. Connect the transmission cooler hoses to the pipes, if equipped.
12. Connect the surge tank hose to the radiator.
13. Secure the surge tank hose with a hose clamp.
14. Connect the upper radiator hose and the lower radiator hose to the radiator.



A102D023

15. Secure each hose with a hose clamp.
16. Install the main cooling fan. Refer to "Electric Cooling Fan - Main" in this section.
17. Install the auxiliary cooling fan, if equipped. Refer to "Electric Cooling Fan - Auxiliary" in this section.
18. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
19. Install the hood support bracket.
20. Connect the negative battery cable.



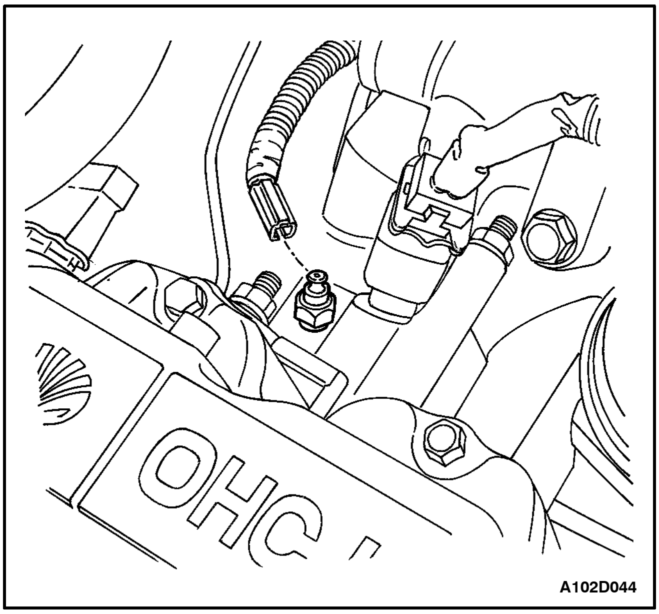
A102D013

ENGINE COOLANT TEMPERATURE SENSOR

Single Overhead Cam Engine

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain the coolant below the engine coolant temperature sensor level.
3. Disconnect the electrical connector from the engine coolant temperature sensor.
4. Remove the temperature sensor from the intake manifold.



A102D044

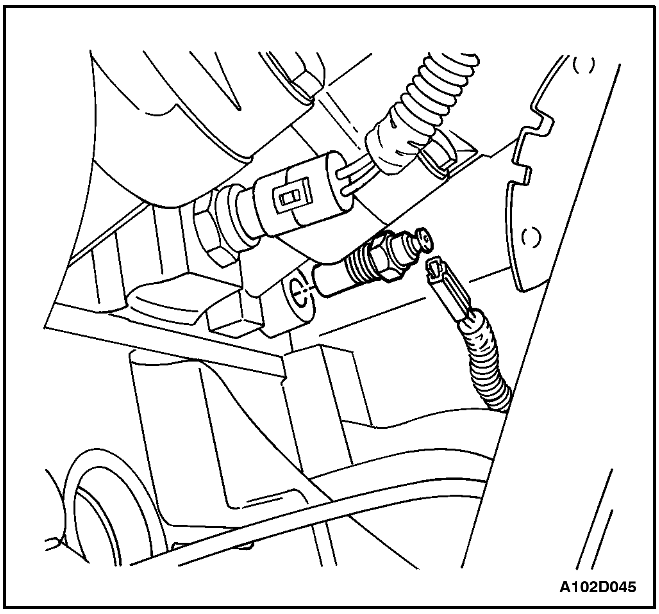
Installation Procedure

1. Install the engine coolant temperature sensor into the threaded hole in the intake manifold.

Tighten

Tighten the engine coolant temperature sensor to 20 NSm (15 lb-ft).

2. Connect the electrical connector to the engine coolant temperature sensor.
3. Refill the coolant system. Refer to "Draining and Refilling the Cooling System" in this section.
4. Connect the negative battery cable.

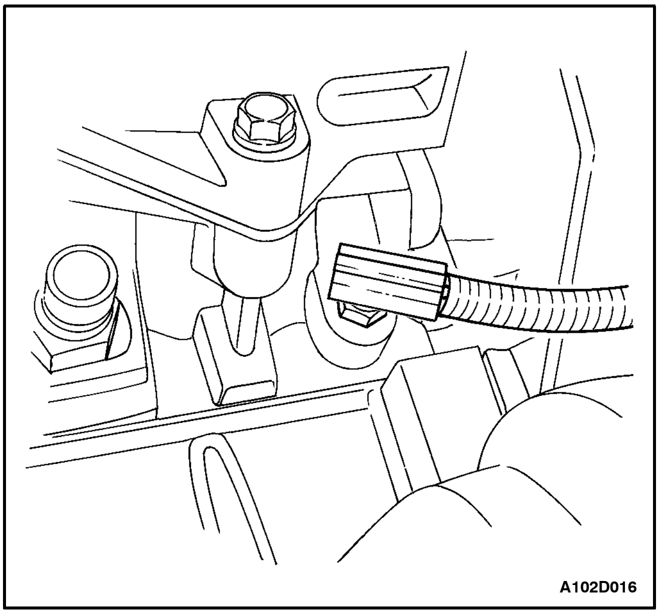


A102D045

Dual Overhead Cam Engine

Removal Procedure

1. Disconnect the negative battery table.
2. Drain the coolant below the engine coolant temperature sensor level.
3. Disconnect the electrical connector from the engine coolant temperature sensor.
4. Remove the temperature sensor from the cylinder head.



A102D016

Installation Procedure

1. Install the engine coolant temperature sensor into the threaded hole in the cylinder head.

Tighten

Tighten the engine coolant temperature sensor to 20 NSm (15 lb-ft).

2. Connect the electrical connector to the engine coolant temperature sensor.
3. Refill the coolant system. Refer to "Draining and Refilling the Cooling System" in this section.
4. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL DESCRIPTION

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. When the engine is cold the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly.

The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, a coolant pump, and a coolant pump drive belt. The timing belt drives the coolant pump.

All components must function properly in order for the cooling system to operate. The coolant pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools.

This system directs some coolant through the hoses to the heater core. This provides for heating and defrosting. The surge tank is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The surge tank maintains the correct coolant level.

The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the surge tank.

RADIATOR

This vehicle has a lightweight tube-and-fin aluminum radiator. Plastic tanks are mounted on the right and the left sides of the radiator core.

On vehicles equipped with automatic transaxles, the transaxle fluid cooler lines run through the left radiator tank. A radiator drain cock is on this radiator.

To drain the cooling system, open the drain cock.

SURGE TANK

The surge tank is a transparent plastic reservoir, similar to the windshield washer reservoir.

The surge tank is connected to the radiator by a hose and to the engine cooling system by another hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the surge tank. The air trapped in the radiator and the engine is degassed into the surge tank.

When the engine is stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency.

Maintain the coolant level between the MIN and the MAX marks on the surge tank when the system is cold.

COOLANT PUMP

The belt-driven centrifugal coolant pump consists of an impeller, a drive shaft, and a belt pulley. The coolant pump is mounted on the front of the transverse-mounted engine, and is driven by the timing belt.

The impeller is supported by a completely sealed bearing.

The coolant pump is serviced as an assembly and, therefore, cannot be disassembled.

THERMOSTAT

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the front of the cylinder head.

The thermostat stops the flow of the engine coolant from the engine to the radiator in order to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator, where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine.

As the wax pellet cools, the contraction allows a spring to close the valve.

The thermostat begins to open at 87_C (189_F) and is fully open at 102_C (226_F). The thermostat closes at 86_C (187_F).

ELECTRIC COOLING FAN

Caution: Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn ON whether or not the engine is running.

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one.

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioner (A/C)-equipped vehicles. This helps to speed cooling when the vehicle is at idle or moving at low speeds.

The main fan size is 320 mm (12.6 inches) in diameter with five blades to aid the air flow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan.

A/C models have two fans - the main fan, and the auxiliary fan. The auxiliary fan is 250 mm (9.8 inches) in diameter. Non-A/C models have only the main fan.

A/C OFF or Non-A/C Model

- The cooling fan(s) are actuated by the electronic control module (ECM) using a low speed cooling fan relay and a high speed cooling fan relay. On A/C equipped vehicles, a series/parallel cooling fan relay is also used.
- The ECM will turn the cooling fan(s) on at low speed when the coolant temperature reaches 93_C (199_F) and high speed at 97_C (207_F).
- The ECM will change the cooling fan(ls) from high speed to low speed at 94_C (201_F) and turn the cooling fans off at 90_C (194_F).

A/C ON

- The ECM will turn the cooling fans on at low speed when the A/C system is on. The ECM will change to high speed when the coolant temperature reaches 97_C (207_F) or highside A/C pressure reaches 1 882 kPa (273 psi).

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor controls the instrument panel temperature indicator. The engine coolant temperature sensor is located on the intake manifold near the throttle body on an SOHC engine, and on the cylinder head, under the intake manifold on a DOHC engine.

ENGINE BLOCK HEATER

The vehicle is designed to accept an engine block heater. The engine block heater helps warm the engine for improved cold weather starting. It can also help reduce fuel consumption when a cold engine is warming up.

The engine block heater utilizes an existing expansion plug for installation and is located under the intake manifold.

Contact your Daewoo dealer for further information or installation.

SECTION 1E

ENGINE ELECTRICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

STARTER SPECIFICATIONS

Application	Description
Starter 0.8 Kilowatts No Load Test @ 10 volts Drive Pinion Speed at:	 Minimum 60 - Maximum 98 amps 6,000-12,000 rpm
Solenoid Hold-in Windings @ 10 volts Pull-in Windings @ 10 volts	 13-19 amps 59-79 amps
Starter 1.4 Kilowatts No Load Test @ 12.2 volts Drive Pinion Speed at:	 Minimum 40 - Maximum 90 amps 3,200-4,800 rpm
Solenoid Hold-in Windings @ 10 volts Pull-in Windings @ 10 volts	 13-19 amps 59-79 amps

GENERATOR SPECIFICATIONS

Application	Description
Types	CS-121D CS-128D

BATTERY SPECIFICATIONS

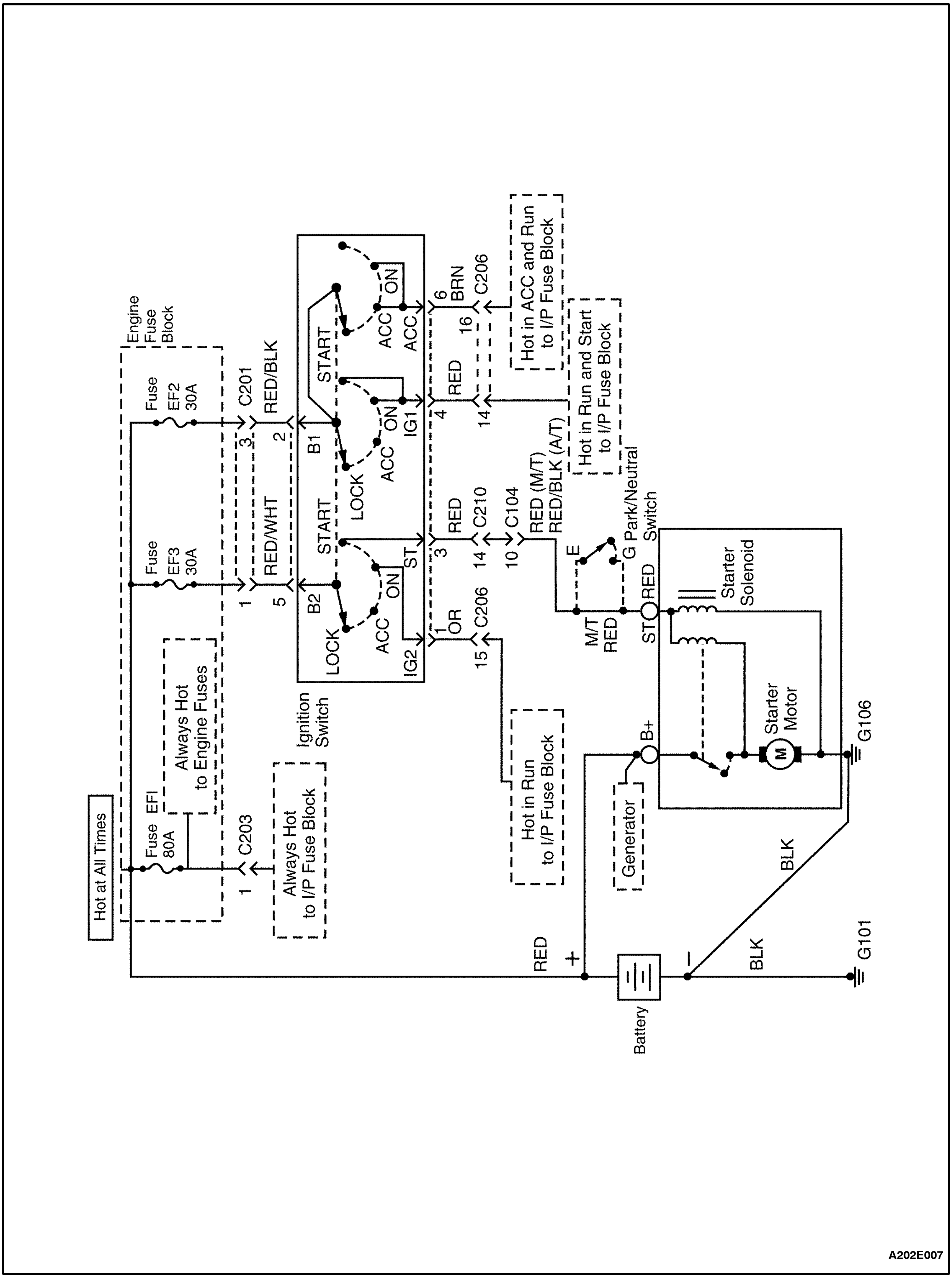
Application	Description
L4 Engine	
Cold Cranking Amps	550 amps
RC (Minimum)	90 minutes
Load Test	270 amps
Replacement	85B-60
Minimum Voltage:	Estimated Temperature:
9.6	21_C (70_F)
9.4	20_C (68_F)
9.1	0_C (32_F)
8.8	* 10_C (14_F)
8.5	* 18_C (0.4_F)
8.0	Below * 18_C (Below 0_F)

FASTENER TIGHTENING SPECIFICATIONS

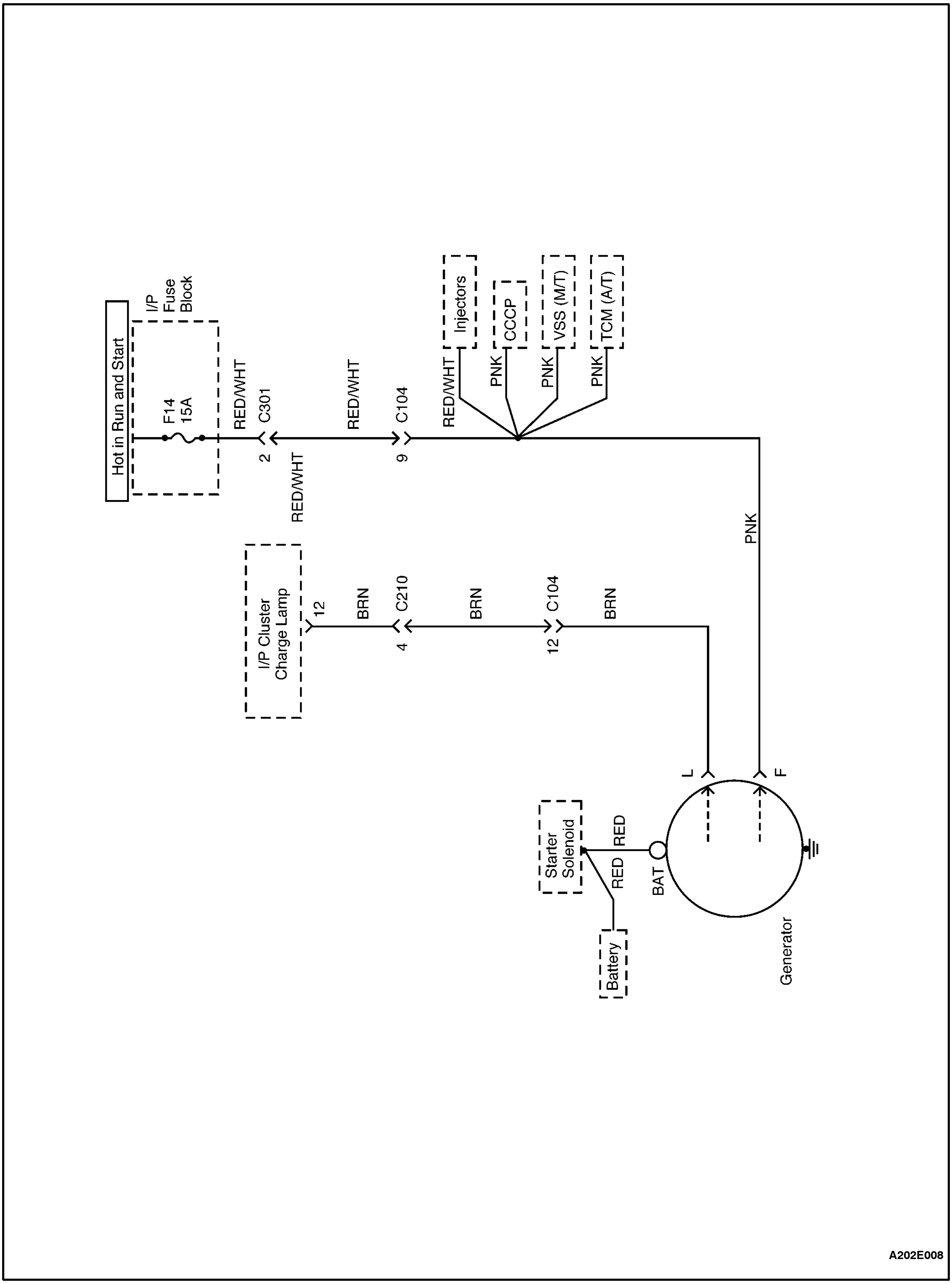
Application	NSm	Lb-Ft	Lb-In
Battery Cable Nuts	15	11	-
Battery Carrier Tray Lower Bolts	20	15	-
Battery Carrier Tray Upper Bolts	20	15	-
Battery Retainer Clamp-to-Battery Rod Nuts	5	-	44
Fuel Rail Retaining Bolts	20	15	-
Generator Battery Lead Connector Nut	15	11	-
Generator Drive End Bearing Nut (CS-121D)	81	60	-
Generator Drive End Nut (CS-128D)	100	74	-
Generator Lower Bracket-to-Generator	20	15	-
Generator Shackle Bracket Bolt	20	15	-
Generator Through-Bolts (CS-121D)	10	-	89
Generator Through-Bolts (C5-128D)	25	18	-
Starter End Frame-to-Brush Holder Assembly Bolts (0.8 Kilowatts)	3	-	27
Starter Field Connector Nut	8	-	71
Starter Mounting Studs	43	32	-
Starter Solenoid Assembly Screws	8	-	71
Starter Solenoid-to-Ignition Terminal Nut	6	-	53
Starter Through-Bolts	6	-	53
Starter Solenoid Terminal-to-Battery Cable Nut	7	-	62

SCHEMATIC AND ROUTING DIAGRAMS

STARTING SYSTEM



CHARGING SYSTEM



DIAGNOSIS

NO CRANK

Step	Action	Value(s)	Yes	No
1	1. Turn the headlamps ON. 2. Turn the dome lamps ON. 3. Turn the key to START. Do the lights dim or go out?	-	Go to Step 2	Go to Step 8
2	Check the battery state of charge. Is the green eye showing from the built-in hydrometer?	-	Go to Step 3	Go to "Charging Procedure"
3	1. Connect the voltmeter positive lead to the positive battery terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Turn the ignition to START. Does the voltmeter indicate the value specified?	< 9.6 v	Go to "Charging Procedure"	Go to Step 4
4	1. Connect the voltmeter negative lead to the negative battery terminal. 2. Connect the voltmeter positive lead to the engine block. 3. Place the ignition in the START position. Does the voltmeter indicate the value specified?	> 0.5 v	Go to Step 5	Go to Step 6
5	1. Clean and tighten the negative battery cable connections both at the battery end and at the ground end. 2. Replace the cable if needed. Is the repair complete?	-	System OK	-
6	1. Connect the voltmeter positive lead to the starter "B" terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Check the cranking voltage. Does the voltmeter indicate the value specified?	< 9 v	Go to Step 7	Go to Step 13
7	Clean, tighten, or replace the positive battery cable. Is the repair complete?	-	System OK	-
8	Check system fuse EF3 in the engine fuse block. Is fuse EF3 blown?	-	Go to Step 9	Go to Step 10
9	Replace system fuse EF3. Is the repair complete?	-	System OK	-
10	Check the connection at the starter "S" terminal. Is the connection in good condition?	-	Go to Step 12	Go to Step 11
11	Repair the starter "S" terminal. Is the repair complete?	-	System OK	-
12	1. Connect the voltmeter positive lead to the starter "S" terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Place the ignition in the START position. 4. Read the voltage present at the "S" terminal. Does the voltmeter indicate the specified value?	> 7 v	Go to Step 13	Go to Step 14

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
13	Repair or replace the starter. Is the repair complete?	-	System OK	-
14	Turn on the heater blower. Does the blower operate?	-	Go to Step 24	Go to Step 15
15	1. Disconnect connector C201. 2. Connect the voltmeter positive lead to terminal 1 of connector C201. 3. Connect the voltmeter negative terminal to ground. Does the voltmeter indicate the specified value?	12 v	Go to Step 17	Go to Step 16
16	Repair the open in the RED/WHT wire from fuse EF3 to Connector C201. Is the repair complete?	-	System OK	-
17	Check the contacts of terminal 1 on connector C201. Are the contacts OK?	-	Go to Step 19	Go to Step 18
18	Repair the faulty contact of connector C201. Is the repair complete?	-	System OK	-
19	1. Reconnect connector C201. 2. Disconnect the ignition switch connector. 3. Connect the voltmeter positive lead to terminal 5 of the ignition switch connector. 4. Connect the voltmeter negative terminal to ground. Does the voltmeter indicate the specified value?	11-14 v	Go to Step 21	Go to Step 20
20	Repair the open in the RED/WHT wire from terminal 1 of connector C201 to terminal 5 of the ignition switch connector. Is the repair complete?	-	System OK	-
21	Check the contacts of terminal 5 of the ignition switch connector. Are the contacts OK?	-	Go to Step 23	Go to Step 22
22	Repair the faulty contact of the ignition switch connector. Is the repair complete?	-	System OK	-
23	Replace the ignition switch. Is the repair complete?	-	System OK	-
24	Does the vehicle have an automatic transmission?	-	Go to Step 25	Go to Step 35
25	1. Disconnect the Park/Neutral switch connector. 2. Connect the voltmeter positive lead to the Park/Neutral switch connector terminal E, connected to the RED/BLK wire. 3. Connect the voltmeter negative lead to the negative battery terminal. 4. Place the ignition in the START position. Does the voltmeter indicate the value specified?	<7 v	Go to Step 26	Go to Step 31
26	Check continuity between the Park/Neutral switch connector terminal G, connected to the RED wire, and the Park/Neutral switch connector terminal E, connected to the RED/BLK wire. Does the ohmmeter indicate the specified value?	0 W	Go to Step 27	Go to Step 30

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
27	Check the condition of terminals E and G on both the Park/Neutral switch connector and on the Park/Neutral switch. Are any of these terminals faulty?	-	Go to Step 28	Go to Step 29
28	Repair the faulty terminal. Is the repair complete?	-	System OK	-
29	Repair the open in the RED wire between terminal G of the Park/Neutral switch connector and the starter "S" terminal. Is the repair complete?	-	System OK	-
30	Replace the Park/Neutral switch. Is the repair complete?	-	System OK	-
31	1. Reconnect the Park/Neutral switch. 2. Disconnect connector C104. 3. Connect the voltmeter positive lead to terminal 10 of connector C104 on the ECM/ABS harness. 4. Connect the voltmeter negative lead to ground. 5. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 32	Go to Step 39
32	Check terminal 10 on both sides of connector C104. Is one of them faulty?	-	Go to Step 33	Go to Step 34
33	Repair the faulty terminal. Is the repair complete?	-	System OK	-
34	Repair the open in the RED/BLK wire from terminal 10 of connector C104 to terminal E of the Park/Neutral switch. Is the repair complete?	-	System OK	-
35	1. Disconnect connector C104. 2. Connect the voltmeter positive lead to terminal 10 of connector C104 on the ECM/ABS harness. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 36	Go to Step 39
36	Check terminal 10 on both sides of connector C104. Is one of them faulty?	-	Go to Step 37	Go to Step 38
37	Repair the faulty terminal. Is the repair complete?	-	System OK	-
38	Repair the open in the RED wire from terminal 10 of connector C104 to the starter "S" terminal. Is the repair complete?	-	System OK	-
39	1. Disconnect connector C210. 2. Connect the voltmeter positive lead to terminal 14 of connector C210 on the I/P harness. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 40	Go to Step 43
40	Check terminal 14 on both sides of connector C210. Is one of them faulty?	-	Go to Step 41	Go to Step 42
41	Repair the faulty terminal. Is the repair complete?	-	System OK	-

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
42	Repair the open in the RED wire from terminal 14 of connector C210 to terminal 10 of connector C104. Is the repair complete?	-	System OK	-
43	1. Disconnect the ignition switch connector. 2. Connect the voltmeter positive lead to terminal ST of the ignition switch. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 45	Go to Step 44
44	Replace the ignition switch. Is the repair complete?	-	System OK	-
45	Check terminal ST on the ignition switch and terminal 3 of the ignition switch connector. Are the terminals in good condition?	-	Go to Step 46	Go to Step 47
46	Repair the open in RED wire between terminal 3 of the ignition switch connector and terminal 14 of connector C210. Is the repair complete?	-	System OK	-
47	Repair the faulty terminal. Is the repair complete?	-	System OK	-

STARTER MOTOR NOISE

To correct starter motor noise during starting, use the following procedure:

Checks	Action
Check for a high-pitched whine during cranking, before the engine fires. The engine cranks and fires properly.	The distance is too great between the starter pinion and the flywheel. Shimming the starter toward the flywheel is required.
Check for a high-pitched whine after the engine fires, as the key is being released. The engine cranks and fires properly. This intermittent complaint is often diagnosed as "starter hang-in" or "solenoid weak."	The distance is too small between the starter pinion and the flywheel. Shimming the starter away from the flywheel is required.
Check for a loud "whoop" after the engine fires but while the starter is still held engaged. The sound is like a siren if the engine is revved while the starter is engaged.	The most probable cause is a defective clutch. A new clutch will often correct this problem.
Check for a "rumble," a "growl," or, in severe cases, a "knock" as the starter is coasting down to a stop after starting the engine.	The most probable cause is a bent or an unbalanced starter armature. A new armature will often correct this problem.

If the complaint is noise, correction can be achieved by proper shimming as follows:

1. Check for a bent or a worn flywheel.
2. Start the engine and carefully touch the outside diameter of the rotating flywheel ring gear with chalk or a crayon to show the high point of the tooth runout. Turn the engine OFF and rotate the flywheel so that the marked teeth are in the area of the starter pinion gear.
3. Disconnect the negative battery cable to prevent the cranking of the engine.
4. Check the pinion-to-flywheel clearance by using a wire gauge of 0.5 mm (0.02 inch) minimum thickness or diameter. Center a pinion tooth between two flywheel teeth and the gauge. Do not gauge in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.
5. If the clearance approaches 1.5 mm (0.06 inch) or more, shimming the starter toward the flywheel is required. This condition is generally the cause of broken flywheel teeth or a broken starter housing. Shim the starter toward the flywheel by shimming only the outboard starter mounting pad. A shim of 0.40 mm (0.016 inch) thickness at this location will decrease the clearance by approximately 0.30 mm (0.012 inch). If normal starter shims are not available, plain washers or other suitable material may be used as shims.

BATTERY LOAD TEST

1. Check the battery for obvious damage, such as a cracked or broken case or cover, which could permit the loss of electrolyte. If damage is obvious, replace the battery.

Caution: Do not charge the battery if the hydrometer is clear or light yellow. Instead, replace the battery. If the battery feels hot or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce the charging rate to avoid injury.

2. Check the hydrometer. If the green dot is visible, go to the load test procedure. If the indicator is dark but green is not visible, charge the battery. For charging a battery removed from the vehicle, refer to "Charging a Completely Discharged Battery (Off the Vehicle)" in this section.
3. Connect a voltmeter and a battery load tester across the battery terminals.
4. Apply a 300-ampere load for 15 seconds to remove any surface charge from the battery.
5. Remove the load.
6. Wait 15 seconds to let the battery recover, and apply a 270-ampere load.

Important: The battery temperature must be estimated by touch and by the temperature condition the battery has been exposed to for the preceding few hours.

7. If the voltage does not drop below the minimum listed, the battery is good and should be reinstalled. If the voltage is less than the minimum listed, replace the battery. Refer to "Battery Specifications" in this section.

GENERATOR OUTPUT TEST

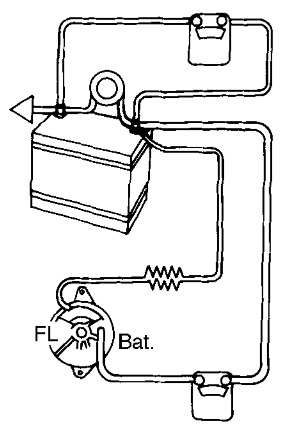
1. Perform the generator system test. Refer to "Generator System Check" in this section.
2. Replace the generator if it fails that test. Refer to "Generator" in the On-Vehicle Service section. If it passes the test, perform the on-vehicle output check which follows.

Important: Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator.

3. Attach a digital multimeter, an ammeter, and a carbon pile load to the vehicle.

Important: Be sure the vehicle battery is fully charged, and the carbon pile load is turned off.

4. With the ignition switch in the OFF position, check and record the battery voltage.
5. Remove the harness connector from the generator.
6. Turn the ignition switch to the RUN position with the engine not running. Use a digital multimeter to check for voltage in the harness connector "L" terminal.
7. The reading should be near the specified battery voltage of 12 volts. If the voltage is too low, check the indicator "L" terminal circuits for open and grounded circuits causing voltage loss. Correct any open wires, terminal connections, etc., as necessary. Refer to "Charging System" in this section.
8. Attach the generator harness connector.
9. Run the engine at a moderate idle, and measure the voltage across the battery terminals. The reading should be above that recorded in Step 14 but less than 16 volts. If the reading is over 16 volts or below the previous reading, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
10. Run the engine at a moderate idle, and measure the generator amperage output.
11. Turn on the carbon pile, and adjust it to obtain the maximum amps while maintaining the battery voltage above 13 volts.
12. If the reading is within 15 amps of the generator's rating noted on the generator, the generator is good. If not, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
13. With the generator operating at the maximum output, measure the voltage between the generator housing and the battery negative terminal. The voltage drop should be 0.5 volt or less. If the voltage drop is more than 0.5 volt, check the ground path from the generator housing to the negative battery cable.
14. Check, clean, tighten, and recheck all of the ground connections.



C102E009

GENERATOR SYSTEM CHECK

When operating normally, the generator indicator lamp will come on when the ignition switch is in the RUN position and go out when the engine starts. If the lamp operates abnormally or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight or by a defective switch that allows a lamp, such as a trunk or glove box lamp, to stay on.

Diagnose the generator with the following procedure:

1. Visually check the belt and wiring.
2. With the ignition switch in the ON position and the engine stopped, the charge indicator lamp should be on. If not, detach the harness at the generator and ground the "L" terminal in the harness with a fused, 5-ampere jumper lead.
   - If the lamp lights, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
   - If the lamp does not light, locate the open circuit between the ignition switch and the harness connector. The indicator lamp bulb may be burned out.
3. With the ignition switch in the ON position and the engine running at moderate speed, the charge indicator lamp should be off. If not, detach the wiring harness at the generator.
   - If the lamp goes off, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
   - If the lamp stays on, check for a short to ground in the harness between the connector and the indicator lamp.

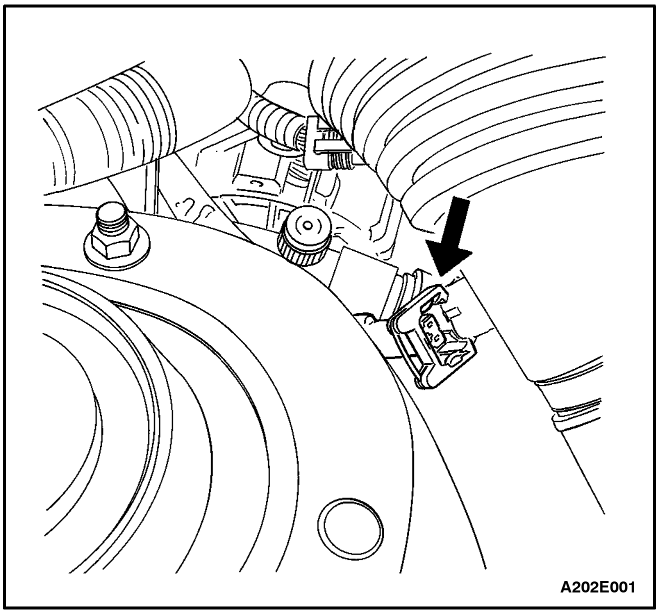
Important: Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator. Refer to "Generator" in the Unit Repair section.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

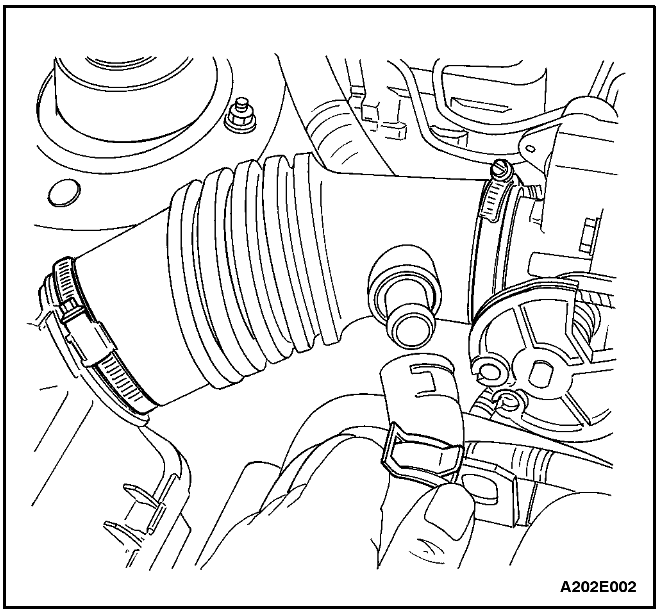
GENERATOR

Removal Procedure



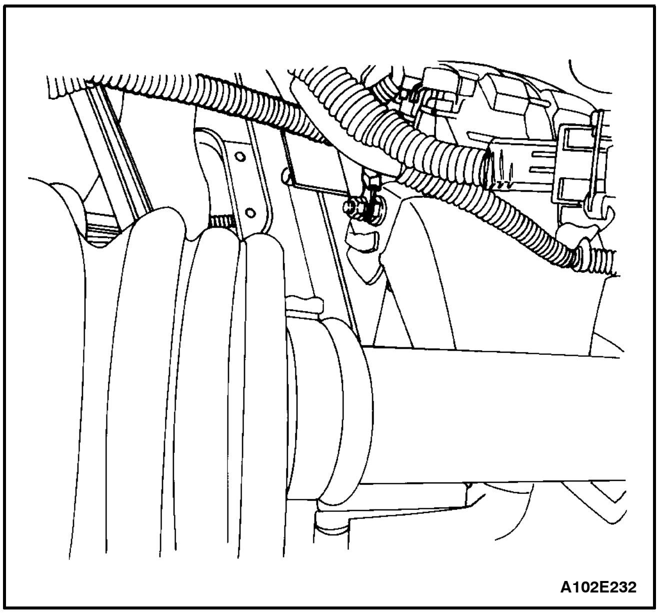
A202E001

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature (MAT) sensor electrical connector from the air intake tube.



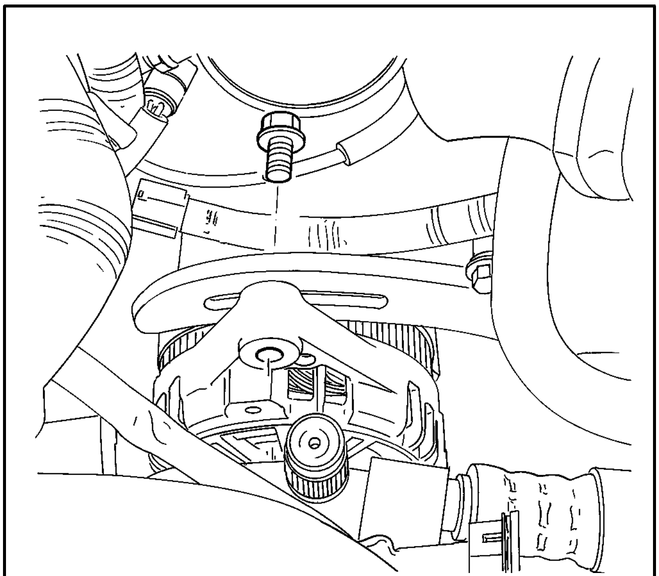
A202E002

3. Remove the breather tube clamp and all other clamps to remove the air intake tube.



A102E232

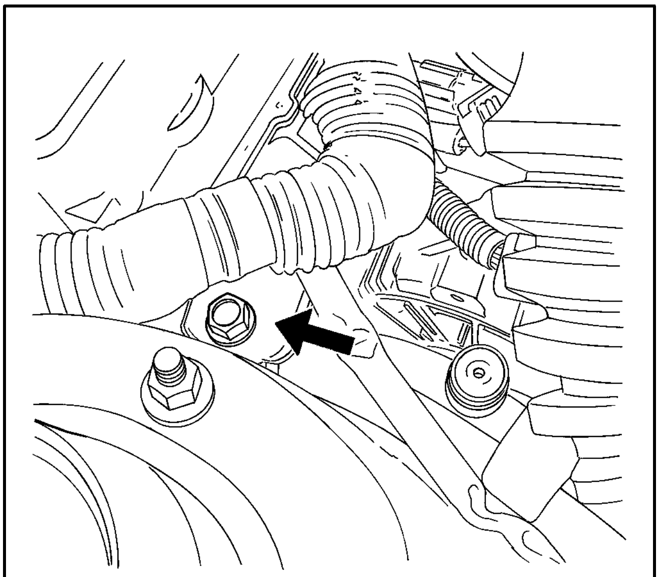
4. Remove the battery harness connector nut from the generator.



A202E003

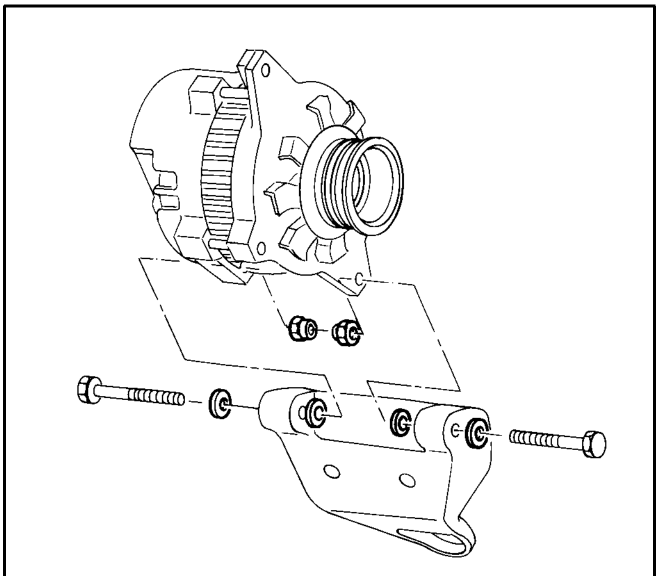
5. Remove the generator shackle bracket bolt and the washer.

6. Remove the serpentine accessory drive belt. For vehicles equipped with power steering and air conditioning, refer to Section 6B, Power Steering Pump for belt removal.



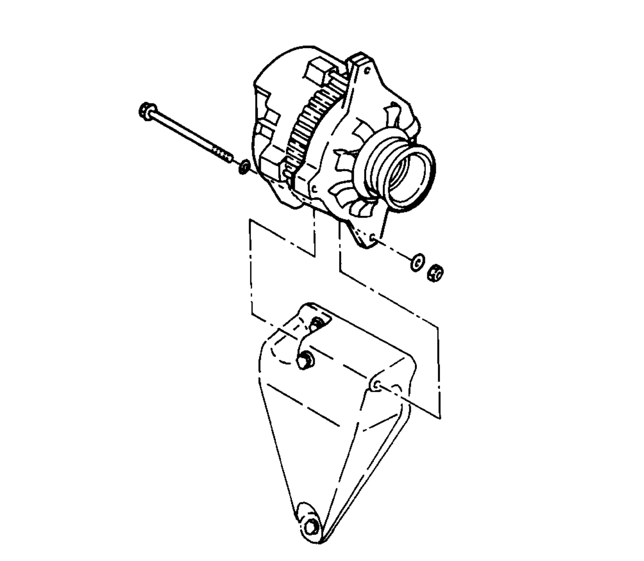
A202E004

7. Remove the bolt and the retaining clamp of the harness.



A102E234

8. For vehicles with the SOHC engine, remove the nuts and the washers which hold the generator lower bracket-to-generator bolts.

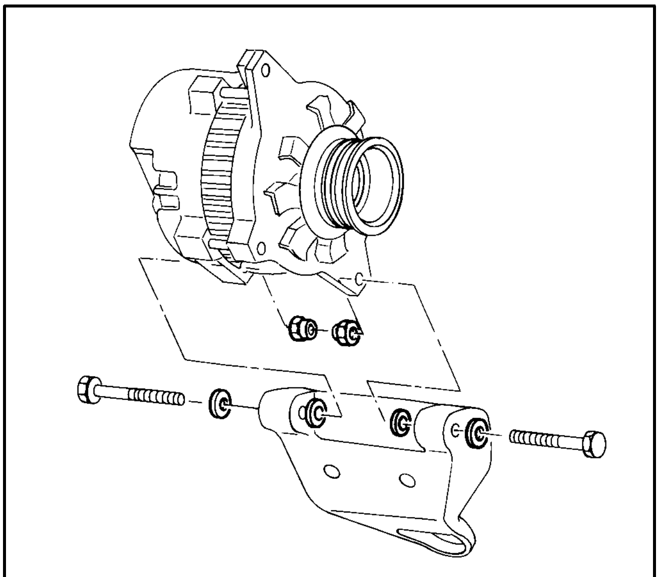


A102E254

9. For vehicles with the DOHC engine, remove the throttle body. Refer to Section 1F, Engine Controls.
10. Remove the fuel rail mounting bolts.

Notice: Take extreme care not to damage the fuel injector O-rings to prevent fuel leaks when the fuel rail is reseated.

11. Unseat the fuel rails from the cylinder head, and slightly push the fuel rail assembly clear of the cylinder head in the direction of the master cylinder.
12. Remove the nut and the washers which hold the generator lower bracket-to-generator bolt.
13. Carefully remove the generator.



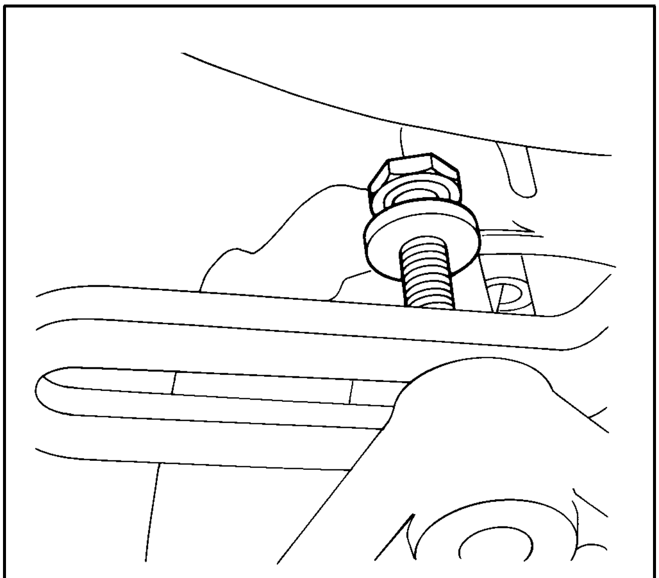
A102E234

Installation Procedure

1. Install the generator at the generator lower bracket and insert the generator bolts.
2. Install the nuts and the washers on the generator lower bracket-to-generator bolts (SOHC engine is shown).

Tighten

Tighten the generator lower bracket-to-generator nuts to 20 NSm (15 lb-ft).

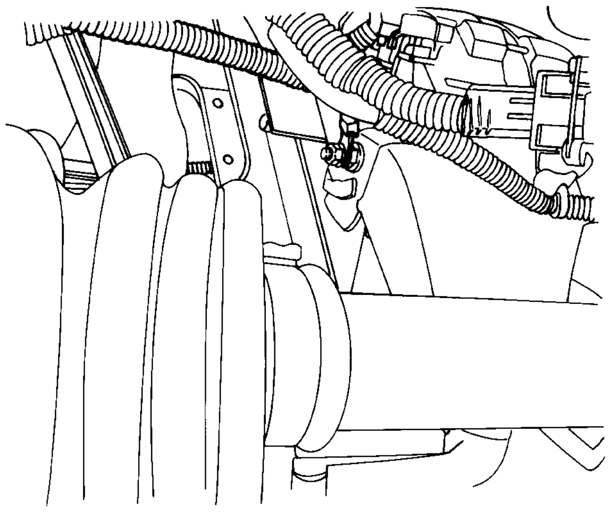


A102E231

3. Install the serpentine accessory drive belt on vehicles not equipped with power steering and air conditioning.
4. Secure the generator to the shackle bracket with the bolt (SOHC engine is shown). For vehicles equipped with power steering and air conditioning, refer to SecĆ tion 6B, Power Steering Pump.

Tighten

Tighten the generator shackle bracket bolt to 20 NSm (15 lb-ft).



A102E232

5. Connect the harness connector to the back of the generator.
6. Install the generator lead to the battery and fasten the lead with the nut.

Tighten

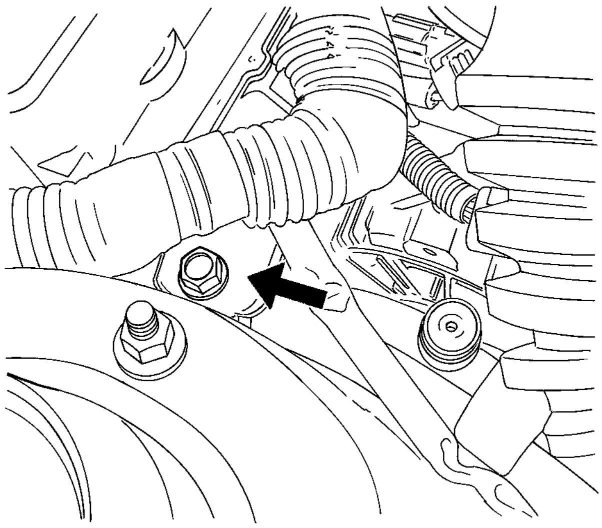
Tighten the generator battery lead connector nut to 15 NSm (11 lb-ft).

7. Lubricate the injector O-rings on the DOHC engine with engine oil.
8. Install the fuel rail assembly.

Tighten

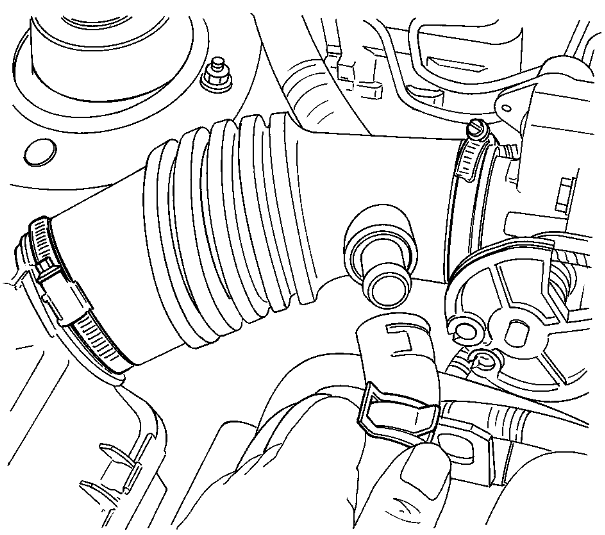
Tighten the fuel rail retaining bolts to 20 NSm (15 lb-ft).

9. Install the throttle body. Refer to Section 1F, Engine Controls.



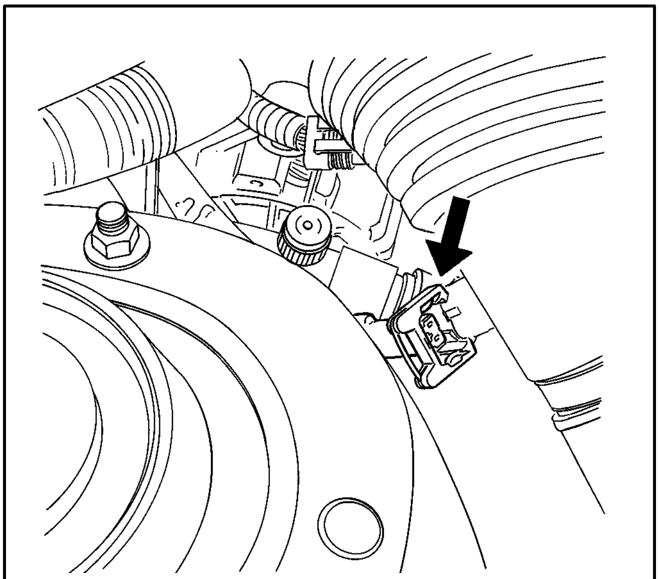
A202E004

10. Install the harness retaining clamp bolt.



A202E002

11. Install the air intake tube and the connector.

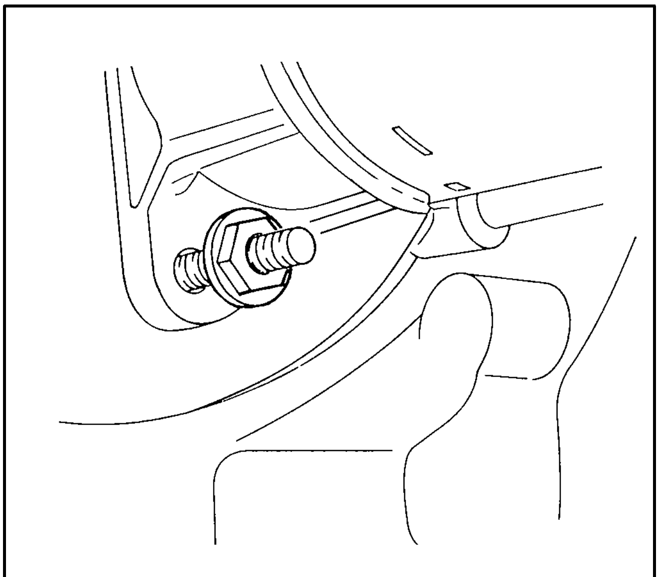


A202E001

12. Install the MAT electrical connector to the air intake tube.
13. Connect the negative battery cable.

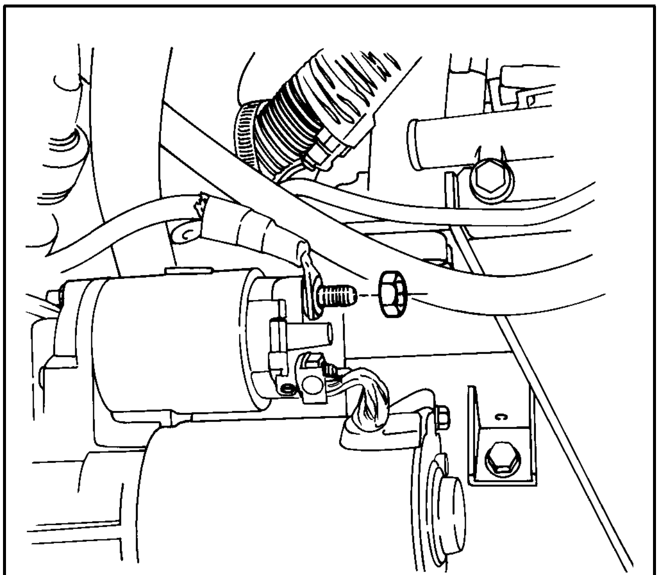
STARTER

Removal Procedure



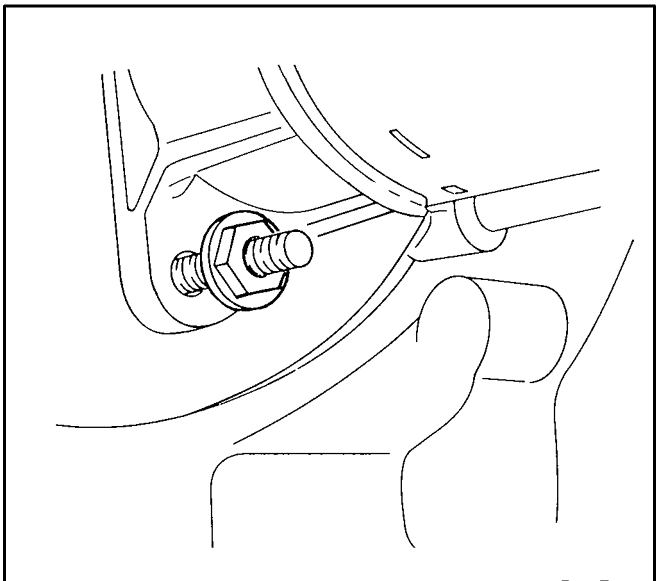
B202E005

1. Remove the nut that secures the starter ground wire to the mounting stud.
2. Remove the ground wire.
3. Remove the lower and then the upper starter stud/weld nut assemblies. (The lower stud/weld nut assembly is shown.)



A102E236

4. Remove the starter solenoid nuts to disconnect the electrical cables.
5. Remove the starter assembly.

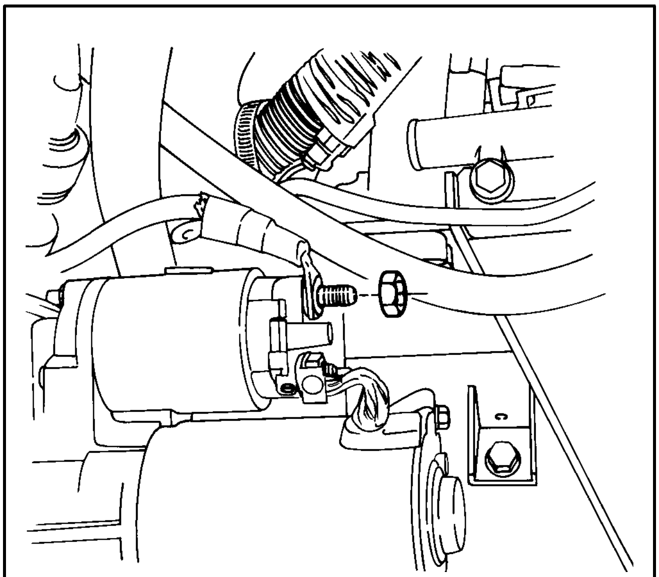

B202E005

Installation Procedure

1. Place the starter assembly in position using an assistant to prop up the starter to aid in fastening the upper mounting stud with the weld nut.
2. Install the upper and the lower starter mounting studs with the weld nuts.

Tighten

Tighten the starter mounting studs to 43 NSm (32 lb-ft).


A102E236

3. Position the starter electrical wires on the solenoid terminals.
4. Position the ground wire on the lower stud.
5. Install the starter solenoid nuts.

Tighten

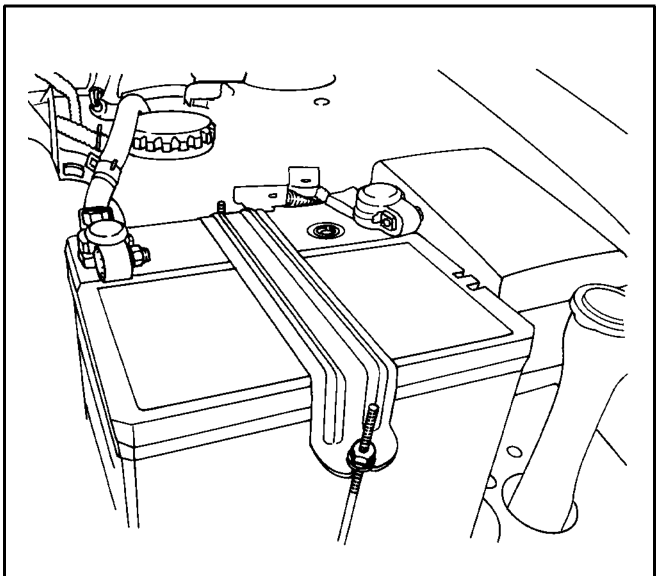
Tighten the starter solenoid terminal-to-battery cable terminal nut to 7 NSm (62 lb-in).

Tighten the starter solenoid terminal-to-ignition terminal nut to 6 NSm (53 lb-in).

6. Install the ground wire nut.

Tighten

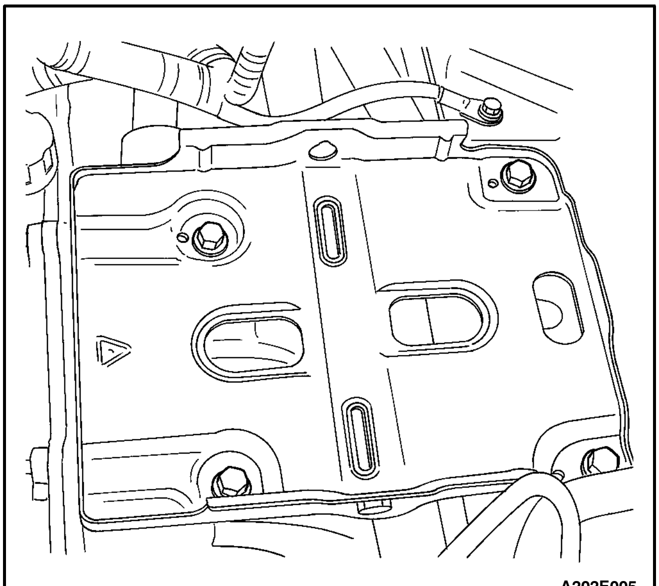
Tighten the ground wire terminal to the point at which it meets the nut. Then tighten the ground wire terminal an additional quarter turn.


A102E241

BATTERY/BATTERY TRAY

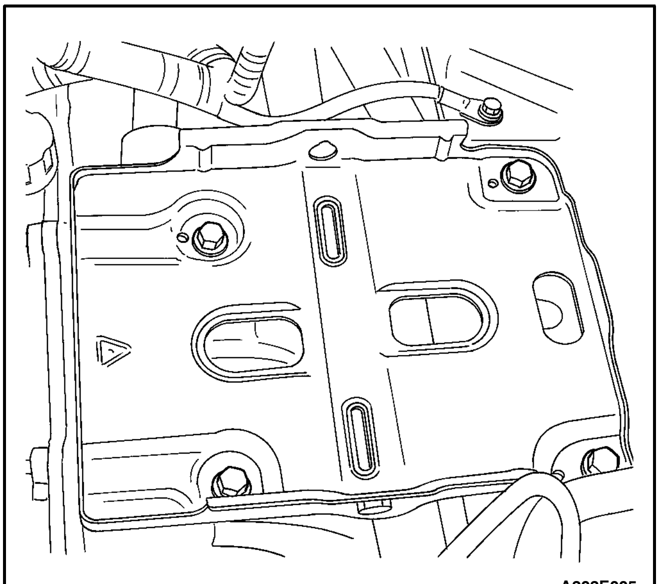
Removal Procedure

1. Disconnect the negative battery cable and then disconnect the positive battery cable.
2. Remove the nuts from the battery rods that fasten the battery hold-down bar clamp.



A202E005

3. Check the battery carrier tray for obvious cracks or damage. Detach the carrier tray if necessary by removing the upper and the lower bolts.



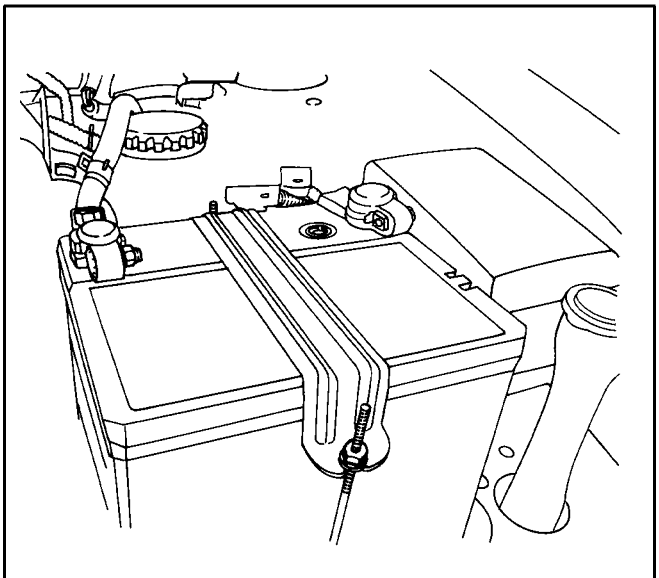
A202E005

Installation Procedure

1. Install the battery carrier by fastening the carrier tray upper and lower bolts.

Tighten

Tighten the battery carrier tray upper and lower bolts to 20 N•m (15 lb-ft).

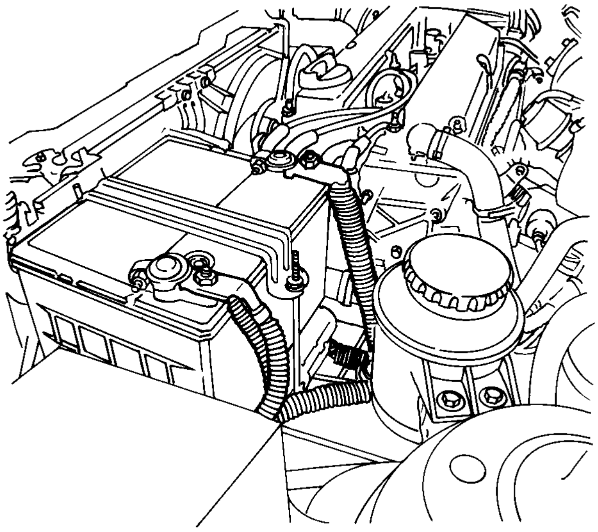


A102E241

2. Install the battery into the tray.
3. Fasten the bar clamp to the battery by loosely attaching the battery rods from the battery tray cutouts through the bar clamp holes, and loosely tightening the nuts.

Tighten

Tighten the battery retainer clamp-to-battery rod nuts to 5 N•m (44 lb-in).



A102E240

4. Connect the negative and the positive battery cables.

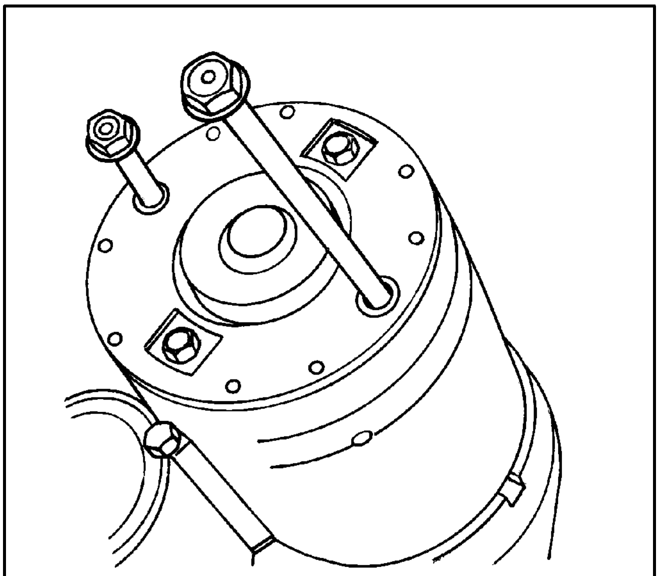
Tighten

Tighten the battery cable nuts to 15 N•m (11 lb-ft).

UNIT REPAIR

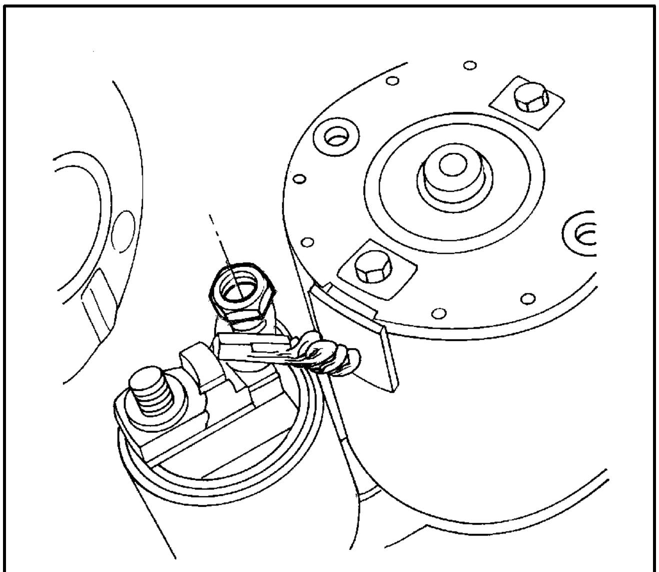
STARTER MOTOR (0.8 KILOWATTS)

Disassembly Procedure



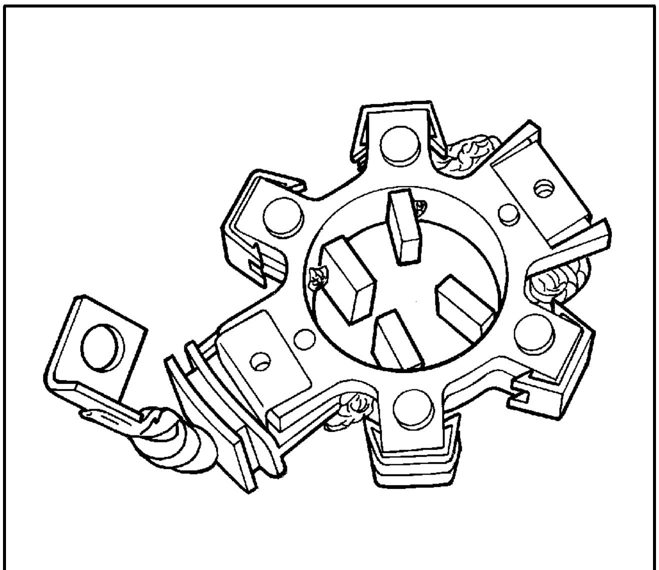
A302E002

1. Remove the starter. Refer to "Starter" in this section.
2. Remove the starter through-bolts.



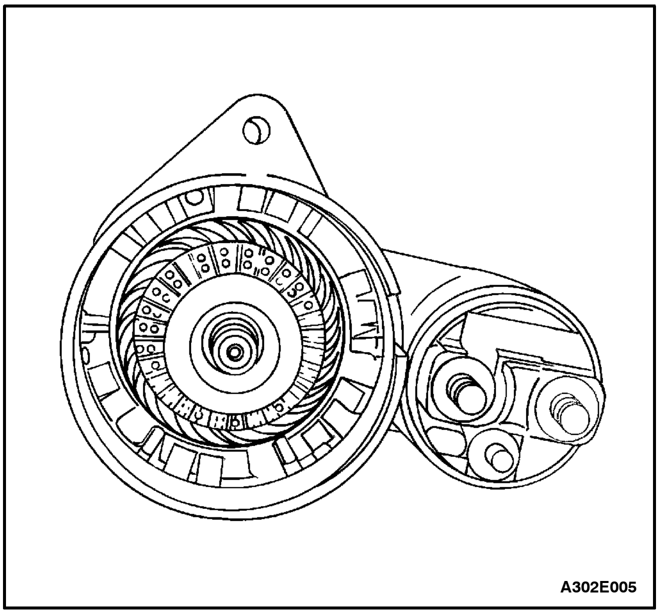
A302E003

3. Remove the field connector nut. Disconnect the field connector.

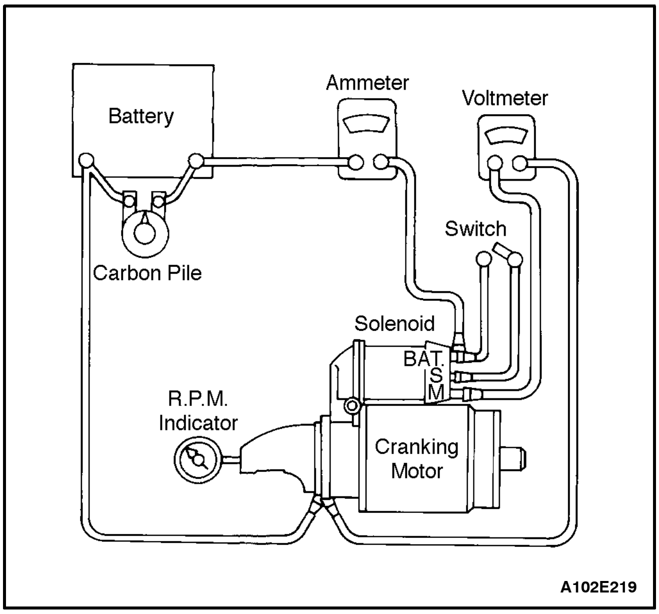


A302E004

4. Pry off the commutator end frame/brush/brush holder assembly from the field frame.
5. Remove the bolts that secure the end frame to the brush/brush holder assembly.
6. Inspect the brushes, the pop-out springs, and the plastic spring retainers for wear and damage. Replace the parts, if necessary.



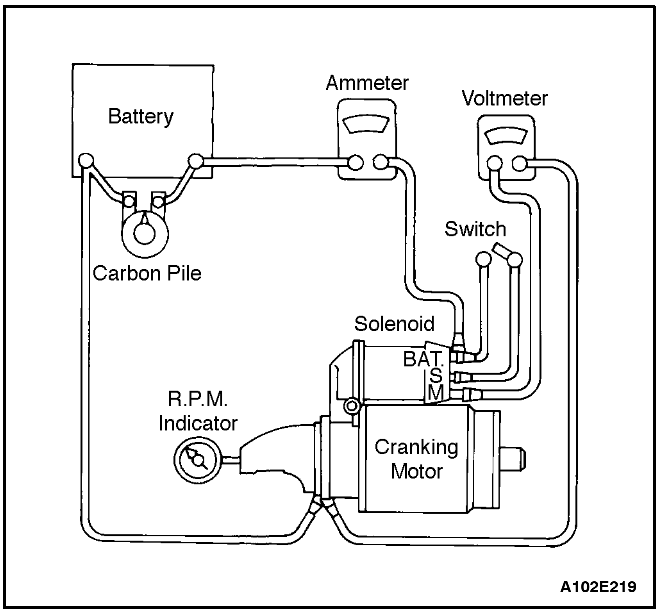
7. Check the armature to see if it turns freely. If the armature does not turn freely, break down the assembly beginning with Step 9. Otherwise, give the armature a no-load test.



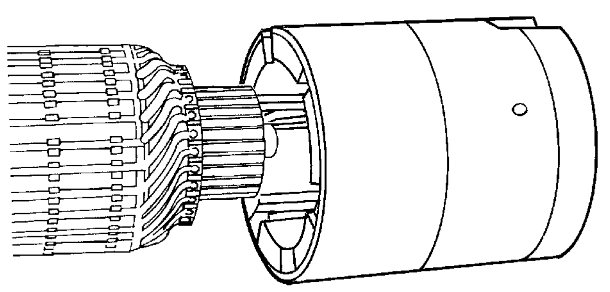
Important: If the specified current draw does not include the solenoid, deduct from the armature reading the specified current draw of the solenoid hold-in winding.

Notice: Complete the testing in a minimum amount of time to prevent overheating and damaging the solenoid.

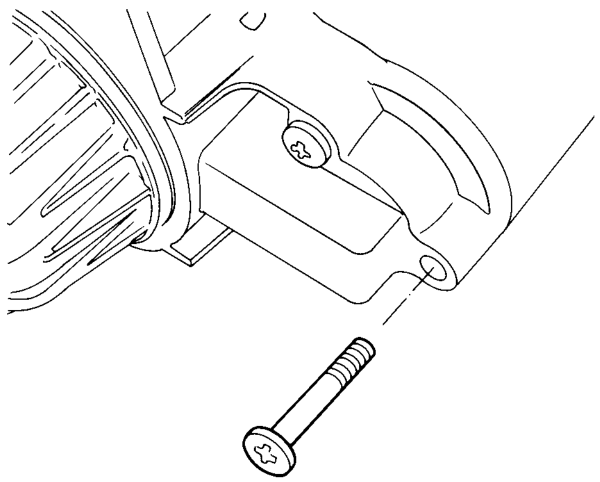
8. To begin the no-load test, close the switch and compare the rpm, the current, and the voltage readings with the specifications. Refer to "Starter Specifications" in this section. Make disconnections only with the switch open. Use the test results as follows:
   8.1. Rated current draw and no-load speed indicate a normal condition for the starter motor.
   8.2. Low free speed and high current draw indicate too much friction (tight, dirty, or worn bearings, or a bent armature shaft), a shorted armature, or a shorted armature and fields.



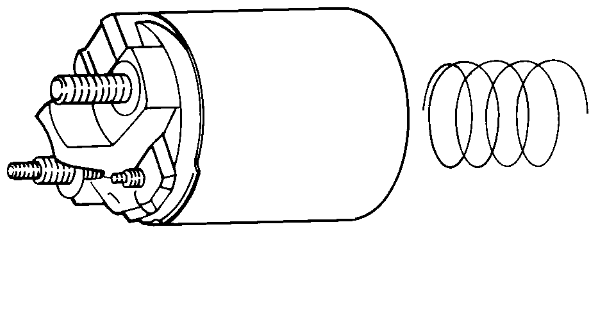
   8.3. Failure to operate with high current draw indicates a direct ground in the terminal or fields, or "frozen" bearings.
   8.4. Failure to operate with no current draw indicates an open field circuit, open armature coils, broken brush springs, worn brushes, high insulation between the commutator bars, or other causes which will prevent good contact between the brushes and the commutator.
   8.5. Low no-load speed and low current indicate high internal resistance and high current draw, which usually means shorted fields.


A302E006

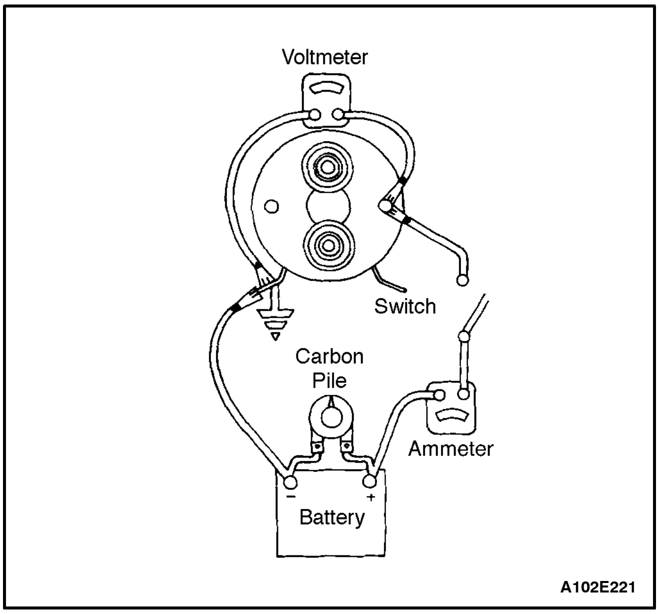
9. Separate the field frame from the armature assembly.


A102E226

10. Remove the solenoid assembly screws.

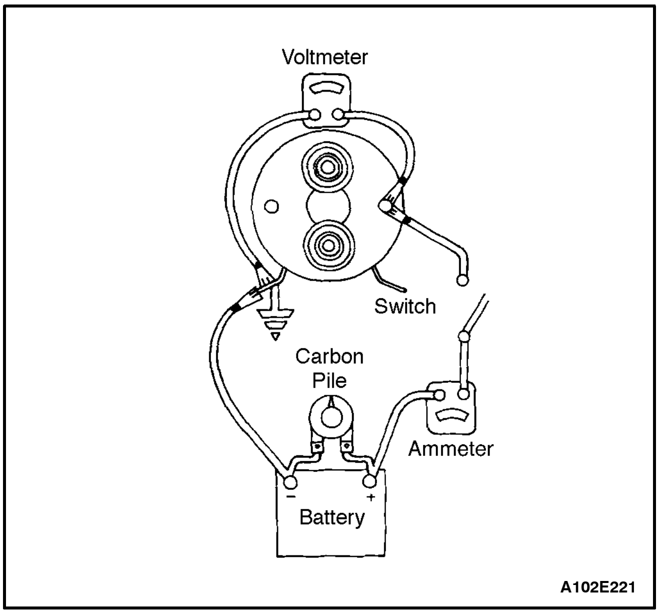

A102E247

11. Rotate the solenoid and remove it along with the plunger return spring.



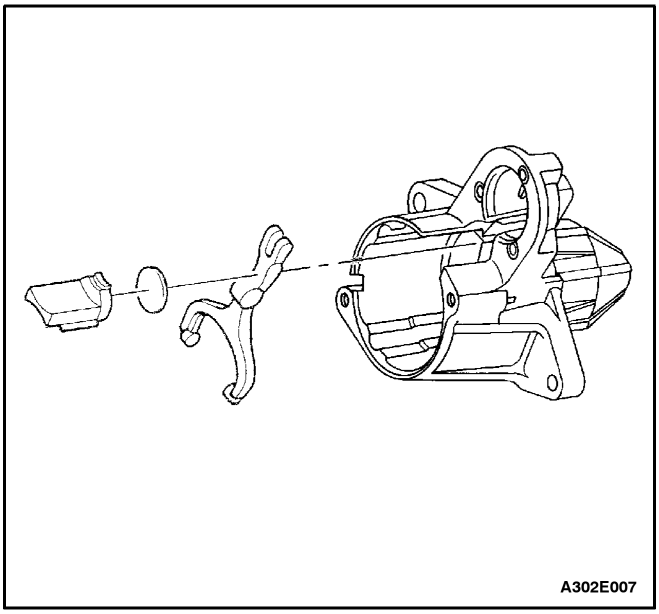
Important: If the solenoid is not removed from the starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests.

12. **Test the solenoid windings by checking the current draw.**
    - 12.1. **Check the hold-in windings by connecting an ammeter in series with a 12-volt battery, the switch terminal, and to ground.**
    - 12.2. **Connect the carbon pile across the battery.**
    - 12.3. **Adjust the voltage to 10 volts. The ammeter reading should be 13 to 19 amperes.**

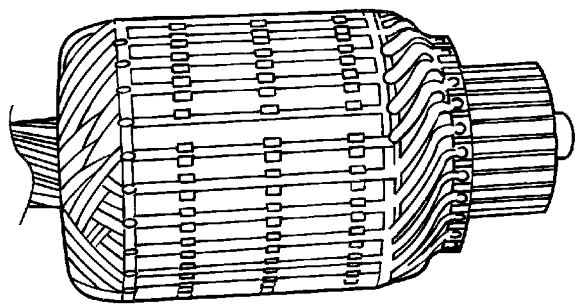


Important: Current will decrease as the windings heat up. Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid Both conditions require replacement of the solenoid. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit.

13. **Check both windings, connecting them as in the preceding test.**
    - 13.1. **Ground the solenoid motor terminal.**
    - 13.2. **Adjust the voltage to 10 volts. The ammeter reading should be 59 to 79 amperes.**
    - 13.3. **Check the connections and replace the solenoid, if needed.**

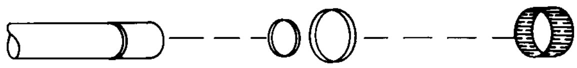


14. **Remove the plunger with the boot and the shift lever assembly.**



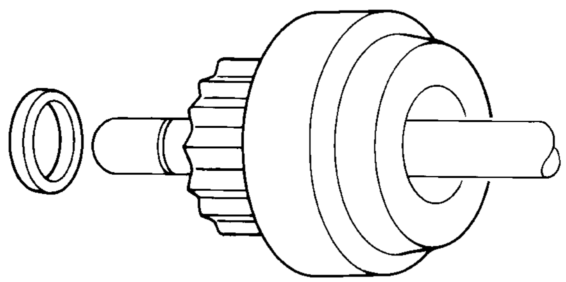
A302E008

15. Remove the armature assembly from the starter housing.



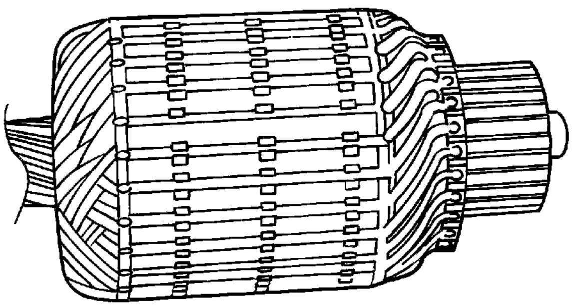
A102E220

16. Disassemble the shaft assembly by separating the bushing from the shaft.
17. Remove the collar and the locking ring from the groove on the shaft.



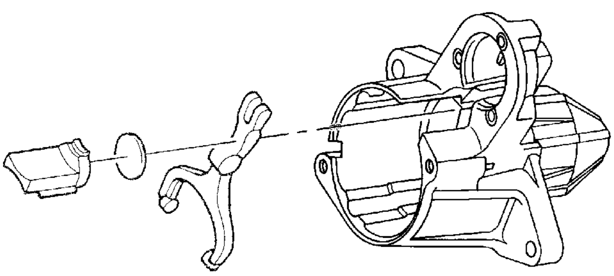
A102E248

18. Remove the pinion stop and the drive from the shaft.



A302E008

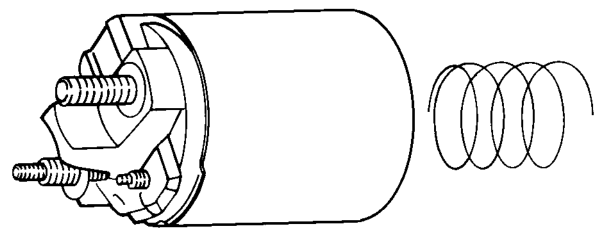
19. Inspect the armature shaft, the collar, and the pinion for discoloration, damage, or wear. Replace the parts, as needed.
20. Inspect the armature commutator. If the commutator is rough, it should be turned down. The outside diameter of the commutator must measure at least 41.91 mm (1.650 inches) after it is undercut or turned. Do not turn out-of-round commutators.
21. Inspect the points where the armature conductors join the commutator bars. Make sure the armature conductors and the commutator bars have a good connection. A burned commutator bar is usually evidence of a poor connection.
22. If test equipment is available, check the armature for short circuits by placing it on a growler and holding a saw blade over the armature core while the armature is rotated. If the saw blade vibrates, replace the armature.
23. Recheck the armature after cleaning between the commutator bars. If the saw blade vibrates, replace the armature.



A302E007

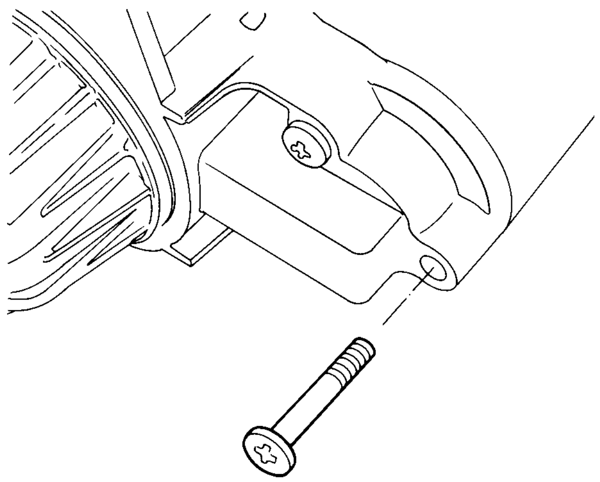
Assembly Procedure

1. Clean all of the starter motor parts, but do not use grease-dissolving solvents for cleaning the armature and the field coils.
2. Lubricate the drive and the bushings.
3. If proceeding with just the reassembly of the solenoid, perform Steps 4 and 5.
4. If the starter and the solenoid were fully disassembled, begin reassembly by installing the shift lever assembly with the plunger and the boot.



A102E247

5. Position the solenoid assembly and the return spring against the plunger, applying the sealer to the solenoid flange.

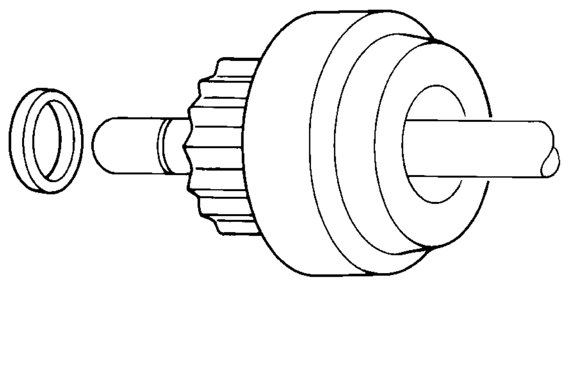


A102E226

6. Fasten the solenoid assembly with the screws.

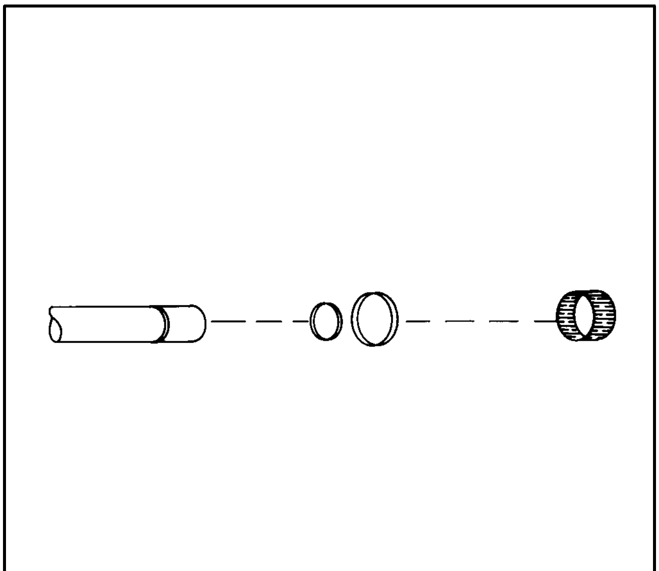
Tighten

Tighten the starter solenoid assembly screws to 8 N•m (71 lb-in).

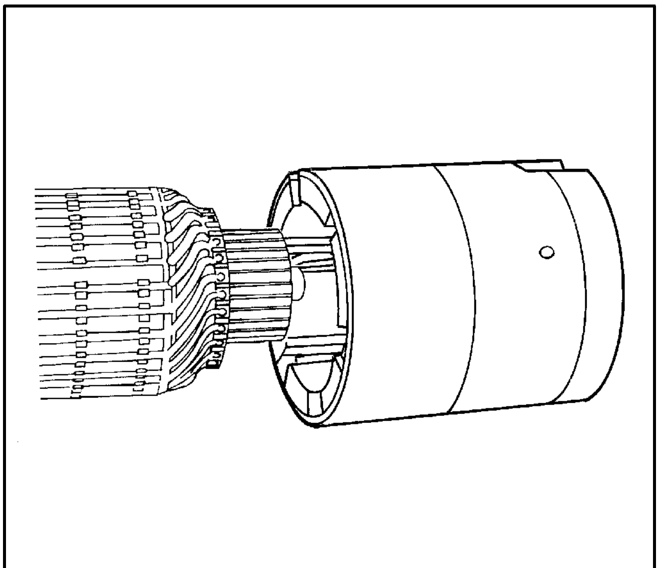


A102E248

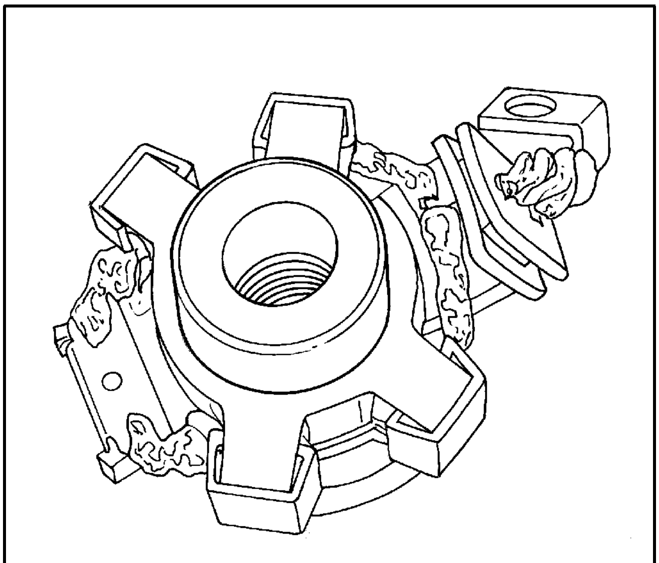
7. Install the drive and the pinion stop on the armature shaft.


A102E220

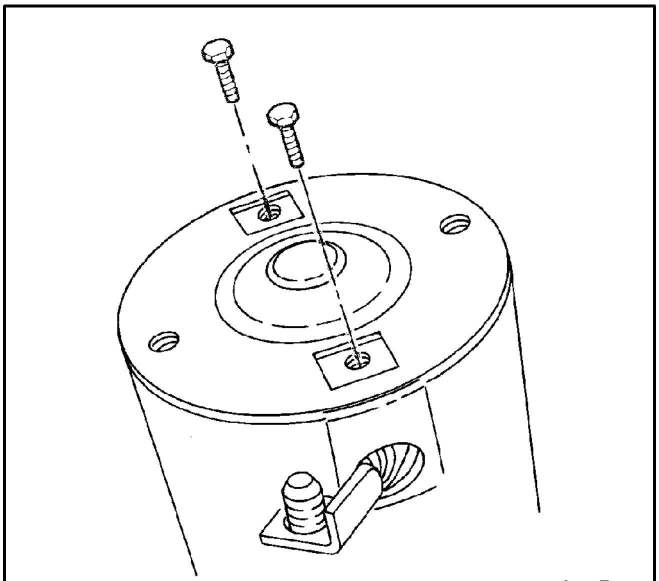
8. Install the lock ring into the groove on the armature shaft.
9. Insert the collar.


A302E006

10. Install the field frame.


A302E009

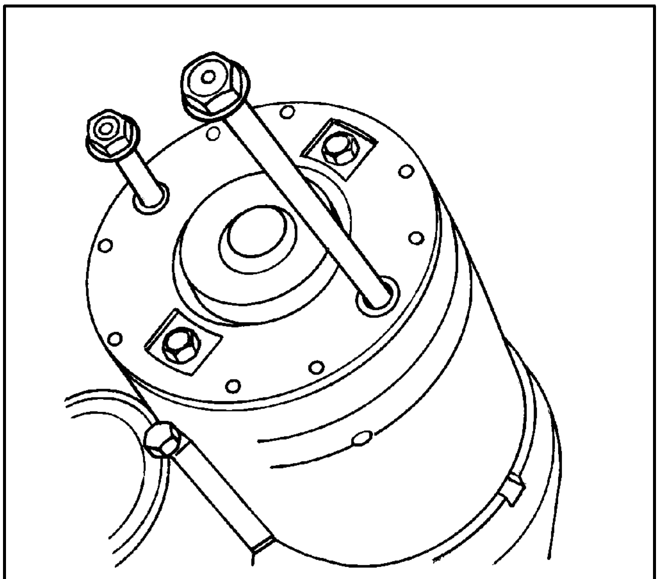
11. With new brushes positioned in the brush holder assembly, measure the inside diameter of the brush holder assembly.
12. Insert the brush holder assembly on a plastic, steel, or wooden dowel about the same diameter as the inside diameter of the brush holder assembly.


A302E010

13. Position the end of the dowel with the armature commutator end. Slide the brush holder assembly onto the armature.
14. Install the end frame on the brush holder assembly with the bolts.

Tighten

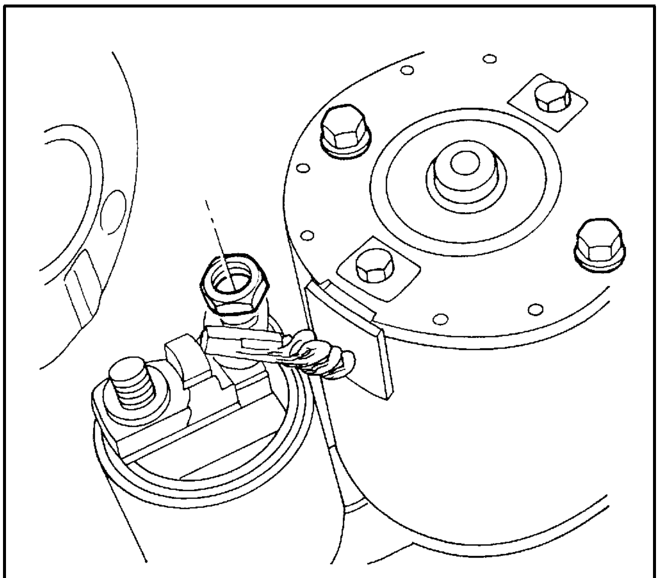
Tighten the starter end frame-to-brush holder assembly bolts to 3 N•m (27 lb-in).


A302E002

15. Install the starter through-bolts.

Tighten

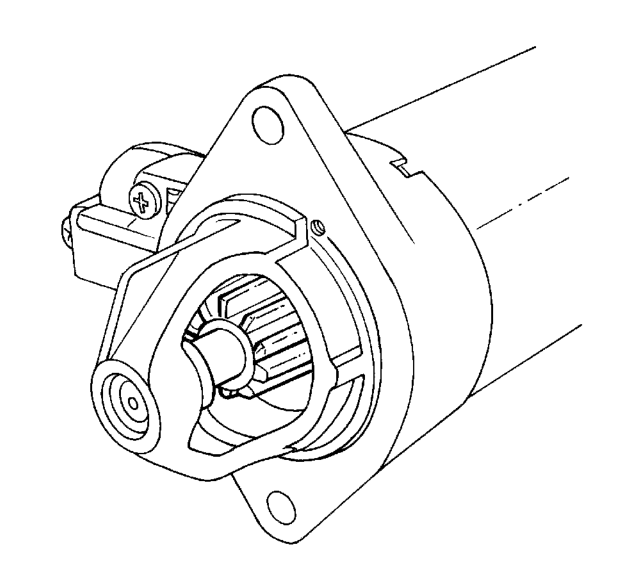
Tighten the starter through-bolts to 6 N•m (53 lb-in).


A302E011

16. Install the starter field coil connection to the starter terminal and fasten it with the nut.

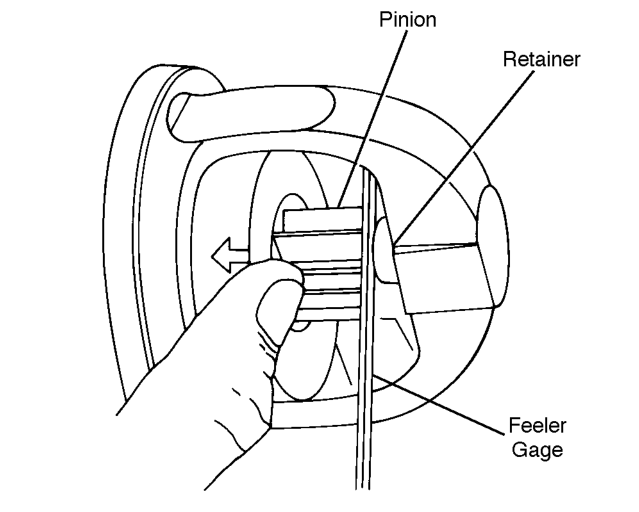
Tighten

Tighten the starter field connector nut to 8 N•m (71 lb-in).


A302E001

Important: The pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

17. **When the solenoid is replaced, it is necessary to check the pinion clearance.**



A102E227

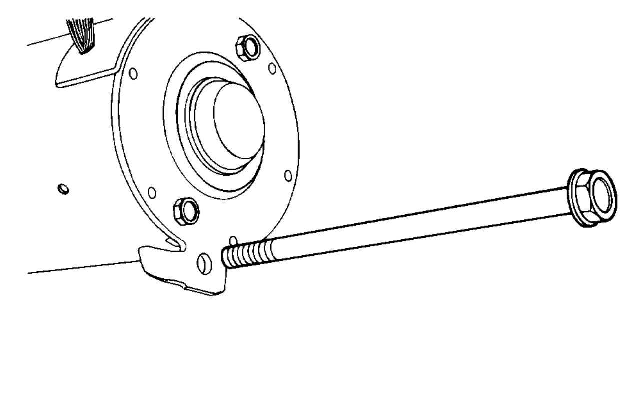
18. **Disconnect the motor field coil connector from the solenoid motor terminal and carefully insulate the connector.**
19. **Connect one 12-volt battery lead to the solenoid switch terminal and the other to the starter frame.**
20. **Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame, allowing the pinion to shift in the cranking position, where it will remain until the battery is disconnected.**

Important: A means for adjusting the pinion clearance is not provided on the starter motor. If the clearance does not fall within the limits, check for improper installation and replace all worn parts.

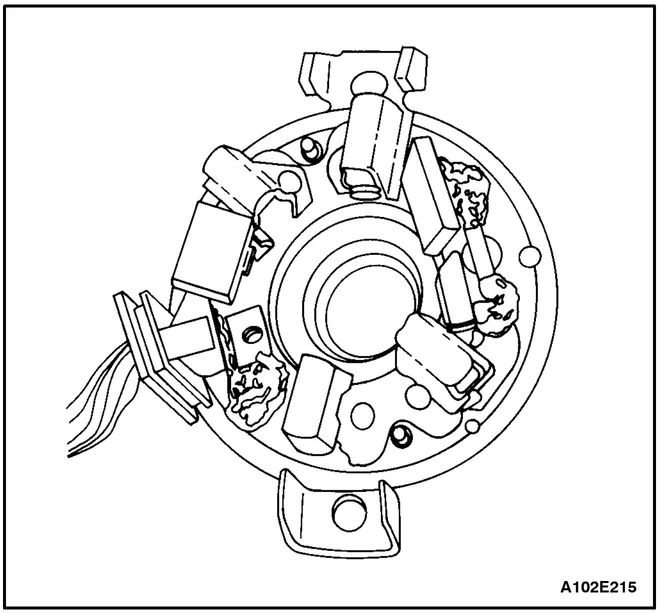
21. **Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge. The clearance should be 0.25 to 3.56 mm (0.01 to 0.14 inch).**

STARTER MOTOR (1.4 KILOWATTS)

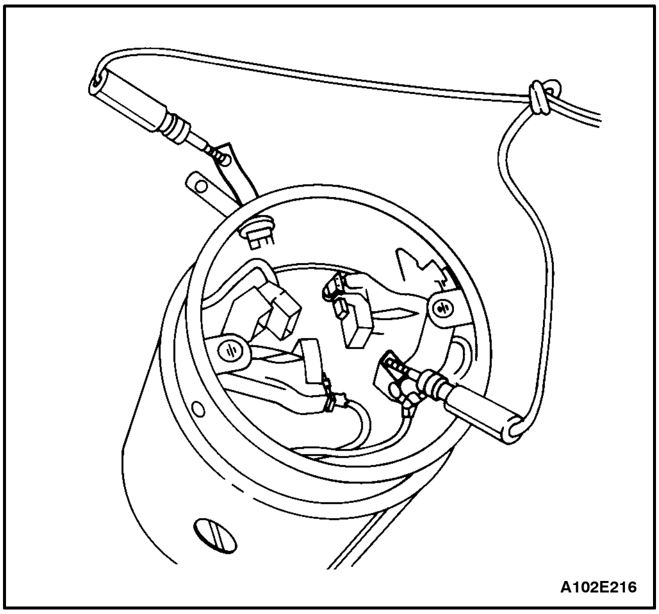
Disassembly Procedure


A102E239

1. **Remove the starter. Refer to “Starter,” in this section.**
2. **Remove the starter through-bolts.**

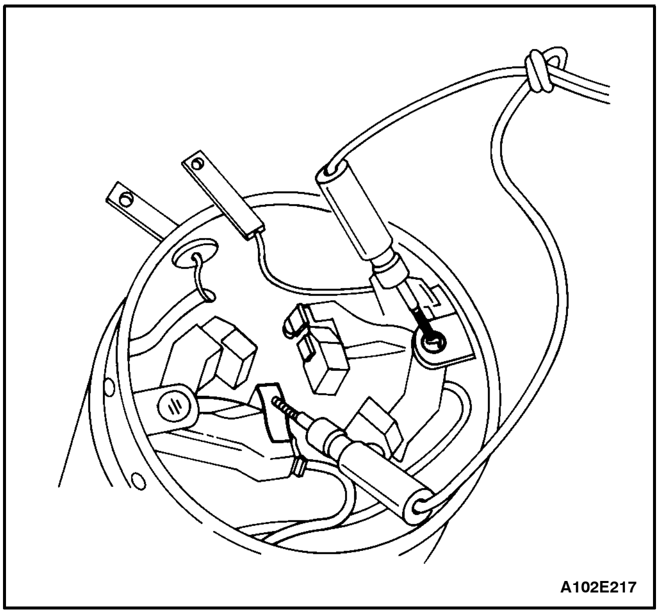


3. Remove the commutator end frame/brush holder assembly.
4. Inspect the brushes, the pop-out springs, and the brush holders for wear and damage. Replace the assembly, if necessary.

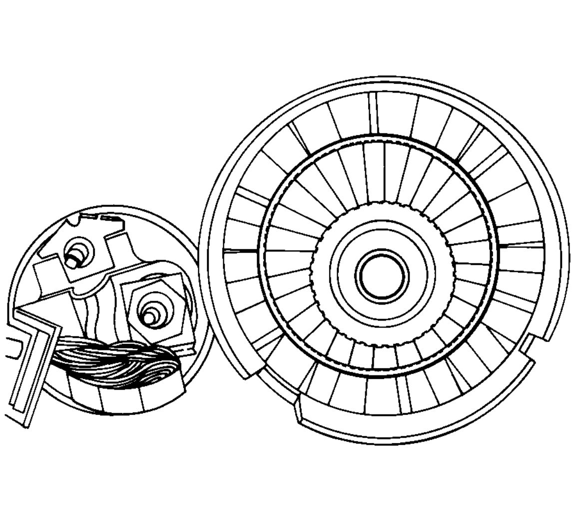


Important: This test should be made for each ground or insulated brush to ensure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

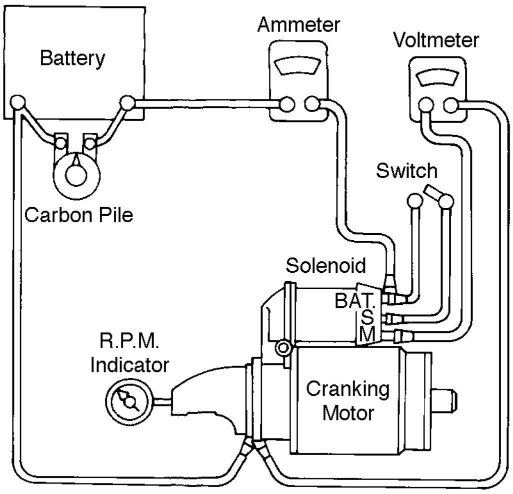
5. For only those starters having a shunt coil connection, use a test lamp, placing one lead on the shunt coil terminal while connecting the other lead to a ground brush or an insulated brush.



6. When testing a series coil for ground, separate the series and the shunt coil strap terminals during the test.
   - 6.1 With the strap terminals not touching the case or the other ground, using a test lamp, placing one lead on the grounded brush holder and the other lead on either insulated brush.
   - 6.2 If the lamp is lit, a grounded series coil is indicated and must be repaired or replaced.
   - 6.3 Test for an open circuit on each insulated brush by placing one lead on the series coil terminal and the other lead on the insulated brush.
   - 6.4 If the test lamp is not lit, the series coil is open and will require repair or replacement.


A102E218

7. Check the armature to see if it turns freely. If the armature does not turn freely, break down the assembly immediately, starting with Step 14. Otherwise, give the armature a no-load test.



A102E219

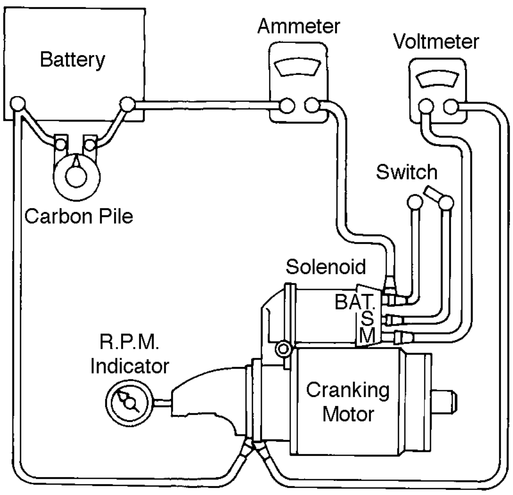
Notice: Complete the testing in a minimum amount of time to prevent overheating and damaging the solenoid.

Important: If the specified current draw does not include the solenoid, deduct from the armature reading the specified current draw of the solenoid hold-in winding.

8. To begin the no-load test, close the switch and compare the rpm, the current, and the voltage readings with the specifications. Refer to "Starter Specifications" in this section. Make disconnections only with the switch open. Use the test results as follows:

8.1 Rated current draw and no-load speed indicate a normal condition for the starter motor.

8.2 Low free speed and high current draw indicate too much friction from tight, dirty, or worn bearings, or a bent armature shaft, a shorted armature, or a shorted armature or fields.

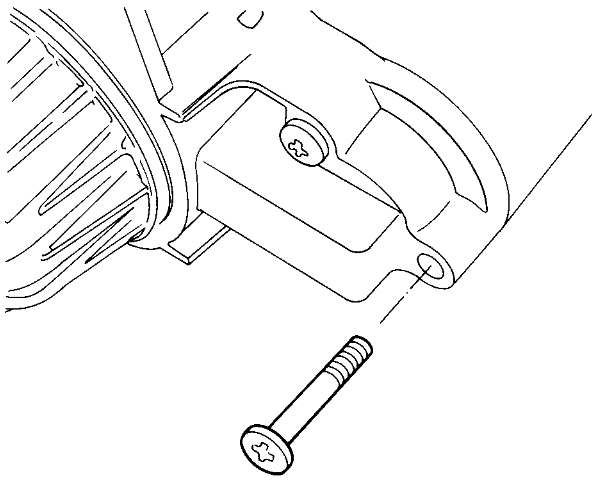


A102E219

8.3 Failure to operate with high current draw indicates a direct ground in the terminal or fields, or "frozen" bearings.

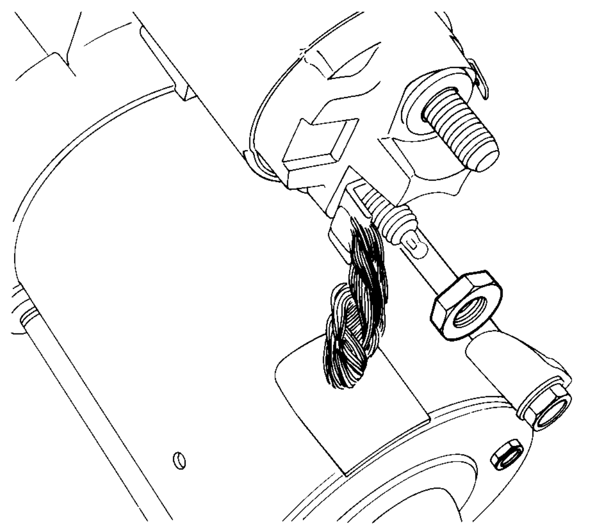
8.4 Failure to operate with no current draw indicates an open field circuit, open armature coils, broken brush springs, worn brushes, high insulation between the commutator bars, or other causes which would prevent good contact between the brushes and the commutator.

8.5 Low no-load speed and low current indicate high internal resistance and high current draw, which usually mean shorted fields.



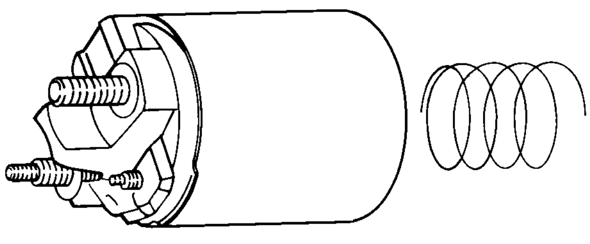
A102E226

9. Remove the solenoid assembly screws.



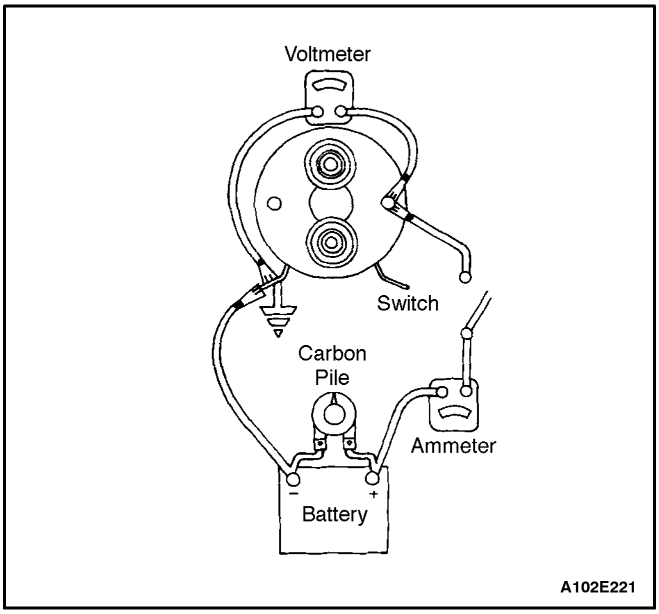
A102E243

10. Remove the field connector nut. Disconnect the field connector.



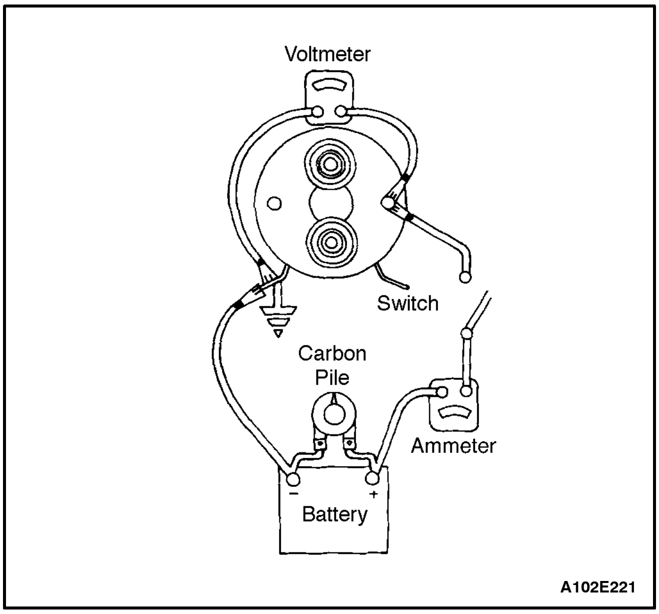
A102E247

11. Rotate the solenoid 90 degrees and remove it along with the plunger return spring.



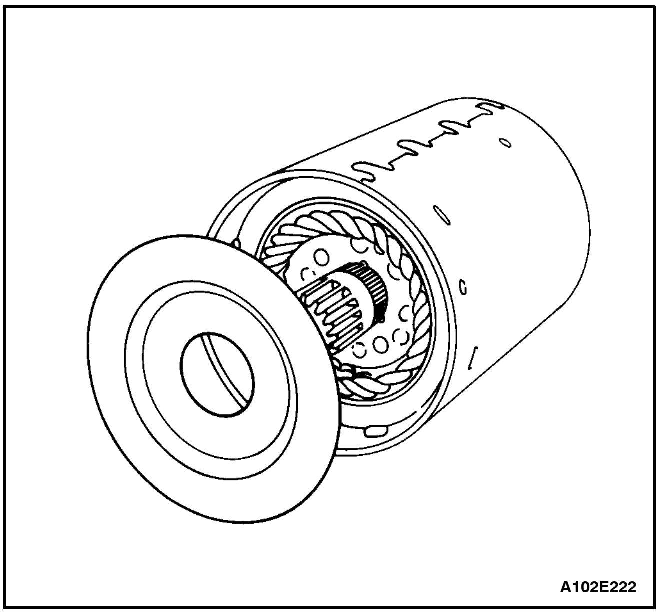
Important: If the solenoid is not removed from the starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests.

12. Test the solenoid windings by checking the current draw.
- **12.1 Check the hold-in windings by connecting an ammeter in series with a 12-volt battery, the switch terminal, and to ground.**
- **12.2 Connect the carbon pile across the battery.**
- **12.3 Adjust the voltage to 12.2 volts. The ammeter reading should be 12 to 21 amperes.**



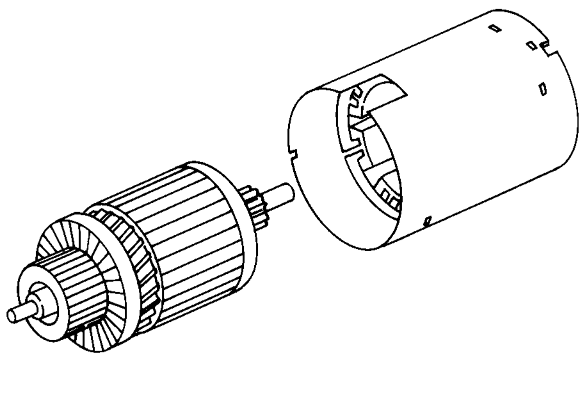
Important: Current will decrease as the windings heat up. Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid. Both conditions require replacement of the solenoid. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit.

13. Check both windings, connecting them according to the preceding test.
- **13.1 Ground the solenoid motor terminal.**
- **13.2 Adjust the voltage to 12.2 volts. The ammeter reading should be 60 to 90 amperes.**
- **13.3 Check the connections and replace the solenoid, if necessary.**



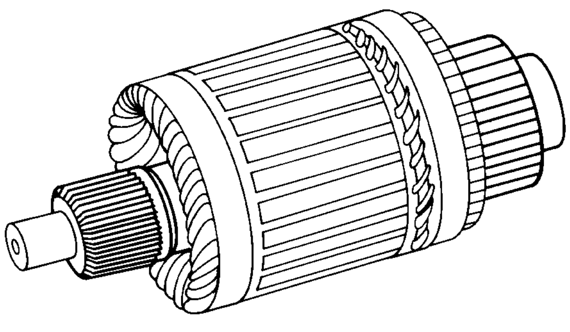
14. Slide the field frame with the enclosed armature assembly away from the starter assembly.

15. Remove the shield.



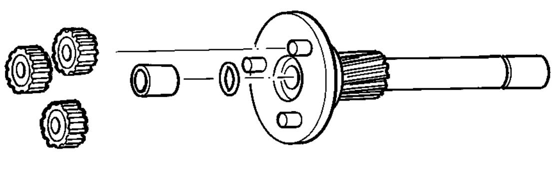
A102E242

16. Separate the field frame from the armature.



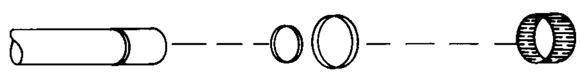
A102E223

17. Inspect the shaft, the bearing, and the pinion for discoloration, damage, or wear. Replace, if necessary.
18. Inspect the armature commutator. If the commutator is rough, it should be turned down. The outside diameter of the commutator must measure at least 41.91 mm (1.650 inches) after it is undercut or turned. Do not turn out-of-round commutators.
19. Inspect the points where the armature conductors join the commutator bars. Make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.
20. If test equipment is available, check the armature for short circuits by placing it on a growler, and holding back a saw blade over the armature core while the armature is rotated. If the saw blade vibrates, replace the armature.
21. Recheck the armature after cleaning between the commutator bars. If the saw blade vibrates, replace the armature.

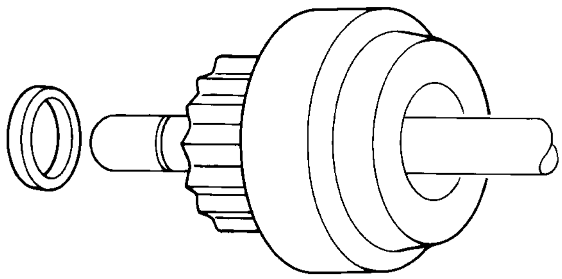


A202E006

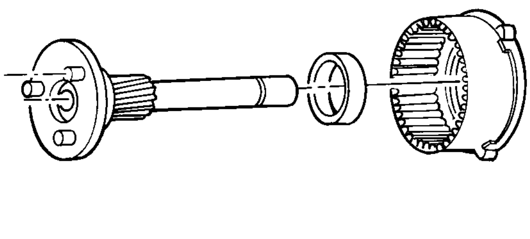
22. Remove the gears, the bushings, and the washer.
23. Remove the cushion and the driveshaft assembly from the starter housing.


A102E220

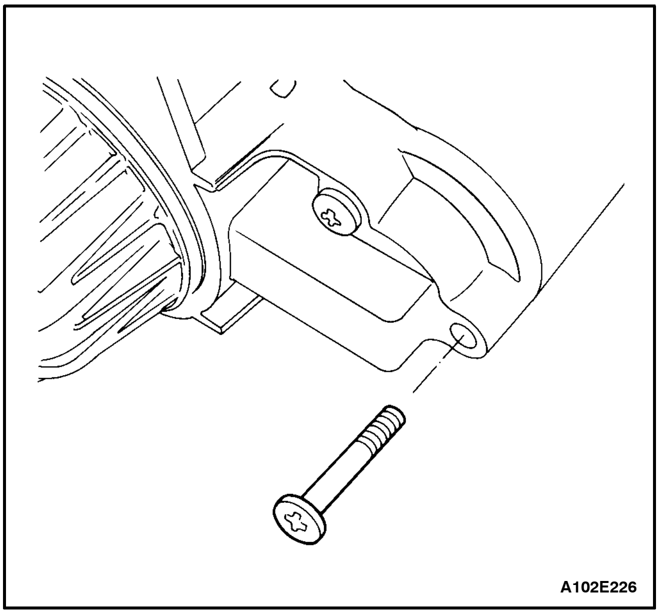
24. Disassemble the driveshaft assembly by first separating the needle bearing from the driveshaft.
25. Remove the collar and the locking ring from the groove in the driveshaft.


A102E248

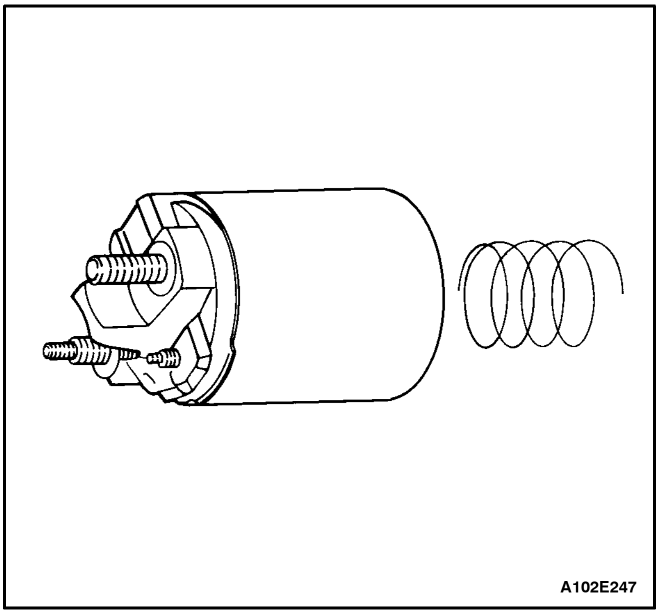
26. Remove the pinion stop and the drive from the driveshaft.


C302E016

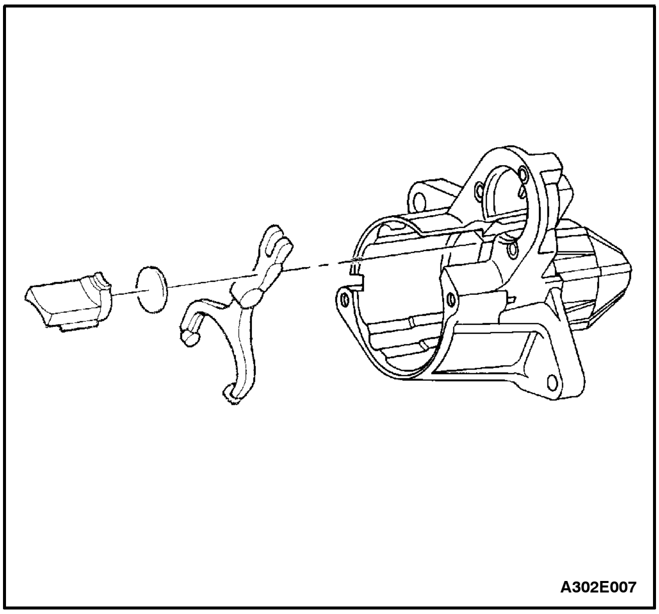
27. Remove the gear support and the collar from the driveshaft.



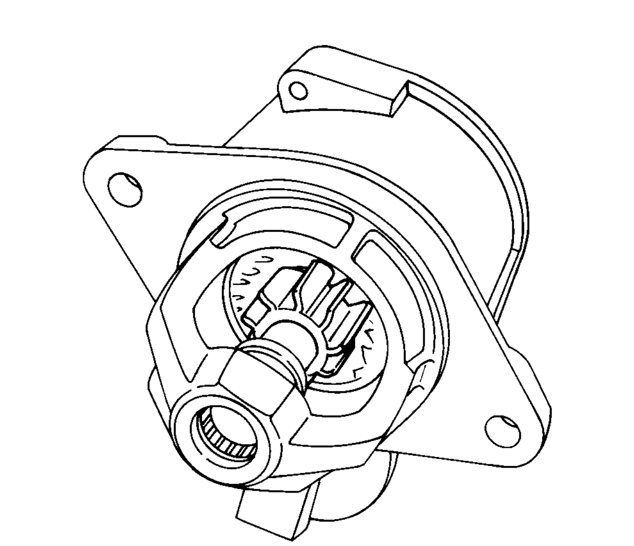
28. If not done in the previous steps, remove the screws that hold the solenoid assembly into the housing, and remove the nut from the field coil connector.



29. Rotate the solenoid 90 degrees and remove it along with the return spring.

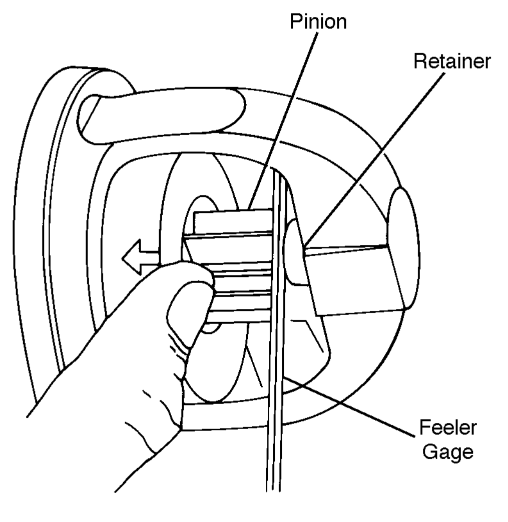


30. Remove the plunger with the boot and the shift lever assembly. Test the solenoid windings, if not done in Step 12.


A102E237

Important: The pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during the cranking.

31. **When the starter motor is disassembled and the solenoid is replaced, it is necessary to check the pinion clearance when the starter is reassembled.**

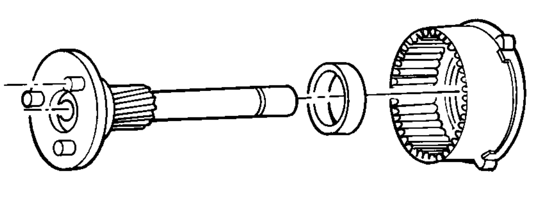


A102E227

32. **Disconnect the motor field coil connector from the solenoid motor terminal and carefully insulate the connector.**
33. **Connect one 12-volt battery lead to the solenoid switch terminal and the other to the starter frame.**
34. **Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame, allowing shifting of the pinion in the cranking position, where it will remain until the battery is disconnected.**

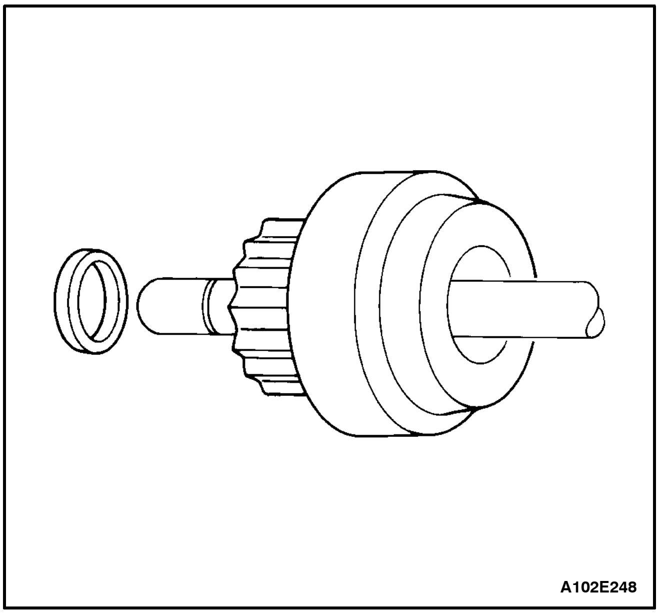
Important: A means for adjusting the pinion clearance is not provided on the starter motor. If the clearance does not fall within the limits, check for improper installation and replace all worn parts.

35. **Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge. The clearance should be 0.25 to 3.56 mm (0.01 to 0.14 inch).**

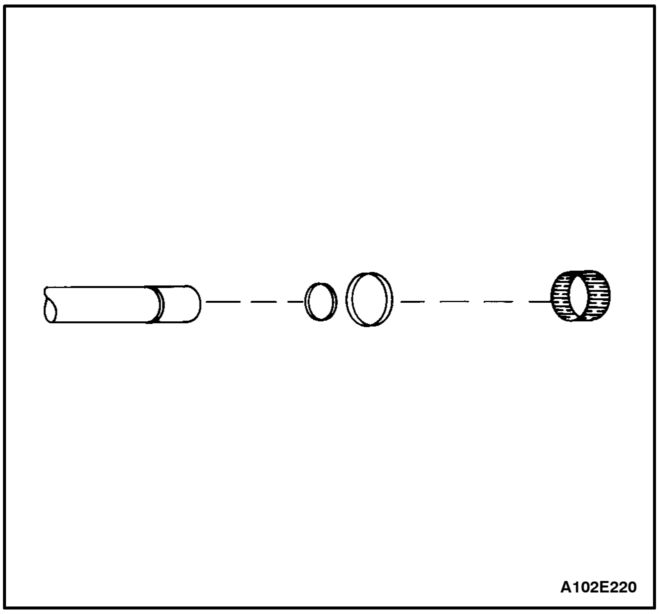

C302E016

Assembly Procedure

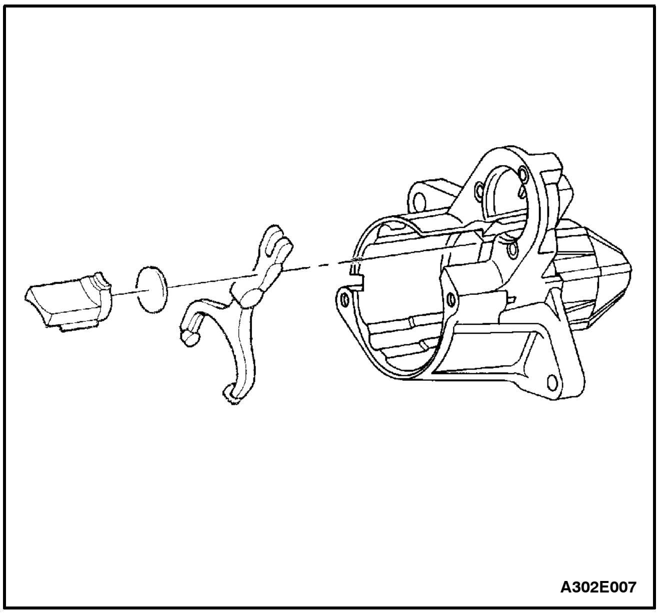
1. **Clean all of the starter motor parts, but do not use grease-dissolving solvents for cleaning the armature and the field coils.**
2. **Lubricate the gears with lubricant. (Begin at Step 7 if proceeding with just the reassembly of the solenoid.)**
3. **If full disassembly of the starter and the solenoid was performed, begin reassembly by placing the gear support and the collar on the driveshaft assembly.**



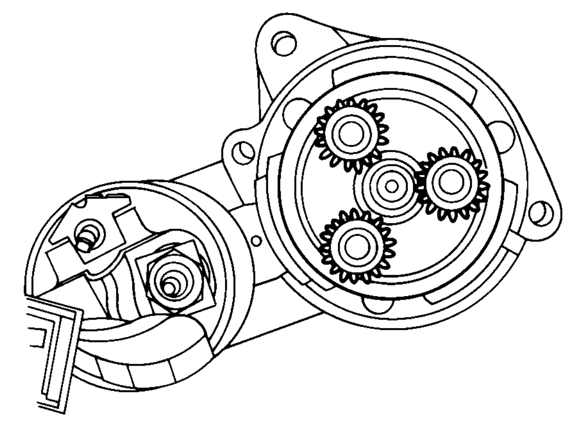
4. Install the drive and the pinion stop on the driveshaft.



5. Install the lock ring into the groove on the driveshaft and insert the collar.
6. Install the needle bearing.

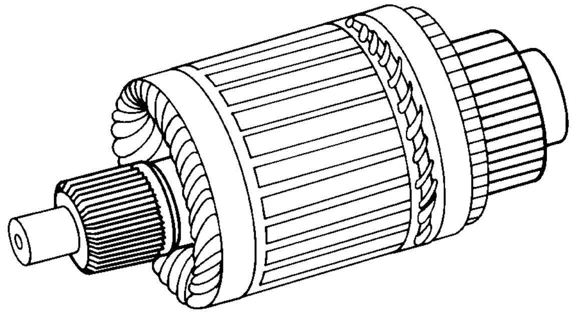


7. Install the shift lever assembly with the plunger and the boot.



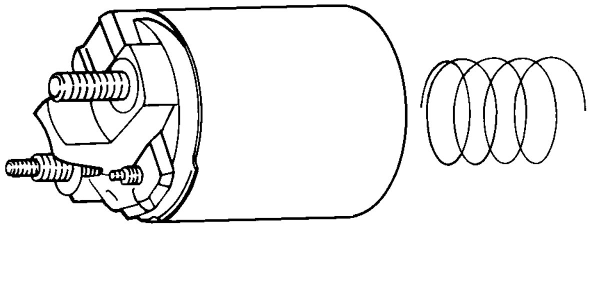
A102E224

8. Lubricate the gears with lubricant and install the driveshaft assembly with the bushing and the washer on the gear end.
9. Install the cushion and the gears.



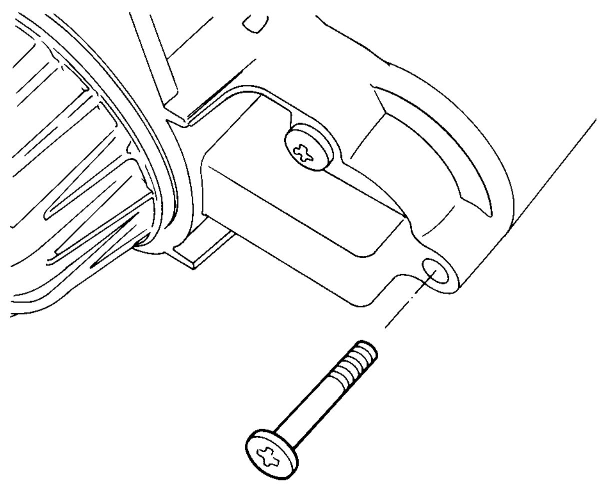
A102E223

10. Lubricate the drive end of the armature shaft with lubricant and install the new gear and the bearing, if necessary.



A102E247

11. Position the solenoid assembly and the return spring against the plunger, applying sealer to the solenoid flange.



A102E226

12. Fasten the solenoid assembly with the screws.

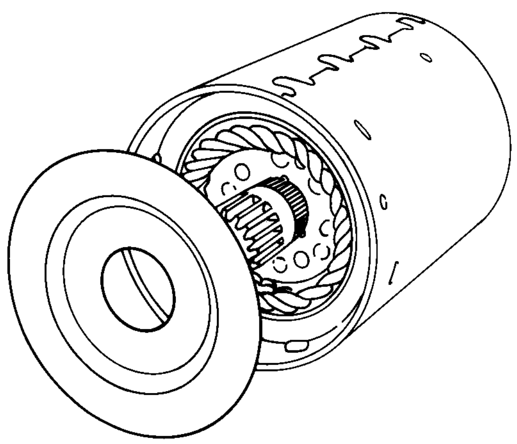
Tighten

Tighten the starter solenoid assembly screws to 8 NSm (71 lb-in).

13. Install the field coil connection to the starter terminal. Install the nut.

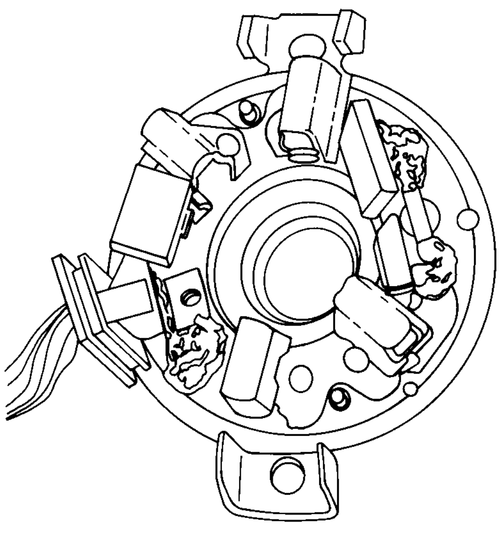
Tighten

Tighten the starter field connector nut to 8 NSm (71 lb-in).



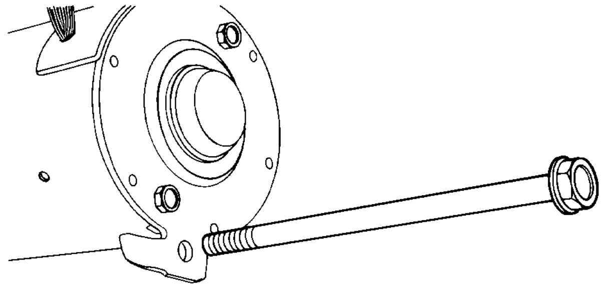
A102E222

14. Position the armature assembly into the field frame.
15. Place the shield on the armature and the field frame assembly.
16. Install the armature and the field frame assembly with the shield into the starter housing.



A102E215

17. Position the commutator end frame/brush holder assembly, lining up the end frame holes with the through-bolt holes in the housing.



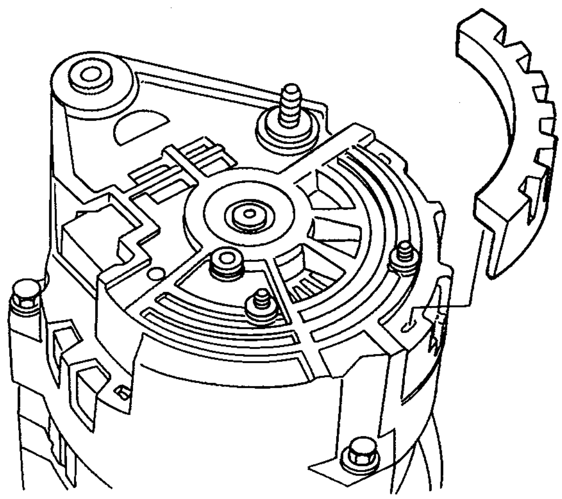
A102E239

18. Install the starter through-bolts.
19. Install the starter. Refer to "Starter" in this section.

Tighten

Tighten the starter through-bolts to 6 NSm (53 lb-in).

20. Refer to "Starter" in this section.

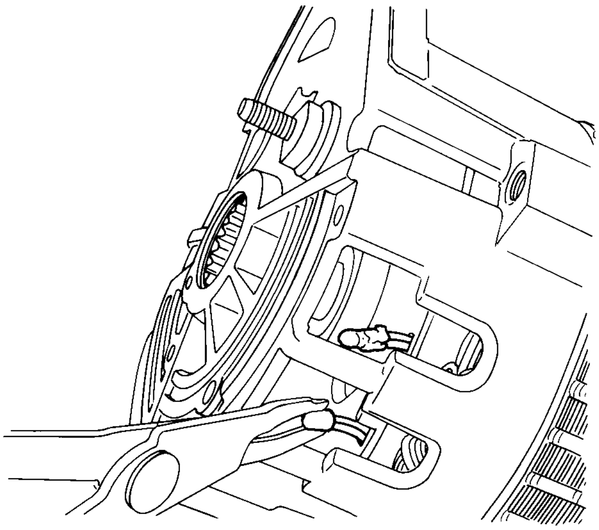


A102E201

GENERATOR (C5-121D)

Disassembly Procedure

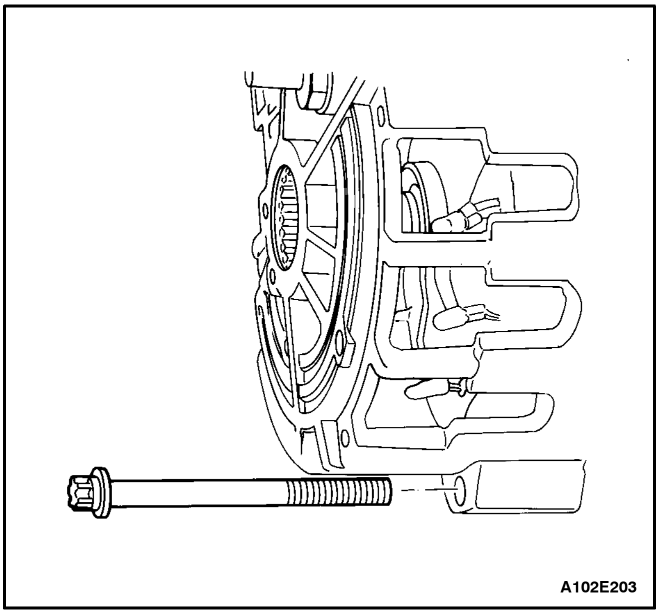
1. Remove the generator. Refer to "Generator" in the On-Vehicle Service section.
2. Mark a match line that cannot easily be removed on the end frame to make assembly easier.
3. Pry off the plastic cover to expose the stator connections.



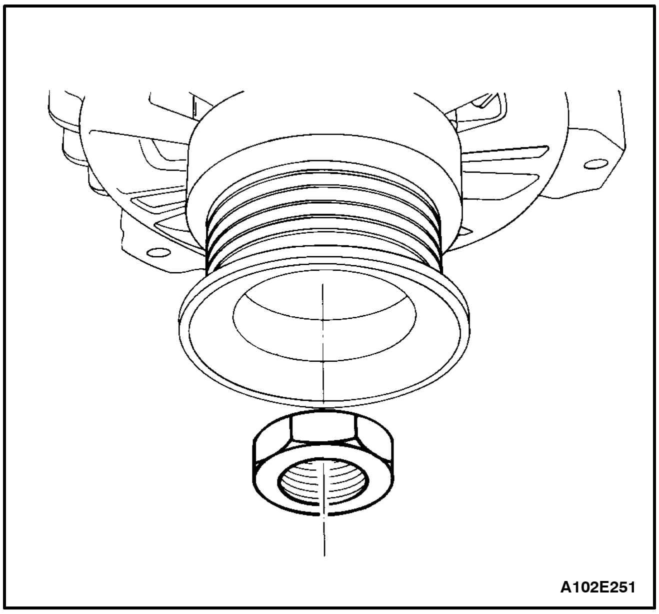
A102E258

Notice: If the stator connections are not welded, melt the lead. Avoid excessive heating, as it can damage the diodes in the rectifier bridge.

4. Remove the stator connections from the rectifier bridge terminals by unsoldering or cutting the wires.

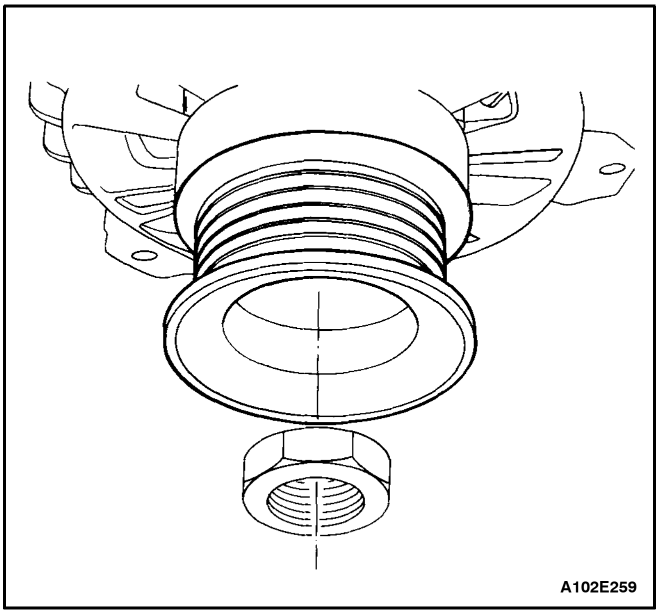


5. Remove the generator through-bolts.

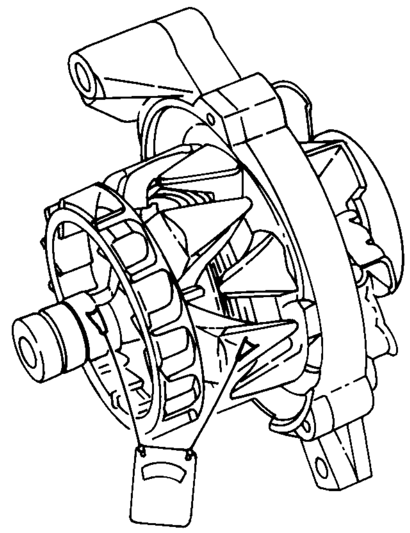


Important: The fastening torque of this nut is 81 N•m (60 lb-ft) and may not normally be unfastened using hand strength.

6. Move to the drive end of the generator and remove the drive end bearing nut.

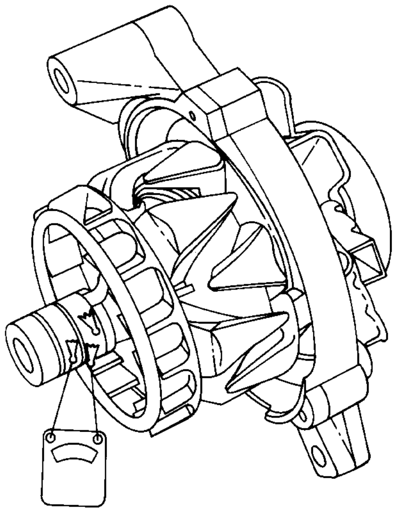


7. Remove the pulley and the collars.



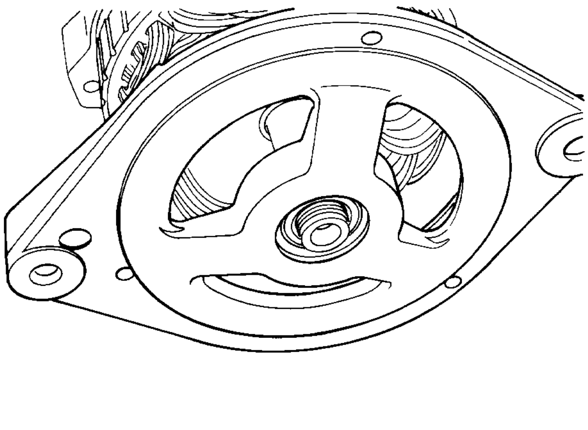
A102E252

8. Test the rotor for an open circuit by using the ohmmeter with the drive end frame assembled. The reading should be sufficiently high, or the rotor must be replaced.



A102E205

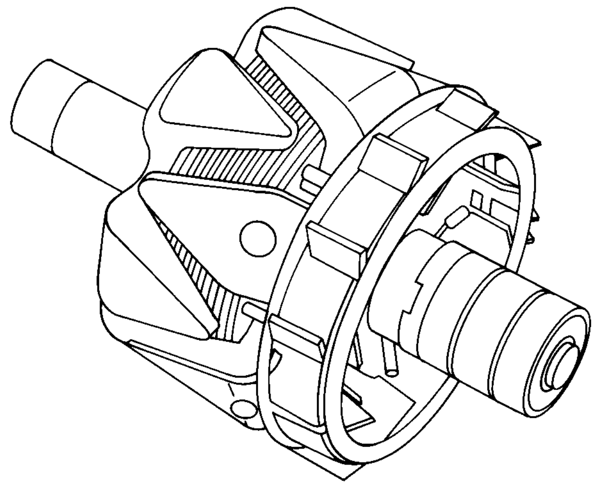
9. Test the rotor for open and short circuits. The reading should be 1.7 to 2.3 ohms, or the rotor should be replaced.



A102E206

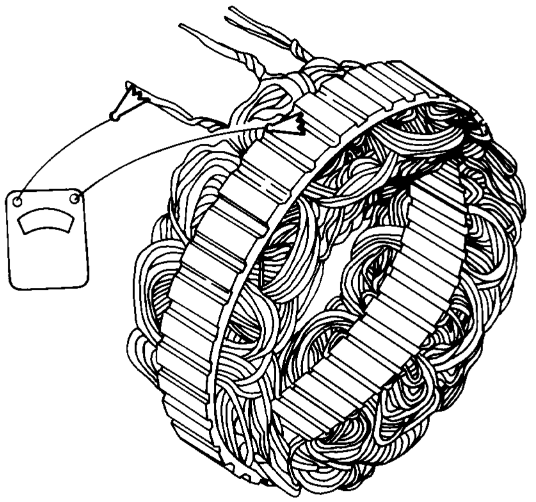
10. Remove the drive end frame from the shaft.

11. For vehicles with an internal generator fan, remove the drive end frame and the fan.



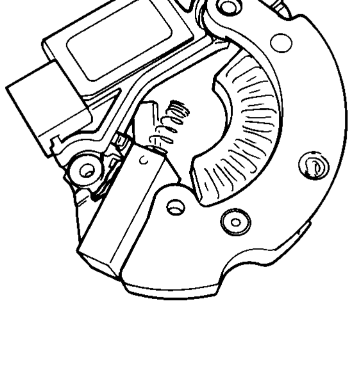
A102E207

12. Remove the rotor assembly.



A102E208

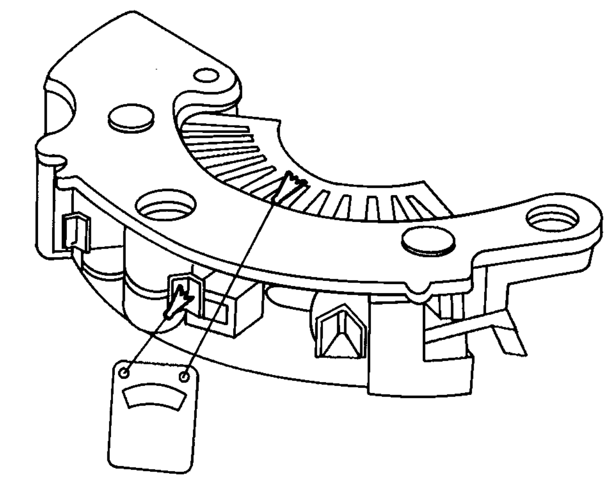
13. Remove the stator.
14. Test the stator for an open circuit using the ohmmeter.



A102E256

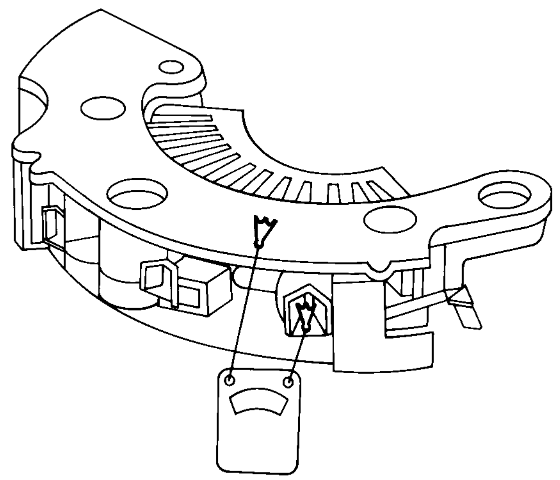
15. Pry off the baffle.
16. Remove the rectifier/regulator/brush holder assembly screws.
17. Remove the brush holder assembly and the regulator, cutting the terminal between the regulator and the rectifier bridge.

Important: If the brush can be reused, reassemble the brush to the holder with the retaining pin, after cleaning the brush with a soft, clean cloth.



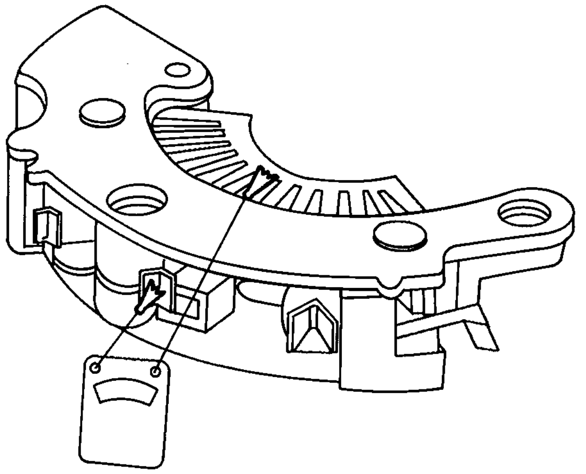
A102E211

18. Test the rectifier bridge by connecting the ohmmeter terminals to the bridge and the heat sink.



A102E204

19. Retest by connecting the ohmmeter terminals in reverse.

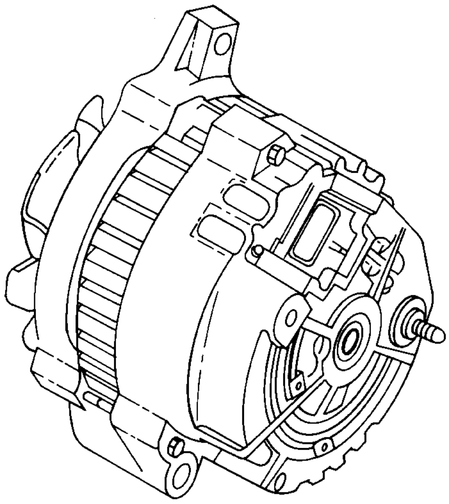


A102E211

20. Replace the rectifier bridge, if each reading is the same.
21. Test the remaining two diodes after the above procedure.

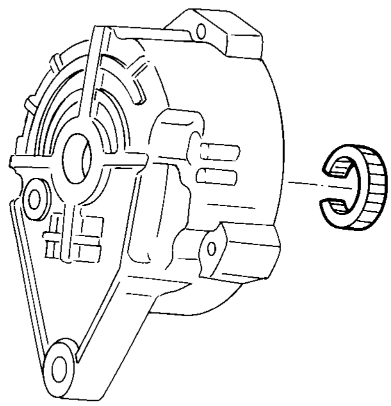
Notice: Some kinds of digital ohmmeters are not suited for the test of the bridge diode. In this case, consult the manufacturer regarding the test capacity.

22. Test the diodes by connecting the ohmmeter terminals to the bridge terminal and the base plate. If the reading is the same, the rectifier bridge should be replaced.



A102E212

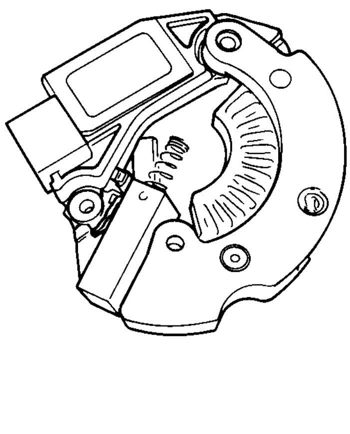
23. Remove the ring in the slip ring end frame.



A102E257

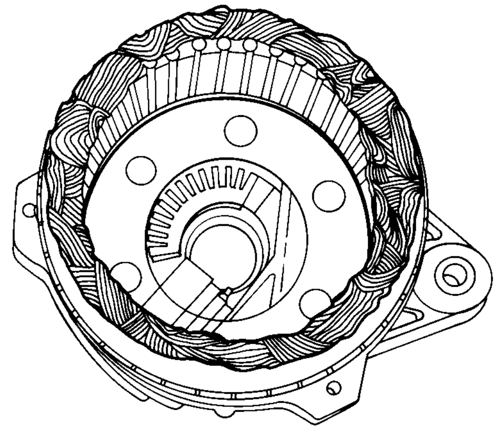
Assembly Procedure

1. Install the new ring in the slip ring end frame.
2. Push the new bearing outer lace into the bottom of the end frame casting.



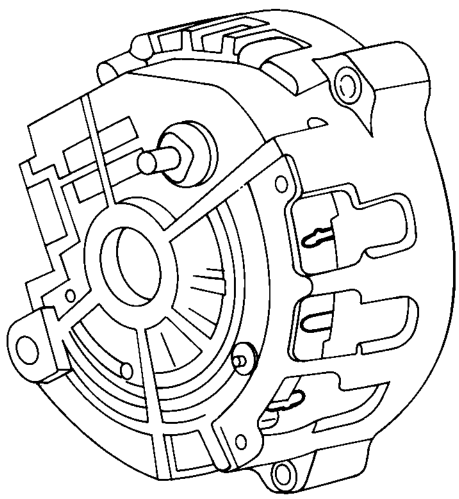
A102E256

3. Solder the brush holder terminal to the regulator terminal, if removed.
4. Fix the brush holder with the retainer pin, and solder the regulator/brush holder assembled terminal to the rectifier terminal.
5. Apply silicone grease between the bridge and the end frame for radiation purposes.
6. Fasten the screws holding the rectifier regulator/ brush holder assembly to the end frame.
7. Punch the new baffle with the pin into the brush.



A102E213

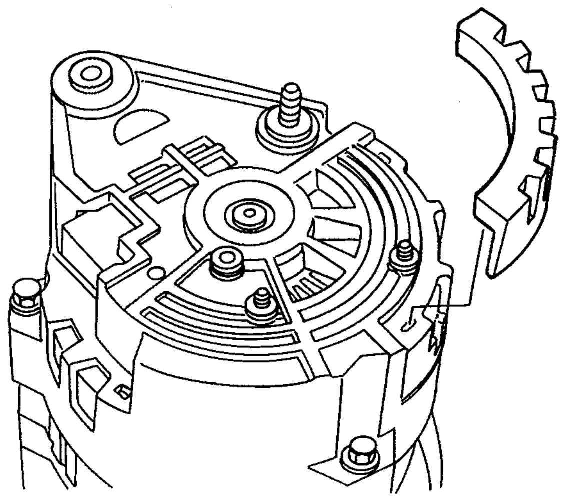
8. Install the stator.



A102E202

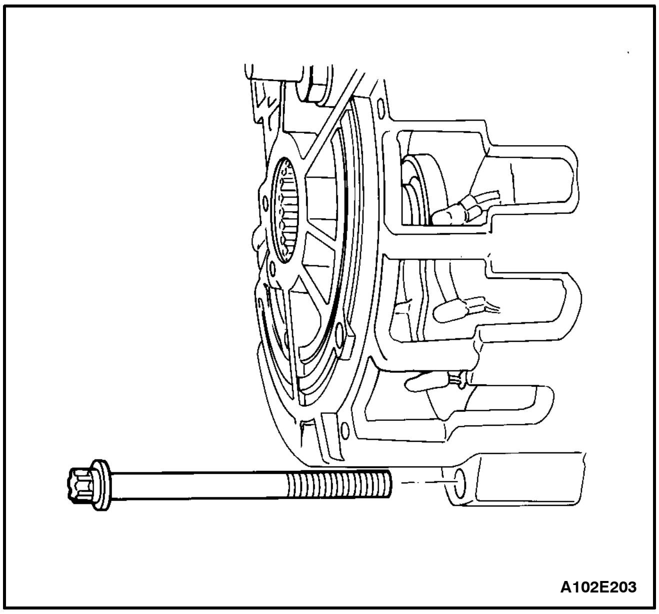
Notice: Take care to prevent damage to the vehicle by protecting the diode in the rectifier bridge from excessive heat while soldering or welding.

9. Solder or weld the connectors of the rectifier bridge.



A102E201

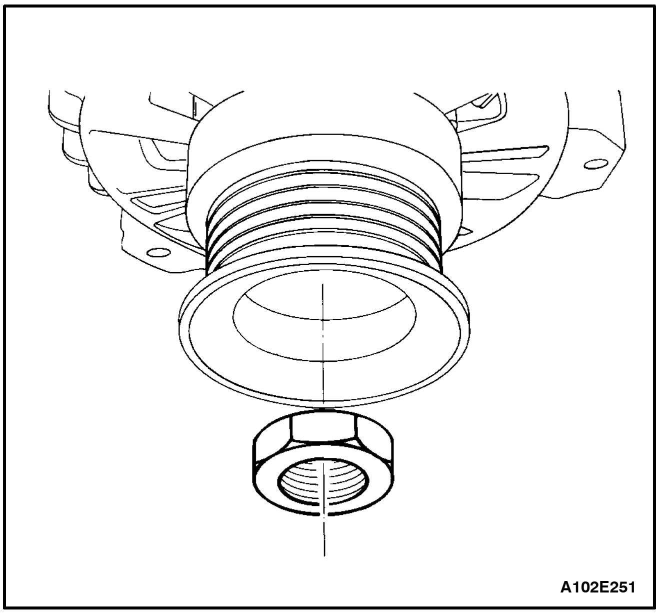
10. Install the outside cover.



11. Position the rotor assembly shaft with the drive end frame in the slip ring end assembly until the gap between the outer lace and the end frame casting is 1.9 mm (0.075 inch).
12. Install the generator through-bolts.

Tighten

Tighten the generator through-bolts to 10 NSm (89 lb-in).

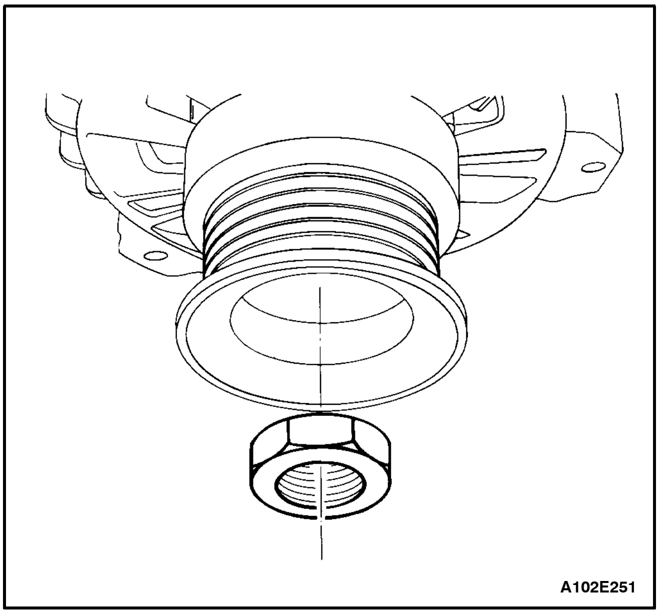


13. Position the fan, the collars, and the pulley on the rotor shaft and secure with the nut.

Tighten

Tighten the generator drive end bearing nut to 81 NSm (60 lb-ft).

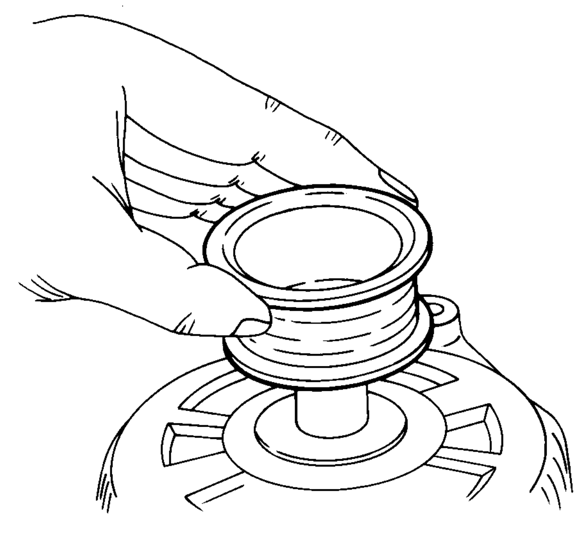
14. Install the generator. Refer to "Generator" in the On-Vehicle Service section.



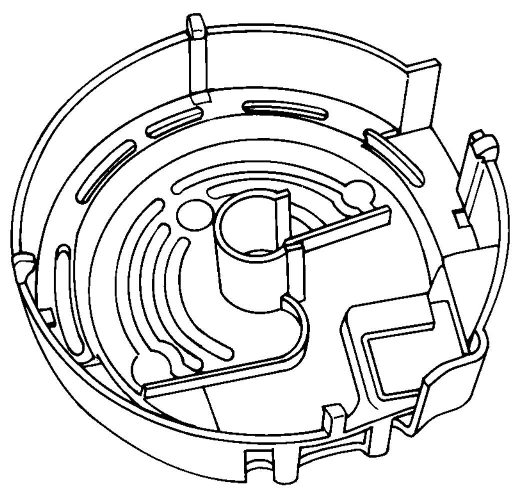
GENERATOR (CS-128D)

Disassembly Procedure

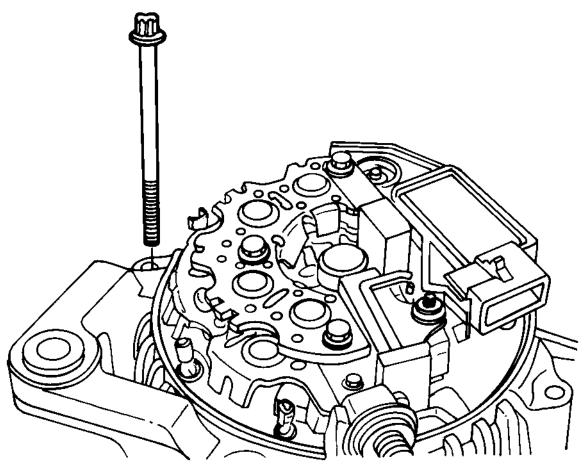
1. Remove the generator. Refer to "Generator" in this section.
2. Remove the driveshaft nut.


C302E002

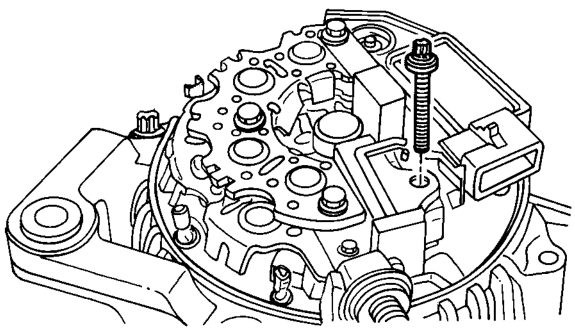
3. Remove the pulley and the collar from the driveshaft.


C302E014

4. Pry off the plastic cover that encloses the rectifier and the regulator/brush holder assemblies.
5. Inspect the cover for damage.

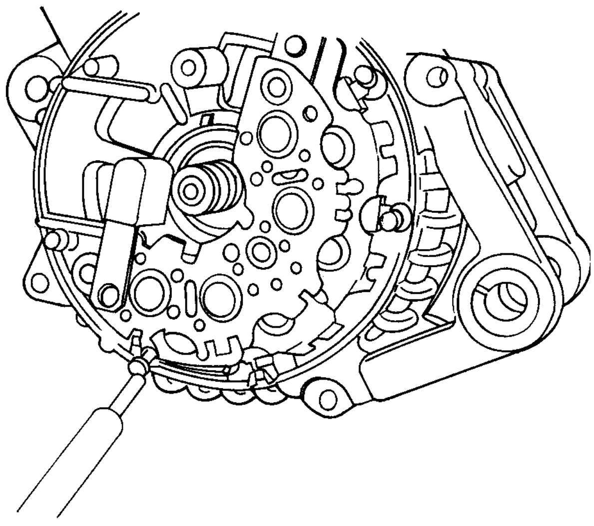

C302E003

6. Remove the generator through-bolts.



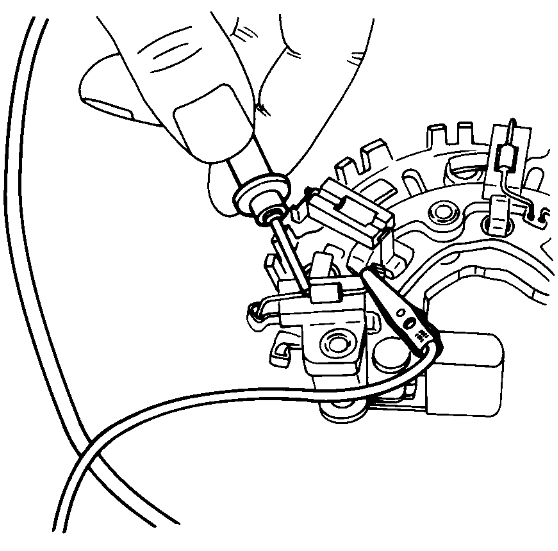
C302E004

7. Remove the bolts that fasten the rectifier assembly and the regulator assembly to the slip ring end frame.



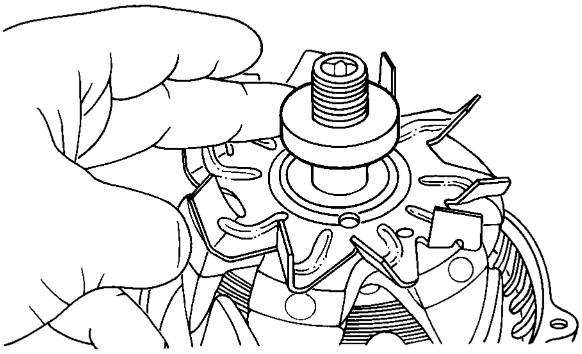
C302E005

8. To remove the regulator/brush holder and the rectifier assemblies, first melt the solder of the lead that connects the regulator/brush holder assembly to the rectifier assembly. Then melt the lead to the stator, followed by the other rectifier assembly leads to the stator (as shown).



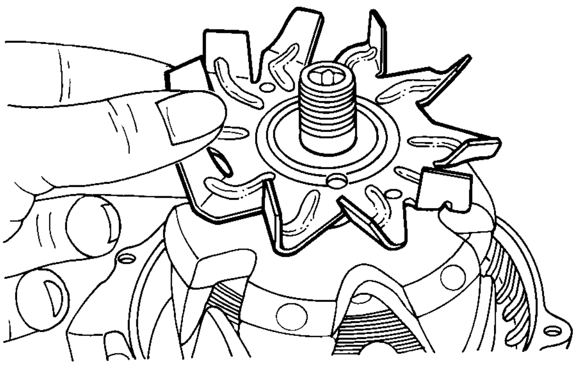
C302E006

9. Test each of the three diodes of the rectifier assembly for continuity. Connect the ohmmeter probes on each side of the diode. Retest by connecting the ohmmeter probes in reverse. If the readings are the same, replace the rectifier.



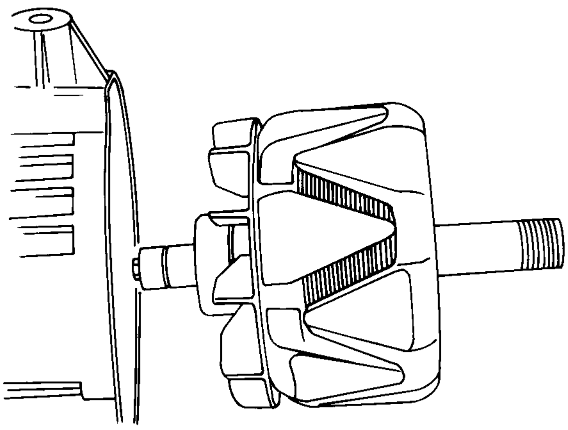
C302E007

10. Mark a line perpendicular to the crack between the case of the drive end frame and that of the slip ring end frame.
11. Pry open the drive end frame from the slip ring end frame.
12. Remove the collar.



C302E008

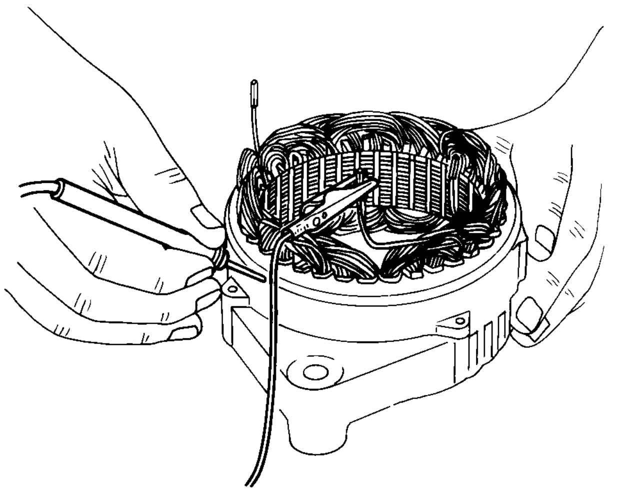
13. Remove the fan.



C302E009

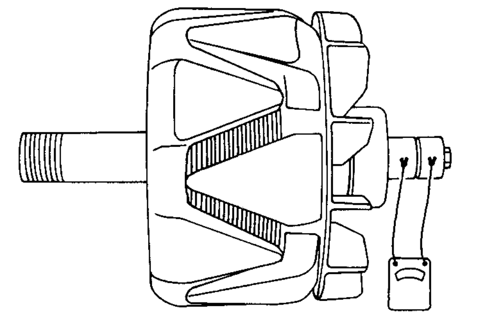
14. Separate the rotor from the slip ring end frame.

15. Using an ohmmeter, test the stator for ground. If the reading is low, replace the stator.
16. Check the stator for an open circuit by placing the probes on two terminals. If the reading is high (infinite), replace the stator.



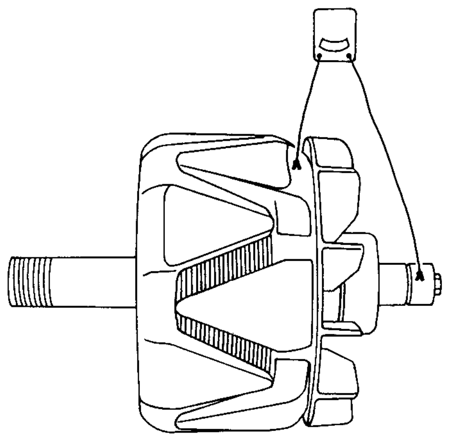
C302E010

17. Using an ohmmeter, test the rotor for an open circuit. Check for continuity between the slip rings. Standard resistance (cold) is 2.8 to 3.0 ohms. If there is no continuity, replace the rotor.

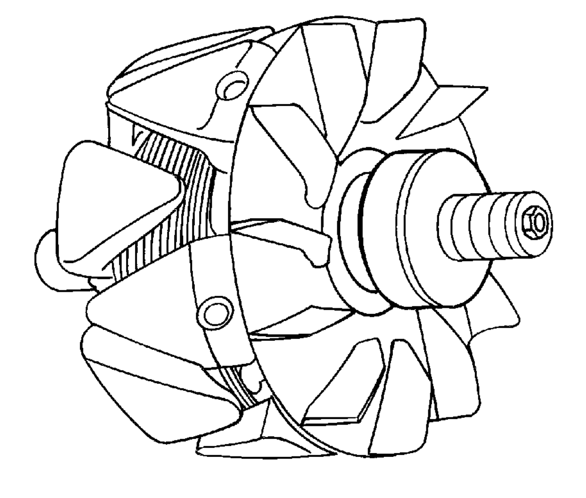


C302E011

18. Using an ohmmeter, inspect the rotor for ground. Check for continuity between the rotor and the slip ring. If there is no continuity between the rotor and the slip ring, replace the rotor.

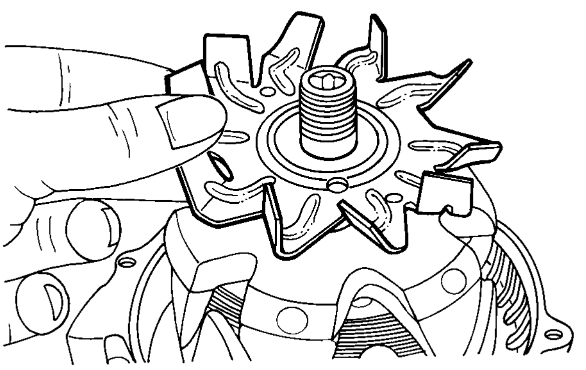


C302E012

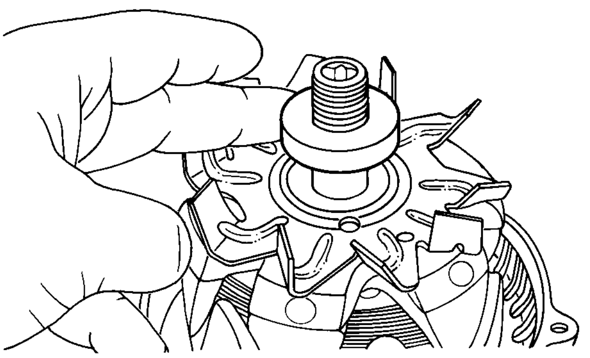

C302E013

Assembly Procedure

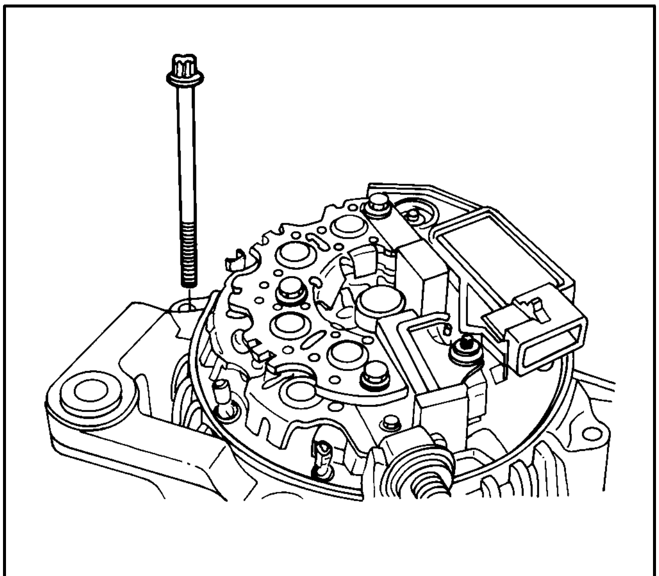
1. Check the bearing on the fan side of the rotor assembly. Replace the bearing if it is rough or worn, especially if the generator is diagnosed as having a noisy bearing with the vehicle running.
2. If required, install a new bearing and insert the bearing retainer on the rotor assembly shaft.


C302E008

3. Press the rotor assembly onto the end frame.
4. Install the fan on the rotor shaft.


C302E007

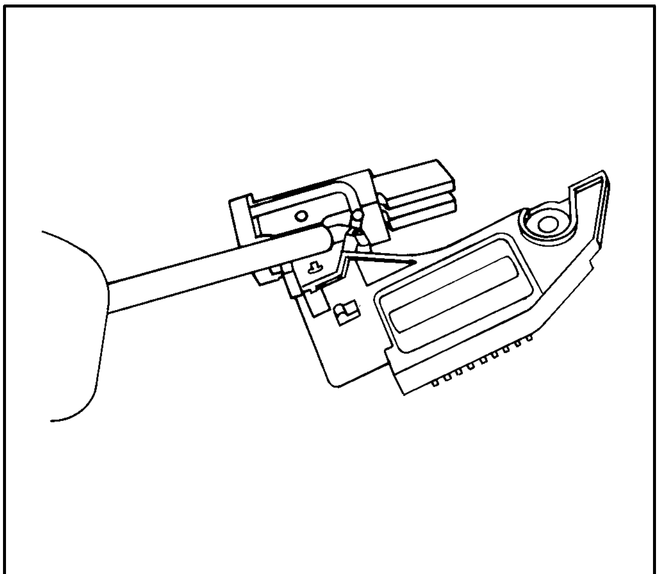
5. Install the collar.


C302E003

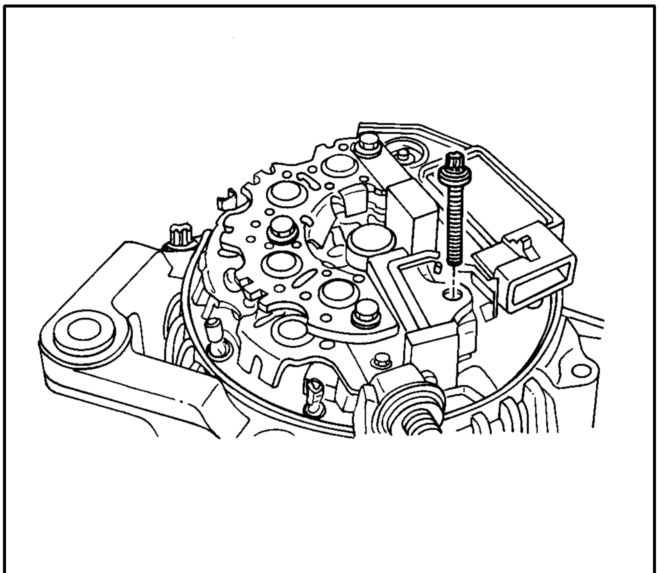
6. Install the slip ring end frame assembly by lining up the terminal ends of the stator with the end frame cover holes, and then lining up the marks that were made on the drive end frame case and the slip ring end frame case before the two cases were separated.
7. Install the generator through-bolts.

Tighten

Tighten the generator through-bolts to 25 N•m (18 lb-ft).


C302E015

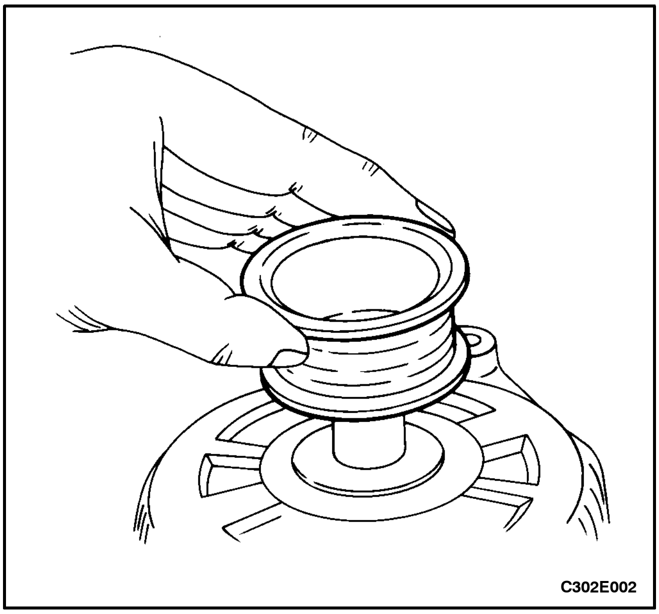
8. Install the rectifier assembly by first soldering its terminals to the stator terminal ends.
9. If the brushes are worn, solder the terminal of the new brush holder assembly to the regulator assembly.


C302E004

10. Solder the terminal of the regulator/brush holder assembly to the rectifier assembly.
11. Fasten the rectifier and the regulator/brush holder assemblies to the slip ring end frame with the bolts.

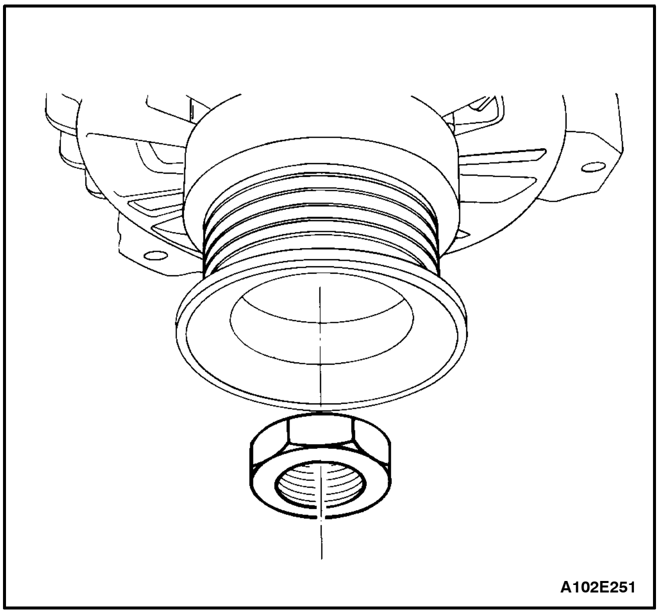
Tighten

Tighten the rectifier and the regulator/brush holder assembly bolts to the point at which they are touching their respective mounting plates. Then tighten the bolts with an additional quarter turn.



C302E002

12. Snap in the cover.
13. Install the collar and the pulley on the drive end shaft.



A102E251

14. Install the drive end nut.

Tighten

Tighten the generator drive end nut to 100 N•m (74 lb-ft).

15. Install the generator in the vehicle. Refer to "Generator" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

BATTERY

The battery has three major functions in the electrical system. First, the battery provides a source of energy for cranking the engine. Second, the battery acts as a voltage stabilizer for the electrical system. Finally, the battery can, for a limited time, provide energy when the electrical demand exceeds the output of the generator.

The sealed battery is standard on all cars. There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The sealed battery has the following advantages over conventional batteries:

- No water need be added for the life of the battery.
- It is protected against overcharge. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.
- It is not as liable to self-discharge as a conventional battery. This is particularly important when a battery is left standing for long periods of time.
- It has more power available in a lighter and a smaller case.

RATINGS

A battery has two ratings: (1) A reserve capacity rating designated at 27_C (81_F), which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; (2) A cold cranking amp rating determined under testing at -18_C (0_F), which indicates the cranking load capacity.

RESERVE CAPACITY

The reserve capacity is the maximum length of time it is possible to travel at night with the minimum electrical load and no generator output. Expressed in minutes, reserve capacity (or RC rating) is the time required for a fully charged battery, at a temperature of 27_C (81_F) and being discharged at a current of 25 amperes, to reach a terminal voltage of 10.5 volts.

COLD CRANKING AMPERAGE

The cold cranking amperage test is expressed at a battery temperature of -18_C (0_F). The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely. However, with proper care, the battery will provide many years of service.

If the battery tests well, but fails to perform satisfactorily in service for no apparent reason, the following factors may point to the cause of the trouble:

- Vehicle accessories left on overnight.
- Slow average driving speeds used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- Defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- Battery abuse, including failure to keep the battery cable terminals clean and tight, or a loose battery hold-down.
- Mechanical problems such as shorted or pinched wires in the electrical system.

BUILT-IN HYDROMETER

The sealed battery has a built-in, temperature-compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure:

1. When observing the hydrometer, make sure that the battery has a clean top.
2. Under normal operation, two indications can be observed:
   - GREEN DOT VISIBLE - Any green appearance is interpreted as a "green dot," meaning the battery is ready for testing.
   - DARK GREEN DOT IS NOT VISIBLE - If there is a cranking complaint, the battery should be tested. The charging and electrical systems should also be checked at this time.
3. Occasionally, a third condition may appear:
   - CLEAR OR BRIGHT YELLOW - This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping, or normal battery wear. Finding a battery in this condition may indicate high charging by a faulty charging system. Therefore, the charging and the electrical systems may need to be checked if a cranking complaint exists. If the cranking complaint is caused by the battery, replace the battery.

CHARGING PROCEDURE

1. Batteries with the green dot showing do not require charging unless they have just been discharged, such as in cranking a vehicle.
2. When charging sealed-terminal batteries out of the vehicle, install the adapter kit. Make sure all the char-

ger connections are clean and tight. For best results, batteries should be charged while the electrolyte and the plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting the charger.
3. Charge the battery until the green dot appears. The battery should be checked every half-hour while charging. Tipping or shaking the battery may be necessary to make the green dot appear.
4. After charging, the battery should be load tested. Refer to "Starter Motor" in this section.

CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

- Size of Battery - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- Temperature - A longer time will be needed to charge any battery at -18°C (0°F) than at 27°C (81°F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher current rate as the battery warms.
- Charger Capacity - A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.
- State-of-Charge - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

CHARGING A COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced.

The following procedure should be used to recharge a completely discharged battery:

1. Measure the voltage at the battery terminals with an accurate voltmeter. If the reading is below 10 volts, the charge current will be very low, and it could take some time before the battery accepts the current in excess of a few milliamperes. Refer to "Charging Time Required" in this section, which focuses on the factors affecting both the charging time required and the rough estimates in the table below. Such low current may not be detectable on ammeters available in the field.
2. Set the battery charger on the high setting.

Important: Some chargers feature polarity protection circuitry, which prevents charging unless the charger leads are correctly connected to the battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction for bypassing or overriding the circuitry so that the charger will turn on and charge a low-voltage battery.

3. Battery chargers vary in the amount of voltage and current provided. The time required for the battery to accept a measurable charge current at various voltages may be as follows:

Voltage	Hours
16.0 or more	Up to 4 hours
14.0-15.9	Up to 8 hours
13.9 or less	Up to 16 hours

- If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

Important: It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore the battery to a usable state. As a general rule, using the reserve capacity rating (RC) as the number of ampere hours of charge usually brings the green dot into view.

- If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

JUMP STARTING PROCEDURE

1. Position the vehicle with the good (charged) battery so that the jumper cables will reach from one battery to the other.
2. Turn off the ignition, all the lights, and all the electrical loads in both vehicles. Leave the hazard flasher on if there may be other traffic and any other lights needed for the work area.
3. In both vehicles, apply the parking brake firmly.

Notice: Make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine starts, damaging the parts.

4. Shift an automatic transaxle to Park (P), or a manual transaxle to Neutral (N).

Caution: Do not use cables that have loose or missing insulation, or injury could result.

5. Clamp one end of the first jumper cable to the positive terminal on the battery. Make sure it does not touch any other metal parts. Clamp the other end of the same cable to the positive terminal on the other battery. Never connect the other end to the negative terminal of the discharged battery.

Caution: Do not attach the cable directly to the negative terminal of the discharged battery. Doing so could cause sparks and a possible battery explosion, possibly resulting in personal injury.

6. Clamp one end of the second cable to the negative terminal of the booster battery. Make the final connection to a solid engine ground, such as the engine lift bracket, at least 450 millimeters (18 inches) from the discharged battery.
7. Start the engine of the vehicle with the good battery. Run the engine at a moderate speed for several minutes. Then start the engine of the vehicle which has the discharged battery.
8. Remove the jumper cables by reversing the above sequence exactly. Remove the negative cable from the vehicle with the discharged battery first. While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

GENERATOR

The Delco-Remy CS charging system has several models available, including the CS-121D and the CS-128D. The number denotes the outer diameter in millimeters of the stator lamination.

CS generators are equipped with internal regulators. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and a fan are used. There is no test hole.

Unlike three-wire generators, the CS-121D and the CS-128D may be used with only two connections: battery positive and an “L” terminal to the charge indicator lamp.

As with other charging systems, the charge indicator lamp lights when the ignition switch is turned to ON, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. This indicator light will glow at full brilliance for several kinds of defects, as well as when the system voltage is too high or too low.

The regulator voltage setting varies with the temperature and limits the system voltage by controlling the rotor field current. The regulator switches rotor field current on and off at a fixed frequency of about 400 hertz. By varying the on-/off-time time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, the on-time may be 90 percent and the off-time 10 percent.

CHARGING SYSTEM

The Delco-Remy CS charging system has several models available, including the CS-121D and the CS-128D. The number denotes the outer diameter in millimeters of the stator laminations.

CS generators use a new type of regulator that incorporates a diode trio. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and a fan are used. There is no test hole.

STARTER

Wound field starter motors have pole pieces, arranged around the armature, which are energized by wound field coils.

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icy conditions, and splashes.

In the basic circuit, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear. The solenoid main contacts close. Cranking then takes place.

When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be released immediately after the engine starts.

STARTING SYSTEM

The engine electrical system includes the battery, the ignition, the starter, the generator, and all the related wiring. Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual.

The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring. All of these components are connected electrically.

SECTION 1F

ENGINE CONTROLS

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TABLE OF CONTENTS

SPECIFICATIONS

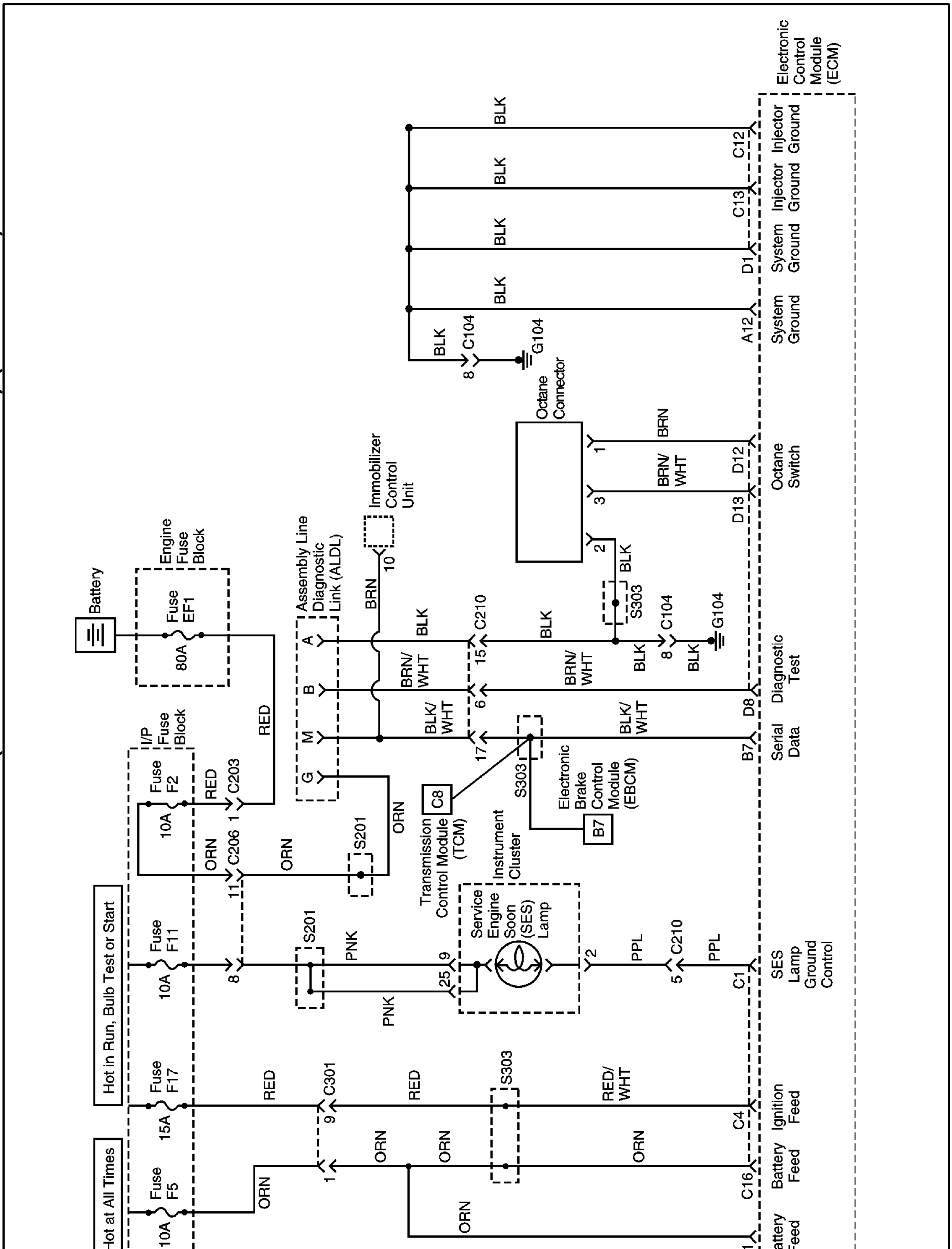
SCAN TOOL DATA TABLE

Parameter	Units Displayed	Typical Data Value
Engine Speed	rpm	$ 50 rpm from desired rpm in drive (A/T) $ 50 rpm from desired rpm in neutral (M/T)
Desired Idle	rpm	ECM idle command (varies with temperature)
Engine Coolant Temperature	degrees Celsius	85-105°C
MAT/Internal Air Temperature	degrees Celsius	10-90°C
MAP	kPa/volts	29-48 kPa/1-2 volts (varies with manifold and barometric pressure)
Barometric Pressure	kPa/volts	varies with altitude
Fueling Mode	open/closed	"Closed Loop" (may enter "Open Loop" at extended idle)
Throttle Position	volts	0.3-1.0 v
Air/Fuel Ratio	-	-
Oxygen Sensor Signal	millivolts	1-1000 mv (varies continuously)
Injector-Pulse Width	milliseconds	0.8-2.5 ms
Spark Advance	degrees	varies
Fuel Integrator	counts	110 X 145
Block Lever	counts	115 X 138
Idle Air Control	counts	1-50
P/N Switch (A/T Only)	P-N and R-D-L	Park/Neutral (P/N)
Vehicle Speed	kph, mph	0
A/C Pressure	kPa	varies
Ignition/Battery Voltage	volts	13.5-14.8 v
Cooling Fan Relay	on/off	on/off
A/C Request	yes/no	no
A/C Clutch	on/off	off
Low Fan Request	on/off	on/off
Prom ID	0-9999	PROM ID number varies
Canister Purge Solenoid	on/off	off
CO Adjust (Leaded Fuel)	count	128
High-Speed Fan	on/off	off

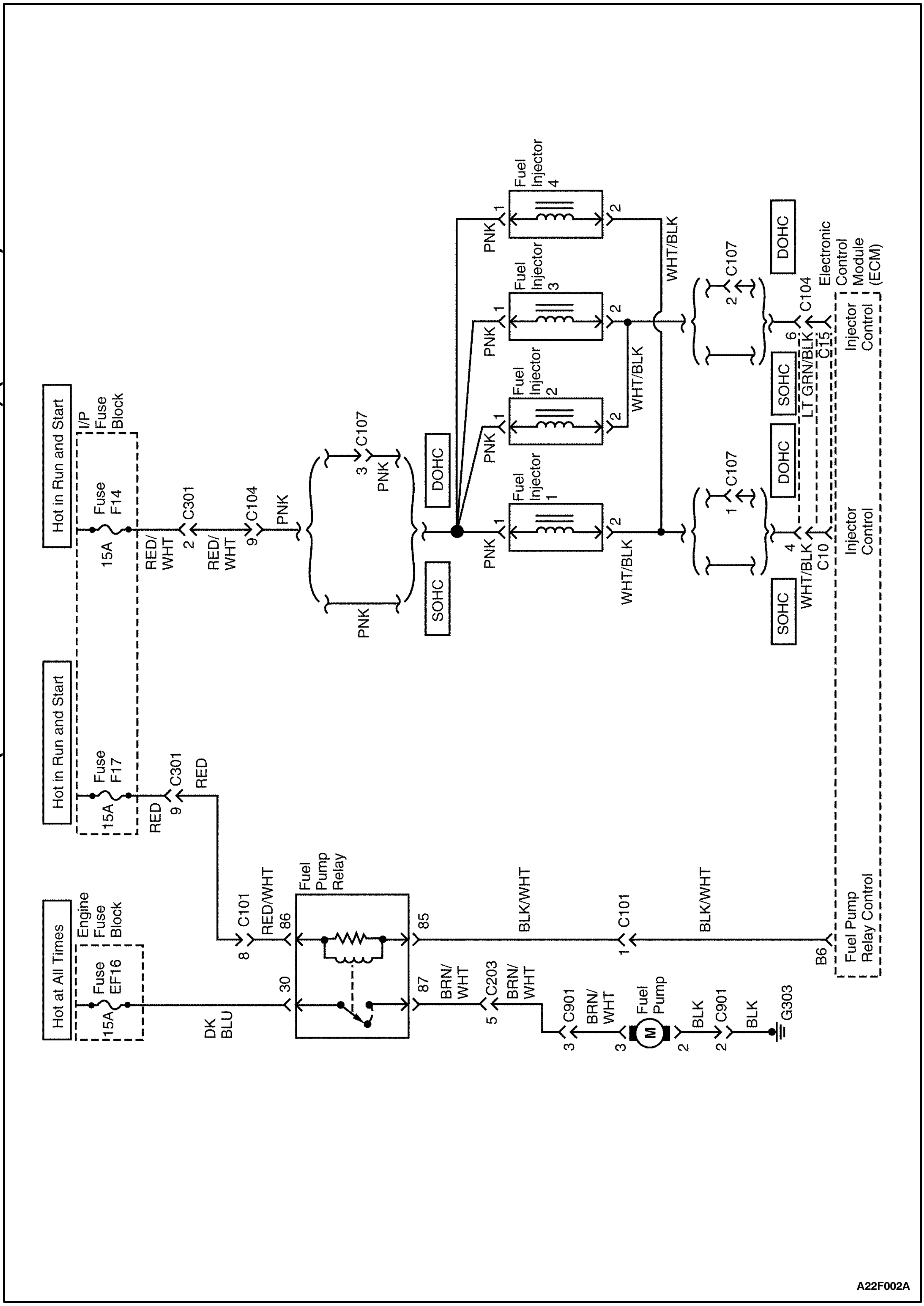
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Coolant Temperature Sensor	20	15	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Direct Ignition System Ignition Coil Retaining Bolts	10	-	89
Evaporative Emission Canister Flange Bolt	20	15	-
Exhaust Gas Recirculation Valve Retaining Bolts	20	15	-
Fuel Pressure Regulator Retaining Bolt - SOHC	12	-	106
Fuel Pressure Regulator Retaining Screw	12	-	106
Fuel Tank Retaining Bolts	20	15	-
Idle Air Control Valve Retaining Bolts	3	-	27
Knock Sensor Bolt	20	15	-
Manifold Absolute Pressure Sensor Mounting Bracket Bolt	10	-	89
Manifold Absolute Pressure Sensor Retaining Bolts and Nuts	8	-	71
Oxygen Sensor	41	30	-
Parking Brake Cable Retainer Clamps	10	-	89
Throttle Body Retaining Bolts	15	11	-
Throttle Position Sensor Retaining Bolts	2	-	18
Variable Geometry Induction System Vacuum Actuator Assembly Mounting Bracket Bolt	16	12	-

SCHEMATIC AND ROUTING DIAGRAMS



ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 2 OF 5) (IEFI-6 ECM)



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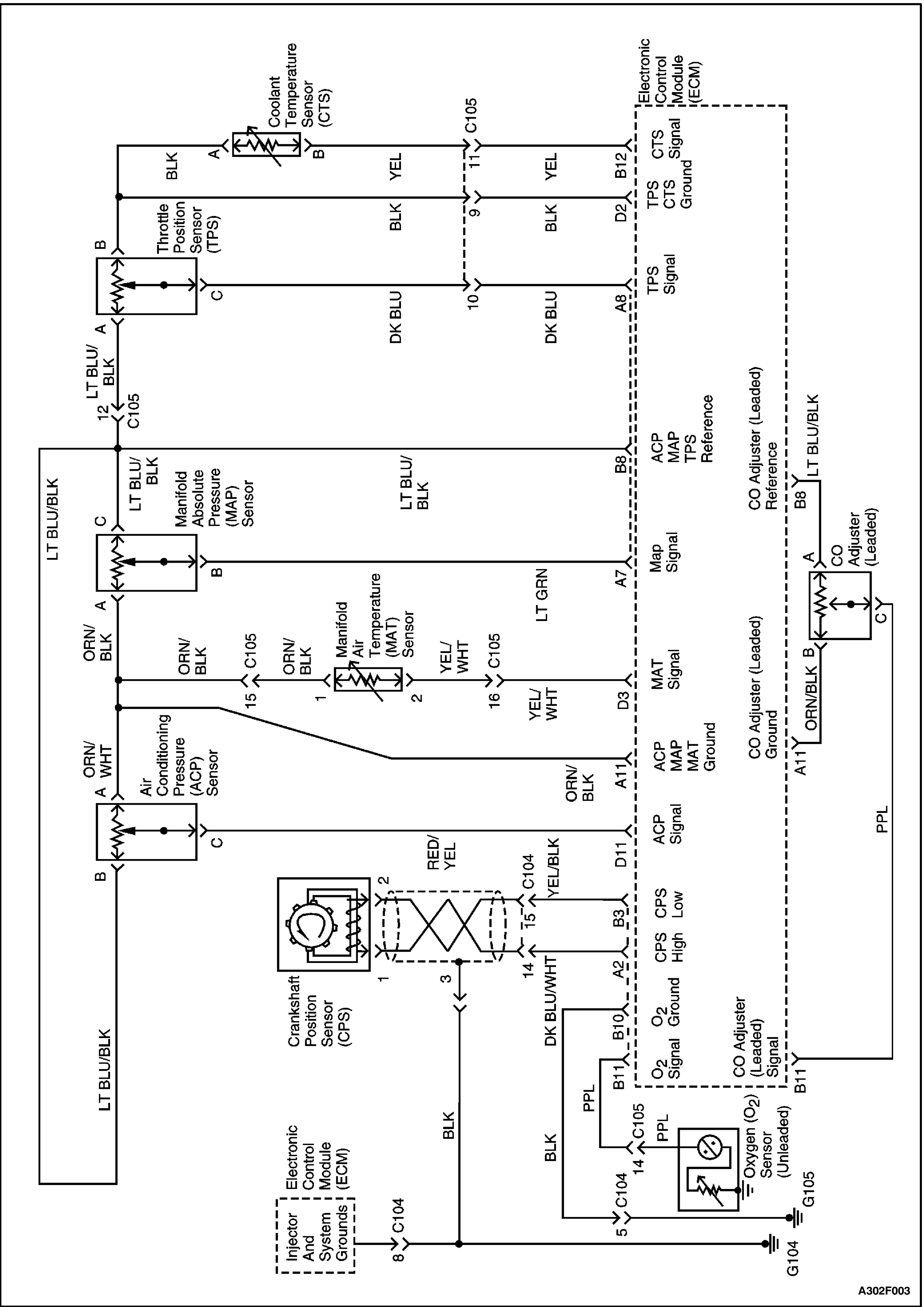
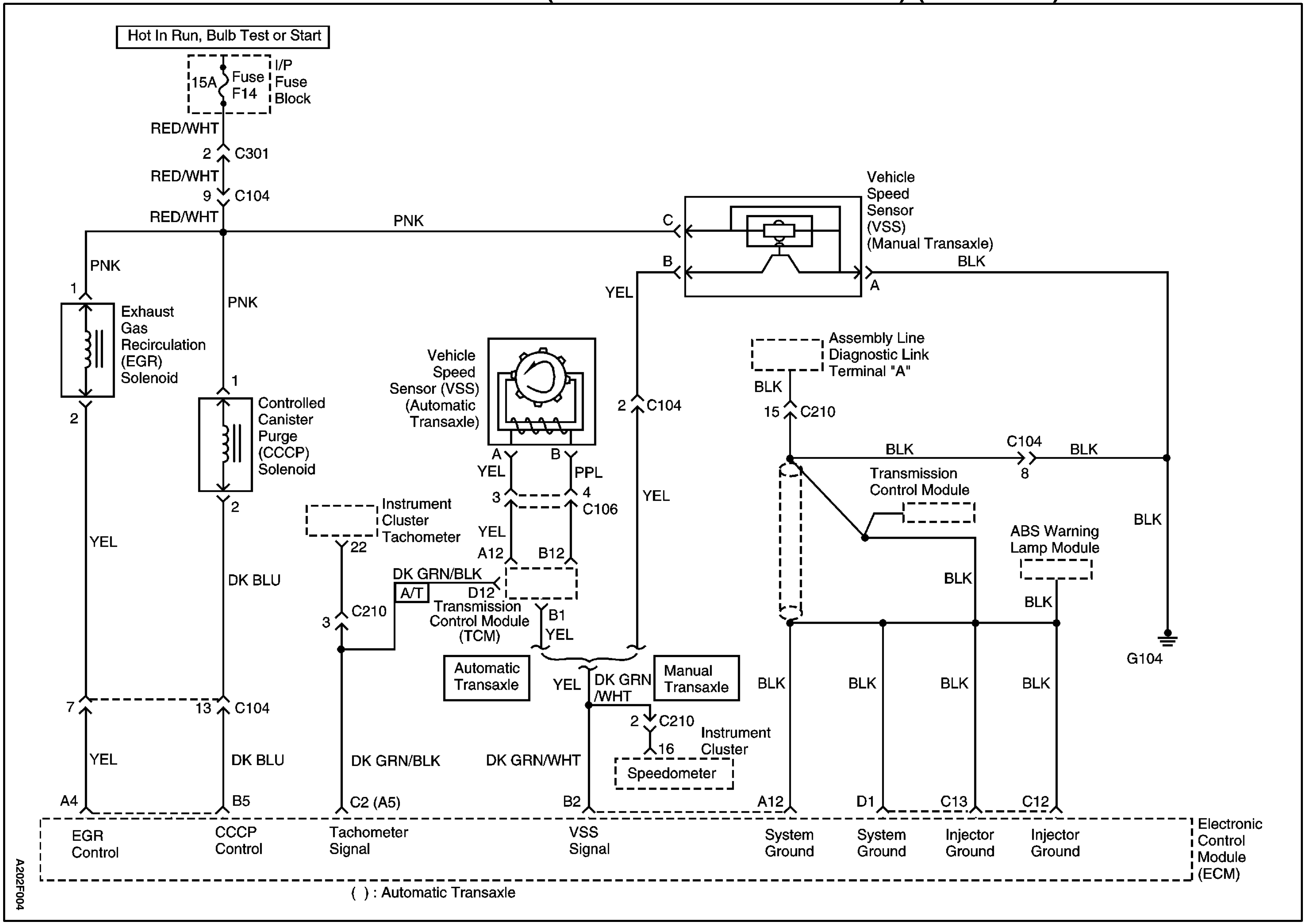
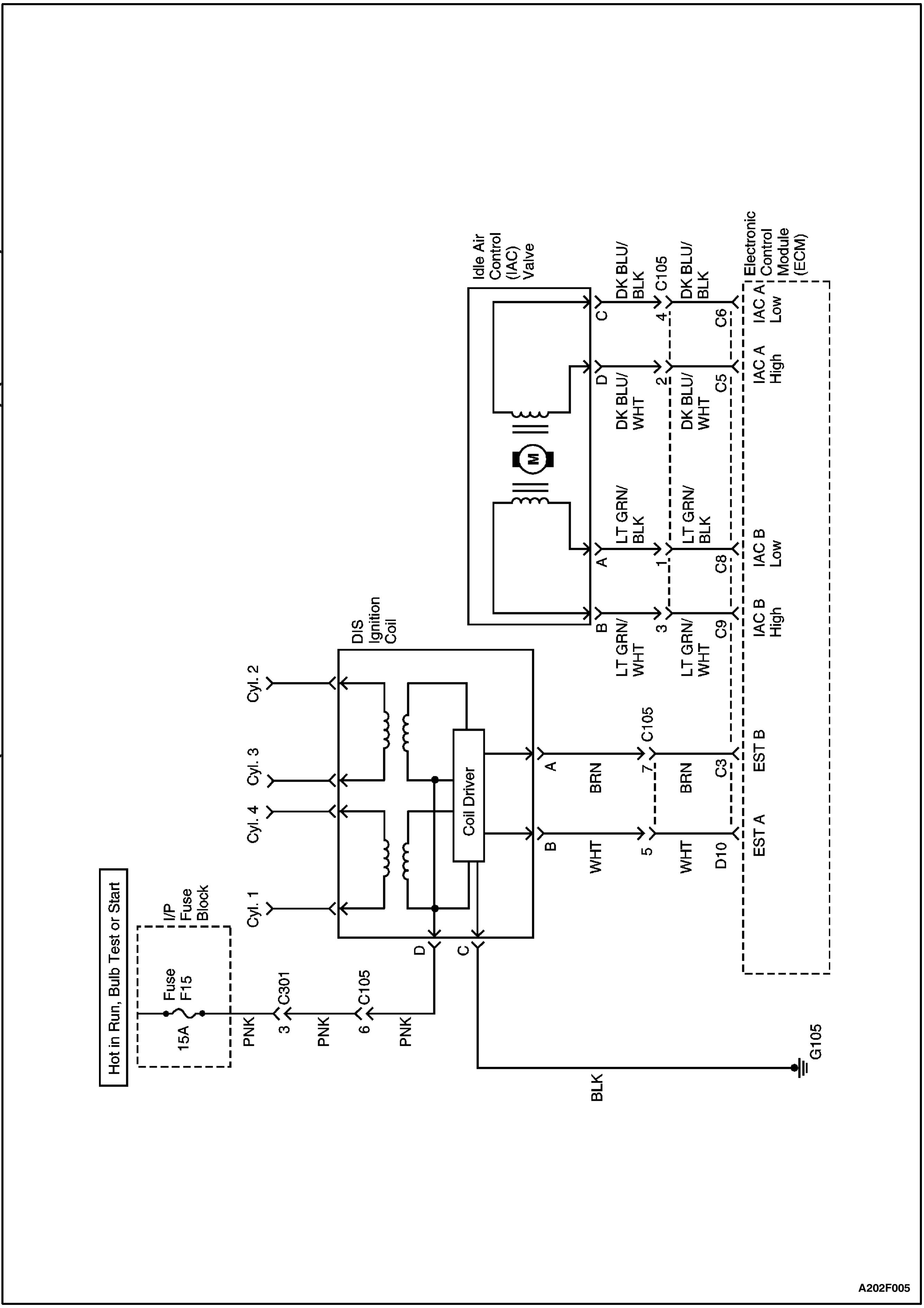


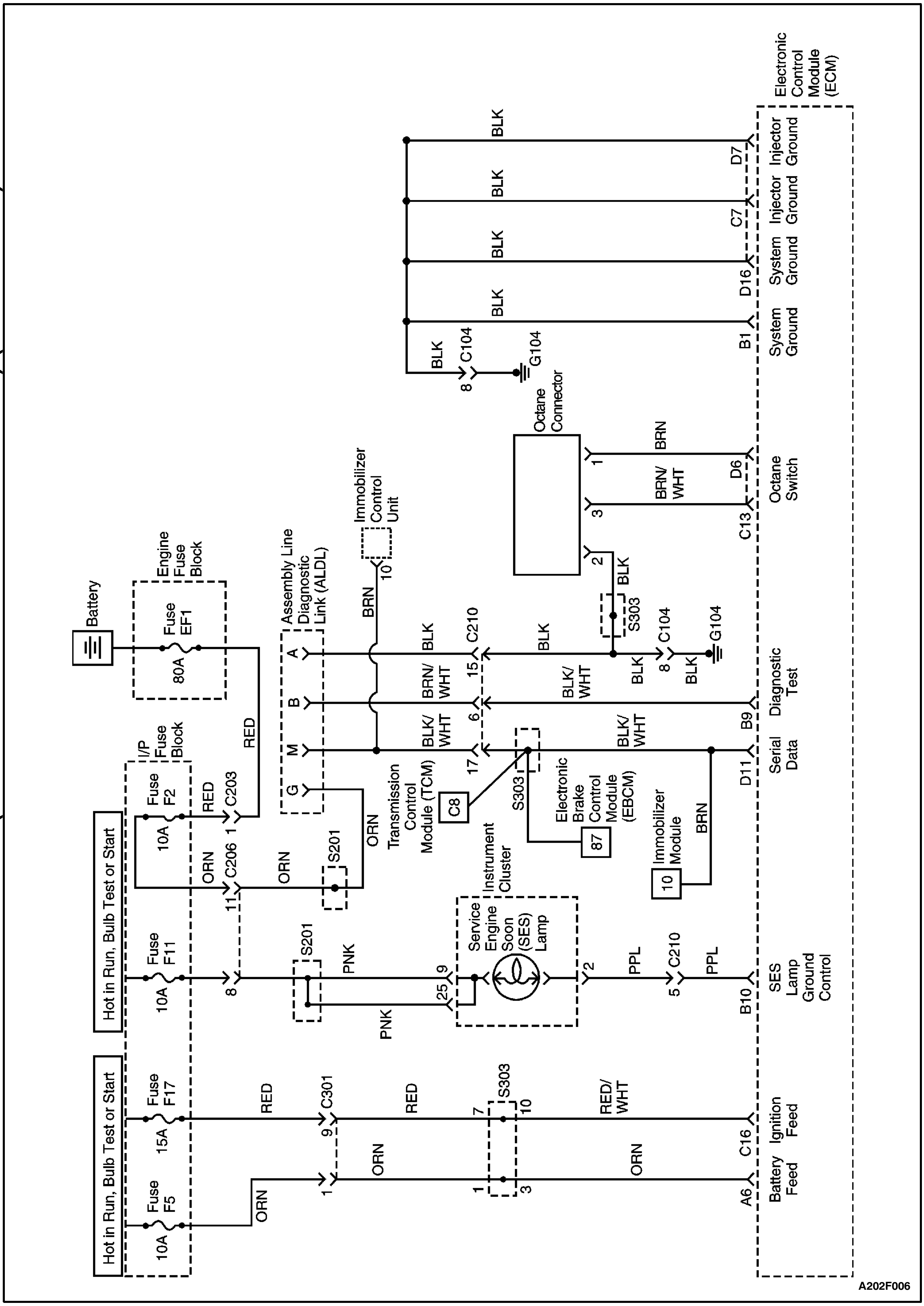
ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 4 OF 5) (IEFI-6 ECM)



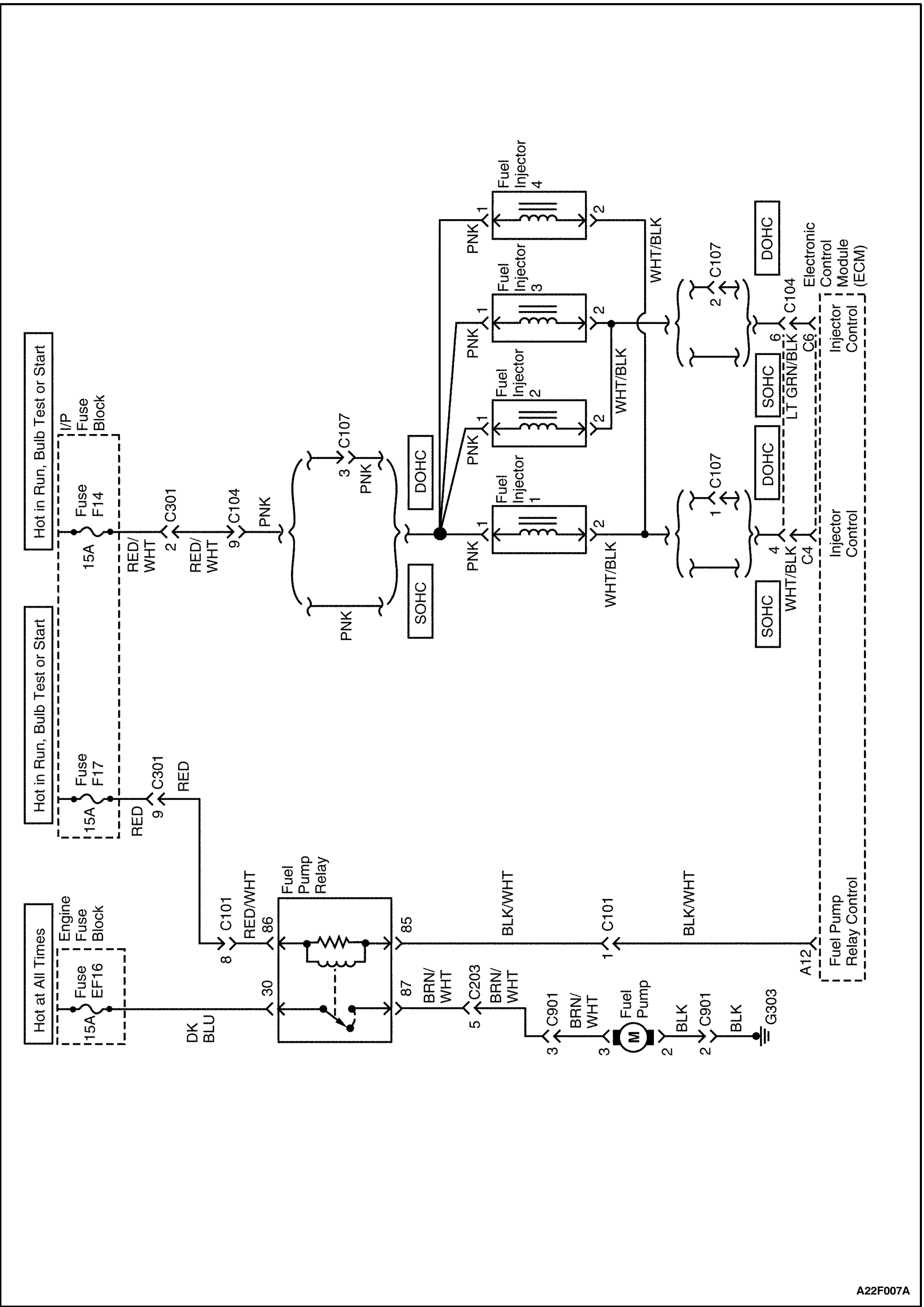
ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 5 OF 5) (IEFI-6 ECM)



ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 1 OF 5) (ITMS-6F ECM)



ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 2 OF 5) (ITMS-6F ECM)



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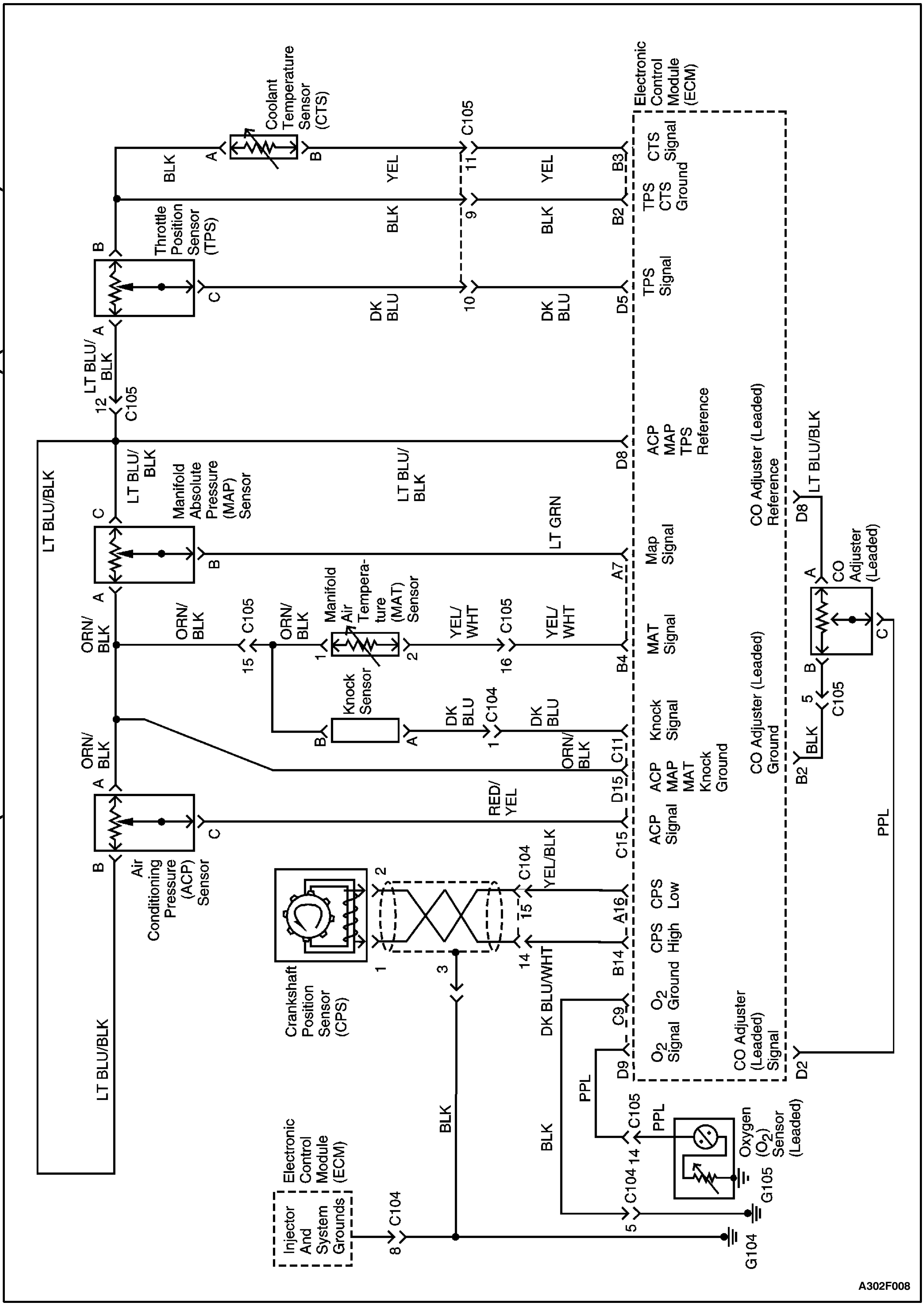

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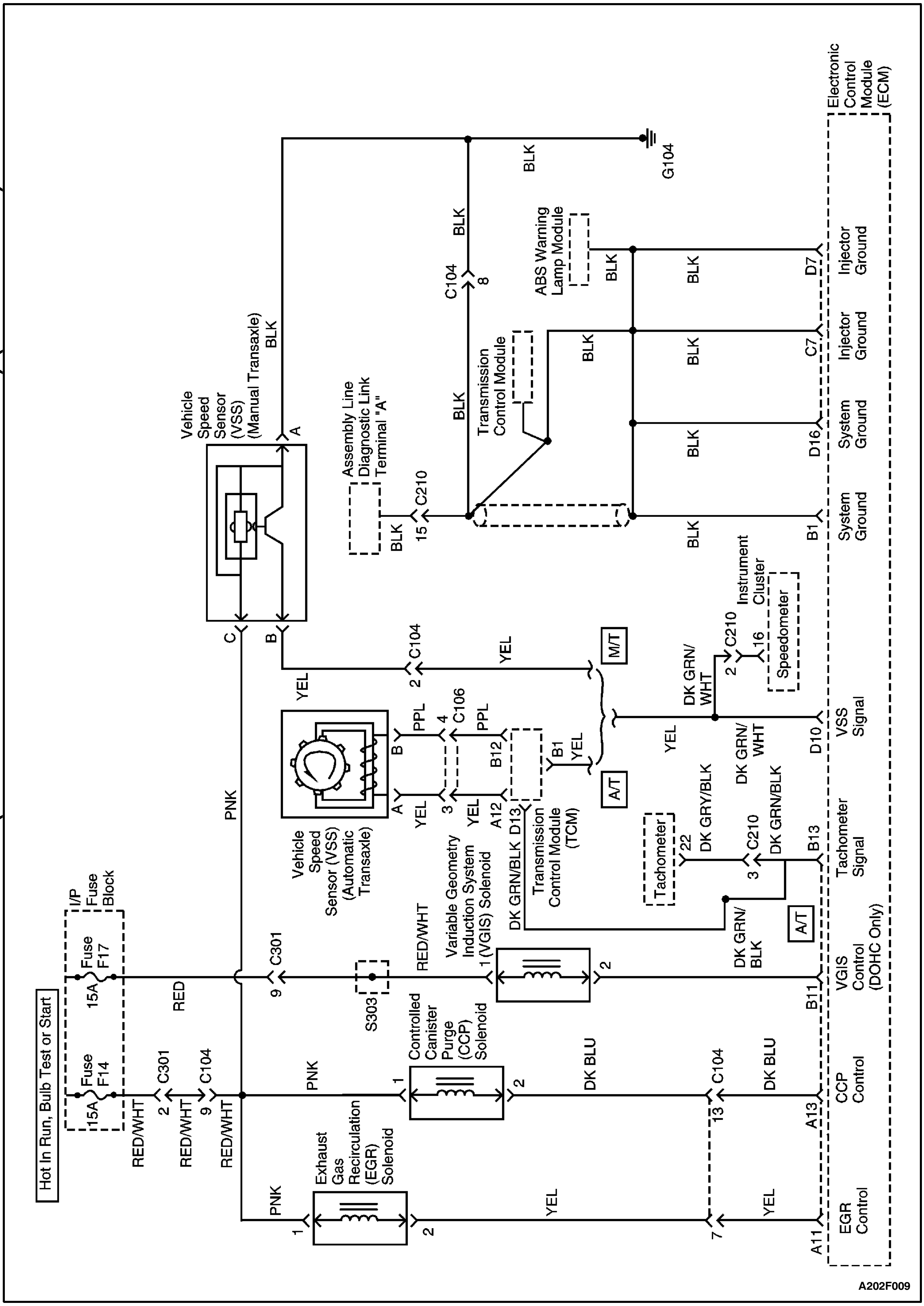
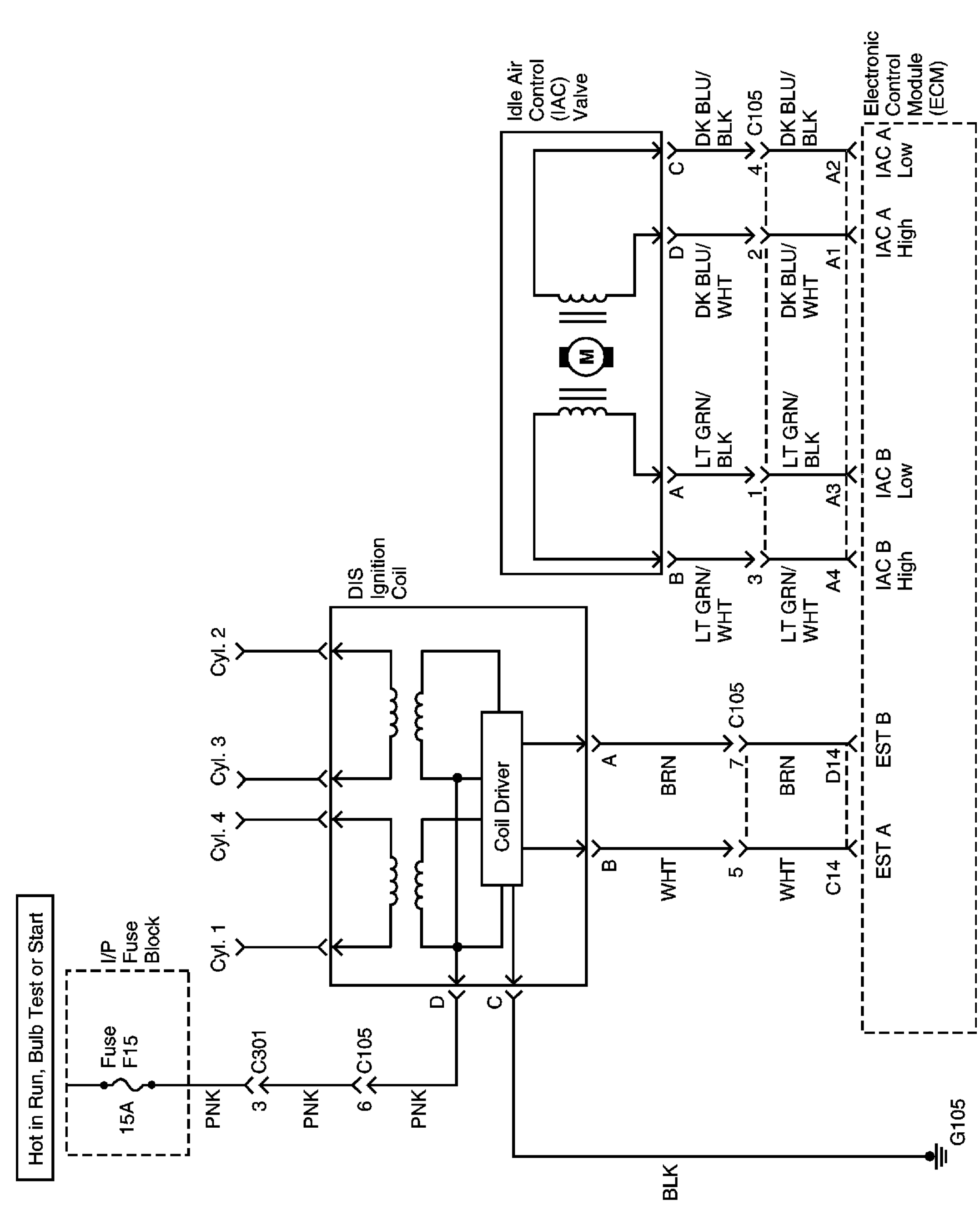


ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 5 OF 5) (ITMS-6F ECM)



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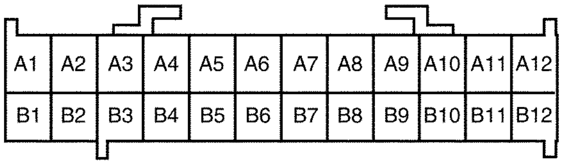
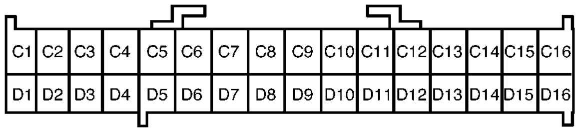
CONNECTOR END VIEW



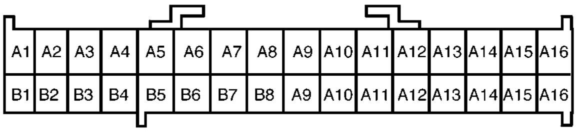
Electronic Control
Module (ECM) 24-Pin
Connector
(1.3L and 1.5L SOHC)

A302F065



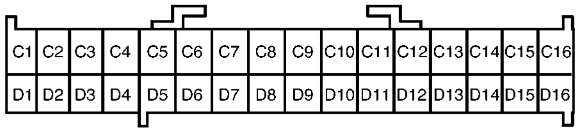
Electronic Control
Module (ECM) 32-Pin
Connector
(1.3L and 1.5L SOHC)

A302F066



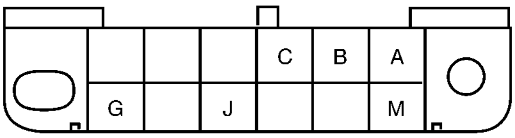
Electronic Control
Module (ECM) J2 (Red)
Connector
(1.3L SOHC and 1.6L DOHC)

A202F067



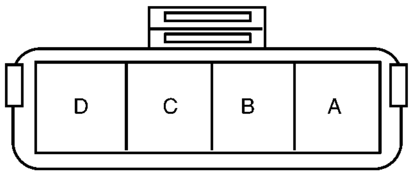
Electronic Control
Module (ECM) J1 (White)
Connector
(1.3L SOHC and 1.6L DOHC)

A202F068



Assembly Line
Diagnostic Link
(ALDL)

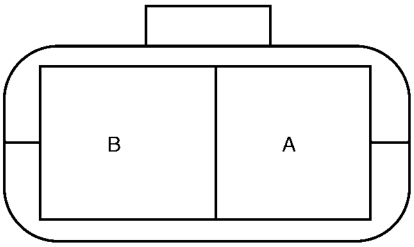
A302F091



Direct Ignition System (DIS)
Ignition Coil
Connector

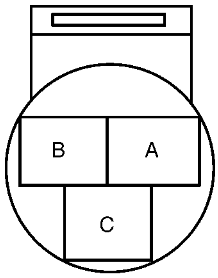
A102F080

CONNECTOR END VIEW (Cont'd)



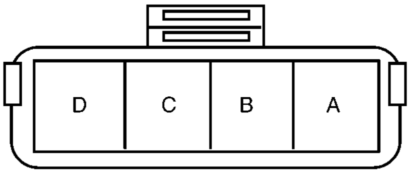
Coolant Temperature
Sensor (CTS) Connector

A102F085



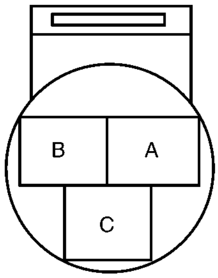
Air Conditioning
Pressure (ACP) Sensor
Connector

A102F088



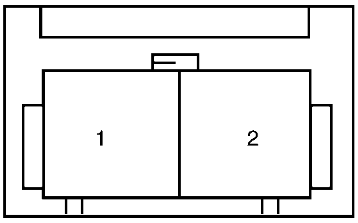
Idle Air Control (IAC) Valve
Connector

A102F076



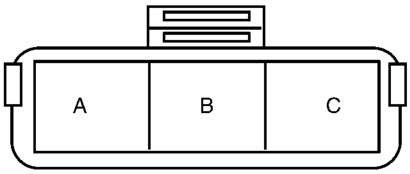
Throttle Position
Sensor (TPS) Connector

A102F074



Manifold Air
Temperature (MAT) Sensor
Connector

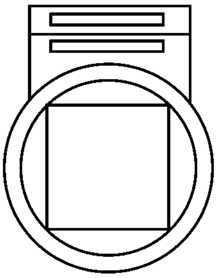
A102F077



Vehicle Speed
Sensor (VSS) (M/T)
Connector

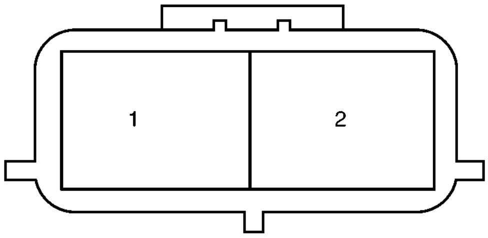
A102F086

CONNECTOR END VIEW (Cont'd)



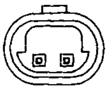
Oxygen (O_2) Sensor
Connector

A102F081



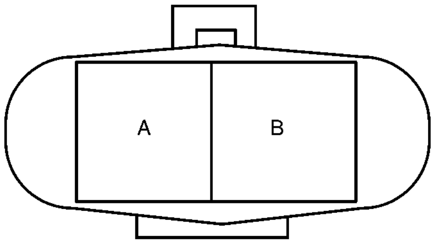
Controlled Canister
Purge (CCP) Solenoid
Connector

A102F078



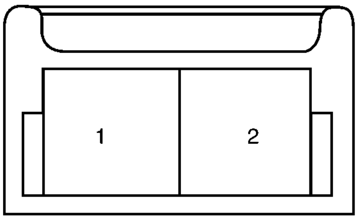
Knock Sensor Connector

A202F069



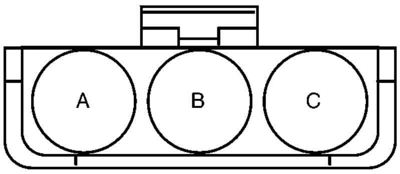
Cooling Fan
Connector

A102F089



Fuel Injector
Connector

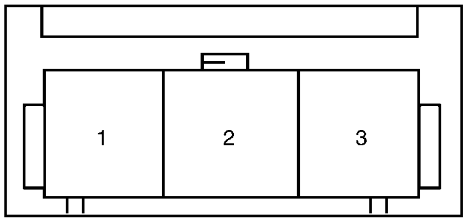
A102F082



Manifold Absolute
Pressure (MAP) Sensor
Connector

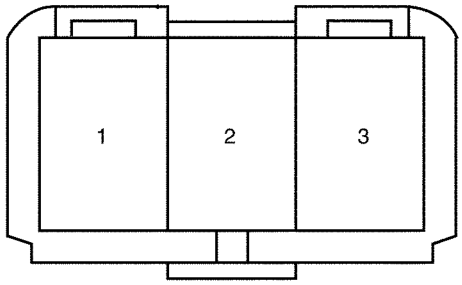
A102F075

CONNECTOR END VIEW (Cont'd)



Crankshaft Position
Sensor (CPS) Connector

A102F084

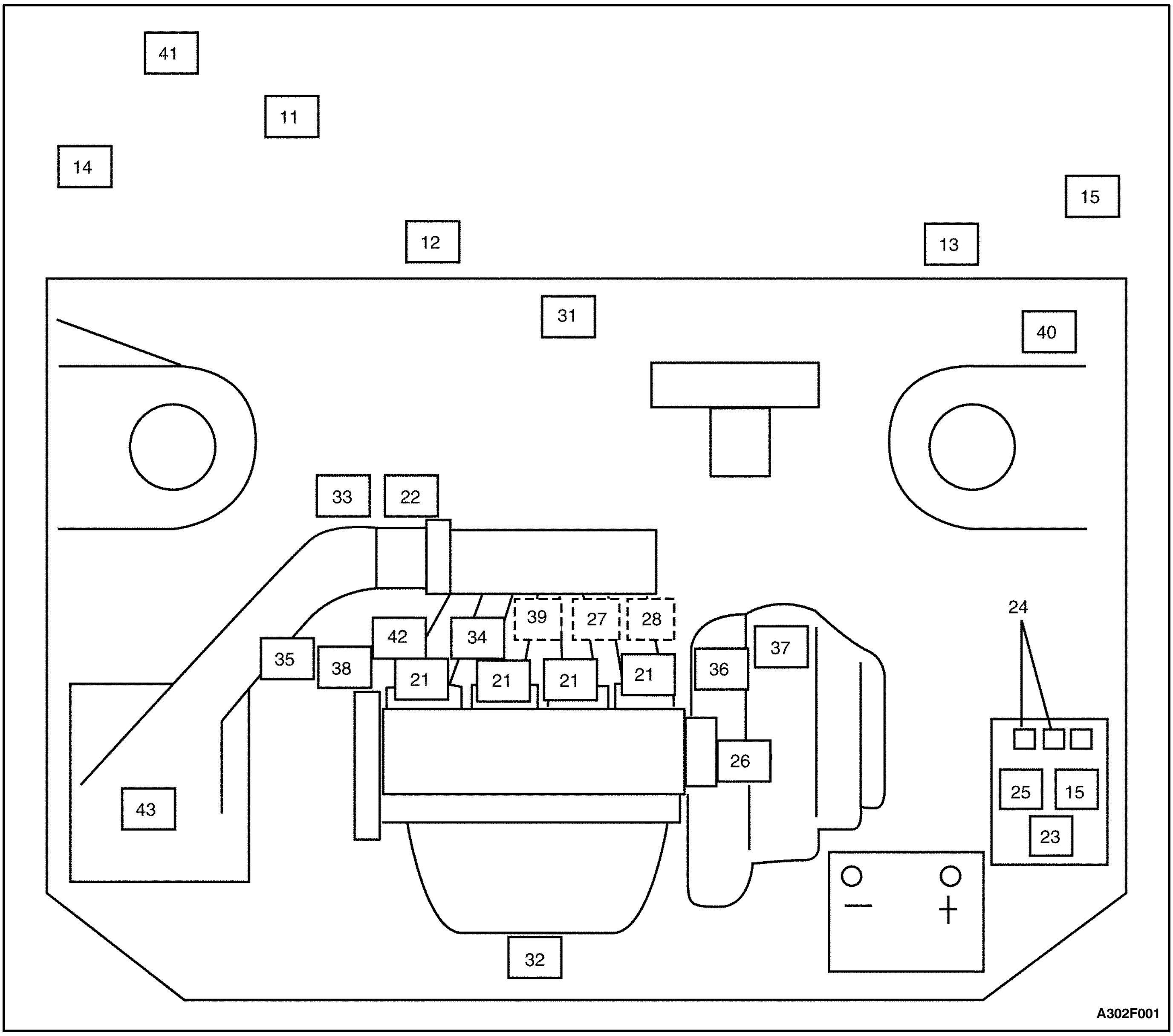


CO Potentiometer Connector

B302F150

COMPONENT LOCATOR

COMPONENT LOCATOR – SOHC



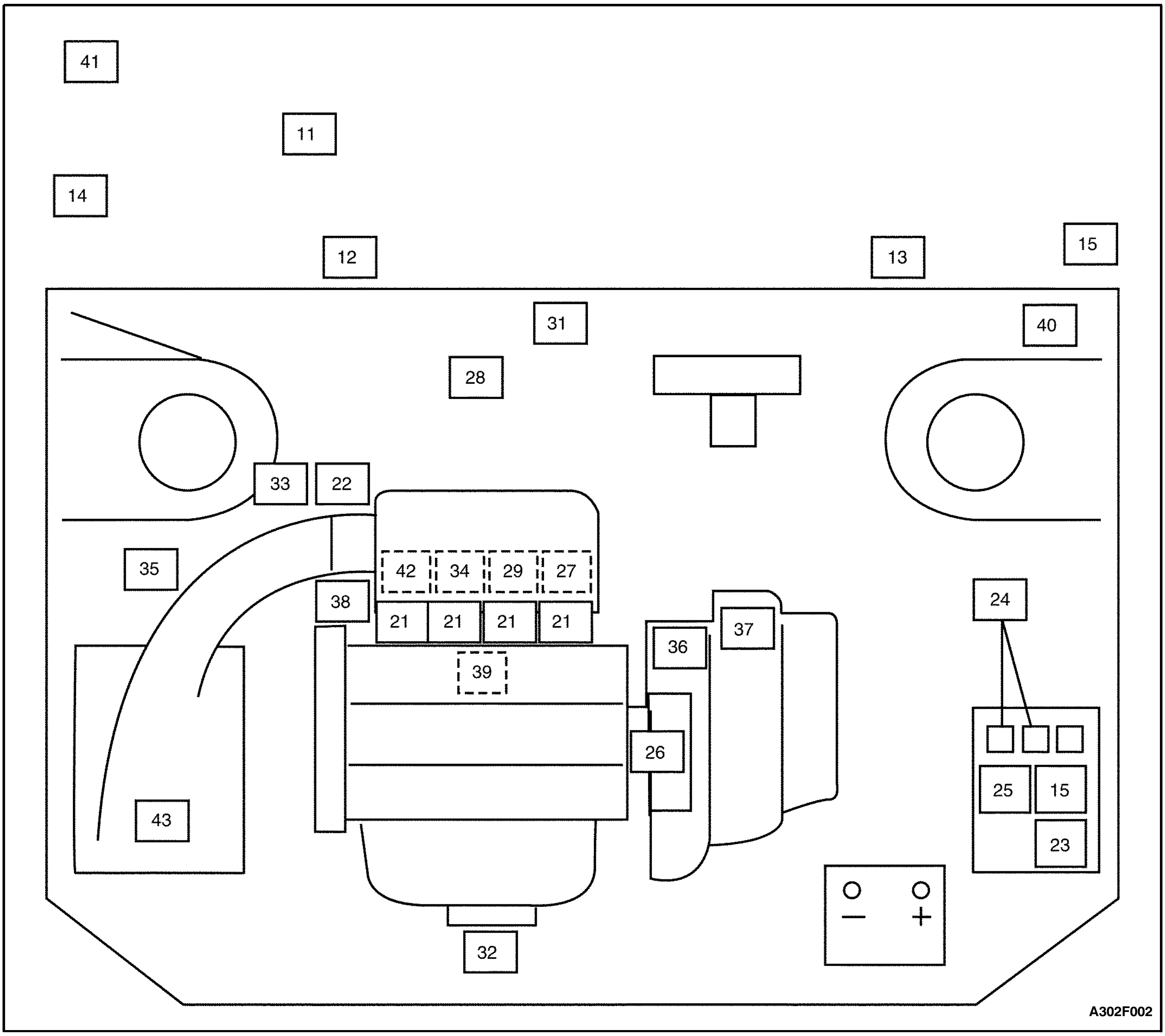
Components on ECM Harness
11 Electronic Control Module (ECM)
12 Assembly Line Diagnostic Link (ALDL) Diagnostic Connector
13 Malfunction Indicator Lamp
14 ECM/ABS Harness Ground
15 Fuse Panel (2)

ECM-Controlled Devices
21 Fuel Injector (4)
22 Idle Air Control (IAC) Valve
23 Fuel Pump Relay
24 Engine Fan Relays
25 A/C Compressor Relay
26 Direct Ignition System (DIS) Ignition Coil
27 Controlled Canister Purge (CCP) Solenoid
28 Exhaust Gas Recirculation (EGR) Solenoid

Information Sensors
31 Manifold Absolute Pressure (MAP) Sensor
32 Oxygen (O_2) Sensor
33 Throttle Position Sensor (TPS)
34 Coolant Temperature Sensor (CTS)
35 Manifold Air Temperature (MAT) Sensor
36 Vehicle Speed Sensor (VSS) (Manual Transaxle Only)
37 P/N Switch (Automatic Transaxle only)
38 Crankshaft Position Sensor (CPS)
39 Knock Sensor
40 CO Potentiometer

Not ECM-Connected
41 Evaporative Emission Canister (under vehicle, behind right rear wheel)
42 Oil Pressure Switch
43 Air Cleaner

COMPONENT LOCATOR – DOHC



Components on ECM Harness
- 11 Electronic Control Module (ECM)
- 12 Assembly Line Diagnostic Link (ALDL) Diagnostic Connector
- 13 Malfunction Indicator Lamp
- 14 ECM/ABS Harness Ground
- 15 Fuse Panel (2)

ECM-Controlled Devices
- 21 Fuel Injector (4)
- 22 Idle Air Control (IAC) Valve
- 23 Fuel Pump Relay
- 24 Engine Fan Relays
- 25 A/C Compressor Relay
- 26 Direct Ignition System (DIS) Ignition Coil
- 27 Controlled Canister Purge (CCP) Solenoid
- 28 Variable Geometry Induction System (VGIS)
- 29 Exhaust Gas Recirculation (EGR) Solenoid

Information Sensors
- 31 Manifold Absolute Pressure (MAP) Sensor
- 32 Oxygen (O_2) Sensor
- 33 Throttle Position Sensor (TPS)
- 34 Coolant Temperature Sensor (CTS)
- 35 Manifold Air Temperature (MAT) sensor
- 36 Vehicle Speed Sensor (VSS) (Manual Transaxle Only)
- 37 P/N Switch (Automatic Transaxle Only)
- 38 Crankshaft Position Sensor (CPS)
- 39 Knock Sensor
- 40 CO Potentiometer

Not ECM-Connected
- 41 Evaporative Emission Canister (under vehicle, behind right rear wheel)
- 42 Oil Pressure Switch
- 43 Air Cleaner

DIAGNOSIS

TROUBLE CODE DIAGNOSIS

CLEARING TROUBLE CODES

Notice: To prevent electronic control module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, electronic control module pigtail connector, electronic control module fuse, jumper cables, etc.).

When the ECM sets a diagnostic trouble code (DTC), the service engine soon (SES) lamp will be turned on and a DTC will be stored in the ECM's memory. If the problem is intermittent, the light will go out after 10 seconds if the fault is no longer present. The DTC will stay in the ECM's memory until the battery voltage to the ECM is removed. Removing battery voltage for 10 seconds will clear all stored DTCs.

DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart. This allows the ECM to set the DTC while going through the chart, which will help to find the cause of the problem more quickly.

IDLE LEARN PROCEDURE

Whenever the battery cables, the electronic control module (ECM), or the ECM fuse is disconnected or replaced, the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 5 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in P/N (park/neutral).
5. Allow the engine run until the engine coolant is above 85°C (185°F).
6. Turn the air conditioning (A/C) ON for 10 seconds, if equipped.
7. Turn the A/C OFF for 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).
9. Turn the A/C ON for 10 seconds, if equipped.
10. Turn the A/C OFF for 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

DIAGNOSTIC SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Check for proper operation of the service engine soon (SES) lamp. When the ignition is ON and the engine is OFF, the SES lamp should come on and remain on steadily.
2. No SES at this point indicates that there is a problem with the SES circuit or the electronic control module (ECM) control of that circuit.
3. This step checks the ability of the ECM to control the SES lamp. With the assembly line diagnostic link (ALDL) terminal grounded, the SES lamp should flash a Code 12 three times, followed by any diagnostic trouble code (DTC) stored in memory. Depending upon the type of ECM, an ECM error may result in the inability to flash Code 12.
4. Most procedures use a scan tool to aid diagnosis; therefore, serial data must be available. If an ECM error is present, the ECM may be able to illuminate the SES lamp, but not enable serial data.
5. Although the ECM is powered up, an "Engine Cranks But Will Not Start" symptom could exist because of an ECM or system problem.
6. This step will isolate if the customer complaint is an SES or a driveability problem with no SES. Refer to the DTC in this section for a list of valid DTCs. An invalid DTC may be the result of a faulty scan tool or a faulty ECM.
7. Comparison of actual control system data with the typical values is a quick check to determine if any parameter is not within limits. Keep in mind that a basic engine problem (such as incorrect valve timing or a vacuum leak) may substantially alter sensor values.
8. Installation of a scan tool will provide a good ground path for the ECM and may hide a driveability complaint due to poor ECM grounds.
9. If the actual data is not within the typical values established, refer to the tables in "Symptom Diagnosis" to provide a functional check of the suspect component or system.

Diagnostic System Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Verify the customer complaint(s). Are the customer's complaint(s) verified?	-	Go to Step 2	-
2	Turn the ignition ON. Is the service engine soon (SES) lamp on steadily?	-	Go to Step 4	Go to Step 3
3	Jumper the assembly line diagnostic link (ALDL) terminals A and B. Does the SES flash Code 12?	-	Go to Step 4	Go to "Will Not Flash SES"
4	1. Connect the scan tool to the ALDL. 2. Turn the ignition ON. Does the scan tool display serial data?	-	Go to Step 5	Go to Step 12
5	Start the engine. Does the engine start?	-	Go to Step 6	Go to "Engine Cranks But Will Not Start"
6	1. Turn the ignition OFF. 2. Connect the scan tool to the ALDL. 3. Turn the ignition ON. Are any diagnostic trouble codes (DTCs) displayed?	-	Go to Step 8	Go to Step 7
7	1. Start the engine. 2. Compare the scan tool data with typical values. Are the values normal or within the normal range?	-	Go to Step 9	Go to Step 10
8	Refer to the applicable DTC table. Start with the DTC with the lowest numerical value and move up. Are the DTC(s) identified as valid trouble code(s)?	-	Go to the applicable DTC table	Go to Step 6
9	Are there any symptoms that have been identified?	-	Go to the applicable symptom table	Go to Step 11
10	Identify the component that has a serial data value outside the normal range. Has the component been identified?	-	Go to "Diagnostic Aids"	-
11	1. Clear any DTC(s) from the electronic control module (ECM) memory. 2. Verify that the DTC(s) have been cleared. 3. Road test the vehicle. 4. Recheck for the presence of any DTC(s). Is the repair complete?	-	System OK	Go to Step 1
12	1. Attach the scan tool to another vehicle. 2. Turn the ignition ON. Does the scan tool read serial data?	-	Go to Step 13	Go to Step 16
13	Check for an open or short in the wire between ECM terminal B7 and ALDL connector M. Is the problem found?	-	Go to Step 14	Go to Step 15
14	1. Repair the open or short as necessary. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	System OK	Go to Step 15

Diagnostic System Check (1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Replace the ECM. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	Go to Step 6	-
16	1. Replace the scan tool. 2. Connect the scan tool to the ALDL. 3. Ignition ON. Does the scan tool read serial data?	-	Go to Step 5	-

DIAGNOSTIC SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Check for proper operation of the service engine soon (SES) lamp. When the ignition is ON and the engine is OFF, the SES lamp should come on and remain on steadily.
2. No SES at this point indicates that there is a problem with the SES circuit or the electronic control module (ECM) control of that circuit.
3. This step checks the ability of the ECM to control the SES lamp. With the assembly line diagnostic link (ALDL) terminal grounded, the SES lamp should flash a Code 12 three times, followed by any diagnostic trouble code (DTC) stored in memory. Depending upon the type of ECM, an ECM error may result in the inability to flash Code 12.
4. Most procedures use a scan tool to aid diagnosis; therefore, serial data must be available. If an ECM error is present, the ECM may be able to illuminate the SES lamp, but not enable serial data.
5. Although the ECM is powered up, an "Engine Cranks But Will Not Start" symptom could exist because of an ECM or system problem.
6. This step will isolate if the customer complaint is an SES or a driveability problem with no SES. Refer to the DTC in this section for a list of valid DTCs. An invalid DTC may be the result of a faulty scan tool or a faulty ECM.
7. Comparison of actual control system data with the typical values is a quick check to determine if any parameter is not within limits. Keep in mind that a basic engine problem (such as incorrect valve timing or a vacuum leak) may substantially alter sensor values.
8. Installation of a scan tool will provide a good ground path for the ECM and may hide a driveability complaint due to poor ECM grounds.
9. If the actual data is not within the typical values established, refer to the tables in "Symptom Diagnosis" to provide a functional check of the suspect component or system.

Diagnostic System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Verify the customer complaint(s). Are the customer's complaint(s) verified?	-	Go to Step 2	-
2	Turn the ignition ON. Is the service engine soon (SES) lamp on steadily?	-	Go to Step 4	Go to Step 3
3	Jumper the assembly line diagnostic link (ALDL) terminals A and B. Does the SES flash Code 12?	-	Go to Step 4	Go to "Will Not Flash SES"
4	1. Connect the scan tool to the ALDL. 2. Turn the ignition ON. Does the scan tool display serial data?	-	Go to Step 5	Go to Step 12
5	Start the engine. Does the engine start?	-	Go to Step 6	Go to "Engine Cranks But Will Not Start"
6	1. Turn the ignition OFF. 2. Connect the scan tool to the ALDL. 3. Turn the ignition ON. Are any diagnostic trouble codes (DTCs) displayed?	-	Go to Step 8	Go to Step 7
7	1. Start the engine. 2. Compare the scan tool data with typical values. Are the values normal or within the normal range?	-	Go to Step 9	Go to Step 10
8	Refer to the applicable DTC table. Start with the DTC with the lowest numerical value and move up. Are the DTC(s) identified as valid trouble code(s)?	-	Go to the applicable DTC table	Go to Step 6
9	Are there any symptoms that have been identified?	-	Go to the applicable symptom table	Go to Step 11
10	Identify the component that has a serial data value outside the normal range. Has the component been identified?	-	Go to "Diagnostic Aids"	-
11	1. Clear any DTC(s) from the electronic control module (ECM) memory. 2. Verify that the DTC(s) have been cleared. 3. Road test the vehicle. 4. Recheck for the presence of any DTC(s). Is the repair complete?	-	System OK	Go to Step 1
12	1. Attach the scan tool to another vehicle. 2. Turn the ignition ON. Does the scan tool read serial data?	-	Go to Step 13	Go to Step 16
13	Check for an open or short in the wire between ECM terminal D11 and ALDL connector M. Is the problem found?	-	Go to Step 14	Go to Step 15
14	1. Repair the open or short as necessary. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	System OK	Go to Step 15

Diagnostic System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Replace the ECM. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	Go to Step 6	-
16	1. Replace the scan tool. 2. Connect the scan tool to the ALDL. 3. Ignition ON. Does the scan tool read serial data?	-	Go to Step 5	-

DIAGNOSTIC AIDS

If an intermittent problem is evident, follow the guidelines below.

Preliminary Checks

Before using this section you should have already performed the "Diagnostic System Check."

Perform a thorough visual inspection. This inspection can often lead to correcting a problem without further checks and can save valuable time. Inspect for the following conditions:

- Electronic control module (ECM) grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks, or collapsing and improper connections as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- Air leaks at the throttle body mounting area and the intake manifold sealing surfaces.
- Ignition wires for cracks, hardness, improper routing, and carbon tracking.
- Wiring for improper connections.
- Wiring for pinches or cuts.

Diagnostic Trouble Code Tables

Do not use the diagnostic trouble code (DTC) tables to try to correct an intermittent fault. The fault must be present to locate the problem.

Incorrect use of the DTC tables may result in the unnecessary replacement of parts.

Faulty Electrical Connections or Wiring

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful inspection of suspect circuits for the following:

- Poor mating of the connector halves.
- Terminals not fully seated in the connector body.
- Improperly formed or damaged terminals. All connector terminals in a problem circuit should be carefully inspected, reformed, or replaced to insure contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body.

Road Test

If a visual inspection does not find the cause of the problem, the vehicle can be driven with a voltmeter or a scan tool connected to a suspected circuit. An abnormal voltage or scan tool reading will indicate that the problem is in that circuit.

If there are no wiring or connector problems found and a DTC was stored for a circuit having a sensor, except for DTC 44 and DTC 45, replace the sensor.

Intermittent Service Engine Soon (SES) Lamp

An intermittent service engine soon (SES) lamp with no DTC present may be caused by the following:

- Electrical system interference caused by a defective relay, ECM-driven solenoid, or switch.
- Improper installation of electrical options such as lights, two-way radios, sound systems, or security systems.
- Ignition control wires not routed away from ignition wires, ignition system components, and the generator.
- Ignition secondary wires shorted to ground.
- SES lamp driver wire or diagnostic test terminal intermittently shorted to ground.
- Intermittent loss of ECM ground connections.

Fuel System

Some intermittent driveability problems can be attributed to poor fuel quality. If a vehicle is occasionally running rough, stalling, or otherwise performing badly, ask the customer about the following fuel buying habits:

- Do they always buy from the same source? If so, fuel quality problems can usually be discounted.
- Do they buy their fuel from whichever fuel station is advertising the lowest price? If so, check the fuel tank for signs of debris, water, or other contamination.

ENGINE CRANKS BUT WILL NOT START (1.3L AND 1.5L SOHC IEFI-6)

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. By performing a compression test, it can be determined if the engine has the mechanical ability to run.
9. It is important to check for the presence of spark from all of the ignition wires. If spark is present from one to three of the ignition coil terminals, the crankshaft position sensor (CPS) is OK.
19. In checking the electronic control module (ECM) outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.
35. This step checks for proper operation of the ECM's control of the fuel pump circuit.
59. This step checks for a ground signal being supplied by the ECM to operate the fuel injectors. If there is no ground present during the cranking of the engine, and the fuel injector wiring is OK, the ECM is at fault.

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to preĆ vent an electrical shock.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Crank the engine. Does the engine start and continue to run?	-	System OK	Go to Step 3
3	Perform a cylinder compression test. Is the cylinder compression for all of the cylinders at or above the value specified?	689 kPa (100 psi)	Go to Step 7	Go to Step 4
4	Inspect the timing belt alignment. Is the timing belt in alignment?	-	Go to Step 6	Go to Step 5
5	Align or replace the timing belt as needed. Is the repair complete?	-	Go to Step 2	-
6	Repair the internal engine damage as needed. Is the repair complete?	-	Go to Step 2	-
7	Inspect the fuel pump fuse. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the fuse. Is the repair complete?	-	Go to Step 2	-
9	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	Go to Step 34	Go to Step 10
10	1. Measure the resistance of the ignition wires. 2. Replace any of the ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	Go to Step 2	Go to Step 11

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Turn the ignition ON. 4. Measure the voltage between the CPS connector terminals 1 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 12	Go to Step 13
12	Measure the voltage between the CPS connector terminals 2 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 19	Go to Step 14
13	Measure the voltage between the CPS connector terminals 1 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 16
14	Measure the voltage between the CPS connector terminals 2 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 17
15	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 18	Go to Step 33
16	Check for an open or short in the wire between the CPS connector terminal 1 and the electronic control module (ECM) connector terminal A2. Is the problem found?	-	Go to Step 18	Go to Step 33
17	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the problem found?	-	Go to Step 18	Go to Step 33
18	Repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
19	1. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at the ECM connector terminal A2 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 20	Go to Step 21
20	Measure the voltage at the ECM connector terminal B3 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 22	Go to Step 21
21	Replace the CPS. Is the repair complete?	-	Go to Step 2	-
22	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the DIS ignition coil. 3. Connect a test light between terminal D of the DIS ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 23	Go to Step 24
23	Connect a test light between terminal C of the DIS ignition coil connector and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 25

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
24	Check for an open in the wiring between the ignition switch and the DIS ignition coil connector terminal D. Is the problem found?	-	Go to Step 26	-
25	Check for an open in the wire from the DIS ignition coil to ground. Is the problem found?	-	Go to Step 26	-
26	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 27
27	1. Turn the ignition OFF. 2. Disconnect the DIS ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 28	Go to Step 29
28	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 32	Go to Step 30
29	Check for an open in the wire from the DIS ignition coil connector terminal B to the ECM connector terminal D10. Is the problem found?	-	Go to Step 31	Go to Step 33
30	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal C3. Is the problem found?	-	Go to Step 31	Go to Step 33
31	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 32
32	Replace the DIS ignition coil. Is the repair complete?	-	Go to Step 2	-
33	Replace the ECM. Is the repair complete?	-	Go to Step 2	-
34	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	-	Go to Step 37	Go to Step 35
35	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminals 3 and 2. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 36	Go to Step 46

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
36	Replace the fuel pump. Is the repair complete?	-	Go to Step 2	-
37	Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 41	Go to Step 38
38	1. Check the fuel filter for a restriction. 2. Inspect the fuel lines for kinks and restrictions. Is the problem found?	-	Go to Step 39	Go to Step 40
39	1. Replace the fuel filter and/or the fuel lines as needed. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 2	Go to Step 40
40	1. Disconnect the vacuum line from the fuel pressure regulator. 2. Inspect the vacuum line for the presence of fuel. 3. Inspect the fuel pressure regulator vacuum port for the presence of fuel. Is any fuel present?	-	Go to Step 43	Go to Step 44
41	Check the fuel for contamination. Is the fuel contaminated?	-	Go to Step 42	Go to Step 58
42	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	-	Go to Step 2	-
43	Replace the fuel pressure regulator. Is the repair complete?	-	Go to Step 2	-
44	1. Remove the fuel pump assembly from the fuel tank. 2. Inspect the fuel pump sender and the fuel coupling hoses for a restriction. 3. Inspect the in-tank fuel filter for a restriction. Is the problem found?	-	Go to Step 45	Go to Step 36
45	Replace the fuel pump sender, the in-tank fuel filter, and/or the fuel coupling hoses as needed. Is the repair complete?	-	Go to Step 2	-
46	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminal 3 and a known good ground. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 47	Go to Step 48
47	Repair the open wire between the fuel pump connector terminal 2 and ground. Is the repair complete?	-	Go to Step 2	-
48	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 49	Go to Step 54

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
49	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 50	Go to Step 55
50	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 51	Go to Step 57
51	1. Turn the ignition OFF. 2. Check the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3 for an open or short to ground. Is the problem found?	-	Go to Step 52	Go to Step 53
52	Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the repair complete?	-	Go to Step 2	-
53	Replace the fuel pump relay. Is the repair complete?	-	Go to Step 2	-
54	1. Inspect the I/P fuse block fuse F17. 2. Check for an open in the wiring between the ignition switch and the fuel pump relay connector terminal 86. Is the problem found?	-	Go to Step 65	-
55	Check the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6 for an open. Is the problem found?	-	Go to Step 56	Go to Step 33
56	Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6. Is the repair complete?	-	Go to Step 2	-
57	Repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. Is the repair complete?	-	Go to Step 2	-
58	1. Turn the ignition OFF. 2. Disconnect the fuel injector harness connectors from all of the fuel injectors. 3. Turn the ignition ON. 4. Connect a test light between the fuel injector harness connector 1 and ground. 5. Repeat step 4 for each of the remaining fuel injectors. Is the test light on at all of the fuel injectors?	-	Go to Step 59	Go to Step 62

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
59	1. Turn the ignition OFF. 2. Connect a test light between the fuel injector harness connector terminal 2 and battery positive. 3. Crank the engine. 4. Repeat Steps 3 and 4 for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	-	Go to Step 60	Go to Step 63
60	Measure the resistance of each fuel injector. Is the resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 61
61	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	-	Go to Step 2	-
62	Repair the open wire(s) between the fuel injector harness connector(s) terminal 1 and the engine harness C104 terminal 9. Is the repair complete?	-	Go to Step 2	-
63	1. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C10 for the fuel injectors 1 and 4. 2. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C15 for the fuel injectors 2 and 3. Is the problem found?	-	Go to Step 64	Go to Step 66
64	Repair the open fuel injector harness wire(s). Is the repair complete?	-	Go to Step 2	-
65	Replace the fuse or repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
66	1. Inspect the I/P fuse F14. 2. Check for an open between the circuits from terminal 1 for each of the four fuel injectors and the ignition switch. Is the problem found?	-	Go to Step 65	-

ENGINE CRANKS BUT WILL NOT START (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. By performing a compression test, it can be determined if the engine has the mechanical ability to run.
9. It is important to check for the presence of spark from all of the ignition wires. If spark is present from one to three of the ignition coil terminals, the crankshaft position sensor (CPS) is OK.
19. In checking the electronic control module (ECM) outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.
35. This step checks for proper operation of the ECM's control of the fuel pump circuit.
59. This step checks for a ground signal being supplied by the ECM to operate the fuel injectors. If there is no ground present during the cranking of the engine, and the fuel injector wiring is OK, the ECM is at fault.

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to preĆ vent an electrical shock.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Crank the engine. Does the engine start and continue to run?	-	System OK	Go to Step 3
3	Perform a cylinder compression test. Is the cylinder compression for all of the cylinders at or above the value specified?	689 kPa (100 psi)	Go to Step 7	Go to Step 4
4	Inspect the timing belt alignment. Is the timing belt in alignment?	-	Go to Step 6	Go to Step 5
5	Align or replace the timing belt as needed. Is the repair complete?	-	Go to Step 2	-
6	Repair the internal engine damage as needed. Is the repair complete?	-	Go to Step 2	-
7	Inspect the fuel pump fuse. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the fuse. Is the repair complete?	-	Go to Step 2	-
9	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	Go to Step 34	Go to Step 10
10	1. Measure the resistance of the ignition wires. 2. Replace any of the ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	Go to Step 2	Go to Step 11

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Turn the ignition ON. 4. Measure the voltage between the CPS connector terminals 1 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 12	Go to Step 13
12	Measure the voltage between the CPS connector terminals 2 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 19	Go to Step 14
13	Measure the voltage between the CPS connector terminal 1 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 16
14	Measure the voltage between the CPS connector terminals 2 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 17
15	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 18	Go to Step 33
16	Check for an open or short in the wire between the CPS connector terminal 1 and the electronic control module (ECM) connector terminal B14. Is the problem found?	-	Go to Step 18	Go to Step 33
17	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the problem found?	-	Go to Step 18	Go to Step 33
18	Repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
19	1. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at the ECM connector terminal B14 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 20	Go to Step 21
20	Measure the voltage at the ECM connector terminal A16 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 22	Go to Step 21
21	Replace the CPS. Is the repair complete?	-	Go to Step 2	-
22	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the DIS ignition coil. 3. Connect a test light between terminal D of the DIS ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 23	Go to Step 24
23	Connect a test light between terminal C of the DIS ignition coil connector and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 25

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
24	Check for an open in the wiring between the ignition switch and the DIS ignition coil connector terminal D. Is the problem found?	-	Go to Step 26	-
25	Check for an open in the wire from the DIS ignition coil to ground. Is the problem found?	-	Go to Step 26	-
26	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 27
27	1. Turn the ignition OFF. 2. Disconnect the DIS ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 28	Go to Step 29
28	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 32	Go to Step 30
29	Check for an open in the wire from the DIS ignition coil connector terminal B to the ECM connector terminal C14. Is the problem found?	-	Go to Step 31	Go to Step 33
30	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal D14. Is the problem found?	-	Go to Step 31	Go to Step 33
31	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 32
32	Replace the DIS ignition coil. Is the repair complete?	-	Go to Step 2	-
33	Replace the ECM. Is the repair complete?	-	Go to Step 2	-
34	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	-	Go to Step 37	Go to Step 35
35	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminals 3 and 2. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 36	Go to Step 46

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
36	Replace the fuel pump. Is the repair complete?	-	Go to Step 2	-
37	Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 41	Go to Step 38
38	1. Check the fuel filter for a restriction. 2. Inspect the fuel lines for kinks and restrictions. Is the problem found?	-	Go to Step 39	Go to Step 40
39	1. Replace the fuel filter and/or the fuel lines as needed. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 2	Go to Step 40
40	1. Disconnect the vacuum line from the fuel pressure regulator. 2. Inspect the vacuum line for the presence of fuel. 3. Inspect the fuel pressure regulator vacuum port for the presence of fuel. Is any fuel present?	-	Go to Step 43	Go to Step 44
41	Check the fuel for contamination. Is the fuel contaminated?	-	Go to Step 42	Go to Step 58
42	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	-	Go to Step 2	-
43	Replace the fuel pressure regulator. Is the repair complete?	-	Go to Step 2	-
44	1. Remove the fuel pump assembly from the fuel tank. 2. Inspect the fuel pump sender and the fuel coupling hoses for a restriction. 3. Inspect the in-tank fuel filter for a restriction. Is the problem found?	-	Go to Step 45	Go to Step 36
45	Replace the fuel pump sender, the in-tank fuel filter, and/or the fuel coupling hoses as needed. Is the repair complete?	-	Go to Step 2	-
46	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminal 3 and a known good ground. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 47	Go to Step 48
47	Repair the open wire between the fuel pump connector terminal 2 and ground. Is the repair complete?	-	Go to Step 2	-

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
48	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 49	Go to Step 54
49	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 50	Go to Step 55
50	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 51	Go to Step 57
51	1. Turn the ignition OFF. 2. Check the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3 for an open or short to ground. Is the problem found?	-	Go to Step 52	Go to Step 53
52	Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the repair complete?	-	Go to Step 2	-
53	Replace the fuel pump relay. Is the repair complete?	-	Go to Step 2	-
54	1. Inspect the I/P fuse block fuse F17. 2. Check for an open in the wiring between the ignition switch and the fuel pump relay connector terminal 86. Is the problem found?	-	Go to Step 65	-
55	Check the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12 for an open. Is the problem found?	-	Go to Step 56	Go to Step 33
56	Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. Is the repair complete?	-	Go to Step 2	-
57	Repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. Is the repair complete?	-	Go to Step 2	-

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
58	1. Turn the ignition OFF. 2. Disconnect the fuel injector harness connectors from all of the fuel injectors. 3. Turn the ignition ON. 4. Connect a test light between the fuel injector harness connector 1 and ground. 5. Repeat Step 4 for each of the remaining fuel injectors. Is the test light on at all of the fuel injectors?	-	Go to Step 59	Go to Step 62
59	1. Turn the ignition OFF. 2. Connect a test light between the fuel injector harness connector terminal 2 and battery positive. 3. Crank the engine. 4. Repeat Steps 3 and 4 for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	-	Go to Step 60	Go to Step 63
60	Measure the resistance of each fuel injector. Is the resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 61
61	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	-	Go to Step 2	-
62	Repair the open wire(s) between the fuel injector harness connector(s) terminal 1 and the engine harness connector C104 terminal 9. Is the repair complete?	-	Go to Step 2	-
63	1. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C4 for the fuel injectors 1 and 4. 2. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C6 for the fuel injectors 2 and 3. Is the problem found?	-	Go to Step 64	Go to Step 66
64	Repair the open fuel injector harness wire(s). Is the repair complete?	-	Go to Step 2	-
65	Replace the fuse or repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
66	1. Inspect the I/P fuse F14. 2. Check for an open between the circuit from terminal 1 for each of the four fuel injectors and the ignition switch. Is the problem found?	-	Go to Step 65	-

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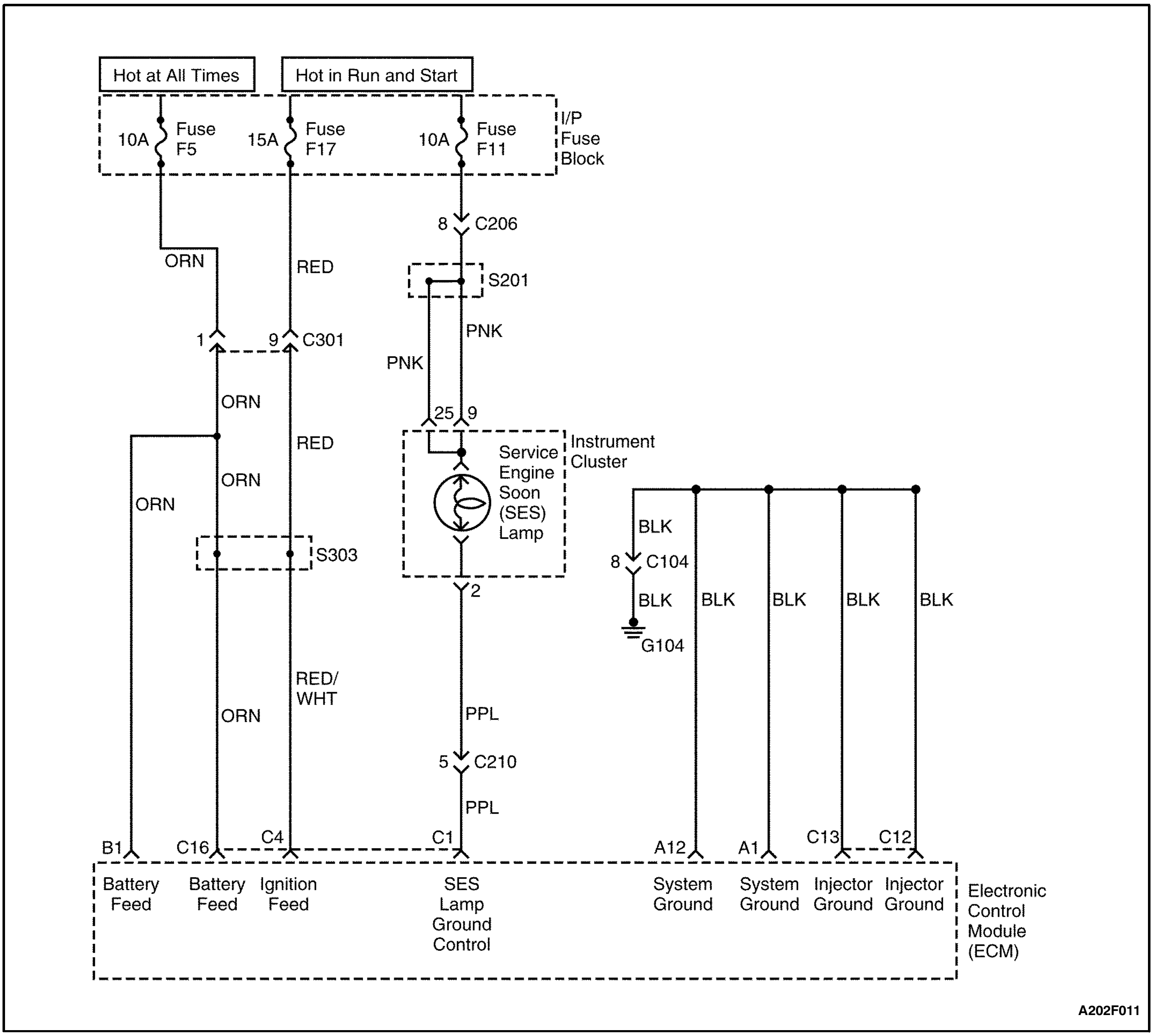

NO SERVICE ENGINE SOON LAMP (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine is stopped. Battery voltage is supplied directly to the SES bulb. The electronic control module (ECM) will control the SES lamp and turn it on by providing a ground path through the ECM connector terminal C1 wire to the SES lamp.

Diagnostic Aids

- If the engine runs OK, inspect for a faulty malfunction indicator lamp bulb.
- If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for battery voltage in the instrument panel SES lamp bulb socket.
8. This step, along with step 9, checks for battery feed to the ECM.
10. This step checks for ignition feed to the ECM.
24. At this point the SES lamp wiring is OK. The problem is a faulty ECM.

No Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Start the engine. Does the engine start?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connectors. 3. Turn the ignition ON. 4. Connect a test light between the ECM connector terminal C1 and ground. Is the service engine soon (SES) lamp on?	-	Go to Step 14	Go to Step 3
3	Inspect the kick panel fuse F11. Is the fuse OK?	-	Go to Step 4	Go to Step 15
4	Check the ignition feed to the SES bulb using a voltmeter. Is the voltage within the value specified?	11-14 v	Go to Step 5	Go to Step 16
5	Inspect the SES bulb. Is the SES bulb OK?	-	Go to Step 6	Go to Step 17
6	Check for an open or short to voltage in the wire between the ECM connector terminal C1 and the SES bulb. Is the problem found?	-	Go to Step 18	Go to Step 13
7	Inspect the ECM fuse F5/F17. Is the problem found?	-	Go to Step 19	Go to Step 8
8	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light to ECM connector terminal B1 and ground. Is the test light on?	-	Go to Step 9	Go to Step 20
9	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light between the ECM connector terminal C16 and ground. Is the test light on?	-	Go to Step 10	Go to Step 21
10	1. Turn the ignition OFF. 2. Connect a test light between the ECM connector terminal C4 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 11	Go to Step 22
11	Inspect the ECM connector terminals B1, C16, and C4 for damage or poor mating. Is the problem found?	-	Go to Step 12	Go to Step 14
12	Repair the ECM connector terminal(s) as needed. Is the repair complete?	-	Go to “Diagnostic System Check”	-
13	Inspect for damage or poor mating at the ECM connector terminal C1. Is the problem found?	-	Go to Step 12	Go to Step 14
14	Check the ECM connector terminals A12 and D1 for ground. Are the grounds OK?	-	Go to Step 24	Go to Step 23

No Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Turn the ignition OFF. 2. Replace the fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 4
16	Repair the open in the ignition feed wire to the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
17	Replace the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
18	Repair the wire between the ECM connector terminal C1 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
19	1. Turn the ignition OFF. 2. Replace the ECM fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 1
20	Repair the wire between the ECM connector terminal B1 and the F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
21	Repair the wire between the ECM connector terminal C16 and the F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
22	Repair the wire between the ECM connector terminal C4 and fuse F17. Is the repair complete?	-	Go to "Diagnostic System Check"	-
23	Repair the open wire between the ECM connector terminals A12 and/or D1 and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
24	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

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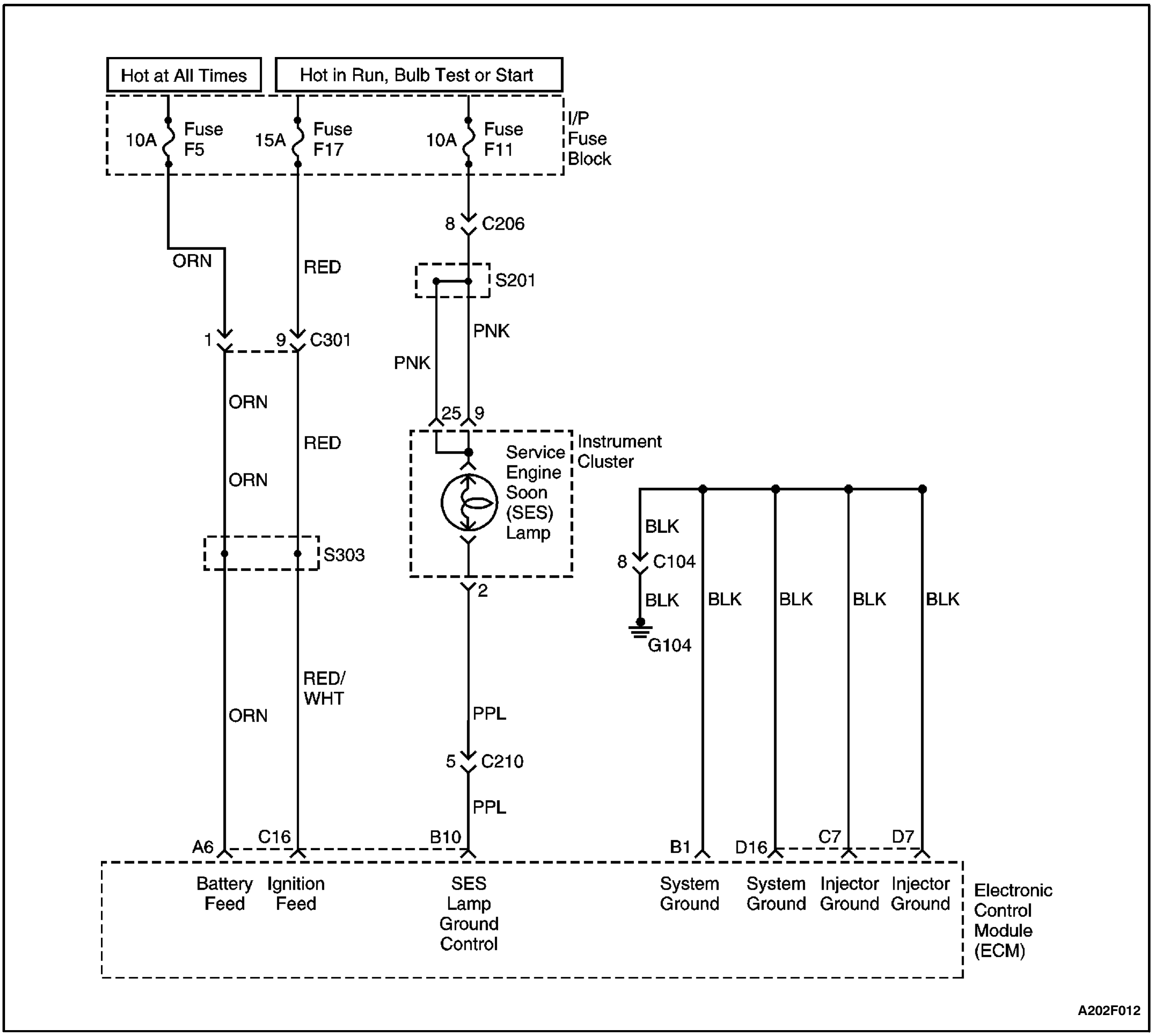

NO SERVICE ENGINE SOON LAMP (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine is stopped. Battery voltage is supplied directly to the SES bulb. The electronic control module (ECM) will control the SES lamp and turn it on by providing a ground path through the ECM connector terminal B10 wire to the SES lamp.

Diagnostic Aids

- If the engine runs OK, inspect for a faulty malfunction indicator lamp bulb.
- If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for battery voltage in the instrument panel SES lamp bulb socket.
8. This step checks for battery feed to the ECM.
9. This step checks for ignition feed to the ECM.
22. At this point the SES lamp wiring is OK. The problem is a faulty ECM.

No Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Start the engine. Does the engine start?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connectors. 3. Turn the ignition ON. 4. Connect a test light between the ECM connector terminal B10 and ground. Is the service engine soon (SES) lamp on?	-	Go to Step 13	Go to Step 3
3	Inspect the kick panel fuse F11. Is the fuse OK?	-	Go to Step 4	Go to Step 14
4	Check the ignition feed to the SES bulb using a voltmeter. Is the voltage within the value specified?	11-14 v	Go to Step 5	Go to Step 15
5	Inspect the SES bulb. Is the SES bulb OK?	-	Go to Step 6	Go to Step 16
6	Check for an open or short to voltage in the wire between the ECM connector terminal B10 and the SES bulb. Is the problem found?	-	Go to Step 17	Go to Step 12
7	Inspect the ECM fuse F5/F17. Is the problem found?	-	Go to Step 18	Go to Step 8
8	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light to ECM connector terminal A6 and ground. Is the test light on?	-	Go to Step 9	Go to Step 19
9	1. Turn the ignition OFF. 2. Disconnect the ECM white connector. 3. Connect a test light between the ECM connector terminal C16 and ground. Is the test light on?	-	Go to Step 10	Go to Step 20
10	Inspect the ECM connector terminals A6 and C16 for damage or poor mating. Is the problem found?	-	Go to Step 11	Go to Step 13
11	Repair the ECM connector terminal(s) as needed. Is the repair complete?	-	Go to "Diagnostic System Check"	-
12	Inspect for damage or poor mating at the ECM connector terminal B10. Is the problem found?	-	Go to Step 11	Go to Step 13
13	Check the ECM connector terminals B1 and D16 for ground. Are the grounds OK?	-	Go to Step 22	Go to Step 21
14	1. Turn the ignition OFF. 2. Replace the fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 4

No Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair the open in the ignition feed wire to the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
16	Replace the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
17	Repair the wire between the ECM connector terminal B10 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
18	1. Turn the ignition OFF. 2. Replace the ECM fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 1
19	Repair the wire between the ECM connector terminal A6 and the fuse F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
20	Repair the wire between the ECM connector terminal C16 and the fuse F17. Is the repair complete?	-	Go to "Diagnostic System Check"	-
21	Repair the open wire between the ECM connector terminals B1 and/or D16 and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
22	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

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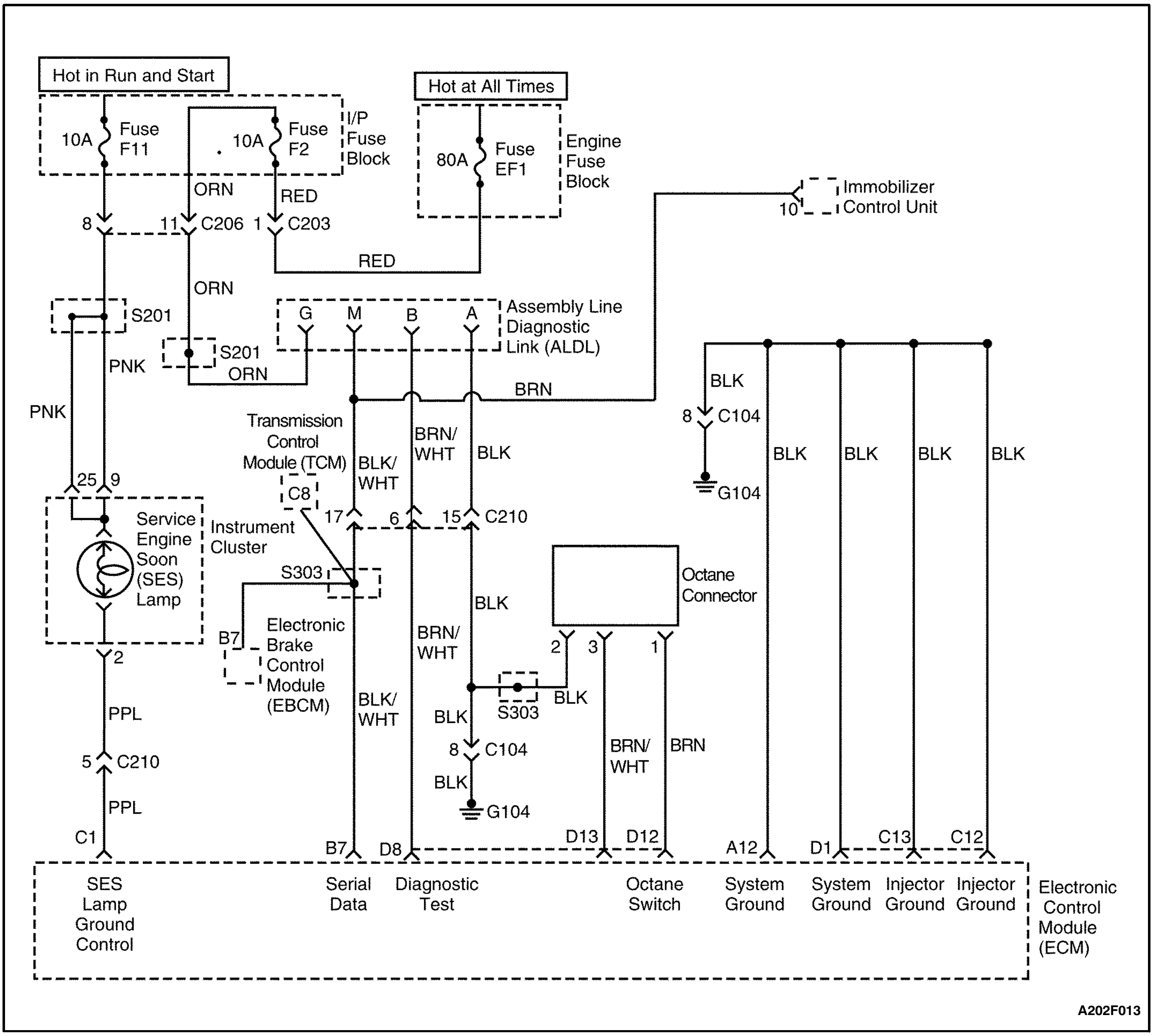


WILL NOT FLASH SERVICE ENGINE SOON LAMP (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine stopped. Battery ignition voltage is supplied directly to the SES bulb. The electronic control module (ECM) will turn the SES on by grounding the ECM connector terminal C1 wire. With the assembly line diagnostic link (ALDL) A and B terminals grounded, the SES lamp should flash a Code 12 followed by any diagnostic trouble codes (DTCs) stored in the ECM memory. A steady SES lamp suggests a short to ground in the ECM connector terminal C1 wire, or an open in the diagnostic test wire. A steady but dim light indicates a failed quad-driver. The table will confirm and suggest the cause.

Diagnostic Aids

- If the engine runs OK, inspect for a faulty SES bulb.
- If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

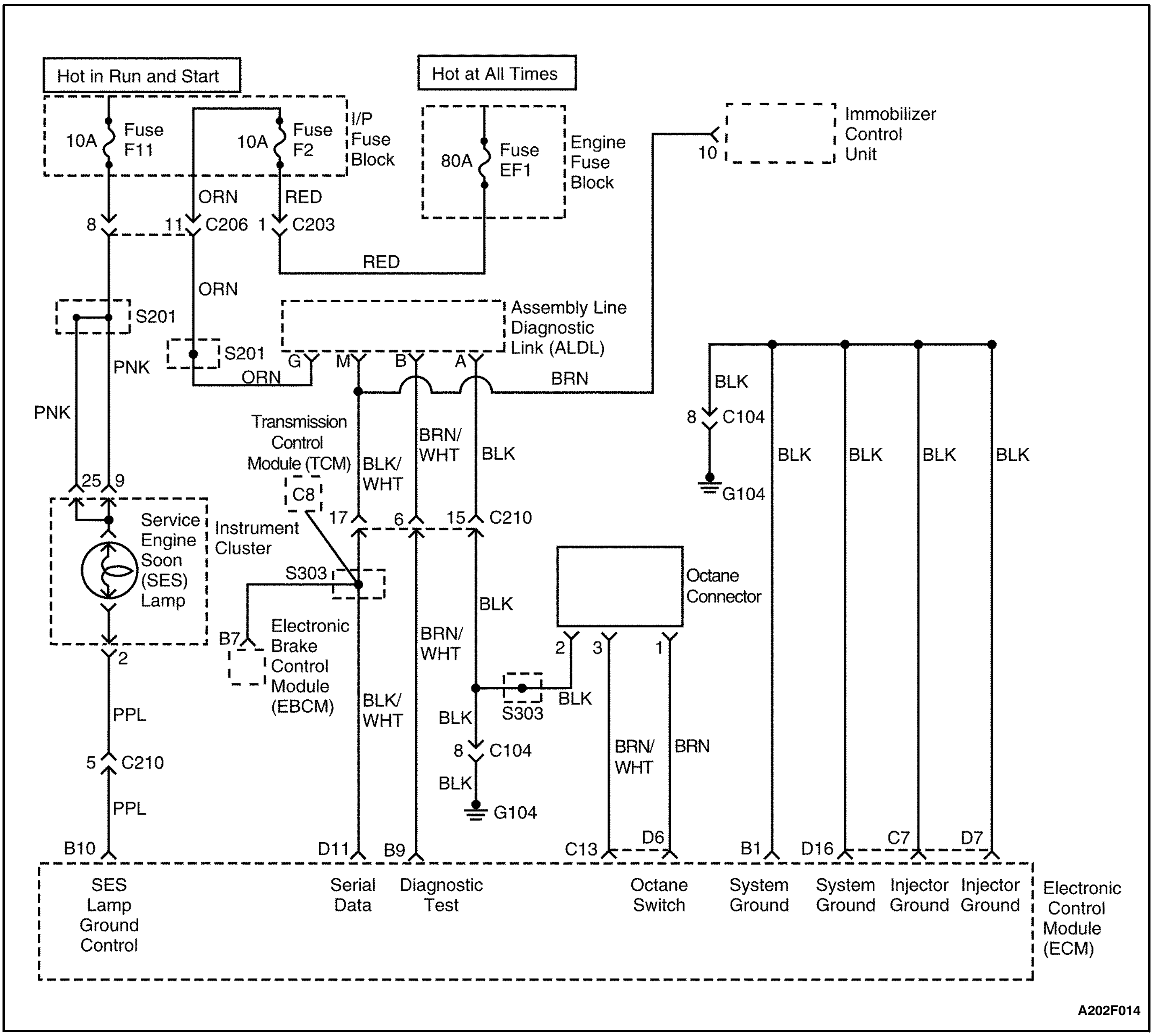
3. If the SES lamp is on when the ECM white connector is disconnected, the wire to the ECM connector terminal C1 is shorted to ground.

5. This step will check for an open diagnostic test wire.

11. At this point the SES wiring is OK. The problem is a faulty ECM.

Will Not Flash Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the service engine soon (SES) lamp on?	-	Go to Step 2	Go to "No Service Engine Soon Lamp"
2	1. Turn the ignition OFF. 2. Jumper the assembly line diagnostic link (ALDL) terminals A and B. 3. Turn the ignition ON. Does the SES lamp flash the diagnostic trouble code (DTC) 12?	-	Go to "Diagnostic System Check"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the ECM white connector. 3. Turn the ignition ON. Is the SES on?	-	Go to Step 4	Go to Step 5
4	Repair the short to ground in the wire between the electronic control module (ECM) connector terminal C1 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
5	1. Turn the ignition OFF. 2. Reconnect the ECM white connector. 3. Turn the ignition ON. 4. Backprobe the ECM connector terminal D8 with a test light connected to ground. Does the SES flash DTC 12?	-	Go to Step 6	Go to Step 8
6	Check for an open wire between the ECM connector terminal D8 and the ALDL terminal B. Is the problem found?	-	Go to Step 10	Go to Step 7
7	Repair the open wire between the ALDL terminal A and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Check for damage or poor mating at the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	Repair the ECM connector terminal D8. Is the repair complete?	-	Go to "Diagnostic System Check"	-
10	Repair the wire between the ECM connector terminal D8 and the ALDL terminal B. Is the repair complete?	-	Go to "Diagnostic System Check"	-
11	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-



WILL NOT FLASH SERVICE ENGINE SOON LAMP (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine stopped. Battery ignition voltage is supplied directly to the SES bulb. The electronic control module (ECM) will turn the SES on by grounding the ECM connector terminal B10 wire. With the assembly line diagnostic link (ALDL) A and B terminals grounded, the SES lamp should flash a Code 12 followed by any diagnostic trouble codes (DTCs) stored in the ECM memory. A steady SES lamp suggests a short to ground in the ECM connector terminal B10 wire, or an open in the diagnostic test wire. A steady but dim light indicates a failed quad-driver. The table will confirm and suggest the cause.

Diagnostic Aids

- If the engine runs OK, inspect for a faulty SES bulb.
- If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. If the SES lamp is on when the ECM red connector is disconnected, the wire to the ECM connector terminal B10 is shorted to ground.

5. This step will check for an open diagnostic test wire.

11. At this point the SES wiring is OK. The problem is a faulty ECM.

Will Not Flash Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the service engine soon (SES) lamp on?	-	Go to Step 2	Go to "No Service Engine Soon Lamp"
2	1. Turn the ignition OFF. 2. Jumper the assembly line diagnostic link (ALDL) terminals A and B. 3. Turn the ignition ON. Does the SES lamp flash the diagnostic trouble code (DTC) 12?	-	Go to "Diagnostic System Check"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Turn the ignition ON. Is the SES on?	-	Go to Step 4	Go to Step 5
4	Repair the short to ground in the wire between the ECM connector terminal B10 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
5	1. Turn the ignition OFF. 2. Reconnect the ECM red connector. 3. Turn the ignition ON. 4. Backprobe the ECM connector terminal B9 with a test light connected to ground. Does the SES flash DTC 12?	-	Go to Step 6	Go to Step 8
6	Check for an open wire between the ECM connector terminal B9 and the ALDL terminal B. Is the problem found?	-	Go to Step 10	Go to Step 7
7	Repair the open wire between the ALDL terminal A and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Check for damage or poor mating at the ECM connector terminal B9. Is the problem found?	-	Go to Step 9	Go to Step 11
9	Repair the ECM connector terminal B9. Is the repair complete?	-	Go to "Diagnostic System Check"	-
10	Repair the wire between the ECM connector terminal B9 and the ALDL terminal B. Is the repair complete?	-	Go to "Diagnostic System Check"	-
11	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

FUEL SYSTEM PRESSURE TEST

Circuit Description

The fuel pump is an in-tank fuel pump mounted to a fuel sender assembly. The fuel pump will remain on as long as the engine is cranking or running and the electronic control module (ECM) is receiving reference pulses from the crankshaft position sensor (CPS). If there are no reference pulses, the ECM will turn off the fuel pump 2 seconds after the ignition switch is turned ON or 2 seconds after the engine stops running. The fuel pump delivers fuel to the fuel rail and the fuel injectors, where the fuel system pressure is controlled from 284 to 325 kPa (41 to 47 psi) by the fuel pressure regulator. The excess fuel is returned to the fuel tank.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. When the engine is idling, the intake manifold vacuum is high. This vacuum is applied to the fuel pressure regulator diaphragm, offsetting the spring pressure inside the fuel pressure regulator and lowering the fuel pressure.
10. If there is fuel bleeding back through the fuel return outlet, this is due to a faulty fuel pressure regulator.
14. Another symptom often present when the fuel injectors are leaking is hard starting. Leaking fuel injectors can cause a flooding condition.
23. Fuel leaking from the fuel pump inlet is due to a faulty one-way check valve in the fuel pump.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resultĆ ing in possible fire or personal injury.

Fuel Pressure Relief Procedure

1. Remove the fuel cap.
2. Remove the fuel pump fuse EF18 from the engine fuse block.
3. Start the engine and allow the engine to stall.
4. Crank the engine for an additional 10 seconds.

Fuel System Pressure Test

Step	Action	Value(s)	Yes	No
1	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	Go to Step 2	Go to Step 5
2	1. Disconnect the fuel pressure regulator vacuum hose. 2. Start the engine. 3. Allow the engine to idle. 4. Connect the fuel pressure regulator vacuum hose. Does the fuel pressure decrease?	-	System OK	Go to Step 3
3	1. Allow the engine to idle. 2. Disconnect the vacuum hose from the fuel pressure regulator. 3. Connect a vacuum pump with a gauge to the fuel pressure regulator vacuum port. 4. Apply 41-47 kPa (12-14 in. Hg) of vacuum to the fuel pressure regulator. Does the fuel pressure decrease?	-	Go to Step 4	Go to Step 16
4	1. Locate and correct the cause of the vacuum restriction to the fuel pressure regulator. 2. Confirm the operation of the fuel pressure regulator. Is the repair complete?	-	System OK	-

Fuel System Pressure Test (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified but not holding steady?	284-325 kPa (41-47 psi)	Go to Step 6	Go to Step 17
6	Inspect the fuel lines for a leak. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Replace the fuel line(s) as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
8	1. Remove the fuel pump assembly. 2. With the fuel pump under pressure, inspect the fuel pump coupling hoses for leaking. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Tighten or replace the fuel pump coupling hoses as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
10	With the fuel system under pressure, inspect the fuel return outlet for leaking. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Replace the fuel pressure regulator. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
12	With the fuel system under pressure, inspect the fuel inlet for leaking. Is the problem found?	-	Go to Step 13	Go to Step 14
13	1. Replace the fuel pump assembly. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
14	1. Remove the fuel rail and the fuel injectors as an assembly. 2. With the fuel system under pressure, inspect all of the fuel injectors for leaking. Is the problem found?	-	Go to Step 15	-
15	1. Replace the leaking fuel injector(s). 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-

Fuel System Pressure Test (Cont'd)

Step	Action	Value(s)	Yes	No
16	1. Replace the fuel pressure regulator. 2. Disconnect the fuel pressure regulator vacuum hose. 3. Start the engine. 4. Allow the engine to idle. 5. Connect the fuel pressure regulator vacuum hose. Does the fuel pressure decrease?	-	System OK	-
17	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel system pressure below the values specified and holding steady?	284-325 kPa (41-47 psi)	Go to Step 13	Go to Step 18
18	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel system pressure below the values specified and not holding steady?	284-325 kPa (41-47 psi)	Go to Step 19	-
19	Inspect the fuel lines for leaks. Is the problem found?	-	Go to Step 7	Go to Step 20
20	1. Remove the fuel pump assembly. 2. With the fuel pump under pressure, inspect the fuel pump coupling hoses for leaking. Is the problem found?	-	Go to Step 9	Go to Step 21
21	1. Remove the fuel pump assembly. 2. With the fuel system under pressure, inspect the fuel return outlet for leaking. Is the problem found?	-	Go to Step 11	Go to Step 22
22	1. Remove the fuel pump assembly. 2. With the fuel system under pressure, inspect the fuel inlet for leaking. Is the problem found?	-	Go to Step 13	Go to Step 23
23	1. Remove the fuel rail and the fuel injectors as an assembly. 2. With the fuel system under pressure, inspect all of the fuel injectors for leaking. Is the problem found?	-	Go to Step 15	Go to Step 13

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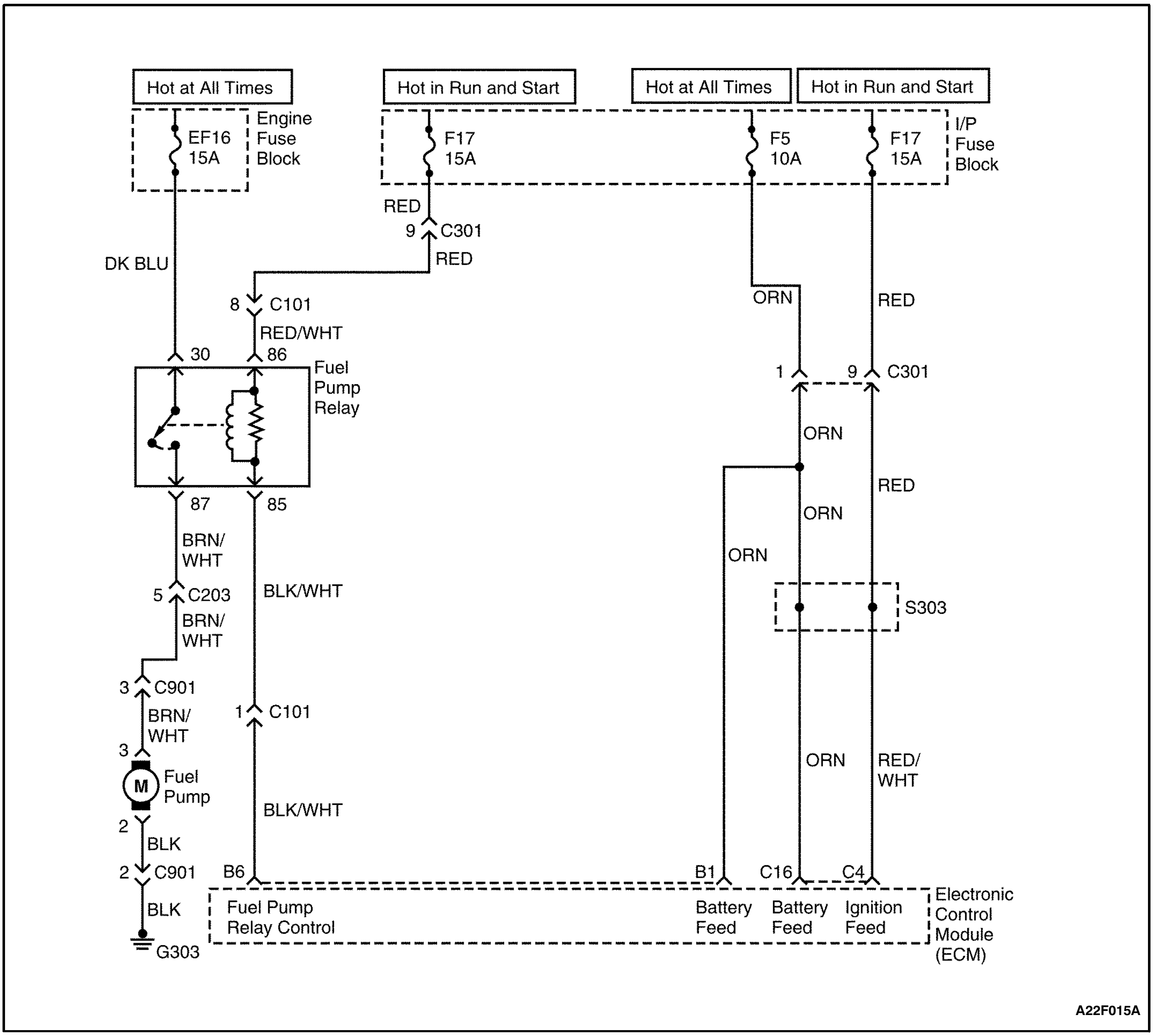

FUEL PUMP RELAY CIRCUIT CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

When the ignition switch is turned ON, the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for the ECM providing a ground for the operation of the fuel pump relay.
7. By confirming that the wiring is OK using Steps 2 through 6, it can be determined that the fuel pump relay is at fault.
8. If there is no voltage present at the fuel pump relay connector terminal 86, the problem is an open I/P fuse block fuse F17, or an open in the wiring between the fuel pump relay and the ignition switch.

9. After determining that there is no ground being provided by the ECM to the fuel pump relay, the fault is either the ECM or the wiring between the ECM and the fuel pump relay.

Fuel Pump Relay Circuit Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF for 10 seconds. 2. Turn the ignition ON. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate for the time specified?	2 sec	System OK	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 3	Go to Step 8
3	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 4	Go to Step 9
4	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 5	Go to Step 11
5	Check for an open or short to ground in the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the problem found?	-	Go to Step 6	Go to Step 7
6	1. Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
7	1. Replace the fuel pump relay. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
8	Check for an open wire between the fuel pump relay connector terminal 86 and the ignition switch. Is the problem found?	-	Go to Step 13	-
9	Check for an open wire between the fuel pump relay connector terminal 85 and the electronic control module (ECM) connector terminal B6. Is the problem found?	-	Go to Step 10	Go to Step 12

Fuel Pump Relay Circuit Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
11	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
12	1. Replace the ECM. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
13	1. Replace the fuse EF17 or repair the wire between the fuel pump relay connector terminal 86 and the ignition system. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-

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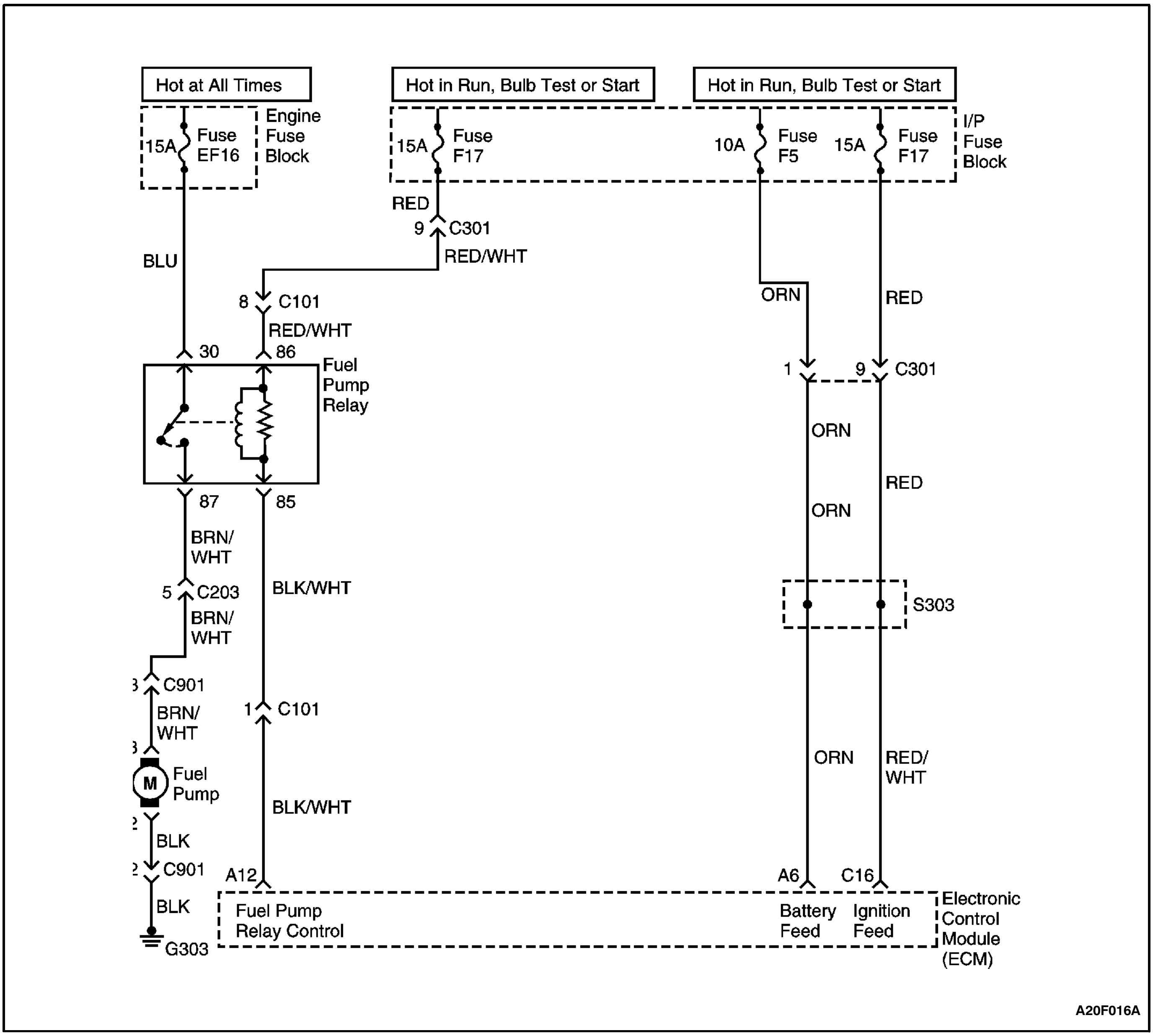

FUEL PUMP RELAY CIRCUIT CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition switch is turned ON, the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for the ECM providing a ground for the operation of the fuel pump relay.
7. By confirming that the wiring is OK using Steps 2 through 6, it can be determined that the fuel pump relay is at fault.
8. If there is no voltage present at the fuel pump relay connector terminal 86, the problem is an open I/P fuse block fuse F17, or an open in the wiring between the fuel pump relay and the ignition switch.

9. After determining that there is no ground being provided by the ECM to the fuel pump relay, the fault is either the ECM or the wiring between the ECM and the fuel pump relay.

Fuel Pump Relay Circuit Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF for 10 seconds. 2. Turn the ignition ON. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate for the time specified?	2 sec	System OK	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 3	Go to Step 8
3	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 4	Go to Step 9
4	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 5	Go to Step 11
5	Check for an open or short to ground in the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the problem found?	-	Go to Step 6	Go to Step 7
6	1. Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
7	1. Replace the fuel pump relay. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
8	Check for an open wire between the fuel pump relay connector terminal 86 and the ignition switch. Is the problem found?	-	Go to Step 13	-
9	Check for an open wire between the fuel pump relay connector terminal 85 and the electronic control module (ECM) connector terminal A12. Is the problem found?	-	Go to Step 10	Go to Step 12

Fuel Pump Relay Circuit Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
11	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 30 and the EF16. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
12	1. Replace the ECM. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
13	1. Replace the fuse EF17 or repair the wire between the fuel pump connector terminal 86 and the ignition switch. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-

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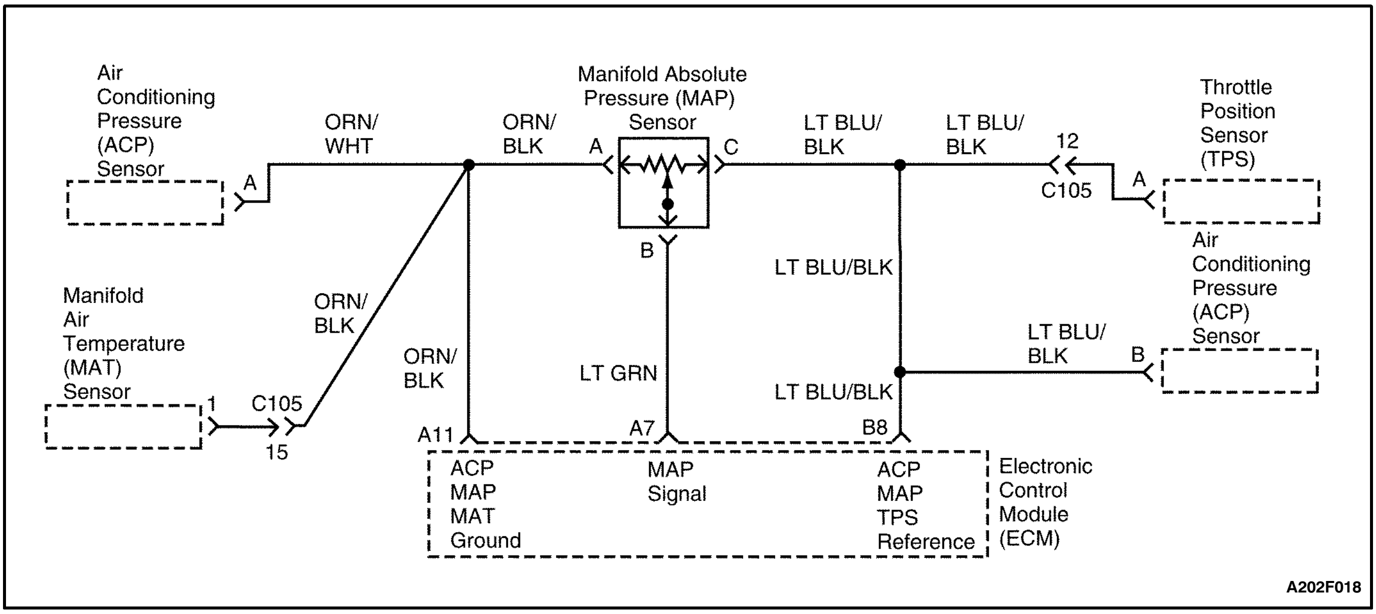


MANIFOLD ABSOLUTE PRESSURE CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load (intake manifold vacuum) and rpm changes. The MAP sensor converts these changes into a voltage output. The electronic control module (ECM) sends a 5-volt reference voltage to the MAP sensor. As the intake manifold pressure changes, the output voltage of the MAP sensor also changes. A low voltage (high vacuum) output of 1 to 2 volts is present at idle. A high voltage (low vacuum) output of 4.0 to 4.8 volts is present at wide open throttle. The MAP sensor is also used under certain conditions to measure barometric pressure. This allows the ECM to make adjustments for altitude changes. The ECM uses the MAP sensor for fuel delivery and ignition timing changes.

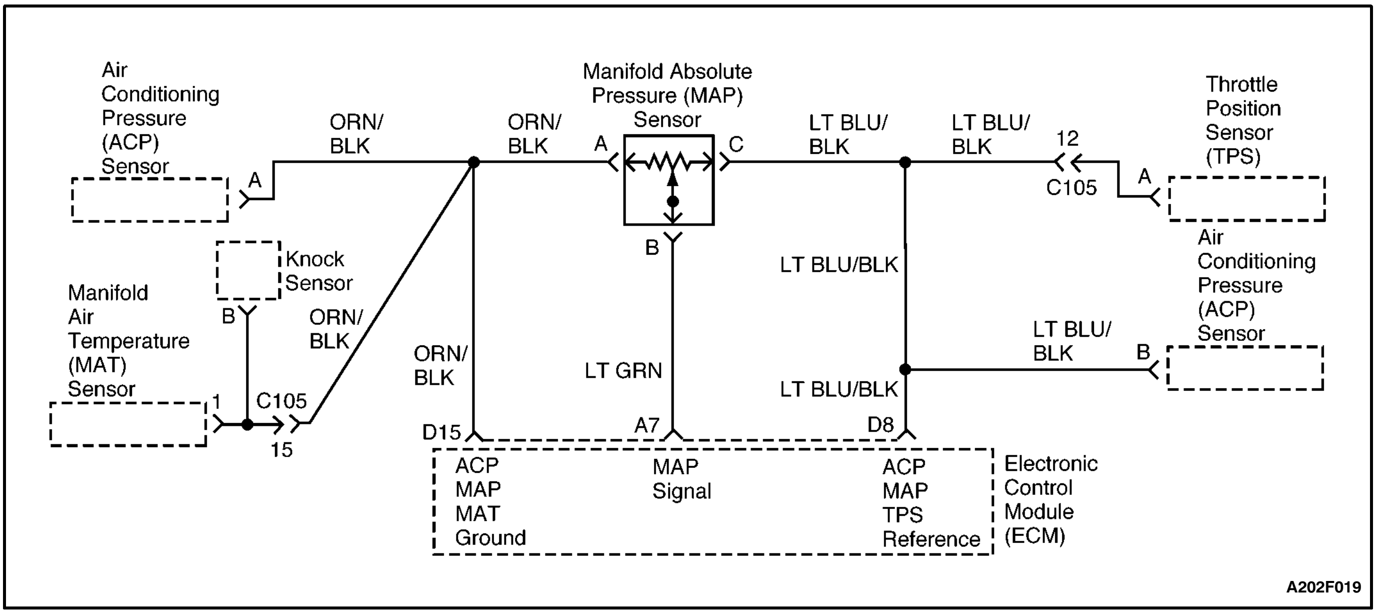
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Applying 34 kPa (10 inches Hg) of vacuum to the MAP sensor should cause the voltage to change. Subtract the second voltage reading from the first. That voltage value should be more than 1.5 volts. When applying vacuum to the MAP sensor, the change in the voltage should happen instantly. A slow voltage change indicates a faulty MAP sensor.
3. Disconnect the MAP sensor from the bracket and twist the MAP sensor. Output changes more than 0.1 volt indicate a faulty connector or connection.

Manifold Absolute Pressure Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the assembly line diagnostic link (ALDL). 3. Turn the ignition ON. 4. Compare the manifold absolute pressure (MAP) sensor voltage reading from the scanner with that from a known good vehicle. Is the difference in the two voltage readings less than the value specified?	0.4 v	Go to Step 2	Go to Step 5
2	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Disconnect the MAP sensor vacuum line. 4. Connect a hand vacuum pump to the MAP sensor. 5. Turn the ignition ON. 6. Note the MAP sensor voltage. 7. Apply 34 kPa (10 in. Hg) of vacuum to the MAP sensor and note the voltage change. Is the difference in voltage readings more than the value specified?	1.5 v	System OK	Go to Step 3
3	Inspect the MAP sensor connector terminals. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair the MAP sensor connector terminals as needed. Is the repair complete?	-	System OK	-
5	Replace the MAP sensor. Is the repair complete?	-	System OK	-



MANIFOLD ABSOLUTE PRESSURE CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load (intake manifold vacuum) and rpm changes. The MAP sensor converts these changes into a voltage output. The electronic control module (ECM) sends a 5-volt reference voltage to the MAP sensor. As the intake manifold pressure changes, the output voltage of the MAP sensor also changes. A low voltage (high vacuum) output of 1 to 2 volts is present at idle. A high voltage (low vacuum) output of 4.0 to 4.8 volts is present at wide open throttle. The MAP sensor is also used under certain conditions to measure barometric pressure. This allows the ECM to make adjustments for altitude changes. The ECM uses the MAP sensor for fuel delivery and ignition timing changes.

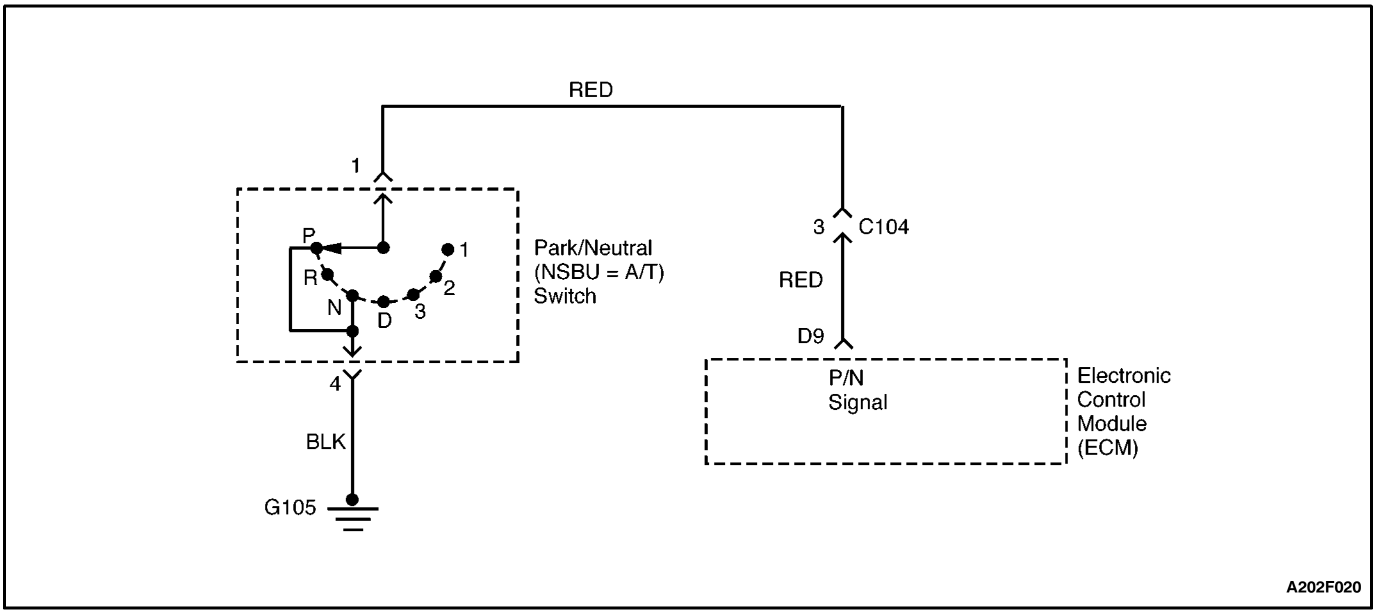
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Applying 34 kPa (10 inches Hg) of vacuum to the MAP sensor should cause the voltage to change. Subtract the second voltage reading from the first. That voltage value should be more than 1.5 volts. When applying vacuum to the MAP sensor, the change in the voltage should happen instantly. A slow voltage change indicates a faulty MAP sensor.
3. Disconnect the MAP sensor from the bracket and twist the MAP sensor. Output changes more than 0.1 volt indicate a faulty connector or connection.

Manifold Absolute Pressure Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the assembly line diagnostic link (ALDL). 3. Turn the ignition ON. 4. Compare the manifold absolute pressure (MAP) sensor voltage reading from the scanner with that from a known good vehicle. Is the difference in the two voltage readings less than the value specified?	0.4 v	Go to Step 2	Go to Step 5
2	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Disconnect the MAP sensor vacuum line. 4. Connect a hand vacuum pump to the MAP sensor. 5. Turn the ignition ON. 6. Note the MAP sensor voltage. 7. Apply 34 kPa (10 in. Hg) of vacuum to the MAP sensor and note the voltage change. Is the difference in voltage readings more than the value specified?	1.5 v	System OK	Go to Step 3
3	Inspect the MAP sensor connector terminals. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair the MAP sensor connector terminals as needed. Is the repair complete?	-	System OK	-
5	Replace the MAP sensor. Is the repair complete?	-	System OK	-



PARK/NEUTRAL SWITCH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The park/neutral (P/N) switch contacts are a part of the selector position switch. The contacts are closed to ground in park and neutral and open in the drive ranges.

The electronic control module (ECM) supplies ignition voltage through a current limiting resistor to the signal wire and senses a closed switch when the voltage on the signal wire drops to less than 1 volt. The ECM uses the P/N signal as one of the inputs to control idle air and spark timing.

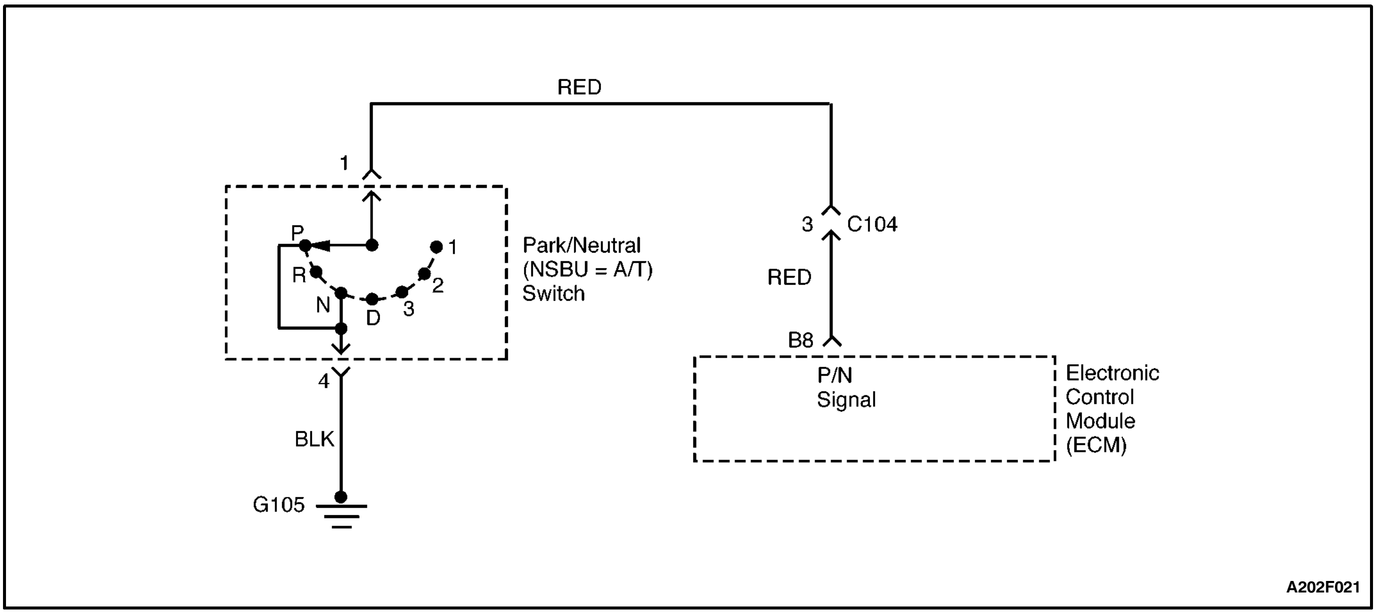
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks for the P/N switch closed to ground in the park position. Different makes of scan tools will read P/N differently. Refer to the tool operations manual for the type of display used.
2. This step checks for an open P/N switch in the drive range.

Park/Neutral Switch (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Place the transaxle in park (P). 3. Turn the ignition ON. Does the scan tool indicate park or neutral?	-	Go to Step 2	Go to Step 10
2	Place the transaxle in drive (D). Does the scan tool indicate drive?	-	System OK	Go to Step 3
3	Disconnect the park/neutral (P/N) switch. Does the scan tool indicate drive?	-	Go to Step 4	Go to Step 7
4	Check the P/N switch adjustment. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Adjust the P/N switch. Is the repair complete?	-	System OK	-
6	Replace the P/N switch. Is the repair complete?	-	System OK	-
7	Check for an open or short to ground in the wire between the P/N switch connector terminal 1 and the electronic control module (ECM) connector terminal D9. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair the open or short to ground in the wire between the P/N switch connector terminal 1 and the ECM connector terminal D9. Is the repair complete?	-	System OK	-
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	1. Disconnect the P/N switch. 2. Jumper the P/N switch connector terminals 1 and 4. 3. Turn the ignition ON. Does the scan tool indicate park?	-	Go to Step 4	Go to Step 11
11	Jumper the P/N switch connector terminal 1 to ground. Does the scan tool indicate park?	-	Go to Step 12	Go to Step 7
12	Repair the open wire between the P/N switch connector terminal 4 and ground. Is the repair complete?	-	System OK	-



PARK/NEUTRAL SWITCH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The park/neutral (P/N) switch contacts are a part of the selector position switch. The contacts are closed to ground in park and neutral and open in the drive ranges.

The electronic control module (ECM) supplies ignition voltage through a current limiting resistor to the signal wire and senses a closed switch when the voltage on the signal wire drops to less than 1 volt. The ECM uses the P/N signal as one of the inputs to control idle air and spark timing.

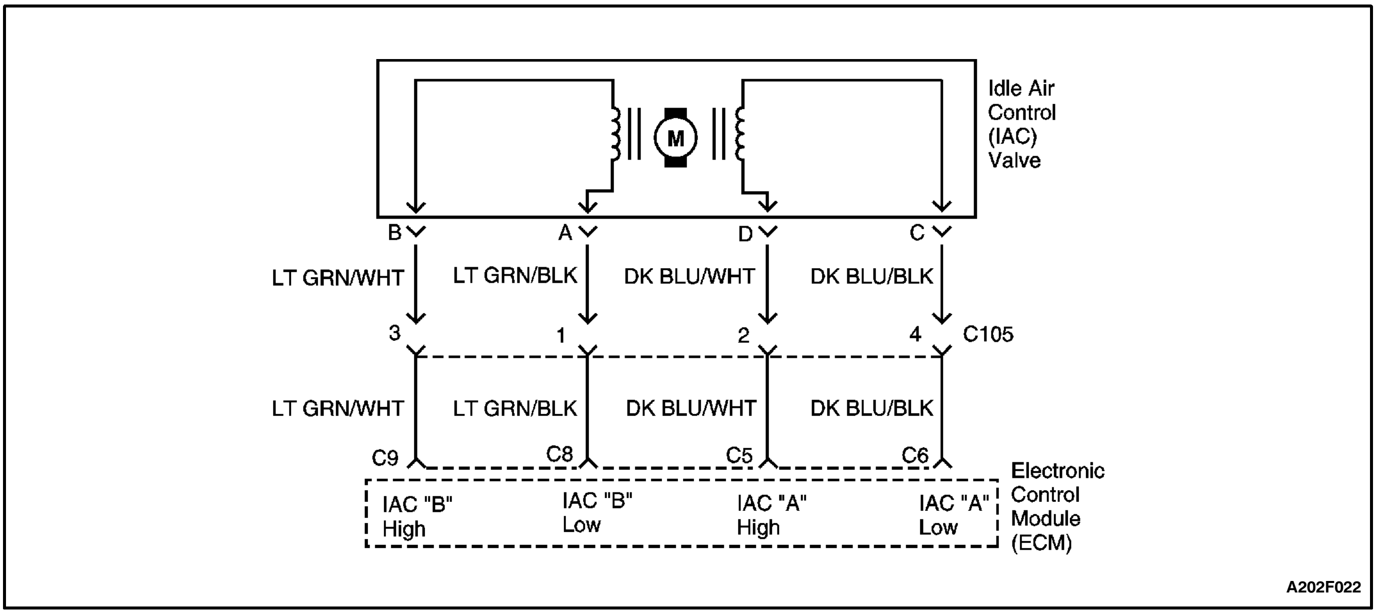
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks for the P/N switch closed to ground in the park position. Different makes of scan tools will read P/N differently. Refer to the tool operations manual for the type of display used.
2. This step checks for an open P/N switch in the drive range.

Park/Neutral Switch (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Place the transaxle in park (P). 3. Turn the ignition ON. Does the scan tool indicate park or neutral?	-	Go to Step 2	Go to Step 10
2	Place the transaxle in drive (D). Does the scan tool indicate drive?	-	System OK	Go to Step 3
3	Disconnect the park/neutral (P/N) switch. Does the scan tool indicate drive?	-	Go to Step 4	Go to Step 7
4	Check the P/N switch adjustment. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Adjust the P/N switch. Is the repair complete?	-	System OK	-
6	Replace the P/N switch. Is the repair complete?	-	System OK	-
7	Check for an open or short to ground in the wire between the P/N switch connector terminal 1 and the electronic control module (ECM) connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair the open or short to ground in the wire between the P/N switch connector terminal 1 and the ECM connector terminal B8. Is the repair complete?	-	System OK	-
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	1. Disconnect the P/N switch. 2. Jumper the P/N switch connector terminals 1 and 4. 3. Turn the ignition ON. Does the scan tool indicate park?	-	Go to Step 4	Go to Step 11
11	Jumper the P/N switch connector terminal 1 to ground. Does the scan tool indicate park?	-	Go to Step 12	Go to Step 7
12	Repair the open wire between the P/N switch connector terminal 4 and ground. Is the repair complete?	-	System OK	-



IDLE AIR CONTROL SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) controls the engine idle speed with the idle air control (IAC) valve. To increase the idle speed, the ECM pulls the IAC pintle away from its seat, allowing more air to pass by the throttle bore. To decrease the idle speed, it extends the IAC valve pintle toward its seat, reducing bypass air flow. A scan tool will read the ECM commands to the IAC valve in counts. The higher counts indicate more air bypass (higher idle). The lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

If the idle is too high, stop the engine. Fully extend the IAC valve with an IAC tester. Start the engine. If the idle speed is above 800 rpm, locate and repair the vacuum leak. Also, check for a binding throttle plate or throttle linkage, or an incorrect base idle setting.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The IAC valve is extended and retracted by the IAC driver. IAC valve movement is verified by an engine speed change. If no change in engine speed occurs, the valve can be removed from the throttle body and tested. Connect the IAC driver to the removed IAC valve and turn the ignition ON. Do not start the engine.
5. This step checks the quality of the IAC valve movement in Step 2. Fully extending the IAC valve may cause an engine stall. This may be normal.
6. Steps 2 and 5 verify proper IAC valve operation. This step checks the IAC circuit for a wiring or ECM fault.

Idle Air Control Valve Reset Procedure

Whenever the battery cable or the ECM connector or the ECM fuse EF31 is disconnected or replaced (more than 10 seconds), the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral (P/N).
5. Allow the engine to run until the engine coolant is above 85°C (185°F).
6. Turn the air conditioning (A/C) ON over 10 seconds, if equipped.
7. Turn the A/C OFF over 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).
9. Turn the A/C ON over 10 seconds, if equipped.
10. Turn the A/C OFF over 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

Idle Air Control System Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the idle air control (IAC) driver to the IAC valve. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. With the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the engine rpm change?	-	Go to Step 5	Go to Step 3
3	1. Remove the IAC valve. 2. Inspect the IAC passages for restrictions. Is the problem found?	-	Go to Step 4	Go to Step 19
4	Clean the IAC passages. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Start the engine. 3. Using the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC driver to the IAC valve. 3. Install an IAC node light to the IAC valve connector. 4. Start the engine. 5. Cycle the IAC driver. 6. Watch the node lights of the IAC driver. Do both lights cycle red and green but never off as the rpm is changed?	-	Go to Step 7	Go to Step 9
7	1. Measure the resistance of the IAC valve between terminals A and B. 2. Measure the resistance of the IAC valve between terminals C and D. Does the resistance measure within the value specified?	40-80 W	Go to Step 8	Go to Step 19
8	1. Measure the resistance of the IAC valve between terminals B and C. 2. Measure the resistance of the IAC valve between terminals A and D. Does the ohmmeter show the specified value?	R	Go to "Diagnostic Aids"	Go to Step 19
9	Inspect the IAC connector terminals. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Repair or replace the IAC connector terminals as needed. Is the repair complete?	-	System OK	-

Idle Air Control System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open or short in the wire between the IAC connector terminal B and the electronic control module (ECM) connector terminal C9. Is the problem found?	-	Go to Step 15	Go to Step 12
12	Check for an open or short in the wire between the IAC connector terminal A and the ECM connector terminal C8. Is the problem found?	-	Go to Step 15	Go to Step 13
13	Check for an open or short in the wire between the IAC connector terminal D and the ECM connector terminal C5. Is the problem found?	-	Go to Step 15	Go to Step 14
14	Check for an open or short in the wire between the IAC connector terminal C and the ECM connector terminal C6. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair the wire as needed. Is the repair complete?	-	System OK	-
16	Inspect the ECM connector terminals. Is the problem found?	-	Go to Step 17	Go to Step 18
17	Repair the ECM connector terminals as needed. Is the repair complete?	-	System OK	-
18	Replace the ECM. Is the repair complete?	-	System OK	-
19	Replace the IAC valve. Is the repair complete?	-	System OK	-

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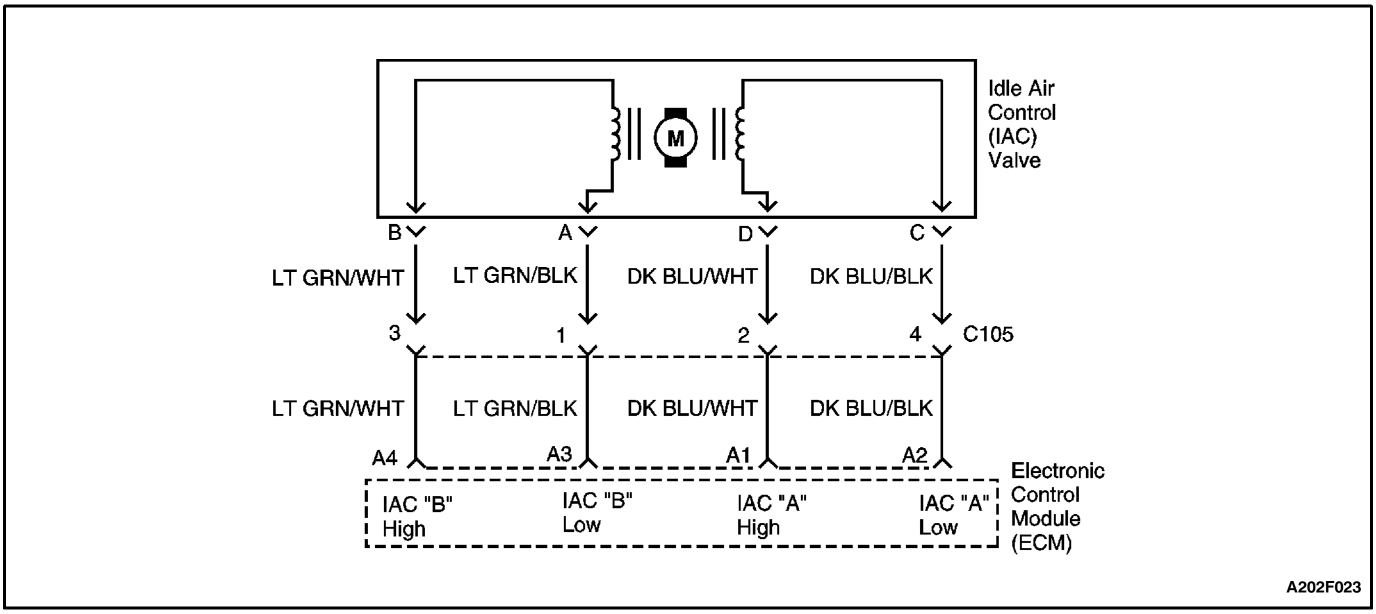

IDLE AIR CONTROL SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) controls the engine idle speed with the idle air control (IAC) valve. To increase the idle speed, the ECM pulls the IAC pintle away from its seat, allowing more air to pass by the throttle bore. To decrease the idle speed, it extends the IAC valve pintle toward its seat, reducing bypass air flow. A scan tool will read the ECM commands to the IAC valve in counts. The higher counts indicate more air bypass (higher idle). The lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

If the idle is too high, stop the engine. Fully extend the IAC valve with an IAC tester. Start the engine. If the idle speed is above 800 rpm, locate and repair the vacuum leak. Also, check for a binding throttle plate or throttle linkage, or an incorrect base idle setting.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The IAC valve is extended and retracted by the IAC driver. IAC valve movement is verified by an engine speed change. If no change in engine speed occurs, the valve can be removed from the throttle body and tested. Connect the IAC driver to the removed IAC valve and turn the ignition ON. Do not start the engine.
5. This step checks the quality of the IAC valve movement in Step 2. Fully extending the IAC valve may cause an engine stall. This may be normal.
6. Steps 2 and 5 verify proper IAC valve operation. This step checks the IAC circuit for a wiring or ECM fault.

Idle Air Control Valve Reset Procedure

Whenever the battery cable or the ECM connector or the ECM fuse EF31 is disconnected or replaced (more than 10 seconds), the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral (P/N).
5. Allow the engine to run until the engine coolant is above 85°C (185°F).
6. Turn the air conditioning (A/C) ON over 10 seconds, if equipped.
7. Turn the A/C OFF over 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).
9. Turn the A/C ON over 10 seconds, if equipped.
10. Turn the A/C OFF over 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

Idle Air Control System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the idle air control (IAC) driver to the IAC valve. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. With the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the engine rpm change?	-	Go to Step 5	Go to Step 3
3	1. Remove the IAC valve. 2. Inspect the IAC passages for restrictions. Is the problem found?	-	Go to Step 4	Go to Step 19
4	Clean the IAC passages. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Start the engine. 3. Using the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC driver to the IAC valve. 3. Install an IAC node light to the IAC valve connector. 4. Start the engine. 5. Cycle the IAC driver. 6. Watch the node lights of the IAC driver. Do both lights cycle red and green but never off as the rpm is changed?	-	Go to Step 7	Go to Step 9
7	1. Measure the resistance of the IAC valve between terminals A and B. 2. Measure the resistance of the IAC valve between terminals C and D. Does the resistance measure within the value specified?	40-80 W	Go to Step 8	Go to Step 19
8	1. Measure the resistance of the IAC valve between terminals B and C. 2. Measure the resistance of the IAC valve between terminals A and D. Does the ohmmeter show the specified value?	R	Go to "Diagnostic Aids"	Go to Step 19
9	Inspect the IAC connector terminals. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Repair or replace the IAC connector terminals as needed. Is the repair complete?	-	System OK	-

Idle Air Control System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open or short in the wire between the IAC connector terminal B and the electronic control module (ECM) connector terminal A4. Is the problem found?	-	Go to Step 15	Go to Step 12
12	Check for an open or short in the wire between the IAC connector terminal A and the ECM connector terminal A3. Is the problem found?	-	Go to Step 15	Go to Step 13
13	Check for an open or short in the wire between the IAC connector terminal D and the ECM connector terminal A1. Is the problem found?	-	Go to Step 15	Go to Step 14
14	Check for an open or short in the wire between the IAC connector terminal C and the ECM connector terminal A2. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair the wire as needed. Is the repair complete?	-	System OK	-
16	Inspect the ECM connector terminals. Is the problem found?	-	Go to Step 17	Go to Step 18
17	Repair the ECM connector terminals as needed. Is the repair complete?	-	System OK	-
18	Replace the ECM. Is the repair complete?	-	System OK	-
19	Replace the IAC valve. Is the repair complete?	-	System OK	-

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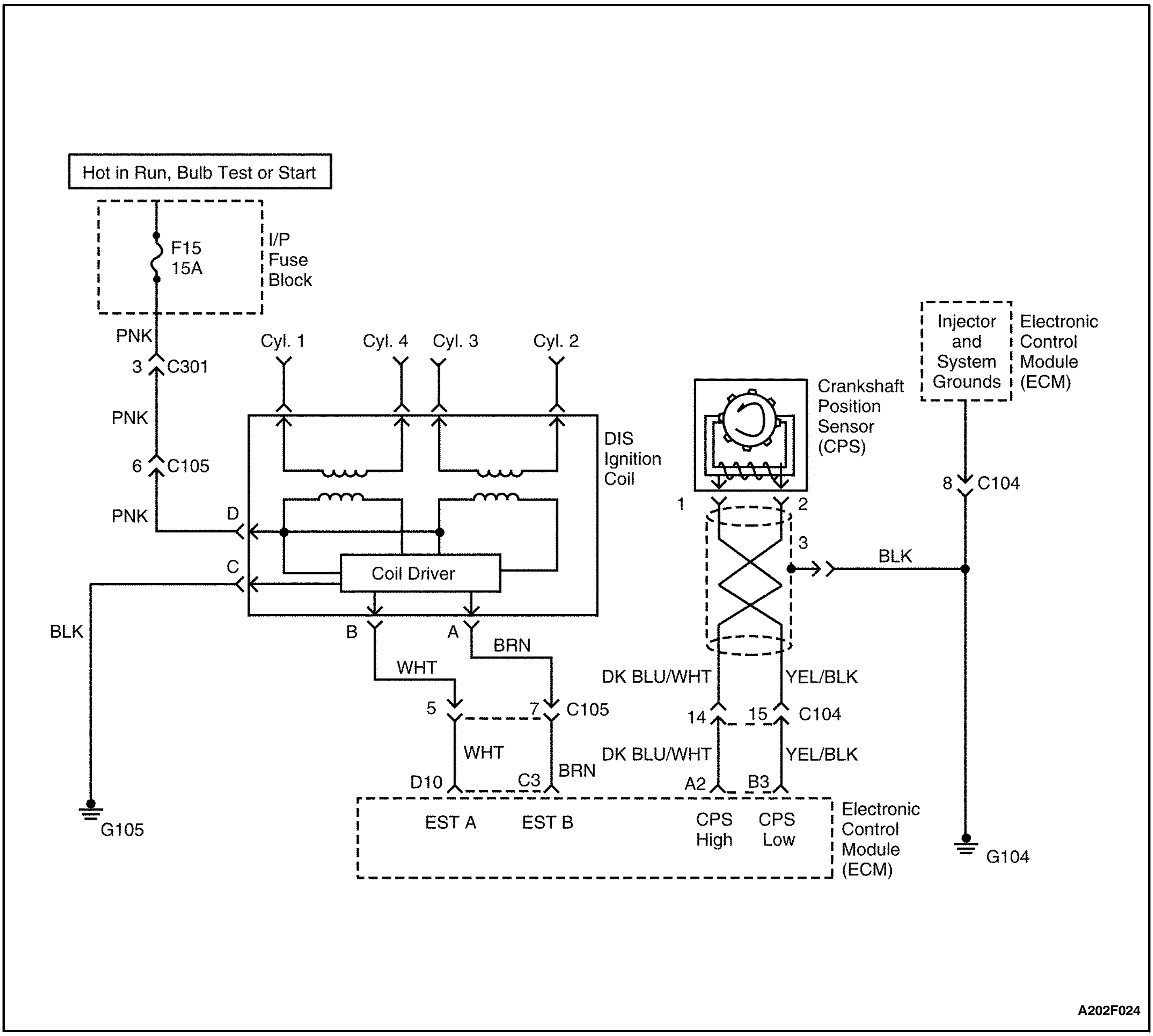


IGNITION SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) uses a waste spark method of spark distribution. In this type of DIS system, the crankshaft position sensor (CPS) is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CPS sends reference pulses to the electronic control module (ECM). The ECM then triggers the DIS ignition coil. Once the ECM triggers the DIS ignition coil, both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke. This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CPS is in a fixed position, timing adjustments are not possible or needed.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. It is important to check for the presence of spark to all of the cylinders to isolate the problem to either DIS ignition coil inputs or outputs.
5. In checking the ECM outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.
6. After confirming ECM inputs for the electronic spark timing to the DIS ignition coil are OK, it can be determined that a faulty DIS ignition coil is the problem.

11. After confirming proper CPS inputs to the ECM and the lack of wiring problems, it can be determined that the ECM is at fault.

24. This step, along with Step 25, checks for battery voltage and a ground to the DIS ignition coil.

Ignition System Check (1.3L and 1.5L SOHC IEFI-6)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to preĆvent an electrical shock.

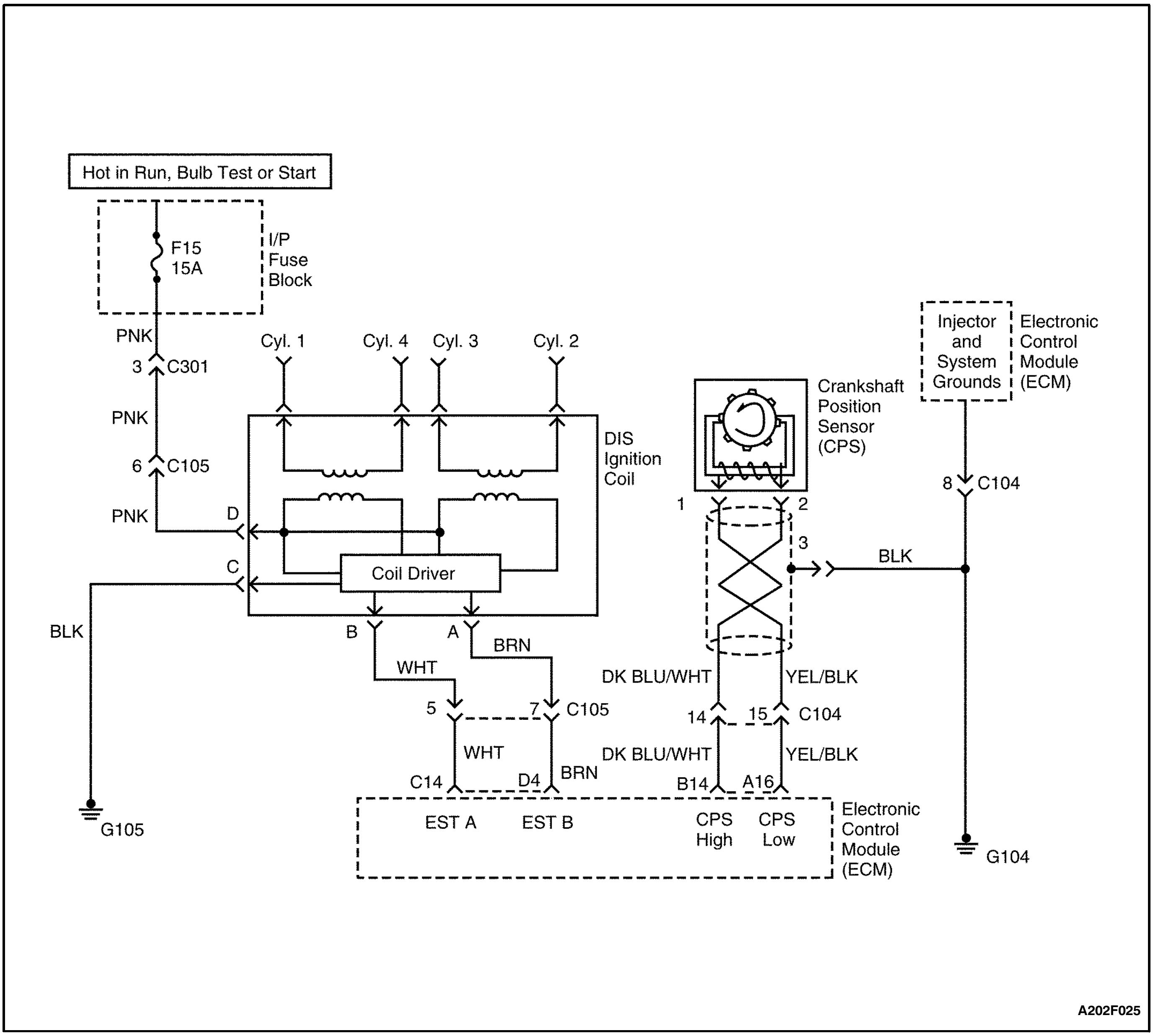
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	-	System OK	Go to Step 2
2	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	System OK	Go to Step 3
3	1. Measure the resistance of the ignition wires. 2. Replace any ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	System OK	Go to Step 4
4	Is spark present from at least one of the ignition wires, but not all of the ignition wires?	-	Go to Step 5	Go to Step 12
5	1. Turn the ignition OFF. 2. Disconnect the direct ignition system (DIS) ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 6	Go to Step 7
6	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 8
7	Check for an open in the wire from the DIS ignition coil connector terminal B to the electronic control module (ECM) connector terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-

Ignition System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the DIS ignition coil. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
11	1. Replace the ECM. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
12	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Measure the resistance between the CPS terminals 1 and 2. Is the resistance within the value specified?	400-600 W	Go to Step 13	Go to Step 28
13	1. Measure the resistance between the CPS terminals 1 and 3. 2. Measure the resistance between the CPS terminals 2 and 3. Is the resistance infinite (open circuit)?	R	Go to Step 14	Go to Step 28
14	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 1 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 20	Go to Step 15
15	Measure the voltage between the CPS connector terminal 1 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 16
16	Check the wire between the CPS connector terminal 1 and the ECM connector terminal A2 for an open or short. Is the problem found?	-	Go to Step 18	Go to Step 11
17	Check the wire between the CPS connector terminal 3 and ground for an open or short. Is the problem found?	-	Go to Step 19	Go to Step 11
18	Repair the wire between the CPS connector terminal 1 and the ECM connector terminal A2. Is the repair complete?	-	System OK	-
19	Repair the wire between the CPS connector terminal 3 and ground. Is the repair complete?	-	System OK	-
20	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 2 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 24	Go to Step 21
21	Measure the voltage between the CPS connector terminal 2 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 22

Ignition System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
22	Check the wire between the CPS connector terminal 2 and the ECM connector terminal B3 for an open or short. Is the problem found?	-	Go to Step 23	Go to Step 11
23	Repair the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the repair complete?	-	System OK	-
24	1. Turn the ignition OFF. 2. Connect a test light between the DIS ignition coil connector terminal D and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 25	Go to Step 26
25	Connect a test light between the DIS ignition coil connector terminal C and battery positive. Is the test light on?	-	Go to Step 5	Go to Step 27
26	Check for an open or short to ground in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the problem found?	-	Go to Step 29	-
27	Repair the wire between the DIS ignition coil connector terminal C and ground. Is the repair complete?	-	System OK	-
28	Replace the CPS. Is the repair complete?	-	System OK	-
29	Replace the fuse F15 or repair the open in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the repair complete?	-	System OK	-



IGNITION SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) uses a waste spark method of spark distribution. In this type of DIS system, the crankshaft position sensor (CPS) is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CPS sends reference pulses to the electronic control module (ECM). The ECM then triggers the DIS ignition coil. Once the ECM triggers the DIS ignition coil, both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke. This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CPS is in a fixed position, timing adjustments are not possible or needed.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. It is important to check for the presence of spark to all of the cylinders to isolate the problem to either DIS ignition coil inputs or outputs.
5. In checking the ECM outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.
6. After confirming ECM inputs for the electronic spark timing to the DIS ignition coil are OK, it can be determined that a faulty DIS ignition coil is the problem.

11. After confirming proper CPS inputs to the ECM and the lack of wiring problems, it can be determined that the ECM is at fault.

24. This step, along with Step 25, checks for battery voltage and a ground to the DIS ignition coil.

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to preĆ vent an electrical shock.

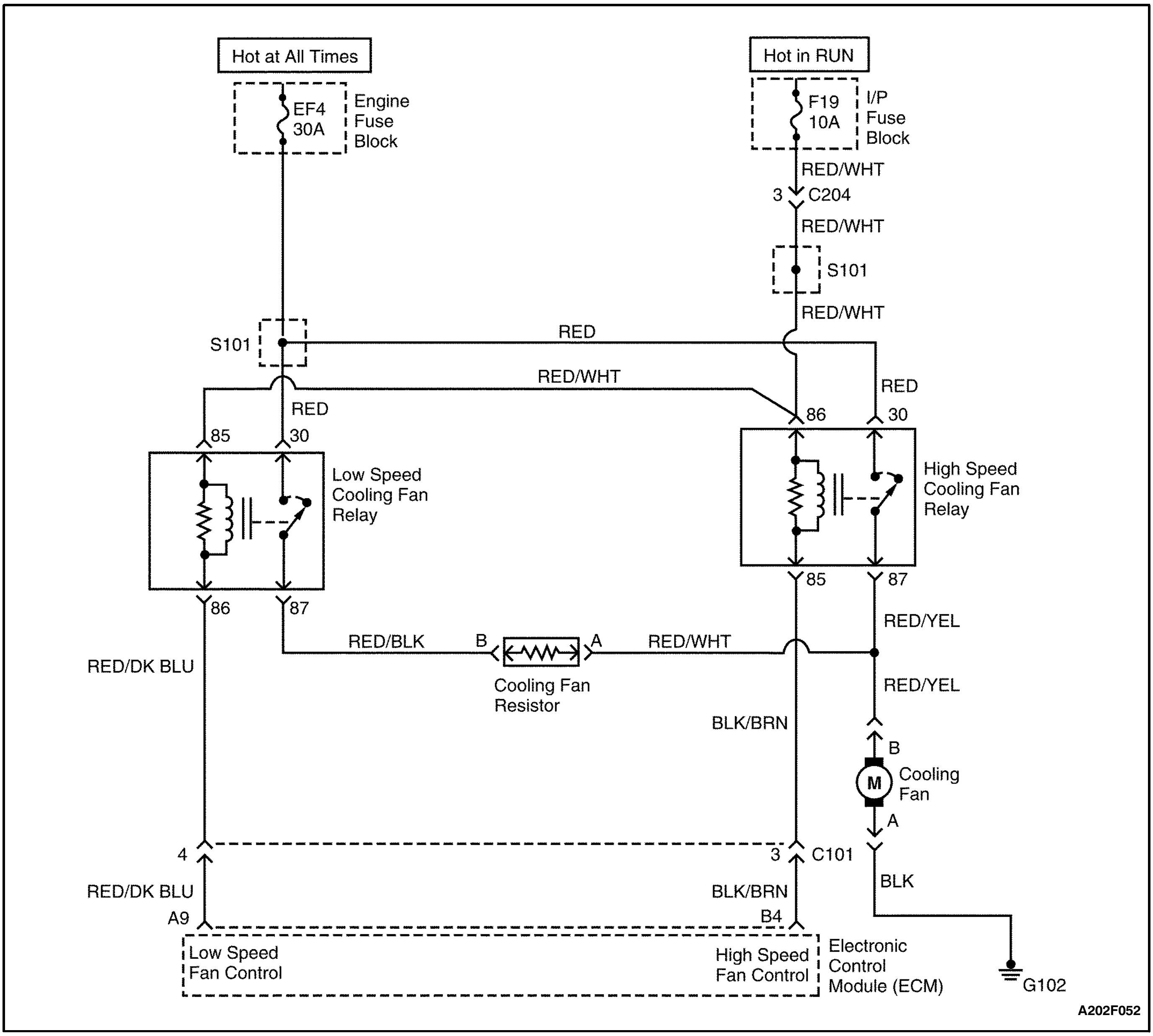
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	-	System OK	Go to Step 2
2	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	System OK	Go to Step 3
3	1. Measure the resistance of the ignition wires. 2. Replace any ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	System OK	Go to Step 4
4	Is spark present from at least one of the ignition wires, but not all of the ignition wires?	-	Go to Step 5	Go to Step 12
5	1. Turn the ignition OFF. 2. Disconnect the direct ignition system (DIS) ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 6	Go to Step 7
6	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 8
7	Check for an open in the wire from the DIS ignition coil connector terminal B to the electronic control module (ECM) connector terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the DIS ignition coil. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
11	1. Replace the ECM. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
12	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Measure the resistance between the CPS terminals 1 and 2. Is the resistance within the value specified?	400-600 W	Go to Step 13	Go to Step 28
13	1. Measure the resistance between the CPS terminals 1 and 3. 2. Measure the resistance between the CPS terminals 2 and 3. Is the resistance infinite (open circuit)?	R	Go to Step 14	Go to Step 28
14	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 1 and 3 Is the voltage within the value specified?	0.95-1.10 v	Go to Step 20	Go to Step 15
15	Measure the voltage between the CPS connector terminal 1 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 16
16	Check the wire between the CPS connector terminal 1 and the ECM connector terminal B14 for an open or short. Is the problem found?	-	Go to Step 18	Go to Step 11
17	Check the wire between the CPS connector terminal 3 and ground for an open or short. Is the problem found?	-	Go to Step 19	Go to Step 11
18	Repair the wire between the CPS connector terminal 1 and the ECM connector terminal B14. Is the repair complete?	-	System OK	-
19	Repair the wire between the CPS connector terminal 3 and ground. Is the repair complete?	-	System OK	-
20	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 2 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 24	Go to Step 21
21	Measure the voltage between the CPS connector terminal 2 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 22

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
22	Check the wire between the CPS connector terminal 2 and the ECM connector terminal A16 for an open or short. Is the problem found?	-	Go to Step 23	Go to Step 11
23	Repair the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the repair complete?	-	System OK	-
24	1. Turn the ignition OFF. 2. Connect a test light between the DIS ignition coil connector terminal D and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 25	Go to Step 26
25	Connect a test light between the DIS ignition coil connector terminal C and battery positive. Is the test light on?	-	Go to Step 5	Go to Step 27
26	Check for an open or short to ground in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the problem found?	-	Go to Step 29	-
27	Repair the wire between the DIS ignition coil connector terminal C and ground. Is the repair complete?	-	System OK	-
28	Replace the CPS. Is the repair complete?	-	System OK	-
29	Replace the fuse F15 or repair the open in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK – WITHOUT A/C (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the electronic control module (ECM) based on input from the coolant temperature sensor (CTS). The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A9. This energizes the low-speed cooling fan relay and operates the cooling fan at low speed. The low-speed cooling fan operation is achieved by the cooling fan resistor causing a drop in the voltage supplied to the cooling fan. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal B4. This energizes the high-speed cooling fan relay, bypassing the radiator fan resistor. This results in high-speed cooling fan operation.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**
- **If the I/P fuse block fuse F19 or the engine fuse block fuse EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fan is to be turned on by the ECM, suspect a faulty cooling fan motor.**

- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM 24-pin connector and grounding the connector terminal A9. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A9 and B4 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with Step 5, checks for the ability of the ECM to operate the cooling fans.
22. By directly grounding the ECM connector terminals A9 and B4, the cooling fan should run at high speed.

Engine Cooling Fan Circuit Check – Without A/C (1.3L and 1.5L SOHC IEFI-6)

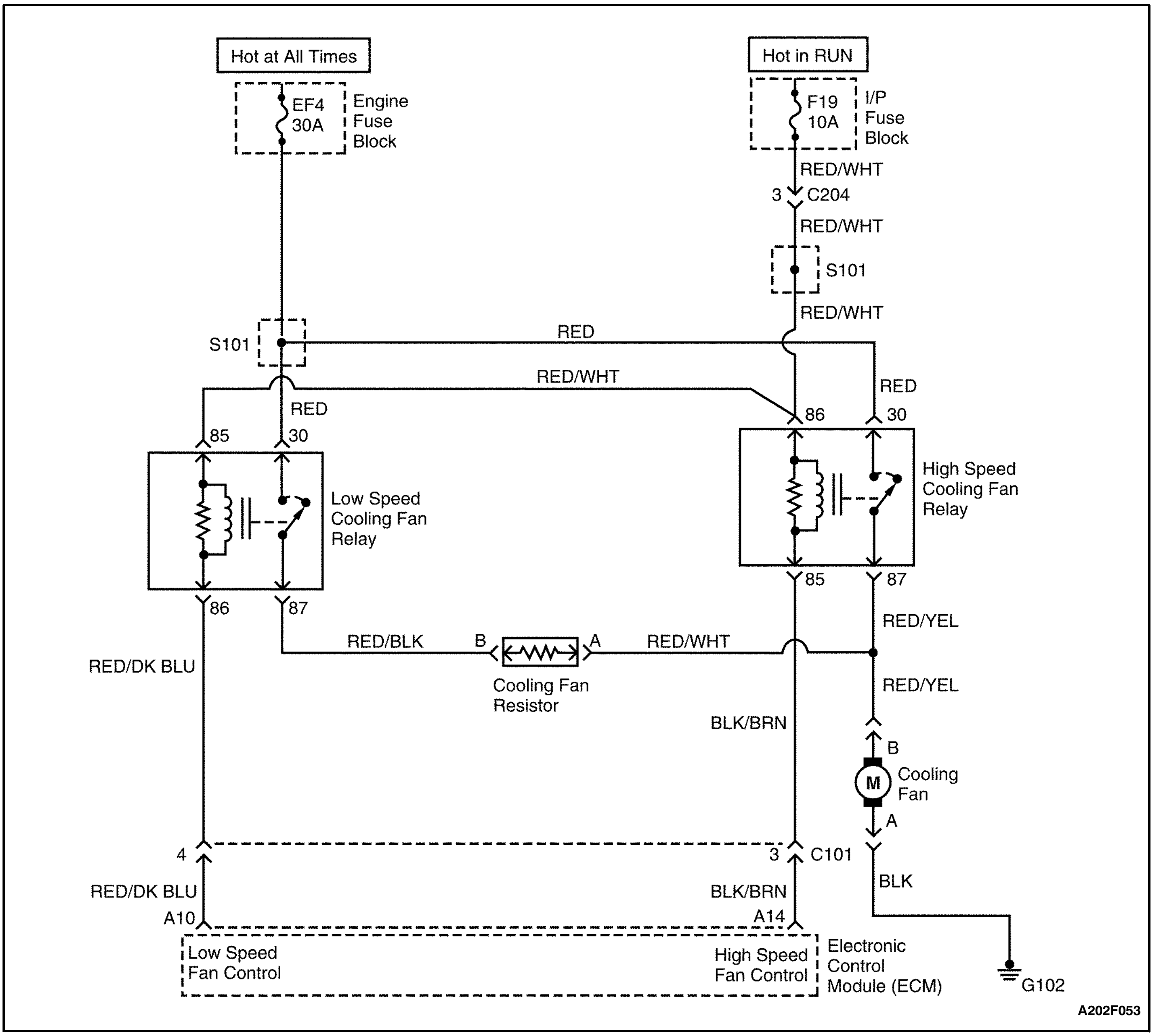
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the I/P fuse block fuse 19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Start the engine. 4. The cooling fan should run at low speed when the coolant temperature reaches 93°C (199°F). Does the cooling fan run at low speed?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Start the engine. 4. The cooling fan should run at high speed when the coolant temperature reaches 97°C (207°F). Does the cooling fan run at high speed?	-	System OK	Go to Step 22
6	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) 24-pin connector. 3. Connect a fused jumper between the ECM connector terminal A9 and ground. 4. Turn the ignition ON. Does the cooling fan run at low speed?	-	Go to Step 21	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A9 and ground. 3. Disconnect the cooling fan connector. 4. Connect a test light between the cooling fan connector terminal B and ground. 5. Turn the ignition ON. Is the test light on?	-	Go to Step 8	Go to Step 9

Engine Cooling Fan Circuit Check – Without A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Connect a test light between the cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 18	Go to Step 17
9	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 10	Go to Step 13
10	1. Turn the ignition OFF. 2. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 11	Go to Step 14
11	Connect a test light between the low-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 12	Go to Step 16
12	1. Connect a fused jumper between the ECM connector terminal A9 and ground. 2. Connect a test light between the low-speed cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 19	Go to Step 15
13	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
14	Repair the open wire between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
15	Repair the open wire between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A9. Is the repair complete?	-	System OK	-
16	Check for an open wire between the low-speed cooling fan connector terminal 87 and the cooling fan connector terminal B. Is the problem found?	-	Go to Step 20	Go to Step 17
17	Check for an open wire between the cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 20	Go to Step 18
18	Replace the cooling fan. Is the repair complete?	-	System OK	-
19	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
20	Repair the wire as needed. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check – Without A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the ECM. Is the repair complete?	-	System OK	-
22	1. Turn the ignition OFF. 2. Disconnect the ECM 24-pin connector. 3. Connect a fused jumper between the ECM connector terminal A9 and ground. 4. Connect a fused jumper between the ECM connector terminal B4 and ground. 5. Turn the ignition ON. Does the cooling fan run at high speed?	-	Go to Step 21	Go to Step 23
23	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 24	Go to Step 28
24	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 25	Go to Step 29
25	Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 26	Go to Step 30
26	1. Connect a fused jumper between the ECM connector terminal B4 and ground. 2. Connect a test light between the high-speed relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 31
27	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
28	Repair the open wire between the high-speed cooling fan connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
29	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
30	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the cooling fan connector terminal B. Is the repair complete?	-	System OK	-
31	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal B4. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK - WITHOUT A/C (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the electronic control module (ECM) based on input from the coolant temperature sensor (CTS). The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A10. This energizes the low-speed cooling fan relay and operates the cooling fan at low speed. The low-speed cooling fan operation is achieved by the cooling fan resistor causing a drop in the voltage supplied to the cooling fan. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A14. This energizes the high-speed cooling fan relay, bypassing the radiator fan resistor. This results in high-speed cooling fan operation.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**
- **If the I/P fuse block fuse F19 or the engine fuse block fuse EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fan is to be turned on by the ECM, suspect a faulty cooling fan motor.**

- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM connector and grounding the connector terminal A10. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A10 and A14 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with step 5, checks for the ability of the ECM to operate the cooling fans.

22. By directly grounding the ECM connector terminals A10 and A14, the cooling fan should run at high speed.

Engine Cooling Fan Circuit Check – Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F)

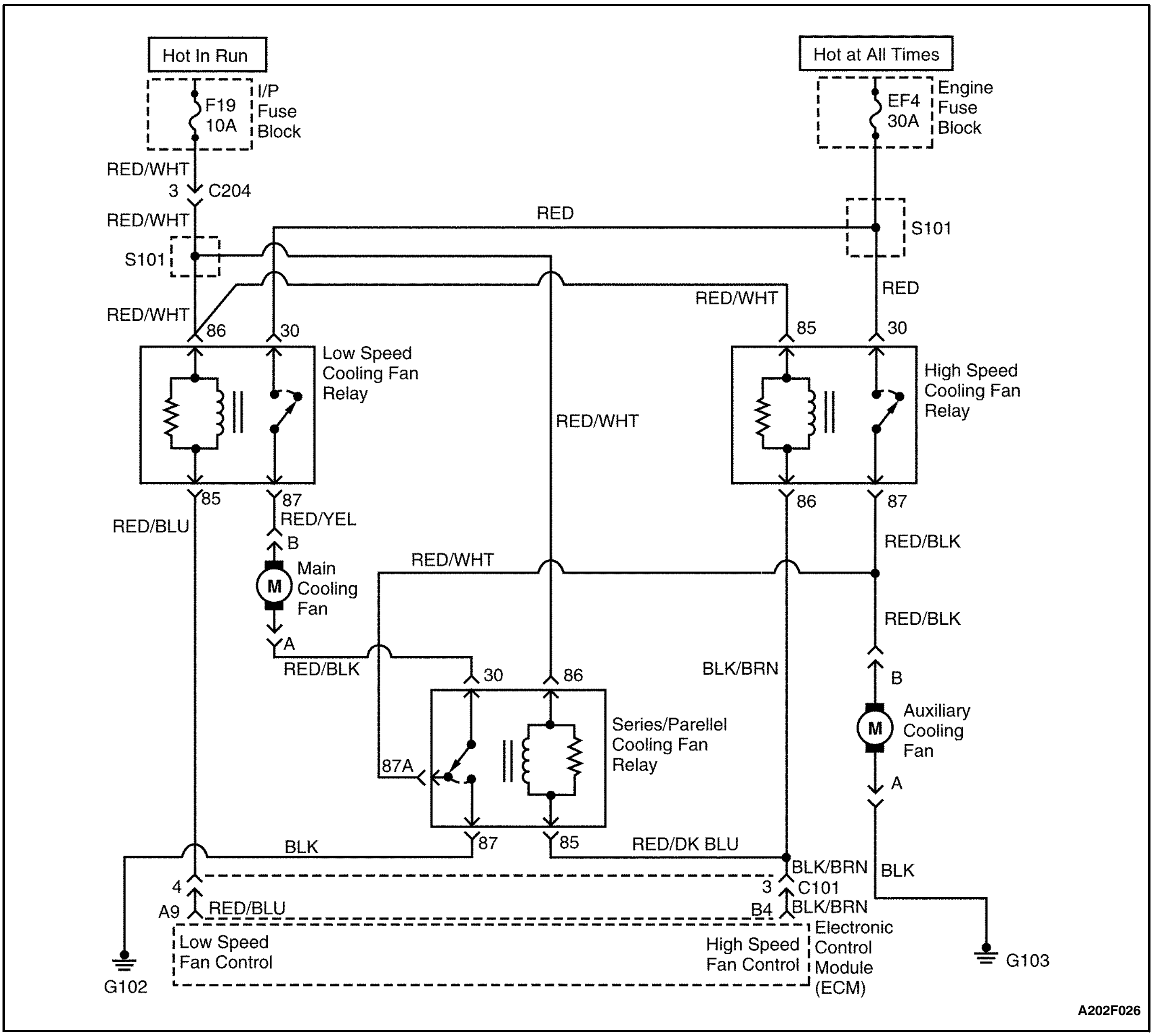
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the I/P fuse block fuse 19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Start the engine. 4. The cooling fan should run at low speed when the coolant temperature reaches 93°C (199°F). Does the cooling fan run at low speed?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Start the engine. 4. The cooling fan should run at high speed when the coolant temperature reaches 97°C (207°F). Does the cooling fan run at high speed?	-	System OK	Go to Step 22
6	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connector. 3. Connect a fused jumper between the ECM connector terminal A10 and ground. 4. Turn the ignition ON. Does the cooling fan run at low speed?	-	Go to Step 21	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A10 and ground. 3. Disconnect the cooling fan connector. 4. Connect a test light between the cooling fan connector terminal B and ground. 5. Turn the ignition ON. Is the test light on?	-	Go to Step 8	Go to Step 9

Engine Cooling Fan Circuit Check – Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Connect a test light between the cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 18	Go to Step 17
9	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 10	Go to Step 13
10	1. Turn the ignition OFF. 2. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 11	Go to Step 14
11	Connect a test light between the low-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 12	Go to Step 16
12	1. Connect a fused jumper between the ECM connector terminal A10 and ground. 2. Connect a test light between the low-speed cooling fan relay connector terminal 86 and battery positive. Is the test light on?	-	Go to Step 19	Go to Step 15
13	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
14	Repair the open wire between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
15	Repair the open wire between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A10. Is the repair complete?	-	System OK	-
16	Check for an open wire between the low-speed cooling fan connector terminal 87 and the cooling fan connector terminal B. Is the problem found?	-	Go to Step 20	Go to Step 17
17	Check for an open wire between the cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 20	Go to Step 18
18	Replace the cooling fan. Is the repair complete?	-	System OK	-
19	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
20	Repair the wire as needed. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check – Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the ECM. Is the repair complete?	-	System OK	-
22	1. Turn the ignition OFF. 2. Disconnect the ECM connector. 3. Connect a fused jumper between the ECM connector terminal A10 and ground. 4. Connect a fused jumper between the ECM connector terminal A14 and ground. 5. Turn the ignition ON. Does the cooling fan run at high speed?	-	Go to Step 21	Go to Step 23
23	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 24	Go to Step 28
24	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 25	Go to Step 29
25	Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 26	Go to Step 30
26	1. Connect a fused jumper between the ECM connector terminal A14 and ground. 2. Connect a test light between the high-speed relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 31
27	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
28	Repair the open wire between the high-speed cooling fan connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
29	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
30	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the cooling fan connector terminal B. Is the repair complete?	-	System OK	-
31	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK – WITH A/C (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The engine cooling fan circuit operates the main cooling fan and the auxiliary cooling fan. The cooling fans are controlled by the electronic control module (ECM) based on inputs from the coolant temperature sensor (CTS) and the air conditioning pressure (ACP) sensor. The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A9. This energizes the low-speed cooling fan relay and operates the main cooling fan and the auxiliary cooling fan at low speed as the cooling fans are connected in a series circuit. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A9 and the ECM connector terminal B4 at the same time. This energizes the low-speed cooling fan relay, the high-speed cooling fan relay, and the series/parallel cooling fan relay resulting in high-speed fan operation as the cooling fans are now connected in a parallel circuit.

Diagnostic Aids

- If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.

- If the engine fuse block fuses EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fans are to be turned on by the ECM, suspect a faulty cooling fan motor.
- The ECM will turn the cooling fans on at low speed when the coolant temperature is 97°C (207°F). The ECM will turn the cooling fans off when the coolant temperature is 94°C (201°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 101°C (214°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 98°C (208°F).
- The ECM will turn the cooling fans on at low speed when the air conditioning (A/C) system is on. The ECM will change the cooling fans from low speed to high speed when the high-side A/C pressure is 1 882 kPa (273 psi), then return to low speed when the high-side A/C pressure is 1 448 kPa (210 psi). When the A/C system is on, the ECM will change the cooling fans from low to high speed when the coolant temperature reaches 117°C (243°F) then return to low speed when the coolant temperature reaches 114°C (237°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM red connector and grounding the connector terminal A9. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A9 and B4 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with Step 5, checks for the ability of the ECM to operate the cooling fans.
8. This step, along with Step 9, checks for the ability of the ECM to operate the cooling fans in response to A/C pressure readings.
16. After confirming battery voltage and the ECM supplying a ground to the coil side of the low-speed cooling fan relay, jumper connector terminals 30 and 87 to determine if the relay is at fault or a wiring problem is present.
31. This step checks for the presence of battery voltage to the main cooling fan when the A/C is on. If battery voltage is present and the cooling fans are not operating, the problem is in the ground side of the cooling fan circuit.
37. By directly grounding the ECM connector terminals A9 and B4, the main and auxiliary cooling fans should run at high speed.

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	–	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	–	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the I/P fuse block fuse F19. 2. Replace the fuse as needed. Is the fuse OK?	–	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Turn the air conditioning (A/C) switch OFF. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. The cooling fans should run at low speed when the coolant temperature reaches 97°C (207°F). Do the cooling fans run at low speed?	–	Go to Step 5	Go to Step 10

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Turn the A/C switch OFF. 3. Connect a scan tool to the ALDL. 4. Start the engine. 5. The cooling fans should run at high speed when the coolant temperature reaches 101°C (214°F). Do the cooling fans run at high speed?	-	Go to Step 6	Go to Step 33
6	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	Go to Step 7
7	1. Diagnose the A/C compressor clutch circuit. 2. Repair the A/C compressor clutch circuit as needed. 3. Start the engine. 4. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	-
8	Do the cooling fans run at low speed?	-	Go to Step 9	Go to Step 31
9	1. Turn the ignition OFF. 2. Connect the A/C pressure gauges. 3. Start the engine. 4. Turn the A/C switch ON. 5. The cooling fans should run at high speed when the high-side A/C pressure reaches 1 882 kPa (273 psi). Do the cooling fans run at high speed?	-	System OK	-
10	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 97°C (207°C). 4. Disconnect the main cooling fan connector. 5. Turn the ignition ON. 6. Connect a test light between the main cooling fan connector terminal B and ground. Is the test light on?	-	Go to Step 11	Go to Step 12
11	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 97°C (207°C). 4. Disconnect the main cooling fan connector. 5. Connect a test light between the main cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 28	Go to Step 17
12	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 13	Go to Step 24

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Disconnect the electronic control module (ECM) red connector. 4. Connect a fused jumper between the ECM connector terminal A9 and ground. 5. Turn the ignition ON. Do the cooling fans run at low speed?	-	Go to Step 30	Go to Step 14
14	Check for an open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A9. Is the problem found?	-	Go to Step 25	Go to Step 15
15	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 16	Go to Step 23
16	Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 26	Go to Step 17
17	1. Disconnect the series/parallel cooling fan relay. 2. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 3. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 27	Go to Step 18
18	Check the wire between the low-speed cooling fan relay connector terminal 87 to the main cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 19
19	Check the wire between the main cooling fan connector terminal A and the series/parallel cooling fan relay connector terminal 30 for an open. Is the problem found?	-	Go to Step 22	Go to Step 20
20	Check the wire between the series/parallel cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 21
21	Check for an open wire between the auxiliary cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 22	Go to Step 29
22	Repair the open wire as needed. Is the repair complete?	-	System OK	-
23	Repair the open between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
24	Repair the open between the low-speed cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A9. Is the repair complete?	-	System OK	-
26	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
27	Replace the series/parallel cooling fan relay. Is the repair complete?	-	System OK	-
28	Replace the main cooling fan. Is the repair complete?	-	System OK	-
29	Replace the auxiliary cooling fan. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-
31	1. Turn the ignition OFF. 2. Disconnect the main cooling fan connector. 3. Connect a test light between the main cooling fan connector terminal B and ground. 4. Turn the A/C switch ON. 5. Start the engine. Is the test light on?	-	Go to Step 32	Go to Step 12
32	1. Turn the ignition OFF. 2. Connect a test light between the main cooling fan connector terminal A and battery positive. 3. Turn the A/C switch ON. 4. Start the engine. Is the test light on?	-	Go to Step 28	Go to Step 17
33	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 34	Go to Step 44
34	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 35	Go to Step 45
35	1. Disconnect the series/parallel cooling fan relay. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 86 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 36	Go to Step 46
36	1. Turn the ignition OFF. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 37	Go to Step 47

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
37	1. Connect the main cooling fan connector. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Disconnect the ECM connector. 5. Connect a fused jumper between the ECM connector terminal A9 and ground. 6. Connect a fused jumper between the ECM connector terminal B4 and ground. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 30	Go to Step 38
38	1. Turn the ignition OFF. 2. Check for an open wire between the high-speed cooling fan relay connector terminal 86 and the ECM connector terminal B4. Is the problem found?	-	Go to Step 22	Go to Step 39
39	1. Disconnect the high-speed cooling fan relay. 2. Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 40	Go to Step 48
40	1. Disconnect the ECM connector. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a test light between the series/parallel cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 41	Go to Step 49
41	1. Connect the series/parallel cooling fan relay. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the high-speed cooling fan relay. 4. Connect a fused jumper between the high-speed cooling fan relay connector terminals 30 and 87. 5. Disconnect the low-speed cooling fan relay. 6. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 43	Go to Step 42
42	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. 5. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 6. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 27	-

Engine Cooling Fan Circuit Check – With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
43	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
44	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
45	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the battery. Is the repair complete?	-	System OK	-
46	Repair the open wire between the series/parallel cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
47	Repair the open wire between the series/parallel cooling fan relay connector terminal 87 and ground. Is the repair complete?	-	System OK	-
48	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B. Is the repair complete?	-	System OK	-
49	Repair the open wire between the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal B4. Is the repair complete?	-	System OK	-

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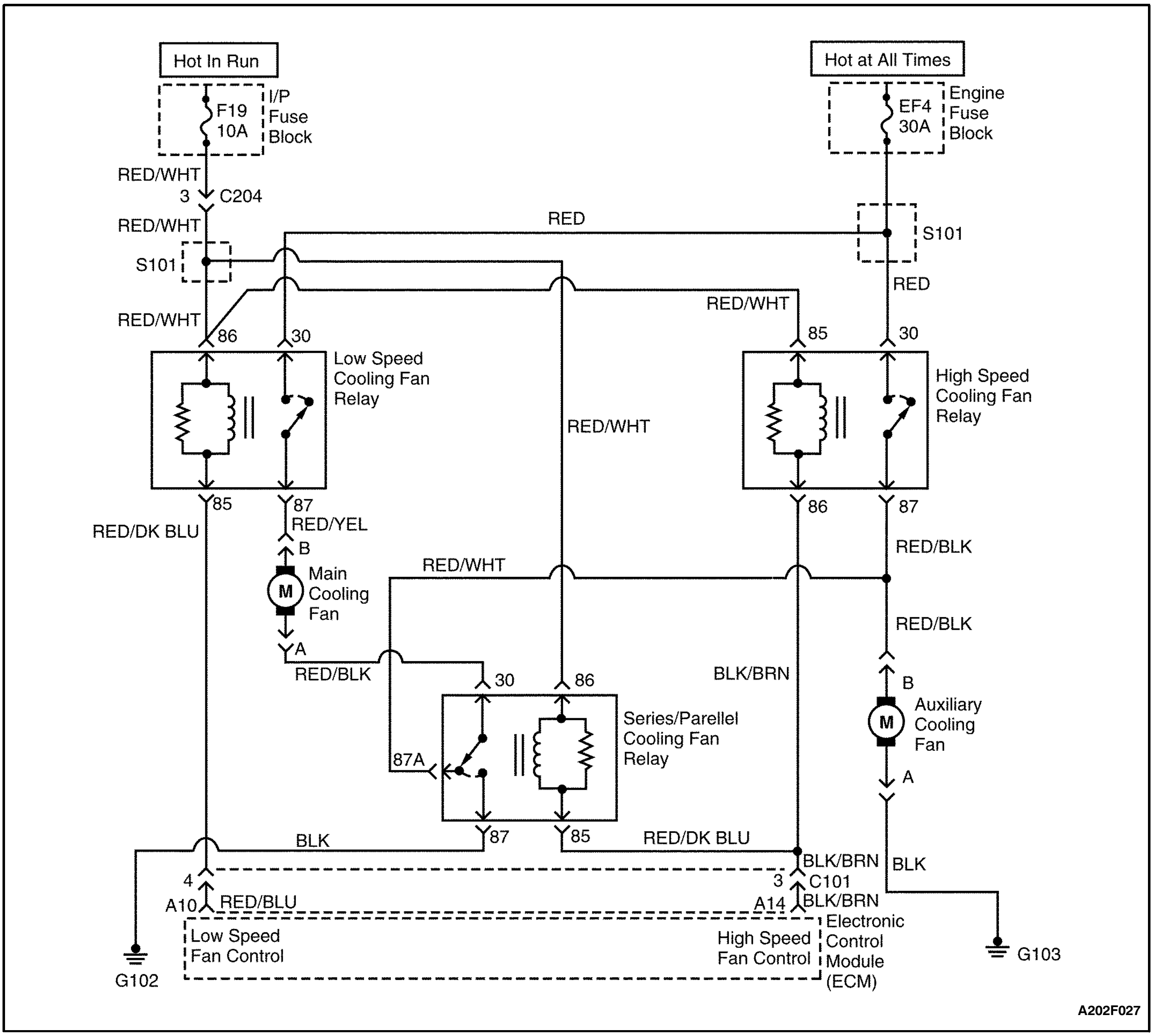


ENGINE COOLING FAN CIRCUIT CHECK – WITH A/C (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The engine cooling fan circuit operates the main cooling fan and the auxiliary cooling fan. The cooling fans are controlled by the electronic control module (ECM) based on inputs from the coolant temperature sensor (CTS) and the air conditioning pressure (ACP) sensor. The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A10. This energizes the low-speed cooling fan relay and operates the main cooling fan and the auxiliary cooling fan at low speed as the cooling fans are connected in a series circuit. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A10 and the ECM connector terminal A14 at the same time. This energizes the low-speed cooling fan relay, the high-speed cooling fan relay, and the series/parallel cooling fan relay resulting in high-speed fan operation as the cooling fans are now connected in a parallel circuit.

Diagnostic Aids

- If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.

- If the engine fuse block fuses EF3 or EF8 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fans are to be turned on by the ECM, suspect a faulty cooling fan motor.
- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The ECM will turn the cooling fans on at low speed when the air conditioning (A/C) system is on. The ECM will change the cooling fans from low speed to high speed when the high-side A/C pressure is 1 882 kPa (273 psi), then return to low speed when the high-side A/C pressure is 1 448 kPa (210 psi). When the A/C system is on, the ECM will change the cooling fans from low to high speed when the coolant temperature reaches 115°C (239°F) then return to low speed when the coolant temperature reaches 112°C (234°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM red connector and grounding the connector terminal A10. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A10 and A14 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with step 5, checks for the ability of the ECM to operate the cooling fans.
8. This step, along with step 9, checks for the ability of the ECM to operate the cooling fans in response to A/C pressure readings.
16. After confirming battery voltage and the ECM supplying a ground to the coil side of the low-speed cooling fan relay, jumper connector terminals 30 and 87 to determine if the relay is at fault or a wiring problem is present.
31. This step checks for the presence of battery voltage to the main cooling fan when the A/C is on. If battery voltage is present and the cooling fans are not operating, the problem is in the ground side of the cooling fan circuit.
37. By directly grounding the ECM connector terminals A10 and A14, the main and auxiliary cooling fans should run at high speed.

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the I/P fuse block fuse F19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Turn the air conditioning (A/C) switch OFF. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. The cooling fans should run at low speed when the coolant temperature reaches 93°C (199°F). Do the cooling fans run at low speed?	-	Go to Step 5	Go to Step 10

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Turn the A/C switch OFF. 3. Connect a scan tool to the ALDL. 4. Start the engine. 5. The cooling fans should run at high speed when the coolant temperature reaches 97°C (207°F). Do the cooling fans run at high speed?	-	Go to Step 6	Go to Step 33
6	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	Go to Step 7
7	1. Diagnose the A/C compressor clutch circuit. 2. Repair the A/C compressor clutch circuit as needed. 3. Start the engine. 4. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	-
8	Do the cooling fans run at low speed?	-	Go to Step 9	Go to Step 31
9	1. Turn the ignition OFF. 2. Connect the A/C pressure gauges. 3. Start the engine. 4. Turn the A/C switch ON. 5. The cooling fans should run at high speed when the high-side A/C pressure reaches 1 882 kPa (273 psi). Do the cooling fans run at high speed?	-	System OK	-
10	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 93°C (199°C). 4. Disconnect the main cooling fan connector. 5. Turn the ignition ON. 6. Connect a test light between the main cooling fan connector terminal B and ground. Is the test light on?	-	Go to Step 11	Go to Step 12
11	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 93°C (199°C). 4. Disconnect the main cooling fan connector. 5. Connect a test light between the main cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 28	Go to Step 17
12	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 13	Go to Step 24

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Disconnect the electronic control module (ECM) red connector. 4. Connect a fused jumper between the ECM connector terminal A10 and ground. 5. Turn the ignition ON. Do the cooling fans run at low speed?	-	Go to Step 30	Go to Step 14
14	Check for an open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the problem found?	-	Go to Step 25	Go to Step 15
15	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 16	Go to Step 23
16	Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 26	Go to Step 17
17	1. Disconnect the series/parallel cooling fan relay. 2. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 3. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 27	Go to Step 18
18	Check the wire between the low-speed cooling fan relay connector terminal 87 to the main cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 19
19	Check the wire between the main cooling fan connector terminal A and the series/parallel cooling fan relay connector terminal 30 for an open. Is the problem found?	-	Go to Step 22	Go to Step 20
20	Check the wire between the series/parallel cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 21
21	Check for an open wire between the auxiliary cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 22	Go to Step 29
22	Repair the open wire as needed. Is the repair complete?	-	System OK	-
23	Repair the open between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
24	Repair the open between the low-speed cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the repair complete?	-	System OK	-
26	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
27	Replace the series/parallel cooling fan relay. Is the repair complete?	-	System OK	-
28	Replace the main cooling fan. Is the repair complete?	-	System OK	-
29	Replace the auxiliary cooling fan. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-
31	1. Turn the ignition OFF. 2. Disconnect the main cooling fan connector. 3. Connect a test light between the main cooling fan connector terminal B and ground. 4. Turn the A/C switch ON. 5. Start the engine. Is the test light on?	-	Go to Step 32	Go to Step 12
32	1. Turn the ignition OFF. 2. Connect a test light between the main cooling fan connector terminal A and battery positive. 3. Turn the A/C switch ON. 4. Start the engine. Is the test light on?	-	Go to Step 28	Go to Step 17
33	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 34	Go to Step 44
34	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 35	Go to Step 45
35	1. Disconnect the series/parallel cooling fan relay. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 86 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 36	Go to Step 46
36	1. Turn the ignition OFF. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 37	Go to Step 47

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
37	1. Connect the main cooling fan connector. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Disconnect the ECM connector. 5. Connect a fused jumper between the ECM connector terminal A10 and ground. 6. Connect a fused jumper between the ECM connector terminal A14 and ground. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 30	Go to Step 38
38	1. Turn the ignition OFF. 2. Check for an open wire between the high-speed cooling fan relay connector terminal 86 and the ECM connector terminal A14. Is the problem found?	-	Go to Step 22	Go to Step 39
39	1. Disconnect the high-speed cooling fan relay. 2. Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 40	Go to Step 48
40	1. Disconnect the ECM connector. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a test light between the series/parallel cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 41	Go to Step 49
41	1. Connect the series/parallel cooling fan relay. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the high-speed cooling fan relay. 4. Connect a fused jumper between the high-speed cooling fan relay connector terminals 30 and 87. 5. Disconnect the low-speed cooling fan relay. 6. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 43	Go to Step 42
42	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. 5. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 6. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 27	-

Engine Cooling Fan Circuit Check – With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
43	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
44	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
45	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the battery. Is the repair complete?	-	System OK	-
46	Repair the open wire between the series/parallel cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
47	Repair the open wire between the series/parallel cooling fan relay connector terminal 87 and ground. Is the repair complete?	-	System OK	-
48	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B. Is the repair complete?	-	System OK	-
49	Repair the open wire between the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the repair complete?	-	System OK	-

FUEL INJECTOR BALANCE TEST

A fuel injector tester is used to energize the injector for a precise amount of time, thus spraying a measured amount of fuel into the intake manifold. This causes a drop in the fuel rail pressure that can be recorded and used to compare each of the fuel injectors. All of the fuel injectors should have the same pressure drop 10 kPa (1.5 psi).

Injector Balance Test Example

Cylinder	1	2	3	4
First Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
Second Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount Of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Faulty Injector - Too Much Pressure Drop	Injector OK	Faulty Injector - Too Little Pressure Drop

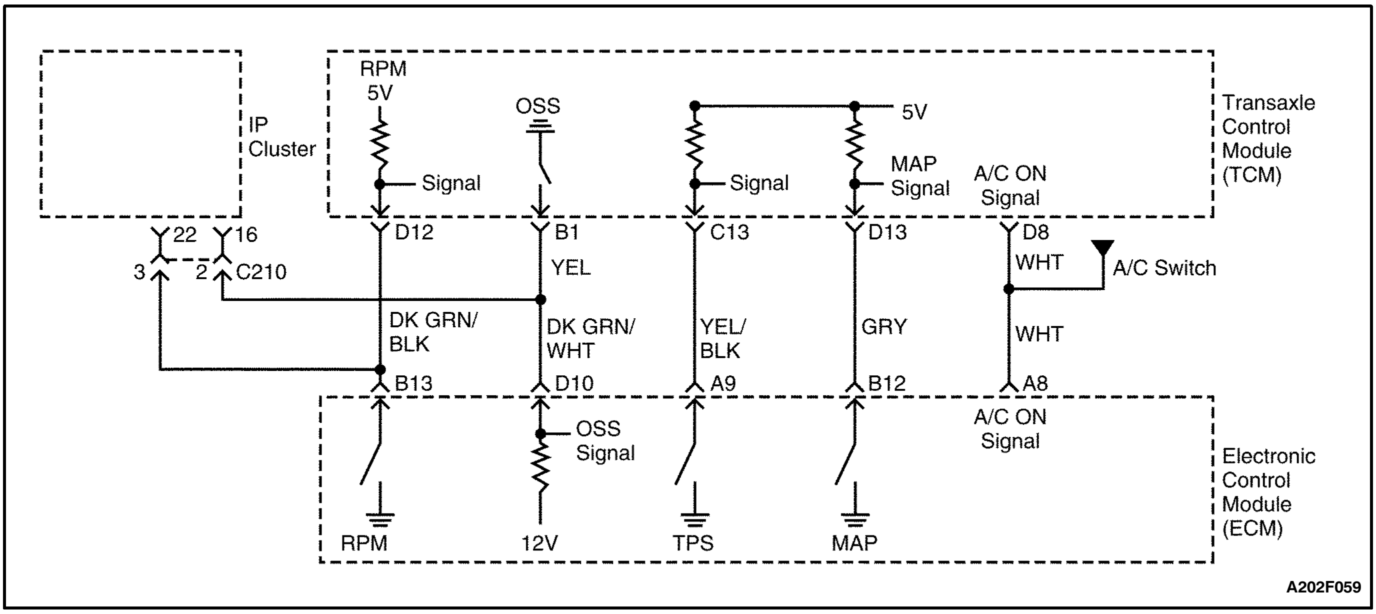
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Notice: In order to prevent flooding of the engine, do not perform the Injector Balance Test more than once (including any retest on faulty fuel injectors) without running the engine.

Test

1. An engine cool down period of 10 minutes is necessary in order to avoid irregular readings due to hot soak fuel boiling.
2. Connect the fuel pressure gauge carefully to avoid any fuel spillage.
3. The fuel pump should run about 2 seconds after the ignition is turned to the ON position.
4. Insert a clear tube attached to the vent valve of the fuel pressure gauge into a suitable container.
5. Bleed the air from the fuel pressure gauge and the hose until all of the air is bled from the fuel pressure gauge.
6. The ignition switch must be in the OFF position at least 10 seconds in order to complete the electronic control module (ECM) shutdown cycle.
7. Turn the ignition ON in order to get the fuel pressure to its maximum level.
8. Allow the fuel pressure to stabilize and then record this initial pressure reading. Wait until there is no movement of the needle on the fuel pressure gauge.
9. Follow the manufacturer's instructions for the use of the adapter harness. Energize the fuel injector tester once and note the fuel pressure drop at its lowest point. Record this second reading. Subtract it from the first reading to determine the amount of the fuel pressure drop.
10. Disconnect the fuel injector tester from the fuel injector.
11. After turning the ignition ON, in order to obtain maximum pressure once again, make a connection at the next fuel injector. Energize the fuel injector tester and record the fuel pressure reading. Repeat this procedure for all the injectors.
12. Retest any of the fuel injectors for which the pressure drop exceeds the 10 kPa (1.5 psi) specification.
13. Replace any of the fuel injectors that fail the retest.
14. If the pressure drop of all of the fuel injectors is within 10 kPa (1.5 psi), then the fuel injectors are flowing normally and no replacement should be necessary.
15. Reconnect the fuel injector harness and review the symptom diagnostic tables.



DIAGNOSTIC TROUBLE CODE (DTC) 1 TCMPWM LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position angle is computed by the transaxle control module (TCM) and the electronic control module (ECM) from the throttle position sensor (TPS) voltage input.

DTC 1 Will Set When

- TCMPWM output short to ground (TPS: 0 - 5%) is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

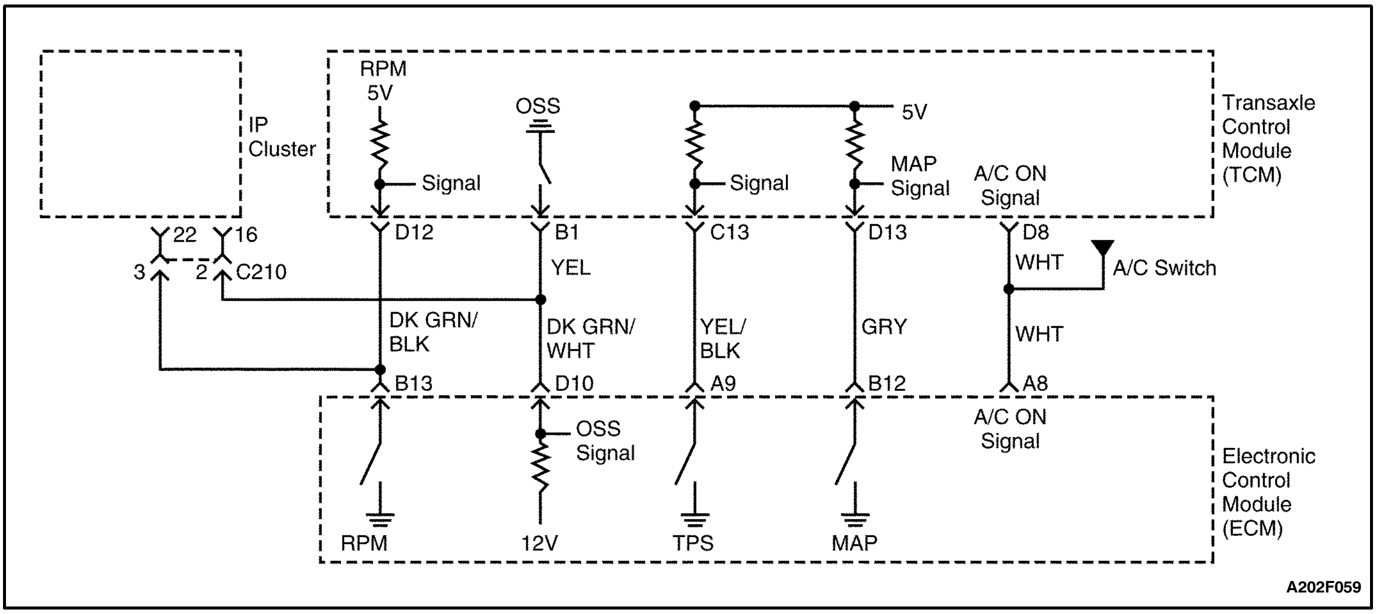
4. This step checks to see if the TCM is receiving TPS signal voltage.

DTC 1 – TCMPWM Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect a voltmeter to terminal C13 of the transaxle control module (TCM) and ground. 3. Turn the ignition ON. Does the voltmeter show the value specified?	6 v	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the repair complete?	-	System OK	-

DTC 1 – TCMPWM Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value	Yes	No
4	1. To determine if the TCM is receiving throttle position sensor (TPS) signal voltage, begin by turning the ignition OFF. 2. Disconnect the electrical connectors at the TCM. 3. Disconnect the electrical connectors at the electronic control module (ECM). 4. Check the wire from terminal C13 of the TCM to terminal A9 of the ECM for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground between terminal C13 of the TCM and terminal A9 of the ECM. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 2 TCMPWM HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position angle is computed by the transaxle control module (TCM) and the electronic control module (ECM) from the throttle position sensor (TPS) voltage input.

DTC 2 Will Set When

- TCMPWM output short to battery voltage (TPS: 95 - 100%) is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

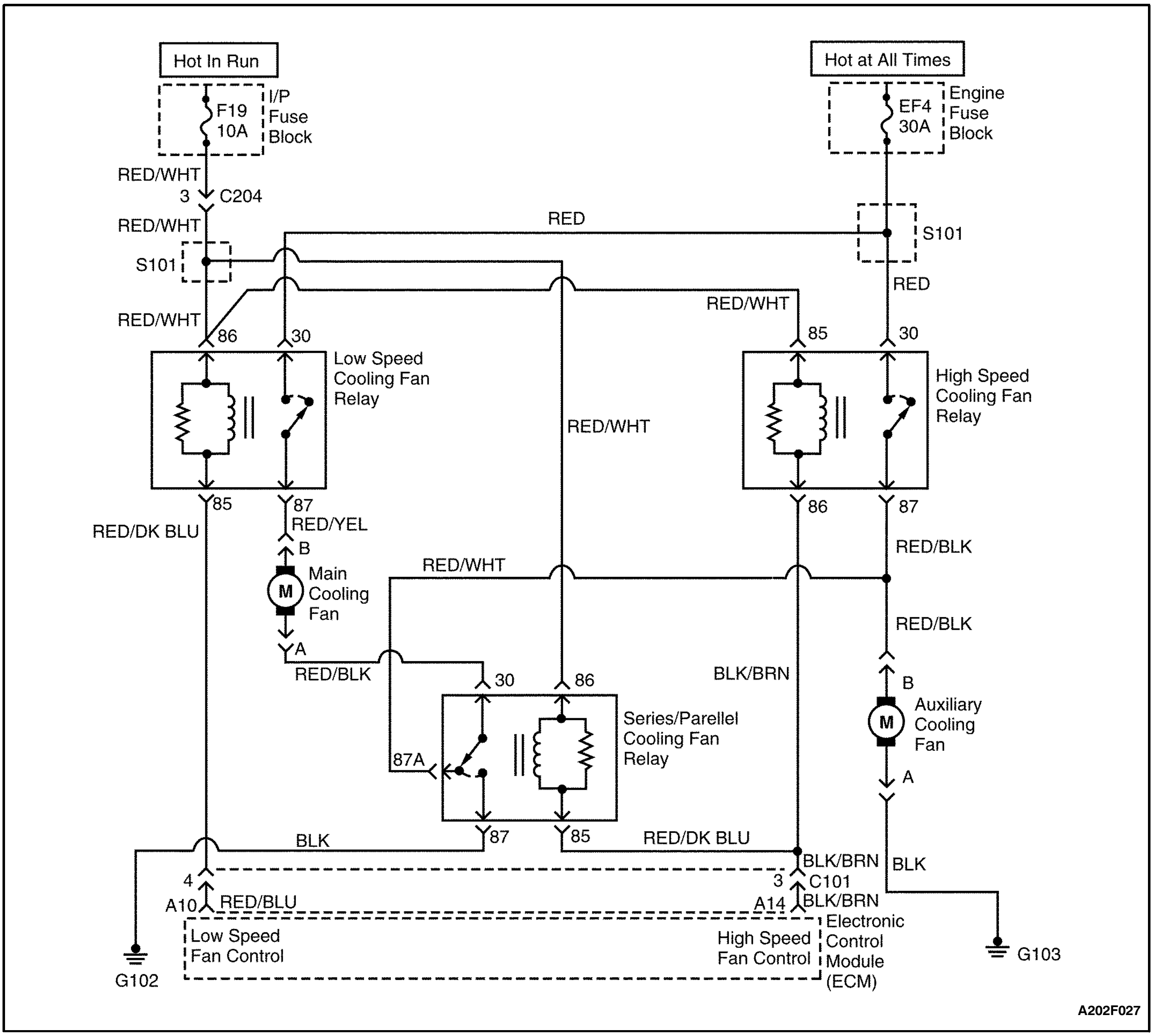
4. This step checks to see if the TCM is receiving TPS signal voltage.

DTC 2 – TCMPWM High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Turn the ignition OFF. 2. Connect a voltmeter to terminal C13 of the transaxle control module (TCM) and ground. 3. Turn the ignition ON. Does the voltmeter show the value specified?	6 v	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the repair complete?	-	System OK	-

DTC 2 – TCMPWM High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value	Yes	No
4	1. To determine if the TCM is receiving throttle position sensor (TPS) signal voltage, begin by turning the ignition OFF. 2. Disconnect the electrical connectors at the TCM. 3. Disconnect the electrical connectors at the electronic control module (ECM). 4. Check the wire from terminal C13 of the TCM to terminal A9 of the ECM for a short to battery voltage. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair the short to battery voltage between terminal C13 of the TCM and terminal A9 of the ECM. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 3
FAN NUMBER TWO LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The high-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the high-speed cooling fan relay, while also applying ground to the low-speed cooling fan relay, to achieve high-speed cooling fan operation. The ECM determines when to activate the high-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 3 Will Set When

- An open or short to ground condition exists and this condition is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for an open or shorted relay.
6. This step checks for an open or shorted relay.
11. This step checks for the ability of the ECM to ground the fan circuits.

DTC 3 – Fan Number Two Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	Inspect the fuse F19. Is the fuse in good condition?	-	Go to Step 4	Go to Step 3
3	1. Replace the fuse. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Disconnect the high-speed cooling fan relay. 2. Measure the resistance between the high-speed cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 5	Go to Step 6
5	1. Replace the high-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Disconnect the series/parallel cooling fan relay. 2. Measure the resistance between the series/parallel cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 7	Go to Step 8
7	1. Replace the series/parallel cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check for an open or short to ground in the wiring between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the problem found?	-	Go to Step 10	Go to Step 9
9	Check for an open or short to ground in the wiring between the series/parallel cooling fan relay connector terminal 85 and ECM connector terminal A14. Is the problem found?	-	Go to Step 10	Go to Step 11
10	1. Repair the open or short to ground in the wiring. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Connect the ECM red connector. 5. Jumper terminals A and B of the assembly line diagnostic link (ALDL) connector. 6. Turn the ignition ON. 7. With a test light connected to battery voltage, backprobe the ECM connector terminal A14. Is the test light on?	-	Go to “Diagnostic Aids”	Go to Step 12

DTC 3 – Fan Number Two Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect for a poor connection at the ECM connector terminal A14. Is the problem found?	-	Go to Step 13	Go to Step 14
13	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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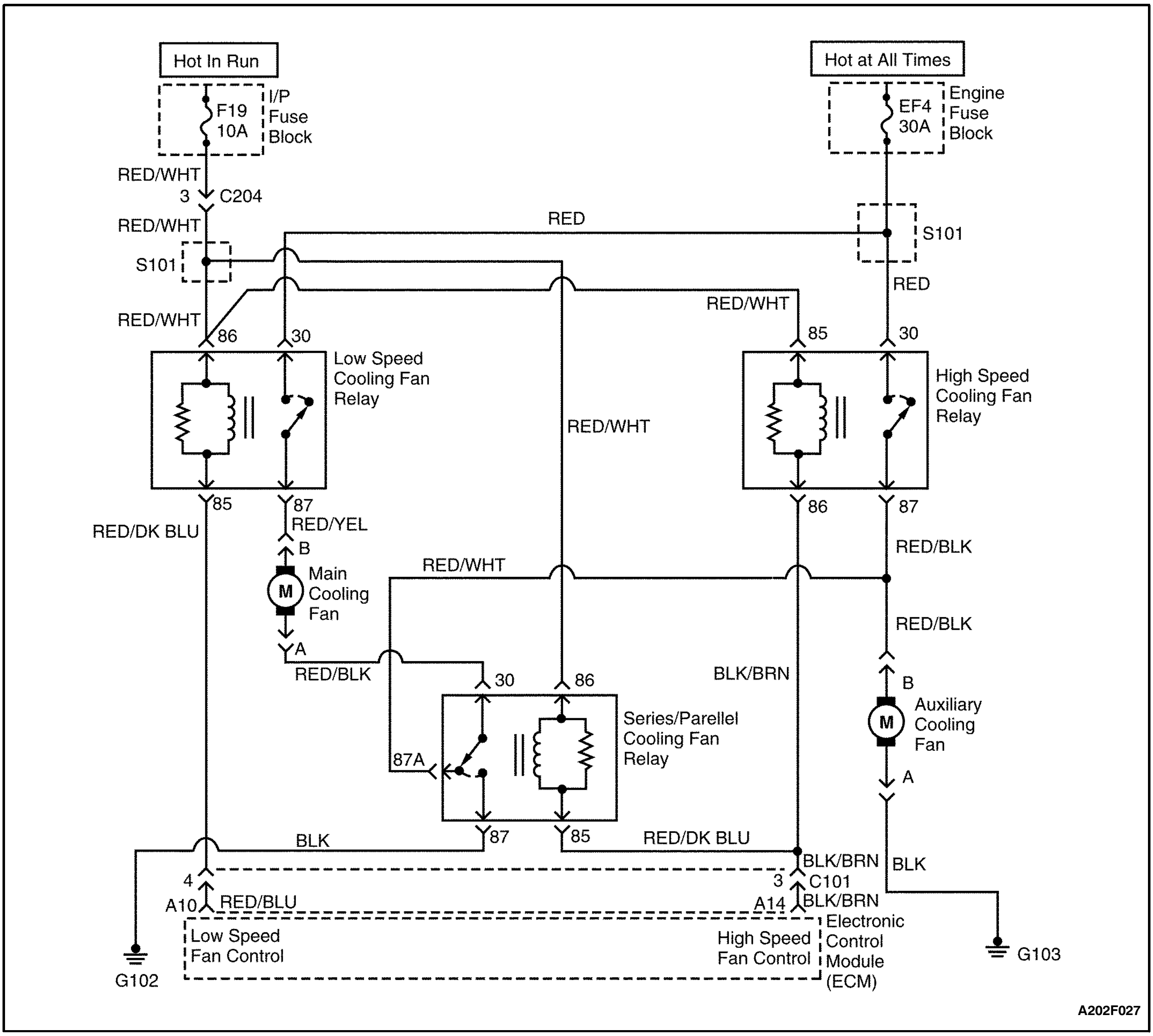


DIAGNOSTIC TROUBLE CODE (DTC) 4
FAN NUMBER TWO HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The high-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the high-speed cooling fan relay, while also applying ground to the low-speed cooling fan relay, to achieve high-speed cooling fan operation. The ECM determines when to activate the high-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 4 Will Set When

- A short to battery voltage condition exists and this condition is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

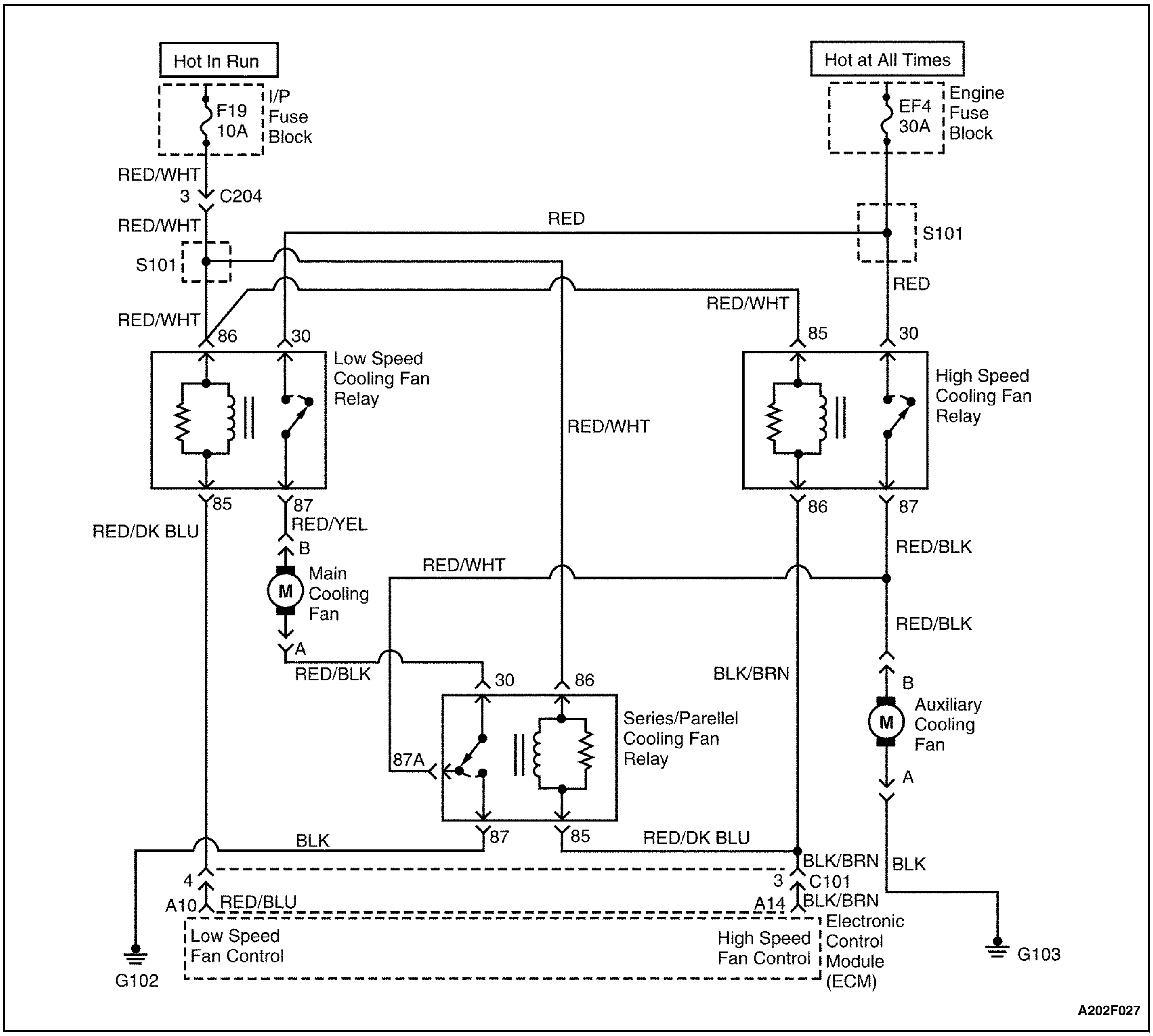
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the wires for a short to battery voltage.
4. This step checks for a shorted relay.
6. This step checks for a shorted relay.

DTC 4 – Fan Number Two High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Disconnect the high-speed cooling fan relay and the series/parallel cooling fan relay. 3. Measure the voltage between the ECM connector terminal A14 and ground. Does the voltage measure within the value specified?	0 v	Go to Step 4	Go to Step 3
3	1. Repair the short to voltage between the high-speed cooling fan relay or the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal A14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	Measure the resistance between the high-speed cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 5	Go to Step 6
5	1. Replace the high-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the resistance between the series/parallel cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 7	Go to Step 8
7	1. Replace the series/parallel cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Inspect for a poor connection at the ECM connector terminal A14. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 5
FAN NUMBER ONE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The low-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the low-speed cooling fan relay to achieve low-speed cooling fan operation. The ECM determines when to activate the low-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 5 Will Set When

- An open or short to ground condition exits and this condition is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

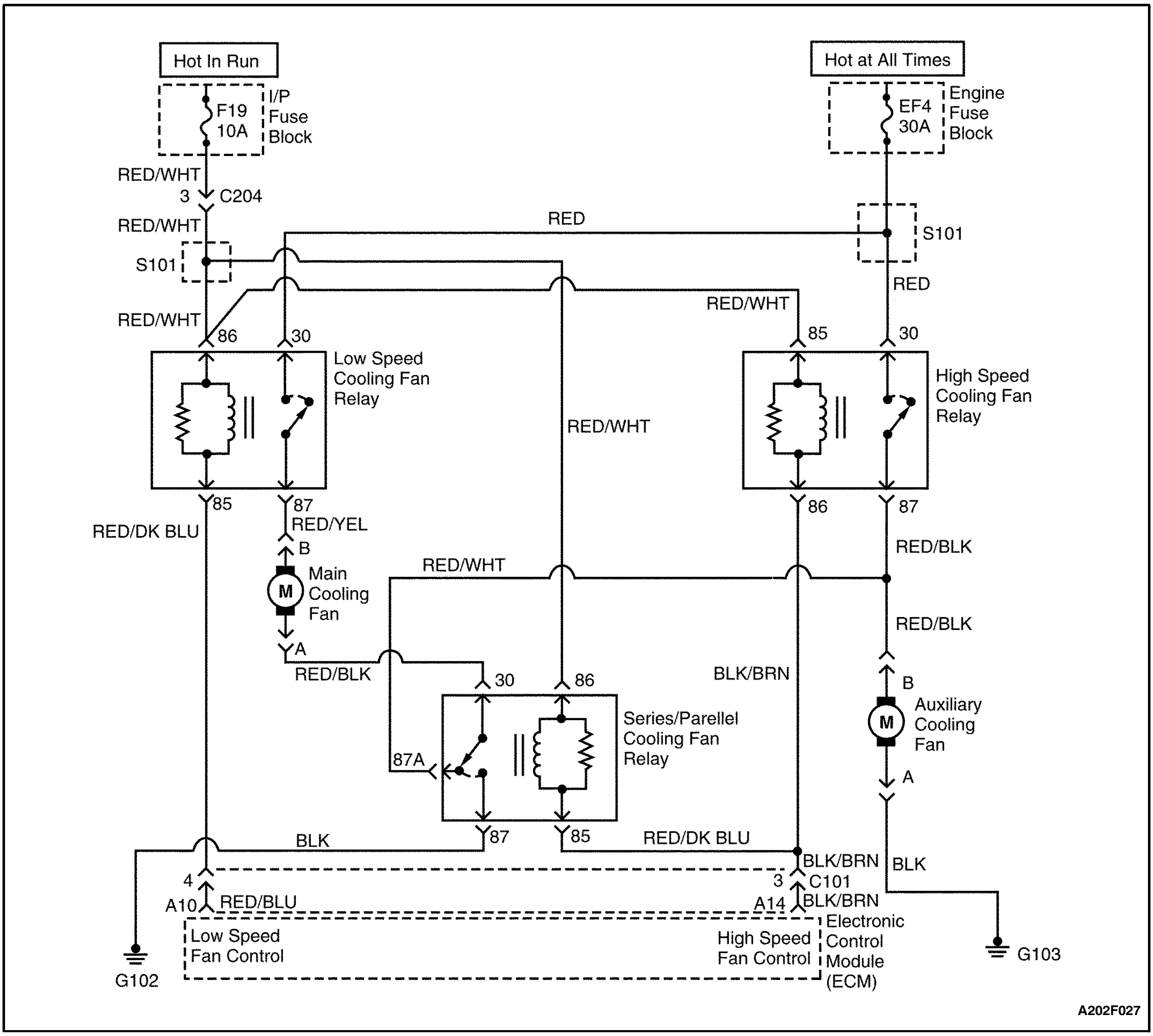
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for an open or shorted relay.
8. This step checks for the ability of the ECM to ground the fan circuits.

DTC 5 – Fan Number One Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Inspect the fuse F19. Is the fuse in good condition?	-	Go to Step 4	Go to Step 3
3	1. Replace the fuse. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Disconnect the low-speed cooling fan relay. 2. Measure the resistance between the low-speed cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 5	Go to Step 6
5	1. Replace the low-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Check for an open or short to ground in the wiring between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground in the wiring. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Connect the ECM red connector. 4. Jumper terminals A and B of the assembly line diagnostic link (ALDL) connector. 5. Turn the ignition ON. 6. With a test light connected to battery voltage, backprobe the ECM connector terminal A10. Is the test light on?	-	Go to "Diagnostic Aids"	Go to Step 9
9	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect for a poor connection at the ECM connector terminal A10. Is the problem found?	-	Go to Step 10	Go to Step 11
10	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 6
FAN NUMBER ONE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The low-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the low-speed cooling fan relay to achieve low-speed cooling fan operation. The ECM determines when to activate the low-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 6 Will Set When

- A short to battery voltage condition exists and this condition is present for more than 2 seconds.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

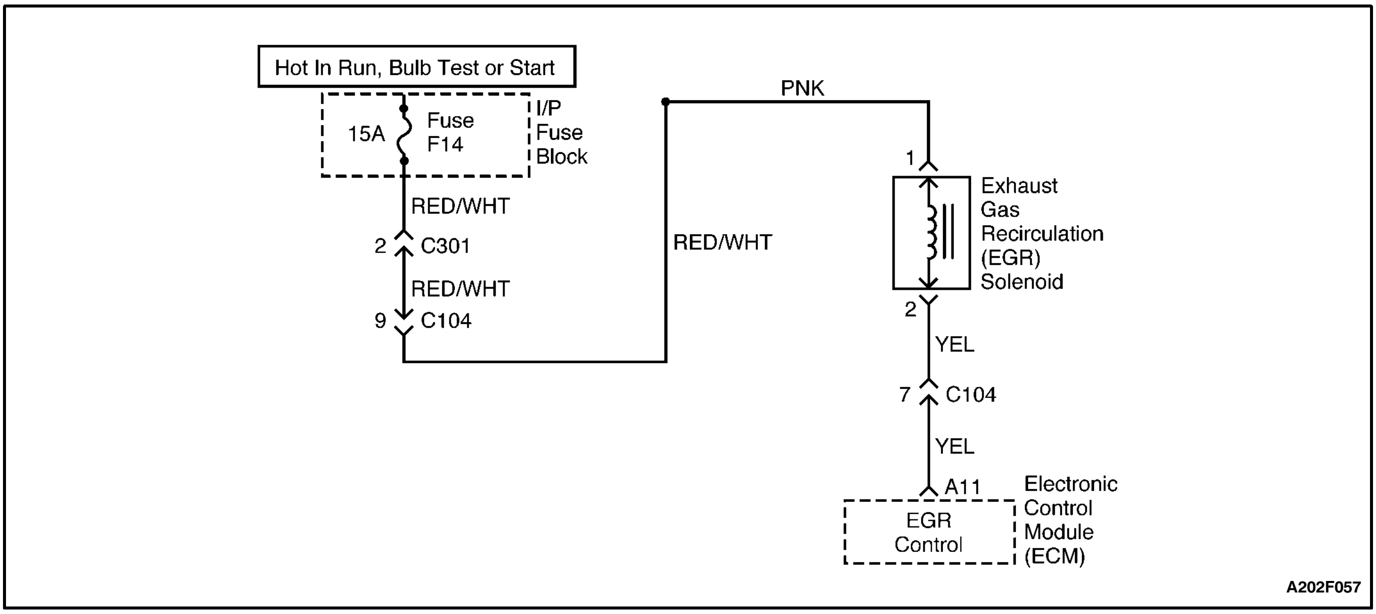
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the wires for a short to battery voltage.
4. This step checks for a shorted relay.

DTC 6 – Fan Number Two High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Disconnect the low-speed cooling fan relay. 3. Measure the voltage between the ECM connector terminal A10 and ground. Does the voltage measure within the value specified?	0 v	Go to Step 4	Go to Step 3
3	1. Repair the short to voltage between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A10. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	Measure the resistance between the low-speed cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 5	Go to Step 6
5	1. Replace the low-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Inspect for a poor connection at the ECM connector terminal A10. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 7
EGR ON/OFF SOLENOID LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) operates a solenoid to control the back pressure (BP) exhaust gas recirculation (EGR) valve.

The solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid, which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR solenoid and shutting off vacuum to the EGR valve. With the EGR valve closed and the oxygen (O_2) sensor fluctuating normally, short-term fuel trim counts will be greater than they were during normal operation.

DTC 7 Will Set When

- A short to ground condition exits.
- This condition is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the controlled canister purge (CCP) solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

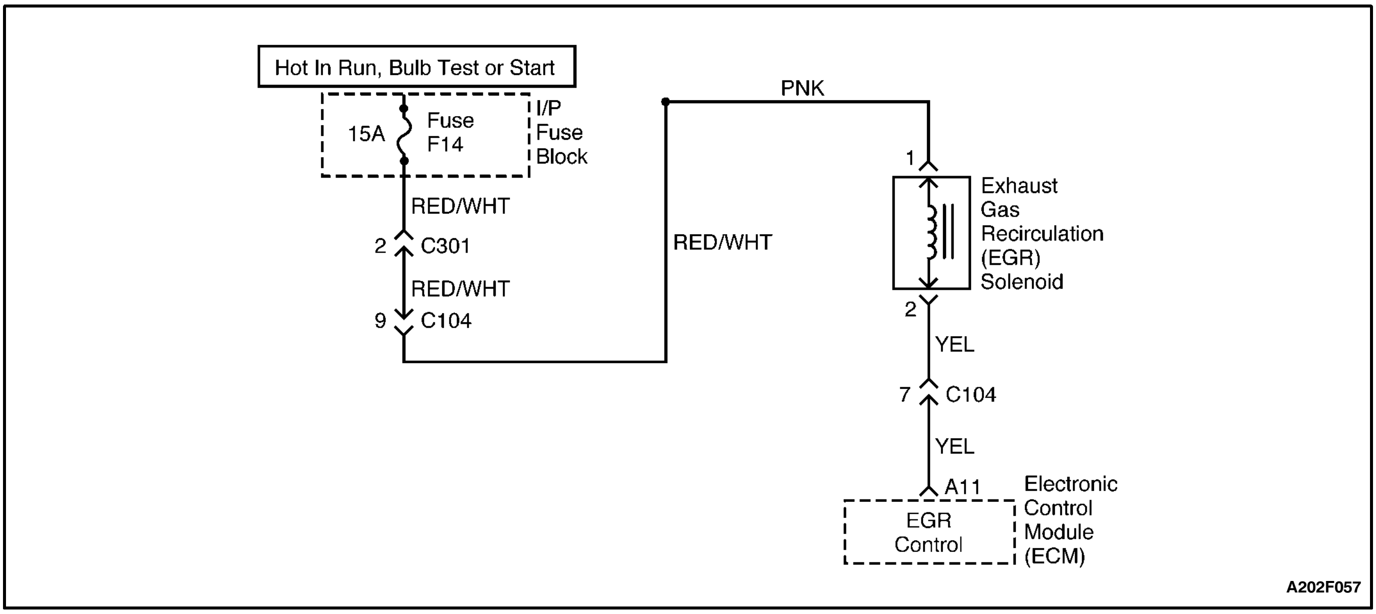
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition OFF the ECM should not be applying ground to the EGR solenoid.
3. If the test light is still on after disconnecting the ECM red connector the wire between the EGR solenoid and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.

DTC 7 – EGR On/Off Solenoid Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the exhaust gas recirculation (EGR) solenoid connector. 2. Connect a test light between the EGR solenoid connector terminal 2 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the ECM red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the EGR solenoid connector terminal 2 and the ECM connector terminal A11. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 8
EGR ON/OFF SOLENOID HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) operates a solenoid to control the back pressure (BP) exhaust gas recirculation (EGR) valve.

The solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid, which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR solenoid and shutting off vacuum to the EGR valve. With the EGR valve closed and the oxygen (O_2) sensor fluctuating normally, short-term fuel trim counts will be greater than they were during normal operation.

DTC 8 Will Set When

- A short to battery voltage condition exits.
- This condition is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the controlled canister purge (CCP) solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and thd ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 8 – EGR On/Off Solenoid High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the exhaust gas recirculation (EGR) solenoid connector. 2. Measure the resistance of the EGR solenoid. Does the resistance measure near the value specified?	9 0 W	Go to Step 6	Go to Step 3
3	1. Disconnect the EGR solenoid connector. 2. Connect a test light between the EGR solenoid connector terminal 2 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the EGR solenoid connector terminal 2 and the ECM connector terminal A11. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the EGR solenoid. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 12
NO PULSE REFERENCE

Circuit Description

This is a normal code that the electronic control module (ECM) stores when the engine is not running and the ignition key is ON.

DTC 12 Will Set When

- The engine is not running and the ignition key is ON.

Diagnostic Aids

- This code indicates a normal condition with no malfunction noted.
- This code indicates that the ECM has the ability to store codes.

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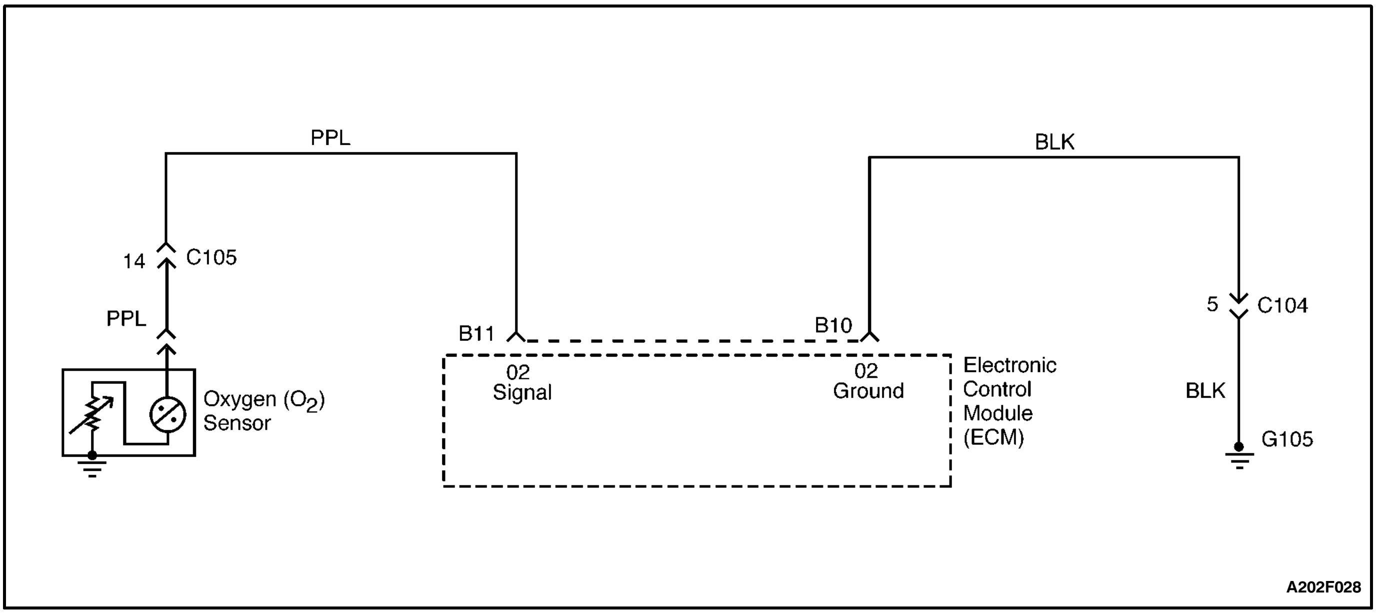

DIAGNOSTIC TROUBLE CODE (DTC) 13
OXYGEN SENSOR NOT TOGGLING (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes “open loop” operation.

DTC 13 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The O_2 sensor is steady between 350 millivolts and 550 millivolts.
- These conditions are present for 30 seconds.

Diagnostic Aids

Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. If the conditions for DTC 13 are present, the engine controls system will not operate in closed loop.

5. By making a vacuum leak, a lean running condition should now be present. If the O_2 sensor toggles below 450 millivolts, the O_2 sensor is sensing the lean running condition.

6. By making a slight vacuum leak at the manifold absolute pressure (MAP) sensor, a rich running condition should now be present. If the O_2 sensor toggles above 550 millivolts, the O_2 sensor is sensing the rich running condition.

10. An open or short to ground in the O_2 sensor circuit will not allow the ECM to operate in closed loop.

DTC 13 – Oxygen Sensor Not Toggling (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Check for closed loop operation. Does the electronic control module (ECM) go into closed loop?	-	Go to Step 3	Go to Step 8
3	1. Run the engine until it reaches operating temperature. 2. Check the oxygen (O_2) sensor reading at different throttle settings. Does the scan tool read the O_2 sensor input toggling between the values specified?	100-900 mv	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Check the O_2 sensor pigtail lead at the sensor. Is the lead properly attached to the sensor?	-	Go to Step 5	Go to Step 9
5	1. Reconnect the O_2 sensor connector. 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Make a vacuum leak by disconnecting or partially disconnecting a vacuum hose. Do not disconnect the manifold absolute pressure (MAP) sensor. Does the O_2 sensor input stay fixed at or below the value specified?	300 mv	Go to Step 6	Go to Step 8
6	1. Run the engine until it reaches operating temperature. 2. Make a slight vacuum leak at the MAP sensor vacuum hose. Does the O_2 sensor input stay fixed at or above the value specified?	600 mv	Go to Step 7	Go to Step 8
7	1. Clear the intermittent diagnostic trouble code (DTC) 13 from the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Does DTC 13 reset in the ECM?	-	Go to Step 2	Go to "Diagnostic Aids"
8	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the O_2 sensor connector on the ECM side of the connector. Is the voltage within the value specified?	300-600 mv	Go to Step 9	Go to Step 10
9	1. Replace the O_2 sensor. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 13 – Oxygen Sensor Not Toggling (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for an open or short to ground between the O_2 sensor connector and the ECM connector terminal B11. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Repair the wire as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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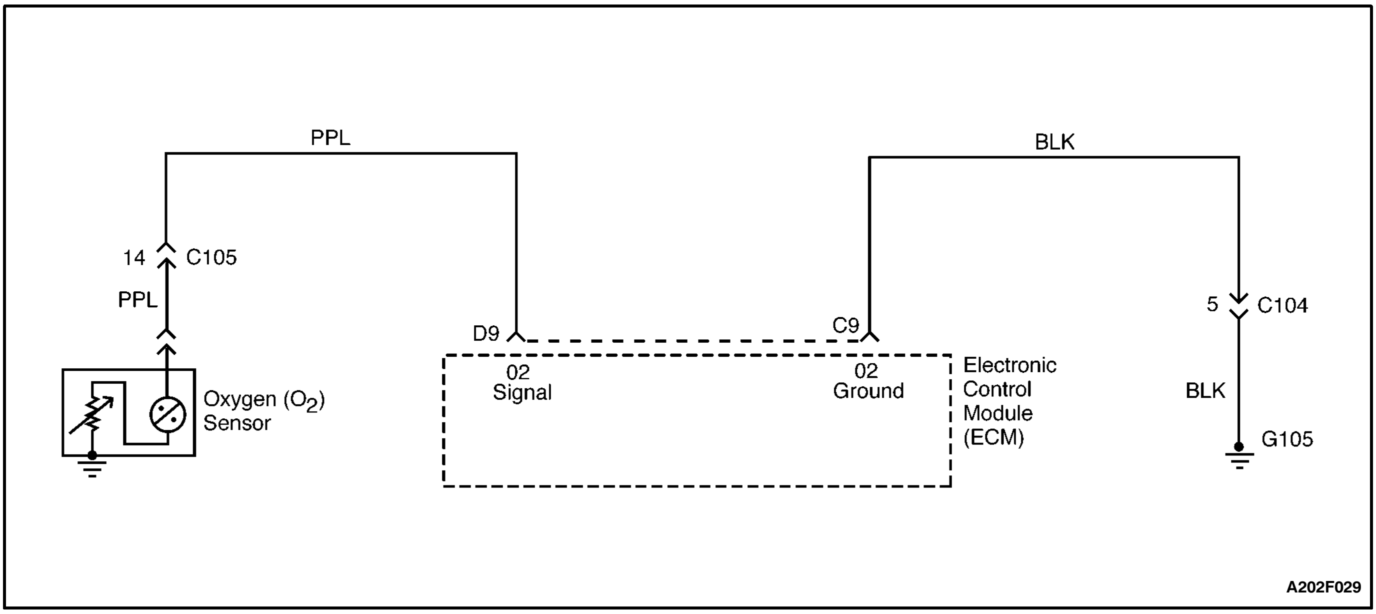

DIAGNOSTIC TROUBLE CODE (DTC) 13
OXYGEN SENSOR NOT TOGGLING (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 13 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The O_2 sensor is steady between 340 millivolts and 540 millivolts.
- These conditions are present for 20 seconds.

Diagnostic Aids

Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. If the conditions for DTC 13 are present, the engine controls system will not operate in closed loop.
5. By making a vacuum leak, a lean running condition should now be present. If the O_2 sensor toggles below 450 millivolts, the O_2 sensor is sensing the lean running condition.
6. By making a slight vacuum leak at the manifold absolute pressure (MAP) sensor, a rich running condition should now be present. If the O_2 sensor toggles above 550 millivolts, the O_2 sensor is sensing the rich running condition.
10. An open or short to ground in the O_2 sensor circuit will not allow the ECM to operate in closed loop.

DTC 13 – Oxygen Sensor Not Toggling (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Check for closed loop operation. Does the electronic control module (ECM) go into closed loop?	-	Go to Step 3	Go to Step 8
3	1. Run the engine until it reaches operating temperature. 2. Check the oxygen (O_2) sensor reading at different throttle settings. Does the scan tool read the O_2 sensor input toggling between the values specified?	100-900 mv	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Check the O_2 sensor pigtail lead at the sensor. Is the lead properly attached to the sensor?	-	Go to Step 5	Go to Step 9
5	1. Reconnect the O_2 sensor connector. 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Make a vacuum leak by disconnecting or partially disconnecting a vacuum hose. Do not disconnect the manifold absolute pressure (MAP) sensor. Does the O_2 sensor input stay fixed at or below the value specified?	300 mv	Go to Step 6	Go to Step 8
6	1. Run the engine until it reaches operating temperature. 2. Make a slight vacuum leak at the MAP sensor vacuum hose. Does the O_2 sensor input stay fixed at or above the value specified?	600 mv	Go to Step 7	Go to Step 8
7	1. Clear the intermittent diagnostic trouble code (DTC) 13 from the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Does DTC 13 reset in the ECM?	-	Go to Step 2	Go to "Diagnostic Aids"
8	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the O_2 sensor connector on the ECM side of the connector. Is the voltage within the value specified?	300-600 mv	Go to Step 9	Go to Step 10
9	1. Replace the O_2 sensor. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 13 – Oxygen Sensor Not Toggling (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for an open or short to ground between the O_2 sensor connector and the ECM connector terminal D9. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Repair the wire as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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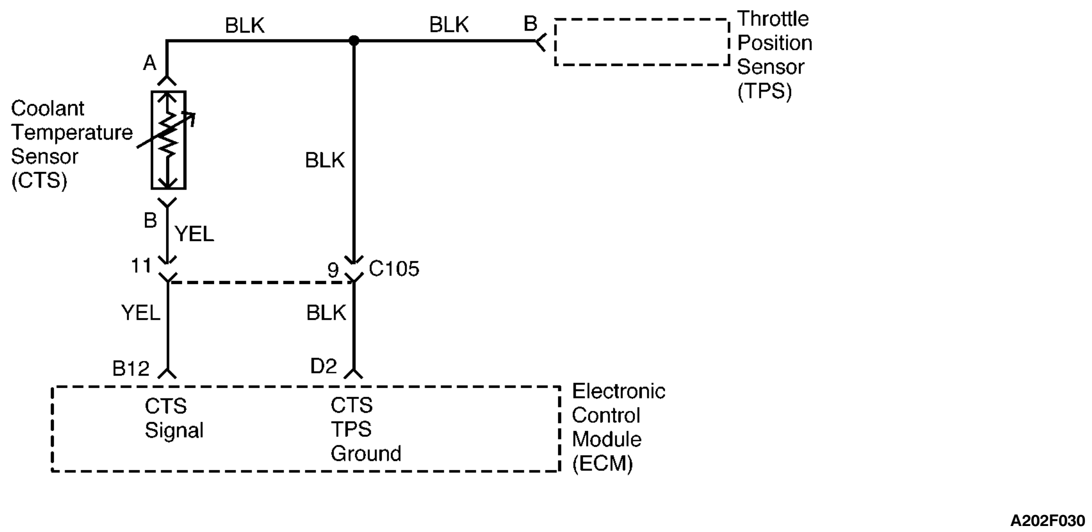

DIAGNOSTIC TROUBLE CODE (DTC) 14
COOLANT TEMPERATURE HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 14 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature above 145°C (293°F).

Diagnostic Aids

- If the connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 14. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 14 – Coolant Temperature High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display the engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Below * 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	1. Jumper terminals A and B of the CTS connector. 2. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Above 180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic controld module (ECM) white connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal D2 for a short to ECM reference voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the electronic control module. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 14 – Coolant Temperature High (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire for a short to ground between the CTS connector terminal B and the ECM connector terminal B12. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal D2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the short to ground in the wire between the CTS connector terminal B and the ECM connector terminal B12. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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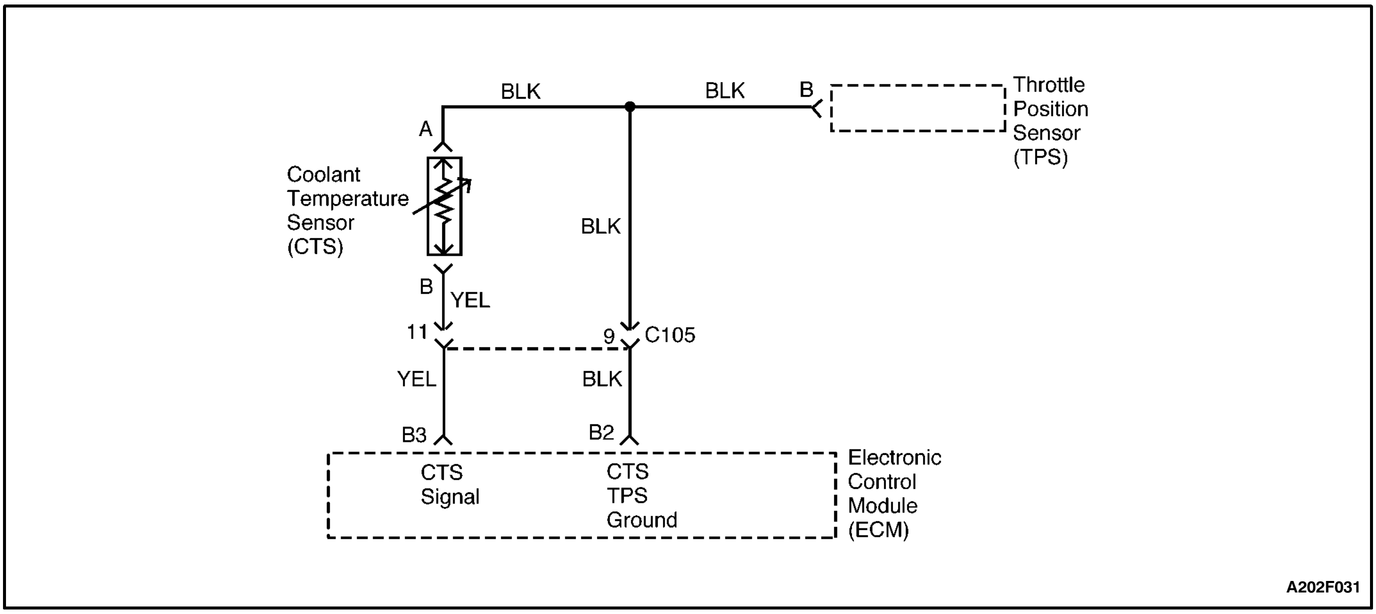

DIAGNOSTIC TROUBLE CODE (DTC) 14
COOLANT TEMPERATURE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 14 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature above 145°C (293°F).

Diagnostic Aids

- If the connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 14. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 14 – Coolant Temperature High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display the engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Below * 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	1. Jumper terminals A and B of the CTS connector. 2. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Above 180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal B2 for a short to ECM reference voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 14 – Coolant Temperature High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire for a short to ground between the CTS connector terminal B and the ECM connector terminal B3. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal B2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the short to ground in the wire between the CTS connector terminal B and the ECM connector terminal B3. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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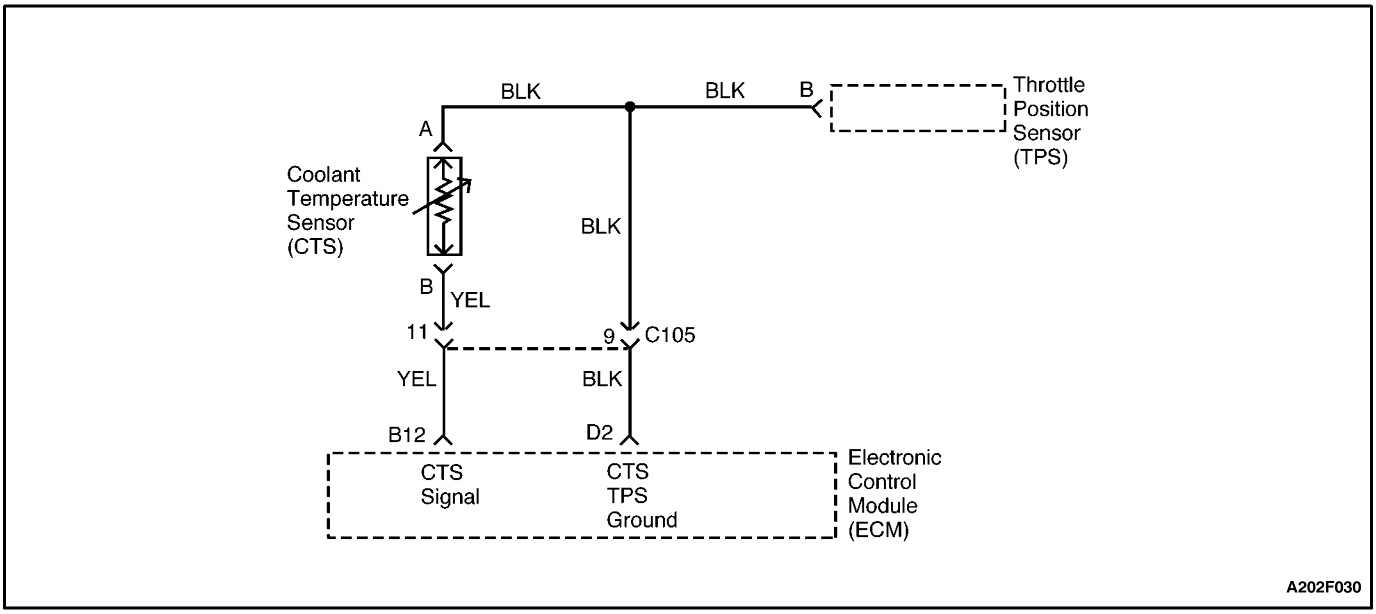

DIAGNOSTIC TROUBLE CODE (DTC) 15
COOLANT TEMPERATURE LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 15 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature below * 35°C (* 31°F).

Diagnostic Aids

- If connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The “Temperature Vs. Resistance Values” scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a “shifted” or “mis-scaled” CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 15. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 15 – Coolant Temperature Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display engine coolant temperature below the value specified?	* 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	Jumper terminals A and B of the CTS connector. Does the scan tool display engine coolant temperature above the value specified?	180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace damaged terminals as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal D2 for an open or short to battery voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 15 – Coolant Temperature Low (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire between the CTS connector terminal B and the ECM connector terminal B12 for an open or short battery voltage. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect ECM red connector. 3. Check the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the ECM connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the open or short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal D2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the open or short to voltage in the wire between the CTS connector terminal B and the ECM connector terminal B12. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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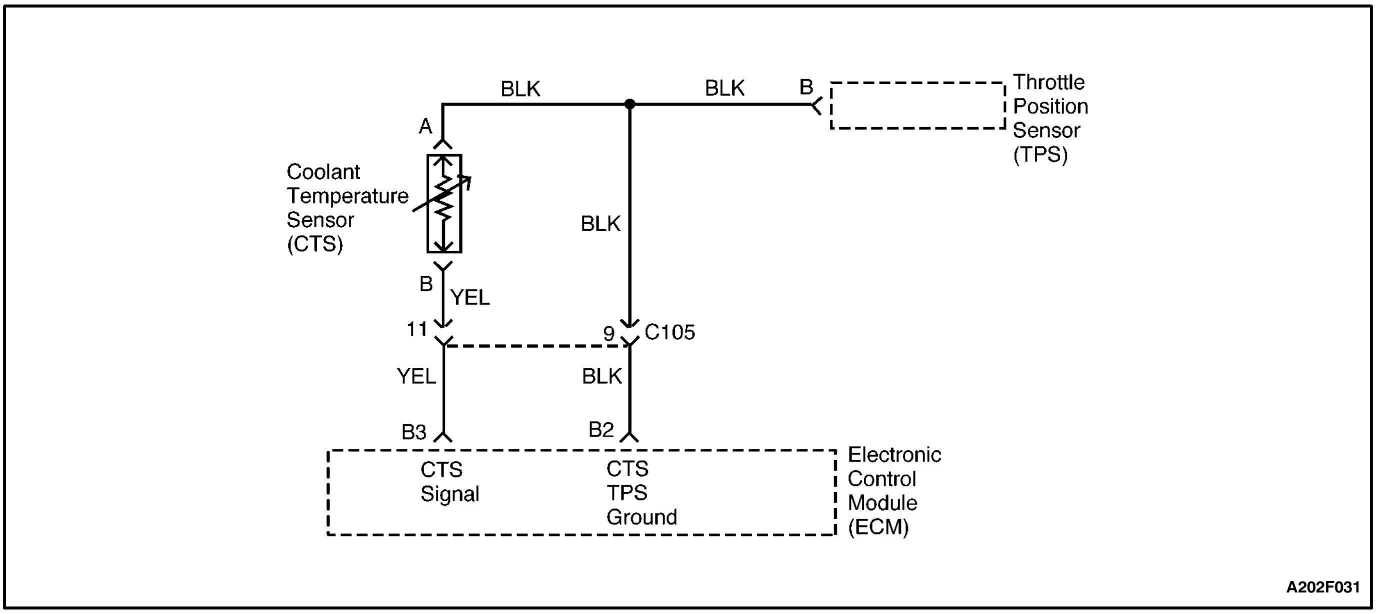

DIAGNOSTIC TROUBLE CODE (DTC) 15
COOLANT TEMPERATURE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 15 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature below * 35°C (* 31°F).

Diagnostic Aids

- If connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The “Temperature Vs. Resistance Values” scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a “shifted” or “mis-scaled” CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
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60	140	667
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0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 15. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 15 – Coolant Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display engine coolant temperature below the value specified?	* 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	Jumper terminals A and B of the CTS connector. Does the scan tool display engine coolant temperature above the value specified?	180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace damaged terminals as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal B2 for an open or short to battery voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 15 – Coolant Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire between the CTS connector terminal B and the ECM connector terminal B3 for an open or short battery voltage. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect ECM red connector. 3. Check the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the ECM connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the open or short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal B2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the open or short to voltage in the wire between the CTS connector terminal B and the ECM connector terminal B3. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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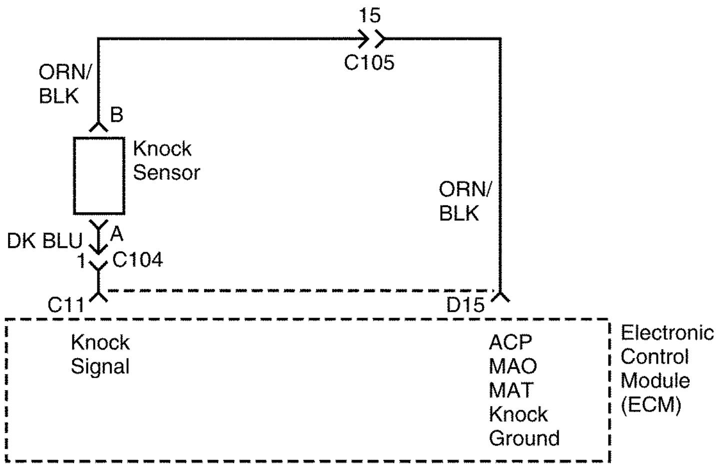


DIAGNOSTIC TROUBLE CODE (DTC) 16
KNOCK SENSOR FAILURE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

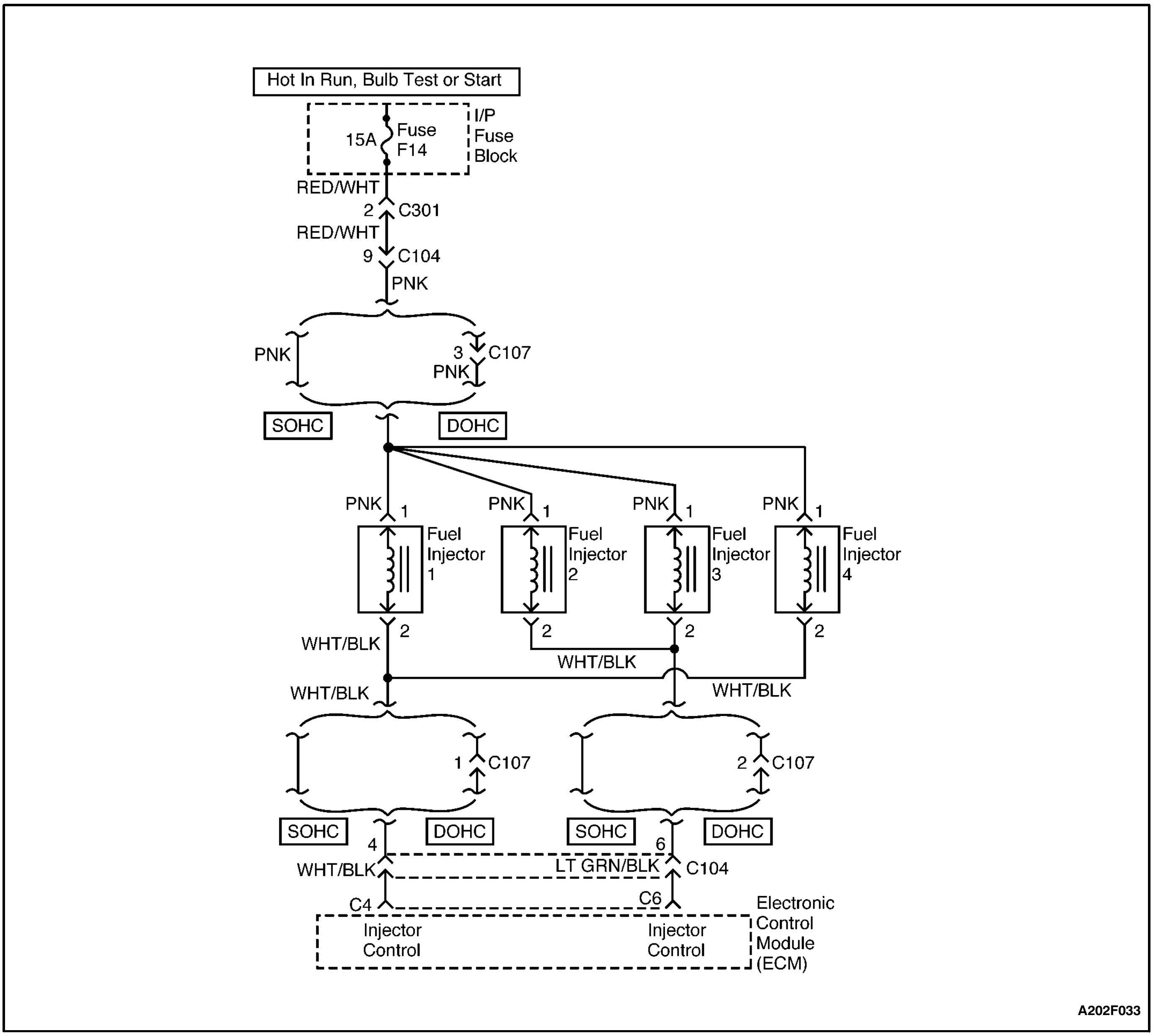
The knock sensor is used to detect engine detonation, allowing the electronic control module (ECM) to retard ignition control spark timing based on the knock sensor signal being received. The knock sensor produces an AC signal. The knock sensor signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM contains a non-replaceable knock filter module called a signal-to-noise enhancement filter (SNEF) module. This filter module in the ECM determines whether knock is occurring by comparing the signal level on the knock sensor circuit with the voltage level on the noise channel. The noise channel allows the ECM to reject any false knock signal by knowing the amount of normal engine mechanical noise present. Normal engine noise varies depending on engine speed and load. When the ECM determines that an abnormally low noise channel voltage level is being experienced, Diagnostic Trouble Code (DTC) 16 will set.

DTC 16 Will Set When

- **The engine speed is above 2,800 rpm.**
- **Maximum integrated value is above 192.**
- **Minimum integrated value is below 20.**
- **The setup time is more than 8 seconds.**

DTC 16 – Knock Sensor (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check was performed?	-	Go to Step 2	-
2	Replace the electronic control module (ECM). Is the repair complete?	-	Go to "Diagnostic System Check"	-



DIAGNOSTIC TROUBLE CODE (DTC) 17 INJECTOR SHORTED TO GROUND/BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition switch is turned to ON or START, the electronic control module (ECM) will energize and de-energize the fuel injector solenoid coil. With the solenoid coil energized, a plunger is activated, which allows pressurized fuel to be sprayed through the fuel injector into the combustion chamber where it is mixed with air from the intake manifold. This creates the proper air/fuel mixture needed for combustion.

DTC 17 Will Set When

- The fuel pump is running.
- Battery voltage is equal to or greater than 9 volts.
- A fuel injector fault has been detected more than three times in successive 1-second intervals.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the presence of battery voltage to the fuel injectors.

3. If the fuel injector test light does not flash for one of the fuel injectors, there is an open fuel injector control wire to the ECM or the ECM is faulty.

13. An open coil in a fuel injector will prevent the fuel injector from operating.

DTC 17 – Injector Shorted to Ground/Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the fuel injector harness from all of the fuel injectors. 2. Turn the ignition ON. 3. Measure the voltage at all of the fuel injector harness terminals. Is battery voltage present only on terminal 1 of each connector?	-	Go to Step 3	Go to Step 8
3	Connect a fuel injector test light to each of the fuel injector harness connectosr while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 13	Go to Step 4
4	Does the fuel injector test light stay off for one or more of the fuel injector(s)?	-	Go to Step 6	Go to Step 5
5	Does the fuel injector test light stay on for one or more of the fuel injector(s)?	-	Go to Step 11	-
6	1. Check for a short to battery positive between the fuel injector harness connector terminal 2 and the electronic control module (ECM) connector terminal C4 for fuel injectors 1 and 4. 2. Check for a short to battery positive between the fuel injector harness connector terminal 2 and the ECM connector terminal C6 for fuel injectors 2 and 3. Is the problem found?	-	Go to Step 7	Go to Step 15
7	1. Repair the short to battery positive as needed. 2. Connect an injector test light to each injector harness connector while cranking the engine. Does the test light blink on all of the connectors?	-	Go to "Diagnostic System Check"	-
8	Is battery voltage not present at terminal 1 of any injector harness connector?	-	Go to Step 10	Go to Step 9
9	Is battery voltage present at terminal 2 of any injector harness connector?	-	Go to Step 6	-
10	1. Check for a short to ground in the fuel injector harness. 2. Check the fuel injector harness connectors for damaged terminals. 3. Perform repairs as needed. 4. Check for battery voltage at terminal 1 of all of the fuel injector harness connectors. Is battery voltage present only on terminal 1 of each connector?	-	Go to Step 3	-

DTC 17 – Injector Shorted to Ground/Battery (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Check for a short to ground between the fuel injector harness connector terminal 2 and ECM connector terminal C4 for injectors 1 and 4. 2. Check for a short to ground between the fuel injector harness connector terminal 2 and ECM connector terminal C6 for injectors 2 and 3. Is the problem found?	-	Go to Step 12	Go to Step 15
12	1. Repair the short to ground as needed. 2. Connect a fuel injector test light to each of the fuel injector harness connectors while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 13	Go to Step 4
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 14
14	1. Replace any of the fuel injectors with a resistance that is out of specification. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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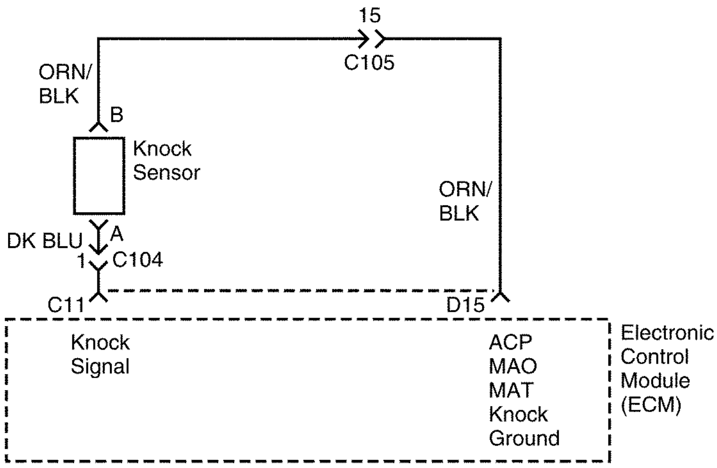


DIAGNOSTIC TROUBLE CODE (DTC) 18
DSNEF CONTROL ERROR FAILURE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) uses the knock sensor to detect engine detonation, allowing the ECM to retard ignition control spark timing based on the knock sensor signal being received. The knock sensor produces an AC signal. The signal amplitude and frequency are dependent upon the amount of knock being experienced.

DTC 18 Will Set When

- Knock detection is enabled.
- Diagnostic Trouble Code (DTC) 16 is not set.
- The engine speed is above 2,000 rpm.
- Maximum integrated value is above 110 for at least 2 seconds.
- Minimum integrated value is below 1 for at least 2 seconds.
- Noise value is above 32 counts for at least 4 seconds.
- Noise value is below 0 counts for at least 4 seconds.

Diagnostic Aids

- Repair any engine mechanical problem before proceeding with diagnostics.
- Make sure the correct fuel octane rating is used.

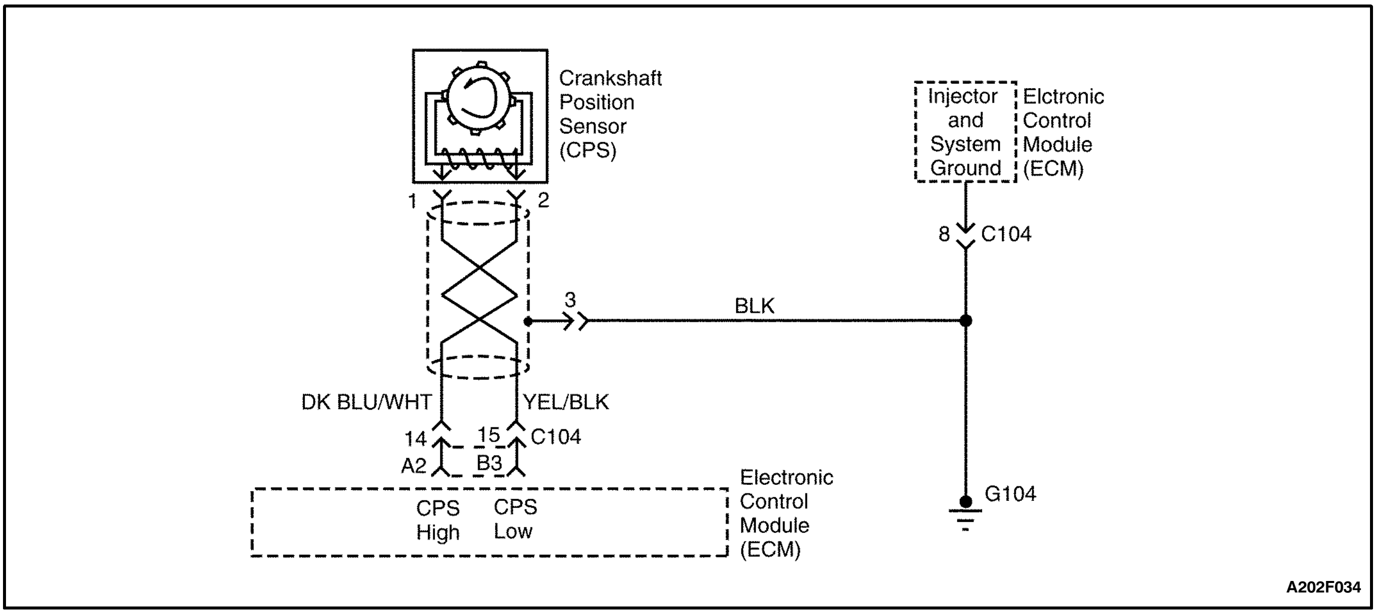
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the signal circuit and not sensor voltage.
6. Check the ground side of the circuit for an open, a short to ground, or a short to battery.

DTC 18 – DSNEF Control Error Failure (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the electronic control module (ECM). 3. Connect a digital voltmeter (DVM) to monitor AC voltage between terminal C11 of the ECM connector and ground. 4. Tap on the engine with an extension near the knock sensor while observing the signal on the DVM. Is any signal indicated on the DVM while tapping on the engine?	-	Go to Step 3	Go to Step 4
3	1. Connect the electrical connector at the ECM. 2. Disconnect the electrical connector at the knock sensor. 3. Using a test light to battery positive, probe terminal B on the ECM side of the knock sensor. Did the test light illuminate?	-	Go to Step 6	Go to Step 8
4	Check the wire from terminal C11 on the ECM to terminal A on the ECM side of the knock sensor for an open, a short to ground, or a short to battery. Does the wire indicate an open, a short to ground, or a short to battery?	-	Go to Step 5	Go to Step 7
5	Repair the wire from terminal C11 of the ECM to terminal A on the ECM side of the knock sensor. Is the repair complete?	-	Go to "Diagnostic System Check"	-
6	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-
7	Replace the knock sensor. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Repair the wire from terminal B of the knock sensor to terminal D15 of the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-



DIAGNOSTIC TROUBLE CODE (DTC) 19
58X SIGNAL ERROR (A AND B) (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The crankshaft position sensor (CPS) is a Hall-effect sensor which senses a slotted wheel that is attached to the crankshaft pulley. The slotted wheel interrupts a magnetic field and produces a reference signal from the sensor.

DTC 19 Will Set When

- The revolutions of the 58X signal are fewer than 64.
- There are 10 or more consecutive missing pulses.
- The manifold absolute pressure (MAP) drops when the starter motor running is below 0.6 kPa for more than 3 seconds.
- Voltage drops when the starter motor is running below 0.5 v for more than 3 seconds.

Diagnostic Aids

Check for poor connections at the electronic control module (ECM) and at the CPS.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

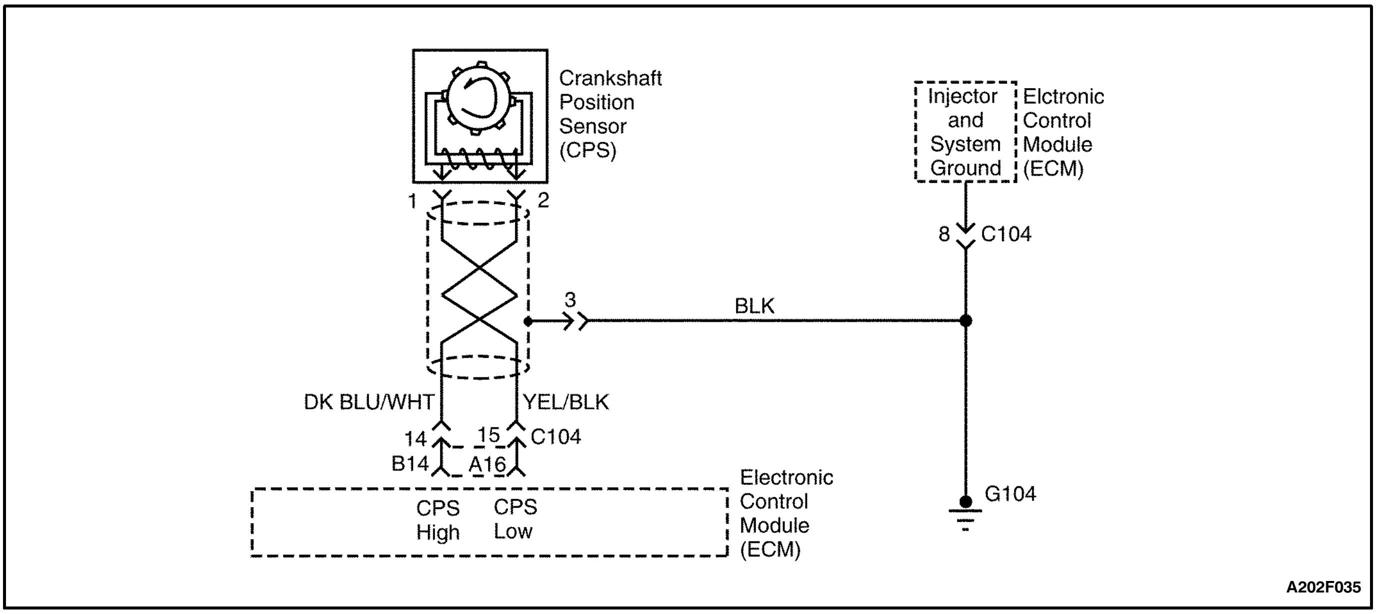
3. It is important to inspect all of the connector terminals to prevent inaccurate diagnosis.
6. The specified value during cranking is an average voltage produced as the sensor voltage oscillates.

DTC 19 – 58X Signal Error (A and B) (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Start the engine and allow it to idle. Does the engine start?	-	Go to Step 3	Go to "Engine Cranks But Will Not Start"
3	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Inspect the CPS terminals. Are any terminals damaged?	-	Go to Step 13	Go to Step 4

DTC 19 – 58X Signal Error (A and B) (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Inspect the CPS connector terminals. Are any connector terminals damaged?	-	Go to Step 5	Go to Step 6
5	1. Repair or replace any damaged terminals. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Connect the CPS connector. 2. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 3. Connect a voltmeter between ground and the ECM connector terminal A2 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 7	Go to Step 9
7	Connect a voltmeter between ground and the ECM connector terminal B3 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 8	Go to Step 10
8	1. Connect the DIS ignition coil connector 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	Check for an open or short in the wire between the CPS connector terminal 1 and the ECM connector terminal A2. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the problem found?	-	Go to Step 12	Go to Step 11
11	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 12	Go to Step 13
12	1. Connect the DIS ignition coil connector. 2. Repair the wiring needed. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Connect the DIS ignition coil connector. 2. Replace the CPS. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 19
58X SIGNAL ERROR (A AND B) (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The crankshaft position sensor (CPS) is a Hall-effect sensor which senses a slotted wheel that is attached to the crankshaft. The slotted wheel interrupts a magnetic field and produces a reference signal from the sensor.

DTC Will Set When

- Starting manifold absolute pressure (MAP) is less than 0.600 kPa (0.178 inches Hg).
- Starting battery voltage is less than 0.5 volt for at least 3 seconds.
- There are 10 or more consecutive missing pulses.
- The revolutions of the 58X signal are fewer than 64.

Diagnostic Aids

Check for poor connections at the electronic control module (ECM) and at the CPS.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

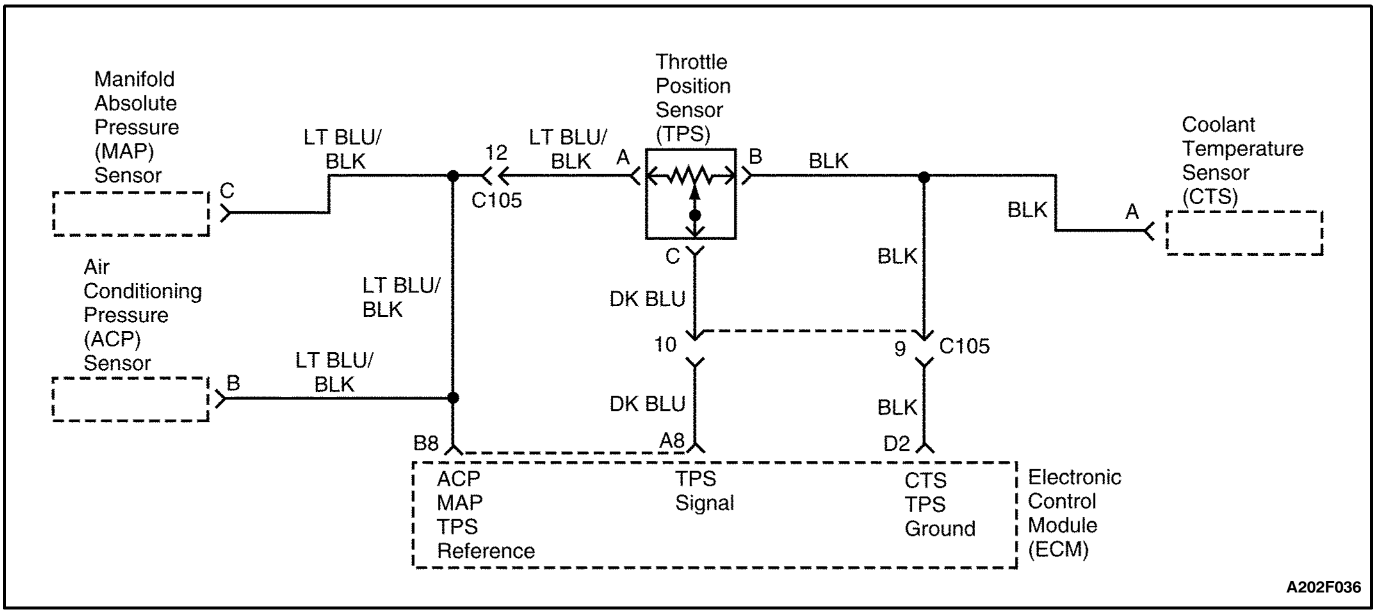
3. It is important to inspect all of the connector terminals to prevent inaccurate diagnosis.
6. The specified value during cranking is an average voltage produced as the sensor voltage oscillates.

DTC 19 – 58X Signal Error (A and B) (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Start the engine and allow it to idle. Does the engine start?	-	Go to Step 3	Go to "Engine Cranks But Will Not Start"
3	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Inspect the CPS terminals. Are any terminals damaged?	-	Go to Step 13	Go to Step 4

DTC 19 – 58X Signal Error (A and B) (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Inspect the CPS connector terminals. Are any connector terminals damaged?	-	Go to Step 5	Go to Step 6
5	1. Repair or replace any damaged terminals. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Connect the CPS connector. 2. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 3. Connect a voltmeter between ground and the ECM connector terminal B14 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 7	Go to Step 9
7	Connect a voltmeter between ground and the ECM connector terminal A16 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 8	Go to Step 10
8	1. Connect the DIS ignition coil connector 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	Check for an open or short in the wire between the CPS connector terminal 1 and the ECM connector terminal B14. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the problem found?	-	Go to Step 12	Go to Step 11
11	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 12	Go to Step 13
12	1. Connect the DIS ignition coil connector. 2. Repair the wiring needed. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Connect the DIS ignition coil connector. 2. Replace the CPS. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION SENSOR HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 21 Will Set When

- Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.
- The engine speed is less than 1,750 rpm.
- The manifold absolute pressure (MAP) reading is below 65 kPa (19 inches Hg).
- The TPS reading is greater than 200 counts.
- All of the above conditions are present for 5 seconds.

Diagnostic Aids

- Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.
- Observe the TPS voltage on a scan tool with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.

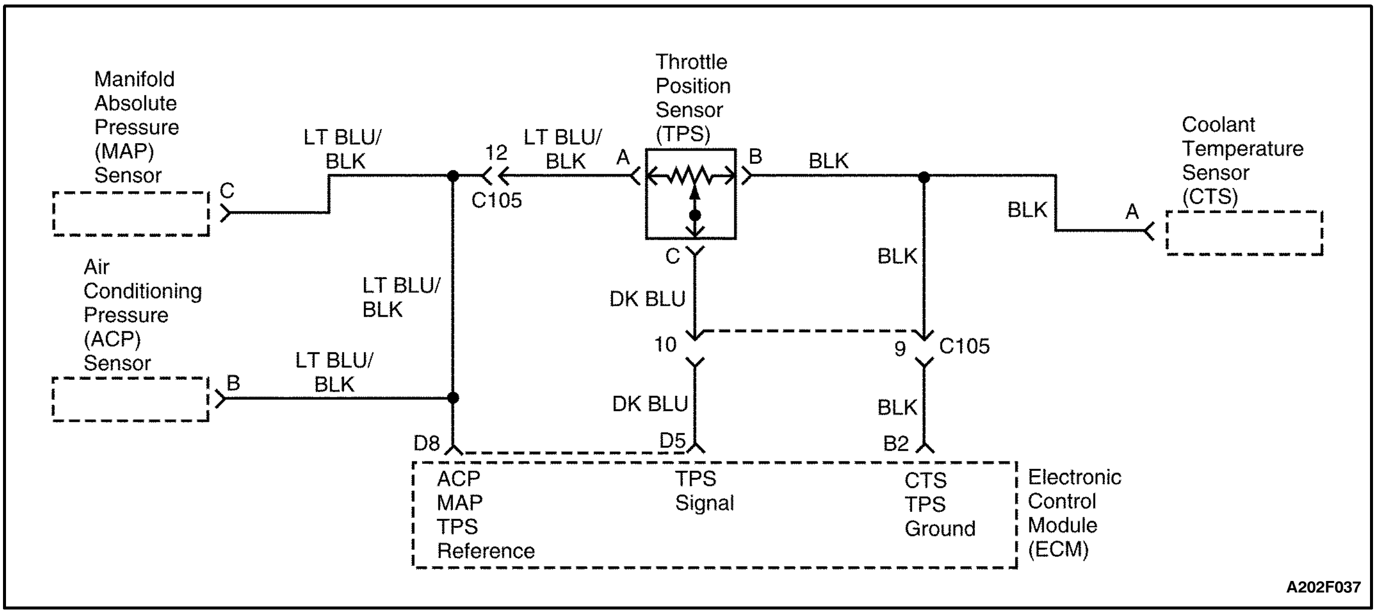
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the voltage reference from the ECM and also the ground wire to the ECM.
4. This step checks the TPS signal wire. If the scan tool shows the TPS voltage above 4 volts, the signal wire is OK.
10. After checking the TPS wiring and confirming the ECM's ability to read a TPS signal, it can be determined that the TPS is at fault.

DTC 21 – Throttle Position Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage change smoothly within the value specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Jumper the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4.0 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check for a short to battery voltage in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal D2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	Check for a short to battery voltage in the wire between the TPS connector terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for a short to voltage in the wire between the TPS connector terminal C and the ECM connector terminal A8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the TPS. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Replace the electronic control module. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION SENSOR HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 21 Will Set When

- Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.
- The engine speed is less than 3,000 rpm.
- The manifold absolute pressure (MAP) reading is below 85 kPa (25 inches Hg).
- The TPS reading is greater than 240 counts.
- These conditions are present for 2 seconds.

Diagnostic Aids

- Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.
- Observe the TPS voltage on a scan tool with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.

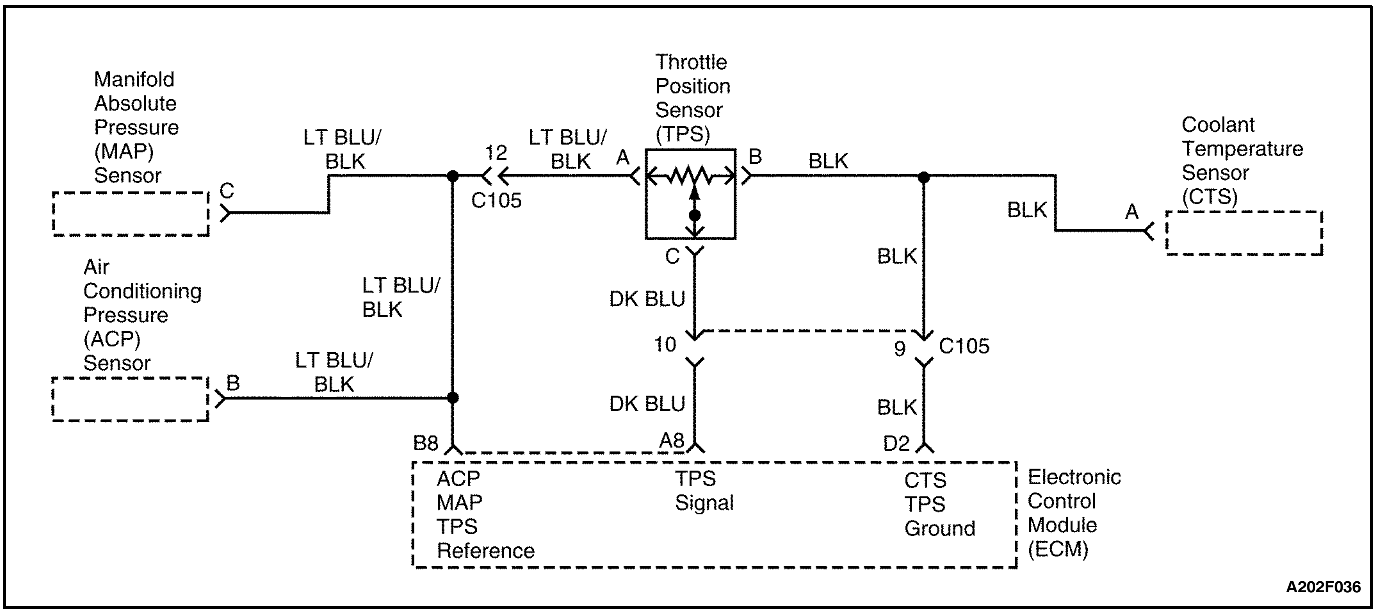
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the voltage reference from the ECM and also the ground wire to the ECM.
4. This step checks the TPS signal wire. If the scan tool shows the TPS voltage above 4 volts, the signal wire is OK.
10. After checking the TPS wiring and confirming the ECM's ability to read a TPS signal, it can be determined that the TPS is at fault.

DTC 21 – Throttle Position Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage change smoothly within the value specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Jumper the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4.0 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check for a short to battery voltage in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	Check for a short to battery voltage in the wire between the TPS connector terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for a short to voltage in the wire between the TPS connector terminal C and the ECM connector terminal D5. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the TPS. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 22
THROTTLE POSITION SENSOR LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 22 Will Set When

- Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.
- The TPS reading is less than 10 counts.
- The condition is present for 5 seconds.

Diagnostic Aids

- Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.
- Observe the TPS voltage on a scanner with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.

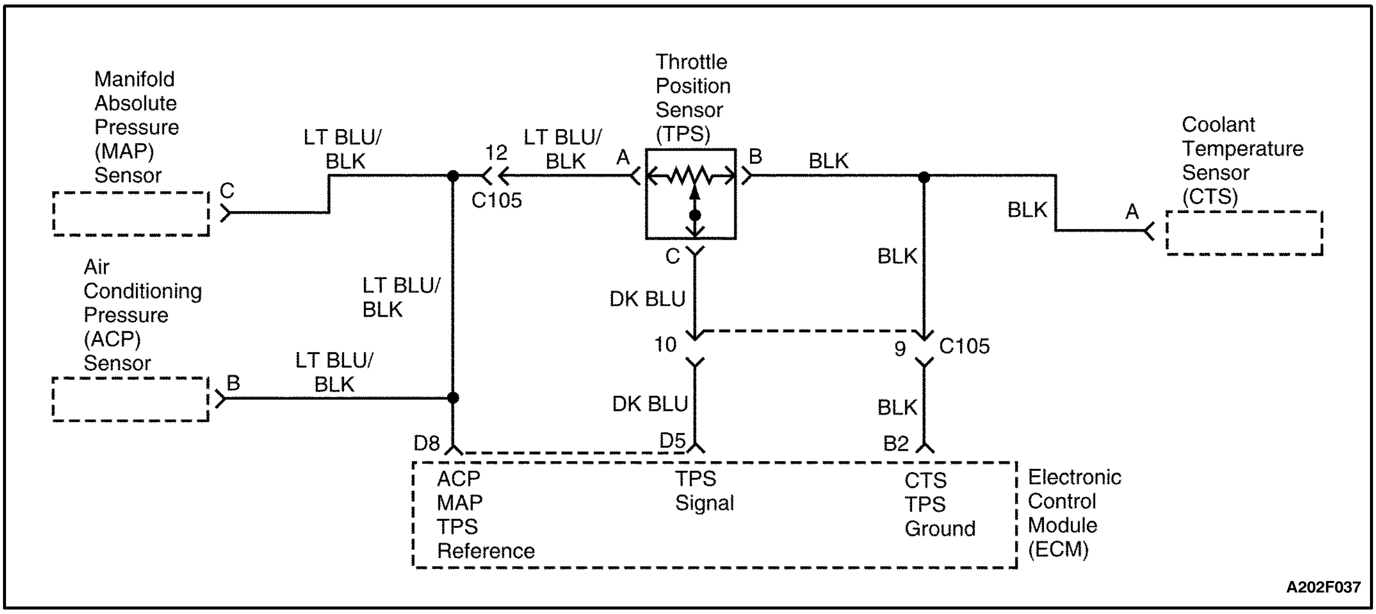
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. When measuring the voltage between the TPS terminals A and B, 4.5 to 5.5 volts confirms the 5-volt reference and ground from the ECM are OK.
11. If there is a problem with the voltage reference or the ground from the ECM, confirm that the wiring is OK. If there is no problem present in the wiring, the ECM is at fault.

DTC 22 – Throttle Position Sensor Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage changing smoothly within the values specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Connect a fused jumper between the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and the ground. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Check for an open in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal D2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the TPS connector terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to ground between the TPS connector terminal C and the ECM connector terminal A8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the TPS. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 22
THROTTLE POSITION SENSOR LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 22 Will Set When

- The TPS reading is less than 11 counts.
- Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.

Diagnostic Aids

- Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.
- Observe the TPS voltage on a scanner with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.

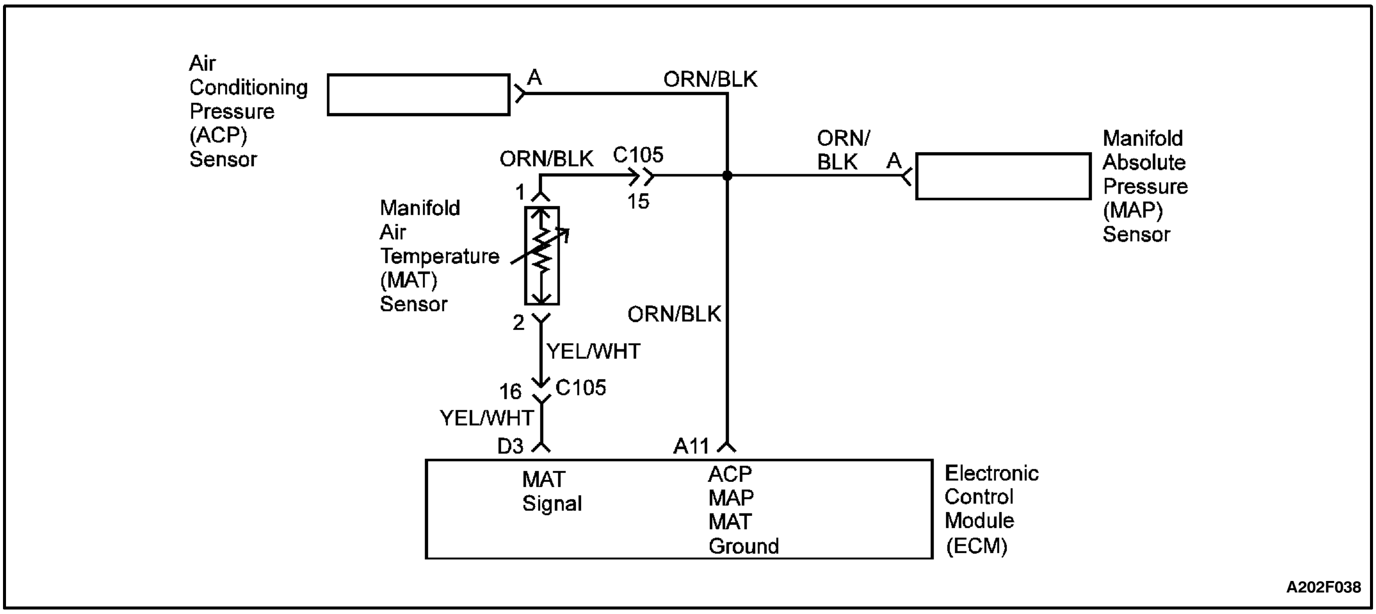
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. When measuring the voltage between the TPS terminals A and B, 4.5 to 5.5 volts confirms the 5-volt reference and ground from the ECM are OK.
11. If there is a problem with the voltage reference or the ground from the ECM, confirm that the wiring is OK. If there is no problem present in the wiring, the ECM is at fault.

DTC 22 – Throttle Position Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage changing smoothly within the values specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Connect a fused jumper between the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and the ground. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Check for an open in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the TPS connector terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to ground between the TPS connector terminal C and the ECM connector terminal D5. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the TPS. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 23
MANIFOLD AIR TEMPERATURE HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 23 Will Set When

- The engine has been running longer than 50 seconds.
- The MAT sensor signal voltage indicates a temperature above 145°C (293°F).

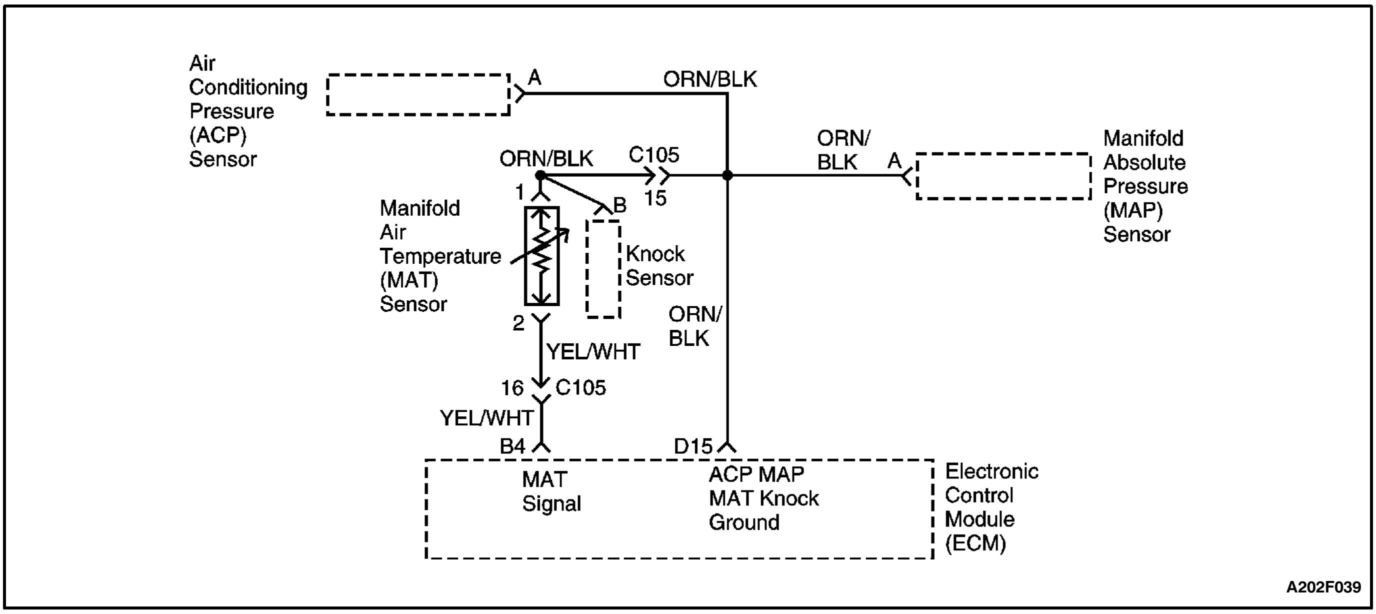
Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 23 – Manifold Air Temperature Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Turn the ignition ON. Does the scan tool show the MAT sensor reading below the value specified?	Lower Than * 35°C (* 31°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 7	Go to Step 8
5	Check the wire for a short to ground between the MAT connector terminal 2 and the electronic control module (ECM) connector terminal D3. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check the wire for a short to ECM reference voltage between the MAT connector terminal 1 and the ECM connector terminal A11. Is the problem found?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 2
8	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ECM. 3. Run the engine until it reaches operating temperature. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 23
MANIFOLD AIR TEMPERATURE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 23 Will Set When

- The engine has been running longer than 120 seconds.
- The MAT sensor signal voltage indicates a temperature above 140°C (284°F).

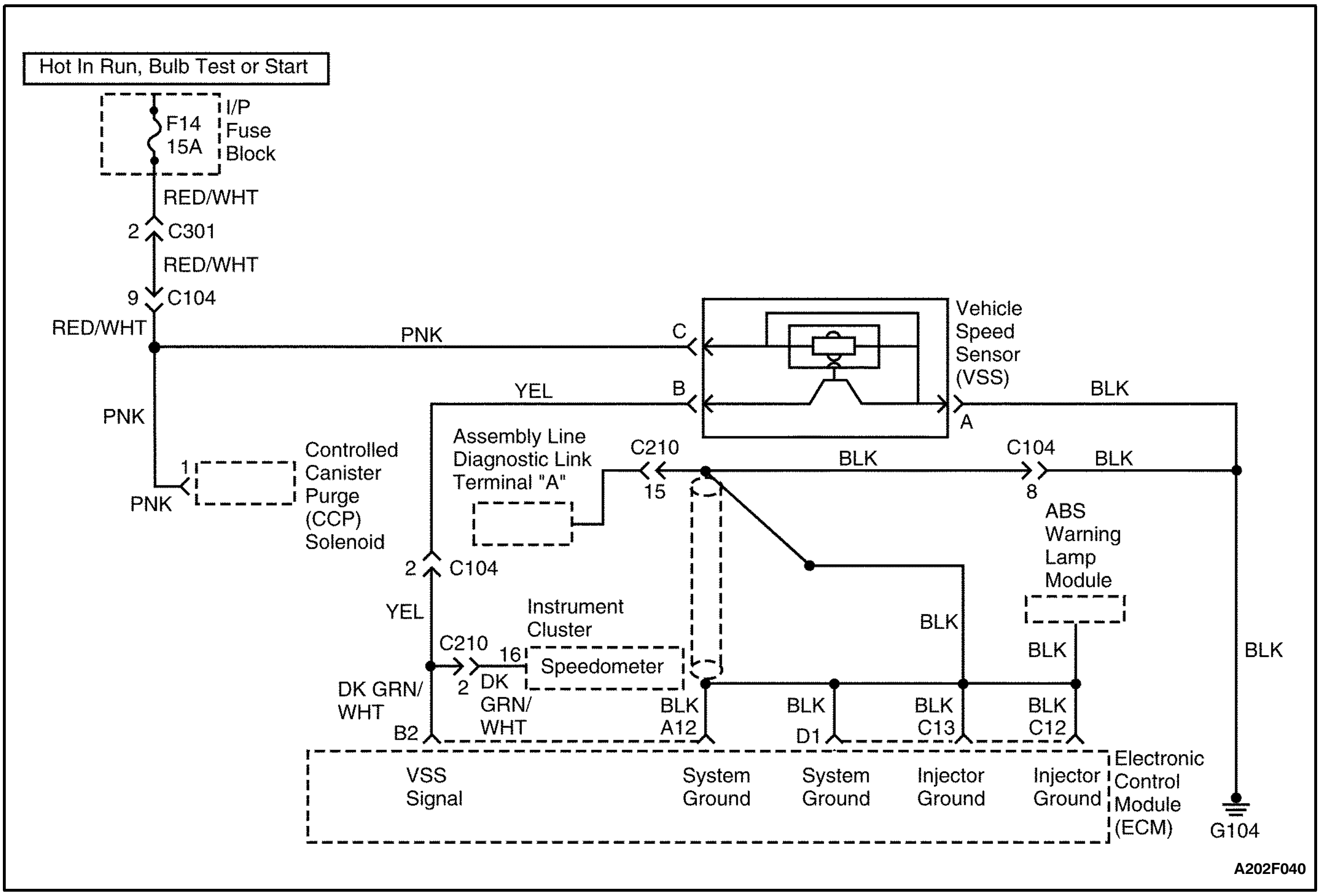
Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 23 – Manifold Air Temperature Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Turn the ignition ON. Does the scan tool show the MAT sensor reading below the value specified?	Lower Than * 35°C (* 31°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 7	Go to Step 8
5	Check the wire for a short to ground between the MAT connector terminal 2 and the electronic control module (ECM) connector terminal B4. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check the wire for a short to ECM reference voltage between the MAT connector terminal 1 and the ECM connector terminal D15. Is the problem found?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 2
8	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ECM. 3. Run the engine until it reaches operating temperature. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR ERROR – MANUAL TRANSAXLE
(1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) applies and monitors 12 volts on the signal wire between the vehicle speed sensor (VSS) and the ECM. The signal wire connects to the VSS which alternately grounds the signal wire when the drive wheels are turning. This pulsing action takes place 2,289 times per kilometer (3,683 times per mile). The ECM will calculate vehicle speed based on the time between the pulses. This information is also displayed by the vehicle speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Code (DTC) 34 is not set.
- The engine speed is between 1,600 rpm and 4,300 rpm.
- The VSS indicates a speed less than 8 km/h (5 mph).
- The manifold absolute pressure (MAP) sensor signal indicates less than 23 kPa (7 inches of Hg).
- These conditions are present for 10 seconds.

Diagnostic Aids

- Scan tool data should indicate a vehicle speed whenever the drive wheels are turning at more than 5 km/h (3 mph).

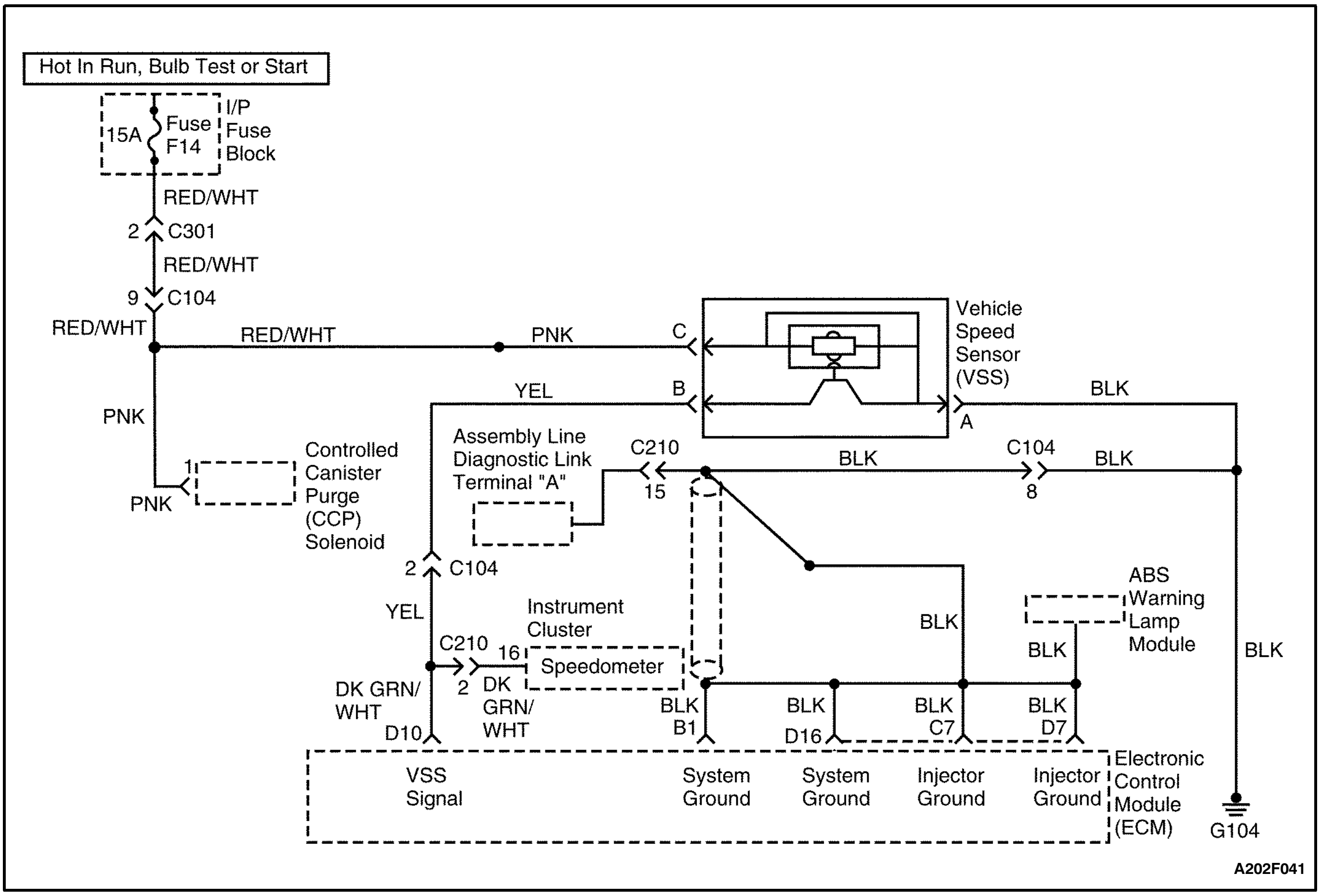
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. By momentarily touching the VSS connector terminal 2 several times a second, a simulated VSS signal is created. If voltage and ground are present at the VSS, the VSS is faulty.

DTC 24 – Vehicle Speed Sensor Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. Does the scan tool read vehicle speed?	-	Go to “Diagnostic Aids”	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the vehicle speed sensor (VSS) connector. 3. Turn the ignition ON. 4. Connect a test light between the VSS connector terminal B and ground. Is the test light on?	-	Go to Step 9	Go to Step 4
4	With a test light connected to ground, momentarily touch the VSS connector terminal B several times a second. Does the scan tool read vehicle speed?	-	Go to Step 5	Go to Step 11
5	Connect a test light between the VSS connector terminal C and ground. Is the test light on?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Connect a test light between the VSS connector terminal A and battery positive. Is the test light on?	-	Go to Step 10	Go to Step 8
7	Repair the open wire between the VSS connector terminal C and the ignition switch. Is the repair complete?	-	System OK	-
8	Repair the open wire between the VSS connector terminal A and ground. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in the wire between the VSS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the repair complete?	-	System OK	-
10	Replace the VSS. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Check for an open wire between the VSS connector terminal B and the ECM connector terminal B2. Is the problem found?	-	Go to Step 12	Go to Step 13
12	Repair the open wire between the VSS connector terminal B and the ECM connector terminal B2. Is the repair complete?	-	System OK	-
13	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24 VEHICLE SPEED SENSOR ERROR – MANUAL TRANSAXLE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) applies and monitors 12 volts on the signal wire between the vehicle speed sensor (VSS) and the ECM. The signal wire connects to the VSS which alternately grounds the signal wire when the drive wheels are turning. This pulsing action takes place 2,289 times per kilometer (3,683 times per mile). The ECM will calculate vehicle speed based on the time between the pulses. This information is also displayed by the vehicle speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Codes (DTCs) 21, 22, 33, and 34 are not set.
- The engine speed is between 2,000 rpm and 5,000 rpm.
- The VSS indicates a speed less than 6 km/h (4 mph).
- The manifold absolute pressure (MAP) sensor signal indicates less than 24 kPa (7 inches of Hg) for more than 4 seconds.
- These conditions are present for 4 seconds.

Diagnostic Aids

- Scan tool data should indicate a vehicle speed whenever the drive wheels are turning at more than 5 km/h (3 mph).

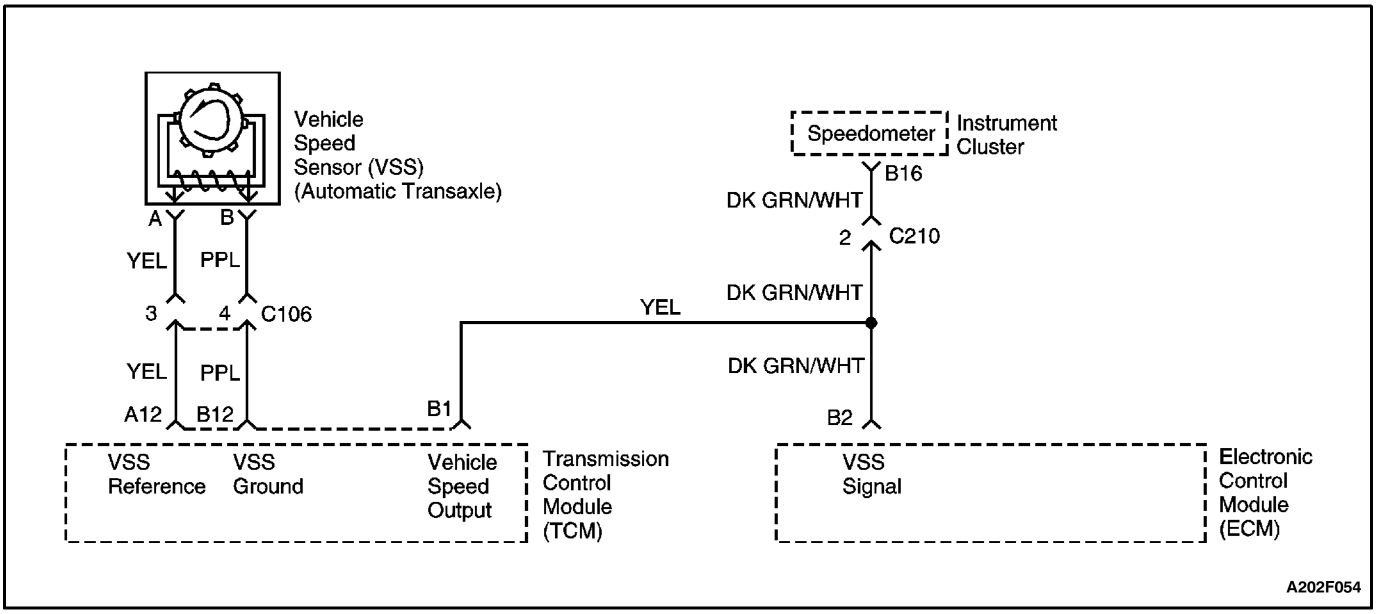
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. By momentarily touching the VSS connector terminal 2 several times a second, a simulated VSS signal is created. If voltage and ground are present at the VSS, the VSS is faulty.

DTC 24 – Vehicle Speed Sensor Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. Does the scan tool read vehicle speed?	-	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the vehicle speed sensor (VSS) connector. 3. Turn the ignition ON. 4. Connect a test light between the VSS connector terminal B and ground. Is the test light on?	-	Go to Step 9	Go to Step 4
4	With a test light connected to ground, momentarily touch the VSS connector terminal B several times a second. Does the scan tool read vehicle speed?	-	Go to Step 5	Go to Step 11
5	Connect a test light between the VSS connector terminal C and ground. Is the test light on?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Connect a test light between the VSS connector terminal A and battery positive. Is the test light on?	-	Go to Step 10	Go to Step 8
7	Repair the open wire between the VSS connector terminal C and the ignition switch. Is the repair complete?	-	System OK	-
8	Repair the open wire between the VSS connector terminal A and ground. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in the wire between the VSS connector terminal B and the electronic control module (ECM) connector terminal D10. Is the repair complete?	-	System OK	-
10	Replace the VSS. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Check for an open wire between the VSS connector terminal B and the ECM connector terminal D10. Is the problem found?	-	Go to Step 12	Go to Step 13
12	Repair the open wire between the VSS connector terminal B and the ECM connector terminal D10. Is the repair complete?	-	System OK	-
13	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24 VEHICLE SPEED SENSOR ERROR – AUTOMATIC TRANSAXLE (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

Vehicle speed is provided to the transaxle control module (TCM) by the automatic transaxle output (shaft) vehicle speed sensor (VSS), which is a permanent magnet (PM) generator mounted to the transaxle case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, torque converter clutch (TCC) apply, TCC release, and gear ratio calculations. A digital output signal is then sent from the TCM to the electronic control module (ECM). This signal is also sent to the instrument panel for operation of the speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Code (DTC) 34 is not set.
- The engine speed is between 1,600 rpm and 4,300 rpm.
- The VSS indicates a speed less than 8 km/h (5 mph).
- The manifold absolute pressur (MAP) sensor signal indicates less than 23 kPa (7 inches of Hg).
- These conditions are present for 10 seconds.

Diagnostic Aids

- The condition may be intermittent. Check for a loose VSS mounting or poor connections.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing the test equipment for a change.

Test Description

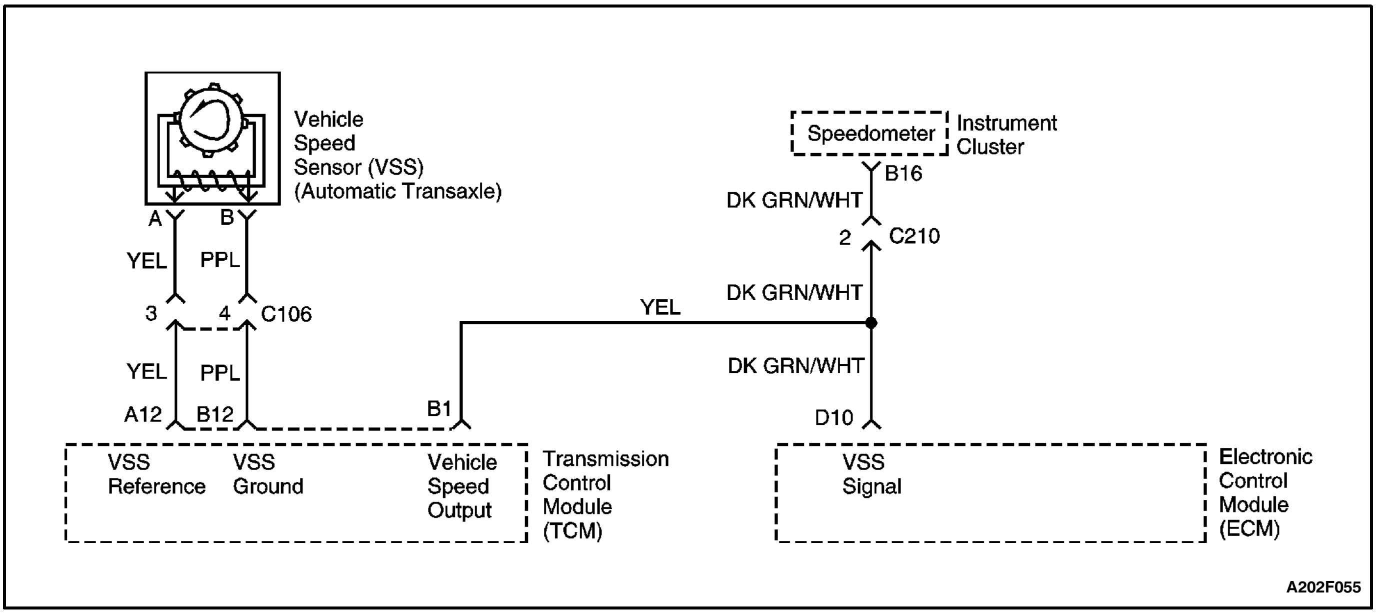
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for an output signal from the TCM to the electronic control module (ECM).
4. It is important to remember that the vehicle speed output is also sent to the instrument panel for speedometer operation.

DTC 24 – Vehicle Speed Sensor Error – Automatic Transaxle (1.3L and 1.5L SOHC IEFI-6)

Notice: In order to avoid damage to the drive axles when raising the drive wheels, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.

Step	Action	Value(s)	Yes	No
1	Check for the presence of any transaxle control module (TCM) diagnostic trouble code(s) (DTCs) for the vehicle speed sensor (VSS). Is a TCM DTC present?	-	Go to the applicable DTC Table	Go to Step 2
2	1. Turn the ignition OFF. 2. Raise and suitably support the drive wheels. 3. Measure the voltage by backprobing the electronic control module (ECM) 24-pin connector terminal B2. 4. Start the engine and allow the engine to idle. 5. Place the transaxle in drive (D). Is a fluctuating voltage present?	-	Go to Step 6	Go to Step 3
3	1. Turn the ignition OFF. 2. Check for an open or short in the wire between the ECM connector terminal B2 and the TCM connector terminal B1. Is the problem found?	-	Go to Step 5	Go to Step 4
4	Check for an open or short in the wire between the ECM connector terminal B2 and the instrument panel connector terminal B16. Is the problem found?	-	Go to Step 5	Go to Step 7
5	Repair the wire as needed. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-
7	Replace the TCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24 VEHICLE SPEED SENSOR ERROR – AUTOMATIC TRANSAXLE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Vehicle speed is provided to the transaxle control module (TCM) by the automatic transaxle output (shaft) vehicle speed sensor (VSS), which is a permanent magnet (PM) generator mounted to the transaxle case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, torque converter clutch (TCC) apply, TCC release, and gear ratio calculations. A digital output signal is then sent from the TCM to the electronic control module (ECM). This signal is also sent to the instrument panel for operation of the speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Codes (DTCs) 21, 22, 33, and 34 is not set.
- The engine speed is between 2,000 rpm and 5,000 rpm.
- The VSS indicates a speed less than 6 km/h (3.5 mph).
- The manifold absolute pressure (MAP) sensor signal indicates less than 24 kPa (7 inches of Hg).
- These conditions are present for 4 seconds.

Diagnostic Aids

- The condition may be intermittent. Check for a loose VSS mounting or poor connections.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing the test equipment for a change.

Test Description

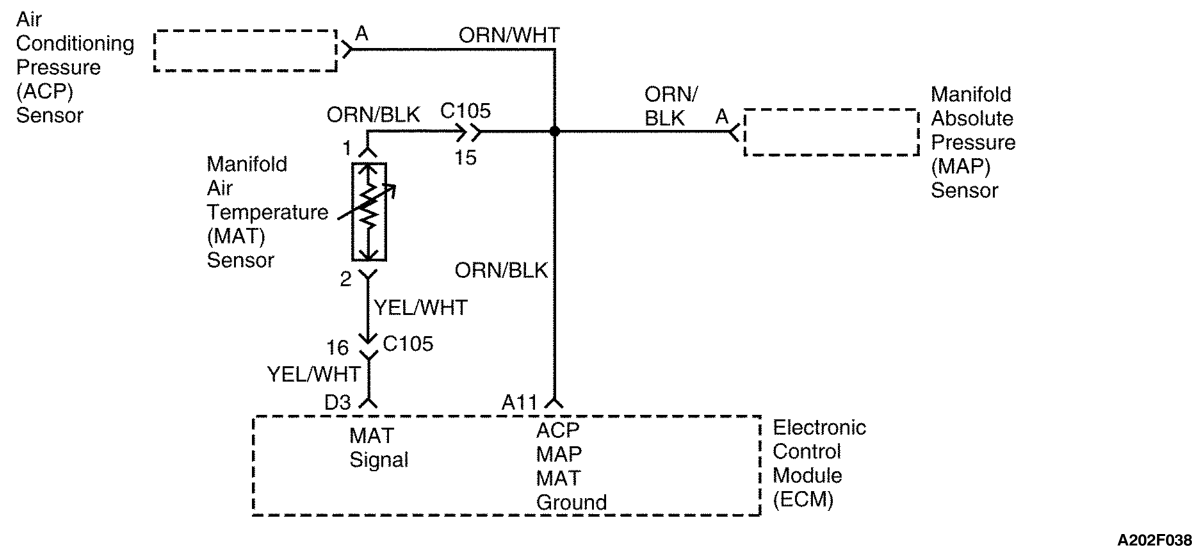
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for an output signal from the TCM to the ECM.
4. It is important to remember that the vehicle speed output is also sent to the instrument panel for speedometer operation.

DTC 24 – Vehicle Speed Sensor Error – Automatic Transaxle (1.3L SOHC and 1.6L DOHC ITMS-6F)

Notice: In order to avoid damage to the drive axles when raising the drive wheels, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.

Step	Action	Value(s)	Yes	No
1	Check for the presence of any transaxle control module (TCM) diagnostic trouble code(s) (DTCs) for the vehicle speed sensor (VSS). Is a TCM DTC present?	-	Go to the Applicable DTC Table	Go to Step 2
2	1. Turn the ignition OFF. 2. Raise and suitably support the drive wheels. 3. Measure the voltage by backprobing the electronic control module (ECM) 24-pin connector terminal D10. 4. Start the engine and allow the engine to idle. 5. Place the transaxle in drive (D). Is a fluctuating voltage present?	-	Go to Step 6	Go to Step 3
3	1. Turn the ignition OFF. 2. Check for an open or short in the wire between the ECM connector terminal D10 and the TCM connector terminal B1. Is the problem found?	-	Go to Step 5	Go to Step 4
4	Check for an open or short in the wire between the ECM connector terminal B2 and the instrument panel connector terminal B16. Is the problem found?	-	Go to Step 5	Go to Step 7
5	Repair the wire as needed. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-
7	Replace the TCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 25
MANIFOLD AIR TEMPERATURE LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 25 Will Set When

- **The engine has been running longer than 50 seconds.**
- **The MAT sensor signal voltage indicates a temperature less than * 35°C (* 31°F).**

Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

Test Description

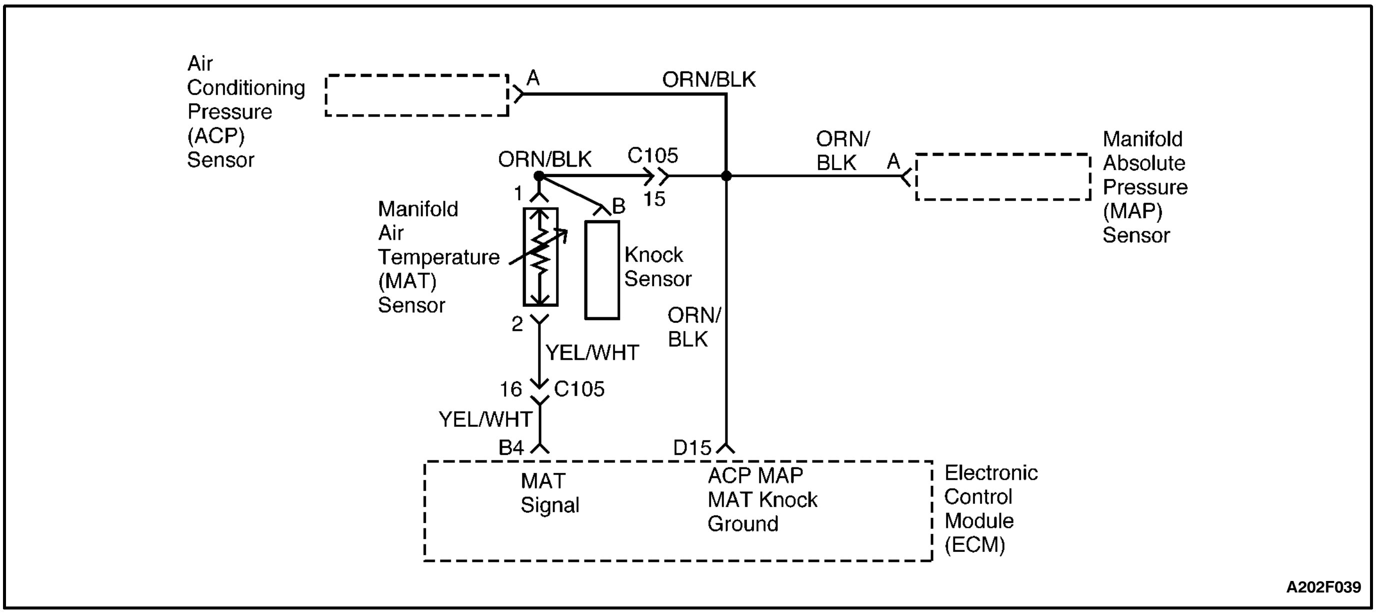
The number(s) below refer to step(s) on the diagnostic table.

6. This step checks for reference voltage and ground from the ECM.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 25 – Manifold Air Temperature Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Jumper the MAT connector terminals. 4. Turn the ignition ON. Does the scan tool show the MAT sensor reading above the value specified?	180°C (356°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 10	Go to Step 9
5	Measure the voltage between terminals 1 and 2 of the MAT connector. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 11	Go to Step 6
6	Measure the voltage between the MAT terminal 2 and the battery ground (negative) post. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 1 and the electronic control module (ECM) connector terminal A11. Is the problem found?	-	Go to Step 10	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 2 and the ECM connector terminal D3. Is the problem found?	-	Go to Step 10	Go to Step 11
9	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Run the vehicle until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 25
MANIFOLD AIR TEMPERATURE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 25 Will Set When

- **The engine has been running longer than 120 seconds.**
- **The MAT sensor signal voltage indicates a temperature less than * 38.5°C (* 37°F).**

Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

Test Description

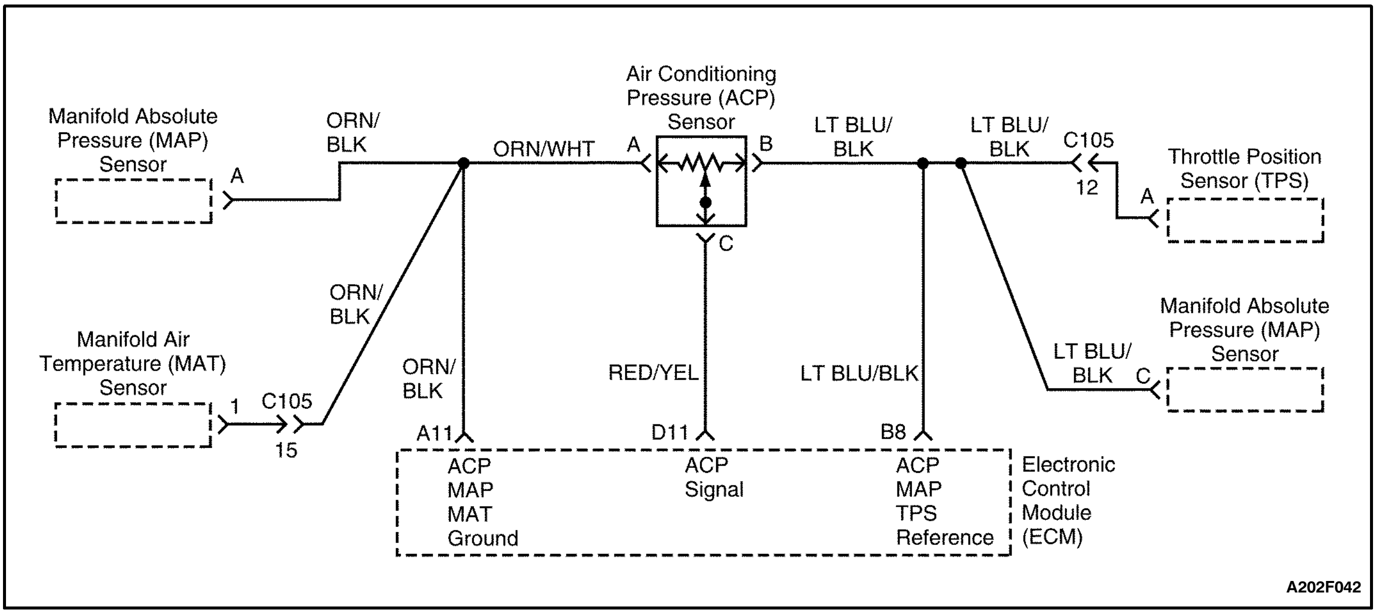
The number(s) below refer to step(s) on the diagnostic table.

6. **This step checks for reference voltage and ground from the ECM.**

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 25 – Manifold Air Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	–	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Jumper the MAT connector terminals. 4. Turn the ignition ON. Does the scan tool show the MAT sensor reading above the value specified?	180°C (356°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	–	Go to Step 10	Go to Step 9
5	Measure the voltage between terminals 1 and 2 of the MAT connector. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 11	Go to Step 6
6	Measure the voltage between the MAT terminal 2 and the battery ground (negative) post. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 1 and the electronic control module (ECM) connector terminal D15. Is the problem found?	–	Go to Step 10	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 2 and the ECM connector terminal B4. Is the problem found?	–	Go to Step 10	Go to Step 11
9	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	–	System OK	–
10	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Run the engine until It reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	–	System OK	–
11	1. Replace the ECM. 2. Run the vehicle until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	–	System OK	–



DIAGNOSTIC TROUBLE CODE (DTC) 27
AIR CONDITIONING PRESSURE SENSOR HIGH ERROR
(1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The air conditioning (A/C) system uses an air conditioning pressure (ACP) sensor mounted in the high-pressure side of the A/C refrigerant system to monitor the A/C refrigerant pressure. The electronic control module (ECM) uses this information to turn the cooling fans on at high speed when the A/C refrigerant pressure is high and to keep the A/C compressor disengaged when the A/C refrigerant pressure is excessively high or low.

DTC 27 Will Set When

- The ACP sensor reading is above 3 115 kPa (452 psi).
- This condition is present for 10 seconds.

Diagnostic Aids

- Inspect the wiring harness for damage. If the wiring harness appears OK, observe the A/C pressure display on the scan tool while moving the connectors and the wiring harnesses related to the ACP sensor. A change in the A/C pressure display on the scan tool will indicate the location of the fault.
- A fault in the A/C system or inoperative cooling fans may set an ACP diagnostic trouble code (DTC).

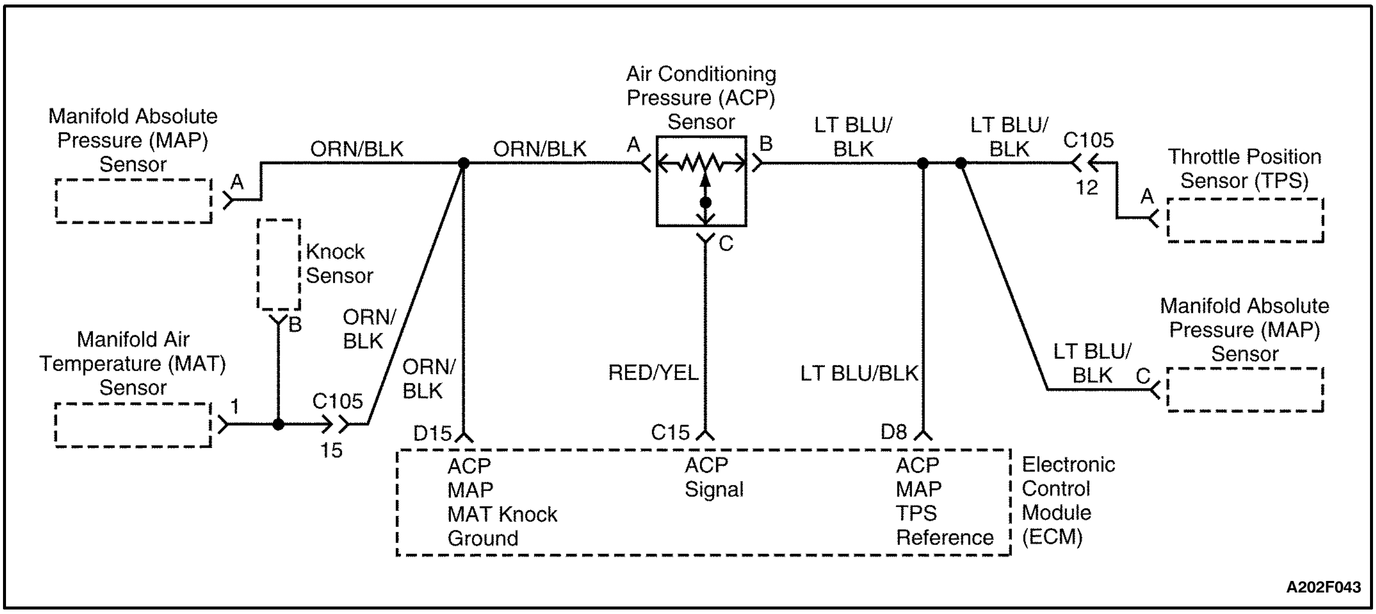
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for reference voltage and ground from the ECM.
3. A voltage over 2 volts indicates an A/C refrigerant system pressure over 1 241 kPa (180 psi).

DTC 27 – Air Conditioning Pressure Sensor High Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning pressure (ACP) sensor connector. 2. Turn the ignition ON. 3. Measure the voltage between the ACP connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Connect the ACP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the electronic control module (ECM) connector terminal D11 by backprobing the connector. Does the voltage measure below the value specified?	2 v	Go to "Diagnostic Aids"	Go to Step 4
4	Check for a short to voltage in the wire between the ACP connector terminal C and the ECM connector terminal D11. Is the problem found?	-	Go to Step 8	Go to Step 9
5	Measure the voltage between the ACP connector terminal B and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check the wire between the ACP connector terminal A and the ECM connector terminal A11 for a short to the battery voltage. Is the problem found?	-	Go to Step 8	Go to Step 10
7	Check for a short to battery voltage in the wire between the ACP connector terminal B and the ECM connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 10
8	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ACP sensor. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 27 AIR CONDITIONING PRESSURE SENSOR HIGH ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The air conditioning (A/C) system uses an air conditioning pressure (ACP) sensor mounted in the high-pressure side of the A/C refrigerant system to monitor the A/C refrigerant pressure. The electronic control module (ECM) uses this information to turn the cooling fans on at high speed when the A/C refrigerant pressure is high and to keep the A/C compressor disengaged when the A/C refrigerant pressure is excessively high or low.

DTC 27 Will Set When

- The ACP sensor reading is above 3 115 kPa (452 psi).
- This condition is present for 10 seconds.

Diagnostic Aids

- Inspect the wiring harness for damage. If the wiring harness appears OK, observe the A/C pressure display on the scan tool while moving the connectors and the wiring harnesses related to the ACP sensor. A change in the A/C pressure display on the scan tool will indicate the location of the fault.
- A fault in the A/C system or inoperative cooling fans may set an ACP diagnostic trouble code (DTC).

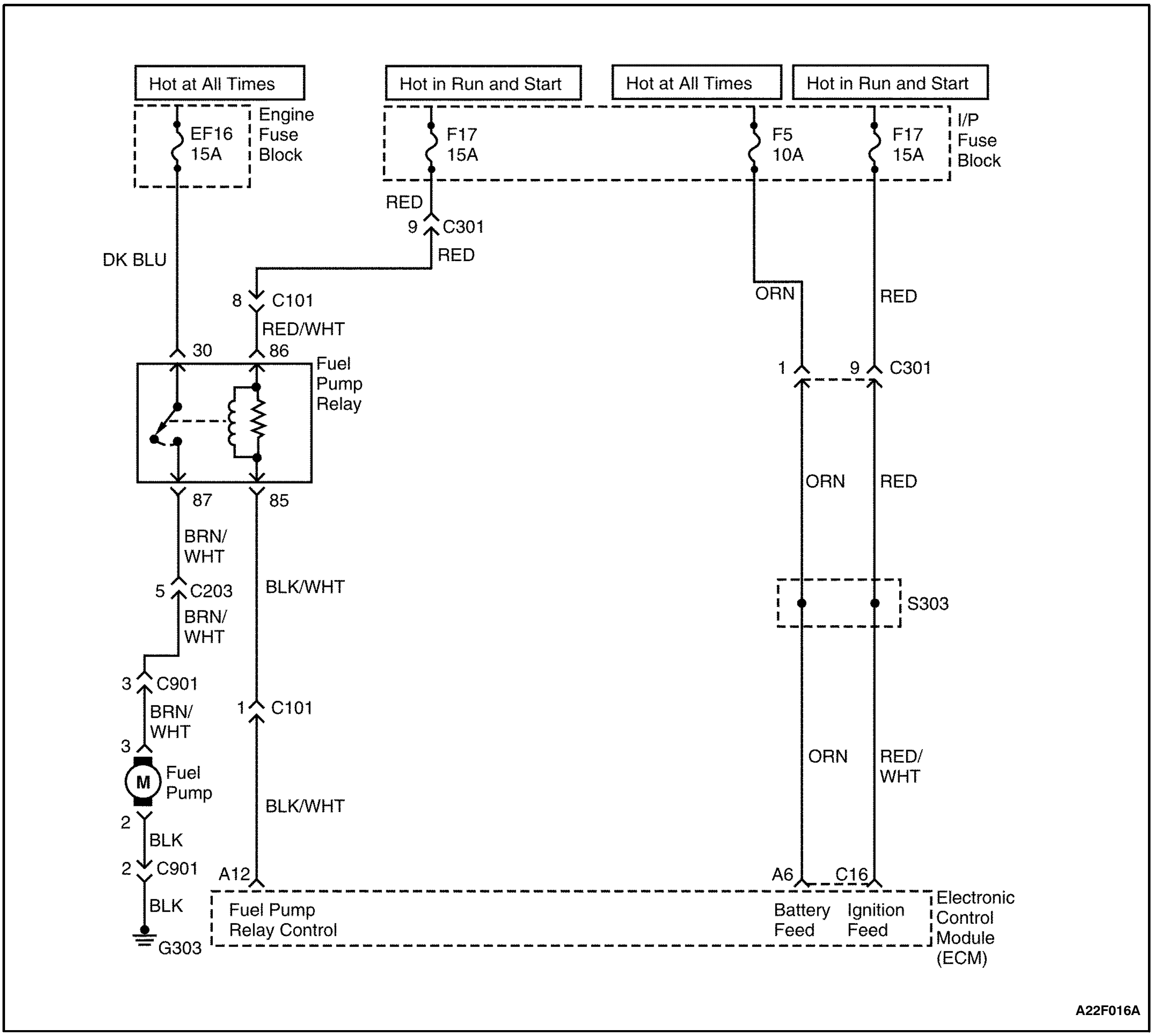
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for reference voltage and ground from the ECM.
3. A voltage over 2 volts indicates an A/C refrigerant system pressure over 1 241 kPa (180 psi).

DTC 27 – Air Conditioning Pressure Sensor High Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning pressure (ACP) sensor connector. 2. Turn the ignition ON. 3. Measure the voltage between the ACP connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Connect the ACP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the electronic control module (ECM) connector terminal C15 by backprobing the connector. Does the voltage measure below the value specified?	2 v	Go to "Diagnostic Aids"	Go to Step 4
4	Check for a short to voltage in the wire between the ACP connector terminal C and the ECM connector terminal C15. Is the problem found?	-	Go to Step 8	Go to Step 9
5	Measure the voltage between the ACP connector terminal B and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check the wire between the ACP connector terminal A and the ECM connector terminal D15 for a short to the battery voltage. Is the problem found?	-	Go to Step 8	Go to Step 10
7	Check for a short to battery voltage in the wire between the ACP connector terminal B and the ECM connector terminal D8. Is the problem found?	-	Go to Step 8	Go to Step 10
8	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ACP sensor. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 29
FUEL PUMP RELAY SHORT TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the electronic control module (ECM) applies ground to the fuel pump relay coil side. The ECM will apply this ground for 2 seconds or until reference pulses are received by the ECM from the crankshaft position sensor. This activates the fuel pump relay, applying battery voltage to the fuel pump.

DTC 29 Will Set When

The fuel pump relay circuit is shorted to ground for more than 1.6 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, and a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the fuel pump relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

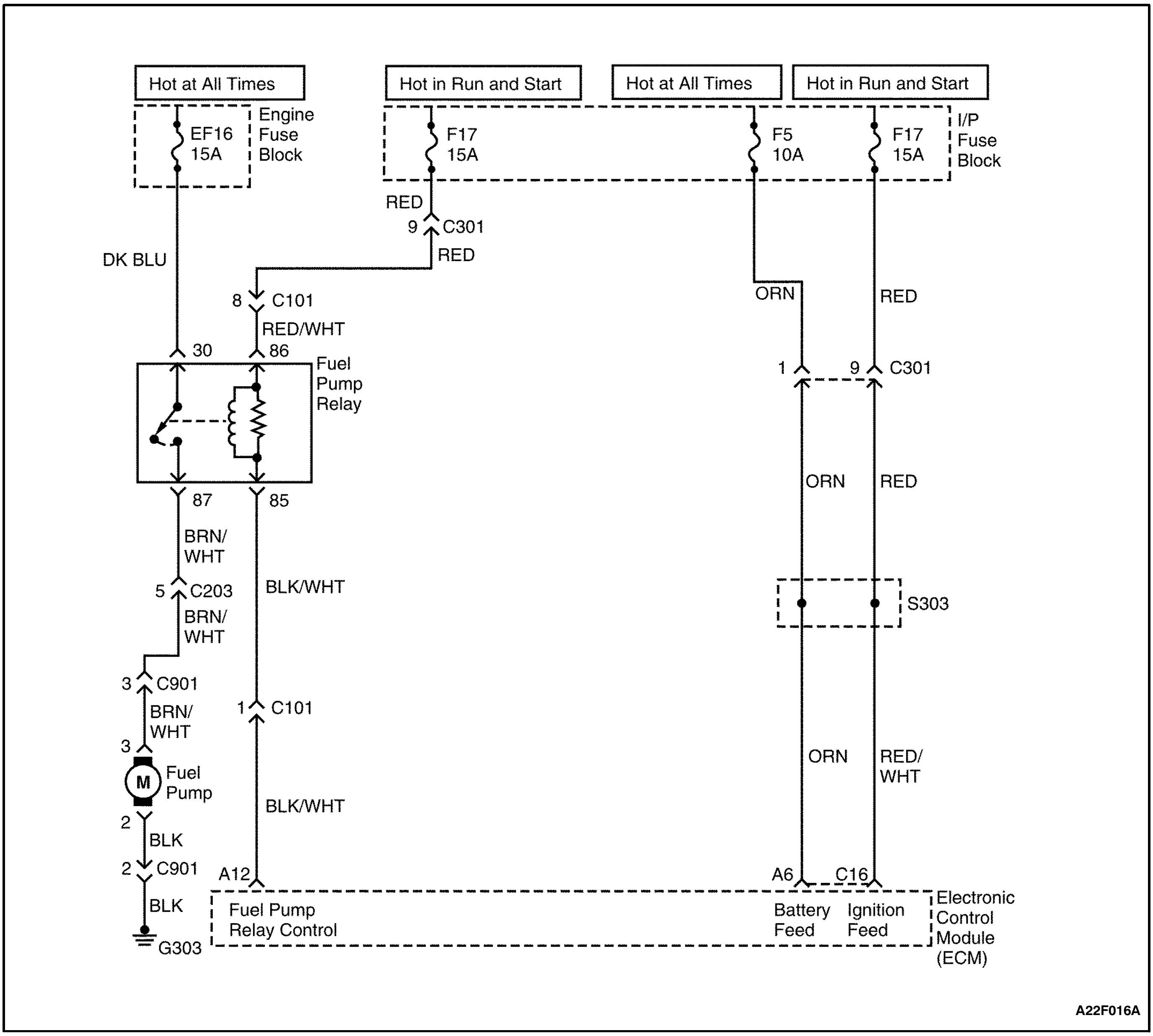
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition OFF, the ECM should not be applying ground to the fuel pump relay.
3. If the test light is still on after disconnecting the ECM red connector, the wire between the fuel pump relay and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.

DTC 29 – Fuel Pump Relay Short to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disconnect the fuel pump relay. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 3	Go to “Diagnostic Aids”
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 32 FUEL PUMP RELAY SHORT TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the electronic control module (ECM) applies ground to the fuel pump relay coil side. The ECM will apply this ground for 2 seconds or until reference pulses are received by the ECM from the crankshaft position sensor. This activates the fuel pump relay, applying battery voltage to the fuel pump.

DTC 32 Will Set When

The fuel pump relay circuit is shorted to battery for more than 1.6 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, and a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the fuel pump relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

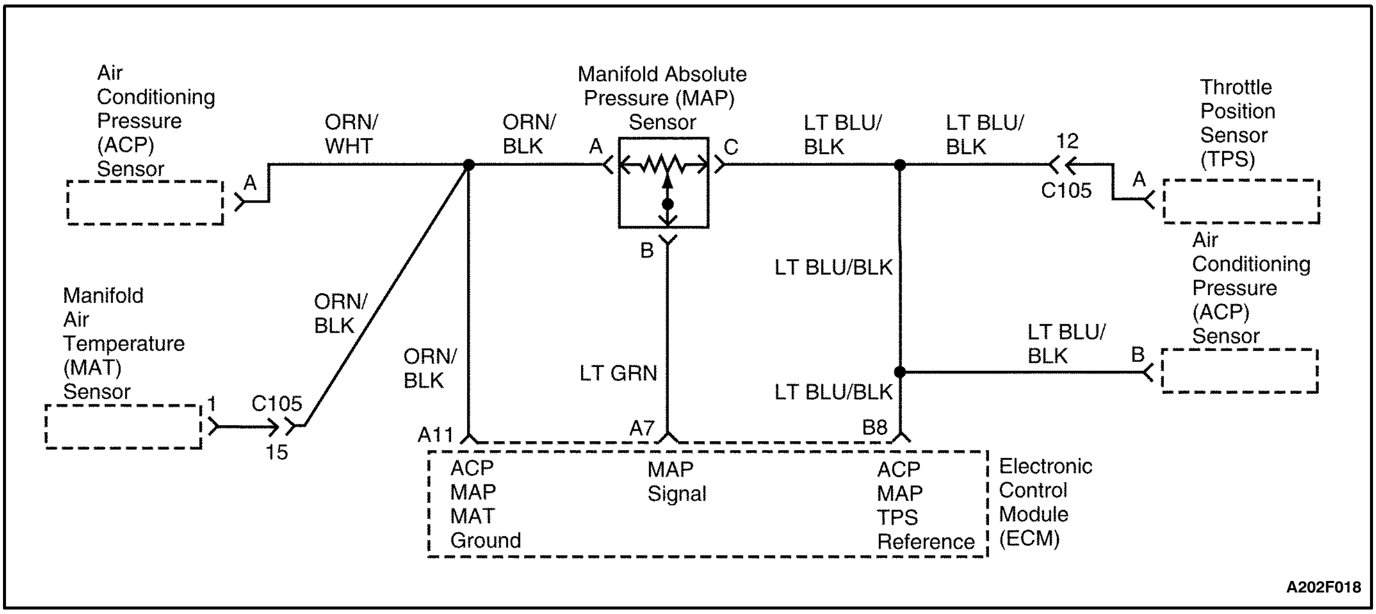
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the fuel pump relay and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 32 – Fuel Pump Relay Short to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disconnect the fuel pump relay. 2. Measure the resistance between the fuel pump relay terminals 85 and 86. Does the resistance measure near the value specified?	90 W	Go to Step 6	Go to Step 3
3	Connect a test light between the fuel pump relay connector terminal 86 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the fuel pump relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 33 MANIFOLD ABSOLUTE PRESSURE SENSOR HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 33 Will Set When

- Diagnostic trouble codes (DTCs) 21 and 22 are not set.
- The throttle angle is below 3 percent.
- The MAP sensor signal indicates greater than 98 kPa (29 inches of Hg).
- These conditions are present for 5 seconds.

Diagnostic Aids

- If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.
6. This step checks for a reference voltage and a ground from the ECM.
7. This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.

DTC 33 – Manifold Absolute Pressure Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Check the vacuum line from the manifold absolute pressure (MAP) sensor for cracks, leaks, or restrictions. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the vacuum line as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 5	Go to Step 6
5	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 13	Go to Step 11
8	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 9	Go to Step 10
9	Check for a short to battery voltage in the wire between the MAP sensor connector terminal A and the ECM connector terminal A11. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for a short to battery voltage in the wire between the MAP sensor connector terminal C and the electronic control module (ECM) connector terminal B8. Is the problem found?	-	Go to Step 12	Go to Step 14
11	Check for a short to voltage in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 12	Go to Step 14

DTC 33 – Manifold Absolute Pressure Sensor High (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 5
13	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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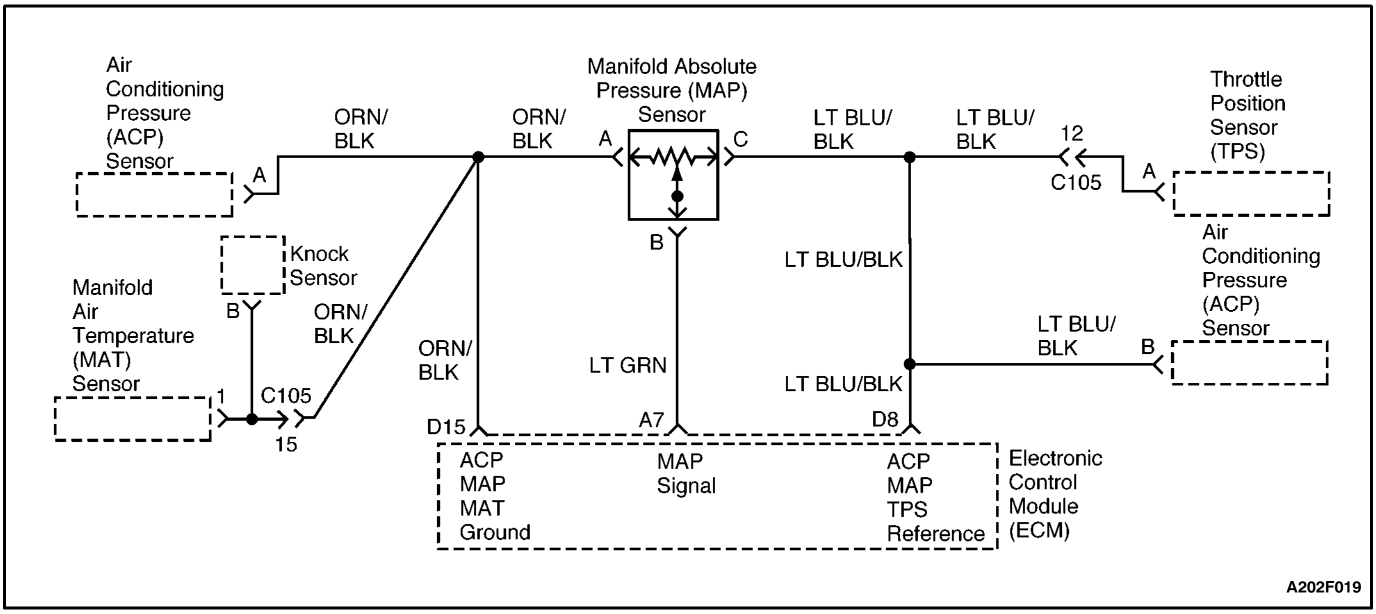

DIAGNOSTIC TROUBLE CODE (DTC) 33 MANIFOLD ABSOLUTE PRESSURE SENSOR HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 33 Will Set When

- Diagnostic trouble codes (DTCs) 21 and 22 are not set.
- The throttle angle is below 5 percent.
- The MAP sensor signal indicates greater than 95 kPa (28 inches of Hg).
- These conditions are present for 5 seconds.

Diagnostic Aids

- If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.
6. This step checks for a reference voltage and a ground from the ECM.
7. This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.

DTC 33 – Manifold Absolute Pressure Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Check the vacuum line from the manifold absolute pressure (MAP) sensor for cracks, leaks, or restrictions. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the vacuum line as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 5	Go to Step 6
5	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 13	Go to Step 11
8	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 9	Go to Step 10
9	Check for a short to battery voltage in the wire between the MAP sensor connector terminal A and the ECM connector terminal D15. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for a short to battery voltage in the wire between the MAP sensor connector terminal C and the electronic control module (ECM) connector terminal D8. Is the problem found?	-	Go to Step 12	Go to Step 14
11	Check for a short to voltage in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 12	Go to Step 14

DTC 33 – Manifold Absolute Pressure Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 5
13	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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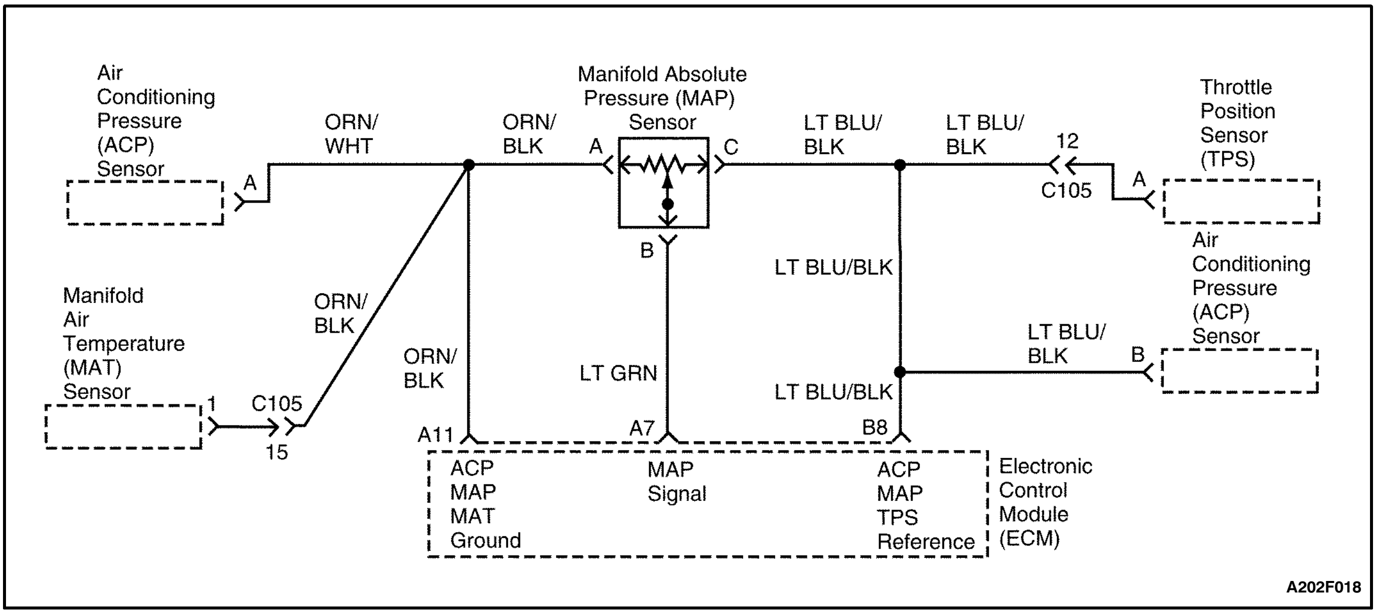

DIAGNOSTIC TROUBLE CODE (DTC) 34 MANIFOLD ABSOLUTE PRESSURE SENSOR LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 34 Will Set When

- Diagnostic trouble codes (DTCs) 21 and 22 are not set.
- The engine speed is less than 1,200 rpm or the engine speed is greater than 1,200 rpm and the throttle angle is greater than 15 percent.
- The MAP sensor signal voltage indicates less the 15 kPa (4.5 inches of Hg).
- These conditions have been present for 0.125 second.

Diagnostic Aids

- If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.
4. This step checks for a reference voltage and a ground from the ECM.
5. This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.

DTC 34 – Manifold Absolute Pressure Sensor Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the manifold absolute pressure (MAP) sensor voltage above the value specified?	4 v	Go to Step 3	Go to Step 4
3	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between the MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 5	Go to Step 6
5	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 11	Go to Step 9
6	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open wire between the MAP sensor connector terminal A and the electronic control module (ECM) connector terminal A11. Is the problem found?	-	Go to Step 10	Go to Step 12
8	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal C and the ECM connector terminal B8. Is the problem found?	-	Go to Step 10	Go to Step 12
9	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 34 – Manifold Absolute Pressure Sensor Low (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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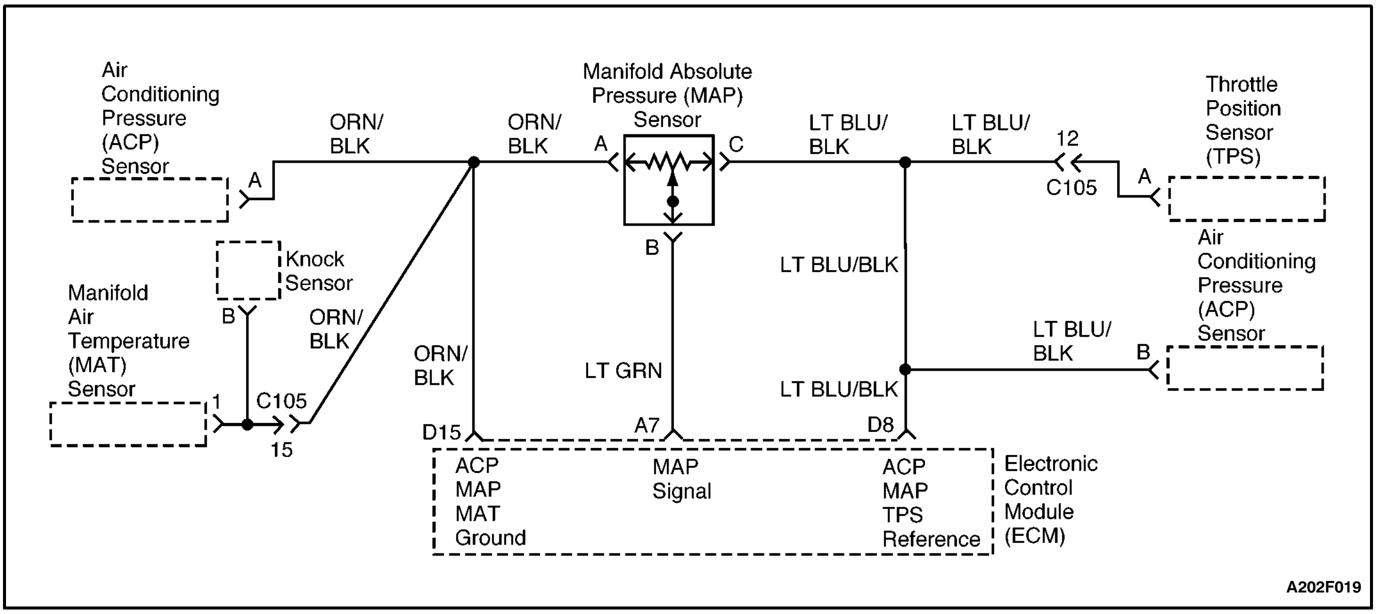

DIAGNOSTIC TROUBLE CODE (DTC) 34 MANIFOLD ABSOLUTE PRESSURE SENSOR LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 34 Will Set When

- Diagnostic trouble codes (DTCs) 21 and 22 are not set.
- The engine speed is less than 1,050 rpm or the engine speed is greater than 1,050 rpm and the throttle angle is greater than 19 percent.
- The MAP sensor signal voltage indicates less than 14 kPa (4.0 inches of Hg).
- These conditions have been present for 1 second.

Diagnostic Aids

- If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.
4. This step checks for a reference voltage and a ground from the ECM.
5. This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.

DTC 34 – Manifold Absolute Pressure Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the manifold absolute pressure (MAP) sensor voltage above the value specified?	4 v	Go to Step 3	Go to Step 4
3	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between the MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 5	Go to Step 6
5	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 11	Go to Step 9
6	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open wire between the MAP sensor connector terminal A and the electronic control module (ECM) connector terminal D15. Is the problem found?	-	Go to Step 10	Go to Step 12
8	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal C and the ECM connector terminal D8. Is the problem found?	-	Go to Step 10	Go to Step 12
9	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 34 – Manifold Absolute Pressure Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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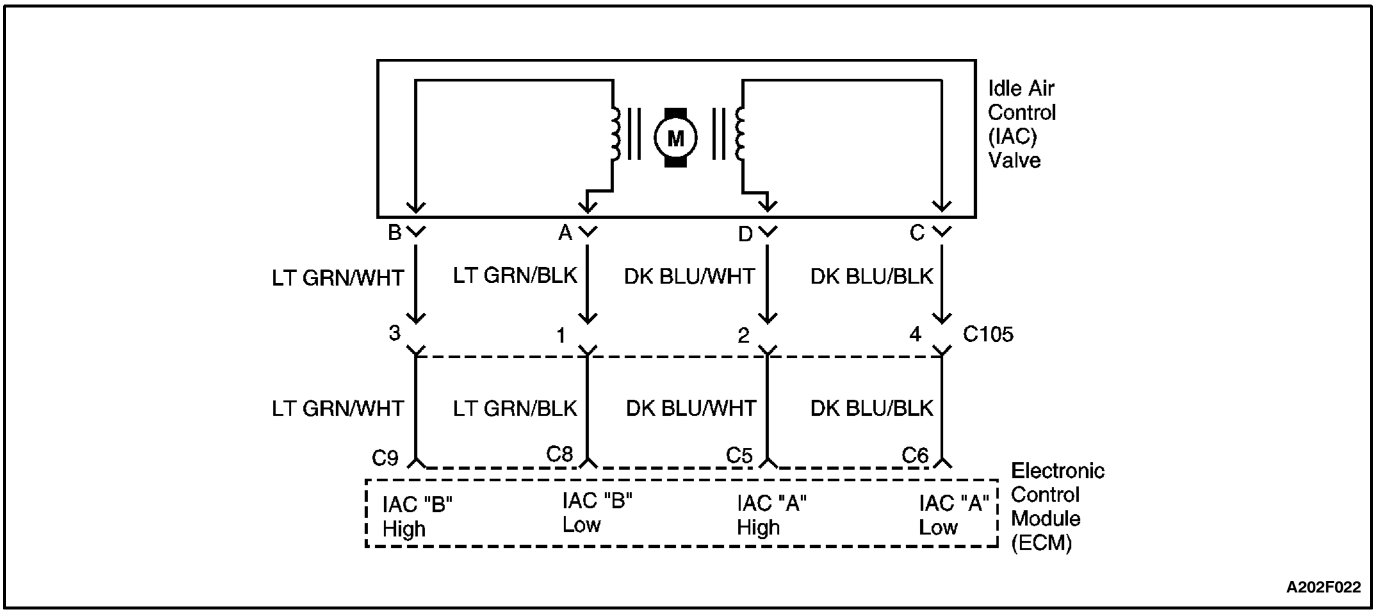

DIAGNOSTIC TROUBLE CODE (DTC) 35
IDLE AIR CONTROL ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) controls the idle speed to a calculated rpm based on inputs and the actual engine rpm. This is determined by the ignition reference pulses received by the ECM from the crankshaft position sensor. The ECM uses four circuits to move the idle air control (IAC) valve. The IAC valve allows varying amounts of air to flow into the intake manifold, controlling the idle speed.

DTC 35 Will Set When

- Diagnostic trouble codes (DTCs) 21, 22, and 24 are not set.
- The throttle is closed.
- The engine speed is 150 rpm above or below the commanded idle speed for 30 seconds.

Diagnostic Aids

- Inspect for vacuum leaks, unconnected or brittle vacuum hoses, cuts, etc.
- Inspect the intake manifold and the throttle body gaskets for proper sealing.
- An IAC valve which does not respond to the ECM, an incorrect base idle adjustment, a damaged throttle body, or damage to the throttle body linkage could create the conditions for setting DTC 35.

DTC 35 – Idle Air Control Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Monitor the engine rpm. 4. Disconnect the idle air control (IAC) valve connector. 5. Connect the IAC driver to the IAC valve. 6. Start the engine. Allow the engine to idle in park (P), or neutral (N) for the manual transaxle, with the air conditioning (A/C) off and the parking brake applied. 7. Using the IAC driver, extend and retract the IAC valve. Does the rpm change as the IAC driver is cycled?	-	Go to Step 5	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Remove the IAC valve from the throttle body. 4. Inspect the IAC passages for restrictions. Are the IAC passages restricted?	-	Go to Step 4	Go to Step 14
4	1. Clean the IAC passages. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	Cycle the IAC driver while monitoring the engine rpm. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC node light to the IAC connector. 3. Start the engine and cycle the IAC driver. Do both lights of the IAC node light cycle red and green but never turn off as the rpm is changed using the IAC driver?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Measure the resistance between IAC terminals A and B, then C and D. Is the resistance within the value specified?	40-80 W	Go to Step 8	Go to Step 14
8	Measure the resistance between IAC terminals B and C, then A and D. Does the resistance match the specified value?	R	Go to "Diagnostic Aids"	Go to Step 14
9	1. Turn the ignition OFF. 2. Disconnect the IAC node light from the IAC valve connector. 3. Check for faulty connector terminals. Is the problem found?	-	Go to Step 13	Go to Step 10

DTC 35 – Idle Air Control Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for any open circuits or open connections between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 11
11	Check for a short to ground between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 12
12	1. Turn the ignition ON. 2. Check for a short to voltage between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 15
13	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Perform the IAC valve reset procedure. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the IAC valve. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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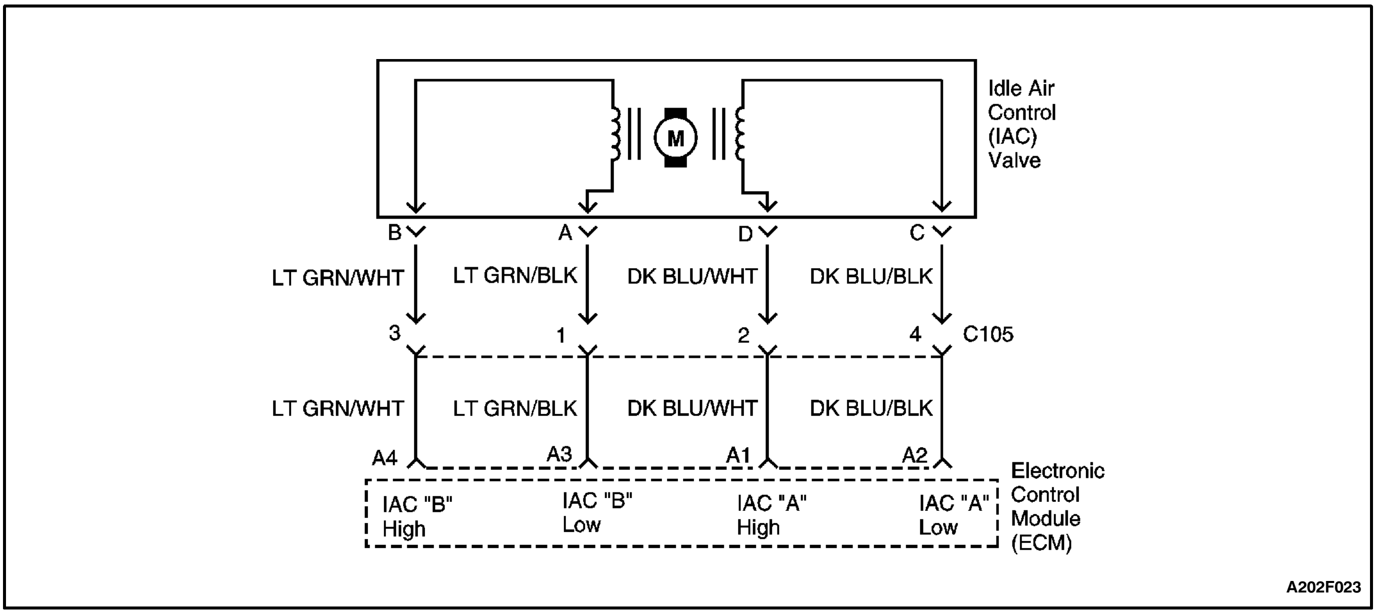

DIAGNOSTIC TROUBLE CODE (DTC) 35
IDLE AIR CONTROL ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) controls the idle speed to a calculated rpm based on inputs and the actual engine rpm. This is determined by the ignition reference pulses received by the ECM from the crankshaft position sensor. The ECM uses four circuits to move the idle air control (IAC) valve. The IAC valve allows varying amounts of air to flow into the intake manifold, controlling the idle speed.

DTC 35 Will Set When

- Diagnostic trouble codes (DTCs) 21, 22 and 24 are not set.
- The throttle is closed.
- Rpm error (RPMVAR) is 175 rpm above or below the commanded idle speed for more than 20 seconds.

Diagnostic Aids

- Inspect for vacuum leaks, unconnected or brittle vacuum hoses, cuts, etc.
- Inspect the intake manifold and the throttle body gaskets for proper sealing.
- An IAC valve which does not respond to the ECM, an incorrect base idle adjustment, a damaged throttle body, or damage to the throttle body linkage could create the conditions for setting DTC 35.

DTC 35 – Idle Air Control Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Monitor the engine rpm. 4. Disconnect the idle air control (IAC) valve connector. 5. Connect the IAC driver to the IAC valve. 6. Start the engine. Allow the engine to idle in park (P), or neutral (N) for the manual transaxle, with the air conditioning (A/C) off and the parking brake applied. 7. Using the IAC driver, extend and retract the IAC valve. Does the rpm change as the IAC driver is cycled?	-	Go to Step 5	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Remove the IAC valve from the throttle body. 4. Inspect the IAC passages for restrictions. Are the IAC passages restricted?	-	Go to Step 4	Go to Step 14
4	1. Clean the IAC passages. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	Cycle the IAC driver while monitoring the engine rpm. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC node light to the IAC connector. 3. Start the engine and cycle the IAC driver. Do both lights of the IAC node light cycle red and green but never turn off as the rpm is changed using the IAC driver?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Measure the resistance between IAC terminals A and B, then C and D. Is the resistance within the value specified?	40-80 W	Go to Step 8	Go to Step 14
8	Measure the resistance between IAC terminals B and C, then A and D. Does the resistance match the specified value?	R	Go to “Diagnostic Aids”	Go to Step 14
9	1. Turn the ignition OFF. 2. Disconnect the IAC node light from the IAC valve connector. 3. Check for faulty connector terminals. Is the problem found?	-	Go to Step 13	Go to Step 10

DTC 35 – Idle Air Control Error (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for any open circuits or open connections between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 11
11	Check for a short to ground between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 12
12	1. Turn the ignition ON. 2. Check for a short to voltage between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 15
13	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Perform the IAC valve reset procedure. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the IAC valve. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 36
EXHAUST GAS RECIRCULATION ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

A properly operating exhaust gas recirculation (EGR) system will directly affect the air/fuel requirements of the engine. Since the exhaust gas introduced into the air/fuel mixture cannot be used in combustion due to the lack of oxygen in the exhaust gas, less fuel is needed to maintain a correct air/fuel ratio. If the EGR system were to fail in a closed position, the exhaust gas would be replaced with air and the air/fuel mixture would be leaner. The electronic control module (ECM) would compensate for the lean condition by adding fuel, resulting in higher long term fuel trim values.

DTC 36 Will Set When

- The EGR valve is installed.
- Barometric pressure is above 90.0 kPa (26.65 inches Hg).
- Diagnostic trouble codes (DTCs) 21, 22, and 34 are not set.
- The engine coolant temperature is above 75°C (167°F).
- The long term fuel trim values are above 151 when the manifold absolute pressure (MAP) sensor indicates greater than 85 kPa (25.17 inches Hg) in open throttle.
- There is no vehicle speed present and the difference between the long term fuel trim values in open throttle and closed throttle is above 20.
- All conditions present for at least 60 seconds.

Diagnostic Aids

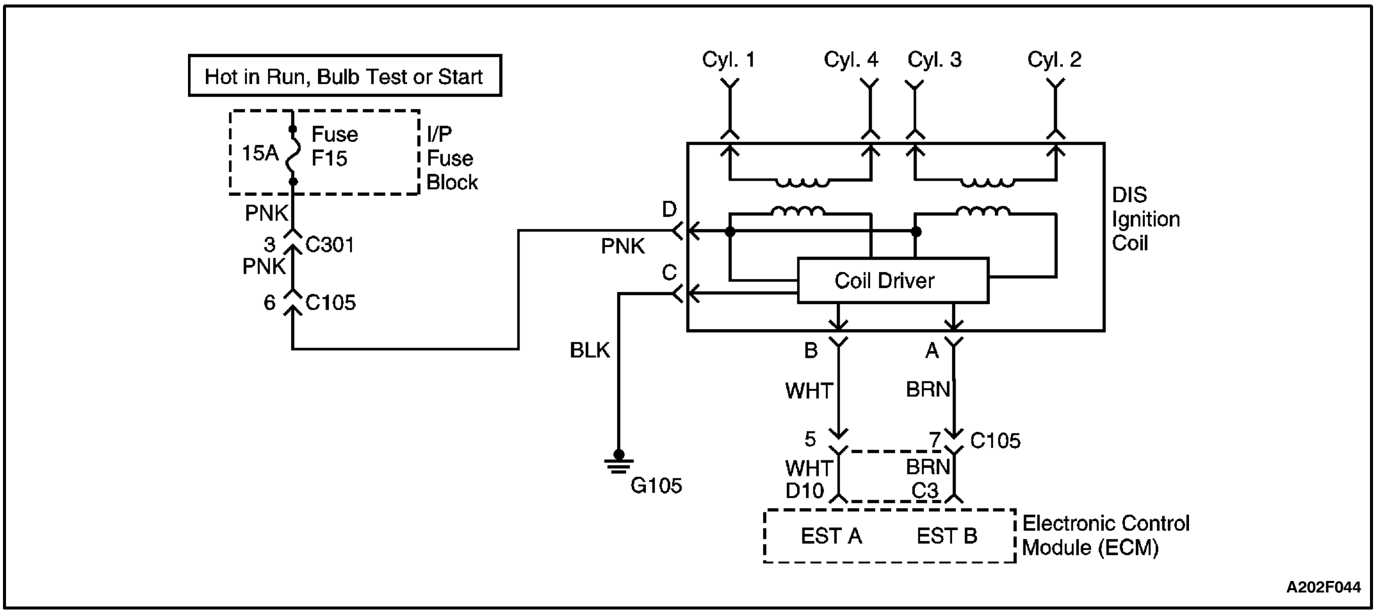
- The DTC 36 table is a functional check of the EGR system. If the EGR system is operating properly but a DTC 36 has been set, check other items that could result in high long term fuel trim values above idle.
- It is very common for the EGR valve spring to weaken over an extended period of time. As the EGR valve spring becomes weak, the EGR valve is allowed to open prematurely and excessively, causing excessive EGR flow. This can create the conditions needed to set the DTC 36.
- Check for restricted or blocked EGR passages.
- Perform a MAP sensor output check.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.

DTC 36 – Exhaust Gas Recirculation Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Inspect for looseness of the exhaust gas recirculation (EGR) valve by grasping the valve and trying to rotate it in both directions. Is there looseness in the EGR valve?	-	Go to Step 10	Go to Step 3
3	1. Disconnect the vacuum hose from the EGR valve. 2. Apply the specified value of vacuum to the EGR valve vacuum port. 3. Note the EGR valve diaphragm movement. Does the EGR valve diaphragm move?	33.77 kPa (10 in. Hg)	Go to Step 4	Go to Step 10
4	1. Disconnect the vacuum hose from the EGR valve. 2. Apply the specified value of vacuum to the EGR valve vacuum port. Does the EGR valve hold the vacuum?	33.77 kPa (10 in. Hg)	Go to Step 5	Go to Step 10

DTC 36 – Exhaust Gas Recirculation Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Place the transaxle in park (P) or neutral (N). 2. Run the warm engine at idle. 3. Push on the under side of the EGR valve diaphragm. Does the engine rpm decrease or does the engine stall?	-	Go to Step 6	Go to Step 11
6	1. Increase the engine rpm from idle to 2,000 rpm. 2. Note the EGR valve diaphragm movement. Does the EGR valve diaphragm move?	-	Go to "Diagnostic Aids"	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a vacuum gauge directly to the EGR valve vacuum source. 3. Start the engine. 4. Increase the engine rpm from idle to 2,000 rpm. 5. Note the vacuum gauge reading. Does the vacuum gauge read above the specified value?	20 kPa (6 in. Hg)	Go to Step 8	Go to Step 9
8	1. Turn the ignition OFF. 2. Check the EGR valve vacuum hose for a restriction or a leak. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Clean the EGR valve vacuum source at the throttle body vacuum port. Is the repair complete?	-	System OK	-
10	Replace the EGR valve. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Remove the EGR valve. 3. Inspect the EGR passages of the intake manifold for a restriction. Is the problem found?	-	Go to Step 12	Go to "Diagnostic Aids"
12	1. Clean the EGR passages of the intake manifold. 2. Clean the EGR valve passages. 3. Install the EGR valve. 4. Place the transaxle in park (P) or neutral (N). 5. Run the warm engine at idle. 6. Push on the under side of the EGR valve diaphragm. Does the engine rpm decrease or does the engine stall?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 41 ELECTRONIC SPARK TIMING "B" SHORTED TO BATTERY (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 41 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

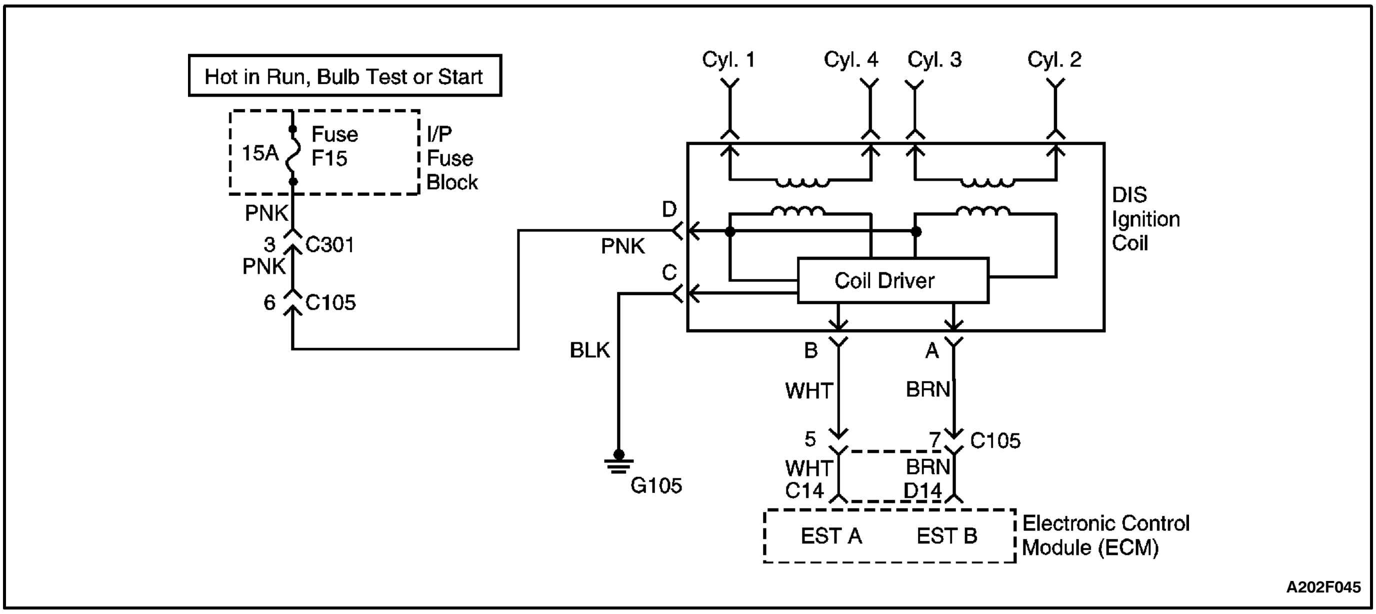
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 41 – Electronic Spark Timing "B" Shorted to Battery (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal A and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the value specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C3 or near terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal A. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal A while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal A and the ECM connector terminal C3. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 41 ELECTRONIC SPARK TIMING "B" SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 41 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

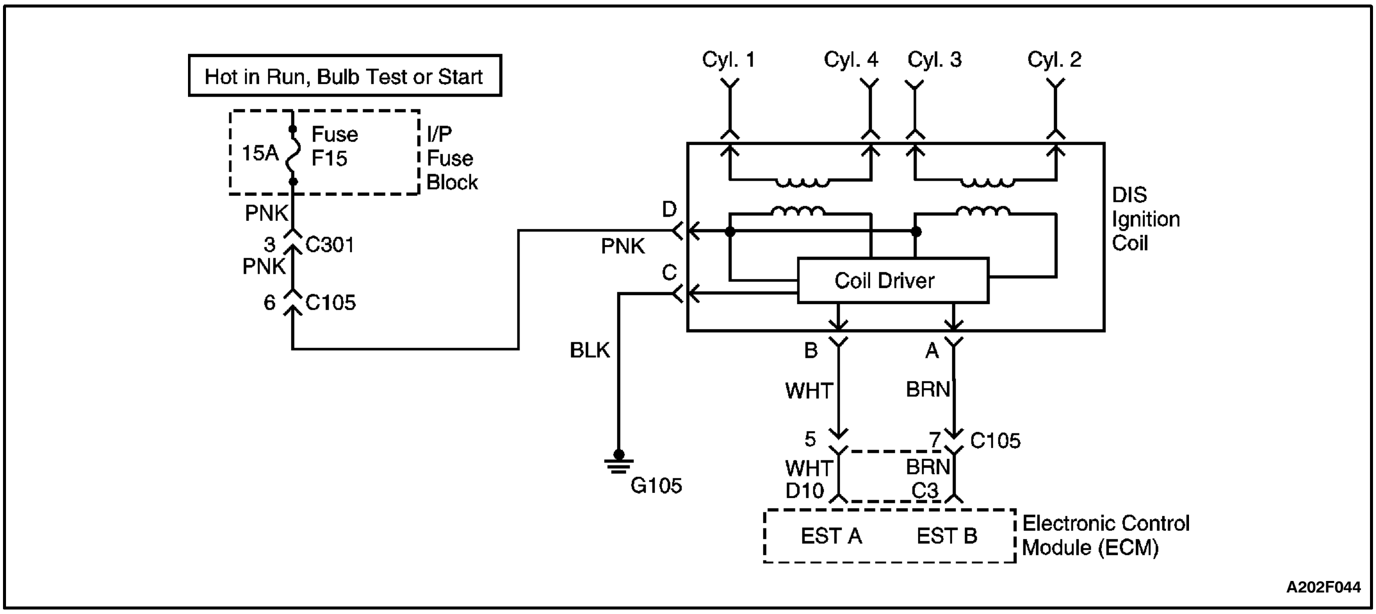
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 41 – Electronic Spark Timing "B" Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal A and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the value specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D14 or near terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal A. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal A while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal A and the ECM connector terminal D14. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 42
ELECTRONIC SPARK TIMING “A” SHORTED TO BATTERY
(1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 42 Will Set When

- The ECM receives voltage greater than 12 volts through the EST “A” line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

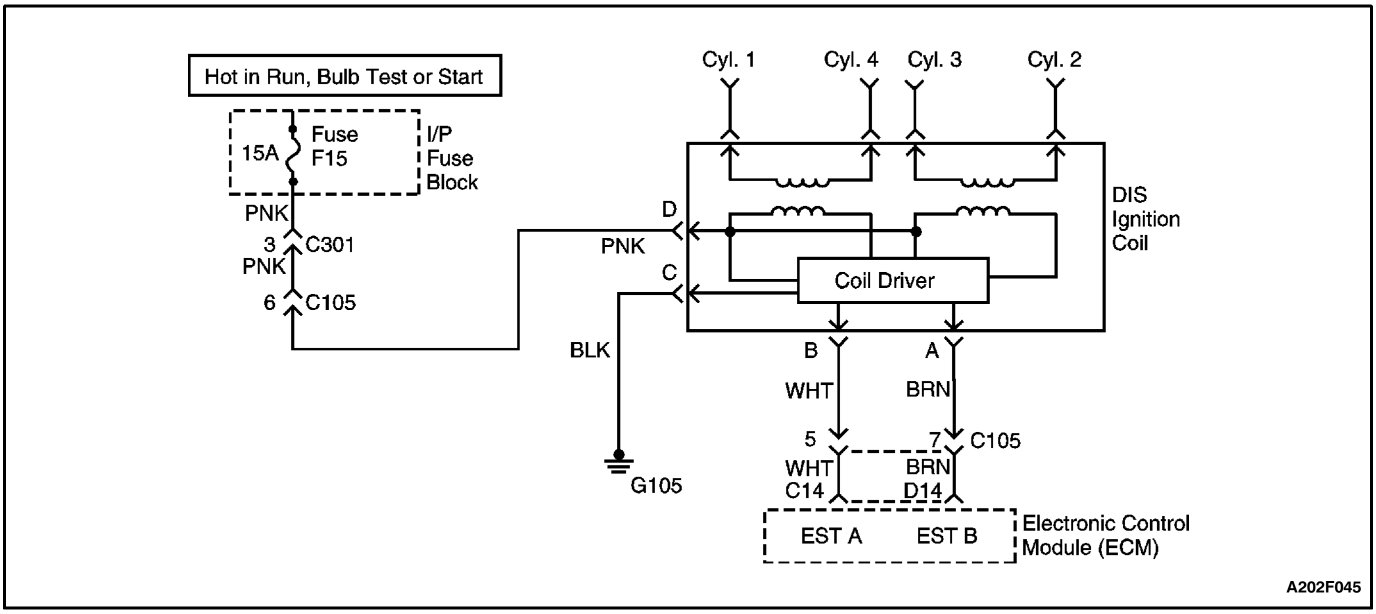
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST “A” and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST “A” wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 42 – Electronic Spark Timing “A” Shorted to Battery (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal B and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D10 or near terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal B. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal B while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal B and the ECM connector terminal D10. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and the harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 42 ELECTRONIC SPARK TIMING “A” SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 42 Will Set When

- The ECM receives voltage greater than 12 volts through the EST “A” line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

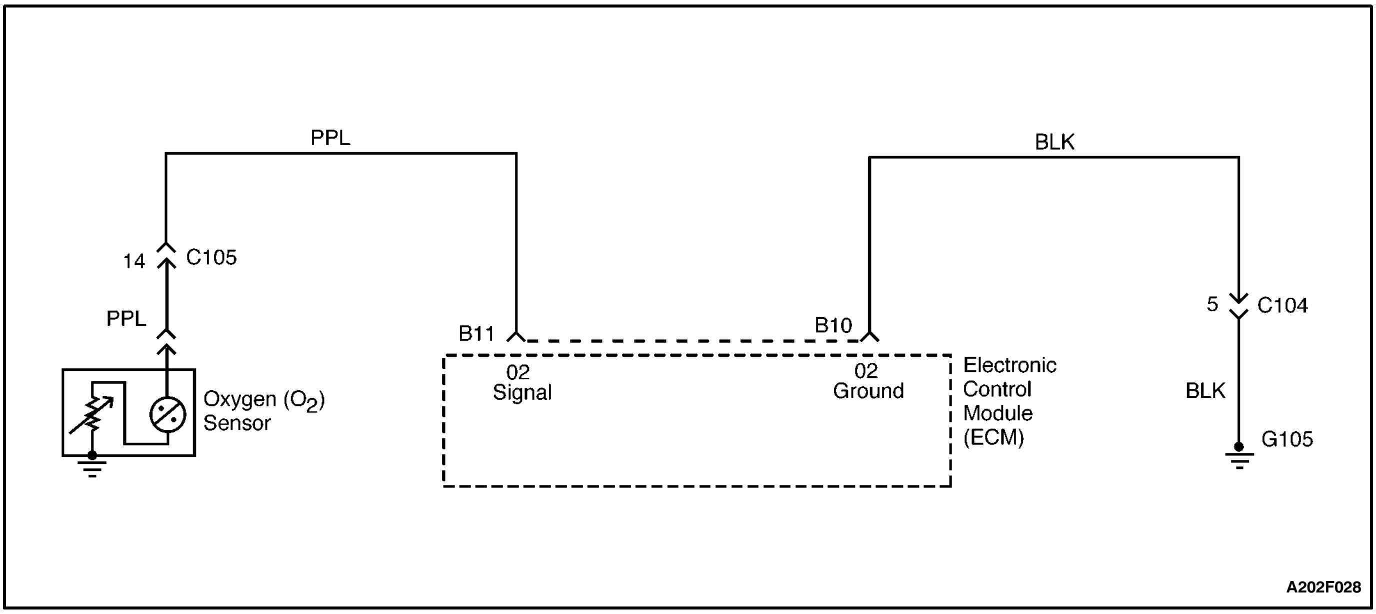
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST “A” and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST “A” wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 42 – Electronic Spark Timing "A" Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal B and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C14 or near terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal B. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal B while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal B and the ECM connector terminal C14. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and the harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 44
OXYGEN SENSOR LEAN (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 44 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is below 200 millivolts for at least 30 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Inspect the O_2 sensor wire. The O_2 sensor pigtail may be positioned incorrectly and contacting the exhaust manifold.
- Check for an intermittent ground in the wire between the O_2 sensor and the ECM.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.
- An exhaust manifold gasket leak or a cracked exhaust manifold may cause outside air to be pulled into the exhaust and past the sensor.

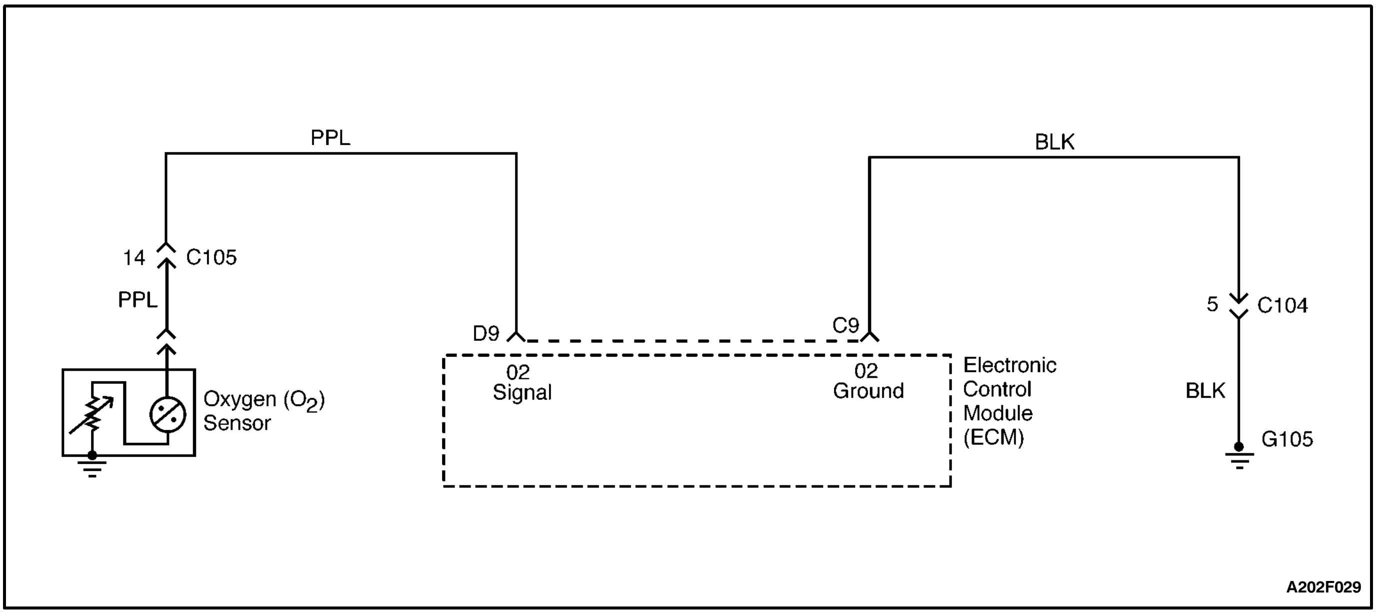
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
4. If the O_2 sensor voltage stays fixed below 350 millivolts after disconnecting the O_2 sensor, there is either a short to ground in the O_2 sensor wire to the ECM or a faulty ECM.

DTC 44 – Oxygen Sensor Lean (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed below the value specified?	220 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector. 2. Run the warm engine at idle. Does the scan tool read O_2 sensor voltage within the value specified?	350-550 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Check the O_2 sensor signal wire between the O_2 sensor and electronic control module (ECM) connector terminal B11 for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 44
OXYGEN SENSOR LEAN (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 44 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is below 274 millivolts.
- The conditions are present for 40 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Inspect the O_2 sensor wire. The O_2 sensor pigtail may be positioned incorrectly and contacting the exhaust manifold.
- Check for an intermittent ground in the wire between the O_2 sensor and the ECM.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.
- An exhaust manifold gasket leak or a cracked exhaust manifold may cause outside air to be pulled into the exhaust and past the sensor.

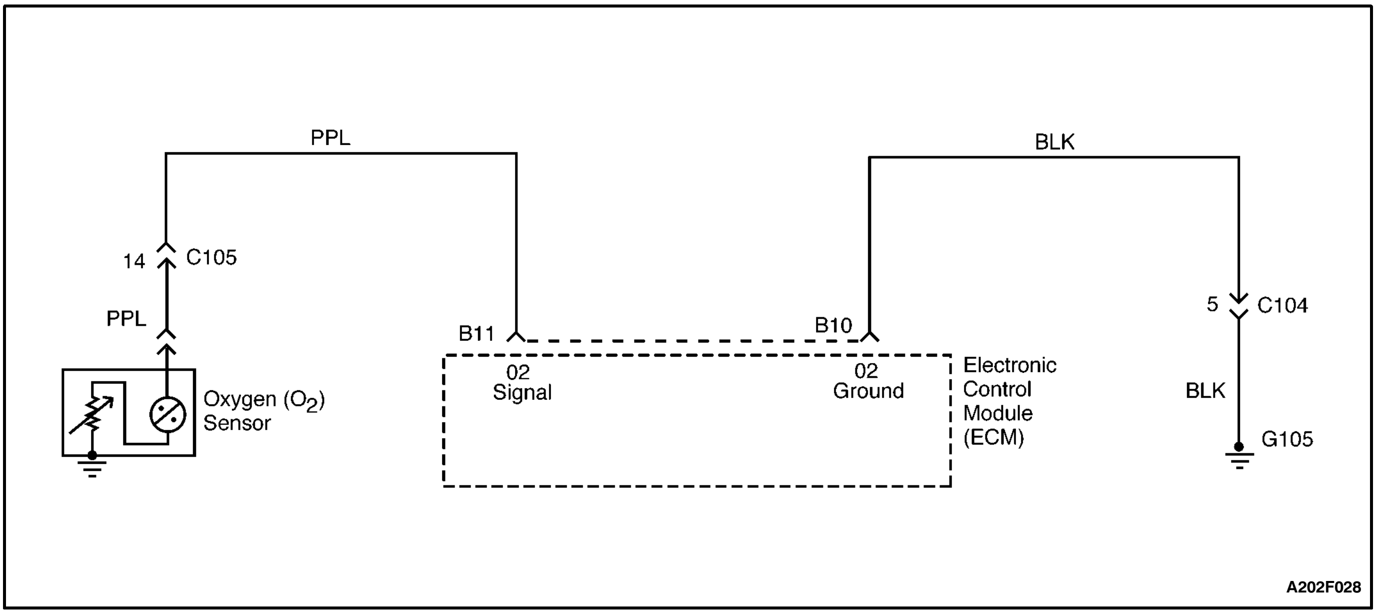
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
4. If the O_2 sensor voltage stays fixed below 350 millivolts after disconnecting the O_2 sensor, there is either a short to ground in the O_2 sensor wire to the ECM or a faulty ECM.

DTC 44 – Oxygen Sensor Lean (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed below the value specified?	274 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector. 2. Run the warm engine at idle. Does the scan tool read O_2 sensor voltage within the value specified?	350-550 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Check the O_2 sensor signal wire between the O_2 sensor and electronic control module (ECM) connector terminal D9 for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 45 OXYGEN SENSOR RICH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 45 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is above 800 millivolts for at least 30 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Fuel pressure that is too high may cause a rich running condition.
- A leaking fuel pressure regulator diaphragm will cause a rich running condition.
- Check for leaking fuel injectors by performing a fuel injector balance test.
- An intermittent throttle position sensor output will cause a rich running condition due to a false indication of the engine accelerating.
- A false rich indication due to silicone contamination of the O_2 sensor. This will be indicated by the presence of the DTC 45 accompanied by lean driveability conditions and a powdery white deposit on the O_2 sensor.

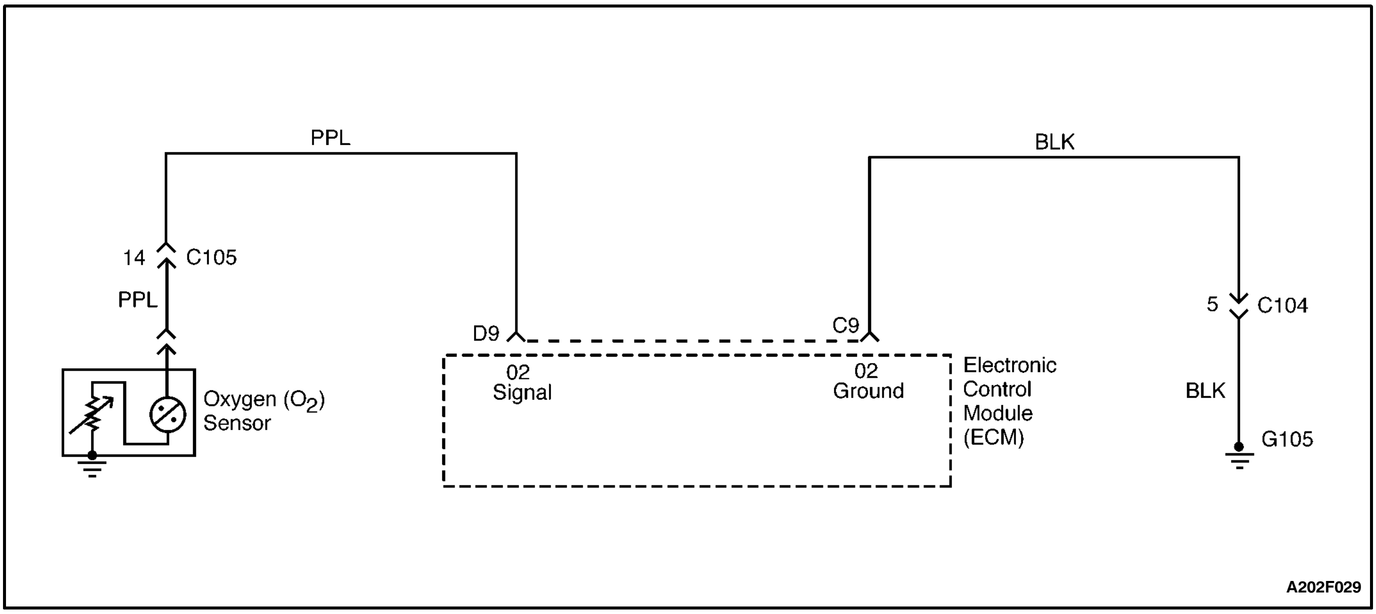
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
3. This step checks for the electronic control module ability to read a simulated lean O_2 sensor signal.

DTC 45 – Oxygen Sensor Rich (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed above the value specified?	800 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector and jumper the connector terminal to ground on the side of the electronic control module (ECM). 2. Run the warm engine at idle. Does the scan tool read the O_2 sensor voltage below the value specified?	350 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 45
OXYGEN SENSOR RICH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 45 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is above 865 millivolts.
- These conditions are present for more than 10 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Fuel pressure that is too high may cause a rich running condition.
- A leaking fuel pressure regulator diaphragm will cause a rich running condition.
- Check for leaking fuel injectors by performing a fuel injector balance test.
- An intermittent throttle position sensor output will cause a rich running condition due to a false indication of the engine accelerating.
- A false rich indication due to silicone contamination of the O_2 sensor. This will be indicated by the presence of the DTC 45 accompanied by lean driveability conditions and a powdery white deposit on the O_2 sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
3. This step checks for the electronic control module ability to read a simulated lean O_2 sensor signal.

DTC 45 – Oxygen Sensor Rich (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed above the value specified?	800 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector and jumper the connector terminal to ground on the side of the electronic control module (ECM). 2. Run the warm engine at idle. Does the scan tool read the O_2 sensor voltage below the value specified?	350 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 49 BATTERY VOLTAGE TOO HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) monitors the battery voltage at the ECM connector terminal C16. If the ECM detects voltage above the tolerance, the diagnostic trouble code (DTC) 49 will be set.

DTC 49 Will Set When

- The battery voltage (ADBAT) is greater than 17.2 volts for more than 2 seconds.

Diagnostic Aids

- Charging the battery with a battery charger and starting the engine may set the DTC 49.
- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness check OK, monitor the battery voltage display on the scan tool while moving related connectors. If the fault is induced, the battery voltage will abruptly change. This may help to isolate the location of the problem.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. If the scan tool is showing incorrect battery voltage, the ECM is at fault.

DTC 49 – Battery Voltage Too High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine and raise the engine speed to 1,200 rpm. 3. Monitor the battery voltage on the scan tool. Is the voltage at or above the value specified?	17.2 v	Go to Step 3	Go to Step 4
3	Measure the voltage across the battery. Is the voltage at or above the value specified?	17.2 v	Go to Step 5	Go to Step 6
4	1. Turn the headlamps ON. 2. Turn the air conditioning (A/C) ON. 3. Turn the blower switch to HIGH. 4. Raise the engine speed to 2,000 rpm. 5. Monitor the battery voltage on the scan tool. Is the voltage at or above the value specified?	17.2 v	Go to Step 5	Go to "Diagnostic Aids"
5	1. Turn the ignition OFF. 2. Repair the generator or the generator circuit as needed. 3. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 51
ECM ERROR (CHECKSUM OR KKPGMID ERROR)
(1.3L AND 1.5L SOHC IEFI-6, 1.3L SOHC AND 1.6L DOHC ITMS-6F)

DTC Will Set When

- KKPGMID is not set into $95 for the IEFI-6 ($99 for the ITMS-6F), or the calculated CHECKSUM is not consistent with the KKSUM.

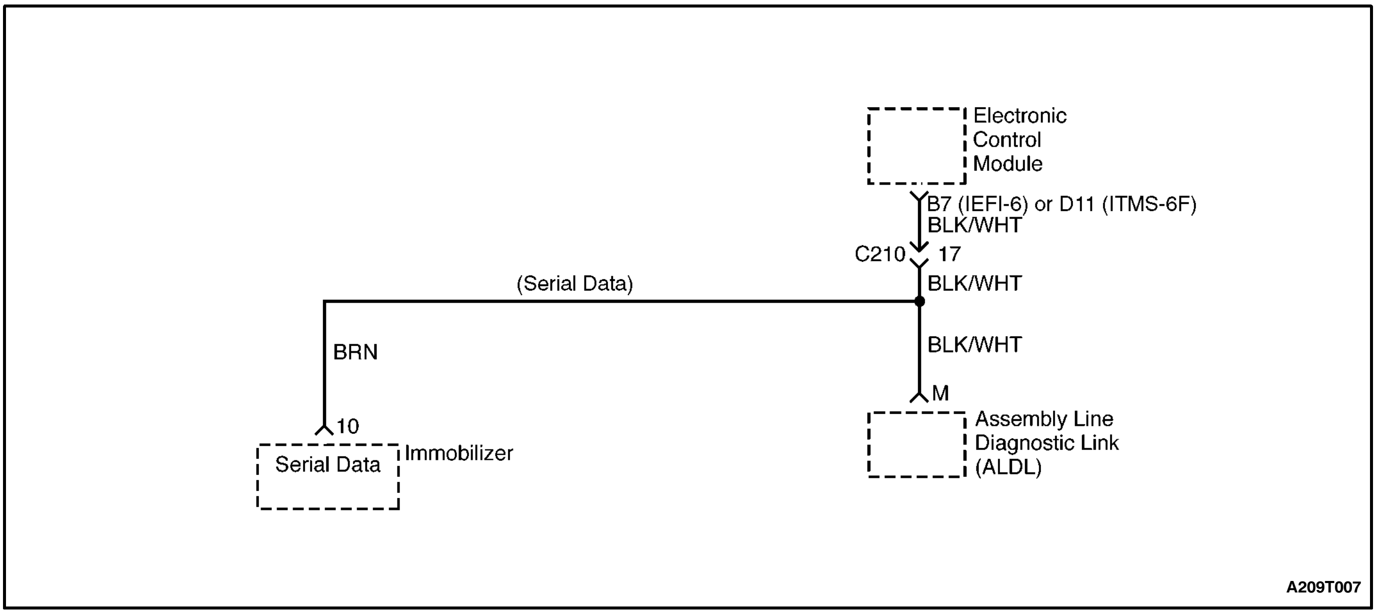
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. A programmable read-only memory (PROM) that is incorrectly installed will set the diagnostic trouble code (DTC) 51.

DTC 51 – ECM Error (CHECKSUM or KKPGMID Error)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	Check that all of the programmable read-only memory (PROM) pins are fully inserted in the socket. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Install the PROM correctly in the socket. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Check for the presence of any DTCs. Does the DTC 51 reappear?	-	Go to Step 4	Go to “Diagnostic System Check”
4	1. Replace the PROM. 2. Clear any DTCs from the ECM. 3. Check for the presence of any DTCs. Does the DTC 51 reappear?	-	Go to Step 5	Go to “Diagnostic System Check”
5	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 53 ECM IMMOBILIZED ERROR (1.3L AND 1.5L SOHC IEFI-6, 1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the key is tested by the immobilizer anti-theft system. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the memory of the immobilizer control unit. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM have been substituted to defeat the system. If the ECM receives an invalid release message, the ECM performs the following actions:

- Disables the fuel injector circuit.
- Disables the fuel pump circuit.

DTC 53 Will Set When

- The ECM does not receive the signal from the immobilizer control module within .562 seconds when the vehicle is stationary, or within 1.5 seconds when the vehicle is moving.
- The ECM receives an incorrect release message from the immobilizer control unit more than five times.

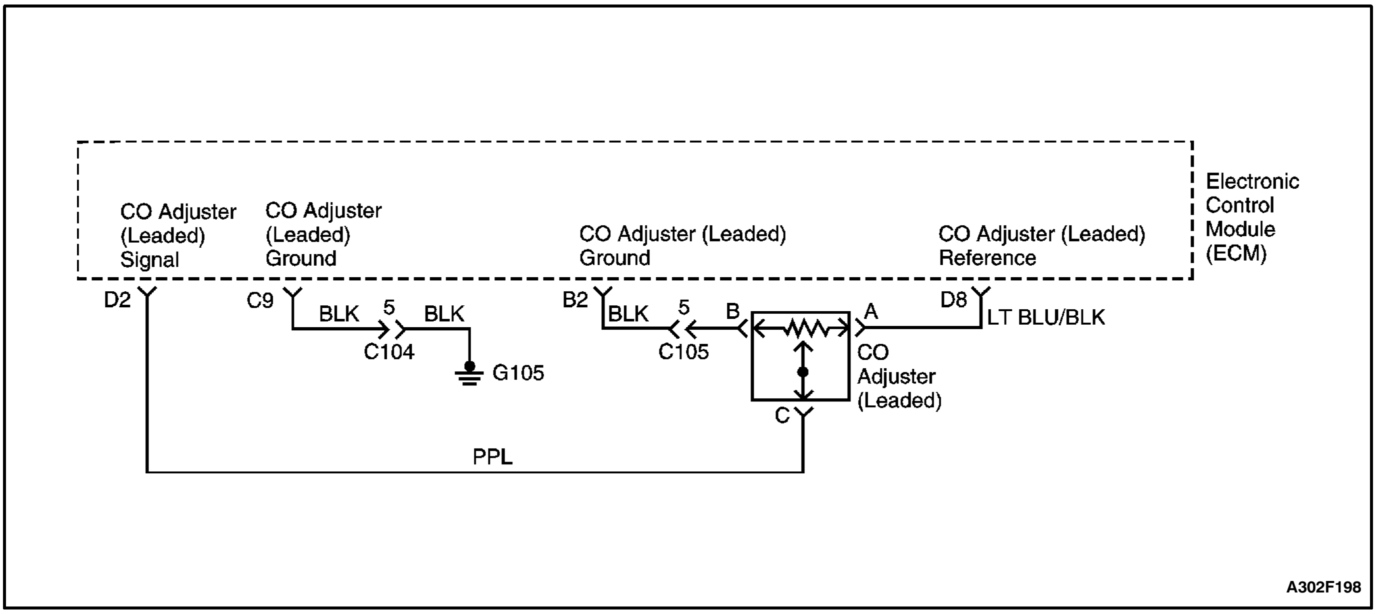
The above conditions are maintained until the ignition is switched OFF.

DTC 53 Will Clear When

- The ignition switch is turned OFF or the scan tool CLEAR CODES command is issued.

DTC 53 – ECM Immobilized Error (1.3L and 1.5L SOHC IEFI-6, 1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Connect the scan tool using the following procedure: 1. Insert the immobilizer data cartridge into the scan tool. 2. Turn the ignition switch OFF. 3. Connect the scan tool to the assembly line diagnostic link (ALDL). 4. Connect the scan tool's power cord to the cigar lighter socket. 5. Turn the ignition ON, but do not start the engine. Is communication established between the scan tool and the immobilizer control unit?	-	Go to Step 2	Go to Section 9T, ImĆ mobilizer AntiĆ Theft System
2	1. Select SYSTEM DIAGNOSIS from the scan tool menu. 2. Read the KEY STATUS message. Does the KEY STATUS message indicate POS NR (position number) 00?	-	Go to Section 9T, ImĆ mobilizer AntiĆ Theft System	Go to Step 3
3	1. Select SYSTEM DIAGNOSIS from the scan tool menu. 2. Read the IMMO & ECM ID CODE (immobilization and electronic control module identification code) message. Does the ID CODE DIFFERENT message appear?	-	Go to Section 9T, ImĆ mobilizer AntiĆ Theft System	Go to Step 4
4	Check for an open serial data wire between the immobilizer control unit and the electronic control module (ECM). Is the circuit open?	-	Go to Step 5	Go to Step 6
5	Repair the open serial data wire between the ECM and the immobilizer control unit. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Reprogram the ID code. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 54
CO ADJUST ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The CO adjuster is only used on vehicles that use leaded fuel. The CO adjuster is used in place of the O_2 sensor.

DTC 54 Will Set When

- The engine control system is in open loop.
- The CO potentiometer is greater than 250 counts or less than 5 counts.

Diagnostic Aids

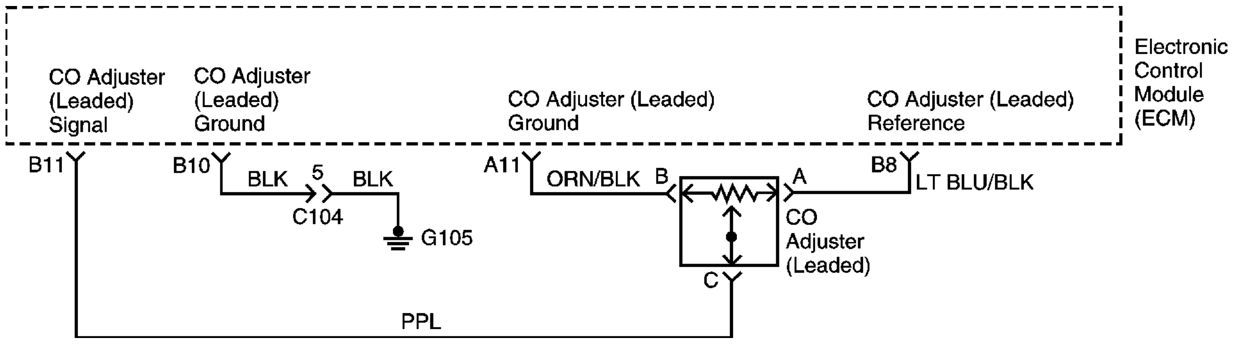
- Inspect the electronic control module (ECM) wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.

DTC 54 – CO Adjust Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Adjust the CO adjuster. Is the CO adjustable and in proper adjustment?	-	System OK	Go to Step 3
3	1. To check the ability of the electronic control module (ECM) to provide a 5-volt supply to the CO adjuster, begin by turning the ignition OFF. 2. Disconnect the electrical connector at the CO adjuster. 3. Turn the ignition ON. 4. Measure the voltage between the CO adjuster terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 7

DTC 54 – CO Adjust Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal C and the ECM connector terminal B11. Is the problem found?	-	Go to Step 8	Go to Step 9
7	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal B and the ECM connector terminal A11. Is the problem found?	-	Go to Step 8	Go to Step 6
8	1. Repair the wire or the connector terminal, as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Disconnect the electrical connector at the CO adjuster. 2. Measure the resistance between terminal A and terminal B of the CO adjuster. Is the resistance the value specified?	12.6 W	Go to Step 10	Go to Step 11
10	To check the ability of the CO adjuster to vary the resistance in the circuit, begin by measuring the resistance between terminal A and terminal C of the CO adjuster. Does the resistance vary with the turn of the CO adjuster screw?	-	Go to Step 12	Go to Step 11
11	1. Replace the CO adjuster. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	Check for an open or a short to battery voltage between terminal B10 of the ECM and ground. Is the problem found?	-	Go to Step 8	Go to Step 5



DIAGNOSTIC TROUBLE CODE (DTC) 54
CO ADJUST ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The CO adjuster is only used on vehicles that use leaded fuel. The CO adjuster is used in place of the O_2 sensor.

DTC 54 Will Set When

- The engine control system is in open loop.
- CO potentiometer is greater than 250 counts or less than 5 counts.

Diagnostic Aids

- Inspect the electronic control module (ECM) wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.

DTC 54 – CO Adjust Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Adjust the CO adjuster. Is the CO adjustable and in proper adjustment?	-	System OK	Go to Step 3
3	1. To check the ability of the electronic control module (ECM) to provide a 5-volt supply to the CO adjuster, begin by turning the ignition OFF. 2. Disconnect the electrical connector at the CO adjuster. 3. Turn the ignition ON. 4. Measure the voltage between the CO adjuster terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 8	Go to Step 7

DTC 54 – CO Adjust Error (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal C and the ECM connector terminal D2. Is the problem found?	-	Go to Step 8	Go to Step 9
7	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal B and the ECM connector terminal B2. Is the problem found?	-	Go to Step 8	Go to Step 6
8	1. Repair the wire or the connector terminal, as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Disconnect the electrical connector at the CO adjuster. 2. Measure the resistance between terminal A and terminal B of the CO adjuster. Is the resistance the value specified?	12.6 W	Go to Step 10	Go to Step 11
10	To check the ability of the CO adjuster to vary the resistance in the circuit, begin by measuring the resistance between terminal A and terminal C of the CO adjuster. Does the resistance vary with the turn of the CO adjuster screw?	-	Go to Step 12	Go to Step 11
11	1. Replace the CO adjuster. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	Check for an open or a short to battery voltage between terminal C9 of the ECM and ground. Is the problem found?	-	Go to Step 8	Go to Step 5

DIAGNOSTIC TROUBLE CODE (DTC) 55
EEPROM OR CONFIG REG ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) utilizes an electronically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine diagnostics operation.

DTC 55 Will Set When

- Microprocessor configuration register is not equal to $0B.

Diagnostic Aids

The diagnostic trouble code (DTC) 55 indicates that the contents of the EEPROM have changed since the ECM was programmed. The only possible repair is ECM replacement. Remember to program the replacement ECM with the correct software and calibration for the vehicle.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. When the ECM is being replaced, the new ECM must be programmed.

DTC 55 – EEPROM or Config Reg Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	–	Go to Step 2	Go to "Diagnostic System Check"
2	1. Replace the electronic control module (ECM). 2. Perform the Diagnostic System Check. Is the repair complete?	–	System OK	–

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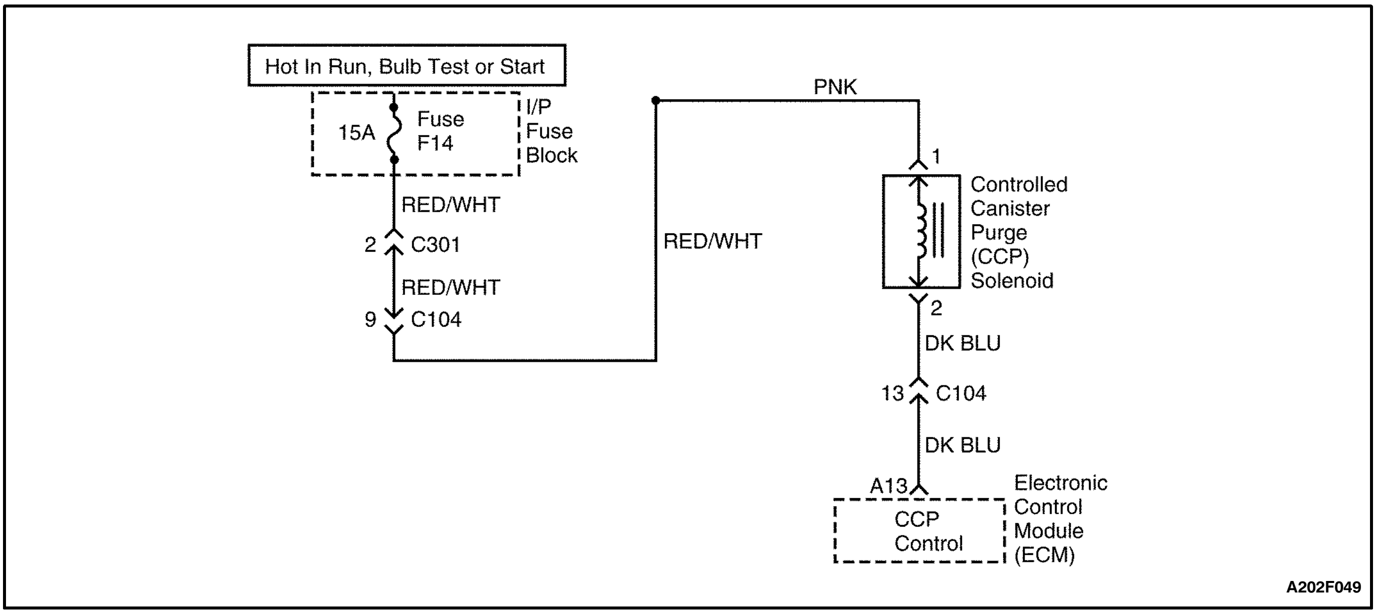


DIAGNOSTIC TROUBLE CODE (DTC) 61
CCP SOLENOID SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Evaporative canister purge is controlled by the electronic control module (ECM). The ECM applies a ground to the controlled canister purge (CCP) solenoid. The ECM determines when to activate the CCP solenoid depending on operating conditions, including throttle position, engine speed, coolant temperature, and ambient temperature.

DTC 61 Will Set When

- A short to ground condition exits.
- This condition is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the CCP solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

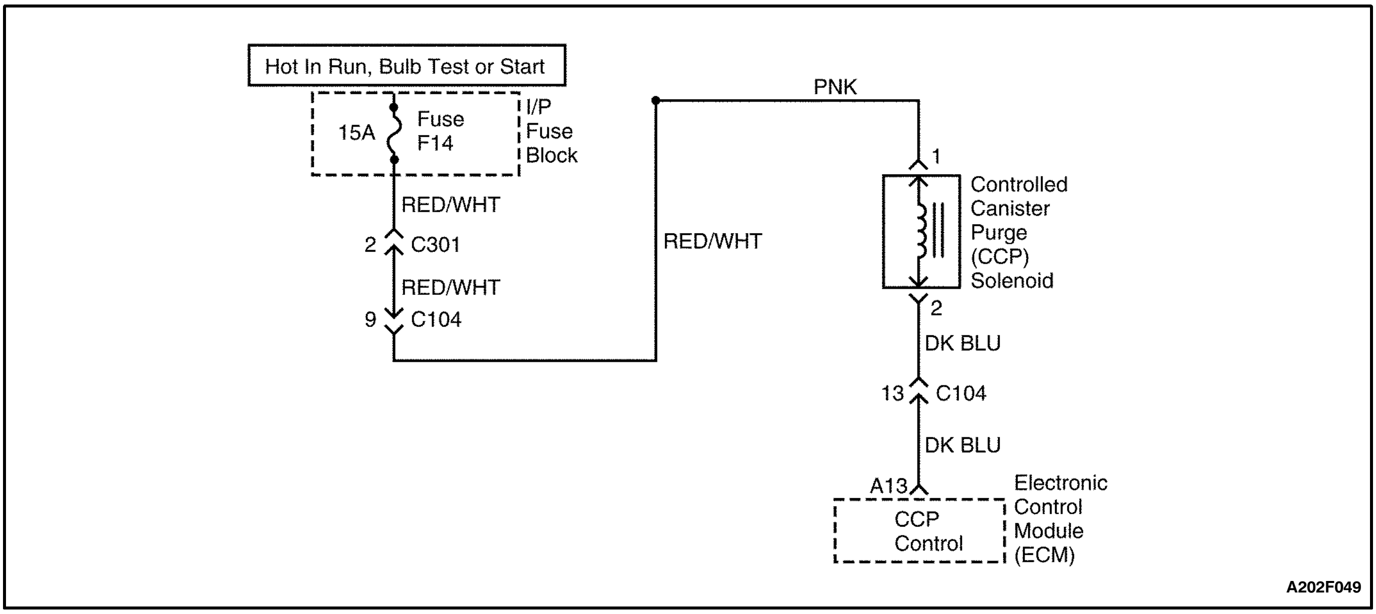
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition OFF, the ECM should not be applying ground to the CCP solenoid.
3. If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.

DTC 61 – CCP Solenoid Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Disconnect the controlled canister purge (CCP) solenoid connector. 2. Connect a test light between the CCP solenoid connector terminal 2 and battery positive. Is the test light on?	-	Go to Step 3	Go to “Diagnostic Aids”
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the CCP solenoid connector terminal 2 and the ECM connector terminal A13. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 62
CCP SOLENOID SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Evaporative canister purge is controlled by the electronic control module (ECM). The ECM applies a ground to the controlled canister purge (CCP) solenoid. The ECM determines when to activate the CCP solenoid depending on operating conditions, including throttle position, engine speed, coolant temperature, and ambient temperature.

DTC 62 Will Set When

- A short to battery voltage condition exits.
- This condition is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the CCP solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

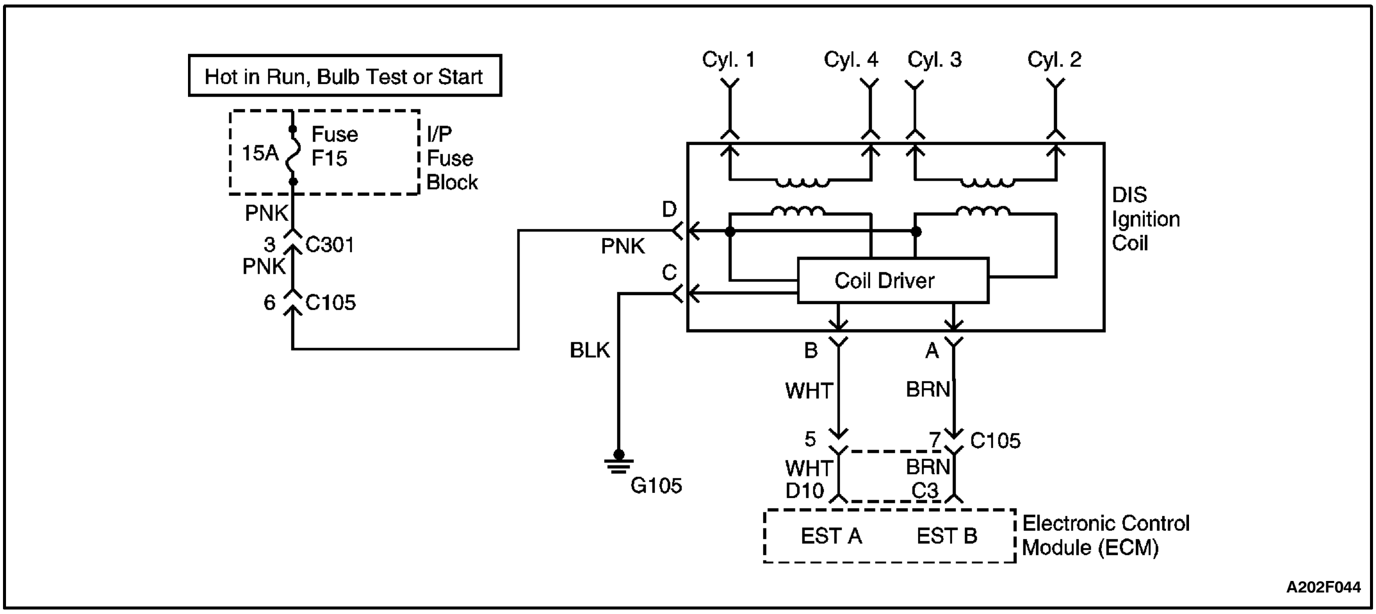
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 62 – CCP Solenoid Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Disconnect the controlled canister purge (CCP) solenoid connector. 2. Measure the resistance of the CCP solenoid. Does the resistance measure near the value specified?	[0 W	Go to Step 6	Go to Step 3
3	1. Disconnect the CCP solenoid connector. 2. Connect a test light between the CCP solenoid connector terminal 2 and ground. Is the test light on?	-	Go to Step 4	Go to “Diagnostic Aids”
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the CCP solenoid connector terminal 2 and the ECM connector terminal A13. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the CCP solenoid. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 63 ELECTRONIC SPARK TIMING "B" SHORTED TO GROUND (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 63 Will Set When

- No voltage is supplied by the ECM through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

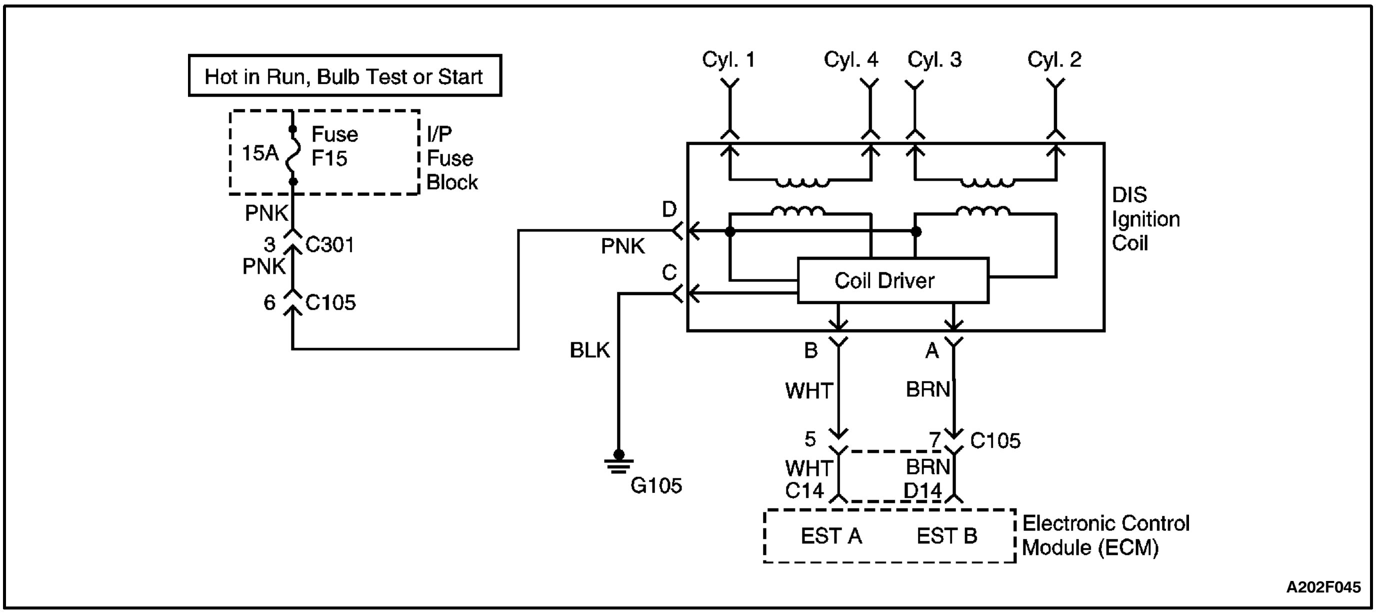
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 63 – Electronic Spark Timing "B" Shorted to Ground (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal A and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C3 or near terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 63
ELECTRONIC SPARK TIMING “B” SHORTED TO GROUND
(1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 63 Will Set When

- No voltage is supplied by the ECM through the EST “B” line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

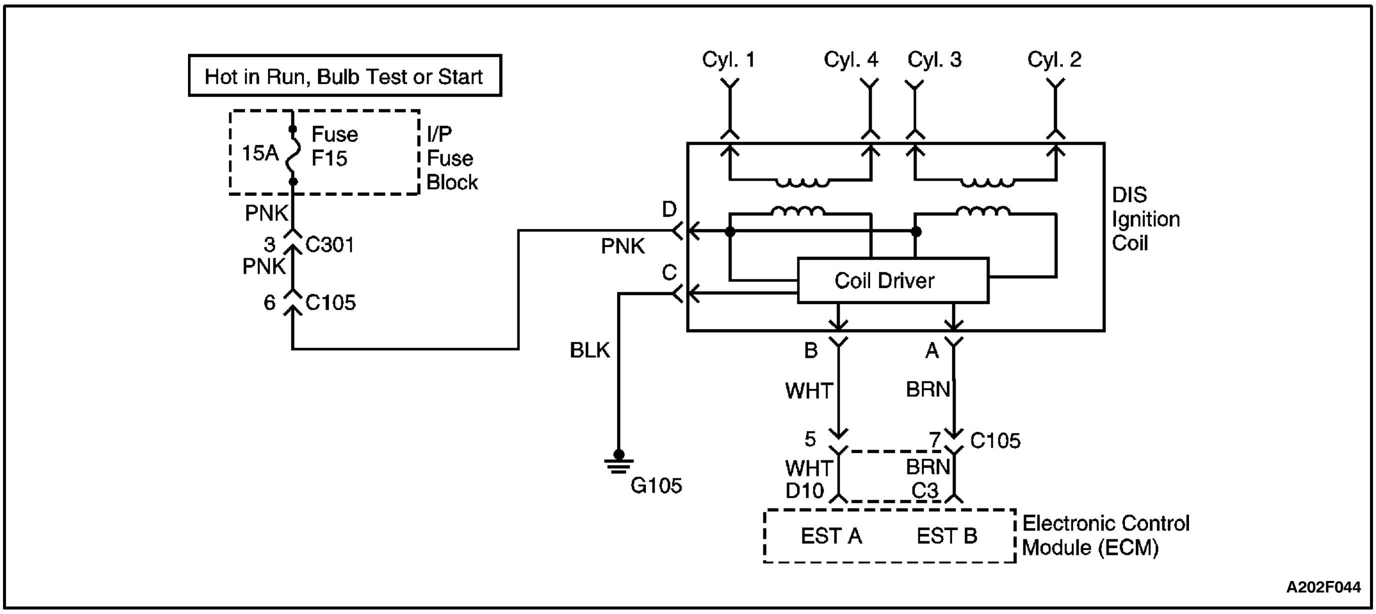
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST “B” and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST “B” wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 63 – Electronic Spark Timing “B” Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to “Diagnostic System Check”
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal A and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at or near the ECM connector terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 64 ELECTRONIC SPARK TIMING "A" SHORTED TO GROUND (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 64 Will Set When

- No voltage is supplied by the ECM through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

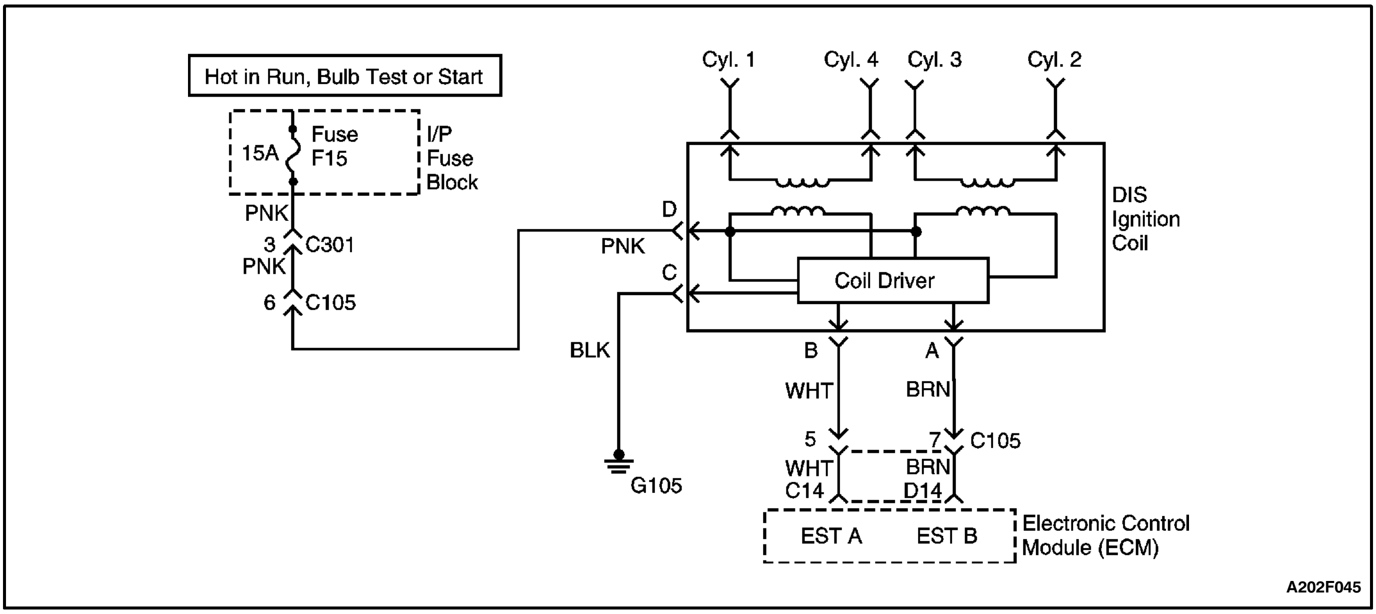
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "A" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "A" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 64 – Electronic Spark Timing "A" Shorted to Ground (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal B and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D10 or near terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 64 ELECTRONIC SPARK TIMING "A" SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 64 Will Set When

- No voltage is supplied by the ECM through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

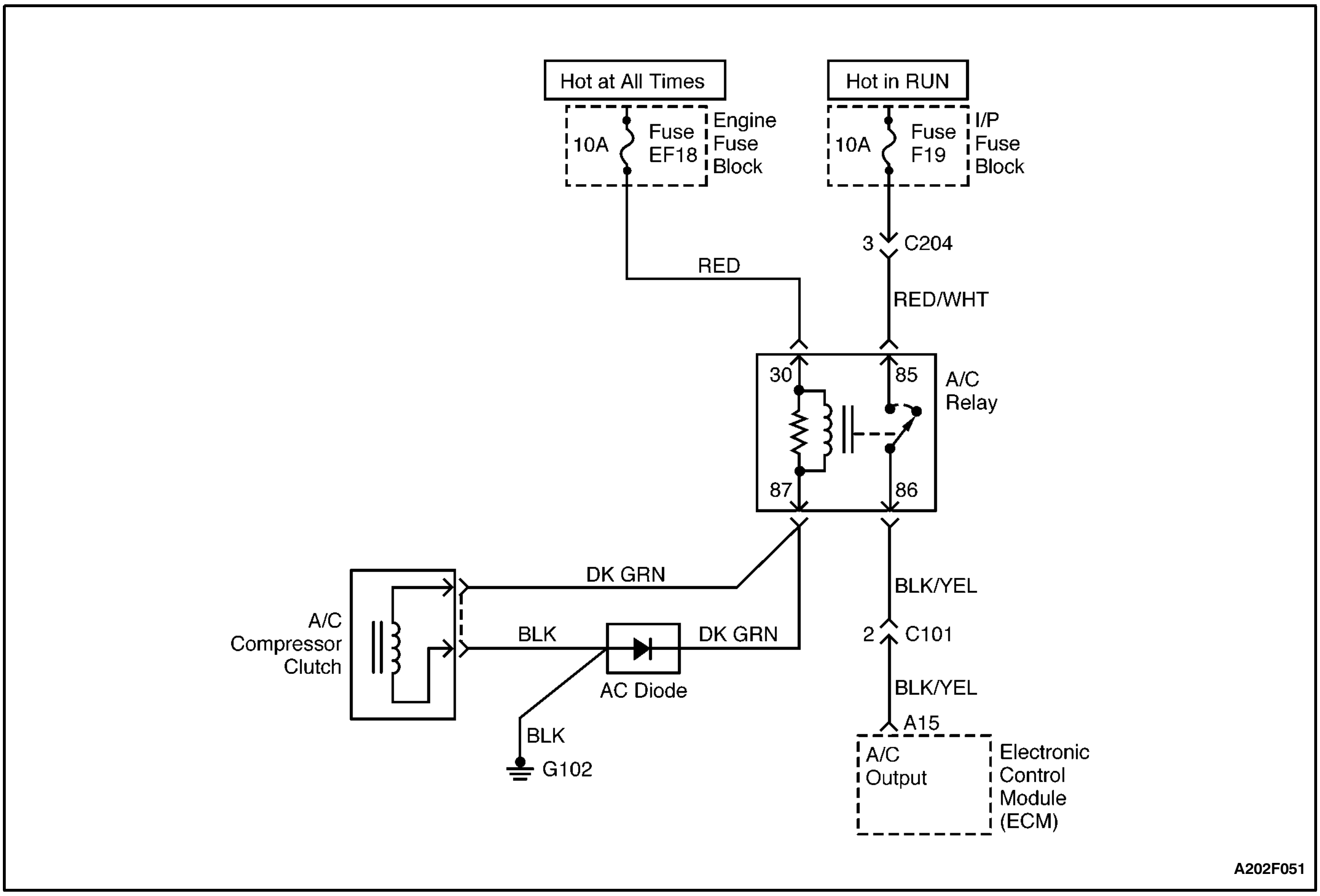
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "A" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "A" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 64 – Electronic Spark Timing "A" Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal B and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C14 or near terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 87
A/C CUT SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the air conditioning (A/C) switch is turned ON, the electronic control module (ECM) grounds the A/C compressor relay to initiate A/C compressor operation. Under various operating conditions, the ECM will interrupt A/C compressor operation.

DTC 87 Will Set When

- A short to ground condition exits and is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the A/C compressor relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

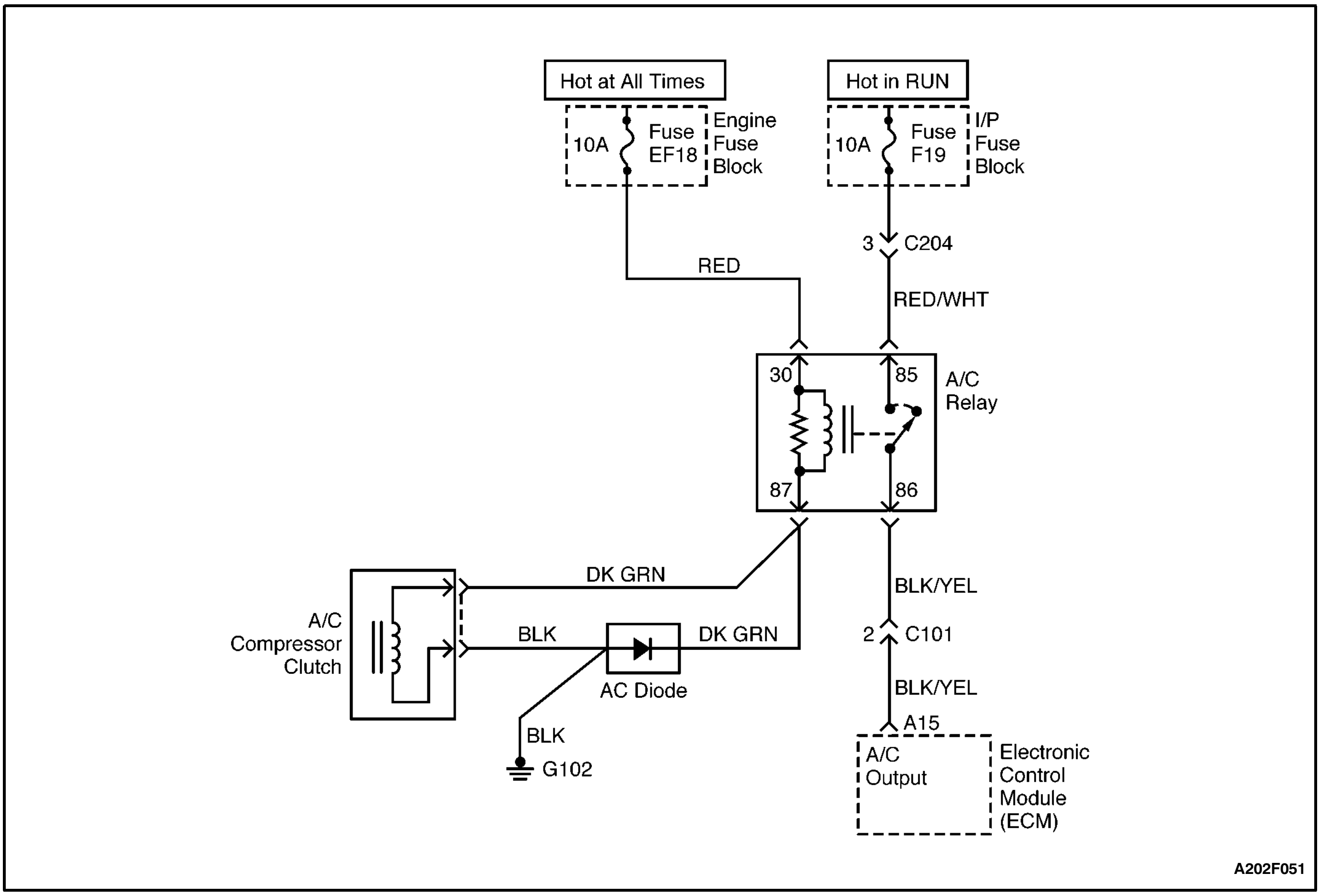
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition OFF, the ECM should not be applying ground to the A/C compressor relay.
3. If the test light is still on after disconnecting the ECM red connector, the wire between the A/C compressor relay and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.

DTC 87 – A/C Cut Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning (A/C) compressor relay. 2. Connect a test light between the A/C compressor relay connector terminal 86 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the A/C compressor relay connector terminal 86 and the ECM connector terminal A15. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 88
A/C CUT SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the air conditioning (A/C) switch is turned ON, the electronic control module (ECM) grounds the A/C compressor relay to initiate A/C compressor operation. Under various operating conditions, the ECM will interrupt A/C compressor operation.

DTC 88 Will Set When

- A short to battery voltage condition exits and is present for more than 2 seconds.

Diagnostic Aids

- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness are in good condition, connect a test light between the A/C compressor relay connector terminal 85 and ground while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.

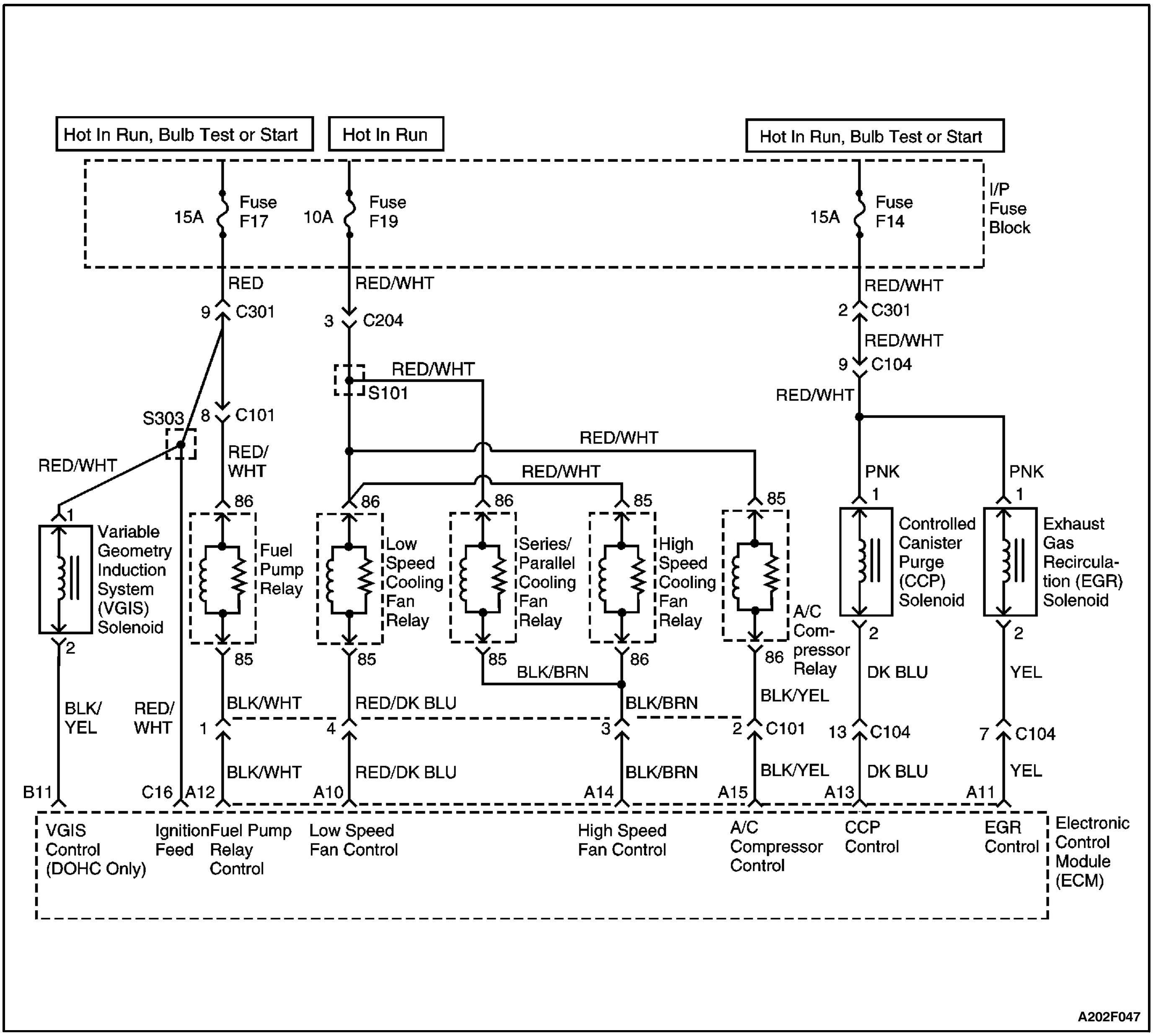
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the A/C compressor relay and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 88 – A/C Cut Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning (A/C) compressor relay. 2. Measure the resistance between the A/C compressor relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 6	Go to Step 3
3	Connect a test light between the A/C compressor relay connector terminal 86 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the A/C compressor relay connector terminal 86 and the ECM connector terminal A15. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the A/C compressor relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 93
QDM ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) is used to control several components such as those illustrated above. The ECM controls these devices through the use of a quad-driver module (QDM). When the ECM is commanding a component on, the voltage potential of the output circuit will be low (near 0 volts). When the ECM is commanding the output circuit to a component off, the voltage potential of the circuit will be high (near battery voltage). The primary function of the QDM is to supply the ground for the component being controlled.

The ECM has an internally protected QDM. This internal protection can be compared to a circuit breaker. If too much current flows in a controlled circuit, this type of QDM turns itself off. This allows the QDM to survive a shorted relay, solenoid, or wire. Repair the fault in the output circuit and the QDM will return to normal operation. It is not necessary to replace the ECM unless it is determined that the ECM itself is faulty.

Each QDM has a fault line which is monitored by the ECM. The ECM will compare the voltage at the QDM based on accepted values of the fault line. If the QDM fault detection circuit senses a voltage other than the accepted value, the diagnostic trouble code (DTC) 93 will be set.

DTC 93 Will Set When

- A QDM fault has been detected consecutively three times.

Diagnostic Aids

- Related symptoms of a QDM fault, such components on all the time or never on, will isolate the problem circuit.
- Monitor the voltage at connector terminals shown in the wiring diagram while moving related harness connectors, including the ECM harness. This may help in locating an intermittent condition.
- Check for bent connector terminals at the ECM connectors and the connectors of the relays and solenoids.
- Check for bent pins at the ECM.
- If the DTC 93 reoccurs with no apparent connector problem, replace the ECM.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The ECM does not know which controlled circuit caused the DTC 93. This step will go through each of the circuits to determine which is at fault.
3. By grounding the assembly line diagnostic link (ALDL), this causes the ECM to actuate all relays and solenoids.
4. By removing the jumper from the ALDL, only the ignition feed should be present to the relay or solenoid. The ECM should no longer be supplying a ground to complete the circuit.
5. With the ECM connectors disconnected, only a short to ground in the wiring between the affected component and the ECM will allow the test light to turn on.
7. If there are no problems found in the wiring and the connections are OK, replace the affected relay or solenoid.
11. If there is no ignition feed to the affected component, check for a blown fuse or open in the wiring. If the fuse is blown, locate and repair the short to ground in that ignition feed circuit.

DTC 93 – QDM ERROR (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Turn the ignition ON. 3. Connect an ammeter (set to 2 amp scale) between each of the following ECM connector terminals and ground: • A10 - Fan low relay. • A14 - Fan high relay. • A15 - Air conditioning (A/C) compressor relay. • A12 - Fuel pump relay. • A13 - Controlled canister purge (CCP) solenoid. Does the amperage of all circuits measure within the value specified?	<0.75 amps but not 0.0 amps	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Connect the ECM red connector. 3. Use the wiring diagram to determine the specific component terminals to be tested. 4. Disconnect the relay/solenoid from the affected circuit. 5. Jumper terminals A and B of the assembly line diagnostic link (ALDL). 6. Turn the ignition ON. 7. Connect a test light between the connector terminals for the component of the affected circuit. Is the test light on?	-	Go to Step 4	Go to Step 8

DTC 93 – QDM ERROR (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Remove the jumper from the ALDL. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Turn the ignition ON. 4. Connect a test light between the connector terminals for the component of the affected circuit. Is the test light on?	-	Go to Step 6	Go to Step 12
6	1. Turn the ignition OFF. 2. Repair the short to ground between the component of the affected circuit and the ECM. 3. Connect the ECM red connector. 4. Clear any diagnostic trouble codes (DTCs) from the ECM. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Turn the ignition OFF. 2. Check for poor connections and repair as needed. 3. If the connections are OK, replace the component of the affected circuit. 4. Clear any DTCs from the ECM. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Connect the test light between the ignition feed connector terminal for the component of the affected circuit and ground. Is the test light on?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Check for an open in the wiring between the component of the affected circuit and the ECM. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the open wire. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Repair the open in the affected component ignition feed circuit. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

SYMPTOM DIAGNOSIS

IMPORTANT PRELIMINARY CHECKS

Important: Several symptom procedures call for a careful visual/physical inspection. Always perform the visual/physical test first. Visual inspections may lead to correcting a problem without further checks and can save valuable time.

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Are any diagnostic trouble code(s) (DTCs) stored in the electronic control module (ECM) memory?	-	Go to Appropriate DTC Table	Go to Step 2
2	1. Inspect all of the ECM ground connections. 2. Inspect all of the vacuum hoses for splits, kinks, or improper connections. 3. Check for air leaks at all of the mounting areas of the intake manifold sealing surfaces. 4. Inspect the ignition wires for cracking, hardness, proper routing, or carbon tracking. 5. Inspect the wiring for proper connections, pinches, or cuts. Are all checks complete?	-	Go to Appropriate Symptom Table	-

INTERMITTENTS

Definition: The problem may or may not turn on the service engine soon (SES) warning or store a diagnostic trouble code (DTC).

Important: Do not use the DTC tables for intermittent problems. A fault must be present in order to locate the problem. If a fault is intermittent, use of DTC tables may result in the replacement of good parts.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Perform a careful inspection of any suspect circuits. 2. Inspect for poor mating of the connector halves, or terminals not fully seated into the connector body. 3. Inspect for improperly formed or damaged terminals. 4. Inspect for poor terminal-to-wire connections. This requires removing the terminal from the connector body to inspect it. Are any problems present?	-	Go to Step 3	Go to Step 4
3	Repair the electrical connections as needed. Is the repair complete?	-	System OK	-
4	Road test the vehicle with a voltmeter connected to a suspected circuit or a scan tool connected to the assembly line diagnostic link (ALDL). Does the voltmeter or the scan tool indicate an abnormal voltage or scan reading?	-	Go to Step 5	Go to Step 6

Intermittents (Cont'd)

Step	Action	Value(s)	Yes	No
5	Replace the sensor in the affected circuit, if a diagnostic trouble code (DTC) is stored for this circuit (except for the DTCs 44 and 45). Is the repair complete?	-	System OK	-
6	Does an intermittent service engine soon (SES) warning or a DTC occur?	-	Go to Step 7	Go to Step 8
7	1. Check for a faulty relay, electronic control module (ECM) driven solenoid, or switch. 2. Check for improper installation of electrical devices, such as lights, two-way radios, electric motors, etc. 3. Inspect the ignition control wires for proper routing away from ignition wires, ignition system components, and the generator. 4. Check for a short to ground in the SES circuit or the ALDL "test" terminal. 5. Inspect the ECM ground connections. 6. Correct or repair the affected circuits as needed. Is the repair complete?	-	System OK	-
8	1. Check for a loss of DTC memory. 2. Disconnect the throttle position sensor (TPS). 3. Run the engine at idle until the SES comes on. 4. Turn the ignition OFF. Is DTC 22 stored in memory?	-	Go to Step 10	Go to Step 9
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	Does the vehicle stall while driving?	-	Go to Step 11	Go to Step 12
11	Monitor the oxygen (O_2) sensor and the injector base pulse width with the scan tool. Does the scan tool display a steady low voltage (about 0 mv) for the O_2 sensor with the control module commanding an injector base pulse width of the value specified?	8 ms	Go to Step 9	Go to Step 12
12	1. Check for an open diode across the air conditioning (A/C) clutch and for other open diodes. 2. Repair or replace any components as needed. Is the repair complete?	-	System OK	-

HARD START

Definition: The engine cranks OK, but does not start for a long time. The engine eventually runs or may start and immediately die.

Important: Ensure that the driver is using the correct starting procedure. Before diagnosing, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Check the coolant temperature sensor (CTS) and the manifold air temperature (MAT) sensor using the scan tool. 3. Compare the coolant temperature and the MAT with the ambient temperature when the engine is cold. Do the CTS and the MAT readings differ from the ambient temperature by more than the value specified?	3°C (5°F)	Go to Step 3	Go to Step 4
3	1. Measure the resistance of the CTS and the MAT sensor. 2. Compare the resistance value to specifications using the Temperature Vs. Resistance tables for diagnostic trouble codes (DTCs) 14 and 23. 3. If the resistance is not the same, replace the faulty sensor. Is the repair complete?	-	System OK	-
4	1. Check for a sticking throttle shaft or a binding linkage that may cause a high throttle position sensor (TPS) voltage. Repair or replace the parts as needed. 2. Check the TPS voltage reading with the throttle closed. Does the voltage measure within the value specified?	0.4-0.8 v	Go to Step 5	Go to Step 26
5	1. Check the manifold absolute pressure (MAP) sensor response and accuracy. 2. Replace the MAP sensor as needed. Is the repair complete?	-	System OK	Go to Step 6
6	Check the fuel pump operation. Does the fuel pump operate for the specified time when the ignition switch is turned ON?	2 sec	Go to Step 7	Go to "Fuel Pump Relay Circuit Check"
7	Check the fuel system pressure. Is the fuel pressure within the specifications?	284-325 kPa (41-47 psi)	Go to Step 29	Go to Step 8
8	Check for water contamination in the fuel. Is the fuel contaminated?	-	Go to Step 9	Go to Step 10
9	Replace the contaminated fuel. Is the repair complete?	-	System OK	-

Hard Start (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check the fuel injector driver circuit. 2. Disconnect all of the fuel injector harness connectors at the fuel injectors. 3. Connect an injector test light between the harness terminals of each fuel injector connector. 4. Note the test light while cranking the engine. Does the test light blink at all connectors?	-	Go to Step 13	Go to Step 11
11	Check the fuel injector driver wiring harness, the connectors, and the connector terminals for the proper connections. Is the problem found?	-	Go to Step 12	Go to Step 30
12	Repair the wiring harness, the connector, or the connector terminal as needed. Is the repair complete?	-	System OK	-
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified at 20°C (68°F)?	11.6-12.4 W	Go to Step 15	Go to Step 14
14	Replace any fuel injector with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
15	Perform an injector balance test. Is the problem found?	-	Go to Step 16	Go to Step 17
16	Replace any restricted or leaking fuel injectors as needed. Is the repair complete?	-	System OK	-
17	1. Check for the proper ignition voltage output for each cylinder with a spark tester. 2. Inspect the spark plugs for cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Inspect the ignition wires for short conditions. 4. Inspect all of the ignition grounds for loose connections. 5. Inspect the electronic control module (ECM) for the proper operation. Is the problem found?	-	Go to Step 18	Go to Step 19
18	Correct or replace any faulty ignition components. Is the repair complete?	-	System OK	-
19	Does the engine misfire or cut out under load or at idle?	-	Go to "Ignition System Check"	Go to Step 20
20	Does the engine start, but then immediately stall?	-	Go to Step 21	Go to Step 23
21	1. Remove the crankshaft position sensor (CPS). 2. Inspect for faulty connections and repair as needed. Is the problem found?	-	Go to Step 22	Go to Step 25
22	Repair the faulty connections as needed. Is the repair complete?	-	System OK	-

Hard Start (Cont'd)

Step	Action	Value(s)	Yes	No
23	1. Check for the proper valve timing. 2. Check the cylinder compression. 3. Inspect the pushrods, the rocker arms, the valve springs, and the camshaft lobes for excessive wear. 4. Inspect the intake manifold and the exhaust manifold passages for casting flash. Is the problem found?	-	Go to Step 24	Go to Step 25
24	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
25	Check the idle air control (IAC) valve operation. Repair or replace components as needed. Is the repair complete?	-	System OK	-
26	Check the base idle setting of the throttle body. Is the base idle setting properly adjusted?	-	Go to Step 27	Go to Step 28
27	Check the TPS circuit for proper operation. Repair or replace components as needed. Is the repair complete?	-	System OK	-
28	Adjust the base idle setting to specifications. Is the repair complete?	-	System OK	-
29	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-

SURGES OR CHUGGLES

Definition: Engine power varies under steady throttle or cruise and feels as if the vehicle speeds up and slows down with no change in the accelerator pedal position.

Important: Make sure the driver understands torque converter clutch (TCC) and air conditioning (A/C) compressor operation as described in the owner's manual.

The speedometer reading and the speed reading on the scan tool should be equal.

Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	Connect the scan tool to the assembly line diagnostic link (ALDL). Does the oxygen (O_2) sensor respond quickly to different throttle positions?	-	Go to Step 4	Go to Step 3
3	1. Check the O_2 sensor for silicone or other contaminants from fuel or use of improper room temperature vulcanizing (RTV) sealant. 2. Replace the contaminated O_2 sensor. Is the repair complete?	-	System OK	-

Surges or Chuggles (Cont'd)

Step	Action	Value(s)	Yes	No
4	1. Drive the vehicle at the speed of the complaint. 2. Monitor the long-term fuel trim reading using the scan tool. Is the long-term fuel trim reading within the value specified?	115-150 counts	Go to Step 7	Go to Step 5
5	Is the long-term fuel trim reading below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 6
6	Is the long-term fuel trim reading above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	-
7	Check the fuel system pressure while the condition exists. Is the fuel system pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 8	Go to Step 17
8	Check the in-line fuel filter. Is the filter dirty or plugged?	-	Go to Step 18	Go to Step 9
9	Perform an injector balance test. Does the injector balance test pinpoint the problem?	-	Go to Step 19	Go to Step 10
10	1. Check for proper ignition voltage output using a spark tester. 2. Inspect the spark plugs for cracks, wear, improper gap, burned electrodes, or heavy deposits. Is the problem found?	-	Go to Step 11	Go to Step 12
11	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
12	1. Inspect the electronic control module (ECM) grounds for being clean, tight, and in their proper locations. 2. Inspect the vacuum lines for kinks or leaks. Is the problem found?	-	Go to Step 13	Go to Step 14
13	Repair the electrical connections or the vacuum lines as needed. Is the repair complete?	-	System OK	-
14	Check the generator output voltage. Is the generator voltage within the value specified?	12-16 v	Go to Step 16	Go to Step 15
15	Repair the generator. Is the repair complete?	-	System OK	-
16	1. Check for intermittent exhaust gas recirculation (EGR) valve operation. 2. Check torque converter clutch (TCC) operation. 3. Repair or replace any components as needed. Is the repair complete?	-	System OK	-
17	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
18	Replace the fuel filter. Is the repair complete?	-	System OK	-
19	Replace the leaking or restricted fuel injectors. Is the repair complete?	-	System OK	-

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Definition: The engine delivers less than expected power. There is little or no increase in speed when the accelerator pedal is partially applied.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Verify the customer's complaint. 2. Compare the performance of the customer's vehicle with a similar unit. Does the problem exist?	-	Go to Step 3	System OK
3	1. Inspect the air filter for excessive contamination. 2. Replace the air filter as needed. 3. Check the transaxle shift pattern and downshift operation. Does the transaxle operate properly?	-	Go to Step 4	Go to Step 5
4	Check the fuel system pressure. Is the fuel system pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 7	Go to Step 6
5	Repair the transaxle as needed. Is the repair complete?	-	System OK	-
6	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
7	Check for a restricted fuel filter or contaminated fuel. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
9	1. Check the ignition system output for all of the cylinders using a spark tester. 2. Check for proper ignition control operation. Is the ignition system operating properly?	-	Go to Step 10	Go to Step 11
10	1. With the engine at normal operating temperature, connect a vacuum gauge to a vacuum port on the intake manifold. 2. Operate the engine at 1,000 rpm. 3. Record the vacuum reading. 4. Increase the engine speed to 2,500 rpm. 5. Note the vacuum reading at a steady 2,500 rpm. Does the vacuum decrease more than the value specified?	10 kPa (3 in. Hg)	Go to Step 12	Go to Step 15
11	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
12	Inspect the exhaust system for restrictions and damaged or collapsed pipes. Is the problem found?	-	Go to Step 13	Go to Step 14
13	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
14	1. Check the cylinder compression and valve timing. 2. Inspect the camshaft for excessive wear. Is the problem found?	-	Go to Step 15	Go to Step 16

Lack of Power, Sluggishness, or Sponginess (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair or replace any engine components as needed. Is the repair complete?	-	System OK	-
16	1. Check the electronic control module (ECM) grounds for being clean, tight, and in their proper location. 2. Check the exhaust recirculation gas (EGR) valve for being open or partially open all the time. 3. Check the torque converter clutch (TCC) operation. 4. Check the air conditioning (A/C) system operation. 5. Check the generator output. 6. Repair the generator if the output is not within the specified range. Are all checks and repairs complete?	12-16 v	System OK	-

DETONATION/SPARK KNOCK

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Fill the fuel tank with a known good grade of gasoline that has the octane rating of the value specified. 2. Reevaluate the vehicle's performance. Does the detonation problem still exist?	87-89 octane	Go to Step 3	System OK
3	1. Inspect for low engine coolant. 2. Check for restricted airflow to the radiator or restricted coolant flow. 3. Check for a faulty thermostat. 4. Check for an incorrect coolant solution. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair or replace any cooling system components as needed. Is the repair complete?	-	System OK	-
5	1. Check the voltage using the scan tool. 2. Replace the coolant temperature sensor (CTS) if the resistance is not within specifications as listed in the Diagnostic Aids for Diagnostic Trouble Code (DTC) 14. Is the problem found?	-	Go to Step 6	Go to Step 7
6	Replace the CTS or repair the circuit as needed. Is the repair complete?	-	System OK	-
7	1. Check the ignition system output with a spark tester. 2. Inspect the spark plugs for the proper heat range and gap. 3. Check for the proper operation of the ignition controls. Is the ignition system operating properly?	-	Go to Step 9	Go to Step 8

Detonation/Spark Knock (Cont'd)

Step	Action	Value(s)	Yes	No
8	Repair or replace the ignition system components as needed. Is the repair complete?	-	System OK	-
9	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle at the speed of the complaint. 3. Monitor the long-term fuel trim reading from the scanner data stream. Is the long-term fuel trim reading above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	Go to Step 10
10	Check the fuel system pressure. Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 11	Go to Step 12
11	Repair or replace the fuel system components as needed. Is the repair complete?	-	System OK	-
12	1. Inspect for carbon buildup inside the engine. 2. Remove the carbon with a top engine cleaner. Follow the instructions supplied with the product. 3. Check the basic engine parts such as the camshaft, the cylinder head, the pistons, etc. for excessive wear. 4. Replace any excessively worn parts. Is the procedure complete?	-	Go to Step 13	-
13	1. Check the exhaust gas recirculation (EGR) valve for proper operation. 2. Check the air intake system for proper operation. 3. Check the torque converter clutch (TCC) operation and transaxle shift points. 4. Check the service bulletins for programmable read-only memory (PROM) updates. 5. Check the cylinder compression. 6. Repair or replace any faulty components. Are all checks and repairs complete?	-	System OK	-

HESITATION, SAG, STUMBLE

Definition: There is a momentary lack of response as the accelerator is pushed down. This can occur at any vehicle speed. It is usually the most severe when first trying to make the vehicle move, as from a stop. Hesitation, sag, or stumble may cause the engine to stall if severe enough.

Important: Before diagnosing this condition, check service bulletins for programmable read-only memory (PROM) updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Check the fuel system pressure. If the pressure is not within the value specified, service the fuel system as needed. 2. Inspect the throttle position sensor (TPS) for binding or sticking. The TPS voltage should increase at a steady rate as the throttle is moved toward wide-open throttle (WOT). Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 3	Go to Step 4
3	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
4	1. Check the manifold absolute pressure (MAP) sensor response and accuracy. 2. Inspect the fuel for water contamination. 3. Check the canister purge system for proper operation. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
6	1. Disconnect all of the fuel injector harness connectors. 2. Connect an injector test light between the harness terminals of each fuel injector. 3. Note the test light while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 8	Go to Step 7
7	1. Repair or replace the faulty fuel injector drive harness, the connector, or the connector terminal. 2. If the connections and the harnesses are good, replace the electronic control module (ECM) for an internal open in the fuel injector driver circuit. Is the repair complete?	-	System OK	-
8	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified?	11.6-12.4 W	Go to Step 10	Go to Step 9
9	Replace any of the fuel injectors for which there is a resistance that is out of specifications. Is the repair complete?	-	System OK	-
10	Perform an injector balance test. Is the problem found?	-	Go to Step 11	Go to Step 12

Hesitation, Sag, Stumble (Cont'd)

Step	Action	Value(s)	Yes	No
11	Replace any restricted or leaking fuel injectors. Is the repair complete?	-	System OK	-
12	Check the fuel system pressure after a cold start or during moderate or full throttle acceleration. Is the fuel pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 14	Go to Step 13
13	Repair the restriction in the fuel system or replace the faulty fuel pump. Is the repair complete?	-	System OK	-
14	1. Check for faulty ignition wires. 2. Inspect for fouled spark plugs. 3. Check the ignition system output on each cylinder with a spark tester. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair or replace any ignition components as needed. Is the repair complete?	-	System OK	-
16	1. Check the generator output voltage. 2. Repair or replace the generator if the generator output is less than the value specified. 3. Check the exhaust gas recirculation (EGR) valve operation. Are all checks and needed repairs complete?	12-16 v	System OK	-

CUTS OUT, MISSES

Definition: There is a steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to “Important Preliminary Checks”
2	Check the ignition system output voltage for all of the cylinders using a spark tester. Is spark present on all of the cylinders?	-	Go to Step 3	Go to “Ignition System Check”
3	1. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 2. Check the resistance of the ignition wires. Replace any ignition wires that have a resistance greater than the value specified. Is the problem found?	30,000 W	Go to Step 4	Go to Step 5
4	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
5	With the engine running, spray the ignition wires with a fine water mist to check for arcing and shorting to ground. Is the problem found?	-	Go to Step 6	Go to Step 7
6	Replace the ignition wires. Is the repair complete?	-	System OK	-

Cuts Out, Misses (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Perform a cylinder compression test. 2. If the compression is low, repair the engine as needed. 3. Inspect for proper valve timing, bent pushrods, worn rocker arms, broken or weak valve springs, and worn camshaft lobes. 4. Inspect the intake manifold and the exhaust manifold passages for casting flash. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
9	1. Check the fuel system for a plugged in-line fuel filter. 2. Check the fuel system for low fuel pressure. If the fuel pressure is below the value specified, service the fuel system as needed. 3. Inspect for contaminated fuel. Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 10	Go to Step 11
10	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
11	1. Disconnect all of the fuel injector harness connectors at the fuel injectors. 2. Connect an injector test light to the harness terminals of each fuel injector connector. 3. Note the test light while cranking the engine for each fuel injector. Does the test light blink for all of the fuel injectors?	-	Go to Step 13	Go to Step 12
12	1. Repair or replace the faulty injector drive circuit harness, the connector, or the connector terminal. 2. If the harness, the connectors, and the terminals are OK, replace the electronic control module (ECM). Is the repair complete?	-	System OK	-
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the injector resistance within the value specified?	11.6-12.4 W	Go to Step 15	Go to Step 14
14	Replace any fuel injectors with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
15	Perform an injector balance test. Is the problem found?	-	Go to Step 16	Go to Step 17
16	Replace any restricted or leaking fuel injectors. Is the repair complete?	-	System OK	-
17	1. Check for electromagnetic interference. 2. Monitor the engine rpm with a scan tool. Does the scan tool rpm change greatly with little change in actual engine rpm?	-	Go to Step 18	-
18	1. Inspect the routing of the ignition wires. 2. Inspect all of the ignition system grounds. 3. Correct the routing or repair the ground connections as needed. Are all checks and needed repairs complete?	-	System OK	-

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Important: Driving habits affect fuel economy. Check the owner's driving habits by asking the following questions:

1. Is the air conditioning (A/C) system (i.e. defroster mode) turned on all the time?
2. Are the tires at the correct air pressure?
3. Have excessively heavy loads been carried?
4. Does the driver accelerate too much and too often? Suggest the driver read the section in the owner's manual about fuel economy.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to Important Preliminary Checks”
2	1. Inspect the air filter for excessive contamination. 2. Inspect for fuel system leaks. Are all needed checks complete?	-	Go to Step 3	-
3	1. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 2. Replace any faulty spark plugs. 3. Inspect the ignition wires for cracking, hardness, and proper connections. Are all needed checks and repairs complete?	-	Go to Step 4	-
4	1. Inspect the engine coolant level. 2. Check the thermostat for being always open or for an incorrect heat range. 3. Replace the thermostat as needed. Are all needed checks and repairs complete?	-	Go to Step 5	-
5	1. Check the transaxle shift pattern. Ensure that all transaxle gears are functioning. 2. Check the torque converter clutch (TCC) operation with a scan tool. The scan tool should indicate rpm drop when the TCC is commanded on. 3. Check for proper calibration of the speedometer. 4. Check the brakes for dragging. 5. Check the cylinder compression. 6. Repair, replace, or adjust any components as needed. Are all checks and needed repairs complete?	-	System OK	-

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If the condition is bad enough, the vehicle may shake. Also, the idle varies in rpm (called "hunting"). Either condition may be severe enough to cause stalling. The engine idles at incorrect idle speed.

Important: Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Monitor the oxygen (O_2) sensor reading at different throttle positions. Does the O_2 sensor change quickly from rich to lean at the different throttle positions?	-	Go to Step 5	Go to Step 3
3	Check the O_2 sensor for contamination from fuel or improper use of room temperature vulcanizing (RTV) sealant. Is the O_2 sensor contaminated?	-	Go to Step 4	Go to Step 5
4	Replace the contaminated O_2 sensor as needed. Is the repair complete?	-	System OK	-
5	1. Check for a sticking throttle shaft or binding throttle linkage that may cause incorrect throttle position sensor (TPS) voltage. 2. Check the TPS voltage reading with the throttle closed. Is the TPS voltage within the value specified?	0.4-0.8 v	Go to Step 6	Go to "Diagnostic Aids for DTC 21"
6	1. Check the coolant temperature sensor (CTS) voltage reading using the scan tool. 2. Compare the CTS reading with the ambient temperature when the engine is cold. Does the CTS temperature reading differ from the ambient temperature by more than the value specified?	3°C (5°F)	Go to Step 7	Go to Step 9
7	Check for high resistance in the CTS circuit or the sensor itself. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the CTS or repair the circuit as needed. Is the repair complete?	-	System OK	-
9	Check the manifold absolute pressure (MAP) sensor for response and accuracy. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Replace the MAP sensor or repair the MAP sensor circuit as needed. Is the repair complete?	-	System OK	-
11	1. Road test the vehicle at the speed of the complaint. 2. Monitor the fuel trim reading using the scan tool. Is the fuel trim reading within the value specified?	115-150 counts	Go to Step 14	Go to Step 12
12	Is the fuel trim reading below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 13

Rough, Unstable, or Incorrect Idle, Stalling (Cont’d)

Step	Action	Value(s)	Yes	No
13	Is the fuel trim reading above the value specified?	150 counts	Go to “Diagnostic Aids for DTC 44”	-
14	1. Disconnect all of the fuel injector harness connectors at the fuel injectors. 2. Connect an injector test light between the harness terminals of each fuel injector connector. 3. Note the test light while cranking the engine. Does the test light blink for all of the fuel injectors?	-	Go to Step 16	Go to Step 15
15	1. Repair or replace the faulty injector drive circuit harness, the connector, or the connector terminals as needed. 2. If the harness, the connectors, and the terminals are OK, replace the electronic control module (ECM). Is the repair complete?	-	System OK	-
16	Measure the resistance of each of the fuel injectors. The resistance will increase slightly at higher temperatures. Is the resistance within the value specified?	11.6-12.4 W	Go to Step 18	Go to Step 17
17	Replace any fuel injectors with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
18	Perform an injector balance test. Is the problem found?	-	Go to Step 19	Go to Step 20
19	Replace any leaking or restricted fuel injectors. Is the repair complete?	-	System OK	-
20	1. With the engine OFF, disconnect the fuel pressure regulator vacuum hose. 2. Thoroughly inspect the fuel pressure regulator vacuum port and the fuel pressure regulator vacuum hose for the presence of fuel. Is the problem found?	-	Go to Step 21	Go to Step 22
21	Replace the fuel pressure regulator as needed. Is the repair complete?	-	System OK	-
22	1. Check the ignition system output voltage for all of the cylinders using a spark tester. 2. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 3. Inspect the ignition wires for cracking, hardness, or improper connections. 4. Replace any ignition wires that have a resistance over the value specified. Is the problem found?	30,000 W	Go to Step 23	Go to Step 24
23	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
24	1. Inspect for vacuum leaks. 2. Check for proper positive crankcase ventilation (PCV) operation. 3. Check the idle air control (IAC) valve operation. 4. Inspect the ECM ground connections. Is the problem found?	-	Go to Step 25	Go to Step 26

Rough, Unstable, or Incorrect Idle, Stalling (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
26	1. Check the exhaust gas recirculation (EGR) valve for proper operation. 2. Inspect the battery cables and the ground straps for proper connections. 3. Check the generator voltage output. Repair or replace the generator if the voltage output is not within the value specified. Is the problem found?	12-16 v	Go to Step 27	Go to Step 28
27	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
28	1. Inspect for broken engine mounts. 2. Check for proper valve timing. 3. Perform a cylinder compression test. 4. Inspect for bent pushrods, worn rocker arms, broken or weak valve springs, and a worn camshaft. 5. Perform repairs as needed. Are all of the checks and needed repairs complete?	-	System OK	-

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Excessive exhaust emissions cause a vehicle to fail an emission test or have an excessive rotten egg smell. Excessive odors do not necessarily indicate excessive emissions.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Run the engine until it reaches operating temperature. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	Go to Step 3
3	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. 3. Monitor the long-term fuel trim memory. Is the long-term fuel trim memory within the value specified?	115-150 counts	Go to Step 6	Go to Step 4
4	Is the long-term fuel trim memory below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 5
5	Is the long-term fuel trim memory above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	-
6	1. Check for a properly installed fuel cap. 2. Check the fuel system pressure. 3. Perform an injector balance test. Is the problem found?	-	Go to Step 7	Go to Step 8

Excessive Exhaust Emissions or Odors (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Repair or replace any fuel system components as needed. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	-
8	1. Check the ignition system for proper operation. 2. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 3. Check the ignition wires for cracking, hardness, or improper connections. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Repair or replace any ignition system components as needed. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	-
10	1. Inspect for vacuum leaks. 2. Inspect the catalytic converter for contamination. 3. Inspect for carbon buildup on the throttle body, the throttle plate, and inside the engine. Remove any carbon buildup with a top engine cleaner. 4. Check the exhaust gas recirculation (EGR) valve for not opening. 5. Check for proper positive crankcase ventilation (PCV) operation. Are all checks and needed repairs complete?	-	System OK	-

DIESELING, RUN-ON

Definition: Dieseling is a condition in which an engine continues to run after the ignition switch is turned OFF.

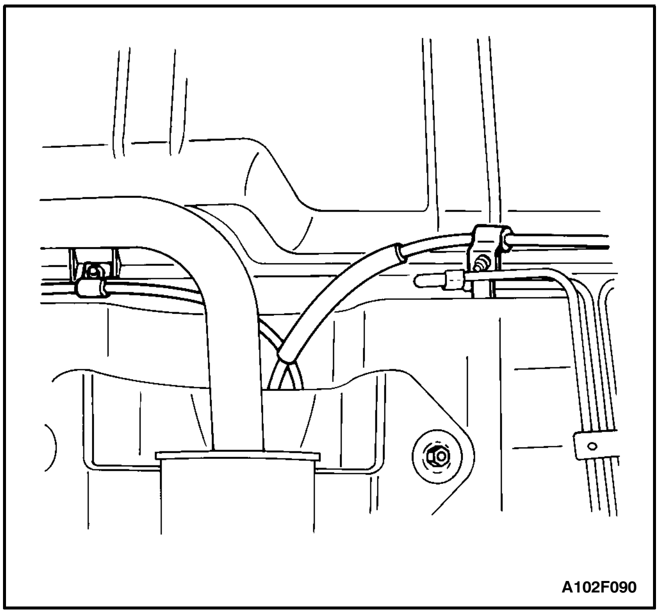
Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	Does the engine run smoothly after the ignition switch is turned OFF?	-	Go to Step 3	Go to Step 4
3	1. Check the ignition switch and the ignition switch adjustment. 2. Replace the ignition switch if needed. Is the repair complete?	-	System OK	-
4	1. Check the evaporative emission system. 2. Check for leaking fuel injectors. 3. Check the idle air control (IAC) valve operation. 4. Inspect for vacuum leaks. 5. Check for the proper base idle setting. Are all checks and repairs complete?	-	System OK	-

BACKFIRE

Definition: A backfire occurs when fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.

Important: Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Inspect for crossed or crossfiring ignition wires. 2. Check the ignition system output voltage for all cylinders using a spark tester. 3. Inspect the spark plugs for excessive wear, burned electrodes, improper gap, or heavy deposits. Is the problem found?	-	Go to Step 3	Go to Step 4
3	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
4	1. Check the fuel system operation. 2. Check the fuel injectors by performing an injector balance test. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair or replace any fuel system components as needed. Is the repair complete?	-	System OK	-
6	1. Inspect the exhaust gas recirculation (EGR) gasket for a leak or a loose fit. 2. Check the EGR valve for proper operation. 3. Inspect the intake manifold and the exhaust manifold for a casting flash. Is the problem found?	-	Go to Step 7	Go to Step 8
7	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
8	1. Inspect the timing belt for proper installation and tension. 2. Check the engine compression. 3. Inspect the intake manifold gasket and the exhaust manifold gasket for leaks. 4. Check for sticking or leaking valves. 5. Repair or replace any components as needed. Are all checks and corrections complete?	-	System OK	-


A102F090

MAINTENANCE AND REPAIR

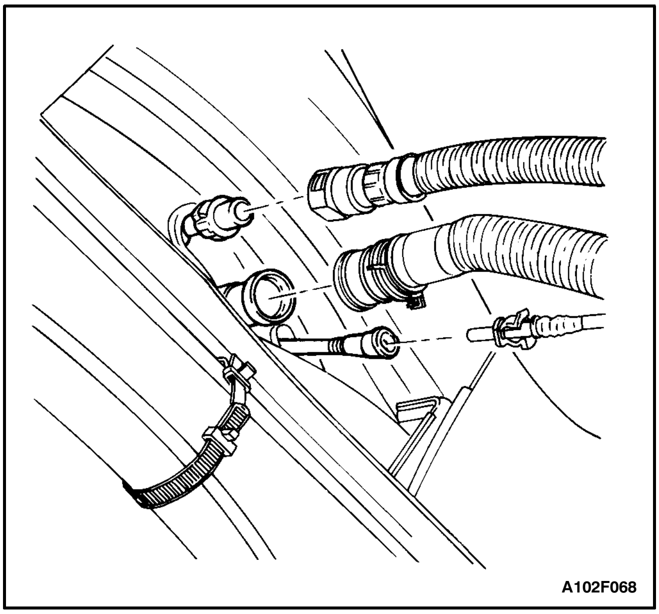
ON-VEHICLE SERVICE

FUEL TANK

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Disconnect the parking brake cable retainer clamps and the support along the fuel tank to provide clearance for the tank.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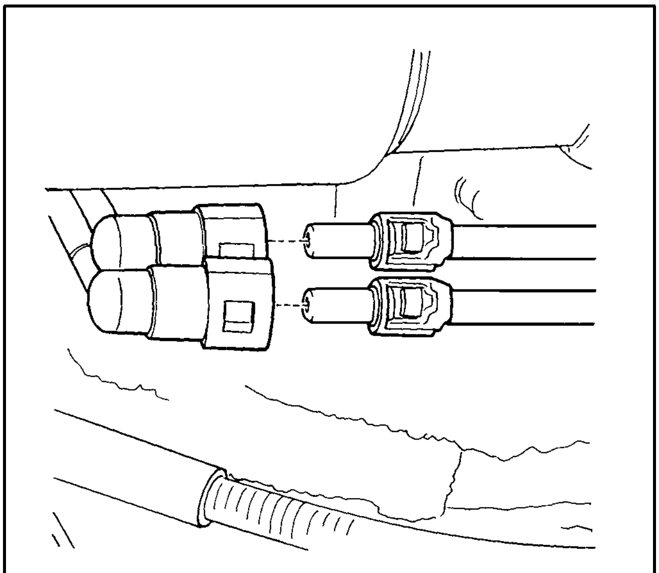
5. Remove the fuel tank filler tube clamp at the fuel tank.
6. Disconnect the fuel tank filler tube.
7. Disconnect the fuel tank vent tube at the fuel tank.
8. Disconnect the fuel vapor line near the fuel tank filler tube.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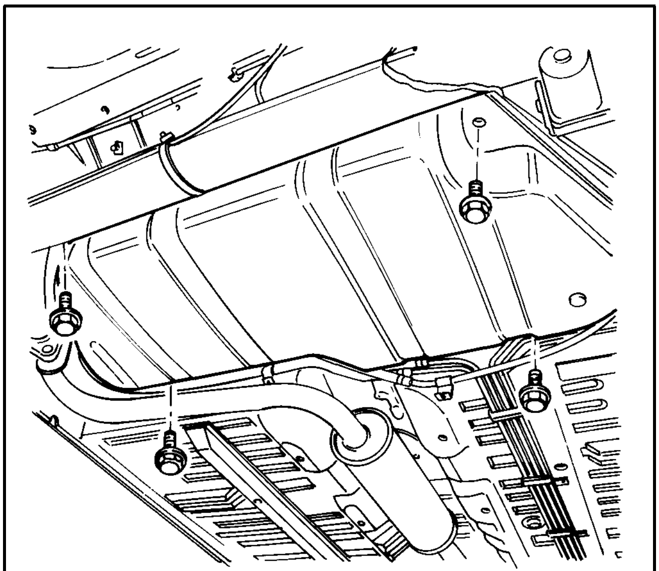
9. Disconnect the fuel pump harness connector at the right rear corner of the fuel tank.
10. Disconnect the fuel inlet line and the fuel return line near the right front of the fuel tank.
11. Disconnect the wiring harness clips and the fuel line clips as needed.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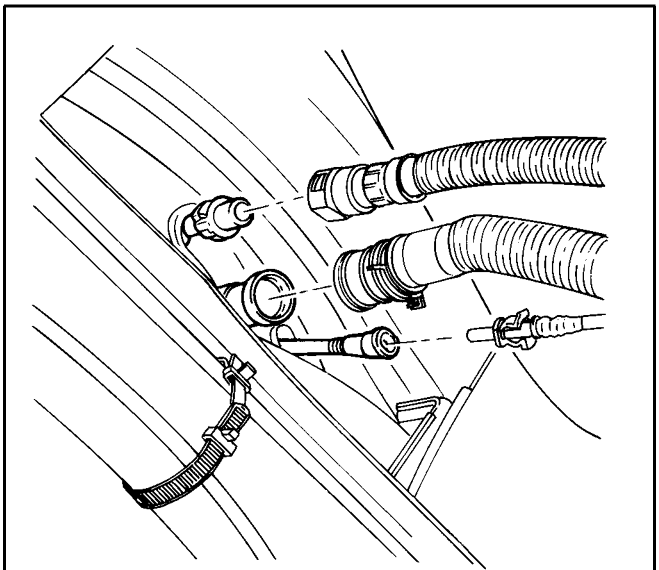
12. Support the fuel tank.
13. Remove the fuel tank retaining bolts.
14. Carefully lower the fuel tank.
15. Remove the fuel tank.
16. Transfer any parts as needed.


A102F068

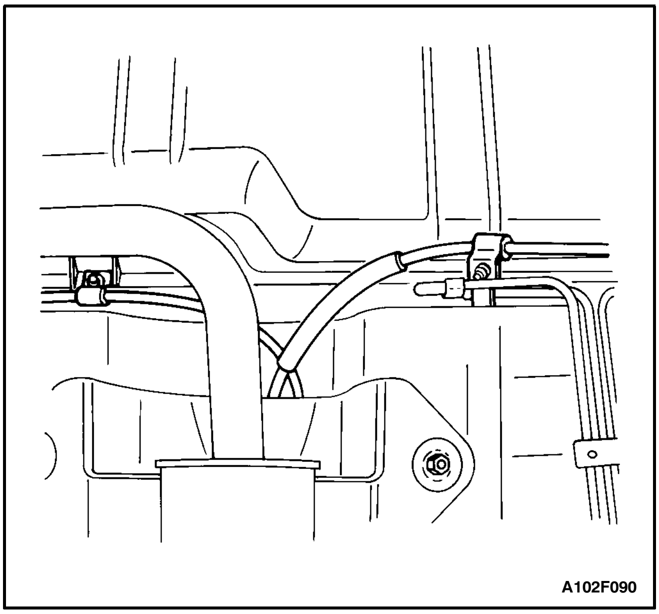
Installation Procedure

1. Raise the fuel tank into position.
2. Install the fuel tank mounting bolts.

Tighten

Tighten the fuel tank retaining bolts to 20 N•m (15 lb-ft).

3. Connect the fuel outlet line and the fuel return line.
4. Connect the wiring harness clips and the fuel line clips as needed.
5. Connect the fuel pump electrical connector.
6. Connect the fuel vapor line.
7. Connect the fuel tank filler tube.
8. Connect the fuel tank vent tube.
9. Install the fuel tank filler tube clamp at the fuel tank.



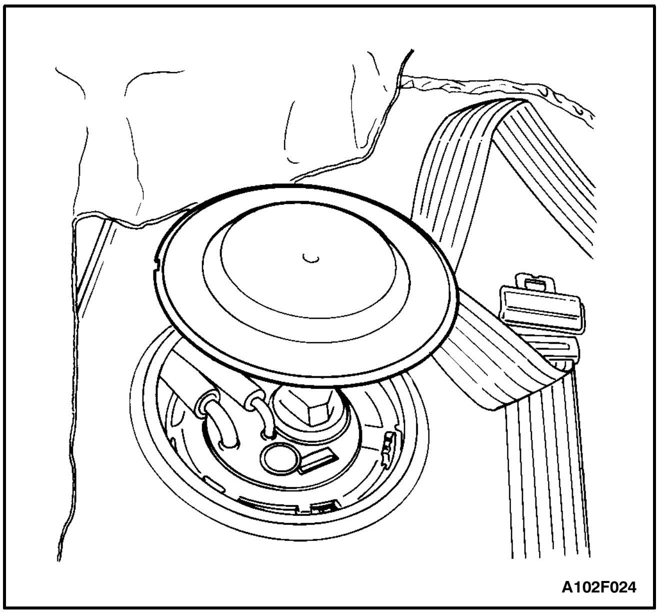
A102F090

10. Install the parking brake cable retainer clamps and the support.

Tighten

Tighten the parking brake cable retainer clamps to 10 N•m (89 lb-in).

11. Connect the negative battery cable.
12. Fill the fuel tank.
13. Perform a leak check of the fuel tank and the fuel line connections.



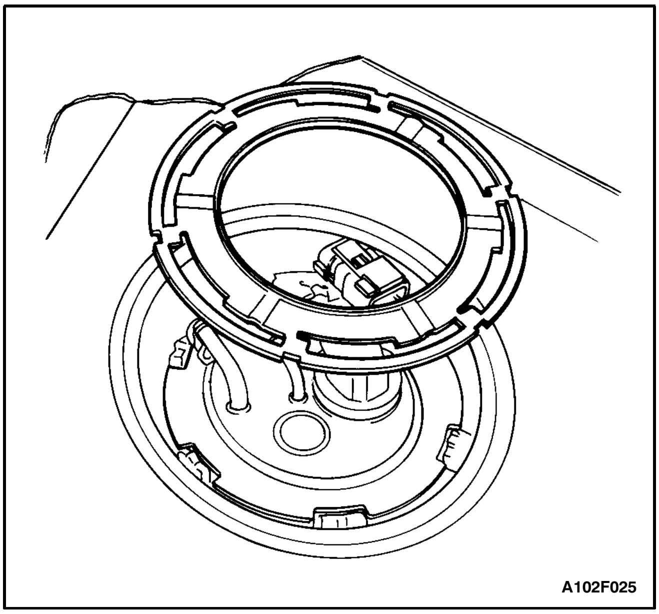
A102F024

FUEL PUMP

Removal Procedures

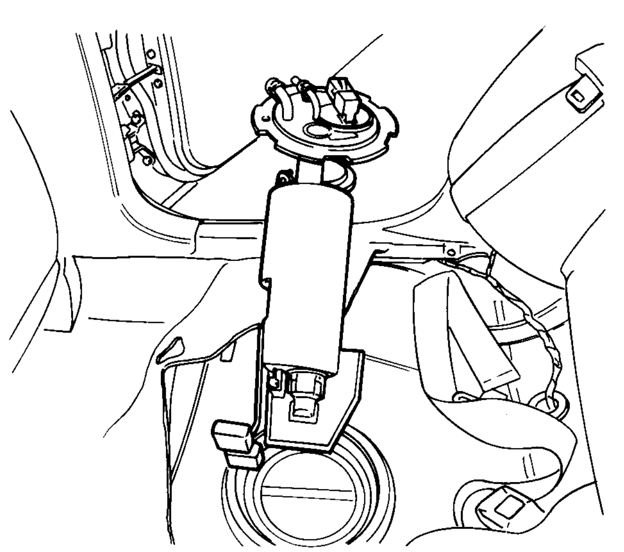
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure.
   1.1. Remove the fuel cap.
   1.2. Remove fuel pump fuse EF8 from the engine fuse block.
   1.3. Start the engine and allow the engine to stall.
   1.4. Crank the engine for an additional 10 seconds.
2. Disconnect the negative battery cable.
3. Remove the rear seat. Refer to Section 9H, Seats.
4. Remove the fuel pump access cover.



A102F025

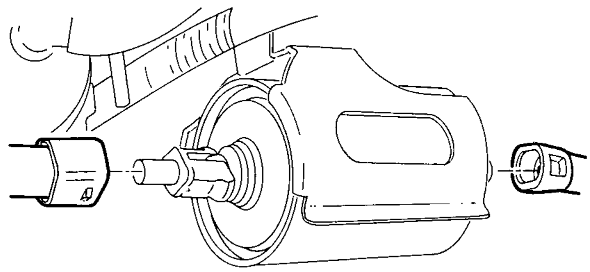
5. Disconnect the electrical connector at the fuel pump assembly.
6. Disconnect the fuel outlet line.
7. Disconnect the fuel tank return line.
8. Turn the lock ring counterclockwise to clear the tank tabs.
9. Remove the fuel pump assembly from the tank.
10. Remove and discard the gasket.



A102F026

Installation Procedure

1. Clean the gasket mating surface on the fuel tank.
2. Position the new gasket in place.
3. Install the fuel pump into the fuel tank in the same location as removed for ease of line and connector installation.
4. Position the lock ring in place and turn it clockwise until it contacts the tank stop.
5. Connect the fuel pump assembly connector.
6. Install the fuel pump outlet line.
7. Install the fuel tank return line.
8. Install the pump access cover.
9. Connect the negative battery cable.
10. Perform an operational check of the fuel pump.
11. Install the rear seat. Refer to Section 9H, Seats.



A102F091

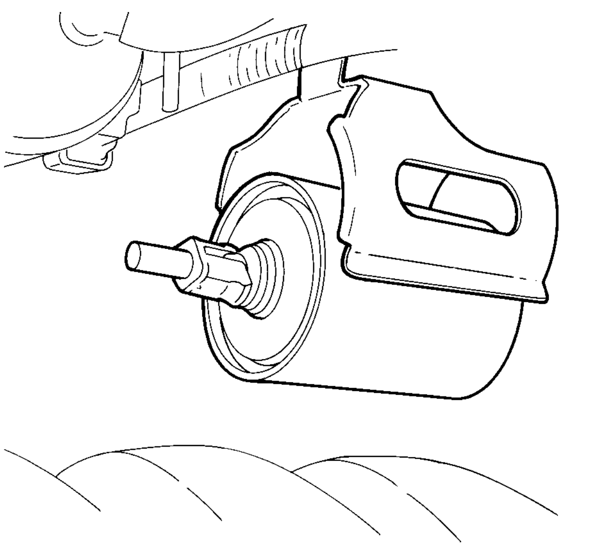
FUEL FILTER

Removal Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to "Fuel Pump" in this section.
3. Disconnect the inlet/outlet fuel lines by moving the line connector lock forward and pulling the hose off of the fuel filter tube.
4. Pull the fuel filter out of the retaining clamp.



A102F014

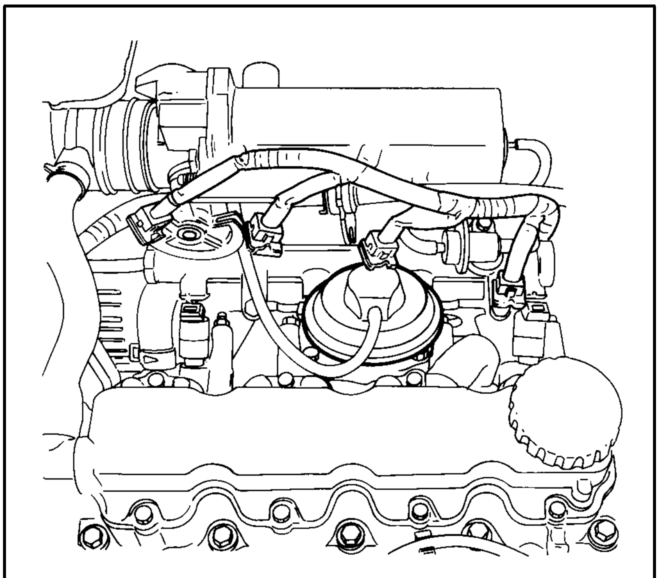
Installation Procedure

1. Install the new fuel filter into the retaining clamp. Note the flow direction.
2. Connect the inlet/outlet lines. Secure the lines with the connector lock.
3. Connect the negative battery cable.
4. Perform a leak test of the fuel filter.

FUEL RAIL AND INJECTORS (SOHC)

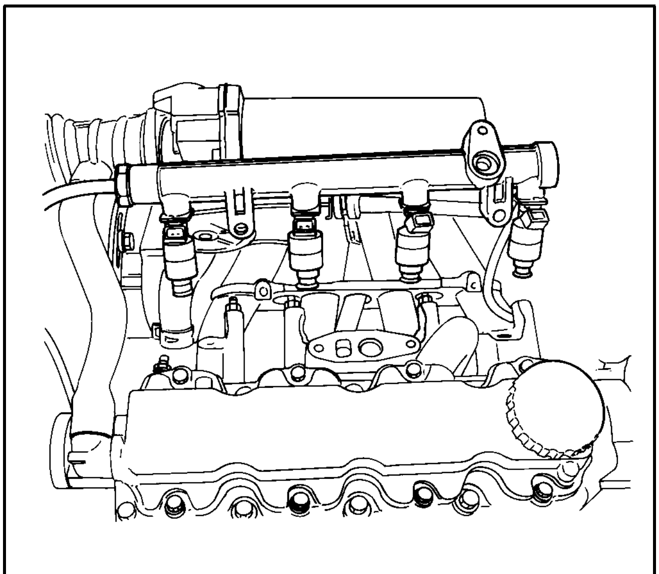
Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.



A102F005

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the fuel injector harness connectors.
4. Remove the exhaust gas recirculation valve. Refer to "Exhaust Gas Recirculation Valve (SOHC)" in this section.
5. Remove the fuel pressure regulator. Refer to "Fuel Pressure Regulator (SOHC)" in this section.



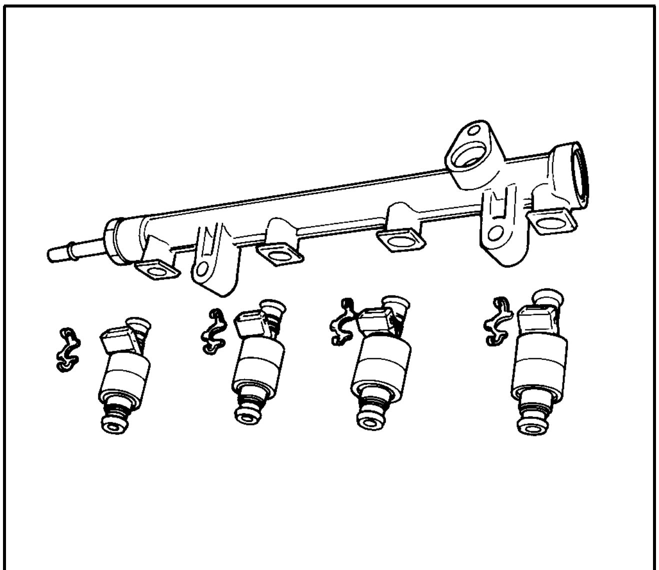
A102F006

6. Remove the fuel inlet line.
7. Remove the fuel rail mounting bolts.

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and the injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

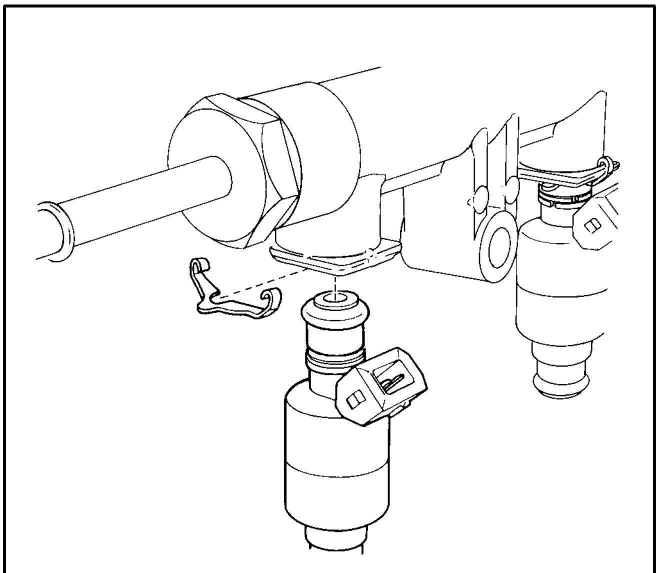
Important: If a fuel injector becomes separated from the fuel rail and remains in the cylinder head, replace the fuel injector O-ring seals and the retaining clip.

8. Remove the fuel rail with the fuel injectors attached.



A102F007

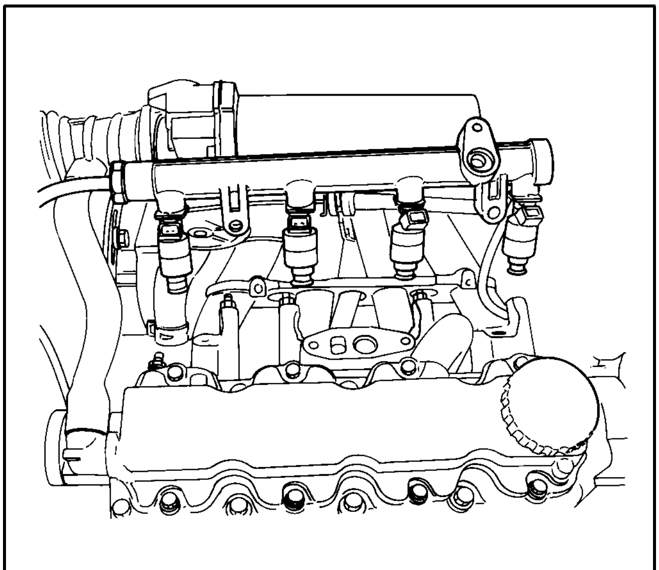
9. Remove the fuel injector retainer clips.
10. Remove the fuel injectors by pulling them down and out.
11. Discard the fuel injector O-rings.


A102F008

Installation Procedure

Important: Different fuel injectors are calibrated for different flow rates. When ordering new fuel injectors, be certain to order the identical part number that is inscribed on the old fuel injector.

1. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
2. Install the fuel injectors into the fuel rail sockets with the fuel injector terminals facing outward.
3. Install the fuel injector retainer clips onto the fuel injectors and the fuel rail ledge.
4. Make sure that the clip is parallel to the fuel injector harness connector.

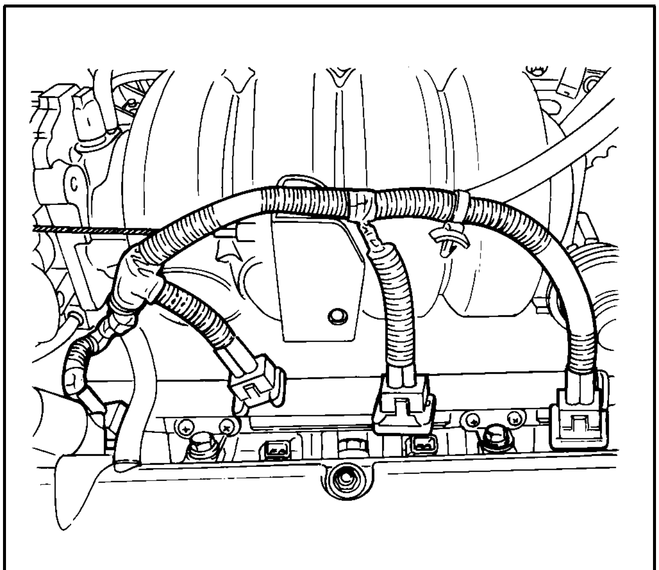

A102F006

5. Install the fuel rail assembly into the cylinder head.
6. Install the fuel rail retaining bolts.

Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

7. Connect the fuel inlet hose line.
8. Connect the fuel injector harness connectors. Rotate the fuel injector as required to avoid stretching the wire harness.
9. Install the fuel pressure regulator. Refer to "Fuel Pressure Regulator (SOHC)" in this section.
10. Install the exhaust gas recirculation valve, if equipped. Refer to "Exhaust Gas Recirculation Valve (SOHC)" in this section.
11. Connect the negative battery cable.
12. Perform a leak check of the fuel rail and the fuel injectors.

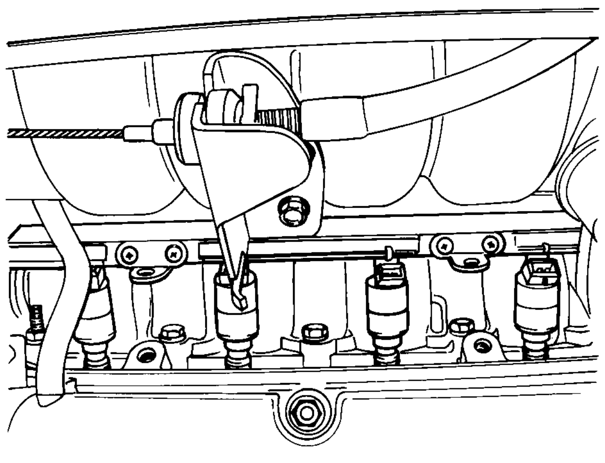

A102F033

FUEL RAIL AND INJECTORS (DOHC)

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the fuel injector harness connectors.
4. Remove the fuel line at the fuel pressure regulator. Refer to "Fuel Pressure Regulator (DOHC)" in this section.



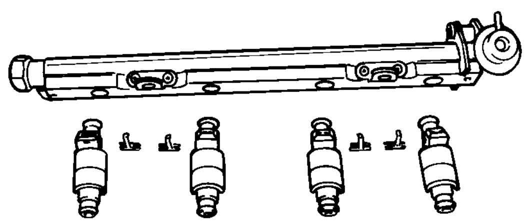
A102F035

5. Remove the fuel inlet line.
6. Remove the fuel rail mounting bolts.

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and the injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

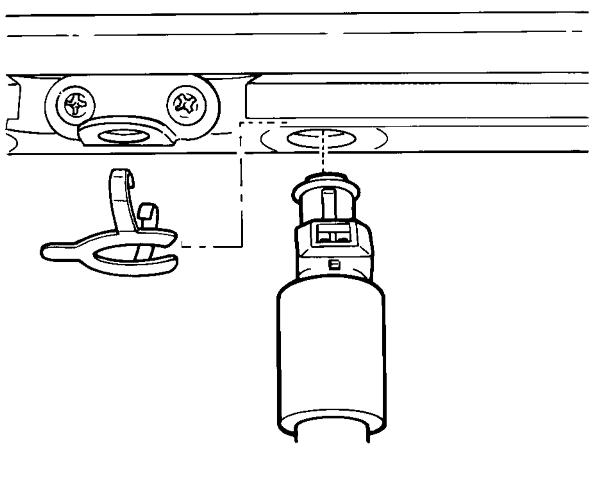
Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

7. Remove the fuel rail with the fuel injectors attached.



A102F036

8. Remove the fuel injector retainer clips.
9. Remove the fuel injectors by pulling down and out.
10. Discard the fuel injector O-rings.

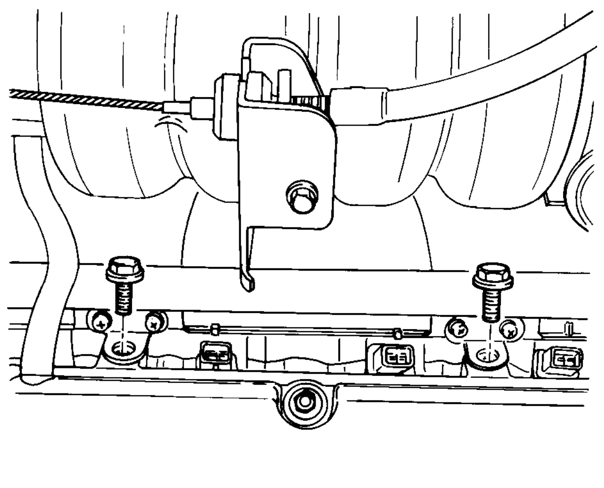


A102F063

Installation Procedure

Important: Different injectors are calibrated for different flow rates. When ordering new fuel injectors, be certain to order the identical part number that is inscribed on the old injector.

1. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
2. Install the fuel injectors into the fuel rail sockets with the fuel injector terminals facing outward.
3. Install the fuel injector retainer clips onto the fuel injectors and the fuel rail ledge.
4. Make sure that the clip is parallel to the fuel injector harness connector.



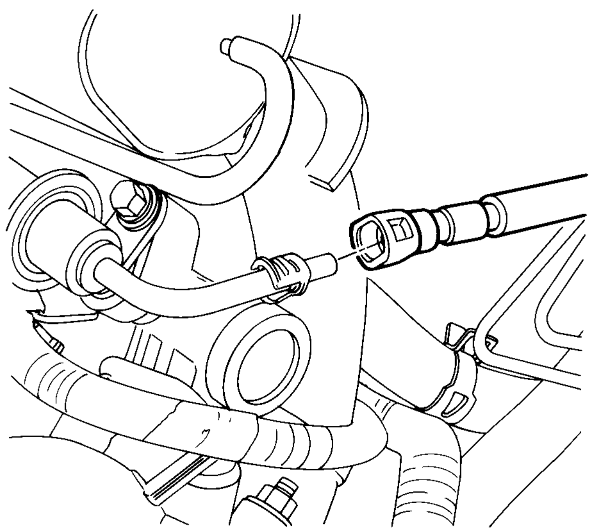
A102F034

5. Install the fuel rail assembly into the cylinder head.
6. Install the fuel rail retaining bolts.

Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

7. Connect the fuel inlet hose.
8. Connect the fuel injector harness connectors. Rotate each fuel injector as required to avoid stretching the wire harness.
9. Install the fuel pressure regulator. Refer to "Fuel Pressure Regulator (DOHC)" in this section.
10. Connect the negative battery cable.
11. Perform a leak check of the fuel rail and fuel injectors.



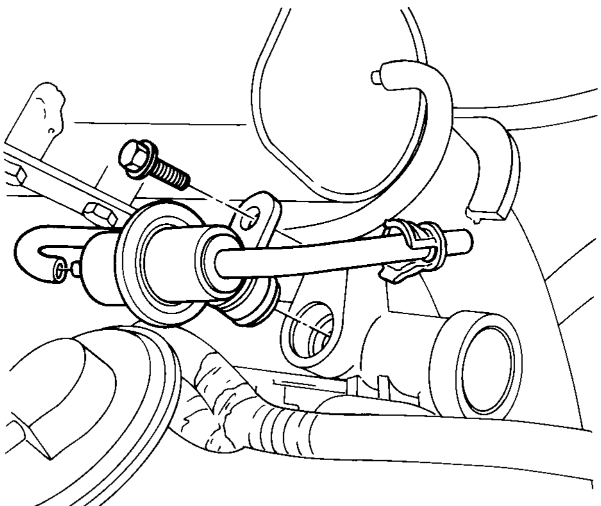
A102F004

FUEL PRESSURE REGULATOR (SOHC)

Removal Procedure

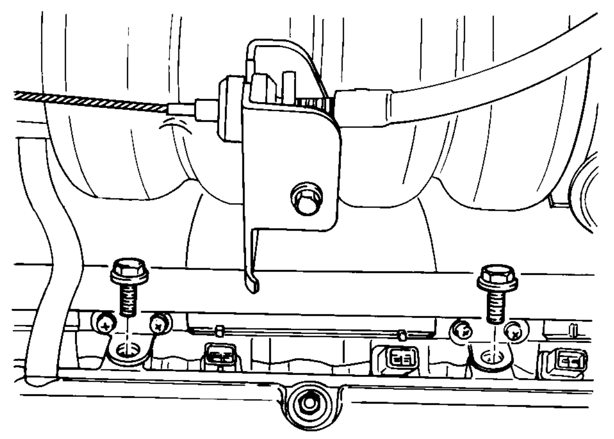
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the fuel line at the fuel pressure regulator by sliding the connector lock forward and pulling the line off.



A102F003

4. Disconnect the vacuum hose from the fuel pressure regulator.
5. Remove the fuel pressure regulator retaining bolt.
6. Remove the fuel pressure regulator by turning it back and forth and then pulling it out.
7. Discard the O-ring.



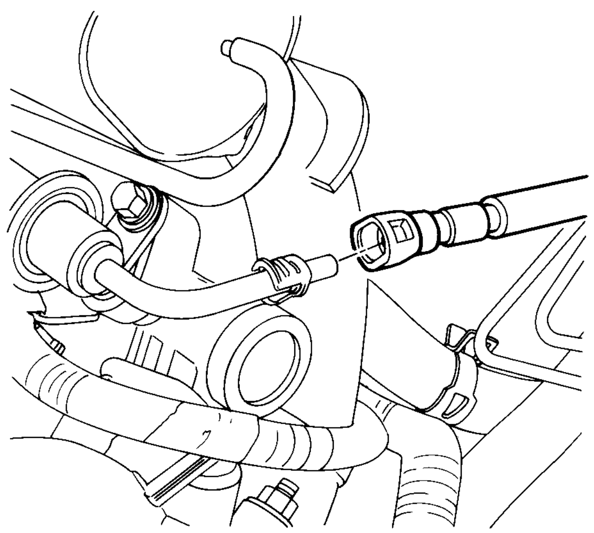
A102F092

Installation Procedure

1. Lubricate a new O-ring with engine oil. Install the new O-ring onto the fuel pressure regulator body.
2. Insert the fuel pressure regulator into the fuel rail body.
3. Install the retaining bolt.

   Tighten

   Tighten the fuel pressure regulator retaining bolt to 12 N•m (106 lb-in).
4. Connect the vacuum hose to the fuel pressure regulator.
5. Connect the fuel line to the fuel pressure regulator by pushing the lock into place.
6. Connect the negative battery cable.
7. Perform a leak test of the fuel pressure regulator with the engine OFF and the ignition ON.



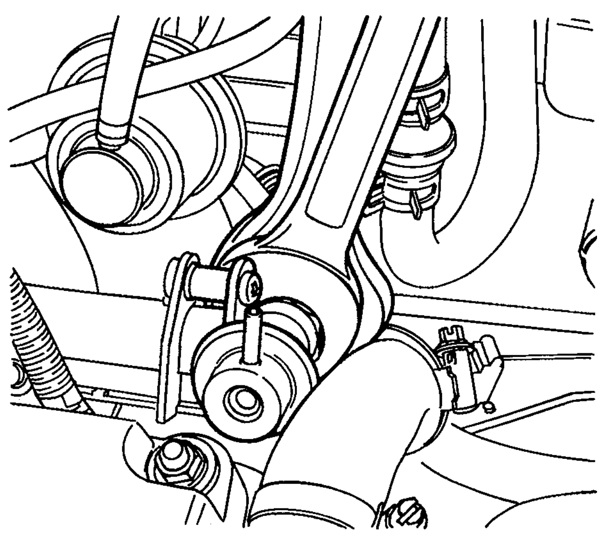
A102F093

FUEL PRESSURE REGULATOR (DOHC)

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

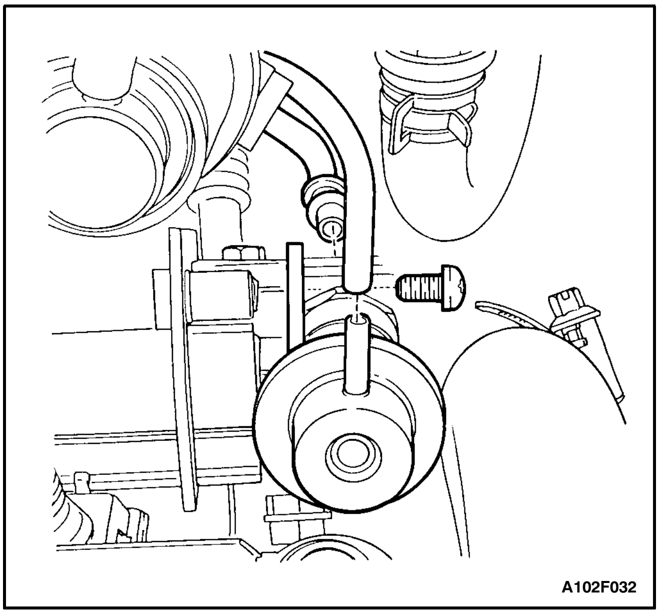
1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Remove the vacuum hose from the fuel pressure regulator.



A102F031

Notice: Use a backup wrench when removing or installing the fuel lines. Damage to the fuel rail can occur if two wrenches are not used.

3. Remove the fuel return line using two wrenches.
4. Remove the retaining screw.
5. Remove the fuel pressure regulator by turning it back and forth and then pulling it out.
6. Discard the O-ring.

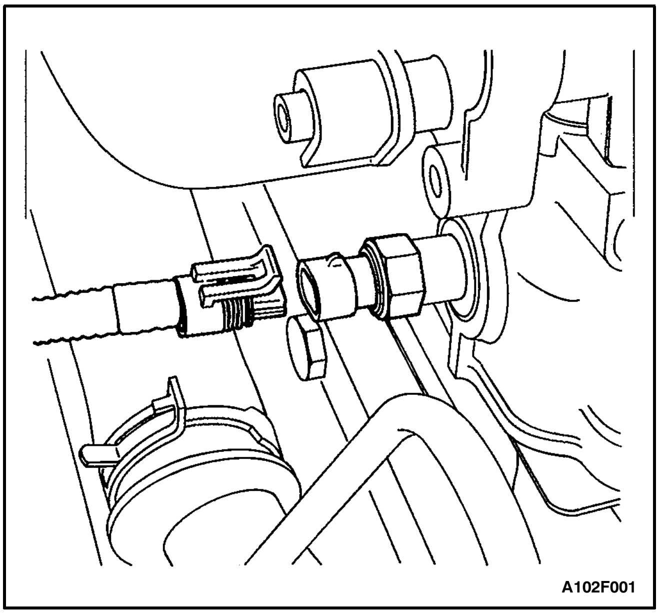


Installation Procedure

1. Lubricate a new O-ring with engine oil. Install the O-ring onto the fuel pressure regulator.
2. Insert the fuel pressure regulator into the fuel rail body.
3. Install the retaining screw.

   Tighten

   Tighten the fuel pressure regulator retaining screw to 12 N•m (106 lb-in).
4. Connect the fuel line using two wrenches.
5. Connect the vacuum hose to the fuel pressure regulator.
6. Connect the negative battery cable.
7. Perform a leak test of the fuel pressure regulator with the engine OFF and the ignition ON.



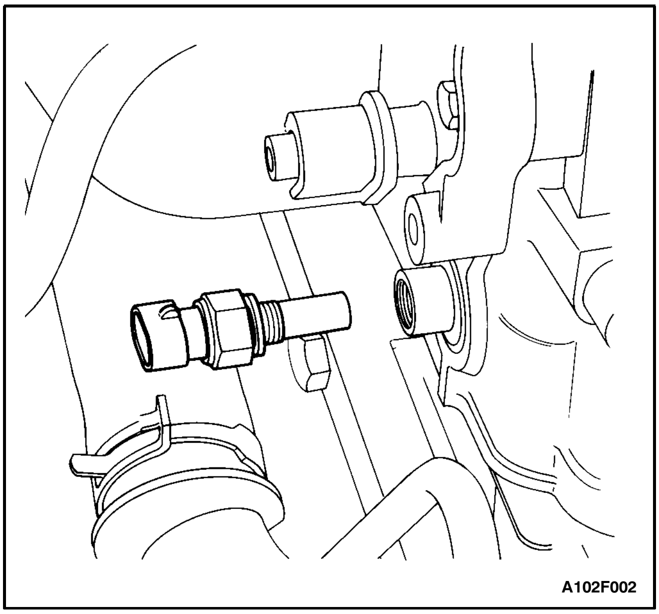
COOLANT TEMPERATURE SENSOR (SOHC)

Removal Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the coolant temperature sensor (CTS) connector.

Notice: Use care when handling the CTS. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Carefully remove the CTS from the cylinder head underneath the direct ignition system (DIS) ignition coil.



Installation Procedure

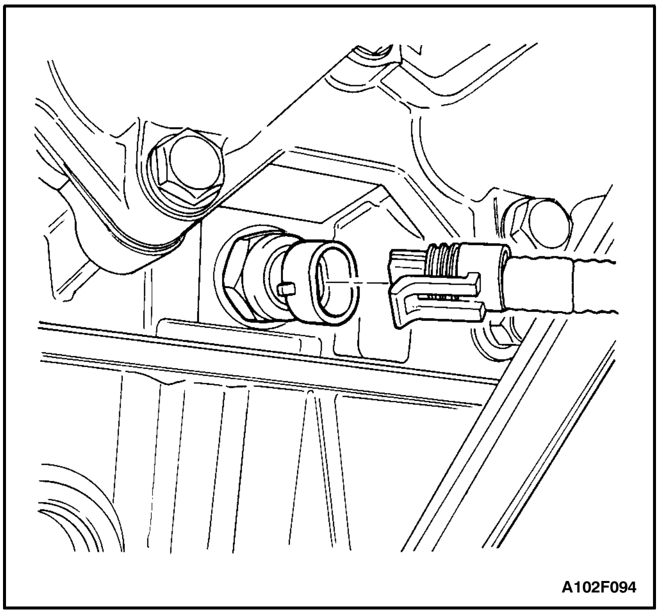
1. Coat the threads on the CTS with sealer.

Notice: Use care when handling the CTS. Damage to the sensor will affect the proper operation of the fuel injection system.

2. Install the CTS into the cylinder head.

   Tighten

   Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).
3. Connect the CTS connector.
4. Fill the coolant system.
5. Connect the negative battery cable.



A102F094

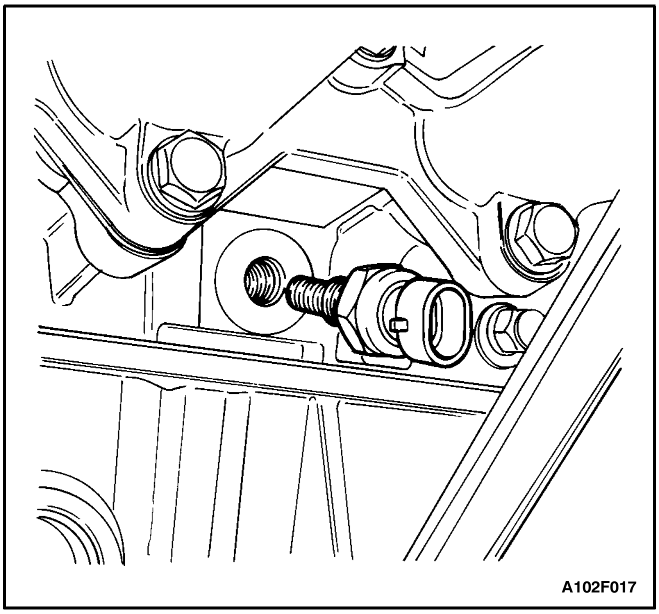
COOLANT TEMPERATURE SENSOR (DOHC)

Removal Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the coolant temperature sensor (CTS) connector.

Notice: Use care when handling the sensor. Damage will affect the proper operation of the fuel injection system.

4. Carefully remove the CTS from the cylinder head underneath the intake manifold.



A102F017

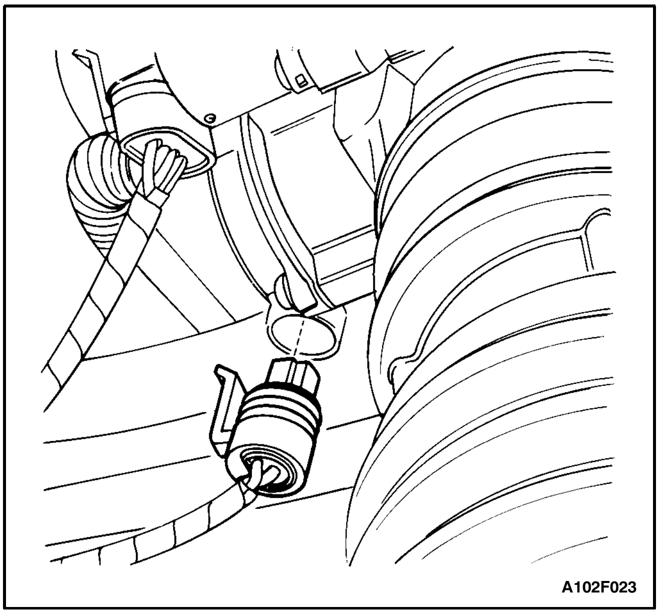
Installation Procedure

1. Coat the threads on the CTS with sealer.
2. Install the CTS into the cylinder head.

   Tighten

   Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).

3. Connect the CTS connector.
4. Fill the cooling system.
5. Connect the negative battery cable.

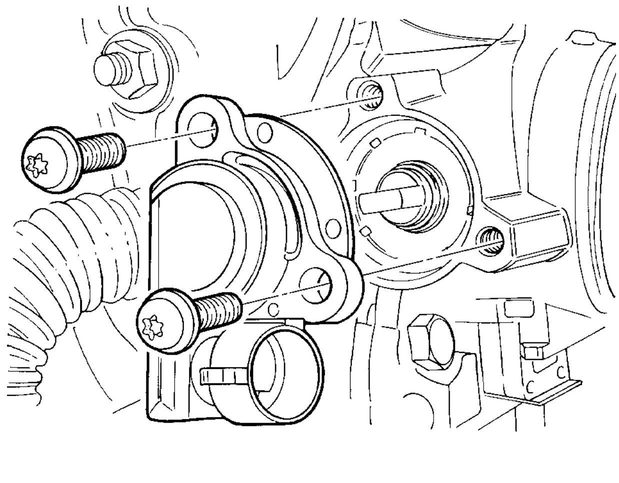


A102F023

THROTTLE POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the throttle position sensor (TPS) connector.
3. Remove the TPS retaining bolts and the TPS.



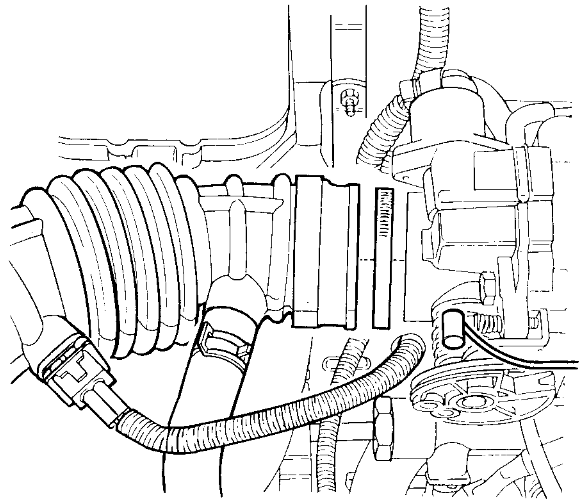
A102F022

Installation Procedure

1. With the throttle valve closed, position the TPS on the throttle shaft. Align the TPS with the bolt holes.
2. Install the TPS retaining bolts.

   Tighten

   Tighten the throttle position sensor retaining bolts to 2 N•m (18 lb-in).
3. Connect the TPS connector.
4. Connect the negative battery cable.

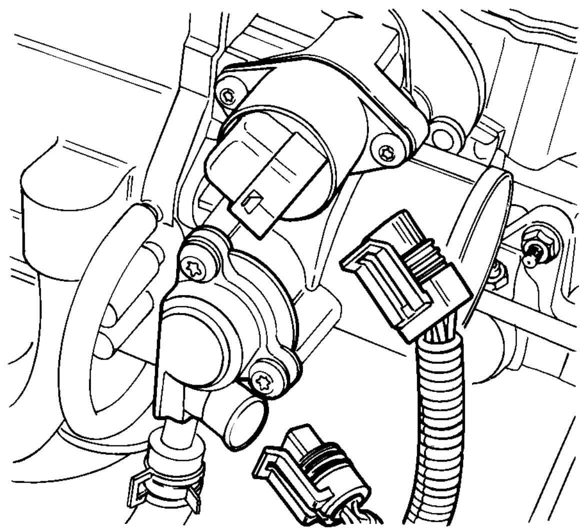


A102F095

THROTTLE BODY (TYPICAL)

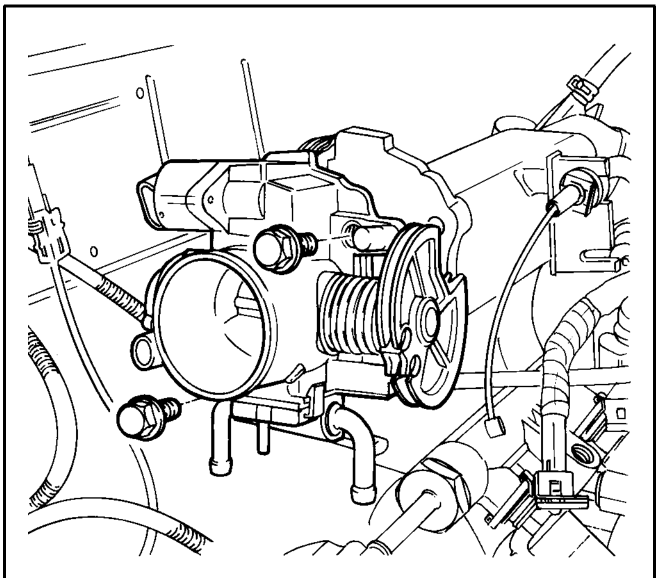
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the air intake tube from the throttle body.
3. Disconnect the throttle cables by opening the throttle and moving the cable through the release slot.



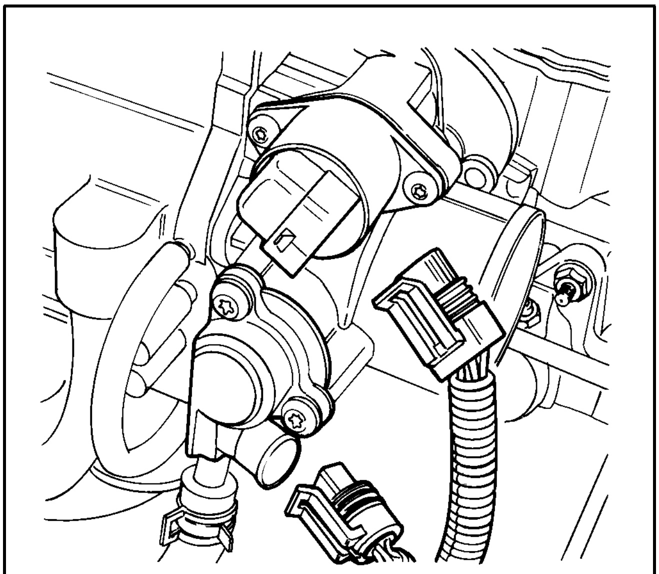
A102F066

4. Disconnect the vacuum hoses from the throttle body.
5. Disconnect the throttle position sensor (TPS) and the idle air control valve connectors.



A102F067

6. Remove the coolant hoses from the throttle body.
7. Remove the throttle body retaining bolts.
8. Remove the throttle body and discard the gasket.
9. Remove the TPS. Refer to "Throttle Position Sensor" in this section.
10. Remove the idle air control (IAC) valve. Refer to "Idle Air Control Valve" in this section.



A102F066

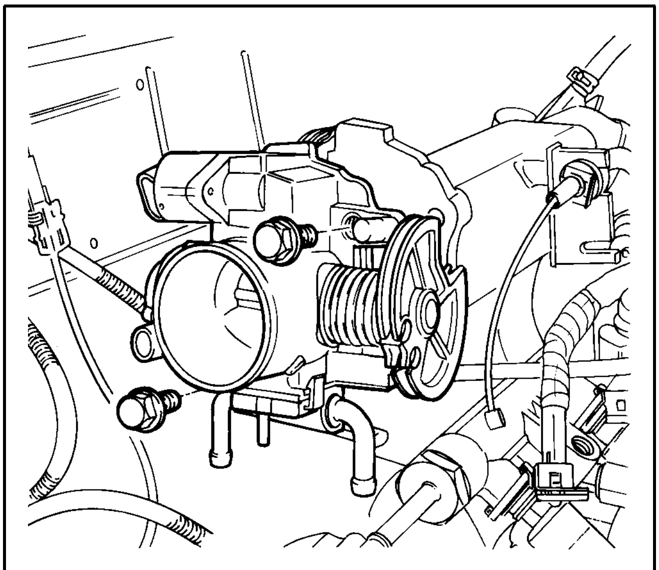
Installation Procedure

Notice: Use care in cleaning old gasket material from machined aluminum surfaces. Sharp tools may damage sealing surfaces.

1. Clean the gasket mating surface on the intake manifold.

Notice: The throttle body may be cleaned in a cold immersion-type cleaner following disassembly. The TPS and the IAC valve should not come in contact with any solvent or cleaner as they may be damaged.

2. Clean the throttle body.
3. Install the TPS. Refer to "Throttle Position Sensor" in this section.
4. Install the IAC valve. Refer to "Idle Air Control Valve" in this section.



A102F067

5. Install the throttle body assembly to the intake manifold with a new gasket.
6. Install the throttle body retaining bolts.

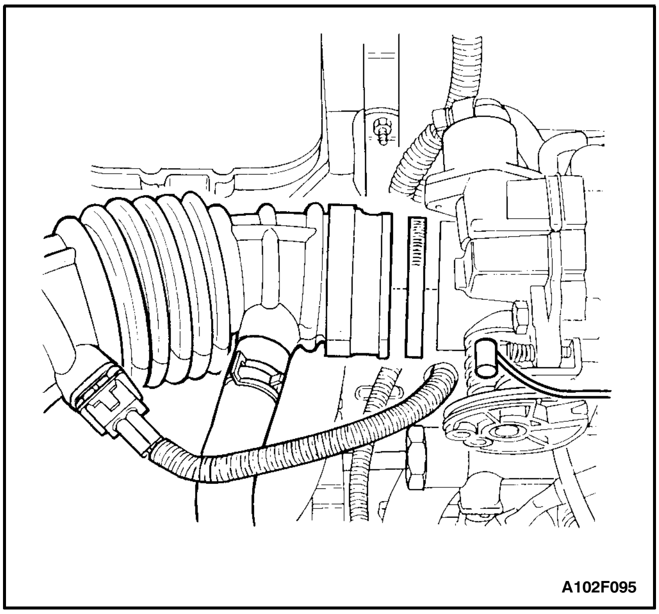
   Tighten

   Tighten the throttle body retaining bolts to 15 N•m (11 lb-ft).

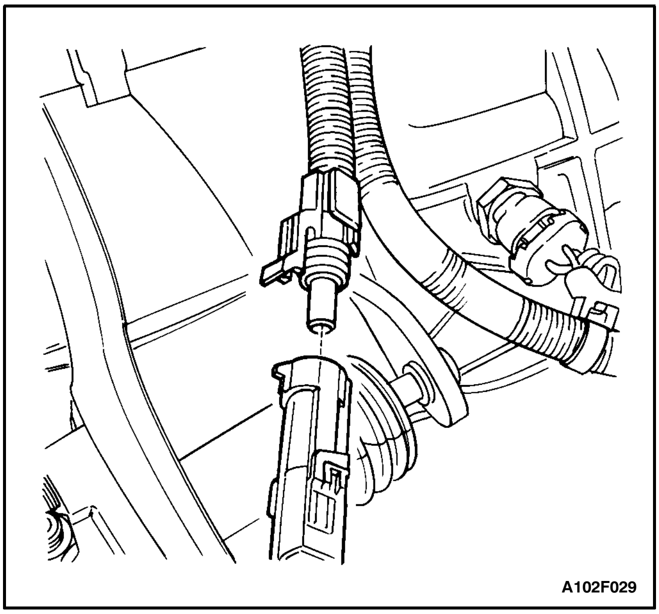
7. Install the coolant hoses.
8. Connect the vacuum hoses to the throttle body.

Important: Make sure the throttle control cables do not hold the throttle open. With the engine OFF, check to see that the accelerator pedal is free.

9. Connect the throttle cables.


A102F095

10. Install the air intake tube.
11. Connect the TPS connector and the IAC valve connector.
12. Connect the negative battery cable.
13. Fill the cooling system.


A102F029

OXYGEN SENSOR (TYPICAL)

Removal Procedure

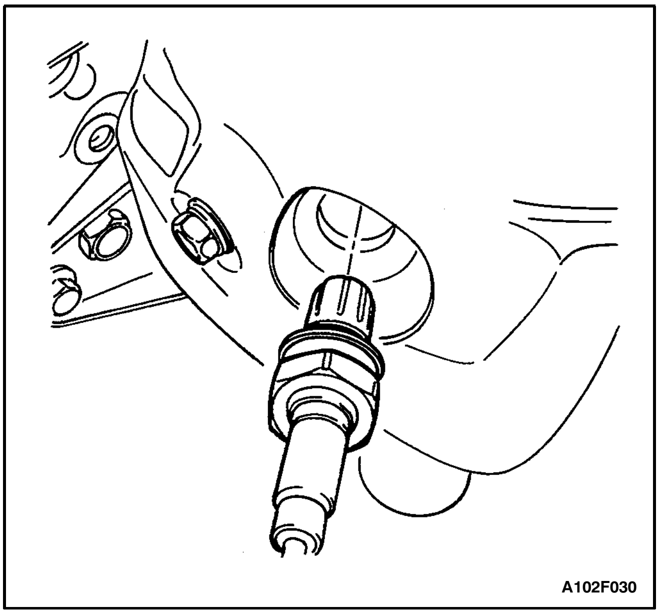
1. Disconnect the negative battery cable.

Notice: The oxygen (O_2) sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the O_2 sensor. Damage or removal of the pigtail or the connector could affect proper operation of the O_2 sensor. Take care when handling the O_2 sensor. Do not drop or the O_2 sensor.

2. Disconnect the O_2 sensor connector.

Notice: The O_2 sensor may be difficult to remove when engine temperature is below 48°C (118°F). Excessive force may damage threads in the exhaust manifold.

3. Carefully remove the O_2 sensor from the exhaust manifold.


A102F030

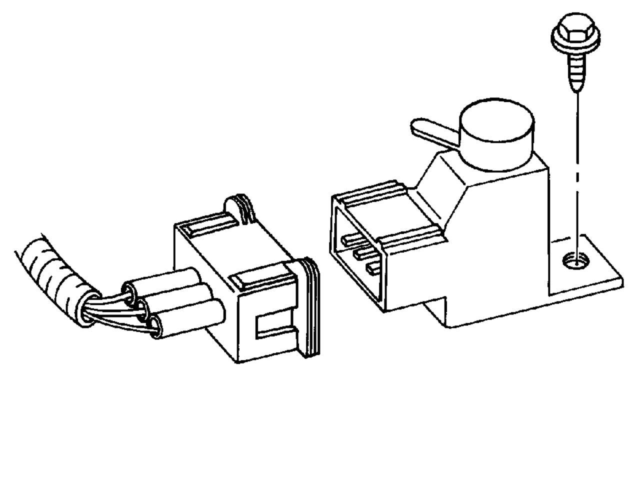
Installation Procedure

Important: A special anti-seize compound is used on the O_2 sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to the threads. If a sensor is removed from any engine and, if for any reason, it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the O_2 sensor with an anti-seize compound, if needed.
2. Install the O_2 sensor into the exhaust manifold.

   Tighten

   Tighten the oxygen sensor to 41 N•m (30 lb-ft).
3. Connect the O_2 sensor connector.
4. Connect the negative battery cable.

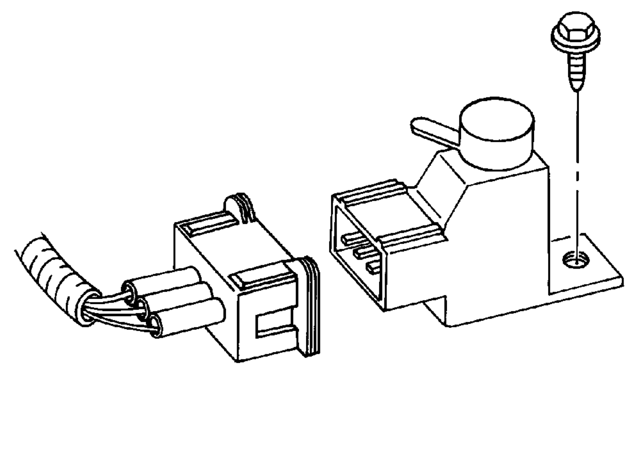


B302F201

CO POTENTIOMETER (LEADED FUEL ONLY)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the CO potentiometer mounting bolt.
3. Remove the electrical connector.



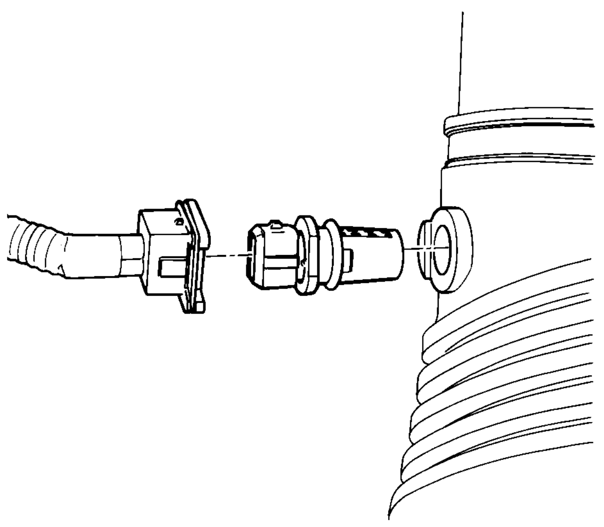
B302F201

Installation Procedure

1. Install the electrical connector.
2. Install the CO potentiometer mounting.

   Tighten

   Tighten the CO potentiometer mounting bolt to 8 N•m (71 lb-in).
3. Connect the negative battery cable.



A102F012

MANIFOLD AIR TEMPERATURE SENSOR (TYPICAL)

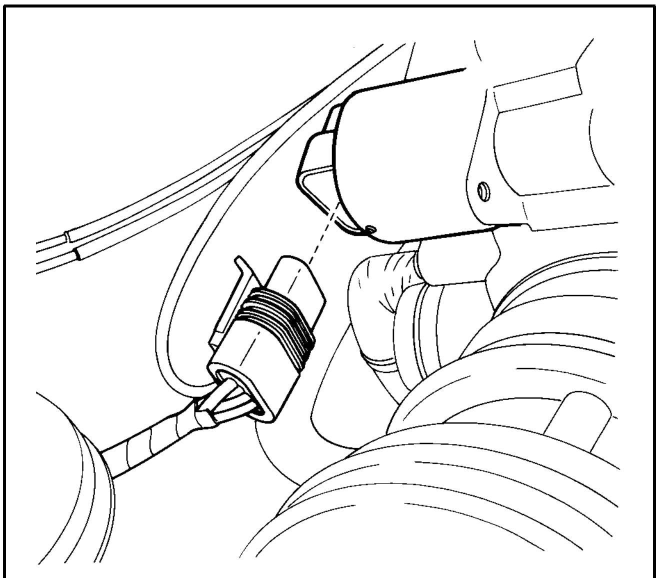
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor (MAT) connector.
3. Remove the MAT sensor by pulling it out of the air intake tube.

Installation Procedure

1. Insert the MAT sensor into the air intake tube.
2. Connect the MAT connector.
3. Connect the negative battery cable.

IDLE AIR CONTROL VALVE (TYPICAL)



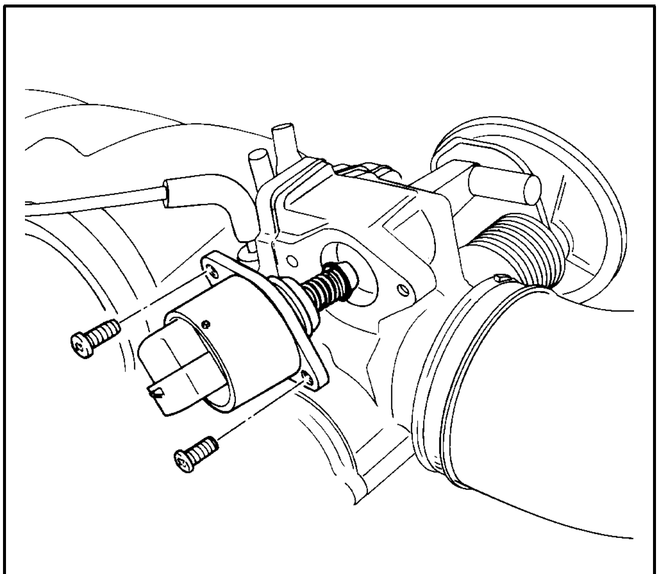
A102F009

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the idle air control (IAC) valve connector.
3. Remove the IAC valve retaining bolts.

Notice: On IAC valves that have been in service, do not push on the valve pintle. The force required to move the pintle may damage the threads on the worm drive.

4. Remove the IAC valve.
5. Clean the IAC valve O-ring seal area, the pintle valve seat and the air passage with a suitable fuel system cleaner. Do not use methyl ethyl ketone.

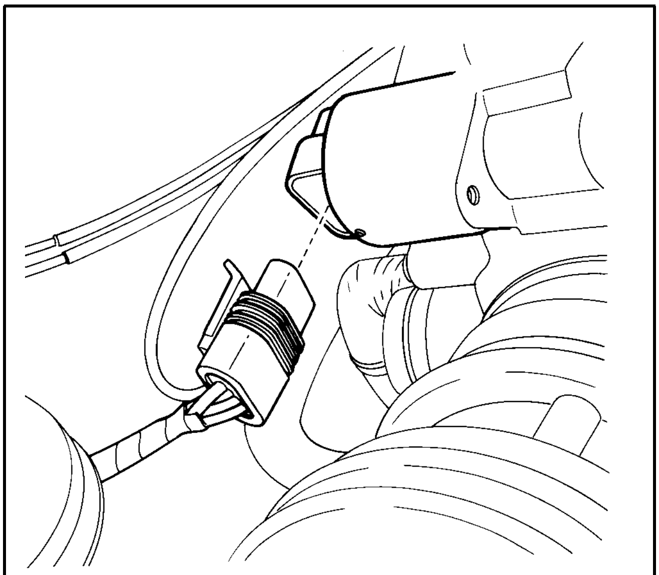


A102F010

Installation Procedure

Important: If installing a new IAC valve, be sure to replace it with an identical part. The IAC valve pintle shape and diameter are designed for the specific application. Measure the distance between the tip of the IAC valve pintle and the mounting flange. If the distance is greater than 28 mm, use finger pressure to slowly retract the pintle. The force required to retract the pintle will not damage the IAC valve. The purpose of the 28 mm setting is to prevent the IAC pintle from bottoming out on the pintle seat. This 28 mm setting is also an adequate setting for controlled idle on a restart.

1. Lubricate a new O-ring with engine oil. Install the new O-ring onto the valve.
2. Install the IAC valve into the throttle body.

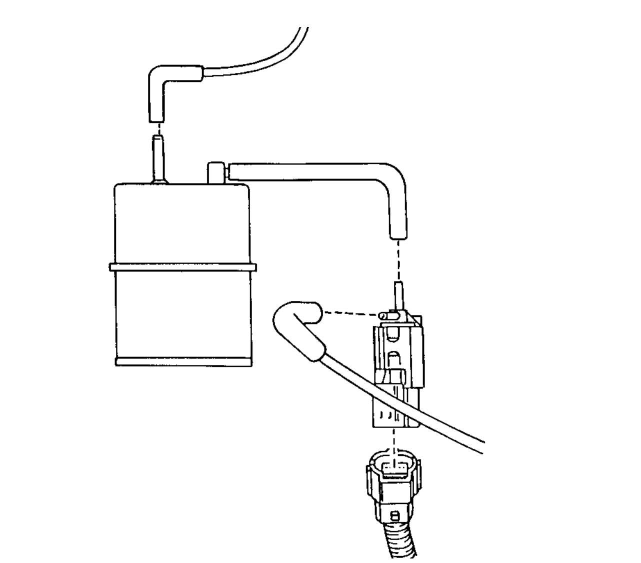


A102F009

3. Install the IAC valve retaining bolts.

   #### Tighten

   Tighten the idle air control valve retaining bolts to 3 N•m (27 lb-in).
4. Connect the IAC valve connector.
5. Connect the negative battery cable.
6. Start the engine and check for the proper idle speed.

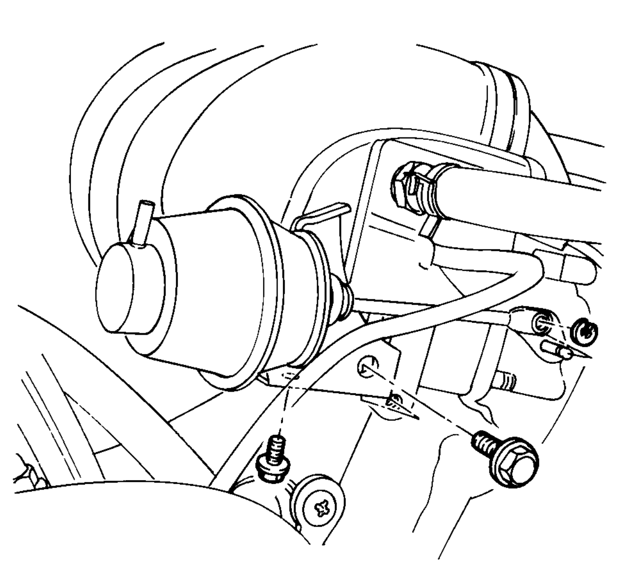


A102F064

VARIABLE GEOMETRY INDUCTION SYSTEM

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the vacuum hoses from the variable geometry induction system (VGIS) solenoid. Note the location of the hoses for ease of installation.
3. Disconnect the VGIS solenoid connector.
4. Remove the VGIS solenoid by pressing the lock in and pulling down on the solenoid.
5. Remove the VGIS vacuum canister.
6. Remove the circlip at the VGIS actuator lever.
7. Remove the VGIS actuator mounting bracket bolt.
8. Remove the VGIS actuator assembly.



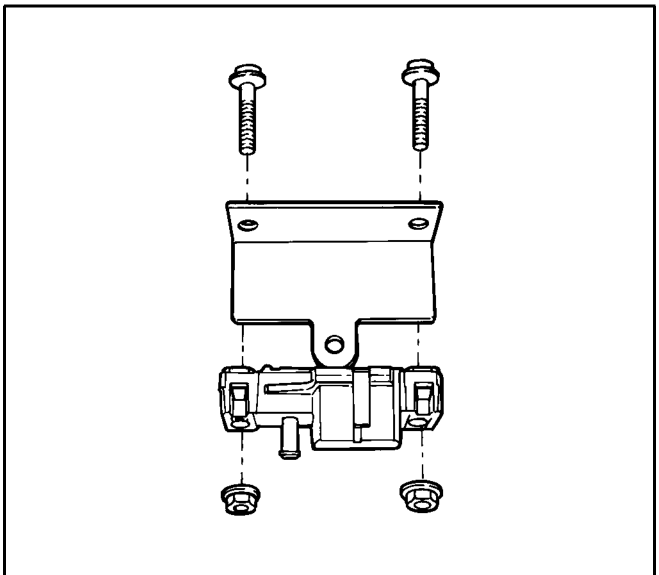
A102F065

Installation Procedure

1. Install the VGIS actuator assembly on the plenum with the mounting bracket bolt.

   ### Tighten

   Tighten the variable geometry induction system actuator assembly mounting bracket bolt to 16 N•m (12 lb-ft).
2. Connect the VGIS actuator assembly rod into the plenum lever.
3. Install the rod circlip.
4. Install the VGIS solenoid into the snap lock.
5. Push the vacuum canister into the bracket.
6. Connect the VGIS solenoid connector.
7. Connect the vacuum hoses.
8. Connect the negative battery cable.

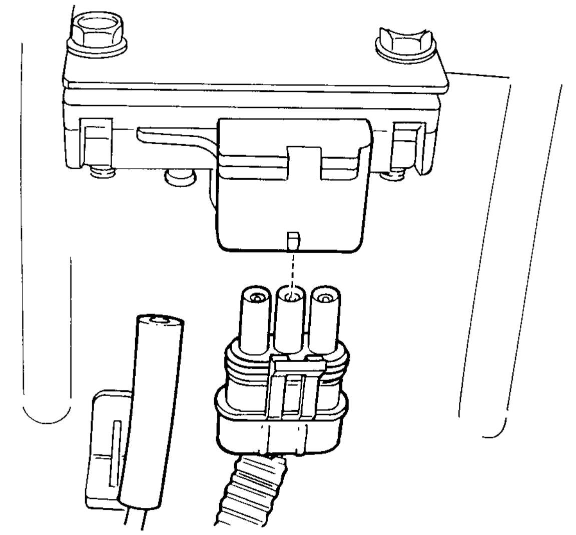


A102F028

MANIFOLD ABSOLUTE PRESSURE SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the vacuum hose from the manifold absolute pressure (MAP) sensor.
3. Disconnect the MAP connector.
4. Remove the MAP sensor mounting bracket bolt.
5. Remove the bolts and the nuts that secure the MAP sensor to the mounting bracket.


A102F027

Installation Procedure

1. Insert the MAP sensor into the mounting bracket.
2. Install the bolts through the MAP sensor and the bracket. Install the retaining nuts.

Tighten

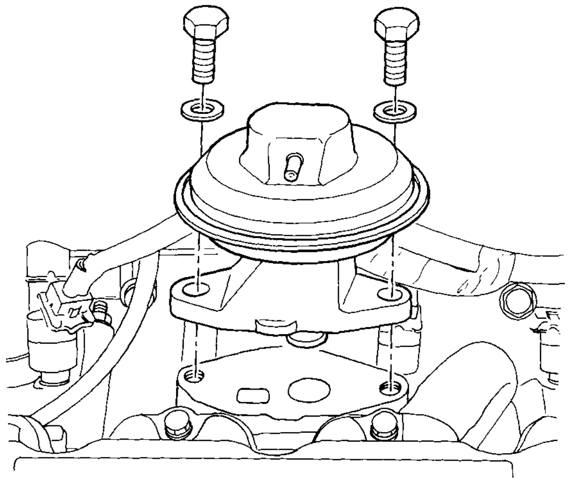
Tighten the manifold absolute pressure sensor retaining bolts and the nuts to 8 N•m (71 lb-in).

3. Install the MAP sensor and the mounting bracket to the fire wall with the mounting bracket bolt.

Tighten

Tighten the manifold absolute pressure sensor mounting bracket bolt to 10 N•m (89 lb-in).

4. Connect the MAP sensor connector.
5. Connect the vacuum hose to the MAP sensor.
6. Connect the negative battery cable.


A102F013

EXHAUST GAS RECIRCULATION VALVE (SOHC)

Removal Procedure

1. Disconnect the vacuum hose from the exhaust gas recirculation (EGR) valve.
2. Remove the bolts and the EGR valve.

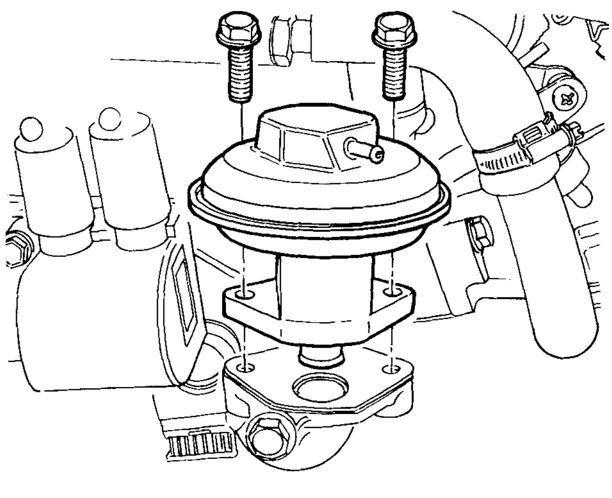
Installation Procedure

1. Clean the cylinder head mating surface.
2. Install the new EGR valve gasket.
3. Install the EGR valve with the retaining bolts.

Tighten

Tighten the exhaust gas recirculation valve retaining bolts to 20 N•m (15 lb-ft).

4. Connect the vacuum hose to the EGR valve.


A102F018

EXHAUST GAS RECIRCULATION VALVE (DOHC)

Removal Procedure

1. Disconnect the vacuum hose from the exhaust gas recirculation (EGR) valve.
2. Remove the bolts and the EGR valve.

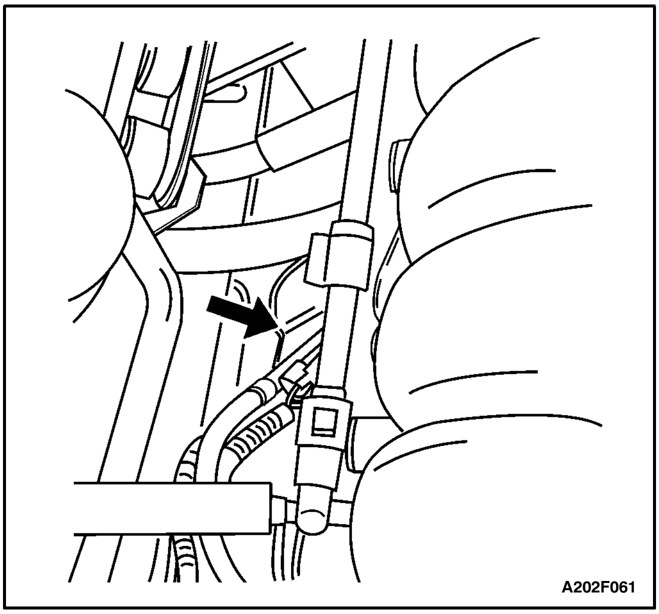
Installation Procedure

1. Clean the cylinder head mating surface.
2. Install a new EGR valve gasket.
3. Install the EGR valve with the retaining bolts.

Tighten

Tighten the exhaust gas recirculation valve retaining bolts to 20 N•m (15 lb-ft).

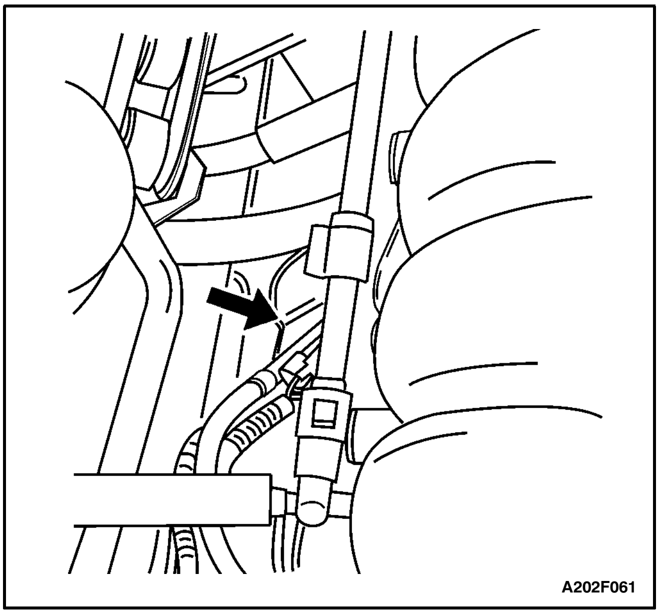
4. Connect the vacuum hose to the EGR valve.



EXHAUST GAS RECIRCULATION VALVE SOLENOID (TYPICAL)

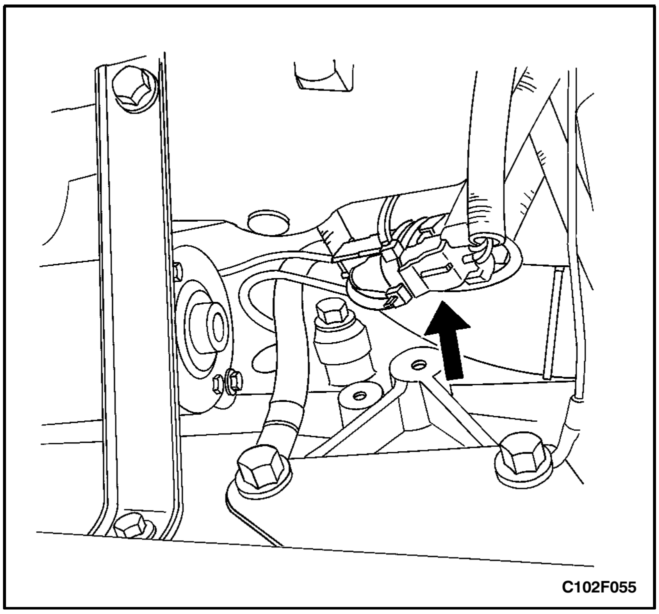
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the canister purge solenoid. Refer to "Canister Purge Solenoid" in this section.
3. Pry off the exhaust gas recirculation (EGR) valve solenoid from the mounting bracket.
4. Disconnect the electrical connector at the EGR valve solenoid.
5. Disconnect the vacuum lines at the EGR valve solenoid.



Installation Procedure

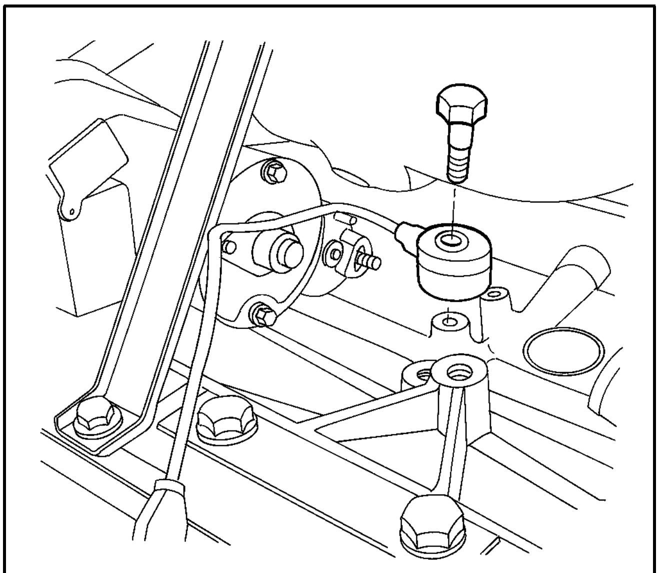
1. Connect the vacuum lines at the EGR valve solenoid.
2. Connect the electrical connector at the EGR valve solenoid.
3. Push the EGR valve solenoid onto the mounting bracket.
4. Install the canister purge solenoid. Refer to "Canister Purge Solenoid" in this section.
5. Connect the negative battery cable.



KNOCK SENSOR

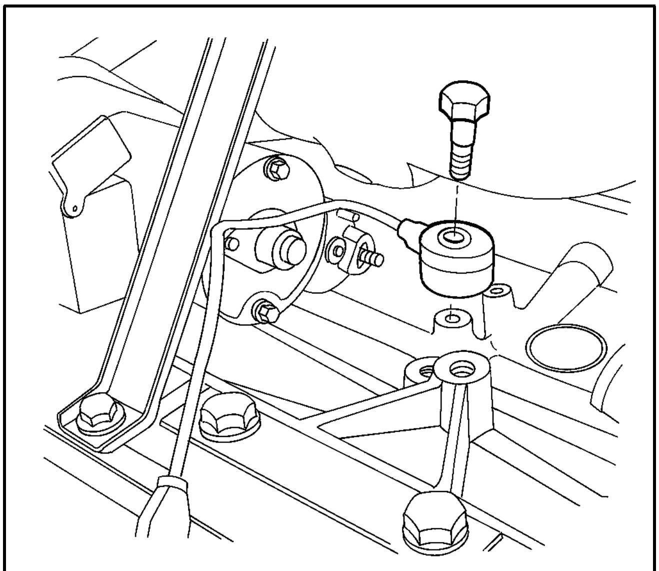
Removal Procedure

1. Disconnect the negative battery cable.
2. For vehicles equipped with an automatic transaxle, remove the intake manifold. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
3. Disconnect the electrical connector at the knock sensor.



C102F056

4. Remove the knock sensor.



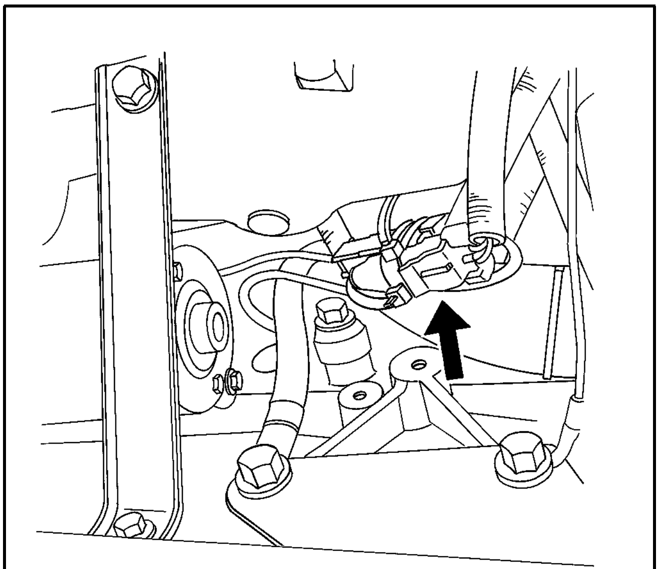
C102F056

Installation Procedure

1. Install the knock sensor.

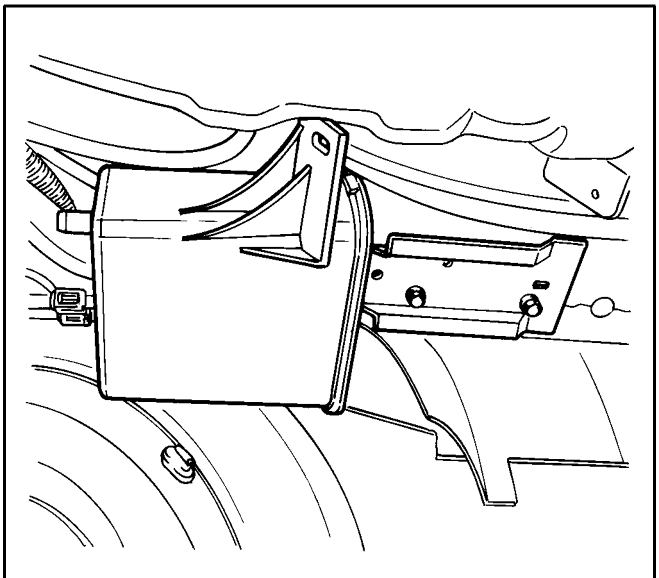
Tighten

Tighten the knock sensor bolt to 20 N•m (15 lb-ft).



C102F055

2. Connect the electrical connector at the knock sensor.
3. For vehicles equipped with an automatic transaxle, remove the intake manifold. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
4. Connect the negative battery cable.

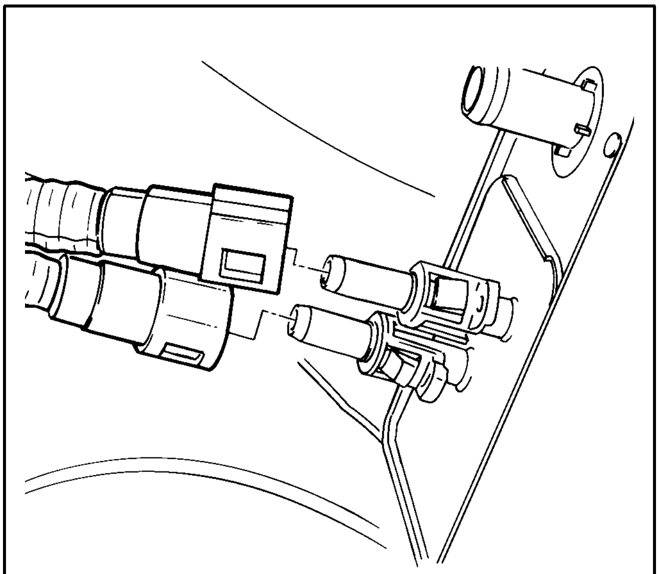

A102F020

EVAPORATIVE EMISSION CANISTER

Removal Procedure

Caution: Canister and vacuum hoses contain fuel vapors. To avoid injury, do not smoke in the area or permit an open flame.

1. Disconnect the canister fuel vapor hoses.
2. Remove the bolt that secures the canister flange to the vehicle.
3. Slide the canister out of the track holder.
4. Remove the canister.

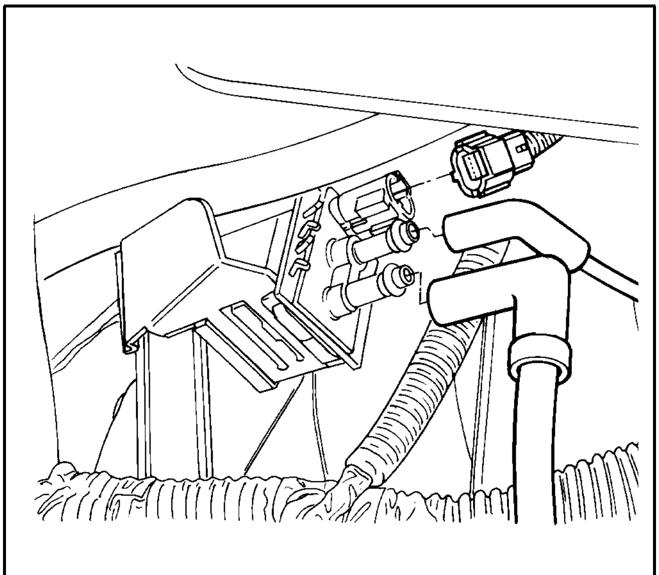

A102F021

Installation Procedure

1. Insert the canister into the track and slide it into position.
2. Install the canister flange bolt.

   Tighten

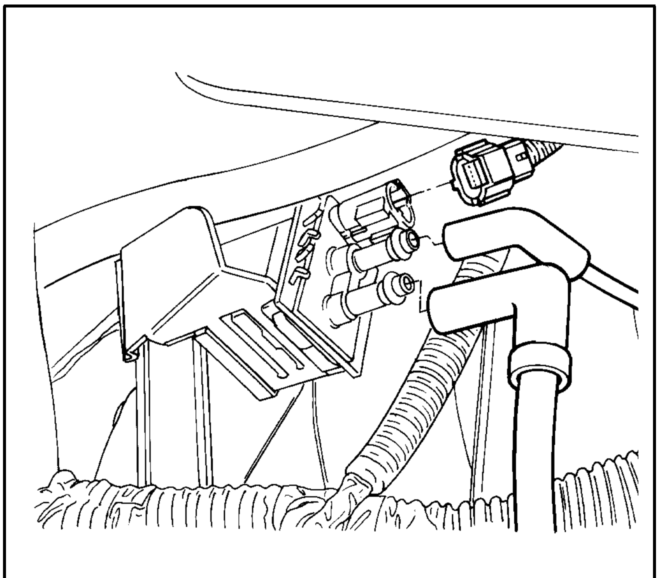
   Tighten the evaporative emission canister flange bolt to 20 N•m (15 lb-ft).
3. Connect the canister fuel vapor hoses.


A202F060

CANISTER PURGE SOLENOID (TYPICAL)

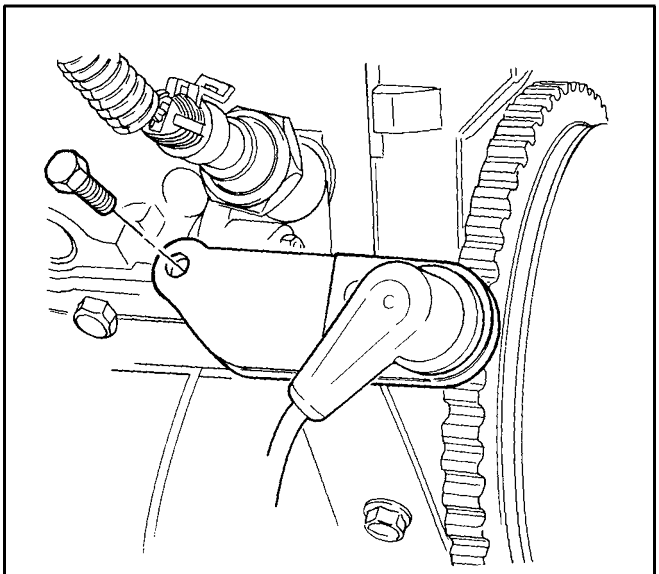
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the controlled canister purge (CCP) solenoid connector.
3. Disconnect the vacuum hoses from the CCP solenoid.
4. Unclip the CCP solenoid from the mounting bracket.


A202F060

Installation Procedure

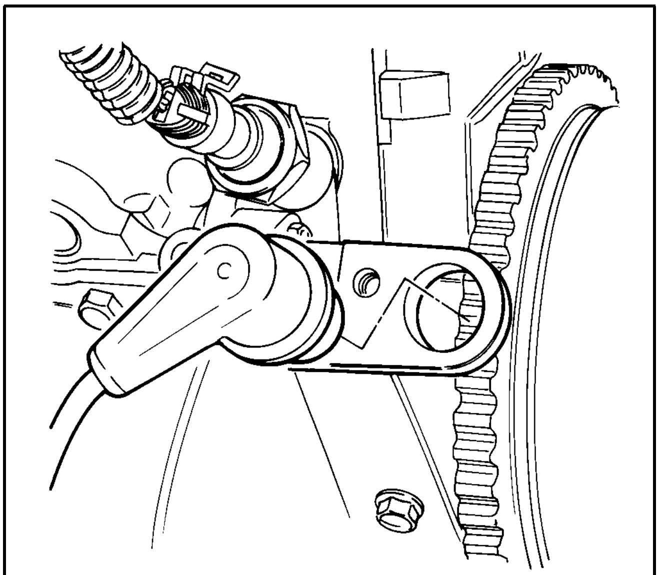
1. Attach the CCP solenoid to the mounting bracket.
2. Connect the CCP solenoid connector.
3. Connect the vacuum hoses to the CCP solenoid.
4. Connect the negative battery cable.


A102F096

CRANKSHAFT POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the crankshaft position sensor (CPS) connector at the frame bracket.
3. Remove the wiring tie straps as needed.
4. Remove the CPS retaining bolt.
5. Remove the CPS.

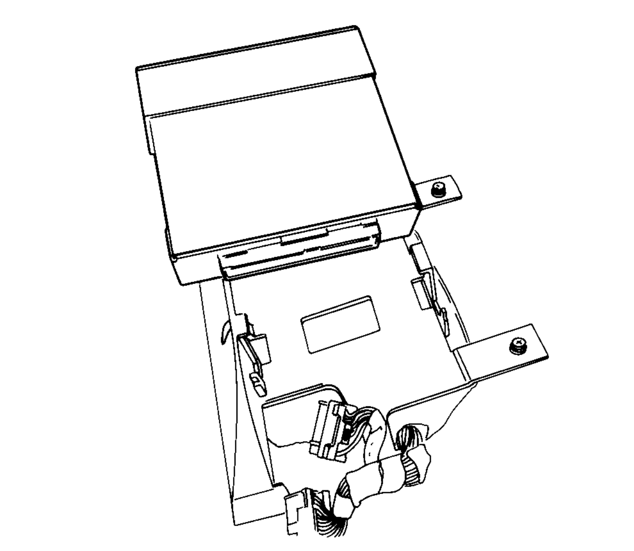

A102F019

Installation Procedure

1. Install the CPS with the retaining bolt.

   Tighten

   Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).
2. Connect the CPS connector at the frame bracket.
3. Secure the wire with the tie straps as needed.
4. Connect the negative battery cable.

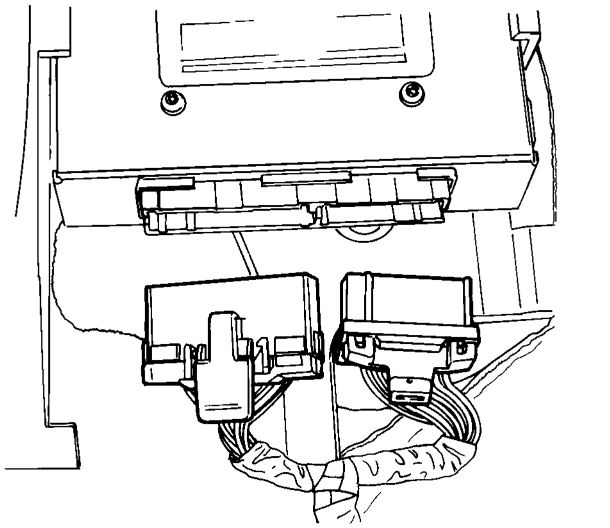


A102F015

ELECTRONIC CONTROL MODULE (TYPICAL)

Removal Procedure

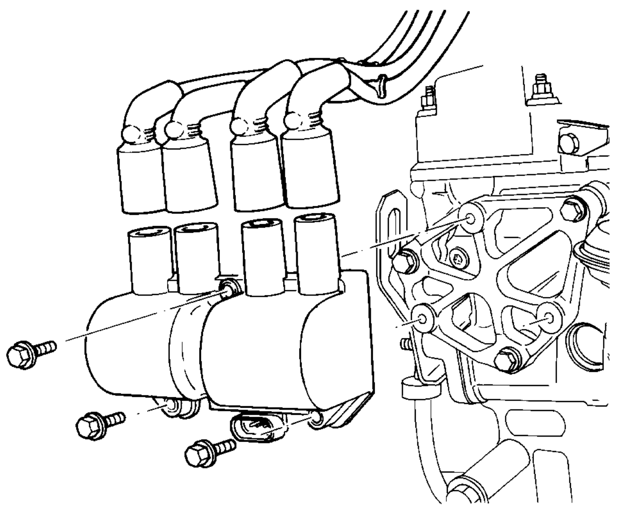
1. Disconnect the negative battery cable.
2. Remove the passenger seat. Refer to Section 9H, Seats.
3. Disconnect the electronic control module (ECM) connectors.
4. Remove the ECM from the ECM mount.



A102F016

Installation Procedure

1. Position the ECM in place.
2. Install the ECM to the ECM mount.
3. Connect the ECM connectors.
4. Install the passenger seat. Refer to Section 9H, Seats.
5. Connect the negative battery cable.

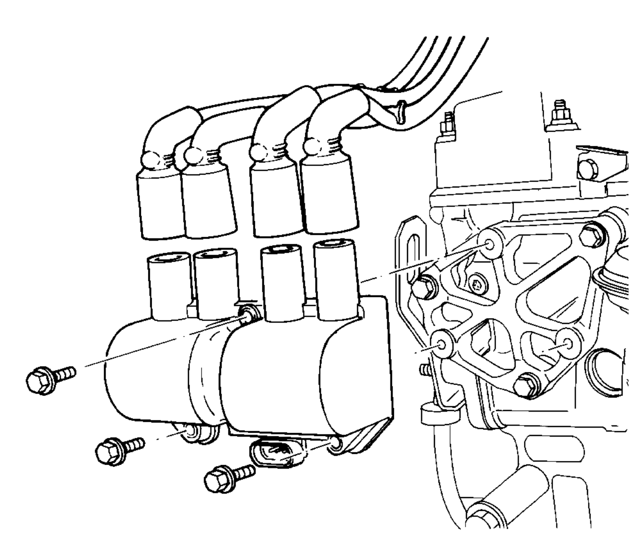


A102F011

DIRECT IGNITION SYSTEM IGNITION COIL (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the direct ignition system (DIS) ignition coil connector.
3. Note the ignition wire location and remove the ignition wires.
4. Remove the DIS ignition coil retaining bolts.
5. Remove the DIS ignition coil.



A102F011

Installation Procedure

1. Install the DIS ignition coil into the mounting location and install the retaining bolts.

Tighten

Tighten the direct ignition system ignition coil retaining bolts to 10 N•m (89 lb-in).

2. Connect the DIS ignition coil connector.
3. Install the ignition wires.
4. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

IGNITION SYSTEM OPERATION

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor (CPS) input to the electronic control module (ECM). The ECM then determines electronic spark timing (EST) and triggers the direct ignition system (DIS) ignition coil.

This type of distributorless ignition system uses a "waste spark" method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-4 or 2-3). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).

DIRECT IGNITION SYSTEM IGNITION COIL

The direct ignition system (DIS) ignition coil is mounted near the rear of the camshaft carrier on the single overhead camshaft engine. On the dual overhead camshaft engine, the DIS ignition coil is mounted near the rear of the cylinder head. Each pair of terminals of the DIS ignition coil provides the spark for two spark plugs simultaneously. The DIS ignition coil is not serviceable and must be replaced as an assembly.

CRANKSHAFT POSITION SENSOR

This direct ignition system (DIS) uses a magnetic crankshaft position sensor (CPS) mounted just ahead of the block below the intake manifold. This sensor protrudes through its mount to within approximately 1.3 mm (0.05 inch) of the crankshaft reluctor. The reluctor is a special wheel attached to the crankshaft pulley with 58 slots machined into it, 57 of which are equally spaced in 6-degree intervals. The last slot is wider than the others and serves to generate a "sync pulse." As the crankshaft rotates, the slots in the reluctor change the magnetic field of the sensor, creating an induced voltage pulse. The longer pulse of the 58th slot identifies a specific orientation of the crankshaft and allows the electronic control module (ECM) to determine the crankshaft orientation at all times. The ECM uses this information to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.

IDLE AIR SYSTEM OPERATION

The idle air system operation is controlled by the base idle setting of the throttle body and the idle air control (IAC) valve.

The electronic control module (ECM) uses the IAC valve to set the idle speed dependent on conditions. The ECM uses information from various inputs, such as coolant temperature, manifold vacuum, etc., for the effective control of the idle speed.

FUEL CONTROL SYSTEM OPERATION

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The two main fuel control sensors are the manifold absolute pressure (MAP) sensor and the oxygen (O_2) sensor.

The MAP sensor measures or senses the intake manifold vacuum. Under high fuel demands, the MAP sensor reads a low vacuum condition, such as wide-open throttle. The electronic control module (ECM) uses this information to richen the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the vacuum increases. This vacuum change is sensed by the MAP sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O_2 sensor is located in the exhaust manifold. The O_2 sensor indicates to the ECM the amount of oxygen in the exhaust gas and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called "modes."

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 2 seconds. The fuel pump then builds fuel pressure. The ECM also checks the coolant temperature sensor (CTS) and the throttle position sensor (TPS) to determine the proper air/fuel ratio for starting the engine. This ranges from 1.5 to 1 at * 36°C (* 33°F) coolant temperature to 14.7 to 1 at 94°C (201°F) coolant temperature. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by "pulsing" the fuel injectors for very short times.

Clear Flood Mode

If the engine floods with excessive fuel, it may be cleared by pushing the accelerator pedal down all the way. The ECM will then completely turn off the fuel by eliminating any fuel injector signal. The ECM holds this injector rate as long as the throttle stays wide open and the engine is below approximately 400 rpm. If the throttle position becomes less than approximately 80 percent, the ECM returns to the starting mode.

Run Mode

The run mode has two conditions called "open loop" and "closed loop."

Open Loop

When the engine is first started and it is above 400 rpm, the system goes into "open loop" operation. In "open loop," the ECM ignores the signal from the O_2 sensor and calculates the air/fuel ratio based on inputs from the CTS and the MAP sensor. The sensor stays in "open loop" until the following conditions are met:

- The O_2 sensor has a varying voltage output, showing that it is hot enough to operate properly.
- The CTS is above a specified temperature.
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the electronically erasable programmable read-only memory (EEPROM). When these conditions are met, the system goes into "closed loop" operation. In "closed loop," the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

Battery Voltage Correction Mode

When the battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the fuel injectors when the ignition is OFF. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the crankshaft position sensor (CPS). This prevents flooding.

EVAPORATIVE EMISSION CONTROL SYSTEM OPERATION

The basic evaporative emission (EVAP) control system used is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake airflow and is consumed in the normal combustion process.

Gasoline vapors from the fuel tank flow into the tube labeled TANK. These vapors are absorbed into the carbon. The canister is purged by electronic control module (ECM) when the engine has been running for a specified amount of time. Air is drawn into the canister and mixed with the vapor. This mixture is then drawn into the intake manifold.

The ECM supplies a ground to energize the controlled canister purge (CCP) solenoid valve. This valve is pulse-width modulated (PWM) or turned on and off several times a second. The CCP PWM duty cycle varies according to operating conditions determined by mass airflow, fuel trim, and intake air temperature.

Poor idle, stalling, and poor driveability can be caused by the following conditions:

- An inoperative CCP valve.
- A damaged canister.
- Hoses that are split, cracked, or not connected to the proper tubes.

EVAPORATIVE EMISSION CANISTER

The evaporative emission canister is an emission control device containing activated charcoal granules. The evaporative emission canister is used to store fuel vapors from the fuel tank. Once certain conditions are met, the electronic control module (ECM) activates the controlled canister purge (CCP) solenoid, allowing the fuel vapors to be drawn into the engine cylinders and burned.

VARIABLE GEOMETRY INDUCTION SYSTEM OPERATION

The variable geometry induction system (VGIS) is used to add more responsive acceleration to the dual overhead camshaft (DOHC) engines. Under certain conditions, the electronic control module (ECM) activates the VGIS solenoid, allowing stored vacuum to actuate the secondary throttle control valve. The secondary throttle control valve then opens the secondary throttle plates, which are internal to the intake manifold and plenum assembly. This allows for increased airflow into the engine, creating more responsive acceleration.

POSITIVE CRANKCASE VENTILATION CONTROL SYSTEM OPERATION

A positive crankcase ventilation (PCV) system is used to provide complete use of the crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase. The fresh air is mixed with blowby gases and then passes through a vacuum hose into the intake manifold.

Periodically inspect the hoses and the clamps. Replace any crankcase ventilation components as required.

A restricted or plugged PCV hose may cause the following conditions:

- Rough idle.
- Stalling or low idle speed.
- Oil leaks.
- Oil in the air cleaner.
- Sludge in the engine.

A leaking PCV hose may cause the following conditions:

- Rough idle.
- Stalling.
- High idle speed.

COOLANT TEMPERATURE SENSOR

The coolant temperature sensor (CTS) is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at * 40°C [* 40°F]) while high temperature causes low resistance (70 ohms at 130°C [266°F]).

The electronic control module (ECM) supplies 5 volts to the coolant sensor through a resistor in the ECM and measures the change in voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the change in voltage, the ECM can determine the coolant temperature. The engine coolant temperature affects most of the systems that the ECM controls. A failure in the coolant sensor circuit should set Diagnostic Trouble Code (DTC) 14 or 15. Remember, these DTCs indicate a failure in the coolant temperature circuit, so proper use of the chart will lead either to repairing a wiring problem or to replacing the sensor to repair a problem properly.

THROTTLE POSITION SENSOR

The throttle position sensor (TPS) is a potentiometer connected to the throttle shaft of the throttle body. The TPS electrical circuit consists of a 5-volt supply line and a ground line, both provided by the electronic control module (ECM). The ECM calculates the throttle position by monitoring the voltage on this signal line. The TPS output changes as the accelerator pedal is moved, changing the throttle valve angle. At a closed throttle position, the output of the TPS is low, about 0.5 volt. As the throttle valve opens, the output increases so that, at wide-open throttle (WOT), the output voltage will be about 5 volts.

The ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits should set DTC 21 or 22. Once the DTC is set, the ECM will substitute a default value for the TPS and some vehicle performance will return. A DTC 21 will cause a high idle speed.

OXYGEN SENSOR

The oxygen (O_2) sensor is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the sensor to produce a voltage output. This voltage ranges from approximately 0.1 volt (high O_2 - lean mixture) to 0.9 volt (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 megohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

The electronic control module (ECM) monitors the O_2 sensor output and determines what changes are necessary in the fuel mixture command.

The O_2 sensor circuit sets Diagnostic Trouble Code (DTC) 13 when it is open. A constant low voltage in the sensor circuit, indicating a lean mixture, sets DTC 44. A constant high voltage, indicating a rich mixture, sets DTC 45. Refer to the DTC charts for conditions that could cause a lean or a rich system.

CO POTENTIOMETER (LEADED FUEL ONLY)

The CO potentiometer is a manually adjustable variable resistor which controls carbon monoxide (CO) emissions in vehicles that use leaded fuel. In these vehicles, the CO potentiometer takes the place of the O_2 sensor in controlling the fuel injector pulse width. The electronic control module (ECM) supplies a 5V reference voltage to the CO potentiometer. The technician can adjust the voltage of the return signal back to the ECM by turning a small screw on the CO potentiometer. By adjusting the voltage, the ECM will adjust the pulse width of the fuel injectors to minimize CO emissions.

EXHAUST GAS RECIRCULATION VALVE AND SOLENOID

The exhaust gas recirculation (EGR) system is used on engines to lower NOX (oxides of nitrogen) emission levels caused by high combustion temperature. The system is operated by the electronic control module (ECM) through the EGR solenoid. The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters, combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

Results of Incorrect Operation

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or to stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may occur:

- The engine stops after a cold start.
- The engine stops at idle after deceleration.
- The vehicle surges during cruise.
- Rough idle.

If the EGR valve stays open all the time, the engine may not idle. Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause the following conditions:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

MANIFOLD AIR TEMPERATURE SENSOR

The manifold air temperature (MAT) sensor is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance (100,000 ohms at * 40°C [* 40°F]), while high temperature causes a low resistance (70 ohms at 130°C [266°F]).

The electronic control module (ECM) provides 5 volts to the MAT sensor through a resistor in the ECM and measures the change in voltage to determine the MAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake MAT by measuring the voltage.

The MAT sensor is also used to control spark timing when the manifold air is cold.

A failure in the MAT sensor circuit sets a Diagnostic Trouble Code (DTC) 23 or 25.

IDLE AIR CONTROL VALVE

Notice: Do not attempt to remove the protective cap and readjust the stop screw. Misadjustment may result in damage to the idle air control (IAC) valve or to the throttle body.

The IAC valve is mounted on the throttle body where it controls the engine idle speed under the command of the electronic control module (ECM). The ECM sends voltage pulses to the IAC valve motor windings, causing the IAC valve pintle to move in or out a given distance (a step or count) for each pulse. The pintle movement controls the airflow around the throttle valves which, in turn, control the engine idle speed.

The desired idle speeds for all engine operating conditions are programmed into the calibration of the ECM.

These programmed engine speeds are based on the coolant temperature, the park/neutral switch status, the vehicle speed, the battery voltage, and the air conditioning (A/C) system pressure (if equipped).

The ECM "learns" the proper IAC valve positions to achieve warm, stabilized idle speeds (rpm) desired for the various conditions (park/neutral or drive, A/C on or off, if equipped). This information is stored in ECM "keep alive" memories (information is retained after the ignition is turned OFF). All other IAC valve positioning is calculated based on these memory values. As a result, engine variations due to wear and variations in the minimum throttle valve position (within limits) do not affect engine idle speeds. This system provides correct idle control under all conditions. This also means that disconnecting power to the ECM can result in incorrect idle control or the necessity to partially press the accelerator when starting until the ECM relearns idle control.

Engine idle speed is a function of total airflow into the engine based on the IAC valve pintle position, the throttle valve opening, and the calibrated vacuum loss through accessories. The minimum throttle valve position is set at the factory with a stop screw. This setting allows enough airflow by the throttle valve to cause the IAC valve pintle to be positioned a calibrated number of steps (counts) from the seat during "controlled" idle operation. The minimum throttle valve position setting on this engine should not be considered the "minimum idle speed," as on other fuel injected engines. The throttle stop screw is covered with a plug at the factory following adjustment.

If the IAC valve is suspected as being the cause of improper idle speed, refer to "Idle Air Control System Check" in this section.

MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts these to a voltage output.

A closed throttle on engine coast down produces a relatively low MAP output. MAP is the opposite of vacuum. When manifold pressure is high, vacuum is low. The

MAP sensor is also used to measure barometric pressure. This is performed as part of MAP sensor calculations. With the ignition ON and the engine not running, the electronic control module (ECM) will read the manifold pressure as barometric pressure and adjust the air/fuel ratio accordingly. This compensation for altitude allows the system to maintain driving performance while holding emissions low. The barometric function will update periodically during steady driving or under a wide open throttle condition. In the case of a fault in the barometric portion of the MAP sensor, the ECM will set to the default value.

A failure in the MAP sensor circuit sets a Diagnostic Trouble Code (DTC) 33 or 34.

The following tables show the difference between absolute pressure and vacuum related to MAP sensor output, which appears as the top row of both tables.

MAP

Volts	4.9	4.4	3.8	3.3	2.7	2.2	1.7	1.1	0.6	0.3	0.3
kPa	100	90	80	70	60	50	40	30	20	10	0
in Hg	29.6	26.6	23.7	20.7	17.7	14.8	11.8	8.9	5.9	2.9	0

VACUUM

Volts	4.9	4.4	3.8	3.3	2.7	2.2	1.7	1.1	0.6	0.3	0.3
kPa	0	10	20	30	40	50	60	70	80	90	100
in Hg	0	2.9	5.9	8.9	11.8	14.8	17.7	20.7	23.7	26.7	29.6

ELECTRONIC CONTROL MODULE

The electronic control module (ECM), located under the passenger seat, is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, alert the driver through the service engine soon (SES) warning, and store diagnostic trouble codes (DTCs) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the programmable read-only memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not come on when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 megohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the fuel injectors, the idle air control (IAC) valve, the A/C clutch relay, etc., by controlling the ground circuit through transistors or a device called a "quad-driver."

FUEL INJECTOR

The multi-port fuel injection (MPFI) assembly is a solenoid-operated device controlled by the electronic control module (ECM) that meters pressurized fuel to a single engine cylinder. The ECM energizes the fuel injector or solenoid to a normally closed ball or pintle valve. This allows fuel to flow into the top of the injector, past the ball or pintle valve, and through a recessed flow director plate at the injector outlet.

The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel from the tip is directed at the intake valve, causing the fuel to become further atomized and vaporized before entering the combustion chamber. A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned OFF.

KNOCK SENSOR

The knock sensor detects abnormal knocking in the engine.

The sensor is mounted in the engine block near the cylinders.

The sensor produces an AC output voltage which increases with the severity of the knock. This signal is sent to the electronic control module (ECM). The ECM then adjusts the ignition timing to reduce the spark knock.

OCTANE NUMBER CONNECTOR

The octane number connector is a jumper harness (White) that signals to the electronic control module (ECM) the octane rating of the fuel.

The connector is located under the passenger seat next to the ECM.

There are four different octane number connector settings available. The vehicle is shipped from the factory with a label attached to the jumper harness to indicate the octane rating setting of the ECM.

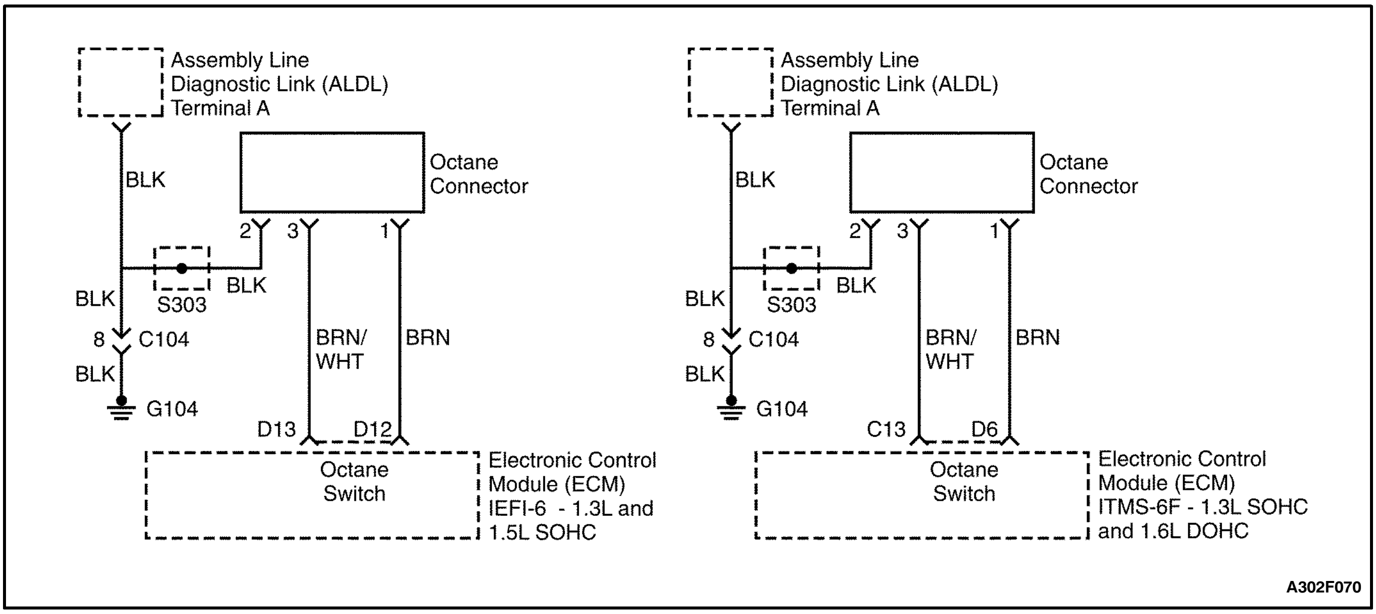
The ECM will alter fuel delivery and spark timing based on the octane number setting.

The following table shows which terminals to jump on the octane number connector in order to achieve the correct fuel octane rating. Terminal 2 is ground on the octane number connector.

To find the appropriate wiring diagram, refer to "ECM Wiring Diagrams" in this section.

Octane Number Selecting

	95	91	87	83
1.5L IEFI-6 (ECM) Terminal D12	Open	Open	Ground	Ground
1.5L IEFI-6 (ECM) Terminal D13	Ground	Open	Open	Ground
1.3L/1.6L ITMS-6F (ECM) Terminal D6	Open	Open	Ground	Ground
1.3L/1.6L ITMS-6F (ECM) Terminal C13	Ground	Open	Open	Ground



SECTION 1G

ENGINE EXHAUST

TABLE OF CONTENTS

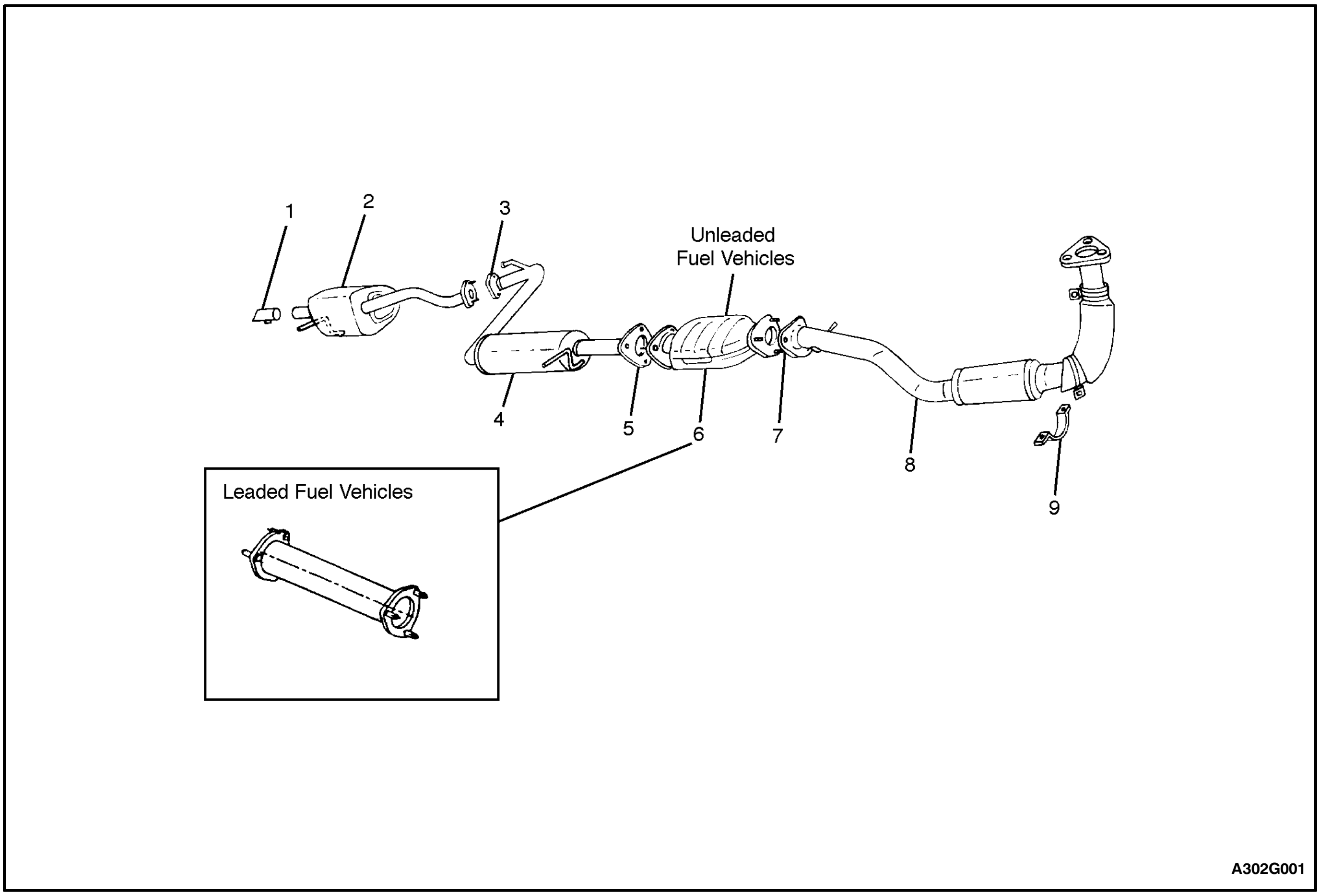
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Exhaust Pipe-to-Catalytic Converter/Connecting Pipe Nuts	30	22	-
Front Exhaust Pipe-to-Exhaust Manifold Nuts	40	30	-
Front Muffler-to-Catalytic Converter/Connecting Pipe Nuts	30	22	-
Front Muffler-to-Rear Muffler Nuts	30	22	-
Lower Front Exhaust Pipe Holding Bracket Nuts	30	22	-

COMPONENT LOCATOR

EXHAUST SYSTEM



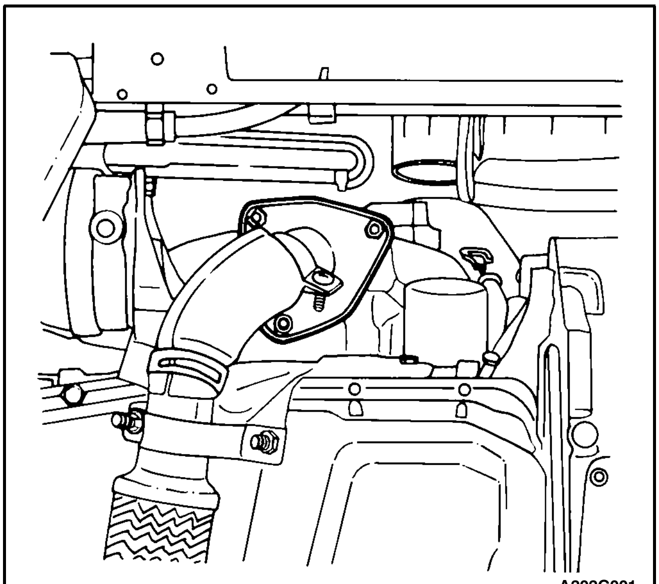
1 **Trim Ring**
2 **Rear Muffler**
3 **Metal Gasket**
4 **Front Muffler**
5 **Metal Gasket**
6 **Catalytic Converter or Connecting Pipe**
7 **Metal Gasket**
8 **Front Exhaust Pipe**
9 **Metal Holding Bracket**

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

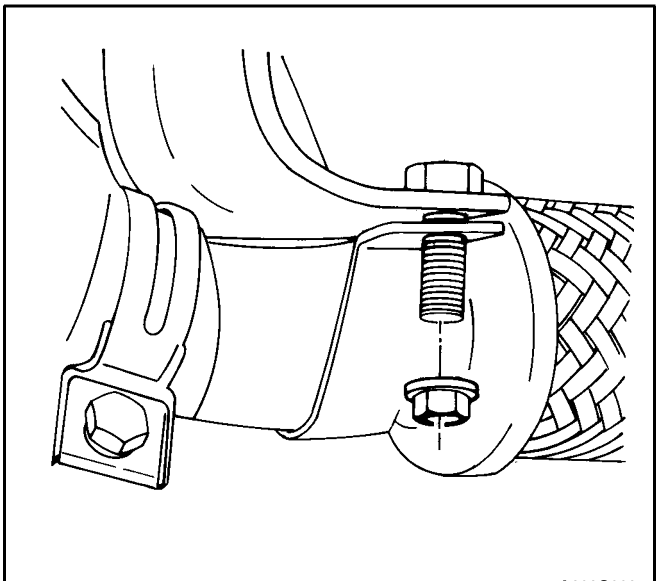
CATALYTIC CONVERTER/ CONNECTING PIPE

Removal Procedure



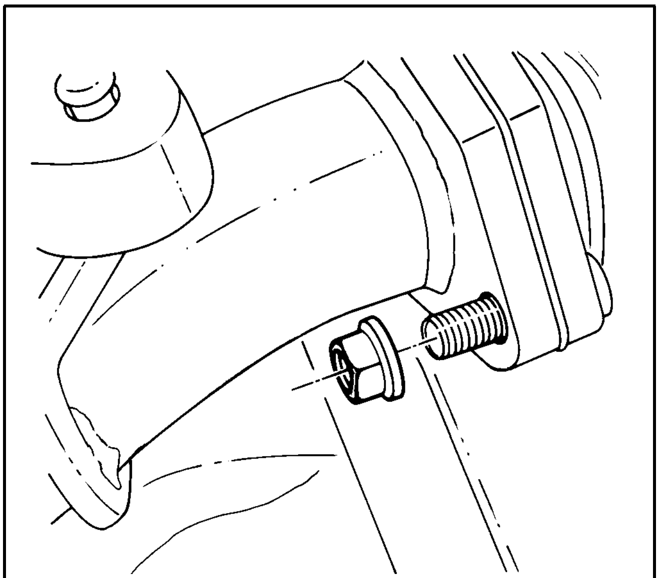
A202G001

1. Remove the front exhaust pipe nuts and the gasket from the exhaust manifold.



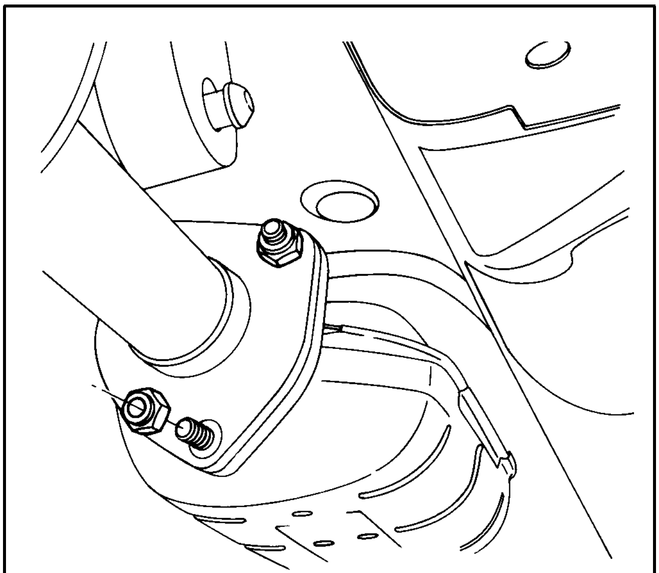
A202G002

2. Remove the nuts from the holding bracket which secures the front exhaust pipe to the engine block bracket near the oil pan.
3. Remove the lower holding bracket.



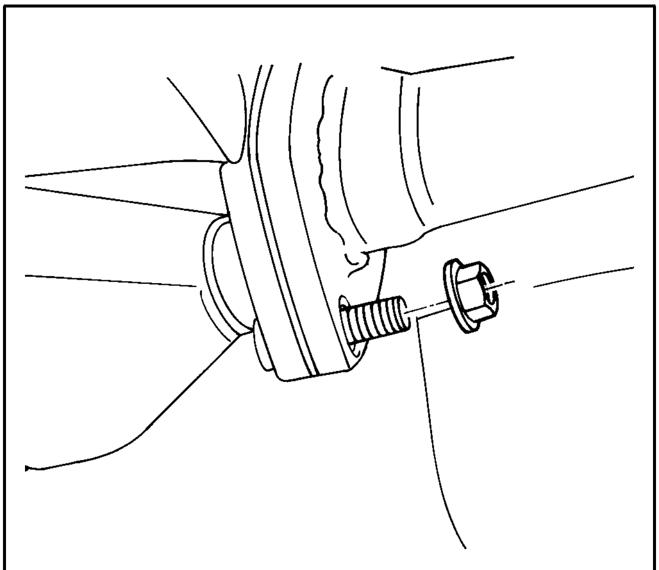
A202G003

4. Disconnect the other end of the front exhaust pipe from the rubber hanger.
5. Remove the nuts from the front exhaust pipe to the catalytic converter or connecting pipe flange.
6. Remove the front exhaust pipe and the gasket.



B102G003

7. Remove the nuts from the front muffler pipe-to-catalytic converter or connecting pipe flange.
8. Remove the catalytic converter or the connecting pipe and the gasket.
9. Clean the sealing surfaces on the front exhaust pipe flange and the exhaust manifold.
10. Check the exhaust pipe and the catalytic converter or the connecting pipe for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment.



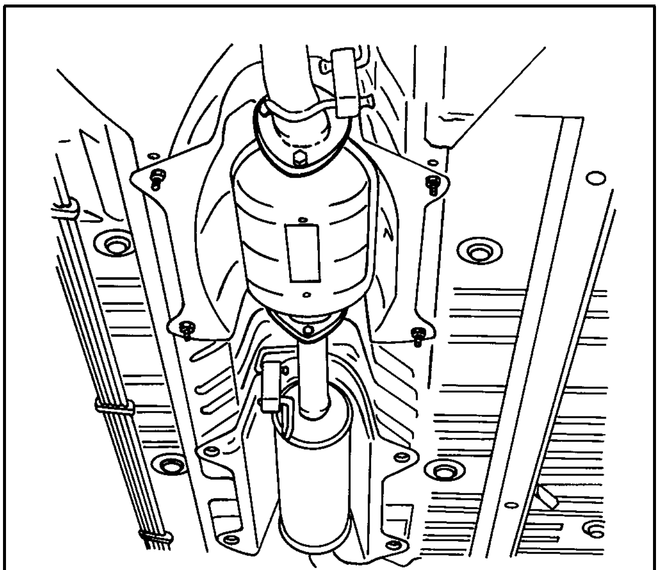
A202G004

Installation Procedure

1. Install the catalytic converter or the connecting pipe and the gasket to the front muffler pipe flange. Use the nuts to secure the converter or the connecting pipe.

Tighten

Tighten the front muffler-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).



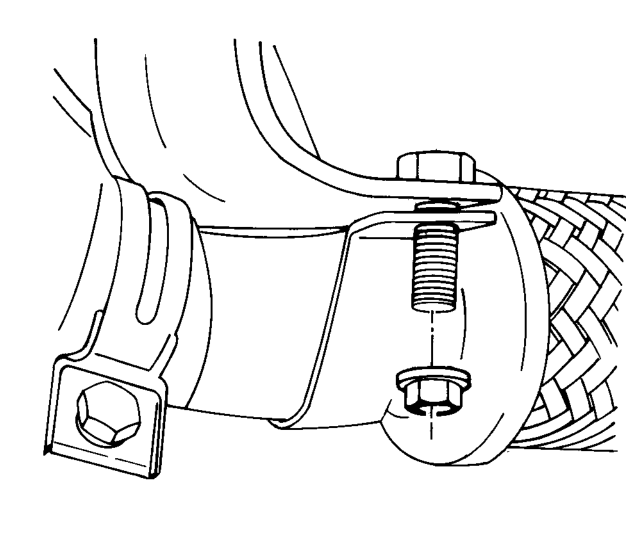
A102G004

2. Connect the front exhaust pipe to the rubber hanger.
3. Using the nuts and the gasket, secure the front exhaust pipe to the catalytic converter or the connecting pipe flange.

Tighten

Tighten the front exhaust pipe-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).

4. Place the front exhaust pipe in the engine block bracket near the oil pan.

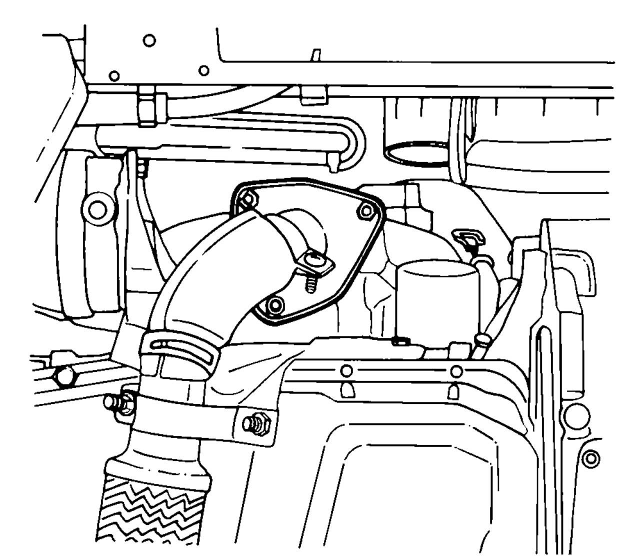


A202G002

5. Secure the front exhaust pipe with the lower holding bracket.

Tighten

Tighten the lower front exhaust pipe holding bracket nuts to 30 N•m (22 lb-ft).

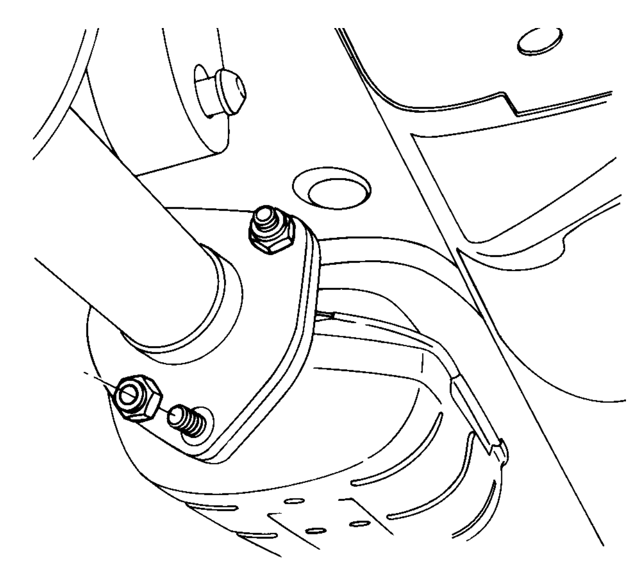


A202G001

6. Using the nuts and the gasket, secure the front exhaust pipe to the exhaust manifold.

Tighten

Tighten the front exhaust pipe-to-exhaust manifold nuts to 40 N•m (30 lb-ft).

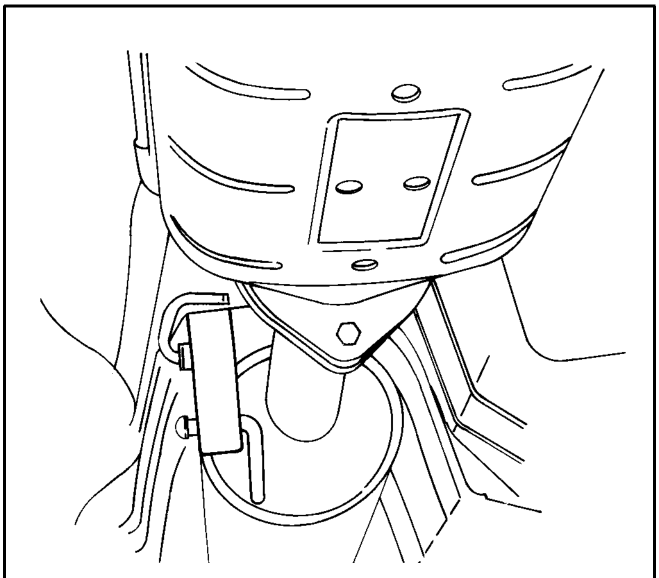


B102G003

MUFFLER – FRONT

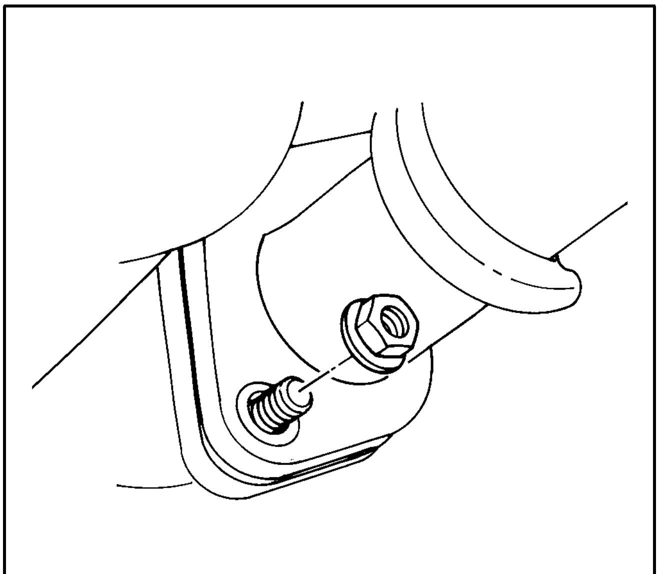
Removal Procedure

1. Remove the nuts and the gasket from the front muffler pipe to the catalytic converter or the connecting pipe flange.



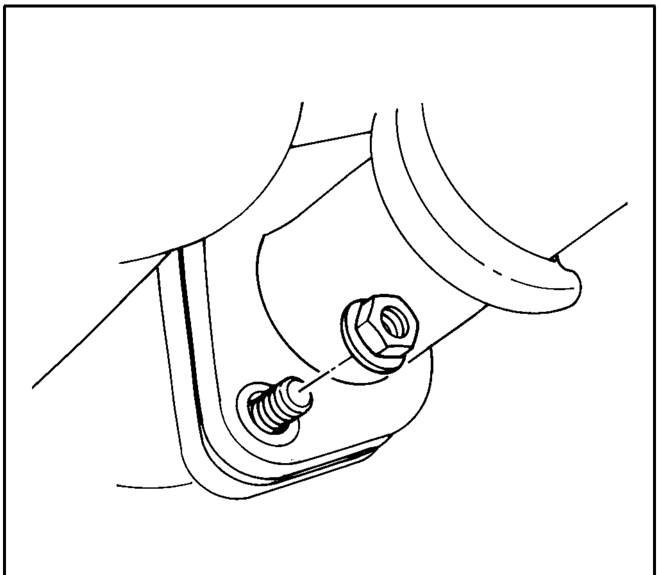
A202G005

2. Detach the front muffler from the rubber hanger.



A202G006

3. Remove the nuts and the gasket from the the rear muffler pipe flange. Disconnect the front muffler from the rubber hanger.
4. Remove the front muffler.
5. Check the exhaust pipe and the front muffler for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment or the trunk.



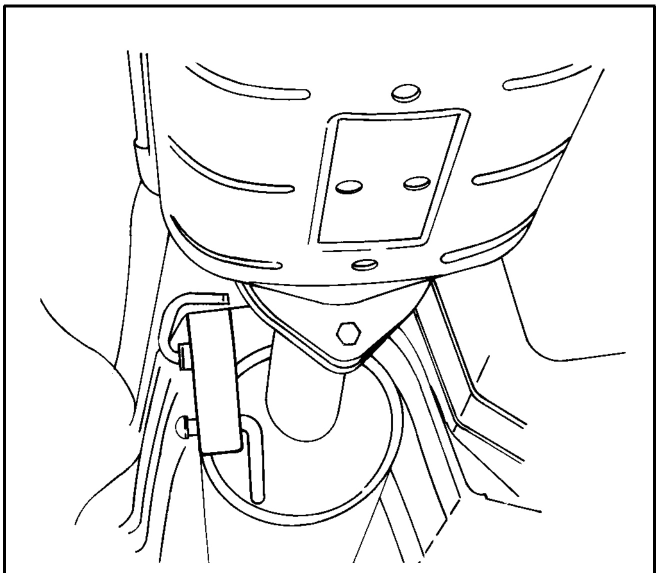
A202G006

Installation Procedure

1. Attach the front muffler and the gasket to the rear muffler using the nuts. Secure the front muffler to the rubber hanger.

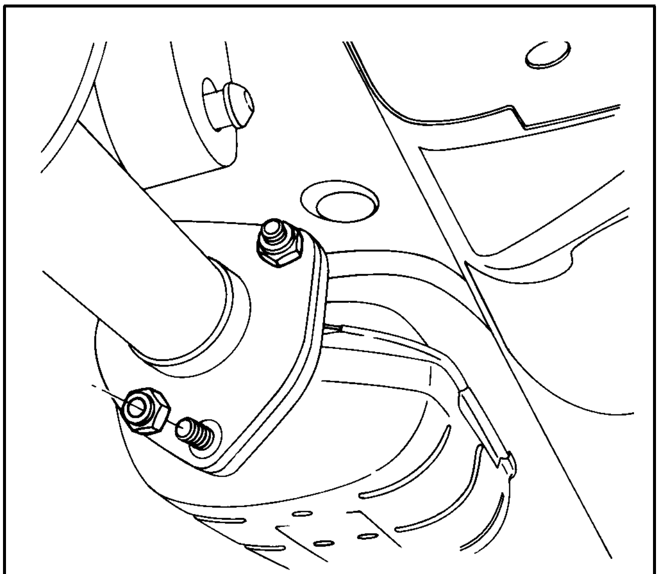
Tighten

Tighten the front muffler-to-rear muffler nuts to 30 N•m (22 lb-ft).



A202G005

2. Attach the front muffler assembly to the rubber hanger. Loosely secure the front muffler assembly to the catalytic converter or connecting pipe flange.

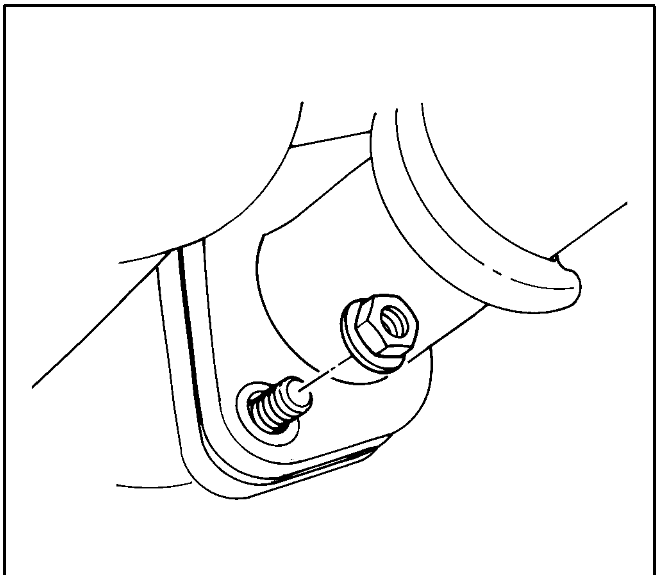


B102G003

3. Secure the front muffler assembly to the catalytic converter or connecting pipe flange with the nuts.

Tighten

Tighten the front muffler-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).

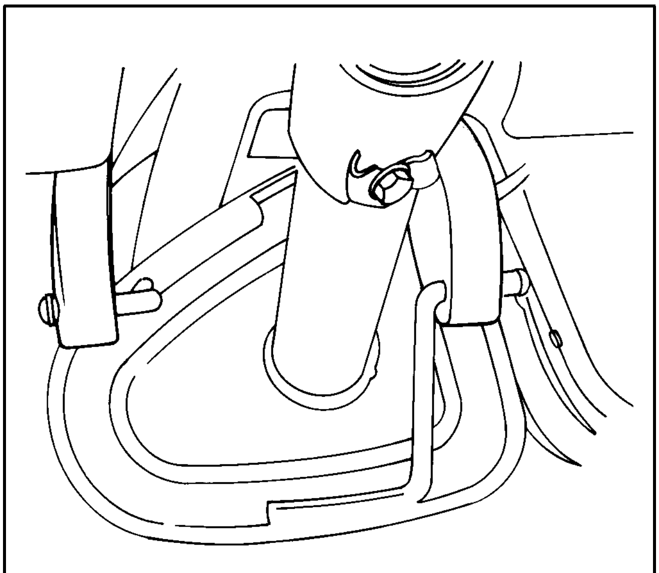


A202G006

MUFFLER – REAR

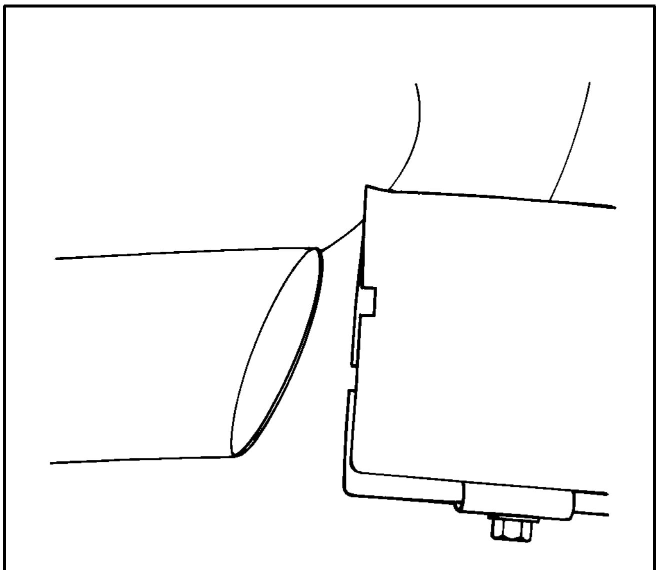
Removal Procedure

1. Remove the nuts and gasket from the rear muffler pipe flange-to-front muffler pipe flange.



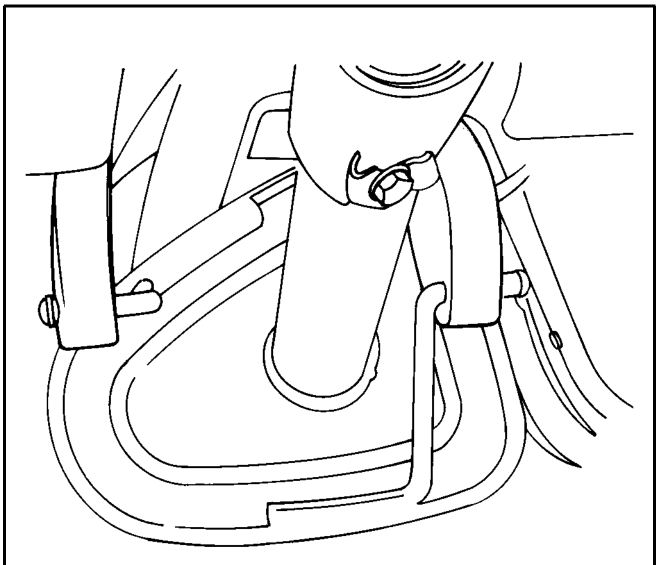
A202G007

2. Detach the rear muffler assembly from the rubber hangers on the tail pipe end.
3. Remove the rear muffler assembly.



A202G008

4. Remove the trim ring from the rear muffler pipe.
5. Check the rear muffler and the pipes for holes, damage, open seams, and other deterioration which could permit exhaust fumes to seep into the passenger compartment or trunk.



A202G007

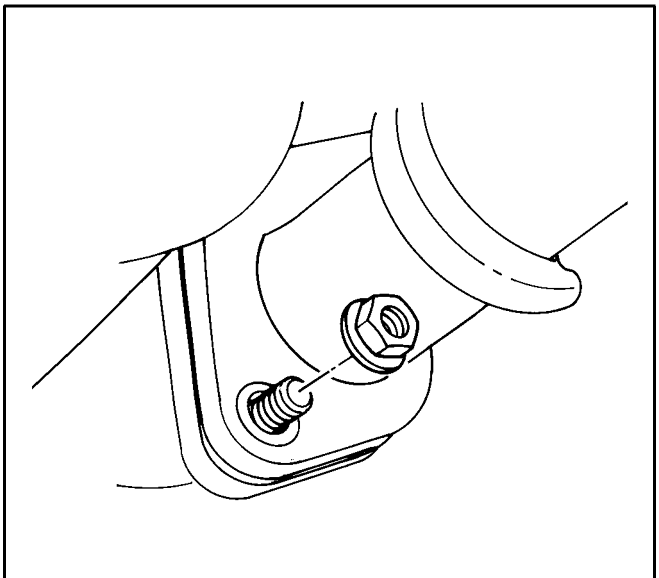
Installation Procedure

1. Install the trim ring on the rear muffler pipe.

Tighten

Tighten the trim ring bolt until it bottoms on the exhaust pipe. Tighten an additional quarter turn.

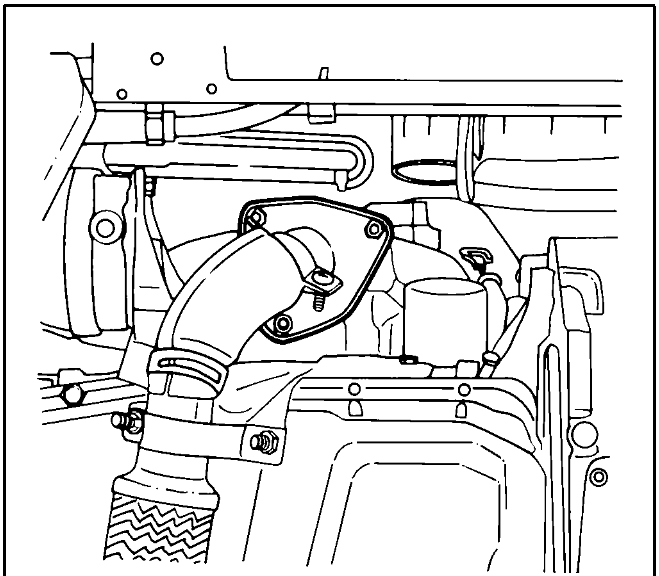
2. Secure the rear muffler assembly to the rubber hangers on the tail pipe end.


A202G006

3. Secure the nuts and the gasket from the rear muffler pipe flange-to-front muffler pipe flange.

Tighten

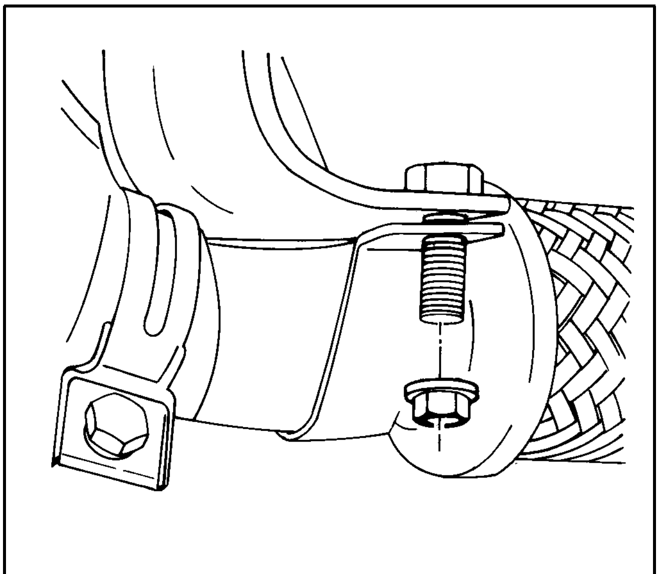
Tighten the front muffler-to-rear muffler nuts to 30 N•m (22 lb-ft).


A202G001

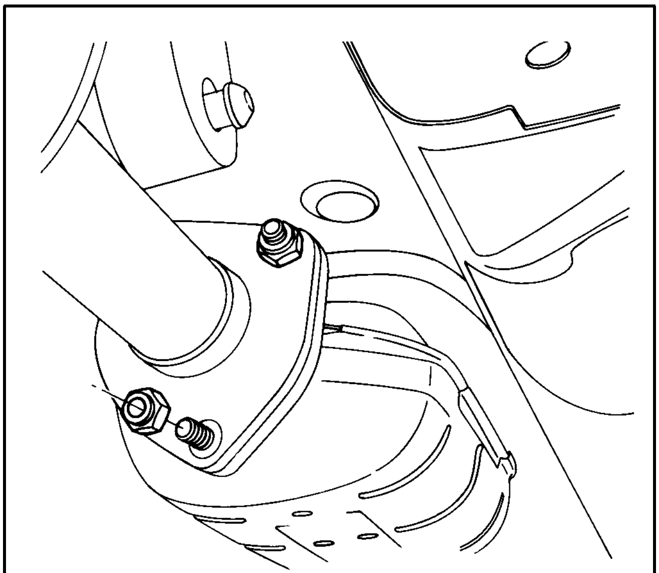
EXHAUST PIPE

Removal Procedure

1. Remove the front exhaust pipe nuts and the gasket from the exhaust manifold.

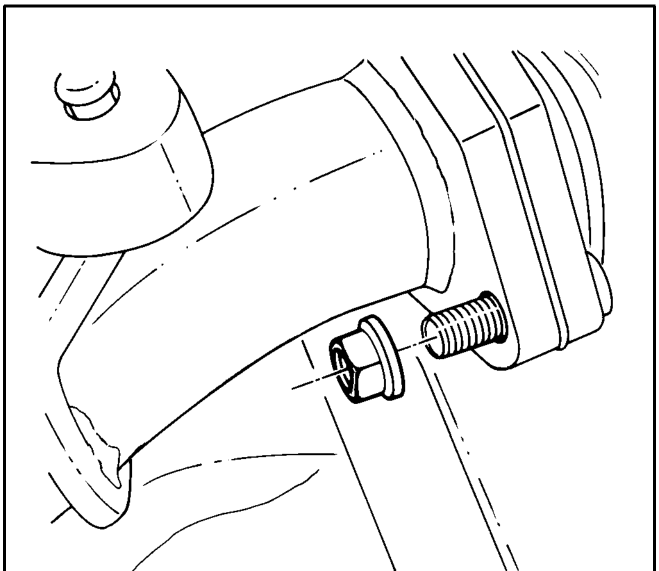

A202G002

2. Remove the nuts from the holding bracket which secures the front exhaust pipe to an engine block bracket near the oil pan.
3. Remove the holding bracket.



B102G003

4. Remove the nuts and the gasket from the converter flange or the connecting pipe and detach the front exhaust pipe from the rubber hanger.
5. Check the exhaust pipe for holes, damage, or other deterioration which could permit fumes to seep into the passenger compartment.
6. Clean the sealing surfaces on the front exhaust flange and the exhaust manifold.



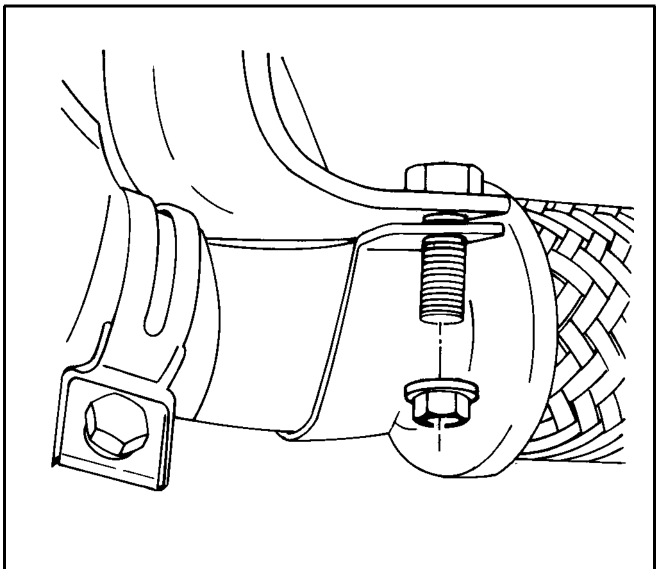
A202G003

Installation Procedure

1. Install the nuts and the gasket from the catalytic converter or the connecting pipe flange. Attach the front exhaust pipe to the rubber hanger.

Tighten

Tighten the front exhaust pipe-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).

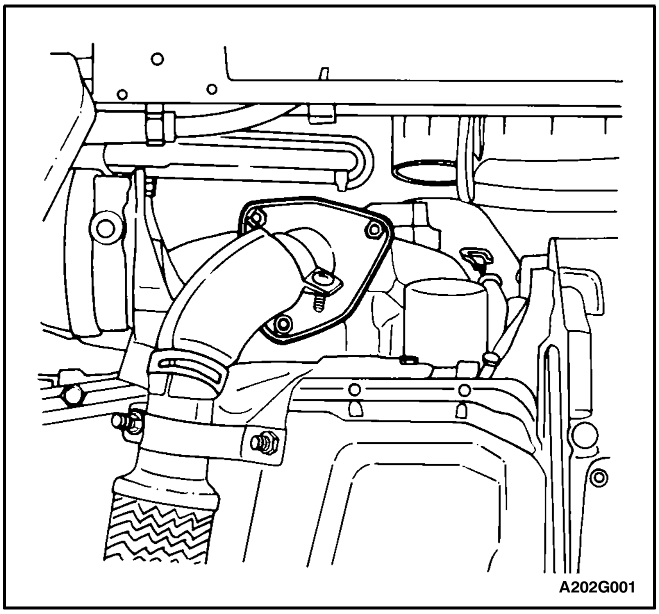


A202G002

2. Place the front exhaust pipe in the engine block bracket near the oil pan.
3. Secure the front exhaust pipe with the lower holding bracket.

Tighten

Tighten the lower front exhaust pipe holding bracket nuts to 30 N•m (22 lb-ft).



4. Using the nuts and the gasket, secure the front exhaust pipe to the exhaust manifold.

Tighten

Tighten the front exhaust pipe-to-exhaust manifold nuts to 40 N•m (30 lb-ft).

GENERAL DESCRIPTION AND SYSTEM OPERATION

EXHAUST SYSTEM

Notice: When you are inspecting or replacing the exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Caution: Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing, or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit hazardous exhaust fumes to seep into the trunk or the passenger compartment. Dust or water in the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

The exhaust manifold-to-front exhaust pipe connection is of the flex joint type.

MUFFLER

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design as opposed to a slip joint coupling design with clamps and U-bolts. The exhaust manifold-to-exhaust pipe connection is of the flex joint type. If holes, open seams or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly.

Heat shields in the front and rear muffler assembly positions, as well as for the catalytic converter and front exhaust pipe, protect the vehicle and the environment from high temperatures the exhaust system develops.

CATALYTIC CONVERTER

Notice: When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter as this could damage the catalytic converter.

Notice: The catalytic converter requires the use of unleaded fuel only, or damage to the catalyst will result.

The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust pipes.

The oxidation catalyst is coated with a catalytic material containing platinum and palladium, which reduces levels of hydrocarbon (HC) and carbon monoxide (CO) from the exhaust gas. The three-way catalyst has coatings which contain platinum and rhodium, which additionally lower the levels of oxides of nitrogen (NOx).

CONNECTING PIPE

Connecting pipe is used in place of the catalytic converter for those vehicles using leaded fuel.

SECTION 2A

SUSPENSION DIAGNOSIS

TABLE OF CONTENTS

DIAGNOSIS

GENERAL DIAGNOSIS

Problems in the steering, the suspension, the tires, and the wheels involve several systems. Consider all systems when you diagnose a complaint. Some problems, such as abnormal or excessive tire wear and scuffed tires, may be the result of hard driving. Always road test the vehicle first. If possible, do this road test with the customer.

Proceed with the following preliminary checks. Correct any substandard conditions.

Preliminary Checks

Checks	Action
Inspect the tires for improper pressure and uneven wear.	Inflate the tires to the proper pressure.
Inspect the joint from the steering column to the steering gear for loose connections or wear.	Tighten the coupling flange pinch bolts. Replace the coupling flange as needed.
Inspect the front and the rear suspension, the steering gear, and the linkage for loose or damaged parts.	Tighten the front and the rear suspension. Tighten the steering gear mounting bracket bolts. Tighten the coupling flange pinch bolts. Replace the front and the rear suspension as needed. Replace the steering gear as needed. Replace the coupling flange as needed.
Inspect for out-of-round tires.	Perform free runout test. Match-mount the tires.
Inspect for out-of-balance tires, bent wheels, and worn or loose wheel bearings.	Balance the wheels. Replace the wheels. Replace the wheel bearings.
Check the power steering pump drive belt tension.	Tighten the power steering pump drive belt.
Inspect the power steering system for leaks. Also check the power steering fluid level.	Repair any leaks. Perform a power steering gear test. Add power steering fluid.

Car Lead/Pull

Checks	Action
Inspect for mismatched or uneven tires.	Replace the tires.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for a radial tire lateral force.	Check the wheel alignment. Switch the tire and wheel assemblies. Replace the tires as needed.
Check the front-wheel alignment.	Align the front wheels.
Inspect for an off-center steering gear.	Reseat the pinion valve assembly. Replace the pinion valve assembly as needed.
Inspect for front-brake dragging.	Adjust the front brakes.

Abnormal or Excessive Tire Wear

Checks	Action
Check the front-wheel and rear-wheel alignment.	Align the front and the rear wheels.
Inspect for excessive toe.	Adjust the toe.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for out-of-balance tires.	Balance the tires.
Inspect for worn strut dampeners.	Replace the strut dampeners.
Check for a failure to rotate tires.	Rotate the tires. Replace the tires as needed.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for low tire inflation.	Inflate the tires to the proper pressure.

Scuffed Tires

Checks	Action
Inspect for incorrect toe.	Adjust the toe.
Inspect for a twisted or a bent suspension arm.	Replace the suspension arm.

Wheel Tramp

Checks	Action
Inspect for an out-of-balance tire or wheel.	Balance the tire or the wheel.
Inspect for improper strut dampener action.	Replace the strut dampeners.

Shimmy, Shake, or Vibration

Checks	Action
Inspect for an out-of-balance tire or wheel.	Balance the tire or the wheel.
Inspect for excessive wheel hub runout.	Measure the hub flange runout. Replace the hub as needed.
Inspect for excessive brake drum or brake rotor imbalance.	Adjust the brakes. Replace the brake rotor or the brake drum as needed.
Inspect for worn tie rod ends.	Replace the outer tie rods.
Inspect for wheel trim imbalance.	Balance the wheel.
Inspect for a worn lower ball joint.	Replace the lower ball joint.
Inspect for excessive wheel runout.	Measure the wheel runout. Replace the wheel as needed.
Inspect for excessive loaded radial runout on the tire and wheel assembly.	Match-mount the tire and wheel assembly.

Hard Steering (Manual)

Checks	Action
Inspect for a lack of lubrication of the ball joints, the tie rods and the steering gear.	Lubricate the ball joints, the tie rods, and the steering gear. Replace the ball joints, the tie rods, and the steering gear as needed.
Check the front-wheel alignment.	Align the front wheels.
Check the steering gear adjusment.	Adjust the steering gear.

Hard Steering (Power)

Checks	Action
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.
Check the hydraulic system. Test the power steering system pressure with a gauge.	Replace the seals and the hoses as needed.
Inspect for binding or catching in the steering gear.	Lubricate the steering gear. Repair or replace the steering gear as needed.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts.

Too Much Play in Steering

Checks	Action
Inspect for worn or loose wheel bearings.	Tighten the drive axle nut. Replace the wheel bearings as needed.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts.
Inspect the joint from the column to the steering gear for loose connections or wear.	Tighten the coupling flange pinch bolts. Replace the coupling flange as needed.
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.

Poor Returnability (Manual)

Checks	Action
Inspect for a lack of lubrication of the ball joints, the tie rods and the steering gear.	Lubricate the ball joints, the tie rods, and the steering gear. Replace the ball joints, the tie rods, and the steering gear as needed.
Inspect for binding in the ball joints.	Replace the ball joints.
Inspect for binding in the steering column.	Lubricate the steering column. Replace the steering column as needed.
Inspect for a lack of lubrication in the steering gear.	Lubricate the steering gear. Repair or replace the steering gear as needed.
Check the front-wheel alignment.	Align the front wheels.
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.

Poor Returnability (Power)

Checks	Action
Inspect for lack of lubrication of the ball joints and the tie rod ends.	Lubricate the ball joints and the tie rod ends. Replace the ball joints and the outer tie rods as needed.
Inspect for binding in the ball joints.	Replace the ball joint.
Inspect for binding in the steering column.	Lubricate the steering column. Replace the steering column as needed.
Check the front-wheel alignment.	Align the front wheels.
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.
Inspect for a sticking valve.	Lubricate the pinion valve assembly. Replace the pinion valve assembly as needed.
Inspect for binding in the coupling flange on the steering gear.	Replace the coupling flange.

Abnormal Noise, Front Suspension

Checks	Action
Inspect for a lack of lubrication of the ball joints and the tie rod ends.	Lubricate the ball joints and the tie rod ends. Replace the ball joints and the outer tie rods as needed.
Inspect for damaged suspension components.	Replace the damaged suspension components.
Inspect for worn control arm bushings or tie rod ends.	Replace the control arm bushings or the tie rods.
Inspect for a loose stabilizer shaft link.	Tighten the stabilizer shaft link.
Inspect for loose wheel bolts.	Tighten the wheel bolts.
Inspect for loose suspension bolts or nuts.	Tighten the suspension bolts or the nuts.
Inspect for loose wheel covers.	Tighten the wheel covers.
Inspect for worn strut dampeners or strut mountings.	Replace the strut dampeners. Tighten the strut mounting bolts.
Inspect for an improperly positioned strut spring.	Adjust the strut spring to the proper position.

Wander or Poor Steering Ability

Checks	Action
Inspect for mismatched or uneven tires.	Replace the tires.
Inspect for lack of lubrication of the ball joints and the tie rod ends.	Lubricate the ball joints and the tie rod ends. Replace the ball joints and the outer tie rods as needed.
Inspect for worn strut dampeners.	Replace the strut dampeners.
Inspect for a loose stabilizer shaft link.	Tighten the stabilizer shaft link.
Inspect for a broken or a sagging spring.	Replace the spring.
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.
Check the front-wheel and the rear-wheel alignment.	Align the front and the rear end wheels.

Erratic Steering when Braking

Checks	Action
Inspect for worn or loose wheel bearings.	Replace the wheel bearings.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for a leaking wheel cylinder or caliper.	Replace the wheel cylinder or the caliper.
Inspect for warped rotors.	Replace the rotors.
Inspect for an incorrect or an uneven caster.	If the caster is beyond specifications, check the frame and repair it as needed.

Low or Uneven Trim Height

Checks	Action
Inspect for a broken or a sagging spring.	Replace the spring.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for an incorrect or weak spring.	Replace the spring.

Ride Too Soft

Checks	Action
Inspect for worn strut dampeners.	Replace the strut dampeners.
Inspect for a broken or a sagging spring.	Replace the spring.

Ride Too Harsh

Checks	Action
Inspect for incorrect strut dampeners.	Replace the strut dampeners.
Inspect for an incorrect spring.	Replace the spring.

Body Leans or Sways in Corners

Checks	Action
Inspect for a loose stabilizer shaft link.	Tighten the stabilizer shaft link.
Inspect for worn strut dampeners or strut mountings.	Replace the strut dampeners. Tighten the strut assembly mounting bolts.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for a broken or a sagging spring.	Replace the spring.

Suspension Bottoms

Checks	Action
Inspect for worn strut dampeners.	Replace the strut dampeners.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for a broken or a sagging spring.	Replace the spring.

Steering Wheel Kickback (Power)

Checks	Action
Inspect for air in the power steering system.	Purge the power steering system of air.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts.
Inspect the joint from the column to the steering gear for loose connections or wear.	Tighten the coupling flange pinch bolts. Replace the coupling flange as needed.
Inspect for loose tie rod ends.	Tighten the tie rod ends. Replace the outer tie rods as needed.
Inspect for loose or worn wheel bearings.	Tighten the drive axle nut. Replace the wheel bearings as needed.

Steering Wheel Surges or Jerks (Power)

Checks	Action
Check the hydraulic system. Test the power steering system pressure with a gauge.	Replace the seals and the hoses as needed.
Inspect for a sluggish steering gear valve.	Clean the pinion valve assembly. Replace the pinion valve assembly as needed.
Inspect for a loose power steering pump drive belt.	Adjust the power steering pump drive belt.

Cupped Tires

Checks	Action
Check the front-wheel and the rear-wheel alignment.	Align the front and the rear wheels.
Inspect for worn strut dampeners.	Replace the strut dampeners.
Inspect for worn or loose wheel bearings.	Tighten the drive axle nut. Replace the wheel bearings as needed.
Inspect for excessive tire or wheel runout.	Match-mount the tires. Replace the tires as needed. Replace the wheels as needed.
Inspect for a worn ball joint.	Replace the ball joint.
Check the steering gear preload adjustment.	Perform a rack bearing preload on-vehicle adjustment.

TORQUE STEER

A degree of torque steer to the right may normally be experienced during the use of heavy throttle on some front-wheel drive cars with drive axles of unequal length. This torque steer to the right results from the right drive axle being longer than the left drive axle, which creates a difference in the drive axle angle. Cars with intermediate shaft assemblies have axles of almost equal length.

A difference in the drive axle lengths results in more torque toe-in in the left front wheel. You will notice the torque toe-in when the vehicle accelerates from a standing start or at lower speeds.

Inspection Procedure

1. Place a small piece of tape at the top center of the steering wheel.
2. Note the inches of steering wheel deflection required to keep the vehicle straight during heavy acceleration.
3. Compare this finding with similar cars.

Factors that may cause torque steer to be more apparent on a particular vehicle include:

- Variations in the tire and wheel assemblies. This has the most significant effect on torque steer. A slightly smaller diameter on the right front tire will increase a right torque lead.
- Large differences in the right and the left front tire pressure.
- Looseness in the control arm bushings, the tie rod assemblies, or the steering gear mounting. This looseness permits a front wheel to pull forward and toe-in under a torque greater than the wheel on the opposite side. A loose suspension component may result in an opposite lead upon deceleration.
- A high front trim height. This height would increase the drive axle angle and could cause wobble at speeds between 24 to 48 km/h (15 to 30 mph).
- Binding or a tight drive axle joint. A tight drive axle joint or a high front trim height may also cause a wobble at speeds between 24 to 48 km/h (15 to 30 mph).
- Incorrect, worn, or loose engine mounts causing adverse drive angles.

Refer to “General Diagnosis” in this section for actions to remedy these problems.

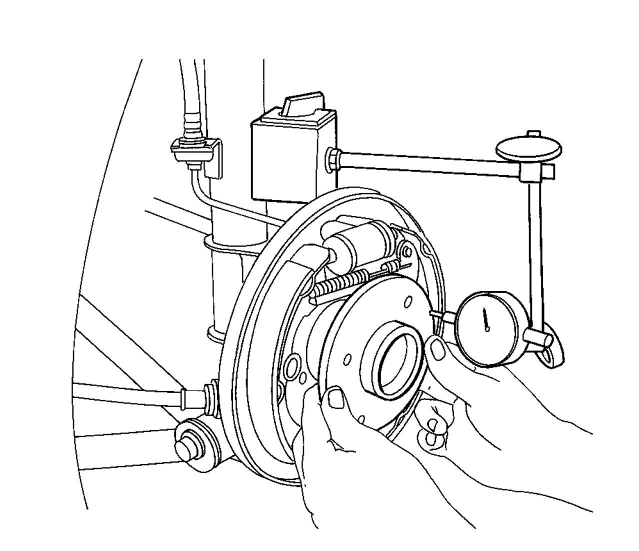
Conditions that may produce an effect similar to torque steer include:

- Incorrect front or rear alignment.
- Frame misalignment or defect.
- Front suspension damage.
- Incorrectly mounted rear crossmember.

TAPERED ROLLER BEARING

Perform the following test to check for looseness in the bearing cartridge assembly:

1. Raise and suitably support the vehicle.
2. Remove the rear wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the brake drum detent screw and the brake drum. Refer to Section 4E, Rear Drum Brakes.
4. Mount a dial indicator set with a magnetic base to a control arm or any other stationary part of the vehicle.
5. Push and pull the wheel hub by hand. If the wheel hub movement exceeds 0.05 mm (0.002 inch), replace the wheel bearing. Refer to Section 2D, Rear Suspension.
6. Install the rear brake drum. Refer to Section 4E, Rear Drum Brakes.
7. Install the rear wheel. Refer to Section 2E, Tires and Wheels.
8. Lower the vehicle.



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SEALED WHEEL BEARING DIAGNOSIS

Vehicles with antilock braking systems have sealed, non-serviceable cartridge bearings in the rear wheels. If any fault is found with a wheel bearing, it must be replaced.

Wheel Bearing Noise

A road test usually reveals excessive wheel bearing noise. Sealed wheel bearings emit a howling sound when loose or damaged. Wheel bearing noise is present only when the vehicle is moving. It is constant and unwavering and increases with the speed of the vehicle. If the wheel bearing noise cannot be positively diagnosed, or if the origin of the noise cannot be determined, perform the following test:

1. Raise and suitably support the vehicle.
2. Spin the wheels using your hand. Check for out-of-round or out-of-balance tires, bent rims, or loose wheel bearings.
3. Spin the rear wheels using a commerical wheel spinner.
4. If a noise can be heard from the passenger compartment, replace the noisy wheel bearing cartridge. Refer to Section 4D, Rear Suspension.
5. Lower the vehicle.

SECTION 2B

WHEEL ALIGNMENT

TABLE OF CONTENTS

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

Application	Front	Rear
Camber	* 1°10′ to 20′	8 2°10′ to * 1° 10′
Caster - Manual Str'g	30′ to 2° 30′	-
Caster - Power Str'g	1° 45′ to 3° 45′	-
Toe-in (2-person load)	* 10′ to 10′	8 10′ to 40′

DIFFERENCE BETWEEN LEFT AND RIGHT

Application	Front	Rear
Camber	1° max	30′ max.
Caster	1° max	-
Toe-in	-	15′ max.

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Inner and Outer Tie Rod Pinch Bolts	20	15	-

DIAGNOSIS

TIRE DIAGNOSIS

Irregular and Premature Wear

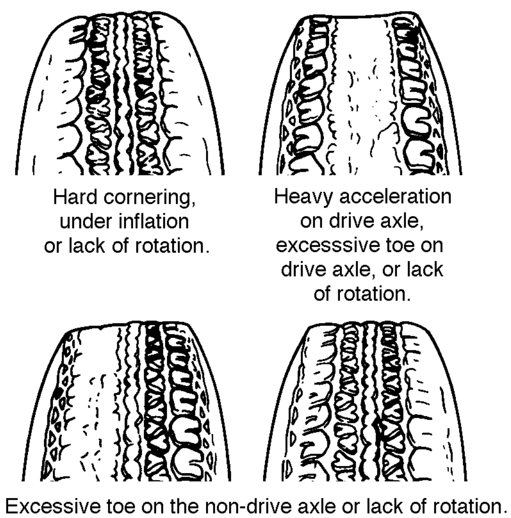
Irregular and premature tire wear has many causes. Some of them are incorrect inflation pressures, lack of regular rotation, poor driving habits, or improper wheel alignment. If the wheel alignment is reset because of tire wear, always reset the toe as close to zero degrees as the specification allows. Refer to "Rear Toe Check" in this section.

Rotate the tires if:

- **The front tire wear is different from the rear.**
- **The left and right front tire wear is unequal.**
- **The left and right rear tire wear is unequal.**

Check wheel alignment if:

- **The left and right front tire wear is unequal.**
- **The wear is uneven across the tread of either front tire.**
- **The front tire treads are scuffed with "feather" edges on the side of the tread ribs or blocks.**



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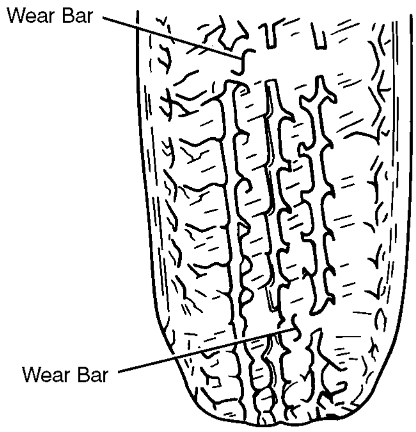
Tread Wear Indicators

The original equipment tires have built-in tread wear indicators to show when the tires need replacement. These indicators appear as bands when the tire tread depth becomes shallow. Tire replacement is recommended when the indicators appear in three or more grooves at six locations.



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Radial Tire Waddle

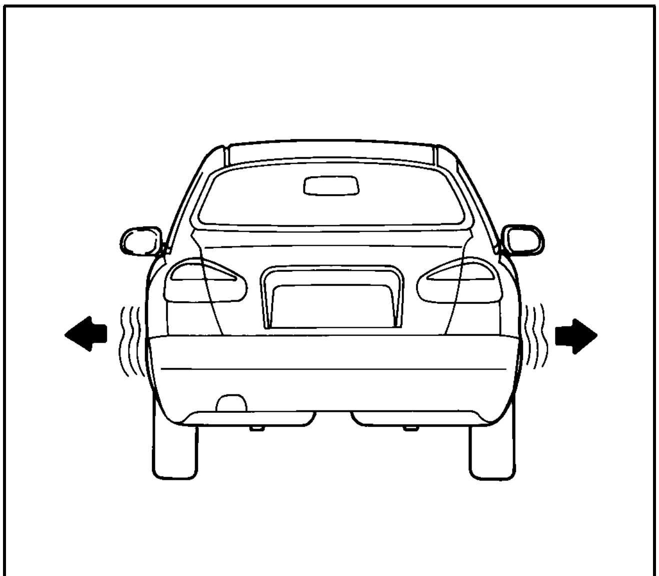
Waddle is side-to-side movement at the front or rear of the vehicle. It is caused by the steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel. It is most noticeable at low speeds, 8 to 48 km/h (5 to 30 mph), but may appear as ride roughness at 80 to 113 km/h (50 to 70 mph).

The vehicle must be road tested to determine which end of the vehicle has the faulty tire. The rear end of the vehicle will shake from side to side or "waddle" if the waddle tire is on the rear of the vehicle. From the driver's seat, it feels as though someone is pushing on the side of the vehicle. If the faulty tire is on the front of the vehicle, the waddle is more visual. The front sheet metal appears to be moving back and forth, and the driver's seat feels like the pivot point in the vehicle.

Waddle can be diagnosed using the method of substituting known good tire and wheel assemblies on the problem vehicle.

1. **Road test the vehicle to determine if the waddle is coming from the front or the rear of the vehicle.**
2. **Install good tires and wheels from a similar vehicle in place of those on the offending end of the problem vehicle. If the source of the waddle is not obvious, change the rear tires.**

3. Road test the vehicle. If there is improvement, install the original tires to find the offending tire. If there is no improvement, install good tires in place of all four offending tires.
4. Install original tires one at a time to find the offending tire.



RADIAL TIRE LEAD/PULL

Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel. Lead is usually caused by:

- Incorrect alignment.
- Uneven brake adjustment.
- Tire construction.

The way in which a tire is built can produce lead/pull in the vehicle. Off-center belts on radial tires can cause the tire to develop a side force while the vehicle rolls straight down the road. If one side of the tire has even a little larger diameter than the diameter of the other side, the tire will tend to roll to one side. Unequal diameters will cause the tire to develop a side force which can produce vehicle lead/pull.

The radial lead/pull diagnosis chart should be used to determine whether the problem originates from an alignment problem or from the tires. Part of the lead diagnosis procedure calls for tire rotation that is different from the proper tire rotation pattern. If a medium- to high-mileage tire is moved to the other side of the vehicle, be sure to check for ride roughness. Rear tires will not cause lead/pull.

Radial Tire Lead/Pull Diagnosis Chart

Step	Action	Value(s)	Yes	No
1	1. Perform wheel alignment preliminary inspection. 2. Check the brakes for dragging. 3. Road test the vehicle. Does the vehicle lead/pull?	-	Go to Step 2	System OK
2	1. Cross switch the front tire and wheel assemblies. 2. Road test the vehicle. Does the vehicle lead/pull?	-	Go to Step 3	System OK
3	1. Check the front wheel alignment. Is the alignment within specifications?	-	Go to Step 4	Adjust alignment
4	1. Compare the front camber and front caster to specifications. Are they within specifications?	–	Go to Step 7	Go to Step 5
5	1. Check the vehicle frame. Is the frame bent?	-	Go to Step 6	Go to Step 1
6	1. Straighten the frame. Is the repair complete?	-	Go to Step 3	-
7	1. The probable cause is the tires. 2. Switch the left front tire and wheel assembly with the left rear tire and wheel assembly. 3. Road test the vehicle. Does the vehicle still lead/pull?	-	Go to Step 9	Go to Step 8
8	1. Switch the left front tire and wheel assembly with the left rear tire and wheel assembly and replace the left front tire. Is the repair complete?	-	System OK	Go to Step 1
9	1. Switch the right front tire and wheel assembly with the right rear tire and wheel assembly. 2. Road test the vehicle. Does the vehicle still lead/pull?	-	Go to Step 1	Go to Step 10
10	1. Switch the right front tire and wheel assembly with the right rear tire and wheel assembly and replace the right front tire. Is the repair complete?	-	System OK	Go to Step 1

VIBRATION DIAGNOSIS

Wheel imbalance causes most highway speed vibration problems. A vibration can remain after dynamic balancing because:

- A tire is out of round.
- A rim is out of round.
- A tire stiffness variation exists.

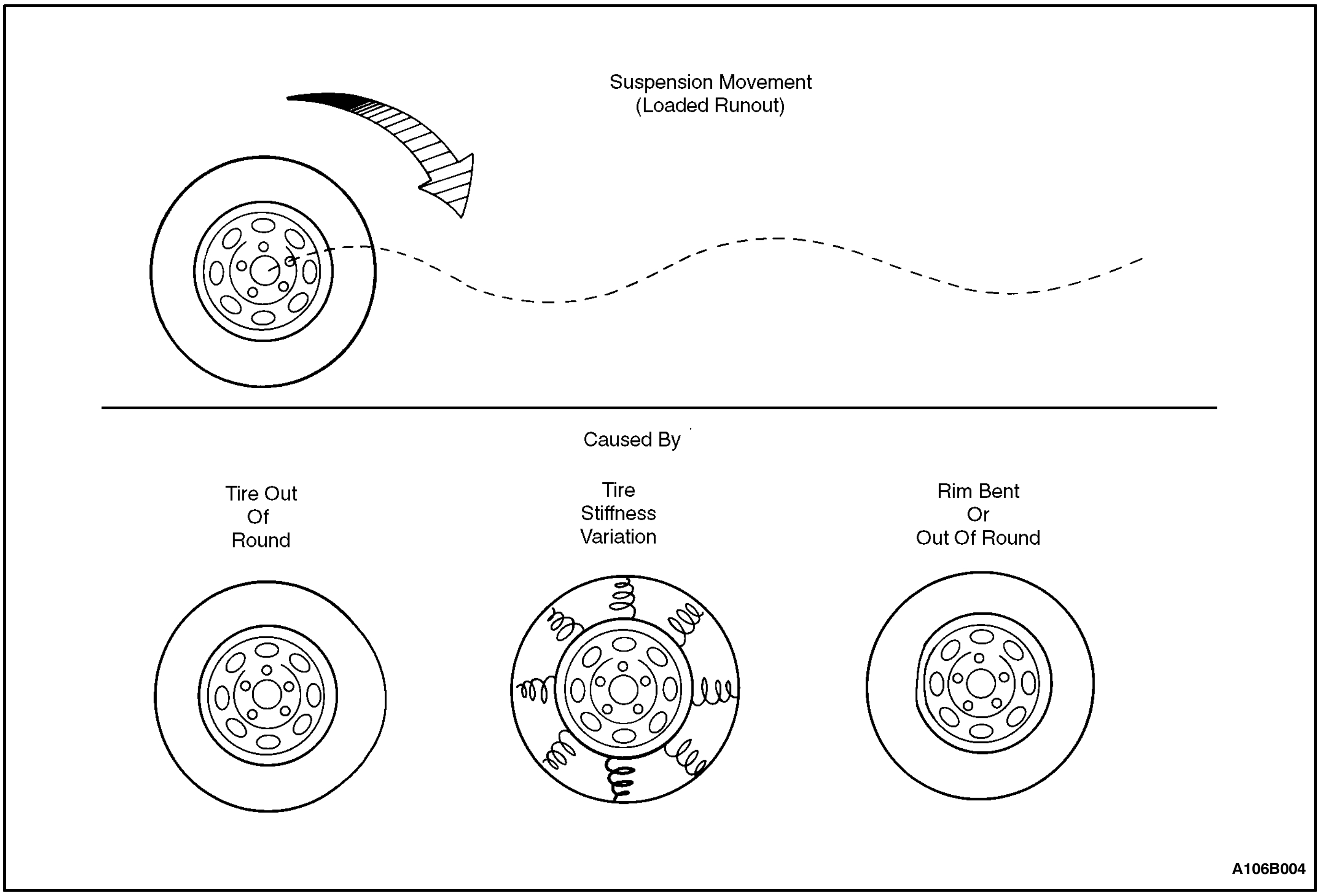
Measuring tire and wheel free runout will uncover only part of the problem. All three causes, known as loaded radial runout, must be checked using method of substituting known good tire and wheel assemblies on the problem vehicle.

Low-speed vibrations, which occur below 64 km/h (40 mph), are usually caused by runout. High-speed vibrations, which occur above 64 km/h (40 mph), can be caused by either imbalance or runout.

Preliminary Checks

Prior to performing any work, always road test the car and perform a careful visual inspection for:

- Obvious tire and wheel runout.
- Obvious drive axle runout.
- Improper tire inflation.
- Incorrect trim height.
- Bent or damaged wheels.
- Debris build-up on the tire or the wheel.
- Irregular or excessive tire wear.
- Improper tire bead seating on the rim.
- Imperfections in the tires, including: tread deformations, separations, or bulges from impact damage. Slight sidewall indentations are normal and will not affect ride quality.



Tire Balancing

Balance is the easiest procedure to perform and should be done first if the vibration occurs at high speeds. Do an off-vehicle, two-plane dynamic balance first to correct any imbalance in the tire and wheel assembly.

An on-vehicle finish balance will correct any brake drum, rotor, or wheel cover imbalance. If balancing does not correct the high-speed vibration, or if the vibration occurs at low speeds, runout is the probable cause.

Runout

Runout can be caused by the tire, the wheel, or the way the wheel is attached to the vehicle. To investigate the possibility of wheel runout, refer to the following procedures as well as the wheel runout diagnosis chart in this section:

1. If runout is suspected, measure the on-vehicle free lateral and free radial runout of the tire and wheel assembly. Refer to Section 2E, Tires and Wheels. Both

the free lateral and the free radial runout should be less than 1.5 mm (0.06 inch). If either measurement exceeds this number, proceed to Step 2.

2. Mount the tire and the wheel on a dynamic balancing machine and remeasure the free lateral and the free radial runout. Record the amount of the free lateral and the free radial runout and the location of the highest measurement. Refer to Section 2E, Tires and Wheels. If the free radial or the free lateral runout exceeds 1.3 mm (0.05 inch) at the tire tread, proceed to Step 4.
3. Measure the wheel runout. Refer to Section 2E, Tires and Wheels. If the wheel exceeds specifications, replace it.
4. Deflate the tire and match-mount the high radial runout point of the tire to the low radial runout point of the wheel. Reinflate the tire and mount it on the dynamic balancing machine. Measure and record the free radial and the free lateral runout and their locations. In many cases, match mounting the tire on the wheel will bring the tire and wheel assembly's free runout into an acceptable range of 1.3 mm (0.05 inch) or less.
5. If the free runout of the tire and wheel assembly is 1.3 mm (0.05 inch) or less when it was measured off the vehicle, yet exceeds 1.3 mm (0.05 inch) when measured on the vehicle, the attachment of the tire and wheel assembly to the hub is the probable cause of the vibration. Rotate the assembly's two wheel studs and recheck the runout. Refer to Section 2E, Tires and Wheels. Several positions may have to be tried to find the best location for the studs.
6. If the tire and wheel assembly free runout cannot be reduced to 1.3 mm (0.05 inch) or less, remove the assembly.
   - 6.1 Measure the wheel stud runout using a dial indicator set with a magnetic base.
   - 6.2 Zero the dial indicator set button on one stud.
   - 6.3 Gently lift the set button off the stud. Rotate the flange to position the next stud against the dial indicator set.
   - 6.4 Record the runout of all the studs. The dial indicator should read zero when it is repositioned on the first stud that was checked.
   - 6.5 If the runout exceeds 0.76 mm (0.03 inch), the hub or the hub and bearing assembly should be replaced.

Whenever a tire is rotated on the wheel, or whenever a tire or wheel is replaced, rebalance the assembly.

Wheel Runout Diagnosis Chart

Step	Action	Value(s)	Yes	No
1	Road test the vehicle to verify the vibration complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	1. Perform a vibration diagnosis preliminary check. 2. Repair any of the problems found. Is the vibration still present?	-	Go to Step 3	System OK
3	Determine at what speed the vibration is present. Is the vibration over 64 km/h (40 mph)?	-	Go to Step 4	Go to Step 6
4	Perform off-vehicle dynamic wheel balance. Is the vibration still present?	-	Go to Step 5	System OK
5	Perform on-vehicle finish balance. Is the vibration still present?	-	Go to Step 6	System OK
6	Perform free lateral and radial on-vehicle runout check. Does the runout match the value specified?	1.5 mm (0.06 in.)	Go to Step 4	Go to Step 7
7	Perform free lateral and free radial off-vehicle runout check. Does the runout match the value specified?	1.3 mm (0.05 in.)	Go to Step 8	Go to Step 12
8	1. Index the tire and wheel assembly on the wheel studs. 2. Obtain the least amount of runout possible. Does the runout match the value specified?	0.76 mm (0.03 in.)	Go to Step 9	Go to Step 14
9	Perform off-vehicle dynamic wheel balance. Is the vibration still present?	-	Go to Step 10	System OK
10	Perform on-vehicle finish balance. Is the vibration still present?	-	Go to Step 11	System OK
11	1. Check for any engine driveline imbalance. 2. Thoroughly inspect the drive axles and the constant velocity joints. 3. Repair any problems found. Are the repairs complete?	-	Go to Step 1	-
12	1. Match-mount the tire on the wheel. 2. Perform free lateral and free radial off-vehicle runout check. Does the runout match the value specified?	1.5mm (0.06 in.)	Go to Step 9	Go to Step 13
13	1. Dismount the tire from the wheel of the suspected assembly. 2. Measure the runout of the wheel. Does the runout match the value specified?	0.8 mm (0.03 in.)	Go to Step 15	Go to Step 16
14	Measure the hub flange runout. Does the runout match the value specified?	0.76 mm (0.03 in.)	Go to Step 9	Go to Step 17
15	Replace the tire. Is the repair complete?	-	Go to Step 1	-
16	Replace the wheel. Is the repair complete?	-	Go to Step 1	-
17	Replace the hub. Is the repair complete?	-	Go to Step 1	-

PRELIMINARY INSPECTION

Checks	Action
Check the tires for proper inflation pressures and normal tread wear.	Inflate the tires to the proper tire pressure. Replace the tires as needed.
Check the wheel bearings for looseness.	Tighten the axle nut to the proper specification. Replace the strut wheel bearing as needed.
Check for loose ball joints and tie rod ends.	Tighten the ball joints and the tie rods.
Check the runout of the wheels and the tires.	Measure and correct the tire runout.
Check the vehicle trim heights.	Correct the trim heights. Make the correction before adjusting the toe.
Check for loose rack and pinion mounting.	Tighten the mounting brackets for the rack and pinion assembly.
Check for improperly operating struts.	Replace the strut assembly.
Check for loose control arms.	Tighten the control arm attachment bolts. Replace the control arm bushings as needed.

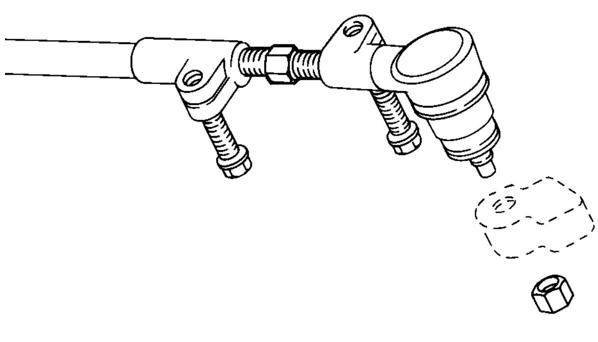
FRONT TOE ADJUSTMENT

1. Loosen the right and the left inner and outer tie rod pinch bolts.
2. Turn the right and the left tie rod adjusters to align the toe to 0 degrees * 10 to +10 minutes.

In this adjustment, the right and left tie rods must be equal in length.

Tighten

Tighten the inner and outer tie rod pinch bolts to 20 N•m (15 lb-ft).



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FRONT CAMBER AND CASTER CHECK

The front camber and caster are not adjustable. Refer to “Wheel Alignment Specifications” in this section. Jounce the bumper three times before measuring the camber or the caster in order to prevent an incorrect reading. If the front camber or caster measurements deviate from the specifications, locate and replace or repair any damaged, loose, bent, dented, or worn suspension part. If the problem is body related, repair the body.

REAR CAMBER CHECK

The rear camber is not adjustable. Refer to “Wheel Alignment Specifications” in this section. If the rear camber deviates from the specification, locate the cause and correct it. If damaged, loose, bent, dented, or worn suspension parts are found, they should be repaired or replaced. If the problem is body related, repair the body.

REAR TOE CHECK

The rear toe is not adjustable. Refer to “Wheel Alignment Specifications” in this section. If the toe deviates from the specification, check the rear axle assembly and the wheel spindle on vehicles without an anti-lock braking system (ABS) or the rear axle assembly and the hub and bearing assembly on vehicles with ABS for possible damage.

GENERAL DESCRIPTION AND SYSTEM OPERATION

FOUR WHEEL ALIGNMENT

The first responsibility of engineering is to design safe steering and suspension systems. Each component must be strong enough to withstand and absorb extreme punishment. Both the steering system and the front and the rear suspension must function geometrically with the body mass.

The steering and the suspension systems require that the front wheels self-return and that the tire rolling effort and the road friction be held to a negligible force in order to allow the customer to direct the vehicle with the least effort and the most comfort.

A complete wheel alignment check should include measurements of the rear toe and camber.

Four-wheel alignment assures that all four wheels will be running in precisely the same direction.

When the vehicle is geometrically aligned, fuel economy and tire life are at their peak, and steering and performance are maximized.

TOE

Toe-in is the turning in of the tires, while toe-out is the turning out of the tires from the geometric centerline or thrust line. The toe ensures parallel rolling of the wheels.

The toe serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward. The specified toe angle is the setting which achieves 0 degrees of toe when the vehicle is moving.

Incorrect toe-in or toe-out will cause tire wear and reduced fuel economy. As the individual steering and suspension components wear from vehicle mileage, additional toe will be needed to compensate for the wear.

Always correct the toe dimension last.

CASTER

Caster is the tilting of the uppermost point of the steering axis either forward or backward from the vertical when viewed from the side of the vehicle. A backward tilt is positive, and a forward tilt is negative. Caster influences directional control of the steering but does not affect tire wear. Weak springs or overloading a vehicle will affect caster. One wheel with more positive caster will pull toward the center of the car. This condition will cause the car to move or lean toward the side with the least amount of positive caster. Caster is measured in degrees and is not adjustable.

CAMBER

Camber is the tilting of the top of the tire from the vertical when viewed from the front of the vehicle. When the tires tilt outward, the camber is positive. When the tires tilt inward, the camber is negative. The camber angle is measured in degrees from the vertical. Camber influences both directional control and tire wear.

If the vehicle has too much positive camber, the outside shoulder of the tire will wear. If the vehicle has too much negative camber, the inside shoulder of the tire will wear.

Camber is not adjustable.

STEERING AXIS INCLINATION

Steering Axis Inclination (SAI) is the tilt at the top of the steering knuckle from the vertical. Measure the SAI angle from the true vertical to a line through the center of the strut and the lower ball joint as viewed from the front of the vehicle.

SAI helps the vehicle track straight down the road and assists the wheel back into the straight ahead position. SAI on front wheel drive vehicles should be negative.

INCLUDED ANGLE

The included angle is the angle measured from the camber angle to the line through the center of the strut and the lower ball joint as viewed from the front of the vehicle.

The included angle is calculated in degrees. Most alignment racks will not measure the included angle directly. To determine the included angle, subtract the negative or add the positive camber readings to the Steering Axis Inclination (SAI).

SCRUB RADIUS

The scrub radius is the distance between true vertical and the line through the center of the strut and lower ball joint to the road surface. Scrub radius is built into the design of the vehicle. Scrub radius is not adjustable.

SETBACK

The setback is the distance in which one front hub and bearing assembly may be rearward of the other front hub and bearing assembly. Setback is primarily caused by a road hazard or vehicle collision.

TURNING ANGLE

The turning angle is the angle of each front wheel to the vertical when the vehicle is making a turn.

SECTION 2C

FRONT SUSPENSION

TABLE OF CONTENTS

SPECIFICATIONS

GENERAL SPECIFICATIONS

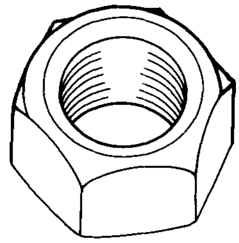
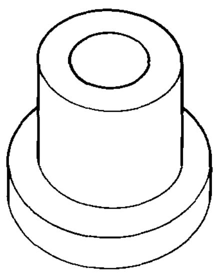
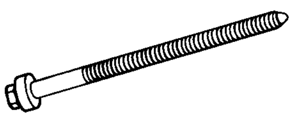
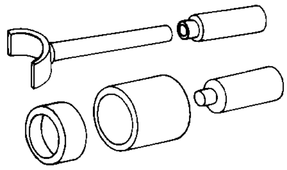
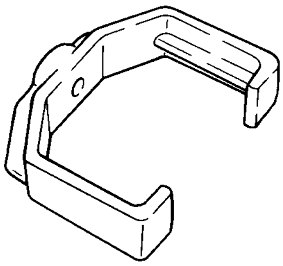
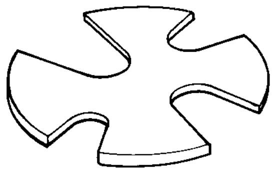
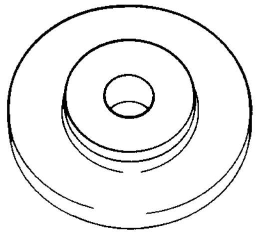
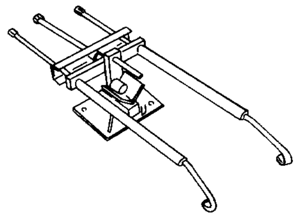
Application	Trim Height
Rocker Panel, Front to Ground	195 mm (7.7 in.)
Rocker Panel, Rear to Ground	191 mm (7.5 in.)

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Ball Joint-to-Control Arm Nuts	65	48	-
Ball Joint-to-Knuckle/Strut Nut	70	52	-
Control Arm Front Mounting Bolt	140	103	-
Control Arm Rear Mounting Bolts	70	52	-
Drive Axle-to-Hub Caulking Nut (First Torque)	180	133	-
Drive Axle-to-Hub Caulking Nut (Last Torque)	50 +60°	37 +60°	-
Piston Rod Nut	55	41	-
Stabilizer Shaft-to-Body Clamp Bolt	40	30	-
Strut Assembly-to-Body Nuts	25	18	-
Strut Cartridge Closure Nut	200	148	-

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A106C056	**500-20** Hex Nut	 A106C055	**J-37105-B-3** Hub Adapter
 A106C053	**J-36661-2** Forcing Screw	 A106C029	**KM-158** Remover/Installer
 A106C052	**J-37105-B-1** Support Bridge	 A106C030	**KM-307-B** Removal Plate
 A106C054	**J-37105-B-2** Bearing Adapter	 A106C031	**KM-329-A** Spring Compressor

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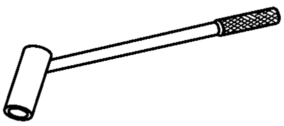
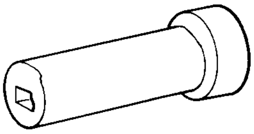
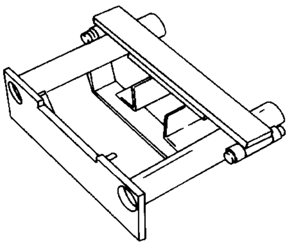
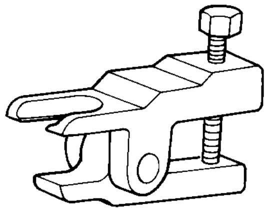
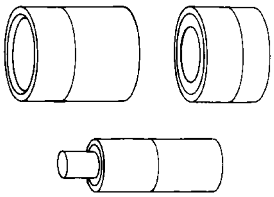
 A106C062	J-42468 Front Strut Mount Nut Wrench
 A106C036	KM-331 Strut Cartridge Closure Nut Wrench
 A106C033	KM-465-A Front Spring Compressor
 A106C034	KM-507-B Ball Joint Remover
 A106C035	KM-508-A Remover/Installer

DIAGNOSIS

STRUT DAMPENER

A strut dampener is basically a shock absorber. However, strut dampeners are easier to extend and retract by hand than are shock absorbers. Strut dampeners are used only on the front in most vehicles, including this vehicle. Shock absorbers are used on the rear wheels.

Struts Seem Weak

Checks	Action
Check the tire pressures.	Adjust the tire pressures to the specifications on the tire placard.
Check the load conditions under which the vehicle is normally driven.	Consult with the owner to confirm the owner's understanding of normal load conditions.
Check the compression and rebound effectiveness of the strut dampener.	Quickly push down and then lift up on the corner of the bumper nearest the strut dampener being tested. Compare the compression and rebound with those of a similar vehicle that has an acceptable ride quality. Replace the strut dampener, if needed.

Struts Are Noisy

Checks	Action
Check the mountings for looseness or damage.	Tighten the strut dampener. Replace the strut dampener, if needed.
Check the compression and rebound effectiveness of the strut dampener.	Quickly push down and then lift up on the corner of the bumper nearest the strut dampener being tested. Compare the compression and rebound with those of a similar vehicle that has an acceptable ride quality. Replace the strut dampener, if needed.

Leaks

Checks	Action
Check for a slight trace of fluid.	The strut dampener is OK.
Check the seal cover on the fully extended strut.	Replace the strut dampener.
Check for an excessive amount of fluid on the strut dampener.	Replace the strut dampener.

BALL JOINT AND KNUCKLE

Ball Joint Inspection

1. Raise the front of the vehicle to allow the front suspension to hang free.
2. Grasp the tire at the top and the bottom.
3. Move the top of the tire in an in-and-out motion.
4. Look for any horizontal movement of the knuckle relative to the control arm.
5. Ball joints must be replaced if the following conditions exist:
   - The joint is loose.
   - The ball seal is cut.
   - The ball stud is disconnected from the knuckle.
   - The ball stud is loose at the knuckle.
   - The ball stud can be twisted in its socket with finger pressure.

Ball Stud Inspection

Make sure to check the tightness of the ball stud in the knuckle boss during each inspection of the ball joint. One way to inspect the ball stud for wear is to shake the wheel and feel for movement of the stud end or the castellated nut at the knuckle boss.

Another way to inspect the ball stud for wear is to check the fastener torque at the castellated nut. A loose nut can indicate a stressed stud or a hole in the knuckle boss.

Worn or damaged ball joints and knuckles must be replaced.

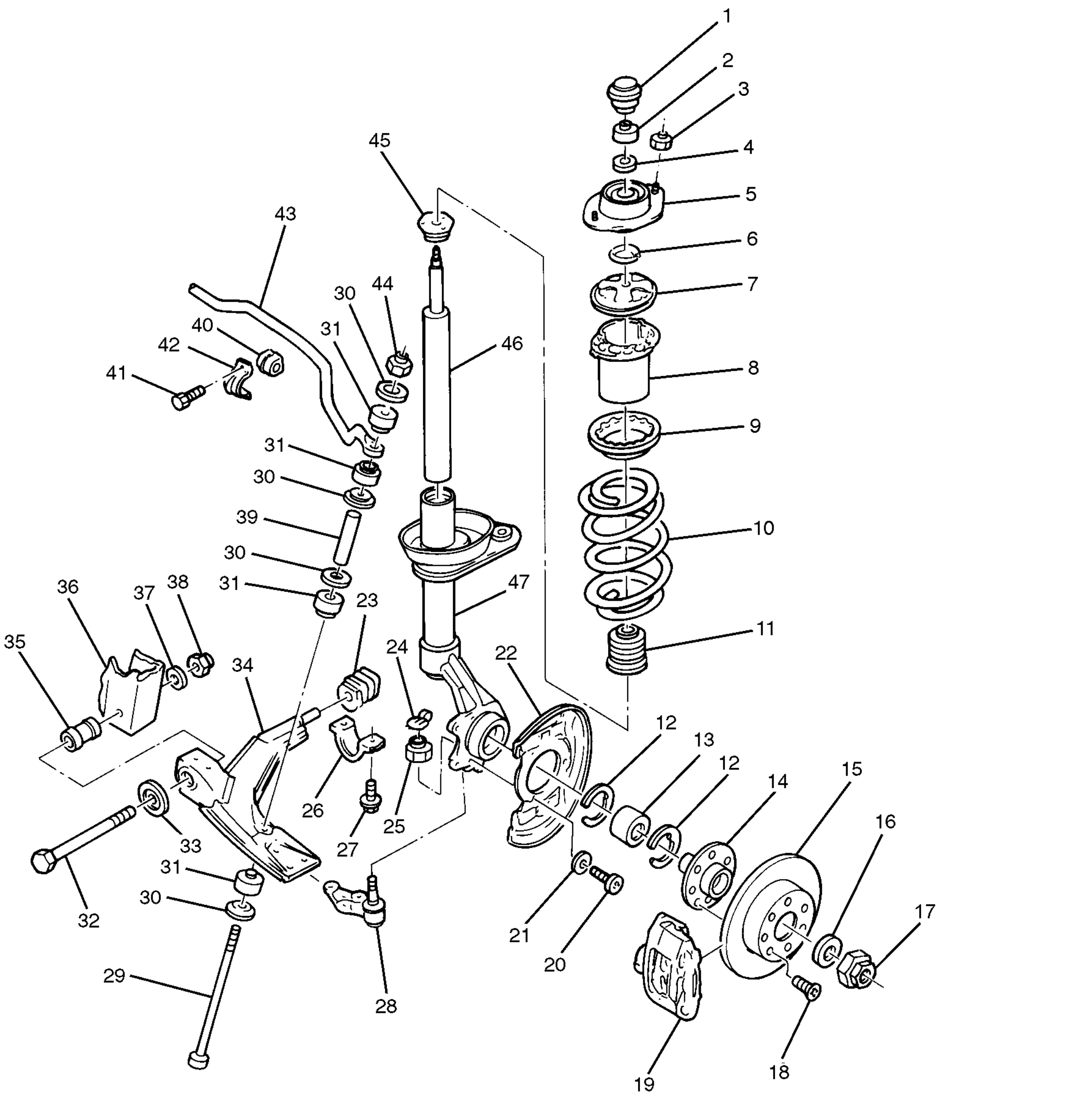
EXCESSIVE FRICTION CHECK

Use the following procedures in order to check excessive friction in the front suspension.

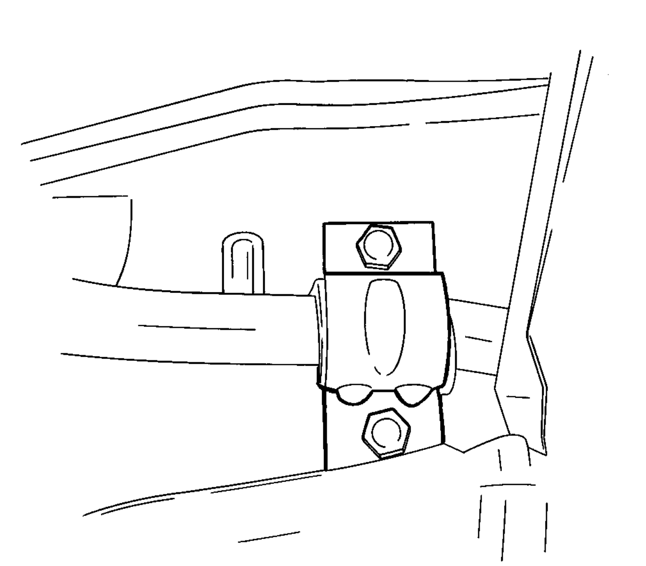
1. Enlist the help of another technician to lift up on the front bumper, raising the vehicle as high as possible.
2. Slowly release the bumper, allowing the vehicle to assume its normal trim height. See "General Specifications" in this section.
3. Measure the distance from the street level to the center of the bumper.
4. Push down on the bumper, release slowly, and allow the vehicle to assume its normal trim height.
5. Measure the distance from the street level to the center of the bumper.
6. The difference between the two measurements should be less than 12.7 mm (0.5 inch). If the difference exceeds this limit, inspect the control arms, the struts, and the ball joints for damage or wear.

COMPONENT LOCATOR

FRONT SUSPENSION



1 Upper Bearing Dust Cover
2 Piston Nut
3 Strut Assembly-to-Body Nut
4 Piston Nut Washer
5 Upper Strut Mount Bearing
6 Bearing Support Washer
7 Plastic Mount
8 Strut Shield
9 Upper Spring Insulator Ring
10 Coil Spring
11 Strut Bumper
12 Snap Ring
13 Front Wheel Bearing
14 Front Wheel Hub
15 Rotor
16 Drive Axle-to-Hub Nut Lock Washer
17 Drive Axle-to-Hub Caulking Nut
18 Detent Screw
19 Front Brake Caliper
20 Brake Shield Attachment Screw
21 Brake Shield Attachment Screw Washer
22 Brake Shield
23 Lower Control Arm Rear Bushing
24 Lower Ball Joint Cotter Pin
25 Lower Ball Joint Nut
26 Lower Control Arm Rear Bushing Mounting Bracket
27 Lower Control Arm Rear Bushing Mounting Bracket Bolt
28 Lower Ball Joint
29 Front Stabilizer Shaft Link Assembly Bolt
30 Front Stabilizer Shaft Link Grommet Washer
31 Front Stabilizer Shaft Link Grommet
32 Lower Control Arm Front Mounting Bracket Bolt
33 Lower Control Arm Front Mounting Bracket Bolt Washer
34 Lower Control Arm
35 Lower Control Arm Front Bushing
36 Vehicle Body
37 Lower Control Arm Front Mounting Bracket Nut Washer
38 Lower Control Arm Front Mounting Bracket Nut
39 Front Stabilizer Shaft Link Assembly Spacer
40 Front Stabilizer Shaft Insulator
41 Front Stabilizer Shaft Clamp Bolt
42 Front Stabilizer Shaft Clamp
43 Front Stabilizer Shaft
44 Front Stabilizer Shaft Link Assembly Nut
45 Strut Cartridge Closure Nut
46 Strut Cartridge
47 Knuckle and Support Tube



A106C001

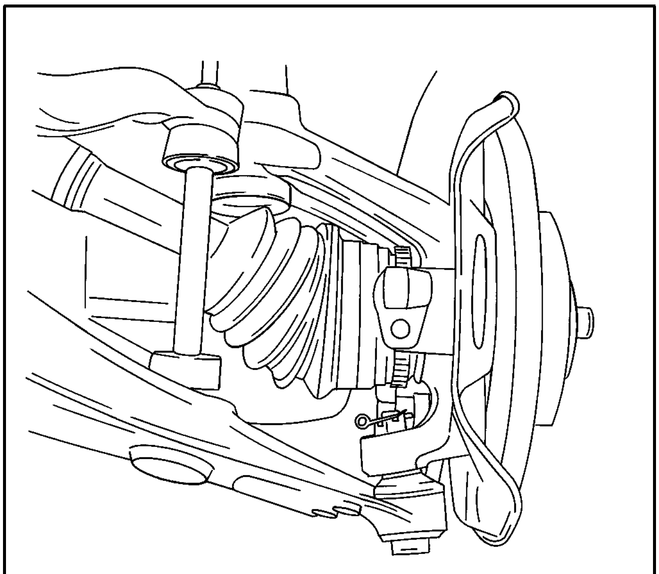
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

STABILIZER SHAFT AND INSULATORS

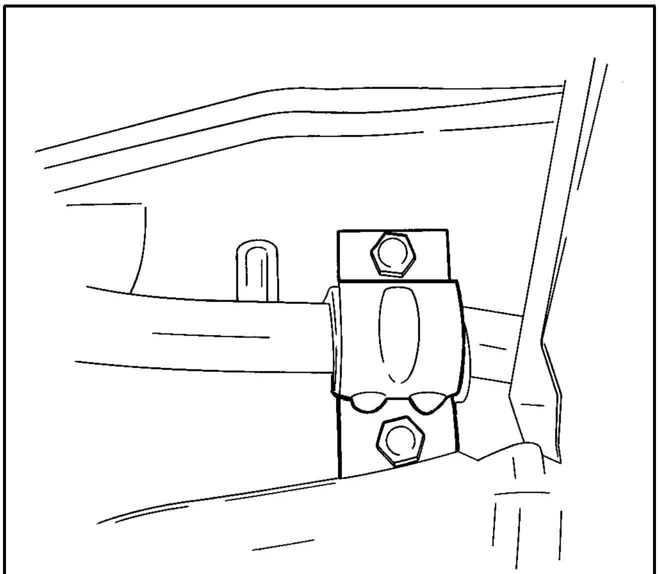
Removal Procedure

1. Lift and suitably support the vehicle, allowing the front suspension to hang free.
2. Remove the front wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the stabilizer shaft-to-body clamp bolts, the stabilizer shaft clamps, and the insulators from the vehicle.



A106C002

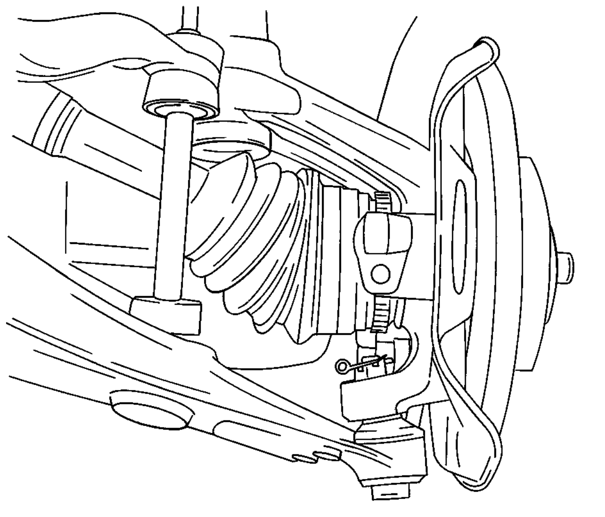
4. Disconnect the stabilizer shaft from the lower control arm by removing the stabilizer shaft link assembly.



A106C001

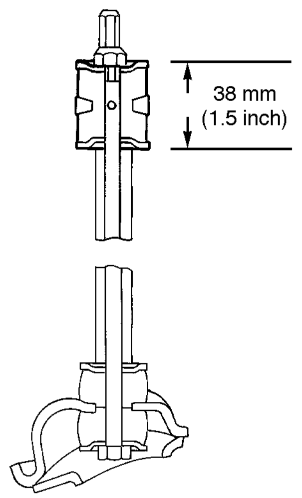
Installation Procedure

1. Install the stabilizer shaft into the vehicle.
2. Install the stabilizer shaft clamp insulators, the stabilizer shaft clamps, and the stabilizer shaft-to-body clamp bolts. Do not tighten the bolts.



A106C002

3. **Connect the stabilizer shaft to the lower control arm with the stabilizer shaft link assembly.**



A106C003

4. **Make certain the stabilizer shaft is centered side-to-side.**

Tighten

Tighten the stabilizer shaft-to-body clamp bolt to 40 N•m (30 lb-ft).

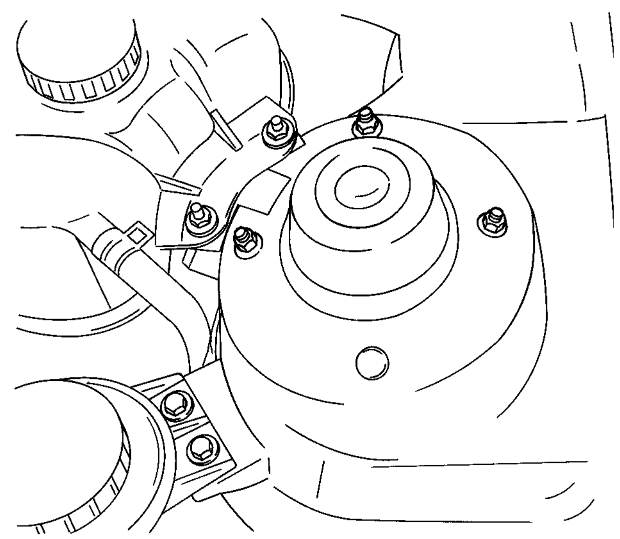
5. **Connect the stabilizer shaft to the control arm with a new self-locking nut.**
6. **Tighten the self-locking nut to achieve 38 mm (1.5 inch) between the self-locking nut and the control arm spacer.**
7. **Install the wheel. Refer to Section 2E, Tires and Wheels.**
8. **Lower the vehicle.**

KNUCKLE/STRUT ASSEMBLY

Tools Required

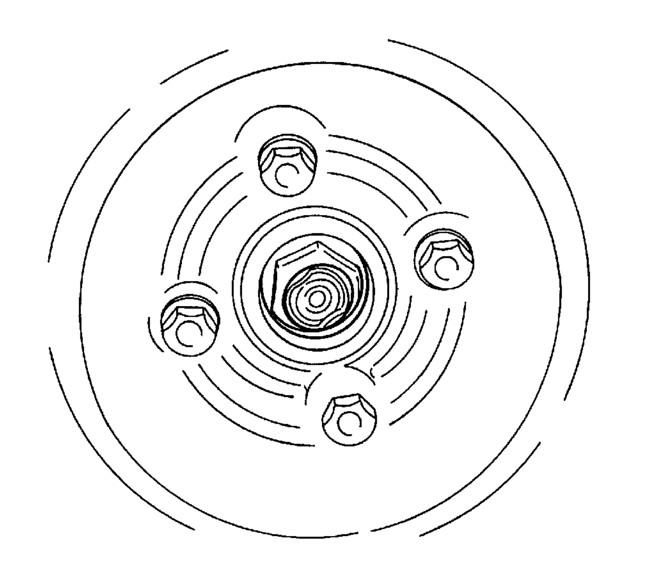
KM-507-B Ball Joint Remover

Removal Procedure



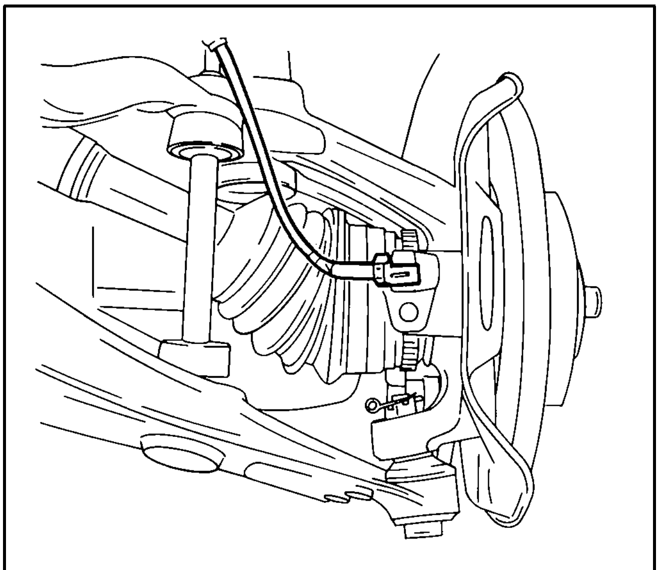
A106C004

1. **Loosen the nuts that attach the top of the strut assembly to the vehicle.**



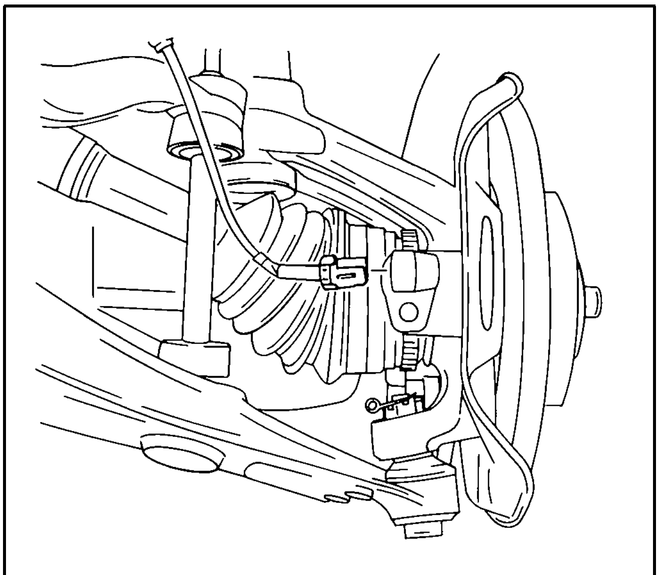
A106C046

2. Uncrimp the caulking nut sleeve and remove the caulking nut and the washer.



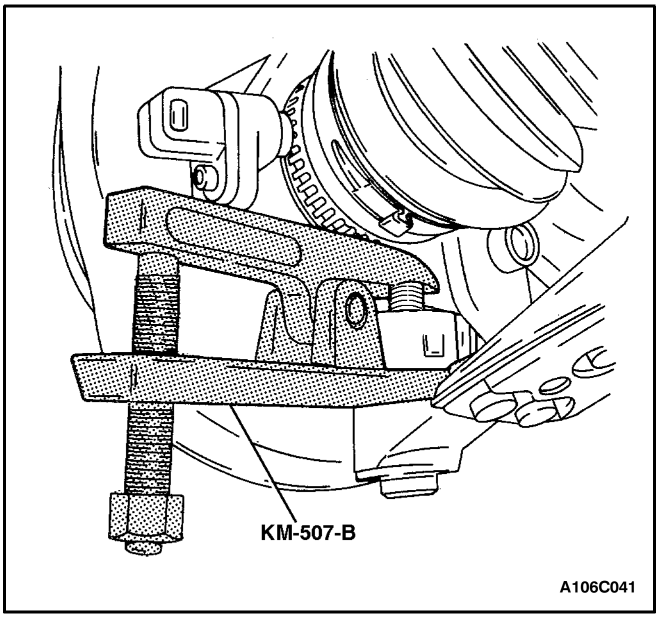
A106C049

3. Raise and suitably support the vehicle.
4. Place the jackstands under the frame of the vehicle.
5. Lower the vehicle slightly so the weight of the vehicle rests on the jackstands and not on the control arms.
6. Remove the wheel. Refer to Section 2E, Tires and Wheels.
7. Disconnect the brake caliper from the knuckle/strut assembly and support the caliper. Do not hang the caliper from the hydraulic brake hose. Refer to Section 4D, Front Disc Brakes.
8. Disconnect the ABS speed sensor electrical connector, if applicable.



A106C043

9. Remove the ball joint cotter pin by lifting up on the rear of the clip and using the two loops on the front of the clip to pull the clip out.
10. Remove the ball joint-to-knuckle-strut nut.



Notice: Failure to use the recommended tool for separating the ball joint from the steering knuckle assembly may damage the ball joint and seal.

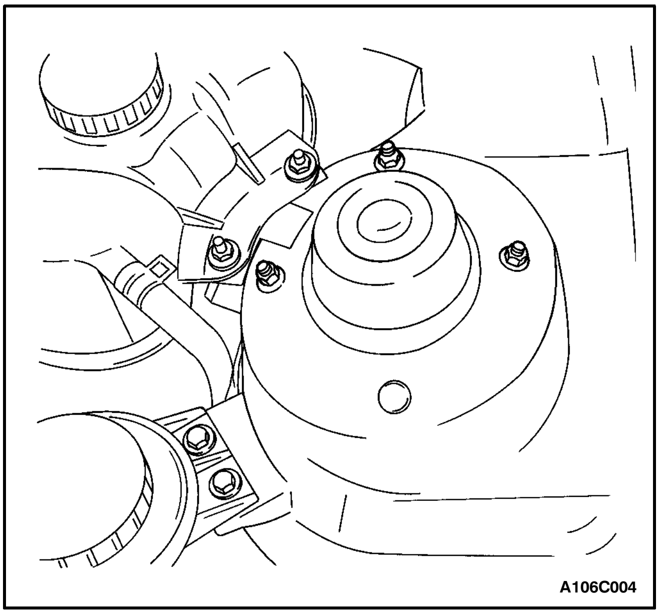
11. **Separate the steering knuckle assembly from the ball joint using the ball joint remover KM-507-B.**
12. **Remove the outer tie rod from the steering knuckle assembly. Refer to Section 6C, Power Steering Gear [Includes Rack & Pinion Gear] or Section 6D, Manual Steering Gear [Includes Rack & Pinion Gear].**

Notice: Take care to prevent the axle joints from being overextended. When either end of the shaft is disconnected, the joint can become overextended. This overextension can cause the internal components to separate. This separation can cause joint failure. Use drive axle joint seal protectors during any service on or near the drive axles. Failure to use joint seal protectors can damage the interior joint seal and cause joint failure.

13. **Push the drive axle shaft from the front wheel hub.**
14. **Support the drive axle.**
15. **Lower the vehicle in order to gain access to the strut-to-body nuts and the washers.**

Notice: Chipping or scratching the spring coating when handling the front suspension coil spring can cause the spring to fail.

16. **Remove the strut assembly-to-body nuts.**
17. **Remove the strut assembly from the vehicle.**



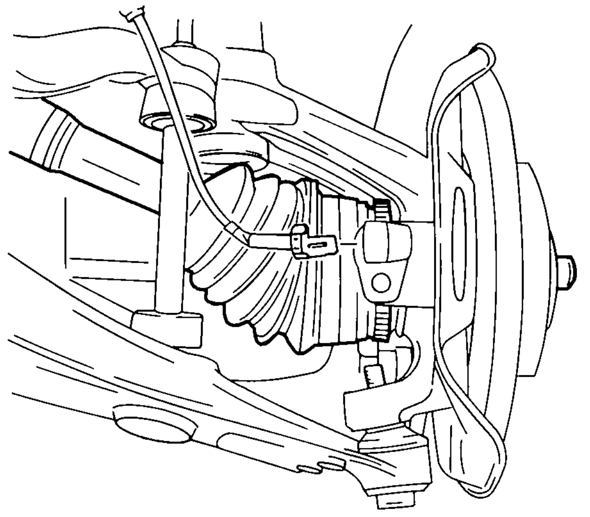
Installation Procedure

Notice: Chipping or scratching the spring coating when handling the front suspension coil spring can cause the spring to fail.

1. **Install the strut assembly into the vehicle with the strut assembly-to-body nuts.**

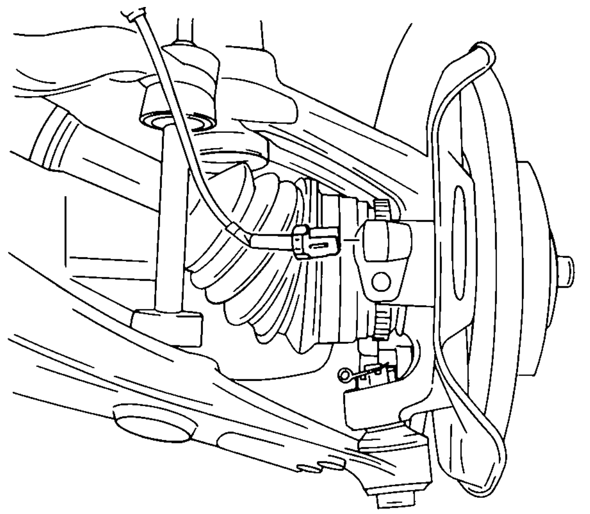
Tighten

Tighten the strut assembly-to-body nuts to 25 N•m (18 lb-ft).



A106C042

2. Connect the drive axle to the front wheel hub.

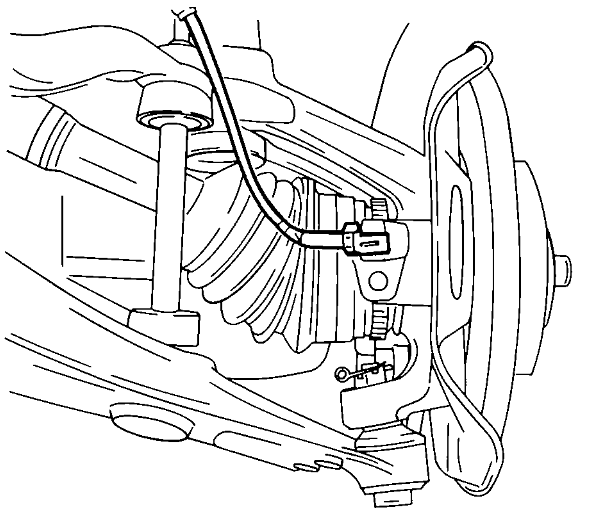


A106C043

3. Connect the outer tie rod to the steering knuckle assembly. Refer to Section 6C, Power Steering Gear [Includes Rack & Pinion Gear] or Section 6D, Manual Steering Gear [Includes Rack & Pinion Gear].
4. Connect the ball joint to the steering knuckle assembly.
5. Install the ball joint-to-knuckle/strut nut and the ball joint cotter pin.

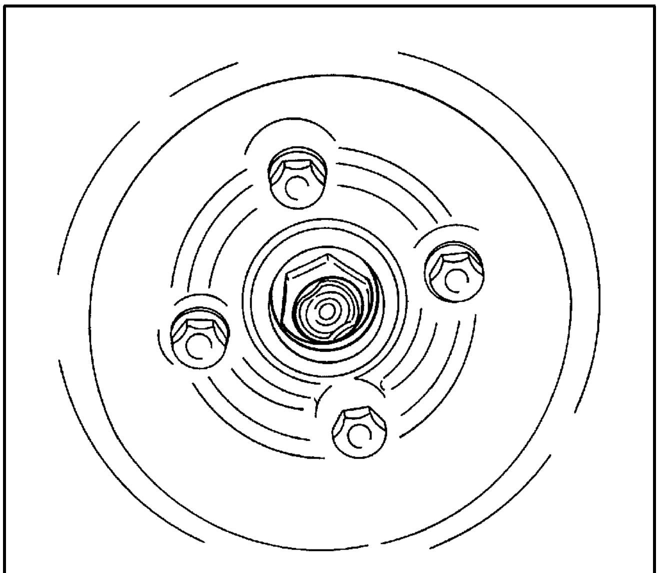
Tighten

Tighten the ball joint-to-knuckle/strut nut to 70 N•m (52 lb-ft).



A106C049

6. Connect the ABS speed sensor electrical connector, if applicable.



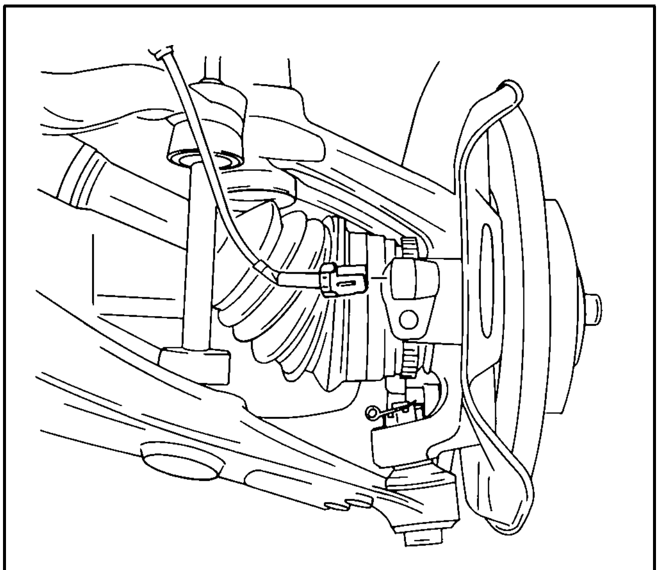
A106C046

7. Connect the brake caliper to the knuckle/strut assembly. Refer to Section 4D, Front Disc Brakes.
8. Install the wheel. Refer to Section 2E, Tires and Wheels.
9. Install a new drive axle-to-hub caulking nut.

Tighten

Tighten the drive axle-to-hub caulking nut to 180 N•m (133 lb-ft). Loosen the nut and retighten the nut to 50 N•m (37 lb-ft). Then tighten the nut an additional 60 degrees.

10. Crimp the caulking nut sleeve onto the drive axle shaft.



A106C043

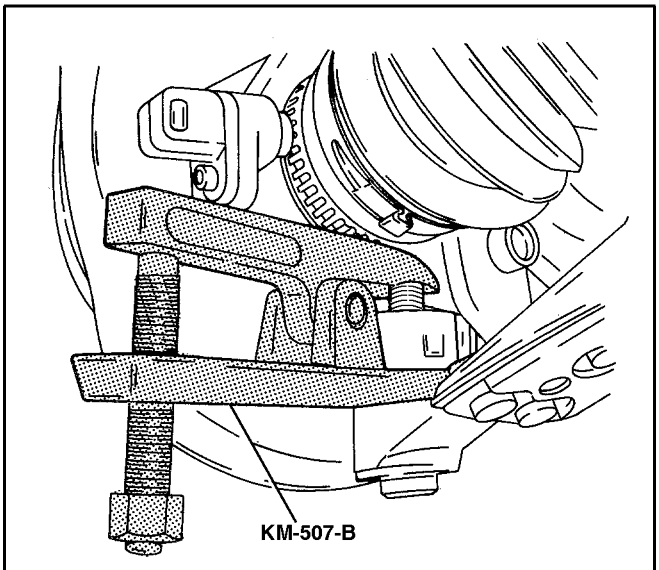
CONTROL ARM

Tools Required

KM-507-B Ball Joint Remover

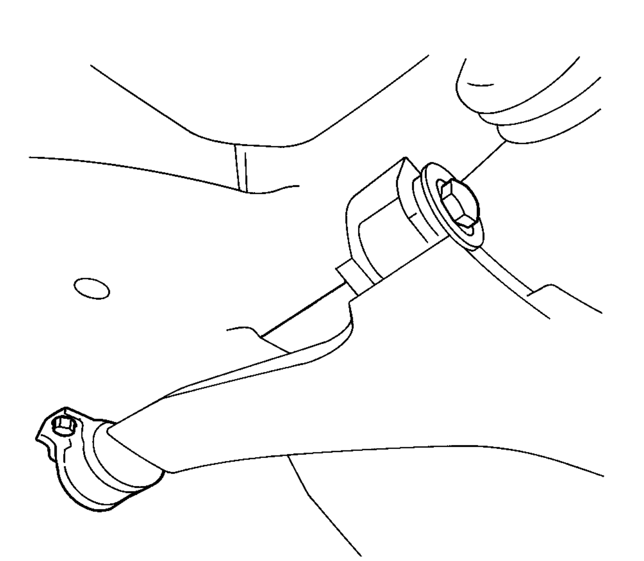
Removal Procedure

1. Raise and suitably support the vehicle.
2. Place the jackstands under the frame of the vehicle.
3. Lower the vehicle slightly so the weight of the vehicle rests on the jackstands and not on the control arms.
4. Remove the wheel. Refer to Section 2E, Tires and Wheels.
5. Disconnect the stabilizer shaft from the control arm by removing the control arm link bolt assembly. Refer to "Stabilizer Shaft and Insulators" in this section.
6. Remove the retaining clip and the ball joint-to-knuckle/strut nut from the ball joint.

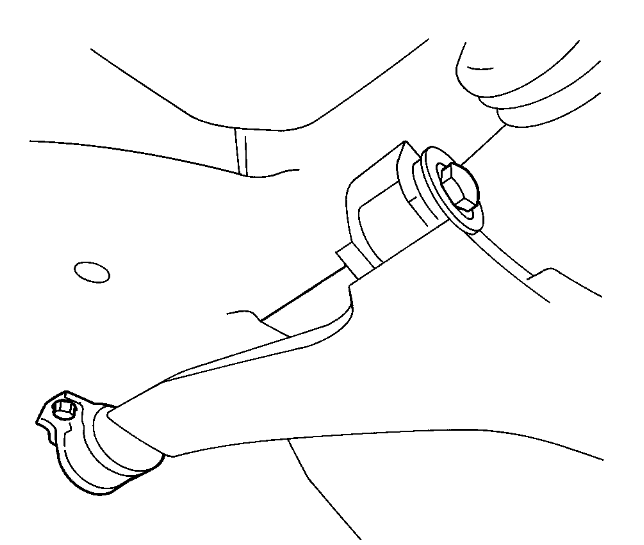


A106C041

7. Disconnect the ball joint from the steering knuckle using the ball joint remover KM-507-B.


A106C006

8. Remove the control arm front mounting bolt.
9. Remove the control arm rear mounting bolts and the bracket.
10. Remove the control arm from the vehicle.


A106C006

Installation Procedure

1. Install the control arm onto the vehicle.
2. Connect the front of the control arm to the body of the vehicle with the front mounting bolt and the washer.
3. Apply a thread sealer to the control arm rear mounting bolts.
4. Connect the rear of the control arm to the body of the vehicle with the rear mounting bracket and bolts.

Important: Do not tighten the control arm bolts at this point.

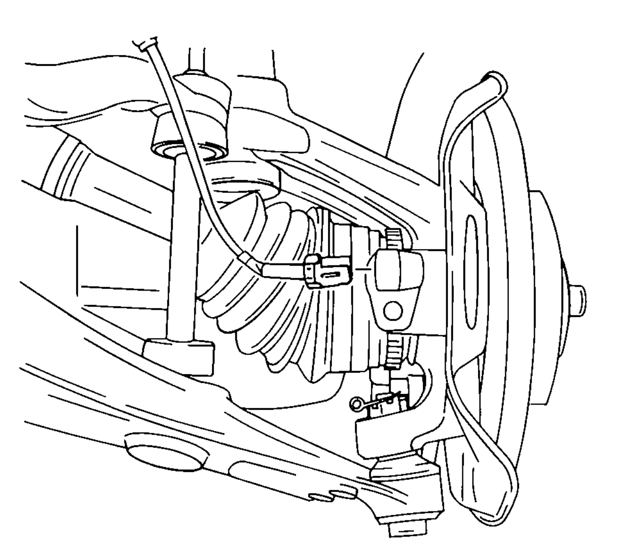
Notice: Use a new self-locking nut to install the control arm link bolt assembly. Failure to do so will allow the normal vibration of the vehicle to loosen the nut and damage the vehicle.

5. Install the stabilizer shaft link bolt assembly. Refer to "Stabilizer Shaft and Insulators" in this section.
6. Connect the ball joint to the steering knuckle.
7. Tighten the ball joint-to-knuckle/strut nut.

Tighten

Tighten the ball joint-to-knuckle/strut nut to 70 N•m (52 lb-ft).

8. Connect the retaining clip to the ball joint stud.
9. Install the wheel. Refer to Section 2E, Tires and Wheels.
10. Raise the vehicle.
11. Place the jackstands under the control arms.
12. Lower the vehicle.


A106C043

Important: The control arms must support the weight of the vehicle while the control arm mounting bolts are being tightened.

13. Tighten the control arm rear mounting bolts.

Tighten

Tighten the control arm rear mounting bolts to 70 N•m (52 lb-ft).

14. Tighten the control arm front mounting bolt.

Tighten

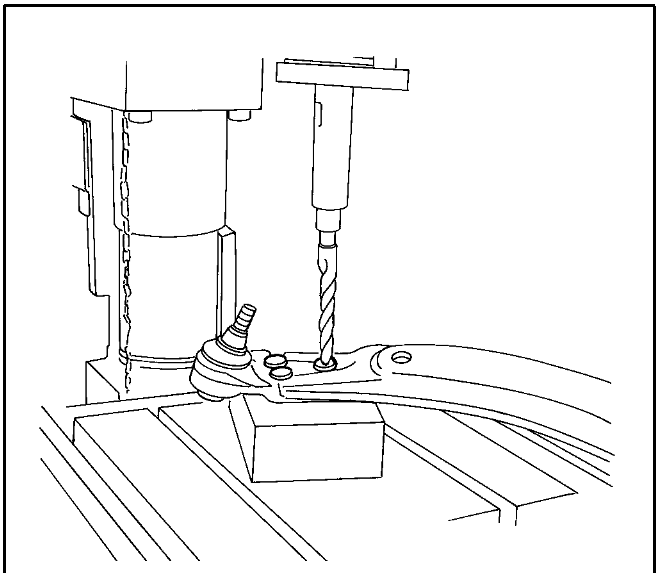
Tighten the control arm front mounting bolt to 140 N•m (103 lb-ft).

15. Raise the vehicle.
16. Remove the jackstands.
17. Lower the vehicle.

UNIT REPAIR

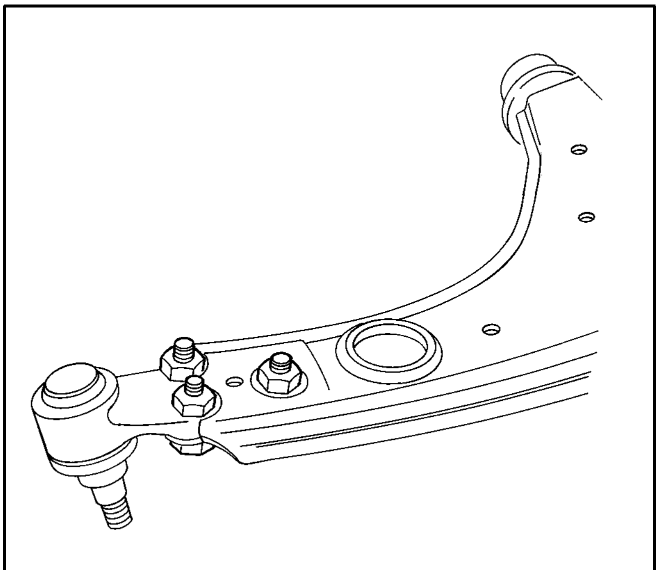
BALL JOINT

Disassembly Procedure


A106C007

1. Raise and suitably support the vehicle.
2. Place the jackstands under the frame of the vehicle and lower the vehicle slightly so the weight of the vehicle rests on the jackstands and not on the control arms.
3. Remove the wheel. Refer to Section 2E, Tires and Wheels.
4. Remove the control arm. Refer to "Control Arm" in this section.
5. Drill off the heads of the rivets with a 12 mm (0.47-inch) drill bit.
6. Punch out the rivets with a drift.

Assembly Procedure

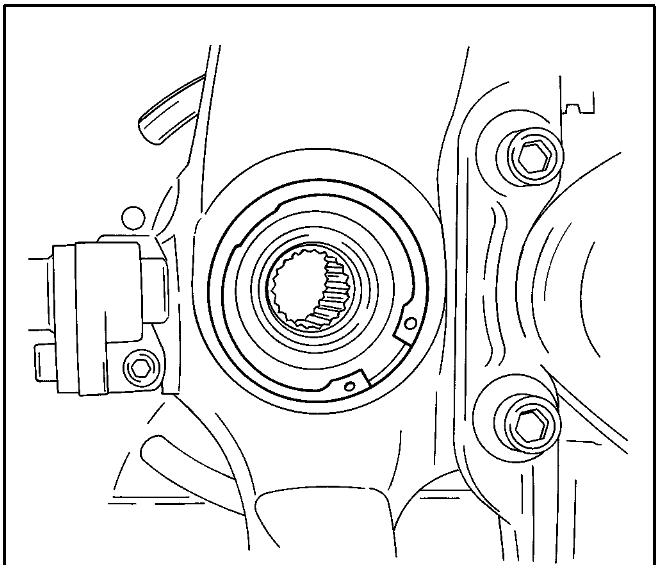

A106C008

1. Connect the ball joint to the control arm by inserting the ball joint bolts.
2. Install the nuts to secure the bolts from below the control arm.

   Tighten

   Tighten the ball joint-to-control arm nuts to 65 N•m (48 lb-ft).
3. Install the control arm. Refer to "Control Arm" in this section.

HUB AND BEARING


A106C047

Tools Required

500-20 Hex Nut

J-36661-2 Forcing Screw

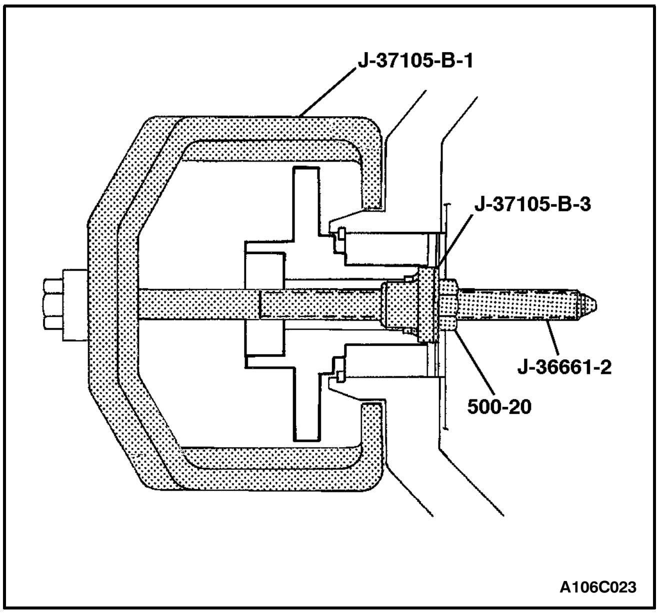
J-37105-B-1 Support Bridge

J-37105-B-2 Bearing Adapter

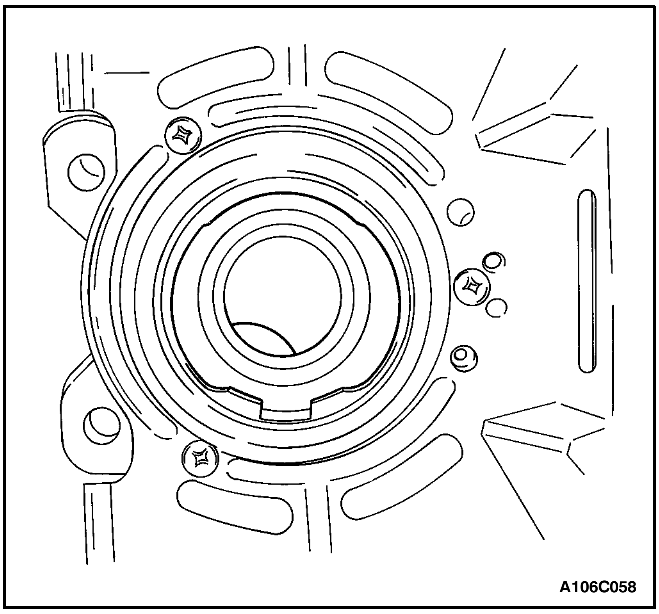
J-37105-B-3 Hub Adapter

Disassembly Procedure

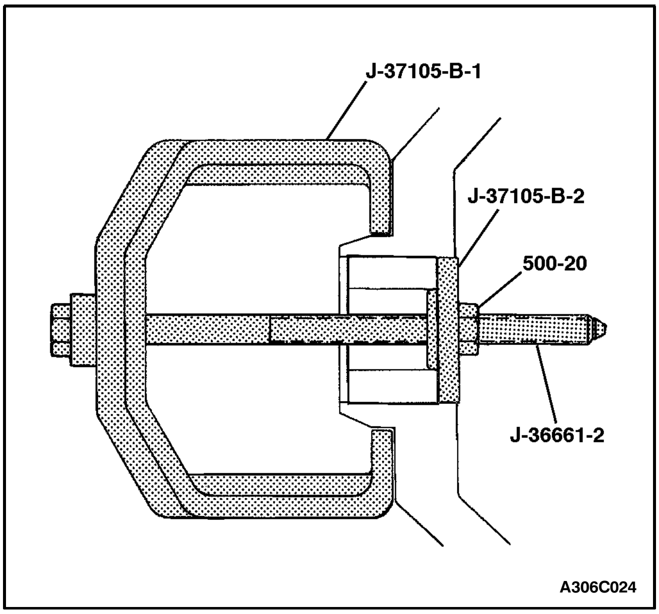
1. Remove the drive axle from the front wheel hub. Refer to "Knuckle/Strut Assembly" in this section.
2. Remove the inner snap ring.



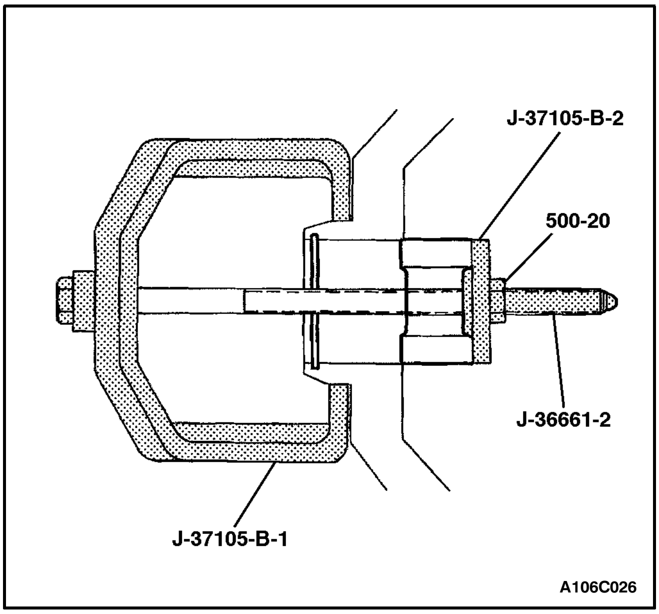
3. Remove the wheel hub with the support bridge J-37105-B-1, the hub adapter J-37105-B-3, the hex nut 500-20, and the forcing screw J-36661-2.



4. Remove the brake shield. Refer to Section 4D, Front Disc Brakes.
5. Remove the outer snap ring.

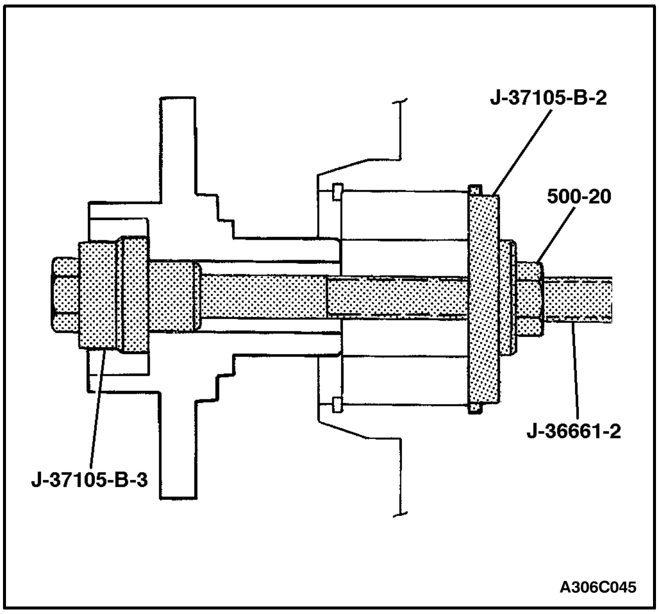


6. Remove the wheel bearing with the support bridge J-37105-B-1, the bearing adapter J-37105-B-2, the hex nut 500-20, and the forcing screw J-36661-2.
7. Clean the bore of the knuckle.

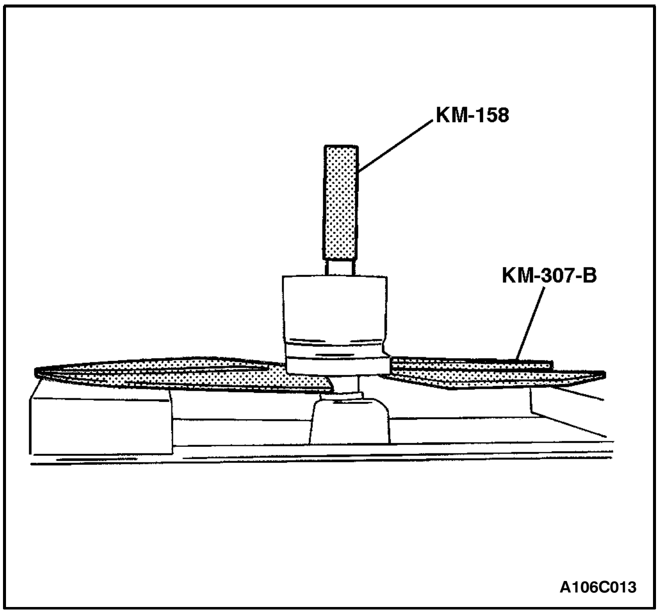


Assembly Procedure

1. Install the outer snap ring and push the wheel bearing into place with the support bridge J-37105-B-1, the bearing adapter J-37105-B-2, the hex nut 500-20, and the forcing screw J-36661-2.



2. Install the brake shield. Refer to Section 4D, Front Disc Brakes.
3. Install the inner snap ring and push the wheel hub into place with the hub adapter J-37105-B-3, the bearing adapter J-37105-B-2, the hex nut 500-20, and the forcing screw J-36661-2.
4. Install the drive axle into the front wheel hub. Refer to "Knuckle/Strut Assembly" in this section.



CONTROL ARM BUSHINGS

Tools Required

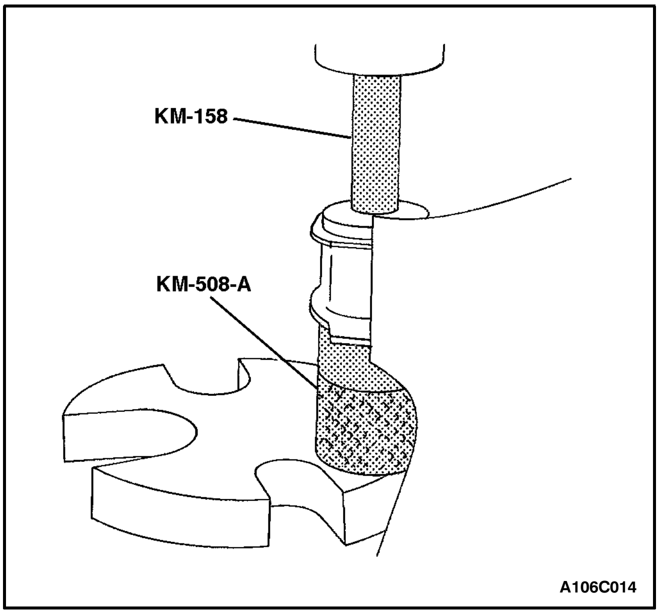
KM-508-A Remover/Installer

KM-158 Remover/Installer

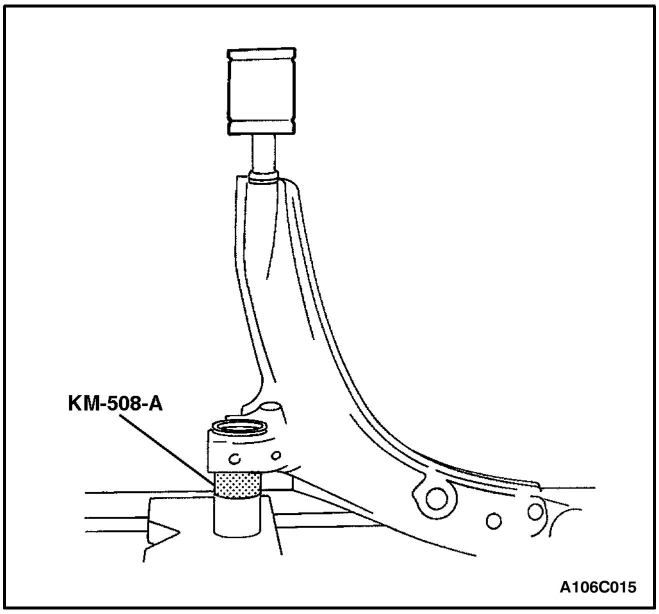
KM-307-B Removal Plate

Disassembly Procedure

1. Remove the control arm. Refer to "Control Arm" in this section.
2. Press off the rear bushing using a press, the remover/installer KM-158, and the removal plate KM-307-B.

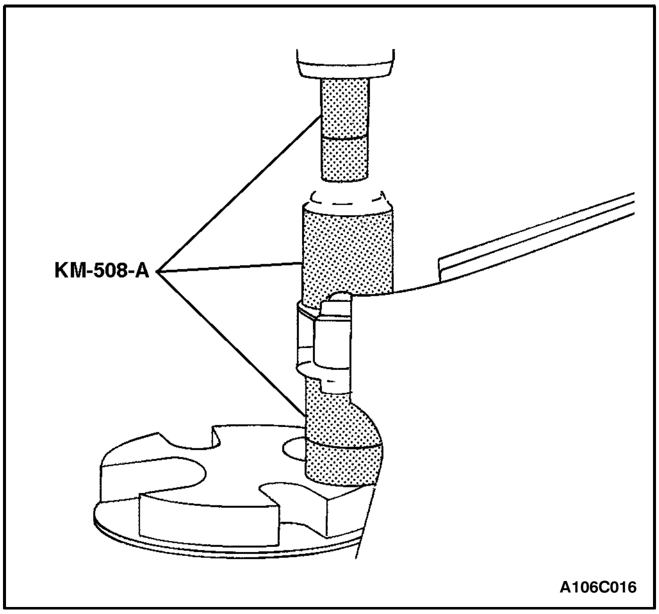


3. Press out the front bushing using the remover/installer KM-508-A, and the remover/installer KM-158.



Assembly Procedure

1. Coat the control arm rear shaft with a multipurpose lubricant. Refer to Section 0B, General Information.
2. Press the rear bushing onto the shaft. The flat of the bushing must be on the top side, the same as the ball joint. Use the remover/installer KM-508-A to support the control arm.



3. Coat the outside of the front bushing and the inside of the lower control arm with a multipurpose lubricant. Refer to Section 0B, General Information.
4. Press the new bushing into the control arm from the back to the front, using the remover/installer KM-508-A.
5. Center the bushing.
6. Install the control arm. Refer to "Control Arm" in this section.

FRONT SPRING/STRUT CARTRIDGE

Tools Required

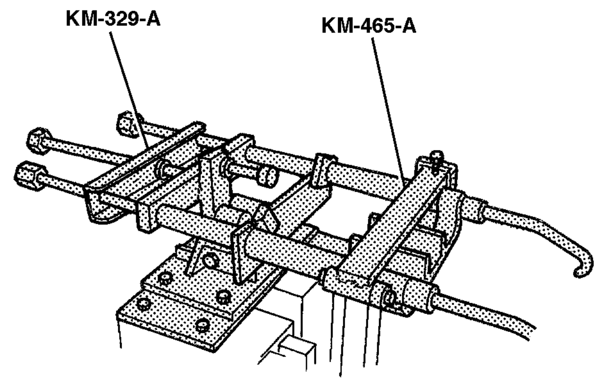
J-42468 Front Strut Mount Nut Wrench

KM-329-A Spring Compressor

KM-331 Strut Cartridge Closure Nut Wrench

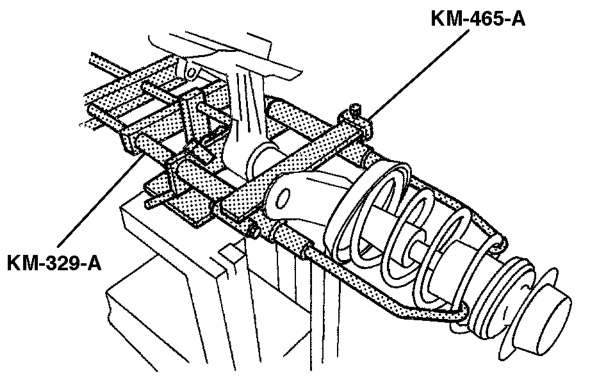
KM-465-A Front Spring Compressor

Disassembly Procedure



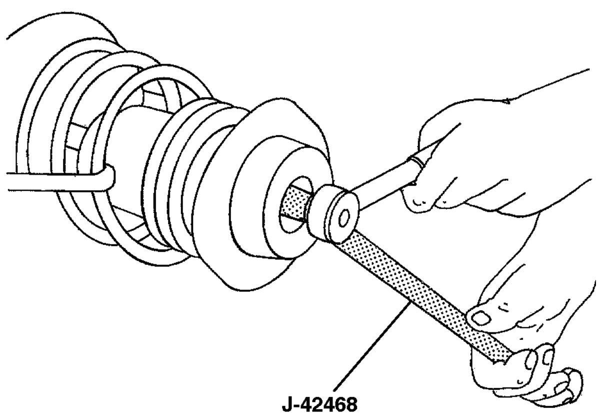
A106C017

1. Mount the front spring compressor KM-465-A and the spring compressor KM-329-A on a mounting trestle, a workbench, or any other suitable surface.



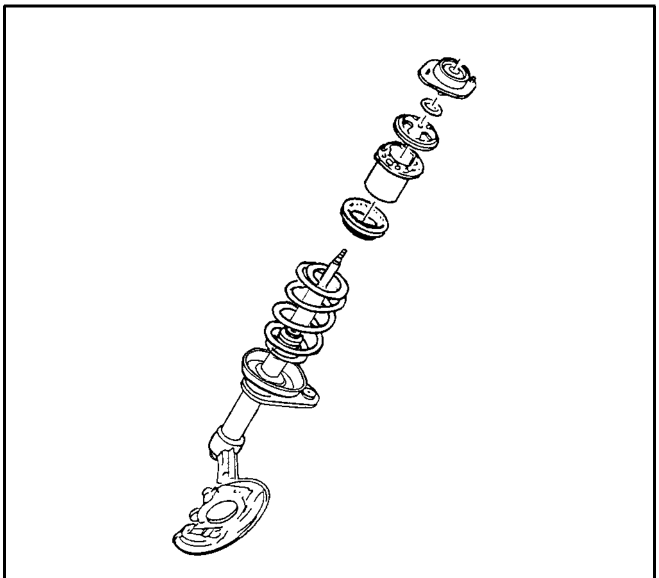
A106C018

2. Raise and suitably support the vehicle.
3. Remove the wheel. Refer to Section 2E, Tires and Wheels.
4. Remove the strut assembly. Refer to "Knuckle/Strut Assembly" in this section.
5. Fasten the strut assembly to the spring compressor. Make sure the hooks are seated on the strut spring properly.
6. Compress the front spring with the front spring compressor KM-465-A and the spring compressor KM-329-A.

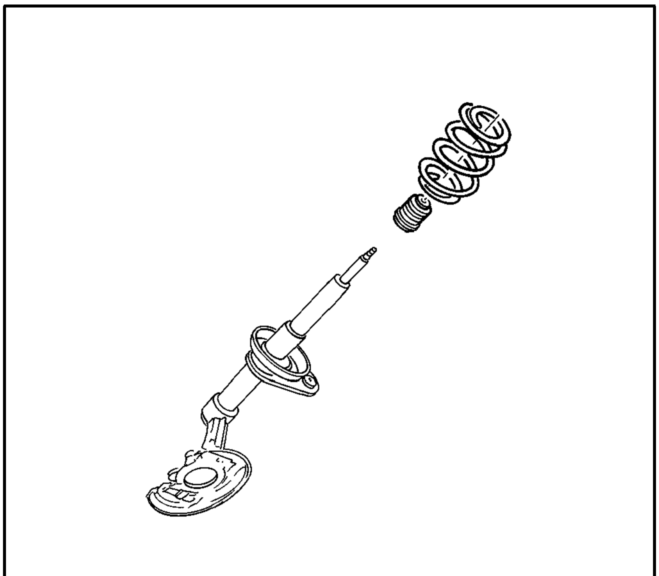


A106C019

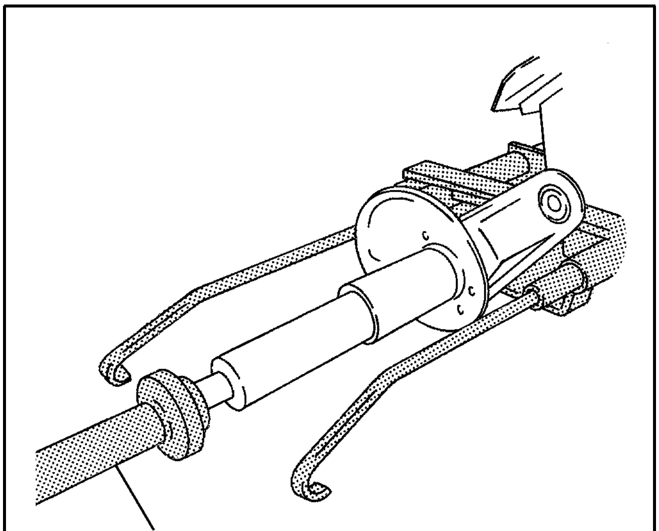
7. Remove the dust cover from the support bearing assembly.
8. Use an open end wrench to hold the threaded piston rod while removing the piston rod nut with the front strut mount nut wrench J-42468. Remove the washer.


A16C060A

9. Remove the support bearing, the washer, the plastic mount, the shield, and the upper insulator.

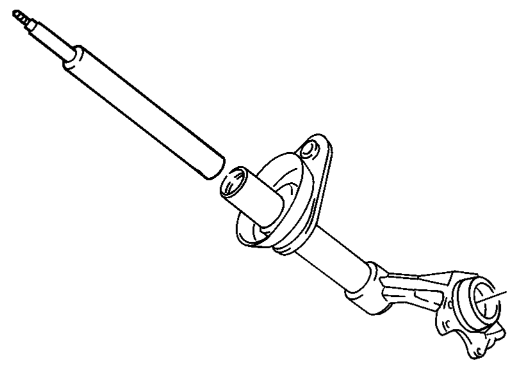

A16C020A

10. Release the spring compressor.
11. Remove the spring and the bumper.



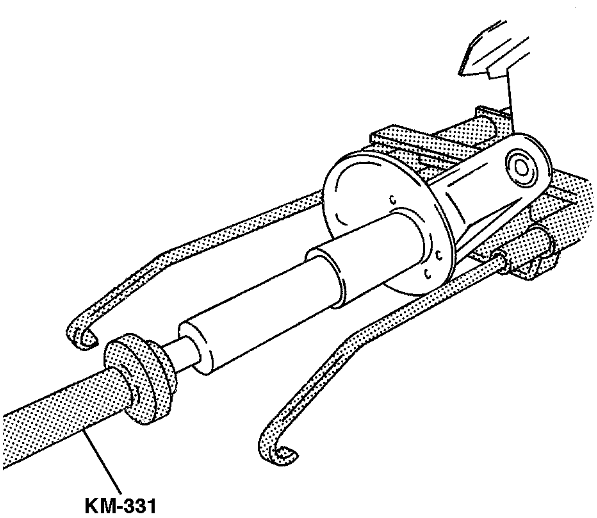
A106C027

12. Remove the strut cartridge closure nut with the strut cartridge closure nut wrench KM-331. This nut is under high torque.



A106C051

13. Remove the strut cartridge.
14. Clean the threaded area of the strut opening.



A106C027

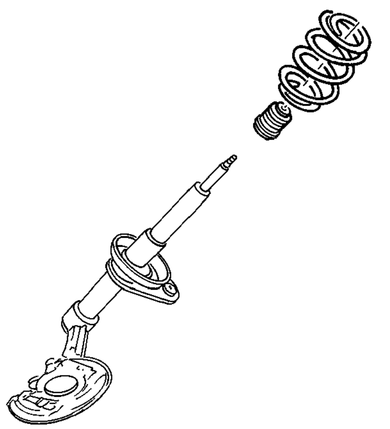
Assembly Procedure

1. Install the strut cartridge and secure it with the strut cartridge closure nut using the strut cartridge closure nut wrench KM-331.

Important: Use a new strut cartridge closure nut. The new nut is coated in wax. Do not wipe off the wax. It is both a lubricant and a corrosion preventative.

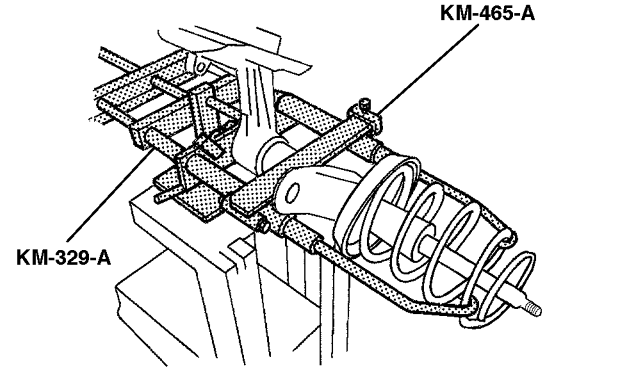
Tighten

Tighten the strut cartridge closure nut to 200 N•m (148 lb-ft).



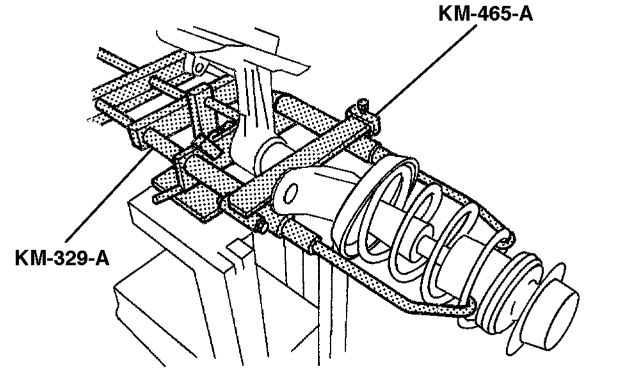
A16C020A

2. Lubricate the upper strut mount bearing with multipurpose grease. Refer to Section 0B, General Information.
3. Install the bumper and the spring.



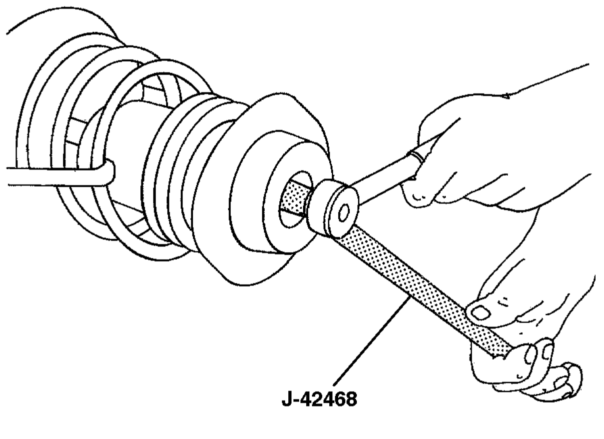
A106C061

4. **Compress the front spring with the front spring compressor KM-465-A and the spring compressor KM-329-A.**



A106C018

5. **Install the upper insulator, the shield, the plastic mount, the washer, and the support bearing.**



A106C019

6. **Tighten the piston rod nut using the front strut mount nut wrench J-42468.**

Tighten

Tighten the piston rod nut to 55 N•m (41 lb-ft).

7. **Remove the strut assembly from the spring compressor and install the strut assembly onto the vehicle. Refer to "Knuckle/Strut Assembly" in this section.**
8. **Install the wheel. Refer to Section 2E, Tires and Wheels.**
9. **Lower the vehicle.**

SUPPORT BEARING

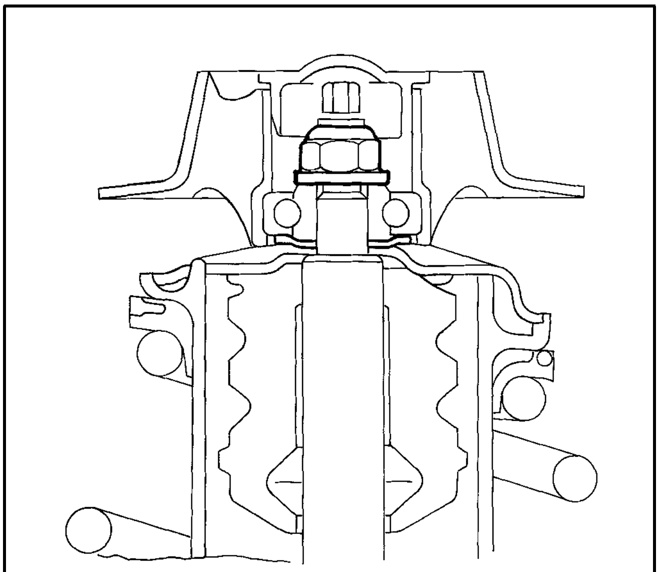
Tools Required

J-42468 Front Strut Mount Nut Wrench

Disassembly Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the strut assembly. Refer to "Knuckle/Strut Assembly" in this section.
4. Compress the spring and remove the support bearing. Refer to "Front Spring/Strut Cartridge" in this section.

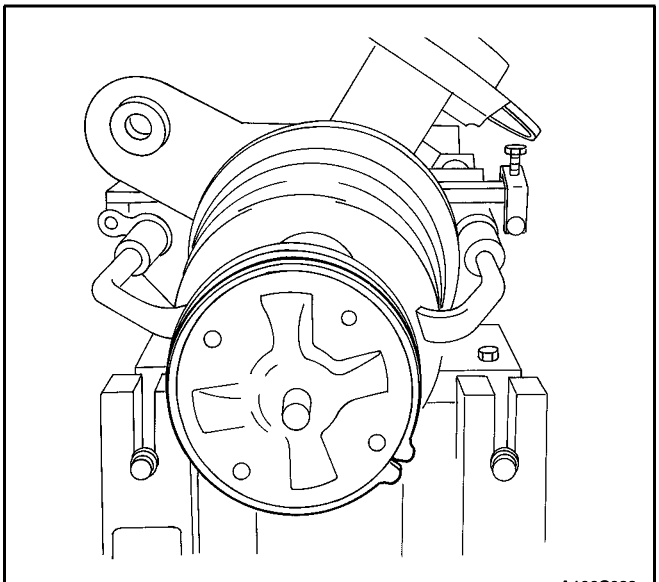
Important: The support bearing is only supplied as an assembly with the ball bearing. This assembly cannot be further disassembled.



A106C021

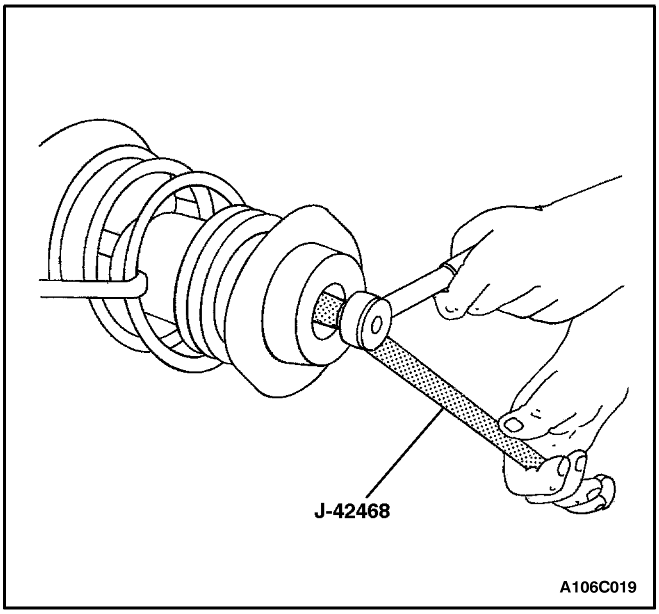
Assembly Procedure

1. Lubricate the support bearing assembly with a multipurpose grease. Refer to Section 0B, General Information.
2. Push the support bearing assembly onto the piston rod. Make sure that the metal washer with the raised edge is below the bearing and that the thrust washer is on top of the bearing.



A106C022

3. Use the lug on the plastic front spring mount as an installation guide. When looking in the direction of travel, the lug should point forward on the spring strut for the left side of the vehicle, and backward for the right side of the vehicle.



4. Tighten the piston rod nut using the front strut mount nut wrench J-42468.

Tighten

Tighten the piston rod nut to 55 N•m (41 lb-ft).

5. Remove the strut assembly from the spring compressor. Refer to "Knuckle/Strut Assembly" in this section.
6. Install the strut assembly onto the vehicle. Refer to "Knuckle/Strut Assembly" in this section.
7. Install the wheel. Refer to Section 2E, Tires and Wheels.
8. Lower the vehicle.

KNUCKLE

Disassembly Procedure

1. Raise and suitably support the vehicle.
2. Remove the knuckle/strut assembly from the vehicle. Refer to "Knuckle/Strut Assembly" in this section.
3. Remove the wheel hub and the wheel bearing. Refer to "Hub and Bearing" in this section.
4. Remove the spring and the strut cartridge. Refer to "Front Spring/Strut Cartridge" in this section.

Assembly Procedure

1. Install the strut cartridge and the spring. Refer to "Front Spring/Strut Cartridge" in this section.
2. Install the wheel bearing and hub. Refer to "Hub and Bearing" in this section.
3. Install the knuckle/strut assembly. Refer to "Knuckle/Strut Assembly" in this section.
4. Lower the vehicle.

GENERAL DESCRIPTION AND SYSTEM OPERATION

FRONT SUSPENSION (SOHC ENGINE)

The front suspension for this vehicle is a combination knuckle/strut and spring design.

The control arms pivot from the body. The lower control arm pivots use rubber bushings. The upper end of the strut is isolated by a rubber mount and contains a bearing to allow the wheel to turn.

The lower end of the steering knuckle pivots on a ball joint bolted to the control arm. The ball joint is fastened to the steering knuckle with a nut, and to the lower control arm with rivets.

When servicing the control arm-to-body attachment and the stabilizer shaft-to-body insulators, make sure the attaching bolts are loose until the control arms are moved to the trim height, which is curb height. Trim height is the normal position to which the control arms move when the vehicle is sitting on the ground. Refer to "General Specifications" in this section.

FRONT SUSPENSION (DOHC ENGINE)

The front suspension for this vehicle is a combination knuckle/strut and spring design.

The control arms pivot from the body. The lower control arm pivots use rubber bushings. The upper end of the strut is isolated by a rubber mount and contains a bearing to allow the wheel to turn.

The lower end of the steering knuckle pivots on a ball joint bolted to the control arm. The ball joint is fastened to the steering knuckle with a nut, and to the lower control arm with rivets.

When servicing the control arm-to-body attachment and the stabilizer shaft-to-body insulators, make sure that the attaching bolts are loose until the control arms are moved to the trim height, which is curb height. Trim height is the normal position to which the control arms move when the vehicle is sitting on the ground. Refer to "General Specifications" in this section.

The springs in Front Suspension (DOHC engine) are stronger and the shocks are heavier than are the springs and shocks in Front Suspension (SOHC engine).

SECTION 2D

REAR SUSPENSION

TABLE OF CONTENTS

SPECIFICATIONS

GENERAL SPECIFICATIONS

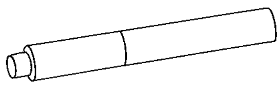
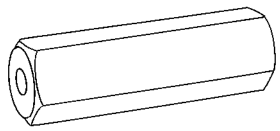
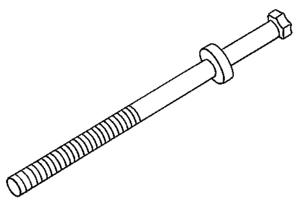
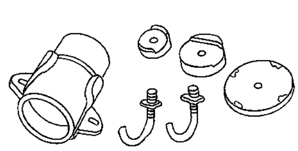
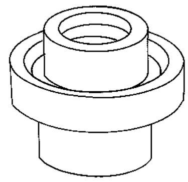
Application	Description
Shock Absorber Stud Thread Above Upper Mounting Nut	9.0 mm (0.36 in.)
Lubrication	Wheel Bearing Lubricant GM P/N 1051344

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Anchor Plate-to-Rear Axle Arm Bolts	28	21	-
Rear Axle-to-Body Bracket Nuts	105	78	-
Shock Absorber-to-Axle Bolt	70	52	-
Stabilizer Shaft-at-Axle Nuts	80	59	-
Wheel Bearing Spindle Nut	25 - 180° +2	18 - 180° +1.5	-
Wheel Hub and Bearing Assembly Nuts	40 +60° +15°	30 +60° +15°	-

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A106D020	KM-266-A Remover
 A106D029	J-21474-18 Nut
 A106D030	J-21474-19 Puller Bolt/ Thrust Washer
 A106D031	J-29376-A, Rear Control Arm Bushing Service Set. Includes: • J-29376-6A Rear Control Arm Bushing Remover/Installer • J-29376-7 Rear Control Arm Bushing Plate • J-29376-A Rear Control Arm Bushing Housing
 A106D028	J-36791 Installer

DIAGNOSIS

EXCESSIVE FRICTION TEST

Check excessive friction in the rear suspension as follows:

1. With the aid of a helper, lift up on the rear bumper and raise the vehicle as high as possible. Slowly release the bumper and allow the car to assume normal trim height.
2. Measure the distance from the floor to the center of the bumper.
3. Push down on the bumper, release slowly, and allow the car to assume normal trim height.
4. Measure the distance from the floor to the center of the bumper.

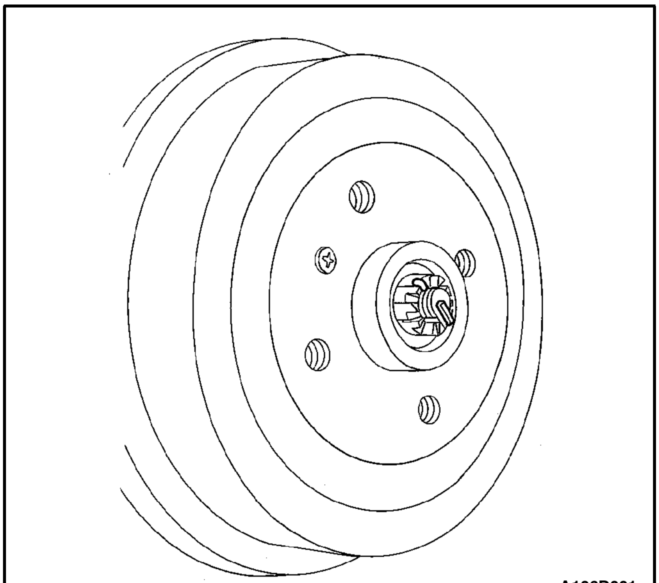
The difference between the two measurements should be less than 12.7 mm (0.50 inch). If the difference exceeds this limit, inspect the control arms for damage or wear.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

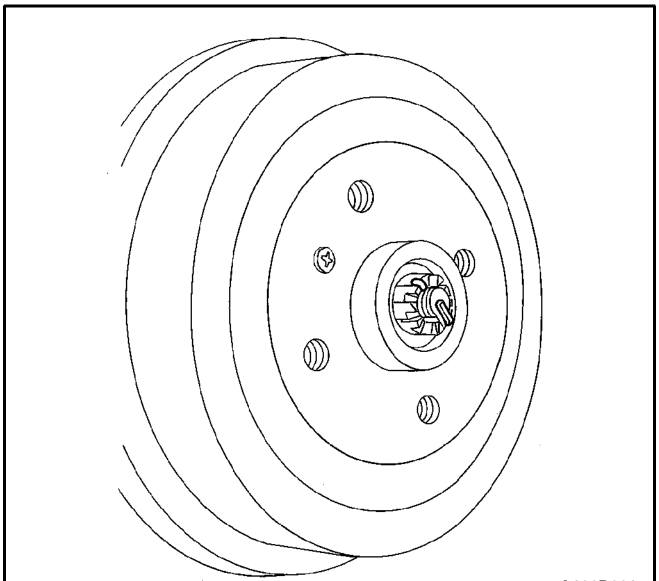
WHEEL BEARING ADJUSTMENT

Adjustment Procedure


A106D001

Notice: The wheel bearings can only be adjusted on cars without the anti-lock braking system.

1. Remove the dust cap from the hub and the cotter pin from the spindle.


A106D001

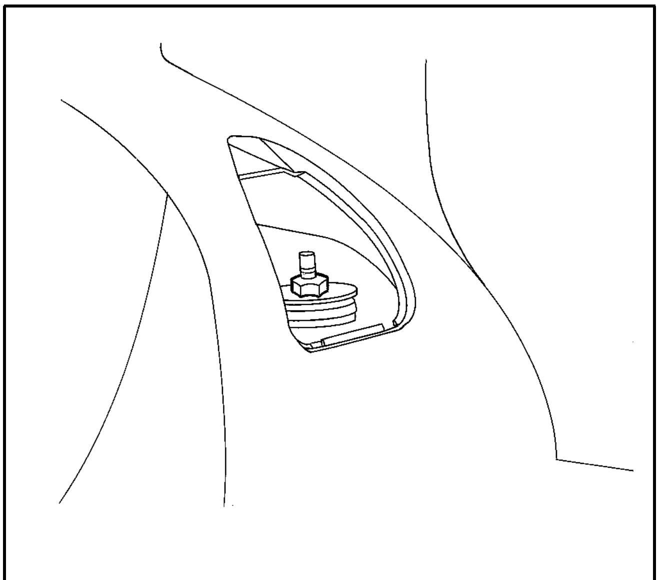
Tighten

Tighten the wheel bearing spindle nut to 25 N•m (18 lb-ft) while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play. Loosen the wheel bearing spindle nut 180 degrees. Tighten the wheel bearing spindle nut to 2 N•m (18 lb-in).

2. Install the new cotter pin and bend the ends.
3. Measure the end play. There will be from 0.03 to 0.13mm (0.001 to 0.005 inch) end play when properly adjusted.
4. Install the dust cap on the hub.

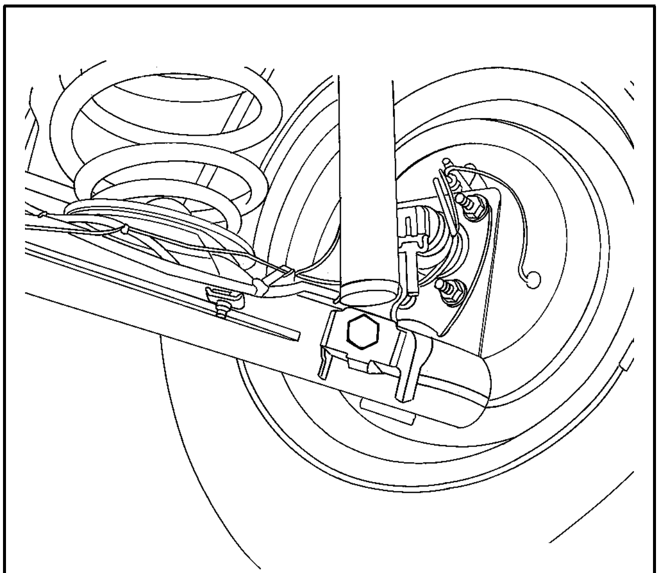
SHOCK ABSORBER

Removal Procedure


A106D002

Notice: Remove only one shock at a time when both shocks are being replaced. Suspending the rear axle at full length can result in damage to brake lines and hoses.

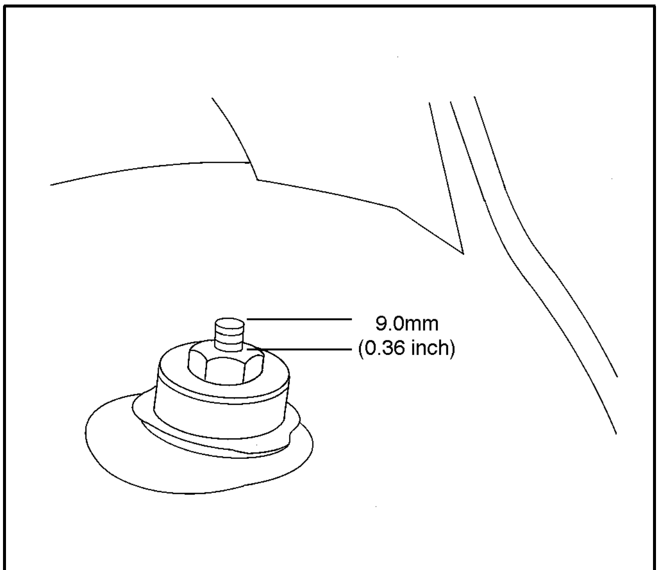
1. Open the trunk and remove the section of the trim cover covering the upper mount nut.
2. Counterhold the threaded shock absorber shaft and remove the upper mounting nut.



A106D003

Important: When lifting the vehicle with a body hoist, it will be necessary to support the rear axle with adjustable jack stands.

3. Raise the vehicle and support the rear axle assembly.
4. Remove the lower shock absorber-to-axle nut and the bolt. Remove the shock.



A106D004

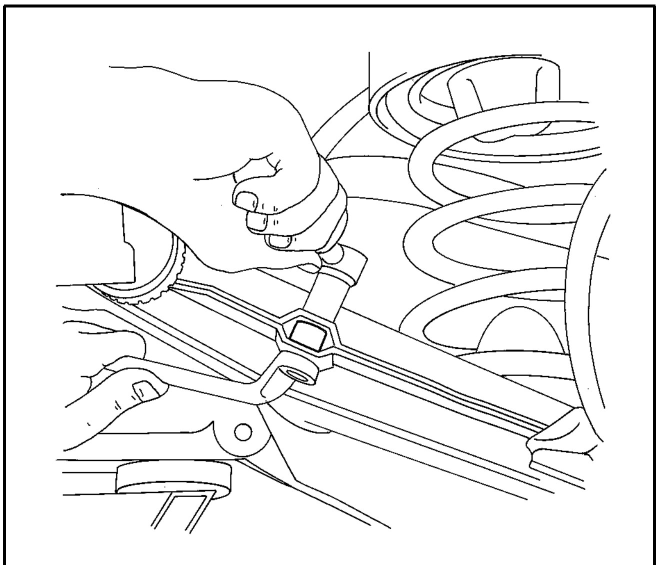
Installation Procedure

Important: It will be necessary to bring the axle assembly to trim height prior to tightening the shock absorber attachment bolts.

1. Insert the lower shock absorber-to-axle bolt through the shock absorber lower attachment bracket and into the axle. Loosely attach the nut.
2. Lower the vehicle enough to guide the upper shock stud through the body opening and loosely install the attaching nut.

   #### Tighten

   Tighten the lower shock absorber-to-axle bolt to 70 N•m (52 lb-ft).
3. Remove the axle support, lower the vehicle all the way, and tighten the upper nut until 9.0 mm (0.36 inch) of thread is visible.
4. Replace the trim cover.

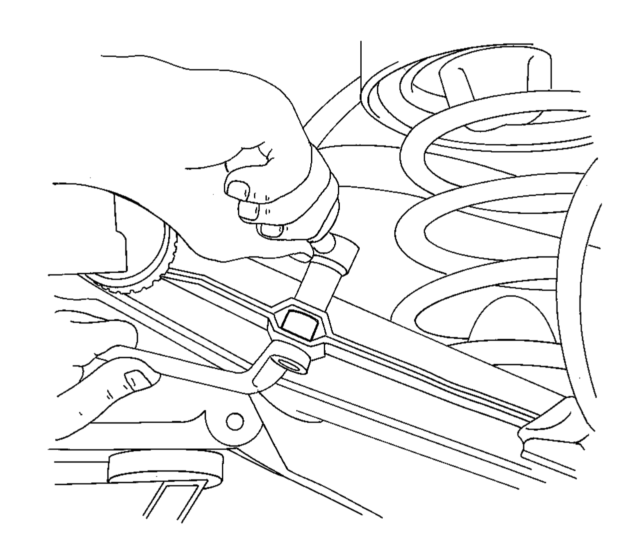


A106D005

STABILIZER

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the nut, the washer, and the bolt at both sides of the axle.
4. Remove the insulator and the stabilizer shaft.
5. Pull the stabilizer toward the side of the car without the wheel.



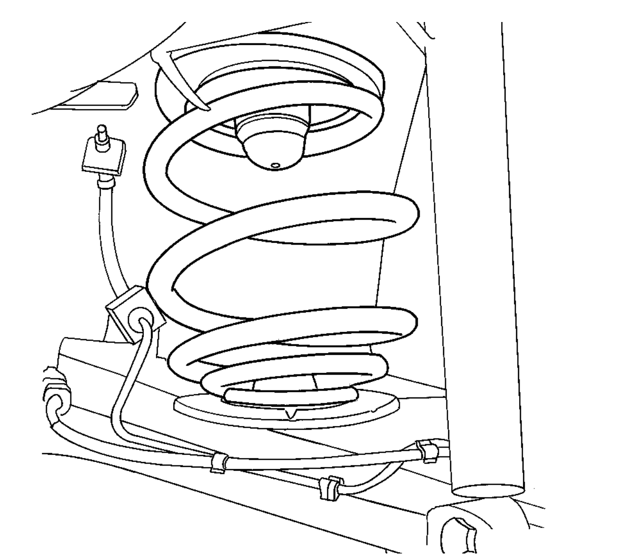
A106D005

Installation Procedure

1. Install the stabilizer shaft inside the axle.
2. Install the bolts with the washers through the control arms of the axle and the stabilizer shaft. Attach the nuts onto the bolts.

   Tighten

   Tighten the stabilizer shaft-at-axle nuts to 80 N•m (59 lb-ft).
3. Coat the insulators with lubricant and insert them into the rear axle.
4. Replace the rear wheel. Refer to Section 2E, Tires and Wheels.
5. Lower the vehicle.



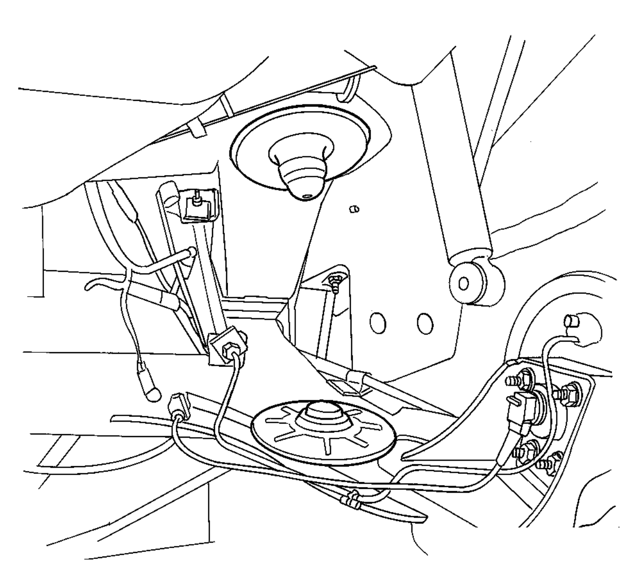
A106D008

SPRINGS AND INSULATORS

Caution: When removing the rear springs, do not use a twin-post type hoist. The tendency of the rear axle assembly to swing when certain fasteners are removed may cause it to slip from the hoist. This may result in personal injury. Perform the operation on the floor if necessary.

Removal Procedure

1. Raise and suitably support the vehicle. Use a frame contact hoist if possible and support the rear control arms with jack stands. If it becomes necessary to lift the vehicle with a twin-post hoist, lift the body and support the control arms with jack stands.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the right and the left shock absorber bolts. Refer to “Shock Absorber” in this section.
4. Lower the rear axle and remove the springs and the top insulator.

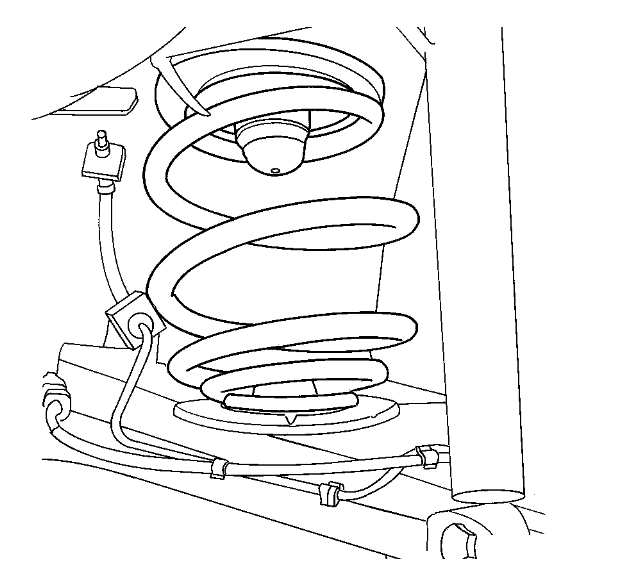


A106D015

Installation Procedure

Important: Prior to installing the springs, it will be necessary to install the upper insulators to the body with adhesive to keep them in position while raising the axle assembly and the springs.

1. Install the upper insulator and seat the lower bumper.

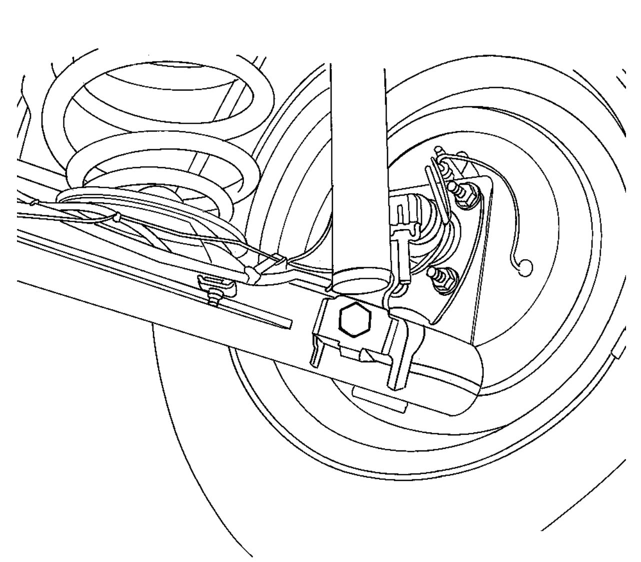


A106D008

2. Install the springs and raise the axle.
3. Install the shock absorbers. Refer to "Shock Absorber" in this section.

Important: It will be necessary to bring the axle assembly to trim height prior to tightening the shock absorber attachment bolts.

4. Install the wheel. Refer to Section 2E, Tires and Wheels.
5. Remove the jack stands and lower the vehicle.

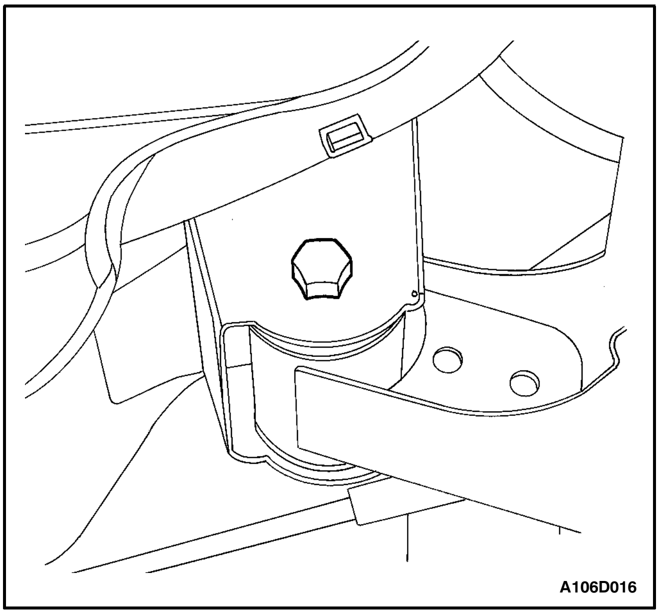


A106D003

REAR AXLE ASSEMBLY

Removal Procedure

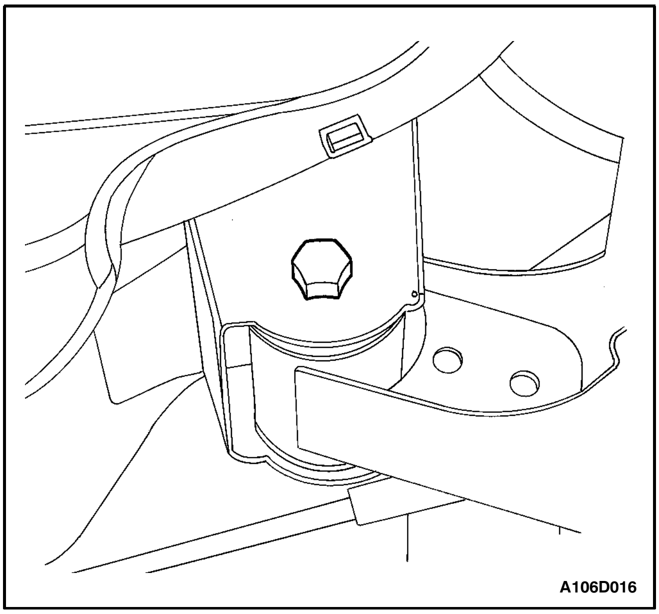
1. Raise and suitably support the vehicle.
2. Remove the rear wheels. Refer to Section 2E, Tires and Wheels.
3. Disconnect the parking brake. Refer to Sectlon 4G, Parking Brake.
4. Disconnect the ABS sensor line.



5. Disconnect the brake pipes from the brake hoses at the rear axle brackets by removing the cap screws and the retaining clip. Cap or tape the brake hose openings to prevent entry of foreign matter. Unclip the brake hose from the rear axle brackets. Refer to Section 4E, Rear Drum Brakes.
6. Place support jacks under the arms of the rear axle and raise the rear axle arms slightly.
7. Remove the shock absorbers. Refer to "Shock Absorbers" in this section.
8. Lower the support jacks and remove the rear springs. Refer to "Springs and Insulators" in this section.
9. Remove the rear axle support bolts and nuts from the underbody. Pry the rear axle slightly with a screwdriver, if required.
10. Remove the rear axle.

Installation Procedure

1. Raise the rear axle and loosely fasten it to the vehicle underbody mountings with the rear axle-to-body bracket nuts and bolts.
2. Install the rear springs and insulators. Refer to "Springs and Insulators" in this section.
3. Raise the rear axle arm with the support jacks. Attach the shock absorber to the axle with the lower attachment bolt. Refer to "Shock Absorbers" in this section.
4. Connect the brake pressure hoses into the bracket on the rear axle. Mount the retaining clips. Connect the brake pipes to the brake hoses. Bleed the brakes. Refer to Section 4E, Rear Drum Brakes.
5. Install the parking brake. Refer to Section 4G, Parking Brake.

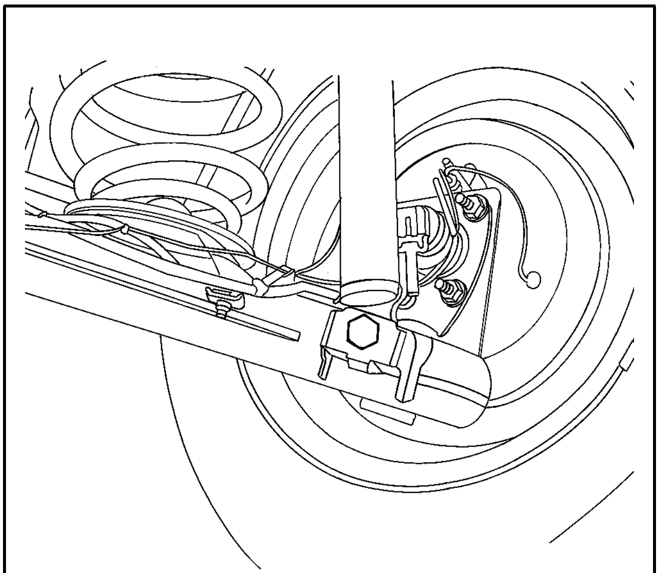


6. Lower the vehicle slightly and install the rear wheels. Refer to Section 2E, Tires and Wheels.
7. Adjust the wheel bearing (if applicable). Refer to "Wheel Bearing Adjustment" in this section.
8. At curb height, tighten the rear axle-to-body bracket nuts

Tighten

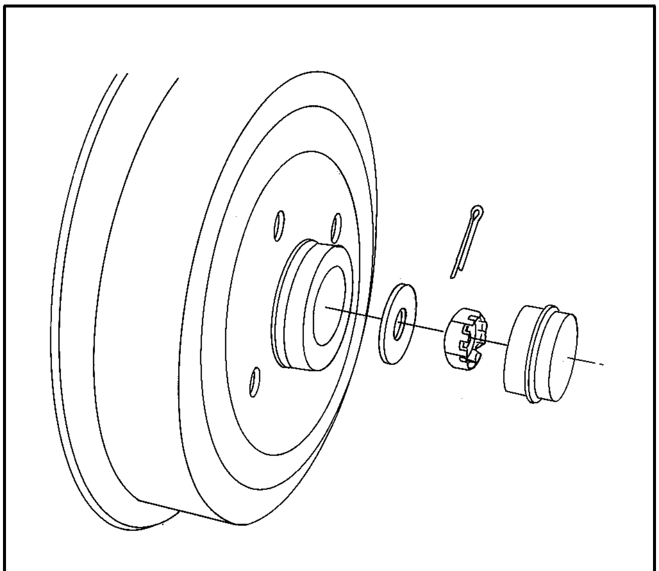
Tighten the rear axle-to-body bracket nuts to 105 N•m (78 lb-ft).

9. Adjust the rear wheel brakes. Bleed the brake system and check for leaks. Refer to Section 4E, Rear Drum Brakes.



A106D003

10. Connect the ABS sensor line.
11. Adjust the parking brake. Refer to Section 4G, Parking Brake.
12. Lower the vehicle completely.



A106D027

HUB AND BEARING ASSEMBLY WITHOUT ABS

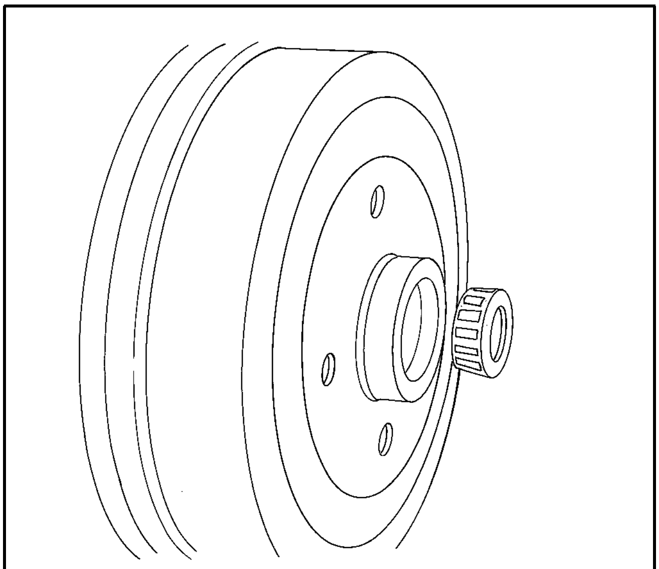
Tools Required

J-36791 Installer

KM-266-A Installer

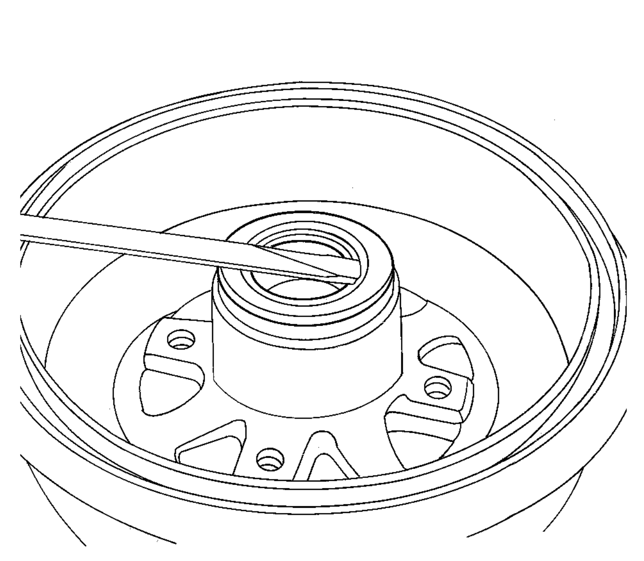
Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Loosen the parking brake cable. Refer to Section 4G, Parking Brake.
4. Remove the dust cap, the cotter pin, the spindle nut and the lock washer.



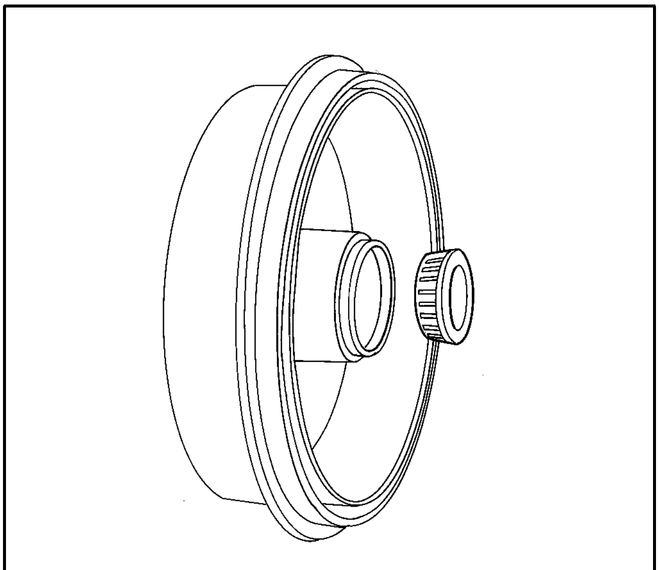
A106D011

5. Remove the wheel hub and the outer tapered roller bearing.



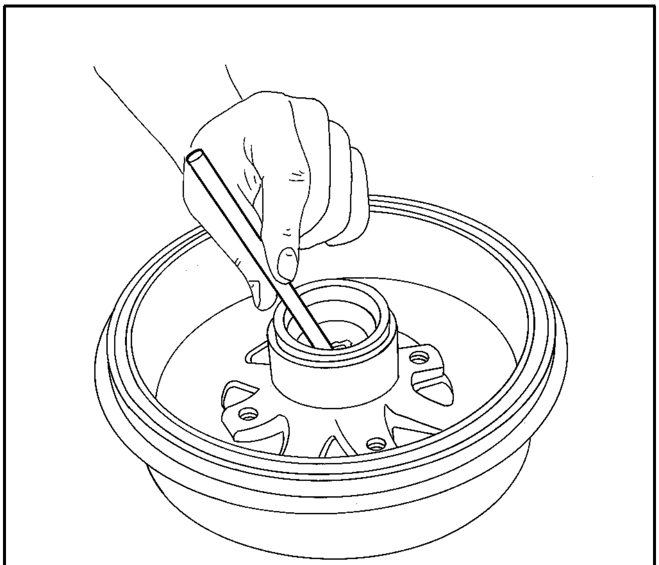
A106D012

6. Pry the seal ring from the inside of the wheel hub with a screwdriver.



A106D025

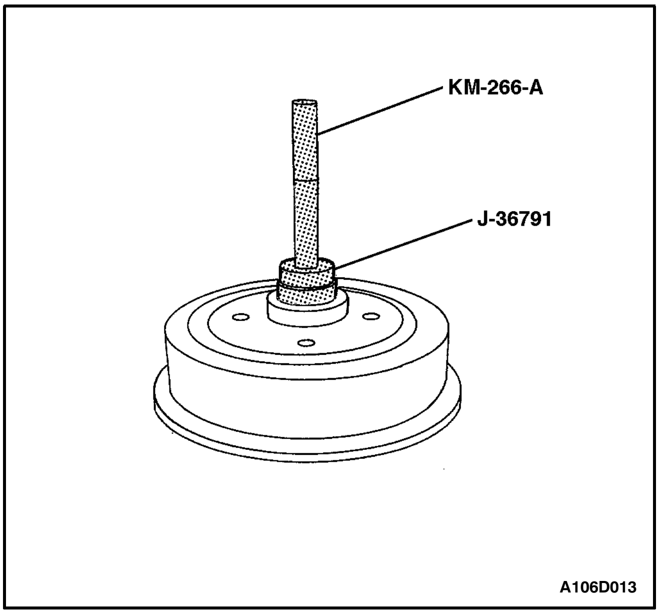
7. Remove the inner tapered roller bearing from the wheel hub.



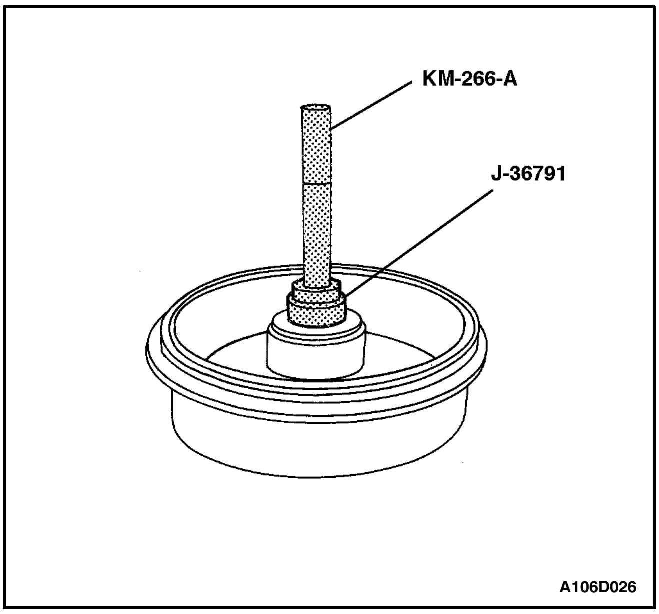
A106D024

8. Remove the races of the inner and the outer bearings from the wheel hub using a drift.
9. Clean the spindle and check it for damage.

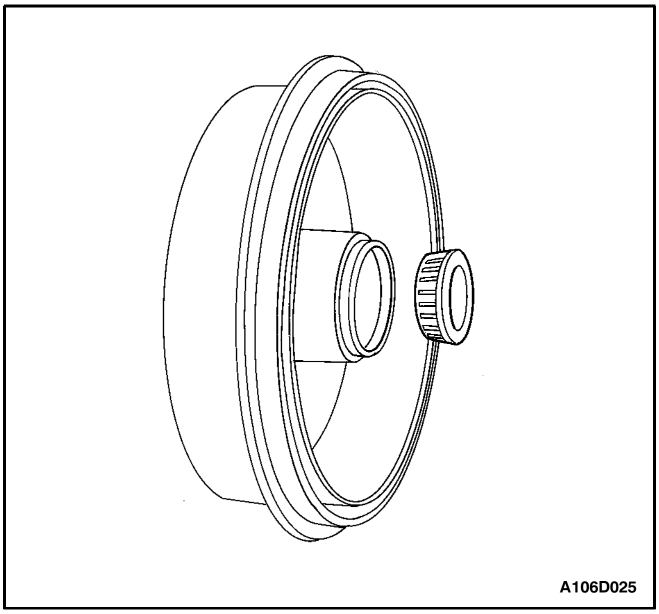
Installation Procedure



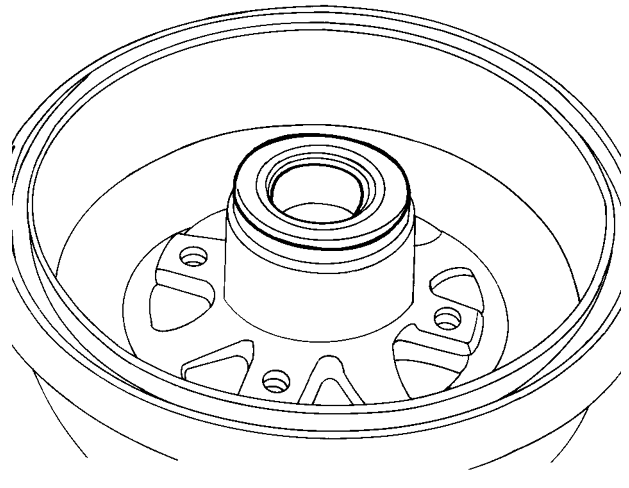
1. Press the outer race of the outer bearing into the wheel hub using installers J-36791 and KM-266-A.



2. Press the outer race of the inner bearing into the wheel hub using installers J-36791 and KM-266-A.

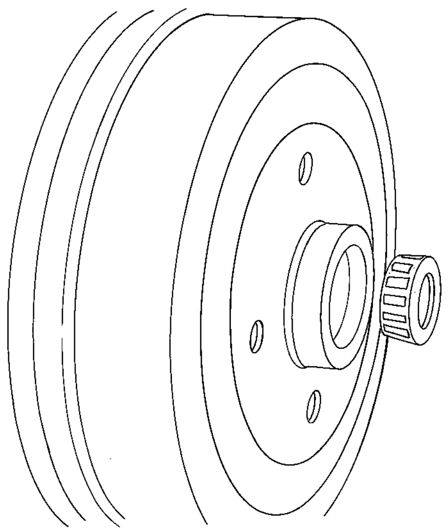


3. Install the inner tapered roller bearing.



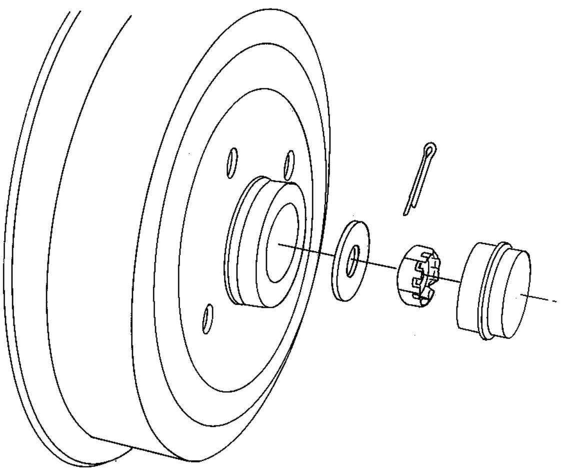
A106D014

4. Coat or fill all the hollow spaces of both wheel bearings, the ring seal lip, and the wheel hub with antifriction grease. Press the seal into the hub.



A106D011

5. Install the hub and bearing assembly onto the rear axle spindle.

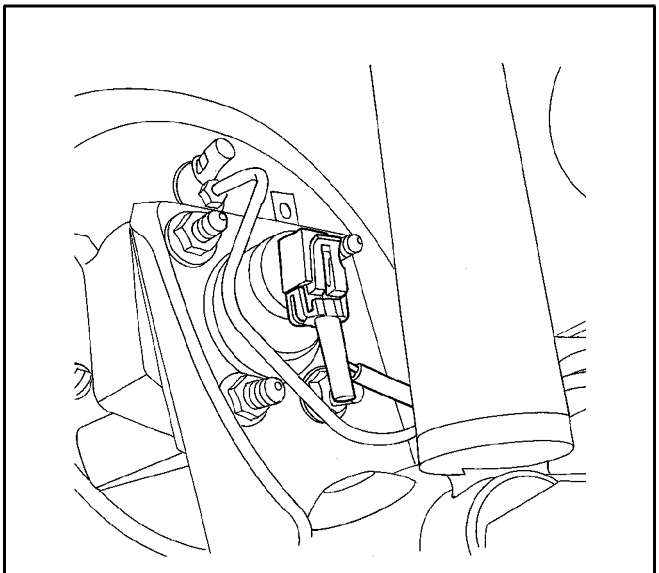


A106D027

6. Install the lock washer and spindle nut. Hand tighten the spindle nut.
7. Install the brake drum detent screw. Refer to Section 4E, Rear Drum Brakes.
8. Mount the rear wheel. Refer to Section 2E, Tires and Wheels.
9. Adjust the wheel bearing. Refer to "Wheel Bearing Adjustment" in this section.
10. Adjust the parking brake. Refer to Section 4G, Parking Brake.
11. Install the dust cap.
12. Lower the vehicle.

HUB AND BEARING ASSEMBLY WITH ABS

Removal Procedure

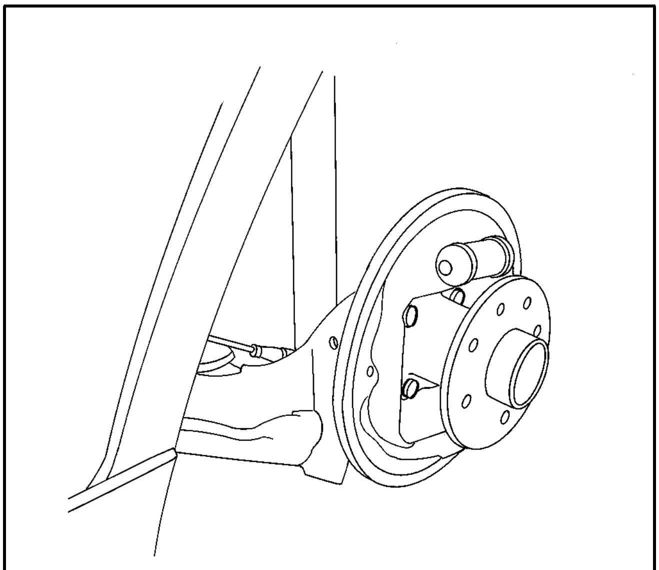


A106D017

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.

Notice: Do not hammer on the brake drum. Damage to the bearing could result.

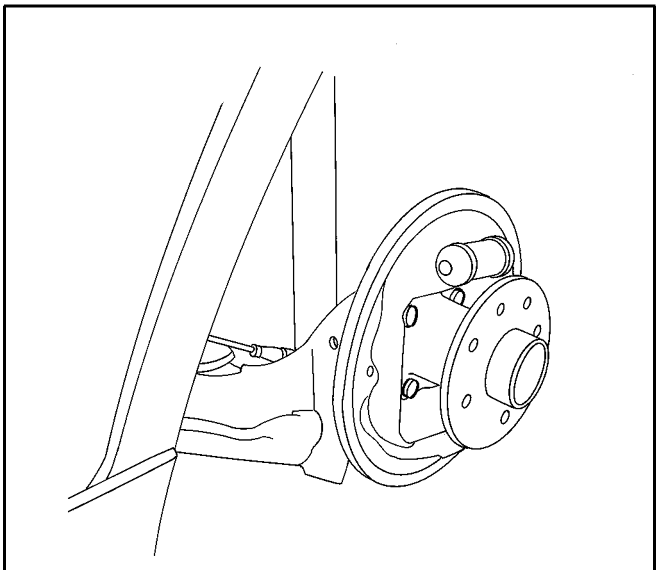
3. Remove the brake drum and the detent screw. Refer to Section 4E, Rear Drum Brakes.
4. Loosen the parking brake cable. Refer to Section 4G, Parking Brake.
5. Disconnect the ABS sensor line.



A106D018

6. Remove the wheel hub and bearing assembly by removing the bolts and the nuts.

Installation Procedure



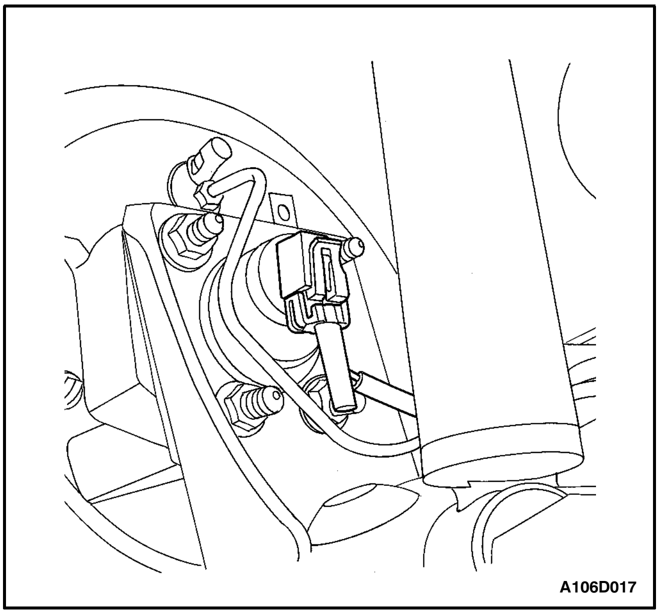
A106D018

Notice: The wheel hub and bearing assembly is not to be serviced. The assembly must be replaced.

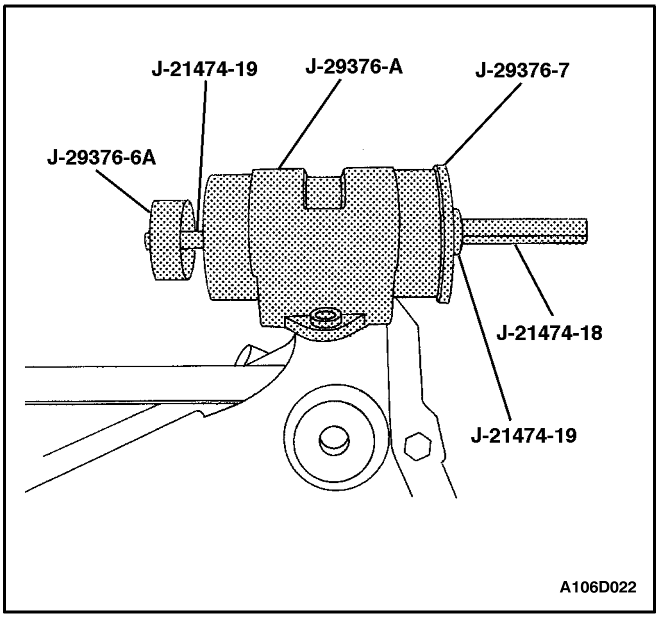
1. Install the wheel hub and bearing assembly with the bolts and the nuts.

Tighten

Tighten the wheel hub and bearing assembly nuts to 40 N•m (30 lb-ft). Turn the nut an additional 60 degrees followed by an additional 15 degrees.



2. Connect the ABS sensor line.
3. Install the brake drum and tighten the brake detent screw. Refer to Section 4E, Rear Drum Brakes.
4. Mount the rear wheel. Refer to Section 2E, Tires and Wheels.
5. Adjust the parking brake. Refer to Section 4G, Parking Brake.
6. Lower the vehicle.



UNIT REPAIR

CONTROL ARM BUSHINGS

Tools Required

KM-266-A Remover

J-21474-18 Nut

J-21474-19 Puller Bolt/Thrust Washer

J-29376-A Control Arm Bushing Housing

J-29376-6A Rear Control Arm Bushing Remover/Installer

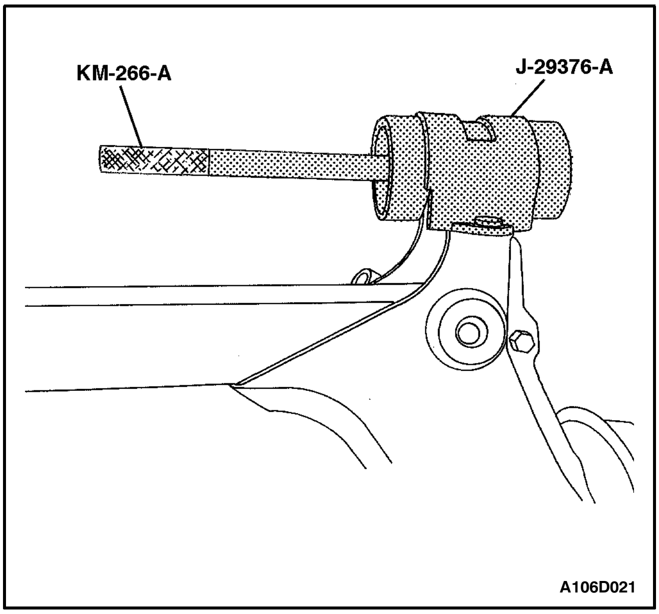
J-29376-7 Rear Control Arm Bushing Plate

Disassembly Procedure

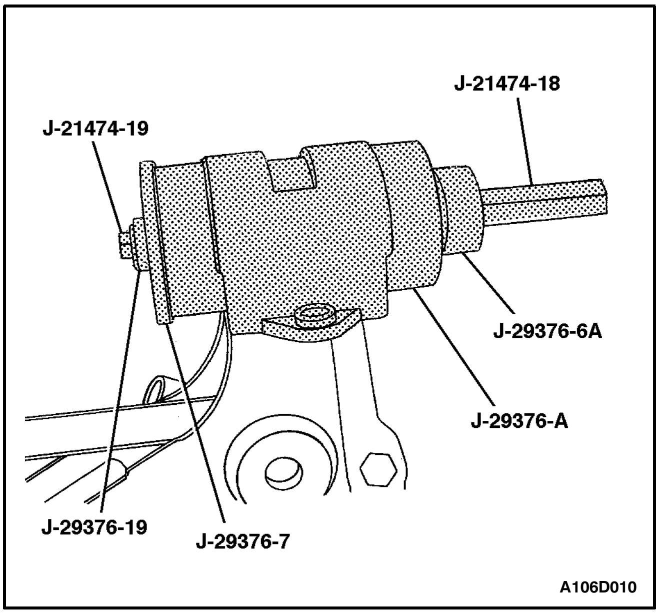
1. Raise and suitably support the vehicle.
2. Remove the rear axle and secure it to a workbench. Refer to "Rear Axle Assembly" in this section.

Notice: To facilitate removal of damping bushings, warm the rear axle in the area of the bushings to approximately 50 to 75°C (122 to 158°F) using an industrial hot air dryer.

3. Place the control arm bushing housing J-29376-A on the rear axle. Slide the puller bolt/thrust washer J-21474-19 through the control arm bushing remover/installer J-29376-6A, the rear control arm bushing, the control arm bushing plate J-29376-7 and into the nut J-21474-18.
4. Partially remove the rear axle bushing by turning the nut J-21474-18 and counterholding the puller bolt J-21474-19.

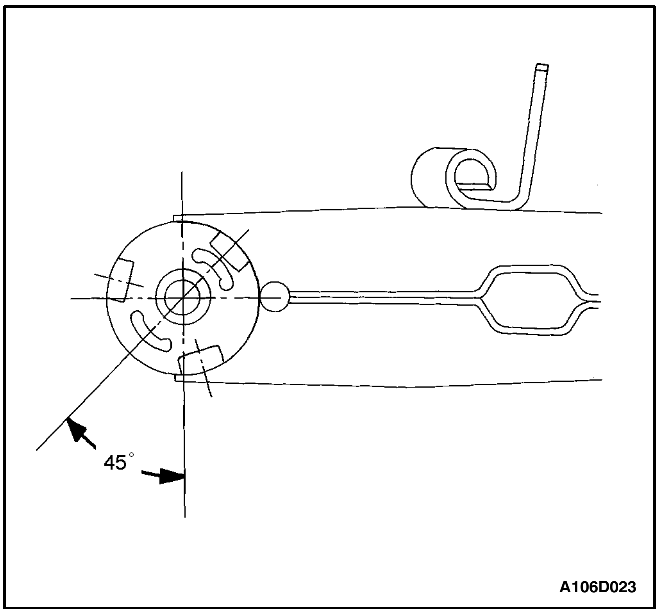


5. Remove the rear axle bushing completely by striking the control arm bushing remover/installer J-29376-6A with the remover KM-266-A.



Assembly Procedure

1. Place the control arm bushing housing J-29376-A on the rear axle. Slide the puller bolt J-21474-19 through the thrust washer J-1474-19, the control arm bushing plate J-29376-7, the rear control arm bushing, the control arm bushing remover/installer J-29376-6A and into the nut J-21474-18.
2. Install the rear axle bushing by turning the nut J-21474-18 and counterholding the puller bolt J-21474-19.



3. Be sure the bushing angle is 40 to 50 degrees to the axis of the rear axle.
4. Install the rear axle. Refer to "Rear Axle Assembly" in this section.
5. Lower the vehicle.

REAR AXLE WITHOUT ABS

Disassembly Procedure

1. Remove the rear axle. Refer to "Rear Axle Assembly" in this section.
2. Remove the hub and bearing assembly. Remove the spindle from the rear axle. Refer to "Hub and Bearing Assembly Without ABS" in this section.
3. Remove the rear brake assembly. Refer to Section 4E, Rear Drum Brakes.
4. Remove the stabilizer shaft. Refer to "Stabilizer" in this section.
5. Remove the rear control arm bushings. Refer to "Control Arm Bushings" in this section

Assembly Procedure

1. Install the rear control arm bushings. Refer to "Control Arm Bushings" in this section
2. Install the stabilizer shaft. Refer to "Stabilizer" in this section.
3. Install the rear brake assembly. Refer to Section 4E, Rear Drum Brakes.
4. Thinly coat the wheel spindle with antifriction bearing grease in the area of the brake anchor plate. Install the spindle and the hub and bearing assembly. Refer to "Hub and Bearing Assembly Without ABS" in this section.
5. Install the rear axle. Refer to "Rear Axle Assembly" in this section.
6. Adjust the wheel bearing. Refer to "Wheel Bearing Adjustment" in this section.

REAR AXLE WITH ABS

Disassembly Procedure

1. Remove the rear axle. Refer to "Rear Axle Assembly" in this section.
2. Remove the hub and bearing assembly. Refer to "Hub and Bearing Assembly" in this section.
3. Remove the rear brake assembly. Refer to Section 4E, Rear Drum Brakes.
4. Remove the stabilizer shaft. Refer to "Stabilizer" in this section.
5. Remove the rear control arm bushings. Refer to "Control Arm Bushings" in this section.

Assembly Procedure

1. Install the rear control arm bushings. Refer to "Control Arm Bushings" in this section.
2. Insert the stabilizer shaft into new rear axle and screw the shaft into place. Refer to "Stabilizer" in this section.
3. Install the rear brake assembly. Refer to Section 4E, Rear Drum Brakes.
4. Install the hub and bearing assembly. Refer to "Hub and Bearing Assembly" in this section.
5. Install the rear axle. Refer to "Rear Axle Assembly with ABS" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

REAR SUSPENSION

General Description

The rear suspension consists of an axle with trailing arms and a twisting cross beam, two coil springs, two shock absorbers, two upper spring insulators, and two spring compression bumper. The axle support assembly attaches to the underbody through a rubber bushing located at the front of each of the control arms. The brackets are integral with the underbody side rails. The axle structure maintains the relationship of the wheels to the body. A serviceable stabilizer shaft, incorporated with the axle beam, attaches to each of the control arms.

Each coil spring is retained between a seat in the underbody and a seat welded to the top of the rear axle control arm. The coil spring lower end rests on a compression bumper in the welded bracket on top of the rear axle, while a rubber insulator is used to isolate the coil spring upper end from the vehicle underbody seat.

SECTION 2E

TIRES AND WHEELS

TABLE OF CONTENTS

SPECIFICATIONS

TIRE SIZE AND PRESSURE SPECIFICATIONS

Inflation Pressure at Full Load

Engine	Tires	Wheel	Front		Rear	
			kPa	psi	kPa	psi
1.3 SOHC	155/80R13	5Jx13	240	35	240	35
	175/70R13	5Jx13	220	32	220	32
1.5 SOHC	175/70R13	5Jx13	220	32	220	32
	185/60R14	5.5Jx14 (steel)	220	32	220	32
	185/60R14	5.5Jx14 (Aluminum)	220	32	220	32
1.6 DOHC	185/60R14	5.5Jx14 (Steel)	220	32	220	32
	185/60R14	5.5Jx14 (Aluminum)	220	32	220	32

INFLATION PRESSURE CONVERSION SPECIFICATIONS

kPa	psi	kPa	psi	kPa	psi
140	20	185	27	235	34
145	21	190	28	240	35
155	22	200	29	250	36
160	23	205	30	275	40
165	24	215	31	310	45
170	25	220	32	345	50
180	26	230	33	380	55

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Wheel Bolt (Aluminum Wheel)	90	66	-
Wheel Bolt (Steel Wheel)	90	66	-

DIAGNOSIS

WHEEL RUNOUT

Measure wheel runout with an accurate dial indicator. Measurements may be taken with the wheels either on or off the vehicle, using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel.

Measure radial runout and lateral runout on both the inboard and the outboard rim flanges. With the dial indicator firmly seated next to the wheel and tire assembly, slowly rotate the wheel one revolution and record the indicator reading. If any measurement exceeds the following specifications and there is a vibration that wheel balancing will not correct, replace the wheel. Disregard any indicator readings due to welds, paint runs, or scratches.

Steel Wheels

- Radial runout: 0.8 mm (0.03 inch)
- Lateral runout: 1.0 mm (0.04 inch)

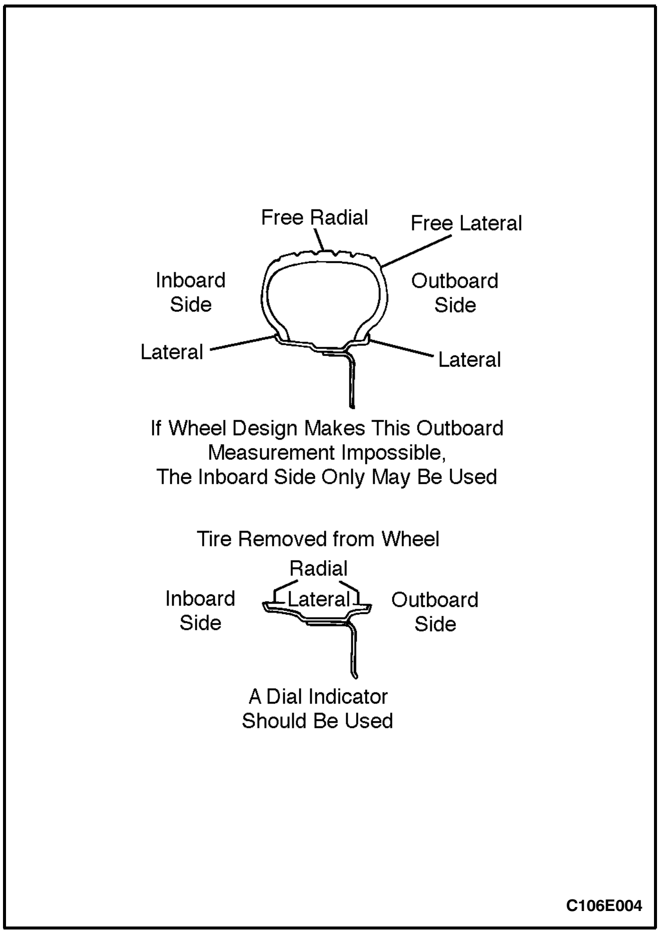
Aluminum Wheels

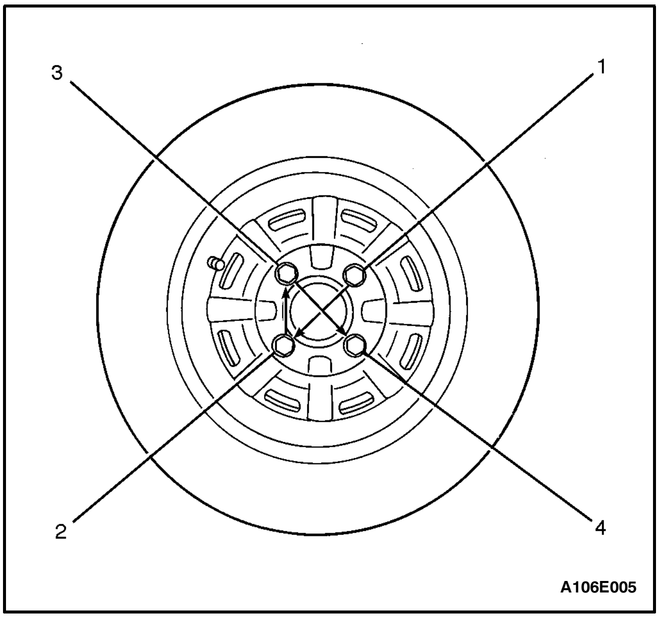
- Radial runout: 0.8 mm (0.03 inch)
- Lateral runout: 0.8 mm (0.03 inch)

Measure free radial runout on the center of the tire tread. The tread can be taped to present a smooth surface. Measure free lateral runout on the outboard side of the tire nearest to the tread.

Steel and Aluminum Wheels

- Free radial runout: 1.5 mm (0.06 inch)
- Free lateral runout: 1.5 mm (0.06 inch)





MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

WHEEL

Removal Procedure

1. Loosen the wheel bolts.
2. Raise and suitably support the vehicle.
3. Remove the wheel bolts.

Notice: Never use heat to loosen a tight wheel. It can shorten the life of the wheel, the wheel nuts and the wheel bearings. Excessive force, such as hammering the wheel or tire, can also cause damage and is not recommended. Slight tapping of the wheel sidewall with one's hand or with a rubber mallet is acceptable.

4. Remove the wheel.

Difficulty in removing the wheels from the vehicle can be due to foreign material or to a tight fit between the wheel centerhole and the hub or the rotor. These wheels can be removed by

1. Retightening the wheel bolts on the affected wheel and then loosening the wheel bolts by two turns.
2. Lowering the vehicle and rocking it from side to side as hard as possible, using one or more person's body weight to loosen the wheel.
3. Raising the vehicle and removing the wheel.

Caution: Do not allow the penetrating oil to get on the vertical surfaces between the wheel and the drum (or rotor) because penetrating oil in this area could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident.

Penetrating oil is not effective in removing tight wheels. If it is used, however, apply it sparingly and only to the wheel's centerhole area.

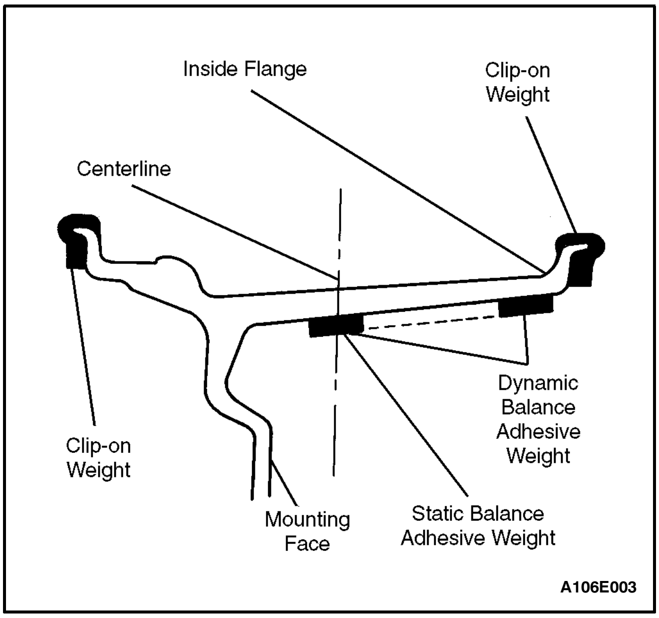
Installation Procedure

Notice: Before installing the wheels, remove any build-up of corrosion on the wheel mounting surface and the brake drum or the rotor mounting surface by scraping and brushing them with a wire brush. Installing the wheels without good metal-to-metal contact at the mounting surfaces can cause the wheel nuts to loosen, which can later allow a wheel to come off while the vehicle is moving. Wheel bolts must be tightened in sequence and to the proper torque to avoid bending the wheel, the brake drum or the rotor.

1. Mount the wheel.
2. Install the wheel bolts in the sequence shown. Do not tighten the wheel bolts.
3. Lower the vehicle.

   #### Tighten

   Tighten the wheel bolts to 90 N•m (66 lb-ft).



ON-VEHICLE BALANCING

On-vehicle balancing will help correct vibrations due to brake drum, rotor, and wheel cover imbalances.

Notice: Do not allow the front suspension to hang free. When the drive axle is run at an extreme angle, extra vibrations can occur, as well as damage to seals and joints.

1. During on-vehicle balancing, do not remove the balance weights from the off-vehicle dynamic balance.
2. If more than 1 ounce of additional weight is required, split the weight between the inner and the outer rim flanges.

Caution: Do not spin the drive wheels faster than 55km/h (35 mph) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Personal injury and damage may result from high-speed spinning.

3. Spin the driven tire and wheel assemblies using the engine.

UNIT REPAIR

ALUMINUM WHEEL POROSITY

Wheel repairs that use welding, heating or peening are not approved.

1. Raise and suitably support the vehicle.
2. Remove the tire and wheel assembly. Refer to "Wheel" in this section.

Caution: To avoid serious injury, do not stand over the tire when inflating, because the bead may break when it snaps over the safety hump. Do not exceed 275 kPa (40 psi) of air pressure in any tire if the beads are not seated. If 275 kPa (40 psi) of air pressure will not seat the beads, deflate the tire. Relubricate the beads. Reinflate the tire. Overinflation may cause the bead to break and cause serious injury.

3. Locate leaking areas by inflating the tire to 345 kPa (50 psi) and dipping the tire and wheel assembly into a water bath.
4. Mark the leak areas and remove the tire from the wheel.
5. Scuff the inside wheel surface at the leak area with 80-grit sandpaper. Clean the leak area with a general-purpose cleaner.
6. Apply a 3.3 mm (0.13 inch) thick layer of adhesive/sealant to the leak area. Allow it to dry for 12 hours.
7. Install the tire on the wheel. Inflate the tire to 345 kPa (50 psi) and check for leaks as in step 3.

8. Adjust the tire pressure to meet specifications. Refer to "Tire Size and Pressure Specifications" in this section.
9. Balance the tire and wheel assembly. Refer to "Tire and Wheel Balancing" in this section.
10. Install the tire and wheel assembly. Refer to "Wheel" in this section.
11. Lower the vehicle.

ALUMINUM WHEEL REFINISHING

A protective clear or color coating is applied to the surface of the original equipment cast aluminum wheels. Surface degradation can develop if this clear coating is damaged or removed. This can happen at some automatic car wash facilities that use silicone carbide-tipped tire brushes to clean white walls and tires. Once the protective coating is damaged, exposure to caustic cleaners or road salt causes further surface degradation. The following procedure details how to strip, clean and recoat aluminum wheels.

Caution: Follow the manufacturer's recommendations and cautions when using these materials.

Required materials:

Amchem Alumi Prep No. 23, stock No. DX533 or equivalent cleaning and conditioning chemical for aluminum.

Amchem Alodine No. 101, stock No. DX50T or equivalent coating chemical for aluminum.

Ditzler Delclear Acrylic Urethane Clear, Stock No. DAU-75 or equivalent.

Ditzler Delthane Ultra-Urethane Additive, Stock No. DXR-80 or equivalent.

Before repairing the aluminum damage or the clear coat damage, prepare the wheels and the tires.

1. Remove the wheel from the vehicle.
2. Mark the location of the outboard weights and remove them.
3. Wash the wheel inside and out with a water-based, all-purpose cleaner. Remove the grease and oil with a solvent cleaner.
4. Mask the tire prior to painting.
5. Using a 400-grit wet or dry sandpaper, sand over the painted areas that will not require recoloring. Sanding will promote the adhesion of the clear coat.

Aluminum Damage on Wheel Surface

1. Mount the wheel on a brake lathe and spin the assembly slowly.

2. Sand the wheel with a backing block or pad. Hold the backing block or pad flat to the surface of the wheel and sand slowly back and forth from the center to the outer edge of the tire to remove the damage. Use the following sandpaper grits in the order listed:
   - 2.1. 80 grit.
   - 2.2. 150 grit.
   - 2.3. 240 grit.

Clear Coat Damage on Unpainted Wheels

1. Apply the chemical stripper Amchem Alumi Prep No. 23. Use a small 1/4-inch detail brush to apply the stripper around the perimeter and spoke-like areas.
2. Remove the stripper according to manufacturer's recommendations.

Caution: To avoid serious personal injury, do not use engine power to rotate the wheel while sanding.

1. Sand the wheel with 240-grit sandpaper by rotating the wheel on a slow-spinning brake lathe or by mounting the wheel on the car and spinning it by hand. Sanding restores the machined appearance and promotes adhesion.

After repairing the aluminum or clear coat damage, the wheels must be recoated.

Recoating Procedure

Caution: To avoid serious personal injury when applying any two-part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and an allergic respiratory reaction.

1. Clean the surface.
2. Soak the wheel with Amchem Alumi Prep No. 33 or equivalent for 1 to 3 minutes. Rinse the wheel with water and blow it dry.
3. Soak the wheel with Amchem Alodine No. 1001 or equivalent for 1 to 3 minutes. Rinse the wheel with water and blow it dry.
4. Finish with Ditzler Delclear Urethane and Ditzler Ultra-Urethane Additive or equivalent, using three coats.
   - 1st coat - spray on a light mist coat; let dry.
   - 2nd coat - spray or paint on a light coat; let dry.
   - 3rd coat - spray or paint on a heavy double wet coat; let dry.
5. Let the urethane dry for 24 hours or flash for 30 minutes and force dry at 60°C (140°F) for 30 minutes. Allow the urethane to cool for 5 minutes before mounting the wheel on the vehicle.

OFF-VEHICLE BALANCING

Perform wheel balancing with an electronic off-vehicle balancer. The balancer is easy to use and gives both a static and a dynamic balance. Unlike on-vehicle balancing, the off-vehicle balancer does not correct for drum or rotor imbalance. This drawback is overcome by its accuracy (usually to within 1/8 ounce). Secure the wheel on the balancer with a cone through the back side of the centerhole, not through the wheel bolt holes.

CORRECTING NON-UNIFORM TIRES

There are two ways to correct properly balanced tires which still vibrate. One method uses an automatic machine which loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows. Correction by this method is usually permanent and, if it is done properly, does not significantly affect the appearance or the tread life of the tire. Tire truing with a blade-type machine is not recommended because it substantially reduces the tread life and often does not correct the problem permanently.

Another method is to dismount the tire and rotate it 180 degrees on the rim. Do this only on the tire and wheel assemblies which are known to be causing a vibration because this method is just as likely to cause good assemblies to vibrate.

TIRE AND WHEEL MATCH-MOUNTING

The tires and wheels are match-mounted at the assembly plant. Match-mounting aligns the radially stiffest part of the tire, or high spot, to the smallest radius, or low spot, of the wheel.

The high spot of the tire is originally marked by a red paint mark or an adhesive label on the outboard sidewall.

The low spot of the wheel will be at the location of the valve stem.

Before dismounting a tire from its wheel, scribe a line on the tire at the valve stem to assure that it is remounted in the same position.

Replacement tires that are of original equipment quality will have their high and low spot marked in the same manner.

TIRE MOUNTING AND DISMOUNTING

Notice: Use a tire-changing machine to mount or dismount the tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change tires. These tools may damage the beads or the wheel rim.

1. Clean the rim bead seats with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust. Before mounting or dismounting a tire, lubricate the bead area well with an approved tire lubricant.

Caution: To avoid serious injury, do not stand over the tire when inflating it, because the bead may break when it snaps over the safety hump. Do not exceed 275 kPa (40 psi) of air pressure in any tire if the beads are not seated. If 275 kPa (40 psi) of air pressure will not seat the beads, deflate the tire. Re-lubricate the bead and reinflate the tire. Overinflation may cause the bead to break and cause serious injury.

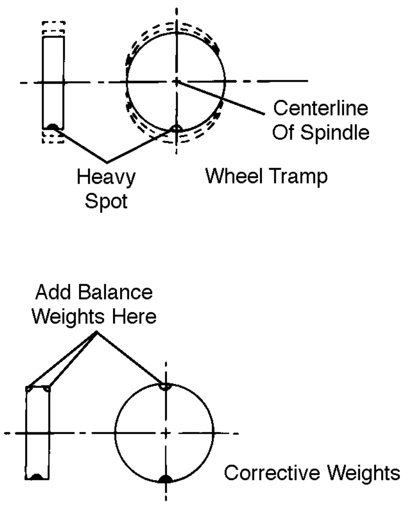
2. After mounting the tire, inflate it until the beads are seated. Never exceed 275 kPa (40 psi) to seat the beads.
3. Install the valve core and inflate the tire to the proper pressure. Make sure the locating ring outside of the bead of the tire shows around the rim flanges of the wheel on both sides. This positioning of the tire will insure that the bead of the tire is seated.

GENERAL DESCRIPTION AND SYSTEM OPERATION

TIRE AND WHEEL BALANCING

There are two types of tire and wheel balancing: static and dynamic.

Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition may eventually cause uneven tire wear.



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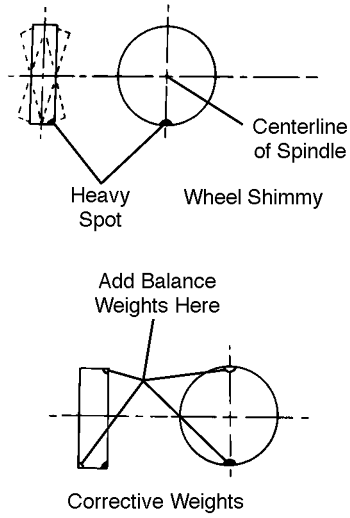
Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.



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General Balance Precautions

Remove all deposits of foreign material from the inside of the wheel.

Caution: Remove stones from the tread in order to avoid operator injury during spin balancing.

Inspect the tire for any damage. Balance the tire according to the equipment manufacturer's recommendations.

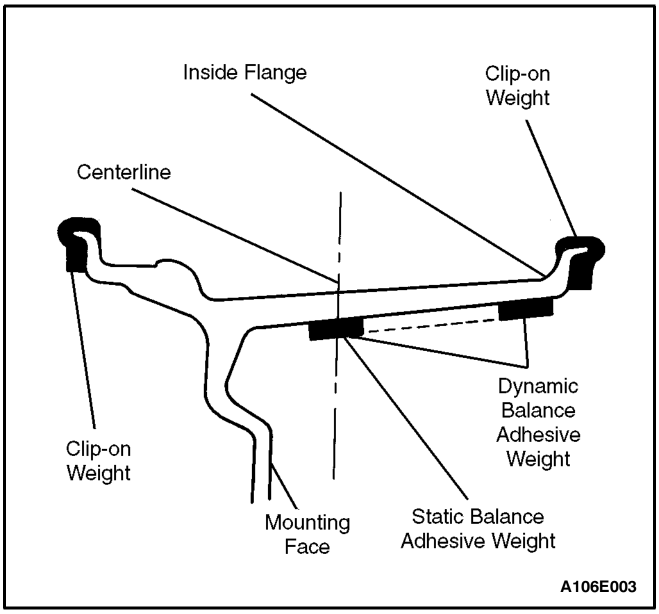
Wheel Weights

If more than 85 grams (3.0 ounces) are needed to static balance the wheel, split the wheel weights as equally as possible between the inboard and the outboard flanges.

Balancing the assemblies with factory aluminum wheels requires the use of special nylon-coated, clip-on wheel weights. These weights are designed to fit over the

thicker rim flange of the aluminum wheel. Install these weights with a plastic-tipped hammer.

Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.



Adhesive Wheel Weight Installation

1. Clean the wheel by sanding it to bare aluminum where the wheel weight will be installed.
2. Use a clean cloth or paper towel saturated with a mixture of half isopropyl alcohol and half water to wipe the place where the wheel weight will be installed.
3. Dry the area with hot air. The surface of the wheel should be warm to the touch.
4. Warm the adhesive backing on the wheel weights to room temperature.
5. Remove the tape from the back of the weights. Do not touch the adhesive surface.
6. Apply the the wheel weight and press it on with hand pressure.
7. Secure the wheel weight with a 70-110 N (16-25 lb) force applied with a roller.

TIRE CHAIN USAGE

Due to limited tire-to-body clearance on certain vehicles, recommendations for tire chain use are published in the Owner's Manual. When tire chains need to be used, most current Daewoo vehicles require SAE Class "S" tire chains. These may also be designated as 1100 Series, type PL tire chains. These chains are specifically designed to limit the "fly off" effect which occurs when the wheel rotates.

Be sure that only fine-link chains are used which do not add more than 15 mm (0.590 inch), including the lock, to the tread surface and the inner sides of the tires. Manufacturers of tire chains have a specific chain size for each tire size to ensure a proper fit when the chain is installed. Be sure to purchase the correct chains for the tires on which they are to be used. Use rubber adjusters to take up any slack or clearance in loose chains.

Use of chains may adversely affect vehicle handling.

When tire chains are installed, follow these precautions:

- Adjust speed to road conditions.
- Avoid sharp turns.
- Avoid locked-wheel braking.

To prevent chain damage to the vehicle, install the chains on the front tires as tightly as possible. Tighten them again after driving 0.4 to 0.8 kilometer (0.3 to 0.5 mile). The use of chains on the rear tires is not recommended because they may contact the vehicle and possibly damage it. If chains must be used on the rear tires, be sure there is sufficient clearance between the chains and the body. Do not exceed 70 km/h (45 mph) or the chain manufacturer's speed limit, if lower. Avoid large bumps, potholes, severe turns and any other maneuvers which could cause the tires to bounce. Follow any other instructions of the chain manufacturer which do not disagree with the above instructions.

REPLACEMENT TIRES

A Tire Performance Criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets performance standards for traction, endurance, dimensions, noise, handling and rolling resistance. Usually a specific TPC number is assigned to each tire size.

Caution: Do not mix different types of tires on the same vehicle such as radial, bias and bias-belted tires except in emergencies, because vehicle handling may be seriously affected and may result in loss of control.

Use only replacement tires with the same size, load range, and construction as the original. The use of any other tire size or construction type may seriously affect ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and the chassis. This does not apply to the spare tire furnished with the vehicle.

It is recommended that new tires be installed in pairs on the same axle.

If it is necessary to replace only one tire, pair it with the tire having the most tread to equalize the braking action.

Although they may appear different in tread design, tires built by different manufacturers with identical TPC specifications may be used on the same vehicle.

ALL SEASON TIRES

Most vehicles are now equipped with steel-belted all season radial tires as standard equipment. These tires qualify as snow tires, with a 37 percent higher average rating for snow traction than the non-all season radial tires previously used. Other performance areas, such as wet traction, rolling resistance, tread life, and air retention, have also been improved. This was done by improvements in both tread design and tread compounds. These tires are identified by an "M + S" molded in the tire sidewall following the size number. The suffix "MS" is also molded in the sidewall after the TPC specification number.

The optional handling tires used on some vehicles are not all season tires. These will not have the "MS" marking after the tire size or the TPC specification number.

PASSENGER METRIC SIZED TIRES

All Daewoo vehicles now use Passenger (P) metric sized tires. P-metric tires are available in two load ranges: standard load (35 psi maximum) and extra load (41 psi maximum). Most passenger vehicle tires are standard load.

Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. For example, a P175/70R13 is not exactly equal in size and load-carrying capacity to an FR70-13. For this reason, replacement tires should be of the same TPC specification number as the originals. If P-metric tires must be replaced with other sizes, consult a tire dealer. Tire companies can best recommend the closest match of alphanumeric to P-metric sizes within their own tire lines.

The metric term for measuring tire inflation pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and psi. One psi equals 6.895 kPa.

See the tire label or refer to "Tire Size and Pressure Specifications" in this section for tire inflation pressures.

TIRE LABEL

The tire label is permanently located on the rear face of the driver's door and should be referred to for tire information. It lists the maximum vehicle load, the tire size (including the spare tire), and the cold inflation pressure (including the spare tire).

SPARE TIRE

This vehicle comes equipped with a full-sized spare tire and wheel.

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, or if the wheel bolts won't stay tight or are heavily rusted. Wheels with excessive runout may cause vehicle vibration. Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and the chassis. The wheel offset is 49 ± 1 mm (1.93 ± 0.04 inches). Steel wheels may be identified by a two- or three-letter code stamped into the rim near the valve stem. Aluminum wheels should have the code, the part number, and the manufacturer ID cast into the back side.

INFLATION OF TIRES

The pressure recommended for any vehicle line is carefully calculated to give a satisfactory ride, handling, tread life, and load-carrying capacity.

Tire pressure should be checked monthly or before any extended trip. Check the tires when they are cold, after the vehicle has sat for 3 hours or more or has been driven less than 1 mile. Set the tire pressure to the specifications on the tire label located on the rear face of the driver's door. Tire inflation pressure is also given under "Tire Size and Pressure Specifications" in this section.

Valve caps or extensions should be on the valves to keep dust and water out.

For sustained driving at speeds up to 140 km/h (85 mph), inflate the tires to the pressure recommended on the tire. Sustained driving at speeds faster than 140 km/h (85 mph), even if permitted by law, is not advised unless the vehicle has special high-speed tires available from many tire dealers. Tire pressures may increase as much as 41 kPa (6 psi) when the tires are hot.

Higher than recommended tire pressure can cause:

- Hard ride
- Tire bruising or damage
- Rapid tread wear at the center of the tire

Lower than recommended pressure can cause:

- Tire squeal on turns
- Hard steering
- Rapid and uneven wear on the edges of the tread
- Tire rim bruises and rupture
- Tire cord breakage
- High tire temperatures

Unequal tire pressures on same axle can cause:

- Uneven braking
- Steering lead
- Reduced handling
- Swerve on acceleration
- Torque steer

SECTION 3A

AUTOMATIC TRANSAXLE DRIVE AXLE

TABLE OF CONTENTS

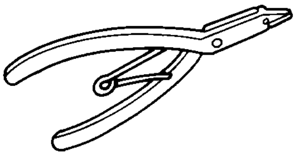
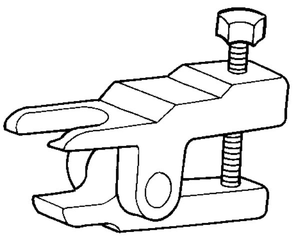
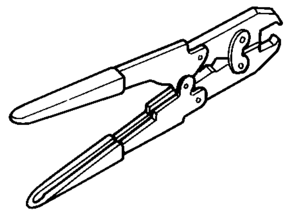
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Axle Shaft Castle Nut Initial Torque	100	74	-
Axle Shaft Castle Nut Final Torque	20 +90°	15 +90°	-
Axle Shaft Caulking Nut Initial Torque	180	134	-
Axle Shaft Caulking Nut Final Torque	50 +60°	37 +60°	-
Lower Ball Joint Nut	70	52	-
Tie Rod Nut	60	44	-
Wheel Bolts	90	66	-

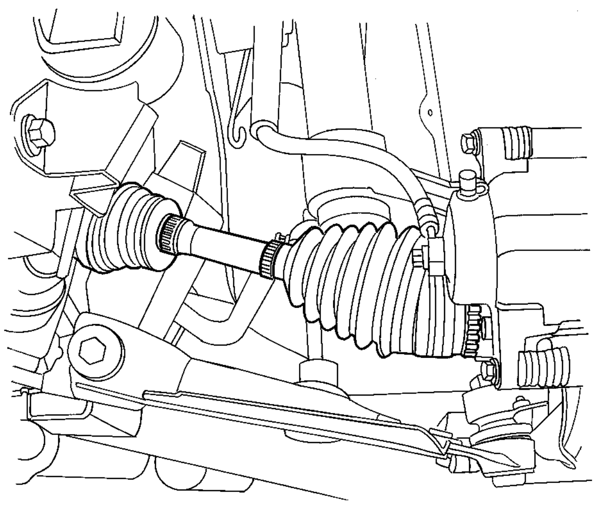
SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A104A001	**J-8059** **Snap Ring Pliers**	 A106C032	**KM-460-A** **Axle Shaft Remover**
 A106C034	**KM-507-B** **Ball Joint Remover**	 A104A008	**J-26610** **Seal Clamp Pliers**

COMPONENT LOCATOR

FRONT DRIVE AXLES



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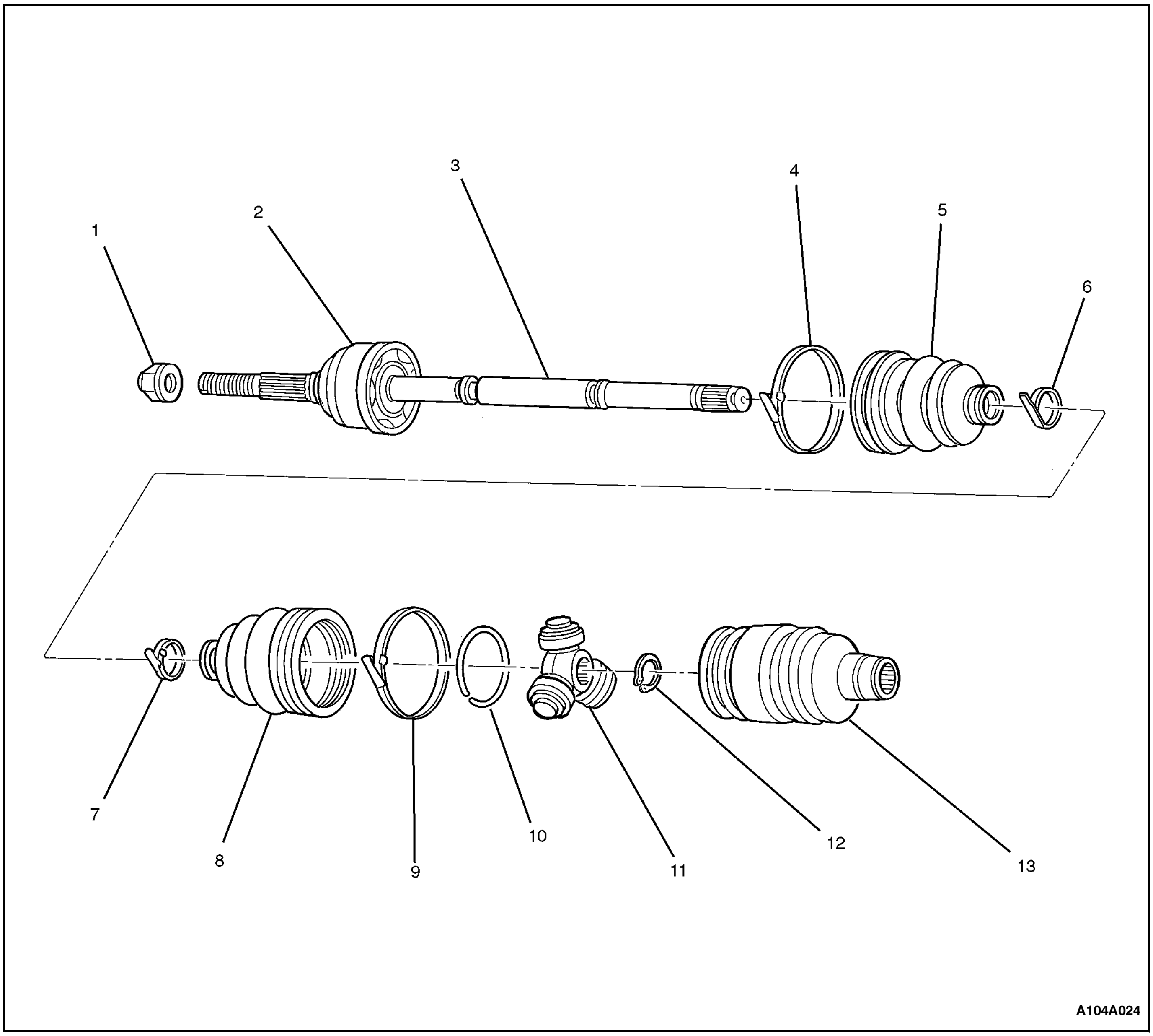
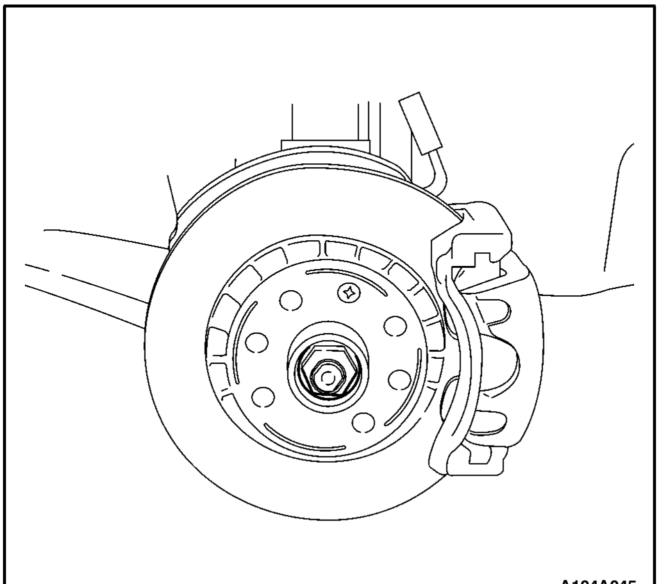


1 **Caulking Nut**
2 **C/V Joint**
3 **Axle Shaft (right-hand shown, left-hand similar)**
4 **Seal Retaining Clamp**
5 **Drive Axle Outboard Seal**
6 **Seal Retaining Clamp**
7 **Seal Retaining Clamp**
8 **Drive Axle Inboard Seal**
9 **Seal Retaining Clamp**
10 **Race Retaining Ring**
11 **Tripot Joint**
12 **Shaft Retaining Ring**
13 **Tripot Housing**



A104A045

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

DRIVE AXLE ASSEMBLY

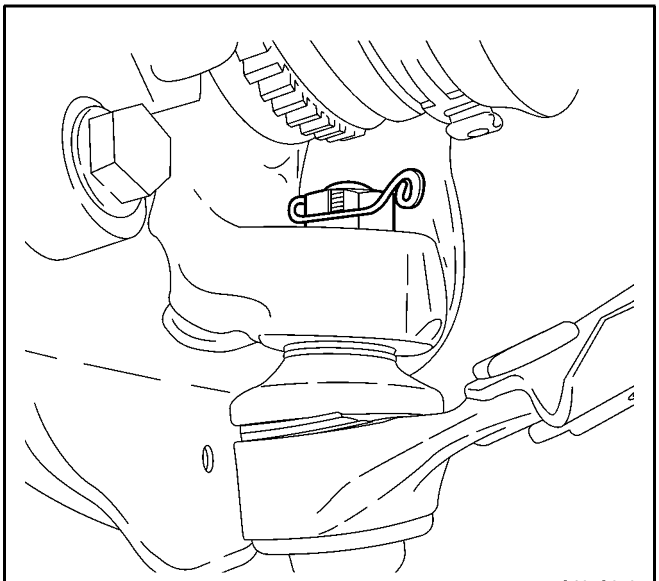
Tools Required

KM-507-B Ball Joint Separator

KM-460-A Axle Shaft Remover

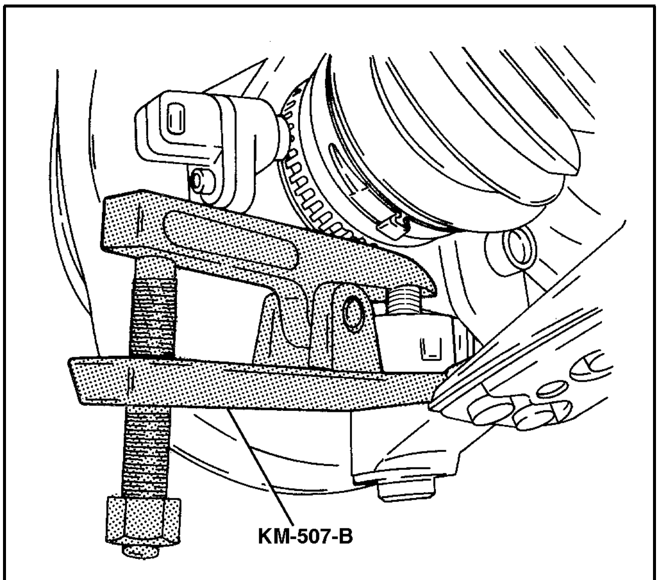
Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheels. Refer to Section 2E, Tires and Wheels.
3. Remove the engine under covers. Refer to Section 9N, Frame and Underbody.
4. Remove the axle shaft caulking nut. Discard the nut.



A104A040

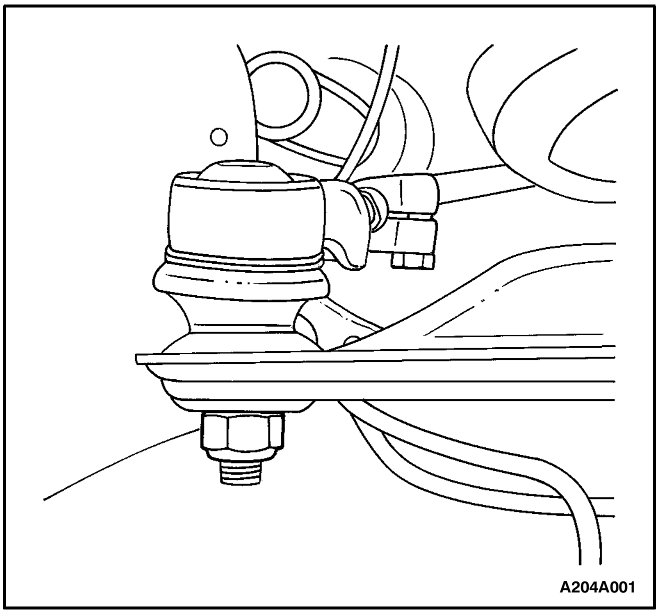
5. Remove the lower ball joint retaining clip and the nut.



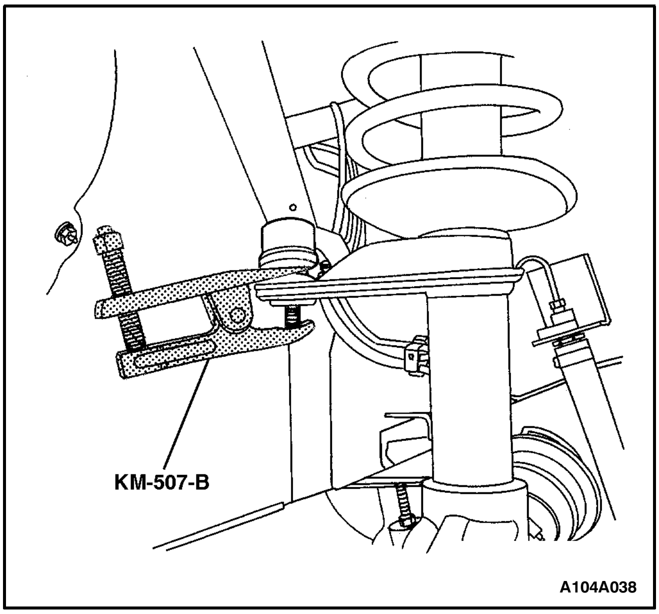
A106C041

Notice: Use only the recommended tool for separating the lower ball joint. Failure to use the recommended tool may cause damage to the ball joint and the seal.

6. Separate the steering knuckle from the lower ball joint using the ball joint separator KM-507-B.

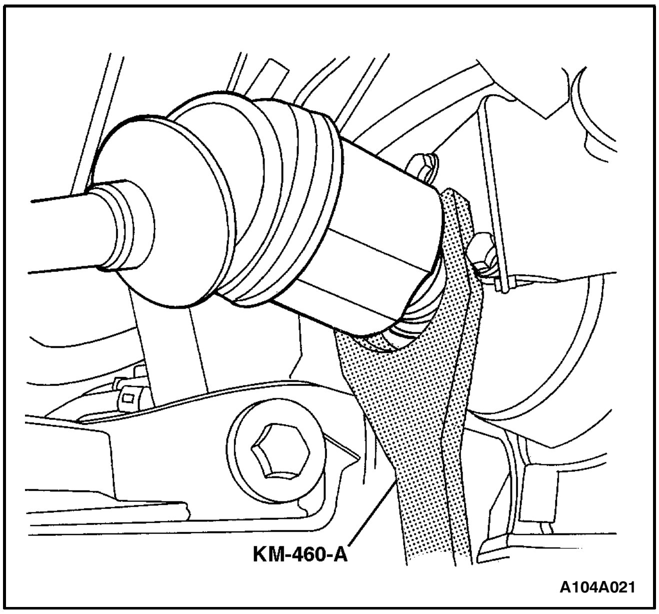


7. Remove the tie rod nut.



Notice: Use only the recommended tool for separating the tie rod from the knuckle/strut assembly. Failure to use the recommended tool may cause damage to the knuckle/strut assembly.

8. Separate the tie rod end using the ball joint separator KM-507-B.



9. Push the drive axle shaft from the wheel hub.

Important: Support the unfastened end of the drive axle. Do not allow the drive axle to dangle freely from the transaxle for any length of time after it has been removed from the wheel hub.

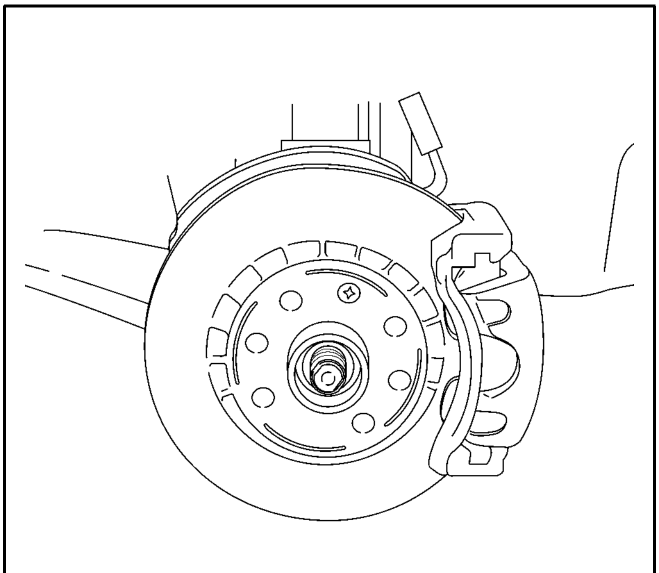
Important: Place a drain pan below the transaxle to catch the escaping fluid. Cap the transaxle drive opening after the drive axle has been removed to keep the fluid in and any contamination out.

10. Remove the drive axle from the transaxle using the axle shaft remover KM-460-A.

Installation Procedure

Notice: Do not damage the seals.

1. Clean the hub seal and the transaxle seal.
2. Install the drive axle into the transaxle.
3. Install the wheel hub onto the axle shaft.



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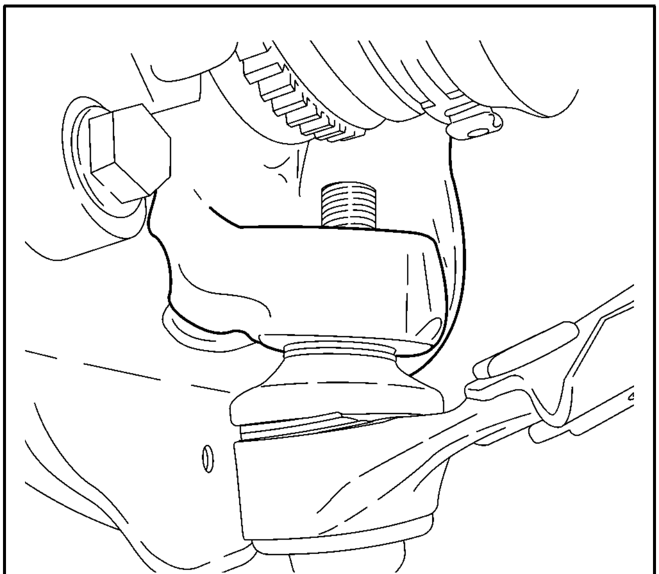
4. Mount the steering knuckle onto the lower ball joint.



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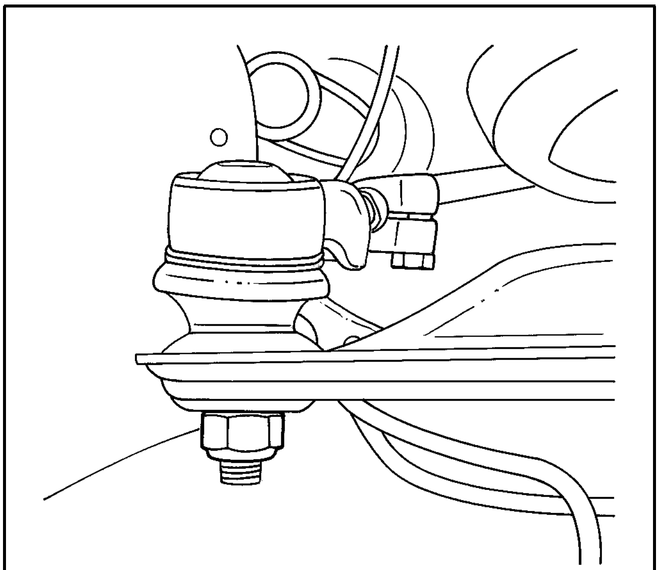
5. Install the tie rod into the knuckle/strut and install the tie rod nut.

Tighten

Tighten the tie rod nut to 60 N•m (44 lb-ft).



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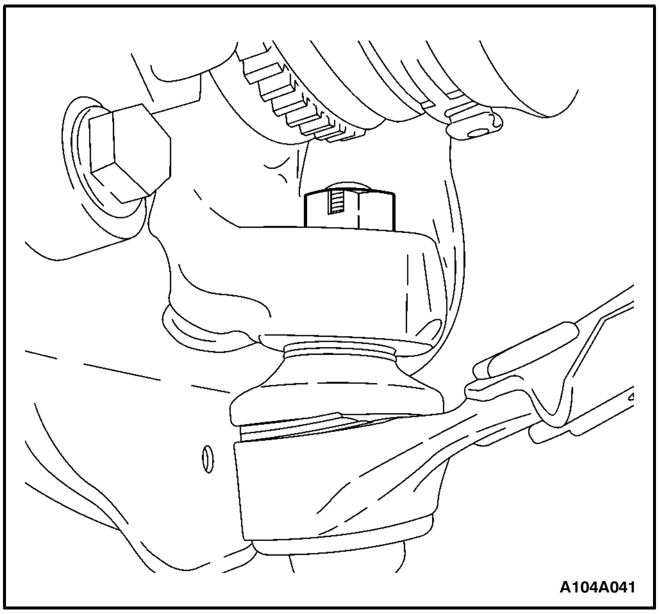
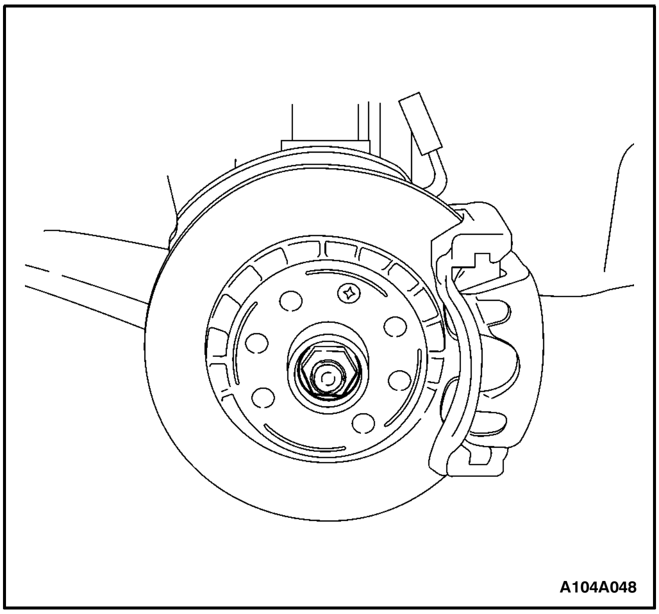


A104A041

6. Install the lower ball joint nut.

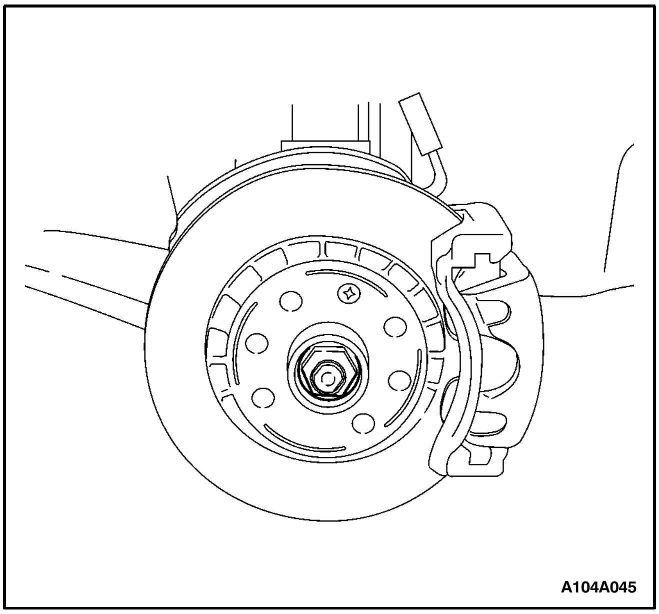
Tighten

Tighten the lower ball joint nut to 70 N•m (52 lb-ft).



A104A048

7. Loosely install a new axle shaft caulking nut. Always use a new nut.



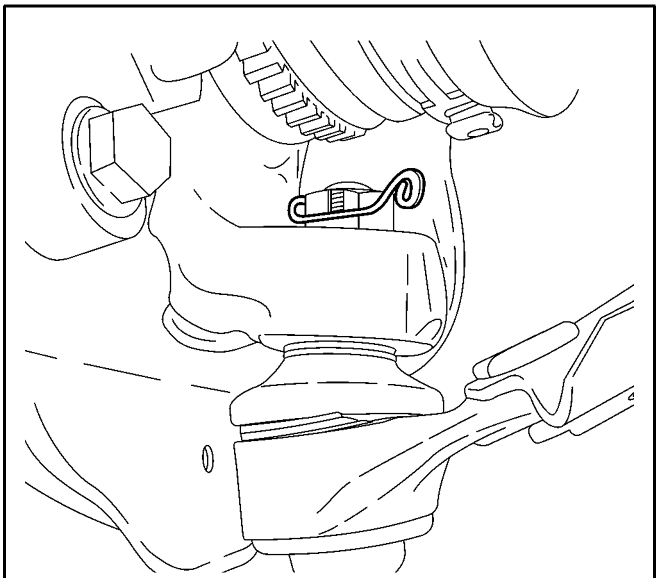
A104A045

9. Install the wheels. Loosely install the bolts. Refer to Section 2E, Tires and Wheels.
10. Lower the vehicle to the floor.

Tighten

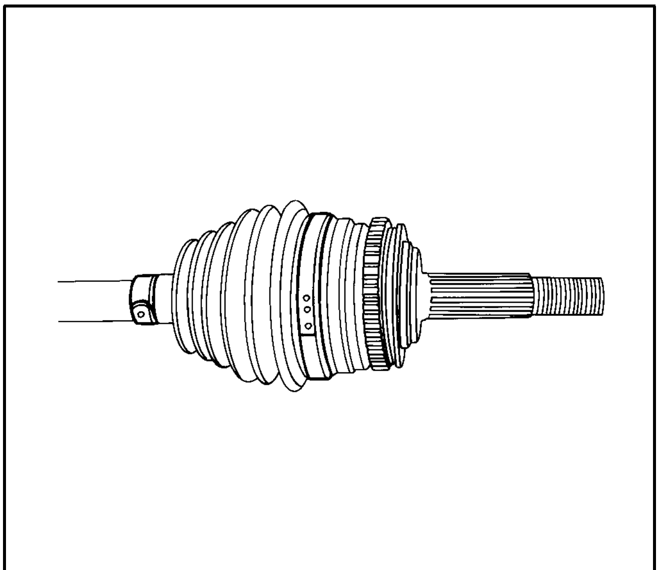
Tighten the wheel bolts to 90 N•m (66 lb-ft).

11. Tighten the axle shaft caulking nuts to 180 N•m (134 lb-ft). Loosen the nut and re-tighten the nut to 50 N•m (37 lb-ft). Then tighten the nut further by 60 degrees.
11. Peen the caulking nut with a punch and a hammer until the nut is locked into place on the axle shaft hub.



A104A042

12. Install the retaining clip to the lower ball joint.
13. Install the engine under covers. Refer to Section 9N, Frame and Underbody.
14. Refill the transaxle fluid to the proper level. Refer to Section 5A, 4T40E Automatic Transaxle.



A104A020

UNIT REPAIR

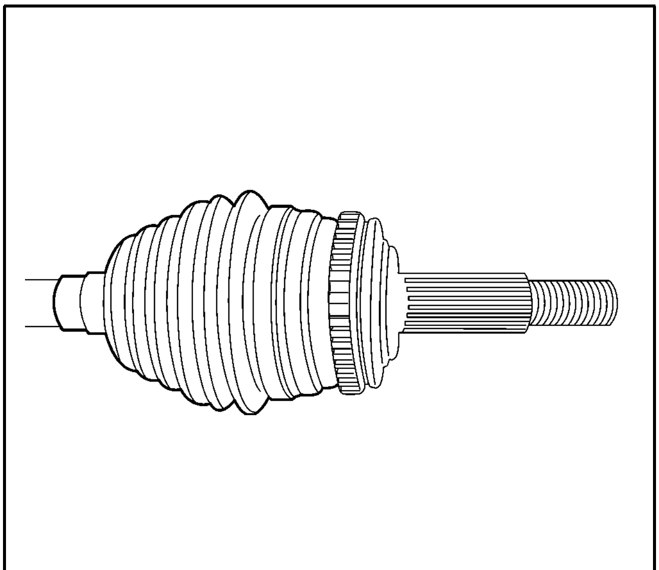
OUTER JOINT SEAL

Tools Required

J-8059 Snap Ring Pliers

Removal Procedure

1. Remove the inner tripot seal assembly. Refer to “Inner Tripot Seal” in this section.
2. Remove the large seal retaining clamp. Discard the clamp.
3. Remove the small seal retaining clamp. Discard the clamp.

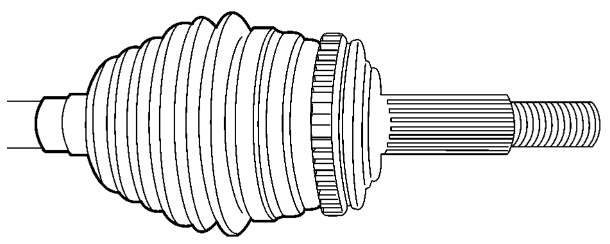


A104A044

4. Degrease the joint.

Caution: Do not remove the axle shaft from the outer joint assembly or disassemble the outer joint assembly. Parts are match fit and cannot be serviced separately. Improper reassembly will adversely affect both performance and safety.

5. Remove the seal from the joint assembly.



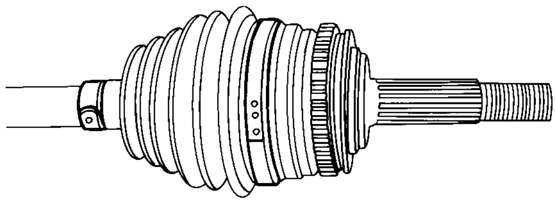
A104A044

Installation Procedure

Tools Required

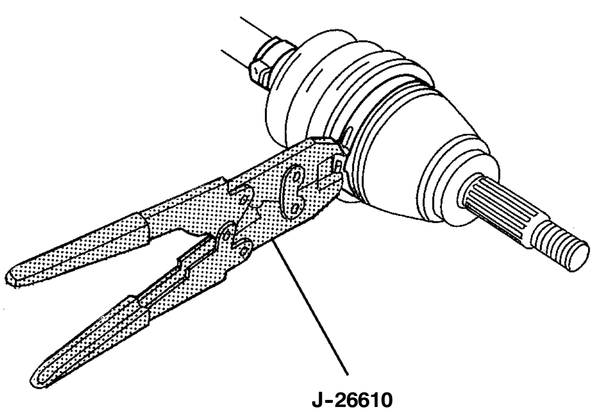
J-26610 Seal Clamp Pliers

1. Install the seal onto the axle shaft.
2. Fill the joint seal with 75 to 95 g (2.6 to 3.4 ounces) of the recommended grease. Repack the joint with 75 to 95 g (2.6 to 3.4 ounces) of the recommended grease.



A104A020

3. Install a new large seal retaining clamp and a new small seal retaining clamp.



A104A016

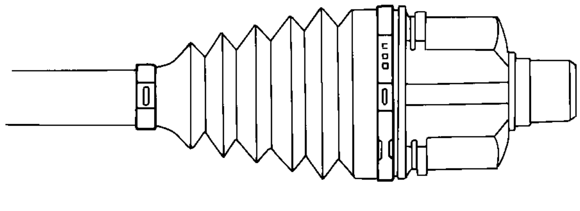
4. Crimp the new small seal retaining clamp and the new large seal retaining clamp using the seal clamp pliers J-26610.
5. Install the inner tripot seal assembly. Refer to "Inner Tripot Seal" in this section.

INNER TRIPOT SEAL

Tools Required

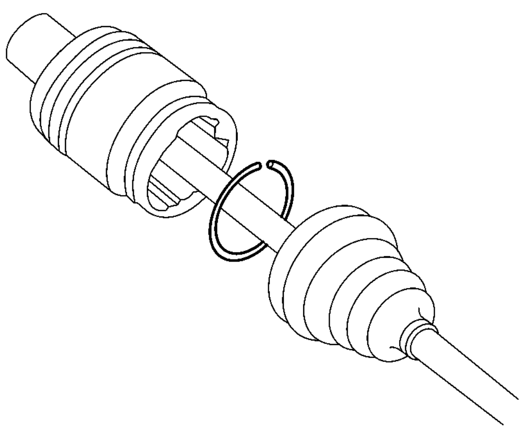
J-8059 Snap Ring Pliers

Removal Procedure



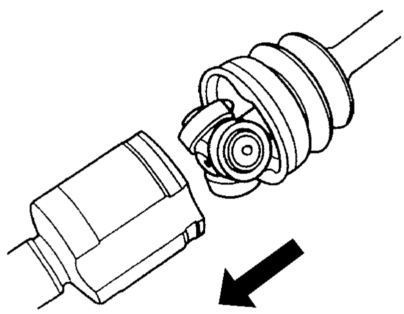
A104A022

1. Remove the large seal retaining clamp. Discard the clamp.
2. Remove the small seal retaining clamp. Discard the clamp.



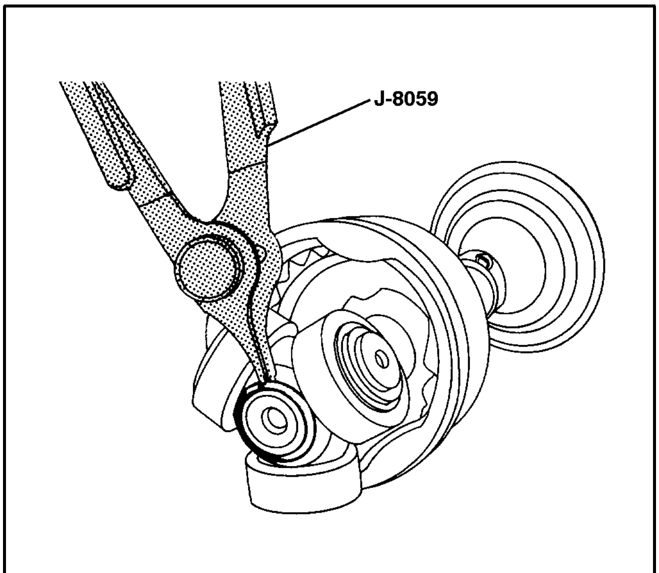
A104A049

3. Remove the race retaining ring.



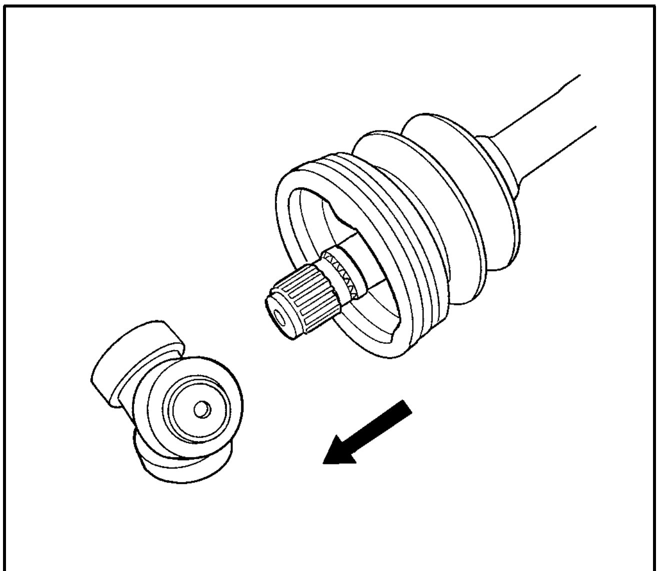
A104A028

4. Remove the tripot housing from the seal.

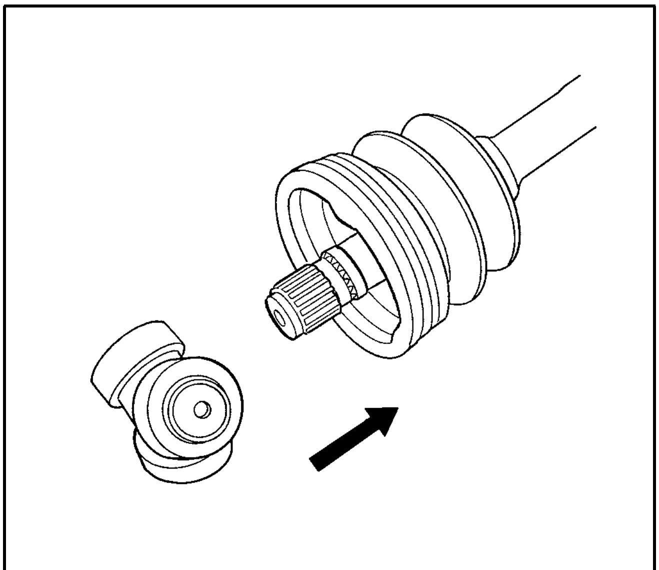


A104A026

5. Degrease the tripot assembly.
6. Remove the shaft retaining ring using the snap ring pliers J-8059.


A104A029

7. Remove the tripot from the axle shaft.
8. Remove the tripot joint seal from the axle shaft.

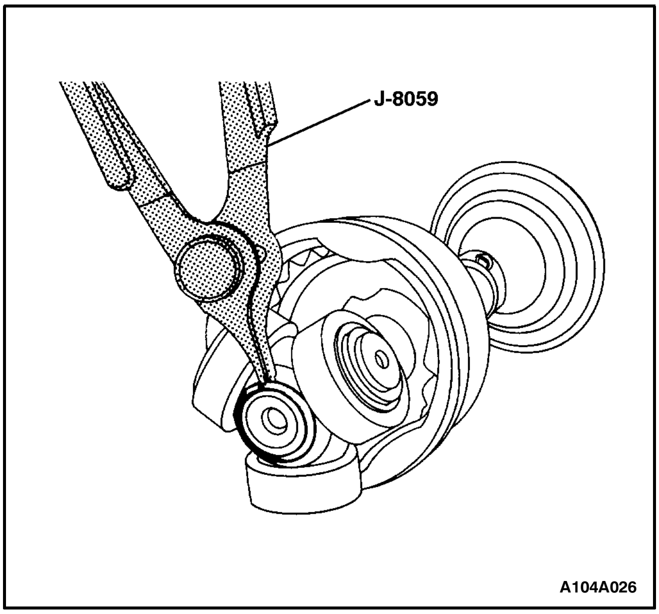

A104A030

Installation Procedure

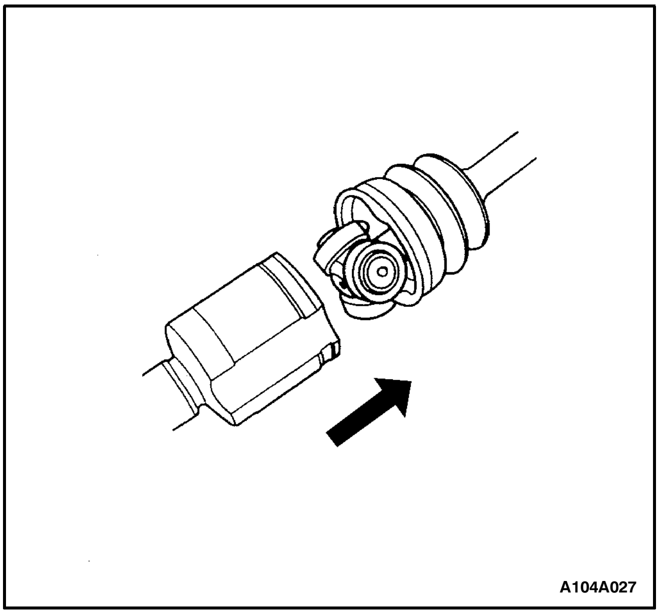
Tools Required

J-26610 Seal Clamp Pliers

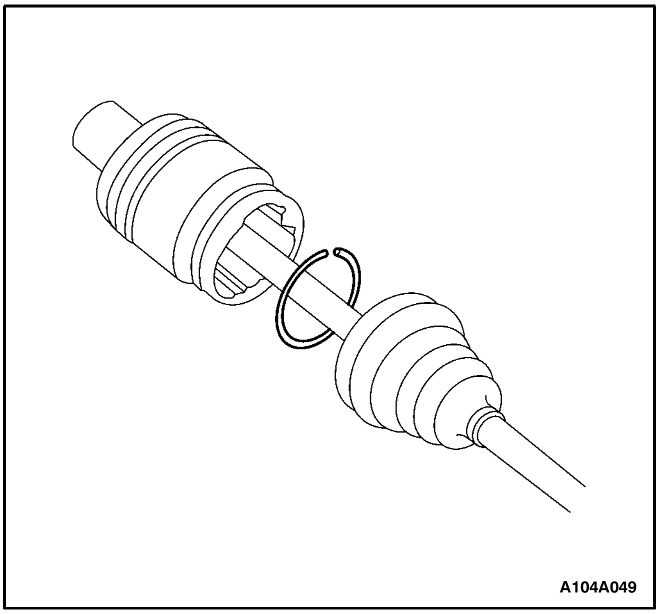
1. Install a new small seal retaining clamp onto the seal. Do not crimp the seal retaining clamp.
2. Install the seal onto the axle shaft.
3. Install the tripot onto the axle shaft.



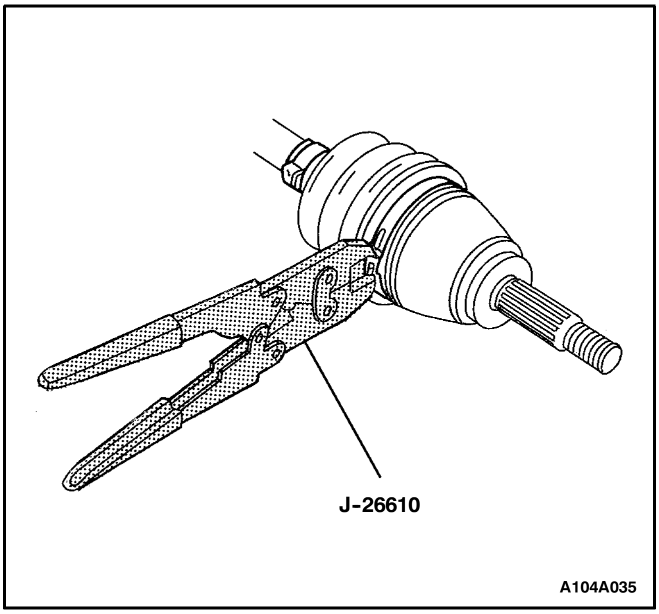
4. Install the shaft retaining ring onto the axle shaft using the snap ring pliers J-8059.



5. Fill the tripot housing with 140 to 160 g (4.9 to 5.6 ounces) of the recommended grease. Repack the tripot with 140 to 160 g (4.9 to 5.6 ounces) of the recommended grease.
6. Install the tripot housing onto the tripot assembly.



7. Install the race retaining ring.



8. Install a new large seal retaining clamp. Crimp the large seal retaining clamp using the seal clamp pliers J-26610.
9. Crimp the new small seal retaining clamp using the seal clamp pliers J-26610.

GENERAL DESCRIPTION AND SYSTEM OPERATION

FRONT DRIVE AXLE

General Description

Drive axles are flexible shaft assemblies that transmit rotational force from the transaxle to the front-wheel assemblies. Each axle assembly consists of an inner and an outer constant-velocity joint connected to an axle shaft. The inner joint is completely flexible and has the ability to move in and out. The outer joint is also flexible, but it cannot move in and out.

The drive axles use one type of outboard joint and one type of inboard joint. The inboard ends of both drive axles incorporate a female spline that installs over a stub shaft protruding from the transaxle.

SECTION 3B

MANUAL TRANSAXLE DRIVE AXLE

TABLE OF CONTENTS

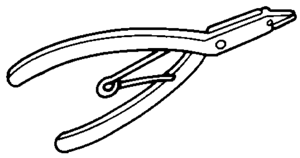
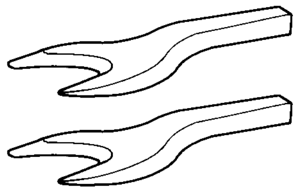
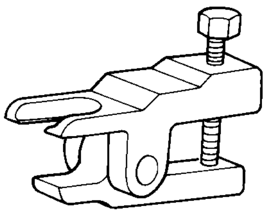
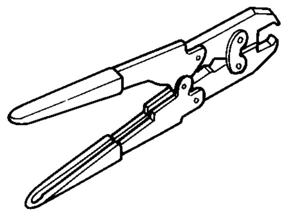
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Axle Shaft Castle Nut Initial Torque	100	74	-
Axle Shaft Castle Nut Final Torque	20 +90°	15 +90°	-
Axle Shaft Caulking Nut Initial Torque	180	134	-
Axle Shaft Caulking Nut Final Torque	50 +60°	37 +60°	-
Lower Ball Joint Nut	70	52	-
Tie Rod Nut	60	44	-
Wheel Bolts	90	66	-

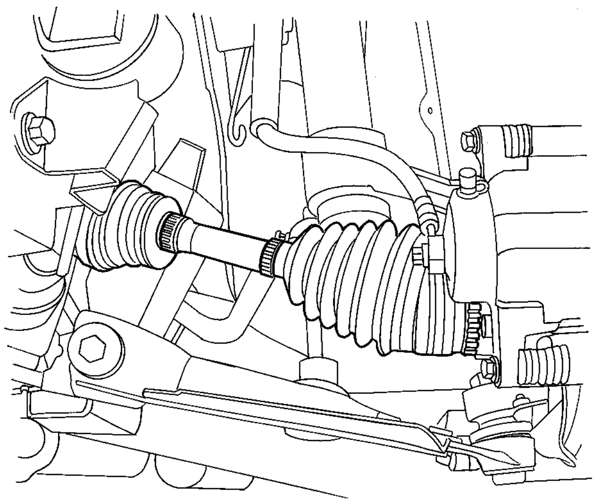
SPECIAL TOOLS

SPECIAL TOOLS TABLE

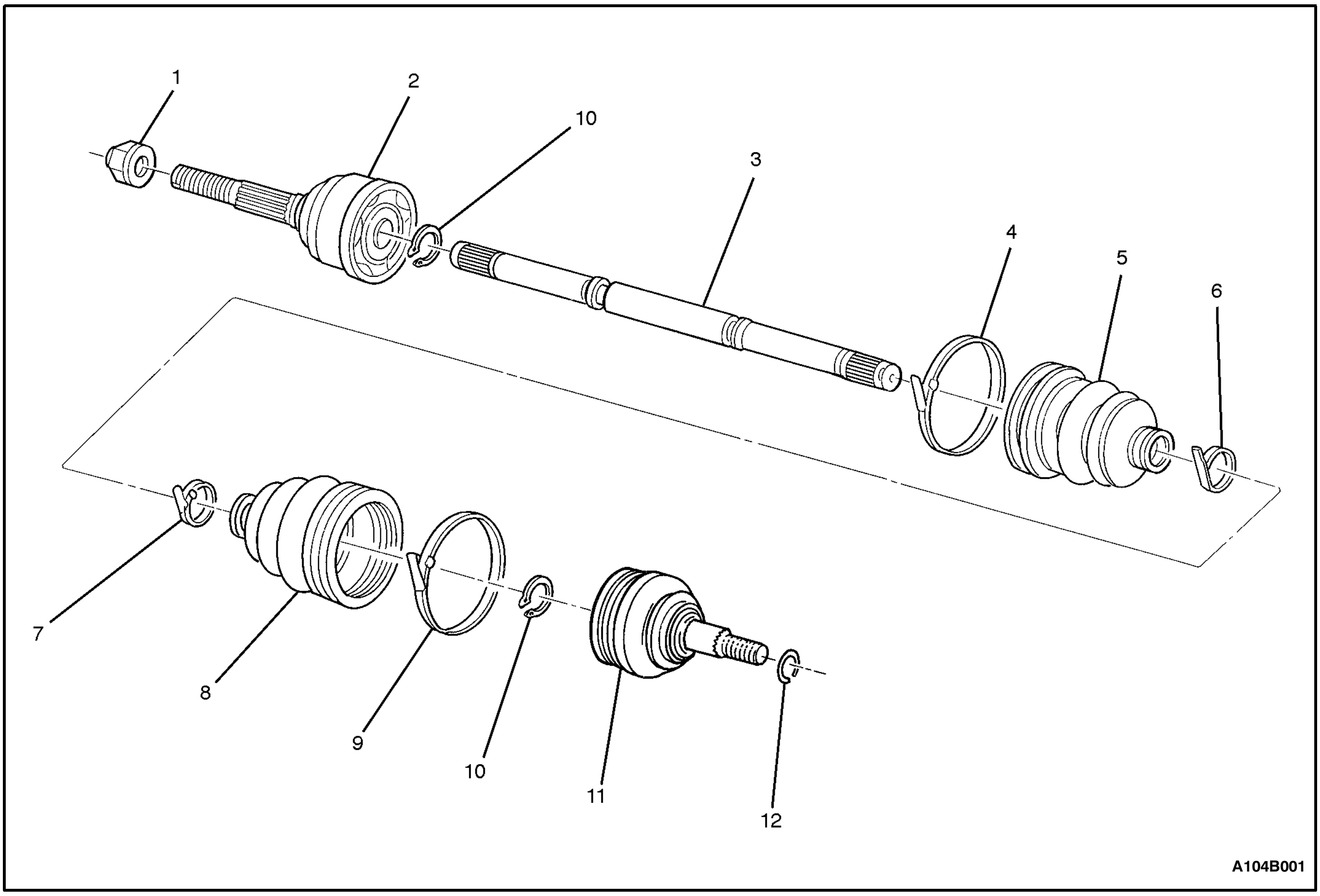
 A104A001	J-8059 Snap Ring Pliers	 A106C032	KM-460-A Axle Shaft Remover
 A106C034	KM-507-B Ball Joint Remover	 A104A008	J-35566 Seal Clamp Pliers

COMPONENT LOCATOR

FRONT DRIVE AXLE



A104A023



1	Caulking Nut	7	Seal Retaining Clamp
2	C/V Joint	8	Drive Axle Inboard Seal
3	Axle Shaft	9	Seal Retaining Clamp
4	Seal Retaining Clamp	10	Race Retaining Ring
5	Drive Axle Outboard Seal	11	Cross Groove Joint
6	Seal Retaining Clamp	12	Retaining Ring

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

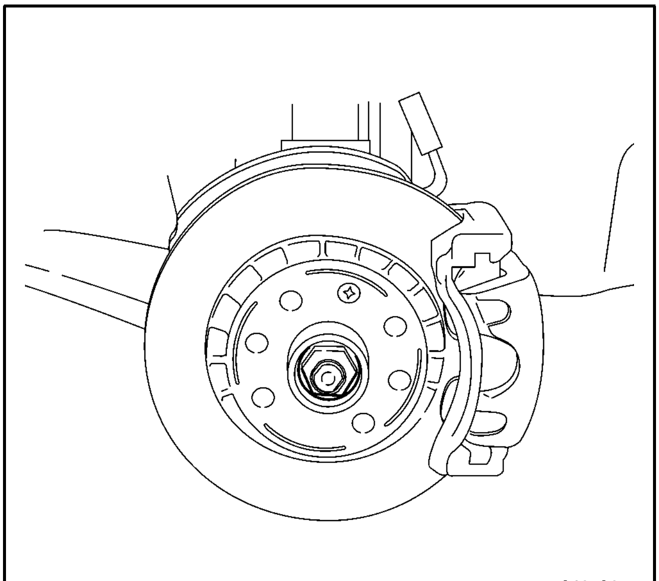
DRIVE AXLE ASSEMBLY

Tools Required

KM-507-B Ball Joint Separator

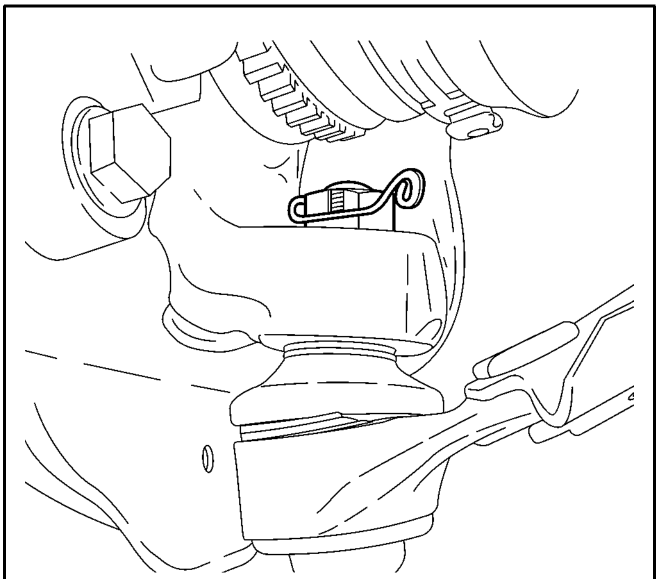
KM-460-A Axle Shaft Remover

Removal Procedure



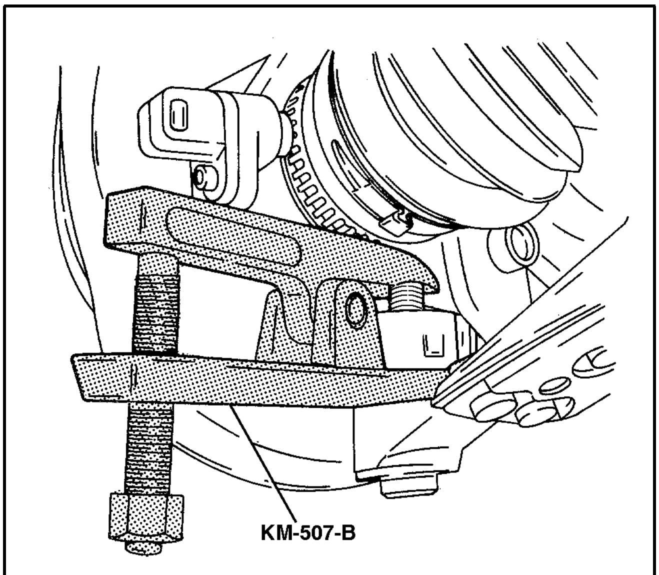
A104A045

1. Raise and suitably support the vehicle.
2. Remove the wheels. Refer to Section 2E, Tires and Wheels.
3. Remove the engine under covers. Refer to Section 9N, Frame and Underbody.
4. Remove the axle shaft caulking nut. Discard the nut.



A104A040

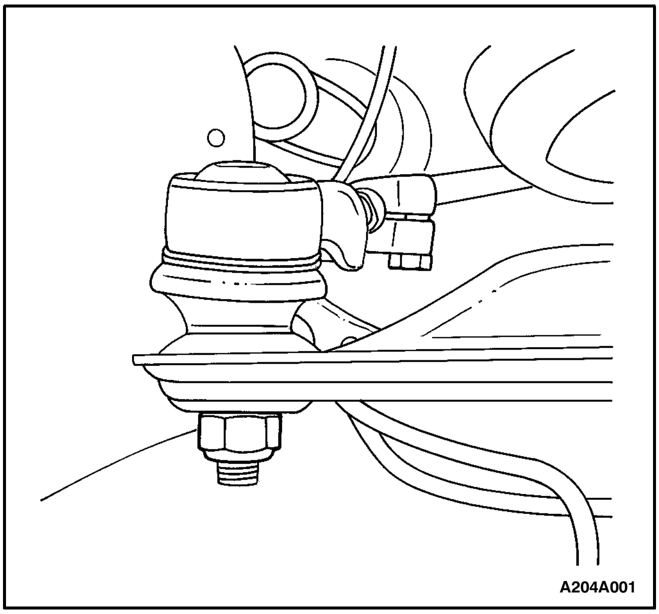
5. Remove the lower ball joint retaining clip and the nut.



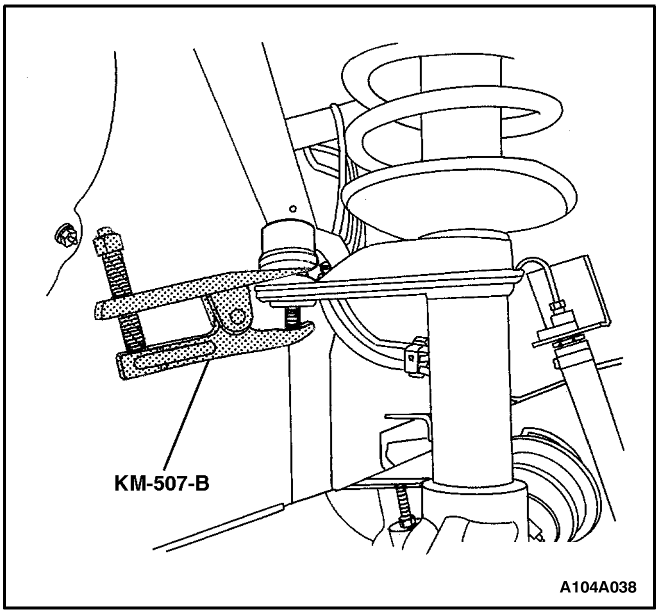
A106C041

Notice: Use only the recommended tool for separating the lower ball joint. Failure to use the recommended tool may damage the ball joint and the seal.

6. Separate the steering knuckle from the lower ball joint using the ball joint separator KM-507-B.

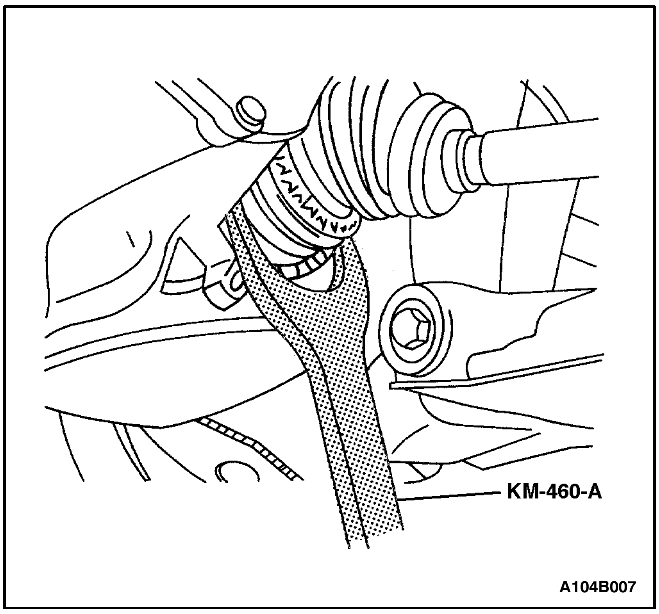


7. Remove the tie rod nut.



Notice: Use only the recommended tool for separating the tie rod from the knuckle/strut assembly. Failure to use the recommended tool may damage the knuckle/ strut assembly.

8. Separate the tie rod end using the ball joint separator KM-507-B.

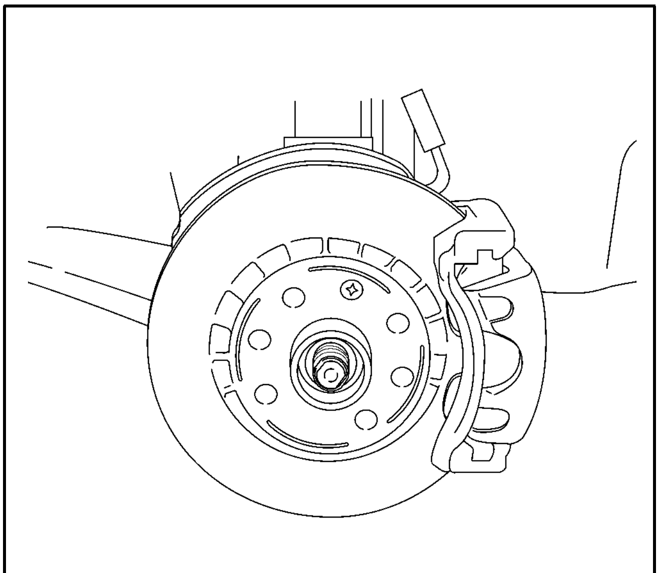


9. Push the drive axle shaft from the wheel hub.

Important: Support the unfastened end of the drive axle. Do not allow the drive axle to dangle freely from the transaxle for any length of time after it has been removed from the wheel hub.

Important: Place a drain pan below the transaxle to catch the escaping fluid. Cap the transaxle drive opening after the drive axle has been removed to keep the fluid in and any contamination out.

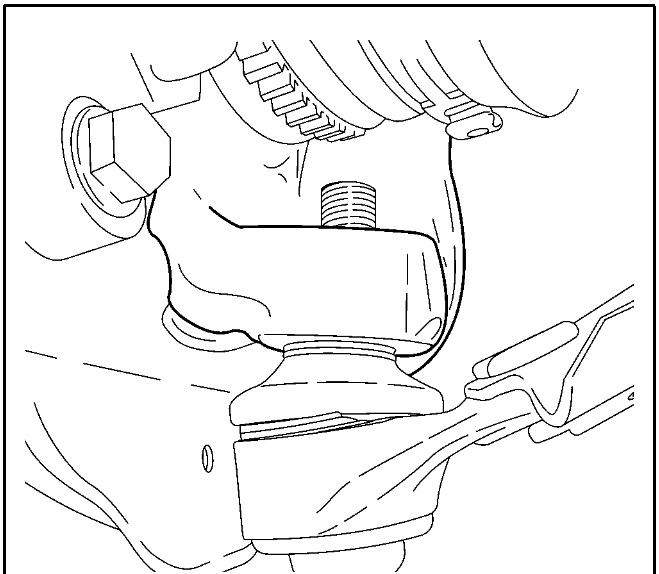
10. Remove the drive axle from the transaxle using the axle shaft remover KM-460-A.


A104A047

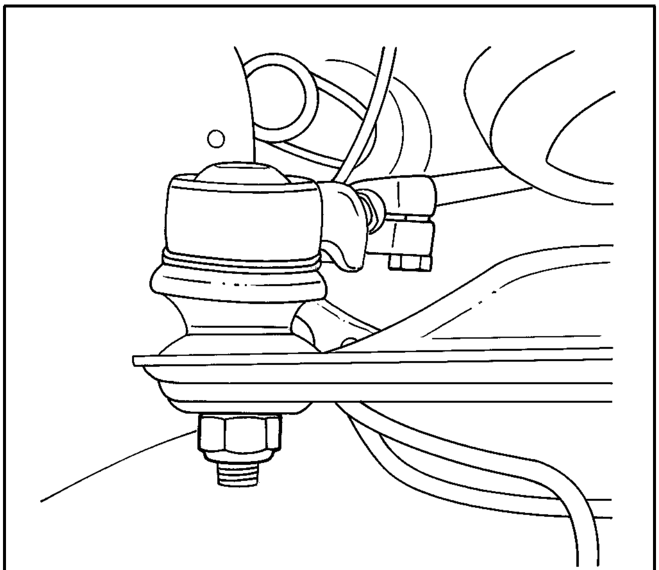
Installation Procedure

Notice: Do not damage the seal.

1. Clean the hub seal and the transaxle seal.
2. Install the drive axle into the transaxle.
3. Install the wheel hub onto the drive axle shaft.


A104A037

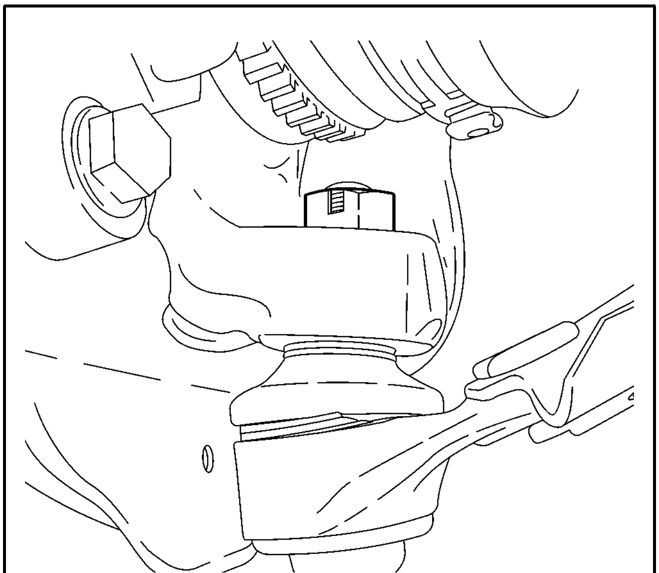
4. Mount the steering knuckle onto the lower ball joint.


A204A001

5. Install the tie rod into the knuckle/strut and install the tie rod nut.

Tighten

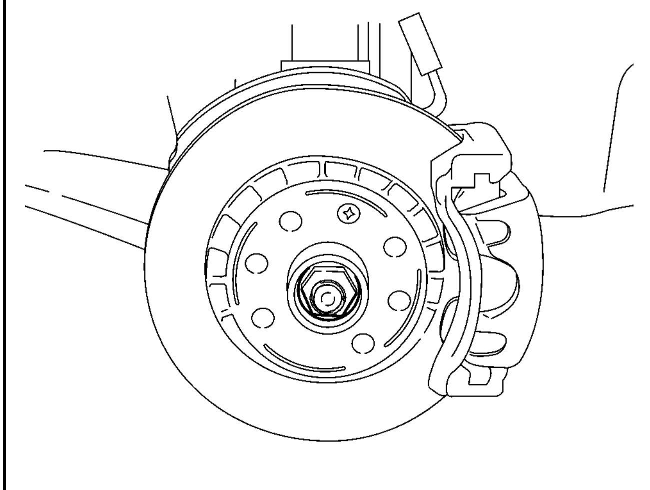
Tighten the tie rod nut to 60 N•m (44 lb-ft).


A104A041

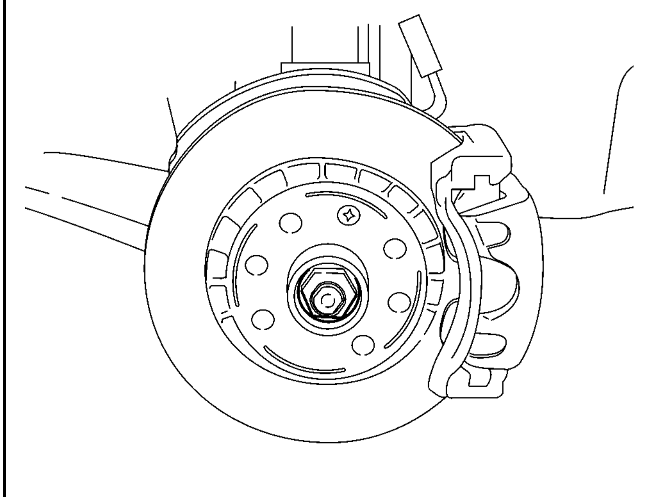
6. Install the lower ball joint nut.

Tighten

Tighten the lower ball joint nut to 70 N•m (52 lb-ft).


A104A048

7. Loosely install a new axle shaft caulking nut. Always use a new nut.
8. Install the wheels. Loosely install the bolts. Refer to Section 2E, Tires and Wheels.


A104A045

9. Lower the vehicle to the floor.

Tighten

Tighten the wheel bolts to 90 N•m (66 lb-ft).

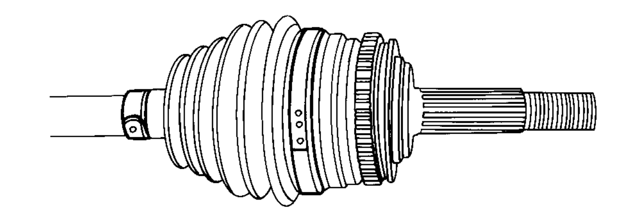
Tighten

Tighten the axle shaft caulking nut to 180 N•m (134 lb-ft). Loosen the nut and re-tighten the nut to 50 N•m (37 lb-ft). Then tighten the nut further by 60 degrees.

10. Peen the caulking nut with a punch and a hammer until the nut is locked into place on the axle shaft hub.

A104A042

11. Install the retaining clip to the lower ball joint.
12. Install the engine under covers. Refer to Section 9N, Frame and Underbody.
13. Refill the transaxle fluid to the proper level. Refer to Section 5B, Five-Speed Manual Transaxle.



A104A020

UNIT REPAIR

OUTER JOINT SEAL

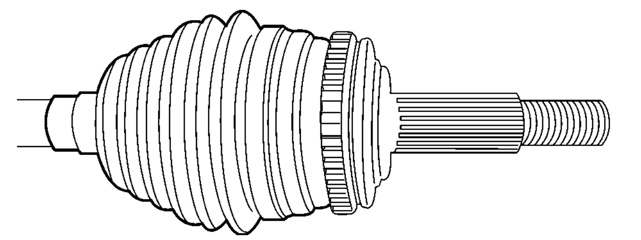
Tools Required

J-8059 Snap Ring Pliers

J-35566 Seal Clamp Pliers

Removal Procedure

1. Remove the cross groove joint seal assembly. See "Cross Groove Joint Seal" in this section.
2. Remove the large seal retaining clamp. Discard the clamp.
3. Remove the small seal retaining clamp. Discard the clamp.

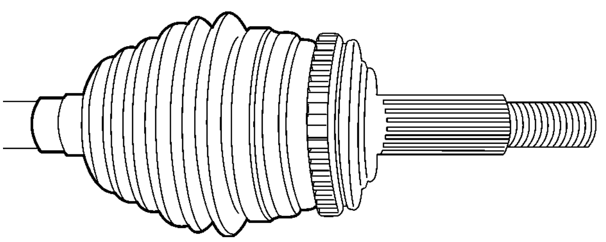


A104A044

4. Degrease the joint.

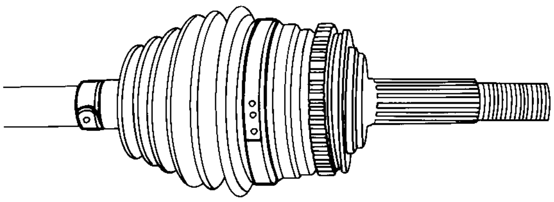
Caution: Do not remove the axle shaft from the outer joint assembly or disassemble the outer joint assembly. Parts are match fit and cannot be serviced separately. Improper reassembly will adversely affect both performance and safety.

5. Remove the seal from the joint assembly.

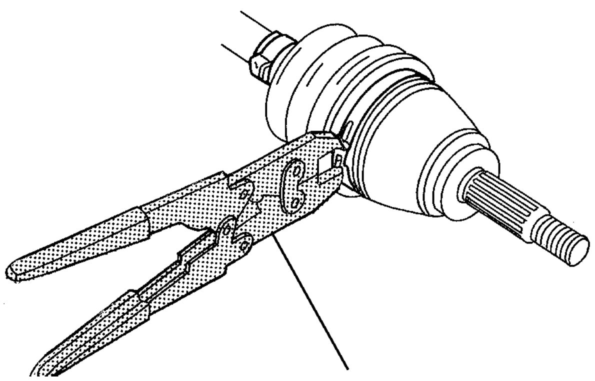

A104A044

Installation Procedure

1. Install the seal onto the axle shaft.
2. Fill the joint seal with 175 to 195 g (6.2 to 6.8 ounces) of the recommended grease. Repack the joint with 175 to 195 g (6.2 to 6.8 ounces] of the recommended grease.


A104A020

3. Install a new large seal retaining clamp and a new small seal retaining clamp.



A104A016

4. Crimp the new small seal retaining clamp and the new large seal retaining clamp using the seal clamp pliers J-35566.
5. Install the cross groove joint seal assembly. Refer to the "Cross Groove Joint Seal" in this section.

CROSS GROOVE JOINT SEAL

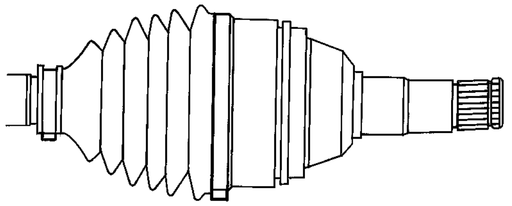
Tools Required

J-26610 Seal Clamp Pliers

J-8059 Snap Ring Pliers

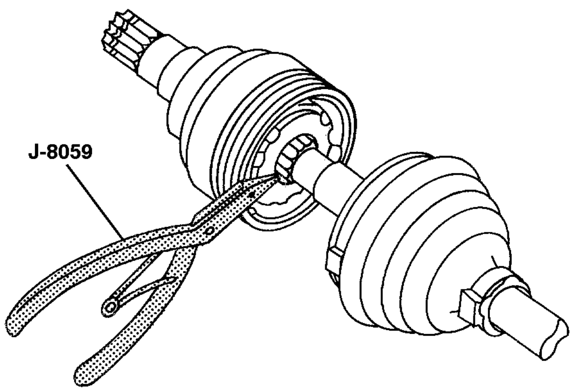
Removal Procedure

1. Remove the large seal retaining clamp. Discard the clamp.
2. Remove the small seal retaining clamp. Discard the clamp.



A104B002

3. Degrease the joint.
4. Remove the shaft retaining ring using the snap ring pliers J-8059.

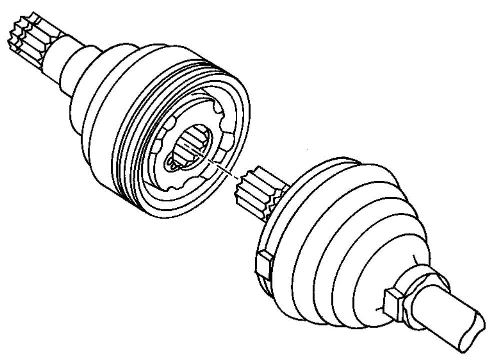


A104B003

5. Remove the axle shaft from the joint assembly.

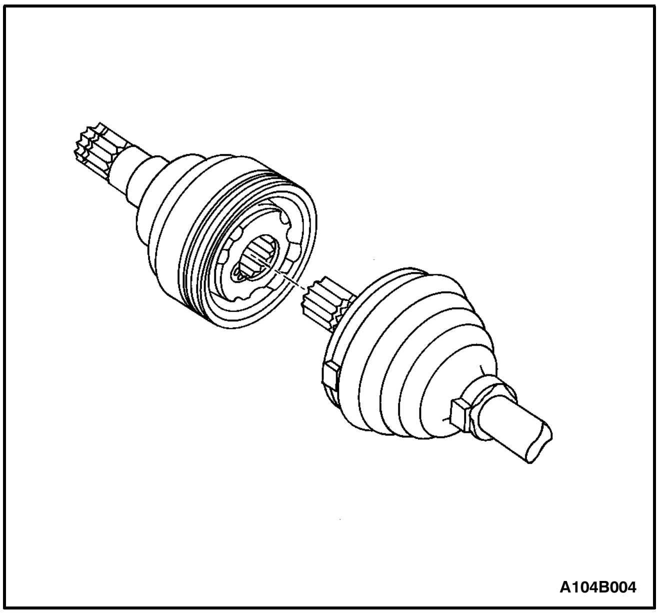
Caution: The ball retainer is staked in position and must not be disassembled. Cross groove joint internal parts are match fit and cannot be serviced separately. Improper reassembly will adversely affect both performance and safety.

6. Remove the seal from the joint assembly.

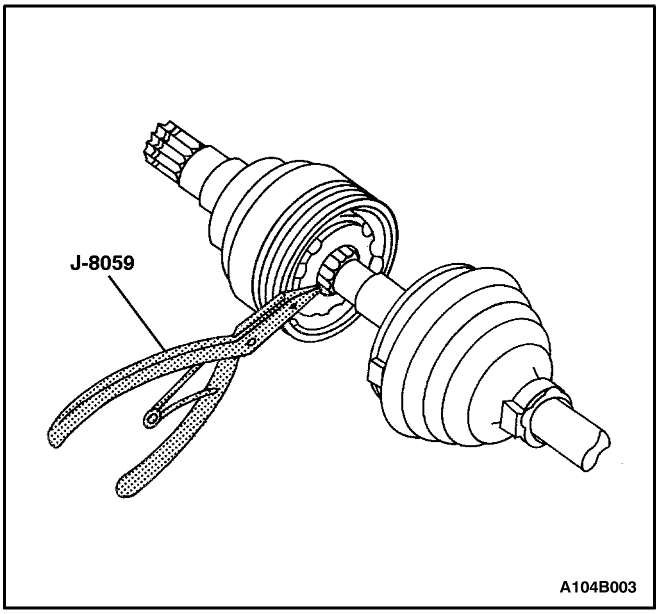


A104B004

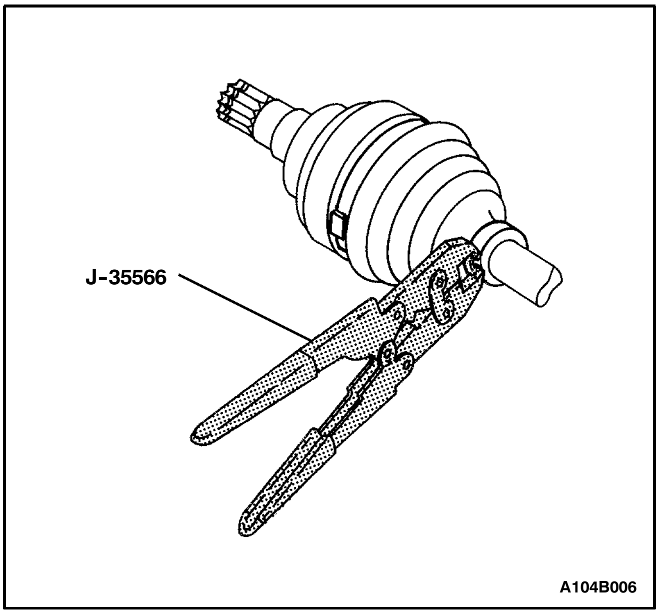
Installation Procedure



1. Install a new small retaining clamp onto the seal. Do not crimp.
2. Install the seal onto the axle shaft.
3. Install the joint assembly onto the axle shaft.



4. Install the shaft retaining ring using the snap ring pliers J-8059.



5. Fill the joint assembly with 120 to 140 g (4.2 to 4.9 ounces) of the recommended grease. Repack the joint seal with 120 to 140 g (4.2 to 4.9 ounces) of the recommended grease.
6. Install a new large seal retaining clamp.
7. Crimp the new large seal retaining clamp using the seal clamp pliers J-35566.
8. Crimp the new small retaining clamp using the seal clamp pliers J-35566.

GENERAL DESCRIPTION AND SYSTEM OPERATION

FRONT DRIVE AXLE

General Description

Drive axles are flexible shaft assemblies that transmit a rotational force from the transaxle to the front-wheel assemblies. Each axle assembly consists of an inner constant-velocity joint and an outer constant-velocity joint connected to an axle shaft. The inner joint is completely flexible and has the ability to move in and out. The outer joint is also flexible, but it cannot move in and out.

The drive axles use one type of outboard joint and one type of inboard joint. The inboard ends of both drive axles incorporate a male spline that interlocks with the transaxle gears using snap rings.

SECTION 4A
HYDRAULIC BRAKES

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS
GENERAL SPECIFICATIONS

	1.3/1.5 SOHC Engine		1.6 DOHC Engine	
Application	Millimeters	Inches	Millimeters	Inches
Brake Drums:				
Inside Diameter	200.00	7.87	200.00	7.87
Maximum Rebore Diameter	201.00	7.91	201.00	7.91
Out-of-Round	0.050	0.002	0.050	0.002
Brake Rotors:				
Discard Thickness	19.00	0.75	23.00	0.90
Lateral Runout (Installed)	0.030	0.001	0.030	0.001
Rotor Diameter	236.00	9.29	256.00	10.08
Rotor Thickness (New)	20.00	0.79	24.00	0.95
Thickness Variation	0.005	0.0002	0.005	0.0002
Master Cylinder:				
Bore Diameter	20.71	0.82	22.29	0.88
Minimum Bore Diameter	20.64	0.81	22.22	0.88
Caliper:				
Piston Minimum Diameter	47.99	1.89	51.99	2.05
Wheel Cylinder Diameter:				
Maximum	17.460	0.687	19.050	0.750
Nominal	17.529	0.690	19.116	0.753

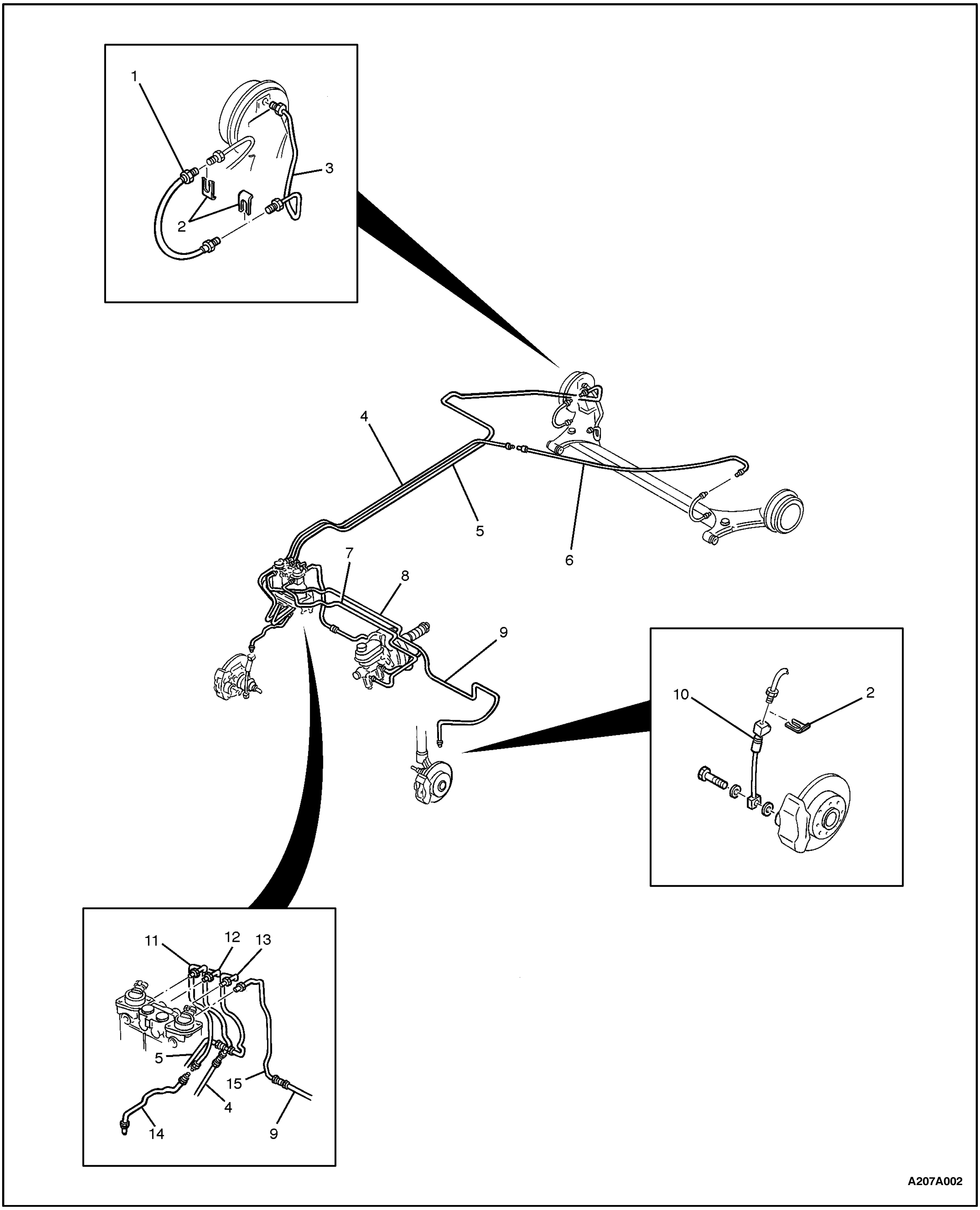
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Bleeder Screw	9	-	80
Brake Lines	16	12	-
Brake Pedal-to-Pedal Bracket Hex Nut	18	13	-
Front Brake Hose-to-Caliper Bolt	40	30	-
Trim Panel Screws	7	-	62

COMPONENT LOCATOR

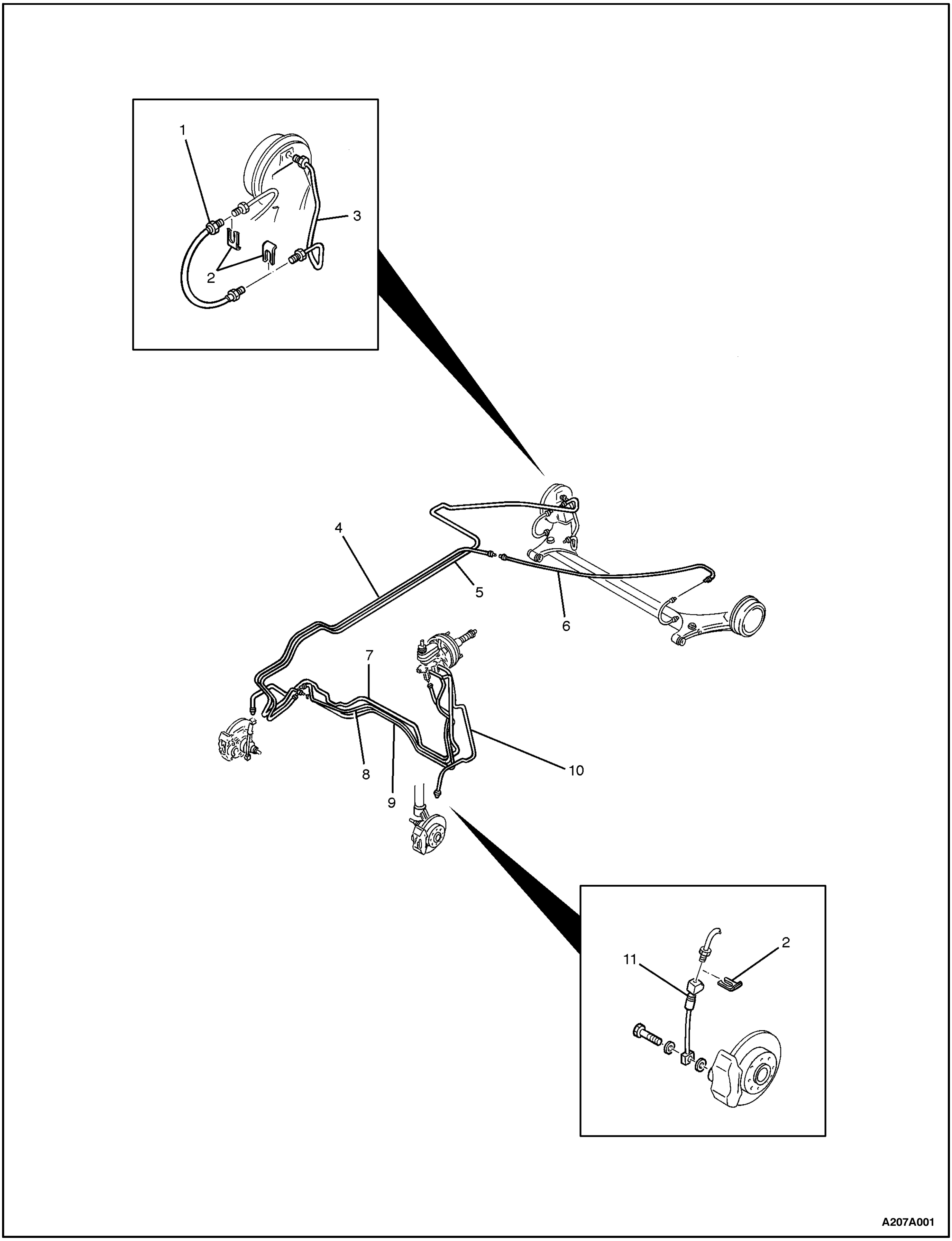
BRAKE SYSTEM (ABS)

(Left-Hand Drive Shown, Right-Hand Drive Similar)



1 Rear Brake Hose
2 E-ring
3 Rear Brake Pipe
4 LH 2nd Rear Brake Pipe
5 RH 2nd Rear Brake Pipe
6 3rd Rear Brake Pipe
7 Secondary Brake Pipe
8 Primary Brake Pipe
9 LH 2nd Front Brake Pipe
10 Brake Hose
11 RH 1st Front Brake Pipe
12 RH 1st Rear Brake Pipe
13 LH 1st Rear Brake Pipe
14 RH 2nd Front Brake Pipe
15 LH 1st Front Brake Pipe

BRAKE SYSTEM (NON-ABS)



1 LH or RH Rear Brake Hose
2 E-ring
3 LH or RH Rear Brake Pipe
4 LH 2nd Rear Brake Pipe
5 RH 2nd Rear Brake Pipe
6 3rd Rear Brake Pipe
7 RH Front Brake Pipe
8 RH 1st Rear Brake Pipe
9 LH 1st Rear Brake Pipe
10 LH Front Brake Pipe
11 Brake Hose

DIAGNOSIS

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy, or covered with loose dirt whereby all tires do not grip the road equally. Testing will also be adversely affected if the roadway is crowned so as to throw the weight so roughly that the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light and heavy pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency since heavily braked, but turning, wheels will stop the vehicle in less distance than locked brakes. More tire-to-road friction is present with a heavily braked, turning tire than with a sliding tire.

Because of the high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

There are three major external conditions that affect brake performance:

- Tires having unequal contact and grip of the road will cause unequal braking. Tires must be equally inflated, and the tread pattern of the right and the left tires must be approximately equal.
- Unequal loading of the vehicle can affect the brake performance since the most heavily loaded wheels require more braking power, and thus more braking effort, than the others.
- Misalignment of the wheels, particularly conditions of excessive camber and caster, will cause the brakes to pull to one side.

To check for brake fluid leaks, hold constant foot pressure on the pedal with the engine running at idle and the shift lever in N (Neutral). If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leaks.

Check the master cylinder fluid level. While a slight drop in the reservoir level results from normal lining wear, an abnormally low level indicates a leak in the system. The hydraulic system may be leaking either internally or externally. Refer to the procedure below to check the master cylinder. Also, the system may appear to pass this test while still having a slight leak. If the fluid level is normal, check the vacuum booster pushrod length. If an incorrect pushrod length is found, adjust or replace the rod.

Check the master cylinder using the following procedure:

- Check for a cracked master cylinder casting or brake fluid leaking around the master cylinder. Leaks are indicated only if there is at least one drop of fluid. A damp condition is not abnormal.
- Check for a binding pedal linkage and for an incorrect pushrod length. If both of these parts are in satisfactory condition, disassemble the master cylinder and check for an elongated or swollen primary cylinder or piston seals. If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated brake fluid is found, all the components should be disassembled and cleaned, and all the rubber components should be replaced. All of the pipes must also be flushed.

Improper brake fluid, or mineral oil or water in the fluid, may cause the brake fluid to boil or cause deterioration of the rubber components. If the primary piston cups in the master cylinder are swollen, then the rubber parts have deteriorated. This deterioration may also be evidenced by swollen wheel cylinder piston seals on the drum brake wheels.

If rubber deterioration is evident, disassemble all the hydraulic parts and wash the parts with alcohol. Dry these parts with compressed air before reassembly to keep alcohol out of the system. Replace all the rubber parts in the system, including the hoses. Also, when working on the brake mechanisms, check for fluid on the linings. If excessive fluid is found, replace the linings.

If the master cylinder piston seals are in satisfactory condition, check for leaks or excessive heat conditions. If these conditions are not found, drain the fluid, flush the master cylinder with brake fluid, refill the master cylinder, and bleed the system. Refer to "Manual Bleeding the Brakes" or "Pressure Bleeding the Brakes" in this section.

BRAKE HOSE INSPECTION

The hydraulic brake hoses should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, cracks, chafing of the outer cover, and for leaks or blisters. Inspect the hoses for proper routing and mounting. A brake hose that rubs on a suspension component will wear and eventually fail. A light and a mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, adjust or replace the hose as necessary.

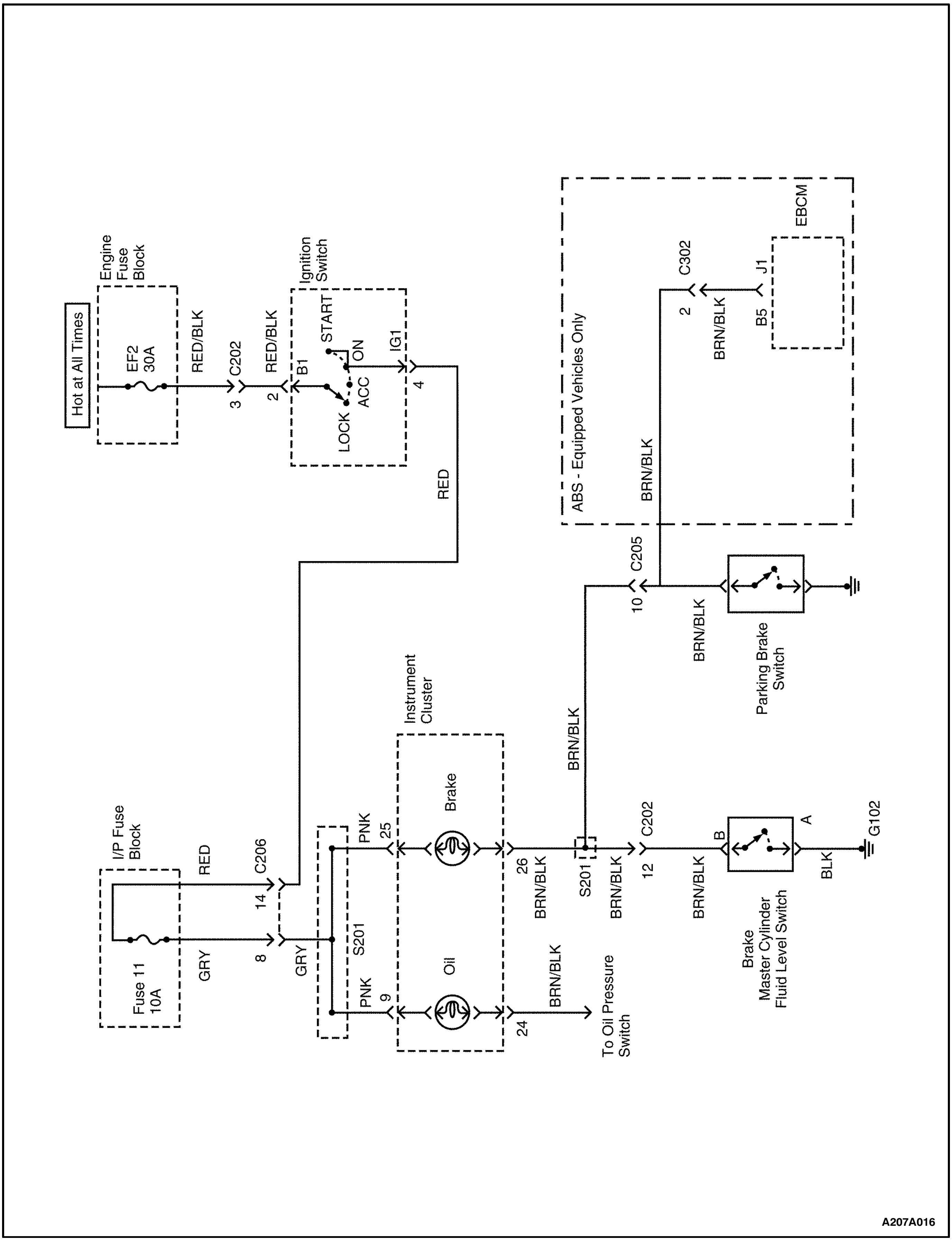
WARNING LAMP OPERATION

This brake system uses a BRAKE warning lamp located in the instrument panel cluster. When the ignition switch is in the START position, the BRAKE warning lamp should glow and then go off when the ignition switch returns to the RUN position.

The following conditions will activate the BRAKE lamp:

- Parking brake applied. The light should be on whenever the parking brake is applied and the ignition switch is ON.
- Low fluid level. A low fluid level in the master cylinder will turn the BRAKE lamp on.

BRAKE LAMP WARNING CIRCUIT DIAGNOSIS



Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. There are three possible symptoms of a problem: the brake warning lamp is always on; the brake warning lamp is never on; the brake warning lamp will not operate for a particular function. This test takes you to the appropriate starting point in the procedure.
2. This test checks whether the Antilock Brake System (ABS) system has turned on the brake warning lamp. If the vehicle is not equipped with ABS, the answer will be NO.

4, 5. These steps test for simple conditions that can turn on the brake warning lamp.

7. This checks whether the brake fluid level switch is faulty.
9. This checks whether the parking brake switch is faulty.
12. This removes the circuit to the electronic brake control module (EBCM) in a vehicle with ABS.
14. This removes the parking brake switch circuit.
16. This removes the brake fluid level switch circuit.
18. This checks the only remaining circuitry that can activate the brake warning lamp.
20. This tests for the presence of battery voltage used by both the oil pressure lamp and the brake warning lamp.
21. This step begins a sequence that will restore voltage to the lamps.
29. This checks for a burned out indicator lamp.
31. This begins a sequence that will find the open that prevents contact to ground needed to operate the lamp.
33. This checks whether the ABS system has tried to turn on the brake warning lamp and could not. If the vehicle is not equipped with ABS, the answer is NO.
34. This step begins a search for a problem in the parking brake switch circuit.
38. This step begins a search for a problem in the brake fluid level switch circuit.

Brake Lamp Warning Circuit Diagnosis

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the brake warning lamp always on?	-	Go to Step 2	Go to Step 19
2	Check the ABS warning lamp. Is the ABS warning lamp also on?	-	Go to Step 3	Go to Step 4
3	Use a scan tool to check for diagnostic trouble codes (DTCs) and follow the procedures for any DTCs found. Is the lamp still on?	-	Go to Step 4	System OK
4	Release the parking brake fully. Is the lamp off?	-	System OK	Go to Step 5
5	Check the brake fluid level. Is the fluid level acceptable?	-	Go to Step 7	Go to Step 6
6	1. Fill the brake fluid reservoir with clean DOT 3 equivalent hydraulic fluid. 2. Replace the cap on the brake fluid reservoir. Is the lamp still on?	-	Go to Step 7	System OK
7	Unplug the harness connector from the brake fluid sensor switch. Is the lamp still on?	-	Go to Step 9	Go to Step 8
8	Replace the brake fluid level switch. Is the repair complete?	-	System OK	-
9	1. Reconnect the brake fluid level switch. 2. Remove the rear console cover to expose the parking brake mechanism. 3. Release the brake completely. 4. Slide off the terminal with the BRN/BLK wire from the wiring harness. Does the lamp go out?	-	Go to Step 10	Go to Step 11
10	Replace the switch. Is the repair complete?	-	System OK	-
11	Replace the terminal back onto the switch. Is the vehicle equipped with ABS?	-	Go to Step 12	Go to Step 14
12	Unplug connector C302. This is a flat, 6-pin connector found under the passenger seat near the engine control module (ECM). Does the lamp go out?	-	Go to Step 13	Go to Step 14
13	Repair the short to ground in circuit BRN/BLK between terminal 2 of connector C302 and terminal B5 of connector J1 on the EBCM. Is the repair complete?	-	System OK	-
14	Disconnect connector C205. This is the large connector in the center of the connection block behind the left-side kick panel. Is the lamp still on?	-	Go to Step 16	Go to Step 15
15	Repair the short to ground in circuit BRN/BLK between connector C205 and connector C302 or between connector C205 and the parking brake switch. Is the repair complete?	-	System OK	-

Brake Light Warning Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
16	Disconnect connector C202. This is the 18-pin connector to the front harness just above the left side kick panel, near the grommet that allows that harness through the fire wall. Does the lamp go out?	-	Go to Step 17	Go to Step 18
17	Repair the short to ground in circuit BRN/BLK between connector C202 and the brake fluid level switch. Is the repair complete?	-	System OK	-
18	Repair the short to ground in circuit BRN/BLK between terminal 25 of the instrument cluster and splice S201, or between S201 and connector C202 or connector C205. Is the repair complete?	-	System OK	-
19	Check the brake lamp after doing each of the following functions: • Apply the parking brake. • Remove the cap from the brake fluid reservoir. • Command the lamp on using a scan tool. Does the brake warning lamp operate for any of these conditions?	-	Go to Step 32	Go to Step 20
20	Turn the ignition ON. Does the oil pressure indicator light?	-	Go to Step 27	Go to Step 21
21	Check fuse 11 in the I/P fuse block behind the left-side kick panel. Is the fuse in good condition?	-	Go to Step 23	Go to Step 22
22	Replace fuse 11 with another 10-amp fuse. Does the brake warning lamp function now?	-	System OK	-
23	Check EF2 in the engine fuse block. Is EF2 in good condition?	-	Go to Step 25	Go to Step 24
24	Replace EF2 with another 30-amp device. Is the repair complete?	-	System OK	-
25	1. Unplug C206 from the connection box behind the left-side kick panel. This is the large connector at the bottom of the box. 2. Use a digital volt meter (DVM) to measure voltage from terminal 8 of the connector in the box to ground. This is the fourth pin from the left on the top row as you face the connection box. Does the DVM indicate the specified voltage?	11-14 v	Go to Step 27	Go to Step 26
26	Repair the open in circuit GRY from connector C206 in the connection box fuse 11 in the I/P fuse block. Is the repair complete?	-	System OK	-
27	1. Reconnect harness connector C206 to the connection box. 2. Gain access to the rear of the instrument cluster. 3. Unplug the instrument 10-pin cluster connector. 4. Use a DVM to measure the voltage from terminal 26 of the 10-pin cluster connector to ground. Does the DVM show the specified value?	11-14 v	Go to Step 28	Go to Step 29

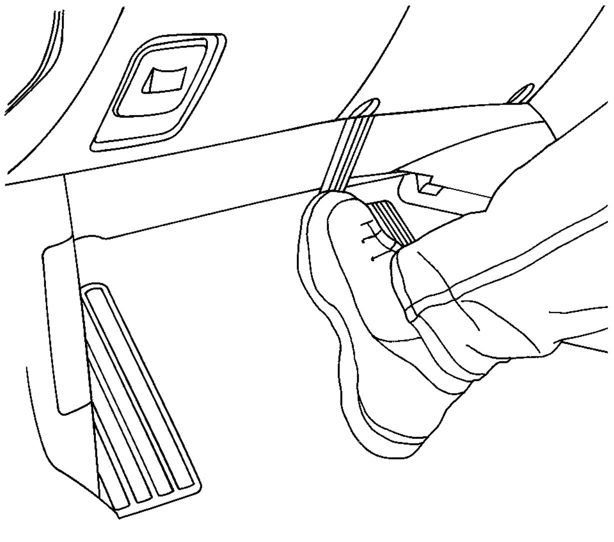
Brake Light Warning Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
28	Repair the open in circuit PNK between the 10-pin instrument cluster connector terminal 26 and splice S201 or from there in circuit GRY to terminal 8 of connector C206. Is the repair complete?	-	System OK	-
29	Remove the brake indicator lamp from its socket and examine it. Is the lamp burned out?	-	Go to Step 30	Go to Step 31
30	Replace the brake indicator lamp. Is the repair complete?	-	System OK	-
31	1. Return the brake indicator lamp to its socket in the instrument cluster. 2. Look for the open in circuit BRN/BLK between terminal 25 of the 10-pin I/P harness cluster connector and splice S201. 3. Repair any open found in circuit BRN/BLK. Is the repair complete?	-	System OK	-
32	Check the ABS lamp. Is the ABS lamp flashing?	-	Go to Step 33	Go to Step 34
33	Use a scan tool to determine what DTCs are present and repair them according to the tables for the DTCs involved. Is the repair complete?	-	System OK	-
34	Try applying the parking brake fully. Does the brake warning lamp fail to light when the parking brake is applied?	-	Go to Step 35	Go to Step 38
35	1. Expose the parking brake mechanism by removing the rear console. 2. Use a jumper to short the terminal from the BRN/BLK wire to ground. Does the lamp come on?	-	Go to Step 36	Go to Step 37
36	Replace the parking brake switch or repair the grounding between the parking brake switch and the brake handle mounting or between the brake handle mounting and the vehicle body. Is the repair complete?	-	System OK	-
37	Repair the open in circuit BRN/BLK. This will be in one of two places: • The I/P harness between splice S201 and terminal 10 of connector C205. • The floor harness between terminal 10 of connector C205 and the parking brake switch. Is the repair complete?	-	System OK	-
38	If the brake warning lamp is not indicating low brake fluid, remove the cap from the brake fluid reservoir to lift the sensor from the brake fluid. Does the lamp come on?	-	System OK	Go to Step 39
39	1. Unplug the harness connector from the sensor on the brake fluid reservoir cap. 2. Use a jumper to short the terminals in the harness connector together. Does the lamp come on?	-	Go to Step 40	Go to Step 41

Brake Light Warning Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
40	Install a new fluid level sensor switch into the brake fluid reservoir. Is the repair complete?	-	System OK	-
41	Use the jumper to short terminal B (BRN/BLK wire) to ground. Does the lamp come on?	-	Go to Step 42	Go to Step 43
42	Repair the open to ground in circuit BLK between the terminal A (BLK wire) of the harness connector for the level sensor switch and ground G102 at the left front corner of the vehicle. Is the repair complete?	-	System OK	-
43	Repair the open in circuit BRN/BLK. There are two possible locations for this open: ● The I/P harness between splice S201 and terminal 12 of connector C202. ● The front harness between terminal 12 of connector C202 and terminal B of the harness connector for the level sensor switch. Is the repair complete?	-	System OK	-

Low brake fluid level in the master cylinder will turn the BRAKE lamp ON. Refer to "Brake System Testing" in this section to test for fluid leaks.


A207A003

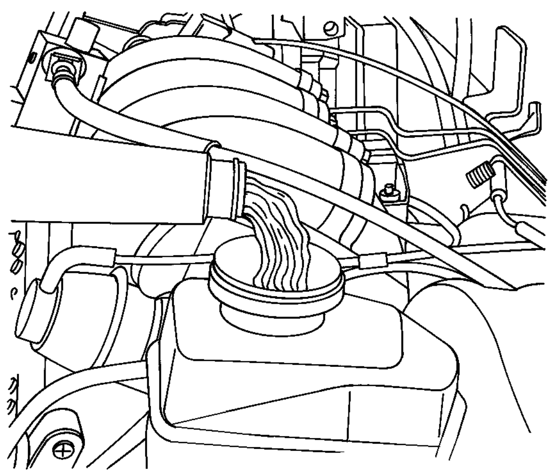
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

MANUAL BLEEDING THE BRAKES

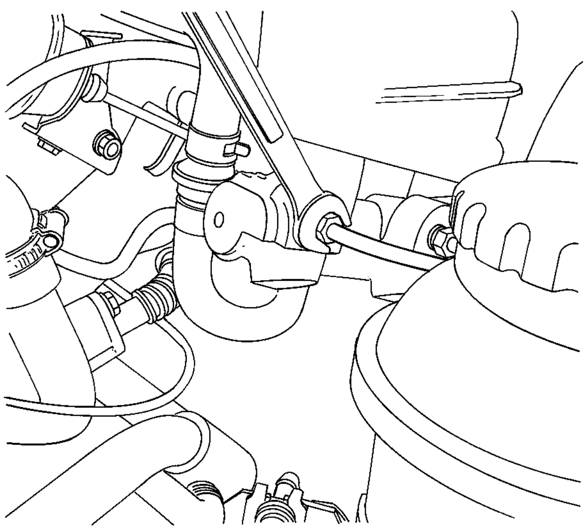
(Left-Hand Drive Shown, Right-Hand Drive Similar)

1. Remove the booster reserve by applying the brakes several times with the engine OFF until all the reserve is depleted.


A207A004

Important: If the master cylinder is known or suspected to have air in the bore, then it must be bled before any wheel cylinder or caliper is bled.

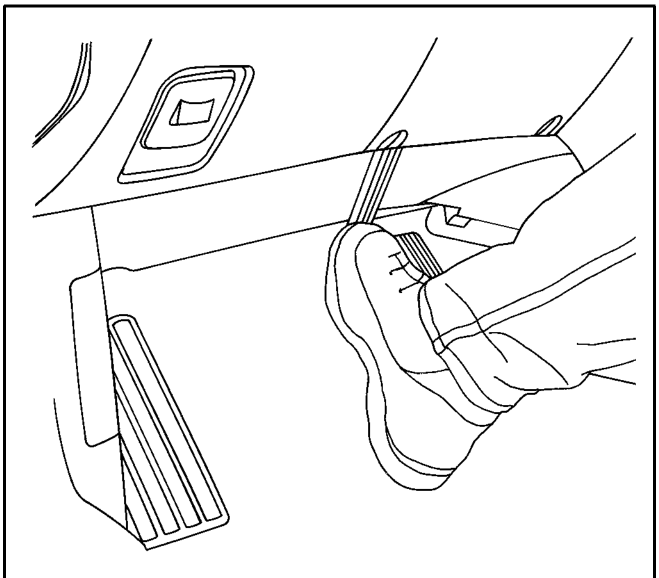
2. Fill the master cylinder reservoir with brake fluid. Keep the master cylinder at least one-half full of fluid during the bleeding operation.


A207A009

3. Disconnect the front brake line(s) at the master cylinder.
4. Allow the brake fluid to fill the master cylinder until it begins to flow from the front pipe connector port.
5. Connect the front brake line(s) to the master cylinder.

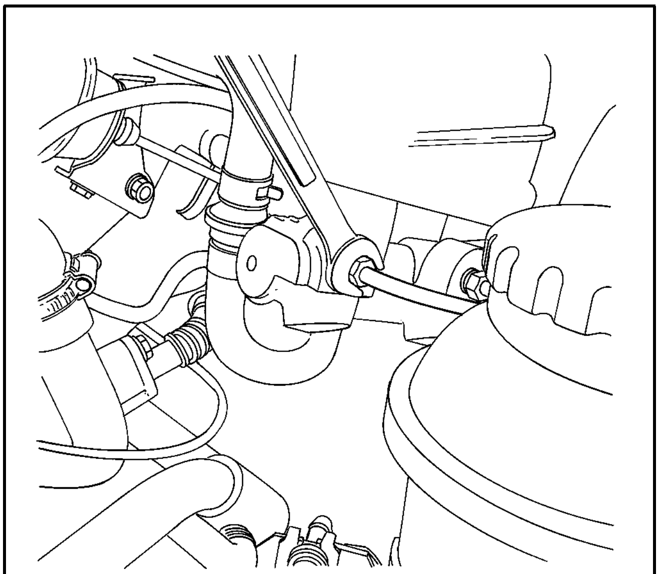
Tighten

Tighten the brake lines to 16 N•m (12 lb-ft).



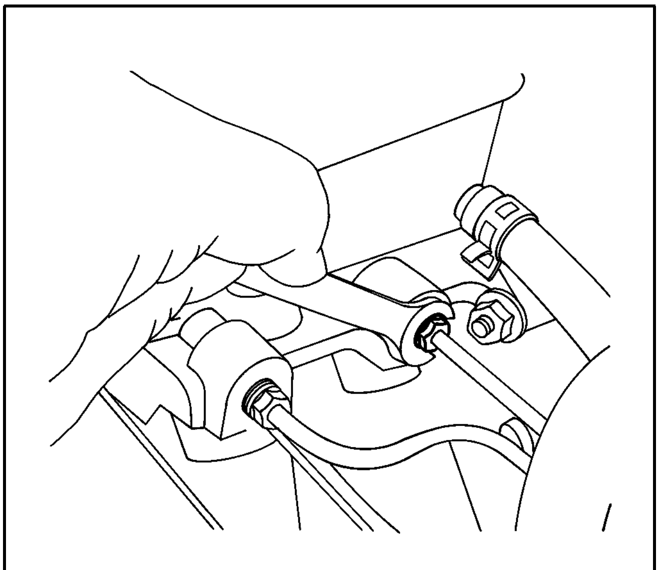
A207A003

6. Slowly push and hold the brake pedal one time.



A207A009

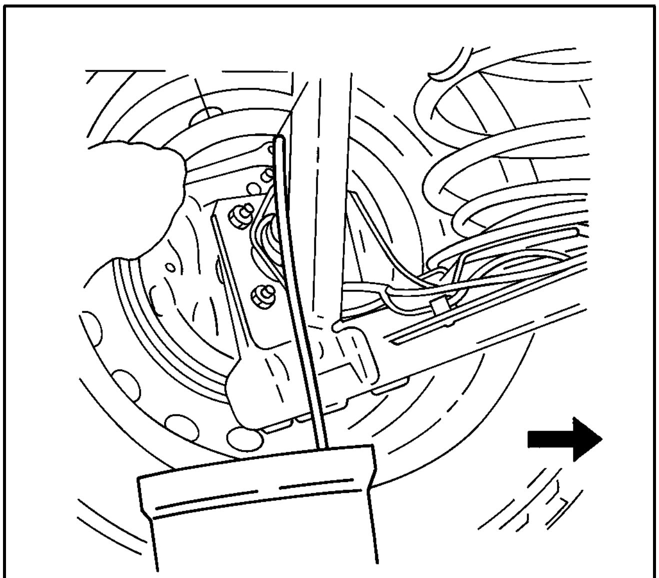
7. Loosen the front brake line at the master cylinder to purge all air from the cylinder.
8. Tighten the brake line as in Step 5, and then release the brake pedal slowly. Wait 15 seconds before proceeding to the next step.
9. Repeat the sequence, including the 15-second wait, until all the air is removed from the master cylinder bore.



A107A004

Notice: Care must be taken to prevent brake fluid from contacting any painted surface to prevent damage to the paint finish.

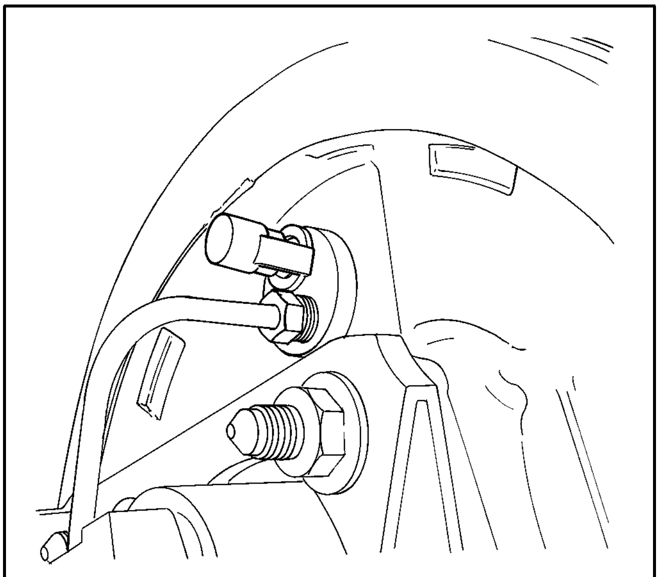
10. After all the air has been removed at the forward connection(s), bleed the master cylinder at the rear (cowl) connection(s) in the same manner as with the front connections.



A107A006

Important: For vehicles equipped with a non-antilock braking system, non-ABS, the bleeding sequence is as follows: right rear, left front, left rear, and right front. For ABS-equipped vehicles, refer to Section 4F, Antilock Brake System for the correct sequence and bleeding procedure.

11. Attach a transparent tube over the valve. Allow the tube to hang submerged in brake fluid in a transparent container.



A207A005

12. Slowly push and hold the brake pedal one time.
13. Remove the bleeder cap and loosen the bleeder screw to purge the air from the cylinder.
14. Tighten the bleeder screw.

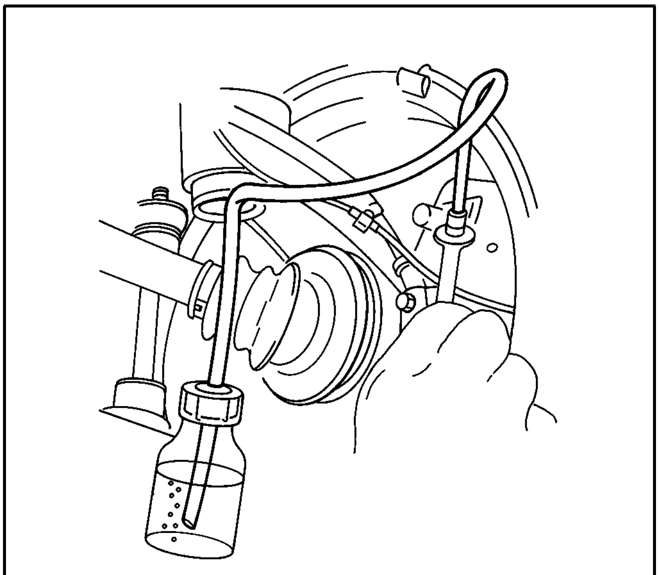
Tighten

Tighten the bleeder screw to 9 N•m (80 lb-in).

15. Slowly release the brake pedal. Wait 15 seconds before proceeding with the next step.

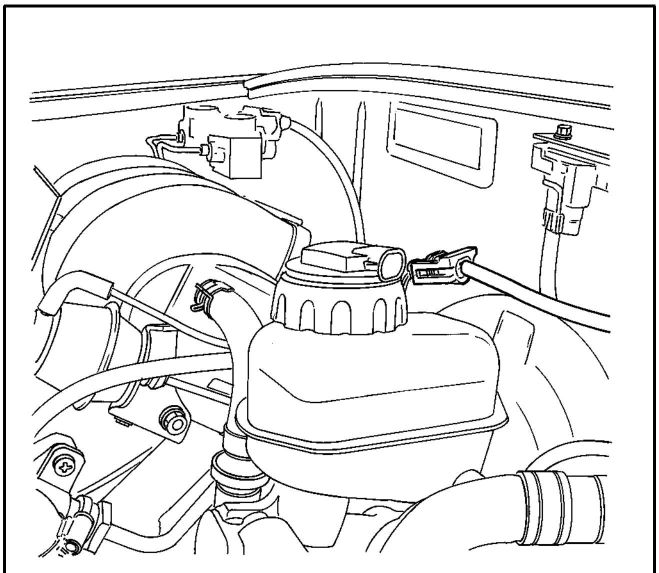
Important: Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a manner that makes it difficult to bleed the system.

16. Repeat the sequence, including the 15-second wait, until all the air is removed. It may be necessary to repeat the sequence 10 or more times to remove all the air.
17. Locate the front bleeder caps.



A107A008

18. Proceed to bleed the front brakes following the appropriate sequence, beginning with Step 12.
19. Check the brake pedal for sponginess. Repeat the entire bleeding procedure to correct this condition.



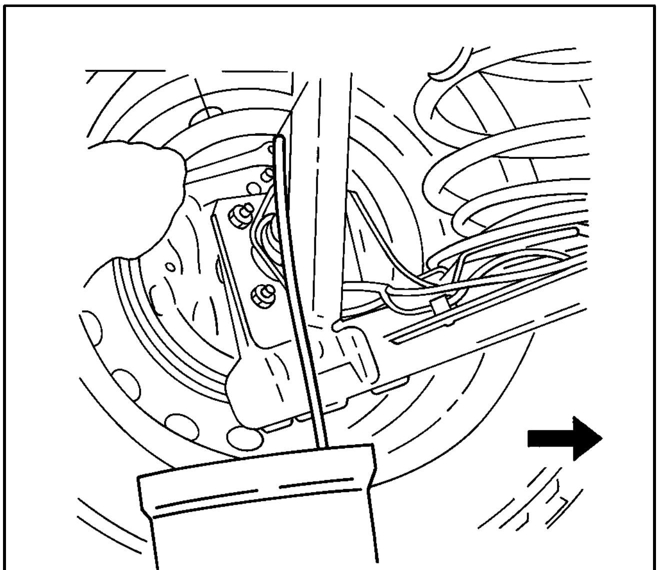
A207A011

PRESSURE BLEEDING THE BRAKES

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Notice: Pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil, and other contaminants from entering the hydraulic system. Contamination could lead to deterioration of the braking components and loss of braking action.

1. Disconnect the master cylinder electrical connector.
2. Remove the master cylinder reservoir cap.

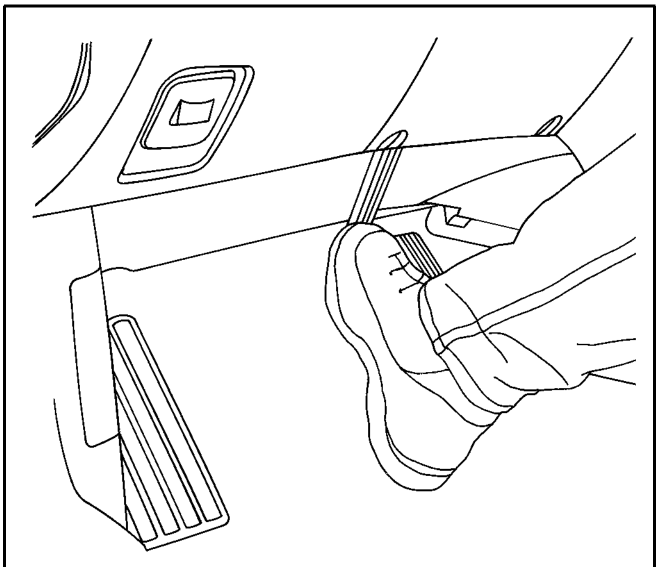


A107A006

3. Connect the bleeder with the adapter to the master cylinder reservoir.
4. For vehicles with the antilock brake system (ABS), locate and remove the hydraulic modulator bleeder valves. Refer to Section 4F, Antilock Brake System.
5. Charge the bleeder ball to 140 to 172 kPa (20 to 25 psi).
6. Connect the line to the adapter. Open the line valve.
7. Raise and suitably support the vehicle.

Important: The bleeding sequence is as follows: right rear, left front, left rear, and right front.

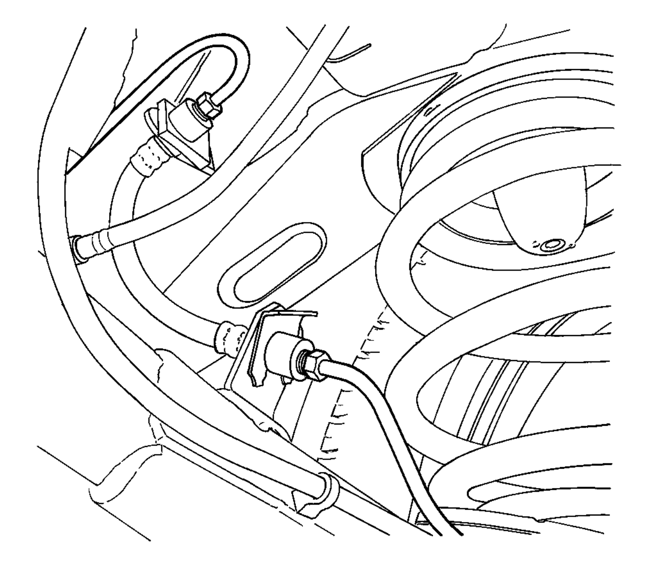
8. Attach the bleeder hose to the bleeder valve. Submerge the opposite end of the hose in a clean container partially filled with brake fluid.
9. Open the bleeder valve one-half to three-fourths of a turn and allow the fluid to flow until no air is seen in the fluid.



A207A003

Notice: After the bleeding operation, the brake reservoir may be pressurized. While disconnecting the bleeder hose or the unthreaded adapter cap, cover the cap and the connection with a shop towel to protect painted surfaces from contact with the brake fluid.

10. Inspect the brake pedal for sponginess. Repeat the entire bleeding procedure to correct this condition.

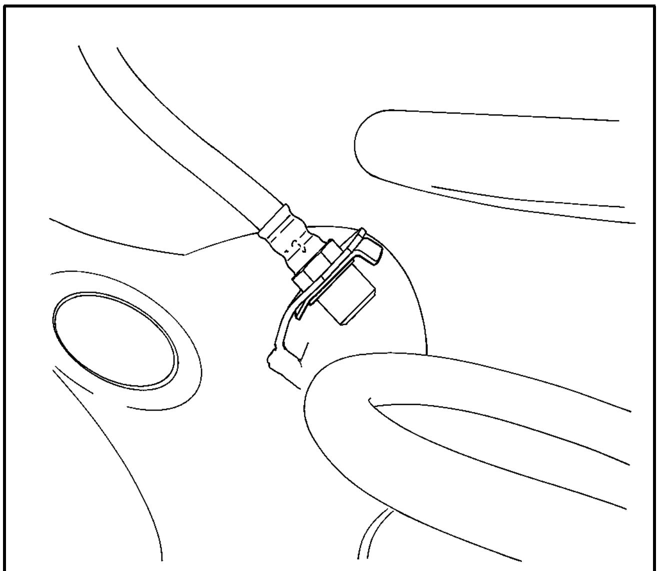


A207A012

BRAKE HOSE (REAR)

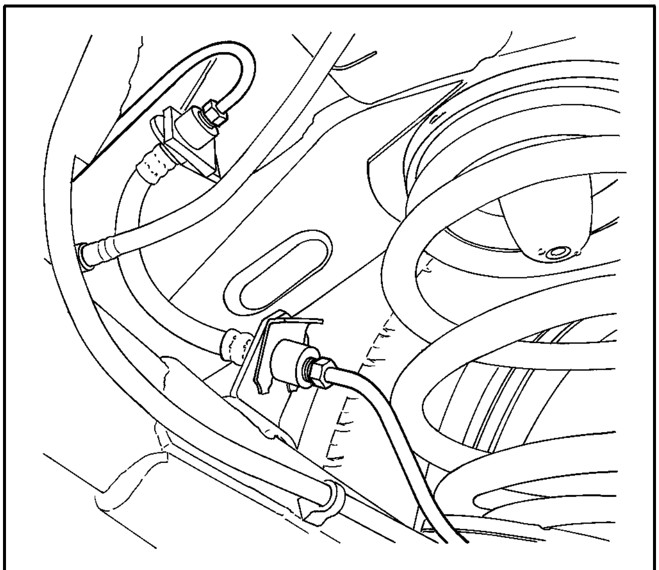
Removal Procedure

1. Raise and suitably support the vehicle.
2. Disconnect the brake lines from the brake hoses at the body and the rear axle brackets.



A207A013

3. Remove both brake hose E-ring retainers.
4. Remove the brake hoses from the brackets.



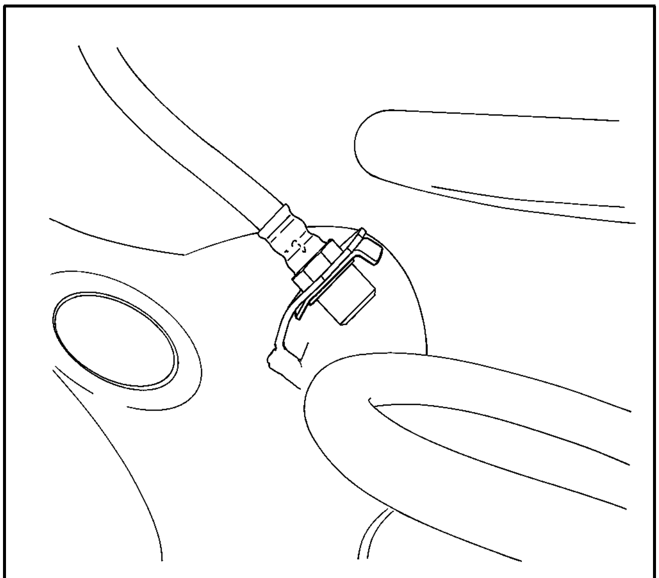
A207A012

Installation Procedure

1. Install the brake hoses to the body and the rear axle brackets.
2. Connect the brake lines to the brake hose.

Tighten

Tighten the brake lines to 16 N•m (12 lb-ft).

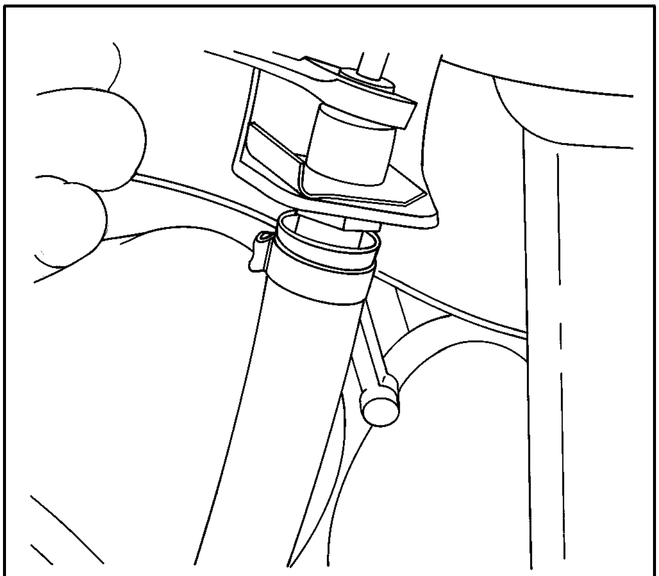


A207A013

3. Install the brake hose retainers.
4. Lower the vehicle.
5. Bleed the brake system. Refer to "Manual Bleeding the Brakes" in this section.
6. Check the brake system for leaks.

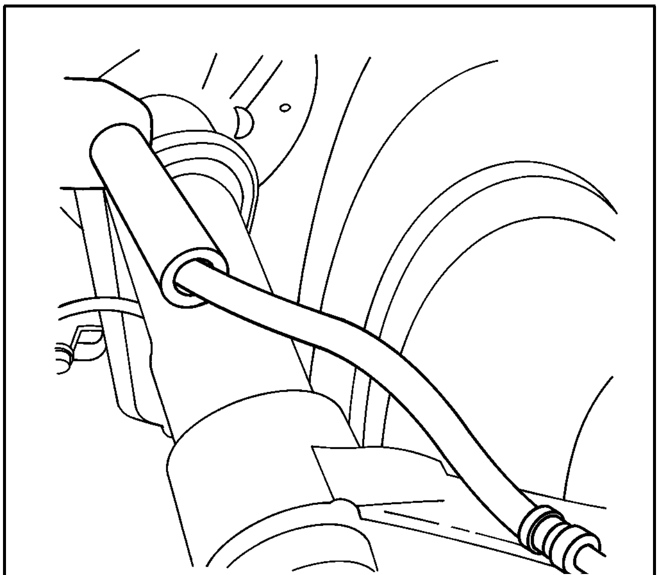
BRAKE HOSE (FRONT)

Removal Procedure



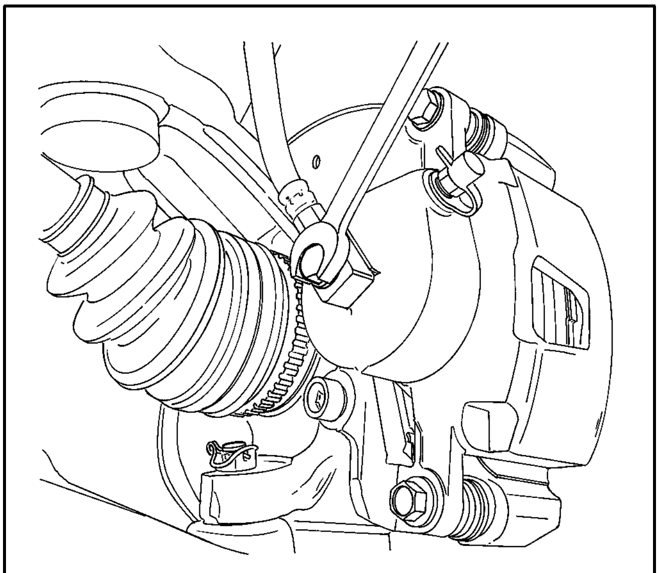
A107A013

1. Raise and suitably support the vehicle.
2. Disconnect the brake line from the brake hose support bracket on the wheel housing.
3. Remove the E-ring retainer.



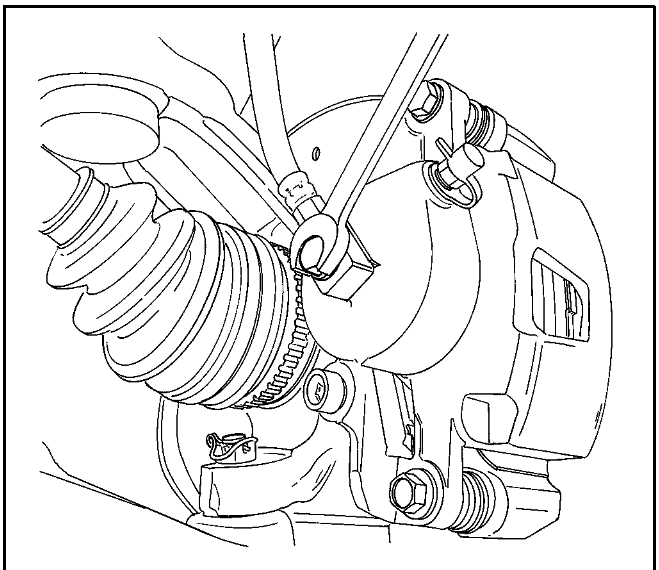
A107A014

4. Remove the brake hose from the wheel housing bracket.



A207A006

5. Remove the bolt from the brake caliper.
6. Remove the seal rings and the brake hose.



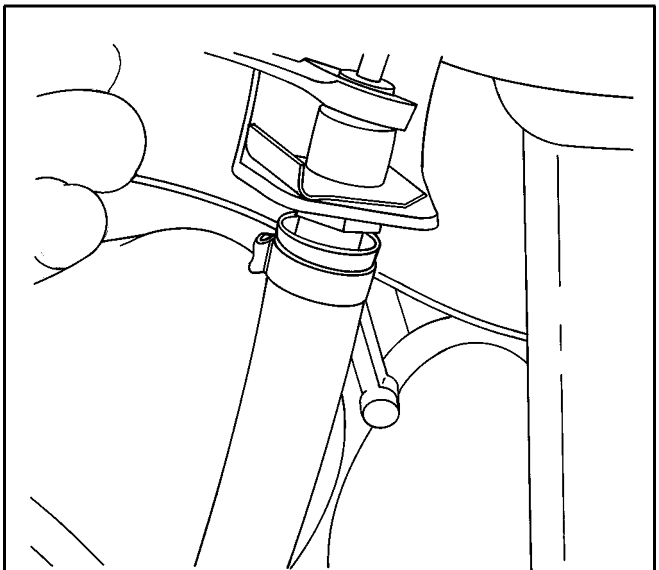
A207A006

Installation Procedure

1. Install the new brake hose to the caliper with new seal rings and the bolt.

   ### Tighten

   Tighten the front brake hose-to-caliper bolt to 40 N•m (30 lb-ft).

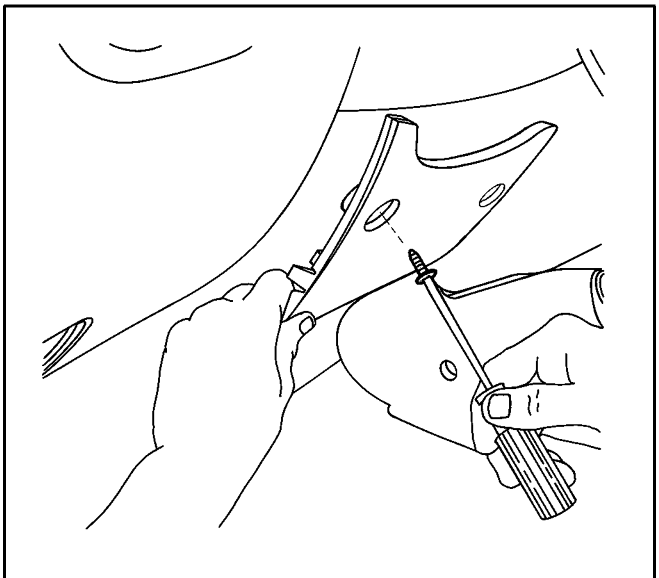


A107A016

2. Install the brake hose and the E-ring retainer to the wheel housing bracket.
3. Connect the brake line to the brake hose.

   ### Tighten

   Tighten the brake line to 16 N•m (12 lb-ft).
4. Lower the vehicle.
5. Bleed the brake system. Refer to "Manual Bleeding the Brakes" in this section.
6. Check the brake system for leaks.



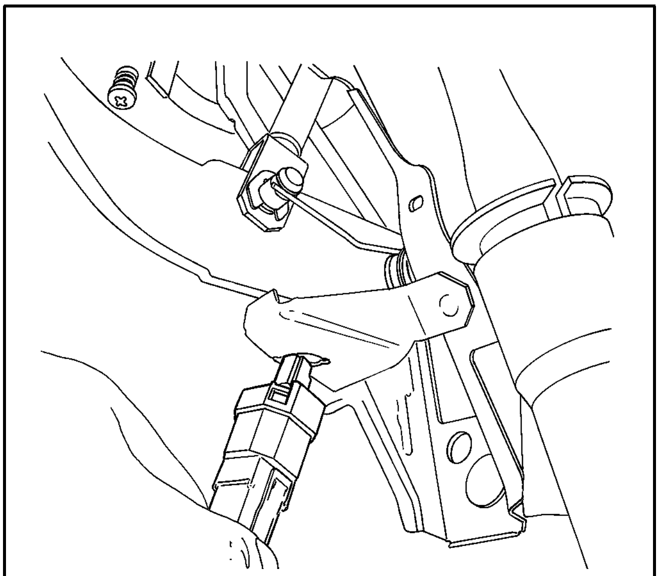
A207A008

STOPLAMP SWITCH

(Left-Hand Drive Shown, Right-Hand Drive Similar)

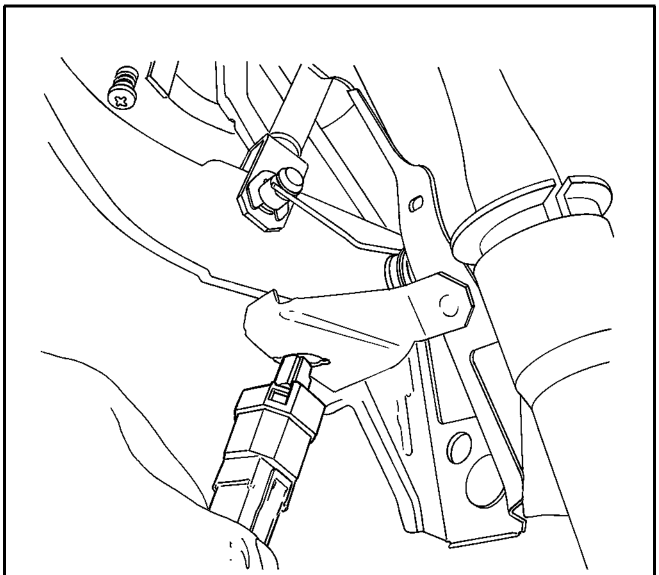
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the trim panel screws.
3. Remove the trim panel.



A207A014

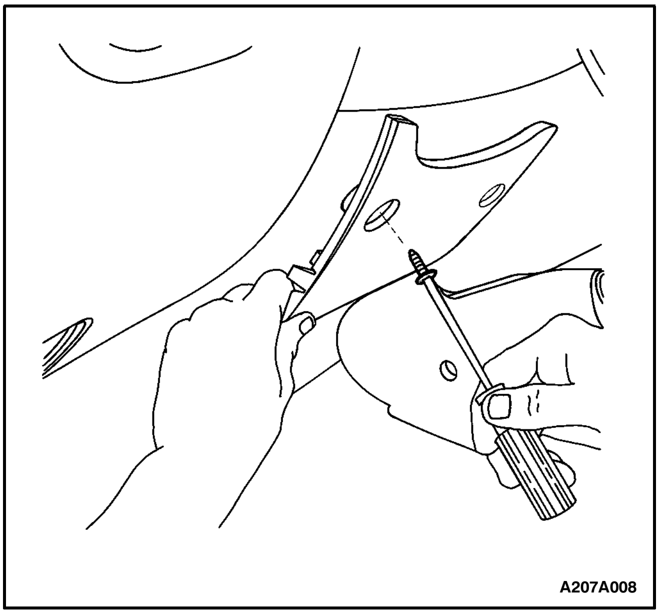
4. Turn the stoplamp switch and the connector assembly, and pull it from the brake pedal bracket.
5. Separate the stoplamp switch from the connector to replace the stoplamp switch.



A207A014

Installation Procedure

1. Turn the stoplamp switch and the connector assembly, and twist it into the brake pedal bracket.



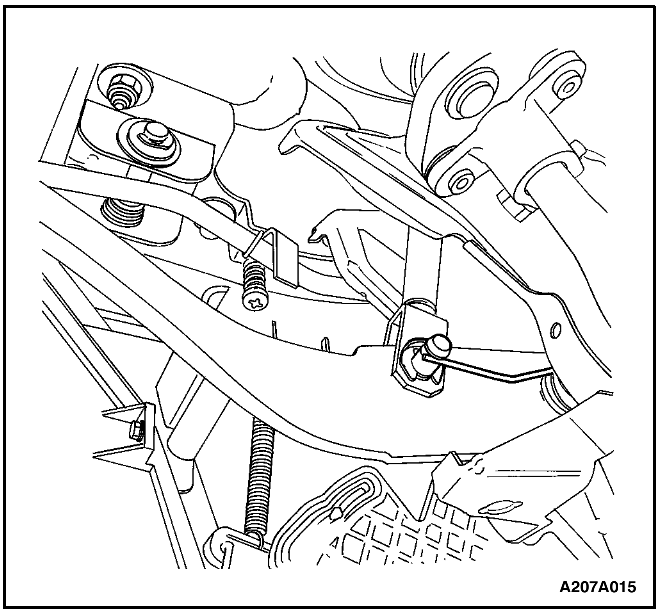
A207A008

2. Press the brake pedal and pull the switch plunger to its maximum setting to adjust the switch.
3. Release the plunger and pull up on the pedal.
4. Install the trim panel screws.

Tighten

Tighten the trim panel screws to 7 N•m (62 lb-in).

5. Connect the negative battery cable.



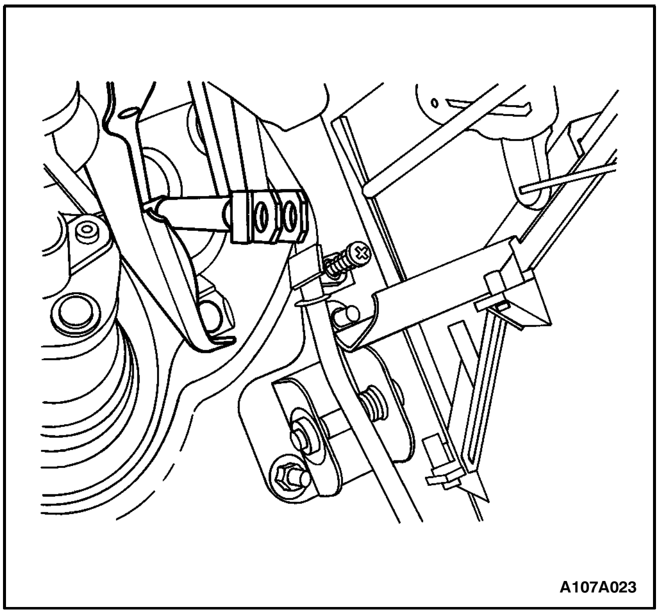
A207A015

BRAKE PEDAL

(Left-Hand Drive Shown, Right-Hand Drive Similar)

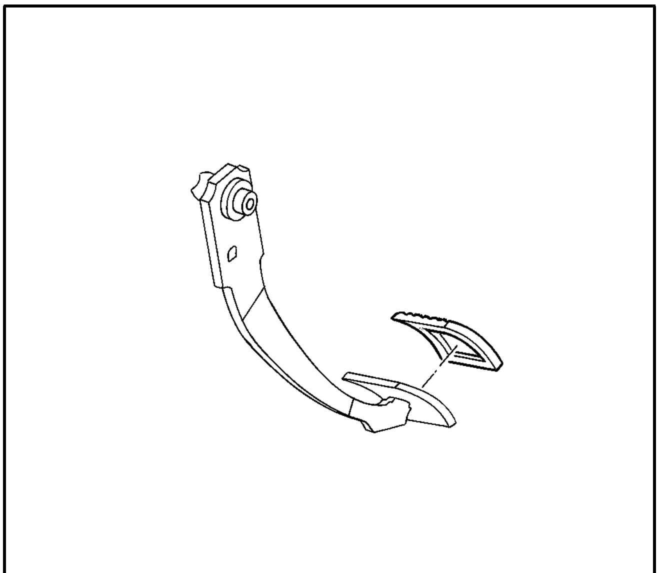
Removal Procedure

1. Remove the screws that hold the trim panel to the instrument panel.
2. Remove the trim panel.
3. Remove the stoplamp switch. Refer to "Stoplamp Switch" in this section.
4. Disconnect the retaining ring, the pin, and the spring from the pushrod/brake pedal connection.



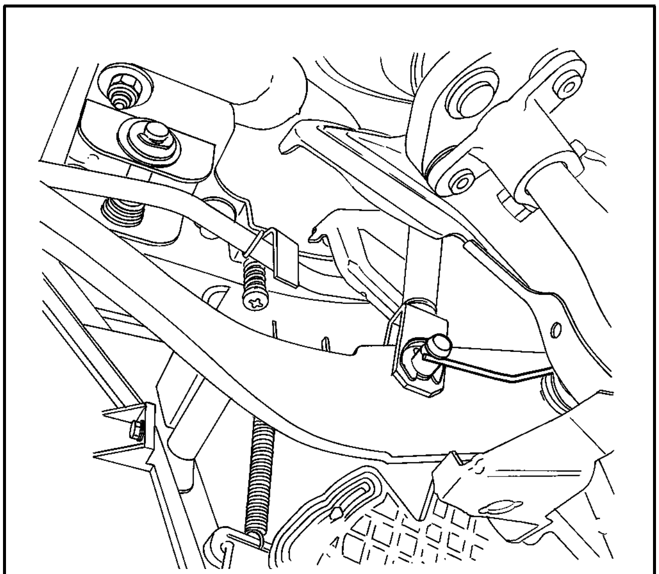
A107A023

5. Remove the pedal mounting shaft and nut.
6. Remove the brake pedal, exposing the brake booster pushrod and the pedal-to-dash panel bracket.



A207A010

7. Remove the brake pedal cover.



A207A015

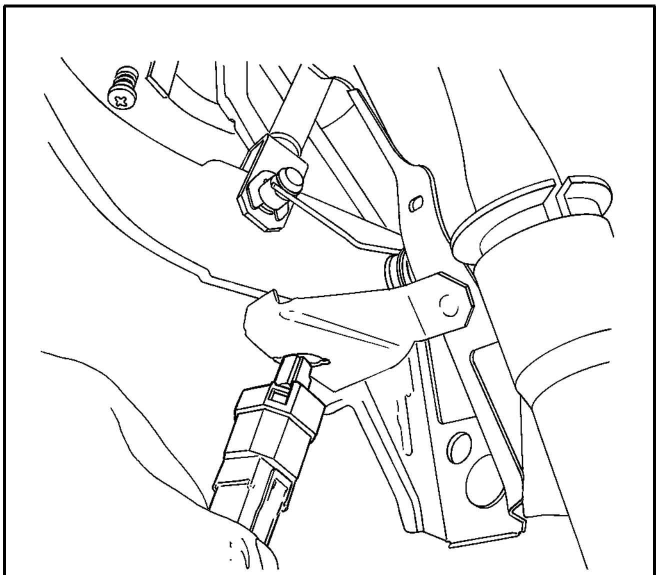
Installation Procedure

1. Install a new brake pedal cover, if needed.
2. Coat the pedal shaft with grease.
3. Position the brake pedal on the pedal-to-dash panel bracket and the pedal shaft.
4. Place the nut on the pedal mounting shaft.

Tighten

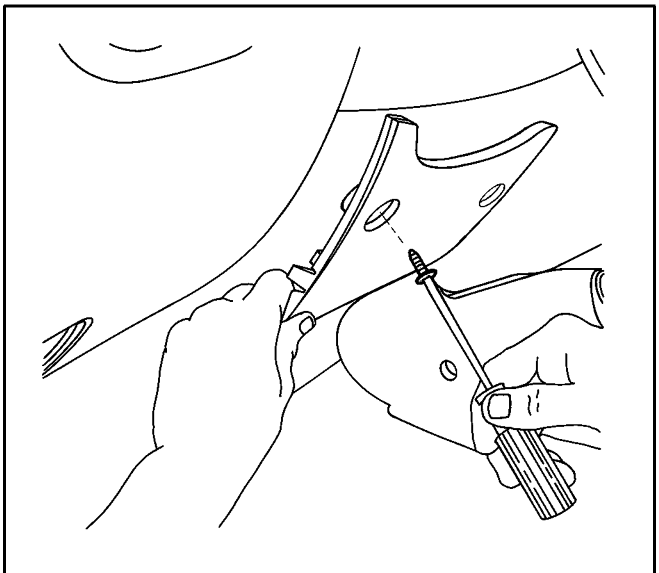
Tighten the brake pedal-to-pedal bracket nut to 18 N•m (13 lb-ft.)

5. Install the pushrod to the pedal with the pin and the retaining ring.



A207A014

6. Install the spring on the shaft in its original position.
7. Connect the stoplamp switch and the connector assembly by twisting it into the pedal bracket.



A207A008

8. Install the trim panel with the screws.

Tighten

Tighten the trim panel screws to 7 N•m (62 lb-in).

GENERAL DESCRIPTION AND SYSTEM OPERATION

WARNING LAMP OPERATION

This brake system uses a BRAKE warning lamp located in the instrument panel cluster. When the ignition switch is in the START position, the BRAKE warning lamp should illuminate. It should go off when the ignition switch returns to the ON position.

The following conditions will activate the BRAKE warning lamp:

- The lamp should be on whenever the parking brake is applied and the ignition switch is in the ON position.
- A low fluid level in the master cylinder will turn the BRAKE lamp on.

SECTION 4B

MASTER CYLINDER

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Lines	16	12	-
Master Cylinder Attaching Nuts	18	13	-
Proportioning Valves	22	16	-
Bleeder Valves	6	-	53

DIAGNOSIS

CHECKING BRAKE PROPORTIONING VALVE

Use two brake pressure gauges to check the brake proportioning valves that are attached to the master cylinder on non-ABS braking systems. These valves limit the outlet pressure to the rear brakes after a predetermined master cylinder pressure has been reached. (On ABS braking systems, the hydraulic modulator/motor pack assembly controls the hydraulic pressure to both the rear wheel cylinders and the front calipers.)

When checking the brake proportioning valves, be sure that the hydraulic line pressure is measured simultaneously and diagonally on the front and the rear axles. To measure the pressure, use the following steps:

1. Remove the bleeder valve and install a pressure gauge to one of the rear wheel cylinders.
2. At the diagonally opposite front brake caliper, remove the bleeder valve and install another pressure gauge.
3. Build pressure by pressing firmly on the brake pedal several times. (The pressure indicated on the gauge is not regulated and represents the actual brake system hydraulic pressure.)
4. Build pressure until the test values in the following proportioning valve test chart are achieved.

Engine	Reference Number for Gradient and Switching Pressure on the Valve Housing	Input Pressure Read on the Manometer at the Front Axle in kPa (psi)	Output Pressure Read on the Manometer at the Rear Axle in kPa (psi)
1.6L	0.3/30	500 (73)	500 (73)
		4 500 (653)	3 450 $ 200 (500 $ 29)
		10 000 (1,450)	5 100 $ 300 (740 $ 44)
1.3L/1.5L	0.3/40	500 (73)	500 (73)
		5 500 (798)	4 450 $ 200 (645 $ 29)
		10 000 (1,450)	5 800 $ 300 (841 $ 44)

Important: If the pressure exceeds 10 000 kPa (1,450 psi), the pressure reading on the rear gauge will not be accurate.

5. Remove the gauges from the tested brake circuit.
6. Reinstall the bleeder valves.

   Tighten

   Tighten the bleeder valves to 6 N•m (53 lb-in).

7. Repeat the test on the remaining front/rear brake circuit.
8. Reinstall the bleeder valves.

   Tighten

   Tighten the bleeder valves to 6 N•m (53 lb-in).

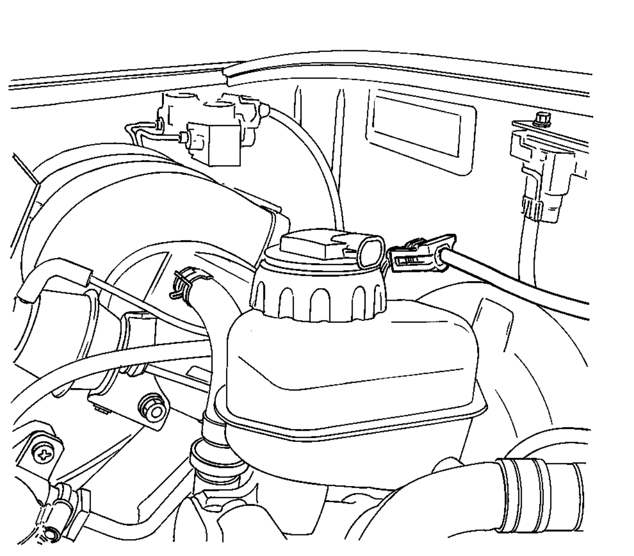
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

MASTER CYLINDER ASSEMBLY

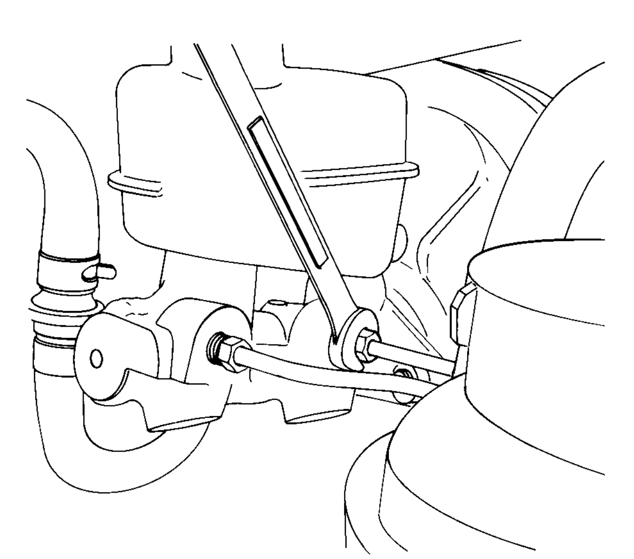
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



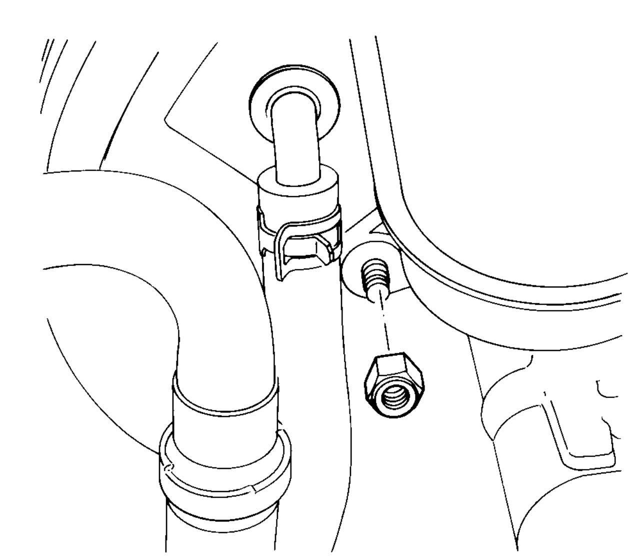
A207A011

1. Disconnect the electrical connector from the reservoir cap.



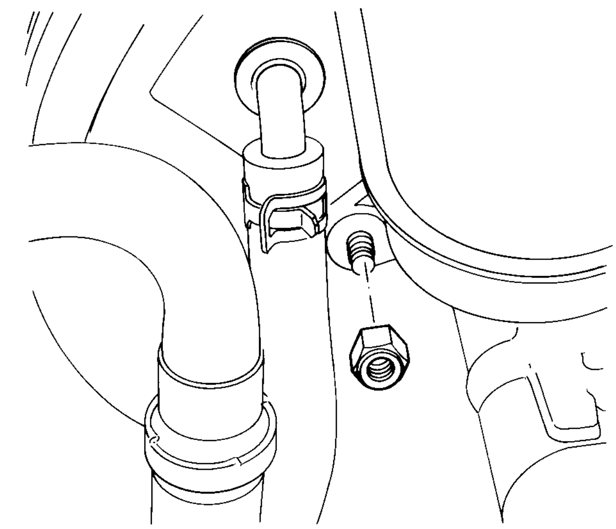
A207B001

2. For vehicles with the ABS braking system, disconnect the brake lines from the master cylinder body.
3. For vehicles with the non-ABS braking system, disconnect the brake lines from the proportioning valves.
4. For vehicles with the manual transaxle, disconnect the clip to the clutch hose connection at the master cylinder.
5. Plug the opening to the brake lines to prevent fluid loss and contamination.



A207B002

6. Remove the attaching nuts from the power booster.
7. Remove the master cylinder assembly.
8. Remove the seal from the booster housing. Discard the seal.
9. Drain the brake fluid.

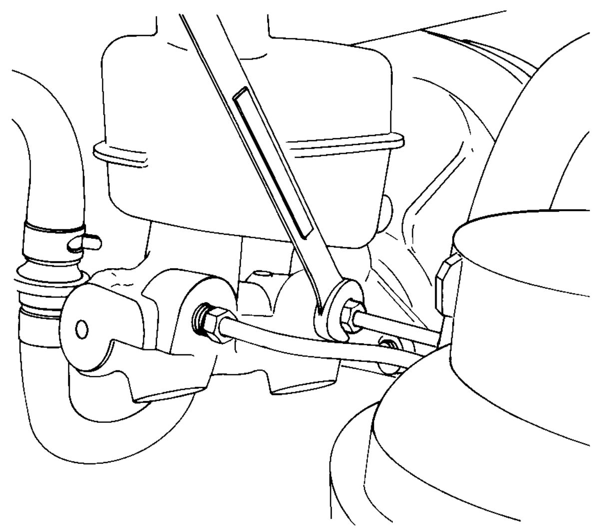

A207B002

Installation Procedure

1. Install the master cylinder assembly with the new attaching nuts.
2. Install the new seal to the booster housing.

Tighten

Tighten the master cylinder attaching nuts to 18 N•m (13 lb-ft).

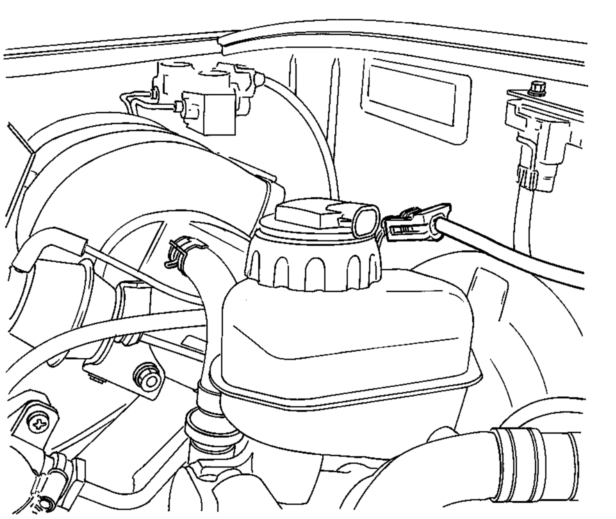

A207B001

3. For vehicles with the ABS braking system (as shown), connect the brake lines to the cylinder body.
4. For vehicles with the non-ABS braking system, connect the brake lines to the proportioning valves.

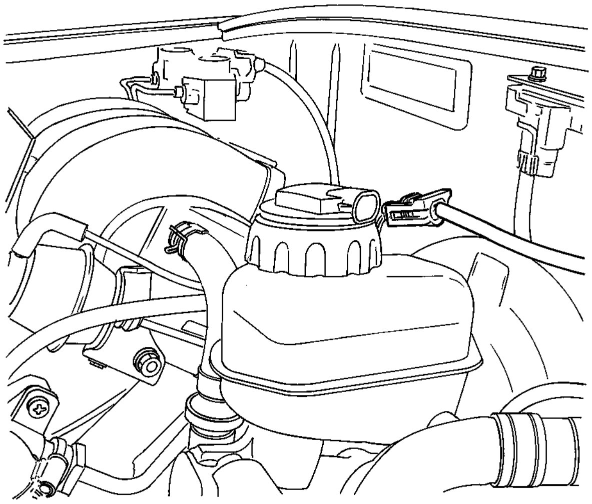
Tighten

Tighten the brake lines to 16 N•m (12 lb-ft).

5. For vehicles with the manual transaxle, connect the clip to the clutch hose connection at the master cylinder.


A207A011

6. Connect the electrical connector on the reservoir cap.
7. Add brake fluid.
8. Check for leaks and recheck the fluid level.
9. Bleed the brake system. Refer to Section 4A, Hydraulic Brakes.



A207A011

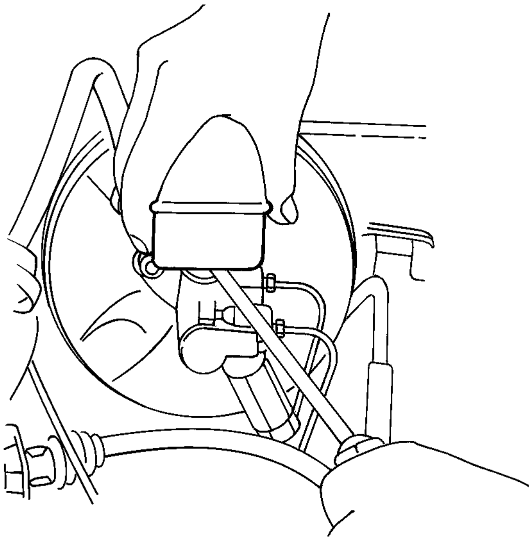
BRAKE FLUID RESERVOIR

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

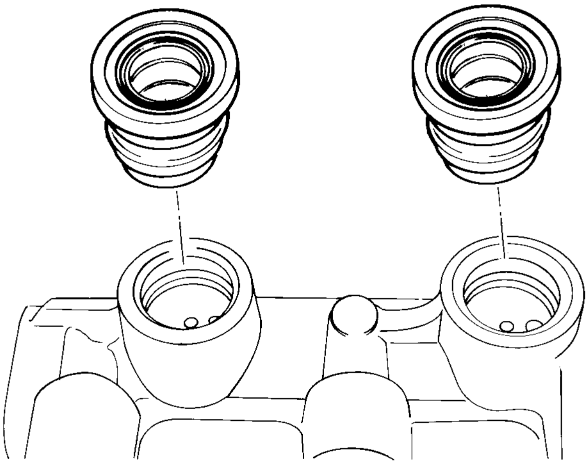
Important: Remove the reservoir only when replacing a damaged or a leaking reservoir.

1. Disconnect the electrical connector from the reservoir cap.



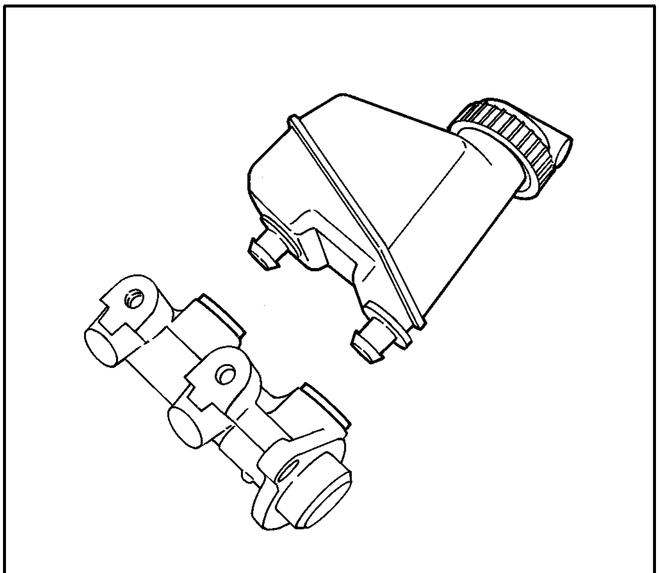
A107B005

2. For vehicles with the manual transaxle, disconnect the clip to the clutch hose connection at the master cylinder.
3. Gently pry upward with a screwdriver to release the reservoir.
4. Tilt the reservoir and pull it upward in order to remove it.



B107B004

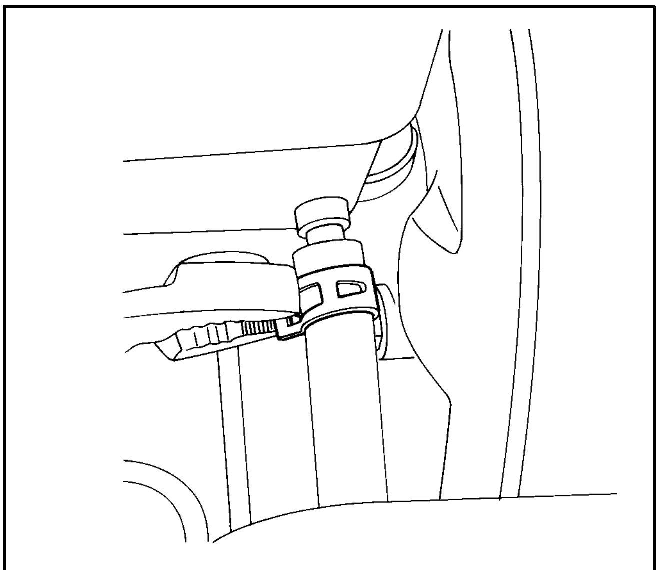
5. Remove the reservoir seals from the master cylinder body.



A107B004

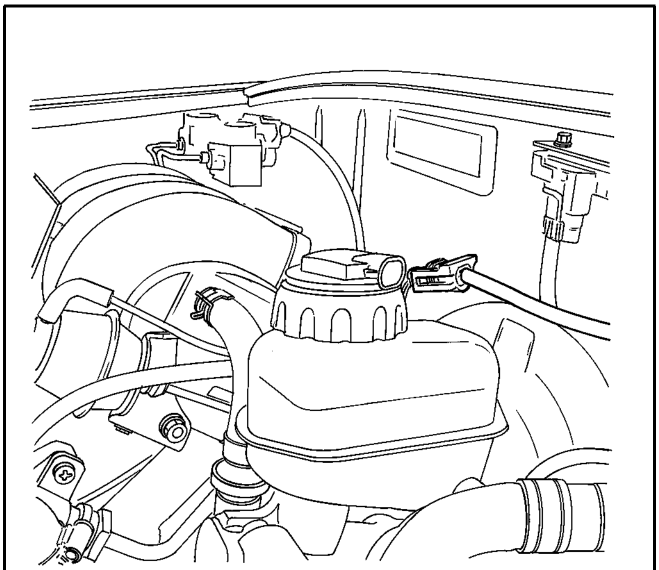
Installation Procedure

1. Lubricate the new seals with clean brake fluid. Install the seals into the cylinder body.
2. Install the reservoir on the master cylinder body. (The ABS system is shown.)



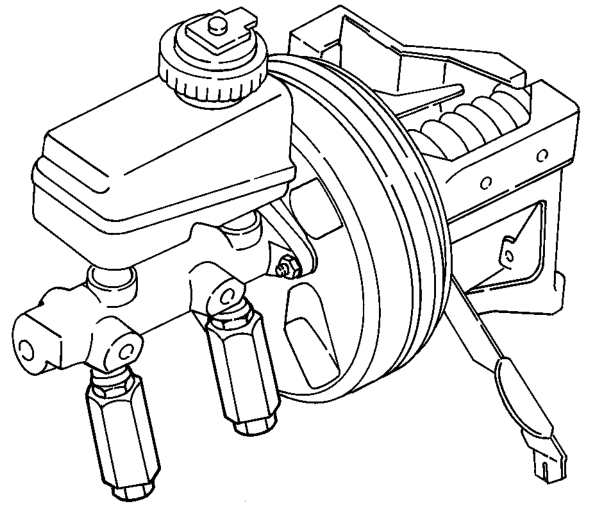
A207B003

3. For vehicles with the manual transaxle, connect the clip to the clutch hose connection at the master cylinder.



A207A011

4. Add brake fluid.
5. Raise and suitably support the vehicle.
6. Bleed the braking system. Refer to Section 4A, Hydraulic Brakes or Section 4F, Antilock Brake System. Bleed the clutch master cylinder. Refer to Section 5C, Clutch.
7. Lower the vehicle.
8. Connect the reservoir electrical connector.

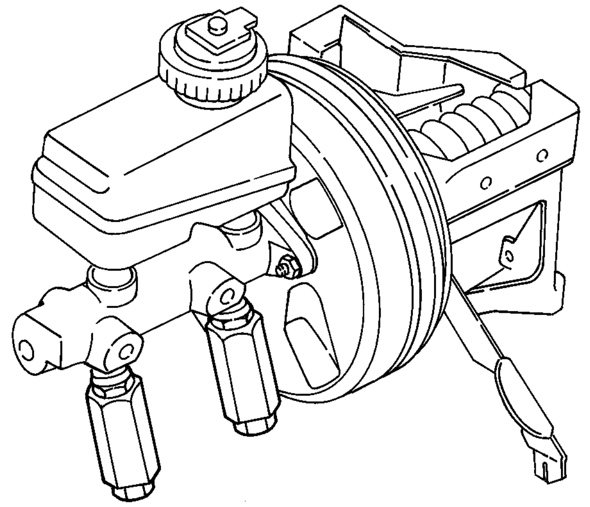


A107B007

PROPORTIONING VALVES

Removal Procedure

1. Disconnect the brake lines from the proportioning valves.
2. Remove the valves from the master cylinder body.



A107B007

Installation Procedure

Important: Since these valves are adjusted in pairs to the correct control range, they must be replaced in pairs.

1. Install the proportioning valves to the cylinder body.

   Tighten

   Tighten the proportioning valves to 22 N•m (16 lb-ft).
2. Connect the brake lines to the valves.

   Tighten

   Tighten the brake lines to 16 N•m (12 lb-ft).
3. Raise and suitably support the vehicle.
4. Bleed the braking system. Refer to Section 4A, Hydraulic Brakes or Section 4F, Antilock Brake System.
5. Lower the vehicle.

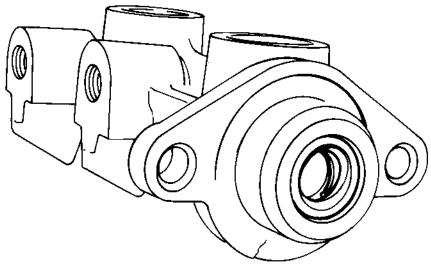
UNIT REPAIR

MASTER CYLINDER OVERHAUL

Disassembly Procedure

1. Remove the master cylinder. Refer to "Master Cylinder Assembly" in this section.
2. Remove the brake fluid reservoir. Refer to "Brake Fluid Reservoir" in this section.
3. Remove the seal ring from the cylinder bore.

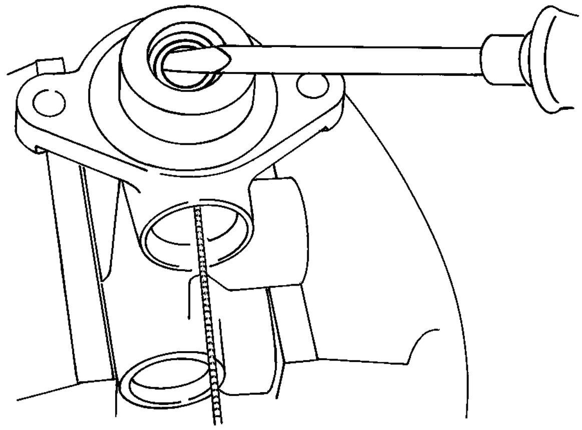
Notice: When removing the retaining ring, avoid damaging the piston or the cylinder wall.



B107B007

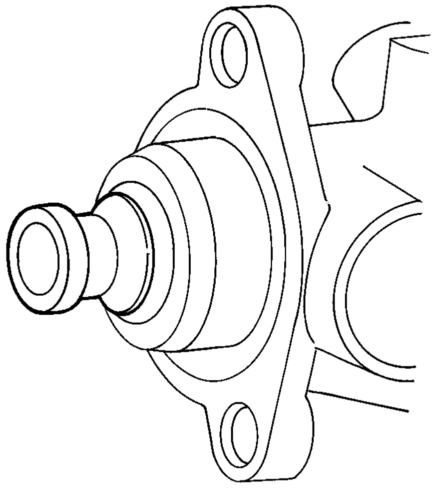
Important: A welding rod or its equivalent can be used in a compensating port to keep the piston pressed down.

4. Remove and discard the retaining ring from the cylinder body using a suitable screwdriver. (The non-ABS master cylinder body is shown.)



A107B010

5. Remove the primary piston. (The ABS master cylinder body is shown.)
6. Carefully remove the secondary piston assembly and the spring from the master cylinder bore.

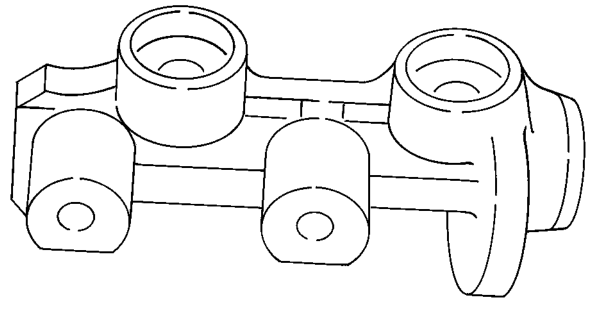


A107B009

Assembly Procedure

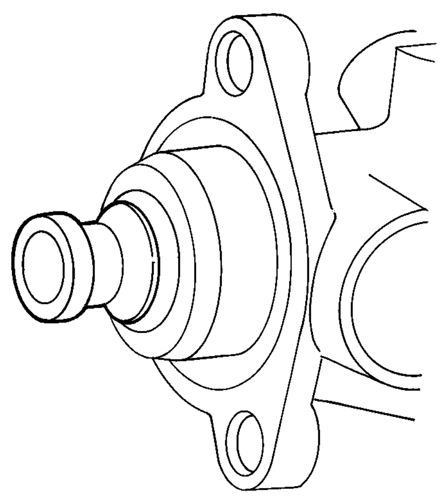
Notice: Do not use abrasives in the master cylinder bore. Abrasives can damage the bore.

Important: Rubber parts and retaining rings must be discarded and replaced with new parts



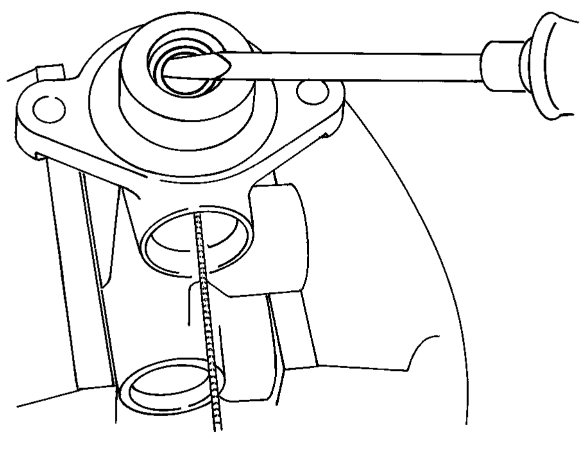
A107B012

1. Clean all parts with denatured alcohol or clean brake fluid. Dry the parts with compressed air.
2. Inspect the master cylinder bore for scoring or corrosion. If scoring or corrosion is evident, replace the master cylinder body.
3. Lubricate the master cylinder bore with clean brake fluid. (The non-ABS master cylinder is shown.)



A107B009

4. Carefully insert the secondary piston assembly bore until the secondary piston contacts the base of the cylinder body. Use a wood or a plastic drift, if necessary.
5. Insert the primary piston.

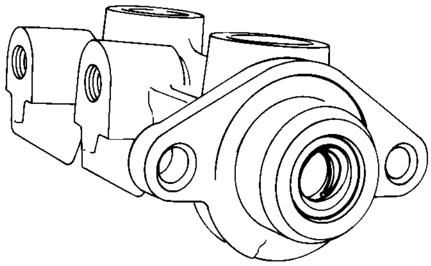


A107B010

6. Press the pistons into the cylinder bore using a wooden or a plastic drift.

Notice: When installing the new retaining ring, take care not to damage the cylinder bore.

7. Insert the new retaining ring into the groove in the cylinder bore. (The non-ABS cylinder body is shown.) Remove the welding rod.
8. Move the pistons backward and forward after installation to check for free movement.



B107B007

9. Lubricate the seal ring and insert the seal on the shaft into the cylinder bore. The open side must face outward until the seal rests on the piston.
10. Install the brake fluid reservoir to the master cylinder. Refer to "Brake Fluid Reservoir" in this section.
11. Install the master cylinder assembly. Refer to the "Master Cylinder Assembly" in this section.
12. Raise and suitably support the vehicle.
13. Bleed the braking system. Refer to Section 4A, Hydraulic Brakes or Section 4F, Antilock Brake System.
14. Lower the vehicle.

GENERAL DESCRIPTION AND SYSTEM OPERATION

MASTER CYLINDER

The master cylinder is designed for use in a diagonal-split system. One front and one diagonally opposite rear brake are served by the primary piston. The opposite front and rear brakes are served by the secondary piston. The master cylinder incorporates the functions of the standard dual master cylinder, plus a low fluid level indicator and the proportioning valves in the non-antilock braking system. The proportioning valves limit the outlet pressure to the rear brakes after a predetermined master cylinder pressure has been reached.

Notice: Do not use lubricated shop air on brake parts, as this may damage rubber components.

Important:

- Replace all the components included in the repair kits used to service this master cylinder.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- if any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform all service operations on a clean bench, free from all traces of mineral oil.

PROPORTIONING VALVES

The proportioning valves limit the outlet pressure to the rear brakes on the non-antilock braking system after a predetermined master cylinder pressure has been reached. This is used when less rear apply force is needed to obtain optimum braking and is usually found on disc/drum brake configurations. On ABS-equipped vehicles, refer to Section 4F, Antilock Brake System.

FLUID LEVEL SENSOR

The master cylinder is equipped with a fluid level sensor. This sensor will activate the BRAKE light if a low fluid level condition is detected. Once the fluid level is corrected, the BRAKE light will go out.

SECTION 4C

POWER BOOSTER

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Booster and Support Bracket-to-Dash Panel Nuts	22	16	-
Booster Pushrod Hex Nut	18	13	-
Booster-to-Support Bracket Nuts	22	16	-
Master Cylinder Attaching Nuts	18	13	-

DIAGNOSIS

POWER BOOSTER FUNCTIONAL CHECK

1. With the engine stopped, eliminate the vacuum in the booster by pumping the brake pedal several times.
2. Push the pedal down and hold it in this position.
3. Start the engine.
4. The booster is OK if the pedal drops further because of extra force produced.

If the brake pedal does not drop, the vacuum system (vacuum hoses, check valve, etc.) is probably defective and should be checked.

If no defect is revealed by checking the vacuum system, the defect is in the booster itself.

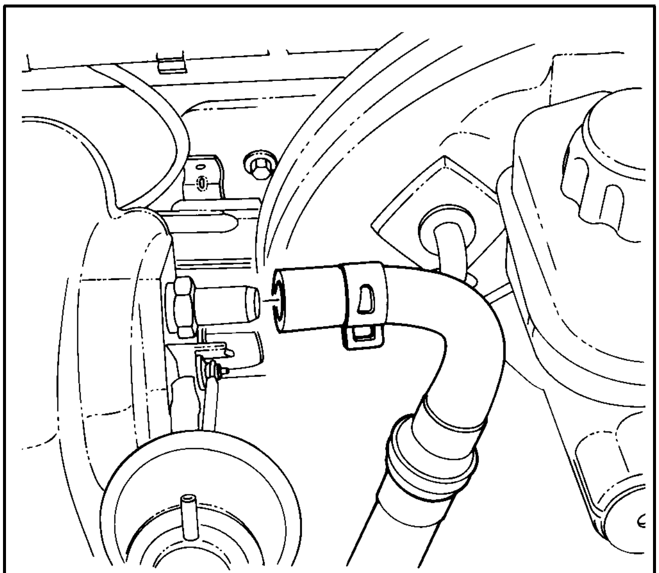
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

VACUUM HOSE

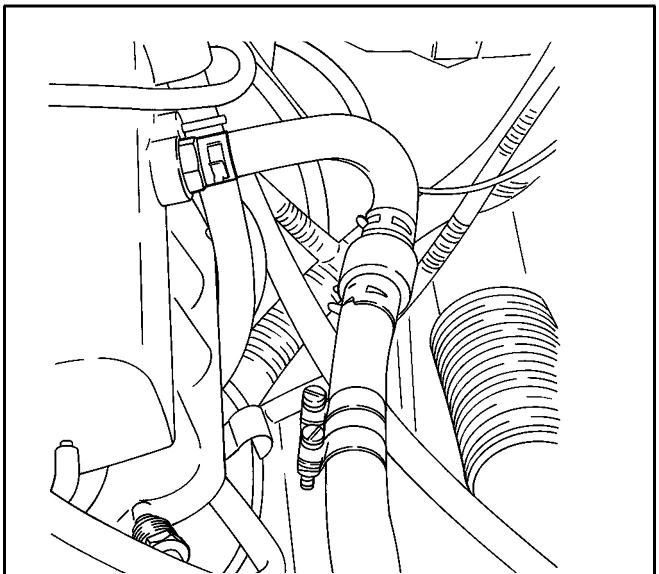
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



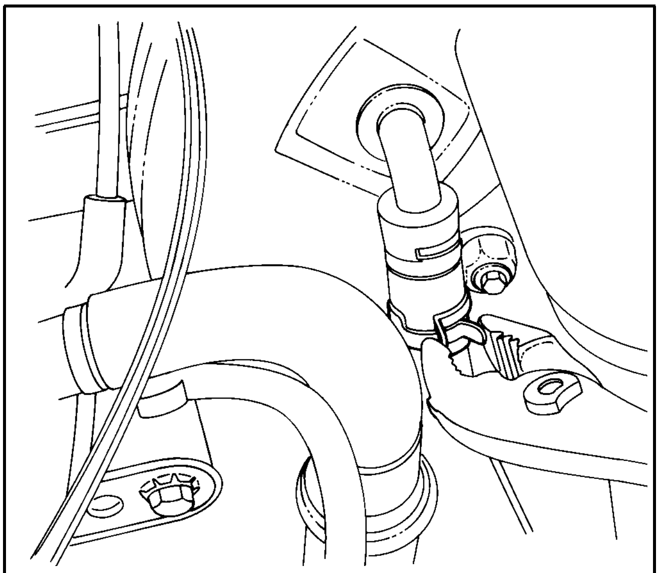
A207C001

1. For vehicles with a DOHC engine, remove the clip on the vacuum hose connection at the intake manifold.
2. Pull the hose from the union nut connection. If the hose does not remove easily or is deteriorated, pry off and discard the hose.



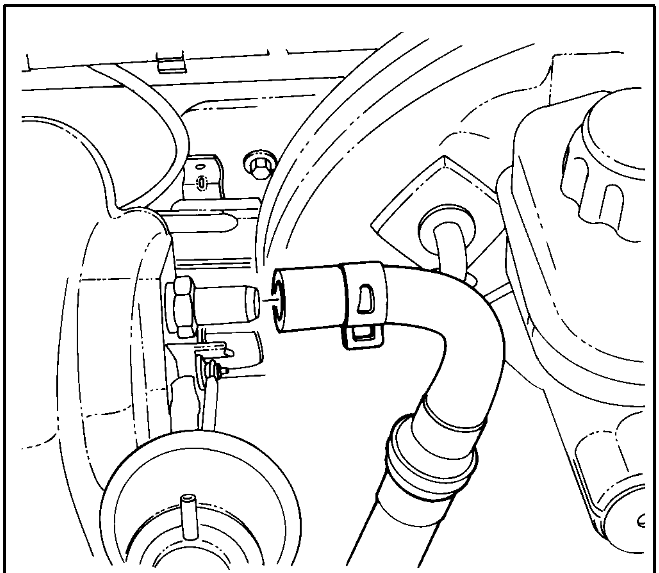
A107C002

3. For vehicles with a SOHC engine, similarly remove the clip on the vacuum hose nut connection to the intake manifold.
4. Pull the hose from the union nut connection. If the hose does not remove easily or is deteriorated, pry off and discard the hose.



A207C002

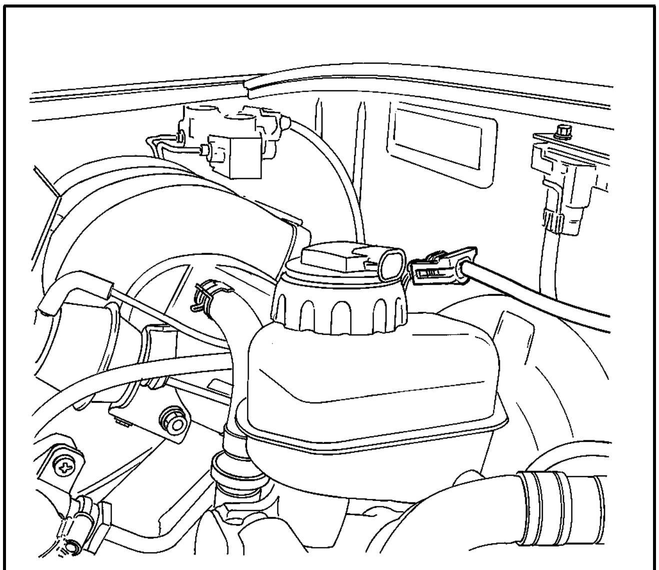
5. Remove the clip on the vacuum hose connection to the brake booster.
6. Remove the vacuum hose.



A207C001

Installation Procedure

1. Mount the vacuum hose (DOHC engine connection shown), and make sure the connections are tight on each end.
2. Install the vacuum hose clips.
3. Check the function of the booster. Refer to the "Power Booster Functional Check" in this section.



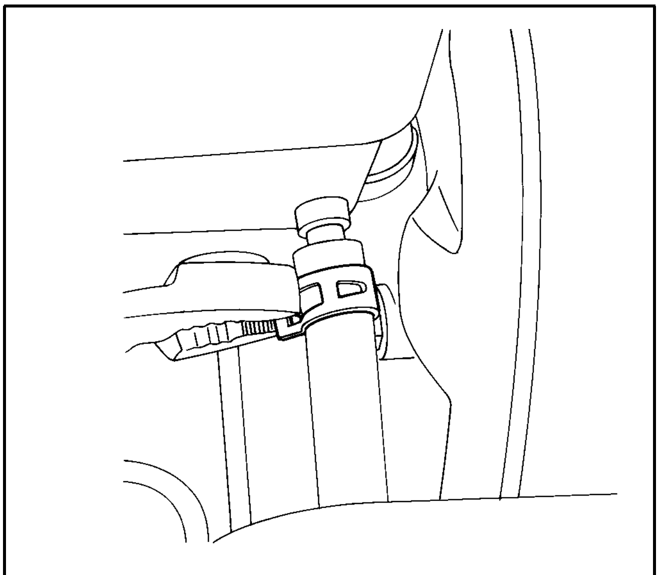
A207A011

POWER BOOSTER ASSEMBLY

(Left-Hand Drive Shown, Right-Hand Drive Similar)

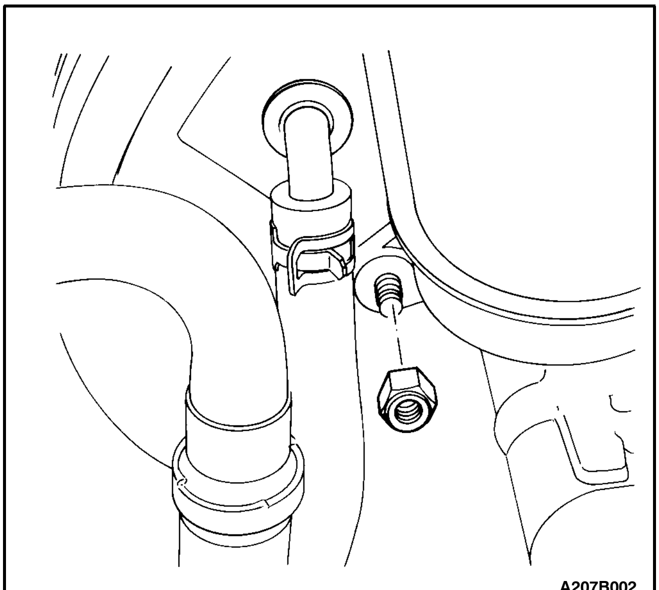
Removal Procedure

1. Disconnect the electrical connector from the reservoir cap.

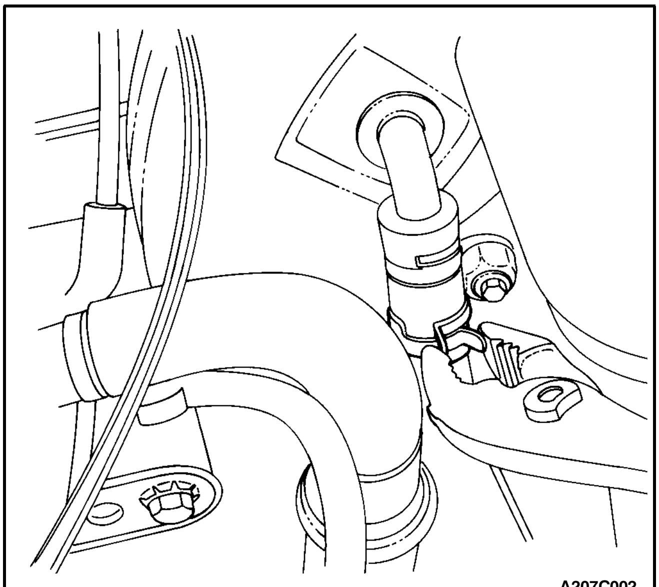


A207B003

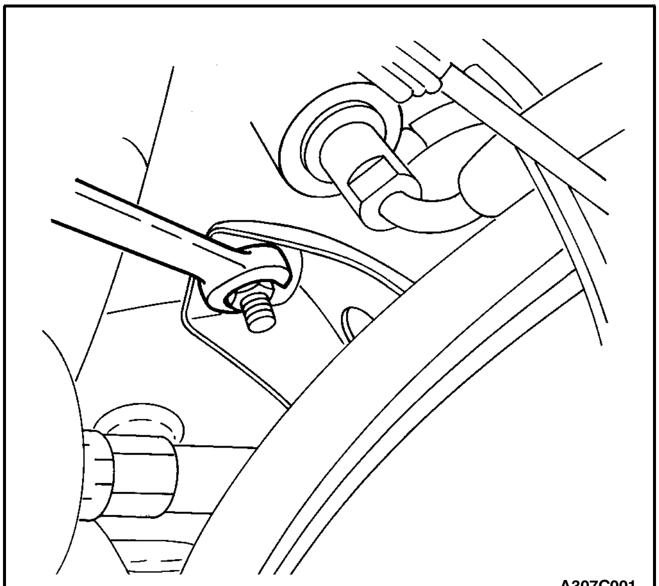
2. For vehicles with a manual transaxle, disconnect the clip on the clutch hose connection to the master cylinder.
3. Plug the clutch hose and the master cylinder so that the fluid does not escape.


A207B002

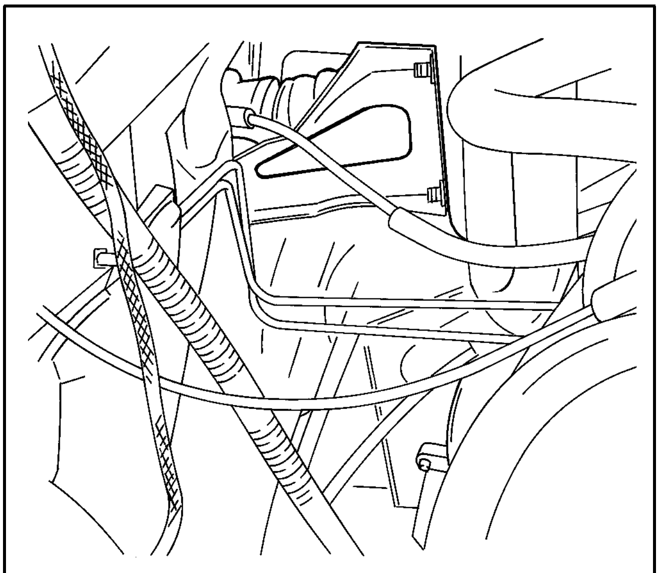
4. Remove the master cylinder attaching nuts.
5. Push the master cylinder forward slightly and move it out of the way. Do not disconnect the brake lines.
6. Remove and discard the booster housing seal.


A207C002

7. Remove the clip on the vacuum hose connection to the booster (DOHC engine connection shown).
8. Disconnect the brake lamp switch.
9. Remove the brake pedal spring.
10. Disconnect the clip and the pushrod pin from the pedal bracket assembly. Refer to Section 4A, Hydraulic Brakes.

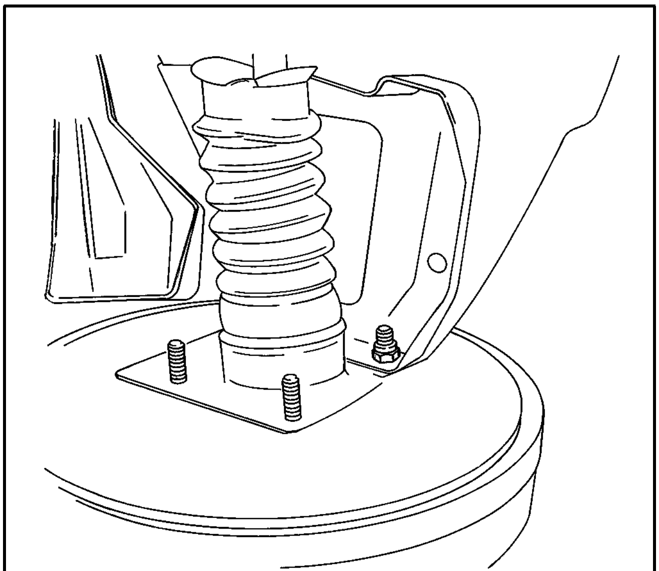

A307C001

11. For vehicles with left-hand drive, remove the booster and the support bracket-to-dash panel nuts. For vehicles with right-hand drive, remove the brake pedal bracket nuts from under the dashboard. Then remove the booster.



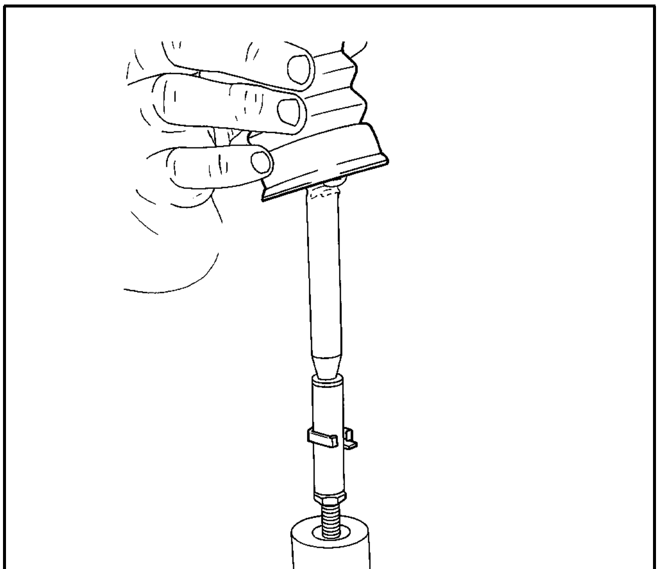
A107C006

12. Remove the booster and the bracket assembly from the dash panel.



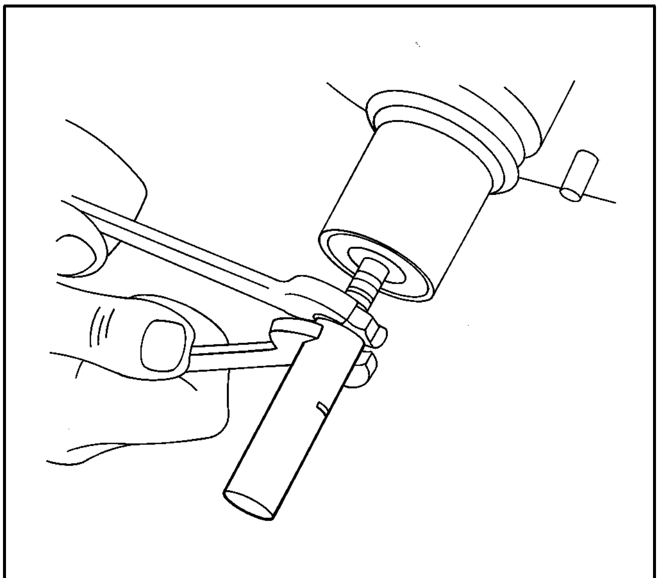
A107C007

13. Remove the bracket nuts from the booster and remove the booster.



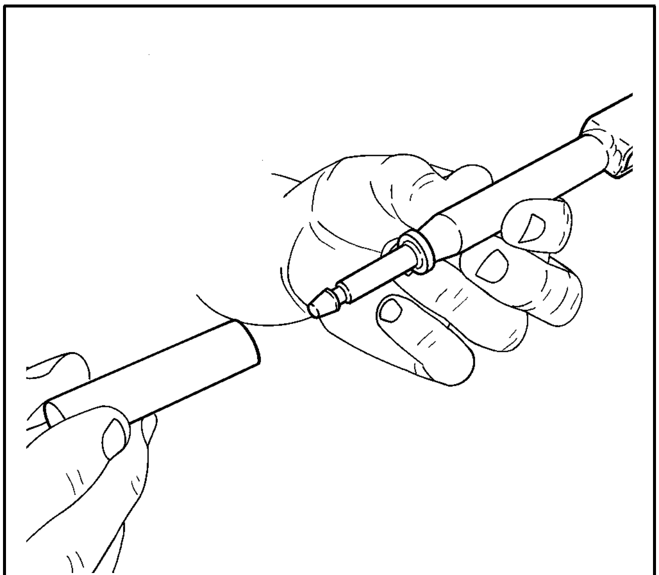
A107C008

14. Remove the rubber boot and the retainer.



A107C009

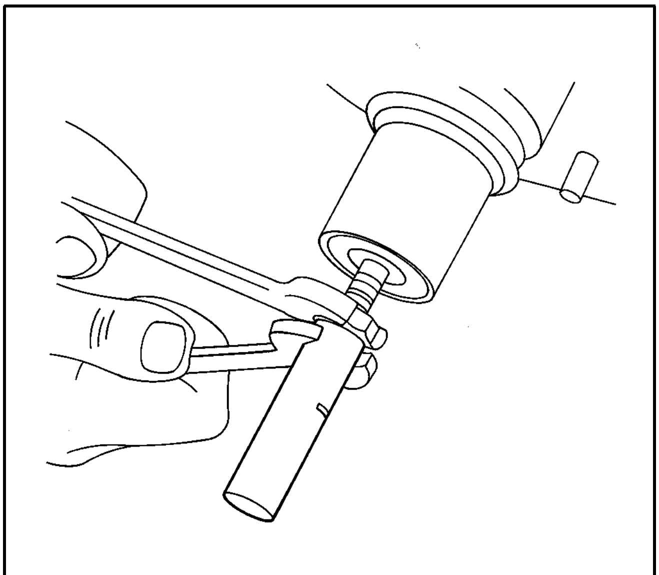
15. Remove the pushrod.
16. Remove the adjustment sleeve from the pushrod.
17. Remove the hex nut.



A107C010

Installation Procedure

1. Check the pushrod and the adjustment sleeve for damage and proper fit.

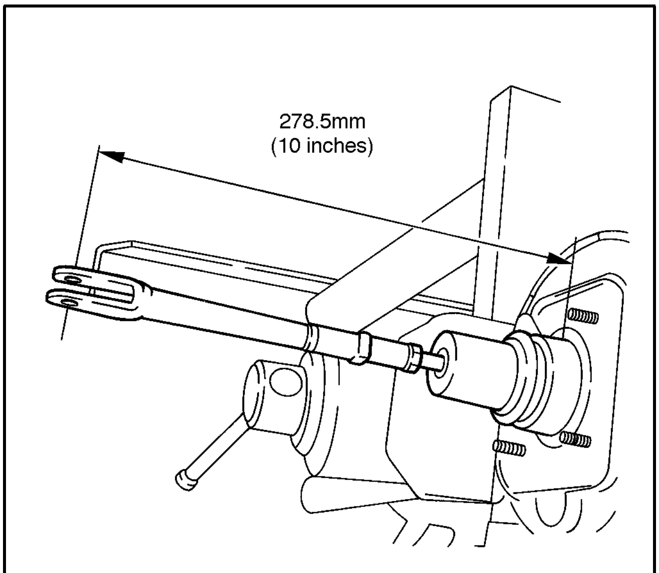


A107C009

2. Install the hex nut and the adjustment sleeve on the booster.

Tighten

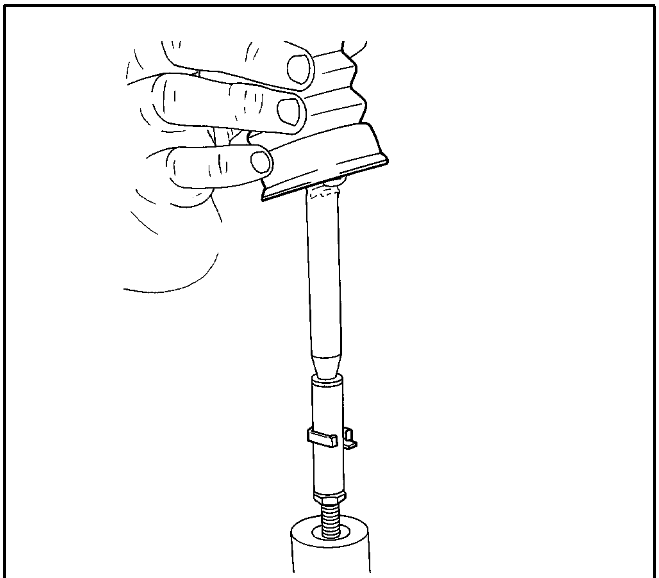
Tighten the booster pushrod hex nut and the adjustment sleeve to 18 N•m (13 lb-ft).



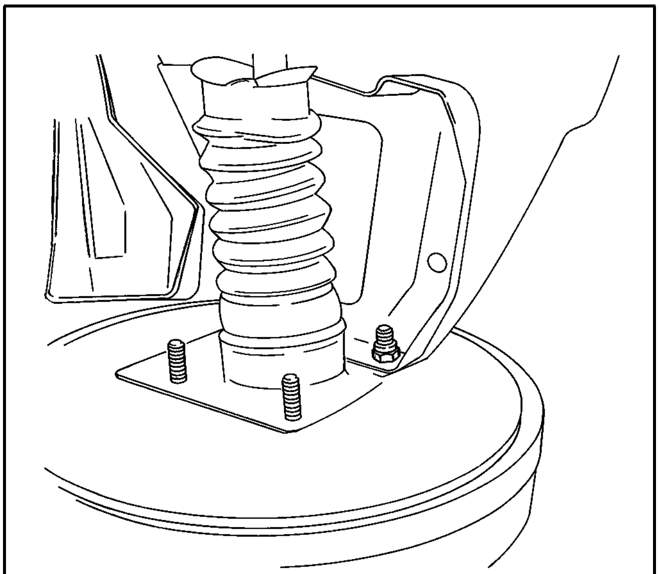
A107C011

3. Insert the pushrod in the adjustment sleeve and mount the retainer.
4. Measure the distance from the booster to the center of the fork bin bore.

Important: This measurement should be 278.5 mm (10 inches).


A107C008

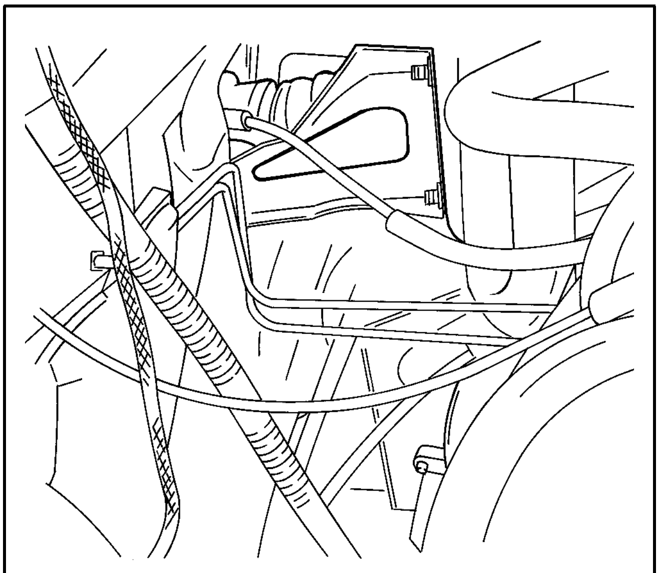
5. Install the rubber boot on the booster.


A107C007

6. Install the brackets to the booster.

Tighten

Tighten the booster-to-support bracket nuts to 22 N•m (16 lb-ft).

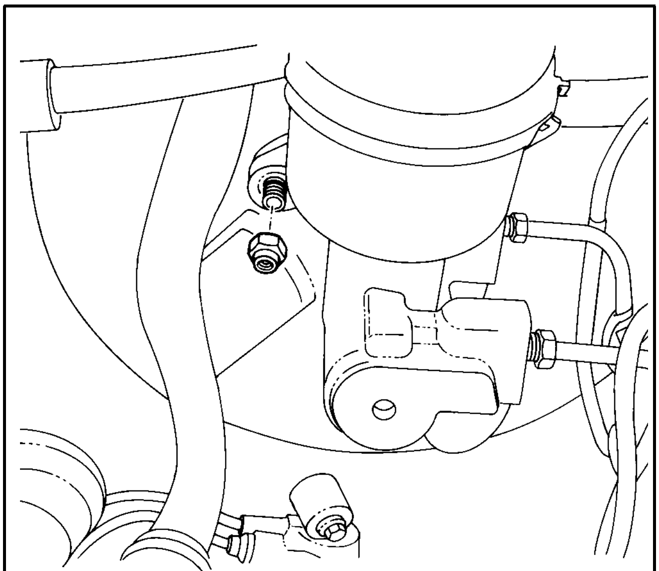


A107C006

7. For vehicles with left-hand drive, install the booster and the bracket assembly to the dash panel. For vehicles with right-hand drive, install the booster to the vehicle. Then install the brake pedal bracket and the brake pedal bracket nuts.

Tighten

Tighten the booster and support bracket-to-dash panel nuts to 22 N•m (16 lb-ft).

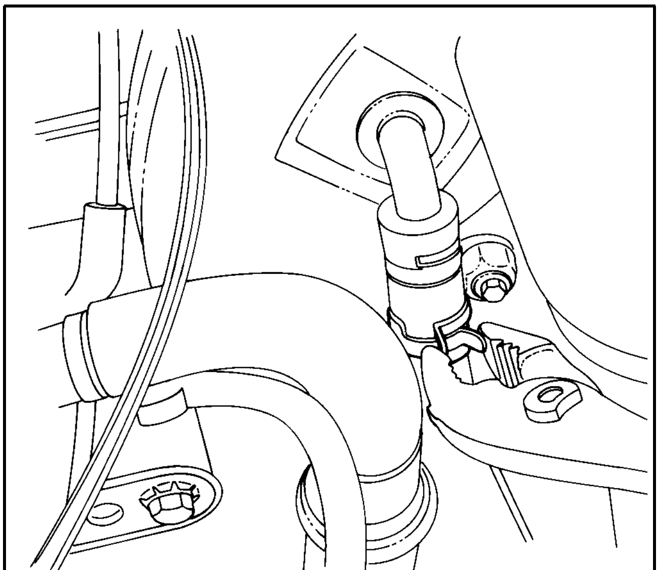


A207C003

8. Connect the master cylinder to the booster and install a new booster housing seal.

Tighten

Tighten the master cylinder attaching nuts to 18 N•m (13 lb-ft).



A207C002

9. Install the new vacuum hose to the booster (DOHC engine connection shown). Refer to "Vacuum Hose" in this section.
10. Install new hose clamps on the vacuum hose.
11. Install the pushrod pin to the brake pedal bracket assembly and connect the clip and the spring. Refer to Section 4A, Hydraulic Brakes.
12. Install the brake lamp switch.

GENERAL DESCRIPTION AND SYSTEM OPERATION

POWER BOOSTER

This booster is a single diaphragm, vacuum-suspended unit. In a normal operating mode, with the service brakes in the release position, a vacuum-suspended booster operates with a vacuum on both sides of its diaphragm.

When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist. When the brakes are released, atmospheric air is shut off from that side of the diaphragm. The air is then drawn from the booster through the vacuum check valve by the vacuum source.

Important: If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.

SECTION 4D

FRONT DISC BRAKES

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Hose Inlet Fitting-to-Caliper Bolt	40	30	-
Caliper Bleeder Valve	6	-	53
Caliper-to-Steering Knuckle Mounting Bolts	95	70	-
Retaining Frame-to-Caliper Housing Bolts	27	20	-
Rotor-to-Front Wheel Hub Detent Screw	4	-	35
Splash Shield-to-Steering Knuckle Screws	4	-	35

DIAGNOSIS

LINING INSPECTION

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to Section 2E, Tires and Wheels.
3. Visually check the linings for minimum thickness and wear.
4. Measure the thickness.

Important: The minimum thickness of the inner or the outer pad is 7 mm (0.28 inch).

5. Install the brake pads in axle sets only.
6. Install the front wheels. Refer to Section 2E, Tires and Wheels.
7. Lower the vehicle.

ROTOR INSPECTION

Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

A rotor that varies by more than 0.10 mm (0.004 inch) can cause pedal pulsations and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

During manufacturing, the brake rotor and the tolerances of the braking surface regarding flatness, thickness variation, and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding 0.40 mm (0.016 inch) in depth, which may result from normal use, is not detrimental to brake operation.

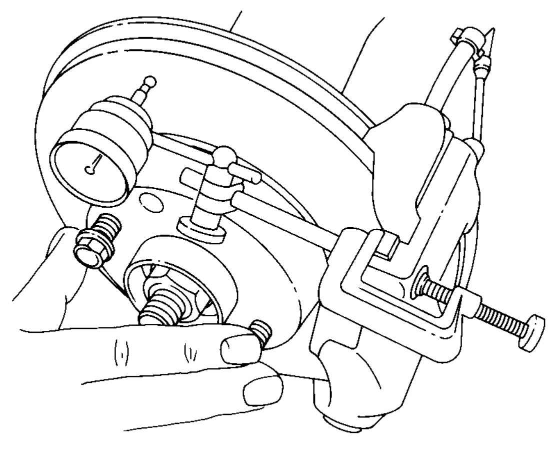
Using a commercially available dial indicator, check lateral runout as follows:

Notice: Permissible lateral runout is a maximum 0.10 mm (0.004 inch). If lateral runout exceeds the specification, make sure there is no dirt between the rotor and the hub and that contact surfaces are smooth and free from burrs.

1. Position the transaxle in NEUTRAL.
2. Remove the rotor. Refer to "Rotor" in this section.
3. Fasten the brake rotor to the wheel hub with two wheel bolts.
4. Fasten a dial indicator to the brake caliper.
5. Set the gauge probe tip to approximately 10 mm (0.39 inch) from the outer edge of the brake rotor, perpendicular to the disc and under slight preload.
6. Remove the dial indicator and connecting wheel bolts to the hub.

Important: Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, refinishing of the rotor should be done only with precision equipment.

7. Refinish the rotor, if required, with precision equipment. Discard the rotor if it fails to meet the above specifications after refinishing.
8. Install the rotor. Refer to "Rotor" in this section.



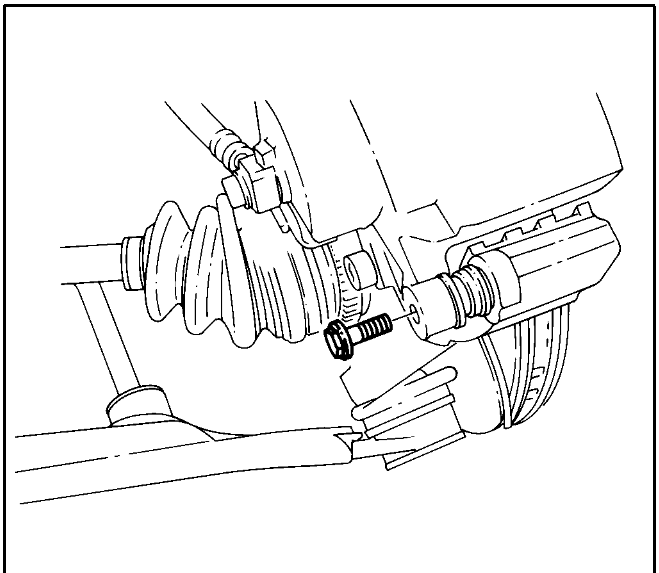
A207D004

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

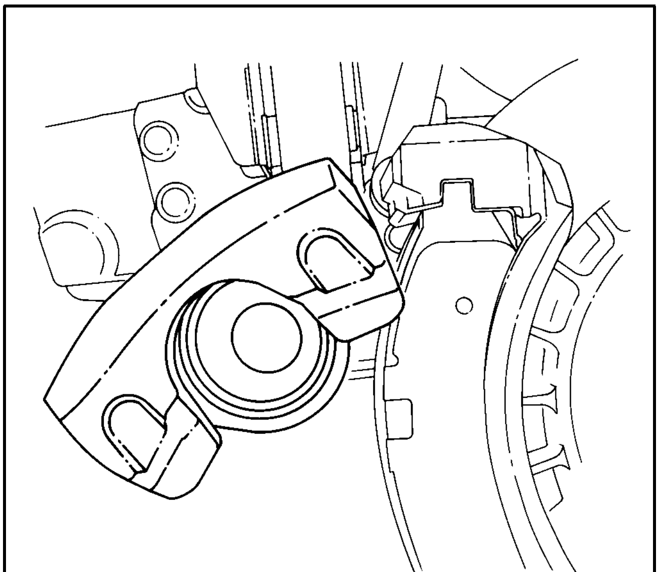
SHOE AND LINING

Removal Procedure

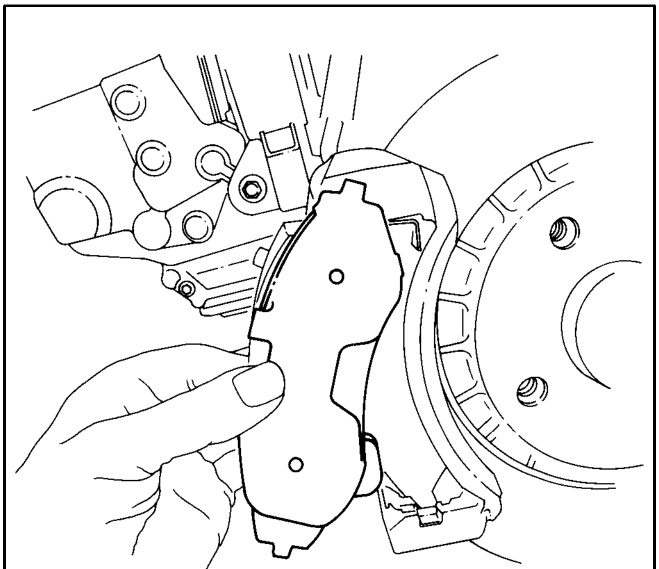

A207D001

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to Section 2E, Tires and Wheels.
3. Remove the lower bolt of the caliper assembly retaining frame.

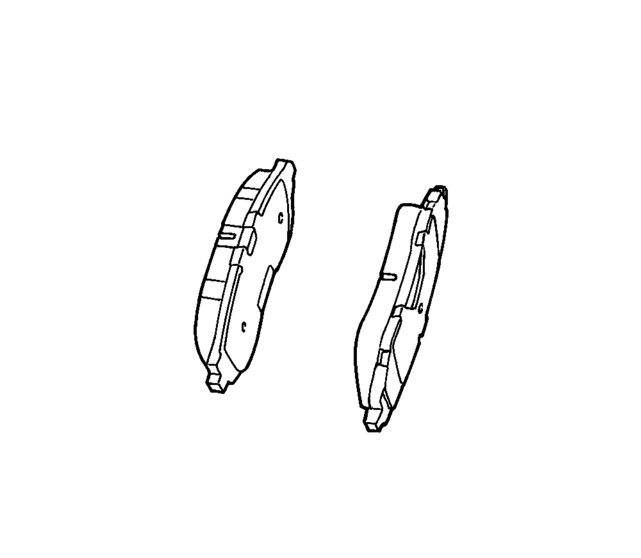
Important: Caliper assembly removal is not necessary to service the brake pads.


A207D002

4. Pull the caliper piston housing up.


A207D003

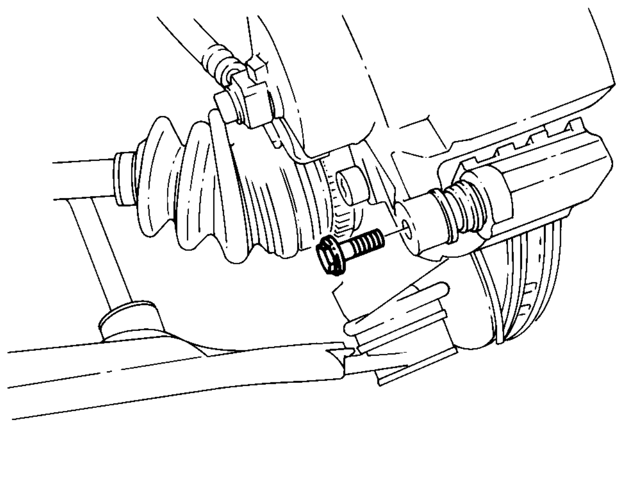
5. Remove the brake pads.



A107D004

Installation Procedure

1. Measure the minimum lining thickness. Refer to "Lining Inspection" in this section.
2. Install the brake pads into the caliper.
3. Push the piston inward, if needed.



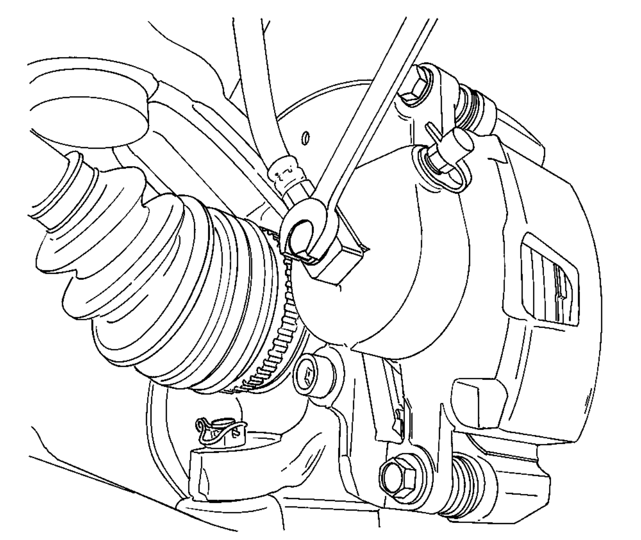
A207D001

Notice: Take care not to damage the piston seal when the piston housing is pulled down.

4. Pull down the caliper piston housing and secure it to the retaining frame with the lower bolt.

   Tighten

   Tighten the retaining frame-to-caliper housing bolts to 27 N•m (20 lb-ft).
5. Install the front wheels. Refer to Section 2E, Tires and Wheels.
6. Lower the vehicle.

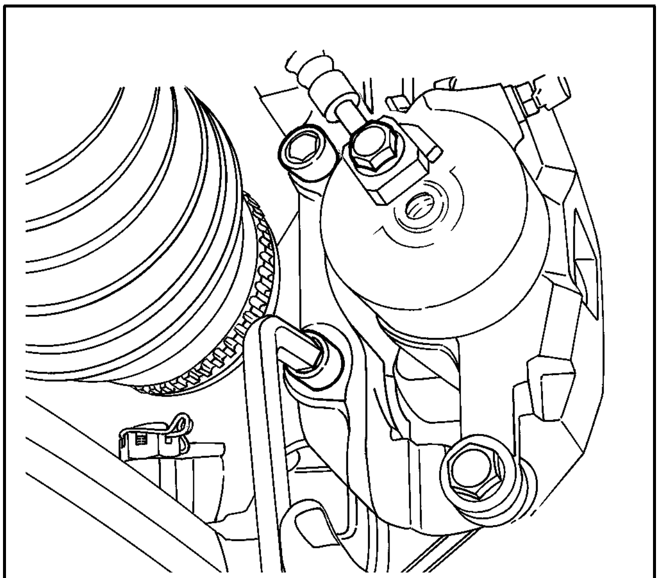


A207A006

CALIPER ASSEMBLY

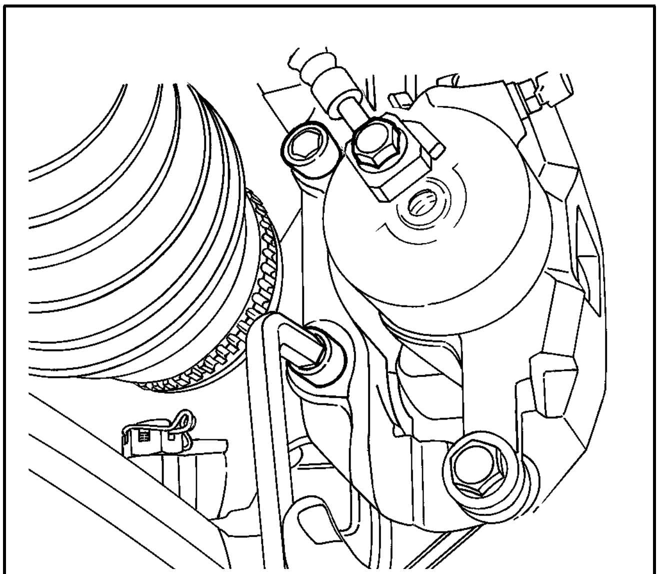
Removal Procedure

1. Raise and suitably support the vehicle.
2. Mark the position of the front wheels relative to the wheel hubs and remove the wheels. Refer to Section 2E, Tires and Wheels.
3. Remove the bolt and the washers that attach the brake hose to the caliper.



A107D007

4. Disconnect the brake hose, and plug the openings in the caliper and the brake hose to prevent fluid loss and contamination.
5. Remove the caliper mounting bolts from the steering knuckle, and remove the caliper assembly.



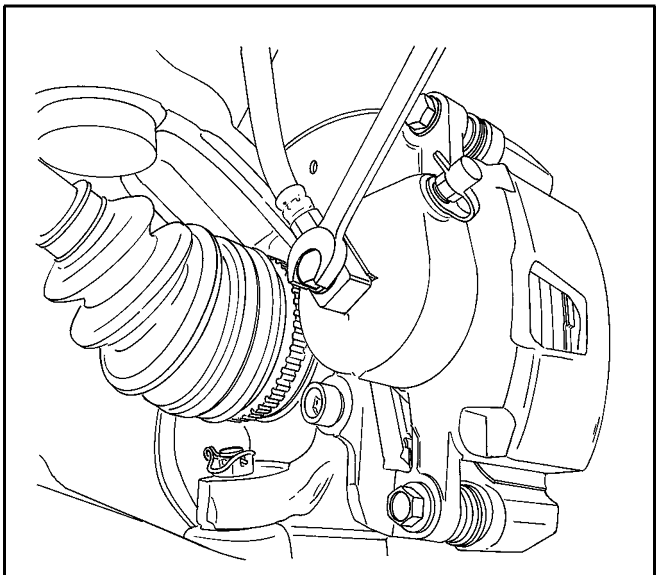
A107D007

Installation Procedure

1. Install the caliper assembly with the mounting bolts.

Tighten

Tighten the caliper-to-steering knuckle mounting bolts to 95 N•m (70 lb-ft).

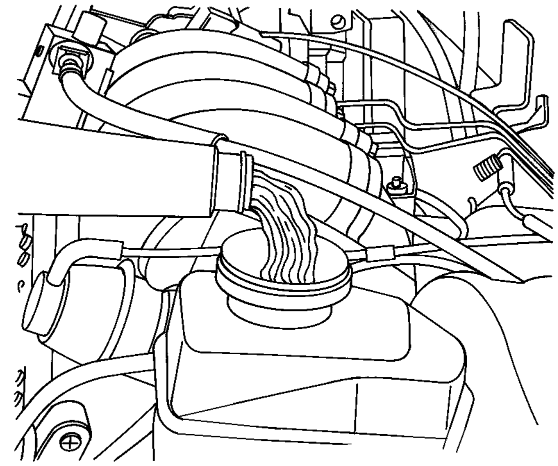


A207A006

2. Connect the brake hose.

Tighten

Tighten the brake hose inlet fitting-to-caliper bolt and washers to 40 N•m (30 lb-ft).

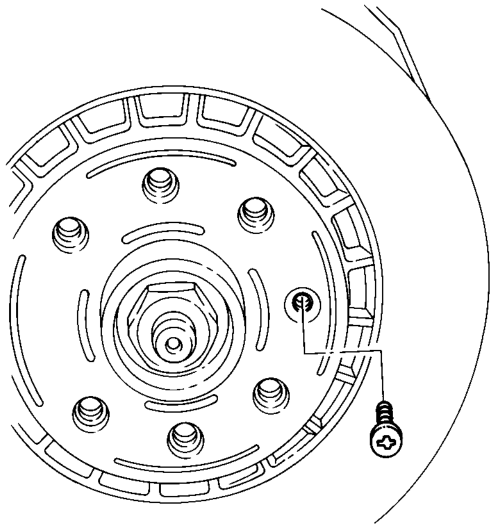


A207A004

3. Install the front wheels. Refer to Section 2E, Tires and Wheels.
4. Lower the vehicle.
5. Fill the master cylinder to the proper level with clean brake fluid.
6. Bleed the caliper. Refer to Section 4A, Hydraulic Brakes.
7. Recheck the fluid level.

Notice: Do not move the vehicle until a firm pedal is obtained, or improper braking action will result.

8. Repeatedly press the brake pedal to bring the pads in contact with the rotor.



A207D005

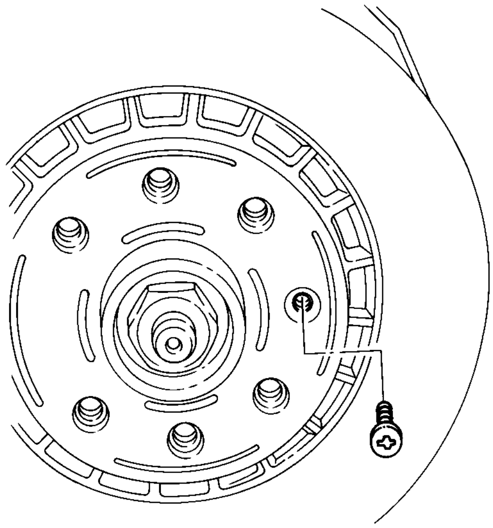
ROTOR

Removal Procedure

Notice: Do not hang the caliper assembly from the brake hose. Any resulting internal hose restriction will impede uniform braking action.

Important: To guarantee uniform braking on both sides, both rotors must have identical surfaces regarding smoothness and scoring depth. For this reason, always replace both rotors.

1. Remove the caliper assembly without disconnecting the brake hoses. Refer to "Caliper Assembly" in this section.
2. Remove the rotor-to-front wheel hub detent screw from the rotor and the front wheel hub.
3. Pull off the rotor.



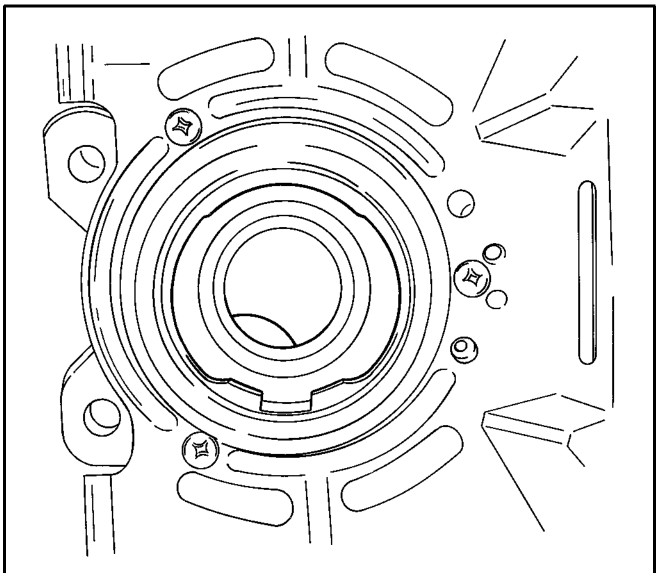
A207D005

Installation Procedure

1. Inspect the rotor. Refer to "Rotor Inspection" in this section.
2. Install the rotor to the front wheel hub by tightening the detent screw.

   ### Tighten

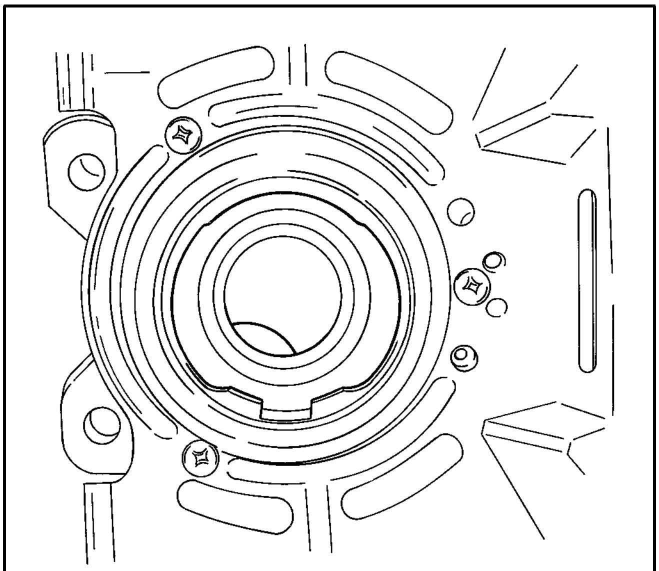
   Tighten the rotor-to-front wheel hub detent screw to 4 N•m (35 lb-in).
3. Install the caliper assembly. Refer to "Caliper Assembly" in this section.


A106C058

SPLASH SHIELD

Removal Procedure

1. Remove the rotor. Refer to “Rotor” in this section.
2. Remove the screws for the splash shield from the steering knuckle.
3. Remove the splash shield.


A106C058

Installation Procedure

1. Install the splash shield.
2. Secure the splash shield to the steering knuckle with the screws.

   Tighten

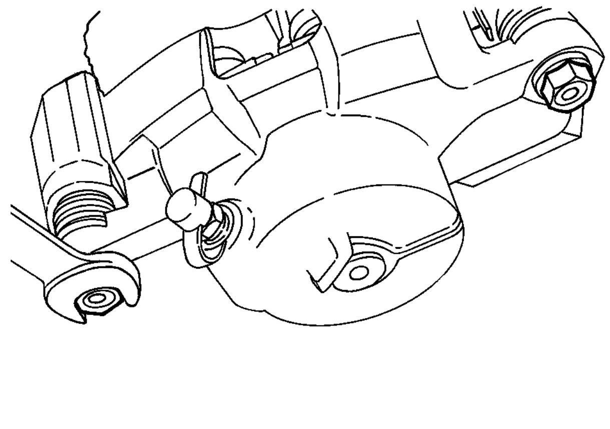
   Tighten the splash shield-to-steering knuckle screws to 4 N•m (35 lb-in).
3. Install the rotor. Refer to “Rotor” in this section.

UNIT REPAIR

CALIPER OVERHAUL

Disassembly Procedure

1. Remove the caliper assembly. Refer to "Caliper Assembly" in this section.
2. Remove the caliper guide pin that connects the caliper piston housing to the retaining frame.



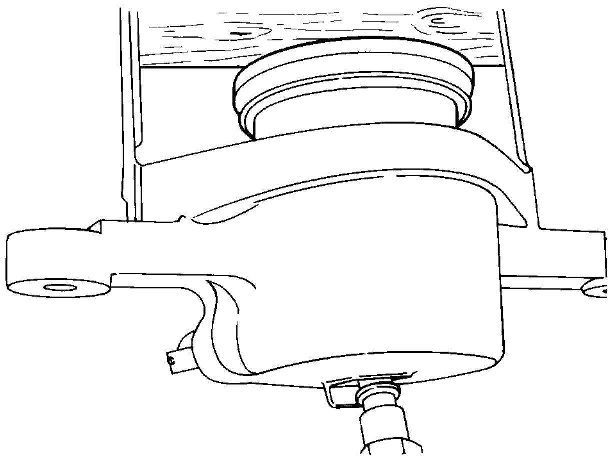
A107D012

3. Remove the front pad brake set, including the pad springs, from the caliper. Refer to "Shoe and Lining" in this section.

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

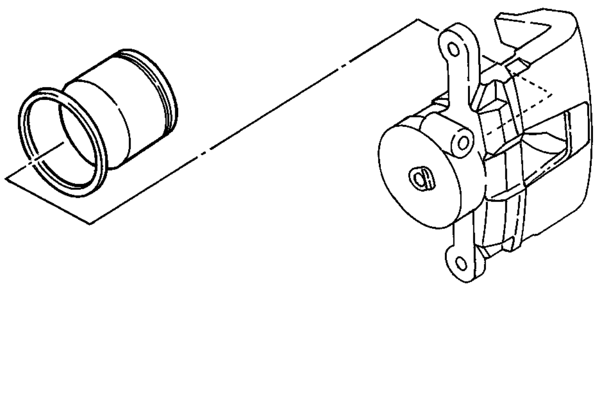
Important: Insert a piece of hardwood into the caliper housing interior when removing the piston.

4. Using compressed air, blow out the piston from the housing.
5. Remove the outer seal.

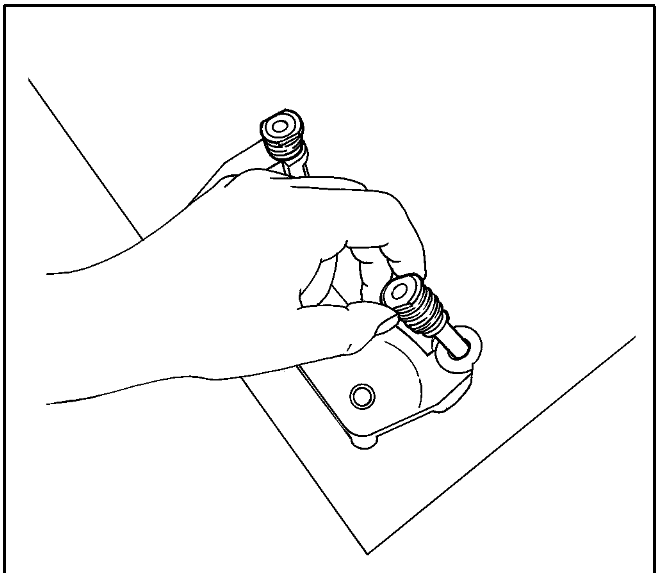


B107D006

6. Remove the inner seal from the caliper piston bore.

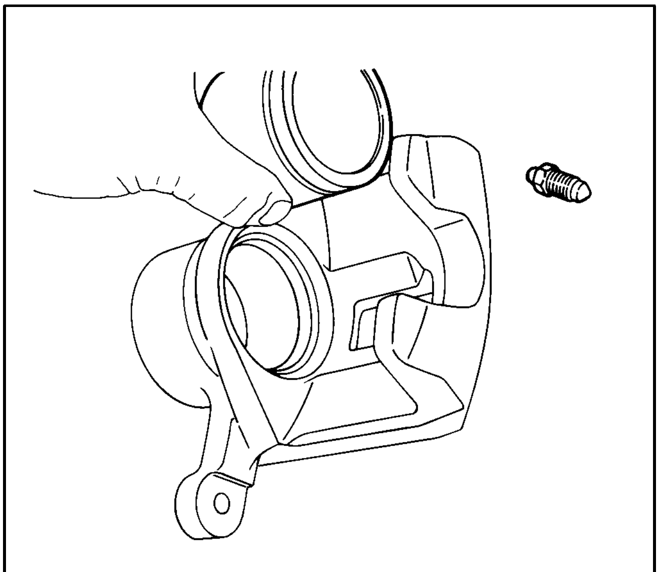


A107D015



A107D016

7. Remove the bleeder valve protector and the bleeder valve.
8. Pull out the pins and the rubber boots.

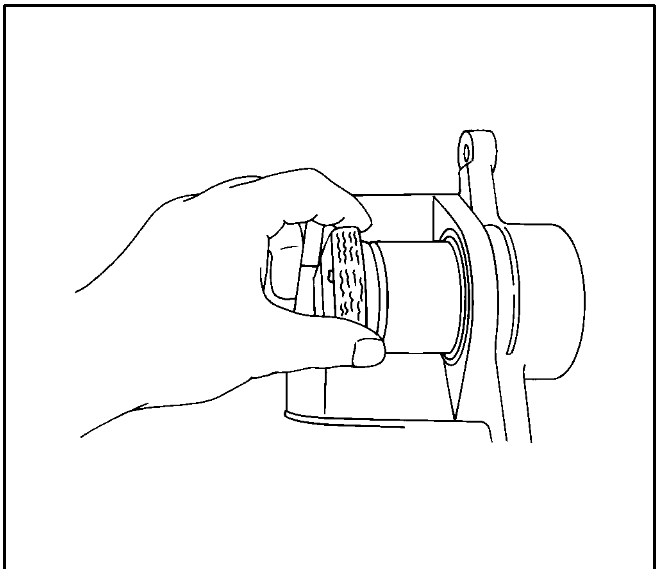


C107D008

Assembly Procedure

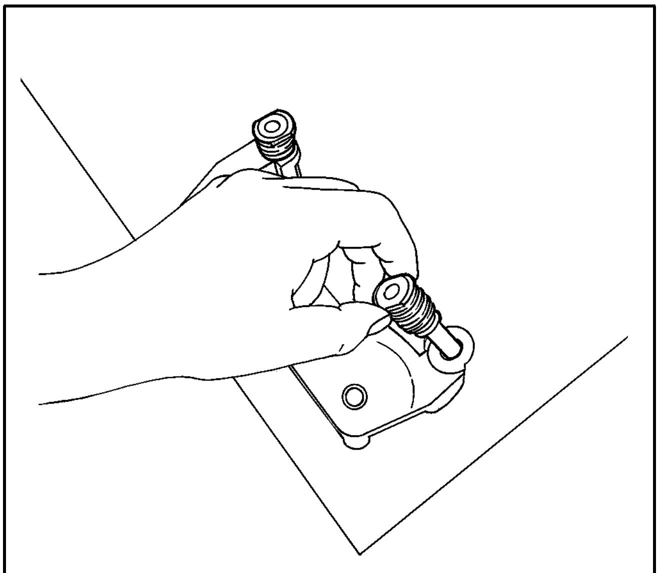
1. Clean all parts in denatured alcohol or brake fluid. Dry the parts with unlubricated compressed air and blow out all passages in the housing and the bleeder valve.
2. Inspect the piston and the caliper for scoring, nicks, and corrosion. Replace components if these elements are found.
3. Inspect the caliper bleeder valve.

Important: Do not remove material from the piston or the caliper bore.



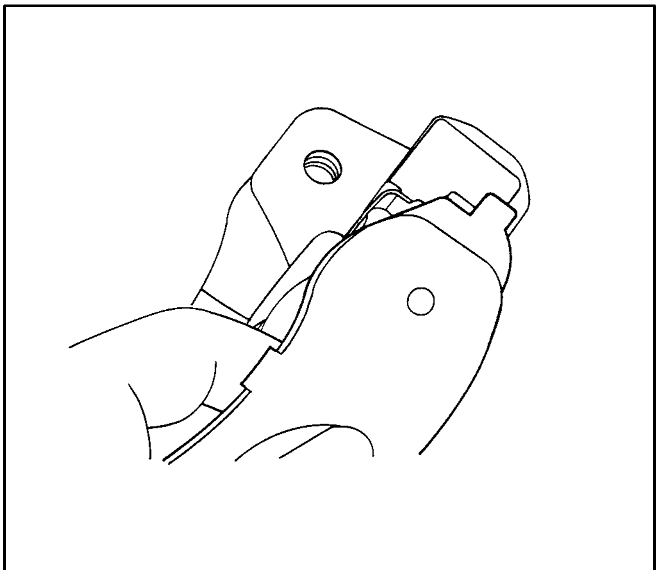
C107D009

4. Lubricate a new piston inner seal.
5. Install the piston inner seal into the caliper housing groove. Make sure the seal is not twisted.
6. Install the outer piston dust seal in the groove.
7. Lubricate the piston with brake fluid.
8. Push the piston inward until it is properly seated.



A107D016

9. Coat the pins with rubber grease and install the boots.



B207D002

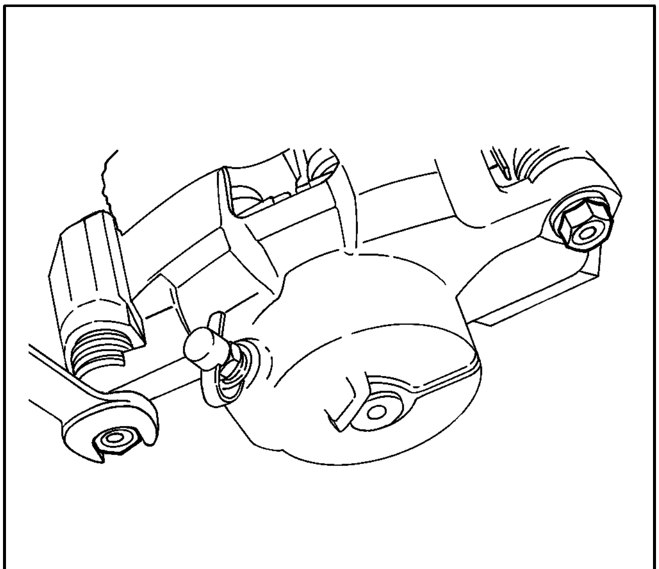
10. Install the caliper bleeder valve and the protector.

Tighten

Tighten the caliper bleeder valve to 6 N•m (53 lb-in).

11. Connect the brake pads and the pad springs.

Important: Make sure the pad springs are properly installed.



A107D012

12. Connect the retaining frame to the caliper housing with the guide pin bolts.

Tighten

Tighten the retaining frame-to-caliper housing bolts to 27 N•m (20 lb-ft).

13. Install the caliper assembly. Refer to “Caliper Assembly” in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

DISC BRAKE CALIPER ASSEMBLY

This caliper has a single bore and is mounted to the steering knuckle with two mounting bolts. Hydraulic pressure, created by applying the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward, resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor, creating friction to stop the vehicle.

Important:

- Replace all components included in the repair kits used to service this caliper.
- Lubricate the rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts, as damage to the rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

SECTION 4E

REAR DRUM BRAKES

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Drum Detent Screw	4	-	35
Brake Line	16	12	-
Brake Wheel Hub/Backing Plate-to-Rear Axle Nuts	28	21	-
One-Piece Drum Castle Nut	25 - 180° +2	18 - 180° +1.5	-
Wheel Cylinder-to-Backing Plate Bolt	8	-	71

DIAGNOSIS

LINING INSPECTION

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Release the parking brake.
4. Remove the drum. Refer to “One-Piece Drum” or “Two-Piece Drum” in this section.
5. Measure the lining thickness. The minimum lining thickness is 0.5 mm (0.02 inch).

Caution: To avoid injury when servicing brake parts, do not create dust by grinding or sanding the brake linings or by cleaning the wheel brake parts with a dry brush or with compressed air.

Important: Replace the shoe and lining assembly in axle sets only.

7. Install the drum, if removed. Refer to “One-Piece Drum” or “Two-Piece Drum” in this section.
8. Install the wheel, if removed. Refer to Section 2E, Tires and Wheels.
9. Lower the vehicle.

DRUMS

Whenever brake drums are removed, they should be thoroughly cleaned and inspected to see if the drums are cracked, scored, deeply grooved, or beyond the specified out-of-round limit.

- A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum. Smooth out any slight scores.
- Heavy or extensive scoring will cause excessive brake lining wear and may require refinishing the drum braking surface.

- If the brake linings are slightly worn but are still reusable and the drum is grooved, polish the drum with a fine emery cloth but do not refinish it. Eliminating all grooves in the drum and smoothing the ridges on the lining would remove too much metal and lining. If left alone, the grooves and ridges match, and satisfactory service can be obtained. If the brake linings need to be replaced, refinish a grooved drum. A grooved drum, used with a new lining, will not only wear the lining, but also will make it difficult, if not impossible, to obtain proper brake performance.
- An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of the brake mechanism. An out-of-round drum can also cause severe and irregular tire tread wear, as well as a pulsating brake pedal.
- The extent to which a drum is worn or out of round can be measured accurately with an inside micrometer fitted with the proper extension rods. When measuring a drum for wear or the extent to which it is out of round, take measurements from the inside edge to the outside edge of the machined surface at 90-degree intervals around the circumference of the drum.

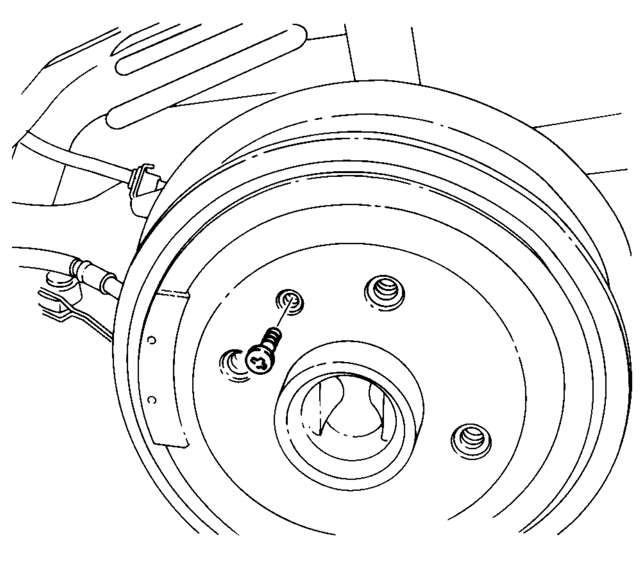
  When the drum exceeds the specified out-of-round limit, refinish the drum.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

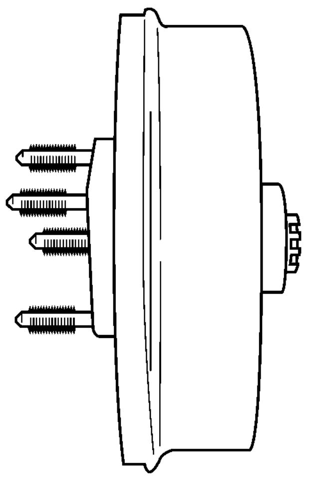
BRAKE ADJUSTMENT

Removal Procedure



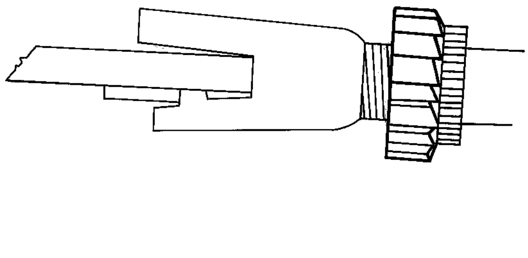
A207E001

1. Release the parking brake.
2. Operate the brake at least 10 times until the jumping of the adjustment spring on the adjustment nut can no longer be heard on either brake drum.
3. Raise and suitably support the vehicle.
4. Remove the rear wheels. Refer to Section 2E, Tires and Wheels. Mark the position of the wheels relative to the wheel hubs.
5. For vehicles with an ABS braking system, remove the detent screw from the brake drum.



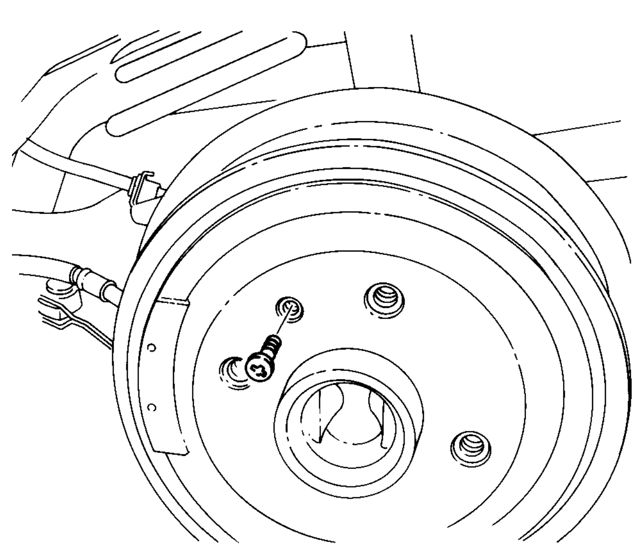
A107E024

6. For vehicles with a non-ABS system, remove the split pin and the nut that secures the drum to the spindle.
7. Remove the brake drum.



A107E002

8. Using the rear brake adjuster nut, turn the adjuster assembly in until there is a sufficient amount of drag on the brake drum.
9. Make sure that the parking brake lever stops are against the edge of the shoe web. If they are not, loosen the parking brake cable at the equalizer.

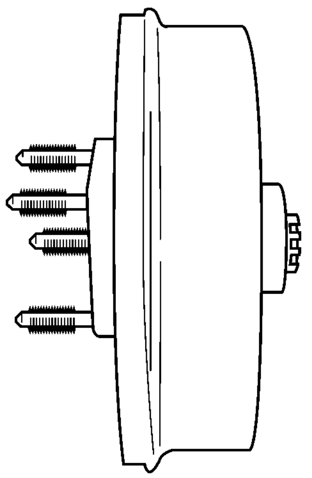

A207E001

Installation Procedure

1. For vehicles with an ABS braking system, position the rear brake drum and fasten the detent screw.

   Tighten

   Tighten the brake drum detent screw to 4 N•m (35 lb-in).


A107E024

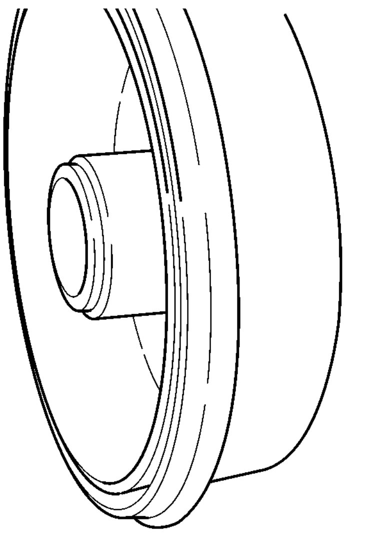
2. For vehicles with a non-ABS braking system, position the rear brake drum. Fasten the one-piece drum castle nut and secure it with the new split pin.

   Tighten

   Tighten the one-piece drum castle nut to 25 N•m (18 lb-ft) minus 180 degrees plus 2 N•m (18 lb-in).
3. Install the rear wheels. Refer to Section 2E, Tires and Wheels.

Important: The brake pedal must be operated more than 10 times. When the clicking can no longer be heard, the clearance between the brake shoe and drum is adjusted.

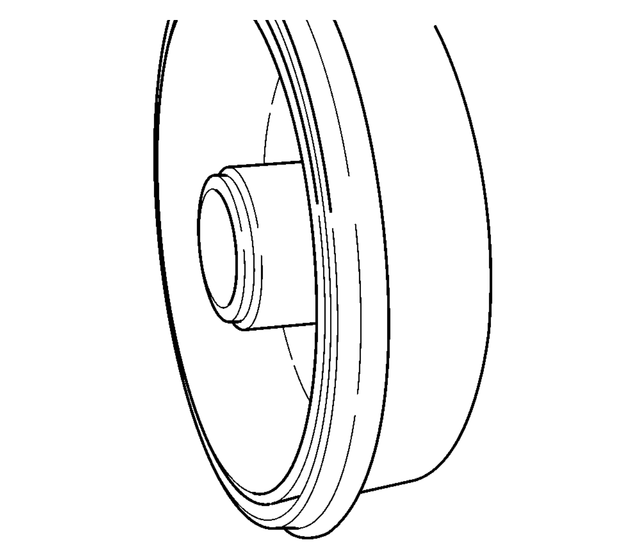
4. Apply the foot brake several times until the clicking of the adjustment actuator can no longer be heard.
5. Adjust the parking brake. Refer to Section 4G, Parking Brake.


A107E023

ONE-PIECE DRUM

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the split pin and the castle nut that secures the drum to the spindle. Discard the split pin.
4. Remove the rear brake drum.



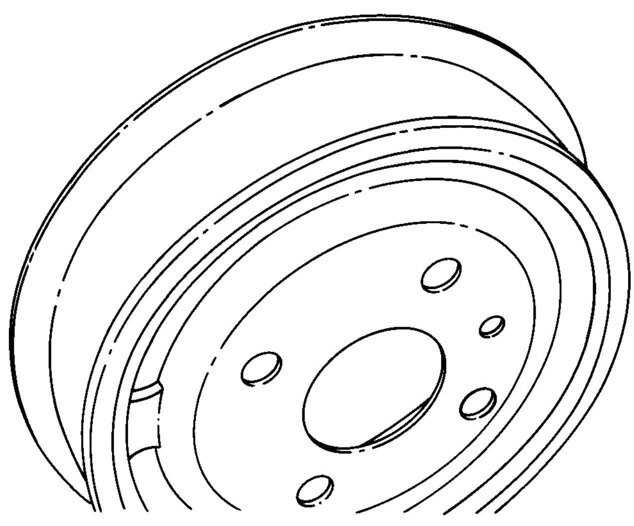
A107E023

Installation Procedure

1. Inspect the hub bearing, and coat it with grease, if needed.
2. Install the rear brake drum.
3. Secure the drum with the castle nut and the new split pin.

   Tighten

   Tighten the one-piece drum castle nut to 25 N•m (18 lb-ft) minus 180 degrees plus 2 N•m (18 lb-in).
4. Install the wheel. Refer to Section 2E, Tires and Wheels.
5. Lower the vehicle.

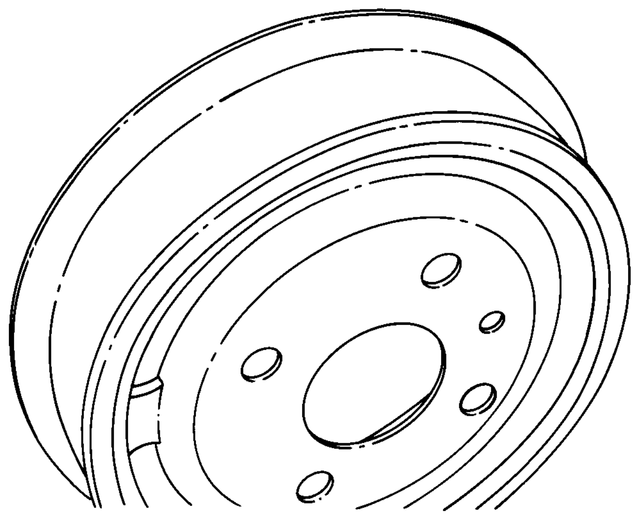


A207E002

TWO-PIECE DRUM

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the detent screw from the brake drum.
4. Remove the brake drum.



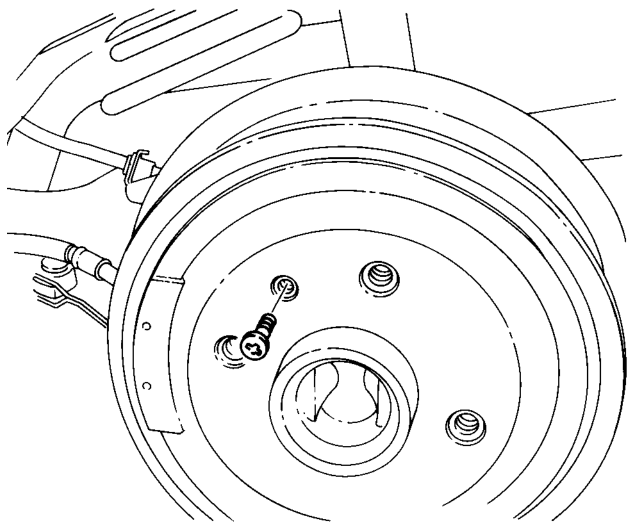
A207E002

Installation Procedure

1. Inspect the brake drum. Refer to "Drums" in this section.
2. Install the brake drum.
3. Tighten the detent screw to secure the brake drum.

   Tighten

   Tighten the brake drum detent screw to 4 N•m (35 lb-in).
4. Install the wheel. Refer to Section 2E, Tires and Wheels.
5. Lower the vehicle.

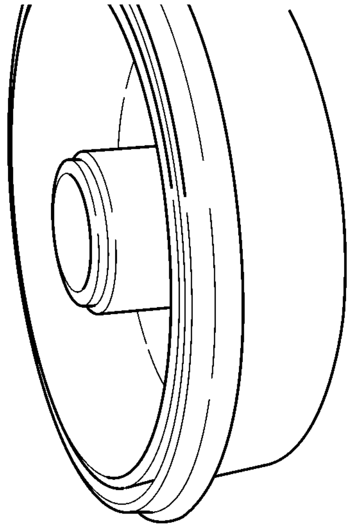


A207E001

SHOE AND LINING

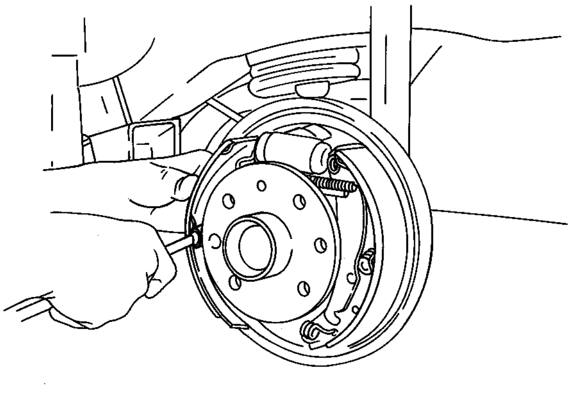
Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear wheels. Refer to Section 2E, Tires and Wheels.
3. Mark the position of the wheels relative to the wheel hub.
4. Loosen the parking brake cable. Refer to Section 4G, Parking Brake.
5. For vehicles with the ABS braking system, remove the detent screw from the brake drum. Remove the brake drum.



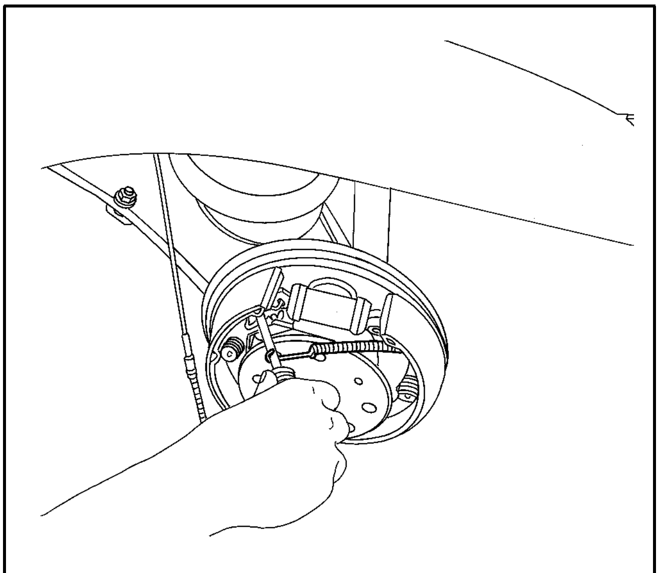
A107E023

6. For vehicles with the non-ABS braking system, remove the rear brake drum by unfastening the split pin and the one-piece drum castle nut. Discard the split pin.



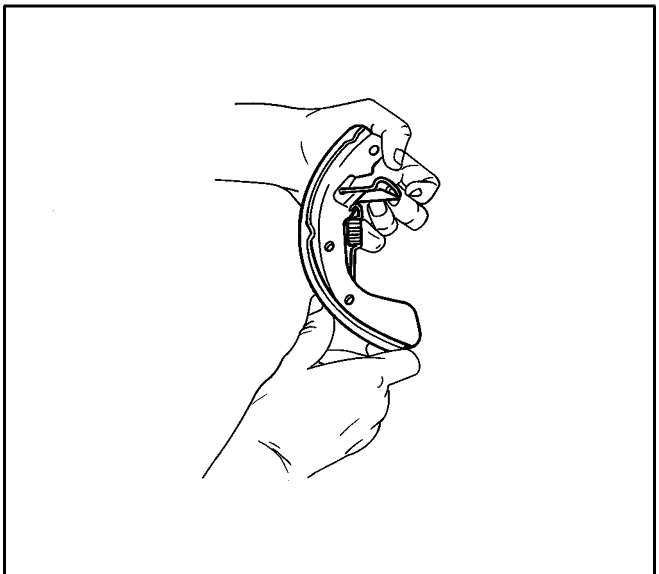
A107E003

7. Loosen the leading shoe hold-down return spring. (The ABS braking system configuration is illustrated.)



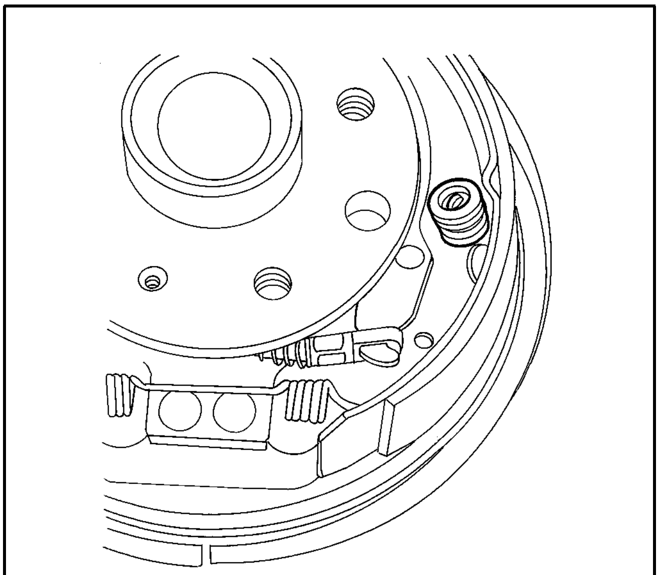
A107E013

8. Disconnect the upper link of the connecting link-spring of the leading shoe to relieve tension on the upper return spring.
9. Remove the upper return spring and the adjuster.



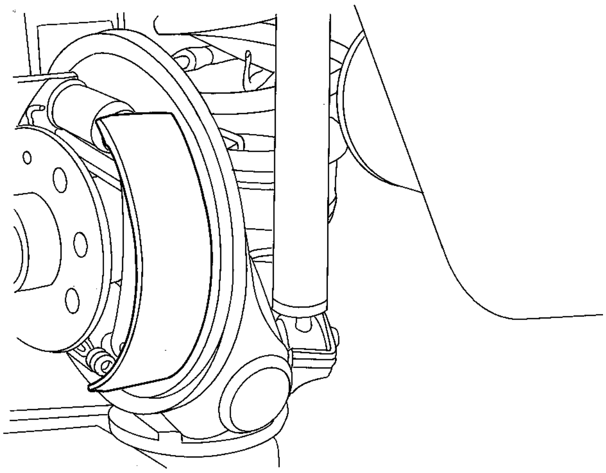
A107E005

10. Remove the leading shoe by unlatching it from the lower return spring.



A107E006

11. Unfasten the trailing shoe and lining assembly hold-down return spring.


A107E007

12. Disconnect the trailing shoe and lining assembly on the right side.
13. Detach the lower return spring.

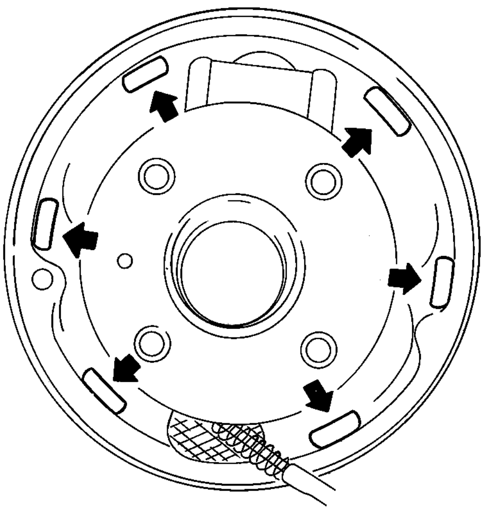

A107E008

Installation Procedure

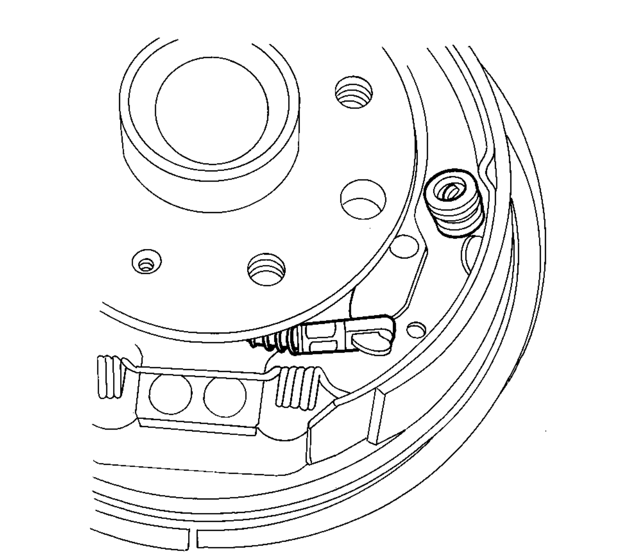
1. Measure the minimum brake lining thickness. Refer to "Lining Inspection" in this section.
2. Clean the adjuster assembly and apply grease.

Notice: If any parts are of questionable strength or quality because of heat discoloration, excessive stress, or wear, the shoes, the springs, or the adjuster assembly should be replaced.

3. Inspect the threads of the adjuster assembly for smooth rotation.


A107E010

4. Coat the backing plate with grease at the brake shoe contact points.

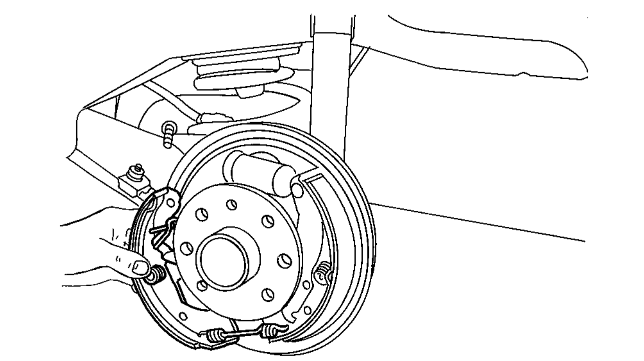


A107E011

5. Install the trailing shoe and lining assembly with the hold-down spring, the washer, and the pin.
6. Make sure the parking brake cable is properly routed and attached to the shoe lever.

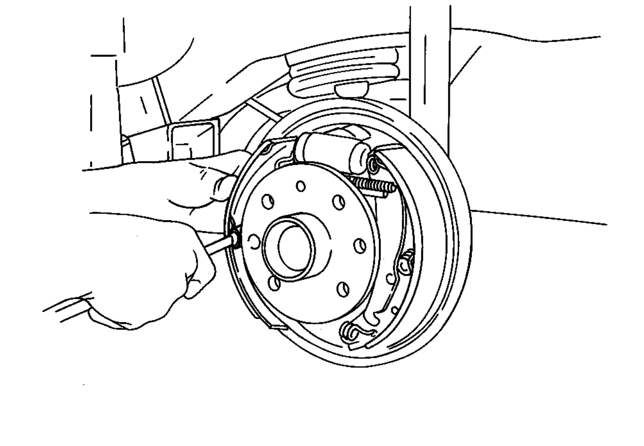
Notice: Do not overstretch the lower return spring.

7. Fasten the lower return spring on the shoe.



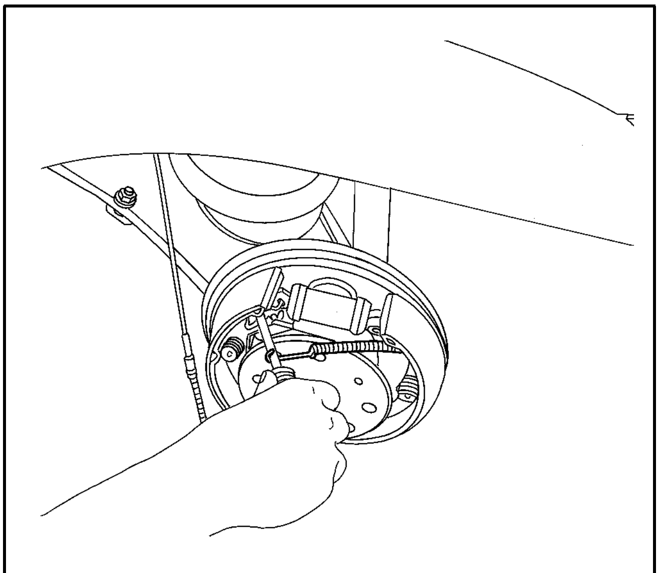
A107E012

8. Position the leading shoe and the adjuster assembly against the backing plate.
9. Fasten the lower return spring to the leading shoe.



A107E003

10. Install the adjuster assembly.
11. Turn the adjuster in as far as possible.
12. Position the spring clip toward the backing plate.
13. Install the leading shoe with the hold-down spring.

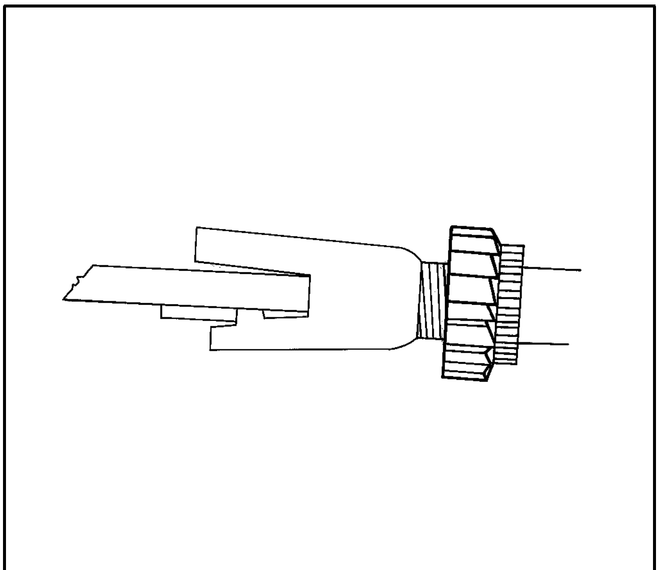


A107E013

14. Attach the leading shoe upper link-spring connection, which applies tension to the upper return spring.

Notice: Do not overstretch the upper return spring.

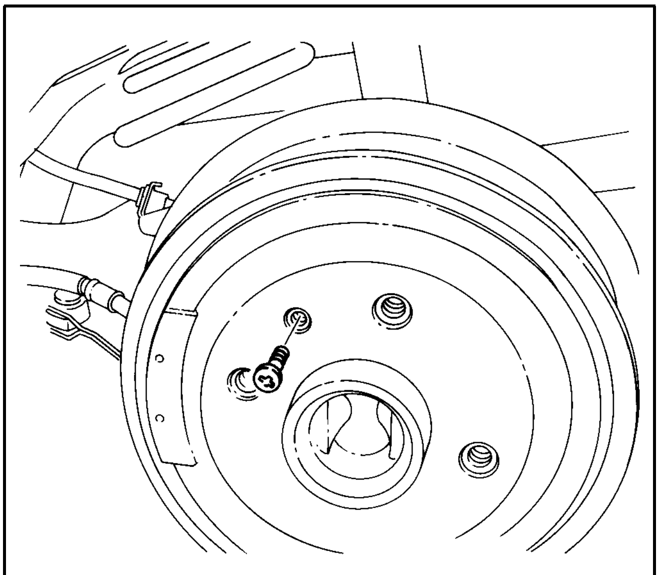
15. Install the upper return spring from the spring connecting link to the brake shoe.



A107E002

Notice: The nut must not lock firmly at the end of the adjustment assembly.

16. Before installing the brake drum, make sure the adjuster assembly nut is drawn all the way to the stop.

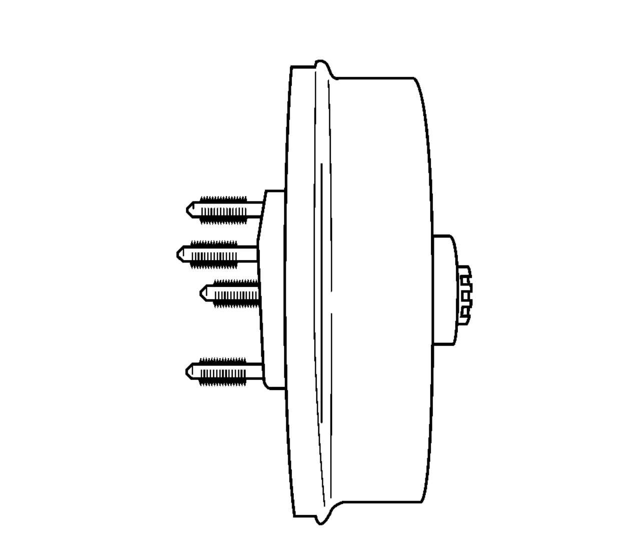


A207E001

17. For vehicles with the ABS braking system, install the brake drum and fasten it with the detent screw.

Tighten

Tighten the brake drum detent screw to 4 N•m (35 lb-in).



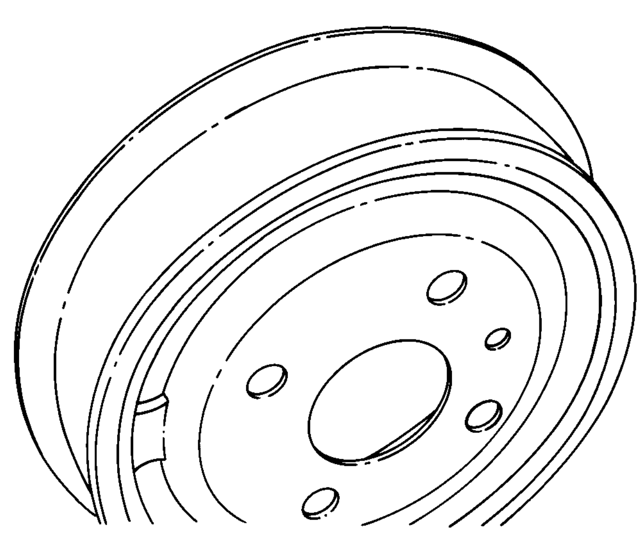
A107E024

18. For vehicles with the non-ABS braking system, install the brake drum and fasten it with the castle nut and the new split pin.

Tighten

Tighten the one-piece drum castle nut to 25 N•m (18 lb-ft) minus 180 degrees plus 2 N•m (18 lb-in).

19. Install the rear wheels. Refer to Section 2E, Tires and Wheels.
20. Adjust the rear wheel brakes. Refer to "Brake Adjustment" in this section.
21. Adjust the parking brake. Refer to Section 4G, Parking Brake.
22. Lower the vehicle.

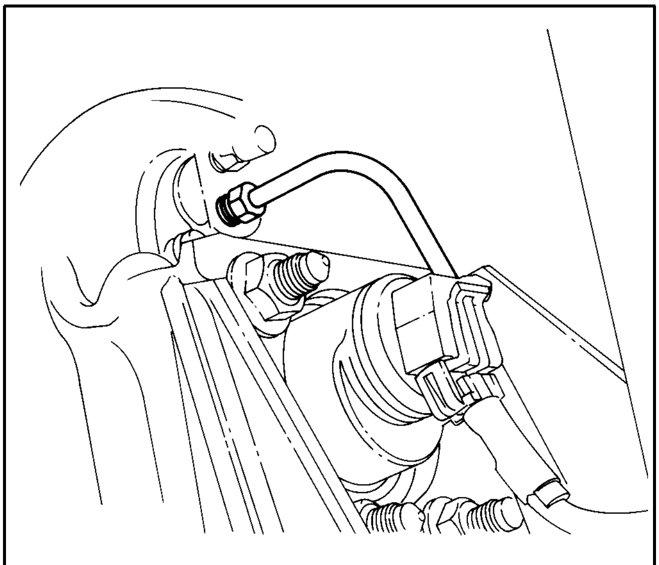


A207E002

WHEEL CYLINDER ASSEMBLY

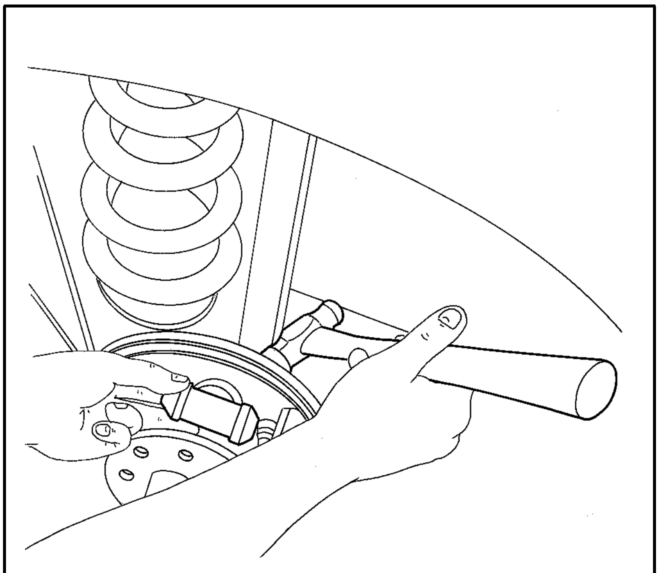
Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear wheels. Refer to Section 2E, Tires and Wheels.
3. Mark the position of the wheels relative to the wheel hubs.
4. Remove the brake drum.
5. Remove the shoe and lining. Refer to "Shoe and Lining" in this section.



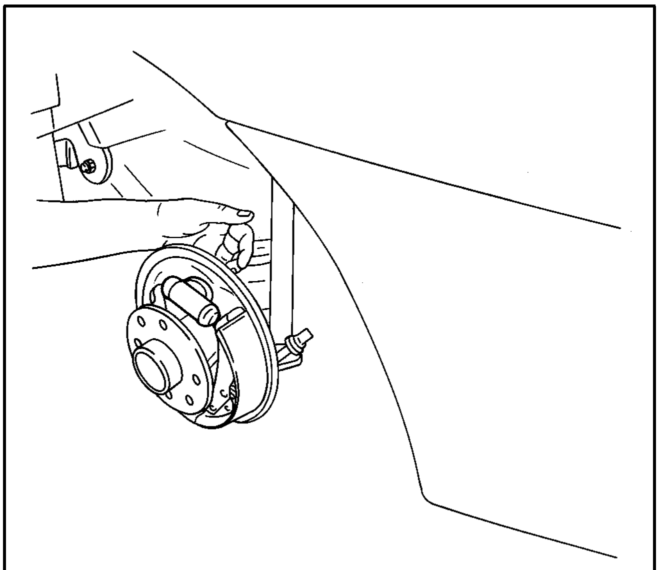
A207E003

6. Clean dirt and foreign material from around the wheel cylinder brake line inlet, the pilot, and the bolt.
7. Disconnect the brake line from the wheel cylinder.
8. Plug the opening in the brake line to prevent fluid loss or contamination.



A107E015

9. Remove the wheel cylinder-to-backing plate bolt.
10. Gently tap out the wheel cylinder from the backing plate, using care not to damage the bleeder valve or its cap.



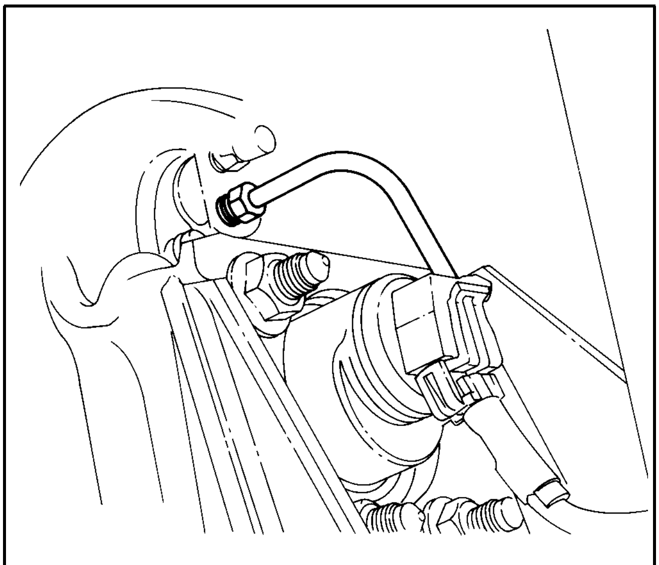
A107E016

Installation Procedure

1. Install the wheel cylinder to the backing plate with the wheel cylinder bolt.

Tighten

Tighten the wheel cylinder-to-backing plate bolt to 8 N•m (71 lb-in).



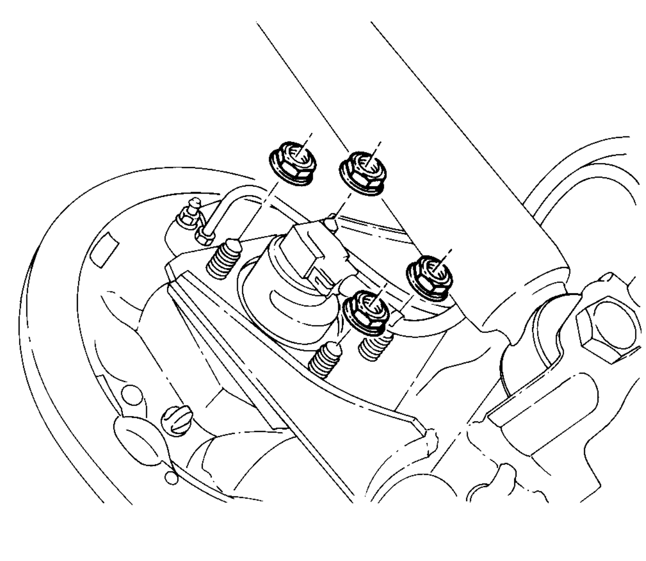
A207E003

2. Connect the brake line to the wheel cylinder.

Tighten

Tighten the brake line to 16 N•m (12 lb-ft).

3. Install the shoe and lining, and the brake drum. Refer to “Shoe and Lining” in this section.
4. Bleed the brakes. Refer to Section 4A, Hydraulic Brakes.

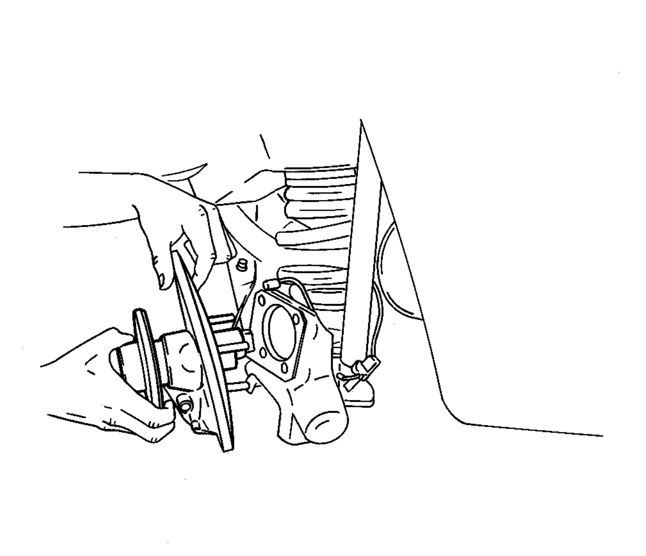


A207E004

BACKING PLATE

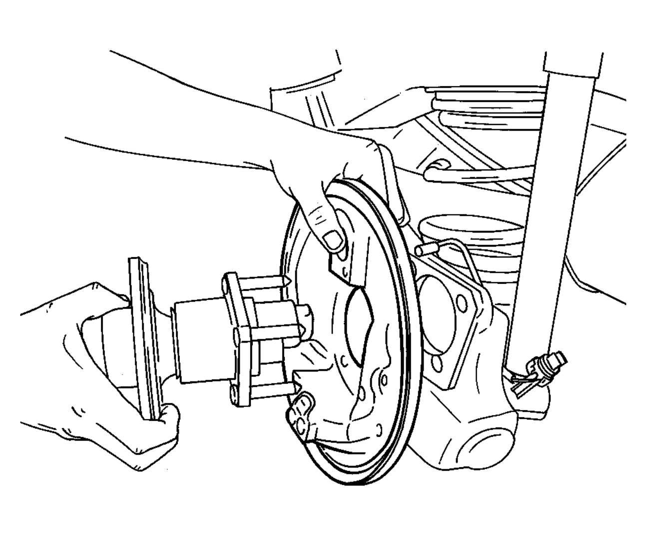
Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the brake shoe components, including complete removal of the parking brake with the retainer. Refer to "Shoe and Lining" in this section.
3. Remove the nuts that secure the wheel hub assembly to the backing plate.
4. Remove the brake line and plug the opening in the line to prevent fluid loss or contamination.



A107E021

5. Remove the wheel cylinder assembly. Refer to "Wheel Cylinder Assembly" in this section.
6. Remove the wheel hub assembly. (The ABS hub is shown.) Disconnect the cable that goes to the wheel speed sensor on ABS brakes.
7. Separate the backing plate and the gasket.



A107E022

Installation Procedure

1. Place the backing plate with a new gasket on the wheel hub. (The ABS hub is shown.)
2. Insert the complete wheel hub/backing plate assembly into the rear axle plate. Install the nuts and connect the wheel speed sensor on ABS brakes.

Tighten

Tighten the brake wheel hub/backing plate-to-rear axle nuts to 28 N•m (21 lb-ft).

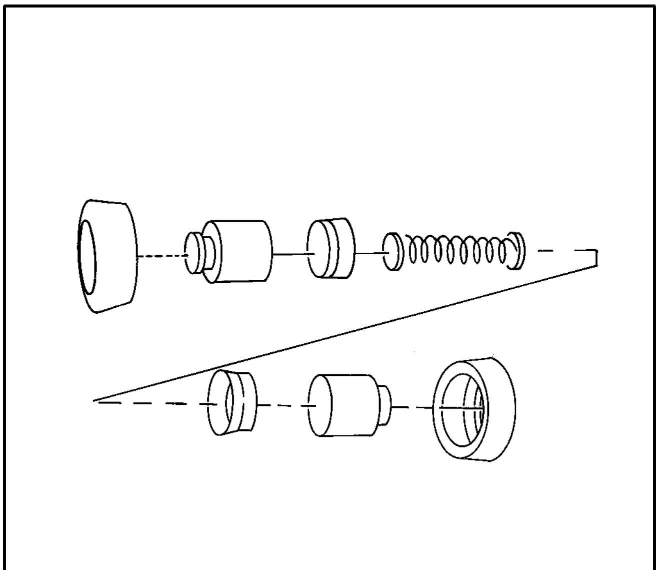
A207E003

3. Install the brake wheel cylinder assembly to the backing plate. Refer to “Wheel Cylinder Assembly” in this section.
4. Connect the brake line.

Tighten

Tighten the brake line to 16 N•m (12 lb-ft).

5. Install the brake components. Refer to “Shoe and Lining” in this section.
6. Install the parking brake cable with the retainer by attaching the cable to the brake shoe lever. Refer to Section 4G, Parking Brake.
7. Bleed the brakes. Refer to Section 4A, Hydraulic Brakes.
8. Lower the vehicle.



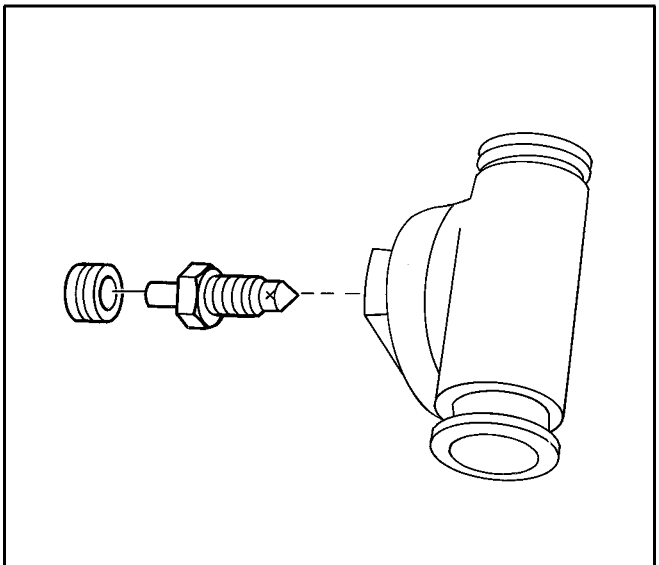
A107E017

UNIT REPAIR

WHEEL CYLINDER

Disassembly Procedure

1. Remove the wheel cylinder assembly from the backing plate. Refer to “Wheel Cylinder Assembly” in this section.
2. Twist off the boots, the pistons, and the seals from each end of the wheel cylinder.
3. Remove the spring assembly.



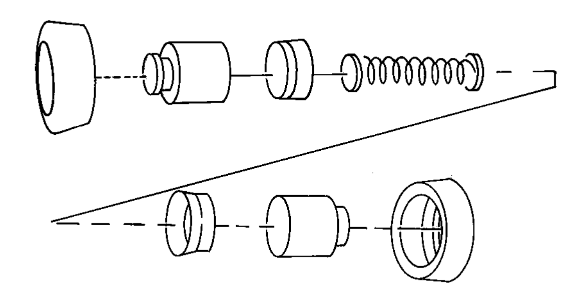
A107E019

4. Remove the bleeder cap and the bleeder valve.

Assembly Procedure

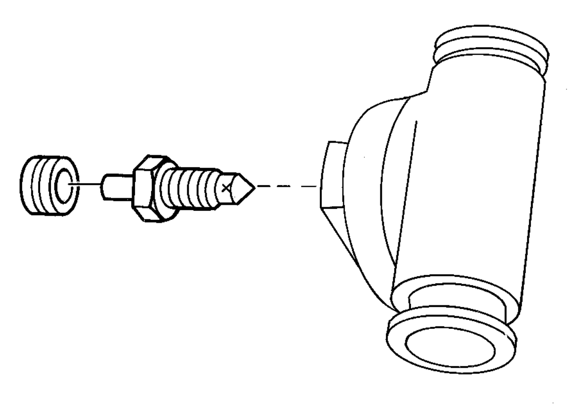
1. Inspect the wheel cylinder bore and the pistons for scoring, nicks, corrosion, and wear.
2. Use a crocus cloth to polish out light corrosion in the wheel cylinder bore.

Important: If the bore will not clean up with a crocus cloth, replace the assembly.



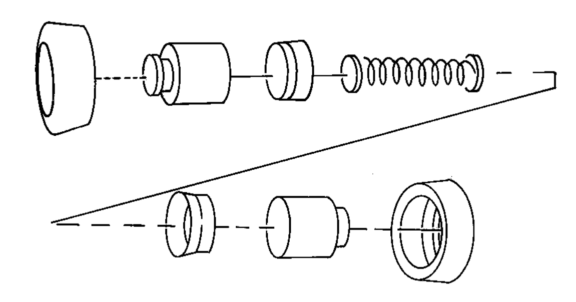
A107E017

3. Clean all the parts in clean denatured alcohol or brake fluid. Dry all the parts with unlubricated compressed air and lubricate the new seals, the pistons, and the wheel cylinder bore with clean brake fluid before assembly.
4. Thinly coat all the parts except the dust caps with brake cylinder fluid.
5. Fasten the bleeder valve and the cap to the wheel cylinder.



A107E019

6. Attach to the wheel cylinder the spring assembly, followed by the pistons, the seals, and the boots.
7. Inspect the pistons for free movement.
8. Install the wheel cylinder assembly. Refer to "Wheel Cylinder Assembly" in this section.



A107E017

GENERAL DESCRIPTION AND SYSTEM OPERATION

DRUM BRAKES

This drum brake assembly is a leading/trailing shoe design. Both brake shoes are held against the wheel cylinder pistons by the lower return spring and the fixed anchor plate near the lower return spring. When the brakes are applied, the wheel cylinder pistons move both shoes out to contact the drum. With forward wheel rotation, the forward brake shoe will wrap into the drum and become self-energized. With reverse wheel rotation, the rear brake shoe is self-energized. Force from the brake shoes is transferred to the anchor plate through the backing plate to the axle flange. Adjustment is automatic and occurs on any service brake application. Do not switch the position of shoes that have been in service, as this may render the self-adjustment feature inoperative and result in increased pedal travel.

Notice: To avoid damaging the vehicle, observe the following directions:

- Replace all the components included in the repair kits used to service this drum brake.
- Do not use lubricated shop air on the brake parts, as damage to the rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the braking system.
- Replace the shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench that is free from all mineral oil materials.

SECTION 4F

ANTILOCK BRAKE SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

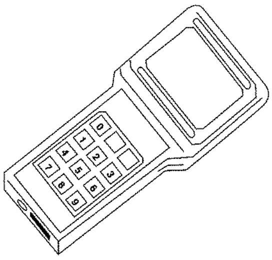
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Bleeder Valve	9	-	80
Brake Pipe Nuts	16	12	-
Front Wheel Speed Sensor Bolt	7.8	-	69
Gear Cover Torx[Head Screws	4	-	35
Gear Nuts	8.5	-	76
Hydraulic Modulator/Motor Pack Assembly Nuts	5	-	44
Motor Pack Torx[Head Screws	4.5	-	40
Solenoid Torx[Head Bolts	4.5	-	40

SPECIAL TOOLS

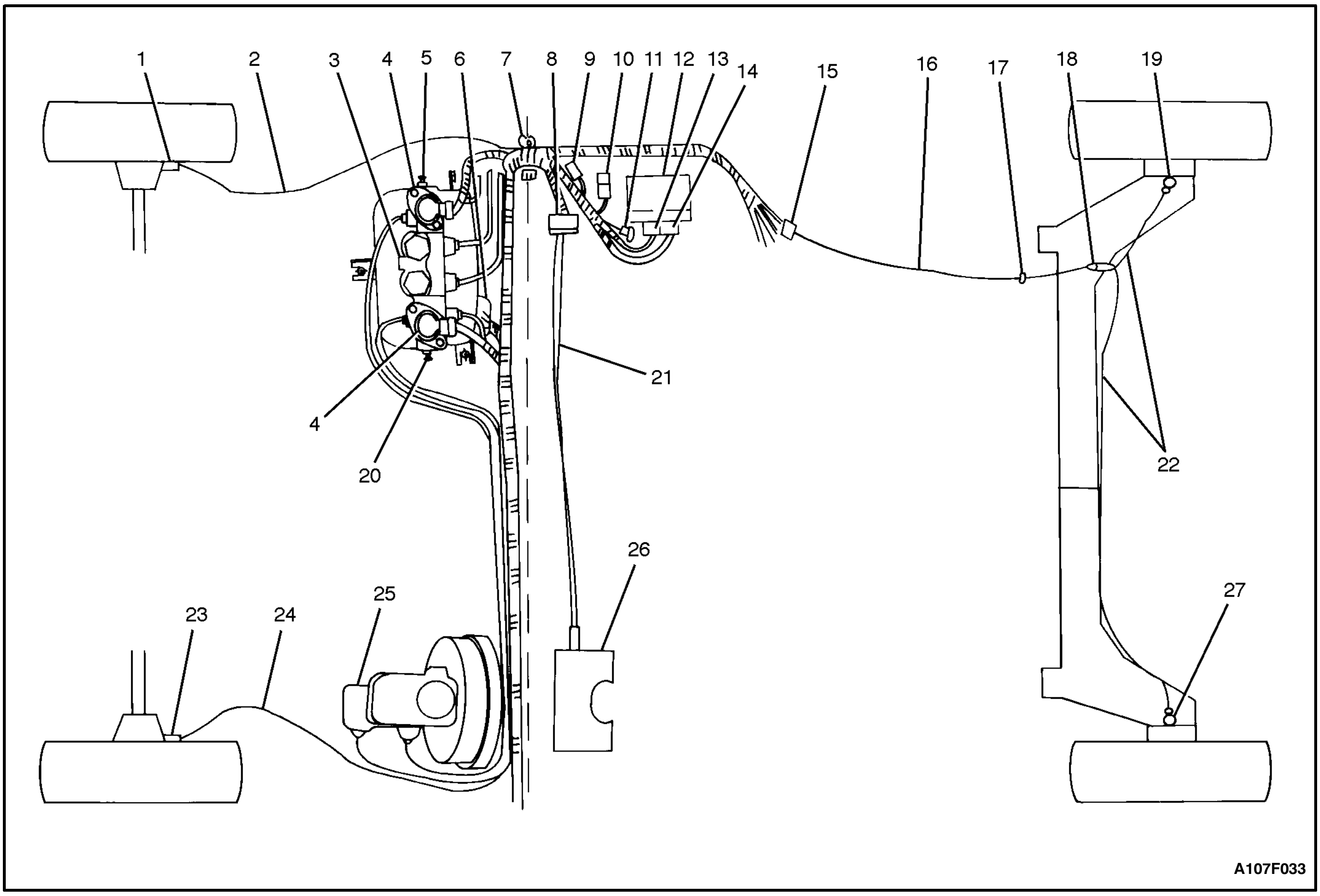
SPECIAL TOOLS TABLE

 A107F057	Scan Tool

COMPONENT LOCATOR

ABS COMPONENT LOCATOR

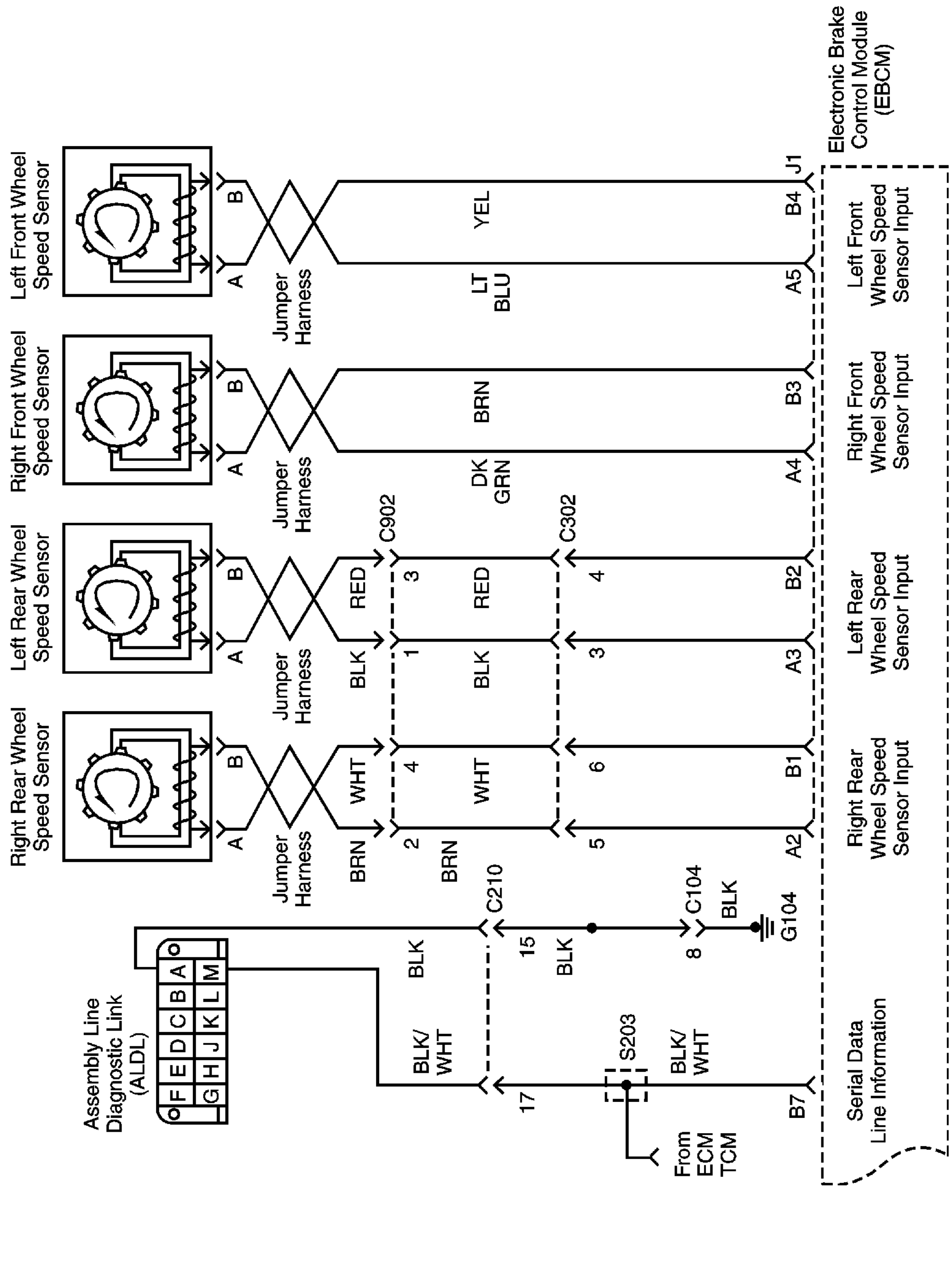
(Left-Hand Drive Shown, Right-Hand Drive Simi8lar)



1 Right Front Wheel Speed Sensor
2 Right Front Wheel Speed Sensor Harness
3 Hydraulic Modulator/Motor Pack Assembly
4 Isolation Solenoid
5 Right-side Hydraulic Modulator Bleeder Valve
6 Motor Pack Electrical Connector
7 ECM/ABS Wiring Harness Pass-through Grommet
8 Connector C210
9 Lamp Driver Module
10 ABS Relay
11 ABS Fuse
12 EBCM
13 EBCM Connector J2
14 EBCM Connector J1
15 Connector C302
16 Floor Wiring Harness
17 Floor Pass-through Grommet
18 Connector C902
19 Right Rear Wheel Speed Sensor
20 Left-side Hydraulic Modulator Bleeder Valve
21 I/P Wiring Harness
22 Rear Wheel Speed Sensor Harness
23 Left Front Wheel Speed Sensor
24 Left Front Wheel Speed Sensor Harness
25 Master Cylinder
26 Instrument Cluster
27 Left Rear Wheel Speed Sensor

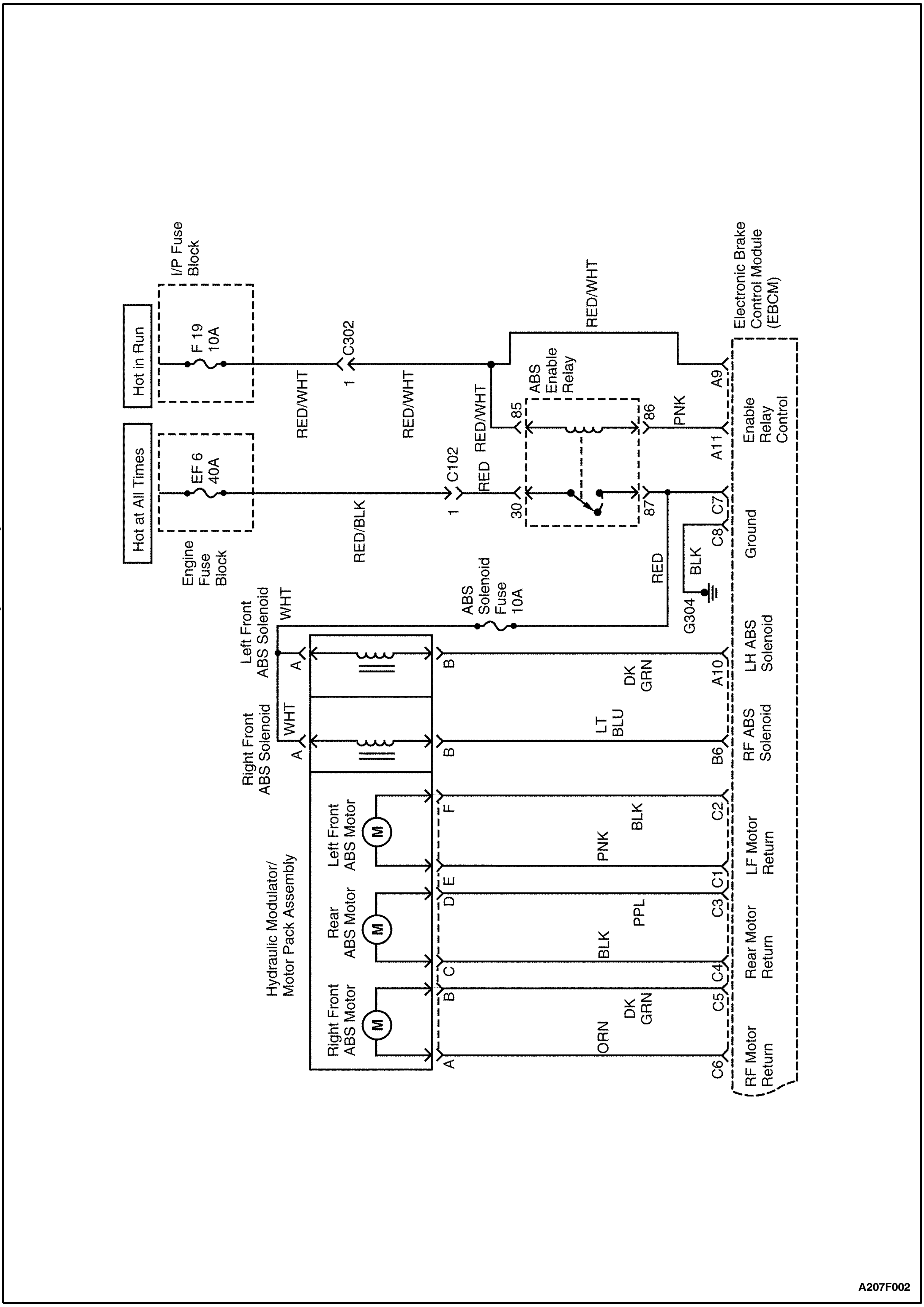
SCHEMATIC AND ROUTING DIAGRAMS

ABS CIRCUIT (1 OF 3)

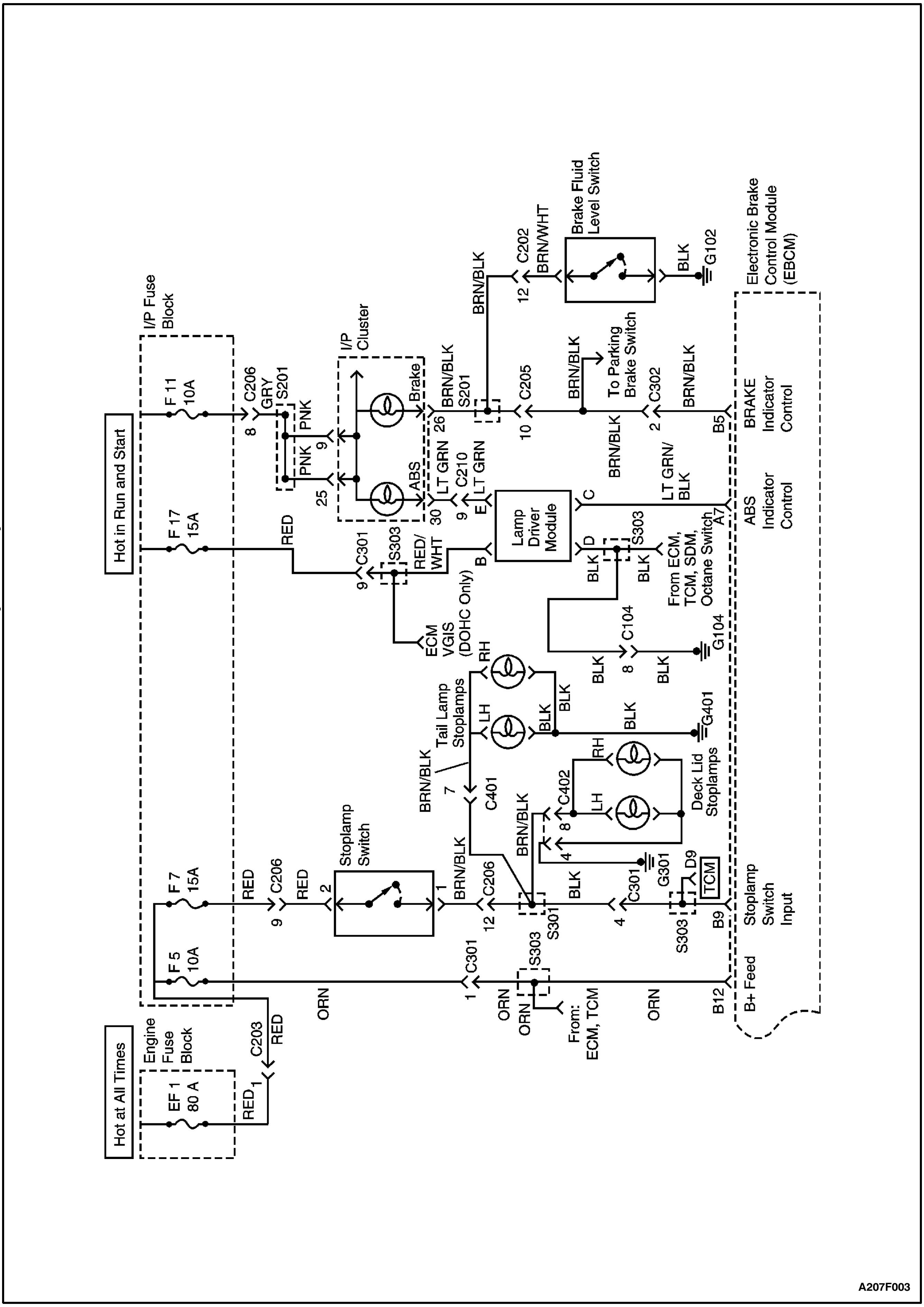


A207F001

ABS CIRCUIT (2 OF 3)



ABS CIRCUIT (3 OF 3)

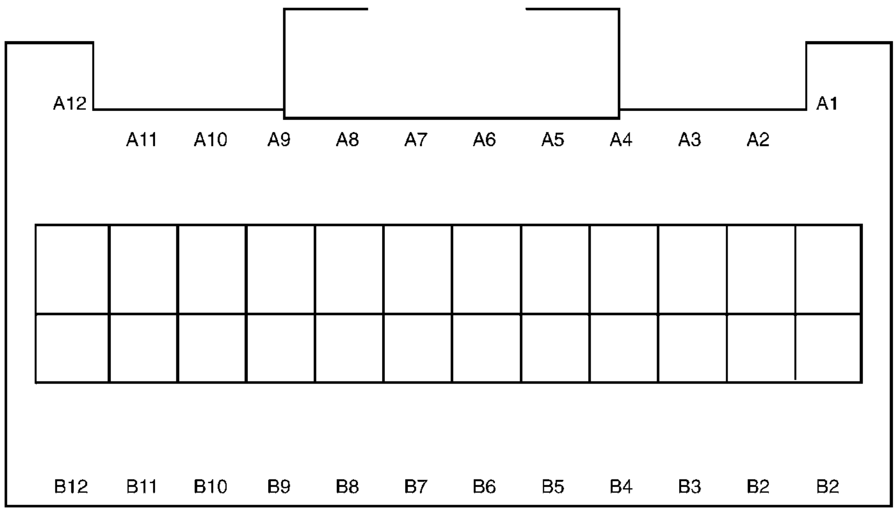


VISUAL IDENTIFICATION

EBCM CONNECTOR FACE VIEW (1 OF 2)

Terminals are identified as they appear from the wire entry end of the harness connector.

EBCM Connector J1

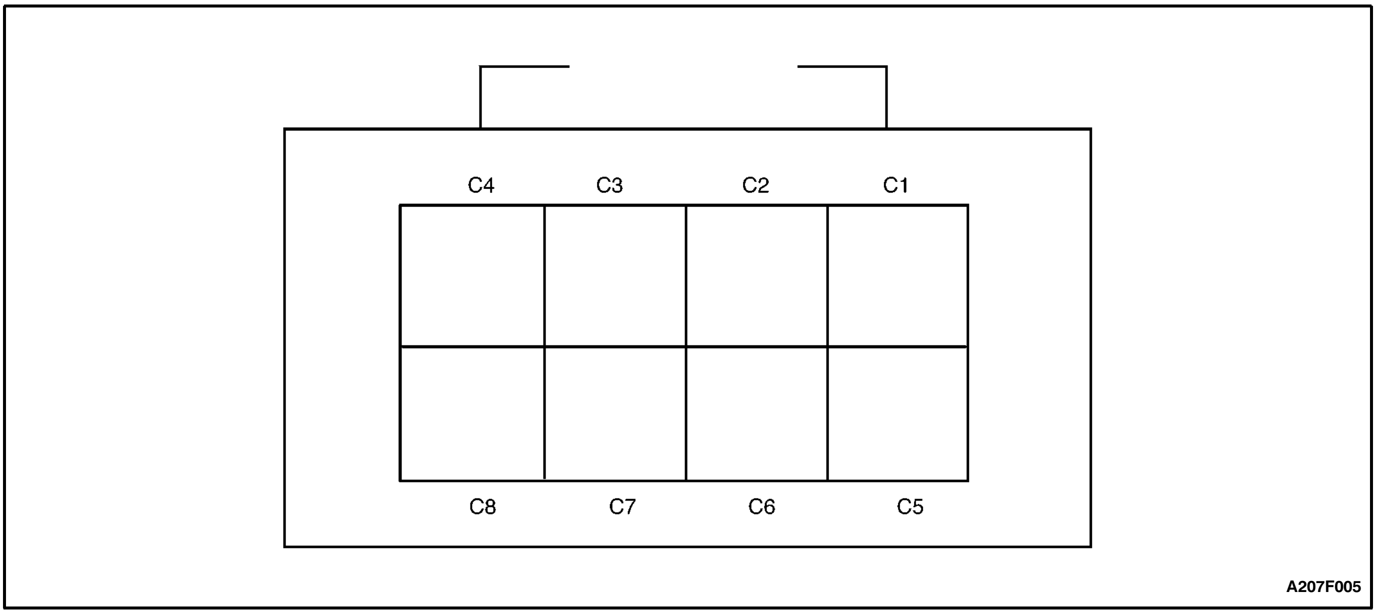


Pin	Signal Name	Color	Circuit
A1	-	-	Not Used
A2	RRWSHI	BRN	Right Rear Wheel Speed High
A3	LRWSHI	BLK	Left Rear Wheel Speed High
A4	RFWSHI	DK GRN	Right Front Wheel Speed High
A5	LFWSHI	LT BLU	Left Front Wheel Speed High
A6	-	-	Not Used
A7	ABSWARN	LT GRN/BLK	ABS Warning Indicator
A8	-	-	Not Used
A9	IGN	RED/WHT	Ignition
A10	LFABSOL	LT GRN	Left Front ABS Isolation Solenoid
A11	ENRELAY	PPL	ABS Enable Relay
A12	-	-	Not Used
B1	RRWSLO	WHT	Right Rear Wheel Speed Low
B2	LRWSLO	RED	Left Rear Wheel Speed Low
B3	RFWSLO	BRN	Right Front Wheel Speed Low
B4	LFWSLO	YEL	Left Front Wheel Speed Low
B5	BRAKETT	BRN/BLK	Brake Tell Tale
B6	REABSOL	DK GRN	Right Front ABS Isolation Solenoid
B7	SDLUART	BLK/WHT	Serial Data Link, UART
B8	-	-	Not Used
B9	BRAKESW	BRN/BLK	Brake Switch
B10	-	-	Not Used
B11	-	-	Not Used
B12	BATT	ORN	Battery

EBCM CONNECTOR FACE VIEW (2 OF 2)

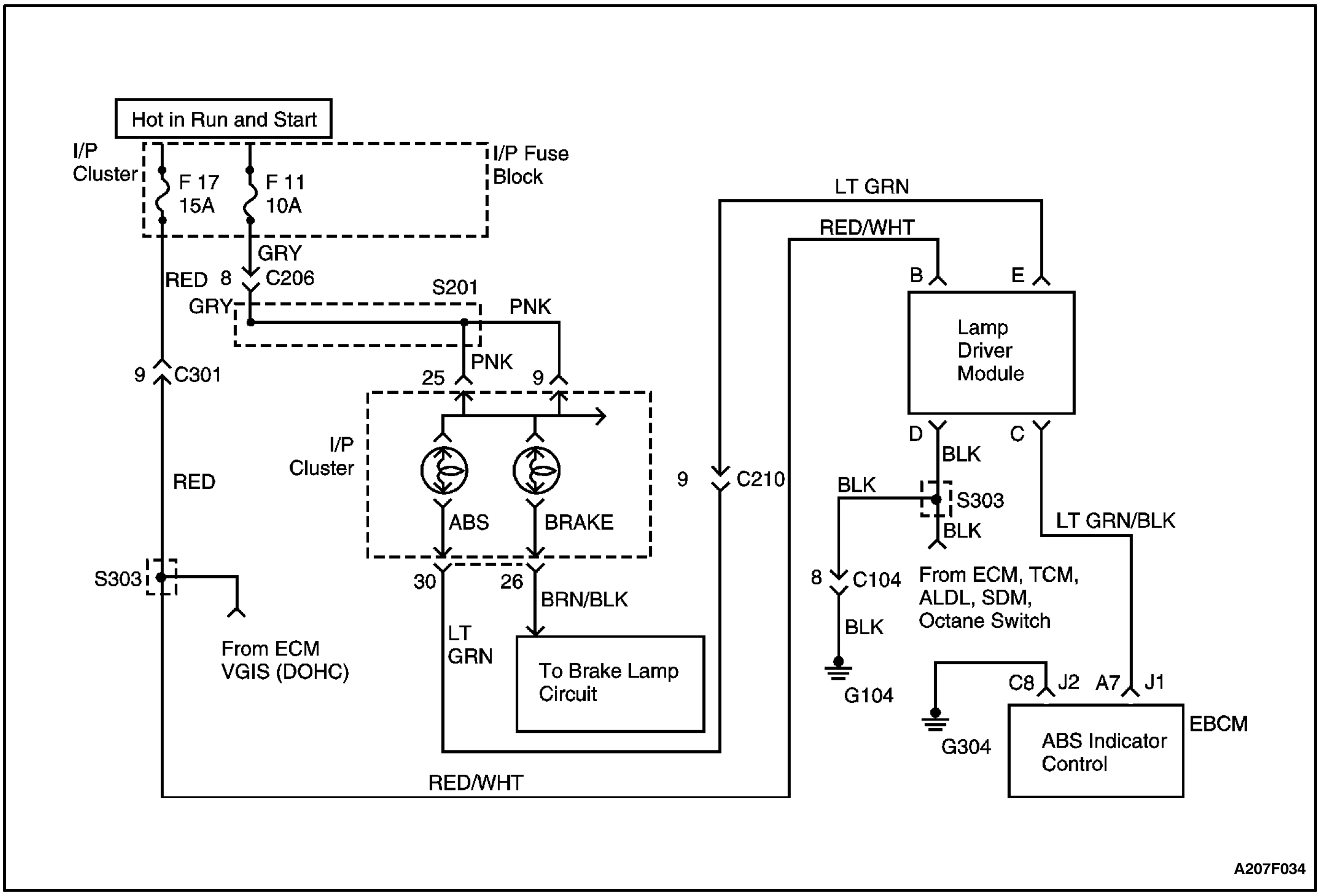
Terminals are identified as they appear from the wire entry end of the harness connector.

EBCM Connector J2



PIN	SIGNAL NAME	COLOR	CIRCUIT
C1	LFMOTLO	PNK	Left Front Motor Low
C2	LFMOTHI	BLK	Left Front Motor High
C3	RAMOTHI	PPL	Rear Axle Motor High
C4	RAMOTLO	BLK	Rear Axle Motor Low
C5	RFMOTHI	DK GRN	Right Front Motor High
C6	RFMOTLO	ORN	Right Front Motor Low
C7	SWBATT	RED	Battery Feed Through Relay
C8	GND	BLK	Negative Battery Terminal

DIAGNOSIS



ABS (AMBER) INDICATOR ON CONSTANTLY, NO DTCS STORED

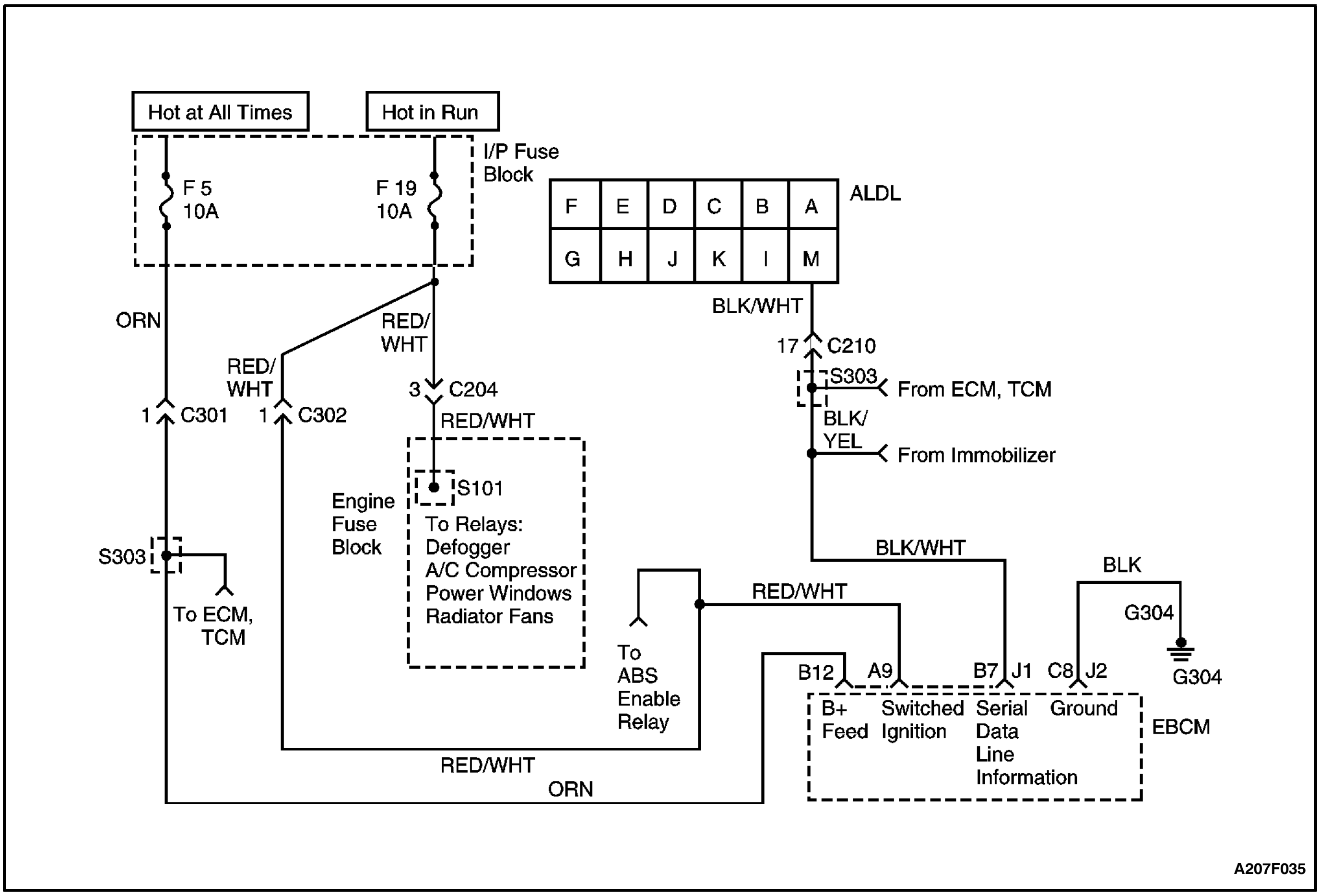
Important: Complete the Diagnostic Circuit Check before using this table.

ABS (Amber) Indicator On Constantly, No DTCs Stored

Step	Action	Value(s)	Yes	No
1	Use the scan tool to command the ABS (amber) indicator OFF. Is the indicator off?	-	Go to “Intermittents and Poor Connections”	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J1. 3. Turn the ignition switch to ON. 4. Connect a jumper wire to ground and to probe terminal A7 of the EBCM harness connector J1. Does the ABS indicator go off?	-	Go to Step 3	Go to Step 7
3	Inspect the EBCM harness connector J1 terminal A7 for a poor contact. Is the contact good?	-	Go to Step 5	Go to Step 4

ABS (Amber) Indicator On Constantly, No DTCs Stored (Cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the contact. Is the repair complete?	-	System OK	-
5	1. Reconnect all of the connectors. 2. Turn the ignition switch to ON. Does the ABS indicator still stay ON?	-	Go to Step 6	System OK
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	1. Turn the ignition switch to LOCK. 2. Remove fuse F17. 3. Turn the ignition switch to ON. 4. Measure the voltage between terminal A7 of the EBCM harness connector J1 and ground. Is this voltage less than the specified value?	1 v	Go to Step 9	Go to Step 8
8	Repair the short to B+ in circuit LT GRN/BLK between terminal A7 of the EBCM harness connector J1 and terminal C of the lamp driver module. Is the repair complete?	-	System OK	-
9	1. Turn the ignition switch to LOCK. 2. Reinstall fuse F17. 3. Disconnect the lamp driver module from the harness. 4. Turn the ignition switch to ON. Is the ABS indicator off?	-	Go to Step 11	Go to Step 10
10	Repair the short to ground in circuit LT GRN between terminal E of the lamp driver module and terminal 30 of the instrument cluster. Is the repair complete?	-	System OK	-
11	1. Turn the ignition switch to LOCK. 2. Use a digital voltmeter (DVM) to measure the resistance from EBCM harness connector J1, terminal A7 to lamp driver module harness connector terminal C. Is this resistance less than the specified value?	2 W	Go to Step 12	Go to Step 13
12	1. Reconnect all connections. 2. Turn the ignition switch to ON. Does the ABS indicator still remain ON?	-	Go to Step 6	System OK
13	Check for an open in circuit LT GRN/BLK between terminal A7 of the EBCM harness connector J1 and terminal C of the lamp driver module. Is there an open present?	-	Go to Step 14	Go to Step 15
14	Repair the open in circuit LT GRN/BLK between terminal A7 of EBCM harness connector J1 and terminal C of the lamp driver module. Is the repair complete?	-	System OK	-
15	Replace the lamp driver module. Is the repair complete?	-	System OK	-



ABS (AMBER) INDICATOR ON INTERMITTENTLY, NO DTCS STORED

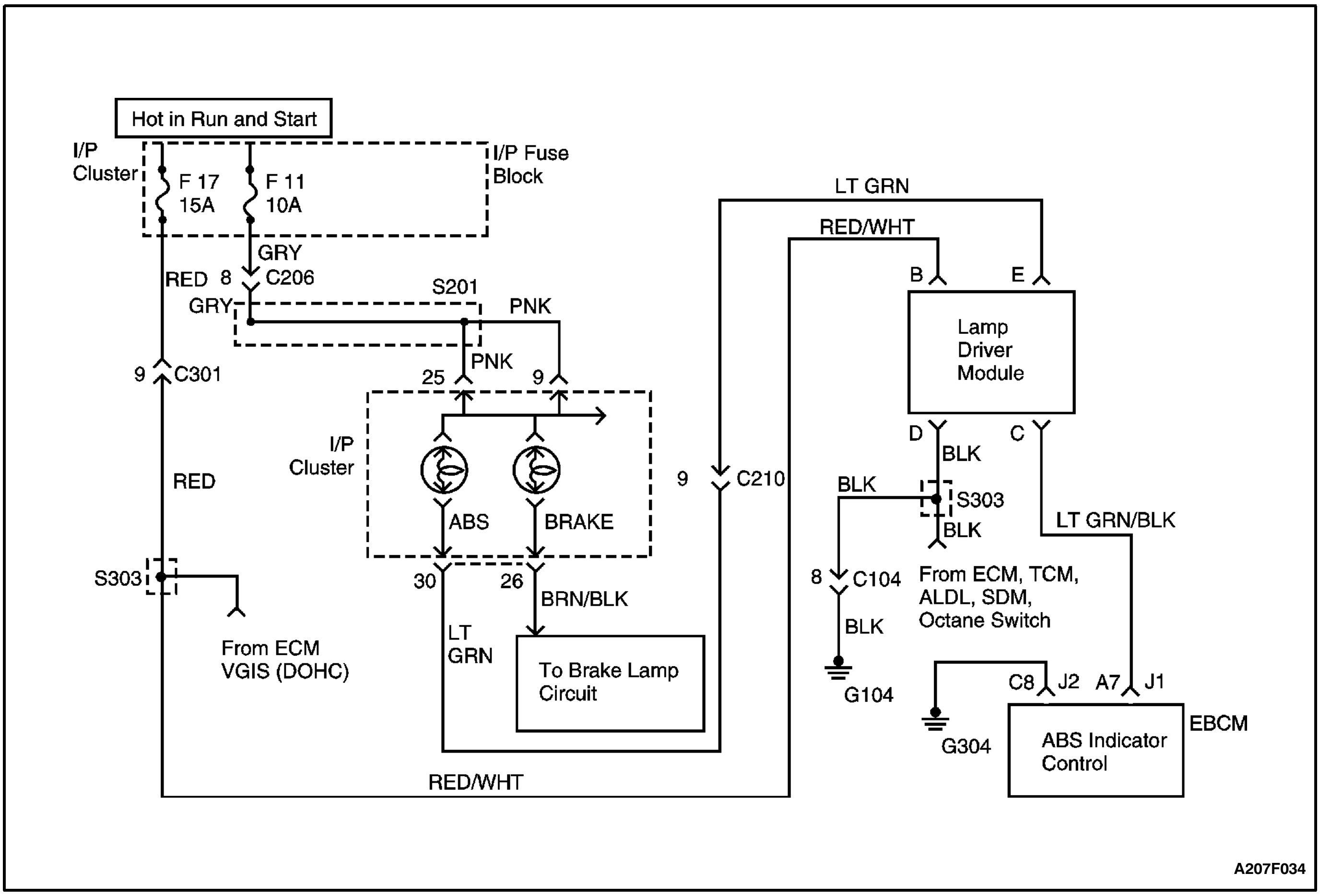
Important: Complete the Diagnostic Circuit Check before using this table.

ABS (Amber) Indicator On Intermittently, No DTCs Stored

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Connect a test light to ground and to probe terminal B12 of the EBCM harness connector J1. 4. Observe the test light while moving the wire harness and the connectors. Does the test light remain on steadily?	-	Go to Step 2	Go to Step 5
2	Check for a proper connection at terminal 1 of connector C301 between the ECM/ABS harness and the floor harness. Is this connection in good condition?	-	Go to Step 3	Go to Step 4
3	Repair the intermittent connection in circuit ORN between the EBCM harness terminal B12 and fuse F5 of the I/P fuse block. Is the repair complete?	-	System OK	-

ABS (Amber) Indicator On Intermittently, No DTCs Stored (Cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the poor connection at terminal 1 of connector C301. Is the repair complete?	-	System OK	-
5	1. Connect a test light between ground and the EBCM harness connector J1, terminal A9. 2. Turn the ignition switch to ON and observe the test light while moving the wire harness and the connectors. Does the test light remain on steadily?	-	Go to "Intermittents and Poor Connections"	Go to Step 6
6	Repair the intermittent connection in circuit RED/WHT between terminal A9 of the EBCM harness connector J1 and fuse F19 of the I/P fuse block. Is the repair complete?	-	System OK	-



ABS (AMBER) INDICATOR OFF CONSTANTLY, NO DTCS STORED

Important: Complete the Diagnostic Circuit Check before using this table.

ABS (Amber) Indicator Off Constantly, No DTCs Stored

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Select Lamp Test on the scan tool and command the ABS indicator ON. Is the ABS indicator ON?	-	Go to "Intermittents and Poor Connections"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the lamp driver module (LDM) from the harness connector. 3. Turn the ignition switch to ON. 4. Use a fused jumper to connect terminal E of the LDM connector to ground. Is the ABS indicator ON?	-	Go to Step 3	Go to Step 10
3	1. Turn the ignition switch to LOCK. 2. Use a digital voltmeter (DVM) to measure the resistance between terminal D of the LDM harness connector and ground. Is the resistance below the specified value?	2 W	Go to Step 5	Go to Step 4
4	Repair the open in circuit BLK from terminal D of the lamp driver module to ground. Is the repair complete?	-	System OK	-

ABS (Amber) Indicator Off Constantly, No DTCs Stored (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition switch to ON. 2. Use a DVM to measure the voltage between terminal B of the LDM harness connector and chassis ground. Is this voltage less than the specified value?	10 v	Go to Step 6	Go to Step 7
6	Repair the open or high resistance in circuit RED/WHT between terminal B of the lamp driver module and fuse F17 of the I/P fuse block. Is the repair complete?	-	System OK	-
7	Check for a short to ground in circuit LT GRN/BLK between terminal A7 of the EBCM harness connector J1 and terminal C of the lamp driver module. Is there a short?	-	Go to Step 8	Go to Step 9
8	Repair the short to ground in circuit LT GRN/BLK between terminal A7 of the EBCM harness connector J1 and terminal C of the lamp driver module. Is the repair complete?	-	System OK	-
9	Replace the LDM. Is the repair complete?	-	System OK	-
10	1. Turn the ignition switch to LOCK. 2. Disconnect the I/P cluster harness connector C. 3. Use a DVM to measure the resistance between terminal E of the LDM connector and terminal 30 of the I/P cluster harness connector. Is this resistance below the specified value?	2 W	Go to Step 14	Go to Step 11
11	Inspect terminal 9 of connector C210 between the ECM/ABS harness and the I/P harness for proper connection. Is this connection in good condition?	-	Go to Step 13	Go to Step 12
12	Repair the connection at terminal 9 of connector C210. Is the repair complete?	-	System OK	-
13	Repair the open or high resistance in circuit LT GRN between terminal E of the lamp driver connector and terminal 30 of the I/P cluster harness connector. Is the repair complete?	-	System OK	-
14	Inspect the ABS indicator bulb. Is the bulb open?	-	Go to Step 15	Go to Step 16
15	Replace the ABS indicator bulb. Is the repair complete?	-	System OK	-
16	1. Turn the ignition switch to ON. 2. Connect a test light between ground and terminal E of the LDM harness connector. Is the test light on?	-	Go to Step 17	Go to Step 20
17	Examine circuit LT GRN between terminal E of the lamp driver connector and terminal 30 of the I/P cluster harness connector for a short to B+. Was a short found?	-	Go to Step 18	Go to Step 19
18	Repair the short to B+ on circuit LT GRN between terminal E of the lamp driver connector and terminal 30 of the I/P cluster harness connector. Is the repair complete?	-	System OK	-

ABS (Amber) Indicator Off Constantly, No DTCs Stored (Cont'd)

Step	Action	Value(s)	Yes	No
19	Replace the Lamp Driver Module. Is the repair complete?	-	System OK	-
20	1. Turn the ignition switch to LOCK. 2. Reconnect the LDM connector and the I/P cluster connector C. 3. Turn the ignition switch to ON. Does the ABS indicator come on for 3 seconds then go off?	-	Go to "Intermittents and Poor Connections"	Go to Step 21
21	Replace the EBCM. Is the repair complete?	-	System OK	-

SELF-DIAGNOSTICS

Tools Required

Scan Tool

The EBCM contains sophisticated on-board diagnostics that, when accessed with a scan tool, are designed to identify the source of any system malfunction as specifically as possible, including whether the malfunction is intermittent. There are 53 DTCs to assist with diagnosis.

When using the scan tool with the ABS VI, the last DTC is specifically identified, and specific ABS data is stored at the time of this malfunction. Also, in addition to the last DTC set, there is information about the first three DTCs set. Using the scan tool, each input and output can be monitored, thus enabling malfunction confirmation and repair verification. Manual control of components and automated functional tests are also available when using the scan tool. Details of many of these functions are contained in the following sections.

DISPLAYING DTCS

Tools Required

Scan Tool

DTCs can be read through the use of the scan tool. There are no provisions for "Flash Code" diagnostics.

CLEARING DTCS

Tools Required

Scan Tool

The DTCs in the EBCM memory are erased in one of two ways:

1. Scan tool "Clear DTCs" selection.
2. After 100 DTC free drive cycles.

These two methods are detailed below. Be sure to verify proper system operation and absence of DTCs when the clearing procedure is completed.

The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by disconnecting the EBCM, disconnecting the battery cables, or turning the ignition switch to LOCK.

Ignition Cycle Default

If no DTC occurs for 100 drive cycles (a drive cycle occurs when the ignition switch is turned to ON and the vehicle is driven faster than 16 km/h (10 mph), any existing DTCs are cleared from the EBCM memory. This is not an acceptable method for clearing ABS DTCs.

INTERMITTENTS AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunctions may be difficult to diagnose accurately. The following is a method to try to isolate an intermittent malfunction, especially wheel speed circuitry.

If an ABS malfunction occurs, the ABS indicator will illuminate during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS indicator off), a history DTC will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. The scan tool modular diagnostic system must be used to read ABS history data.

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault.

SCAN TOOL DIAGNOSTICS

Tools Required

Scan Tool

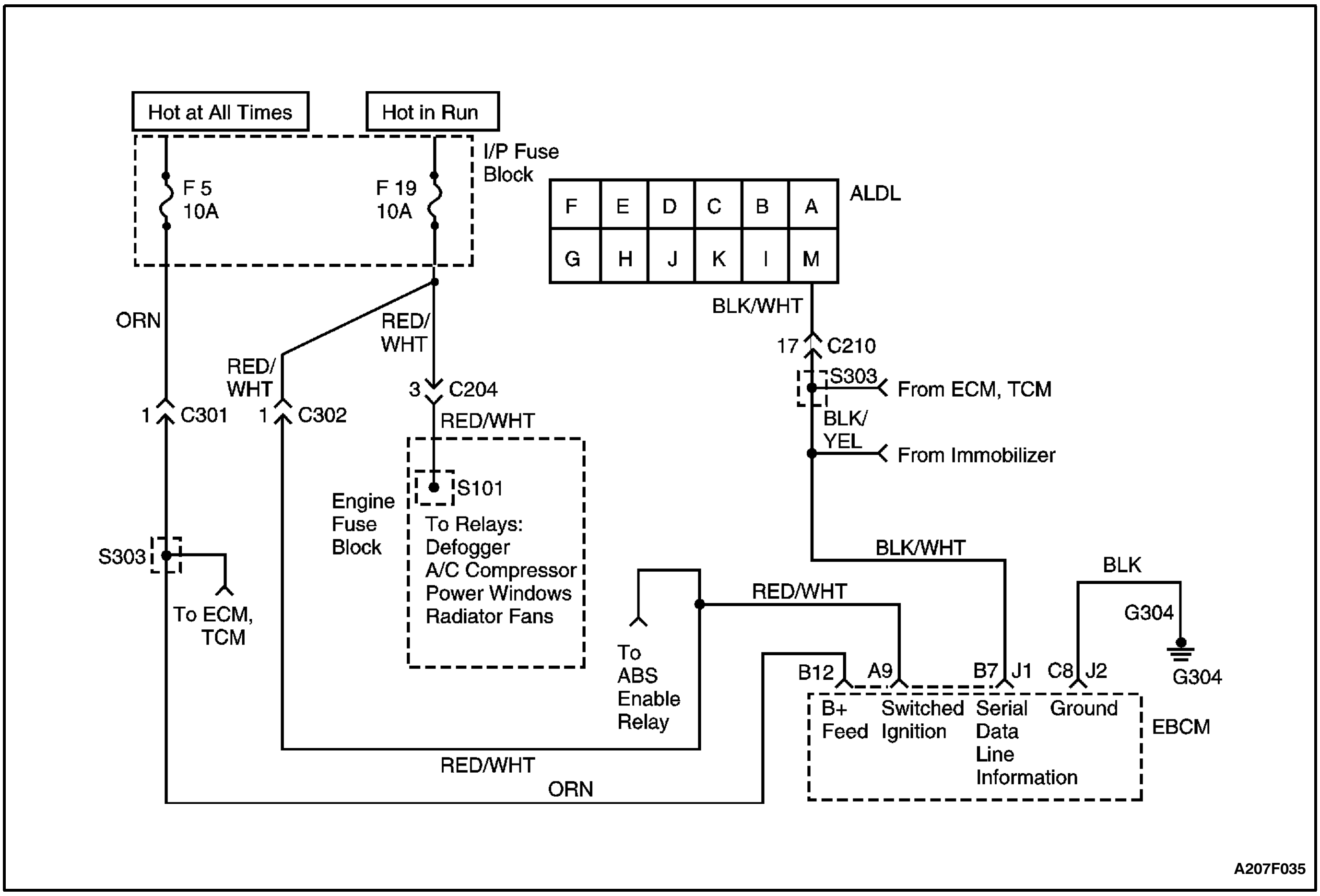
Enhanced Diagnostics

Enhanced diagnostic information, found in the CODE HISTORY function of the scan tool, is designed to provide the service technician with specific malfunction occurrence information. For each of the first three DTCs and the very last DTC stored, data is stored to identify the specific DTC, the number of occurrences, and the number of drive cycles since the malfunction first and last occurred. A normal drive cycle consists of starting the engine, driving the vehicle over 16 km/h (10 mph), and turning the ignition OFF. These first three DTCs are also stored in the order of occurrence. The order in which the first three DTCs occurred can be useful in determining if a previous malfunction, such as an intermittent open in a wheel speed sensor circuit which later becomes completely open. However, if a malfunction is present, the drive cycle counter will increase by turning the ignition switch to ON and LOCK.

During difficult diagnosis situations, this information can be used to identify malfunction occurrence trends. Does the malfunction occur more frequently now than it did during the last customer visit? Did the malfunction only occur once over a large number of driving cycles, indicating an unusual condition present when it occurred? Does the malfunction occur infrequently over a large number of drive cycles, indicating that special diagnosis techniques may be required to identify the source of the malfunction?

If, for example, a malfunction occurred in one out of 20 drive cycles, the malfunction is intermittent and has not recurred for 19 drive cycles. This malfunction may be difficult or impossible to duplicate and may have been caused by a severe vehicle impact (such as a large pot hole or a speed bump at high speed) that momentarily opened an electrical connector or caused unusual vehicle suspension movement. Problem resolution is unlikely, and the problem may never recur (check diagnostic aids provided for that DTC). If, for example, the malfunction occurred in three out of 15 drive cycles, the odds of finding the cause are still not good, but you know how often it occurs. You can determine whether or not the malfunction is becoming more frequent based on an additional or past customer visit if the source of the problem cannot or could not be found. If the malfunction occurred 10 out of 20 drive cycles, the odds of finding the cause are very good.

By using the additional malfunction data, you can also determine if a malfunction is randomly intermittent or if it has not recurred for long periods of time due to weather changes or a repair prior to this visit. For example, if a DTC occurred 10 out of 20 drive cycles but has not recurred since, a significant environmental change or repair may have occurred 10 drive cycles ago. A repair may not be necessary if customer information can confirm a recent repair. If no repair was made, the service technician can focus on diagnosis techniques used to locate difficult-to-recreate problems.



DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an antilock brake system (ABS) malfunction. It must be the starting point for any ABS complaint diagnosis, because it directs the service technician to the next logical step in diagnosing the complaint.

The Scan Data listed in the table may be used after completing the Diagnostic Circuit Check and finding the on-board diagnostics functioning properly and diagnostic trouble codes (DTCs) displayed.

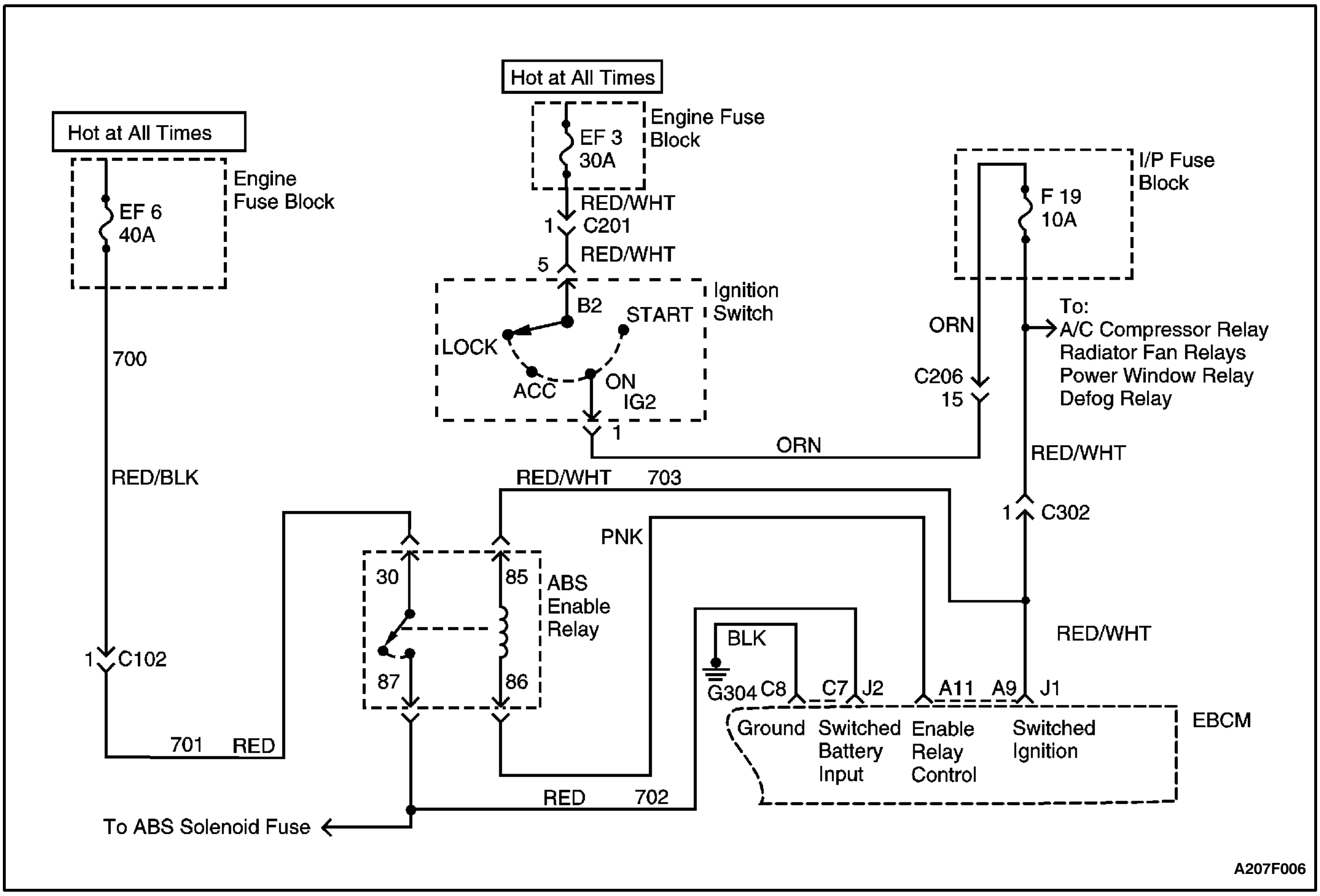
Notice: Do not use a scan tool that displays faulty data. This can result in misdiagnosis and unnecessary parts replacement. Report that problem to the manufacturer.

Diagnostic Circuit Check

Step	Action	Value(s)	Yes	No
1	1. Verify that all ABS connectors are connected properly. 2. Install the scan tool. 3. Turn the ignition switch to ON. 4. Select the Data List mode. Is the scan tool receiving data from the EBCM?	-	Go to Step 2	Go to Step 7
2	Check the display. Are there any current DTCs displayed?	-	Go to the applicable DTC table	Go to Step 3
3	1. Turn the ignition switch to LOCK for 10 seconds. 2. Turn the ignition switch to ON and observe the ABS indicator. Does the indicator light for 3 seconds and then go off?	-	Go to Step 4	Go to Step 5

Diagnostic Circuit Check (Cont'd)

Step	Action	Value(s)	Yes	No
4	Check for history DTCs. Are any history DTCs present?	-	Go to "Scan Tool Diagnostics"	Go to "Hydraulic Functional Control"
5	Check the ABS indicator. Did the ABS indicator turn on and stay on?	-	Go to "ABS Indicator On Constantly"	Go to Step 6
6	Check the ABS indicator. Did the ABS indicator remain off through the entire procedure?	-	Go to "ABS Indicator Off Constantly"	Go to "ABS Indicator On Intermittently"
7	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J1. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage from ground to terminal B12, then A9 of EBCM harness connector J1. Is the voltage greater than the specified value on each terminal?	10 v	Go to Step 9	Go to Step 8
8	Repair the open or short to ground in the circuit that did not indicate the specified voltage. Is the repair complete?	-	System OK	-
9	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J2. 3. Use a DVM to measure the resistance from the EBCM harness connector J2, terminal C8, to ground. Is the resistance below the specified value?	2 W	Go to Step 11	Go to Step 10
10	Repair the open in circuit BLK between terminal D of the EBCM harness connector J2 and ground G304 next to the EBCM. Is the repair complete?	-	System OK	-
11	Use a DVM to measure the resistance between terminal B7 of the EBCM harness connector J1 and terminal M of the ALDL. Is the resistance below the specified value?	2 W	Go to Step 12	Go to Step 13
12	Replace the EBCM. Is the repair complete?	-	System OK	-
13	Check for a proper connection at terminal 17 of connector C210. Is this connection in good condition?	-	Go to Step 15	Go to Step 14
14	Repair the bad connection. Is the repair complete?	-	System OK	-
15	Repair the open in circuit BLK/WHT between terminal B7 of EBCM harness connector J1 and terminal M of the ALDL jack.	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A014
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description

Ignition voltage is supplied through terminal 6 of the ABS enable relay socket. The EBCM then is able to energize the pull-in coil by completing the ground circuit at pin A11 of the EBCM. The magnetic field created closes the ABS enable relay contacts and supplies battery voltage and current to the EBCM, which supplies power to the motors.

Diagnosis

This test checks for continuity in the switched battery circuit to the EBCM. A fault exists if for 0.056 seconds the switched battery voltage falls below 7.5 volts and the ignition voltage is greater than 10.6 volts while the controller output for the relay coil is less than 3.4 volts.

Cause(s)

- There is a blown fuse (from the battery to the relay contacts).
- Relay contacts are malfunctioning.
- There is high resistance in a connector terminal or the wiring.
- There is an open circuit in the switched battery voltage wire.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The brake warning lamp is turned on only if the rear piston is not at the top of the bore. This could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks to see if the EBCM is sensing battery voltage at connector J2, terminal C7.
3. This step checks for improper operation of the ABS enable relay and the related circuitry.
4. This step checks for excessive resistance in the switched battery input circuitry.
5. This step checks for excessive resistance in the B+ feed circuit.

10. This step determines if the malfunction is due to a poor connection.
12. This step determines if the malfunction is due to the EBCM.
14. This step checks for excessive resistance in the ABS enable relay control circuitry.
15. This step checks for improper battery voltage.
16. This step checks for an open in the B+ feed circuit.
17. This step checks for an open in the switched battery input circuit.
18. This step checks for improper operation of the ABS enable relay.
26. This step checks for excessive resistance in the ignition switch ON feed (Fuse F19) circuit.
27. This step checks for excessive resistance in the ABS enable relay coil.
28. This step checks for excessive resistance in the ABS enable relay control circuit between the relay and the EBCM .
29. This step checks for excessive resistance in the ABS enable relay control circuit between the relay and the I/P harness connector.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

Vibration, Temperature Effects

1. Check for vibration effects by performing the relay test function of the scan tool.
2. Use the scan tool to command the relay ON.
3. Monitor the relay voltage while lightly tapping the top and the sides of the relay.
4. Replace the relay if the voltage changes significantly.

If DTC A014 only occurs when the vehicle is initially started in cold ambient conditions (temperature less than 0°C / 32°F), replace the relay.

DTC A014 – ABS Enable Relay Contact Circuit Open

Step	Action	Value(s)	Yes	No
1	Check the DTC code history. Is DTC A016 also present in history?	-	Go to "DTC A016"	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Using the scan tool, select Data List and observe the ABS battery voltage. Is the voltage above the specified value?	10 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect both EBCM harness connectors. 3. Connect a fused jumper between ground and terminal A11 of the EBCM harness connector J1. 4. Turn the ignition switch to ON. 5. Use a digital voltmeter (DVM) to measure the voltage between ground and the EBCM harness connector J2, terminal C7. Is the voltage above the specified value?	10 v	Go to Step 4	Go to Step 14
4	1. Turn the ignition switch to LOCK. 2. Disconnect the jumper used in Step 3. 3. Unplug the ABS Enable Relay from the harness connector. 4. Use a DVM to measure the resistance between terminal 8 of the ABS enable relay harness connector and terminal C7 of EBCM harness connector J2. Is the resistance below the specified value?	2 W	Go to Step 5	Go to Step 9

DTC A014 – ABS Enable Relay Contact Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the positive and the negative battery cables. 2. Use a DVM to measure the resistance between the positive battery cable terminal and terminal 2 of the ABS enable relay harness connector. Is the resistance below the specified value?	2 W	Go to Step 10	Go to Step 6
6	Inspect the system fuse, EF6, in the engine compartment fuse block. Is the fuse in good condition?	-	Go to Step 7	Go to Step 8
7	Repair the open or high resistance in circuit RED-RED/BLK between terminal 2 of the ABS relay socket and system fuse EF6. Is the repair complete?	-	System OK	-
8	Replace the system fuse, EF6, in the engine compartment fuse block. Is the repair complete?	-	System OK	-
9	Repair the high resistance in circuit RED between terminal 8 of the ABS relay socket and terminal C7 of EBCM connector J2. Is the repair complete?	-	System OK	-
10	1. Inspect the ABS enable relay and harness connector for a poor connection. 2. Inspect the positive battery cable terminal for a poor connection. Do you see evidence of a poor terminal contact or a poor connection?	-	Go to Step 11	Go to Step 12
11	Repair any terminals that exhibit poor contact or repair connection integrity if poor contact exists at a battery terminal. Is the repair complete?	-	System OK	-
12	1. Reconnect all of the connectors. 2. Turn the ignition switch to ON. Does DTC A014 reset?	-	Go to Step 13	Go to "Diagnostic Aids"
13	Replace the EBCM. Is the repair complete?	-	System OK	-
14	1. Turn the ignition switch to LOCK. 2. Disconnect the I/P harness connector C302. 3. Use a DVM to measure the resistance between terminal 1 of connector C302, and terminal A11 of EBCM harness connector J1. Is the resistance less than the specified value when measured at approximately 24°C (75°F)?	95 W	Go to Step 15	Go to Step 27
15	Use a DVM to measure the voltage between the positive and the negative battery terminals. Is the voltage greater than the specified value?	10 v	Go to Step 16	Go to Step 20
16	1. Unplug the ABS enable relay from the harness connector. 2. Use a DVM to measure the voltage between ABS enable relay harness connector terminal 2 and ground. Is the voltage above the specified value?	10 v	Go to Step 17	Go to Step 21

DTC A014 – ABS Enable Relay Contact Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
17	Use a DVM to measure the resistance between ABS enable relay harness connector terminal 8 and terminal C7 of the EBCM harness connector J2. Is the resistance below the specified value?	2 W	Go to Step 18	Go to Step 23
18	1. Use a jumper wire to connect ABS enable relay terminal 86 to ground. 2. Use a fused jumper wire to connect ABS enable relay terminal 85 to B+. 3. Use a DVM to measure the resistance between ABS enable relay terminals 30 and 87. Is the resistance below the specified value?	2 W	Go to Step 24	Go to Step 19
19	Replace the ABS enable relay. Is the repair complete?	-	System OK	-
20	Correct the low voltage condition. Is the repair complete?	-	System OK	-
21	Check the system fuse, EF6, in the engine compartment fuse block. Is the fuse in good condition?	-	Go to Step 22	Go to Step 34
22	Repair the open in circuit RED-RED/BLK between terminal 2 on the ABS relay socket and system fuse EF6. Is the repair complete?	-	System OK	-
23	Repair the open in circuit RED between terminal 8 of the ABS relay socket and terminal C7 of the EBCM connector J2. Is the repair complete?	-	System OK	-
24	1. Disconnect the ignition switch harness connector. 2. Use a DVM to measure the resistance between the ignition switch harness connector terminal 1 (IG2), ORN, and terminal 1 of connector C302. Is the resistance below the specified value?	2 W	Go to Step 25	Go to Step 26
25	1. The malfunction is due to a poor connection. 2. Check for poor terminal contacts: • Between the ABS enable relay and the harness connector. • At terminal 1 of connector C302. • Between the ignition switch harness connector and the ignition switch. 3. Replace terminals that exhibit poor terminal contact. Is the repair complete?	-	System OK	-
26	1. Check the ignition ON feed path for high resistance • From terminal 1 (IG2), ORN, of the ignition switch harness connector to terminal 15 of connector C206. • From terminal 15 of C206, ORN, to fuse F19. • From fuse F19, RED/WHT, to terminal 1 of connector C302. 2. Repair any source of high resistance found. Is the repair complete?	-	System OK	-

DTC A014 – ABS Enable Relay Contact Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
27	1. Disconnect the ABS enable relay from the harness connector. 2. Use a DVM to measure the resistance between ABS enable relay terminal 85 and 86. Is the resistance less than the specified value when measured at approximately 24°C (75°F)?	95 W	Go to Step 28	Go to Step 31
28	Use a DVM to measure the resistance between terminal 4 of the ABS enable relay harness connector and terminal A11 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 29	Go to Step 32
29	Use a DVM to measure the resistance between terminal 6 of the ABS enable relay harness connector and terminal 1 of connector C 302. Is the resistance below the specified value?	2 W	Go to Step 30	Go to Step 33
30	1. Check for a poor terminal contact between the ABS enable relay and the harness connector. 2. Replace the terminals that exhibit poor terminal contact. Is the repair complete?	-	System OK	-
31	Replace the ABS enable relay. Is the repair complete?	-	System OK	-
32	Repair high resistance in circuit PNK between terminal 4 of the ABS enable relay harness connector and terminal A11 of the EBCM harness connector J1. Is the repair complete?	-	System OK	-
33	Repair the high resistance in circuit RED/WHT between terminal 6 of the ABS enable relay harness connector and terminal 1 of connector C 302. Is the repair complete?	-	System OK	-
34	Replace ABS system fuse EF6. Is the repair complete?	-	System OK	-

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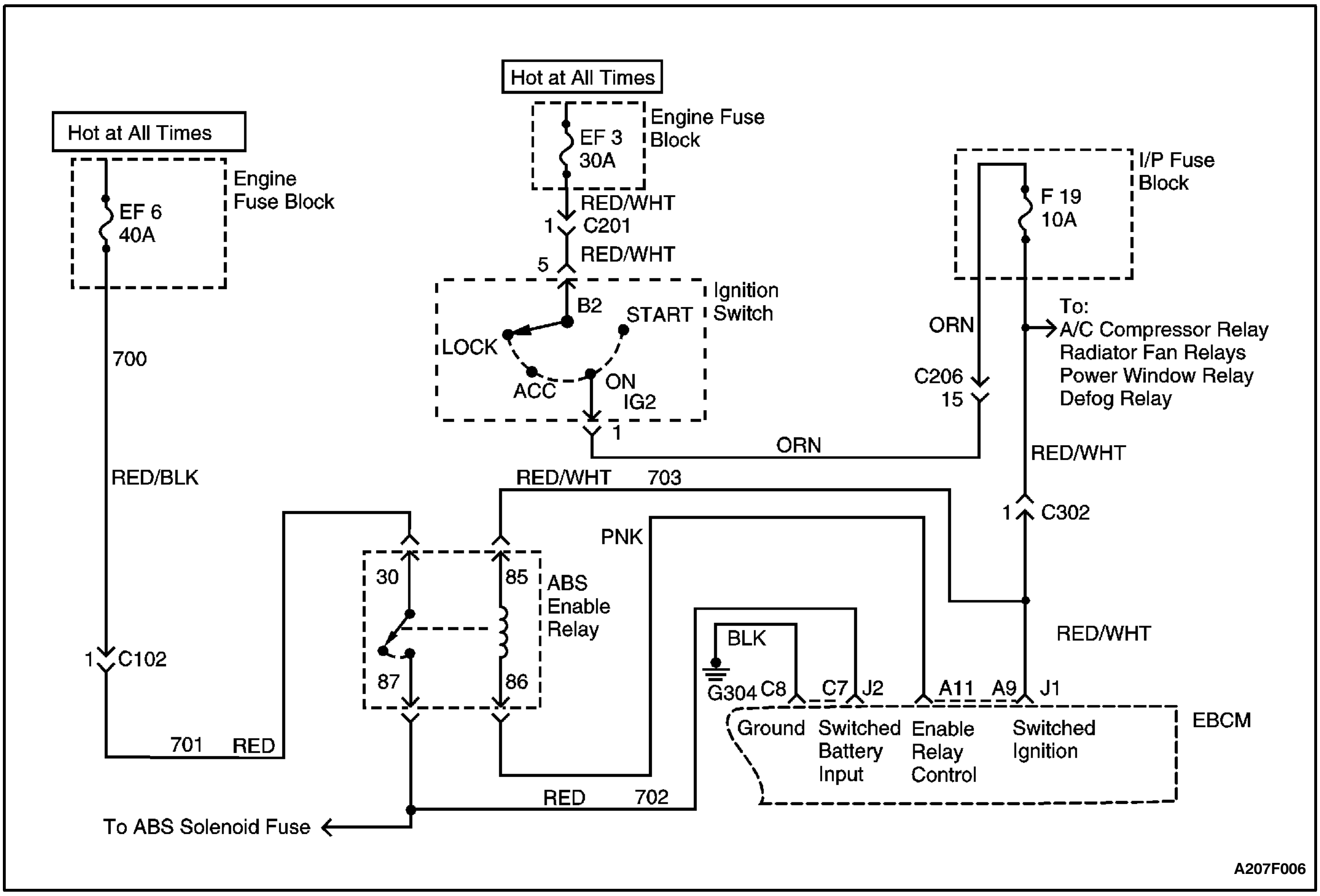


DIAGNOSTIC TROUBLE CODE (DTC) A015
ABS ENABLE RELAY CIRCUIT SHORTED TO BATTERY OR ALWAYS CLOSED

Circuit Description

Ignition voltage is supplied through terminal 6 of the ABS enable relay socket. The EBCM then is able to energize the pull-in coil by completing the ground circuit at pin A11 of the EBCM. The magnetic field created closes the ABS enable relay contacts and supplies battery voltage and current to the EBCM, which supplies power to the motors.

Diagnosis

This test determines a situation in which switched battery power is present at the EBCM when the relay is deenergized due to an ABS failure. A fault exists if for 4 seconds the switched battery voltage is greater than 4.5 volts. This code may accompany the following codes:

A058 LF Motor (high side) short to battery.

A063 RF Motor (high side) short to battery.

A064 RA Motor (high side) short to battery.

A077 LF Solenoid short to battery.

A081 RF Solenoid short to battery.

This is due to the electrical connection of the above circuits to the relay. If code A015 is detected along with the above codes, troubleshoot the above codes first.

Cause(s)

- There are malfunctioning relay contacts (contacts are closed all the time).
- A solenoid or motor circuit has shorted to battery.
- A short to battery is present on the switched battery circuit.
- The EBCM is faulty.

Fail Action

Set history code.

A DTC A015 is stored. The ABS is not disabled, but the ABS indicator will flash to indicate that a malfunction exists.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step indicates that the EBCM is capable of controlling the ABS enable relay as commanded.
2. This step checks for voltage at terminal C7 of the EBCM harness connector J2. If voltage is present, the malfunction exists in the ABS enable relay and/or its circuitry.

3. This test checks for a short to ground in the ABS enable relay control circuit.
4. This step checks for a short to voltage in circuit RED.
5. This step identifies if the EBCM is malfunctioning.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

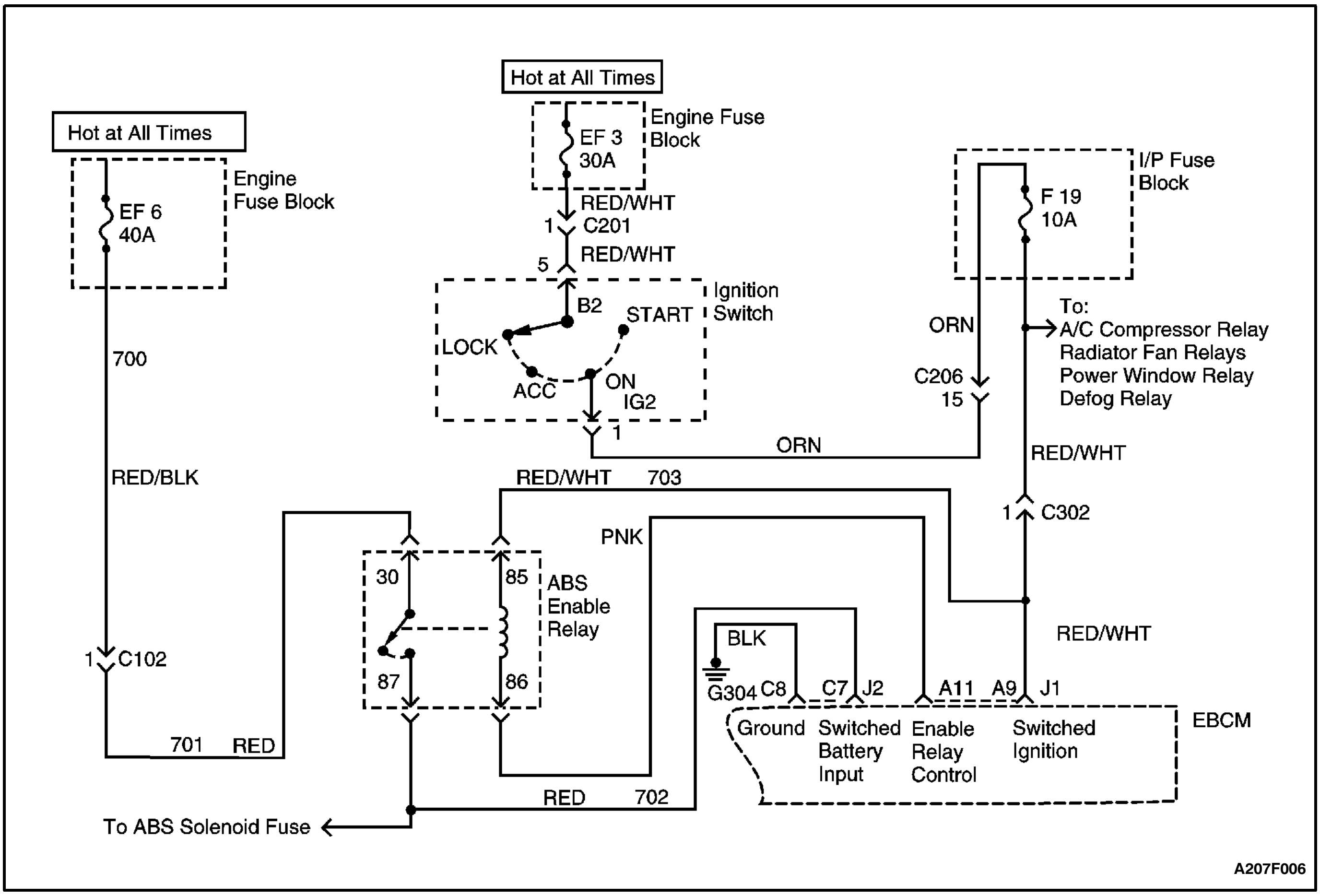
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A015 – ABS Enable Relay Circuit Shorted to Battery or Always Closed

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Use the relay test function of the scan tool scanner to command the ABS enable relay OFF. Does the scan tool indicate that the ABS enable relay is OFF and the battery voltage is less than the specified value?	5 v	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect both EBCM connectors. 3. Turn the ignition switch to ON. 4. Measure the voltage between ground and terminal C7 of the EBCM harness connector J2. Is the voltage less than the specified value?	2 v	Go to Step 5	Go to Step 3
3	Measure the voltage between terminal A11 of the EBCM harness connector J1 and B+. Is the voltage less than the specified value?	2 v	Go to Step 4	Go to Step 7
4	1. Turn the ignition switch to LOCK. 2. Unplug the ABS enable relay. 3. Turn the ignition switch to ON. 4. Measure the voltage between ground and terminal C7 of the EBCM harness connector J2. Is the voltage less than the specified value?	2 v	Go to Step 8	Go to Step 9
5	1. Turn the ignition switch to LOCK. 2. Reconnect both EBCM connectors. 3. Turn the ignition switch to ON. 4. Clear any DTCs with the scan tool scanner. 5. Use the scan tool relay test function to command the ABS enable relay OFF. Does the scan tool indicate that the ABS enable relay is OFF and the battery voltage is less than the specified value?	5 v	Go to "Diagnostic Aids"	Go to Step 6
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit PNK. Is the repair complete?	-	System OK	-
8	Replace the ABS enable relay. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in circuit RED. Is the repair complete?	-	System OK	-

After the diagnosis is complete, clear all DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving above 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A016
ABS ENABLE RELAY COIL CIRCUIT OPEN

Circuit Description

Ignition voltage is supplied through terminal 6 of the ABS enable relay socket. The EBCM then is able to energize the pull-in coil by completing the ground circuit at pin A11 of the EBCM. The magnetic field created closes the ABS enable relay contacts and supplies battery voltage and current to the EBCM, which supplies power to the motors.

Diagnosis

This test detects an open in the enable relay coil circuit. If for 0.056 seconds the enable relay input voltage to the controller falls below 7.5 volts while the controller output for the enable relay is less than 3.4 volts, a fault exists.

Cause(s)

- The enable relay coil is open.
- An open exists within the enable relay coil circuit.
- There is high resistance in the connector terminal or wiring.
- The driver circuit in the EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The brake warning lamp is turned on only if the rear piston is not at the top of the bore. This could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step indicates if the EBCM is capable of controlling the ABS enable relay as commanded.
2. This step ensures that there is continuity through the pull-in coil of the relay.
3. This step checks to ensure that voltage is available to the pull-in coil of the relay.
4. This step checks for continuity in circuit PNK.
5. This step ensures that the DTC was not set due to a poor connection.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A016 – ABS Enable Relay Coil Circuit Open

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Use the relay test function of the scan tool scanner to command the ABS enable relay ON. Does the scan tool indicate that the ABS enable relay is ON and the battery voltage is above the specified value?	10 v	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal A11 of the EBCM harness connector J1. Is the voltage above the specified value?	10 v	Go to Step 5	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the ABS enable relay. 3. Turn the ignition switch to ON. 4. Use a DVM to measure the voltage between ground and terminal 6 of the ABS enable relay harness connector. Is the voltage above the specified value?	10 v	Go to Step 4	Go to Step 7
4	Use a DVM to measure the resistance between terminal A11 of the EBCM harness connector J1 and terminal 4 of the ABS enable relay harness connector. Is the resistance below the specified value?	2 W	Go to Step 9	Go to Step 10
5	1. Turn the ignition switch to LOCK. 2. Inspect terminal A11 of the EBCM connector J1 for poor contact. 3. Reconnect all of the connectors. 4. Turn the ignition switch to ON. Does DTC reset?	-	Go to Step 6	Go to "Diagnostic Aids"
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	1. Check fuse F19. 2. Check for a poor connection at terminal 1 of connector C302. Are fuse F19 and the connection in good condition?	-	Go to Step 8	Go to Step 11
8	Repair the open or high resistance in circuit RED/WHT. Is the repair complete?	-	System OK	-

DTC A016 – ABS Enable Relay Coil Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	Replace the ABS enable relay. Is the repair complete?	-	System OK	-
10	Repair the open in circuit PNK. Is the repair complete?	-	System OK	-
11	Replace fuse F19 or repair the poor connection. Is the repair complete?	-	System OK	-

After the diagnosis is complete, clear all DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving above 16 km/h (10 mph), and then turning off the ignition.

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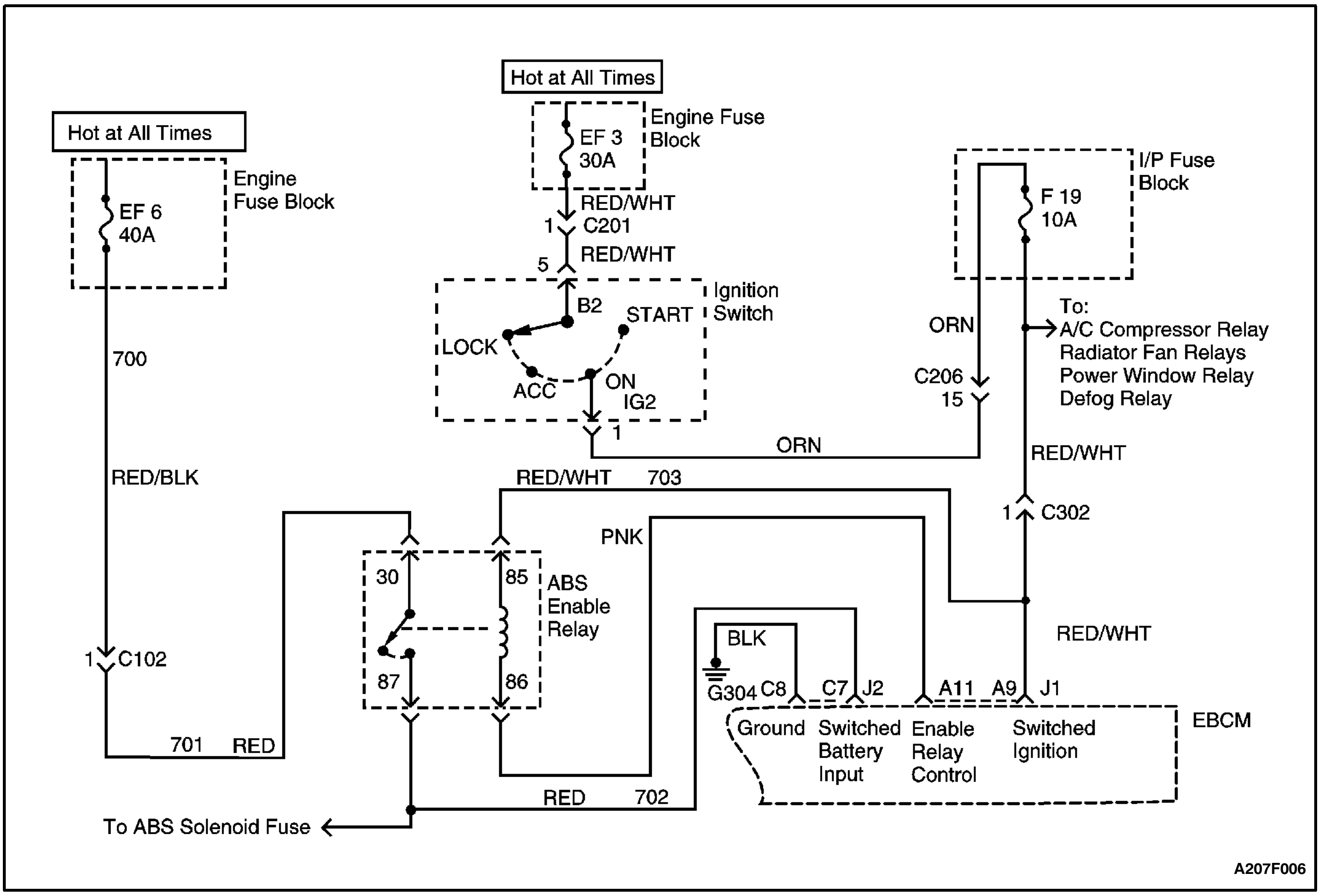


DIAGNOSTIC TROUBLE CODE (DTC) A017
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO GROUND

Circuit Description

Ignition voltage is supplied through terminal 6 of the ABS enable relay socket. The EBCM then is able to energize the pull-in coil by completing the ground circuit at pin A11 of the EBCM. The magnetic field created closes the ABS enable relay contacts and supplies battery voltage and current to the EBCM, which supplies power to the motors.

Diagnosis

This test determines a situation in which switched battery power is greater than 7.5 volts at the EBCM for at least 4 seconds after the relay is de-energized and the relay coil is shorted to ground. The relay coil is considered shorted to ground when the coil circuit voltage at the controller is less than 4.5 volts.

Cause(s)

- The relay coil circuit is shorted to ground.
- The EBCM driver circuit is malfunctioning.

Fail Action

This sets a history code.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step indicates if the EBCM is capable of controlling the ABS enable relay as commanded.
2. This checks to ensure the ABS enable relay or control circuit PNK is not shorted to ground.
3. This test determines whether the fault is due to a short to ground in circuit PNK or a faulty ABS enable relay.
4. This step ensures that the DTC was not set due to a poor connection.

Diagnostic Aids

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

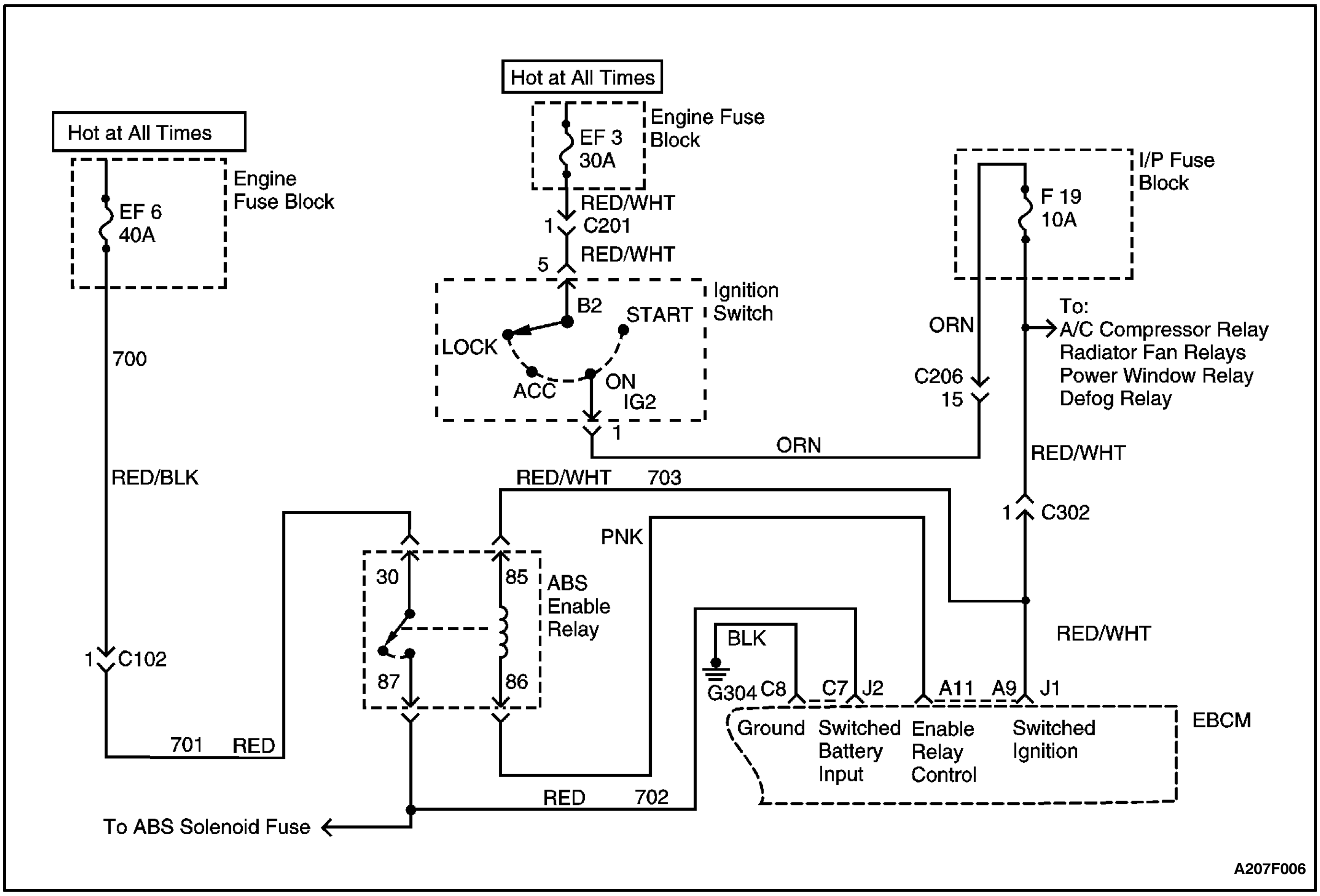
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A017 – ABS Enable Relay Coil Circuit Shorted to Ground

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Use the relay test function of the scan tool scanner to command the ABS enable relay OFF. Does the scan tool indicate that the ABS enable relay is OFF and the battery voltage is less than the specified value?	5 v	Go to “Diagnostic Aids”	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter (DVM) between B+ and terminal A11 of the EBCM harness connector J1. Is the voltage less than the specified value?	2 v	Go to Step 4	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Unplug the ABS enable relay. 3. Connect a DVM between B+ and terminal 6 of the ABS enable relay harness connector. Is the voltage less than the specified value?	2 v	Go to Step 6	Go to Step 7
4	1. Turn the ignition switch to LOCK. 2. Inspect the EBCM connector J1 terminal A11 for a poor contact. 3. Reconnect all of the connectors. 4. Turn the ignition switch to ON. Does DTC reset?	-	Go to Step 5	Go to “Diagnostic Aids”
5	Replace the EBCM. Is the repair complete?	-	System OK	-
6	Replace the ABS enable relay. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit PNK. Is the repair complete?	-	System OK	-

This chart assumes that a current DTC is stored indicating that this malfunction is present.



DIAGNOSTIC TROUBLE CODE (DTC) A018
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY

Circuit Description

Ignition voltage is supplied through terminal 6 of the ABS enable relay socket. The EBCM then is able to energize the pull-in coil by completing the ground circuit at pin A11 of the EBCM. The magnetic field created closes the ABS enable relay contacts and supplies battery voltage and current to the EBCM, which supplies power to the motors.

Diagnosis

This test checks for a short to battery in the relay coil circuit. Such a short would cause the relay to remain off all the time. The relay coil is considered shorted to battery when the coil circuit voltage at the controller is greater than 3.4 volts.

Cause(s)

- The relay coil circuit is shorted to battery.
- The enable relay coil has low/no resistance.
- The EBCM driver circuit is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The brake warning lamp is turned on only if the rear piston is not at the top of the bore. This could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step indicates if the EBCM is capable of controlling the ABS enable relay as commanded.
2. With the ABS enable relay removed, voltage should not be available at terminal 4 of the relay socket. Any voltage at this point would indicate that circuit PNK was shorted to a voltage source.
3. This step checks for a shorted coil.
4. This ensures that a malfunction was not due to a poor connection.

Diagnostic Aids

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

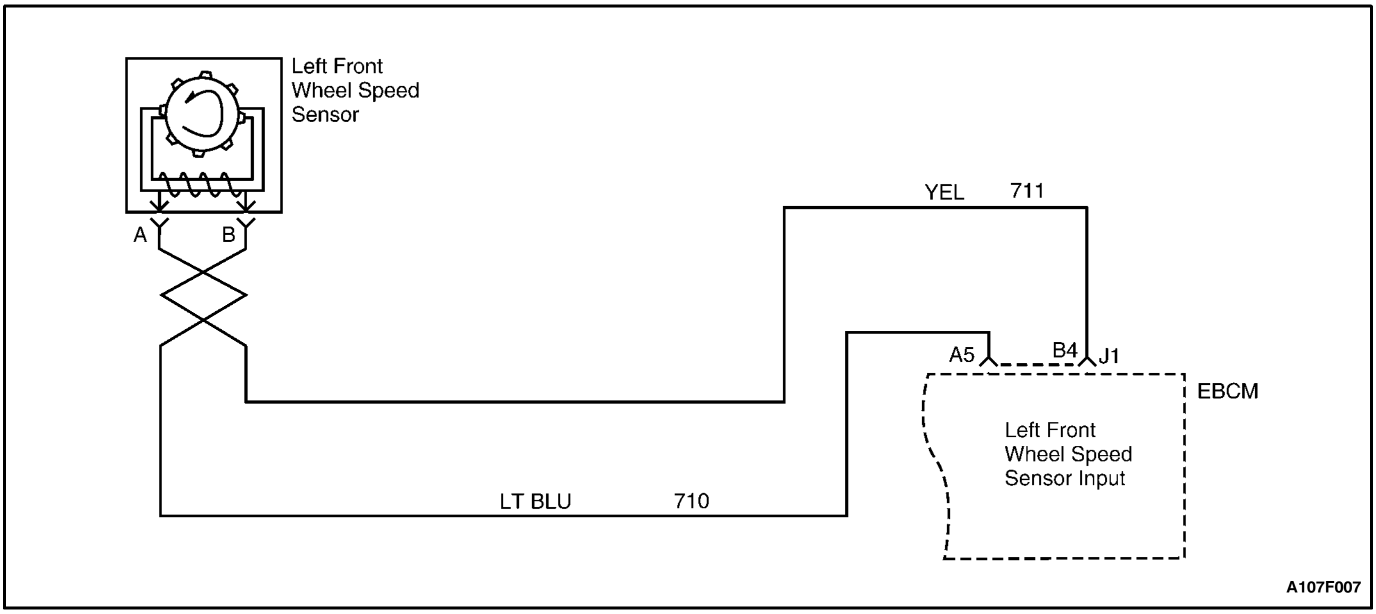
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A018 – ABS Enable Relay Coil Circuit Shorted to Battery

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Use the relay test function of the scan tool scanner to command the ABS enable relay ON. Does the scan tool indicate that the ABS enable relay is ON and the battery voltage is greater than the specified value?	10 v	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Unplug the ABS enable relay. 3. Disconnect the EBCM connector J1. 4. Connect a digital voltmeter (DVM) between terminal 4 of the ABS enable relay harness connector and ground. 5. Turn the ignition switch to ON. Is the voltage less than the specified value?	2 v	Go to Step 3	Go to Step 6
3	1. Turn the ignition switch to LOCK. 2. Use a DVM to measure the resistance between ABS enable relay terminals 85 and 86. Is the resistance above the specified value?	40 W	Go to Step 4	Go to Step 7
4	1. Inspect terminal A11 of the EBCM connector J1 for a poor contact to the EBCM. 2. Reconnect all of the connectors. 3. Turn the ignition switch to ON. Does the DTC reset?	-	Go to Step 5	Go to "Diagnostic Aids"
5	Replace the EBCM. Is the repair complete?	-	System OK	-
6	Repair the short to voltage on circuit PNK. Is the repair complete?	-	System OK	-
7	Replace the ABS enable relay. Is the repair complete?	-	System OK	-

This chart assumes that a current DTC is stored indicating that this malfunction is present.



DIAGNOSTIC TROUBLE CODE (DTC) A021 LEFT FRONT WHEEL SPEED = 0

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test checks for the left front wheel speed equal to 0 km/h (0 mph) for greater than 1.6 seconds while the other three wheel speeds are greater than 8 km/h (5 mph) and within 11 km/h (7 mph). This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- The sensor is physically damaged.
- The wheel speed input wires are shorted together.
- A sensor harness lead is shorted to voltage.
- A sensor harness lead is shorted to ground.
- There is an open or high resistance in a sensor harness lead.
- The speed ring is missing.
- The air gap exceeds the required specifications.
- The connector is damaged.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position. Two separate wheel speed = 0 codes are set if the following conditions are met:

- Two wheel speeds are 0 mph for greater than 20 seconds.
- The remaining wheel speeds are greater than 10 mph and within 7 mph.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
3. This test checks the wheel speed sensor for the proper resistance values.
6. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
7. This step ensures the wheel speed sensor is not shorted to ground.
8. This step checks for proper voltages at the speed sensor harness connector.
9. This test ensures that the wheel speed sensor circuitry is not internally shorted.
21. This checks for an open in circuit YEL.
23. This checks both wheel speed signal circuits for a short to ground.
25. This step ensures that DTC A021 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
31. This checks for an open in circuit LT BLU.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and the jumper harness as necessary.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A021 – Left Front Wheel Speed = 0

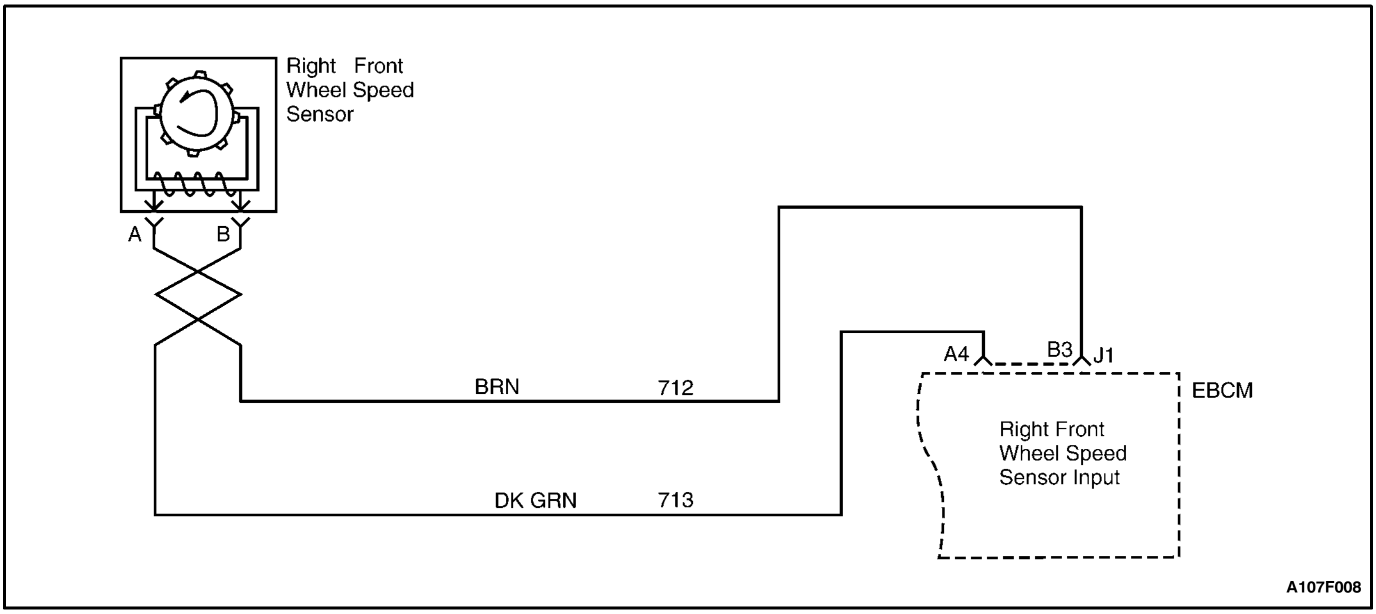
Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the left front wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the value specified?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Speed ring • Wiring • Connectors Pay particular attention to the speed ring. Any significant damage (other than nicks from stones, etc.) will affect the wheel speed input signal. Is any physical damage indicated?	-	Go to Step 5	Go to Step 3
3	1. Unplug the connector from left front wheel speed sensor. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals A and B of the sensor. Is the resistance within the specified value when the sensor is approximately 20°C (68°F)?	969-1185 W	Go to Step 6	Go to Step 4
4	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
5	Correct any physical damage. Is the repair complete?	-	System OK	-

DTC A021 – Left Front Wheel Speed =0 (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage while spinning the wheel by hand. Voltage will increase as the wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 7	Go to Step 4
7	Use the DVM to measure resistance between sensor terminal A and ground. Does the DVM display the specified value?	R	Go to Step 8	Go to Step 4
8	1. Turn the ignition switch to ON. 2. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the left front sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 9	Go to Step 15
9	1. Turn the ignition switch to LOCK. 2. Unplug the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B4 and A5 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 13
10	1. Inspect the EBCM connector J1 for poor connection. Is a poor connection found?	-	Go to Step 11	Go to Step 12
11	Repair the connector. Is the repair complete?	-	System OK	-
12	Replace the EBCM. Is the repair complete?	-	System OK	-
13	Check for an internal short between circuits YEL and LT BLU. Is there a short?	-	Go to Step 14	Go to Step 15
14	Repair the short between circuits YEL and LT BLU. Is the repair complete?	-	System OK	-
15	Replace the LF jumper harness. Is the repair complete?	-	System OK	-
16	Check the voltage at terminal B. Is the voltage outside of the value specified?	2.25-2.75 v	Go to Step 17	Go to Step 27
17	Check the voltage at terminal B. Is the voltage above the specified value?	2.75 v	Go to Step 18	Go to Step 21
18	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal B4 of EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 19	Go to Step 20
19	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
20	Repair the short to voltage in circuit YEL. Is the repair complete?	-	System OK	-

DTC A021 – Left Front Wheel Speed =0 (Cont'd)

Step	Action	Value(s)	Yes	No
21	1. Turn the ignition switch to LOCK. 2. Disconnect EBCM connector J1. 3. Use a DVM to measure the resistance between terminal B on the left front wheel speed sensor harness connector and terminal B4 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 23	Go to Step 22
22	Repair the open or high resistance in circuit YEL. Is the repair complete?	-	System OK	-
23	Use a DVM to measure the resistance between ground and terminal B4, then terminal A5 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 25	Go to Step 24
24	Repair the short to ground in circuit LT BLU or YEL. Is the repair complete?	-	System OK	-
25	Inspect the EBCM connector J1 for a poor connection. Reconnect all of the connections and repeat the test of Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the specified value?	8 km/h (5 mph)	System OK	Go to Step 26
26	Replace the EBCM. Is the repair complete?	-	System OK	-
27	Check the voltage at terminal A. Is the voltage above the specified value?	2.75 v	Go to Step 28	Go to Step 31
28	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal A5 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 29	Go to Step 30
29	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
30	Repair the short to voltage in circuit LT BLU. Is the repair complete?	-	System OK	-
31	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal A, the wheel speed sensor harness connector, and terminal A5 of the EBCM harness connector J1. Does the DVM display less than the specified value?	2 W	Go to Step 23	Go to Step 32
32	Repair the open or high resistance in circuit LT BLU. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A022 RIGHT FRONT WHEEL SPEED = 0

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test checks for the right front wheel speed equal to 0 km/h (0 mph) for greater than 1.6 seconds while the other three wheel speeds are greater than 8 km/h (5 mph) and within 11 km/h (7 mph). This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- The sensor is physically damaged.
- The wheel speed input wires are shorted together.
- A sensor harness lead is shorted to voltage.
- A sensor harness lead is shorted to ground.
- There is an open or high resistance in a sensor harness lead. The speed ring is missing.
- The air gap exceeds the required specifications.
- The connector is damaged.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position. Two separate wheel speed = 0 codes are set if the following conditions are met:

- Two wheel speeds are 0 mph for greater than 20 seconds.
- The remaining wheel speeds are greater than 10 mph and within 7 mph.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
3. This test checks the wheel speed sensor for the proper resistance values.
6. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
7. This step ensures the wheel speed sensor is not shorted to ground.
8. This step checks for proper voltages at the speed sensor harness connector.
9. This test ensures that the wheel speed sensor circuitry is not internally shorted.
21. This checks for an open in circuit BRN.
23. This checks for a short to ground in both wheel speed signal circuits.
25. This step ensures that DTC A022 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
31. This checks for an open in circuit DK GRN.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and the jumper harness as necessary.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A022 – Right Front Wheel Speed = 0

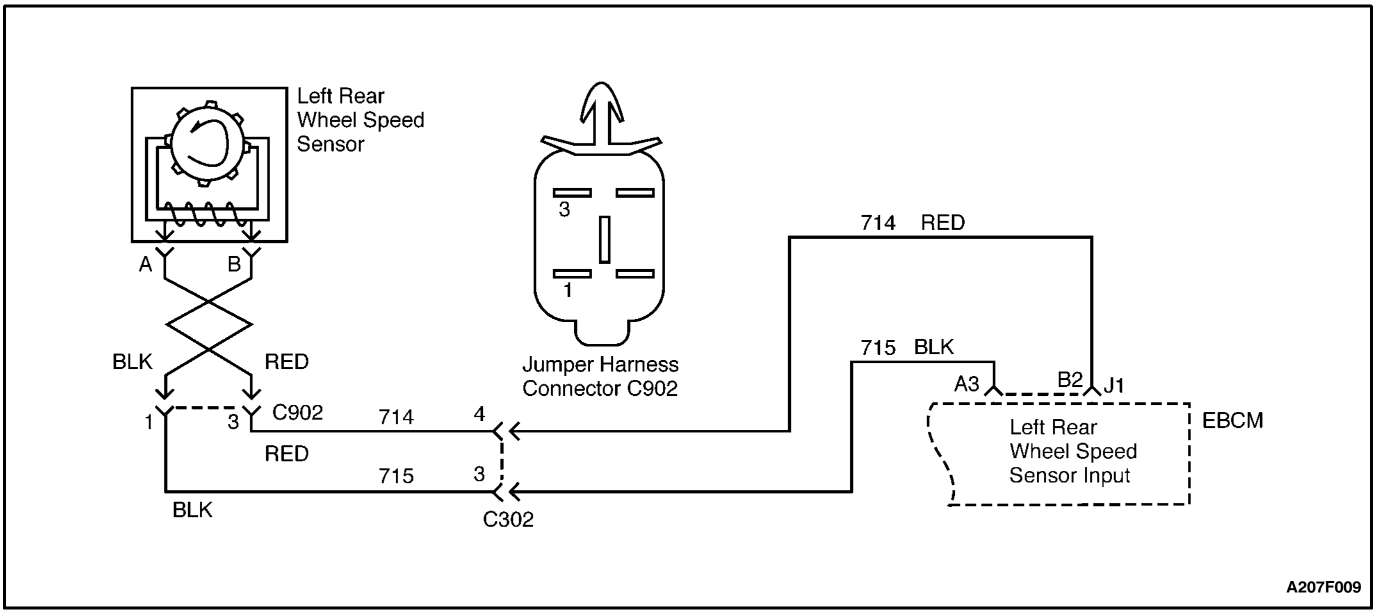
Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the right front wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Speed ring • Wiring • Connectors Pay particular attention to the speed ring. Any significant damage (other than nicks from stones, etc.) will affect the wheel speed input signal. Is any physical damage indicated?	-	Go to Step 5	Go to Step 3
3	1. Unplug the connector from the right front wheel speed sensor. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals A and B of the sensor. Is the resistance within the specified value while the sensor is at a temperature of approximately 20°C (68°F)?	969-1185 W	Go to Step 6	Go to Step 4
4	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
5	Correct the physical damage. Is the repair complete?	-	System OK	-

DTC A022 - Right Front Wheel Speed = 0 (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Select the A/C voltage scale on the DVM. 2. Monitor voltage while spinning the wheel by hand. Voltage will increase as the wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 7	Go to Step 4
7	Use the DVM to measure the resistance between sensor terminal A and ground. Does the DVM display the specified value?	R	Go to Step 8	Go to Step 4
8	1. Turn the ignition switch to ON. 2. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the right front sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 9	Go to Step 16
9	1. Turn the ignition switch to LOCK. 2. Unplug the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals A4 and B3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 13
10	1. Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 11	Go to Step 12
11	Repair the connection. Is the repair complete?	-	System OK	-
12	Replace the EBCM. Is the repair complete?	-	System OK	-
13	Check for an internal short between circuits BRN and DK GRN. Is there a short?	-	Go to Step 14	Go to Step 15
14	Repair the short between circuits BRN and DK GRN. Is the repair complete?	-	System OK	-
15	Replace the RF jumper harness. Is the repair complete?	-	System OK	-
16	Check the voltage at terminal B. Is the voltage outside of the specified value?	2.25-2.75 v	Go to Step 17	Go to Step 27
17	Check the voltage at terminal B. Is the voltage above the specified value?	2.75 v	Go to Step 18	Go to Step 21
18	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal B3 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 19	Go to Step 20
19	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK.	-
20	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-

DTC A022 – Right Front Wheel Speed =0 (Cont'd)

Step	Action	Value(s)	Yes	No
21	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal B on the right front wheel speed sensor harness connector and terminal B3 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 23	Go to Step 24
22	Repair the open or high resistance in circuit BRN. Is the repair complete?	-	System OK	-
23	Use a DVM to measure the resistance between ground and terminal A4, then terminal B3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 25	Go to Step 24
24	Repair the short to ground in circuits DK GRN and BRN. Is the repair complete?	-	System OK	-
25	1. Inspect the EBCM connector J1 for a poor connection. 2. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the value specified?	8 km/h (5 mph)	System OK	Go to Step 26
26	Replace the EBCM. Is the repair complete?	-	System OK	-
27	Check the voltage at terminal A. Is the voltage on terminal A above the minimum value specified?	2.75 v	Go to Step 28	Go to Step 31
28	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal A4 of the EBCM harness connector J1. Is the voltage below the maximum value specified?	1 v	Go to Step 29	Go to Step 30
29	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
30	Repair the short to voltage in circuit DK GRN. Is the repair complete?	-	System OK	-
31	1. Turn the ignition switch to LOCK. 2. Unplug EBCM connector J1. 3. Use the DVM to measure resistance between terminal A the wheel speed sensor harness connector and terminal A4 of EBCM harness connector J1. Does the DVM display the specified value?	t 2 W	Go to Step 23	Go to Step 32
32	Repair the open or high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A023
LEFT REAR WHEEL SPEED = 0

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test checks for the left rear wheel speed equal to 0 km/h (0 mph) for greater than 1.6 seconds while the other three wheel speeds are greater than 8 km/h (5 mph) and within 11 km/h (7 mph). This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- The sensor is physically damaged.
- The wheel speed input wires are shorted together.
- The speed ring is missing.
- A sensor harness lead is shorted to voltage.
- A sensor harness lead is shorted to ground.
- There is an open or high resistance in a sensor harness lead.
- The air gap exceeds the required specifications.
- The connector is damaged.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position. Two separate wheel speed = 0 codes are set if the following conditions are met:

- Two wheel speeds are 0 mph for greater than 20 seconds.
- The remaining wheel speeds are greater than 10 mph and within 7 mph.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
3. This test checks the wheel speed sensor for the proper resistance values.
8. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
9. This step ensures the wheel speed sensor is not shorted to ground.
10. This step checks for proper voltages at the speed sensor harness connector.
11. This test ensures that the wheel speed sensor circuitry is not internally shorted.
23. This checks for an open in circuit BLK.
25. This checks for a short to ground in both wheel speed signal circuits.
27. This step ensures that DTC A023 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
34. This checks for an open in circuit RED.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and jumper harness as necessary.

It is difficult to measure the resistance and the voltage at the terminals of the wheel speed sensor due to sensor mounting location and position. Terminals at the other end of the jumper harness are much more accessible. The rear wheel speed sensor jumper harnesses are connected to the system through connector C902, which is clipped to the vehicle near the right rear wheel. It connects to the floor harness, which passes through a grommet near that point. The clamp securing it to the vehicle is removed easily by pinching the tabs together and pushing up on the clamp. It is easier to handle the connector and take measurements if you free the connector from the axle first. Refer to "Rear Wheel Speed Sensor Jumper Harness" for illustrations.

After you unplug the jumper harness from the floor harness at C902, stand toward the rear of the car. Rotate the connector so you are looking at the open end, and you will see it as it appears in the sketch at the top of this procedure. It will then be easy to make the necessary measurements.

The jumper harnesses for both rear wheels are bound together at this connector and are replaced as a single assembly, not as separate right or left jumper harnesses.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A023 – Left Rear Wheel Speed = 0

Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the left rear wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor jumper harness • Jumper harness connectors • Connector at the left wheel speed sensor Is any physical damage indicated?	-	Go to Step 7	Go to Step 3

DTC A023 – Left Rear Wheel Speed = 0 (Cont'd)

Step	Action	Value(s)	Yes	No
3	1. Disconnect the rear jumper harness assembly from the floor harness at connector C902. See "Diagnostic Aids" for details on this connector. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals 1 and 3 on the connector C902. Is the resistance within the specified value while the sensor is at a temperature of approximately 20°C (68°F)?	969-1185 W	Go to Step 8	Go to Step 4
4	Check the connection at the speed sensor. Is the connection in good condition?	-	Go to Step 6	Go to Step 5
5	Repair the speed sensor connection. Is the repair complete?	-	System OK	-
6	Replace the rear wheel hub assembly. Is the repair complete?	-	System OK	-
7	Correct any physical damage. Is the repair complete?	-	System OK	-
8	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage from the left wheel speed sensor while spinning the wheel by hand. Voltage will increase as the wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 9	Go to Step 6
9	Use the DVM to measure the resistance between terminal 1 of connector C902 and ground. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 6
10	1. Reconnect connector C902. 2. Unplug the jumper harness connector from the left rear wheel speed sensor. 3. Turn the ignition switch to ON . 4. Connect the DVM to ground and measure the voltage at terminal B, then terminal A of the left rear speed sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 11	Go to Step 18
11	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B2 and A3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 12	Go to Step 15
12	Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 13	Go to Step 14
13	Repair the connection. Is the repair complete?	-	System OK	-
14	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A023 – Left Rear Wheel Speed = 0 (Cont'd)

Step	Action	Value(s)	Yes	No
15	Check for an internal short between circuits BLK and RED. Is there a short?	-	Go to Step 16	Go to Step 17
16	Repair the short between circuits BLK and RED. Is the repair complete?	-	System OK	-
17	Replace the rear jumper harness. Is the repair complete?	-	System OK	-
18	Check the voltage at terminal A of the rear speed sensor harness connector. Is the voltage outside of the specified value?	2.25-2.75 v	Go to Step 19	Go to Step 31
19	Check the voltage at terminal A of the rear speed sensor harness connector. Is voltage above the specified value?	2.75 v	Go to Step 20	Go to Step 23
20	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal A3 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 20	Go to Step 21
21	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
22	Repair the short to voltage in circuit BLK. Is the repair complete?	-	System OK	-
23	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal A on the left rear wheel speed sensor harness connector and terminal A3 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 25	Go to Step 24
24	Check the jumper harness connector terminal B for a poor connection. Is the connection in good condition?	-	Go to Step 29	Go to Step 30
25	Use a DVM to measure resistance between ground and terminal B2, then terminal A3 of the EBCM harness connector J1. Does the resistance meet the specified value?	R	Go to Step 27	Go to Step 26
26	Repair the short to ground in circuits BLK and RED. Is the repair complete?	-	System OK	-
27	1. Inspect the EBCM connector J1 for a poor connection. 2. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the specified value ?	8 km/h (5 mph)	System OK	Go to Step 28
28	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
29	Repair the open or high resistance in circuit BLK. Is the repair complete?	-	System OK	-

DTC A023 – Left Rear Wheel Speed =0 (Cont'd)

Step	Action	Value(s)	Yes	No
30	Repair the poor connection in the jumper harness connector terminal B. Is the repair complete?	-	System OK	-
31	Check the voltage at terminal A. Is the voltage greater than the specified minimum value?	2.75 v	Go to Step 32	Go to Step 34
32	1. Turn ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal B2 of the EBCM harness connector J1. Is the voltage less than the specified value?	1 v	Go to Step 28	Go to Step 33
33	Repair the short to voltage in circuit RED. Is the repair complete?	-	System OK	-
34	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal B, the wheel speed sensor harness connector, and terminal B2 of the EBCM harness connector J1. Does the DVM display the specified value?	t 2 W	Go to Step 25	Go to Step 35
35	Check the jumper harness connector terminal A for a poor connection. Is the connection in good condition?	-	Go to Step 36	Go to Step 37
36	Repair the open or high resistance in circuit RED. Is the repair complete?	-	System OK	-
37	Repair the poor connection in the jumper harness connector terminal A. Is the repair complete?	-	System OK	-

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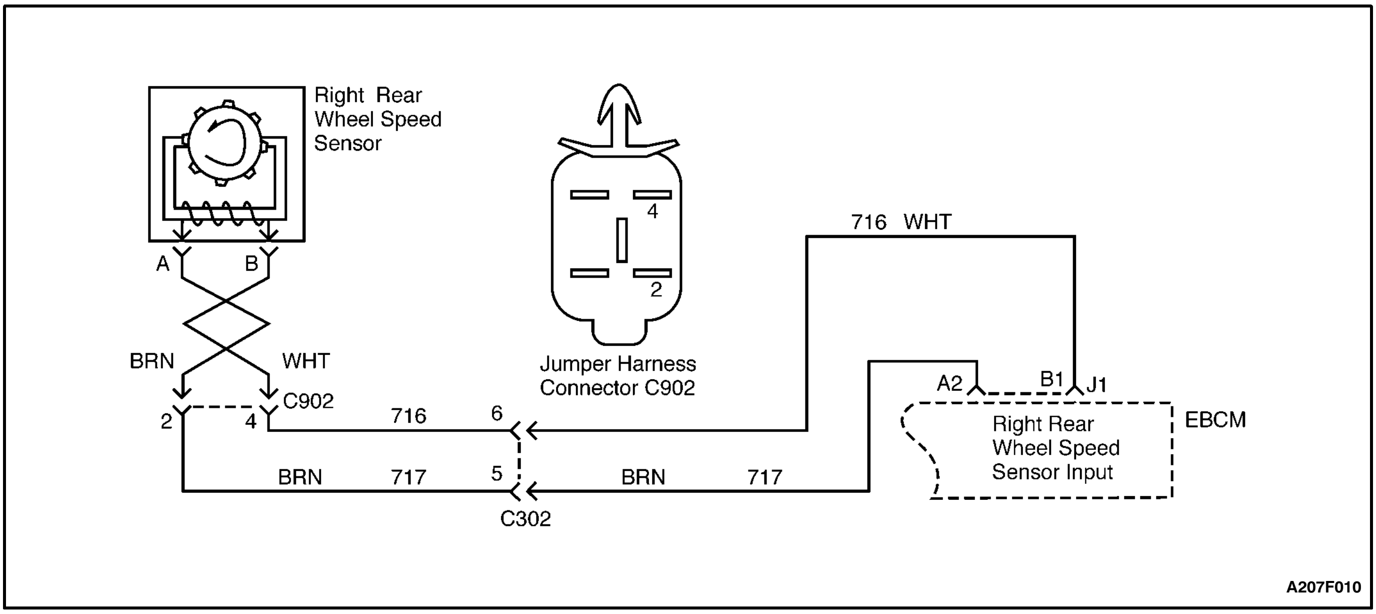

DIAGNOSTIC TROUBLE CODE (DTC) A024 RIGHT REAR WHEEL SPEED = 0

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test checks for the right rear wheel speed equal to 0 km/h (0 mph) for greater than 1.6 seconds while the other three wheel speeds are greater than 8 km/h (5 mph) and within 11 km/h (7 mph). This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- The sensor is physically damaged.
- The wheel speed input wires are shorted together.
- A sensor harness lead is shorted to voltage.
- A sensor harness lead is shorted to ground.
- There is an open or high resistance in a sensor harness lead.
- The speed ring is missing.
- The air gap exceeds the required specifications.
- The connector is damaged.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position. Two separate wheel speed = 0 codes are set if the following conditions are met:

- Two wheel speeds are 0 mph for greater than 20 seconds.
- The remaining wheel speeds are greater than 10 mph and within 7 mph.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
3. This test checks the wheel speed sensor for the proper resistance values.
8. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
9. This step ensures the wheel speed sensor is not shorted to ground.
10. This step checks for proper voltages at the speed sensor harness connector.
11. This test ensures that the wheel speed sensor circuitry is not internally shorted.
24. This checks for an open in circuit WHT.
26. This checks for a short to ground in both wheel speed signal circuits.
28. This step ensures that DTC A024 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
35. This checks for an open in circuit BRN.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and jumper harness as necessary.

It is difficult to measure the resistance and the voltage at the terminals of the wheel speed sensor due to sensor mounting location and position. Terminals at the other end of the jumper harness are much more accessible. The rear wheel speed sensor jumper harnesses are connected to the system through connector C902, which is clipped to the vehicle near the right rear wheel. It connects to the floor harness, which passes through a grommet near that point.

It is easier to handle the connector and take measurements if you free the connector from the axle first. Remove the clamp securing it to the vehicle by pinching the tabs together and pushing up on the clamp.

After you unplug the jumper harness from the floor harness at C902, stand toward the rear of the car. Rotate the connector so you are looking at the open end, and you will see it as it appears in the sketch at the top of this procedure. It will then be easy to make the necessary measurements. Refer to "Rear Wheel Speed Sensor Jumper Harness" in this section for illustrations.

The jumper harnesses for both rear wheels are bound together at this connector and are replaced as a single assembly, not as separate right or left jumper harnesses.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A024 – Right Rear Wheel Speed = 0

Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the right rear wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor jumper harness • Jumper harness connectors • Connector at right wheel speed sensor Is any physical damage indicated?	-	Go to Step 7	Go to Step 3

DTC A024 – Right Rear Wheel Speed = 0 (Cont'd)

Step	Action	Value(s)	Yes	No
3	1. Disconnect the rear jumper harness assembly from the floor harness at connector C902. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals 2 and 4 on connector C902. Is the resistance within the specified value while the sensor is at a temperature of approximately 20°C (68°F)?	969-1185 W	Go to Step 8	Go to Step 4
4	Check the connection at the speed sensor. Is the connection in good condition?	-	Go to Step 6	Go to Step 5
5	Repair the speed sensor connection. Is the repair complete?	-	System OK	-
6	Replace the rear wheel hub assembly. Is the repair complete?	-	System OK	-
7	Correct any physical damage. Is the repair complete?	-	System OK	-
8	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage while spinning the wheel by hand. Voltage will increase as the wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 9	Go to Step 6
9	Use the DVM to measure the resistance between terminal 4 of connector C902 and ground. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 6
10	1. Reconnect connector C902. 2. Unplug the jumper harness connector from the right rear wheel speed sensor. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal B, then terminal A of the right rear speed sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 11	Go to Step 18
11	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B1 and A2 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 12	Go to Step 15
12	Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 13	Go to Step 14
13	1. Repair the connection. 2. Reconnect all of the connections. Is the repair complete?	-	Go to Step 1	-
14	Replace the EBCM. Is the repair complete?	-	System OK	-
15	Check for an internal short between circuits WHT and BRN. Is there a short?	-	Go to Step 16	Go to Step 17

DTC A024 – Right Rear Wheel Speed = 0 (Cont'd)

Step	Action	Value(s)	Yes	No
16	Repair the short between circuits WHT and BRN. Is the repair complete?	-	System OK	-
17	Replace the rear jumper harness. Is the repair complete?	-	System OK	-
18	Check the voltage at terminal A of the right rear speed sensor harness connector. Is voltage outside of the specified value ?	2.25-2.75 v	Go to Step 19	Go to Step 31
19	Check the voltage at terminal A of the right rear speed sensor harness connector. Is voltage above the specified value?	2.75 v	Go to Step 20	Go to Step 23
20	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A2 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 21	Go to Step 22
21	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
22	Repair short to voltage in circuit WHT. Is the repair complete?	-	System OK	-
23	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal A on the right rear wheel speed sensor harness connector and terminal A2 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 25	Go to Step 24
24	Check the jumper harness connector terminal B for poor connection. Is the connection in good condition?	-	Go to Step 29	Go to Step 30
25	Use a DVM to measure the resistance between ground and terminal B1, then terminal A2 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 27	Go to Step 26
26	Repair the short to ground in circuits WHT and BRN. Is the repair complete?	-	System OK	-
27	1. Inspect the EBCM connector J1 for a poor connection. 2. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the value specified?	8 km/h (5 mph)	System OK	Go to Step 28
28	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
29	Repair the open or high resistance in circuit WHT. Is the repair complete?	-	System OK	-

DTC A024 – Right Rear Wheel Speed =0 (Cont'd)

Step	Action	Value(s)	Yes	No
30	Repair the poor connection in jumper harness connector terminal B. Is the repair complete?	-	System OK	-
31	Check the voltage at terminal B. Is the voltage at terminal B greater than the specified value?	2.75 v	Go to Step 32	Go to Step 34
32	1. Turn ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal B1 of the EBCM harness connector J1. Is the voltage less than the specified value?	1 v	Go to Step 28	Go to Step 33
33	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-
34	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal B, the wheel speed sensor harness connector, and terminal B1 of the EBCM harness connector J1. Does the DVM display a resistance less than the specified value?	2 W	Go to Step 25	Go to Step 35
35	Check the jumper harness connector terminal A for a poor connection. Is the connection in good condition?	-	Go to Step 36	Go to Step 37
36	Repair the open or high resistance in circuit BRN. Is the repair complete?	-	System OK	-
37	Repair the poor connection in the jumper harness connector terminal A. Is the repair complete?	-	System OK	-

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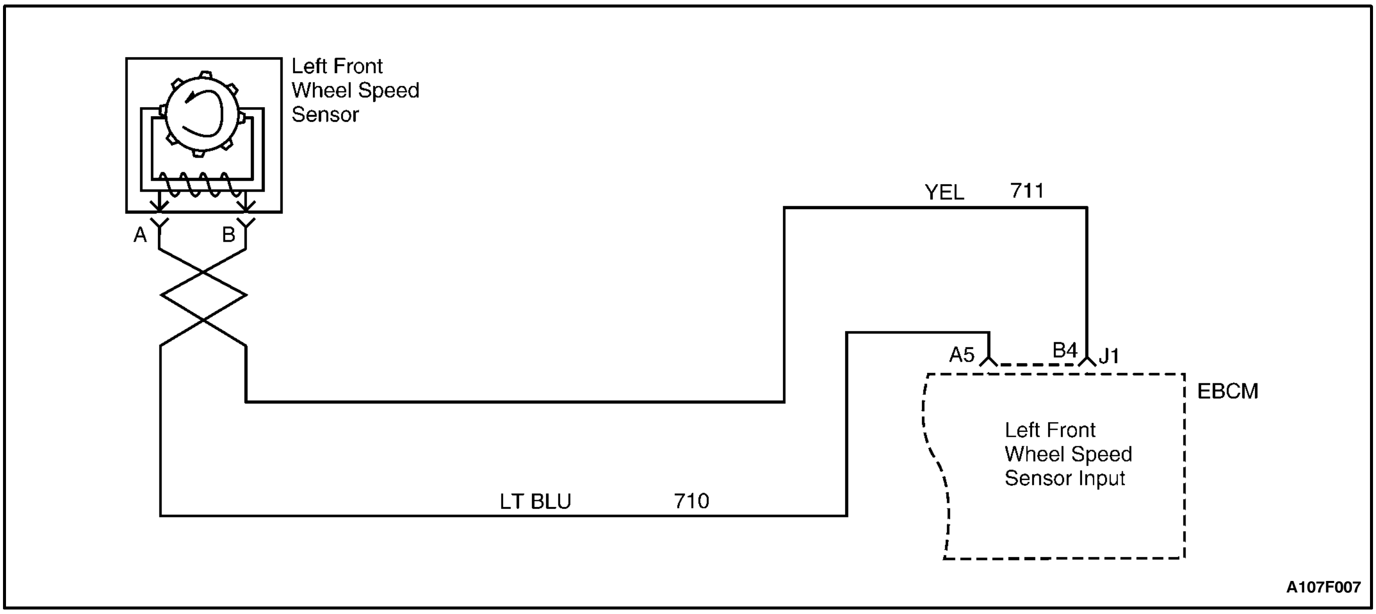


DIAGNOSTIC TROUBLE CODE (DTC) A025
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test detects a situation in which the left front wheel speed changes more than 19 km/h (12 mph) in 8 milliseconds. This change must occur five times with less than 0.2 second between occurrences. This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- A sensor is loose.
- There are worn suspension/drivetrain components.
- There is an intermittent short in the wheel speed input wires.
- The sensor is physically damaged.
- The wheel speed ring is damaged.
- A connector is damaged.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled, and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This test checks to see if excessive wheel bearing end play caused the DTC.
4. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
5. This test checks the wheel speed sensor for the proper resistance values.
8. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
9. This step ensures the wheel speed sensor is not shorted to ground.
10. This step checks for proper voltages at the speed sensor harness connector.
11. This test ensures that the wheel speed sensor circuitry is not internally shorted.
23. This checks for an open in circuit YEL.
25. This checks for a short to ground in both wheel speed signal circuits.
27. This step ensures that DTC A025 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
33. This checks for an open in circuit LT BLU.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and jumper harness as necessary.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A025 – Left Front Excessive Wheel Speed Variation

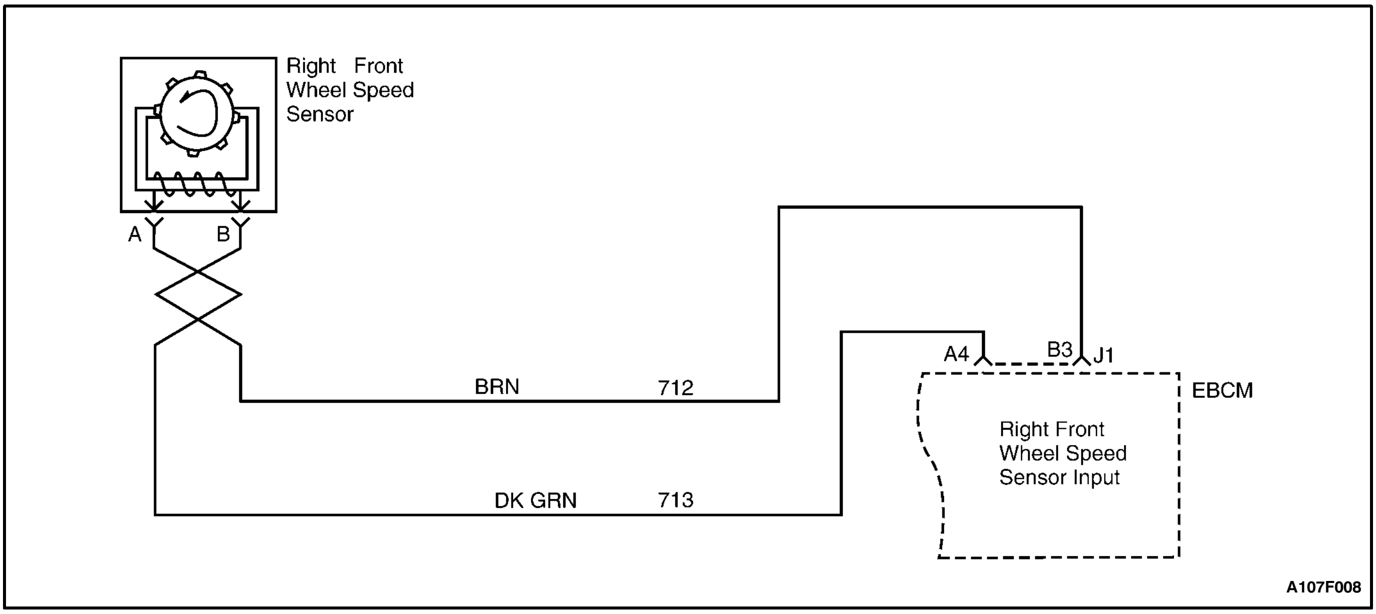
Step	Action	Value(s)	Yes	No
1	1. Test drive vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the left front wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	Remove the left front tire and measure the bearing end play. Does the end play exceed the specified value?	0.5 mm (0.02 in.)	Go to Step 3	Go to Step 4
3	Replace the front wheel bearing assembly. Is the repair complete?	-	System OK	-
4	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Speed Ring • Wiring • Connectors Pay particular attention to the speed ring. Any significant damage (other than nicks from stones, etc.) will affect the wheel speed input signal. Is any physical damage indicated?	-	Go to Step 7	Go to Step 5
5	1. Disconnect the connector from the left front wheel speed sensor. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals A and B of the sensor. Is resistance within specified value when the sensor is approximately 20°C (68°F)?	969-1185 W	Go to Step 8	Go to Step 6

DTC A025 – Left Front Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
6	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
7	1. Correct any physical damage. 2. Clear the DTCs. Is the repair complete?	-	Go to Step 1	-
8	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage while spinning the wheel by hand. Voltage will increase as wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 9	Go to Step 6
9	Use the DVM to measure the resistance between sensor terminal A and ground. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 6
10	1. Turn the ignition switch to ON. 2. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the left front sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 11	Go to Step 18
11	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B4 and A5 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 12	Go to Step 15
12	Inspect the EBCM connector J1 for poor connection. Is a poor connection found?	-	Go to Step 13	Go to Step 14
13	Repair the connection. Is the repair complete?	-	System OK	-
14	Replace the EBCM. Is the repair complete?	-	System OK	-
15	Check for an internal short between circuits YEL and LT BLU. Is there a short?	-	Go to Step 16	Go to Step 17
16	Repair the short between circuits YEL and LT BLU. Is the repair complete?	-	System OK	-
17	Replace the left front jumper harness. Is the repair complete?	-	System OK	-
18	Check the voltage at terminal B. Is the voltage out of the specified value	2.25-2.75 v	Go to Step 19	Go to Step 29
19	Check the voltage at terminal B. Is the voltage above the specified value?	2.75 v	Go to Step 20	Go to Step 23
20	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal B4 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 21	Go to Step 22

DTC A025 – Left Front Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
22	Repair the short to voltage in circuit YEL. Is the repair complete?	-	System OK	-
23	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal B on the left front wheel speed sensor harness connector and terminal B4 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 25	Go to Step 24
24	Repair the open or high resistance in circuit YEL. Is the repair complete?	-	System OK	-
25	Use a DVM to measure the resistance between ground and terminal B4, then terminal A5 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 27	Go to Step 26
26	Repair the short to ground in circuits LT BLU and YEL. Is the repair complete?	-	System OK	-
27	1. Inspect the EBCM connector J1 for a poor connection. 2. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the specified value?	8 km/h (5 mph)	System OK	Go to Step 28
28	Replace the EBCM. Is the repair complete?	-	System OK	-
29	Check the voltage at terminal A. Is the voltage at terminal A above the specified value?	2.75 v	Go to Step 30	Go to Step 33
30	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A5 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 31	Go to Step 32
31	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
32	Repair the short to voltage in circuit LT BLU. Is the repair complete?	-	System OK	-
33	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal A the wheel speed sensor harness connector and terminal A5 of the EBCM harness connector J1. Does the DVM display less than the specified value?	2 W	Go to Step 25	Go to Step 34
34	Repair the open or high resistance in circuit LT BLU. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A026
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test detects a situation in which the right front wheel speed changes more than 19 km/h (12 mph) in 8 milliseconds. This change must occur five times with less than 0.2 second between occurrences. This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- A sensor is loose.
- There are worn suspension/drivetrain components.
- There is an intermittent short in the wheel speed input wires.
- The sensor is physically damaged.
- The wheel speed ring is damaged.
- A connector is damaged.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This test checks to see if excessive wheel bearing end play caused the DTC.
4. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
5. This test checks the wheel speed sensor for the proper resistance values.
8. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
9. This step ensures the wheel speed sensor is not shorted to ground.
10. This step checks for proper voltages at the speed sensor harness connector.
11. This test ensures that the wheel speed sensor circuitry is not internally shorted.
23. This checks for an open in circuit BRN.
25. This checks for a short to ground in both wheel speed signal circuits.
27. This step ensures that DTC A026 was not set due to a poor connection between the EBCM and EBCM harness connector J1.
33. This checks for an open in circuit DK GRN.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]. Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and jumper harness as necessary.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A026 – Right Front Excessive Wheel Speed Variation

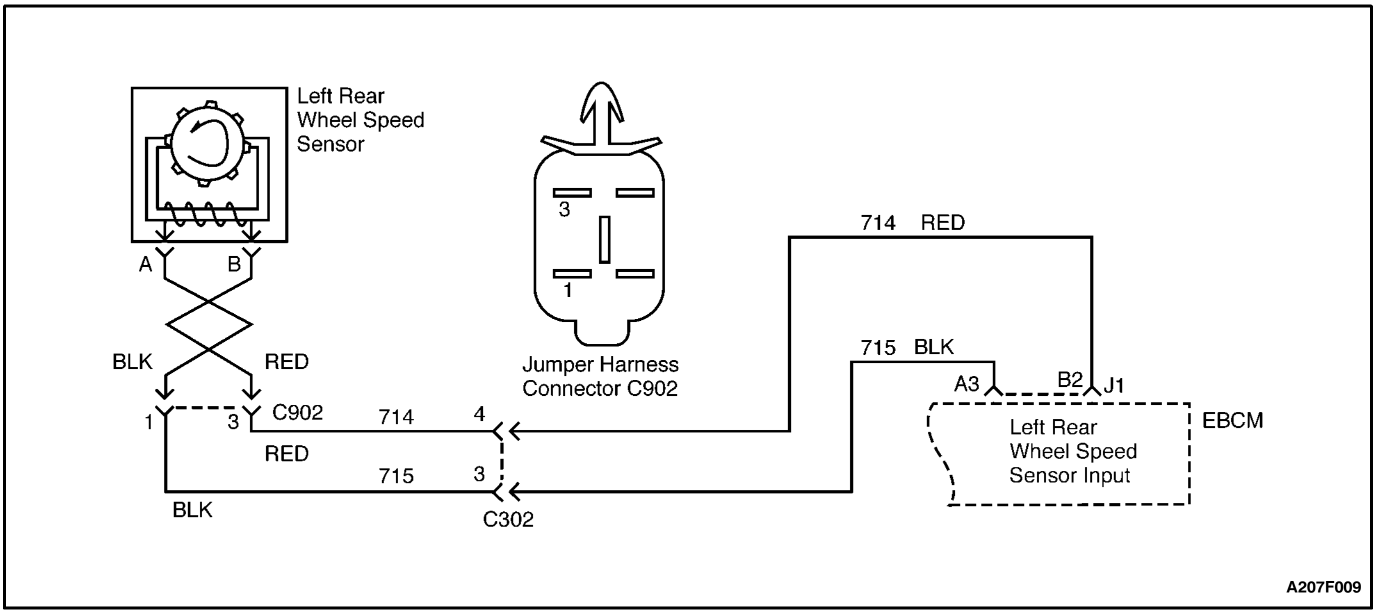
Step	Action	Value(s)	Yes	No
1	1. Test drive vehicle. 2. Select "Data List" on the scan tool. 3. Monitor wheel speed on the right front wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	Remove the right front tire and measure the bearing end play. Does the end play exceed the specified value?	0.5 mm (0.02 in.)	Go to Step 3	Go to Step 4
3	Replace the front wheel bearing assembly. Is the repair complete?	-	System OK	-
4	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Speed Ring • Wiring • Connectors Pay particular attention to the speed ring. Any significant damage (other than nicks from stones, etc.) will affect the wheel speed input signal. Is any physical damage indicated?	-	Go to Step 7	Go to Step 5
5	1. Disconnect the connector from the right front wheel speed sensor. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals A and B of the sensor. Is the resistance within the specified value when the sensor is approximately 20°C (68°F)?	969-1185 W	Go to Step 8	Go to Step 6

DTC A026 – Right Front Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
6	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
7	1. Correct any physical damage. 2. Clear the DTCs. Is the repair complete?	-	Go to Step 1	-
8	1. Select the A/C voltage scale on the DVM. 2. Monitor voltage while spinning wheel by hand. Voltage will increase as wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 9	Go to Step 6
9	Use the DVM to measure the resistance between sensor terminal A and ground. Does the DVM display the specified value?	R	Go to Step 10	Go to Step 6
10	1. Turn the ignition switch to ON. 2. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the right front sensor harness connector. Was voltage within the specified value at each terminal?	2.25-2.75v	Go to Step 11	Go to Step 18
11	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals A4 and B3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 12	Go to Step 15
12	Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 13	Go to Step 14
13	Repair the connection. Is the repair complete?	-	System OK	-
14	Replace the EBCM. Is the repair complete?	-	System OK	-
15	Check for an internal short between circuits BRN and DK GRN. Is there a short?	-	Go to Step 16	Go to Step 17
16	Repair the short between circuits BRN and DK GRN. Is the repair complete?	-	System OK	-
17	Replace the RF jumper harness. Is the repair complete?	-	System OK	-
18	Check the voltage at terminal B. Is the voltage outside of the specified value?	2.25-2.75 v	Go to Step 19	Go to Step 29
19	Check the voltage at terminal B. Is the voltage above the specified value?	2.75 v	Go to Step 20	Go to Step 23
20	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal B3 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 21	Go to Step 22
21	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-

DTC A026 – Right Front Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
22	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-
23	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal B on the right front wheel speed sensor harness connector and terminal B3 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 25	Go to Step 24
24	Repair the open or high resistance in circuit BRN. Is the repair complete?	-	System OK	-
25	Use a DVM to measure the resistance between ground and terminal A4, then terminal B3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 27	Go to Step 26
26	Repair the short to ground in circuits DK GRN and BRN. Is the repair complete?	-	System OK	-
27	1. Inspect the EBCM connector J1 for a poor connection. 2. Repair any bad connections found. 3. Reconnect all connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the specified value?	8 km/h (5 mph)	System OK	Go to Step 28
28	Replace the EBCM. Is the repair complete?	-	System OK	-
29	Check the voltage at terminal A. Is the voltage above the specified value?	2.75 v	Go to Step 30	Go to Step 33
30	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A4 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 31	Go to Step 32
31	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
32	Repair the short to voltage in circuit DK GRN. Is the repair complete?	-	System OK	-
33	1. Turn ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal A, the wheel speed sensor harness connector, and terminal A4 of the EBCM harness connector J1. Does the DVM display less than the specified value?	2 W	Go to Step 25	Go to Step 34
34	Repair the open or high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A027
LEFT REAR EXCESSIVE WHEEL SPEED VARIATION

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring(often referred to as the air gap).

Diagnosis

This test detects a situation in which the left rear wheel speed changes more than 19 km/h (12 mph) in 8 milliseconds. This change must occur five times with less than 0.2 second between occurrences. This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- A sensor is loose.
- There are worn suspension/drivetrain components.
- There is an intermittent short in the wheel speed input wires.
- The sensor is physically damaged.
- The wheel speed ring is damaged.
- A connector is damaged.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This test checks to see if excessive wheel bearing end play caused the DTC.
4. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
5. This test checks the wheel speed sensor for the proper resistance values.
7. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
8. This step ensures the wheel speed sensor is not shorted to ground.
9. This step checks for proper voltages at the speed sensor harness connector.
10. This test ensures that the wheel speed sensor circuitry is not internally shorted.
22. This checks for an open in circuit BLK.
24. This checks for a short to ground in both wheel speed signal circuits.
26. This step ensures that DTC A027 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
32. This checks for an open in circuit RED.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and the harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and jumper harness as necessary.

It is difficult to measure the resistance and the voltage at the terminals of the wheel speed sensor due to sensor mounting location and position. Terminals at the other end of the jumper harness are much more accessible. The rear wheel speed sensor jumper harnesses are connected to the system through connector C902, which is clipped to the vehicle near the right rear wheel. It connects to the floor harness, which passes through a grommet near that point. The clamp securing it to the vehicle is removed easily by pinching the tabs together and pushing up on the clamp. It is easier to handle the connector and take measurements if you free the connector from the axle first. Refer to "Rear Wheel Speed Sensor Jumper Harness" in this section for illustrations.

After you unplug the jumper harness from the floor harness at C902, stand toward the rear of the car. Rotate the connector so you are looking at the open end, and you will see it as it appears in the sketch at the top of this procedure. It will then be easy to make the necessary measurements.

The jumper harnesses for both rear wheels are bound together at this connector and are replaced as a single assembly, not as separate right or left jumper harnesses.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A027 – Left Rear Excessive Wheel Speed Variation

Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the left rear wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variance within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	Remove the left rear tire and measure the bearing end play. Does the end play exceed the specified value?	0.5 mm (0.02 in.)	Go to Step 3	Go to Step 4
3	Replace the rear wheel hub assembly. Is the repair complete?	-	System OK	-
4	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Jumper harness • Wiring • Connectors Is any physical damage indicated?	-	Go to Step 6	Go to Step 5

DTC A027 – Left Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the rear jumper harness assembly from the floor harness at connector C902. 2. Use a digital voltmeter (DVM) to measure the resistance between terminals 1 and 3 on connector C902. Is the resistance within the specified value when the sensor is approximately 20°C (68°F)?	989-1185 W	Go to Step 7	Go to Step 3
6	Correct any physical damage. Is the repair complete?	-	System OK	-
7	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage while spinning the wheel by hand. Voltage will increase as wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 8	Go to Step 3
8	Use the DVM to measure the resistance between terminal 1 of connector C902 and ground. Does the DVM display the specified value?	R	Go to Step 9	Go to Step 3
9	1. Reconnect the rear wheel speed sensor jumper harness to connector C902. 2. Unplug the jumper harness connector from the left rear wheel speed sensor. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the left rear sensor harness connector. Is the voltage within the specified value at each terminal?	2.25-2.75 v	Go to Step 10	Go to Step 17
10	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B2 and A3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 11	Go to Step 14
11	Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 12	Go to Step 13
12	Repair the connection. Is the repair complete?	-	System OK	-
13	Replace the EBCM. Is the repair complete?	-	System OK	-
14	Check for an internal short between circuits BLK and RED. Is there a short?	-	Go to Step 15	Go to Step 16
15	Repair the short between circuits BLK and RED. Is the repair complete?	-	System OK	-
16	Replace the rear jumper harness. Is the repair complete?	-	System OK	-
17	Check the voltage at terminal A. Is the voltage outside of the specified value?	2.25-2.75 v	Go to Step 18	Go to Step 28

DTC A027 – Left Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
18	Check the voltage at terminal A. Is the voltage above the specified value?	2.75 v	Go to Step 19	Go to Step 22
19	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A3 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 20	Go to Step 21
20	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
21	Repair the short to voltage in circuit BLK. Is the repair complete?	-	System OK	-
22	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal A on the left rear wheel speed sensor harness connector and terminal A3 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 24	Go to Step 23
23	Check terminal 3 of the jumper harness connector C902 for a poor connection. Was a poor connection found?	-	Go to Step 35	Go to Step 36
24	Use a DVM to measure the resistance between ground and terminal B2, then terminal A3 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 26	Go to Step 25
25	Repair the short to ground in circuits BLK and RED. Is the repair complete?	-	System OK	-
26	1. Inspect the EBCM connector J1 for a poor connection. 2. Repair any faulty connection found. 3. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variance within the specified value?	8 km/h (5 mph)	System OK	Go to Step 27
27	Replace the EBCM. Is the repair complete?	-	System OK	-
28	Check the voltage at terminal B. Is the voltage above the specified value?	2.75 v	Go to Step 29	Go to Step 32
29	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal B2 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 30	Go to Step 31
30	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-

DTC A027 – Left Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
31	Repair the short to voltage in circuit RED. Is the repair complete?	-	System OK	-
32	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal B, the wheel speed sensor harness connector, and terminal B2 of the EBCM harness connector J1. Does the DVM display less than the specified value?	2 W	Go to Step 24	Go to Step 33
33	Check terminal 3 of the jumper harness connector C902 for a poor connection. Is a poor connection found?	-	Go to Step 34	Go to Step 37
34	Repair terminal 3 of the jumper harness connector C902. Is the repair complete?	-	System OK	-
35	Repair terminal 1 of the jumper harness connector C902. Is the repair complete?	-	System OK	-
36	Repair the open or high resistance in circuit BLK. Is the repair complete?	-	System OK	-
37	Repair the open or high resistance in circuit RED. Is the repair complete?	-	System OK	-

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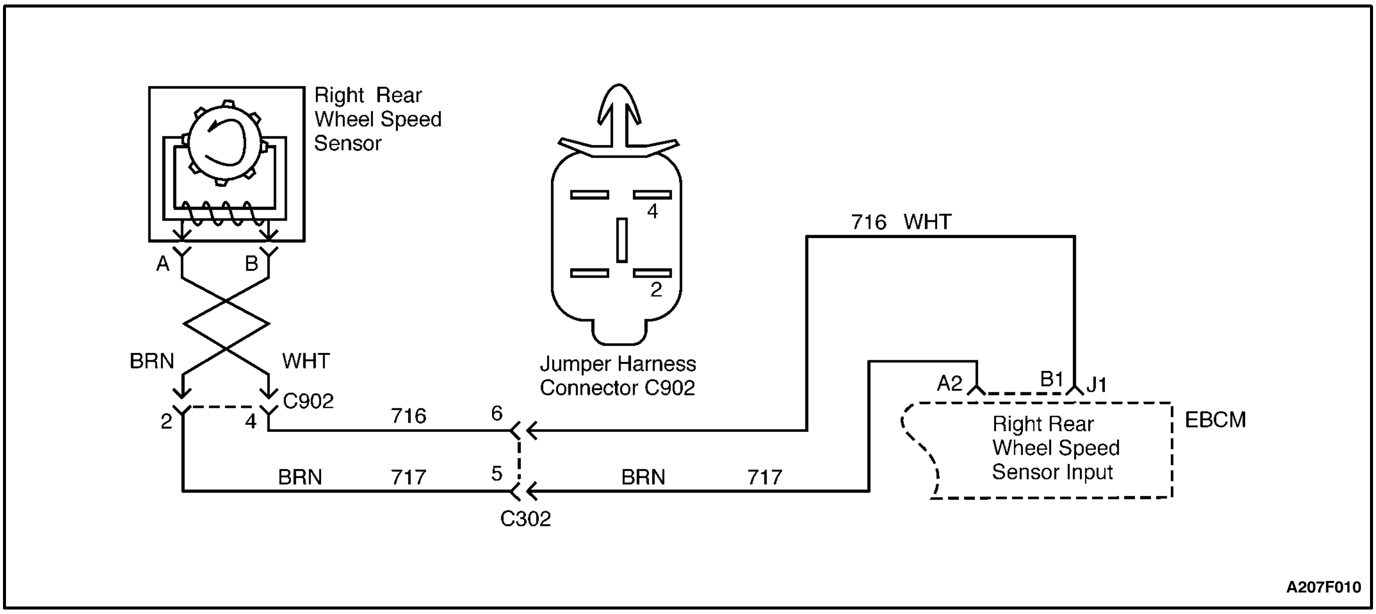

DIAGNOSTIC TROUBLE CODE (DTC) A028 RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring (often referred to as the air gap).

Diagnosis

This test detects a situation in which the right rear wheel speed changes more than 19 km/h (12 mph) in 8 milliseconds. This change must occur five times with less than 0.2 second between occurrences. This test will not fail if any wheel speed hardware faults (codes A032-A035) have already failed.

Cause(s)

- A sensor is loose.
- There are worn suspension/drivetrain components.
- There is an intermittent short in the wheel speed input wires.
- The sensor is physically damaged.
- The wheel speed ring is damaged.
- A connector is damaged.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test verifies whether the malfunction is currently present.
2. This test checks to see if excessive wheel bearing end play caused the DTC.
4. This step will identify a wheel speed sensor or circuitry that is damaged and visibly apparent.
5. This test checks the wheel speed sensor for the proper resistance values.
7. This test ensures the wheel speed sensor and the sensor ring generate the proper voltage.
8. This step ensures the wheel speed sensor is not shorted to ground.
9. This step checks for proper voltages at the speed sensor harness connector.
10. This test ensures that the wheel speed sensor circuitry is not internally shorted.
22. This checks for an open in circuit BRN.
24. This checks for a short to ground in both wheel speed signal circuits.
26. This step ensures that DTC A028 was not set due to a poor connection between the EBCM and the EBCM harness connector J1.
32. This checks for an open in circuit WHT.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS indicator is on only during moist environmental changes (rain, snow, vehicle wash, etc.), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. Use the following procedure:

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Start the vehicle and allow it to run for 10 seconds.
3. If the DTC returns immediately, replace the suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

When measuring wheel speed sensor resistance, ensure that the vehicle is at room temperature (approximately 20°C [68°F]). Wheel speed sensor resistance will vary with temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor and the jumper harness as necessary.

It is difficult to measure the resistance and the voltage at the terminals of the wheel speed sensor due to sensor mounting location and position. Terminals at the other end of the jumper harness are much more accessible. The rear wheel speed sensor jumper harnesses are connected to the system through connector C902, which is clipped to the vehicle near the right rear wheel. It connects to the floor harness, which passes through a grommet near that point. The clamp securing it to the vehicle is removed easily by pinching the tabs together and pushing up on the clamp. It is easier to handle the connector and take measurements if you free the connector from the axle first. Refer to "Rear Wheel Speed Sensor Jumper Harness" for illustrations.

After you unplug the jumper harness from the floor harness at C902, stand toward the rear of the car. Rotate the connector so you are looking at the open end, and you will see it as it appears in the sketch at the top of this procedure. It will then be easy to make the necessary measurements.

The jumper harnesses for both rear wheels are bound together at this connector and are replaced as a single assembly, not as separate right or left jumper harnesses.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections prior to an indicated step of this chart. This will insure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A028 – Right Rear Excessive Wheel Speed Variation

Step	Action	Value(s)	Yes	No
1	1. Test drive the vehicle. 2. Select "Data List" on the scan tool. 3. Monitor the wheel speed on the right rear wheel while decelerating slowly from 56 km/h (35 mph) to 0. Is the result normal, with no DTCs and the wheel speed variation within the specified value?	8 km/h (5 mph)	Go to "Diagnostic Aids"	Go to Step 2
2	Remove the right rear tire and measure the bearing end play. Does the end play exceed the specified value?	0.5 mm (0.02 in.)	Go to Step 3	Go to Step 4
3	Replace the rear wheel hub assembly. Is the repair complete?	-	System OK	-
4	1. Turn the ignition switch to LOCK. 2. Physically inspect the following components for damage: • Wheel speed sensor • Jumper harness • Wiring • Connectors Is any physical damage indicated?	-	Go to Step 6	Go to Step 5

DTC A028 – Right Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the rear jumper harness assembly from the floor harness at connector C902. 2. Use a digital voltmeter (DVM) to measure resistance between terminals 2 and 4 on connector C902 of the sensor. Is resistance within the specified value when the sensor is approximately 20°C (68°F)?	989-1185 W	Go to Step 7	Go to Step 3
6	Correct any physical damage. Is the repair complete?	-	System OK	-
7	1. Select the A/C voltage scale on the DVM. 2. Monitor the voltage while spinning the wheel by hand. Voltage will increase as wheel speed increases. Is the voltage above the specified value?	100 mv	Go to Step 8	Go to Step 3
8	Use the DVM to measure the resistance between terminal 2 of connector C902 and ground. Does the DVM display the specified value?	R	Go to Step 9	Go to Step 3
9	1. Reconnect the rear wheel speed sensor jumper harness to connector C902. 2. Unplug the jumper harness connector from the right rear wheel speed sensor. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal A, then terminal B of the right rear sensor harness connector. Is the voltage within the specified value?	2.25-2.75 v	Go to Step 10	Go to Step 17
10	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminals B1 and A2 of the EBCM harness connector J1. Does the DVM display the specified value?	R	Go to Step 11	Go to Step 14
11	Inspect the EBCM connector J1 for a poor connection. Is a poor connection found?	-	Go to Step 12	Go to Step 13
12	Repair the connection. Is the repair complete?	-	System OK	-
13	Replace the EBCM. Is the repair complete?	-	System OK	-
14	Check for an internal short between circuits BRN and WHT. Is there a short?	-	Go to Step 15	Go to Step 16
15	Repair the short between circuits BRN and WHT. Is the repair complete?	-	System OK	-
16	Replace the rear jumper harness. Is the repair complete?	-	System OK	-
17	Check the voltage at terminal A. Is the voltage outside of the specified value?	2.25-2.75 v	Go to Step 18	Go to Step 28

DTC A028 – Right Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
18	Check the voltage at terminal A. Is the voltage above the specified value?	2.75 v	Go to Step 19	Go to Step 22
19	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect a DVM to ground and measure the voltage at terminal A2 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 20	Go to Step 21
20	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
21	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-
22	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use a DVM to measure the resistance between terminal A on the right rear wheel speed sensor harness connector and terminal A2 of the EBCM harness connector J1. Is the resistance below the specified value?	2 W	Go to Step 24	Go to Step 23
23	Check terminal 4 of the jumper harness connector C902 for a poor connection. Was a poor connection found?	-	Go to Step 35	Go to Step 36
24	Use a DVM to measure the resistance between ground and terminal B1, then terminal A2 of the EBCM harness connector J1. Does the DVM display the specified resistance?	R	Go to Step 26	Go to Step 25
25	Repair the short to ground in circuits BRN and WHT. Is the repair complete?	-	System OK	-
26	1. Inspect the EBCM connector J1 for a poor connection. 2. Repair any faulty connection found. 3. Reconnect all of the connections and repeat the test from Step 1. Is the result normal, with no DTCs, and the wheel speed variation within the specified value?	8 km/h (5 mph)	System OK	Go to Step 27
27	Replace the EBCM. Is the repair complete?	-	System OK	-
28	Check the voltage at terminal B. Is the voltage at terminal B above the maximum value specified?	2.75 v	Go to Step 29	Go to Step 32
29	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. 4. Connect the DVM to ground and measure the voltage at terminal B1 of the EBCM harness connector J1. Is the voltage below the specified value?	1 v	Go to Step 30	Go to Step 31
30	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-

DTC A028 – Right Rear Excessive Wheel Speed Variation (Cont'd)

Step	Action	Value(s)	Yes	No
31	Repair the short to voltage in circuit WHT. Is the repair complete?	-	System OK	-
32	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Use the DVM to measure the resistance between terminal B of the wheel speed sensor harness connector and terminal B1 of the EBCM harness connector J1. Does the DVM display less than the specified value?	2 W	Go to Step 24	Go to Step 33
33	Check the jumper harness connector terminal 4 for a poor connection. Is a poor connection found?	-	Go to Step 34	Go to Step 37
34	Repair the jumper harness connector terminal 4. Is the repair complete?	-	System OK	-
35	Repair the jumper harness connector terminal 2. Is the repair complete?	-	System OK	-
36	Repair the open or high resistance in circuit BRN. Is the repair complete?	-	System OK	-
37	Repair the open or high resistance in circuit WHT. Is the repair complete?	-	System OK	-

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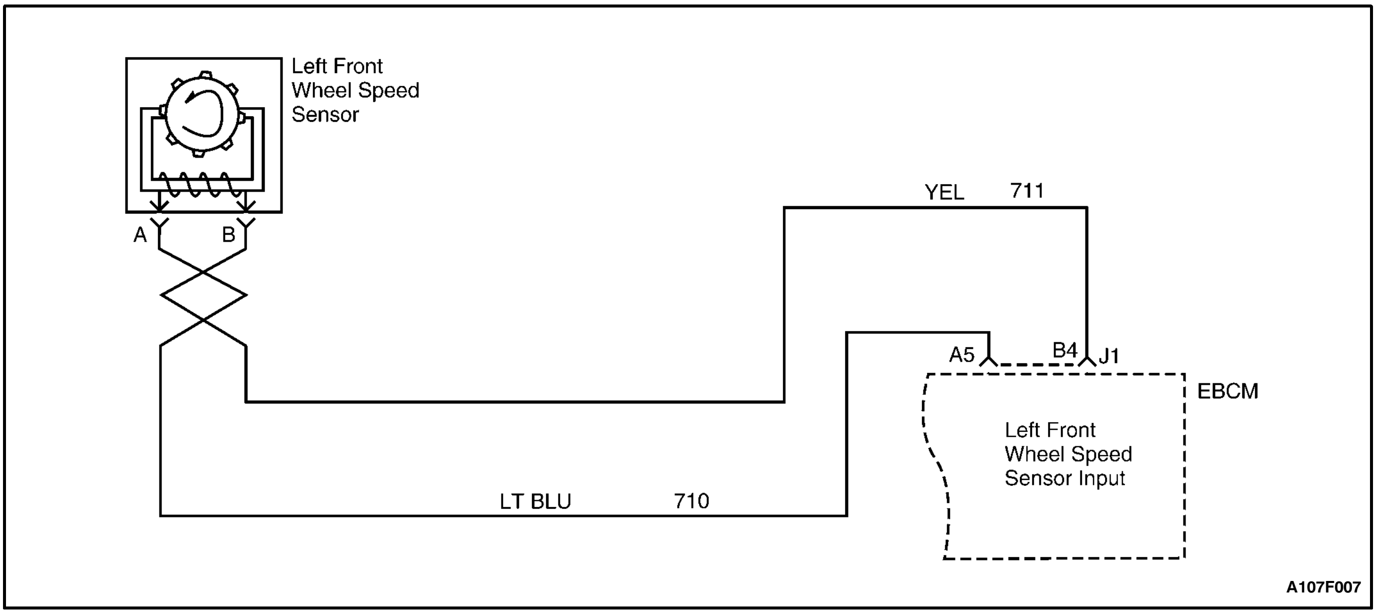


DIAGNOSTIC TROUBLE CODE (DTC) A032 LEFT FRONT SPEED SENSOR CIRCUIT OPEN OR SHORTED TO GROUND OR BATTERY

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

Diagnosis

This test detects a short to battery, ground, or open in the left front wheel speed sensor circuit.

Cause(s)

- The wheel speed circuit is shorted to the battery or ground.
- There is a loose connection in the wheel speed circuit.
- The wheel speed sensor resistance is very high.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Ensures that the malfunction was not due to physical damage of the circuitry.
8. Checks for a short to voltage in circuit LT BLU.
10. Checks for a short to voltage in circuit YEL.
13. Checks for high resistance in circuit LT BLU.
15. Checks for high resistance in circuit YEL.
17. Verifies proper wheel speed sensor resistance.
20. Checks for a short to ground in circuit YEL.
22. Checks for a short to ground in circuit LT BLU.
24. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids

An “intermittent” malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool, as described in “Scan Tool Diagnostics.”

If the customer’s comments reflect that the ABS warning lamp is ON only during moist environmental changes (rain, snow, vehicle wash), inspect all wheel speed sensor circuitry thoroughly for signs or water intrusion. If the DTC is not current, clear the DTCs and simulate the effects of water intrusion. Use the following procedure.

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [2 teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds.
3. If the DTC returns, replace the suspected harness.

Thoroughly check any circuitry suspected of causing the intermittent complaint. Look for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections, or physical damage to the wiring harness.

Wheel speed sensor resistance will increase as the sensor temperature increases.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor harness. If replacing a wheel speed sensor harness, inspect the sensor terminals. If you find evidence of corrosion or water intrusion, replace the wheel speed sensor. Refer to "Front Wheel Speed Sensor" in this section.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections before performing an indicated step of this table. That will ensure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A032 – Left Front Speed Sensor Circuit Open or Shorted

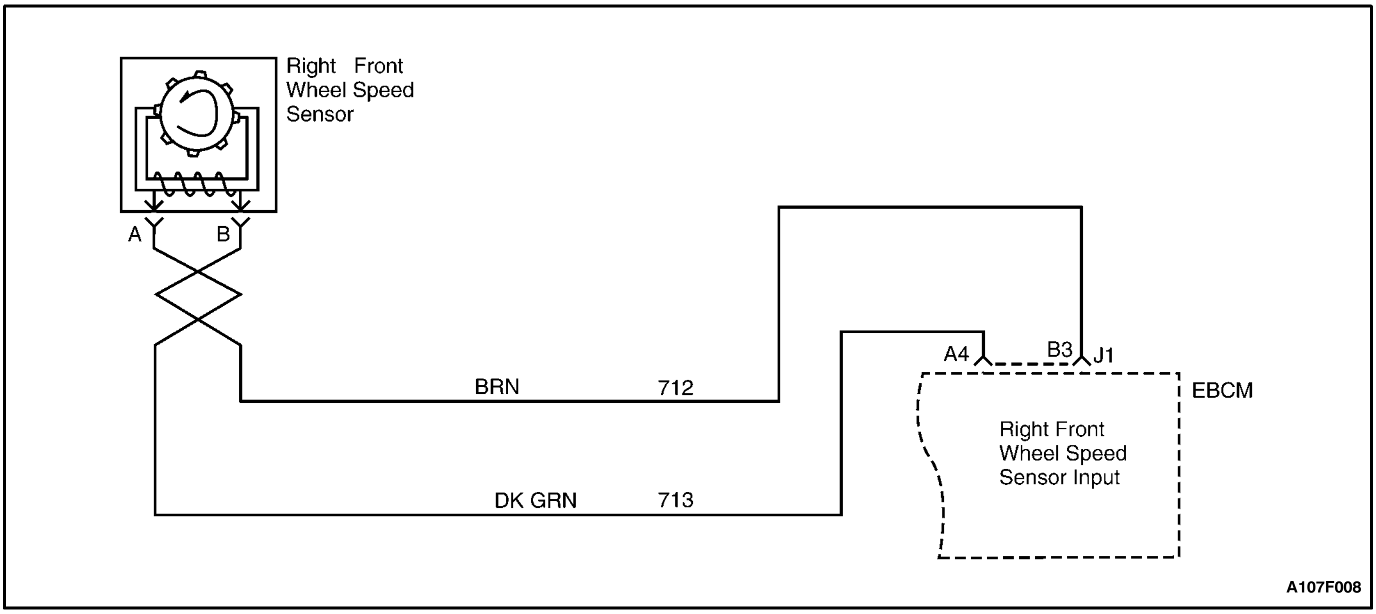
Step	Action	Value(s)	Yes	No
1	1. Turn the ignition to LOCK. 2. Thoroughly spray the speed sensor harness at the left front wheel with a 5% salt water solution. 3. Disconnect the connector J1. 4. Use a digital voltmeter (DVM) to measure the resistance between terminals A5 and B4 of connector J1 on the EBCM harness. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	969-1185 W	Go to Step 2	Go to Step 13
2	Measure the resistance between ground and terminal B4 of the EBCM harness connector J1. Does the DVM show the specified resistance?	R	Go to Step 3	Go to Step 20
3	1. Turn the ignition ON. 2. Use a DVM to measure the voltage between ground and terminal A5 of EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 4	Go to Step 8
4	1. Turn the ignition to LOCK. 2. Inspect terminals A5 and B4 of the EBCM harness connector J1 for poor terminal contact and contamination. Also inspect circuits YEL and LT BLU for damage which may result in an open circuit, a short to ground, or a short to voltage. Did you find any damage?	-	Go to Step 5	Go to Step 6
5	1. Repair the damage as required. 2. Reconnect all of the connectors. 3. Turn the ignition ON. Does DTC A032 set as a current DTC?	-	Go to Step 7	System OK
6	1. Reconnect all of the connectors. 2. Turn the ignition ON. Does DTC A032 set as a current DTC?	-	Go to Step 7	Go to "Diagnostic Aids"
7	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A032 – Left Front Speed Sensor Circuit Open or Shorted (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition to LOCK. 2. Disconnect the harness from the left front wheel speed sensor. 3. Turn the ignition ON. 4. Use a DVM to measure the voltage between ground and terminal A5 of the EBCM harness connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 9	Go to Step 10
9	Repair the short to voltage in circuit LT BLU. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the voltage between ground and terminal B4 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 11	Go to Step 12
11	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
12	Repair the short to voltage in circuit YEL. Is the repair complete?	-	System OK	-
13	1. Disconnect the harness from the left front wheel speed sensor. 2. Use the DVM to measure the resistance between terminal A5 of the EBCM harness connector J1, and terminal A of the left front wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 15	Go to Step 14
14	1. Repair the high resistance in circuit LT BLU. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
15	Use a DVM to measure the resistance between terminal B4 of the EBCM harness connector J1, and terminal B of the lest front wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 17	Go to Step 16
16	1. Repair the high resistance in circuit YEL. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
17	Use a DVM to measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	969-1185 W	Go to Step 18	Go to Step 19

DTC A032 – Left Front Speed Sensor Circuit Open or Shorted (Cont'd)

Step	Action	Value(s)	Yes	No
18	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. 4. Refer to "Diagnostic Aids" for more information. Is the repair complete?	-	System OK	-
19	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
20	1. Disconnect the EBCM harness from the left front wheel speed sensor. 2. Use a DVM to measure the resistance between ground and terminal B4 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 22	Go to Step 21
21	Repair the short to ground in circuit YEL. Is the repair complete?	-	System OK	-
22	Use a DVM to measure the resistance between ground and terminal A5 of the EBCM connector J1. Does the DVM show the specified value?	R	Go to Step 24	Go to Step 23
23	Repair the short to ground in circuit LT BLU. Is the repair complete?	-	System OK	-
24	Use a DVM to measure the resistance between ground and terminal A of the left front wheel speed sensor. Does the DVM show the specified value?	R	Go to Step 25	Go to Step 26
25	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
26	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A033
RIGHT FRONT SPEED SENSOR CIRCUIT OPEN OR SHORTED TO GROUND OR BATTERY

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

Diagnosis

This test detects a short to battery, ground, or open in the right front wheel speed sensor circuit.

Cause(s)

- The wheel speed circuit is shorted to the battery or ground.
- There is a loose connection in the wheel speed circuit.
- The wheel speed sensor resistance is very high.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The EBCM commands a rehome to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Ensures that the malfunction was not due to physical damage of the circuitry.
8. Checks for a short to voltage in circuit DK GRN.
10. Checks for a short to voltage in circuit BRN.
13. Checks for high resistance in circuit DK GRN.
15. Checks for high resistance in circuit BRN.
17. Verifies proper wheel speed sensor resistance.
20. Checks for a short to ground in circuit BRN.
22. Checks for a short to ground in circuit DK GRN.
24. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool, as described in "Scan Tool Diagnostics" found in this section.

If the customer's comments reflect that the ABS warning lamp is ON only during moist environmental changes (rain, snow, vehicle wash), inspect all wheel speed sensor circuitry thoroughly for signs or water intrusion. If the DTC is not current, clear the DTCs and simulate the effects of water intrusion. Use the following procedure.

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [two teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds.
3. If the DTC returns, replace the suspected harness.

Thoroughly check any circuitry suspected of causing the intermittent complaint. Look for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections, or physical damage to the wiring harness.

Wheel speed sensor resistance will increase as the sensor temperature increases.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/ or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor harness. If replacing a wheel speed sensor harness, inspect the sensor terminals. If you find evidence of corrosion or water intrusion, replace the wheel speed sensor. Refer to "Front Wheel Speed Sensor" in this section.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections before performing an indicated step of this table. That will ensure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A033 – Right Front Speed Sensor Circuit Open or Shorted to Ground or Battery

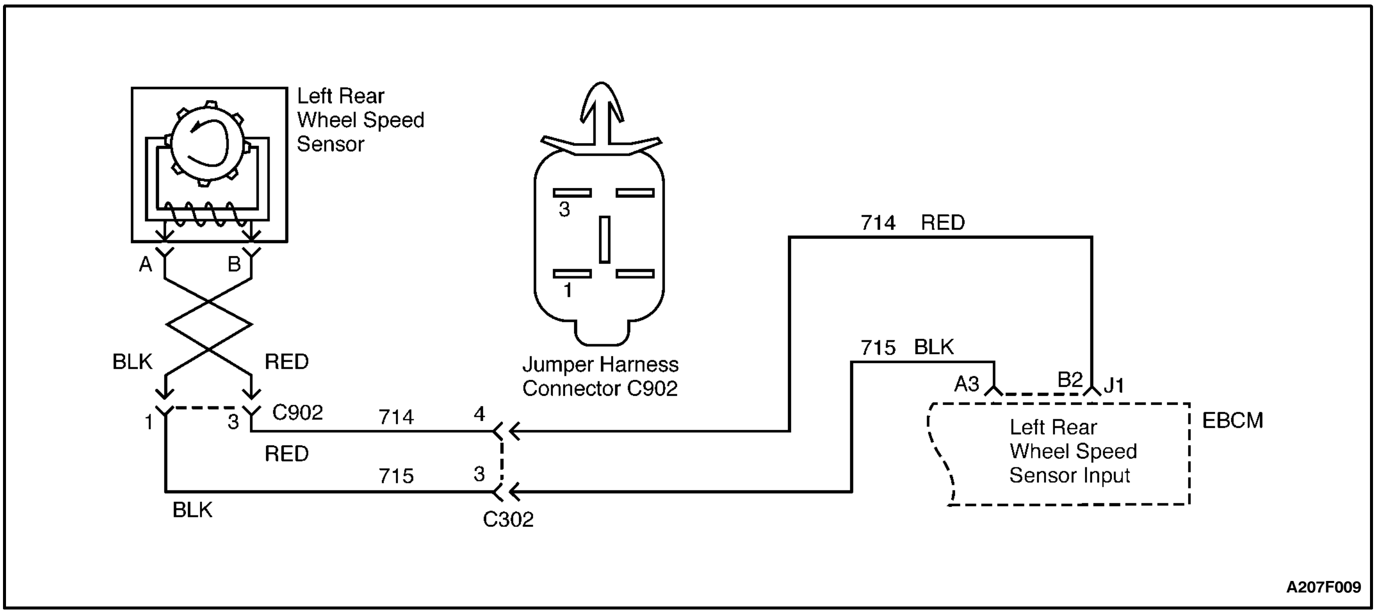
Step	Action	Value(s)	Yes	No
1	1. Turn the ignition to LOCK. 2. Thoroughly spray the speed sensor harness at the right front wheel with a 5% salt water solution. 3. Disconnect connector J1. 4. Use a digital voltmeter (DVM) to measure the resistance between terminals A4 and B3 of connector J1 on the EBCM harness. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	969-1185 W	Go to Step 2	Go to Step 13
2	Measure the resistance between ground and terminal B3 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 20
3	1. Turn the ignition ON. 2. Use a DVM to measure the voltage between ground and terminal A4 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 4	Go to Step 8
4	1. Turn the ignition to LOCK. 2. Inspect terminals A4 and B3 of the EBCM harness connector J1 for a poor terminal contact and contamination. Also inspect circuits DK GRN and BRN for damage which may result in an open circuit, short to ground, or short to voltage. Did you find any damage?	-	Go to Step 5	Go to Step 6
5	1. Repair the damage as required. 2. Reconnect all of the connectors. 3. Turn the ignition ON. Does DTC A032 set as a current DTC?	-	Go to Step 7	System OK
6	1. Reconnect all of the connectors. 2. Turn the ignition ON. Does DTC A033 set as a current DTC?	-	Go to Step 7	Go to "Diagnostic Aids"
7	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A033 – Right Front Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition to LOCK. 2. Disconnect the harness from the right front wheel speed sensor. 3. Turn the ignition ON. 4. Use a DVM to measure the voltage between ground and terminal A4 of the EBCM harness connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 9	Go to Step 10
9	Repair the short to voltage in circuit DK GRN. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the voltage between ground and terminal B3 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 11	Go to Step 12
11	1. This is an intermittent malfunction. 2. Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
12	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-
13	1. Disconnect the harness from the right front wheel speed sensor. 2. Use the DVM to measure the resistance between terminal A4 of the EBCM harness connector J1, and terminal A of the right front wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 15	Go to Step 14
14	1. Repair the high resistance in circuit DK GRN. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
15	Use a DVM to measure the resistance between terminal B3 of the EBCM harness connector J1, and terminal B of the right front wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 17	Go to Step 16
16	1. Repair the high resistance in circuit BRN. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
17	Use a DVM to measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	1502-2103 W	Go to Step 18	Go to Step 19
18	1. This is an intermittent malfunction. 2. Inspect all connectors and harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-

DTC A033 – Right Front Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
19	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
20	1. Disconnect the EBCM harness from the right front wheel speed sensor. 2. Use a DVM to measure the resistance between ground and terminal B3 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 22	Go to Step 21
21	Repair the short to ground in circuit BRN. Is the repair complete?	-	System OK	-
22	Use a DVM to measure the resistance between ground and terminal A4 of the EBCM connector J1. Does the DVM show the specified resistance?	R	Go to Step 24	Go to Step 23
23	Repair the short to ground in circuit DK GRN. Is the repair complete?	-	System OK	-
24	Use the DVM to measure the resistance between ground and terminal A of the right front wheel speed sensor. Does the DVM show the specified value?	R	Go to Step 25	Go to Step 26
25	1. This is an intermittent malfunction. 2. Inspect all of the connectors and harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
26	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A034 LEFT REAR SPEED SENSOR CIRCUIT OPEN OR SHORTED TO GROUND OR BATTERY

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

Diagnosis

This test detects a short to battery, ground, or open in the left rear wheel speed sensor circuit.

Cause(s)

- The wheel speed circuit is shorted to the battery or ground.
- There is a loose connection in the wheel speed circuit.
- The wheel speed sensor resistance is very high.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The EBCM commands a rehome to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Ensures that the malfunction was not due to physical damage of the circuitry.
8. Checks for a short to voltage in circuit BLK.
10. Checks for a short to voltage in circuit RED.
13. Checks for high resistance in circuit BLK.
15. Checks for high resistance in circuit RED.
17. Verifies proper wheel speed sensor resistance.
20. Checks for a short to ground in circuit RED.
22. Checks for a short to ground in circuit BLK.

Important: Do not allow water to enter any wheel speed sensor connector.

24. Checks for a short to ground in the rear wheel speed sensor harness.
26. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool, as described in "Scan Tool Diagnostics" found in this section.

If the customer's comments reflect that the ABS warning lamp is ON only during moist environmental changes (rain, snow, vehicle wash), inspect all wheel speed sensor circuitry thoroughly for signs or water intrusion. If the DTC is not current, clear the DTCs and simulate the effects of water intrusion. Use the following procedure.

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [two teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds.
3. If the DTC returns, replace the suspected harness.

Thoroughly check any circuitry suspected of causing the intermittent complaint. Look for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections, or physical damage to the wiring harness.

Wheel speed sensor resistance will increase as the sensor temperature increases.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor harness. If replacing a wheel speed sensor harness, inspect the sensor terminals. If you find evidence of corrosion or water intrusion, replace the wheel speed sensor. Refer to "Rear Wheel Speed Sensor" in this section.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections before performing an indicated step of this table. That will ensure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A034 – Left Rear Speed Sensor Circuit Open or Shorted to Ground or Battery

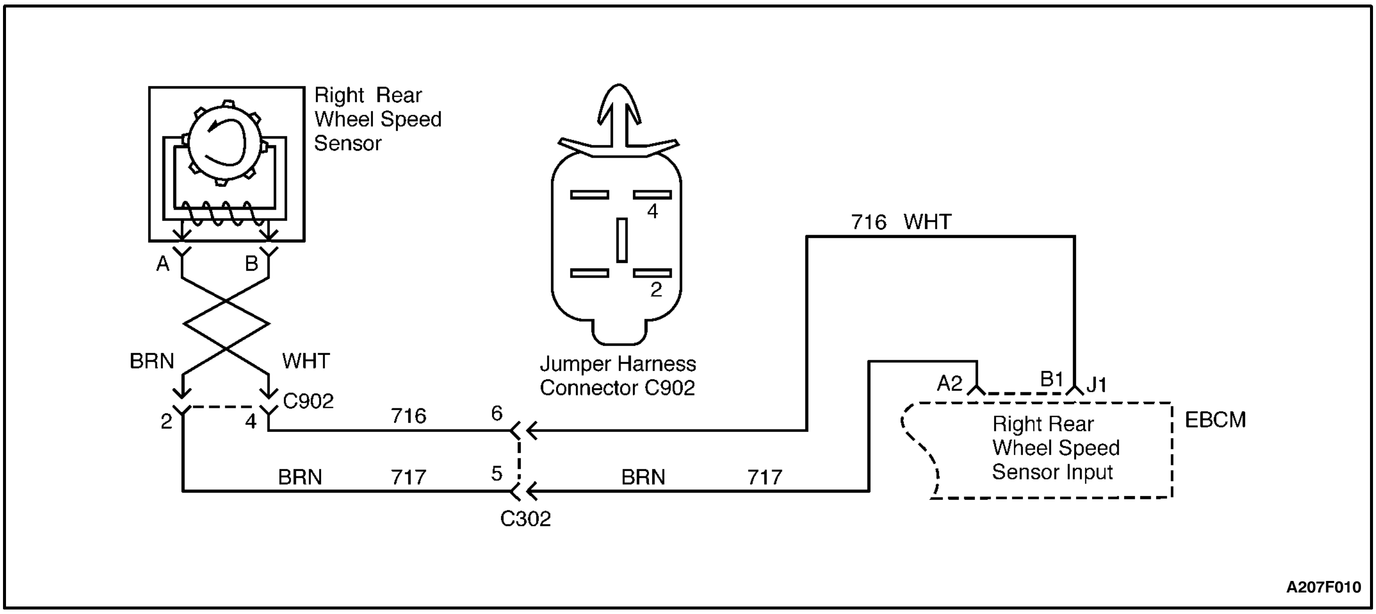
Step	Action	Value(s)	Yes	No
1	1. Turn the ignition to LOCK. 2. Thoroughly spray the speed sensor harness at the left rear wheel with a 5% salt water solution. 3. Disconnect connector J1. 4. Use a digital voltmeter (DVM) to measure the resistance between terminals A3 and B2 of connector J1 on the EBCM harness. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	969-1185 W	Go to Step 2	Go to Step 13
2	Measure the resistance between ground and terminal B2 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 20
3	1. Turn the ignition ON. 2. Use a DVM to measure the voltage between ground and terminal A3 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 4	Go to Step 8
4	1. Turn the ignition to LOCK. 2. Inspect terminals A3 and B2 of the EBCM harness connector J1 for poor terminal contact and contamination. Also inspect circuits BLK and RED for damage which may result in an open circuit, short to ground, or short to voltage. Did you find any damage?	-	Go to Step 5	Go to Step 6
5	1. Repair the damage as required. 2. Reconnect all of the connectors. 3. Turn the ignition ON. Does DTC A032 set as a current DTC?	-	Go to Step 7	System OK
6	1. Reconnect all of the connectors. 2. Turn the ignition ON. Does DTC A034 set as a current DTC?	-	Go to Step 7	Go to "Diagnostic Aids"
7	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A034 - Left Rear Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition to LOCK. 2. Disconnect the harness from the left rear wheel speed sensor. 3. Turn the ignition ON. 4. Use a DVM to measure the voltage between ground and terminal A3 of the EBCM harness connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 9	Go to Step 10
9	Repair the short to voltage in circuit BLK. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the voltage between ground and terminal B2 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 11	Go to Step 12
11	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
12	Repair the short to voltage in circuit RED. Is the repair complete?	-	System OK	-
13	1. Disconnect the harness from the left rear wheel speed sensor. 2. Use the DVM to measure the resistance between terminal A3 of the EBCM harness connector J1, and terminal A of the left rear wheel speed sensor harness connector. Does the DVM show the specified value?	v 2 W	Go to Step 15	Go to Step 14
14	1. Repair the high resistance in circuit BLK. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
15	Use a DVM to measure the resistance between terminal B2 of the EBCM harness connector J1, and terminal B of the left rear wheel speed sensor harness connector. Does the DVM show the specified value?	v 2 W	Go to Step 17	Go to Step 16
16	1. Repair the high resistance in circuit RED. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
17	Use a DVM to measure the resistance between terminal A and terminal B of the left rear wheel speed sensor connector. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	1930-2566 W	Go to Step 18	Go to Step 19
18	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-

DTC A034 – Left Rear Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
19	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
20	1. Disconnect the rear wheel speed sensor harness from the floor wiring harness at connector C902. This is a four-pin connector located under the car, on the right side, above the rear axle. 2. Use a DVM to measure the resistance between ground and terminal B2 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 22	Go to Step 21
21	Repair the short to ground in circuit RED between the EBCM and connector C902. Is the repair complete?	-	System OK	-
22	Use a DVM to measure the resistance between ground and terminal A3 of the EBCM connector J1. Does the DVM show the specified value?	R	Go to Step 24	Go to Step 23
23	Repair the short to ground in circuit BLK. Is the repair complete?	-	System OK	-
24	1. Thoroughly respray the left rear wheel speed sensor harness with the salt water solution. 2. Disconnect the left rear wheel speed sensor harness from the sensor. 3. Use the DVM to measure the resistance between ground and terminal A, then terminal B of the left rear wheel speed sensor harness. Does the DVM show the specified value?	R	Go to Step 26	Go to Step 25
25	Replace the rear wheel speed sensor harness. This harness serves both rear wheels. Is the repair complete?	-	System OK	-
26	Use a DVM to measure the resistance between ground and terminal A of the left rear wheel speed sensor. Does the DVM show the specified value?	R	Go to Step 27	Go to Step 28
27	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
28	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A035 RIGHT REAR SPEED SENSOR CIRCUIT OPEN OR SHORTED TO GROUND OR BATTERY

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 whose frequency is proportional to the wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

Diagnosis

This test detects a short to battery, ground, or open in the right rear wheel speed sensor circuit.

Cause(s)

- The wheel speed circuit is shorted to the battery or ground.
- There is a loose connection in the wheel speed circuit.
- The wheel speed sensor resistance is very high.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The EBCM commands a rehome to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Ensures that the malfunction was not due to physical damage of the circuitry.
8. Checks for a short to voltage in circuit BRN.
10. Checks for a short to voltage in circuit WHT.
13. Checks for high resistance in circuit BRN.
15. Checks for high resistance in circuit WHT.
17. Verifies proper wheel speed sensor resistance.
20. Checks for a short to ground in circuit WHT.
22. Checks for a short to ground in circuit BRN.

Important: Do not allow water to enter any wheel speed sensor connector.

24. Checks for a short to ground in the rear wheel speed sensor harness.
26. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool, as described in "Scan Tool Diagnostics."

If the customer's comments reflect that the ABS warning lamp is ON only during moist environmental changes (rain, snow, vehicle wash), inspect all wheel speed sensor circuitry thoroughly for signs or water intrusion. If the DTC is not current, clear the DTCs and simulate the effects of water intrusion. Use the following procedure.

1. Spray down the suspected area with a 5 percent salt water solution (10 ml [two teaspoons] of salt to 355 ml [12 fluid ounces] of water).
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds.
3. If the DTC returns, replace the suspected harness.

Thoroughly check any circuitry suspected of causing the intermittent complaint. Look for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections, or physical damage to the wiring harness.

Wheel speed sensor resistance will increase as the sensor temperature increases.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace the wheel speed sensor harness. If replacing a wheel speed sensor harness, inspect the sensor terminals. If you find evidence of corrosion or water intrusion, replace the wheel speed sensor. Refer to "Rear Wheel Speed Sensor" in this section.

Important: Wheel speed sensor intermittent malfunctions may be difficult to locate. Take care not to disturb any electrical connections before performing an indicated step of this table. That will ensure that an intermittent connection will not be corrected before the source of the malfunction is found.

DTC A035 – Right Rear Speed Sensor Circuit Open or Shorted to Ground or Battery

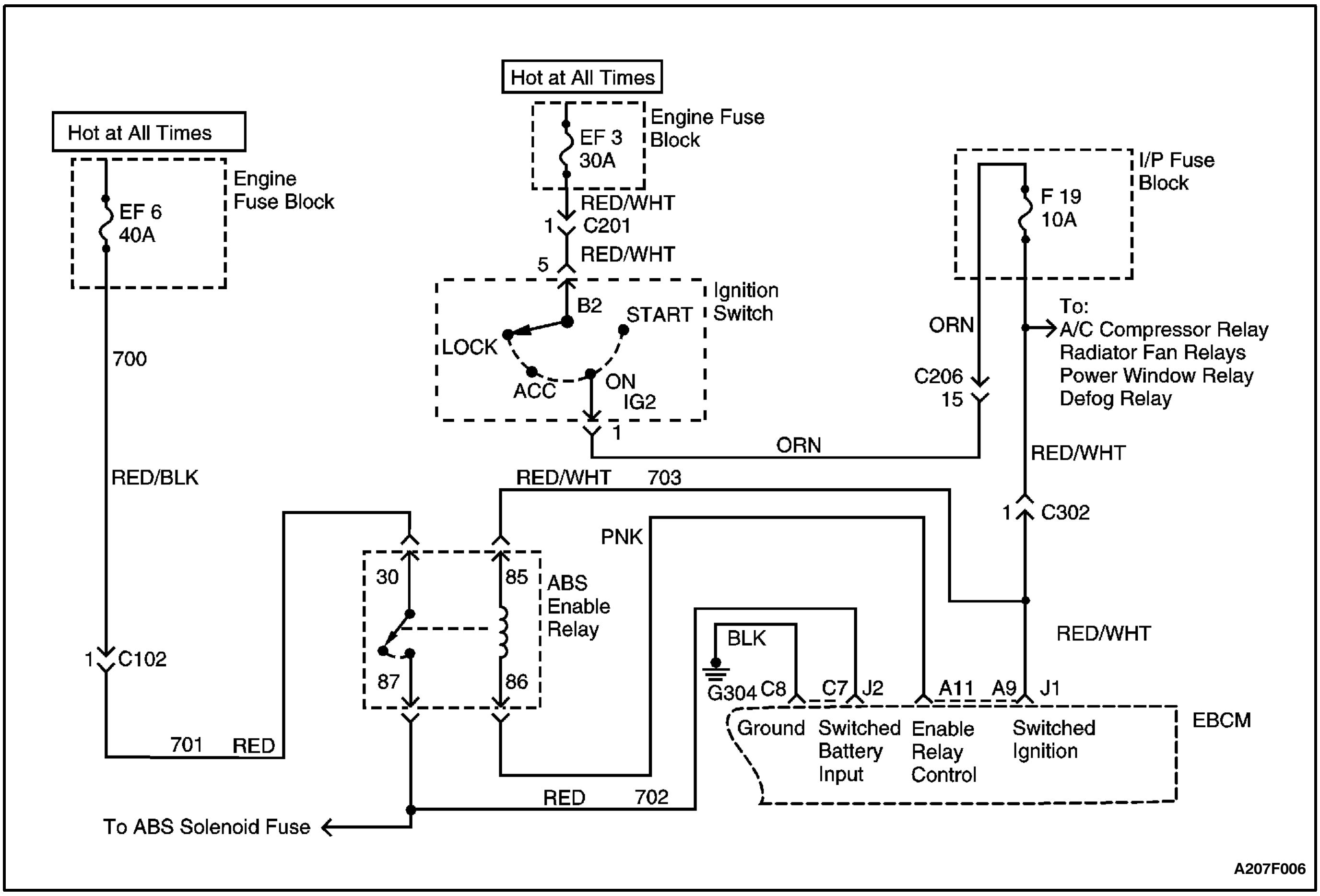
Step	Action	Value(s)	Yes	No
1	1. Turn the ignition to LOCK. 2. Thoroughly spray the speed sensor harness at the right rear wheel with a 5% salt water solution. 3. Disconnect connector J1. 4. Use a digital voltmeter (DVM) to measure the resistance between terminals A2 and B1 of connector J1 on the EBCM harness. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	969-1185 W	Go to Step 2	Go to Step 13
2	Measure the resistance between ground and terminal B1 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 20
3	1. Turn the ignition ON. 2. Use a DVM to measure the voltage between ground and terminal A2 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 4	Go to Step 8
4	1. Turn the ignition to LOCK. 2. Inspect terminals A2 and B1 of the EBCM harness connector J1 for poor terminal contact and contamination. Also inspect circuits BRN and WHT for damage which may result in an open circuit, short to ground, or short to voltage. Did you find any damage?	-	Go to Step 5	Go to Step 6
5	1. Repair the damage as required. 2. Reconnect all of the connectors. 3. Turn the ignition ON. Does DTC A032 set as a current DTC?	-	Go to Step 7	System OK
6	1. Reconnect all of the connectors. 2. Turn the ignition ON. Does DTC A034 set as a current DTC?	-	Go to Step 7	Go to "Diagnostic Aids"
7	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A035 - Right Rear Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition to LOCK. 2. Disconnect the harness from the right rear wheel speed sensor. 3. Turn the ignition ON. 4. Use a DVM to measure the voltage between ground and terminal A2 of the EBCM harness connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 9	Go to Step 10
9	Repair the short to voltage in circuit BRN. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the voltage between ground and terminal B1 of the EBCM connector J1. Is the voltage within the specified value?	v 1 v	Go to Step 11	Go to Step 12
11	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
12	Repair the short to voltage in circuit WHT. Is the repair complete?	-	System OK	-
13	1. Disconnect the harness from the right rear wheel speed sensor. 2. Use the DVM to measure the resistance between terminal A2 of the EBCM harness connector J1, and terminal A of the right rear wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 15	Go to Step 14
14	1. Repair the high resistance in circuit BRN. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
15	Use a DVM to measure the resistance between terminal B1 of the EBCM harness connector J1, and terminal B of the right rear wheel speed sensor harness connector. Is the resistance within the specified value?	v 2 W	Go to Step 17	Go to Step 16
16	1. Repair the high resistance in circuit WHT. 2. If the wheel speed sensor harness is damaged, replace it. Is the repair complete?	-	System OK	-
17	Use a DVM to measure the resistance between terminal A and terminal B of the right rear wheel speed sensor connector. Is the resistance within the specified value when the sensor temperature is 5-43°C (41-110°F)?	1930-2566 W	Go to Step 18	Go to Step 19
18	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-

DTC A035 – Right Rear Speed Sensor Circuit Open or Shorted to Ground or Battery (Cont'd)

Step	Action	Value(s)	Yes	No
19	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
20	1. Disconnect the rear wheel speed sensor harness from the floor wiring harness at connector C902. This is a four-pin connector located under the car, on the right side, above the rear axle. 2. Use a DVM to measure the resistance between ground and terminal B1 of EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 22	Go to Step 21
21	Repair the short to ground in circuit WHT between the EBCM and connector C902. Is the repair complete?	-	System OK	-
22	Use a DVM to measure the resistance between ground and terminal A2 of the EBCM connector J1. Does the DVM show the specified value?	R	Go to Step 24	Go to Step 23
23	Repair the short to ground in circuit BRN. Is the repair complete?	-	System OK	-
24	1. Thoroughly respray the right rear wheel speed sensor harness with the salt water solution. 2. Disconnect the right rear wheel speed sensor harness from the sensor. 3. Use the DVM to measure the resistance between ground and terminal A, then terminal B of the right rear wheel speed sensor harness. Does the DVM show the specified value?	R	Go to Step 26	Go to Step 25
25	Replace the rear wheel speed sensor harness. This harness serves both rear wheels. Is the repair complete?	-	System OK	-
26	Use a DVM to measure the resistance between ground and terminal A of the right rear wheel speed sensor. Does the DVM show the specified value?	R	Go to Step 27	Go to Step 28
27	1. This is an intermittent malfunction. 2. Inspect all of the connectors and the harnesses for damage which may result in a short to voltage when all components are connected. 3. Repair all damage found. Is the repair complete?	-	System OK	-
28	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A036
LOW SYSTEM VOLTAGE

Circuit Description

This DTC is used to monitor the voltage level available to the EBCM. If the voltage drops below 11 volts, full performance of the ABS cannot be guaranteed. During ABS operation, there are several current requirements that will cause battery voltage to drop. Because of this, the voltage is monitored prior to ABS operation to indicate good charging system condition. The voltage is also monitored during ABS operation when voltage may drop significantly.

Diagnosis

The system checks the switched battery and the ignition voltage level for less than 10.6 volts when not in ABS or less than 8.3 volts while in ABS for more than 720 milliseconds. Voltage calibrations are based on wiring harness specifications.

Cause(s)

- The vehicle charging system is not functioning well.
- There is high resistance in the ABS wiring harness.
- The vehicle battery is not performing well.

Fail Action

Low voltage prevents ABS operation. The ABS system is disabled and the ABS warning lamp is turned on. The brake warning lamp is turned on only if the rear piston is not at the top of the bore. This could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks to see what voltage is readily available at terminal C or EBCM harness connector J2. If the voltage is representative of good charging system condition, a malfunction is not present.
2. This step checks for a possible intermittent malfunction.
3. This step isolates the EBCM to check the condition of the circuitry and charging system.
4. This step checks for adequate voltage at the EBCM when a load is applied to the system.

8. This step isolates the low voltage condition to high circuit resistance or improper charging system operation.
13. This step isolates which circuit is the source of the low voltage condition.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A036 – Low System Voltage

Step	Action	Value(s)	Yes	No
1	1. Start the engine. 2. Select "Data List" on the scan tool and monitor the system voltage with the engine running. Is the voltage above the specified value?	11.4 v	Go to Step 2	Go to Step 3
2	Use the scan tool to perform the voltage load test. Are the ignition and battery voltages above the specified value?	10 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connectors J1 and J2. 3. Jumper terminal A11 of the EBCM harness connector J1 to ground. 4. Start the engine. 5. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal C7 of the EBCM harness connector J2. Is the voltage greater than the specified value?	11.4 v	Go to Step 4	Go to Step 8
4	1. Turn the ignition switch to LOCK. 2. Reconnect the EBCM connectors. 3. Turn the ignition switch to ON. 4. Connect a test light between ground and terminal C7 of the EBCM harness connector J2. (Backprobe terminal C7, being careful not to damage the terminal.) 5. Observe the test light while using the scan tool to perform the voltage load test. Does the test light turn on?	-	Go to Step 5	Go to Step 8
5	Check for a poor connection at terminal C7 of the EBCM connector J2. Is the connection in good condition?	-	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair the connection at terminal C7 of the EBCM connector J2. Is the repair complete?	-	System OK	-
8	1. Turn the ignition switch to LOCK. 2. Reconnect both EBCM connectors. 3. Start the engine. 4. Use the scan tool to perform the voltage load test. 5. Monitor the battery and the ignition voltage. Are both the ignition and the battery voltages below the specified value?	10 v	Go to Step 9	Go to Step 12

DTC A036 - Low System Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
9	Inspect the following connections for corrosion or poor contact: ● EBCM connector J1, terminal A11 ● EBCM connector J2, terminal C7 Are the connectors in good condition?	-	Go to Step 10	Go to Step 11
10	Correct the low voltage condition. Is the repair complete?	-	System OK	-
11	Repair any poor connection found. Is the repair complete?	-	System OK	-
12	Check the battery voltage. Is the battery voltage less than the specified value?	10 v	Go to Step 13	Go to Step 18
13	Use the DVM to measure the voltage between ground and terminal 2 of the ABS enable relay socket. Is the voltage above the specified value?	10 v	Go to Step 14	Go to Step 15
14	Repair the high resistance or the open in circuit RED from terminal 8 of the ABS relay socket to terminal C7 of the EBCM harness connector J2. Is the repair complete?	-	System OK	-
15	Check the system fuse, EF6. Is the fuse open?	-	Go to Step 16	Go to Step 17
16	Replace the system fuse, EF6. Is the repair complete?	-	System OK	-
17	Repair high resistance or open in circuit RED/BLK from the system fuse EF6 to the front harness connector C102 (one terminal), or circuit RED from the ECM and ABS harness connector C102 to the ABS relay socket terminal 2. Is the repair complete?	-	System OK	-
18	Repair the open or high resistance in circuit RED/WHT. Is the repair complete?	-	System OK	-

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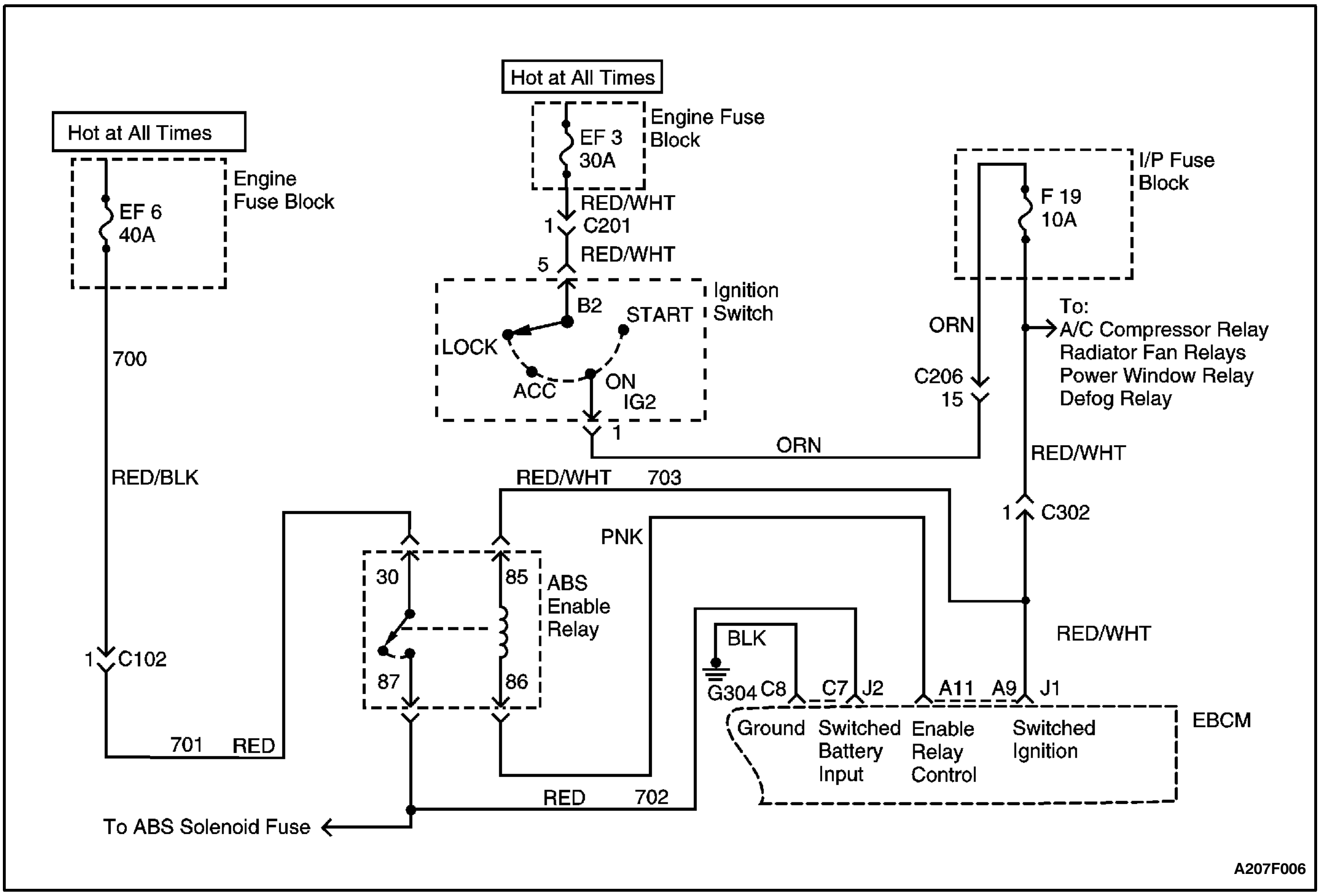


DIAGNOSTIC TROUBLE CODE (DTC) A037 HIGH SYSTEM VOLTAGE

Circuit Description

This DTC is designed to detect high vehicle voltage levels prior to any required motor movement (initialization or ABS operation). If excessive voltage exists, demagnetization of the motor magnets may occur, which would eventually affect or eliminate ABS performance.

Diagnosis

The system checks whether the switched battery voltage level is greater than 17 volts for 720 milliseconds.

Cause

- The vehicle charging system is not functioning well.

Fail Action

The ABS is deactivated to prevent damage to the EBCM motor circuit. The ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks the voltage level being received by the EBCM.
2. This step indicates whether the high voltage condition is caused by a malfunctioning charging system or by the EBCM.

Diagnostic Aids

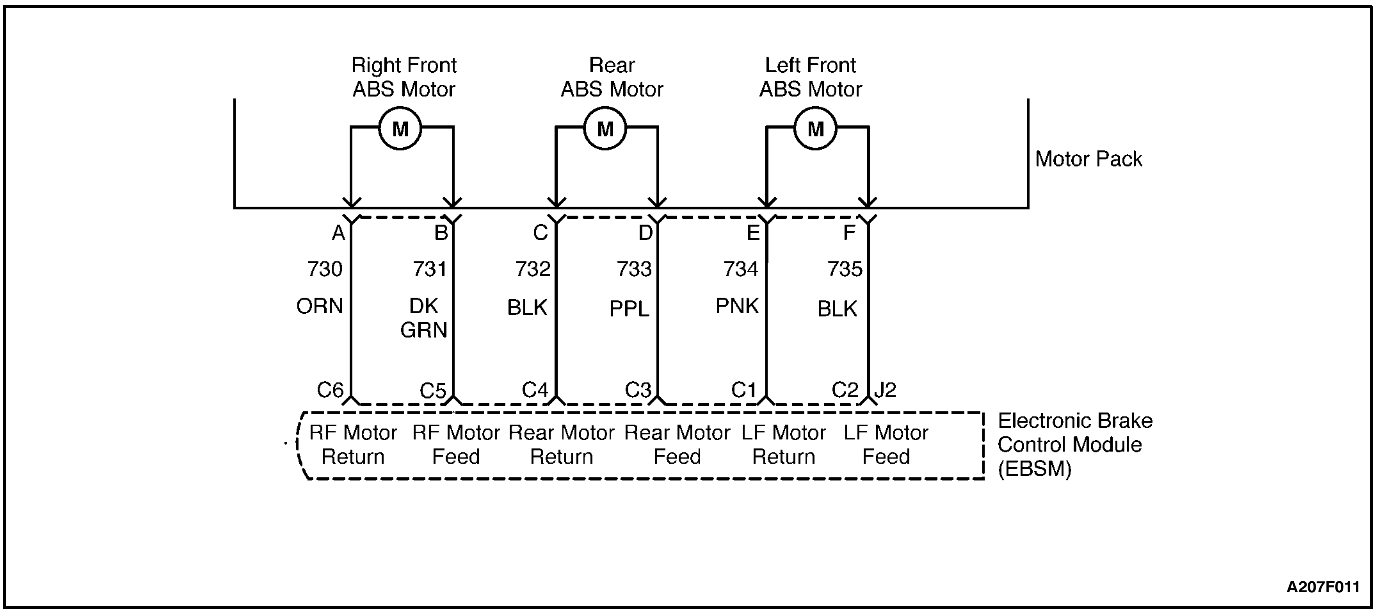
An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

DTC A037 – High System Voltage

Step	Action	Value(s)	Yes	No
1	1. Start the engine. 2. Select "Data List" on the scan tool and monitor the system voltage. Is the system voltage less than the specified value?	16 v	Go to "Diagnostic Aids"	Go to Step 2
2	Connect a DVM between terminal 2 of the ABS enable relay harness connector and ground by backprobing. (This is a large red wire on the side of the connector housing with a ridge running along the side from the wire entry end to the relay. Is the voltage less than the specified value?	16 v	Go to Step 3	Go to Section 1E, Engine Electrical
3	Replace the EBCM and recheck. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A038 LEFT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description

This DTC is designed to detect a slipping left front expansion spring brake (ESB). During initialization and braking, the left front motor is rehomed. If the ESB slips, the motor/piston will move. During the next ignition ON initialization, a rehome of the motor verifies that the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

Diagnosis

This test checks to see if the modulator is in the home position at ignition ON. If forward motor movement is detected and the modulator piston was expected to be at the home position, this fault is registered. This failure is detected if the motor sense current is less than the stall current (10.7 amps).

Cause(s)

- There has been a mechanical failure of the ESB.
- There is high resistance in the motor.
- The motor pack assembly is malfunctioning.
- The piston is sticking and not returning to the home position.

Fail Action

This is a critical operational fault as the driver might backdrive the motor when applying the brake, causing the brake pedal to drop. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks the left front ESB. A broken or defective ESB would result in the left front piston's being backdriven by hydraulic pressure, and pedal movement would result.
3. This test checks for high resistance in the left front motor feed circuit.
4. This test checks for high resistance in the left front motor return circuit.
5. This test checks for high resistance in the left front motor.
6. This test determines if the fault is due to poor terminal contact or corrosion.
8. This test determines if the fault is due to a faulty EBCM.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

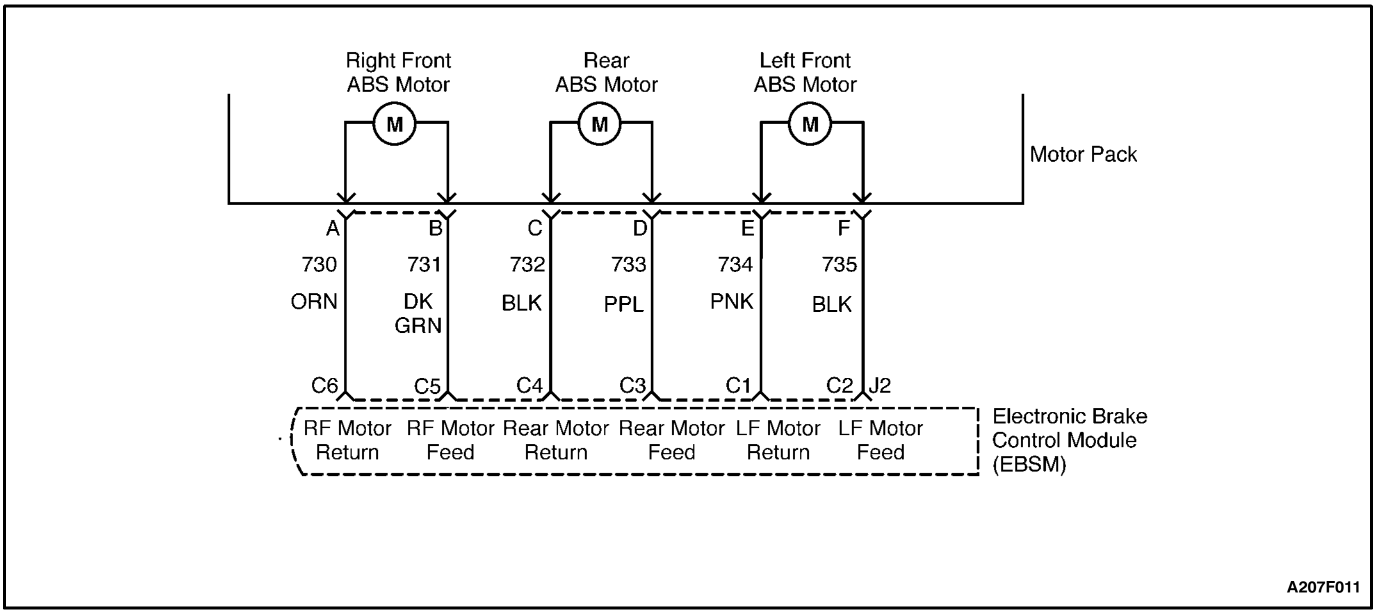
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Use the static modulator test function of the scan tool to locate an intermittent malfunction associated with the ESB.

DTC A038 – Left Front ESB Will Not Hold Motor

Step	Action	Value(s)	Yes	No
1	Inspect the motor pack harness connector and the EBCM connector J2 for proper wire color and terminal locations. Are all of the connections in good condition?	-	Go to Step 2	Go to Step 10
2	1. Turn the ignition switch to ON. 2. Deplete the vacuum reserve. 3. Select "ABS Tests" on the scan tool. 4. Use manual control to select "Left Front Motor Apply" and apply the motor. 5. Wait 5 seconds, then apply firm pressure on the brake pedal. Did the brake pedal fall?	-	Go to Step 11	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the motor pack connector and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between motor pack harness connector terminal F and the EBCM harness connector J2, terminal C2. Is the resistance less than the specified value?	1.5 W	Go to Step 4	Go to Step 12
4	Use a DVM to measure the resistance between the motor pack harness connector terminal E and the EBCM harness connector J2, terminal C1. Is the resistance less than the specified value?	1.5 W	Go to Step 5	Go to Step 13
5	Use a DVM to measure the resistance of the motor pack between terminal E and terminal F. Is the resistance less than the specified value?	1.5 W	Go to Step 6	Go to Step 11
6	Inspect the motor pack harness connector and the EBCM harness connector J2 for poor terminal contact or corrosion. Do any terminals exhibit poor contact or evidence of corrosion?	-	Go to Step 7	Go to Step 8
7	Replace the terminals that exhibit poor terminal contact or evidence of corrosion. Is the repair complete?	-	System OK	-
8	1. Reconnect all of the connectors. 2. Drive the vehicle for two drive cycles. Does DTC A038 reset?	-	Go to Step 9	Go to "Diagnostic Aids"
9	Replace the EBCM. Is the repair complete?	-	System OK	-
10	Repair any bad connections. Is the repair complete?	-	System OK	-
11	Replace the motor pack. Is the repair complete?	-	System OK	-
12	Repair the high resistance in circuit BLK. Is the repair complete?	-	System OK	-
13	Repair the high resistance in circuit PNK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A041
RIGHT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description

This DTC is designed to detect a slipping right front expansion spring brake (ESB). During initialization and braking, the right front motor is rehomed. If the ESB slips, the motor/piston will move. During the next ignition ON initialization, a rehome of the motor verifies that the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

Diagnosis

This test checks to see if the modulator is in the home position at ignition ON. If forward motor movement is detected and the modulator piston was expected to be at the home position, this fault is registered. This failure is detected if the motor sense current is less than the stall current (10.7 amps).

Cause(s)

- There has been a mechanical failure in the ESB.
- There is high resistance in the motor.
- The motor pack assembly is malfunctioning.
- A piston is sticking and not returning to the home position.

Action Taken

This is a critical operational fault as the driver might backdrive the motor when applying the brake, causing the brake pedal to drop. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The numbers below refer to steps on the diagnostic table.

1. This step checks the right front ESB. A broken or defective ESB would result in the right front piston's being backdriven by hydraulic pressure, and pedal movement would result.
3. This test checks for high resistance in the right front motor feed circuit.
4. This test checks for high resistance in the right front motor return circuit.
5. This test checks for high resistance in the right front motor.
6. This test determines if the fault is due to poor terminal contact or corrosion.
8. This test determines if the fault is due to a faulty EBCM.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

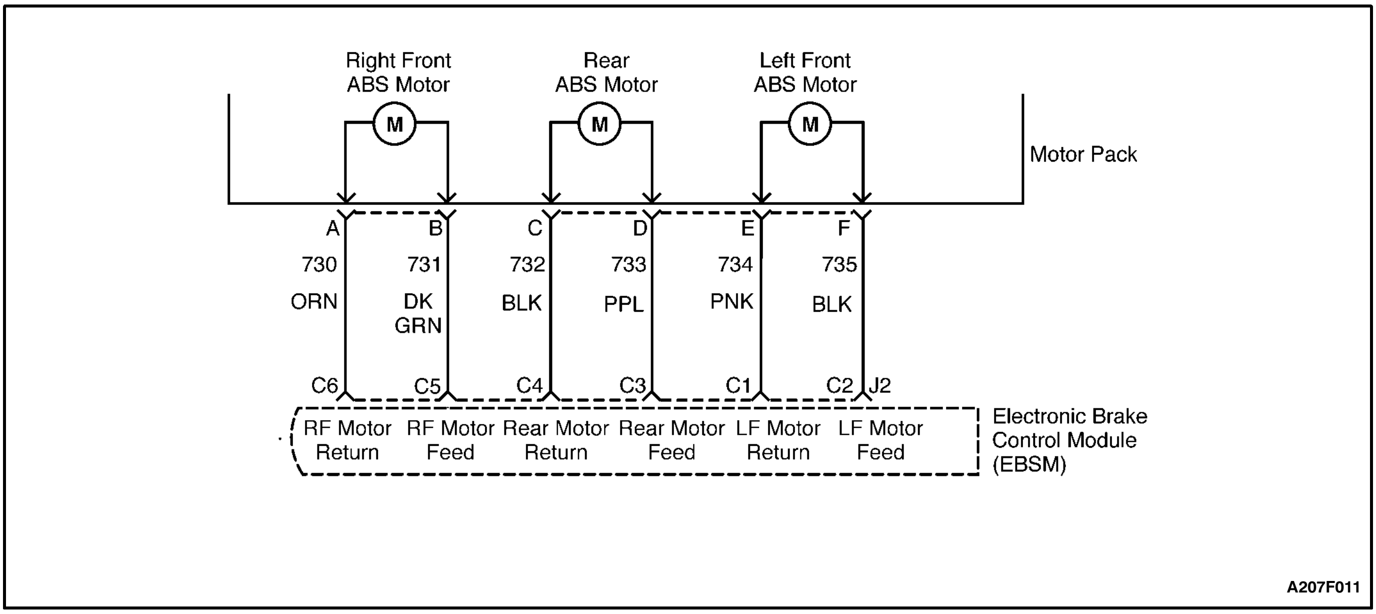
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Use the static modulator test function of the scan tool to locate an intermittent malfunction associated with the ESB.

DTC A041 – Right Front ESB Will Not Hold Motor

Step	Action	Value(s)	Yes	No
1	Inspect the motor pack harness connector and the EBCM connector J2 for proper wire color and terminal locations. Are all of the connections in good condition?	-	Go to Step 2	Go to Step 10
2	1. Turn the ignition switch to ON. 2. Deplete the vacuum reserve. 3. Select “ABS Tests” on the scan tool. 4. Use manual control to select “Right Front Motor Apply” and apply the motor. 5. Wait 5 seconds, then apply firm pressure on the brake pedal. Did the brake pedal fall?	-	Go to Step 11	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the motor pack connector and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between the motor pack harness connector terminal B and the EBCM harness connector J2, terminal C5. Is the resistance less than the specified value?	1.5 W	Go to Step 4	Go to Step 12
4	Use a DVM to measure the resistance between the motor pack harness connector terminal A and the EBCM harness connector J2, terminal C6. Is the resistance less than the specified value?	1.5 W	Go to Step 5	Go to Step 13
5	Use a DVM to measure the resistance of the motor pack between terminal A and terminal B. Is the resistance within the specified value?	0.2-1.5 W	Go to Step 6	Go to Step 11
6	Inspect the motor pack harness connector and the EBCM harness connector J2 for poor terminal contact or corrosion. Do any terminals exhibit poor contact or evidence of corrosion?	-	Go to Step 7	Go to Step 8
7	Replace the terminals that exhibit poor terminal contact or evidence of corrosion. Is the repair complete?	-	System OK	-
8	Reconnect all of the connectors. Drive the vehicle for two drive cycles. Does DTC A041 reset?	-	Go to Step 9	Go to “Diagnostic Aids”
9	Replace the EBCM. Is the repair complete?	-	System OK	-
10	Repair any bad connections. Is the repair complete?	-	System OK	-
11	Replace the motor pack. Is the repair complete?	-	System OK	-
12	Repair the high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-
13	Repair the high resistance in circuit ORN. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A042 REAR AXLE ESB WILL NOT HOLD MOTOR

Circuit Description

This DTC is designed to detect a slipping rear expansion spring brake (ESB). During initialization and braking, the rear motor is rehomed. If the ESB slips, the motor/piston will move. During the next ignition ON initialization, a re-home of the motor verifies that the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

Diagnosis

This test checks to see if the modulator is in the home position at ignition ON. If forward motor movement is detected and the modulator piston was expected to be at the home position, this fault is registered. This failure is detected if the motor sense current is less than the stall current (10.7 amps).

Cause(s)

- There has been a mechanical failure of the ESB.
- There is high resistance in the motor.
- The motor pack assembly is malfunctioning.
- The piston is sticking and not returning to the home position.

Fail Action

This is a critical operational fault as the driver might backdrive the motor when applying the brake, causing the brake pedal to drop. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks the rear ESB. A broken or defective ESB would result in the rear piston's being backdriven by hydraulic pressure, and pedal movement would result.
3. This test checks for high resistance in the rear motor feed circuit.
4. This test checks for high resistance in the rear motor return circuit.
5. This test checks for high resistance in the rear motor.
6. This test determines if the fault is due to poor terminal contact or corrosion.
8. This test determines if the fault is due to a faulty EBCM.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

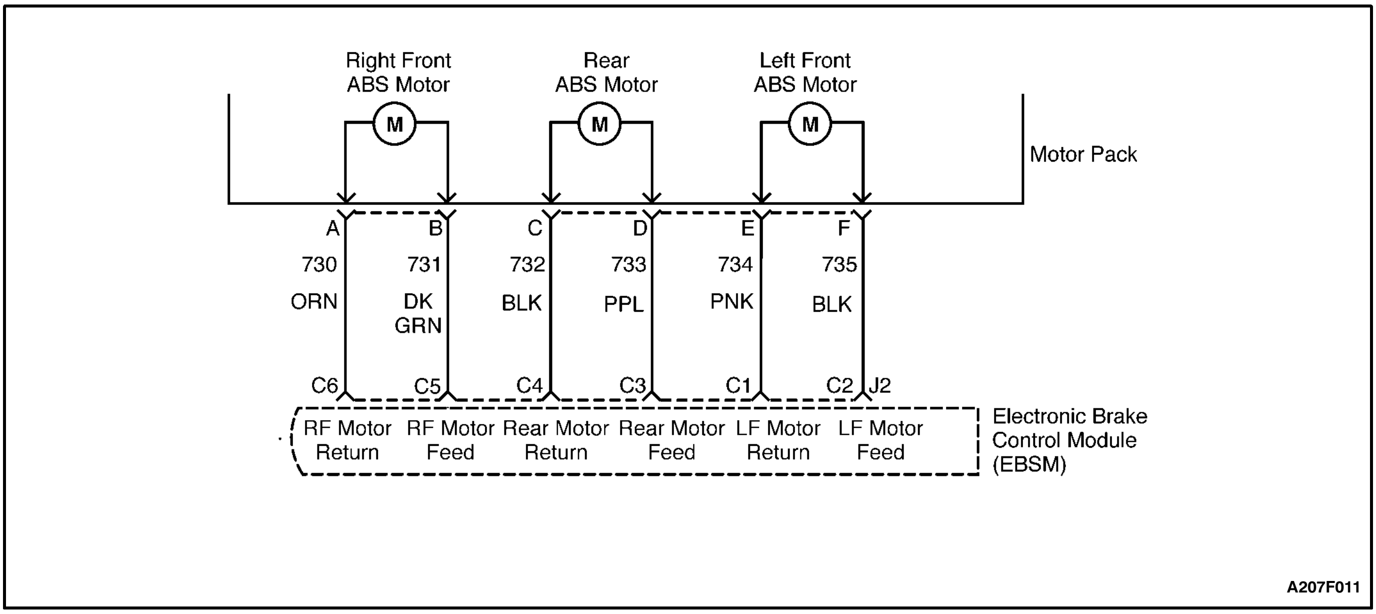
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Use the static modulator test function of the scan tool to locate an intermittent malfunction associated with the ESB.

DTC A042 – Rear Axle Will Not Hold Motor

Step	Action	Value(s)	Yes	No
1	Inspect the motor pack harness connector and the EBCM connector J2 for proper wire color and terminal locations. Are all of the connections in good condition?	-	Go to Step 2	Go to Step 10
2	1. Raise and support the vehicle so that the wheels are approximately 152 mm (6 in.) off the floor. 2. Turn the ignition switch to ON. 3. Deplete the vacuum reserve. 4. Apply firm pressure to the brake pedal and release. 5. Reapply firm pressure to the brake pedal and have an assistant try to spin the rear wheels by hand. Can the assistant spin the rear wheels?	-	Go to Step 11	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the motor pack connector and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between the motor pack harness connector terminal D and the EBCM harness connector J2, terminal C3. Is the resistance less than the specified value?	1.5 W	Go to Step 4	Go to Step 12
4	Use a DVM to measure the resistance between the motor pack harness connector terminal C and the EBCM harness connector J2, terminal C4. Is the resistance less than the specified value?	1.5 W	Go to Step 5	Go to Step 13
5	Use a DVM to measure the resistance of the motor pack between terminal C and terminal D. Is the resistance within the specified value?	0.2-1.5 W	Go to Step 6	Go to Step 11
6	Inspect the motor pack harness connector and the EBCM harness connector J2 for poor terminal contact or corrosion. Do any terminals exhibit poor contact or evidence of corrosion?	-	Go to Step 7	Go to Step 8
7	Replace the terminals that exhibit poor terminal contact or evidence of corrosion. Is the repair complete?	-	System OK	-
8	1. Reconnect all of the connectors. 2. Drive the vehicle for two drive cycles. Does DTC A042 reset?	-	Go to Step 9	Go to “Diagnostic Aids”
9	Replace the EBCM. Is the repair complete?	-	System OK	-
10	Repair any bad connections. Is the repair complete?	-	System OK	-
11	Replace the motor pack. Is the repair complete?	-	System OK	-
12	Repair the high resistance in circuit PPL. Is the repair complete?	-	System OK	-
13	Repair the high resistance in circuit BLK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A044 LEFT FRONT CHANNEL WILL NOT MOVE

Circuit Description

This DTC is designed to detect a bound-up ESB, a stuck motor, or a seized hydraulic modulator. When the release is commanded during initialization, the ESB should release the motor, resulting in the sensed current being less than the commanded current (motor is spinning freely). If the motor is not moving, the sensed current will be equal to the stall current.

Diagnosis

The system commands the motors in the reverse and the forward directions. The left front channel fails to move if the motor sense current is always greater than 7 amps.

Cause(s)

- The gears are frozen.
- A nut failed.
- The shaft is binding.
- There has been an ESB mechanical failure (the ESB does not release the motor).
- The motor pack assembly is malfunctioning.
- The piston is sticking or at the bottom of the bore.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper motor movement during apply and release commands from the scan tool.
3. This step verifies that the motor can actually apply when commanded.
4. This step compares the EBCM command current to the motor feedback current.
5. This test determines if the malfunction is caused by a defective EBCM or by a short circuit.
6. This step checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics” earlier in this section. DTC A044 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

DTC A044 – Left Front Channel Will Not Move

Step	Action	Value(s)	Yes	No
1	Visually inspect the motor pack harness connector and the EBCM harness connector J2 for proper wire color/connector cavity combination. Are the proper wires located in the proper connector cavities?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition switch to ON. 2. Deplete the vacuum reserve. 3. Select "Manual Control" from the scan tool ABS tests. 4. Select "Left Front Motor Apply" and apply the motor. 5. Apply firm pressure to the brake pedal. 6. Select "Left Front Motor Release" and release the motor. Did the brake pedal fall?	-	Go to Step 3	Go to Step 4
3	1. Maintain firm pressure on the brake pedal. 2. Select "Left Front Motor Apply" and apply the motor. Did the brake pedal rise?	-	Go to "Diagnostic Aids"	Go to Step 4
4	1. Remove your foot from the brake pedal. 2. Select "Left Front Motor Apply" and apply the motor while carefully observing the commanded current and the feedback current on the scan tool. Is the feedback current higher than the commanded current?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J2 and the motor pack connector. 3. Use a DVM to measure the resistance between terminal C1 and terminal C2 of the EBCM harness connector J2. Is the resistance value as specified?	R	Go to Step 8	Go to Step 9
6	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Grasp and attempt to move the left front hydraulic modulator gear. Can the gear be rotated at least eight full turns lock to lock?	-	Go to Step 10	Go to Step 11
7	Repair any bad connections. Is the repair complete?	-	System OK	-
8	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A044 – Left Front Channel Will Not Move (Cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the short between circuit BLK and circuit PNK. Is the repair complete?	-	System OK	-
10	Replace the motor pack Is the repair complete?	-	System OK	-
11	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

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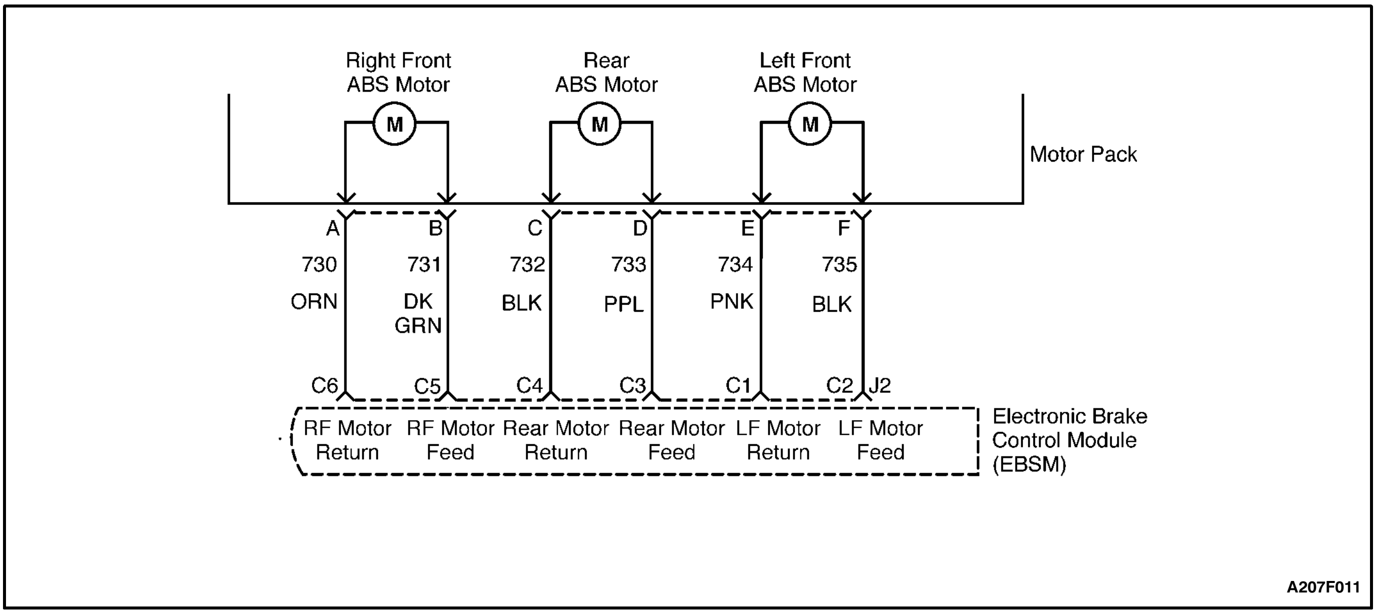

DIAGNOSTIC TROUBLE CODE (DTC) A045 RIGHT FRONT CHANNEL WILL NOT MOVE

Circuit Description

This DTC is designed to detect a bound-up ESB, a stuck motor, or a seized hydraulic modulator. When the release is commanded during initialization, the ESB should release the motor, resulting in the sensed current being less than the commanded current (motor is spinning freely). If the motor is not moving, the sensed current will be equal to the stall current.

Diagnosis

The system commands the motors in the reverse and the forward directions. The right front channel fails to move if the motor sense current is always greater than 7 amps.

Cause(s)

- The gears are frozen.
- A nut failed.
- The shaft is binding.
- An ESB mechanical failure (the ESB does not release the motor).
- The motor pack assembly is bad.
- The piston is sticking or at the bottom of the bore.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper motor movement during apply and release commands from the scan tool.
3. This step verifies that the motor can actually apply when commanded.
4. This step compares the EBCM command current to the motor feedback current.
5. This test determines if the malfunction is caused by a defective EBCM or by a short circuit.
6. This step checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics." DTC A045 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

DTC A045 – Right Front Channel Will Not Move

Step	Action	Value(s)	Yes	No
1	Visually inspect the motor pack harness connector and the EBCM harness connector J2 for proper wire color/connector cavity combination. Are the proper wires located in the proper connector cavities?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition switch to ON. 2. Deplete the vacuum reserve. 3. Select "Manual Control" from the scan tool ABS tests. 4. Select "Right Front Motor Apply" and apply the motor. 5. Apply firm pressure to the brake pedal. 6. Select "Right Front Motor Release" and release the motor. Did the brake pedal fall?	-	Go to Step 3	Go to Step 4
3	1. Maintain firm pressure on the brake pedal. 2. Select "Right Front Motor Apply" and apply the motor. Did the brake pedal rise?	-	Go to "Diagnostic Aids"	Go to Step 4
4	1. Remove your foot from the brake pedal. 2. Select "Right Front Motor Apply" and apply the motor while carefully observing the commanded current and the feedback current on the scan tool. Is the feedback current higher than the commanded current?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J2 and the motor pack connector. 3. Use a digital voltmeter (DVM) to measure the resistance between terminal C5 and terminal C6 of the EBCM harness connector J2. Is the resistance value as specified?	R	Go to Step 8	Go to Step 9
6	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Grasp and attempt to move the right front hydraulic modulator gear. Can the gear be rotated at least 8 full turns lock to lock?	-	Go to Step 10	Go to Step 11
7	Repair any bad connections. Is the repair complete?	-	System OK	-
8	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A045 – Right Front Channel Will Not Move (Cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the short between circuit DK GRN and circuit ORN. Is the repair complete?	–	System OK	–
10	Replace the motor pack Is the repair complete?	–	System OK	–
11	Replace the hydraulic modulator. Is the repair complete?	–	System OK	–

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

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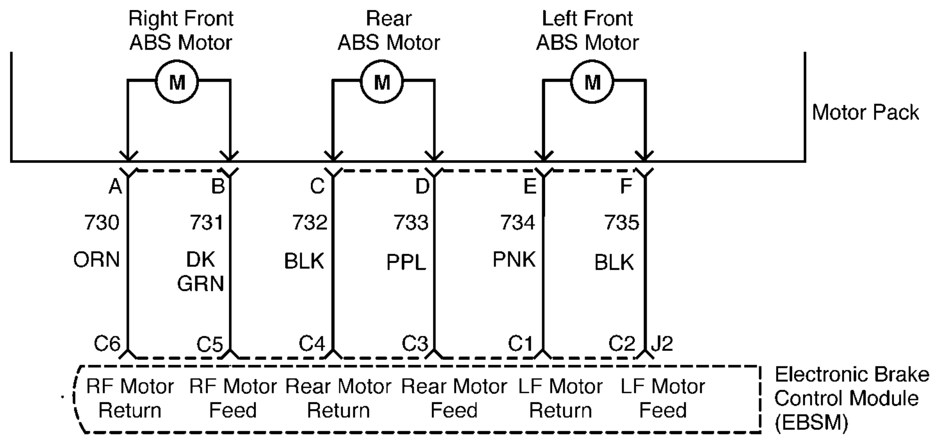

DIAGNOSTIC TROUBLE CODE (DTC) A046 REAR AXLE CHANNEL WILL NOT MOVE

Circuit Description

This DTC is designed to detect a bound-up ESB, a stuck motor, or a seized hydraulic modulator. When the release is commanded during initialization, the ESB should release the motor, resulting in the sensed current being less than the commanded current (motor is spinning freely). If the motor is not moving, the sensed current will be equal to the stall current.

Diagnosis

The system commands the motors in the reverse and the forward directions. The rear axle channel fails to move if the motor sense current is always greater than 7 amps.

Cause(s)

- The gears are frozen.
- A nut failed.
- The shaft is binding.
- An ESB mechanical failure (the ESB does not release the motor).
- The motor pack assembly is bad.
- The piston is sticking or at the bottom of the bore.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on since this failure could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper motor movement during apply and release commands from the scan tool.
3. This step verifies that the motor can actually release when commanded.
4. This step compares the EBCM command current to the motor feedback current.
5. This test determines if the malfunction is caused by a defective EBCM or by a short circuit.
6. This step checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics." DTC A046 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC A046 – Rear Axle Channel Will Not Move

Step	Action	Value(s)	Yes	No
1	Visually inspect the motor pack harness connector and the EBCM harness connector J2 for proper wire color/connector cavity combination. Are the proper wires located in the proper connector cavities?	-	Go to Step 2	Go to Step 7
2	1. Raise and support the vehicle so that the rear wheels are approximately 152 mm (6 in.) off the floor. 2. Turn the ignition switch to ON. 3. Deplete the vacuum reserve. 4. Apply firm pressure to the brake pedal. 5. Select "Manual Control" from the scan tool ABS tests. 6. Select "Rear Motor Apply" and apply the motor. 7. Have an assistant try to spin the rear wheels by hand. Can the assistant spin the rear wheels?	-	Go to Step 4	Go to Step 3
3	1. Maintain firm pressure on the brake pedal. 2. Select "Rear Motor Release" and release the motor. 3. Have an assistant try to spin the rear wheels by hand. Can the assistant spin the rear wheels?	-	Go to "Diagnostic Aids"	Go to Step 4
4	1. Remove your foot from the brake pedal. 2. Select "Right Front Motor Apply" and apply the motor while carefully observing the commanded current and the feedback current on the scan tool. Is the feedback current higher than the commanded current?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J2 and the motor pack connector. 3. Use a digital voltmeter (DVM) to measure the resistance between terminal C4 and terminal C3 of the EBCM harness connector J2. Is the resistance value as specified?	R	Go to Step 8	Go to Step 9
6	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Grasp and attempt to move the middle gear on the hydraulic modulator. Can the gear be rotated at least four full turns lock to lock?	-	Go to Step 10	Go to Step 11
7	Repair any bad connections. Is the repair complete?	-	System OK	-
8	Replace the EBCM. Is the repair complete?	-	System OK	-

DTC A046 – Rear Axle Channel Will Not Move (Cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the short between circuit PPL and circuit BLK. Is the repair complete?	-	System OK	-
10	Replace the motor pack Is the repair complete?	-	System OK	-
11	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

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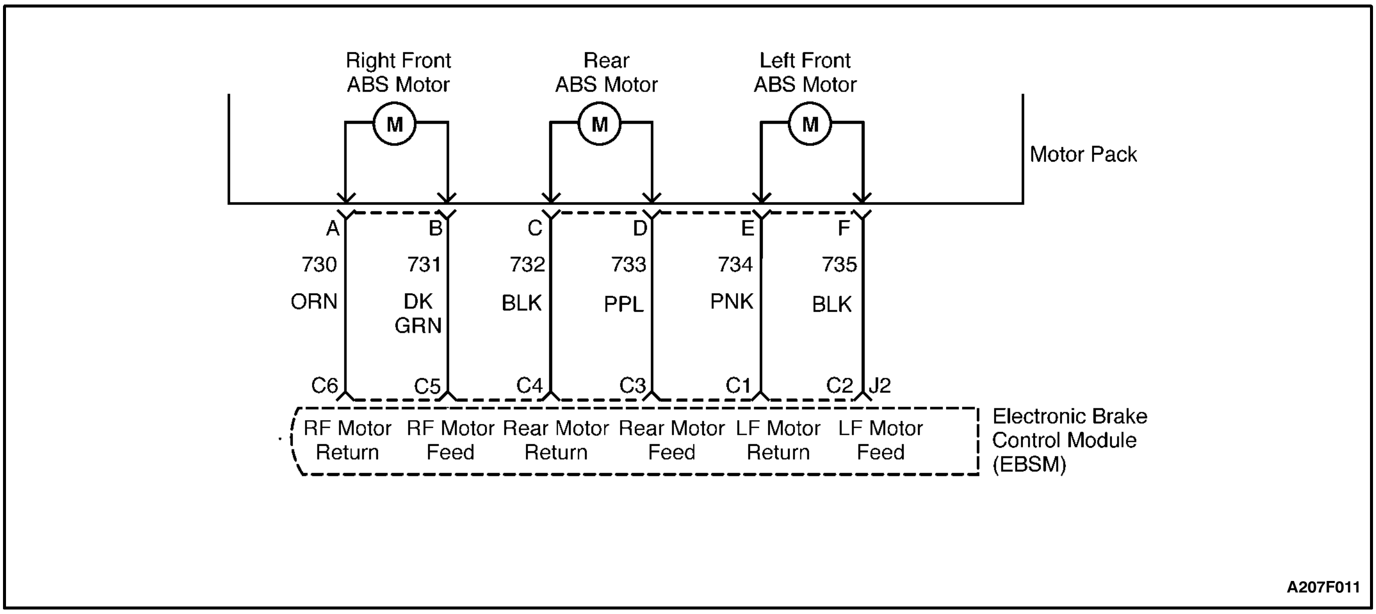


DIAGNOSTIC TROUBLE CODE (DTC) A047 LEFT FRONT MOTOR FREE SPINS

Circuit Description

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore, resulting in a stalled motor. If this does not occur, the motor must be spinning with little or no resistance. This indicates a nut/screw or gear malfunction.

Diagnosis

The system monitors the time in which the left front motor is commanded in the forward direction. If this time duration exceeds the modulator total travel time, the motor is spinning freely. The motor is considered moving if the sense current is less than 10.7 amps.

Cause(s)

- The gear, the nut, or the shaft is stripped.
- The gears or the shaft is dislocated.
- The motor pack assembly is faulty.
- There is a high resistance or an open circuit in the motor during ABS or initialization.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks to see if the corresponding open ABS motor DTC is also set.
2. This step verifies that the ABS motor was actually applied as commanded by observing the feedback current.
3. This step verifies that the ABS motor can release.
4. This step verifies that the ABS motor can be applied by observing the pedal movement.
5. This test checks for high resistance in the left front ABS motor LOW circuit.
7. This test checks for high resistance in the left front ABS motor HIGH circuit.
9. This test checks for proper resistance of the left front ABS motor winding.
12. This step checks for a stripped gear on the hydraulic modulator.

Notice: Be careful not to damage the gear set.

14. This test verifies that the left front ABS motor can be applied.
15. This verifies that the hydraulic modulator is functioning properly.
17. This ensures that the malfunction was not due to a poor terminal contact.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

If the DTC fails only once and DTC A056 also fails, refer to the table for DTC A056. If intermittent and enhanced diagnostics show this DTC fails during ABS operation, refer to the table for DTC A056.

Depending on the frequency of the malfunction, it may be necessary to perform a physical inspection of the mechanical parts suspected.

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

DTC A047 – Left Front Motor Free Spins

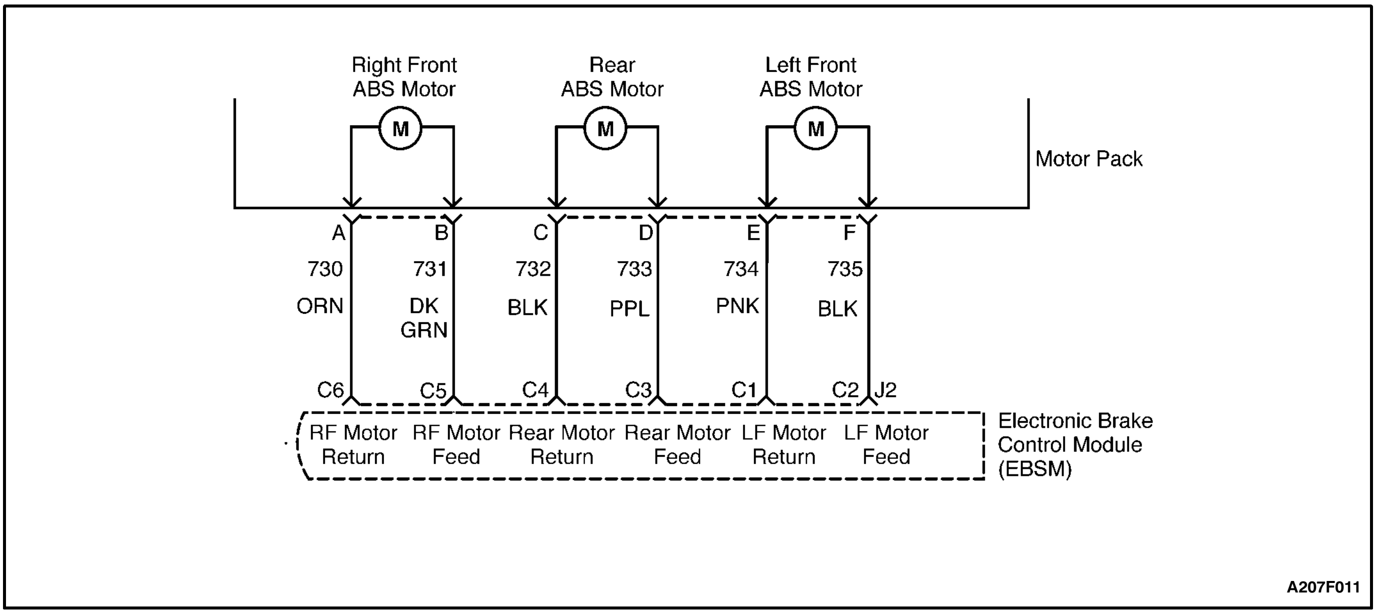
Step	Action	Value(s)	Yes	No
1	Check the scan tool for additional DTC codes. Is DTC A056 also currently set?	-	Go to DTC A056 Table	Go to Step 2
2	1. Turn the ignition switch to ON (engine OFF). 2. Pump the brake pedal until it is firm to deplete the vacuum reserve. 3. Select "Manual Control" from the scan tool ABS tests. 4. Select "Left Front ABS Motor Apply." 5. Apply the left front motor while carefully observing the command current and the feedback current on the scan tool. Are both the command and feedback current 10 amps?	-	Go to Step 3	Go to Step 5
3	1. Apply firm pressure to the brake pedal. 2. Select "Left Front ABS Motor Release" on the scan tool. 3. Release the left front motor. Does the brake pedal fall and are both the command and the feedback current 6 amps?	-	Go to Step 4	Go to Step 5
4	1. Maintain firm pressure on brake pedal. 2. Select "Left Front ABS Motor Apply" on the scan tool. 3. Apply the left front motor. This moves the piston to the top of its bore. Did the brake pedal rise?	-	Go to "Diagnostic Aids"	Go to Step 5
5	1. Using the scan tool misc. tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Disconnect the motor pack connector. 4. Use a digital voltmeter (DVM) to measure resistance between terminal E of the motor pack harness connector and terminal C1 of the EBCM harness connector J2. Is the resistance less than the specified value?	1.5 W	Go to Step 6	Go to Step 7
6	Repair the high resistance in circuit PNK. Is the repair complete?	-	System OK	-
7	Measure the resistance between the motor pack harness connector terminal F and the EBCM harness connector J2, terminal C2. Is the resistance less than the specified value?	1.5 W	Go to Step 8	Go to Step 9
8	Repair the high resistance in circuit BLK. Is the repair complete?	-	System OK	-
9	Measure the resistance of the motor pack between terminal E and terminal F. Is the resistance less than the specified value?	1.5 W	Go to Step 11	Go to Step 10

DTC A047 – Left Front Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the ABS motor pack. Is the repair complete?	-	System OK	-
11	1. Remove the hydraulic modulator/motor pack assembly from the vehicle. 2. Remove the gear cover from the hydraulic modulator/motor pack assembly. 3. Check for a stripped gear on the ABS motor pack. The ABS motor pack is the unit with the three small gears. The left front gear is the gear nearest to the motor pack electrical connector. Is the ABS motor pack gear stripped?	-	Go to Step 10	Go to Step 12
12	Check for a stripped gear on the hydraulic modulator. The modulator is the unit with three large gears; the left front gear is the gear nearest to the motor pack electrical connector. Is the larger gear stripped?	-	Go to Step 13	Go to Step 14
13	Replace the hydraulic modulator gear. Is the repair complete?	-	System OK	-
14	1. Reconnect all of the electrical connectors. 2. Securely position the hydraulic modulator assembly onto the vehicle with its cover removed so that you can observe the gear set. 3. Do not allow the hydraulic modulator to move while testing. 4. Turn the ignition switch to ON. 5. Select "Manual Control" from the scan tool ABS tests. 6. Select "Left Front Motor Apply." 7. Apply the left front motor while observing the gear set nearest to the ABS motor electrical connector. 8. Select "Left Front Motor Release." 9. Release the left front motor while observing the gear set. 10. Again, select "Left Front Motor Apply" and apply the motor. Did the gear set move in both directions for at least one revolution?	-	Go to Step 15	Go to Step 10
15	1. Use the scan tool to perform the gear tension relief test. 2. Turn the ignition to OFF. 3. Separate the ABS motor pack from the hydraulic modulator. 4. Grasp the gear on the hydraulic modulator (the unit with the three large gears) and rotate the gear by hand. Can the gear be rotated more than eight full turns lock to lock?	-	Go to Step 17	Go to Step 16
16	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

DTC A047 – Left Front Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. Inspect all of the connectors and the terminals for poor terminal contact and evidence of corrosion. 2. Replace all terminals that show signs of poor terminal contact or corrosion. 3. Reinstall the hydraulic modulator/motor pack assembly into the vehicle. 4. Reconnect all of the electrical connectors. 5. Start the engine with your foot off of the brake. 6. Allow the engine to run for at least 10 seconds. 7. Repeat the ignition cycle two more times. Did DTC A047 set in the last three ignition cycles?	-	Go to Step 18	Go to "Diagnostic Aids"
18	Replace the EBCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A048 RIGHT FRONT MOTOR FREE SPINS

Circuit Description

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore, resulting in a stalled motor. If this does not occur, the motor must be spinning with little or no resistance. This indicates a nut/screw or gear malfunction.

Diagnosis

The system monitors the time in which the right front motor is commanded in the forward direction. If this time duration exceeds the modulator total travel time, the motor is spinning freely. The motor is considered moving if the sense current is less than 10.7 amps.

Cause(s)

- The gear, the nut, or the shaft is stripped.
- The gears or the shaft is dislocated.
- The motor pack assembly is faulty.
- There is a high resistance or an open circuit in the motor during ABS or initialization.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table

1. This step checks to see if the corresponding open ABS motor DTC is also set.
2. This step verifies that the ABS motor was actually applied as commanded by observing the feedback current.
3. This step verifies that the ABS motor can release.
4. This step verifies that the ABS motor can be applied by observing the pedal movement.
5. This test checks for high resistance in the right front ABS motor HIGH circuit.
7. This test checks for high resistance in the right front ABS motor LOW circuit
9. This test checks for proper resistance of the right front ABS motor winding.
12. This step checks for a stripped gear on the hydraulic modulator.

Notice: Be careful not to damage the gear set.

14. This test verifies that the right front ABS motor can be applied.
15. This verifies that the hydraulic modulator is functioning properly.
17. This ensures that the malfunction was not due to a poor terminal contact.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

If the DTC fails only once and DTC A061 also fails, refer to the table for DTC A061. If intermittent and enhanced diagnostics show this DTC fails during ABS operation, refer to the table for DTC A061.

Depending on the frequency of the malfunction, it may be necessary to perform a physical inspection of the mechanical parts suspected.

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

DTC A048 – Right Front Motor Free Spins

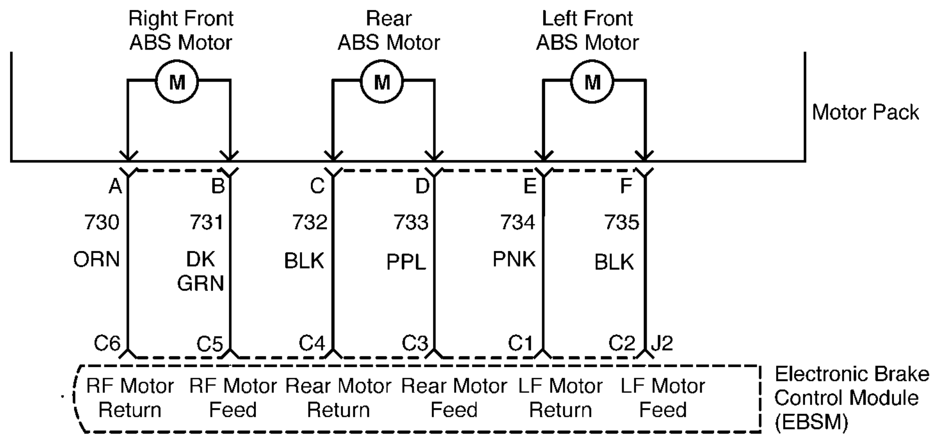
Step	Action	Value(s)	Yes	No
1	Check the scan tool for additional DTC codes. Is DTC A061 also currently set?	-	Go to DTC A061 Table	Go to Step 2
2	1. Turn the ignition switch to ON (engine OFF). 2. Pump the brake pedal until it is firm to deplete the vacuum reserve. 3. Select “Manual Control” from the scan tool ABS tests. 4. Select “Right Front ABS Motor Apply.” 5. Apply the right front motor while carefully observing the command current and the feedback current on the scan tool. Are both the command and feedback current 10 amps?	-	Go to Step 3	Go to Step 5
3	1. Apply firm pressure to the brake pedal. 2. Select “Right Front ABS Motor Release” on the scan tool. 3. Release the right front motor. Does the brake pedal fall and are both the command and the feedback current 6 amps?	-	Go to Step 4	Go to Step 5
4	1. Maintain firm pressure on brake pedal. 2. Select “Right Front ABS Motor Apply” on the scan tool. 3. Apply the right front motor. This moves the piston to the top of its bore. Does the brake pedal rise?	-	Go To “Diagnostic Aids”	Go to Step 5
5	1. Using the scan tool misc. tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Disconnect the motor pack connector. 4. Use a digital voltmeter (DVM) to measure the resistance between terminal B of the motor pack harness connector and terminal C5 of the EBCM harness connector J2. Is the resistance less than the specified value?	1.5 W	Go to Step 6	Go to Step 7
6	Repair the high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-
7	Measure the resistance between the motor pack harness connector terminal A and the EBCM harness connector J2, terminal C6. Is the resistance less than the specified value?	1.5 W	Go to Step 8	Go to Step 9
8	Repair the high resistance in circuit ORN. Is the repair complete?	-	System OK	-
9	Measure the resistance of the motor pack between terminal A and terminal B. Is the resistance less than the specified value?	1.5 W	Go to Step 11	Go to Step 10

DTC A048 – Right Front Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the ABS motor pack. Is the repair complete?	-	System OK	-
11	1. Remove the hydraulic modulator/motor pack assembly from the vehicle. 2. Remove the gear cover from the hydraulic modulator/motor pack assembly. 3. Check for a stripped gear on the ABS motor pack. The ABS motor pack is the unit with the three small gears. The right front gear is the gear farthest from the motor pack electrical connector. Is the ABS motor pack gear stripped?	-	Go to Step 10	Go to Step 12
12	Check for a stripped gear on the hydraulic modulator. The modulator is the unit with three large gears; the right front gear is the gear farthest from the motor pack electrical connector. Is the larger gear stripped?	-	Go to Step 13	Go to Step 14
13	Replace the hydraulic modulator gear. Is the repair complete?	-	System OK	-
14	1. Reconnect all of the electrical connectors. 2. Securely position the hydraulic modulator assembly onto the vehicle with its cover removed so that you can observe the gear set. 3. Do not allow the hydraulic modulator to move while testing. 4. Turn the ignition switch to ON. 5. Select "Manual Control" from the scan tool ABS tests. 6. Select "Right Front Motor Apply." 7. Apply the right front motor while observing the gear set farthest from the ABS motor electrical connector. 8. Select "Right Front Motor Release." 9. Release the right front motor while observing the gear set. 10. Again, select "Right Front Motor Apply" and apply the motor. Did the gear set move in both directions for at least one revolution?	-	Go to Step 15	Go to Step 10
15	1. Use the scan tool to perform the gear tension relief test. 2. Turn the ignition to OFF. 3. Separate the ABS motor pack from the hydraulic modulator. 4. Grasp the gear on the hydraulic modulator (the unit with the three large gears) and rotate the gear by hand. Can the gear be rotated more than eight full turns lock to lock?	-	Go to Step 17	Go to Step 16
16	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

DTC A048 – Right Front Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. Inspect all of the connectors and the terminals for poor terminal contact and evidence of corrosion. 2. Replace all terminals that show signs of poor terminal contact or corrosion. 3. Reinstall the hydraulic modulator/motor pack assembly into the vehicle. 4. Reconnect all of the connectors. 5. Start the engine with your foot off of the brake. 6. Allow the engine to run for at least 10 seconds. 7. Repeat the ignition cycle two more times. Did DTC A048 set in the last three ignition cycles?	-	Go to Step 18	Go to 'Diagnostic Aids"
18	Replace the EBCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A051 REAR MOTOR FREE SPINS

Circuit Description

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore, resulting in a stalled motor. If this does not occur, the motor must be spinning with little or no resistance. This indicates a nut/screw or gear malfunction.

Diagnosis

The system monitors the time in which the rear motor is commanded in the forward direction. If this time duration exceeds the modulator total travel time, the motor is spinning freely. The motor is considered moving if the sense current is less than 10.7 amps.

Cause(s)

- The gear, a nut, or a shaft is stripped.
- The gears or the shaft is dislocated.
- The motor pack assembly is faulty.
- There is a high resistance or an open circuit in the motor during ABS or initialization.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The brake warning lamp is also turned on since this failure could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks to see if the corresponding open ABS motor DTC is also set.
2. This step verifies that the ABS motor was actually applied as commanded by observing the feedback current.
3. This step verifies that the ABS motor can release.
4. This step verifies that the ABS motor can be applied by observing the pedal movement.
5. This test checks for high resistance in the rear ABS motor HIGH circuit.
7. This test checks for high resistance in the rear ABS motor LOW circuit
9. This test checks for proper resistance of the rear ABS motor winding.
12. This step checks for a stripped gear on the hydraulic modulator.

Notice: Be careful not to damage the gear set.

14. This test verifies that the rear ABS motor can be applied.
15. This verifies that the hydraulic modulator is functioning properly.
17. This ensures that the malfunction was not due to a poor terminal contact.

Diagnostic Aids

An “intermittent” malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

If the DTC fails only once and DTC A064 also fails, refer to the table for DTC A064. If intermittent and enhanced diagnostics show this DTC fails during ABS operation, refer to the table for DTC A064.

Depending on the frequency of the malfunction, it may be necessary to perform a physical inspection of the mechanical parts suspected.

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

DTC A051 – Rear Motor Free Spins

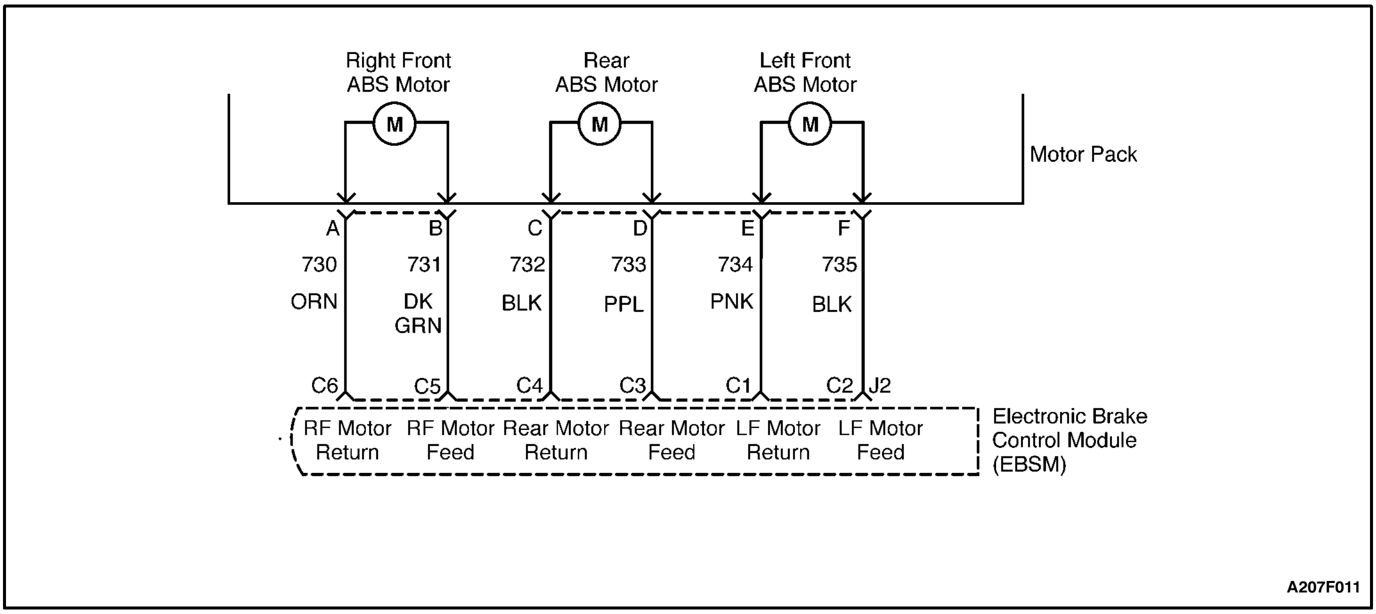
Step	Action	Value(s)	Yes	No
1	Check the scan tool for additional DTC codes. Is DTC A064 also currently set?	-	Go to DTC A064 Table	Go to Step 2
2	1. Turn the ignition switch to ON (engine OFF). 2. Pump the brake pedal until it is firm to deplete the vacuum reserve. 3. Select "Manual Control" from the scan tool ABS tests. 4. Select "Rear ABS Motor Apply." 5. Apply the rear motor while carefully observing the command current and the feedback current on the scan tool. Are both the command and feedback current 10 amps?	-	Go to Step 3	Go to Step 5
3	1. Apply firm pressure to the brake pedal. 2. Select "Rear ABS Motor Release" on the scan tool. 3. Release the rear motor. Does the brake pedal fall and are both the command and feedback current 6 amps?	-	Go to Step 4	Go to Step 5
4	1. Maintain firm pressure on the brake pedal. 2. Select "Rear ABS Motor Apply" on the scan tool. 3. Apply the rear motor. This moves the piston to the top of its bore. Does the brake pedal rise?	-	Go to "Diagnostic Aids"	Go to Step 5
5	1. Using the scan tool misc. tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Disconnect the motor pack connector. 4. Use a digital voltmeter (DVM) to measure the resistance between terminal D of the motor pack harness connector and terminal C3 of the EBCM harness connector J2. Is the resistance less than the specified value?	1.5 W	Go to Step 6	Go to Step 7
6	Repair the high resistance in circuit PPL. Is the repair complete?	-	System OK	-
7	Measure the resistance between the motor pack harness connector terminal C and the EBCM harness connector J2, terminal C4. Is the resistance less than the specified value?	1.5 W	Go to Step 8	Go to Step 9
8	Repair the high resistance in circuit BLK. Is the repair complete?	-	System OK	-

DTC A051 – Rear Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
9	Measure the resistance of the motor pack between terminal C and terminal D. Is the resistance less than the specified value?	1.5 W	Go to Step 11	Go to Step 10
10	Replace the ABS motor pack. Is the repair complete?	-	System OK	-
11	1. Remove the hydraulic modulator/motor pack assembly from the vehicle. 2. Remove the gear cover from the hydraulic modulator/motor pack assembly. 3. Check for a stripped gear on the ABS motor pack. The ABS motor pack is the unit with the three small gears. The rear gear is the gear in the center of the gear set. Is the ABS motor pack gear stripped?	-	Go to Step 10	Go to Step 12
12	Check for a stripped gear on the hydraulic modulator. The modulator is the unit with three large gears; the rear gear is the gear in the center of the gear set. Is the larger gear stripped?	-	Go to Step 13	Go to Step 14
13	Replace the hydraulic modulator gear. Is the repair complete?	-	System OK	-
14	1. Reconnect all of the electrical connectors. 2. Securely position the hydraulic modulator assembly onto the vehicle with its cover removed so that you can observe the gear set. 3. Do not allow the hydraulic modulator to move while testing. 4. Turn the ignition switch to ON. 5. Select "Manual Control" from the scan tool ABS tests. 6. Select "Rear Motor Apply." 7. Apply the rear motor while observing the gear set in the center of the gear assembly. 8. Select "Rear Motor Release." 9. Release the rear motor while observing the gear set. 10. Again select "Rear Motor Apply" and apply the motor. Did the gear set move in both directions for at least one revolution?	-	Go to Step 15	Go to Step 10
15	1. Use the scan tool to perform the gear tension relief test. 2. Turn the ignition to OFF. 3. Separate the ABS motor pack from the hydraulic modulator. 4. Grasp the gear on the hydraulic modulator (the unit with the three large gears) and rotate the gear by hand. Can the gear be rotated more than four full turns lock to lock?	-	Go to Step 17	Go to Step 16
16	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

DTC A051 - Rear Motor Free Spins (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. Inspect all of the connectors and the terminals for poor terminal contact and evidence of corrosion. 2. Replace all terminals that show signs of poor terminal contact or corrosion. 3. Reinstall the hydraulic modulator/motor pack assembly into the vehicle. 4. Reconnect all connectors. 5. Start the engine with your foot off of the brake. 6. Allow the engine to run for at least 10 seconds. 7. Repeat the ignition cycle two more times. Did DTC A051 set in the last three ignition cycles?	-	Go to Step 18	Go to "Diagnostic Aids"
18	Replace the EBCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A052 LEFT FRONT CHANNEL IN RELEASE TOO LONG

Circuit Description

This DTC will diagnose a motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the motor does not turn, the left front solenoid mechanically fails open, or the motor wires are crossed.

Diagnosis

The system monitors the total time in which release is commanded. If the left front channel is in release for more than 3 seconds, the system will store a failure code.

Cause(s)

- The left front wheel speed sensor or the wiring shorted together during ABS operation.
- The solenoid had a mechanical failure.
- The motor pack assembly is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step identifies a problem in a wheel speed sensor that may cause the system to be in release too long.
3. This step identifies a motor as being failed or wired incorrectly.
4. This step checks for a solenoid that may have mechanically failed open.
6. If Step 4 has failed, this serves to trace the cause of the hydraulic problem to either the solenoid or the hydraulic modulator.
11. This step determines whether a malfunctioning motor pack or hydraulic modulator is the reason for DTC A052 being set.

Diagnostic Aids

An “intermittent” malfunction in this DTC may result from a mechanical part of the system that sticks or binds.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

DTC A052 may fail if the vehicle is on ice and the steering wheel is turned to lock during braking. Use the scan tool to perform the hydraulic test to ensure that the total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A052 – Left Front Channel in Release Too Long

Step	Action	Value(s)	Yes	No
1	Check the scan tool for current DTC codes. Are any wheel speed DTCs or DTC A056 currently set?	-	Go to the appropriate DTC table	Go to Step 2
2	Test the vehicle during a steady decelerating condition from 56 km/h (35 mph) to 0 while monitoring all wheel speeds on the scan tool data list. Do any of the wheel speeds indicate erratic or intermittent operation?	-	Go to the "Wheel Speed = 0" table for the affected wheel	Go to Step 3
3	1. Stop the engine and return the ignition switch to ON. 2. Select "Left Front Motor Apply" with the manual control function of the scan tool. 3. Apply the left front motor. 4. Apply firm pressure to the brake pedal. 5. Select "Left Front Motor Release" on the scan tool and release the motor. Does the brake pedal fall?	-	Go to Step 4	Go to Step 9
4	1. Release the brake pedal. 2. Select "Left Front Solenoid Apply" on the scan tool. 3. Energize the left front solenoid. 4. Apply firm pressure to the brake pedal. Does the brake pedal fall?	-	Go to Step 6	Go to Step 5
5	1. Maintain firm pressure on the brake pedal. 2. Use the scan tool to turn off the left front solenoid. Does the brake pedal fall?	-	Go to "Diagnostic Aids"	Go to Step 6
6	Replace the left front solenoid with the right front solenoid and repeat the tests of steps 4 and 5. Does the brake pedal fall in either test?	-	Go to Step 7	Go to Step 8
7	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Replace the hydraulic modulator. Is the repair complete?	-	System OK	-
8	Replace the solenoid that failed step 4 of this test. Is the repair complete?	-	System OK	-
9	Does the brake pedal rise?	-	Go to Step 10	Go to Step 11
10	Repair the crossed wires to the left front ABS motor circuit. Is the repair complete?	-	System OK	-

DTC A052 – Left Front Channel in Release Too Long (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Grasp and attempt to move the left front gear on the hydraulic modulator. Can the gear be moved in either direction by hand?	-	Go to Step 12	Go to Step 13
12	Replace the motor pack. Is the repair complete?	-	System OK	-
13	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

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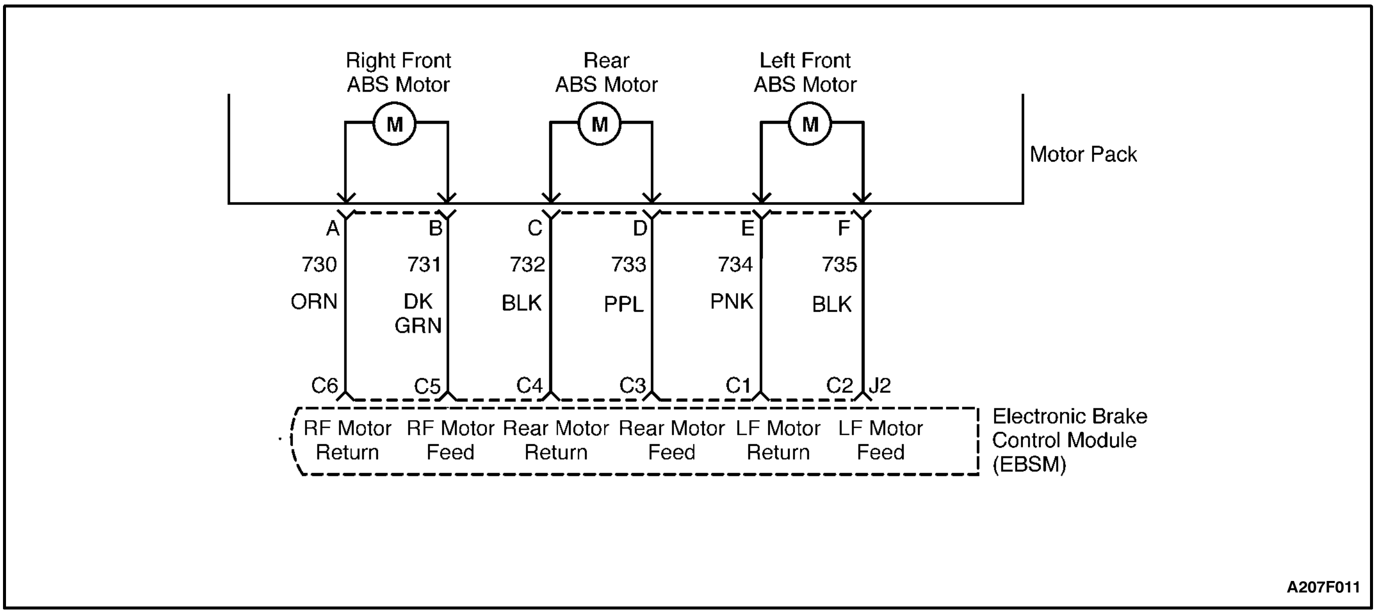

DIAGNOSTIC TROUBLE CODE (DTC) A053 RIGHT FRONT CHANNEL IN RELEASE TOO LONG

Circuit Description

This DTC will diagnose a motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the motor does not turn, the right front solenoid mechanically fails open, or the motor wires are crossed.

Diagnosis

The system monitors the total time in which release is commanded. If the right front channel is in release fro more than 3 seconds, the system will store a failure code.

Cause(s)

- The right front wheel speed sensor or the wiring shorted together during ABS operation.
- The solenoid had a mechanical failure.
- The motor pack assembly is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step identifies a problem in a wheel speed sensor that may cause the system to be in release too long.
3. This step identifies a motor as being failed or wired incorrectly.
4. This step checks for a solenoid that may have mechanically failed open.
6. If Step 4 has failed, this serves to trace the cause of the hydraulic problem to either the solenoid or the hydraulic modulator.
11. This step determines whether a malfunctioning motor pack or hydraulic modulator is the reason for DTC A053 being set.

Diagnostic Aids

An “intermittent” malfunction in this DTC may result from a mechanical part of the system that sticks or binds.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

DTC A053 may fail if the vehicle is on ice and the steering wheel is turned to lock during braking. Use the scan tool to perform the hydraulic test to ensure that the total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Important: Excessive drag or high resistance in the base brake or suspension system must be inspected and corrected before proceeding with DTC analysis.

DTC A053 – Right Front Channel in Release Too Long

Step	Action	Value(s)	Yes	No
1	Check the scan tool for current DTC codes. Are any wheel speed DTCs or DTC A061 currently set?	-	Go to the appropriate DTC table	Go to Step 2
2	Test the vehicle during a steady decelerating condition from 56 km/h (35 mph) to 0 while monitoring all wheel speeds on the scan tool data list. Do any of the wheel speeds indicate erratic or intermittent operation?	-	Go to the "Wheel Speed = 0" table for the affected wheel	Go to Step 3
3	1. Stop the engine and return the ignition switch to ON. 2. Select "Right Front Motor Apply" with the manual control function of the scan tool. 3. Apply the right front motor. 4. Apply firm pressure to the brake pedal. 5. Select "Right Front Motor Release" on the scan tool and release the motor. Does the brake pedal fall?	-	Go to Step 4	Go to Step 9
4	1. Release the brake pedal. 2. Select "Right Front Solenoid Apply" on the scan tool. 3. Energize the right front solenoid. 4. Apply firm pressure to the brake pedal. Does the brake pedal fall?	-	Go to Step 6	Go to Step 5
5	1. Maintain firm pressure on the brake pedal. 2. Use the scan tool to turn off the right front solenoid. Does the brake pedal fall?	-	Go to "Diagnostic Aids"	Go to Step 6
6	Replace the right front solenoid with the right front solenoid and repeat the tests of steps 4 and 5. Does the pedal fall?	-	Go to Step 7	Go to Step 8
7	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Replace the hydraulic modulator. Is the repair complete?	-	System OK	-
8	Replace the solenoid that failed step 4 of this test. Is the repair complete?	-	System OK	-
9	Does the brake pedal rise?	-	Go to Step 10	Go to Step 11
10	Repair the crossed wires to the right front ABS motor circuit. Is the repair complete?	-	System OK	-

DTC A053 – Right Front Channel in Release Too Long (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool ABS tests, perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly from the vehicle. 4. Separate the motor pack from the hydraulic modulator. 5. Grasp and attempt to move the right front gear on the hydraulic modulator. Can the gear moved in either direction by hand?	-	Go to Step 12	Go to Step 13
12	Replace the motor pack. Is the repair complete?	-	System OK	-
13	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.

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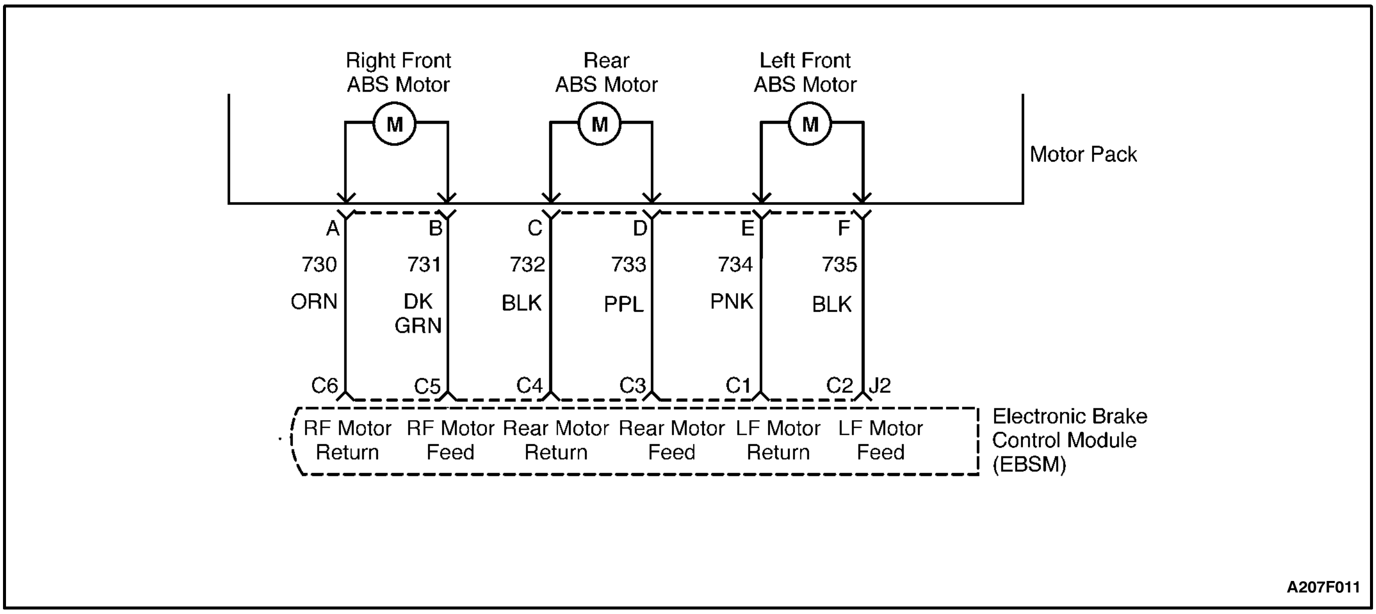


DIAGNOSTIC TROUBLE CODE (DTC) A054 REAR CHANNEL IN RELEASE TOO LONG

Circuit Description

This DTC will diagnose a motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the motor does not turn, or the motor wires are crossed.

Diagnosis

The system monitors the total time in which the rear axle release mode is commanded. This test fails under the following conditions:

- The difference between the reference speed and the maximum rear speed exceeds 11 km/h (7 mph) while the rear channel is in release for more than 3 seconds.
- The difference between the reference speed and the maximum rear speed is less than 11 km/h (7 mph) while the rear channel is in release for more than 4 seconds.

Cause(s)

- The rear axle wheel speed sensor or the wiring shorted together during ABS operation.
- The motor pack assembly is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded to ensure that the motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step identifies a problem in a wheel speed sensor that may cause the system to be in release too long.
3. This checks for a wheel that may stick or bind because of a mechanical fault.
4. This checks to see if the motor is capable of moving and applying the hydraulic piston for the rear wheels.
5. This step ensures that the motor wiring is not crossed.
6. This isolates the fault of a "no-apply" situation to either the motor pack or the hydraulic modulator.

Diagnostic Aids

An "intermittent" malfunction in this DTC may result from a mechanical part of the system that sticks or binds.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics." Use the scan tool to perform the hydraulic test to ensure that the total brake system is functional.

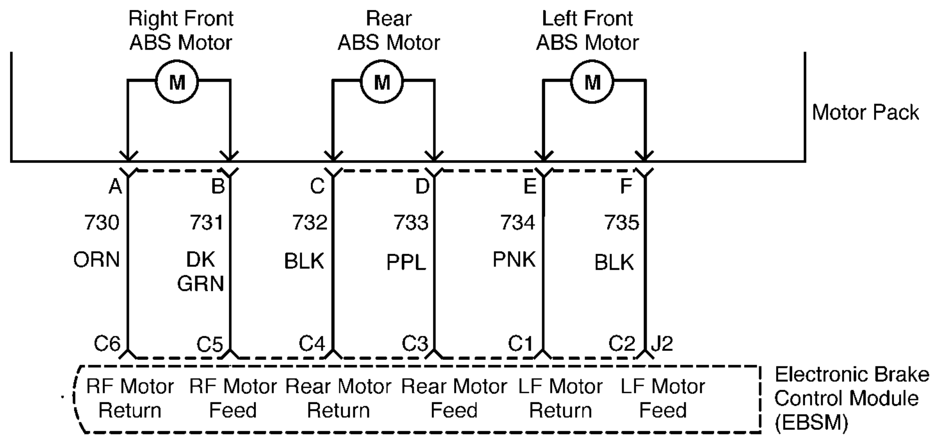
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Important: Excessive drag or high resistance in the base brake or suspension system must be inspected and corrected before proceeding with DTC analysis.

DTC A054 – Rear Channel in Release Too Long

Step	Action	Value(s)	Yes	No
1	Check the scan tool for current DTC codes. Are any wheel speed DTCs or DTC A064 currently set?	-	Go to the appropriate DTC table	Go to Step 2
2	Test the vehicle during a steady decelerating condition from 56 km/h (35 mph) to 0 while monitoring all wheel speeds on the scan tool data list. Do any of the wheel speeds indicate erratic or intermittent operation?	-	Go to the "Wheel Speed = 0" table for the affected wheel	Go to Step 3
3	1. Turn ignition switch to LOCK. 2. Raise and support vehicle such that the rear wheels are approximately 152 mm (6 in.) off the floor. 3. Spin both rear wheels and confirm physical condition of base brake system. Can both rear wheels be spun freely by hand?	-	Go to Step 4	Go to Step 9
4	1. Turn ignition switch to ON. 2. Select "Rear Motor Apply" with the manual control function of the scan tool. 3. Apply firm pressure to the brake pedal. 4. Apply the rear motor with the scan tool. 5. Have an assistant try to spin the rear wheels by hand. Can the rear wheels be spun by hand?	-	Go to Step 5	Go to "Diagnostic Aids"
5	1. Maintain firm pressure on the brake pedal. 2. Use the scan tool to release the rear motor. Can the wheels be moved?	-	Go to Step 6	Go to Step 10
6	1. Use the scan tool to perform the gear tension relief test. 2. Turn the ignition switch to LOCK. 3. Remove the hydraulic modulator/motor pack assembly. 4. Separate the motor pack from the hydraulic modulator. 5. Connect the motor pack wiring. 6. Turn the ignition switch to ON. 7. Perform the motor test with the scan tool. Do all three motor pack gears (small gears) spin freely?	-	Go to Step 7	Go to Step 8
7	Replace the hydraulic modulator. Is the repair complete?	-	System OK	-
8	Replace the motor pack. Is the repair complete?	-	System OK	-
9	Replace the source of the resistance in the base brake system. Is the repair complete?	-	System OK	-
10	Repair the crossed wires at the rear motor circuit. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A055 EBCM MALFUNCTION

Circuit Description

This DTC identifies a malfunction detected by the MDI custom IC. It also insures that the cause of the malfunction is not a result of a problem with the enable relay under a DTC A055 malfunction.

Diagnosis

This test checks for a failure of the EBCM internal circuitry. It also performs fail-safe diagnostics.

Cause(s)

- The EBCM is faulty.

Fail Action

The EBCM will not operate properly and ABS is unpredictable. ABS is therefore disabled and the ABS warning lamp is turned on. The brake warning lamp is turned on if the rear piston is not at the top of the bore, since this could cause degradation of the base brakes.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

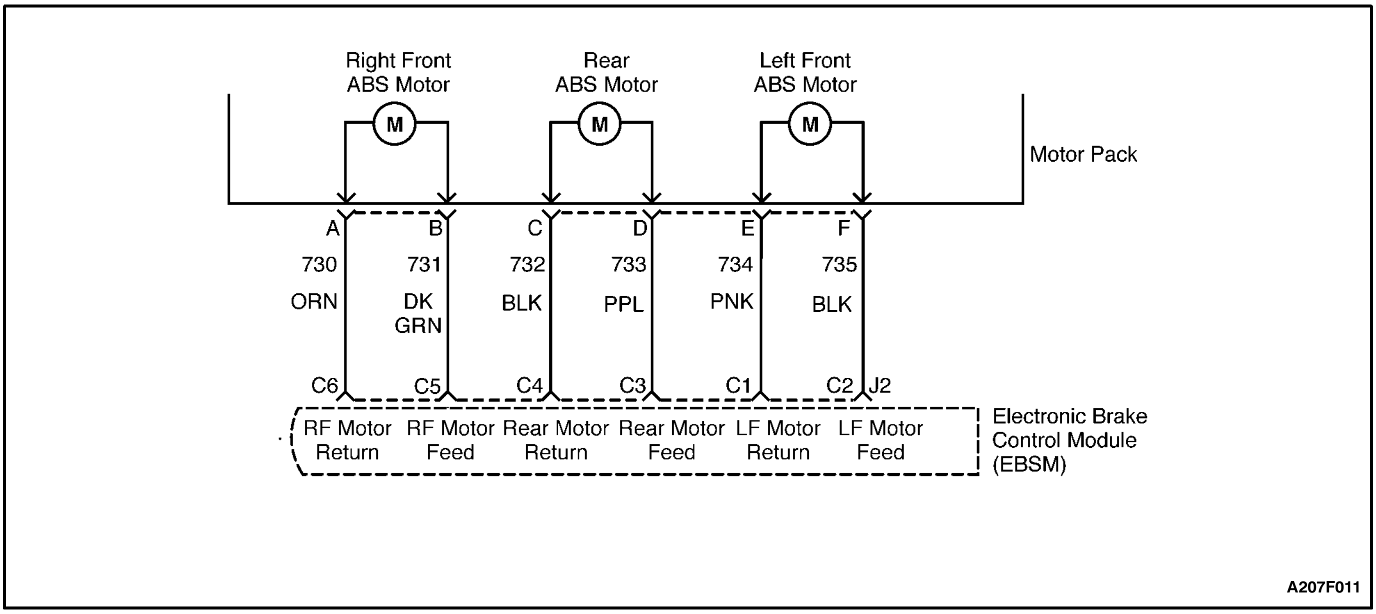
1. This checks to see if the malfunction is still present.
2. This step checks to see if the malfunction is intermittent.

Diagnostic Aids

Check the frequency of the malfunction by using the enhanced diagnostic function of the scan tool as described in “Scan Tool Diagnostics.”

DTC A055 – EBCM Malfunction

Step	Action	Value(s)	Yes	No
1	Turn the ignition switch to ON. Read any DTCs on the scan tool. Is DTC A055 currently set?	-	Go to Step 2	Go to "Diagnostic Aids"
2	Clear the DTCs with the scan tool. Test drive the vehicle for three drive cycles. A drive cycle consists of turning the ignition ON, driving the vehicle over 16 km/h (10 mph), then turning the ignition OFF. Does DTC A055 reset?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Replace the EBCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A056 LEFT FRONT MOTOR CIRCUIT OPEN

Circuit Description

This DTC identifies a motor that cannot be energized due to an open in its circuitry.

Diagnosis

This test will detect an open in the left front motor circuit any time the motor is off and the system is enabled.

Cause(s)

- An open exists in the wiring from the EBCM to the motor.
- The motor armature winding is open or has high resistance.
- There is a poor contact at the EBCM or at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper resistance of the motor.
3. This step checks for an open in the motor feed circuitry.
4. This step checks for an open in the motor return circuitry.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

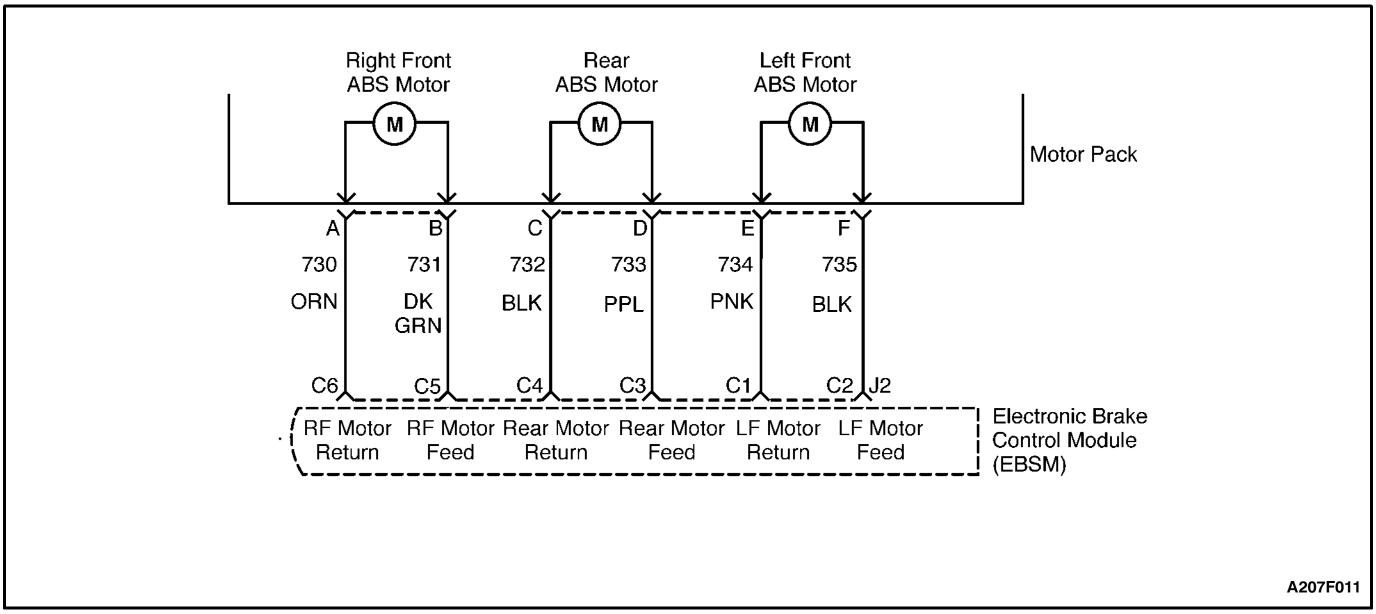
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A056 – Left Front Motor Circuit Open

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC A056. Does DTC A056 occur intermittently?	-	Go to “Diagnostic Aids”	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack. 3. Use a digital voltmeter (DVM) to measure the resistance across motor pack terminals E and F. Is the resistance below the specified value?	2000 W	Go to Step 3	Go to Step 9
3	1. Disconnect the EBCM connector J2. 2. Use a DVM to measure the resistance between terminal C2 of EBCM harness connector J2 and terminal F of the motor pack. Is the resistance below the specified value?	2 W	Go to Step 4	Go to Step 10
4	Use a DVM to measure the resistance between terminal C1 of the EBCM harness connector J2 and terminal E of the motor pack harness connector. Is the resistance below the specified value?	2 W	Go to Step 5	Go to Step 8
5	Check for a poor contact or corrosion at the EBCM connector J2 and at the motor pack connector. Are all contacts in good condition?	-	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair or replace the connectors showing contact problems. Is the repair complete?	-	System OK	-
8	Repair the open or high resistance in circuit PNK. Is the repair complete?	-	System OK	-
9	Replace the motor pack. Is the repair complete?	-	System OK	-
10	Repair the open or high resistance in circuit BLK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A057 LEFT FRONT MOTOR CIRCUIT SHORTED TO GROUND

Circuit Description

This DTC identifies a motor circuit that is shorted to ground. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the driver circuit to allow current directly to ground.

Diagnosis

This test will identify a situation in which a short to ground exists in the left front motor circuit.

Cause(s)

- There is a short to ground in the wiring from the EBCM to the motor.
- The motor armature winding is grounded (low resistance to ground).
- There is a short to ground at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for a short to ground in the motor feed circuit.
3. This step checks for a short to ground in the motor return circuit.
4. This step checks for a motor that is internally shorted to ground.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

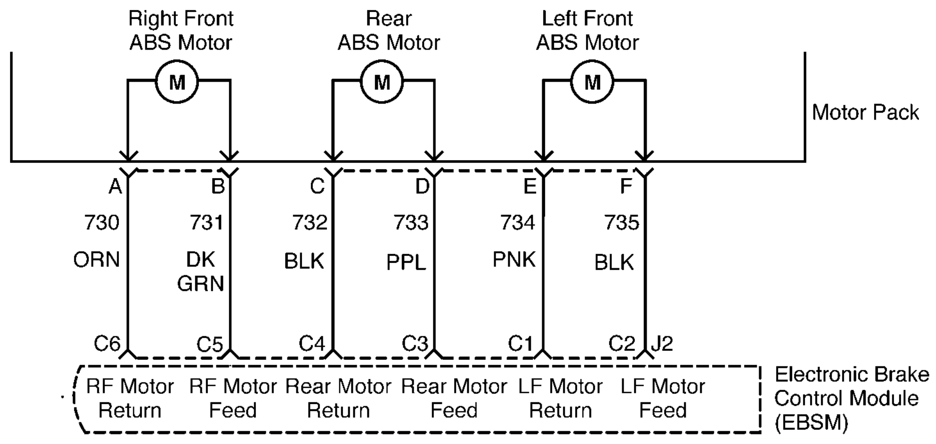
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A057 – Left Front Motor Circuit Shorted to Ground

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A057. Does DTC A057 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between ground and terminal F of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 7
3	Measure the resistance between ground and terminal E of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 4	Go to Step 8
4	Measure the resistance between ground and terminal F of the motor pack. Does the DVM show the specified value?	R	Go to Step 5	Go to Step 6
5	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
6	Replace the motor pack. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit BLK. Is the repair complete?	-	System OK	-
8	Repair the short to ground in circuit PNK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A058
LEFT FRONT MOTOR CIRCUIT SHORTED TO BATTERY OR MOTOR SHORTED

Circuit Description

This DTC identifies a motor circuit that is shorted to the battery or a motor that has low or no resistance. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the motor to turn in the opposite direction or not at all.

Diagnosis

This test will detect a short to the battery in the left front motor circuitry.

Cause(s)

- There is a short to battery in the wiring from the EBCM to the motor.
- The motor armature winding has low/no resistance.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for a short to voltage in the motor feed circuitry.
4. This step checks for a short to voltage in the motor return circuitry.
5. This step checks for a motor that is internally shorted.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or “jumpy” brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

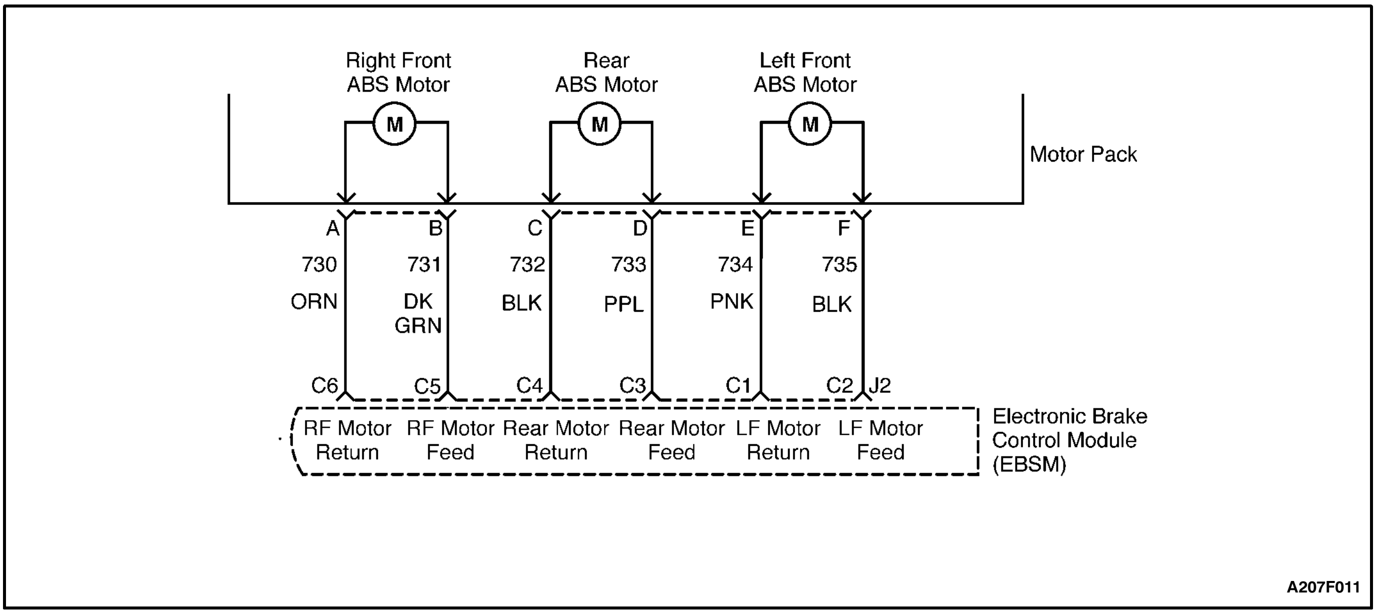
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

DTC A058 – Left Front Motor Circuit Shorted to Battery or Motor Shorted

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A058. Does DTC A058 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	Check the scan tool for DTC code A036. Is DTC A036 also set?	-	Go to DTC A036 chart	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal F of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 4	Go to Step 8
4	Measure the voltage between ground and terminal E of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 5	Go to Step 9
5	1. Turn the ignition switch to LOCK. 2. Use a DVM to measure the resistance between terminal E and terminal F of the motor pack. Is this resistance greater than the specified value?	0.4 W	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Replace the motor pack. Is the repair complete?	-	System OK	-
8	Repair the short to voltage in circuit BLK. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in circuit PNK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A061 RIGHT FRONT MOTOR CIRCUIT OPEN

Circuit Description

This DTC identifies a motor that cannot be energized due to an open in its circuitry.

Diagnosis

This test will detect an open in the right front motor circuit any time the motor is off and the system is enabled.

Cause(s)

- An open exists in the wiring from the EBCM to the motor.
- The motor armature winding is open or has high resistance.
- There is a poor contact at the EBCM or at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper resistance of the motor.
3. This step checks for an open in the motor feed circuitry.
4. This step checks for an open in the motor return circuitry.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

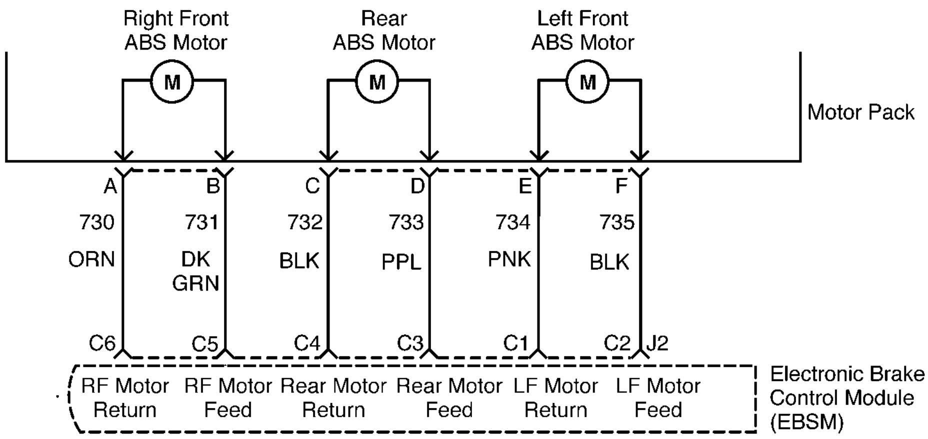
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

DTC A061 – Right Front Motor Circuit Open

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A061. Does DTC A061 occur intermittently?	-	Go to “Diagnostic Aids”	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack. 3. Use a digital voltmeter (DVM) to measure the resistance across motor pack terminals A and B. Is the resistance below the specified value?	2000 W	Go to Step 3	Go to Step 9
3	1. Disconnect the EBCM connector J2. 2. Use a DVM to measure the resistance between terminal C5 of the EBCM harness connector J2 and terminal B of the motor pack. Is the resistance below the specified value?	2 W	Go to Step 4	Go to Step 10
4	Use a DVM to measure the resistance between terminal C6 of the EBCM harness connector J2 and terminal A of the motor pack harness connector. Is the resistance below the specified value?	2 W	Go to Step 5	Go to Step 8
5	Check for a poor contact or corrosion at the EBCM connector J2 and at the motor pack connector. Are all contacts in good condition?	-	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair or replace any connectors showing contact problems. Is the repair complete?	-	System OK	-
8	Repair the open or high resistance in circuit ORN. Is the repair complete?	-	System OK	-
9	Replace the motor pack. Is the repair complete?	-	System OK	-
10	Repair the open or high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A062
RIGHT FRONT MOTOR CIRCUIT SHORTED TO GROUND

Circuit Description

This DTC identifies a motor circuit that is shorted to ground. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the driver circuit to allow current directly to ground.

Diagnosis

This test will identify a situation in which a short to ground exists in the right front motor circuit.

Cause(s)

- There is a short to ground in the wiring from the EBCM to the motor.
- The motor armature winding is grounded (low resistance to ground).
- There is a short to ground at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for a short to ground in the motor feed circuit.
3. This step checks for a short to ground in the motor return circuit.
4. This step checks for a motor that is internally shorted to ground.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

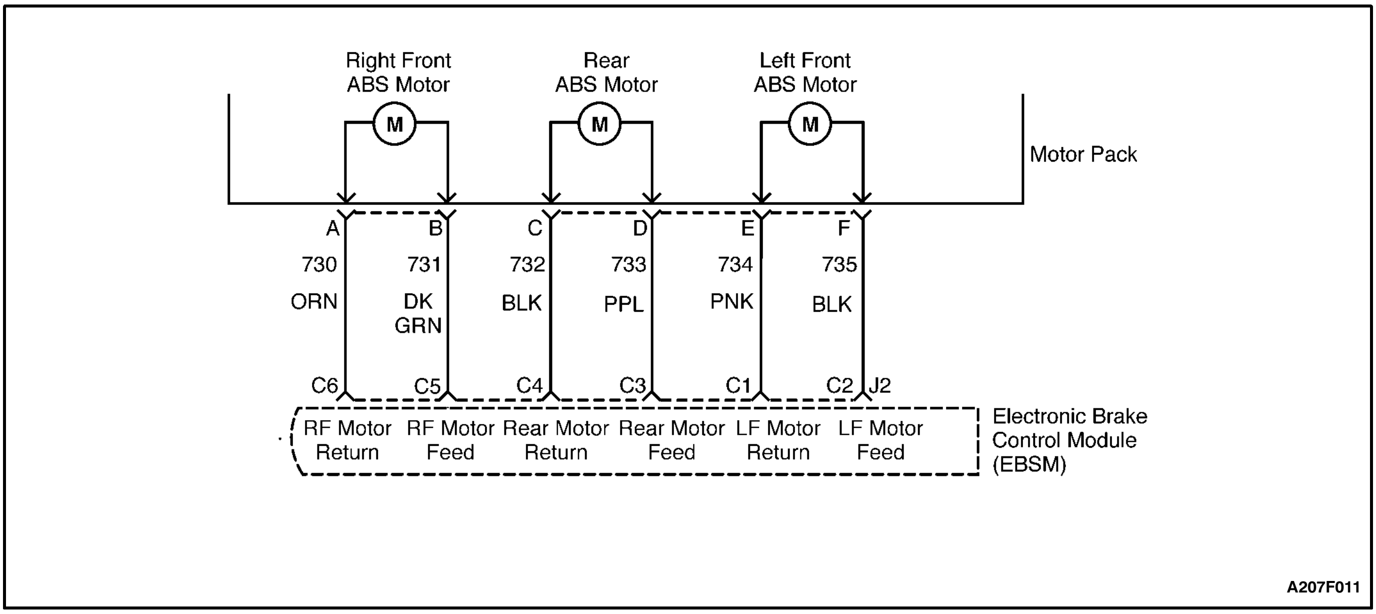
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A062 – Right Front Motor Circuit Shorted to Ground

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A062. Does DTC A062 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between ground and terminal B of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 7
3	Measure the resistance between ground and terminal A of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 4	Go to Step 8
4	Measure the resistance between ground and terminal B of the motor pack. Does the DVM show the specified value?	R	Go to Step 5	Go to Step 6
5	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
6	Replace the motor pack. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit DK GRN. Is the repair complete?	-	System OK	-
8	Repair the short to ground in circuit ORN. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A063 RIGHT FRONT MOTOR CIRCUIT SHORTED TO BATTERY OR MOTOR SHORTED

Circuit Description

This DTC identifies a motor circuit that is shorted to the battery or a motor that has low or no resistance. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the motor to turn in the opposite direction or not at all.

Diagnosis

This test will detect a short to the battery in the right front motor circuitry.

Cause(s)

- There is a short to battery in the wiring from the EBCM to the motor.
- The motor armature winding has low/no resistance.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for a short to voltage in the motor feed circuitry.
4. This step checks for a short to voltage in the motor return circuitry.
5. This step checks for a motor that is internally shorted.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

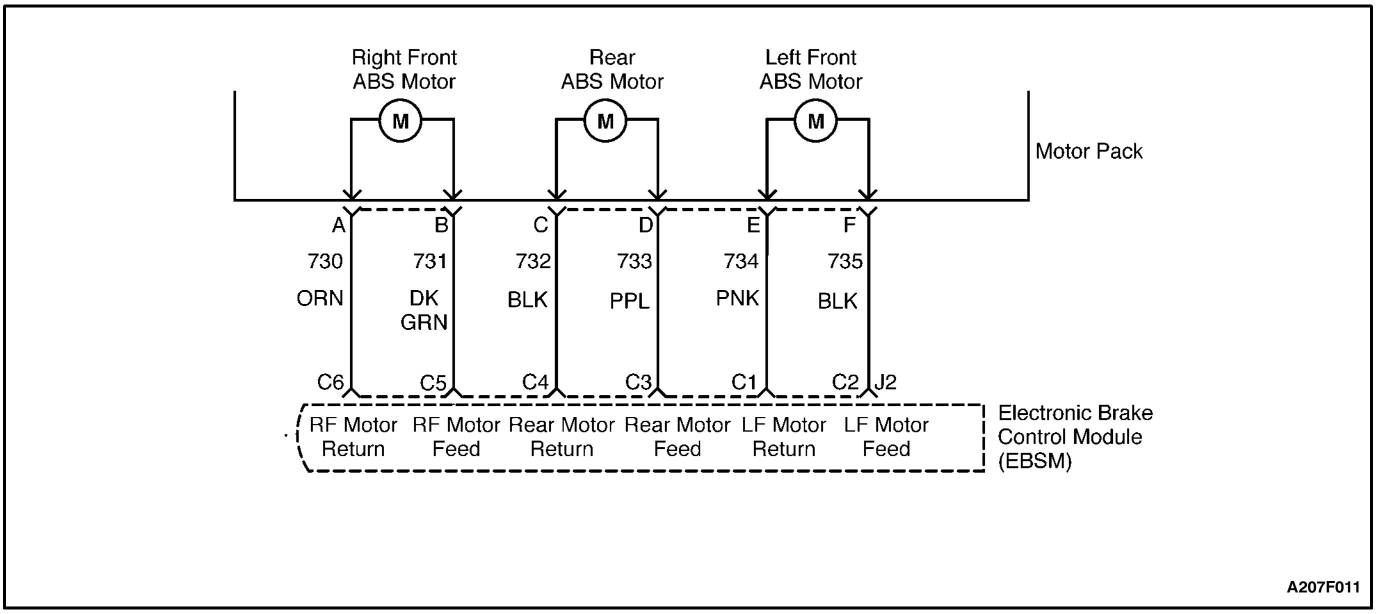
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A063 – Right Front Motor Circuit Shorted to Battery or Motor Shorted

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A063. Does DTC A063 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	Check the scan tool for DTC A036. Is DTC A036 also set?	-	Go to DTC A036 chart	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal B of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 4	Go to Step 8
4	Measure the voltage between ground and terminal A of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 5	Go to Step 9
5	1. Turn the ignition switch to LOCK. 2. Use a DVM to measure the resistance between terminal A and terminal B of the motor pack. Is this resistance greater than the specified value?	0.4 W	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Replace the motor pack. Is the repair complete?	-	System OK	-
8	Repair the short to voltage in circuit DK GRN. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in circuit ORN. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A064 REAR AXLE MOTOR CIRCUIT OPEN

Circuit Description

This DTC identifies a motor that cannot be energized due to an open in its circuitry.

Diagnosis

This test will detect an open in the rear axle motor circuit any time the motor is off and the system is enabled.

Cause(s)

- An open exists in the wiring from the EBCM to the motor.
- The motor armature winding is open or has high resistance.
- There is a poor contact at the EBCM or at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for proper resistance of the motor.
3. This step checks for an open in the motor feed circuitry.
4. This step checks for an open in the motor return circuitry.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

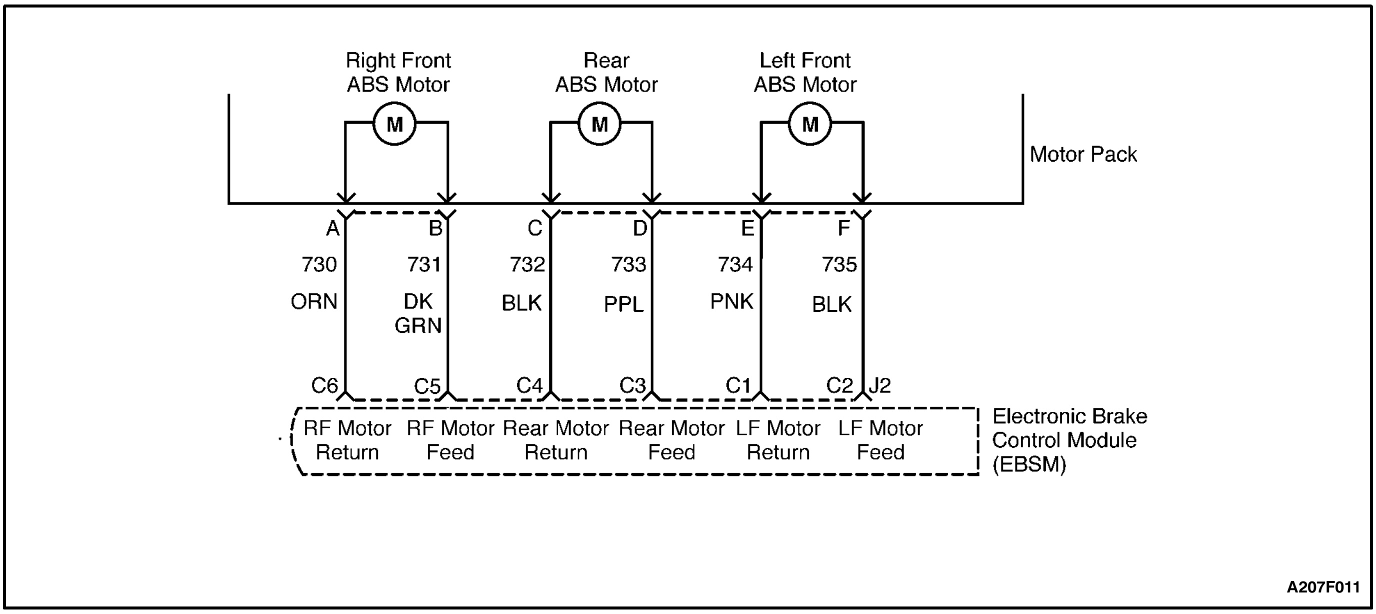
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A064 – Rear Axle Motor Circuit Open

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A064. Does DTC A064 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack. 3. Use a digital voltmeter (DVM) to measure the resistance across motor pack terminals C and D. Is the resistance below the specified value?	2000 W	Go to Step 3	Go to Step 9
3	1. Disconnect the EBCM connector J2. 2. Use a DVM to measure the resistance between terminal C3 of the EBCM harness connector J2 and terminal D of the motor pack. Is the resistance below the specified value?	2 W	Go to Step 4	Go to Step 10
4	Use a DVM to measure the resistance between terminal C4 of the EBCM harness connector J2 and terminal C of the motor pack harness connector. Is the resistance below the specified value?	2 W	Go to Step 5	Go to Step 8
5	Check for a poor contact or corrosion at the EBCM connector J2 and at the motor pack connector. Are all contacts in good condition?	-	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair or replace any connectors showing contact problems. Is the repair complete?	-	System OK	-
8	Repair the open or high resistance in circuit BLK. Is the repair complete?	-	System OK	-
9	Replace the motor pack. Is the repair complete?	-	System OK	-
10	Repair the open or high resistance in circuit PPL. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A065 REAR AXLE MOTOR CIRCUIT SHORTED TO GROUND

Circuit Description

This DTC identifies a motor circuit that is shorted to ground. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the driver circuit to allow current directly to ground.

Diagnosis

This test will identify a situation in which a short to ground exists in the rear axle motor circuit.

Cause(s)

- There is a short to ground in the wiring from the EBCM to the motor.
- The motor armature winding is grounded (low resistance to ground).
- There is a short to ground at the motor pack connector.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position. The brake warning lamp is also turned on if the rear axle piston is not in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for a short to ground in the motor feed circuit.
3. This step checks for a short to ground in the motor return circuit.
4. This step checks for a motor that is internally shorted to ground.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or "jumpy" brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

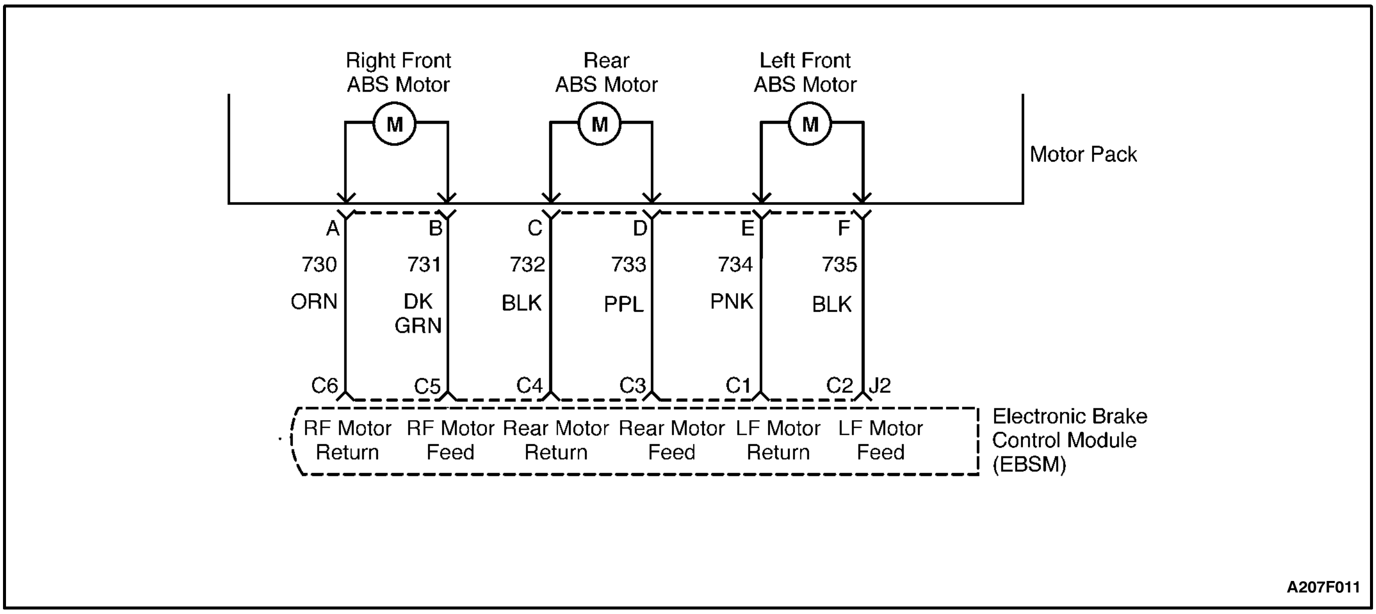
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A065 – Rear Axle Motor Circuit Shorted to Ground

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A065. Does DTC A065 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Use a digital voltmeter (DVM) to measure the resistance between ground and terminal D of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 3	Go to Step 7
3	Measure the resistance between ground and terminal C of the motor pack harness connector. Does the DVM show the specified value?	R	Go to Step 4	Go to Step 8
4	Measure the resistance between ground and terminal D of the motor pack. Does the DVM show the specified value?	R	Go to Step 5	Go to Step 6
5	Replace the EBCM and recheck the ABS system. Is the repair complete?	-	System OK	-
6	Replace the motor pack. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit PPL. Is the repair complete?	-	System OK	-
8	Repair the short to ground in circuit BLK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A066 REAR AXLE MOTOR CIRCUIT SHORTED TO BATTERY OR MOTOR SHORTED

Circuit Description

This DTC identifies a motor circuit that is shorted to the battery or a motor that has low or no resistance. This malfunction will prevent the motor from being controlled at the commanded current rate or will cause the motor to turn in the opposite direction or not at all.

Diagnosis

This test will detect a short to the battery in the rear axle motor circuitry.

Cause(s)

- There is a short to battery in the wiring from the EBCM to the motor.
- The motor armature winding has low/no resistance.
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. A rehome is commanded on the other two channels to ensure that they are in the home position. The brake warning lamp is also turned on if the rear axle piston is not in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for a short to voltage in the motor feed circuitry.
4. This step checks for a short to voltage in the motor return circuitry.
5. This step checks for a motor that is internally shorted.

Diagnostic Aids

Select the manual control function of the scan tool to exercise motor movement of the affected channel in both directions while applying light pressure on the brake pedal. If erratic or “jumpy” brake pedal movement is detected while performing an APPLY or a RELEASE function on the motor, an intermittent malfunction may be indicated.

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or the connections.

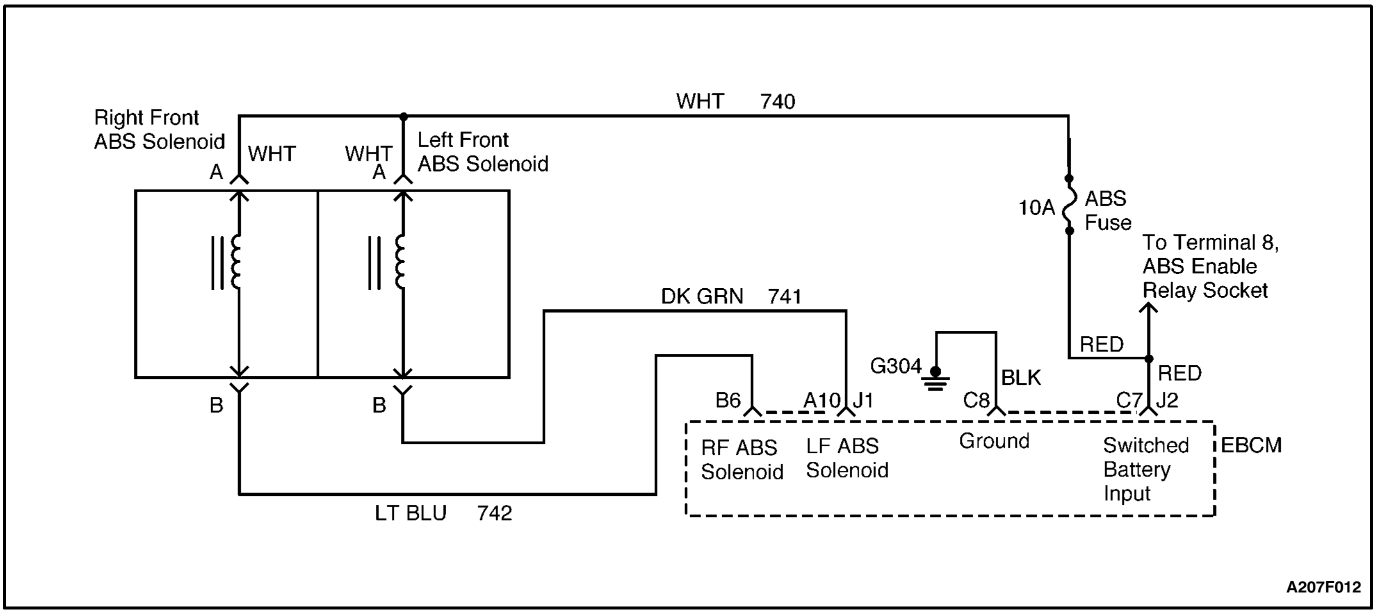
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A066 – Rear Axle Motor Circuit Shorted to Battery or Motor Shorted

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A066. Does DTC A066 occur intermittently?	-	Go to "Diagnostic Aids"	Go to Step 2
2	Check the scan tool for DTC code A036. Is DTC A036 also set?	-	Go to DTC A036 chart	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Disconnect the connector from the motor pack and the EBCM connector J2. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal D of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 4	Go to Step 8
4	Measure the voltage between ground and terminal C of the motor pack harness connector. Is the voltage below the specified value?	1 v	Go to Step 5	Go to Step 9
5	1. Turn the ignition switch to LOCK. 2. Use a DVM to measure the resistance between terminal C and terminal D of the motor pack. Is this resistance greater than the specified value?	0.4 W	Go to Step 6	Go to Step 7
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Replace the motor pack. Is the repair complete?	-	System OK	-
8	Repair the short to voltage in circuit PPL. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in circuit BLK. Is the repair complete?	-	System OK	-

After all diagnosis is complete, clear the DTCs and test drive the vehicle for three drive cycles to verify that the DTC does not reset. A drive cycle consists of starting the vehicle, driving over 16 km/h (10 mph), and then turning off the ignition.



DIAGNOSTIC TROUBLE CODE (DTC) A076
LEFT FRONT SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND

Circuit Description

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to ground in its circuitry between the driver and the solenoid. An open will prevent proper ABS operation, but the short to ground simply turns the solenoid ON. A path for base brakes is still allowed once the motor rehomes and the check ball is lifted off its seat during ignition ON initialization.

Diagnosis

This test detects a short to ground or open in the left front solenoid circuitry. The open will prevent proper ABS operation, but the short to ground simply turns on the solenoid. The system can not differentiate between the two faults.

Cause(s)

- The solenoid connector is open.
- There is a short to ground in the solenoid control circuitry.
- There is an open in the solenoid control circuitry.
- There is an open in the solenoid or battery circuit.
- The solenoid is defective (high/infinite coil resistance).
- The EBCM is faulty.

Fault Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The system commands a rehome to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This checks for a short to ground in the control circuitry of the solenoid.
2. This checks for an open in the control circuit of the solenoid.
3. This step checks the solenoid coil for proper resistance.
4. This step checks for an open in the solenoid voltage supply.
5. This step checks for a possible intermittent malfunction in the solenoid circuitry due to a poor terminal contact.

Diagnostic Aids

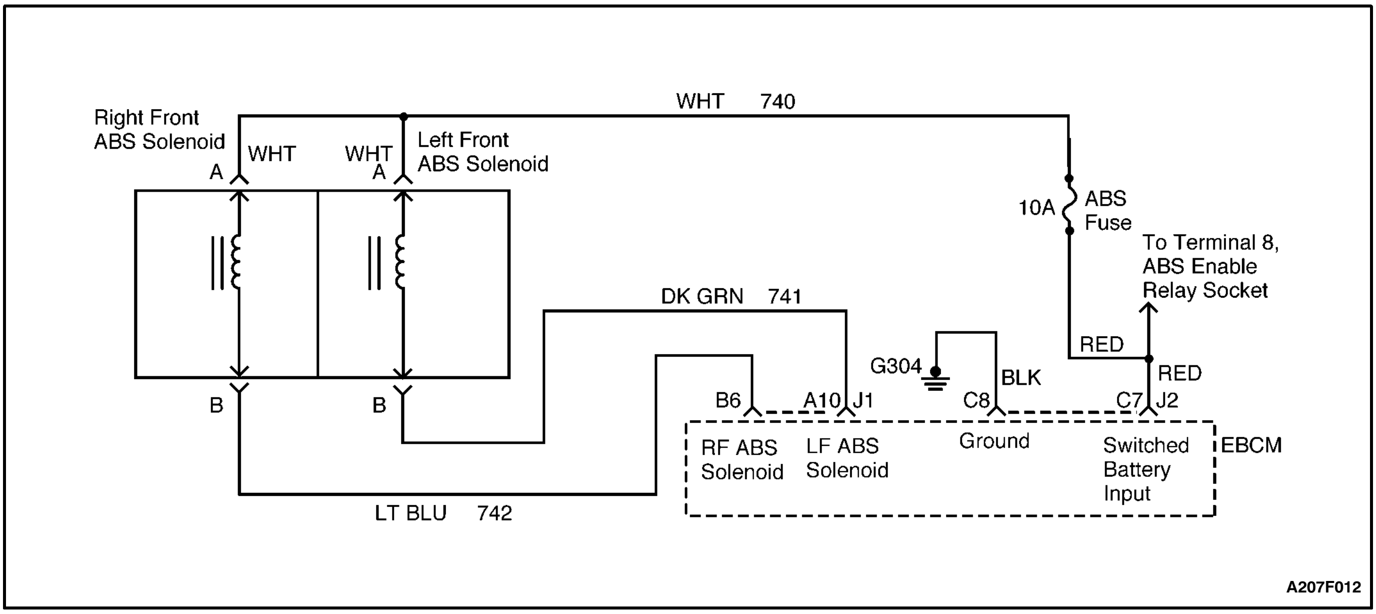
An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A076 – Left Front Solenoid Circuit Open or Shorted to Ground

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. Do not start the engine. 4. Use a digital voltmeter (DVM) to measure the resistance between ground and terminal A10 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 2	Go to Step 7
2	1. Turn the ignition switch to LOCK. 2. Disconnect the left front solenoid connector. 3. Use a DVM to measure the resistance between terminal A10 of the EBCM harness connector J1 and the terminal of the left front solenoid harness connector fed by the DK GRN wire. Is the resistance no more than the specified value?	2 W	Go to Step 3	Go to Step 8
3	Use a DVM to measure the resistance between the two terminals of the left front solenoid. Is this resistance within the specified value?	2.5-5 W	Go to Step 4	Go to Step 9
4	Use a DVM to measure the resistance between the ABS relay connector terminal 8 and the terminal of the left front solenoid harness connector fed by the WHT wire. Is the resistance no more than the specified value?	2 W	Go to Step 5	Go to Step 10
5	1. Inspect the left front solenoid and the EBCM harness connector J1 terminals for poor terminal contact and evidence of corrosion. 2. Replace any terminals that show signs of poor terminal contact or corrosion. 3. Inspect circuit DK GRN for any damage which may result in a short to ground with all connectors connected. 4. Repair any damage found. 5. Reconnect the solenoid connector and the EBCM connector J1. 6. Turn the ignition switch to ON. 7. Use the scan tool to clear the DTCs. 8. Test drive the vehicle for one drive cycle. Does DTC A076 reset?	-	Go to Step 6	Go to "Diagnostic Aids"
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit DK GRN. Is the repair complete?	-	System OK	-
8	Repair the open or high resistance in circuit DK GRN. Is the repair complete?	-	System OK	-
9	Replace the left front solenoid. Is the repair complete?	-	System OK	-
10	Locate and repair the open or high resistance in circuit WHT-Fuse-RED-ABS relay socket terminal 8. • The 10 amp ABS solenoid fuse is located in the ABS wiring harness between the blower housing and the firewall. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A077 LEFT FRONT SOLENOID CIRCUIT SHORTED TO BATTERY

Circuit Description

This DTC identifies a solenoid that cannot be energized due to a short to voltage in its driver circuitry. These malfunctions can affect ABS operation since the flow of brake fluid to the caliper cannot be stopped, making ABS operation for that channel impossible.

Diagnosis

This test identifies a situation in which a short to battery in the driving circuitry for the left front solenoid prevents energizing the solenoid.

Cause(s)

- The solenoid circuitry is shorted to the battery.
- The solenoid is shorted to the battery internally.
- The solenoid is defective (low coil resistance).
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The system commands a rehome to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This checks for a solenoid that is internally shorted to voltage.
2. This checks for a solenoid that is not within proper resistance values.
3. This step indicates if a short to voltage exists in the solenoid control circuitry.
4. This step checks for a possible intermittent malfunction in the solenoid control circuitry due to connector damage.

Diagnostic Aids

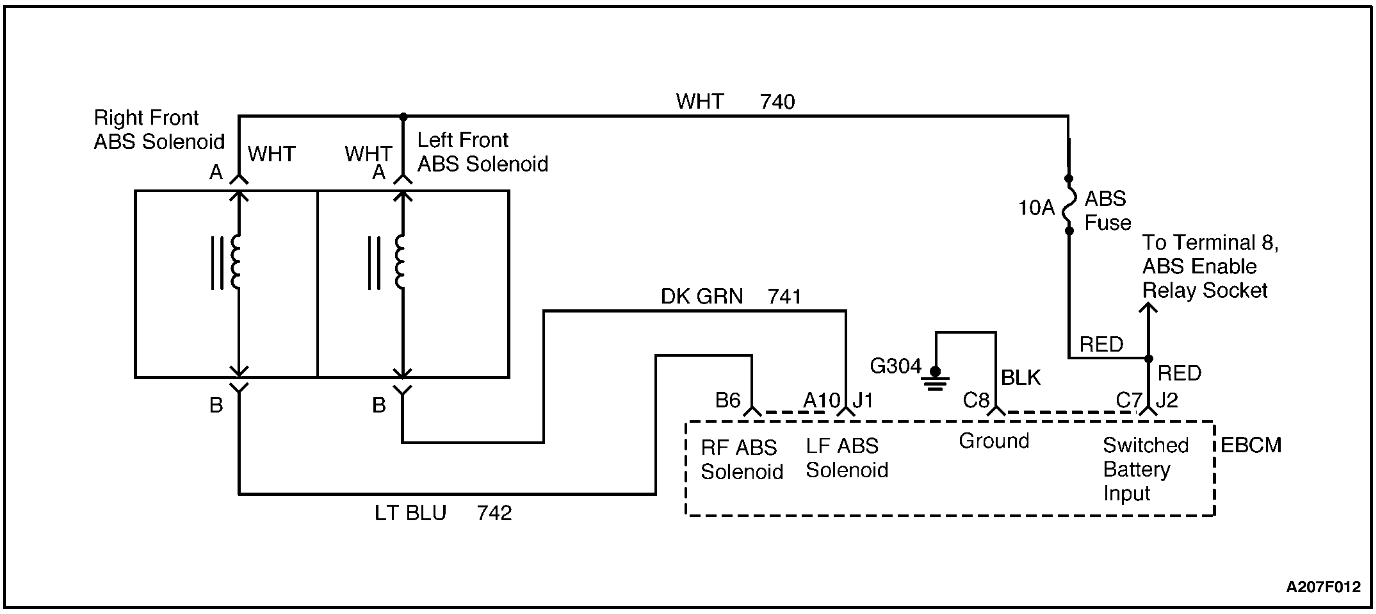
An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A077 – Left Front Solenoid Circuit Shorted to Battery

Step	Action	Value(s)	Yes	No
1	Turn the ignition switch to LOCK. Disconnect the left front solenoid connector. Use a DVM to measure the voltage between ground and the terminal of the left front solenoid connector that is fed by the DK GRN wire. Is the less than the specified limit?	1 v	Go to Step 2	Go to Step 6
2	Use a digital voltmeter (DVM) to measure the resistance between the two terminals of the left front solenoid. Is the resistance within the specified value?	2.5-5 W	Go to Step 3	Go to Step 6
3	Disconnect the EBCM connector J1. Use a DVM to measure the voltage between ground and terminal A10 of the EBCM harness connector J1. Is the resistance less than the specified value?	1 v	Go to Step 4	Go to Step 7
4	1. Inspect circuit DK GRN, the left front solenoid, and connector J1 for damage which may result in a short to voltage with all of the connectors connected. 2. Repair any damage found. 3. Reconnect the solenoid connector and the EBCM connector J1. 4. Turn the ignition switch to ON. 5. Use the scan tool to clear the DTCs. 6. Start the engine with your foot off the brake. 7. Allow the engine to run for at least 10 seconds. Does DTC A077 reset?	-	Go to Step 5	Go to "Diagnostic Aids"
5	Replace the EBCM. Is the repair complete?	-	System OK	-
6	Replace the left front solenoid. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit DK GRN. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A078
RIGHT FRONT SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND

Circuit Description

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to ground in its circuitry between the driver and the solenoid. An open will prevent proper ABS operation, but the short to ground simply turns the solenoid on. A path for base brakes is still allowed once the motor rehomes and the check ball is lifted off its seat during initialization.

Diagnosis

This test detects a short to ground or open in the right front solenoid circuitry. The open will prevent proper ABS operation, but the short to ground simply turns on the solenoid. The system can not differentiate between the two faults.

Cause(s)

- The solenoid connector is open.
- There is a short to ground in the solenoid control circuitry.
- There is an open in the solenoid control circuitry.
- There is an open in the solenoid or battery circuit.
- The solenoid is defective (high/infinite coil resistance).
- The EBCM is faulty.

Fault Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The system commands a rehome to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This checks for a short to ground in the control circuitry of the solenoid.
2. This checks for an open in the control circuit of the solenoid.
3. This step checks the solenoid coil for proper resistance.
4. This step checks for an open in the solenoid voltage supply circuit.
5. This step checks for a possible intermittent malfunction in the solenoid circuitry due to a poor terminal contact.

Diagnostic Aids

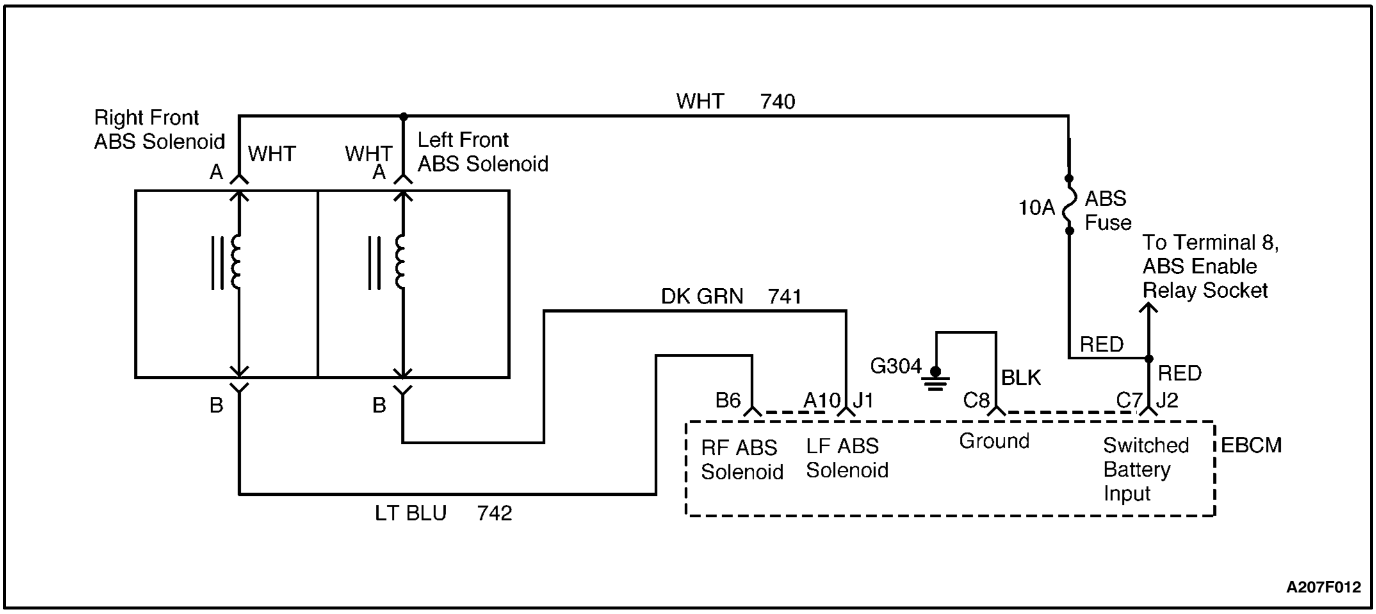
An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A078 – Right Front Solenoid Circuit Open or Shorted to Ground

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM connector J1. 3. Turn the ignition switch to ON. Do not start the engine. 4. Use a digital voltmeter (DVM) to measure the resistance between ground and terminal B6 of the EBCM harness connector J1. Does the DVM show the specified value?	R	Go to Step 2	Go to Step 7
2	1. Turn the ignition switch to LOCK. 2. Disconnect the right front solenoid connector. 3. Use a DVM to measure the resistance between terminal B6 of the EBCM harness connector J1 and the terminal of the right front solenoid harness connector fed by the LT BLU wire. Is the resistance less than the specified value?	2 W	Go to Step 3	Go to Step 8
3	Use a DVM to measure the resistance between the two terminals of the right front solenoid. Is this resistance within the specified value?	2.5-5 W	Go to Step 4	Go to Step 9
4	Use a DVM to measure the resistance between ABS relay connector terminal 8 and the terminal of the right front solenoid harness connector fed by the WHT wire. Is the resistance less than the specified value?	2 W	Go to Step 5	Go to Step 10
5	1. Inspect the right front solenoid and the EBCM connectors J1 for poor terminal contact and evidence of corrosion. 2. Replace any terminals that exhibit signs of poor terminal contact or corrosion. 3. Inspect circuit LT BLU for any damage which may result in a short to ground when all of the connectors are connected. 4. Repair any damage found. 5. Reconnect the solenoid connector and the EBCM connector J1. 6. Turn the ignition switch to ON. 7. Use the scan tool to clear the DTCs. 8. Test drive the vehicle for one drive cycle. Does DTC A078 reset?	-	Go to Step 6	Go to "Diagnostic Aids"
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair the short to voltage in circuit LT BLU. Is the repair complete?	-	System OK	-
8	Repair the open or high resistance in circuit LT BLU. Is the repair complete?	-	System OK	-
9	Replace the right front solenoid. Is the repair complete?	-	System OK	-
10	Locate and repair the open or high resistance in circuit WHT-fuse-RED-ABS enable relay socket terminal 8. • The ABS solenoid fuse is located in the ABS wiring harness between the blower housing and the firewall. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A081
RIGHT FRONT SOLENOID CIRCUIT SHORTED TO BATTERY

Circuit Description

This DTC identifies a solenoid that cannot be energized due to a short to voltage in its driver circuitry. This malfunction can affect ABS operation since the flow of brake fluid to the caliper cannot be stopped, making ABS operation for that channel impossible.

Diagnosis

This test identifies a situation in which a short to battery in the driving circuitry for the right front solenoid prevents energizing the solenoid.

Cause(s)

- The solenoid circuitry is shorted to the battery.
- The solenoid is shorted to the battery internally.
- The solenoid is defective (low coil resistance).
- The EBCM is malfunctioning.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on. The system commands a rehome to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This checks for a solenoid that is internally shorted to voltage.
2. This checks for a solenoid that is not within proper resistance values.
3. This step indicates if a short to voltage exists in the solenoid circuitry.
4. This step checks for a possible intermittent malfunction in the solenoid control circuitry due to a damaged connector.

Diagnostic Aids

An “intermittent” malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in “Scan Tool Diagnostics.”

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A081 – Right Front Solenoid Circuit Shorted to Battery

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to LOCK. 2. Disconnect the right front solenoid connector. 3. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal A of the right front solenoid. Is the voltage less than the specified value?	1 v	Go to Step 2	Go to Step 6
2	Use a DVM to measure the resistance between the two terminals of the right front solenoid. Is the resistance within the specified value?	2.5-5 W	Go to Step 3	Go to Step 6
3	1. Disconnect the EBCM connector J1. 2. Use a DVM to measure the voltage between ground and terminal B6 of the EBCM harness connector J1. Is the voltage less than the specified value?	1 v	Go to Step 4	Go to Step 7
4	1. Reconnect the solenoid connector and the EBCM connector J1. 2. Turn the ignition switch to ON. 3. Use the scan tool to clear the DTCs. 4. Test drive the vehicle for one drive cycle. Does DTC A081 reset?	-	Go to Step 5	Go to "Diagnostic Aids"
5	Replace the EBCM. Is the repair complete?	-	System OK	-
6	Replace the right front solenoid. Is the repair complete?	-	System OK	-
7	Repair the short to ground in circuit LT BLU. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) A082 CALIBRATION MALFUNCTION

Circuit Description

This DTC allows the EBCM to check for a calibration malfunction by comparing the calibration value to a known value stored in the EEPROM. This DTC is also used as a security measure to prevent improper use of calibrations or changes to these calibrations that may alter the designed function of the ABS.

Diagnosis

This test will identify a situation in which the calibration checksum is not equal to the resident checksum.

Cause(s)

- The calibration is incorrect.
- The calibrations are not programmed.
- The EBCM is faulty.

Fail Action

This is a critical operational fault. The ABS is disabled and the ABS warning lamp is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks to see if the malfunction is present during diagnosis. If present, the EBCM is not functioning correctly and must be replaced.

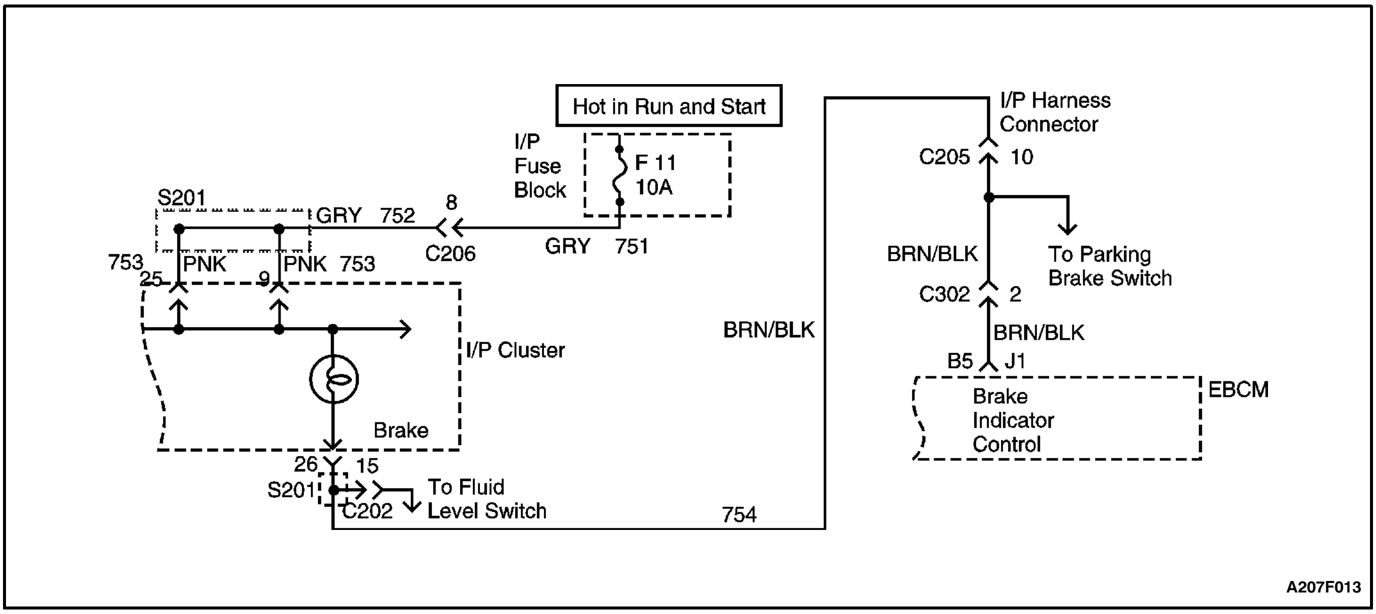
Diagnostic Aids

An "intermittent" DTC A082 may be caused by a bad cell in the EEPROM that is sensitive to temperature changes. If DTC A082 failed more than once, but is intermittent, replace the EBCM.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

DTC A082 – Calibration Malfunction

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Use the scan tool to clear the DTCs. Does DTC 082 reset?	-	Go to Step 2	Go to "Diagnostic Aids"
2	1. Replace the EBCM. 2. Verify the ABS operation. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A086 EBCM TURNED ON THE RED BRAKE WARNING LAMP

Diagnosis

This is an information-only test and reflects the status of the command issued by the ABS EBCM to illuminate the brake warning light.

Fail Action

This test is for service only. It is to distinguish if the brake warning lamp was enabled due to an ABS failure. If another diagnostic test issues a command to illuminate the BRAKE indicator, DTC A086 will be stored in EEPROM as a history DTC at the conclusion of the ignition cycle.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step serves to identify if a DTC other than DTC A086 commanded the BRAKE indicator on.

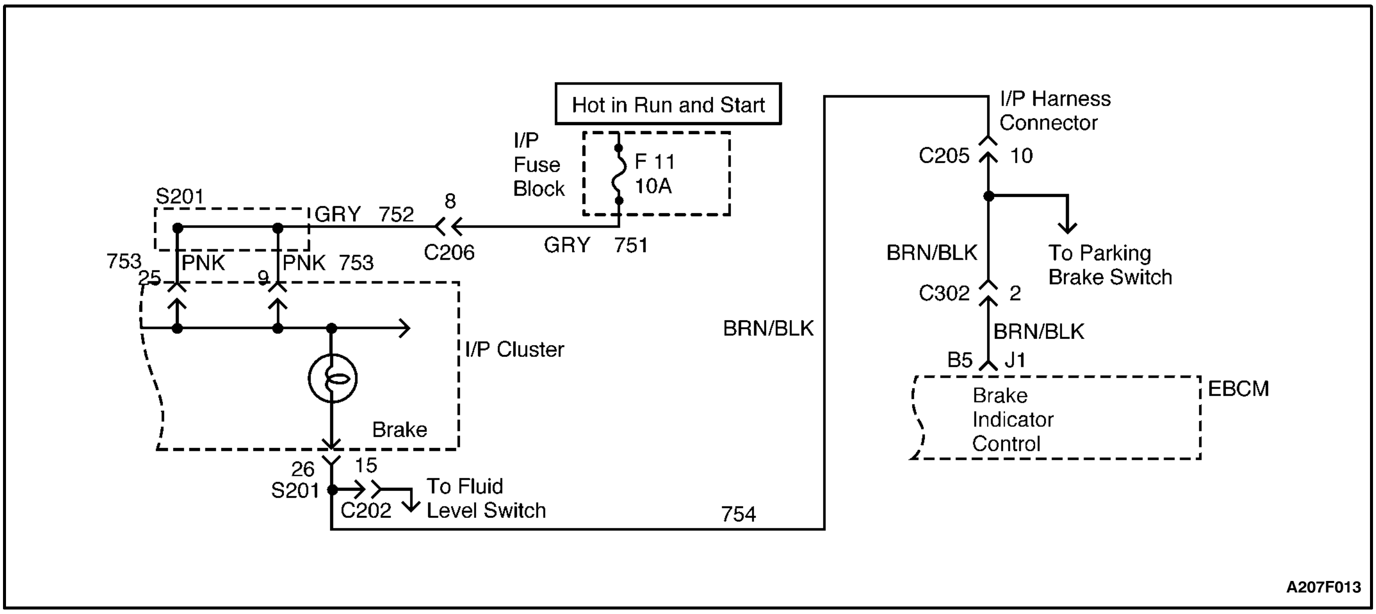
Diagnostic Aids

Any ABS mechanical DTC that issues a command to illuminate the BRAKE indicator will also result in DTC A086 being stored in EEPROM during shut down. These DTCs are A042, A046, and A051. If the motors are not in their home position, certain electrical DTCs will also command the BRAKE indicator on. These DTCs are A014, A016, A018, A036, A055, A064, A065, and A066.

Any other DTCs indicated along with DTC A086 must be corrected prior to addressing a DTC A086 malfunction.

DTC A086 – EBCM Turned on the Red Brake Warning Lamp

Step	Action	Value(s)	Yes	No
1	Check the scan tool for current DTCs. Are there any other DTCs currently set with DTC A086?	-	Go to Step 2	Go to “Diagnostic Aids”
2	Use the scan tool to clear the DTC. Is the DTC cleared?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A087 RED BRAKE WARNING LAMP CIRCUIT OPEN OR SHORT TO BATTERY

Circuit Description

This DTC identifies an open or short to voltage between the EBCM and the red BRAKE warning lamp, or an open driver that prevents the EBCM from turning ON the BRAKE warning lamp. This will occur only if the system detects an ABS malfunction that may degrade base brake operation. Because the ABS is not the only device controlling the BRAKE warning lamp (the parking brake switch or the brake fluid level switch may also turn it ON), the system cannot detect a short to ground in this circuit.

Diagnosis

This test will detect an open or short to battery between the EBCM and the BRAKE warning lamp. A short to battery exists if for 2 seconds the output for the BRAKE warning lamp circuit is greater than 3.43 volts when the lamp is commanded ON. An open is detected when the BRAKE warning lamp voltage is between 3.35 volts and 5.23 volts for more than 2 seconds. This failure prevents the EBCM from illuminating the BRAKE warning lamp.

Cause(s)

- There is a short to battery in the brake warning lamp circuitry.
- The brake warning lamp bulb or fuse is blown.
- The brake warning lamp circuit is open.
- There is high resistance in the parking brake switch.
- There are poor contacts in the EBCM connector J1.
- The EBCM driving circuit is malfunctioning.

Fail Action

Only a history code is stored for this fault. If the ABS is disabled and the brake warning lamp is commanded on to indicate the possibility of base brake degradation, the ABS warning lamp will flash.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step tests whether the BRAKE warning lamp circuitry is open or shorted to voltage.
2. This step checks the complete BRAKE warning lamp circuitry by attempting to turn the BRAKE warning lamp ON manually.
3. This step checks the integrity of the BRAKE warning lamp.
5. This step checks for high resistance in the BRAKE warning lamp control circuitry.
7. This tests for high resistance in the parking brake circuitry.
8. This test checks for a malfunctioning EBCM.
10. This test ensures that the malfunction is not due to a poor terminal contact at the at the brake fluid level switch.
11. This identifies if a malfunction is currently present.
12. This checks for the presence of DTC A086.
14. This test uses a scan tool to attempt to turn on the BRAKE warning lamp.

15. This tests for a short to voltage in the I/P circuitry associated with the BRAKE warning lamp.
17. This ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A087 – Red Brake Warning Lamp Circuit Open or Short to Battery

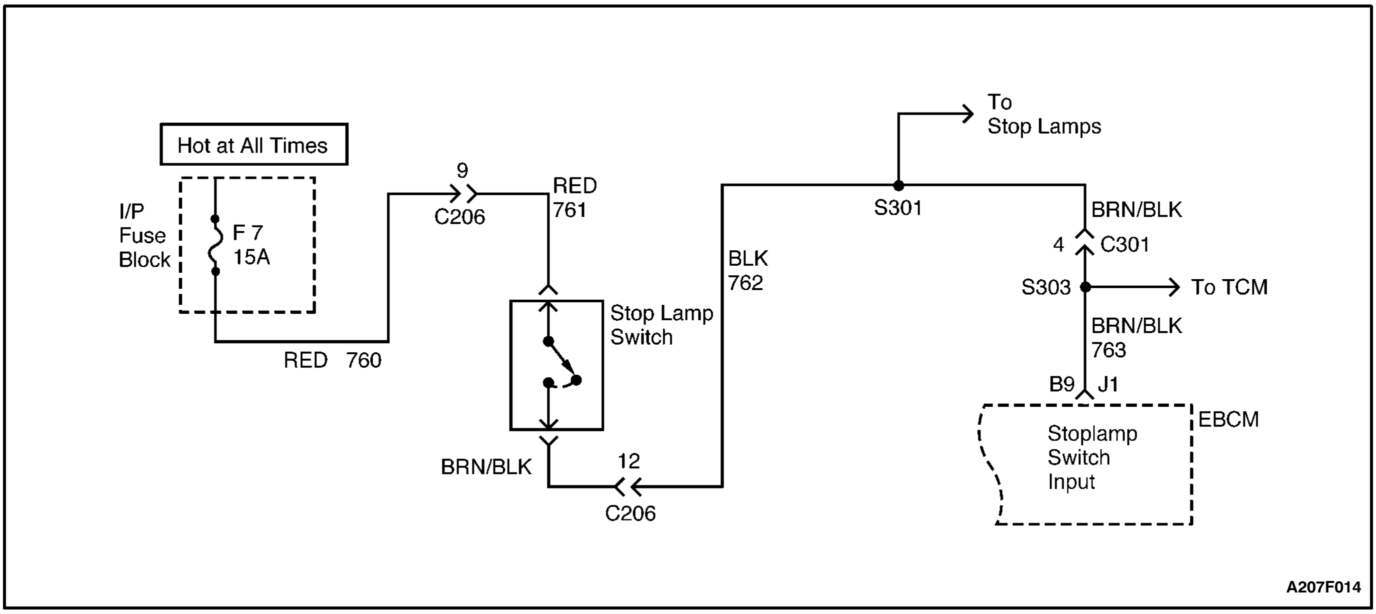
Step	Action	Value(s)	Yes	No
1	1. Turn the ignition to LOCK. 2. Disconnect the EBCM harness connector J1 (24-pin) from the EBCM. 3. Disconnect the 10-pin instrument cluster harness connector from the instrument cluster. 4. Turn the ignition ON. 5. Use a digital voltmeter (DVM) to measure the voltage from ground to terminal B5 of the EBCM harness connector J1. Does the voltage exceed the specified value?	1 v	Go to Step 11	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Reconnect the 10-pin instrument cluster harness connector to the instrument cluster. 3. Use a fused jumper with a 3-amp fuse to connect terminal B5 of the EBCM harness connector J1 to ground. Is the red BRAKE warning lamp ON ?	-	Go to Step 7	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Remove the instrument cluster. 3. Remove and inspect the red BRAKE warning lamp. Is the bulb open?	-	Go to Step 4	Go to Step 5
4	Replace the BRAKE warning lamp. Is the repair complete?	-	System OK	-
5	Use a DVM to measure resistance between terminal 25 of the 10-pin instrument cluster harness connector and terminal B5 of the EBCM harness connector J1. Is the resistance less than the specified value?	2 W	Go to Section 9E, Instrumentation/Driver Information	Go to Step 6
6	Repair the open or high resistance in the circuit from terminal B5 of the EBCM connector J1 to terminal 25 of the 10-pin instrument cluster harness connector.	-	System OK	-
7	1. Check whether the brake fluid is at the proper level in the master cylinder reservoir. Add fluid as needed. 2. Remove the jumper used in Step 2. 3. Apply the parking brake. 4. Turn the ignition ON. 5. Use a DVM to measure the voltage between ground and terminal B5 of the EBCM harness connector J1. Is the voltage less than the specified value?	2 v	Go to Step 8	Go to Section 9E, Instrumentation/Driver Information

DTC A087 – Red Brake Warning Lamp Circuit Open or Short to Battery (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Release the parking brake. 2. Turn the ignition to LOCK. 3. Disconnect the brake fluid level indicator sensor at the cap on the master cylinder reservoir. 4. Inspect terminal B5 of the EBCM harness connector J1 for poor terminal contact or corrosion. Repair as needed. 5. Reconnect the EBCM harness connector J1 to the EBCM. 6. Start the engine. 7. Wait 10 seconds. Does the scan tool indicate that DTC A087 is set as a current DTC?	-	Go to Step 9	Go to Step 10
9	Replace the EBCM. Is the repair complete?	-	System OK	-
10	1. Turn the ignition to LOCK. 2. Inspect the harness connector terminals of the brake fluid level sensor for evidence of corrosion or poor terminal contact. Replace any terminals that exhibit signs of poor terminal contact or corrosion. 3. Reconnect connector to the brake level fluid level sensor. 4. Start the engine. 5. Wait 10 seconds. Does DTC A087 set as a current DTC?	-	Go to Section 9E, Instrumentation/Driver Information	Go to "Diagnostic Aids"
11	1. Turn the ignition to LOCK. 2. Reconnect the 10-pin instrument cluster harness connector to the instrument cluster. 3. Turn the ignition ON. Is the red BRAKE warning lamp OFF?	-	Go to Step 14	Go to Step 12
12	Check the scan tool for DTC code A086. Is DTC A086 also set?	-	Go to DTC A086 table	Go to Step 13
13	Check for low brake fluid level or parking brake switch closed and correct as necessary. Is the repair complete?	-	System OK	-
14	Using the scan tool misc. tests, select "Lamp Test Function," and command the BRAKE lamp ON. Is the lamp on?	-	Go to "Diagnostic Aids"	Go to Step 15
15	1. Turn the ignition to LOCK. 2. Remove the 10 amp fuse F11 in the I/P fuse block. 3. Disconnect the EBCM connector J1. 4. Turn the ignition ON. 5. Use the DVM to measure the voltage between ground and terminal B5 of the EBCM harness connector J1. Is the voltage less than the specified value?	1 v	Go to Step 17	Go to Step 16

DTC A087 – Red Brake Warning Lamp Circuit Open or Short to Battery (Cont'd)

Step	Action	Value(s)	Yes	No
16	Repair the short to voltage in BRAKE lamp circuit between terminal B5 of the EBCM connector J1 and I/P Fuse 11 output. Is the repair complete?	-	System OK	-
17	1. Turn the ignition switch to LOCK. 2. Inspect the circuit from terminal B5 of the EBCM harness connector J1 to terminal 25 of the 10-pin instrument cluster for any damage which may result in a short to voltage with all connectors connected. 3. Repair any damage found. 4. Reconnect all of the connectors. 5. Turn the ignition ON. Does DTC A087 set as a current DTC?	-	Go to Step 18	Go to "Diagnostic Aids"
18	Replace the EBCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A091 OPEN STOPLAMP SWITCH DURING DECELERATION

Circuit Description

This DTC is used to detect an open stoplamp switch in the non-ABS mode. The EBCM looks for deceleration rates that would indicate braking action and verifies this assumption by requiring several repeats of this detection method. In each case, ABS will not be available since no stoplamp switch input is seen.

Diagnosis

This test monitors and calculates the deceleration for each wheel on a continuous basis. A fault is stored if a deceleration of 6.4 km/h/second (4 mph/second) is seen on 3 separate occasions while the stoplamp switch is off. The deceleration must begin above 24 km/h (15 mph) and end below 16 km/h (10 mph).

Cause(s)

- The stoplamp switch is malfunctioning (contacts open all the time).
- The stoplamp switch fuse is blown.
- The power feed circuit for the stoplamp switch is open.
- The EBCM is faulty.

Fail Action

The ABS is not available since the stoplamp switch is not available. The ABS is disabled and the ABS warning lamp is turned on. The system commands a rehome to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This indicates if the EBCM has received the stoplamp switch signal.
3. This step indicates the existence of an open circuit in the stoplamp switch or the rear combination light circuitry.
4. This step traces the open circuit to either the stoplamp switch input circuitry or the EBCM.
11. This step verifies that voltage is available at the stoplamp switch.
15. This step verifies that the stoplamp switch is functioning properly.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A091 – Open Stoplamp Switch During Deceleration

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A095. Is DTC A095 currently set?	-	Go to DTC A095 table	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Select "ABS Data List" on the scan tool. 3. Apply light pressure to the brake pedal while monitoring the brake switch on the scan tool. Does the scan tool indicate stoplamp ON within 25 mm (1 in.) of pedal travel?	-	Go to "Diagnostic Aids"	Go to Step 3
3	Maintain pressure on the brake pedal and observe the stoplamps. Are they lit?	-	Go to Step 4	Go to Step 11
4	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J1. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal B9 of the EBCM harness connector J1 while applying firm pressure to the brake pedal. Is the voltage above the specified value?	10 v	Go to Step 5	Go to Step 8
5	Check for a poor contact at the EBCM harness connector J1, terminal B9. Is the contact bad?	-	Go to Step 6	Go to Step 7
6	Repair the contact at terminal B9 on the EBCM harness connector J1. Is the repair complete?	-	System OK	-
7	Replace the EBCM. Is the repair complete?	-	System OK	-
8	Check BRN/BLK wire terminal of the stoplamp switch connector for a poor connection. Is the connection bad?	-	Go to Step 9	Go to Step 10
9	Repair the connection at BRN/BLK wire terminal of the stoplamp switch connector. Is the repair complete?	-	System OK	-
10	Repair the open or short to ground in the circuit between BRN/BLK wire terminal of the stoplamp switch connector and terminal B9 of the EBCM connector J1. Is the repair complete?	-	System OK	-
11	Use a DVM to measure the voltage between ground and RED wire terminal of the stoplamp switch. Is the voltage greater than the specified value?	10 v	Go to Step 15	Go to Step 12
12	Check for an open in fuse F7. Is the fuse open?	-	Go to Step 13	Go to Step 14
13	Replace fuse F7. Is the repair complete?	-	System OK	-
14	Repair the open or short to ground in the wire between fuse F7 and RED wire terminal of the brake light switch connector. Is the repair complete?	-	System OK	-

DTC A091 – Open Stoplamp Switch During Deceleration (Cont'd)

Step	Action	Value(s)	Yes	No
15	Use a DVM to measure the voltage between ground and BRN/BLK wire terminal of the stoplamp switch while applying firm pressure to the brake pedal. Is the voltage greater than the specified value?	10 v	Go to Step 17	Go to Step 16
16	1. The problem is a misadjusted or faulty stoplamp switch. 2. Adjust or replace the brake light switch as required. Is the repair complete?	-	System OK	-
17	Check BRN/BLK wire terminal of the stoplamp switch connector for a poor connection. Is the connection bad?	-	Go to Step 18	Go to Step 10
18	Correct the poor connection at BRN/BLK wire terminal of the stoplamp switch connector. Is the repair complete?	-	System OK	-

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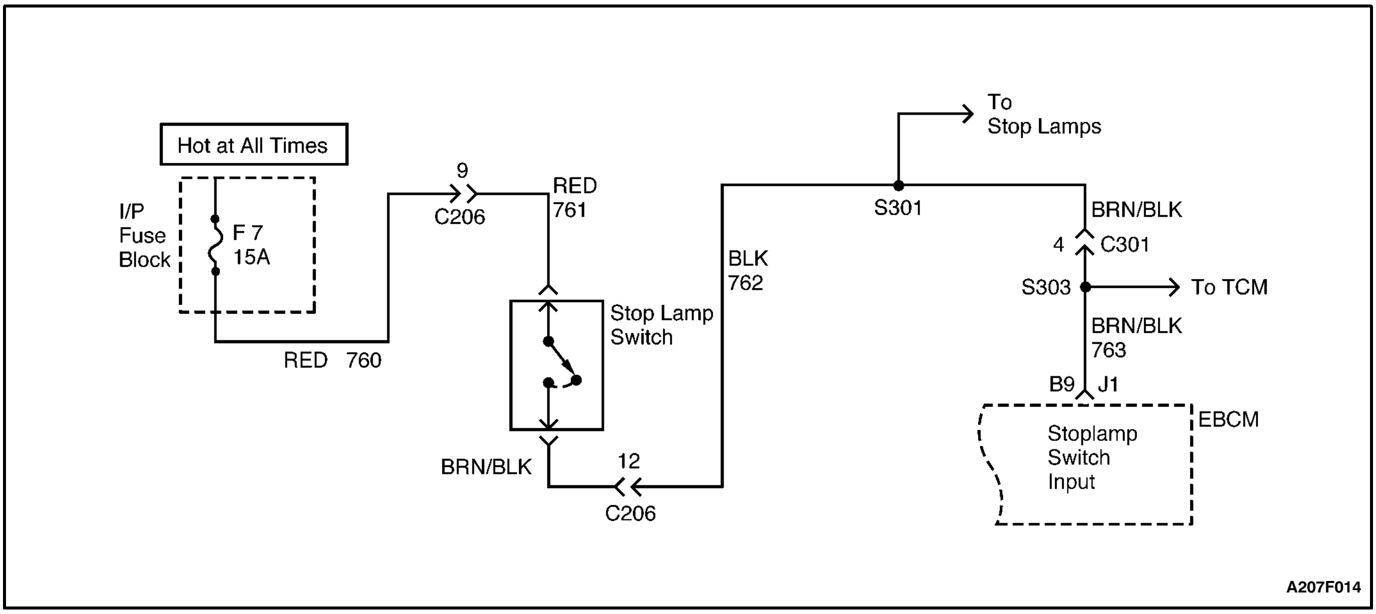

DIAGNOSTIC TROUBLE CODE (DTC) A092
OPEN STOPLAMP SWITCH WHEN ABS WAS REQUIRED

Circuit Description

This DTC is run to determine the proper operation of the stoplamp switch. This is important because ABS is activated when the stoplamp switch is closed. If the stoplamp switch is open, the ABS will never be activated. Since this malfunction is difficult to detect under normal braking conditions, this malfunction is detected only when ABS if required.

Cause(s)

- The stoplamp switch is malfunctioning.
- The stoplamp switch fuse is blown.
- The stoplamp switch fuse power feed circuit is open.
- Two wheel speed sensors have been lost at the same time.
- The EBCM is malfunctioning.

Fail Action

DTC A092 can be set if the vehicle's speed is greater than 8 km/h (5 mph). If the stoplamp switch was not closed and a release was required on two channels for 0.5 seconds, a malfunction exists.

Action Taken

A DTC A092 is stored, ABS is disabled and the ABS indicator is turned on.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This indicates if the EBCM has received the stoplamp switch signal.
3. This step indicates the existence of an open circuit in the stoplamp switch or the rear combination light circuitry.
4. This step isolates the open circuit to either the stoplamp switch input circuitry or the EBCM.
11. This step verifies that voltage is available at the stoplamp switch.
15. This step verifies that the stoplamp switch is functioning properly.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A092 – Open Stoplamp Switch When ABS Was Required

Step	Action	Value(s)	Yes	No
1	Check the scan tool for DTC code A095. Is DTC A095 currently set?	-	Go to DTC A095 table	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Select "ABS Data List" on the scan tool. 3. Apply light pressure to the brake pedal while monitoring the stoplamp switch on the scan tool. Does the scan tool indicate stoplamp switch ON within 25 mm (1 in.) of pedal travel?	-	Go to "Diagnostic Aids"	Go to Step 3
3	Maintain pressure on the brake pedal and observe the stoplamps. Are they lit?	-	Go to Step 4	Go to Step 11
4	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J1. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal B9 of the EBCM harness connector J1 while applying firm pressure to the brake pedal. Is the voltage above the specified value?	10 v	Go to Step 5	Go to Step 8
5	Check for a poor contact at the EBCM harness connector J1, terminal B9. Is the contact bad?	-	Go to Step 6	Go to Step 7
6	Repair the contact at terminal B9 on the EBCM harness connector J1. Is the repair complete?	-	System OK	-
7	Replace the EBCM. Is the repair complete?	-	System OK	-
8	Check BRN/BLK wire terminal of the stoplamp switch connector for a poor connection. Is the connection bad?	-	Go to Step 9	Go to Step 10
9	Repair the connection at the BRN/BLK wire terminal of the stoplamp switch connector. Is the repair complete?	-	System OK	-
10	Repair the open or short to ground between stoplamp switch connector BRN/BLK wire terminal and the EBCM connector J1, terminal B9. Is the repair complete?	-	System OK	-
11	Use a DVM to measure the voltage between ground and RED terminal wire or the stoplamp switch. Is the voltage greater than the specified value?	10 v	Go to Step 15	Go to Step 12
12	Check for an open in fuse F7. Is the fuse open?	-	Go to Step 13	Go to Step 14
13	Replace fuse F7. Is the repair complete?	-	System OK	-
14	Repair the open or short to ground in the wire between fuse F7 and the stoplamp switch. Is the repair complete?	-	System OK	-

DTC A092 – Open Stoplamp Switch When ABS Was Required (Cont'd)

Step	Action	Value(s)	Yes	No
15	Use a DVM to measure the voltage between ground and BRN/BLK wire terminal of the stoplamp switch while applying firm pressure on the brake pedal. Is the voltage greater than the specified value?	10 v	Go to Step 17	Go to Step 16
16	1. The problem is a misadjusted or faulty stoplamp switch. 2. Adjust or replace the stoplamp switch as required. Is the repair complete?	-	System OK	-
17	Check the I/P harness connector BRN/BLK wire terminal for a poor connection? Is the connection bad?	-	Go to Step 18	Go to Step 10
18	Correct the poor connection at the BRN/BLK wire terminal of the I/P harness. Is the repair complete?	-	System OK	-

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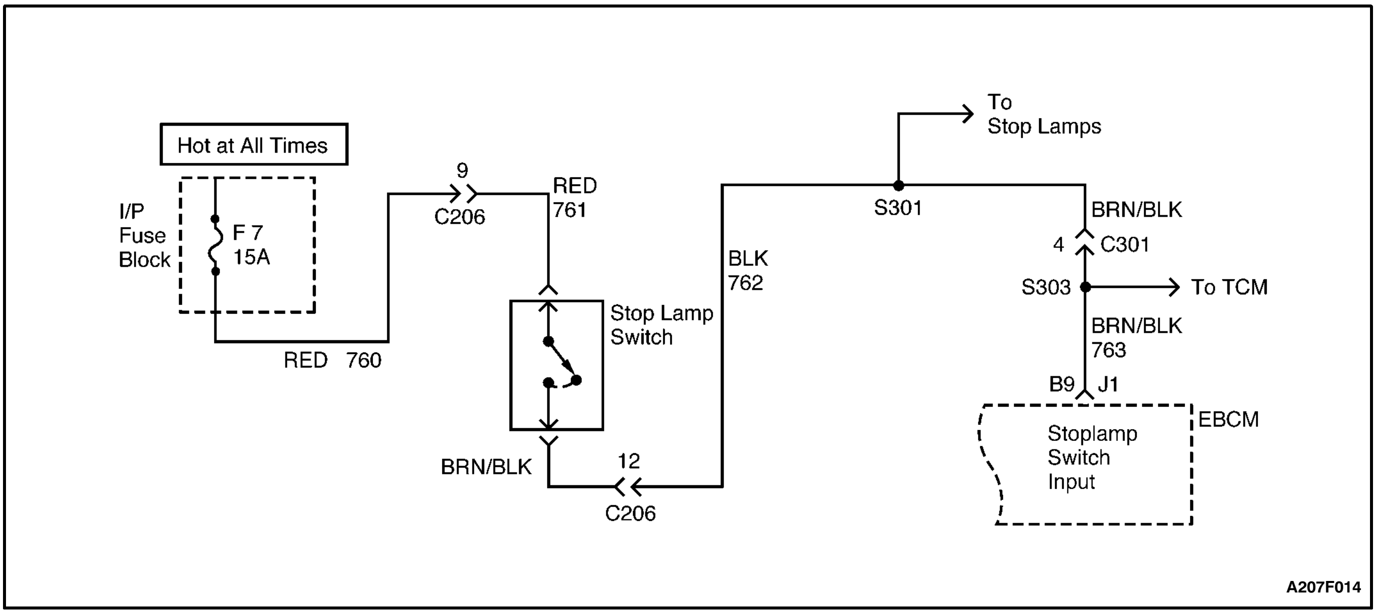


DIAGNOSTIC TROUBLE CODE (DTC) A093
CODE A091 OR A092 SET IN CURRENT OR PREVIOUS IGNITION CYCLE

Diagnosis

The system monitors tests A091 and A092 during the last or current ignition cycle and sees no transition of the brake switch from OFF to ON.

Fail Action

This DTC is the second portion of DTCs A091 and A092. If DTCs A091 or A092 failed during the last ignition cycle, DTC A093 becomes a current failure during the next ignition cycle, keeping the ABS disabled and the ABS warning lamp ON until a brake light switch transition is seen from OFF to ON. When a brake ON is seen during an ignition cycle in which DTC A093 is a current malfunction, the system will enable the ABS at the start of the next ignition cycle. If no transition is seen, DTC A093 will remain a current failure during all following ignition cycles until a transition from OFF to ON is seen.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step indicates which DTC (either A091 or A092) caused DTC A093 to set.
2. This insures that the DTC that set is repaired so that DTC A093 can be cleared.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

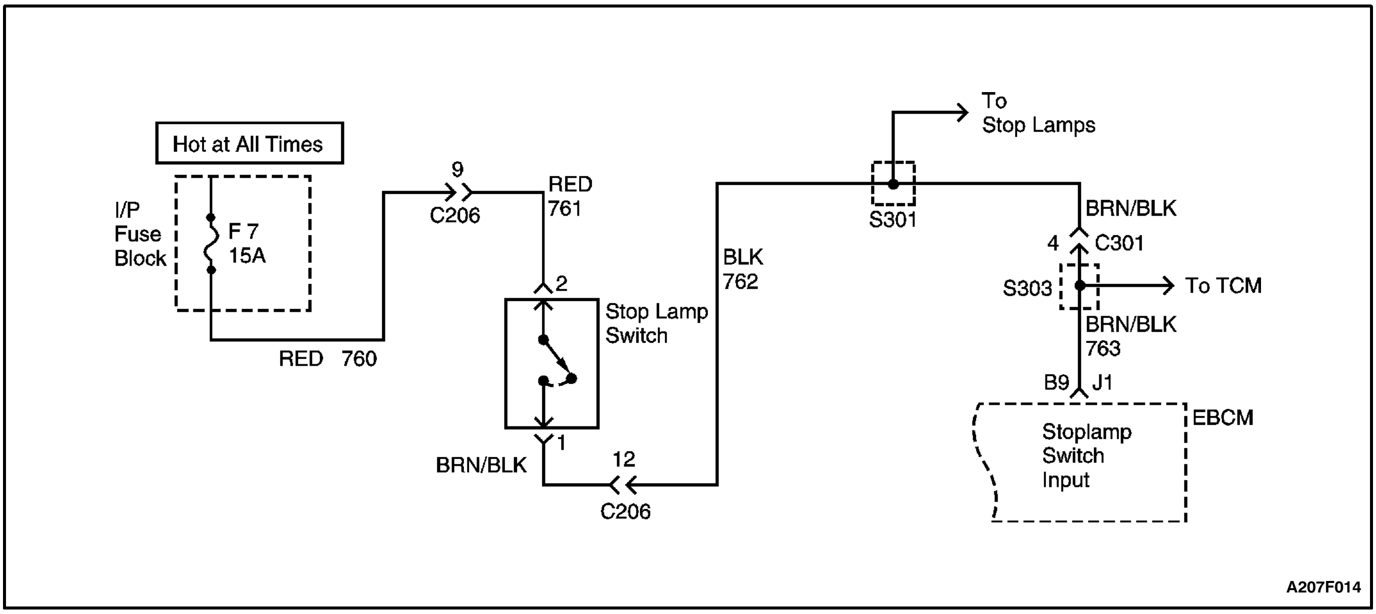
Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

Verify proper brake light switch operation with the Data List of the scan tool. As the brake is applied, the data list should display the brake switch ON within 25 mm (1 in.) of travel.

DTC A093 – Code A091 or A092 Set in Current or Previous Ignition Cycle

Step	Action	Value(s)	Yes	No
1	1. Turn ignition switch to ON. 2. Read the DTCs on the scan tool. Is DTC A091 or A092 set as history or current DTCs?	-	Go to Step 2	Go to Step 3
2	Proceed to the table for the DTC that set and repair the problem as necessary. Is the repair complete?	-	System OK	-
3	1. Use the enhanced diagnostic function of the scan tool to verify that the malfunction frequency was low. 2. Use the scan tool to clear the DTCs. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A094 STOPLAMP SWITCH CONTACTS ALWAYS CLOSED

Circuit Description

This DTC is run to determine the proper operation of the stoplamp switch. This is important because ABS is activated when the stoplamp switch is closed and deactivated when the switch is open. If the stoplamp switch is always closed, ABS operation will always be requested, resulting in potential hydraulic modulator cycling on rough roads. Additionally, this malfunction will most likely result in a discharged battery (due to the stoplamps remaining on) if the driver is not informed of the problem.

Diagnosis

This test checks if the stoplamp switch input is seen at ignition ON and remains on for the rest of the drive cycle until the vehicle reaches 40 km/h (25 mph) for two consecutive drive cycles.

Cause(s)

- The stoplamp switch contacts are misadjusted or shorted.
- There is a short to voltage in the stoplamp switch circuitry.
- The EBCM is faulty.

Fail Action

Set history code.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This checks if the malfunction is currently present.
2. This step checks for unwanted voltage on the stoplamp switch input circuit.
3. This step checks for a possible intermittent malfunction.
8. This step traces the cause of the malfunction to either a malfunctioning or misadjusted stoplamp switch or a short to voltage in the stoplamp switch circuitry.

Diagnostic Aids

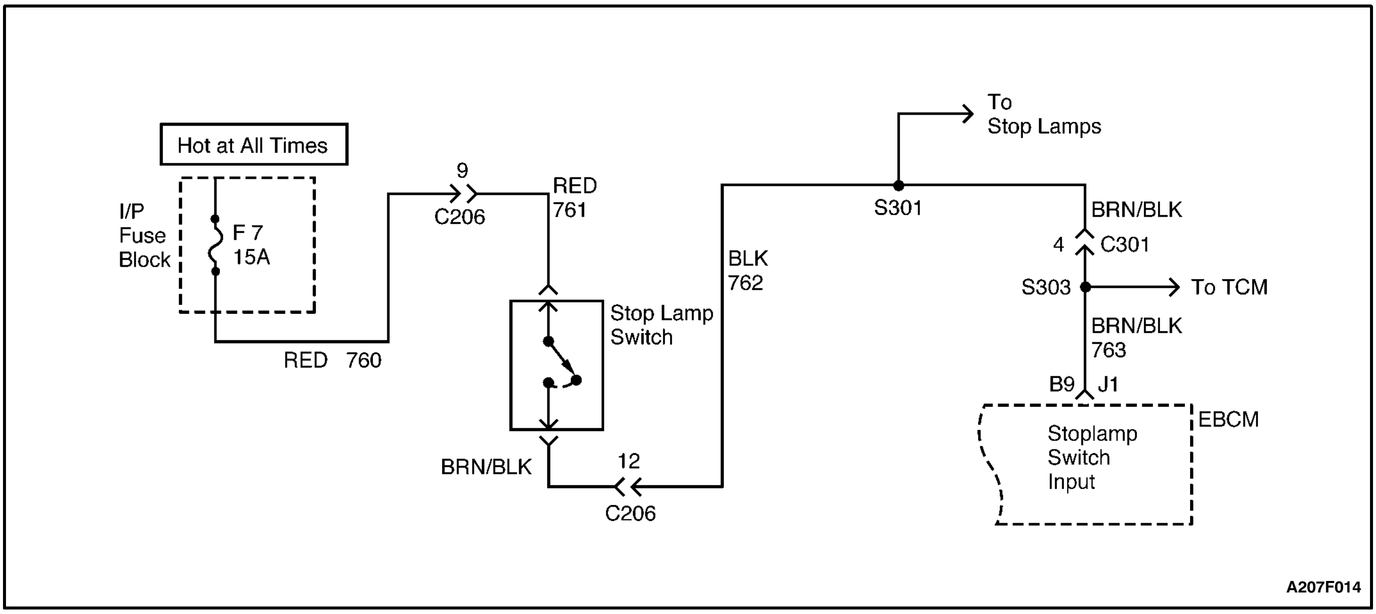
An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, or physical damage to the wiring harness.

DTC A094 – Stoplamp Switch Contacts Always Closed

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to LOCK. 2. Observe the stoplamps. Are the stoplamps OFF?	-	Go to Step 2	Go to Step 8
2	1. Disconnect the EBCM harness connector J1. 2. Turn the ignition switch to ON. 3. Use a digital voltmeter (DVM) to measure the voltage between terminal B9 of the EBCM connector J1 and ground. Is the voltage less than the specified value?	2 v	Go to Step 3	Go to Step 7
3	1. Turn the ignition switch to LOCK. 2. Inspect the EBCM harness connector J1, terminal B9 for a poor contact. Is there poor contact?	-	Go to Step 4	Go to Step 5
4	Repair the poor contact found at terminal B9 of the EBCM harness connector J1. Is the repair complete?	-	Go to Step 5	-
5	1. Reconnect all of the connectors. 2. Test drive the vehicle for two consecutive drive cycles above 40 km/h (25 mph). Does DTC A094 reset?	-	Go to Step 6	Go to “Diagnostic Aids”
6	Replace the EBCM. Is the repair complete?	-	System OK	-
7	Repair the short to voltage between BRN/BLK wire terminal of the stoplamp switch connector and terminal B9 of the EBCM connector J1. Is the repair complete?	-	System OK	-
8	Disconnect the stoplamp switch connector. Are the stoplamps on?	-	Go to Step 7	Go to Step 9
9	1. The problem is a misadjusted or malfunctioning stoplamp switch. 2. Adjust or replace the switch as required. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) A095
STOPLAMP SWITCH CIRCUIT OPEN

Diagnosis

This test checks for an open in the stoplamp circuit that prevents the stoplamp input to the EBCM from changing states when the bake is applied. A fault exists if the voltage reading for the stoplamp switch is between 5.23 volts and 3.35 volts for 1 second.

Cause(s)

- There is an open in the stoplamp switch circuit.
- All the stoplamps are open.
- The ground path for all the stoplamps is open.
- There is a poor contact in the EBCM connector J1.
- The EBCM is faulty.

Fail Action

This DTC is used in conjunction with DTCs A091, and A092 to determine the cause of an open stoplamp switch fault. A "not open" circuit condition with no brake input may indicate a stoplamp contact, a fuse, or a mounting/adjustment problem and is associated with DTC A091 and A092 failures. This fault identifies the cause as the monitor line, the lights (all bulbs open), the controller connection, or the controller interface circuit. The ABS is disabled and the ABS warning lamp is turned ON. A rehome is commanded to ensure that all motors are in the home position.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step is used to confirm the existence of an open in the stoplamp switch circuitry.
2. This step indicates if the EBCM has received the stoplamp switch signal.
3. This step indicates the existence of an open circuit in the stoplamp switch or the stoplamp circuitry.
4. This step isolates the open circuit to either the stoplamp switch input circuitry or the EBCM.

Diagnostic Aids

An "intermittent" malfunction may be caused by a poor connection, wire insulation that has been rubbed through, or a wire that is broken inside the insulation.

Check the frequency of the malfunction by using the enhanced diagnostic feature of the scan tool as described in "Scan Tool Diagnostics."

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

DTC A095 – Stoplamp Switch Circuit Open

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to ON. 2. Monitor the stoplamp switch status from "ABS Data List" on the scan tool. Does the scan tool indicate that the stoplamp switch is open?	-	Go to Step 2	Go to "Diagnostic Aids"
2	Apply light pressure to the brake pedal while monitoring the stoplamp switch status on the scan tool. Does the scan tool indicate stoplamp switch ON within 25 mm (1 in.) of pedal travel?	-	Go to Step 11	Go to Step 3
3	Apply firm pressure to the brake pedal and observe the stoplamps. Are the stoplamps on?	-	Go to Step 4	Go to Step 11
4	1. Turn the ignition switch to LOCK. 2. Disconnect the EBCM harness connector J1. 3. Turn the ignition switch to ON. 4. Use a digital voltmeter (DVM) to measure the voltage between ground and terminal B9 of the EBCM harness connector J1 while applying firm pressure to the brake pedal. Is the voltage greater than the specified value?	10 v	Go to Step 8	Go to Step 5
5	Check BRN/BLK terminal wire of the stoplamp switch connector for a poor connection. Is the connection bad?	-	Go to Step 6	Go to Step 7
6	Repair the connection at the BRN/BLK terminal wire of the stoplamp switch connector. Is the repair complete?	-	System OK	-
7	Repair the open between the BRN/BLK terminal wire of the stoplamp switch connector and terminal B9 of the EBCM harness connector J1. Is the repair complete?	-	System OK	-
8	Check for a poor contact at terminal B9 of the EBCM harness connector J1. Is the contact bad?	-	Go to Step 9	Go to Step 10
9	Repair the poor connection at terminal B9 of the EBCM harness connector J1. Is the repair complete?	-	System OK	-
10	Replace the EBCM . Is the repair complete?	-	System OK	-
11	Repair the open in the stoplamp circuit. Is the repair complete?	-	System OK	-

AUTOMATED MODULATOR TEST

Tools Required

Scan Tool

If a mechanical modulator malfunction is suspected, rough ABS performance is reported, or if any modulator service has been performed, the automated modulator test must be performed to verify the repair has corrected the identified problem and the displacement cylinder pistons are returned to their top-most (home) position. The scan tool will prompt you for replies to changes in the brake pedal position. These brake pedal position changes are a result of modulator component control in a specific order that allows component malfunctions to be determined. It is very important, especially when testing the rear channel, that each reply to the scan tool questions be carefully considered. During rear channel testing, pedal movement will be felt as a bump, which is much different from the movement felt in the front channels. The pedal movement for the front brakes should be smoothly downward toward the floor on "release" or smoothly upward toward the top of the pedal travel on "apply."

AUTOMATED MOTOR PACK DIAGNOSIS TEST

Tools Required

Scan Tool

Using the scan tool, perform the motor pack diagnosis test to identify a potential problem in the motor pack. If a problem exists, the results of the motor pack test will be indicated on the scan tool.

If the motor is indicated to be malfunctioning, the motor pack is not serviceable and must be replaced as an assembly. Refer to "Motor Pack" in this section.

NO GEAR MOVEMENT

If all three motors release at this point, the motor pack appears to function properly. Remove the hydraulic pack from the hydraulic modulator. Refer to "Motor Pack" in this section. Rotate each gear on the hydraulic modulator by hand. The front gears should be free to rotate approximately 8.5 turns lock to lock. If the gears do not turn freely or if at least eight turns are not possible, replace the hydraulic modulator. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.

The rear gear should rotate approximately four turns. If the gear does not turn freely or if at least 3.5 turns are not possible, replace the hydraulic modulator. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.

HYDRAULIC FUNCTIONAL CONTROL

Tools Required

Scan Tool

This test is used to verify base brake apply and ABS release, hold and apply functions. During testing, the scan tool will provide information on any problem that may be encountered.

1. Turn the ignition switch to LOCK.
2. Raise and suitably support the vehicle so that all four wheels are off the ground.
3. Install the brake cartridge into the scan tool and connect it to the ALDL. Power the scan tool using the battery adapter.
4. Turn the ignition switch to ON.
5. Select a channel to test - left front, right front, or rear. When testing the rear brakes, both rear wheels should rotate and not rotate together at the various points in the test. This is true because both rear brake pressures are controlled together.
6. Firmly depress the brake pedal. The pedal should remain high and firm.
7. Have an assistant attempt to rotate the wheel being tested. If the wheel does not rotate, base brake apply is functioning properly.
8. With the brake pedal still depressed, press the â (up arrow) key on the scan tool to begin the test. The brake pedal should remain high and firm. If the brake pedal drops toward the floor, verify the solenoid electrical connectors are connected to the correct solenoids.
9. With the brake pedal still depressed, have the assistant attempt to rotate the wheel. The wheel should rotate with little or no resistance for the full 18 seconds of this test.
10. After 18 seconds, brake pressure will be applied, and a slight bump may be felt in the brake pedal. This is normal. The assistant should not be able to rotate the wheel at this point.

MOTOR TESTING

Tools Required

Scan Tool

Each motor can be turned on manually for up to 5 seconds at a current of 10 amps forward or 6 amps backward. The test below describes how the front motors will operate. The rear motor can be tested in a similar manner, except there will be only a slight pedal drop and rise (bump) during the test.

1. Turn the ignition switch to LOCK.
2. Install the brake cartridge into the scan tool and connect it to the ALDL. Power the scan tool using the battery adapter.
3. Turn the ignition switch to ON, with the engine stopped.
4. Pump the brake pedal several times to deplete the vacuum reserve.

5. Depress and hold the brake pedal.
6. Using the scan tool, release one of the motors. The brake pedal should move smoothly toward the floor. As the pedal drops, the feedback current should momentarily drop to only a few amps (indicated motor movement) and then become equal to the command current (6 amps). This indicates the motor is no longer moving since the piston has bottomed out.
   - Rough or "jumpy" pedal movement indicates an intermittent electrical connection within the motor.
7. With the brake pedal still depressed and at the floor, apply the same motor. The brake pedal should now rise smoothly back to the top of its travel. The feedback current should drop momentarily to a few amps, then quickly increase to the command current (10 amps). This indicates that the motor is no longer moving since the piston has reached the top of its travel.

If the brake pedal does not move both up and down as indicated and there are no DTCs set, monitor the feedback current closely while performing the test again. If the feedback current is only a few amps, the motor is free-spinning. The motor pack must be separated from the hydraulic modulator to identify an expansion spring brake (ESB), a motor, a gear, or a ball screw problem. Refer to "Motor Pack" in this section.

MOTOR PACK FUNCTIONAL TEST

Once the motor pack has been separated from the hydraulic modulator, this test will help to determine if the motor pack is operating properly.

The scan tool will rotate the motors in one direction, then the other.

- If any motor does not turn in both directions, the motor pack is malfunctioning and must be replaced. Refer to "Motor Pack" in this section.
- If all three motors rotate, try to rotate each gear on the hydraulic modulator. Refer to "No Gear Movement" in this section.

SOLENOID TEST

Tools Required

Scan Tool

1. Turn the ignition switch to LOCK.
2. Install the brake cartridge into the scan tool and connect it to the ALDL. Power the scan tool using the battery adapter.
3. Turn the ignition switch to ON, with the engine stopped.
4. Pump the brake pedal to deplete the vacuum from the power booster.
5. Select manual control.
6. Select left front or right front motor release.
7. Release the motor for the channel being tested. Check the motor command and feedback currents to be sure that the motor released properly. Refer to "Motor Testing" in this section.
8. Select the solenoid for the same channel.
9. With no brake pressure applied, turn the solenoid on.
10. Depress the brake pedal. It should be very high and firm.
    - If the pedal goes nearly to the floor, the solenoid is leaking or not closing and/or the checkball is leaking. Go to step 12.
11. With brake pressure still applied, turn the solenoid off. If the brake pedal drops immediately toward the floor, operation is normal. End the test.
12. If the brake pedal does not drop and the motor is moving, the solenoid is stuck on.
13. Physically switch the two solenoids.
14. Repeat the test for the channel in question.
    - If the pedal sinks slowly to the floor, the check valve is leaking, and the hydraulic modulator must be replaced. Refer to "Hydraulic Modulator/ Motor Pack Assembly" in this section.
    - If the test now works properly, test the opposite channel. If the pedal sinks or rises, that solenoid must be replaced. Refer to "ABS Solenoid" in this section.

ABS ENABLE RELAY TEST

Tools Required

Scan Tool

This test allows monitoring of the voltage at the EBCM while turning the ABS enable relay ON and OFF.

When the relay is commanded ON, the voltage should be equal to the battery voltage. When the relay is OFF, the voltage should drop below 5 volts.

Important: Voltage will not drop to zero when the relay contacts are open due to capacitors in the EBCM. If the voltage drops below 5 volts, the relay is operating properly.

VOLTAGE LOAD TEST

Tools Required

Scan Tool

The ABS VI system can draw significant amounts of current while operating. This test turns on many of the system components to load test the vehicle's electrical system.

If low voltage malfunctions or intermittent EBCM operation are occurring, this test will allow you to monitor two separate power circuits for ABS: ignition and battery. If only one of these two inputs drops below 10 volts during testing, a high resistance may be present in that power feed circuit.

GEAR TENSION RELIEF SEQUENCE

Tools Required

Scan Tool

When the displacement cylinder pistons are in the topmost (home) position, each motor has prevailing torque due to the force necessary to ensure each piston is held firmly at the top of its travel. This torque results in gear tension, or force on each gear that makes motor pack separation difficult. To avoid injury or damage to the gears, the gear tension relief sequence briefly reverses each motor to eliminate the prevailing torque.

Always perform the gear tension relief sequence prior to removing the hydraulic modulator from the vehicle. Each hydraulic modulator gear (the large gears) should be free to turn in one direction and then in the other direction when the motor pack is removed. If any gear will not move, replace the hydraulic modulator. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.

ABS AND BRAKE INDICATOR CONTROL

Tools Required

Scan Tool

This allows a functional test of the ABS indicator circuit and lamp driver module by flashing the indicator or illuminating it. The BRAKE indicator can be cycled ON and OFF using this test.

MOTOR REHOME FUNCTION

Tools Required

Scan Tool

The motor rehome function is initiated by pressing the "F%" key from the scan tool main ABS VI screen. The motor rehome function should always be used prior to bleeding the brake system to eliminate any trapped air within the hydraulic modulator cylinders. It accomplishes this by returning the hydraulic modulator pistons to their home positions and forcing any trapped air toward the bleeder valves where it can easily be bled out.

Important: The motor rehome function cannot be performed if any current DTCs are present. If current DTCs are present, the vehicle must be repaired and the DTCs cleared before performing the motor rehome function.

MAINTENANCE AND REPAIR
ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

Caution: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- [illegible]
- **Skin contact - wash with soap and water.**
- **Ingestion - consult a physician immediately.**

Caution: To help avoid personal injury due to poor braking, do not tap into the vehicle's brake system to operate a trailer brake system.

Notice: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused and those requiring thread-locking compound will be called out. The correct torque values must be used when installing fasteners that require them. If the above procedures are not followed, parts or system damage could result.

Notice: Use only DOT 3 or equivalent hydraulic brake fluid. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced brake performance or durability may result.

Notice: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables, or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

BLEEDING SYSTEM

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

Scan Tool

Notice: Prior to bleeding the brakes, the front and rear displacement cylinder pistons must be returned to the top-most (home) position. Using a scan tool, select the motor rehome function. You cannot perform the motor rehome function if current DTCs are present. If DTCs are present, you must repair the vehicle and clear the DTCs.

If you do not have a scan tool available to command a motor rehome, follow the procedure below:

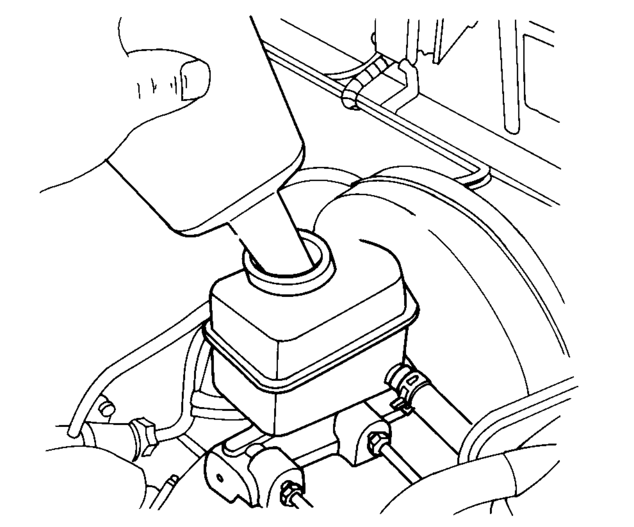
1. Raise and suitably support the front end of the vehicle so that the drive wheels are off the ground.
2. Start the engine, engage the transaxle, and run the vehicle above 5 km/h (3 mph) for at least 10 seconds.

3. Observe the ABS indicator. Make sure that the indicator goes out after approximately 3 seconds.
   - If the ABS indicator remains illuminated, use a scan tool to diagnose the malfunction.
   - If the ABS indicator goes out and stays off, stop the engine and repeat steps 2 and 3 one more time.

Caution: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- Ingestion - consult a physician immediately.

Important: In the following procedure, use a suitable container and/or shop cloths to catch brake fluid and prevent it from contacting any painted surfaces, wiring, cables, or electrical connectors.

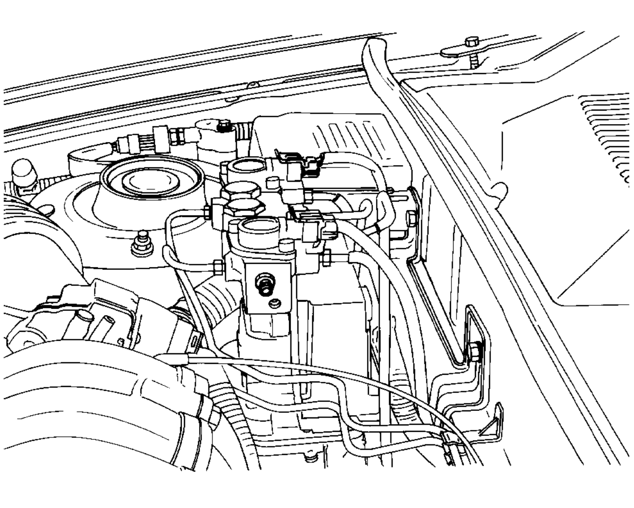


A107F038

4. Clean the master cylinder reservoir and the surrounding area.
5. Remove the master cylinder reservoir cap.

Notice: Do not use fluid from an open container that may be contaminated with water.

6. Inspect the brake fluid level. Add clean DOT 3 or equivalent hydraulic brake fluid if needed.
7. Install the master cylinder reservoir cap.

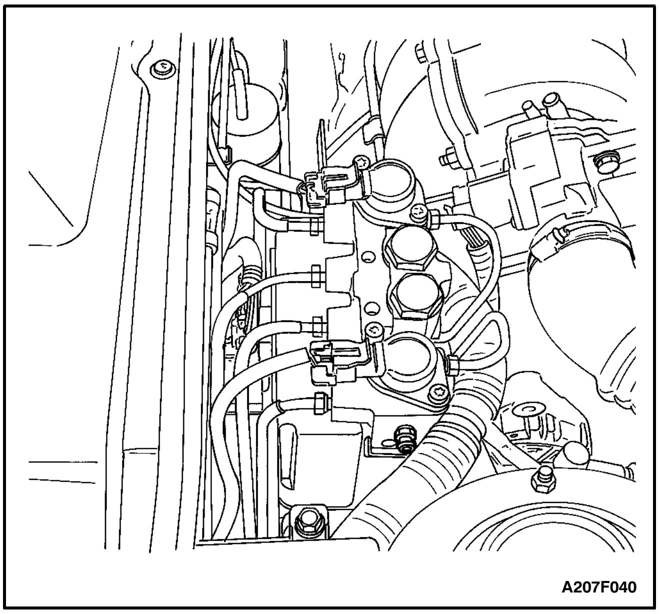


A207F015

8. Bleed the hydraulic modulator:
   - 8.1. Attach a clear plastic bleeder hose to the left-side bleeder valve on the hydraulic modulator. Submerge the other end of the bleeder hose in a clean container partially filled with brake fluid.
   - 8.2. Slowly open the left-side bleeder valve 1/2 to 3/4 turn.
   - 8.3. Have an assistant press the brake pedal and hold it down until the brake fluid begins to flow.
   - 8.4. Close the bleeder valve and release the brake pedal. Repeat steps 5.2 and 5.3 until no air bubbles are present.

Tighten

Tighten the bleeder valve to 9 N•m (80 lb-in).

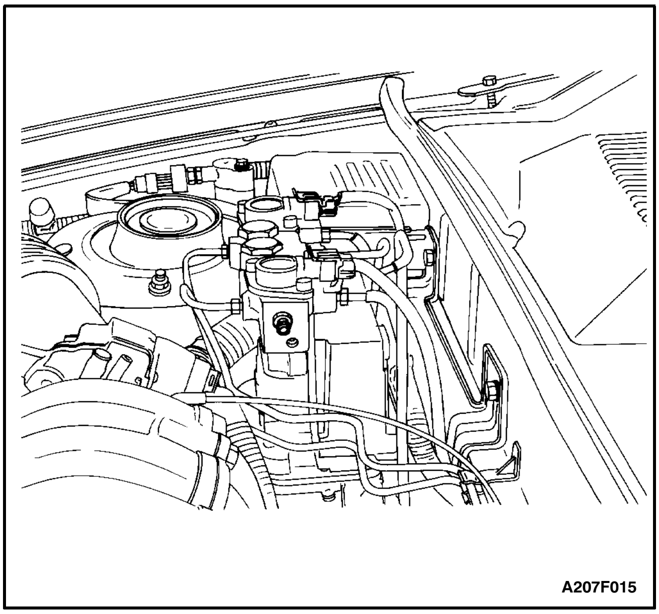


A207F040

8.5. Repeat the procedure for the right-side bleeder valve.

Important: Once fluid flows from both hydraulic modulator bleeder valves, the hydraulic modulator is sufficiently full of brake fluid. However, it may not be completely purged of air. At this point, move to the wheel cylinders and the calipers and bleed them. This ensures that the lowest points in the system are completely free of air. Then the hydraulic modulator can be purged of any remaining air.

9. Bleed the system according to one of the bleeding procedures. Refer to Section 4A, Hydraulic Brakes.

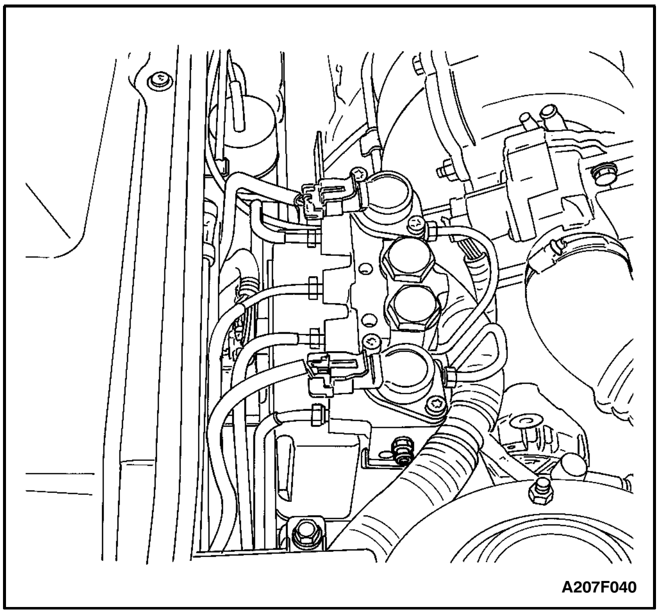


A207F015

10. Bleed the hydraulic modulator.
    10.1. Attach a clear plastic bleeder hose to the left-side bleeder valve on the hydraulic modulator. Submerge the other end of the bleeder hose in a clean container partially filled with brake fluid.
    10.2. Slowly open the left-side bleeder valve 1/2 to 3/4 turn.
    10.3. Have an assistant press the brake pedal and hold it down until the brake fluid begins to flow.
    10.4. Close the bleeder valve and have the assistant release the brake pedal. Repeat Steps 15.2 and 15.3 until no air bubbles are present.

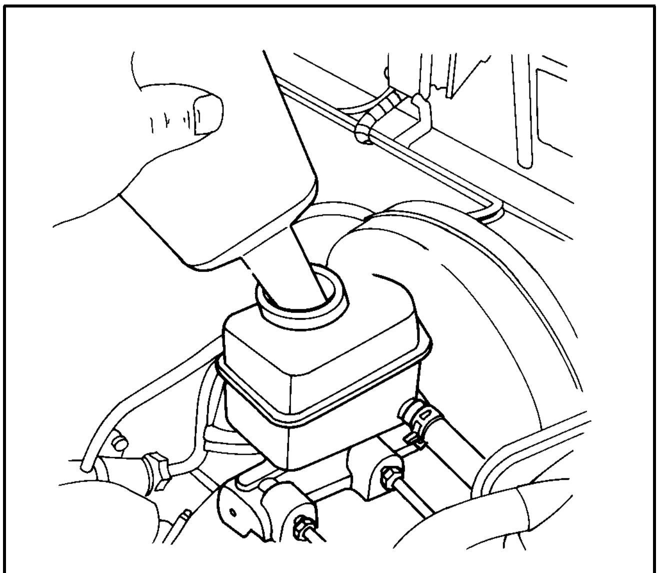
Tighten

Tighten the bleeder valve to 9 N•m (80 lb-in).



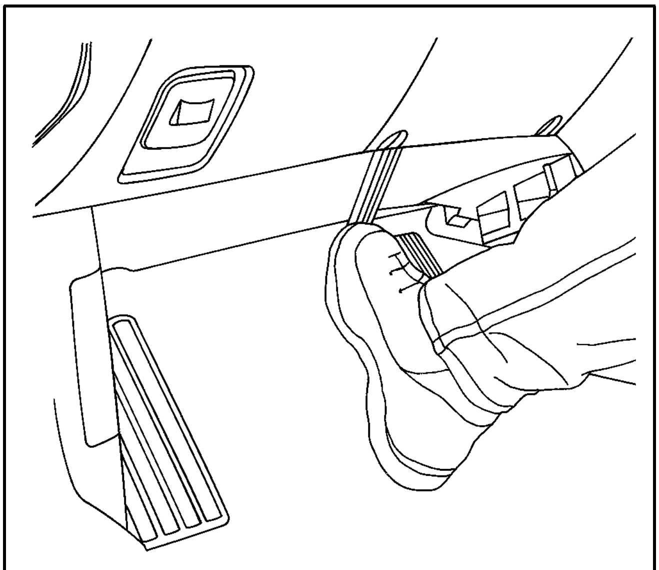
A207F040

    10.5. Repeat the procedure for the right-side bleeder valve.



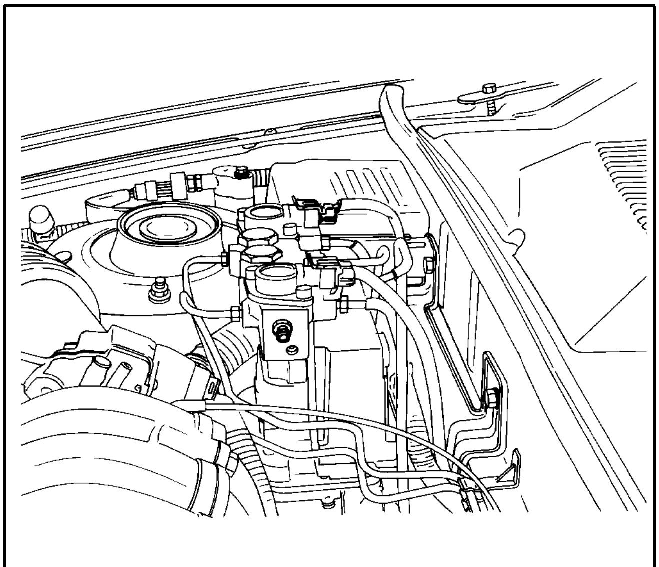
A107F038

11. Remove the master cylinder reservoir cap.
12. Inspect the brake fluid level; add clean DOT 3 or equivalent hydraulic brake fluid if needed.
13. Install the master cylinder reservoir cap.



A107A001

14. Inspect the brakes.
    - With the ignition switch ON, press the brake pedal with moderate force and hold it in position. Note pedal travel and feel.
    - If the pedal feels firm and constant and pedal travel is not excessive, start the engine. With the engine running, re-check the pedal travel. If it is still firm and pedal travel is not excessive, proceed with step 15.
    - If the pedal feels soft or has excessive travel whether initially or after the engine starts, using the scan tool, release then apply the motors 3 times and cycle the solenoids 10 times. Be sure to apply the motors to ensure that the pistons are in the home position. Repeat the bleeding procedure.
15. Road test the vehicle. Make several normal (non-ABS) stops from a moderate speed to ensure proper brake system function.



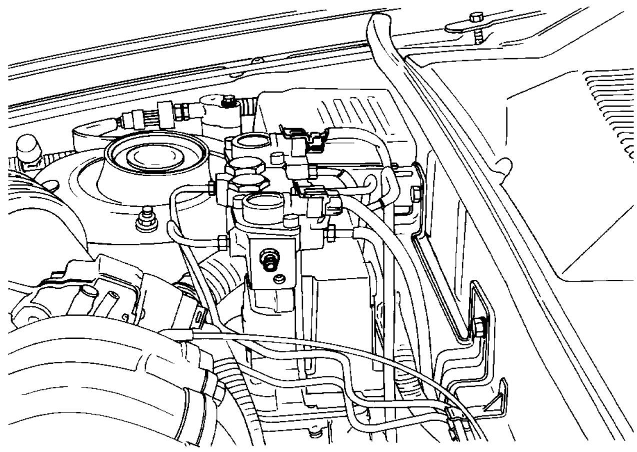
A207F015

HYDRAULIC MODULATOR BLEEDER VALVE

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

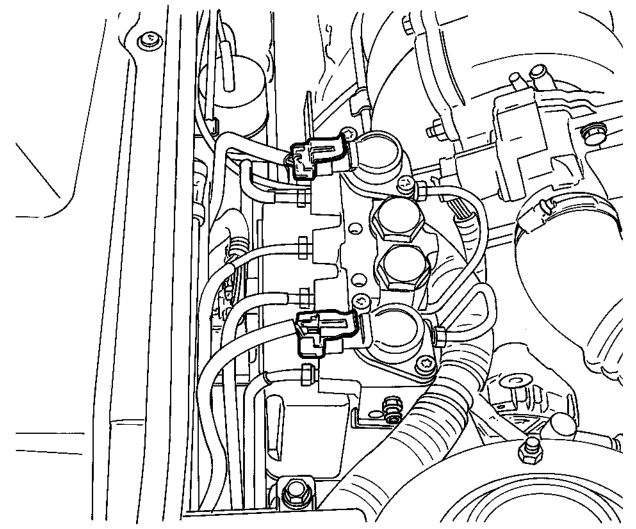
1. Place a shop cloth or suitable container below the bleeder valve to catch escaping brake fluid.
2. Unscrew and remove the bleeder valve from the hydraulic modulator. This illustration shows the left-side bleeder valve. There is another bleeder valve on the right side.



A207F015

Installation Procedure

1. Install the bleeder valve into the hydraulic modulator. Do not tighten fully.
2. Bleed the brake system. Refer to “Bleeding System” in this section.



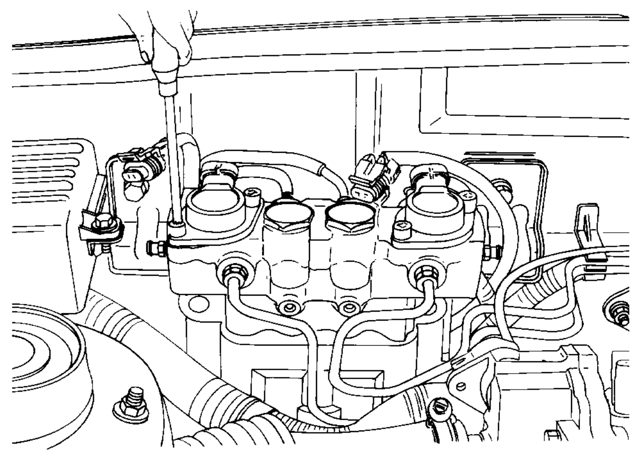
A207F018

ABS SOLENOID

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Unplug the ABS solenoid electrical connector.

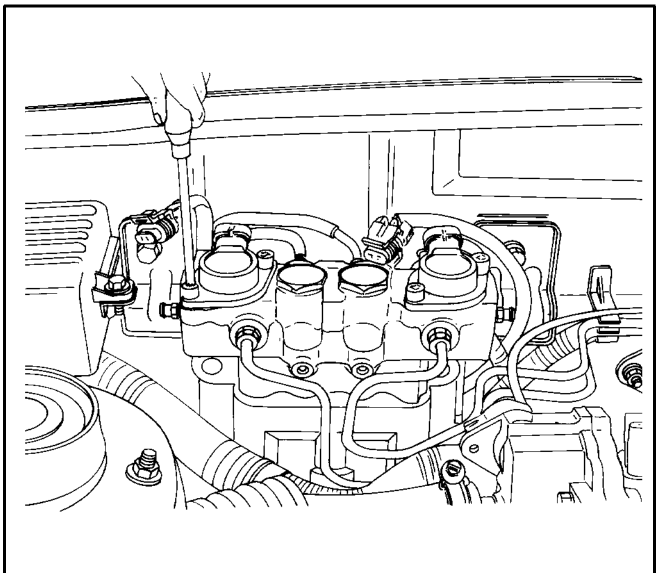


A207F019

3. Remove the Torx® head bolts and the solenoid from the hydraulic modulator.

Important:

- Be sure that the O-ring seal is still attached to the solenoid shaft when it is removed. If not, check the solenoid bore in the hydraulic modulator.
- Do not attempt to disassemble the solenoid; it is serviceable only as an assembly.



A207F019

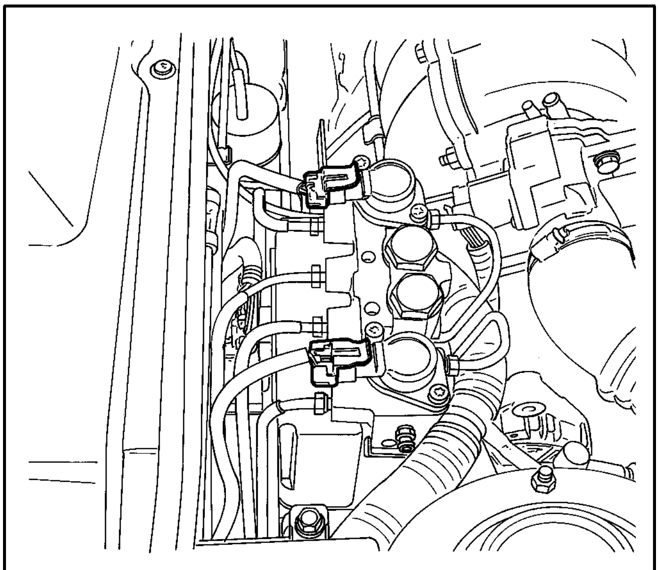
Installation Procedure

Important: Verify that the solenoid O-ring seal is properly positioned before installing the solenoid into the hydraulic modulator.

1. Lubricate the seal on the solenoid with clean brake fluid.
2. Install the solenoid to the hydraulic modulator.
3. Install the Torx® head bolts securing the solenoid.

Tighten

Tighten the ABS solenoid Torx® head bolts to 4.5 N•m (40 lb-in).

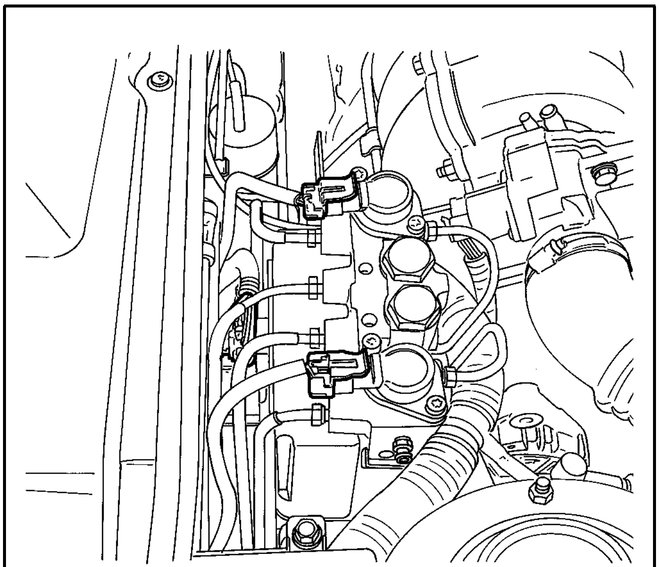


A207F018

4. Connect the solenoid electrical connector.

Important: Make sure that the solenoid electrical connectors are correctly installed.

5. Connect the negative battery cable.
6. Bleed the brake system. Refer to "Bleeding System" in this section.



A207F039

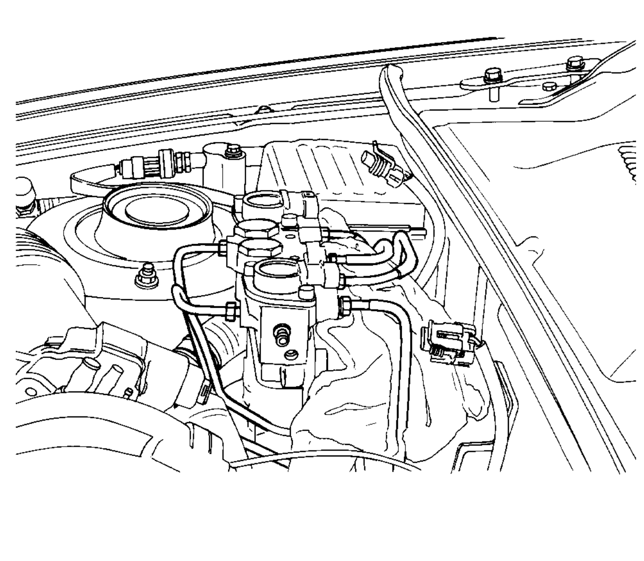
HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Caution: To help avoid personal injury due to the re-tained load on the hydraulic modulator/motor pack assembly, perform the gear tension relief function of the scan tool before removing the hydraulic mod-ulator/motor pack assembly.

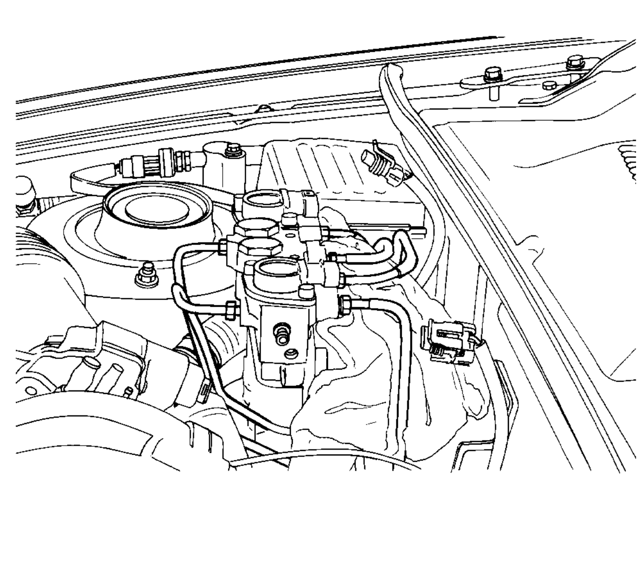
Removal Procedure

1. Using the scan tool, perform the gear tension relief sequence. Refer to "Gear Tension Relief Sequence" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the ABS solenoid and the motor pack electrical connectors.


A207F041

Notice: Place a shop cloth beneath the hydraulic modulator brake pipes to prevent brake fluid from contaminating the motor pack or the electrical connectors. Plug the brake pipes to prevent loss or contamination of brake fluid.

4. Disconnect the brake pipes from the hydraulic modulator.
5. Remove the nuts securing the hydraulic modulator/ motor pack assembly to its mount.
6. Remove the hydraulic modulator/motor pack assembly from the vehicle.


A207F041

Installation Procedure

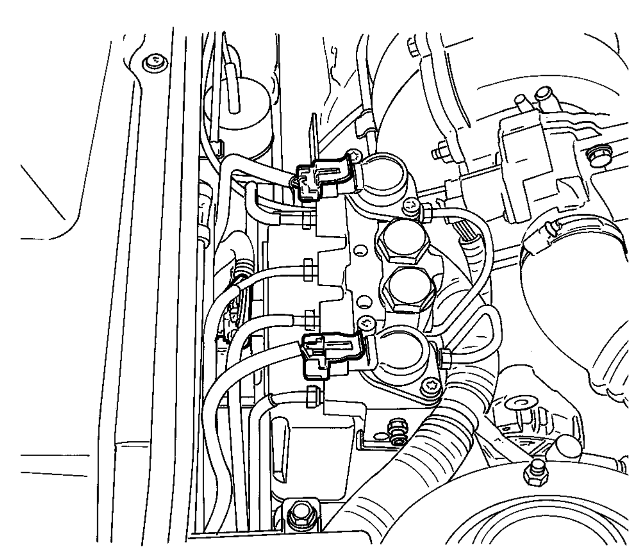
1. Install the hydraulic modulator/motor pack assembly to the vehicle. Install the nuts.

   ### Tighten

   Tighten the hydraulic modulator/motor pack assembly nuts to 5 N•m (44 lb-in).
2. Remove the plugs from the brake pipes and connect them to the hydraulic modulator. Secure each pipe with a pipe nut.

   ### Tighten

   Tighten the brake pipe nuts to 16 N•m (12 lb-ft).

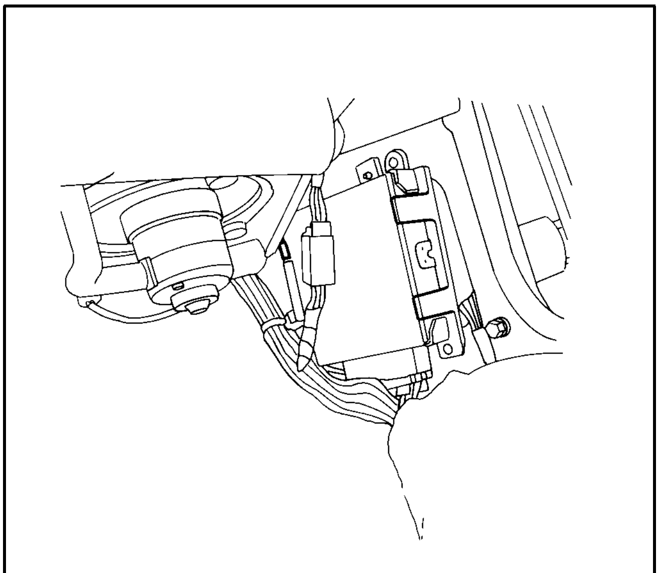

A207F039

3. Install the motor pack and solenoid electrical connectors.

Important: Make sure that the solenoid electrical connectors are correctly installed.

4. Reconnect the negative battery cable.
5. Bleed the brake system. Refer to "Bleeding System" in this section.

ELECTRONIC BRAKE CONTROL MODULE (EBCM)

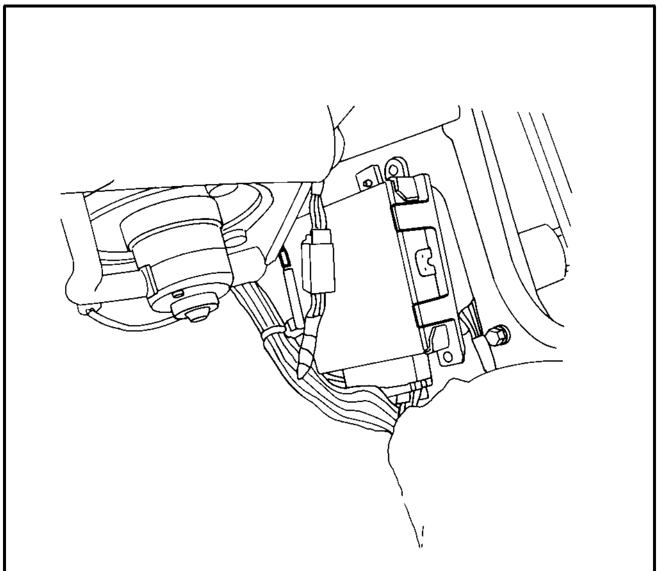


A207F020

The EBCM is located behind the kick panel, on the right side of the car.

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the right-side kick panel. Refer to Section 9G, Interior Trim.
3. Pull back the retaining clamps and remove the EBCM from its holding fixture.
4. Disconnect the EBCM electrical connectors and remove the EBCM from the vehicle.

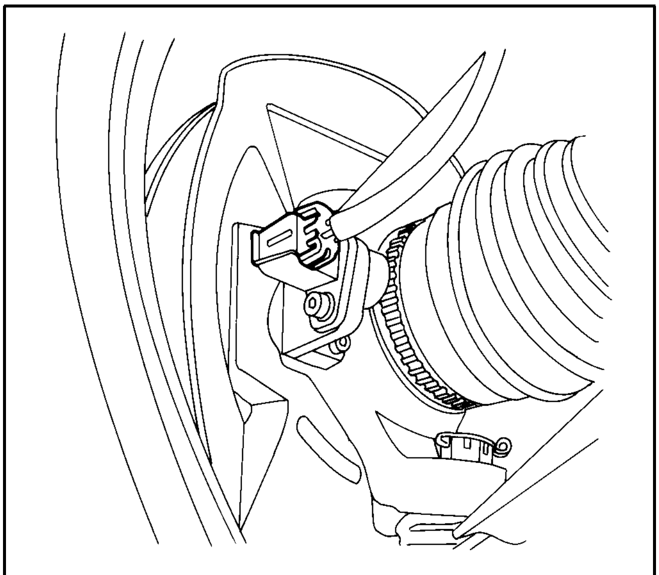


A207F020

Installation Procedure

1. Connect the EBCM to the vehicle by connecting the electrical connectors.
2. Install the EBCM to the vehicle. Secure the EBCM under the clamps.
3. Install the right-side kick panel. Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.

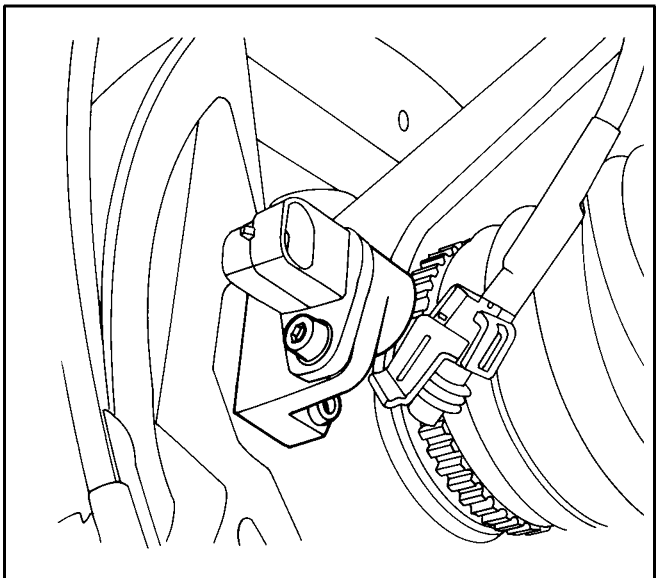
FRONT WHEEL SPEED SENSOR



A107F021

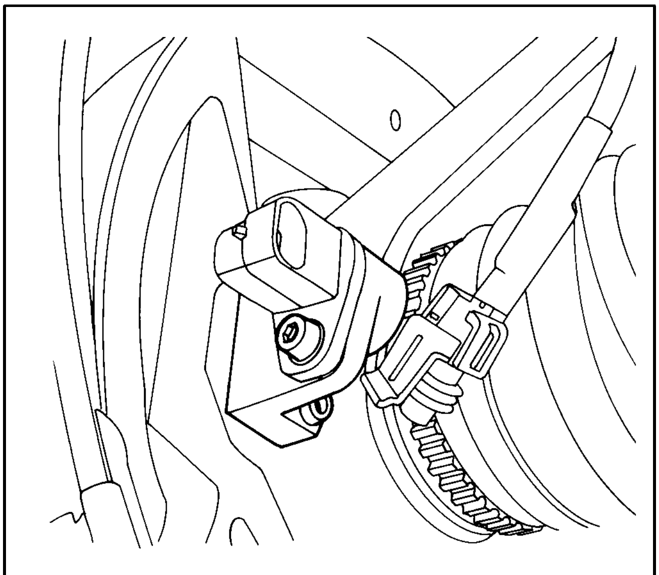
Removal Procedure

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Disconnect the front wheel speed sensor electrical connector.



A107F042

4. **Remove the bolt and the front wheel speed sensor from the steering knuckle.**



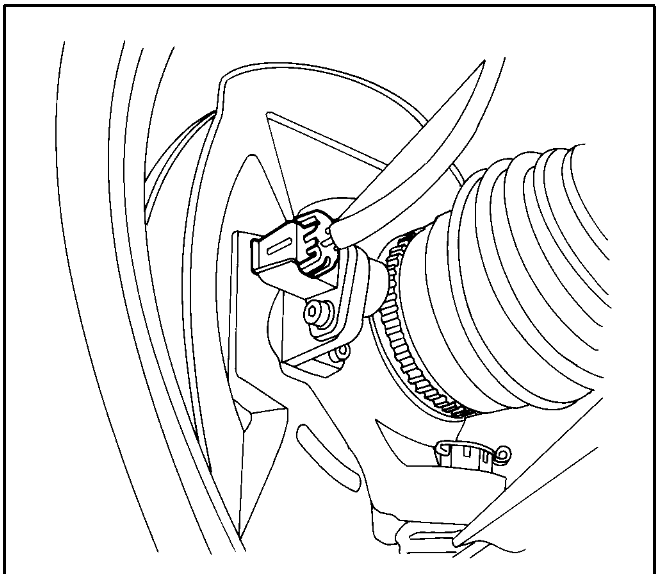
A107F042

Installation Procedure

1. **Install the front wheel speed sensor to the steering knuckle. Secure it with the bolt.**

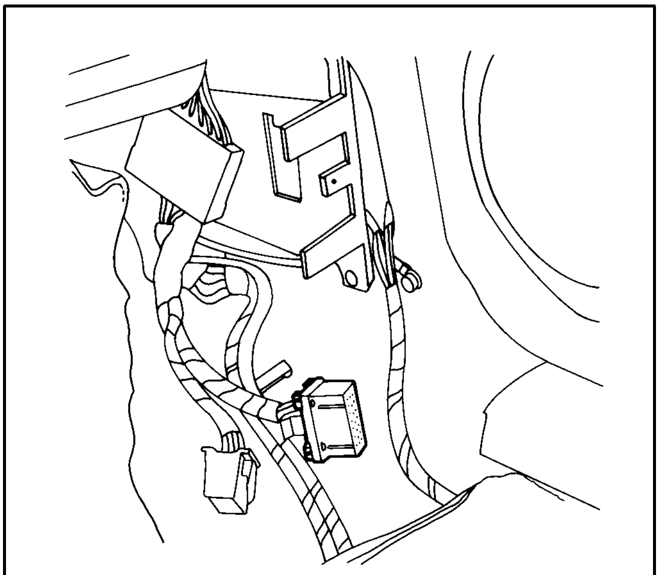
Tighten

Tighten the front wheel speed sensor bolt to 7.8 N•m (69 lb-in).



A107F021

2. **Connect the front wheel speed sensor electrical connector.**
3. **Lower the vehicle.**
4. **Connect the negative battery cable.**

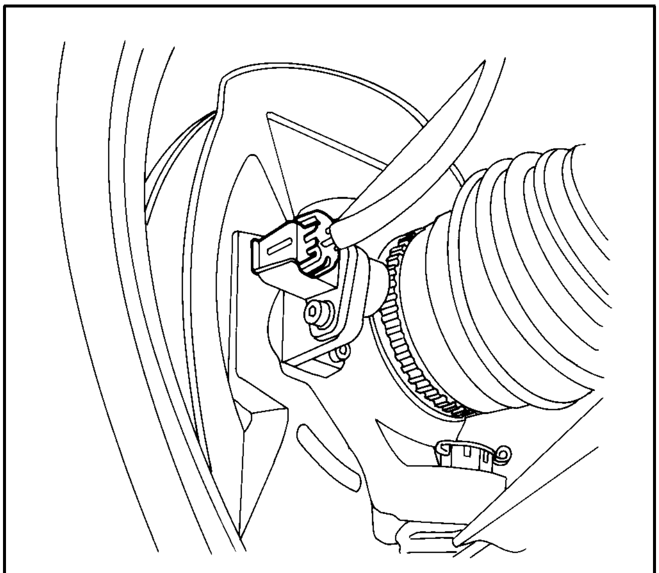


A207F023

FRONT WHEEL SPEED SENSOR JUMPER HARNESS

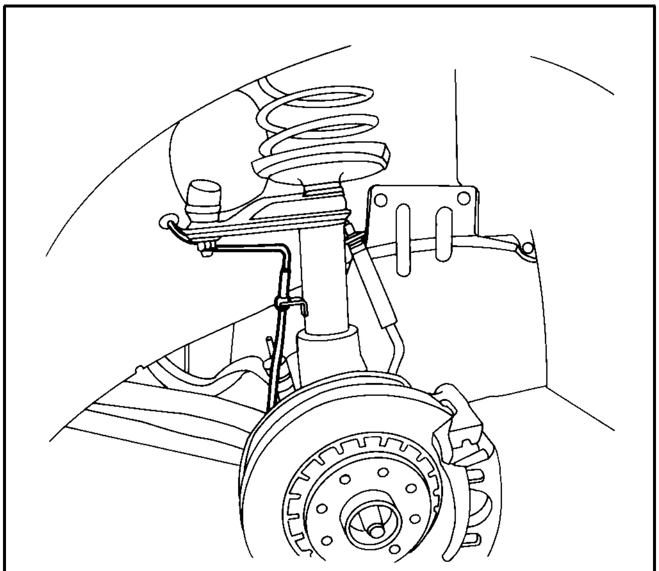
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the EBCM from its retaining clamp. Refer to "Electronic Brake Control Module (EBCM)" in this section.
3. Disconnect connector J1 (24-pin connector) from the EBCM which is located behind the right-side kick panel.
4. Remove the appropriate terminals from connector J1:
   - Right side: terminals B3 (BRN) and A4 (DK GRN).
   - Left side: terminals B4 (YEL) and A5 (LT BLU).



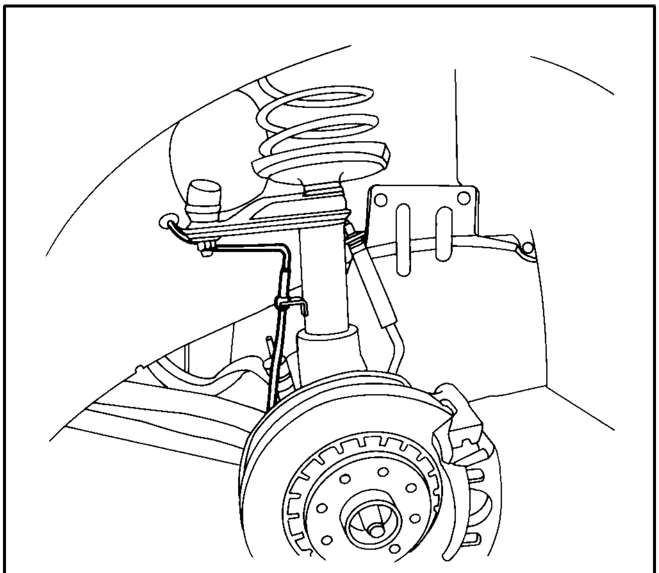
A107F021

5. Open the wiring harness along the path of the harness to be replaced. They both pass through the firewall. The right-side speed sensor harness breaks out just inside the engine compartment. The left-side speed sensor harness follows a branch of the wiring harness along the top of the firewall to the left side of the vehicle where it breaks out behind the surge tank.
6. Remove the speed sensor harness from the wiring harness.
7. Raise and suitably support the vehicle.
8. Disconnect the front wheel speed sensor electrical connector.



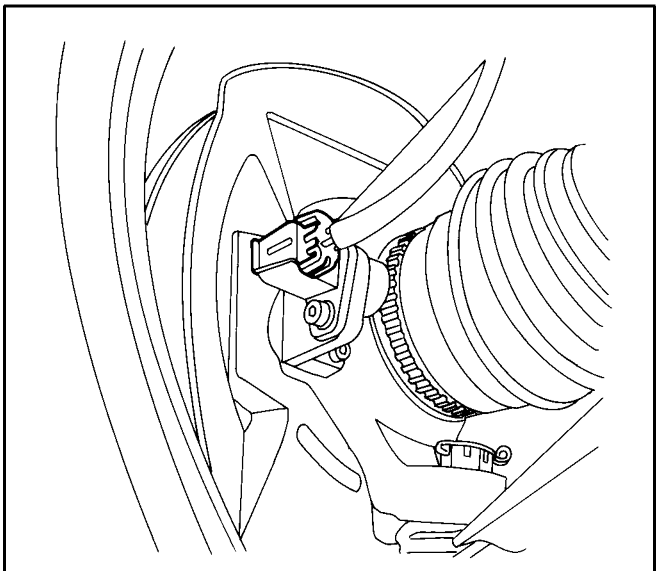
A107F022

9. Remove the jumper harness grommet and pull the jumper harness through the body.

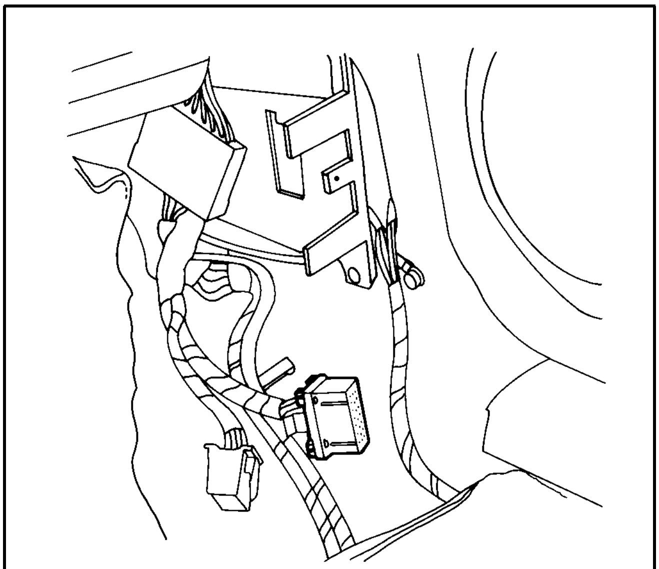

A107F022

Installation Procedure

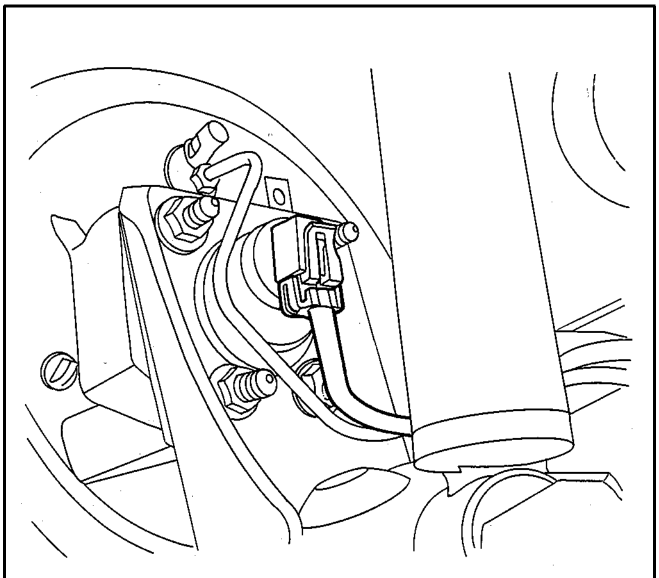
1. Install the front wheel speed sensor jumper harness. Route the harness through the body and secure the grommet.


A107F021

2. Connect the front wheel speed sensor electrical connector.


A207F023

3. Lower the vehicle.
4. Replace the jumper harness into the wiring harness and route it through the firewall into the vehicle interior at the EBCM.
5. Insert the terminals into connector J1 as they had been removed:
   - Right side: terminals B3 (BRN) and A4 (DK GRN).
   - Left side: terminals B4 (YEL) and A5 (LT BLU).
6. Connect the EBCM connector J1.
7. Replace the EBCM into its mounting. Refer to "Electronic Brake Control Module (EBCM)" in this section.
8. Connect the negative battery cable.



A107F058

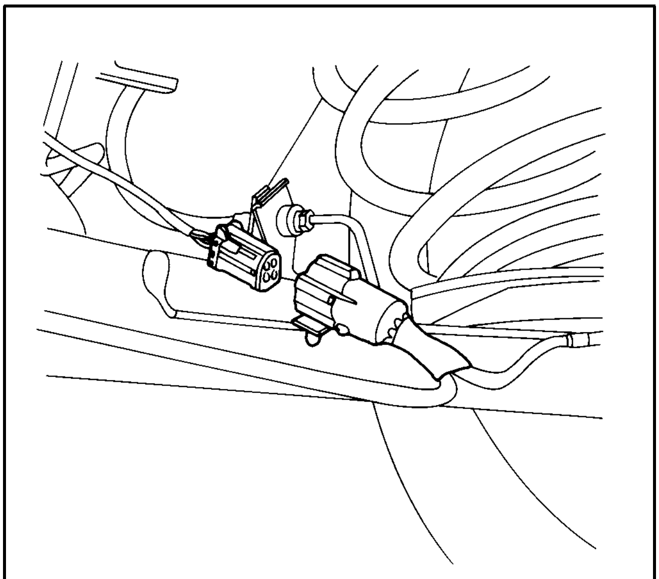
REAR WHEEL SPEED SENSOR

The rear wheel speed sensor is an integral component of the rear wheel hub assembly. If the rear wheel speed sensor is defective, you must replace the wheel hub assembly. Refer to Section 2D, Rear Suspension.

REAR WHEEL SPEED SENSOR JUMPER HARNESS

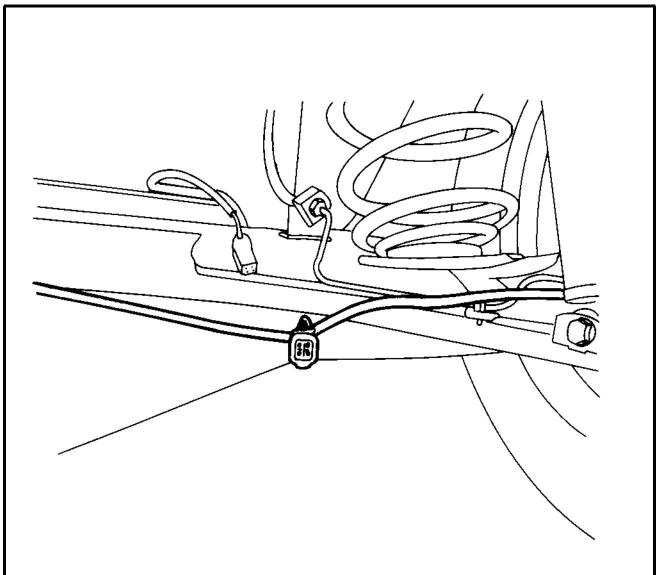
Removal Procedure

1. Remove the negative battery cable.
2. Raise and suitably support the vehicle.
3. Disconnect the rear wheel speed sensor electrical connectors at both wheels.



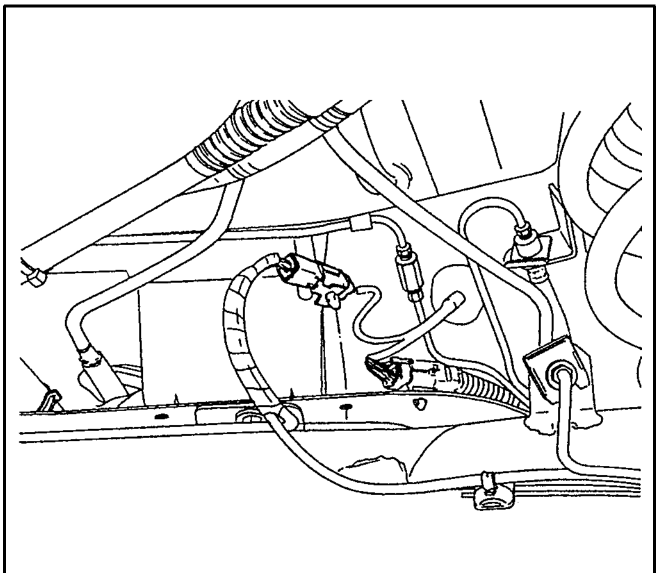
A107F055

4. Remove connector C902 from its mounting by pinching the retainer clips and pushing the retainer up and out of its mounting hole in the axle.
5. Unplug the rear jumper harness from connector C902.



A107F016

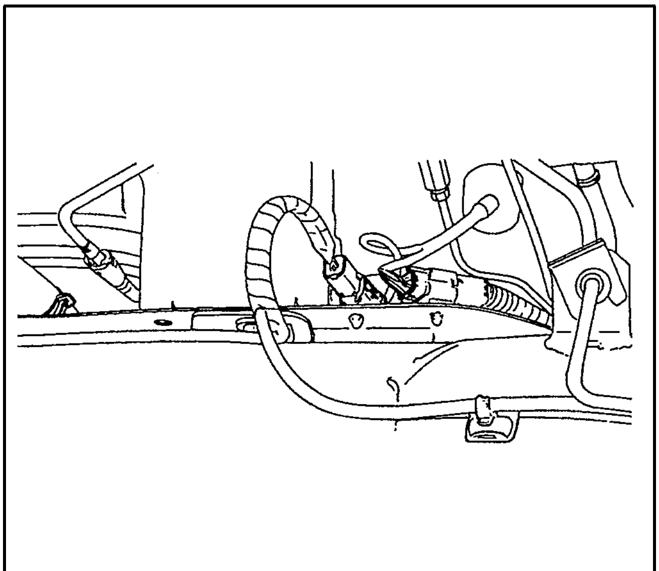
6. Release both branches of the harness from the retainers and remove it from the vehicle.



A207F056

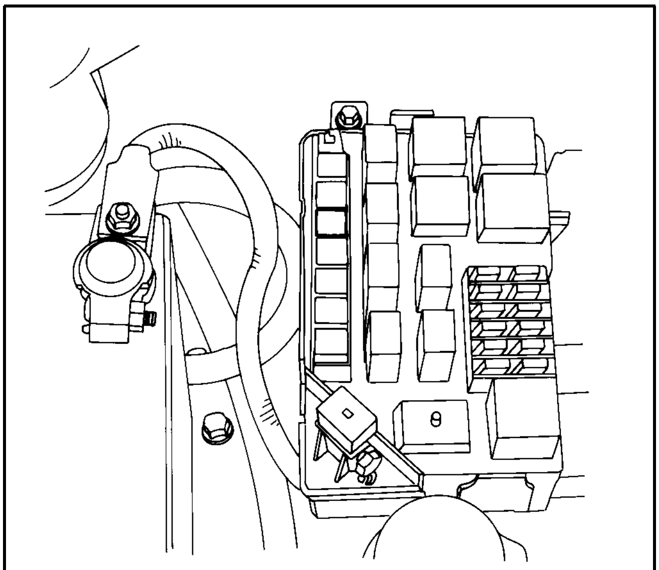
Installation Procedure

1. Connect the new wheel speed sensor harness to both wheel speed sensors.
2. Plug the harness connector into C902.



A207F043

3. Secure the harness into its retainers.
4. Push the retainer clamp of C902 into its mounting hole.
5. Lower the vehicle.
6. Connect the negative battery cable.



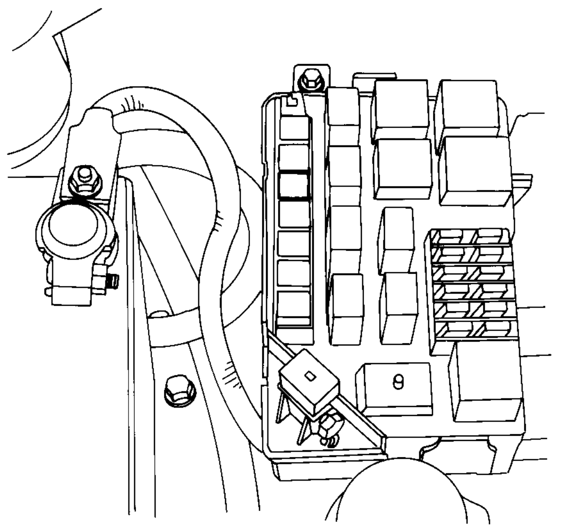
A107F025

SYSTEM FUSE

Removal Procedure

The ABS system fuse, EF6, is located in the engine fuse block, the fifth system fuse in the row behind the main fuse, EF1, which is mounted diagonally at the front of the fuse block, toward the battery.

1. Disconnect the negative battery cable.
2. Remove the system fuse from the fuse holder.

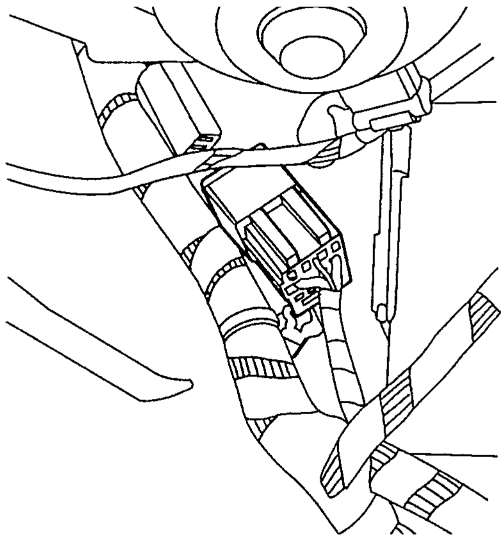


A107F025

Installation Procedure

1. Install a new 40-amp system fuse into the fuse holder.
2. Connect the negative battery cable.

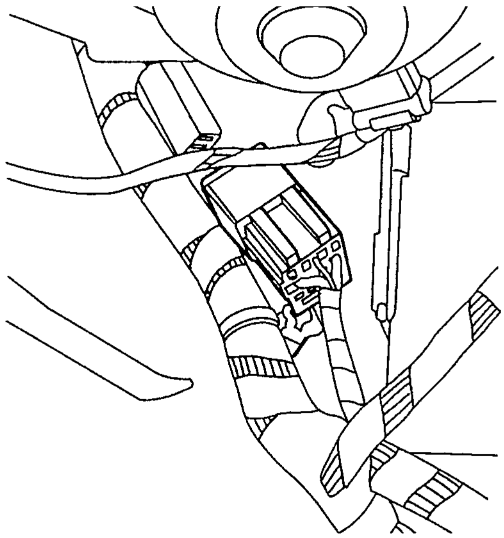
ABS ENABLE RELAY



A107F026

Removal Procedure

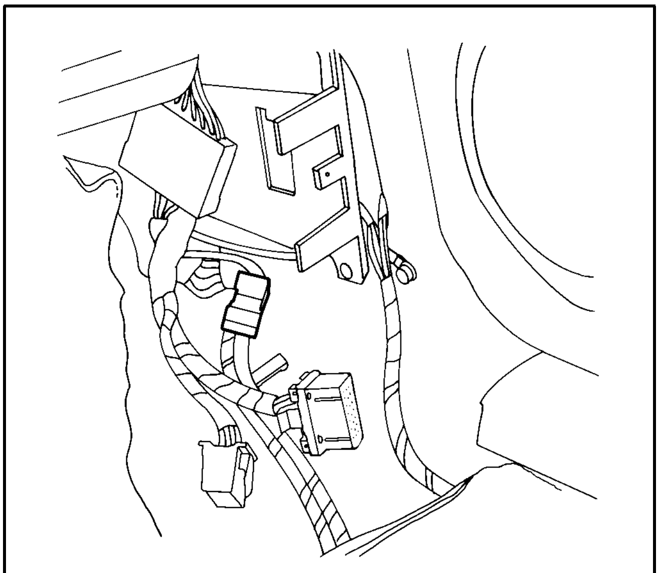
1. Disconnect the negative battery cable.
2. Remove the right-side kick panel. Refer to Section 9G, Interior Trim.
3. Remove the ABS enable relay from the connector in the wiring harness.



A107F026

Installation Procedure

1. Install the ABS enable relay to the electrical connector.
2. Install the right-side kick panel. Refer to Section 9G, Interior Trim.
3. Connect the negative battery cable.

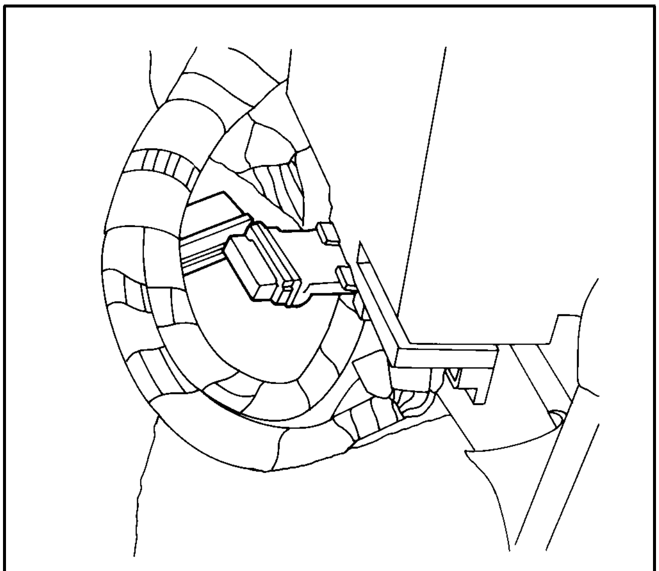


A107F050

ABS SOLENOID FUSE

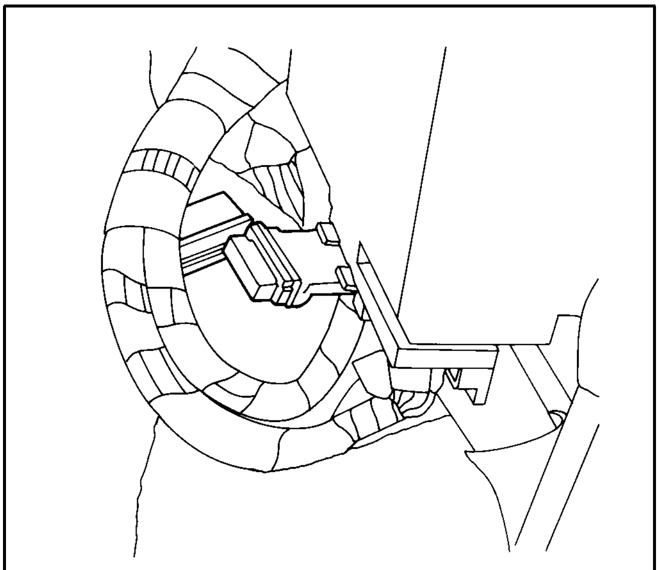
Removal Procedure

1. Disconnect the negative battery cable.
2. Locate the ABS solenoid fuse holder taped to the ABS wiring harness between the heater/air distributor case and the firewall.



A107F051

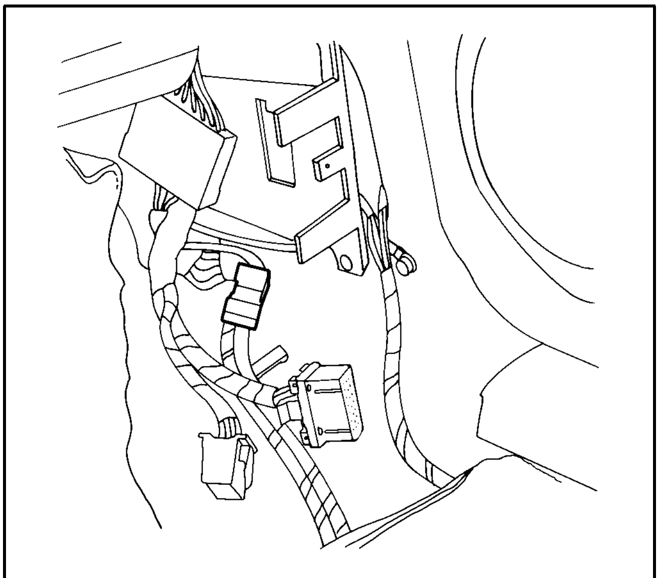
3. Unlatch the cover and open the fuse holder.
4. Remove the fuse.



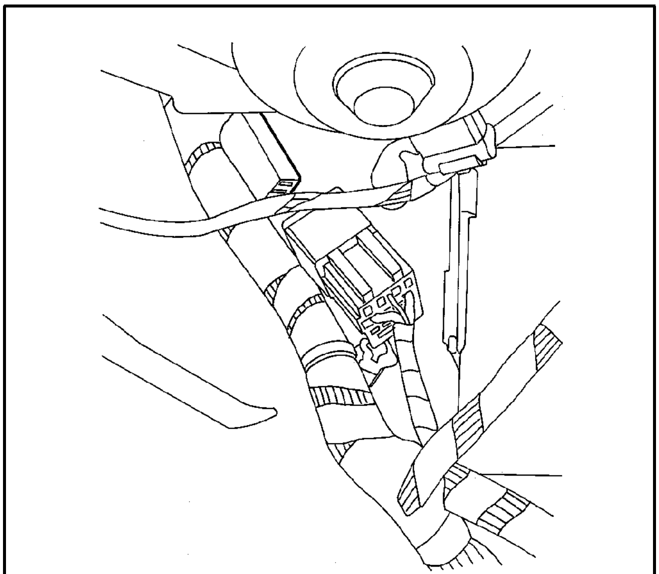
A107F051

Installation Procedure

1. Install the new 10-amp solenoid fuse into the connector.


A107F050

2. Close and latch the cover.
3. Install the right-side kick panel. Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.


A107F044

INDICATORS

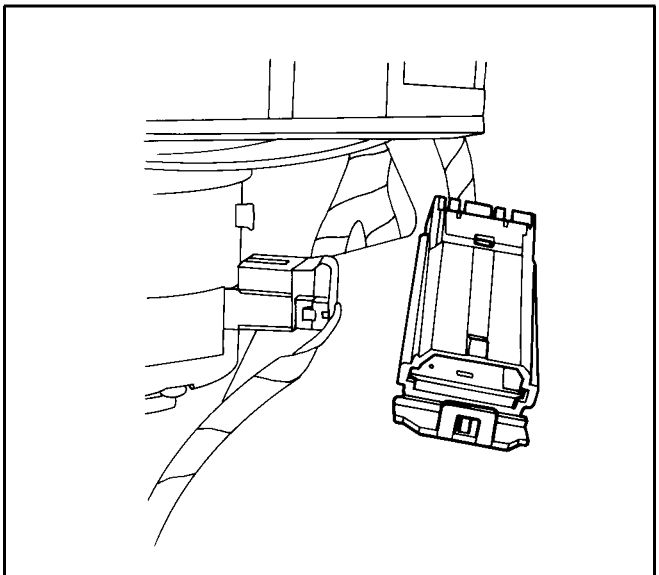
The indicator lamps associated with ABS operation are part of the instrument cluster. Refer to Section 9E, Instrumentation/Driver Information for removal and replacement details.

LAMP DRIVER MODULE

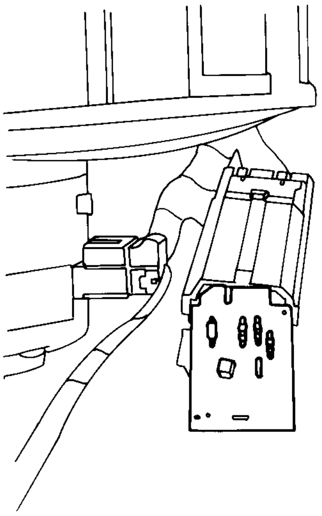
The lamp driver module is taped to the ABS wiring harness between the heater/air distributor case and the firewall.

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the right-side kick panel. Refer to Section 9G, Interior Trim.
3. Untape the lamp driver module from the ABS wiring harness.

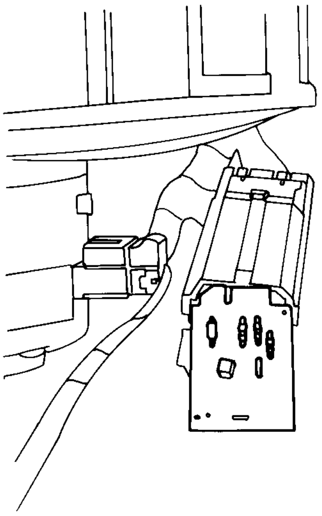

A107F045

4. Open the lamp driver module cover.



A107F046

5. Remove the module from the housing. You may need to insert the blade of a screwdriver into the slot near the end of the card and use the screwdriver as a lever to free the card from its connector inside the housing.

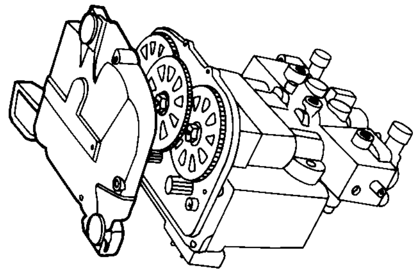


A107F046

Installation Procedure

1. Install the lamp driver module into the housing. Press the card into the connector inside the module, and close the cover. Be sure to orient the card the same as the card you removed. There is a slot that serves as a keyway to allow entry one way only. Look into the housing to see where the slot has to be.
2. Secure the lamp driver module to the ABS harness with electrical tape.
3. Install the right-side kick panel. Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.

UNIT REPAIR

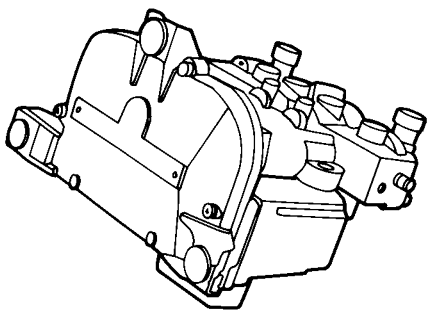


A107F027

GEAR COVER

Disassembly Procedure

1. Remove the hydraulic modulator/motor pack assembly from the vehicle. Refer to "Hydraulic Modulator/ Motor Pack Assembly" in this section.
2. Remove the Torx® head screws.
3. Lift the gear cover from the hydraulic modulator/motor pack assembly.



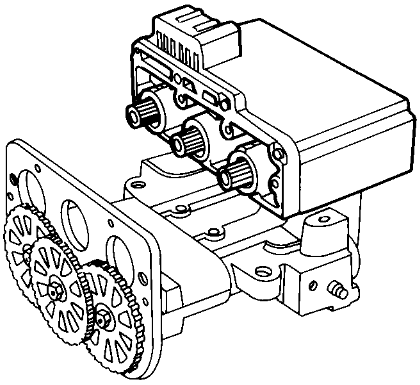
A107F054

Assembly Procedure

1. Install the gear cover to the hydraulic modulator/motor pack assembly.
2. Secure it with Torx® head screws.

   Tighten

   Tighten the gear cover Torx® head screws to 4 N•m (35 lb-in).
3. Install the hydraulic modulator/motor pack assembly into the vehicle. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.



A107F052

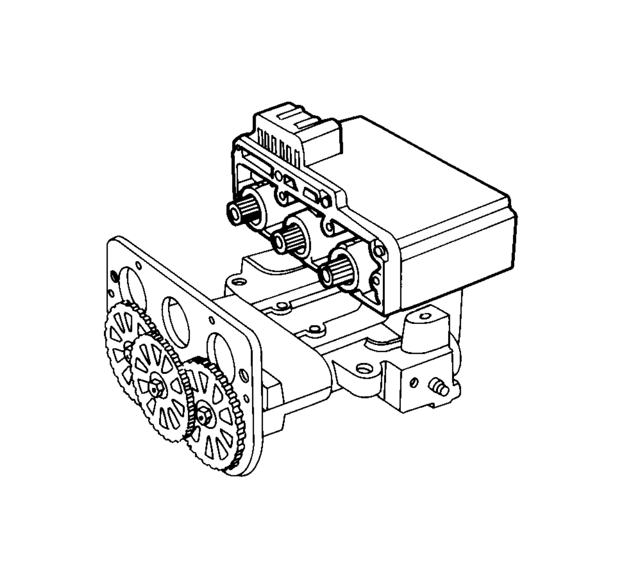
MOTOR PACK

Disassembly Procedure

1. Remove the hydraulic modulator/motor pack assembly from the vehicle. Refer to "Hydraulic Modulator/ Motor Pack Assembly" in this section.
2. Remove the gear cover. Refer to "Gear Cover" in this section.

Caution: The modulator drive gears are under spring load and will turn during disassembly. After removing the gear cover, exercise extreme care not to place fingers into the gear set, since fingers can be pinched by the rotating gears.

3. Remove the Torx® head screws that hold the motor pack to the hydraulic modulator.
4. Remove the motor pack from the hydraulic modulator.



A107F052

Assembly Procedure

1. Position the hydraulic modulator upside down with the gears facing you.
2. Rotate each hydraulic modulator gear counterclockwise until the movement stops. This will position the pistons very close to the top of the modulator bore, simplifying the brake bleeding procedure.

Important:

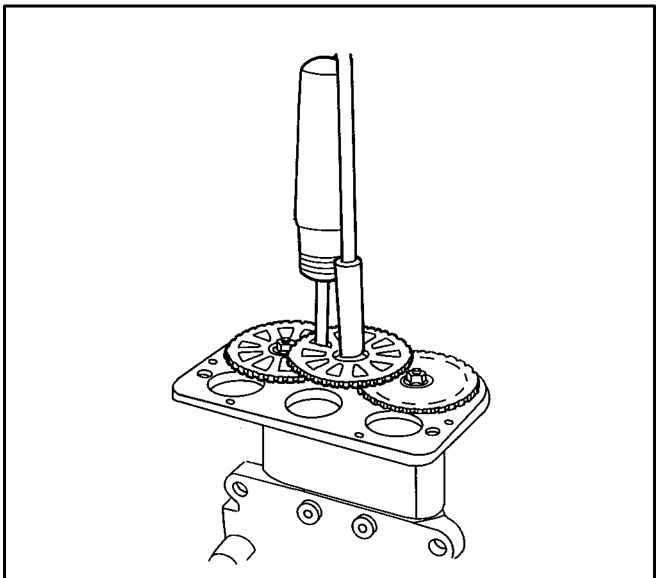
- Take care in handling the motor pack. If it is dropped or damaged during handling, the motor pack must be replaced.
- Align each of the three motor pack pinions with the hydraulic modulator gears.

3. Install the motor pack to the hydraulic modulator.
4. Install the Torx® head screws securing the motor pack.

Tighten

Tighten the motor pack Torx® head screws to 4.5 N•m (40 lb-in).

5. Install the gear cover to the hydraulic modulator/motor pack assembly. Refer to "Gear Cover" in this section.
6. Install the hydraulic modulator/motor pack assembly into the vehicle. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.



A107F028

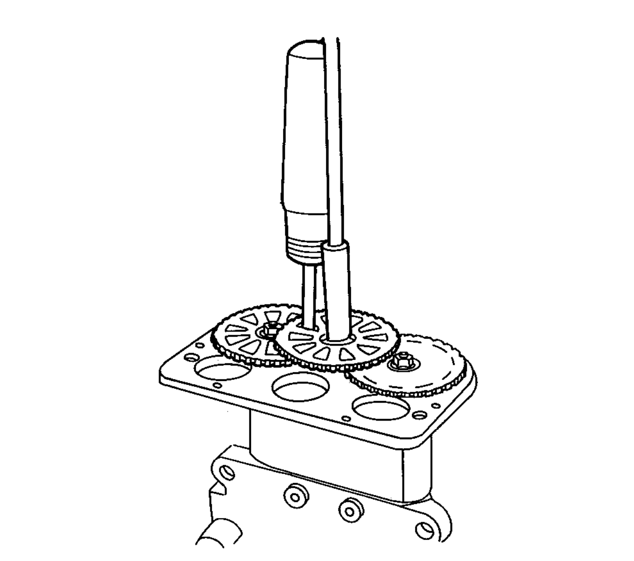
GEAR REPLACEMENT

Disassembly Procedure

1. Remove the motor pack from the hydraulic modulator/motor pack assembly. Refer to "Motor Pack" in this section.

Notice: Do not allow the gear to turn while removing the retaining nut, since the modulator piston can hit the top of the modulator bore, damaging the piston. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear removal.

2. Remove the retaining nut holding the gear(s) you are replacing.
3. Remove the gear(s).



A107F028

Assembly Procedure

Notice:

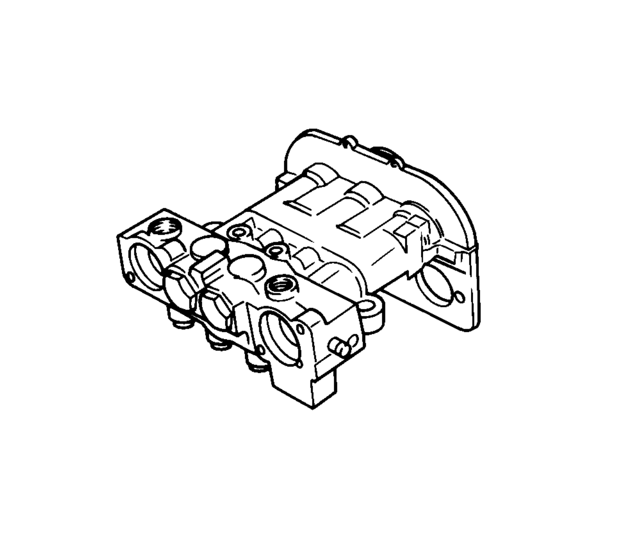
- Do not allow the gear to turn while installing the retaining nut. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear removal.
- Install the gears in the same locations they had before removal.

Important: Do not lubricate or oil the gears on the motor pack.

1. Install the gear(s) onto the hydraulic modulator. Secure each gear with one nut.

   Tighten

   Tighten gear nuts to 8.5 N•m (76 lb-in).
2. Install the motor pack to the hydraulic modulator. Refer to "Motor Pack" in this section.



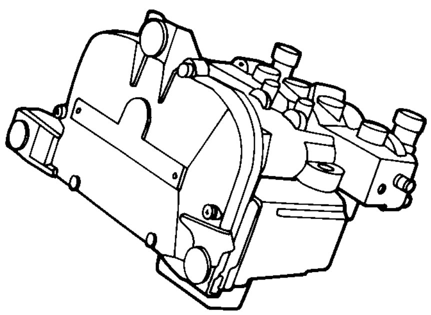
A107F053

HYDRAULIC MODULATOR

Disassembly Procedure

1. Remove the hydraulic modulator/motor pack assembly from the vehicle. Refer to "Hydraulic Modulator/ Motor Pack Assembly" in this section.
2. Remove the two solenoids from the hydraulic modulator/motor pack assembly. Refer to "ABS Solenoid" in this section.
3. Remove the gear cover from the hydraulic modulator/ motor pack assembly. Refer to "Gear Cover" in this section.
4. Remove the motor pack from the hydraulic modulator. Refer to "Motor Pack" in this section.

Important: No repair of the hydraulic modulator is authorized. Replace the modulator as an assembly.


A107F054

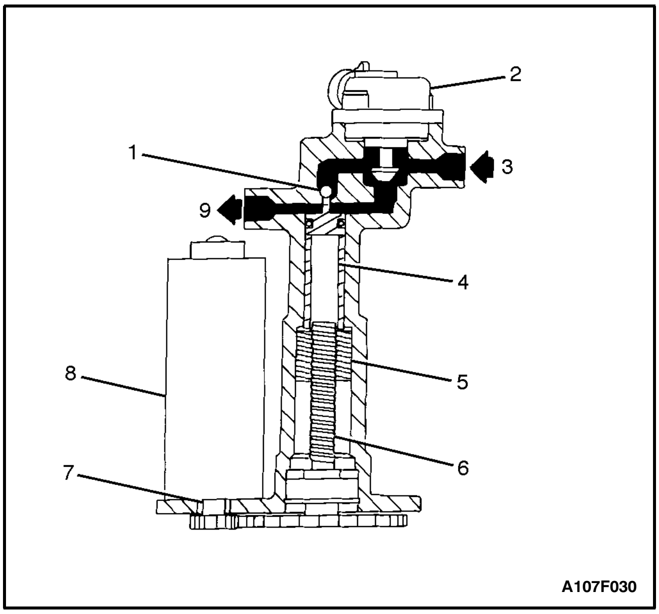
Assembly Procedure

1. Install the motor pack onto the hydraulic modulator aligning the motor pack gears with the modulator gears. Refer to "Motor Pack" in this section.
2. Install the gear cover to the hydraulic modulator/motor pack assembly. Refer to "Gear Cover" in this section.
3. Install the solenoids onto the hydraulic modulator/motor pack assembly. Refer to "ABS Solenoid" in this section.
4. Install the hydraulic modulator/motor pack assembly into the vehicle. Refer to "Hydraulic Modulator/Motor Pack Assembly" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

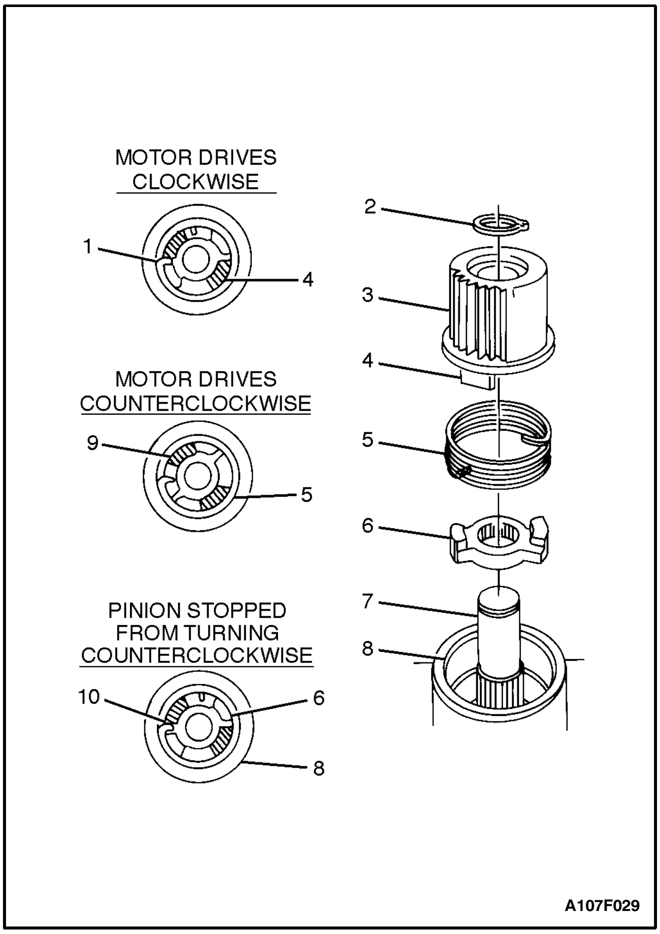
BASE BRAKING MODE

Under normal operating conditions, the brake system will operate using conventional braking by means of brake pedal force, the vacuum booster, and the master cylinder. Each front channel consists of a motor, a solenoid, an expansion spring brake (ESB), a ball screw, a piston, and a check valve. As illustrated, under normal operating conditions (base braking), the piston is held in the upmost or "home" position. This is accomplished by the screw via the motor turning the ball screw and driving the nut upwards.



1 Check Valve Open
2 Solenoid Valve Open
3 Brake Pressure from Proportional Valve
4 Piston
5 Ball Screw Nut
6 Ball Screw Spindle
7 Expansion Spring Brake (ESB)
8 ABS Motor Pack
9 Brake Pressure to Front Brake

Once the piston is at the upmost position, it is held by an ESB. An ESB is a spring that is retained in a housing at a close tolerance. One end of the spring is in contact with the motor drive dog, and the other end is in contact with the pinion drive dog. In normal braking, brake pressure is present on the top of the piston, applying a downward force. This force applies a counterclockwise torque to the motor pinion, which tries to rotate the spring counterclockwise. This torque expands the spring outward within the housing and prevents the gear from rotating. While the piston is at the upmost position, it unseats the check valve and opens a path for the brake fluid.



1 Motor Drive Dog Releases Spring Brake and Drive Pinion
2 Circlip
3 Motor Pinion
4 Pinion Drive Dog
5 Expansion Spring Brake (ESB)
6 Motor Drive Dog
7 Motor Shaft
8 Steel Sleeve
9 Motor Drive Dog Releases Spring Brake (spring leg beneath pinion dog)
10 Pinion Dog Expands Spring and Locks Against Sleeve

Two paths are available to transfer brake fluid to the calipers: (1) through the modulator, around the open check valve, and out to the caliper; and (2) through the modulator, through the normally open solenoid and out to the caliper. The solenoid in the front circuits provides an alternate brake fluid pressure path to the caliper. With this arrangement, if the ABS were to lose power or malfunction with the piston out of the "home" position, an equivalent brake fluid path would always be available.

The rear channels operate in a similar manner except: (1) both rear channels are controlled together and (2) no solenoid exists. Both rear channels are controlled by one motor to simplify the design. Since ABS operates on a select low principle (if either rear wheel begins to lock, brake pressure to both rear wheels is reduced to maximize vehicle stability), both rear brakes are controlled together.

There is no rear solenoid due to the nature of the braking system. The vast majority of the braking is accomplished with the front brakes. An ABS failure that affected the operation of the rear base brakes would cause a DTC to be stored and the EBCM would illuminate both the amber ABS indicator and the red BRAKE indicator.

ANTILOCK BRAKING MODE

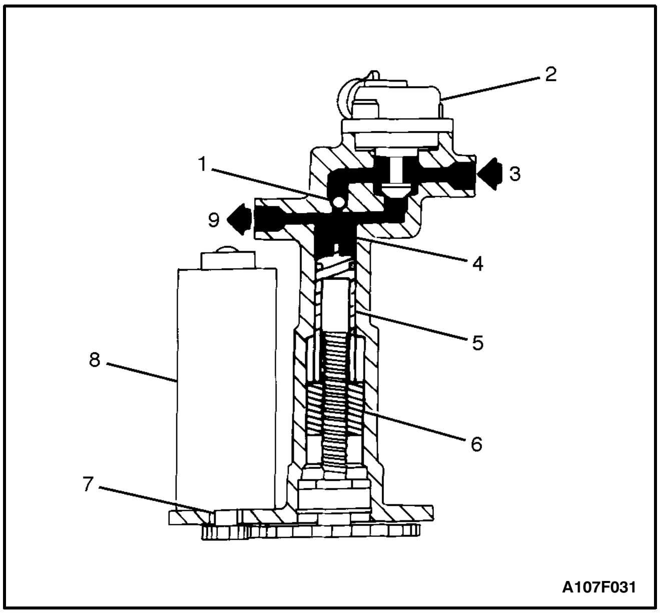
ABS VI has been designed to improve the controllability and steerability of a vehicle during braking. ABS VI accomplishes this by controlling the hydraulic brake pressure applied to each front caliper and the rear wheel cylinders. Antilock braking occurs only when the stoplamp switch is closed and a microprocessor, located in the EBCM, determines that at least one wheel is about to lose traction during braking. The EBCM will then allow the hydraulic modulator to change the brake pressures several times each second to keep the wheel(s) from locking and provide the driver with maximum vehicle controllability. ABS VI cannot increase the brake pressure above the master cylinder pressure applied by the driver and cannot apply the brakes by itself.

The result is greatly improved braking, enabling the driver to maintain steerability more easily and to bring the vehicle to a controlled stop. ABS VI provides effective braking and directional control over a wide range of read surfaces and driving conditions.

If any wheel begins to approach lockup, the EBCM will control the three motors and two solenoids, appropriately, to control brake pressure to the affected wheel(s). During front wheel ABS operation, the solenoids are turned on to isolate that brake pressure path to the caliper.

The EBCM then provides controlled current to the motors to regulate the speed and amount of movement. When the motor is activated and tries to drive the ball screw nut, the end of the ESB in contact with the motor drive dog rotates inward, causing the spring to contract in its housing and allowing the motor to rotate the modulator gear.

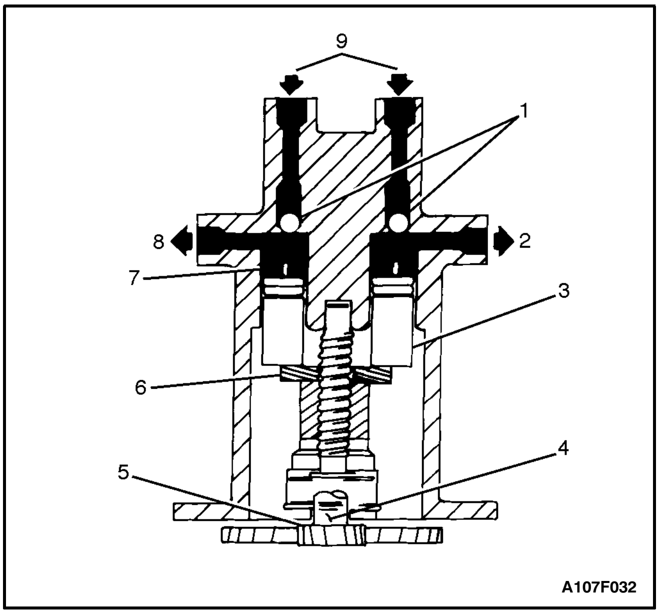
The most common application of this principle is in window crank mechanisms, where the weight of the window or the force of the window will not allow the window to move downward, but a small amount of force on the regulator handle allows the window to be lowered or raised. For the ESB, brake pressure on the top of the pistons corresponds to the weight of the window and the motor corresponds to the window regulator handle. As the motor moves backwards, the piston follows the nut downward, allowing the check valve to seat. The brake pressure to the caliper is now a function of the controlled volume within the piston chamber. To reduce brake pressure, the motor drives the nut further downward. To reapply or increase brake pressure, the motor drives the nut and piston upward. If ABS were entered during low brake pressure, such as in ice, and dry pavement is then encountered during reapply, the piston is driven all the way to the top. This results in the unseating of the check valve and a return to base braking until sufficient brake pressure exists to cause the wheel to approach lockup again. At this point, the ABS cycle would start again. Total brake pressure during ABS is limited to the brake pressure present when ABS was entered. Also, any time wheel brake pressure exceeds the brake pressure at the master cylinder (caused by reduced force on the brake pedal), the check valve unseats and a small volume of brake fluid is returned to the master cylinder to equalize pressure. In this manner, ABS VI cannot increase the brake pressure above the master cylinder pressure applied by the driver and cannot apply the brakes by itself. When ABS is no longer required, the pistons are returned to their upmost position, and the solenoids on the front channels are opened to provide an optional base braking path again.



1 Check Valve Closed
2 Solenoid Valve Closed
3 Brake Pressure from Master Cylinder
4 Modulation Chamber
5 Piston in "Modulation" Position
6 Ball Screw Nut in "Modulation" Position
7 Expansion Spring Brake (ESB)
8 ABS Motor Pack
9 Modulated to Front Brake

The rear channel operates in a similar manner except that no solenoid is used.

Both rear brakes' pressures are controlled by the same motor, and both rear brakes' pressures are maintained at nearly equal levels.



1 Check Valves Closed
2 Modulated Pressure to Left Rear Brake
3 Piston Lowered
4 Expansion Spring Brake (ESB) Location
5 Motor Pinion
6 Yoke on Ball Screw Drives Both Rear Circuit Pistons
7 Modulation Chamber
8 Modulated Pressure to Right Rear Brake
9 Brake Pressure from Master Cylinder

Initialization

The "ABS" indicator will be illuminated for about 3 seconds when the ignition switch is first turned to ON. System initialization will occur when the vehicle speed reaches approximately 8 km/h (5 mph). A slight mechanical noise may be heard during system initialization. This is a normal occurrence, the result of the hydraulic modulator pistons returning to their upmost (or home) position. A driver who is applying the brake during system initialization may feel a slight pedal bump. When this occurs, system initialization is interrupted.

Indicator Operation

The standard brake system uses a single red BRAKE indicator located in the instrument cluster. The antilock brake system uses two lamps, the red BRAKE indicator, and an amber ABS indicator.

1. When the ignition switch is turned to the ON position, before starting the engine, the amber ABS indicator should illuminate for approximately 3 seconds. The red BRAKE indicator will quickly flash on also.
2. As the engine is cranked, the red BRAKE indicator and the amber ABS indicator should illuminate steadily.
3. In 3 to 4 seconds after the engine is started, the ABS indicator should be off. The red BRAKE indicator will go off immediately.

For further information regarding indicator operation, refer to "Indicators" in this section.

TIRES AND ABS

Replacement Tires

Tire size is important for proper performance of the ABS. Replacement tires should be the same size, load range, and construction as the original tires. Replace tires in axle sets and only with tires of the same tire performance criteria (TPC) specification number. Use of any other size or type may seriously affect the ABS operation.

ABS SYSTEM COMPONENTS

The ABS VI Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear leading/trailing drum brakes, interconnecting hydraulic brake pipes and hoses, a brake fluid level sensor and the BRAKE indicator.

The ABS components include a hydraulic modulator/motor pack assembly, an EBCM, a system enable relay, two system fuses, four wheel speed sensors (one at each wheel), interconnecting wiring, a lamp driver module, and the ABS indicator. See "ABS Component Locator" in this section for the general layout of this system.

The hydraulic modulator/motor pack assembly is located at the firewall on the right side of the vehicle.

The basic hydraulic modulator configuration consists of drive gear subassemblies, ball screws, nuts, pistons, and hydraulic check valves. The hydraulic modulator/motor pack assembly controls hydraulic pressure to the front calipers and the rear wheel cylinders by modulating hydraulic pressure to prevent wheel lockup. For more information, refer to "Base Braking Mode" and "Antilock Braking Mode" in this section.

ELECTRONIC BRAKE CONTROL MODULE (EBCM)

Notice: There is no serviceable or removable PROM. The EBCM must be replaced as an assembly.

The EBCM is located behind the right-side kick panel.

The controlling element of ABS VI is a microprocessor-based EBCM. Inputs to the system include four wheel speed sensors, the stoplamp switch, the ignition switch and the unswitched battery voltage. Outputs include three bi-directional motor controls, two solenoid controls, and the system enable relay. A bi-directional serial data link, located in pin M of the ALDL, is provided for service diagnostic tools and assembly plant testing.

The EBCM monitors the speed of each wheel. If any wheel begins to approach lockup and the brake switch is closed (brake pedal depressed), the EBCM controls the motors and solenoids to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lockup. This cycle repeats until either the vehicle comes to a stop, the brake pedal is released, or no wheels approach lockup.

Additionally, the EBCM monitors itself, each input (except the serial data link), and each output for proper operation. If it detects any system malfunction, the EBCM will store a DTC in nonvolatile memory (DTCs will not disappear if the battery is disconnected). Refer to "Self Diagnostics" in this section for more detailed information.

FRONT WHEEL SPEED SENSORS

The front wheel speed sensors are of a variable reluctance type. Each sensor is attached to the steering knuckle close to a toothed ring. The result, as teeth pass by the sensor, is an AC voltage with a frequency proportional to the speed of the wheel. The magnitude of the voltage and frequency increase with increasing speed. The sensor is not repairable, nor is the air gap adjustable.

FRONT WHEEL SPEED SENSOR RINGS

The toothed ring mentioned above is pressed onto the wheel-side (outer) constant velocity joint. Each ring contains 47 equally-spaced teeth. Exercise care during service procedures to avoid prying or contacting this ring. Excessive contact may cause damage to one or of the more teeth. If the ring is damaged, the wheel-side constant velocity joint must be replaced.

REAR WHEEL SPEED SENSORS AND RINGS

The rear wheel speed sensors operate in the same manner as the front wheel speed sensors. The rear wheel speed sensors and the speed sensor rings are integrated into the rear wheel hub assembly and are not serviced separately. If a rear wheel speed sensor or a speed sensor ring is malfunctioning, you must replace the rear wheel hub assembly.

ABS ENABLE RELAY

The ABS enable relay is located near the EBCM behind the right-side kick panel.

The ABS enable relay is a normally-open contact type and has special contact material to handle the high currents required for ABS VI operation. The relay supplies the battery voltage and the current to the solenoids and to the EBCM, which supplies power to the motors and operates the solenoids by switching ground for them.

BRAKE FLUID LEVEL SWITCH

The brake fluid level switch is contained within the master cylinder reservoir cap.

WIRING HARNESS

The wiring harness is the mechanism by which the EBCM is electrically connected to power and to ground, the wheel speed sensors, the motors, the solenoids, the fuses, the switches, the indicators, the enable relay, and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection and the connectors (terminals, pins, contacts, or lugs) that provide an electrical/mechanical interface from the wire to a system component.

INDICATORS

The EBCM continuously monitors itself and the other ABS components. If the EBCM detects a problem with the system, the amber ABS indicator will either flash or light continuously to alert the driver to the problem. The ABS indicator will flash if the problem does not immediately hamper ABS operation. However, a flashing ABS indicator signals the driver that repairs must be made to the system as soon as possible.

A solid ABS indicator indicates that the ABS system has detected a problem that affects the operation of the ABS. No antilock braking will be available. Normal, non-antilock brake performance will remain. In order to regain ABS braking ability, the ABS must be serviced.

The red BRAKE indicator will be illuminated when the system detects a low brake fluid level in the master cylinder, the parking brake switch is closed (parking brake engaged), or the ignition switch is ON and the engine is not running or under control of the EBCM. The EBCM will illuminate the BRAKE indicator when an ABS fault could interfere with base brake operation. When this type of fault is detected, the EBCM will store the appropriate DTC, store a DTC A086 (indicating that the EBCM has turned the BRAKE indicator on), and disable the ABS.

SECTION 4G

PARKING BRAKE

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Muffler Heat Shield Nuts	2.5	-	22
Parking Brake Cable-to-Fuel Tank Bracket Nut	12	-	106
Parking Brake Cable-to-Rear Axle Bracket Nut	12	-	106
Parking Brake Cable-to-Underbody Side and Near Side Bracket Nuts	12	-	106
Parking Brake Console Hood-to-Tunnel Bracket Screws	2.5	-	22
Parking Brake Lever-to-Vehicle Underbody Bolts	20	15	-
Parking Brake Switch-to-Parking Brake Lever Screw	4	-	35
Rear Brake Drum Castle Nut (Non-ABS)	25 - 180° + 2	18 - 180° + 1.5	-
Rear Brake Drum Detent Screw (ABS)	4	-	35

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

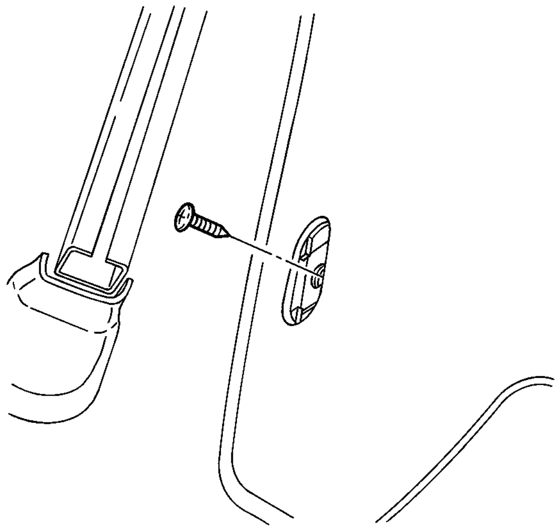
PARKING BRAKE ADJUSTMENT

Adjustment Procedure

1. Adjust the rear brakes. Refer to Section 4E, Rear Drum Brakes.
2. Release the parking brake.
3. Raise and suitably support the vehicle.
4. Check the parking brake cables for free movement.

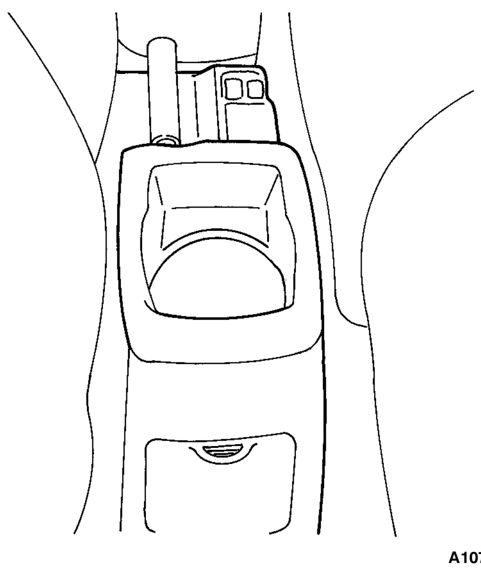
A207G001

5. Lower the vehicle
6. Move the front seats forward.
7. Pry off the plastic caps that cover the access holes to the parking brake console hood-to-tunnel bracket screws.
8. Unfasten the screws that secure the parking brake console hood to the tunnel brackets.

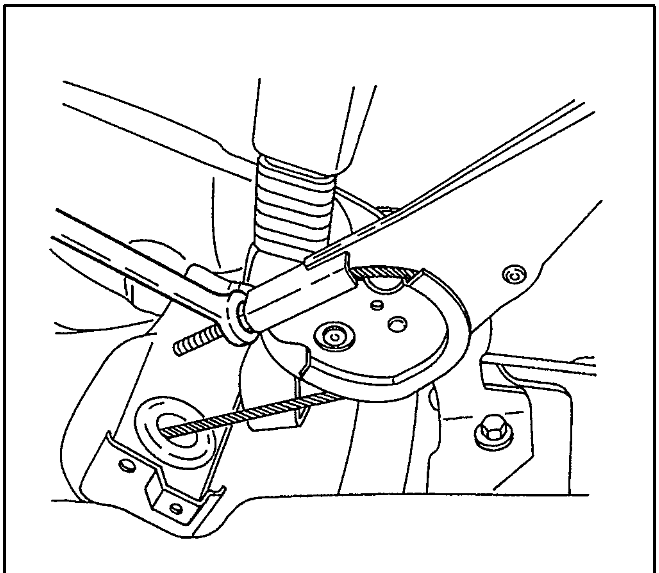


A207G006

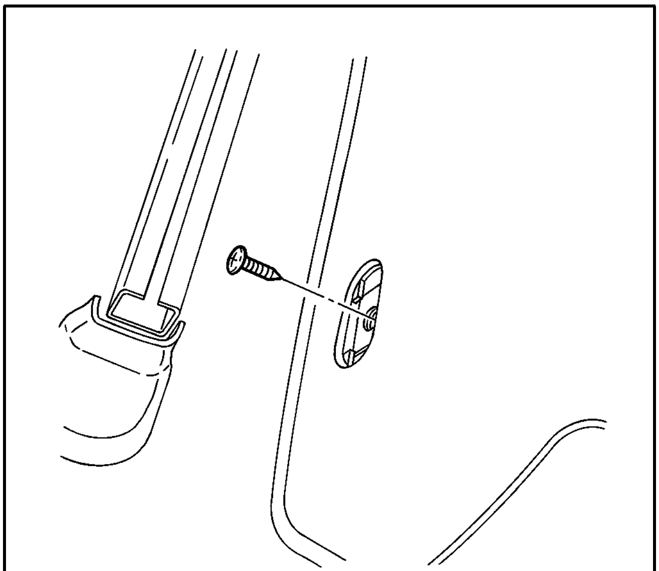
9. Raise the console hood to expose the parking brake lever assembly and the adjustment nut.



A107G003


A207G002

10. Partially raise and suitably support the vehicle.
11. Turn the adjustment nut on the lever assembly until the wheels are difficult to turn.
12. Loosen the nut until the rear wheels are just free to turn.

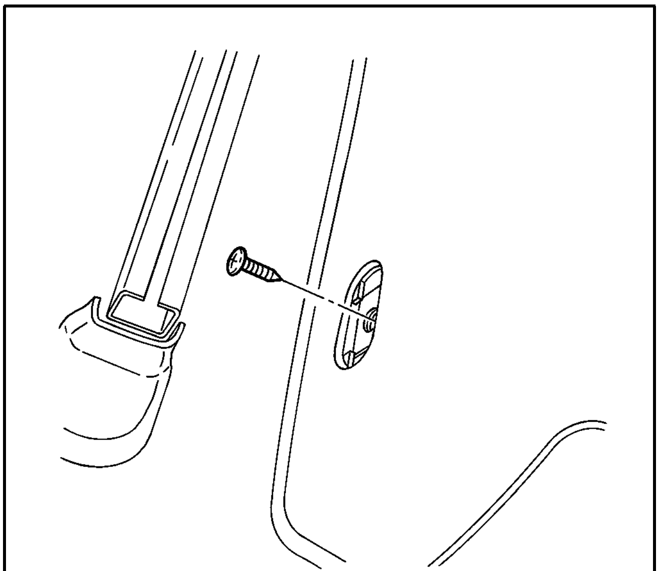

A207G006

13. Lower the vehicle.
14. Position the parking brake console hood and fasten it to the tunnel brackets with the screws.

Tighten

Tighten the parking brake console hood-to-tunnel bracket screws to 2.5 N•m (22 lb-in).

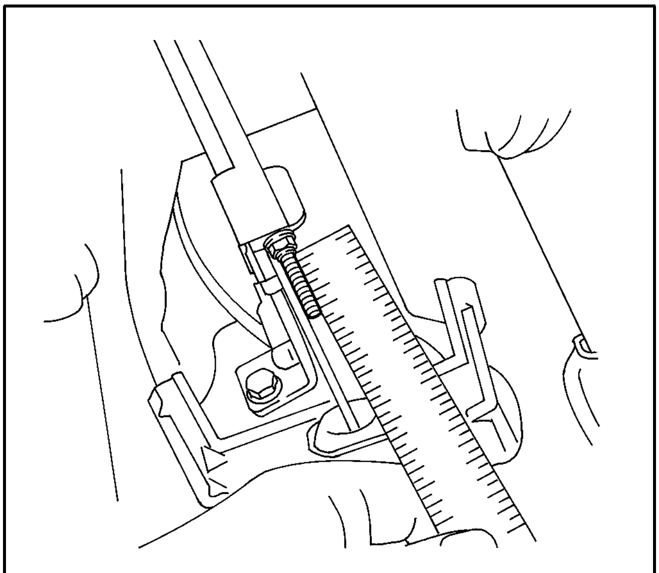
15. Snap in the plastic caps that cover the access holes to the parking brake console hood-to-tunnel bracket screws.
16. Adjust the front seats to their previous position.


A207G006

PARKING BRAKE LEVER

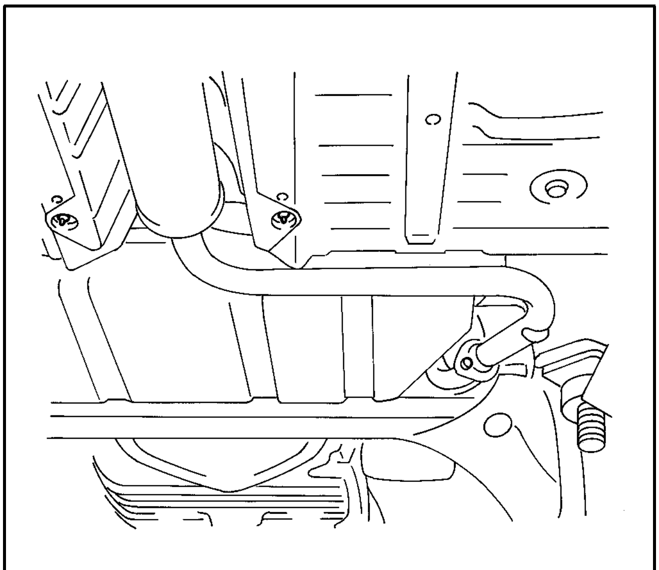
Removal Procedure

1. Release the parking brake.
2. Move the front seats forward.
3. Pry off the plastic caps that cover the access holes to the parking brake console hood-to-tunnel bracket screws.
4. Remove the screws that secure the parking brake console hood-to-the-tunnel brackets. Raise the console hood.



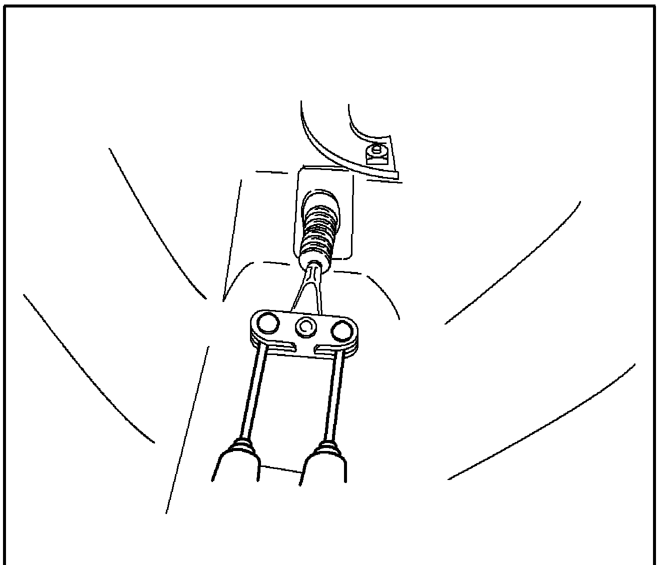
A107G005

5. Measure the thread length from the end of the push-rod to the adjustment nut. Loosen the adjustment nut.



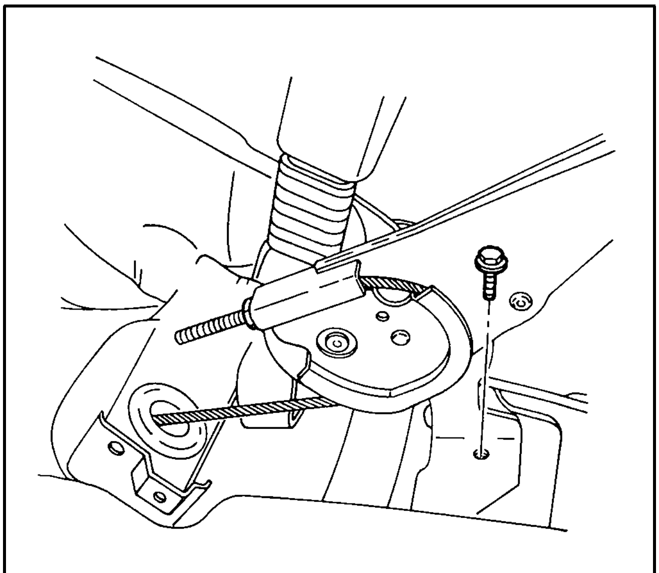
A107G006

6. Raise and suitably support the vehicle.
7. Disconnect the front muffler assembly from the flange of the rear muffler assembly and from the flange of the catalytic converter. Refer to Section 1G, Engine Exhaust.
8. Remove the heat shield nuts. Remove the heat shield.



A107G020

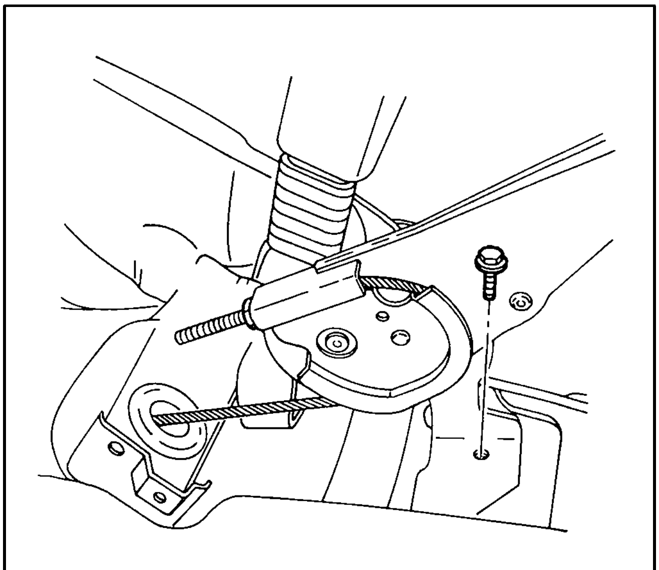
9. Twist the brake cables from the equalizer. Remove the equalizer.
10. Dislodge the rubber grommet from the underbody.


A207G003

11. Lower the vehicle.
12. Remove the complete parking brake lever assembly and the cable from the assembly by unfastening the parking brake lever-to-vehicle underbody bolts and removing the adjustment nut which was previously loosened on the pushrod.

Notice: The parking brake switch should be replaced if the BRAKE warning light in the instrument panel cluster does not glow when the parking brake is applied with the ignition switch ON.

13. If necessary, remove the parking brake switch, which is attached to the parking brake lever assembly by a small screw.
14. Inspect the parking brake lever cable and the lever grip for damage, and replace if necessary.


A207G003

Installation Procedure

Notice: If the parking brake lever is bent or damaged or if a new grip is required, replace the complete parking brake lever assembly, which includes a new parking brake switch and lever cable.

1. Fasten the parking brake switch to the parking brake lever with the screw.

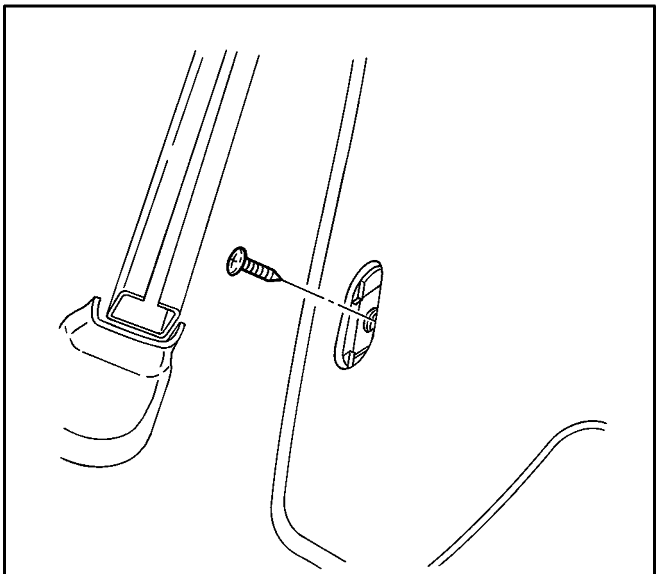
Tighten

Tighten the parking brake switch-to-parking brake lever screw to 4 N•m (35 lb-in).

2. Fasten the parking brake lever assembly to the vehicle underbody. Insert the cable, and the pushrod.
3. Tighten the hex adjusting nut on the pushrod approximating the measurement noted in the removal procedure.

Tighten

Tighten the parking brake lever-to-vehicle underbody bolts to 20 N•m (15 lb-ft).

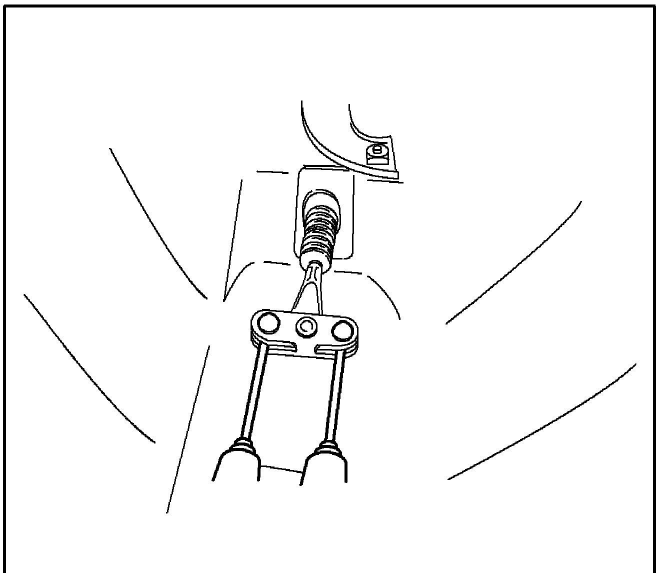

A207G006

4. Install the screws that secure the parking brake console hood to the tunnel brackets.

Tighten

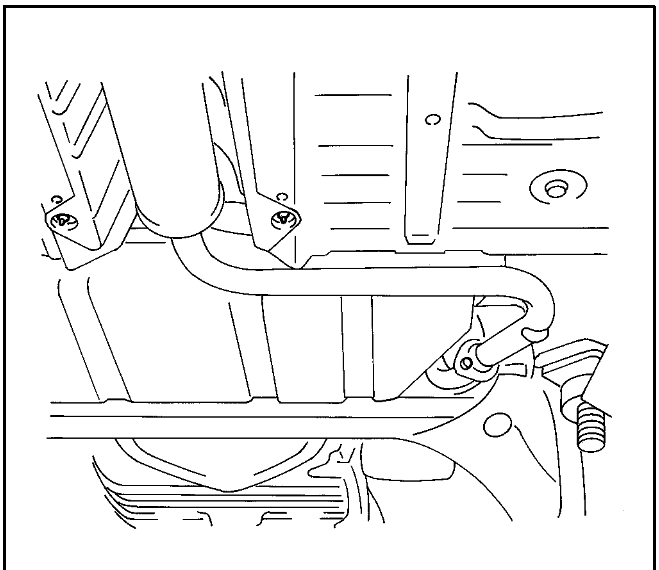
Tighten the parking brake console hood-to-tunnel bracket screws to 2.5 N•m (22 lb-in).

5. Install the plastic caps that cover the access holes to the parking brake console hood-to-tunnel bracket screws.
6. Raise the vehicle.
7. Insert the rubber grommet into the vehicle underbody and fasten the equalizer.



A107G020

8. Insert the parking brake cables into the equalizer.



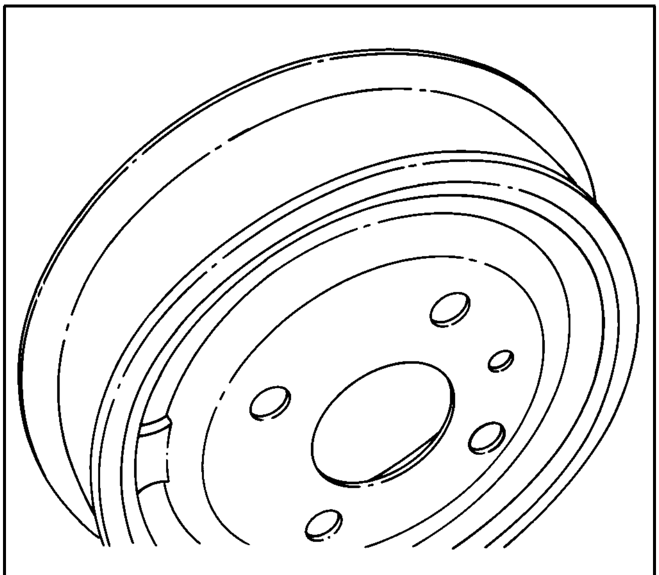
A107G006

9. Install the front muffler heat shield to the underbody with the heat shield nuts.

Tighten

Tighten the front muffler heat shield nuts to 2.5 N•m (22 lb-in).

10. Install the front muffler assembly. Refer to Section 1G, Engine Exhaust.
11. Check the parking brake adjustment. Refer to "Parking Brake Adjustment" in this section.

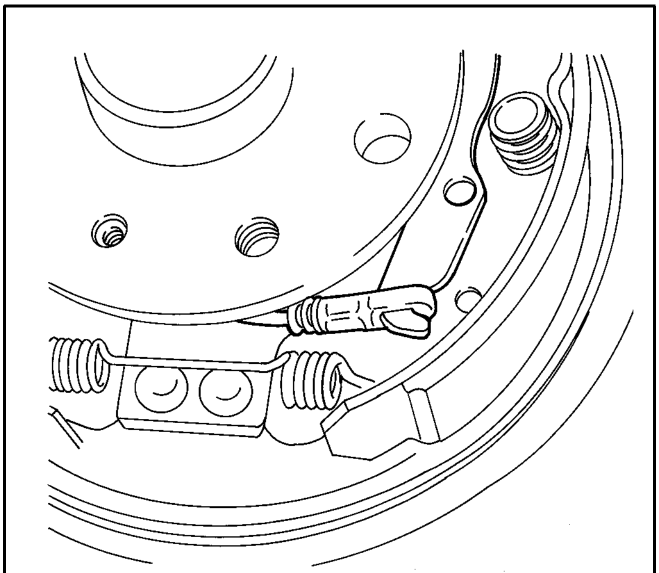


A207E002

PARKING BRAKE CABLE

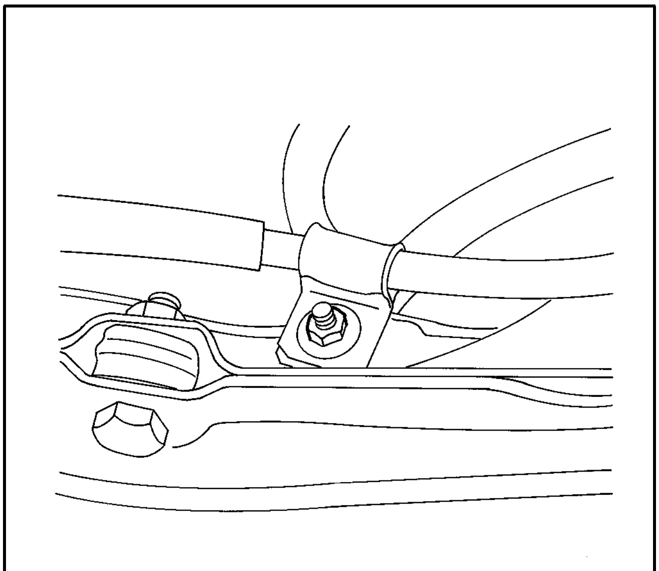
Removal Procedure

1. To remove the parking brake console hood, the front muffler, and the heat shield, refer to "Parking Brake Lever" in this section.
2. Remove the rear wheels. Refer to Section 2E, Tires and Wheels.
3. For the ABS braking system (shown), unfasten the detent screw to remove the rear brake drums. For the non-ABS system, remove the split pin and the castle nut to remove the brake drum.



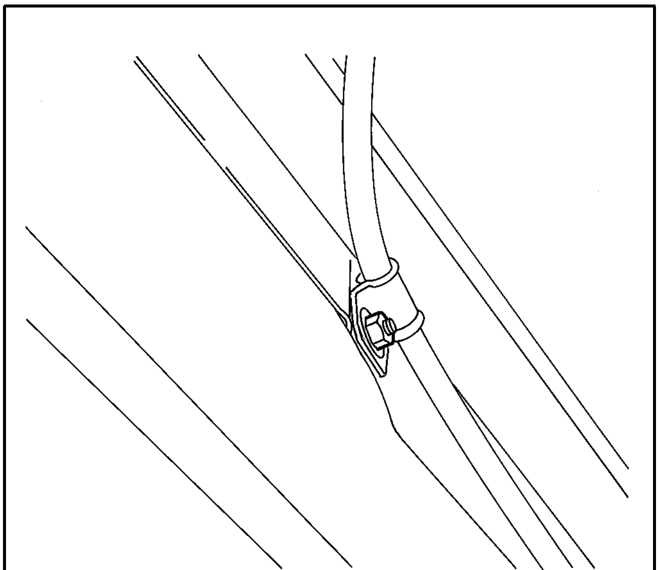
A107G011

4. **Remove the retaining ring for the parking brake cable on each side of the vehicle.**
5. **Remove the plastic sleeve.**
6. **Remove the brake cable from the parking brake shoe lever and from the brake backing plate.**



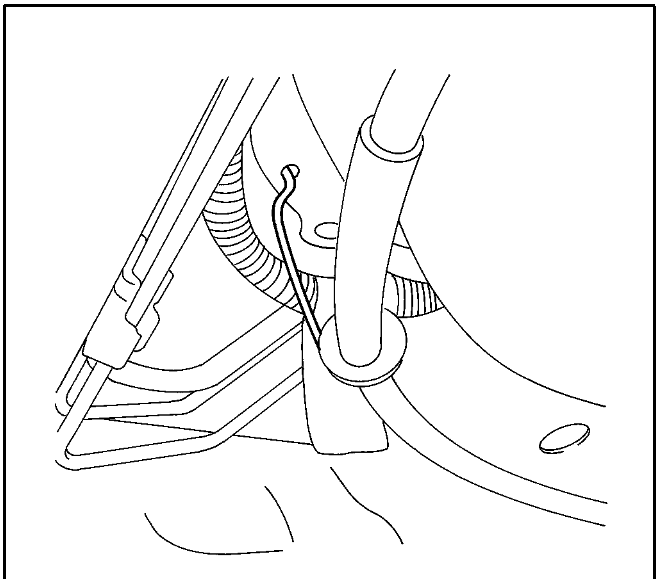
A107G015

7. **Remove the nut that fastens the brake cable to a holding bracket on the rear axle. Remove the cable from the bracket on each side of the vehicle.**



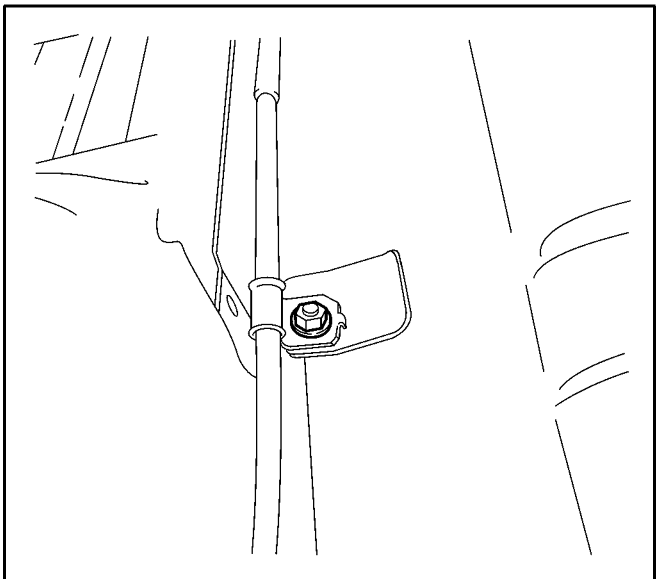
A107G016

8. **Remove the nut that fastens the brake cable to the underbody side bracket on each side of the vehicle. Remove the cable.**
9. **Remove the nut that fastens the brake cable to a holding bracket near the underbody side bracket (driver side only).**



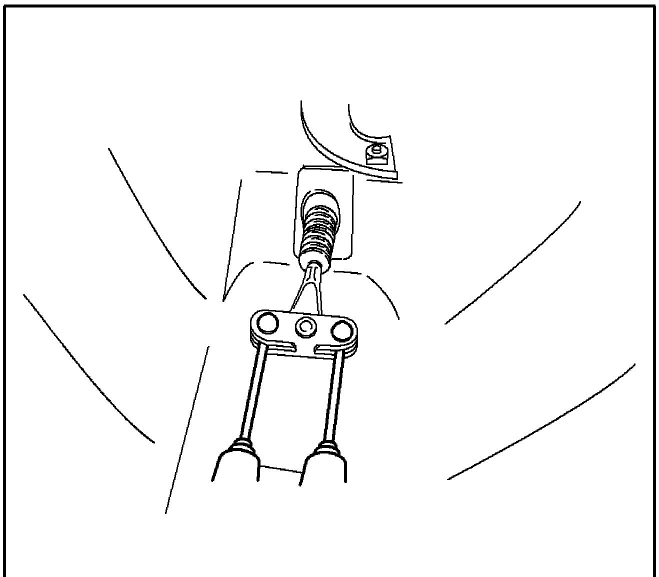
A107G017

10. Remove the brake cable from the wire hanger (passenger side only). Remove the cable.
11. Grasp and pull the brake cable from the open-ended holding bracket near the wire hanger.



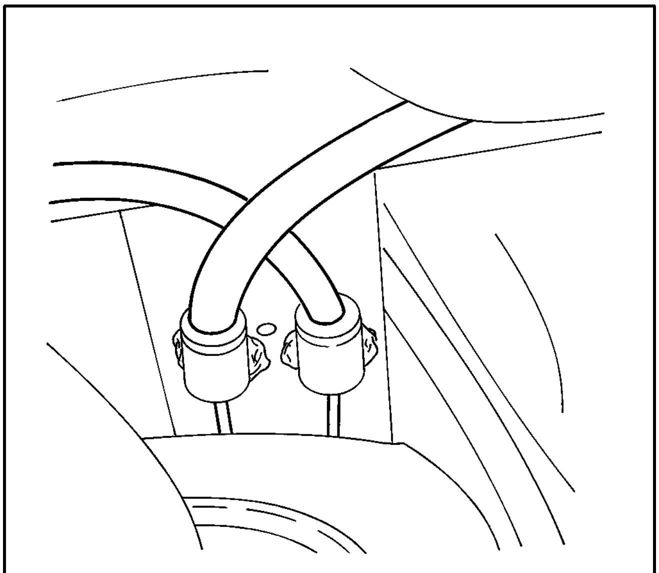
A207G004

12. Remove the nut that fastens the brake cable to the fuel tank bracket near the edge of the fuel tank. Remove the cable.



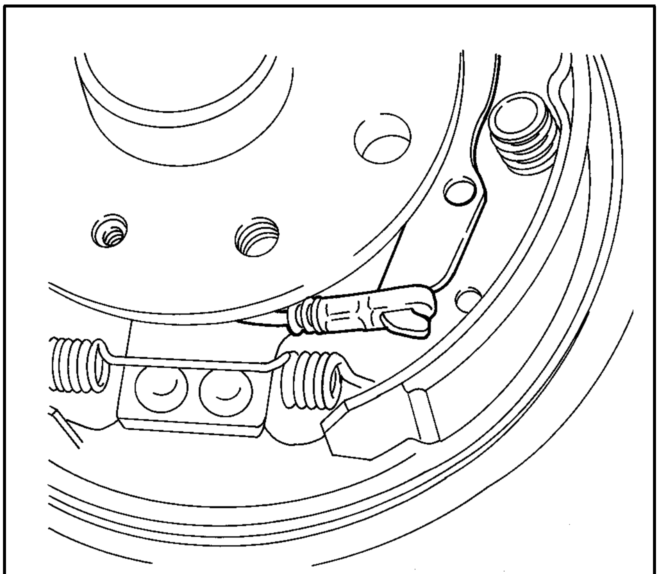
A107G020

13. Twist the brake cables from the equalizer.
14. Remove the equalizer.



A207G005

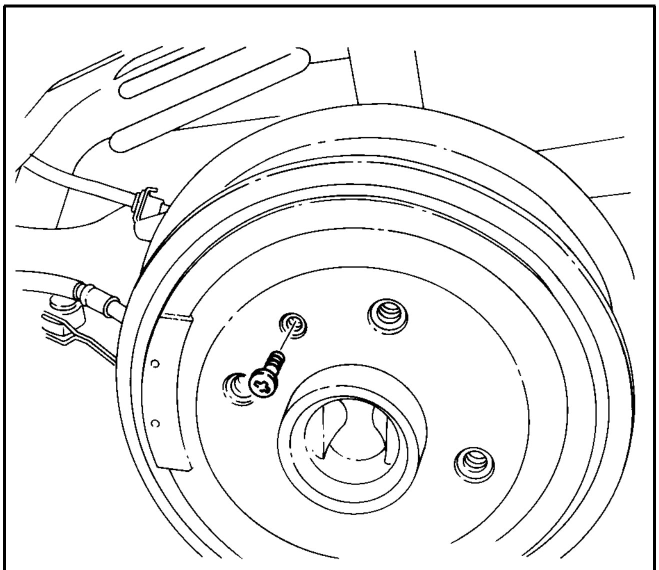
15. Remove the parking brake cables from the welded body bracket.



A107G011

Installation Procedure

1. Install the new parking brake cable through the brake backing plate. Use a new cable if the original is frayed or damaged. Attach the cable to the parking brake shoe lever.



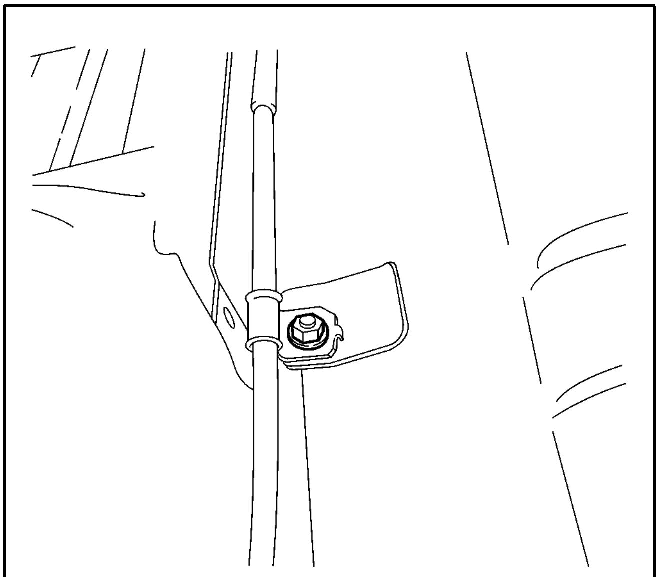
A207E001

2. Insert the plastic sleeve into the brake backing plate and press in the retaining ring. Make sure the parking brake cable is routed correctly.
3. For the ABS braking system (shown), install the brake drums and the detent screw. For the non-ABS braking system, remove the brake drums by unfastening the split pin and the castle nut.

Tighten

Tighten the rear brake drum detent screw (ABS) to 4 N•m (35 lb-in).

Tighten the rear brake drum castle nut (non-ABS) to 25 N•m (18 lb-ft) minus 180 degrees plus 2 N•m (18 lb-in).

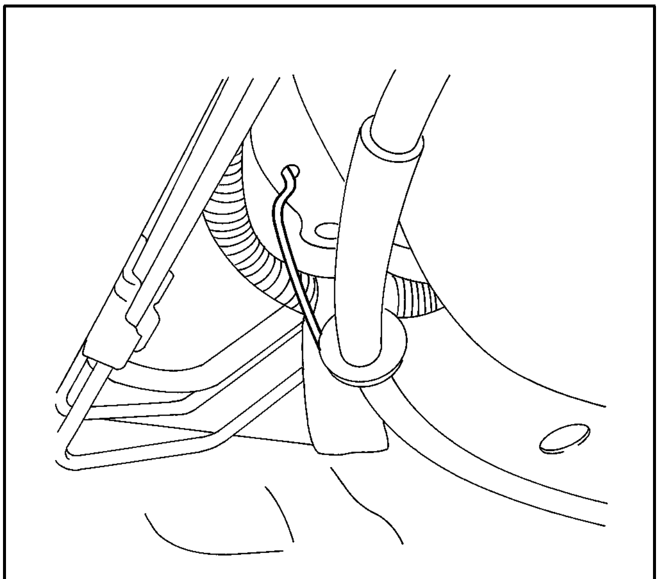


A207G004

4. Install the rear wheels. Refer to Section 2E, Tires and Wheels.
5. Install the parking brake cable to the fuel tank bracket.

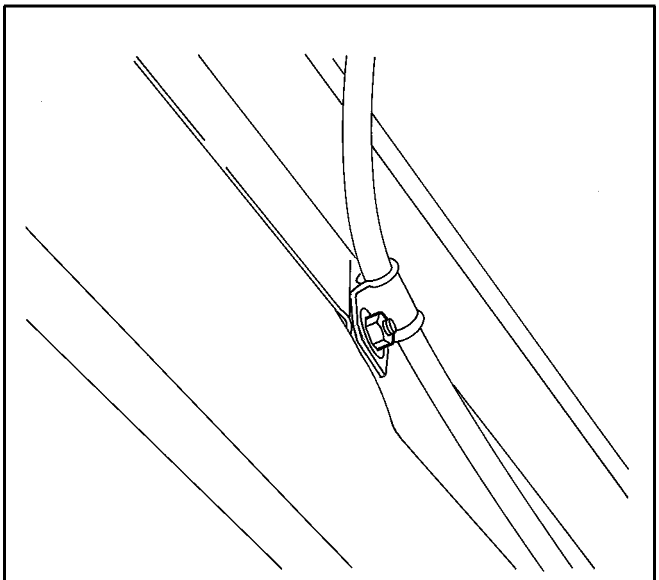
Tighten

Tighten the parking brake cable-to-fuel tank bracket nut to 12 N•m (106 lb-in).



A107G017

6. Install the parking brake cable on the wire hanger (passenger side only).
7. Insert the brake cable into the open-ended holding bracket near the wire hanger.

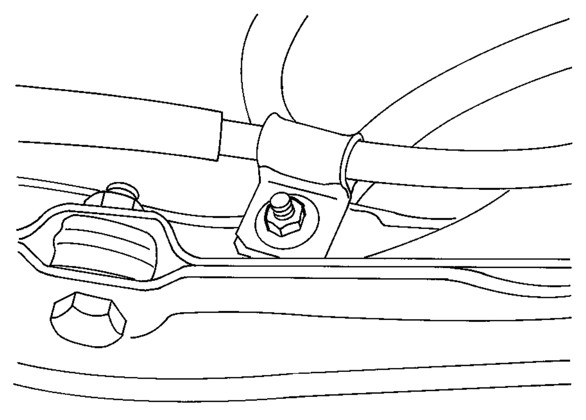


A107G016

8. Install the parking brake cable to the underbody side brackets on each side of the vehicle, and a bracket near the underbody side bracket (passenger side only).

Tighten

Tighten the parking brake cable-to-underbody side and near side bracket nuts to 12 N•m (106 lb-in).



A107G015

9. Install the parking brake cable on the rear axle brackets on each side of the vehicle.

Tighten

Tighten the parking brake cable-to-rear axle bracket nut to 12 N•m (106 lb-in).

10. Insert the parking brake cables through the welded body bracket.
11. To install the equalizer, the front muffler, and the heat shield, refer to "Parking Brake Lever" in this section.
12. If the parking brake shoe lever was pressed backward before removing the brake drum, press it forward and adjust the parking brake. Refer to "Parking Brake Lever" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

PARKING BRAKE

This braking system uses a BRAKE warning light located in the instrument panel cluster. When the ignition switch is in the START position, the BRAKE warning light should glow and go off when the ignition switch returns to the RUN position. Whenever the parking brake is applied and the ignition switch is ON, the BRAKE warning light should glow.

When the brake is firmly applied, the parking brake should securely hold the vehicle with ample pedal travel remaining. Check for frayed cables, rust, etc., or any condition that may inhibit present (or future) free movement of the parking brake lever assembly.

SECTION 5A

4T40-E AUTOMATIC TRANSAXLE

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

END PLAY SPECIFICATIONS

Dimension A (mm)	Washer Selection	Washer Dimension
100.40-100.70	Brown	1.50-1.60
100.70-100.99	Grey	1.80-1.90
100.99-101.29	Natural	2.09-2.19
101.29-101.59	Black	2.39-2.49
101.59-101.88	Orange	2.68-2.78
101.88-102.18	Violet	2.98-3.08
102.18-102.48	Yellow	3.28-3.38
102.48-102.77	Red	3.57-3.67
102.77-103.07	Green	3.87-3.97

TRANSAXLE GENERAL SPECIFICATIONS

Dimension A (mm)	Backing Plate Identification
8.970-9.433	A
9.434-10.007	B
10.008-10.470	C

FLUID CAPACITY

	Litres	Quarts
Bottom Pan Removal	6.5	6.9
Complete Overhaul	9.0	9.5
Dry	12.2	12.9
(Measurements are approximate)		

RANGE REFERENCE

Range	Park/ Neutral	Reverse	D				3			2			1	
Gear	N	R	1st	2nd	3rd	4th	1st	2nd	3rd	1st	2nd	3rd**	1st	2nd***
1-2 Shift Solenoid	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
2-3 Shift Solenoid	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
2nd Clutch	–	–	–	A	A*	A*	–	A	A*	–	A	A*	–	A
2nd Roller Clutch	–	–	–	H	O	–	–	H	O	–	H	O	–	H
Int./4th Band	–	–	–	–	–	A	–	–	–	–	A	–	–	A
Reverse Clutch	–	A	–	–	–	–	–	–	–	–	–	–	–	–
Coast Clutch	–	–	–	–	–	–	A	A	A	A	A	A	A	A
Input Sprag	–	–	H	H	H	O	H	H	H	H	H	H	H	H
Direct Clutch	–	–	–	–	A	A	–	–	A	–	–	A	–	–
Forward Clutch	–	–	A	A	A	A*	A	A	A	A	A	A	A	A
LO/Rev Band	A	A	–	–	–	–	–	–	–	–	–	–	A	–
LO Roller Clutch	–	–	H	O	O	O	H	O	O	H	O	O	H	O

A = Applied
H = Holding
O = Overrunnig
ON = The solenoid is energized.
OFF = The solenoid is de-energized.
* = Applied with no load.
** = Manual Second-Third gear is only available above approximately 100 km/h (62 mph).
*** = Manual First-Second gear is only available above approximately 60 km/h (37 mph).
NOTE: Manual First-Third gear is also possible at high vehicle speed as a safety feature.

4T40-E GEAR RATIOS

Gear	Ratio
First	2.96
Second	1.62
Third	1.00
Fourth	0.68
Reverse	2.14

SHIFT SPEED

% of TPS		1-2 Shift @ +/- 3 mph			2-3 Shift @ +/- 4 mph			3-4 Shift @ +/- 5 mph			Downshift @ +/- 4 mph			TCC Apply 4th Gear
Model	Series	10	25	50	10	25	50	10	25	50	4-3 Coast	3-2 Coast	2-1 Coast	
WKR	J	9	14.5	20	17	25	39.5	30	36	57	26	11.5	6	42
WBR	J	9	15	27	17	28	51	38	40	78	30	13	7	36

LINE PRESSURE

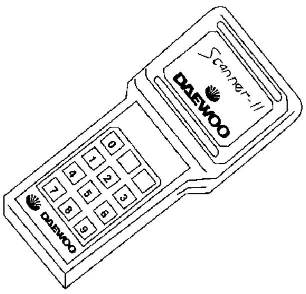
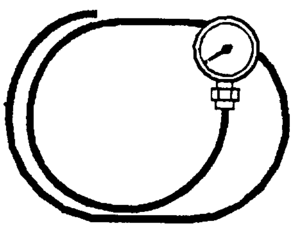
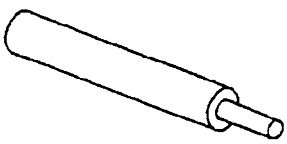
Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (psi)
0.00	152-160
0.10	149-151
0.30	141-143
0.50	124-127
0.60	111-115
0.70	97-101
0.80	81-84
0.90	64-67
0.95	56-58
1.00	50-51
1.05	50
1.10	50

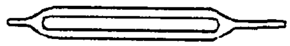
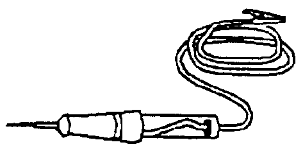
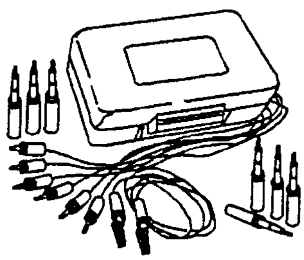
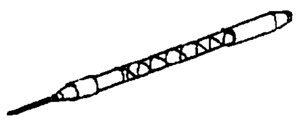
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
A/T OSS Stud	12	-	106
Bell Housing Bolts	75	55	-
Channel Plate-to-Case Bolt	12	9	-
Channel Plate-to-Case Valve Body Bolts	12	-	106
Channel Plate-to-Case Valve Body Pressure Switch Manual Bolts	12	-	106
Channel Plate-to-Case Valve Body Pump Bolts	12	-	106
Channel Plate-to-Support-Driven Sprocket Bolt	14	10.5	-
Channel Plate-to-Support-Driven Sprocket Spacer Bolts	14	10.5	-
Channel Plate Valve Body Pressure Switch Manual Bolts	12	-	106
Detent-to-Channel Plate Spring & Roller Assembly	12	-	106
Drive Sprocket-to-Case Support Assembly Bolts	12	9	-
Engine Mounting Bolts	75	55	-
Floor Bracket Bolt	8	-	71
Fluid Level Plug	12	-	106
Flywheel Bolts	65	48	-
Frame Bolts	75	55	-
Input Speed Sensor Bolt	12	-	106
Oil Pipe Bolts	12	9	-
Pivot Bolt	65	48	-
Servo Cover Bolts	12	-	106
Side Cover Bolts	20	15	-
Shift Control Cable Adjuster Pinch Bolt	8	-	71
Side-to-Case (Stud) Cover	20	15	-
Speed Sensor Stud	12	9	-
Transaxle Mount Bolts	75	55	-
Transaxle Mounting Bracket Bolt	75	55	-
Transaxle Pan Bolts	12	-	106
Trans Oil-to-Cover LO/Reverse Servo Tube Assembly	12	-	106
Trans Oil-to-Support Forward Clutch Tube Assembly	12	-	106
Valve Body-to-Channel Plate Bolts	12	-	106
Valve Body-to-Channel Plate Pump Bolts	12	-	106
Wiring Harness Clip	12	9	-

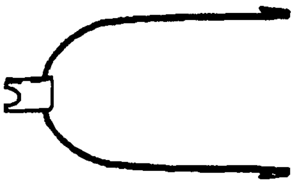
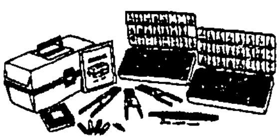
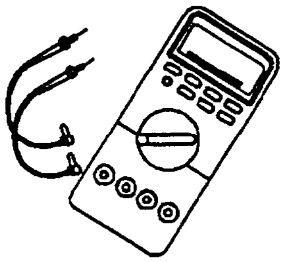
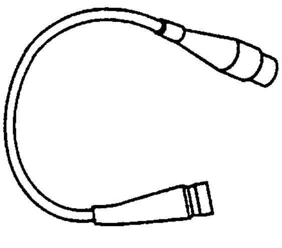
SPECIAL TOOLS

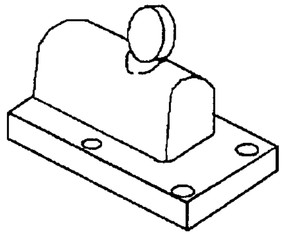
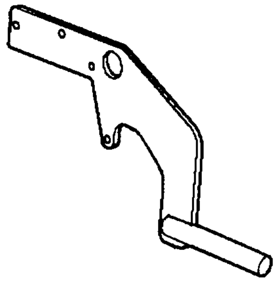
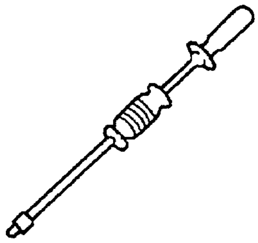
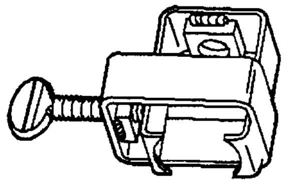
SPECIAL TOOLS TABLE

 A110B003	Tech 2 Scan Tool
 A103A263	J 21867 Universal Pressure Gauge Set
 A103A264	J 28742-A Weather Pack Terminal Remover

 A103A265	J 33095 Control Module Connector Terminal Remover
 A103A266	J 34142-B Universal Test Lamp
 A103A267	J 35616 Connector Test Adapter Kit
 A103A268	J 35689-A Metri-pack Terminal Remover

SPECIAL TOOLS TABLE (Cont'd)

 A103A269	J 36169-A Fused Jumper Wire
 A103A270	J 38125-4 Terminal Repair Kit
 A103A271	J 39200 Digital Volt-Ohmmeter (DVOM)
 A103A272	J 39775 Jumper Harness

 A103A273	J 3289-20 Transmission Holding Fixture Base
 A103A274	J 41230 Transmission Holding Fixture
 A103A275	J 6125-1B Slide Hammer
 A103A276	J 38868 Stub Shaft Sleeve Remover

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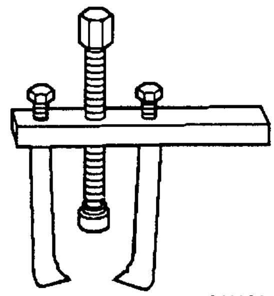
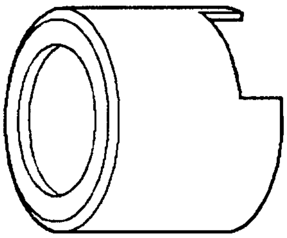
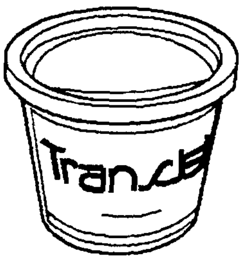
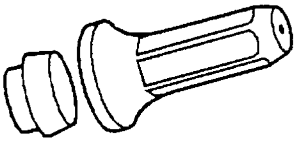
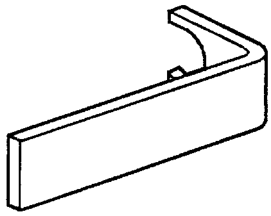
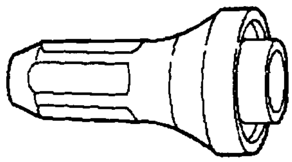
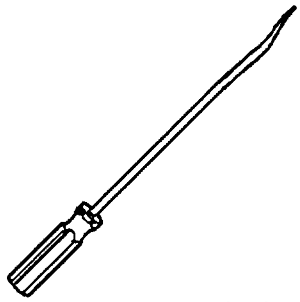
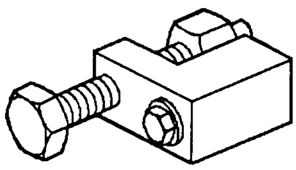
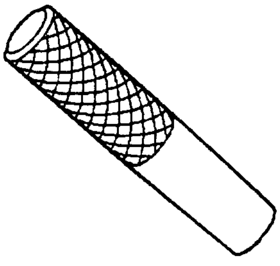
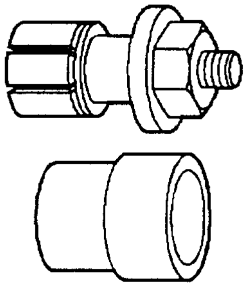
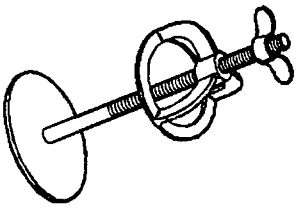
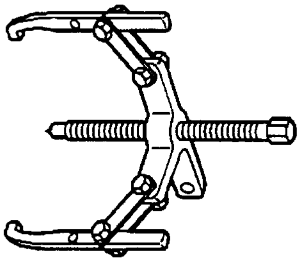
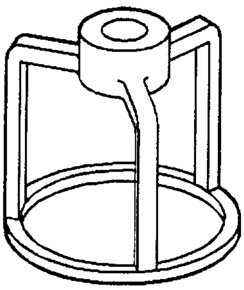
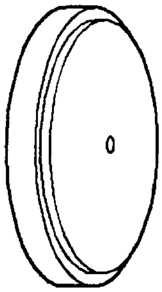
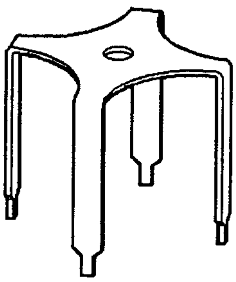
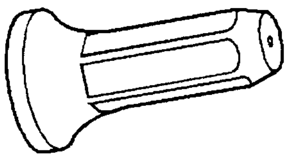
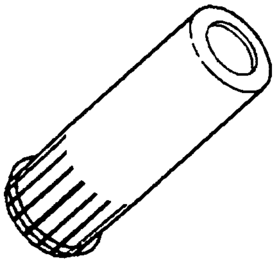
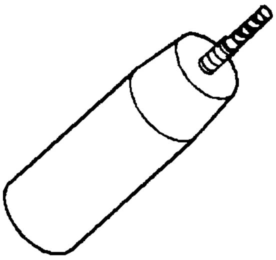
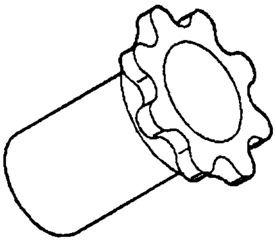
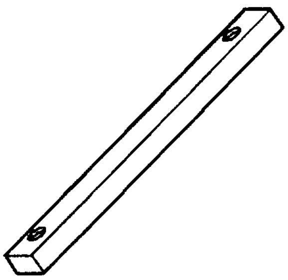
 A103A277	J 41227 Output Shaft Sleeve Remover
 A103A278	J 41101 Pass Through Connector Remover
 A103A279	J 36850 Assembly Lubricant
 A103A280	J 41102 Axle Seal Installer

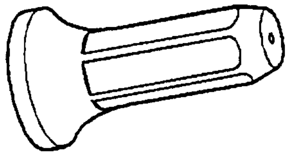
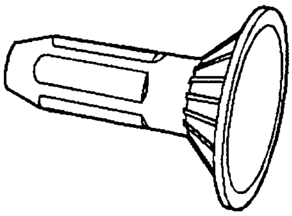
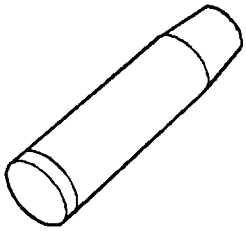
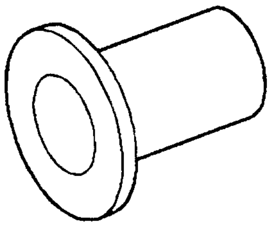
 A103A281	J 41239-2 Cooler Line Seal Remover
 A103A282	J 28540-A Torque Converter Seal Installer
 A103A283	J 28585 Snap Ring Screwdriver
 A103A284	J 41239-1 Cooler Line Seal Installer

SPECIAL TOOLS TABLE (Cont'd)

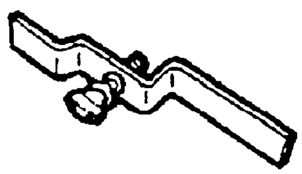
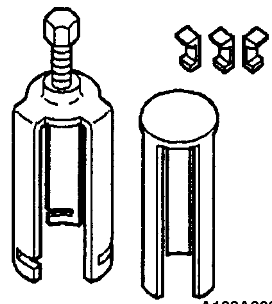
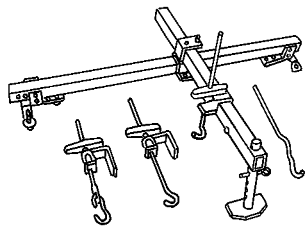
 A103A285	**J 41229** Manual Shaft to Case Pin	 A103A289	**J 41228** Stub Shaft Sleeve Installer
 A103A286	**J 23327** Clutch Spring Compressor	 A103A290	**J 25031-A** Forward and Reverse Clutch Inner Seal Assembly Remover
 A103A287	**J 41236** Coast Clutch Return Spring Compressor Adapter	 A103A291	**J 41097-2** Inner Seal Assembly Remover - Disc
 A103A288	**J 41232** Direct Reverse, Second Clutch Return Spring Compressor Adapter	 A103A292	**J 41231** Forward Clutch Inner Seal Assembly Installer

SPECIAL TOOLS TABLE (Cont'd)

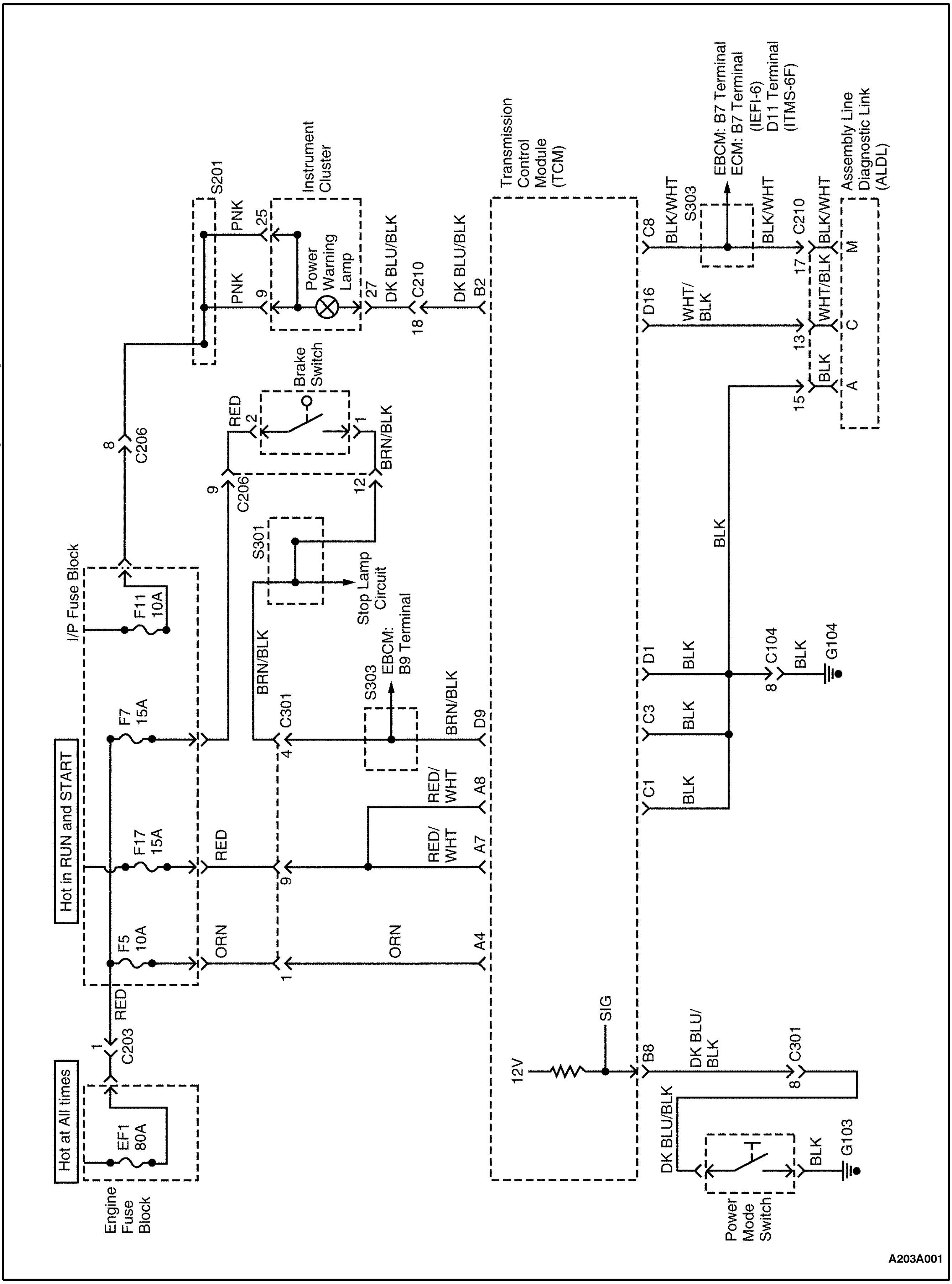
 A103A293	**J 41234-1 Input Shaft Seal Installer Pusher**
 A103A294	**J 41234-2 Input Shaft Seal Installer Protector**
 A103A295	**J 41234-3 Input Shaft Seal Installer Sizer**
 A103A296	**J 34673 Input Shaft End Play Gauge Block**

 A103A297	**J 41233 Reverse Clutch Inner Seal Installer**
 A103A298	**J 41235 Second Roller Clutch Installer**
 A103A299	**J 29569-1/J 29829-1 Turbine Shaft Seal Installer**
 A103A300	**J 29569-2/J 29829-2 Turbine Shaft Seal Sizer**

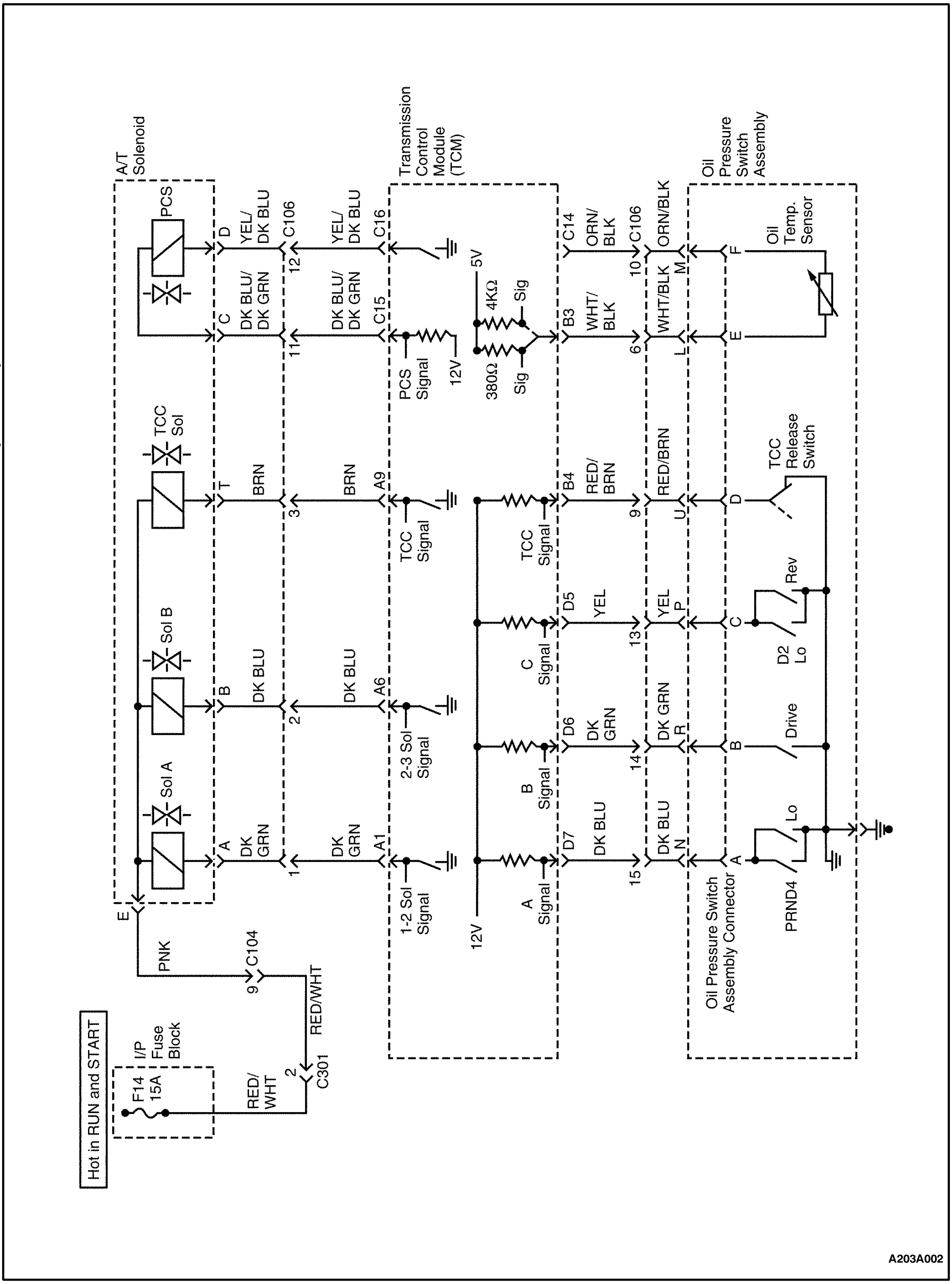
SPECIAL TOOLS TABLE (Cont'd)

 A103A301	**J 21366** **Torque Converter Holding Strap**
 A103A302	**J 41103** **Torque Converter Seal Remover Set**
 A102B152	**J 28467-B** **Engine Support Fixture**

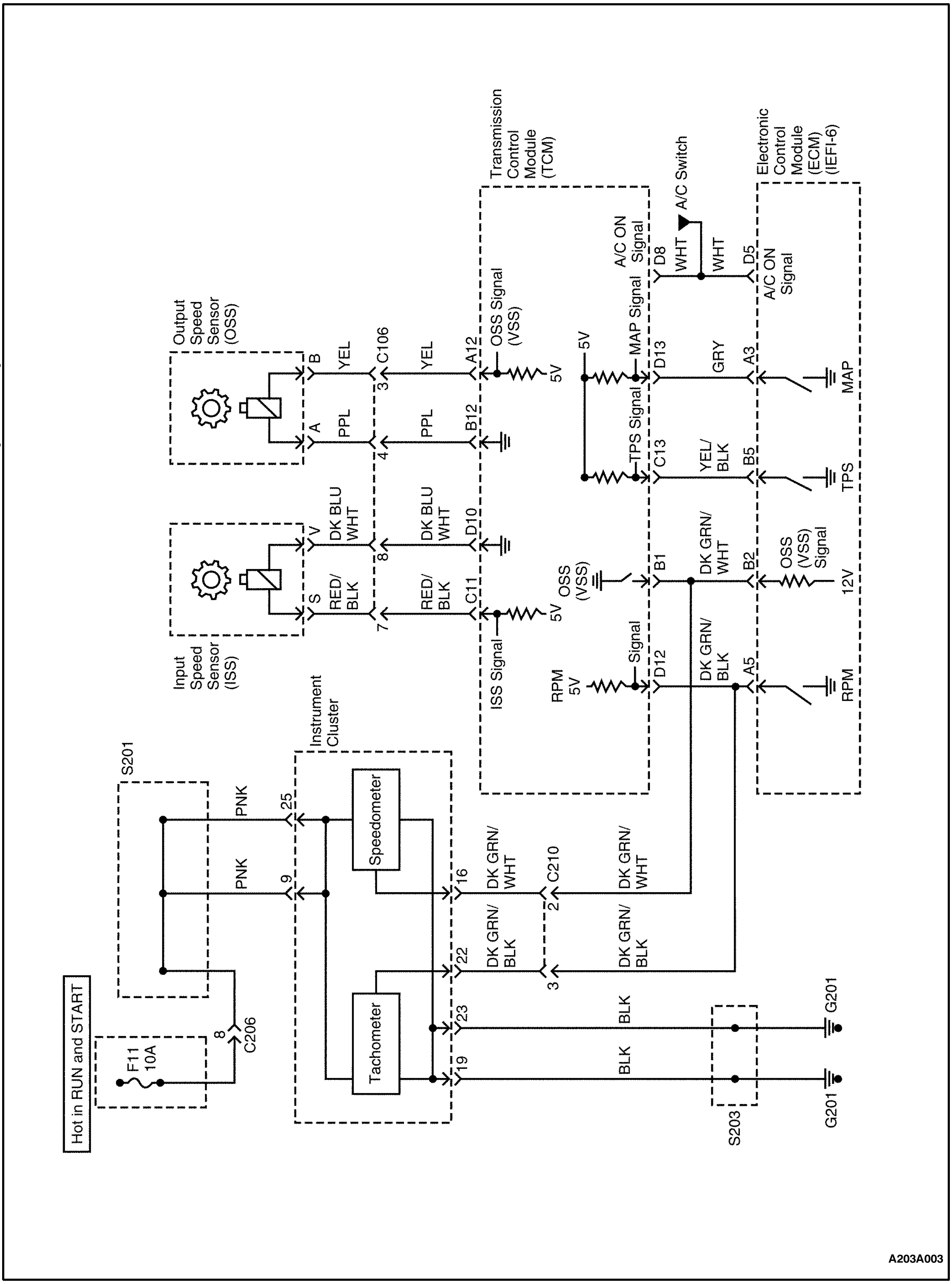
SCHEMATIC AND ROUTING DIAGRAMS



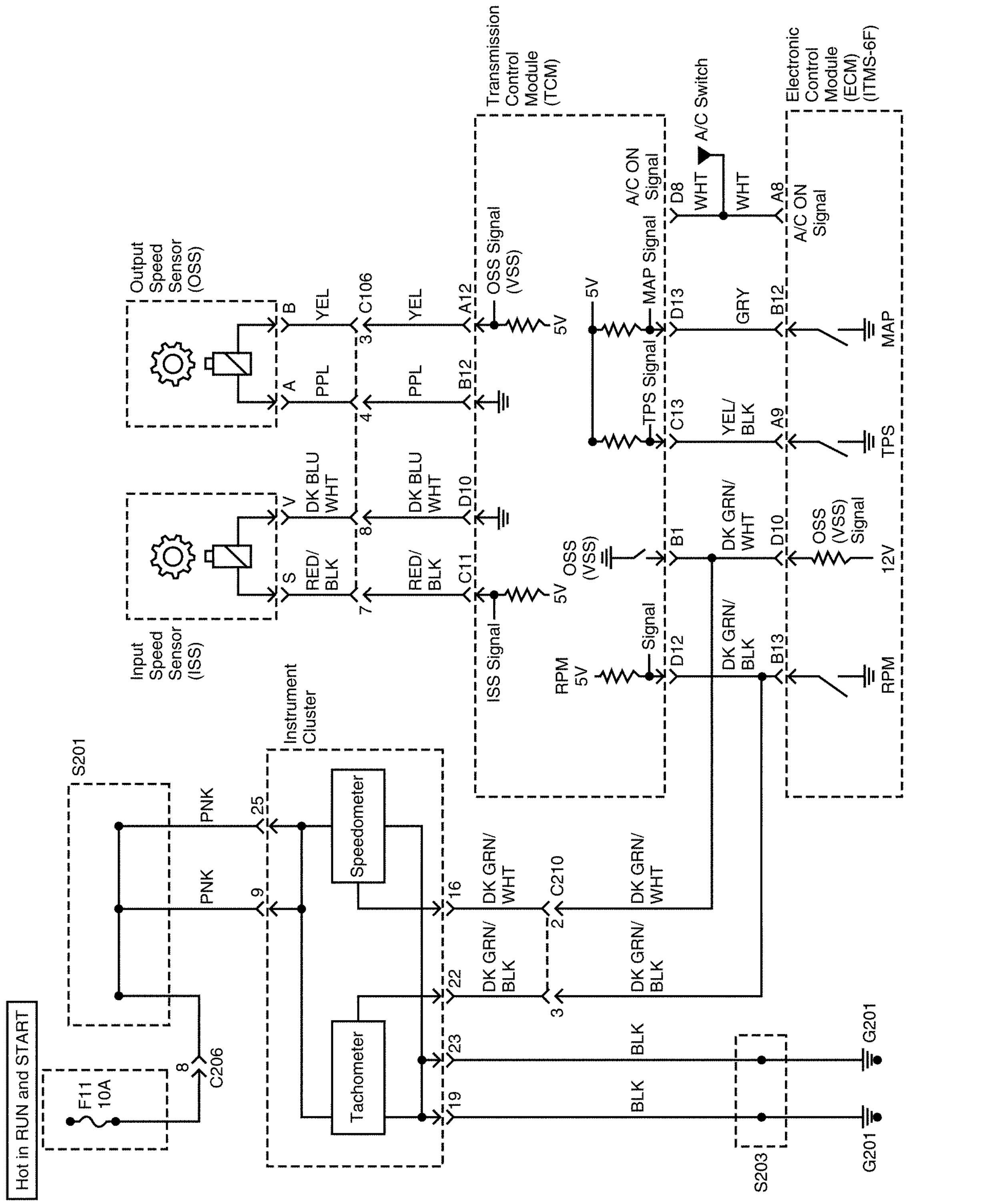
TRANSMISSION CONTROL MODULE (2 OF 4)



TRANSMISSION CONTROL MODULE (3 OF 4)

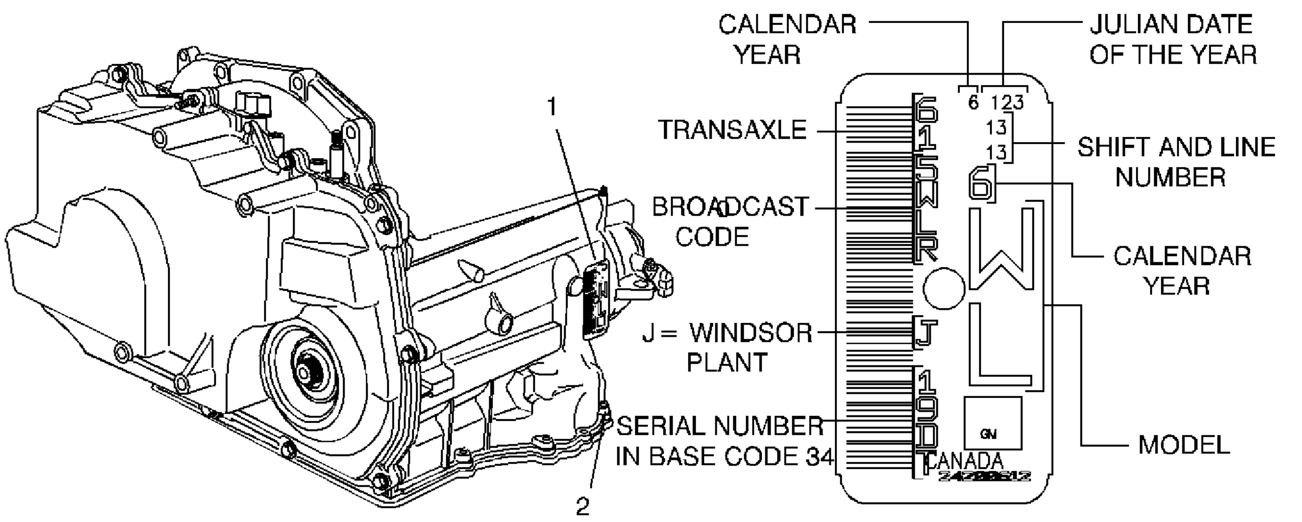


TRANSMISSION CONTROL MODULE (4 OF 4)



VISUAL IDENTIFICATION

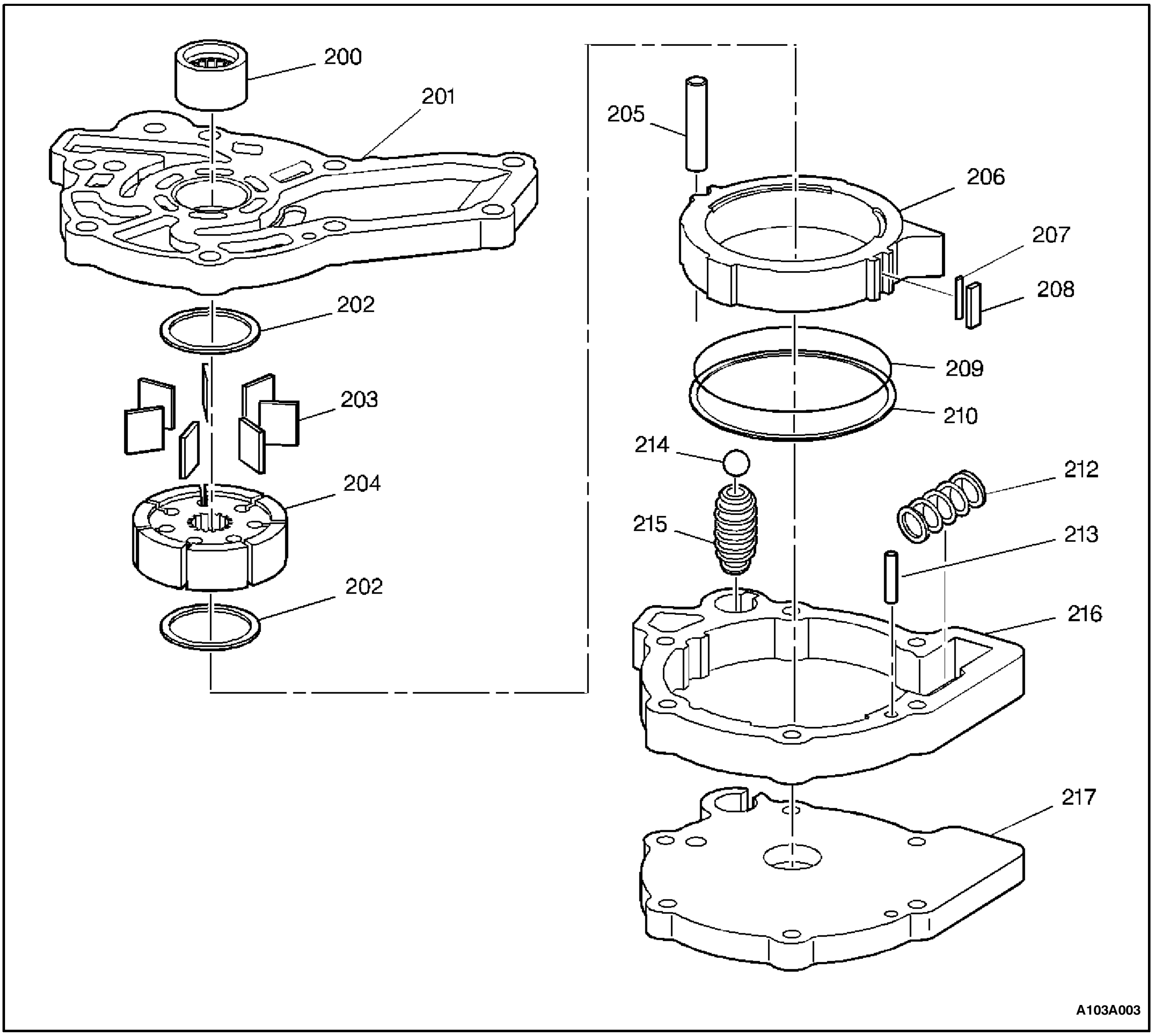
TRANSAXLE IDENTIFICATION INFORMATION



A103A001

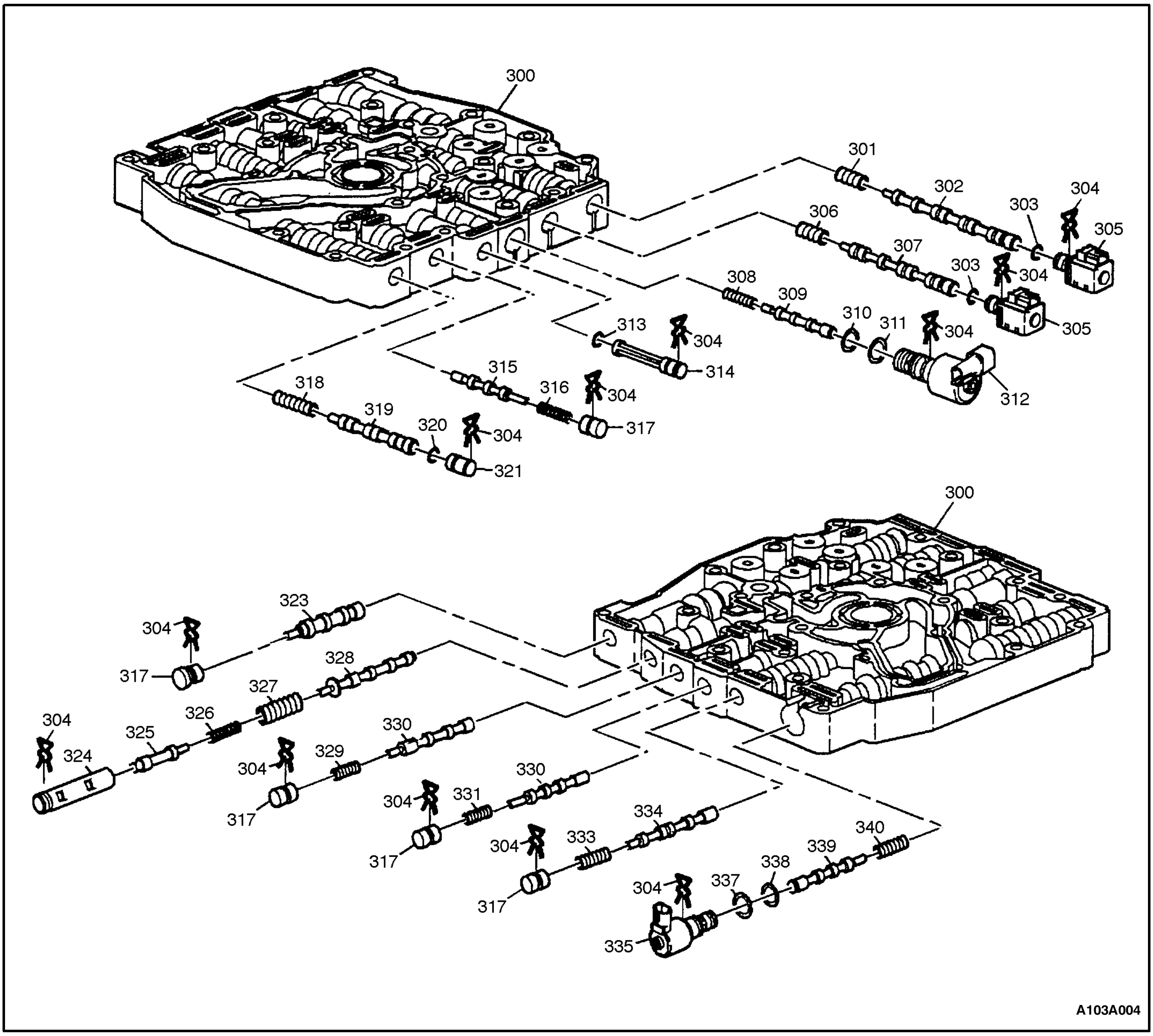
COMPONENT LOCATOR

OIL PUMP ASSEMBLY



200 Oil Pump Bearing and Seal Assembly
201 Oil Pump Base
202 Oil Pump Vane Ring
203 Oil Pump Vane
204 Oil Pump Rotor
205 Pivot (Oil Pump Slide Pin)
206 Oil Pump Slide
207 Oil Pump Slide Seal Support
208 Oil Pump Slide Seal
209 O-Ring (Oil Pump Slide) Seal
210 Fluid Seal (Slide-to-Body) Ring
212 Oil Pump Priming Spring
213 Locating Pin
214 Pressure Relief Ball
215 Pressure Relief Spring
216 Oil Pump Body
217 Pump Cover

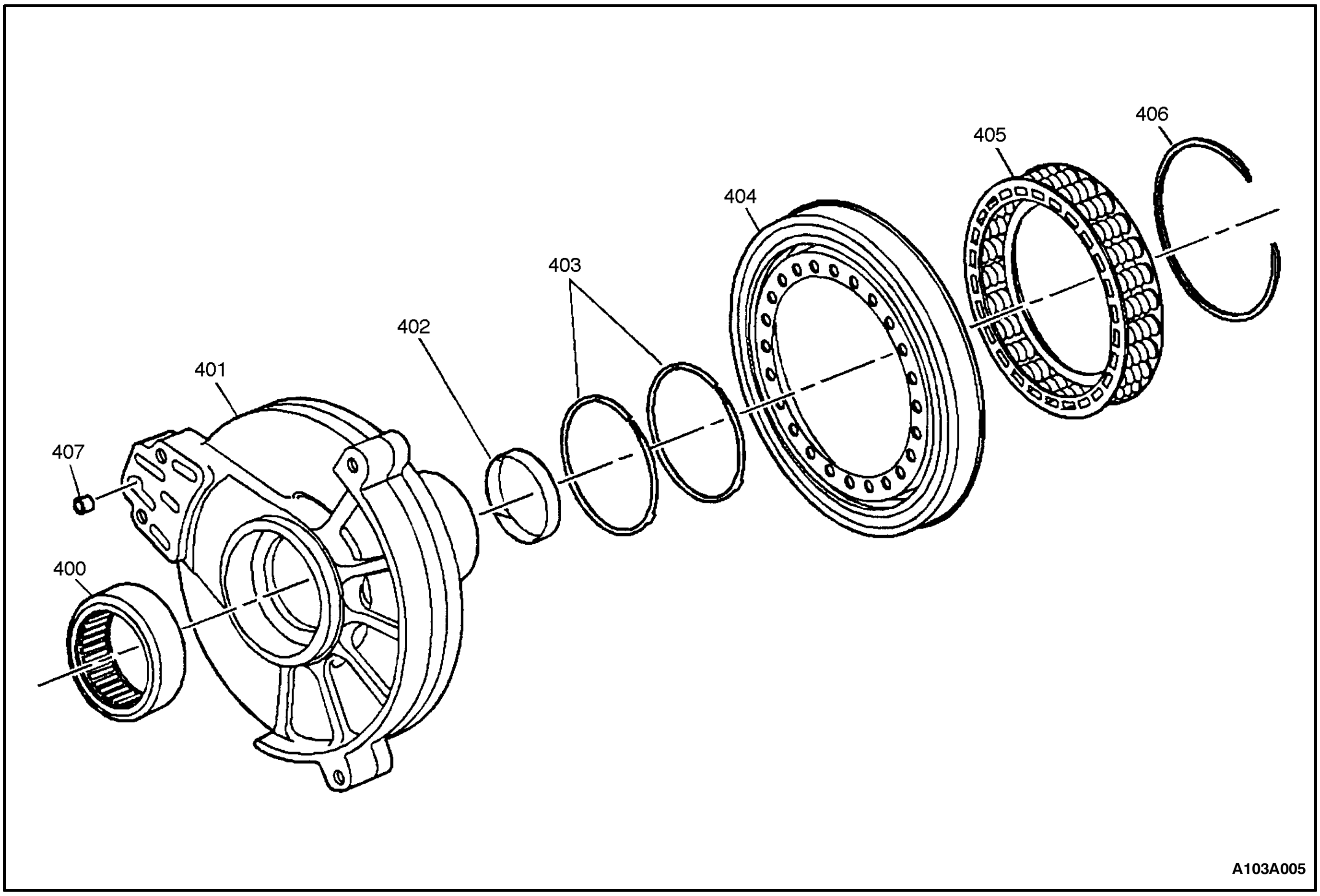
CONTROL VALVE BODY ASSEMBLY



300 Control Valve Assembly Body
301 1-2 Shift Valve Spring
302 1-2 Shift Valve
303 Shift Solenoid A and B O-Ring
304 Retainer Clip
305 Shift (A and B) Solenoid
306 2-3 Shift Valve Spring
307 2-3 Shift Valve
308 Torque Signal Regulator Valve Spring
309 Torque Signal Regulator Valve
310 Pressure Control Solenoid O-Ring
311 Pressure Control Solenoid O-Ring
312 Pressure Control Solenoid
313 Actuator Oil Filter O-Ring
314 Actuator Oil Filter
315 Actuator Feed Limit Valve
316 Actuator Feed Limit Valve Spring
317 Bore Plug
318 3-4 Shift Valve Spring
319 3-4 Shift Valve
320 3-4 Shift Valve Plug O-Ring
321 Bore Plug
323 1-2/3-4 Accumulator Valve
324 Pressure Regulator Boost Bushing
325 Pressure Regulator Boost Valve
326 Isolator Spring
327 Pressure Regulator Valve Spring
328 Pressure Regulator Valve
329 2-3 Accumulator Valve Spring
330 2-3 Accumulator Valve

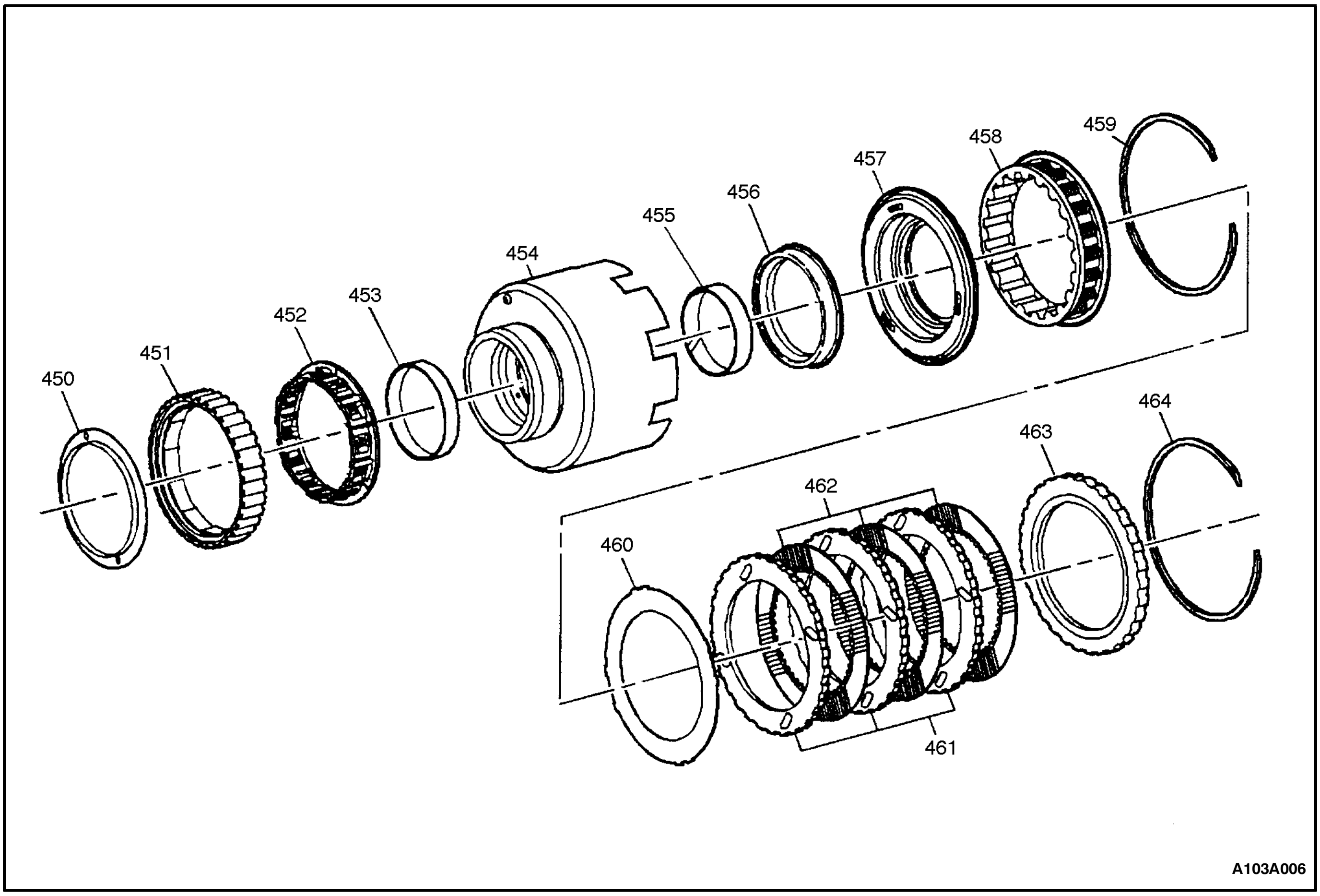
331 TCC Feed Limit Valve Spring
332 TCC Feed Limit Spring
333 TCC Control Valve Spring
334 TCC Control Valve
335 TCC Control Solenoid
337 TCC Control Solenoid O-Ring
338 TCC Control Solenoid O-Ring
339 TCC-Regulated Apply Valve
340 TCC-Regulated Apply Valve Spring

DRIVEN SPROCKET SUPPORT ASSEMBLY/2ND CLUTCH



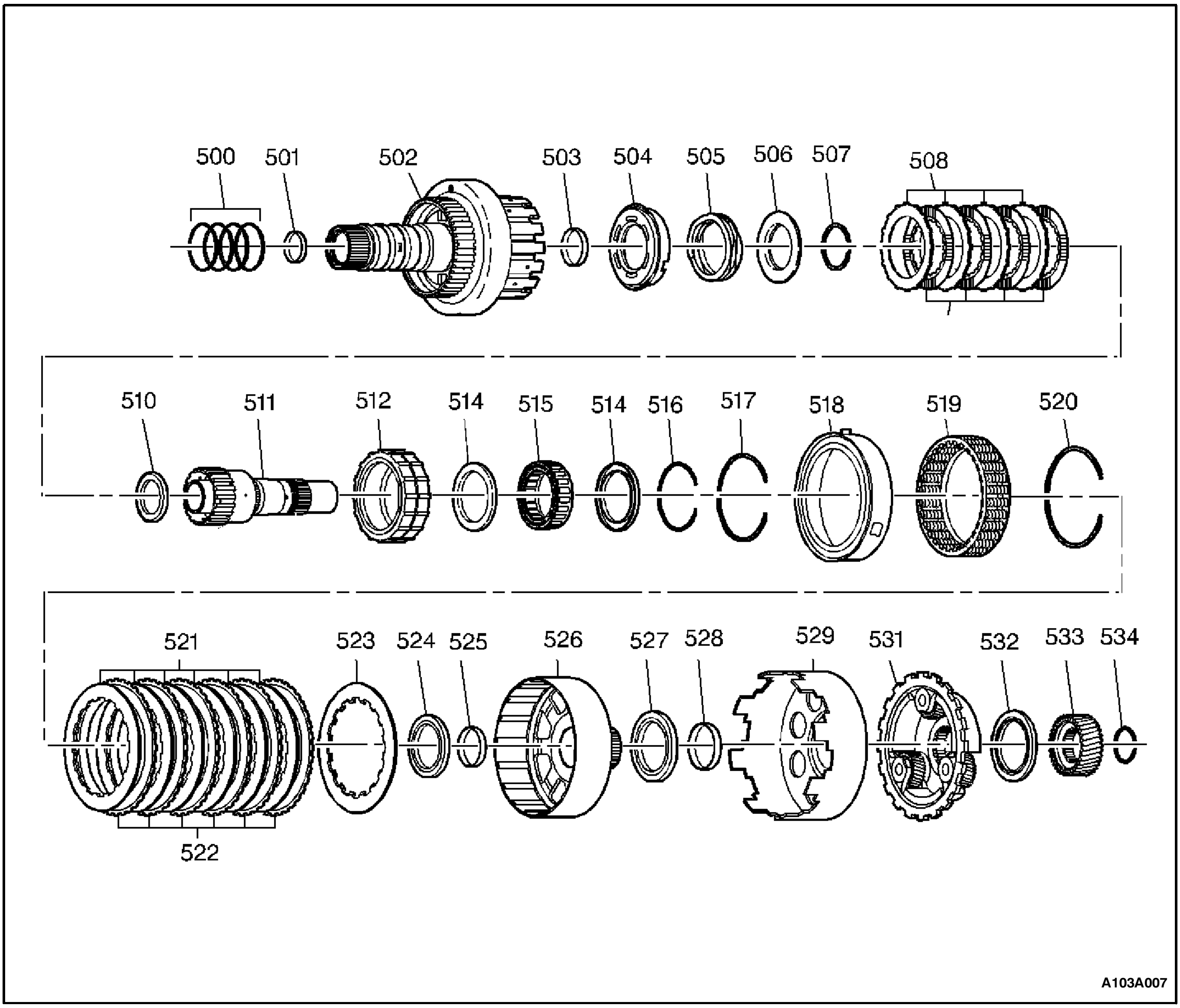
400 Driven Sprocket Support Bearing
401 Driven Sprocket Support
402 Driven Sprocket Support Bushing
403 Oil Seal Ring
404 2nd Clutch Piston Assembly
405 2nd Clutch Spring Assembly
406 2nd Clutch Spring Retaining Ring
407 Reverse Intermediate Clutch Housing Valve Assembly

REVERSE INPUT CLUTCH ASSEMBLY



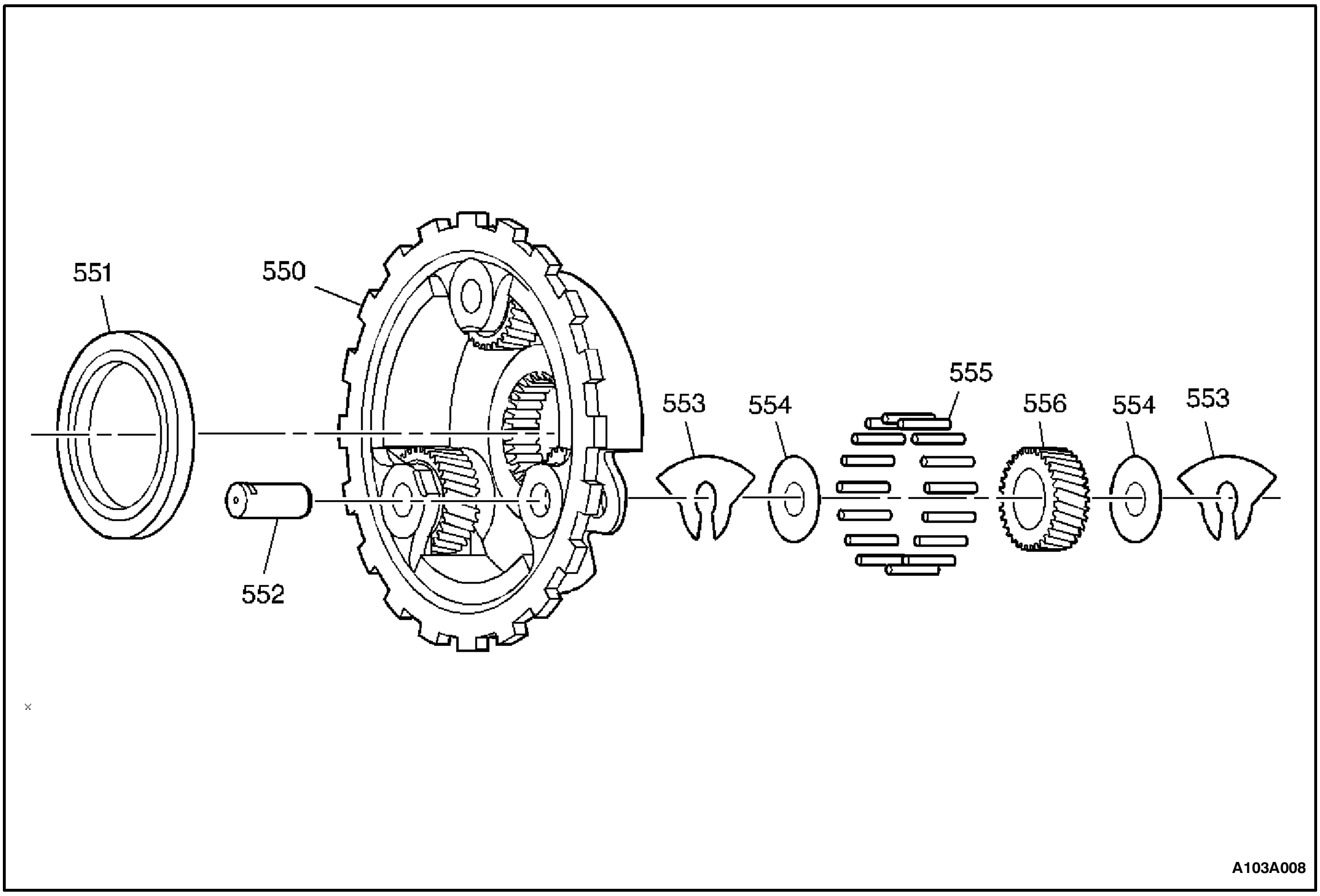
450 2nd Roller Clutch Retainer
451 2nd Roller Clutch Cam
452 2nd Roller Clutch Assembly
453 Reverse Clutch Bushing
454 Reverse Clutch Housing
455 Reverse Clutch Bushing
456 Reverse Clutch Center Retainer and Seal Assembly
457 Reverse Clutch Piston Assembly
458 Reverse Clutch Spring and Retainer Assembly
459 Snap (Reverse Clutch Spring Retainer) Ring
460 Reverse Clutch (Waved) Plate
461 Reverse Clutch (Steel) Plate
462 Reverse Clutch (Fiber) Plate
463 Reverse Clutch (Backing) Selective Plate
464 Snap (Reverse Clutch) Ring

DIRECT AND COAST CLUTCH ASSEMBLIES



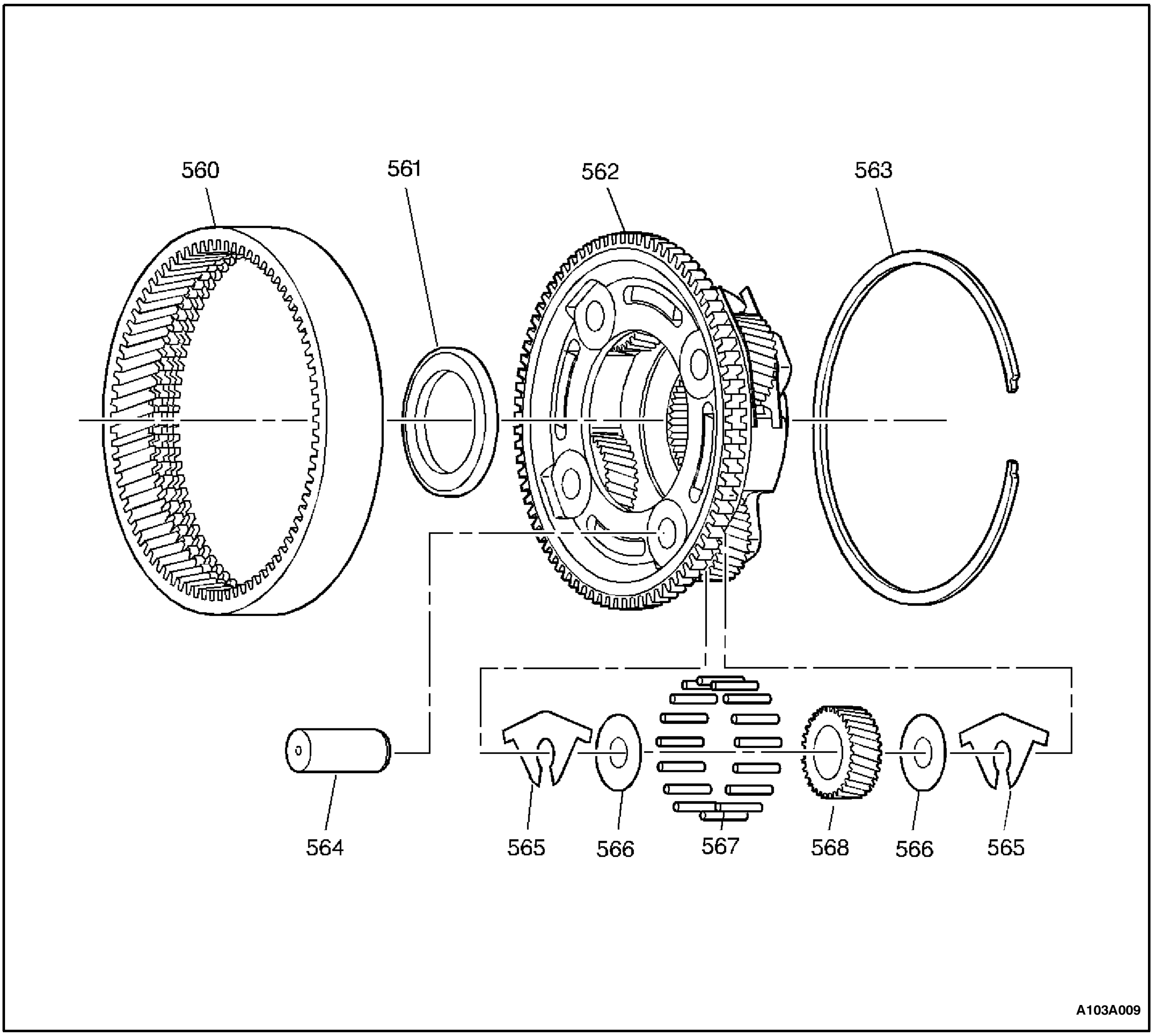
500 Oil Seal - Input Shaft Ring
501 Input Shaft Bushing
502 Direct and Coast Clutch and Input Shaft
503 Direct Clutch Housing-to-Output Shaft
504 Coast Clutch Piston Assembly
505 Coast Clutch Release Spring
506 Coast Clutch Spring Retainer
507 Snap (Coast Clutch Spring Retainer) Ring
508 Coast Clutch (Steel) Plate
509 Coast Clutch (Fiber) Plate
510 Thrust Bearing
511 Input Sun Gear Shaft and Inner Race Assembly
512 Outer (Input Sprag) Race
514 Sprag Clutch (2) End Bearings
515 Input Sprag Assembly
516 Snap (Outer Race-to-Sprag Assembly) Ring
517 Snap (Direct/Coast Clutch Retaining) Ring
518 Direct Clutch Piston Assembly
519 Direct Clutch Spring and Retainer Assembly
520 Direct Clutch Spring Retainer Ring
521 Direct Clutch (Steel) Plate
522 Direct Clutch (Fiber) Plate
523 Direct Clutch (Backing) Plate
524 Thrust Bearing
525 Reaction Carrier Shaft Bushing
526 Reaction Carrier Shaft Shell
527 Thrust (Carrier Shaft-to-Shell) Bearing
528 Reaction Sun Gear Bushing
529 Reaction Sun Shell
531 Reaction Carrier Assembly
532 Thrust (Reaction Carrier-to-Sun Gear) Bearing
533 Input Sun Gear
534 Snap Ring

REACTION CARRIER ASSEMBLY



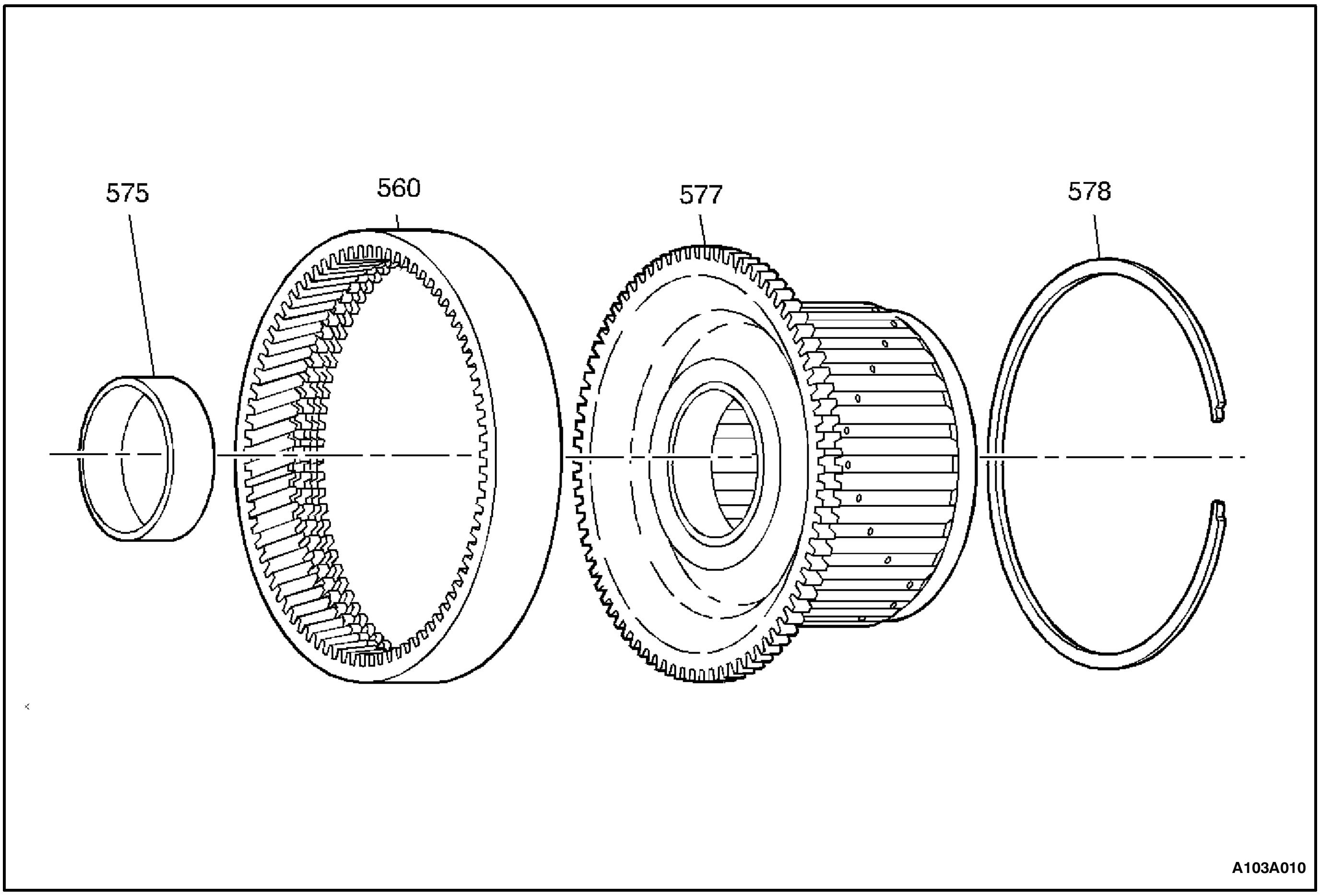
550 Reaction Carrier
551 Thrust Bearing
552 Planet Pinion Pin
553 Pinion Thrust Reaction Washer
554 Pinion Thrust Inner Washer
555 Roller Needle Bearing
556 Reaction Planet Pinion

INPUT CARRIER ASSEMBLY



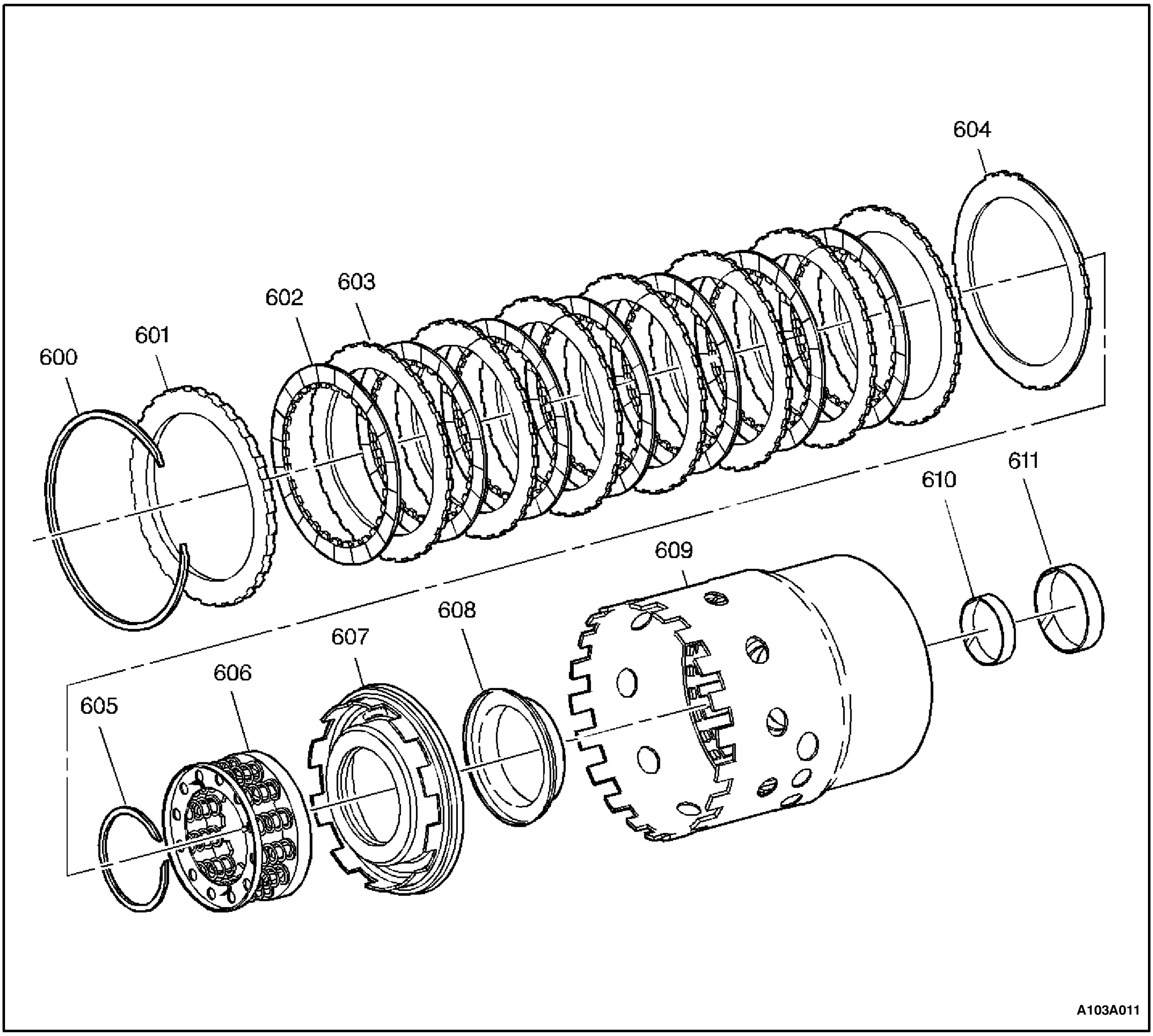
560 Internal (Input and Reaction) Gear
561 Thrust Bearing
562 Input Carrier
563 Snap (Input Carrier-to-Internal Gear) Ring
564 Planet Pinion Pin
565 Pinion Thrust Input Washer
566 Pinion Thrust Inner Washer
567 Roller Needle Bearing
568 Pinion Gear

INPUT INTERNAL GEAR AND FORWARD CLUTCH HUB



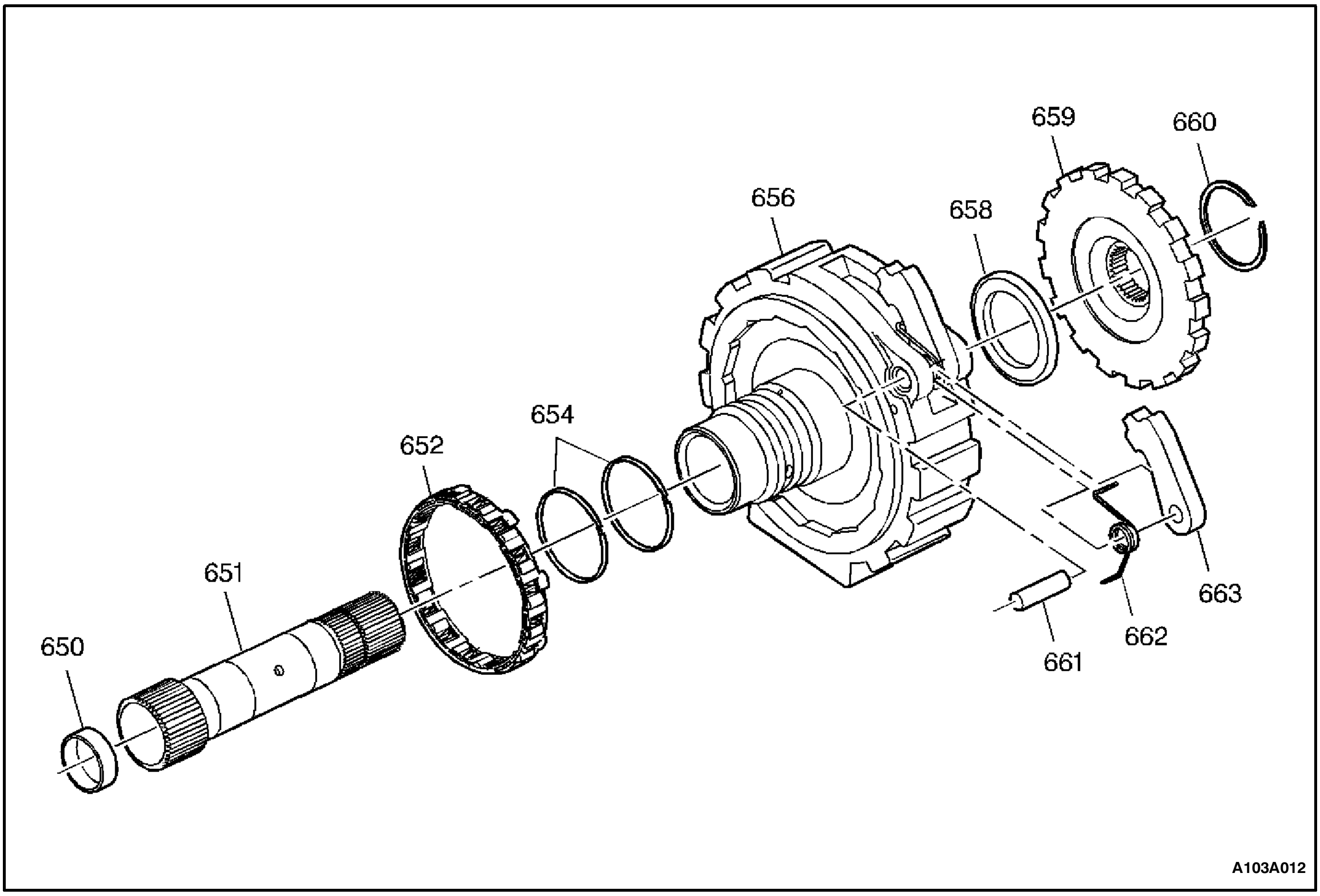
560 Internal (Input and Reaction) Gear
575 Input Flange Bushing
577 Input Flange and Forward Clutch Hub
554 Snap (Input Internal Gear-to-Input Flange) Ring

FORWARD CLUTCH ASSEMBLY



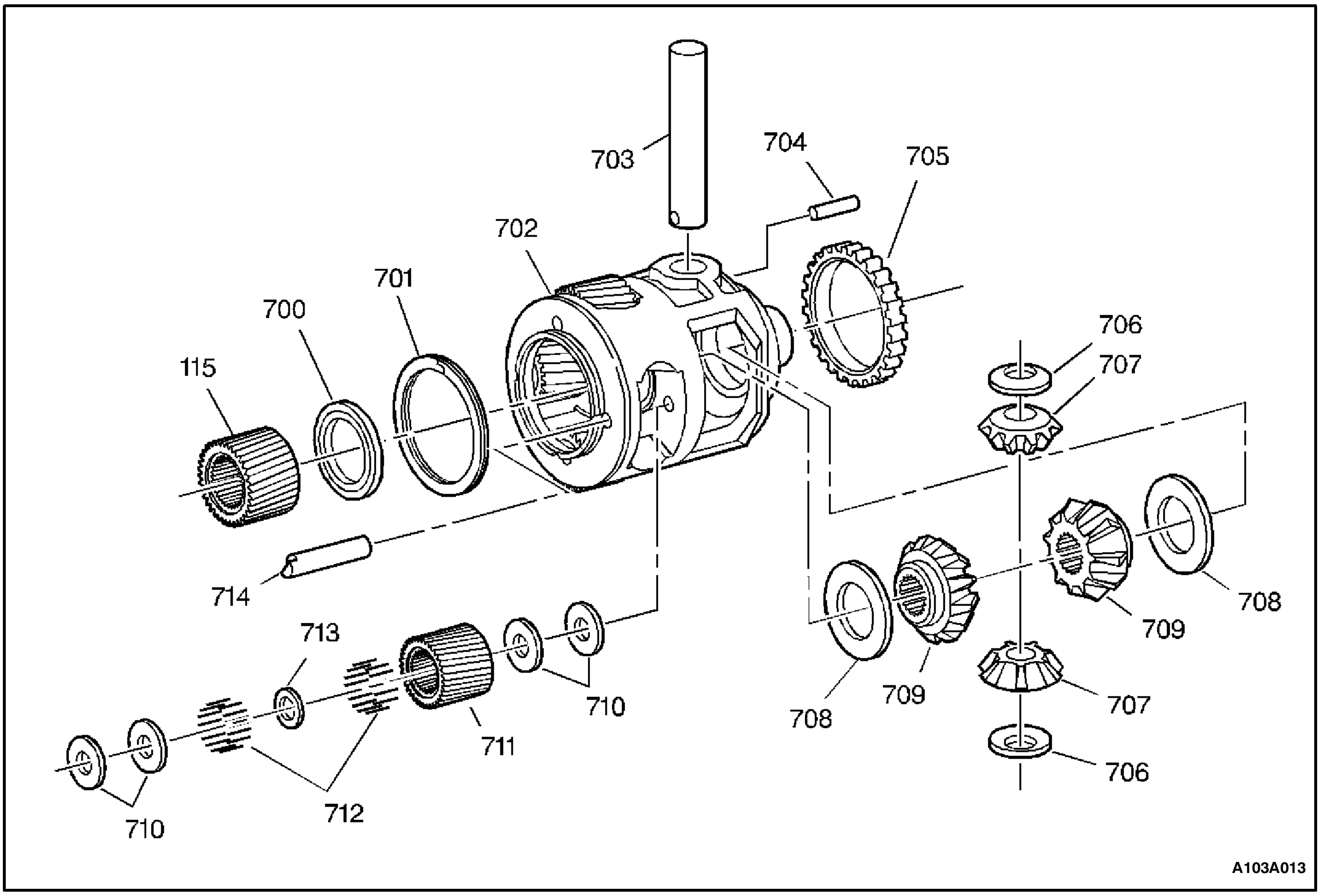
600 Snap (Forward Clutch) Ring
601 Forward Clutch (Backing) Plate
602 Forward Clutch (Fiber) Plate
603 Forward Clutch (Steel) Plate
604 Forward Clutch (Waved) Plate
605 Snap (Forward Clutch Spring Assembly) Ring
606 Forward Clutch Return Spring Assembly
607 Forward Clutch Piston Assembly
608 Forward Clutch Inner Seal and Sleeve Assembly
609 Forward Clutch Housing
610 Forward Clutch Support Bushing
611 Forward Clutch Support Bushing

FORWARD CLUTCH SUPPORT ASSEMBLY



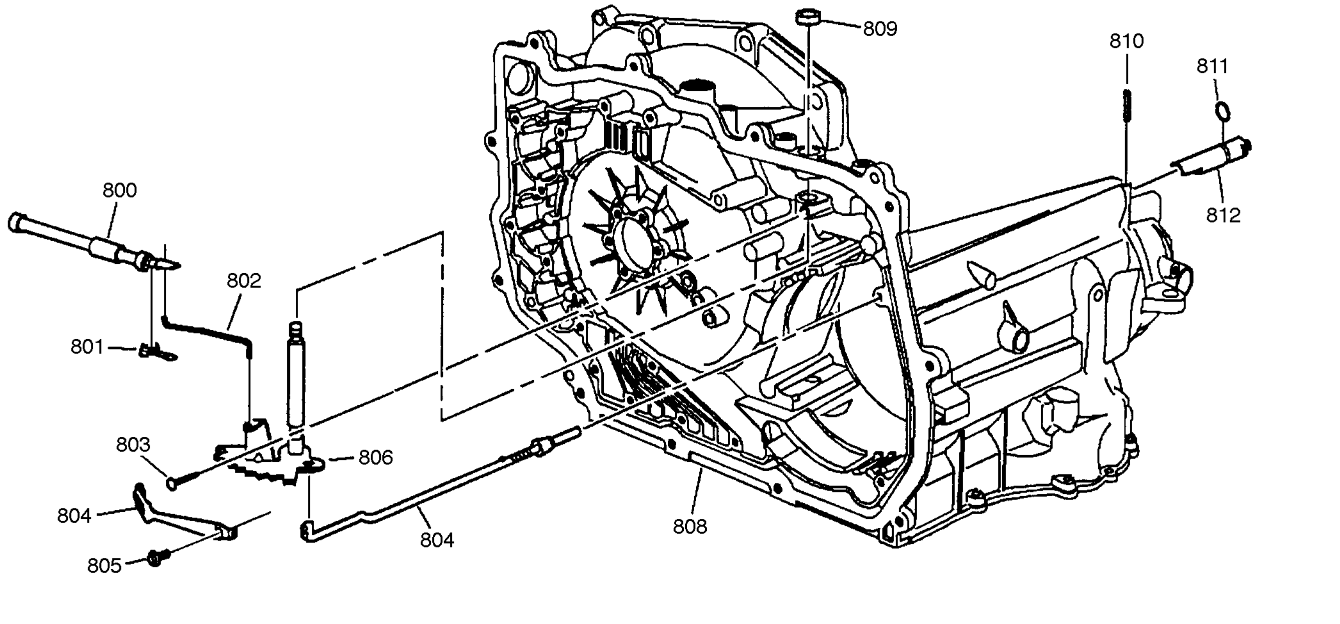
650	Final Drive Sun Shaft Bushing	659	Park Lock Gear
651	Final Drive Sun Shaft	660	Snap (Final Drive Sun Shaft) Ring
652	Lo Roller Clutch Assembly	661	Parking Lock Pawl Shaft
654	Oil Seal (Forward Clutch Support) Ring	662	Parking Lock Pawl Return Spring
656	Forward Clutch Support	663	Parking Lock Pawl
658	Thrust (Forward Support-to-Park Gear) Bearing		

FINAL DRIVE AND DIFFERENTIAL ASSEMBLY



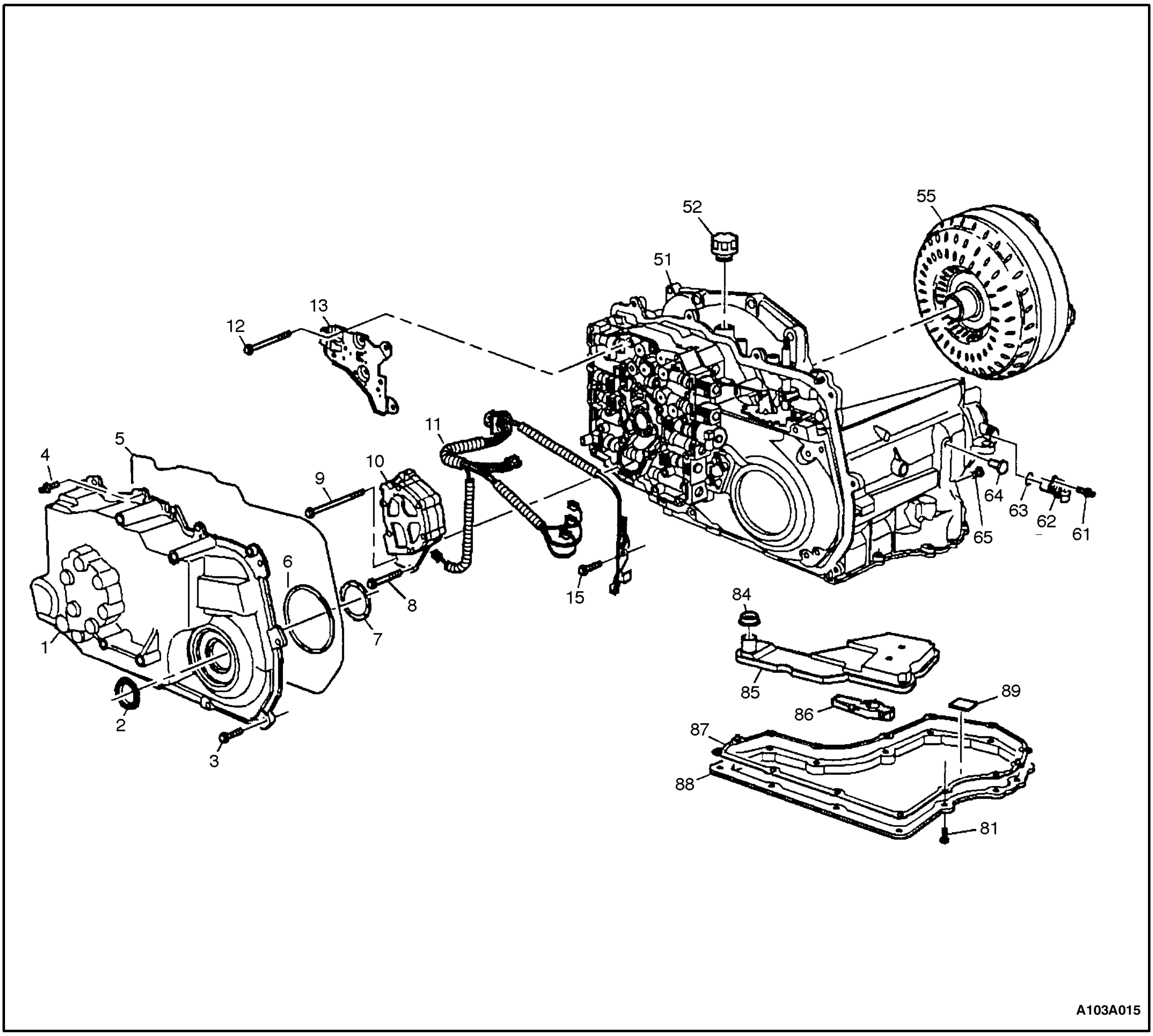
700 Thrust Bearing
701 Spiral Pin Retaining Ring
702 Differential and Final Drive Carrier
703 Differential Pinion Shaft
704 Differential Pinion Shaft Retaining Pin
705 Speed Sensor Rotor
706 Thrust (Differential Pinion) Washer
707 Differential Pinion Gear
708 Thrust Differential Side Gear Washer
709 Differential Slide Gear
710 Pinion Thrust Washer
711 Pinion (Final Drive Planet) Gear
712 Roller Needle Bearing
713 Pinion Needle Bearing Spacer
714 Pin, Planet Pinion Gear

MANUAL SHAFT, PARKING PANEL AND ACTUATOR ASSEMBLY



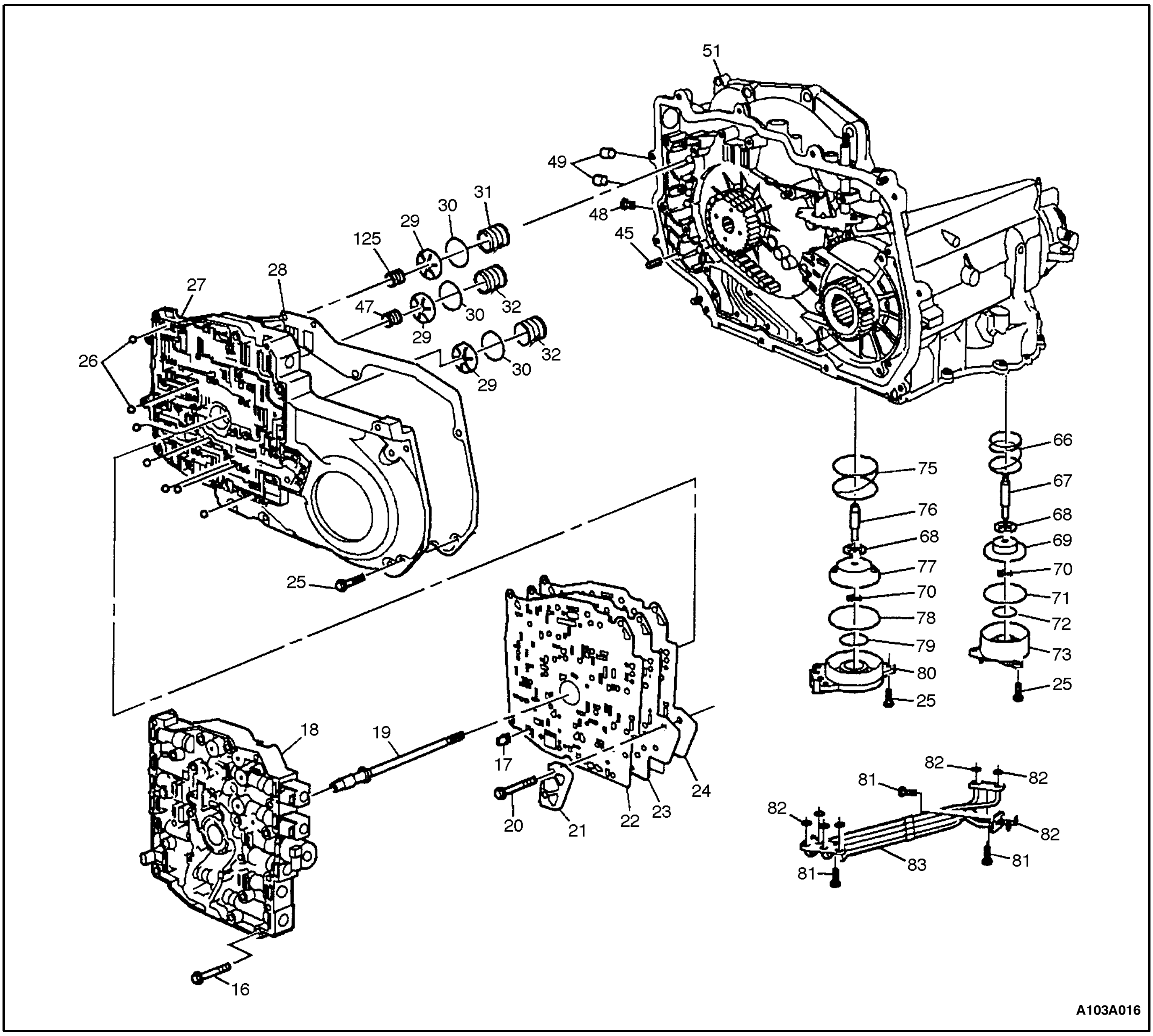
800 Manual Valve
801 Manual Valve-to-Link Clip
802 Manual Valve-to-Detent Lever Link
803 Manual Shaft-to-Case Pin
804 Manual Detent Spring and Roller Assembly
805 Spring and Roller Assembly-to-Channel Plate Bolt
806 Manual Shaft and Detent Lever Assembly
807 Parking Lock Actuator Assembly
809 Manual Shaft-to-Case Seal
810 Spring (Actuator Guide) Pin
811 Actuator Guide Seal
812 Actuator Guide

CASE AND ASSOCIATED PARTS (1 OF 3)



1 Side Cover (Structural)
2 Axle Oil Seal
3 Side Cover Bolt
4 Side Cover Stud
5 Side Cover Gasket
6 Side Cover Oil Level Control Gasket
7 Thrust (Side Cover-to-Driven Sprocket) Washer
8 Oil Pump Bolt
9 Oil Pump Bolt
10 Transmission Oil Pump Assembly
11 Transmission Wiring Harness
12 Transmission Fluid Pressure Switch Bolt
13 Transmission Fluid Pressure (TFP) Switch
15 Wiring Harness Bracket Bolt/Input Speed Sensor Bolt
51 Transmission Case
52 Vent Cap
55 Torque Converter Assembly
61 Output Speed Sensor Stud
62 Output Speed Sensor
63 O-Ring (Output Speed Sensor) Seal
64 Band Anchor-LO/Reverse Pin
65 Oil Level Control Plug
81 Tube Assembly Bolt/Bottom Pan Bolt
84 Transmission Oil Filter Seal
85 Transmission Oil Filter Assembly
86 Oil Level Control Valve
87 Transmission Bottom Pan Gasket
88 Transmission Oil Pan
89 Chip Collector Magnet

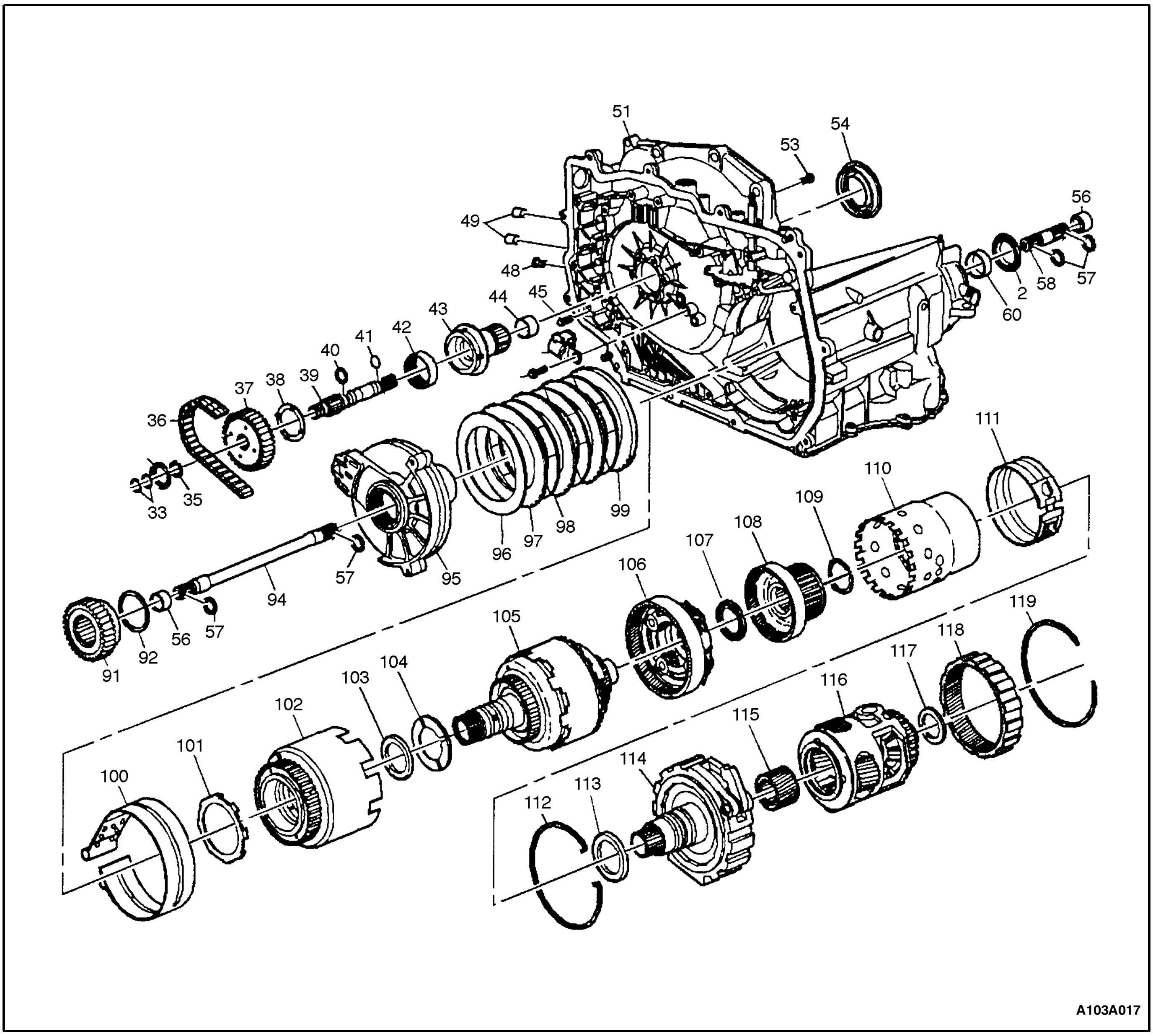
CASE AND ASSOCIATED PARTS (2 OF 3)



16	Valve Body Bolt	29A	Accumulator Piston (1-2, 2-3, and 3-4)
17	Filter	29B	Accumulator Piston (1-2, 2-3, and 3-4)
18	Control Valve Body Assembly	29C	Accumulator Piston (1-2, 2-3, and 3-4)
19	Oil Pump Drive Shaft	30A	Accumulator Piston Seal (1-2, 2-3 and 3-4)
20	Spacer Plate Support Bolt	30B	Accumulator Piston Seal (1-2, 2-3 and 3-4)
21	Spacer Plate Support	30C	Accumulator Piston Seal (1-2, 2-3 and 3-4)
22	Valve Body-to-Spacer Plate Gasket	31	1-2 Accumulator Piston Spring
23	Valve Body Spacer Plate	32A	2-3 and 3-4 Accumulator Piston Spring
24	Spacer Plate-to-Channel Plate Gasket	32B	2-3 and 3-4 Accumulator Piston Spring
25A	Channel Plate Bolt/Servo Cover Bolt	45	Dowel (Channel Plate-to-Case) Pin
25B	Channel Plate Bolt/Servo Cover Bolt	48	Line Pressure Tap Plug
25C	Channel Plate Bolt/Servo Cover Bolt	49	Cooler Pipe Seal
26	Checkballs	51	Transmission Case
27	Channel Plate	66	Servo Return (LO/Reverse) Spring
28	Case-to-Channel Plate Gasket	67	Servo Apply (LO/Reverse) Pin

68A Servo Cushion Spring
68B Servo Cushion Spring
69 Servo (LO/Reverse) Piston
70A Servo Snap Ring
70B Servo Snap Ring
71 Servo Piston (LO/Reverse) Seal
72 Servo Cover (LO/Reverse) Seal
73 Servo (LO/Reverse) Cover
75 Servo Return (Intermediate/4th) Spring
76 Servo Apply (Intermediate/4th) Pin
77 Servo (Intermediate/4th) Piston
78 Servo Piston (Intermediate/4th) Seal
79 Servo Cover (Intermediate/4th) Seal
80 Servo (Intermediate/4th) Cover
81A Tube Assembly Bolt/Bottom Pan Bolt
81B Tube Assembly Bolt/Bottom Pan Bolt
81C Tube Assembly Bolt/Bottom Pan Bolt
82A Oil Feed Tube Assembly Seal
82B Oil Feed Tube Assembly Seal
82C Oil Feed Tube Assembly Seal
82D Oil Feed Tube Assembly Seal
83 Oil Feed Tube Assembly

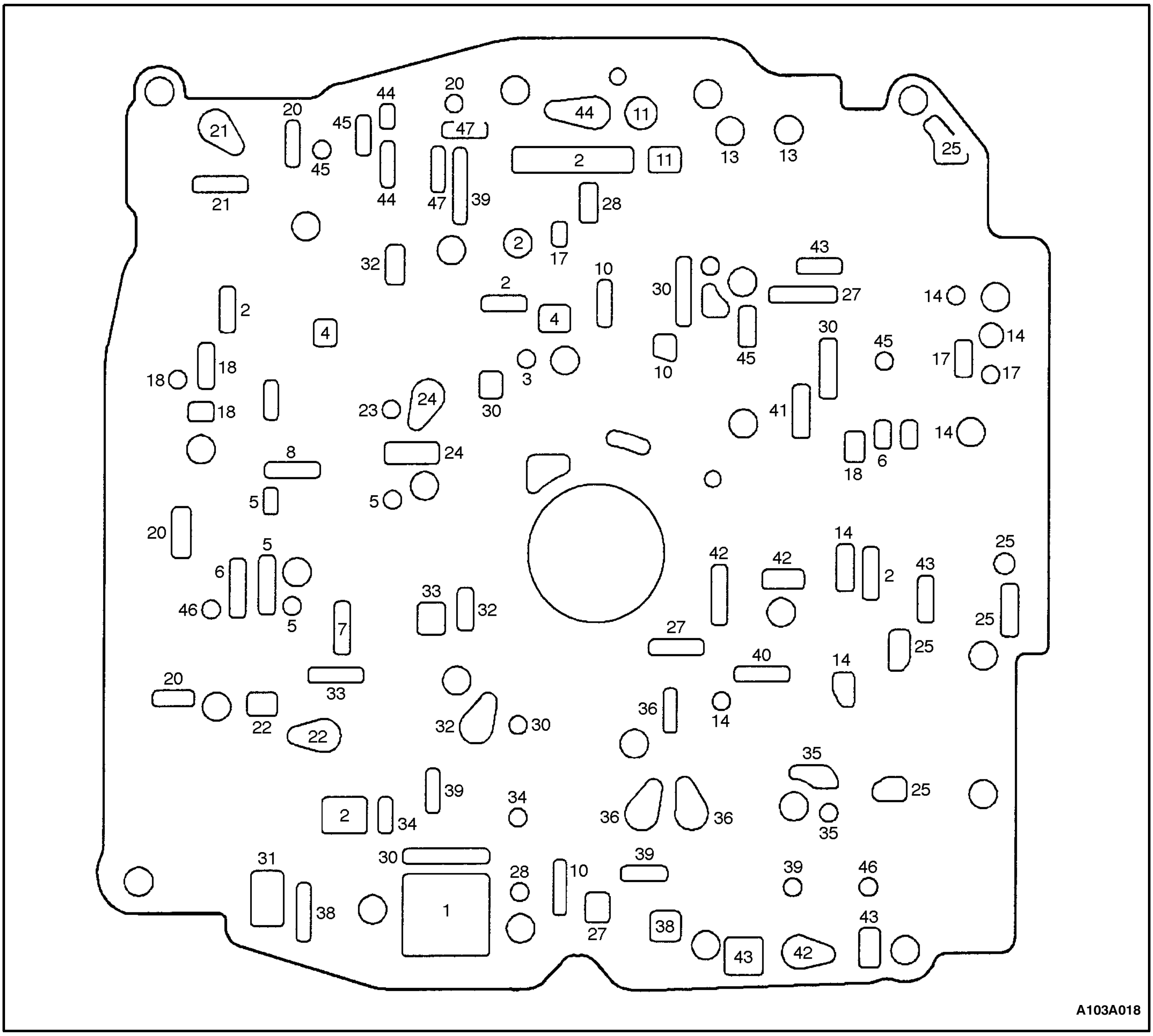
CASE AND ASSOCIATED PARTS (3 OF 3)



2 Axle Oil Seal
15 Wiring Harness Bracket Bolt/Input Speed Sensor Bolt
33 Turbine Shaft-to-Drive Sprocket Ring
35 Snap (Turbine Shaft-to-Drive Sprocket) Ring
36 Drive Link Assembly
37 Drive Sprocket
38 Thrust (Drive Sprocket-to-Support) Washer
39 Turbine Shaft
40 Turbine Shaft-to-Support Seal
41 O-ring Seal (Torque Converter)
42 Drive Sprocket Support Bearing
43 Drive Sprocket Support
44 Drive Sprocket Support Bushing
45 Dowel Pin (Channel Plate-to-Case)
46 Input Speed Sensor
48 Line Pressure Tap Plug
49 Cooler Pipe Seal
51 Transmission Case
52 Vent Cap
53 Drive Sprocket Support Screw
54 Converter Seal
56 Output/Stub Shaft Sleeve
57A Output/Stub Shaft Snap Ring
57B Output/Stub Shaft Snap Ring
57C Output/Stub Shaft Snap Ring
58 Output Stub Shaft
60 Case-to-Final Drive Bushing
91 Driven Sprocket
92 Thrust (Driven Sprocket-to-Support) Washer

94 Output Shaft
95 Driven Sprocket Support Assembly
96 2nd Clutch Waved Plate
97 2nd Clutch Steel Plate
98 2nd Clutch Fiber Plate
99 2nd Clutch Backing Plate
100 Intermediate/4th Band
101 Thrust (Support-to-Reverse Input Clutch) Washer
102 Reverse Input Clutch Assembly
103 Thrust Bearing
104 Thrust (Selective) Washer
105 Direct & Coast Clutch Assembly
106 Input Carrier Assembly
107 Thrust Bearing
108 Input Flange & Forward Clutch Hub Assembly
109 Thrust Washer
110 Forward Clutch Assembly
111 LO/Reverse Band
112 Snap Ring (Forward Clutch Support-to-Case)
113 Thrust Bearing
114 Forward Clutch Support Assembly
115 Sun Gear (Final Drive)
116 Differential and Final Drive Assembly
117 Thrust Bearing
118 Final Drive Internal Gear
119 Fretting Internal Gear-to-Case Ring

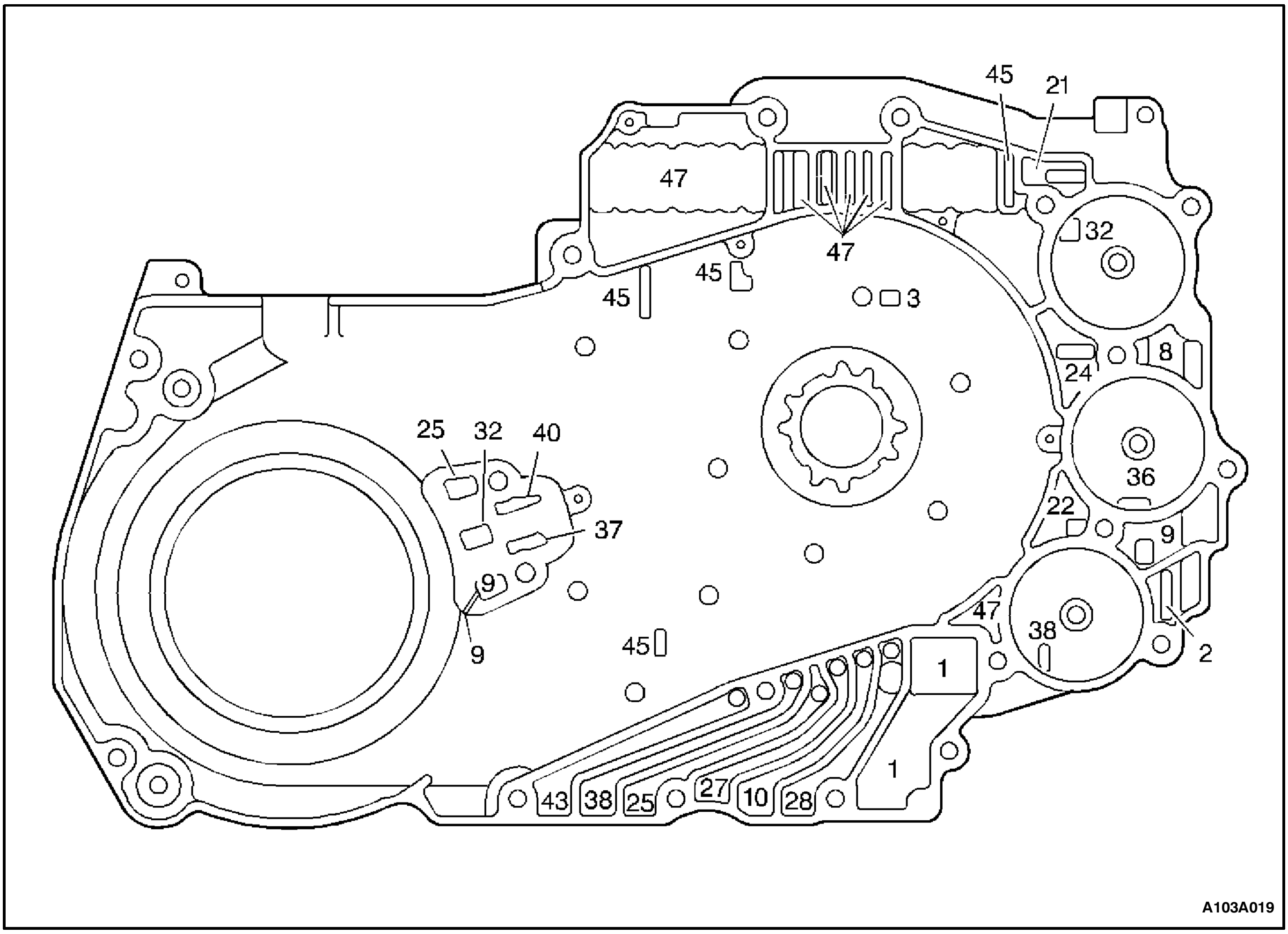
VALVE BODY-TO-SPACER PLATE GASKET



1 Suction
2 Line
3 Decrease
4 Converter Feed
5 TCC Feed Limit
6 Release
7 Apply
8 Cooler
10 Lube 2
11 PRN
13 PRND4
14 Actuator Feed
17 2-3 Signal
18 Torque Signal
20 1-2/3-4 Accumulator
21 1-2 Accumulator Feed
22 3-4 Accumulator Feed
23 2-3 Accumulator
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
30 2-3 Drive
31 Filtered 2-3 Drive
32 2nd Clutch
33 TCC Signal (PWM)
34 TCC-Regulated Apply
35 3-4 Drive
36 Direct Clutch Feed
38 4th Band

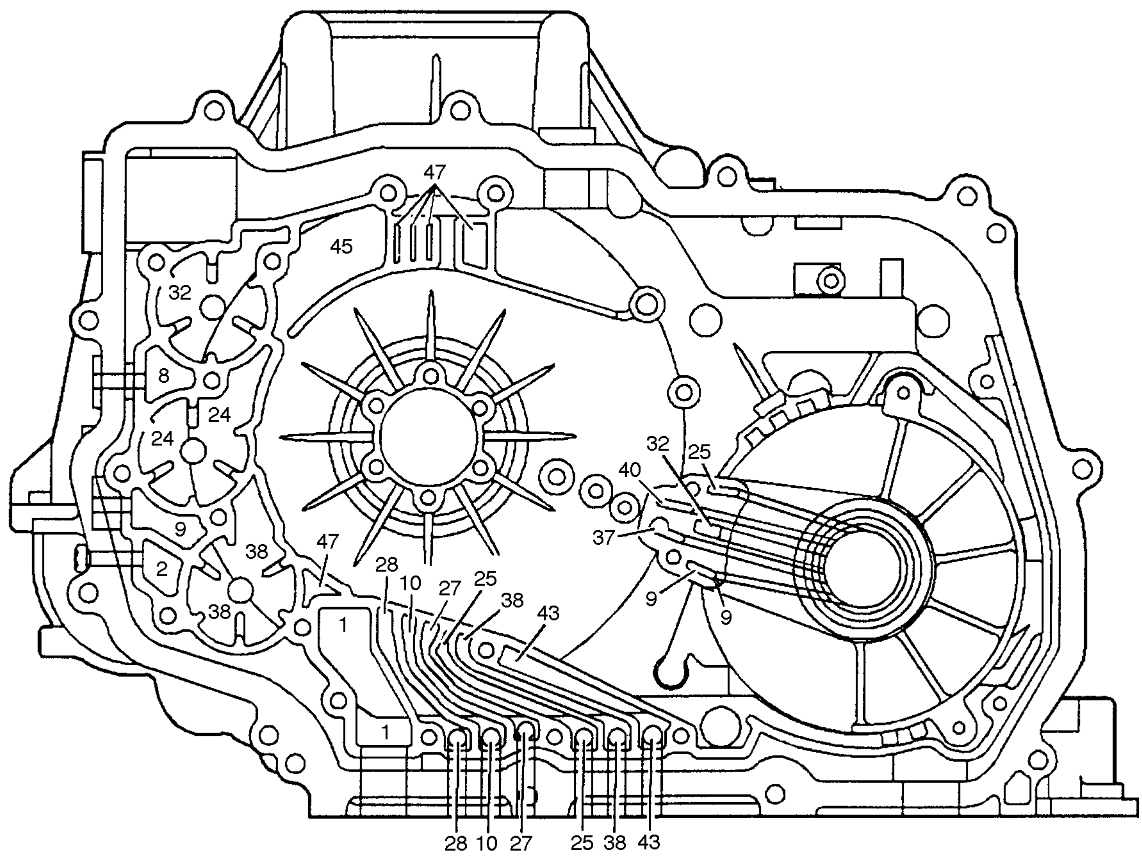
39 D321
40 Coast Clutch
41 D21
42 Intermediate Band Feed
43 Intermediate Band
44 LO
45 Exhaust
46 Orificed Exhaust
47 Void

CHANNEL PLATE PASSAGES – CASE SIDE



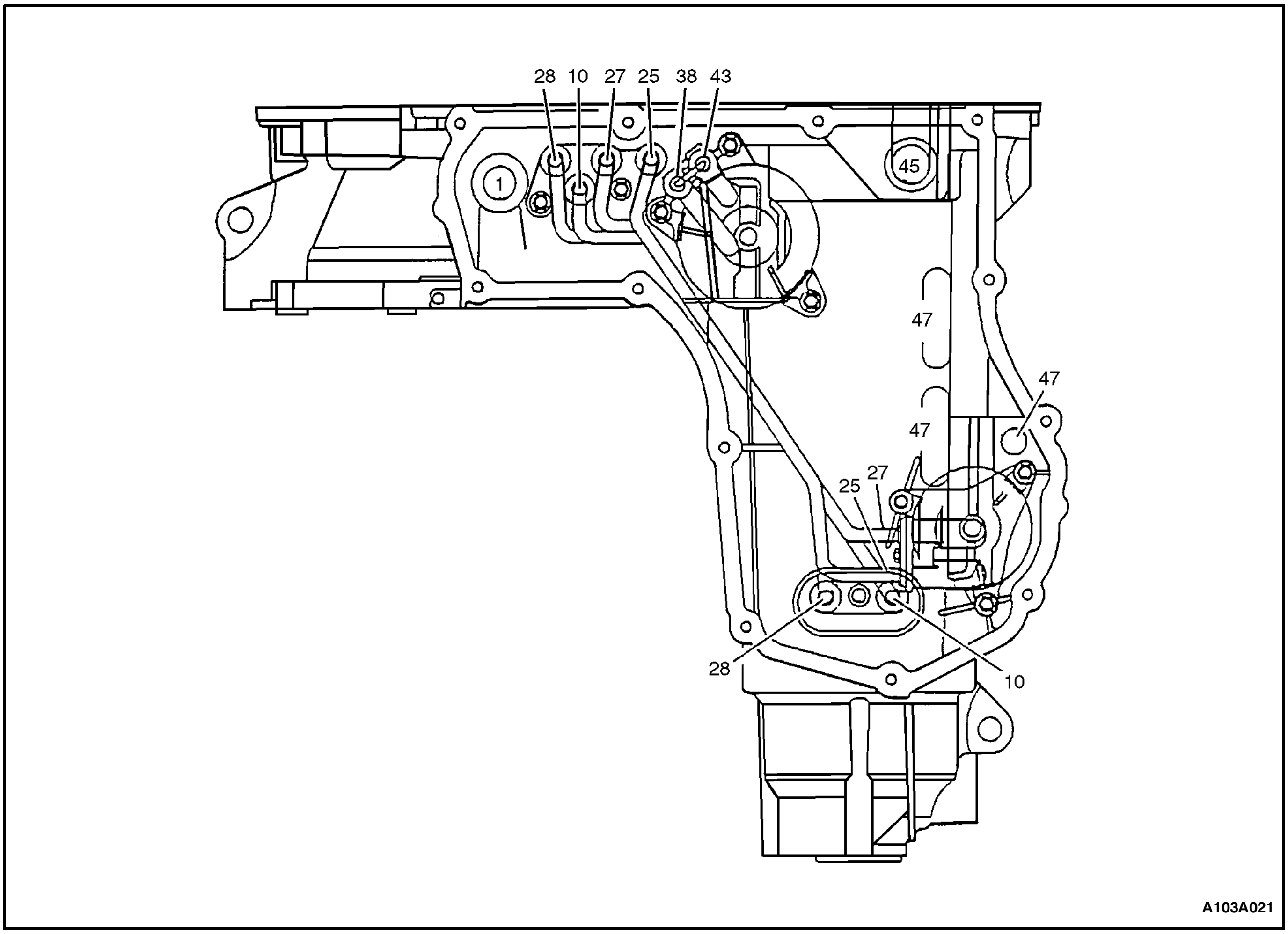
1 Suction
2 Line
3 Decrease
8 Cooler
9 Lube 1
10 Lube 2
21 1-2 Accumulator Feed
22 3-4 Accumulator Feed
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
32 2nd Clutch
36 Direct Clutch Feed
37 Direct Clutch
38 4th Band
40 Coast Clutch
43 Intermediate Band
45 Exhaust
47 Void

CASE PASSAGES – CHANNEL PLATE SIDE



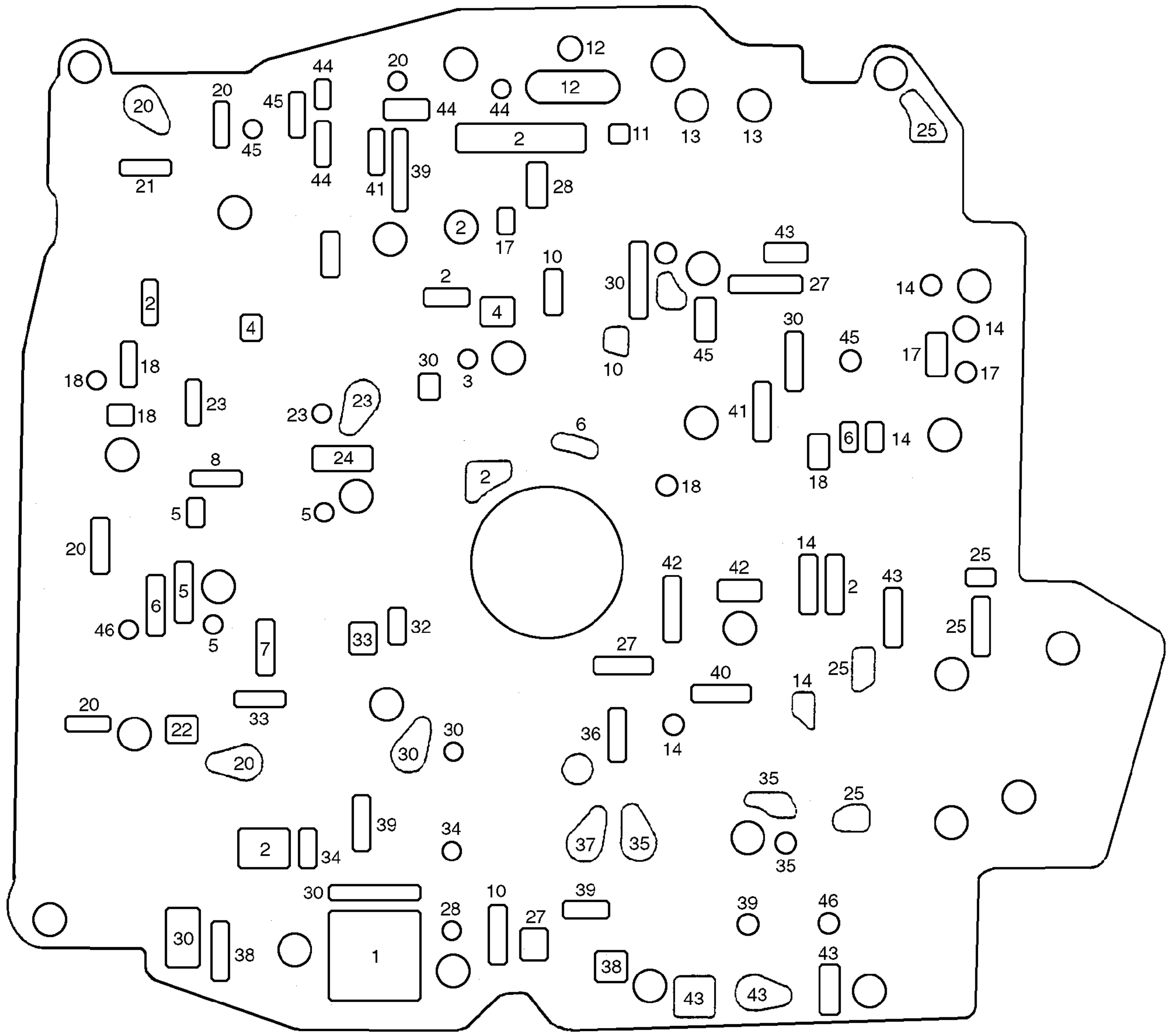
1	Suction	28	Drive
2	Line	32	2nd Clutch
8	Cooler	37	Direct Clutch
9	Lube 1	38	4th Band
10	Lube 2	40	Coast Clutch
24	Direct Clutch Feed	43	Intermediate Band
25	Reverse	45	Exhaust
27	LO Band	47	Void

CASE PASSAGES – BOTTOM



1 Suction
10 Lube 2
25 Reverse
27 LO Band
28 Drive
38 4th Band
43 Intermediate Band
45 Exhaust
47 Void

SPACER PLATE-TO-CHANNEL PLATE GASKET



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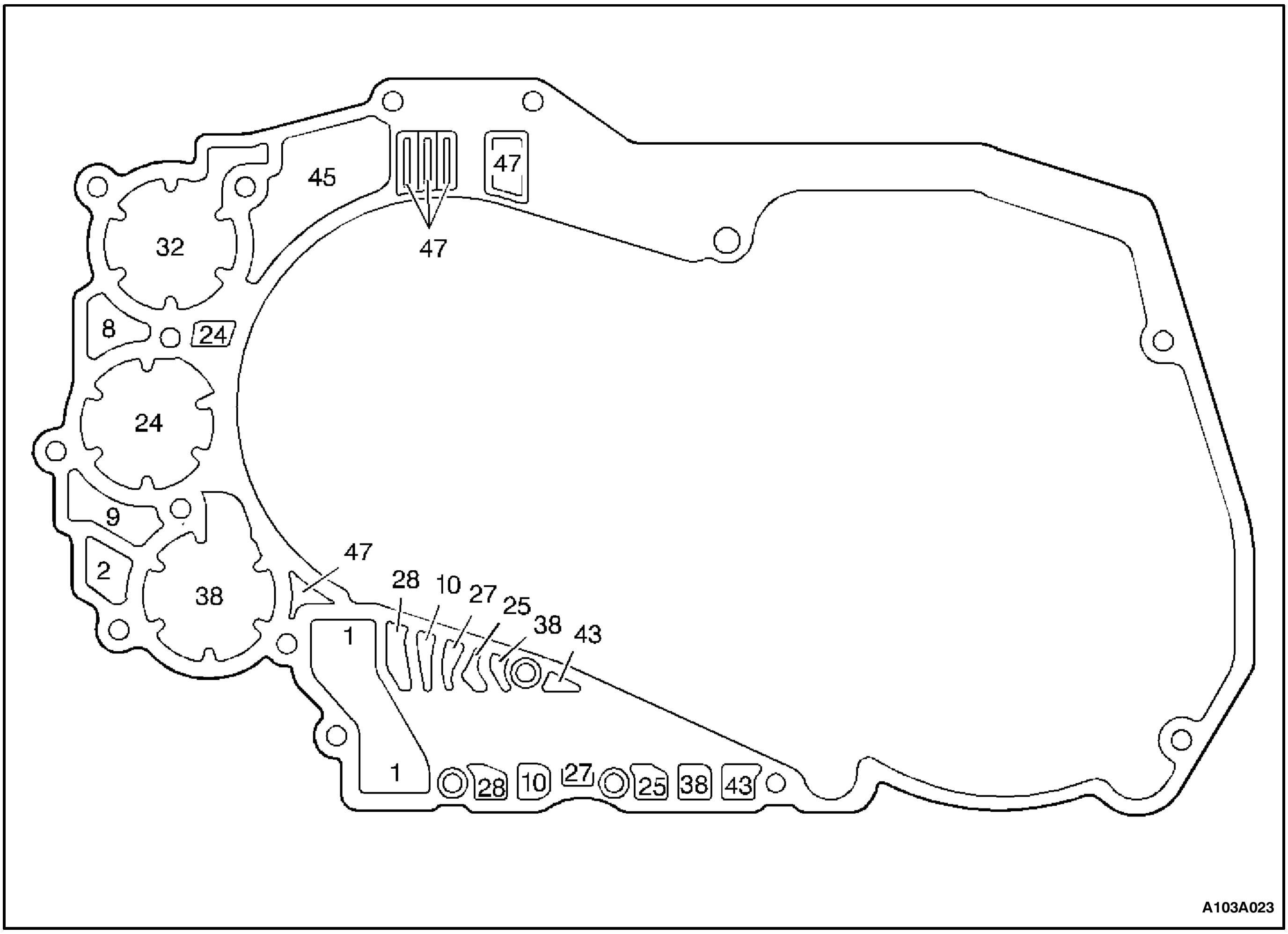
1 Suction
2 Line
3 Decrease
4 Converter Feed
5 TCC Feed Limit
6 Release
7 Apply
8 Cooler
10 Lube 2
11 PRN
12 LO/PRN
13 PRND4
14 Actuator Feed
17 2-3 Signal
18 Torque Signal
20 1-2/3-4 Accumulator
21 1-2 Accumulator Feed
22 3-4 Accumulator Feed
23 2-3 Accumulator
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
30 2-3 Drive
32 2nd Clutch
33 TCC Signal (PWM)
34 TCC-Regulated Apply
35 3-4 Drive
36 Direct Clutch Feed
37 Direct Clutch

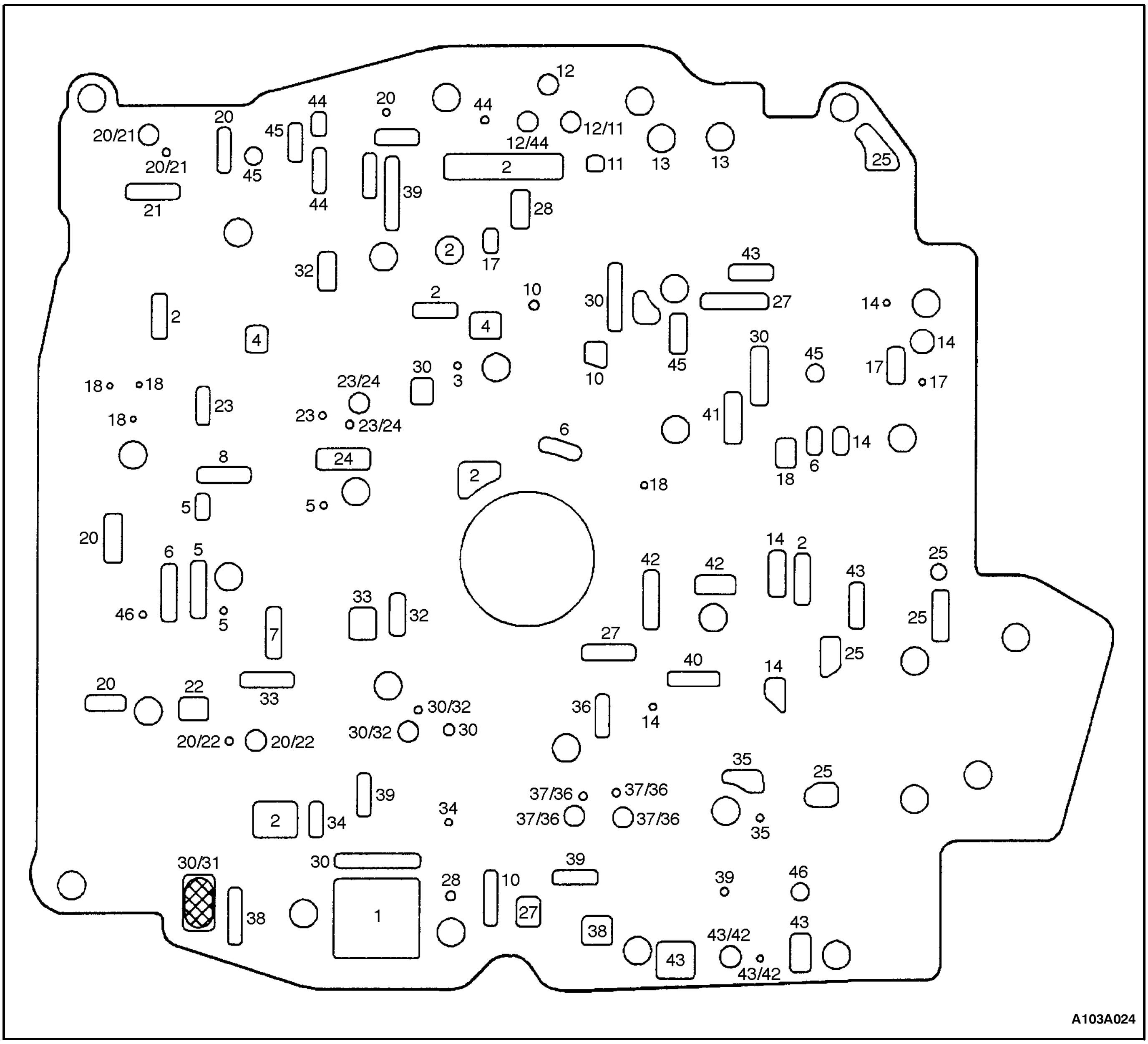
38 4th Band
39 D321
40 Coast Clutch
41 D21
42 Intermediate Band Free
43 Intermediate Band
44 LO
45 Exhaust
46 Orificed Exhaust

CHANNEL PLATE-TO-CASE GASKET



1 Suction
2 Line
8 Cooler
9 Lube 1
10 Lube 2
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
32 2nd Clutch
38 4th Band
43 Intermediate Band
45 Exhaust
47 Void

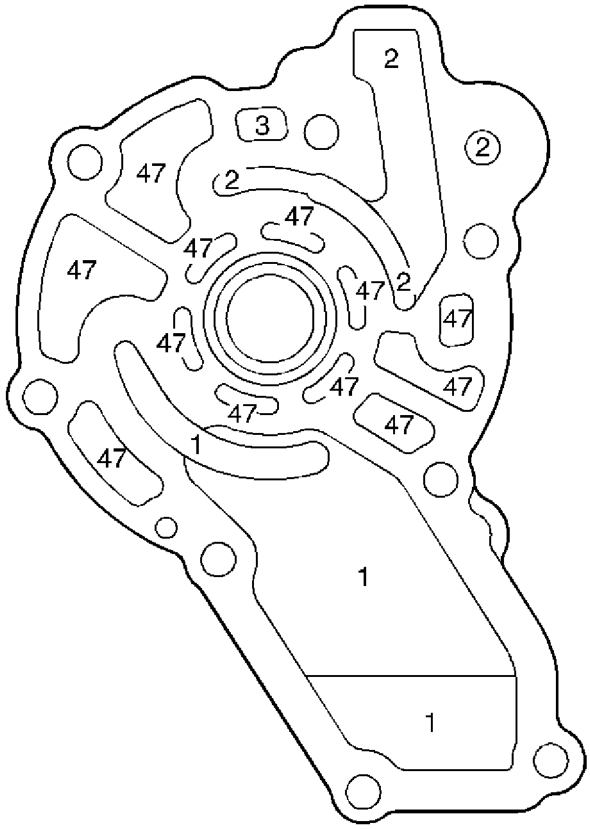
SPACER PLATE



1 Suction
2 Line
3 Decrease
4 Converter Feed
5 TCC Feed Limit
6 Release
7 Apply
8 Cooler
10 Lube 2
11 PRN
12 LO/PRN
13 PRND4
14 Actuator Feed
17 2-3 Signal
18 Torque Signal
20 1-2/3-4 Accumulator
21 1-2 Accumulator Feed
22 3-4 Accumulator Feed
23 2-3 Accumulator
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
30 2-3 Drive
31 Filtered 2-3 Drive
32 2nd Clutch
33 TCC Signal (PWM)
34 TCC-Regulated Apply
35 3-4 Drive
36 Direct Clutch Feed

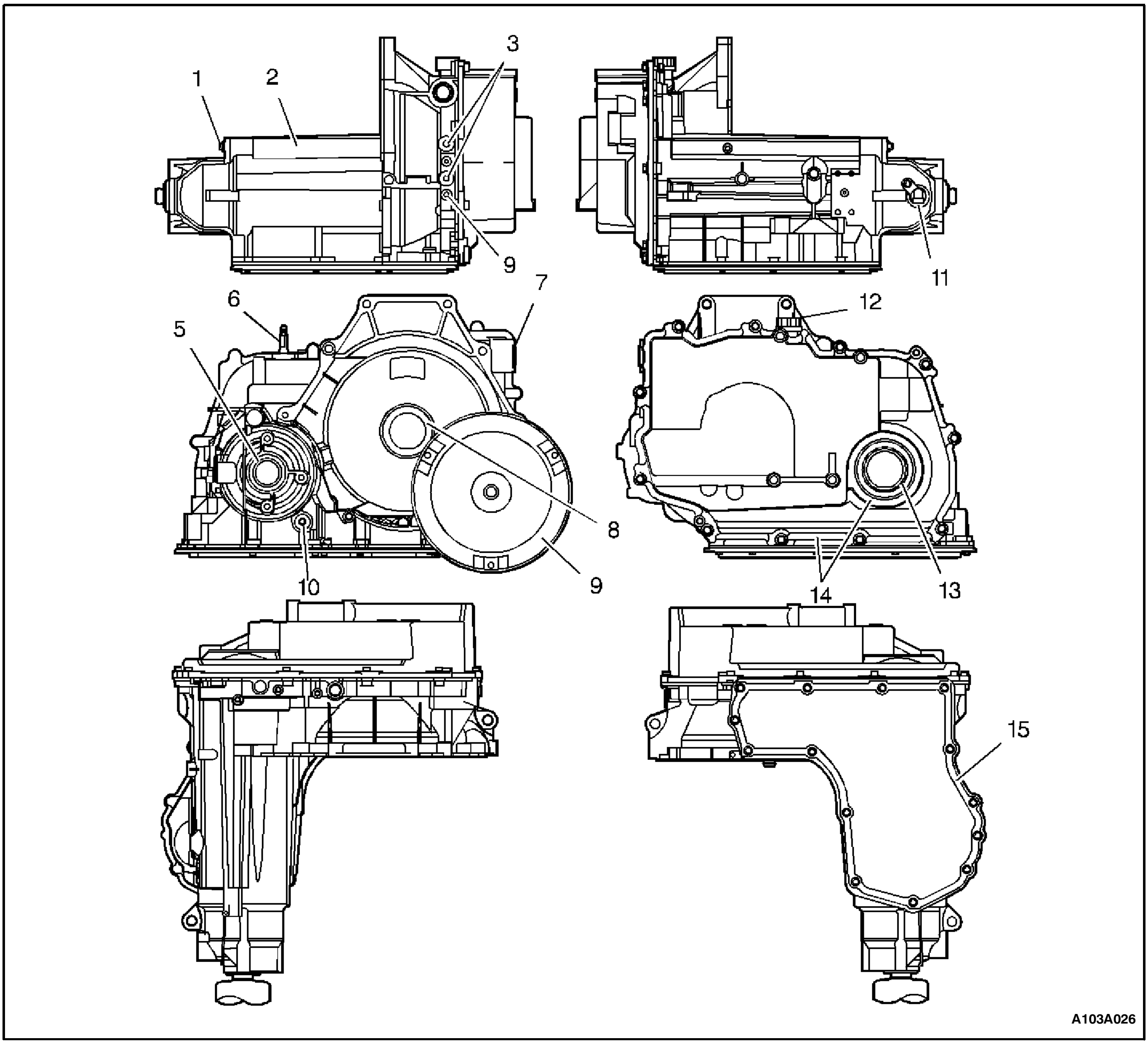
37 Direct Clutch
38 4th Band
39 D321
40 Coast Clutch
42 Intermediate Band Feed
43 Intermediate Band
44 LO
45 Exhaust
46 Orificed Exhaust

PUMP BODY OIL CHANNELS



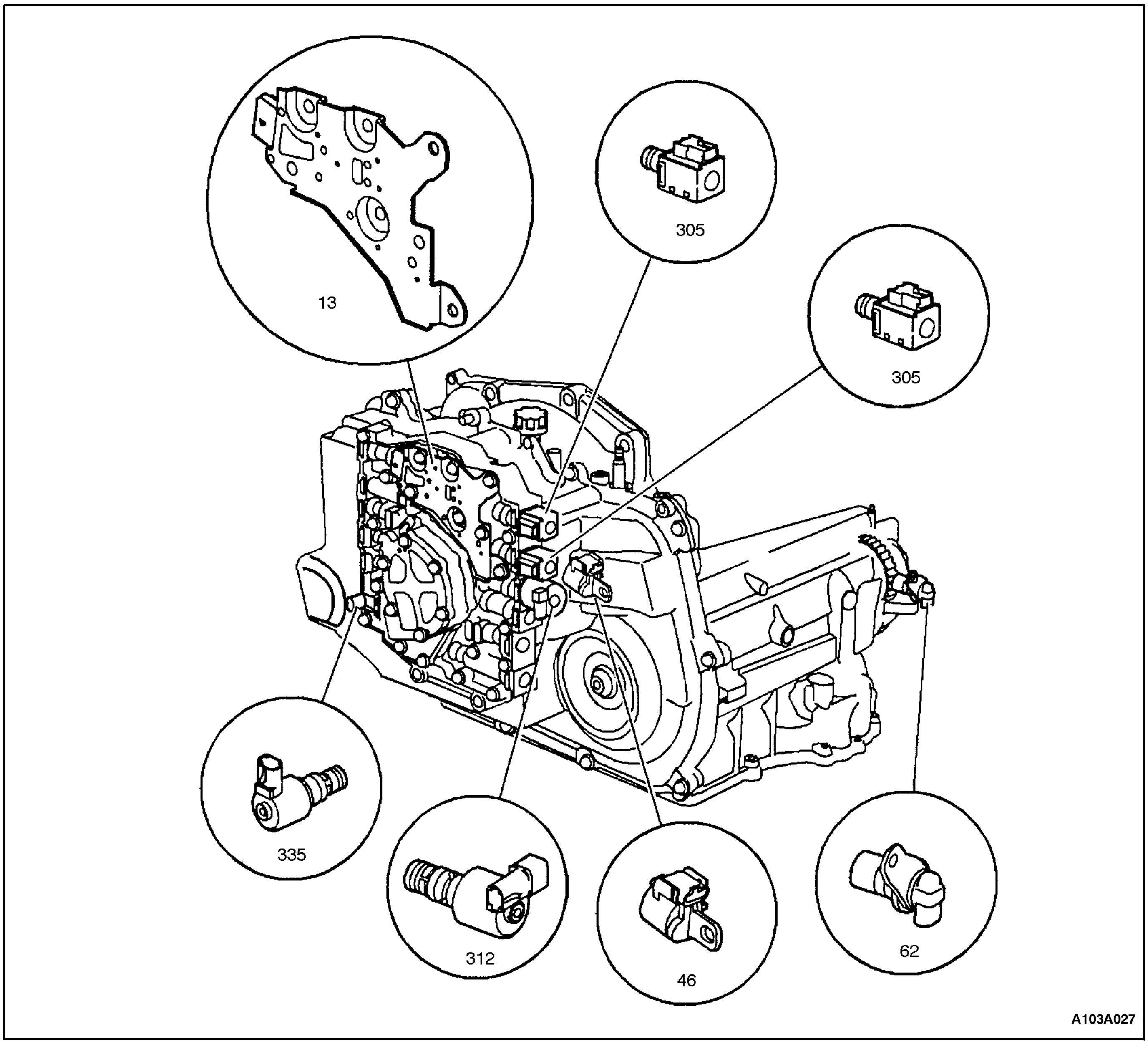
1 Suction
2 Line
3 Decrease
47 Void

4T40-E LEAK INSPECTION POINTS



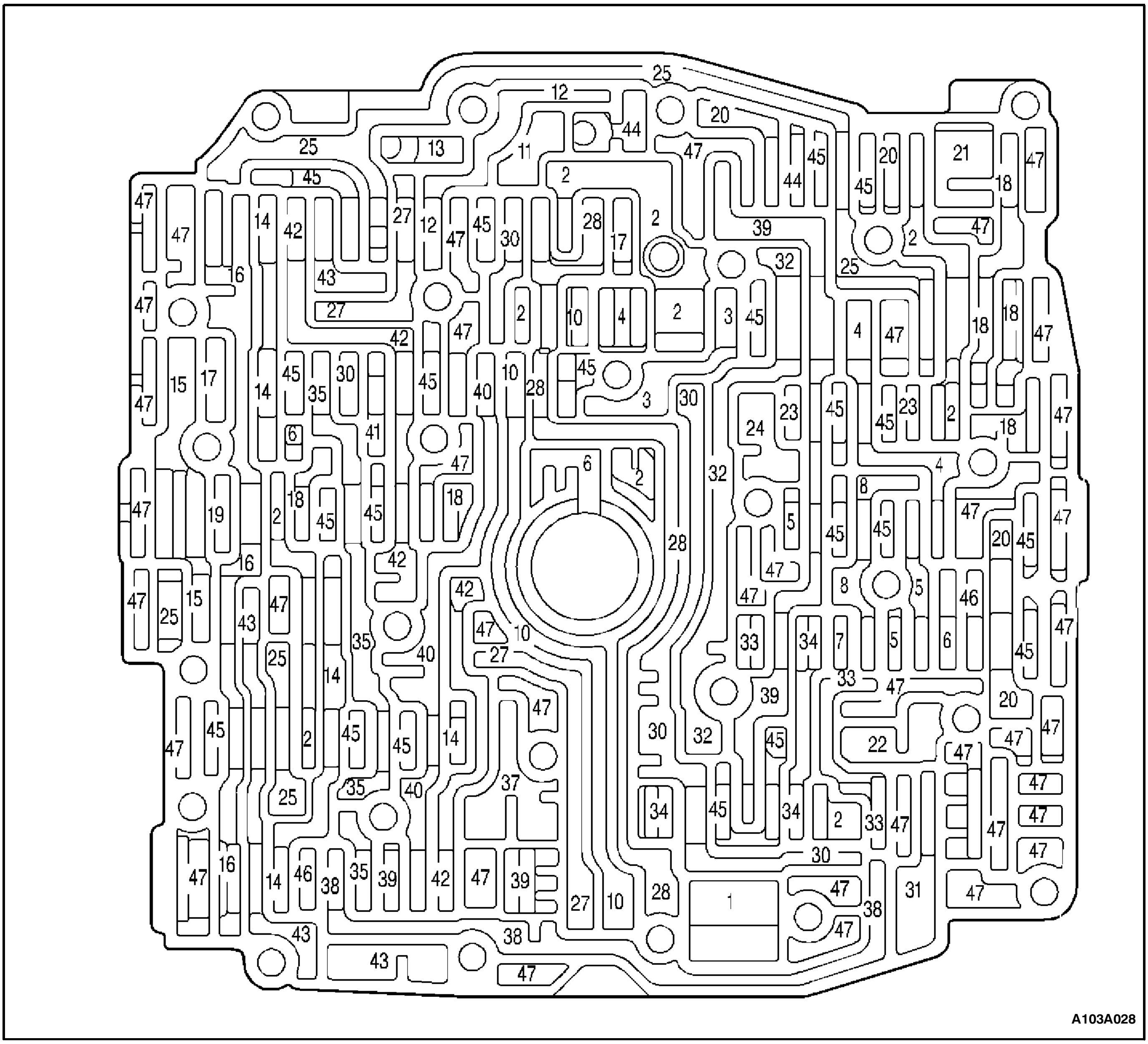
1 Actuator Guide Seal
2 Case
3 Cooler Line Seals
4 Line Pressure Plug
5 Axle Seal (Case) and Stub Shaft Sleeve
6 Manual Shaft Seal
7 Pass-Thru Connector Seal
8 Converter Seal
9 Torque Converter
10 Fluid Level Plug
11 Output Speed Sensor Seal
12 Fill Cap Seal and Vent
13 Axle Seal (Side Cover) and Output Shaft Sleeve
14 Side Cover Seals
15 Bottom Pan Gasket

ELECTRONIC COMPONENT LOCATION VIEWS



13 Pressure Switch Assembly
305 1-2/2-3 Shift Solenoid
62 A/T Output Speed Sensor
46 A/T Input Speed Sensor
312 Pressure Control Solenoid
335 TCC Control PWM Solenoid

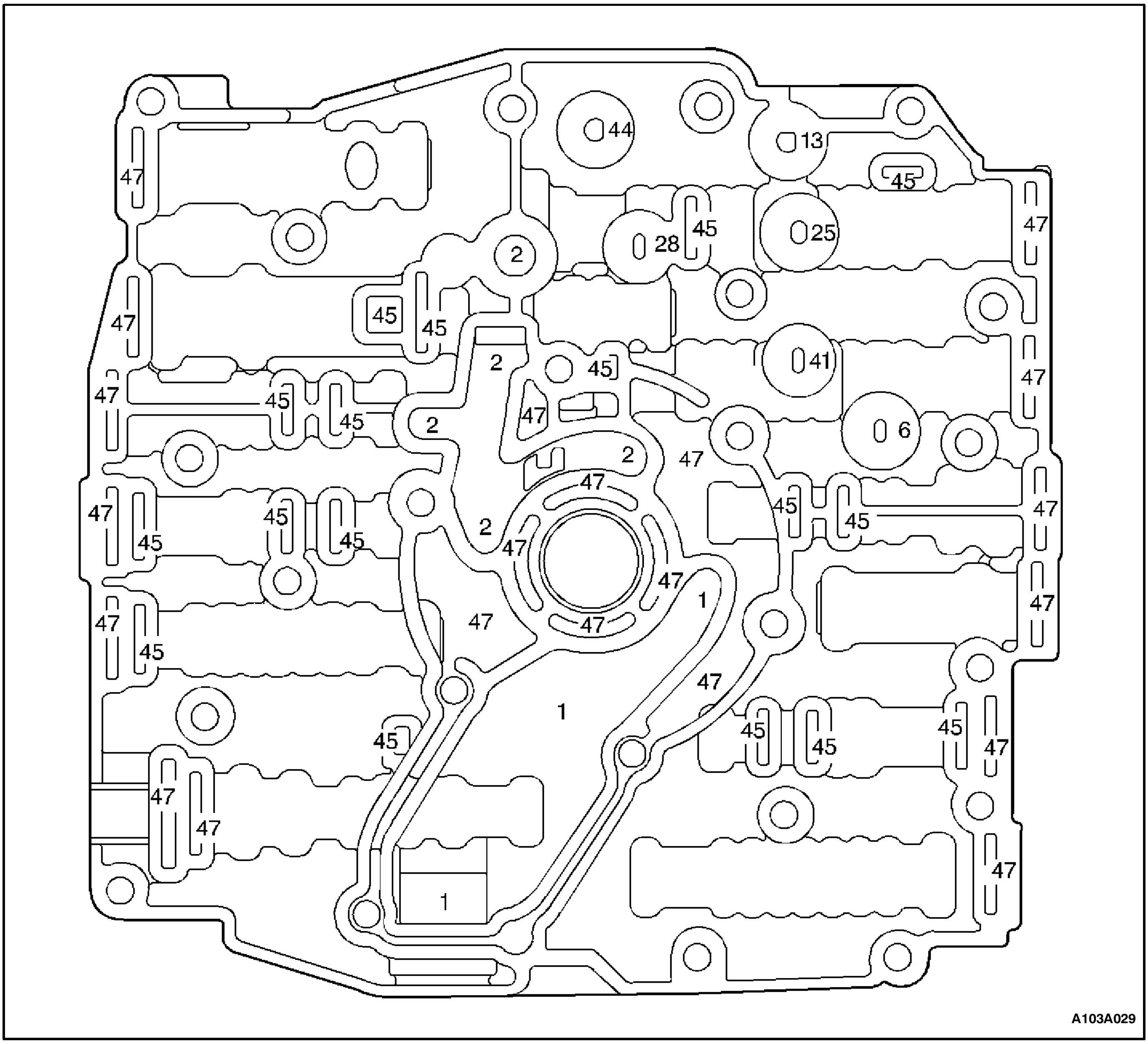
CONTROL VALVE BODY CHANNELS – CHANNEL PLATE SIDE



1 Suction
2 Line
3 Decrease
4 Converter Feed
5 TCC Feed Limit
6 Release
7 Apply
8 Cooler
10 Lube 2
11 PRN
12 LO/PRN
13 PRND4
14 Actuator Feed
15 Filtered Actuator Feed
16 1-2 Signal
17 2-3 Signal
18 Torque Signal
19 PCS Signal
20 1-2/3-4 Accumulator
21 1-2 Accumulator Feed
22 3-4 Accumulator
23 2-3 Accumulator
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
30 2-3 Drive
32 2nd Clutch
33 TCC Signal (PCM)
34 TCC-Regulated Apply
35 3-4 Drive
37 Direct Clutch

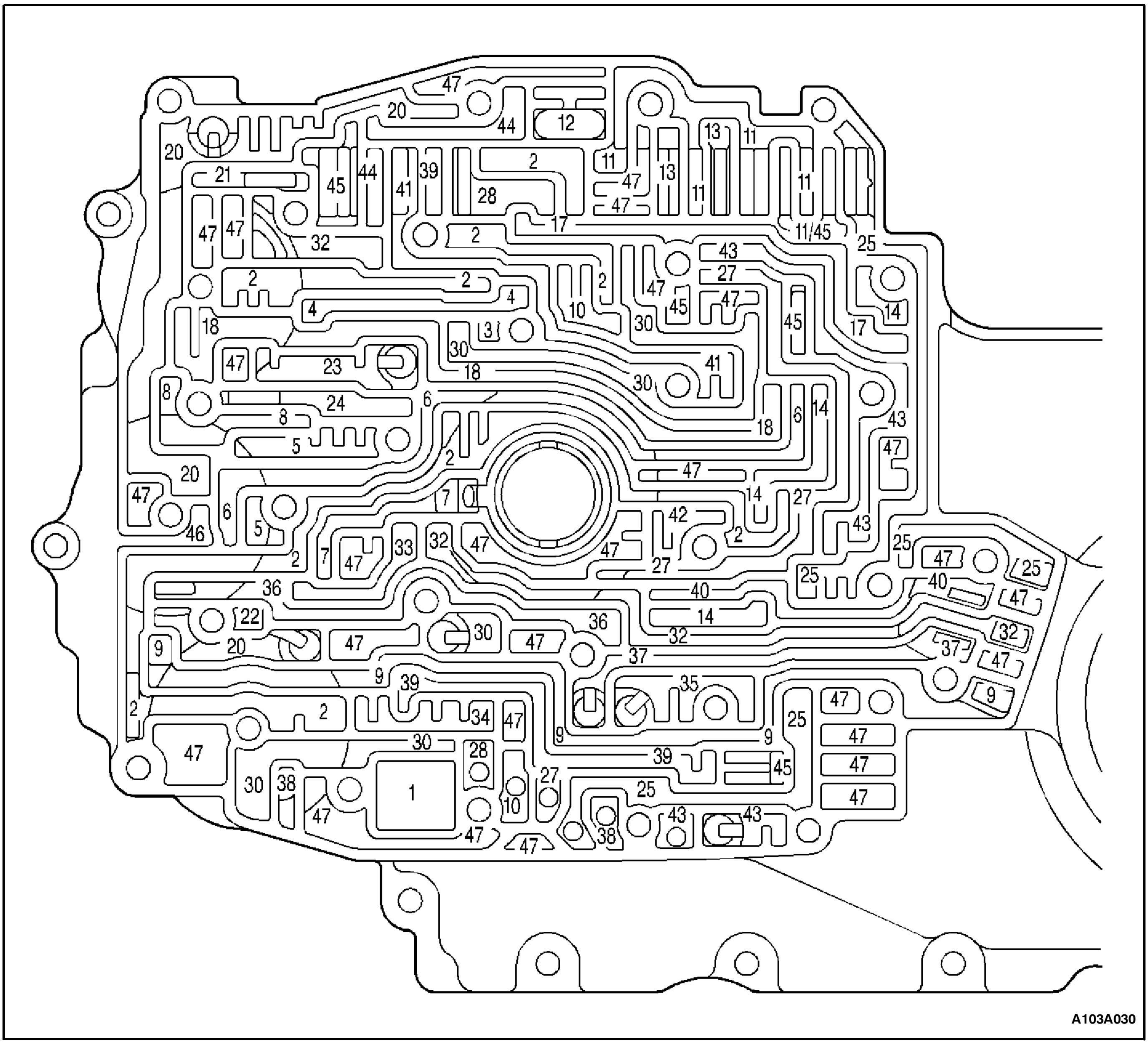
38 4th Band
39 D321
40 Coast Clutch
41 D21
42 Intermediate Band Feed
43 Intermediate Band
44 LO
45 Exhaust
46 Orificed Exhaust
47 Void

CONTROL VALVE BODY CHANNELS – OIL PUMP SIDE



1 Suction
2 Line
6 Release
13 PRND4
25 Reverse
28 Drive
41 D21
44 LO
45 Exhaust
47 Void

CHANNEL PLATE PASSAGES – CONTROL VALVE BODY SIDE



1 Suction
2 Line
3 Decrease
4 Converter Feed
5 TCC Feed Limit
6 Release
7 Apply
8 Cooler
9 Lube 1
10 Lube 2
11 PRN
12 LO/PRN
13 PRND4
14 Actuator Feed
17 2-3 Signal
18 Torque Signal
20 1-2/3-4 Accumulator
21 1-2 Accumulator Feed
22 3-4 Accumulator
23 2-3 Accumulator
24 2-3 Accumulator Feed
25 Reverse
27 LO Band
28 Drive
30 2-3 Drive
32 2nd Clutch
33 TCC Signal (PWM)
34 TCC-Regulated Apply
35 3-4 Drive
36 Direct Clutch Feed
37 Direct Clutch

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be familiar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

Notice: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in incorrect diagnostic performance or damage to powertrain components. Do not, under any circumstances, attempt to diagnose a transmission problem without this basic knowledge.

Notice: If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional test procedure is designed to verify the correct operation of electronic components in the transaxle. This will eliminate the unnecessary removal of transaxle components.

FUNCTIONAL CHECK PROCEDURE

Begin with the Functional Check Procedure which provides a general outline of how to diagnose HYDRA-MATIC 4T40-E. The Functional Check Procedure will indicate the proper path of diagnosing the transaxle by describing the basic checks and then referencing the locations of the specific checks.

Use on-board diagnostics or TECH 1 (or other scan tool) to see if any transaxle trouble codes have been set. Refer to the appropriate "Diagnostic Trouble Code" information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.

If no trouble codes have been set and the condition is suspected to be hydraulic, take the vehicle on a road test. Refer to "Road Test Procedure" in this section.

4T40-E TRANSAXLE FUNCTIONAL CHECK PROCEDURE

Step	Action	Value(s)	Yes	No
1	Perform the Fluid Level Service Procedure. Is the fluid level correct?	-	Go to Step 2	-
2	Check for TCM trouble codes, both current and history. Are TCM trouble codes present?	-	Go to Tech 1 Data Value Examples	Go to Step 3
3	1. Perform the Electrical/Garage Shift Tests. 2. Perform the Road Test Procedure. Was the condition duplicated?	-	Go to Step 4	Go to Step 12
4	Is a harsh or soft shift condition present?	-	Go to Step 7	Go to Step 5
5	Is the vehicle's performance poor?	-	Go to Torque Converter Evaluation section of "Torque Converter Clutch Diagnosis"	Go to Step 6
6	Is the engagement into Drive or Reverse delayed or missing?	-	Go to Step 7	Go to Step 9
7	Perform the Line Pressure Check Procedure. Is the line pressure correct?	-	Go to Step 8	Refer to Symptom Diagnosis Charts

4T40-E Transaxle Functional Check Procedure (Cont'd)

Step	Action	Value(s)	Yes	No
8	Inspect the transmission wire harness connectors and the transmission range switch. Was the problem found and corrected?	-	System OK	Refer to Symptom Diagnosis Charts
9	Is vibration or noise a problem?	-	Refer to Vibration Test Procedure of "Torque Converter Clutch Diagnosis"	Go to Step 10
10	Is the fluid leaking?	-	Refer to Leak Diagnosis and Repair	Go to Step 11
11	Are other transmission conditions present?	-	Refer to Symptom Diagnosis Chart	Go to Step 12
12	The condition is intermittent. Re-examine the complaint.	-	Exit Table	-

LINE PRESSURE CHECK PROCEDURE

The HYDRA-MATIC 4T40-E uses a vane type oil pump to produce hydraulic pressure, and a transaxle pressure control solenoid to control that pressure at the pressure regulator valve, after it leaves the pump. The transaxle pressure control solenoid is controlled by an electrical signal that ranges from 0 to 1.1 amp 1.1 amp corresponds to minimum line pressure (approx. 310 to 380 kPa: 45-55 psi not 0 psi) and 0 amps corresponds to a maximum line pressure (approx. 965 to 1240 kPa: 140 to 180 psi) in Overdrive (D).

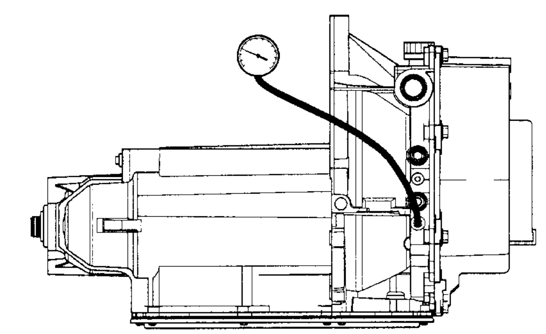
Line pressures are calibrated for two sets of gear ranges - Drive-Park-Neutral and Reverse. This allows the transaxle line pressure to be appropriate for different pressure needs in different gear ranges:

Gear Range	Nominal Line Pressure Range
Drive, Park or Neutral	50-160 psi (345-1103 kPa)
Reverse	58-186 psi (400-1282 kPa)

Before performing a line pressure check, verify that the pressure control solenoid is receiving the correct electrical signal from the TCM:

1. Install a scan tool.
2. Start the engine and set parking brake.
3. Check for a stored pressure control solenoid diagnostic trouble code, and other diagnostic trouble codes.
4. Repair vehicle if necessary.
   Inspect
   - Fluid level
   - Manual linkage

   Install or Connect
   - TECH 1 (Scan tool)
   - Oil pressure gage at line pressure tap



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5. Put gear selector in Park and set the parking brake.
6. Start engine and allow it to warm up at idle.

7. Access the "PCS Control" test on the TECH 1 (scan tool).
8. Increase DESIRED PCS in 0.1 Amp increments and read the corresponding line pressure on the pressure gage. (Allow pressure to stabilize for 5 seconds after each current change.)
9. Compare data to the Drive-Park-Neutral line pressure chart below.

Notice: Total test running time should not exceed 2 minutes, or transaxle damage could occur.

Caution: Brakes must be applied at all times to prevent unexpected vehicle motion.

If pressure readings differ greatly from the line pressure chart, refer to the Diagnosis Charts contained in this section.

The TECH 1 scan tool is only able to control the pressure control solenoid in Park and Neutral with the vehicle stopped. This protects the clutches from extremely high or low pressures in Drive or Reverse ranges.

Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (psi)
0.00	152-160
0.10	149-151
0.30	141-143
0.50	124-127
0.60	111-115
0.70	97-101
0.80	81-84
0.90	64-67
0.95	56-58
1.00	50-51
1.05	50
1.10	50

NOTE: Pressures are at 705C and vary with temperature. Pressure drops as temperature increases.

COMPONENT RESISTANCE CHECK PROCEDURE

Component	Pass Through Pins	Resistance 20°C (68°F)	Resistance 100°C (212°F)	Resistance to Ground (Case)
1-2 Shift Solenoid Valve	A, E	19-24W	24-31W	Greater than 250KW
2-3 Shift Solenoid Valve	B, E	19-24W	24-31W	Greater than 250KW
Torque Converter Clutch Pulse Width Modulation Solenoid Valve	T, E	10-11W	13-15W	Greater than 250KW
Pressure Control Solenoid Valve	C, D	3-5W	4-7W	Greater than 250KW
Transmission Fluid Pressure Switch	Refer to Pressure Switch Assembly Resistance Check			
*Transmission Fluid Temperature (TFT) Sensor	L, M	3106-3923W	164-190W	Greater than 20MW
Automatic Transmission Input (Shaft) Speed Sensor	S, V	615-700W	750-835W	Greater than 10MW
Automatic Transmission Output Speed Sensor	A, B	1530-1650W	1700-1870W	Greater than 10MW
Important: The resistance of this device is necessarily dependent on the temperature. Therefore the resistance will vary far more than any other device.				

PRESSURE SWITCH ASSEMBLY RESISTANCE CHECK

Step	Action	Value(s)	Yes	No
1	1. Install J 39775 Jumper Harness on the transmission 20-way connector, if needed. 2. Using J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance from terminal U and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 3	Go to Step 2
2	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal D and the TFP Val. Position Sw. housing. Is the resistance less than the value shown?	50W	Go to Step 15	Go to Step 17
3	Measure the resistance from terminal N and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 5	Go to Step 4
4	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal A and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
5	Measure the resistance from terminal R and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 7	Go to Step 6
6	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal B and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
7	Measure the resistance from terminal P and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 9	Go to Step 8
8	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal C and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
9	1. Start the engine and let the engine idle. 2. Set the parking brake. 3. Place the gear selector in P (Park). 4. Measure the resistance from terminal U and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 10	Go to Step 17
10	1. Place the gear selector in R (Reverse). 2. Measure the resistance from terminal P and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 11	Go to Step 17
11	1. Place the gear selector in D4 (Drive). 2. Measure the resistance from terminal N and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 12	Go to Step 17

Pressure Switch Assembly Resistance Check (Cont'd)

Step	Action	Value(s)	Yes	No
12	Measure the resistance from terminal R and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 13	Go to Step 17
13	1. Place the gear selector in D1 (Low). 2. Measure the resistance from terminal N and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 14	Go to Step 17
14	Measure the resistance from terminal P and the transmission case. Is the resistance less than the value shown?	50W	No problem found; exit table	Go to Step 17
15	Inspect for high resistance: • Inspect the transmission wiring for poor electrical connections at the transmission 20-way connector and at the TFP Val. Position Sw. connector. • Look for possible bent, backed out, deformed, or damaged terminals. • Check for weak terminal tension. Was the condition found?	-	Verify repair and Go to Step 1	Go to Step 16
16	Replace the internal wiring harness. Is the replacement complete?	-	Verify repair and Go to Step 1	-
17	Replace the TFP Val. Position Sw. Is the replacement complete?	-	Verify repair and Go to Step 1	-

CLUTCH PLATE DIAGNOSIS

Composition Plates

Dry the plates and inspect the plates for the following conditions:

- Pitting
- Flaking
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

Steel Plates

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

Important: If the clutch shows evidence or extreme heat or burning, replace the springs.

Causes of Burned Clutch Plates

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch plates.
- Engine coolant in the transmission fluid.
- A cracked clutch piston.
- Damaged or missing seals.
- Low line pressure.
- Valve problems.
  - The valve body face is not flat
  - Porosity between channels
  - The valve bushing clips are improperly installed
  - The check balls are misplaced
- The Teflon® seal rings are worn or damaged.

ENGINE COOLANT IN TRANSAXLE

Notice: Antifreeze will deteriorate the Viton O-ring seals and the glue used to bond the clutch material to the pressure plate. Both conditions may cause transaxle damage.

Perform the following steps if the transmission oil cooler has developed a leak, allowing engine coolant to enter the transmission:

1. Because the coolant will attach the seal material causing leakage, disassemble the transmission and replace all rubber type seals.
2. Because the facing material may become separated from the steel center portion, replace the composition-faced clutch plate assemblies.
3. Replace all nylon parts including washers.
4. Replace the torque converter.
5. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
6. Flush the cooler lines after you have properly repaired or replaced the transmission cooler.

COOLER FLUSHING AND FLOW TEST

Notice: You must flush the cooler whenever you remove a transmission for service. Cooler flushing is essential for SRTA installation, major overhaul, whenever you replace a pump or torque converter, or whenever you suspect that the fluid has been contaminated. Use J 35944 to flush the cooler.

After filling the transmission with fluid, start the engine and run for 30 seconds. This will remove any residual moisture from the oil cooler. A minimum of two quarts of fluid should flow during a 30-second period. To check the fluid flow, disconnect the return line at the transmission and observe the flow with the engine running. If the fluid flow is insufficient, check the fluid flow by disconnecting the feed line at the cooler. Observe the flow with the engine running.

- If the flow from the cooler return line at the transmission is insufficient, check the flow rate from the feed line to the cooler. Blockage exists in the transmission or the cooler.
- If the flow from the transmission feed line to the cooler is insufficient, the transmission is the cause of the fluid flow problem.
- If the flow from the transmission feed line to the cooler is insufficient, but flow from the cooler return line to the transmission is insufficient, inspect the cooler pipes and fittings. Then repeat the cooler flushing procedure. If the flow is still insufficient, replace the cooler.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

Methods for Locating Leaks

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for about 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Park the vehicle over clean paper or cardboard.
5. Shut the engine off and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder Method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Operate the vehicle for about 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Shut the engine off.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

Dye and Black Light Method

1. Add dye to the transaxle though the transmission fill cap. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the Fluid Leak

Once the leak point is found the source of the leak must be determined. Figure 10 shows potential leak points for the transaxle. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Manual shaft nicked or damaged.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the car.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.
2. Using instructions from the manufacturer, mix a sufficient amount of epoxy, GM P/N 1052533 or equivalent, to make the repair.

Caution: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for three hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures.

4T40-E FLUID LEVEL SERVICE PROCEDURE

The fluid level screw is intended to be used for diagnosing a transaxle fluid leak or resetting the transaxle fluid level after service that involves a loss of fluid.

Fluid Level Diagnosis Procedure

The fluid level should be checked when the transmission is above 40°C (104°F). This temperature can be reached by performing the following procedure.

1. Park the vehicle on a hoist, inspection pit or similar raised level surface. The vehicle must be level to obtain a correct fluid level measurement.
2. Place a fluid container below the fluid level screw.
3. Start the engine and allow the engine to idle for approximately 5 minutes or, if possible, drive the vehicle for a few kilometers to warm the transaxle fluid.
4. With the brake pedal depressed, move the shift lever through the gear ranges, pausing a few seconds in each range. Return the shift lever to the P (Park) position.
5. Remove the fluid level screw. Because the transaxle operates correctly over a range of fluid levels, fluid may or may not drain out of the screw hole when the screw is removed.

Caution: Removal of the fluid level screw when the transmission fluid is hot may cause injury if fluid drains from the screw hole.

- If fluid drains through the screw hole the transaxle may have been overfilled. When the fluid stops draining the fluid level is correct. Install the fluid level screw and torque to the proper specification (12 N•m).
- If fluid does not drain through the screw hole the transaxle fluid level may be low. Add fluid through the fill cap hole in 0.5 liter increments, up to 1.5 liters maximum, until fluid drains through the screw hole. If fluid drains through the screw hole the fluid level was in the correct operating range. Allow the fluid to finish draining through the screw hole and install the fluid level screw. Torque the fluid level screw to the proper specification (12 Nwm).
- If fluid does not drain through the screw hole after adding a total of 1.5 liters then the transaxle was either underfilled or is leaking fluid. The transaxle should be inspected for fluid leaks and any leaks should be fixed before setting the transaxle fluid level.

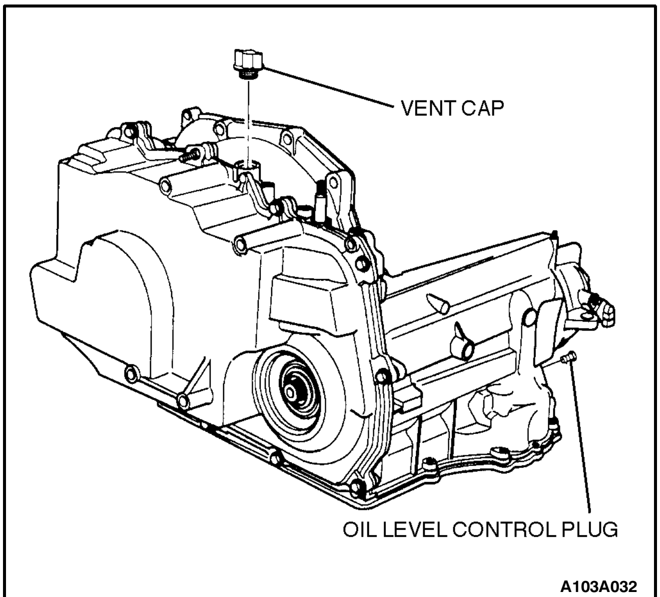
6. When the fluid level checking procedure is completed, wipe any fluid from the transaxle case with a rag or shop towel. Also, check that the fluid fill cap and vent tube are properly installed.

Fluid Level Set After Service

1. Depending on the service procedure performed, add the following amounts of fluid through the fill cap hole prior to adjusting the fluid level:

Bottom pan removal (on-vehicle)	7 liters (7.4 quarts)
New converter	2.5 liters (2.6 quarts)
Complete overhaul	10 liters (10.6 quarts)

2. Follow steps 1 thru 4 of the Fluid Level Diagnosis Procedure.
3. Add additional fluid through the fill cap hole in 0.5 liter (1 pint) increments until fluid comes out the screw hole.



4. Allow the fluid to finish draining out the screw hole, install the fluid level screw and torque the screw to the proper specifications (12 N•m).
5. When the fluid level setting procedure is completed, wipe any fluid from the transaxle case with a rag or shop towel. Also, check that the fluid fill cap and vent tube are properly installed.

ELECTRICAL/GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transaxle, a simple electrical condition could be misdiagnosed as a major transaxle condition.

A scan tool provides valuable information and must be used on the HYDRA-MATIC 4T40-E transaxle for accurate diagnosis.

1. Move gear selector to P (Park) and set the parking brake.
2. Connect scan tool to DLC terminal.
3. Start engine.
4. Connect power to scan tool.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - TRANS INPUT SPEED
   - TRANS OUTPUT SPEED
   - VEHICLE SPEED
   - TFP RANGE A/B/C
   - PRNDL SELECT
   - DESIRED PCS
   - ACTUAL PCS
   - PCS DUTY CYCLE
   - BRAKE SWITCH
   - ENG COOLANT TEMP
   - TRANS FLUID TEMP
   - THROTTLE ANGLE
   - SYSTEM VOLTS
6. Monitor the BRAKE SWITCH signal while tapping the brake pedal with your foot.
   - The BRAKE SWITCH should be on when the pedal is depressed, and come off when the brake pedal is released.
7. Monitor the PRNDL SELECT signal and move the gear selector through all the ranges.
   - Verify that the PRNDL SELECT value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear selector to neutral and monitor the THROTTLE ANGLE signal while increasing and decreasing engine RPM with the accelerator pedal.
   - THROTTLE ANGLE should increase with engine RPM.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

The TCM calculates upshift points based primarily on two inputs: THROTTLE ANGLE and VEHICLE SPEED. When the TCM says a shift should occur, an electrical signal is sent to the shift solenoids which in turn moves the valves to perform the upshift.

The shift speed charts reference THROTTLE ANGLE instead of "min throttle" or "wot" to make shift speed measurement more uniform and accurate. A scan tool should be used to monitor THROTTLE ANGLE. Some scan tools have been programmed to record shift point information. Check the instruction manual to see if this test is available.

Upshift Procedure

With gear selector in Overdrive (D):

1. Look at the shift speed chart contained in this section and choose a percent throttle angle of 10 or 25%.
2. Set up the scan tool to monitor THROTTLE ANGLE and VEHICLE SPEED.
3. Accelerate to the chosen throttle angle and hold the throttle steady.
4. As the transaxle upshifts, note the shift speed and commanded gear changes for:
   - Second gear.
   - Third gear.
   - Fourth gear.

Important: Shift speeds may vary due to slight hydraulic delays responding to electronic controls. A change from the original equipment tire size also affects shift speeds.

Note when TCC applies. This should occur in fourth gear. If the apply is not noticed by an rpm drop, refer to the "Torque Converter Clutch Diagnosis" information contained in this section.

The TCC should not apply unless the transaxle has reached a minimum operating temperature of 8°C (46°F) TRAN TEMP AND engine coolant temp of 50°C (122°F).

5. Repeat steps 1-4 using several different throttle angles.

Part Throttle Detent Downshift

At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in Fourth gear, quickly increase throttle angle to greater than 50%.

Verify that:

- TCC releases.
- Transaxle downshifts to 3rd gear.
- 1-2 Shift Solenoid turns off.
- 2-3 Shift Solenoid remains on.

Full Throttle Detent Downshift

At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in Fourth gear, quickly increase throttle angle to its maximum position (100%).

Verify that:

- TCC releases.
- Transaxle downshifts to second gear immediately.
- Both Shift Solenoids are off.

Manual Downshifts

The shift solenoids do not control the initial 4-3 manual downshift. The 4-3 manual downshift is hydraulic while the 3-2 and 2-1 are electronic. The solenoid states will change during, or shortly after a manual 4-3 downshift is selected.

1. At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in Fourth gear, release the accelerator pedal while moving the gear selector to Manual Third (3). Observe that:
   - TCC releases.
   - Transaxle downshifts to third gear immediately.
   - Engine slows vehicle down.
2. Move gear selector back to Overdrive (D) and accelerate to 64 to 72 km/h (40 to 45 mph). Release the accelerator while moving the gear selector to Manual Second (2) and observe that:
   - TCC releases.
   - Transaxle downshifts to second gear immediately.
   - Engine slows vehicle down.
3. Move gear selector back to Overdrive (D) and accelerate to 64 km/h (40 mph). Release the accelerator pedal while moving the gear selector to Manual First (1) and observe that:
   - TCC releases.
   - Transaxle downshifts to second gear immediately.
   - Engine slows vehicle down.
   - Below 60 km/h (37 mph) transaxle downshifts to first gear.

Notice: A Manual First-Third Gear Ratio will occur at high speeds as an upshift safety feature. Do not attempt to perform this shift.

Coasting Downshifts

1. With the gear selector in Overdrive (D), accelerate to Fourth gear with TCC applied.
2. Release the accelerator pedal and lightly apply the brakes, and observe that:
   - TCC releases.
   - Downshifts occur at speeds shown on the shift speed chart.

Manual Gear Range Selection

Upshifts in the manual gear ranges are controlled by the shift solenoids.

Perform the following tests by accelerating at 10 percent TP Sensor position.

Manual Third (3)

- With vehicle stopped, move the gear selector to Manual Third (3) and accelerate to observe:
  - 1-2 shift.
  - 2-3 shift.

Manual Second (2)

- With vehicle stopped, move gear selector to Manual Second (2) and accelerate to observe:
  - 1-2 shift.
- Accelerate to 40 km/h (35 mph) and observe:
  - 2-3 shift does not occur.
  - TCC does not apply.

Manual First (1)

- With vehicle stopped, move gear selector to Manual First (1). Accelerate to 32 km/h (20 mph) and observe:
  - No upshifts occur.
  - TCC does not apply.

Reverse (R)

- With vehicle stopped, move gear selector to R (Reverse) and observe:
  - 1-2 Shift Solenoid is ON.
  - 2-3 Shift Solenoid is OFF.

Use a scan tool to see if any transaxle trouble codes have been set. Refer to "Diagnostic Trouble Codes" in this section and repair the vehicle as directed. After repairing the vehicle, perform the hoist test and verify that the code has not set again.

If the transaxle is not performing well and no trouble codes have been set, there may be an intermittent condition. Check all electrical connections for damage or a loose fit. Some scan tools have a snapshot test which can help catch an intermittent condition that does not occur long enough to set a code.

You may want to read "Electronic Component Diagnosis" in this section to become familiar with transaxle conditions caused by transaxle electrical malfunctions.

If no trouble codes have been set and the condition is suspected to be hydraulic, take the vehicle on a road test.

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system, perform all electrical testing first and then the hydraulic testing.

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Valve Body. The solenoid is energized by completing an electrical circuit through a combination of switches and sensors.

Functional Check Procedure

Inspect

1. Install a tachometer or scan tool.
2. Operate the vehicle until proper operating temperature is reached.
3. Drive the vehicle at 80 to 88 km/h (50 to 55 mph) with light throttle (road load).
4. Maintaining throttle, lightly touch the brake pedal and check for release of the TCC and a slight increase in engine speed (rpm).
5. Release the brake, slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine speed (rpm).

TORQUE CONVERTER EVALUATION

Torque Converter Stator

The torque converter stator roller clutch can have one of two different type malfunctions:

1. Stator assembly freewheels in both directions.
2. Stator assembly remains locked up at all times.

Condition A – Poor Acceleration Low Speed

The car tends to have poor acceleration from a standstill. At speeds above 50 to 55 km/h (30 to 35 mph), the car may act normal. If poor acceleration is noted, it should first be determined that the exhaust system is not blocked, and the transaxle is in 1st (First) gear when starting out.

If the engine freely accelerates to high rpm in N (Neutral), it can be assumed that the engine and exhaust system are normal. Checking for poor performance in "Drive" and "Reverse" will help determine if the stator is freewheeling at all times.

Condition B – Poor Acceleration High Speed

Engine rpm and car speed limited or restricted at high speeds. Performance when accelerating from a standstill is normal. Engine may overheat. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, the stator roller clutch can be checked by inserting two fingers into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

Noise

Torque converter whine is usually noticed when the vehicle is stopped and the transaxle is in "Drive" or "Reverse". The noise will increase when engine rpm is increased. The noise will stop when the vehicle is moving or when the torque converter clutch is applied because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter:

1. Place foot on brake.
2. Put gear selector in "Drive".
3. Depress accelerator to approximately 1200 rpm for no more than six seconds.

Notice: If the accelerator is depressed for more than six seconds, damage to the transaxle may occur.

A torque converter noise will increase under this load.

Important: This noise should not be confused with pump whine noise which is usually noticeable in P (Park), N (Neutral) and all other gear ranges. Pump whine will vary with pressure ranges.

The torque converter should be replaced under any of the following conditions:

- External leaks in the hub weld area.
- Converter hub is scored or damaged.
- Converter pilot is broken, damaged or fits poorly into crankshaft.
- Steel particles are found after flushing the cooler and cooler lines.
- Pump is damaged or steel particles are found in the converter.
- Vehicle has TCC shudder and/or no TCC apply. Replace only after all hydraulic and electrical diagnoses have been made. (Converter clutch material may be glazed.)
- Converter has an imbalance which cannot be corrected. (Refer to Converter Vibration Test Procedure.)
- Converter is contaminated with engine coolant containing antifreeze.
- Internal failure of stator roller clutch.
- Excess end play.
- Heavy clutch debris due to overheating (blue converter).
- Steel particles or clutch lining material found in fluid filter or on magnet when no internal parts in unit are worn or damaged (indicates that lining material came from converter).

The torque converter should not be replaced if:

- The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
- The threads in one or more of the converter bolt holes are damaged.
  - Correct with thread insert.
- Transaxle failure did not display evidence of damage or worn internal parts, steel particles or clutch plate lining material in unit and inside the fluid filter.

- Vehicle has been exposed to high mileage (only). The exception may be where the torque converter clutch damper plate lining has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery or police use.

TCC SHUDDER DIAGNOSIS

The key to diagnosing Torque Converter Clutch (TCC) shudder is to note when it happens and under what conditions.

TCC Shudder should only occur during the APPLY and/ or RELEASE of the converter clutch; SELDOM after the TCC plate is fully applied.

While TCC Is Applying Or Releasing:

If the shudder occurs while TCC is applying, the problem can be within the transaxle or torque converter. Something is not allowing the clutch to become fully engaged, not allowing clutch to release, or is trying to release and apply the clutch at the same time. This could be caused by leaking turbine shaft seals, a restricted release orifice, a distorted clutch or housing surface due to long converter bolts, or defective friction material on the TCC plate.

Shudder Occurs After TCC Has Applied:

In this case, most of the time there is nothing wrong with the transaxle! As mentioned above, once the TCC has been applied, it is very unlikely that it will slip. Engine problems may go unnoticed under light throttle and load, but become noticeable after TCC apply when going up a hill or accelerating, due to the mechanical coupling between engine and transaxle.

Important: Once TCC is applied there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

Inspect the following components to avoid misdiagnosis of TCC Shudder and possibly disassembling a transaxle and/or replacing a torque converter unnecessarily:

- Spark plugs - Inspect for cracks, high resistance or broken insulator.
- Plug wires - Look in each end. If there is red dust (ozone) or black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire indicating arcing during hard acceleration.
- Distributor cap and rotor - Look for broken or uncrimped parts.
- Coil - Look for black on bottom indication arcing while engine is misfiring.
- Fuel injector - Filter may be plugged.
- Vacuum leak - Engine won't get correct amount of fuel. May run rich or lean depending on where the leak is.
- EGR valve - Valve may let in too much unburnable exhaust gas and cause engine to run lean.
- MAP sensor - Like vacuum leak, engine won't get correct amount of fuel for proper engine operation.
- Carbon on intake valves - Restricts proper flow or air/ fuel mixture into cylinders.
- Flat cam - Valves don't open enough to let proper fuel/air mixture into cylinders.
- Oxygen sensor - May command engine too rich or too lean for too long.
- Fuel pressure - May be too low.
- Engine mounts - Vibration of mounts can be multiplied by TCC engagement.
- Axle joints - Check for vibration.
- TPS - TCC apply and release depends on TPS in many engines. If TPS is out of specification, TCC may remain applied during initial engine crowd.
- Cylinder balance - Bad piston rings or poorly sealing valves can cause low power in a cylinder.
- Fuel contamination - Causes poor engine performance.

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST PROCEDURE

- Start engine.
- With engine at idle speed and transaxle in P (Park) or N (Neutral), observe vibration.
- Key off.

Remove or Disconnect

1. Flexplate shield attaching bolts.
2. Flexplate to torque converter attaching bolts.
3. Rotate torque converter 120 degrees (1/3 turn).

Install or Connect

1. Flexplate to torque converter attaching bolts.

   Tighten

   w Bolts to 62 Nwm (46 lb. ft.)
2. Flexplate shield attaching bolts.
   - Start engine and check for vibration. Repeat procedure until best possible balance is obtained.

HYDRA-MATIC 4T40-E SHIFT SPEED CHART

Upshift Speed Information

MODEL	1-2 SHIFT () /* 3 MPH)				2-3 SHIFT () /* 4 MPH)				3-4 SHIFT () /* 5 MPH)		
	10% TPS	25% TPS	50% TPS	100% TPS	10% TPS	25% TPS	50% TPS	100% TPS	10% TPS	25% TPS	50% TPS
WAR	8.0	12.5	20.0	28.5	16.0	25.0	39.0	54.0	26.0	36.0	57.0

Transaxle Usage and Downshift Speed Information

MODEL	SERIES	ENGINE		DOWNSHIFTS () /* 4 MPH)			TCC APPLY 4TH GEAR		TCC RELEASE 4TH GEAR	
		DISP.	RPO	4-3 COAST	3-2 COAST	2-1 COAST	10% TPS	25% TPS	10% TPS	25% TPS
WAR	DAEWOO	-	-	24	12.5	7	39	47	36	41

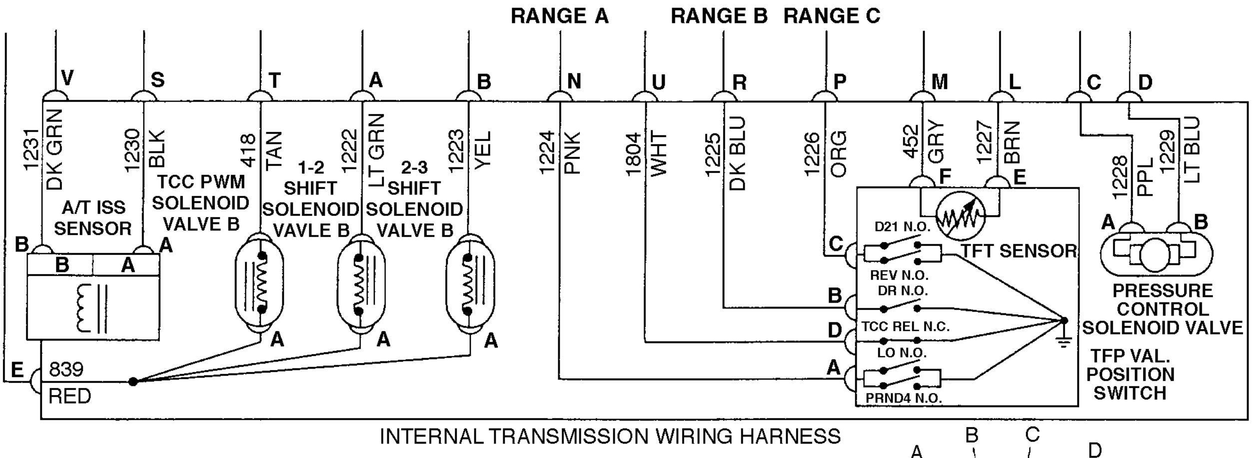
INTERNAL WIRING HARNESS CHECK

Step	Action	Value(s)	Yes	No
1	1. Install J 39775 Jumper Harness on the transmission 20-way connector, if needed. 2. Using J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance between terminals A and E: the 1-2 Shift Solenoid Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 3	Go to Step 2
2	1. Disconnect the internal transmission harness from the 1-2 Shift Solenoid Valve. 2. Using J 39200 DVOM, measure the resistance of the 1-2 Shift Solenoid Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
3	Measure the resistance between terminals B and E: the 2-3 Shift Solenoid Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 5	Go to Step 4
4	1. Disconnect the internal transmission harness from the 2-3 Shift Solenoid Valve. 2. Using J 39200 DVOM, measure the resistance of the 2-3 Shift Solenoid Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
5	Measure the resistance between terminals T and E: the TCC Sol. Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 7	Go to Step 6
6	1. Disconnect the internal transmission harness from the TCC Sol. Valve. 2. Using J 39200 DVOM, measure the resistance of the TCC Sol. Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
7	Measure the resistance between terminals C and D: the TCC Sol. Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 9	Go to Step 8

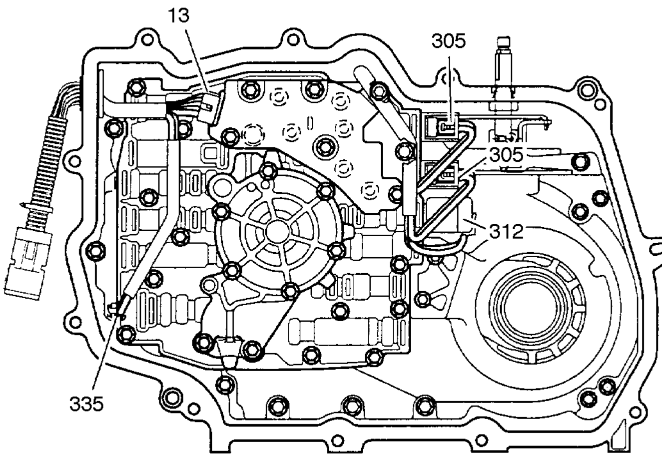
Internal Wiring Harness Check (Cont'd)

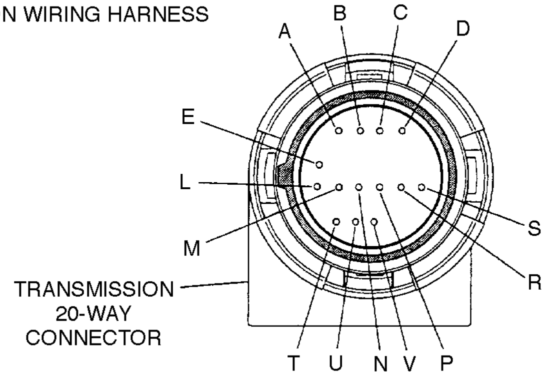
Step	Action	Value(s)	Yes	No
8	1. Disconnect the internal transmission harness from the Pressure Control Solenoid Valve. 2. Using J 39200 DVOM, measure the resistance of the Pressure Control Solenoid Valve. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
9	Measure the resistance between terminals S and V: the A/T ISS. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 11	Go to Step 10
10	1. Disconnect the internal transmission harness from the A/T ISS. 2. Using J 39200 DVOM, measure the resistance of the A/T ISS. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
11	Measure the resistance between terminals M and L: the TFT Sensor. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 13	Go to Step 12
12	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Using J 39200 DVOM, measure the resistance of the TFT Sensor by placing the meter leads between terminals E and F of the TFP Val. Position Sw. Is the resistance within the values shown?	Refer to Component Resistance Chart	Go to Step 14	Go to Step 16
13	Using J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance of the internal transmission harness from pins A, B, C, D, E, L, M, S, T, and V of the transmission 20-way connector to the transmission case. Is the resistance more than shown?	Refer to Component Resistance Chart	No problem found, exit table	Go to Step 15
14	Inspect for resistance: • Inspect the transmission wiring for poor electrical connections at the transmission 20-way connector and at the component connectors. • Look for possible bent, backed out, deformed, or damaged terminals. • Check for weak terminal tension. Was the condition found?	-	Verify repair and Go to Step 1	Go to Step 15
15	Replace the internal wiring harness. Is the replacement complete?	-	Verify repair and Go to Step 1	-
16	Replace the component. Is the replacement complete?	-	Verify repair and Go to Step 1	-

WIRING DIAGRAM



N.C. = NORMALLY CLOSED SWITCH
N.O. = NORMALLY OPEN SWITCH





CAVITY	FUNCTION
A	1-2 SHIFT SOLENOID VALVE
B	2-3 SHIFT SOLENOID VALVE
C	PRESSURE CONTROL SOLENOID (HIGH) VALVE
D	PRESSURE CONTROL SOLENOID (LOW) VALVE
E	BOTH SHIFT SOLENOIDS AND TCC SOLENOID VALVE
L	TRANSMISSION FLUID TEMPERATURE SENSOR (HIGH)
M	TRANSMISSION FLUID TEMPERATURE SENSOR (LOW)
N	RANGE SIGNAL "A"
P	RANGE SIGNAL "C"
R	RANGE SIGNAL "B"
S	INPUT (SHAFT) SPEED SENSOR (HIGH)
T	TCC SOLENOID VALVE
U	TCC RELEASE SWITCH
V	INPUT (SHAFT) SPEED SENSOR (LOW)

13 TFP VALVE POSITION SWITCH
305 SOLENOID, SHIFT (1-2 & 2-3)
312 SOLENOID, PRESSURE CONTROL
335 SOLENOID, TCC CONTROL

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4T40-E COMPONENT RESISTANCE CHART

Component	Pass Through Pins	Resistance 20°C (68°F) Ohms	Resistance 100°C (212°F) Ohms	Resistance to Ground (Case) Ohms
1-2 Shift Solenoid Valve	A, E	19-24W	24-31W	Greater than 250KW
2-3 Shift Solenoid Valve	B, E	19-24W	24-31W	Greater than 250KW
TCC Sol. Valve	T, E	10-11W	13-15W	Greater than 250KW
PC Sol. Valve	C, D	3-5W	4-7W	Greater than 250KW
Automatic Transmission Fluid Pressure Manual Valve Position Switch	Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Resistance Check			
*Transmission Fluid Temperature Sensor	M, L	3106-3923W	164-190W	Greater than 20MW
A/T ISS	S, V	615-700W	750-835W	Greater than 10MW
A/T OSS	A, B (OSS) CONN	1530-1650W	1700-1870W	Greater than 10MW
*NOTE: The resistance of this device is necessarily dependent on the temperature. Therefore the resistance will vary far more than any other device.				

AUTOMATIC TRANSMISSION FLUID PRESSURE MANUAL VALVE POSITION SWITCH RESISTANCE CHECK

Step	Action	Value(s)	Yes	No
1	1. Install J 39775 Jumper Harness on the transmission 20-way connector, if needed. 2. Using J 39200 DVOM and J 35616 Connector Test Adapter Kit, measure the resistance from terminal U and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 3	Go to Step 2
2	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal D and the TFP Val. Position Sw. housing. Is the resistance less than the value shown?	50W	Go to Step 15	Go to Step 17
3	Measure the resistance from terminal N and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 5	Go to Step 4
4	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal A and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
5	Measure the resistance from terminal R and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 7	Go to Step 6

Automatic Transmission Fluid Pressure Manual Valve Position Switch Resistance Check (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal B and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
7	Measure the resistance from terminal P and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 9	Go to Step 8
8	1. Disconnect the internal transmission harness from the TFP Val. Position Sw. 2. Measure the resistance from terminal C and the TFP Val. Position Sw. housing. Is the resistance more than the value shown?	50KW	Go to Step 15	Go to Step 17
9	1. Start the engine and let the engine idle. 2. Set the parking brake. 3. Place the gear selector in P (Park). 4. Measure the resistance from terminal U and the transmission case. Is the resistance more than the value shown?	50KW	Go to Step 10	Go to Step 17
10	1. Place the gear selector in R (Reverse). 2. Measure the resistance from terminal P and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 11	Go to Step 17
11	1. Place the gear selector in D4 (Drive). 2. Measure the resistance from terminal N and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 12	Go to Step 17
12	Measure the resistance from terminal R and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 13	Go to Step 17
13	1. Place the gear selector in D1 (Low). 2. Measure the resistance from terminal N and the transmission case. Is the resistance less than the value shown?	50W	Go to Step 14	Go to Step 17
14	Measure the resistance from terminal P and the transmission case. Is the resistance less than the value shown?	50W	No problem found; exit table	Go to Step 17
15	Inspect for high resistance: • Inspect the transmission wiring for poor electrical connections at the transmission 20-way connector and at the TFP Val. Position Sw. connector. • Look for possible bent, backed out, deformed, or damaged terminals. • Check for weak terminal tension. Was the condition found?	-	Verify repair and Go to Step 1	Go to Step 16
16	Replace the internal wiring harness. Is the replacement complete?	-	Verify repair and Go to Step 1	-
17	Replace the TFP Val. Position Sw. Is the replacement complete?	-	Verify repair and Go to Step 1	-

SYMPTOM DIAGNOSIS

HIGH OR LOW LINE PRESSURE

Condition	Inspect Component	For Cause
HIGH OR LOW LINE PRESSURE (Verify With Gauge) (All Shifts Harsh or Soft) Possible Codes: 712 Trans Fluid Temp Sensor Circuit - Low Input 713 Trans Fluid Temp Sensor Circuit - High Input 716 A/T Input Speed Sensor Circuit - Range/ Performance 717 A/T Input Speed Sensor Circuit - Malfunction 722 A/T OSS - Malfunction 723 A/T OSS - Intermittent/Erratic 727 Engine Speed Sensor Low 730 Undefined Gear Ratio 742 TCC Circuit Stuck ON 748 PCS Circuit - Malfunction 751 1-2 Shift Solenoid Performance Fault 756 2-3 Shift Solenoid Performance 1810 TFP Malfunction 1811 Max Adapt/Longshift 1887 TCC Release Switch Malfunction	Oil Level	• High or Low: correct as required.
	Pressure Regulator Valve (328) Springs (326, 327) Boost Valve (325)	• Stuck.
	Pressure Control Solenoid (312)	• Leak, O-rings damaged. • Loose connector, pins damaged. • Contaminated.
	Torque Signal Regulator Valve (309)	• Stuck.
	Transmission Wiring Harness (11)	• Loose connector at vehicle harness, short.
	Transmission Fluid Pressure Switch (13)	• Loose connector. • Damaged or missing O-ring.
	Throttle Position Sensor	• Damaged, sticking, disconnected. • Intermittent open or shorted circuit.
	Oil Filter (85)	• Clogged, broken, loose.
	Oil Filter Seal (84)	• Leaking.
	Cooler Lines	• Clogged or restricted.
	Cooler Line Seals (49)	• Leaking.
	Oil Pump (10)	• Damaged, sticking, porosity, leaking.
	Oil Pump Drive Shaft (19)	• Damaged.
	Pressure Relief Valve (214)	• Damaged sprimg, ball missing.
	Transaxle Case (1) Valve Body (18) Channel Plate (27)	• Porosity, leaking circuits. • Flatness of machined surfaces.

INACCURATE/INCONSISTENT SHIFT POINTS

Condition	Inspect Component	For Cause
INACCURATE / INCONSISTENT SHIFT POINTS Possible Codes: 716 A/T Input Speed Sensor Circuit - Range/Performance 717 A/T Input Speed Sensor Circuit - Malfunction 722 A/T OSS - Malfunction 723 A/T OSS - Intermittent/ Erratic 751 1-2 Shift Solenoid Performance Fault 756 2-3 Shift Solenoid Performance	Shift Solenoids (305)	• Contamination. • Intermittent open or shorted circuit.
	Throttle Position Sensor	• Damaged, disconnect. • Intermittent open or shorted circuit.
	Output Speed Sensor (62) Input Speed Sensor (46)	• Damaged, disconnected, loose. • Intermitten open or shorted circuit.

HARSH SHIFTS

Condition	Inspect Component	For Cause
HARSH SHIFTS (General)	Line Pressure	• High (See High Line Pressure).
	Checkballs (26)	• Missing, no orifice applied.
	Accumulators	• Springs or piston binding; no accumulation. • Accumulator valve stuck.
	Clutch Housing Retainer and Ball Assemblies	• Plugged.

NO REVERSE, SLIPS IN REVERSE

Condition	Inspect Component	For Cause
NO REVERSE, SLIPS IN REVERSE Possible Codes: 1810 TFP Malfunction with Input Speed Sensor	Reverse Clutch • Piston and Seal Assembly (457) • Inner Seal (456) • Clutch Plates (460-463) • Snap Ring (459, 464) • Housing • Housing Retainer and Ball Assembly • Springs (458)	• No apply/slipping. • Binding, cracked, leaking. • Orifice plugged. • Friction worn, splines broken. • Out of position. • Cracked, feed holes plugged, tangs broken. • Missing/out of position. • Binding.
	Reverse Clutch Fluid Routing • Driven Sprocket Support (95) • Channel Plate & Gasket, Valve Body, Gaskets and Channel Plate	• Fluid leak/restriction. • Seal rings leaking. • Porosity, damaged, misaligned. • Porosity, fluid leak across channels, misaligned, damaged, fluid restriction.
	Lo & Reverse Band and Servo • Servo Piston (69) • Servo Piston Seals (71, 72) • Servo Pin (67) and Springs (66, 68) • Servo Cover (73) • Lo & Reverse Band (111) • Anchor Pin (64) • Fluid Feed Tubes (83) • Transaxle Case (1)	• No apply/slipping. • Broken, binding. • Leaking. • Binding. • Broken, loose, leaking. • Broken, worn, out of position. • Broken. • Broken, bent, plugged, seal rings missing/leaking. • Porosity, fluid leak or restriction.
	Shift Linkage	• Disconnected, misaligned.
	Manual Valve (800) Link (802)	• Disconnected, misaligned.
	#1 Checkball (LO/PRN)	• Missing (No LO Band Fluid).
	Fluid Level	• Low.
	Fluid Pressure	• Low (See Low Fluid Pressure).

NO FIRST GEAR, SLIPS IN FIRST GEAR

Condition	Inspect Component	For Cause
NO FIRST GEAR, SLIPS IN FIRST GEAR Possible Codes: 716 A/T Input Speed Sensor Circuit - Range/Performance 717 A/T Input Speed Sensor Circuit - Malfunction 722 A/T OSS - Malfunction 723 A/T OSS Circuit-Intermittent/Erratic 730 Undefined Gear Ratio 751 1-2 Shift Solenoid Performance Fault 756 2-3 Shift Solenoid Performance 1810 PSA Malfunction with Input Speed Sensor	Forward Clutch • Piston and Seal Assembly (607) • Inner Seal (608) • Clutch Plates (601-604) • Snap Ring (600, 605) • Housing (609) • Housing Retainer and Ball Assembly • Springs (606)	• No apply/slipping. • Binding, cracked, leaking. • Orifice plugged. • Splines, broken, friction worn. • Out of position. • Cracked, feed holes plugged. • Missing, out of position. • Binding.
	Input Sprag (515)	• Damaged, not holding.
	LO Roller Clutch (652)	• Damaged, not holding.
	Forward Clutch Fluid Routing • Oil Feed Tubes (83) • Forward Clutch Support (114) • Channel Plate (27) and Gasket (28) • TFP (13)	• Fluid leak or restriction. • Bent, broken, seal rings leaking, plugged. • Porosity, seal rings leaking, damaged, feed holes plugged. • Porosity, misaligned, fluid leak across channels or restriction. • Drive switch O-ring leaking.
	1-2 Shift Solenoid (305)	• Failed OFF, leaking.
	1-2 Shift Valve (302)	• Stuck in upshifted position.
	2-3 Shift Solenoid (305)	• Failed ON, exhaust plugged.
	Manual Valve (800)/Shift Linkage	• Misaligned.
	Torque Converter (55)	• Stator roller clutch not holding.
	Line Pressure	• Low (See Low Line Pressure).

NO SECOND GEAR, SLIPS IN SECOND GEAR

Condition	Inspect Component	For Cause
NO SECOND GEAR, SLIPS IN SECOND GEAR Possible Codes: 730 Undefined Gear Ratio 751 1-2 Shift Solenoid Performance	2nd Clutch • Piston and Seal Assembly (404) • Clutch Plates (96-99) • Snap Ring (406) • Springs (405) • Driven Sprocket Support (95)	• No apply/slipping. • Binding, cracked, leaking. • Friction worn, splines broken. • Out of position. • Binding. • Damaged, leaking, porosity.
	2nd Clutch Fluid Routing	• Fluid leak or restriction.
	Valve Body Gaskets & Spacer Plate Channel Plate & Gasket Driven Sprocket Support	• Porosity, misaligned, loose, restriction, fluid leak across channels.
	2nd Roller Clutch (452)	• Damaged, not holding.
	1-2 Shift Solenoid (305)	• Stuck ON, plugged.
	Forward Clutch	• Low capacity shows up in 2nd gear.
	Line Pressure	• Low (See Low Line Pressure).

No Second Gear, Slips in Second Gear (Cont'd)

Condition	Inspect Component	For Cause
NO SECOND GEAR, SLIPS IN SECOND GEAR (Continued)	1-2 Accumulator (29-31)	• Leak at piston seal. • Channel plate/case porosity.
	1-2 Accumulator Valve (323)	• Stuck.
	2-3 Shift Valve (306)	• Stuck in upshifted position.
	TFP (13)	• Malfunction (Electrical or Hydraulic)

NO THIRD GEAR, SLIPS IN THIRD GEAR

Condition	Inspect Component	For Cause
NO THIRD GEAR, SLIPS IN THIRD GEAR Possible Codes: 756 2-3 Shift Solenoid Performance 1871 Undefined Gear Ratio	Direct Clutch • Piston and Seal Assembly (518) • Clutch Plates (521-523) • Snap Ring (520) • Springs (519) • Direct & Coast Housing and Input Shaft (520) • Housing Retainer and Ball Assembly	• No apply/slipping. • Binding, cracked, leaking. • Friction worn, splines broken. • Out of position. • Binding. • Damaged, cracked, feed holes restricted. • Missing, loose.
	Direct Clutch Fluid Routing • Valve Body Gaskets & Spacer Plate Channel Plate & Gasket Driven Sprocket Support • Driven Sprocket Support Seals • Input Shaft	• Porosity, misaligned, loose, fluid restriction, fluid leak across channels. • Leaking. • Seals leaking. • Sleeve damaged, misaligned.
	2-3 Shift Solenoid (305)	• Stuck OFF, leaking.
	2-3 Accumulator	• Leak at piston seal. • Channel plate/case porosity.
	2-3 Accumulator Valve (330)	• Stuck.
	Line Pressure	• Low (See Low Line Pressure).
	3-4 Shift Valve (319)	• Stuck in upshifted position.
	TFP (13)	• Malfunction (Electrical or Hydraulic).

SECOND GEAR ONLY

Condition	Inspect Component	For Cause
SECOND GEAR ONLY	1-2 Shift Valve (302)	• Stuck in downshifted position.

NO FOURTH GEAR, SLIPS IN FOURTH GEAR

Condition	Inspect Component	For Cause
NO FOURTH GEAR, SLIPS IN FOURTH GEAR Possible Codes: 751 1-2 Shift Solenoid Performance Fault 1871 Undefined Gear Ratio	Intermediate/4th Band & Servo • Servo Piston (77) • Servo Piston Seals (78, 79) • Servo Pin (76) Springs (75, 68) • Servo Cover (80) • Band (100) • Case (1)	• No apply/slipping. • Broken, binding. • Leaking. • Binding. • Broken, loose, leaking. • Broken, worn, out of position. • Cracket at band seat.
	Band Apply Fluid Routing • Valve Body Gaskets & Spacer Plate Channel Plate; Gasket	• Porosity, misaligned, loose, fluid restriction, fluid leak across channels.
	1-2 Shift Solenoid (305)	• Stuck OFF, leaking.
	3-4 Shift Valve (319)	• Stuck in downshifted position.
	Manual Valve (800)	• Misaligned (in Manual Third).
	3-4 Accumulator	• Leak at piston seal. • Channel plate/case porosity.
	3-4 Accumulator Valve (323)	• Stuck.
	Line Pressure	• Low (See Low Line Pressure).
	Direct Clutch	• Low capacity will cause failure in Fourth gear.
	TFP (13)	• Malfunction (Electrical or Hydraulic).

LOSS OF DRIVE

Condition	Inspect Component	For Cause
LOSS OF DRIVE	Torque Converter (55)	• Broken lugs, failed lug weld. • Sheared lug bolts. • Worn turbine shaft splines. • Internal failure. • Cracked cover at weld.
	Axles	• Damaged, splines worn, loose.
	Turbine Shaft (39)	• Stripped splines.
	Oil Pump (10)	• Seized, broken pump gears.
	Oil Pump Shaft (19)	• Broken, stripped splines.
	Filter and Filter Seal (85, 84)	• Plugged, missing.
	Fluid Level	• Low.
	Shift Linkage	• Disconnected.
	Drive/Driven Sprockets and Drive Chain (36, 37, 91)	• Broken.
	Planetary Gears	• Failure, lack of lube.
	Final Drive	• Gear failure, lack of lube.

Loss of Drive (Cont'd)

Condition	Inspect Component	For Cause
LOSS OF DRIVE (Continued)	Channel Plate and Gasket (28)	• Damaged, leaking, misaligned.
	Valve Body Gaskets and Spacer Plate	• Damaged, leaking, misaligned.
	Forward Sprag Clutch Forward Clutch LO Roller Clutch	• Damaged, not holding. (See No First Gear)
	Hydraulic System	• Tie up, fluid circuit leaks.

LOSS OF POWER

Condition	Inspect Component	For Cause
LOSS OF POWER Possible Codes: 751 1-2 Shift Solenoid Performance Fault 756 2-3 Shift Solenoid Performance	Fluid Level	• Low.
	Shift Solenoids (305)	• Failed OFF, 2nd gear start. • 2-3 Shift Solenoid, failed ON.
	TCC System	• TCC stuck ON or dragging.
	Torque Converter (55)	• Contaminated, damaged.

ENGINE STALL

Condition	Inspect Component	For Cause
ENGINE STALL Possible Codes: 742 TCC Circuit Stuck ON	TCC System • TCC Solenoid (335) • TCC-Regulated Apply Valve (339)	• TCC stuck ON or dragging. • Stuck ON, solenoid exhaust plugged. • Stuck in apply position.

FIRST AND SECOND GEARS ONLY

Condition	Inspect Component	For Cause
1ST AND 2ND GEARS ONLY Possible Codes: 756 2-3 Shift Solenoid Performance	2-3 Shift Solenoid (305)	• Stuck OFF, solenoid leaking, electrical.
	2-3 Shift Valve (307)	• Stuck in downshifted position.
	Direct Clutch	• Failed clutch (released).

THIRD AND FOURTH GEARS ONLY

Condition	Inspect Component	For Cause
3RD AND 4TH GEARS ONLY Possible Codes: 756 2-3 Shift Solenoid Performance	2-3 Shift Solenoid (305)	• Stuck ON, solenoid plugged, electrical.
	1-2 and 2-3 Shift Valves	• Both stuck in upshifted position.

FIRST AND FOURTH GEARS ONLY

Condition	Inspect Component	For Cause
1ST AND 4TH GEARS ONLY Possible Codes: 751 1-2 Shift Solenoid Performance Fault	1-2 Shift Solenoid (305)	• Stuck ON, electrical, solenoid plugged.

SECOND AND THIRD GEARS ONLY

Condition	Inspect Component	For Cause
2ND AND 3RD GEARS ONLY Possible Codes: 751 1-2 Shift Solenoid Performance Fault	1-2 Shift Solenoid (305)	• Stuck OFF, electrical, solenoid leaking.

NO PARK

Condition	Inspect Component	For Cause
NO PARK	Parking Lock Actuator Assembly (807)	• Rod bent or damaged. • Spring binding or broken. • Rod not attached to detent lever.
	Detent Roller and Spring (804)	• Bolt not torqued, loose. • Bent, damaged.
	Detent Lever (806)	• Damaged, loose (manual shift pin missing).
	Manual Valve (800)	• Misaligned, manual valve to detent lever link bent.
	Park Lock Gear (659)	• Damaged teeth, splines damaged.
	Parking Lock Pawl (663)	• Damaged, tooth broken.
	Park Pawl Spring (662)	• Broken, missing.
	Shift Linkage	• Misadjusted.

RATCHETING NOISE

Condition	Inspect Component	For Cause
RATCHETING NOISE	Parking Pawl (663)	• Return spring damaged, weak or misassembled.

NO ENGINE BRAKING; ALL MANUAL RANGES

Condition	Inspect Component	For Cause
NO ENGINE COMPRESSION BRAKING: ALL MANUAL RANGES	Coast Clutch • Piston and Seal Assembly (504) • Clutch Plates (508, 509) • Springs (505) • Direct & Coast Clutch Housing and Input Shaft (502) • Housing Retainer and Ball Assembly	• No apply/slipping. • Binding, cracked, leaking. • Friction worn, splines broken. • Binding. • Damaged, cracked, fluid feed holes restricted. • Missing, loose.
	Coast Clutch Fluid Routing • Valve Body Gaskets and Spacer Plate Channel Plate & Gasket Driven Sprocket Support • Driven Sprocket Support Seals • Input Shaft (502)	• Porosity, misaligned, loose, fluid restriction, fluid leak across channels. • Leaking. • Seals leaking. • Sleeve damaged, misaligned.
	Oil Level/Line Pressure	• Low (See Low Line Pressure).
	3-4 Shift Valve (319)	• Stuck in 4th gear position. (No coast clutch apply).
	Manual Valve/Shift Linkage (800)	• Misaligned.

NO ENGINE BRAKING; MANUAL SECOND – SECOND GEAR

Condition	Inspect Component	For Cause
NO ENGINE COMPRESSION BRAKING: MANUAL SECOND - SECOND GEAR Possible Codes: 1810 TFP Malfunction	Coast Clutch	• No apply/slipping. (See No Engine Compression Braking: All Ranges).
	Intermediate/4th Band (100)	• No apply/slipping (See No 4th Gear: Intermediate/4th Band - No apply).
	TFP (13)	• Leaking, inoperative.
	A/T OSS (62)	• Reads 0 mph.

NO ENGINE BRAKING; MANUAL FIRST – FIRST GEAR

Condition	Inspect Component	For Cause
NO ENGINE COMPRESSION BRAKING: MANUAL FIRST - FIRST GEAR Possible Codes: 1810 TFP Malfunction	Coast Clutch	• No apply/slipping. (See No Engine Compression Braking: All Ranges).
	LO & Reverse Servo	• No apply/slipping (See No Reverse: LO & Reverse Band - No apply/slipping).
	TFP (13)	• Leaking, inoperative.
	#1 Checkball (LO/PRN)	• Missing.

DRIVES IN NEUTRAL

Condition	Inspect Component	For Cause
DRIVES IN NEUTRAL	Forward Clutch (Drives Forward)	• Not releasing.
	Reverse Clutch LO & Reverse Servo (Drives in Reverse)	• Both not releasing. • Misaligned.

NO GEAR SELECTION

Condition	Inspect Component	For Cause
NO GEAR SELECTIONS	Manual Valve to Detent Lever Link (802)	• Broken, missing. • Disconnected from manual valve.
	Manual Valve to Link Clip (801)	• Disconnected.
	Manual Valve (800)	• Stuck.
	Shift Linkage	• Disconnected.
	Valve Body Channel Plate and Case	• Blocked fluid channels.

SHIFT INDICATOR INDICATES WRONG GEAR SELECTION

Condition	Inspect Component	For Cause
SHIFT INDICATOR INDICATES WRONG GEAR SELECTION	Indicator Linkage	• Misadjusted.
	Detent Spring and Roller Assembly (804)	• Broken, missing. • Bolt loose.
	Manual Valve	• Not connected to detent lever.

FLUID LEAKS

Condition	Inspect Component	For Cause
FLUID LEAKS	Refer to Fluid Leak Diagnosis in this section.	

FLUID FOAMING

Condition	Inspect Component	For Cause
FLUID FOAMING	Fluid	• Degraded fluid. • Contaminate (Antifreeze). • Transaxle overfilled.
	Cooler Lines	• Plugged.
	Transaxle Oil Filter (85)	• Clogged. • Cracked.
	Filter Seal (84)	• Leaking.
	Side Cover Seal (6)	• Damaged.
	Engine	• Overheated.
	Vehicle	• Overloaded.
	Oil Level Control Valve (86)	• Damaged, loose.

VIBRATION

Condition	Inspect Component	For Cause
VIBRATION	Torque Converter (55)	• Out of balance. • Internal failure.
	Transaxle/Engine	• Misaligned.
	Output (94)/Stub Shafts (58)	• Out of balance. • Bushings worn or damaged.
	Turbine Shaft (39)	• Worn bushings. • Out of balance.

NOISE

Condition	Inspect Component	For Cause
NOISE - In All Ranges or a WHINE which may be rpm or load sensitive or ceases when TCC engages.	Torque Converter (55)	• Verify noise internal to torque converter by placing left foot on brake with gear or selector in Drive and momentarily stall engine. Torque converter noise increases under load.
A high pitch WHINE which will intensify with engine rpm or is oil pressure sensitive.	Oil Pump System	• Verify noise internal to oil pump during preliminary oil pressure check. An increase in line pressure will vary an oil pump noise.
A popping noise similar to popcorn popping.	Oil Pump System	• Pump cavitation - indicated by bubbles in fluid. • Transaxle fluid filter for seam leak. • Transaxle fluid filter seal for proper positioning or cut seal,
A BUZZ or high frequency rattle sound.	Trace cooler pipes and check for binding or contact at the radiator other than the cooler pipe connectors.	• Verify pressure buzz by watching for a needle vibration on the pressure gauge. (Road test may be necessary.)
A WHINE or GROWL that increases and fades with vehicle speed and is most noticeable under light acceleration.	Drive Link Assembly System Verify noise from sprockets and/or drive link assembly (chain) by placing left foot on brake and moving gear selector from P (Park) or R (Reverse). If noise stops check items below:	
	Drive Chain (36)	• Stretched.
	Drive Sprocket (37) Driven Sprocket (91)	• Teeth broken or sheared. • Bearing surfaces nicked or scored. • Bearing race or roller bearing surfaces on gear support inner bearing rough or pitted. • Bearing damage.
	Drive Sprocket Support (43) Driven Sprocket Support (95)	• Bearing outer race support rough or nicked.

Noise (Cont'd)

Condition	Inspect Component	For Cause
NOISE - (Continued)		
A final drive noise or HUM, is most noticeable under light throttle acceleration and/or turns.	Final Drive Gear Set (116) Final Drive Internal Gear (118)	• Worn, planet pinions or washers. • Worn, tooth damage.
	Differential Carrier (116) Differential Side Gears (709)	• Gears worn or pitted. • Thrust washer damage.
Noise in 1st, 2nd, 3rd or 4th.	Final Drive Sun Gear (115)	• Gear worn or damage.
	Final Drive Pinions (707)	• Gears worn or damaged.
Noise only in certain gear ranges.	Check Range Reference Chart. Determine power flow and applicable components that may be causing noise.	

NO TCC/SLIPPING/SOFT APPLY

Condition	Inspect Component	For Cause
NO TCC/SLIPPING/SOFT APPLY Possible Codes: 703 Brake Switch Malfunction 712 Trans Fluid Temp Sensor Circuit - Low Input 713 Trans Fluid Temp Sensor Circuit - High Input 716 A/T Input Speed Sensor Circuit - Range/Performance 717 A/T Input Speed Sensor Circuit - Malfunction 722 A/T OSS - Malfunction 723 A/T OSS - Intermittent/Erratic 726 Engine Speed Sensor Circuit - Intermittent 727 Engine Speed Sensor Low 742 TCC Circuit Stuck ON 751 1-2 Shift Solenoid Performance 756 2-3 Shift Solenoid Performance 1810 TFP Malfunction 1812 Trans Fluid Overtemp 1887 TCC Release Switch Malfunction	TCC Solenoid (335)	• Stuck OFF. • O-ring leaking. • No voltage to solenoid. • Poor electrical connection.
	Wiring Harness (11)	• Pinched wire (electrical short). • Damaged electrical connector.
	TCM	• No signal to solenoid.
	Brake Switch	• Not functioning (open).
	Pressure Regulator Valve	• Stuck.
	Torque Converter (55)	• Internal failure.
	TCC Fluid Circuits	• Leaks (Refer to Oil Flow Diagrams). • Plugged release exhaust orifice.
	TCC-Regulated APply Valve (339) TCC Control Valve (334)	• Stuck in TCC release position.
	TCC Feed Limit Valve	• Stuck.
	Fluid Level or Pressure	• Low.
	Cooler Lines	• Plugged.

NO TCC RELEASE

Condition	Inspect Component	For Cause
NO TCC RELEASE	TCC Solenoid (335)	• Internal failure. • Fluid exhaust plugged. • External ground.
	Torque Converter (55)	• Internal failure.
	TCC-Regulated Apply Valve (339) TCC Control Valve (334)	• Stuck in TCC apply position.

TCC APPLY WITH COLD ENGINE

Condition	Inspect Component	For Cause
TCC APPLY WITH COLD ENGINE	Engine Coolant Temp Sensor	• Malfunction.

TCC SHUDDER

Condition	Inspect Component	For Cause
TCC SHUDDER	Refer to TCC Shudder Diagnosis in this section.	

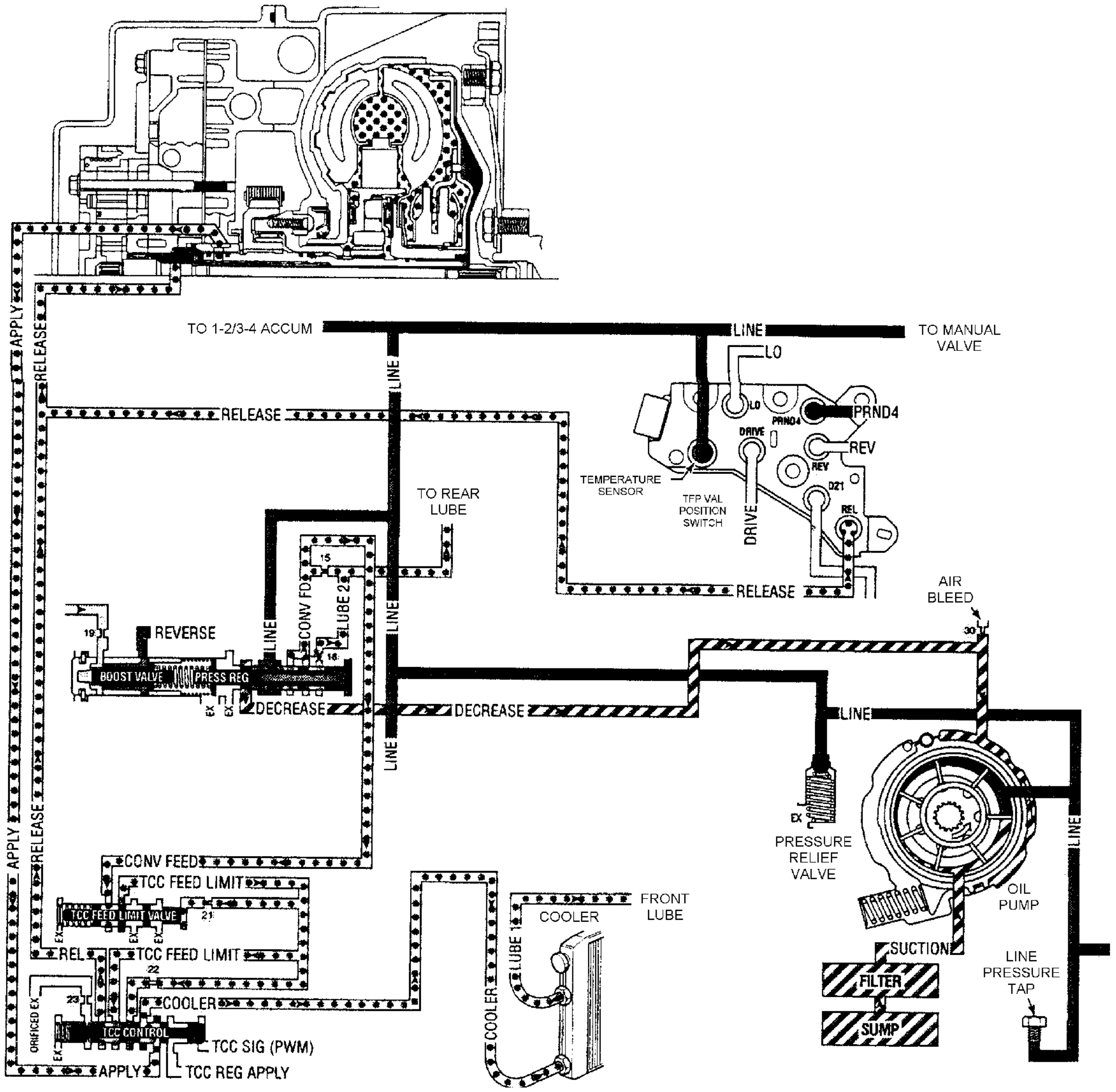
DIAGNOSTIC TROUBLE CODE DIAGNOSIS

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description	Power Lamp	Default Action
P0218	Transmission Fluid Overtemperature	Off	• DTC P0218 will be stored in TCM memory. • Freeze shift adapts.
P0711	Transmission Fluid Temperature Sensor Circuit Range/Performance	Flashing	• DTC P0711 will be stored in TCM memory. • Freeze shift adapts. • Transmission default temperature calculated based on engine coolant temperature, manifold air temperature, and engine run time.
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	Off	• DTC P0712 will be stored in TCM memory. • Freeze shift adapts. • Transmission default temperature calculated based on engine coolant temperature, manifold air temperature, and engine run time.
P0713	Transmission Fluid Temperature Sensor Circuit High Input	Off	• DTC P0713 will be stored in TCM memory. • Freeze shift adapts. • Transmission default temperature calculated based on engine coolant temperature, manifold air temperature, and engine run time.
P0716	Automatic Transmission Input Speed Sensor Circuit Range/Performance	Flashing	• DTC P0716 will be stored in TCM memory. • Inhibit TCC engagement. • Freeze shift adapts. • Maximum line pressure.
P0717	Automatic Transmission Input Speed Sensor Circuit No Signal	Flashing	• DTC P0717 will be stored in TCM memory. • Inhibit TCC engagement. • Freeze shift adapts. • Maximum line pressure.
P0719	Brake Switch Circuit Low	Off	• DTC P0719 will be stored in TCM memory.
P0722	Automatic Transmission Output Speed Sensor (A/T OSS) Low Input	Flashing	• DTC P0722 will be stored in TCM memory. • Freeze shift adapts. • Maximum line pressure. • Output speed calculated from input speed, engine speed, and commanded gear.
P0723	Automatic Transmission Output Speed Sensor (A/T OSS) Intermittent	Flashing	• DTC P0723 will be stored in TCM memory. • Freeze shift adapts. • Commands maximum line pressure. • Output speed calculated from input speed, engine speed, and commanded gear.
P0724	Brake Switch Circuit High	Off	• DTC P0724 will be stored in TCM memory.
P0726	Engine Speed Sensor Circuit Intermittent	Flashing	• DTC P0726 will be stored in TCM memory. • Inhibit TCC engagement. • Freeze shift adapts.
P0727	Engine Speed Sensor Circuit Low Input	Flashing	• DTC P0727 will be stored in TCM memory. • Inhibit TCC engagement. • Freeze shift adapts. • Maximum line pressure.

Diagnostic Trouble Code (DTC) Identification (Cont'd)

DTC	Description	Power Lamp	Default Action
P0730	Incorrect Gear Ratio	Off	• DTC P0730 will be stored in TCM memory. • Maximum line pressure. • Freeze shift adapts.
P0741	Torque Converter Clutch Circuit Stuck Off	Flashing	• DTC P0741 will be stored in TCM memory. • Freeze shift adapts. • Inhibit TCC engagement.
P0742	Torque Converter Clutch Circuit Stuck On	Flashing	• DTC P0742 will be stored in TCM memory. • Freeze shift adapts. • TCC commanded for 1-2, 2-3 and 3-4 shifts.
P0748	Pressure Control Solenoid Circuit Electrical	Off	• DTC P0748 will be stored in TCM memory. • Freeze shift adapts. • Maximum line pressure.
P0751	1-2 Shift Solenoid Performance	Flashing	• DTC P0751 will be stored in TCM memory. • Freeze shift adapts. • Inhibit TCC engagement. • Maximum line pressure. • Commands soft landing to 2nd gear.
P0756	2-3 Shift Solenoid Performance	Flashing	• DTC P0756 will be stored in TCM memory. • Freeze shift adapts. • Inhibit TCC engagement. • Maximum line pressure. • Immediate landing to 2nd gear.
P1810	Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) Malfunction	Flashing	• DTC P1810 will be stored in TCM memory. • Freeze shift adapts. • Assume D4 shift pattern. • Inhibit TCC engagement. • Assume D2 braking pressure.
P1811	Maximum Adapt and Long Shift	Off	• DTC P1811 will be stored in TCM memory. • Maximum line pressure. • Freeze shift adapts.
P1814	Torque Converter Overstress	Off	• DTC P1814 will be stored in TCM memory.
P1887	TCC Release Switch Circuit Malfunction	Flashing	• DTC P1887 will be stored in TCM memory. • Freeze shift adapts. • Inhibit TCC engagement.



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DIAGNOSTIC TROUBLE CODE (DTC) P0218 TRANSMISSION FLUID OVERTEMPERATURE

Circuit Description

The transmission fluid pump is constantly circulating fluid through the torque converter. Hot fluid leaving the converter flows through the transmission cooler lines to the oil cooler located in the vehicle radiator. From the cooler, fluid returns to the transmission.

Lube 1 fluid flows through the input shaft to lubricate transmission components in the front of the transmission. Lube 2 fluid circuit is fed by line pressure at the pressure regulator valve. This fluid flows through the oil feed pipes and into the forward clutch support. Lube 2 fluid provides lubrication to the rear components of the transmission.

When the TCM detects a high transmission fluid temperature for a long period of time, then DTC P0218 sets.

Conditions For Setting The DTC

- Transmission temperature is greater than 130°C (260°F) for 15 minutes.
- No TFT Sensor DTC(s) P0711, P0712 or P0713.

Action Taken When The DTC Sets

- TCM will NOT flash the Power Lamp.
- Freeze shift adapts from being updated.
- DTC P0218 will be stored in TCM memory.

Conditions For Clearing The DTC

- Transmission temperature is less than or equal to 129°C (260°F) for five seconds.
- History DTC(s) can be cleared by using a Scan Tool.
- Check the transmission cooling system.
- Question the owner for the possibility of vehicle overloading, exceeding trailer towing limits or towing in overdrive.

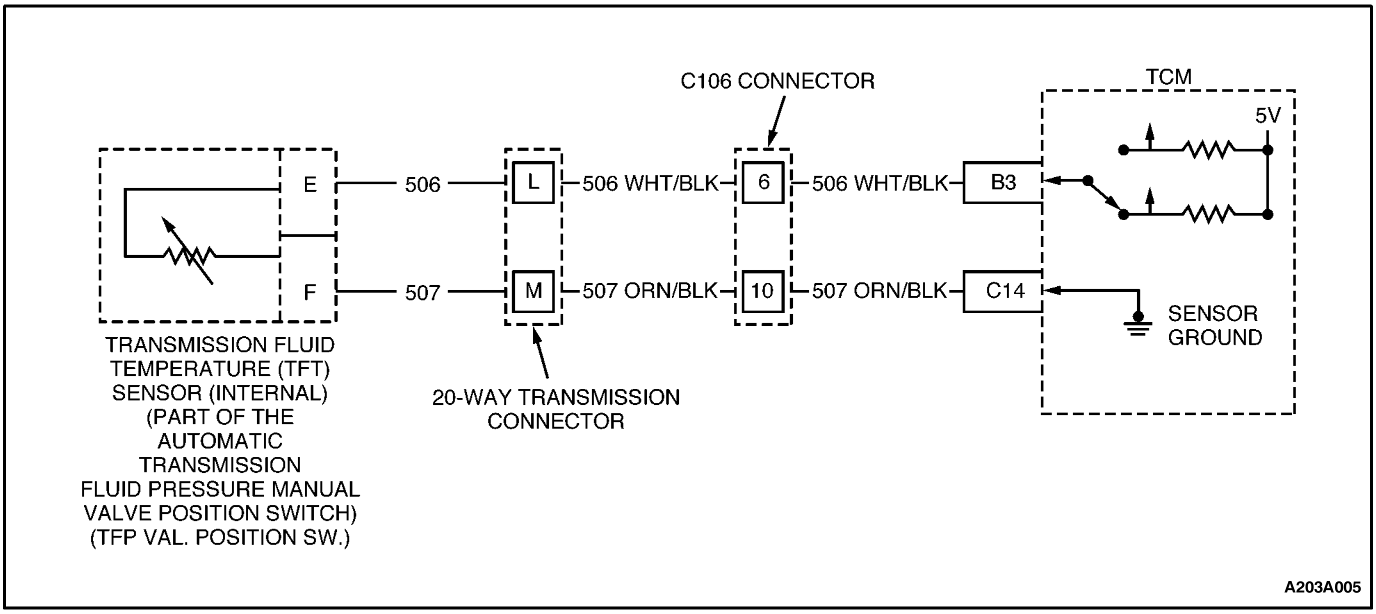
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This step checks for possible low fluid level causing high transmission fluid temperatures.
2. This step checks for possible transmission cooling restrictions.
5. This step checks for possible torque converter failure.

DTC P0218 – Transmission Fluid Overtemperature

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). Has the transmission fluid checking procedure been performed? Refer to Transmission Fluid Checking Procedure.	-	Go to Step 2	Go to Fluid Checking Procedure
2	Inspect the engine and transmission cooling system for air flow restrictions or blockage, debris, or damaged cooler lines. Was the problem found and corrected?	-	Go to Step 6	Go to Step 3
3	Check the valve body for a stuck or leaking pressure regulator (PR) valve. Was the problem found and corrected?	-	Go to Step 6	Go to Step 4
4	Inspect the oil feed tubes for restrictions or leaking seals. Was the problem found and corrected?	-	Go to Step 6	Go to Step 5
5	Check for torque converter stator damage. Refer to Torque Converter Diagnosis. Was the problem found and corrected?	-	Go to Step 6	-
6	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0711 TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CIRCUIT RANGE/PERFORMANCE

Circuit Description

The Automatic Transmission Fluid Temperature (TFT) sensor assembly is a thermistor and is part of the Automatic Transmission Fluid Pressure Manual Valve Position Switch Assembly (TFP Val. Position Sw.). The Transmission Control Module (TCM) supplies a 5-volt reference signal to the sensor on circuit 506. When transmission fluid is cold, the sensor resistance is high and the TCM senses a high signal voltage. As the transmission fluid warms, the sensor resistance lowers and the TCM senses lower voltage. The TCM uses the TFT readings to control Torque Converter Clutch (TCC) line pressure adjustments, and temperature compensated shifts.

When the TCM detects one of the following unusual conditions, then DTC P0711 sets.

1. An unrealistically large change in transmission temperature.
2. A value which remains constant for a period of time in which a measurable amount of change is expected.

Conditions For Setting The DTC

- Engine is running.
- System voltage is between 9-16 volts.
- No VSS codes P0722 or P0723.
- No ISS codes P0716 or P0717.
- Vehicle speed is greater than 8 km/h (5 mph) for 409 seconds, cumulative.
- Transmission start up temperature is between * 40° and 21°C (* 40° and 69.8°F).
- TCC slip speed is greater than 300 rpm for 409 seconds, cumulative.
- Engine Coolant Temperature is greater than 70°C (158°F).
- Engine Coolant Temperature has changed by more than 50° since start up.
- All of the above must be true and one of the following fail cases must be true:

Fail Case 1

- Transmission temperature has not changed more than 1.5°C (2°F) since start-up.

Fail Case 2

- Transmission temperature changes more than 20°C (36°F) within 200 milliseconds.

Action Taken When The DTC Sets

- The TCM will flash the Power Lamp after two consecutive ignition cycles with a failure reported.
- DTC P0711 is stored in the TCM history.
- The TCM freezes shift adapts from being updated.
- The TCM calculates transmission temperature based on engine coolant temperature, intake manifold air temperature and engine run time.

Conditions For Clearing The DTC

Fail Case 1

- The TFT changes by more than 2.25 degrees for at least 5 seconds.

Fail Case 2

- The TFT does not change by more than 20 degrees within 0.200 second for a period of at least 11 seconds.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wire that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

5. This step checks for an intermittent short or open condition in the engine wiring harness. The test light is used as a resistor in the circuit.
6. This step determines if the TCM or the TFT sensor is causing a steady, unchanging TFT reading.

DTC P0711 – Transmission Fluid Temperature (TFT) Sensor Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Perform the transmission fluid checking procedure. Refer to Transmission Fluid Checking Procedure. Did you perform the fluid checking procedure?	-	Go to Step 2	Go to Transmission Fluid Checking Procedure
2	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the ON position. 3. Record then clear DTC(s). 4. Select TFT on the scan tool. 5. Drive the vehicle and observe the scan tool for either of the following conditions: • The TFT does not change more than 1.5°C (2.7°F) in 80 seconds since start-up. • The TFT changes more than 20°C (36°F) in 0.200 seconds 14 times within 7 seconds (unrealistic change). Did either of the fail conditions occur?	-	Go to Step 3	Go to Diagnostic Aids
3	Did the scan tool display a condition in which the TFT does not change by more than the specified value in 80 seconds since start-up?	1.5°C (2.7°F)	Go to Step 5	Go to Step 4
4	1. Turn the engine OFF. 2 Disconnect the transmission 20-way connector. 3. Install the J 39775 Jumper Harness on the engine side of the 20-way connector. 4. Using the J 35616 Connector Test Adapter Kit, connect a test light from terminal L to terminal M. 5. Turn the ignition switch to the ON position. 6. While observing the scan tool display, move or massage the engine wiring harness from the TCM connectors to the transmission 20-way connector. Does the TFT change by more than the specified value?	20°C (36°F)	Go to Step 6	Go to Step 7
5	1. Turn the ignition OFF. 2 Disconnect the transmission 20-way connector. 3. Turn the ignition switch to the ON position. Did the scan tool display a condition in which the TFT does not change by more than the specified value in 80 seconds since start-up?	1.5°C (2.7°F)	Go to Step 10	Go to Step 9

DTC P0711 – Transmission Fluid Temperature (TFT) Sensor Circuit Range/Performance (Cont'd)

Step	Action	Value(s)	Yes	No
6	Inspect circuits 506 and 507 of the engine wiring harness for an intermittent open or short condition. Repair the circuits if necessary. Was a problem found?	-	Go to Step 11	Go to Step 10
7	Inspect the automatic transmission wiring harness for an intermittent short to ground or a short together on circuits 506 or 507. Was a problem found?	-	Go to Step 8	Go to Step 9
8	Replace the automatic transmission wiring harness. Is the replacement complete?	-	Go to Step 11	-
9	Replace the TFT sensor (this is part of the TFP Valve Position Switch). Is the replacement complete?	-	Go to Step 11	-
10	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 11	-
11	1. After the repair, use a scan tool "Clear Info" function and road test the vehicle. 2 Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

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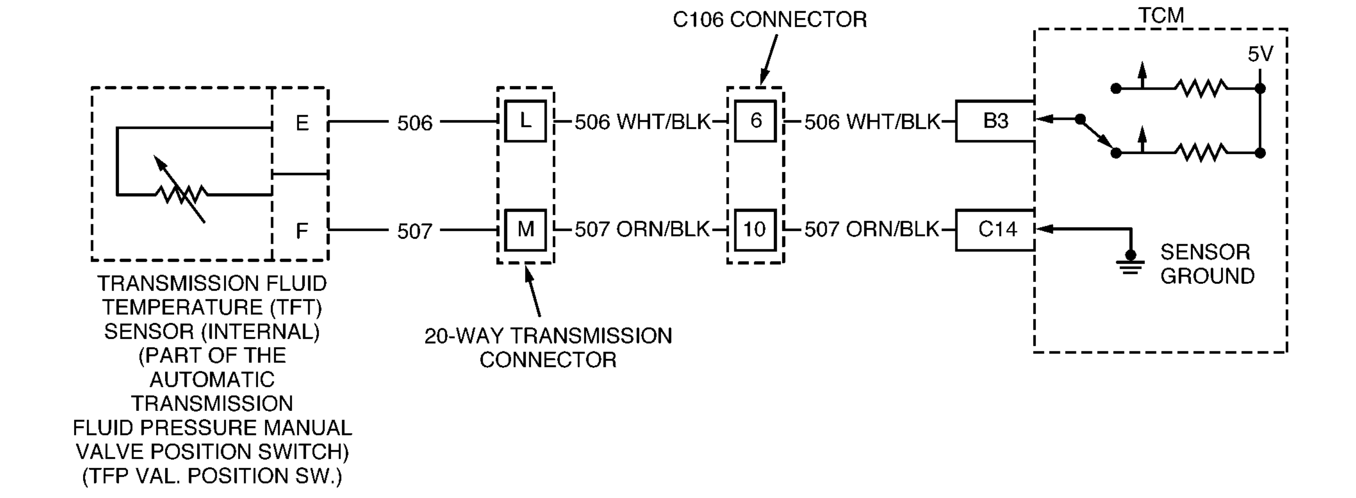

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DIAGNOSTIC TROUBLE CODE (DTC) P0712 TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CIRCUIT LOW INPUT

Circuit Description

The Automatic Transmission Fluid Temperature (TFT) sensor assembly is a thermistor and is part of the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.). The TCM supplies a 5 volt reference signal to the sensor on circuit 506. When transmission fluid is cold, the sensor resistance is high and the TCM will sense a high signal voltage. As the transmission fluid warms, the sensor resistance lowers and the TCM senses lower voltage. The TCM uses the TFT readings to control Torque Converter Clutch (TCC) apply and release, line pressure adjustments, and temperature compensated shifts.

When the TCM detects a continuous short to ground in the TFT signal circuit or the TFT sensor, then DTC P0712 sets.

Conditions For Setting The DTC

- Ignition is ON.
- TFT voltage is less then 0.33 volts for 10 seconds.

Action Taken When The DTC Sets

- Freeze shift adapts from being updated.
- Transmission default temperature will be calculated based on engine coolant temperature, manifold air temperature, and engine run time.
- DTC P0712 will be stored in TCM memory.

Conditions For Clearing The DTC

- When TFT voltage is greater than 0.33 volts for 10 seconds for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

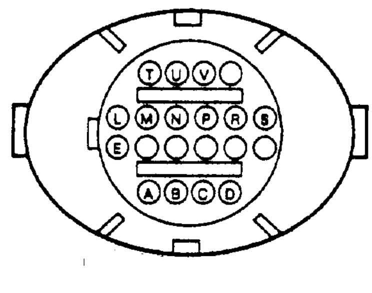
Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- DTC P0712 could set if the vehicle or transmission has been exposed to temperature above 150°C (300°F).

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

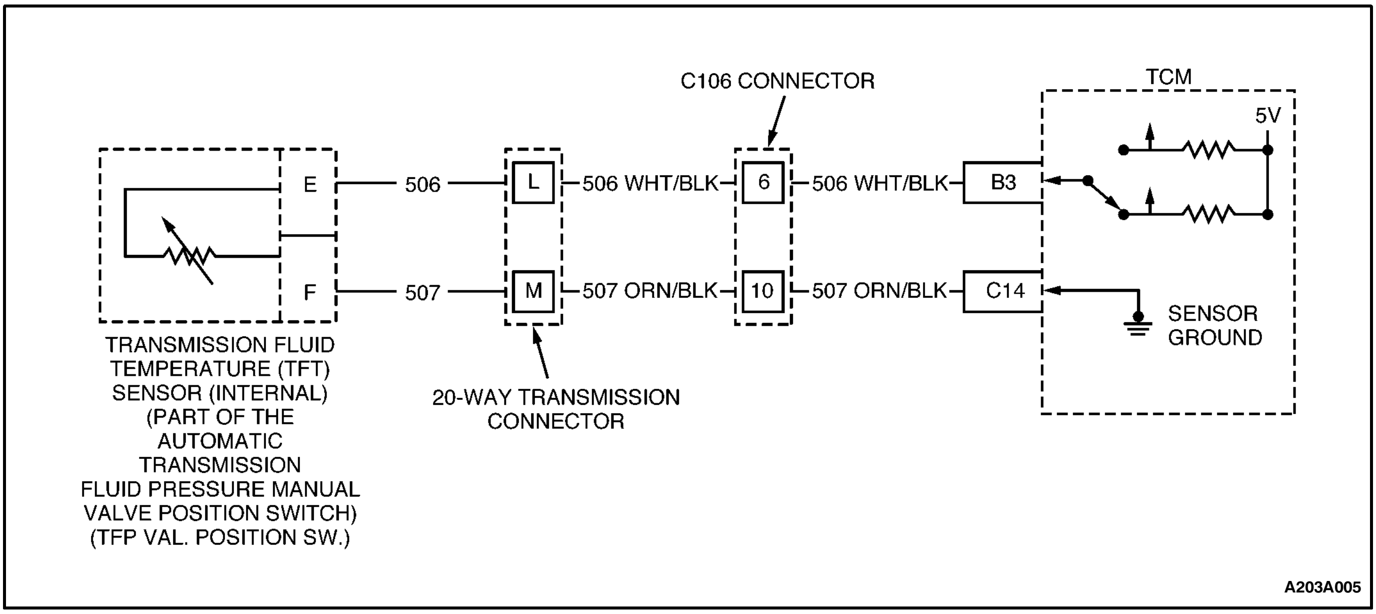
2. This test checks the TCM's ability to detect an open circuit.
3. This test checks the TFT Sensor for correct resistance.



A103A036

DTC P0712 – Transmission Fluid Temperature (TFT) Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). 4. Select Scan Tool Data List Trans Fluid Temp Sensor. Does the scan tool display transmission fluid temperature as shown?	152°C	Go to Step 2	Go to Diagnostic Aids
2	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Ignition ON. Does the scan tool display transmission fluid temperature as shown?	* 40°C	Go to Step 4	Go to Step 3
3	Check circuit 506 from the engine side of the transmission 20-way connector to the TCM connector for a short to ground. Was the problem found and corrected?	-	Go to Step 8	Go to Step 5
4	Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal L to terminal M. (Refer to Transmission Connector End View.) Are ohm readings within range shown for the given transmission temperature range?	20°C (68°F) 3106-3923W 100°C (212°F) 164-190W	Go to Step 5	Go to Step 6
5	Replace the TCM. Is the replacement complete?	-	Go to Step 8	-
6	Check circuit 506 from the transmission 20-way connector to the TFT sensor connector for a short to ground. Was the problem found and corrected?	-	Go to Step 8	Go to Step 7
7	Replace the TFP Val. Position Sw. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Replacement. Is the replacement complete?	-	Go to Step 8	-
8	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0713 TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CIRCUIT HIGH INPUT

Circuit Description

The Automatic Transmission Fluid Temperature (TFT) Sensor Assembly is a thermistor and is part of the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.). The TCM supplies a 5 volt reference signal to the sensor on circuit 506. When transmission fluid is cold, the sensor resistance is high and the TCM will sense a high signal voltage. As the transmission fluid warms, the sensor resistance lowers and the TCM senses lower voltage. The TCM uses the TFT readings to control Torque Converter Clutch (TCC) apply and release, line pressure adjustments, and temperature compensated shifts.

When the TCM detects a continuous open or short to power in the TFT signal circuit or the TFT sensor, then DTC P0713 sets.

Conditions For Setting The DTC

- Ignition is ON.
- TFT voltage is greater than 4.92 volts for 30 seconds.

Action Taken When The DTC Sets

- DTC P0713 will be stored in TCM memory.
- Freeze shift adapts from being updated.
- Transmission default temperature will be calculated based on engine coolant temperature, manifold air temperature, and engine run time.

Conditions For Clearing The DTC

- When the TFT voltage is less than 4.92 volts for 30 seconds for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

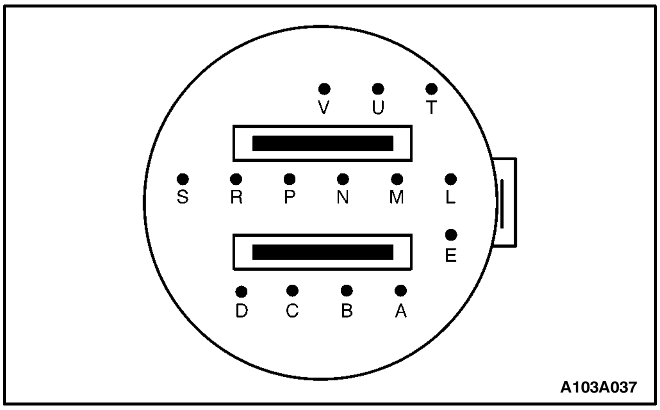
Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

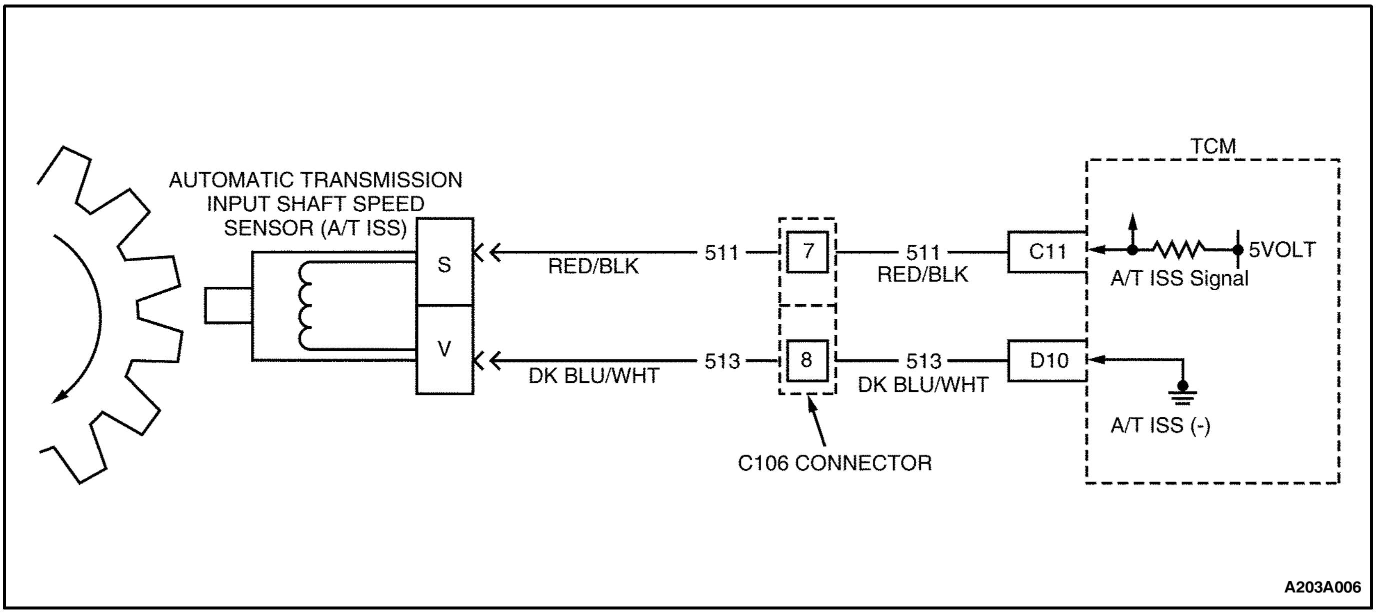
The numbers below refer to the step numbers on the diagnostic chart.

2. This test checks the wiring from the transmission 20-way connector to the TCM for an open or short.
3. This test checks circuit 507 from the TCM to the transmission connector.



DTC P0713 – Transmission Fluid Temperature (TFT) Sensor Circuit High Input

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). 4. Select Scan Tool Data List Trans Fluid Temp Sensor. Does the scan tool display transmission fluid temperature as shown?	* 40°C	Go to Step 2	Go to Diagnostic Aids
2	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Using J 35616 Connector Test Adapter Kit, install a fused jumper wire from terminal L to terminal M. 4. Ignition ON, engine OFF. Does the scan tool display transmission fluid temperature as shown?	152°C	Go to Step 6	Go to Step 3
3	Using J 35616 Connector Test Adapter Kit, jump terminal L to a good ground. Does the scan tool display transmission fluid temperature as shown?	152°C	Go to Step 6	Go to Step 4
4	Check circuit 506 from the engine side of the transmission 20-way connector to connector for an open. Was the problem found and corrected?	-	Go to Step 8	Go to Step 5
5	Replace the TCM. Is the replacement complete?	-	Go to Step 8	-
6	Check circuit 506 and circuit 507 from the transmission 20-way connector to the TFT sensor for an open. Was the problem found and corrected?	-	Go to Step 8	Go to Step 7
7	Replace the TFP Val. Position Sw. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Replacement. Is the replacement complete?	-	Go to Step 8	-
8	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0716
INPUT SPEED SENSOR CIRCUIT RANGE/PERFORMANCE

Circuit Description

Transmission input speed is provided to the Transmission Control Module (TCM) by the Automatic Transmission Input (Shaft) Speed Sensor (A/T ISS), which is a Permanent Magnet (PM) generator. The sensor mounts into the transmission case and maintains a slight air gap between the sensor and the drive sprocket. The PM generator produces an AC voltage as the drive sprocket rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the turbine shaft increases. The TCM then converts the AC voltage into a digital signal. This digital signal is then used by the TCM to determine actual turbine speed. The TCM uses input speed to calculate torque converter slip speed and gear ratios.

When the TCM detects an unrealistic large change in input speed, then DTC P0716 sets.

Conditions For Setting The DTC

- Input speed change is greater than 1300 rpm in 0.8 seconds.
- No Input Speed Sensor DTC P0717.
- No TPS DTC P1791.
- No VSS DTC(s) P0722 or P0723.
- No 1-2 shift solenoid DTC P0751.
- Engine running.
- TP angle is greater then 15%.
- Vehicle speed is greater than 8 km/h (5 mph).

Action Taken When The DTC Sets

- DTC P0716 will be stored in TCM memory.
- TCM inhibits TCC engagement.
- Freeze shift adapts from being updated.
- TCM commands maximum line pressure.

Conditions For Clearing The DTC

- Input speed is greater than 50 rpm.
- When the input speed has changed less than 300 rpm in 0.3 seconds for three consecutive ignition cycles.
- No Input Speed Sensor DTC P0717.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- This diagnostic test checks for an input speed sensor circuit problem. If the engine is running and the vehicle is moving above a certain speed, then the input speed must be non-zero.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

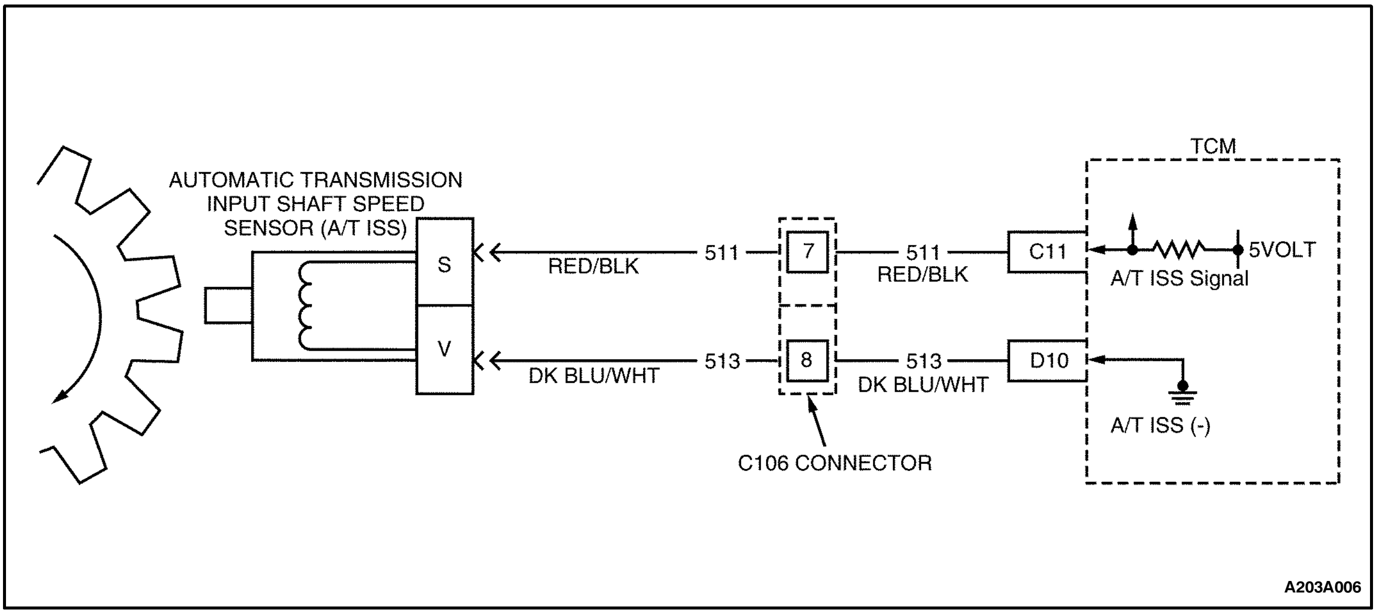
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This test checks the input speed sensor for correct resistance.
6. This test verifies the wiring from the transmission 20-way connector to the TCM, and tests the ability of the A/T ISS to produce an AC current.

DTC P0716 – Input Speed Sensor Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn the ignition switch to the ON position. 3. Engine not running. 4. Record then clear the DTC(s). 5. Start the engine. 6. Select scan tool Trans ISS. Does the scan tool display transmission input speed more than shown?	500 rpm	Go to Diagnostic Aids	Go to Step 2
2	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Install J 39775 Jumper Harness to the transmission 20-way connector. 4. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter between terminals S and V. Does the ohmmeter display resistance as shown?	615-835W	Go to Step 6	Go to Step 3
3	Check circuit 511 from the transmission 20-way connector to the A/T ISS for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 4
4	Check circuit 513 from the transmission 20-way connector to the A/T ISS for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 5
5	Replace the A/T ISS. Refer to Automatic Transmission Input (Shaft) Speed Sensor Replacement. Is the replacement complete?	-	Go to Step 10	-
6	1. Ignition OFF. 2. Disconnect J 39775 Jumper Harness and reconnect the 20-way connector. 3. Disconnect the TCM connector. 4. Using J 35616 Connector Test Adapter Kit, connect a voltmeter from terminals C11 to terminal D10. 5. Select the A/C volts. 6. Crank the engine. Does the voltmeter display volts greater than shown?	0.150 mV (50 Hz)	Go to Step 9	Go to Step 7
7	Check circuit 511 from the engine 20-way connector to the TCM connector for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 8
8	Check circuit 513 from the engine 20-way connector to the TCM connector for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	-
9	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 10	-
10	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0717 INPUT SPEED SENSOR CIRCUIT NO SIGNAL

Circuit Description

Transmission input speed is provided to the Transmission Control Module (TCM) by the Automatic Transmission Input (Shaft) Speed Sensor (A/T ISS), which is a Permanent Magnet (PM) generator. The sensor mounts into the transmission case and maintains a slight air gap between the sensor and the drive sprocket. The PM generator produces an AC voltage as the drive sprocket rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the turbine shaft increases. The TCM then converts the AC voltage into a digital signal. This digital signal is then used by the TCM to determine actual turbine speed. The TCM uses input speed to calculate torque converter slip speed and gear ratios.

When the TCM detects a low input speed when the vehicle has a large output speed, then DTC P0717 sets.

Conditions For Setting The DTC

- No TFP Val. Position Sw. DTC P1810.
- No VSS DTC(s) P0722 or P0723.
- Engine running.
- TFP Val. Position Sw. is indicating transmission is not in Park or Neutral.
- Turbine input speed is less than 100 rpm for five seconds.
- Vehicle speed is greater than 8 km/h (5 mph).

Action Taken When The DTC Sets

- DTC P0717 will be stored in TCM memory.
- TCM commands maximum line pressure.
- TCM inhibits TCC engagement.
- Freeze shift adapts from being updated.

Conditions For Clearing The DTC

- When turbine speed is greater than 120 rpm for three seconds for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- This diagnostic test checks for an input speed sensor circuit problem. If the engine is running and the vehicle is moving above a certain speed, then the input speed must be non-zero.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

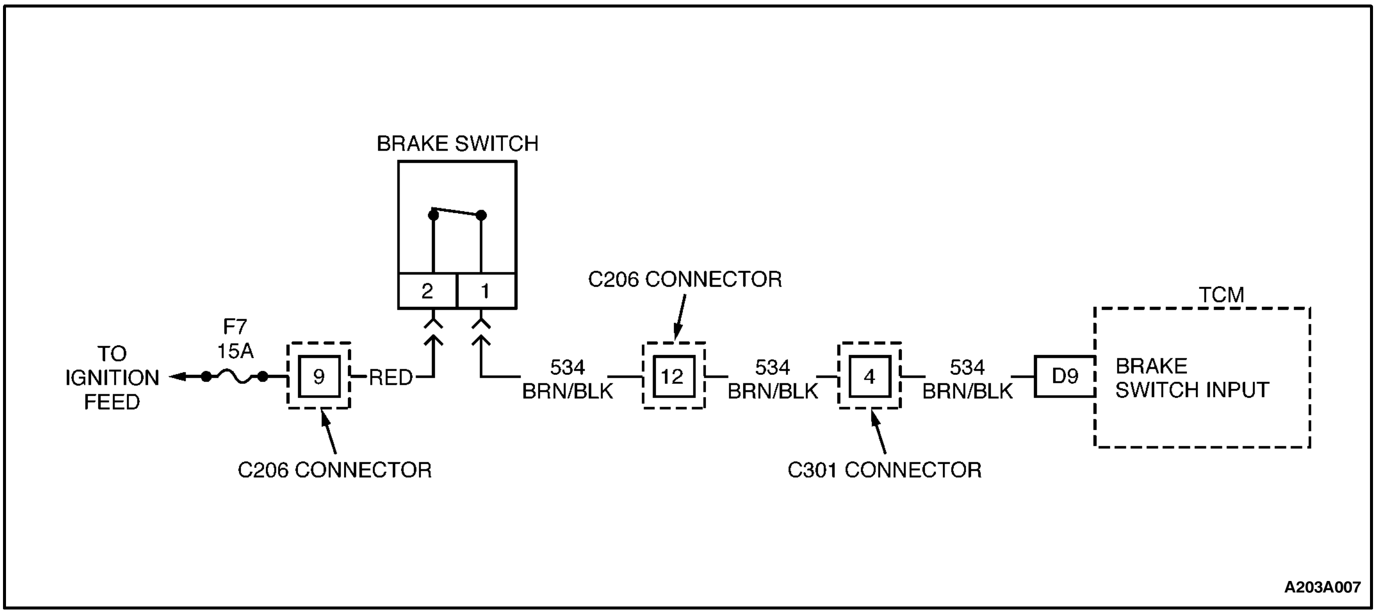
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This test checks the input speed sensor for correct resistance.
6. This test verifies the wiring from the transmission 20-way connector to the TCM, and tests the ability of the A/T ISS to produce an AC current.

DTC P0717 – Input Speed Sensor Circuit No Signal

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn the ignition switch to the ON position. 3. Engine not running. 4. Record then clear the DTC(s). 5. Start the engine. 6. Select scan tool Trans ISS. Does the scan tool display transmission input speed more than shown?	500 rpm	Go to Diagnostic Aids	Go to Step 2
2	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Install J 39775 Jumper Harness to the transmission 20-way connector. 4. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter between terminals S and V. Does the ohmmeter display resistance as shown?	615-835W	Go to Step 6	Go to Step 3
3	Check circuit 511 from the transmission 20-way connector to the A/T ISS for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 4
4	Check circuit 513 from the transmission 20-way connector to the A/T ISS for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 5
5	Replace the A/T ISS. Refer to Automatic Transmission Input (Shaft) Speed Sensor Replacement. Is the replacement complete?	-	Go to Step 10	-
6	1. Ignition OFF. 2. Disconnect J 39775 Jumper Harness and reconnect the 20-way connector. 3. Disconnect the TCM connector. 4. Using J 35616 Connector Test Adapter Kit, connect a voltmeter from terminals C11 to terminal D10. 5. Select the A/C volts. 6. Crank the engine. Does the voltmeter display volts greater than shown?	0.150 mV (50 Hz)	Go to Step 9	Go to Step 7
7	Check circuit 511 from the engine 20-way connector to the TCM connector for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 8
8	Check circuit 513 from the engine 20-way connector to the TCM connector for an open or short to ground. Was the condition found and corrected?	-	Go to Step 10	Go to Step 9
9	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 10	-
10	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0719 BRAKE SWITCH CIRCUIT LOW

Circuit Description

The brake switch is used to indicate brake pedal status to the Transmission Control Module (TCM). The brake switch is a normally-open switch. Applying the brake pedal closes the switch, supplying voltage to the TCM. Releasing the brake pedal interrupts voltage to the TCM. When the TCM sees 12 volts at the brake switch input, the TCM de-energizes the Torque Converter Clutch Solenoid Valve (TCC Sol. Val.).

When the TCM detects an open brake switch during decelerations, then DTC P0719 sets.

Conditions For Setting The DTC

This DTC will set if the TCM detects an open brake switch/circuit (0 volts) during vehicle deceleration and the following conditions occur six consecutive times:

- Vehicle speed is greater than 32 km/h for six seconds; then vehicle speed is between 8 and 32 km/h for four seconds; then vehicle speed is less than 8 km/h.

Action Taken When The DTC Sets

- DTC P0719 will be stored in TCM memory.

Conditions For Clearing The DTC

- When the TCM has seen a change in the brake switch state and three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Ask customer about driving habits and/or unusual traffic conditions, such as heavy stop and go driving.
- Check brake switch for proper adjustment.
- Inspect the wiring for poor electrical connections at the TCM and at the brake switch connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

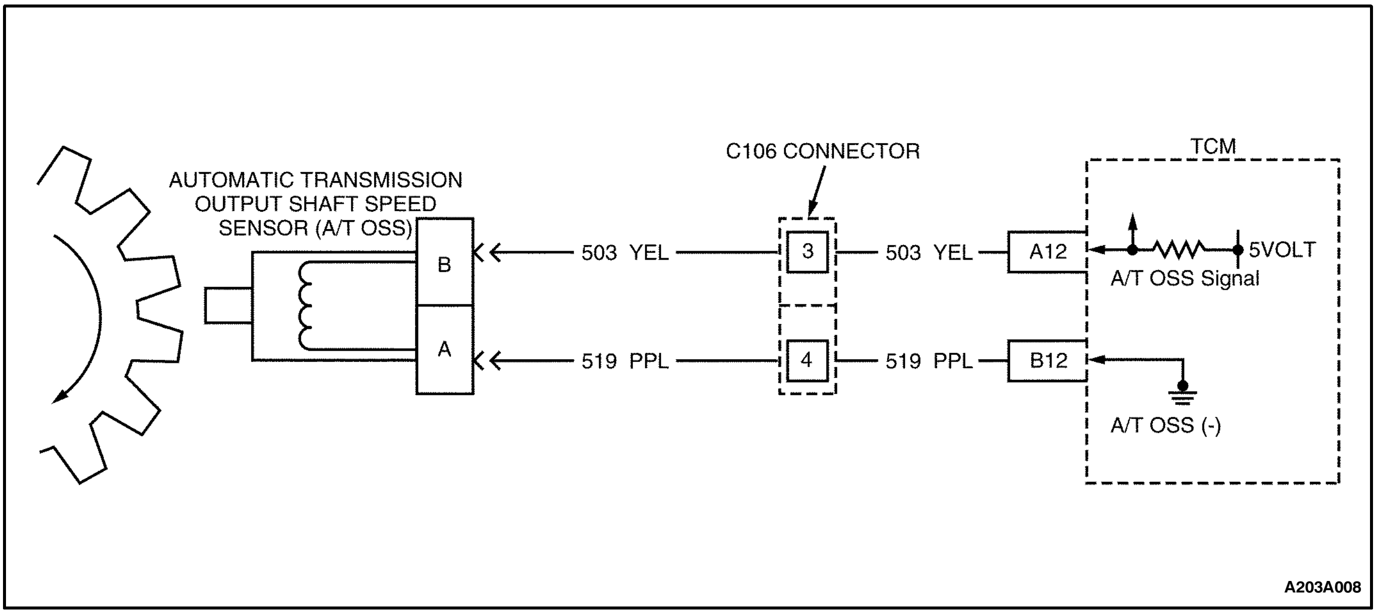
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. Disconnecting the brake switch connector, and jumping the circuit, and observing a status change, isolates the brake switch as the source for setting the DTC.
2. If the brake switch circuit is shorted to ground, the ignition feed fuse would open.
4. If the brake switch is adjusted properly, then the brake switch must be replaced.
7. Replacement of the TCM only after the brake switch and all related circuitry have been properly inspected or repaired.

DTC P0719 – Brake Switch Circuit Low

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn the ignition switch to the ON position. 3. Engine not running. 4. Record then clear the DTC(s). 5. Select scan tool Brake Switch. 6. Disconnect the brake switch connector. 7. Install a fuse jumper from terminal 1 to terminal 2 of the brake switch connector. Did the brake switch status change from “Open” to “Close”?	-	Go to Step 4	Go to Step 2
2	Remove and inspect the brake switch ignition feed fuse for an open. Was the fuse open?	-	Go to Step 3	Go to Step 6
3	Inspect the brake switch feed circuit for a short to ground. Was the condition found and corrected?	-	Go to Step 8	-
4	Inspect the brake switch for proper adjustment. Was the condition found and corrected?	-	Go to Step 8	Go to Step 5
5	Replace the brake switch. Refer to Brake Switch Replacement. Is the replacement complete?	-	Go to Step 8	-
6	Inspect circuit 534 for an open. Was the condition found and corrected?	-	Go to Step 8	Go to Step 7
7	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 8	-
8	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0722
AUTOMATIC TRANSMISSION OUTPUT SPEED SENSOR (A/T OSS) LOW INPUT

Circuit Description

Vehicle speed is provided to the Transmission Control Module (TCM) by the Automatic Transmission Output (Shaft) Speed Sensor (A/T OSS), which is a Permanent Magnet (PM) generator mounted to the transmission case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, TCC apply, TCC release, and gear ratio calculations.

When the TCM detects a low vehicle output speed when the vehicle has a large engine speed in a drive gear, then DTC P0722 sets.

Conditions For Setting DTC

- Transmission not in P (Park) or N (Neutral).
- No MAP DTC.
- No A/T ISS DTC(s) P0716 or P0717.
- No TP DTC P1791.
- No TFP Val. Position Sw. DTC P1810.
- TP is greater than 10%.
- MAP is greater than 10 kPa.
- Transmission input speed is greater than 1000 rpm.
- Engine speed is greater than 6000 rpm.
- Output speed is less than 100 rpm.
- All the above conditions are met for five seconds.

Action Taken When The DTC Sets

- TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- TCM freezes shift adapts from being updated.
- TCM commands maximum line pressure.
- TCM calculates output speed based on input speed, engine speed, and commanded gear.
- DTC P0722 will be stored in TCM memory.

Conditions For Clearing The DTC

- The TCM will turn the Power Lamp off after the transmission output speed is greater than 500 rpm for three seconds and three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Condition may be intermittent. Check for loose output speed sensor mounting or poor sensor connection.
- Inspect for a damaged output speed sensor or transmission rotor teeth.
- Inspect the wiring for poor electrical connections at the TCM and at the A/T OSS. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

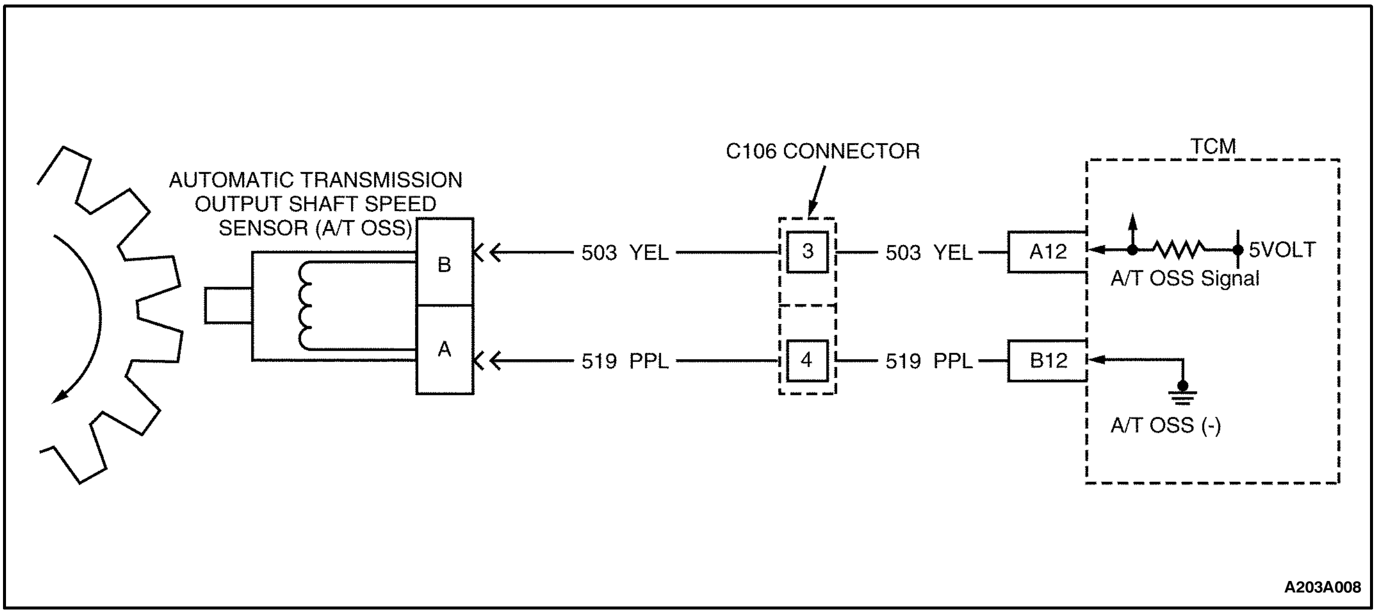
Test Description

The numbers below refer to the numbered steps on the diagnostic chart.

2. This test checks the A/T OSS for correct resistance.
3. This tests the A/T OSS ability to produce an AC current and the integrity of the wiring to the TCM.

DTC P0722 – Automatic Transmission Output Speed Sensor (A/T OSS) Low Input

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the ON position. 3. Record then clear the DTC(s). Notice: In order to avoid damage to the drive axles, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel. 4. Raise and support the drive wheels. 5. Start and idle the engine. 6. Place the transmission in Drive. With the drive wheels rotating, does the transmission output speed increase when the wheel speed increases?	-	Go to Diagnostic Aids	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the A/T OSS connector at the transmission. 3. Using J 35616 Connector Test Adapter Kit, connect the ohmmeter from terminal A to terminal B of the A/T OSS. Is the resistance within the specified range?	1530-1870W	Go to Step 3	Go to Step 5
3	1. Reconnect the A/T OSS connector. 2. Disconnect the TCM connector. 3. Connect a voltmeter between terminals A12 and B12. 4. Select the AC volts. 5. Rotate the drive wheels. 6. Observe the voltmeter display. Is the voltage greater than the specified value?	0.5 V	Go to Step 6	Go to Step 4
4	Inspect circuits 503 and 519 for an open, short to ground, or short together. Refer to Troubleshooting Procedures. Was the condition found and corrected?	-	Go to Step 7	Go to Diagnostic Aids
5	Replace the A/T OSS. Refer to Sensor Replacement. Is the replacement complete?	-	Go to Step 7	-
6	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 7	-
7	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0723 AUTOMATIC TRANSMISSION OUTPUT SPEED SENSOR (A/T OSS) INTERMITTENT

Circuit Description

Vehicle speed is provided to the Transmission Control Module (TCM) by the Automatic Transmission Output (Shaft) Speed Sensor (A/T OSS), which is a Permanent Magnet (PM) generator mounted to the transmission case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, TCC apply, TCC release, and gear ratio calculations.

When the TCM detects an unrealistic large change in vehicle speed, then DTC P0723 sets.

Conditions For Setting The DTC

- Engine running.
- No TFP Val. Position Sw. DTC P1810.
- Time since last manual gear select lever change is greater than 3 seconds.
- A decrease in output speed greater than 900 rpm in park or neutral or a decrease greater than 1300 rpm in drive.

Action Taken When The DTC Sets

- TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- TCM freezes shift adapts from being updated.
- TCM commands maximum line pressure.
- The TCM calculates ouput speed based on input speed, engine speed, and commanded gear.
- DTC P0723 will be stored in TCM memory.

Conditions For Clearing The DTC

- The TCM will turn the Power Lamp off after the output speed sensor has not failed this DTC for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Condition may be intermittent. Check for loose output speed sensor mounting or poor sensor connection.
- Inspect for a damaged output speed sensor or transmission rotor teeth.
- Inspect the wiring for poor electrical connections at the TCM and at the A/T OSS. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

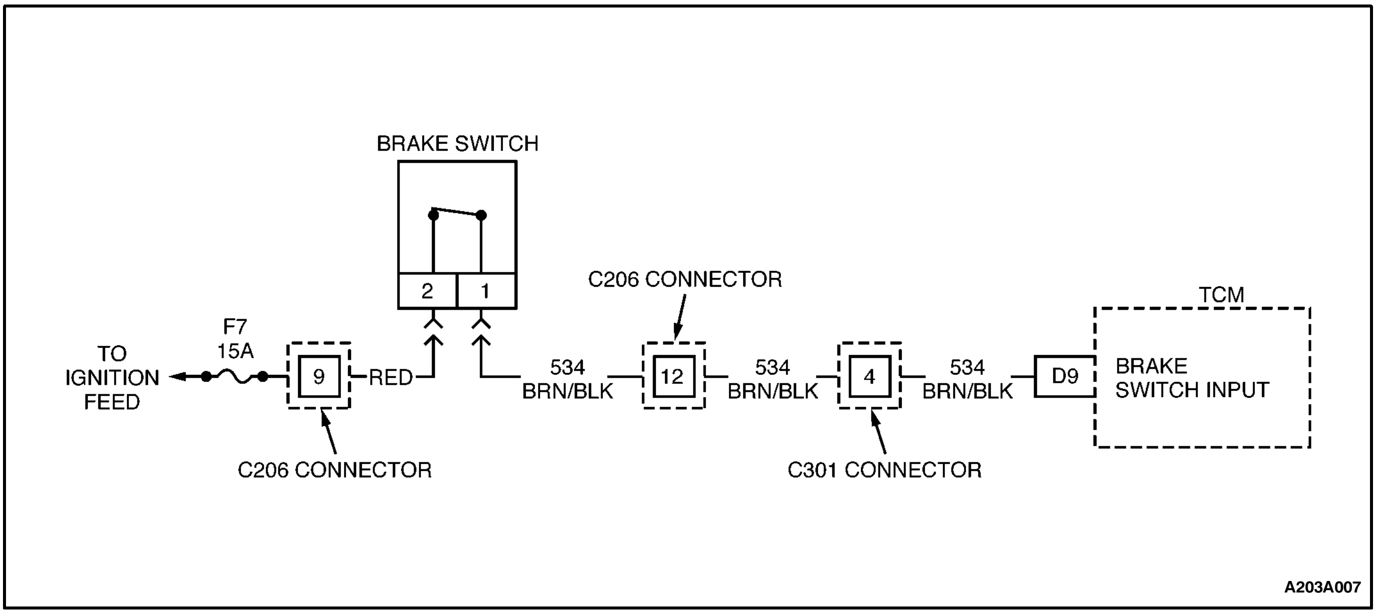
Chart Test Description

The numbers below refer to the numbered steps on the diagnostic chart.

2. This test checks the A/T OSS for correct resistance.
3. This tests the A/T OSS ability to produce an AC current and the integrity of the wiring to the TCM.

DTC P0723 – Automatic Transmission Output Speed Sensor (A/T OSS) Intermittent

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the ON position. 3. Record then clear the DTC(s). Notice: In order to avoid damage to the drive axles, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel. 4. Raise and support the drive wheels. 5. Start and idle the engine. 6. Place the transmission in Drive. With the drive wheels rotating, does the transmission output speed increase when the wheel speed increases?	-	Go to Diagnostic Aids	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the A/T OSS connector at the transmission. 3. Using J 35616 Connector Test Adapter Kit, connect the ohmmeter from terminal A to terminal B of the A/T OSS. Is the resistance within the specified range?	1530-1870W	Go to Step 3	Go to Step 5
3	1. Reconnect the A/T OSS connector. 2. Disconnect the TCM connector. 3. Connect a voltmeter between terminals A12 and B12. 4. Select the AC volts. 5. Rotate the drive wheels. 6. Observe the voltmeter display. Is the voltage greater than the specified value?	0.5 V	Go to Step 6	Go to Step 4
4	Inspect circuits 503 and 519 for an open, short to ground, or short together. Refer to Troubleshooting Procedures. Was the condition found and corrected?	-	Go to Step 7	Go to Diagnostic Aids
5	Replace the A/T OSS. Refer to Sensor Replacement. Is the replacement complete?	-	Go to Step 7	-
6	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 7	-
7	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0724 BRAKE SWITCH CIRCUIT HIGH

Circuit Description

The brake switch is used to indicate brake pedal status to the Transmission Control Module (TCM). The brake switch is a normally-open switch. Applying the brake pedal closes the switch, supplying voltage to the TCM. Releasing the brake pedal interrupts voltage to the TCM. When the TCM sees 12 volts at the brake switch input, the TCM de-energizes the Torque Converter Clutch Solenoid Valve (TCC Sol. Val.).

When the TCM detects a closed brake switch during accelerations, then DTC P0724 sets.

Conditions For Setting The DTC

This DTC will set if the TCM detects a closed brake switch/circuit (12 volts) during vehicle acceleration and the following conditions occur six consecutive times:

- Vehicle speed is less than 8 km/h; then vehicle speed is between 8 and 32 km/h for four seconds; then vehicle speed is greater than 32 km/h for six seconds.

Action Taken When The DTC Sets

- DTC P0724 will be stored in TCM memory.

Conditions For Clearing The DTC

- When the TCM has seen a change in the brake switch state and three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Ask customer about driving habits and/or unusual traffic conditions, such as heavy stop and go driving.
- Check brake switch for proper adjustment.
- Inspect the wiring for poor electrical connections at the TCM and at the brake switch. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

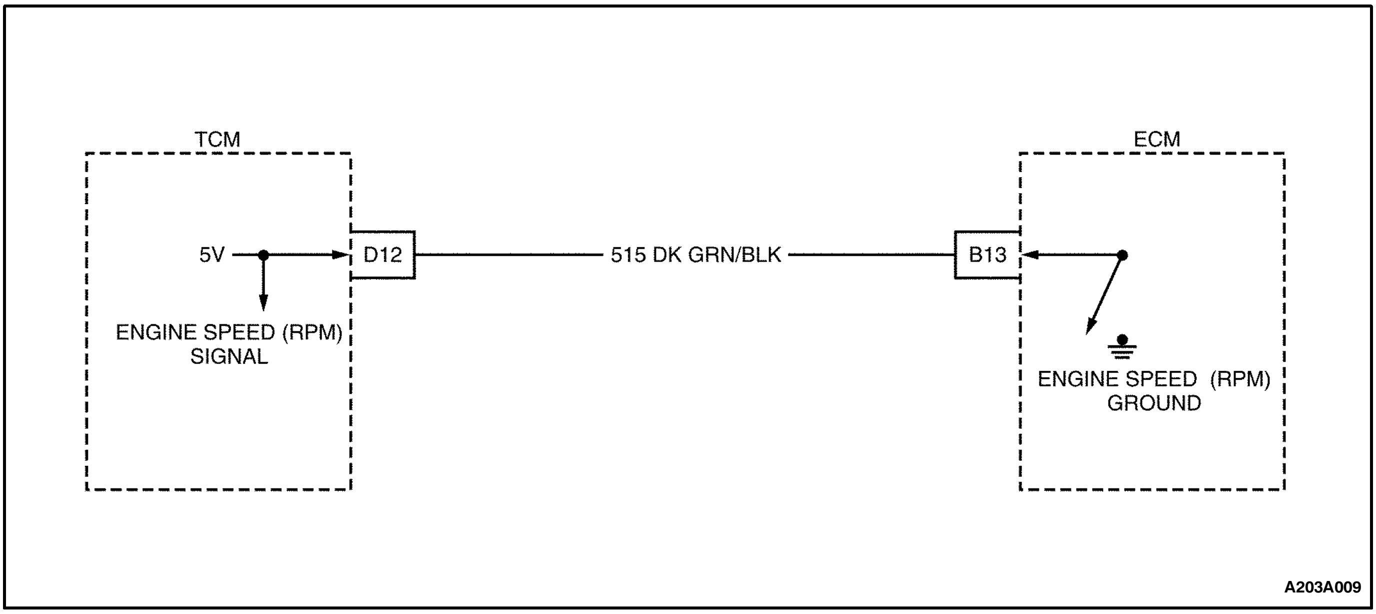
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. Disconnecting the brake switch connector, and observing a status change, isolates the brake switch as the source for setting the DTC.
2. If the brake switch is adjusted properly, then the brake switch must be replaced.
3. This step will inspect circuit 534 for a short to power if the status on the scan tool never changed from "Closed" to "Open." If a short is found, make the appropriate repair.
4. Replacement of the TCM only after the brake switch and all related circuitry have been properly inspected or repaired.

DTC P0724 – Brake Switch Circuit High

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn the ignition switch to the ON position. 3. Engine not running. 4. Record then clear the DTC(s). 5. Select scan tool Brake Switch. 6. Disconnect the brake switch connector. Did the brake switch status change from "Closed" to "Open"?	-	Go to Step 2	Go to Step 3
2	Replace the brake switch. Refer to Brake Switch Replacement. Is the replacement complete?	-	Go to Step 5	-
3	Inspect circuit 534 for being short to power. Was the condition found and corrected?	-	Go to Step 5	Go to Step 4
4	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 5	-
5	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0726 ENGINE SPEED SENSOR CIRCUIT INTERMITTENT

Circuit Description

The ECM receives a signal from the ignition system to determine engine speed. The TCM sends five volts on circuit 515 to the ECM. The ECM pulses this circuit to ground at the rate of 33 Hz per 1000 rpm. The TCM uses the rpm signal to calculate torque converter slip and TCC apply rate.

When the TCM detects a loss of engine input speed, then DTC P0726 sets.

Conditions For Setting The DTC

- Engine is running.
- Engine speed is greater than 250 rpm.
- Engine rpm changes more than 1000 rpm within one second.

Action Taken When The DTC Sets

- TCM inhibits TCC engagement.
- TCM freezes shift adapts from being updated.
- The TCM will flash the Power Lamp.

Conditions For Clearing The DTC

- The TCM will turn the Power Lamp off after the engine speed is greater than 200 rpm for one second.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the ECM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wires inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

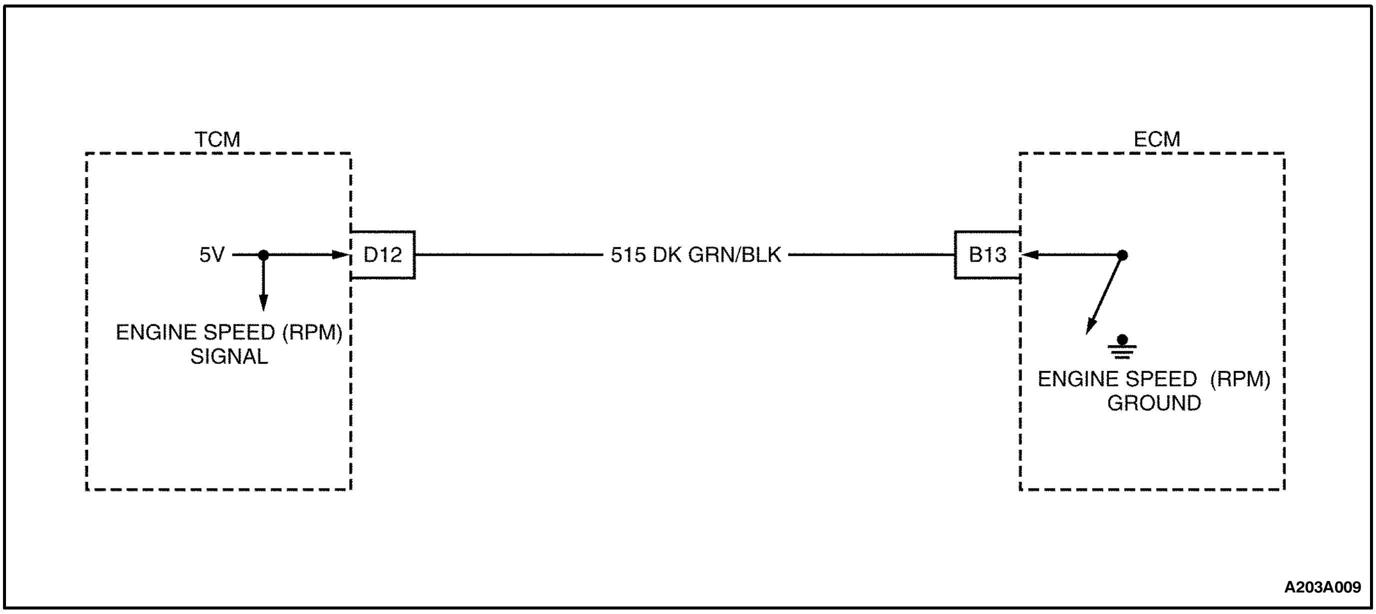
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This step checks for a five volt signal from the TCM.
2. This step checks for a short to power (12V) on circuit 515.
4. This step checks for a short to power (12V) on circuit 515.

DTC P0726 – Engine Speed Sensor Circuit Intermittent

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear the DTC(s). 4. Ignition OFF. 5. Disconnect the ECM connector. 6. Ignition ON. 7. Set voltmeter to DC volts. 8. Connect a voltmeter from terminal B13 of the ECM connector to a good ground. Is voltage reading as shown?	5.0 V	Go to Step 2	Go to Step 5
2	Is voltage greater than shown?	u 5.0 V	Go to Step 3	Go to Step 7
3	1. Connect a test light from terminal B13 of the ECM connector to a good ground. 2. Disconnect the TCM connector. Is the test light ON?	-	Go to Step 4	-
4	Check circuit 515 for a short to power. Was the condition found and corrected?	-	Go to Step 8	-
5	Check circuit 515 from the TCM to ECM connector terminal B13 for an open or short to ground. Was the condition found and corrected?	-	Go to Step 8	Go to Step 6
6	Replace the TCM. Is the replacement complete?	-	Go to Step 8	-
7	Replace the ECM. Is the replacement complete?	-	Go to Step 8	-
8	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0727 ENGINE SPEED SENSOR CIRCUIT LOW INPUT

Circuit Description

The ECM receives a signal from the ignition system to determine engine speed. The TCM sends five volts on circuit 515 to the ECM. The ECM pulses this circuit to ground at the rate of 33 Hz per 1000 rpm. The TCM uses the rpm signal to calculate torque converter slip and TCC apply rate.

The TCM detects low engine rpm when the vehicle has a large input speed, throttle position, and vehicle speed in a drive gear range, then DTC P0727 sets.

Conditions For Setting The DTC

- Transmission not in P (Park) or N (Neutral).
- Engine is running.
- TP is greater than 20%.
- Engine speed is less than 200 rpm.
- Output speed is greater than 600 rpm.
- Input speed is greater than 600 rpm.
- No input speed sensor DTC(s) P0716 or P0717.
- No engine speed DTC P0726
- No vehicle speed DTC(s) P0722 or P0723.
- No TFP Val. Position Sw. DTC P1810
- No TP DTC P1791.
- All the above conditions are met for five seconds.

Action Taken When The DTC Sets

- TCM will flash the Power Lamp.
- Freeze shift adapts from being updated.
- TCM commands maximum line pressure.
- TCM inhibits TCC engagement.

Conditions For Clearing The DTC

- The TCM will turn the Power Lamp off when engine speed is greater than 250 rpm for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and the ECM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This step checks for a five volt signal from the TCM.
2. This step checks for a short to power (12V) on circuit 515.
4. This step checks for a short to power (12V) on circuit 515.

DTC P0727 – Engine Speed Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear the DTC(s). 4. Ignition OFF. 5. Disconnect the ECM connector. 6. Ignition ON. 7. Set voltmeter to DC volts. 8. Connect a voltmeter from terminal B13 of the ECM connector to a good ground. Is voltage reading as shown?	5.0 V	Go to Step 2	Go to Step 5
2	Is voltage greater than shown?	u 5.0 V	Go to Step 3	Go to Step 7
3	1. Connect a test light from terminal B13 of the ECM connector to a good ground. 2. Disconnect the TCM connector. Is the test light ON?	-	Go to Step 4	-
4	Check circuit 515 for a short to power. Was the condition found and corrected?	-	Go to Step 8	-
5	Check circuit 515 from the TCM to ECM connector terminal B13 for an open or short to ground. Was the condition found and corrected?	-	Go to Step 8	Go to Step 6
6	Replace the TCM. Is the replacement complete?	-	Go to Step 8	-
7	Replace the ECM. Is the replacement complete?	-	Go to Step 8	-
8	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

RANGE	GEAR	1-2 SHIFT SOL	2-3 SHIFT SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT./4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FOR-WARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
PARK	N	ON	OFF									Applied	
REV	R	ON	OFF				Applied					Applied	
NEU	N	ON	OFF									Applied	
D	1st	ON	OFF						Holding		Applied		Holding
	2nd	OFF	OFF	Applied	Holding				Holding		Applied		Over-running
	3rd	OFF	ON	Applied*	Over-running				Holding	Applied	Applied		Over-running
	4th	ON	ON	Applied*		Applied			Over-running	Applied	Applied*		Over-running
3	1st	ON	OFF					Applied	Holding		Applied		Holding
	2nd	OFF	OFF	Applied	Holding			Applied	Holding		Applied		Over-running
	3rd	OFF	ON	Applied*	Over-running			Applied	Holding	Applied	Applied		Over-running
2	1st	ON	OFF					Applied	Holding		Applied		Holding
	2nd	OFF	OFF	Applied	Holding	Applied		Applied	Holding		Applied		Over-running
	3rd**	OFF	ON	Applied*	Over-running			Applied	Holding	Applied	Applied		Over-running
1	1st	ON	OFF					Applied	Holding		Applied	Applied	Holding
	2nd***	OFF	OFF	Applied	Holding	Applied		Applied	Holding		Applied		Over-running

ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED.
* = APPLIED WITH NO LOAD.
** = MANUAL SECOND – THIRD GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 100 km/h (62 mph).
*** = MANUAL FIRST – SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 60 km/h (37 mph).
NOTE: MANUAL FIRST – THIRD GEAR IS ALSO POSSIBLE AT HIGH VEHICLE SPEED AS A SAFETY FEATURE.

DIAGNOSTIC TROUBLE CODE (DTC) P0730 INCORRECT GEAR RATIO

Circuit Description

The Transmission Control Module (TCM) calculates gear ratio based on the transmission input and output speed sensor readings. The TCM compares the known transmission gear ratio to calculated ratio for the particular gear range selected.

When the TCM detects an unknown transmission gear ratio, then DTC P0730 sets.

Conditions For Setting The DTC

- No Output Speed Sensor DTC(s) P0722 or P0723.
- No Input Speed Sensor DTC(s) P0716 or P0717.
- No TP Sensor DTC P1791.
- No TFP Val. Position Sw. DTC P1810.
- Engine running.
- Time since last manual gear select lever change is greater than three seconds.
- Transmission not in P (Park) or N (Neutral).
- TP is greater than 15%.
- MAP is greater than 10 kPa.
- Vehicle speed is greater than 16 km/h (10 mph).
- Transmission temperature is greater than * 10°C (14°F).
- And one of the following conditions occur:
  - Gear ratio is less than 2.87 or greater than 3.13 for seven seconds.
  - Gear ratio is less than 1.54 or greater than 1.71 for seven seconds.
  - Gear ratio is less than 0.91 or greater than 1.07 for seven seconds.
  - Gear ratio is less than 0.61 or greater than 0.72 for seven seconds.
  - Gear ratio is less than 2.02 or greater than 2.23 for seven seconds.

Action Taken When The DTC Sets

- TCM will command maximum line pressure.
- TCM will freeze shift adapts from being updated.
- TCM will flash the Power Light.
- DTC P0730 will be stored in TCM memory.

Conditions For Clearing The DTC

- No Output Speed Sensor DTCs P0722 or P0723.
- No Input Speed Sensor DTCs P0716 or P0717.
- No TP Sensor DTC P1791.
- No TFP Val. Position Sw. DTC P1810.
- Engine running.
- Time since last manual gear select lever change is greater than three seconds.
- Transmission not in Park or Neutral.
- TP is greater than 15%.
- MAP is greater than 10 kPa.
- Vehicle speed is greater than 16 km/h (10 mph).
- Transmission temperature is greater than * 10°C (14°F).
- All the above conditions are met and any one of the following occur:
  - Gear ratio is between 2.87-3.13 for seven seconds.
  - Gear ratio is between 1.54-1.71 for seven seconds.
  - Gear ratio is between 0.91-1.07 for seven seconds.
  - Gear ratio is between 0.61-0.72 for seven seconds.
  - Gear ratio is between 2.02-2.23 for seven seconds.
- To cancel DTC fail actions, the fault must no longer exist and the ignition must be cycled off for five seconds.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Check for intermittent input speed sensor or output speed sensor circuit problems.
- Check for possible incorrect calibration.

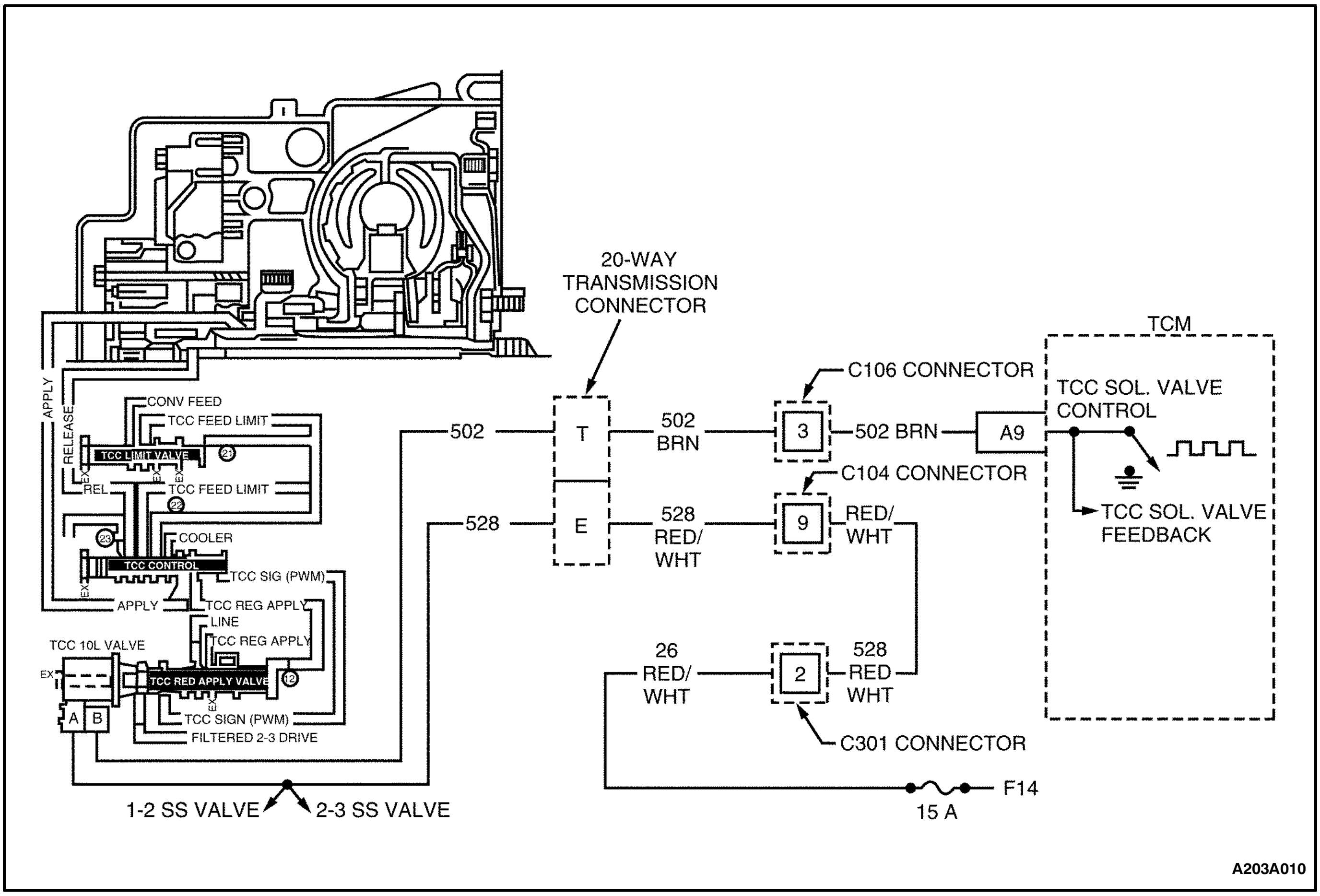
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This step checks for possible low fluid level causing slipping resulting in an undefined gear ratio.
3. This step checks for correct gear ratios for commanded gears.
4. This step checks for low line pressure.

DTC P0730 – Incorrect Gear Ratio

Step	Action	Value(s)	Yes	No
1	Visually inspect the transmission cooling system for fluid leaks. Was condition found and corrected?	5.0 V	Go to Step 6	Go to Step 2
2	Has the transmission fluid checking procedure been performed?	-	Go to Step 3	Go to Transmission Fluid Check, Procedures
3	1. Using the scan tool record each transmission drive range. 2. Drive the vehicle in transmission gear ranges 1, 2, 3, and D with TP greater than 15% and vehicle speed greater than 16 km/h (10 mph) for five seconds. Does commanded gear ratio match ranges as shown?	1st: 2.87-3.13 2nd: 1.54-1.71 3rd: 0.91-1.07 4th: 0.61-0.72	Refer to Diagnostic Aids	Go to Step 4
4	Perform line pressure check. Was the condition found and corrected?	-	Go to Step 6	Go to Step 5
5	Check for possible clutch slippage. Was the condition found and corrected?	-	Go to Step 6	-
6	1. After the repair is complete, select scan tool “Clear Info” function and road test the vehicle. 2. Review the “DTC Info”. Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0741 TORQUE CONVERTER CLUTCH CIRCUIT STUCK OFF

Circuit Description

The Torque Converter Clutch Solenoid Valve (TCC Sol. Valve) is a pulse width modulated solenoid. The Transmission Control Module (TCM) energizes the TCC Sol. Valve by grounding circuit 502. When vehicle operating conditions are appropriate to apply the TCC, the TCM begins the TCC Sol. Valve duty cycle at 68%. The TCM then ramps the duty cycle up to 93% to achieve full TCC apply pressure.

When the TCC Sol. Valve is de-energized, the solenoid blocks filtered 2-3 drive fluid and allows TCC signal fluid to exhaust. When energized, the solenoid modulates fluid into the TCC signal fluid circuit. When fully energized, modulation stops and the solenoid blocks both 2-3 drive fluid and TCC signal fluid from being exhausted.

When the TCM detects a high TCC slip speed when the TCC is commanded on, then DTC P0741 sets.

Conditions For Setting The DTC

- No TP DTC P1791.
- No TFP Val. Position Sw. DTC P1810.
- No VSS DTC(s) P0722 or P0723.
- No TCC stuck on DTC P0742.
- No TCC release switch DTC P1887.
- Transmission is in 2, 3, or D.
- Time since last manual gear select lever change is greater than three seconds.
- TCM commands TCC ON.
- TP is greater than 12%.
- Transmission fluid temperature is between 0°C and 120°C (32°F and 248°F).
- Commanded gear is greater than 1st gear.
- TCC slip speed is 250 rpm or greater for five seconds.

Action Taken When The DTC Sets

- The TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- DTC P0741 will be stored in TCM memory.
- TCM inhibits TCC engagement.
- Freeze shift adapts from being updated.

Conditions For Clearing The DTC

- The TCM will turn the Power Lamp off after DTC P0741 passes condition test. This DTC passes when all conditions for setting the DTC, (except TCC slip is less than 50 rpm for three seconds) are met for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

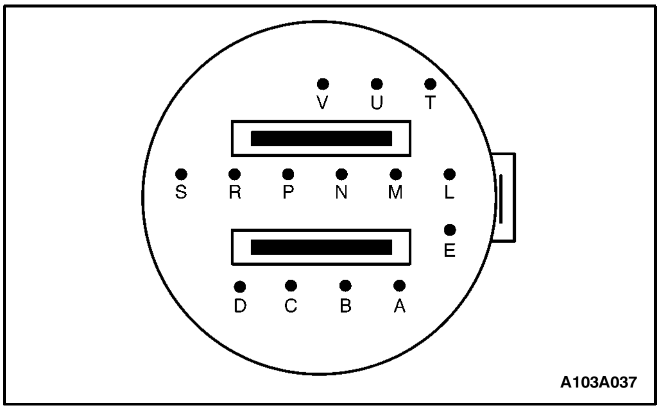
Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wire that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This test looks for other DTC(s) that would set when the feed circuit is open.
7. This tests the TCM ability to command the TCC Sol. Valve ON and OFF.
9. This tests for proper transmission component/circuit resistance.



DTC P0741 – Torque Converter Clutch Circuit Stuck Off

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). Are DTCs P0751 and P0756 also set?	-	Go to Step 2	Go to Step 5
2	1. Ignition OFF. 2. Inspect circuit 26/524 from the power feed to connector C301 terminal 2 for an open. Was the condition found?	-	Go to Step 3	Go to Step 4
3	Repair short to ground in circuit 26/524. Was the condition found?	-	Go to Step 14	Go to Step 9
4	Repair open in circuit 26/524. Was the condition found and corrected?	-	Go to Step 14	-
5	1. Ignition OFF. 2. Disconnect transmission 20-way connector (additional DTC(s) will set). 3. Using J 35616 Connector Test Adapter Kit, connect a test light from terminal E to a good ground. (See Connector View.) 4. Ignition ON, engine OFF. Is test light ON?	-	Go to Step 7	Go to Step 6
6	Check circuit 528/525 between terminal E and splice for an open. Was the problem found and corrected?	-	Go to Step 14	-

DTC P0741 – Torque Converter Clutch Circuit Stuck Off (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Connect a test light from terminal E to terminal T. 2. With the scan tool, command TCC Duty Cycle 100% and then 0%. Is test light ON when commanded 100% and OFF when commanded 0%?	-	Go to Step 9	Go to Step 8
8	Check circuit 502 for an open. Was the problem found and corrected?	-	Go to Step 14	Go to Step 12
9	Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal E to terminal T. (See Transmission Connector View.) Does ohmmeter display resistance as shown?	11 to 15 W	Go to Step 13	Go to Step 10
10	Check circuit 528 and 502 from transmission 20-way connector to TCC Sol. Valve for an open. Was the condition found and corrected?	-	Go to Step 14	Go to Step 11
11	Replace the TCC Sol. Valve. Is the replacement complete?	-	Go to Step 14	-
12	Replace the TCM. Is the replacement complete?	-	Go to Step 14	-
13	Repair TCC shift valve circuit. Inspect for: • Leak at TCC Sol. Valve. • TCC regulator apply valve stuck in the release position. • TCC control valve stuck in the release position. • Plugged TCC Sol. Valve filter. Is the repair complete?	-	Go to Step 14	-
14	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

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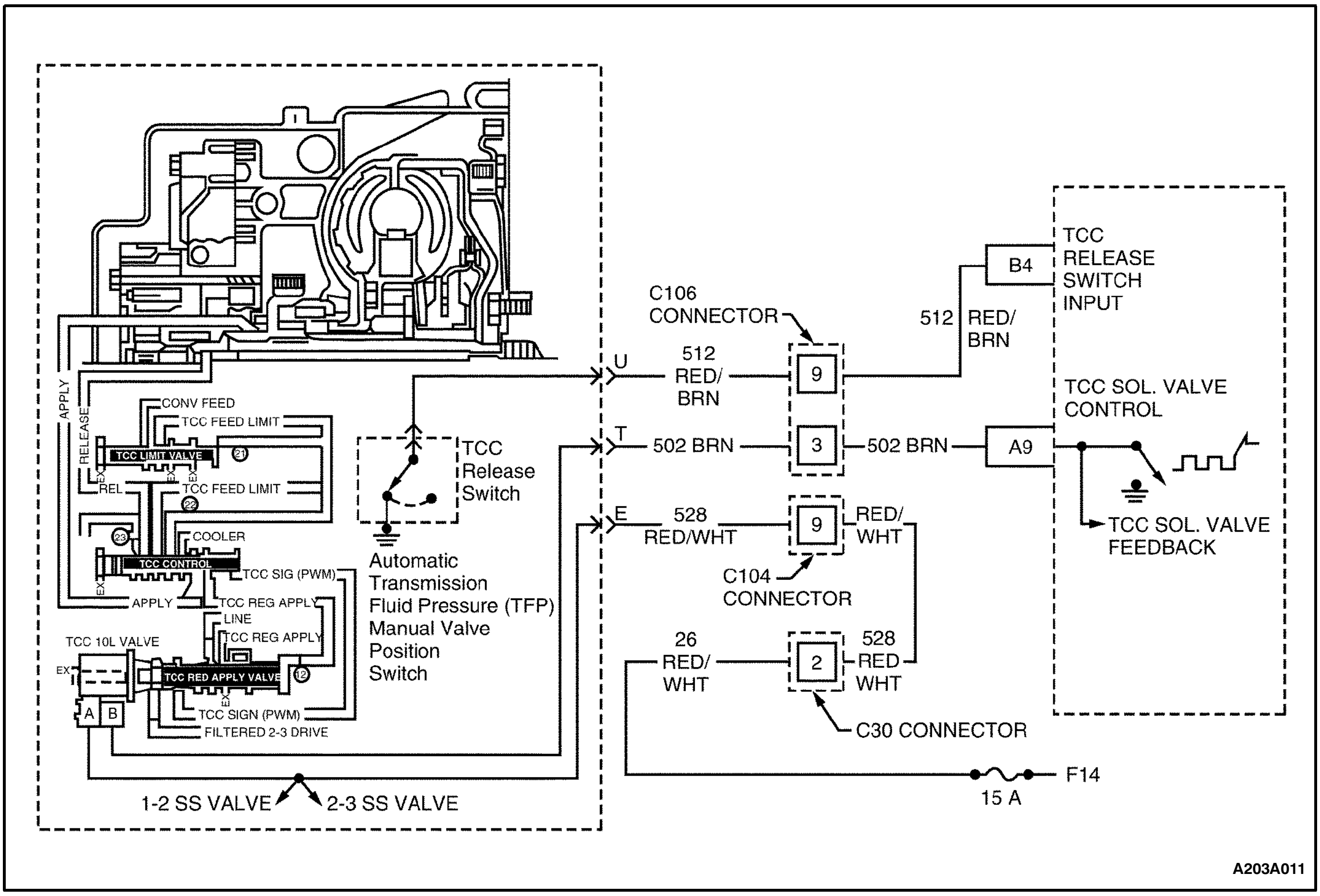


DIAGNOSTIC TROUBLE CODE (DTC) P0742 TORQUE CONVERTER CLUTCH CIRCUIT STUCK ON

Circuit Description

The Torque Converter Clutch Solenoid Valve (TCC Sol. Valve) is a pulse width modulated solenoid. The Transmission Control Module (TCM) energizes the TCC Sol. Valve by grounding circuit 502. When vehicle operating conditions are appropriate for TCC application, the TCM begins the TCC duty cycle at approximately 68%. The TCM then increases the duty cycle up to 93%, in order to achieve full TCC-apply pressure.

When the TCC Sol. Valve is de-energized, the solenoid blocks filtered 2-3 drive fluid, and allows TCC signal fluid to exhaust. When energized, the solenoid modulates fluid into the TCC signal fluid circuit. When fully energized, modulation stops, and the solenoid blocks both 2-3 drive fluid and TCC signal fluid exhaust.

The Torque Converter Clutch (TCC) release switch is part of the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.). The TFP Val. Position Sw. is mounted to the transmission valve body.

The TCC release switch is a normally-closed switch. Torque Converter release fluid pressure acts on the switch contact, opening the circuit, signaling the TCM that the TCC is released. When the voltage on the circuit is high, the TCM recognizes that the TCC is no longer engaged.

When the TCM detects that the TCC release switch is closed when the TCC is commanded off, then DTC P0742 sets.

Conditions For Setting The DTC

- No TCC release DTC P1887.
- No TP DTC P1791.
- Engine running.
- Time since last manual gear select lever change is greater than three seconds.
- TP is greater than 20%.
- TCC commanded off.
- TCC release switch is closed.
- All the above conditions met for eight seconds.

Action Taken When The DTC Sets

- The TCM will flash the Power Lamp.
- DTC P0742 will be stored in TCM memory.
- Freeze shift adapts from being updated.
- TCC commanded on in 2nd, 3rd, and 4th gears.

Condition For Clearing DTC

- The TCM will turn the Power Lamp off after DTC P0742 passes condition test. This DTC passes when all conditions for setting the DTC are true, (except TCC release switch is open when TCC is commanded off for three seconds) for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Rapid fluctuation in line pressure could set a DTC P0742.
- Check for a possible pressure regulator problem.
- Check for possible high or low line pressure.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

2. This step tests for a TCC release switch status change when the engine is running. If TCC release oil is present, the switch should be open.
3. If you disconnect the transmission connector, the TCM should recognize an open TCC Release switch. This indicates the wiring from the transmission connector to the TCM is OK.
11. This step tests circuit 502 from the transmission connector to the TFP Val. Position Sw. for a short to ground.
16. This step ensures that the TCC release switch is in good working condition.
18. This step tests the TCC circuit for a mechanical or hydraulic problem.

DTC P0742 – Torque Converter Clutch Circuit Stuck On

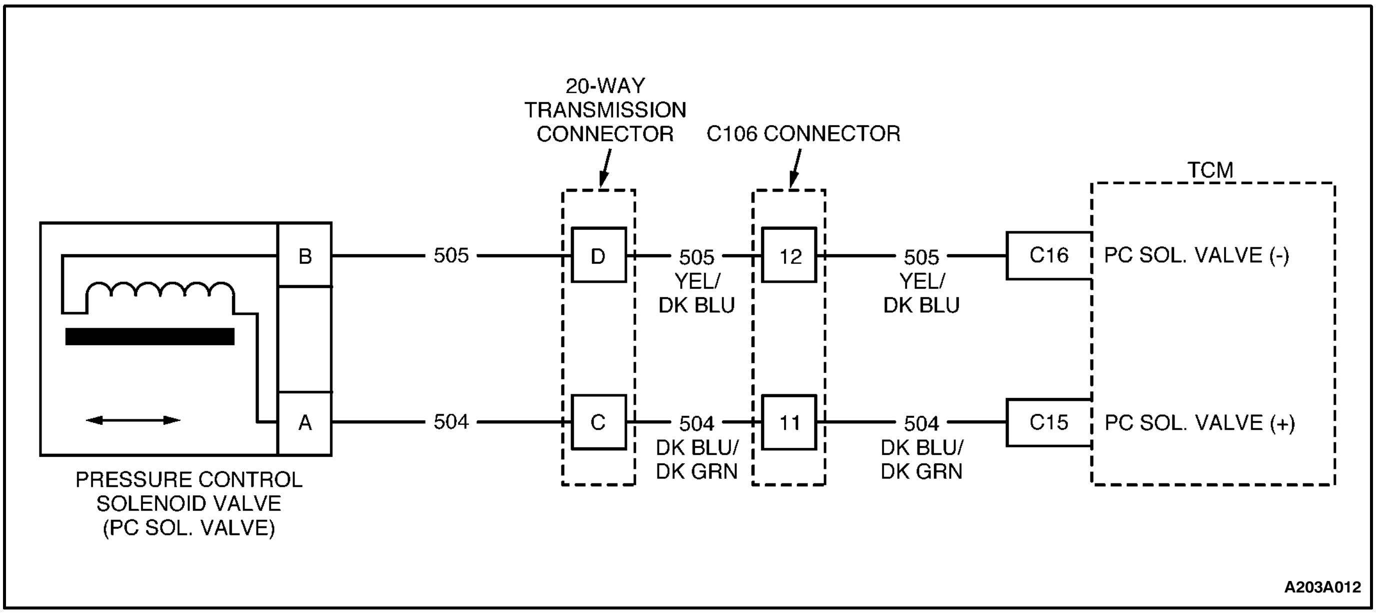
Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the ON position. 3. Record then clear the DTC(s). 4. Select scan tool TCC Release switch. Is the TCC Release Switch status as shown?	Closed	Go to Step 2	Go to Diagnostic Aids
2	Start the engine Is the TCC Release Switch status as shown?	Open	Go to Step 8	Go to Step 3
3	1. Ignition OFF. 2. Disconnect the transmission 20-way connector. 3. With the engine OFF, turn the ignition switch to the ON position. Is the TCC Release Switch status as shown?	Open	Go to Step 4	Go to Step 6
4	Inspect circuit 512 from the transmission 20-way connector to the TFP Val. Position SW. for a short to ground. Was the condition found?	-	Go to Step 5	Go to Step 16
5	Repair the short to ground in circuit 512. Is the repair complete?	-	Go to Step 20	-
6	Inspect circuit 512 from the transmission connector to the TCM for a short to ground. Was the condition found?	-	Go to Step 7	Go to Step 15

DTC P0742 - Torque Converter Clutch Circuit Stuck On (Cont'd)

Step	Action	Value(s)	Yes	No
7	Repair the short to ground in circuit 512. Is the repair complete?	-	Go to Step 20	-
8	1. Install the J 39775 Jumper Harness to the engine 20-way connector. 2. Using the J 35616 Connector Test Adapter Kit, connect a test lamp from battery power to terminal T of the jumper harness. Is the test lamp ON?	-	Go to Step 9	Go to Step 11
9	Inspect circuit 502 from the engine 20-way connector to the TCM for a short to ground. Was the condition found?	-	Go to Step10	Go to Step 19
10	Repair the short to ground in circuit 502. Is the repair complete?	-	Go to Step 20	-
11	1. Ignition OFF. 2. Disconnect the J 39775 Jumper Harness from the engine 20-way connector. 3. Instal the J 39775 Jumper Harness to the transmission 20-way connector. 4. Using the J 35616 from battery power to terminal T. Is the test lamp ON?	-	Go to Step 12	Go to Step 18
12	Inspect circuit 502 from the transmission connector to the Torque Converter Clutch Solenoid Valve (TCC Sol. Valve) for a short ground. Was the condition found?	-	Go to Step 13	Go to Step 14
13	Repair circuit 502 from the transmission connector to the TCC Sol. Valve. Is the repair complete?	-	Go to Step 20	-
14	Inspect the TCC Sol. Valve for an internal short. Was the condition found?	-	Go to Step 15	-
15	Replace the TCC Sol. Valve. Refer to Torque Converter Clutch Solenoid Valve Replacement. Is the replacement complete?	-	Go to Step 20	-
16	1. Remove the TFP Val. Position Sw. 2. Inspect the TCC Release Switch for the following conditions: • A damaged or leaking seal. • Sediment or debris in the switch. • Damaged switch contacts. • Stuck switch contacts. Were any of these conditions found?	-	Go to Step 17	-
17	Replace the TFP Val. Position Sw. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Replacement. Is the replacement complete?	-	Go to Step 20	-

DTC P0742 - Torque Converter Clutch Circuit Stuck On (Cont'd)

Step	Action	Value(s)	Yes	No
18	Inspect the TCC hydraulic circuit for the following conditions: • TCC PWM solenoid exhaust plugged. • The TCC regulator apply valve stuck in the apply position. • The TCC control valve stuck in the apply position. • The TCC feed limit valve stuck (this causes the TCC feed limit pressure, and the TCC release pressure to be low or nonexistent). • A stuck pressure regulator valve. Is the repair complete?	-	Go to Step 20	-
19	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 20	-
20	1. After the repair is complete, select scan tool "Clear info" function and road test the vehicle. 2. Review the "DTC info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0748 PRESSURE CONTROL SOLENOID CIRCUIT ELECTRICAL

Circuit Description

The Pressure Control Solenoid Valve (PC Sol. Valve) is used to regulate transmission line pressure. The PC Sol. Valve consists of an electrical connector, coil, armature, regulating spring and a poppet valve. The PC Sol. Valve is attached to the upper control body. The TCM compares TP voltage, engine rpm and other inputs to determine the line pressure appropriate for a given load. The TCM will regulate pressure by applying a varying amperage to the PC Sol. Valve. The applied amperage can vary from 0.1 to 1.0 amps. The TCM then monitors the amperage at the return line.

When the TCM detects a continuous open or short to ground in PC Sol. Valve circuit or the PC Solenoid Valve, then DTC P0748 sets.

Conditions For Setting The DTC

- System voltage is 10-17 volts.

Action Taken When The DTC Is Set

- Freeze shift adapts from being updated.
- TCM commands maximum line pressure (0 Amps).
- DTC P0748 will be stored in TCM memory.
- TCM will NOT flash the Power Lamp.

Conditions For Clearing The DTC

- System voltage is 10-17 volts.
- History DTC(s) can be cleared by using a Scan Tool.

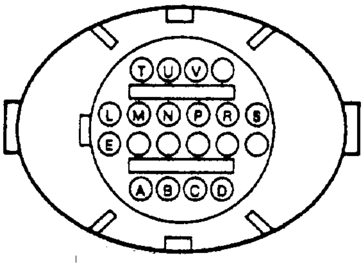
Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- Extended engine cranking with a low battery could set DTC P0748.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This test checks the ability of the TCM to command the PC Sol. Valve.
2. This test checks internal transmission wiring and the PC Sol. Valve for correct resistance.
7. This test checks circuit 505 of the transmission wiring for a short to ground.
8. This test checks circuit 505 from the engine 20-way connector for a short to ground.
9. This test checks circuit 505 from the engine 20-way connector to the TCM for an open.
10. This test checks circuit 504 from the engine 20-way connector to the TCM for a short to ground.
11. This test checks circuit 504 from the engine 20-way connector to the TCM for an open.



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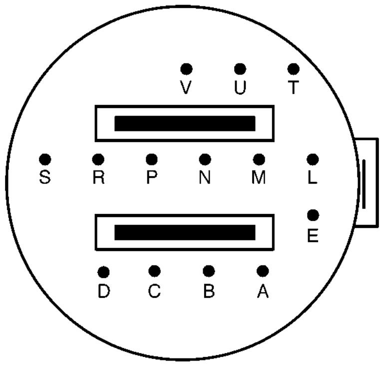

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DTC P0748 – Pressure Control Solenoid Circuit Electrical

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Record then clear DTC(s). 3. Start engine. 4. Select scan tool PC Solenoid. 5. Using the scan tool, apply 0.1 through 1.0 Amps and observe the display. Is the PC Act. Current Amp reading within specification of desired PC Ref. Current Amp reading as shown?	0.16 Amps	Go to Diagnostic Aids	Go to Step 2
2	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal C to terminal D. (See Transmission Connector View.) Does the ohmmeter display range as shown?	3 to 7 W	Go to Step 7	Go to Step 3
3	Is the resistance value greater than shown?	7 W	Go to Step 4	Go to Step 5
4	Check circuit 504 and 505 for an open. Was the condition found and corrected?	-	Go to Step 19	Go to Step 9
5	Is the resistance value less than shown?	3 W	-	Go to Step 6
6	Check circuit 504 and 505 for being shorted together. Was the condition found and corrected?	-	Go to Step 19	Go to Step 9
7	Connect an ohmmeter from terminal D to a good ground. Is the resistance value less than shown?	¦ 1000 W	Go to Step 8	Go to Step 10
8	Check circuit 504 or 505 from transmission 20-way connector to PC Sol. Valve for a short to ground. Is the resistance value less than shown?	-	Go to Step 19	Go to Step 9
9	Replace the Pressure Control Solenoid Valve. Refer to PC Sol. Valve Replacement. Was the replacement completed?	-	Go to Step 19	-

DTC P0748 – Pressure Control Solenoid Circuit Electrical (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Disconnect the TCM connector (additional DTC(s) will set). 2. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal D to a good ground. (See Connector View.) Does the ohmmeter display resistance as shown?	¦ 10 W	Go to Step 12	Go to Step 11
11	Check circuit 505 for a short to ground. Was the condition found and corrected?	-	Go to Step 19	-
12	Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal D of the connector to TCM terminal C16. Does the ohmmeter display resistance as shown?	¦ 10 W	Go to Step 14	Go to Step 13
13	Check circuit 505 for an open. Was the condition found and connected?	-	Go to Step 19	-
14	Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal C of the connector to a good ground. Does the ohmmeter display resistance as shown?	¦ 10 W	Go to Step 16	Go to Step 15
15	Check circuit 504 for a short to ground. Was the condition found and corrected?	-	Go to Step 19	-
16	Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal C of the connector to TCM terminal C15. Does the ohmmeter display resistance as shown?	¦ 10 W	Go to Step 18	Go to Step 17
17	Check circuit 504 for an open. Was the condition found and corrected?	-	Go to Step 19	-
18	Replace the TCM. Was the replacement completed?	-	Go to Step 19	-
19	1. After the repair, use a scan tool "Clear Info." function an road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is a current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

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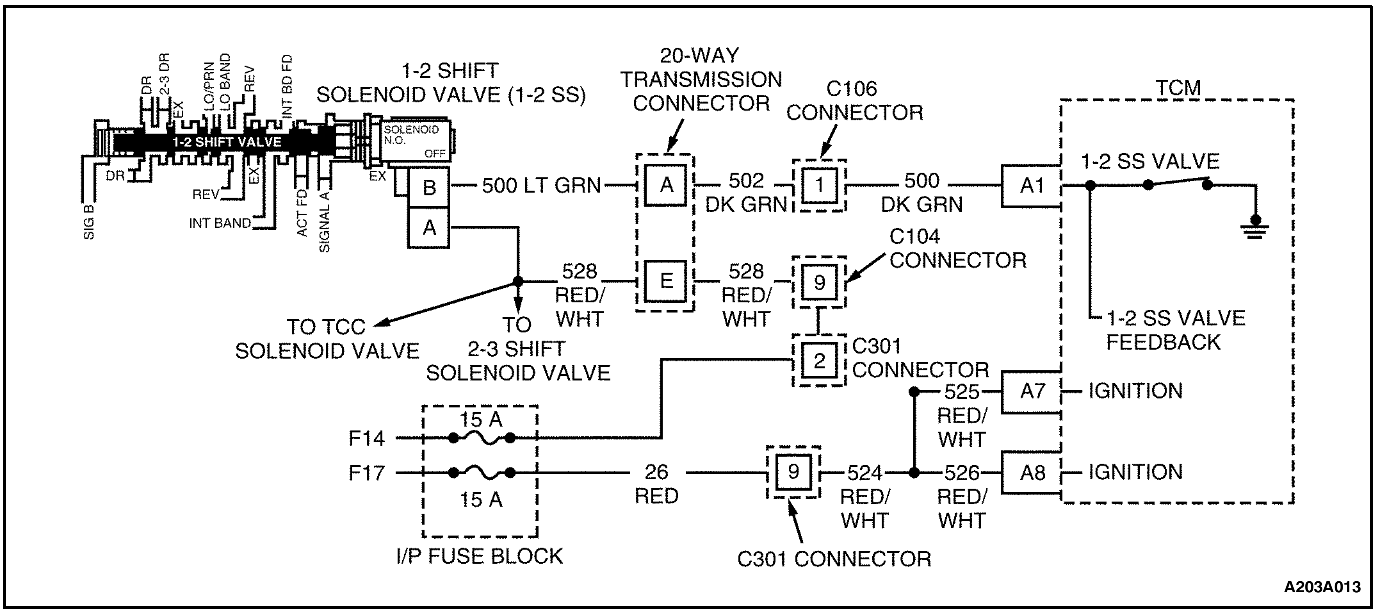


DIAGNOSTIC TROUBLE CODE (DTC) P0751
1-2 SHIFT SOLENOID PERFORMANCE

Circuit Description

The 1-2 Shift Solenoid Valve (1-2 SS Valve) is used to control fluid flow acting on the 1-2 shift valve. The solenoid is a normally open valve that is used in conjunction with the 2-3 Shift Solenoid Valve (2-3 SS Valve) to allow four different shifting combinations (Refer to Shift Solenoid Chart). The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM). The TCM commands the solenoid ON or OFF by providing a ground path through circuit 500.

The Transmission Control Module (TCM) monitors the actual gear ratio, and compares the actual gear ratio with the commanded gear ratio. DTC P0751 sets under four conditions:

- A stuck ON 1-2 SS Valve.
- A stuck OFF 1-2 SS Valve.
- A stuck ON 1-2 shift Valve.
- A stuck OFF 1-2 shift Valve.

Conditions For Setting The DTC

- No Input Speed Sensor DTC(s) P0716 or P0717.
- No TFP Val. Position Sw. DTC P1810.
- No TP Sensor DTC P1791.
- No Vehicle Speed Sensor DTC(s) P0722 or P0723.
- Engine running.
- MAP is greater than 20 kPa.
- Transmission not in Park, Neutral or Reverse.
- Transmission Fluid Temperature is greater than * 10°C (14°F).
- Vehicle speed above 8 km/h (5 mph).
- TP is greater than 8%.

All the above conditions are true and any one of the following conditions occur:

- TCM commands 1st gear and 2nd gear ratio between 1.54-1.71 is detected for 2 seconds.
- TCM commands 2nd gear and 1st gear ratio between 2.87-3.13 is detected for 4 seconds.
- TCM commands 3rd gear and 4th gear ratio between 0.67-0.72 is detected for 5 seconds.
- TCM commands 4th gear and 3rd gear ratio between 0.93-1.05 is detected for 5 seconds.

Action Taken When The DTC Is Set

- TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- Freeze shift adapts from being updated.
- TCM inhibits TCC engagement.
- TCM commands maximum line pressure.
- TCM commands soft landing to 2nd gear.
- DTC P0751 will be stored in TCM memory.

Conditions For Clearing The DTC

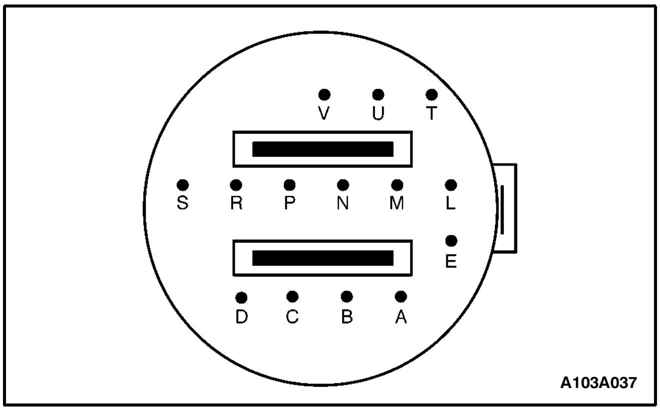
- The TCM will turn the Power Lamp off after DTC P0751 passes condition test. This DTC passes when all conditions for setting the DTC are met and the gear ratio matches the commanded gear for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- If the DTC cannot be reset after clearing the code, check for possible fluid contamination, plugged or restricted oil circuit.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Shift Solenoid Status Chart

Gear	1-2 Shift Solenoid Valve	2-3 Shift Solenoid Valve
1st	ON	OFF
2nd	OFF	OFF
3rd	OFF	ON
4th	ON	ON



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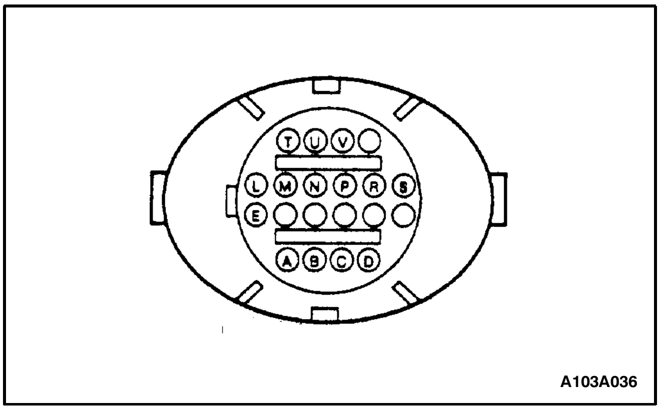

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DTC P0751 – 1-2 Shift Solenoid Performance

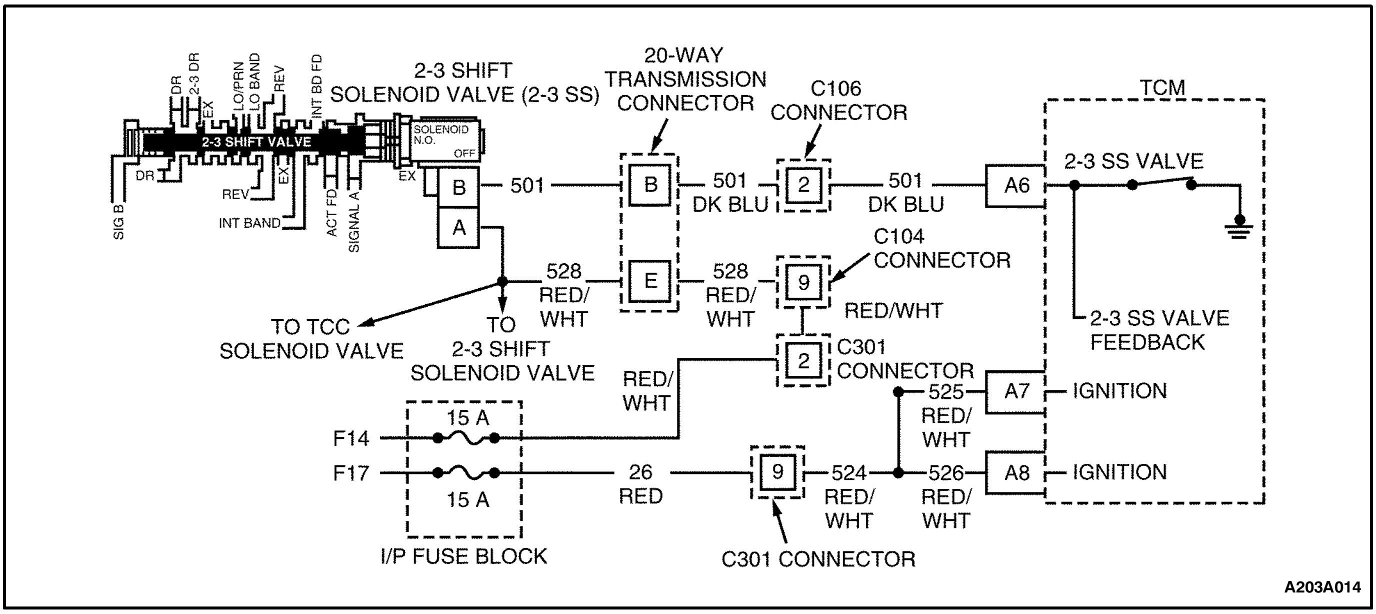
Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). Are DTCs P0741 and P0756 also set?	-	Go to Step 2	Go to Step 5
2	Inspect circuit 26/524 from the power feed to connector C301 terminal 9 for an open. Was condition found?	-	Go to Step 3	Go to Step 4
3	Repair the short to ground in circuit 26/524. Was the condition found and corrected?	-	Go to Step 29	-
4	Check circuit 528 for an open. Was the condition found and corrected?	-	Go to Step 29	-
5	1. Select scan tool 1-2 Shift Solenoid. 2. Command solenoid ON and OFF three times. 3. Listen at transmission side cover. Does the solenoid click when commanded ON and OFF?	-	Go to Step 24	Go to Step 6
6	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Using J 35616 Connector Test Adapter Kit, connect a test light from terminal E to terminal A. (See Connector View.) 4. Ignition ON, engine OFF. 5. Command the 1-2 shift solenoid ON and OFF three times. Does the test light cycle ON and OFF as commanded?	-	Go to Step 14	Go to Step 7

DTC P0751 – 1-2 Shift Solenoid Performance (Cont'd)

Step	Action	Value(s)	Yes	No
7	Is the test light always ON?	-	Go to Step 8	Go to Step 11
8	1. Ignition OFF. 2. Disconnect the TCM connector (additional DTC(s) will set). 3. Ignition ON. Is the test light ON?	-	Go to Step 9	Go to Step 12
9	Check circuit 500 for a short to ground. Was the problem found?	-	Go to Step 10	-
10	Repair the short to ground in circuit 500. Is the repair complete?	-	Go to Step 29	-
11	Is the test light always OFF?	-	Go to Step 12	-
12	Check circuit 500 for an open. Was the problem found and corrected?	-	Go to Step 13	Go to Step 19
13	Repair the open in circuit 500. Is the repair complete?	-	Go to Step 29	-
14	1. Ignition OFF. 2. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal E to terminal A. (See Transmission Connector View.) Does the ohmmeter display resistance as shown?	19 to 31 W	Go to Step 17	Go to Step 15
15	Is the resistance greater than shown?	§ 250 W	Go to Step 16	Go to Step 17
16	Check circuit 500 and 528 from 20-way transmission connector to the 1-2 SS Valve for an open or poor connection at solenoid connector. Was the problem found and corrected?	-	Go to Step 29	-
17	Connect the ohmmeter from terminal A to a good ground. Is the resistance less than shown?	¦ 1000 W	Go to Step 18	Go to Step 22
18	Check circuit 500 for a short to ground. was the problem found and corrected?	-	Go to Step 29	-
19	Connect a test light from a good ground to terminal A. Is the test light ON?	-	Go to Step 20	Go to Step 23
20	Check circuit 500 for a short to battery power. Was the problem found?	-	Go to Step 21	-
21	Repair the short to battery power in circuit 500. Is the repair complete?	-	Go to Step 29	-
22	Replace the 1-2 Shift Solenoid valve. Refer to Solenoid Replacement. Is the replacement complete?	-	Go to Step 29	-
23	Replace the TCM. Is the replacement complete?	-	Go to Step 29	-
24	Has the transmission fluid checking procedure been performed?	-	Go to Step 25	Go to Transmission Fluid Check

DTC P0751 – 1-2 Shift Solenoid Performance (Cont'd)

Step	Action	Value(s)	Yes	No
25	1. Use the scan tool to record current gear and gear ratio. 2. Drive the vehicle in D to obtain 1-2, 2-3, and 3-4 shifts with TP greater than 8% and vehicle speed greater than 8 km/h (5mph) for three seconds. Is the current gear 2nd and the gear ratio within range shown?	2.87-3.13	Go to Step 27	Go to Step 26
26	Is the current gear 1st and the gear ratio within range shown?	1.54 -1.71	Go to Step 28	Go to Step 27
27	Is the commanded gear 3rd and the gear ratio within range shown?	0.67-0.72	Go to Step 29	Go to Step 28
28	Is the commanded gear 4th and the gear ratio within range shown?	0.93-1.05	Go to Step 30	Go to Diagnostic Aids
29	Repair the 1-2 shift circuit. Check 1-2 shift circuit for the following: • 1-2 shift Solenoid Valve mechanically stuck OFF. • 1-2 Shift Solenoid Valve O-ring damage. • 1-2 Shift valve stuck in released (downshift) position. Was the condition found and corrected?	-	Go to Step 31	-
30	Repair the 1-2 shift circuit. Check 1-2 shift circuit for the following: • 1-2 Shift Valve mechanically stuck on. • 1-2 Shift valve stuck in applied (upshift) position. • 1-2 Shift valve stuck in released (downshift) position. Was the condition found and corrected?	-	Go to Step 31	-
31	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P0756 2-3 SHIFT SOLENOID PERFORMANCE

Circuit Description

The 2-3 Shift Solenoid Valve (2-3 SS Valve) is a normally open valve that is used in conjunction with the 1-2 Shift Solenoid Valve (1-2 SS Valve) to allow four different shifting combinations (Refer to Shift Solenoid Chart). The 2-3 SS Valve blocks 2-3 signal fluid from exhausting. 2-3 Signal fluid is routed to both the 1-2 and 2-3 shift valves. The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM). The TCM commands the solenoid ON or OFF by providing a ground path through circuit 500.

The Transmission Control Module (TCM) monitors the actual gear ratio, and compares the actual gear ratio with the commanded gear ratio. DTC P0756 sets under four conditions:

- A stuck ON 2-3 SS Valve.
- A stuck OFF 2-3 SS Valve.
- A stuck ON 2-3 shift Valve.
- A stuck OFF 2-3 shift Valve.

Conditions For Setting The DTC

- No TFP Val. Position Sw. DTC P1810.
- No TP Sensor DTC P1791.
- No Input Speed Sensor DTC(s) P0716 or P0717.
- No Vehicle Speed Sensor DTC(s) P0722 or P0723.
- Engine running.
- Transmission is in D, 3, 2 or 1.
- Vehicle speed above 8 km/h (5 mph).
- TP is greater than 8%.
- No MAP is greater than 20 kPa.
- Transmission fluid temperature is greater than * 10°C (14°F).

All the above conditions are true and any one of the following conditions occur:

- TCM commands 1st gear and 4th gear ratio between 0.67-0.72 is detected for 2 seconds.
- TCM commands 2nd gear and 3rd gear ratio between 0.93-1.05 is detected for 2 seconds.
- TCM commands 3rd gear and 2nd gear ratio between 1.54-1.71 is detected for 3 seconds.
- TCM commands 4th gear and 1st gear ratio between 2.87-3.13 is detected for 4 seconds.

Action Taken When The DTC Is Set

- TCM will flash the Power Lamp.
- Freeze shift adapts from being updated.
- TCM inhibits TCC engagement.
- TCM commands maximum line pressure.
- Immediate landing to 2nd gear.
- DTC P0756 will be stored in TCM memory.

Conditions For Clearing The DTC

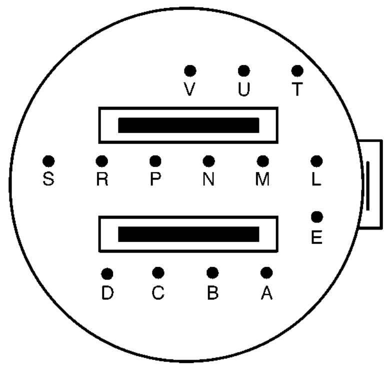
- The TCM will turn the Power Lamp off after DTC P0756 passes condition test. This DTC passes when all conditions for setting the DTC are met and the gear ratio matches the commanded gear for 3 consecutive ignition cycles.
- History DTC(s) can be cleared by using a scan tool.

Diagnostic Aids

- If the DTC cannot be reset after clearing the code, check for possible fluid contamination, plugged or restricted oil circuit.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Shift Solenoid Status Chart

Gear	1-2 Shift Solenoid Valve	2-3 Shift Solenoid Valve
1st	ON	OFF
2nd	OFF	OFF
3rd	OFF	ON
4th	ON	ON



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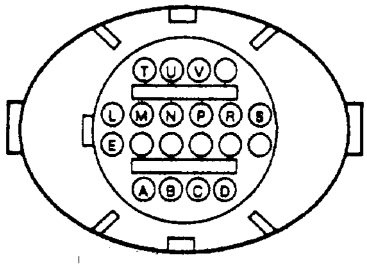

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DTC P0756 – 2-3 Shift Solenoid Performance

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. record then clear DTC(s). Are DTCs P0751 and P0741 also set?	-	Go to Step 2	Go to Step 5
2	Inspect circuit 26/524 from the power feed to connector C301 terminal 9 for an open. Was the condition found?	-	Go to Step 3	Go to Step 4
3	Repair the short to ground in circuit 26/524. Was the condition found and corrected?	-	Go to Step 29	-
4	Check circuit 528 for an open. Was the condition found and corrected?	-	Go to Step 29	-
5	1. Select scan tool 2-3 shift solenoid. 2. Command solenoid ON and OFF three times. 3. Listen at transmission side cover. Does the solenoid click when commanded ON and OFF?	-	Go to Step 24	Go to Step 6
6	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Using J 35616 Connector Test Adapter Kit, connect a test light from terminal E to terminal B. (See Connector View.) 4. Ignition ON, engine OFF. 5. Command the 2-3 Shift Solenoid ON and OFF three times. Does the test light cycle ON and OFF as commanded?	-	Go to Step 14	Go to Step 7

DTC P0756 – 2-3 Shift Solenoid Performance (Cont'd)

Step	Action	Value(s)	Yes	No
7	Is the test light always ON?	-	Go to Step 8	Go to Step 11
8	1. Ignition OFF. 2. Disconnect the TCM connector (additional DTC(s) will set). 3. Ignition ON. Is the test light ON?	-	Go to Step 9	Go to Step 12
9	Check circuit 501 for a short to ground. Was the problem found?	-	Go to Step 10	-
10	Repair short to ground in circuit 501. Is the repair complete?	-	Go to Step 29	-
11	Is the test light always OFF?	-	Go to Step 12	-
12	Check circuit 501 for an open. Was the problem found?	-	Go to Step 13	Go to Step 19
13	Repair the open in circuit 501. Is the repair complete?	-	Go to Step 29	-
14	1. Ignition OFF. 2. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal E to terminal B. (See Transmission Connector View.) Does the ohmmeter display resistance as shown?	19 to 31 W	Go to Step 17	Go to Step 15
15	Is the resistance greater than shown?	§ 250 W	Go to Step 16	Go to Step 17
16	Check circuit 501 and 528 from the transmission connector to the solenoid for an open or poor connection at connector. Was the problem found and corrected?	-	Go to Step 29	-
17	Connect the ohmmeter from terminal B to a good ground is the resistance less than shown?	¦ 1000 W	Go to Step 18	Go to Step 22
18	Check circuit 501 for a short to ground. Was the problem found and corrected?	-	Go to Step 29	-
19	Connect a test light from a good ground to terminal B. Is the test light ON?	-	Go to Step 20	Go to Step 23
20	Check circuit 501 for a short to battery power. Was the problem found?	-	Go to Step 21	-
21	Repair the short to battery power in circuit 501. Is the repair complete?	-	Go to Step 29	-
22	Replace 2-3 Shift Solenoid Valve. Refer to Solenoid Replacement. Is the replacement complete?	-	Go to Step 29	-
23	Replace the TCM. Is the replacement complete?	-	Go to Step 29	-
24	Has the transmission fluid checking procedure been performed?	-	Go to Step 25	Go to Transmission Fluid Check

DTC P0756 – 2-3 Shift Solenoid Performance (Cont'd)

Step	Action	Value(s)	Yes	No
25	1. Use the scan tool to record current gear and gear ratio. 2. Drive the vehicle in D to obtain a 2-3 shift with TP greater than 8% and vehicle speed greater than 8 km/h (5 mph) for three seconds. Are gear rations within given gear range?	1st: 2.87 - 3.13 4th: 0.61 - 0.72	Go to Diagnostic Aids	Go to Step 26
26	Does the engine labor upon start off, or is 3rd gear indicated when 1st gear is commanded?	-	Go to Step 28	Go to Step 27
27	Repair 2-3 Shift circuit. Check 2-3 Shift Solenoid Valve mechanically stuck off. • Solenoid O-ring damage. • 2-3 valve stuck in released position. Was the condition found and corrected?	-	Go to Step 29	-
28	Repair 2-3 shift circuit. Check 2-3 shift circuit for the following: • 2-3 Shift Solenoid Valve mechanically stuck off. • 2-3 Shift valve stuck in applied position. Was the condition found and corrected?	-	Go to Step 29	-
29	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

DIAGNOSTIC TROUBLE CODE (DTC) P1790 TCM CHECKSUM ERROR

Circuit Description

A normal function of the transmission control module (TCM) programming is to perform an internal check that verifies the integrity of the RAM and ROM memory allocations. This function is called a checksum. When the TCM runs this check and the memory allocations do not agree with the previous checksum, then DTC P1790 will set.

Conditions For Setting The DTC

- Ignition ON.
- TCM checksum is incorrect.

Action Taken When The DTC Is Set

- TCM commands maximum line pressure.
- TCM commands 2nd gear.
- TCM inhibits TCC engagement.
- Freeze shift adapts from being updated.
- TCM flashes the power lamp.
- DTC P1790 will be stored in TCM memory.

Conditions For Clearing The DTC

- The TCM will turn the power lamp off after the TCM checksum is correct for three consecutive ignition cycles.
- History DTC(s) can be cleared by using a scan tool.

Diagnostic Aids

Flashing the TCM is not recommended. When DTC P1790 sets, the TCM must be replaced.

DTC P1790 TCM Checksum Error

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn the ignition switch to the ON position. 3. Record, then clear the DTC(s). 4. Turn the ignition OFF for 30 seconds. 5. Engine running. Does the DTC P1790 reset?	-	Go to Step 2	Go to Diagnostic Aids
2	Replace the TCM. Is the replacement complete?	-	Verify repair and exit DTC chart	Refer to TCM replacement procedures

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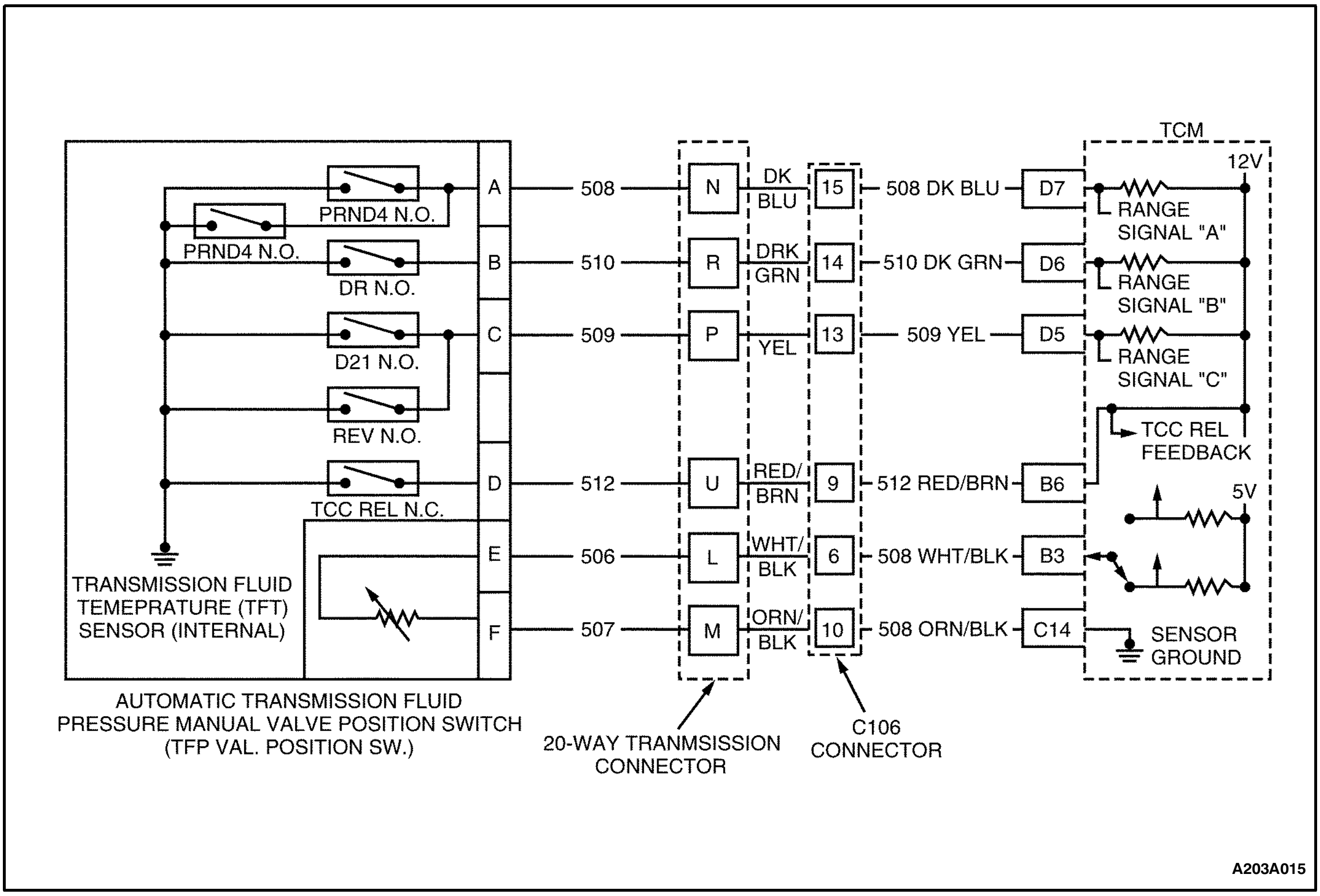


DIAGNOSTIC TROUBLE CODE (DTC) P1810 AUTOMATIC TRANSMISSION FLUID PRESSURE MANUAL VALVE POSITION SWITCH (TFP VAL. POSITION SW.) MALFUNCTION

Circuit Description

The Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) consists of six pressure switches. Five of the switches are normally open and are used for determining gear range selection. The sixth switch is a normally closed switch and is used to detect TCC release fluid pressure. The TFP Val. Position Sw. also contains a Trans Fluid Temperature (TFT) sensor. These components are combined into one unit and mounted on the valve body.

The TCM provides battery voltage on each range signal. By grounding one or more of these switches with fluid pressure from the manual shift valve, the TCM detects what gear range has been selected. When the transmission electrical connector is disconnected and the ignition is on, the ground potential for three range signals from the TCM will be removed and an illegal gear will be indicated.

When the TCM detects an invalid state of the TFP Val. Position Sw. then DTC P1810 sets.

Conditions For Setting The DTC

This DTC will set under any one of the following three conditions:

Condition 1

- Engine running.
- Gear range is illegal for five seconds.

Condition 2

- No VSS DTC(s) P0722 or P0723.
- Engine speed is in transition from 0 to more than 500 rpm.
- TFP Val. Position Sw. indicates D2, D4 or reverse at engine start-up.
- All the above conditions are met for 2 seconds.

Condition 3

- Engine running.
- No TP DTC P1791.
- No VSS DTC(s) P0722 or P0723.

- No Input Speed Sensor DTC(s) P0716 or P0717.
- MAP is 10-105 kPa.
- No shift solenoid DTC(s) P0751 or P0756.
- Vehicle speed is equal to or greater than 8 km/h (5 mph).
- TP is greater than 10%.

And any one of the following three conditions occur:

- TFP Val. Position Sw. indicates P (Park)/N (Neutral) when gear ratio is less than 0.72 (4th gear) for 5 seconds.
- TFP Val. Position Sw. indicates Reverse when ratio is greater than 2.23 or less than 2.02 for 5 seconds.
- TFP Val. Position Sw. indicates D, 3, 2, or 1 when ratio indicates Reverse for 5 seconds.

Action Taken When The DTC Sets

- The TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- Freeze shift adapts from being updated.
- TCM assumes D4 shift pattern.
- Elevate line pressure.
- TCM inhibits TCC engagement.
- DTC P1810 will be stored in TCM memory.

Conditions For Clearing the DTC

Condition 1

- Engine running.
- The TFP Val. Position Sw. does not detect an illegal range for 5 seconds, three consecutive ignition cycles.

Condition 2

- When the following is true for three consecutive ignition cycles.
  - System voltage is 10-17 volts.
  - No VSS DTC(s) P0722 or P0723.
  - Vehicle speed less than 11 km/h (7 mph).
  - TFP Val. Position Sw. indicates park or neutral for 3 seconds.

Condition 3

- After three consecutive ignition cycles when the following is true:
  - TFP Val. Position Sw. indicates P (Park) or N (Neutral) when ratio is greater than 0.72 for 5 seconds.
  - TFP Val. Position Sw. indicates Reverse when ratio is between 2.02 and 2.23 for 5 seconds.
  - TFP Val. Position Sw. indicates D or 3 or 2 or 1 when the ratio is less than 2.02 or greater than 2.23 for 5 seconds.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

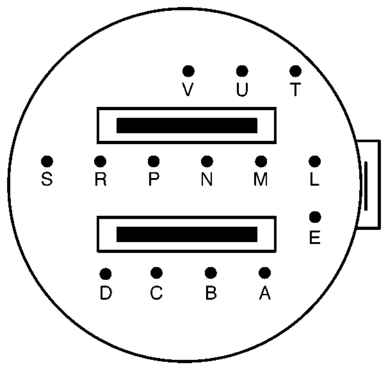
- A pressure regulator problem could possibly set DTC P1810.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

4. This step tests the TCM's ability to recognize an open circuit on signal "A", "B" and "C" ranges.

Gear Position	Range Signal A	Range Signal B	Range Signal c
Park	ON	OFF	OFF
Reverse	ON	OFF	ON
Neutral	ON	OFF	OFF
Drive/OD	ON	ON	OFF
D3/3rd	OFF	ON	OFF
D2/2nd	OFF	ON	ON
D1/Lo	ON	ON	ON
Illegal	OFF	OFF	OFF
Illegal	OFF	OFF	ON



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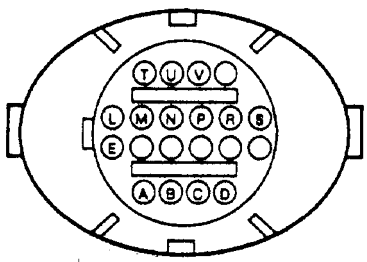

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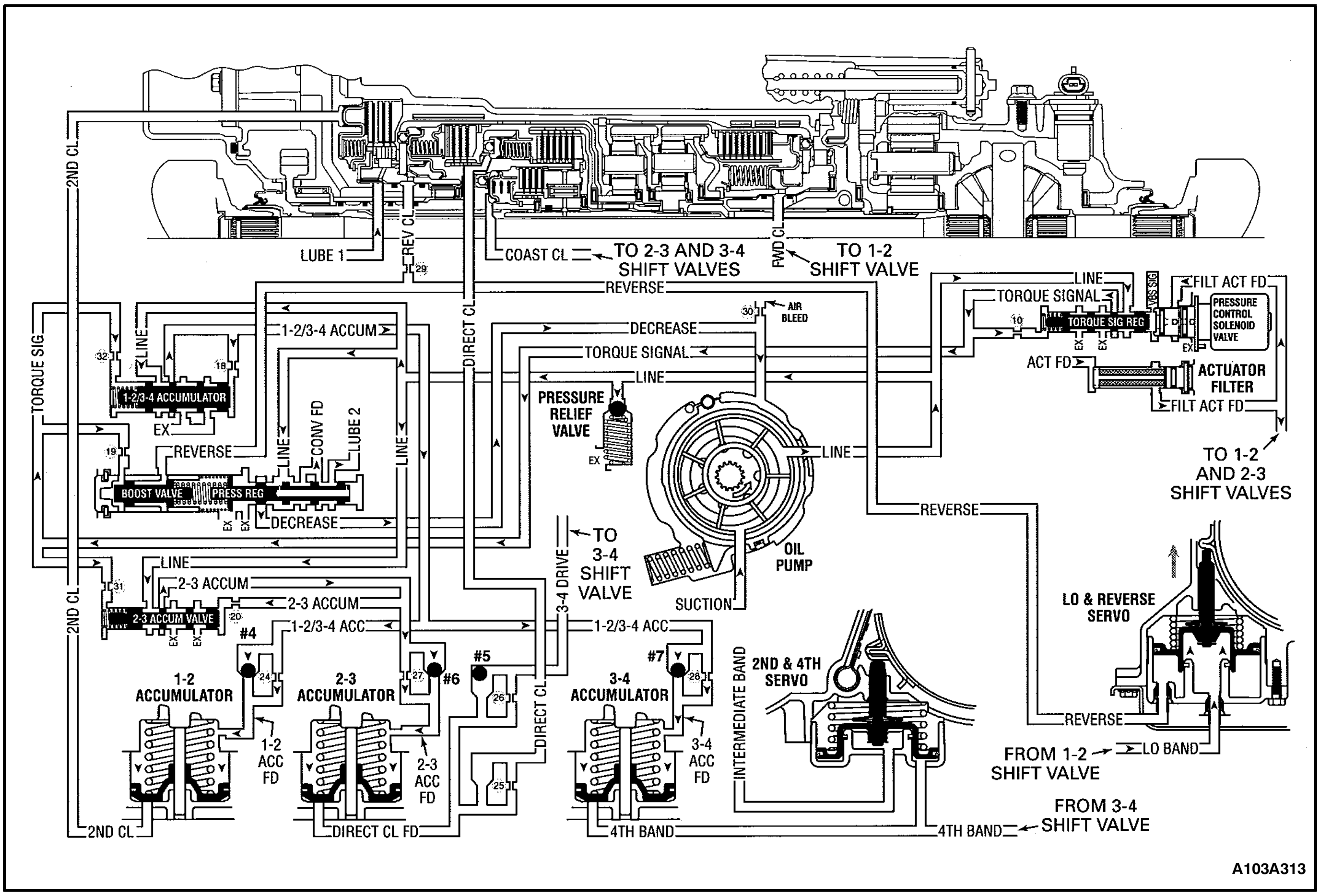
DTC P1810 – Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) Malfunction

Step	Action	Value(s)	Yes	No
1	Has the transmission fluid checking procedure been performed?	-	Go to Step 2	Go to Fluid Check Procedures
2	Check the transmission shift linkage for proper adjustment. Was the condition found and corrected?	-	Go to Step 28	Go to Step 3
3	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). 4. Apply the parking brake. 5. Engine running. 6. Apply the brakes and select each transmission range (P, R, N, 1, 2, 3, D), while monitoring scan tool. Refer to Gear Position and Range Signal Chart. Does each selected transmission range match scan tool and signal range chart?	-	Go to Diagnostic Aids	Go to Step 4
4	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. Ignition ON, engine OFF. Is the TFP Switch display as shown?	A B C OFF/OFF/OFF	Go to Step 11	Go to Step 5
5	Does the TFP Switch signal “A” display ON?	-	Go to Step 8	Go to Step 6
6	Does the TFP Switch signal “B” display ON?	-	Go to Step 9	Go to Step 7
7	Does the TFP Switch signal “C” display ON?	-	Go to Step 10	Go to Step 8
8	Check circuit 508 from the 20-way connector to TCM for a short to ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27
9	Check circuit 510 from the 20-way connector to TCM for a short ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27
10	Check circuit 509 from the 20-way connector to TCM for a short to ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27
11	Note: While performing Steps 11, 12, and 13, if two or more signal ranges display ON, those circuits will be shorted together. Using J 35616 Connector Test Adapter Kit, connect a fused jumper wire from terminal N to a good ground. (See Connector View.) Does the TFP Switch signal “A” display ON?	A ON	Go to Step 12	Go to Step 13
12	Connect a fused jumper wire from terminal R to a good ground. Does the TFP Switch signal “B” display ON?	B ON	Go to Step 13	Go to Step 15
13	Connect a fused jumper wire from terminal P to a good ground. Does the TFP Switch signal “C” display ON?	C ON	Go to Step 17	Go to Step 16
14	Check circuit 508 from the 20-way connector to TCM for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27

DTC P1810 – Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) Malfunction (Cont'd)

Step	Action	Value(s)	Yes	No
15	Check circuit 510 from the 20-way connector to TCM for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27
16	Check circuit 509 from the 20-way connector to TCM for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 27
17	1. Ignition OFF. 2. Using J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal N to a good ground. (See Transmission Connector View.) 3. Observe the ohmmeter display. Is the circuit resistance as shown?	u 1000 W	Go to Step 18	Go to Step 20
18	Connect an ohmmeter from terminal R to a good ground. Observe the ohmmeter display. Is the resistance as shown?	u 1000 W	Go to Step 19	Go to Step 21
19	Connect an ohmmeter from terminal P to a good ground. Observe the ohmmeter display. Is the resistance as shown?	u 1000 W	Go to Step 23	Go to Step 22
20	Check circuit 508 of the transmission harness for a short to ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
21	Check circuit 510 of the transmission harness for a short to ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
22	Check circuit 509 of the transmission harness for a short to ground. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
23	Check circuit 508 from the transmission 20-way connector to TFP Val. Position Sw. for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
24	Check circuit 510 from the transmission 20-way connector to TFP Val. Position Sw. for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
25	Check circuit 509 from the transmission 20-way connector to TFP Val. Position Sw. for an open. Was the condition found and corrected?	-	Go to Step 28	Go to Step 26
26	Replace the TFP Val. Position Sw. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) Replacement. Is the repair complete?	-	Go to Step 28	-
27	Replace the TCM. Is the replacement complete?	-	Go to Step 28	-
28	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



DIAGNOSTIC TROUBLE CODE (DTC) P1811 MAXIMUM ADAPT AND LONG SHIFT

Circuit Description

The transmission line pressure is modified by the TCM through the Pressure Control Solenoid Valve (PC Sol. Valve) to control the gear shift execution time and shift consistency. The TCM monitors various inputs and modifies the shift execution and timing by applying a calculated duty cycle to the PC Sol. Valve, the TCM alters the shifting based on driving habits, transmission load and internal transmission condition.

When the TCM detects long shifts that can not be shortened by shift adapts during the same ignition cycle, then DTC P1811 sets.

Conditions For Setting The DTC

- **Shift time is greater than 1 second at maximum adapt for a total four times per ignition cycle.**

Action Taken When The DTC Sets

- **TCM will NOT flash the Power Lamp.**
- **TCM will command maximum line pressure.**
- **TCM will freeze shift adapts from being updated.**
- **DTC P1811 will be stored in TCM memory.**

Conditions For Clearing The DTC

- **After each ignition cycle without the fault condition present.**
- **To cancel DTC fail actions, the fault must no longer exist and the ignition must be cycled off for five seconds.**
- **History DTC(s) can be cleared by using a Scan Tool.**

Diagnostic Aids

- **Question the owner for the possibility of vehicle overloading, exceeding trailer towing limit, or towing in overdrive.**
- **If after several attempts to gain accurate shift times and an adapt can be made, reset adapts and operate vehicle to assure proper shifting.**

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. **This step checks for possible low fluid level causing delayed shift(s).**
4. **This step checks for possible low line pressure causing delayed shift(s).**

DTC P1811 – Maximum Adapt and Long Shift

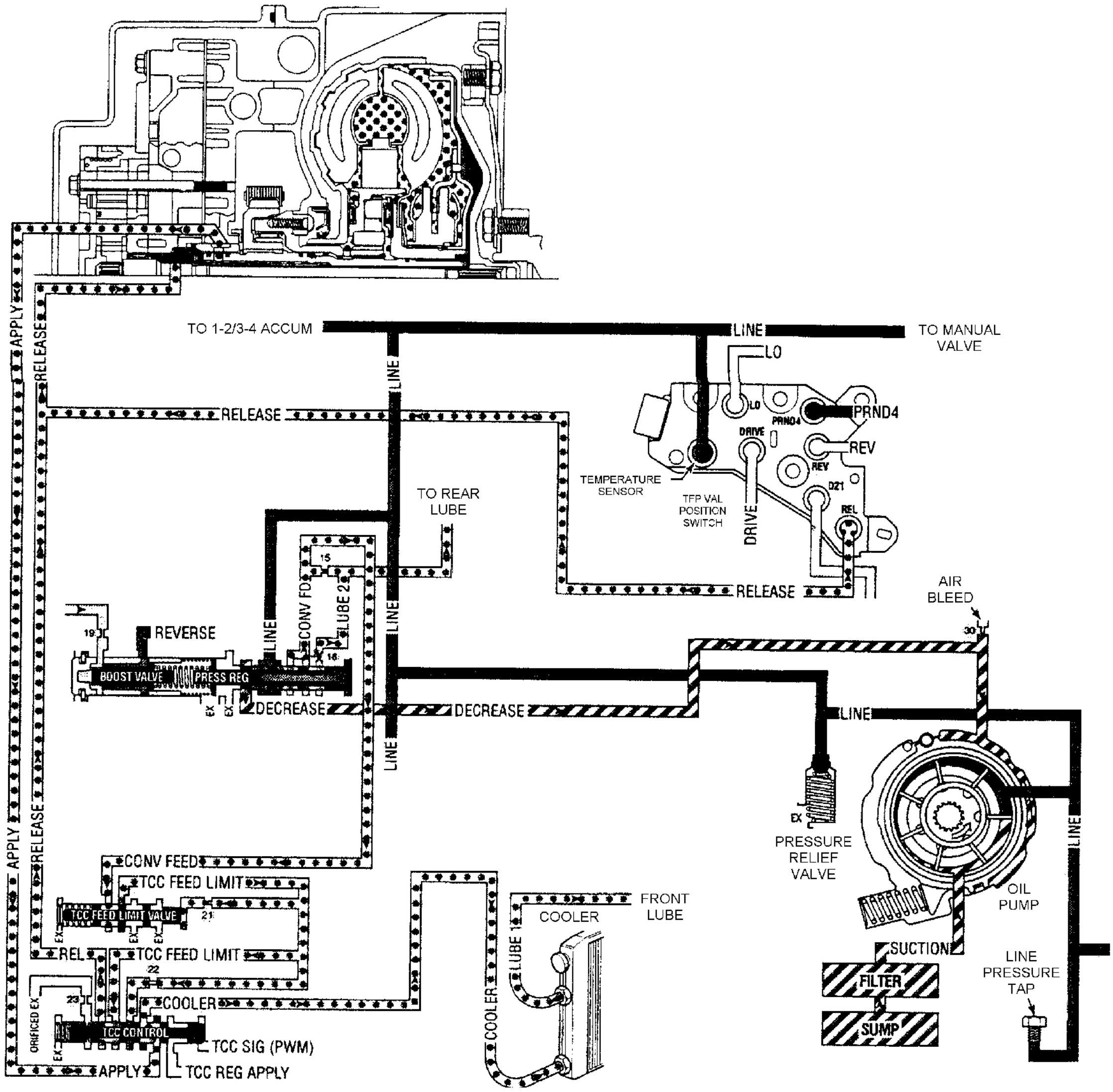
Step	Action	Value(s)	Yes	No
1	Has the transmission fluid checking procedure been performed?	-	Go to Step 2	Go to Transmission Fluid Check
2	1. Install the scan tool. 2. Ignition ON, engine OFF. 3. Record then clear DTC(s). 4. Drive the vehicle in D to obtain a 1-2, 2-3, and 3-4 upshifts. 5. With the scan tool, record 1-2, 2-3, 3-4 shift times. Did all shifts exceed time shown?	u 1 second	Go to Step 3	Go to Step 5
3	Perform the line pressure check. Was the line pressure within specifications?	-	Go to Diagnostic Aids	Go to Step 4
4	Inspect the transmission for: • Low fluid level caused by external leaks • Clogged fuel filter • Out-of-position fluid filter • Internal fluid passage leaks • Casting porosity or damage • Damaged gasket or spacer plate • Out-of-position gasket or spacer plate • Contaminated PC Sol. Valve • Damaged PC Sol. Valve • Stuck PC Sol. Valve • Stuck pressure regulator valve train • Leaking pressure regulator valve train • Stuck torque signal valve train • Leaking torque signal valve train • Leaking oil pump • Damaged oil pump • Inadequate oil pump suction • Oil pump cavitation. Was the condition found and corrected?	-	Go to Step 10	-
5	Did 1-2 shift exceed time shown?	u 1 second	Go to Step 8	Go to Step 6
6	Did 2-3 shift exceed time shown?	u 1 second	Go to Step 9	Go to Step 7
7	Did 3-4 shift exceed time shown?	u 1 second	Go to Step 10	-

DTC P1811 – Maximum Adapt and Long Shift (Cont'd)

Step	Action	Value(s)	Yes	No
8	Inspect the 1-2 shift circuit for the following conditions: • Leaking 1-2 accumulator piston seals • Rolled 1-2 accumulator piston seals • Cut 1-2 accumulator piston seals • Leaking 2nd clutch piston seals • Rolled 2nd clutch piston seals • Cut 2nd clutch piston seals • Burned 2nd clutch plates • Damaged 2nd clutch plates • Broken 2nd clutch springs • Out-of-position 2nd clutch springs • Damaged 2nd clutch piston • Leaking driven sprocket support seals • Damaged driven sprocket support seals • Internal fluid passage leaks • Casting porosity or damage • Damaged gasket or spacer plate • Out-of-position gasket or spacer plate • Slipping forward clutch • Cracked or damaged driven sprocket support • Damaged sprag clutch (not holding) • 2nd roller clutch damaged (not holding) Was the condition found and corrected?	-	Go to Step 11	-
9	Inspect the 2-3 shift circuit for the following conditions: • Leaking 2-3 accumulator piston seals • Rolled 2-3 accumulator piston seals • Cut 2-3 accumulator piston seals • Leaking direct clutch piston seals • Rolled direct clutch piston seals • Cut direct clutch piston seals • Burned direct clutch plates • Damaged direct clutch plates • Broken direct clutch springs • Out-of-position direct clutch springs • Damaged direct clutch piston • Leaking driven sprocket support seals • Damaged driven sprocket support seals • Damaged driven sprocket support • Damaged (or not holding) sprag clutch • Internal fluid passage leaks • Casting porosity or damage • Damaged gasket or spacer plate • Out-of-position gasket or spacer plate Was the condition found and corrected?	-	Go to Step 11	-

DTC P1811 – Maximum Adapt and Long Shift (Cont'd)

Step	Action	Value(s)	Yes	No
10	Inspect the 3-4 shift circuit for the following conditions: • Leaking 3-4 accumulator piston seals • Rolled 3-4 accumulator piston seals • Cut 3-4 accumulator piston seals • Leaking intermediate/4th servo piston seals • Rolled intermediate/4th servo piston seals • Cut intermediate/4th servo piston seals • Burned intermediate/4th band • Out-of-position intermediate/4th band • Damaged intermediate/4th band • Slipping intermediate/4th band • Internal fluid passage leaks • Casting porosity or damage • Damaged gasket or spacer plate • Out-of-position gasket or spacer plate • Slipping direct clutch • Damaged intermediate/4th servo pin • Seized intermediate/4th servo pin • Damaged intermediate/4th servo piston • Cracked intermediate/4th servo cover • Leaking intermediate/4th servo cover Was the condition found and corrected?	-	Go to Step 11	-
11	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart



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DIAGNOSTIC TROUBLE CODE (DTC) P1814
TORQUE CONVERTER OVERSTRESS

Circuit Description

This diagnostic checks for unusually high throttle angle and torque converter slip speed when the transmission is in a drive range. Sustained high torque converter slip speeds will generate excessive heat build-up in the transmission fluid. Operating the vehicle under these conditions is unsafe and will damage the powertrain. When the transmission fluid becomes overheated, it is less effective at providing cooling, lubrication, and cleaning of the transmission components.

When the TCM detects high throttle angle with high torque converter slip then DTC P1814 will set.

Conditions For Setting The DTC

- No TP DTC P1791.
- No VSS DTCs P0722 or P0723 are set.
- No TFP Val. Position Sw. DTC P1810 is set.
- Transmission output speed is less than 1500 rpm.
- The transmission is in Drive or Reverse.
- The throttle angle is greater than 50%.
- The TCC slip speed is greater than 1500 rpm for 8 seconds.

Action Taken When The DTC Is Set

- DTC P1814 will be stored in TCM memory.

Conditions For Clearing The DTC

- When the TCC slip speed is less than 1450 rpm.
- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

A simultaneous acceleration and application of the brakes may cause the DTC to occur.

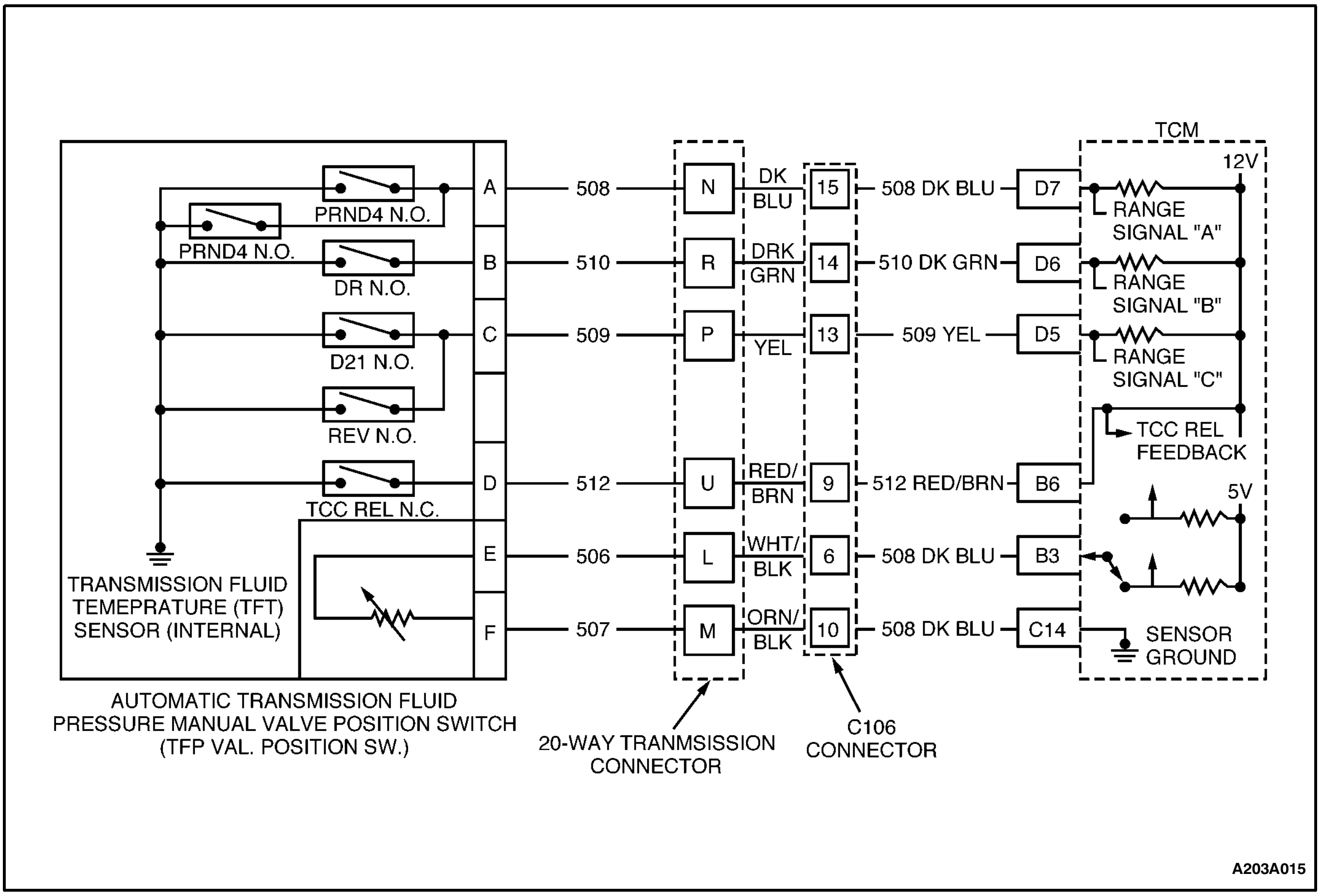
Test Description

The numbers below refer to the step numbers on the diagnostic chart.

1. This step inspects the fluid level and condition. If the fluid condition is suspect, replace the fluid.
3. This step replaces the transmission fluid and filter, and flushes the transmission cooler.

DTC P1814 – Torque Converter Overstress

Step	Action	Value(s)	Yes	No
1	Inspect the transmission fluid level and condition. Is the insepction complete?	-	Go to Step 2	Go to Fluid Checking Procedures
2	Is the transmission fluid dark brown in color and have a burnt odor?	-	Go to Step 3	Go to Step 4
3	Replace the transmission fluid and filter. Flush the transmission cooler. Refer to Changing Oil and Filter. Refer to Transmission Cooler Flush. Are the procedures complete?	-	Go to Step 4	-
4	Advise the customer that overloading the vehicle, exceeding the trailer-towing limit, towing in Overdrive, or simultaneous acceleration and application of the brakes can damage the powertrain.	-	Repair verified, exit DTC Chart	-



DIAGNOSTIC TROUBLE CODE (DTC) P1887
TCC RELEASE SWITCH CIRCUIT MALFUNCTION

Circuit Description

The Torque Converter Clutch (TCC) release switch is part of the Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.) that is mounted to the transmission valve body. The switch is a normally closed switch. The purpose of the switch is to provide a signal to the Transmission Control Module (TCM) that the TCC is released. This is accomplished by Torque Converter release fluid pressure acting on the switch contact and opening the circuit. When the voltage is high on circuit 512, the TCM recognizes that the TCC is no longer engaged.

When the TCM detects the TCC release switch is open indicating TCC is not applied and TCC slip speed indicate the TCC is engaged, then DTC P1887 sets.

Conditions For Setting The DTC

- No Input Speed Sensor DTCs P0716 or P0717.
- No TCC stuck Off DTC P0741.
- No TCC stuck On DTC P0742.
- Engine running.
- Transmission is in D4.
- TCC commanded On.
- TCC slip speed is between -20 RPM and 20 RPM.
- TCC release switch is open.
- All above conditions met for 8 seconds.

Action Taken When The DTC Is Set

- TCM will flash the Power Lamp after two consecutive trips with a failure reported.
- Freeze shift adapts from being updated.
- TCM inhibits TCC engagement.
- DTC P1887 will be stored in TCM memory.

Conditions For Clearing The DTC

- When the following is true for three consecutive ignition cycles and:
  - No Input Speed Sensor DTCs P0716 or P0717.
  - No TCC stuck Off DTC P0741.
  - No TCC stuck On DTC P0742.
  - Engine is running.
  - Transmission is in D4.
  - TCC is commanded ON.

- TCC slip speed is between -20 RPM and 20 RPM.
- TCC Release Switch is closed.
- All above conditions are met for 8 seconds.

- History DTC(s) can be cleared by using a Scan Tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and at the transmission 20-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The numbers below refer to the step numbers on the diagnostic chart.

4. This Step tests the TCM's ability to recognize an open circuit.
5. This Step tests the TCM's ability to recognize a grounded circuit.

DTC P1887 – TCC Release Switch Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. With the engine OFF, turn the ignition switch to the ON position. 3. Record then clear DTC(s). 4. Select scan tool TCC Release Switch. Is the TCC Release Switch status as shown?	Closed	Go to Step 2	Go to Step 4
2	Start the engine. Is the TCC Release Switch status as shown?	Open	Go to Step 13	Go to Step 3
3	1. Ignition OFF. 2. Disconnect the transmission 20-way connector (additional DTC(s) will set). 3. With the engine OFF, turn the ignition switch to the ON position. Is the TCC Release Switch status as shown?	Open	Go to Step 7	Go to Step 6
4	1. Install the J 39775 Jumper Harness to the engine 20-way connector. 2. Using the J 35616 Connector Test Adapter Kit, connect a fused jumper from terminal U to a good ground. Is the TCC Release Switch status as shown?	Closed	Go to Step 7	Go to Step 5
5	Inspect circuit 512 for an open. Was the condition found and corrected?	-	Go to Step 14	Go to Step 12
6	Inspect circuit 512 for a short to ground. Was the condition found and corrected?	-	Go to Step 14	Go to Step 12
7	1. IDisconnect the J 39775 Jumper Harness from the engine 20-way connector. 2. Install the J 39775 Jumper Harness to the transmission 20-way connector. 3. Using the J 35616 Connector Test Adapter Kit, connect an ohmmeter from terminal U to a good ground. Is the resistance less than the specified value?	50 W	Go to Step 8	Go to Step 9
8	Start the engine. Is the resistance greater than the specified value?	50 W	Go to Step 9	Go to Step 10
9	Inspect circuit 512 of the internal wiring harness for an open. Was the condition found and corrected?	-	Go to Step 14	Go to Step 11

7DTC P1887 – TCC Release Switch Circuit Malfunction (Cont'd)

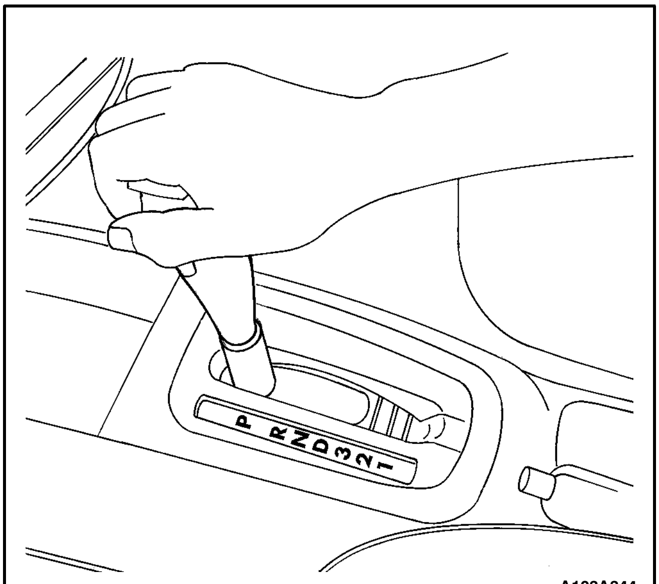
Step	Action	Value(s)	Yes	No
10	Inspect circuit 512 of the internal wiring harness for a short to ground. Was the condition found and corrected?	-	Go to Step 14	Go to Step 11
11	Replace the TFP Val. Position Sw. Refer to Automatic Transmission Fluid Pressure Manual Valve Position Switch Replacement. Is the replacement complete?	-	Go to Step 14	-
12	Replace the TCM. Refer to TCM Replacement. Is the replacement complete?	-	Go to Step 14	-
13	Inspect for the following conditions: • Leaking torque converter O-ring seal (41). Refer to Case and Associated Parts in Automatic Transmission Component Location. • Cut torque converter O-ring seal (41). • Debris or flash blocking the channel plate (27). Refer to Case and Associated Parts in Automatic Transmission Component Location at the TCC release exhaust passage (48), refer to Channel Plate Passages in Automatic Transmission Component Location. • Leaking oil pump bearing and seal assembly (200) seal. Refer to Oil Pump Assembly in Automatic Transmission Component Location. • Cut oil pump bearing and seal assembly (200) seal. • Oil pump bearing and seal assembly (200) installed backward. • Misaligned valve body-to-spacer plate gasket (22). Refer to Case and Associated Parts in Automatic Transmission Component Location. • Misaligned spacer plate-to-channel plate gasket (24). • Channel plate (27) turbine shaft sleeve installed backward or with no press fit. • Valve body spacer plate (23), refer to Case and Associated Parts in Automatic Transmission Component Location or release exhaust orifice (46), refer to Channel Plate Passages in Automatic Transmission Component Location blocked by debris, valve body-to-spacer plate gasket (22) or spacer plate-to-channel plate gasket (24). • Cut turbine shaft-to-sprocket seal (33). Refer to Case and Associated Parts in Automatic Transmission Component Location. • Missing turbine shaft-to-sprocket seal (33). Was the condition found and corrected?	-	Go to Step 14	-
14	1. After the repair is complete, select scan tool "Clear Info" function and road test the vehicle. 2. Review the "DTC Info". Has the last test failed or is the current DTC displayed?	-	Begin Diagnosis again	Repair verified, exit DTC Chart

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

TRANSAXLE FLUID LEVEL CHECKING PROCEDURE

1. Start the engine and allow the engine to idle for approximately 5 minutes, or, if possible, drive the vehicle for a few miles to warm the transaxle fluid. Check the fluid level when the transaxle is above 40°C (104°F).
2. Park the vehicle on a hoist, inspection pit, or similar raised-level surface. The vehicle must be level to obtain a correct fluid level measurement.
3. Place a fluid container below the fluid level plug.



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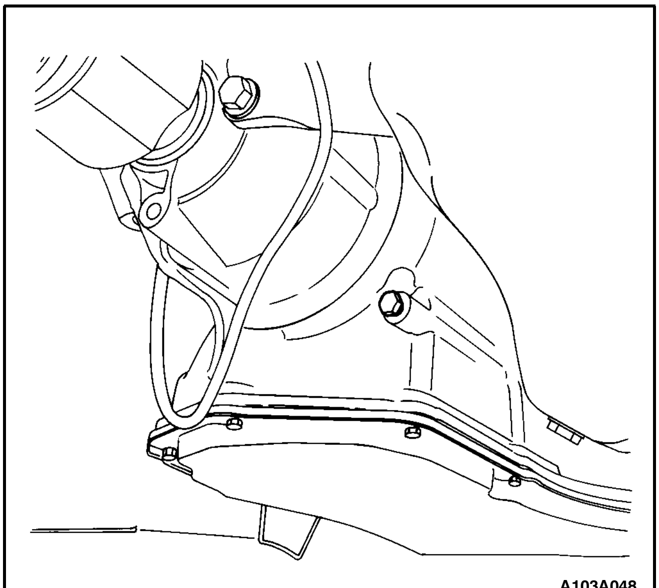
4. Press the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each range. Return the shift lever to the PARK position. (Left-Hand Drive Shown, Right-Hand Drive Similar.)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Caution: Do not remove the fluid level plug if the transaxle fluid is hot. This may cause injury if the fluid drains from the plug hole.

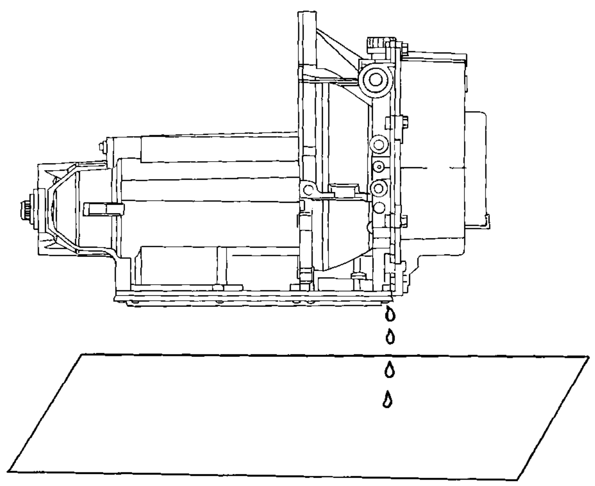
5. Remove the fluid level plug. Because the transaxle operates correctly over a range of fluid levels, fluid may or may not drain out of the plug hole when the plug is removed.
6. If fluid does not drain through the plug hole after adding a total of 1.5 liters, then the transaxle was either underfilled or the transaxle is leaking fluid. Inspect the transaxle for fluid leaks. Fix any leaks before setting the transaxle fluid level.
7. Install the fluid level plug.

   Tighten

   Tighten the fluid level plug to 12 N•m (106 lb-in).
8. When the fluid level checking procedure is completed, wipe any fluid from the transaxle case with a rag or shop towel. Also, check that the fluid fill cap and the vent tube are properly installed.

CHANGING THE FLUID

1. Disconnect the negative battery cable.
2. Remove the transaxle fluid filter and the filter seal. Refer to "Fluid Filter and Seal" in this section.
3. Flush the oil cooler. Refer to "Oil Cooler Flushing" in this section.
4. Install the transaxle fluid filter and the filter seal. Refer to "Fluid Filter and Seal" in this section.
5. Add transaxle fluid. Refer to "Transaxle Fluid Level Checking Procedure" in this section.
6. Connect the negative battery cable.



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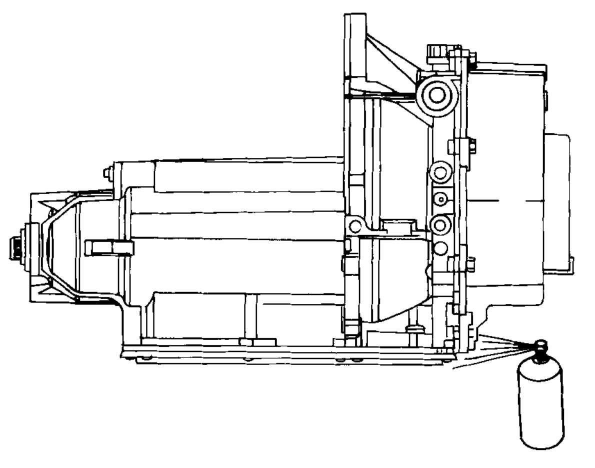
REPAIRING FLUID LEAKS

Locating Leaks

General Method

1. Verify that the leak is transaxle fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for about 15 miles or until the transaxle reaches normal operating temperature, 88°C (190°F).
4. Park the vehicle over clean paper or cardboard.
5. Shut the engine off and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.



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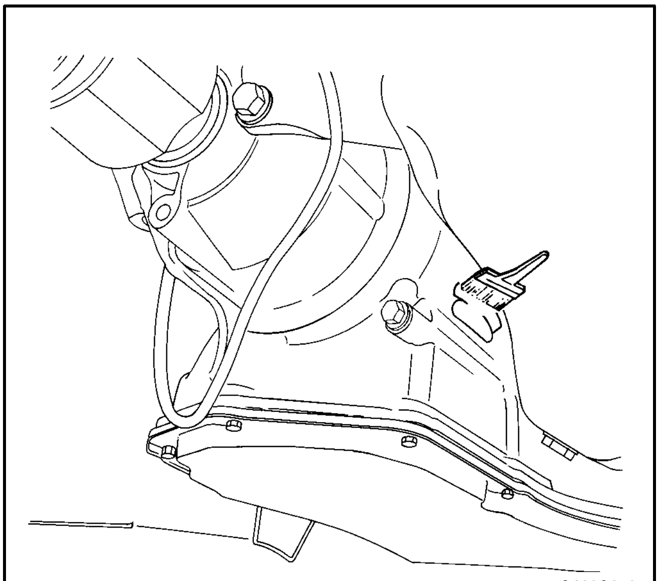
Powder Method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol-type powder (foot powder) to the suspected leak area.
3. Operate the vehicle for about 15 miles or until the transaxle reaches normal operating temperature, 88°C (190°F).
4. Shut the engine off.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

Repairing the Fluid Leak

The following are potential causes for fluid leaks. Check these and repair as necessary.

- Fasteners are not tightened to specifications.
- Fastener threads and tapped holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged, or worn.
- The seal bore or the gasket surface is damaged, warped, or scratched.
- The manual shaft is nicked or damaged.
- There is a loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- The fluid level is too high.
- There is a plugged vent or a damaged vent tube.
- There is water or coolant in the fluid.
- Fluid drain back holes are plugged.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CASE POROSITY REPAIR

Caution: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.
2. Using instructions from the manufacturer, mix a sufficient amount of epoxy to make the repair.
3. While the transaxle case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for 3 hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures. Refer to “Fluid Leak Diagnosis and Repair” in this section.

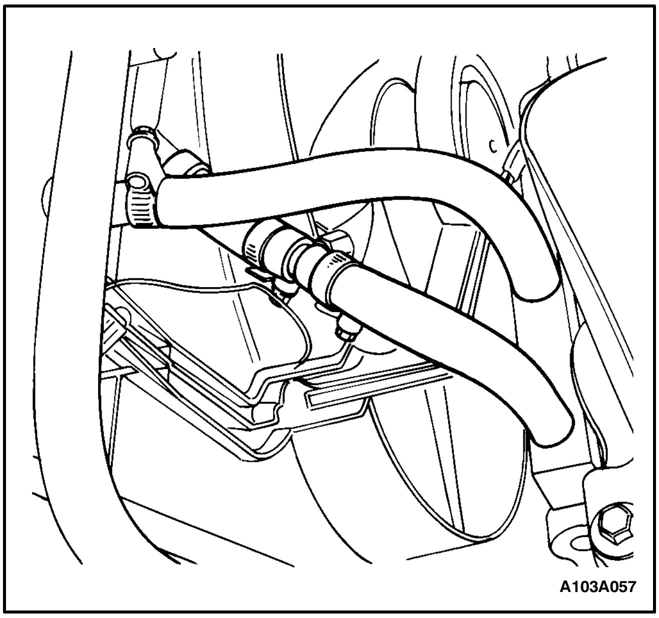
FLUID LEVEL SET AFTER SERVICE

1. Add transaxle fluid through the fill cap hole prior to adjusting the fluid level. The amount of fluid to add should be based on the type of service done. If the bottom pan was removed, add 7 liters (7.4 quarts). If a new torque converter was installed, add 2.5 liters (2.6 quarts). If a complete overhaul was done, refill the system with 10 liters (10.6 quarts). Use DEXRON[-III transaxle fluid only.
2. Check the transaxle fluid level. Refer to "Transaxle Fluid Level Checking Procedure" in this section.
3. Add additional fluid through the fill cap hole in 0.5 liter increments until the fluid comes out through the plug hole.
4. Allow the fluid to finish draining out through the plug hole, then install the fluid level plug.

   Tighten

   Tighten the fluid level plug to 12 N•m (106 lb-in).
5. When the fluid level setting procedure is completed, wipe any fluid from the transaxle case with a rag or shop towel. Also, check that the fluid fill cap and the vent tube are properly installed.

OIL COOLER FLUSHING



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1. Disconnect both cooler lines from the transaxle. Refer to "Oil Cooler Hoses" in this section.
2. Place a hose over the end of the cooler inlet line (from the top of the cooler) and insert the hose into an empty container.
3. Flush clean transaxle fluid through the return line (from the bottom of the cooler) using an oil suction gun until clean transaxle fluid comes out of the hose. This will back flush the cooler.

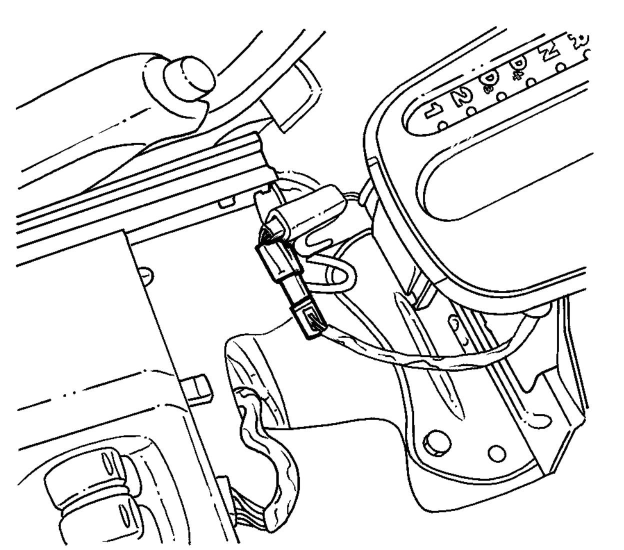
Important: If transmission fluid does not come out of the hose from the radiator, the cooler tubes within the radiator are damaged. The radiator should be repaired or replaced.

4. Remove the hose from the inlet cooler line and place it on the return line.
5. Flush clean transaxle fluid through the inlet line until clean transaxle fluid comes out of the return line. Remove the remaining transaxle fluid with compressed air. Flush with new transaxle fluid.
6. Reconnect the oil cooler lines to the transaxle. Refer to "Oil Cooler Hoses" in this section.

SHIFT CONTROL LEVER

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



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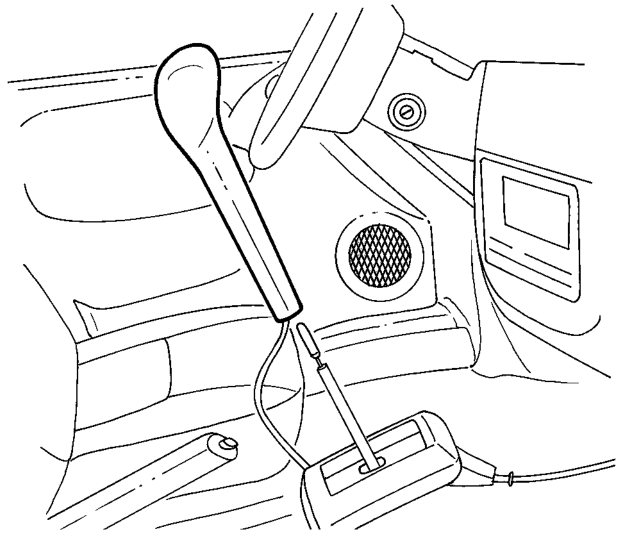
1. Disconnect the negative battery cable.
2. Remove the front part of the floor console. Refer to Section 9G, Interior Trim.
3. Disconnect the power mode switch electrical connection.



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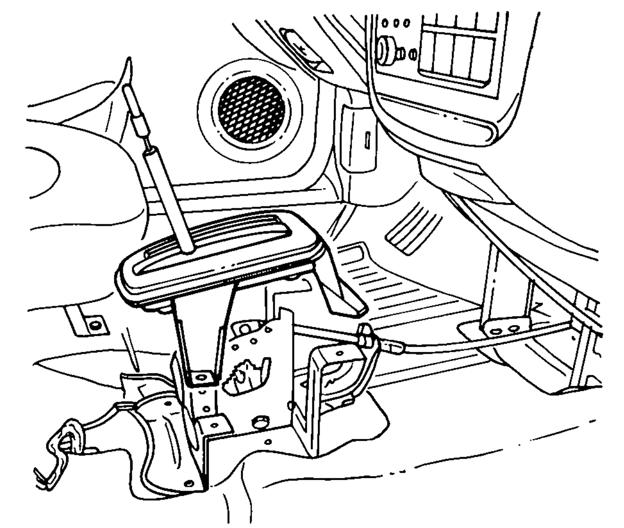
4. Remove the screws securing the shift control lever handle to the shift control lever. Remove the shift control lever handle.



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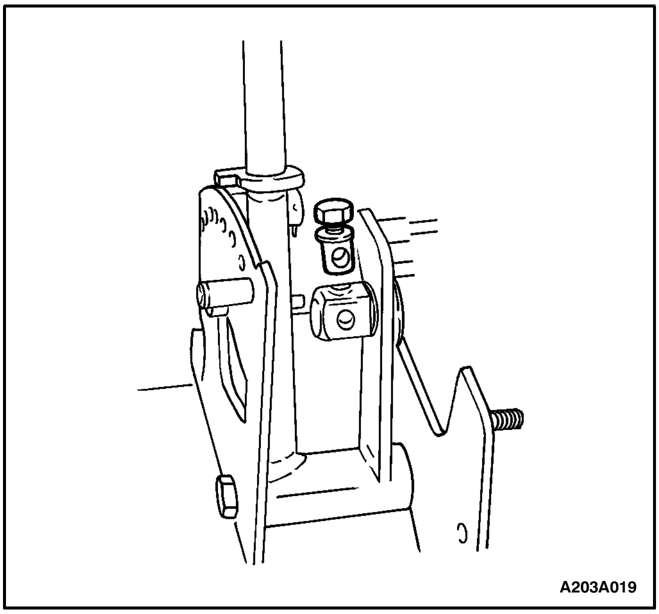
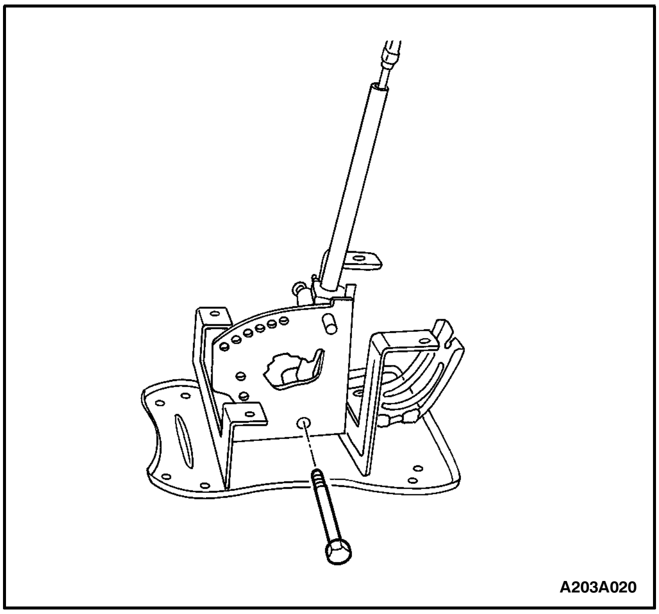
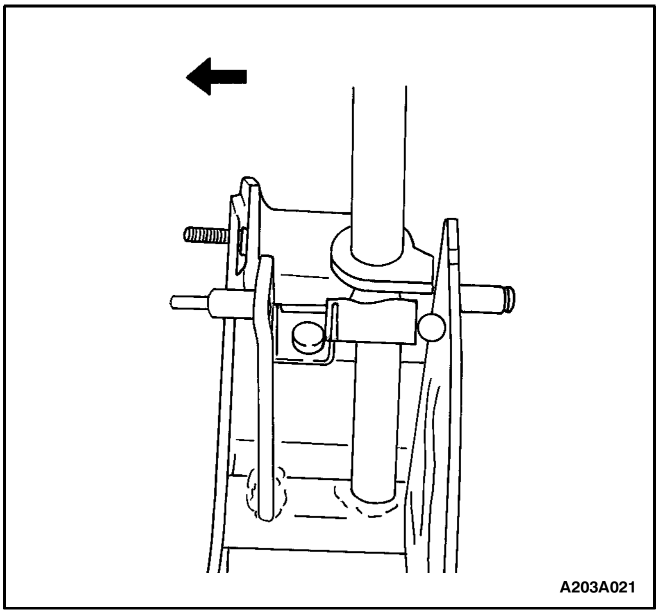
5. Remove the selector position indicator bracket.



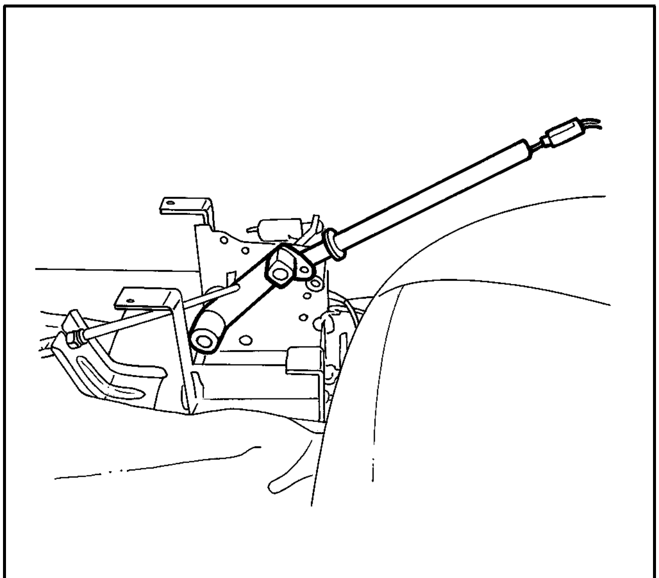
6. Slide the shift control cable out of the shift control cable adjuster and remove the pinch bolt assembly.



7. Remove the bolt from the bottom of the shift control lever.



8. Tilt the shift control lever to the left side and remove the spring-loaded detent ball.



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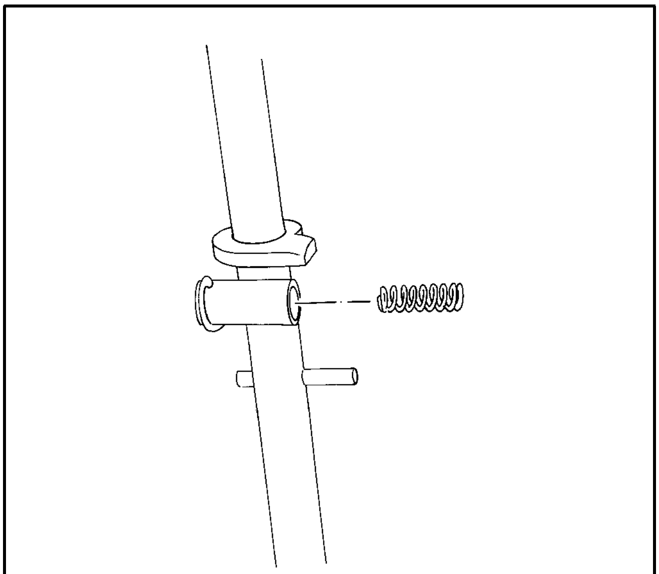
9. Remove the shift control lever by pressing the lock release shaft while pivoting the bottom of the shift control lever toward the front of the vehicle.



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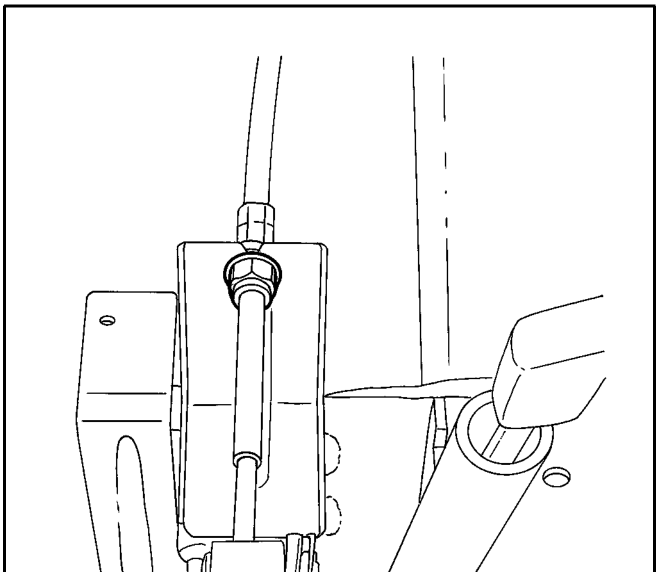
10. Slide the detent spring out of the shift control lever.



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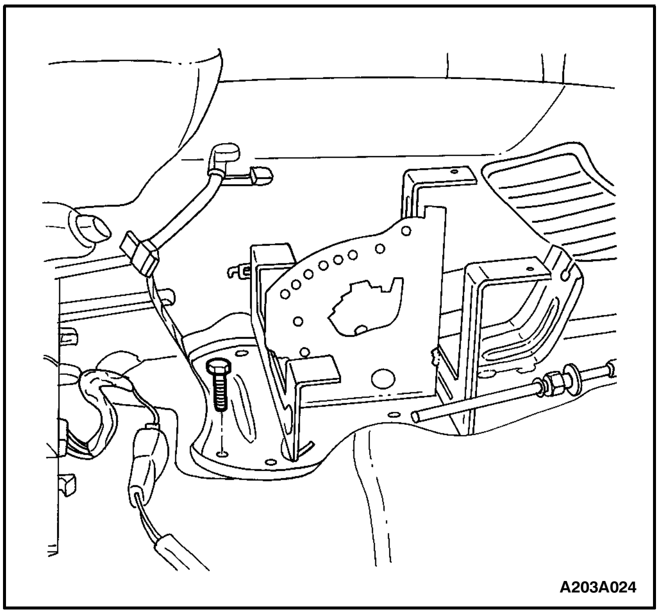
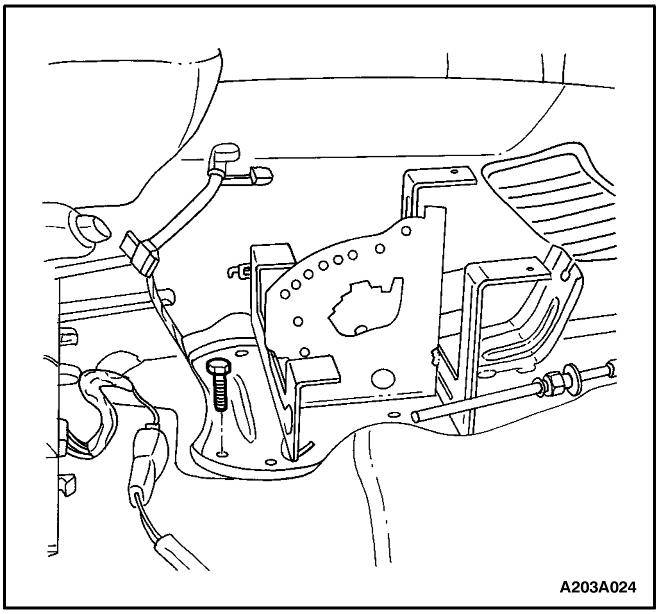
11. Loosen the shifter cable nut.
12. Remove the shift control cable from the shift control assembly.

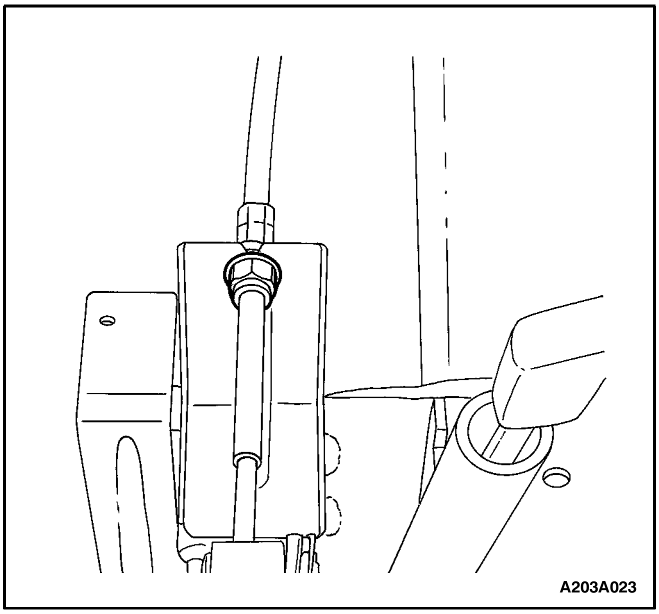


12. Remove the bolts securing the shift control assembly to the floor panel.
13. Remove the shift control assembly.

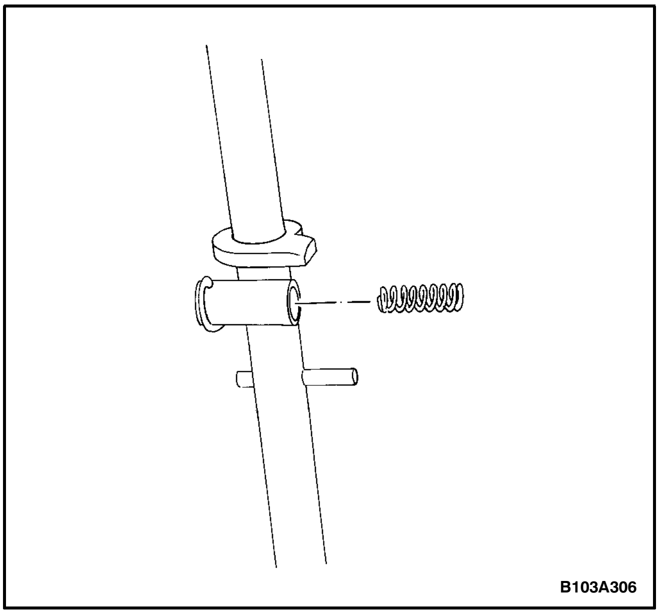


Installation Procedure

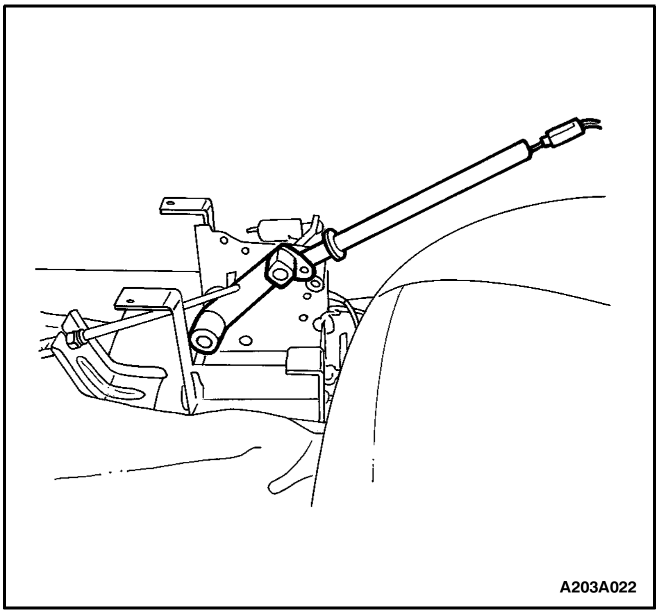
1. Install the shift control assembly to the floor panel with the bolts.



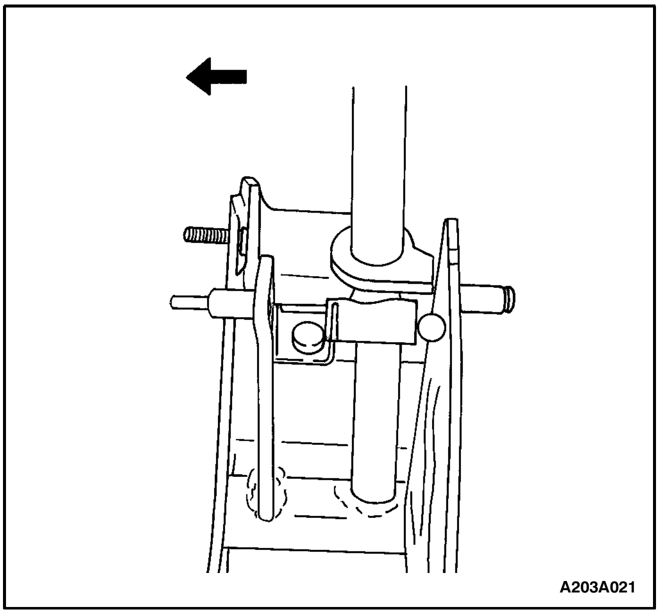
2. Install the shift control cable into the shift control assembly.
3. Tighten the shifter cable nut.



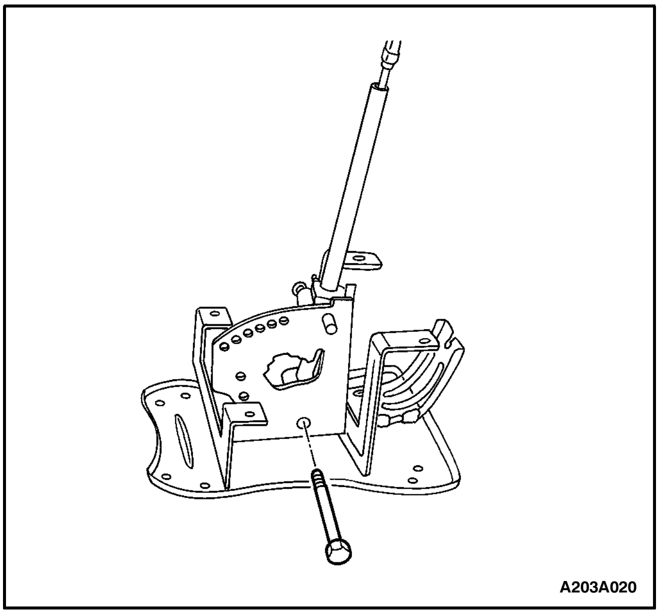
4. Install the detent spring into the shift control lever.



5. Install the shift control lever by pressing the lock release shaft while pivoting the bottom of the shift control lever toward the rear of the vehicle.

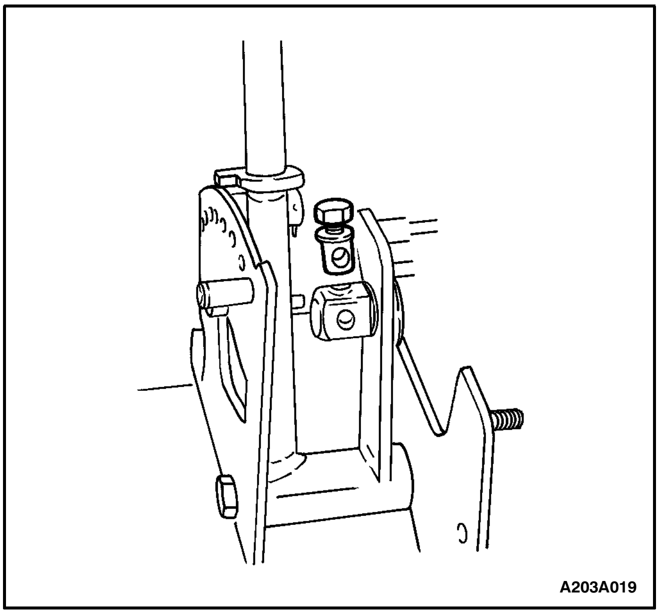


6. Tilt the shift control lever to the left side and install the spring-loaded detent ball.



A203A020

7. Install the bolt into the bottom of the shift control lever.

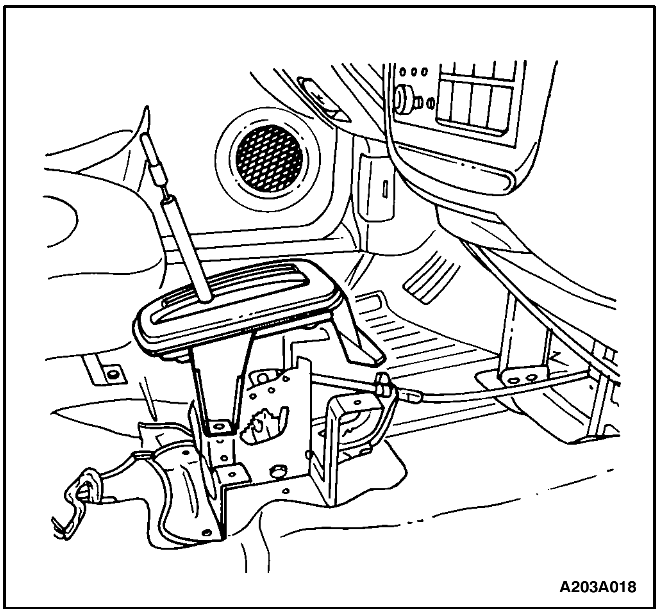


A203A019

8. Install the pinch bolt assembly into the shift control cable adjuster and slide the shift control cable into the shift control cable adjuster. Refer to "Control Cable Adjustment" in this section.

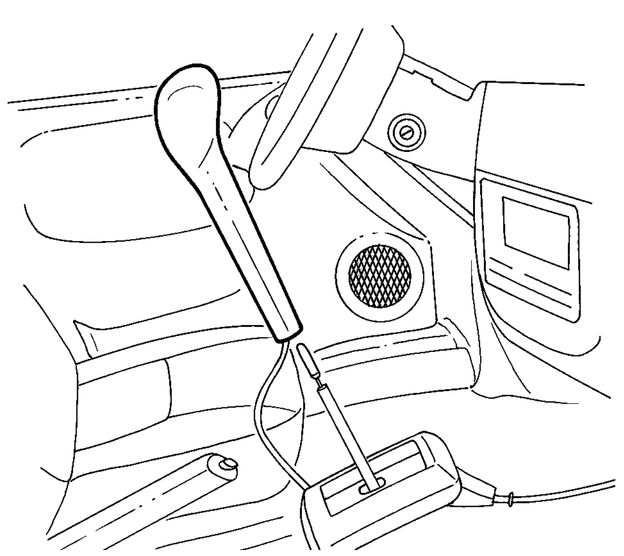
Tighten

Tighten the shift control cable adjuster pinch bolt to 8 N•m (71 lb-in).



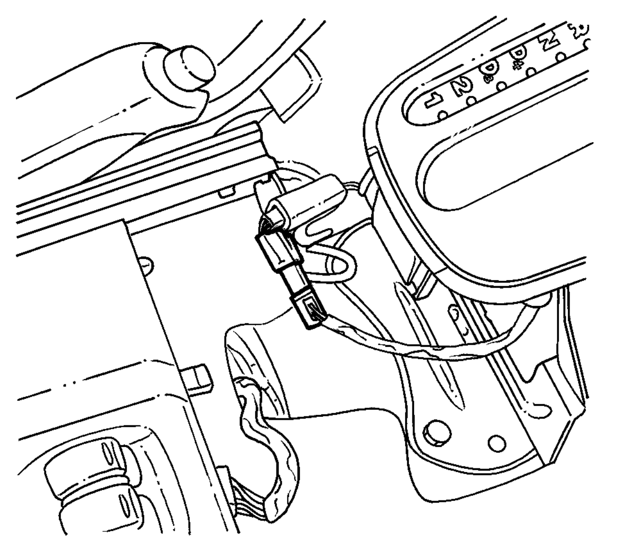
A203A018

9. Install the selector position indicator bracket.



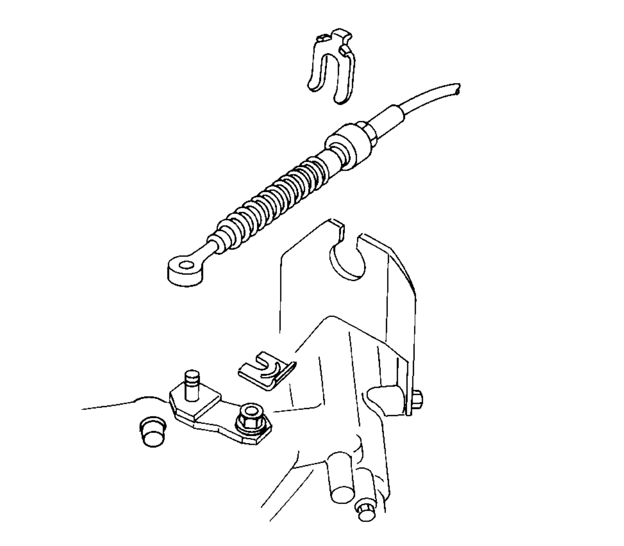
A203A017

10. Install the shift control lever handle. Install the two screws securing the shift control lever handle to the shift control lever.



A203A016

11. Connect the power mode switch electrical connection.
12. Install the front part of the center console. Refer to Section 9G, Interior Trim.
13. Connect the negative battery cable.

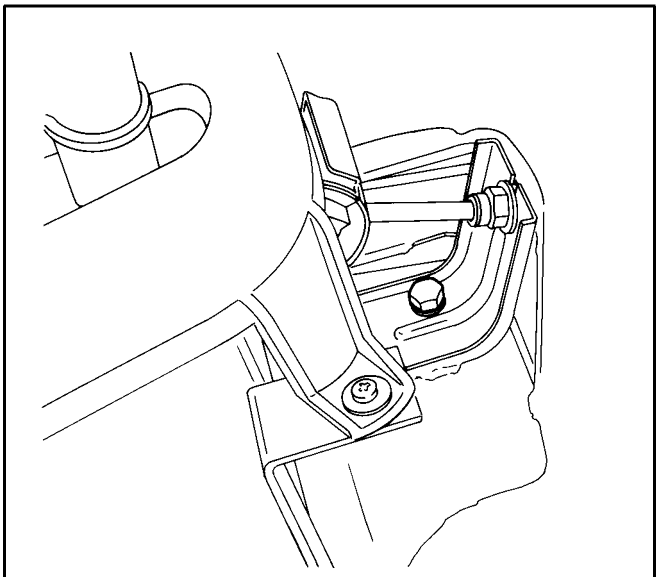


A103A049

SHIFT CONTROL CABLE

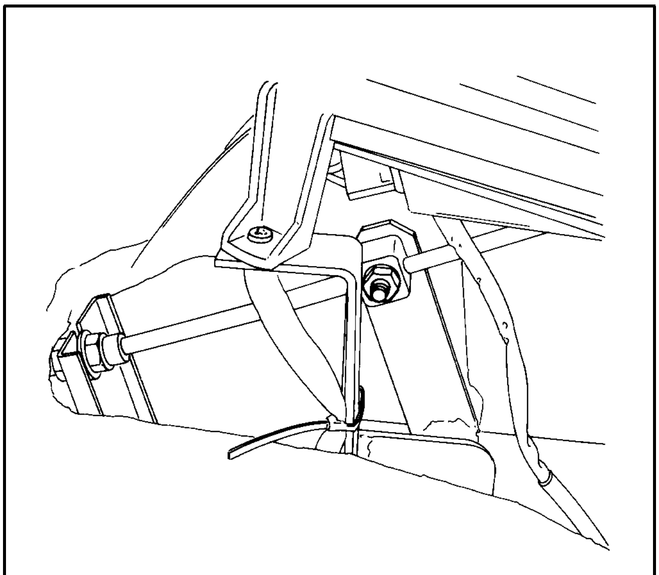
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the shift control cable from the shift lever.
3. Disconnect the shift control cable from the bracket.



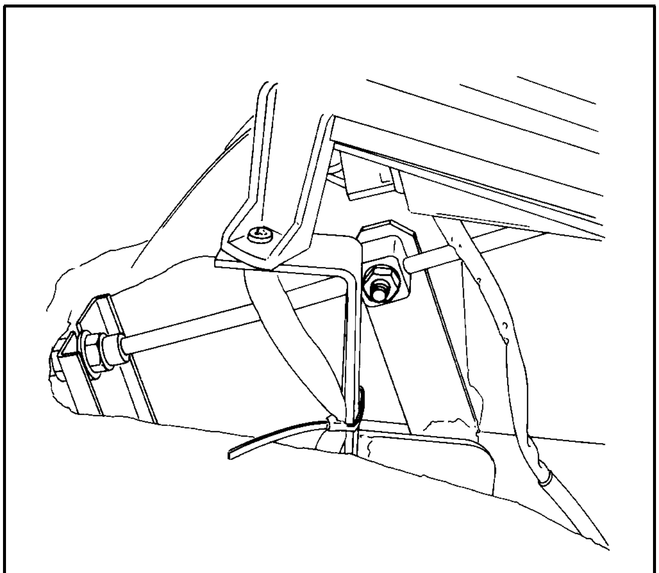
A103A050

4. Remove the front part of the floor console. Refer to Section 9G, Interior Trim.
5. Loosen the floor bracket bolt.



A103A052

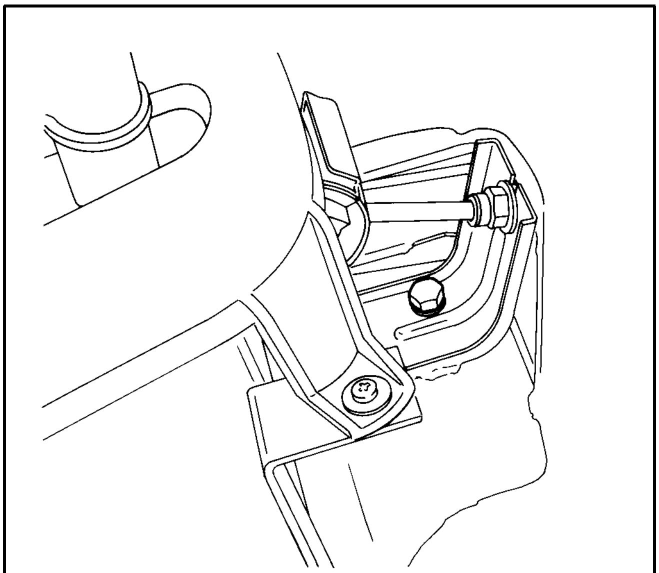
6. Loosen the shifter cable nut.
7. Remove the shift control cable from the floor bracket and the shifter post.
8. Remove the shift control cable through the firewall.



A103A052

Installation Procedure

1. Install the shift control cable through the firewall.
2. Install the shift control cable through the floor bracket and the shifter post.
3. Tighten the shifter cable nut.

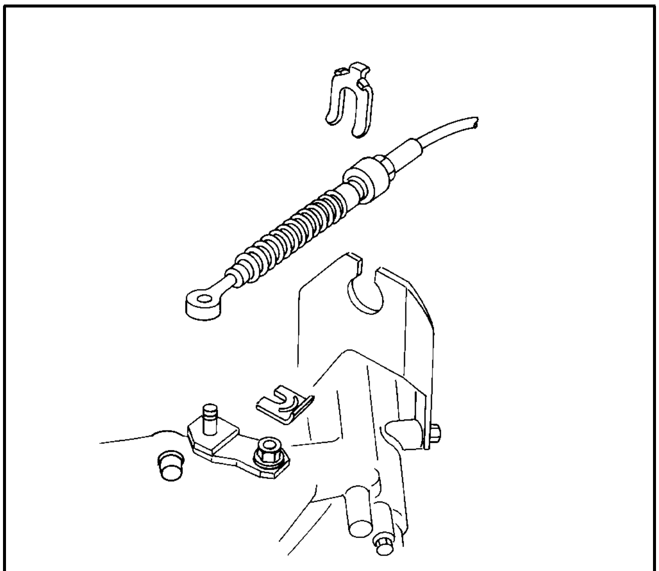


A103A050

4. Tighten the floor bracket bolt.

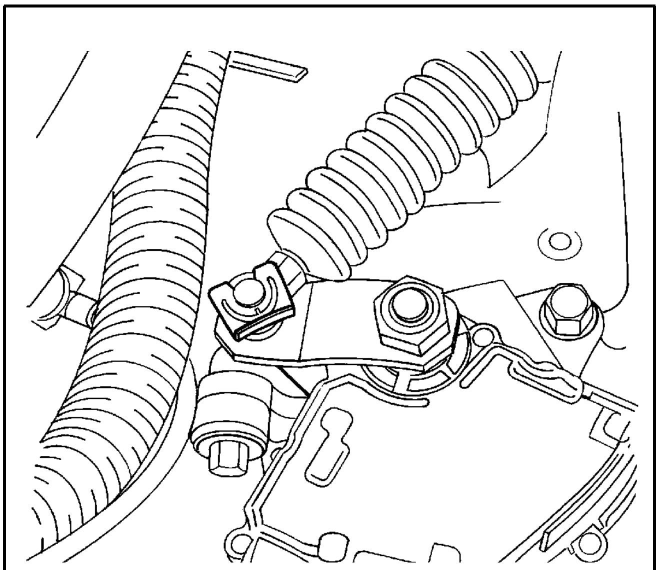
Tighten

Tighten the floor bracket bolt to 8 N•m (71 lb-in).



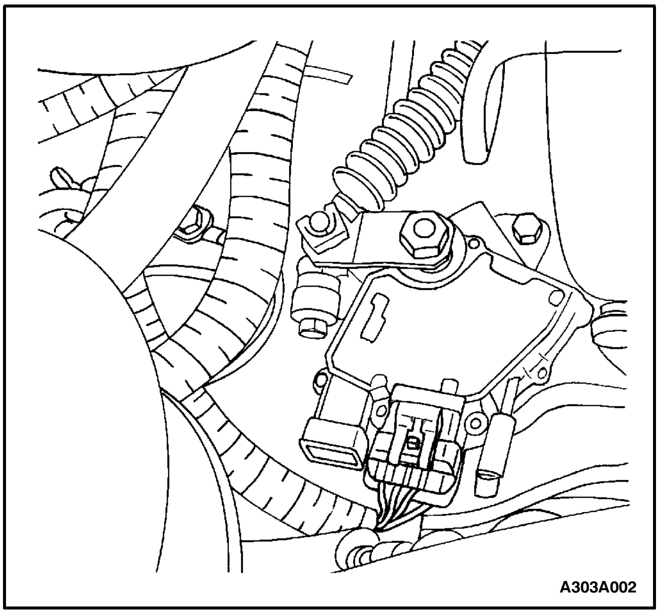
A103A049

5. Install the shift control cable into the engine compartment bracket and secure with the clip.



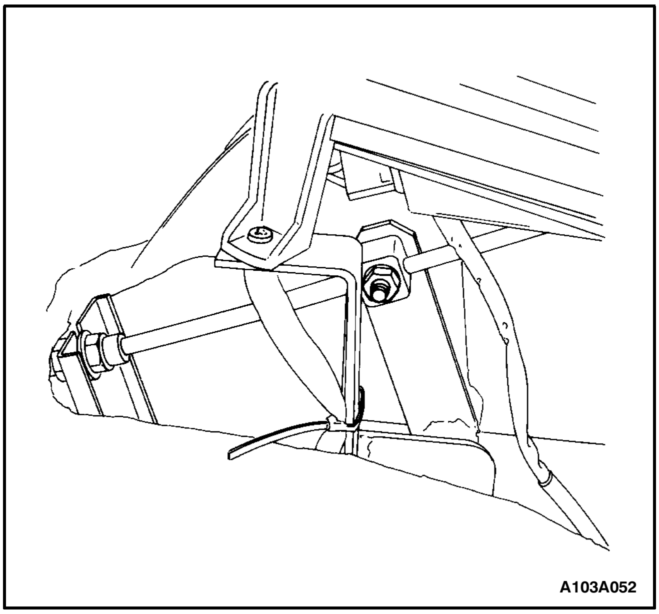
A303A001

6. Install the front part of the floor console. Refer to Section 9G, Interior Trim.
7. Install the shift control cable onto the shift lever and secure with the clip.
8. Connect the negative battery cable.

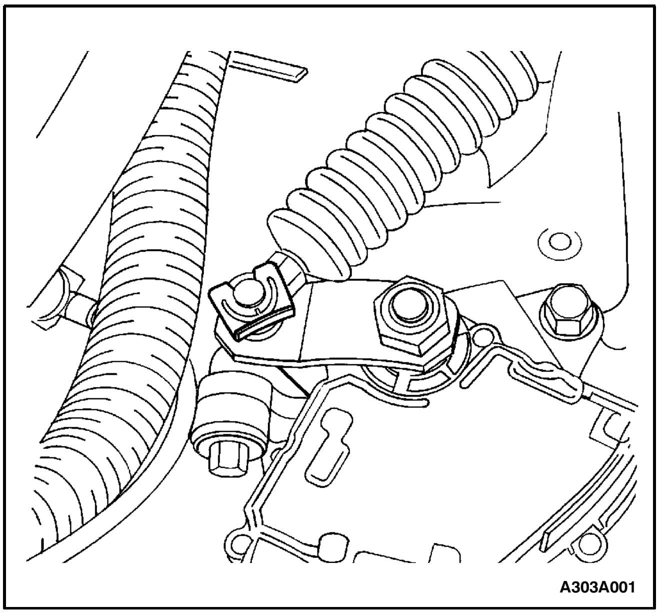


CONTROL CABLE ADJUSTMENT

1. Disconnect the negative battery cable.
2. Move the shift lever to the PARK position.
3. Make sure the range selector lever on the transaxle is in the PARK position.



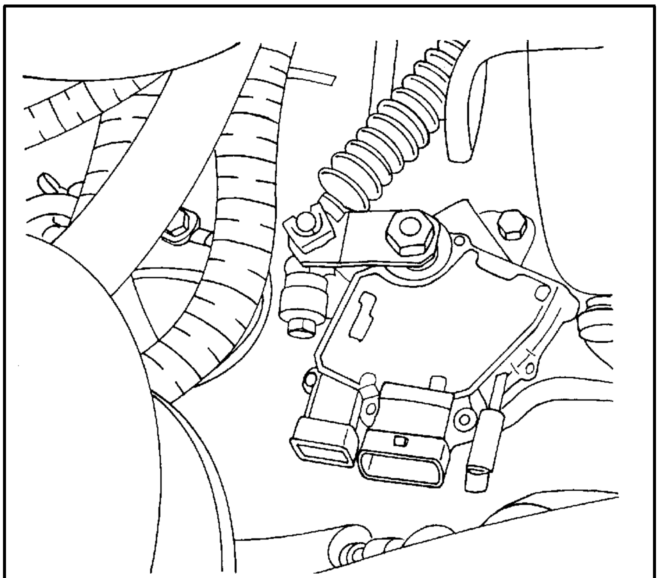
4. Remove the front part of the floor console. Refer to Section 9G, Interior Trim.
5. Loosen the shifter post nut.
6. Pull the shifter control cable until it is tight.
7. Tighten the shifter post nut.
8. Install the the front part of floor console. Refer to Section 9G, Interior Trim.
9. Connect the negative battery cable.



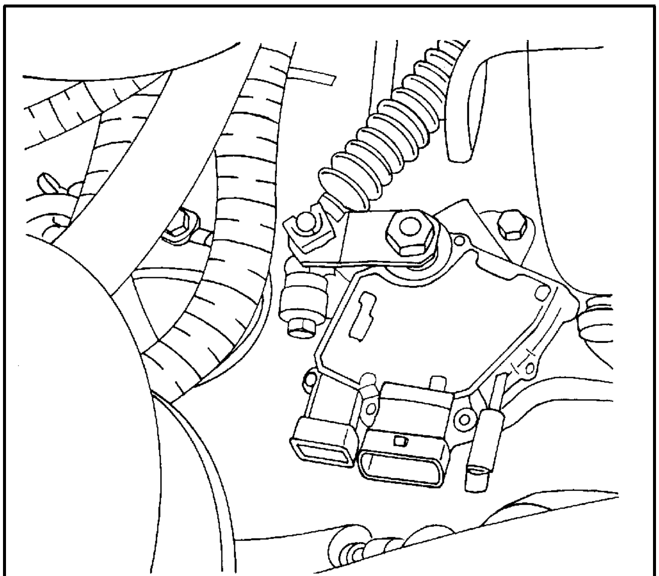
NEUTRAL START SWITCH

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the neutral start switch electrical connector.
3. Disconnect the shift control cable and the retaining clip.

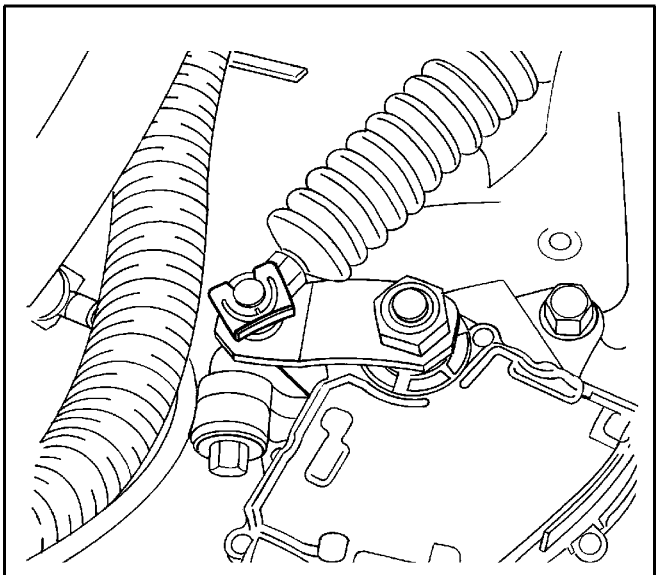

A303A003

4. Remove the shift lever nut and the shift lever.
5. Remove the neutral start switch.

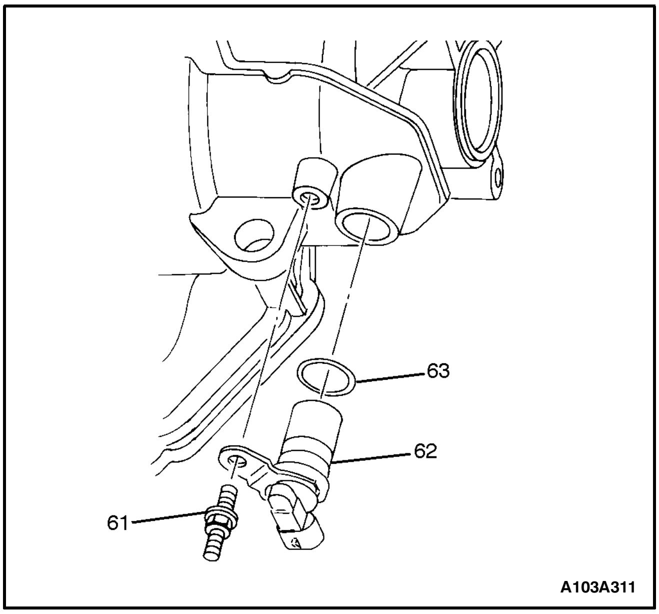

A303A003

Installation Procedure

1. Install the neutral start switch.
2. Install the shift lever and the shift lever nut.


A303A001

3. Connect the shift control cable and the retaining clip.
4. Connect the neutral start switch electrical connector.
5. Connect the negative battery cable.



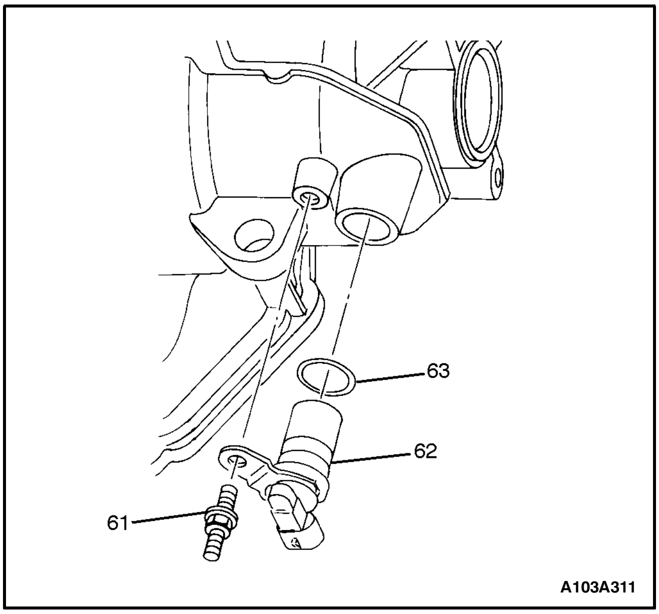
AUTOMATIC TRANSMISSION OUTPUT SPEED SENSOR (A/T OSS)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the A/T OSS electrical connector.
3. Remove the A/T OSS stud (61).

Notice: Be sure to pull the A/T OSS straight out of the transaxle case in order to prevent damage to the case bore.

4. Pull the A/T OSS (62) straight out of the transaxle case.
5. Remove the O-ring (63) from the A/T OSS (62).

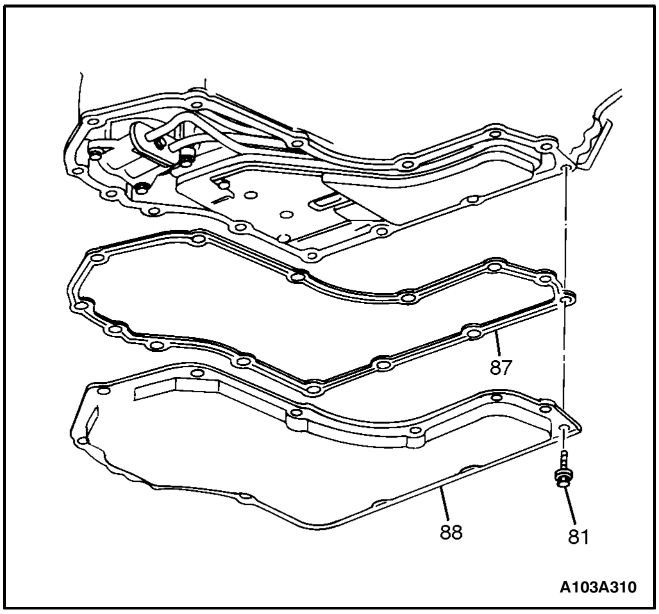


Installation Procedure

1. Inspect the A/T OSS for damage. Clean and dry the A/T OSS. Install the O-ring (63) on the A/T OSS (62).
2. Install the A/T OSS (62) in the transaxle case.
3. Install the A/T OSS stud (61).

   Tighten

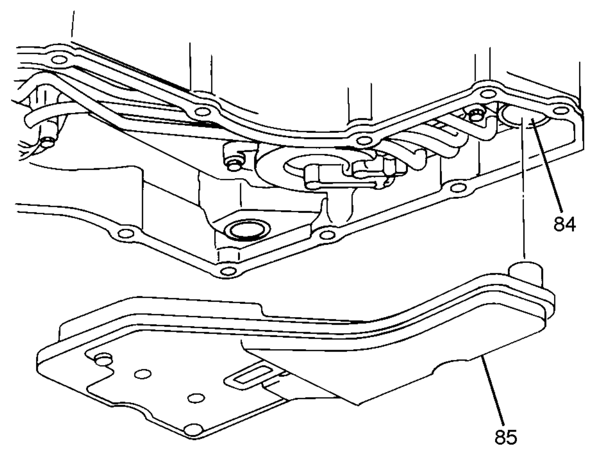
   Tighten the A/T OSS stud (61) to 12 N•m (106 lb-in).
4. Connect the A/T OSS electrical connector.
5. Connect the negative battery cable.



PAN, GASKET, AND FILTER

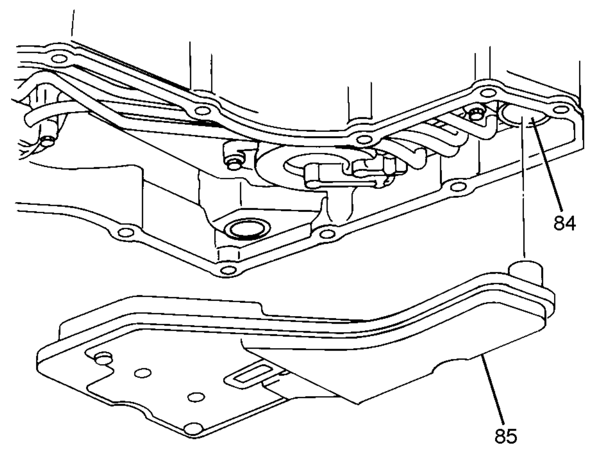
Removal Procedure

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Place a fluid container below the oil pan.
4. Remove the transaxle oil pan bolts (81) and the pan (88).
5. Remove the transaxle oil pan gasket (87). The gasket is reusable.



A103A305

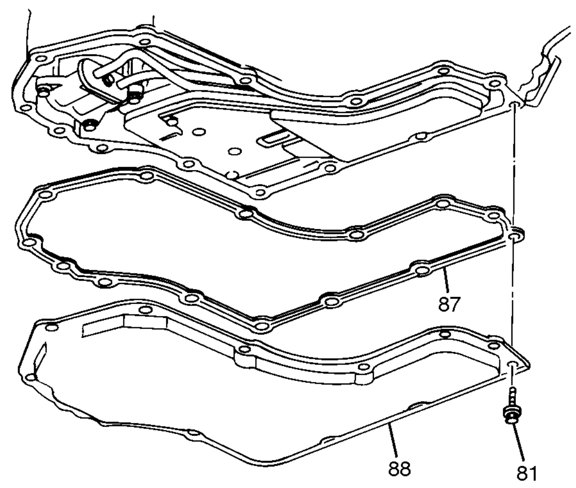
6. Remove the transaxle filter (85) and the neck seal (84).



A103A305

Installation Procedure

1. Install a new transaxle filter neck seal (84) and a transaxle filter (85).



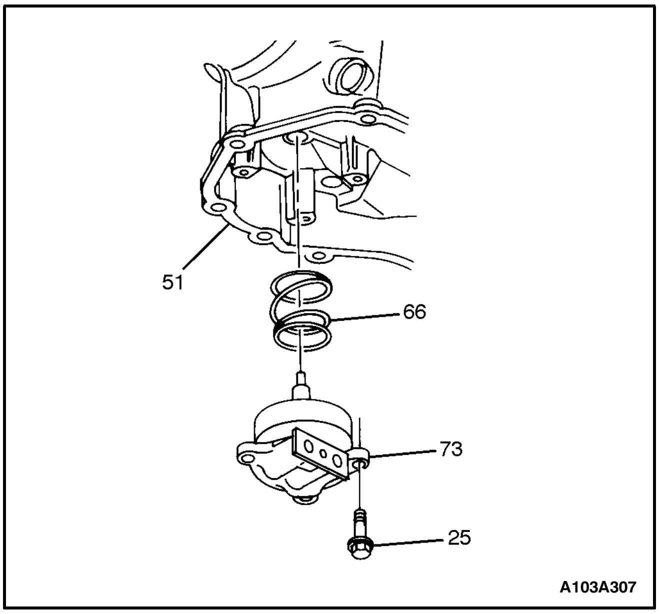
A103A310

2. Inspect the gasket (87) and the pan (88) for cracks, dents, or cuts. Install the transaxle pan (88) and the gasket (87).
3. Install the transaxle pan bolts (81).

Tighten

Tighten the transaxle pan bolts (81) to 12 N•m (106 lb-in).

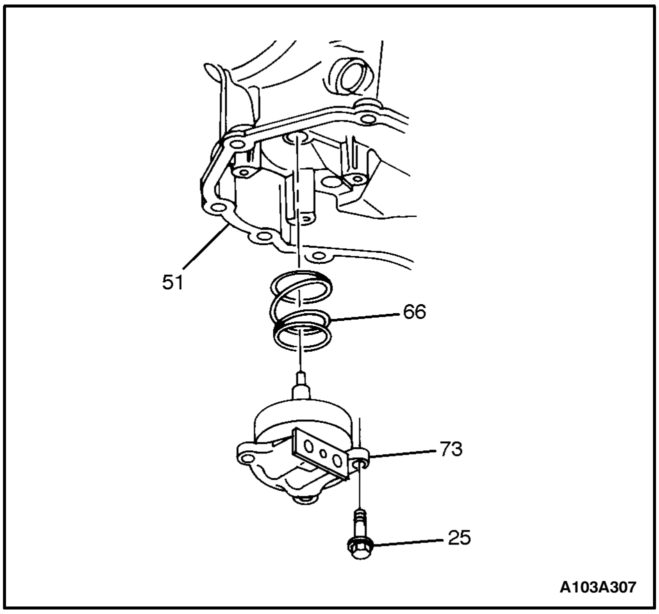
4. Lower the vehicle.
5. Refill the transaxle fluid. Refer to “Transaxle Fluid Level Checking Procedure” in this section.
6. Connect the negative battery cable.



REVERSE/LOW SERVO ASSEMBLY

Removal Procedure

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Remove the transaxle pan, gasket, and filter. Refer to "Pan, Gasket and Filter" in this section.
4. Remove the servo cover bolts (25) and the servo cover (73).
5. Remove the piston assembly and the return spring (66).

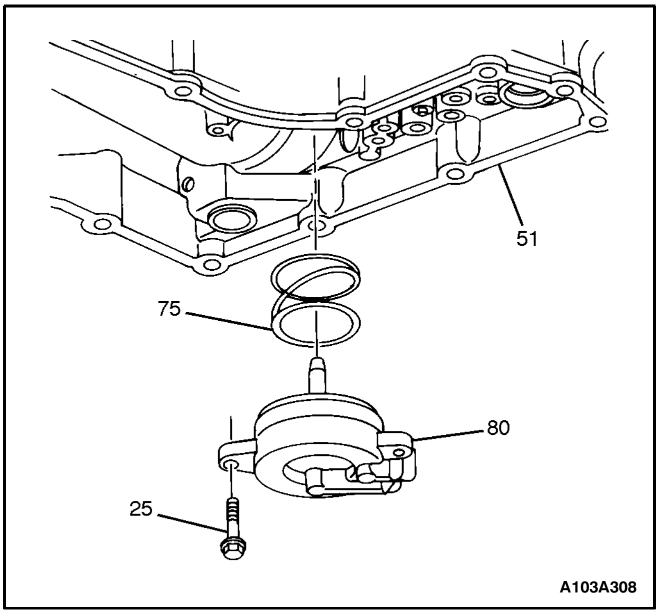


Installation Procedure

1. Install the return spring (66) and the piston assembly.
2. Install the servo cover (73) and the servo cover bolts (25).

   Tighten

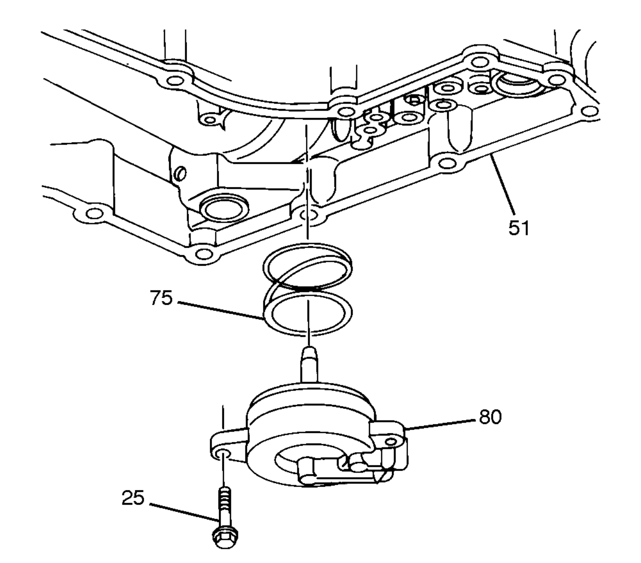
   Tighten the servo cover bolts (25) to 12 N•m (106 lb-in).
3. Install the transaxle filter, gasket, and pan. Refer to "Pan, Gasket and Filter" in this section.
4. Lower the vehicle.
5. Refill the transaxle fluid. Refer to "Transaxle Fluid Level Checking Procedure" in this section.
6. Connect the negative battery cable.



2ND/4TH SERVO ASSEMBLY

Removal Procedure

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Remove the transaxle pan, gasket, and filter. Refer to "Pan, Gasket, and Filter" in this section.
4. Remove the servo cover bolts (25) and the servo cover (80).
5. Remove the piston assembly and the return spring (75).



A103A308

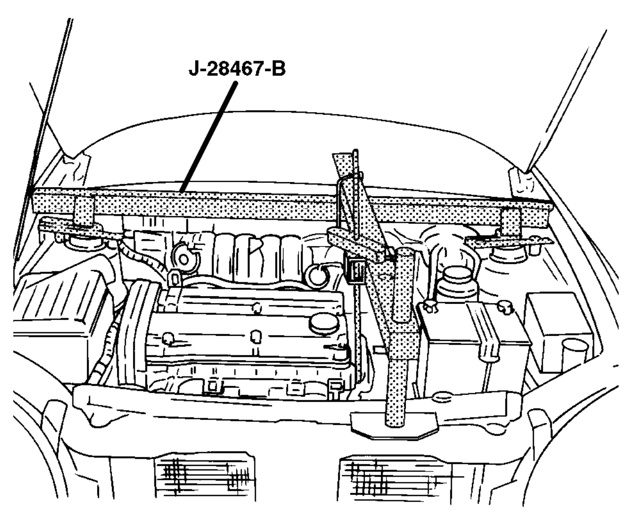
Installation Procedure

1. Install the servo return spring (75), the piston assembly, the servo cover (80), and servo cover bolts (25).

Tighten

Tighten the servo cover bolts (25) to 12 N•m (106 lb-in).

2. Install the transaxle filter, gasket, and pan. Refer to “Pan, Gasket, and Filter” in this section.
3. Lower the vehicle.
4. Refill the transaxle fluid. Refer to ‘Transaxle Fluid Level Checking Procedure” in this section.
5. Connect the negative battery cable.



A103A071

CASE SIDE COVER AND GASKETS

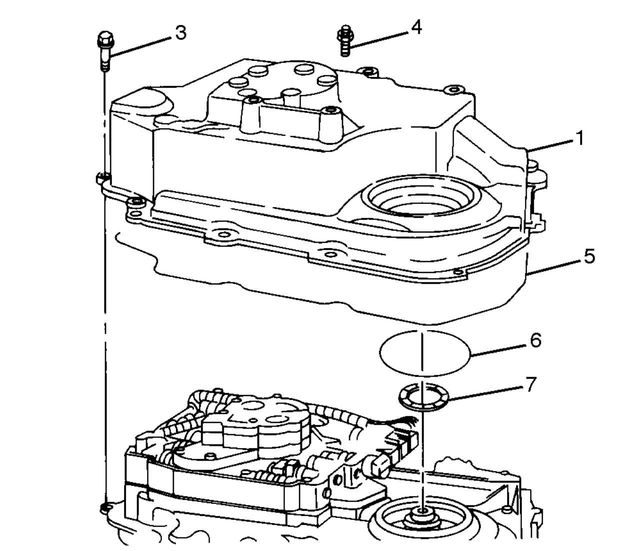
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

J-28467-B Engine Support Fixture

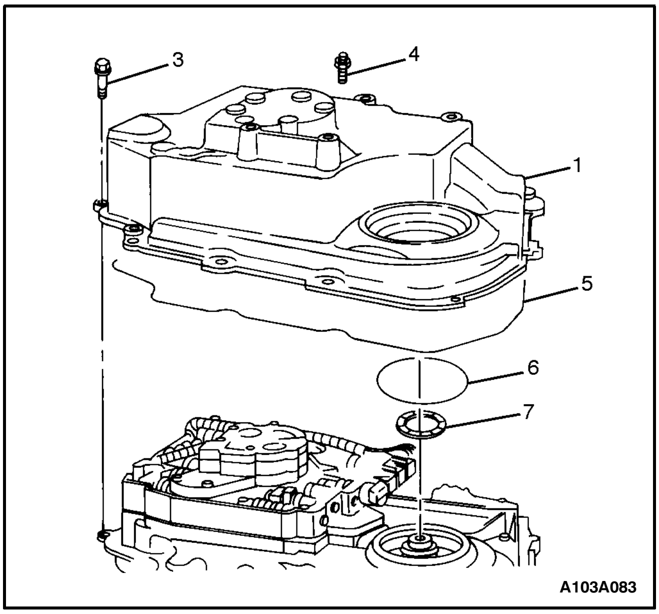
Removal Procedure

1. Disconnect the negative battery cable.
2. Install the engine support fixture J-28467-B.



A103A083

3. Raise and suitably support the vehicle.
4. Remove the front exhaust pipe. Refer to Section 1G, Engine Exhaust.
5. Remove the left wheel. Refer to Section 2E, Tires and Wheels.
6. Remove the left drive axle. Refer to Section 3A, Automatic Transaxle Drive Axle.
7. Remove the battery and the battery tray. Refer to Section 1E, Engine Electrical.
8. Remove the left transaxle mount. Refer to ‘Transaxle Mount” in this section.
9. Lower the engine until the side cover is accessible.
10. Remove the shifter linkage and the neutral start switch. Refer to ‘Neutral Start Switch” in this section.
11. Remove the side cover bolts (3 and 4), the side cover (1), and the gaskets (6 and 7).

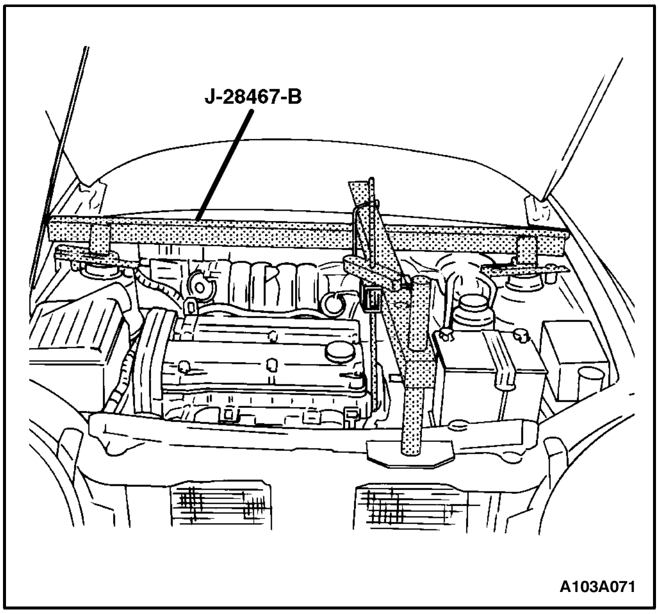


Installation Procedure

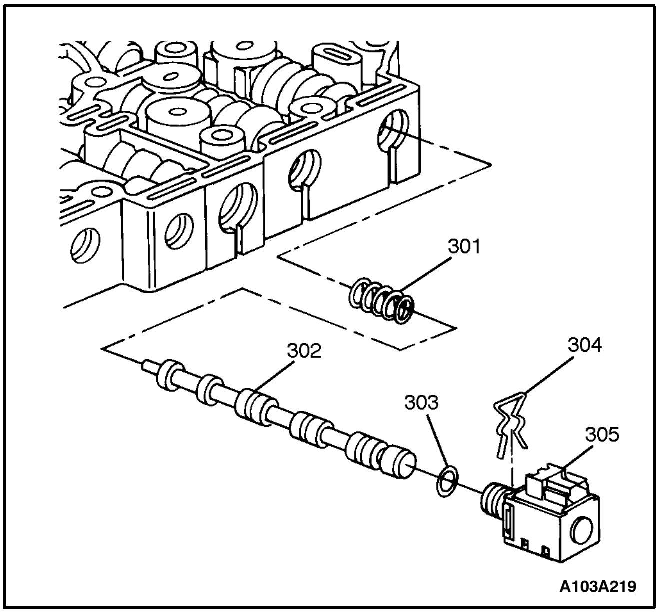
1. Install the side cover (1), the gaskets (6 and 7), and the side cover bolts (3 and 4).

Tighten

Tighten the side cover bolts (3 and 4) to 20 N•m (15 lb-ft).



2. Install the shifter linkage and the neutral start switch. Refer to "Neutral Start Switch" in this section.
3. Raise the engine.
4. Install the left transaxle mount. Refer to "Transaxle Mount" in this section.
5. Install the battery and the battery tray. Refer to Section 1E, Engine Electrical.
6. Install the left drive axle. Refer to Section 3A, Automatic Transaxle Drive Axle.
7. Install the left wheel. Refer to Section 2E, Tires and Wheels.
8. Install the front exhaust pipe. Refer to Section 1G, Engine Exhaust.
9. Lower the vehicle.
10. Remove the engine support fixture J-28467-B.
11. Connect the negative battery cable.



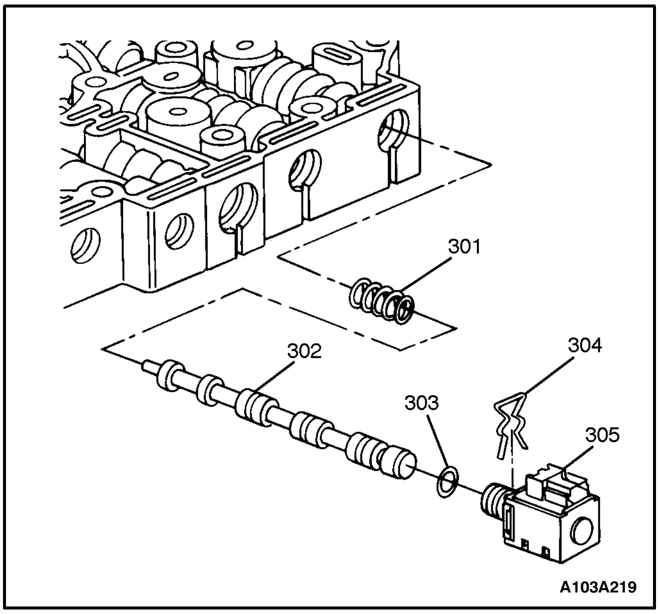
1-2 SHIFT SOLENOID

Removal Procedure

1. Remove the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.
2. Disconnect the electrical connection from the 1-2 shift solenoid (305).

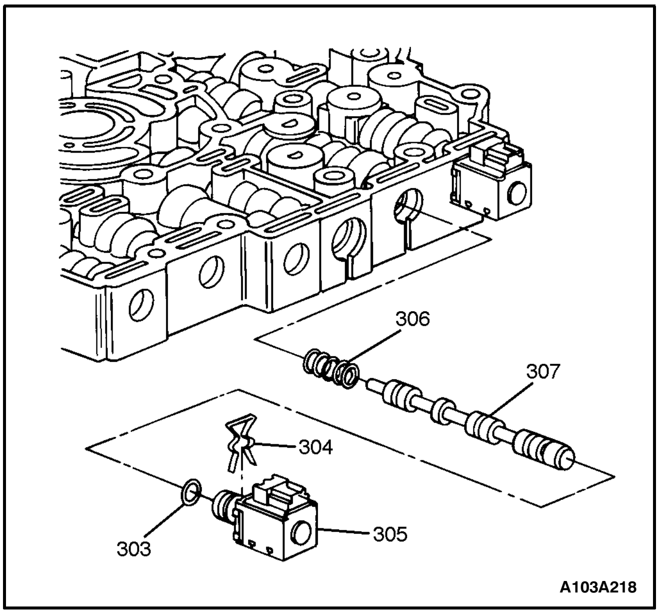
Important: Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips.

3. Remove the solenoid retainer clip (304) from the valve body.
4. Remove the 1-2 shift solenoid (305).



Installation Procedure

1. Install the 1-2 shift solenoid (305) into the valve body.
2. Install the retainer clip (304) into the valve body.
3. Connect the electrical connection to the solenoid (305).
4. Install the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.



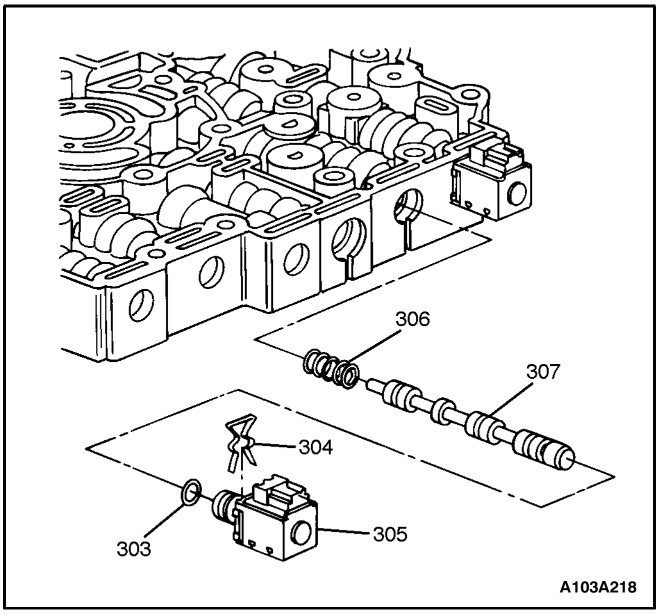
2-3 SHIFT SOLENOID

Removal Procedure

1. Remove the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.
2. Disconnect the electrical connection from the 2-3 shift solenoid (305).

Notice: Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips.

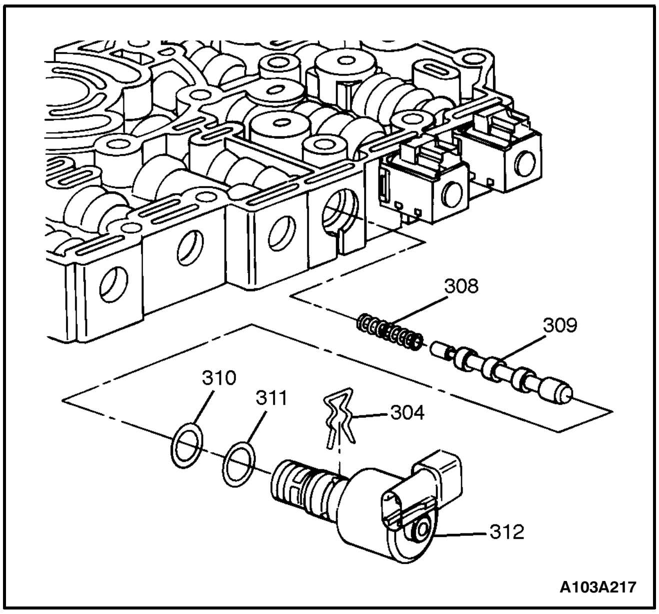
3. Remove the solenoid retainer clip (304) from the valve body.
4. Remove the 2-3 shift solenoid (305).



Installation Procedure

1. Install the 2-3 shift solenoid (305) into the valve body.
2. Install the retainer clip (304) into the valve body.
3. Connect the electrical connection to the 2-3 shift solenoid (305).
4. Install the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.

PRESSURE CONTROL SOLENOID

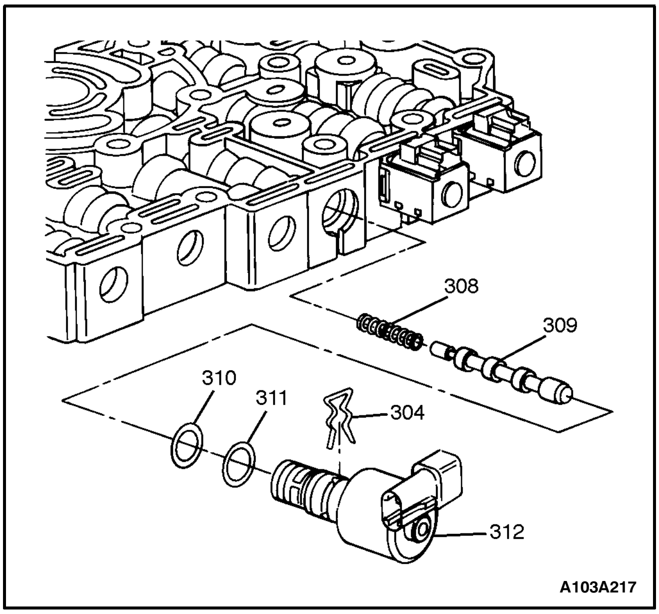


Removal Procedure

1. Remove the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.
2. Disconnect the electrical connection from the pressure control solenoid (PCS) (312).

Notice: Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips.

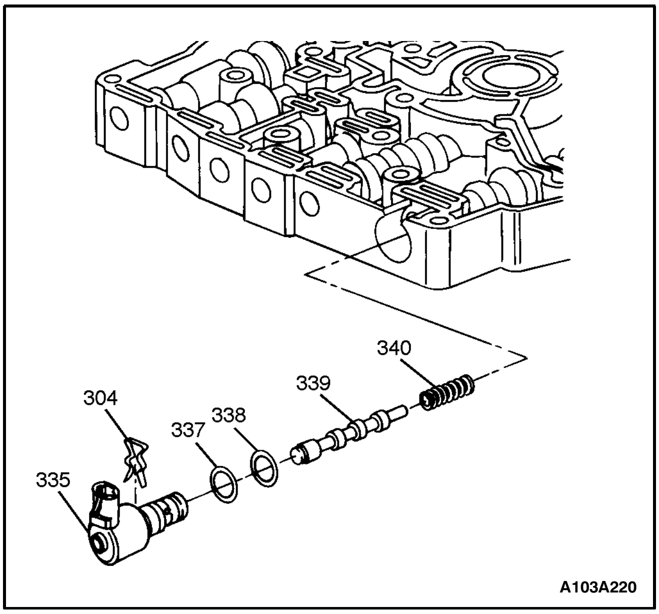
3. Remove the solenoid retainer clip (304) from the valve body.
4. Remove the pressure control solenoid (312).



Installation Procedure

1. Install the pressure control solenoid (312) into the valve body.
2. Install the retainer clip (304) into the valve body.
3. Connect the electrical connection to the pressure control solenoid (312).
4. Install the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.

TCC SOLENOID

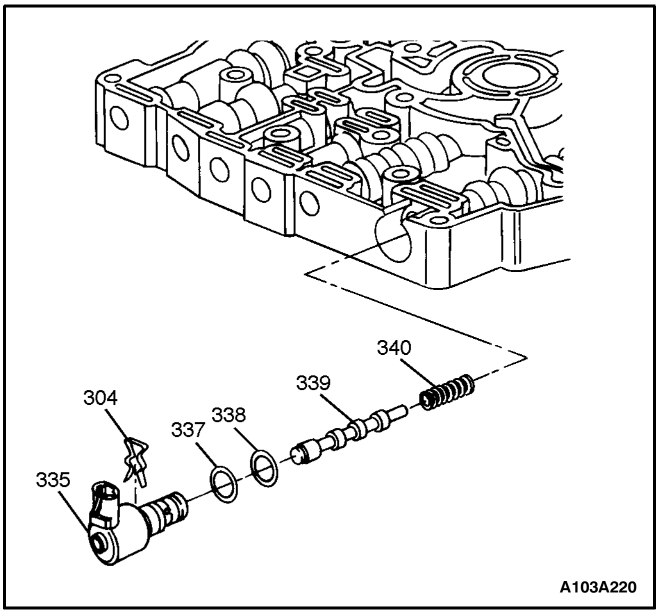


Removal Procedure

1. Remove the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.
2. Disconnect the electrical connection from the TCC solenoid (335).

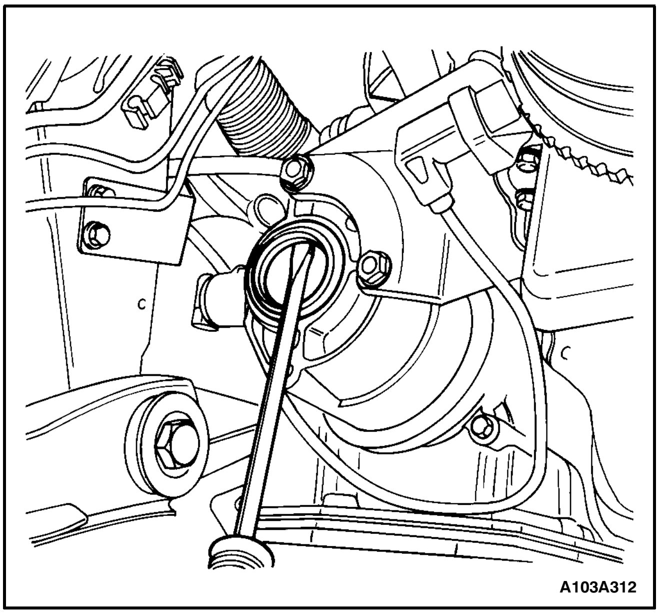
Notice: Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips.

3. Remove the solenoid retainer clip (304) from the valve body.
4. Remove the TCC solenoid (335).



Installation Procedure

1. Install the TCC solenoid (335) into the valve body.
2. Install the retainer clip (304) into the valve body.
3. Connect the electrical connection to the solenoid (335).
4. Install the transaxle side cover. Refer to "Case Side Cover and Gaskets" in this section.



DRIVE AXLE OIL SEAL

Tools Required

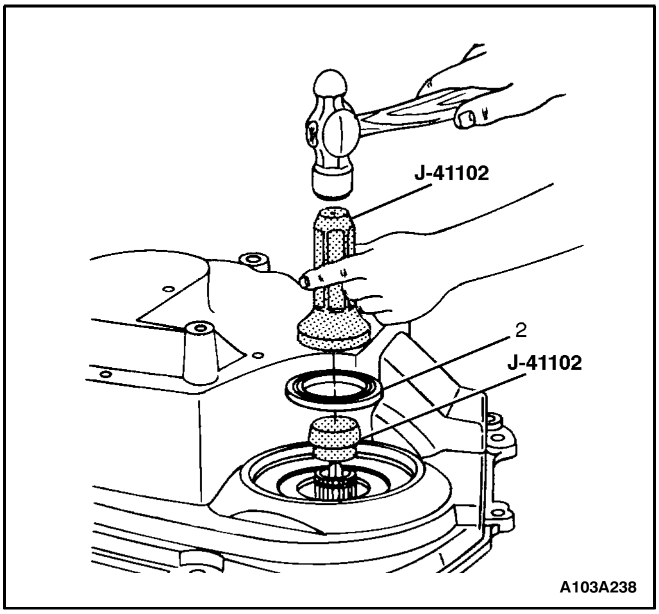
J-41102 Axle Seal Installer

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the drive axles. Refer to Section 3A, Automatic Transaxle Drive Axle.

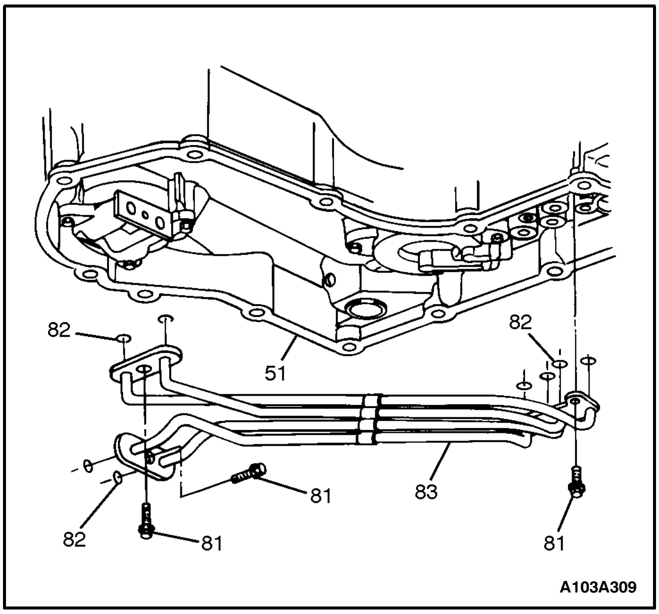
Notice: Be careful not to damage the bore of the transaxle case.

3. Remove the transaxle drive seal using a screwdriver. If necessary, crush the seal first with the screwdriver in order to loosen the seal from the case.



Installation Procedure

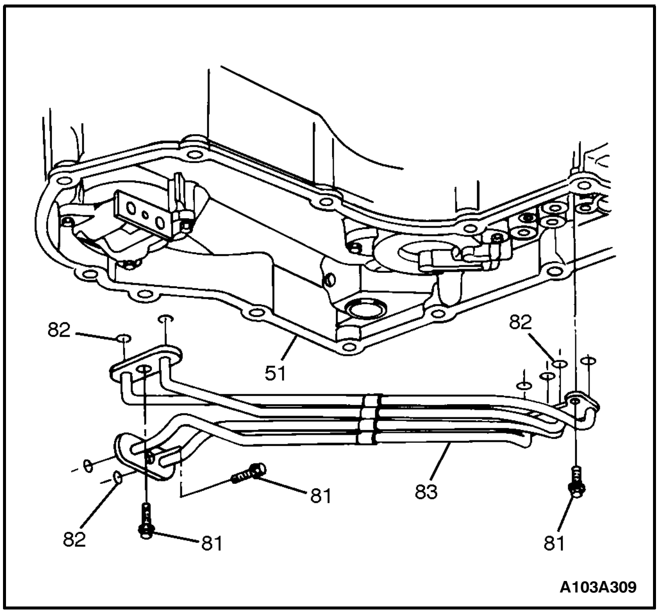
1. Install the transaxle drive seal (2) using the axle seal installer J-41102.
2. Install the drive axles. Refer to Section 3A, Automatic Transaxle Drive Axle.
3. Connect the negative battery cable.



OIL COOLER PIPES

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the transaxle oil pan and the filter. Refer to "Pan, Gasket, and Filter" in this section.
3. Remove the oil pipe bolts (81) and the pipes (83) from the transaxle case (51).

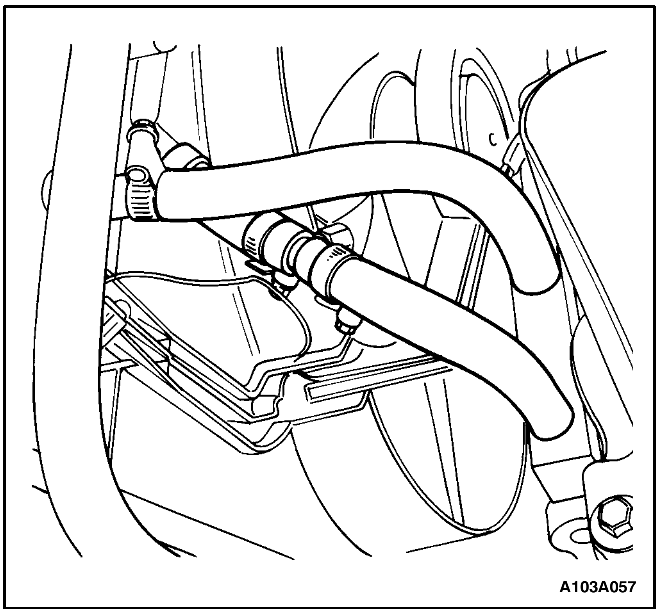


Installation Procedure

1. Install the oil pipes (83) and the oil pipe bolts (81).

   Tighten

   Tighten the oil pipe bolts (81) to 12 N•m (106 lb-in).
2. Install the transaxle oil pan and filter. Refer to "Pan, Gasket, and Filter" in this section.
3. Connect the negative battery cable.

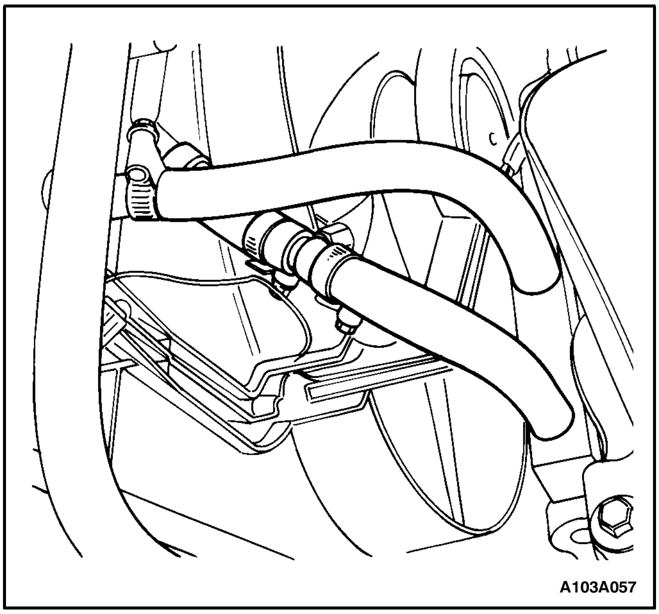


OIL COOLER HOSES

Removal Procedure

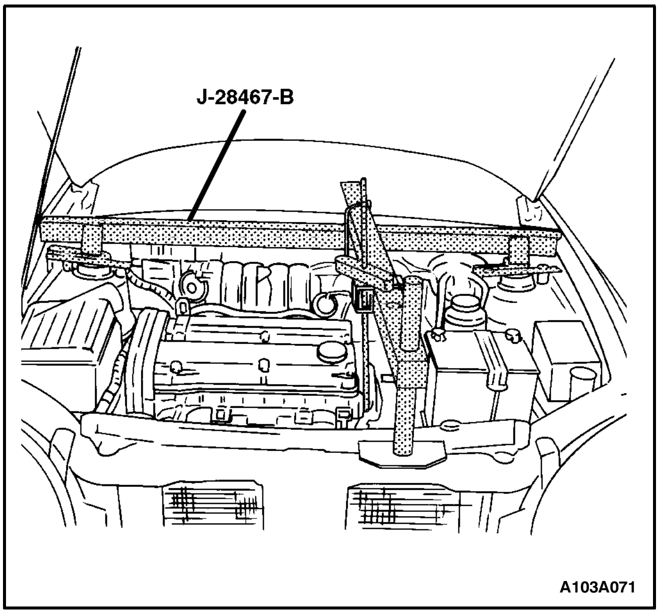
Important: Place a drip pan under the hoses to catch the fluid that will run out of the lines.

1. Loosen the hose clamps and disconnect the hoses from the transaxle.
2. Loosen the hose clamps and disconnect the hoses from the radiator.



Installation Procedure

1. Install the hose clamps onto the radiator hoses.
2. Install the hoses onto the radiator.
3. Tighten the radiator hose clamps.
4. Install the hose clamps onto the transaxle hoses.
5. Install the hoses onto the transaxle.
6. Tighten the transaxle hose clamps.
7. Refill the transaxle fluid. Refer to "Transaxle Fluid Checking Procedure" in this section.



TRANSAXLE MOUNT

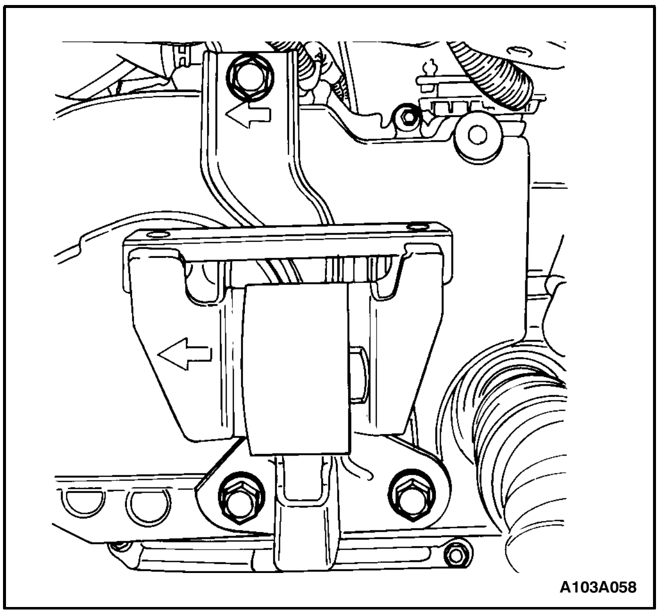
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

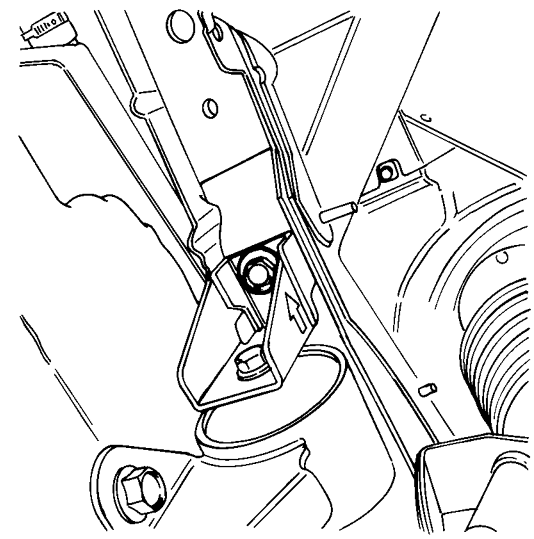
J-28467-B Engine Support Fixture

Removal Procedure

1. Disconnect the negative battery cable.
2. Install the engine support fixture J-28467-B.
3. Raise and suitably support the vehicle.
4. Remove the left front wheel. Refer to Section 2E, Tires and Wheels.



5. Remove the left side under cover. Refer to Section 9N, Frame and Underbody.
6. Remove the bolts from the transaxle mount.



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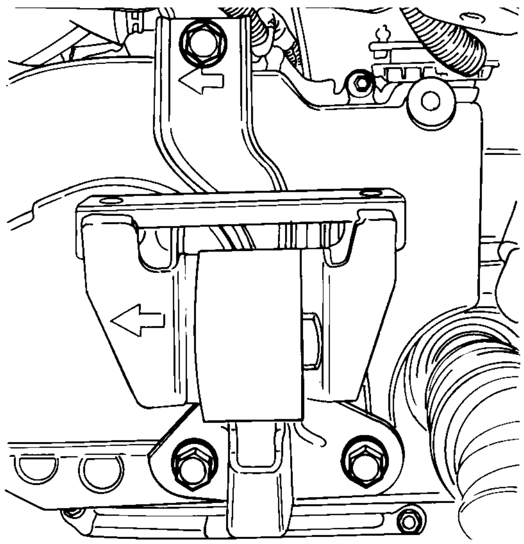
7. Remove the bolts from the frame and remove the transaxle mount.



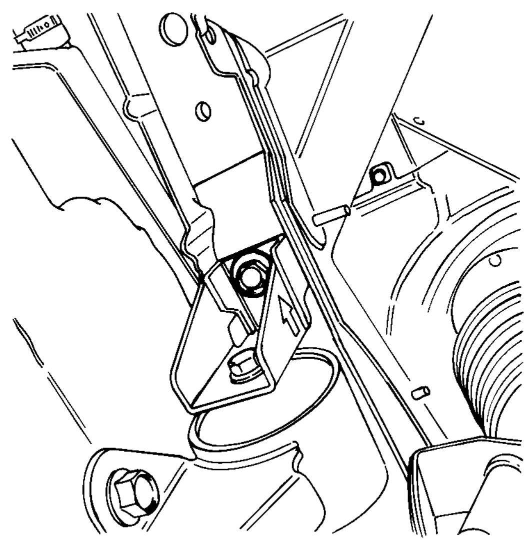
A103A058

Installation Procedure

1. Install the transaxle mount and the transaxle mount bolts.

Tighten

Tighten the transaxle mount bolts to 75 N•m (55 lb-ft).

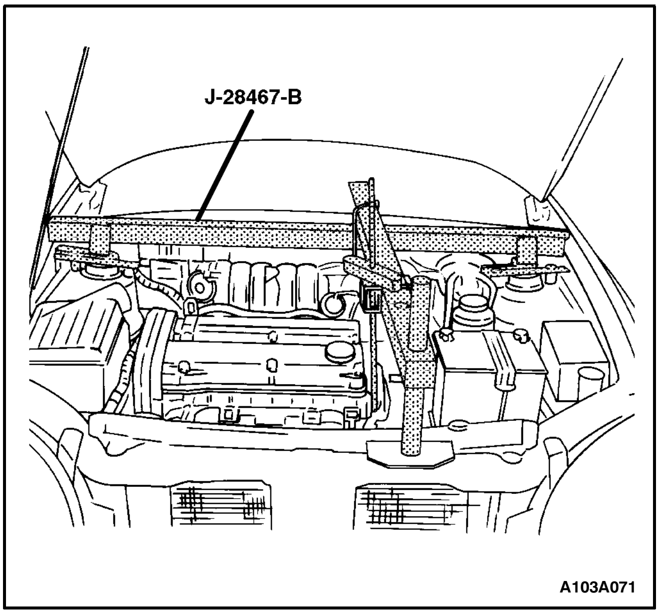


A103A059

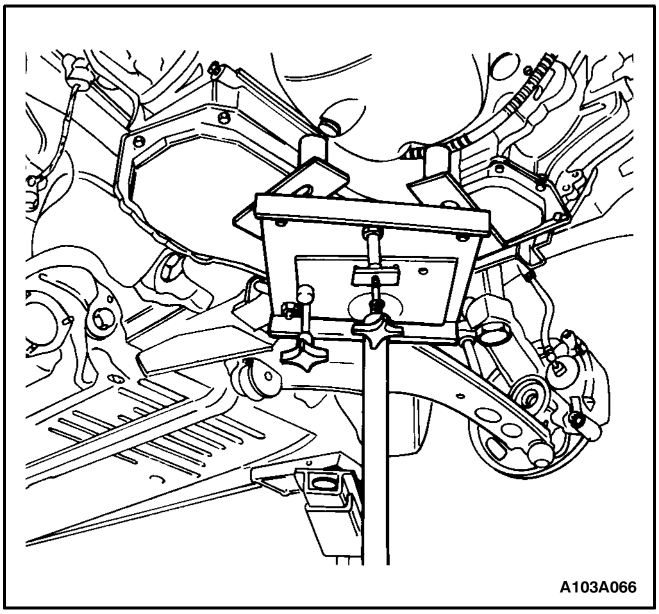
2. Raise the engine.
3. Install the bolts to the frame.

Tighten

Tighten the frame bolts to 75 N•m (55 lb-ft).



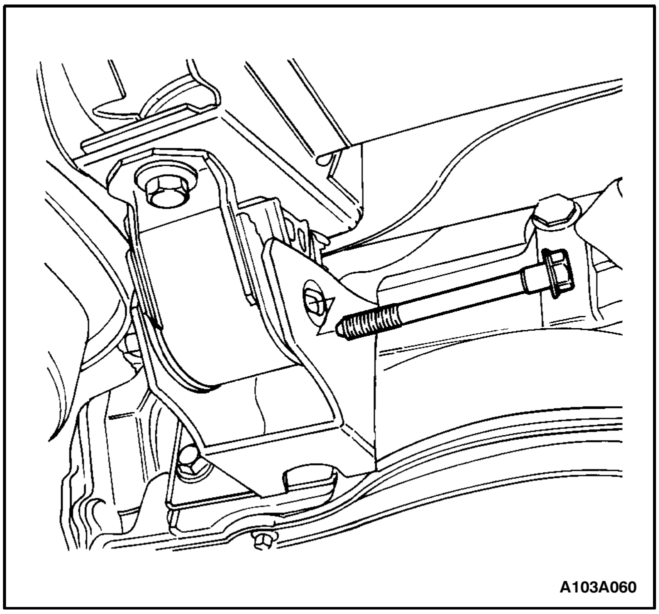
4. Install the left side splash shield. Refer to Section 9N, Frame and Underbody.
5. Install the left front wheel. Refer to Section 2E, Tires and Wheels.
6. Lower the vehicle.
7. Remove the engine support fixture J-28467-B.
8. Refill the transaxle fluid. Refer to "Transaxle Fluid Level Checking Procedure" in this section.
9. Connect the negative battery cable.



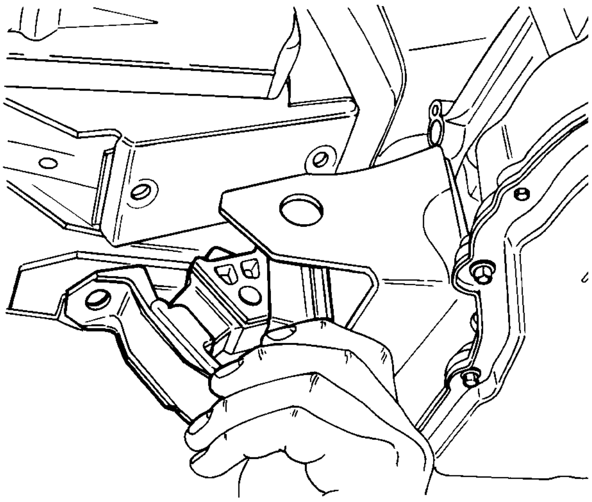
TRANSAXLE BRACKET

Removal Procedure

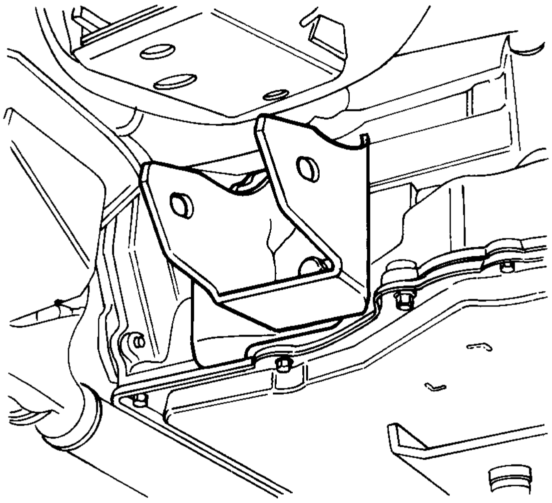
1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Install the transaxle jack.



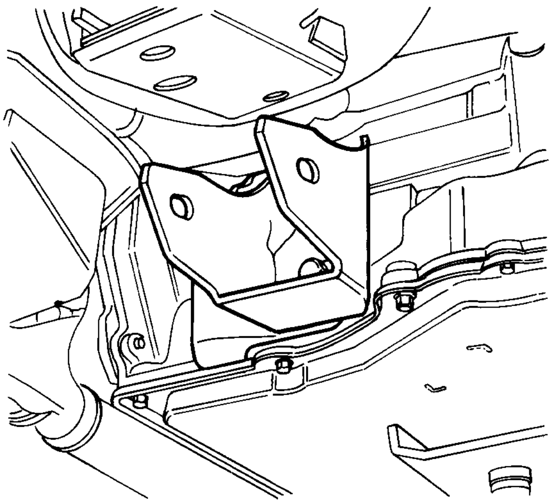
4. Remove the pivot bolt.


A103A061

5. Remove the bolts and the transaxle mounting bracket from the frame.

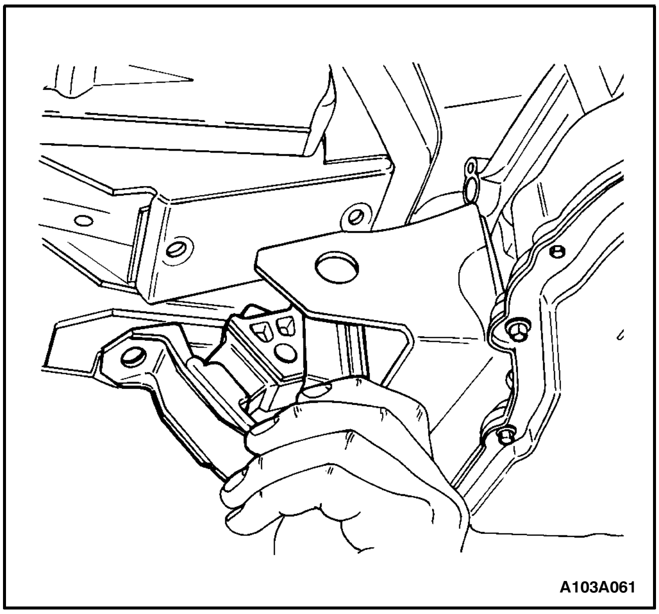

A103A062

6. Remove the bolts and the transaxle mounting bracket from the transaxle.


A103A062

Installation Procedure

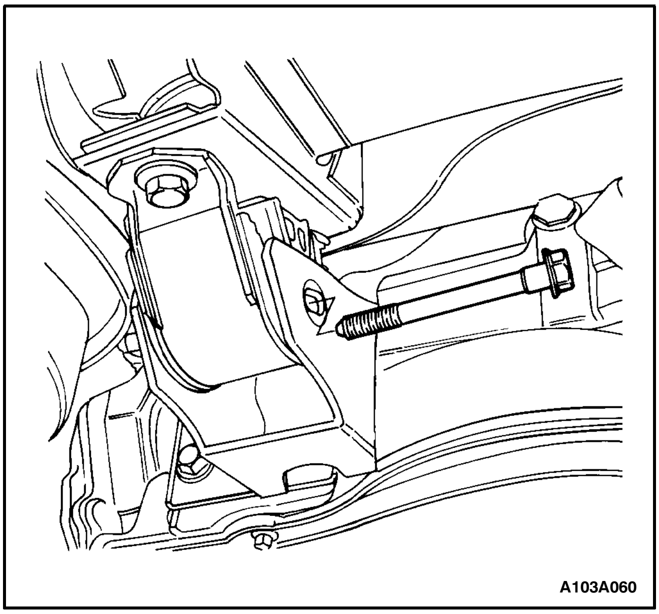
1. Install the transaxle mounting bracket on the transaxle. Install the bolts.



2. Install the transaxle mounting bracket on the frame. Install the bolts.

Tighten

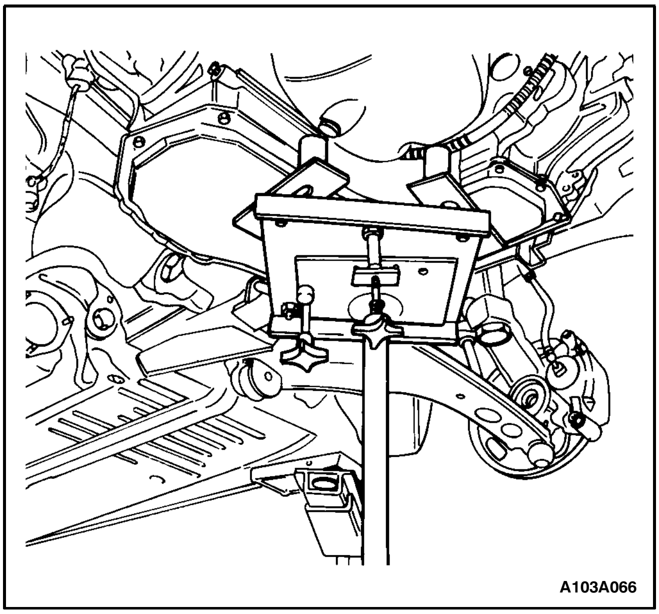
Tighten the transaxle mounting bracket bolts to 75 N•m (55 lb-ft).



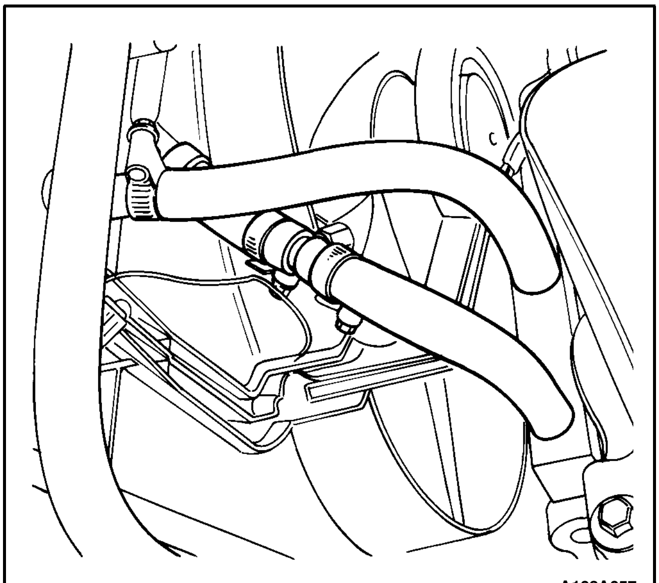
3. Install the pivot bolt.

Tighten

Tighten the pivot bolt to 65 N•m (48 lb-ft).



4. Remove the transaxle jack.
5. Lower the vehicle.
6. Connect the negative battery cable.



A103A057

TRANSAXLE ASSEMBLY

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

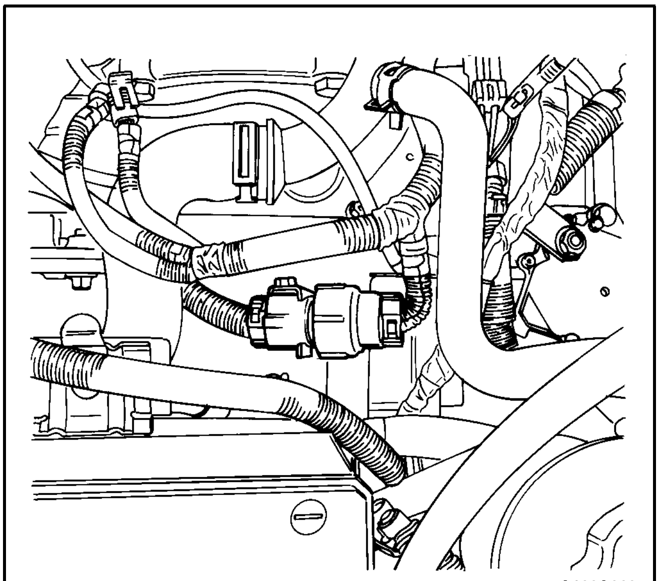
J-28467-B Engine Support Fixture

Removal Procedure

1. Disconnect the negative battery cable.

Important: Be sure to have a pan ready to catch any transaxle fluid that might come out.

2. Disconnect the transaxle cooler lines from the transaxle.



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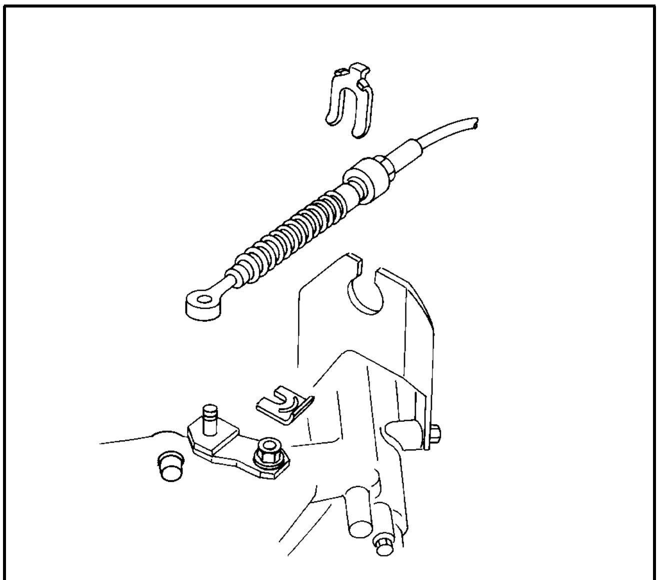
3. Disconnect the transaxle wiring harness.



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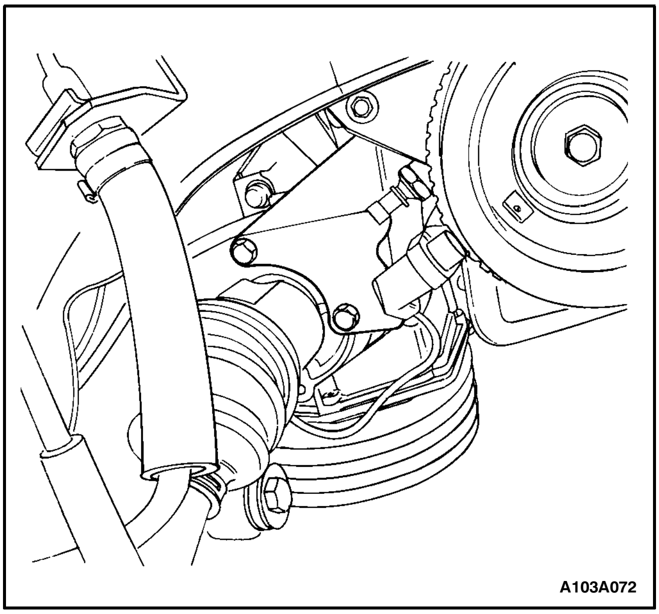
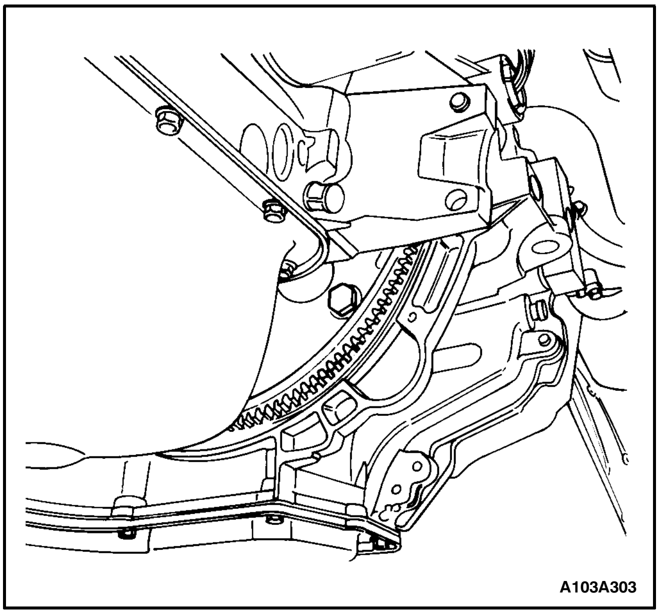
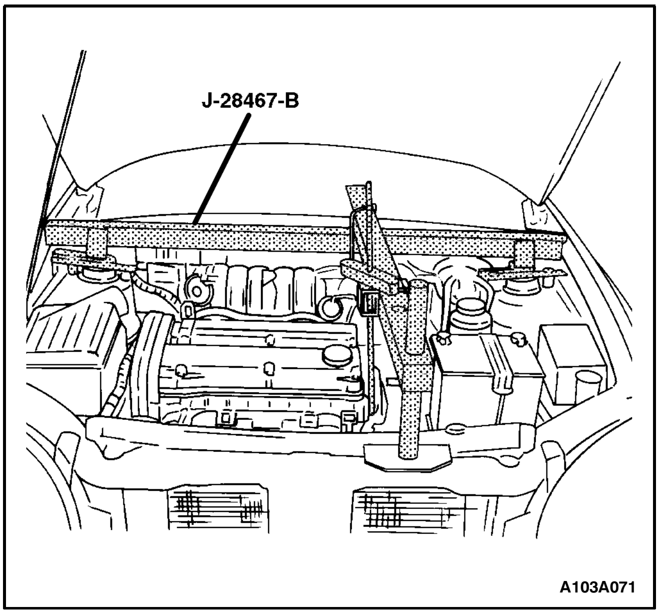
4. Disconnect the neutral start switch electrical connector.
5. Disconnect the shift cable from the shift lever and the shift cable mounting bracket.



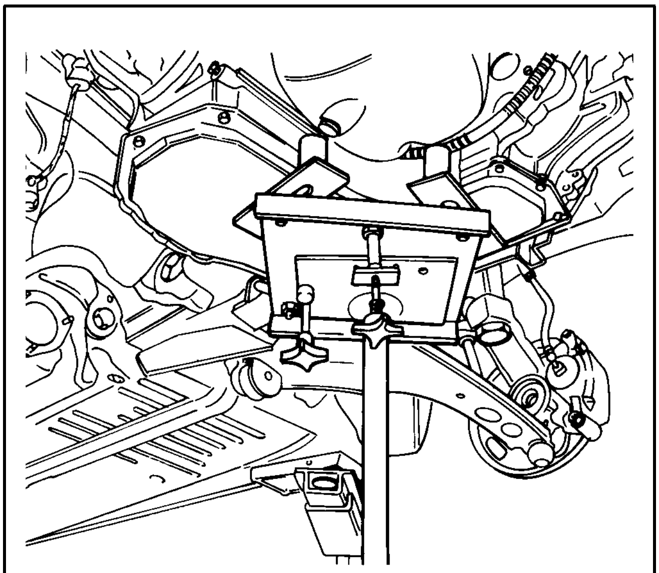
6. Disconnect the automatic transmission output speed sensor (A/T OSS) electrical connector.



7. Remove the front exhaust pipe. Refer to Section 1G, Engine Exhaust.
8. Remove the drive axles. Refer to Section 3A, Automatic Transaxle Drive Axle.
9. Remove the flywheel inspection shield.
10. Remove the flywheel bolts.

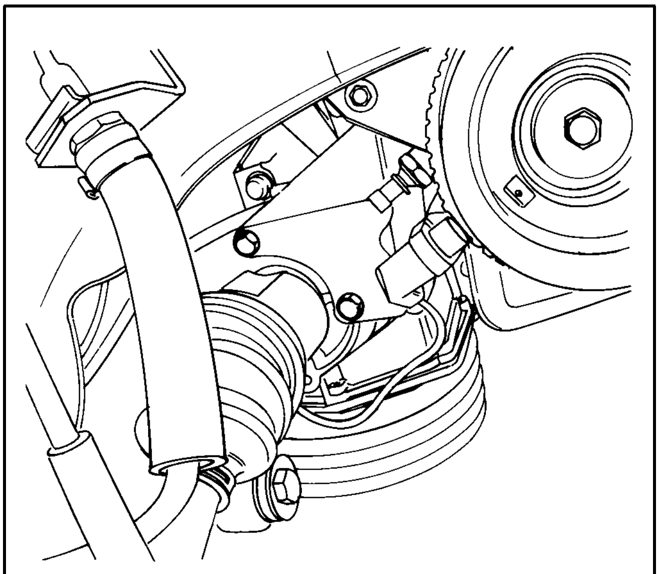


11. Install the engine support fixture J-28467-B.



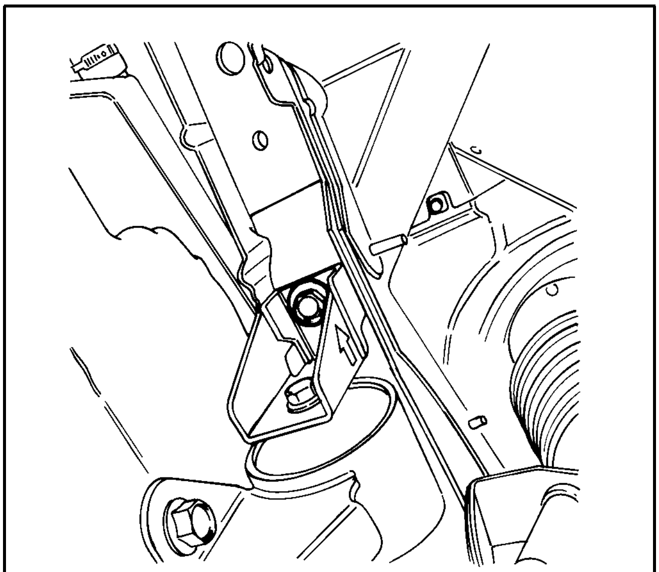
A103A066

12. Install the transaxle support jack.



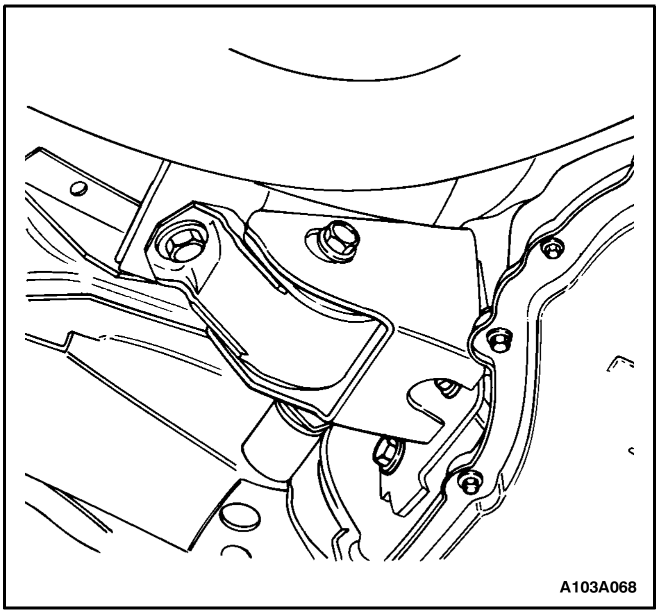
A103A067

13. Remove the bell housing bolts.
14. Disconnect the right transaxle mount bolts.

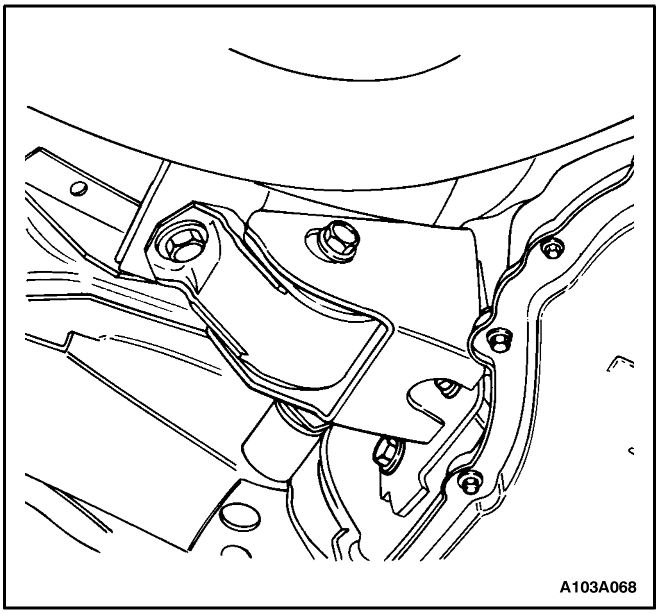


A103A059

15. Disconnect the left transaxle mount bolts.



16. Remove the rear transaxle mount bolts.
17. Remove the transaxle from the vehicle.

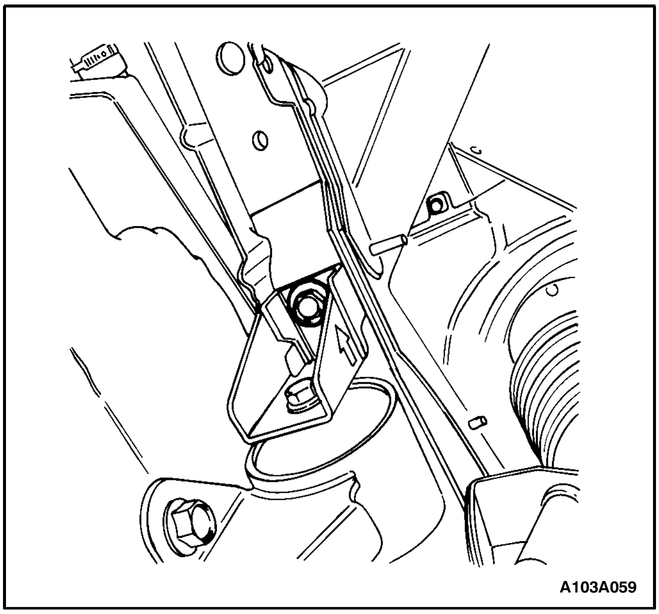


Installation Procedure

1. Install the transaxle into the vehicle.
2. Install the rear transaxle mount bolts.

Tighten

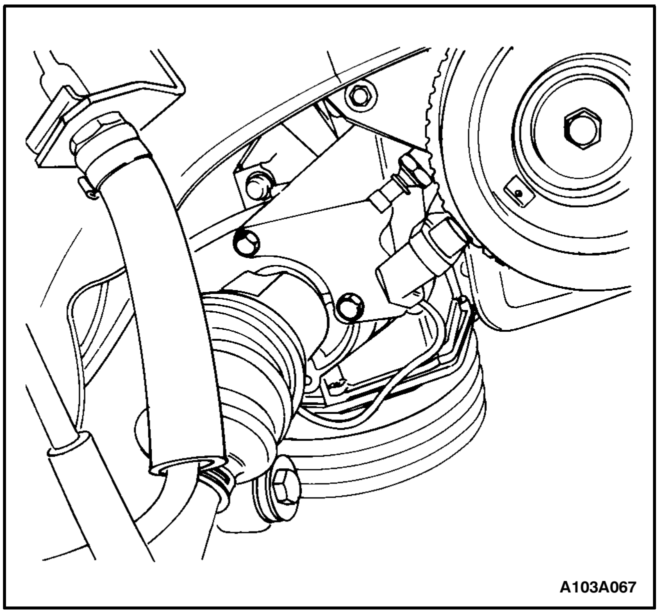
Tighten the rear transaxle mount bolts to 75 N•m (55 lb-ft).



3. Connect the left transaxle mount bolts.

Tighten

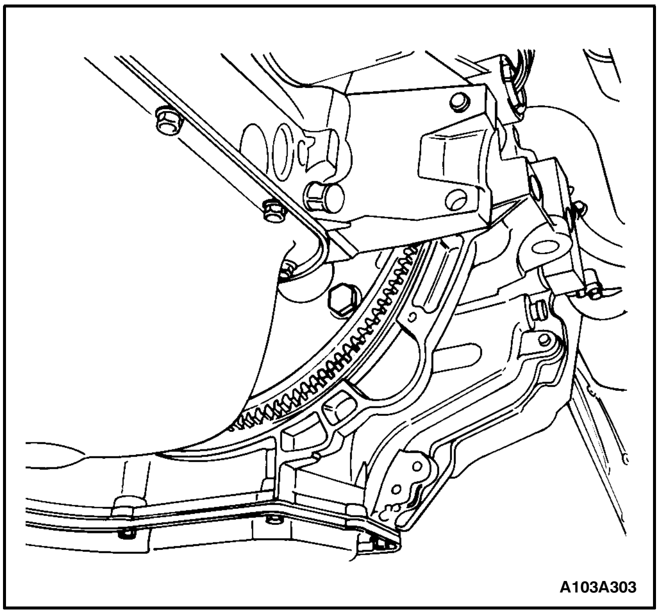
Tighten the left transaxle mount bolts to 75 N•m (55 lb-ft).



4. Connect the right transaxle mount bolts.

   Tighten

   Tighten the right transaxle mount bolts to 75 N•m (55 lb-ft).



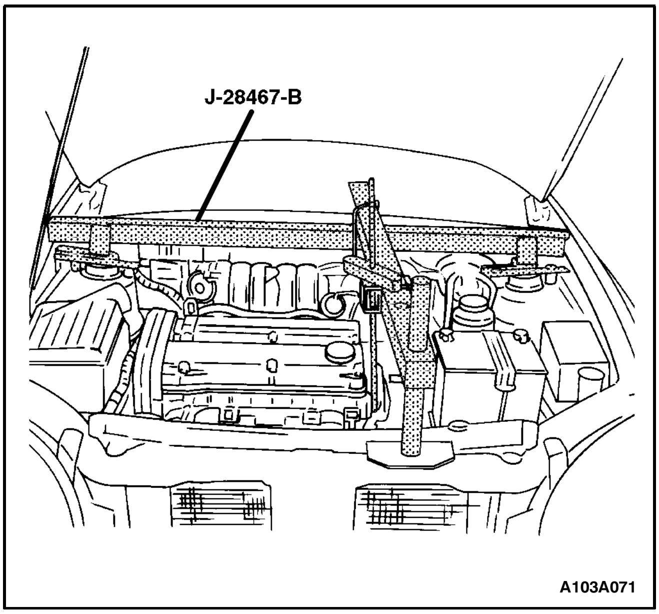
5. Install the bell housing bolts.

   Tighten

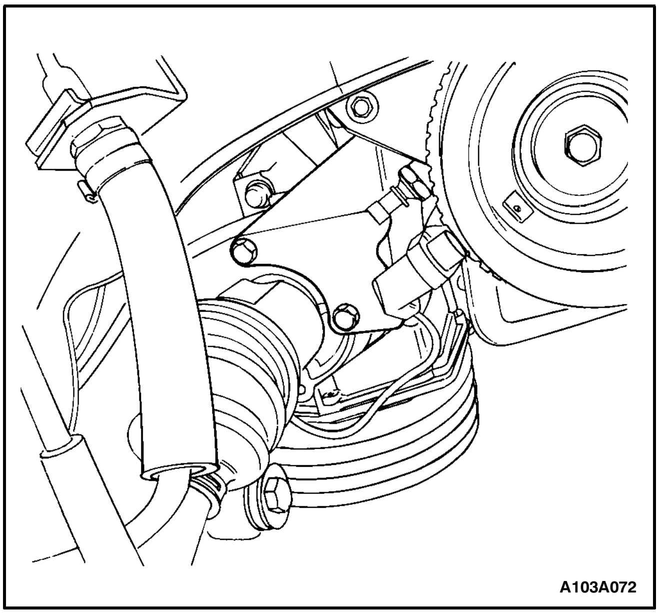
   Tighten the bell housing bolts to 75 N•m (55 lb-ft).
6. Install the flywheel bolts.

   Tighten

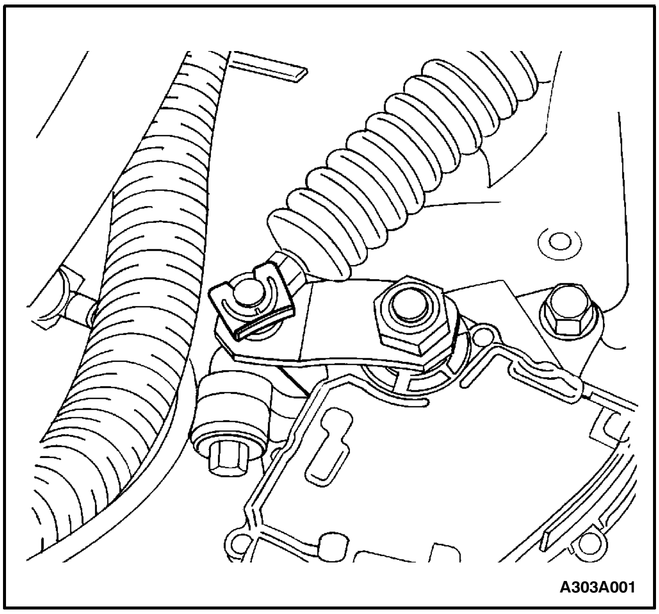
   Tighten the flywheel bolts to 65 N•m (48 lb-ft).
7. Install the flywheel inspection shield.



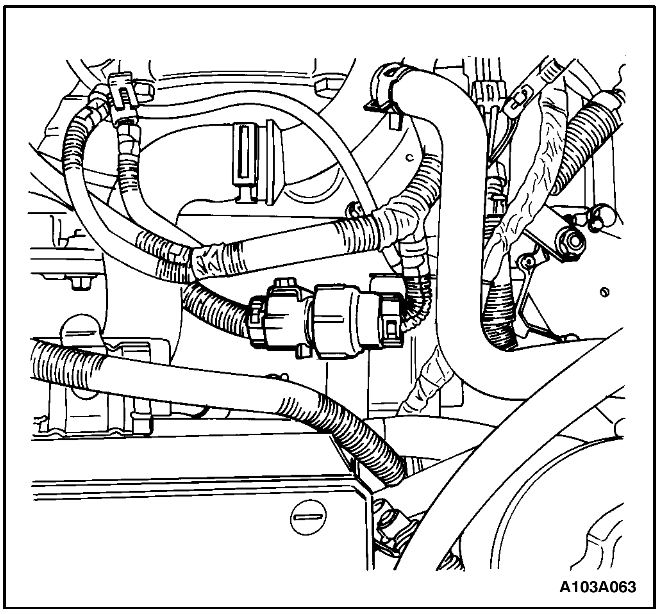
8. Remove the transaxle support jack.
9. Remove the engine support fixture J-28467-B.



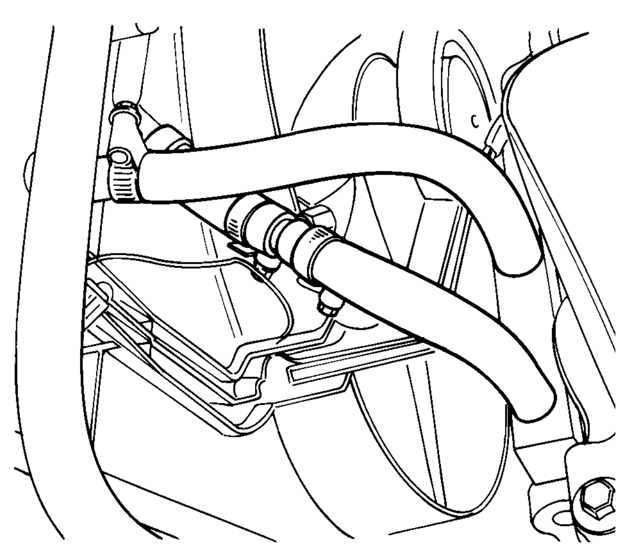
10. Install the drive axles. Refer to Section 3A, Automatic Transaxle Drive Axle.
11. Install the front exhaust pipe. Refer to Section 1G, Engine Exhaust.
12. Connect the A/T OSS electrical connector.



13. Connect the shift cable to the shift lever and the shift cable mounting bracket.



14. Connect the neutral start switch electrical connector.
15. Connect the transaxle wiring harness.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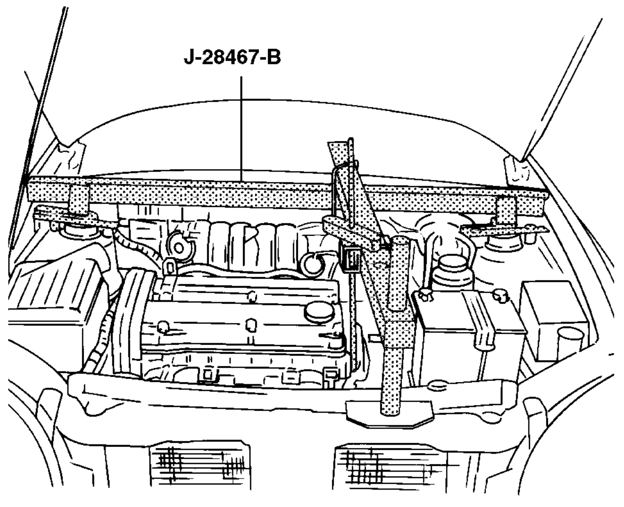
16. Connect the transaxle cooler lines to the transaxle and install the hose clamps.
17. Add transaxle fluid. Refer to "Transaxle Fluid Level Checking Procedure" in this section.
18. Connect the negative battery cable.



A103A071

TRANSAXLE BRACE

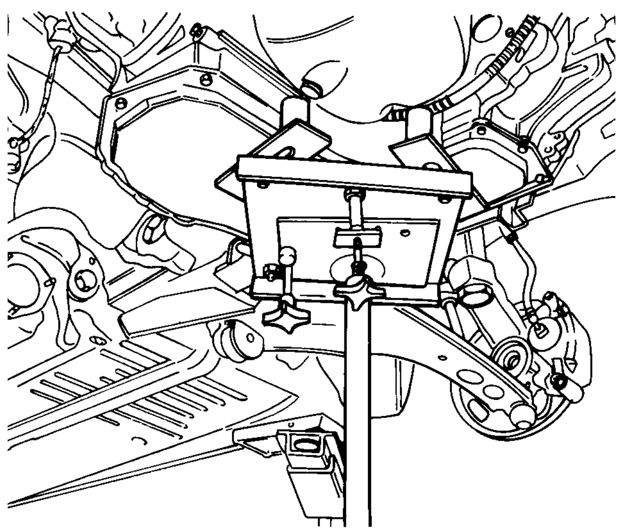
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

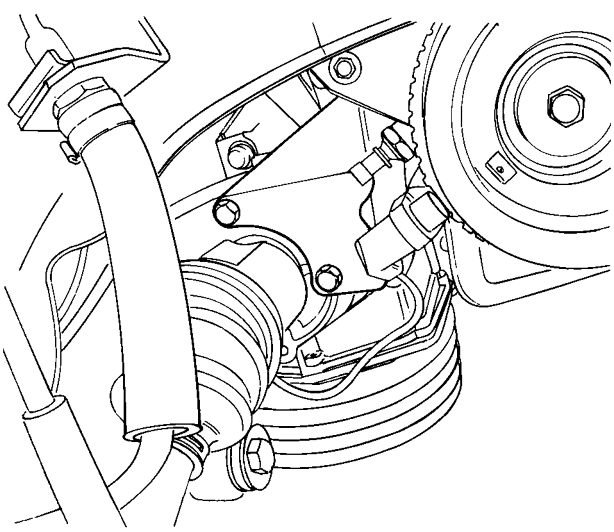
J-28467-B Engine Support Fixture

Removal Procedure

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle.
3. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
4. Remove the right splash shield. Refer to Section 9N, Frame and Underbody.
5. Install the engine support fixture J-28467-B.

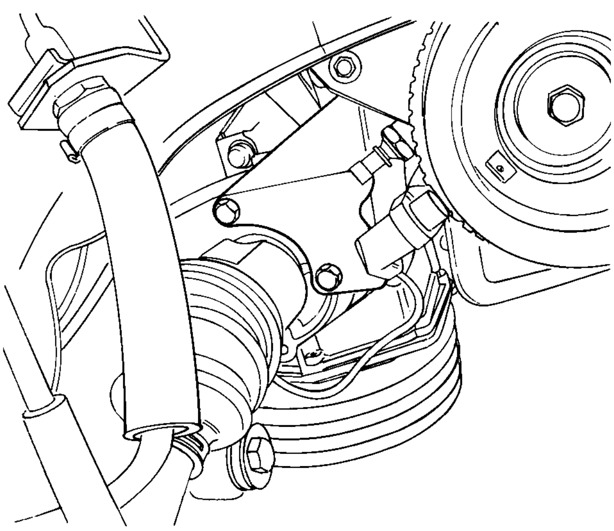

A103A066

6. Install the transaxle support jack.



A103A072

7. Remove the side transaxle mounting bolts.
8. Remove the engine mounting bolts.
9. Remove the transaxle brace.



A103A072

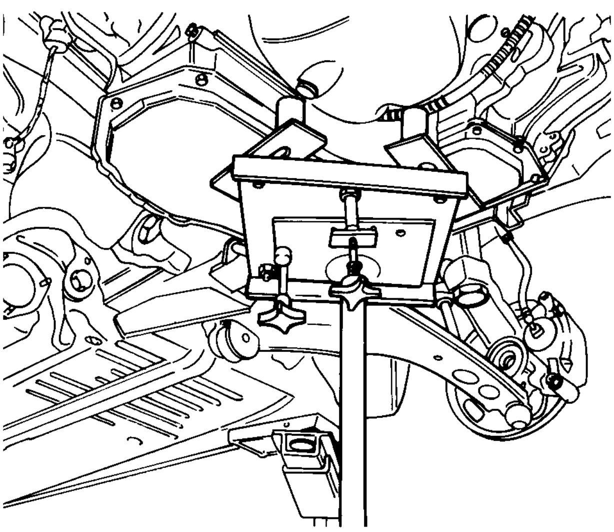
Installation Procedure

1. Install the transaxle brace.
2. Loosely install the side transaxle mounting bolts.
3. Install the engine mounting bolts.

Tighten

Tighten the transaxle mounting bolts to 75 N•m (55 lb-ft).

Tighten the engine mounting bolts to 75 N•m (55 lb-ft).



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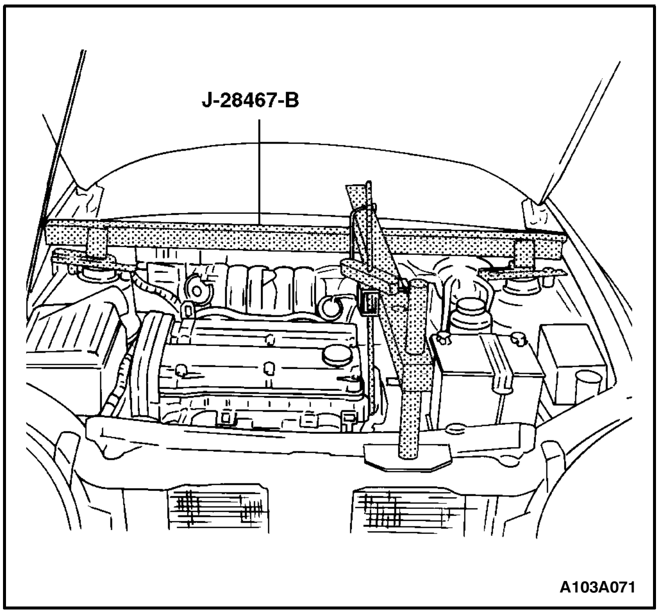
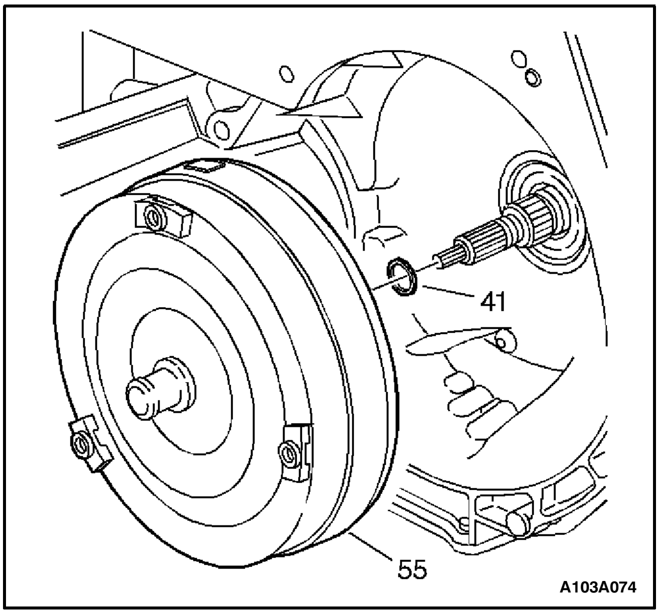
4. Remove the transaxle support jack.



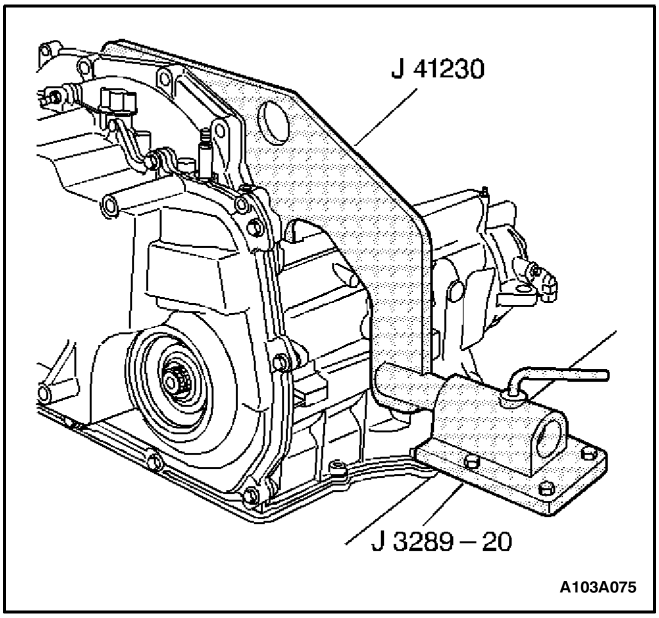
5. Remove the engine support fixture J-28467-B.
6. Install the right splash shield. Refer to Section 9N, Frame and Underbody.
7. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Lower the vehicle.
9. Connect the negative battery cable.



UNIT REPAIR

TORQUE CONVERTER REMOVAL

1. Remove the torque converter assembly (55).
2. Remove the turbine shaft O-ring (41) from the end of the turbine shaft.



TRANSAXLE HOLDING FIXTURE ASSEMBLY

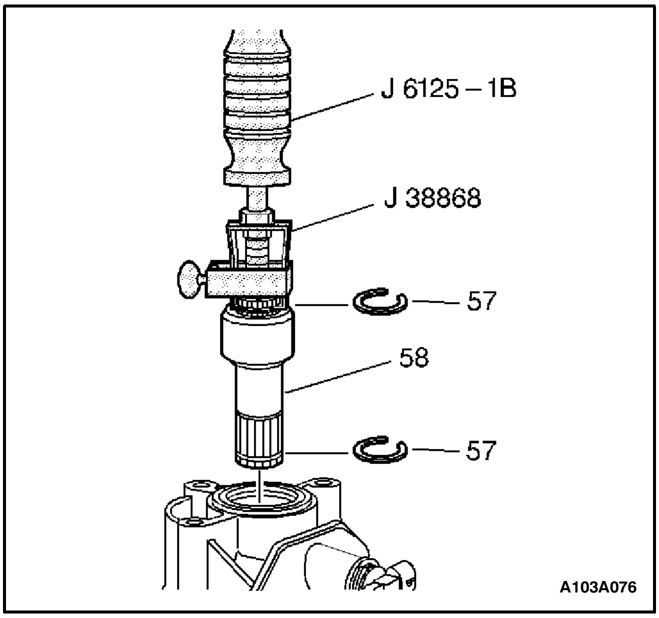
Tools Required

J 41230 Transmission Support Fixture

J 3289-20 Support Fixture

Caution: To reduce the possibility of personal injury or transmission damage, make sure, when doing the next step, that all of the bolts for the support fixture are installed as shown, and that the bolts are tightened to 11 N•m (98 lb-in).

1. Install the J 41230 transmission support fixture onto the transmission.
2. Torque the support fixture bolts to 11 N•m (8 lb-ft.)
3. Install the transmission and the support fixture onto the J 3289-20 fixture base.
4. Position the transmission with the side cover facing down.
5. Insert the pin into the J 3289-20 fixture base in order to lock the unit into place.



STUB SHAFT REMOVAL

Tools Required

J 6125-1B Slide Hammer

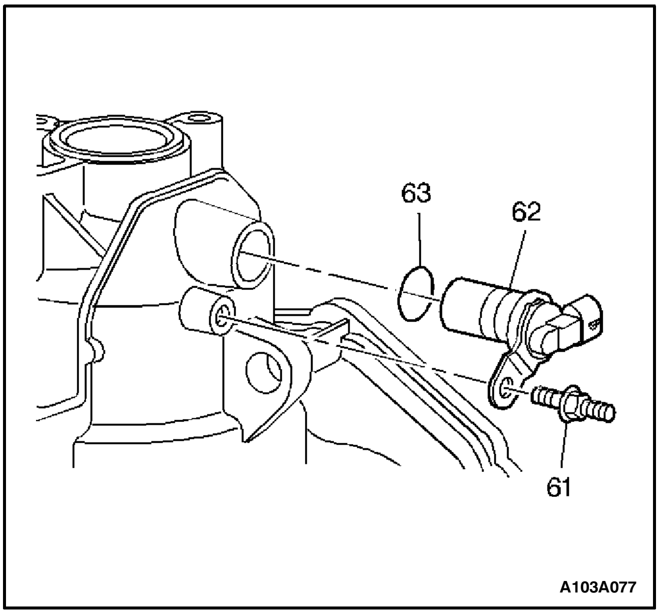
J 38868 Shaft Remover

Important: Handle the stub shaft carefully. The stub shaft sleeve is reusable if the sleeve is not damaged or removed from the stub shaft. Damage to the stub shaft sleeve will result in a transmission fluid leak.

1. **Remove and discard the snap ring (57) from the end of the stub shaft (68). The stub shaft snap ring is not reusable.**
2. **Attach the J 6125-1B to the J 38868. Install the J 38868 into the snap ring groove on the stub shaft (58). Tighten the J 38868 securely to the stub shaft.**
3. **Pull lightly on the shaft and rotate it until the stub shaft snap ring at the differential seats in the taper on the differential side gear.**

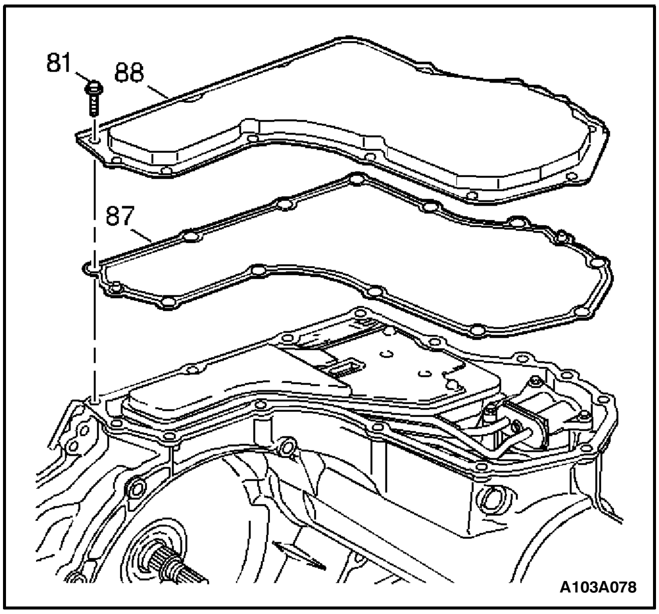
Important: Confirm that the stub shaft snap ring (57 is properly seated in the differential side gear. If not, damage may occur to the transmission when you attempt to remove the stub shaft (58).

4. **Pull the stub shaft (58) out with the slide hammer impact.**



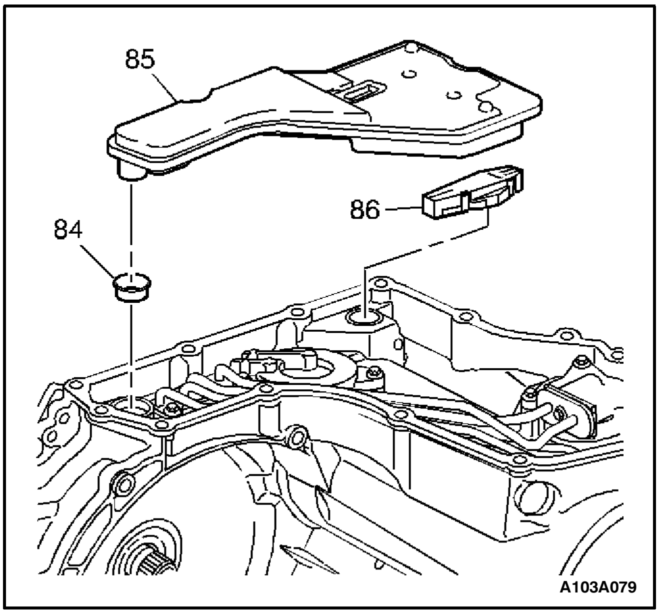
AUTOMATIC TRANSMISSION OUTPUT SPEED SENSOR (A/T OSS) REMOVAL

1. **Rotate the transmission so that the case side cover is facing upward in order to drain the transmission fluid through the stub shaft end of the transmission.**
2. **Rotate the transmission with the oil pan facing upward.**
3. **Remove the output speed sensor stud (61).**
4. **Remove the output speed sensor assembly (62). Pull the speed sensor assembly straight out from the transmission case in order to prevent damage to the case bore.**
5. **Remove the O-ring (63).**



OIL PAN AND GASKET REMOVAL

1. Remove the twelve oil pan bolts (81).
2. Remove the oil pan (88). The magnet can remain in the oil pan.
3. Remove the oil pan gasket (87). The oil pan gasket is reusable.

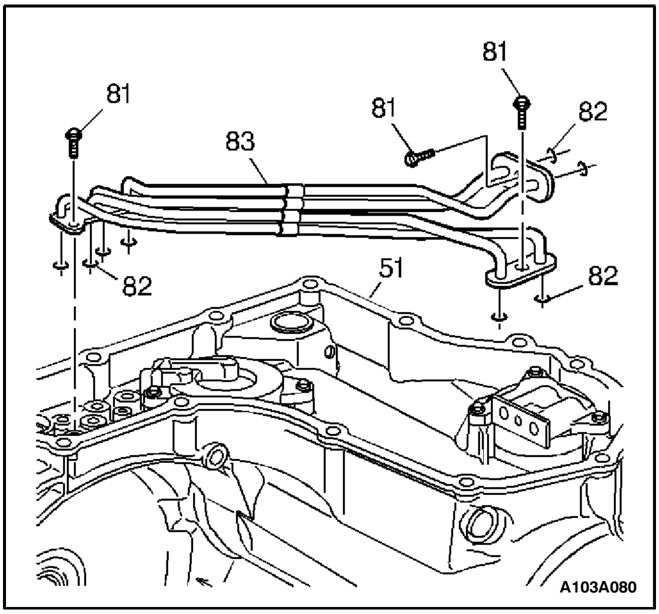


OIL FILTER/SEAL, OIL LEVEL CONTROL VALVE REMOVAL

1. Remove the transmission filter assembly (85).

Important: You may use a small screwdriver in order to pry the seal from case. Be careful not to score or damage the case with the screwdriver.

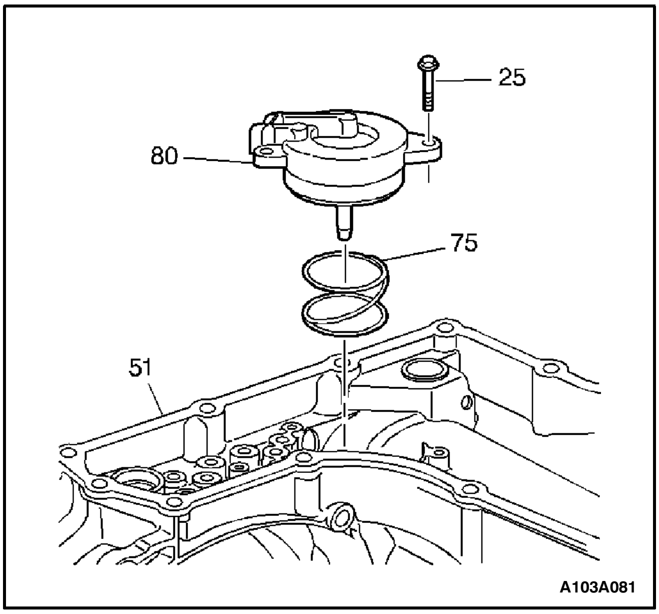
2. Remove the filter neck seal (84) from the transmission case. The filter neck seal (84) is not reusable and should be discarded.
3. Remove the oil level control valve (86).



OIL FEED PIPES REMOVAL

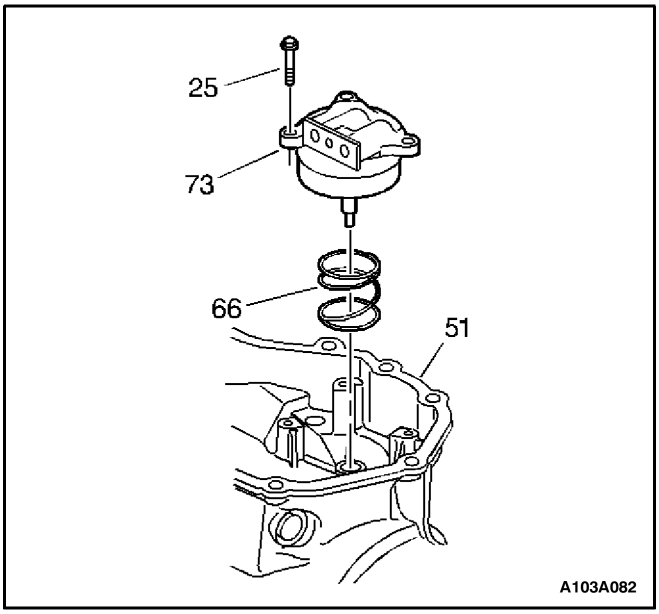
Important: The feed pipe seal rings (82) are glued into place and should remain with the feed pipe assembly (83). The feed pipe seal rings are reusable.

Remove the four oil feed pipe bolts (81) and remove the oil feed pipe assembly (83).



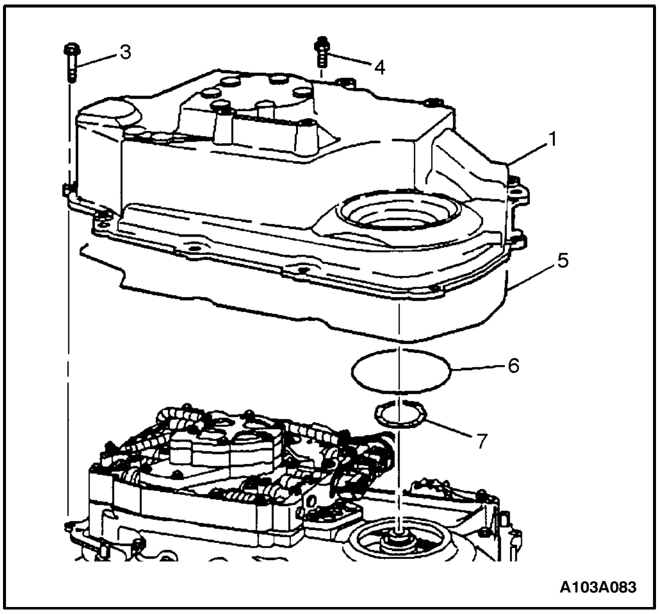
INTER 4TH SERVO REMOVAL

1. Remove the three servo cover bolts (25).
2. Remove the servo cover (intermediate/fourth) (80) assembly.
3. Remove the servo return spring (75).



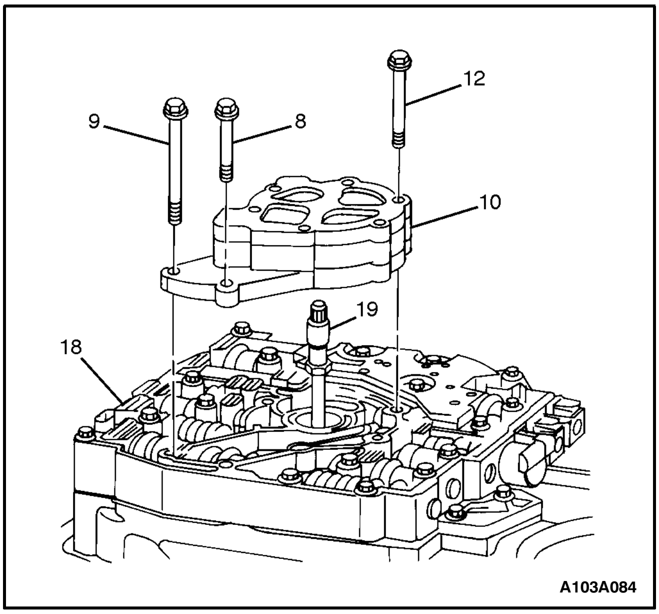
LOW/REVERSE SERVO REMOVAL

1. Remove the three servo cover bolts (25).
2. Remove the servo cover (Lo/Reverse) (73).
3. Remove the servo return spring (66).



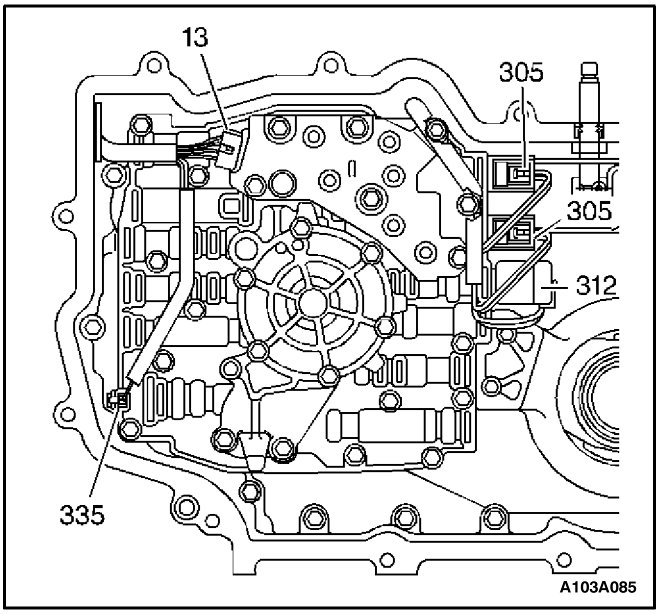
CASE SIDE COVER REMOVAL

1. Rotate the transmission so that the side cover faces upward.
2. Remove the 11 side cover bolts (3) or studs (4) (model dependant).
3. Remove the transmission side cover (1).
4. Remove the two side cover gaskets (5 and 6) and the side cover to driven support thrust washer (7), if they did not remain with the side cover.



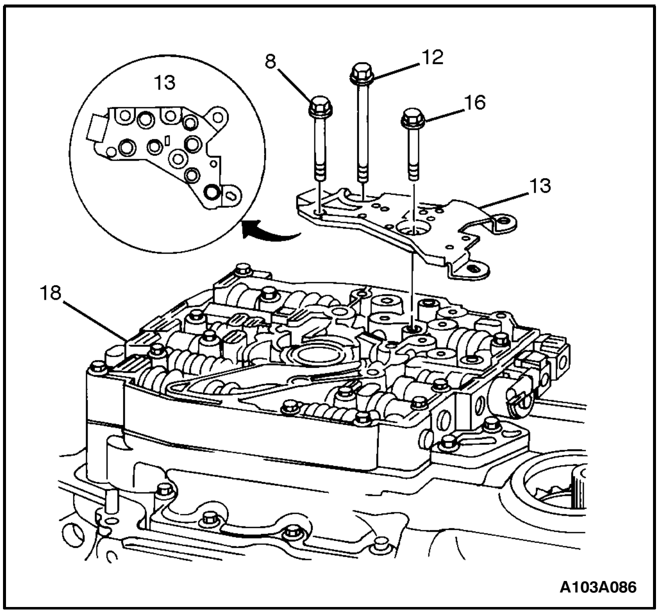
OIL PUMP AND OIL PUMP SHAFT REMOVAL

1. Remove the eight bolts from the oil pump (8, 9 and 12).
2. Remove the oil pump assembly (10).
3. Remove the oil pump shaft (19).



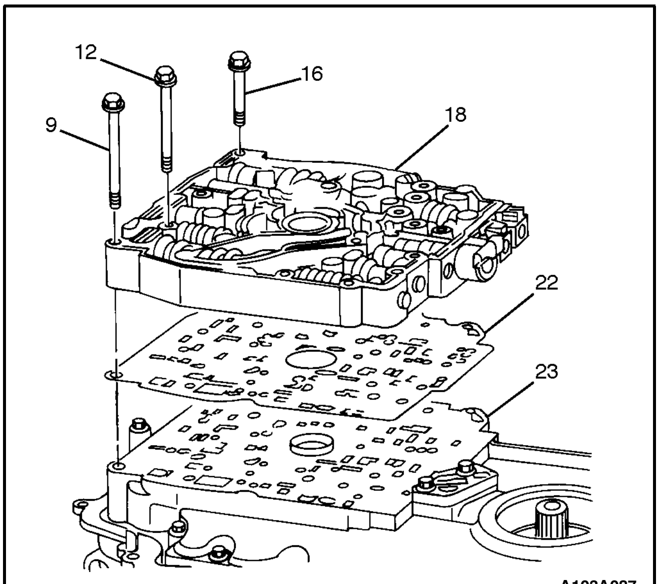
WIRE HARNESS DISCONNECT

1. Disconnect the wiring harness connectors from the pressure control solenoid (312).
2. Disconnect the wiring harness connectors from the 1-2 and 2-3 shift solenoids (305).
3. Disconnect the wiring harness connectors from the pressure switch assembly (13).
4. Disconnect the wiring harness connectors from the TCC solenoid (335).



PRESSURE SWITCH ASSEMBLY REMOVAL

1. Remove the six bolts from the pressure switch assembly (8, 12 and 16).
2. Remove the pressure switch assembly (PSA) (13) from the control valve body assembly (18). The seven pressure switch O-rings are reusable and should remain with the pressure switch assembly.



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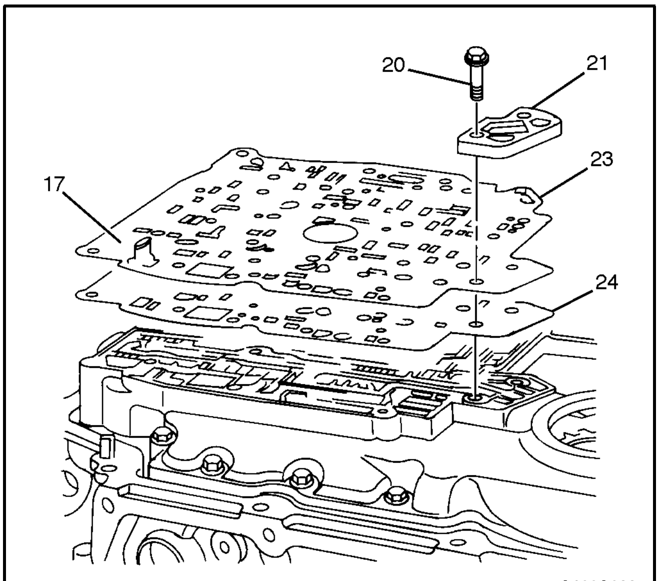
CONTROL VALVE BODY ASSEMBLY AND GASKET REMOVAL

1. Remove the remaining twelve bolts (8, 12 and 16) from the control valve body assembly (18).
2. Remove the control valve body assembly (18).
3. Remove and discard the valve body to spacer plate gasket (22).



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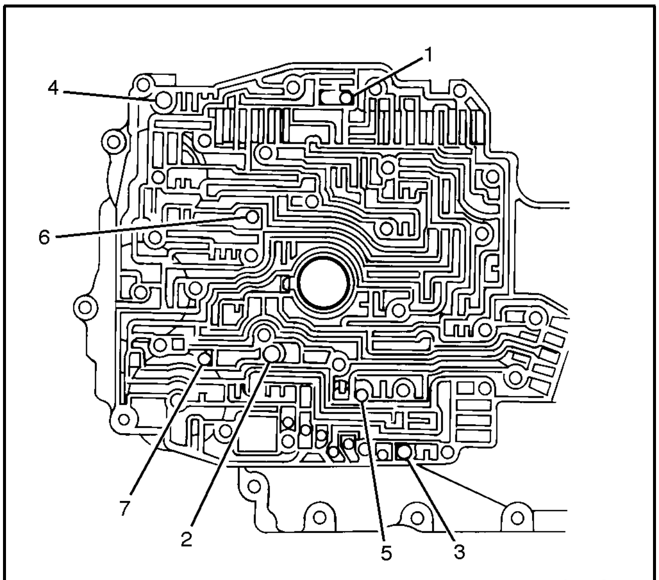
SPACER PLATE AND GASKET REMOVAL

1. Remove the two spacer plate support bolts (20).
2. Remove the spacer plate support (21).
3. Remove the spacer plate (23) with the spacer plate filter (17) attached.
4. Remove and discard the spacer plate to channel plate gasket (24).



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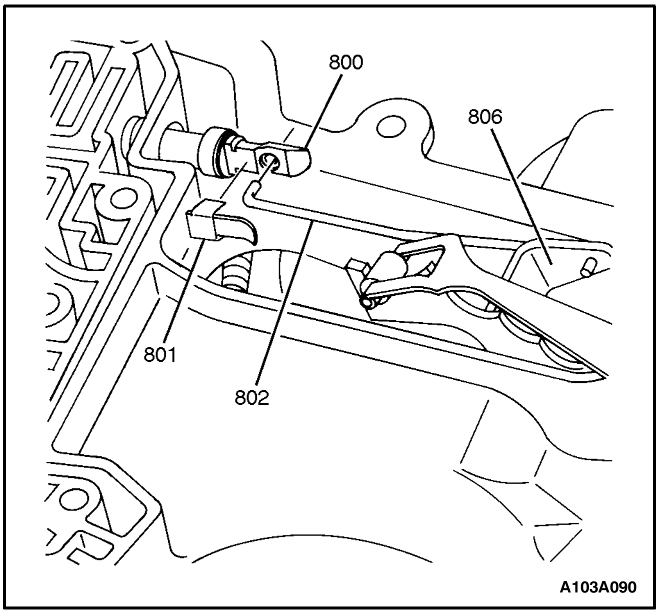
CHECKBALL REMOVAL

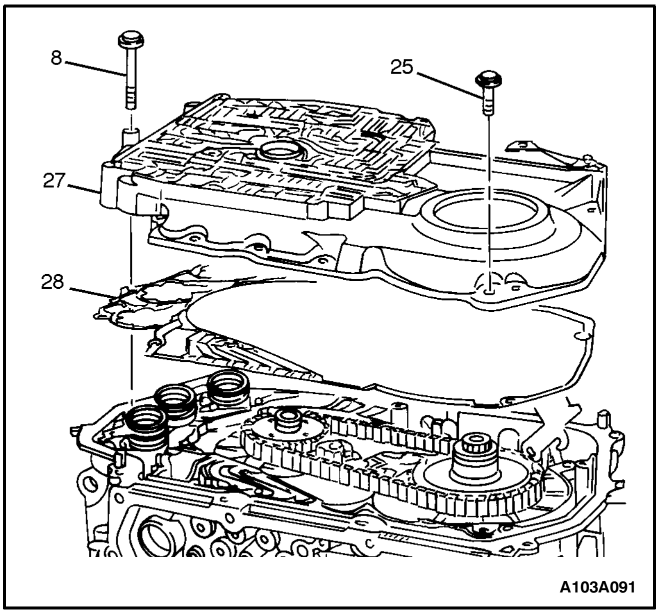
Important: Do not use a magnet in order to remove the checkballs. The magnet may magnetize the checkballs, and the checkballs may attract metallic particles.

Remove the seven checkballs (26) in the channel plate.



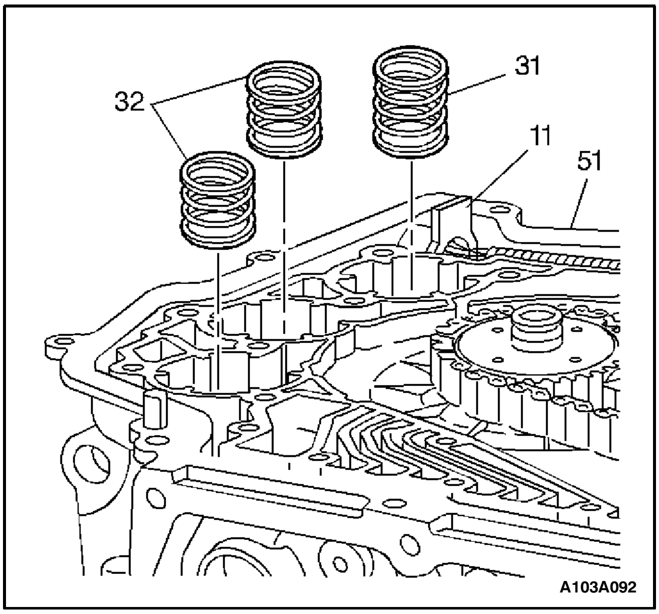
MANUAL VALVE CLIP REMOVAL

1. Disconnect the manual valve clip (801) from the manual valve.
2. Disconnect the manual valve link (802) from the manual valve.



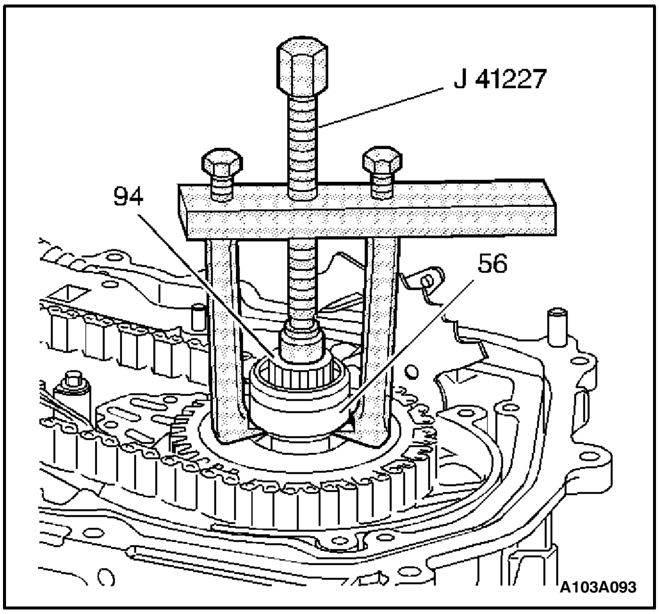
CHANNEL PLATE AND GASKET REMOVAL

1. Remove the ten channel plate bolts (8 and 25).
2. Remove the channel plate assembly (27). Keep the following components with the channel plate:
   - The drive sprocket to channel plate thrust washer (34).
   - The three accumulator pistons (29)
   - The manual valve (800)
   - The detent lever spring (804) and bolt (805)
3. Remove and discard the channel plate to case gasket (28).



ACCUMULATOR SPRING REMOVAL

Remove the three accumulator springs (31 and 32) from the case.



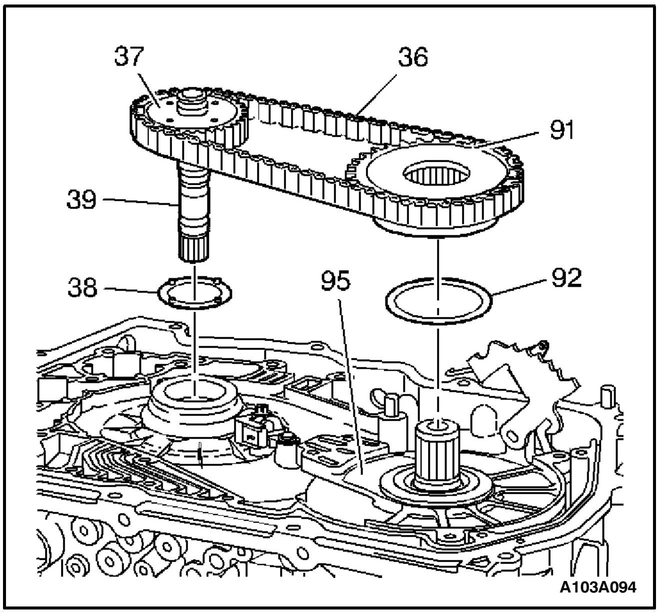
OUTPUT SHAFT SLEEVE REMOVAL

Tools Required

J 41227 Output Shaft Sleeve Puller

Important: Do not remove the output shaft (94) in the same manner as the stub shaft. In order to remove the output shaft (94), you must completely disassemble the transmission. Removing the output shaft (94) at this time will damage other transmission components.

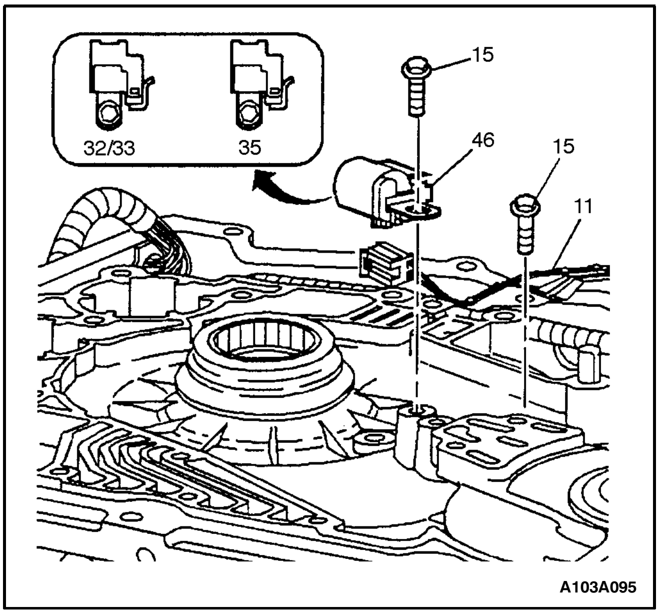
1. Insert the legs of J 41227 under the output shaft sleeve (56).
2. Tighten the center bolt of the J 41227 down in order to pull the output shaft sleeve (56) off the output shaft (94).
3. Remove and discard the output shaft sleeve (56). Use the J 41227. The output shaft sleeve is not reusable.



DRIVE, DRIVEN SPROCKETS, DRIVE LINK REMOVAL

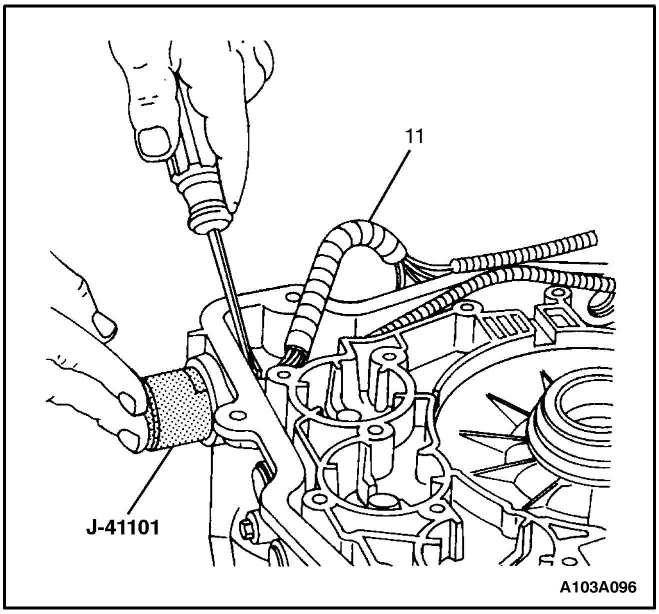
Important: When removing the drive link assembly (36) note which direction the chain faces. You must later install the chain in the same direction in order to prevent excessive noise.

1. Remove, as an entire unit, the drive sprocket (37), the turbine shaft (39), the driven sprocket (81) and the drive link assembly (36).
2. If the drive sprocket to drive sprocket support thrust washer (38) has not remained with the drive sprocket assembly (37 and 39), remove the drive sprocket to drive sprocket support thrust washer (38). The driven sprocket to driven sprocket support thrust washer (92) should remain with the driven sprocket support assembly (95).



INPUT SPEED SENSOR REMOVAL

1. Remove the wiring harness connector at the input speed sensor (46).
2. Remove the input speed sensor bolt (15) and the input speed sensor (46).
3. Remove the wire retainer slip bolt (15) and retainer clip.

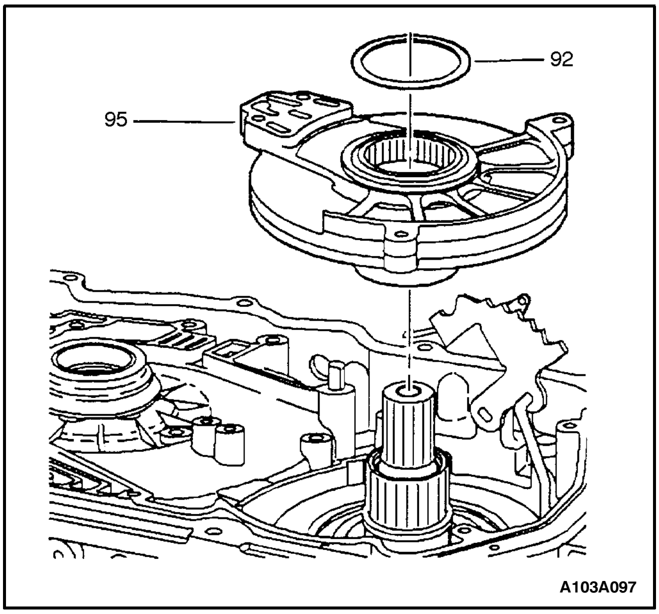


WIRING HARNESS REMOVAL

Tools Required

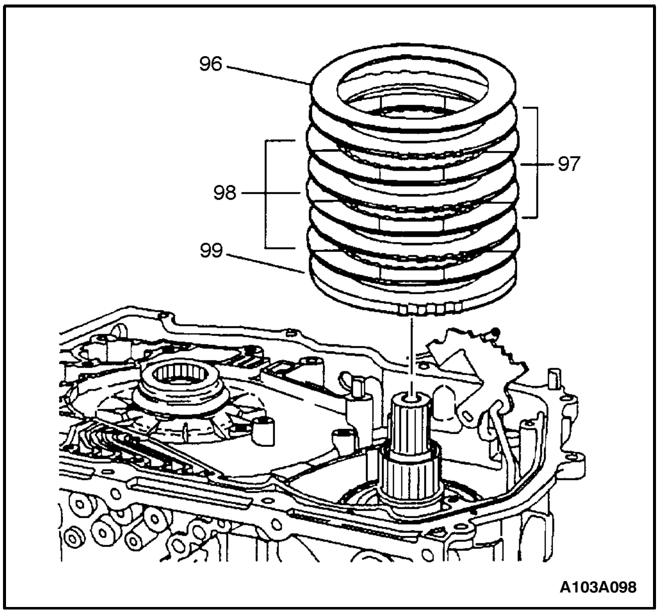
J 41101 Pass-Through Connector Remover

1. Push the J 41101 onto the pass-through connector from the outside of the transmission case in order to compress the pass-through connector's retaining tabs.
2. With the retaining tabs compressed, use a screwdriver in order to remove the pass-through connector through the inside of the transmission case.
3. Remove the wiring harness (11).



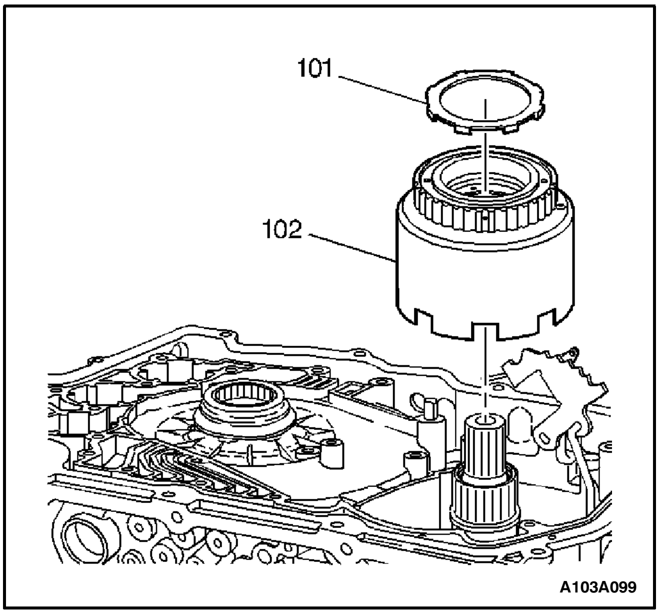
DRIVEN SPROCKET SUPPORT ASSEMBLY REMOVAL

1. Remove the driven sprocket to driven sprocket support thrust washer (92).
2. Remove the driven sprocket support assembly (95).



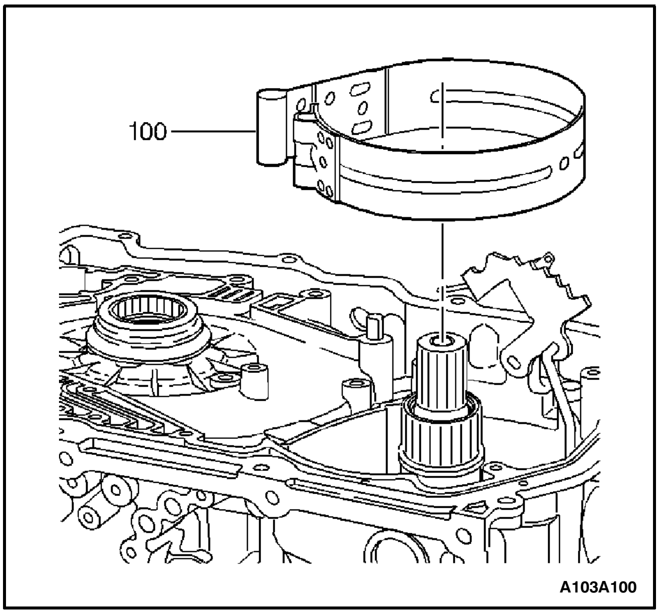
2ND CLUTCH PLATES REMOVAL

1. Remove the 2nd clutch wave plate (96).
2. Remove the three 2nd clutch steel plates (97).
3. Remove the three 2nd clutch fiber plates (98).
4. Remove the backing plate (99).



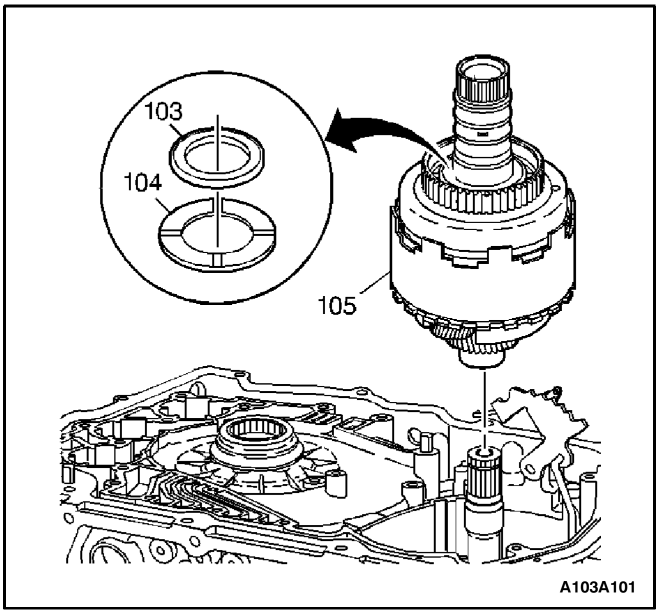
REVERSE INPUT CLUTCH HOUSING REMOVAL

1. Remove the driven sprocket support to reverse clutch housing thrust washer (101).
2. Remove the reverse input clutch housing and the 2nd roller clutch assembly (102).



INTERMEDIATE 4TH BAND REMOVAL

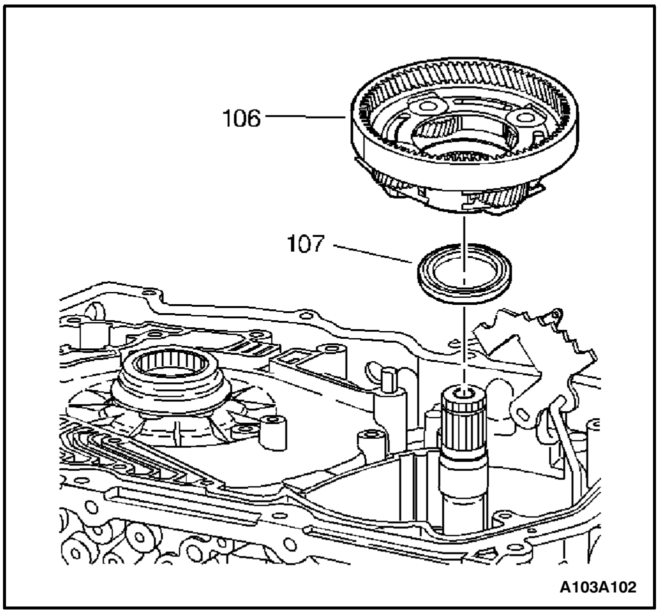
Remove the intermediate 4th band (100).



DIRECT/COAST CLUTCH AND REACTION GEAR SET REMOVAL

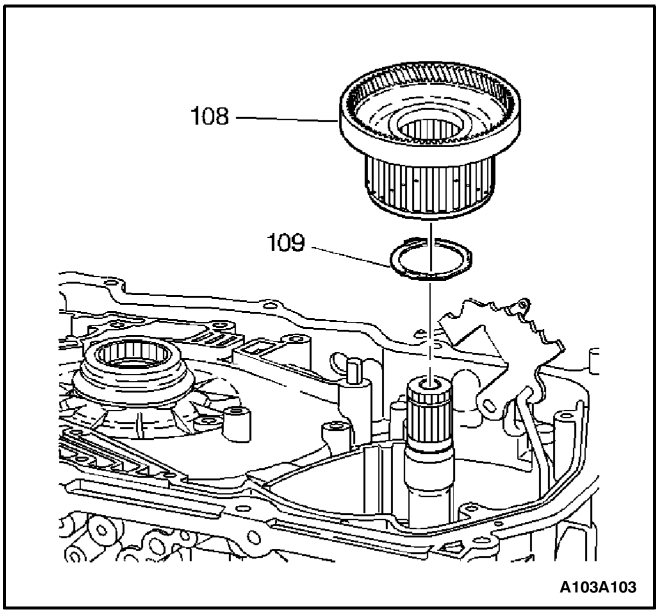
Important: Keep the bearing assembly (103) and the selective thrust washer (104) on top of the direct/coast clutch and reaction carrier assembly (105).

Remove the direct/coast clutch and reaction carrier assembly (105).



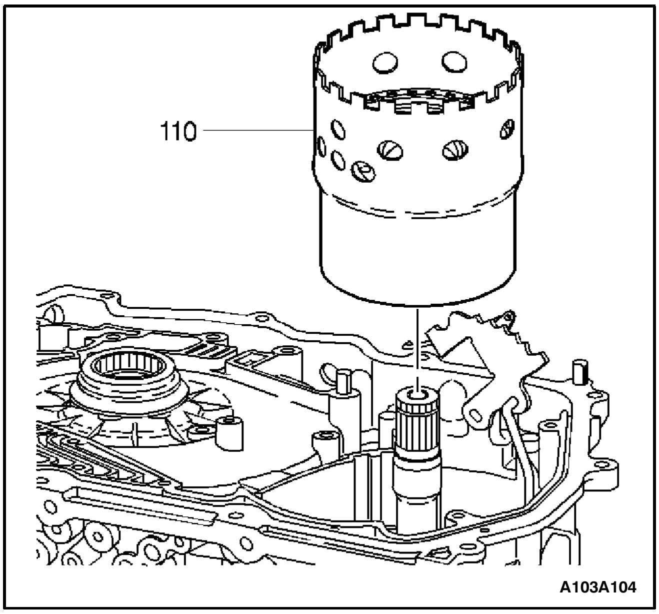
INPUT CARRIER AND REACTION GEAR ASSEMBLY REMOVAL

1. Remove the input carrier and reaction internal gear assembly (106). A bearing assembly is permanently inside the input carrier.
2. Remove the input carrier to forward clutch hub thrust bearing (107). The input carrier to forward clutch hub thrust bearing may have remained with the input carrier.



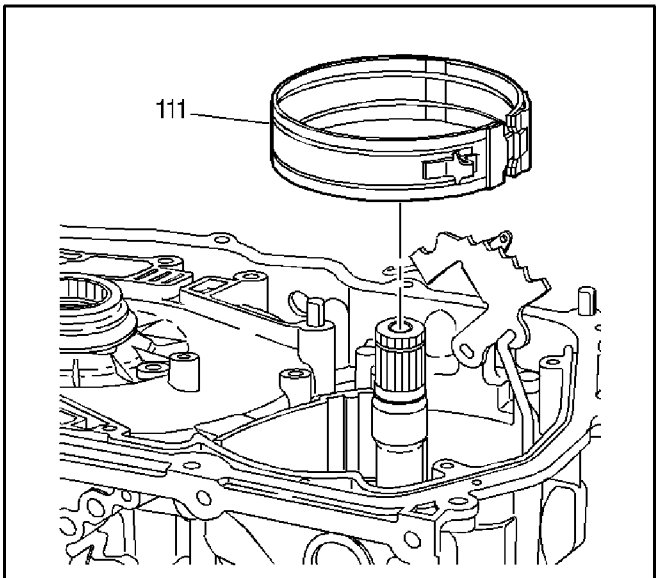
INPUT INTERNAL GEAR, FORWARD CLUTCH HUB REMOVAL

1. Remove the input internal gear and forward clutch hub assembly (108).
2. If the forward clutch hub to race thrust washer (109) did not remain with the forward clutch hub, remove the forward clutch hub to race thrust washer (109).



FORWARD CLUTCH AND LOW/REVERSE BAND REMOVAL

1. Remove the forward clutch assembly (110).



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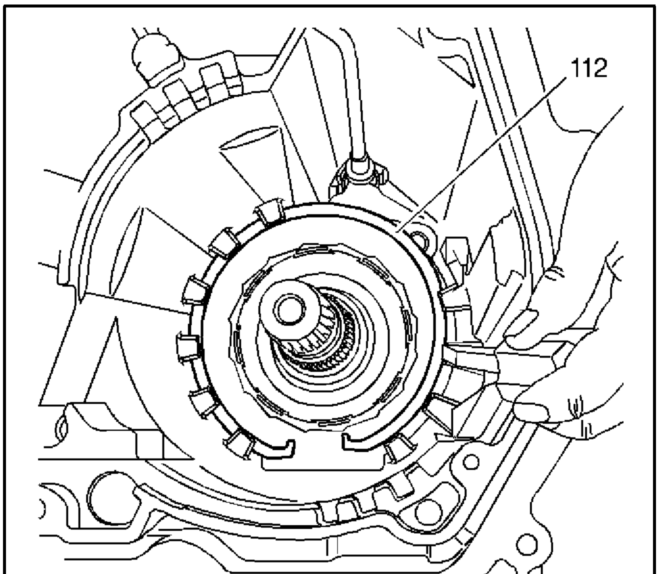
2. Remove the low/reverse band (111).



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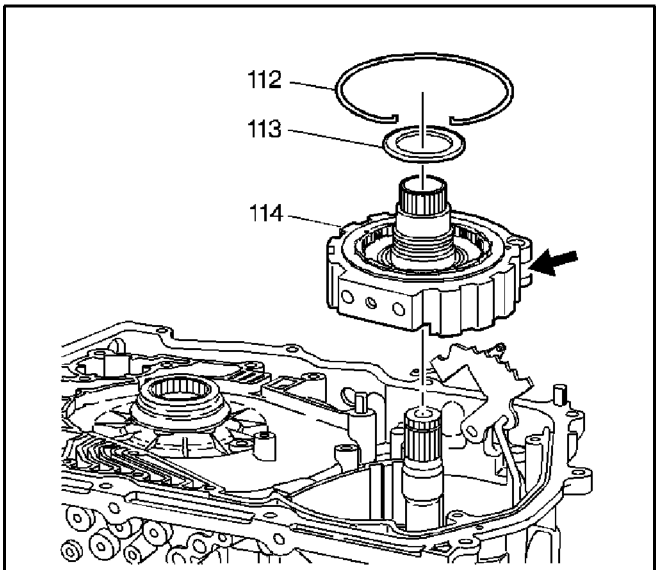
FORWARD CLUTCH SUPPORT, LOW ROLLER CLUTCH REMOVAL

Tools Required

J28585 Snap Ring Screwdriver

Important: The snap ring opening must be at the bottom of the transmission case. If the snap ring opening is out of position, inspect the transmission case for damage.

1. Remove the forward clutch support snap ring (112) from the transmission case. Use the J 28585.



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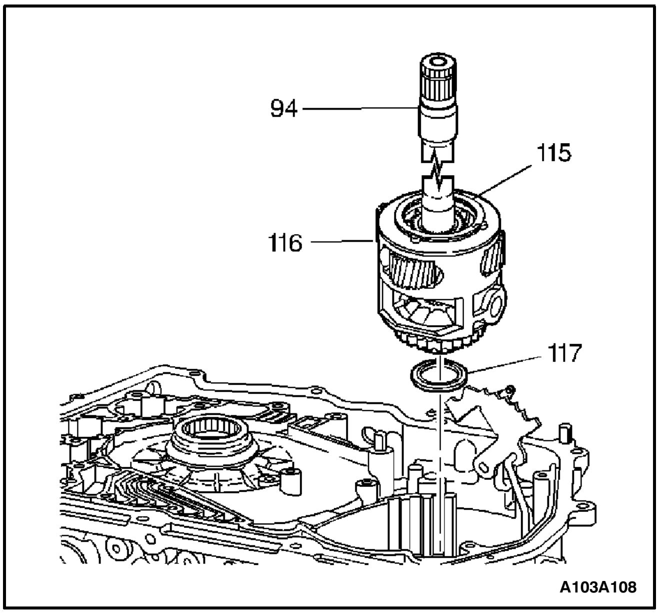
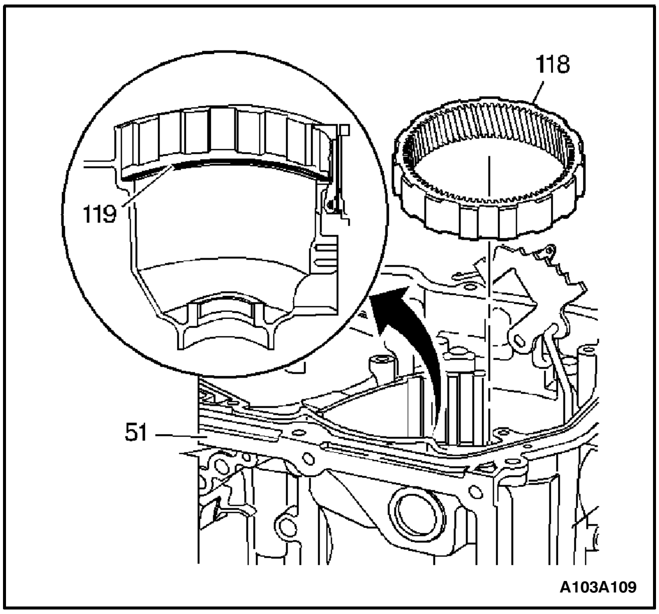
Important: You may need to depress the parking pawl in order to remove the forward clutch support.

2. Remove the forward clutch support and the low roller clutch assembly (114). Keep the forward clutch housing to the forward clutch support thrust bearing (113) with the forward clutch support assembly (114).



OUTPUT SHAFT AND FINAL DRIVE ASSEMBLY REMOVAL

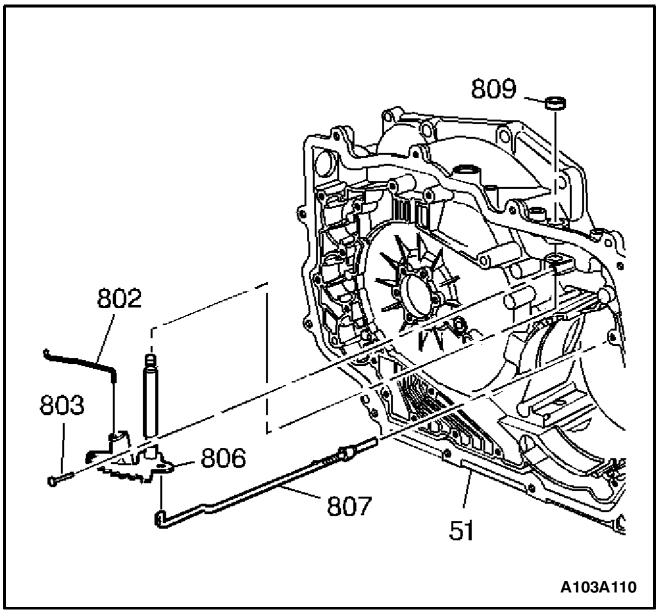
1. Remove, as one unit, the output shaft (94), the final drive assembly (116), and the final drive sun gear (115).
2. If the differential carrier to case thrust bearing (117) did not remain with the final drive assembly (116), remove the differential carrier to case thrust bearing (117).



FINAL DRIVE INTERNAL GEAR REMOVAL

Important: The fretting ring (119) is in the case ring groove. Do not remove the fretting ring unless it appears damaged.

Remove the final drive internal gear (118).



MANUAL SHAFT, DETENT LEVER, PARK LOCK REMOVAL

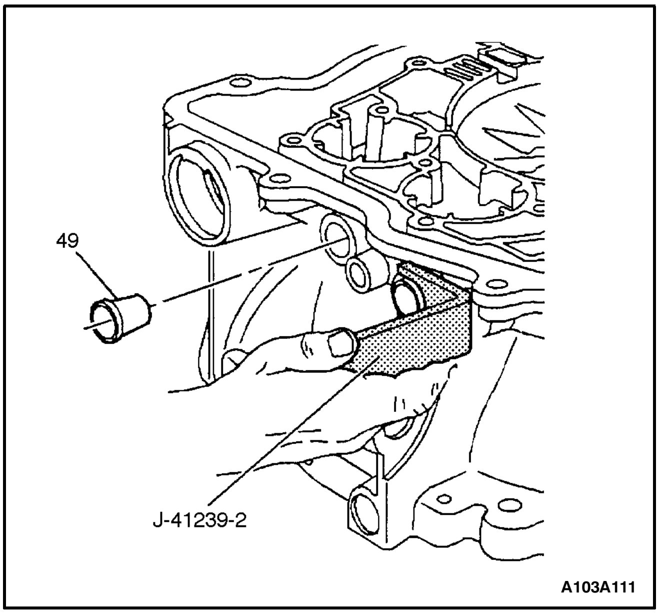
1. Remove the manual shaft to transmission case pin (803).

Important: The parking lock actuator assembly (807) remains attached to the manual shaft and detent lever until the assembly is removed.

2. Remove the manual shaft and detent lever assembly (806) by pushing the manual shaft into the transmission case (51). The parking lock actuator assembly (807) remains attached to the detent lever until you remove the manual shaft and detent lever assembly.

Important: Do not damage the case bore during removal of the manual shaft seal (809).

3. Remove the manual shaft seal (809) from the case (51).

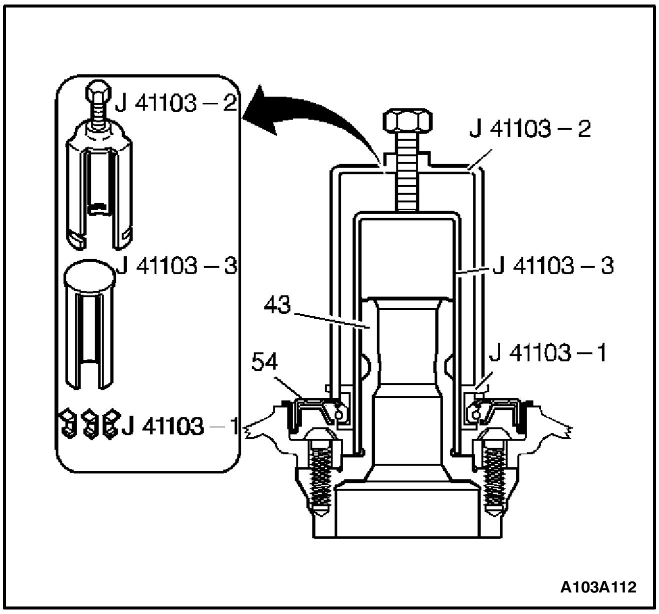


TRANSAXLE COOLER LINE SEAL REMOVAL

Tools Required

J 41239-2 Cooler Line Seal Removal Tool

1. **Use a hammer in order to wedge the J 41239-2 into the transmission cooler line seal (49) on the outside of the case bore.**
2. **Remove the transmission cooler line seal by prying the transmission cooler line seal out of the case. If necessary strike the J 41239-2 with a hammer.**



TORQUE CONVERTER SEAL REMOVAL

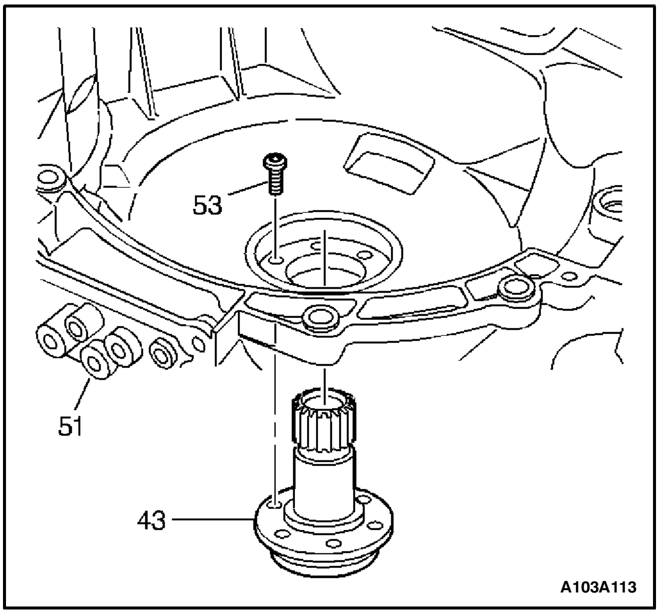
Tools Required

J 41103 Torque Converter Seal Remover

1. **Insert the three J 41103 puller legs under the torque converter seal (54).**
2. **Insert the J 41103 support body over the stator shaft (43).**
3. **Insert the J 41103 puller bridge over the J 41103 support body. Connect the J 41103 puller legs into the slots on the J 41103 bridge.**

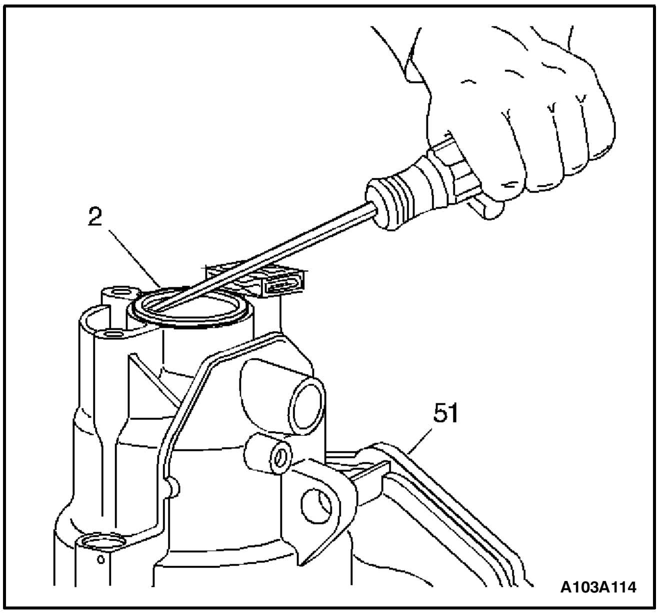
Important: The puller legs will damage the torque converter seal (54). Discard the torque converter seal (54) after removal.

4. **Tighten the forcing screw on the J 41103 puller bridge until the J 41103 puller legs remove the torque converter seal (54).**



DRIVE SPROCKET SUPPORT REMOVAL

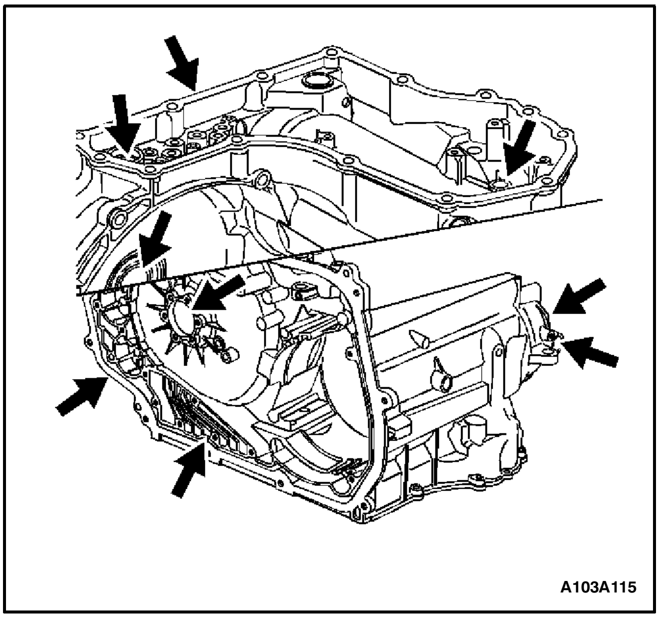
1. **Remove the six bolts (53) from the drive sprocket support (43).**
2. **Remove the drive sprocket support (43 from the case (51).**



RIGHT HAND AXLE SEAL REMOVAL

Important: Be careful not to damage the case bore with the screwdriver.

Use a screwdriver in order to remove the right hand axle seal (2) from the transmission case (51). If necessary, crush the right hand axle seal first with the screwdriver in order to loosen the seal from the case.

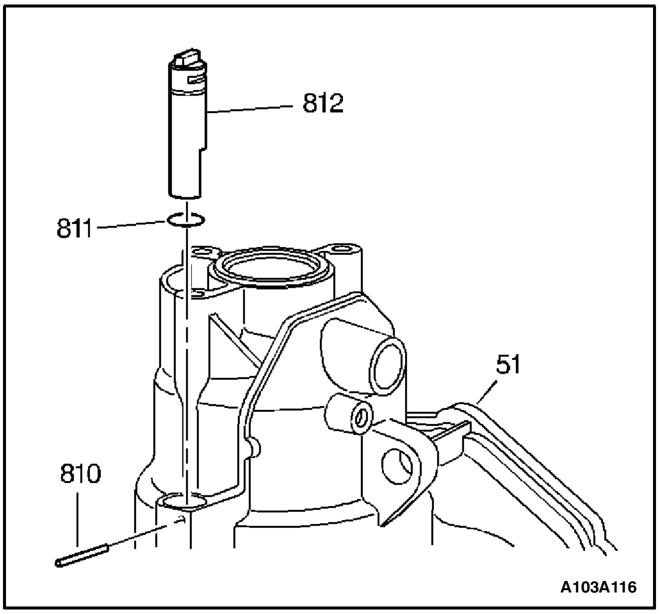


CASE INSPECTION

Notice: Use Transjel™ J 36850 or equivalent during assembly in order to retain checkballs or to lubricate components. Greases other than the recommended assembly lube will change the transmission fluid characteristics and will cause undesirable shift conditions or filter clogging.

Important: After cleaning the transmission case, allow the case to air dry. Do not use cloth or paper towels in order to dry the transmission case or any other transmission components. Lint from the towels can cause component failure.

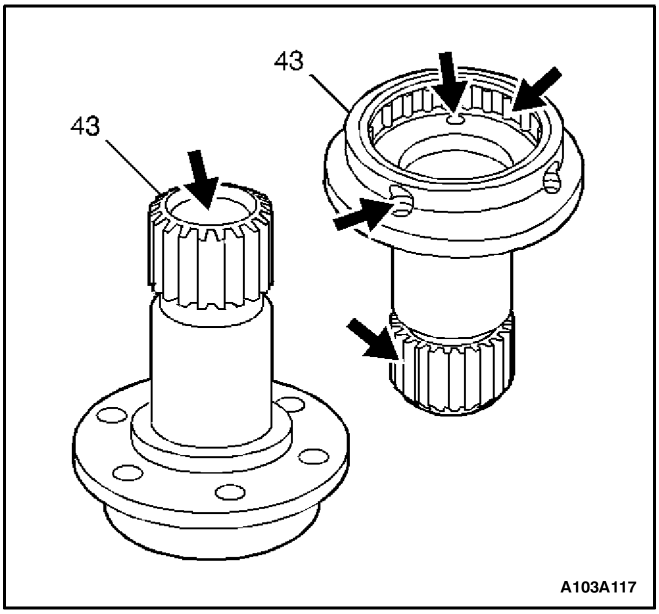
1. **Thoroughly clean the transmission case and all the case threads with solvent.**
2. **Inspect the case exterior and the external bores for cracks, sharp edges, porosity and excessive bushing wear.**
3. **Inspect the case interior for damage at the snap ring grooves, case lugs and band anchor pin.**
4. **Inspect all the gasket surfaces for surface damage and in order to ensure surface flatness.**
5. **Inspect the corresponding gasket for proper impressions in order to ensure surface flatness.**
6. **Inspect the bolt holes and fasteners for thread damage. If necessary, repair or replace any bolt holes or fasteners.**
7. **Air check the oil passages. For identification of the oil passages, refer to the transmission diagnosis section.**



ACTUATOR GUIDE REPLACEMENT

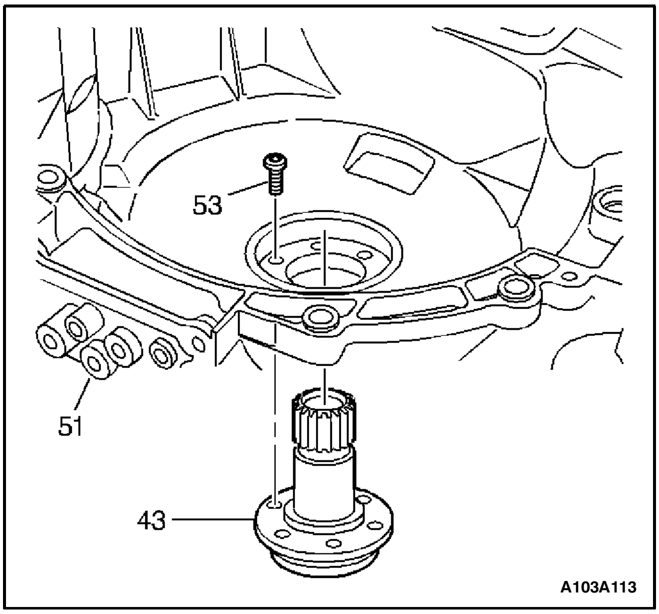
Important: Do not remove the actuator guide unless the actuator guide appears damaged.

1. Remove the actuator guide roll pin (810) from the case.
2. Remove the actuator guide (812) and O-ring seal (811) assembly from the case (51). For easiest removal, tap the actuator guide (812) into the case (51).
3. Install a new O-ring seal (811) on the actuator guide (812).
4. Install the actuator guide (812) and O-ring assembly (811) into the transmission case (51).
5. Install the actuator guide roll pin (810) into the case (51) in order to secure the actuator guide (812).

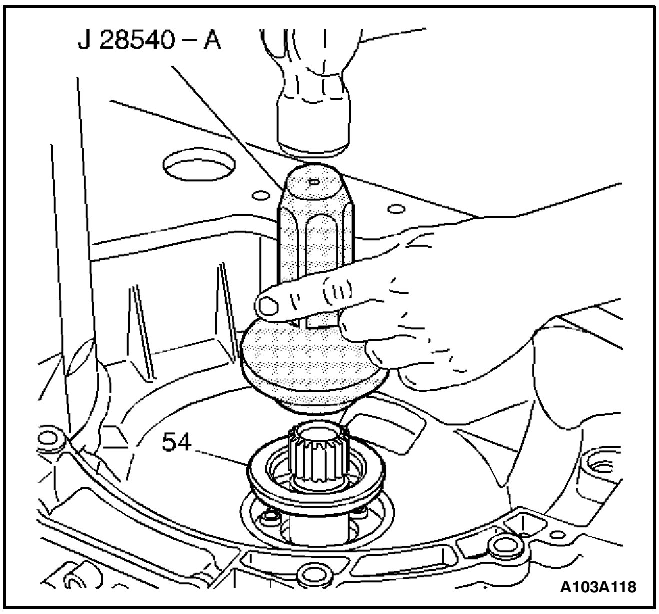


DRIVE SPROCKET SUPPORT INSTALLATION

1. Inspect the drive sprocket support (43) for damage to the stator shaft splines, the journals, the bushings, and the roller bearing.
2. Inspect the converter seal drain holes for blockage.



3. Install the drive sprocket support (43) into the bell housing of the transmission case.
4. Install the six drive sprocket support bolts (53) into the drive sprocket support (43).
5. Hand start the bolts and tighten the bolts to 12 N•m (9 lb-ft).

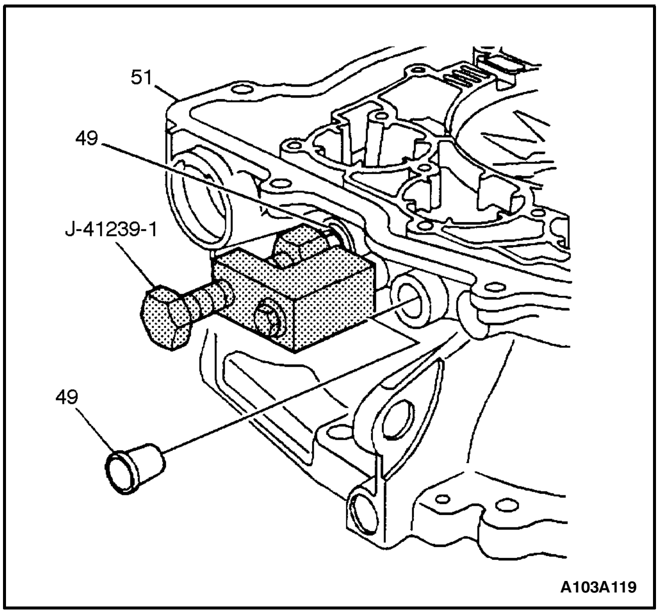


TORQUE CONVERTER SEAL INSTALLATION

Tools Required

J 28540 Torque Converter Seal Installer

Install a new torque converter seal (54). Use the J 28540.

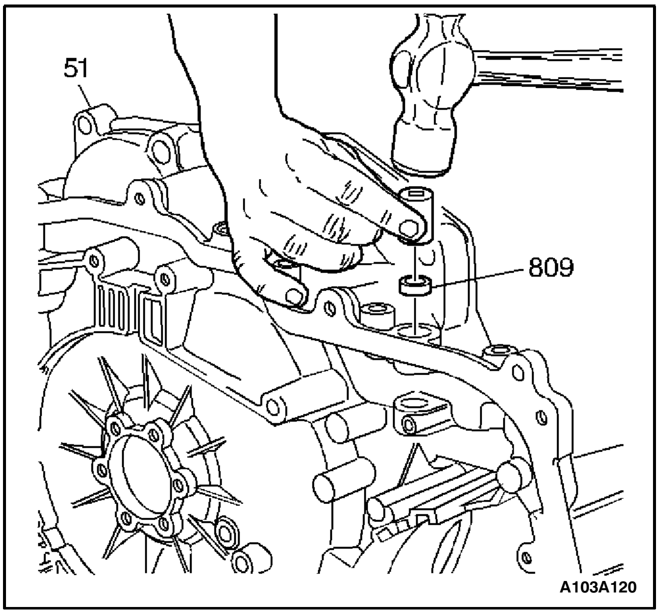


TRANSAXLE COOLER LINE SEALS INSTALLATION

Tools Required

J 41239-1 Cooler Line Seal Installer

1. **Place a new cooler line seal (49) in the case bore.**
2. **Install the J 41239-1 on the transmission case (51) at the cooler line bracket bolt hole.**
3. **Press the new cooler line seal (49) in by tightening the seal pressing bolt on the J 41239-1 until the seal bottoms out in the case bore.**
4. **Repeat steps 1-3 for the second cooler line seal (49).**

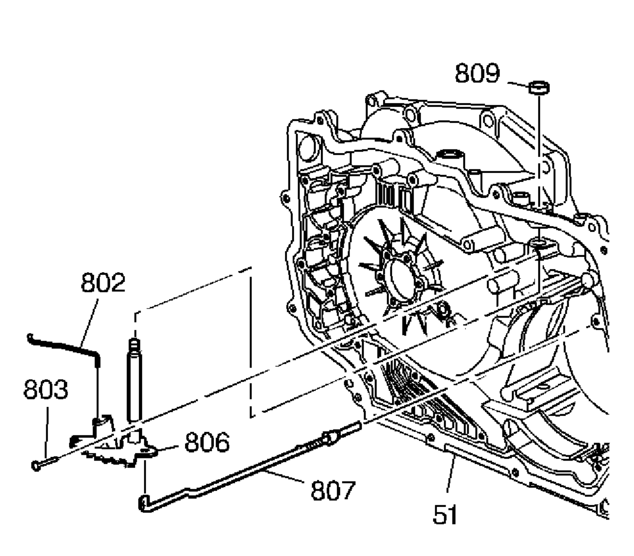


MANUAL SHAFT, DETENT LEVER, PARK LOCK INSTALLATION

Tools Required

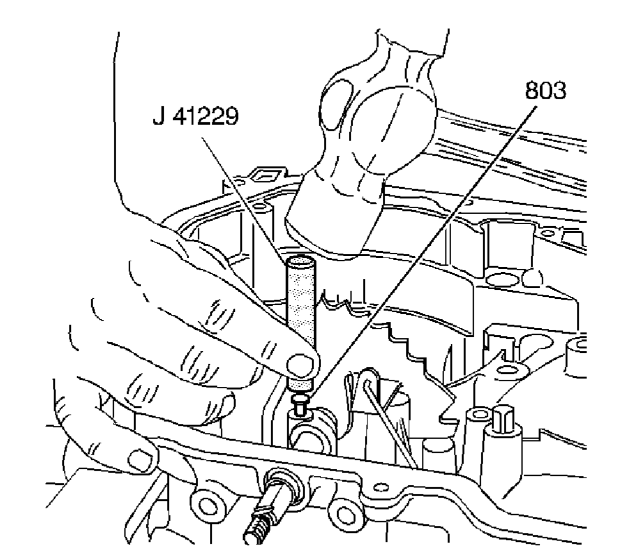
J 41229 Manual Shaft to Case Pin Installer

1. **Install a new manual shaft seal (809) into the case (51). Use a 13 mm socket.**



A103A110

2. With the manual valve to detent lever link (802) and the parking lock actuator assembly (807) attached, install the manual shaft and detent lever assembly (806) into the case.
3. Ensure that the parking lock actuator rod is correctly positioned into the actuator guide.



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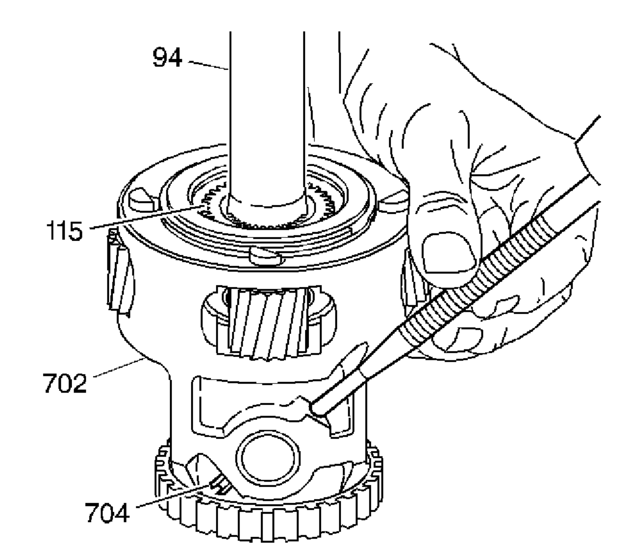
Important: Install the manual shaft pin at the correct height in order to properly secure the manual shaft. The J 41229 provides the correct installation height. If you install the pin too deep, the case boss might crack.

4. Install the manual shaft pin (803) into the case. Use the J 41229.



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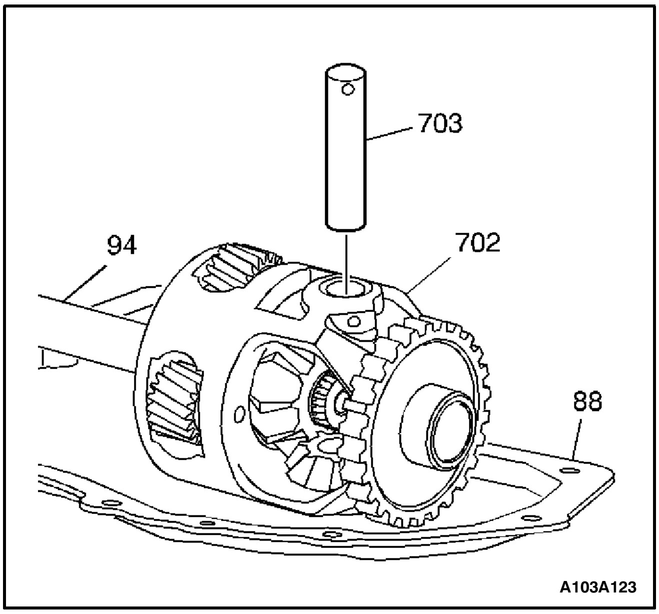
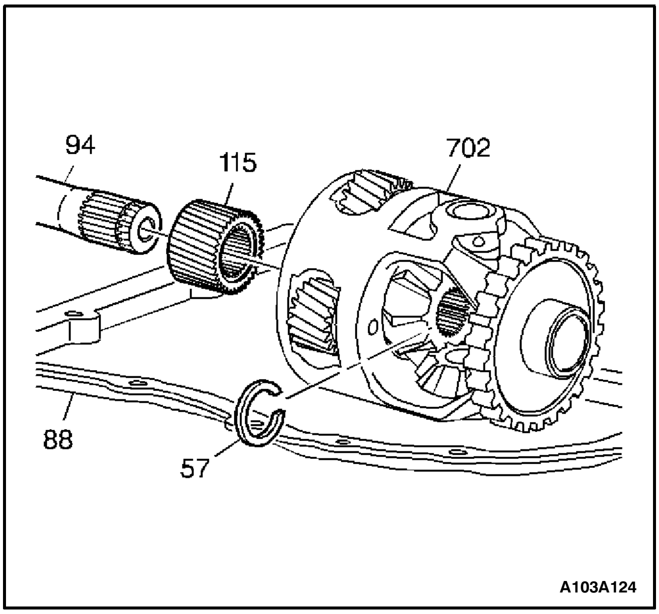
FINAL DRIVE ASSEMBLY DISASSEMBLE

1. Remove the differential pinion shaft retaining pin (704). Use a pin punch.



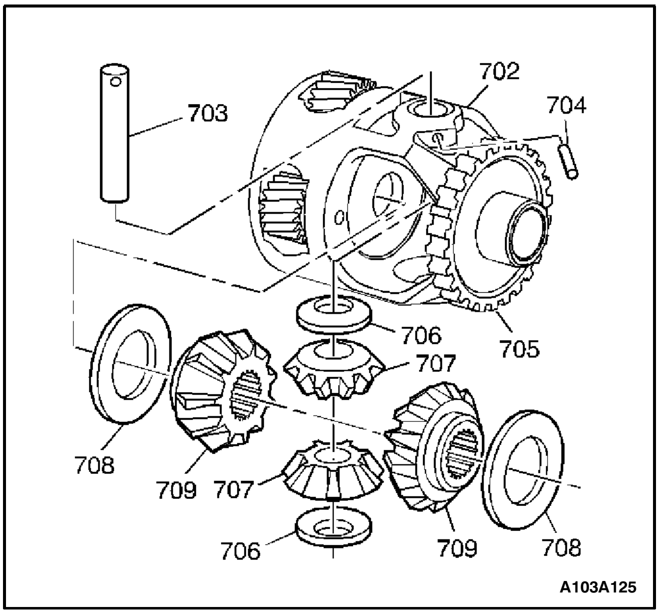
Important: If the pinion gears are removed, place the final drive carrier into a clean transmission oil pan in order to prevent losing the needle bearings.

2. **Remove the differential pinion shaft (703).**

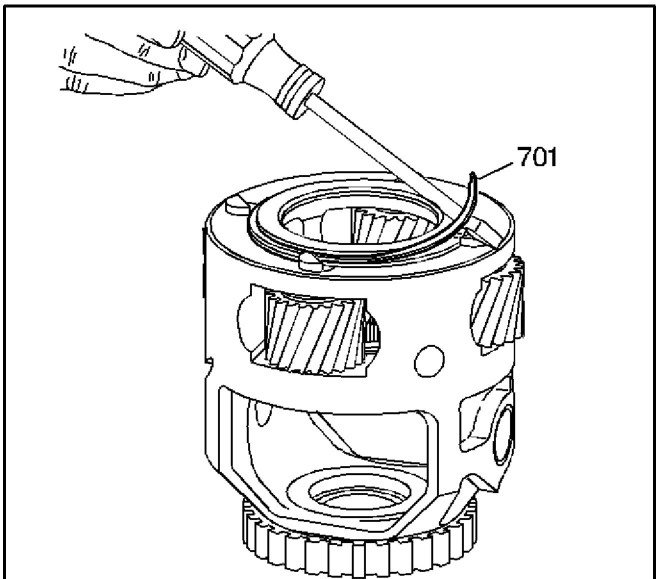


Important: The snap ring (57) is not reusable. Discard the snap ring (57).

3. **Remove the snap ring (57) from the end of the output shaft (94).**
4. **Remove the output shaft (94) from the differential carrier (702).**
5. **Remove the final drive sun gear (115).**



6. **Remove the differential pinion gears (707) and the thrust washers (706).**
7. **Remove the differential side gears (709) and the thrust washers (708).**



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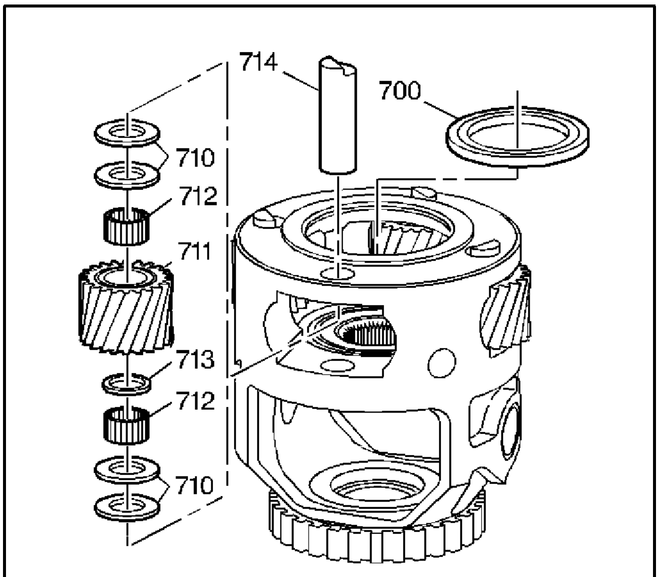
8. Remove the final drive carrier spiral retaining ring (701).



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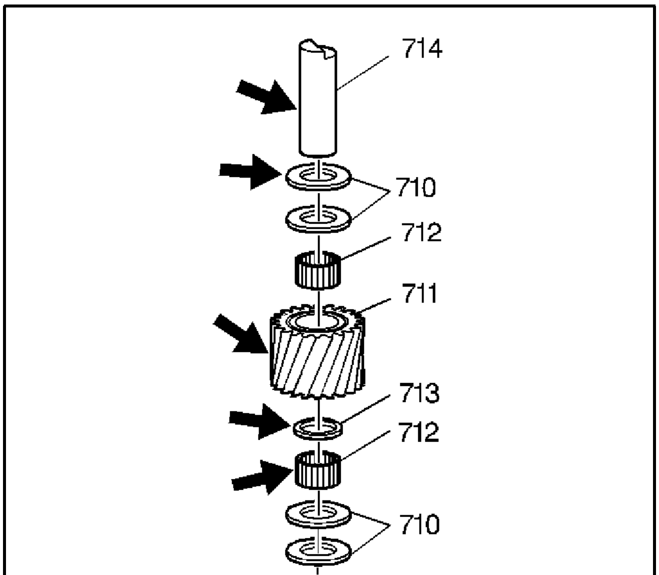
Important: When removing the pinion gears, note the orientation. You must install the pinion gears in the same direction in which you removed the pinion gears. If you install the pinion gear upside down. the change in set wear patterns will cause a noise condition.

9. Remove the four planet pinion pins (714).
10. Remove the four pinion gears (711).
11. Remove the pinion thrust washers (710).
12. Remove the needle roller bearings (712).
13. Remove the needle bearing spacers (713).
14. Remove the final drive sun gear to carrier thrust bearing (700).



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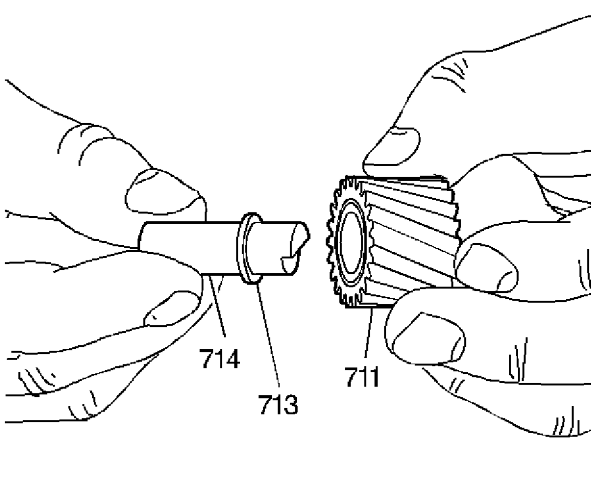
15. Inspect the needle roller bearings (712), the pinion thrust washers (710), the pinion gears (711), and the planet pinion pins (714) for excessive wear. Polishing is a normal condition for the pinion pins and the needle bearings.
16. Inspect the pinion shaft (714) for spalling or for wear.
17. Inspect the pinion thrust washers (710) for wear and for cracks.
18. Clean and dry the final drive carrier and the final drive components.

FINAL DRIVE ASSEMBLY ASSEMBLE



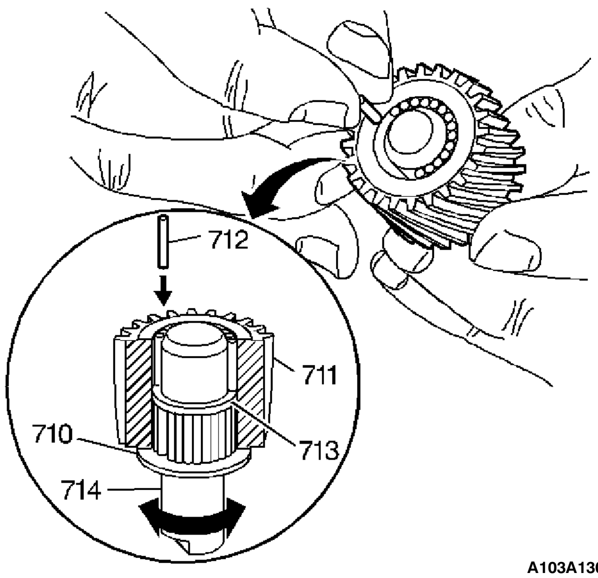
A103A129

Tools Required

J 36850 Transjel™

Important: You must assemble the spacer between the two rows of needle bearings. In order to aid in the assembly of the needle bearings, place the spacer and the pinion gear onto the planet pinion gear pin (714).

1. Install the pinion gear needle bearing spacer (713) onto the planet pinion gear (711).



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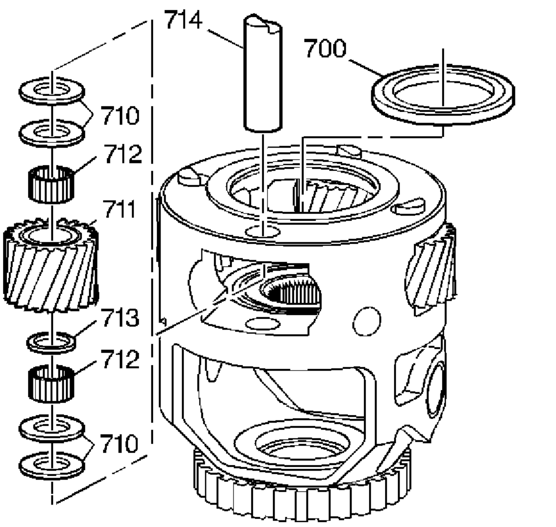
2. Place a thrust washer (710) on the bottom of the planet pinion (711) in order to retain the bottom row of needle bearings.
3. Use J 36850 or equivalent in order to aid in the assembly and in order to keep the needle roller bearings (712) in the race.
4. Install the needle roller bearings (712) one at a time into the planet pinion (711).



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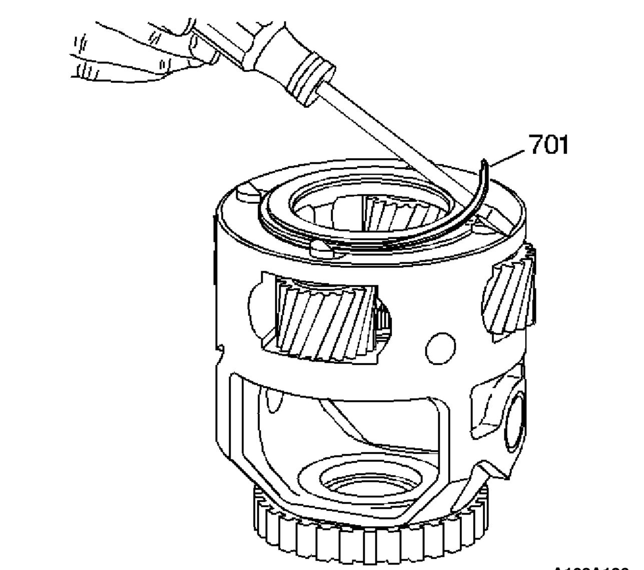
5. Install the sun gear to final drive carrier thrust bearing (700) onto the final drive carrier (116). Retain the thrust bearing with J 36850 or equivalent.

Important: Assemble the pinion gears (711) in the same direction that you removed the pinion gears in order to prevent noise due to changing the gear wear pattern.

6. Assemble the pinion gear thrust washers (710) and the planet pinion gears into the final drive carrier (116).
7. Install the planet pinion gear pins (714) into the final drive carrier (116) in order to retain the planet pinion gears (711).



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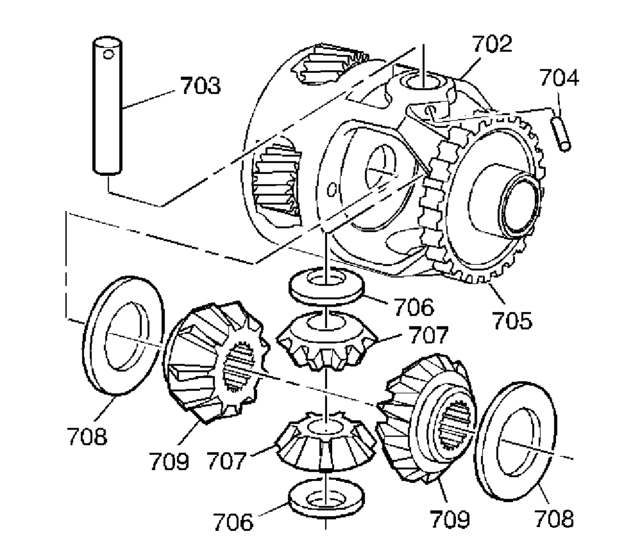
8. Install the final drive carrier spiral retaining ring (701) in order to retain the planet pinion gear pins.



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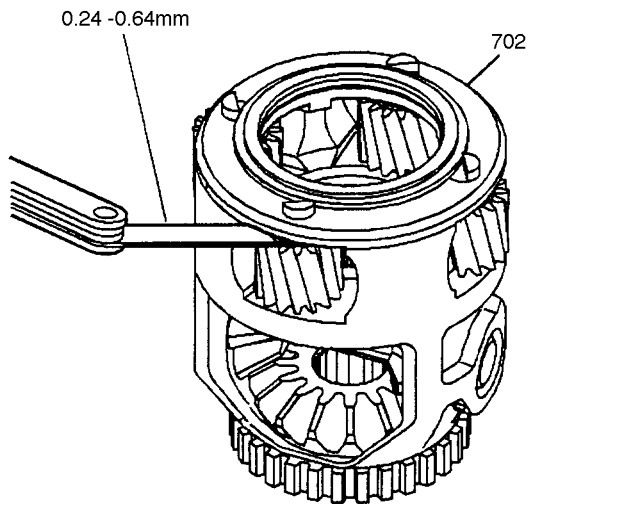
9. Assemble the thrust washers (708) onto the differential side gears (709).
10. Install the differential side gears into the final drive carrier (116).
11. Assemble the thrust washers (706) onto the pinion gears (707). Retain the thrust washers with J 36850 or equivalent.
12. With the thrust washers (706) attached, install the pinion gears (707) into the final drive carrier (116).
13. Rotate the pinion gears (707) into position, and install the pinion shaft (703) through the final drive carrier (116) and through the pinion gears (707).
14. Position the pinion shaft (703) in order to allow installation of the retaining pin.
15. Install the retaining pin (704) through the final drive carrier (116) and through the pinion shaft (703) in order to retain the pinion shaft (703).



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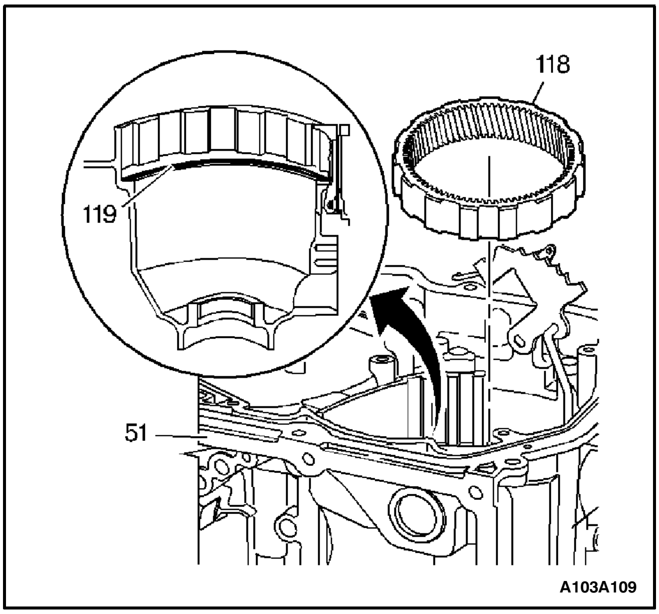
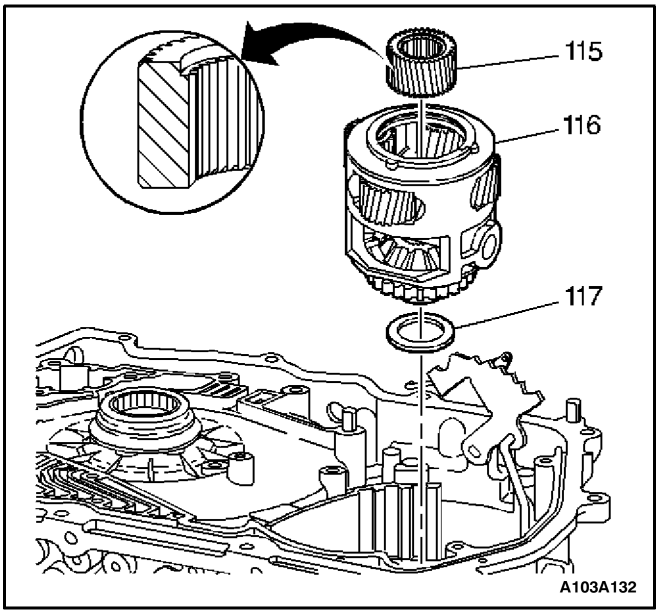
FINAL DRIVE PINION END PLAY CHECK

1. Inspect the end play with a feeler gauge for proper clearance. Proper clearance is 24-62 mm (0.009-0.024 inch).
2. If the clearance is out of specification on the low side, repair the differential assembly as necessary.
3. If the clearance is out of specification on the high side, replace the differential assembly.



FRETTING RING, FINAL DRIVE INTERNAL GEAR INSTALL

1. If the fretting ring 9119) has been removed, install the fretting ring (119) into the small groove in the transmission case (51).
2. Install the final drive internal gear (118) into the transmission case (51).



FINAL DRIVE AND DIFFERENTIAL ASSEMBLY INSTALL

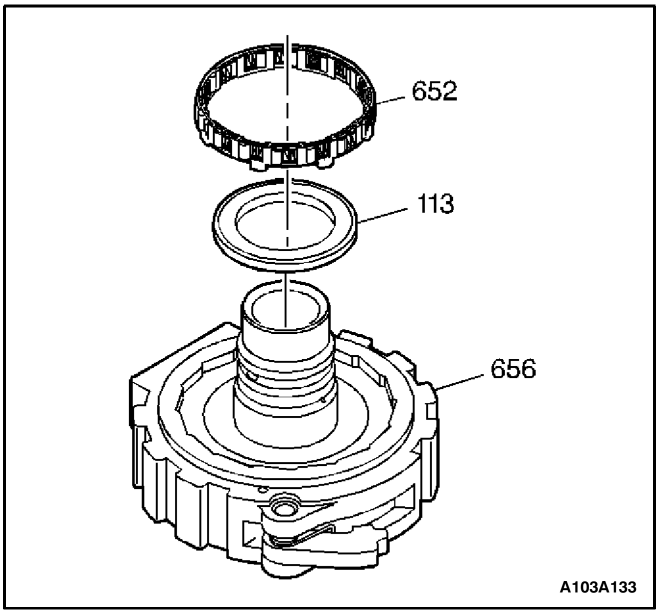
Tools Required

J 36850 Transjel™

1. Install the final drive carrier to case thrust bearing (117) onto the final drive carrier. Retain the bearing with J 36850.
2. Install the complete final drive carrier assembly (116) into the transmission case (51).

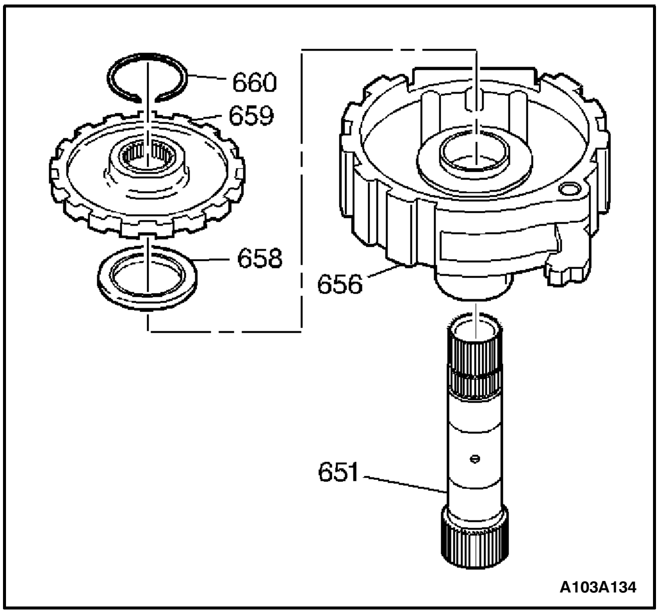
Important: Install the sun gear with the grooved side up (flat side down).

3. Install the final drive sun gear (115) into the final drive carrier (116).

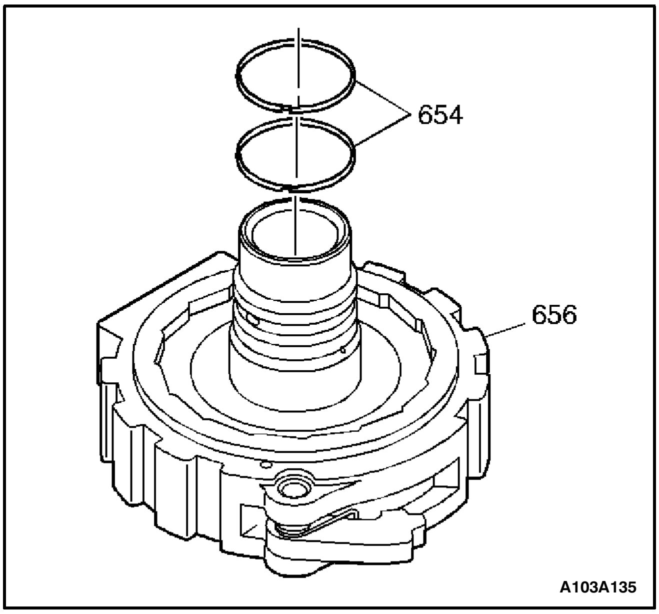


FORWARD CLUTCH SUPPORT, ROLLER CLUTCH DISASSEMBLE

1. Remove the roller clutch assembly (652) from the forward clutch support (656) by turning the roller clutch assembly (652) clockwise and gently lifting upward.
2. Remove the thrust bearing (113) from the forward clutch support (656).

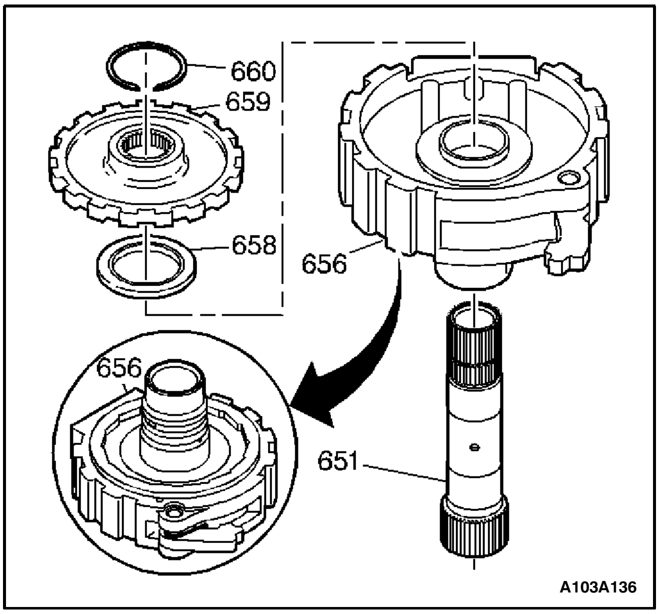


3. Remove the final drive sun gear shaft snap ring (660).
4. Remove the parking pawl gear (659).
5. Remove the forward clutch support to parking pawl gear thrust bearing (658).
6. Remove the forward clutch support (656) from the final drive sun gear shaft (651).

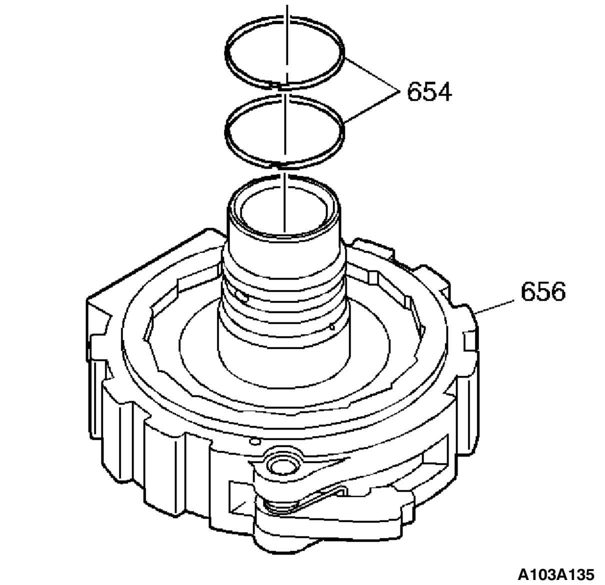


Important: The parking pawl pin has a pressed fit into the forward clutch support. The parking pawl pin is not serviceable. Do not remove the parking pawl pin.

7. Remove and discard the two seals (654) from the forward clutch support (656).



8. Inspect the snap ring for overextension (660).
9. Inspect the seal grooves for damage (656).
10. Inspect for signs of excessive bearing and bushing wear.
11. Inspect the splines and the parking gear teeth for cracks or excessive wear.
12. Inspect the fluid feed holes for the proper opening.
13. Inspect all other components for excessive wear or damage.
14. Clean and dry all of the components.



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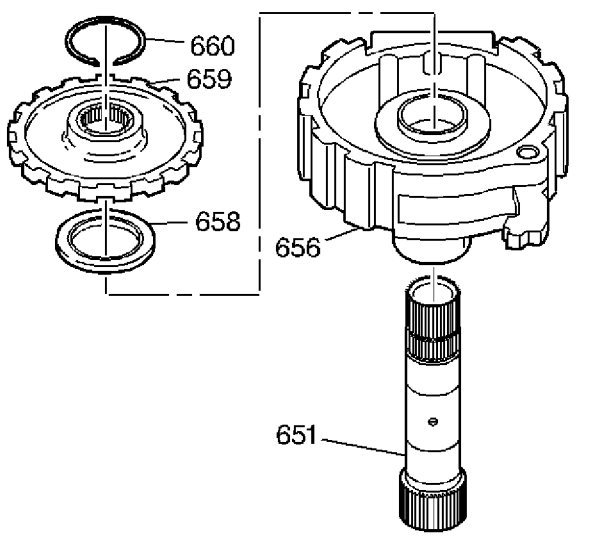
FORWARD CLUTCH SUPPORT, LOW ROLLER CLUTCH ASSEMBLE

1. Assemble two new seals (654) on the forward clutch support (656).



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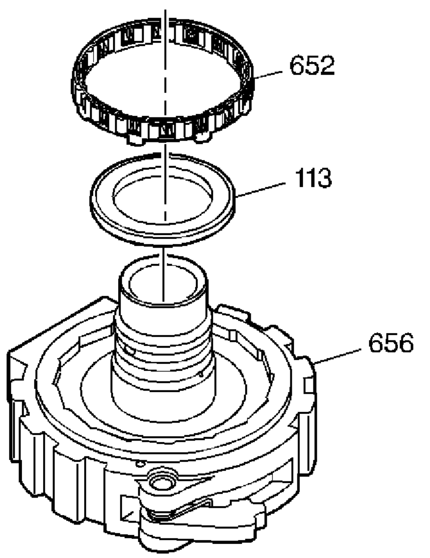
2. Assemble the forward clutch support (656) onto the final drive sun gear shaft (651).
3. Assemble the roller bearing (658) onto the forward clutch support (656).
4. Assemble the parking pawl gear (659) onto the final drive sun gear shaft (651) with the raised inner boss facing up, so that the parking pawl properly engages the teeth on the parking pawl gear.

Important: The space between the parking pawl gear (659) and the snap ring (660) is approximately 3 mm (0.12 inch).

5. Assemble the snap ring (660) to the final drive sun gear shaft (651) in order to retain the parking pawl gear (659).



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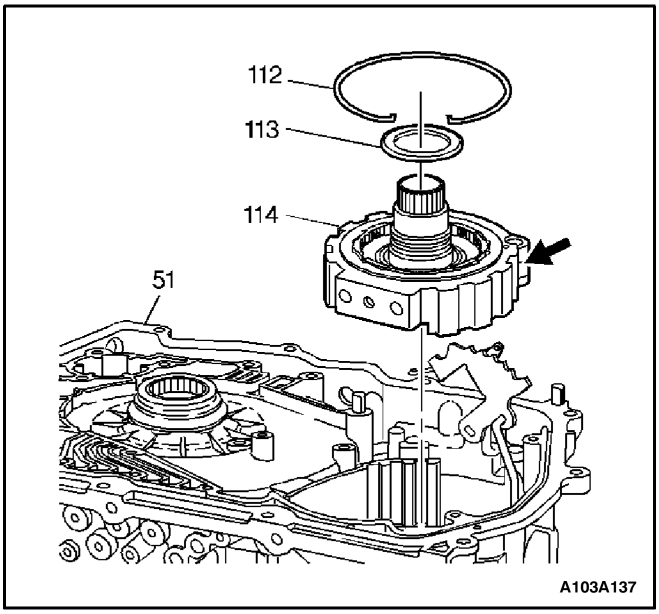
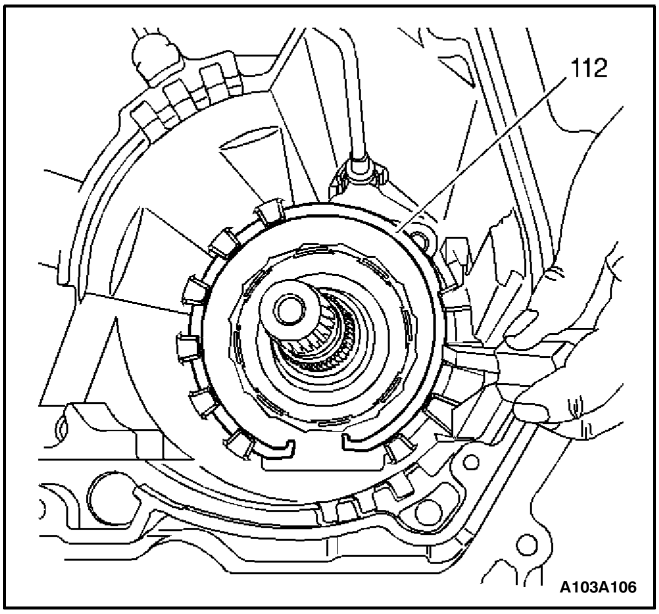
6. Assemble the lo roller clutch assembly (652) onto the forward clutch support (656). The larger tabs on the cage must face down into the forward clutch support (656). Rotate the cage slightly counterclockwise in order to lock the tabs into the grooves in the forward clutch support (656).
7. Assemble the thrust bearing (113) onto the forward clutch support (656).

FORWARD CLUTCH SUPPORT, LOW ROLLER CLUTCH INSTALL



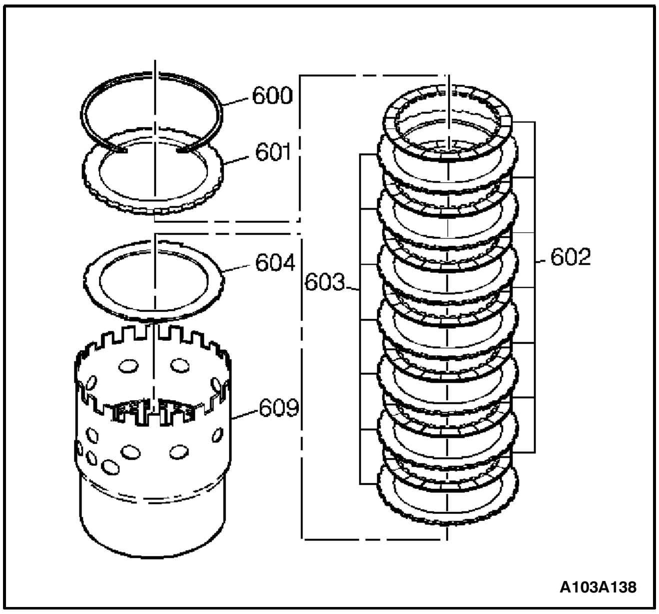
1. Install the forward clutch support and lo roller clutch assembly (114) into the transmission case (51). Compress the parking pawl spring, and line up the parking pawl with the parking pawl gear.



Important: When installing the forward clutch support snap ring (112), the snap ring opening must be toward the bottom of the transmission case and facing the bottom pan.

2. Install the forward clutch support snap ring (112) into the transmission case with the chamfer side up. Use a screwdriver in order to set the snap ring into place.

FORWARD CLUTCH DISASSEMBLE



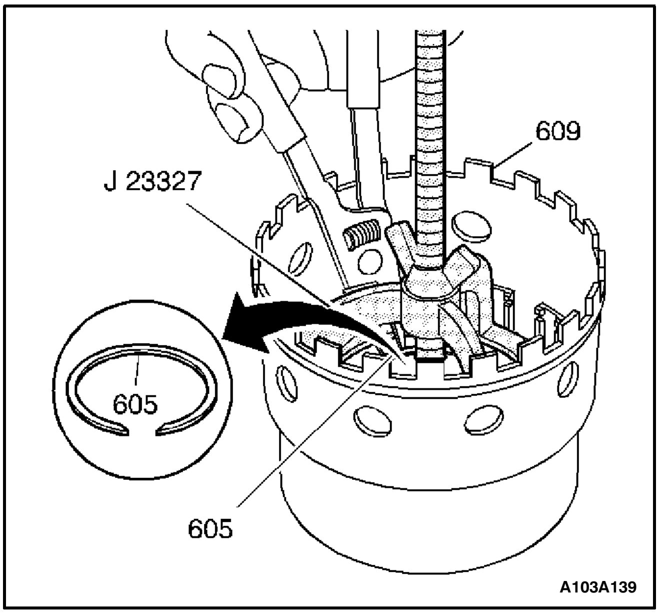
Tools Required

J 23327 Return Spring Compressor

J 41097-2 Inner Seal Remover-Disc

J 25031-A Puller/Inner Seal Remover

1. Remove the snap ring (600 from the housing assembly (609).
2. Remove the backing plate (601).
3. Remove the seven fiber plates (602).
4. Remove the seven steel plates (603).
5. Remove the wave plate (604).



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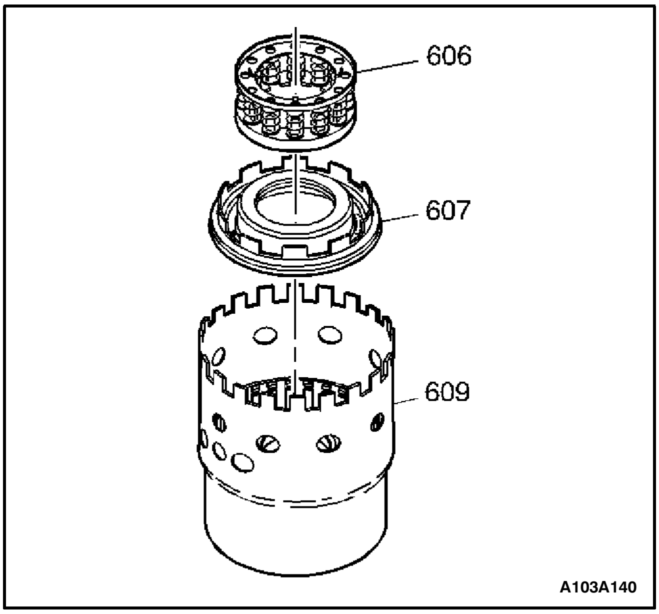
Important: In order to prevent damage to the spring assembly (606), only compress the return spring assembly (606) enough so that you can remove the snap ring (605).

6. **Compress the forward clutch return spring assembly. Use the J 23327.**
7. **Remove the return spring snap ring (605).**
8. **Remove the J 23327.**



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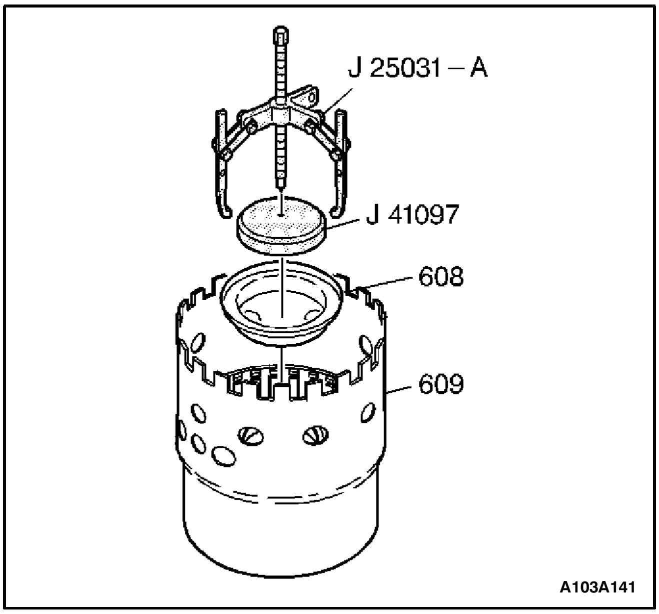
9. **Remove the forward clutch return spring assembly (606).**
10. **Remove the forward clutch piston and seal assembly (607).**



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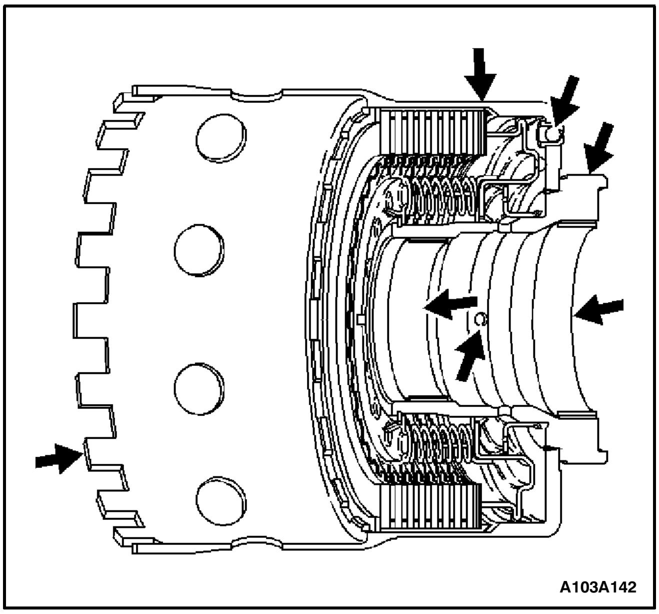
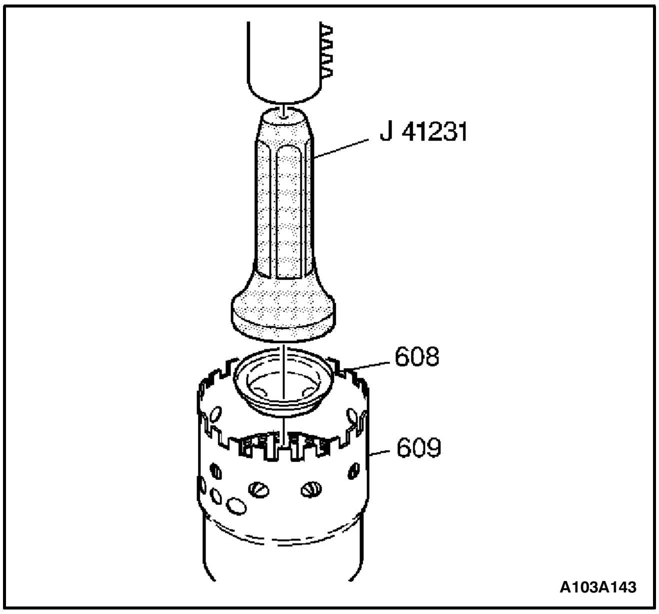
11. **Inspect the forward clutch inner seal assembly (608) for damage.**
12. **If the seal is damaged, place the J 41097-2 on the inner hub of the clutch housing.**
13. **Remove the seal. Use the J 25031-A.**



14. Inspect the housing, the plates, the bushings, the splines, the band apply surface, the roller clutch race, and the spring assembly.
15. Inspect fluid feed holes for proper openings.
16. Inspect the retainer and ball assembly for proper openings.
17. Inspect the piston and seal assembly for cut seals or other damage. The piston and seal assemblies are reusable, if not damaged.
18. Clean and dry all of the components.



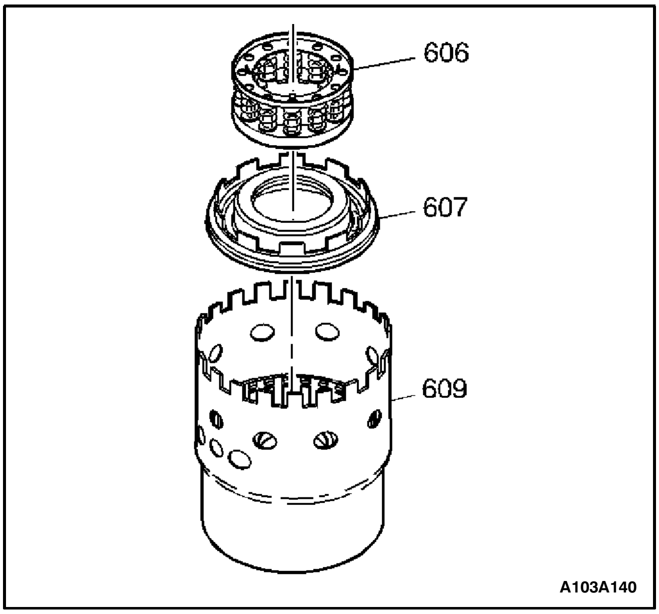
FORWARD CLUTCH ASSEMBLE

Tools Required

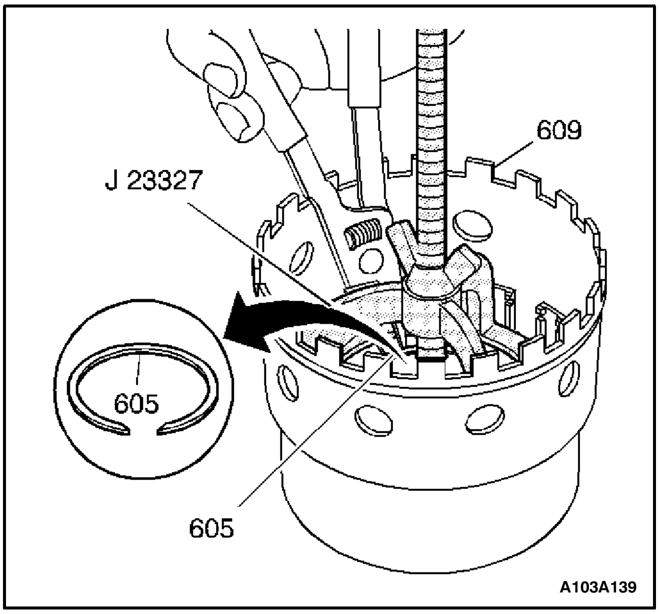
J 41231 Inner Seal Installer

J 23327 Return Spring Compressor

1. Assemble a new inner seal assembly (608) if the old seal was damaged and removed. Use an arbor press and the J 41231 in order to press the inner seal assembly onto the forward clutch housing (609).

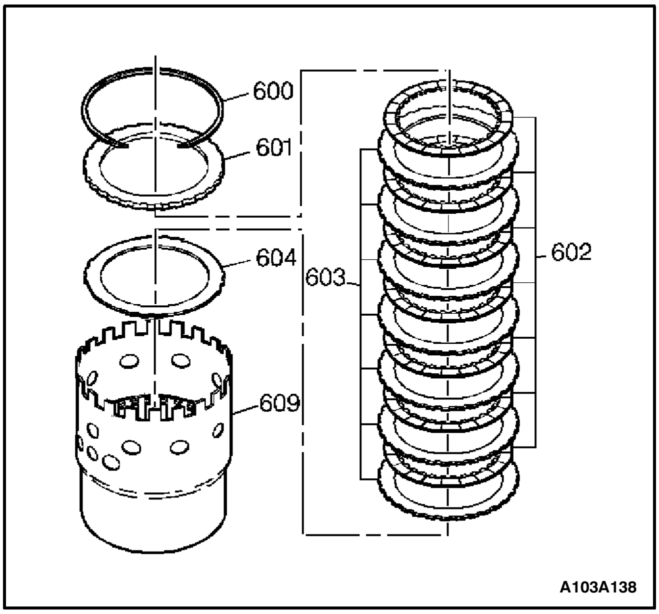


2. Assemble the forward clutch piston assembly (607) into the forward clutch housing (609). In order to ease assembly, lubricate the seals with transmission fluid.
3. With the snap ring tabs facing up, assemble the forward clutch return spring assembly (606) into the forward clutch housing (609).

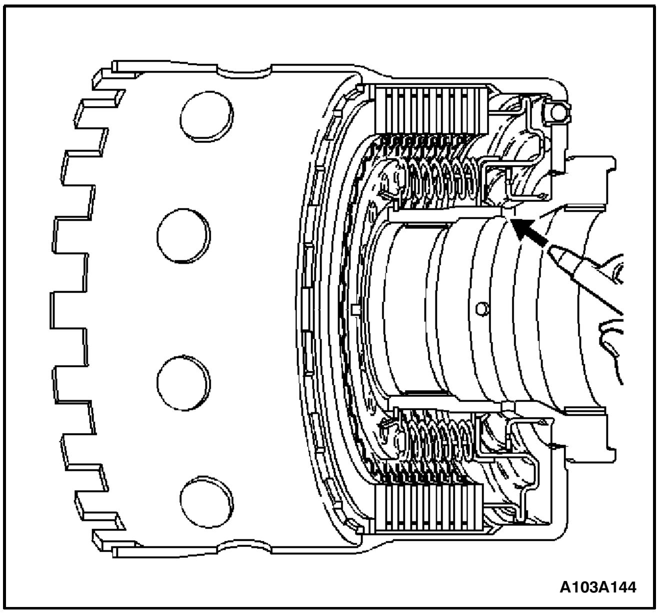


Important: In order to prevent damage to the spring assembly (606), only compress the return spring assembly (606) enough so that you can install the snap ring (605).

4. Compress the return spring assembly. Use the J 23327.
5. Assemble the snap ring (605) in order to retain the forward clutch return spring.
6. Remove the J 23327.

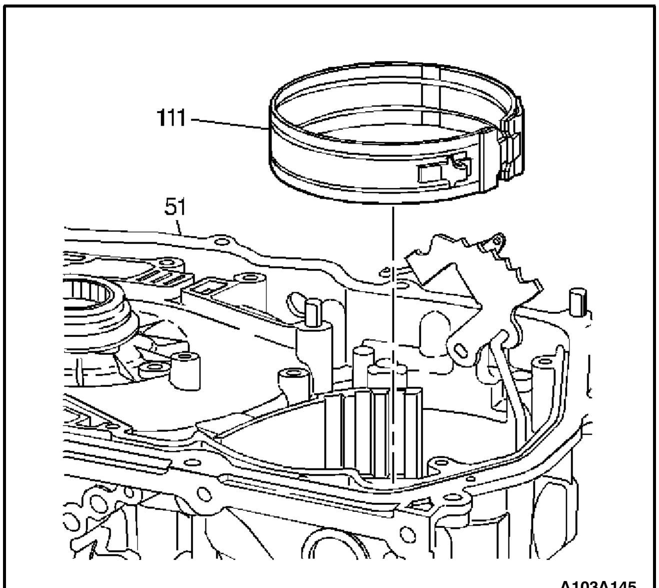


7. Install the forward clutch waved plate (604).
8. Install the seven steel plates (603) and the seven new fiber plates (602) in alternating order beginning with a steel plate (603).
9. Install the forward clutch backing plate (601).
10. Install the forward clutch backing plate snap ring (600) in order to retain the clutch pack.



FORWARD CLUTCH FUNCTIONAL AIR CHECK

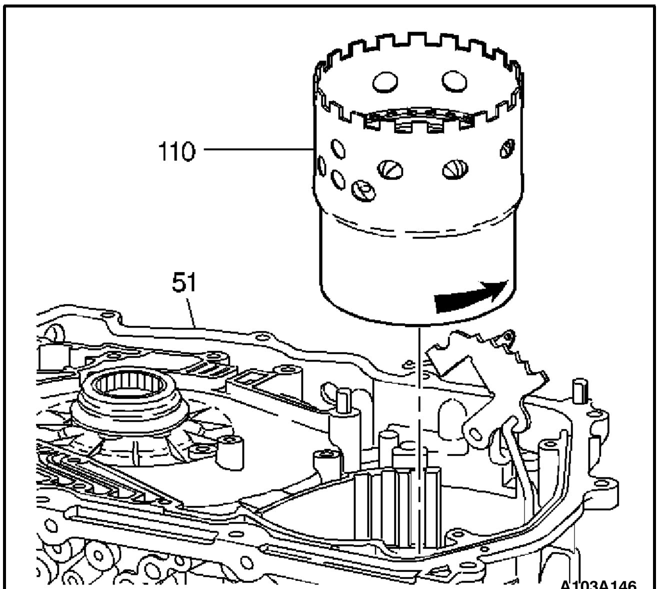
Air check the forward clutch to verify proper operation of the seals and clutch assembly.



A103A145

LOW/REVERSE BAND INSTALL

Install the low/reverse band (111) into the transmission case (51). Align the servo pin apply surface toward the bottom pan and hook the band into the band anchor pin inside the transmission case (51).



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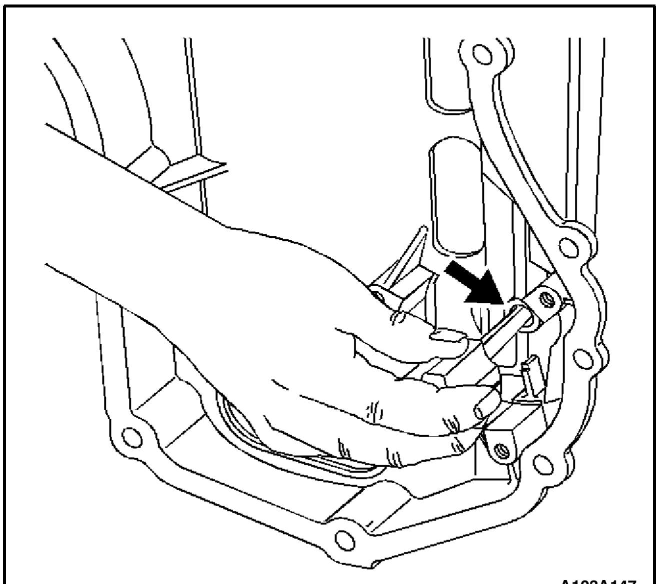
FORWARD CLUTCH INSTALLATION

Important: Rotate the forward clutch assembly (110) counterclockwise during assembly in order to seat the assembly into the lo roller clutch. When assembled correctly, the forward clutch assembly (110) should not turn clockwise.

1. **Install the forward clutch assembly (110) into the transmission case (51).**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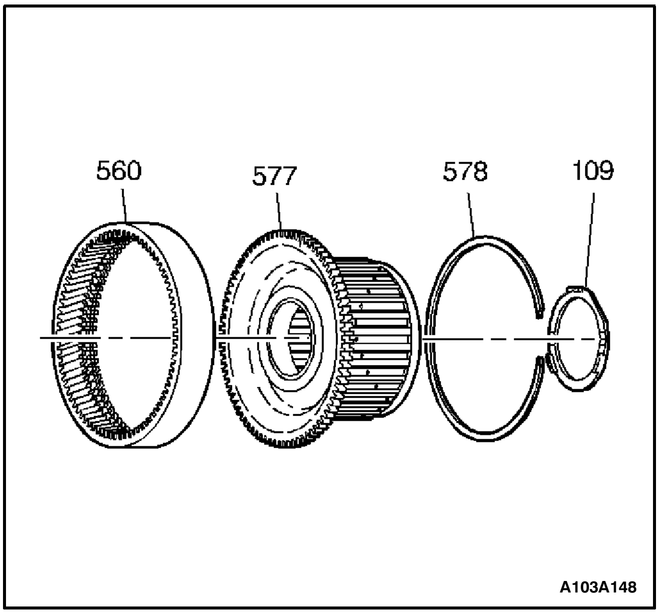
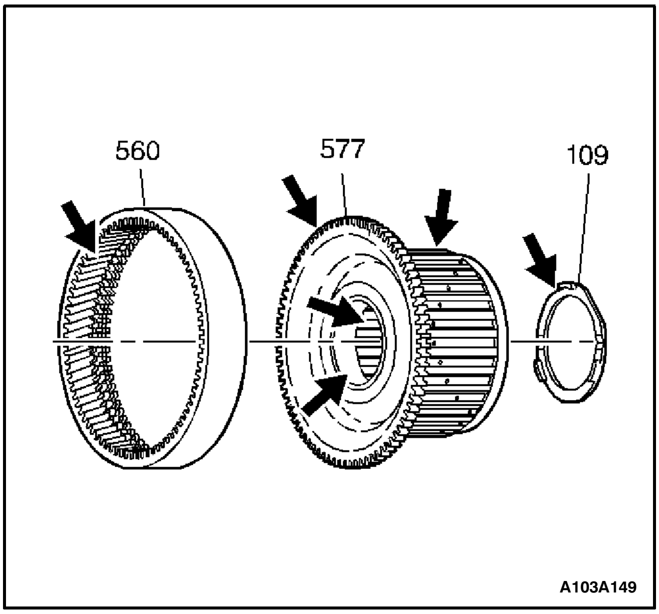
2. **Insert a screwdriver through the reverse servo pin hole in order to verify the correct installation of the lo/reverse band (111). The screwdriver should compress the band around the forward clutch housing (110).**

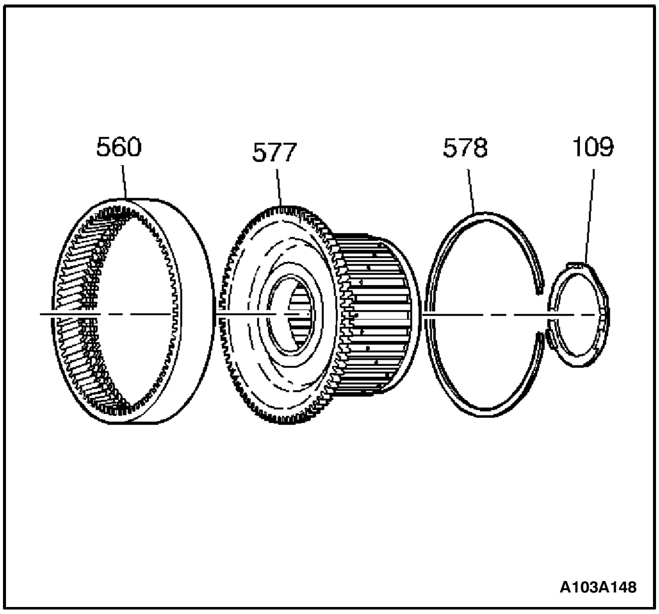


INPUT INTERNAL GEAR, FORWARD CLUTCH HUB DISASSEMBLE

1. If the thrust washer (109) has not been removed, remove the thrust washer (109) from the forward clutch hub (577).
2. Remove the input internal gear to forward clutch hub assembly snap ring (578).
3. Remove the forward clutch hub (577) from the input internal gear (560).



4. Inspect the input internal gear for damage or excessive wear.
5. Inspect the forward clutch hub splines for damage or excessive wear.
6. Inspect the busing and the thrust washer for damage or excessive wear.
7. Clean and dry all of the components.

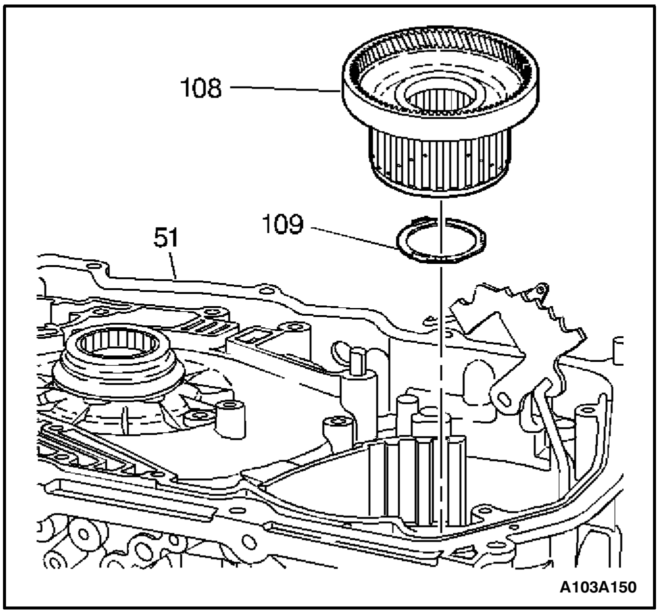


INPUT INTERNAL GEAR, FORWARD CLUTCH HUB ASSEMBLE

Tools Required

J 36850 Transjel™

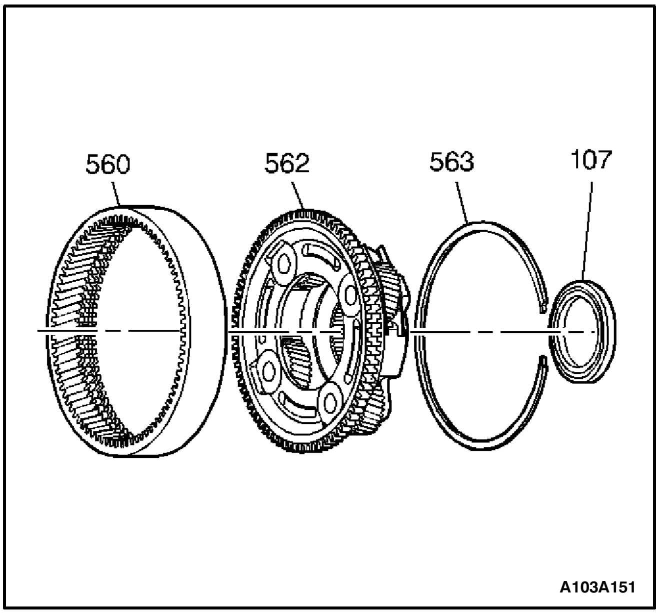
1. Assemble the forward clutch hub (577) onto the input internal gear (560) and retain it with the snap ring (578).
2. Assemble the thrust washer (109) onto the forward clutch hub (577) with the thrust washer tabs toward the forward clutch hub (577). Retain the thrust washer with J 36850 or equivalent.



INPUT INTERNAL GEAR, FORWARD CLUTCH HUB INSTALL

Important: Install the forward clutch hub and input internal gear assembly into the transmission case (51). Rotate the assembly while installing in order to spline the forward clutch hub (108) to the forward clutch plates (602).

Install the forward clutch hub and input internal gear assembly into the transmission case (51).

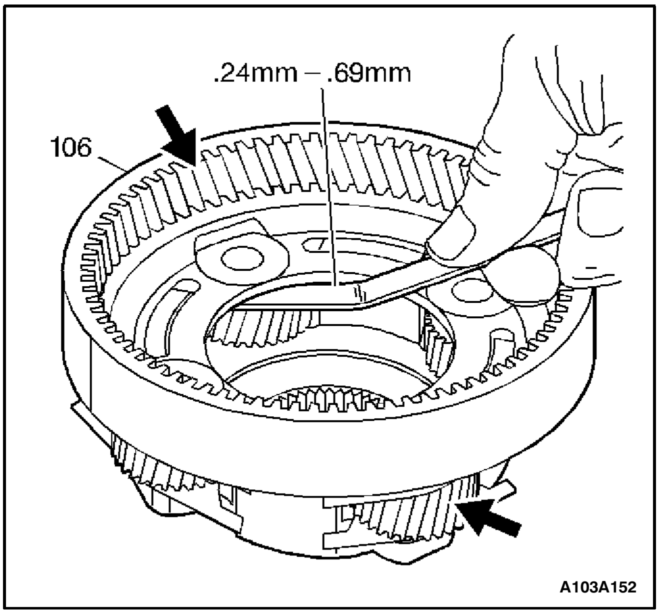


REACTION INTERNAL GEAR, INPUT CARRIER DISASSEMBLE

1. **Remove the thrust bearing (107) from the reaction carrier (562) if the thrust bearing has not been removed.**
2. **Remove the reaction internal gear (560) to input carrier assembly snap ring (563).**

Important: The reaction internal gear and the input internal gear are identical parts. However, these parts are not interchangeable after the transmission has operated in a vehicle.

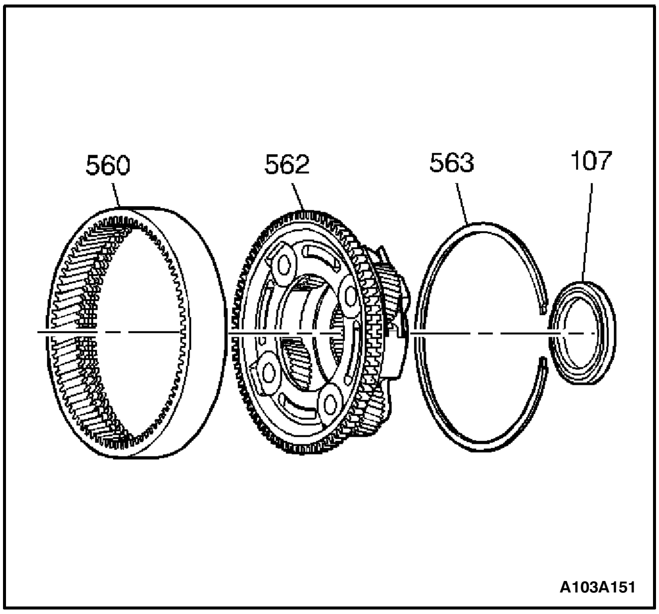
3. **Remove the input carrier assembly (562) from the reaction internal gear (560).**



INPUT CARRIER PINION GEAR CLEARANCE CHECK

Important: Replace the carrier if pinion gear clearance is out of specification. The pinion gears are permanently assembled to the carrier and are not serviced individually.

1. **Measure the pinion gear end play for proper clearance. Use a feeler gage. The clearance should be 0.24-0.69 mm (0.01-0.027 inch).**
2. **Inspect the reaction internal gear and the input carrier assembly for damage or excessive wear. Specifically inspect the condition of the pinion gears, the washers, and the thrust bearings.**
3. **Clean and dry each of the components.**

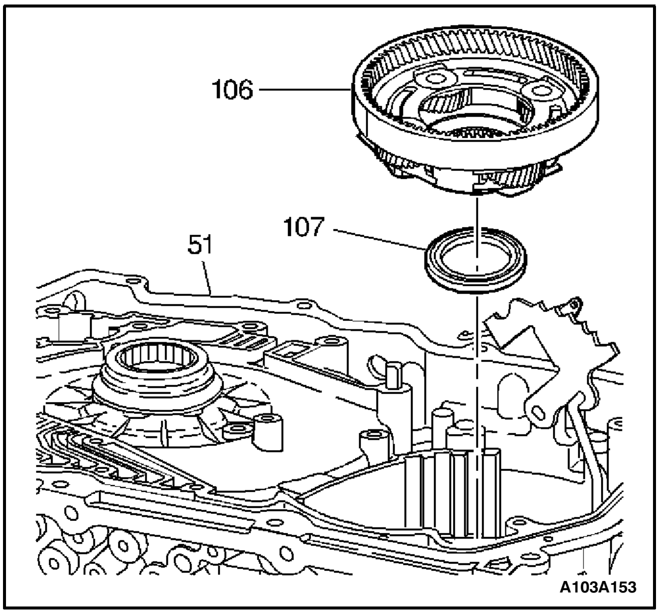


REACTION INTERNAL GEAR, INPUT CARRIER ASSEMBLE

Tools Required

J 36850 Transjel™

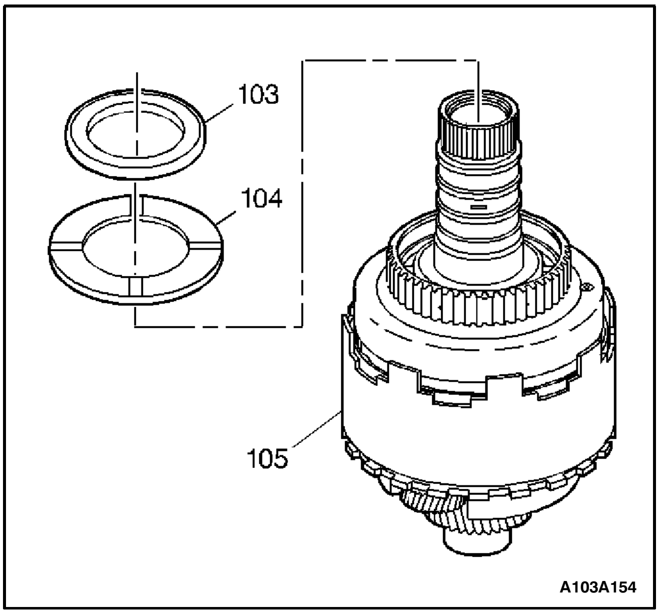
1. Assemble the input carrier assembly (562) to the reaction internal gear (560).
2. Retain the input carrier assembly with the snap ring (563).
3. Assemble the thrust bearing (107) onto the input carrier assembly.
4. Retain the thrust bearing with J 36850 or equivalent. You will find another thrust bearing permanently retained in the input carrier assembly (562).



REACTION INTERNAL GEAR, INPUT CARRIER INSTALL

Important: While installing the reaction internal gear and input carrier assembly, rotate the assembly in order to mesh the input carrier pinion gears to the input internal gear.

Install the reaction internal gear and input carrier assembly (106) into the transmission case (51).



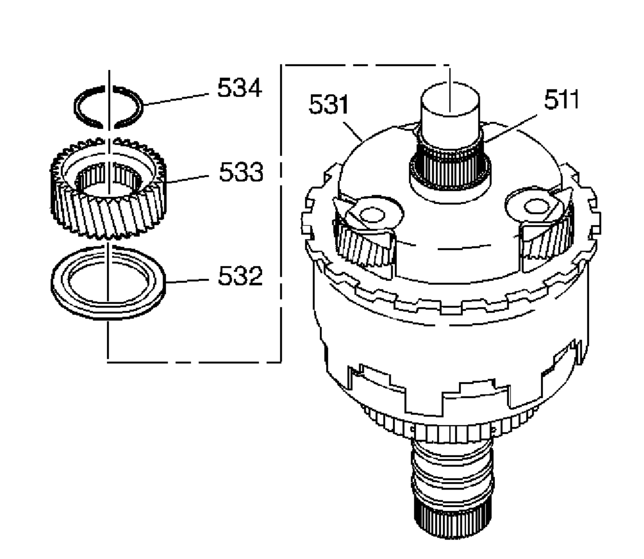
DIRECT/COAST CLUTCH, REACTION CARRIER DISASSEMBLE

Tools Required

J 41232 Direct Clutch Return Spring

J 41236 Coast Clutch Return Spring Compressor

1. Remove the selective thrust bearing (103) and the thrust washer (104) from the input shaft of the direct and coast clutch assembly (105).



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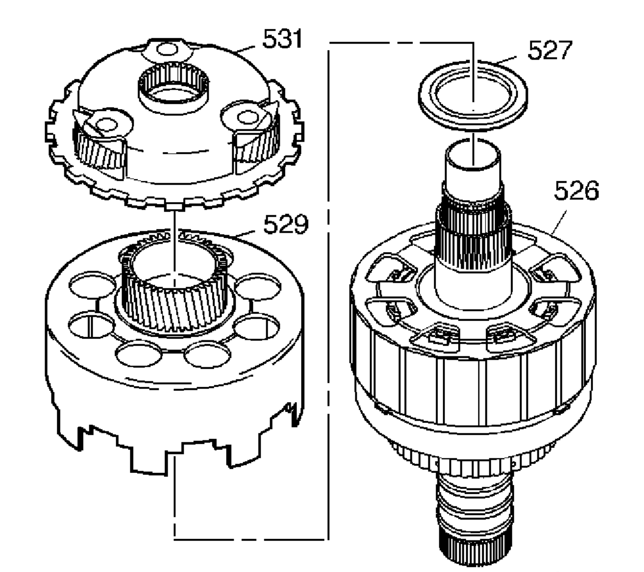
2. Remove the input sun gear to input sun gear shaft snap ring (534).
3. Remove the input sun gear (533) from the input sun gear shaft (511).
4. Remove the thrust bearing (532) from the reaction carrier assembly (531).



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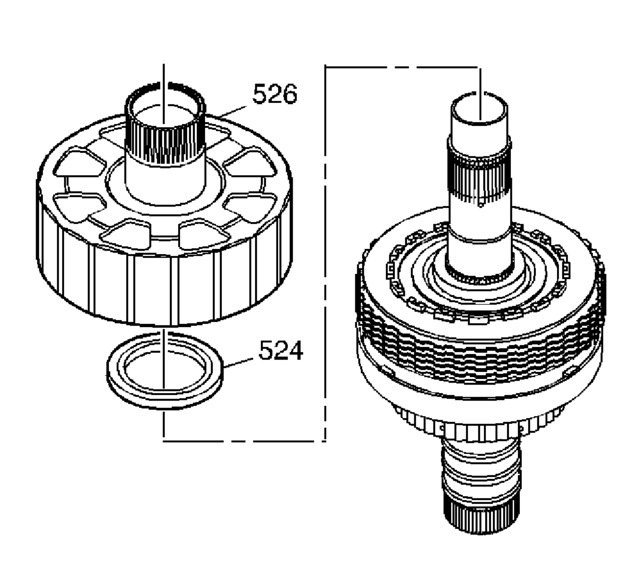
5. Remove the reaction carrier assembly (531).You will find a thrust bearing permanently installed in the reaction carrier assembly under the pinion gears.
6. Remove the reaction sun gear and shell assembly (529).
7. Remove the thrust bearing (527) from the reaction carrier shaft and shell assembly (526).



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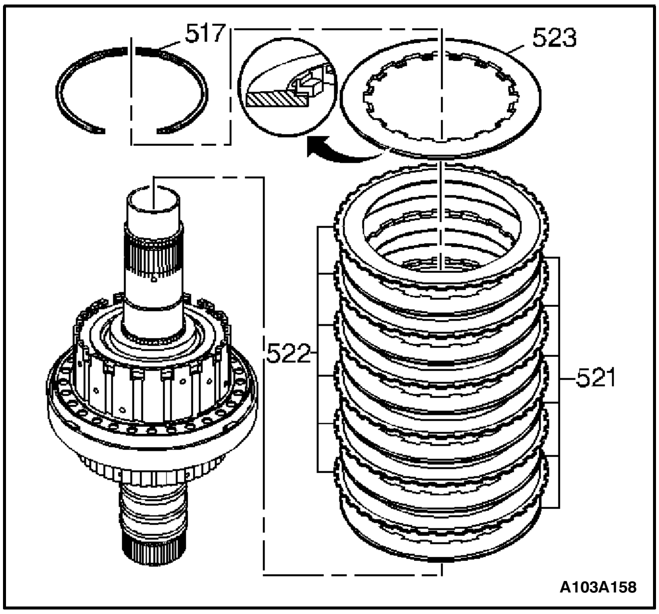
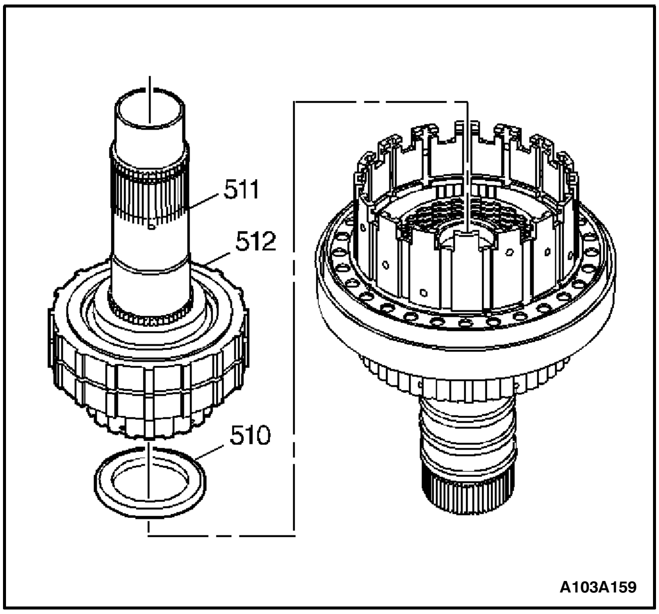
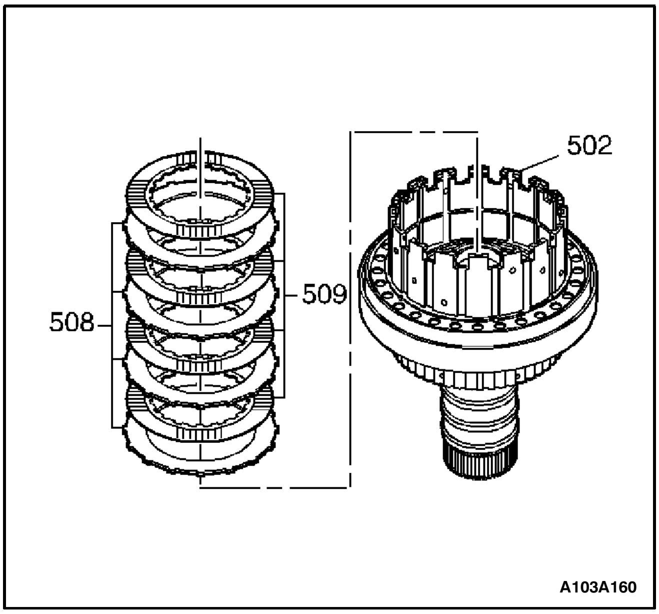
8. Remove the reaction carrier shaft and shell assembly (526).
9. Remove the thrust bearing (524) from the top of the sprag race assembly.



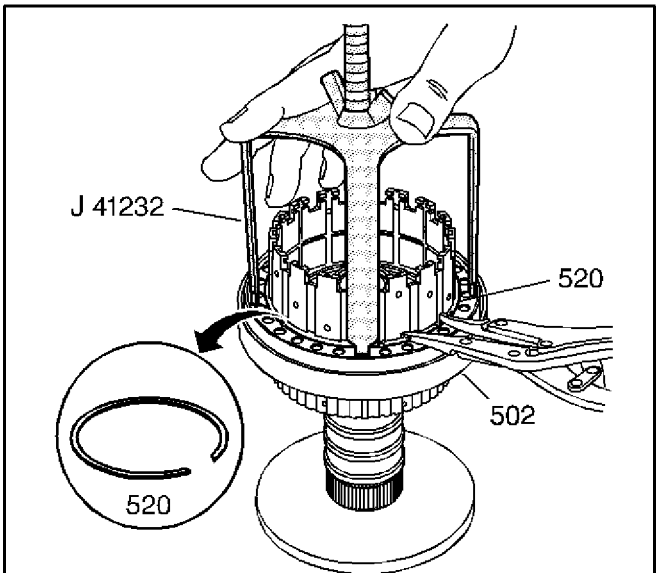
10. Remove the sprag clutch retaining snap ring (517).
11. Remove the direct clutch plates from the direct coast clutch input housing. The direct clutch consists of a backing plate (523), steel plates (521) and fiber plates (522).



12. Lift up on the input sun shaft (511) in order to remove the input sun shaft (511) and the sprag (512) as an assembly.
13. Remove the inner race to input housing thrust bearing (510) if the inner race to input housing thrust bearing did not remain with the input sun shaft and sprag assembly.



14. Remove the coast clutch plates from the input housing (502). The coast clutch consists of four steel plates (508) and four fiber plates (509).



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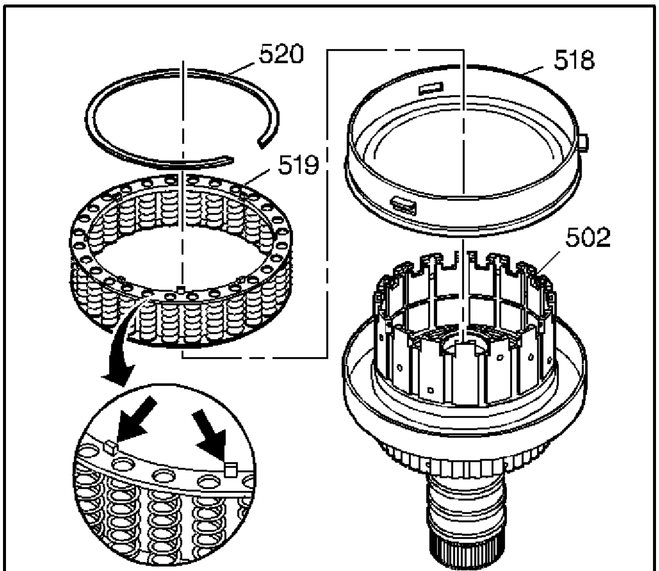
15. Compress the direct clutch return spring assembly. Use the J 41232.
16. Remove the spring retaining snap ring (520).
17. Remove the J 41232.



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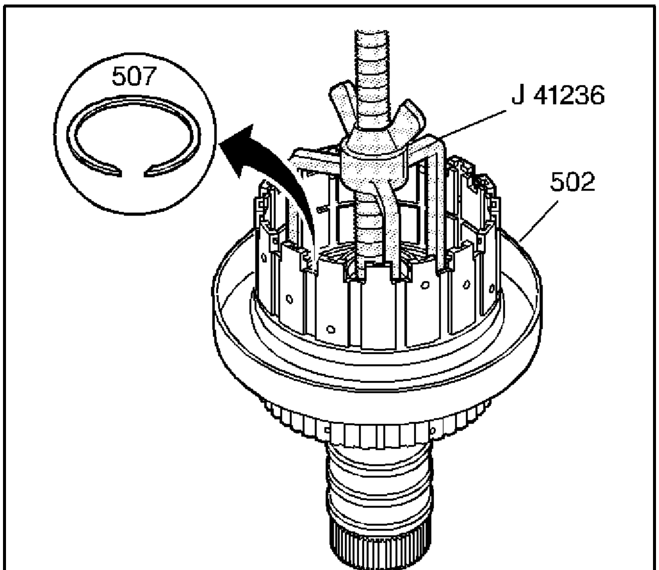
18. Remove the direct clutch return spring (519).
19. Remove the direct clutch piston and seal assembly (518).



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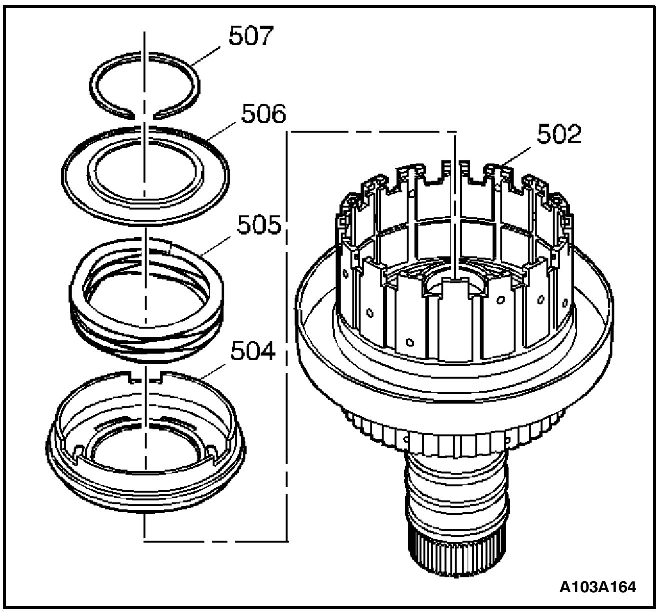
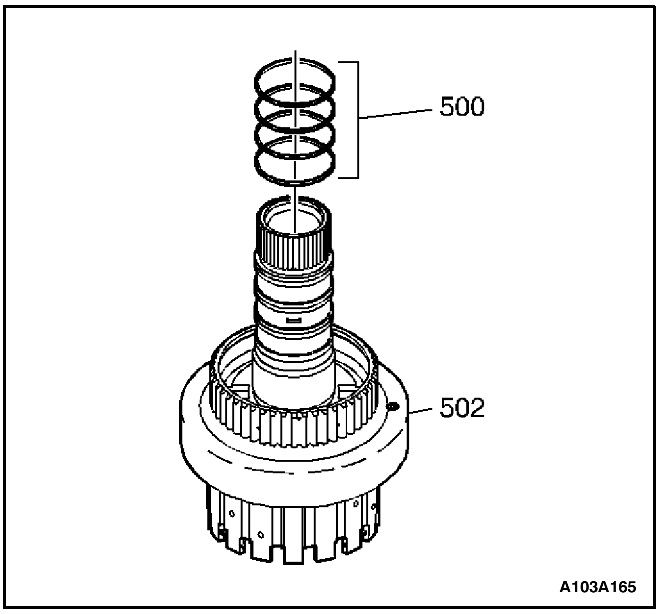
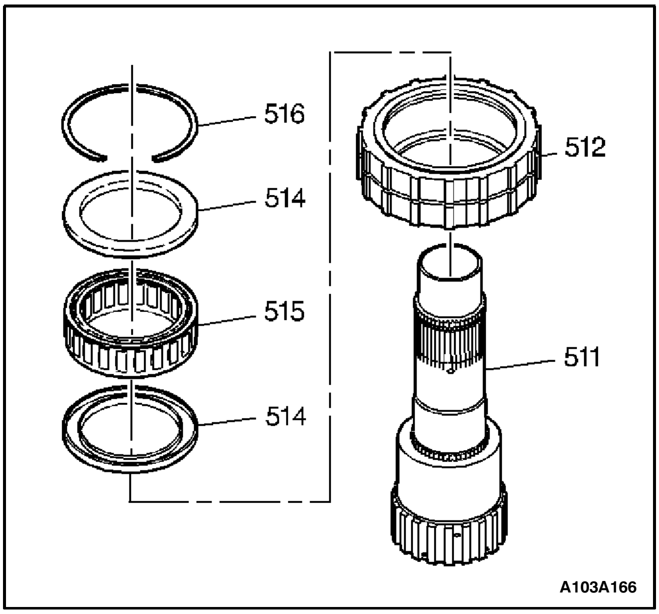
20. Compress the coast clutch return spring. Use the J 41236.
21. Remove the spring retaining snap ring (507).
22. Remove the J 41236.



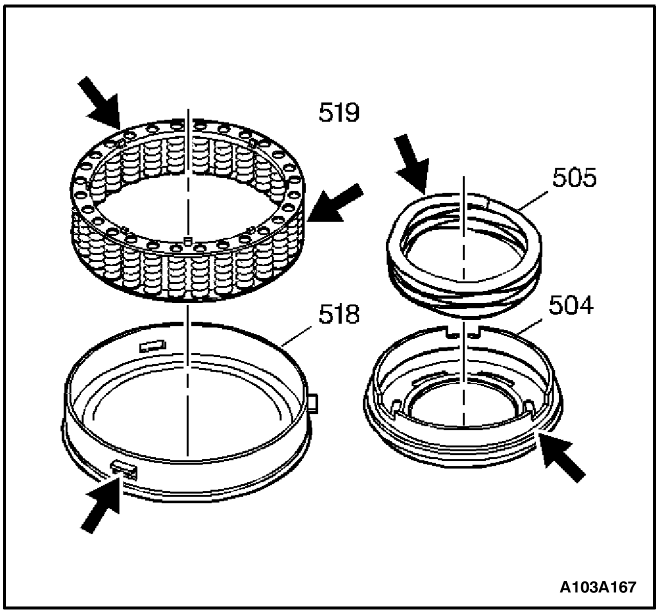
23. Remove the coast clutch return spring retainer (506) and the release spring (505).
24. Remove the coast clutch piston and seal assembly (504).



25. Remove and discard the four Teflon™ oil seals (500) from the input shaft assembly (502).

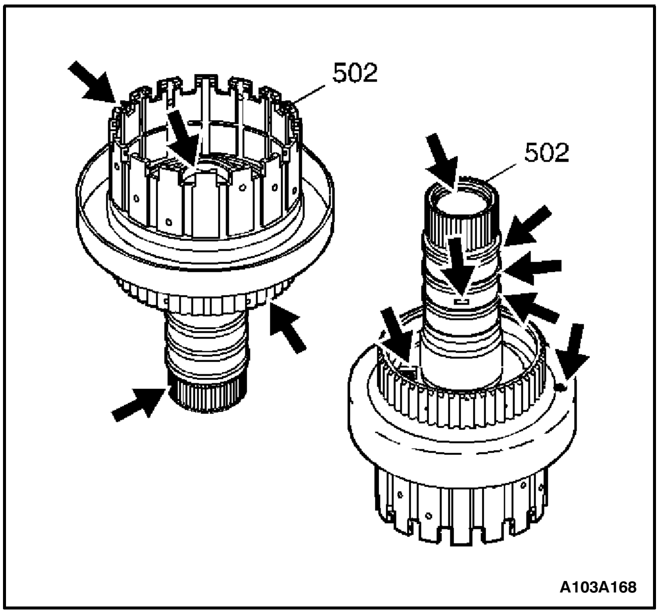


26. Remove the input sprag assembly (512-516) from the input sun gear shaft (511).
27. Remove the snap ring (516) from the sprag assembly (515).
28. Remove the sprag clutch assembly (515) from the sprag outer race (513).
29. Remove the two end bearings (514) from the sprag clutch assembly (515).

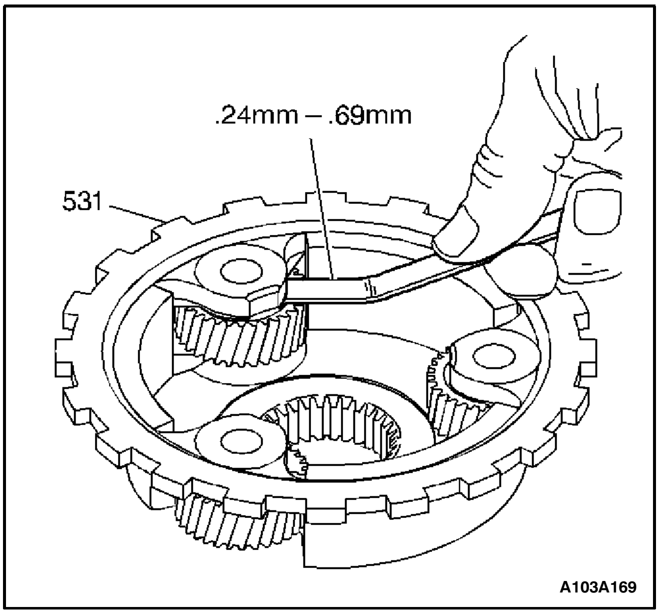


Important: The pistons are reusable if not damaged. If the pistons or seals are damaged, replace the assembly.

30. Inspect the piston (518 and 504) and seal assemblies for damage or cut seals.
31. Inspect the clutch spring (519) assemblies for distortion or missing springs.



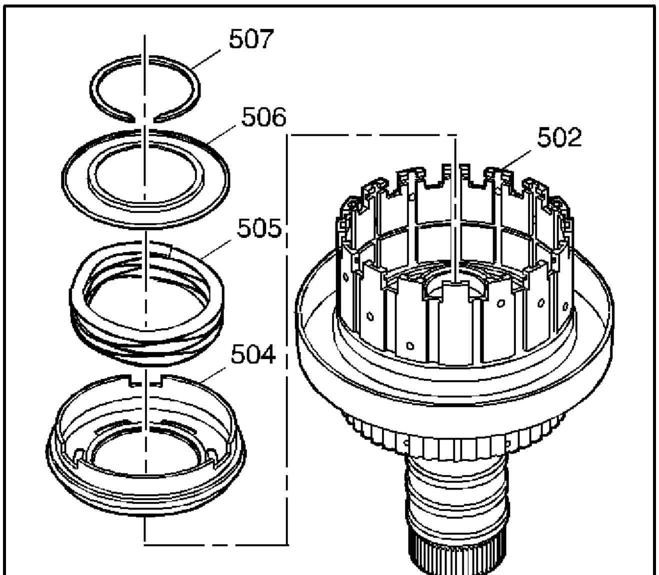
32. Inspect the direct clutch and coast clutch retainer and ball assemblies for leaks or damage.
33. Inspect the oil passages for blockage.
34. Inspect the bushings and bearings for excessive wear.
35. Inspect the seal grooves on the input shaft for nicks or damage.
36. Inspect the splines, housings and clutch plates for cracks, excessive wear or damage.
37. Inspect all other components for damage or excessive wear.



REACTION CARRIER PINION CLEARANCE CHECK

Important: Replace the carrier assembly if the pinion gear clearance is out of specification. The pinion gears are permanently assembled to the carrier and are not serviced individually.

1. Measure the reaction carrier pinion gear end play for proper clearance. Use a feeler gauge. The clearance is 0.24-0.69 mm (0.01-0.027 inch).
2. Clean and dry each of the components.



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DIRECT/COAST CLUTCH, REACTION CARRIER ASSEMBLE

Tools Required

J 41236 Coast Clutch Return Spring Compressor Adapter

J 41232 Direct Clutch Return Spring Compressor Adapter

J 36850 Transjel™

J 41234-1 Input Shaft Seal Installer Pusher

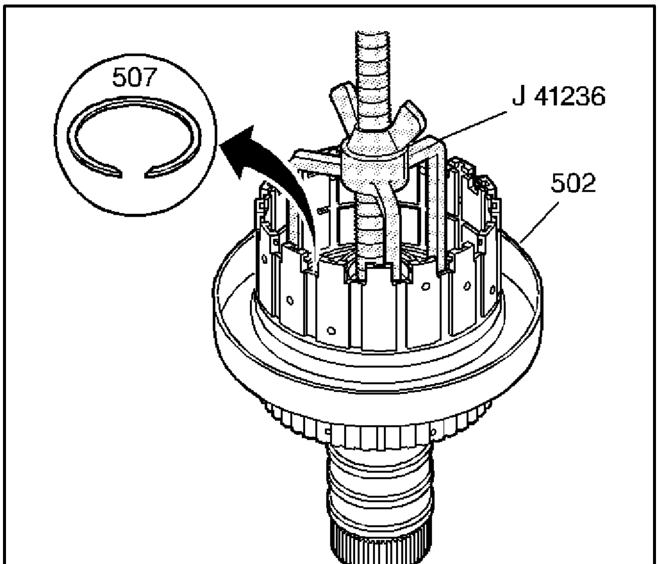
J 41234-2 Input Shaft Seal Installer Protector

J 41234-3 Input Shaft Seal Installer Sizer

1. In order to aid in the assembly, lubricate the seal with transmission fluid.
2. Assemble the coast clutch piston and seal assembly (504) into the input housing (502).

Important: You must assemble the spring retainer with the inner lip facing up.

3. Assemble the coast clutch release spring (505) and spring retainer (506) into the input housing (502).



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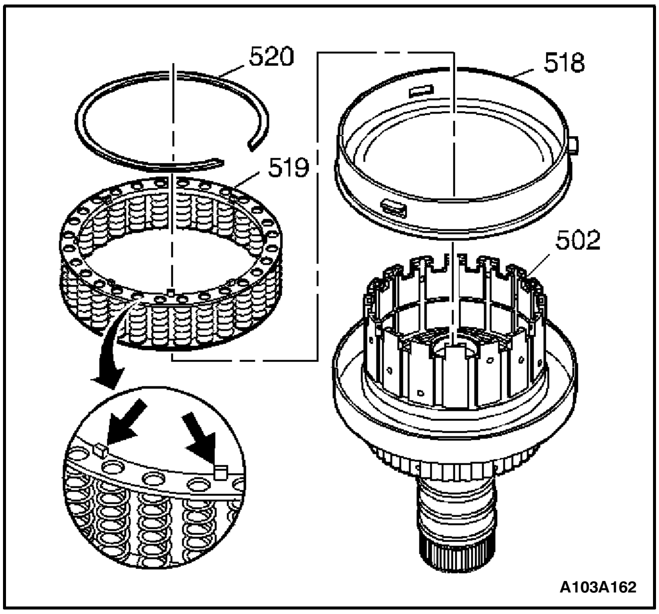
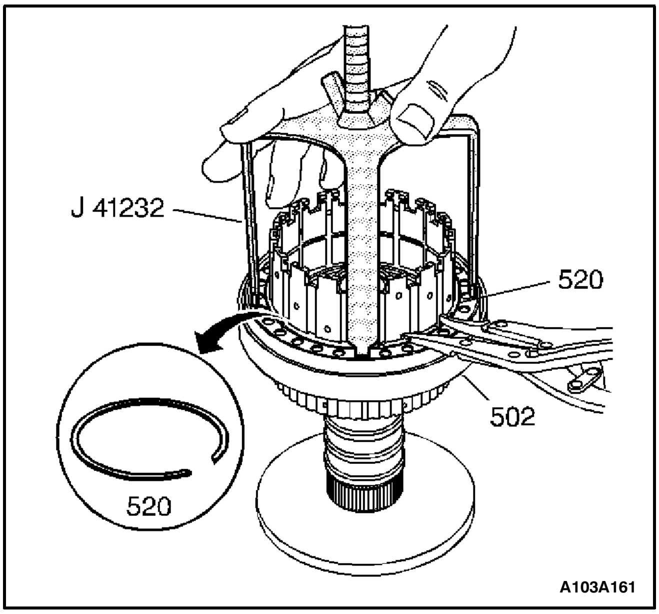
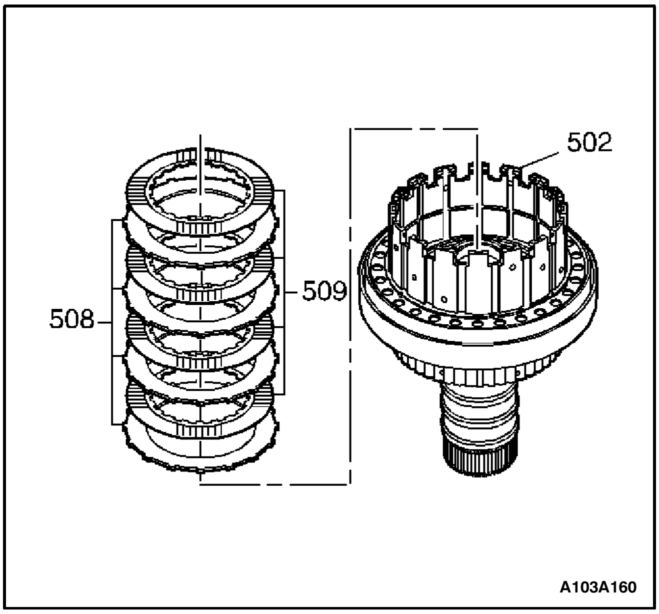
4. Compress the coast clutch return spring retainer (506). Use the J 41236.
5. Assemble the coast clutch spring retainer snap ring (507) onto the input housing (502).
6. Remove the J 41236.



7. In order to aid in the assembly, lubricate the seal with transmission fluid.
8. Assemble the direct clutch piston and seal assembly (518) into the input housing (502).
9. Assemble the direct clutch return spring assembly (519) into the input housing with the snap ring retaining tabs facing up.

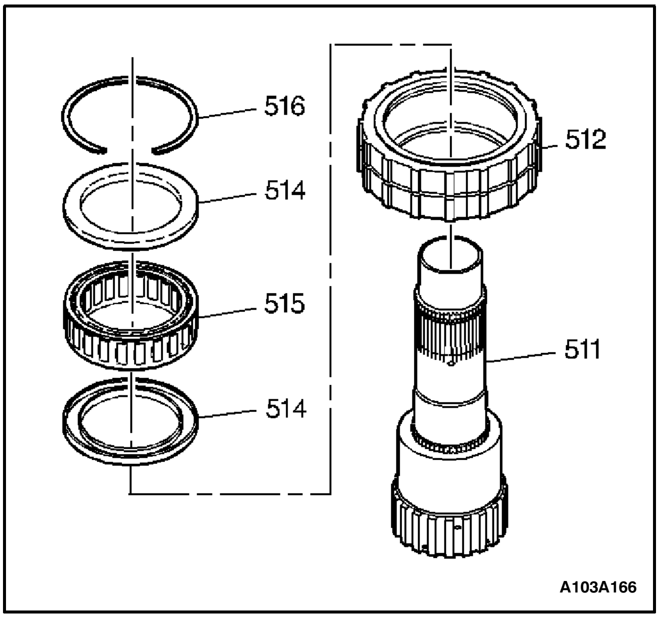


10. Compress the direct clutch spring assembly. Use the J 41232.
11. Assemble the direct clutch snap ring (520) into the input housing (502).
12. Remove the J 41232.



Important: Assemble the steel plates (508) with the splines in the input housing groove that are machined to the pistons.

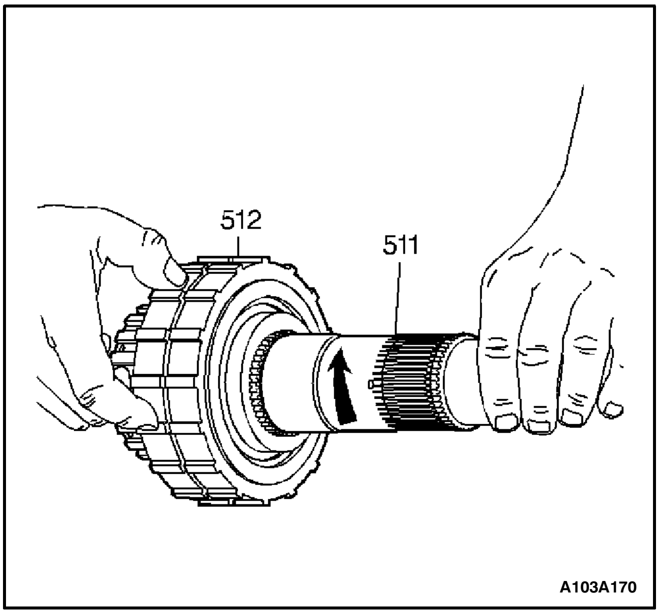
13. Assemble the 4 steel coast clutch plates (508) and the 4 new fiber coast plates (509) into the input housing in alternating order beginning with a steel plate (508).



14. Place the sprag outer race (512) on the bench with the flat side down and the side with the snap ring groove up.
15. Place one end bearing (514) into the outer race.
16. While rotating the sprag slowly, assemble the sprag clutch (515) into the sprag outer race. Keep the grooved edge up and the flat side down.
17. Assemble the other end bearing (514) on top of the sprag clutch.
18. Assemble the snap ring (516) into the sprag outer race (512) in order to retain the sprag clutch and end bearings.

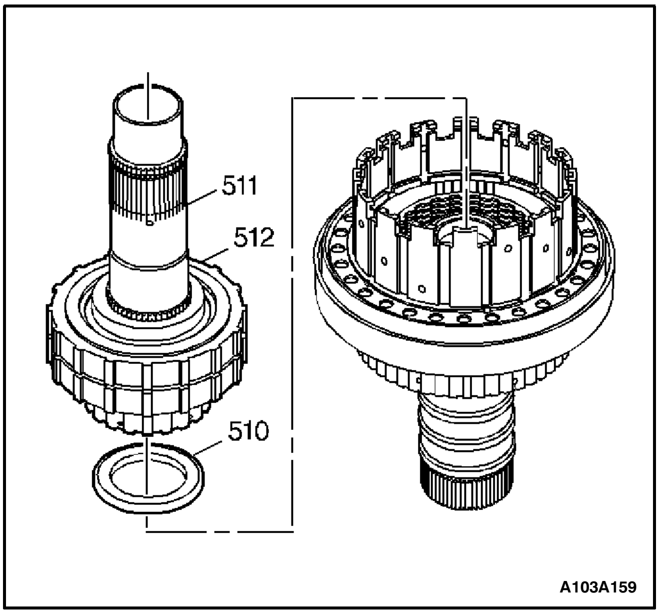
Important: The snap ring side of the assembly faces up when installing the sprag clutch onto the input sun shaft. The flat side of the sprag outer race functions as the backing plate for the coast clutch.

19. While rotating the input sun shaft clockwise in order to help seat the sprags, assemble the sprag clutch and outer race assembly onto the input sun shaft (511).

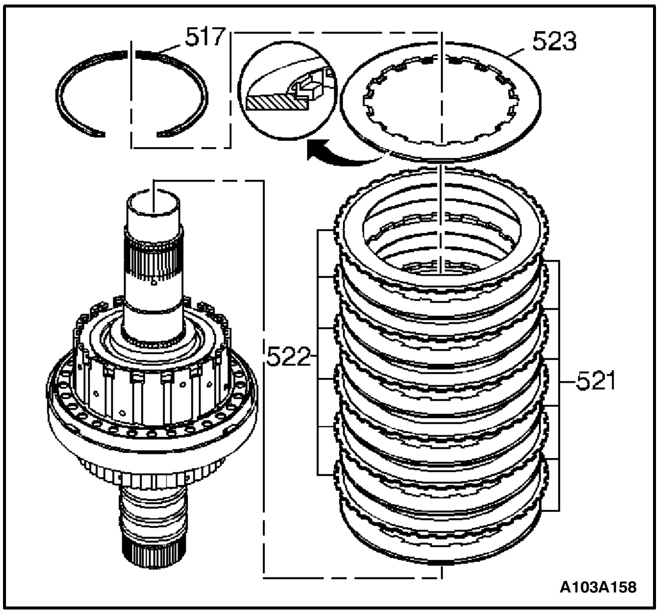


Important: The input sun shaft (511) must only rotate clockwise.

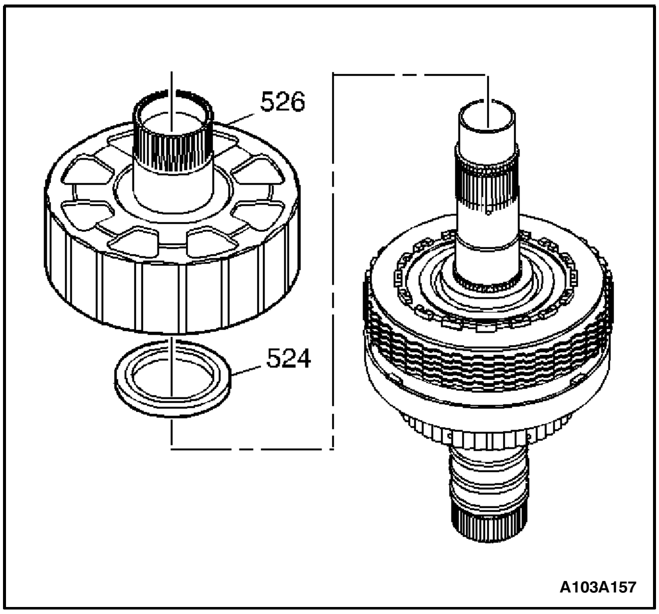
20. Verify the correct operation of the sprag clutch by holding the sprag clutch outer race (512) and rotating the input sun shaft (511).



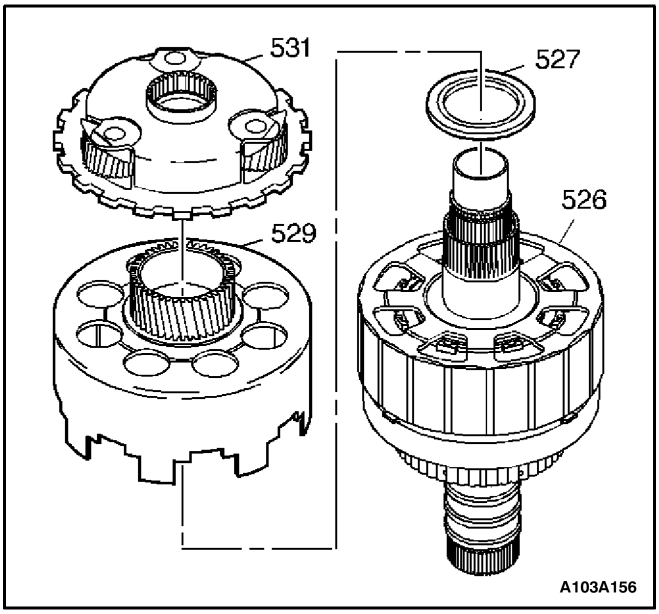
21. Assemble the thrust bearing (510) on the underside of the input sun shaft.
22. Retain the thrust bearing with J 36850 or equivalent.
23. Assemble the input sun shaft and sprag clutch assembly (511 and 512) into the input housing. The splines on the input sun shaft engage with the coast clutch fiber plates.



24. Assemble the steel (521) and new fiber (522) direct clutch plates into the input housing in alternating order beginning with a steel plate (521).
25. Assemble the direct clutch backing plate (523) onto the input housing with the flat side down.
26. Assemble the snap ring (517) in order to retain the input sun shaft and sprag clutch assembly and the direct clutch plates.



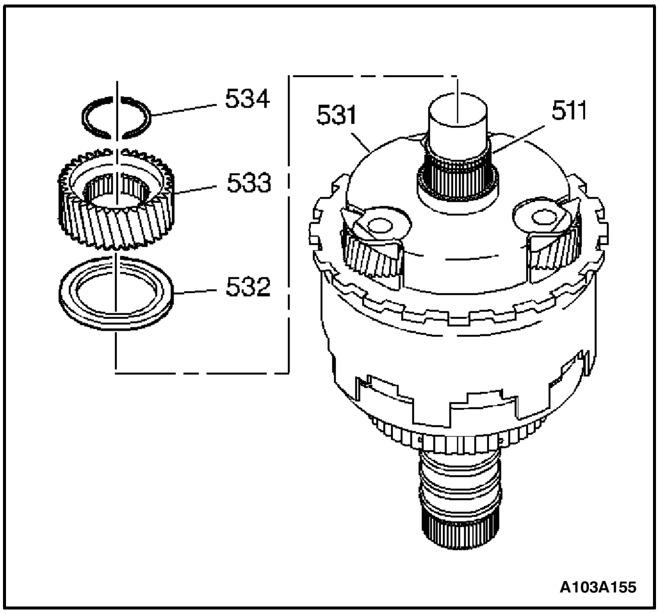
27. Assemble the thrust bearing (524) on the top of the sprag clutch assembly. Retain with J 36850 or equivalent.
28. Assemble the reaction carrier shaft and shell assembly (526) onto the input housing. The splines on the inside of the shell engage the direct clutch fiber plates.



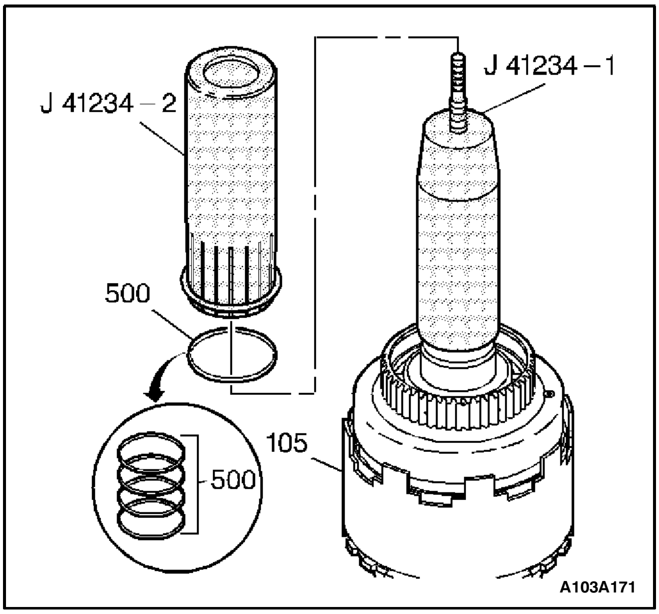
29. Assemble the thrust bearing (527) onto the top of the reaction carrier shaft and shell assembly.
30. Assemble the reaction carrier sun gear and shell assembly (529) onto the reaction shaft shell.

Important: Rotate the reaction carrier during assembly in order to mesh the sun gear with the pinion gears.

31. Assemble the reaction carrier assembly (531) onto the reaction sun gear.

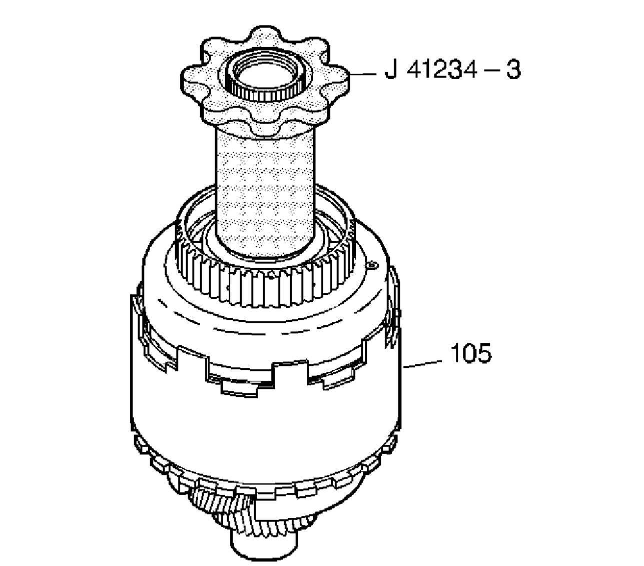


32. Assemble the reaction carrier assembly to input sun gear thrust bearing (532) onto the reaction carrier assembly.
33. Assemble the input sun gear (533) onto the input sun shaft.
34. Assemble the input sun gear snap ring (534) onto the input sun shaft.



Important: When assembling the four new Teflon™ seals (500) onto the input shaft, begin with the seal closest to the housing.

35. Slide the J 41234-1 over the input shaft, and position the J 41234-1 at the seal groove closest to the housing. Coat the J 41234-1 with transmission fluid.
36. Guide a new seal onto the J 41234-1 and slide the seal into the seal groove with the J 41234-2.
37. Repeat the above procedure for each seal. Adjust the J 41234-1 as necessary for each seal groove.



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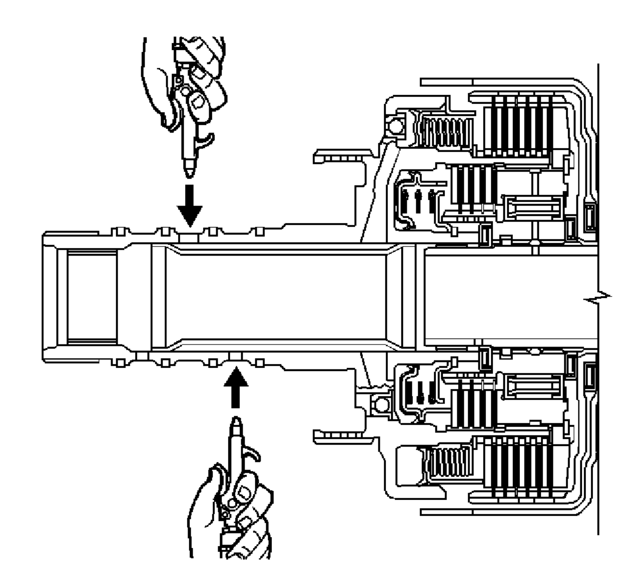
38. Size the seals with the J41234-3.
39. Leave the J 41234-3 in place for at least five minutes. If possible, leave the J 41234-3 in place until when you install the assembly into the transmission case.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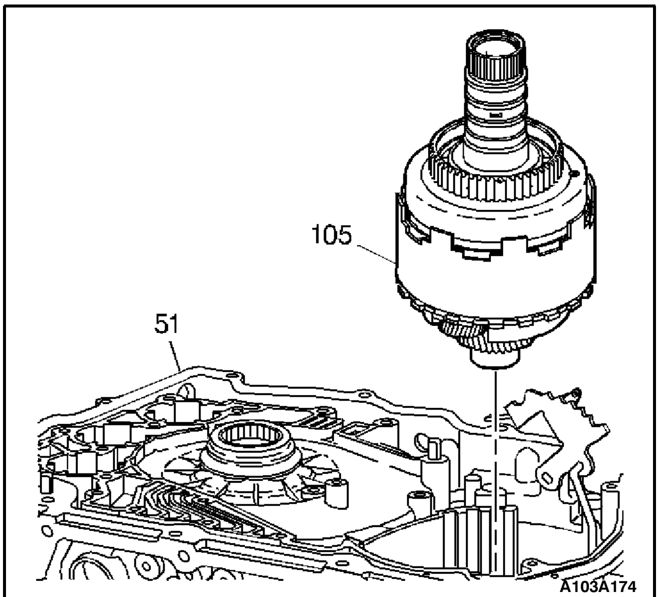
DIRECT AND COAST CLUTCH FUNCTIONAL AIR CHECKS

1. Air check the direct clutch in order to verify the proper operation of the seals and clutch assembly.
2. Air check the coast clutch in order to verify the proper operation of the seals and clutch assembly.



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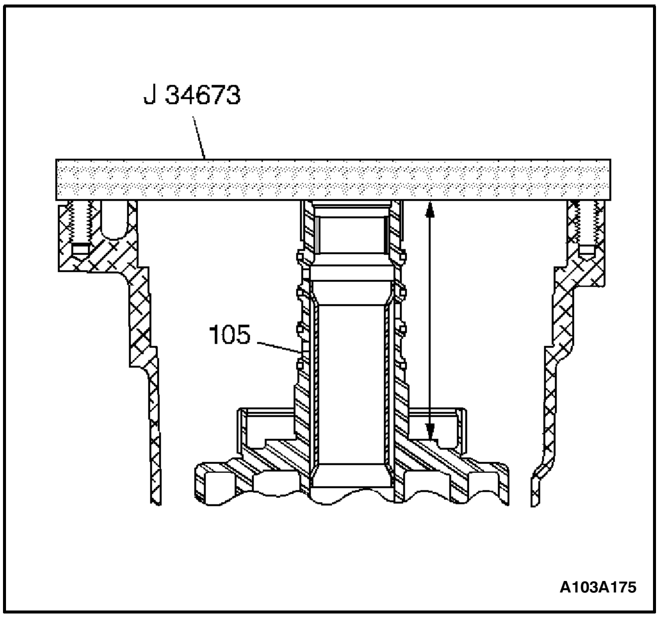
DIRECT/COAST CLUTCH, REACTION CARRIER INSTALL

Install the direct/coast clutch and reaction carrier assembly (105) into the transmission case (51).



SELECTIVE WASHER MEASUREMENT AND INSTALLATION

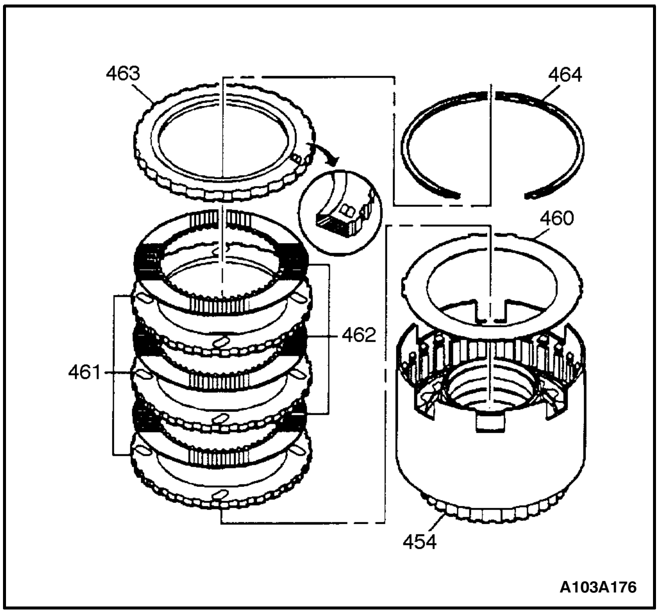
Tools Required

J 34673 Gage Block

1. Place the J 34673 across the machined surface of the case.
2. Measure the distance between the top of the direct/coast clutch housing (105) and the machined surface of the case (Dimension A).
3. Note the measurement of Dimension A and choose the correct selective washer. Refer to Selective Washer Table in End Play Specifications.

Important: Position the tab on the thrust washer in the recessed area for the retainer and ball assembly (104).

4. Assemble the selective washer (104) onto the top of the input housing.
5. Assemble the thrust bearing (103) over the input shaft and onto the top of the selective thrust washer (104).



REVERSE INPUT AND 2ND ROLLER CLUTCH DISASSEMBLE

Tools Required

J 41232 Return Spring Compressor

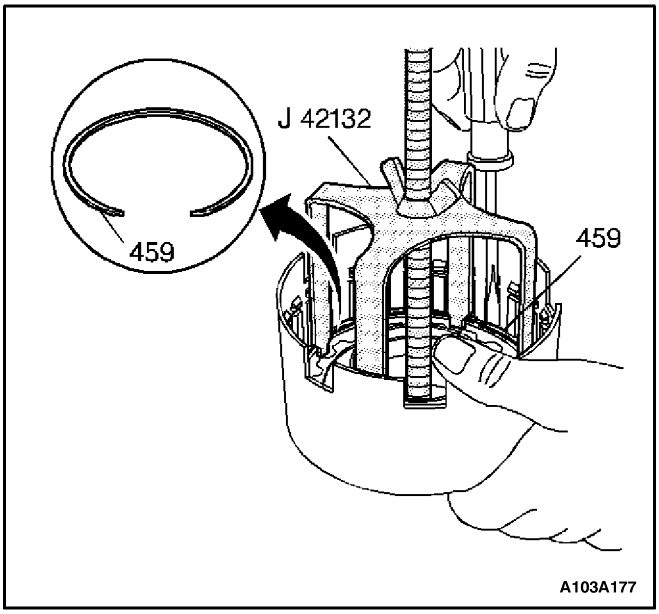
J 41097-1 Inner Seal Remover Adapter

J 41097-2 Inner Seal Remover Adapter Ring

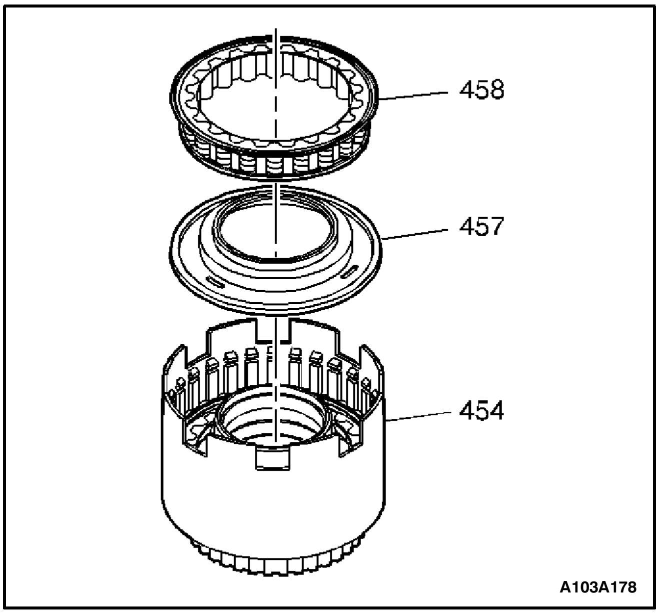
J 25031-A Inner Seal Remover

J 4646 Internal Snap Ring Pliers

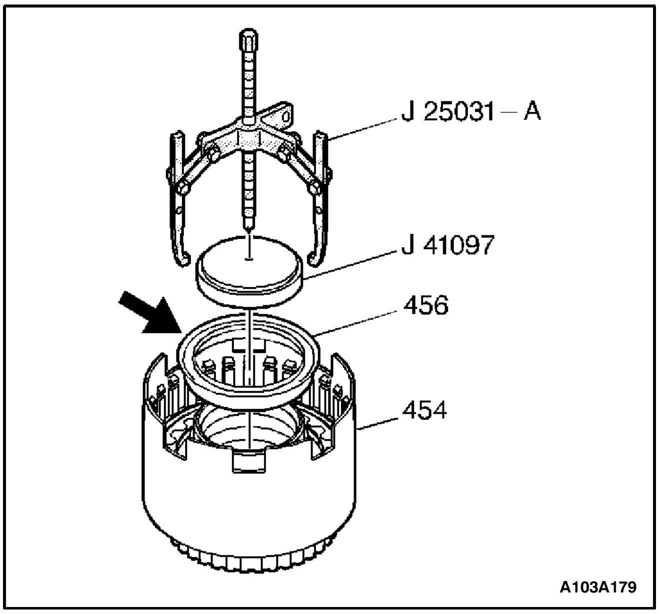
1. Remove the reverse clutch snap ring (464).
2. Remove the reverse clutch plates (one backing plate (463)l, three steel plates (461), three fiber plates (462), and a waved plate (460)).



3. Compress the reverse clutch return spring. Use the J 41232.
4. Remove the reverse clutch return spring and the retainer snap ring (459).
5. Remove the J 41232.

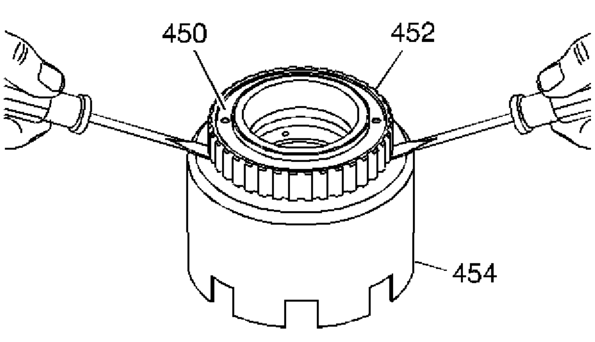


6. Remove the reverse clutch return spring and retainer assembly (458).
7. Remove the reverse clutch piston and seal assembly (457).



Important: If the seal assembly is not damaged do not remove the seal assembly.

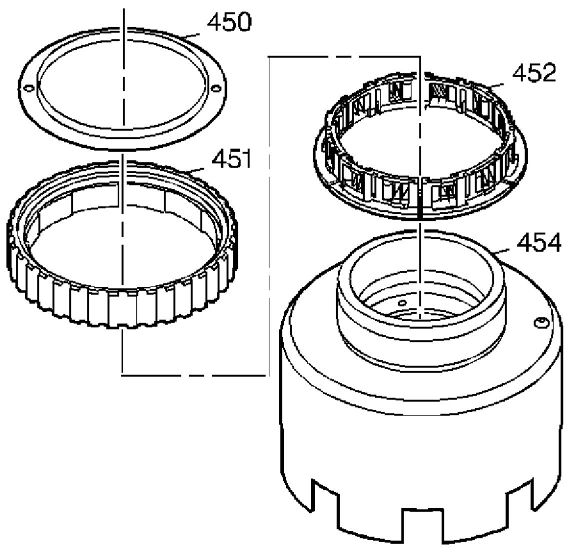
8. Inspect the reverse clutch inner seal (456).
9. If the seal assembly is damaged, perform the following procedure in order to remove the seal assembly:
   - 9.1. Attach the J 41097-1 (not shown in the illustration) to the J 41097-2.
   - 9.2. Place the J 41097-2 on the inner hub of the reverse clutch housing (454).
   - 9.3. Use the J 4646 or equivalent in order to install the J 41097-2 under the outer lip of the reverse clutch inner seal (456).
   - 9.4. Use the puller J 25031-A in order to remove the seal.



A103A180

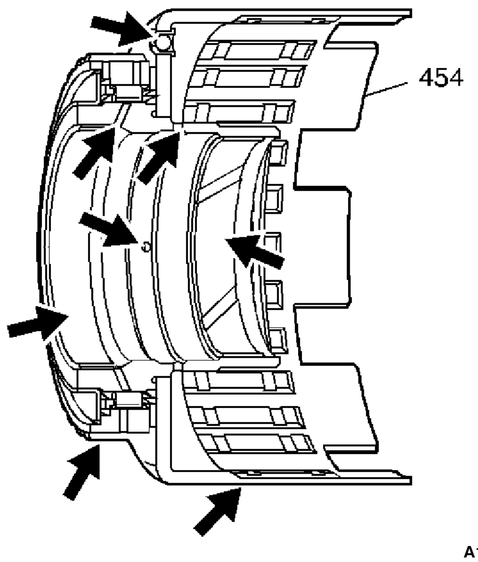
Important: Be careful when removing the second roller clutch not to score the roller clutch inner race with the screwdrivers.

10. Remove the 2nd roller clutch (452) and roller clutch retainer (450) by prying up on the roller clutch assembly with two screwdrivers. The second roller clutch retainer is pressed onto the reverse clutch housing (454) and is not reusable after removal.



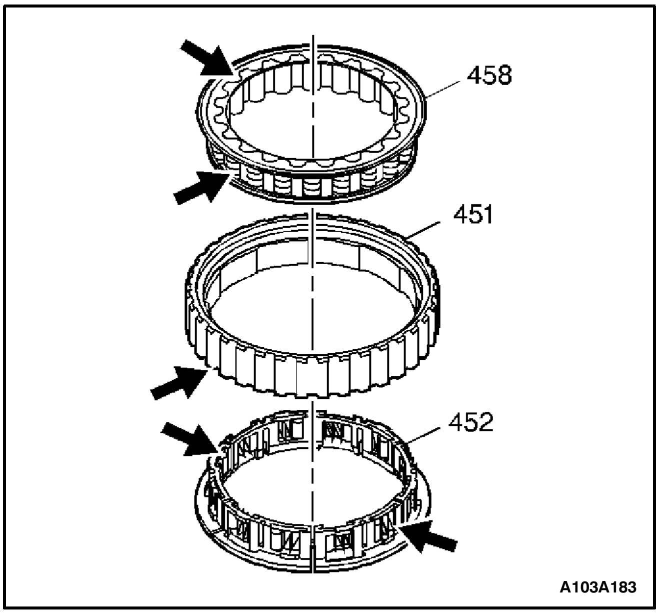
A103A181

11. Remove the 2nd roller clutch (452) from the inside of the roller clutch cam (451).

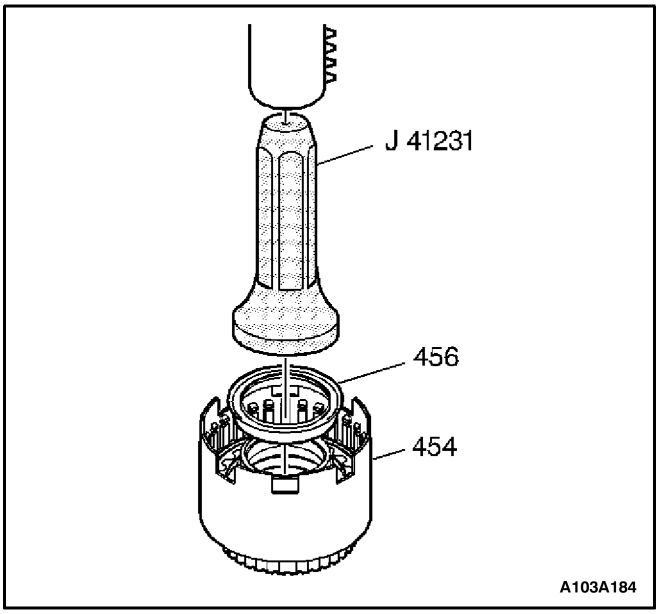


A103A182

12. Inspect the reverse housing for excessive band wear and damaged splines.
13. Inspect the retainer and ball capsule for damage or clogging.
14. Inspect the fluid feed holes for proper opening.



15. Inspect the roller clutch for excessive wear (451 and 452).
16. Inspect the spring assembly for dislocated or damaged springs (458).
17. Inspect all components for damage and excessive wear.
18. Clean and dry each of the components.



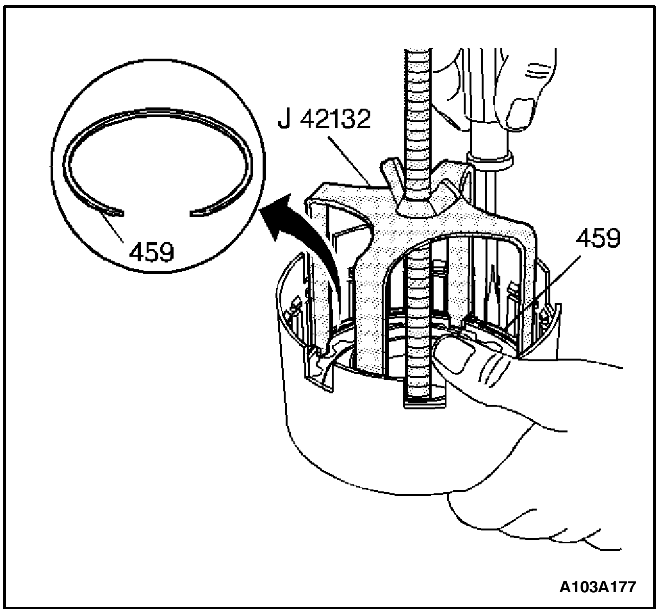
REVERSE INPUT AND 2ND ROLLER CLUTCH ASSEMBLE

Tools Required

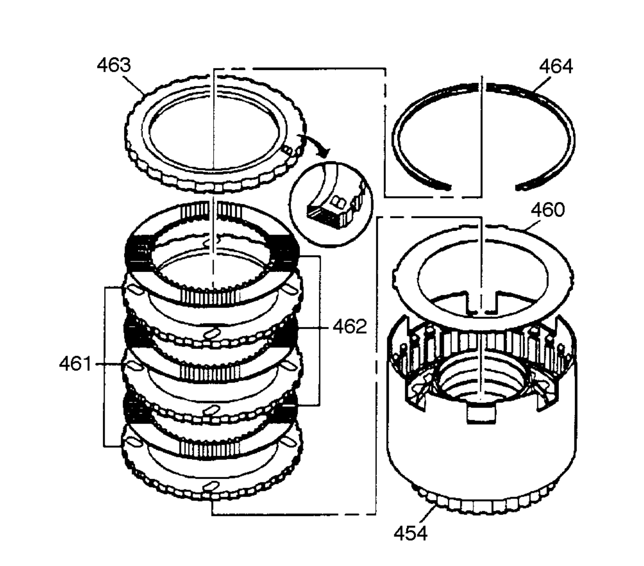
J 41232 Return Spring Compressor

J 41233 Inner Seal Installer

1. If the reverse clutch inner seal assembly (456) was damaged and removed, install a new reverse clutch inner seal assembly (456). Use the J 41233.
2. Assemble the reverse clutch piston and seal assembly (457). In order to aid in the assembly, lubricate the seal with transmission fluid.
3. Assemble the reverse clutch return spring and retainer assembly (458) with the smaller outside diameter down.

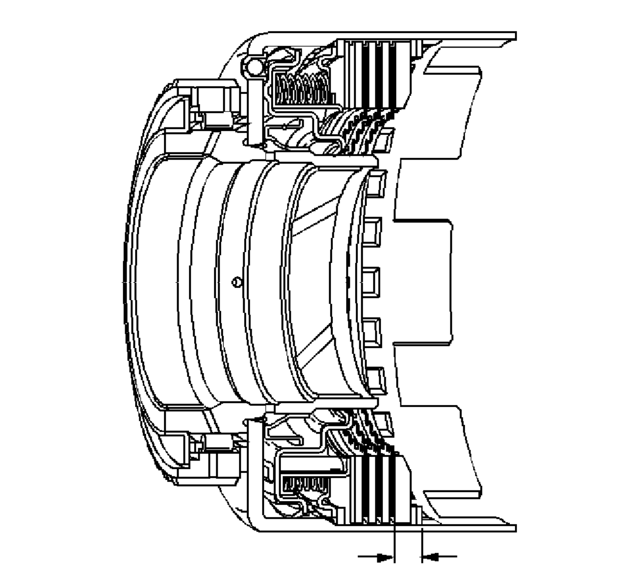


4. Compress the reverse clutch return spring. Use the J 41232.
5. Assemble the return spring snap ring (59).
6. Remove the J 41232.

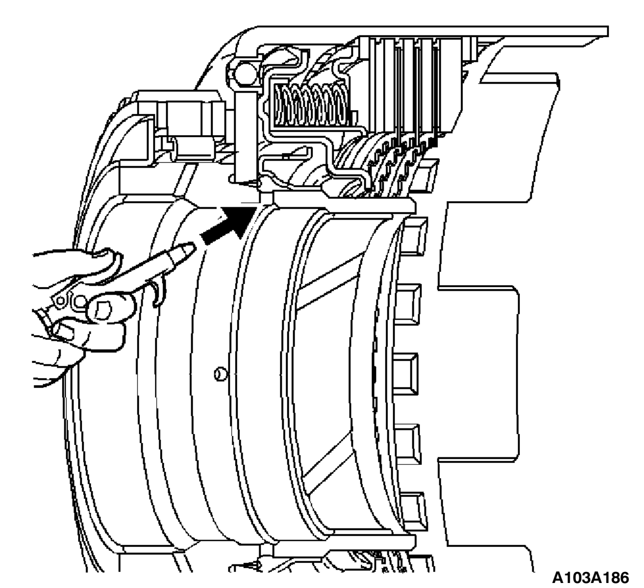


A103A176

7. Assemble the wave plate (460).
8. Assemble the three steel plates (461) and the three new fiber plates (462) in alternating order beginning with a steel plate (461).


A103A185

9. Measure the distance between the top of the snap ring groove and the top friction plate (Dimension A).
10. In order to select the appropriate backing plate, use Dimension A. You will find the backing plate identification stamped onto the beveled side of the backing plate. Refer to the Reverse Clutch Table in Transaxle General Specifications.
11. Assemble the reverse clutch backing plate (463) with the beveled edge up.
12. Assemble the snap ring (464) in the reverse clutch housing in order to retain the reverse clutch plates.

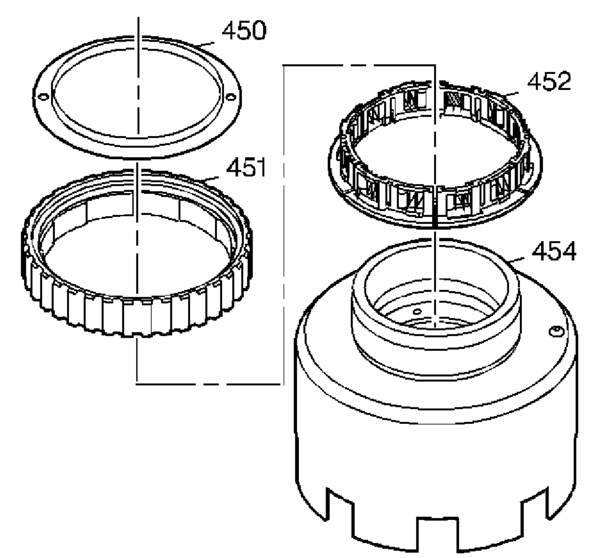

A103A186

REVERSE CLUTCH FUNCTIONAL AIR CHECK

Tools Required

J 41235 Second Roller Clutch Installer

1. Air check the reverse clutch in order to verify the proper operation of the seals and clutch assembly.

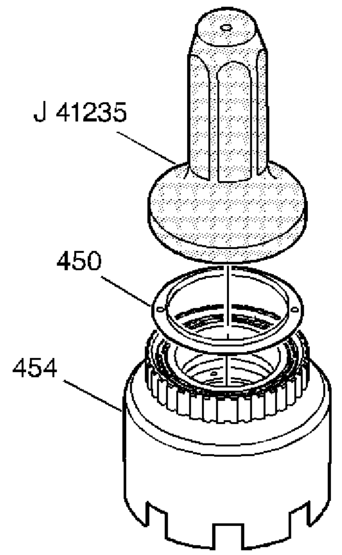


A103A181

2. Assemble the 2nd roller clutch assembly (452) into the roller clutch cam (451).

Important: When installing the 2nd roller clutch assembly onto the reverse clutch housing, the flat side of the roller clutch cam faces down toward the housing (454).

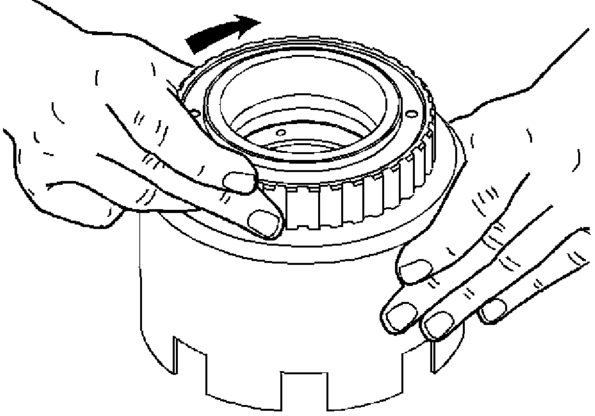
3. While rotating the roller clutch in order to properly engage the rollers, assemble the 2nd roller clutch onto the reverse clutch housing (454).



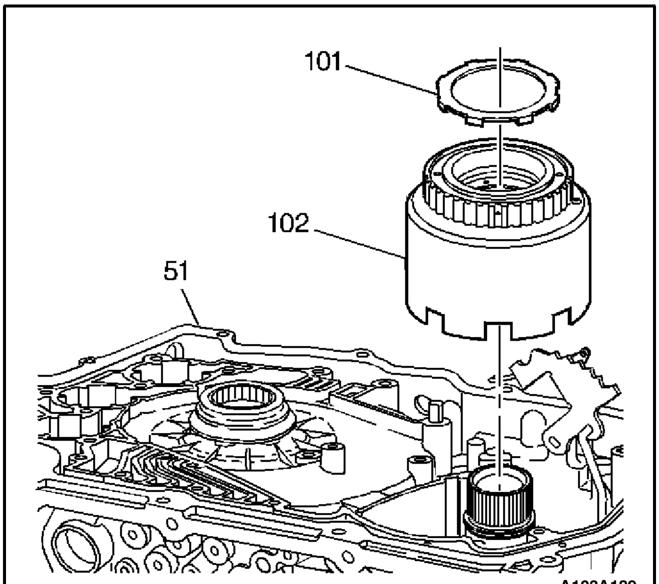
A103A187

Important: The J 41235 will press the roller clutch assembly to a specified depth. If you install the 2nd roller too far down onto the inner race, the roller clutch may not operate properly.

4. Assemble a new 2nd roller clutch retainer (450) onto the 2nd roller clutch assembly. Use the J 41235 in order to press the retainer and roller clutch assembly into place on the reverse clutch housing and roller clutch inner race.


A103A188

5. Hold the reverse clutch housing and ensure that the roller clutch cam rotates clockwise only.

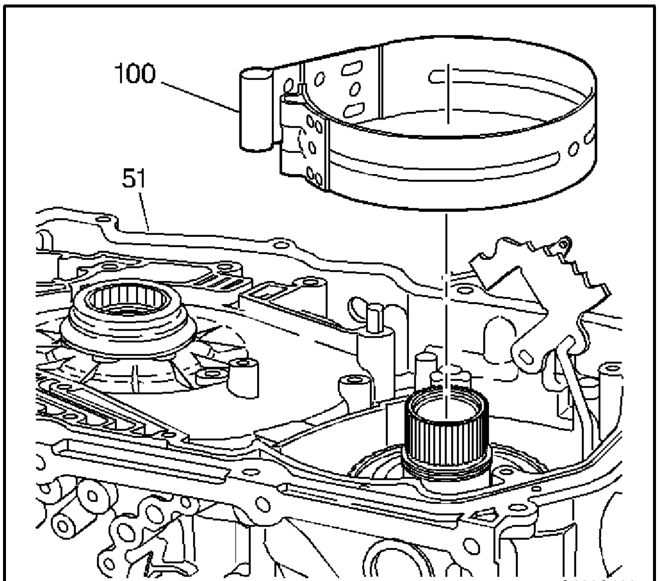


A103A189

REVERSE INPUT AND 2ND ROLLER CLUTCH INSTALL

Important: The tangs on the reverse clutch housing spline to the tangs on the reaction carrier sun gear and shell assembly.

1. While rotating the reverse clutch housing in order to align the clutch plates, install the reverse clutch and 2nd roller clutch assembly into the transmission case.
2. Assemble the reverse clutch thrust washer (101) onto the top of the 2nd roller clutch. The tabs must face down onto the housing.



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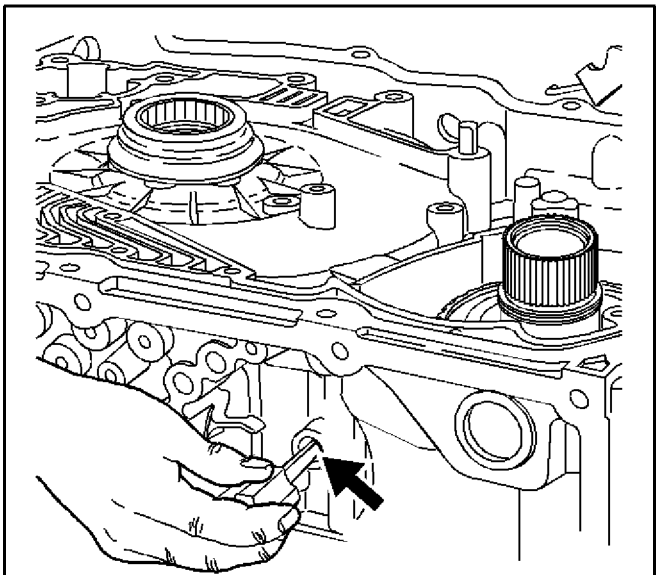
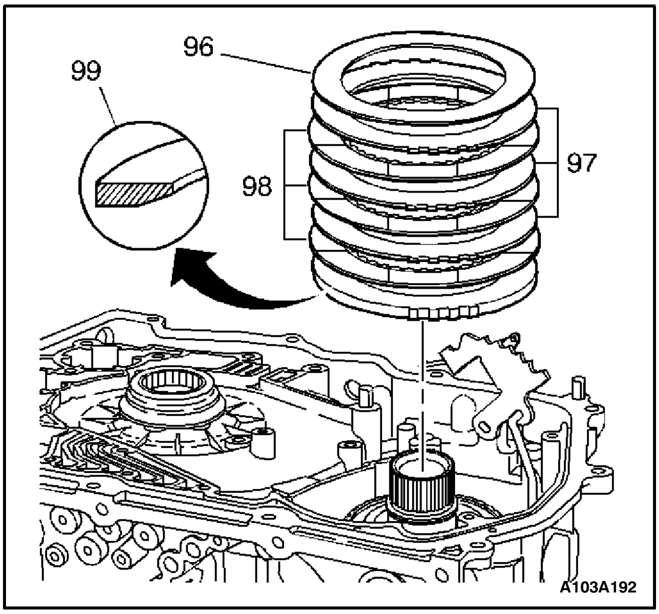
INTERMEDIATE 4TH BAND ASSEMBLY INSTALL

1. Assemble a new intermediate/fourth band (100) into the transmission case (51).

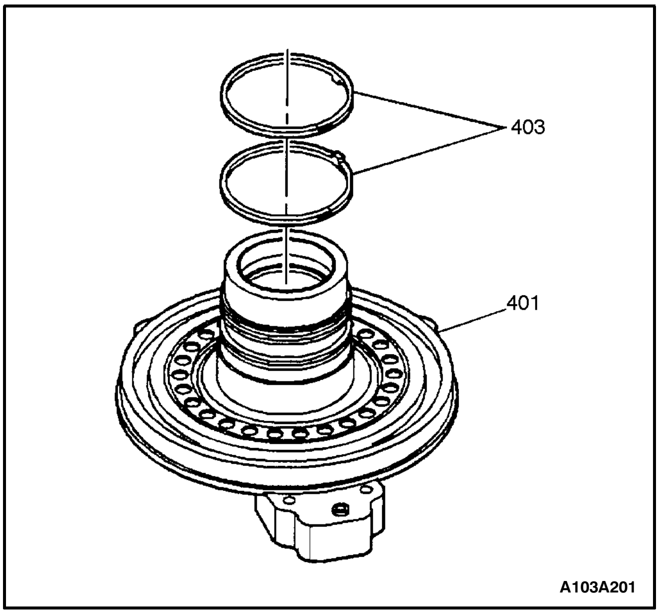

A103A191

2. In order to verify the proper positioning of the band, insert a screwdriver through the intermediate/fourth servo bore. The screwdriver should press on the servo pin rest and compress the band around the reverse clutch housing.



2ND CLUTCH PLATE INSTALLATION

1. Inspect the 2nd clutch plates for excessive wear.
2. Clean and dry each of the components.
3. Assemble the 2nd clutch backing plate (99) with the flat side facing up.
4. Assemble the three steel (97) and the three new fiber plates (98) in alternating order beginning with a fiber plate (98).
5. Assemble the 2nd clutch wave plate (96).

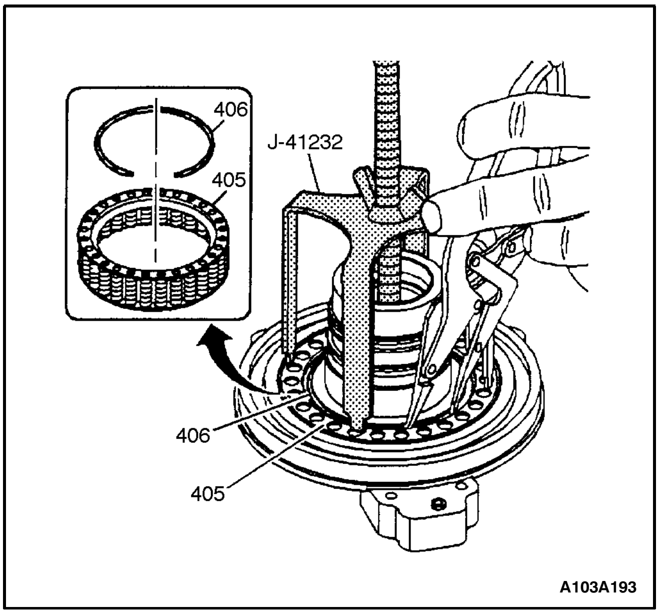


DRIVEN SPROCKET ASSEMBLY DISASSEMBLE

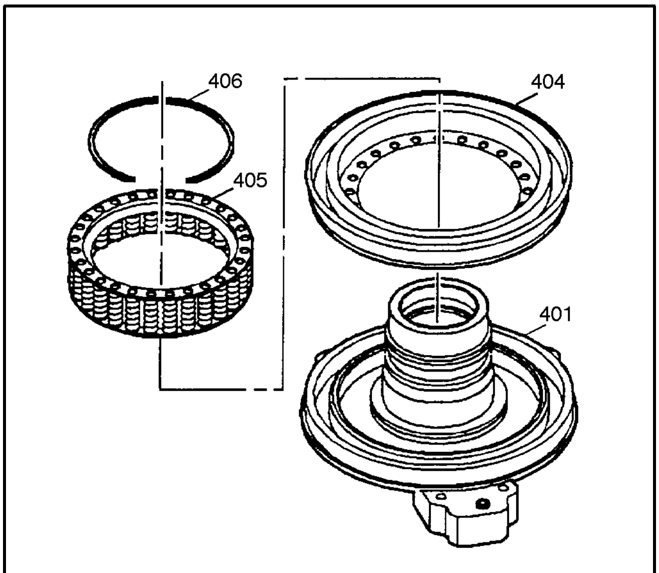
Tools Required

J 41232 Return Spring Compressor

1. Remove the two seal rings (403) from the driven sprocket support.
2. Discard the two seal rings (401).

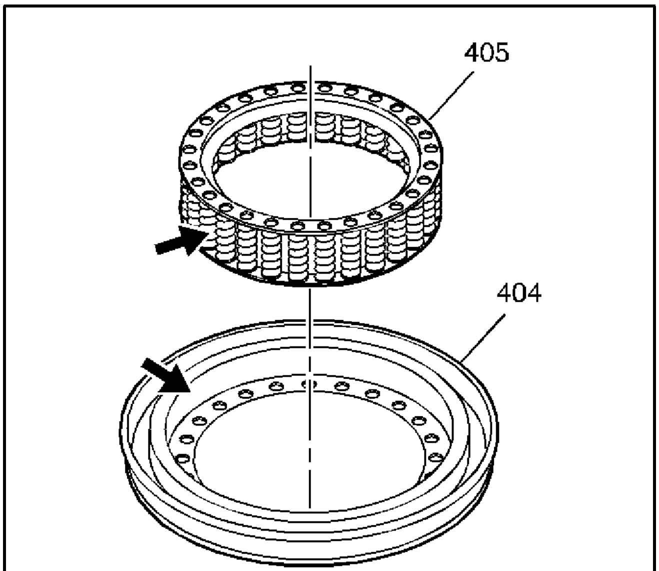


3. Compress the 2nd clutch spring and retainer assembly (405). Use the J 41232.
4. Remove the 2nd clutch spring retainer snap ring (406).
5. Remove the J 41232.



A103A194

6. Remove the 2nd clutch spring and retainer assembly (405).
7. Remove the 2nd clutch piston and seal assembly (404). If not damaged, the piston and seal assembly is reusable.



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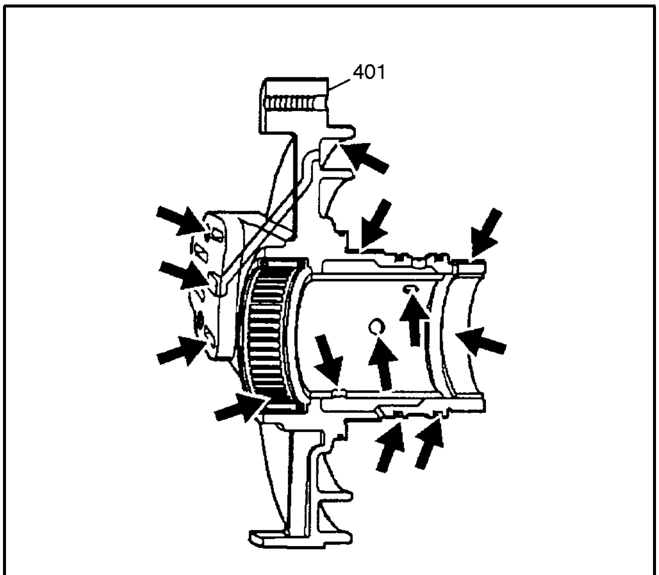
8. Inspect the piston and seal assembly for damaged seals.
9. If the seal is cut or damaged replace the seal with a new piston and seal assembly.



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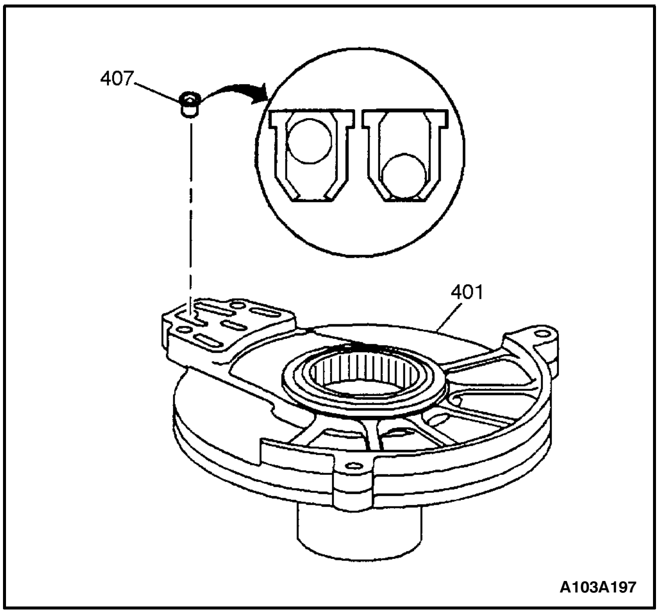
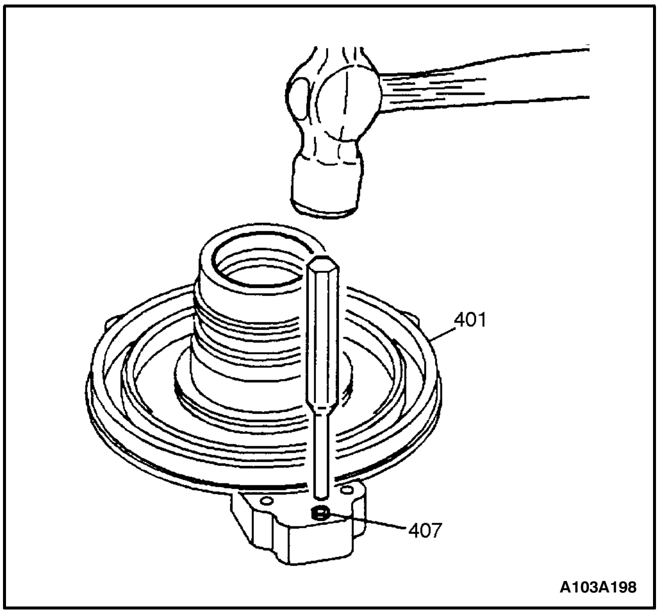
10. Inspect the bushing and bearing for damage or excessive wear.
11. Inspect the driven sprocket support for plugged feed holes, damaged seal grooves, stripped bolt holes, and a damaged machined surface.



12. Inspect the reverse intermediate clutch housing valve assembly (407) for free operation.

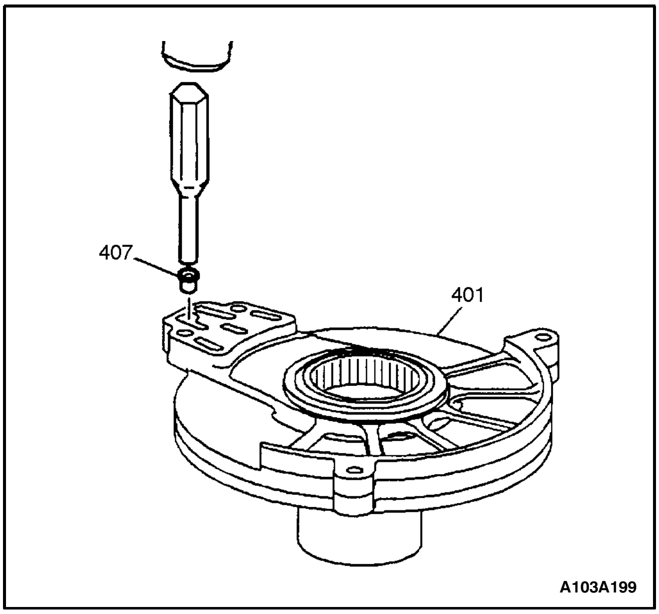
Important: The valve assembly must be in its seated position before you perform the leak test.

13. Using automatic transmission fluid, inspect the reverse intermediate clutch housing valve assembly (407) for leaks.

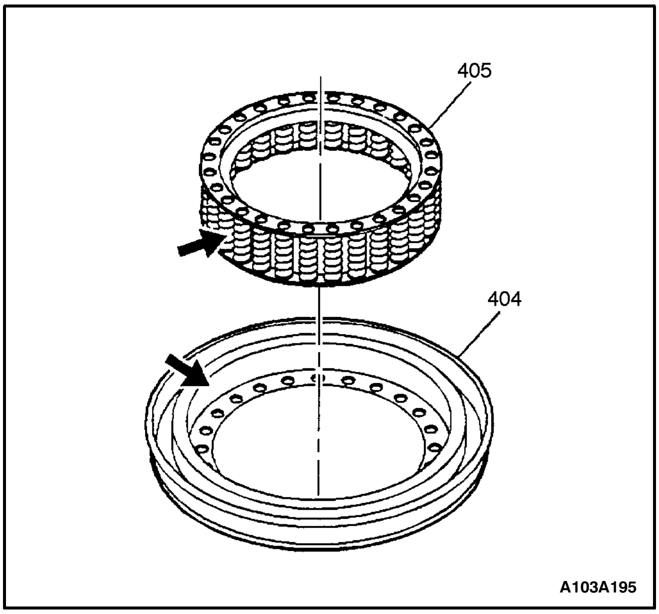


Important: Remove the reverse clutch housing valve assembly (407) only if inspection or the leak test has indicated a problem.

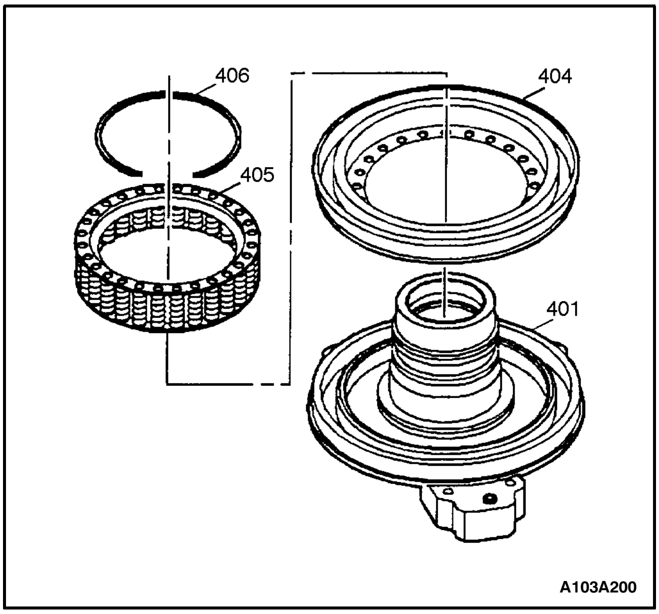
14. Using a 6.25 mm (1/4 inch) drift and a mallet, remove the valve assembly (407) from the driven sprocket support (401).



15. Using a 6.25 mm (1/4 inch) drift and a mallet, install the valve assembly (407) in the driven sprocket support (401).



16. Inspect the spring assembly for dislocated or damaged springs.
17. Clean and dry each of the components.

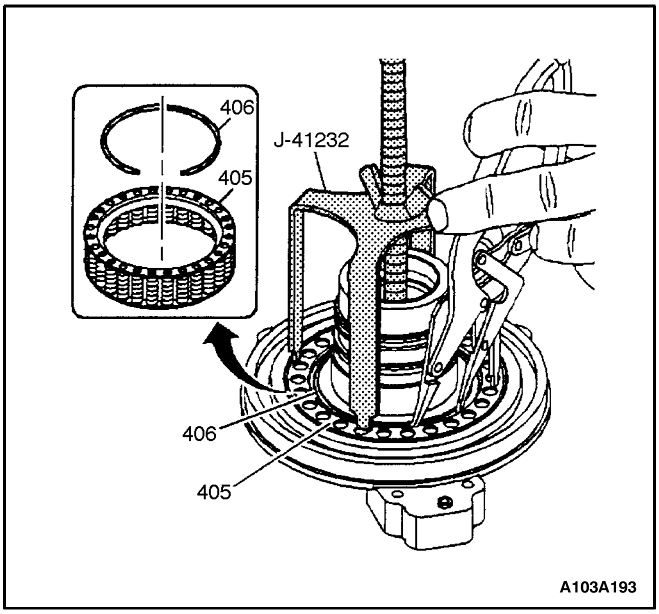


DRIVE SPROCKET SUPPORT ASSEMBLE

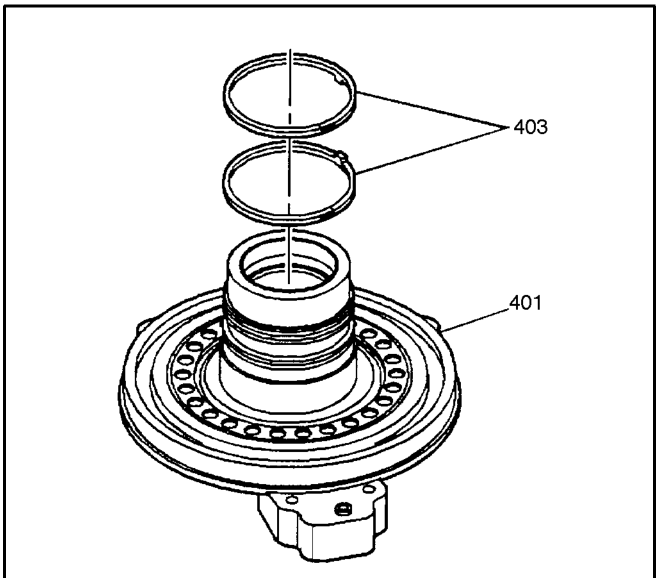
Tools Required

J 41232 Return Spring Compressor

1. In order to aid in the assembly, lubricate the seal with transmission fluid.
2. Assemble the 2nd clutch piston and seal assembly (404) into the driven sprocket support (401).
3. Assemble the 2nd clutch spring and retainer assembly (405) into the driven sprocket support.



4. Compress the 2nd clutch spring assembly. Use the J 41232.
5. Assemble the 2nd clutch spring retainer snap ring (406).
6. Remove the J 41232.



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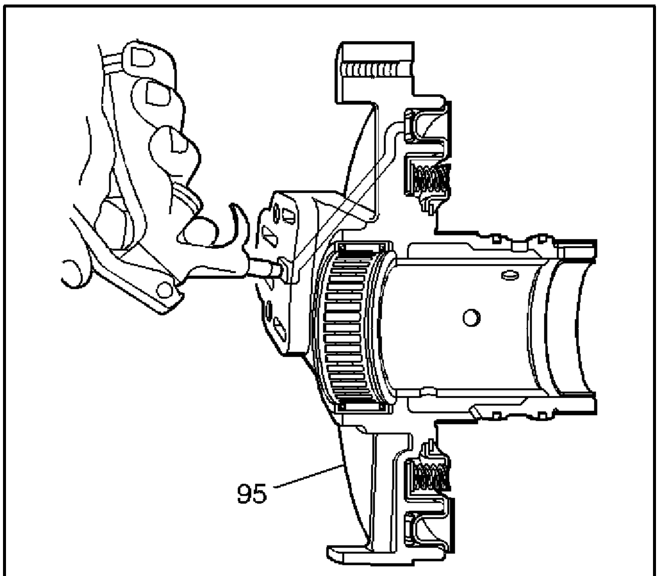
7. Assemble two new seal rings (403) onto the driven sprocket support.



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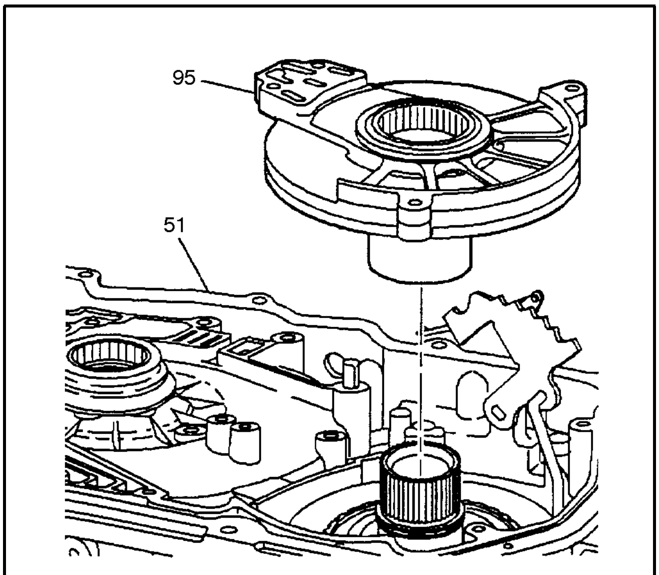
2ND CLUTCH FUNCTIONAL AIR CHECK

Air check the 2nd clutch in order to verify proper operation of the seals and clutch assembly.



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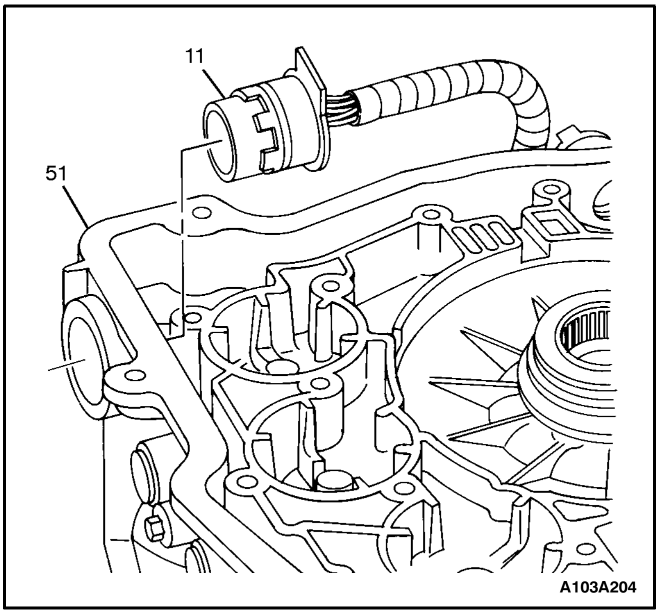
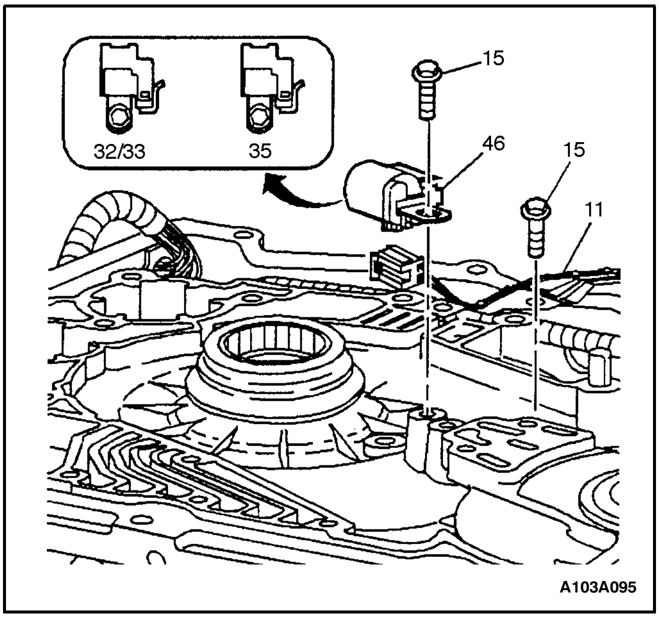
DRIVEN SPROCKET SUPPORT ASSEMBLY INSTALLATION

Install the driven sprocket support and 2nd clutch assembly (95) into the transaxle case (51). When installed properly, the driven sprocket support sits slightly below the machined surface of the transaxle case (51).



WIRING HARNESS INSTALLATION

1. Inspect the wiring harness (11) for damage.
2. Inspect the pass thru connector pins and O-ring seal for damage.
3. Assemble the wiring harness pass thru connector into the transaxle case bore from the inside of the transaxle case.

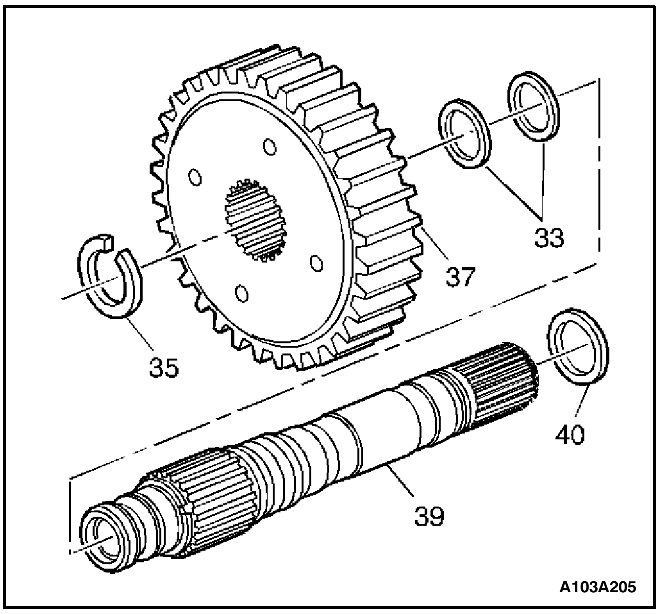


INPUT SPEED SENSOR INSTALL

Important: The tab on the sensor housing (46) fits into the recess on the case boss.

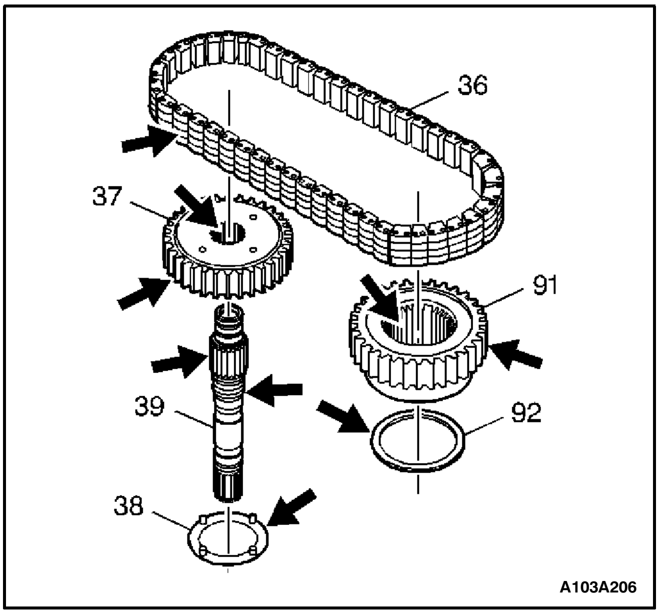
Important: For drive sprockets with 35 teeth, use a black sensor housing. For drive sprockets with 32 or 33 teeth, use a natural colored sensor housing.

1. Assemble the input speed sensor (46) to the transmission case (51).
2. Install the input speed sensor bolt (15). Hand start and tighten the input speed sensor bolt to 12 N•m (9 lb-ft).
3. Route the input speed sensor wiring harness in the case channel.
4. Connect the input speed sensor connector to the input speed sensor.
5. Install the wire harness retainer and wire harness retainer bolt. Tighten the wire harness retainer bolt to 12 N•m (9 lb-ft).

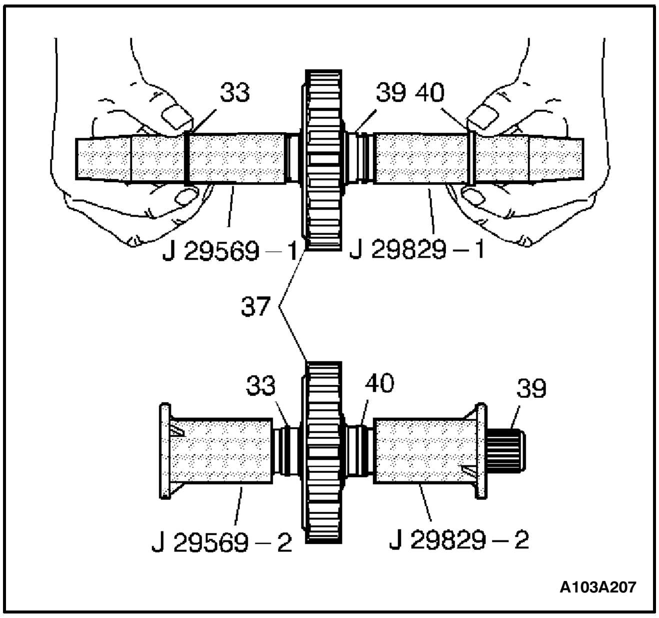


DRIVE, DRIVEN SPROCKETS AND DRIVE LINK DISASSEMBLE

1. Remove the turbine shaft to drive sprocket snap ring (35).
2. Remove the drive sprocket (37) from the turbine shaft (39).
3. Remove the three Teflon™ seals (33 and 40) from the turbine shaft.
4. Discard the Teflon™ seals (33 and 40).



5. Inspect the drive sprocket, the driven sprocket, the drive link assembly, and the turbine shaft for damage or excessive wear.
6. Inspect the seal grooves for damage.
7. Inspect the thrust washers for damage or excessive wear.
8. Clean and dry each of the components.



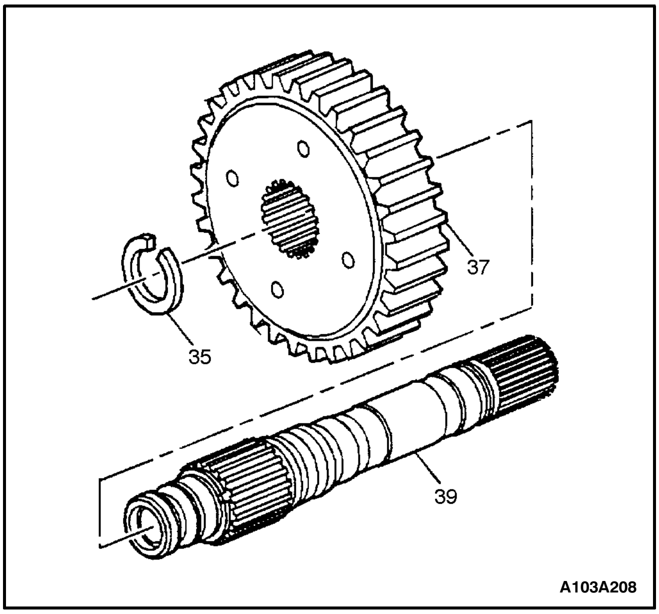
DRIVE, DRIVEN SPROCKETS AND DRIVE LINK ASSEMBLE

Tools Required

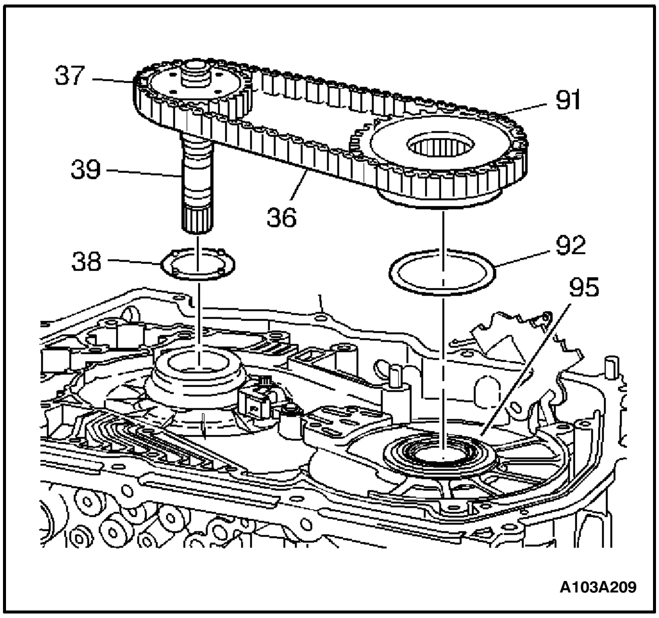
J 29569-1/J 29829-1 Turbine Shaft Seal Installer

J 29569-2/J 29829-2 Turbine Shaft Seal Sizer

1. In order to assemble three new Teflon™ seals onto the turbine shaft, perform the following procedure:
   - 1.1. Slide both halves of the J 29569-1/J 29829-1 over the turbine shaft.
   - 1.2. Coat the J 29569-1/J 29829-1 with transmission fluid.
   - 1.3 Use your fingers in order to guide the new Teflon™ seals over the J 29569-1/J 29829-1 and into the seal ring grooves on the turbine shaft.
   - 1.4. Remove the J 29569-1/J 29829-1 when the seals are in place.
   - 1.5. Size the new Teflon™ seals. Use both halves of the J 29569-2/J 29829-2.
   - 1.6. In order to properly size the seals, keep the J 29569-2/J 29829-2 in place for five minutes.



2. Assemble the drive sprocket (37) onto the turbine shaft (39).
3. Retain the drive sprocket with the turbine shaft to drive sprocket snap ring (35).



DRIVE, DRIVEN SPROCKETS AND DRIVE LINK INSTALL

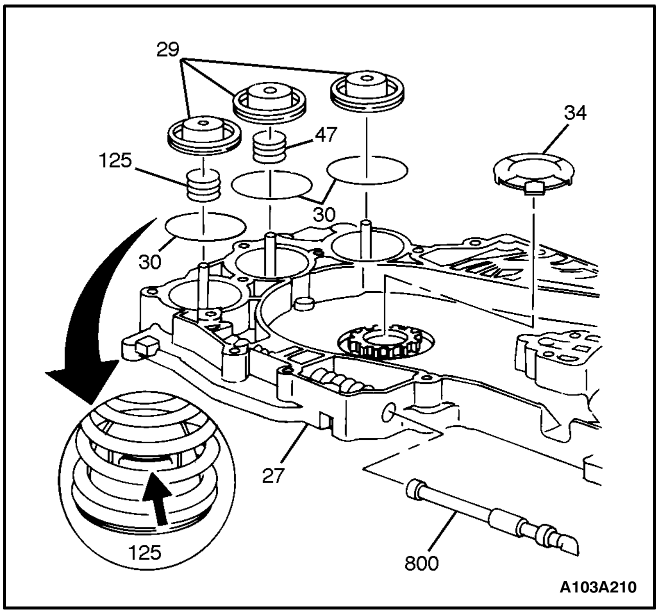
Tools Required

J 36850 Transjel™

1. Install the drive sprocket to drive sprocket support thrust washer (38) to the drive sprocket (37). Place the tabs on the thrust washer into the holes on the drive sprocket.
2. Retain the thrust washer with J 36850 or equivalent.
3. Install the driven sprocket to driven sprocket support thrust washer (92) onto the driven sprocket support (95).

Important: Orient the drive link assembly (36) in the same direction in which the drive link assembly (36) was removed. If the drive link assembly (36) is new, you can install it in either direction.

4. Install the drive link assembly (36) to the drive and driven sprockets (37 and 91).
5. Install as a complete assembly, the drive sprocket (37), the driven sprocket (91), and the drive link assembly (36) onto the transmission.



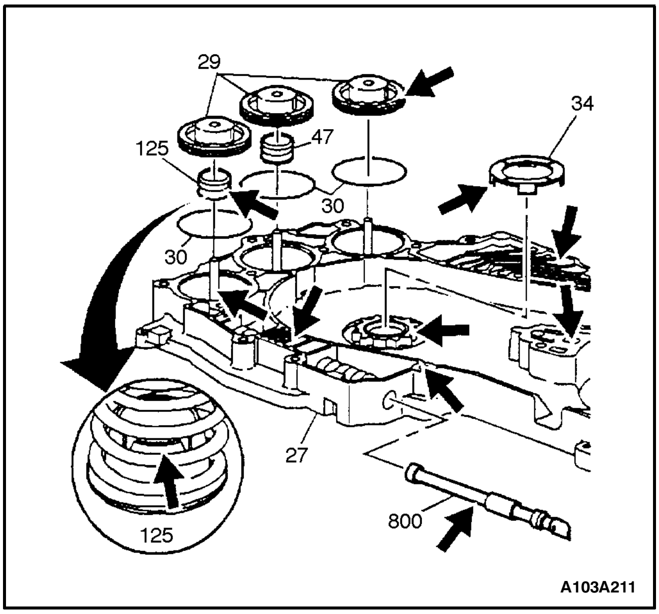
CHANNEL PLATE ASSEMBLY DISASSEMBLE

Important: The accumulator pins are pressed into the channel plate (27). Do not remove the accumulator pins.

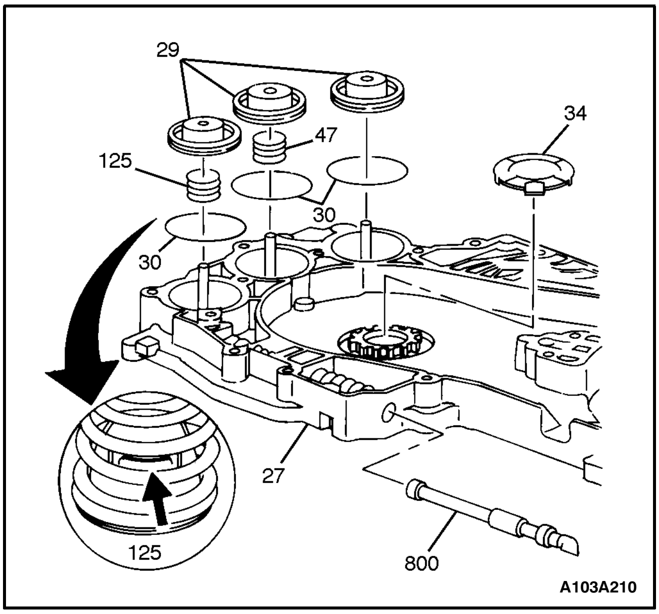
1. Remove the three accumulator pistons (29) from the channel plate (27).

Important: The 1-2 accumulator assist spring (125) has a retainer that presses into the spring. Keep the retainer and the spring together as an assembly.

2. Remove the 1-2 accumulator assist spring 9125).
3. Remove the 2-3 accumulator assist spring (47).
4. Remove the seals (30) from the accumulator pistons (29).
5. Discard the accumulator piston seals (30).
6. Remove the manual valve (800) from the channel plate (27).



7. Inspect the channel plate (27) for damage.
8. Inspect the channel plate (27) passages for debris.
9. Inspect the accumulator pistons (29), the assist springs (47 and 125), and the pins for damage.
10. Inspect the channel plate sleeve for wear from the turbine shaft.
11. Inspect the channel plate (27) bolt holes for stripped threads and debris.
12. Inspect the channel plate machined surface for nicks or scratches that could cause a fluid leak.
13. Inspect the manual valve (800) for freedom of movement.
14. Inspect the drive sprocket to channel plate thrust washer (34).
15. Clean and dry each component.

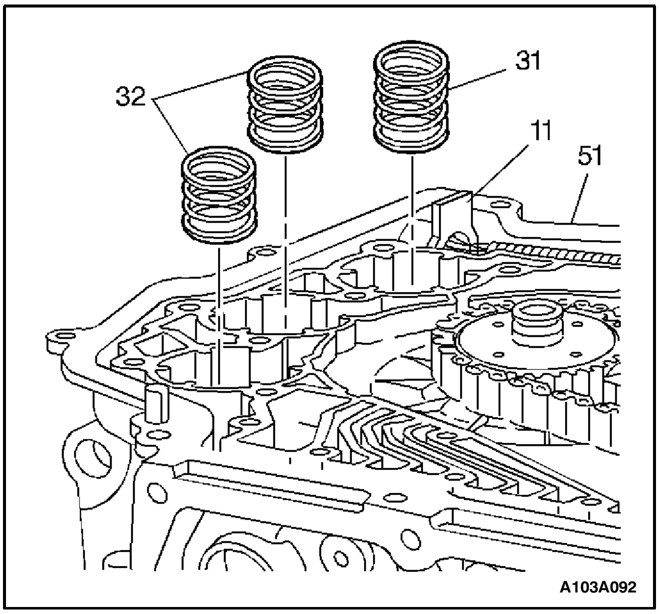


CHANNEL PLATE ASSEMBLY ASSEMBLE

Tools Required

J 36850 Transjel™

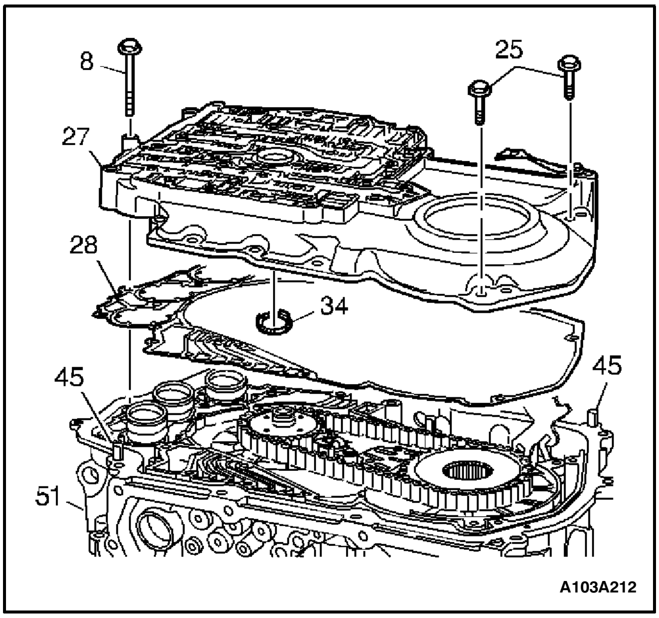
1. Assemble the new accumulator piston seals (30) on the three accumulator pistons (29).
2. Install the 1-2 and 2-3 accumulator assist springs (47 and 125).
3. Install the accumulator pistons (29) into the channel plate over the guide pins. The pistons are identical. You can assemble the pistons in any of the three accumulator bores.
4. In order to retain the pistons, apply J 36850 onto the piston seals.



ACCUMULATOR SPRINGS INSTALL

Important: The 1-2 accumulator spring (31) is slightly taller than the other two springs (32). Install a 1-2 accumulator spring in the bore closest to the electrical pass-through connector (11).

Install the two remaining accumulator springs into the transmission case accumulator bores.



CHANNEL PLATE ASSEMBLY INSTALLATION

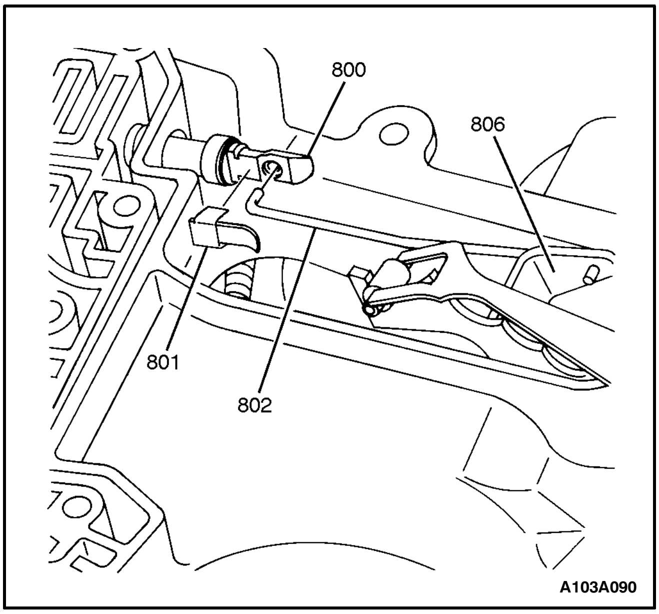
Tools Required

J 36850 Transjel™

1. Install the channel plate to drive sprocket thrust washer (34) onto the channel plate (27).
2. Retain the thrust washer (34) with J 36850 or equivalent.
3. Install a new channel plate to case gasket (28) onto the transmission case (51).
4. Install the channel plate assembly onto the transmission case (51). The channel plate should fit tightly over the guide pins (45) located on the transmission case (51).

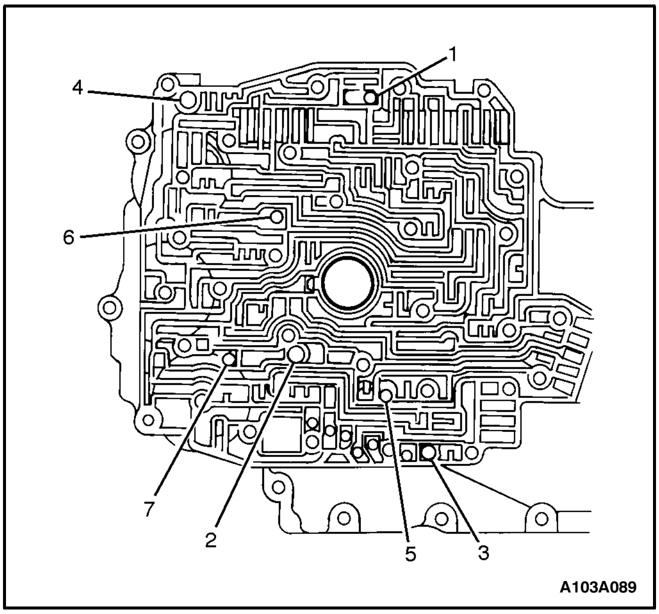
Important: Tighten the two channel plate bolts (25) to 14 N•m (10.5 lb-ft).

5. Install the eight channel plate to case bolts (8 and 25) and the two channel plate to driven sprocket support bolts (25). Hand tighten the bolts and tighten to either 12 N•m (9 lb-ft) or 14 N•m (10.5 lb-ft).



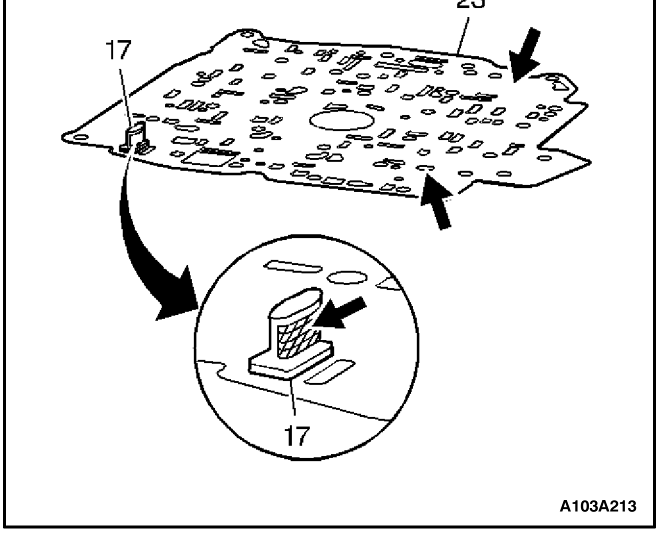
MANUAL VALVE INSTALL

1. Install the manual valve (800) into the channel plate.
2. Connect the manual valve link (802) to both the manual valve and detent lever.
3. Install the manual valve clip (801) onto the manual valve.



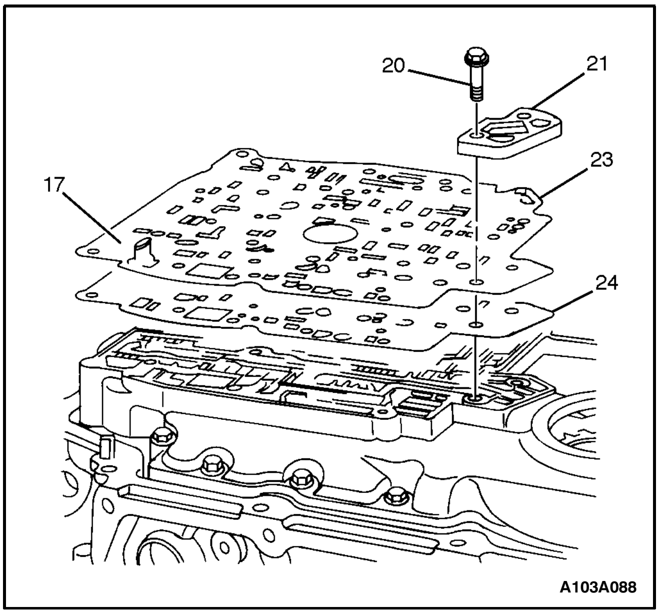
CHECKBALLS INSTALLATION

Install the seven checkballs into the proper locations on the channel plate.



SPACER PLATE AND GASKETS INSTALL

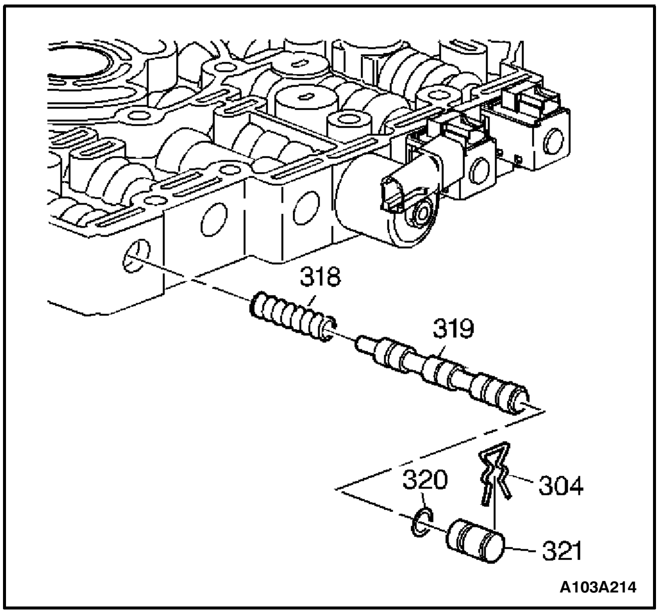
1. **Inspect the spacer plate and spacer plate filter for damage.**
2. **If damaged, replace the spacer plate and spacer plate filter.**



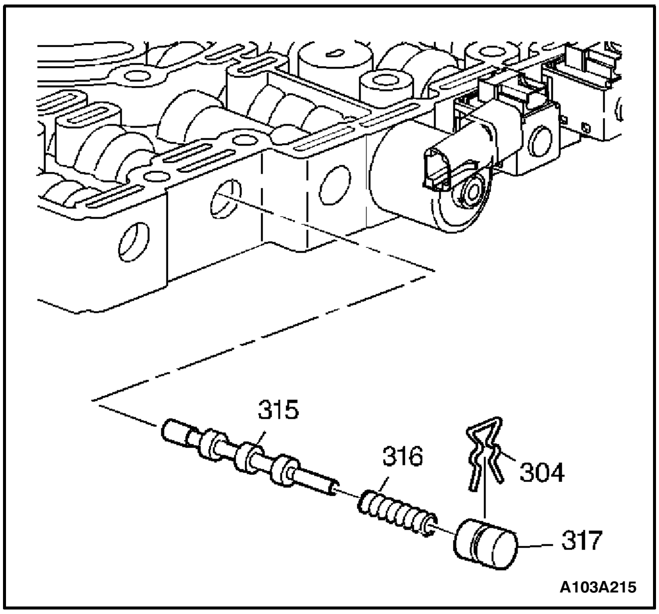
3. **Install a new spacer plate to channel plate gasket (24) onto the channel plate.**
4. **Install the spacer plate (23) on top of the gasket and channel plate.**
5. **Install the spacer plate support (21) and the two bolts (20) onto the spacer plate. Hand start and then tighten the bolts to 14 N•m (10.5 lb-ft).**

CONTROL VALVE BODY DISASSEMBLE

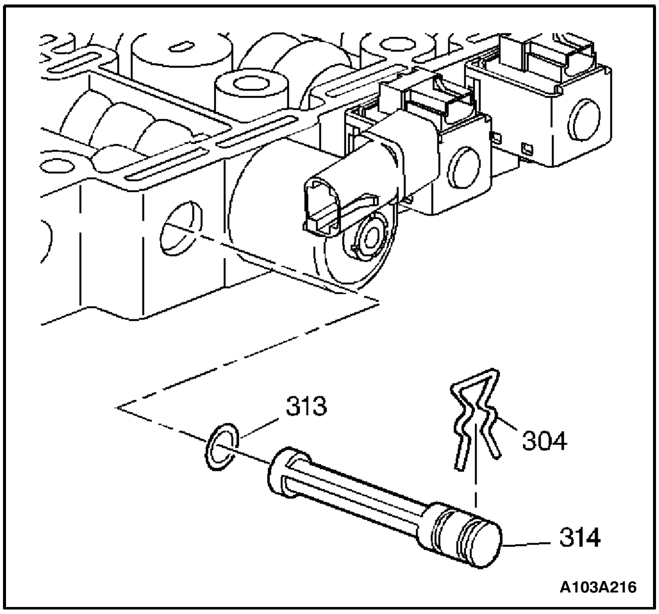
Important: Retainer clips hold in each of the valve line-ups. Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips and valves. Before removing the valve line-ups, inspect each valve line-up for freedom of movement.



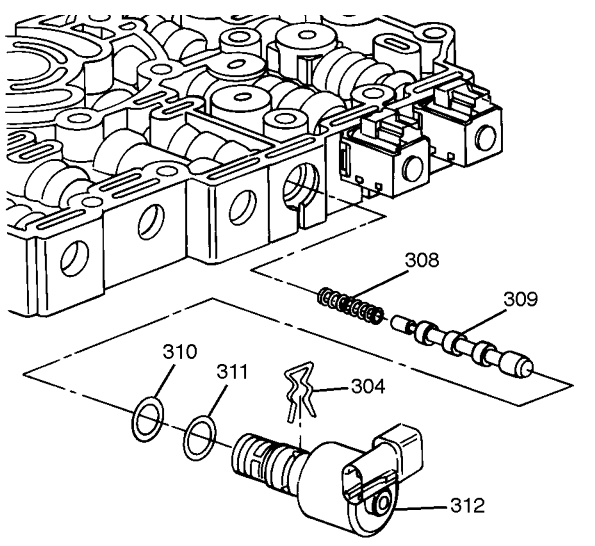
1. **Remove the 3-4 shift valve retainer clip (304), the bore plug (321), with O-ring (320), the 3-4 shift valve (319) and the 3-4 shift valve spring (318).**



2. **Remove the actuator feed limit valve retainer clip (304), the bore plug (317), the actuator feed limit spring (316) and the actuator feed limit valve (315).**



3. **Remove the actuator oil filter retainer clip (304) and the actuator oil filter (324) with O-ring (313).**



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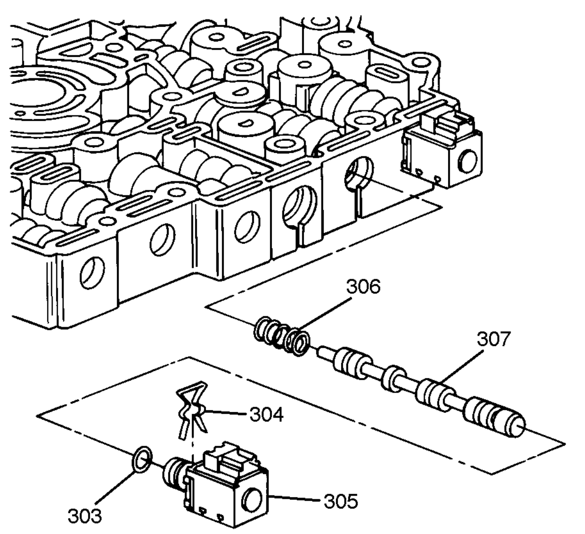
4. **Remove the Pressure Control Solenoid (PCS) retainer clip (304), the PCS with two O-rings and screen (312, 309, and 310), the torque signal regulator valve (309), and the torque signal regulator spring (308).**



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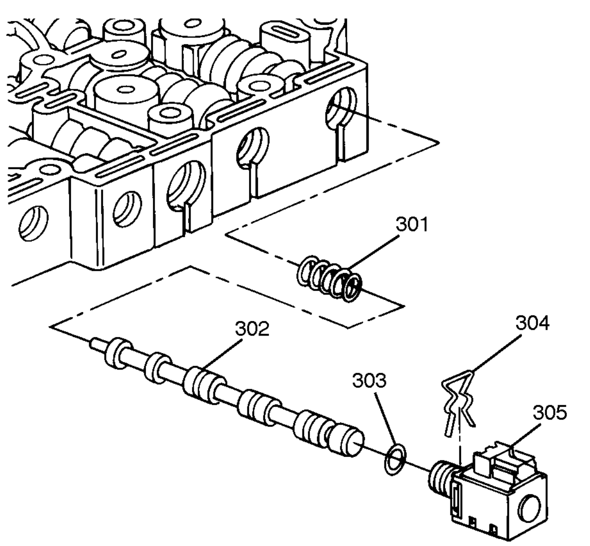
5. **Remove the 2-3 shift solenoid retainer clip (304), the 2-3 shift solenoid (305) with O-ring (303), the 2-3 shift valve (307), and the 2-3 shift valve spring (306).**



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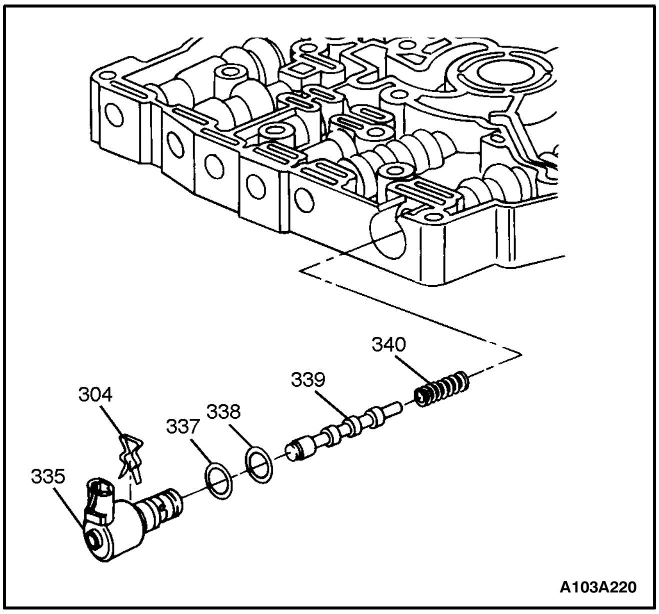
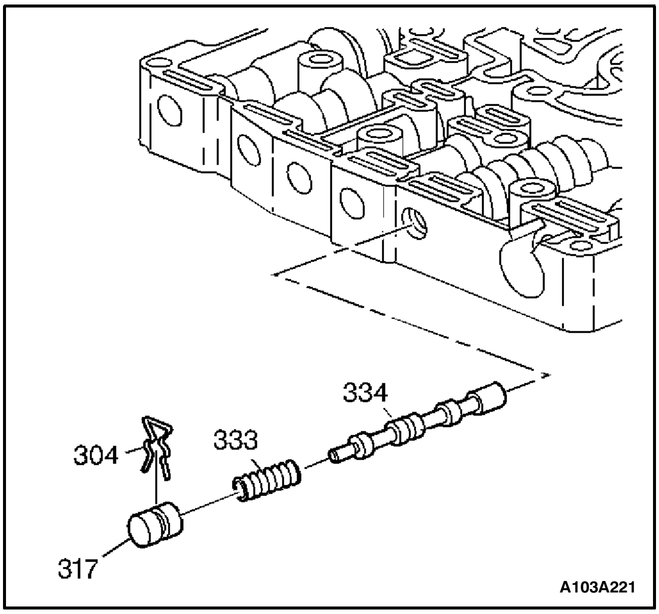
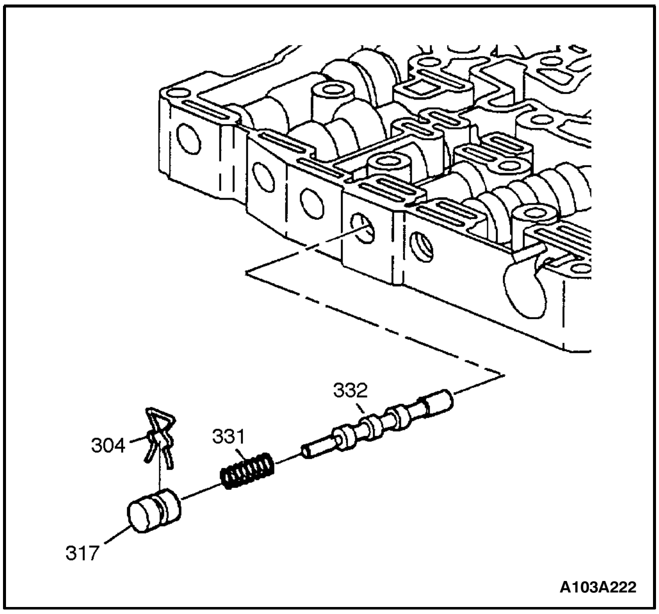
6. **Remove the 1-2 shift solenoid retainer clip (304), the 1-2 shift solenoid (305) with O-ring (303), the 1-2 shift valve (302), and the 1-2 shift valve spring (301).**



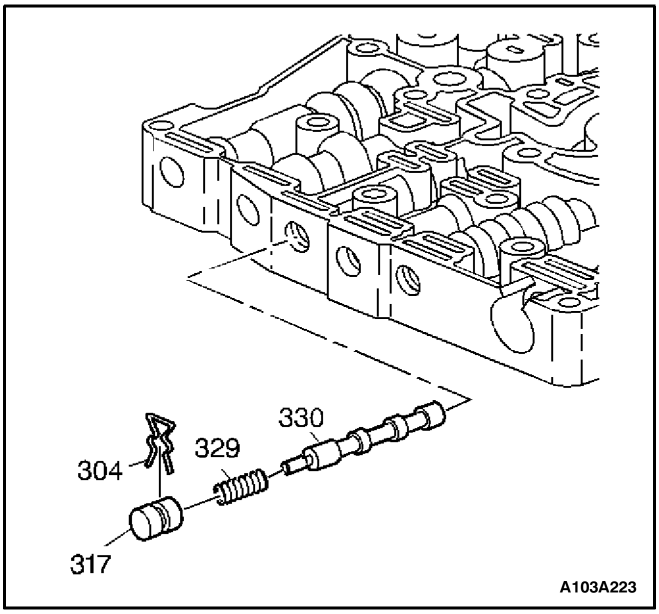
7. Remove the TCC solenoid retainer clip (304), the TCC solenoid (335) with two O-rings (337 and 338) and screen, the TCC regulated apply valve (339) and the spring (340).



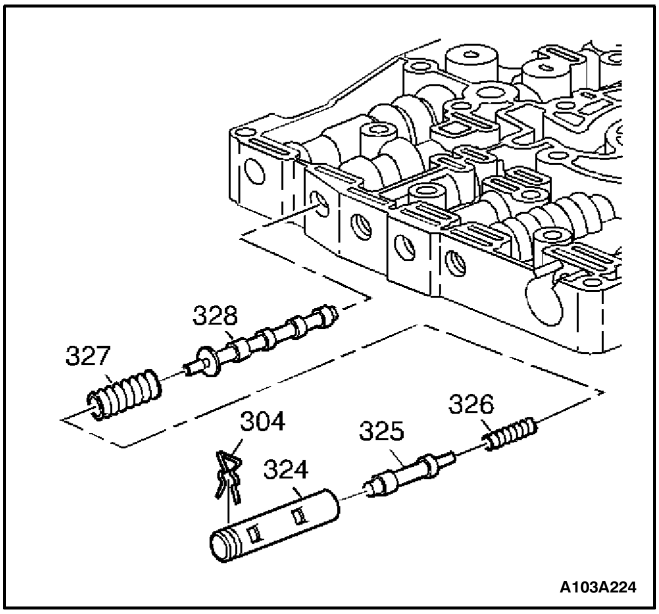
8. Remove the TCC control valve retainer clip (304), the bore plug (317), the spring (333), and the TCC control valve (334).



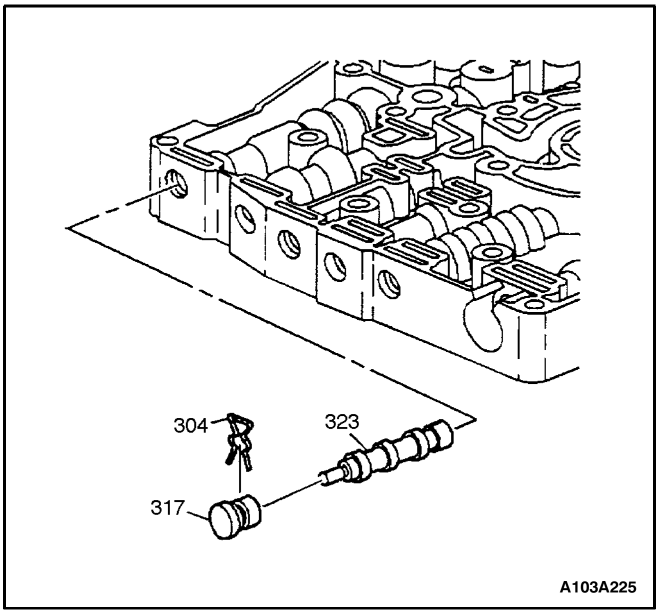
9. Remove the TCC feed limit valve retainer clip (304), the bore plug (317), the spring (331), and the TCC feed limit valve (332).



10. Remove the 2-3 accumulator valve retainer clip (304), the 2-3 accumulator valve bore plug (317), the 2-3 accumulator valve spring (329), and the 2-3 accumulator valve (330).

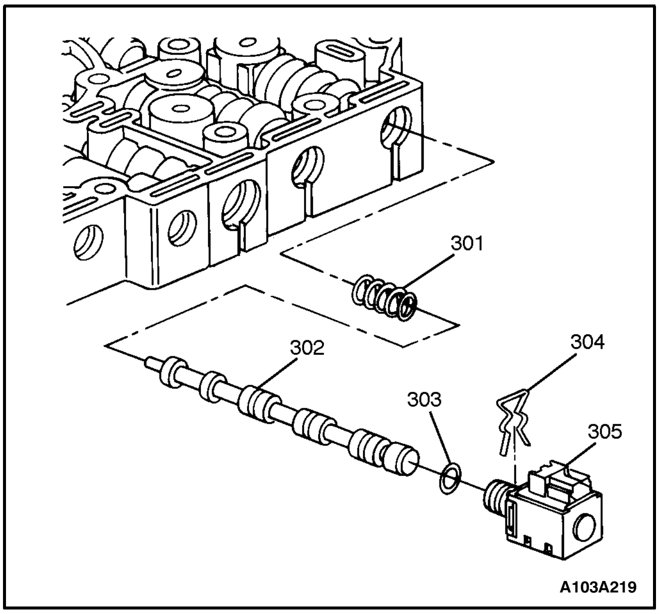


11. Remove the pressure regulator valve retainer clip (304), the bushing (324), the pressure regulator boost valve (325), the isolator spring (326), the pressure regulator valve spring (327), and the pressure regulator valve (328).

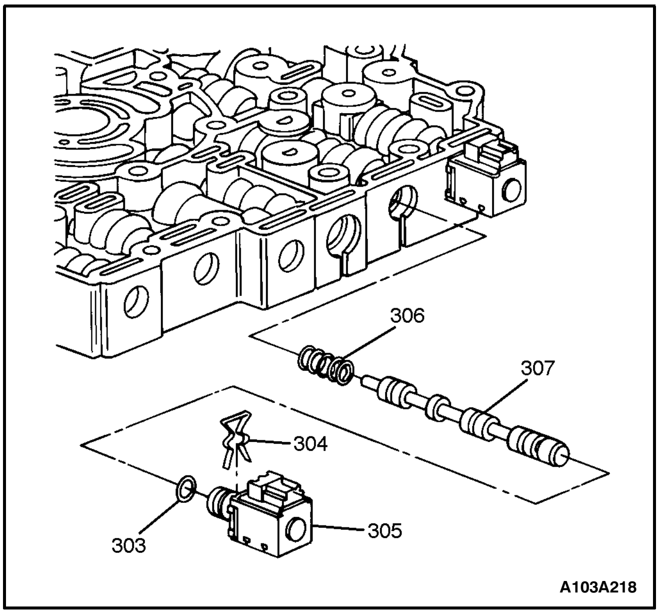


12. Remove the 1-2/3-4 accumulator valve retainer clip (304), the plug (317), and the accumulator valve (323).
13. Inspect the valve body passages for debris.
14. Inspect the machined surfaces for nicks or scratches. Some polish is normal for the machined surfaces.
15. Inspect the valves for nicks or scratches that could cause sticking valves or fluid leaks.
16. Inspect the springs, bushings, O-rings, screens and solenoids for damage.
17. Clean and dry the valve body and valve body components.

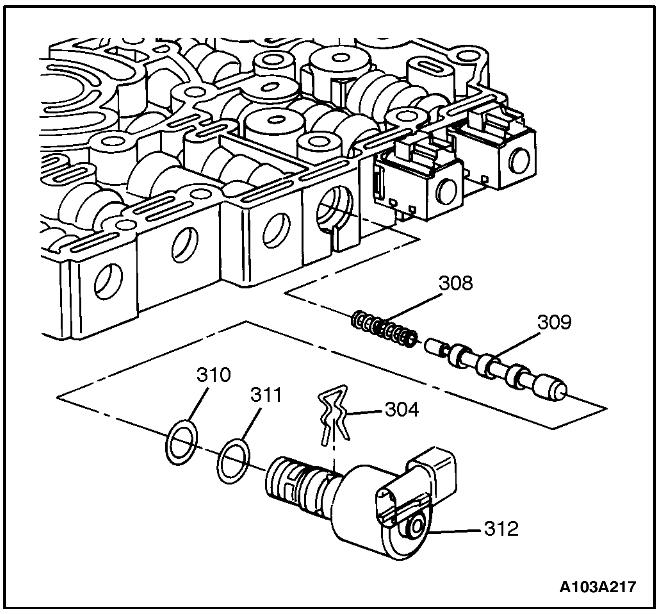
CONTROL VALVE BODY ASSEMBLE



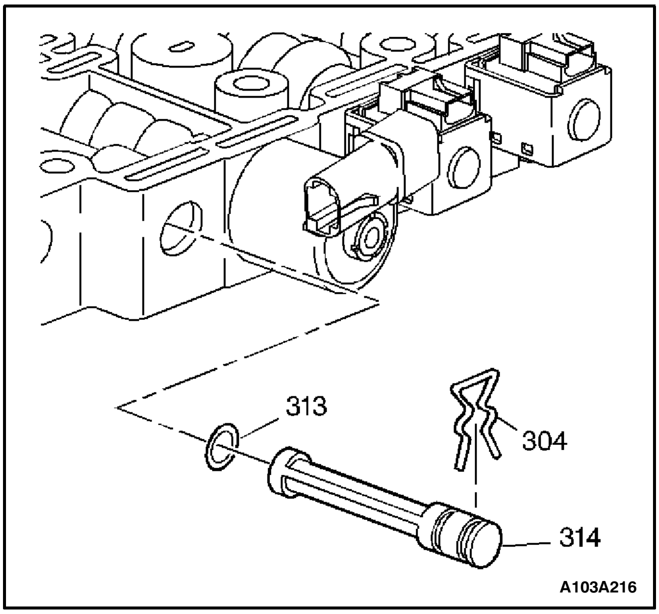
1. Install the 1-2 shift valve spring (301), the 1-2 shift valve (302), the 1-2 shift solenoid (305) with O-ring (303), and the 1-2 shift solenoid retainer clip (304).



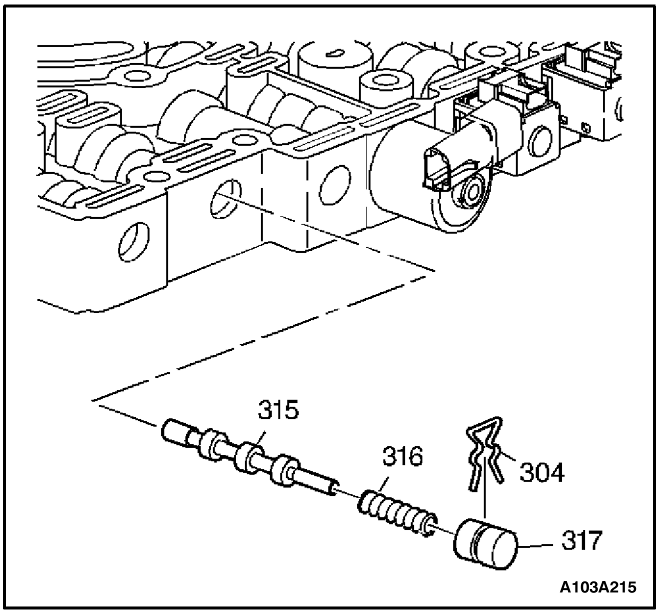
2. Install the 2-3 shift valve spring (306), the 2-3 shift valve (307), the 2-3 shift solenoid (305) with O-ring (303), and the 2-3 shift solenoid retainer clip (304).



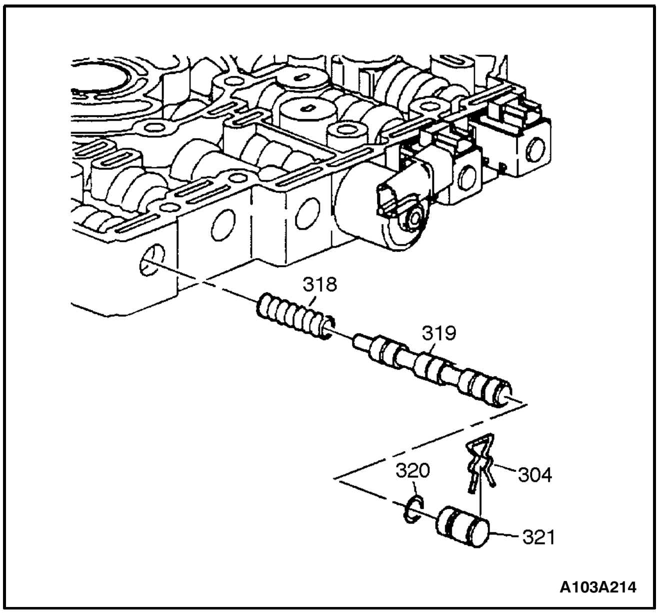
3. Install the torque signal regulator spring (308), the torque signal regulator valve (309), the Pressure Control Solenoid (PCS) with two O-rings and screen (312, 309 and 310), and the PCS retainer clip (304).



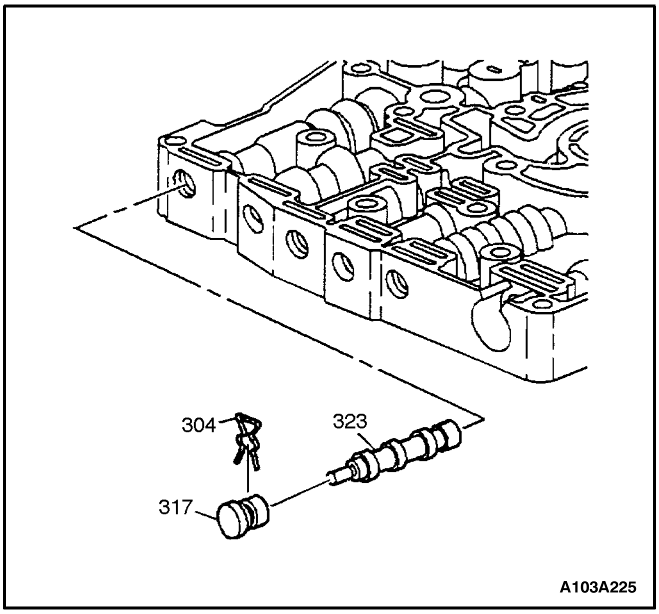
4. Install the actuator oil filter (324) with the O-ring (313) and the actuator oil filter retainer clip (304).



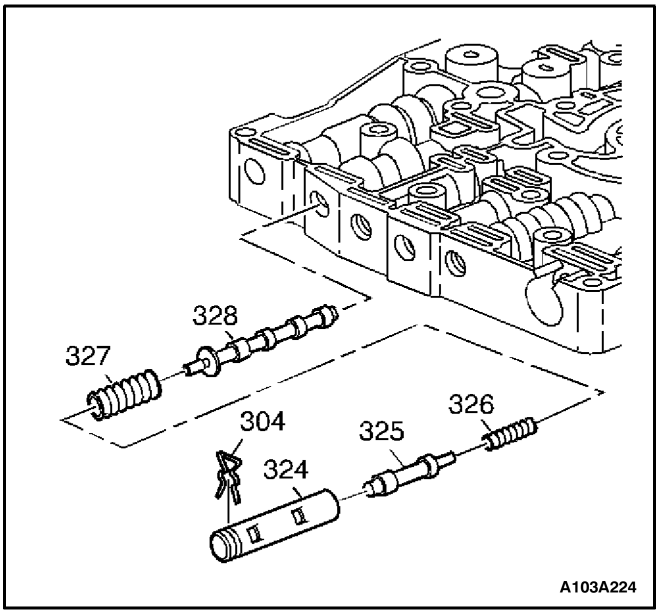
5. Install the actuator feed limit valve (315), the actuator feed limit spring (316), the bore plug (317), and the actuator feed limit valve retainer clip (304).



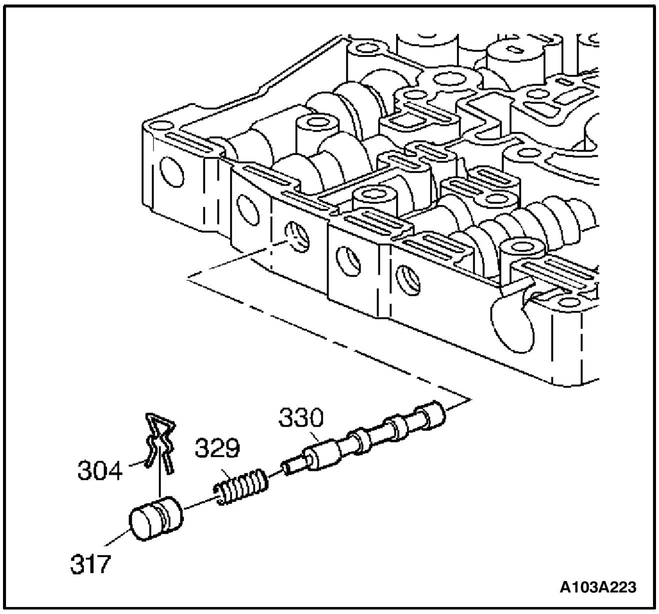
6. Install the 3-4 shift valve spring (318), the 3-4 shift valve (319), the bore plug (321), with O-ring (320), and the 3-4 shift valve retainer clip (304).



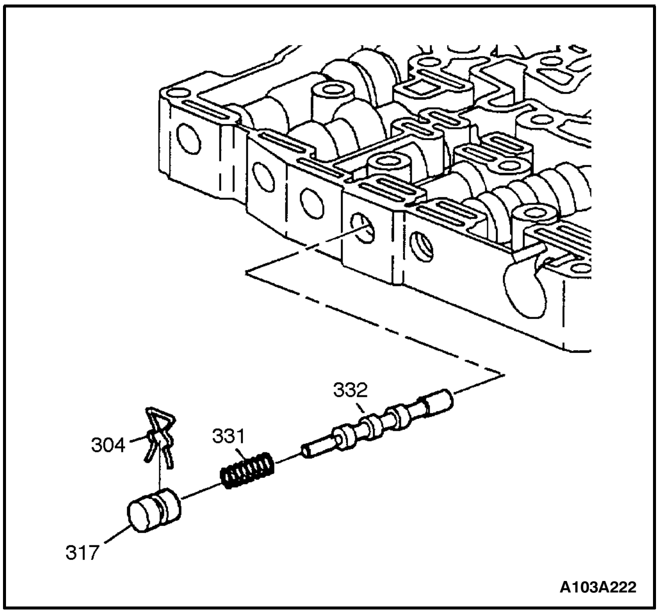
7. Install the accumulator valve (323), the plug (317), and the 1-2/3-4 accumulator valve retainer clip (304).



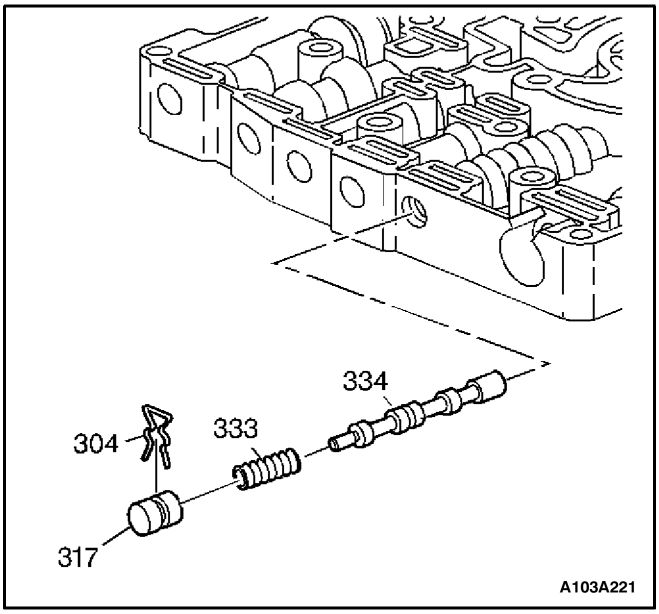
8. Install the pressure regulator valve (328), the pressure regulator valve spring (327), the isolator spring (326), the pressure regulator boost valve (325), the bushing (324), and the pressure regulator valve retainer clip (304).



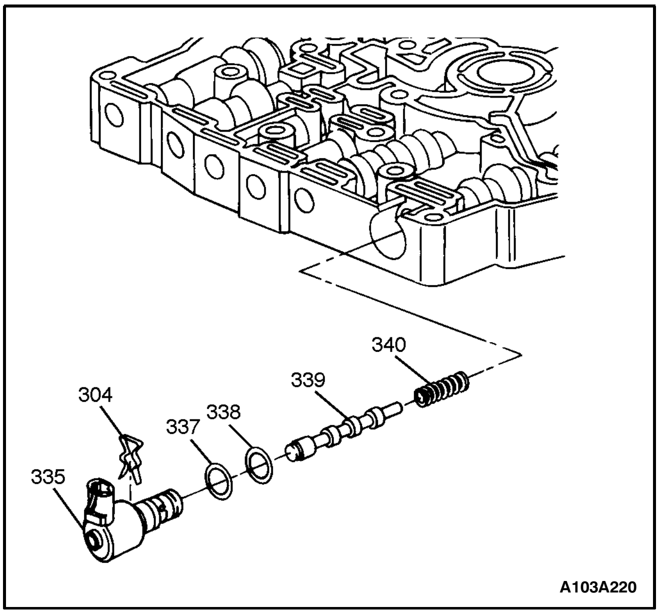
9. Install the 2-3 accumulator valve (330), the 2-3 accumulator valve spring (329), the 2-3 accumulator valve bore plug (317), and the 2-3 accumulator valve retainer clip (304).



10. **Install the TCC feed limit valve (332), the spring (331), the bore plug (317), and the TCC feed limit valve retainer clip (304).**

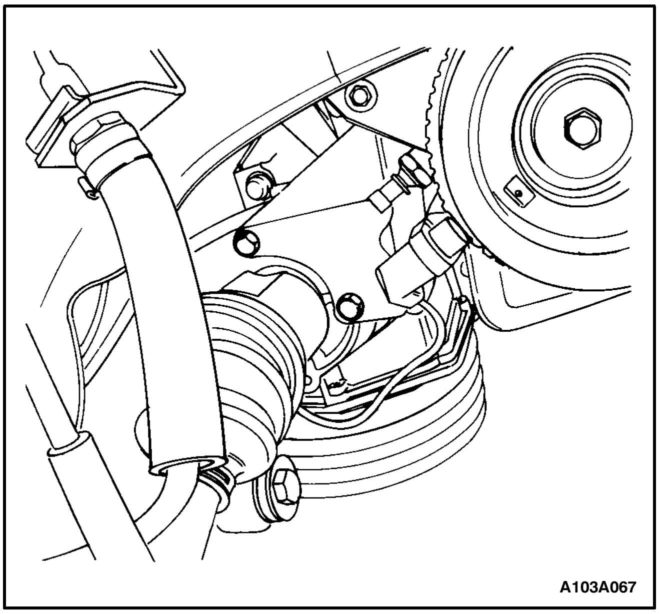


11. **Install the TCC control valve (334), the spring (333), the bore plug (317), and the TCC control valve retainer clip (304).**

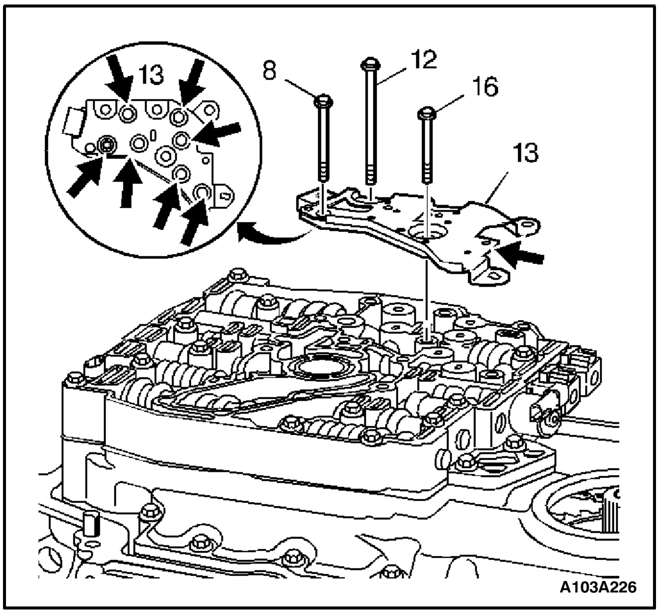


12. **Install the spring (340), the TCC regulated apply valve (339), the TCC solenoid (335) with two O-rings (337 and 338) and screen, and the TCC solenoid retainer clip (304).**

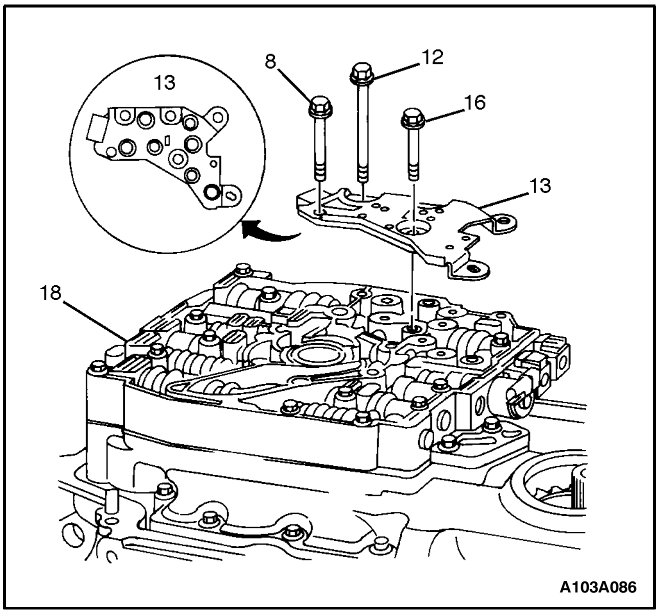
CONTROL VALVE ASSEMBLY AND TFP SWITCH INSTALL



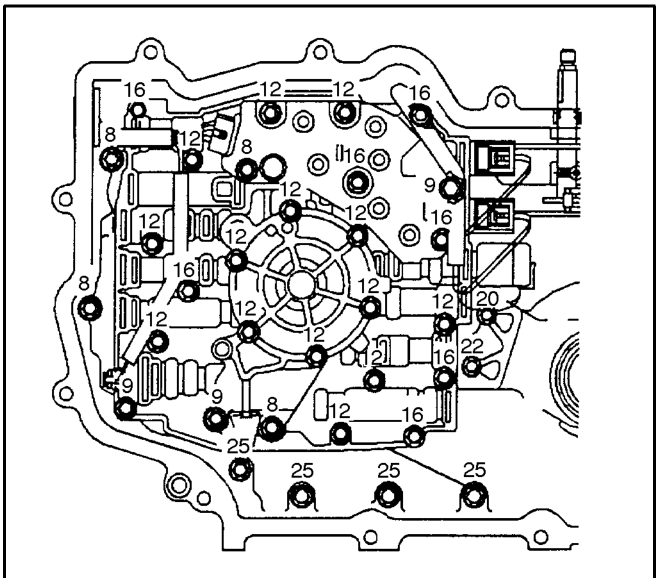
1. Install the control valve body assembly to spacer plate gasket (22) onto the spacer plate (23).
2. Install the control valve body assembly (18) onto the transmission.



3. Inspect the TFP switch (13) in order to verify the condition and correct location of the seven pressure switch O-rings.
4. If necessary, replace the pressure switch O-rings.



5. Install the TFP switch (13) onto the control valve assembly.



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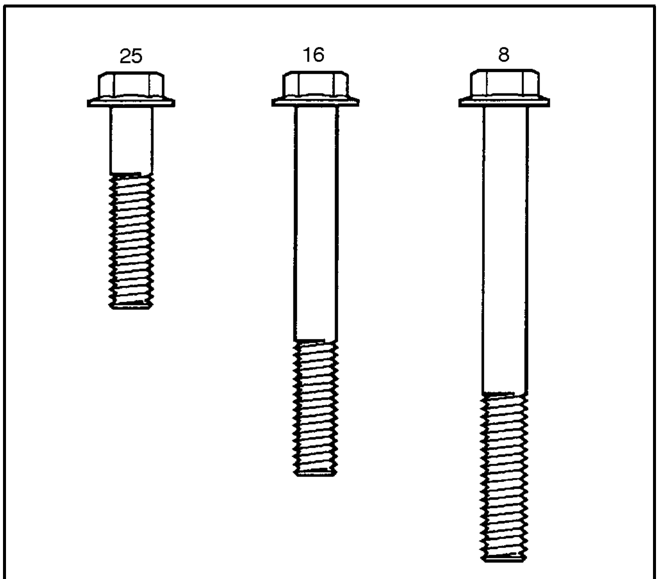
6. Install the eighteen control valve assembly bolts.



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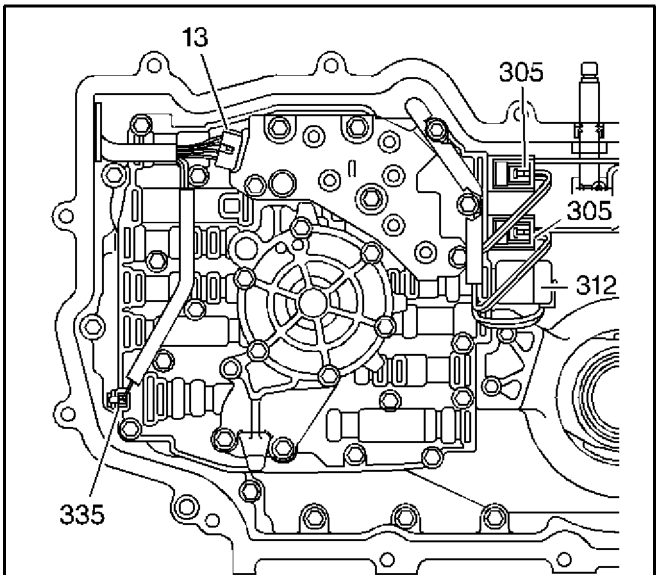
7. Hand start the bolts, then tighten the bolts to 12 N•m (9 lb-ft).



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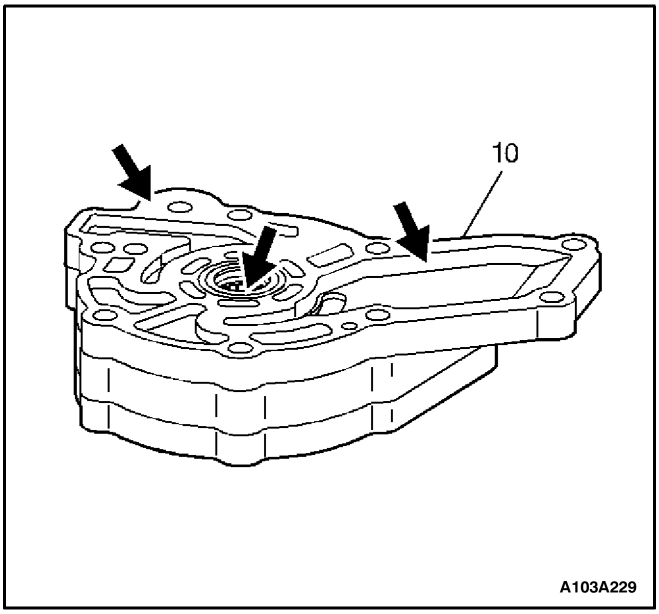
WIRING HARNESS ASSEMBLY CONNECT

Connect the wiring harness assembly to the following components:

- **The TFP switch (13)**
- **The pressure control solenoid (312) (red connector)**

Important: The 1-2 shift solenoid wires are red and light green. The 2-3 shift solenoid wires are red and yellow.

- **The 1-2 shift solenoid (305) (white connector)**
- **The 2-3 shift solenoids (305) (white connectors)**
- **The TCC solenoid (335)**

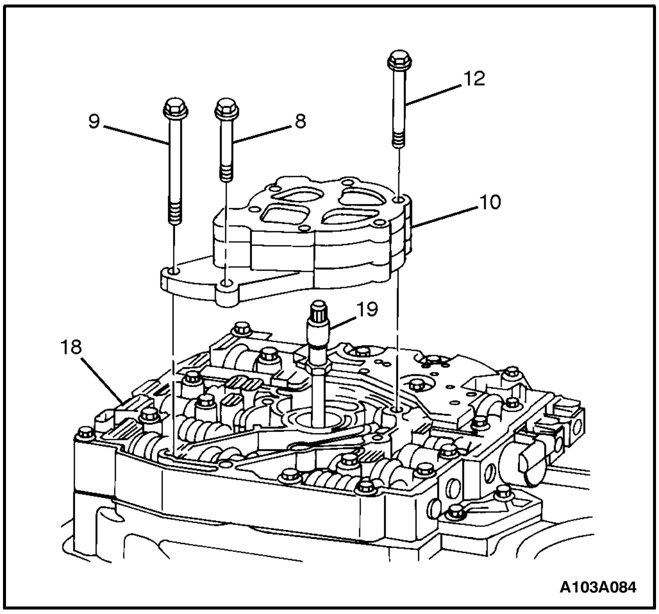


OIL PUMP CLEAN AND INSPECT

1. Inspect the bearing on the flange for excessive wear or damage.
2. Inspect the machined surfaces for scratches or nicks that may cause a fluid leak.

Important: While flushing, rotate the oil pump rotor with the oil pump drive shaft. Rotating the oil pump rotor flushes clean fluid through the oil pump.

3. Thoroughly flush the oil pump with clean transmission fluid through the pump inlet and outlet passages.
4. Drain excess fluid from the oil pump assembly.

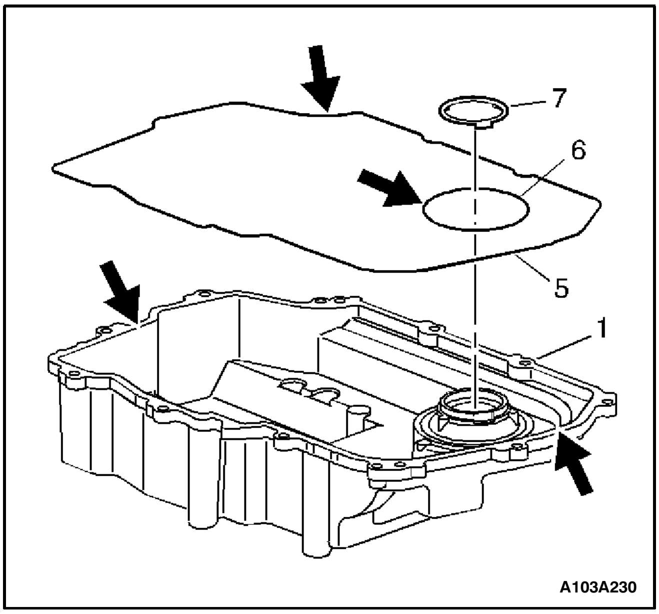


OIL PUMP ASSEMBLY INSTALLATION

1. Install the oil pump shaft (19) into the control valve body assembly (18).

Important: If necessary, rotate the oil pump shaft while installing the oil pump assembly in order to engage the shaft splines to the splines on the pump rotor.

2. Install oil pump assembly (10) onto the oil pump shaft (19) and control valve body (20).
3. Install the eight oil pump bolts (8, 9 and 12). Hand start the bolts, then tighten the bolts to 12 N•m (9 lb-ft.)

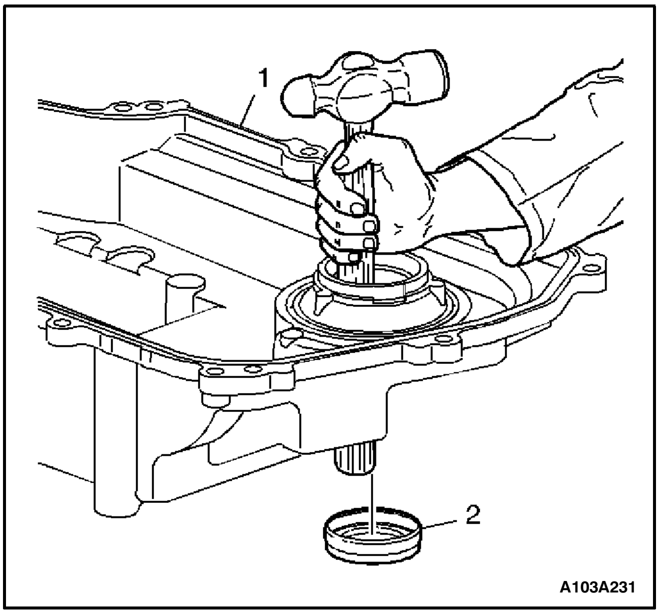


SIDE COVER/GASKETS, DISASSEMBLE, ASSEMBLE, INSTALL

Tools Required

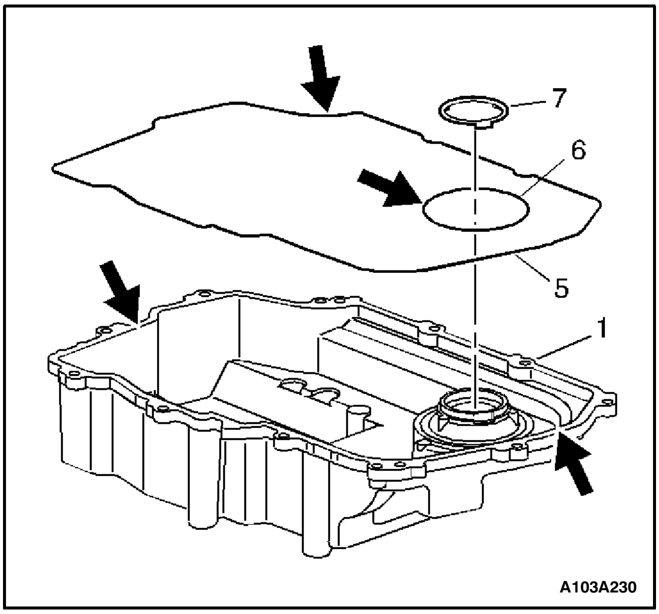
J 36850 Transjel™

1. Remove the side cover gaskets (5 and 6) and the thrust washer (17) from the side cover (1).

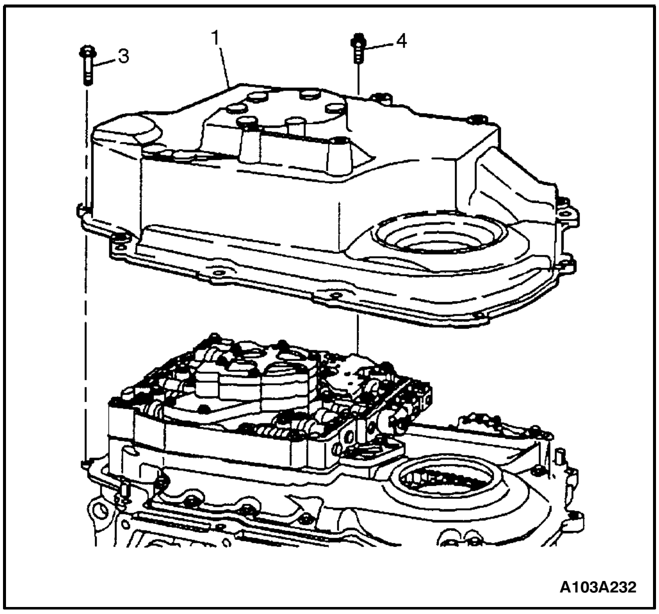


Important: Do not score or damage the side cover bore.

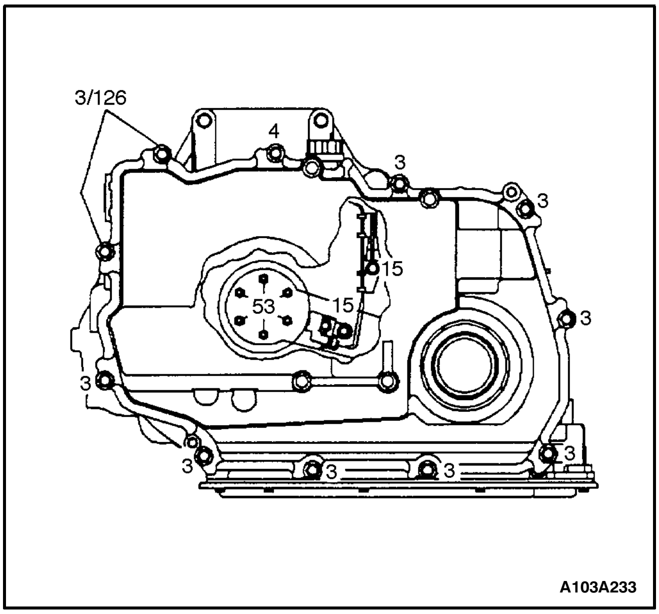
2. Remove the side cover axle seal. Use the handle end of a hammer.



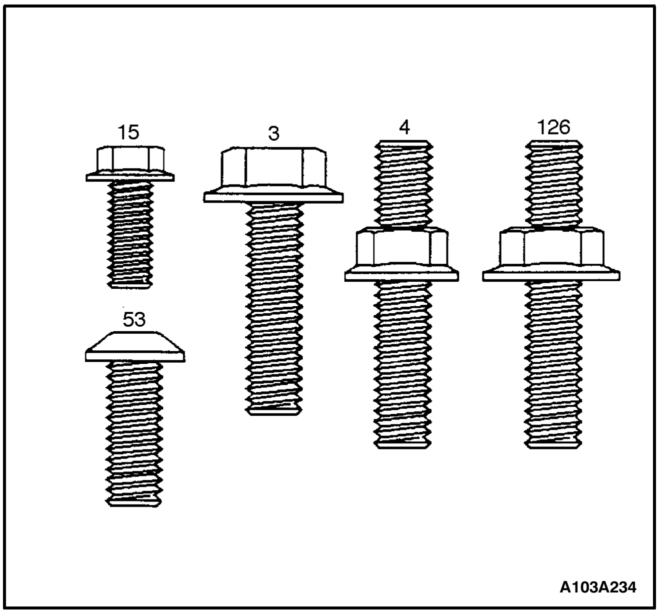
3. Inspect the side cover for cracks or damage to the seal grooves and mounting bosses.
4. Inspect the side cover seals for damage. The side cover seals are reusable if not damaged.
5. Thoroughly clean the side cover and the side cover seals.
6. Clean and dry the seal grooves and the axle seal bore.
7. Install the side cover gaskets (5 and 6) into the grooves on the side cover (1).
8. Retain the seals with J 36850 or equivalent.
9. Install the side cover to drive sprocket thrust washer (7) onto the side cover.
10. Retain the thrust washer with J 36850 or equivalent.



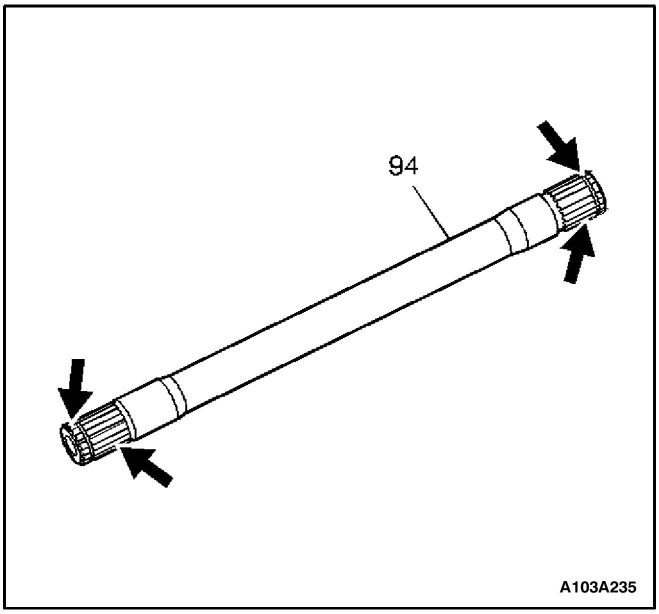
11. Install the side cover assembly onto the transmission case (51).
12. Install the 11 side cover bolts (3) and one stud (4).



13. Refer to the graphic in order to find the correct installation points of the bolts and the stud.



14. Hand start and then tighten the side cover bolts and stud to 20 N•m (15 lb-ft).

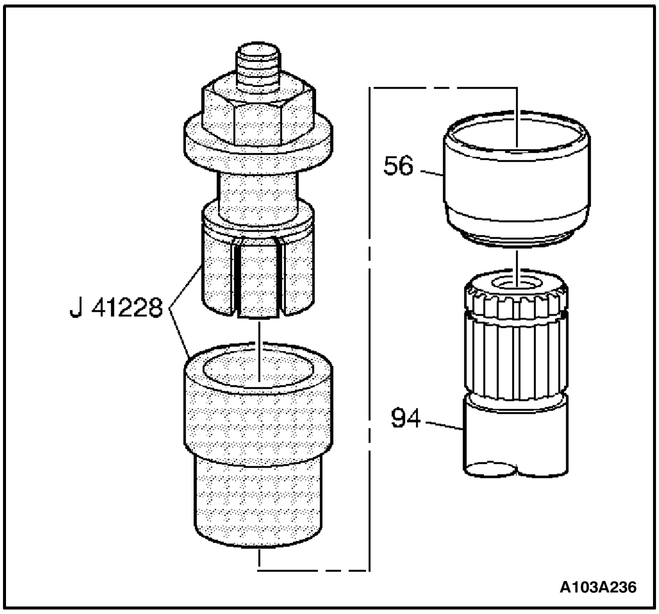


OUTPUT SHAFT SLEEVE ASSEMBLE

Tools Required

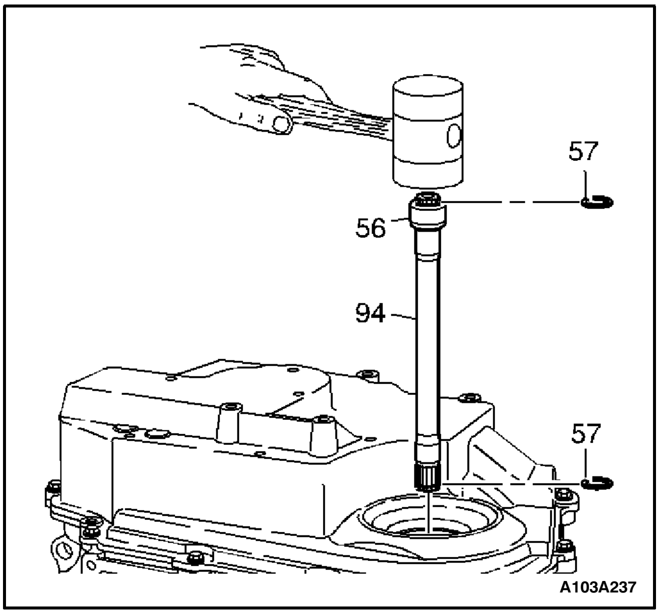
J 41228 Output Shaft Sleeve Installer

1. Inspect the output shaft (94) for damage to the splines, snap ring grooves and the journals.
2. Clean and dry the output shaft.



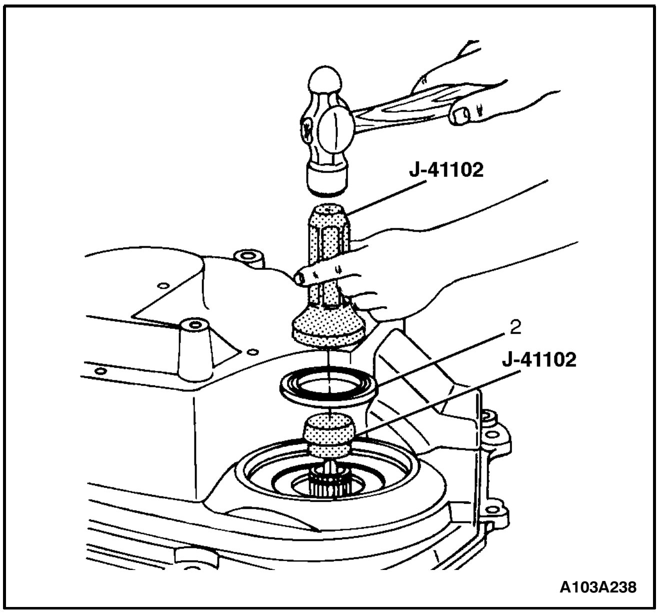
Important: You must use the J 41228 in order to install the sleeve onto the output and stub shafts. If you do not use the J 41228, you will cause a fluid leak.

3. Place a sleeve (56) over the end of the output shaft (94).
4. Install the collet into the output shaft snap ring groove with the collet attached to the threaded collet shaft.
5. Place the sleeve installing tube over the collet. Be sure the small outside diameter of the tube fits securely into the sleeve.
6. Install the bearing and nut onto the threaded collet shaft.
7. In order to move the installing tube and press the sleeve onto the output shaft, hold the end of the threaded collet shaft while tightening the nut down.
8. Remove the J 41228.



OUTPUT SHAFT AND SLEEVE ASSEMBLY INSTALL

1. Install the two new snap rings (57) into the output shaft (94) snap ring grooves.
2. Install the output shaft and sleeve assembly (94 and 56) into the transmission case. Use a mallet in order to install the shaft (94) through the final drive differential gear.



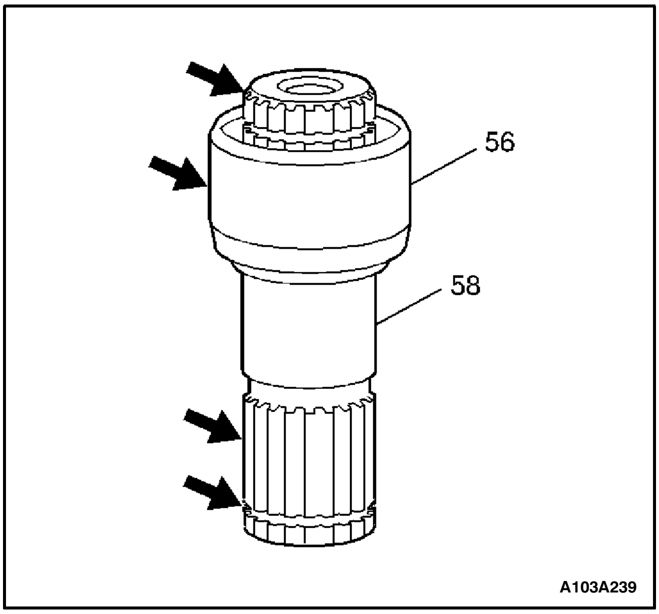
SIDE COVER AXLE SEAL INSTALL

Tools Required

J 41102 Axle Seal Installer

Important: You must use the J 41102 in order to install the seal correctly. The J 41102 installs the axle seal to a given depth.

1. Install a new side cover axle seal (2) into the side cover. Use the J 41102.
2. In order to prevent damage to the shaft splines during vehicle operation, add Polyurea grease (part number 7843867) to the splines on the output shaft.

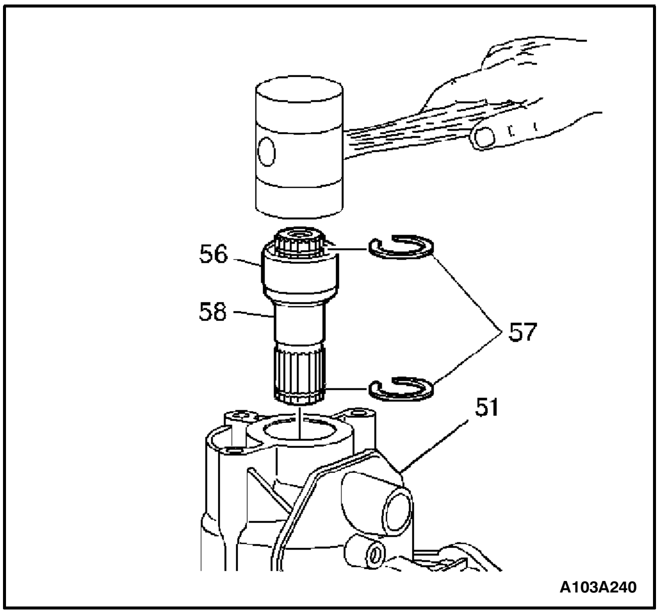


STUB SHAFT SLEEVE ASSEMBLE AND INSTALL

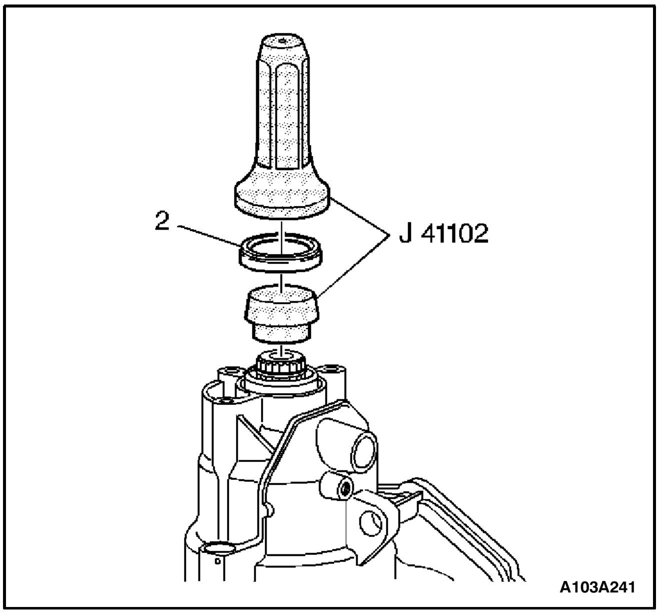
1. Inspect the stub shaft (58) for damage to the splines, the snap ring grooves, and the journals.

Important: If the sleeve (56 appears damaged, replace the sleeve (56) using the same procedure for removal and installation as with the output shaft sleeve. Refer to Output Shaft and Sleeve Assembly Install.

2. Inspect the sleeve (56) for excessive wear, scratches or nicks that could cause a leak or damage the seal portion.
3. Clean and dry the stub shaft and sleeve assembly.



4. Install the two new snap rings (57) on the stub shaft (58). The snap rings (57) are not reusable after you remove the shaft (58).
5. Install the stub shaft into the transmission. Use a mallet in order to install the shaft through the final drive differential gear.



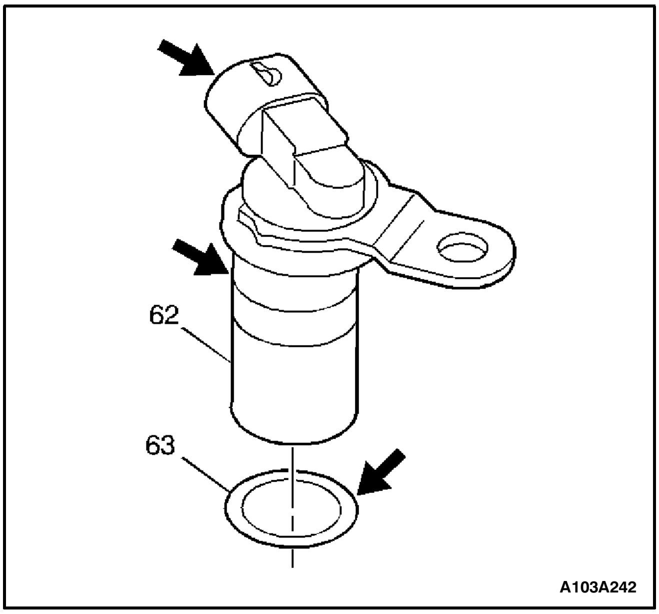
RIGHT HAND AXLE SEAL ASSEMBLE

Tools Required

J 41102 Axle Seal Installer

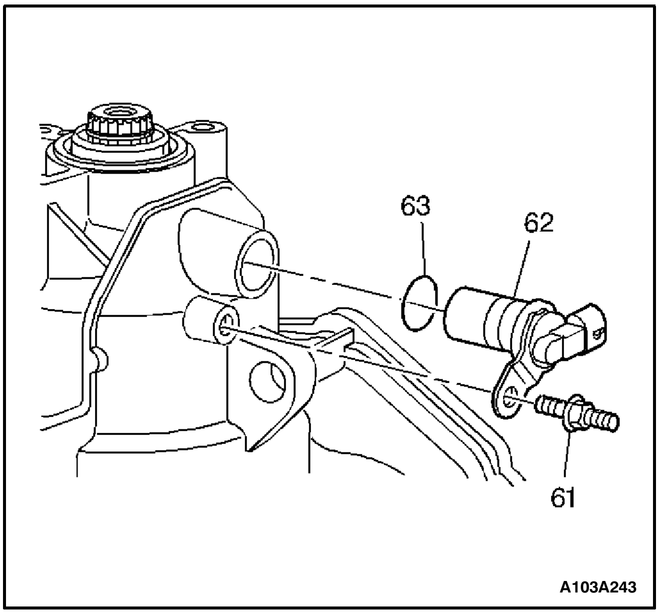
Important: You must use the J 41102 in order to install the seal correctly. The J 41102 installs the axle seal to a given depth.

1. Install a new right hand axle seal (2) into the transmission case. Use the J 41102.
2. In order to prevent damage to the shaft splines during vehicle operation, add Polyurea grease (part number (7843867) to the splines on the output shaft.

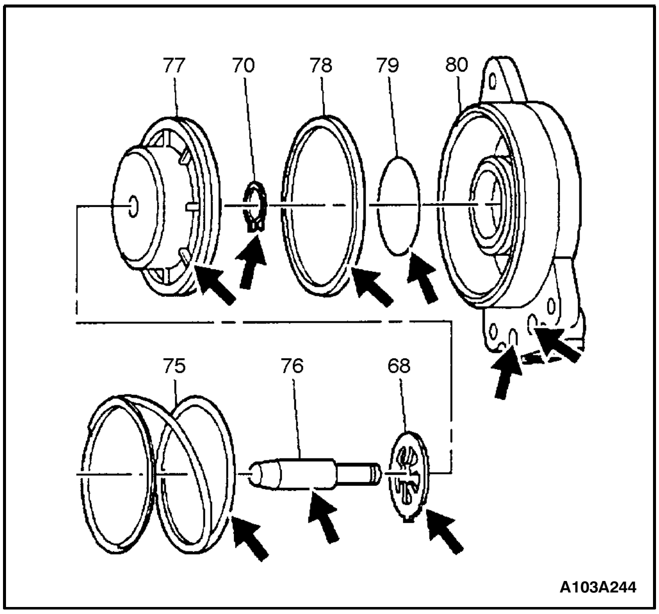


OUTPUT SPEED SENSOR INSTALLATION

1. Inspect the output speed sensor (62) for damage to the sensor, the electrical connector, or the O-ring (63).
2. Clean and dry the output speed sensor (62).

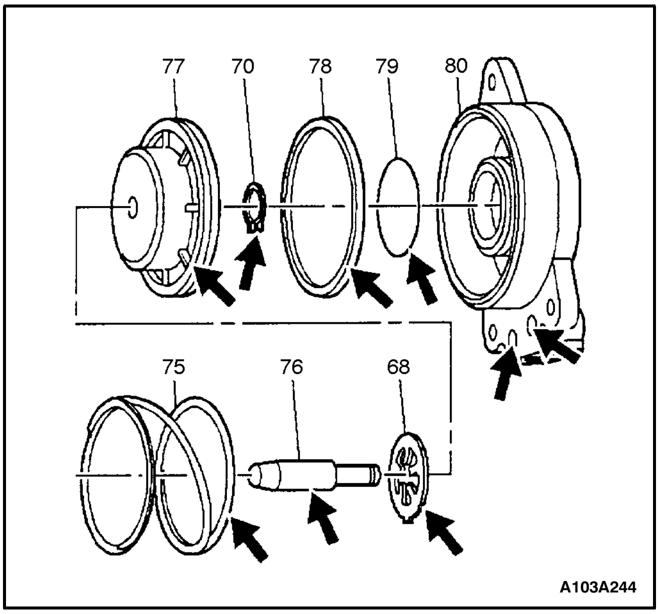


3. Install the O-ring (63) onto the output speed sensor (62).
4. Install the output speed sensor (62) into the transmission case.
5. Install the output speed sensor stud (61). Tighten the speed sensor stud to 12 N•m (9 lb-ft).

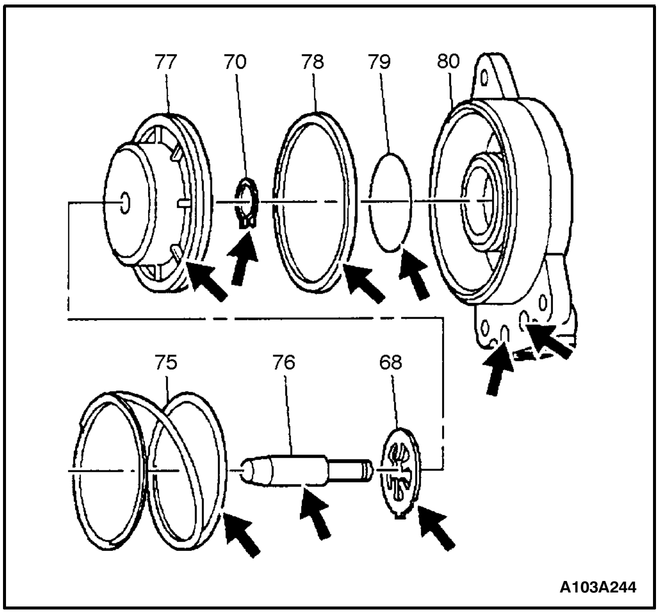


INTER 4TH SERVO DISASSEMBLE, ASSEMBLE, AND INSTALL

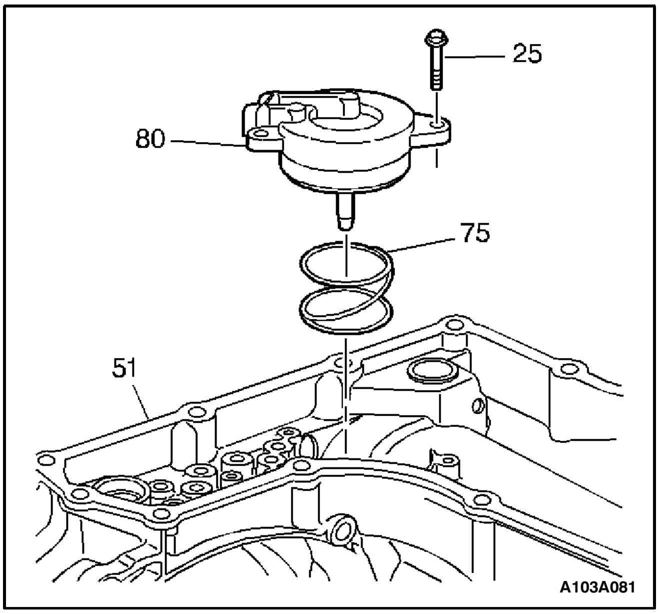
1. Remove the piston and pin assembly (76 and 77) from the servo cover (80).
2. Remove the snap ring (70) from the servo pin (76).
3. Remove the piston (77) and servo cushion springs (68) from the servo pin (76).
4. Remove the outer (78) and inner (79) servo piston seal from the cover (80).
5. Discard the outer and inner servo piston seals. Do not reuse the servo piston seals.



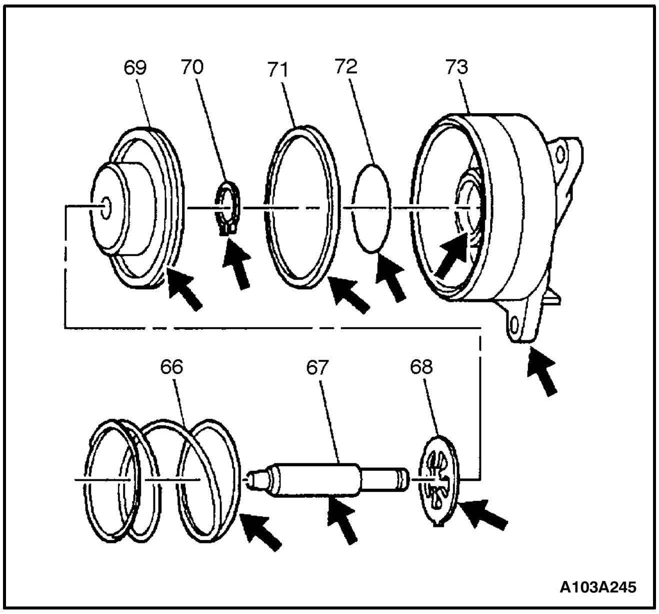
6. Inspect all components for damage.
7. Inspect the fluid feed holes for proper opening.
8. Inspect the bolt hole threads for debris and stripping.
9. Inspect the seal grooves for damage.
10. Clean and dry each component.



11. Install the servo cushion springs (68) and the servo piston (77) onto the servo pin (76).
12. Install the snap ring (70) onto the servo pin (76) in order to retain the springs (68) and piston (77).
13. Install the new seals (78 and 79) onto the servo piston (77) and servo cover (80).
14. Install the servo piston assembly into the servo cover (80). Lubricate the piston seals with transmission fluid in order to aid in assembly.

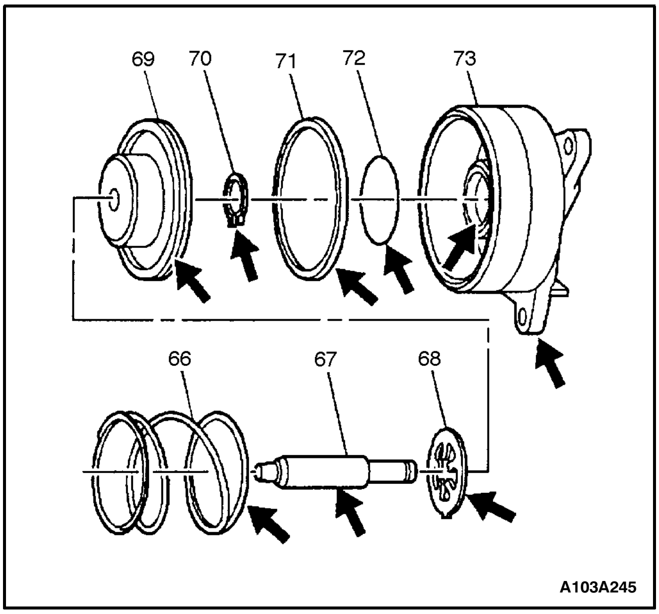


15. Install the servo return spring (75) onto the transmission case (51).
16. Install the servo cover (80) and the piston assembly over the servo return spring (75).
17. Install the three servo cover bolts (25). Hand start the bolts and then tighten the bolts to 12 N•m (9 lb-ft).



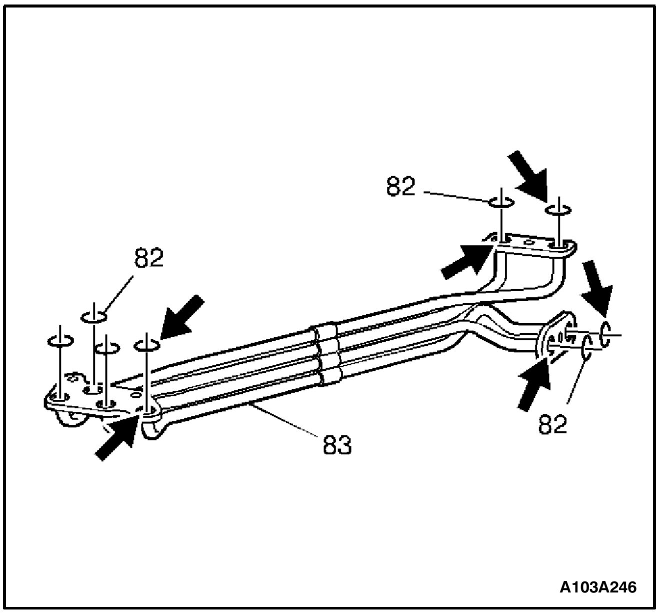
LOW/REVERSE SERVO DISASSEMBLE

1. Remove the piston pin assembly (67-70) from the servo cover (73).
2. Remove the snap ring (70) from the servo pin (67).
3. Remove the piston (69) and the servo cushion springs (68) from the servo pin (67).
4. Remove the servo piston seals (71 and 72) from the cover (73).
5. Discard the servo piston seals (71 and 72).
6. Inspect all the components for damage.
7. Inspect the fluid feed holes for the proper opening.
8. Inspect the bolt hole threads for debris or stripping.
9. Inspect the seal grooves for damage.
10. Clean and dry each component.



LOW/REVERSE SERVO ASSEMBLE, INSTALL

1. Assemble the servo cushion springs (68) and servo piston (69) onto the servo pin (67).
2. Install the snap ring onto the servo pin (67) in order to retain the servo cushion springs (68) and the servo piston (69).
3. Assemble the new seals (71, 72) onto the servo piston (69) and the servo cover (73).
4. Assemble the servo piston assembly (67-70) into the servo cover (73). Lubricate the piston seals with transmission fluid in order to aid in assembly.



OIL FEED PIPES ASSEMBLE

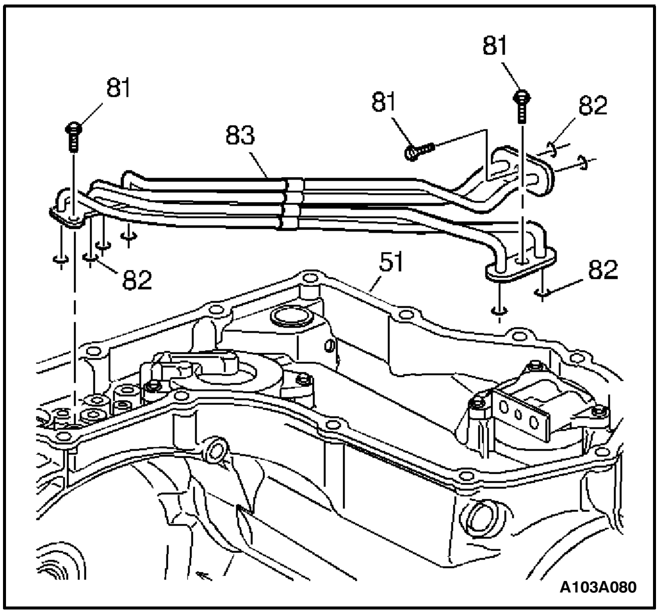
Tools Required

J 36850 Transjel™

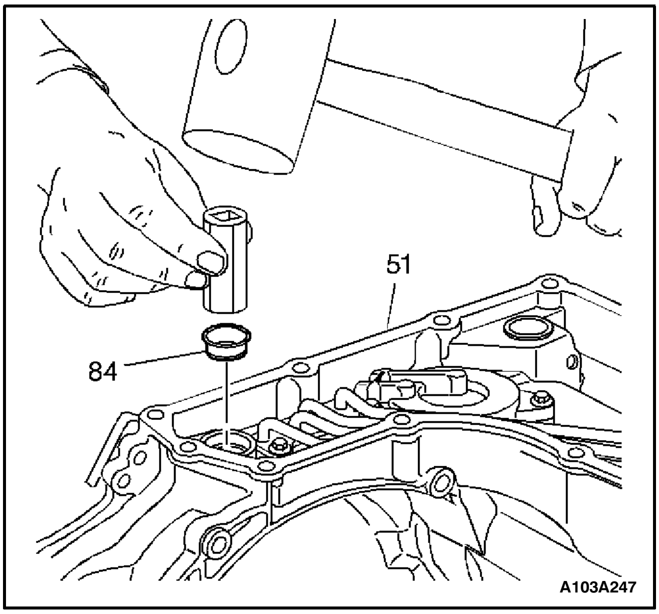
1. Inspect the oil feed pipes (83) for plugged passages, bent pipes, or cracks.
2. Inspect the oil feed pipe seal rings (82) in order to verify the proper location of the seal rings (82).

Important: The oil feed pipe seals are glued into place during initial assembly. If you must replace a seal ring, be sure to thoroughly clean any residual glue from the oil feed pipes.

3. Replace the seal rings (82) only if they are cut, swelled or damaged.
4. Clean and dry the oil feed pipes.



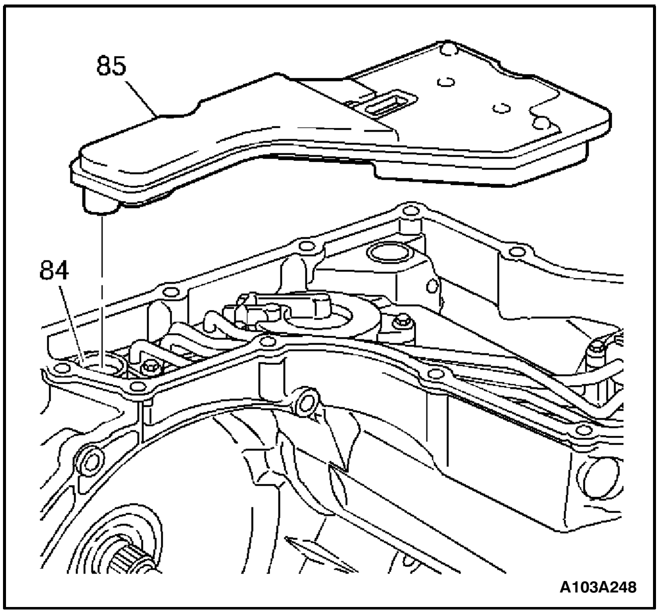
5. Install new oil feed pipe seal rings (82) if necessary.
6. Retain any newly installed oil feed pipe seal rings (82) with J 36850 or equivalent.
7. Install the oil feed pipe assembly (83) onto the transmission case (51).
8. Install the four oil feed pipe bolts (81). Hand start and then tighten the bolts to 12 N•m (9 lb-ft).



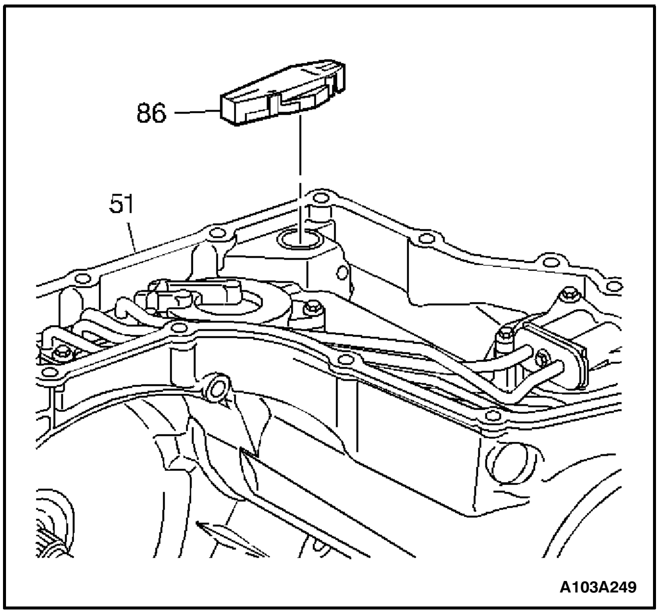
FILTER ASSEMBLY AND SEAL INSTALL

Important: In order to prevent damage to the case bore and seal, tap gently and evenly of the seal (84).

1. Install a new oil filter seal (84) into the transmission case (51). Use a large socket in order to tap on the seal.

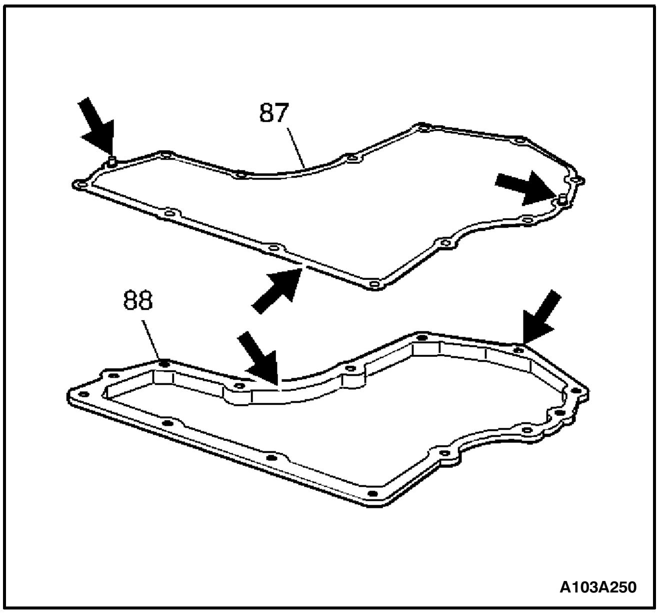


2. Install a new filter assembly (85) into the filter seal (81). If necessary, twist the filter slightly during installation.



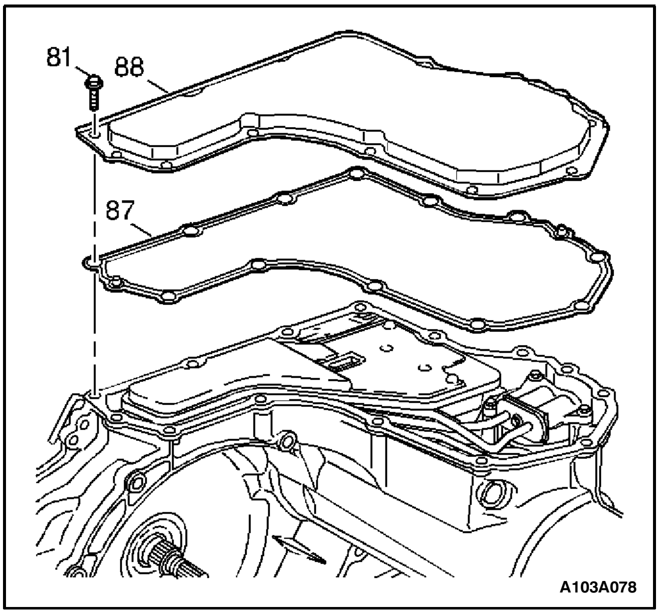
OIL LEVEL CONTROL VALVE INSTALL

Install the oil level control valve into the transmission case (51). Push straight down on the center of the oil level control valve in order to prevent damage to the case bore.

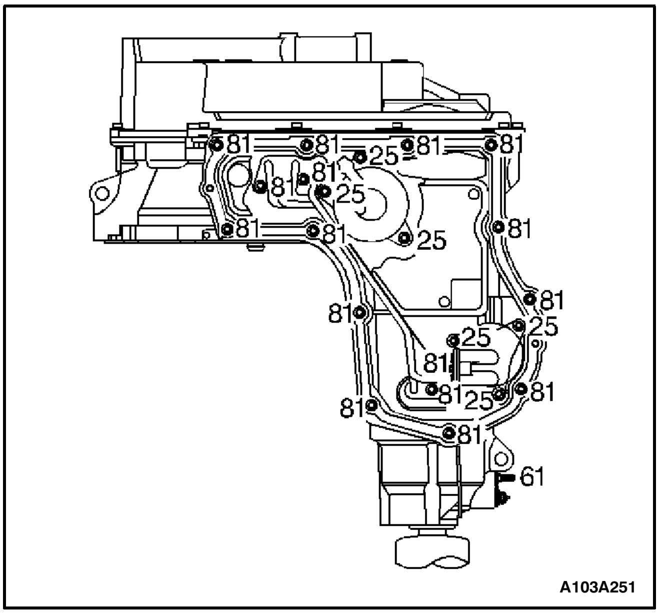


OIL PAN AND GASKET INSTALL

1. Inspect the oil pan (88) for cracks, dents or damage to the gasket sealing surface.
2. Inspect the gasket (87) for cuts or other damage. The bottom pan gasket is reusable if not damaged.
3. Clean and dry the bottom pan and gasket.



4. Install the gasket and bottom pan onto the transmission case.



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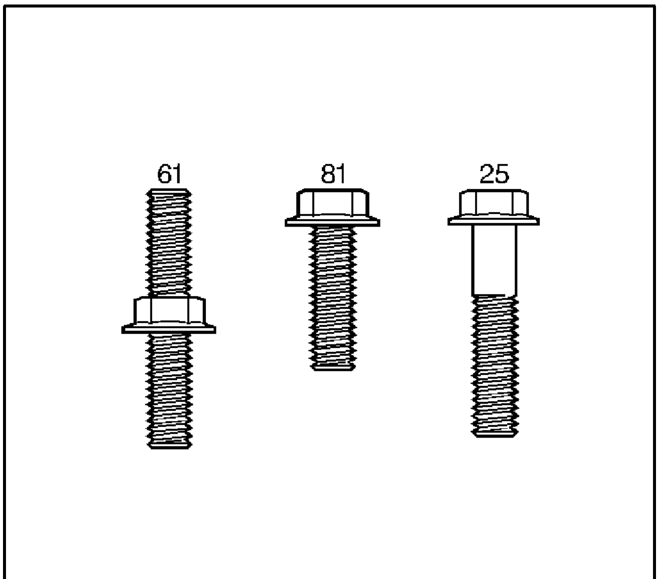
5. Install the twelve bottom pan bolts (81).



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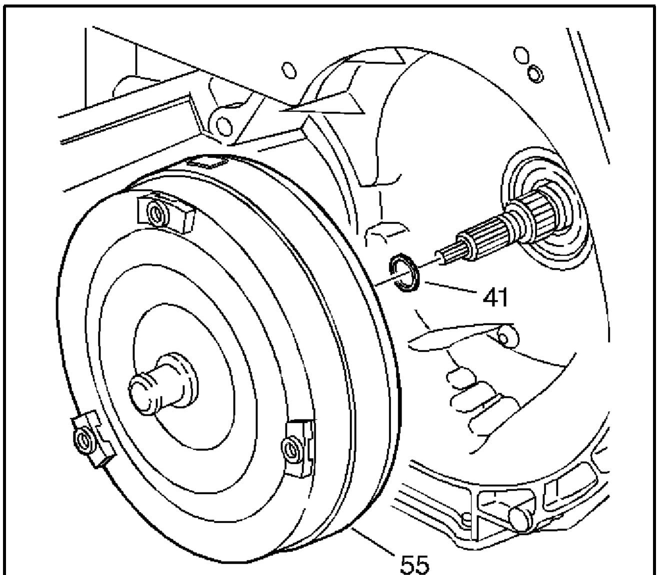
6. Hand start and then tighten the bottom pan bolts to 12 N•m (9 lb-ft).



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TORQUE CONVERTER INSTALLATION

Tools Required

J 21366 Torque Converter Holding Strap

1. Install a new turbine shaft O-ring (41) on the end of the turbine shaft.
2. Install the torque converter onto the transmission.
3. Install the J 21366.
4. Remove the transmission from the holding fixture.

GENERAL DESCRIPTION AND SYSTEM OPERATION

TRANSAXLE DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations are provided to establish a common language for describing transaxle-related conditions. These terms are used in the transaxle section of this manual.

Throttle Positions

- Minimum Throttle - the least amount of throttle opening required for an upshift.
- Light Throttle - approximately 1/4 of accelerator pedal travel (25% throttle position).
- Medium Throttle - approximately 1/2 of accelerator pedal travel (50% throttle position).
- Heavy Throttle - approximately 3/4 of accelerator pedal travel (75) throttle position).
- Wide Open Throttle (WOT) - full travel of the accelerator pedal (100% throttle position).
- Full Throttle Detent Downshift - a quick apply of the accelerator pedal to its full travel, forcing a downshift.
- Zero Throttle Coastdown - a full release of the accelerator pedal while the car is in motion and in drive range.
- Engine Braking - a condition where the engine is used to slow the car by manually downshifting during a zero throttle coastdown.

Shift Conditions

- Bump - a sudden and forceful apply of a clutch or band.
- Chuggle - a bucking or jerking that may be most noticeable when the converter clutch is engaged; similar to the feel of towing a trailer.
- Delayed - a condition where a shift is expected but does not occur for a period of time. Samples of this could be described as clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator or, when manually downshifting to a lower range. Also defined as "LATE" or "EXTENDED."
- Double Bump (Double Feel) - two sudden and forceful applies of a clutch or band.
- Early - a condition where the shift occurs before the car has reached proper speed. Tends to labor the engine after the upshift.
- End Bump - a firmer feel at the end of a shift as compared to the feel at the start of the shift. Also defined as "END FEEL" or "SLIP BUMP."
- Firm - a noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. Should not be confused with "HARSH" or "ROUGH."
- Flare - a quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. Also defined as "SLIPPING."
- Harsh (Rough) - a more noticeable apply of a clutch or band as compared with "FIRM." This condition is considered undesirable at any throttle position.
- Hunting - a repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM. An example could be described as a 4-3-4 shift pattern. Also defined as "BUSYNESS."
- Initial Feel - a distinct firmer feel at the start of a shift as compared to the finish of the shift.
- Late - a shift that occurs when the engine is at a higher than normal RPM for a given amount of throttle.
- Shudder - a repeating jerking condition similar to "CHUGGLE" but more severe and rapid. This condition may be most noticeable during certain ranges of car speed.
- Slipping - a noticeable increase in engine RPM without a car speed increase. A slip usually occurs during or after initial clutch or band apply.
- Soft - a slow, almost unnoticeable clutch or band apply with very little shift feel.
- Surge - a repeating engine related condition of acceleration and deceleration that is less intense than "CHUGGLE."
- Tie-Up - a condition where two opposing clutches and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

- Drive Link Noise - a whine or growl that increases or fades with engine RPM. Noise is not noticeable under light throttle acceleration or in "DRIVE" or "REVERSE" with the car stationary.
- Final Drive Noise - a hum related to car speed and is most noticeable under light throttle acceleration or zero throttle coast down.
- Planetary Gear Noise - a whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.
- Pump Noise - a high pitch whine that increases intensity with engine RPM. This condition may also be noticeable in ALL operating ranges.
- Torque Converter - a whine usually noticed when a vehicle is stopped and transaxle is in "DRIVE" or "REVERSE." The noise will increase with engine RPM. See Torque Converter Evaluation for further information.

Abbreviations

- TCM - Transmission Control Module
- TCC Sol. Valve - Torque Converter Clutch Solenoid Valve
- TP Sensor - Throttle Position Sensor
- ECT Sensor - Engine Coolant Temperature Sensor
- A/T OSS Sensor - Automatic Transmission Output Shaft Speed Sensor
- A/T ISS Sensor - Automatic Transmission Input Shaft Speed Sensor
- NC - Normally Closed
- NO - Normally Open
- PCS - Pressure Control Solenoid
- TFP Val Position Sw. - Transmission Fluid Pressure Valve Position Switch
- PWM - Pulse Width Modulated
- WOT - Wide Open Throttle
- RPM - Revolutions Per Minute
- ECM - Electronic Control Module
- PM - Permanent Magnet
- A/C - Air Conditioning
- MAP - Manifold Absolute Pressure
- TFT - Transmission Fluid Temperature (Sensor)
- AC - Alternating Current
- DC - Direct Current
- CKT - Circuit
- DTC - Diagnostic Trouble Code
- DVM - Digital Volt Meter
- OBD - On Board Diagnostics
- DLC - Diagnostic Link Connector
- EGR - Exhaust Gas Recirculation

TRANSAXLE GENERAL DESCRIPTION

The 4T40-3 is a fully automatic, electronically-controlled front wheel drive transaxle. It provides four forward gear ranges including overdrive and one reverse gear range. Shift points are controlled by the TCM through two shift solenoids. Oil pressure is supplied by a vane-type pump and is regulated electronically by the TCM through the Pressure Control Solenoid (PC Sol. Valve).

The transaxle can be operated in any one of the following seven modes.

- P - Park position prevents the vehicle from rolling either forward or backward. (For safety reasons, the parking should be used in addition to the park position.)
- R - Reverse allows the vehicle to be operated in a rearward direction.
- N - Neutral allows the engine to be started and operated while driving the vehicle. If necessary, this position may be selected if the engine must be restarted with the vehicle moving.
- D - Overdrive Range is used for all normal driving conditions. It provides four gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.
- 3 - Drive Range position is used for city traffic, hilly terrain and trailer towing. It provides three gear ratios and prevents the transaxle from operating in fourth gear. Again, downshifts are available by depressing the accelerator.
- 2 - Manual Second Range only provides two gear ratios (under most operating conditions). It is used to provide acceleration and engine braking. This range may be selected at any vehicle speed, but the transaxle will not downshift into Second gear until vehicle speed drops below approximately 100 km/h (62 mph).
- 1 - Manual Lo Range is used to provide maximum engine braking. This range may also be selected at any vehicle speed, but the transaxle will not downshift into First gear until vehicle speed drops below approximately 60 km/h (37 mph).

TRANSAXLE COMPONENT AND SYSTEM DESCRIPTION

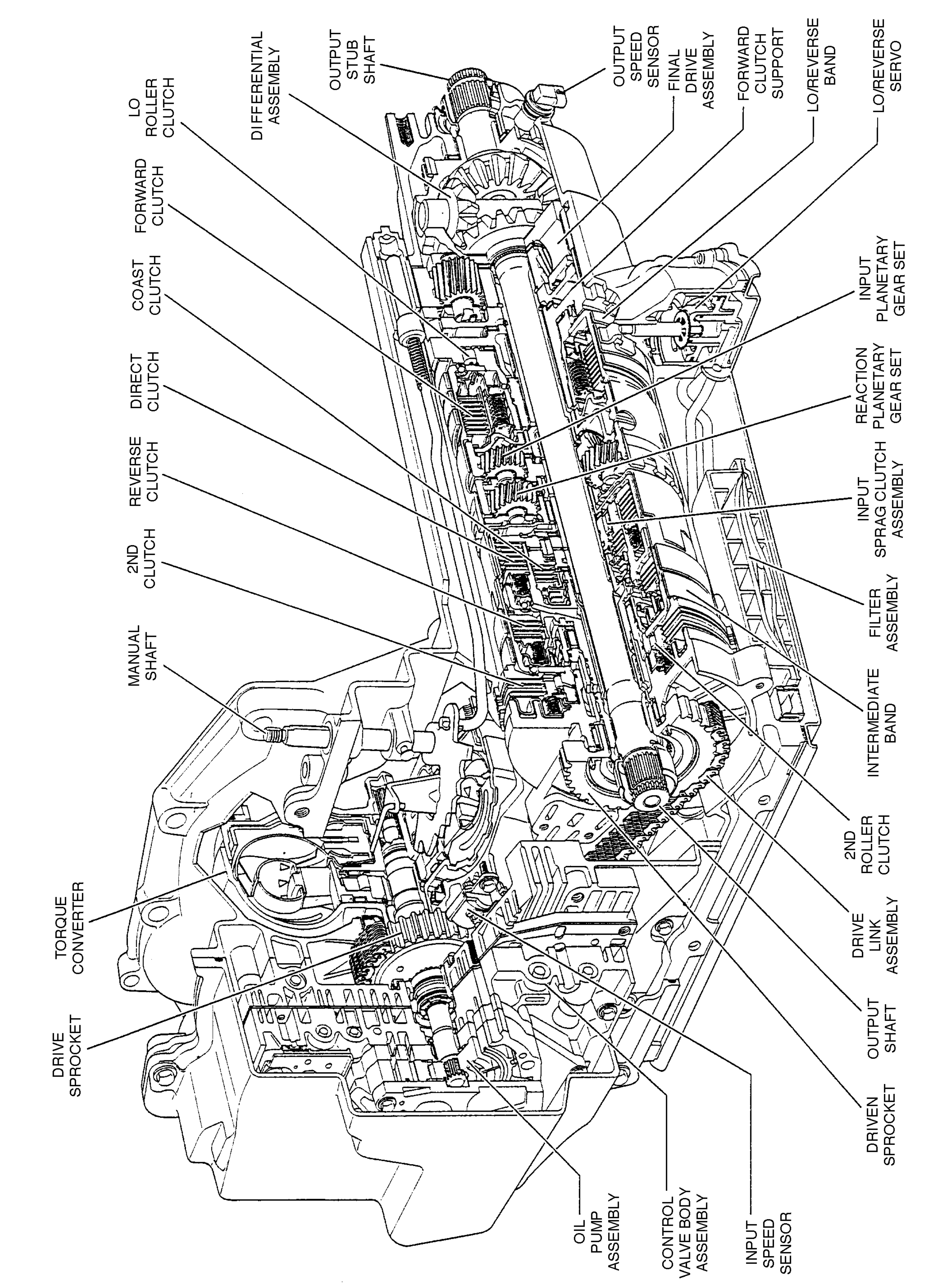
The 4T40-E transaxle consists primarily of the following components.

Mechanical

- Torque converter with TCC
- Drive link assembly
- Five multiple disk clutch assemblies: 2nd, Reverse, Direct, Coast and Forward
- Two friction bands: Intermediate/4th band and Lo/Reverse band
- Three one-way clutches: two roller clutches (2nd and Lo) and one sprag clutch
- Two planetary gear sets: Input and Reaction
- Final drive and differential assembly
- One control valve assembly
- One vane-type oil pump

Electronic

- Pressure Control Solenoid Valve (PC Sol. Valve)
- Two shift solenoids: 1-2 and 2-3
- TCC solenoid valve
- Two speed sensors: A/T ISS and A/T OSS
- Fluid temperature sensor
- Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch
- Wiring harness assembly

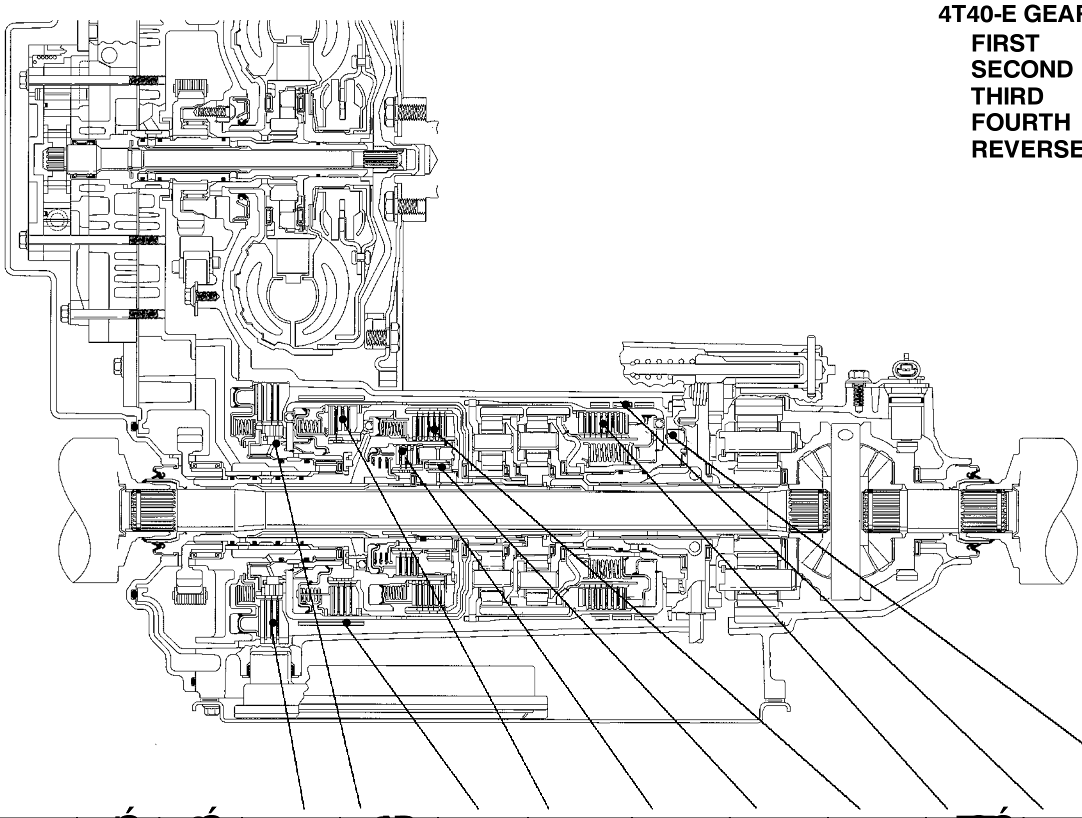

LO ROLLER CLUTCH
DIFFERENTIAL ASSEMBLY
OUTPUT STUB SHAFT
OUTPUT SPEED SENSOR
FINAL DRIVE ASSEMBLY
FORWARD CLUTCH SUPPORT
LO/REVERSE BAND
LO/REVERSE SERVO
FORWARD CLUTCH
COAST CLUTCH
DIRECT CLUTCH
REVERSE CLUTCH
2ND CLUTCH
MANUAL SHAFT
TORQUE CONVERTER
DRIVE SPROCKET
INPUT PLANETARY GEAR SET
REACTION PLANETARY GEAR SET
INPUT SPRAG CLUTCH ASSEMBLY
FILTER ASSEMBLY
INTERMEDIATE BAND
2ND ROLLER CLUTCH
DRIVE LINK ASSEMBLY
OUTPUT SHAFT
DRIVEN SPROCKET
OIL PUMP ASSEMBLY
CONTROL VALVE BODY ASSEMBLY
INPUT SPEED SENSOR

A103A315

RANGE REFERENCE CHART

4T40-E GEAR RATIOS

FIRST	2.96
SECOND	1.62
THIRD	1.00
FOURTH	0.68
REVERSE	2.14



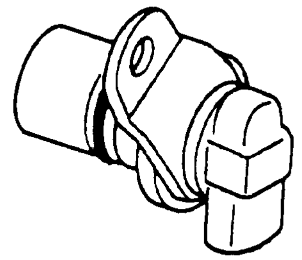
RANGE	GEAR	1-2 SHIFT SOL.	2-3 SHIFT SOL.	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV BAND	LO ROLLER CLUTCH
PARK	N	ON	OFF									APPLIED	
REV	R	ON	OFF				APPLIED					APPLIED	
NEU	N	ON	OFF									APPLIED	
D	1st	ON	OFF						HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVERRUNNING
	3rd	OFF	ON	APPLIED*	OVERRUNNING				HOLDING	APPLIED	APPLIED		OVERRUNNING
	4th	ON	ON	APPLIED*		APPLIED		APPLIED	OVERRUNNING	APPLIED	APPLIED*		OVERRUNNING
3	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING			APPLIED	HOLDING		APPLIED		OVERRUNNING
	3rd	OFF	ON	APPLIED*	OVERRUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVERRUNNING
2	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVERRUNNING
	3rd**	OFF	ON	APPLIED*	OVERRUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVERRUNNING
1	1st	ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING
	2nd***	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVERRUNNING

ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED
* = APPLIED WITH NO LOAD.
** = MANUAL SECOND - THIRD GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 100 km/h (62 mph).
*** = MANUAL FIRST - SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 60 km/h (37 mph).
NOTE: MANUAL FIRST - THIRD GEAR IS ALSO POSSIBLE AT HIGH VEHICLE SPEED AS A SAFETY FEATURE.

A103A316

AUTOMATIC TRANSMISSION OUTPUT (SHAFT) SPEED SENSOR (A/T OSS)

The vehicle A/T OSS is a magnetic inductive pickup that relays information relative to vehicle speed to the TCM. Vehicle speed information is used by the TCM to control shift timing, line pressure, and TCC apply and release.



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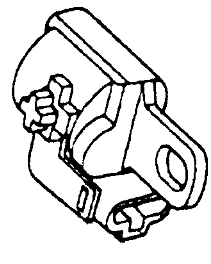
The output speed sensor mounts in the case at the speed sensor rotor which is pressed onto the differential. An air gap of 0.27-1.57 mm (0.011-0.062 inch) is maintained between the sensor and the teeth on the speed sensor rotor. The sensor consists of a permanent magnet surrounded by a coil of wire. As the differential rotates, an AC signal is induced in the vehicle speed sensor. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should measure between 1500-1750 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 volts AC at 25 RPM to 200 volts at 1728 RPM.

AUTOMATIC TRANSMISSION INPUT (SHAFT) SPEED SENSOR (A/T ISS)

The A/T ISS is a magnetic inductive pickup that relays information relative to transaxle input speed to the TCM. The TCM uses transaxle input speed information to control line pressure, TCC apply and release and transaxle shift patterns. This information is also used to calculate the appropriate operating gear ratios and TCC slippage.



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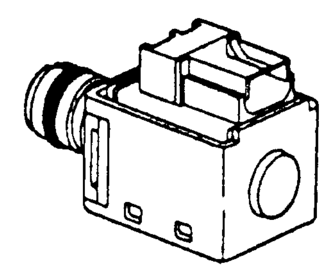
The input speed sensor mounts on the transaxle case under the channel plate and next to the drive sprocket. An air gap of 0.26-2.90 mm (0.010-0.114 inch) is maintained between the sensor and the teeth on the drive sprocket. The sensor consists of a permanent magnet surrounded by a coil of wire. As the drive sprocket is driven by the turbine shaft, an AC signal is induced in the input speed sensor. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should measure between 625-725 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 volts AC at 550 RPM to 200 volts at 7000 RPM.

SHIFT SOLENOIDS: 1-2 AND 2-3

The shift solenoids are two identical, normally open electronic exhaust valves that control upshifts and downshifts in all forward gear ranges. These shift solenoids work together in a combination of ON and OFF sequences to control the positions of the 1-2, 2-3 and 3-4 shift valve trains. The TCM monitors numerous inputs to determine the appropriate solenoid state combination and transmission gear for the vehicle operating conditions.

Gear	Solenoid 1-2	Solenoid 2-3
Park, Reverse, Neutral*	ON	OFF
First	ON	OFF
Second	OFF	OFF
Third	OFF	ON
Fourth	ON	ON
*The solenoid states are normally on (1-2) and off (2-3) in P, R, N. However, these may change based on vehicle speed and throttle position.		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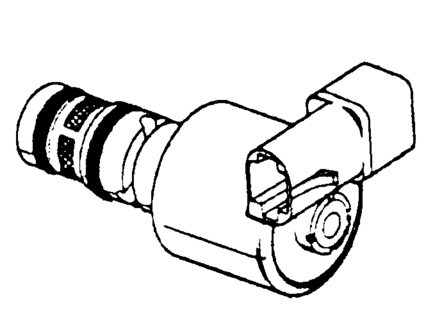

A103A318

The TCM energizes the shift solenoids by providing a ground to the solenoid's electrical circuit. This sends current through the coil winding of the solenoid, thereby creating a magnetic field. The magnetic field repels the plunger inside the solenoid which seats the solenoid metering ball against the fluid inlet port. This action prevents the exhaust of fluid through the solenoid and provides an increase in fluid pressure at the end of the shift valves. This fluid pressure initiates an upshift by moving the shift valves (refer to the oil flow diagrams for a complete description of the hydraulic control of the shift valves for each gear range).

Shift solenoids resistance should measure between 19-24 ohms when measured at 20°C (68°F) and between 24-31 ohms when measured at 88°C (190°F).

The shift solenoids should energize when the voltage is greater than 7.5 volts. The shift solenoids should de-energize when the voltage is less than one volt.

PRESSURE CONTROL SOLENOID VALVE (PC SOL. VALVE)

The pressure control solenoid valve (PC sol. valve) is a precision electronic pressure regulator that controls transaxle line pressure based on current flow through its coil windings. As current flow is increased the magnetic field produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the PC sol. valve, which ultimately decreases line pressure. The TCM controls the PC sol. valve based on various inputs including throttle position, fluid temperature, MAP sensor and gear state.

The TCM controls the PC sol. valve on a positive duty cycle at a fixed frequency of 614 Hz (cycles per second). Duty cycle is defined as the percent of time current is flowing through the solenoid coil during each cycle. A higher duty cycle provides a greater current flow through the solenoid. The high (positive) side of the PC sol. valve electrical circuit at the TCM controls the PC sol. valve operation. The TCM provides a ground path for the circuit, monitors average current and continuously varies the PC sol. valve duty cycle to maintain the correct average current flowing through the PC sol. valve.

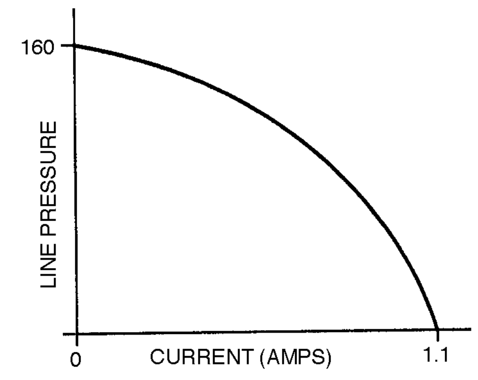
Duty Cycle	Current	Line Pressure
+5%	0.02 amps	Maximum
+40%	1.1 amps	Minimum

Pressure control solenoid valve resistance should measure between 3.5 and 4.6 ohms when measured at 20°C (68°F).

Transmission Adapt Function

The 4T40-E uses a line pressure control system which has the ability to continuously adapt the system's line pressure (increase as needed) to compensate for normal wear of clutch fiber plates, seals, springs, etc. this "learning" feature is similar to what is used for fuel control (integrator/block learn) and throttle position (idle learn). The TCM maintains several adapt parameters for the transaxle:

- Upshift Adapt - The TCM monitors the TIS sensor and VSS during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the transaxle pressure control solenoid signal to maintain a set shift feel.



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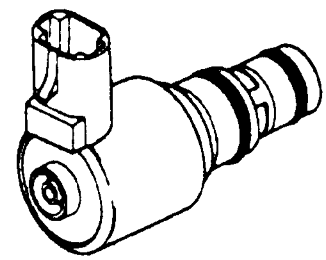
TORQUE CONVERTER CLUTCH SOLENOID VALVE (TCC SOL. VALVE)

The TCC solenoid valve is a normally closed, pulse width modulated (PWM) solenoid used to control the apply and release of the converter clutch. The TCM operates the solenoid with a negative duty cycle at a fixed frequency of 42 Hz to control the rate of TCC apply/release. The solenoid's ability to "ramp" the TCC apply and release pressures results in a smoother TCC operation.



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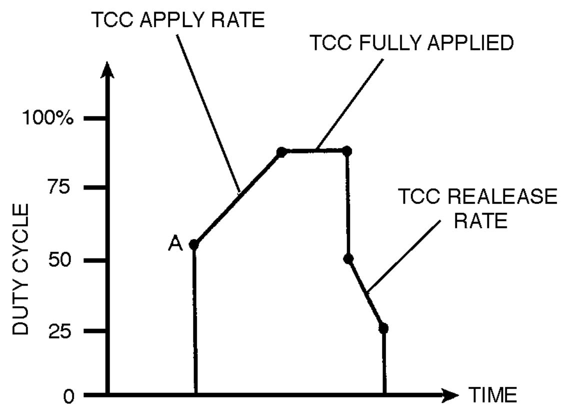
When vehicle operating conditions are appropriate to apply the TCC the TCM immediately increases the duty cycle to approximately 68% (see point A on graph). The TCM then ramps the duty cycle up to approximately 93% to achieve full TCC apply pressure. The rate at which the TCM increases the duty cycle controls the TCC apply. Similarly, the TCM also ramps down the TCC solenoid duty cycle to control TCC release.

There are some operating conditions that prevent or enable TCC apply under various conditions (refer to the temperature sensor description). Also, if the TCM receives a high voltage signal from the brake switch, signalling that the brake pedal is depressed, the TCM immediately releases the TCC.

Important: Duty cycles given are for example only. Actual duty cycles will vary depending on vehicle application and vehicle operating conditions.

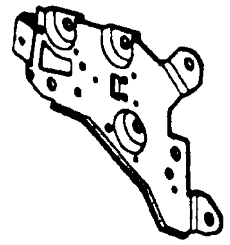


A103A337

TCC solenoid valve resistance should measure between 10.4 and 10.8 ohms when measured at 20°C (68°F). The resistance should measure approximately 16 ohms at 150°C (300°F).

AUTOMATIC TRANSMISSION FLUID PRESSURE MANUAL VALVE POSITION SWITCH (TFP VAL. POSITION SW.)

The pressure switch assembly (TFP val. position sw.) is attached to the valve body and contains six fluid pressure switches and the transaxle temperature sensor (refer to the separate description of the temperature sensor). Five of the fluid pressure switches (PRND4, DRIVE, LO, D21, REV) are normally open and are used to indicate the position of the manual valve. The TCM uses this information to control line pressure, TCC apply and release and shift solenoid operation.



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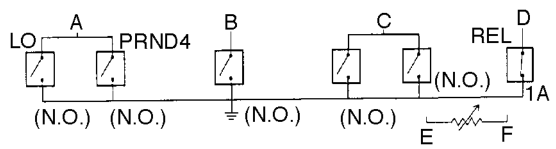
The RELEASE pressure switch is a normally closed pressure switch. This switch is used as a diagnostic tool to confirm that the TCC is actually OFF when it has been commanded OFF by the TCM.

Each fluid pressure switch produces either an open or ground to the TCM depending on the presence of fluid pressure at the switches. The sequence of open and closed switches produces a combination of voltage readings that are monitored by the TCM (see chart and switch logic diagram).



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The TCM measures TFP val. position sw. signal voltage from each pin to ground and compares the voltage to a TFP val position sw. combination chart stored in the TCM memory. If the TCM does not recognize the switch sequence a diagnostic code will be set as a result. A diagnostic code may also be set if the TFP val. position sw. switch sequence indicates a gear range selection that conflicts with other sensory inputs to the TCM.

Range Indicator	Fluid*					Circuit+		
	REV	PRND4	DR	D21	LO	A	B	C
Park/Neutral	0	1	0	0	0	1	0	0
Reverse	1	1	0	0	0	1	0	1
Overdrive	0	1	1	0	0	1	1	0
Manual Third	0	0	1	0	0	0	1	0
Manual Second	0	0	1	1	0	0	1	1
Manual First	0	0	1	1	1	1	1	1

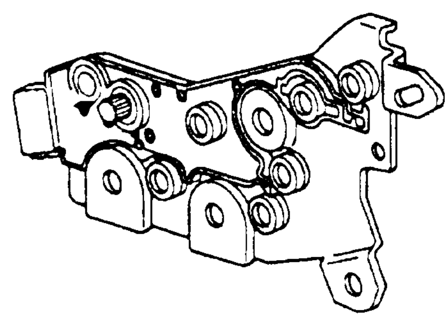
*: 1 = Pressurized
0 = Exhausted

+: 1 = Grounded (resistance <50 ohms, 0 volts)
0 = Open (Resistance >50k ohms, 12 volts)

Important: Resistance should be measured with the engine running. When the transaxle pass thru connector is disconnected from the vehicle harness and the engine is running, multiple diagnostic codes will be set. Be sure to clear these codes when finished with this procedure.

TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

The TFT sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) that provides information to the TCM regarding transmission fluid temperature. The temperature sensor is integrated in the TFP val. position sw. which is volted to the valve body. The sensor monitors pressurized main line pressure from the inside of the valve body to determine the operating temperature of the transaxle fluid. The sensor, similar to each of the TFP val. position sw., uses an O-ring seal to maintain fluid pressure in the valve body.



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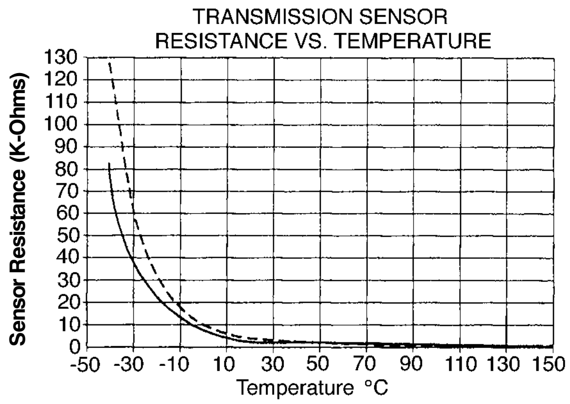
The internal electrical resistance of the sensor varies in relation to the operating temperature of the transmission fluid (see chart).



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The TCM sends a 5 volt reference signal to the temperature sensor and measures the voltage drop in the electrical circuit. A lower fluid temperature creates a higher resistance in the temperature sensor, thereby measuring a higher voltage signal.

The TCM measures this voltage as another input to help control line pressure, shift schedules and TCC apply. When transaxle fluid temperature reaches 140°C (284°F) the TCM enters "hot mode." Above this temperature the TCM modifies transmission shift schedules and TCC apply in an attempt to reduce fluid temperature by reducing transmission heat generation. During hot mode the TCM applies the TCC at all times in third and fourth gears. Also, the TCM performs the 2-3 and 3-4 shifts earlier to help reduce fluid heat generation. Hot mode may not be available on some applications.

Transmission Sensor - Temperature To Resistance To Voltage (approximate)		
°C	R low (ohms)	R high (ohms)
0	7987	10859
10	4934	6407
20	3106	3923
30	1991	2483
40	1307	1611
50	878	1067
60	605	728
70	425	507
80	304	359
90	221	259
100	163	190

TRANSMISSION ELECTRICAL CONNECTOR

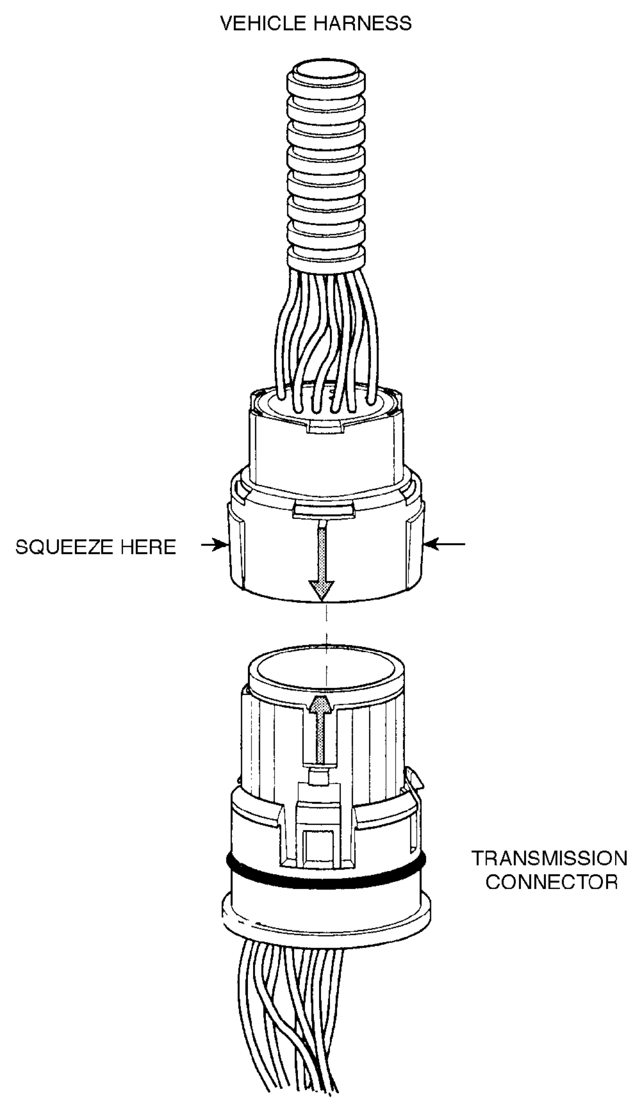
The transmission electrical connector is a very important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set Diagnostic Trouble Codes (DTCs) and/or affect proper operation.

The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection.
- Wires backing away from the pins or coming uncrimped (in either internal or external wiring harness).
- Dirt contamination entering the connector when disconnected.
- Pins in the internal wiring connector backing out of the connector or pushed out during reconnection.
- Excessive transmission fluid leaking into the connector, wicking up into the external wiring harness, and degrading the wire insulation.
- Water/moisture intrusion in the connector.
- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly.
- Pin corrosion from contamination.
- Broken/cracked connector assembly.

Points to remember when working with the transmission wiring connector assembly:

- To remove the connector, squeeze the two tabs towards each other and pull straight up (refer to the illustration).



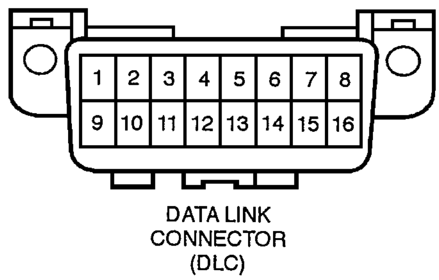
- Carefully limit twisting or wiggling the connector during removal. Bent pins can occur.
- DO NOT pry the connector off with a screwdriver or other tool.
- To reinstall the external wiring connector, first orient the pins by lining up the arrows on each half of the connector. Push the connector straight down into the transmission without twisting or angling the mating parts.
- The connector should click into place with a positive feel and/or noise.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating DTC(s) will set. Clear these DTC(s) after reconnecting the external connector.

TRANSMISSION CONTROL MODULE (TCM)

The transmission control module (TCM) is an electronic device which monitors inputs to control various transmission functions including shift quality and transmission diagnostics. The TCM receives input information from sensors, switches, and components to process for use within its' control program. Based on this input information, the TCM controls various transmission output functions and devices.

DATA LINK CONNECTOR (DLC)

The data link connector (DLC) is a multiple cavity connector. The DLC provides the means to access serial data from the TCM to aid in powertrain diagnosis. The DLC allows the technician to use a scan tool to monitor various systems and display diagnostic trouble codes (DTCs). The DLC connector is located within the driver's compartment, directly below the steering column.



TCM INPUTS THAT AFFECT THE 4T40-E TRANSMISSION

Throttle Position Sensor

- Provides throttle position data to the TCM for determining shift patterns and TCC apply/release.
- An incorrect throttle position sensor input could cause erratic or shift pattern, poor shift quality or TCC function.

Automatic Transmission Output (Shaft) Speed Sensor

- Provides vehicle speed data to the TCM for determining shift patterns, TCC apply/release, and gear ratio calculations.
- An incorrect A/T OSS input could cause erratic or shift pattern, poor shift quality or TCC function.

Automatic Transmission Input (Shaft) Speed Sensor

- Provides transaxle input speed data to the TCM for controlling line pressure, shift patterns, TCC apply and release and calculating gear ratio.

Engine Coolant Temperature Sensor

- Provides coolant temperature data to the TCM for determining initial TCC engagement.
- An incorrect engine coolant temperature sensor input could cause an incorrect initial TCC apply.

Cruise Control

- When engaged, the TCM alters the transaxle shift pattern to reduce the number of 3-4 upshifts and 4-3 downshifts. The TCM also alters TCC apply and release.

Engine Speed

- The ignition module provides engine speed data to the TCM.
- The TCM uses engine speed information for controlling wide open throttle shifts and the TCC PWM solenoid duty cycle.

Brake Switch

- Provides brake apply information to the TCM for controlling TCC apply and release.
- An incorrect TCC brake switch input could cause an incorrect TCC apply or release.

Automatic Transmission Fluid Pressure Manual Valve Position Switch (TFP Val. Position Sw.)

- Provides transaxle shift linkage position information to the TCM for determining transaxle range and shift patterns.
- An incorrect TFP val. position sw. input could cause incorrect shift points, poor shift quality, incorrect or inhibited TCC apply, incorrect line pressure, or erratic manual downshifts.

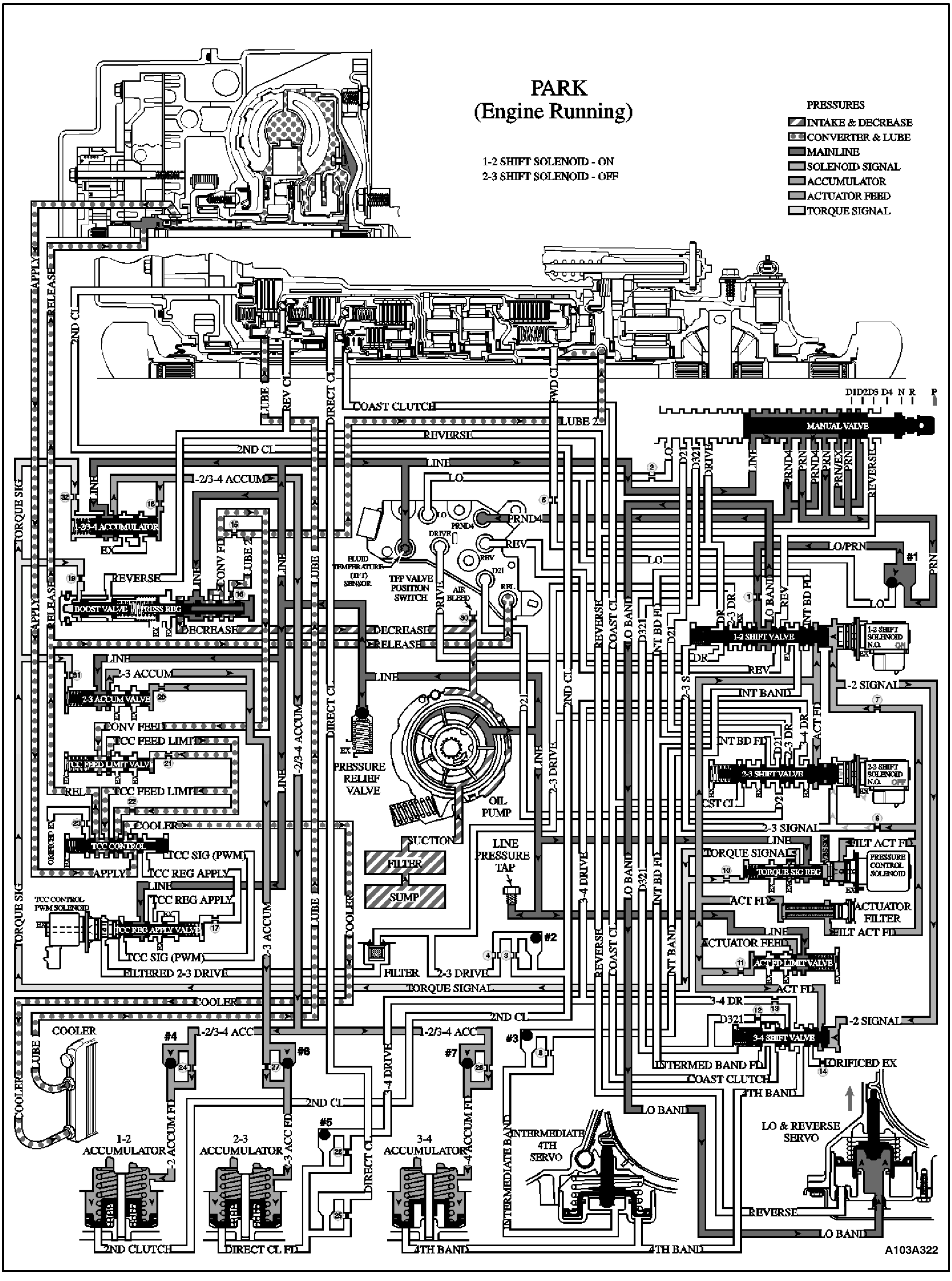
Transmission Fluid Temperature TFT Sensor

- Provides transaxle fluid temperature information to the TCM for determining alternate shift patterns and TCC apply during high temperature conditions (hot mode operation).
- An incorrect transaxle temperature sensor input could cause altered shift patterns, poor shift quality and incorrect TCC apply.

Manifold Absolute Pressure Sensor

- Measures intake manifold pressure which results from changes in engine load and speed. The TCM monitors this information to adjust line pressure and shift patterns.
- An incorrect MAP sensor input could cause altered shift patterns, shift feel and TCC apply.

PARK (ENGINE RUNNING)



When the gear selector lever is in the park (P) position and the engine is running, fluid is drawn into the oil pump and line pressure is directed to the pressure regulator valve.

Pressure Regulation

Pressure Regulator Valve: Regulates pump output (line pressure) in response to torque signal fluid pressure acting on the boost valve, spring force, and line pressure acting on the end of the valve. Line pressure is directed to the manual valve, both accumulator valves, torque signal regulator valve, TCC regulated apply valve, the temperature sensor in the TFP and the actuator feed limit valve. Also, line pressure feeds the converter feed fluid circuit through the pressure regulator valve.

Actuator Feed Limit (AFL) Valve: Line pressure is routed through the valve and into the actuator feed fluid circuit. The valve limits actuator feed fluid pressure to a maximum pressure. Actuator feed fluid is routed to the pressure control solenoid, each of the shift valves, and also feeds the 1-2 signal and 2-3 signal fluid circuits.

Pressure Control Solenoid (PCS): Controlled by the TCM, the PCS regulates filtered actuator feed fluid pressure acting on the end of the torque signal regulating valve.

Torque Signal Regulating Valve: Regulates line pressure into the torque signal fluid circuit. This regulation is controlled by filtered actuator feed fluid pressure from the PCS. Torque signal fluid pressure is routed to the accumulator valves and the boost valve to control shift feel.

Lo/Reverse Band Applies

Manual Valve: Mechanically controlled by the gear selector lever, the manual valve is in the park (P) position and directs line pressure into the PRND4 and PRN fluid circuits.

TFP: PRND4 fluid is routed to the PRND4 fluid pressure switch in the TFP and the TFP signals the TCM that the transaxle is in the park (P) position. Also, line pressure is routed to the temperature sensor in the TFP.

1-2 Shift Solenoid: Energized by the TCM, the normally open 1-2 shift solenoid is ON and blocks 1-2 signal fluid from exhausting. 1-2 signal fluid pressure acts on the 1-2 and 3-4 shift valves.

1-2 Shift Valve: 1-2 signal fluid pressure holds the valve in the downshifted position against spring force. Lo/PRN fluid is routed through the 1-2 shift valve and into the lo band fluid circuit.

Lo and Reverse Servo: Lo band fluid is routed to the inner area of the servo piston. Lo band fluid pressure moves the servo piston and pin assembly against spring force to apply the lo/reverse band.

2-3 Shift Solenoid: The normally open 2-3 shift solenoid is OFF and 2-3 signal fluid is exhausted through the solenoid.

2-3 Shift Valve: Spring force holds the 2-3 shift valve in the downshifted position.

3-4 Shift Valve: 1-2 signal fluid pressure holds the 3-4 shift valve against spring force in the first and fourth gear position.

Lube 2: The lube 2 fluid circuit is fed by line pressure at the pressure regulator valve. Lube 2 fluid is routed through the oil feed pipes and into the forward clutch support. Lube 2 fluid provides lubrication in the rear of the transaxle.

Shift Accumulation

1-2/3-4 and 2-3 Accumulator Valves: Line pressure is regulated into accumulator fluid pressure. This regulation is basically controlled by torque signal fluid pressure acting on the end of the valve.

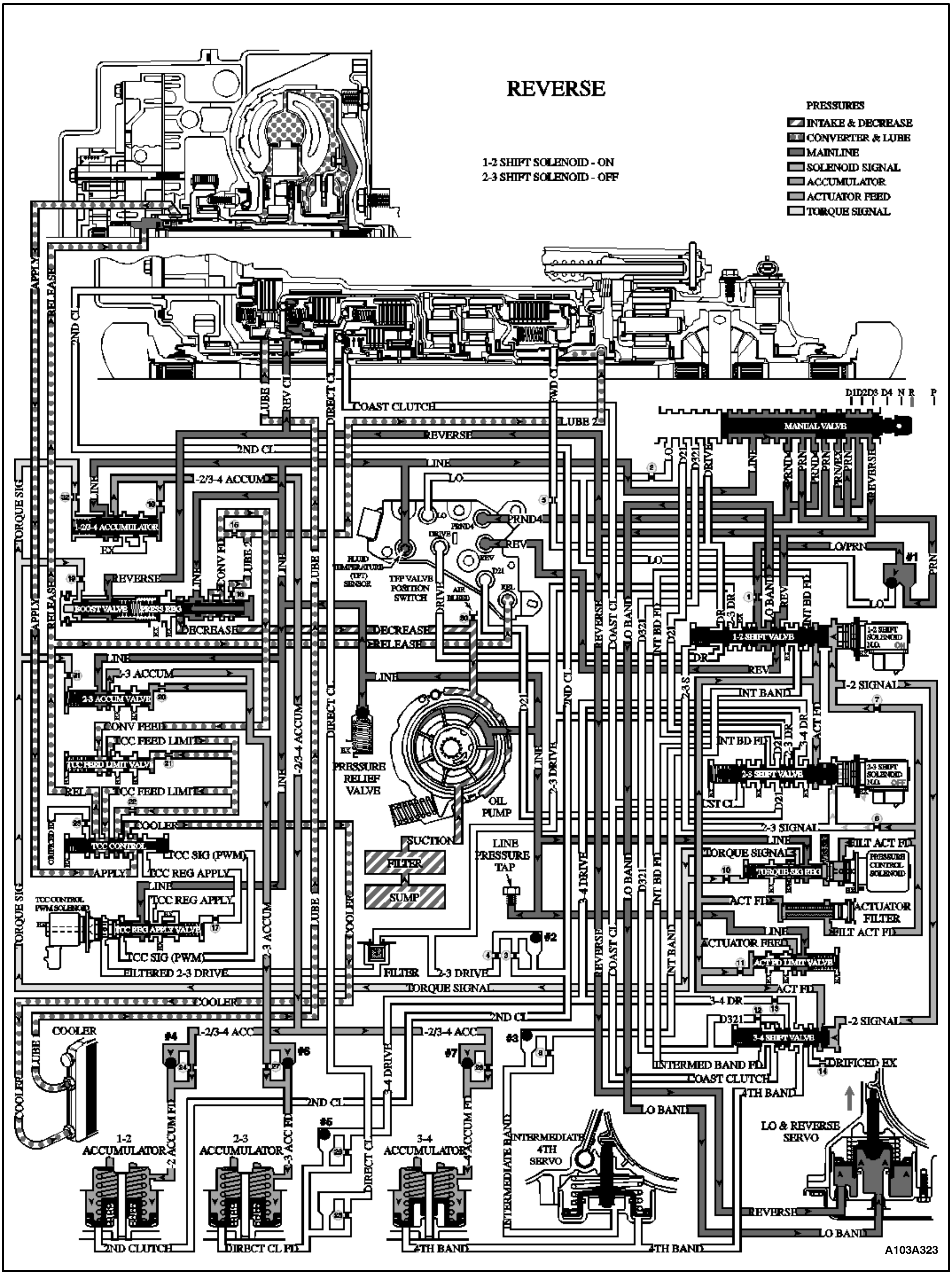
1-2, 2-3 and 3-4 Accumulator Assemblies: Accumulator fluid is routed to each of the accumulator assemblies in preparation for upshifts. The fluid routed to the 1-2 and 3-4 accumulators is orificed by the #4 and #7 checkballs. The 2-3 accumulator fluid circuit is orificed by checkball #6.

Torque Converter/Cooler and Lube Circuits

Refer to reverse (R) range for a complete description of these circuits.

Important: Actuator feed fluid continues to feed the 2-3 signal fluid circuit through orifice #6. However, the exhaust port through 2-3 shift solenoid is larger than orifice #6 to prevent a pressure increase in the 2-3 signal fluid circuit.

REVERSE


REVERSE
PRESSURES
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
1-2 SHIFT SOLENOID - ON
2-3 SHIFT SOLENOID - OFF
MANUAL VALVE
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
1-2/3-4 ACCUMULATOR
2-3 ACCUM VALVE
TCC FEED LIMIT VALVE
TCC CONTROL
TCC REG APPLY VALVE
BOOST VALVE
PRESS REG
PRESSURE RELIEF VALVE
OIL PUMP
FILTER
SUMP
LINE PRESSURE TAP
TORQUE SIG REG
ACTUATOR FILTER
ACTUATOR FEED LIMIT VALVE
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
INTERMEDIATE 4TH SERVO
LO & REVERSE SERVO
COOLER
A103A323

When the gear selector lever is moved to the reverse (R) position (from the park position), the following changes occur in the transaxle's hydraulic and electrical systems.

Pressure Regulation

Manual Valve: With the manual valve in the reverse position, line pressure is directed into the reverse fluid circuit, in addition to the PRND4 and PRN fluid circuits as in park.

Pressure Regulator and Boost Valves: Reverse fluid is routed to the boost valve and assists torque signal fluid pressure. The addition of reverse fluid pressure increases the operating range of line pressure in reverse.

TFP: Reverse fluid is routed through the 1-2 shift valve and to the TFP. The TFP signals the TCM that the transaxle is in reverse.

Reverse Clutch Applies

Reverse Clutch: Reverse clutch fluid pressure applies the reverse clutch.

Lo and Reverse Band Remains Applied

1-2 Shift Solenoid: The TCM keeps the solenoid energized in reverse and 1-2 signal fluid pressure acts on the 1-2 shift valve.

1-2 Shift Valve: 1-2 signal fluid pressure keeps the 1-2 shift valve in the downshifted position. Lo/PRN fluid continues to feed the lo band fluid circuit.

Lo and Reverse Servo: Reverse fluid is routed to the outer area of the servo to increase the servo apply pressure in reverse.

Torque Converter Clutch

Pressure Regulator Valve: Line pressure is routed through the PR valve and into the converter feed fluid circuit. Converter feed fluid is routed to the TCC feed limit valve.

TCC Feed Limit Valve: Converter feed fluid is routed through the valve and into the TCC feed limit fluid circuit. The TCC feed limit valve limits the maximum fluid pressure in the TCC feed limit fluid circuit and the torque converter.

TCC Regulated Apply Valve: Spring force holds the valve in the release position, thereby blocking line pressure.

TCC Control Valve: Spring force holds the valve in the release position and TCC feed limit fluid is routed into the release fluid circuit. Also, fluid returning from the converter in the apply fluid circuit is routed through the valve and into the cooler fluid circuit.

Torque Converter: Release fluid pressure is routed to the torque converter to keep the TCC released. Fluid leaves the converter in the apply fluid circuit.

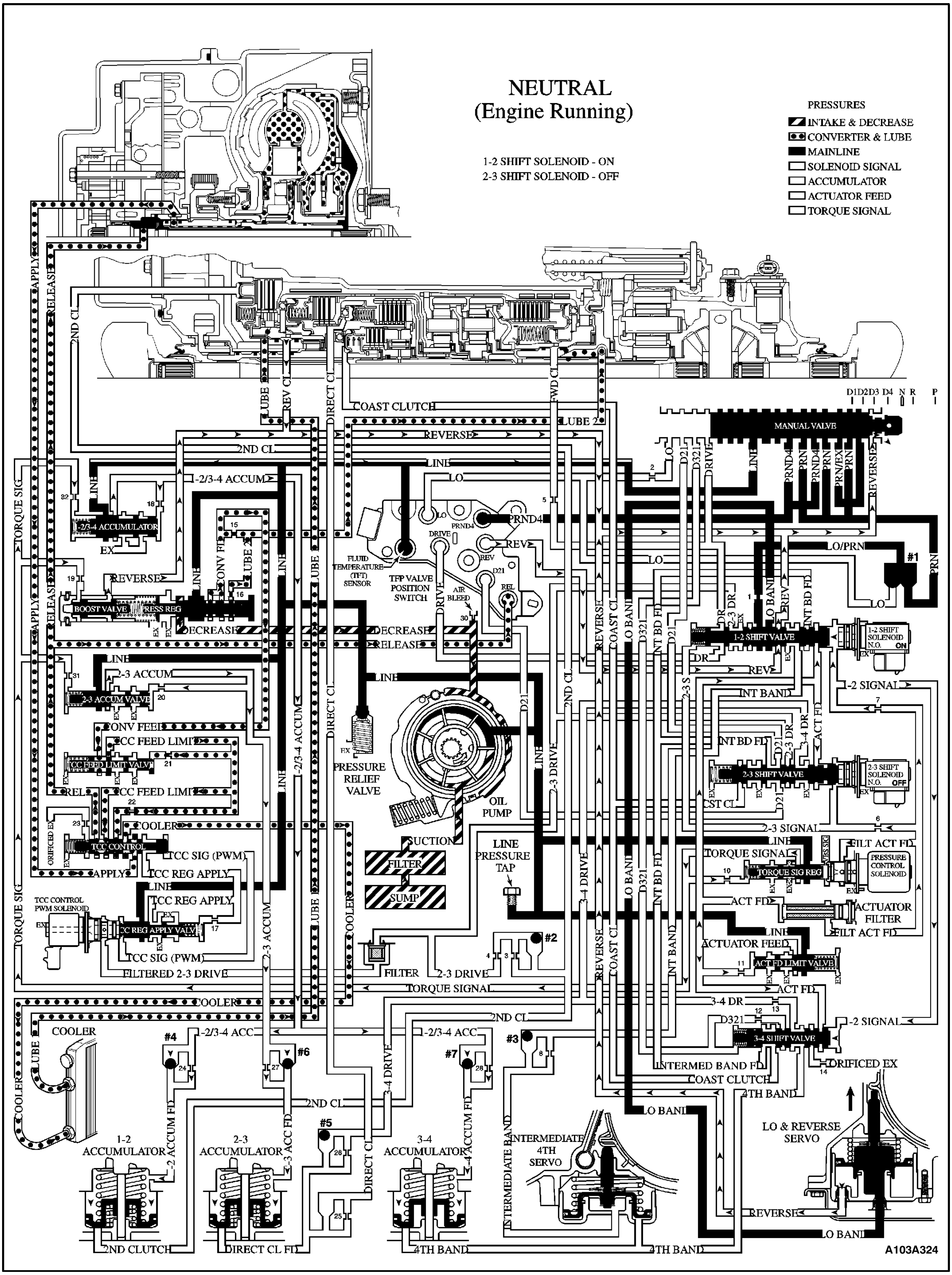
Cooler and Lube

Lube 1: Cooler fluid is routed through the transaxle oil cooler located in the vehicle radiator and into the lube 1 fluid circuit. Lube 1 fluid is routed through the input shaft to lubricate transaxle components in the front of the transaxle.

Lube 2: The lube 2 fluid circuit is fed by line pressure at the pressure regulator valve. Lube 2 fluid is routed through the oil feed pipes and into the forward clutch support. Lube 2 fluid provides lubrication in the rear of the transaxle.

Important: The explanation in each gear range is, for the most part, limited to what changes from the previous range. However, some component descriptions are repeated for clarity and continuity. Also, refer to the appropriate service manual for specific application information.

NEUTRAL (ENGINE RUNNING)



When the gear selector lever is moved from the reverse position to the neutral position, the following changes occur to the hydraulic and electrical systems.

Reverse Clutch Releases

Manual Valve: The manual valve is moved to the neutral position and blocks line pressure from entering the reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

Reverse Clutch: Reverse fluid exhausts from the reverse clutch and the clutch releases, shifting the transaxle into neutral.

Boost Valve: Reverse fluid exhausts from the boost valve and line pressure regulation returns to the normal operating range.

TFP: Reverse fluid pressure exhausts from the TFP, thereby signalling the TCM that the transaxle is in neutral (N) or park (P).

Lo and Reverse Band Remains Applied

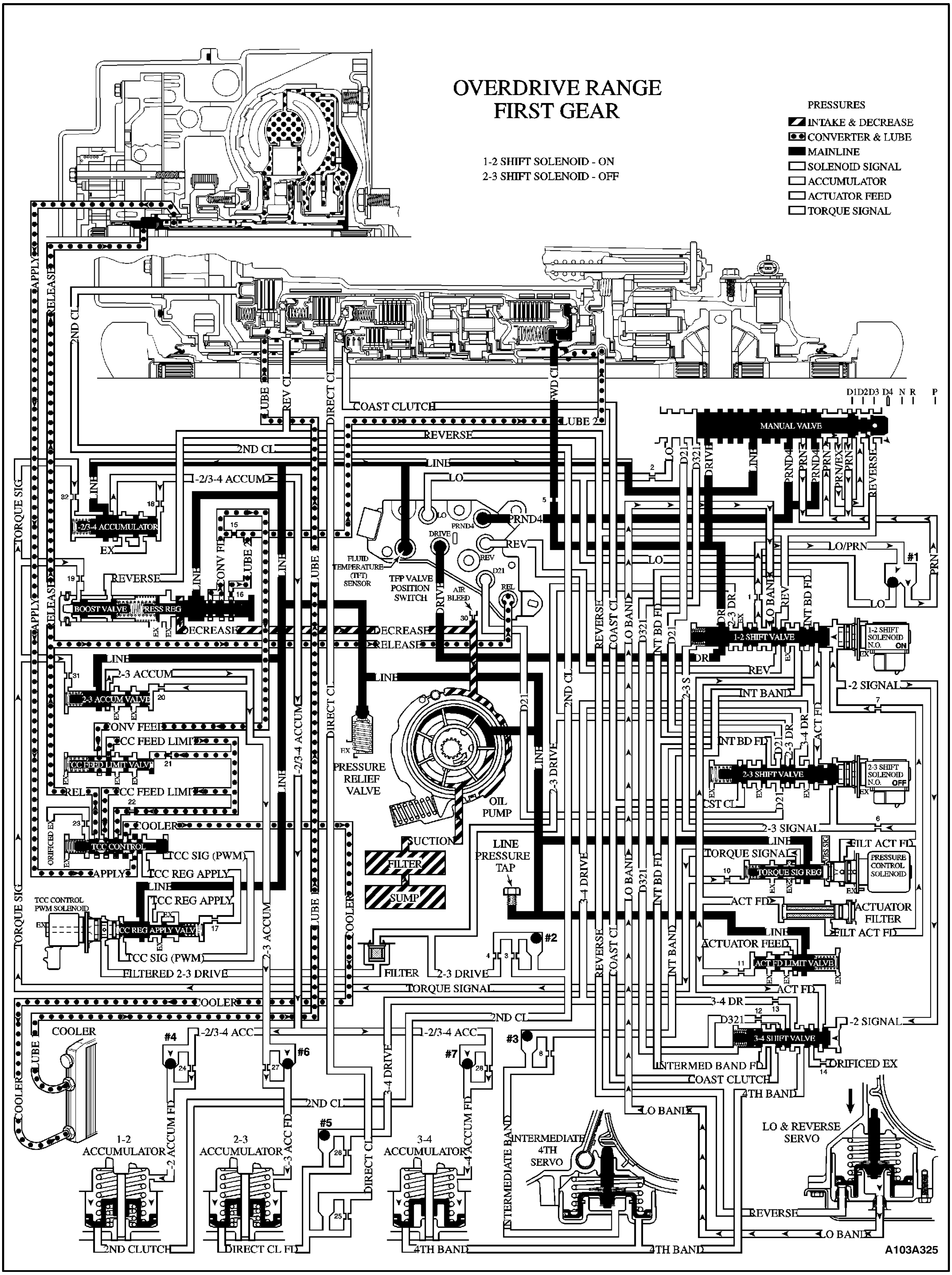
1-2 Shift Solenoid: As in park and reverse, the solenoid is energized and 1-2 signal fluid pressure acts on the 1-2 shift valve.

1-2 Shift Valve: 1-2 signal fluid pressure keeps the 1-2 shift valve in the downshifted position. Lo/PRN fluid continues to feed the lo band fluid circuit.

Lo and Reverse Servo: Reverse fluid exhausts from the servo. However, lo band fluid pressure continues to act on the inner area of the servo piston to keep the band applied.

Important: In park, reverse and neutral, the shift solenoids are shown in the first gear state. This is the normal operating state when the vehicle is stationary or at low vehicle speeds. However, the TCM will change the shift solenoid states depending on vehicle speed. For example, if neutral range is selected when the vehicle is operating in second gear, the shift solenoids will remain in a second gear state. But with the manual valve in neutral, line pressure is blocked, drive fluid exhausts and the transmission will shift into neutral.

OVERDRIVE RANGE － FIRST GEAR



When the gear selector lever is moved to the overdrive (D) position from the neutral (N) position, the following changes occur to shift the transaxle into overdrive range - first gear.

Manual Valve: In the overdrive position the manual valve routes line pressure into the drive fluid circuit. Also, the manual valve blocks line pressure from entering the PRN fluid circuit and opens the PRN fluid circuit to exhaust.

Low and Reverse Band Releases

Lo and Reverse Servo: Lo band fluid pressure exhausts from the servo, thereby releasing the servo and the lo and reverse band.

Forward Clutch Applies

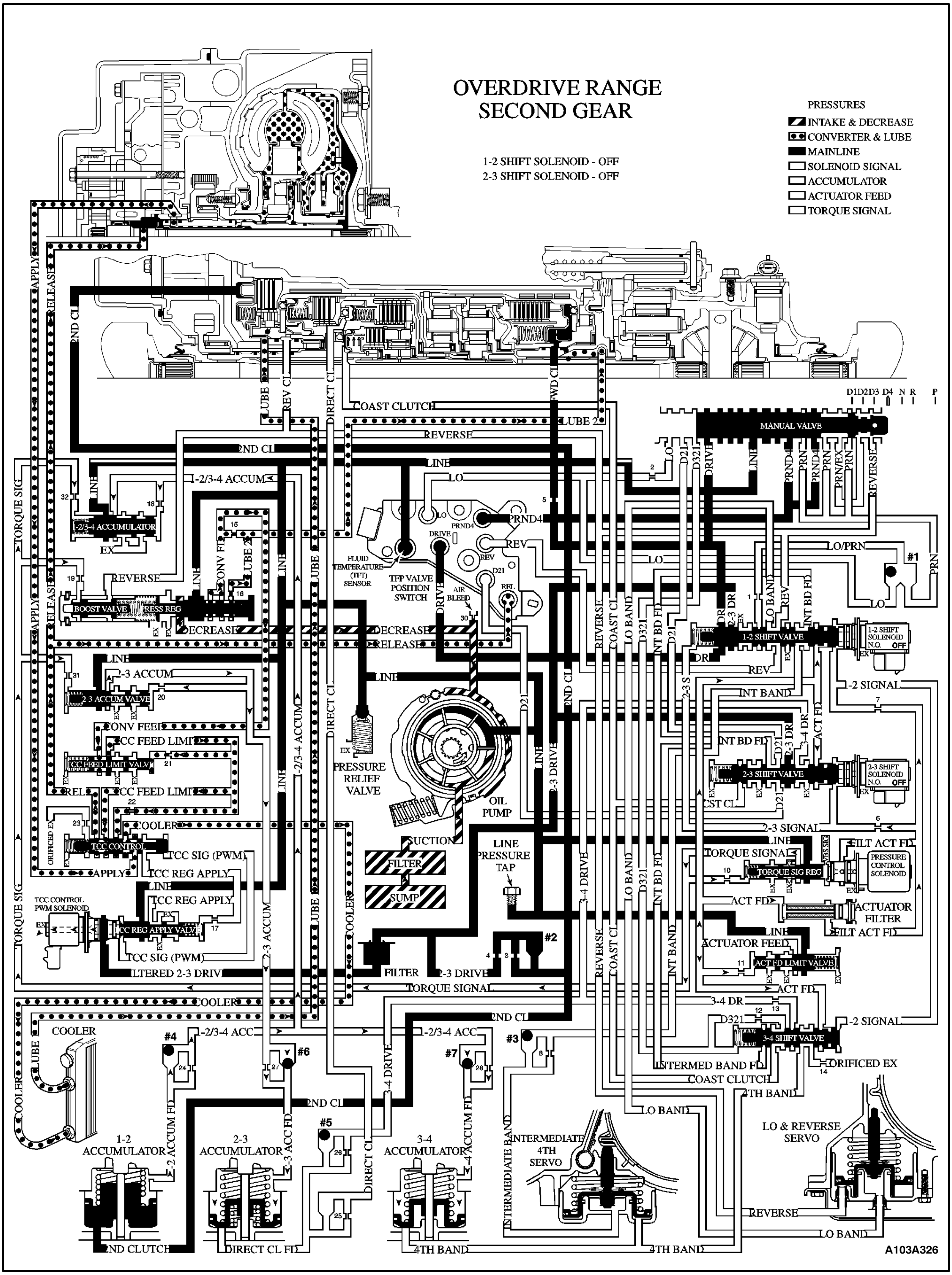
Forward Clutch: Drive fluid is orificed into the forward clutch fluid circuit. Forward clutch fluid pressure applies the forward clutch.

1-2 Shift Solenoid: In first gear 1-2 shift solenoid remains energized by the TCM and 1-2 signal fluid pressure acts on the 1-2 shift valve.

1-2 Shift Valve: 1-2 signal fluid pressure keeps the 1-2 shift valve in the downshifted position against spring force. Drive fluid is routed through the 1-2 shift valve.

TFP: Drive fluid is routed to the TFP and the TFP signals the TCM that the transaxle is in the overdrive range.

OVERDRIVE RANGE – SECOND GEAR



As vehicle speed increases and operating conditions become appropriate, the TCM de-energizes shift 1-2 solenoid to shift the transaxle into second gear. The manual valve remains in the overdrive (D) position and line pressure is routed into the drive and PRND4 fluid circuits.

Second Clutch Applies

1-2 Shift Solenoid: The normally open shift solenoid is de-energized and 1-2 signal fluid exhausts through the open solenoid.

Important: Filtered actuator feed fluid continues to feed the 1-2 signal fluid circuit through orifice #7. However, the exhaust port through the solenoid is larger than orifice #7 to prevent a pressure increase in the 1-2 signal fluid circuit.

1-2 Shift Valve: With 1-2 signal fluid pressure exhausted, spring force moves the valve into the upshifted position and drive fluid is routed into the 2-3 drive fluid circuit. Drive fluid also continues to flow through the valve and to the TFP.

#2 Checkball (Second Clutch Apply): 2-3 drive fluid seats the #2 checkball, forces 2-3 drive fluid through the #3 orifice and feeds the 2nd clutch fluid circuit. The #3 and #4 orifices help control the apply feel of the second clutch.

Second Clutch: 2nd clutch fluid pressure applies the second clutch to shift the transaxle into second gear.

Shift Accumulation

1-2 Accumulator: 2nd clutch fluid is also routed to the 1-2 accumulator piston. Second clutch fluid pressure, in addition to 1-2 assist spring force, moves the piston against spring force and 1-2 accumulator feed fluid pressure. This action absorbs initial 2nd clutch fluid pressure to cushion the second clutch apply. The movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator.

1-2 Accumulator Valve: 1-2 accumulator feed fluid forced from the 1-2 accumulator unseats the #4 checkball and is routed back to the 1-2 accumulator valve. This pressure forces the 1-2 accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the second clutch apply. Figure 39 shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.

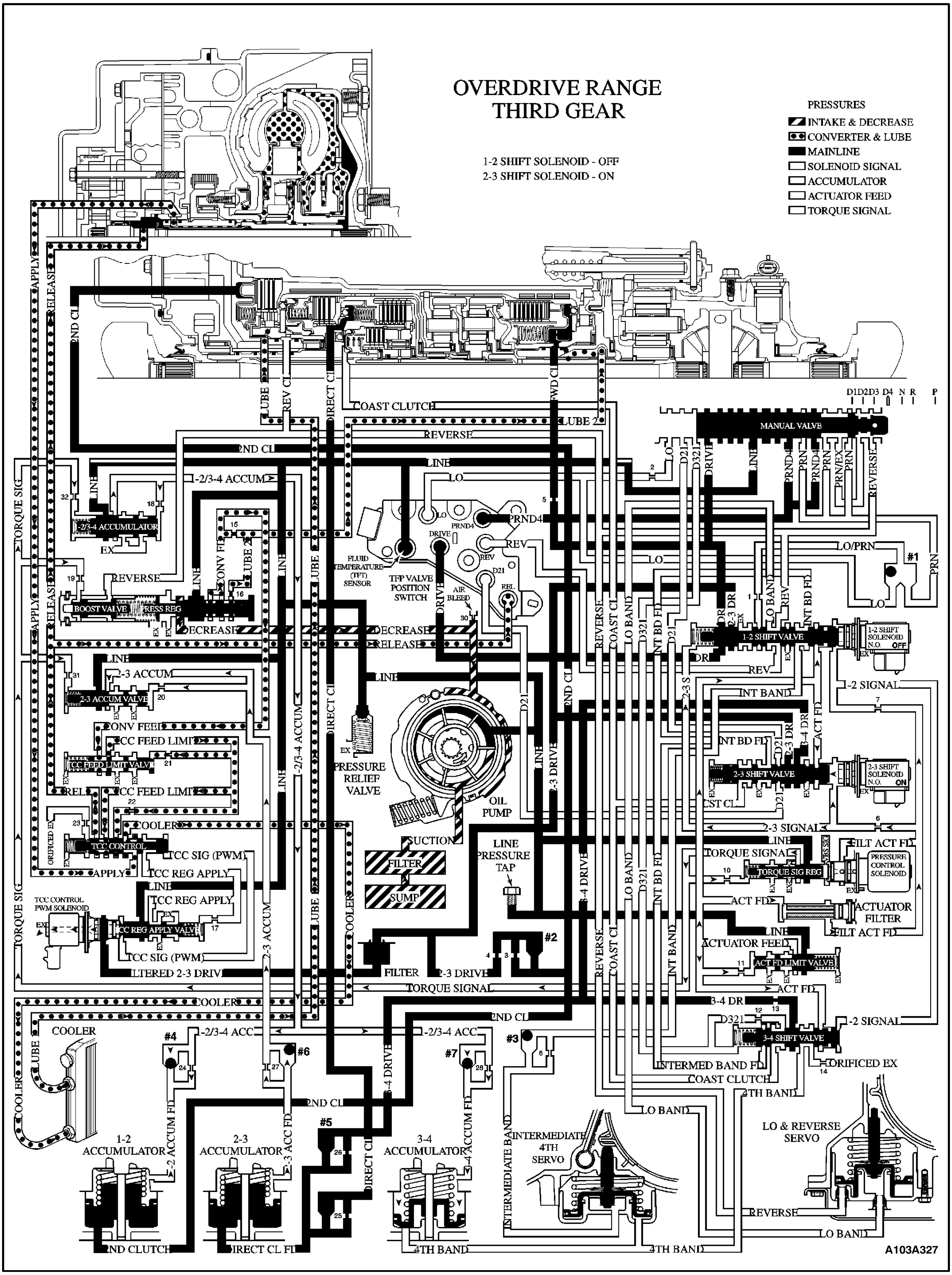
TCC Control - Pulse Width Modulated (PWM) Solenoid: Filtered 2-3 drive fluid is routed to the TCC control solenoid. Under normal operating conditions the TCC control solenoid is OFF in second gear and blocks filtered 2-3 drive fluid from entering the TCC signal fluid circuit.

Torque Converter Clutch: With the TCC control solenoid OFF ,the converter clutch is released in second gear.

2-3 Shift Solenoid: 2-3 shift solenoid remains OFF in second gear and 2-3 signal fluid exhausts through the normally open solenoid.

2-3 Shift Valve: Spring force keeps the 2-3 shift valve in the downshifted position. In this position the valve blocks 2-3 drive fluid in preparation for the upshift to third gear.

OVERDRIVE RANGE – THIRD GEAR



As vehicle speed increases and operating conditions become appropriate, the TCM energizes 2-3 shift solenoid to shift the transaxle into third gear. The manual valve remains in the overdrive (D) position and line pressure continues to feed the drive and PRND4 fluid circuits.

Direct Clutch Applies

2-3 Shift Solenoid: The normally open shift solenoid is energized by the TCM and blocks 2-3 signal fluid from exhausting. 2-3 signal fluid pressure is routed to both the 1-2 and 2-3 shift valves.

2-3 Shift Valve: 2-3 signal fluid pressure moves the valve against spring force to initiate the 2-3 upshift. 2-3 drive fluid is routed through the valve and into the 3-4 drive fluid circuit.

#5 Checkball (Direct Clutch Apply): 3-4 drive fluid pressure seats the #5 checkball and 3-4 drive fluid is forced through the #26 orifice and into the direct clutch feed fluid circuit. The #26 orifice helps control the direct clutch apply.

Direct Clutch: Direct clutch fluid pressure applies the direct clutch and the transaxle shifts into third gear.

3-4 Shift Valve: 3-4 drive fluid is also routed to the 3-4 shift valve in preparation for a 3-4 upshift.

Shift Accumulation

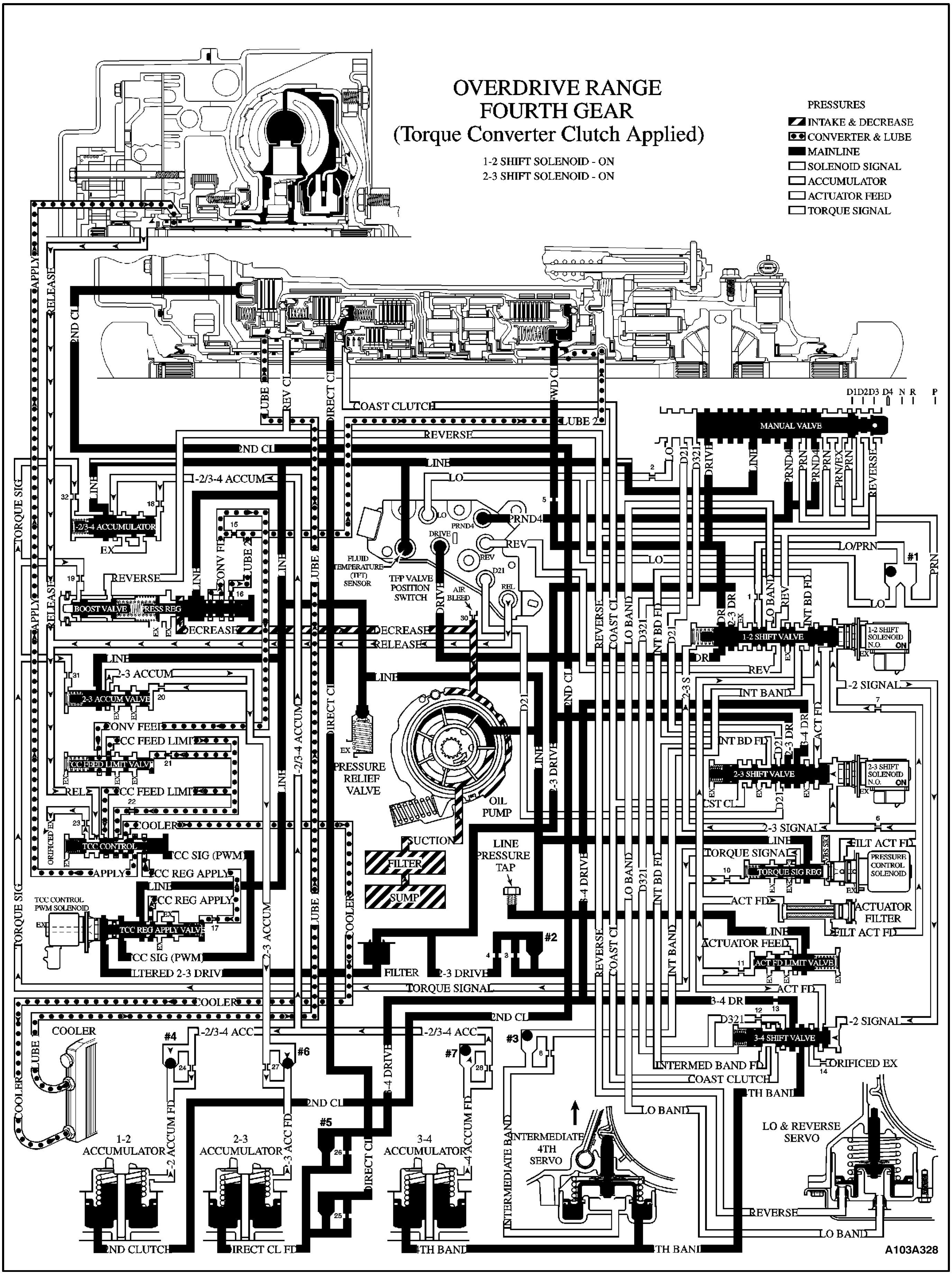
2-3 Accumulator: Direct clutch feed fluid is also routed to the 2-3 accumulator piston. This fluid pressure moves the piston against spring force and 2-3 accumulator feed fluid pressure. This action absorbs initial direct clutch fluid pressure to cushion the direct clutch apply. The movement of the 2-3 accumulator piston forces some accumulator fluid out of the accumulator.

2-3 Accumulator Valve: Excess 2-3 accumulator feed fluid unseats the #6 checkball and is routed back to the 2-3 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the direct clutch apply. The overdrive range - 4-3 downshift illustration shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.

Torque Converter Clutch: Under normal operating conditions the TCC is released in third gear. However, TCC apply could vary depending on vehicle application and may be calibrated to apply in overdrive range - third gear.

TFP: Release fluid pressure routed to the TFP signals the TCM that the TCC is released.

OVERDRIVE RANGE – FOURTH GEAR



When operating conditions are appropriate, the TCM energizes 1-2 shift solenoid to shift the transaxle into fourth gear. In addition, the TCC is applied in fourth gear. The manual valve remains in the overdrive position and line pressure continues to feed the Drive and PRND4 fluid circuits.

Intermediate and 4th Band Applied

1-2 Shift Solenoid: The normally open shift solenoid is energized by the TCM and blocks 1-2 signal fluid from exhausting. 1-2 signal fluid pressure is routed to both the 1-2 and 3-4 shift valves.

1-2 Shift Valve: 1-2 signal fluid pressure does not affect the 1-2 shift valve. Spring force and 2-3 signal fluid pressure keep the 1-2 shift valve in the upshifted position.

3-4 Shift Valve: 1-2 signal fluid pressure moves the valve against spring force and into the fourth gear position. 3-4 drive fluid is routed into the 4th band fluid circuit.

Intermediate and 4th Servo: 4th band fluid pressure acts on the outer area of the servo piston to move the servo pin and apply the intermediate/4th band.

Shift Accumulation

3-4 Accumulator: 4th band fluid is also routed to the 3-4 accumulator piston. 4th band fluid pressure moves the piston against spring force and 3-4 accumulator feed fluid pressure. This action absorbs initial 4th band fluid pressure to cushion the intermediate/4th band apply. The movement of the 3-4 accumulator piston forces some accumulator fluid out of the accumulator.

3-4 Accumulator Valve: 3-4 accumulator feed fluid forced from the 3-4 accumulator unseats the #7 checkball and is routed back to the 3-4 accumulator valve. This pressure forces the 1-2/3-4 accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the intermediate/4th band apply. The manual third - third gear illustration shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.

Torque Converter Clutch Applied

TCC Control Solenoid: When conditions are appropriate, the TCM energizes the TCC control solenoid to initiate the TCC apply. The solenoid is pulse width modulated (PWM) to provide a smooth TCC apply (refer to the electrical controls section for a detailed description of the TCC control solenoid operation). When energized, the solenoid modulates filtered 2-3 drive fluid into the TCC signal fluid circuit.

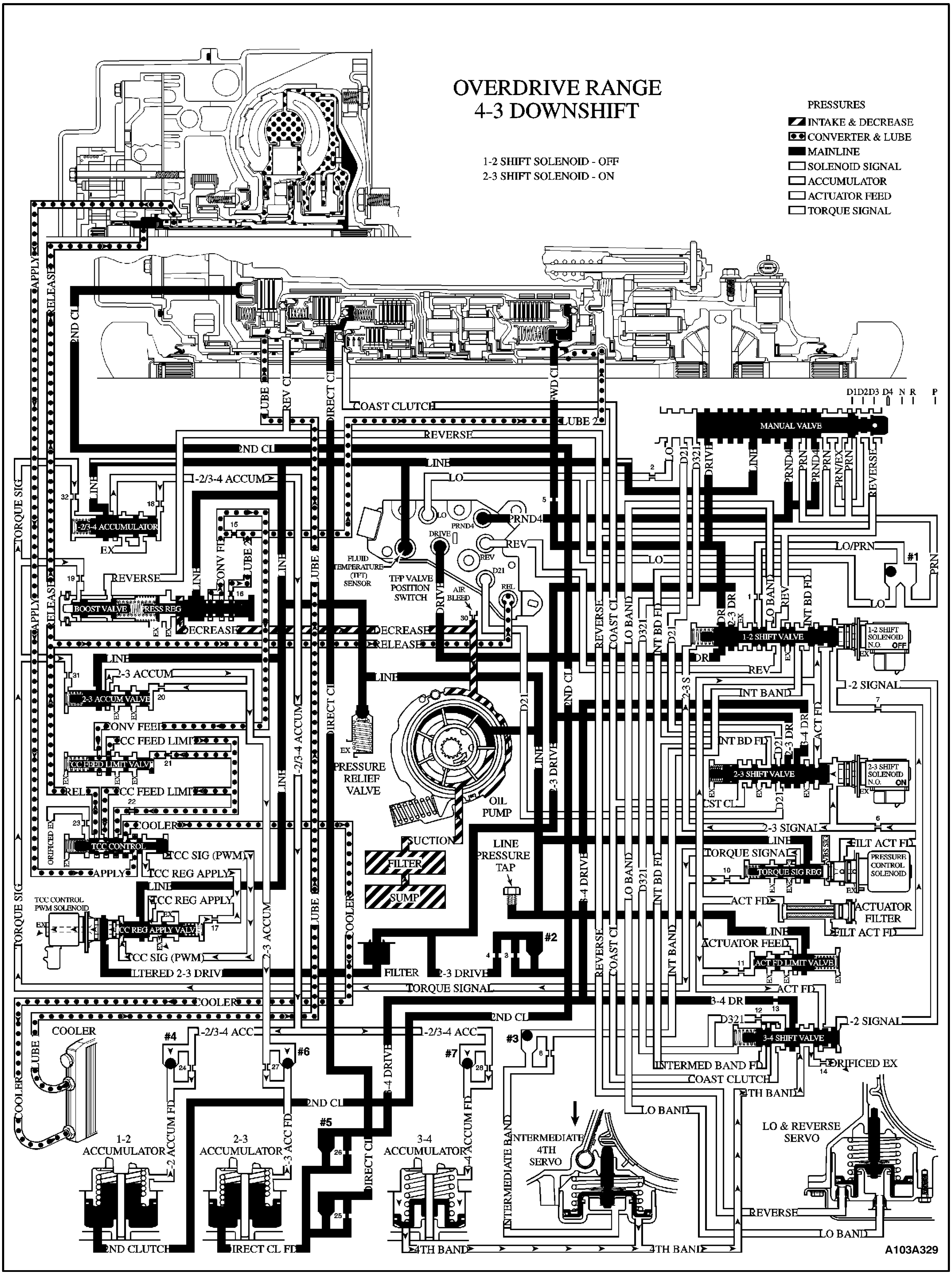
TCC Regulated Apply Valve: TCC signal fluid pressure modulates the valve against spring force and TCC regulated apply fluid pressure. This action directs line pressure into the TCC regulated apply fluid circuit in relation to vehicle operating conditions.

TCC Control Valve: Modulated TCC signal fluid pressure moves the valve against spring force in relation to vehicle operating conditions. This action regulates TCC regulated apply fluid into the apply fluid circuit. At the same time, the release fluid circuit is opened to an orificed exhaust. In this position the valve directs TCC feed limit fluid to feed the cooler fluid circuit.

Torque Converter Clutch: Apply fluid is routed to the torque converter at the same time release fluid exhausts from the converter. Apply fluid pressure applies the TCC.

TFP: Release fluid also exhausts from the TFP and the TFP signals the TCM that the TCC is released.

OVERDRIVE RANGE – 4-3 DOWNSHIFT



When the transaxle is operating in overdrive range - fourth gear, a forced 4-3 downshift will occur if there is a significant increase in throttle position. At minimum throttle, vehicle speed will decrease gradually (coastdown) and the TCM will command a 4-3 downshift. The TCM will also initiate a 4-3 downshift if engine load is increased with throttle position remaining the same (for example, driving up a steep hill).

Line Pressure Increases

Pressure Control Solenoid (PCS): During the downshift, except for a coastdown, the TCM senses the increase in throttle position or engine load and increases the PCS duty cycle. The increase in duty cycle increases output fluid pressure from the PCS, thereby increasing torque signal fluid pressure at the torque signal regulator valve.

Pressure Regulator Valve: Increased torque signal fluid pressure acting on the boost valve increases line pressure at the pressure regulator valve.

Intermediate/4th Band Releases

1-2 Shift Solenoid: The TCM de-energizes the normally open solenoid and 1-2 signal fluid exhausts.

3-4 Shift Valve: 1-2 signal fluid pressure exhausts from the 3-4 shift valve and spring force moves the valve into the third gear position. This opens the 4th band fluid circuit to an orificed exhaust to help control the band release.

Intermediate/4th Servo: 4th band fluid exhausts from the servo and spring force moves the servo to the release position, thereby releasing the band.

3-4 Accumulator: 4th band fluid exhausts from the accumulator. Spring force and 3-4 accumulator feed fluid pressure move the accumulator piston to the third gear position.

1-2/3-4 Accumulator Valve: The accumulator valve regulates line pressure into the 1-2/3-4 accumulator fluid circuit to fill the 3-4 accumulator. This regulation is basically controlled by torque signal fluid pressure. Increased torque signal fluid pressure regulates accumulator fluid to a higher pressure.

#7 Checkball (3-4 Accumulator): 1-2/3-4 accumulator fluid pressure seats the #7 checkball and forces accumulator fluid through orifice #28.

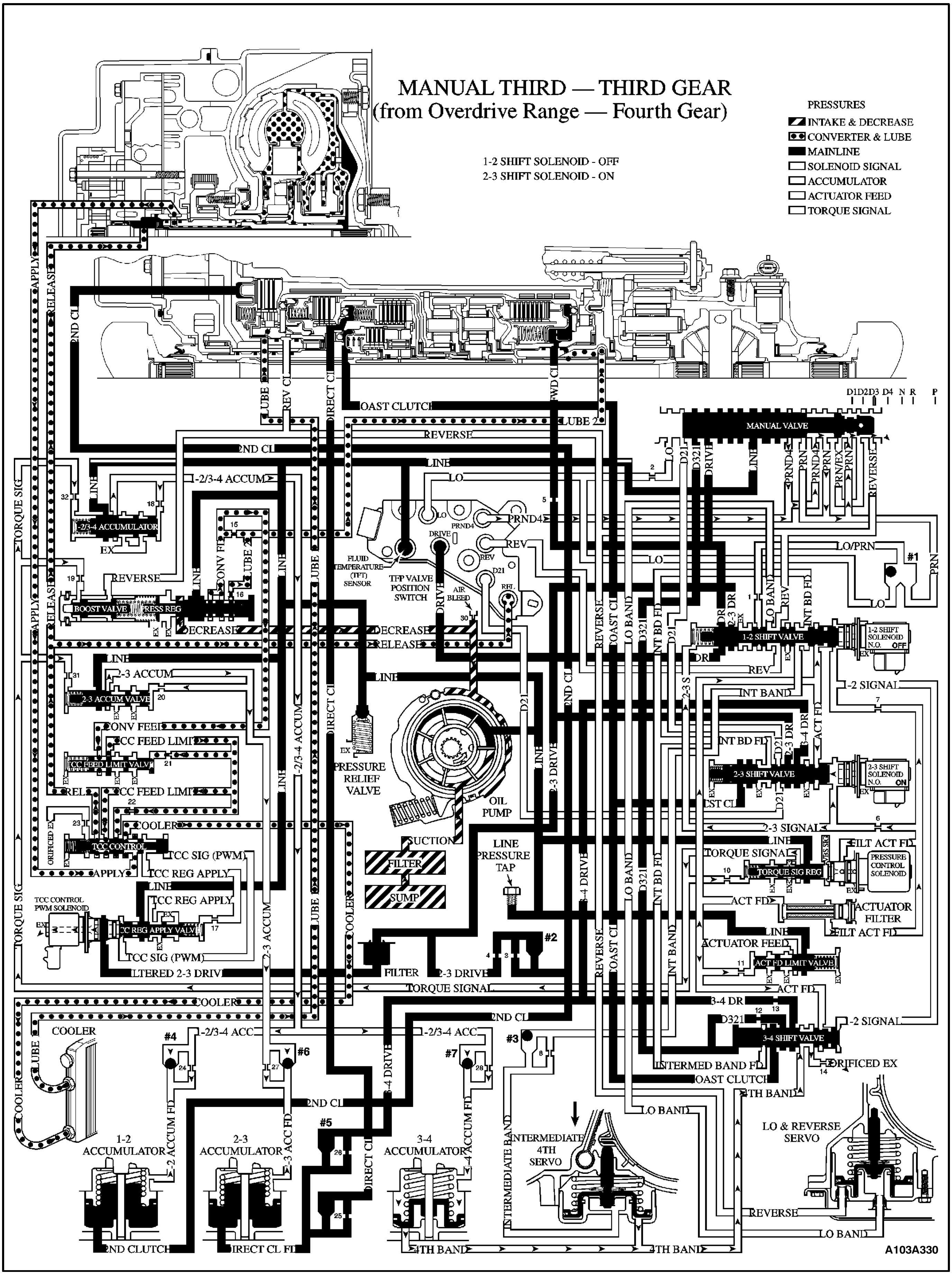
Torque Converter Clutch

The TCM commands TCC release prior to initiating a 4-3 downshift. When the TCC is in the release position, release fluid pressure is routed to the pressure switch assembly. This fluid pressure signals the TCM that the TCC is in the release position. The TCC is not applied under normal operating conditions in third gear (except for some applications).

3-2 and 2-1 Downshifts

Refer to the manual range explanations for a description of the 3-2 and 2-1 downshifts with respect to the clutches releasing.

MANUAL THIRD - THIRD GEAR



A manual 4-3 downshift is accomplished by moving the gear selector lever to the manual third (3) position. In manual third, the transaxle is hydraulically prevented from upshifting into fourth gear under any conditions. Also, the coast clutch is applied in all manual ranges to provide engine compression braking when appropriate. The following information explains the additional changes during a manual 4-3 downshift as compared to a forced 4-3 downshift. Refer to Overdrive Range - 4-3 Downshift for a complete description of a 4-3 downshift.

Fourth Gear Hydraulically Prevented

Manual Valve: The manual valve moves into the manual third (3) position and line pressure enters the D321 fluid circuit. Also, the manual valve blocks line pressure from the PRND4 fluid circuit and PRND4 fluid exhausts past the manual valve.

3-4 Shift Valve: D321 fluid pressure assists spring force to keep the valve in the third gear position under any conditions. This opens the 4th band fluid circuit to an orificed exhaust and the intermediate/4th band releases, thereby preventing fourth gear.

Important: The operating states for the shift solenoids follow the normal operation depending on vehicle driving conditions. The manual first - first gear illustration shows the solenoids in the third gear position.

TFP: PRND4 fluid exhausts from the TFP and the TFP signals the TCM that the manual valve is in the manual third position.

Coast Clutch Applies

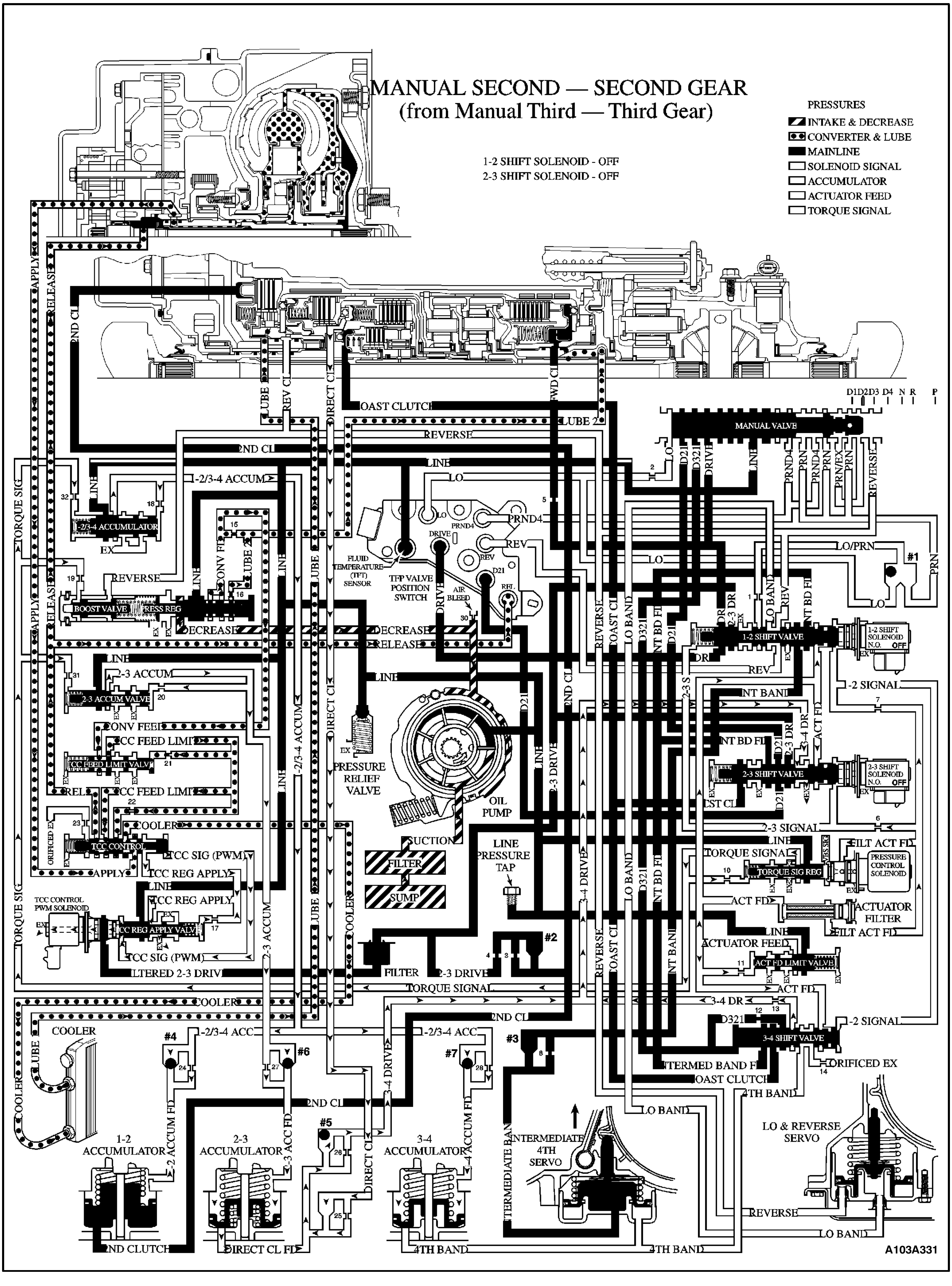
3-4 Shift Valve: D321 fluid is routed through the 3-4 shift valve and into the coast clutch fluid circuit.

Coast Clutch: Coast clutch fluid pressure applies the coast clutch. With the coast clutch applied, engine compression braking is available in manual third - third gear to slow the vehicle when the throttle is released.

Manual Third – Second and First Gears

The transmission operates the same in manual third as in overdrive range with the exception of fourth gear being prevented. The transaxle will upshift and downshift between first, second, and third gears as in overdrive range. However, engine compression braking is not available in manual third - first and second gears and the vehicle will coast when the throttle is released.

MANUAL SECOND - SECOND GEAR



A manual 3-2 downshift is initiated by moving the gear selector lever to the manual second (2) position. However, the transaxle will not downshift into second gear until vehicle speed is below approximately 99 km/h (62 mph). At higher vehicle speeds, the TCM will keep 2-3 shift solenoid energized (ON) and the transaxle will operate in manual second - third gear as a safety precaution. In manual second the transaxle is hydraulically prevented from upshifting into fourth gear under any conditions. Also, the coast clutch remains applied as in manual third and provides engine compression braking in third and second gears. The transaxle upshifts and downshifts between first and second gears as in overdrive range.

Manual Valve: Line pressure is routed into the D21 fluid circuit when the selector lever is moved into the manual second (2) position. Line pressure continues to feed the D321 fluid circuit as in manual third.

2-3 Shift Solenoid: The TCM de-energizes 2-3 shift solenoid when vehicle operating conditions are appropriate for 3-2 downshift. With the solenoid OFF 2-3 signal fluid exhausts through 2-3 shift solenoid.

2-3 Shift Valve: Spring force moves the 2-3 shift valve into the second gear position when 2-3 signal fluid exhausts. D21 fluid continues through the valve and is also routed into the intermediate band feed fluid circuit. 3-4 drive fluid, which feeds the direct clutch, exhausts past the 2-3 shift valve.

Direct Clutch Releases

Direct Clutch: Direct clutch fluid exhausts and the direct clutch releases.

2-3 Accumulator: Direct clutch feed fluid exhausts from the 2-3 accumulator, unseats the #5 checkball and exhausts past the 2-3 shift valve. 2-3 accumulator feed fluid seats the #6 checkball and fluid is routed through orifice #27 to control accumulator feed pressure as direct clutch feed fluid exhausts.

2-3 Accumulator Valve: The accumulator valve regulates line pressure into the 2-3 accumulator fluid circuit to fill the 2-3 accumulator. This regulation is basically controlled by torque signal fluid pressure. Accumulator fluid pressure is regulated to a higher pressure with greater torque signal fluid pressure.

Intermediate/4th Band Applies

1-2 Shift Valve: 1-2 Shift solenoid is OFF when the TCM commands second gear and spring force holds the 1-2 shift valve in the upshifted position. Intermediate band feed fluid is routed through the valve and into the intermediate band fluid circuit.

#3 Checkball (Intermediate Band Apply): Intermediate band fluid pressure seats the #3 checkball and is forced through the #8 orifice. This orifice helps control the intermediate band apply.

Intermediate/4th Servo: Intermediate band fluid pressure is routed to the inner area of the intermediate/4th servo piston. This fluid pressure moves the servo piston and apply pin to apply the intermediate/4th band. The band provides engine compression braking in manual second - second gear.

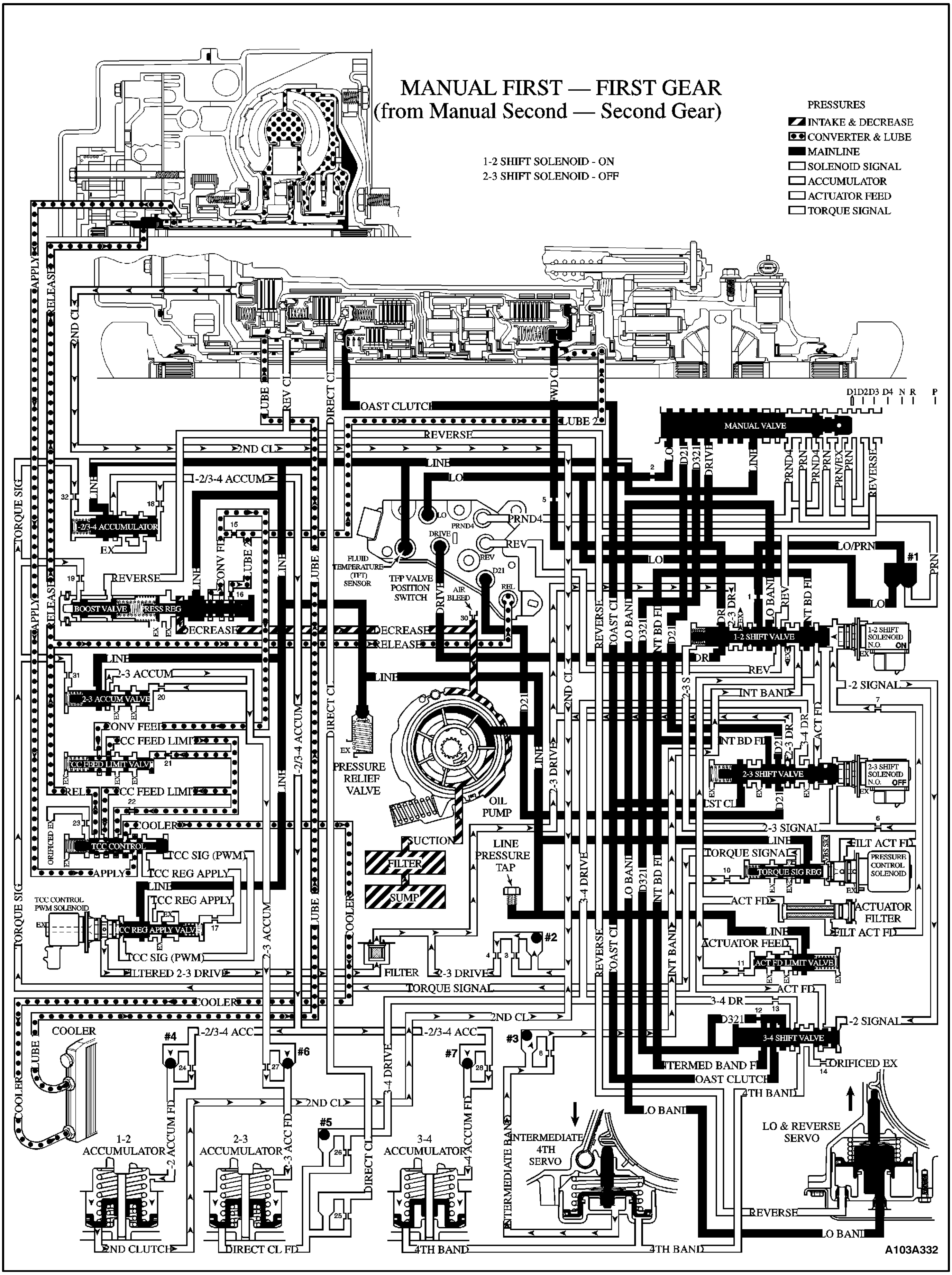
Pressure Control

TFP: D21 fluid from the 2-3 shift valve is routed to the TFP. The TFP signals the TCM that the manual valve is in the manual second position.

Pressure Control Solenoid: The TCM increases the PCS duty cycle to increase the operating range of torque signal fluid pressure in manual second. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine load in manual second.

Torque Converter Clutch: The TCM will release the TCC before downshifting into manual second. The TCC will not re-apply in second gear under normally operating conditions.

MANUAL FIRST - FIRST GEAR



A manual 2-1 downshift is initiated by moving the gear selector lever to the manual first (1) position. However, the transaxle will not downshift into first gear until vehicle speed is below approximately 60 km/h (37 mph). At higher vehicle speeds the TCM will keep 1-2 shift solenoid de-energized (OFF) and the transaxle will operate in manual first - second gear. In manual first, the transaxle is electronically prevented from upshifting into third or fourth gears under any conditions. Also, the coast clutch remains applied, as in manual third and manual second, and provides engine compression braking in first and second gears.

Manual Valve: Line pressure is routed into the LO fluid circuit when the selector lever is moved into the manual first (1) position. Line pressure continues to feed the drive, D321 and D21 fluid circuits as in manual second.

TFP: LO fluid pressure is routed to the TFP and the TFP signals the TCM that the manual valve is in the manual first position.

#1 Checkball (LO/PRN): LO fluid pressure seats the #1 checkball against the PRN fluid circuit and fills the LO/PRN fluid circuit. LO/PRN fluid is routed to the 1-2 shift valve.

1-2 Shift Solenoid: 1-2 shift solenoid is energized by the TCM when vehicle speed is below approximately 30 to 35 mph. 1-2 signal fluid is blocked from exhausting through the solenoid.

1-2 Shift Valve: 1-2 signal fluid pressure shifts the valve into the downshifted position against spring force and the following changes occur:

- The 2-3 drive fluid circuit is open to an exhaust past the valve.
- Intermediate band fluid is exhausted past the valve.
- LO/PRN fluid is routed into the lo band fluid circuit.

Second Clutch Releases

Second Clutch: 2nd clutch fluid exhausts from the clutch piston and through the 2-3 drive fluid circuit. This releases the 2nd clutch and the transaxle operates in first gear.

1-2 Accumulator: 2nd clutch feed fluid exhausts from the 1-2 accumulator, exhausts past the #2 checkball and through the 2-3 drive fluid circuit. 1-2 accumulator feed fluid fills the 1-2 accumulator as 2nd clutch fluid exhausts.

1-2/3-4 Accumulator Valve: The accumulator valve regulates line pressure into the 1-2/3-4 accumulator fluid circuit to fill the 1-2 accumulator. This regulation is basically controlled by torque signal fluid pressure. Accumulator fluid pressure is regulated to a higher pressure with greater torque signal fluid pressure.

TCC Control Solenoid: Filtered 2-3 drive fluid exhausts from the solenoid and through the 2-3 drive fluid circuit.

Intermediate Band Releases

Intermediate/4th Servo: Intermediate band fluid exhausts from the servo piston, spring force moves the piston and apply pin and the intermediate/4th band releases. However, the intermediate/4th band remains applied in manual first - second gear to achieve engine compression braking.

Lo/Reverse Band Applies

Lo/Reverse Servo: Lo/band fluid pressure is routed to the inner area of the lo/reverse servo to apply the lo/reverse band. The lo/reverse band provides engine compression braking when the throttle is released in manual first - first gear.

Important: Manual first - third gear is also possible at high speeds as a safety feature.

SECTION 6A

POWER STEERING SYSTEM

TABLE OF CONTENTS

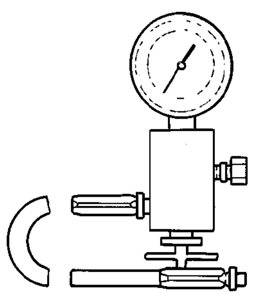
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Air Cleaner Housing Bolts	12	-	106
Power Steering Fluid Reservoir Attaching Bolts	7	-	62
Power Steering Line Fittings-Cylinder End	27	20	-
Power Steering Line Fittings-Valve End	18	13	-
Power Steering Pump Pressure Line Union Nut	27	20	-
Steering Gear Inlet and Outlet Pipe Fittings	27	20	-

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A105A009	KM-354-B Pressure Test Gauge Kit

DIAGNOSIS

POWER STEERING SYSTEM PRESSURE TEST

Tools Required

KM-354-B Pressure Test Gauge Kit

Check the fluid pressure as follows to determine whether the trouble is in the pump or the gear unit.

Test Procedure

1. Check the power steering fluid level and the power steering pump belt tension. Refer to “Checking and Adding Fluid” in this section and Section 6B, Power Steering Pump.
2. Disconnect the high pressure line at the pump. Use a small container to catch any fluid.
3. Connect the hose of the pressure test gauge kit KM-354-B to the power steering pressure hose from the power steering pump.
4. Place the gear selector lever in PARK (automatic transaxle-equipped vehicles) or NEUTRAL (manual transaxle-equipped vehicles). Set the parking brake.
5. Open the gauge valve fully.
6. Start the engine and let it idle.
7. Turn the steering wheel from lock-to-lock several times to warm the fluid to operating temperature.
8. Increase the engine speed to 1,500 rpm.

Notice: The power steering pump could be damaged if the valve is fully closed for more than five seconds.

9. Close the gauge valve fully, and read the pressure. The pump pressure with the valve closed should be between 7 088 kPa to 8 619 kPa (1,028 psi to 1,250 psi).
10. Immediately open the gauge valve fully.
11. Turn the steering wheel all the way to the left and the right. If the pressure is within the specified limits, the problem is not in the pump. Check the power steering gear for leaks.

POWER STEERING SYSTEM LEAK TEST

General Procedure

Inspect the following:

- The fluid reservoir for overfill.
- Fluid for aeration and overflow.
- The hoses for loose connections.
- The torsion bar, stub shaft and adjuster seals for leaks.
- The component sealing surfaces for damage.

Important: Verify the exact point of the leak. The point from which the fluid is dripping is not necessarily the point at which the system is leaking. When service is required, clean the leak area upon disassembly, replace the leaking seal, check the component sealing surfaces for damage and reset the torque bolt to specifications, where required.

External Leak Check

The purpose of this procedure is to pinpoint the location of the leak. In some cases, the leak can be easily located, but seepage-type leaks may be harder to find. To locate seepage leaks, use the following method:

1. With the engine off, wipe dry the complete power steering system.
2. Check the power steering fluid level in the pump's reservoir. Adjust the fluid level as necessary. Refer to “Checking and Adding Fluid” in this section.

Notice: Do not hold the steering wheel at a stop for any length of time as this can damage the power steering pump.

3. Start the engine. Turn the steering wheel counterclockwise and clockwise from stop to stop several times.
4. Find the exact area of the leak and repair it.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

BLEEDING THE POWER STEERING SYSTEM

If the power steering hydraulic system has been serviced, an accurate fluid level reading cannot be obtained until the air is bled from the system. Follow these steps to bleed the air from the system.

1. Turn the wheels all the way to the left and add the power steering fluid to the MIN mark on the fluid level indicator.

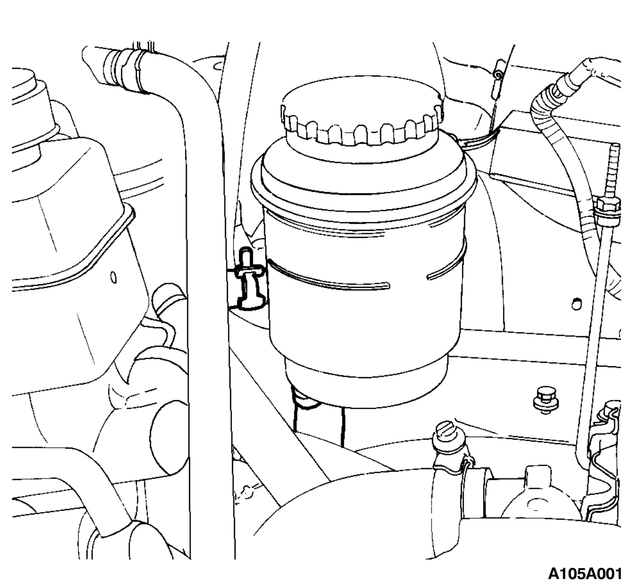
Notice: When adding fluid or making a complete fluid change, always use DEXRON® III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

2. Start the engine. With the engine running at fast idle, recheck the fluid level. If necessary, add fluid to bring the level up to the MIN mark.
3. Bleed the system by turning the wheels from side to side without reaching the stop at either end. Keep the fluid level at the MIN mark. The air must be eliminated from the fluid before normal steering action can be obtained.
4. Return the wheels to the center position. Continue running the engine for two to three minutes.
5. Road test the car to be sure the steering functions normally and is free from noise.
6. Recheck the fluid level as described in steps 1 and 2. Make sure the fluid level is at the MAX mark after the system has stabilized at its normal operating temperature. Add fluid as needed.

CHECKING AND ADDING FLUID

Notice: When adding fluid or making a complete fluid change, always use DEXRON® III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. The power steering fluid level is indicated either by marks on a see-through fluid reservoir or by marks on a fluid level indicator on the fluid reservoir cap.
2. If the fluid is warmed up to 665C (1505F), the fluid level should be between the MAX and MIN marks. Add fluid as needed.
3. If the fluid is cool, 215C (705F), the fluid level should be at the MIN mark. Add fluid as needed.



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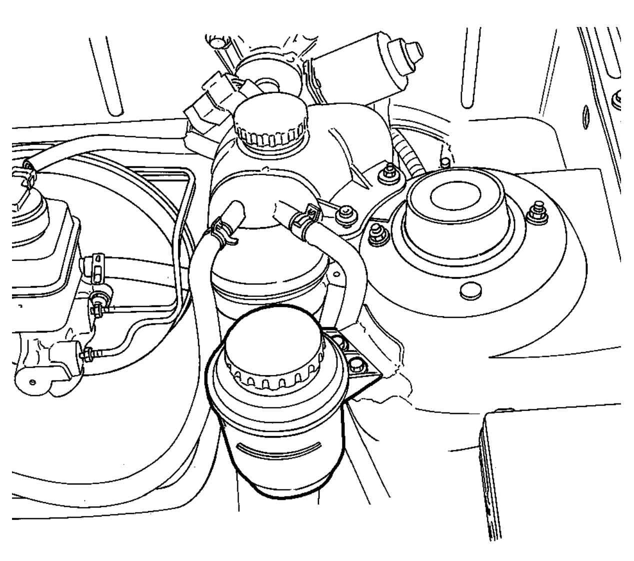
FLUID RESERVOIR

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Siphon the power steering fluid from the fluid reservoir.
2. Loosen the hose clamps and remove both hoses.



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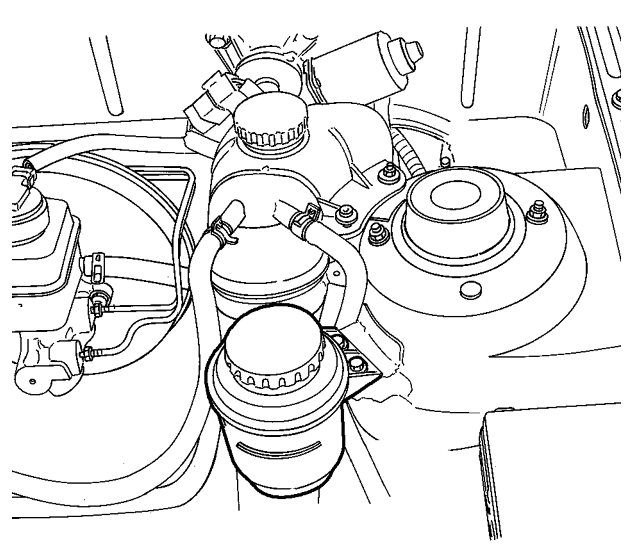
3. Remove the fluid reservoir attaching bolts and remove the fluid reservoir from the power steering fluid reservoir bracket.



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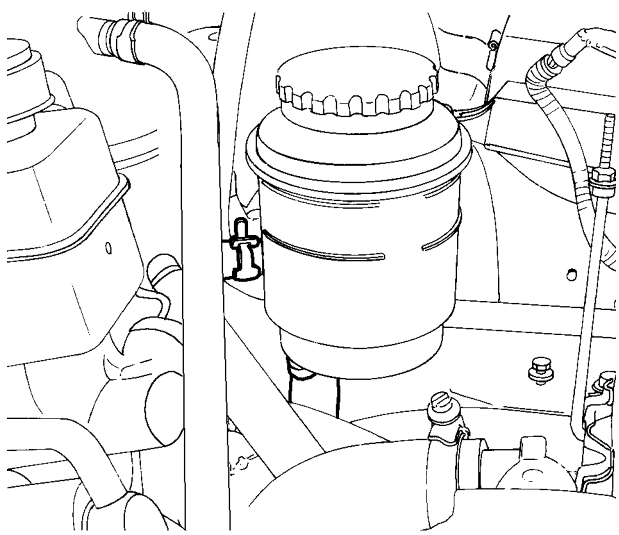
Installation Procedure

1. Attach the fluid reservoir to the power steering fluid reservoir bracket with the power steering fluid reservoir attaching bolts.

   Tighten

   Tighten the power steering fluid reservoir attaching bolts to 7 N•m (62 lb-in).



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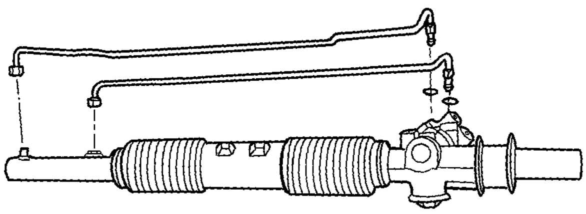
2. Connect both hoses and secure the hose clamps.

Notice: When adding fluid or making a complete fluid change, always use DEXRON® III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

3. Fill the fluid reservoir with power steering fluid.
4. Inspect for leaks. If there are leaks, correct the cause of the leaks and bleed the system. Refer to "Bleeding the Power Steering System" in this section.



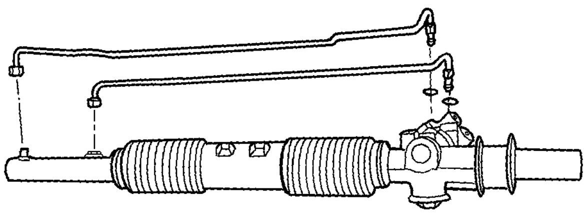
A105A004

HOSES AND PIPES

Steering Gear Cylinder Pipes

Removal Procedure

1. Siphon the power steering fluid from the fluid reservoir.
2. Disconnect and remove the steering gear cylinder pipes at the rack and pinion housing. Remove the O-ring seals from the housing.



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Installation Procedure

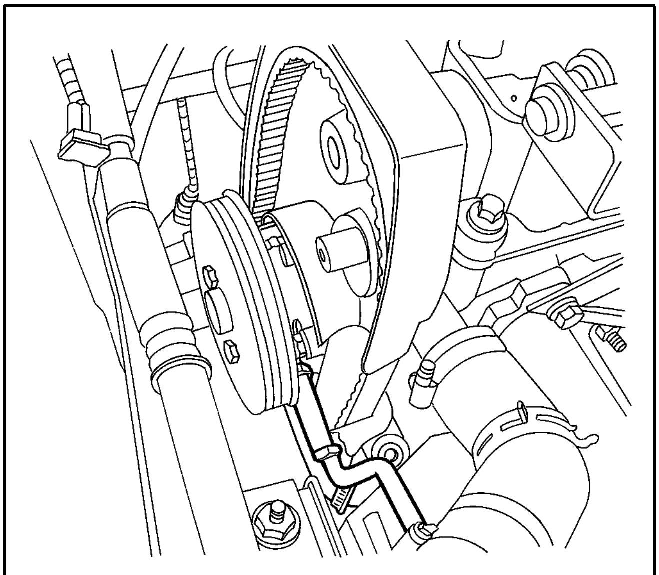
1. Install new O-rings onto the cylinder pipes. Install the steering gear cylinder pipes into the rack and pinion housing.

   Tighten

   Tighten the power steering line fittings at the cylinder end to 27 N•m (20 lb-ft).

   Tighten

   Tighten the power steering line fittings at the valve end to 18 N•m (13 lb-ft).
2. Fill the fluid reservoir with power steering fluid.
3. Inspect for leaks. If there are leaks, correct the cause of the leaks and bleed the system. Refer to "Bleeding the Power Steering System" in this section.



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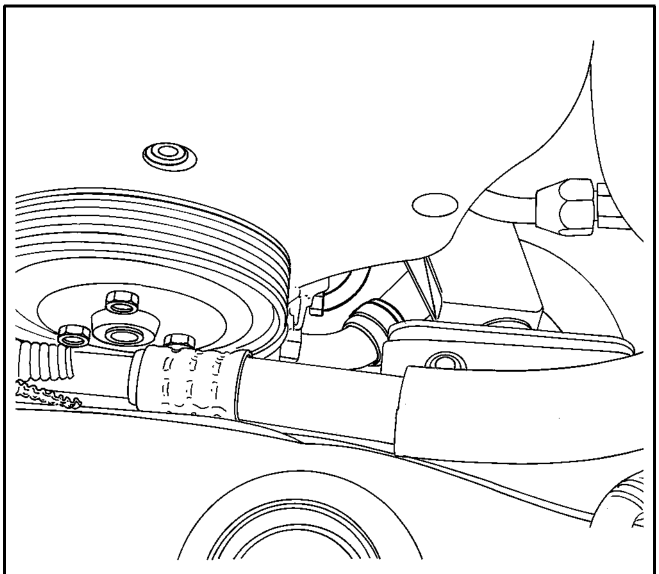
Power Steering Pump Hoses and Pipes (Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Remove the battery and battery tray. Refer to Section 1E, Engine Electrical.
2. Siphon the power steering fluid from the fluid reservoir.
3. On SOHC engines, disconnect the pressure line pipe and the supply line hose from the inlet and outlet connections on the power steering pump.



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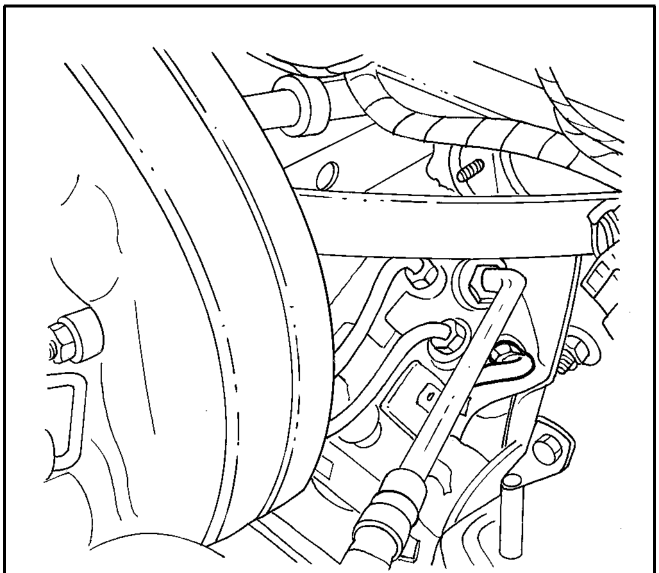
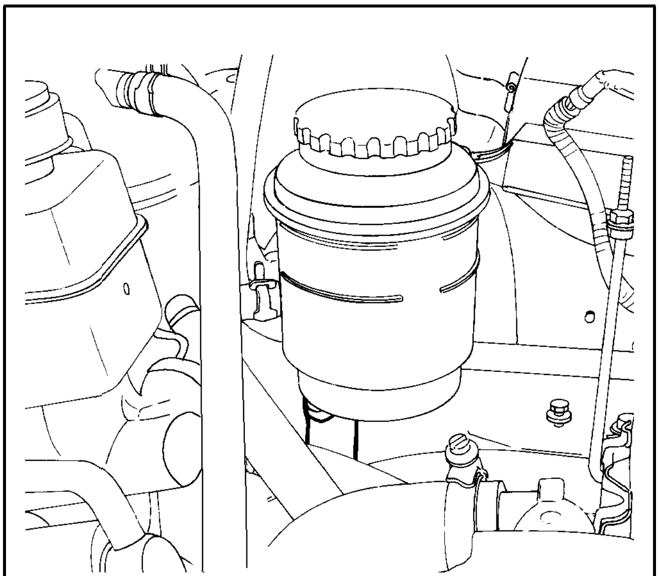
4. On DOHC engines, remove the air cleaner housing and disconnect the pressure line pipe and the supply line hose from the inlet and outlet connections on the power steering pump.



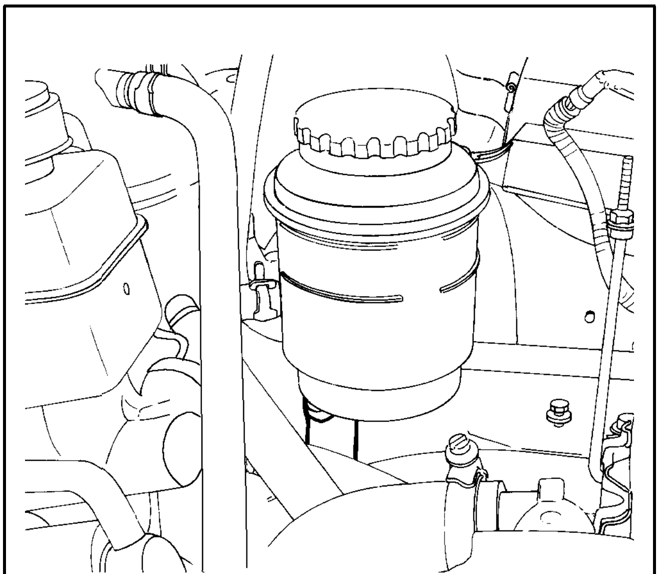
A105A005

5. Disconnect the pressure line and return line hoses from the retaining clips at the bottom and the side of the radiator.
6. Disconnect the pressure line inlet pipe from the steering gear.



A105A006

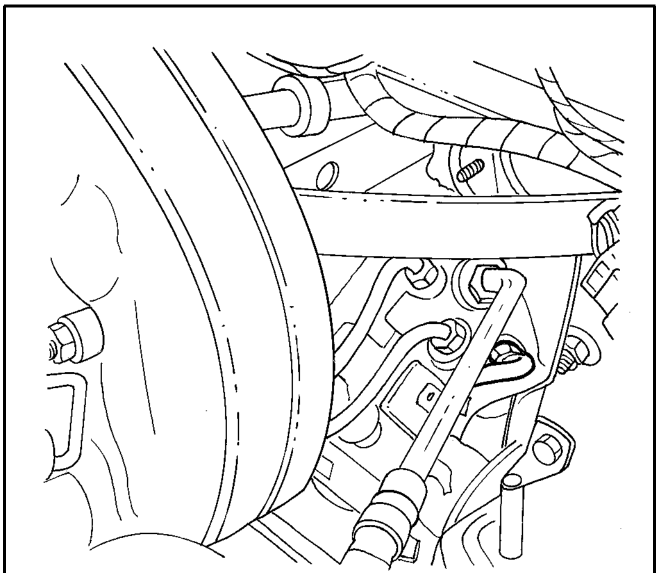
7. **Disconnect the supply line hose from the power steering fluid reservoir.**
8. **Remove the power steering pump pressure line and return line.**



A105A006

Installation Procedure

1. **Install the power steering pump pressure line and return line.**
2. **Connect the supply line hose to the power steering fluid reservoir.**

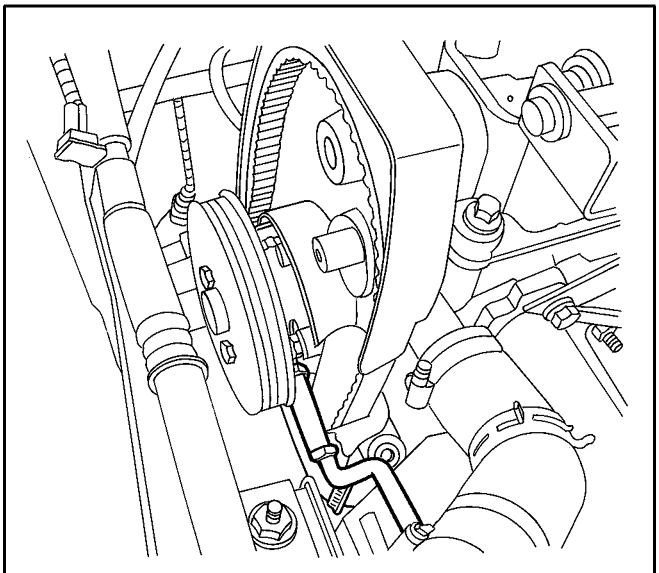


A105A005

3. **Connect the pressure line inlet pipe to the steering gear.**

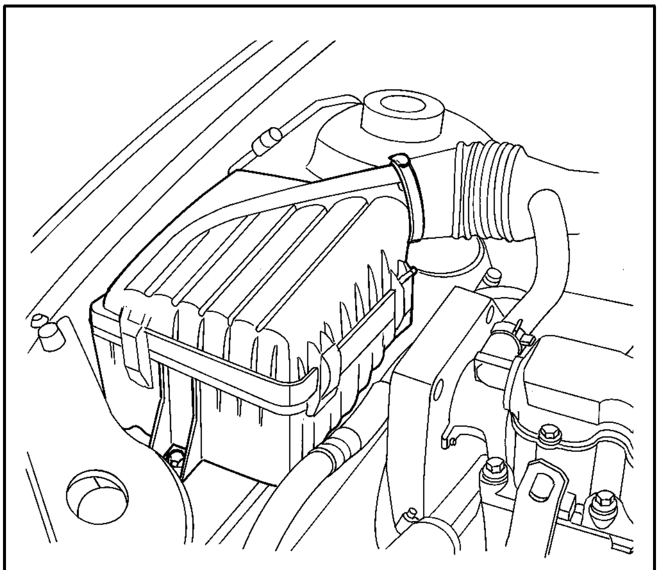
Tighten

Tighten the steering gear inlet pipe fitting to 27 N•m (20 lb-ft).



A105A003

4. Connect the pressure line and return line hoses to the retaining clips at the bottom and the side of the radiator.
5. On SOHC engines, connect the pressure line pipe and the supply line hose to the inlet and outlet connections on the power steering pump.



A105B018

6. On DOHC engines, install the air cleaner housing.

Tighten

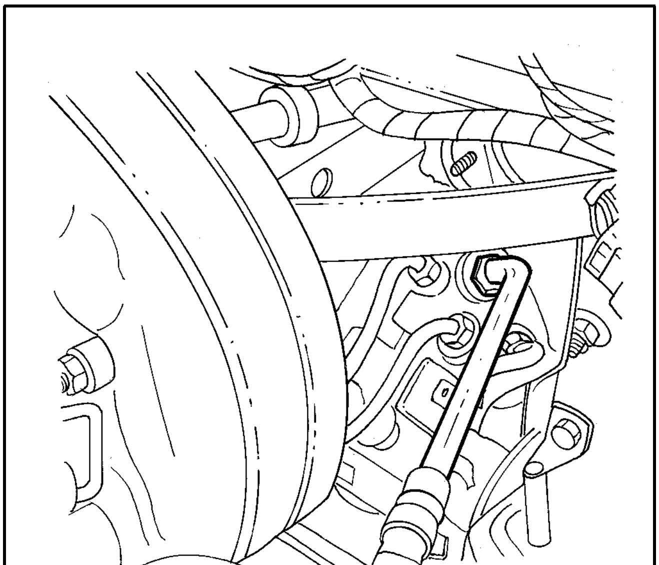
Tighten the air cleaner housing bolts to 12 N•m (106 lb-in).

7. On DOHC engines, connect the pressure line pipe and the supply line hose to the inlet and outlet connections on the power steering pump.

Tighten

Tighten the power steering pump pressure line union nut to 27 N•m (20 lb-ft).

8. Install the battery and battery tray. Refer to Section 1E, Engine Electrical.
9. Fill the fluid reservoir with power steering fluid.
10. Inspect for leaks. If there are leaks, correct the cause of the leaks and bleed the system. Refer to "Bleeding the Power Steering System" in this section.

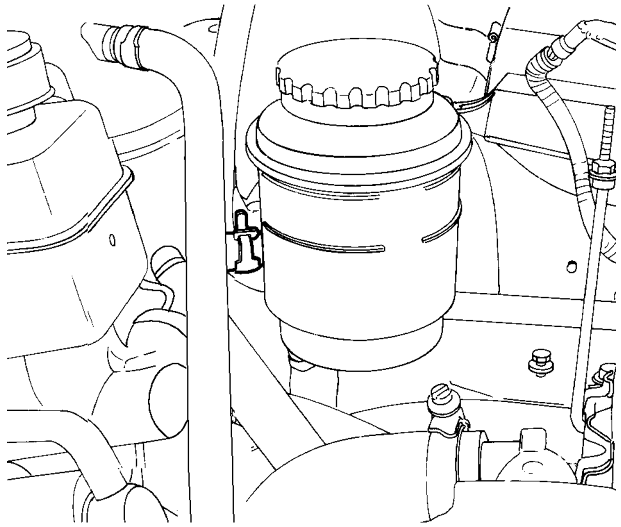


A105A007

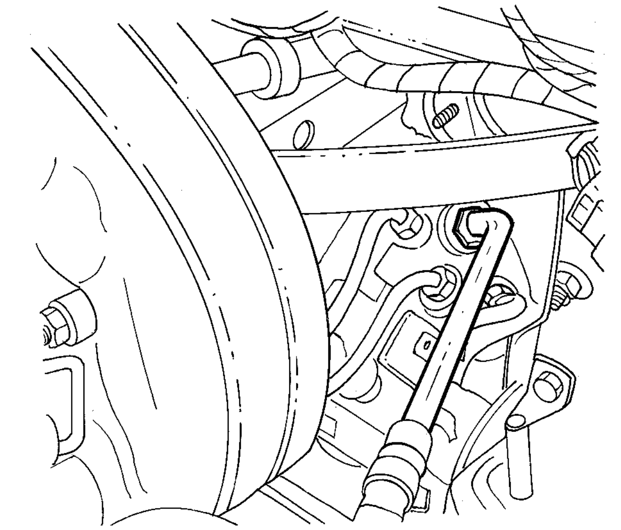
Power Steering Fluid Reservoir Hose (Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Siphon the power steering fluid from the fluid reservoir.
2. Disconnect the return line pipe from the outlet connection at the steering gear.


A105A008

3. Disconnect the fluid reservoir hose from the fluid reservoir.
4. Remove the fluid reservoir hose.


A105A007

Installation Procedure

1. Connect the fluid reservoir hose at the fluid reservoir.
2. Connect the fluid reservoir pipe to the outlet connection at the steering gear.

Tighten

Tighten the steering gear outlet pipe fittings to 27 N•m (20 lb-ft).

Notice: When adding fluid or making a complete fluid change, always use DEXRON® III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

3. Fill the fluid reservoir with power steering fluid.
4. Inspect for leaks. If there are leaks, correct the cause of the leaks and bleed the system. Refer to "Bleeding the Power Steering System" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

POWER STEERING SYSTEM

General Description

The power steering system consists of three components: the power steering pump, the power steering fluid reservoir and the the power steering rack and pinion gear. The power steering pump is a vane-type pump providing hydraulic pressure for the system and is powered by the engine. It draws on the power steering fluid reservoir, which in turn is connected to the power steering gear. A pressure-relief valve inside the flow control valve limits the pump pressure. The power steering rack and pinion gear has a rotary control valve which directs hydraulic fluid coming from the power steering pump to one side or the other side of the rack piston. The integral rack piston is attached to the rack. The rack piston converts hydraulic pressure to a linear force which moves the rack to the left or the right. The force is then transmitted through the inner and the outer tie rods to the steering knuckles, which turn the wheels.

SECTION 6B

POWER STEERING PUMP

TABLE OF CONTENTS

SPECIFICATIONS

GENERAL SPECIFICATIONS

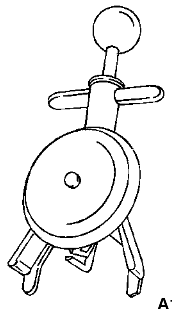
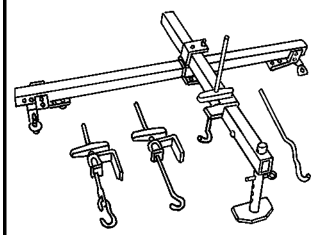
Application	Description
Lubricant	Power steering fluid DEXRON®-III
Capacity	1.0 Liter (1.05 qt)

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Air Cleaner Housing Bolts	12	-	106
Alternator Adjusting Bolt	20	15	-
Crankshaft Pulley Bolt	95 +30° +15°	70 +30° +15°	-
Engine Bracket-to-Mount Bolts	60	44	-
Power Steering Pump Pulley Bolts	25	18	-
Power Steering Pump Retaining Bolts	25	18	-
Tension Pulley Securing Bolt	25	18	-
Timing Belt Cover Bolts	10	-	89

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A105B001	J-23600-B Belt Tension Gauge	 A102B152	J-28467-B Engine Support Fixture

DIAGNOSIS

POWER STEERING PUMP DIAGNOSIS

Foaming, Milky Power Steering Fluid, Low Fluid Level, and Possible Low Pressure

Checks	Action
Check the power steering fluid level.	Fill the power steering fluid reservoir.
Check for air contamination in the power steering fluid.	Bleed the power steering system.
Check the power steering pump for internal leaks and overflow.	Replace the power steering pump.
Check the power steering pump housing and the soft plug for leaks.	Replace the power steering pump.

Low Pressure Due to Steering Pump

Checks	Action
Check the power steering pump flow control valve for sticking and improper operation.	Replace the power steering pump.
Check the power steering pump seals for wear.	Replace the power steering pump.
Check the pressure plate, the pump ring, the thrust plate, and the rotor for scores, cracks, or breaks.	Replace the power steering pump.
Check the vanes for sticking in the rotor slots.	Replace the power steering pump.
Check the power steering pump for internal leaks and overflow.	Replace the power steering pump.

Growling Noise in Steering Pump

Checks	Action
Check the pump hoses and the steering gear pipes for restricted flow.	Clean out the pipes and the hoses. Replace the pipes and the hoses as needed.
Check the pressure plate, the pump ring, the thrust plate, and the rotor for scores, cracks, or breaks.	Replace the power steering pump.
Check the power steering hose for contact with the body.	Secure the pump hose in a clamp away from the body.
Check the power steering fluid level.	Fill the power steering pump reservoir.

Rattling Noise in the Steering Pump

Checks	Action
Check for air contamination in the power steering fluid.	Bleed the power steering system.
Check the power steering hose for contact with the body.	Secure the pump hose in a clamp away from the body.
Check the power steering fluid level.	Fill the power steering pump reservoir.
Check the pump mounting for improper installation.	Tighten the power steering pump attachment bolts.

Swishing Noise in the Steering Pump

Checks	Action
Check the power steering pump flow control valve for damage.	Replace the power steering pump.

Whining Noise in the Steering Pump

Checks	Action
Check the pressure plate and the vanes for scores.	Replace the power steering pump.
Check the pump shaft bearing for scores.	Replace the power steering pump.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

PUMP DRIVE BELT

Tools Required

J-23600-B Belt Tension Gauge

Checking Belt Tension

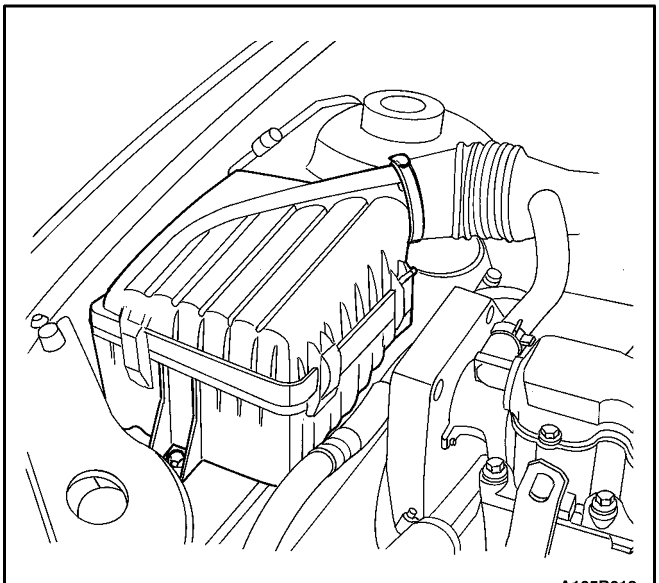
1. Using belt tension gauge J-23600-B, check the tension on the pump drive belt.
2. If belt tension gauge J-23600-B does not indicate the proper tension, adjust the belt.

Adjusting Belt Tension

1. With belt tension gauge J-23600-B on the pump drive belt, loosen the alternator adjusting bolt and move the alternator until the gauge indicates the proper tension.
2. Tighten the alternator adjusting bolt.

Tighten

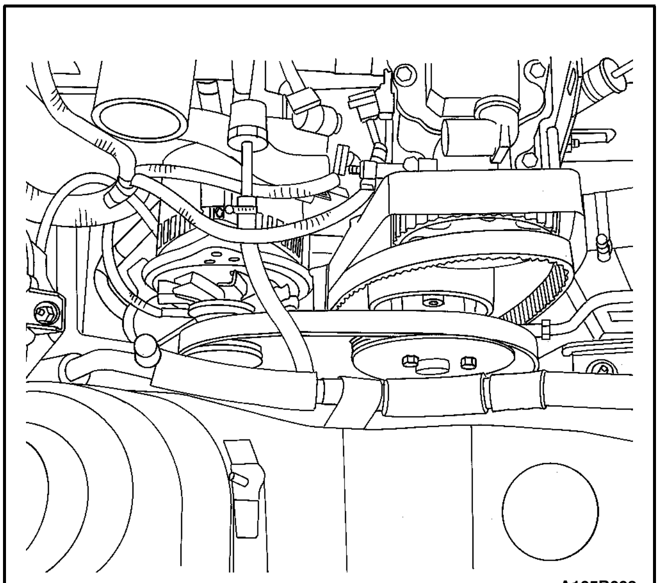
Tighten the alternator adjusting bolt to 20 N•m (15 lb-ft).


A105B018

SOHC PUMP DRIVE PULLEY

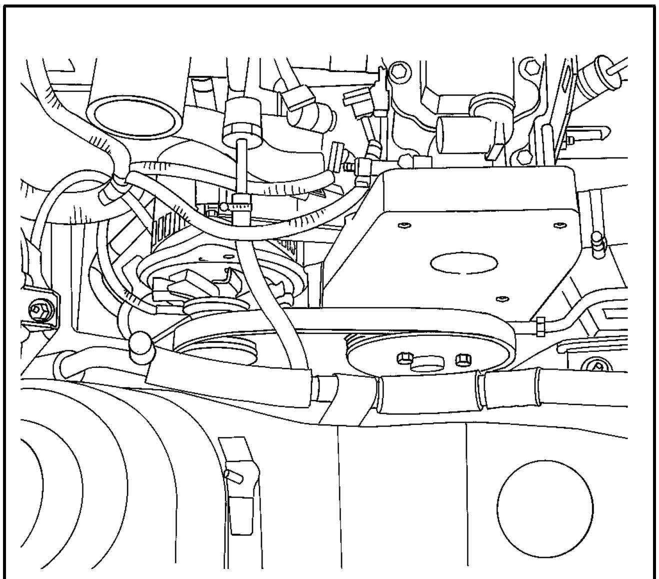
Removal Procedure

1. Remove the air cleaner housing by removing the housing bolts and loosening the clamp.



A105B003

2. Loosen the steering pump pulley bolts.
3. Remove the pump drive belt from the pulley by loosening the alternator adjusting bolt and pulling it forward.
4. Remove the steering pump pulley bolts that connect the pulley to the pump.
5. Remove the pulley from the pump.



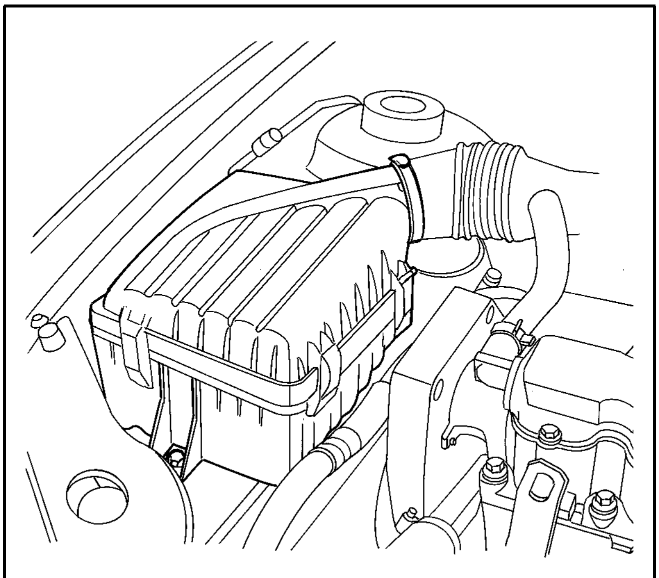
A105B030

Installation Procedure

1. Replace the pump on the engine if the pump was previously removed. Refer to "Pump Assembly" in this section.
2. Install the pulley on the pump. Install the steering pump pulley bolts.
3. Install the pump drive belt.
4. Tighten the steering pump pulley bolts to fasten the pulley to the pump.

   Tighten

   Tighten the steering pump pulley bolts to 25 N•m (18 lb-ft).
5. Adjust the belt tension. Refer to "Pump Drive Belt" in this section.



A105B018

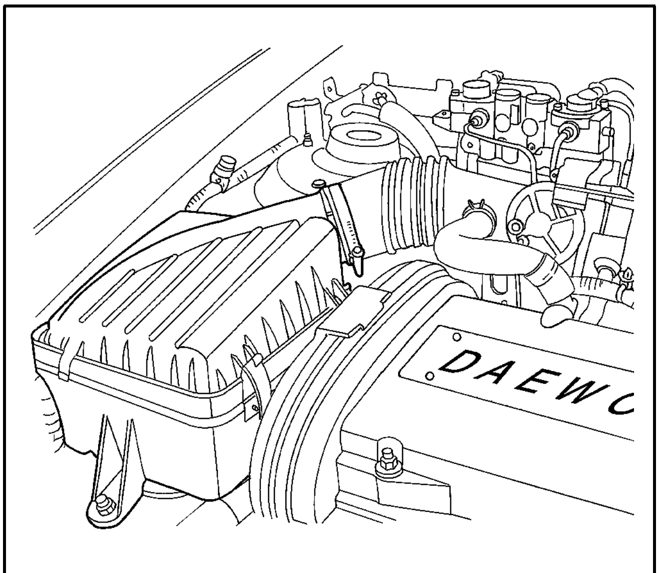
6. Install the air cleaner housing with the housing bolts and the clamp.

   Tighten

   Tighten the air cleaner housing bolts to 12 N•m (106 lb-in).
7. If the pump was removed from the engine, bleed the power steering system. Refer to Section 6A, Power Steering System.

Notice: When adding fluid or making a complete fluid change, always use DEXRON®-III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

8. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed the system.



A105B002

DOHC PUMP DRIVE PULLEY

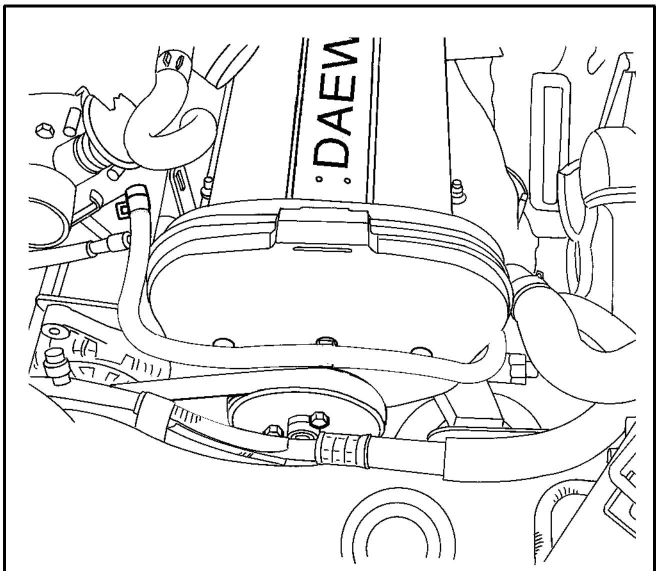
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

J-28467-B Engine Support Fixture

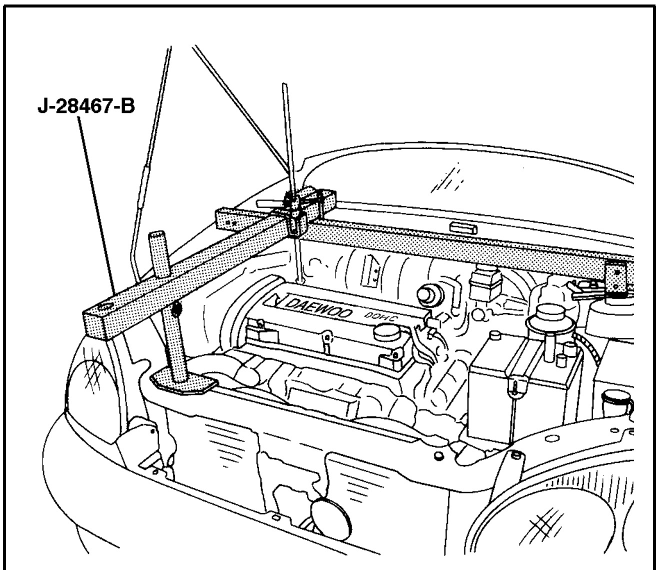
Removal Procedure

1. Remove the air cleaner housing by removing the housing bolts and loosening the clamp.



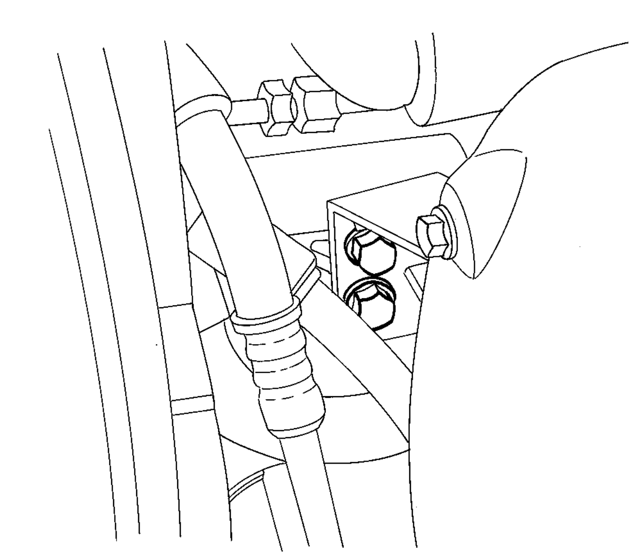
A105B020

2. Loosen the steering pump pulley bolts.
3. Remove the pump drive belt from the pulley by loosening the alternator adjusting bolt and pulling it forward.



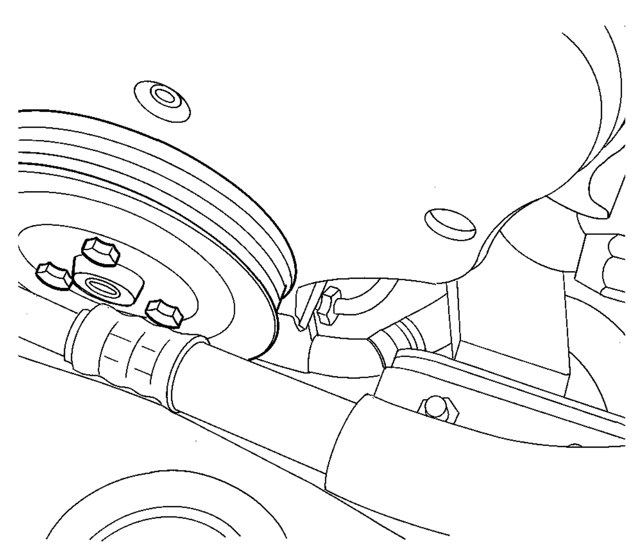
A105B013

4. Install the engine support fixture J-28467-B. Support the engine.



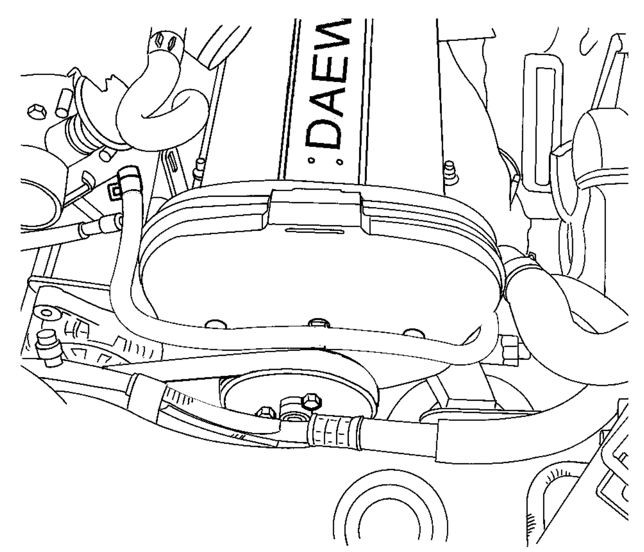
A105B014

5. Remove the engine bracket-to-mount bolts.



A105B024

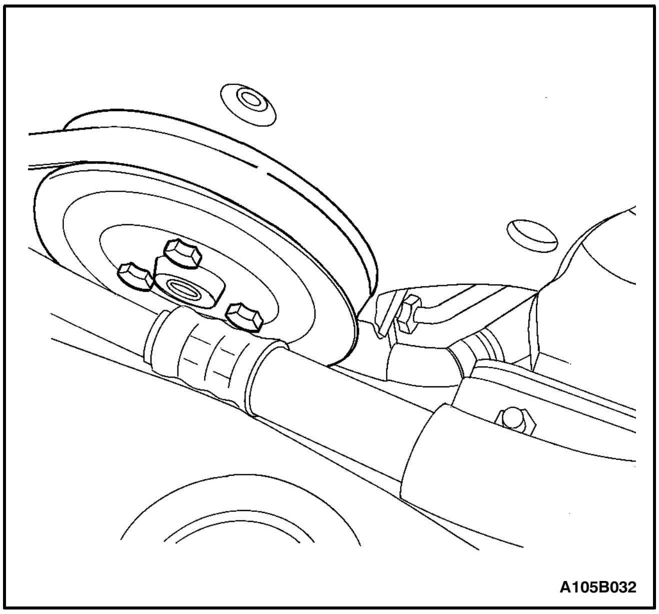
6. Raise the engine using the engine support fixture J-28467-B.
7. Remove the steering pump pulley bolts that connect the pulley to the pump.
8. Remove the pulley from the pump.



A105B020

Installation Procedure

1. Replace the pump on the engine if the pump was previously removed. Refer to "Pump Assembly" in this section.
2. Install the pulley onto the pump. Install the steering pump pulley bolts.
3. Install the pump drive belt.



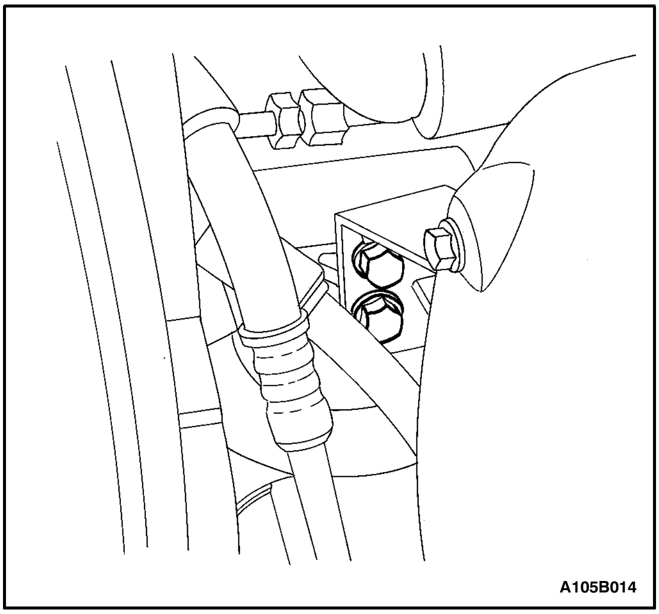
A105B032

4. Tighten the steering pump pulley bolts to fasten the pulley to the pump.

Tighten

Tighten the steering pump pulley bolts to 25 N•m (18 lb-ft).

5. Adjust the belt tension. Refer to "Pump Drive Belt" in this section.

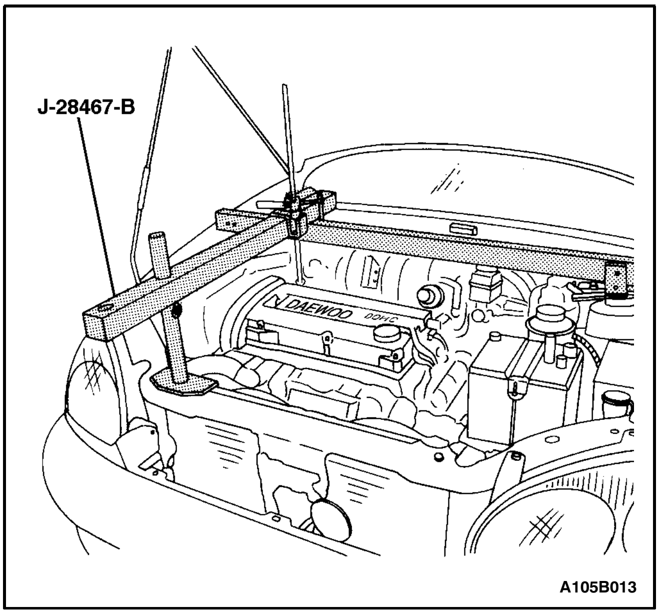


A105B014

6. Lower the engine using the engine support fixture J-28467-B.
7. Install the engine bracket-to-mount bolts.

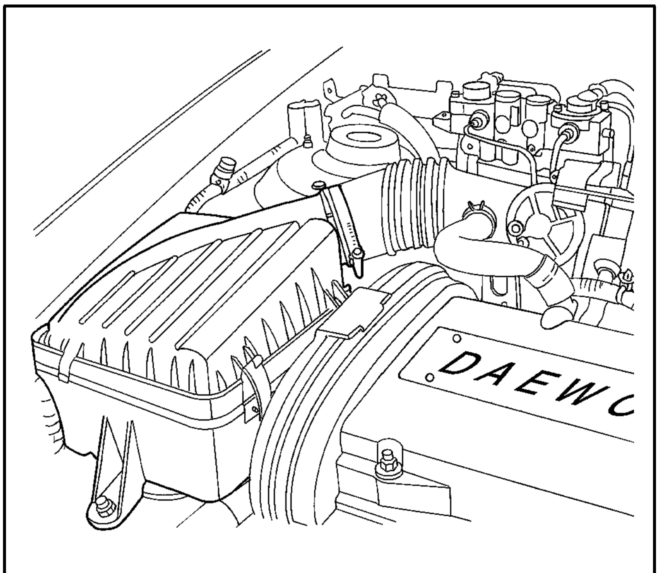
Tighten

Tighten the engine bracket-to-mount bolts to 60 N•m (44 lb-ft).



A105B013

8. Remove the engine support fixture J-28467-B.



A105B002

9. Install the air cleaner housing with the housing bolts and the clamp.

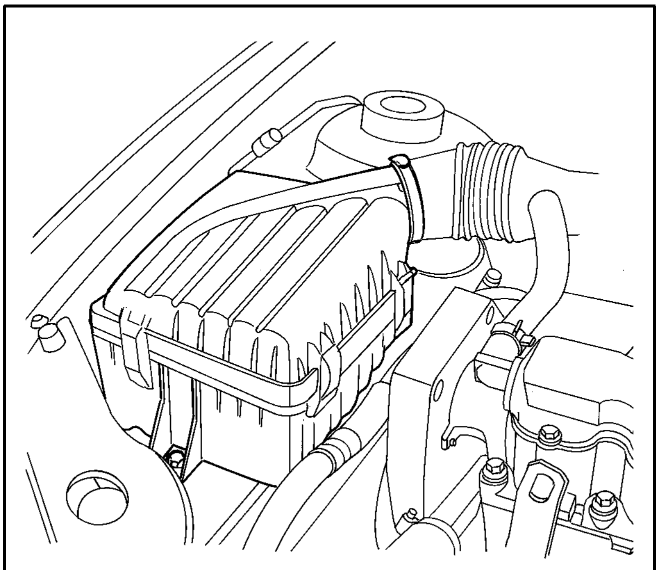
Tighten

Tighten the air cleaner housing bolts to 12 N•m (106 lb-in).

10. If the pump was removed from the engine, bleed the power steering system. Refer to Section 6A, Power Steering System.

Notice: When adding fluid or making a complete fluid change, always use DEXRON®-III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

11. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed the system.



A105B018

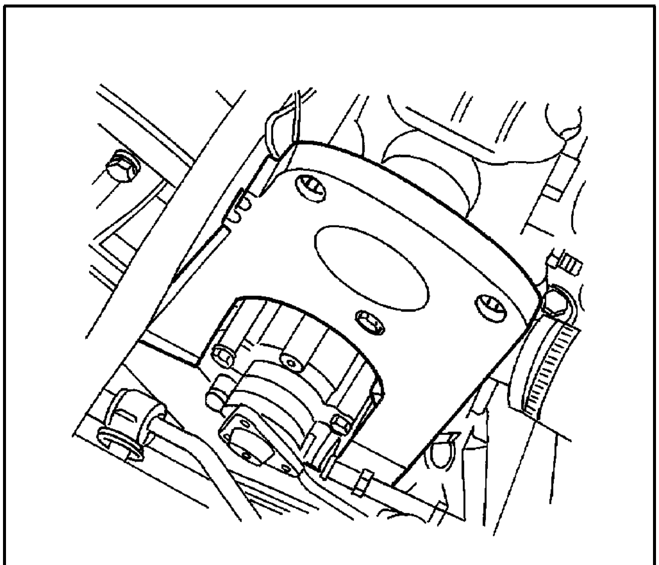
SOHC PUMP ASSEMBLY

Tools Required

J-28467-B Engine Support Fixture

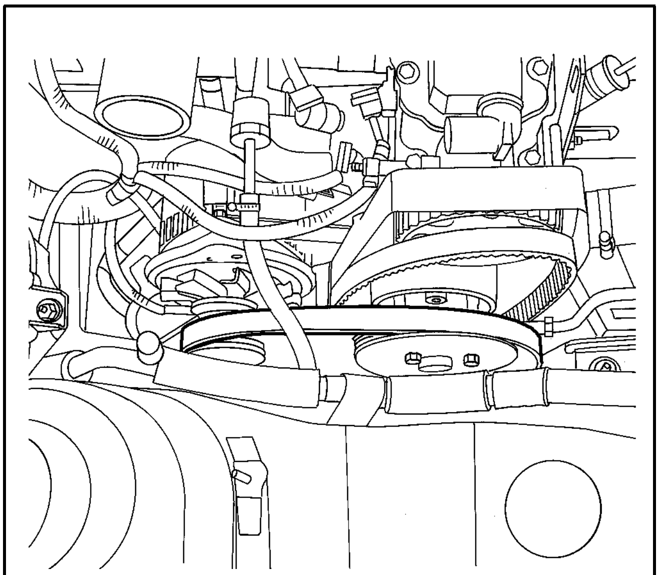
Removal Procedure

1. Remove the air cleaner housing by removing the housing bolts and loosening the clamp.



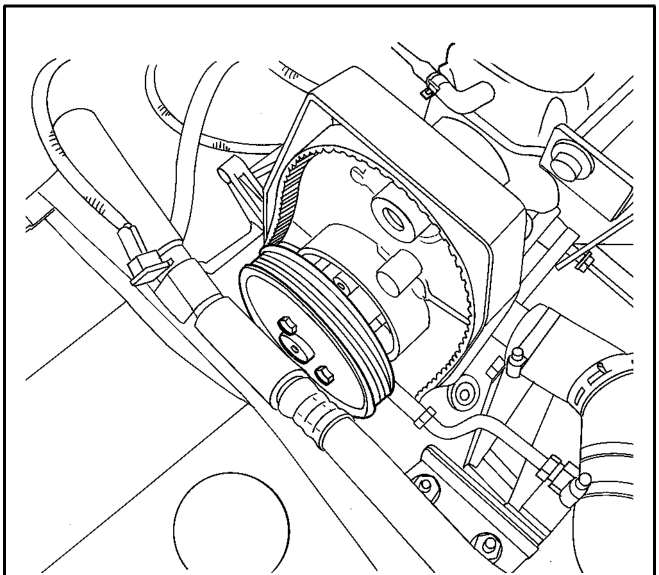
A105B007

2. Remove the the upper timing belt cover bolts and the upper timing belt cover.



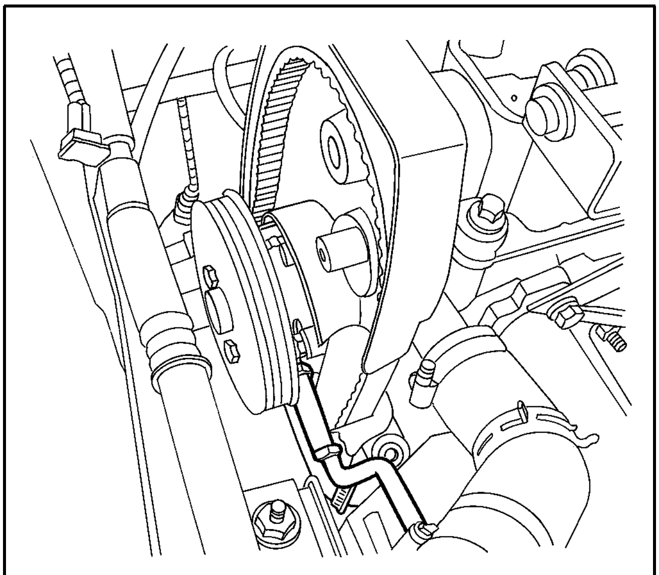
A105B006

3. Remove the pump drive belt from the pulley by loosening the alternator adjusting bolt and pulling the alternator forward.



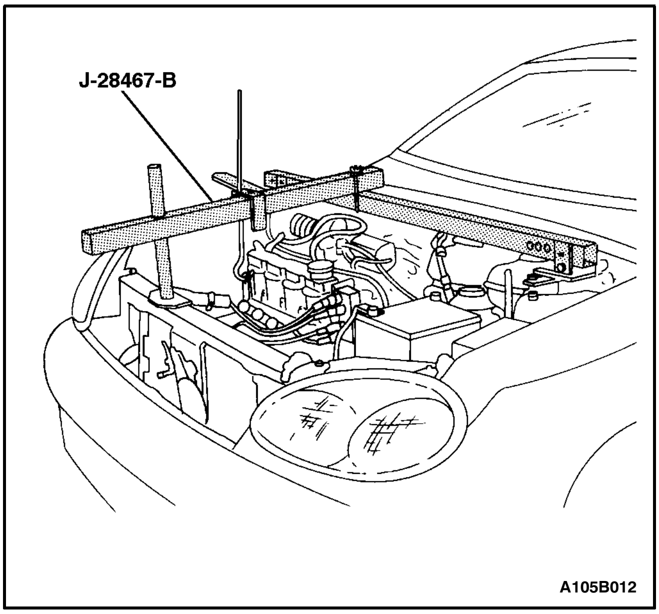
A105B017

4. Remove the power steering pump pulley bolts and the power steering pump pulley.

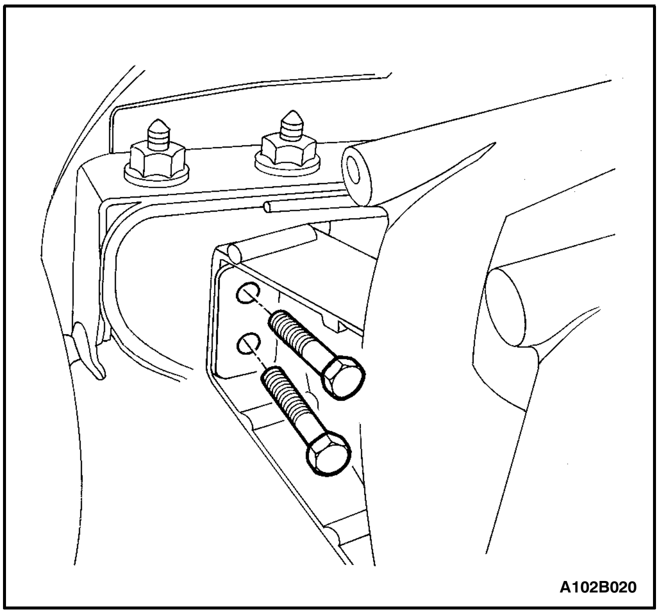


A105A003

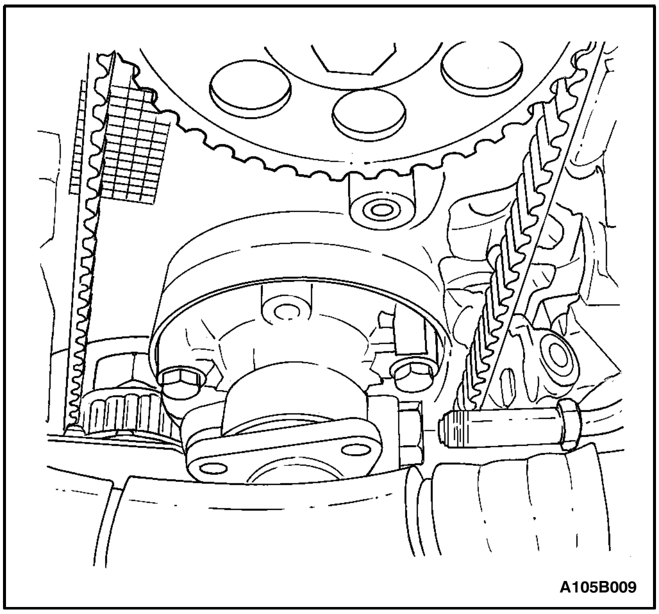
5. Drain the power steering fluid by disconnecting the pressure and supply lines from the pump.



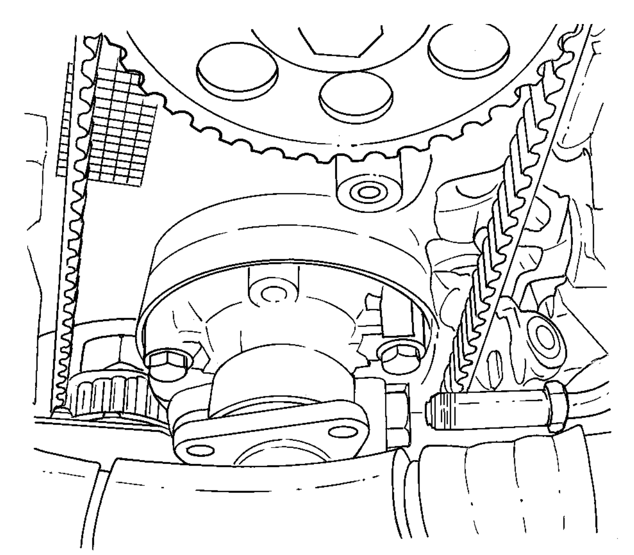
6. Install the engine support fixture J-28467-B.



7. Remove the engine bracket-to-mount bolts.
8. Raise and suitably support the vehicle.
9. Remove the right wheel. Refer to Section 2E, Tires and Wheels.
10. Remove the right engine undercover. Refer to Section 9N, Frame and Underbody.



11. Lower the engine using the engine support fixture J-28467-B.
12. Remove the pump assembly by removing the steering pump retaining bolts.



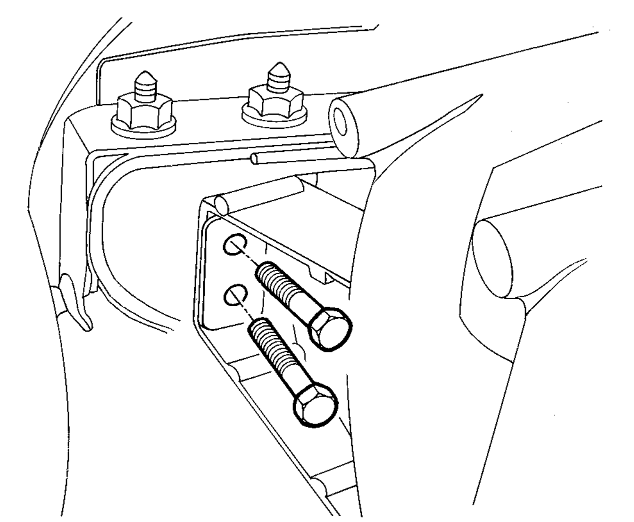
A105B009

Installation Procedure

1. Install the pump and the steering pump retaining bolts.

Tighten

Tighten the steering pump retaining bolts to 25 N•m (18 lb-ft).



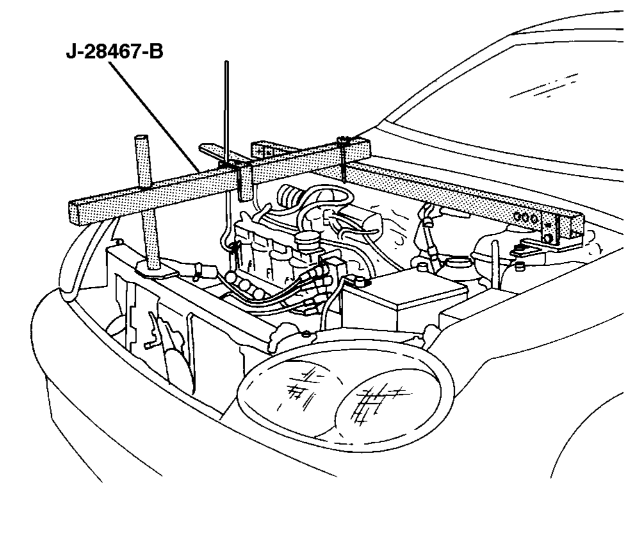
A102B020

2. Raise the engine using the engine support fixture J-28467-B.
3. Install the engine bracket-to-mount bolts.

Tighten

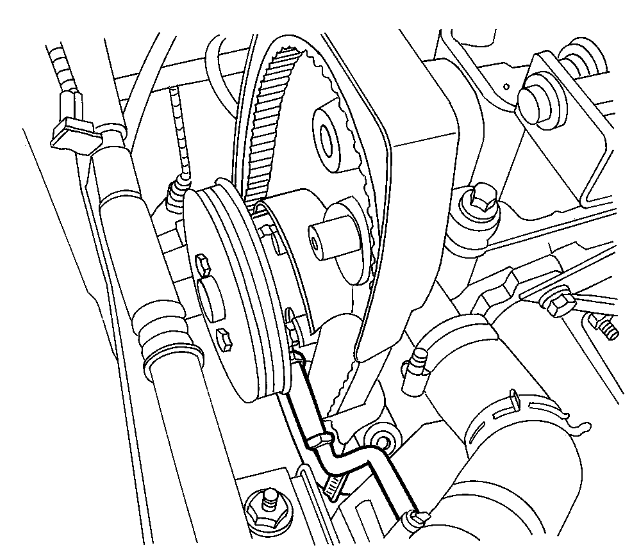
Tighten the engine bracket-to-mount bolts to 60 N•m (44 lb-ft).

4. Install the right engine under cover. Refer to Section 9N, Frame and Underbody.
5. Install the right wheel. Refer to Section 2E, Tires and Wheels.



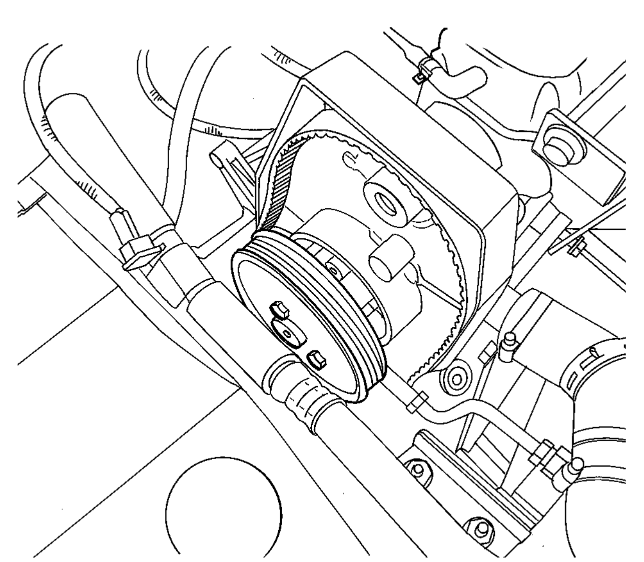
A105B012

6. Lower the vehicle.
7. Remove the engine support fixture J-28467-B.



A105A003

8. Connect the pressure and supply lines to the power steering pump.

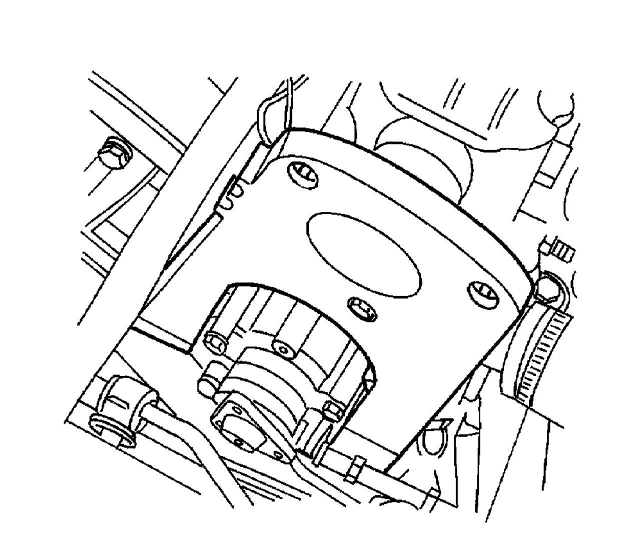


A105B017

9. Install the power steering pump pulley and the pulley bolts.

Tighten

Tighten the power steering pump pulley bolts to 25 N•m (18 lb-ft).

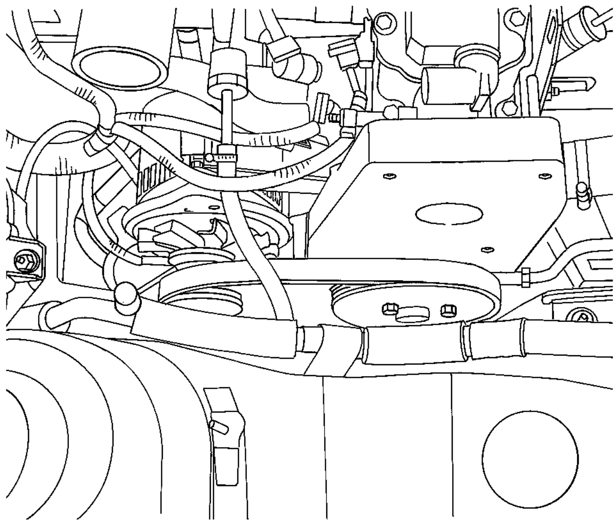


A105B007

10. Install the upper timing belt cover and the cover bolts.

Tighten

Tighten the timing belt cover bolts to 10 N•m (89 lb-in).

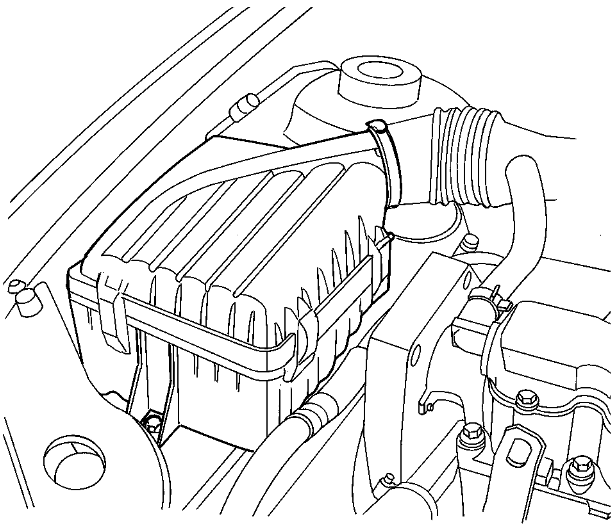


A105B030

11. Install the pump drive belt onto the pulley. Push the alternator rearward and tighten the alternator adjusting bolt.

Tighten

Tighten the alternator adjusting bolt to 20 N•m (15 lb-ft).



A105B018

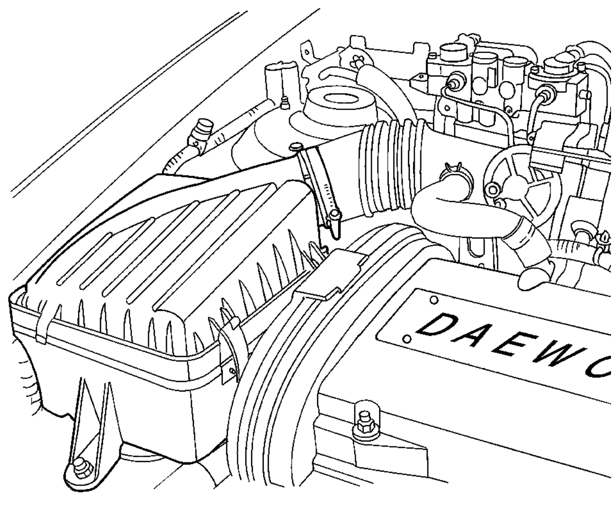
12. Install the air cleaner housing with the housing bolts and the clamp.

Tighten

Tighten the air cleaner housing bolts to 12 N•m (106 lb-in).

Notice: When adding fluid or making a complete fluid change, always use DEXRON®-III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

13. Refill the pump with new fluid and bleed the air from the system. Refer to Section 6A, Bleeding the Power Steering System.
14. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed the system.



A105B002

DOHC PUMP ASSEMBLY

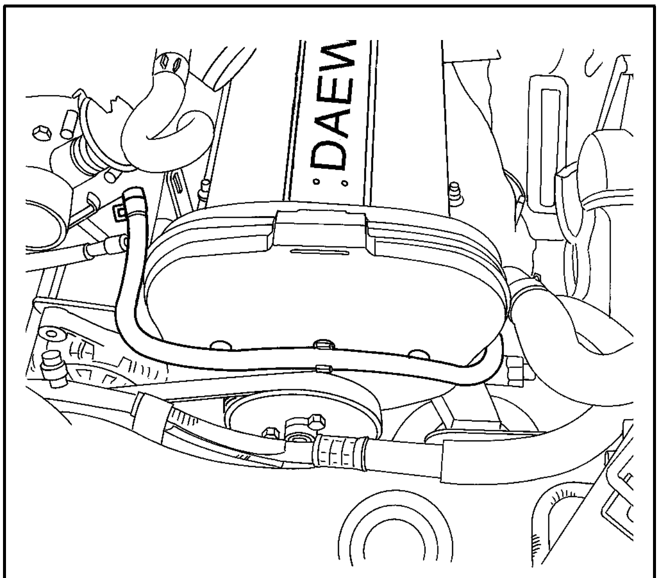
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

J-28467-B Engine Support Fixture

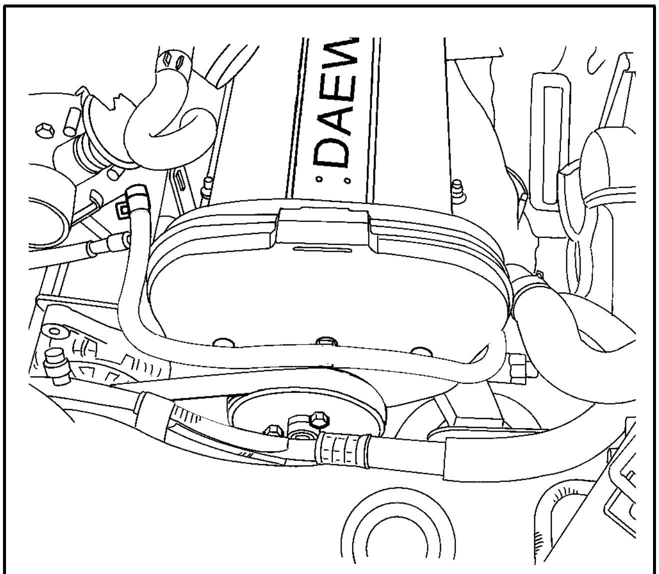
Removal Procedure

1. Remove the air cleaner housing by removing the housing bolts and loosening the clamp.



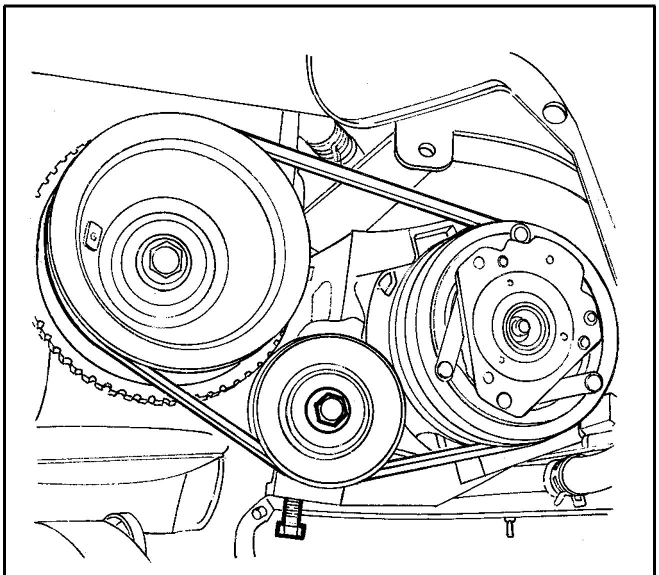
A105B019

2. Disconnect the throttle body inlet coolant hose from the throttle body and the timing belt cover and move it aside.



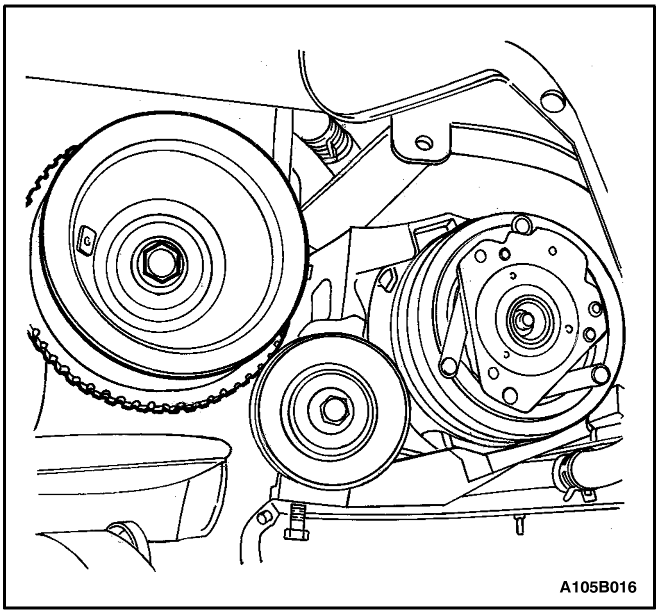
A105B020

3. Loosen the power steering pump pulley bolts.
4. Remove the pump drive belt from the pulley by loosening the alternator adjusting bolt and pulling the alternator forward.
5. Raise and suitably support the vehicle.
6. Remove the right wheel. Refer to Section 2E, Tires and Wheels.
7. Remove the right engine under cover. Refer to Section 9N, Frame and Underbody.

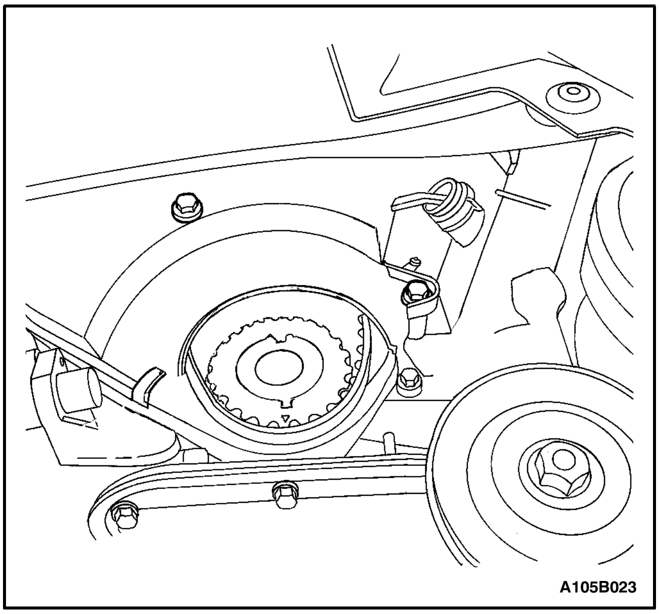


A105B015

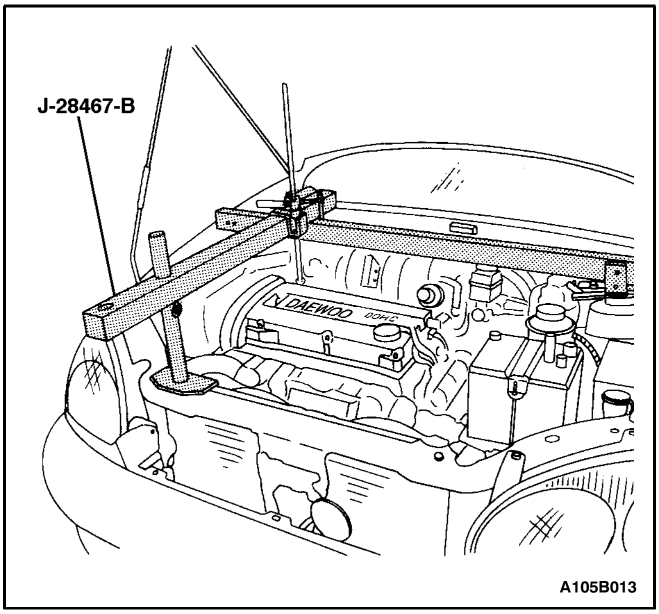
8. Loosen the securing bolt on the tension pulley and release the tension on the A/C compressor belt by turning the tightening bolt.
9. Remove the A/C compressor belt.



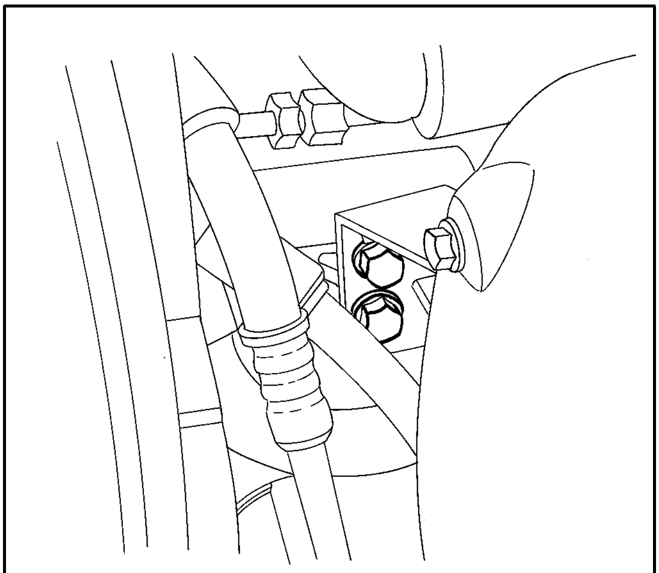
10. Remove the crankshaft pulley and the bolt.



11. Remove the timing belt cover lower bolts and the clip.
12. Lower the vehicle.

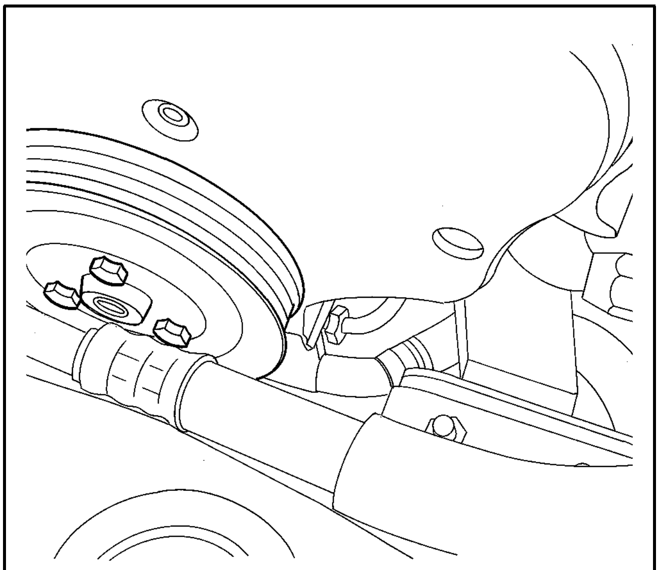


13. Install the engine support fixture J-28467-B. Support the engine.



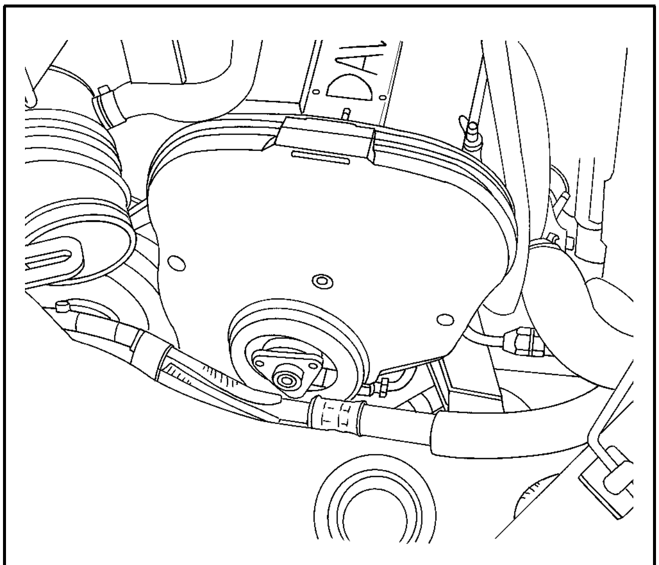
A105B014

14. Remove the engine bracket-to-mount bolts.



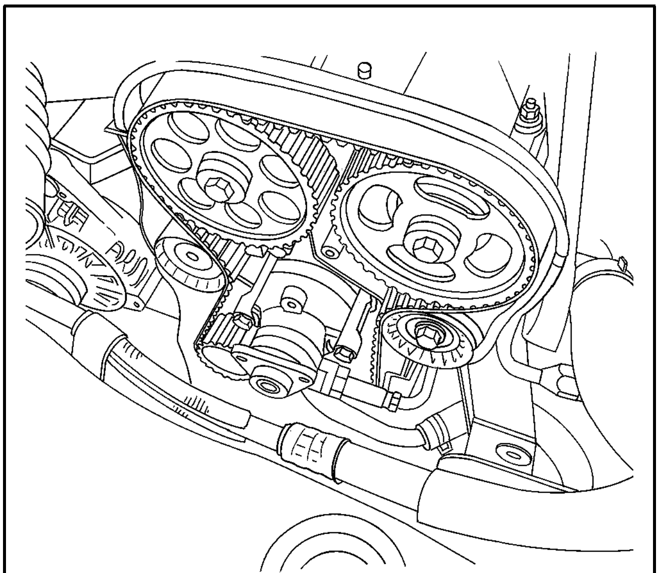
A105B024

15. Raise the engine using the engine support fixture J-28467-B.
16. Remove the power steering pump pulley bolts. Remove the power steering pump pulley.



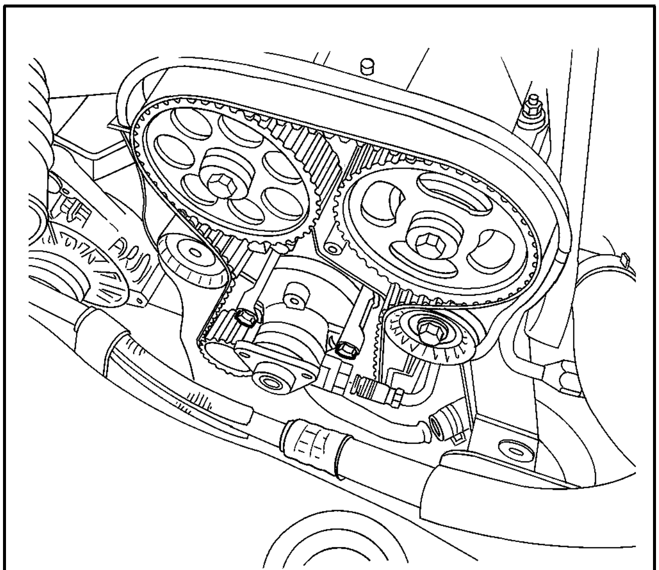
A105B022

17. Remove the the timing belt cover upper bolts and the timing belt cover.



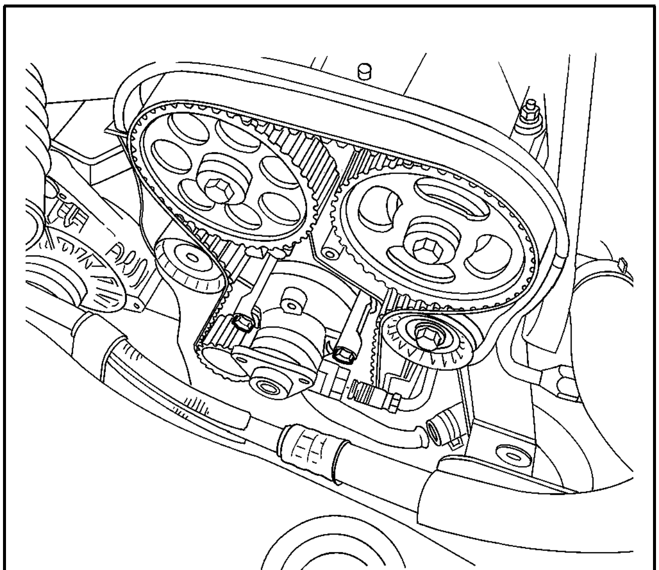
A105B026

18. Drain the power steering fluid by disconnecting the pressure and supply lines from the pump.



A105B027

19. Remove the pump assembly by removing the steering pump retaining bolts.



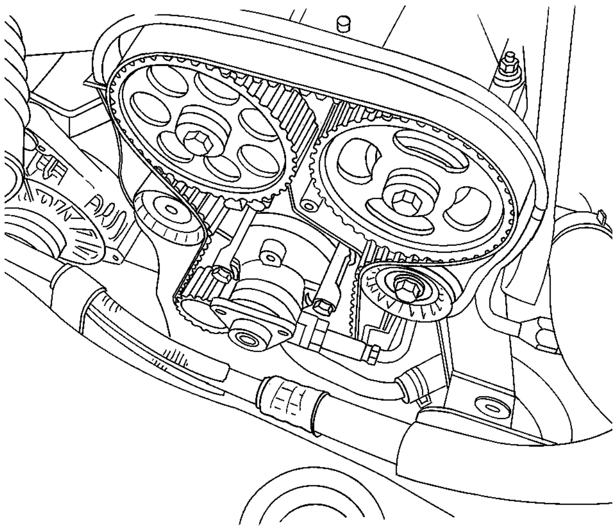
A105B027

Installation Procedure

1. Install the power steering pump and the power steering pump retaining bolts.

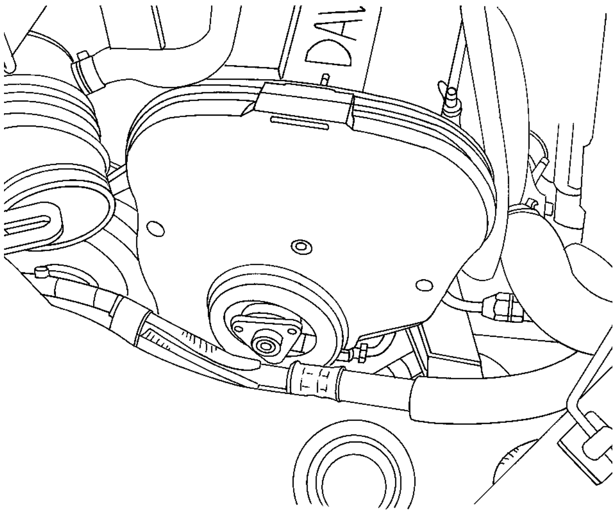
Tighten

Tighten the power steering pump retaining bolts to 25 N•m (18 lb-ft).



A105B026

2. Connect the pressure and the supply lines to the power steering pump.

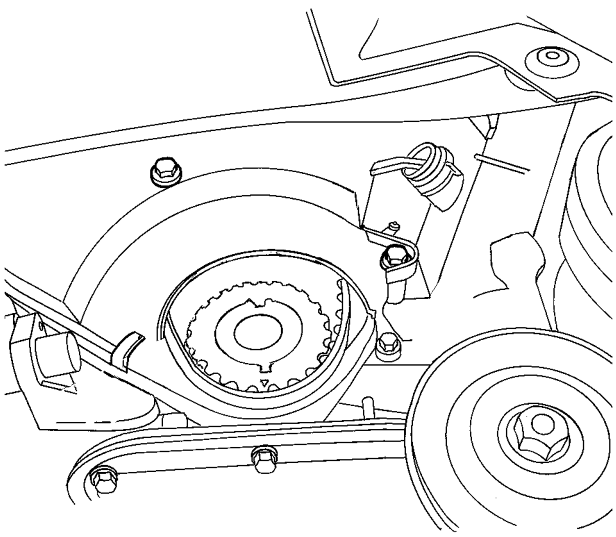


A105B025

3. Install the timing belt cover and timing belt cover upper bolts.

Tighten

Tighten the timing belt cover bolts to 10 N•m (89 lb-in).

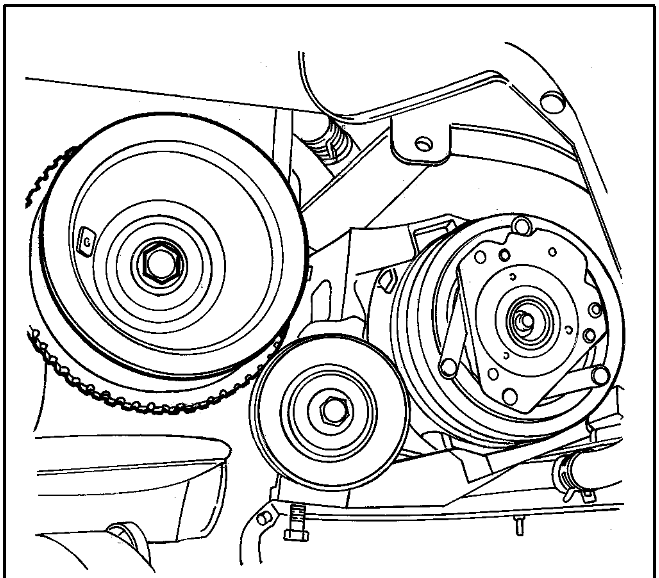


A105B023

4. Raise and suitably support the vehicle.
5. Install the timing belt cover lower bolts and the clip.

Tighten

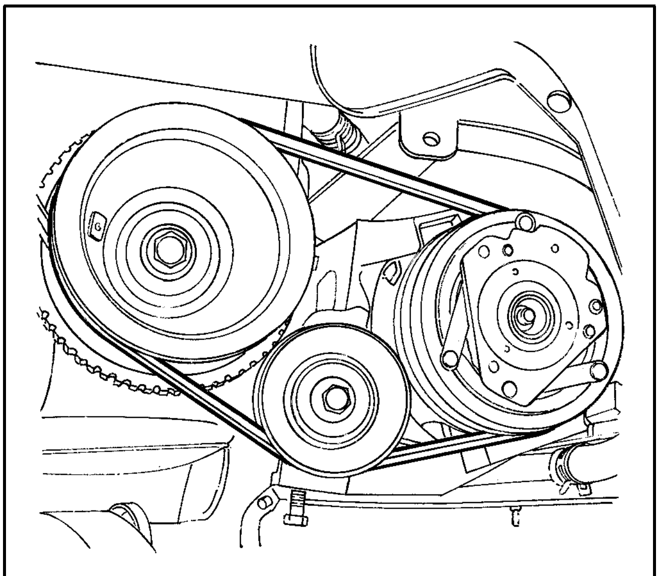
Tighten the timing belt cover bolts to 10 N•m (89 lb-in).


A105B016

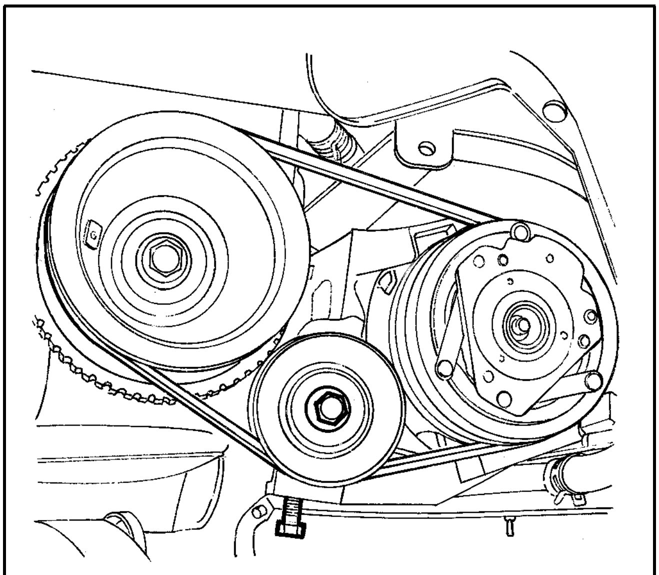
6. Install the crankshaft pulley and the bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft), then tighten the bolt another 30 degrees plus 15 degrees.


A105B010

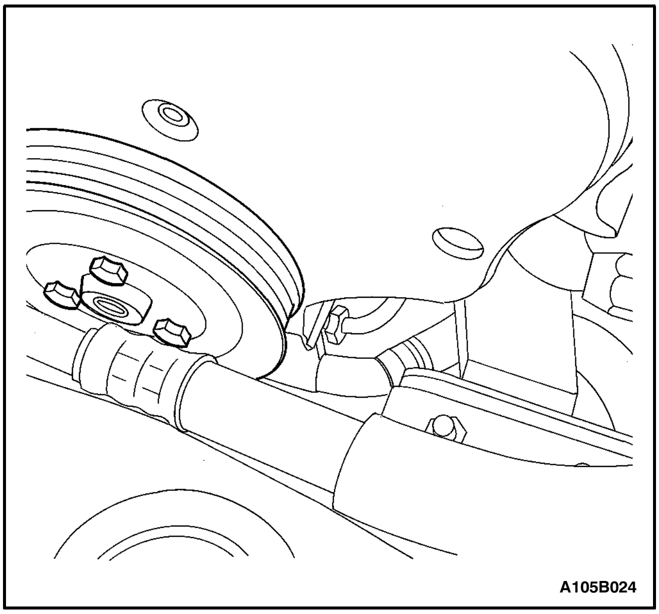
7. Install the A/C compressor belt.


A105B015

8. Turn the tightening bolt on the tension pulley to tighten the A/C compressor belt. Tighten the securing bolt on the tension pulley.

Tighten

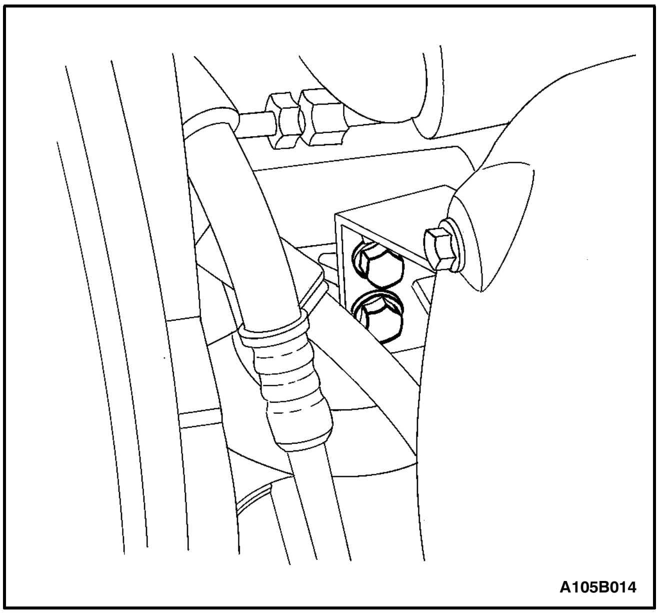
Tighten the tension pulley securing bolt to 25 N•m (18 lb-ft).



9. Install the right engine under cover. Refer to Section 9N, Frame and Underbody.
10. Install the right wheel. Refer to Section 2E, Tires and Wheels.
11. Lower the vehicle.
12. Install the power steering pump pulley and the pulley bolts.

Tighten

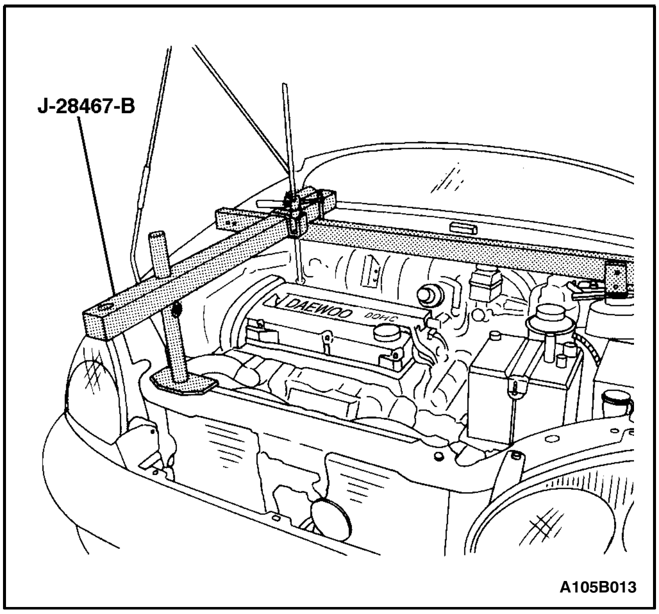
Tighten the steering pump pulley bolts to 25 N•m (18 lb-ft).



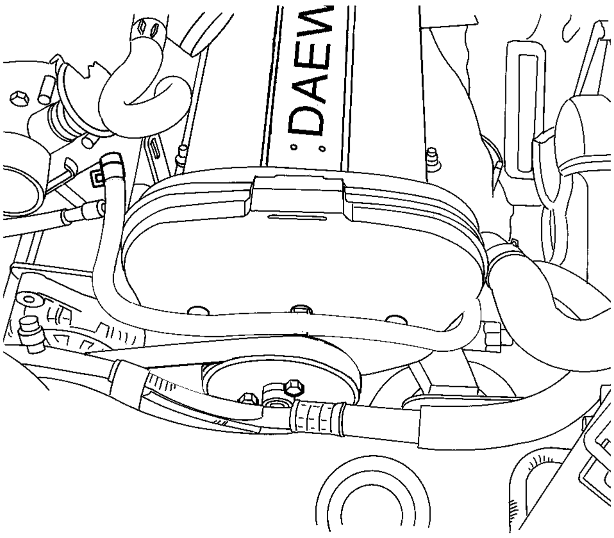
13. Lower the engine using the engine support fixture J-28467-B.
14. Install the engine bracket-to-mount bolts.

Tighten

Tighten the engine bracket-to-mount bolts to 60 N•m (44 lb-ft).



15. Remove the engine support fixture J-28467-B.



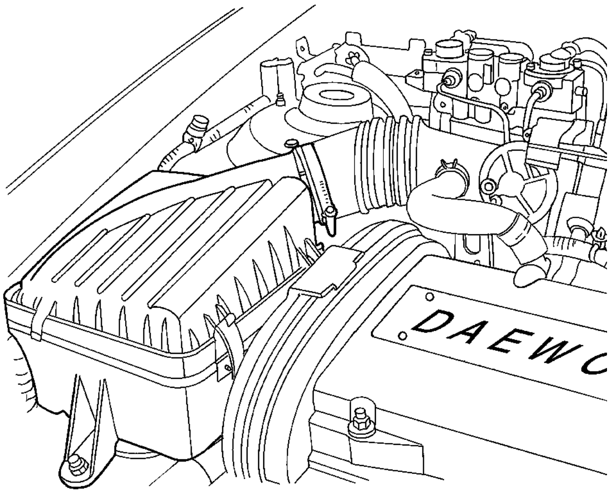
A105B020

16. Install the pump drive belt onto the pulley. Push the alternator rearward and tighten the alternator adjusting bolt.

Tighten

Tighten the alternator adjusting bolt to 20 N•m (15 lb-ft).

17. Connect the throttle body inlet coolant hose to the throttle body and the timing belt cover.



A105B002

18. Install the air cleaner housing with the housing bolts and the clamp.

Tighten

Tighten the air cleaner housing bolts to 12 N•m (106 lb-in).

Notice: When adding fluid or making a complete fluid change, always use DEXRON®-III power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

19. Refill the pump with new fluid and bleed the air from the system. Refer to Section 6A Bleeding the Power Steering System.
20. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed the system.

UNIT REPAIR

PUMP

The power steering pump in this vehicle is not serviceable. A faulty pump must be replaced.

GENERAL DESCRIPTION AND SYSTEM OPERATION

POWER STEERING PUMP

General Description

The pump has a remote fluid reservoir. A pressure-relief valve inside the flow control valve limits pump pressure.

SEALS

Seal Replacement

Lip seals, which seal the rotating shafts, are used on the driveshaft of the pump. This type of seal requires special treatment. When leakage occurs in this area, always replace the seal after inspecting and thoroughly cleaning the sealing surfaces. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with a crocus cloth. Replace the shaft only if the leakage cannot be stopped by first smoothing the shaft with the crocus cloth.

SECTION 6C

POWER STEERING GEAR

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

GENERAL SPECIFICATIONS

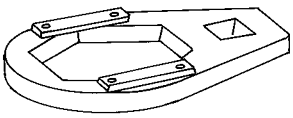
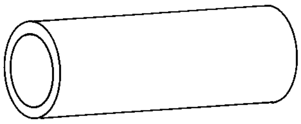
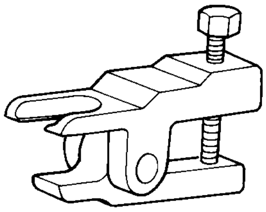
Application	Description
Lubricant	Power Steering Fluid DEXRON®-III
Capacity	1.0 L (1.05 qt)

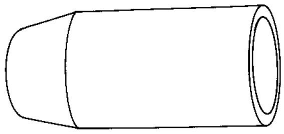
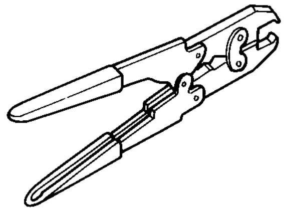
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Adjuster Plug Locknut	70	52	-
Coolant Surge Tank Attaching Nuts	4	-	35
Coupling Flange Pinch Bolt	22	16	-
Inner Tie Rod Bolts	90	66	-
Inner Tie Rod Pinch Bolt	22	16	-
Outer Tie Rod Hex Nut	60	44	-
Outer Tie Rod Pinch Bolt	22	16	-
Pinion Locknut	30	22	
Pinion Preload	0.9 to 1.7	-	8 to 15
Power Steering Line Fittings-Cylinder End	27	20	-
Power Steering Line Fittings-Valve End	18	13	-
Steering Gear Inlet and Outlet Pipe Fittings	27	20	-
Steering Gear Retaining Bracket Nuts	38	28	-
Steering Gear Retaining Bracket Studs	20	15	-

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A105C025	**KM-472** **Wrench**
 A105C026	**J-36545** **Installing Tube**
 A106C034	**KM-507-B** **Ball Joint Remover**

 A105C030	**J-29810** **Stub Shaft Protector**
 A104A008	**KM-J-26610** **Installer**

DIAGNOSIS

POWER RACK AND PINION STEERING GEAR

Hissing Noise

Checks	Action
Check the steering coupling joints for looseness.	Tighten the steering coupling joints.
Check the power steering hose for contact with other components.	Be sure the power steering hose is correctly fitted into the hose clips.

Rattling Noise in Steering Gear

Checks	Action
Check the power steering hose for contact with the body.	Be sure the power steering hose is correctly fitted into the hose clips.
Check the steering gear for insufficient lubrication.	Lubricate the steering gear.
Check the steering gear mounting for looseness.	Tighten the steering gear mounting bracket nuts.
Check the outer tie rods for improper installation.	Tighten the outer tie rod joints. Replace the outer tie rods as needed.

Poor Return of Steering Wheel to Center

Checks	Action
Check the steering wheel for contact with the turn signal housing.	Adjust the turn signal housing.
Check the steering coupling for binding or looseness.	Replace the steering coupling flange.
Check the power steering pump flow control valve for sticking and improper alignment.	Replace the power steering pump.
Check the wheel alignment.	Adjust the wheel alignment.
Check the wheel bearings for wear or damage.	Replace the wheel bearings.
Check the steering gear-to-column joints for improper installation.	Adjust the steering coupling flange on the steering gear and the steering column. Replace the coupling flange as needed.
Check the outer tie rods and the ball joints for binding or looseness.	Tighten the tie rods and the ball joints. Replace the tie rods and the ball joints as needed.
Check the steering gear adjustments.	Perform a straight-ahead check.
Check the steering column shaft seal for rubbing on the shaft.	Replace the shaft seal.
Check the steering shaft bearings for binding.	Replace the steering shaft bearings.

Momentary Increase in Effort When Turning the Wheel Quickly

Checks	Action
Check the power steering pump for internal leaks.	Replace the power steering pump.
Check the hoses for damage or restricted flow.	Replace the power steering hoses and pipes.
Check the power steering fluid level.	Fill the power steering fluid reservoir.
Check the power steering pump flow control valve for sticking and improper operation.	Replace the power steering pump.

Steering Surges or Jerks When Turning with Engine Running

Checks	Action
Check the power steering pump for insufficient pressure.	Replace the power steering pump.
Check the power steering pump flow control valve for sticking and improper operation.	Replace the power steering pump.
Check the pump drive belt for slippage.	Tighten the pump drive belt.
Check for air contamination in the power steering system.	Bleed the power steering system.

Steering Vibrates During Low Speed or Static Steering

Checks	Action
Check for air contamination in the power steering system.	Bleed the power steering system.
Check the pump drive belt for looseness.	Tighten the pump drive belt.

Excessive Wheel Kickback or Loose Steering

Checks	Action
Check for air contamination in the power steering system.	Bleed the power steering system.
Check the wheel bearings for wear or damage.	Replace the wheel bearings.
Check the steering gear mounting for looseness.	Tighten the steering gear mounting bracket nuts.
Check the steering gear-to-column joints for improper installation.	Adjust the steering coupling flange on the steering gear and the steering column. Replace the coupling flange as needed.
Check the outer tie rods and ball joints for looseness.	Tighten the tie rods and the ball joints. Replace the tie rods and the ball joints as needed.

Hard Steering or Lack of Assist (Especially During Parking)

Checks	Action
Check the steering gear-to column joints for improper installation.	Adjust the steering coupling flange on the steering gear and the steering column. Replace the coupling flange as needed.
Check the power steering pump flow control valve for sticking and improper installation.	Replace the power steering pump.
Check the power steering pump for insufficient pressure.	Replace the power steering pump.
Check the power steering pump for internal leaks.	Replace the power steering pump.
Check for a loose or a worn steering coupling.	Tighten the steering coupling flange. Replace the steering coupling flange as needed.
Check the pump drive belt tension.	Adjust the pump drive belt tension.

POWER RACK AND PINION STEERING GEAR BENCH TESTING

Removal, Setup and Testing Procedure

Notice: Pressure checks or pressure and flow checks may also be conducted using this setup.

1. Disconnect and remove the power steering gear. Refer to "Rack and Pinion Assembly" in this section.
2. Place the power steering gear on a bench next to the vehicle.
3. Disconnect the pressure line at the point where the hose connects to the pipe. Extend this line in order to reach the power steering gear on the bench.
4. Disconnect the return line from the the power steering fluid reservoir. Extend this line in order to reach the power steering gear on the bench.
5. Connect the power steering pipes to the power steering gear.
6. Start the engine and allow it to idle for 10 seconds.
7. Check the power steering fluid level. Refer to Section 6A, Power Steering System.
8. Start the engine and turn the rack and pinion stub shaft to a full turn in each direction. Hold the shaft against each stop for 5 seconds.
9. Inspect for possible leak points. Refer to Section 6A, Power Steering System.

Installation Procedure

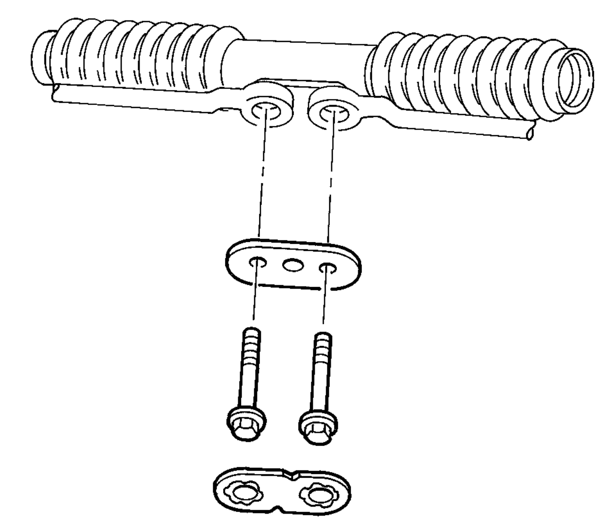
1. Stop the engine.
2. Disconnect the power steering pipes from the power steering gear.
3. Remove the extensions and reconnect the pressure and return lines.
4. Install and connect the power steering gear. Refer to "Rack and Pinion Assembly" in this section.
5. Start the engine and allow it to idle for 10 seconds.
6. Check the power steering fluid level. Refer to Section 6A, Power Steering System.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

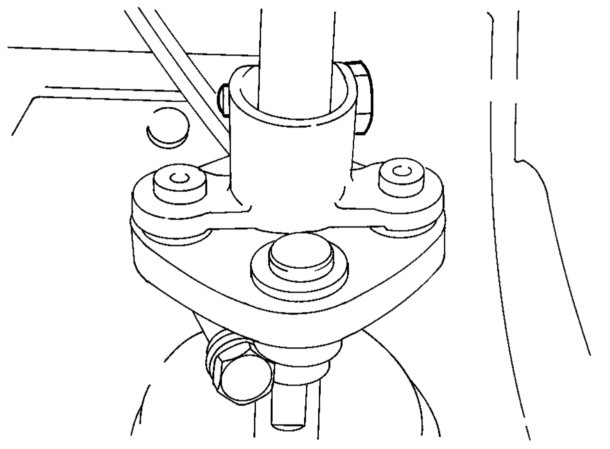
RACK AND PINION ASSEMBLY (LEFT-HAND DRIVE)

Removal Procedure



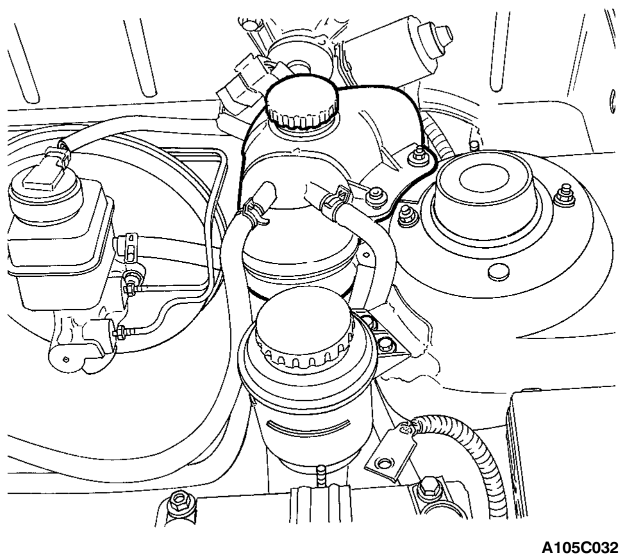
A105C001

1. Disconnect the negative battery cable.
2. Disconnect the inner tie rods from the rack and pinion assembly by removing the lock plate, the inner tie rod bolts, and the inner tie rod plate. Do not reuse the lock plate.



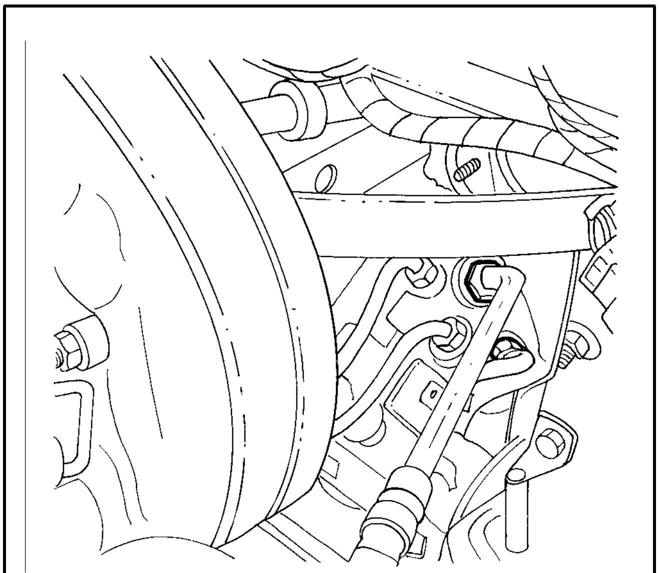
A105C002

3. Position the steering gear straight ahead by turning the steering wheel until the spokes are centered diagonally and pointing downward.
4. Loosen the top pinch bolt on the coupling flange.

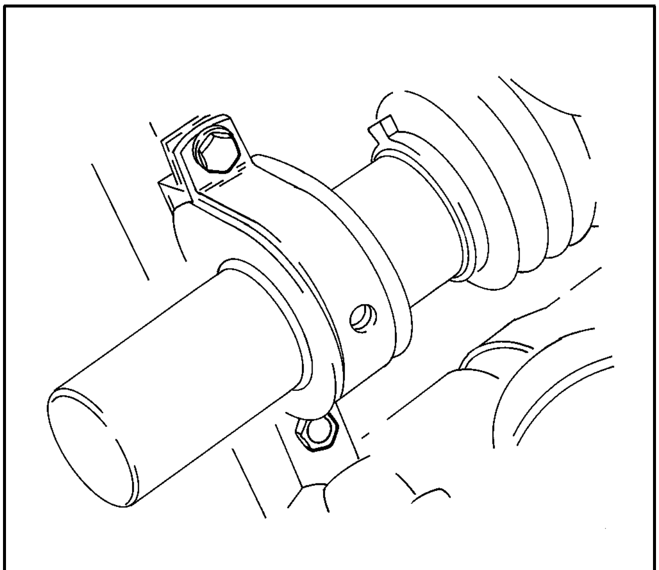


A105C032

5. Disconnect the coolant surge tank from the vehicle by removing the attaching nuts. Without disconnecting the hoses, move the tank out of the repair area.


A105C003

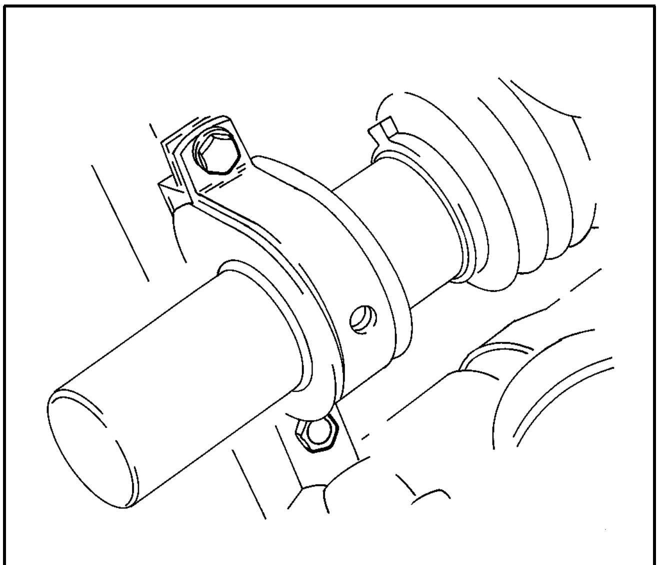
6. Disconnect the steering gear inlet and outlet pipe fittings.


A105C004

7. Remove the left inner and outer tie rod from the vehicle. Refer to "Outer Tie Rod" and "Inner Tie Rod" in this section.
8. Disconnect the steering gear retaining bracket nuts from the bottom of each steering gear retaining bracket. Disconnect the steering gear retaining bracket bolts from the top of each steering gear retaining bracket.
9. Remove the rack and pinion assembly through the front wheel opening.
10. If the studs were removed with the mounting clamps, reinstall the studs into the cowl.

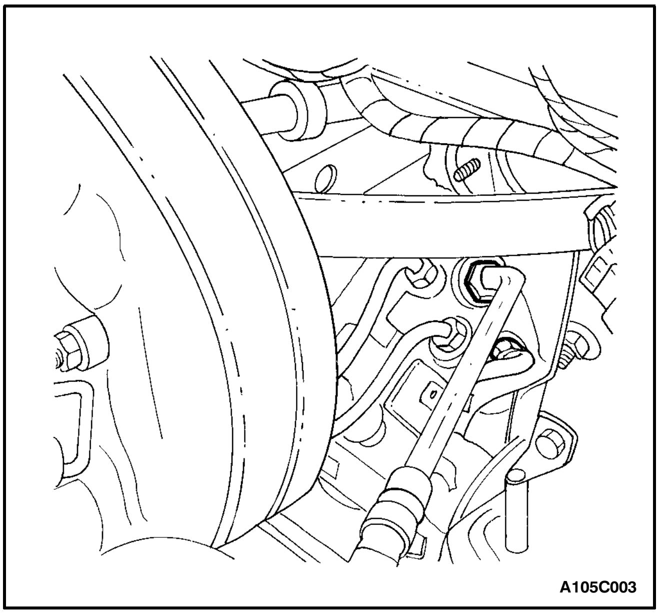
Tighten

Tighten the steering gear retaining bracket studs to 20 N•m (15 lb-ft).


A105C004

Installation Procedure

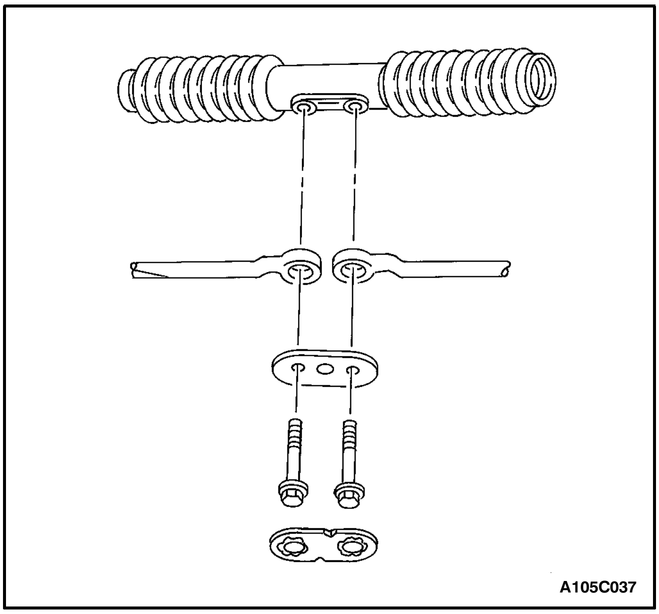
1. Install the rack and pinion steering gear assembly through the front wheel opening. The steering gear must be in a straight-ahead position. The steering wheel spokes must be centered diagonally and point downwards.
2. Connect the steering gear assembly to the body with two mounting brackets. Loosely attach all the steering gear retaining bracket nuts and bolts.



3. Connect the steering gear inlet and outlet pipe fittings.

Tighten

Tighten the steering gear inlet and outlet pipe fittings to 27 N•m (20 lb-ft).

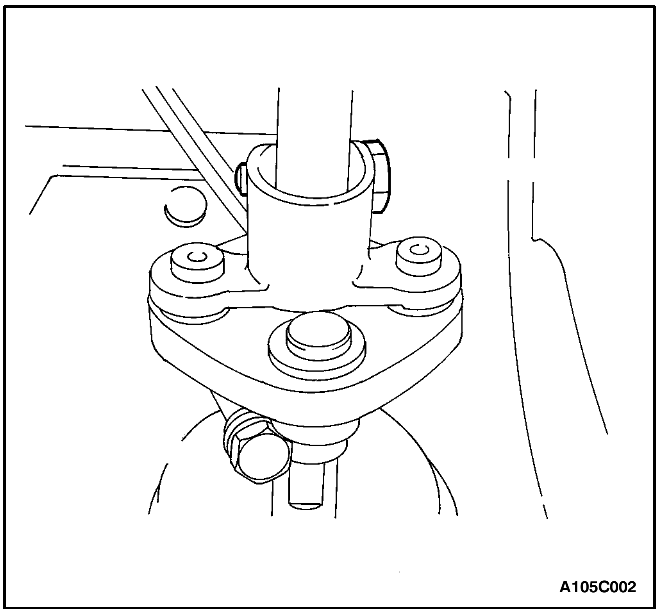


Important: Be sure the center housing cover washers are located between the tie rods and the steering gear. Always use a new lock plate.

4. Connect both tie rods to the steering gear by threading the inner tie rod bolts through the inner tie rod plate, the tie rods, and the center housing cover washers into the rack guide. Install a new lock plate.

Tighten

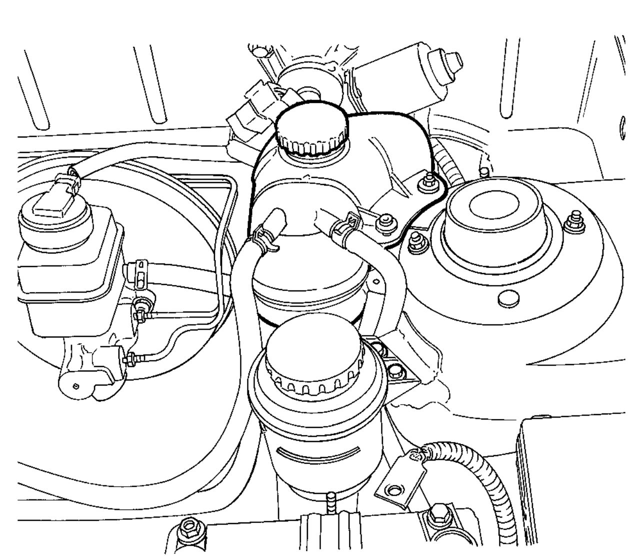
Tighten the inner tie rod bolts to 90 N•m (66 lb-ft).



5. Seat the dash seal and attach the coupling flange to the steering gear. Secure the coupling flange assembly with the top pinch bolt on the coupling flange assembly.

Tighten

Tighten the coupling flange pinch bolt to 22 N•m (16 lb-ft).



A105C032

6. Tighten all the steering gear retaining bracket nuts and bolts.

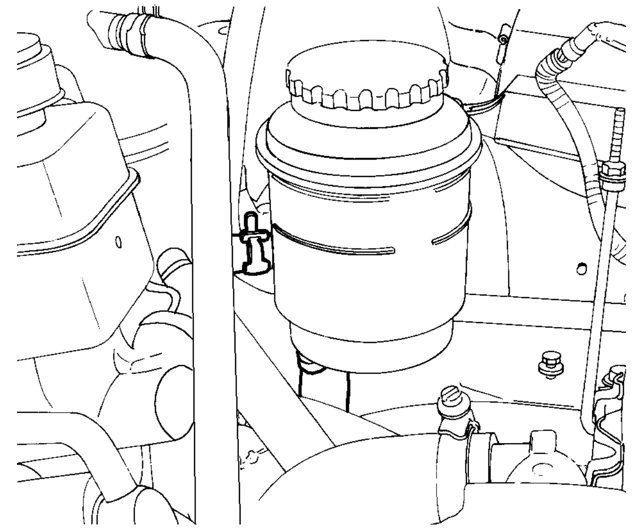
Tighten

Tighten the steering gear retaining bracket nuts to 38 N•m (28 lb-ft).

7. Check that the steering gear has remained in the straight-ahead position.
8. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed system. Refer to Section 6A, Power Steering System.
9. Connect negative battery cable.
10. Reconnect the coolant surge tank with the attaching nuts.

Tighten

Tighten the coolant surge tank attaching nuts to 4 N•m (36 lb-in).

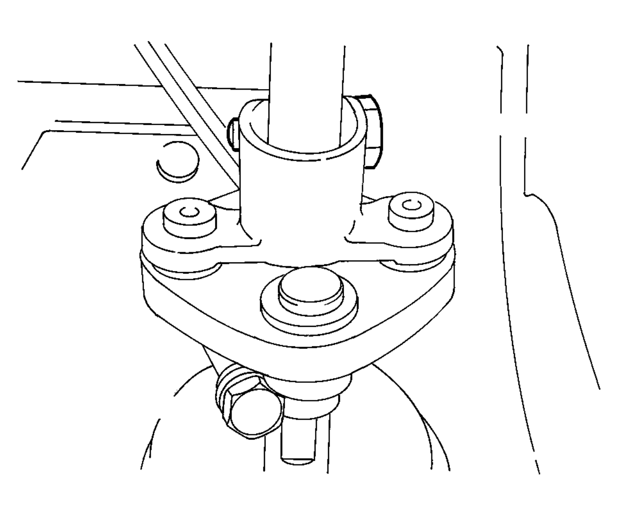


A105A001

RACK AND PINION ASSEMBLY (RIGHT-HAND DRIVE)

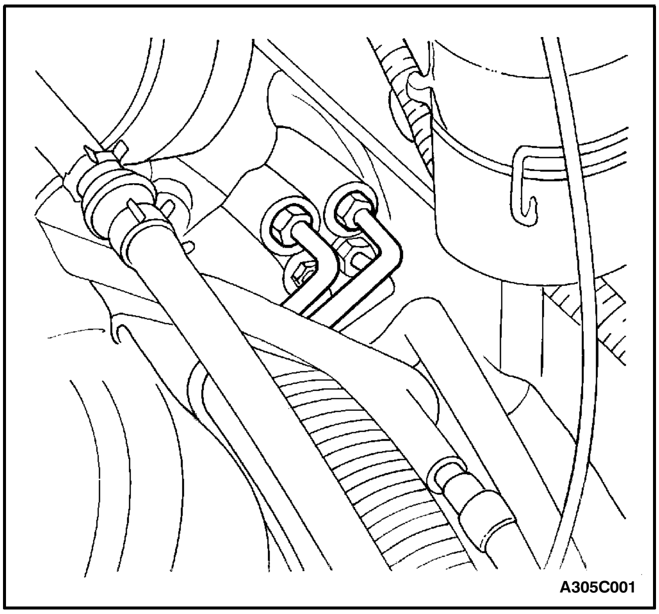
Removal Procedure

1. Disconnect the negative battery cable.
2. Raise the vehicle slightly off the ground.
3. Siphon the power steering fluid from the fluid reservoir.



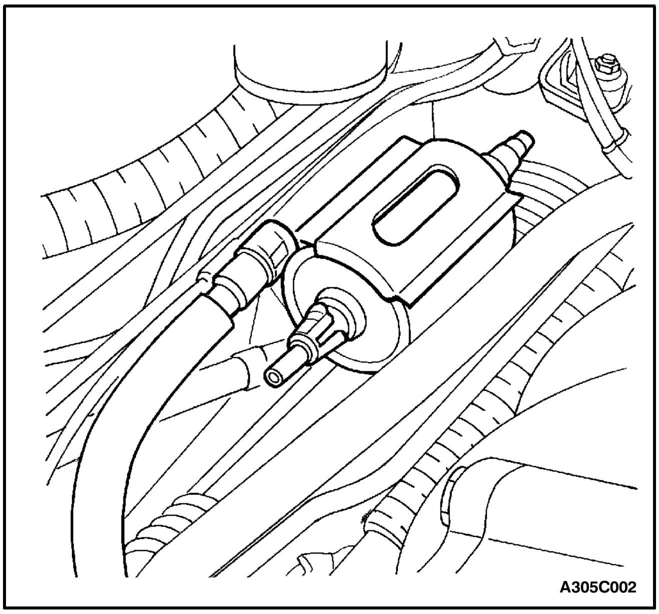
A105C002

4. Remove the left and the right wheel assemblies and the outer tie rod ends. Refer to “Outer Tie Rod” in this section.
5. Loosen the top pinch bolt on the coupling flange.



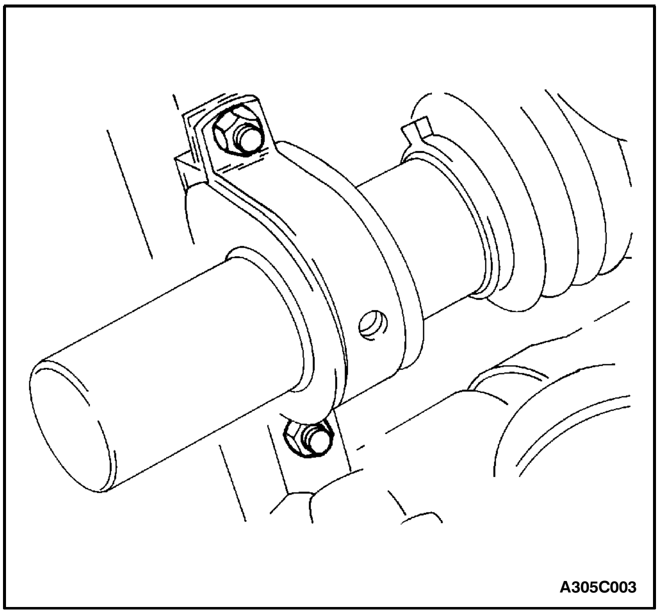
A305C001

6. Disconnect the steering gear inlet pipe and outlet pipe fittings. Position the steering gear inlet pipe away from the steering gear assembly.



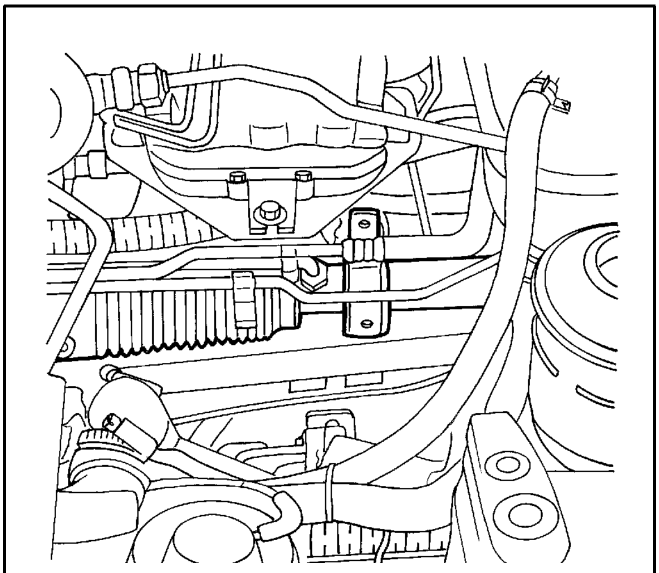
A305C002

7. Remove the hydraulic lines from the spacer clips.
8. Remove the fuel line from the output side of the fuel filter. Remove the fuel filter from the retaining bracket.
9. Remove the fuel filter bracket.



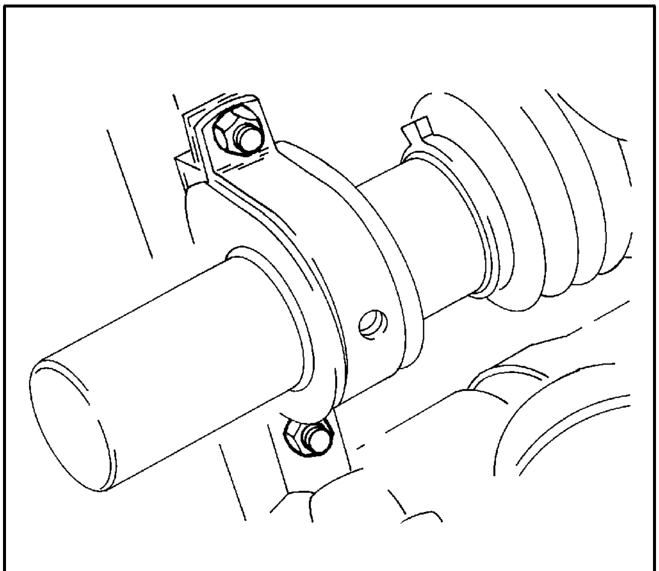
A305C003

10. Remove the two nuts from the steering gear right retaining bracket by reaching through the right front wheel opening.



A305C004

11. Remove the steering gear left retaining bracket.

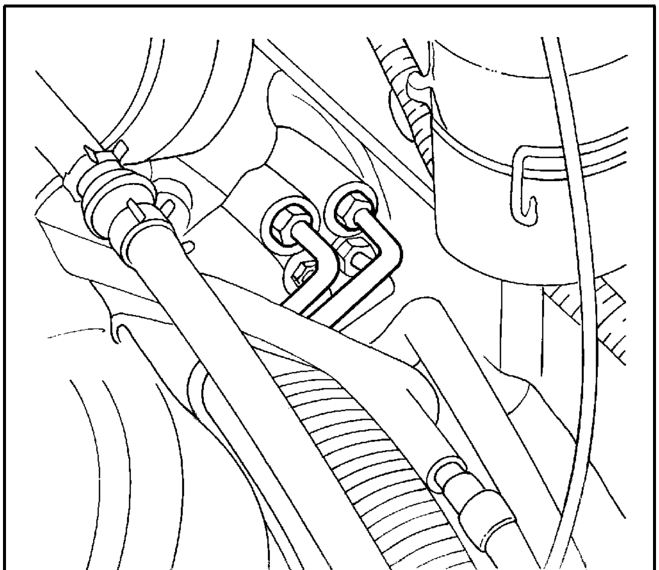


A305C003

12. Remove the rack and pinion assembly (complete with the tie rods) through the left front wheel opening.

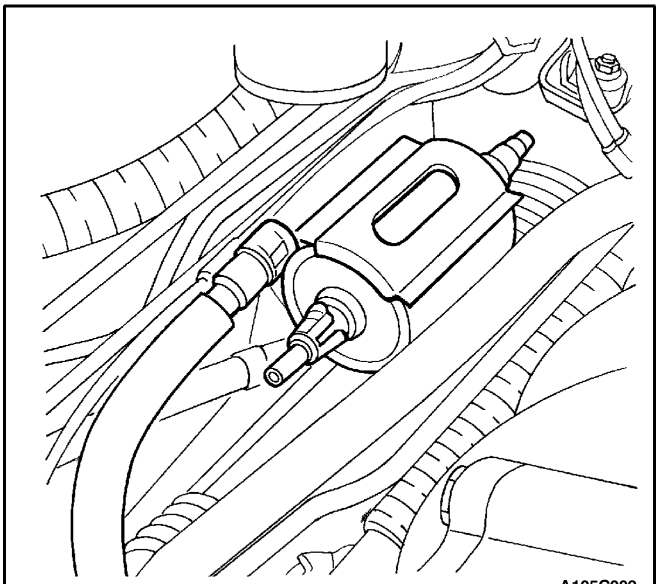
Installation Procedure

1. Install the rack and pinion assembly through the left front wheel opening. The steering gear must be in a straight-ahead position. The steering wheel spokes must be centered diagonally and point downwards.
2. Loosely install the steering gear right retaining bracket.



A305C001

3. Route the steering gear outlet pipe fitting to the steering gear valve, but do not tighten.

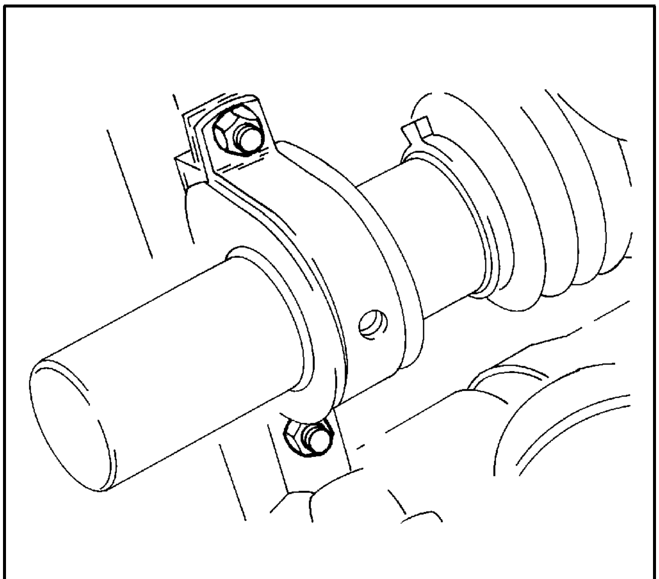


A105C002

4. Seat the dash seal and attach the coupling flange to the steering gear. Secure the coupling flange assembly with the top pinch bolt on the coupling flange assembly.

Tighten

Tighten the coupling flange pinch bolt to 22 N•m (16 lb-ft).

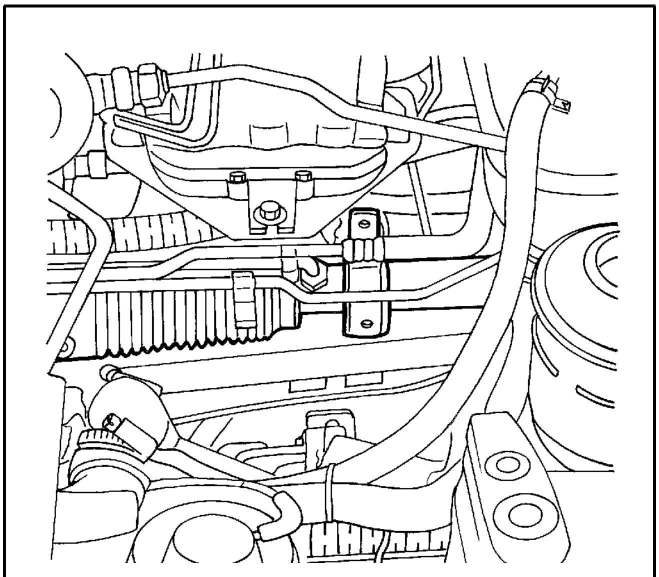


A305C003

5. Loosely install the steering gear left retaining bracket.
6. Install the steering gear right retaining bracket nuts by reaching through the right front wheel opening.

Tighten

Tighten the steering gear retaining bracket nuts to 38 N•m (28 lb-ft).

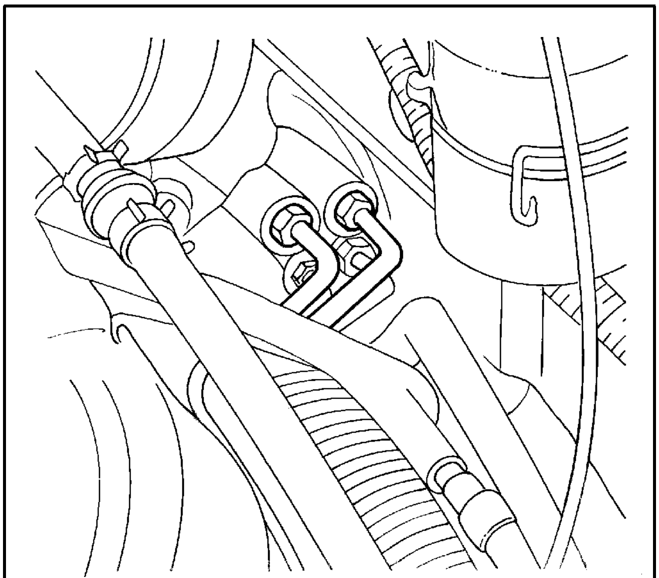


A305C004

7. Install the steering gear left retaining bracket nut and the bolt.

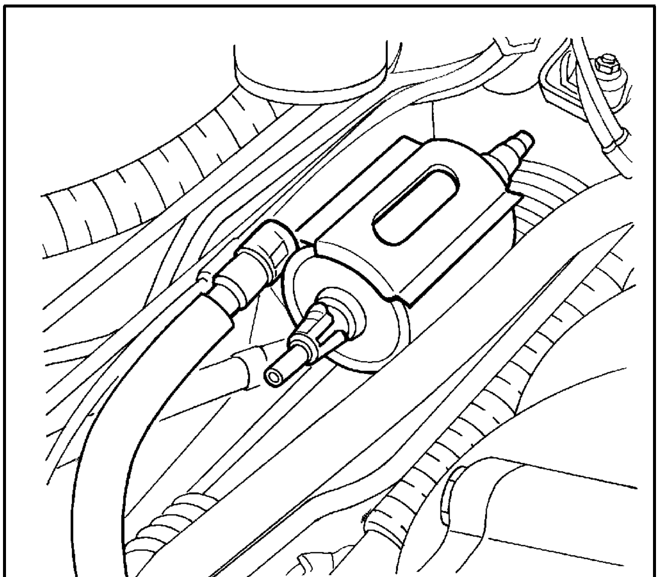
Tighten

Tighten the steering gear retaining bracket nut and the bolt to 38 N•m (28 lb-ft).



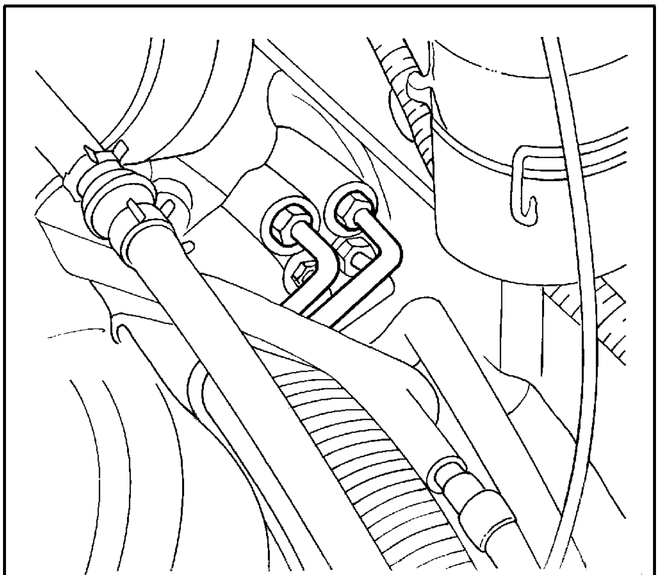
A305C001

8. Route the steering gear inlet pipe to the steering gear valve, but do not tighten.



A305C002

9. Install the fuel filter bracket. Install the fuel filter into the bracket.
10. Install the fuel line to the output side of the fuel filter.



A305C001

11. Install the steering gear hydraulic lines into the spacer clips.
12. Tighten the steering gear inlet and outlet pipes at the steering gear valve.

Tighten

Tighten the steering gear inlet and outlet pipe fittings to 27 N•m (20 lb-ft).

13. Install the left and the right outer tie rod ends and the wheel assemblies. Refer to "Outer Tie Rod" in this section.
14. Check that the steering gear has remained in the straight-ahead position.
15. Inspect for leaks. If leaks are found, correct the cause of the leak and bleed the system. Refer to Section 6A, Power Steering System.
16. Lower the vehicle and connect the negative battery cable.

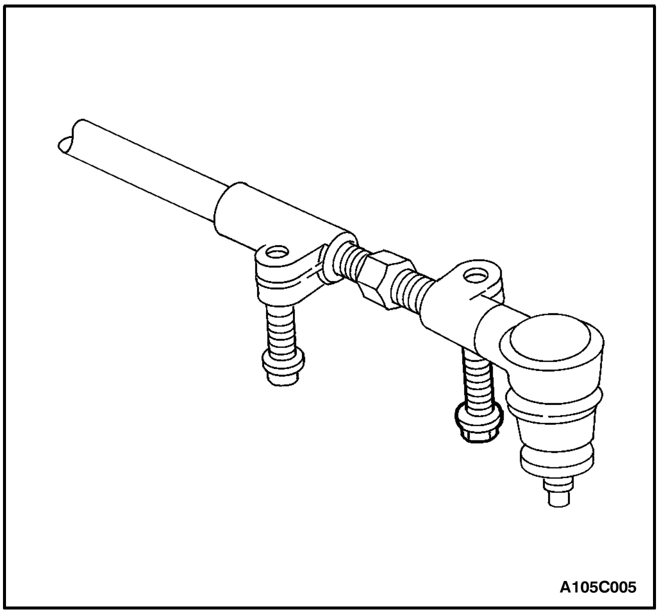
OUTER TIE ROD

Tools Required

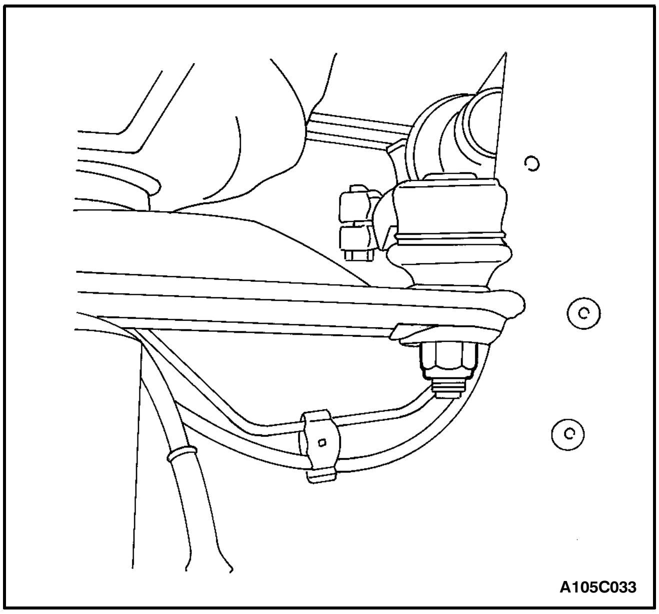
KM-507-B Ball Joint Remover

Removal Procedure

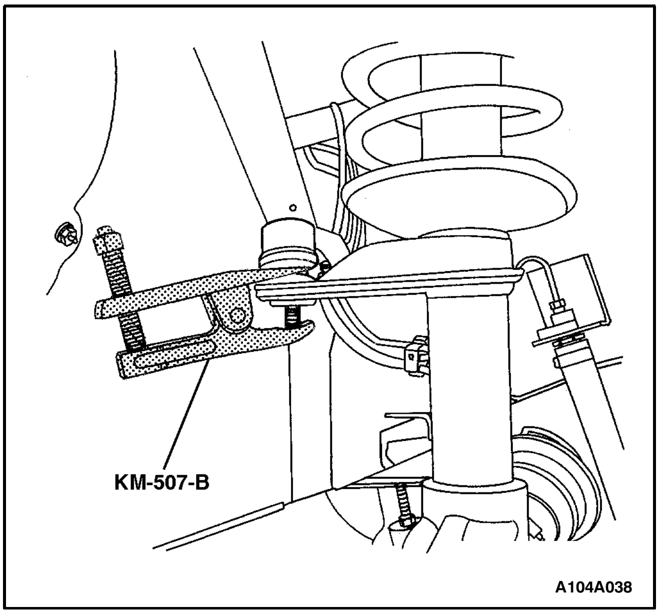
1. Loosen the outer tie rod pinch bolt.

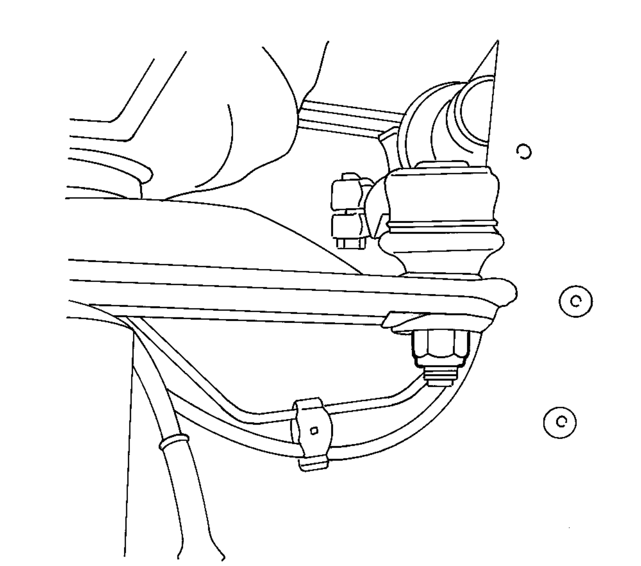


2. Remove outer tie rod hex nut.



3. Disconnect the outer tie rod from the steering knuckle using the ball joint remover KM-507-B.
4. Remove the outer tie rod.





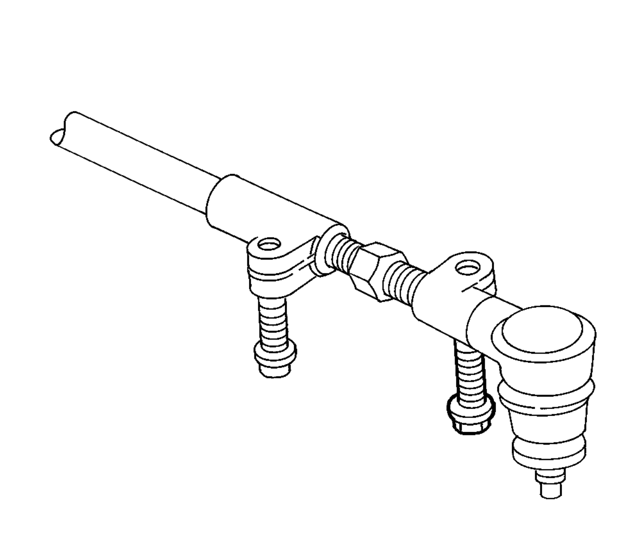
A105C033

Installation Procedure

1. Install the outer tie rod.
2. Connect the outer tie rod to the steering knuckle.
3. Install the outer tie rod hex nut.

Tighten

Tighten the outer tie rod hex nut to 60 N•m (44 lb-ft).

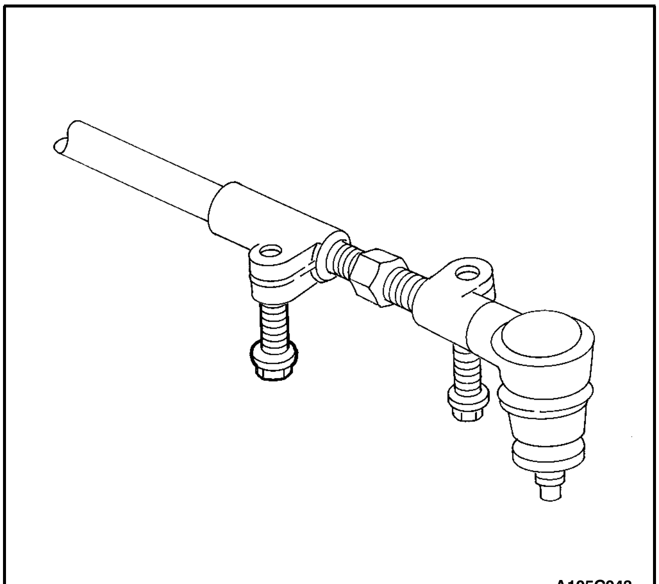


A105C005

4. Make the toe-in adjustment by turning the tie rod adjuster. Refer to Section 2B, Wheel Alignment.
5. Tighten the outer tie rod pinch bolt.

Tighten

Tighten the outer tie rod pinch bolt to 22 N•m (16 lb-ft).

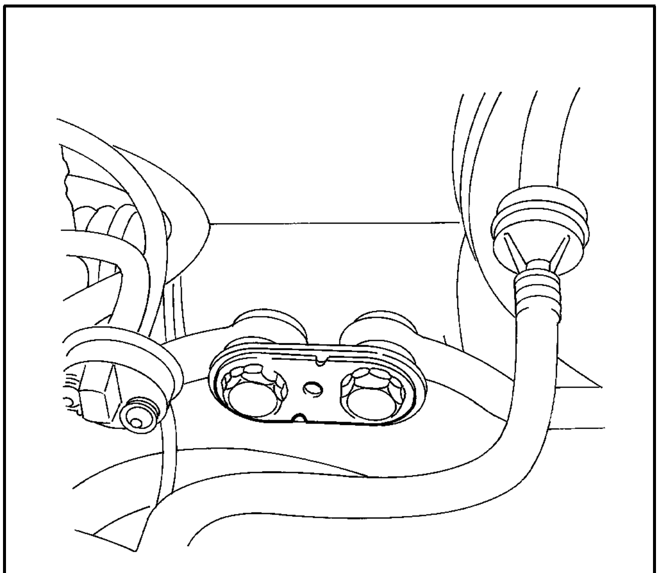


A105C043

INNER TIE ROD

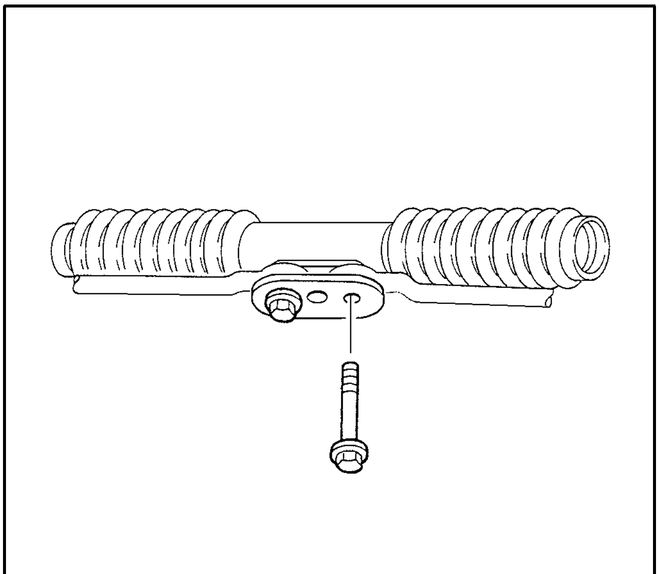
Removal Procedure

1. Loosen the inner tie rod pinch bolt.



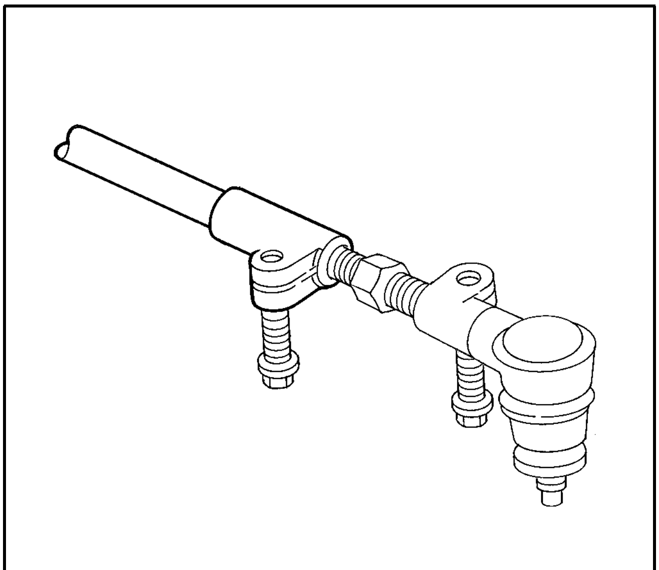
A105C009

2. Remove the lock plate. Do not reuse it.



A105C035

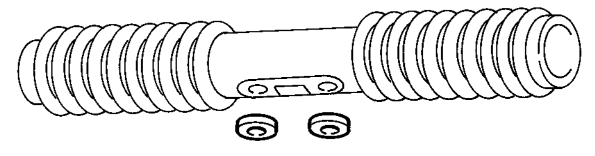
3. Remove the inner tie rod bolt from the rack and pinion assembly.



A105C045

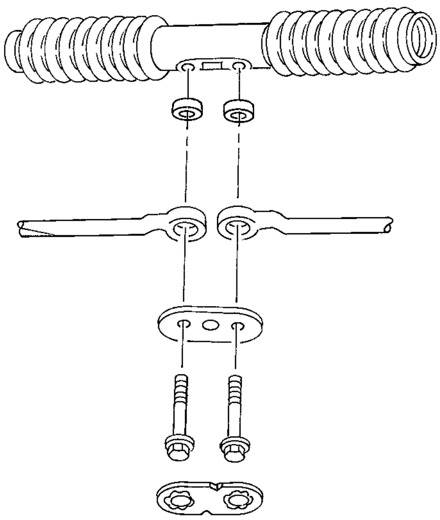
Notice: If both inner tie rods need to be removed, reinstall the tie rod bolt after removing the first tie rod to keep the rack and pinion boot and the other parts properly aligned.

4. Remove the inner tie rod by sliding it out between the bolt support plate and the rack and pinion boot and turning it off the tie rod adjuster screw.


A105C008

Installation Procedure

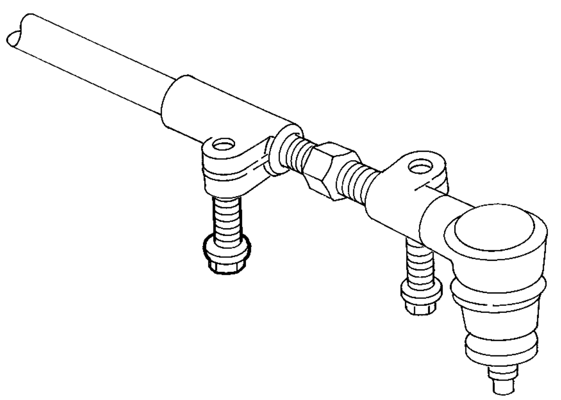
1. Be sure the center housing cover washers are fitted into the rack and pinion boot.


A105C044

2. Install the inner tie rod by turning it onto the tie rod adjuster screw and sliding it between the inner tie rod plate and the center housing cover washer.
3. Insert the inner tie rod bolt through the holes in the inner tie rod plate, the inner tie rod, the center housing cover washer (captured in recesses in rack and pinion boot), the rack guide assembly (which is hidden inside the rack and pinion boot), and into the threaded hole in the rod and rack assembly.

Tighten

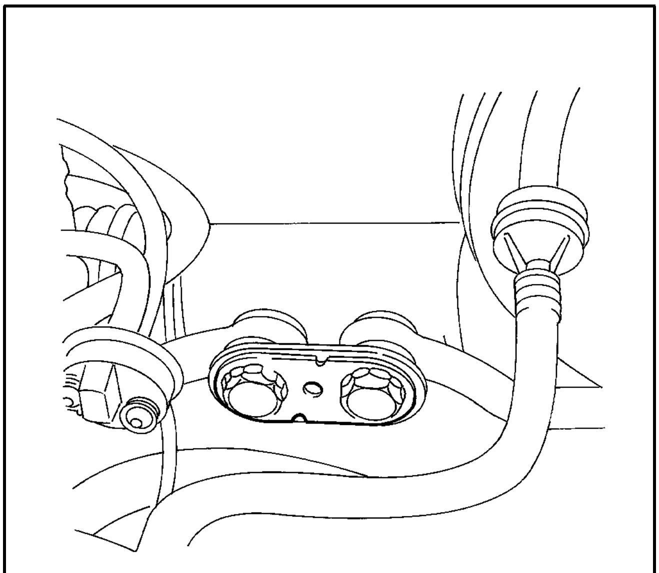
Tighten the inner tie rod bolts to 90 N•m (66 lb-ft).


A105C043

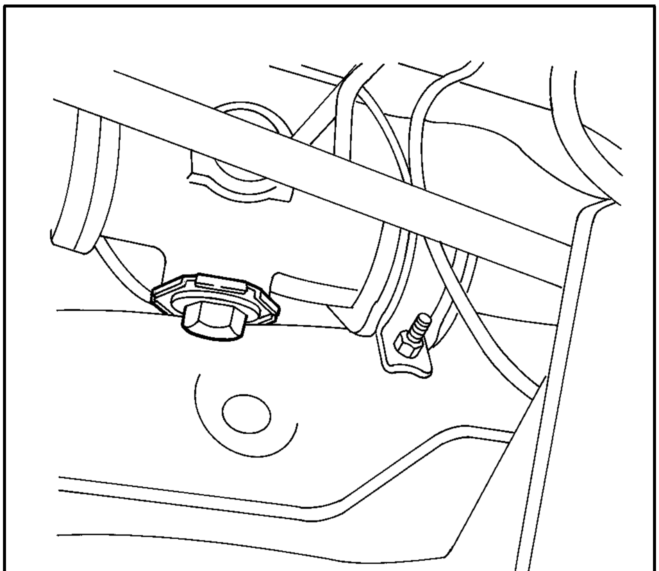
4. Tighten the inner tie rod pinch bolt.

Tighten

Tighten the inner tie rod pinch bolt to 22 N•m (16 lb-ft).


A105C009

5. Install the new lock plate with the notches in the proper position over the flats of the inner tie rod bolts.


A105C031

RACK BEARING PRELOAD ON-VEHICLE ADJUSTMENT

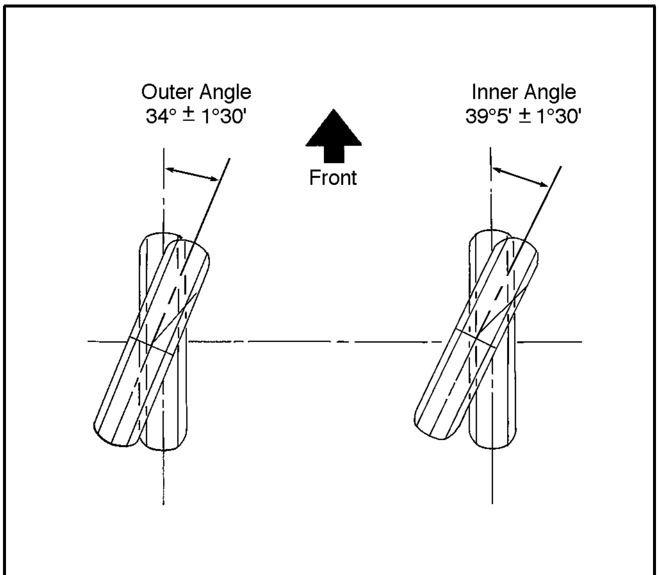
Adjustment Procedure

Make the rack bearing adjustment with the front wheel raised and the steering wheel centered. Be sure to check the returnability of the steering wheel to center after the adjustment.

1. Loosen the locknut and turn the adjuster plug clockwise until a torque of 10 N•m (88 lb-in) is obtained.
2. Back the adjuster plug off by 55 to 65 degrees. Check the pinion preloaded torque is within the range 0.9 to 1.7 N•m (8 to 15 lb-in).
3. Tighten the adjuster plug locknut while holding the adjuster plug stationary.

Tighten

Tighten the adjuster plug locknut to 70 N•m (52 lb-ft).



A105D001

STRAIGHT-AHEAD CHECK

After all the necessary operations on the steering gear are completed, check the exact straight-ahead position of the steering in each case.

With the vehicle on the floor, place the steering wheel in the straight-ahead position. Mark the centerline of both tires on the floor. Turn the steering wheel all the way to the right and mark the new centerline of both tires on the floor.

Straight Ahead Check Table

Step	Action	Value(s)	Yes	No
1	Place the steering wheel in the straight-ahead position. Is the wheel in the correct position?	-	Go to Step 2	-
2	Is the steering coupling flange pinch bolt lying horizontally?	-	Go to Step 3	Go to Step 4
3	Is the steering wheel off center by more than 5 degrees?	-	Go to Step 5	Go to Step 6
4	The pinion is displaced on the rack. The steering pinion position must be corrected. Is the repair complete?	-	Go to Step 2	-
5	Remove steering wheel and center on the spindle splines. Is the repair complete?	-	Go to Step 3	-
6	Turn the steering wheel all the way to the right. Measure the inner and the outer angles of the tire centerline compared to the straight-ahead centerline. Do the angles match the value specified?	Inner angle: 39°5′4 1°30′ Outer angle: 34°4 1°30′	System OK	Go to Step 7
7	The rack assembly was not assembled correctly. Repair as needed. Is the repair complete?	-	Go to Step 6	-

UNIT REPAIR

RACK AND PINION

There is no provision for overhaul or disassembly of the rack and pinion power steering gear. The power steering gear is serviced only as an assembly.

RACK AND PINION BOOT

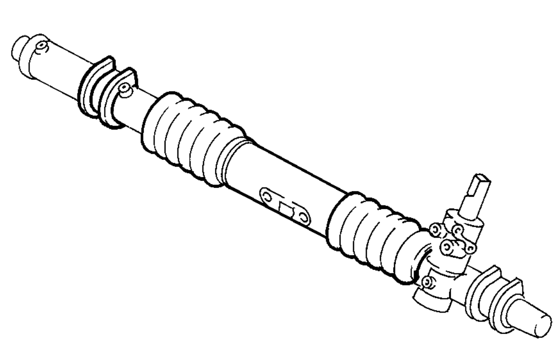
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

KM-J-26610 Installer

Disassembly Procedure

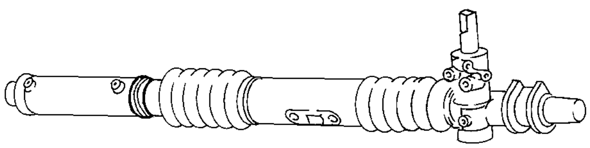
1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Disconnect the hydraulic cylinder lines. Refer to "Hydraulic Cylinder Lines" in this section.



A105C046

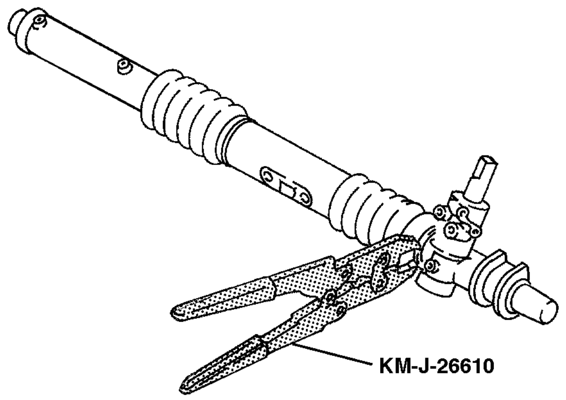
3. Cut off the rack and pinion boot clamps. Remove the mounting bracket bushing, the boot retaining bushing and the rack and pinion boot.
4. Replace the boot retaining bushing if it is damaged.

Assembly Procedure



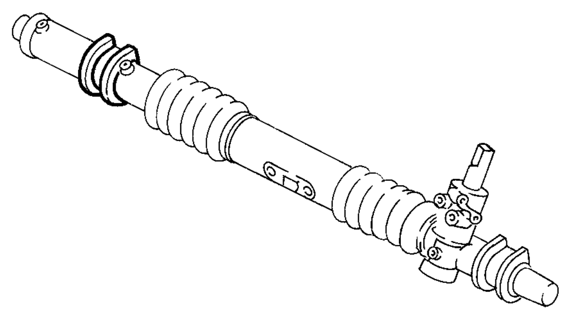
A105C047

1. Slide the boot onto the housing.
2. Install the boot retaining bushing onto the housing. Lightly coat the boot retaining bushing with multipurpose grease for ease of assembly.



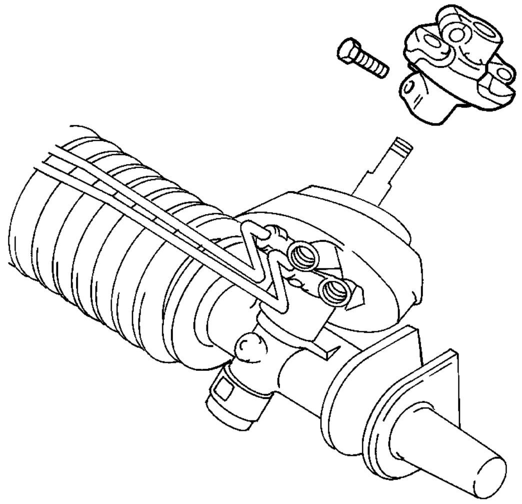
A105C048

3. Slide the boot onto the boot retaining bushing and seat the boot into the housing groove at the pinion end of housing.
4. Crimp the new boot clamps using the installer KM-J-26610.



A105C049

5. Install the mounting bracket bushing onto the housing.
6. Connect the hydraulic cylinder lines. Refer to "Hydraulic Cylinder Lines" in this section.
7. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



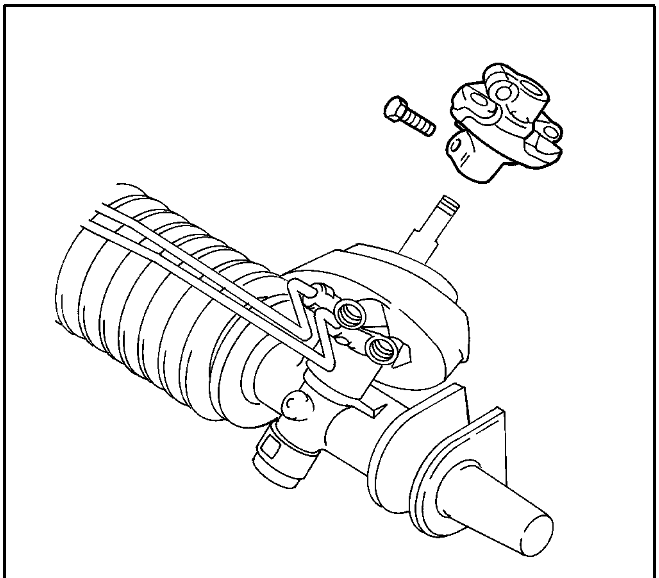
A105C017

FLANGE AND STEERING COUPLING ASSEMBLY

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the pinch bolt from the flange and steering coupling assembly.
3. Disconnect the flange and steering coupling assembly from the stub shaft of the pinion and valve assembly.



A105C017

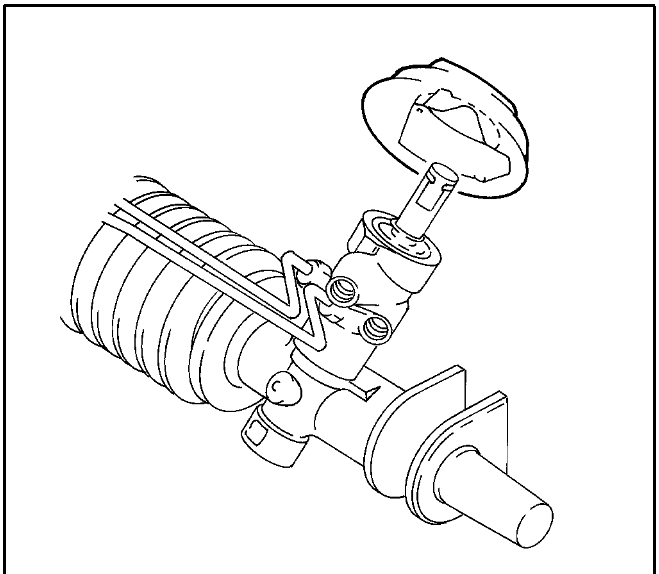
Assembly Procedure

1. Connect the flange and steering coupling assembly to the stub shaft of the pinion and valve assembly.
2. Insert the pinch bolt into the flange and steering coupling assembly.

Tighten

Tighten the coupling flange pinch bolt to 22 N•m (16 lb-ft).

3. Install the rack and pinion steering coupling assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



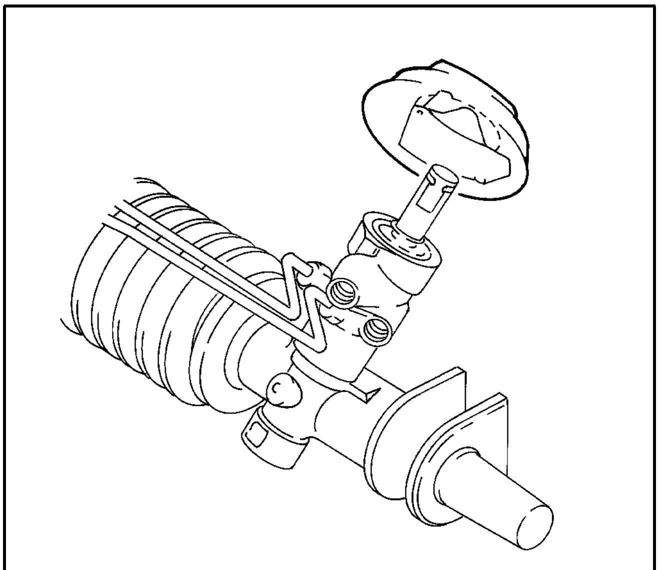
A105C016

DASH SEAL

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Disassembly Procedure

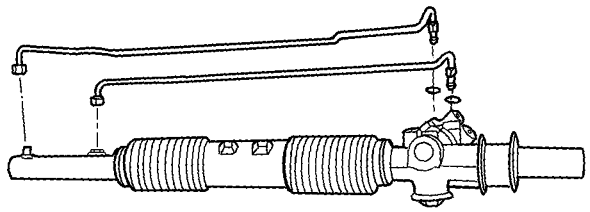
1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the flange and steering coupling assembly. Refer to "Flange and Steering Coupling Assembly" in this section.
3. Remove the dash seal from the rack and pinion housing.



A105C016

Assembly Procedure

1. Line up the notches in the dash seal to the notches in the rack and pinion housing.
2. Connect the dash seal to the housing.
3. Connect the flange and steering coupling assembly. Refer to "Flange and Steering Coupling Assembly" in this section.
4. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



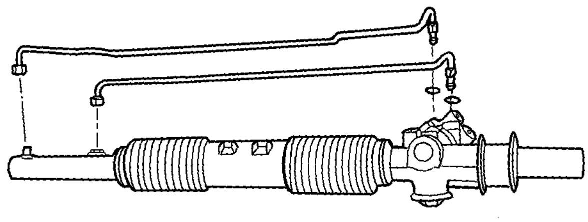
A105A004

HYDRAULIC CYLINDER LINES

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Disconnect the cylinder lines from the rack and pinion housing. Remove the O-ring seals.



A105A004

Assembly Procedure

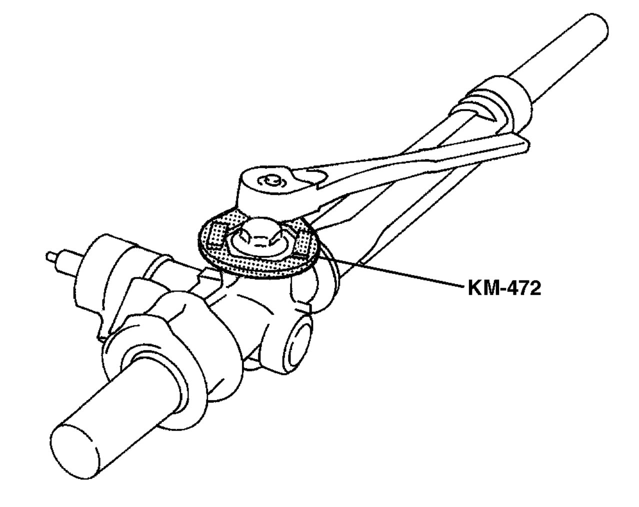
1. Lubricate the O-ring seals with power steering fluid.
2. Place the O-ring seals into the housing. Connect the cylinder lines to the rack and pinion housing.
3. Install the power steering line fittings at the pinion valve end.

   Tighten

   Tighten the power steering line fittings to 18 N•m (13 lb-ft).
4. Install the power steering line fittings at the cylinder end.

   Tighten

   Tighten the power steering line fittings to 27 N•m (20 lb-ft).
5. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



A105C019

STUB SHAFT SEALS AND UPPER BEARING

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Tools Required

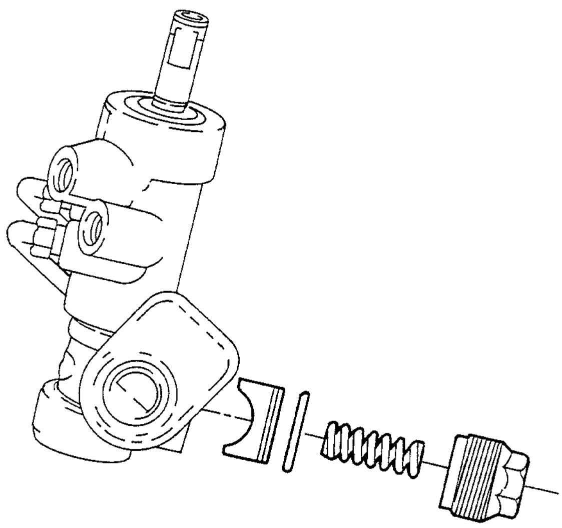
KM-472 Wrench

J-36545 Installing Tube

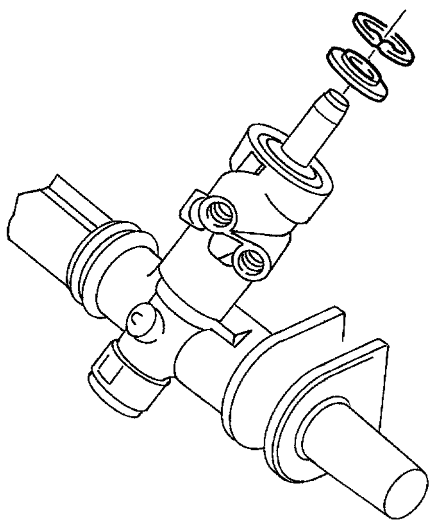
J-29810 Stub Shaft Seal Protector

Disassembly Procedure

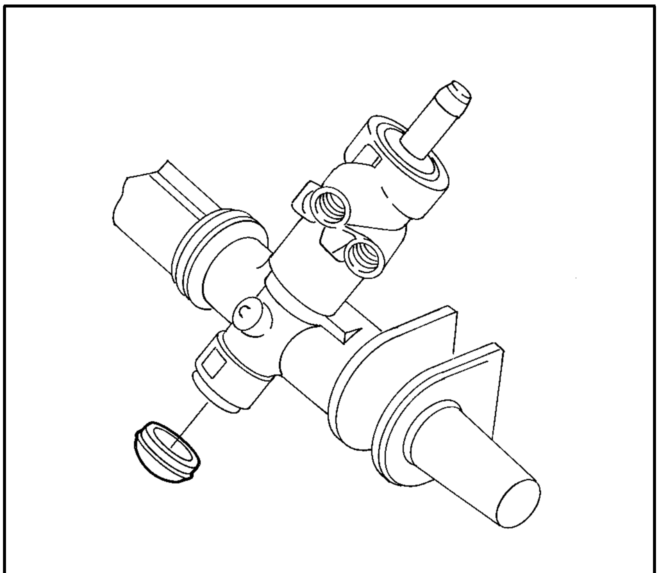
1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the adjuster plug locknut from the adjuster plug using the wrench KM-472.


A105C051

3. Remove the adjuster plug, the adjuster spring, and the rack bearing with the O-ring seal attached from the housing.

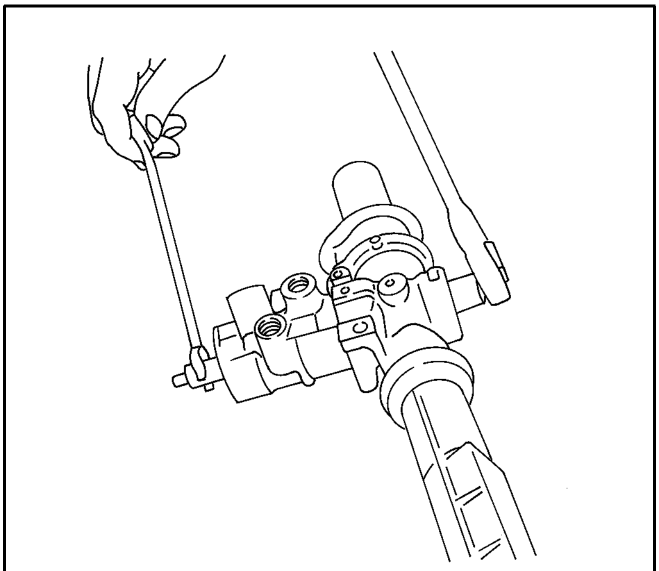

A105C050

4. Remove the retaining ring and the stub shaft dust seal from around the stub shaft.



A105C042

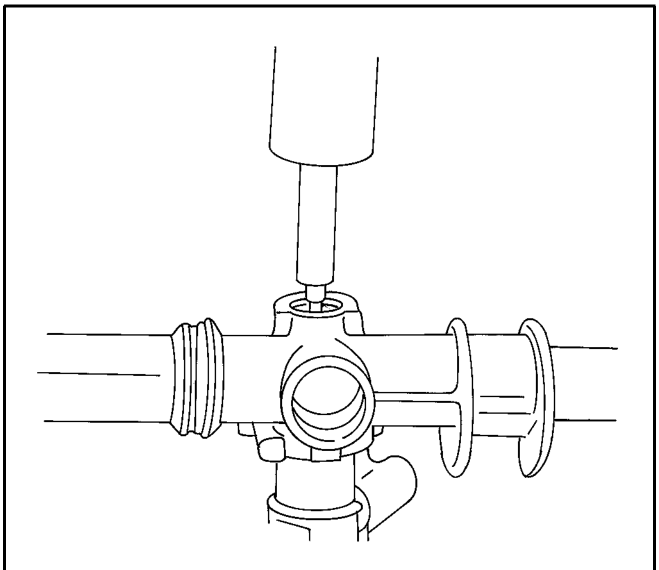
5. Remove the dust cap from the bottom of the housing.



A105C022

Notice: If the stub shaft is not held, damage to the pinion teeth will occur.

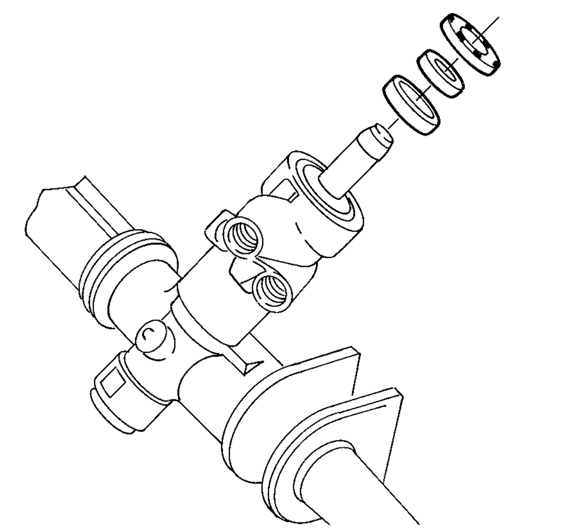
6. While holding the stub shaft, remove the locknut from the pinion.



A105C023

Important: Complete removal of valve and pinion assembly is not required.

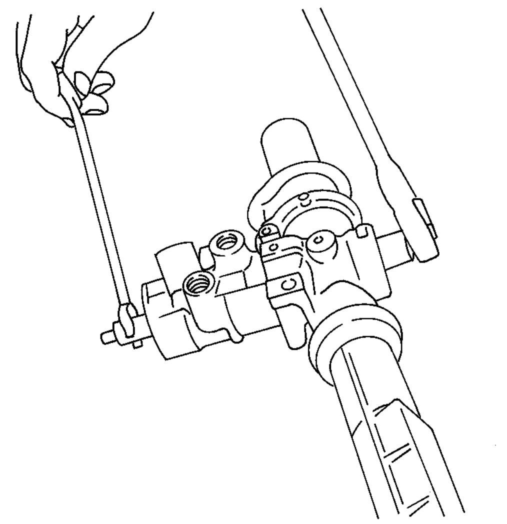
7. Using a press, press on the threaded end of the pinion until it is flush with the ball bearing assembly.



A105C041

Important: The bearing and annulus are pressed together. Disassemble only if bearing replacement is required.

8. **Remove stub shaft dust seal, stub shaft seal and stub shaft bearing annulus assembly from valve end of housing.**



A105C022

Assembly Procedure

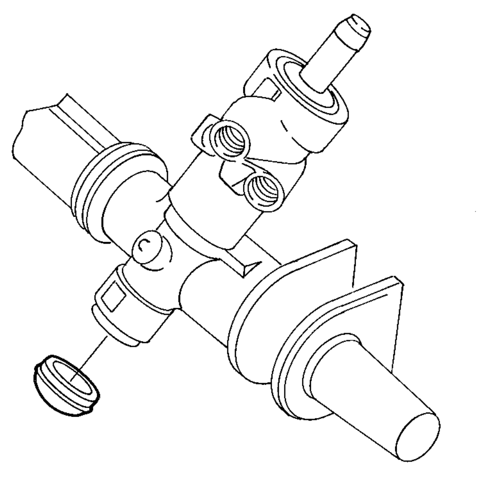
1. **Seat the pinion assembly into the housing.**

Notice: If the stub shaft is not held, damage to the pinion teeth will occur.

2. **While holding the stub shaft, thread the locknut onto the end of the pinion.**

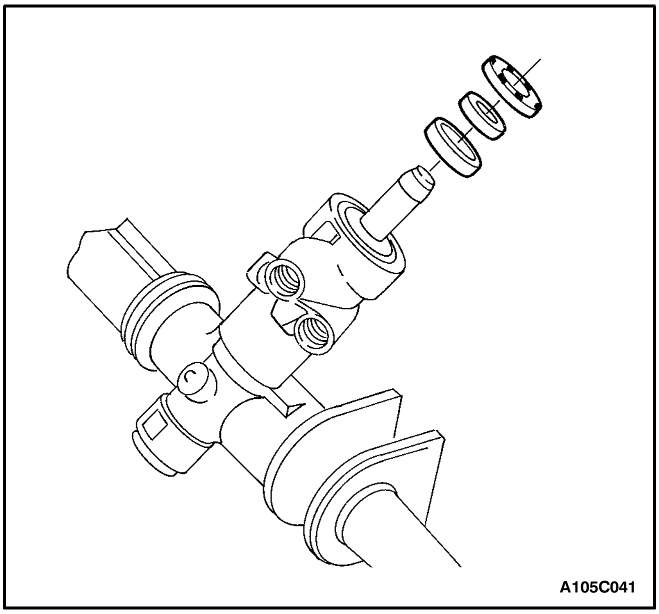
Tighten

Tighten the pinion locknut to 30 N•m (22 lb-ft).

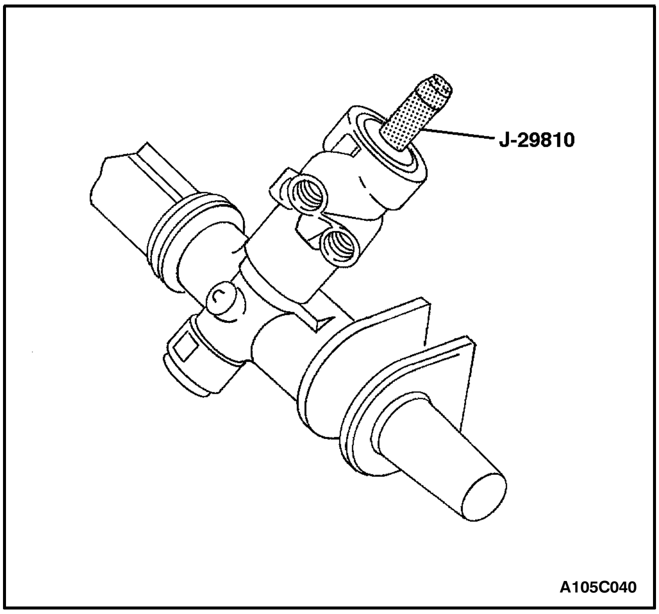


A105C042

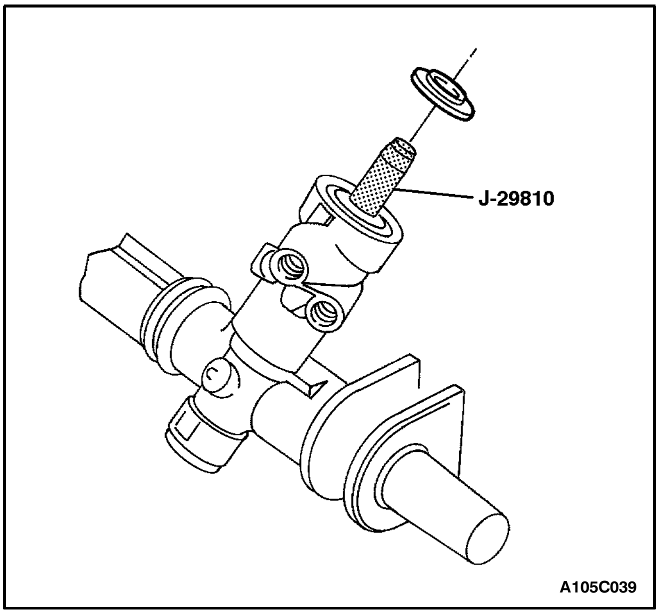
3. **Install the dust cap to the bottom of the housing.**



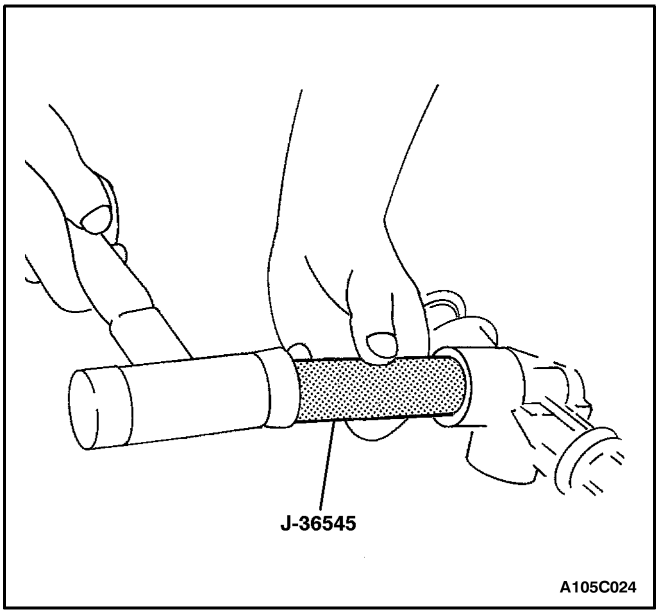
4. Install the stub shaft bearing annulus assembly onto the stub shaft and slide it into the valve end of the housing.



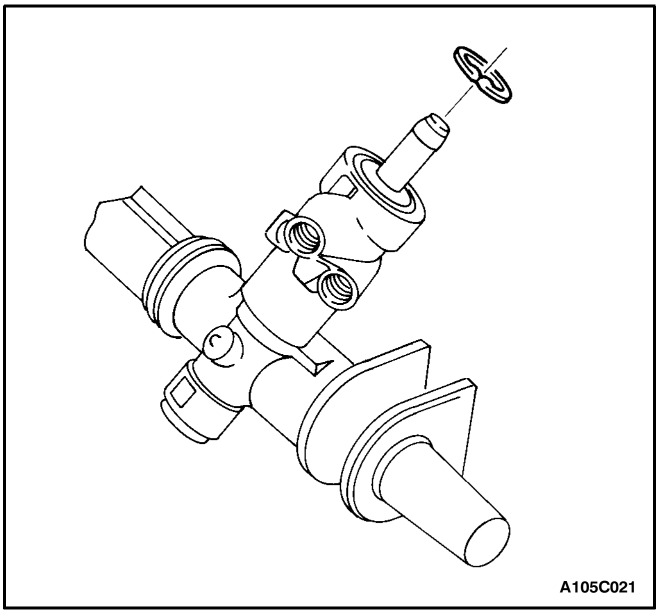
5. Place the stub shaft seal protector J-29810 onto the stub shaft.



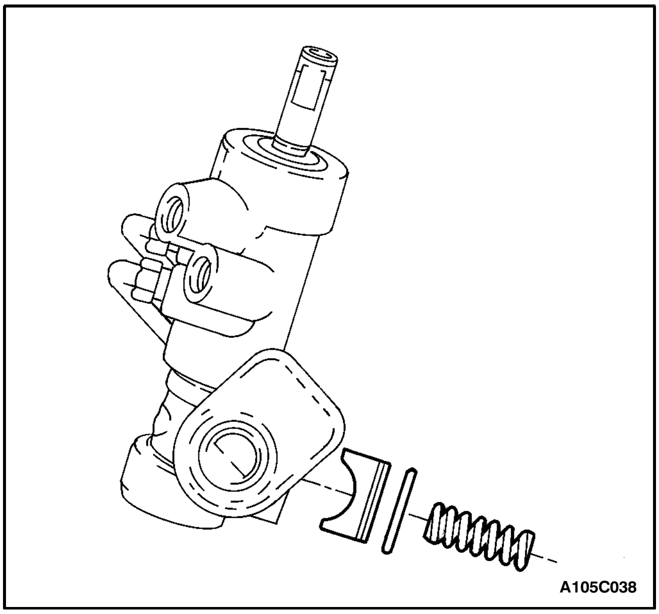
6. Install stub shaft dust seal over the protector and slide it into the housing.



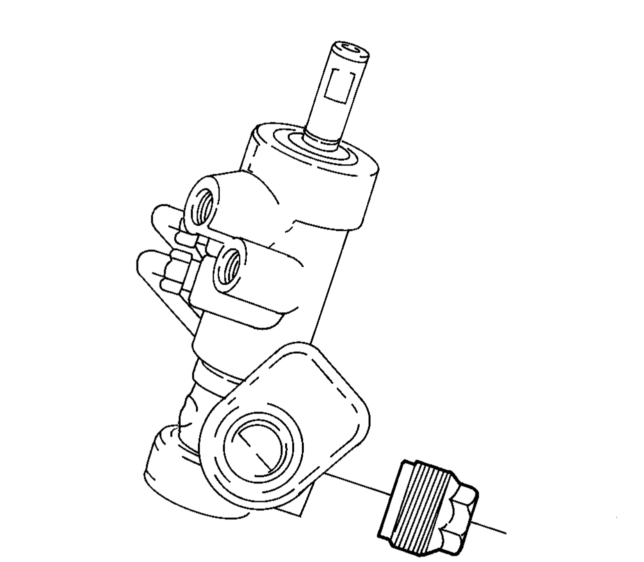
7. Seat the annulus assembly and the stub shaft seal with the installing tube J-36545.



8. Place the retaining ring into the groove in the housing.



9. Coat the rack bearing, the O-ring seal attached to the rack bearing, the adjuster spring, and the adjuster plug with lithium grease.
10. Insert the rack bearing with the O-ring seal and the adjuster spring into the housing.



A105C020

11. With the rack centered in the housing, install the adjuster plug and turn it clockwise until a torque of 10 N•m (88 lb-in) is obtained. Then back the adjuster plug off by 55 to 65 degrees. Check the pinion preloaded torque is within the range 0.9 to 1.7 N•m (8 to 15 lb-in).
12. Install the adjuster plug locknut and tighten while holding the adjuster plug stationary.

Tighten

Tighten the adjuster plug locknut to 70 N•m (52 lb-ft).

13. Install the rack and pinion steering assembly. Refer to "Rack and Pinion Assembly" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

POWER RACK AND PINION

General Description

The power rack and pinion steering system has a rotary control valve which directs the hydraulic fluid coming from the hydraulic pump to one side or the other side of the rack piston. The integral rack piston is attached to the rack. The rack piston converts hydraulic pressure to a linear force which moves the rack left or right. The force is then transmitted through the inner and the outer tie rods to the steering knuckles, which turn the wheels.

If hydraulic assist is not available, manual control is maintained. However, under these conditions, more steering effort is required. The movement of the steering wheel is transferred to the pinion. The movement of the pinion is then transferred through the pinion teeth, which mesh with the teeth on the rack, causing the rack to move.

A vane-type pump provides hydraulic pressure for the system.

The boot and rack guide, the rack bearings, and the valve and pinion assembly are no longer serviceable on this vehicle. They must be replaced as whole units.

SECTION 6D

MANUAL STEERING GEAR

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

GENERAL SPECIFICATIONS

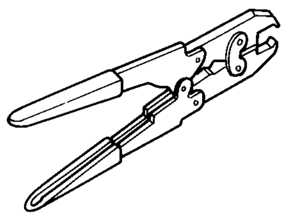
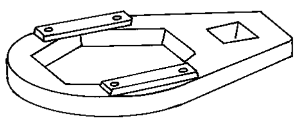
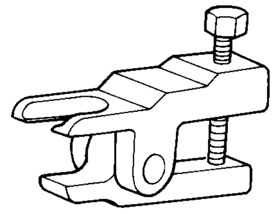
Application	Description
Lubricant	Lithium-Base Grease No. 1051344 or Equivalent

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Adjuster Plug Locknut	70	52	-
Coolant Surge Tank Attaching Nuts	4	-	35
Coupling Flange Pinch Bolt	22	16	-
Inner Tie Rod Bolts	90	66	-
Inner Tie Rod Pinch Bolts	22	16	-
Outer Tie Rod Hex Nut	60	44	-
Outer Tie Rod Pinch Bolts	22	16	-
Pinion Preload	0.7 to 1.5	-	6 to 13
Steering Gear Retaining Bracket Nuts or Bolts	38	28	-
Steering Gear Retaining Bracket Studs	20	15	-

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A104A008	KM-J-26610 Installer
 A105C025	KM-472 Wrench
 A106C034	KM-507-B Ball Joint Remover

DIAGNOSIS

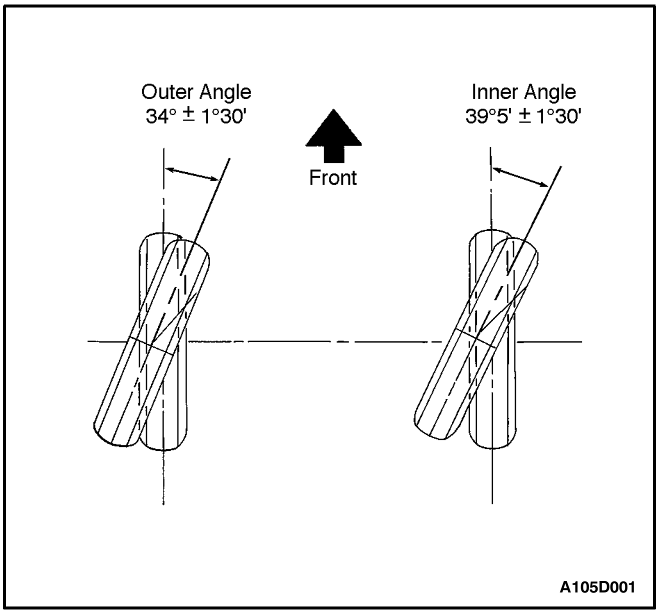
MANUAL RACK AND PINION STEERING GEAR

Excessive Play or Looseness in the Steering System

Checks	Action
Check the steering gear adjustment.	Perform straight-ahead check.
Check the wheel bearing for wear or damage.	Replace the wheel bearing.
Check the outer tie rods for improper installation.	Tighten the tie rods.

Rattling Noise in the Steering Gear

Checks	Action
Check the steering gear for improper and insufficient lubrication.	Lubricate the rack assembly. Lubricate the pinion assembly.
Check the steering gear mounting for improper installation.	Tighten the steering gear mounting bolts and the nuts.
Check the outer tie rods for improper installation.	Tighten the tie rods.



STRAIGHT-AHEAD CHECK

After all the necessary operations on the steering gear are completed, check the exact straight-ahead position of the steering in each case.

With the vehicle on the floor, place the steering wheel in the straight-ahead position. Mark the centerline of both tires on the floor. Turn the steering wheel all the way to the right and mark the new centerline of both tires on the floor.

Straight Ahead Check Table

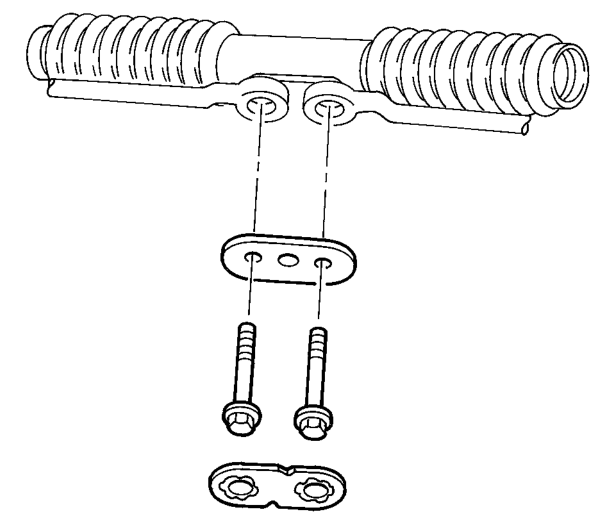
Step	Action	Value(s)	Yes	No
1	Place the steering wheel in the straight-ahead position. Is the wheel in the correct position?	-	Go to Step 2	-
2	Is the steering coupling flange pinch bolt lying horizontally?	-	Go to Step 3	Go to Step 4
3	Is the steering wheel off center by more than 5 degrees?	-	Go to Step 5	Go to Step 6
4	The pinion is displaced on the rack. The steering pinion position must be corrected. Is the repair complete?	-	Go to Step 2	-
5	Remove steering wheel and center on the spindle splines. Is the repair complete?	-	Go to Step 3	-
6	Turn the steering wheel all the way to the right. Measure the inner and the outer angles of the tire centerline compared to the straight-ahead centerline. Do the angles match the value specified?	Inner angle: 39°5′4 1°30′ Outer angle: 34°4 1°30′	System OK	Go to Step 7
7	The rack assembly was not assembled correctly. Repair as needed. Is the repair complete?	-	Go to Step 6	-

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

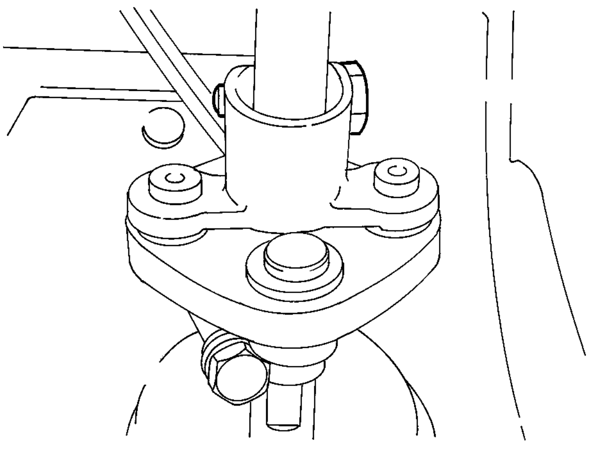
RACK AND PINION ASSEMBLY

Removal Procedure



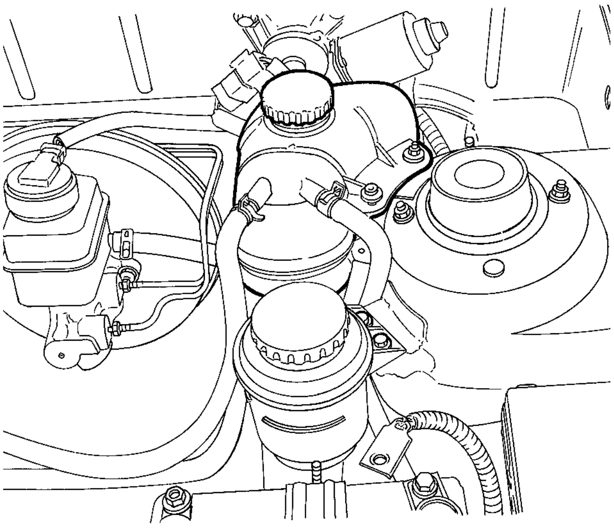
A105C001

1. Disconnect the negative battery cable.
2. Disconnect the inner tie rods from the rack and pinion assembly by removing the lock plate, the inner tie rod bolts, and the inner tie rod plate. Do not reuse the lock plate.



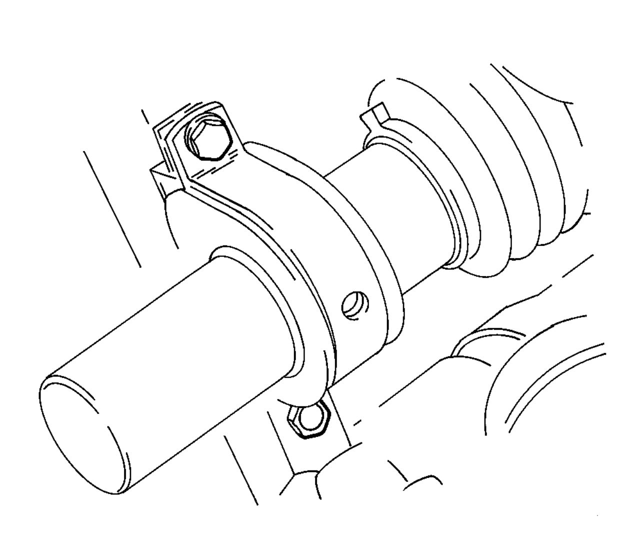
A105C002

3. Position the steering gear straight ahead by turning the steering wheel until the spokes are centered diagonally and pointing downward.
4. Loosen the top pinch bolt on the coupling flange.



A105C032

5. For left-hand drive vehicles, disconnect the coolant surge tank from the vehicle by removing the attaching nuts. Without disconnecting the hoses, move the tank out of the repair area.

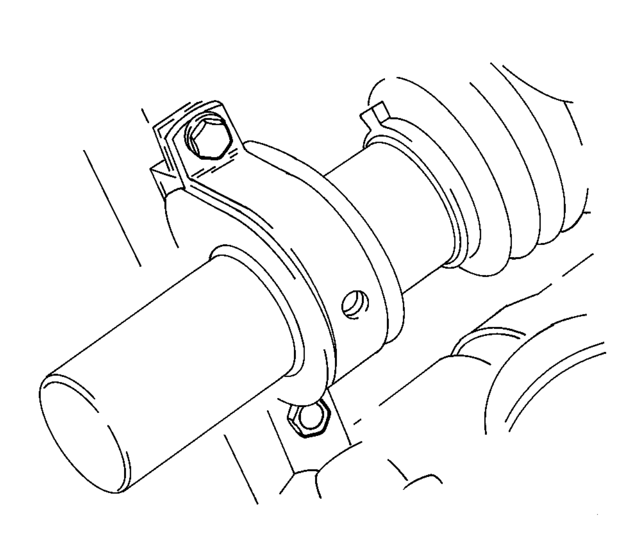


A105C004

6. Disconnect the steering gear retaining bracket nuts from the bottom of each steering gear retaining bracket. Disconnect the steering gear retaining bracket nuts and bolts from the top of each steering gear retaining bracket.
7. Remove the left inner and outer tie rod from the vehicle. Refer to "Outer Tie Rod" and "Inner Tie Rod" in this section.
8. Remove the rack and pinion assembly through the front wheel opening.
9. If the studs were removed with the mounting clamps, reinstall the studs into the cowl.

Tighten

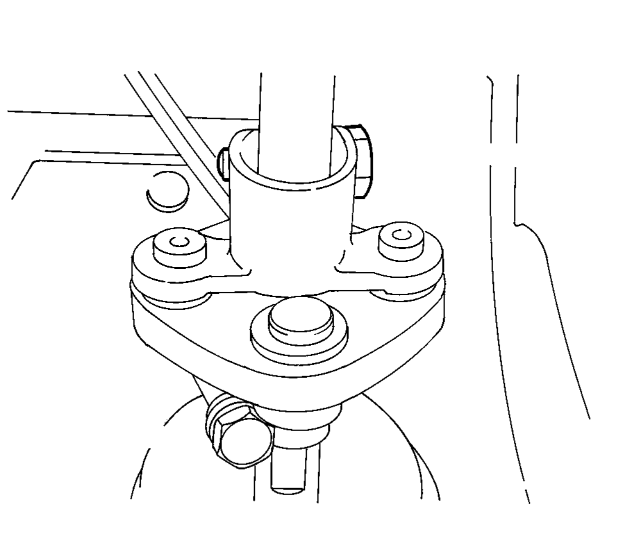
Tighten the steering gear retaining bracket studs to 20 N•m (15 lb-ft).



A105C004

Installation Procedure

1. Install the rack and pinion steering gear assembly through the front wheel opening. The steering gear must be in a straight-ahead position. The steering wheel spokes must be centered diagonally and point downwards.
2. Connect the steering gear assembly to the body with two mounting brackets. Loosely attach all the steering gear retaining bracket nuts and bolts.



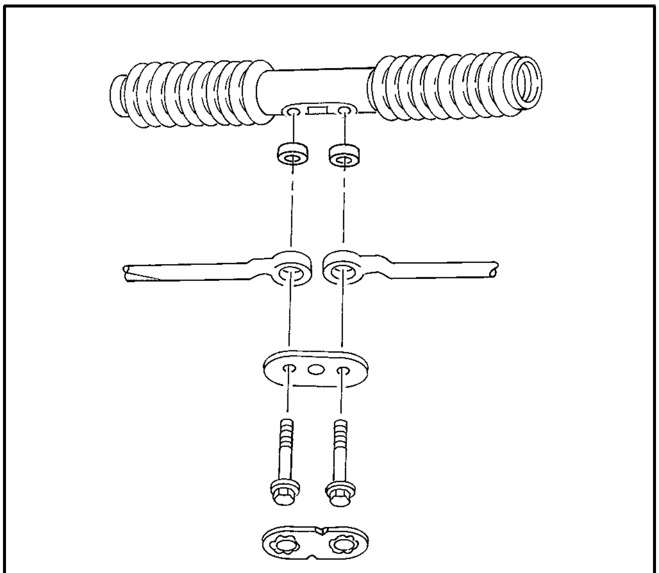
A105C002

Important: Be sure the center housing cover washers are located between the tie rods and the steering gear. Always use a new lock plate.

3. Connect both tie rods to the steering gear by threading the inner tie rod bolts through the inner tie rod plate, the tie rods, and the center housing cover washers into the rack guide. Install a new lock plate.

Tighten

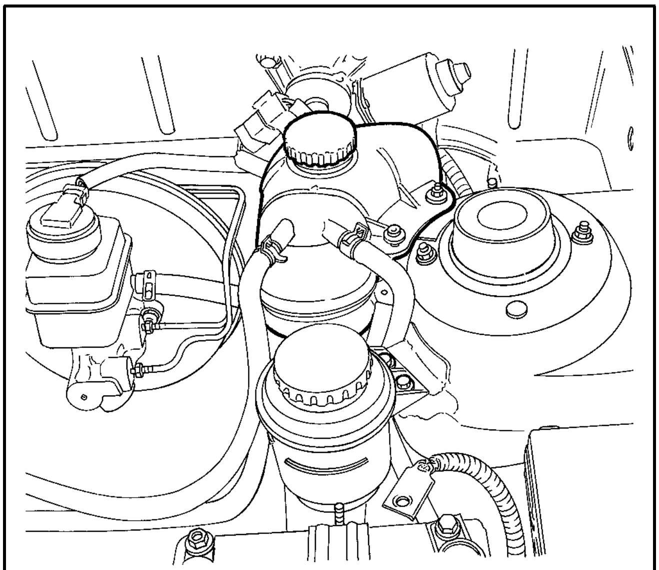
Tighten the inner tie rod bolts to 90 N•m (66 lb-ft).


A105C044

4. Seat the dash seal and attach the coupling flange to the steering gear. Secure the coupling flange assembly with the top pinch bolt on the coupling flange assembly.

   Tighten

   Tighten the coupling flange pinch bolt to 22 N•m (16 lb-ft).


A105C032

5. Tighten all the steering gear retaining bracket nuts and bolts.

   Tighten

   Tighten the steering gear retaining bracket nuts and bolts to 38 N•m (28 lb-ft).
6. Check that the steering gear has remained in the straight-ahead position.
7. Connect negative battery cable.
8. For left-hand drive vehicles, reconnect the coolant surge tank with the attaching nuts.

   Tighten

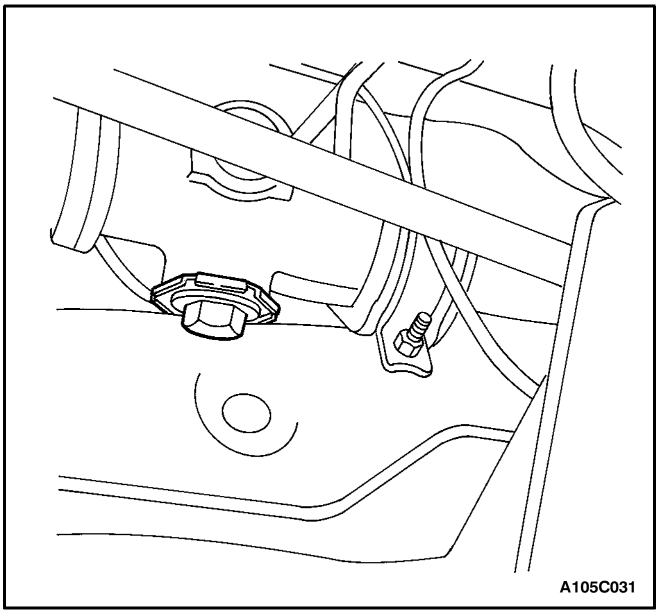
   Tighten the coolant surge tank attaching nuts to 4 N•m (35 lb-in).

OUTER TIE ROD

Refer to Section 6C, Power Steering Gear.

INNER TIE ROD

Refer to Section 6C, Power Steering Gear.



RACK BEARING PRELOAD ON-VEHICLE ADJUSTMENT

Adjustment Procedure

Make the rack bearing adjustment with the front wheel raised and the steering wheel centered. Be sure to check the returnability of the steering wheel to center after the adjustment.

1. Loosen the locknut and turn the adjuster plug clockwise until it bottoms in the housing.
2. Loosen the adjuster plug 30 to 40 degrees.
3. Tighten the adjuster plug locknut while holding the adjuster plug stationary.

Tighten

Tighten the adjuster plug locknut to 70 N•m (52 lb-ft).

UNIT REPAIR

RACK AND PINION

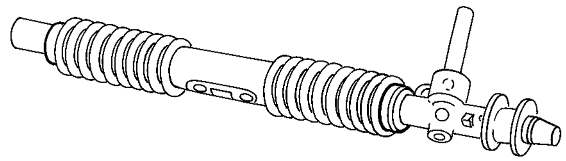
(Left-Hand Drive Shown, Right Hand Drive Similar)

Tools Required

KM-J-26610 Installer

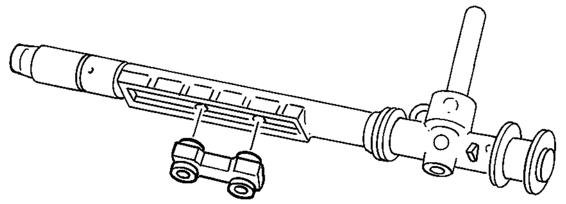
KM-472 Wrench

Disassembly Procedure



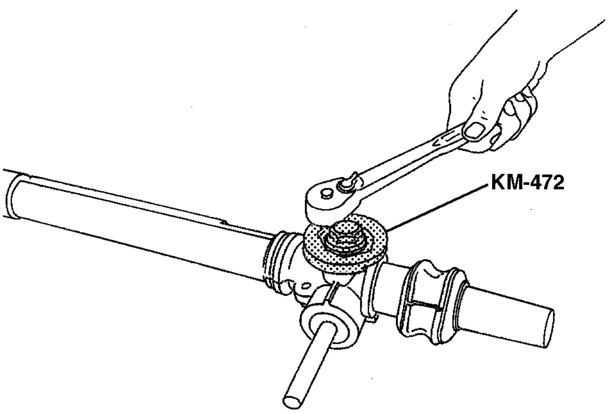
A105D002

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Cut off the rack and pinion boot clamps and remove the rack and pinion boot.



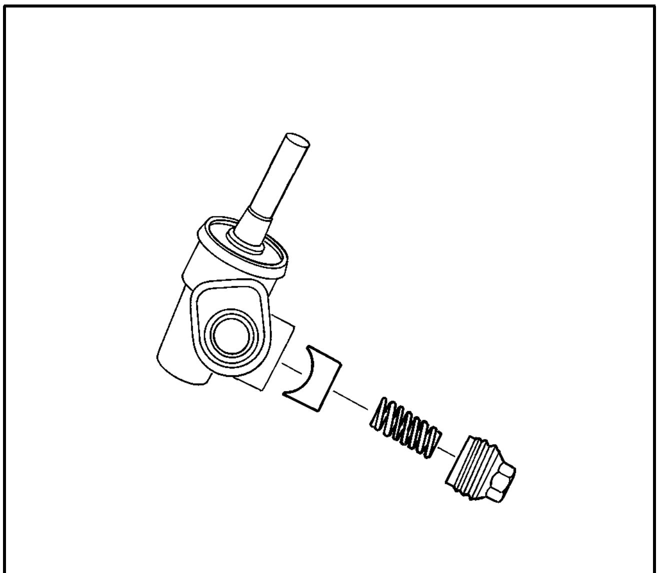
A105D003

3. Remove the rack guide assembly.



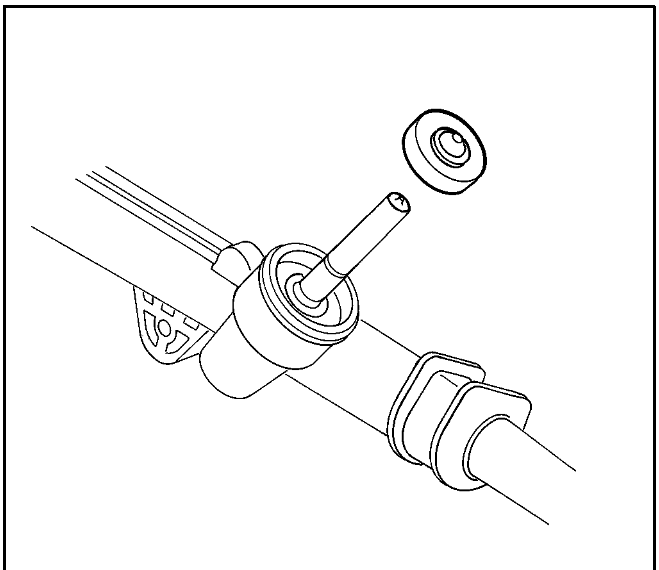
A105D005

4. Remove the adjuster plug locknut from the adjuster plug using the wrench KM-472.



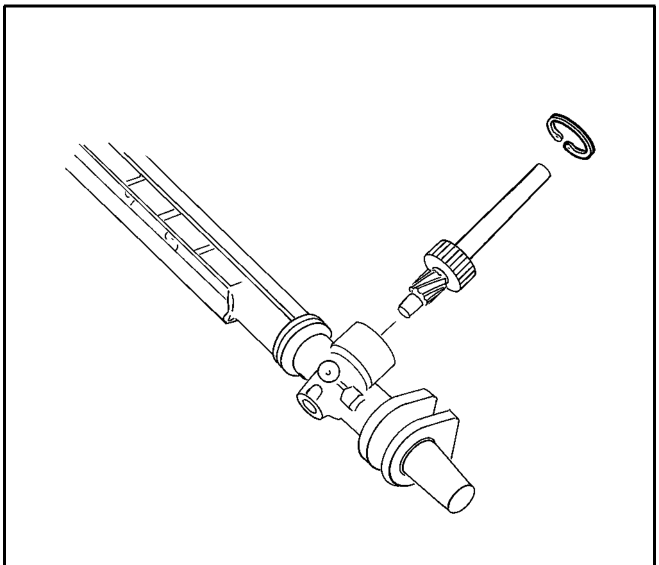
A105D004

5. Remove the adjuster plug, the adjuster spring and the rack bearing with the O-ring seal attached.



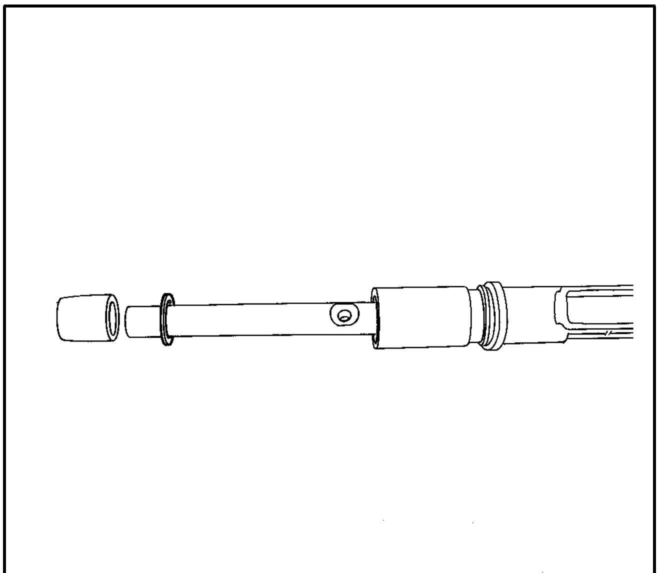
A105D006

6. With the rack gear centered, mark the location of the stub shaft notch on the housing to aid in the proper installation of the pinion and valve assembly.
7. Remove the pinion shaft seal by pressing down on one side of the seal and pulling up on the other side of the seal.



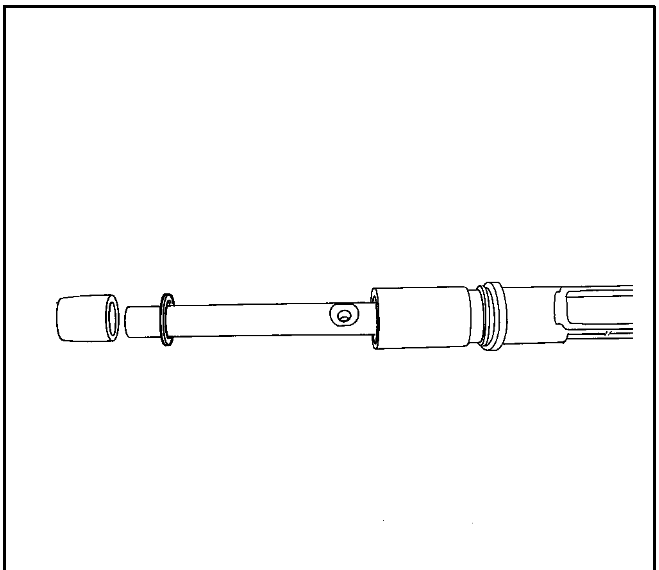
A105D007

8. Remove the retaining ring and pull the pinion and valve assembly out of the rack and pinion housing.



A105D008

9. Remove the housing end cover.
10. Remove the rack housing retaining ring.
11. Remove the rack shaft from the rack and pinion housing.

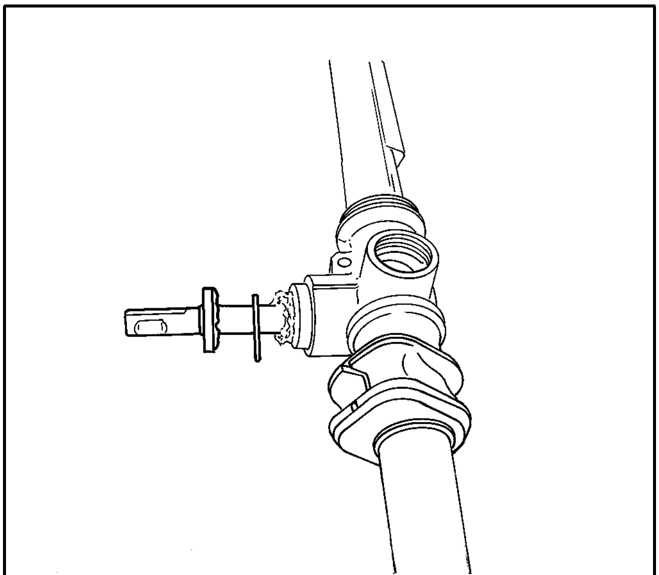


A105D008

Assembly Procedure

Important: All interlocking metal parts must be lubricated with lithium-base grease as they are assembled.

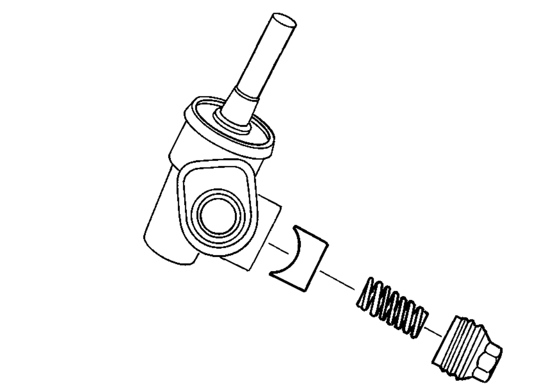
1. Install the rack shaft into the rack and pinion housing. Install the retaining ring.
2. Install the housing end cover.



A105D010

Important: When the pinion and valve assembly is fully seated in the housing, be sure the notch in the stub shaft and the mark on the housing line up. Be sure the rack guide assembly is centered in the housing window.

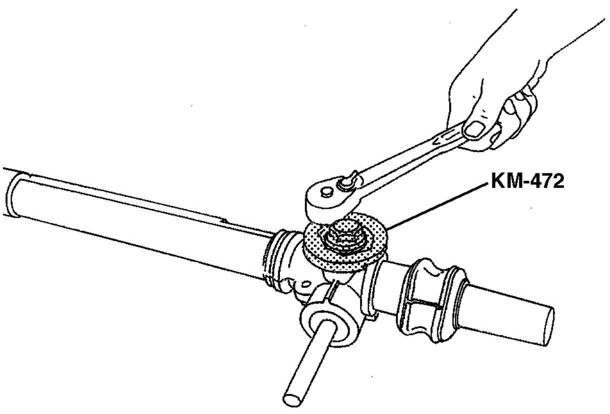
3. Center the rack guide assembly in the housing window opening.
4. Line up the stub shaft notch with the mark on the housing. Seat the pinion and valve assembly into the rack and pinion housing.
5. Install the retaining ring and seat the pinion seal. The top of the seal should be flush with the top of the housing.


A105D004

6. Coat the rack bearing (with the O-ring seal attached), the adjuster spring, and the adjuster plug with lithium-base grease. Install them into the housing.

Tighten

With the rack centered in the window in the housing, turn the adjuster plug clockwise until a torque of 5 N•m (44 lb-in) is obtained. Then back the adjuster plug off by 20 to 30 degrees. Check the pinion pre-loaded torque is within the range 0.7 to 1.5 N•m (6 to 13 lb-in).

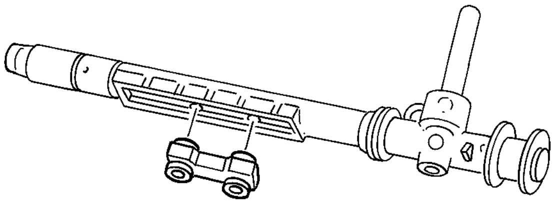


A105D005

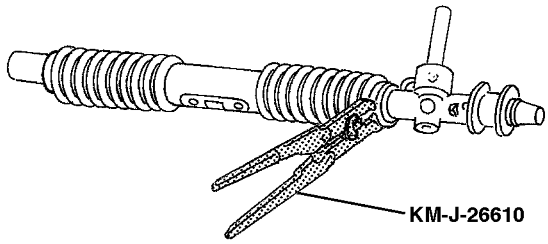
7. Thread the adjuster plug locknut onto the adjuster plug.

Tighten

Tighten the adjuster plug locknut to 70 N•m (52 lb-ft) using the wrench KM-472. Hold the adjuster plug stationary.


A105D003

8. Place the rack guide assembly into the rod and rack assembly. Center the rack guide assembly in the housing window opening.

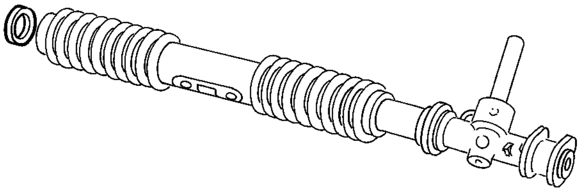


A105D017

9. Slide a new boot clamp onto the rack and pinion boot.

Notice: Be sure centering cover washers are in place on rack and pinion boot. For ease of assembly, install the inner tie rod bolts through the center cover washers and rack guide, then lightly thread the bolt into the rod and rack assembly. This will help keep the components in proper alignment.

10. Position the boot clamps onto the rack and pinion boot. Crimp the clamp using the installer KM-J-26610. Be sure the boot retaining bushing is in place.
11. Install the rack and pinion assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



A105D011

RACK AND PINION BOOT

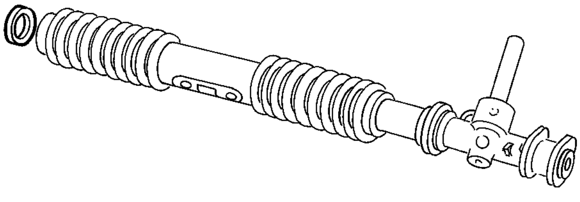
(Left-Hand Drive Shown, Right Hand Drive Similar)

Tools Required

KM-J-26610 Installer

Disassembly Procedure

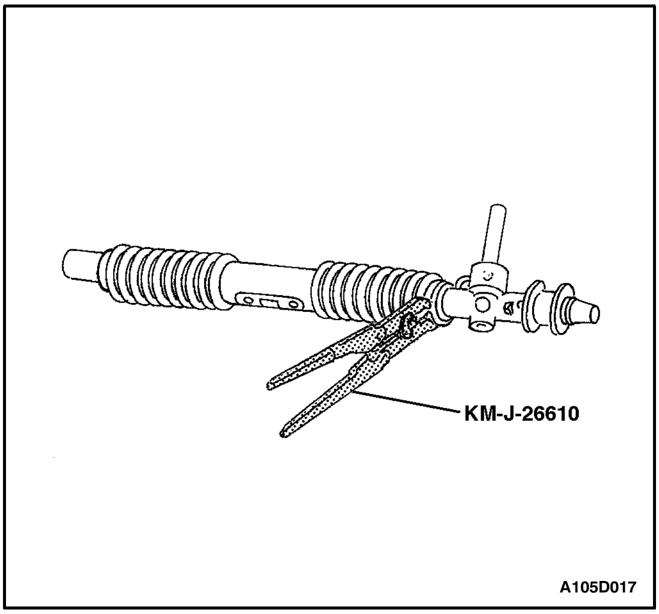
1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the mounting bracket bushing.
3. Cut off the rack and pinion boot clamps. Remove the rack and pinion boot.
4. Replace the boot retaining bushing if it is damaged.
5. Replace the housing end cover only if it is damaged.



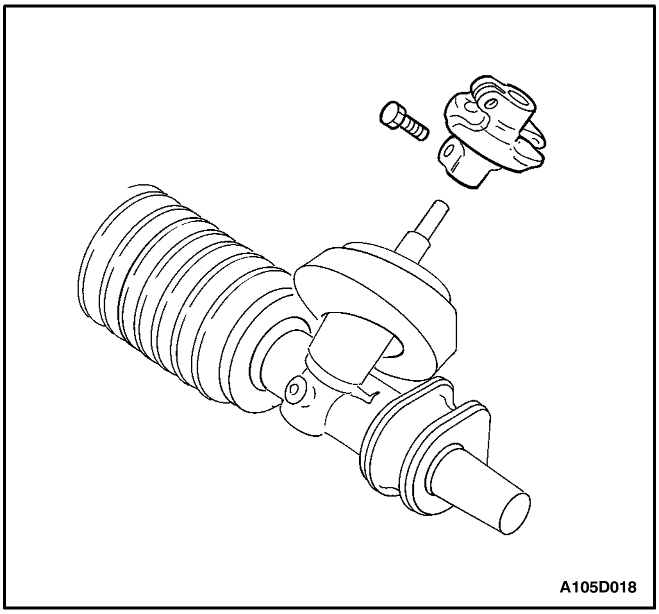
A105D011

Assembly Procedure

1. Slide the new boot clamp onto the boot. Slide the boot onto the housing.
2. Install the boot retaining bushing into the boot. Lightly coat the inner lip of the boot retaining bushing with multipurpose grease for ease of assembly.



3. Slide the boot and the boot retaining bushing until they are seated in the bushing groove at the pinion end of housing.
4. Crimp the new boot clamps using the installer KM-J-26610.
5. Install the mounting bracket bushing.
6. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.

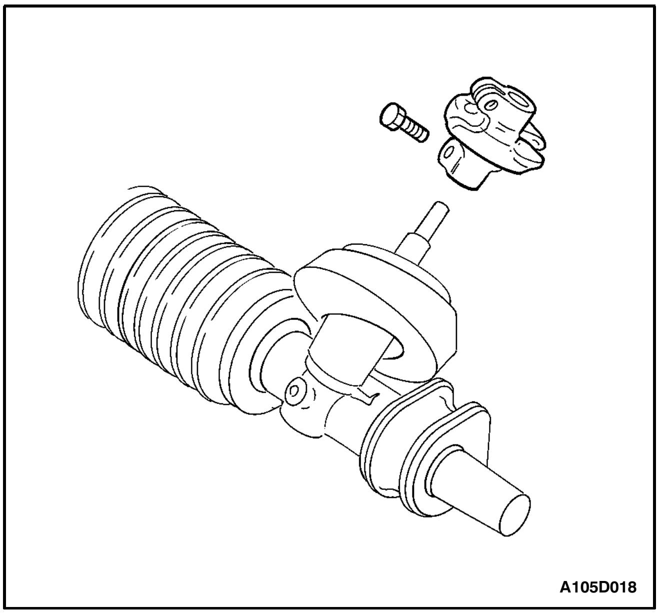


COUPLING ASSEMBLY

(Left-Hand Drive Shown, Right Hand Drive Similar)

Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the pinch bolt from the coupling flange assembly.
3. Remove the coupling flange assembly from the stub shaft of the pinion and valve assembly.

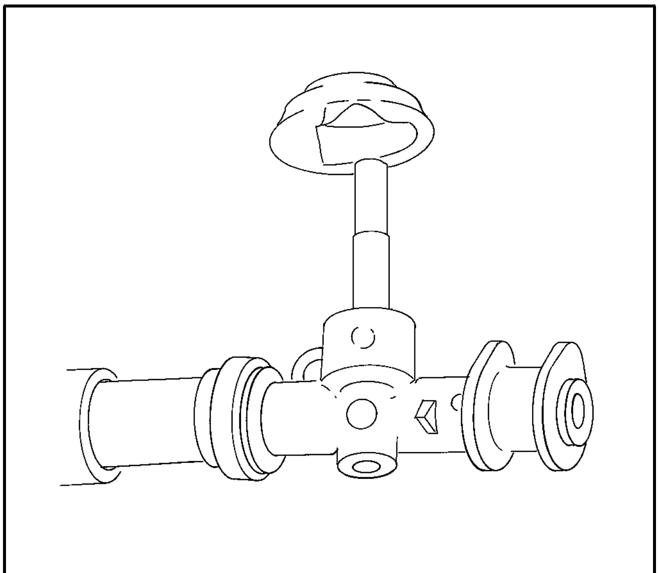


Assembly Procedure

1. Connect the flange and steering assembly to the stub shaft of the pinion and valve assembly.
2. Insert the pinch bolt into the flange and steering coupling assembly.

   Tighten

   Tighten the coupling flange pinch bolt to 22 N•m (16 lb-ft).
3. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



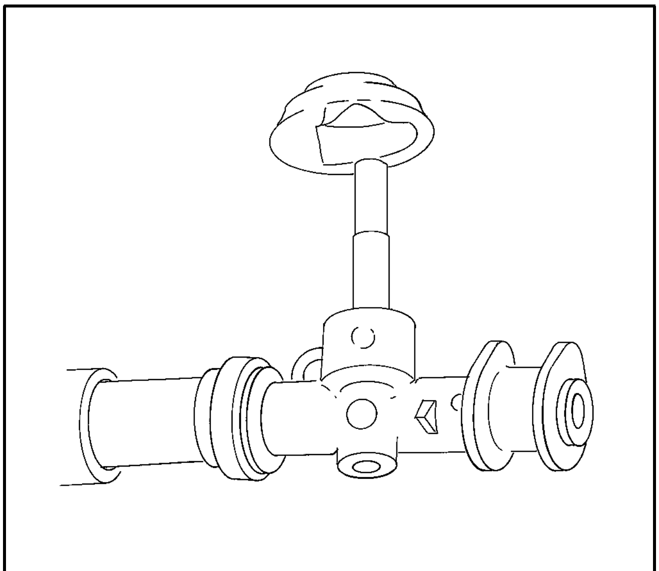
A105D019

DASH SEAL

(Left-Hand Drive Shown, Right Hand Drive Similar)

Disassembly Procedure

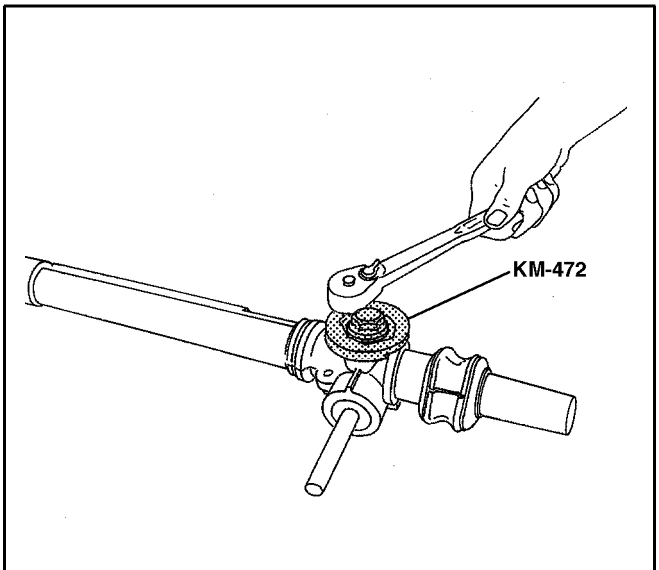
1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the flange and steering coupling assembly. Refer to "Coupling Assembly" in this section.
3. Remove the dash seal from the rack and pinion housing.



A105D019

Assembly Procedure

1. Line up the notch in the dash seal and the rack and pinion housing.
2. Connect the dash seal to the housing.
3. Connect the flange and steering coupling assembly. Refer to "Coupling Assembly" in this section.
4. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



A105D005

RACK BEARING

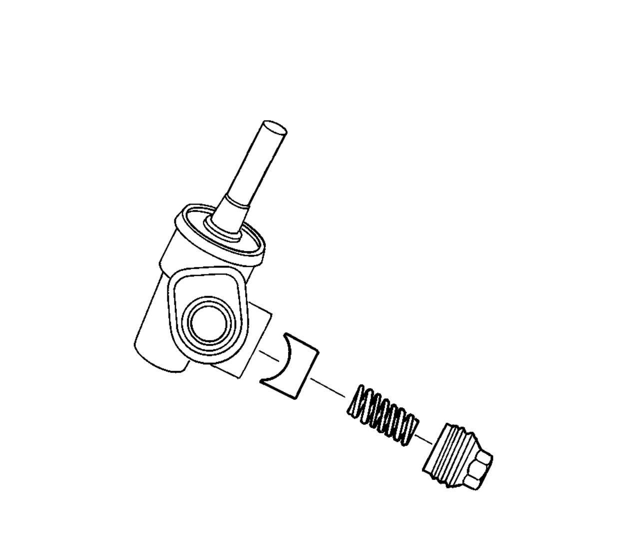
(Left-Hand Drive Shown, Right Hand Drive Similar)

Tools Required

KM-472 Wrench

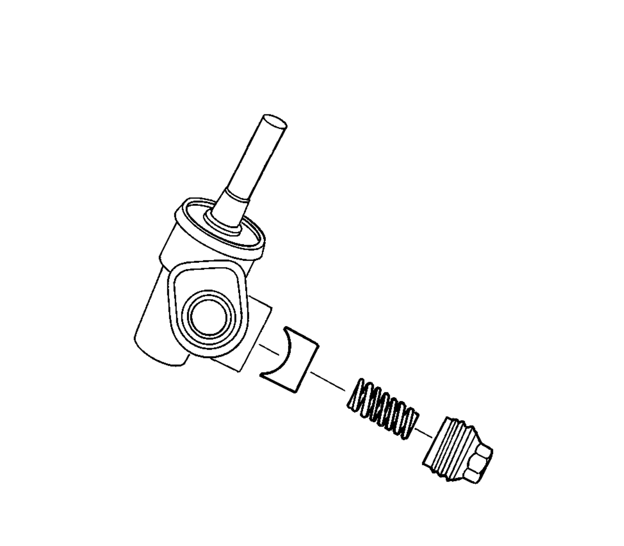
Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the adjuster plug locknut from the adjuster plug using the wrench KM-472.



A105D004

3. Remove the adjuster plug, the adjuster spring and the rack bearing with the O-ring seal attached.



A105D004

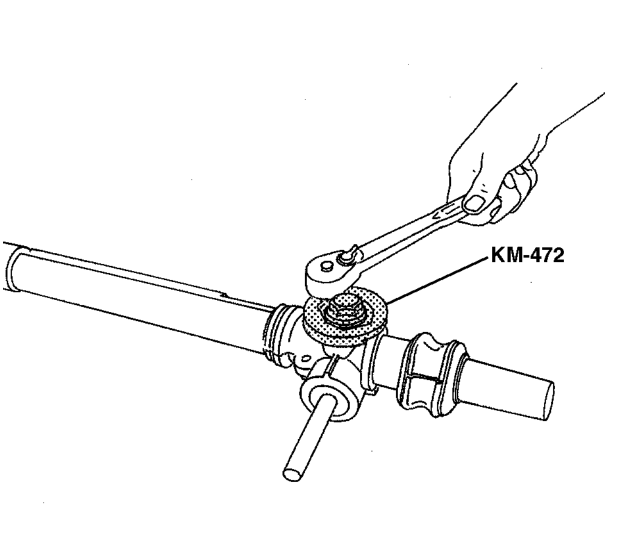
Assembly Procedure

Important: All interlocking metal parts must be lubricated with lithium-base grease 1051344 or equivalent as they are assembled.

1. Coat the rack bearing (with the O-ring seal attached), the adjuster spring, and the adjuster plug with lithium-base grease. Install them into the housing.

Tighten

With the rack centered in the window in the housing, turn the adjuster plug clockwise until a torque of 5 N•m (44 lb-in) is obtained. Then back the adjuster plug off by 20 to 30 degrees. Check the pinion preloaded torque is within the range 0.7 to 1.5 N•m (6 to 13 lb-in).



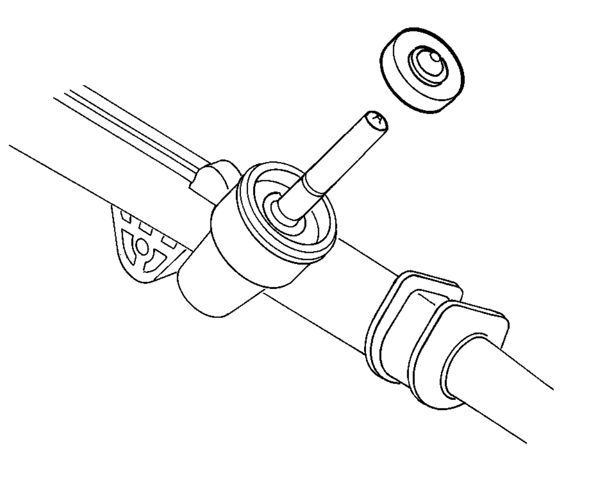
A105D005

2. Thread the locknut onto the adjuster plug.

Tighten

Tighten the locknut to 70 N•m (52 lb-ft) using the wrench KM-472. Hold the adjuster plug stationary.

3. Install the rack and pinion assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.



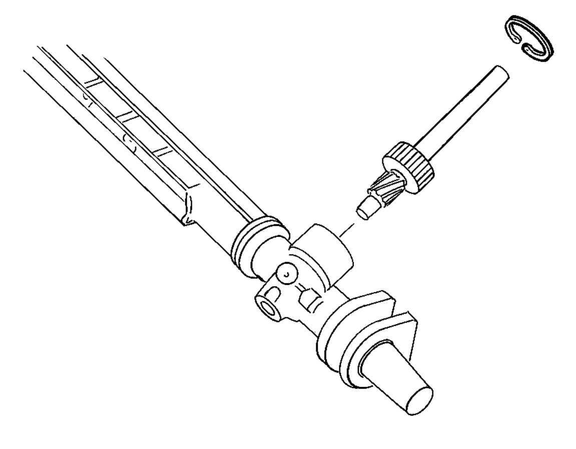
A105D006

PINION SHAFT

(Left-Hand Drive Shown, Right Hand Drive Similar)

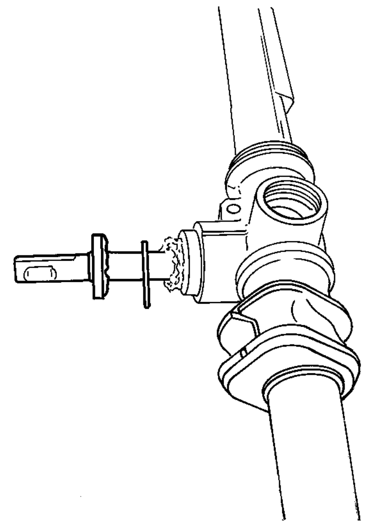
Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. With the rack gear centered, mark the location of the stub shaft notch on the housing to aid in the proper installation of the pinion and valve assembly.
3. Remove the pinion shaft seal by pressing down on one side of the seal and pulling up on the other side of the seal.



A105D007

4. Remove the retaining ring and pull the pinion and valve assembly out of the rack and pinion housing.



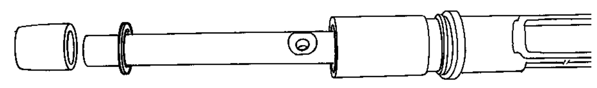
A105D010

Assembly Procedure

Important: All the interlocking metal parts must be lubricated with lithium-base grease 1051344 or equivalent as they are assembled.

Important: When the pinion and valve assembly is fully seated in the housing, be sure the notch in the stub shaft and the mark on the housing line up. Be sure the rack guide assembly is centered in the housing window.

1. Center the rack guide assembly in the housing window opening.
2. Line up the stub shaft notch with the mark on the housing. Seat the pinion and valve assembly into the rack and pinion housing.
3. Install the retaining ring and seat the pinion seal. The top of the seal should be flush with the top of the housing.

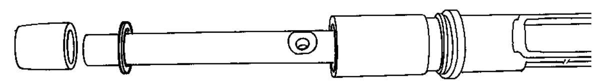


A105D008

RACK

Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the rack bearing assembly. Refer to "Rack Bearing" in this section.
3. Remove the pinion shaft assembly. Refer to "Pinion Shaft" in this section.
4. Remove the housing end cover.
5. Remove the rack shaft from the rack and pinion housing.

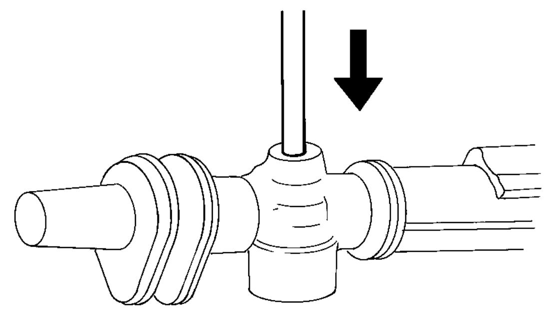


A105D008

Assembly Procedure

Important: All interlocking metal parts must be lubricated with lithium-base grease 1051344 or equivalent as they are assembled.

1. Install the rack shaft into the rack and pinion housing. Install the retaining ring.
2. Install the housing end cover.
3. Install the pinion shaft assembly. Refer to "Pinion Shaft" in this section.
4. Install the rack bearing assembly. Refer to "Rack Bearing" in this section.
5. Install the rack and pinion steering assembly into the vehicle. Refer to "Rack and Pinion Assembly" in this section.

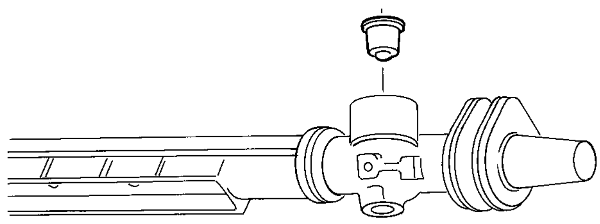


A105D012

ROLLER BEARING

Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the rack bearing assembly. Refer to "Rack Bearing" in this section.
3. Remove the pinion shaft assembly. Refer to "Pinion Shaft" in this section.
4. Remove the roller bearing using a press and a suitable drift.

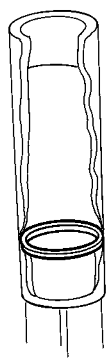


A105D013

Assembly Procedure

Important: Make sure the bearing is fully bottomed in the housing.

1. Install the roller bearing using a press and a suitable drift.
2. Install the pinion shaft assembly. Refer to "Pinion Shaft" in this section.
3. Install the rack bearing assembly. Refer to "Rack Bearing" in this section.
4. Install the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.

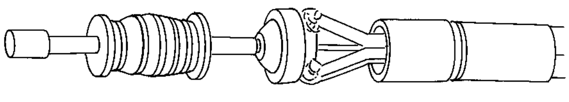


A105D014

RACK BUSHING

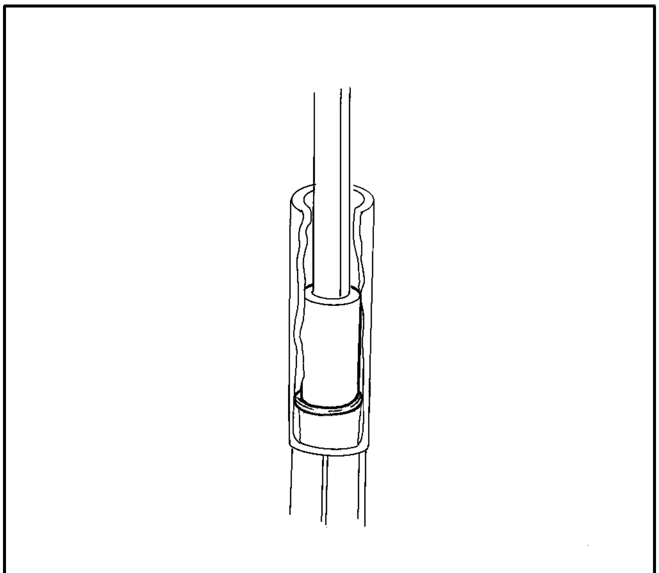
Disassembly Procedure

1. Remove the rack and pinion steering assembly from the vehicle. Refer to "Rack and Pinion Assembly" in this section.
2. Remove the rack bearing assembly. Refer to "Rack Bearing" in this section.
3. Remove the pinion shaft assembly. Refer to "Pinion Shaft" in this section.
4. Remove the rack shaft. Refer to "Rack" in this section.
5. Remove the rack housing retaining ring with extended snap ring pliers.



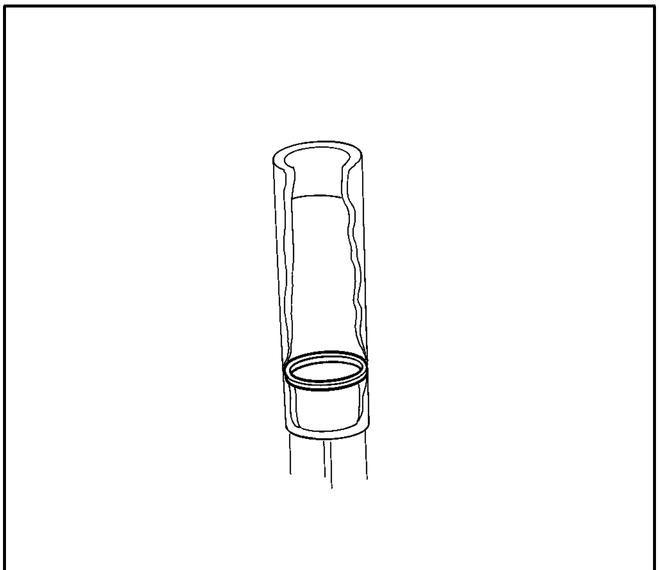
A105D015

6. Remove the rack bushing using a slide hammer and a suitable attachment.


A105D016

Assembly Procedure

1. Install the new rack bushing using a drift and an appropriate socket. Press the bushing into the housing by placing the socket on top of it and applying pressure with a drift and a press.


A105D014

2. Install the rack housing retaining ring.
3. Install the rack shaft. Refer to “Rack” in this section.
4. Install the pinion shaft assembly. Refer to “Pinion Shaft” in this section.
5. Install the rack bearing assembly. Refer to “Rack Bearing” in this section.
6. Install the rack and pinion steering assembly into the vehicle. Refer to “Rack and Pinion Assembly” in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

MANUAL RACK AND PINION

The manual rack and pinion steering system consists of two main components: the rack and the pinion. The motion of the pinion is transferred through the pinion teeth that mesh with the teeth on the rack, which moves the rack. The force is then transmitted through the arms on the struts, which turn the wheels.

SECTION 6E

STEERING WHEEL AND COLUMN

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Coupling Flange Pinch Bolt	25	18	-
Housing Support Screws	16	12	-
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Lower Instrument Trim Panel Screws	3	-	27
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Steering Column Jacket Assembly Bracket Nuts	22	16	-
Steering Wheel Nut (With SIR)	22	16	-
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Turn Signal Switch Housing Screws	3	-	27
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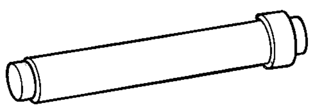
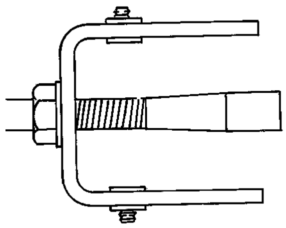
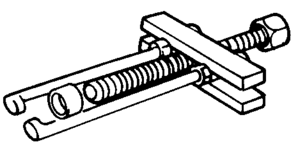
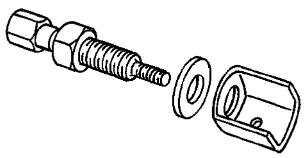
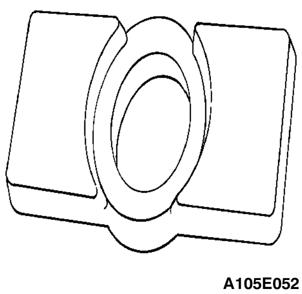
Tilt Steering Lever Cap Screws	3	-	27

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A105E023	KM-108 Remover/Installer	 A105E053	J-23653-D Lock Plate Compressor
 A110B008	KM-210-A Steering Wheel Puller	 A105E063	J-21854-01 Pivot Pin Remover
 A105E052	J-36667 Lock Plate Adapter		

DIAGNOSIS

STEERING COLUMN DIAGNOSIS

Lock System

Lock System Will Not Unlock

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for lack of free movement.	Lubricate the ignition switch.
Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.

Lock System Will Not Lock

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for a lack of free movement.	Lubricate the ignition switch.
Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.

High Lock Effort

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for lack of free movement.	Lubricate the ignition switch.
Check for extreme misalignment of the housing to the cover.	Realign the cover on the housing. Replace the cover as needed.
Check for a bent ignition switch mounting bracket.	Replace the ignition switch mounting bracket.

Key Cannot Be Removed in the LOCK Position

Checks	Action
Check to see that the ignition switch is set correctly.	Reset the ignition switch.
Check the lock cylinder for damage.	Replace the lock cylinder.

Column

Noise in the Column

Checks	Action
Check the steering gear-to-column joints for improper installation.	Tighten the coupling flange pinch bolts. Replace the coupling flange as needed.
Check for column misalignment.	Replace the alignment spacer.
Check the steering shaft bearing for wear or damage.	Replace the steering shaft bearing.
Check the spherical joint for lack of lubrication.	Lubricate the spherical joint.
Check the steering shaft for lack of lubrication.	Lubricate the steering shaft bearing.
Check the shaft lock snap ring for improper seating.	Adjust the shaft lock snap ring. Replace the shaft lock snap ring as needed.

High Steering Shaft Effort

Checks	Action
Check the steering shaft bearing for wear or damage.	Replace the steering shaft bearing.
Check for column misalignment.	Replace the alignment spacer.
Check for an improperly installed or deformed dust seal.	Replace the dust seal.
Check for a damaged upper or lower bearing.	Replace the upper or the lower bearing.
Check the steering shaft universal joint for a lack of free movement.	Lubricate the steering shaft universal joint. Replace the steering shaft universal joint as needed.

Lash in the Steering Column

Checks	Action
Check the steering column bracket mounting bolts for improper installation.	Tighten the steering column bracket mounting bolts.
Check for broken weld nuts on the steering column jacket.	Replace the steering column jacket.
Check for loose steering column housing-to-steering column jacket support screws.	Tighten the support screws.

Loose Steering Wheel

Checks	Action
Check for excessive clearance between the holes in the steering wheel support or the housing and the pivot-pin diameters.	Replace the pivot pins with pivot pins of the correct size.
Check to see if the upper bearing is seated correctly in the housing.	Correctly seat the upper bearing. Replace the upper bearing as needed.
Check for loose steering column housing support screws.	Tighten the steering column housing support screws.

Noise When Tilting the Column

Checks	Action
Check for worn upper tilt bumpers.	Replace the upper tilt bumpers.
Check for tilt spring binding.	Adjust the tilt spring. Replace the tilt spring as needed.

Turn Signal/Dimmer Switch

Turn Signal Will Not Stay in the Turn Position

Checks	Action
Check the turn signal switch for an improper installation.	Remove and inspect the turn signal switch. Reinstall the switch.
Check the cancelling mechanism for broken or missing components.	Replace the cancelling mechanism.
Check the turn signal switch housing for foreign material.	Remove any foreign material.

Turn Signal Will Not Cancel

Checks	Action
Check the cancelling mechanism for broken or missing components.	Replace the cancelling mechanism.

Turn Signal/Dimmer Switch Difficult to Operate

Checks	Action
Check the turn signal/dimmer switch and turn signal/dimmer switch lever for improper installation.	Remove and inspect the turn signal/dimmer switch and signal/dimmer switch lever. Reinstall the signal/dimmer switch and signal/dimmer switch lever.
Check the signal/dimmer switch housing for foreign material.	Remove any foreign material.

Turn Signal Will Not Indicate Lane Change

Checks	Action
Check for a broken lane change pressure pad or a broken spring hanger.	Replace the lane change pressure pad or the spring hanger.
Check for improper functioning of the lane change spring.	Replace the lane change spring.
Check the turn signal switch for improper installation.	Replace the turn signal switch.

No Turn Signal Lights

Checks	Action
Check for an inoperative turn signal flasher.	Replace the turn signal flasher.
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Turn Indicator Lights On, but Not Flashing

Checks	Action
Check for an inoperative turn signal flasher.	Replace the turn signal flasher.
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Front or Rear Turn Signal Lights Not Flashing

Checks	Action
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Turn Signal Lights Flash Very Slowly

Checks	Action
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Ignition Switch

Electrical System Will Not Function

Checks	Action
Check the ignition switch for damage.	Replace the ignition switch.
Check the ignition switch for improper installation.	Remove and inspect the ignition switch. Reinstall the ignition switch.
Check the ignition switch electrical connector for improper installation.	Reconnect the ignition switch electrical connector. Replace the ignition switch electrical connector.

Ignition Switch Will Not Turn

Checks	Action
Check the ignition switch for damage.	Replace the ignition switch.
Check the ignition switch for improper installation.	Remove and inspect the ignition switch. Reinstall the ignition switch.

Wiper Switch Lever

Switch Inoperative: No LOW, HIGH, INTERMITTENT or WASH

Checks	Action
Check the wiper switch for damage.	Replace the wiper switch.
Check the wiper switch for improper installation.	Remove and inspect the wiper switch. Reinstall the wiper switch.

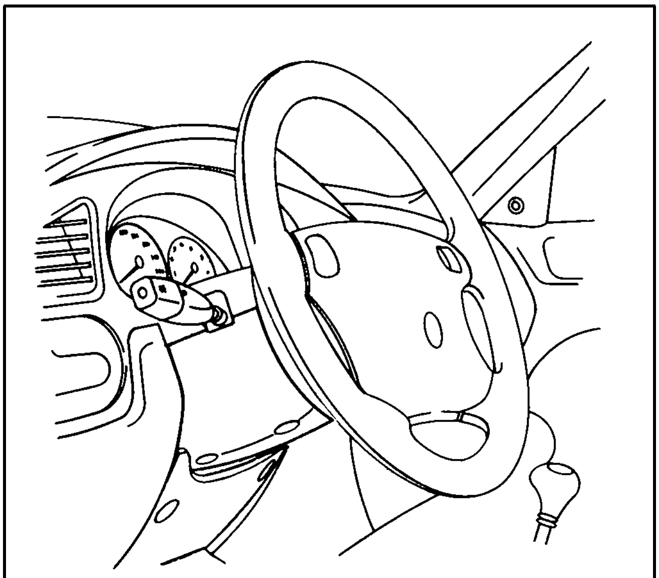
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

TURN SIGNAL SWITCH AND LEVER

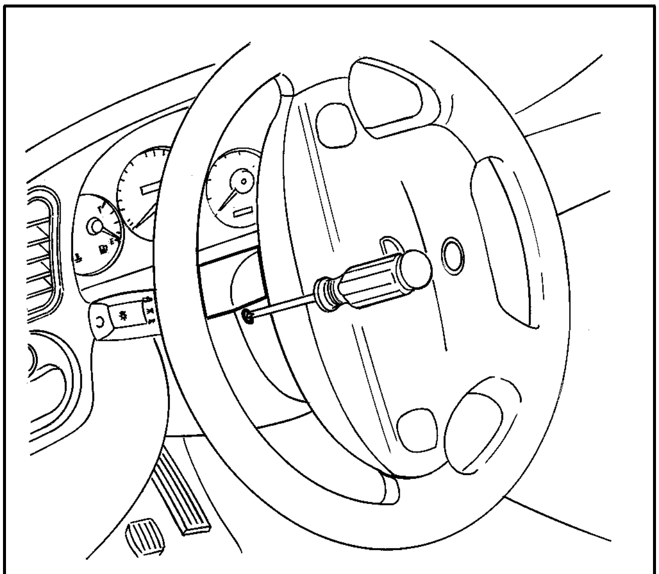
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



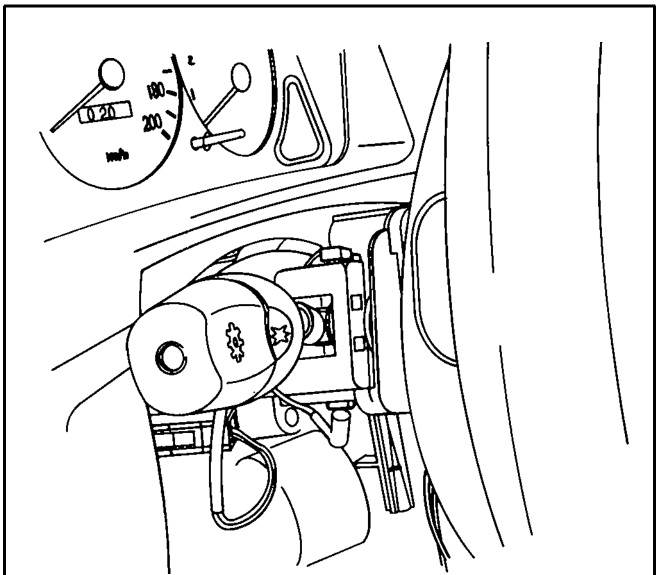
A105E001

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover panel screws and remove the lower steering column cover panel.



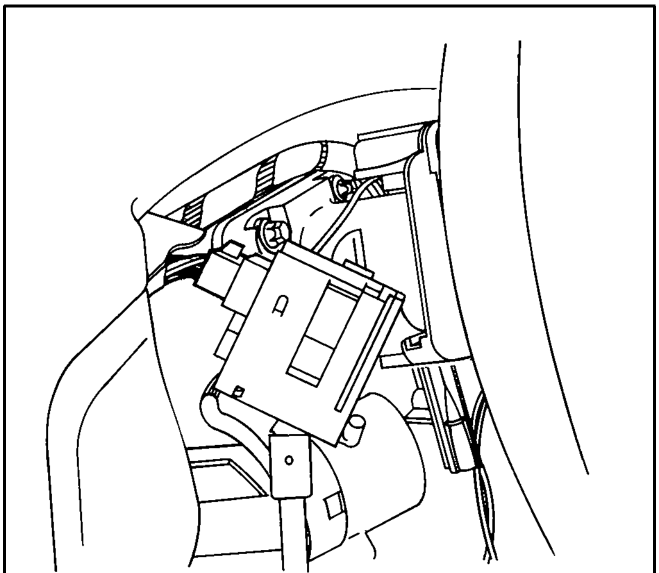
A105E051

3. Turn the steering wheel to expose the upper steering column cover panel screws. Remove the upper steering column cover panel screws and remove the upper steering column cover panel.



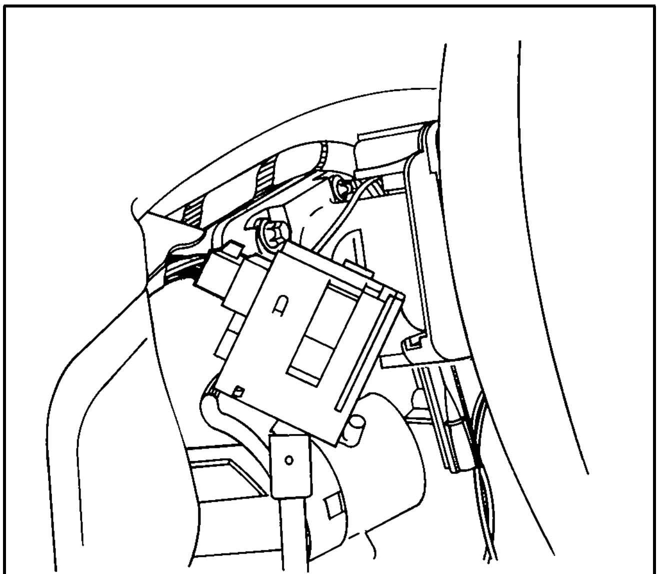
A105E002

4. Remove the turn signal switch by pushing in on the tabs on either side of the switch housing.



A105E003

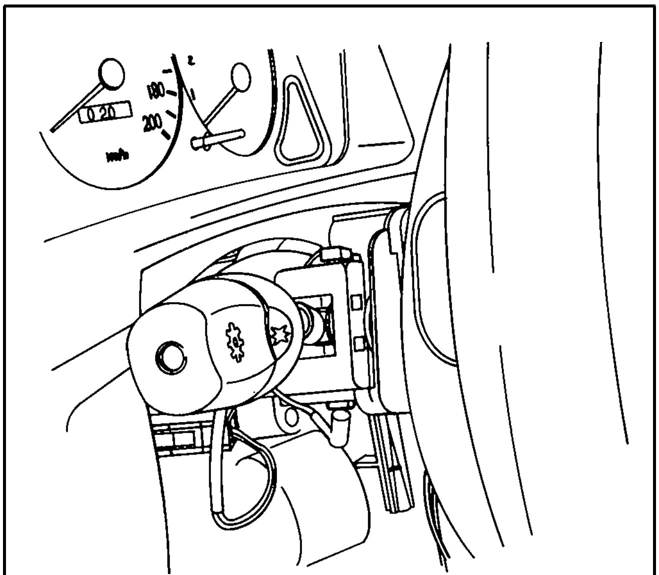
5. Disconnect the electrical connections from the turn signal switch.



A105E003

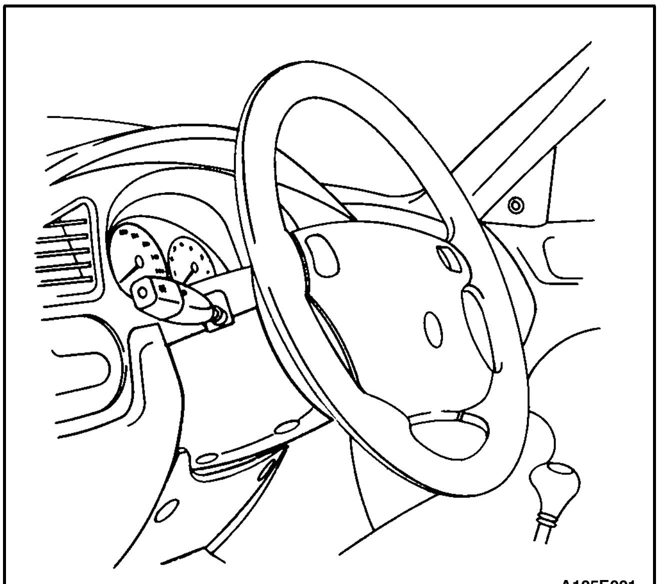
Installation Procedure

1. Connect the electrical connections to the turn signal switch.



A105E002

2. Install the turn signal switch by snapping it into the switch housing.

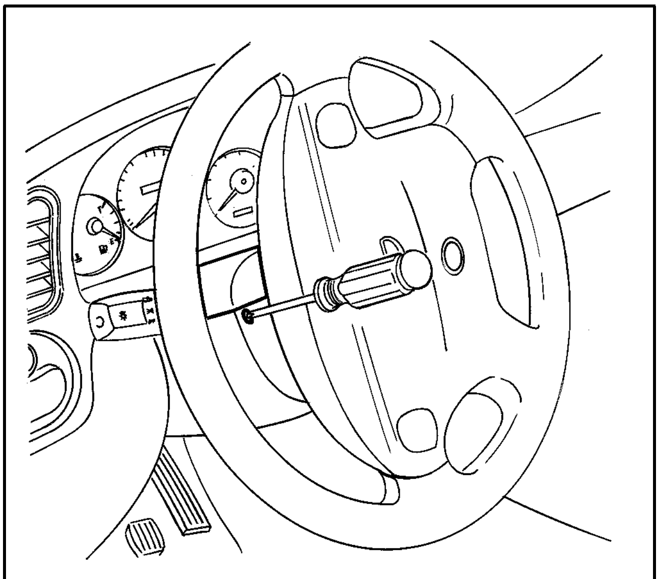


A105E001

3. Install the lower steering column cover panel. Install the lower steering column cover panel screws.

Tighten

Tighten the lower steering column cover panel screws to 3 N•m (27 lb-in).



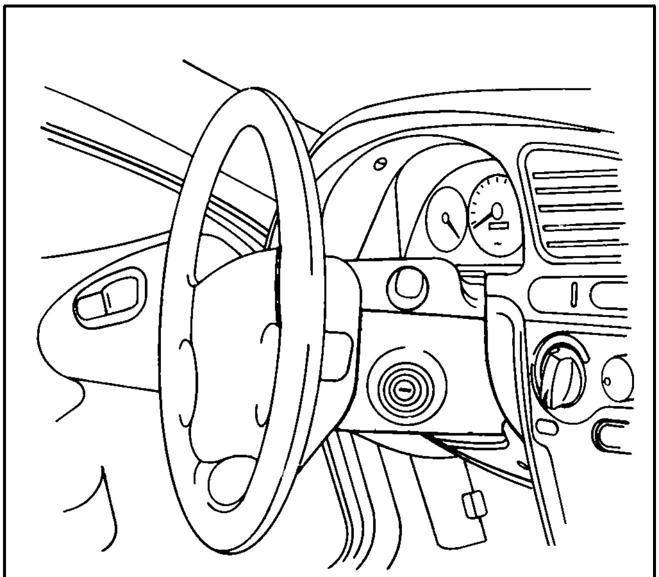
A105E051

4. Install the upper steering column cover panel. Install the upper steering column cover panel screws.

Tighten

Tighten the upper steering column cover panel screws to 3 N•m (27 lb-in).

5. Connect the negative battery cable.



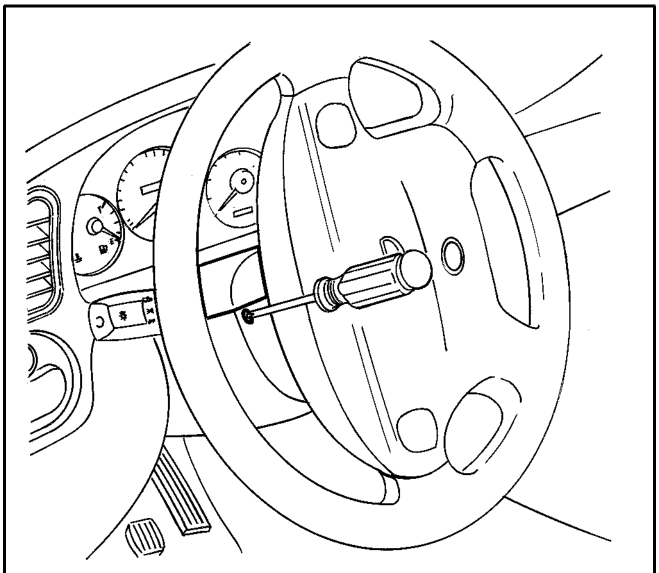
A105E004

WIPER SWITCH AND LEVER

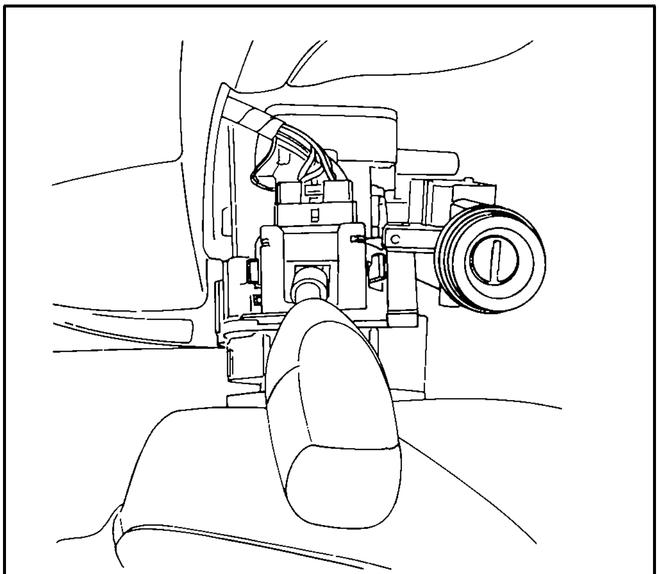
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

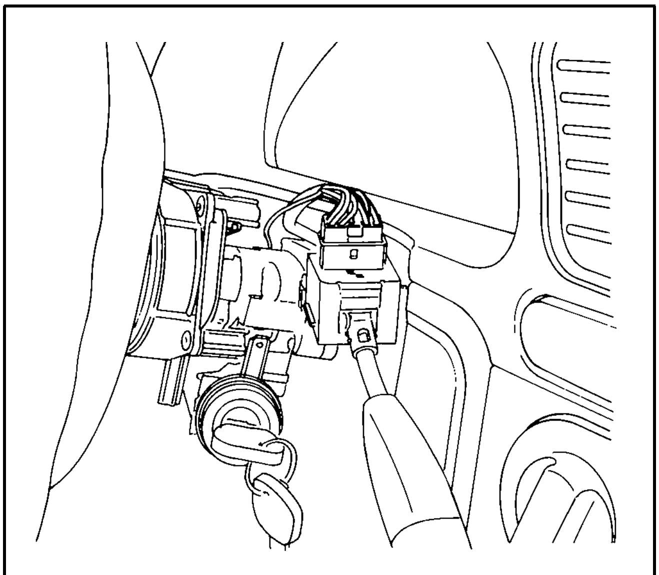
1. Disconnect the negative battery cable.
2. Remove the lower steering column cover panel screws and remove the lower steering column cover panel.


A105E051

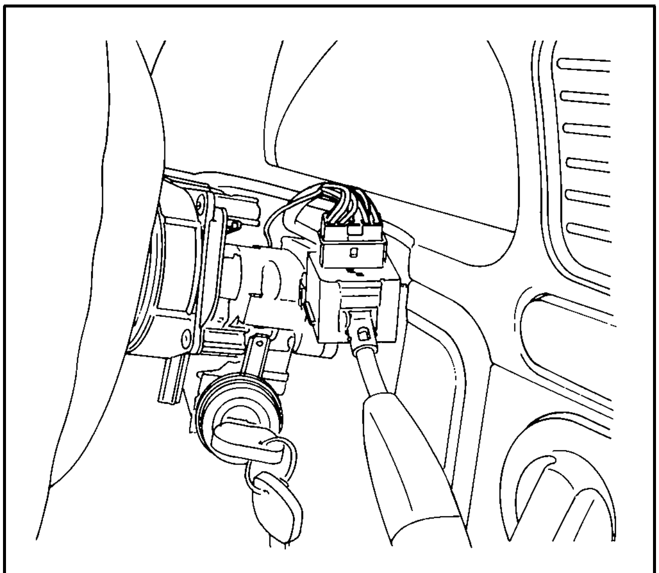
3. Turn the steering wheel to expose the upper steering column cover panel connecting screws. Remove the upper steering column cover panel screws and remove the upper steering column cover panel.


A105E005

4. Remove the wiper switch by pushing in on the tabs on either side of the switch housing.

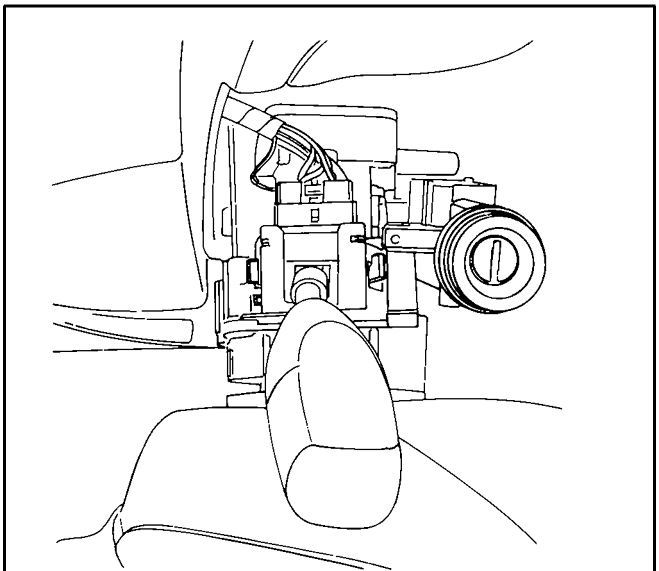

A105E006

5. Disconnect the electrical connections from the wiper switch.

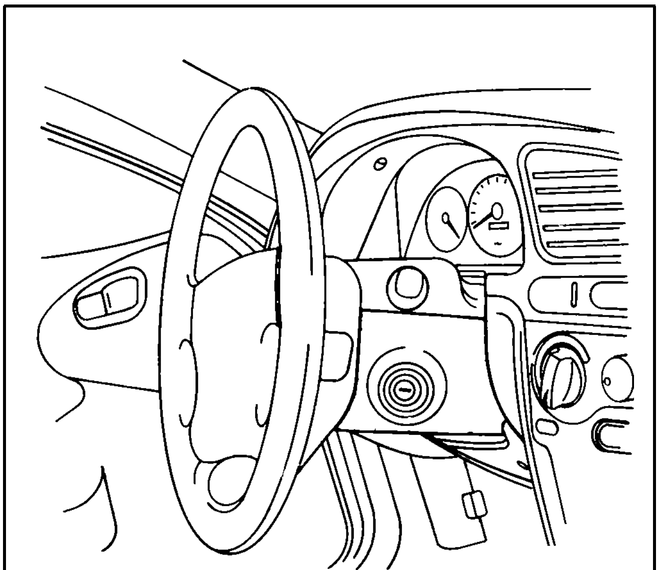

A105E006

Installation Procedure

1. Connect the electrical connections to the wiper switch.


A105E005

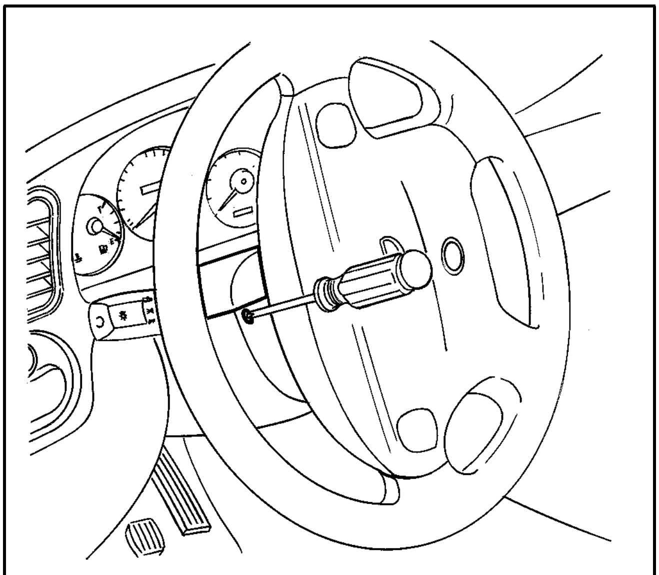
2. Install the wiper switch by snapping it into the switch housing.


A105E004

3. Install the lower steering column cover panel. Install the lower steering column cover panel screws.

Tighten

Tighten the lower steering column cover panel screws to 3 N•m (27 lb-in).



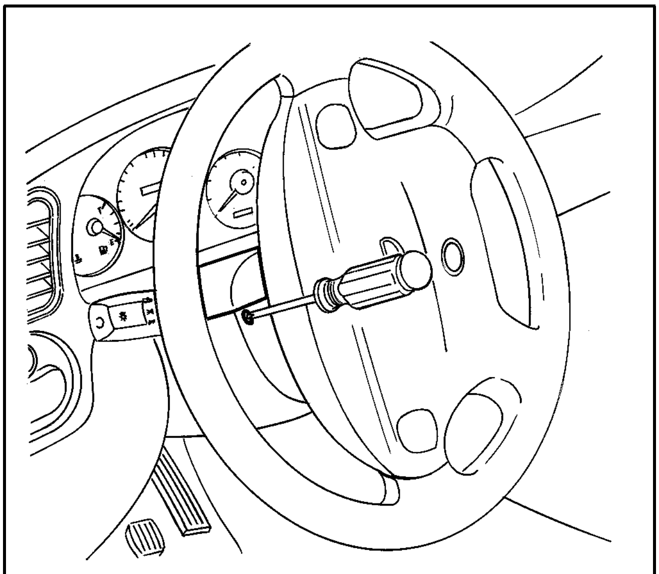
A105E051

4. Install the upper steering column cover panel. Install the upper steering column cover panel screws.

Tighten

Tighten the upper steering column cover panel screws to 3 N•m (27 lb-in).

5. Connect the negative battery cable.

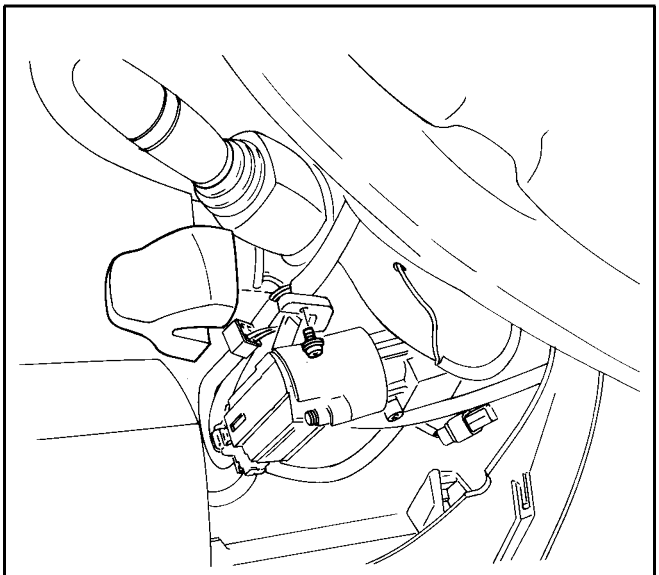


A105E051

TILT STEERING LEVER CAP

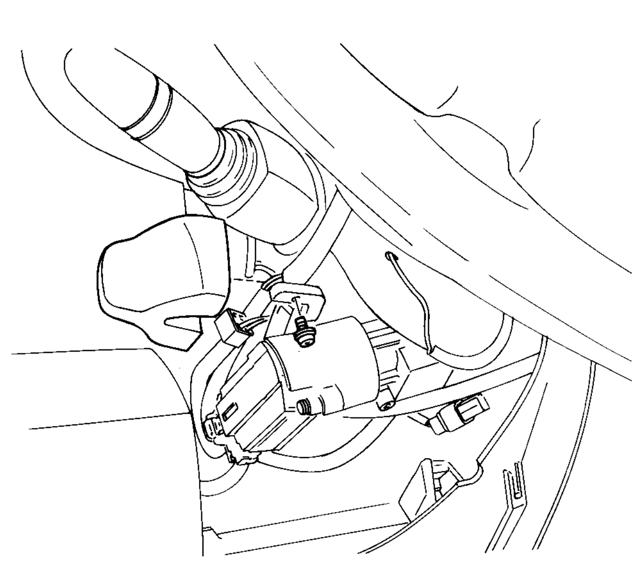
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover panel screws.
3. Remove the upper and the lower steering column cover panels.



B205E001

4. Remove the tilt steering lever cap screw and the tilt steering lever cap.



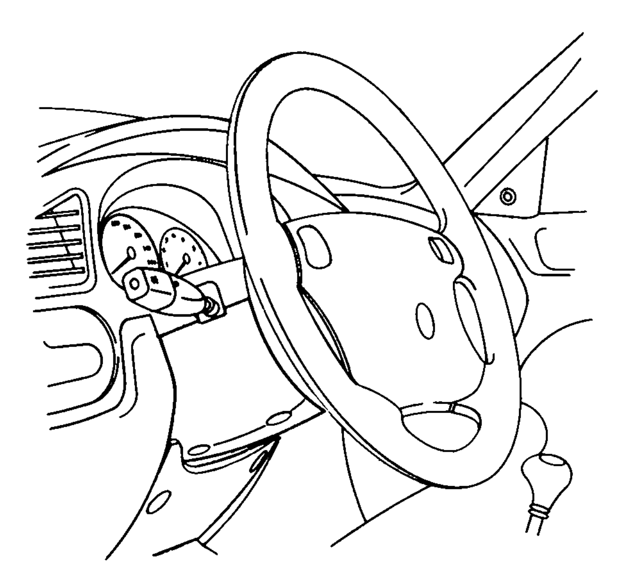
B205E001

Installation Procedure

1. Install the tilt steering lever cap and the tilt steering lever cap screw.

   Tighten

   Tighten the tilt steering lever cap screw to 3 N•m (27 lb-in).

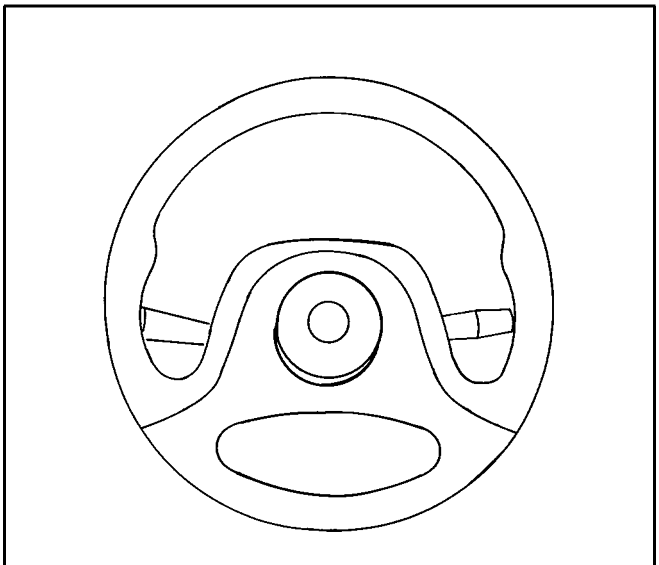


A105E001

2. Install the upper and the lower steering column cover panels.
3. Install the lower steering column cover panel screws.

   Tighten

   Tighten the lower steering column cover panel screws to 3 N•m (27 lb-in).
4. Connect the negative battery cable.



A105E036

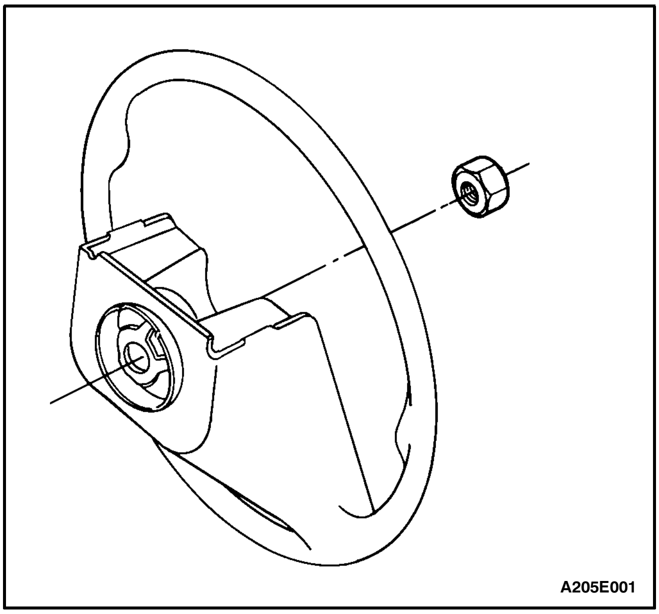
STEERING WHEEL WITHOUT SIR

Tools Required

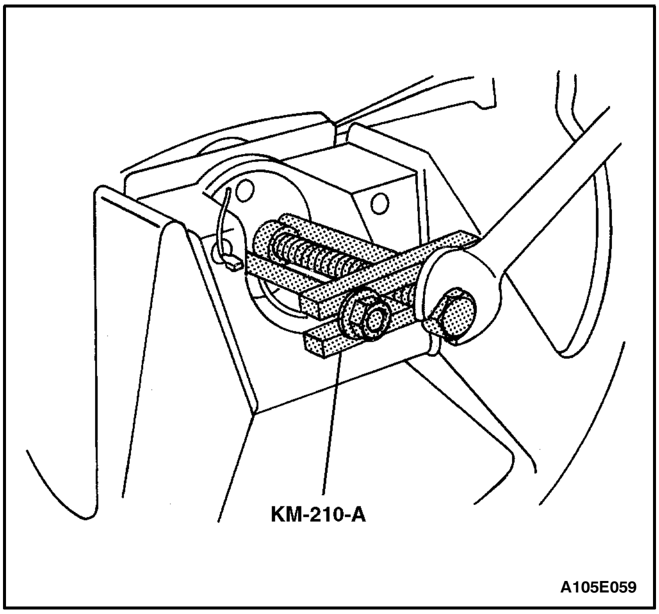
KM-210-A Steering Wheel Puller

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the steering wheel horn cap with a screwdriver. Disconnect the horn leads.

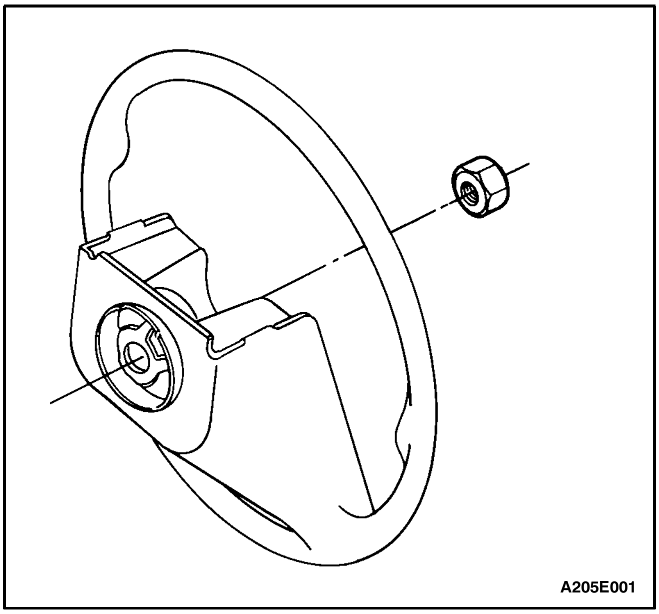


3. Remove the steering wheel nut.



Important: In order to correctly install the steering wheel, match-mark the steering column shaft to the steering wheel.

4. Remove the steering wheel using the steering wheel puller KM-210-A.
5. Unclip the contact ring from the steering wheel, if necessary.

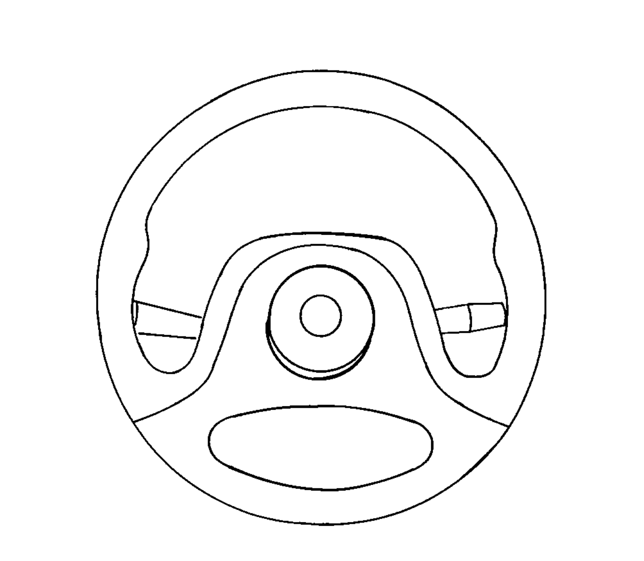


Installation Procedure

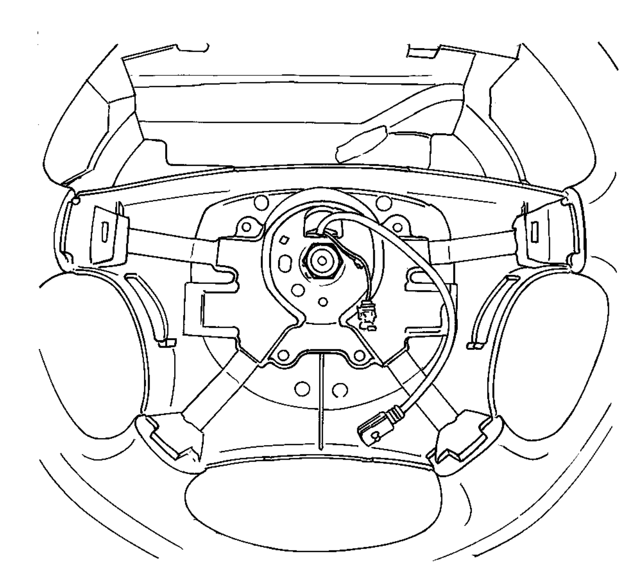
1. Clip the contact ring on the steering wheel, if necessary.
2. Align the match marks on the steering wheel and the steering column shaft.
3. Install the steering wheel nut.

Tighten

Tighten the steering wheel nut to 38 N•m (28 lb-ft).


A105E036

4. Connect the horn leads and install the steering wheel horn cap.
5. Connect the negative battery cable.


A105E020

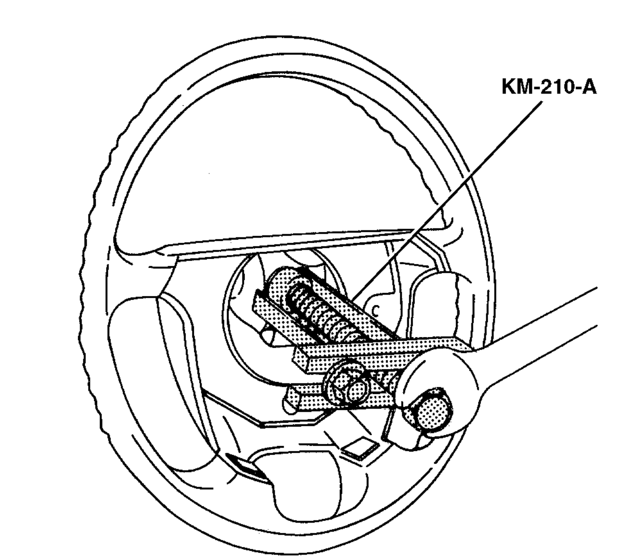
STEERING WHEEL WITH SIR

Tools Required

KM-210-A Steering Wheel Puller

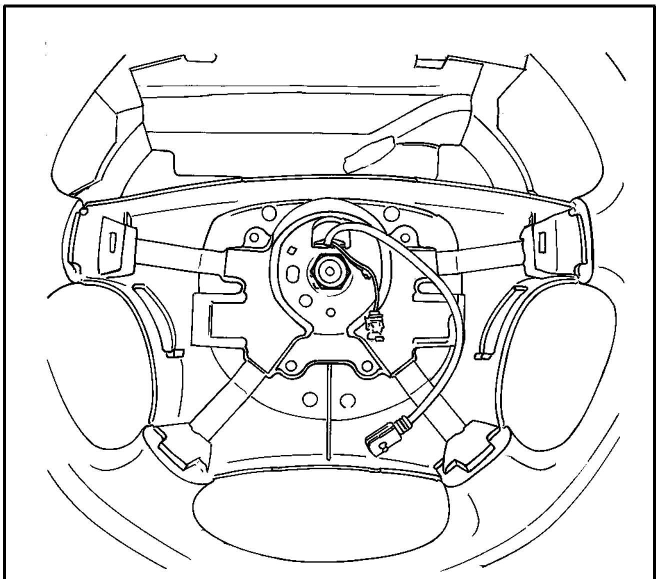
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the SIR module. Refer to Section 8B, Supplemental Inflatable Restraints.
3. Remove the steering wheel nut and the retaining clip.



A110B011

4. Remove the steering wheel using the steering wheel puller KM-210-A.
5. Unclip the contact ring from the steering wheel, if necessary.



A105E020

Installation Procedure

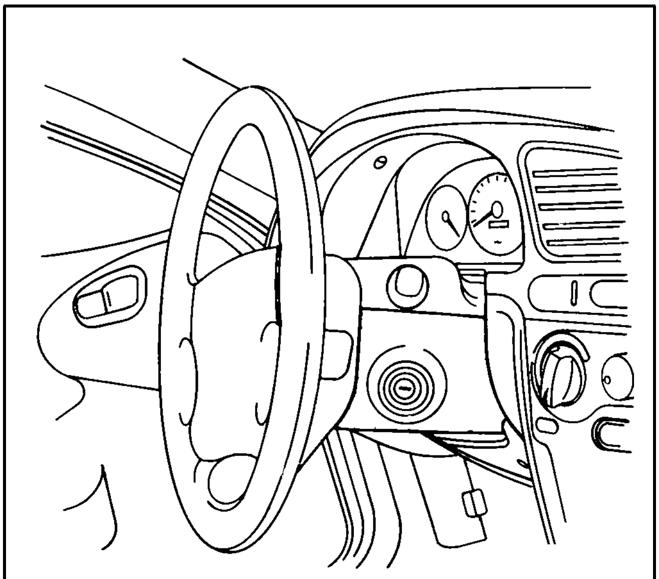
1. Clip the contact ring on the steering wheel, if necessary.

Important: In order to correctly install the steering wheel, match-mark the steering column shaft to the steering wheel.

2. Align the match marks on the steering wheel and the steering column shaft. Turn the signal canceling cam on the wheel to the left.
3. Install the retaining clip and the steering wheel nut.

   Tighten

   Tighten the steering wheel nut to 22 N•m (16 lb-ft).
4. Bend the tabs to secure the retaining clip.
5. Install SIR Module. Refer to Section 8B, Supplemental Inflatable Restraints.
6. Connect the negative battery cable.



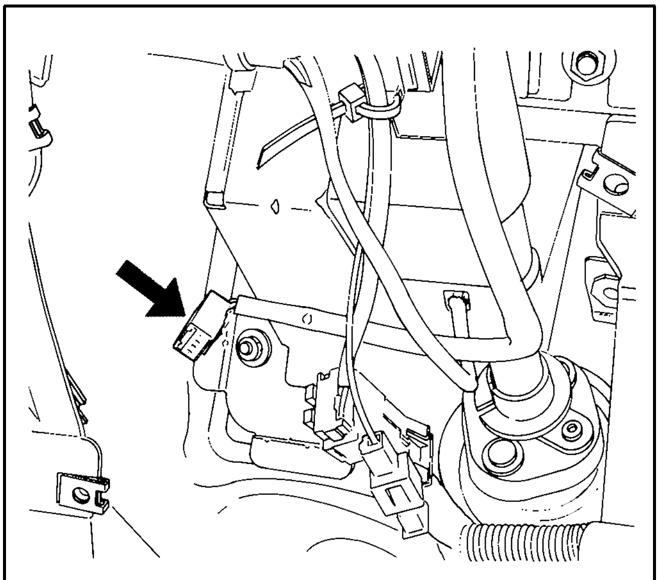
A105E004

IGNITION LOCK CYLINDER AND SWITCH

(Left-Hand Drive Shown, Right-Hand Drive Similar)

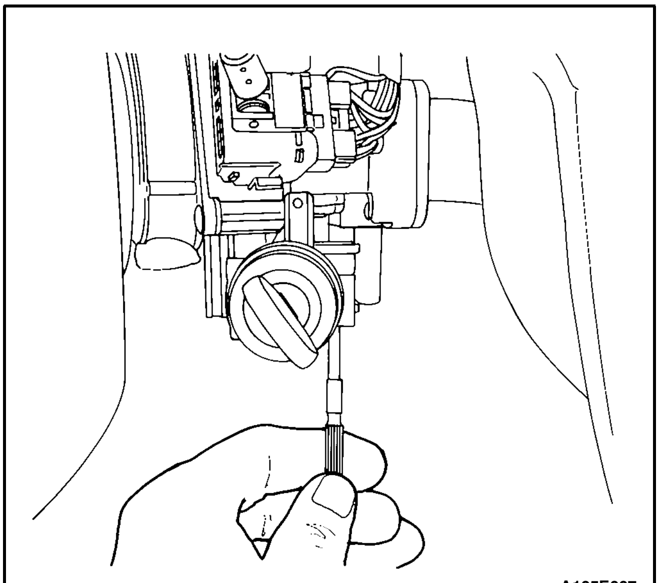
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover panel by removing the screws.



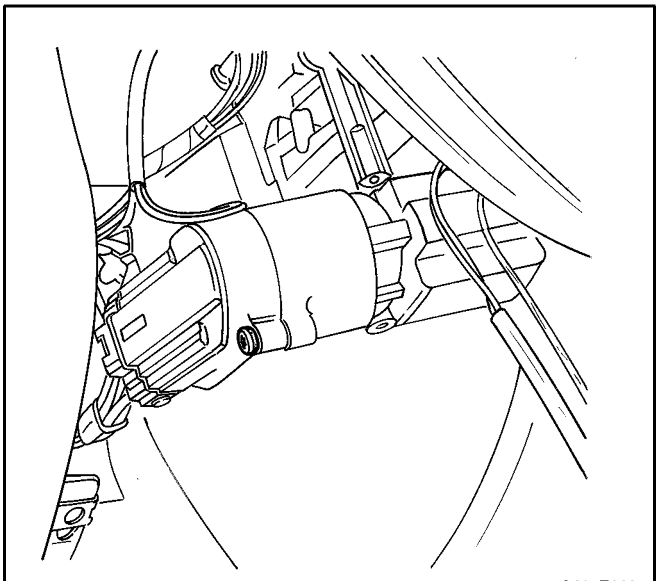
A209T004

3. Disconnect the electrical connector for the immobilizer detection coil, if equipped.



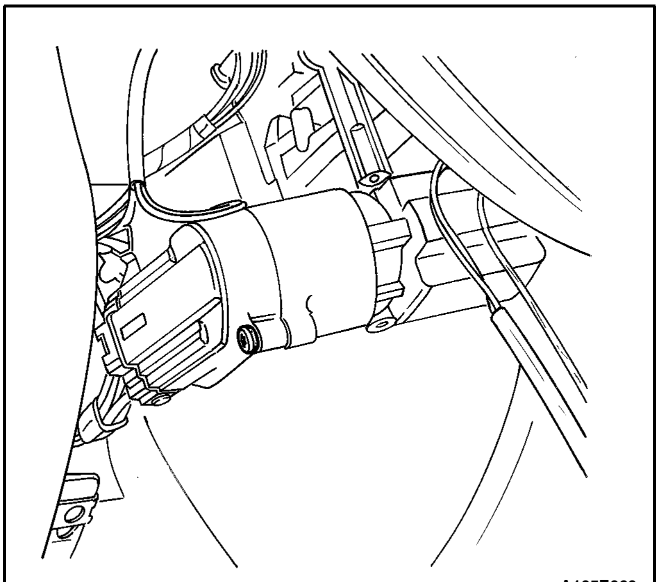
A105E007

4. With the key in the ignition, turned to the position designated ACC, remove the lock cylinder by pressing down the detent spring and pulling the lock cylinder out of the switch cylinder housing.



A105E060

5. Remove the ignition switch retaining screw.
6. Disconnect the wiring and remove the ignition switch.



A105E060

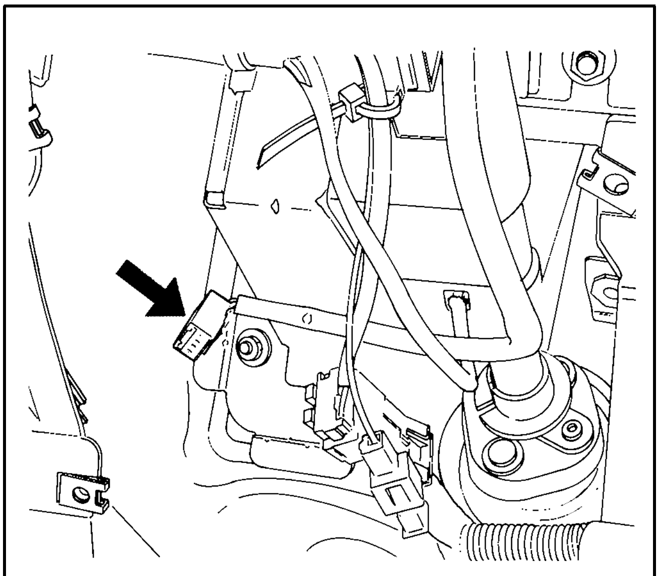
Installation Procedure

1. Install the ignition switch with the ignition switch retaining screw.

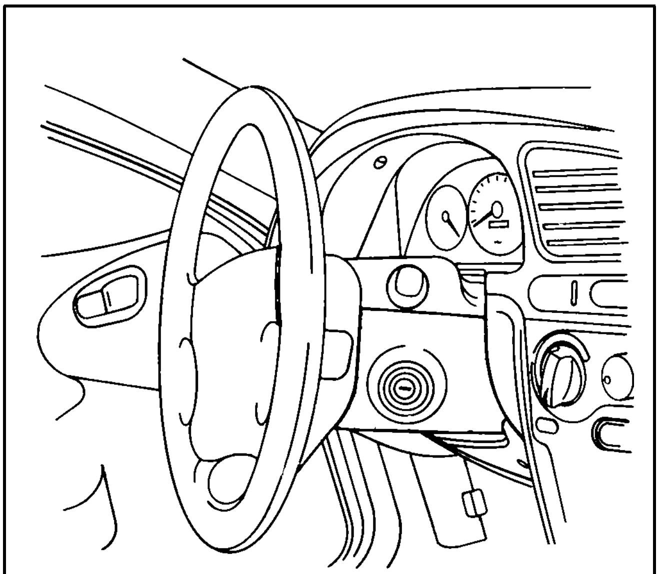
Tighten

Tighten the ignition switch retaining screw to 2 N•m (18 lb-in).

2. Connect the wiring to the ignition switch.


A209T004

3. Install the lock cylinder.
4. Connect the electrical connector for the immobilizer detection coil, if equipped.

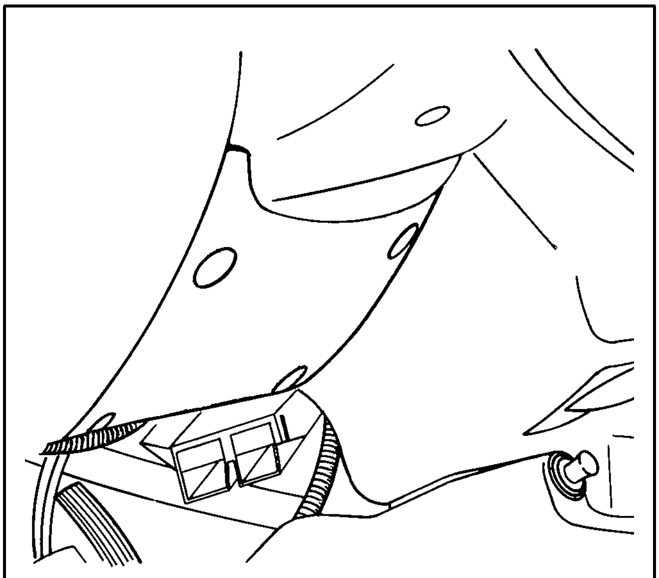

A105E004

5. Install the lower steering column cover panel with the screws.

Tighten

Tighten the lower steering column cover panel screws to 3 N•m (27 lb-in).

6. Connect the negative battery cable.


A105E008

FLEXIBLE COUPLING

Refer to Section 6C, Power Steering Gear.

STEERING COLUMN

(Left-Hand Drive Shown, Right-Hand Drive Similar)

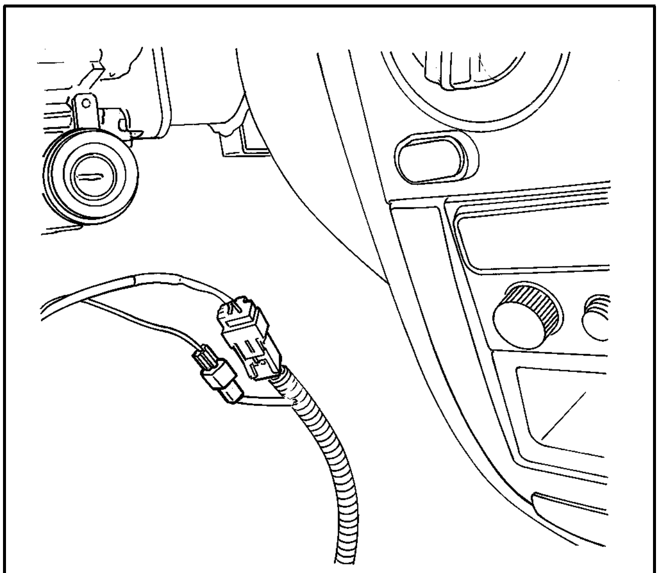
Important: Remove the steering column only if the following conditions exist:

- The steering column requires replacement.
- The steering and the ignition lock housing require replacement.
- Another operation requires the removal of the steering column.

Notice: The steering column is extremely susceptible to damage after it has been removed from the vehicle. Dropping the column assembly on its end or hammering the end of the steering shaft can collapse the steering shaft or loosen plastic injections which maintain column rigidity. Leaning on the column can cause it to bend or deform. Any of the above damage can impair the column's collapsible design. If it is necessary to remove the steering wheel, use only the specified steering wheel puller.

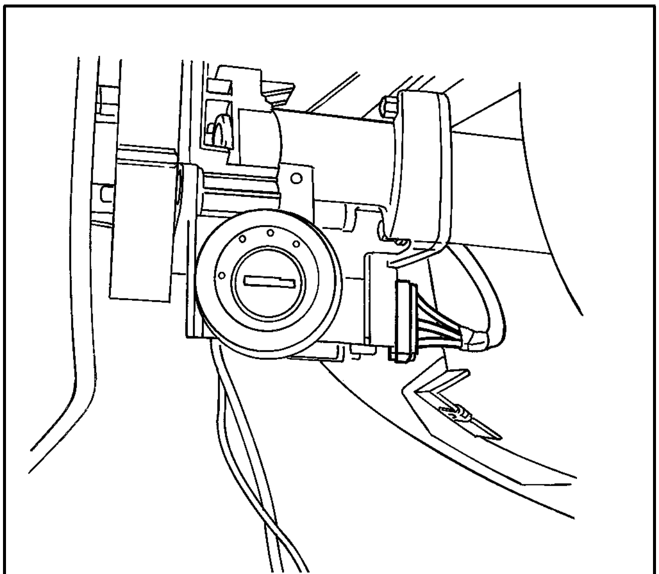
Removal Procedure

1. Disconnect the negative battery cable and let the vehicle sit for one minute to deactivate the air bag.
2. Remove the switch levers. Refer to "Turn Signal Switch and Lever" and "Wiper Switch and Lever" in this section.
3. Remove the lower instrument trim panel by removing the screws.



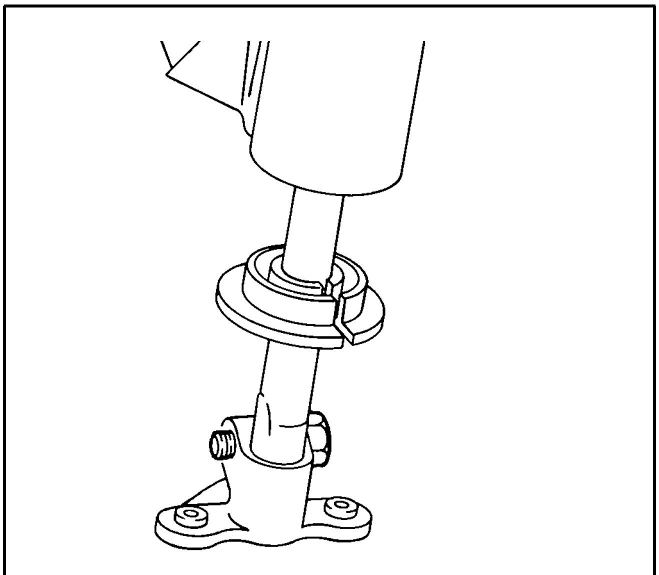
A105E009

4. Disconnect the airbag electrical connections.
5. Remove the immobilizer module if equipped. Refer to Section 9T, Immobilizer Anti- Theft System.



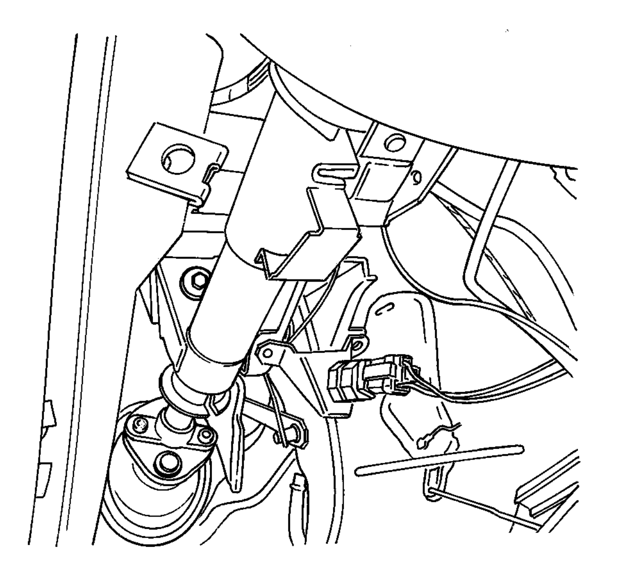
A105E061

6. Disconnect the ignition switch electrical connection.



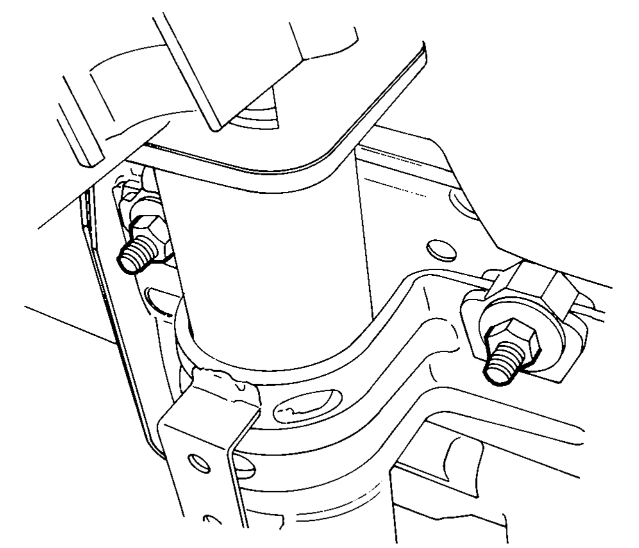
A105E010

7. Adjust the steering to the straight-ahead position.
8. Remove the pinch bolt from the steering shaft coupling flange.



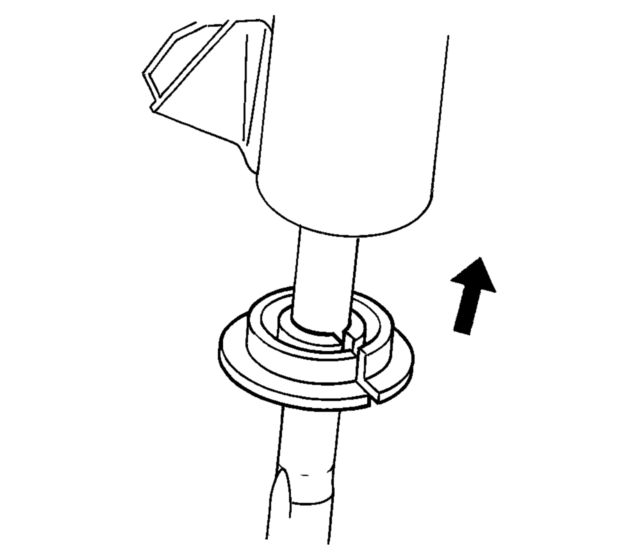
A105E062

9. Remove the nut holding the steering column jacket assembly rear bracket.



A105E011

10. Remove the nuts holding the steering column jacket assembly front bracket.
11. Guide the steering column assembly out of steering shaft flange and carefully lay down the assembly.



A105E057

Installation Procedure

Important: For proper installation of the steering column, be sure the steering wheel spokes are centered diagonally and pointed downwards and the front wheels are positioned in the straight-ahead position.

1. Place the alignment bushing onto the end of the steering column shaft.
2. Carefully guide the steering shaft into the steering shaft coupling flange.

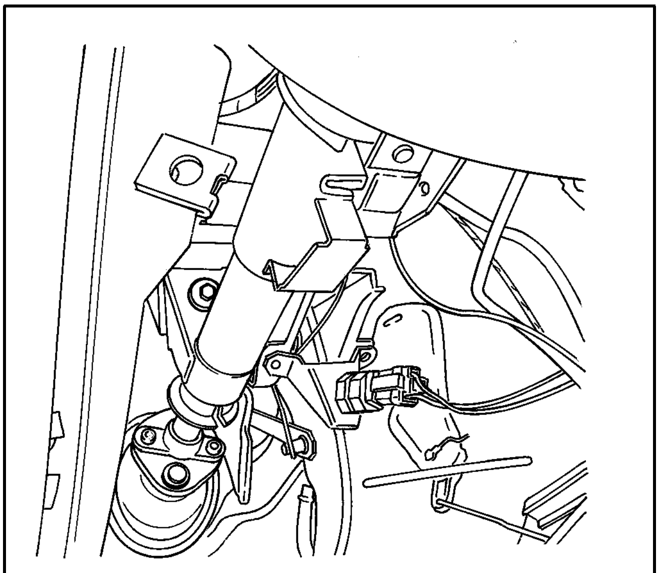
Important: Provide support for the steering column assembly until the mounting nuts are fastened. Do not let the steering column assembly hang unsupported.

3. Install the pinch bolt into the non-threaded hole of the flange.

Tighten

Tighten the coupling flange pinch bolt to 25 N•m (18 lb-ft).

4. Slide the alignment bushing into the steering column housing.

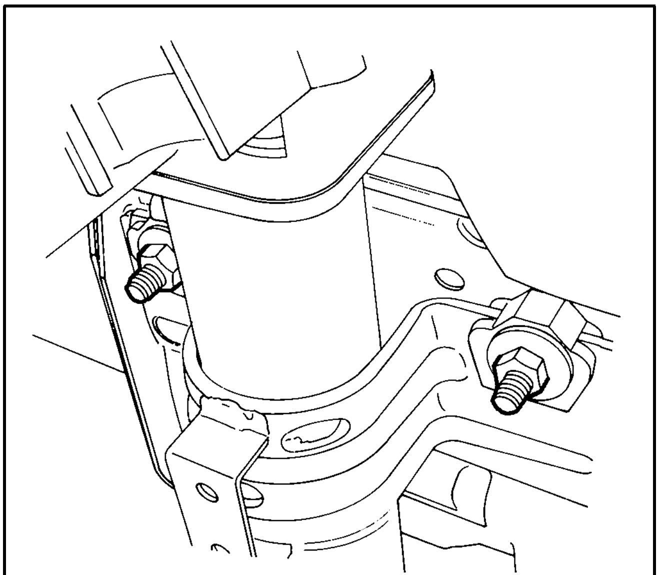


A105E062

5. Install the nut for the rear bracket of the steering column jacket assembly.

Tighten

Tighten the steering column jacket assembly rear bracket nut to 22 N•m (16 lb-ft).

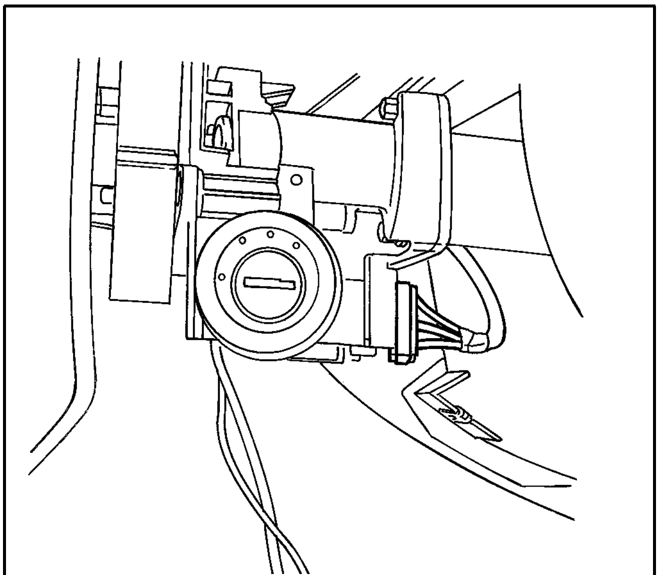


A105E011

6. Install the nuts for the steering column jacket assembly front bracket.

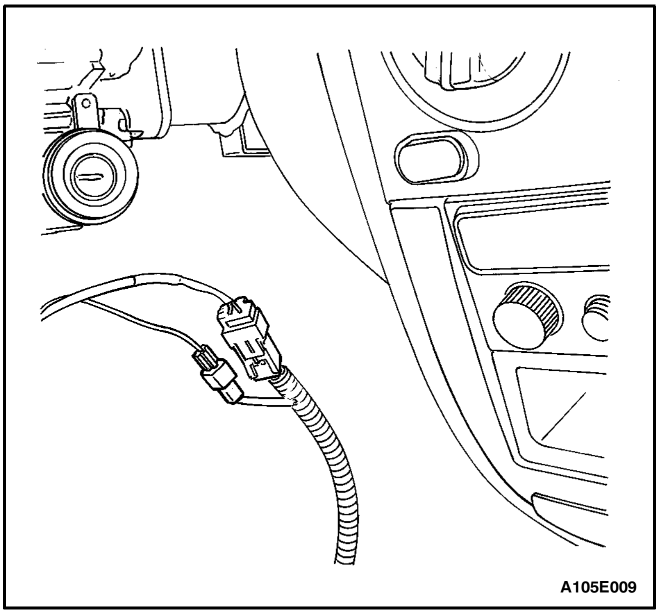
Tighten

Tighten the steering column jacket assembly front bracket nuts to 22 N•m (16 lb-ft).

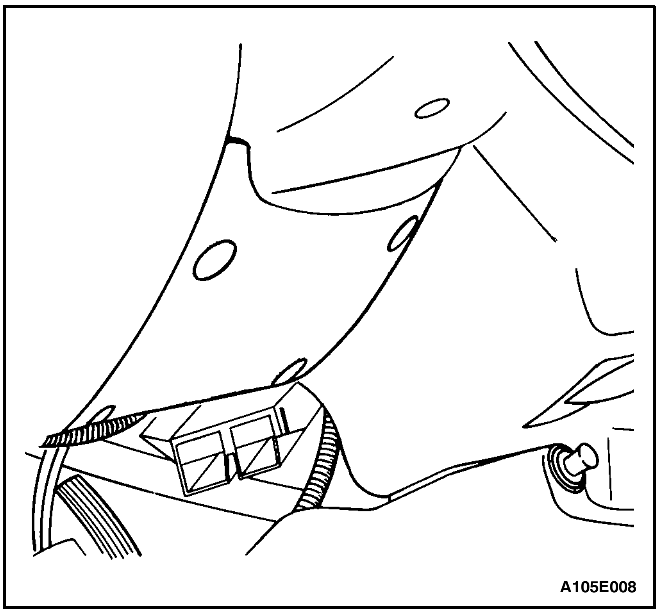


A105E061

7. Connect the ignition switch electrical connection.
8. Install the immobilizer module, if equipped. Refer to Section 9T, Immobilizer Anti-Theft System.



9. Connect the airbag electrical connections.



10. Install the lower instrument trim panel screws.

Tighten

Tighten the lower instrument trim panel screws to 3 N•m (27 lb-in).

11. Install the switch levers. Refer to "Turn Signal Switch and Lever" and "Wiper Switch and Lever" in this section.
12. Inspect the steering wheel in a straight-ahead position. Refer to Section 6C, Power Steering Gear.
13. Connect the negative battery cable.

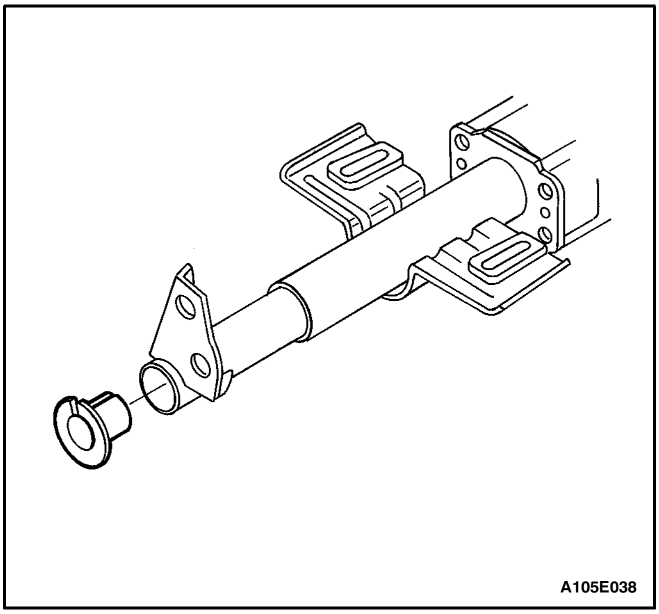
UNIT REPAIR

STANDARD STEERING COLUMN

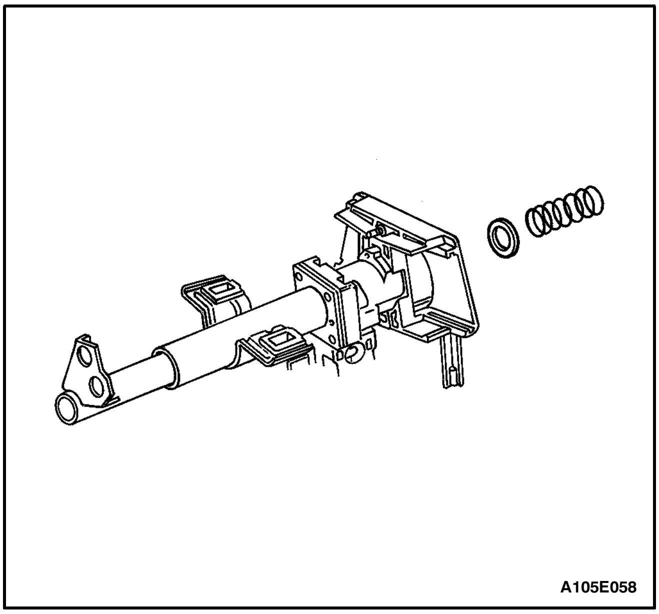
Tools Required

KM-108 Remover/Installer

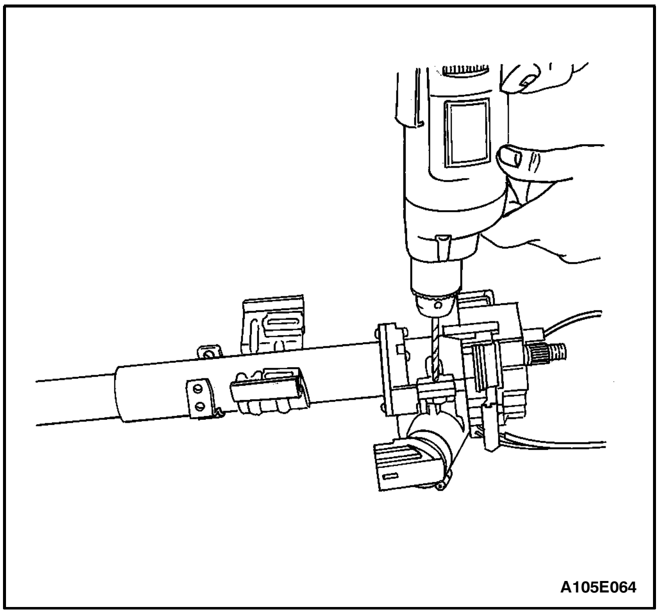
Disassembly Procedure



1. Remove the steering column from the vehicle. Refer to "Steering Column" in this section.
2. Remove the steering wheel from the steering column. Refer to "Steering Wheel without SIR" or "Steering Wheel with SIR" in this section.
3. Pull the alignment bushing from the lower end of the shaft assembly, if it was not previously removed.

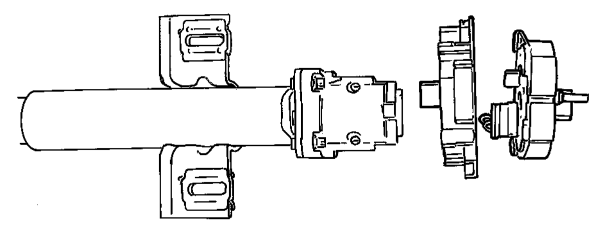


4. Remove the upper steering shaft spring and the thrust washer.



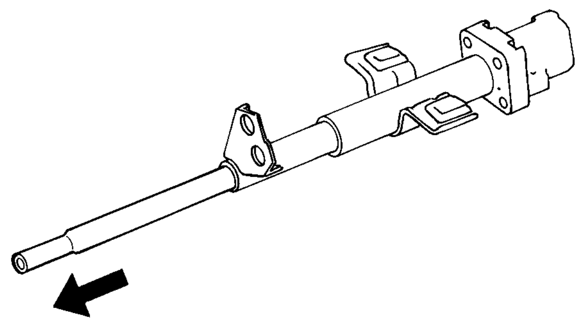
5. Remove the shear bolts, the shear bolt washers, and the ignition switch housing from the steering column housing as follows:
   - 5.1 Use a metal punch to start the drill head.
   - 5.2 Drill off the head of the shear bolts down to the steel shear bolt washers with a 6.5 mm (1/4 inch) drill bit.
   - 5.3 Separate the washers and the ignition switch housing from the column housing.
   - 5.4 Remove the threaded end of the shear bolts from the ignition switch housing with locking pliers.

Important: After drilling and removing the threaded end of the shear bolts, all the metal shavings must be cleaned from all the parts.



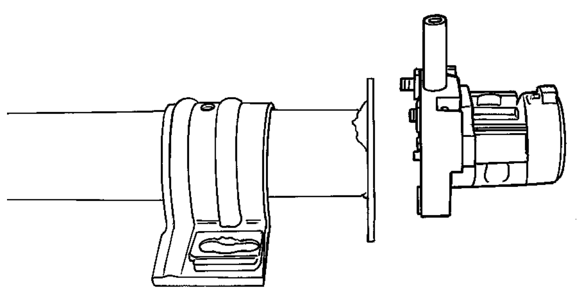
A105E012

6. Remove the turn signal switch housing screws. Remove the upper part of the turn signal switch housing assembly, then remove the lower part of the turn signal switch housing assembly.



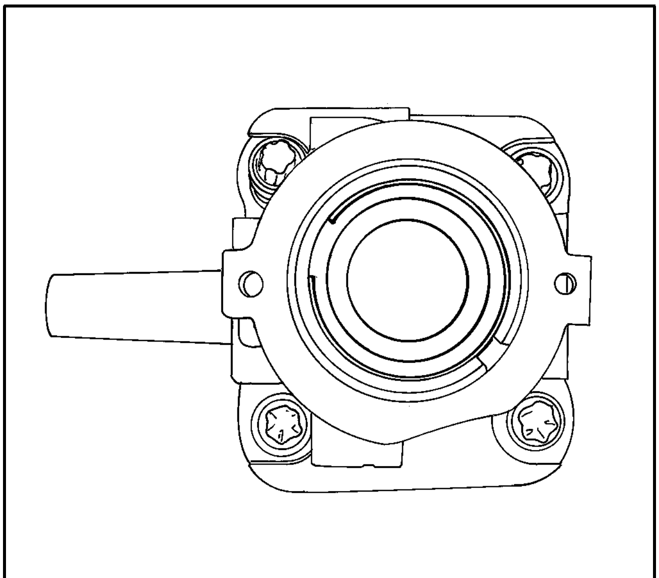
A105E013

7. Remove the steering shaft assembly from the lower end of the jacket assembly.

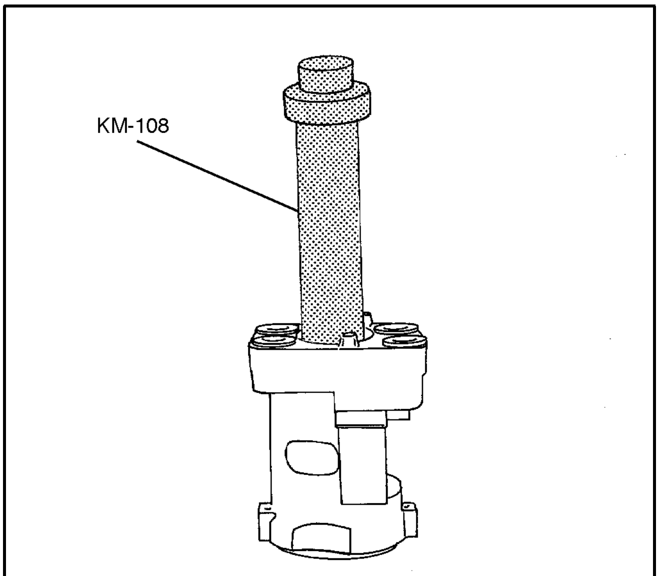


A105E015

8. Remove the column housing from the jacket assembly.

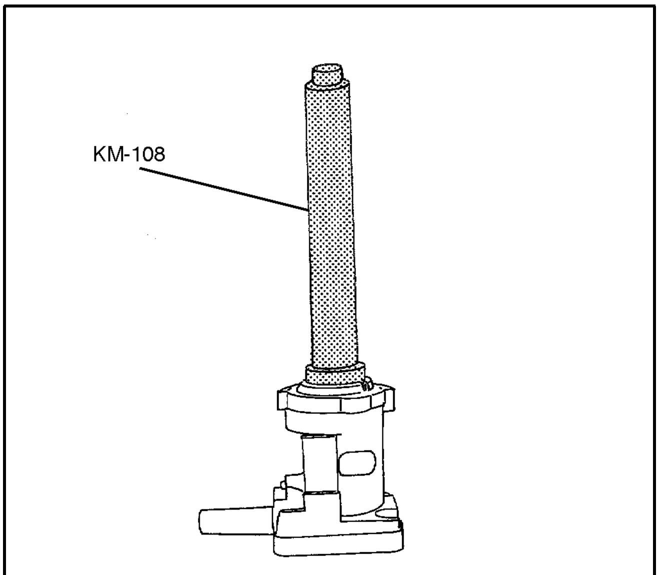

A105E016

9. Remove the washer and the retaining ring.



A105E017

10. Press out the steering column housing bearing using the remover/installer KM-108.

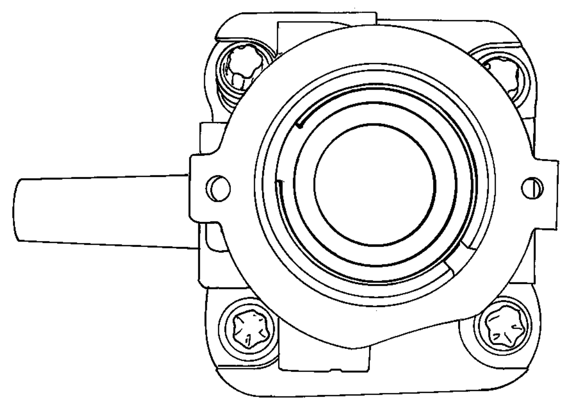


A105E018

Assembly Procedure

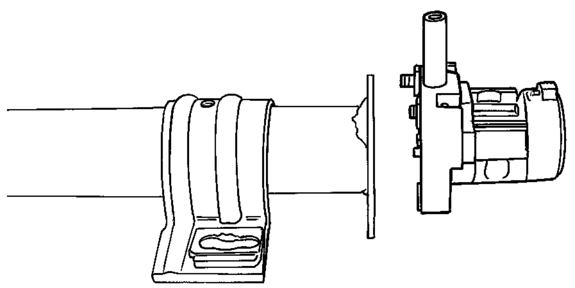
Important: All fasteners in the following steps must be firmly seated before being tightened to specifications.

1. Press in the steering column housing bearing using the remover/installer KM-108.



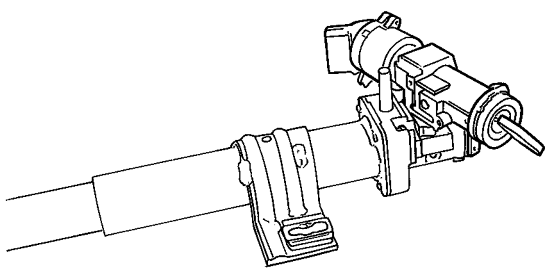
A105E016

2. Install the retaining ring and the washer.



A105E015

3. Connect the column housing to the jacket assembly.

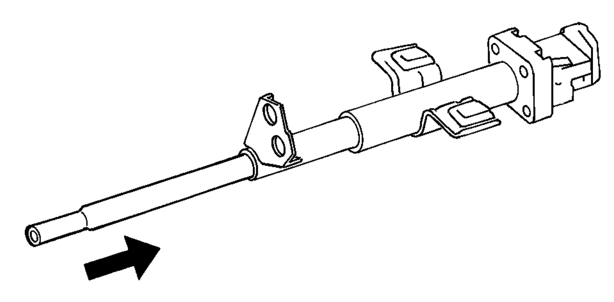


A105E014

4. Attach the ignition switch housing to the column housing with the shear bolt washers and the shear bolts.

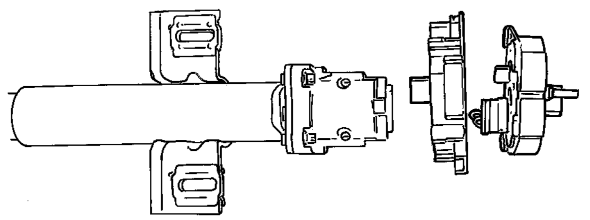
Tighten

Tighten the shear bolts until the bolt head separates from the body, approximately 11 N•m (97 lb-in).



A105E050

5. Place the lock cylinder in the ACC position.
6. Slide the steering shaft assembly into the lower end of jacket assembly until the steering shaft assembly is bottomed.
7. Place the lock cylinder in the LOCK position and remove the key.
8. Rotate the steering shaft until the lock bolt engages and locks the steering shaft in position.

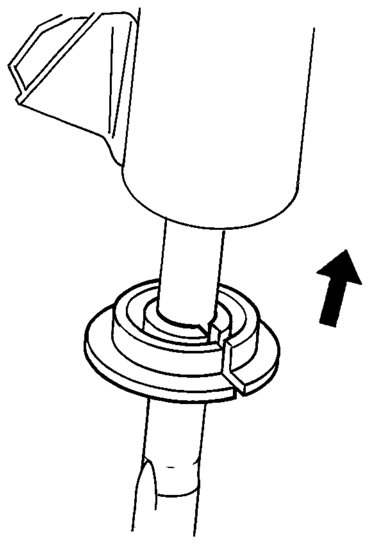


A105E012

9. Install the lower part of the turn signal switch housing assembly, then install the upper part of the turn signal switch housing assembly. Install the screws.

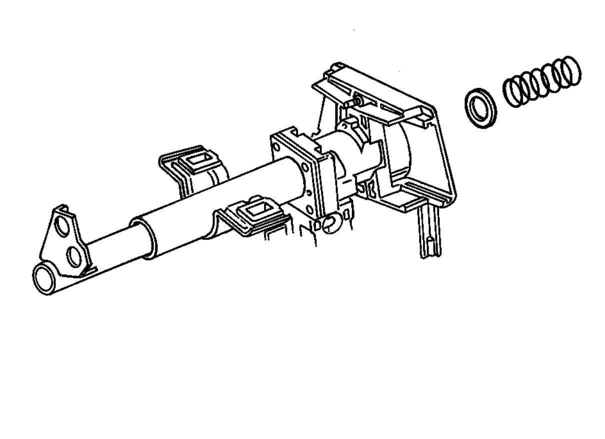
Tighten

Tighten the turn signal switch housing screws to 3 N•m (27 lb-in).



A105E057

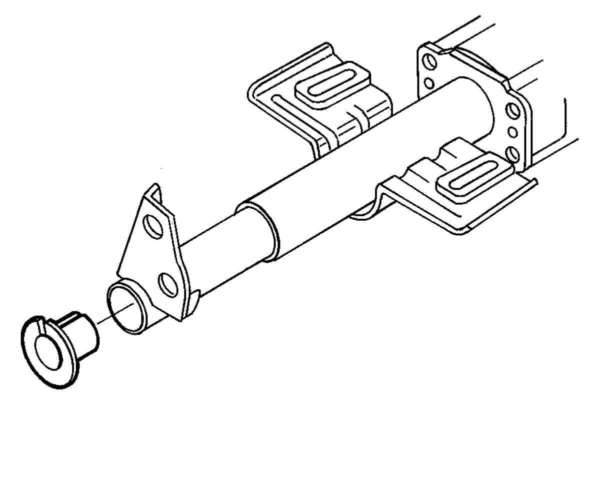
10. Slide the alignment bushing over the lower end of the steering shaft and into the lower end of the jacket assembly.



A105E058

11. Install the thrust washer and the upper steering shaft spring onto the steering shaft.
12. Install the steering wheel onto the steering column. Refer to "Steering Wheel without SIR" or "Steering Wheel with SIR" in this section.
13. Install the steering column into the vehicle. Refer to "Steering Column" in this section.

Important: After the steering column is connected to the coupling flange, pull the alignment bushing away from jacket assembly and leave the bushing on the steering shaft for later use.



A105E038

TILT STEERING COLUMN

Tools Required

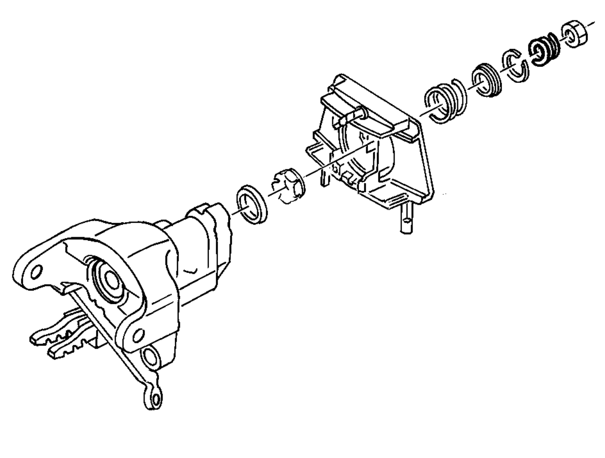
J-36667 Lock Plate Adapter

J-23653-D Lock Plate Compressor

J-21854-01 Pivot Pin Remover

Disassembly Procedure

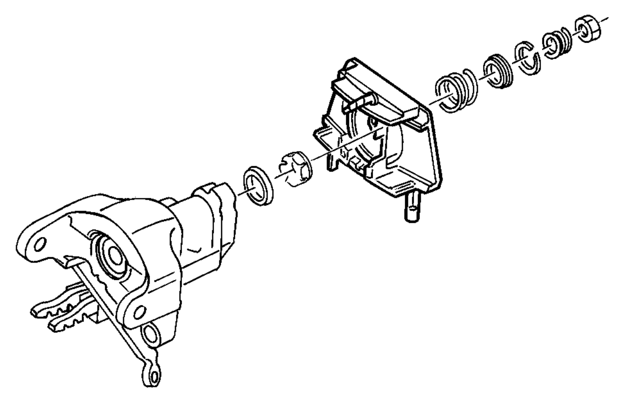
1. Remove the steering column from the vehicle. Refer to "Steering Column" in this section.
2. Remove the steering wheel from the steering column. Refer to "Steering Wheel without SIR" or "Steering Wheel with SIR" in this section.
3. Pull the alignment bushing from the lower end of the shaft assembly, if it has not been previously removed.



A105E025

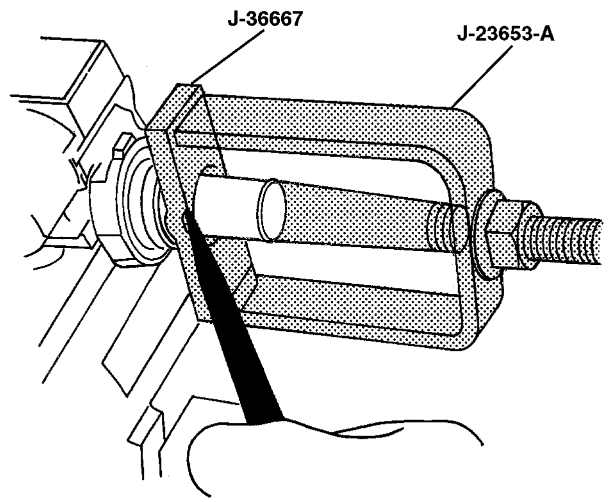
4. Pull the canceling cam spring from the upper end of the shaft assembly, if it has not been previously removed.

5. Remove the turn signal switch housing screws. Remove the turn signal switch housing from the steering column housing.



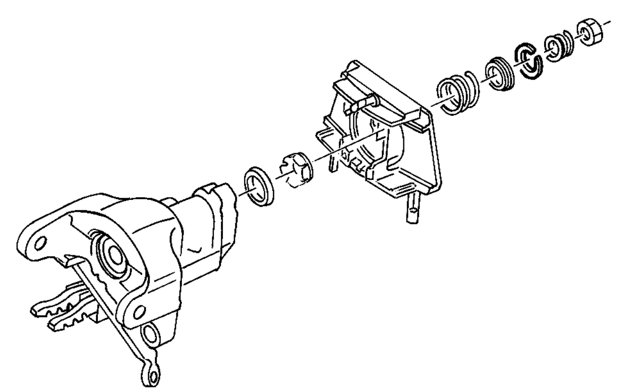
A105E048

6. Compress the spring retainer and upper bearing spring with the lock plate adapter J-36667 and the lock plate compressor J-23653-D.

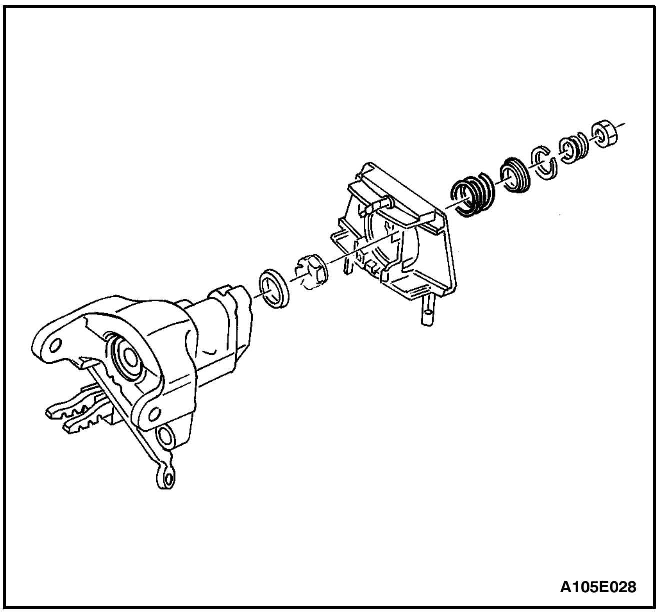


A105E026

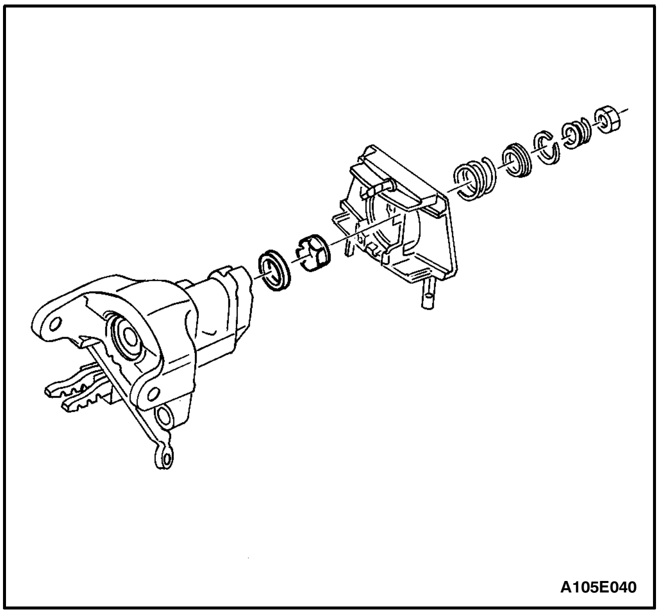
7. Remove the retaining ring.



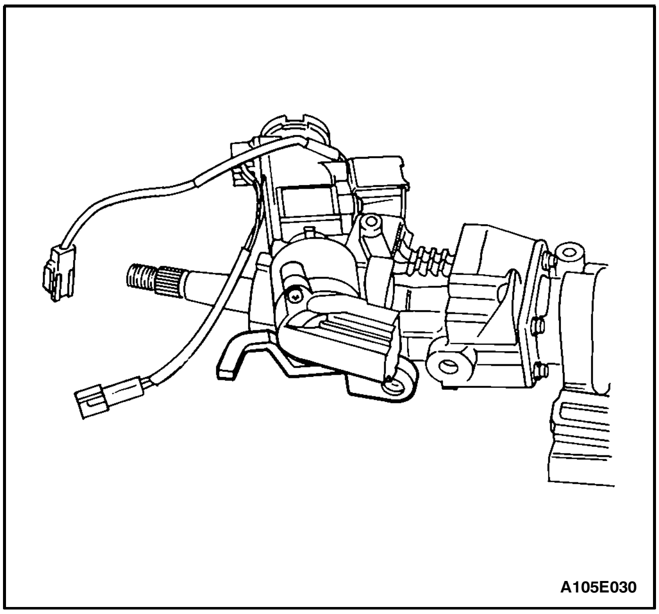
A105E039



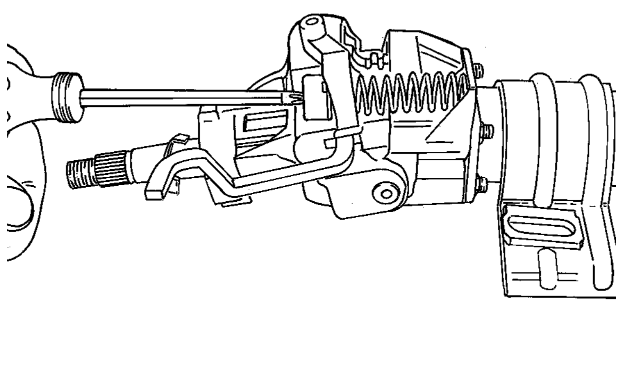
8. Remove the spring retainer and the upper bearing spring.



9. Remove the inner race seat and the inner race.

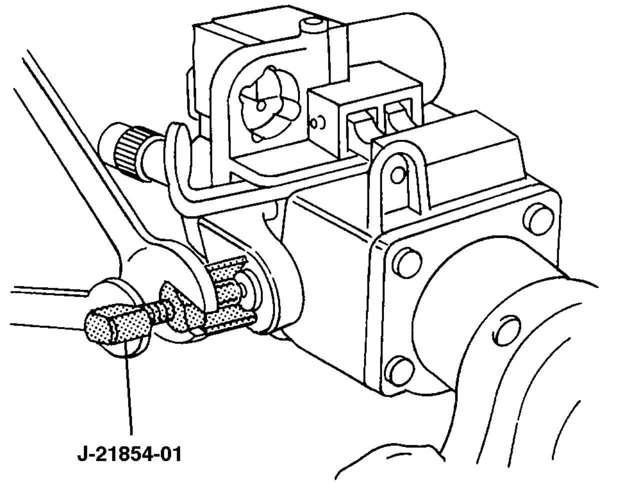


10. Pull the tilt level on the column housing assembly and tilt the column all the way up.



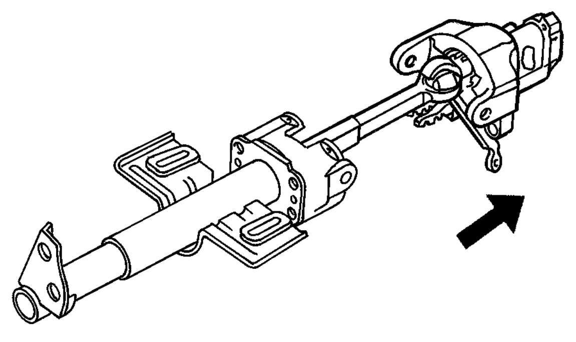
A105E029

11. Insert a Phillips screwdriver into the square opening at the bottom of the spring retainer. Push and turn left to release the spring retainer and the wheel-tilt spring.
12. Remove the spring retainer and the wheel-tilt spring.



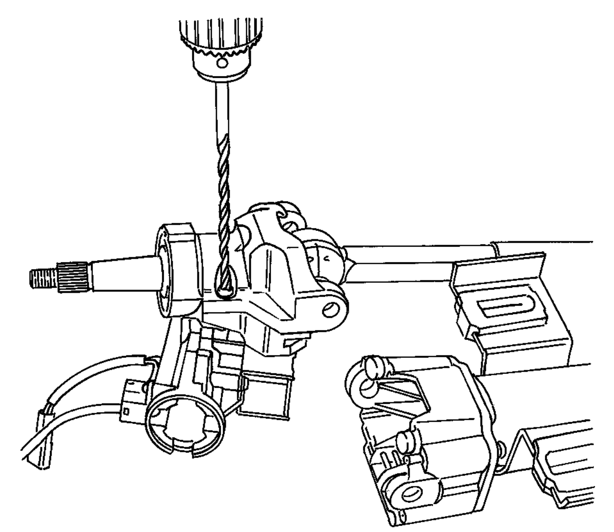
A105E027

13. Remove the two pivot pins using the pivot pin remover J-21854-01.



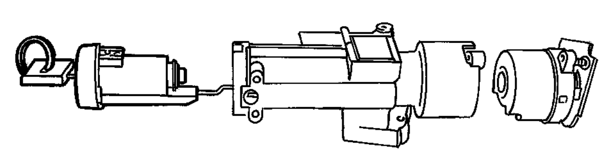
A105E054

14. Place the lock cylinder in the ACC position.
15. Pull the tilt lever to release the column housing. Remove the column housing and the steering shaft from the housing support.

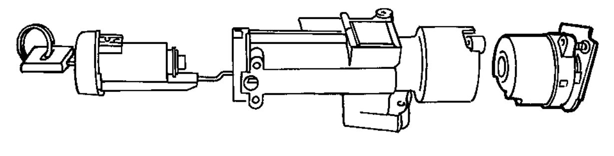

A105E031

16. Remove the shear bolts, the shear bolt washers, and the ignition switch housing from the steering column housing as follows:
    16.1 Use a metal punch to start the drill head.
    16.2 Drill off the head of the shear bolts down to the steel shear bolt washers with a 6.5 mm (1/4 inch) drill bit.
    16.3 Separate the washers and the ignition switch housing from the column housing.
    16.4 Remove the threaded end of the shear bolts from the ignition switch housing with locking pliers.

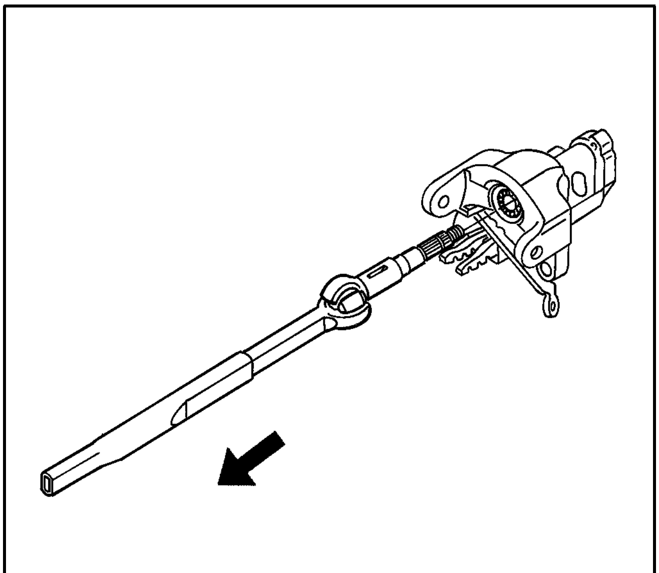
Important: After drilling and removing the threaded end of the shear bolts, all the metal shavings must be cleaned from all the parts.


A105E032

17. Remove the lock cylinder from the ignition switch housing by pushing the lock cylinder release tab.

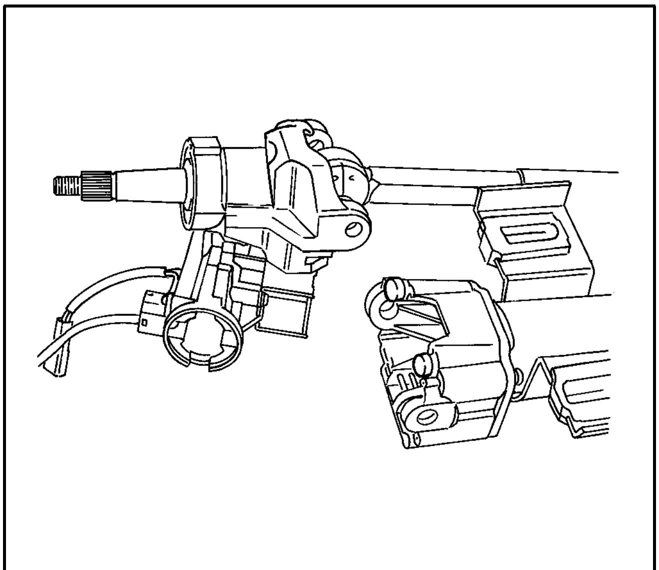

A105E041

18. Remove the ignition switch retaining screw and remove the ignition switch assembly.



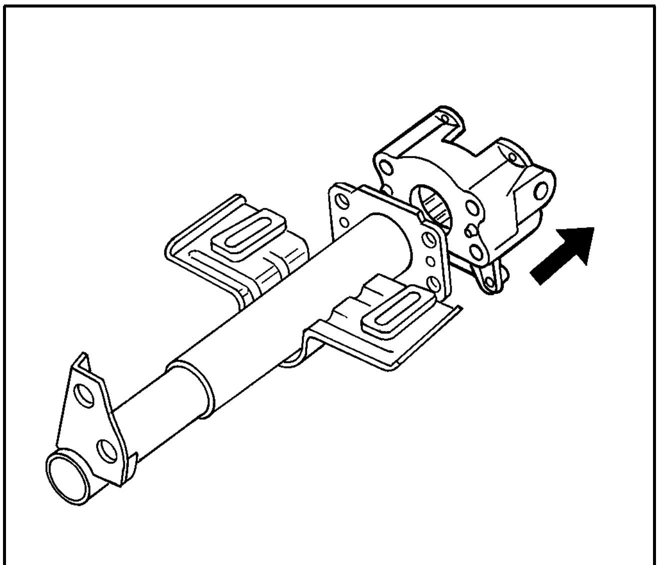
A105E033

19. Remove the steering shaft assembly from the housing support.



A105E042

20. Remove the tilt bumpers with a pair of pliers.

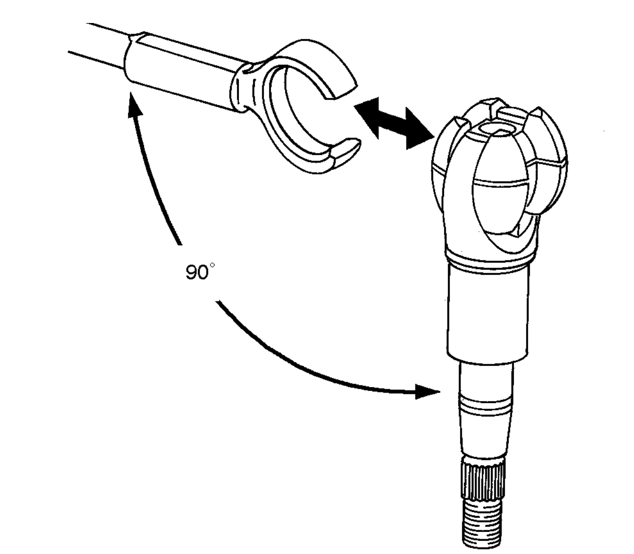


A105E043

21. Remove the support screws and remove the support housing from the jacket assembly.

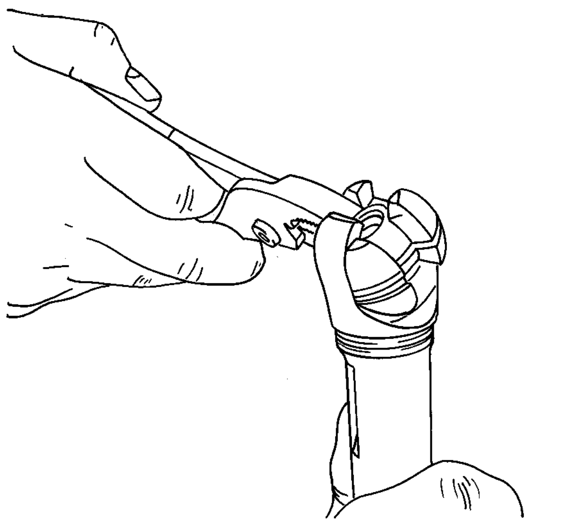
Disassembly Procedure for the Steering Shaft Assembly

Important: Prior to separating the upper shaft from the lower shaft, note the relationship of the upper shaft, with the lock bolt slot at the 12 o'clock position, to the lower shaft pinch bolt groove at the 7 o'clock position. Refer to this orientation for proper assembly.

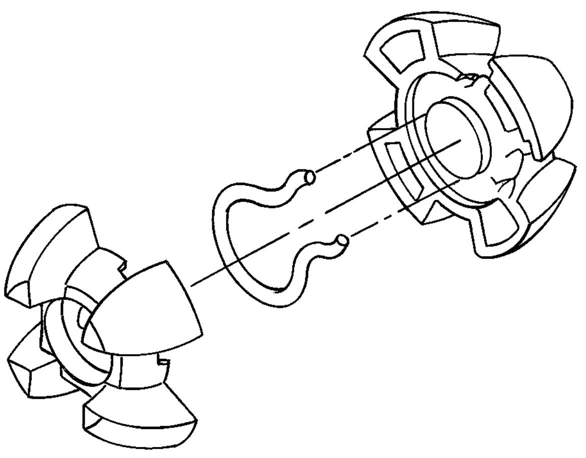


A105E034

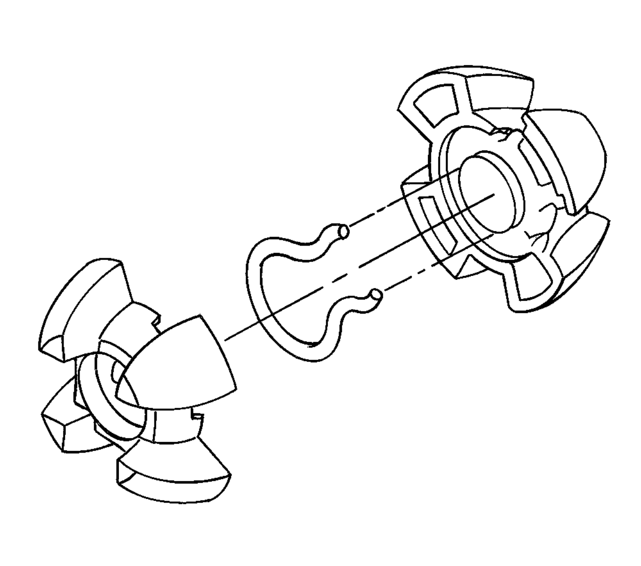
1. Position the upper shaft 90 degrees to the lower shaft and separate the two parts.


A105E044

2. Rotate the centering sphere 90 degrees and remove it from the upper shaft.


A105E045

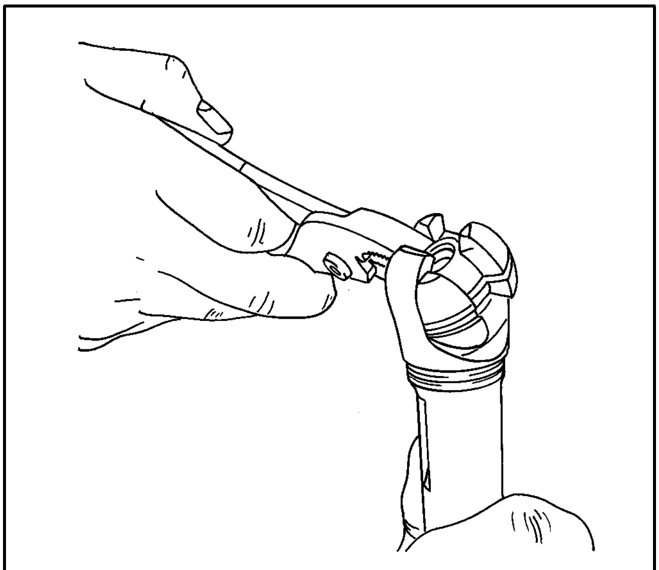
3. Separate the sphere halves and remove the joint pre-load spring.



A105E045

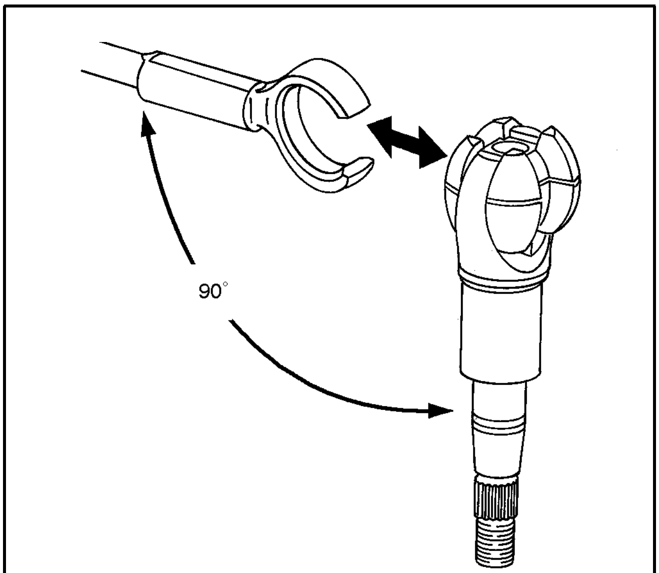
Assembly Procedure for the Steering Shaft Assembly

1. Lubricate the centering sphere halves and the joint preload spring with lithium grease.
2. Place the joint preload spring between the sphere halves with the ends of the spring in the notches.



A105E044

3. Lubricate the sphere end of the upper shaft with lithium grease.
4. Place the sphere into the upper shaft and rotate the sphere 90 degrees.

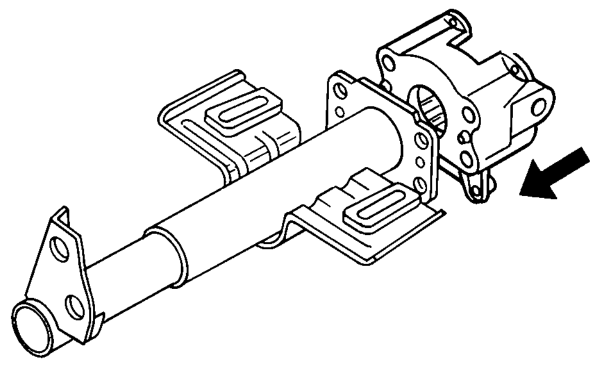


A105E034

5. Lubricate the sphere end of the lower shaft with lithium grease.

Important: To insure proper operation, the upper shaft and the lower shaft must be aligned correctly when they are connected.

6. Place the lock bolt slot on the upper shaft at the 12 o'clock position.
7. Place the pinch bolt groove near the end of the lower shaft at the 7 o'clock position.
8. Connect the upper shaft to the lower shaft.



A105E055

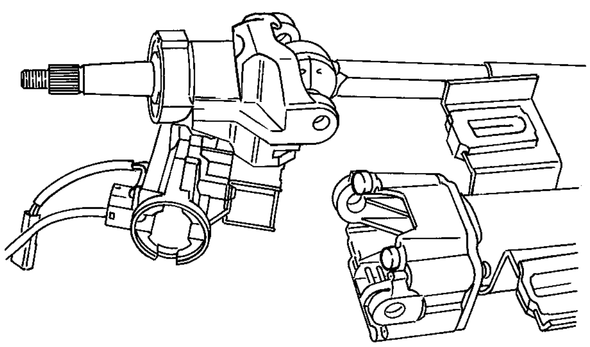
Assembly Procedure

Important: All fasteners in the following steps must be seated firmly before being tightened to specifications.

1. **Connect the support housing to the jacket assembly with the support screws.**

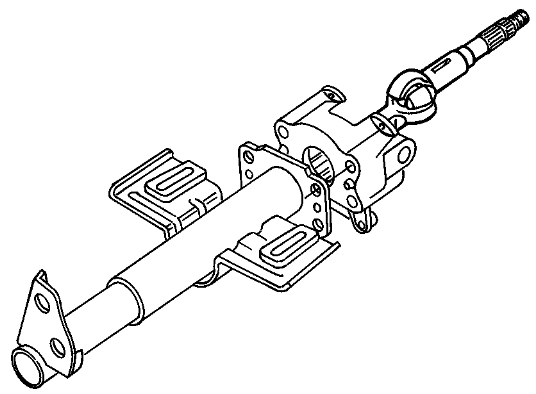
   ### Tighten

   Tighten the support housing screws to 16 N•m (12 lb-ft).



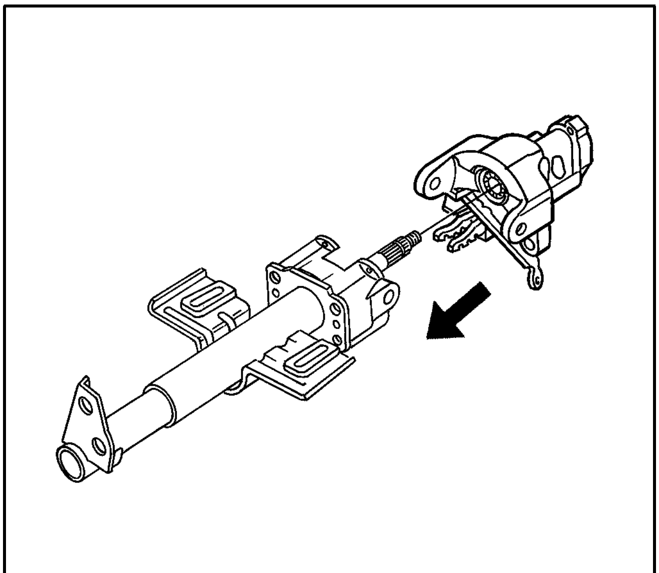
A105E042

2. **Connect the tilt bumpers to the support housing and snap them in place.**



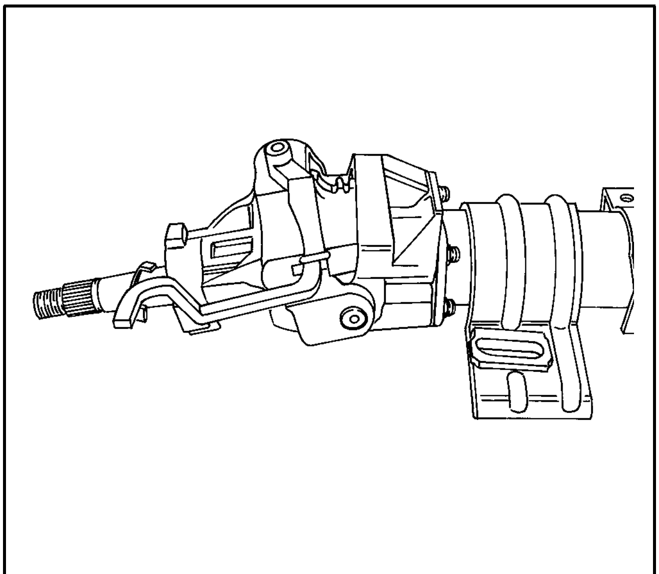
A105E046

3. **Slide the steering shaft assembly into the support housing.**



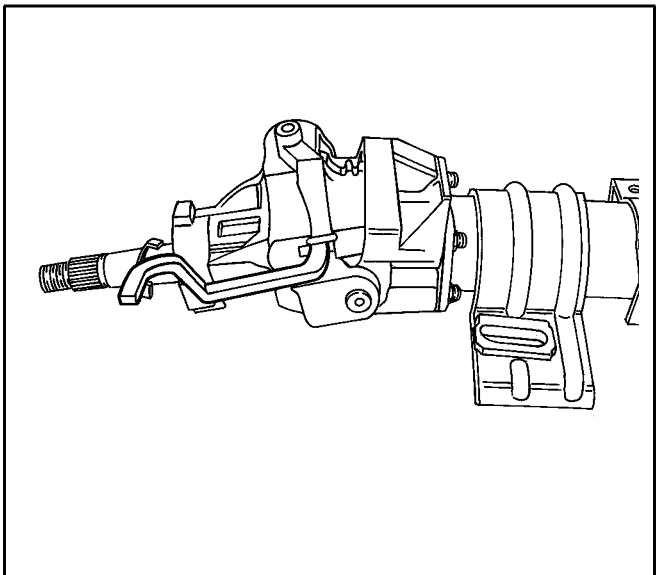
A105E035

4. Lubricate both bearings in the column housing with lithium grease. Slide the column housing onto the shaft assembly and the housing support.



A105E056

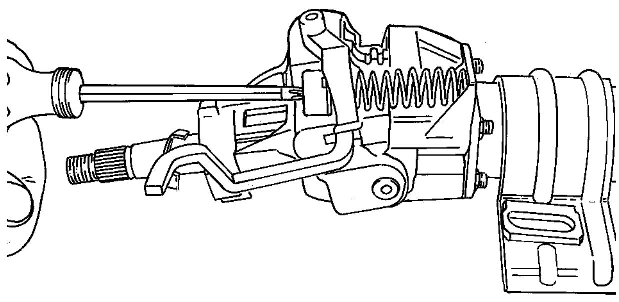
5. Lubricate the pivot pins with lithium grease and slide the pins into the housing until the pins are bottomed. Tap the pivot pins in place.



A105E047

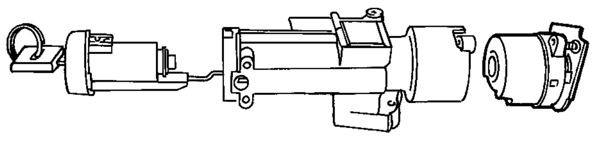
Important: The pivot pins must be staked to the column housing after installation. Stake each pin at three equally-spaced locations.

6. Pull the tilt lever on the column housing and tilt the column all the way up.



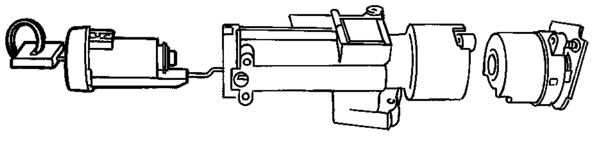
A105E029

7. Lubricate the tilt spring with lithium grease.
8. Install the tilt spring and the spring retainer. Be sure the spring engages the locating tab on the support housing. Insert a Phillips screwdriver into the square opening in the spring retainer, push down, and turn right to lock it in place.



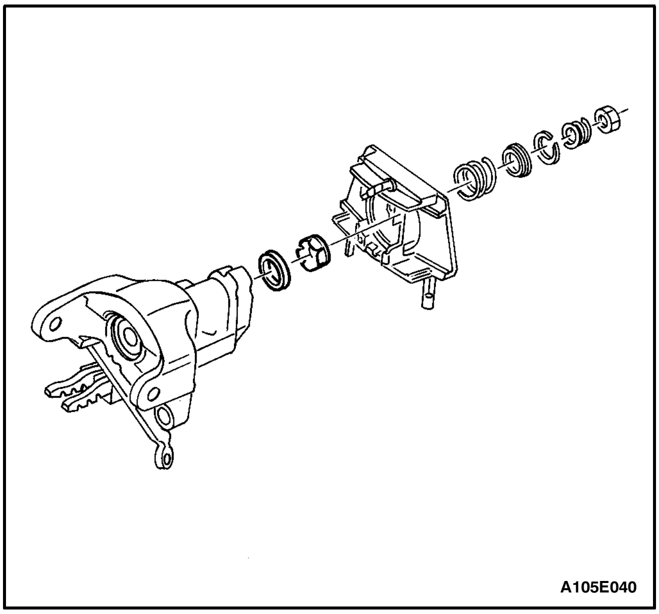
A105E041

9. Install the ignition switch with the ignition switch retaining screw. Connect the wiring. Refer to “Ignition Lock Cylinder and Switch” in this section.



A105E032

10. **Important:** To ensure that the tab on the lock-cylinder shaft and the slotted opening on the ignition switch are in alignment, the lock cylinder must be in the ACC position prior to installation.
11. Install the lock cylinder into the ignition switch housing.

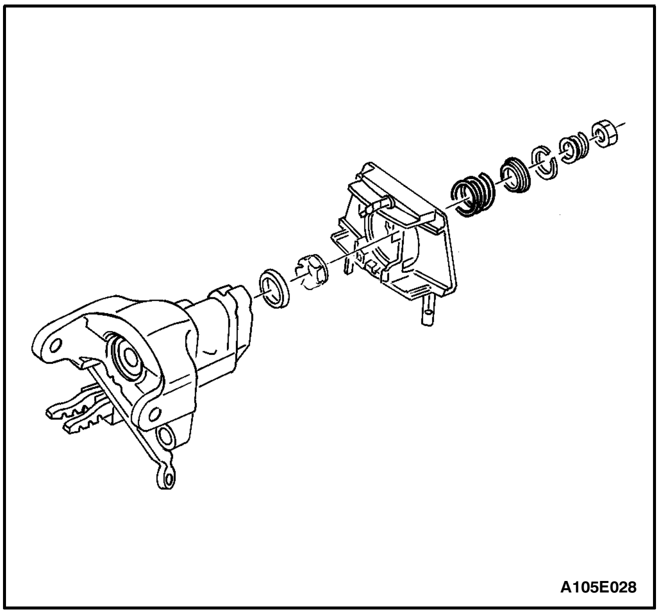


12. Attach the ignition switch housing to the column housing with the shear bolt washers and the shear bolts.

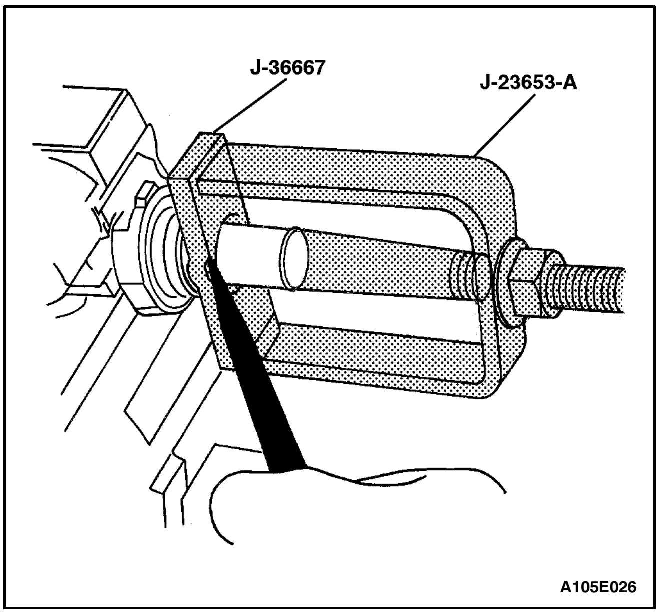
Tighten

Tighten the shear bolts until the bolt head separates from the body, approximately 11 N•m (97 lb-in).

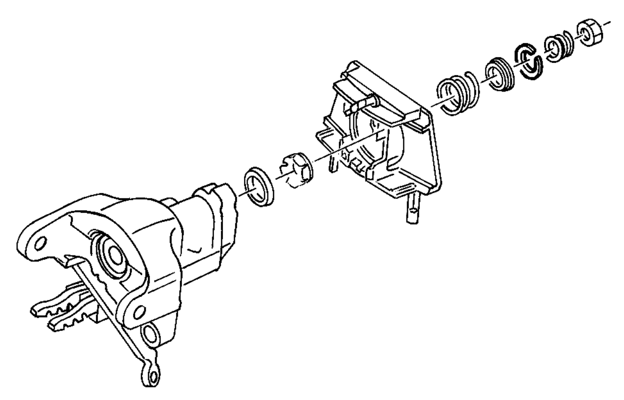
13. Place lock cylinder in the LOCK position and remove the key.
14. Rotate the steering shaft assembly until the lock bolt engages and locks the steering shaft in position.
15. Install the inner race and the inner race seat.



16. Install the upper bearing spring and the spring retainer.

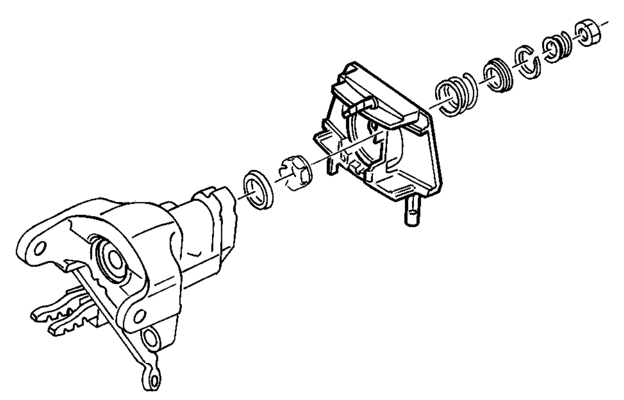


17. Compress the upper bearing spring and the spring retainer with lock plate adapter J-36667 and lock plate compressor J-23653-D.



A105E039

18. Place the retaining ring into the groove on the upper shaft.

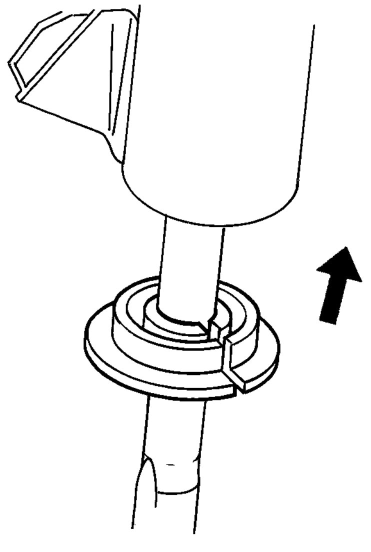


A105E048

19. Connect the turn signal switch housing to the steering column housing with the turn signal switch housing screws.

Tighten

Tighten the turn signal switch housing screws to 3 N•m (27 lb-in).



A105E057

20. Slide the alignment bushing over the lower end of the steering shaft and into the lower end of the jacket assembly.
21. Install the steering column into the vehicle. Refer to "Steering Column" in this section.

Important: After the steering column is connected to the coupling flange, pull the alignment bushing away from jacket assembly and leave the bushing on the steering shaft for later use.

22. Install the cancelling cam spring and the steering wheel onto the steering column. Refer to "Steering Wheel without SIR" or "Steering Wheel with SIR" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

STEERING WHEEL AND COLUMN

In addition to the steering function, the steering column provides safety and security.

Caution: To ensure the energy-absorbing action, it is important to use only the specified screws, bolts, and nuts, tightened to the specified torque.

The energy-absorbing column is designed to compress in a front-end collision to lessen the chance of driver injury.

The ignition switch and the lock are mounted on the column, allowing the ignition and steering operations to be locked to inhibit theft of the car.

The column levers trigger the turn signals, the headlight beams, and the windshield washer and wipers.

A tilt steering column uses a spherical joint to allow the steering wheel to tilt up and down.

This enables the driver to adjust the steering wheel to a comfortable driving position.

Notice: Apply a thin coat of lithium grease to all friction points when reassembling.

The column may be easily disassembled and assembled.

SECTION 7A

HEATING AND VENTILATION SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

HEATER TEMPERATURE SPECIFICATIONS

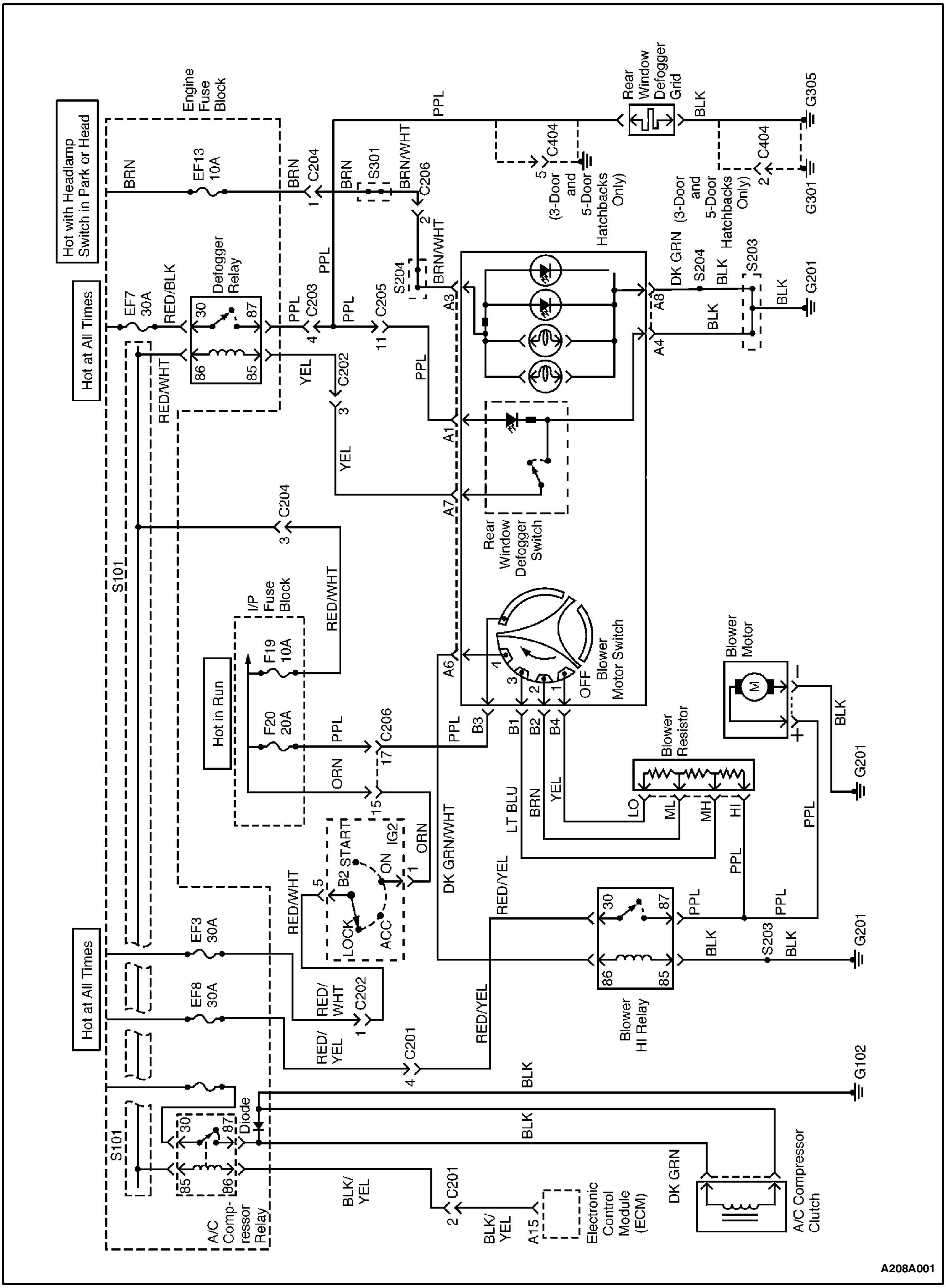
Ambient Air Temperature	Heater Outlet Air Temperature
* 18°C (0°F)	54°C (130°F)
* 4°C (25°F)	59°C (139°F)
10°C (50°F)	64°C (147°F)

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Blower Motor Retaining Screws	6	-	53
Blower Resistor Retaining Screws	6	-	53
HVAC Controller Retaining Screws	2	-	18

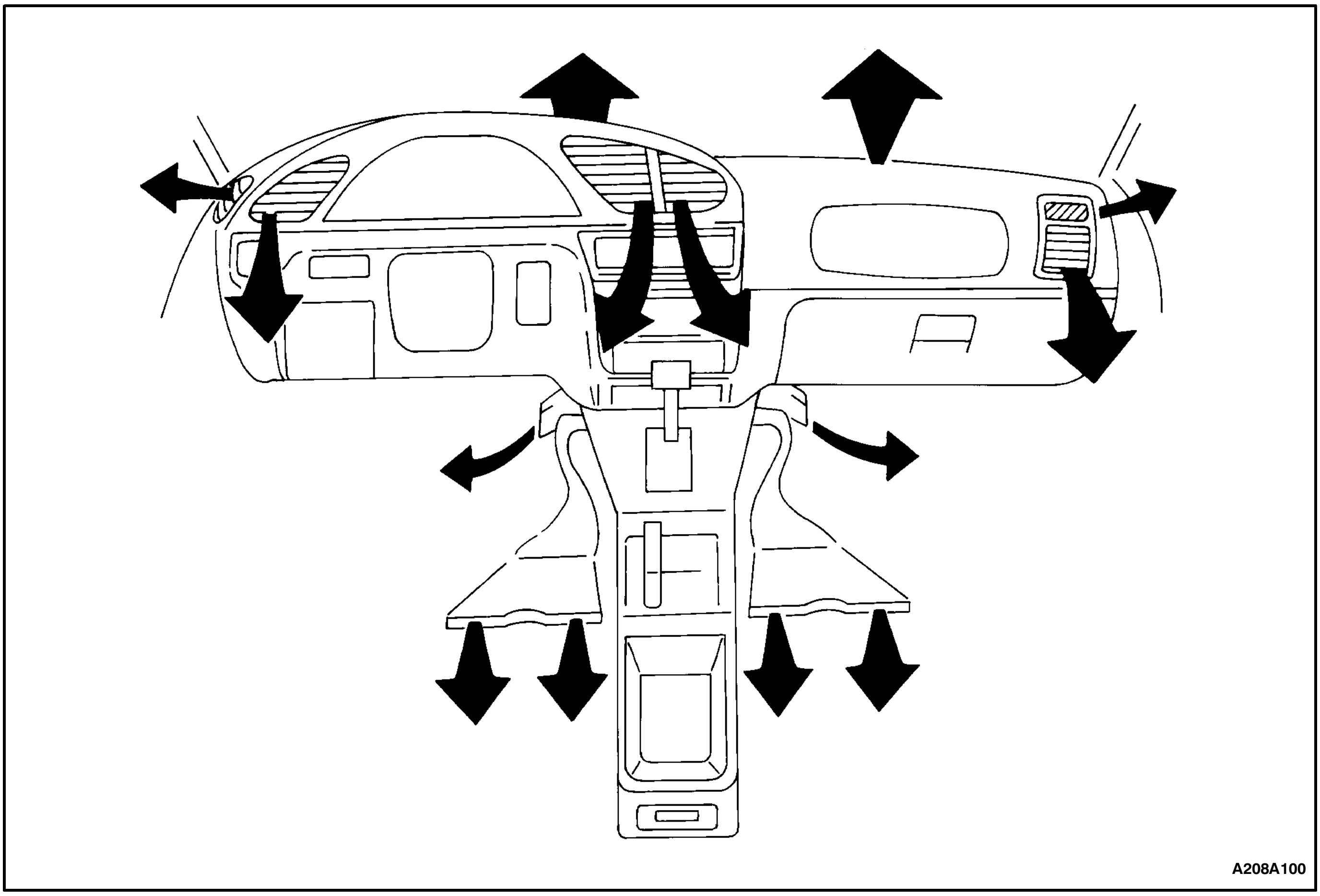
SCHEMATIC AND ROUTING DIAGRAMS

NON-A/C DIAGRAM



AIRFLOW THROUGH VENTS WITH REAR HEATING DUCT*

(Left-Hand Drive Shown, Right-Hand Drive Similar)



*Rear heating duct available on vehicles in cold climate countries.

DIAGNOSIS

HEATER SYSTEM

INSUFFICIENT HEATING OR DEFROSTING

Caution: The cooling system is pressurized when hot. Injury can result from removing the surge tank cap before the engine is sufficiently cool.

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Check the coolant level. Is the coolant level correct?	-	Go to Step 4	Go to Step 3
3	Add coolant as needed. Is the repair complete?	-	System OK	Go to Step 4
4	Check the timing belt for tension or damage. Is the timing belt OK?	-	Go to Step 6	Go to Step 5
5	Correct any problem with the drive belts. Is the repair complete?	-	System OK	Go to Step 6
6	Check the coolant hoses for leaks or kinks. Are the coolant hoses OK?	-	Go to Step 8	Go to Step 7
7	Repair any problem with the coolant hoses. Is the repair complete?	-	System OK	Go to Step 8
8	Check the surge tank cap. Refer to Section 2D, Engine Cooling. Is the surge tank cap OK?	-	Go to Step 10	Go to Step 9
9	Repair or replace the surge tank cap as needed. Is the repair complete?	-	System OK	Go to Step 10
10	1. Set the A/C switch OFF on vehicles equipped with air conditioning (A/C). 2. Set the blower motor switch on 4. 3. Set the heater control to full hot. 4. Turn the ignition ON. 5. Check for airflow from the heater outlet. Is there heavy airflow from the heater outlet?	-	Go to Step 11	Go to Step 26
11	Check for a change in the airflow at various blower speeds. Does the blower speed increase as the switch is turned from 1 to 4?	-	Go to Step 12	Go to "Blower Electrical"
12	1. Set the A/C switch to OFF, on vehicles equipped with A/C. 2. Set the temperature lever to full hot. 3. Set the blower motor switch on 4. 4. With the engine sufficiently cool, remove the surge tank cap. 5. Start the vehicle and idle the engine. 6. Watch for the flow of the coolant. Is the coolant flow visible?	-	Go to Step 14	Go to Step 13

Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Check for the following conditions: • Restriction in the cooling system. • Failed water pump impeller. • Faulty thermostat. 2. Make repairs to the cooling system, as needed. Are the repairs complete?	-	System OK	Go to Step 14
14	1. Install the surge tank cap. 2. With the ignition ON, allow the engine to warm up for about 20 minutes. Drive the vehicle at 48 km/h (30 mph). 3. Use a thermometer to measure the ambient air temperature and the discharge air temperature at the heater outlet. Does the heater output meet the minimum values given?	Refer to "Temperature Specifications"	Go to Step 15	Go to Step 16
15	1. Check the vehicle for cold air leaks at the following locations: • Dash. • Heater cases. • Vents. 2. Check under the seat for obstructions. 3. Repair any leaks or obstructions. Are the repairs complete?	-	System OK	-
16	1. Turn the ignition OFF. 2. Turn the temperature control knob to full cold, then rapidly to full hot. 3. Listen for the sound of the temperature door slam just before reaching the end of the travel range of the control knob. Does the door slam?	-	Go to Step 18	Go to Step 17
17	1. Check the following aspects of the temperature door: • Travel. • Cables. • Linkage. 2. Verify the accuracy of the temperature controls at full hot. 3. Verify the accuracy of the temperature controls at full cold. Is the repair complete?	-	System OK	-
18	1. Set the temperature door to full hot. 2. Start the vehicle. 3. Check the temperature of the heater inlet hose and the heater outlet hose by feel. The air temperature around the hoses should be at least 29°C (84°F). Is the heater inlet hose hot and the heater outlet hose warm?	-	Go to Step 19	Go to Step 22
19	Check the thermostat. Refer to Section 2D, Engine Cooling. Is the thermostat installed and seated properly?	-	Go to Step 20	Go to Step 21

Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
20	Replace the thermostat. Refer to Section 2D, Engine Cooling. Is the repair complete?	-	System OK	-
21	Reinstall the thermostat. Is the repair complete?	-	System OK	-
22	Inspect the heater hoses for proper installation. Are the heater hoses reversed?	-	Go to Step 23	Go to Step 24
23	Reinstall the heater hoses properly. Is the repair complete?	-	System OK	-
24	1. Back flush the heater core. 2. Drain the cooling system. 3. Replace the coolant. 4. Warm the engine to an average operating temperature. 5. Feel the heater inlet hose and the heater outlet hose. Is the heater inlet hose hot and the heater outlet hose warm?	-	System OK	Go to Step 25
25	Replace the heater core. Is the repair complete?	-	System OK	-
26	Recheck the system using the "Control Settings/Correct Results" tests. Refer to "Improper Air Delivery or No Mode Shift" in this section. Is the repair complete?	-	System OK	Go to Step 27
27	Check for airflow from the defroster or the vent outlets. Is there high airflow from the defroster or the vent outlets?	-	Go to Step 28	Go to Step 29
28	Adjust the heater door at the floor and the vent door to get the proper airflow. Is the repair complete?	-	System OK	-
29	Switch the mode knob to defrost. Is the defroster airflow OK?	-	Go to Step 30	Go to Step 31
30	1. Remove the heater outlet and check for obstructions. 2. Remove any obstructions in the heater outlet. Is the repair complete?	-	System OK	-
31	Check for airflow change at various blower speeds. Does the blower speed increase as the control is turned from 1 to 4?	-	Go to Step 32	Go to "Blower Electrical"
32	Check for obstructions in the system at the blower inlet. Are there any obstructions?	-	Go to Step 33	Go to Step 34
33	Remove the obstructions in the system at the blower inlet. Is the repair complete?	-	System OK	-
34	1. Set the blower on 4. 2. Rotate the temperature control from full hot to full cold. 3. Listen for an airflow change. Does the airflow change?	-	Go to Step 35	Go to Step 36

Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
35	1. Check the following aspects of the temperature door: • Travel. • Cables. • Linkage. • Control. 2. Verify the accuracy of the temperature controls at full hot. Is the repair complete?	-	System OK	-
36	1. Check the system for any obstruction between the blower and the system outlets. 2. Remove any obstruction. Is the repair complete?	-	System OK	-

BLOWER ELECTRICAL

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Check the blower. Does the blower run at any speed?	-	Go to Step 14	Go to Step 3
3	1. Disconnect the power connector from the blower motor under the dashboard on the passenger side of the vehicle. 2. Turn the ignition ON. 3. Turn the blower ON. 4. Test for voltage on the connector. The terminal connected to the violet wire is positive and the terminal connected to the black wire is negative. Is the appropriate voltage present?	11-14 v	Go to Step 4	Go to Step 5
4	Replace the blower motor. Is the repair complete?	-	System OK	-
5	Check fuse 20 in the passenger compartment fuse box. Is the fuse blown?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition ON. 2. Use a short detector to locate a possible short in the following connections: • From the fuse panel to the blower speed switch. • From the blower speed switch to the heater resistor block. • From the heater resistor block to the blower motor. • From the blower speed switch to the blower HI relay. 3. Repair any short. 4. Replace any blown fuse. Is the repair complete?	-	System OK	-

Blower Electrical (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition ON. 2. Set the blower switch on 4. 3. Check the blower motor ground. Is the ground OK?	-	Go to Step 9	Go to Step 8
8	Repair the blower motor ground. Is the repair complete?	-	System OK	-
9	Check the motor connector with a 12-volt test light. Does the test light come on?	-	Go to Step 10	Go to Step 11
10	Repair the open in the feed wire from the resistor block to the blower motor. Is the repair complete?	-	System OK	-
11	Use the 12-volt test light to check the power feed terminal on the blower speed switch. Does the light come on?	-	Go to Step 12	Go to Step 13
12	Replace the blower speed switch. Is the repair complete?	-	System OK	-
13	Repair the open in the power wire from the blower speed switch to the fuse panel. Is the repair complete?	-	System OK	-
14	Check the blower operation at speed 4. Does the blower fail to operate at speed 4?	-	Go to Step 15	Go to Step 21
15	Check fuse EF8 in the engine fuse compartment. Is this fuse blown?	-	Go to Step 16	Go to Step 17
16	1. Turn the ignition ON. 2. Set the blower motor switch on 4. 3. Use a short detector to locate a possible short in the following locations: • From the engine fuse panel to the blower HI relay. • From the blower HI relay to the blower motor. 4. Repair any short. 5. Replace the fuse EF8. Is the repair complete?	-	System OK	-
17	1. Turn the ignition switch ON. 2. Set the blower switch on 4. 3. Test for voltage on the blower HI relay coil terminal from the blower speed switch terminal B3. Is the appropriate voltage present?	11-14 v	Go to Step 18	Go to Step 19
18	Replace the blower speed switch. Is the repair complete?	-	System OK	-
19	1. Turn the ignition OFF. 2. Check for opens in the following connections: • EF8-to-the blower HI relay. • Blower speed switch-to-the blower HI relay. • Blower HI relay-to-ground. • Blower HI relay-to-the blower motor. 3. Repair any opens. Is the repair complete?	-	System OK	Go to Step 20

Blower Electrical (Cont'd)

Step	Action	Value(s)	Yes	No
20	Replace the blower HI relay. Is the repair complete?	-	System OK	-
21	1. Disconnect the resistor block connector. 2. Connect one lead of a self-powered test light to any single lead on the resistor block. Use the other lead to probe each of the other two terminals. Does the test light illuminate on all terminals?	-	Go to Step 23	Go to Step 22
22	Replace the resistor block. Is the repair complete?	-	System OK	-
23	1. Turn the ignition to LOCK. 2. Disconnect the connector from the resistor block. 3. Connect a jumper lead from the positive terminal on the battery to any wire terminal in the connector. 4. Test for voltage from the corresponding wire on the blower speed switch. 5. Repeat the same test on the other wires. Does the lamp light on all three wires?	-	Go to Step 25	Go to Step 24
24	Replace the blower speed switch. Is the repair complete?	-	System OK	-
25	Repair the open in the affected wire. Is the repair complete?	-	System OK	-

IMPROPER AIR DELIVERY OR NO MODE SHIFT

This procedure provides a test of all functions of the heater/defroster unit.

1. Warm up the vehicle.
2. Keep the engine running.
3. Perform the tests outlined in the table below and look for the results indicated.

CONTROL SETTINGS			CORRECT RESULTS				
MODE KNOB	TEMP. CONTROL	BLOWER MOTOR SWITCH	BLOWER SPEED	POWER VENT OUTLET	FLOOR OUTLET	DEFROST OUTLET	SIDE WINDOW OUTLET
Vent	Cold	Off	Off	No Airflow	No Airflow	No Airflow	No Airflow
Vent	Cold	4	High	Ambient Airflow	No Airflow	No Airflow	No Airflow
Floor	Cold to Hot	4	High	No Airflow	Cold to Hot Airflow	Minimum Cold to Hot Airflow	Minimum Cold to Hot Airflow
Defroster	Cold to Hot	4	High	No Airflow	Minimum Cold to Hot Airflow	Cold to Hot Airflow	Minimum Cold to Hot Airflow

If any of these settings does not produce the correct results, perform the following diagnostic procedure.

Improper Air Delivery or No Mode Shift (Cont'd)

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Examine the affected door in the unit for proper cable attachment. • Check the cable connection to the door. • Check that the cable sheath is properly retained. Is the cable connected properly?	-	Go to Step 4	Go to Step 3
3	Repair as necessary. Is the repair complete?	-	System OK	-
4	1. Disconnect the cable at the door. 2. Check the range of the door travel and the effort required to move it. Does the door move freely through its entire range of travel so that it can close at both ends of the range?	-	Go to Step 5	Go to Step 3
5	Check the travel of the Bowden cable by turning the control knob. Is the cable travel OK?	-	Go to Step 6	Go to Step 7
6	1. Reinstall the cable. 2. Recheck the system using the "Control Settings/Correct Results" tests in this procedure. Does the system perform properly?	-	System OK	Go to Step 9
7	1. Check the cable attachment at the control. 2. Check for a broken control. Is there a problem with the cable attachment or the control?	-	Go to Step 8	Go to Step 9
8	Repair the cable attachment or control as necessary. Is the repair complete?	-	System OK	Go to Step 9
9	Recheck the system using the "Control Settings/Correct Results" tests in this procedure. Is the repair complete?	-	System OK	Go to Step 10
10	Check for airflow from the defroster or the vent outlets. Is there high airflow from the defroster or the vent outlets?	-	Go to Step 11	Go to Step 12
11	Adjust the heater door at the floor and the vent door to get the proper airflow. Is the repair complete?	-	System OK	-
12	Switch the mode knob to defrost. Is the defroster airflow OK?	-	Go to Step 13	Go to Step 14
13	1. Remove the heater outlet. 2. Check the heater outlet for obstructions. 3. Remove any obstructions in the heater outlet. Is the repair complete?	-	System OK	-
14	Check the blower speeds for change in the airflow. Does the blower speed increase as the control is turned from 1 to 4?	-	Go to Step 15	Go to "Blowe-Electrical"

Improper Air Delivery or No Mode Shift (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Check for obstructions in the system at the blower inlet. 2. Remove any obstructions at the blower inlet. Is the repair complete?	-	System OK	Go to Step 16
16	1. Set the blower on 4. 2. Rotate the temperature control from full hot to full cold. 3. Listen for an airflow change. Does the airflow change?	-	Go to Step 17	Go to Step 18
17	1. Check the temperature door adjustment, the cables, the linkage, and the control. 2. Adjust the temperature control to full hot. Is the repair complete?	-	System OK	-
18	1. Check the system for any obstruction between the blower and the system outlets. 2. Remove any obstruction between the blower and the system outlets. Is the repair complete?	-	System OK	-

TOO MUCH HEAT

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Set the mode switch to the floor position. Is there too much heat when the mode switch is in the floor position?	-	Go to Step 3	Go to Step 9
3	Check for defroster bleed. Is there objectionable defroster bleed?	-	Go to Step 4	Go to Step 5
4	1. Check the door travel, the cables, the controls, and the linkage for the heater and the defroster. 2. Adjust or repair, as required. Is the repair complete?	-	System OK	-
5	1. In vehicles equipped with air conditioning (A/C), set the A/C switch OFF. 2. In all vehicles, set the blower speed to 4. 3. Set the temperature to full hot. 4. Turn the ignition switch to ON. 5. Check for airflow from the floor outlets. 6. Check the floor outlet attachment. Is the airflow high?	-	Go to Step 7	Go to Step 8
6	Check for a change in the airflow at different blower speeds. Does the airflow change as the setting for the blower-speed switch is changed?	-	System OK	Go to "Blower Electrical"
7	1. Check the temperature door travel, the cables, and the linkage. 2. Adjust to full cold. 3. Check for full hot. Is the repair complete?	-	System OK	-

Too Much Heat (Cont'd)

Step	Action	Value(s)	Yes	No
8	Adjust or repair the floor/defroster and/or the vent/ floor mode. Is the repair complete?	-	System OK	-
9	Set the mode switch to the vent position. In the vent position, is the problem objectionable bleed?	-	Go to Step 10	Go to Step 15
10	1. Check the system case for leaks. 2. Check the floor outlet attachment. Are any problems found?	-	Go to Step 11	Go to Step 12
11	Repair the system case or the floor outlet attachment as required. Is the repair complete?	-	System OK	Go to Step 12
12	1. Turn the ignition switch OFF. 2. Turn the temperature control knob to full hot, then rapidly to full cold. Do you hear the door slam just before you reach the end of the control travel?	-	Go to Step 13	Go to Step 14
13	Adjust the vent door to vent more. Is the repair complete?	-	System OK	-
14	1. Check the temperature door travel, the cables, and the linkage. 2. Verify that the temperature door goes to full cold. 3. Check the temperature door for full hot. Is the temperature door travel correct?	-	System OK	-
15	1. Set the fresh air/recirculating air control to fresh air. 2. Set the temperature control to full cold. 3. Start the vehicle and allow the engine to warm up. 4. Measure the air temperature at the blower inlet, or cowl, and at the vent air outlet inside the vehicle. Is the outlet air more than 5°C (41°F) warmer than the inlet air?	-	Go to Step 16	System OK
16	1. Check for hot air leaks from the engine compartment to the blower inlet. 2. Repair as needed. Is the repair complete?	-	System OK	-

CONTROLS

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Is excessive effort required to move a control?	-	Go to Step 5	Go to Step 3
3	Does a door move too easily on a high-blower setting?	-	Go to Step 4	System OK
4	1. Replace the Bowden cable with a longer cable. 2. Add a loop to the cable routing to increase the effort required to move a control. 3. Check for instrument panel interference with the new cable routing. Does the control operate properly?	-	System OK	Go to Step 5
5	Check the cables for improper routing, kinks, wiring interference, or other instrument panel interference. Is any cable problem found?	-	Go to Step 6	Go to Step 7
6	Repair as needed. Is the repair complete?	-	System OK	-
7	1. Remove the cable from any door that binds on the cable. 2. Cycle the door manually. 3. Check for door binding. Is there any door binding?	-	Go to Step 8	Go to Step 11
8	Check the door seal for proper installation. Is the door seal OK?	-	Go to Step 9	Go to Step 10
9	1. Check a binding door for shaft alignment, a bent shaft or a bent door, or a warped case. 2. Repair, as needed. Is the repair complete?	-	System OK	-
10	Repair the door seal, as needed. Is the repair complete?	-	System OK	-
11	Check for control binding. Does the control bind?	-	Go to Step 13	Go to Step 12
12	1. Reinstall the cable to the door. 2. Check the cable-to-dash components clearances. 3. Repair any interference. Is the repair complete?	-	System OK	-
13	1. Remove the cable from the control. 2. Check the control for binding. Does the control bind?	-	Go to Step 14	Go to Step 15
14	Replace the control. Is the repair complete?	-	System OK	-
15	Replace the cable. Is the repair complete?	-	System OK	-

BLOWER NOISE

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	1. Sit inside the vehicle. 2. Close the doors and the windows. 3. Turn the ignition ON. 4. Set the blower speed to 4. 5. Set the temperature to full cold. 6. Cycle through the blower speeds, the modes, and the temperature settings in order to find the noise. Is the blower noise constant at high blower speeds or certain modes, but absent at lower speeds or in other modes?	-	Go to Step 11	Go to Step 3
3	Check for vibrations from the blower motor and fan assembly at each blower speed by feeling the blower motor housing. Do you find excessive vibration?	-	Go to Step 6	Go to Step 4
4	1. Remove the blower motor and fan assembly. Refer to "Blower Motor" in this section. 2. Check for foreign material at the opening of the blower inlet. Do you find any foreign material at the blower inlet?	-	Go to Step 5	Go to Step 6
5	Remove all foreign material. Is the repair complete?	-	System OK	Go to Step 6
6	1. Examine the blower fan for wear spots, cracked blades, a cracked hub, a loose fan retaining nut, or bad alignment. 2. Examine the blower case for wear spots. Do you find any problem?	-	Go to Step 7	Go to Step 9
7	Lubricate the motor. Is the repair complete?	-	System OK	Go to Step 8
8	Replace the motor and fan assembly. Is the repair complete?	-	System OK	Go to Step 9
9	If the noise is a click/tick or whine, replace the motor. Is the repair complete?	-	System OK	Go to Step 10
10	Reinstall the original motor. Is the problem still present?	-	Go to Step 11	System OK
11	1. Set the blower speed on 4. 2. Check full-hot to full-cold temperature positions in the defrost, floor, and vent modes. Is the noise present in the defrost mode only?	-	Go to Step 12	Go to Step 13
12	1. Check the ducts for obstructions or foreign materials. 2. Remove any obstructions or foreign materials. 3. Check the floor/defroster door seals. 4. Repair or replace the ducts and door seals, as needed. Is the repair complete?	-	System OK	-
13	Is the noise present in the floor mode only?	-	Go to Step 12	Go to Step 14

Blower Noise (Cont'd)

Step	Action	Value(s)	Yes	No
14	Is the noise present in the vent mode only?	-	Go to Step 15	Go to Step 16
15	1. Check the ducts for obstructions or foreign materials. 2. Remove any obstructions or foreign materials. 3. Check the vent door seals. 4. Repair or replace the vent door seals, as needed. Is the repair complete?	-	System OK	-
16	Is the noise present in all modes, but not all temperature positions?	-	Go to Step 17	Go to Step 18
17	1. Check the temperature door seals. 2. Repair or replace the temperature door seals, as needed. Is the repair complete?	-	System OK	-
18	1. Check the system for obstructions or foreign materials between the fan and the temperature door. 2. Repair or replace any parts, as needed. Is the repair complete?	-	System OK	Go to Step 2

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

TEMPERATURE CABLE ADJUSTMENT

Because the cable and the cable housings have fixed lengths, it is impossible to make a temperature cable adjustment.

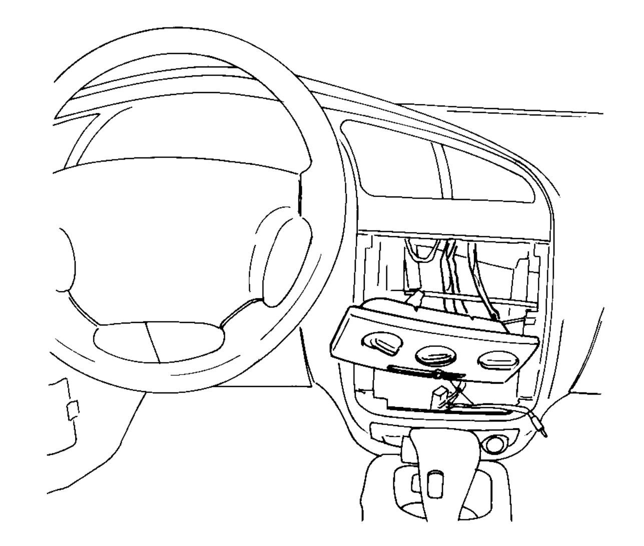
The heater/air distribution case linkage also cannot be adjusted.

If a malfunction is suspected, verify the proper operation of the controller and the mechanical doors for the heater/air distributor case assembly.

CONTROL ASSEMBLY

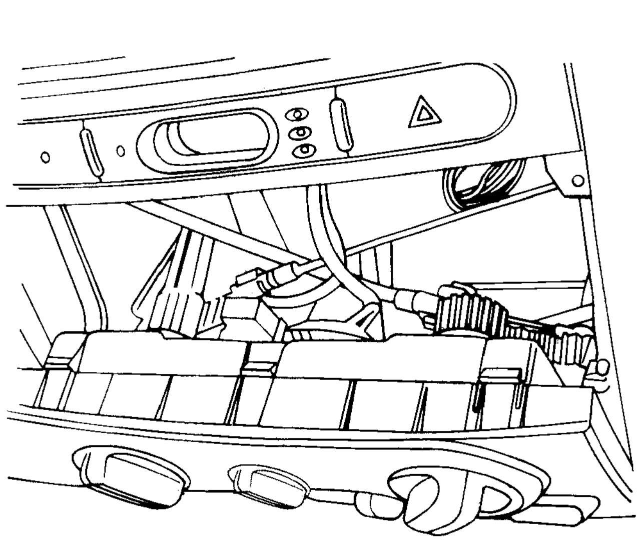
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure



A108B044

1. Disconnect the negative battery cable.
2. Remove the audio system. Refer to Section 9F, Audio Systems.
3. Remove the lower left and the lower right heating, ventilation, and air conditioning (HVAC) controller retaining screws.
4. Remove the controller by pulling it out to provide clearance for the removal of the cable.

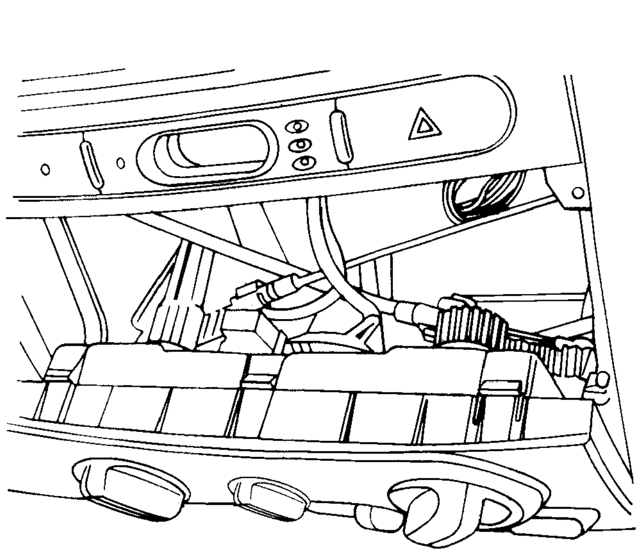


A28B022A

5. Disconnect the mechanical control cables by gently prying off the cable eyelet and unsnapping the cable housing from the mechanical slide.

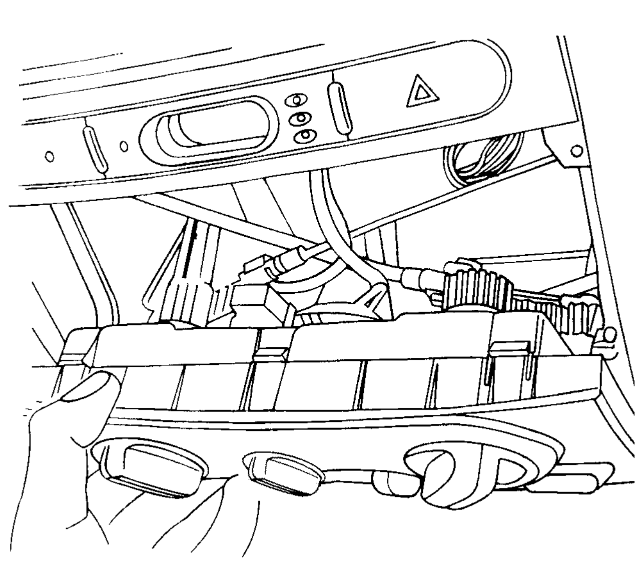
Important: Note the location of the cables and the housings to facilitate their reinstallation.

6. Disconnect the electrical connectors.


A28B022A

Installation Procedure

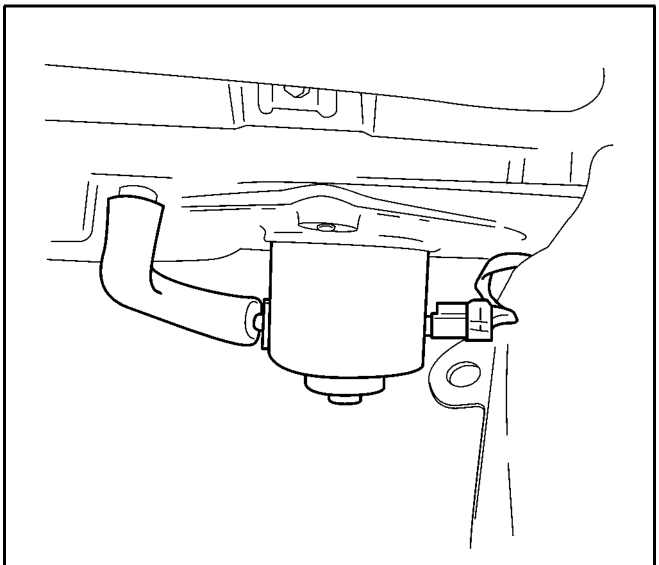
1. Connect the electrical connectors to the proper sockets on the back of the controller.
2. Install the mechanical cable housings to the proper control positions.
3. Install the eyelets on the end of each cable, pressing each onto the proper post.
4. Install the controller by gently inserting the controller into the proper position on the center console.


A28B023A

5. Install the lower left and the lower right controller retaining screws.

   Tighten

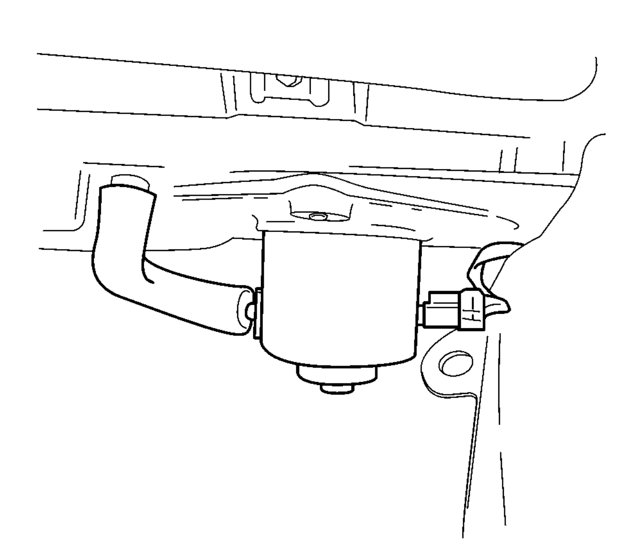
   Tighten the HVAC controller retaining screws to 2 N•m (18 lb-in).
6. Install the audio system. Refer to Section 9F, Audio Systems.
7. Connect the negative battery cable.
8. Confirm the proper operation of the controller by moving it through all of the controller's possible functioning positions.


A108B041

BLOWER MOTOR

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the blower motor electrical connector.
3. Remove the blower cooling hose.
4. Remove the screws that secure the motor to the heater/ air distribution case.
5. Remove the motor and the seal from the heater/air distribution case by gently pulling the motor straight down and out.


A108B041

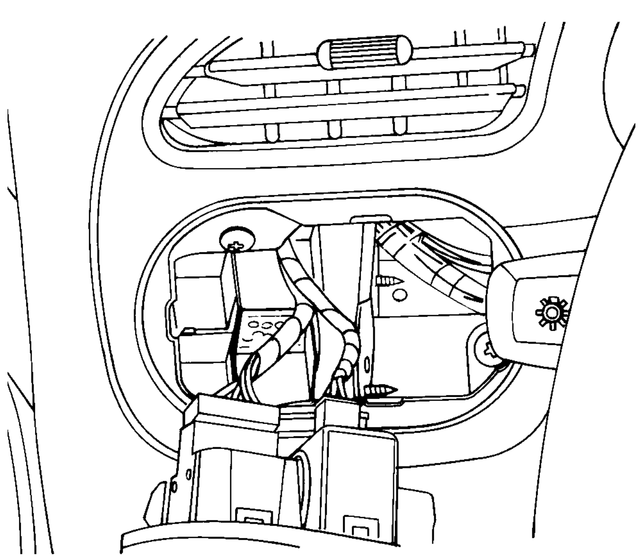
Installation Procedure

1. Install the blower motor and seal, with the shock mount pads, in the heater/air distribution case. Hold the blower motor in position.
2. Install the screws to secure the blower motor to the heater/air distributor case.

Tighten

Tighten the blower motor retaining screws to 6 N•m (53 lb-in).

3. Install the blower motor cooling hose.
4. Connect the electrical connector.
5. Connect the negative battery cable.
6. Confirm that the blower motor operates properly.

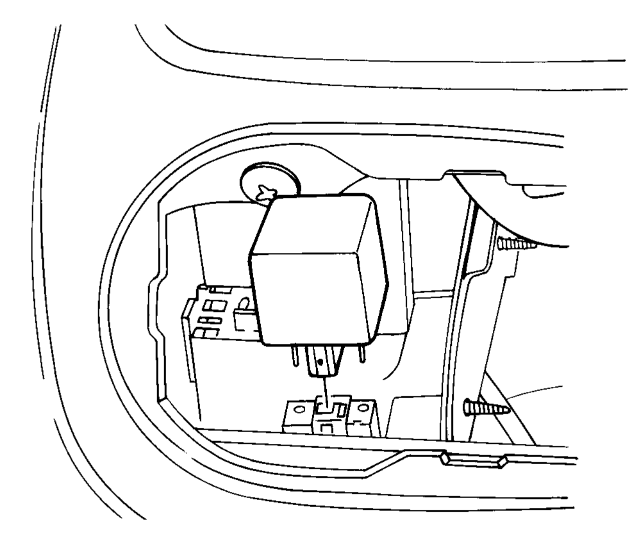

A208A002

HIGH-BLOWER RELAY

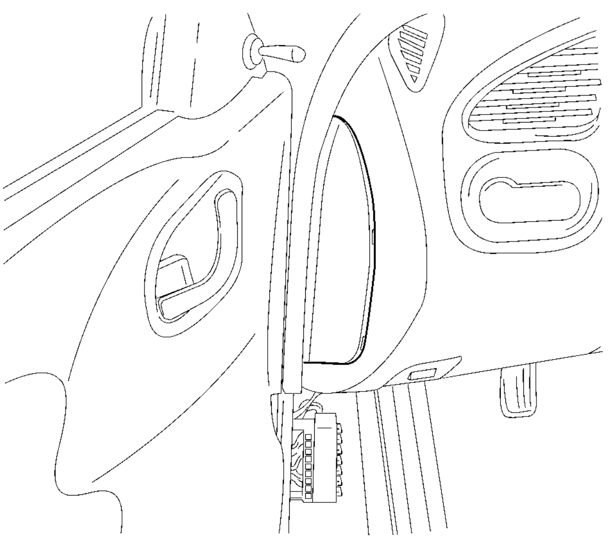
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the access panel at the instrument cluster end of the instrument panel.


A208A009

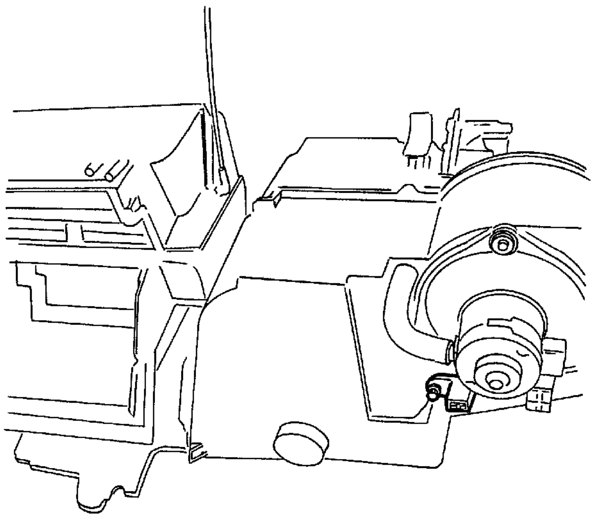
3. Reach through this opening and push back a latch that holds the control panel that contains the remote mirror control and the headlamp leveling control.
4. Remove the panel from the dashboard.
5. Pull out the relay at the front of the relay box.



A108A003

Installation Procedure

1. Align the relay contacts with the relay terminal slots.
2. Push the relay firmly into the base. The relay must be seated and flush with the base edge.
3. Replace the instrument panel access panel.
4. Replace the remote mirror/lighting control panel.
5. Connect the negative battery cable.



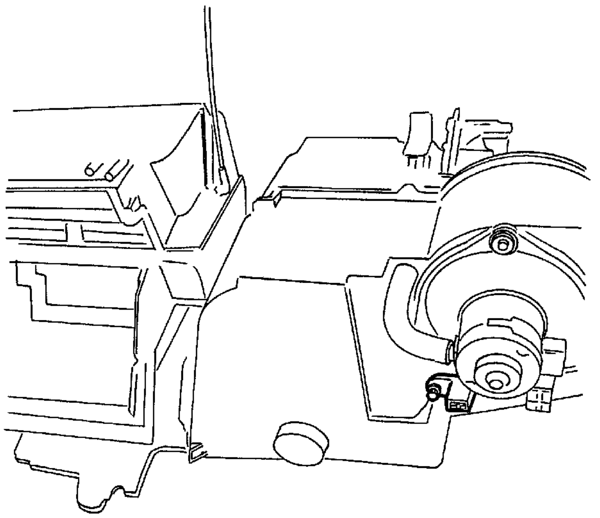
A108B053

BLOWER RESISTOR

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the resistor.
3. Remove the retaining screws from the resistor.
4. Remove the resistor by gently pulling downward.



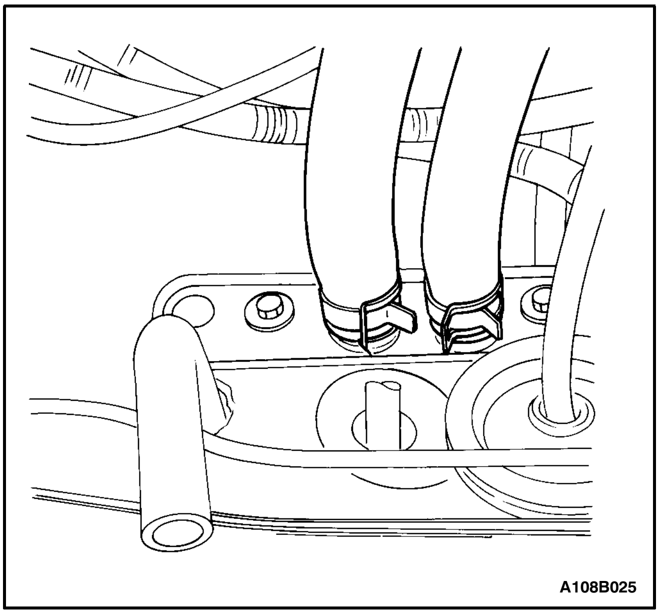
A108B053

Installation Procedure

1. Install the new resistor into the heater/air distribution case with the screws.

   Tighten

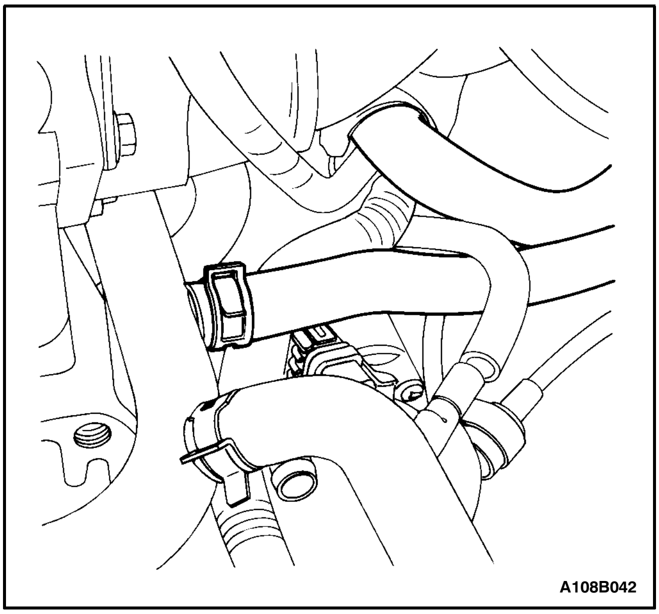
   Tighten the blower resistor retaining screws to 6 N•m (53 lb-ft).
2. Connect the electrical connector at the resistor.
3. Connect the negative battery cable.
4. Confirm the proper performance of the blower.



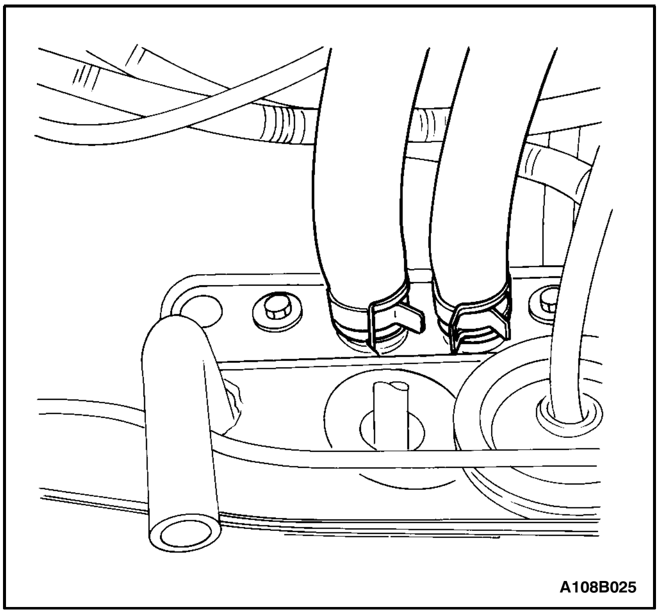
HEATER HOSES

Removal Procedure

1. Partially drain the cooling system.
2. Compress and slide rearward the two heater hose spring clamps at the fire wall.

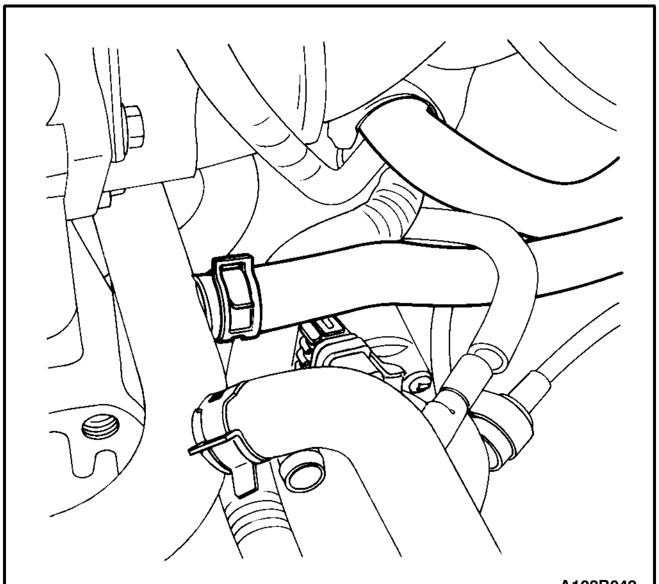


3. Gently twist the hose from the left to the right and back again to loosen the bond between the hose and the tube.
4. Remove the end of the hose from the tube.
5. Repeat steps 3 and 4 with the other hose.
6. Compress the heater hose spring clamp on the inlet coolant line and slide the clamp rearward.
7. Remove the hose from the vehicle.
8. Compress the heater hose spring clamp at the connection below the intake manifold and slide the clamp rearward.
9. Remove hose from the vehicle.



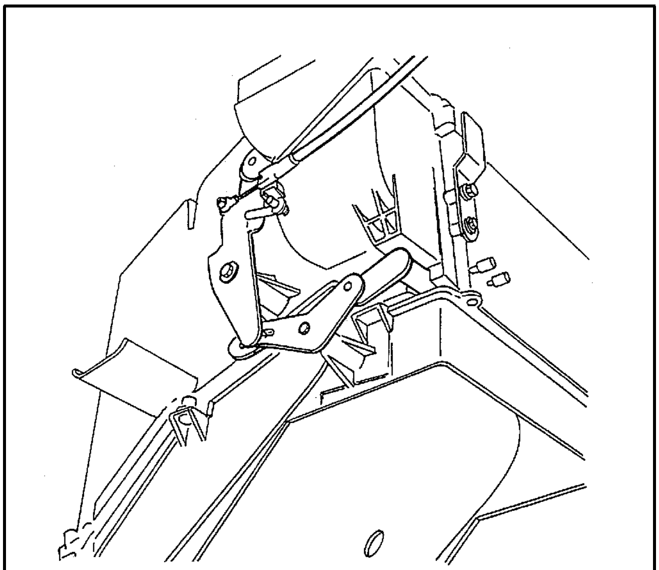
Installation Procedure

1. Install the left heater hose to the coolant inlet line fitting. Slide the end of the heater hose over the coolant fitting until the hose is seated.
2. Install the right heater hose to the fitting below the intake manifold. Slide the end of the heater hose over the fitting until it is seated.
3. Install and seat the other end of each heater hose.
4. Compress and slide the spring clamps into position on the heater hoses and release the tension on the spring clamps.



A108B042

5. Fill the cooling system.
6. Check the hoses for leaks.



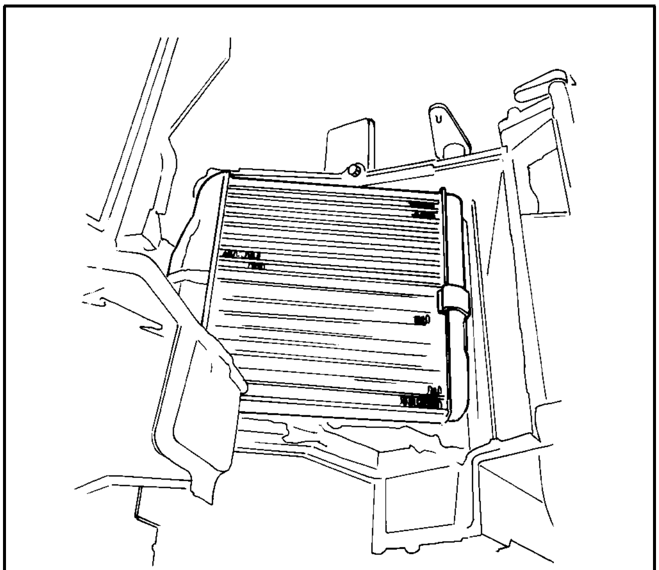
A108B031

HEATER CORE

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

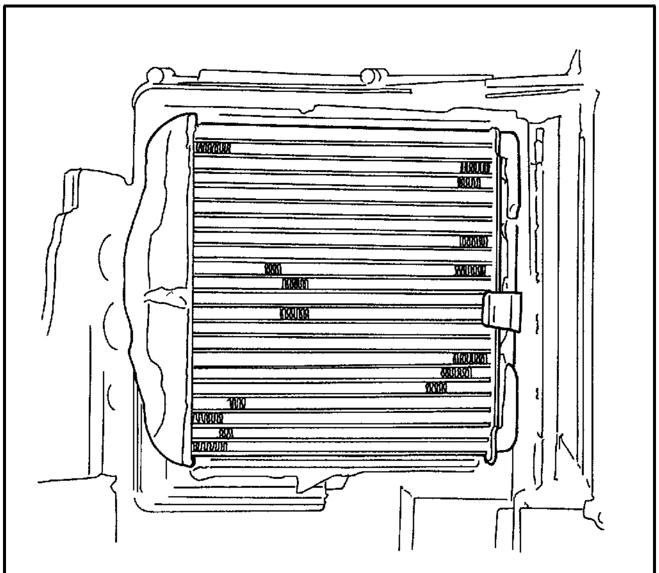
1. Raise the hood.
2. Disconnect the negative battery cable.
3. Remove the instrument panel carrier assembly from the vehicle. Refer to Section 9E, Instrumentation/ Driver Information.
4. Remove the heater/air distribution case from the vehicle. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
5. Remove the linkage screw from the lower heater core cover post.
6. Remove the linkage lever. Note the position of all the levers to facilitate reassembly.



A108B032

Notice: Handle the case carefully to avoid damaging the linkage levers.

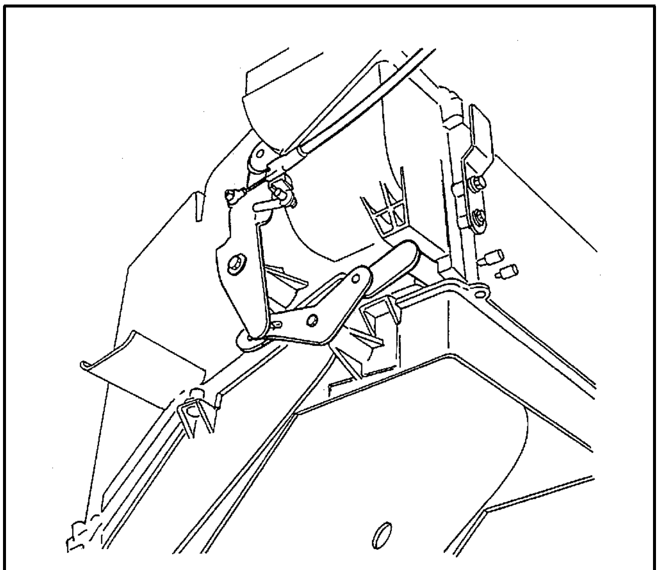
7. Remove the screws that secure the heater core cover.
8. Slowly separate the lower heater core cover from the rest of the assembly. Retain the sealant.
9. Remove the screw and the bracket clamp that secure the heater core lines to the case.
10. Remove the spring clamp that secures the heater core body to the case.
11. Remove the heater core from the case.



A108B033

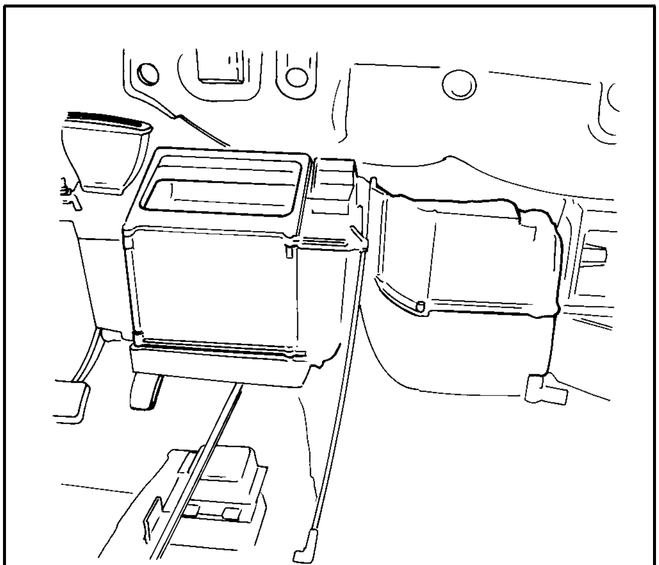
Installation Procedure

1. Install the heater core into the case.
2. Secure the heater core lines to the case with the retaining bracket clamp and the screw.
3. Install the heater core body with the retaining spring clamp.
4. Reapply the sealant to the heater core cover mounting channel flange as removed.
5. Install the heater core cover.



A108B031

6. Install the retaining screws.
7. Install the linkage lever onto the cover post with the screw.
8. Confirm proper operation of the actuating levers for the heater/air distribution case doors.



A108B034

9. Install the heater/air distribution case. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
10. Install the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
11. Fill the cooling system.
12. Connect the negative battery cable.

REAR HEATER

Some vehicles are equipped with rear seat heater ducts. Should there be no airflow to the rear, look for any obstructions, such as items on the floor under the front seats. Also check for air leaks between the heater/air distributor assembly and the rear ducts.

GENERAL DESCRIPTION AND SYSTEM OPERATION

HEATING AND VENTILATION SYSTEMS

The base heater system is designed to provide heating, ventilation, windshield defrosting, side window defogging, and in some vehicles, deliver heat to the rear seat area.

The heater and fan assembly blower regulates the airflow from the air inlet for further processing and distribution.

The heater core transfers the heat from the engine coolant to the inlet air.

The temperature door regulates the amount of the air that passes through the heater core. The temperature door also controls the temperature of the air by controlling the mix of the heated air and the ambient air.

The mode door regulates the flow and the distribution of the processed air to the heater ducts and to the defroster ducts.

This console-mounted heating and ventilation panel contains the following:

Three Rotary Control Knobs

1. The Rotary Temperature Control Knob
   - Actuates by cable.
   - Raises the temperature of the air entering the vehicle by rotation toward the right, or the red portion of the knob.
2. The Rotary Blower Control Knob
   - Turns on to operate the blower motor at four speeds.
   - Turns OFF to stop the blower.
   - Operates completely independently both from the mode control that regulates the defroster door and from the temperature control knob.
   - Changes the fan speed in any mode and at any temperature setting.
3. The Rotary Mode Control Knob
   - Actuates by cable.
   - Regulates the air distribution between the windshield, the instrument panel, and the floor vents.

Push Knobs

1. The Rear Window Defogger Push Knob
   - Controls the rear window defogger.
   - Turns ON the rear window defogger when the push knob is pressed and the indicator lamp is illuminated.
2. The A/C Push Knob (if the vehicle is equipped with air conditioning)
   - Controls the A/C.
   - Turns the A/C ON when the push knob is down. However, if the blower control knob is OFF, the A/C system is OFF, regardless of the position of the A/C knob.

One Lever

1. The Fresh Air Control Lever
   - Operates by cable.
   - Switches between recirculating passenger compartment air and bringing outside air into the passenger compartment.
   - Draws in outside air when the lever is moved to the left.
   - Recirculates inside air when the lever is moved to the right.

SECTION 7B

MANUAL CONTROL HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

A/C SYSTEM CHARGING CAPACITY

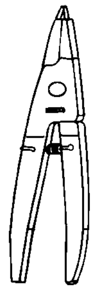
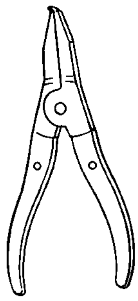
Application	Description
R-134a System	720 " 20 g
Refrigerant Oil in A/C System	Synthetic PAG 265 ml

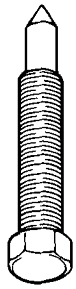
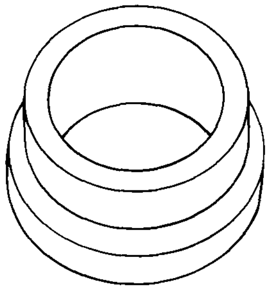
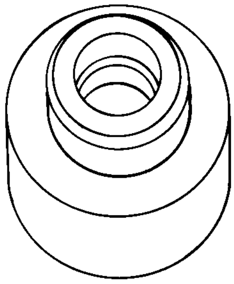
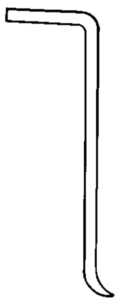
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
A/C System Hose Connector Retaining Nut	33	24	-
Air Cleaner Housing Assembly Bolts	12	-	106
Clutch Plate and Hub Assembly Nut	17	13	-
Compressor Bracket Bolt	27	19	-
Compressor Front Head-to-Rear Head Through-Bolts	10	-	89
Condenser Upper Mount Nuts	3	-	27
Control Assembly Retaining Screws	2	-	18
Discharge Hose-to-Condenser Pipe Connector Block Retaining Nut	16	12	-
Expansion Valve Retaining Bolts	12	-	106
Heater/Air Distribution Case Assembly Screws (Fire Wall Side)	8	-	71
Idler Pulley Lock Nut	50	36	-
Liquid Condenser Pipe Connector Block-to-Receiver-Dryer Bolt	12	-	106
Liquid Evaporator Pipe Connector Block Nuts	12	-	106
Liquid Evaporator Pipe Connector Block-to-Liquid Condenser Pipe Connector Block Retaining Bolt	12	-	106
Pressure Relief Valve	17	12	
Pressure Transducer	8	-	71
Suction Hose Connector Block Retaining Nuts	12	-	106
Suction Hose Support Clamp Bolt	4	-	35

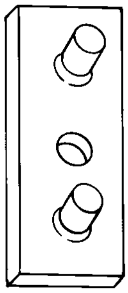
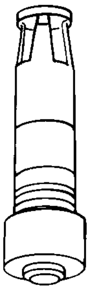
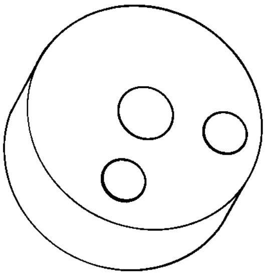
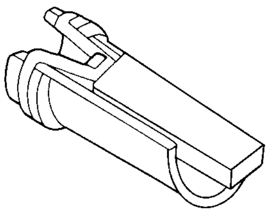
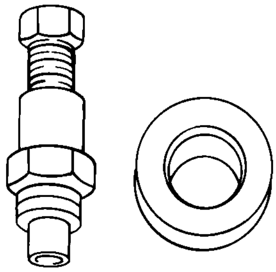
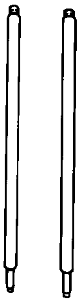
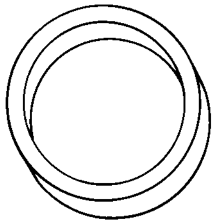
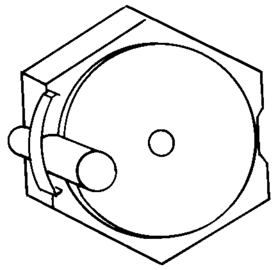
SPECIAL TOOLS

SPECIAL TOOLS TABLE

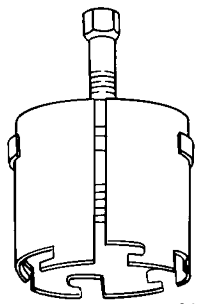
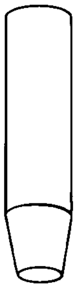
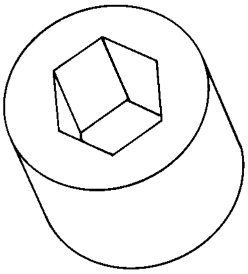
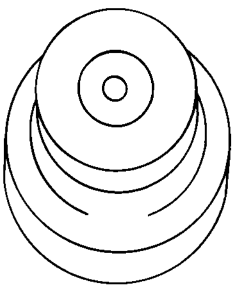
 A108B078	**J-5403** **Snap Ring Pliers**
 A108B079	**J-6083** **Snap Ring Pliers**
 A108B080	**J-8092** **Driver Handle**
 A108B081	**J-8433-1** **Puller Crossbar**

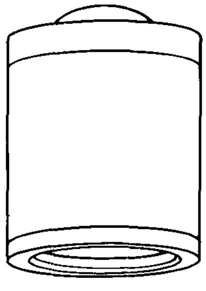
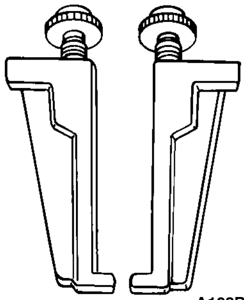
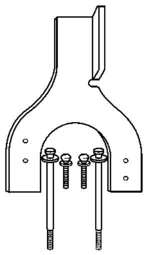
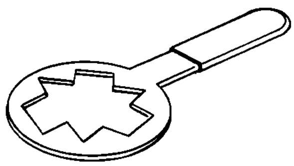
 A108B082	**J-8433-3** **Forcing Screw**
 A108B084	**J-9398-A** **Bearing Remover**
 A108B085	**J-9481** **Bearing Installer**
 A108B086	**J-9553-1** **O-Ring Remover**

SPECIAL TOOLS TABLE (Cont'd)

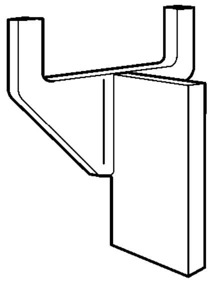
 A108B087	**J-9625-A** **Pressure Test Set Connectors**
 A108B088	**J-23128-A** **Seal Seat Remover and Installer**
 A108B089	**J-35372** **Support Block**
 A108B090	**J-33011** **O-Ring Installer**
 A108B091	**J-33013-B** **Hub and Drive Plate Remover and Installer**
 A108B092	**J-34993** **Cylinder Alignment Rods**
 A108B093	**J-33017** **Pulley Rotor and Bearing Assembly Installer**
 A108B094	**J-33019** **Bearing Staking Tool Set** **Includes:** **J-33019-1** **Bearing Staking Guide** **J-33019-2** **Bearing Staking Pin**

SPECIAL TOOLS TABLE (Cont'd)

 A108B095	**J-33020** **Pulley Puller**
 A108B096	**J-34614** **Shaft Seal Protector**
 A108B097	**J-33022** **Shaft Nut Socket**
 A108B098	**J-33023-A** **Puller Pilot**

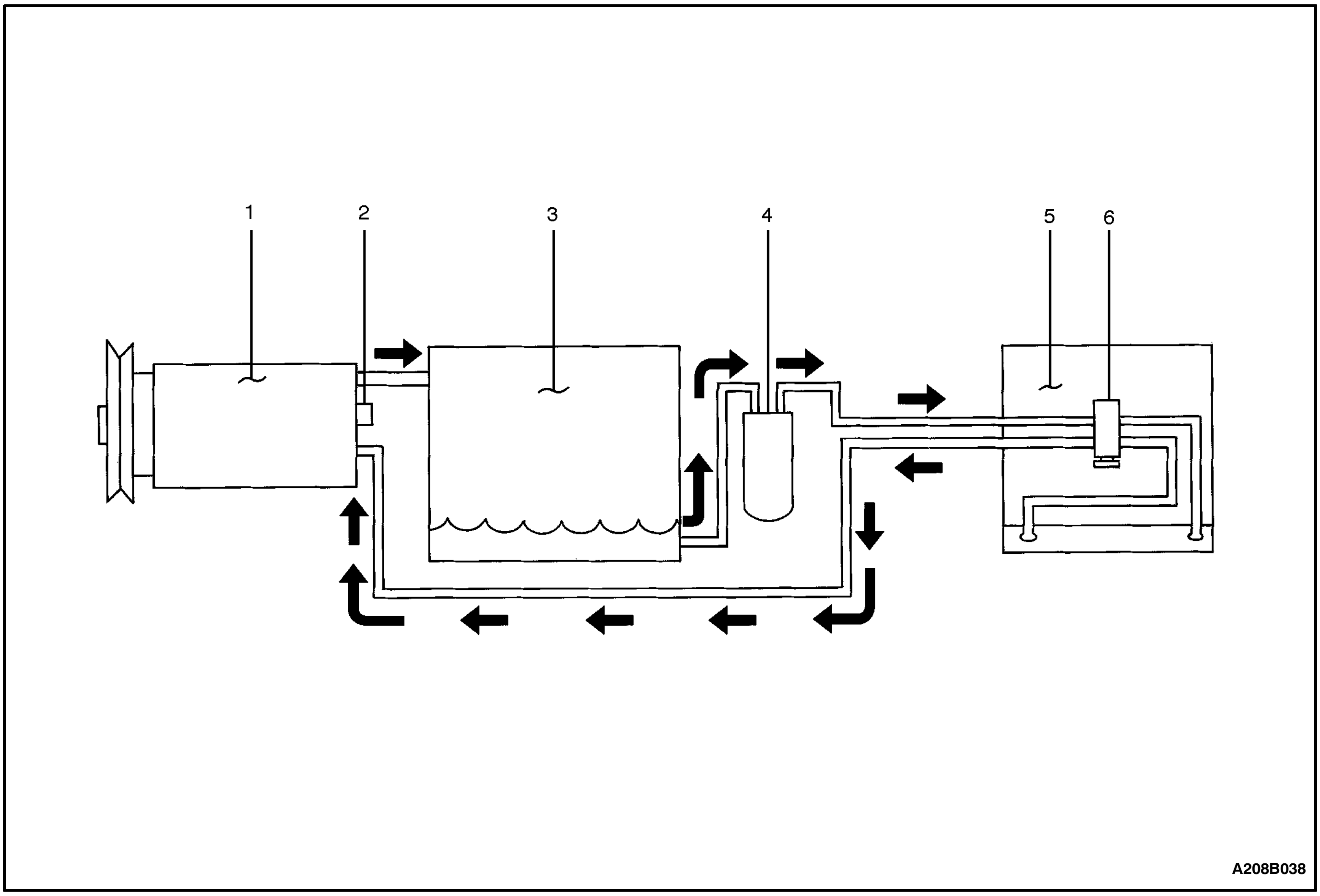
 A108B099	**J-33024** **Clutch Coil** **Installer Adapter**
 A108B100	**J-33025** **Clutch Coil Puller Legs**
 A108B101	**J-34992** **Compressor** **Holding Fixture**
 A108B102	**J-33027** **Clutch Hub** **Holding Tool**

SPECIAL TOOLS TABLE (Cont'd)

 A108B111	J-42428 Compressor Holding Fixture

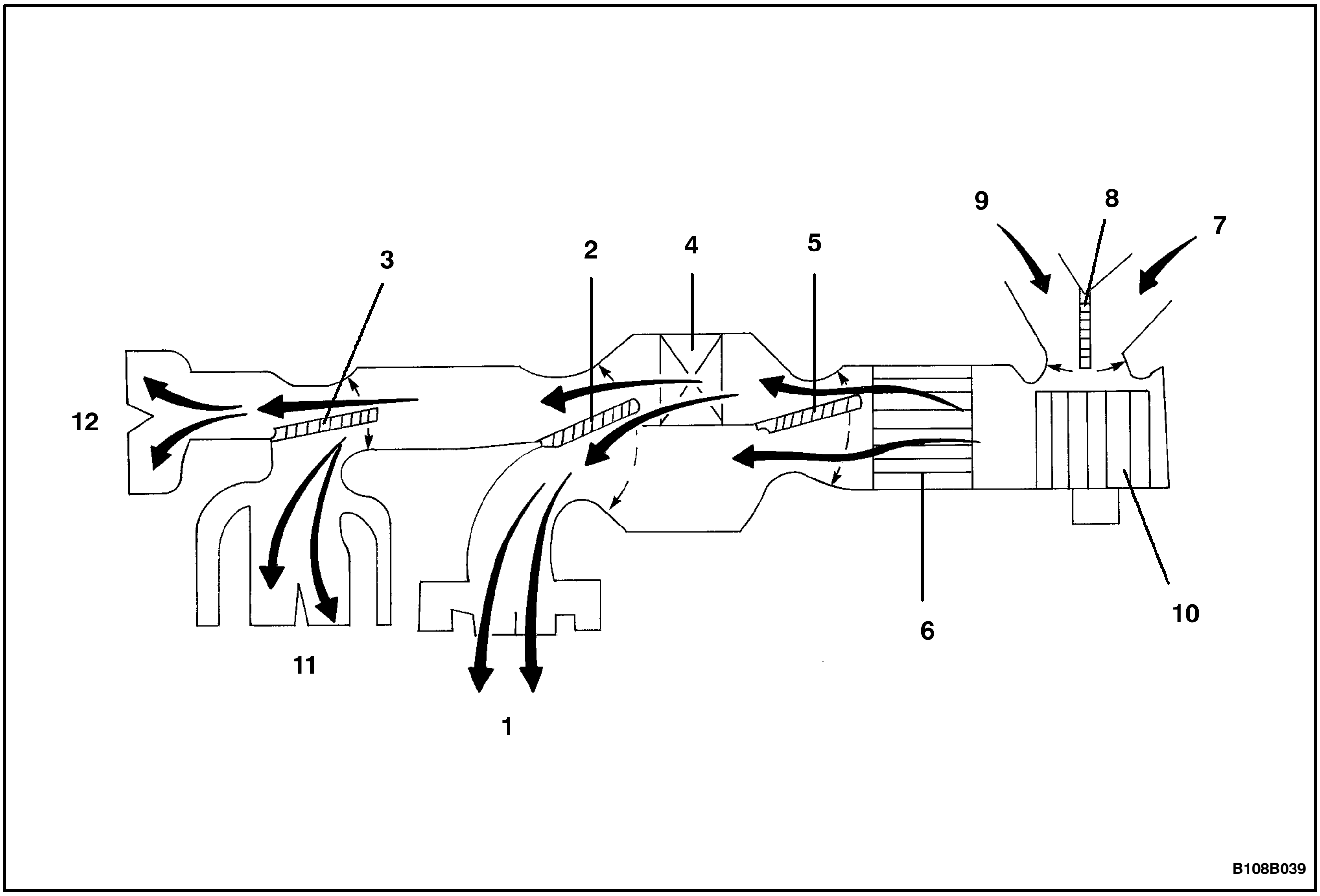
SCHEMATIC AND ROUTING DIAGRAMS

A/C SYSTEM (TYPICAL)



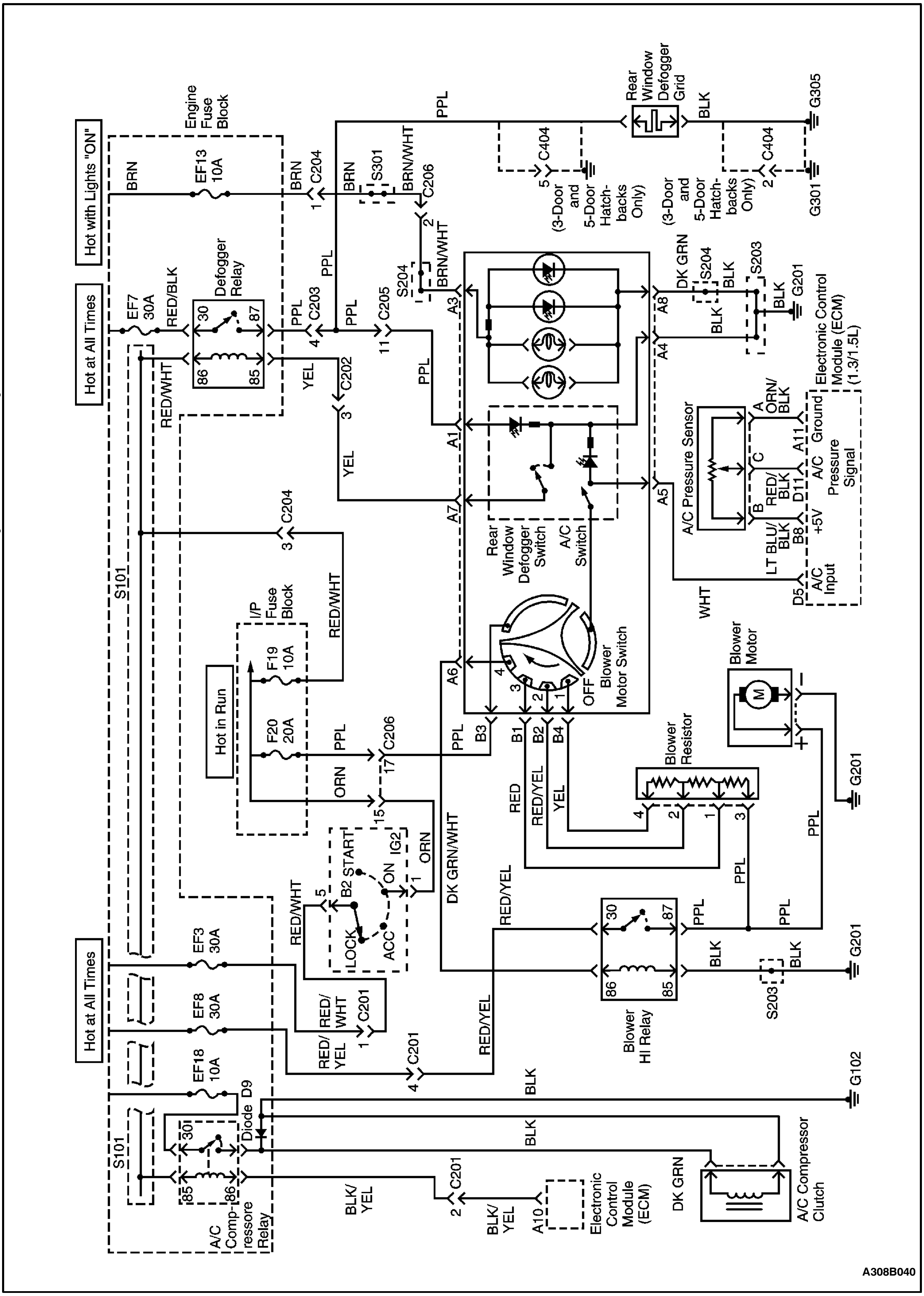
1 **Compressor**
2 **Pressure Relief Valve**
3 **Condenser**
4 **Receiver/Dryer**
5 **Evaporator**
6 **Expansion Valve**

AIRFLOW (TYPICAL)

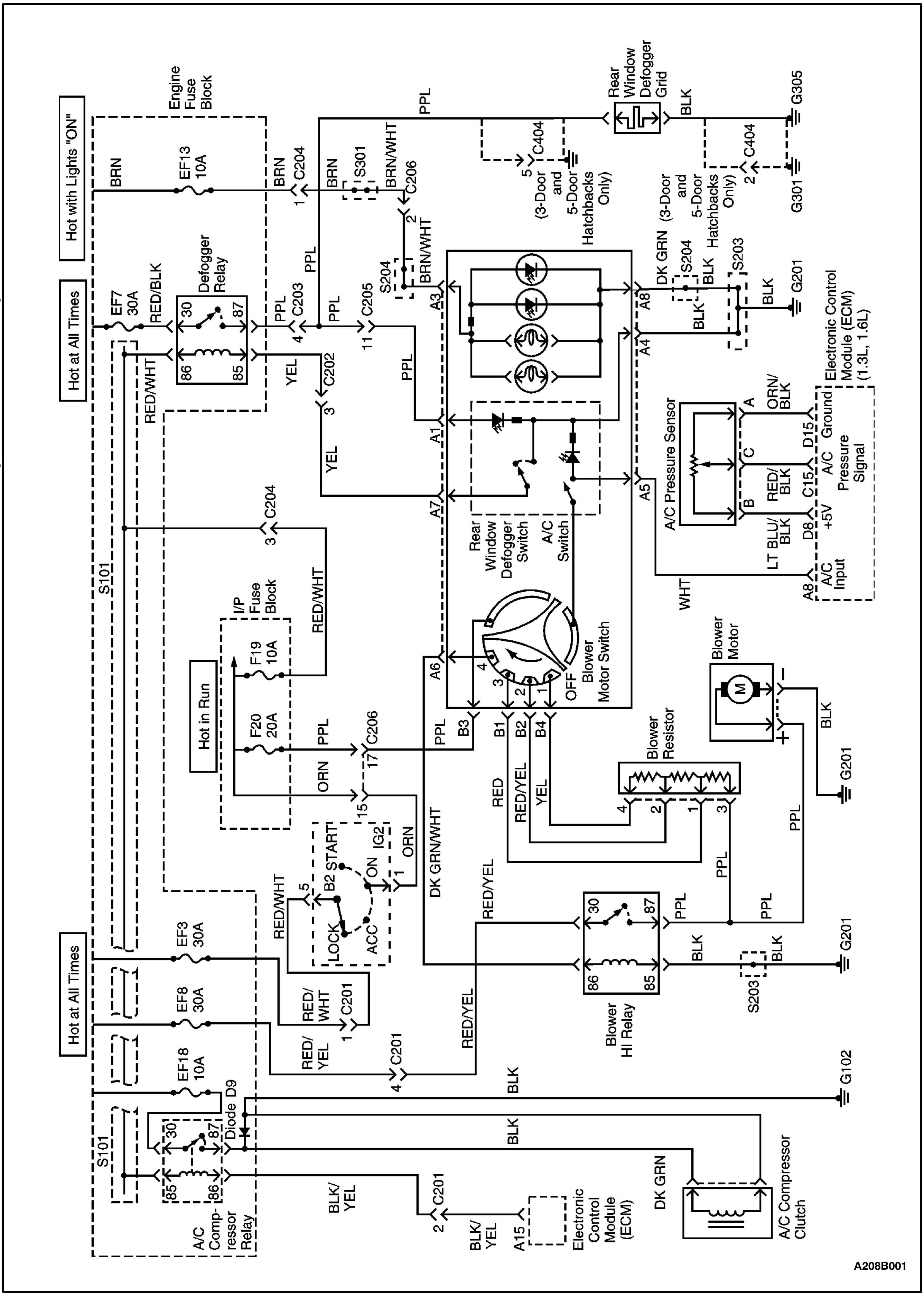


1	Heater Outlets	7	Outside Air Inlet
2	Heater/Defroster Door	8	Fresh Air/Recirculating Air Door
3	Mode Door	9	Inside Air Inlet
4	Heater Core	10	Blower
5	Heater (Air Mix) Door	11	Vent Outlets
6	Evaporator (A/C Only)	12	Defroster Outlets

A/C DIAGRAM, 1.3/1.5L SOHC (IEFI-6 ECM)



A/C DIAGRAM, 1.3L SOHC AND 1.6L DOHC (ITMS-6F ECM)



DIAGNOSIS

GENERAL DIAGNOSIS

TESTING THE REFRIGERANT SYSTEM

If you suspect a problem in the refrigerant system, check for the following conditions:

1. Check the outer surfaces of the radiator and the condenser cores to be sure that the airflow is not blocked by dirt, leaves, or other foreign material. Check between the condenser and the radiator, as well as all outer surfaces.
2. Check for restrictions or kinks in the condenser core, the hoses, and the tubes.
3. Check the operation of the blower fan.
4. Check all the air ducts for leaks or restrictions. A low airflow rate may indicate a restricted evaporator core.
5. Check for slippage of the compressor clutch.
6. Check the serpentine accessory drive belt tension.

INSUFFICIENT COOLING "QUICK CHECK" PROCEDURE

Perform the following "hand-feel" procedure to get a quick idea of whether the air conditioning (A/C) system has the proper charge of Refrigerant-134a. The air temperature must be above 21°C (70°F) for most models.

1. Warm up the engine. Run the engine at idle.
2. Open the hood and all the doors.
3. Turn the A/C switch ON.
4. Set the temperature control to the full cold position.
5. Set the blower speed switch on 4.
6. "Hand-feel" the temperature of the evaporator outlet pipe. The pipe should be cold.
7. Check for other problems. Refer to "Testing the Refrigerant System" in this section.
8. Leak check the system. Refer to "Leak Testing the Refrigerant System" in this section. If you find a leak, discharge the system and repair the leak as required. After completing the repair, evacuate and charge the system.
9. If there is no leak, refer to "Insufficient Cooling Diagnosis" in this section.

A/C PERFORMANCE TEST

RELATIVE HUMIDITY (%)	AMBIENT AIR TEMPERATURE		LOW SIDE PRESSURE		ENGINE SPEED (RPM)	CENTER DUCT AIR TEMPERATURE		HIGH SIDE PRESSURE	
	°C	°F	kPa	psig		°C	°F	kPa	psig
20	21	70	200	29	2000	4	39	1034	150
	27	81	200	29		7	45	1310	190
	32	90	207	30		9	48	1689	245
	38	100	214	31		14	57	2103	305
30	21	70	200	29	2000	6	43	1034	150
	27	81	207	30		8	46	1413	205
	32	90	214	31		11	52	1827	265
	38	100	221	32		16	61	2241	325
40	21	70	200	29	2000	7	45	1138	165
	27	81	207	30		9	48	1482	215
	32	90	221	32		13	55	1931	280
	38	100	269	39		18	64	2379	345
50	21	70	207	30	2000	8	46	1241	180
	27	81	221	32		12	54	1620	235
	32	90	234	34		15	59	2034	295
	38	100	276	40		21	70	2413	350
60	21	70	207	30	2000	9	48	1241	180
	27	81	228	33		13	55	1655	240
	32	90	248	36		17	63	2068	300
	38	100	296	43		23	73	2482	360
70	21	70	207	30	2000	10	50	1276	185
	27	81	234	34		14	57	1689	245
	32	90	262	38		18	64	2103	305
	38	100	303	44		24	75	2517	365
80	21	70	207	30	2000	10	50	1310	190
	27	81	234	34		15	59	1724	250
	32	90	269	39		19	66	2137	310
90	21	70	207	30	2000	10	50	1379	200
	27	81	248	36		17	63	1827	265
	32	90	290	42		22	72	2275	330

PRESSURE-TEMPERATURE RELATIONSHIP OF R-134A

TEMPERATURE °C (°F)*	PRESSURE kPa (psig)*	TEMPERATURE °C (°F)*	PRESSURE kPa (psig)*
-8.89 (16)	105.70 (15.33)	37.78 (100)	856.84 (124.27)
-7.78 (18)	114.87 (16.66)	38.89 (102)	886.56 (128.58)
-6.67 (20)	124.32 (18.03)	40.00 (104)	916.35 (132.98)
-5.56 (22)	134.11 (19.45)	41.11 (106)	947.92 (137.48)
-4.44 (24)	144.24 (20.92)	42.22 (108)	979.64 (142.08)
-3.33 (26)	154.65 (22.43)	43.33 (110)	1012.11 (146.79)
-2.22 (28)	165.48 (24.00)	44.44 (112)	1045.21 (151.59)
-1.11 (30)	176.65 (25.62)	45.56 (114)	1079.14 (156.51)
0.00 (32)	188.16 (27.29)	46.67 (116)	1113.75 (161.53)
1.11 (34)	200.02 (29.01)	47.78 (118)	1149.12 (166.66)
2.22 (36)	212.30 (30.79)	48.89 (120)	1185.18 (171.89)
3.33 (38)	224.98 (32.63)	50.00 (122)	1222.07 (177.24)
4.44 (40)	238.08 (34.53)	51.11 (124)	1259.72 (182.70)
7.22 (45)	272.49 (39.52)	52.22 (126)	1298.12 (188.27)
10.00 (50)	309.58 (44.90)	53.33 (128)	1337.35 (193.96)
12.77 (55)	349.51 (50.69)	54.44 (130)	1377.35 (199.76)
15.56 (60)	392.33 (56.90)	57.22 (135)	1480.91 (214.78)
18.33 (65)	438.18 (63.55)	60.00 (140)	1589.57 (230.54)
21.11 (70)	487.27 (70.67)	62.78 (145)	1703.62 (247.08)
23.89 (75)	539.67 (78.27)	65.56 (150)	1823.04 (264.40)
26.67 (80)	609.38 (88.38)	68.33 (155)	1948.04 (282.53)
29.44 (85)	655.09 (95.01)	71.11 (160)	2078.77 (301.49)
32.22 (90)	718.39 (104.19)	73.89 (165)	2215.29 (321.29)
35.00 (95)	785.61 (113.94)	76.67 (170)	2357.81 (341.96)

*** All values rounded to two decimal places.**

EVAPORATOR RANGE: From * 6.67 to 7.22°C (20 to 45°F), the temperatures represent the gas temperatures inside the coil and not on the coil surfaces. Add 1.67 to 5.56°C (3 to 10°F) the temperature for coil and air-off temperatures.

CONDENSER RANGE: From 110 to 160°F, temperatures are not ambient. Add 19.4 to 22.2°C (35 to 40°F) for proper heat transfer, then refer to the pressure chart.

Example: 32°C (90°F) ambient temperature
+ 22°C (40°F)
54°C (130°F)

Condenser temperature = 1379 kPa (200 psig)
Based on 48.3 km/h (30 mph) air flow.

LEAK TESTING THE REFRIGERANT SYSTEM

Test for leaks whenever you suspect a refrigerant leak in the system. You should also test for leaks whenever you perform a service operation which results in disturbing the lines or the connections. Leaks are commonly found at the refrigerant fittings or at the connections. Leaks are commonly caused by the following problems:

- Improper torque.
- Damaged O-ring seals.
- Dirt or lint on the O-ring seals.

Liquid Leak Detectors

Use a liquid leak detector solution on locations such as fittings. Apply the solution to the area in question with the swab that is supplied with the solution. Look for bubbles to appear. This will indicate the existence and location of any leak.

For areas where this is not practical, such as sections of the evaporator and the condenser, an electronic leak detector is more useful.

Electronic Leak Detectors

Follow the manufacturer's instructions for calibration, operation, and maintenance of an electronic leak detector. Battery condition is especially important to the accuracy of a portable model. Set the detector to R-134a before beginning the test.

Important: Electronic leak detectors are sensitive to windshield washing solutions, solvents and cleaners, and certain vehicle adhesives.

Surfaces must be clean to prevent false readings. Make sure that all surfaces are dry to prevent damage to the detector.

General Testing Instructions

- Follow the entire path of the refrigerant system.
- Completely circle each joint at 25 to 50 mm (1 to 2 inches) per second.
- Hold the probe tip within 6 mm (1/4 inch) of the surface.
- Do not block the air intake.

The audible tone changes from one to two clicks per second into a solid alarm if there is a leak. Adjust the balance control to maintain one to two clicks per second.

Test all of the following areas, even after one leak has been confirmed:

- Evaporator inlet and outlet.
- Receiver-drier inlet and outlet.
- Condenser inlet and outlet.
- Brazed and welded areas.
- Damaged areas.
- Hose couplings.
- Compressor rear head.
- All fittings and joints.

Testing Service Ports/Access Valves

The sealing cap is the primary seal for the service ports. This cap contains a special leak-free O-ring. Make sure that this cap is not missing or loose. Always use the correct cap.

Testing the Evaporator Core

Leaks in the evaporator core are difficult to find. Test the evaporator core using the following procedure:

1. Run the blower fan at speed setting 4 for at least 15 minutes.
2. Turn the blower to the OFF position.
3. Wait for 10 minutes.
4. Remove the blower motor resistor. Refer to "Blower Motor Resistor" in this section.
5. Insert the leak detector probe as close as possible to the evaporator core. The detector will indicate a leak with a solid alarm.
6. Use a flashlight to search for refrigerant oil in the core surface.

Testing the Compressor Shaft Seal

1. Blow shop air behind and in front of the compressor clutch/pulley for at least 15 seconds.
2. Wait 1 to 2 minutes.
3. Probe the area in front of the pulley. If the detector emits a solid alarm, there is a leak.

V5 SYSTEM AIR CONDITIONING DIAGNOSIS

INSUFFICIENT COOLING DIAGNOSIS

Step	Action	Value(s)	Yes	No
1	Can you verify the customer complaint?	-	Go to Step 2	System OK
2	1. Check the A/C fuse. 2. Check the blower fan operation. 3. Check the engine cooling fan operation. 4. Check the A/C compressor belt. 5. Check the A/C condenser for restricted air flow. 6. Check the clutch coil connection. 7. Repair or replace any components as needed. 8. Check the discharge air temperature with the A/C turned on. Is the discharge air temperature normal?	At least 7°C below ambient air temperature	System OK	Go to Step 3
3	1. Turn the ignition switch to LOCK. 2. Connect the high and the low pressure gauges. Are both pressures within the value specified?	69-345 kPa (10-50 psi)	Go to Step 4	Go to Step 5
4	1. Check the A/C system for leaks. 2. Repair any refrigerant leaks as needed. 3. Recover, evacuate, and recharge the A/C system. Are both pressures above the value specified?	345 kPa (50 psi)	Go to Step 7	-
5	Observe the two pressure gauges. Are both pressures below the value specified?	69 kPa (10 psi)	Go to Step 6	Go to Step 7
6	1. Add 0.45 kg (1 pound) of refrigerant R-134a. 2. Check the A/C system for leaks. 3. Repair any refrigerant leaks as needed. 4. Recover, evacuate, and recharge the A/C system. Are both pressures above the value specified?	345 kPa (50 psi)	Go to Step 7	-
7	1. Start the engine and allow it to run at idle. 2. Set the A/C controls to the following positions: • The A/C switch to the ON position. • The fresh air control switch to fresh air (indicator lamp OFF). • The blower motor to 4. • The temperature to full cold. Does the A/C compressor clutch engage?	-	Go to Step 8	Go to Step 10
8	1. Check for a knocking noise from the A/C compressor. 2. Cycle the A/C compressor ON and OFF in order to verify the source of the noise. Do you hear a loud knocking noise?	-	Go to Step 9	Go to Step 13
9	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the compressor running normally?	-	Go to Step 13	-

Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Turn the ignition switch to LOCK. 2. Disconnect the A/C compressor clutch coil connector. 3. Connect a jumper wire from ground to one A/C compressor clutch coil terminal. 4. Connect a fused jumper wire from the positive battery terminal to the other A/C compressor clutch coil terminal. Does the A/C clutch engage?	-	Go to Step 11	Go to Step 12
11	Repair the electrical circuit to the A/C compressor clutch coil. Does the A/C clutch engage?	-	Go to Step 8	-
12	Replace the A/C compressor clutch coil. Does the A/C clutch engage?	-	Go to Step 8	-
13	Important: Perform this test under garage conditions; 21-32°C (70-90°F) and no sun load. Follow this test carefully for accurate results. 1. Close all of the windows and the doors of the vehicle. 2. Set the A/C controls to the following positions: • The A/C switch to the ON position. • The fresh air control switch to fresh air. • The blower motor to 4. • The temperature to full cold. 3. Start the engine and allow it to run at idle for 5 minutes. 4. Feel the evaporator inlet and outlet pipes. Is there a noticeable difference in the temperature of the evaporator inlet and outlet pipes?	-	Go to Step 15	Go to Step 14
14	1. Turn the ignition switch to LOCK. 2. Recover the A/C system refrigerant. 3. Examine the high-pressure pipe for an obstruction. 4. Examine the expansion valve for a malfunction if there is no obstruction. 5. Repair the obstruction or replace the expansion valve as needed. 6. Evacuate and recharge the A/C system. 7. Check the A/C system for leaks. 8. Note the discharge air temperature with the A/C ON. Is the discharge temperature normal?	At least 7°C (12° F) below ambient air temperature	Go to Step 15	Go to Step 13
15	1. Record the low and the high side pressures after the A/C system has been operating for 5 minutes or more and the engine cooling fan is ON. 2. Locate the intersection of the low and the high side pressures. Refer to "Low and High Side Pressure Relationship Chart" in this section. Do the low and the high side pressures intersect in the white area of the chart?	-	System OK	Go to Step 16
16	Check the high-side and low-side pressures. Do the low and the high pressures intersect in the gray area of the chart?	-	Go to Step 17	Go to Step 20

Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
17	Feel the liquid pipe between the condenser and the expansion valve. Is the pipe cold?	-	Go to Step 18	Go to Step 19
18	1. Examine the condenser for any restriction of the air flow. 2. Check the cooling fans for proper operation. 3. Remove the restriction or repair the fan(s) as required. Is the pipe temperature normal now?	-	Go to Step 13	-
19	1. Recover, evacuate, and recharge the A/C system. 2. Check the A/C system for leaks. Is the system leak tight?	-	Go to Step 13	-
20	Observe the readings on the pressure gauges. Are the A/C compressor high and the low side pressures within the specified value of each other?	207 kPa (30 psi)	Go to Step 21	Go to Step 26
21	1. Run the engine at 3,000 rpm. 2. Set the A/C controls to the following positions: • The A/C switch to the ON position. • The fresh air control switch to fresh air. • The blower motor to 4. • The temperature to full cold. 3. Close all of the windows and the doors of the vehicle. 4. Turn the A/C switch ON and OFF every 20 seconds for 3 minutes. Are the A/C compressor high and the low side pressures within the specified value of each other?	207 kPa (30 psi)	Go to Step 22	Go to Step 13
22	Observe the pressure rise on both gauges and the temperatures of both the compressor suction pipe and the discharge pipe. Is the pressure rise on both gauges slow and the suction pipe warm with the discharge pipe very hot?	-	Go to Step 25	Go to Step 23
23	1. Turn the ignition switch to LOCK. 2. Check that the compressor clutch is disengaged. 3. Attempt to turn the clutch driver (not the pulley). Can you turn the clutch driver freely by hand?	-	Go to Step 25	Go to Step 24
24	1. Start the engine. 2. Observe the low-side pressure gauge while running the engine between 3,000 and 3,800 rpm. Does the low-side pressure rise rapidly?	-	Go to Step 32	Go to Step 25
25	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. Is the compressor functioning normally?	-	Go to Step 13	-
26	Check the low-side pressure. Is the low side pressure within the specified value?	172-241 kPa (27-38 psi)	Go to Step 27	Go to Step 32
27	Feel the high-side pipe leading up to the expansion valve connecting block. Is the pipe cold before the connecting block?	-	Go to Step 28	Go to Step 29

Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
28	1. Check for a restriction in the high-side pipe before the expansion valve. 2. Repair or replace the high-side pipe. Is the pipe performing normally?	-	Go to Step 13	-
29	Add the specified amount of refrigerant to the A/C system. Does the cooling performance improve?	0.40 kg (14 ounces)	Go to Step 30	Go to Step 31
30	1. Check the A/C system for leaks. 2. Repair any refrigerant leaks as needed. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the system leak free?	-	Go to Step 13	-
31	1. Recover the refrigerant. 2. Check the expansion valve for obstructions. 3. Repair or replace the expansion valve as required. 4. Evacuate and recharge the system. 5. Leak check the system. Is the system leak free?	-	Go to Step 13	-
32	Important: Perform this test exactly as described to obtain accurate results. 1. Run the engine for 5 minutes at 2,000 rpm. 2. Set the A/C controls to the following positions: • The A/C switch to the ON position. • The fresh air control switch to recirculate (indicator lamp ON). • The blower motor to 1. • The temperature to full cold. 3. Close all of the windows and the doors of the vehicle. 4. Open the vehicle hood. Is the low side pressure within the specified value?	172-241 kPa (25-35 psi)	Go to Step 13	Go to Step 33
33	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor control valve. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the system leak free?	-	Go to Step 13	-

SYMPTOM DIAGNOSIS

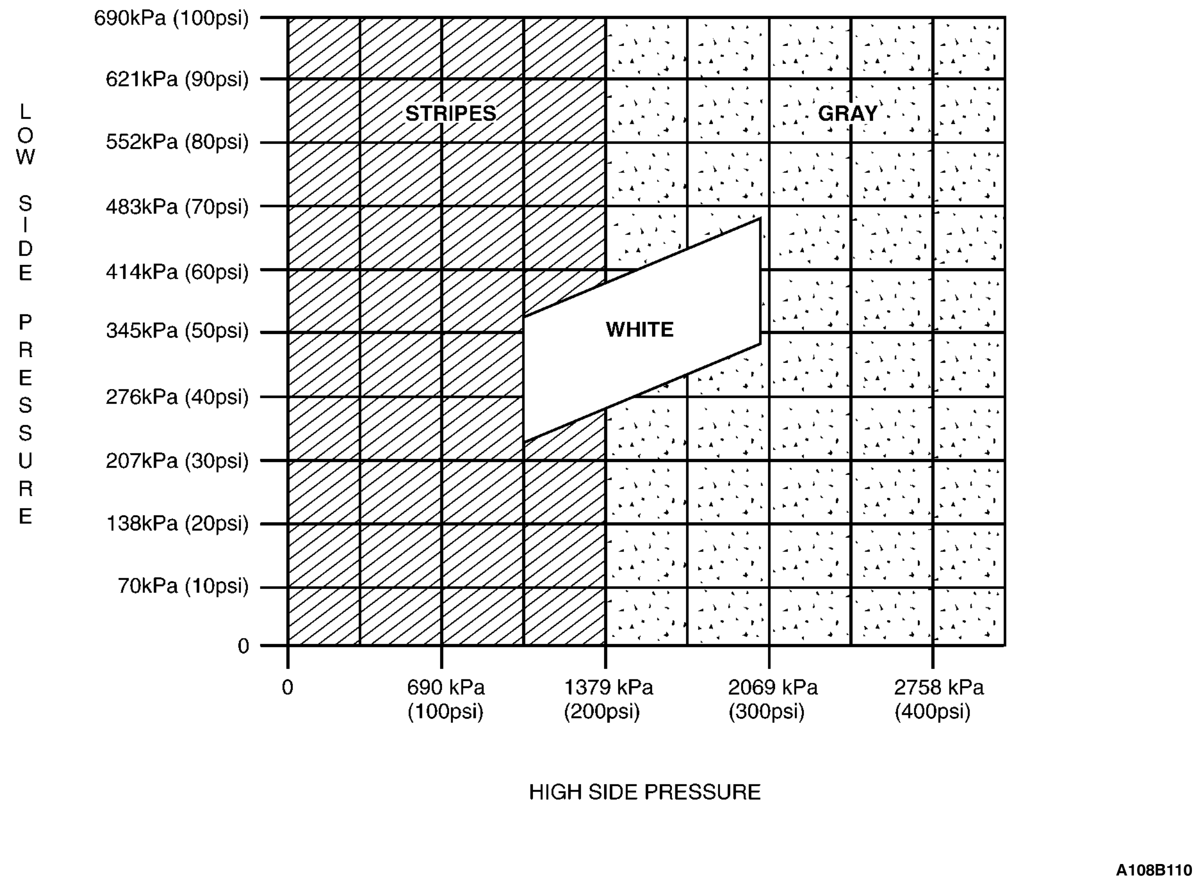
PRESSURE TEST CHART (R-134A SYSTEM)

TEST RESULTS	RELATED SYMPTOMS	PROBABLE CAUSE	REMEDY
Discharge (high) pressure abnormally high	After stopping the compressor, the pressure drops about 299 kPa (28 psi) quickly, then falls gradually.	There is air in the system.	Recover, evacuate and recharge the system with the specified amount of refrigerant.
	The condenser is excessively hot.	There is excessive refrigerant in the system.	Recover, evacuate and recharge the system with the specified amount of refrigerant.
	Reduced or no air flow through the condenser.	The condenser or the radiator fins are clogged.	Clean the condenser or the radiator fins.
		The condenser or the radiator fan is not working properly.	• Check the voltage and the fan rpm. • Check the fan direction.
	Line to the condenser is excessively hot.	Restricted flow of refrigerant in the system	Locate and repair the restriction.
Discharge pressure abnormally low	The condenser is not hot.	Insufficient refrigerant in the system.	• Check the system for a leak. • Charge the system.
	High and low pressures are balanced soon after stopping the compressor. Low side pressure is higher than normal.	Faulty compressor pressure relief valve.	Repair or replace the compressor.
		Faulty compressor seal.	
	The outlet of the expansion valve is not frosted, low pressure gauge indicates vacuum.	Faulty expansion valve.	Replace the expansion valve.
		Moisture in the system.	Recover, evacuate, and recharge the system.
Suction (low) pressure abnormally low	Condenser is not hot.	Insufficient refrigerant in the system.	Repair the leaks. Recover, evacuate, and recharge the system.
	The expansion valve is not frosted and the low pressure line is not cold. Low pressure gauge indicates a vacuum.	Frozen expansion valve.	Replace the expansion valve.
		Faulty expansion valve.	
	Discharge temperature is low and the air flow from the vents is restricted.	The evaporator is frozen.	Clear the restricted evaporator case drain.
	The expansion valve is frosted.	The expansion valve is clogged.	Clean or replace the expansion valve.
	The receiver/drier outlet is cool and the inlet is warm.	The receiver/drier is clogged.	Replace the receiver/drier.
Suction pressure abnormally high	Low pressure hose and check joint are cooler than the temperature around the evaporator.	The expansion valve is opened for too long.	Replace the expansion valve.
		A capillary tube is loose.	

Pressure Test Chart (R-134a System) (Cont'd)

TEST RESULTS	RELATED SYMPTOMS	PROBABLE CAUSE	REMEDY
Suction pressure abnormally high	Suction pressure is lowered when the condenser is cooled by water.	There is excessive refrigerant in the system.	Recover, evacuate, and recharge the system.
	High and low pressure are equalized as soon as the compressor is stopped and both gauges fluctuate while the compressor is running.	A gasket is faulty.	Repair or replace the compressor.
		The high pressure valve is faulty.	
		Foreign particles are stuck in the high pressure valve.	
Suction and discharge pressure abnormally high	Reduced airflow through the condenser.	The condenser or the radiator fins are clogged.	Clean the condenser and the radiator.
		The radiator cooling fans are not working properly.	• Check the voltage and the radiator cooling fan rpm. • Check the fan direction.
	Condenser is excessively hot.	There is excessive refrigerant in the system.	Recover, evacuate, and recharge the system.
Suction and discharge pressure abnormally low	Low pressure hose and metal end areas are cooler than the evaporator.	Clogged or kinked low pressure hose.	Repair or replace the low pressure hose.
	Temperature around the expansion valve is low compared to that around the receiver/drier.	The high pressure line is clogged.	Repair or replace the high pressure line.
Refrigerant leaks	The compressor clutch is dirty.	The compressor shaft seal is leaking.	Repair or replace the compressor.
	The compressor bolts are dirty.	Leaking around a compressor housing bolt.	Tighten the bolt(s) or replace the compressor.
	The compressor gasket is wet with oil.	The compressor gasket is leaking.	Repair or replace the compressor.

LOW AND HIGH SIDE PRESSURE RELATIONSHIP CHART



MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

GENERAL A/C SYSTEM SERVICE PROCEDURES

O-RING REPLACEMENT

Important: Even though O-rings may look identical, it is extremely important that only recommended service replacement air conditioning O-rings be used, or excessive leakage of refrigerant may occur.

Important: Always slip the O-ring onto the flange tube to ensure proper locating and sealing.

Install new DAEWOO-approved service replacement air conditioning O-rings whenever a joint or a fitting is disassembled, except when the O-rings are provided on new components.

When replacing O-rings on an air conditioning component or a joint connection, the fitting design should be identified to ensure installation of the correct air conditioning service replacement O-ring. Some joint connections and components will implement a "captured" O-ring design fitting that uses a groove to retain the O-ring. Others do not have a groove and use a "non-captured" or "standard" O-ring. Assembly and tightening procedures are the same for both designs, but the O-rings are different.

Before installation, verify that both O-rings and fittings have not been nicked or deformed. Deformed or nicked parts must be replaced. Failure to use the proper service replacement parts and procedures may result in excessive refrigerant leakage.

HANDLING REFRIGERANT

Caution: Always work in a well-ventilated area and avoid breathing any refrigerant fumes. If you have difficulty breathing, seek medical attention immediately. If refrigerant comes in contact with any part of your body, flush the exposed area with water. If a rash or pain develops, seek medical attention.

Air conditioning systems contain refrigerant. This is a chemical mixture which requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around the fittings, the valves and the connections when performing work that involves opening the refrigerant system. Do not weld or steam clean on or near any vehicle-installed air conditioning lines or components.

All refrigerant drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and the safety plug from damage. It is good practice to replace the cap after each use of the drum.

If it is necessary to transport or carry any container of refrigerant in a vehicle, do not carry it in the passenger compartment.

HANDLING OF REFRIGERANT LINES AND FITTINGS

Notice: Using too low or too high torque when tightening a fitting can result in loose joints or deformed joint parts. Both conditions can result in refrigerant leakage.

- Keep all metal tubing lines free of dents or kinks. Any line restrictions will cause the loss of system capacity.
- Never bend a flexible hose line to a radius of less than four times the diameter of the hose.
- Never allow a flexible hose line to come within 63.5 mm (2-1/2 inches) of the exhaust manifold.
- Inspect flexible hose lines regularly for leaks or brittleness.
- Replace flexible hose lines with new lines if you find signs of deterioration or leaking.
- Discharge the refrigeration system of all refrigerant before disconnecting any fitting in the refrigeration system.
- Proceed very cautiously regardless of the gauge readings.
- Open the fittings very slowly.
- Keep your face and your hands away from the fitting so that you will not be injured if there happens to be liquid refrigerant in the line.
- If you notice pressure when you loosen a fitting, allow the pressure to bleed off as described under "Discharging, Adding Oil, Evacuating and Charging Procedures for A/C System" in this section.
- Cap or tape any refrigerant line immediately after it is opened. This will prevent the entrance of moisture and dirt, which can cause internal compressor wear or plugged lines in the condenser, the evaporator core, the expansion valve or the compressor inlet screens.

Important: Use two proper wrenches to connect the O-ring fittings.

- Back up the opposing fitting to prevent distortion of the connecting lines or the components.
- Back up both the swaged fitting on the flexible hose connections and the coupling to which it is attached with two wrenches to prevent turning the fitting and damaging the ground seat.
- Keep the O-rings and the seats in perfect condition. A burr or a piece of dirt may cause a refrigerant leak.
- Dip new O-rings in clean polyalkaline glycol (PAG) refrigerant oil before installation.

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system. When foreign materials, such as dirt, air, or moisture, contaminate the refrigeration system, they will change the stability of the refrigerant and the polyalkaline glycol (PAG) compressor oil. They will also affect the pressure-temperature relationship, reduce efficient operation, and can possibly cause interior corrosion and abnormal wear of moving parts.

Observe the following practices to ensure chemical stability in the system:

- Wipe away dirt or oil at and near any connection before opening that connection. This will reduce the chance of dirt entering the system.
- Cap, plug, or tape both sides of a connection as soon as possible after opening the connection. This will prevent the entry of dirt, foreign material, and moisture.
- Keep all tools clean and dry, including the manifold gauge set and all replacement parts.
- Use a clean and dry transfer device and container to add PAG refrigerant oil. This will ensure that the oil remains as moisture-free as possible. Refer to "Discharging, Adding Oil, Evacuating and Charging Procedures for A/C System" in this section.
- Have everything you need ready to allow you to perform all operations quickly when opening an A/C system. Do not leave the A/C system open any longer than necessary.
- Evacuate and recharge any A/C system that has been opened. Refer to "Discharging, Adding Oil, Evacuating and Charging Procedures for A/C System" in this section for the instructions to perform this procedure properly.

All service parts are dehydrated and sealed before shipping. They should remain sealed until just before making connections. All the parts should be at room temperature before uncapping. This prevents condensation of moisture from the air from entering the system. Reseal all parts as soon as possible if the caps have been removed but the connections cannot be made promptly.

DISCHARGING, ADDING OIL, EVACUATING, AND CHARGING PROCEDURES FOR A/C SYSTEM

Caution: Use only refillable refrigerant tanks that are authorized for the charging station being used. The use of other tanks may cause personal injury or void the warranty. Refer to the manufacturer's instructions for the charging station.

Caution: To avoid personal injury, always wear goggles and gloves when performing work that involves opening the refrigeration system.

A charging station discharges, evacuates, and recharges an air conditioning system with one hook-up. Filtering during the recovery cycle together with filtering during the evacuation cycle ensures a supply of clean, dry refrigerant for A/C system charging.

Notice:

- Never use the R-134a charging station on a system charged with R-12. The refrigerants and the oils are not compatible and must never be mixed in even the smallest amount. Mixing refrigerant residue will damage the equipment.
- Never use adapters which convert from one size fitting to another. This will allow contamination which may cause system failure.

Charging Station Setup and Maintenance

Refer to the manufacturer's instructions for all initial set-up procedures and all maintenance procedures. There are many charging stations available. All perform the various tasks required to discharge the system and recover refrigerant, evacuate the system, add a measured amount of oil, and recharge an air conditioning system with a measured amount of refrigerant.

Control Panel Functions

A charging station will have controls and indicators to allow the operator to control and monitor the operation in progress. Refer to the manufacturer's instructions for details. These can be expected to include:

1. Main Power Switch: The main power switch supplies electrical power to the control panel.
2. Display: The display shows the time programmed for vacuum and the weight of the refrigerant programmed for recharging. Refer to the manufacturer's instructions for detailed programming information.
3. Low Side Manifold Gauge: This gauge shows the system's low side pressure.
4. High Side Manifold Gauge: This gauge shows the system's high side pressure.
5. Controls: This will contain the controls that control various operating functions.
6. Low Side Valve: This valve connects the low side of the A/C system to the unit.
7. Moisture Indicator: This indicator shows if the refrigerant is wet or dry.
8. High Side Valve: This valve connects the high side of the A/C system to the unit.

Refrigerant Recovery

Important: Use only a refrigerant tank that is designed for the charging station in use. The unit's overfill limitation mechanism is calibrated specifically for use with this tank. The tank's valves are also specifically for this unit.

1. Attach the high side hose with the quick disconnect coupler to the high side fitting of the vehicle's A/C system.
2. Open the coupler valve after attachment.
3. Attach the low side hose with the quick disconnect coupler to the low side fitting of the vehicle's A/C system.
4. Open the coupler valve after attachment.
5. Check the high side and the low side gauges on the unit's control panel in order to ensure that the A/C system has pressure. If there is no pressure, there is no refrigerant in the system to recover.

Important: If there is no refrigerant in the system, do not continue with the recovery operation. This will draw air into the recovery tank.

6. Open both the high side and the low side valves.
7. Open the gas and the liquid valves on the tank.
8. Drain any oil that may be in the oil separator.
9. Close the oil drain valve.
10. Plug the unit into the proper voltage outlet.
11. Turn on the main power switch.

Notice: Never reuse refrigerant oil. Damage to the A/C system may result. Dispose of the refrigerant oil properly.

12. Begin the recovery process. Refer to the manufacturer's instructions for the charging station in use.

Important: Some A/C system PAG lubricating oil may be removed with the refrigerant during recovery. The amount of oil removed varies. A charging station separates the oil from the refrigerant and allows a means of determining how much oil was removed. Replace the same amount of oil when you recharge the system. Refer to the manufacturer's instructions for the charging station in use.

13. Wait 5 minutes. Check the control panel low side gauge. If the A/C has maintained vacuum, the recovery is complete.
14. There is more refrigerant in the system if the low side gauge pressure rises above zero. Recover the additional refrigerant. Repeat this step until the system maintains vacuum for two minutes.

Important: If the control indicator shows that the refrigerant tank is full during the recovery process and the unit shuts off, install an empty unit tank to store the refrigerant needed for steps later in the procedure. Do not use any other type of tank.

Evacuation

The unit tank must contain a sufficient amount of R-134a refrigerant for charging. Check the amount of refrigerant in the tank. If there is less than 3.6 kg (8 pounds) of refrigerant, add new refrigerant to the tank. Refer to the manufacturer's instructions for adding refrigerant.

1. Verify that the high side and the low side hoses are connected to the A/C system. Open both the high side and the low side valves on the unit's control panel.
2. Open both the gas and the liquid valves on the tank.

Important: Refer to the manufacturer's instructions for the charging station in use. It is necessary to evacuate the system before recharging it with new or recycled refrigerant.

3. Start the vacuum pump and begin the evacuation process. Non-condensable gases (mostly air) are automatically vented from the tank during the recycling process. You may hear the pressure being released.
4. Check for leaks in the system. Refer to the manufacturer's instructions for the charging station in use.

Important:

- Change the vacuum pump oil frequently. Refer to the manufacturer's instructions for the charging station in use.

A/C System Oil Charge Replenishing

Any oil removed from the A/C system during the recovery process must be replenished at this time.

1. Use the correct graduated bottle of polyalkaline glycol (PAG) oil for the R-134a system.

Important:

- Keep the oil bottles tightly capped at all times to protect the oil from moisture and contamination.
- Never open the oil injection valve while there is positive pressure in the A/C system. This will result in oil blow-back through the bottle vent. You must have A/C system vacuum for this operation.
- Never let the oil level drop below the pick-up tube while charging or replenishing the system. This will allow air into the A/C system.

2. Refer to the manufacturer's instructions for the charging station in use. Add the proper amount of PAG oil to the system.
3. Close the valve when the required oil charge has been pulled into the system.

Charging

Important: Evacuate the air conditioning system before charging.

1. Close the low side valve on the control panel.
2. Open the high side valve on the control panel.
3. Refer to the manufacturer's instructions for the charging station in use.
   - Enter the amount of refrigerant needed to charge the A/C. Be sure that you are using the correct system of measurement (kg, lb).
   - Begin the charging process.

Successful Transfer Complete

1. Close the high side valve on the unit's control panel. Both valves should be closed.
2. Start the vehicle and the A/C system.
3. Let the engine run until the readings on the high side and low side gauges stabilize.
4. Compare the readings to the system specifications.
5. Check the evaporator outlet temperature to ensure that the A/C system is operating within the system specifications.
6. Keep the A/C running.
7. Close the high side coupler valve.
8. Disconnect the high side hose from the vehicle.
9. Open the high side and low side valves on the control panel.
10. The system will quickly draw in refrigerant from both hoses through the low side hose.
11. Close the low side coupler valve.
12. Disconnect the low side hose from the vehicle.

Unsuccessful Transfer

Sometimes the total charge does not transfer into the A/C system. There are two reasons why this may occur.

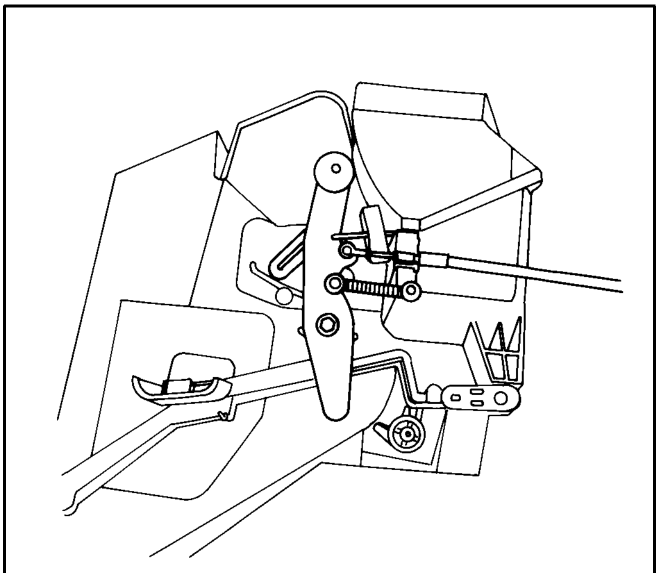
1. The pressure in the unit's tank and the pressure in the A/C system are roughly equal. This will cause the transfer to proceed too slowly. Refer to the manufacturer's instructions for the charging station in use.
2. There was not enough refrigerant in the unit's tank to transfer the full charge. It is necessary to recover the partial charge of refrigerant from the vehicle and evacuate and charge the A/C system again. Refer to the manufacturer's instructions for the charging station in use.

SERVICEABLE COMPONENTS

HVAC CABLES

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the audio system. Refer to Section 9F, Audio Systems.
3. Remove the HVAC controller. Refer to “Control Assembly” in this section.
4. Disconnect the heater/defrost cable eyelet from the post. (Left-hand drive shown, right-hand drive similar.)



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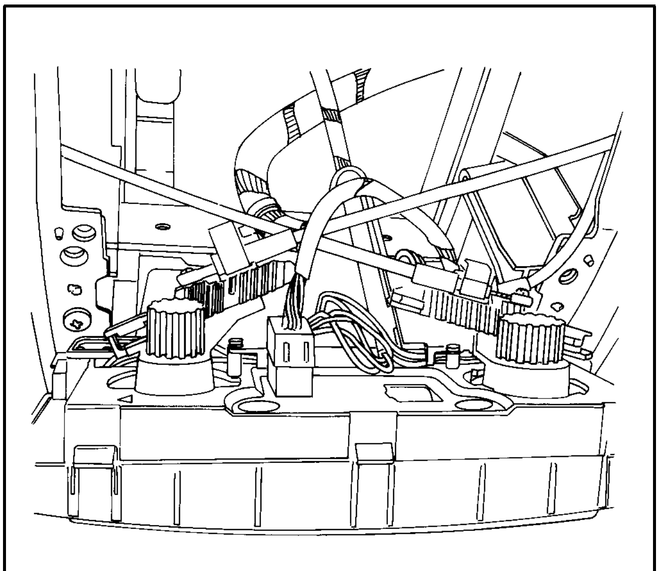
5. Snap the cable housing clip out of the slide position.



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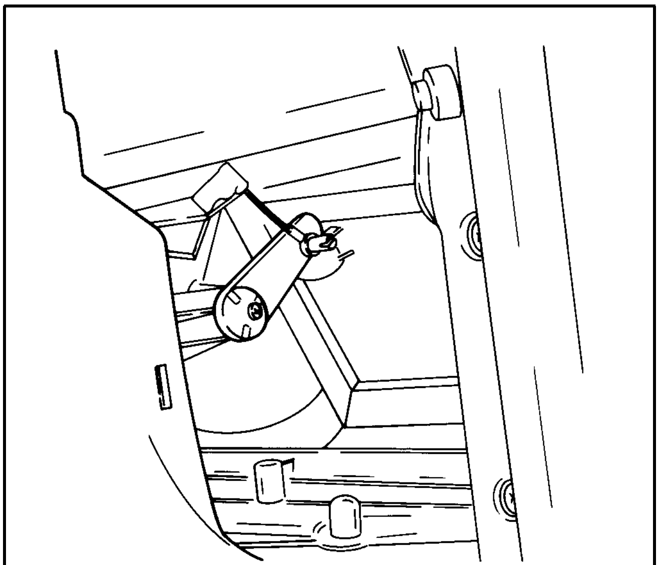
6. Remove the dash end trim panel.
7. Disconnect the vehicle recirculating/fresh air door cable through the dash end panel opening by gently removing the cable eyelet from the post and snapping the housing clip from the retainer.
8. Repeat the procedure for the temperature control cable which is accessed from the lower passenger compartment.



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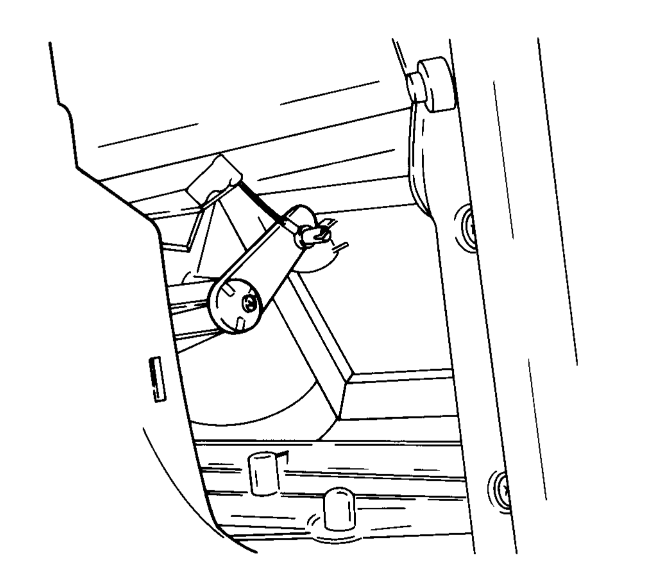

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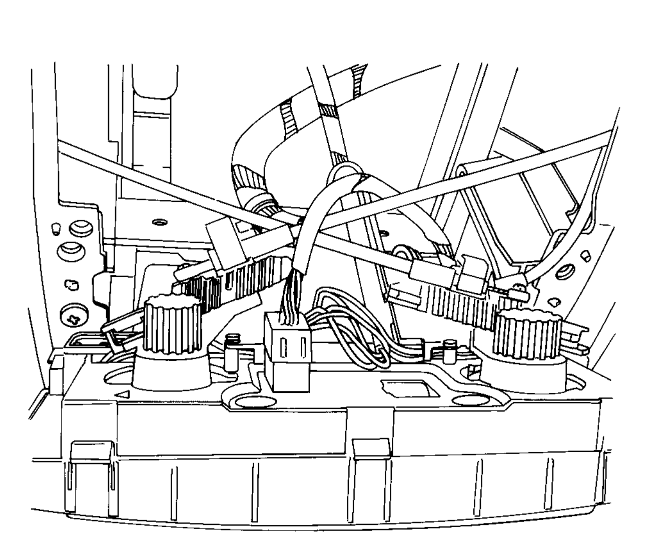
Installation Procedure

1. Connect the vehicle recirculating/fresh air door cable to the appropriate door by attaching the eyelet to the post and the cable housing to the slide.

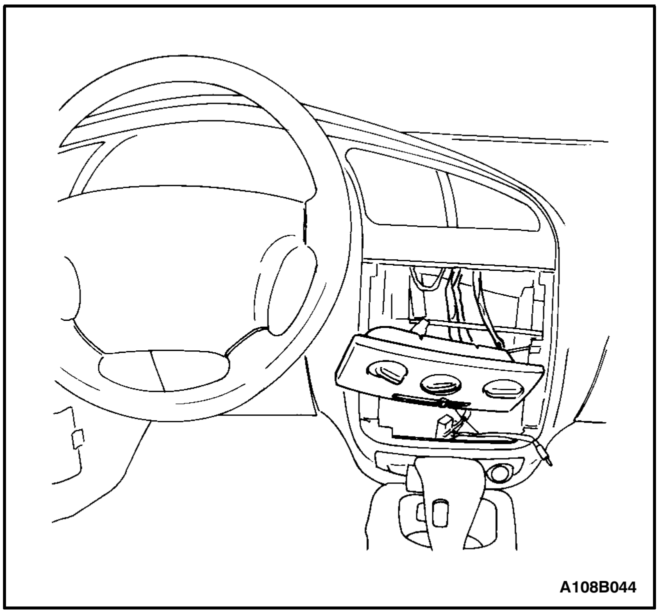


A108B052

2. Move the cable to verify the smooth operation and function of the door and the cable.
3. Install the remaining cables.
4. Install the HVAC controller. Refer to "Control Assembly" in this section.
5. Install the audio system. Refer to Section 9F, Audio Systems.
6. Install the dash end panel.
7. Connect the negative battery cable.
8. Operate the heating/cooling systems to verify proper function.

TEMPERATURE CABLE ADJUSTMENT

The temperature cable is not adjustable. The cable and the housings are of a fixed length. Also, the heater/air distribution case linkage does not provide for adjustment. If a malfunction is suspected, verify the proper operation of the controller and the heater/air distribution mechanical doors.



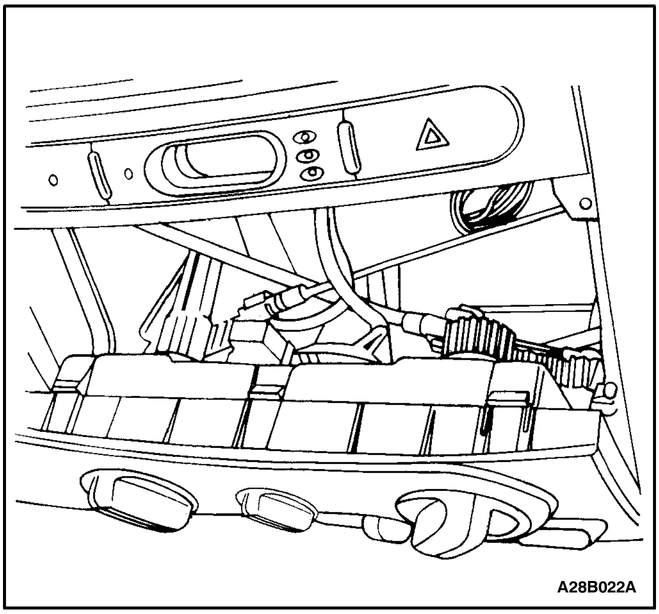
A108B044

CONTROL ASSEMBLY

(Left-Hand Drive Shown, Right-Hand Drive Similar)

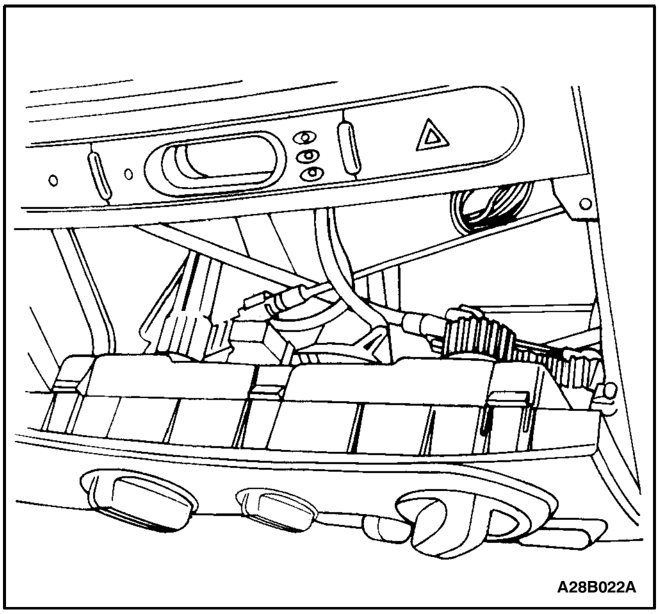
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the audio system. Refer to Section 9F, Audio Systems.
3. Remove the lower left and right controller retaining screws.
4. Pull out the controller to provide clearance for cable removal.



A28B022A

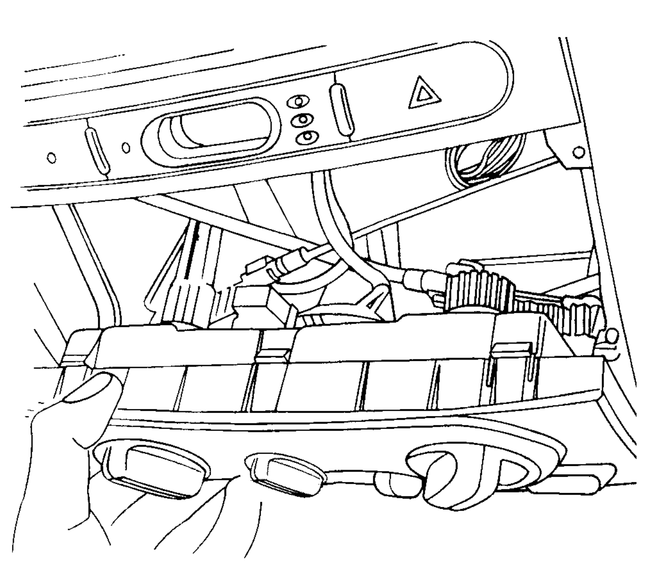
5. Disconnect the mechanical control cables by gently prying the cable eyelet off. Unsnap the cable housing from the mechanical slide. Note the location of the cables and the housings for ease of installation.
6. Disconnect the electrical connectors.



A28B022A

Installation Procedure

1. Connect the electrical connectors to the sockets on the back of the controller.

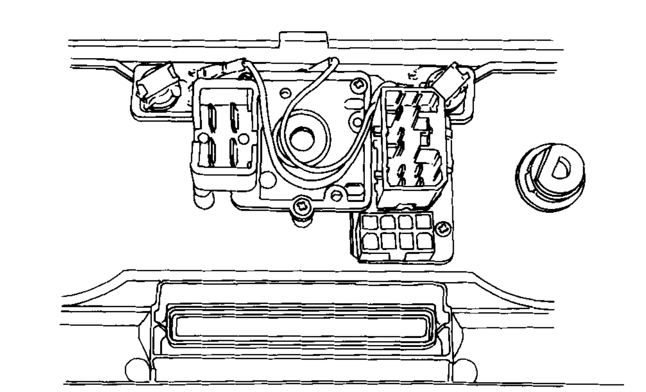

A28B023A

2. Attach the mechanical cable housings to their original control positions.
3. Press the cable end eyelet onto the post.
4. Gently insert the controller into position on the center console.
5. Install the lower left and right retaining screws.

Tighten

Tighten the control assembly retaining screws to 2 N•m (18 lb-in).

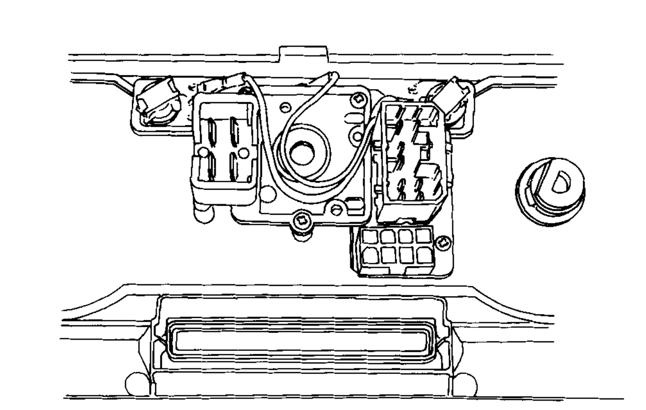
6. Install the audio system. Refer to Section 9F, Audio Systems.
7. Connect the negative battery cable.
8. Operate all of the positions of the controller to ensure proper function.


A108B105

CONTROL ASSEMBLY KNOB LIGHTING

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the HVAC control assembly. Refer to "Control Assembly" in this section.
3. Turn the bulb holder to the left and pullout the bulb.


A108B105

Installation Procedure

1. Install the bulb into the holder and turn the bulb to the right.
2. Install the control assembly. Refer to "Control Assembly" in this section.
3. Connect the negative battery cable.
4. Check knob lighting for proper operation.

BLOWER MOTOR

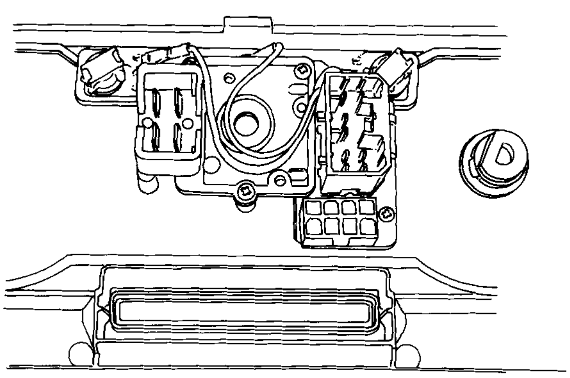
To remove the blower motor, refer to Section 7A, Heating and Ventilation System (Without Air Conditioning).

HIGH-BLOWER RELAY

To remove the high-blower relay, refer to Section 7A, Heating and Ventilation System (Without Air Conditioning).

BLOWER MOTOR RESISTOR

To remove the blower motor resistor, refer to Section 7A, Heating and Ventilation System (Without Air Conditioning).

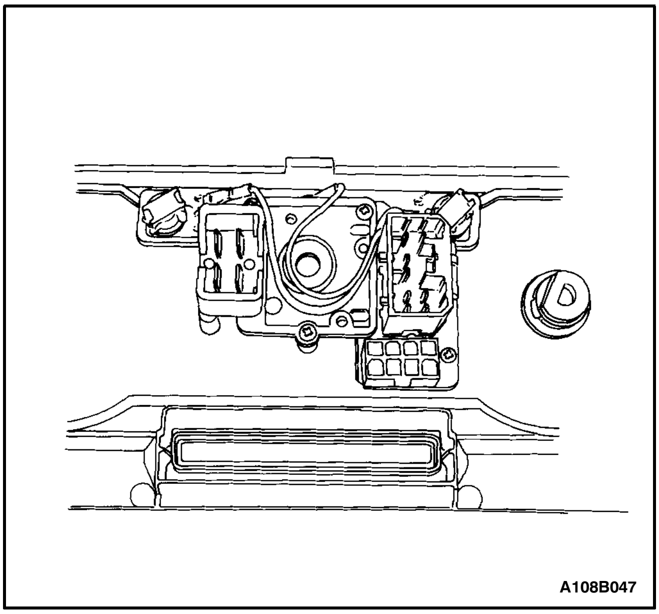


A108B047

BLOWER SWITCH

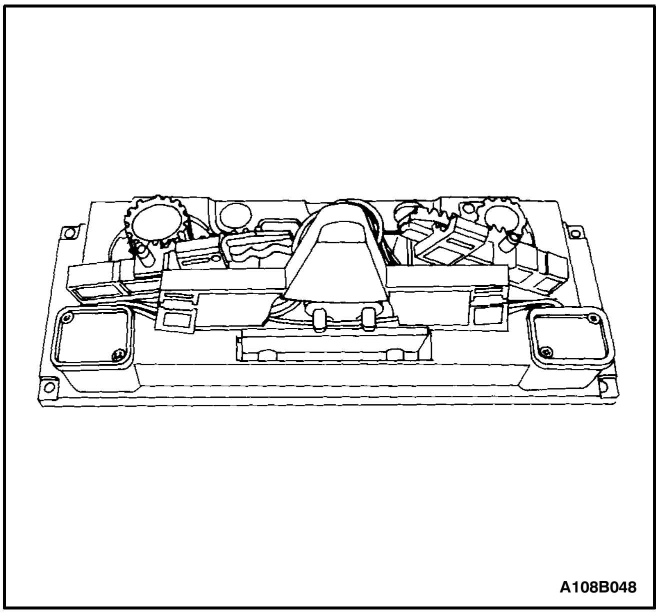
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the HVAC control assembly. Refer to "Control Assembly" in this section.
3. Disconnect the electrical connector.
4. Remove the retaining screws securing the rear case to the front fascia.
5. Separate the two case halves.
6. Disconnect the electrical wires from the light terminals.
7. Remove the screws securing the switch assembly to the knob mount support.
8. Remove the switch assembly. Note the position of the spring, the electrical contact washer and the contact key/keyway on the knob post.



Installation Procedure

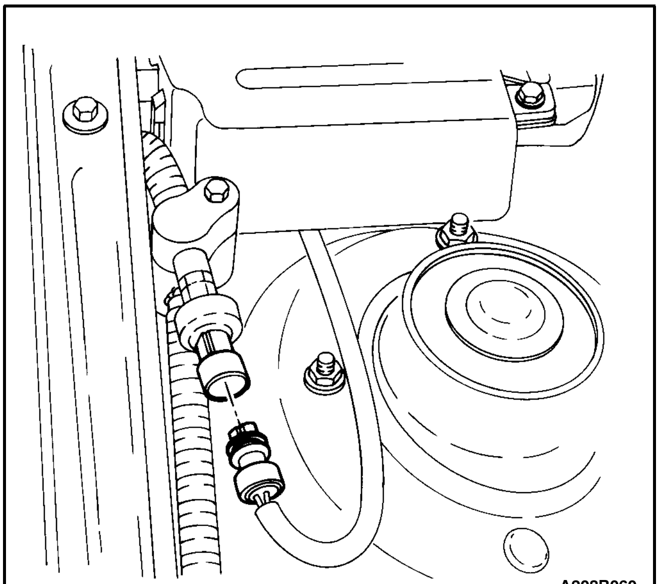
1. Install the spring and the electrical contact washer over the blower switch knob post.
2. Align the contact key with the post keyway.
3. Position the switch assembly over the mount posts.
4. Install the switch assembly with the screws.
5. Connect the electrical wires to the light terminals.
6. Reassemble the two case halves. Note that the knob post shafts are a half-moon shape and must be inserted into the mechanical drive in the correct position.
7. Install the rear case to the front fascia with the retaining screws.



8. Connect the electrical connectors to the rear of the control assembly.
9. Install the HVAC control assembly. Refer to "Control Assembly" in this section.
10. Connect the negative battery cable.
11. Perform an operational check of the blower switch positions.

A/C DEFOGGER SWITCH ASSEMBLY

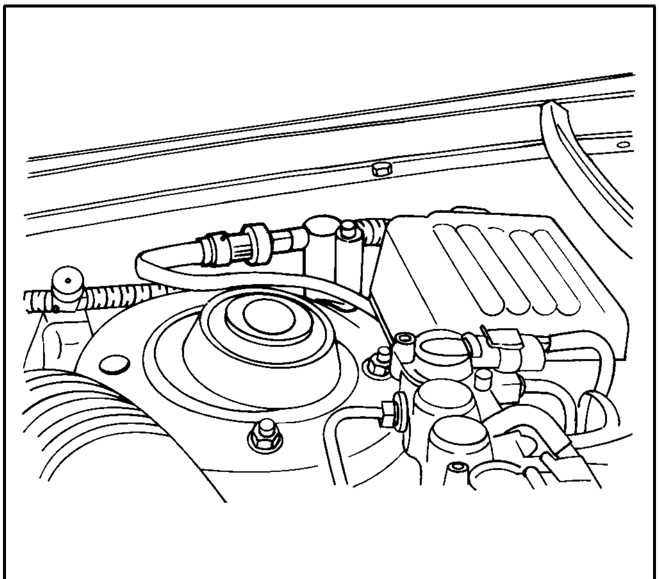
These switches cannot be replaced in the field. If one fails, replace the control assembly. Refer to "Control Assembly" in this section for instructions.


A208B060

A/C PRESSURE TRANSDUCER

Removal Procedure

1. Disconnect the negative battery cable.
2. Release the connector lock and pull the air conditioning (A/C) pressure transducer wire connector out.
3. Hold the line fitting boss with one wrench and remove the A/C pressure transducer with another wrench.
4. Discard the O-ring seal.


A208B061

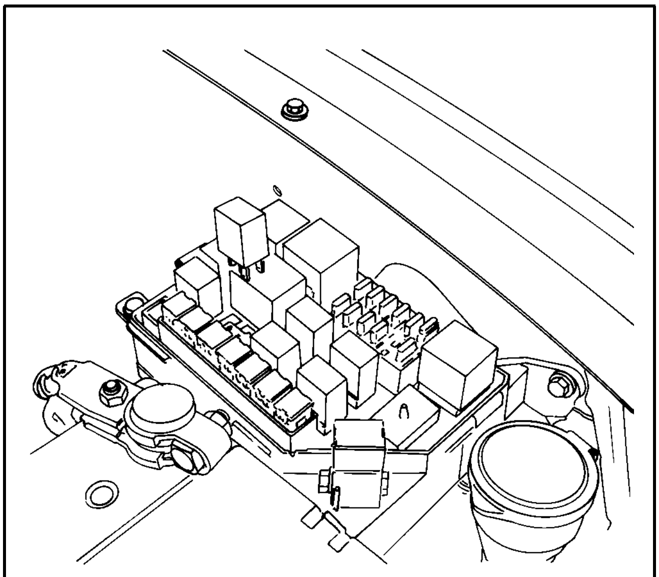
Installation Procedure

1. Install the new seal on the A/C pressure transducer.
2. Install the A/C pressure transducer. (Left-hand drive shown, right-hand drive similar.)

Tighten

Tighten the pressure transducer (using two wrenches) to 8 N•m (71 lb-in).

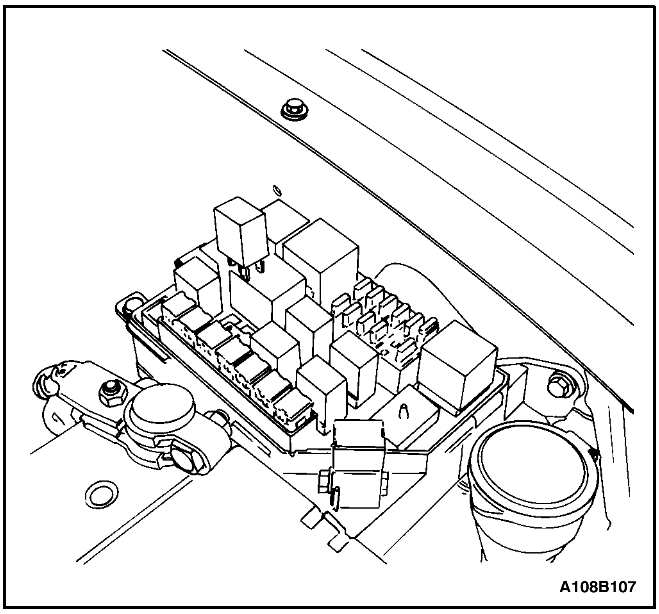
3. Install the wire connector.
4. Connect the negative battery cable.


A108B107

A/C COMPRESSOR RELAY

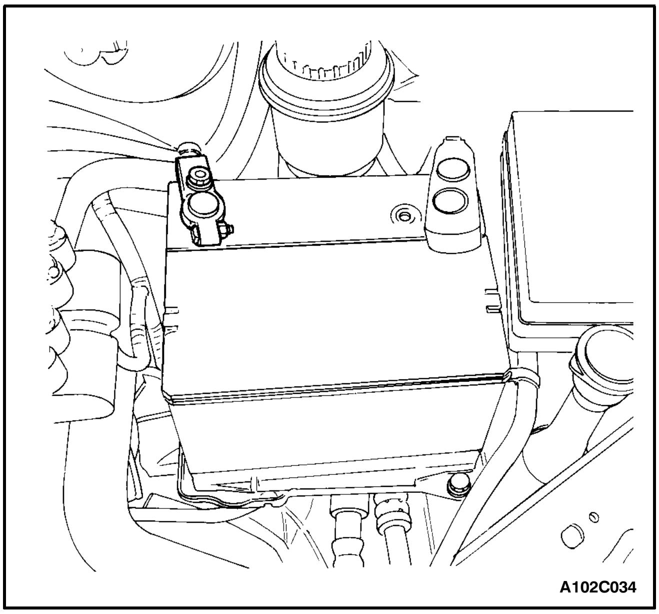
Removal Procedure

1. Disconnect the negative battery cable.
2. The relay is located in the fuse junction box in the engine compartment on the left-hand side.
3. Pull the relay straight up and out.



Installation Procedure

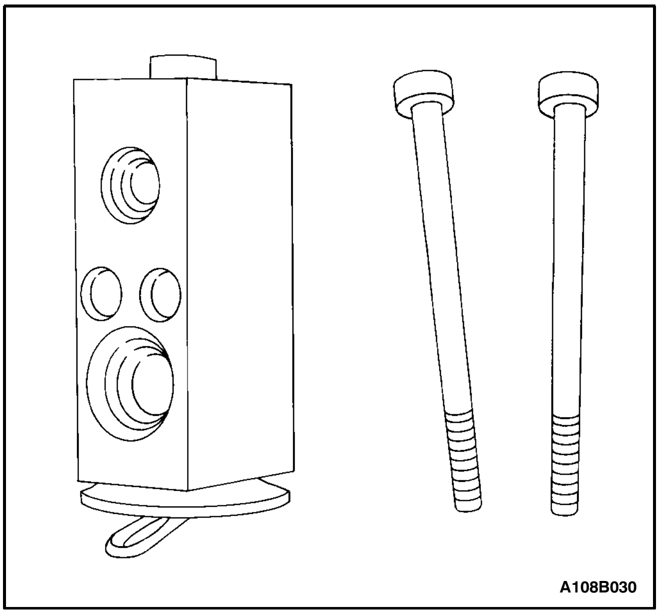
1. Align the relay terminal contacts with the base receptacle.
2. Push the relay into the base until it is seated.
3. Connect the negative battery cable.



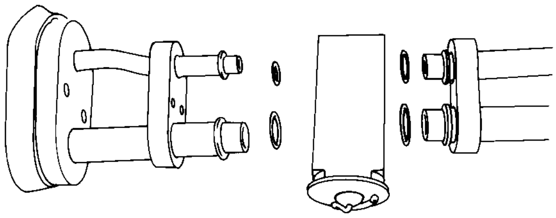
A/C EXPANSION VALVE

Removal Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
4. Remove the heater/air distribution case assembly. Refer to "Heater/Air Distribution Case Assembly" in this section.
5. Remove the evaporator. Refer to "Evaporator Core" in this section.

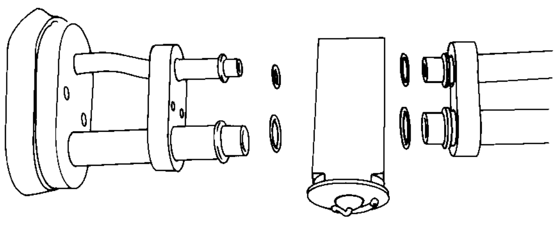


6. Remove the expansion valve connector block retaining bolts.
7. Remove the expansion valve.



A108B040

8. Discard the O-rings.



A108B040

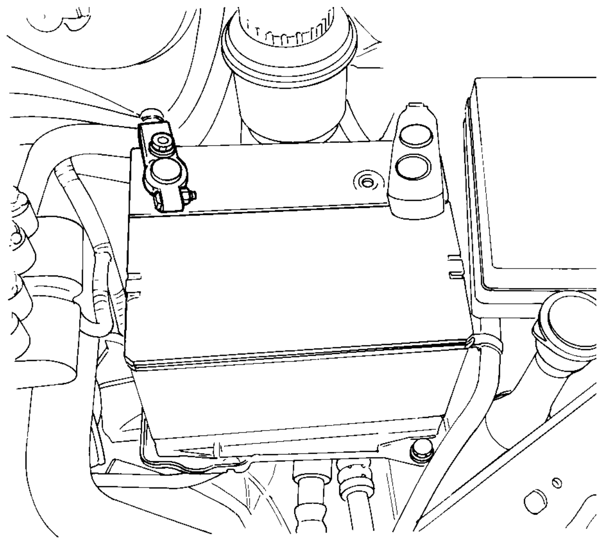
Installation Procedure

1. Clean the O-ring surface areas of dirt or contamination.
2. Install new O-rings on the evaporator tubes.
3. Install a new expansion valve onto the evaporator tubes.
4. Install the expansion valve retaining bolts.

Tighten

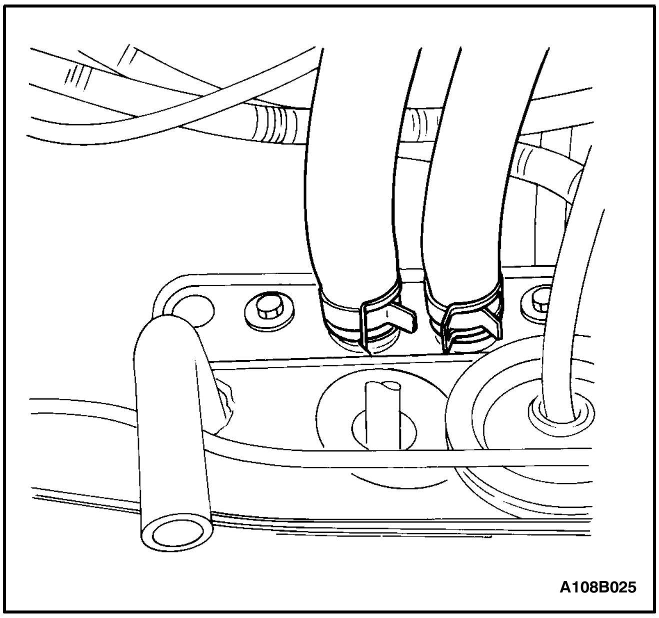
Tighten the expansion valve retaining bolts to 12 N•m (106 lb-in).

5. Install the evaporator into the heater/air distribution case. Refer to "Evaporator Core" in this section.



A102C034

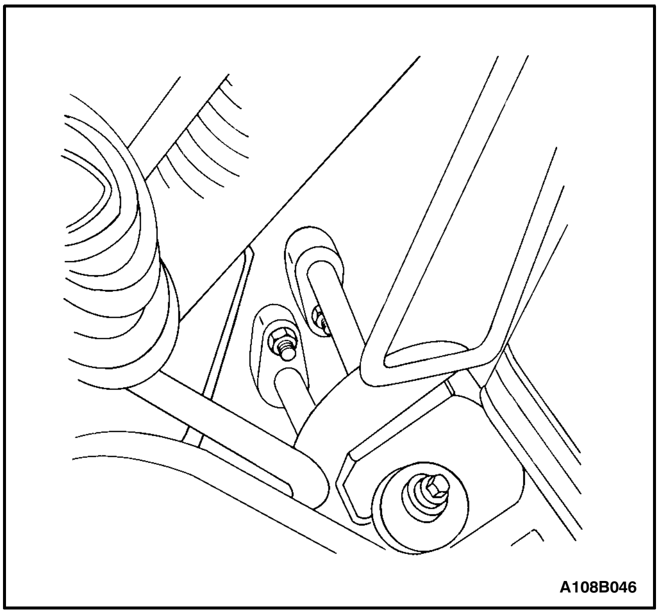
6. Install the heater/air distribution case assembly. Refer to "Heater/Air Distribution Case Assembly" in this section.
7. Install the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
8. Connect the negative battery cable.
9. Evacuate and recharge the system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



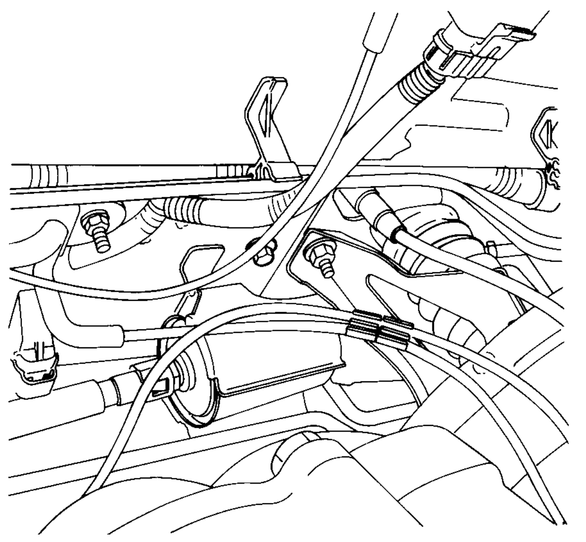
HEATER/AIR DISTRIBUTION CASE ASSEMBLY

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
3. Drain the cooling system. Refer to Section 1D, Engine Cooling.
4. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
5. Raise and suitably support the vehicle.
6. Compress the heater hose clamps at the fire wall and slide the clamps toward the engine.
7. Remove the two heater hoses from the core lines at the fire wall.
8. Turn the condensation drain hose and pull the hose off.
9. Remove the two screws, one on each side of the heater core lines, which secure the heater/air distribution case to the fire wall.



10. Lower the vehicle.
11. Remove the nuts that secure the A/C suction hose and the liquid evaporator pipe block at the fire wall. For right-hand drive and non-ABS vehicles, you can reach them from above. To access the connecting blocks on left-hand drive vehicles equipped with ABS, perform the following steps:
    - 11.1. Remove the front wheel next to the connecting blocks.
    - 11.2. Remove the steering arm access plate.
    - 11.3. Reach through the opening at the steering arm to remove the A/C suction hose and the liquid pipe from the evaporator connecting block.

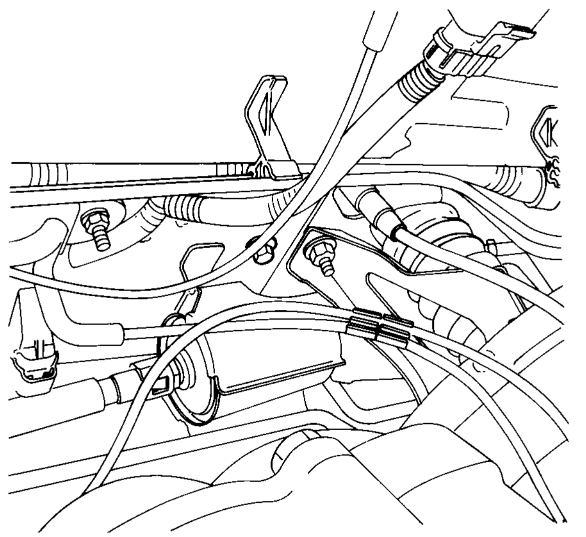


A108B050

12. Have an assistant support the heater/air distribution case from inside the vehicle and, working from the engine side of the fire wall, remove the screw that secures the case assembly at the fuel filter, and the two screws that secure the case assembly to the fire wall at the evaporator connecting block.

Notice: Handle the case carefully to avoid damage to the mechanical door operating linkage.

13. Remove the heater/air distribution case assembly from the vehicle.



A108B050

Installation Procedure

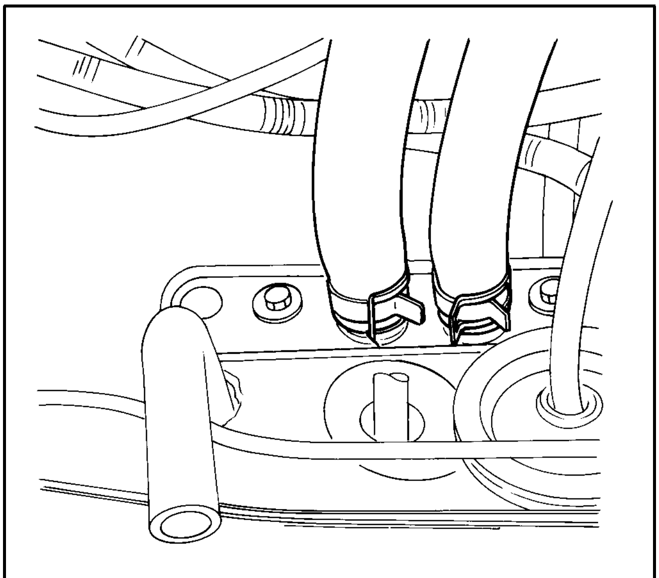
1. Clean the O-ring surfaces to remove any dirt or contamination.
2. Install two new O-rings onto the A/C suction hose and the liquid evaporator pipe at the fire wall in the engine compartment. Note, access for ABS-equipped vehicles is through the steering arm access panel in the right wheel well. For non-ABS vehicles, access is gained from above the tubes at the fire wall.

Notice: Ensure that the heater core tubes do not contact the fire wall opening, or damage to the heater core tubes could occur.

3. Position the heater/air distribution case in the vehicle.
4. Slowly raise the heater/air distribution case into position. The case must be held in position while the first three screws are installed and tightened from the engine side of the fire wall.
5. Install the two screws at the evaporator connecting block and the screw at the fuel filter through the fire wall from the engine compartment side.

Tighten

Tighten the heater/air distribution case screws to 8 Nm (71 lb-in).

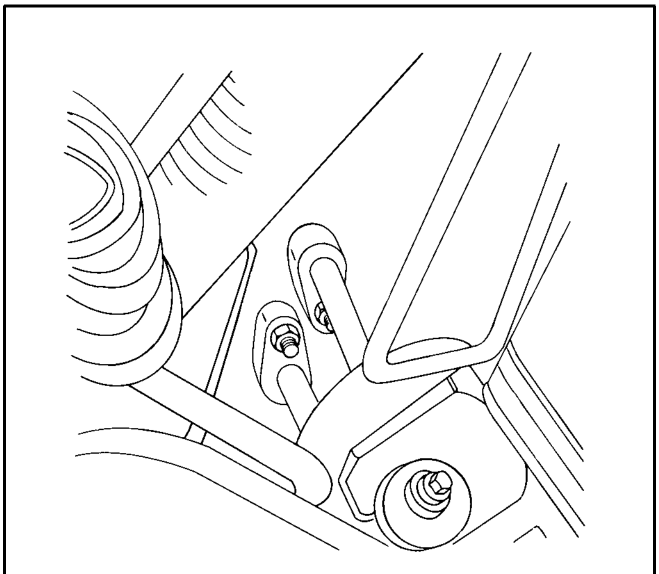

A108B025

6. Raise and suitably support the vehicle and install the two screws that secure the heater/air distribution case on either side of the heater core pipes.

Tighten

Tighten the heater/air distribution case screws to 8 Nwm (71 lb-in).

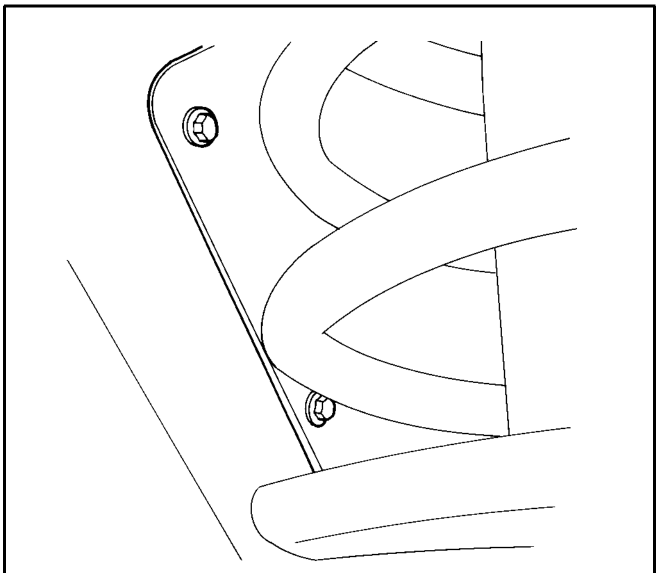
7. Connect the two heater hoses to the heater core tubes.
8. Slide the heater hose clamps into position.
9. Install the case condensation drain tube hose.


A108B046

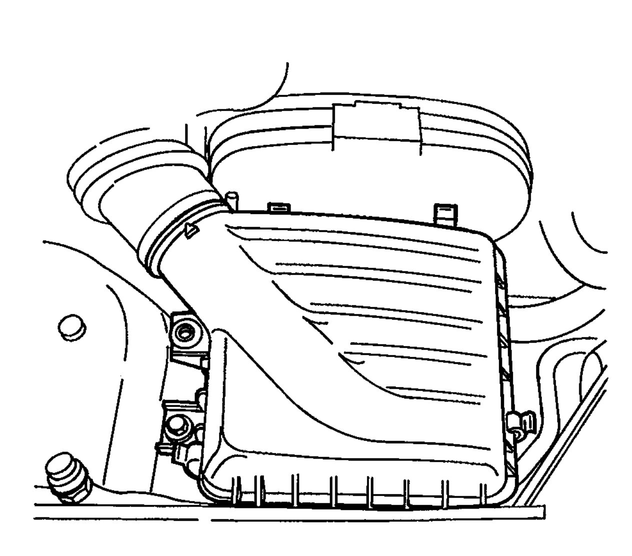
10. Lower the vehicle.
11. Install the A/C suction hose and the liquid evaporator pipes onto the evaporator connecting block screws.

Tighten

Tighten the liquid evaporator pipe and the suction hose connector block retaining nuts to 12 Nwm (106 lb-in).


A108B049

12. For left-hand drive vehicles equipped with ABS, perform the following procedures:
    12.1. Install the steering arm access plate.
    12.2. Install the front wheel. Refer to Section 2E, Tires and Wheels.
13. Install the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
14. Connect the negative battery cable.
15. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
16. Fill the cooling system. Refer to Section 1D, Engine Cooling.
17. Operate the HVAC control to verify the proper function of the heating and cooling systems.

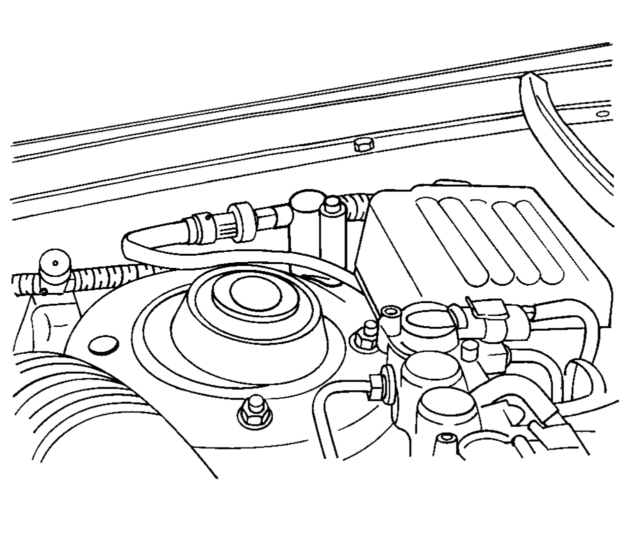


A102C028

A/C HIGH-PRESSURE PIPE LINE

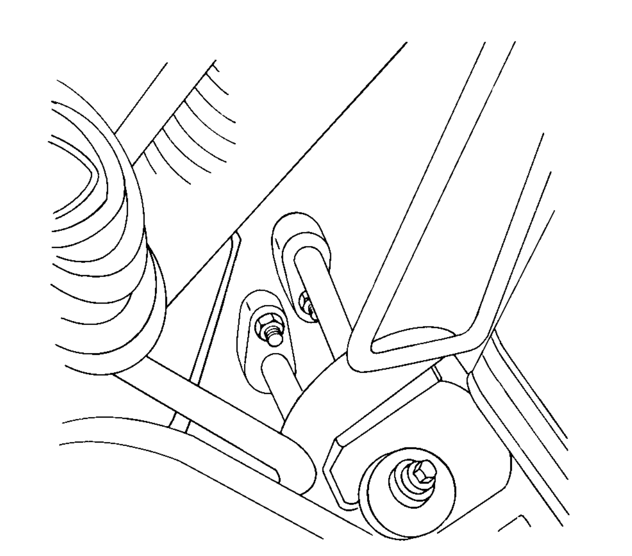
Removal Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the air cleaner housing bolts and the air filter housing assembly.



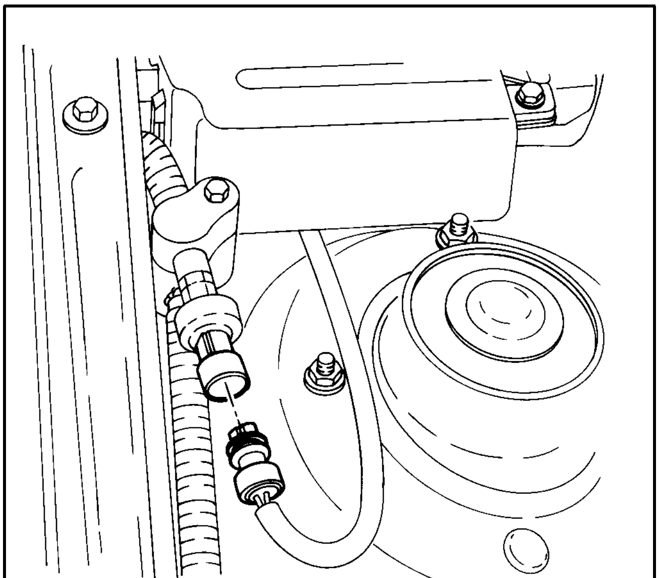
A208B059

4. Remove the bolt securing the liquid evaporator pipe connector block to the liquid condenser connector block and separate the pipes.



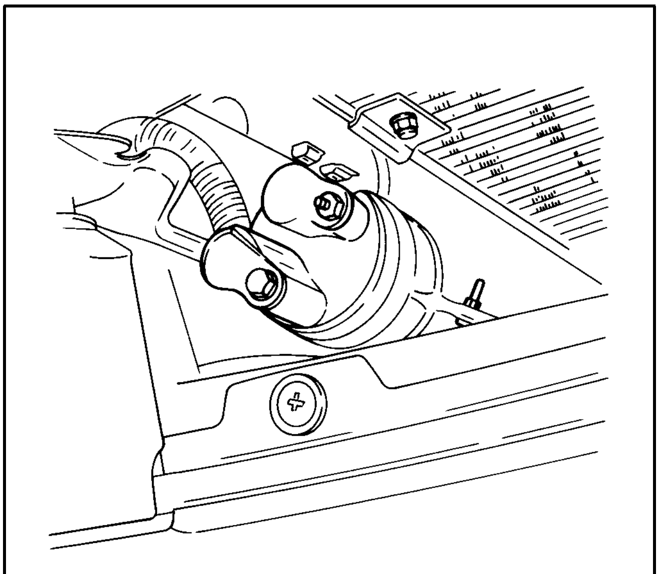
A108B046

5. Remove the liquid evaporator pipe connector block retaining nut at the fire wall opening.
6. Cap the liquid evaporator pipe opening to prevent contamination.
7. Remove the liquid evaporator pipe from the vehicle.



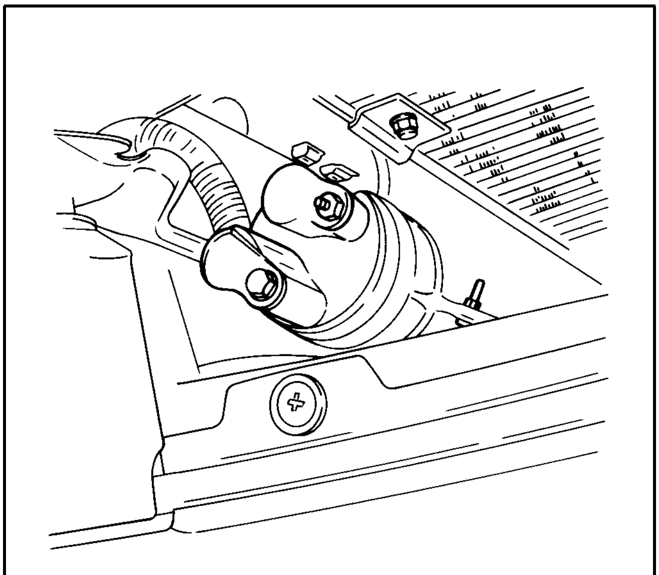
A208B060

8. Disconnect the electrical connector at the pressure transducer.



A108B056

9. Remove the liquid condenser pipe connector block bolt at the receiver-dryer.
10. Remove the liquid condenser pipe from the vehicle.
11. Cap the opening at the receiver-dryer to prevent contamination.



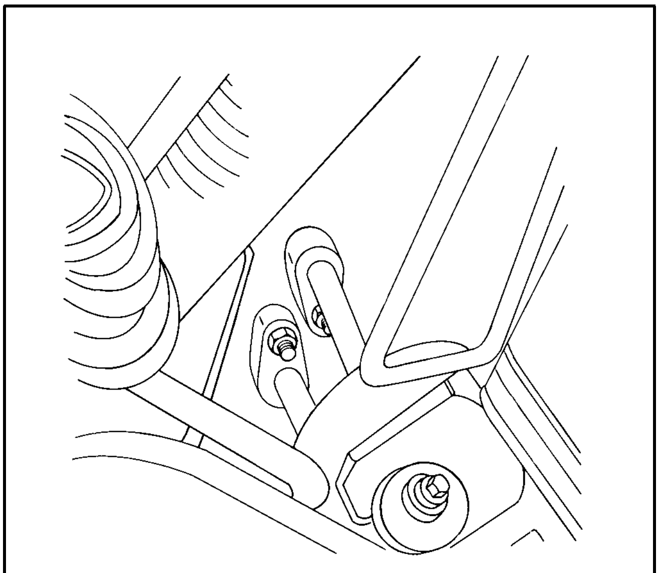
A108B056

Installation Procedure

1. Position the liquid condenser pipe section into the vehicle.
2. Install a new O-ring on the connector block at the receiver-dryer.
3. Install a new O-ring at the liquid condenser to evaporator plate pipe connector block.
4. Install the bolt securing the liquid condenser pipe connector block to the receiver-dryer.

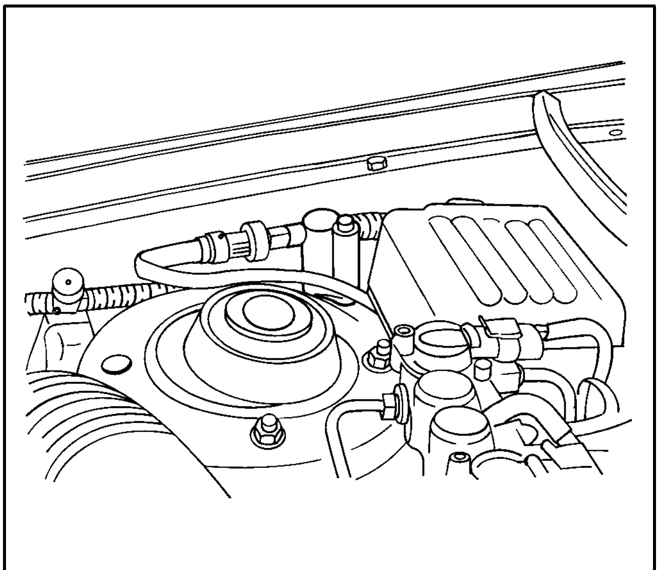
Tighten

Tighten the liquid condenser pipe connector block-to-receiver-dryer bolt to 12 N•m (106 lb-in).



A108B046

5. Position the liquid evaporator pipe into the vehicle.

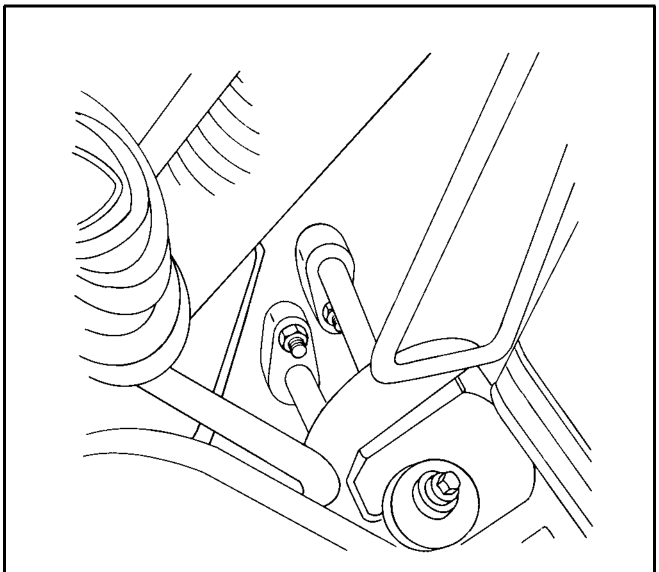


A208B059

6. Install the liquid evaporator pipe connector block-to the liquid condenser pipe connector block with the retaining bolt.

Tighten

Tighten the liquid evaporator pipe connector block-to-to liquid condenser pipe connector block retaining bolt to 12 N•m (106 lb-in).

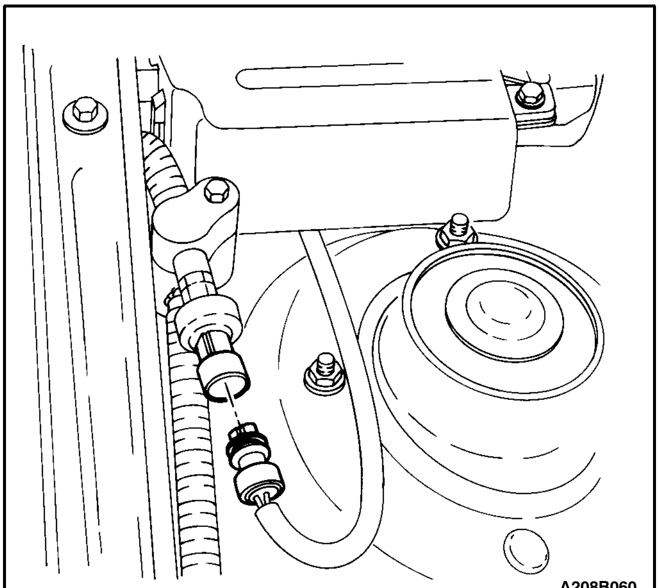


A108B046

7. Install a new O-ring on the liquid evaporator pipe.
8. Install the nut at the liquid evaporator pipe connector block at the evaporator flange.

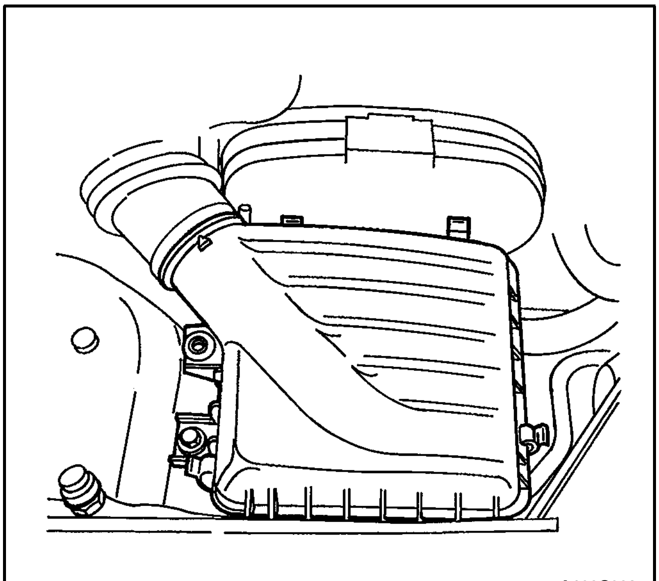
Tighten

Tighten the liquid evaporator pipe connector block nut to 12 N•m (106 lb-in).



A208B060

9. Connect the electrical connector to the pressure transducer.



A102C028

10. Install the air cleaner housing assembly with the retaining bolts.

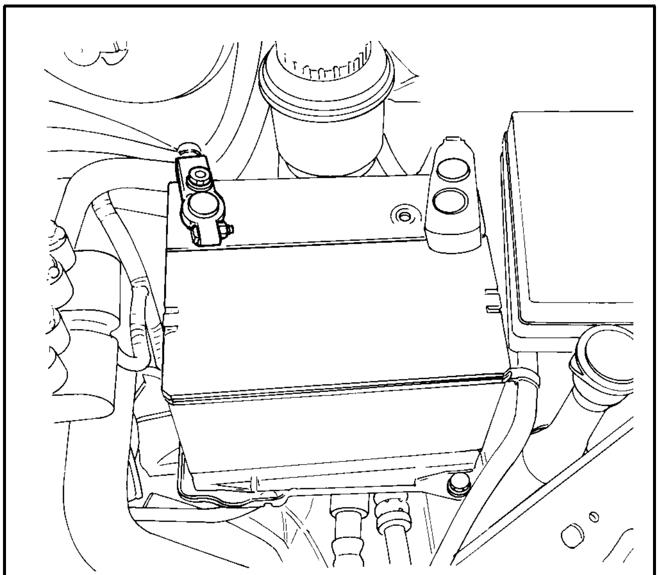
Tighten

Tighten the air cleaner housing assembly retaining bolts to 12 N•m (106 lb-in).

11. Connect the negative battery cable.
12. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.

HEATER HOSES

To remove heater hoses, refer to Section 7A, Heating and Ventilation Systems.

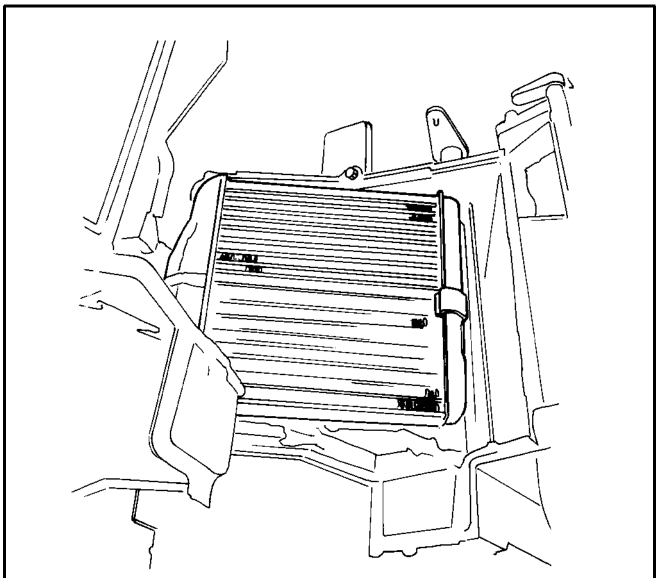


A102C034

HEATER CORE

Removal Procedure

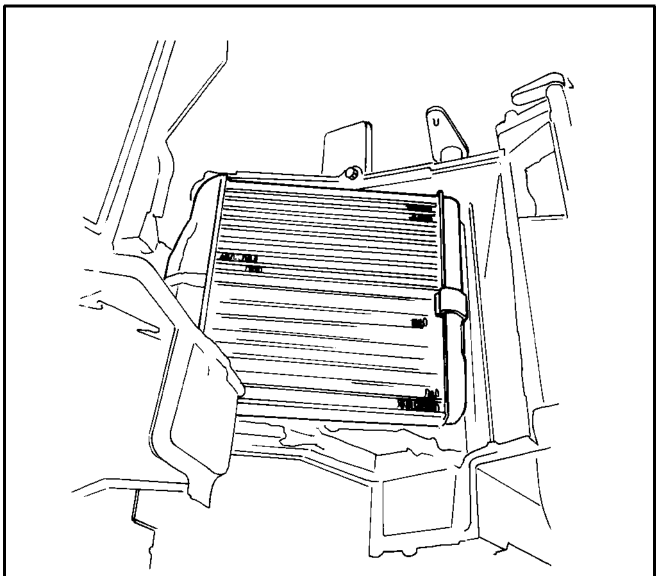
1. Disconnect the negative battery cable.
2. Remove the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
3. Remove the heater/air distribution case assembly. Refer to "Heater/Air Distribution Case Assembly" in this section.



A108B032

Notice: Handle the case carefully to avoid damage to the linkage levers.

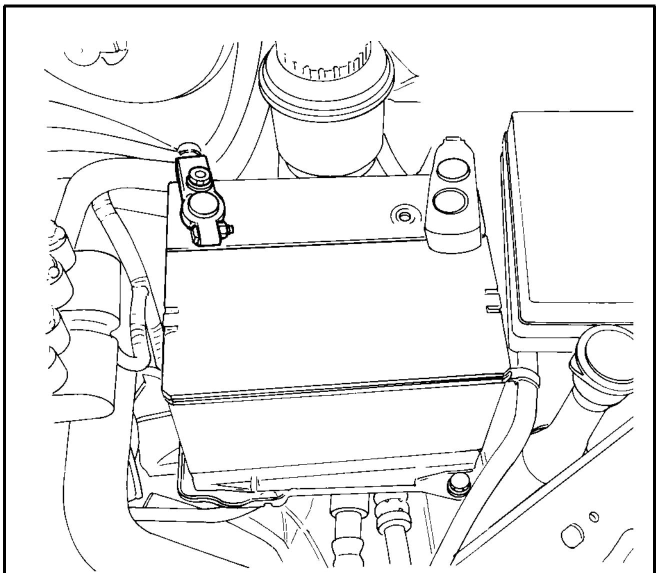
4. Remove the heater core from the heater/air distribution case assembly.



A108B032

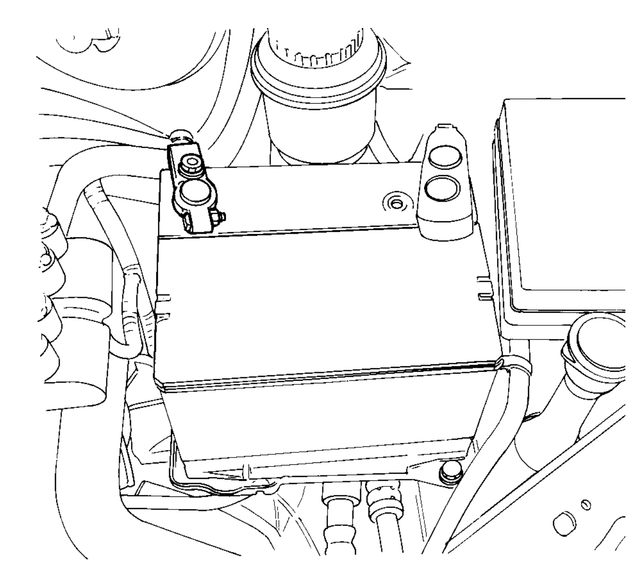
Installation Procedure

1. Install the heater core into the heater/air distribution case assembly.



A102C034

2. Install the heater/air distribution case assembly. Refer to "Heater Air/Distribution Case Assembly" in this section.
3. Install the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
4. Fill the cooling system. Refer to Section 1D, Engine Cooling.
5. Connect the negative battery cable.
6. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.


A102C034

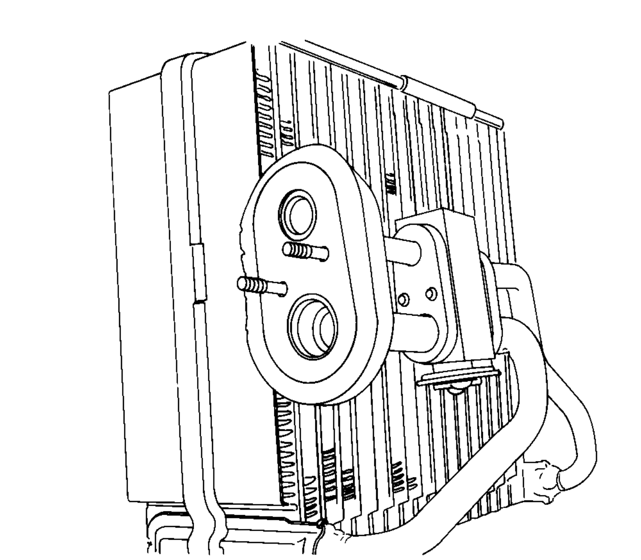
EVAPORATOR CORE

Removal Procedure

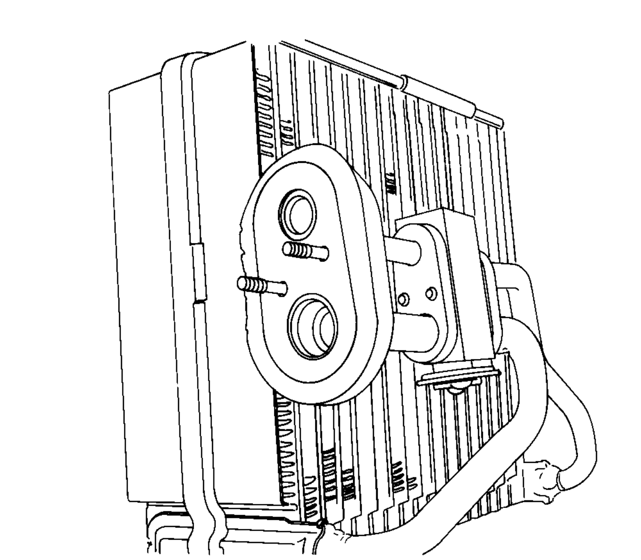
1. Disconnect the negative battery cable.
2. Remove the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.

Notice: Handle the case carefully to avoid damage to the door actuating linkage.

3. Remove the heater/air distribution case assembly. Refer to "Heater/Air Distribution Case" in this section.


A108B035

4. Remove the screws that secure the evaporator case cover.
5. Remove the cover.
6. Slide the evaporator flange support plate upward to facilitate evaporator removal.
7. Remove the evaporator from the case.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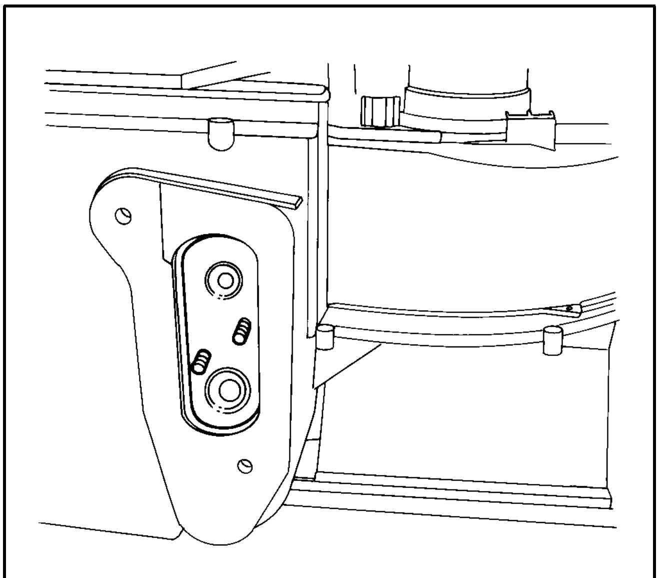
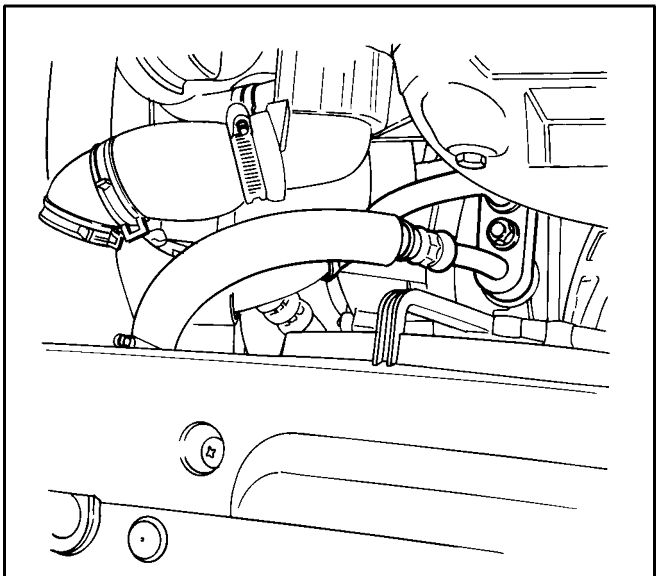
Installation Procedure

1. Install new O-rings onto the evaporator tubes.
2. Install the evaporator core into the case. Center the evaporator flange in the case opening.



A108B029

3. Install the evaporator core case cover with the screws.
4. Install the heater/air distribution case. Refer to "Heater/Air Distribution Case" in this section.
5. Install the instrument panel carrier assembly. Refer to Section 9E, Instrumentation/Driver Information.
6. Connect the negative battery cable.
7. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.

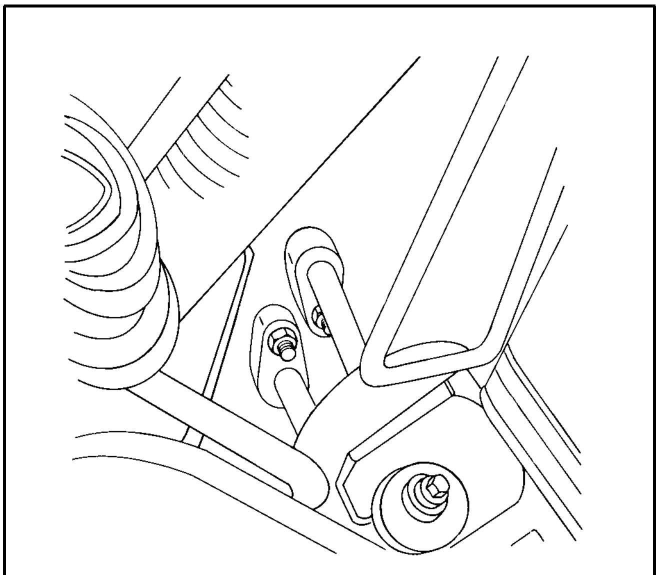


A108B072

A/C HOSE ASSEMBLY

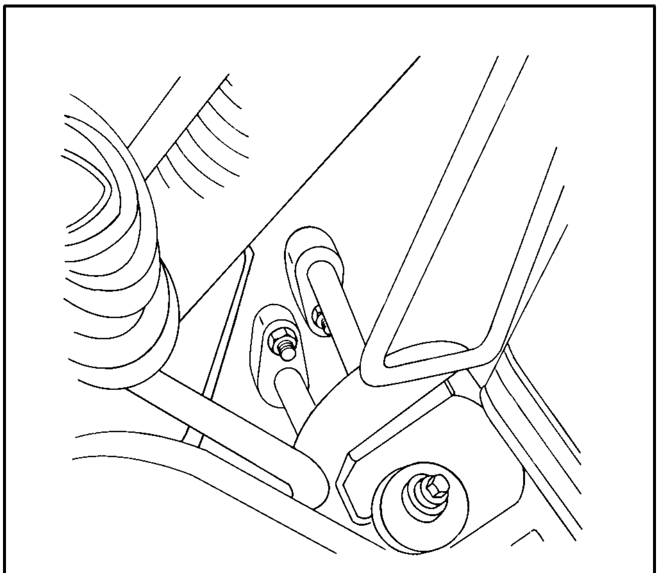
Removal Procedure

1. Cap all openings to prevent contamination.
2. Disconnect the negative battery cable.
3. Discharge and recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
4. Remove the retaining nut and disconnect the A/C hose assembly connector block at the top rear of the compressor. Discard the sealing washers.
5. Separate the A/C hose from the discharge hose connector block.



A108B046

6. Remove the hose support clamp bolt and the clamp along the left side of the engine compartment fender well.
7. Remove the nuts and disconnect the A/C hose at the fire wall evaporator flange connector block. Discard the O-ring.
8. Remove the A/C hose.
9. Cap the opening to the evaporator flange to prevent contamination.
10. Remove the nut securing the discharge hose to the condenser pipe connector block.
11. Remove the discharge hose.



A108B046

Installation Procedure

1. Install a new O-ring on the tube end to the evaporator flange.
2. Position the hose assembly and the support clamp in the vehicle.
3. Insert the suction hose tube end into the evaporator flange.
4. Install the suction hose connector block retaining nut.

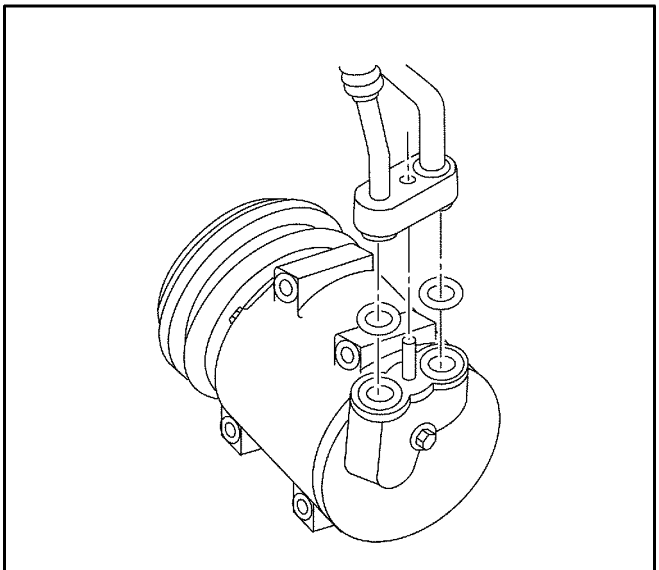
Tighten

Tighten the suction hose connector block retaining nut to 12 N•m (106 lb-in).

5. Install the suction hose support clamp bolt and tighten.

Tighten

Tighten the suction hose support clamp bolt to 4 N•m (35 lb-in).

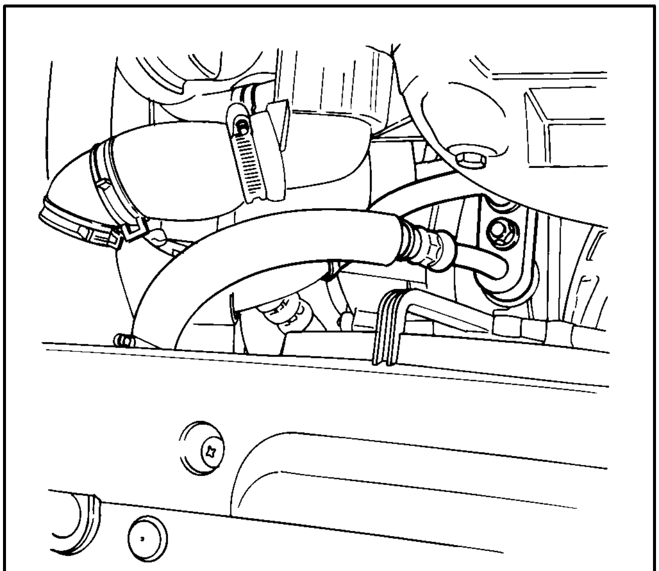


A28B073A

6. Install new sealing washers onto the pilots of the suction/discharge block fitting. The washers must be seated against the surface of the block fitting.
7. Position the discharge hose assembly with the A/C hose connector block.
8. Install a new O-ring and mate the discharge hose to the condenser pipe connector block.
9. Install the discharge hose condenser pipe connector block retaining nut.

Tighten

Tighten the discharge hose-to-condenser pipe connector block retaining nut to 16 N•m (12 lb-ft).



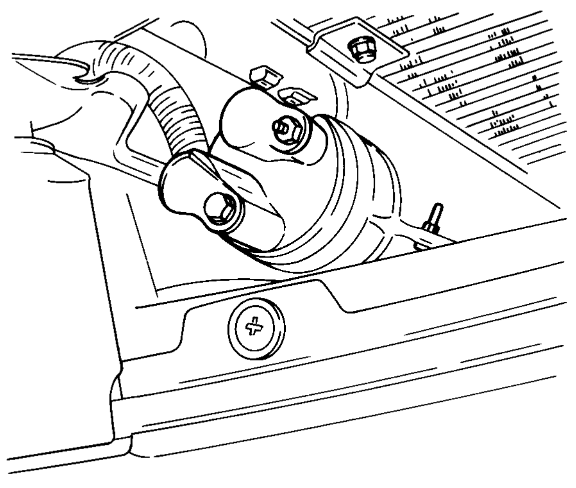
A108B072

10. Mate the A/C system hose connector block to the compressor. Hold it in place while tightening the retaining nut.

Tighten

Tighten the A/C system hose connector retaining nut to 33 N•m (24 lb-ft).

11. Connect the negative battery cable.
12. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.

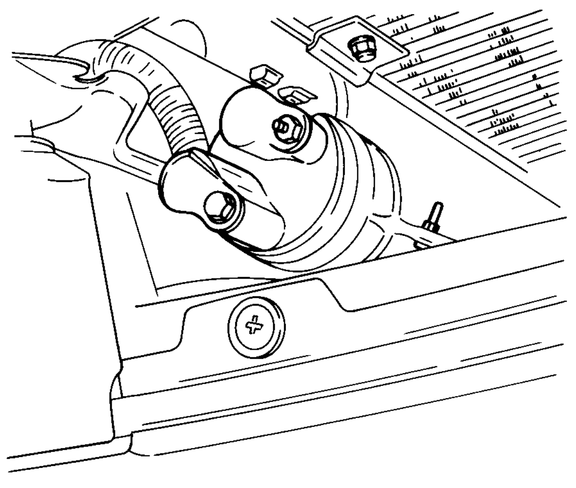


A108B056

RECEIVER-DRYER

Removal Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the nut and bolt securing the connector block to the top of the receiver-dryer.
4. Cap the open connections to prevent contamination.
5. Remove the bolt securing the receiver-dryer band clamp.
6. Remove the receiver-dryer.
7. Drain the oil from the receiver-dryer into a container. Measure the amount of oil drained from the receiver-dryer and then discard this used oil.



A108B056

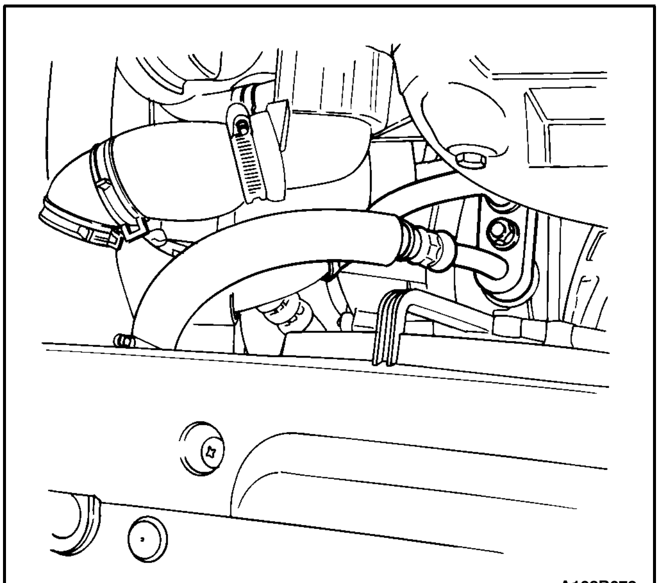
Installation Procedure

Important: Do not uncap new unit until just prior to installation.

1. Add oil to the new receiver-dryer. Use the exact amount of oil that you drained from the receiver-dryer.
2. Install new O-rings in the seal area recess of the new receiver-dryer.
3. Install the receiver-dryer into the clamp position.
4. Install the connector block retaining nut and bolt to the receiver-dryer.

   ### Tighten

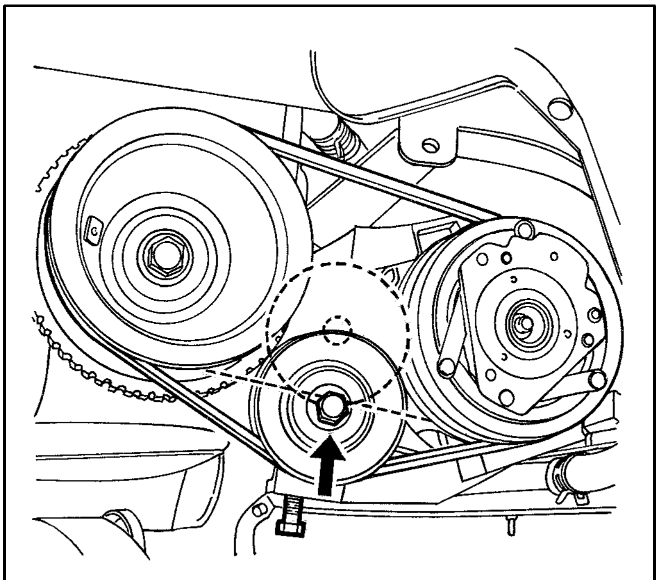
   Tighten the liquid condenser pipe connector block-to-receiver-dryer bolt to 12 N•m (106 lb-in).
5. Install the band clamp bolt and tighten.
6. Connect the negative battery cable.
7. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.


A108B072

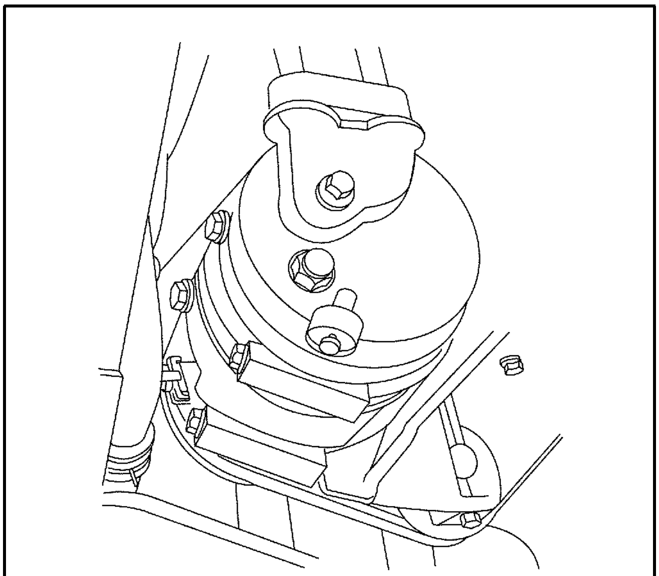
COMPRESSOR

Removal Procedure

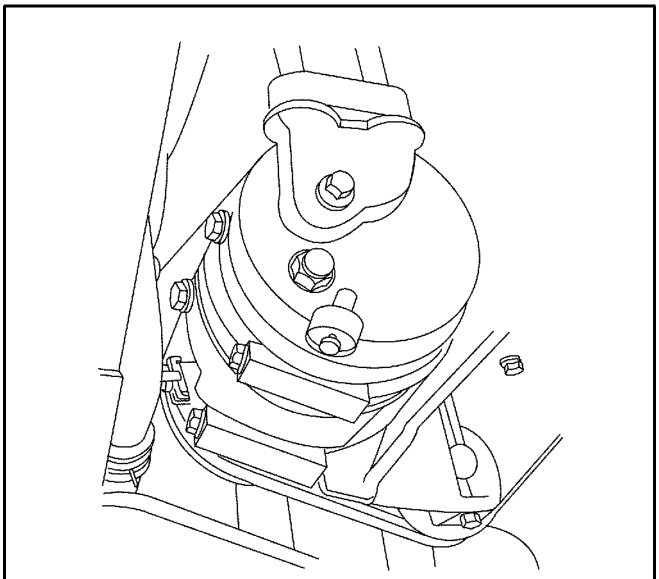
1. Disconnect the negative battery cable.
2. Discharge and recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the compressor A/C hose assembly connector block fitting nut.
4. Raise and suitably support the vehicle.
5. Disconnect the electrical connector at the compressor.


A108B106

6. Loosen the idler pulley lock nut.
7. Relieve the A/C belt tension by loosening the idler pulley tension adjusting bolt.
8. Remove the A/C belt.


A18B045A

9. Remove the A/C compressor-to-bracket bolts.
10. Remove the compressor.
11. Drain the oil from the compressor into a container. It is important to drain the oil completely to get an accurate measure of the amount of oil to add to the new compressor at installation.
    - Remove the drain plug from the compressor body and drain the oil from the crankcase.
    - Drain oil from the suction and discharge ports on the compressor.
    - Measure the amount of oil drained, then discard the used oil.



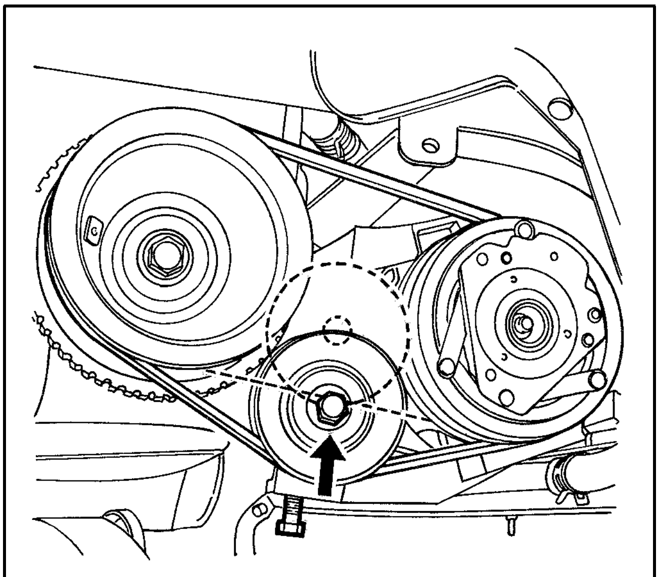
A18B045A

Installation Procedure

1. Add oil to the new compressor. Use the exact amount of oil that you drained from the old compressor.
2. Install the compressor.
3. Install the compressor-to-bracket mounting bolts.

Tighten

Tighten the compressor bracket bolt to 27 N•m (19 lb-ft).



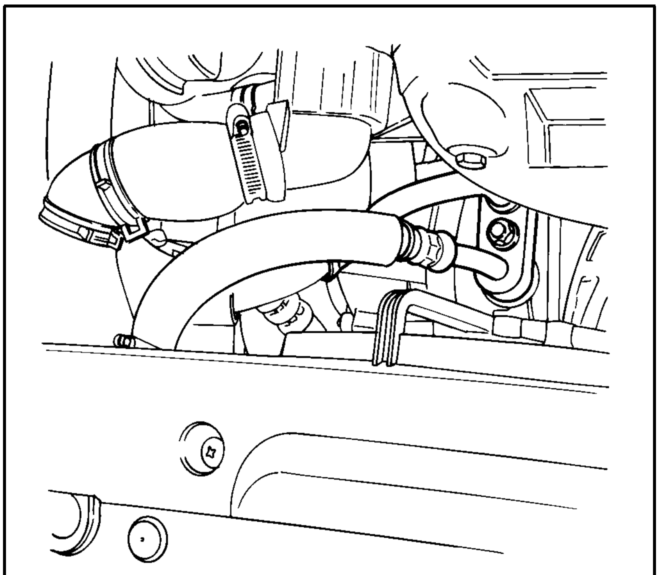
A108B106

4. Install the A/C drive belt.
5. Adjust the idler pulley tension bolt to adjust the drive bolt tension.
6. Tighten the idler pulley lock nut.

Tighten

Tighten the idler pulley lock nut to 50 N•m (36 lb-ft).

7. Lower the vehicle.

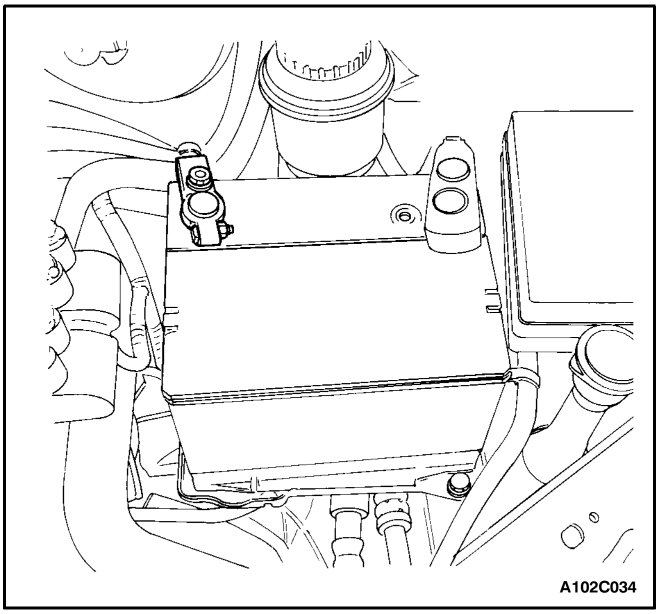


A108B072

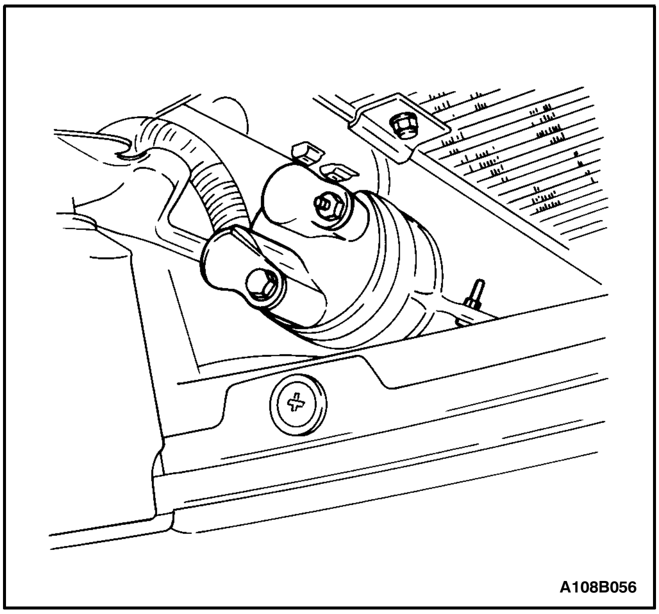
8. Install new sealing washers to the A/C hose assembly connector block fitting.
9. Install the compressor hose assembly connector block fitting and hold while tightening the retaining nut.

Tighten

Tighten the A/C system hose connector retaining nut to 33 N•m (24 lb-ft).



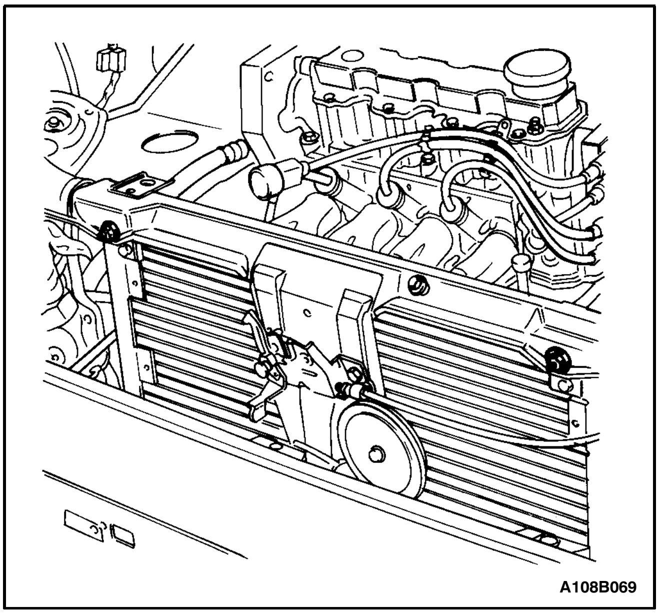
10. Connect the electrical connector at the compressor.
11. Connect the negative battery cable.
12. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



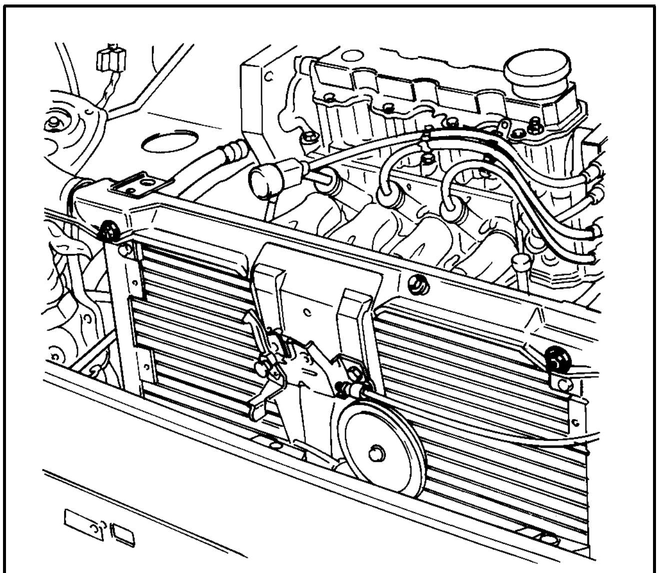
CONDENSER

Removal Procedure

1. Disconnect the negative battery cable.
2. Discharge and recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the radiator. Refer to Section 1D, Engine Cooling.
4. Remove the bolt that secures the liquid condenser connector block at the receiver-dryer.
5. Remove the A/C compressor discharge hose connector block nut.



6. Remove the upper condenser mount nuts and the washers.
7. Move the condenser to the rear, away from the radiator mount support.
8. Lift the condenser up and out of the engine compartment.
9. Remove the condenser pipe-to-receiver-dryer connector block nut.
10. Loosen the receiver-dryer band clamp screw.
11. Remove the receiver-dryer.
12. Cap all the openings to prevent contamination.



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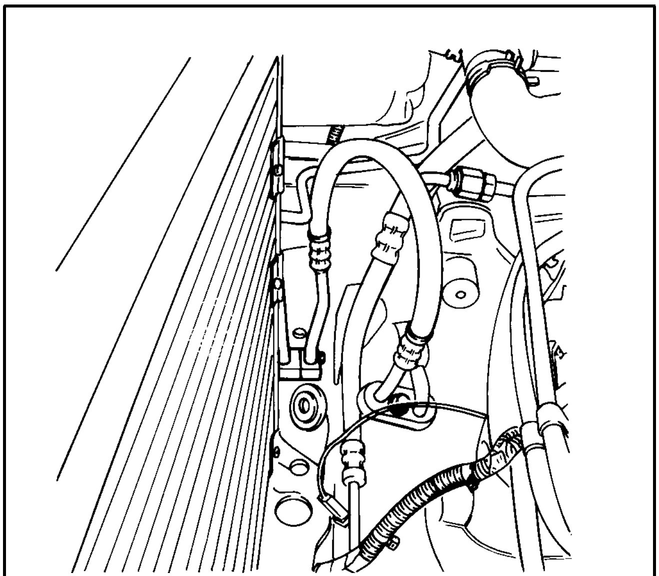


A108B071

Installation Procedure

1. Install new O-rings onto the receiver-dryer tube fittings.
2. Install the receiver-dryer to condenser pipe connector block with the nut.
3. Tighten the band clamp bolt.
4. Ensure that the condenser rubber mounts are in place.
5. Install the condenser into the vehicle. The lower mount shock protectors must fit into the holes provided.
6. Move the condenser forward into the radiator support mount holes.
7. Install the upper mount nuts and washers.

Tighten

Tighten the condenser upper mount nuts to 3 N•m (27 lb-in).

8. Install a new O-ring onto the A/C compressor discharge hose connector block fitting.
9. Install the A/C compressor discharge hose to the condenser pipe connector block and install the retaining nut.

Tighten

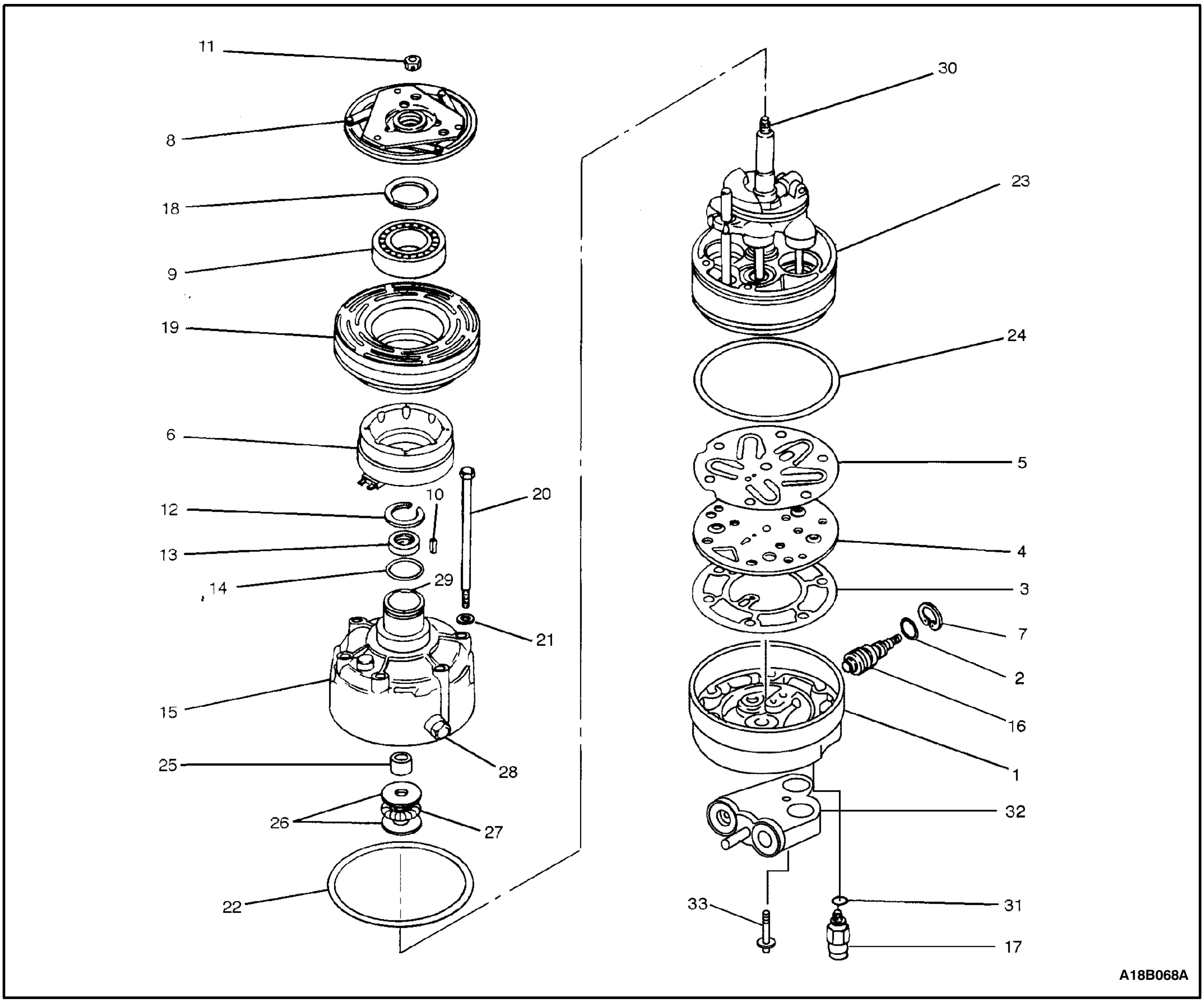
Tighten the discharge hose-to-condenser pipe connector block retaining nut to 16 N•m (12 lb-ft).

10. Install the radiator. Refer to Section 1D, Engine Cooling.
11. Connect the negative battery cable.
12. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.

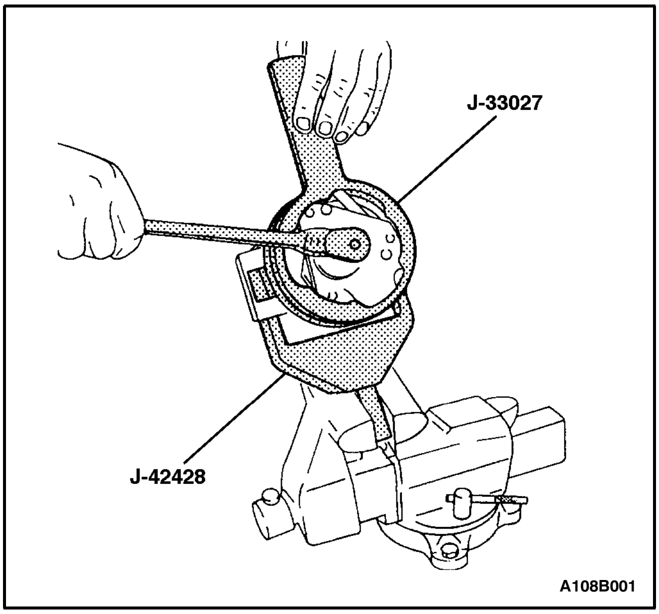
UNIT REPAIR

COMPONENT LOCATOR

V5 COMPRESSOR



1 Rear Head Compressor
2 Control Valve O-Ring
3 Rear Head Gasket
4 Valve Plate
5 Suction Reed
6 Clutch Coil
7 Retaining Ring
8 Drive Plate Clutch
9 Pulley Bearing
10 Clutch Hub Key
11 Shaft Nut
12 Seal Retaining Ring
13 Shaft Lip Seal
14 Shaft Seal O-Ring
15 Compressor Housing
16 Compressor Control Valve
17 Pressure Relief Valve
18 Pulley Bearing to Head Retaining Ring
19 Rotor Pulley
20 Through-Bolt
21 Through-Gasket
22 Compressor Housing-to-Cylinder O-Ring
23 Shaft and Guide Pin Assembly Cylinder
24 Rear Head O-Ring
25 Thrust Washer
26 Race
27 Bearing
28 Oil Drain Plug
29 Clutch and Hub Keyway
30 Compressor Shaft
31 Pressure Relief Valve O-ring
32 Adaptor Compressor
33 Adaptor Bolt



V5 AIR CONDITIONING COMPRESSOR OVERHAUL

CLUTCH PLATE AND HUB ASSEMBLY

Tools Required

J-33013-B Hub and Drive Plate Remover/Installer

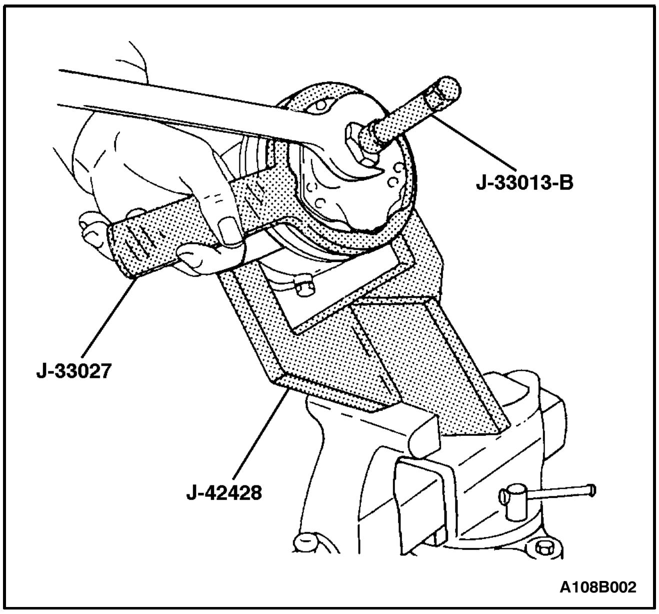
J-33022 Shaft Nut Socket

J-33027 Clutch Hub Holding Tool

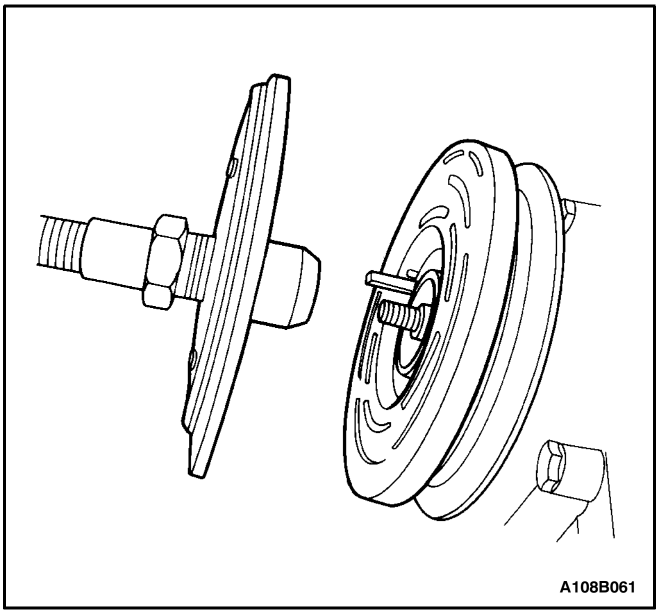
J-42428 Compressor Holding Fixture

Disassembly Procedure

1. Remove the compressor. Refer to "Compressor" in this section.
2. Install the compressor holding fixture J-42428 to the compressor and hold the compressor holding fixture using a bench vise.
3. Use the clutch hub holding tool J-33027 to keep the clutch drive plate and the hub assembly from turning. Remove the shaft nut.



4. Thread the hub and drive plate remover J-33013-B into the hub. Hold the body of the remover with a wrench and turn the center screw into the remover body to remove the clutch drive plate and the hub assembly.
5. Remove the clutch hub key. Retain the key for assembly.

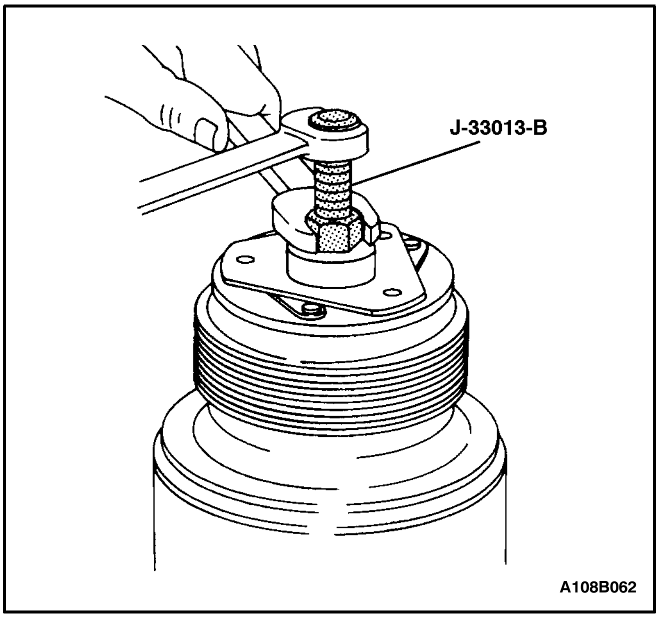


Assembly Procedure

1. Install the clutch hub key into the hub keyway. Allow the key to project approximately 3.2 mm (1/8 inch) out of the keyway. The hub key is curved slightly to provide an interference fit in the hub key groove.
2. Be sure the frictional surface of the clutch plate and the pulley rotor are clean before installing the clutch drive plate and the hub assembly.

Notice: Do not drive or pound on the clutch hub or the shaft. Internal damage to compressor may result.

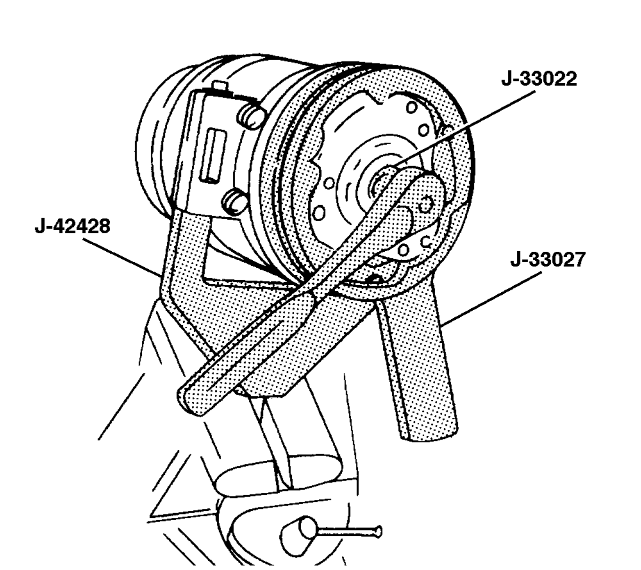
3. Align the clutch hub key with the shaft keyway. Place the clutch drive plate and the hub assembly onto the compressor shaft.



4. Remove the hub and drive plate remover/installer J-33013-B center bolt and reverse the body direction on the center bolt. The body of the hub and drive plate remover/installer J-33013-B should be backed off sufficiently to allow the center bolt to be threaded onto the end of the compressor shaft.

Important: If the center bolt is threaded fully onto the end of the compressor shaft, or if the body of the hub and drive plate remover/installer J-33013-B is held and the center bolt is rotated, the key will wedge and could break the clutch drive plate and the hub assembly.

5. Install the hub and drive plate remover/installer J-33013-B and the bearing onto the clutch drive plate. Thread the center bolt onto the compressor shaft.
6. Hold the center bolt with a wrench. Tighten the hex portion of the hub and drive plate remover/installer J-33013-B body to press the hub onto the shaft. Tighten the body several turns.
7. Remove the hub and drive plate remover/installer J-33013-B and check to see that the clutch hub key is still in place in the keyway before installing the clutch drive plate and the hub assembly to its final position. The air gap between frictional surfaces of the clutch drive plate and the clutch pulley rotor should be 0.38 to 0.64 mm (0.015 to 0.025 inch.).



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8. Remove the hub and drive plate remover/installer J-33013-B. Check for proper positioning of the clutch hub key. It should be even or slightly above the clutch hub.
9. Install the shaft nut. Hold the clutch drive plate and the hub assembly with the clutch hub holding tool J-33027. Use the shaft nut socket J-33022 and tighten the nut against the compressor shaft shoulder.

Tighten

Tighten the clutch plate and hub assembly nut to 17 N•m (13 lb-ft).

10. Spin the pulley rotor by hand to verify that the pulley is not rubbing the clutch drive plate.
11. Remove the compressor from the bend vise and remove the J-42428 compressor holding fixture on the compressor.
12. Install the compressor. Refer to "Compressor" in this section.

CLUTCH ROTOR AND BEARING

Tools Required

J-8433-3 Forcing Screw

J-6083 Snap Ring Pliers

J-9398-A Bearing Remover

J-9481 Bearing Installer

J-33020 Pulley Puller

J-33023-A Puller Pilot

J-33019 Bearing Staking Tool Set
Includes: J-33019-1 Bearing Staking Guide
J-33019-2 Bearing Staking Pin

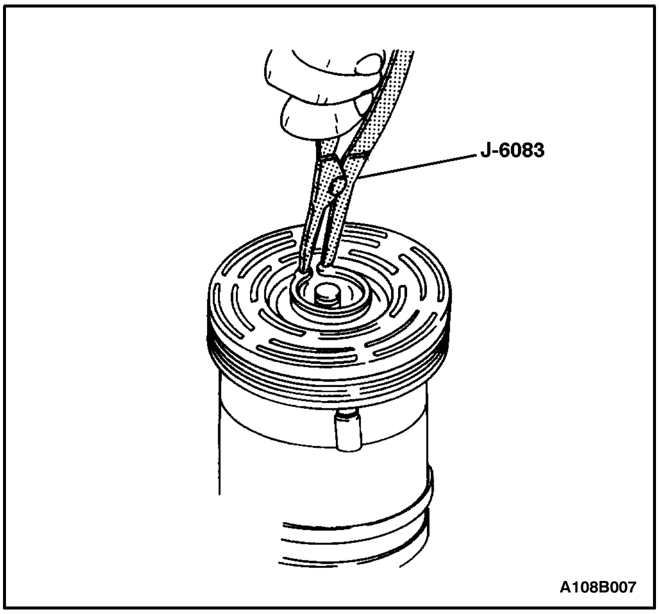
J-33017 Pulley Rotor and Bearing Assembly Installer

J-8433-1 Puller Crossbar

J-34992 Compressor Holding Fixture

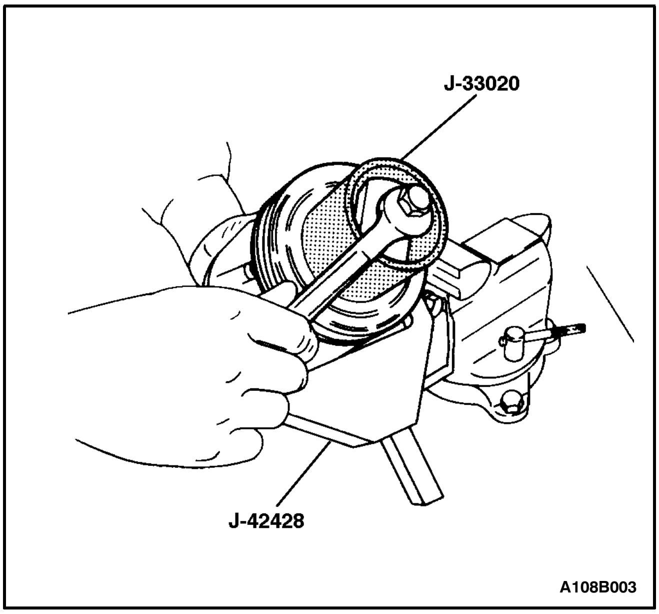
J-42428 Compressor Holding Fixture

J-8092 Driver Handle

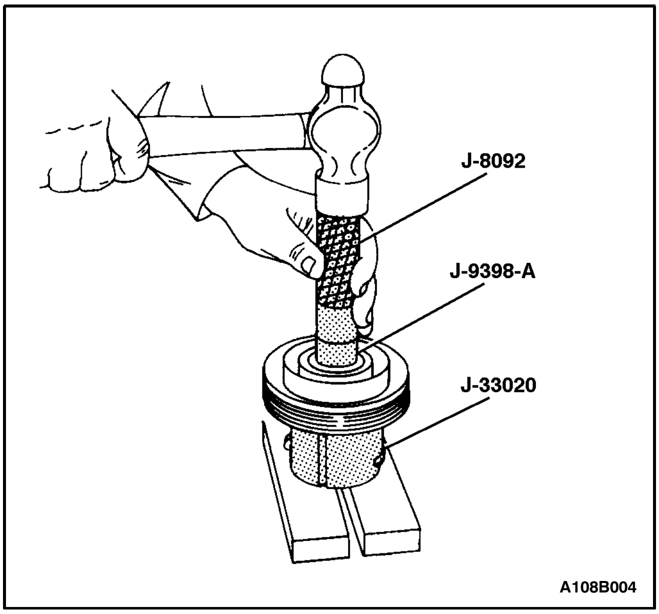


Disassembly Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging for A/C System" in this section.
3. Remove the compressor. Refer to "Compressor" in this section.
4. Remove the clutch drive plate and the hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
5. Remove the pulley rotor and the bearing assembly retaining ring using the snap ring pliers J-6083.



6. Install the pulley puller J-33020 into the inner circle of slots in the pulley rotor. Turn the pulley puller J-33020 clockwise in the slots to engage the puller tangs with the segments between the slots in the rotor.
7. Hold the pulley puller J-33020 in place and tighten the puller bolt against the compressor shaft to remove the pulley rotor and the bearing assembly.

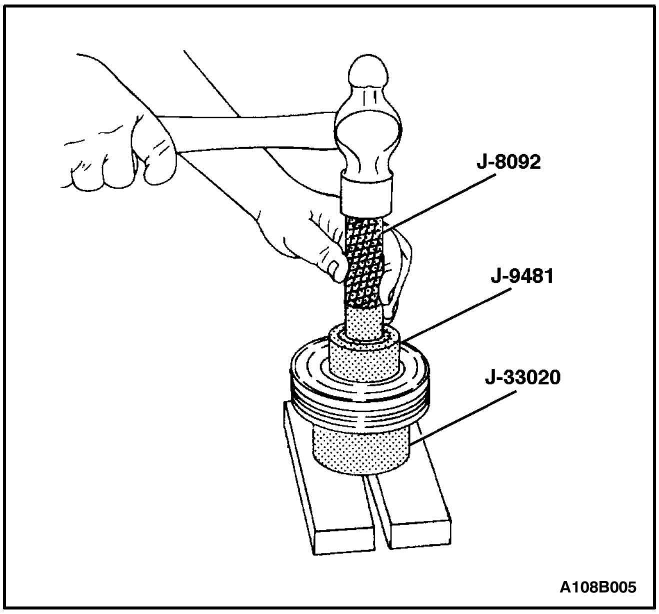


Notice: The rotor hub must be properly supported to prevent damage to the pulley rotor during bearing removal.

8. Remove the puller bolt from the pulley puller J-33020. With the puller tangs still engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks.

Notice: It is not necessary to remove the staking in front of the bearing to remove the bearing. It will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore or the bearing may be damaged.

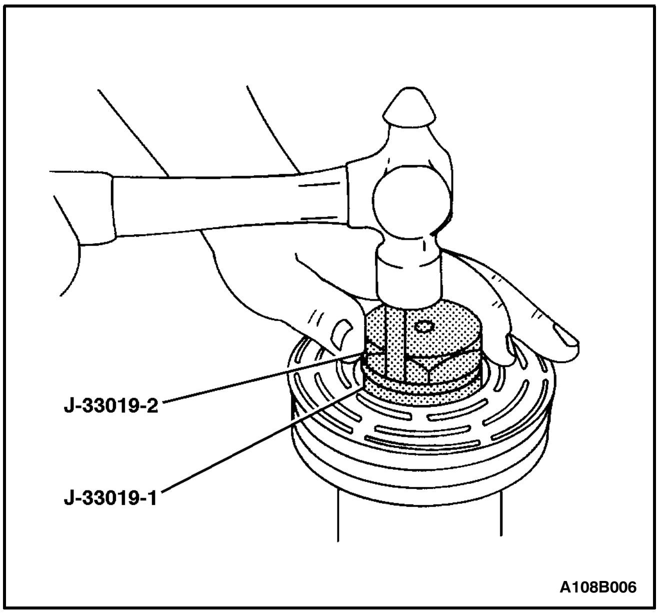
9. Drive the bearing out of the rotor hub with the bearing remover J-9398-A and the driver handle J-8092.



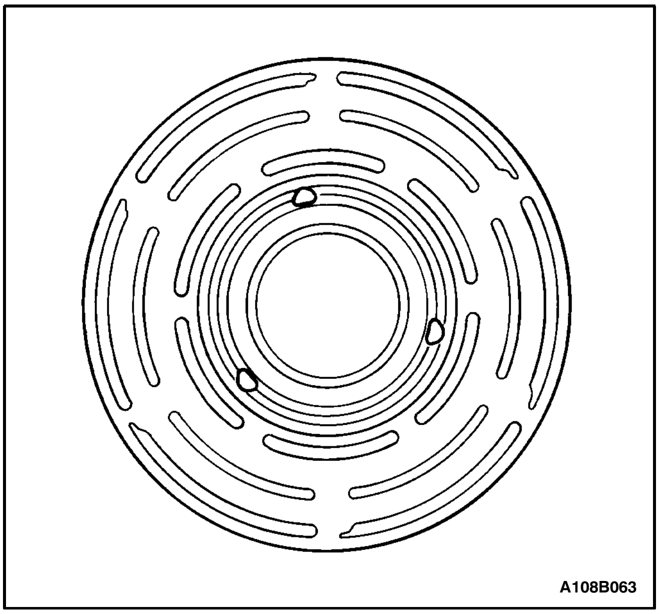
Assembly Procedure

Notice: Do not support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face could be damaged.

1. Invert the pulley rotor and place it on a support block to fully support the rotor hub during bearing installation.
2. Align the new bearing squarely in the pulley bore. Use the bearing installer J-9481 and the driver handle J-8092, drive the bearing fully into the pulley bore.



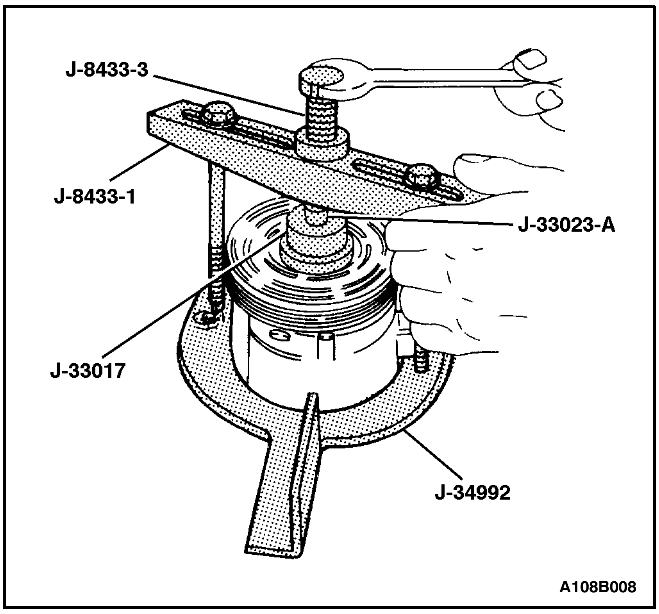
3. Place the bearing staking guide J-33019-1 and the bearing staking pin J-33019-2 in the rotor hub core. Shift the rotor and bearing assembly on the block to give full support to the hub under the staking pin location. A heavy-duty rubber band may be used to hold the staking tool pin in the guide. The pin should be properly positioned in the guide after each impact on the pin.



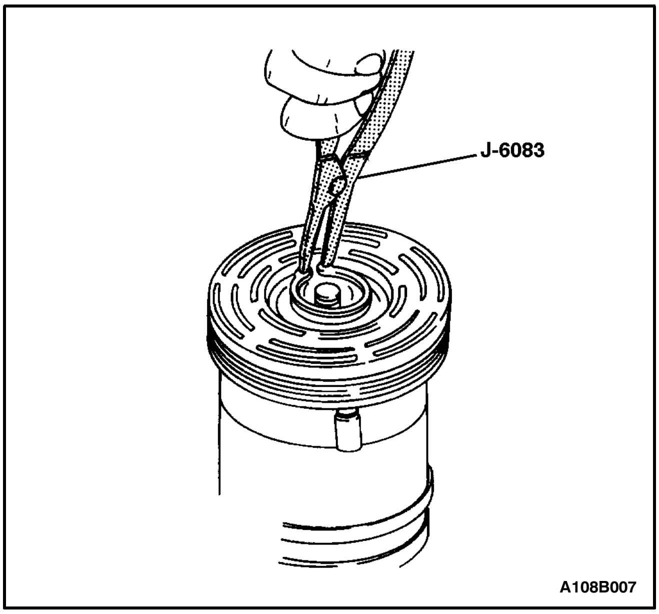
Caution: When striking the pin with a hammer, take care to avoid personal injury.

Notice: Make sure the metal stake does not contact the outer race of the bearing. Otherwise the outer race may become distorted.

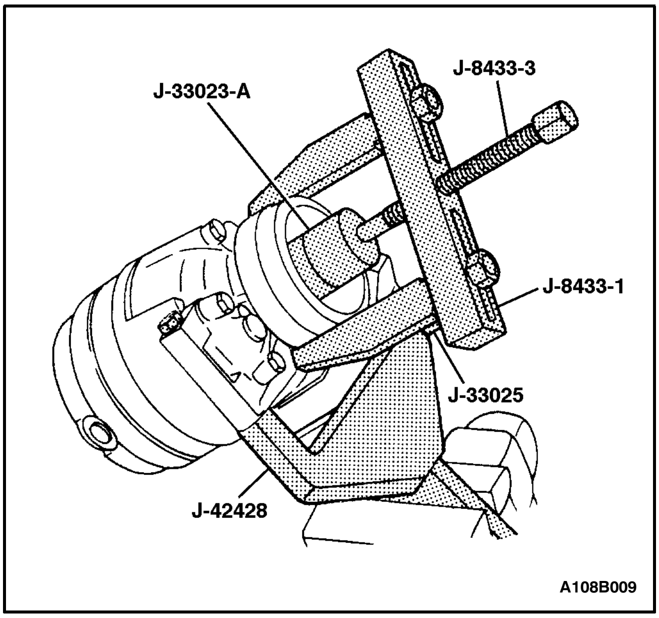
4. Strike the pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching, the bearing. The metal stake should not contact the outer race of the bearing to avoid the possibility of distorting the outer race. Stake in three places 120 degrees apart.



5. With the compressor mounted to the holding fixture J-34992, position the rotor and the bearing assembly on the compressor housing.
6. Position the pulley rotor and bearing assembly installer J-33017 and the puller pilot J-33023-A directly over the inner race of the bearing.
7. Position the puller crossbar J-8433-1 center forcing bolt on the puller pilot J-33023-A and assemble the two through-bolts and the washers through the puller crossbar J-8433-1 slots. Thread them into the holding fixture J-34992. The thread of the through-bolts should engage the full thickness of the fixture.
8. Tighten the center forcing screw J-8433-3 in the puller crossbar J-8433-1 to force the pulley rotor and the bearing assembly onto the compressor housing.



9. Install the rotor and the bearing assembly retainer ring using the snap ring pliers J-6083.
10. Reinstall the clutch drive plate and the hub assembly. Refer to "Clutch Drive Plate and Hub Assembly" in this section.
11. Install the compressor. Refer to "Compressor" in this section.
12. Connect the negative battery cable.
13. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging A/C System" in this section.



CLUTCH COIL

Tools Required

J-8433-1 Puller Crossbar

J-8433-3 Forcing Screw

J-33023-A Puller Pilot

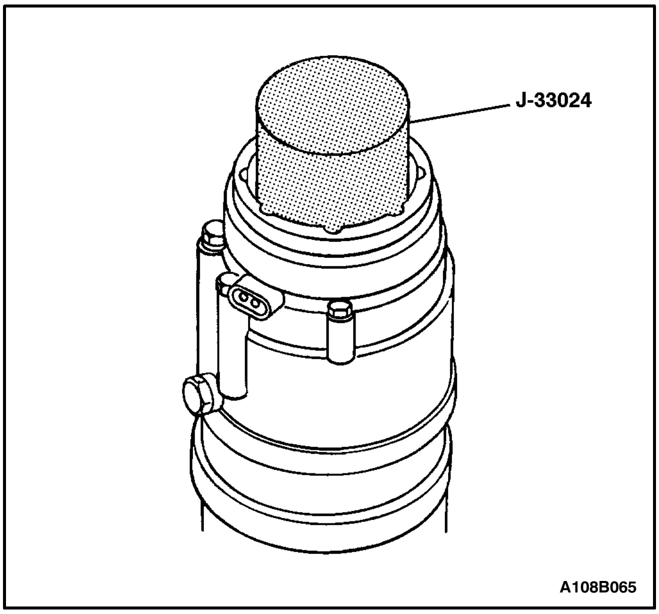
J-33024 Clutch Coil Installer Adapter

J-33025 Clutch Coil Puller Legs

J-34992 Compressor Holding Fixture

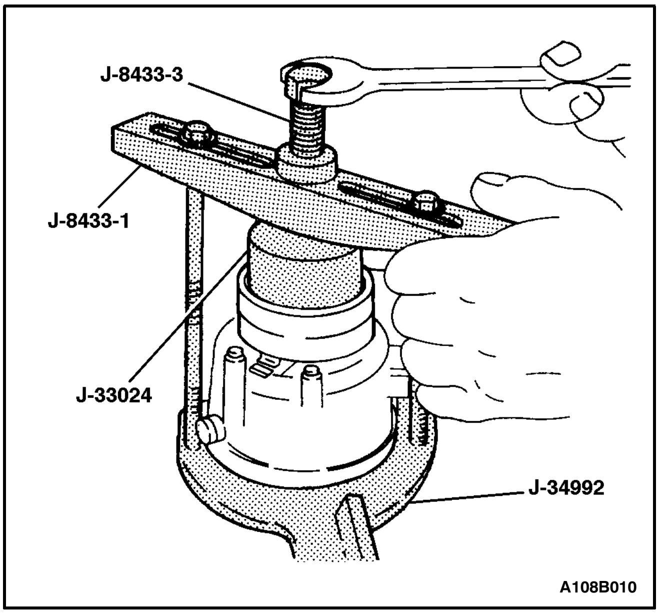
Disassembly Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the compressor. Refer to "Compressor" in this section.
4. Remove the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
5. Remove the clutch rotor and bearing. Refer to "Clutch Rotor and Bearing" in this section.
6. Mark the clutch coil terminal location on the compressor housing.
7. Install the puller pilot J-33023-A on the compressor housing. Also install the puller crossbar J-8433-1 with the clutch coil puller legs J-33025.
8. Tighten the forcing screw J-8433-3 against the puller pilot J-33023-A to remove the clutch coil.



Assembly Procedure

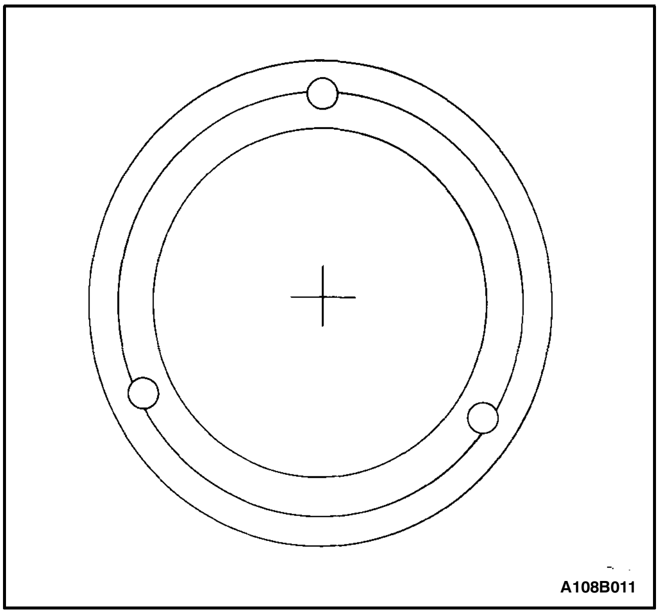
1. Place the clutch coil assembly on the compressor housing with the terminals positioned at the "marked" location.
2. Place the clutch coil installer adapter J-33024 over the internal opening of the clutch coil housing and align the clutch coil installer adapter J-33024 with the compressor housing.



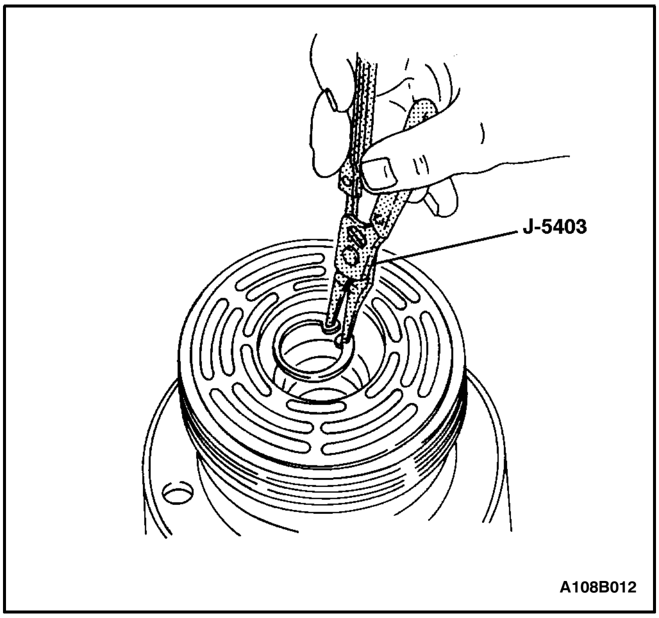
3. Center the puller crossbar J-8433-1 in the countersunk center hole of the clutch coil installer adapter J-33024. Install the compressor holding fixture J-34992 through-bolts and the washers through the crossbar slots. Thread them into the holding fixture to the full thickness of the holding fixture.

Important: Be sure the clutch coil and the installer stay "in-line" during installation.

4. Turn the forcing screw J-8433-3, or use a suitable vise, to force the clutch coil onto the compressor housing.



5. When the clutch coil is fully seated on the compressor housing, use a 3 mm (1/8 inch) diameter drift punch and stake the housing at three places, 120 degrees apart, to ensure that the clutch coil will remain in position. Stake point size should be only one-half the area of the punch tip and approximately 0.28 to 0.35 mm (0.010 to 0.015 inch) deep.
6. Install the clutch rotor and bearing assembly. Refer to "Clutch Rotor and Bearing" in this section.
7. Install the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
8. Install the compressor. Refer to "Compressor" in this section.
9. Connect the negative battery cable.
10. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



SHAFT SEAL REPLACEMENT

Tools Required

J-5403 Snap Ring Pliers

J-9553-1 O-Ring Remover

J-23128-A Seal Seat Remover/Installer

J-33011 O-Ring Installer

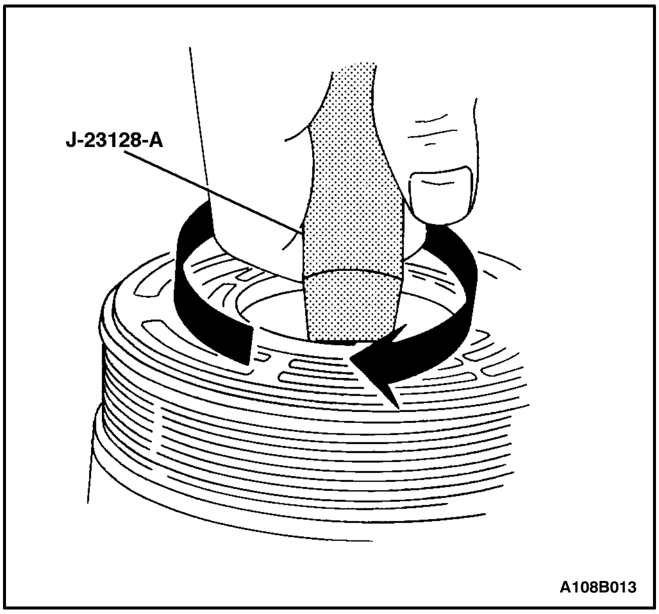
J-34614 Shaft Seal Protector

Important: A shaft seal should not be replaced because a small amount of oil is found on the adjacent surface. The seal is designed to leak some oil for lubrication purposes. A shaft seal should be changed only when a large amount of sprayed oil is found and then only after actual refrigerant leakage is found by using an approved leak detection procedure. Refer to "Leak Testing the Refrigerant System" in this section.

Should a compressor shaft seal ever have to be replaced, the receiver-dryer in this system must also be removed from the vehicle. The oil in the receiver-dryer must then be drained, measured and replaced. Refer to "Adding Oil to the Air Conditioning Refrigerant System" in this section.

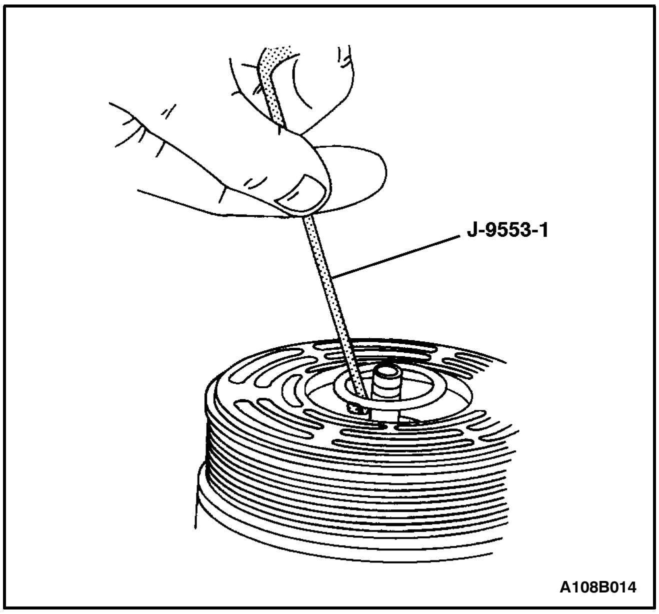
Disassembly Procedure

1. Disconnect the negative battery cable.
2. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Loosen and reposition the compressor in the mounting brackets.
4. Remove the clutch drive plate and hub assembly from the compressor. Refer to "Clutch Plate and Hub Assembly" in this section.
5. Use the snap ring pliers J-5403 to remove the shaft seal retaining ring.

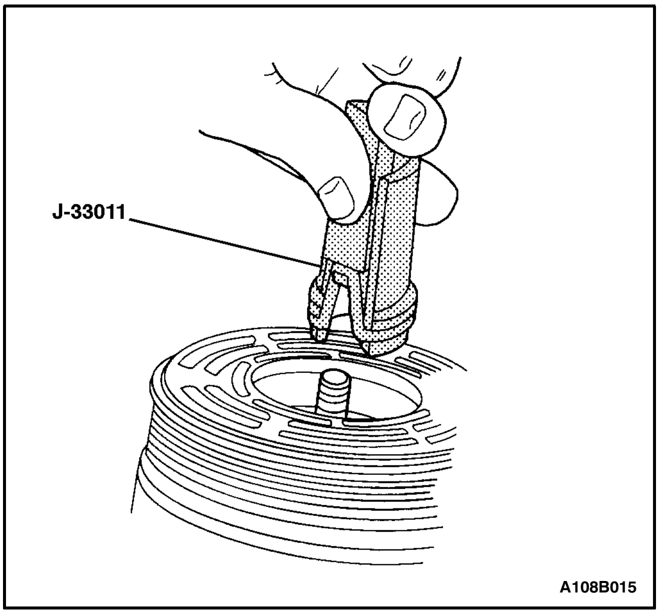


Notice: Any dirt or foreign material that enters the compressor may cause damage.

6. Thoroughly clean the inside of the compressor housing area surrounding the shaft, the exposed portion of the seal, the shaft itself, and the O-ring groove.
7. Fully engage the knurled tangs of the seal seat remover/installer J-23128-A into the recessed portion of the seal by turning the handle clockwise. Remove and discard the seal from the compressor with a rotating-pulling motion. The handle should be hand-tightened securely. Do not use a wrench or pliers to tighten the handle.



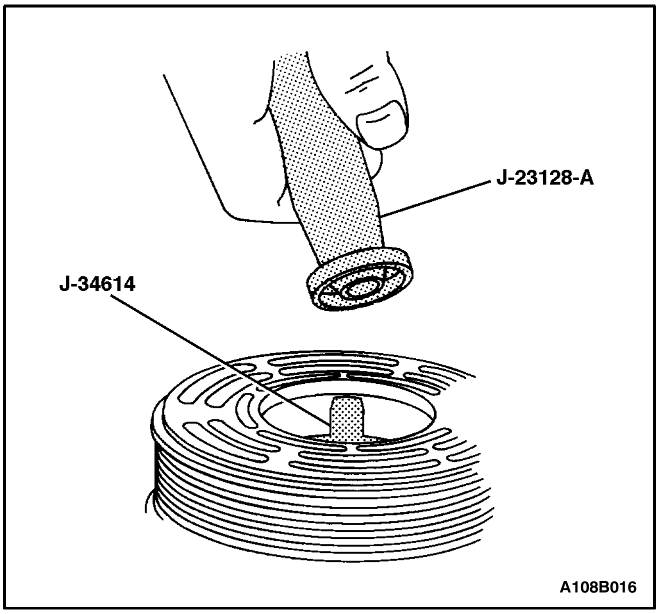
8. Remove and discard the O-ring from the compressor neck using the O-ring remover J-9553-1.
9. Thoroughly clean the seal O-ring groove in the compressor housing.
10. Inspect the shaft and the inside of the compressor housing neck for dirt or foreign material. These parts must be perfectly clean before installing any new parts.



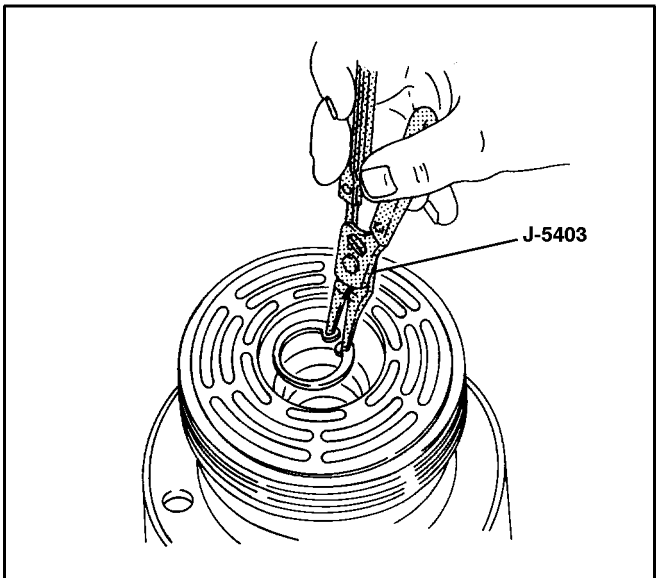
Assembly Procedure

Important: Seals must not be reused. Always use a new specification service seal kit. Be sure that the seal to be installed is not scratched or damaged in any way. The seal must be free of lint and dirt that may damage the seal surface or prevent proper sealing.

1. Dip the new seal O-ring in clean polyalkaline glycol (PAG) refrigerant oil and assemble the O-ring onto the O-ring installer J-33011.
2. Insert the O-ring installer J-33011 into the compressor neck until the installer "bottoms." Lower the moveable slide of the O-ring installer J-33011 to release the O-ring into the seal O-ring lower groove. (The top groove of the compressor neck is for the shaft seal retainer ring.) Rotate the installer to seat the O-ring and then remove the installer.



3. Attach the shaft lip seal to the seal seat remover/installer J-23128-A. Dip the seal in clean PAG oil.
4. Install the shaft seal protector J-34614 in the seal. Place it over the shaft and push the seal into place with a rotary motion.



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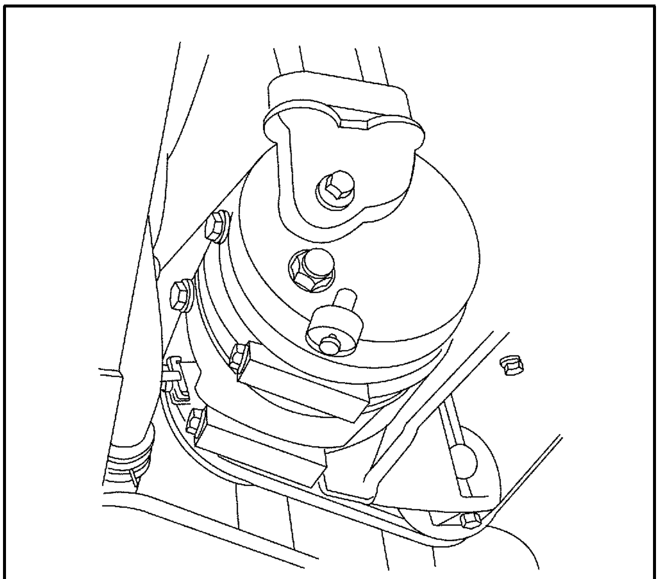
5. Use the snap ring pliers J-5403 to install the shaft seal retaining ring with its flat side against the seal.
6. Remove any excess oil around the shaft and the inside of the compressor housing neck.
7. Install the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
8. Reposition the compressor in its mounting.
9. Adjust the tension on the drive belt.
10. Connect the negative battery cable.
11. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
12. Perform a leak test of the system. Refer to "Leak Testing the Refrigerant System" in this section.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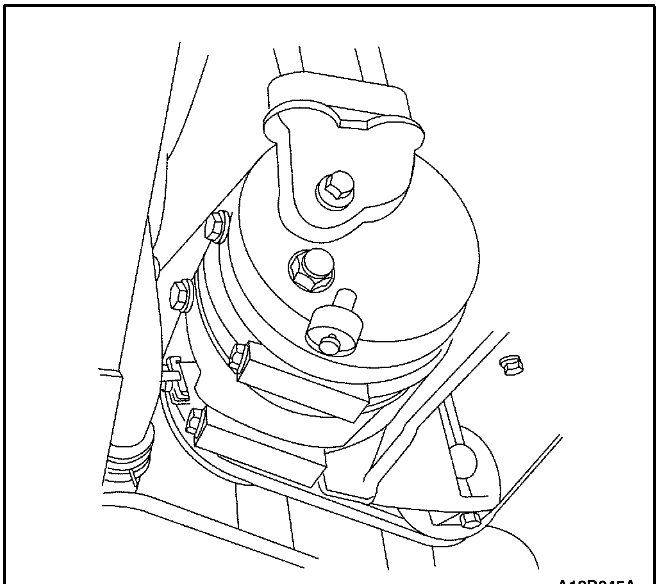
PRESSURE RELIEF VALVE

Disassembly Procedure

1. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
2. Raise the vehicle.
3. Remove the pressure relief valve.
4. Clean the valve seat area.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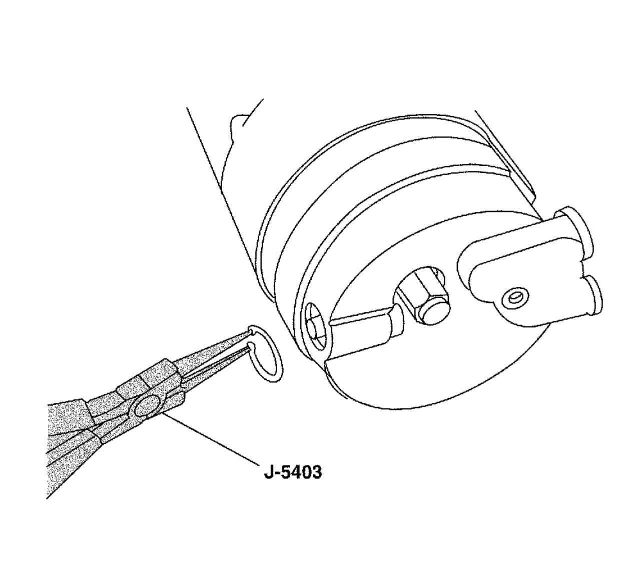
Assembly Procedure

1. Lubricate the O-ring of the new pressure relief valve with new polyalkiline glycol (PAG) oil.
2. Install the new valve.

   #### Tighten

   Tighten the pressure relief valve to 17 N•m (12 lb-ft).
3. Lower the vehicle.
4. Evacuate and recharge the system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



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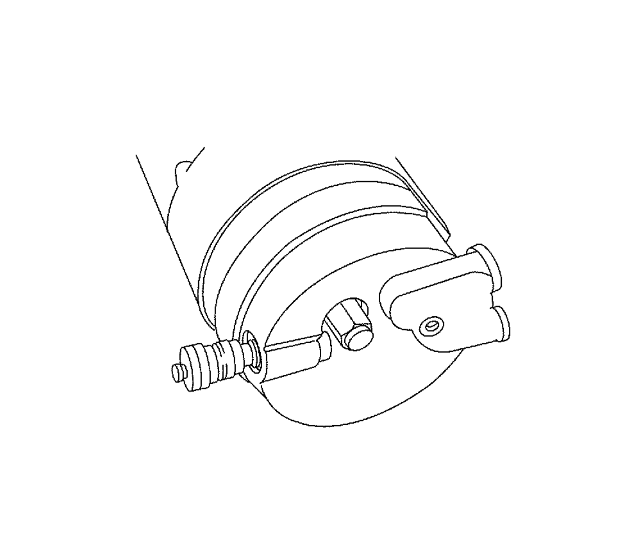
CONTROL VALVE ASSEMBLY

Tools Required

J-5403 Snap Ring Pliers

Disassembly Procedure

1. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
2. Remove the control valve retaining ring using the snap ring pliers J-5403.
3. Remove the control valve assembly.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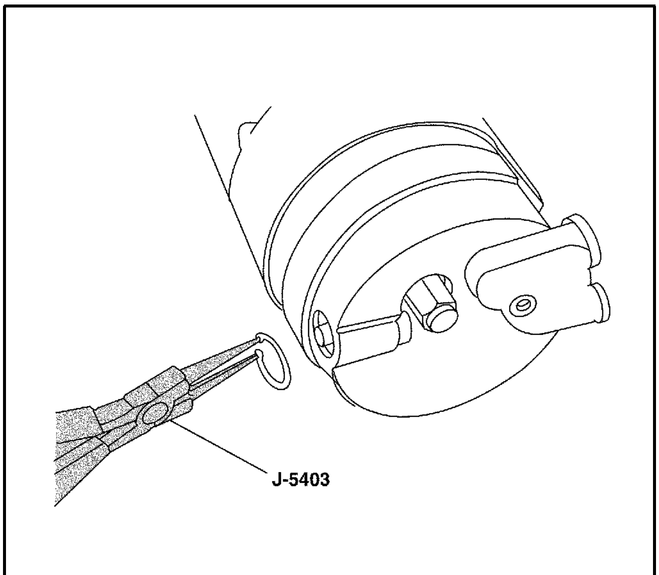
Assembly Procedure

1. Coat all the O-rings with clean polyalkaline glycol (PAG) oil.
2. Push the control valve in place using thumb pressure.



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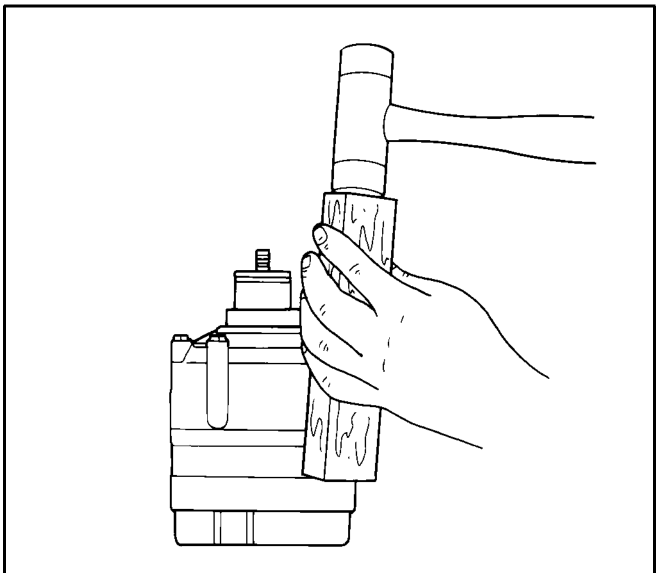
3. Use the snap ring pliers J-5403 to install the valve retaining ring. The high point of the curved sides must be against the valve housing. Be sure the retaining ring is properly seated in the ring groove.
4. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.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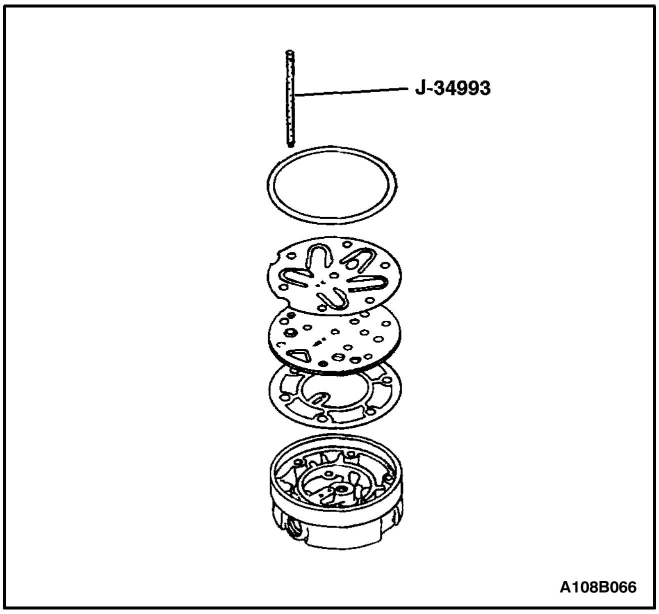
REAR HEAD, GASKET, VALVE PLATE, REED PLATE, AND O-RING

Tools Required

J-34993 Cylinder Alignment Rods

Disassembly Procedure

1. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
2. Discharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
3. Remove the compressor. Refer to "Compressor" in this section.
4. Drain the oil from compressor into a suitable container. Measure and record the amount of oil drained from the compressor. Discard the used oil.
5. Remove the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
6. Remove the clutch rotor and bearing. Refer to "Clutch Rotor and Bearing" in this section.
7. Remove the clutch coil. Refer to "Clutch Coil" in this section.
8. Remove the compressor through-bolts. Remove and discard the gaskets.
9. Using a wooden block and a plastic-headed hammer, tap around the edge of the rear head to disengage the head from the compressor cylinder. Separate the rear head, the head gasket, the rear valve plate, the suction reed plate, and the cylinder to rear head O-ring. Discard the head gasket and the O-ring.



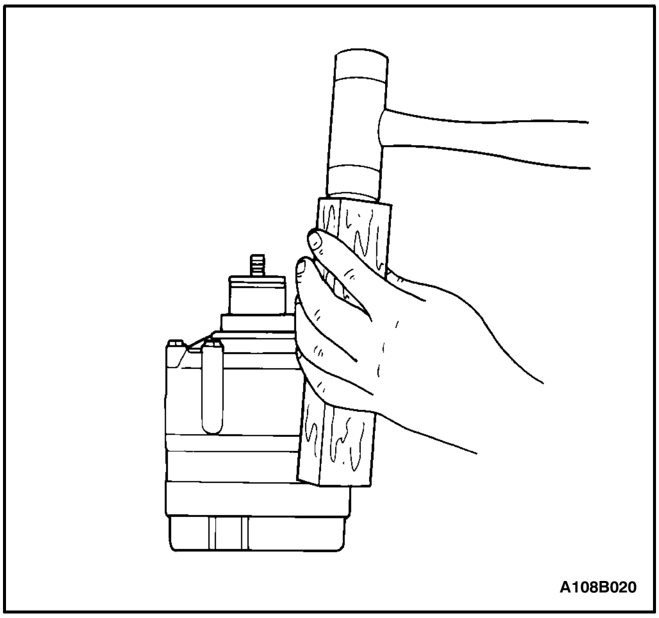
Assembly Procedure

1. Place the rear head on a clean, flat surface. Position the head with the control valve at the 6 o'clock position.
2. Install the cylinder alignment rods J-34993 in the mounting holes at the 11 o'clock and the 5 o'clock positions.
3. Install the head gasket over the cylinder alignment rods J-34993 with the elongated hole at the upper left pin (the 11 o'clock position).
4. Install the rear head valve plate over the cylinder alignment rods J-34993 with the elongated hole at the upper left alignment rod. Lower the rear head valve plate into place.
5. Install the suction reed plate over the cylinder alignment rods J-34993. Remove the alignment rod at the 5 o'clock position.
6. Lubricate the cylinder to the new rear head O-ring with clean polyalkaline glycol (PAG) refrigerant oil.
7. Install the O-ring in the cylinder O-ring groove. The O-ring seal surface of the head may be lubricated to ease assembly.
8. With the O-ring in place on the rear of the cylinder assembly, locate the relief boss for the alignment rod at the 6 o'clock position, directly above the hole in the side of the rear head. Carefully lower the cylinder and the front head assembly over the cylinder alignment rods to the rear head.
9. Press the cylinder and the compressor housing assembly down onto the rear head using both hands.
10. Add the new through-bolt gasket to the through-bolts and install it into the compressor assembly. Four of the through-bolts must thread into the rear head before removing the alignment rods.

Tighten

Alternately tighten the compressor front head-to-rear head through-bolts in progressive torque sequence to 10 N•m (89 lb-in).

11. Add new PAG refrigerant oil as determined in step 1.
12. Place the shaft nut on the shaft and rotate the compressor shaft several times.
13. Perform a leak test on the compressor. Refer to "Leak Testing (External)" in this section.
14. Install the clutch coil. Refer to "Clutch Coil" in this section.
15. Install the clutch rotor and bearing. Refer to "Clutch Rotor and Bearing" in this section.
16. Install the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
17. Install the compressor. Refer to "Compressor" in this section.
18. Evacuate and recharge the A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



CYLINDER TO FRONT HEAD O-RING

Tools Required

J-34993 Cylinder Alignment Rods

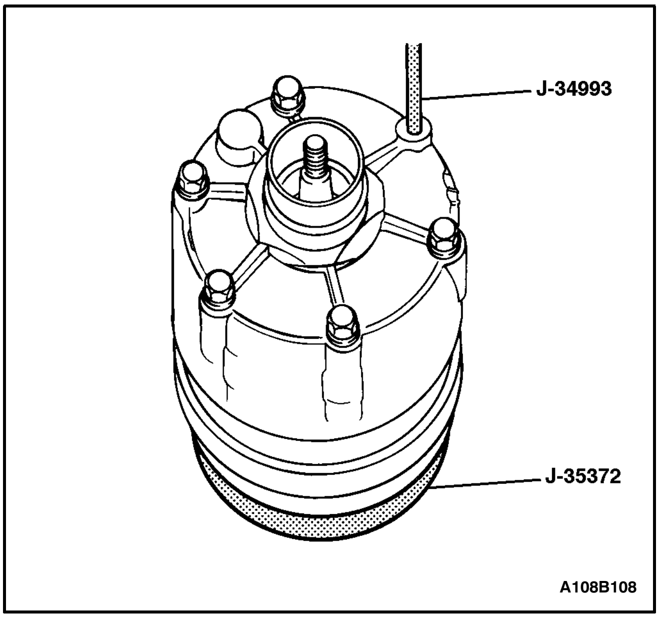
J-35372 Support Block

Disassembly Procedure

1. Recover the refrigerant. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.
2. Remove the compressor. Refer to "Compressor" in this section.
3. Drain the oil from compressor into a suitable container. Measure and record the amount of oil drained from the compressor. Discard all used oil.
4. Remove the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
5. Remove the clutch rotor and bearing. Refer to "Clutch Rotor and Bearing " in this section.
6. Remove the clutch coil. Refer to "Clutch Coil" in this section.
7. Remove and discard the shaft seal parts. Refer to "Shaft Seal Replacement" in this section.
8. Remove the compressor through-bolts. Remove and discard the gaskets.
9. Using a wooden block and a plastic-headed hammer, tap the compressor housing at the mounting locations to disengage the housing from the compressor cylinder.

Important: Note the assembly sequence of the thrust washer and bearing for ease of assembly.

10. Remove the thrust washer and the bearing.
11. Remove and discard the compressor housing-to-cylinder O-ring.



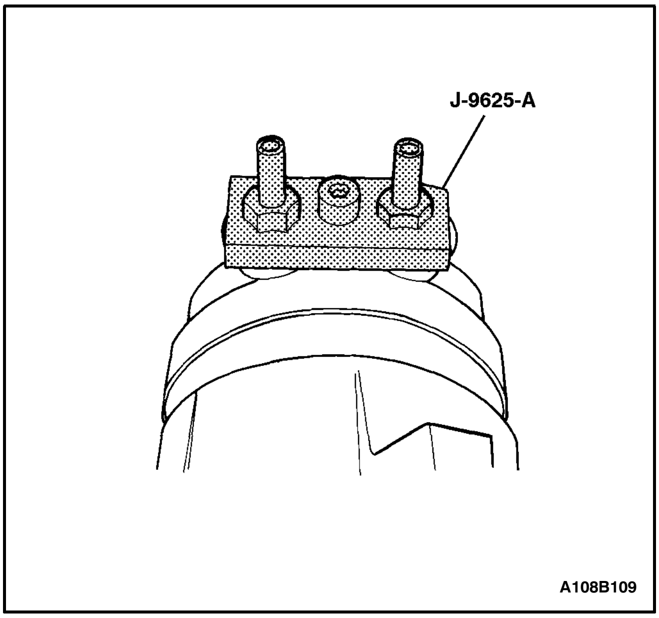
Assembly Procedure

1. Rest the rear head on the support block J-35372. Locate the control valve at the 6 o'clock position.
2. Install cylinder alignment rods J-34993 through the 11 o'clock and the 5 o'clock bolt holes.
3. Lubricate the new cylinder-to-compressor housing O-ring with clean polyalkaline glycol (PAG) oil.
4. Install the new O-ring in the cylinder O-ring groove.
5. Install the thrust washer and bearing in the same order as they were removed.
6. Align the cylinder alignment rod recess in the compressor housing with the cylinder alignment rod. Press down on the compressor housing with both hands to force it over the O-ring on the cylinder assembly.
7. Add a new through-bolt gasket to the through-bolts and install them into the compressor assembly. Four through bolts must thread into the rear head before removing the cylinder alignment rods.

Tighten

Alternately tighten the compressor front head-to-rear head through-bolts in progressive torque sequence to 10 N•m (89 lb-in).

8. Install a new shaft seal. Refer to "Shaft Seal Replacement" in this section.
9. Add new PAG oil equal to the amount drained in Step 3.
10. Install the clutch coil. Refer to "Clutch Coil" in this section.
11. Install the clutch rotor and bearing. Refer to "Clutch Rotor and Bearing" in this section.
12. Install the clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" in this section.
13. Perform a leak test on the compressor. Refer to "Leak Testing (External)" in this section.
14. Install the compressor. Refer to "Compressor" in this section.
15. Evacuate and recharge A/C system. Refer to "Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System" in this section.



LEAK TESTING (EXTERNAL)

Tools Required

J-9625-A Pressure Test Set Connectors

1. Install the pressure test set connectors J-9625-A to the suction/discharge ports on the compressor.
2. Attach the center hose of the manifold gauge set on the charging station to a refrigerant drum standing in an upright position. Open the valve on the drum.
3. Connect the charging station high and low pressure lines to the corresponding fittings on the pressure test set connectors J-9625-A (or hoses equipped with valve depressors). The suction port (low-side) of the compressor has a large internal opening. The discharge port (high-side) has a smaller internal opening into the compressor.
4. Open the low pressure control, the high pressure control and the refrigerant control on the charging station to allow the refrigerant vapor to flow into the compressor.
5. Using a leak detector, check for leaks at the high pressure relief valve seal, the housing seal, the rear head seal, the center cylinder seal, the through-bolt gaskets, and the compressor shaft seal. After checking for leaks, shut off the low pressure control, the high pressure control and the refrigerant control lines on the charging station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to verify that the leak has been corrected.
7. Loosen the manifold gauge hose connections to the gauge adapters connected to the low and high sides. Allow the vapor pressure to release from the compressor. If valve depressor-type hoses are used, loosen the hose connections at the gauge manifold to release vapor pressure from the compressor.
8. Disconnect both gauge hoses. Remove the pressure test set connectors J-9625-A.

GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL INFORMATION

THE V5 A/C SYSTEM

The V5 variable displacement compressor along with the thermal expansion valve on the evaporator, constitutes a largely self-regulating system. There is no pressure cycling switch, no high-pressure cutoff switch, and no low-pressure cutoff switch. The compressor clutch is controlled by the electronic control module (ECM), which receives data from various engine systems and from a pressure transducer located in the high-pressure refrigerant pipe. In normal operation, the clutch is engaged continuously. Should one of the monitored conditions become abnormal, the ECM will disengage the compressor clutch until normal operation is restored. The following conditions are monitored:

- Wide open throttle.
- High engine coolant temperature.
- High engine RPM.
- Refrigerant low pressure.
- Refrigerant high pressure.

SYSTEM COMPONENTS – FUNCTIONAL

Compressor

All compressors are belt-driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft is driven, it compresses the low-pressure refrigerant vapor from the evaporator into a high-pressure, high temperature vapor. The refrigerant oil which is used to lubricate the compressor is carried with the refrigerant. Refer to "Minor V5 Compressor Repair" and "Major V5 Compressor Repair" in this section for complete overhaul procedures.

Pressure Relief Valve

The compressor is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure. In order to prevent system damage, the valve is designed to open automatically at 3 171 to 4 137 kPa (460 to 600 psi) in an R-134a system. Conditions that might cause this valve to open, such as a defective pressure transducer, an inoperative cooling fan, etc., should be corrected and the refrigerant oil and refrigerant should be replaced as necessary.

Condenser Core

The condenser assembly in front of the radiator consists of coils which carry the refrigerant and cooling fins that provide the rapid transfer of heat. The air passing through the condenser cools the high-pressure refrigerant vapor and causes it to condense into a liquid.

Expansion Valve

The expansion valve is attached to the evaporator core inside the heater/air distribution case.

The expansion valve can fail in three different positions: open, closed, or restricted.

An expansion valve that fails in the open position will result in a noisy A/C compressor or no cooling. The cause can be a broken spring, a broken ball, or excessive moisture in the A/C system. If the spring or the ball are found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system, recycle the refrigerant.

An expansion valve that fails in the closed position will result in low suction pressure and no cooling. This may be caused by a failed power dome or excessive moisture in the A/C system. If the power dome on the expansion valve is found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system, recycle the refrigerant.

A restricted expansion valve will result in low suction pressure and no cooling. This may be caused by debris in the refrigerant system. If debris is believed to be the cause, recycle the refrigerant, replace the expansion valve, and replace the receiver/dryer.

Evaporator Core

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High-pressure liquid refrigerant flows through the expansion tube (orifice) and becomes a low-pressure gas in the evaporator. The heat in the air passing through the evaporator core is transferred to the cooler surface of the core, which cools the air. As the process of heat transfer from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

Receiver-Dryer

The sealed receiver-dryer assembly is connected to the evaporator outlet pipe. It acts as a refrigerant storing container, receiving liquid and some vapor and refrigerant oil from the evaporator.

At the bottom of the receiver-dryer is the desiccant, which acts as a drying agent for the moisture that may have entered the system. An oil bleed hole is located near the bottom of the receiver-dryer outlet pipe to provide an oil return path to the compressor. The receiver-dryer is serviceable only as an assembly.

Heater Core

The heater core heats the air before it enters the vehicle. Engine coolant is circulated through the core to heat the outside air passing over the fins of the core. The core is functional at all times and may be used to temper conditioned air in the A/C mode as well as in the heat or the vent mode.

SYSTEM COMPONENTS – CONTROL

Controller

The operation of the A/C system is controlled by the switches and the lever on the control head. This connects electrically to the blower and the electronic control module (ECM) through wiring harnesses. It also connects mechanically to the various doors in the heater/air distribution case by cables. Refer to Section 7A, Heating and Ventilating System for operating details.

The electric engine cooling fans are operational anytime the A/C control is on. This added feature is part of the A/C controller function and is aimed at preventing excessive compressor head temperatures. It also allows the A/C system to function more efficiently. The operation of the cooling fans is controlled by the ECM through the cooling fan relays.

Pressure Transducer

Pressure transducer switching incorporates the functions of the high-pressure and the low-pressure cutout switches along with the fan cycling switch. The pressure transducer is located in the high-side liquid refrigerant line on a connecting block near the right front strut tower. The output from this pressure transducer goes to the ECM which controls the compressor function based on the pressure signal.

Wide-Open Throttle (WOT) Compressor Cutoff

During full throttle acceleration, the throttle position sensor (TPS) sends a signal to the ECM, which then controls the compressor clutch.

A/C Time Delay Relay

This relay on some vehicles controls the current to the entire A/C system and provides a short delay of A/C operation upon start-up.

V5 COMPRESSOR – GENERAL DESCRIPTION

Vehicles using the V5 compressor may have differences between installations in the mounting brackets, the drive systems, the pulleys, the connections, and the system capacities. Basic unit repair procedures are similar between the compressors used on different vehicles.

When servicing the compressor, keep dirt and foreign material from getting on or into the compressor parts and the system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any on-vehicle repairs and before the removal of the compressor. The parts must be kept clean at all times and any parts that are to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvents and dried with dry air. Use only lint-free cloths to wipe the parts.

The operations described are based on bench unit repair with the compressor removed from the vehicle, except as noted. They have been prepared in the order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained, measured and recorded. This oil should then be discarded and new polyalkaline glycol (PAG) refrigerant oil added to the compressor.

Important: The oil drain plug must be removed and the oil drained through the plug opening to insure complete draining of oil from the compressor.

V5 COMPRESSOR – DESCRIPTION OF OPERATION

The V5 is a variable displacement compressor that can match the automotive air conditioning (A/C) demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with five axially oriented cylinders. The center of control of the compressor displacement is a bellows-actuated control valve located in the rear head of the compressor that senses compressor suction pressure.

The wobble-plate angle and the compressor displacement are controlled by the crankcase suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point. The valve will maintain a bleed from crankcase to suction. With no crankcase suction pressure differential, the compressor will have maximum displacement.

When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The angle of the wobble-plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase suction pressure differential creates total force on the pistons resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

The compressor has a unique lubrication system. The crankcase suction bleed is routed through the rotating wobble-plate for lubrication of the wobble-plate bearing. The rotation acts as an oil separator which removes some of the oil from the crankcase suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.

SECTION 8A

SEAT BELTS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

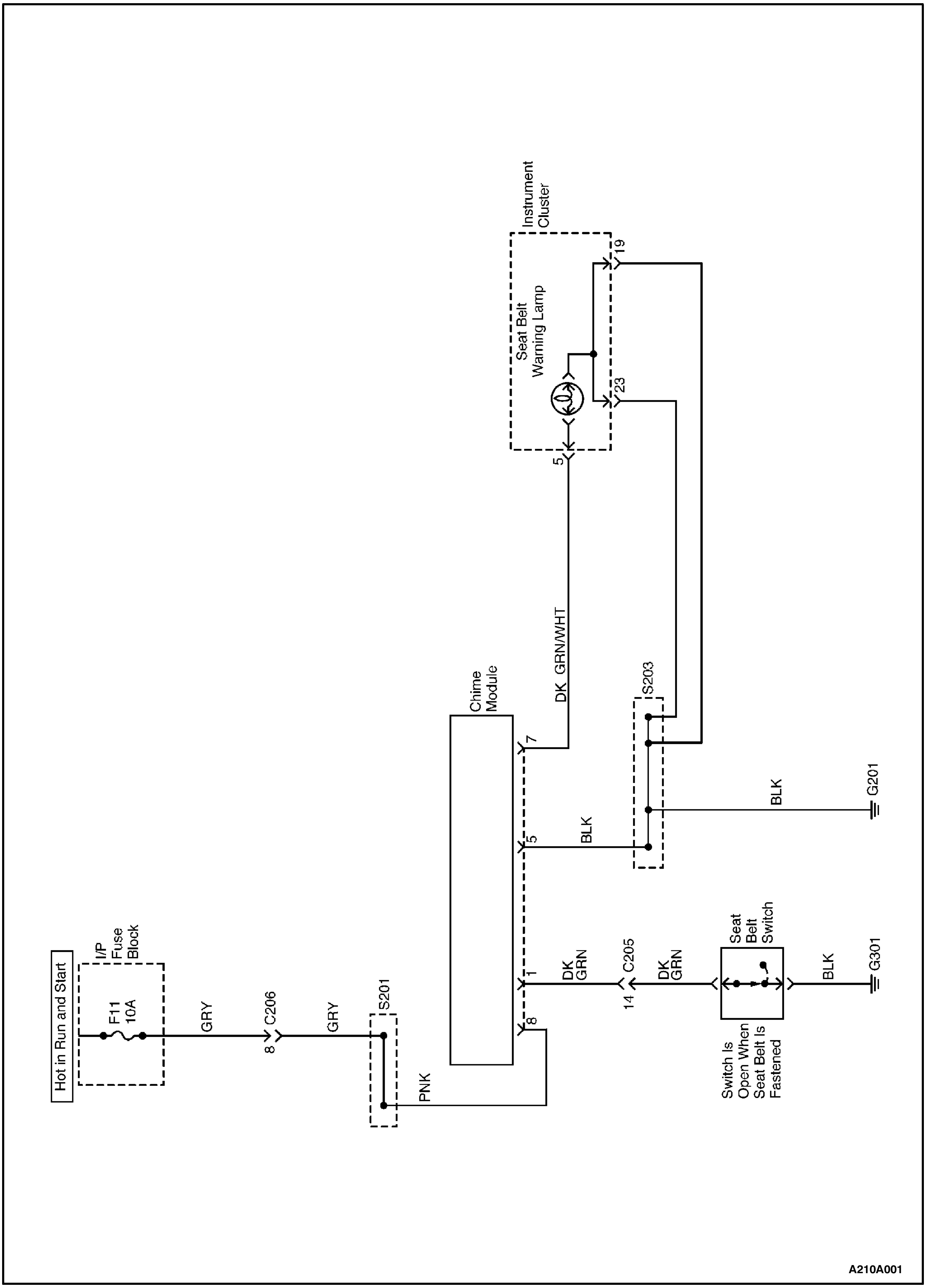
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Child Seat Tether Anchor Bolts	25	18	-
Seat Belt Anchor Bolt	35	26	-
Seat Belt Bracket Screws	10	-	89
Seat Belt Height Adjuster Bolts	19	14	-
Seat Belt Retractor Screw	10	-	89

SCHEMATIC AND ROUTING DIAGRAMS

DRIVER SEAT BELT WARNING



DIAGNOSIS

SEAT BELT WARNING LAMP IS INOPERATIVE

Diagnostic Aids

The chime module is located above the I/P fuse block.

Seat Belt Warning Lamp Is Inoperative

Step	Action	Value	Yes	No
1	Check fuse F11. Is fuse F11 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Use a multimeter to check the voltage at fuse F11. Does the voltmeter show the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit for fuse F11. Is the repair complete?	-	System OK	-
5	1. Disconnect the chime module connector. 2. Turn the ignition ON. 3. Check the voltage at terminal 8 of the chime module connector. Is the voltage equal to the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuse F11 and the chime module. Is the repair complete?	-	System OK	-
7	1. Make sure the seat belt is unfastened. 2. With the chime module connector disconnected, use an ohmmeter to measure continuity between terminal 1 of the chime module and ground. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 13	Go to Step 8
8	1. Make sure the seat belt is unfastened. 2. Disconnect the seat belt connector under the driver's seat. 3. Use an ohmmeter to measure between the two terminals at the switch side of the connector. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 9	Go to Step 12
9	While the seat belt connector is disconnected, measure the continuity between the terminal for the BLK wire and ground. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 10	Go to Step 11
10	Repair the open circuit between the seat belt connector and ground. Is the repair complete?	-	System OK	-
11	Repair the open circuit between the chime module terminal 1 and the seat belt switch. Is the repair complete?	-	System OK	-
12	Replace the seat belt switch. Is the repair complete?	-	System OK	-

Seat Belt Warning Lamp Is Inoperative (Cont'd)

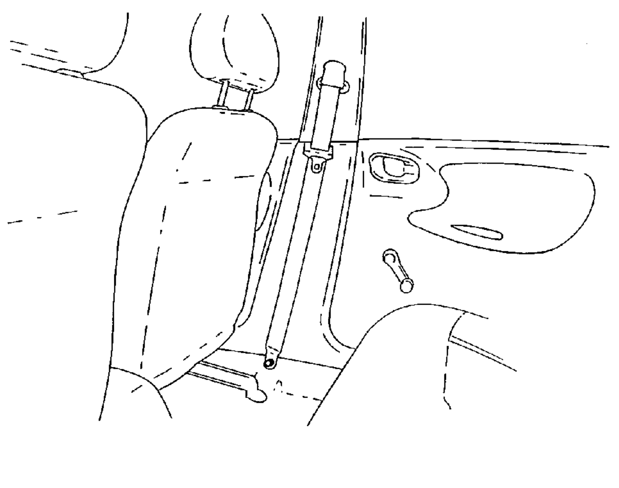
Step	Action	Value	Yes	No
13	With the chime module disconnected, use an ohmmeter to measure continuity between terminal 5 of the chime module and ground. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 15	Go to Step 14
14	Repair the open circuit between terminal 5 of the chime module and ground. Is the repair complete?	-	System OK	-
15	With the chime module disconnected, use an ohmmeter to measure continuity between terminal 7 of the chime module and ground. Does the ohmmeter indicate the specified value?	8	Go to Step 17	Go to Step 16
16	Replace the chime module. Is the repair complete?	-	System OK	-
17	Check the seat belt warning lamp. Is the warning lamp OK?	-	Go to Step 19	Go to Step 18
18	Replace the seat belt warning lamp. Is the repair complete?	-	System OK	-
19	1. Disconnect the instrument cluster connector for terminal 5. 2. Check the continuity between terminal 7 of the chime module and terminal 5 of the instrument cluster connector. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 21	Go to Step 20
20	Repair the open circuit between the chime module terminal 7 and the instrument cluster connector terminal 5. Is the repair complete?	-	System OK	-
21	Repair the open circuit between the instrument cluster and splice S203. Is the repair complete?	-	System OK	-

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

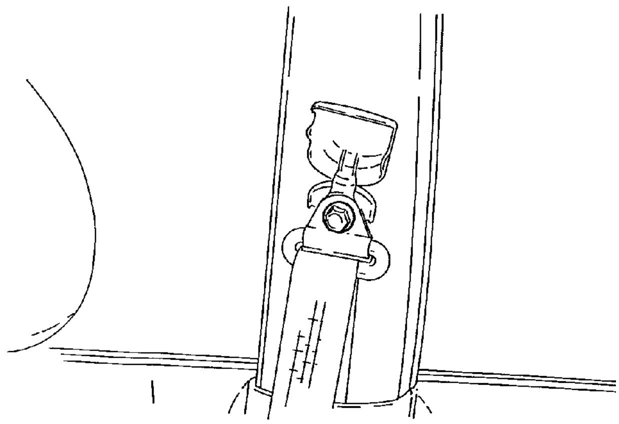
THREE-POINT ELR FRONT SEAT BELT (WITH AIRBAG)

Removal Procedure



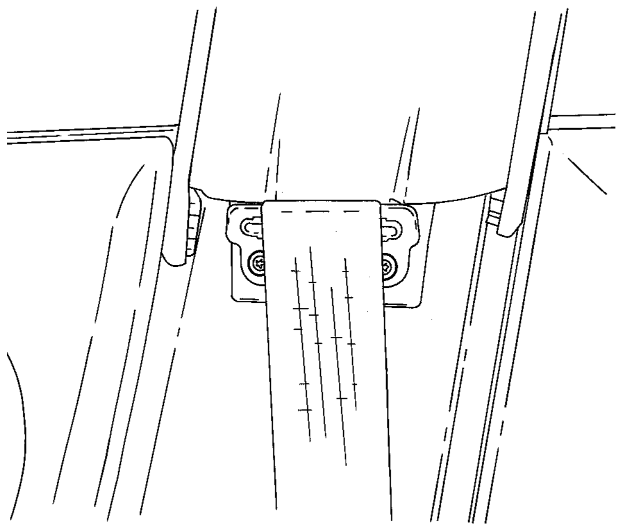
A109G006

1. Remove the bolt and the seat belt anchor on the lower B-pillar.



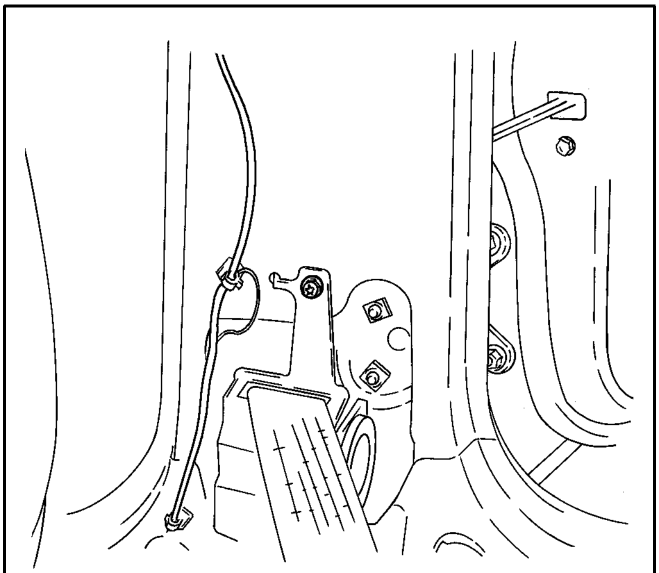
A109G022

2. Remove the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolt and the seat belt anchor on the upper B-pillar.

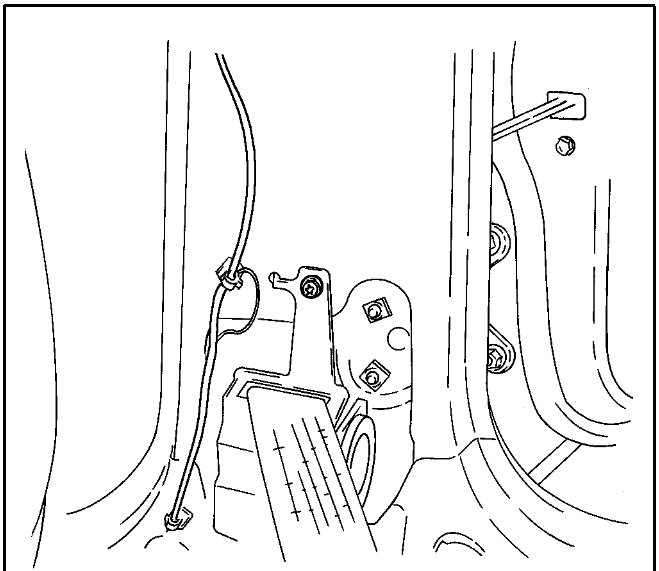


A110A007

4. Remove the screws and the seat belt bracket.


A110A008

5. Remove the screw and the seat belt retractor.


A110A008

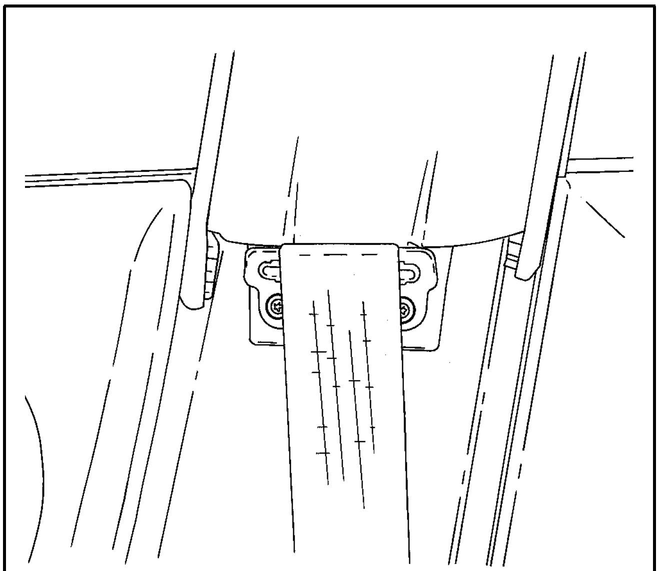
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the seat belt retractor with the screw.

Tighten

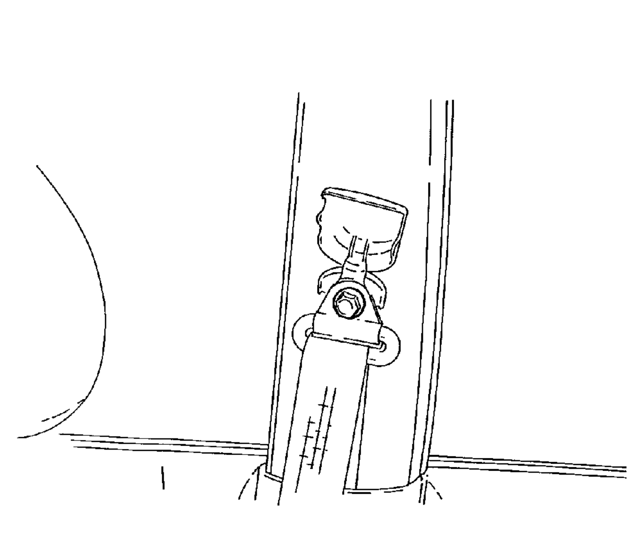
Tighten the seat belt retractor screw to 10 N•m (89 lb-in).


A110A007

2. Install the seat belt bracket with the screws.

Tighten

Tighten the seat belt bracket screws to 10 N•m (89 lb-in).

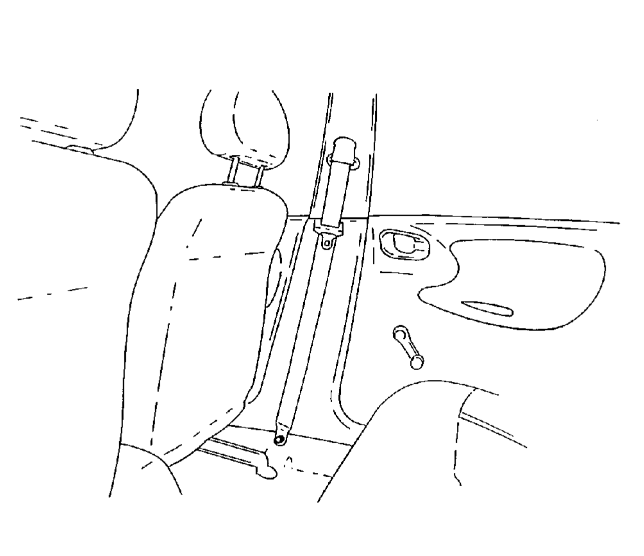


A109G022

3. Install the seat belt anchor to the upper B-pillar with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

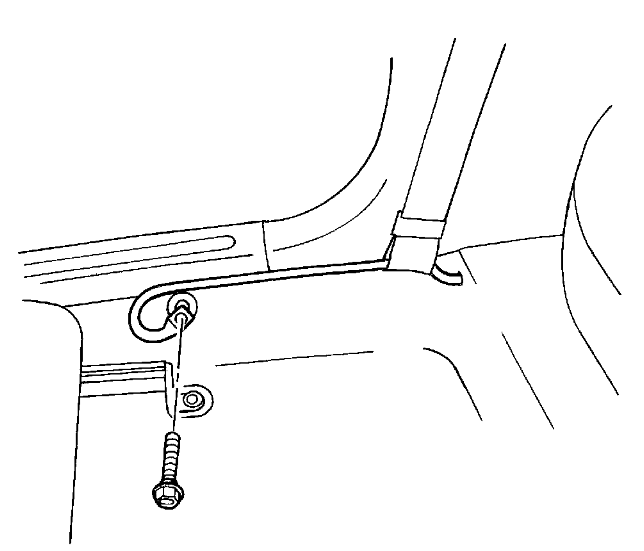


A109G006

4. Install the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
5. Install the seat belt anchor to the lower B-pillar with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

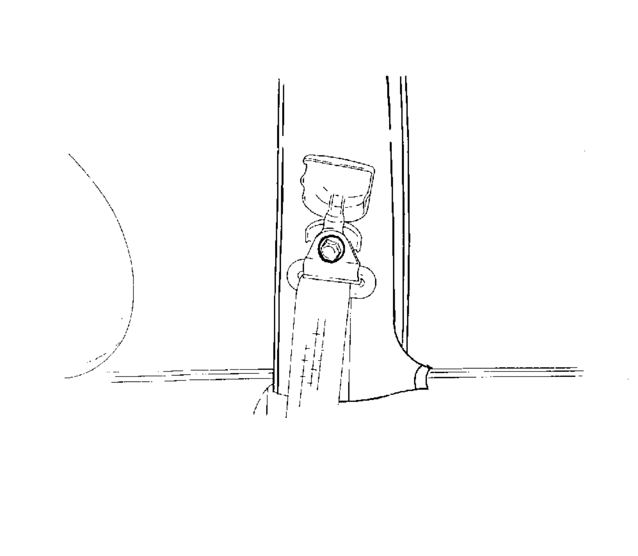


A310A002

THREE-POINT ELR FRONT SEAT BELT (THREE-DOOR HATCHBACK)

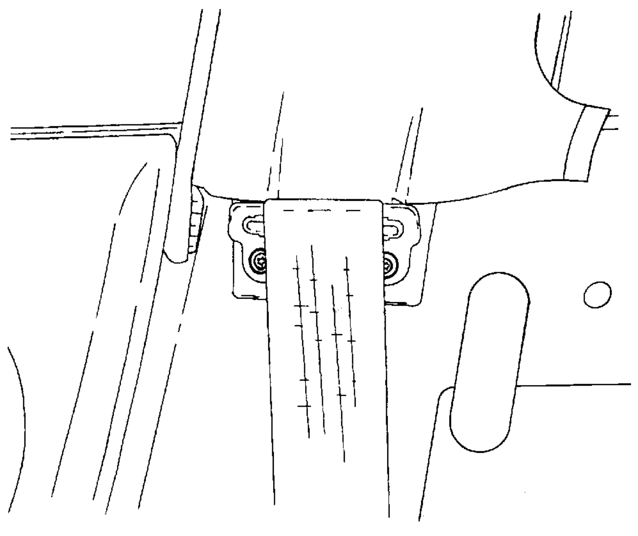
Removal Procedure

1. Remove the bolt and the seat belt anchor rail.



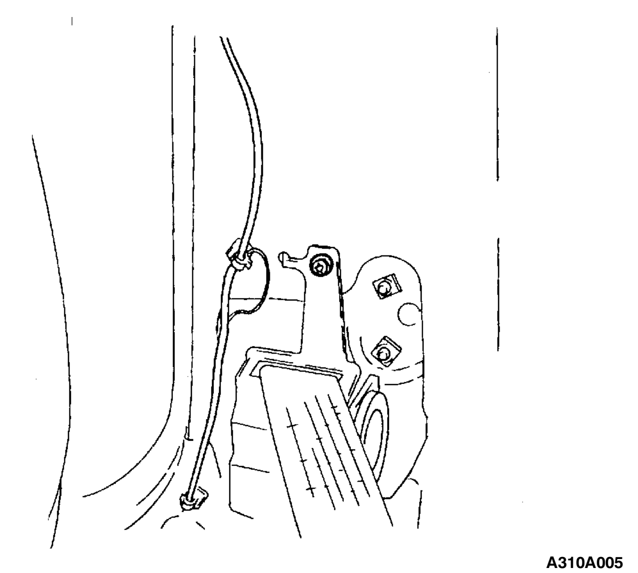
A310A003

2. Remove the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolt and the seat belt anchor on the upper B-pillar.



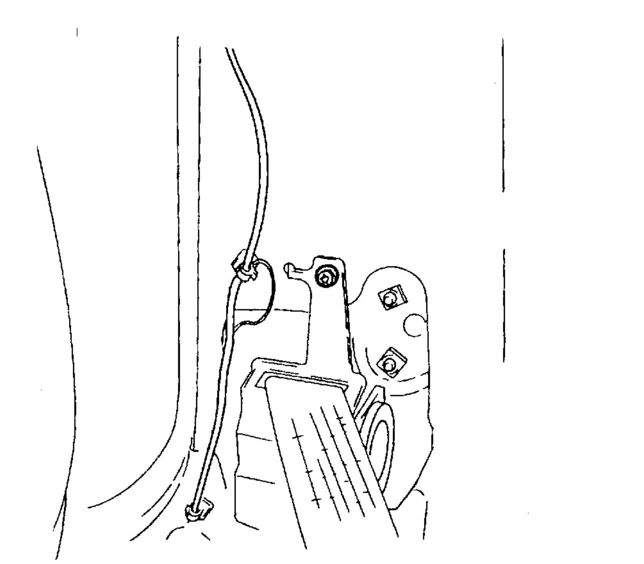
A310A004

4. Remove the screws and the seat belt bracket.



A310A005

5. Remove the screw and the seat belt retractor.



A310A005

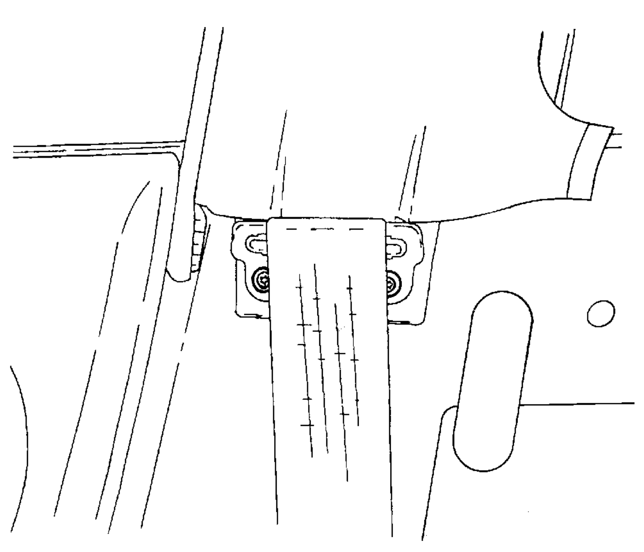
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the seat belt retractor with the screw.

   Tighten

   Tighten the seat belt retractor screw to 10 N•m (89 lb-in).

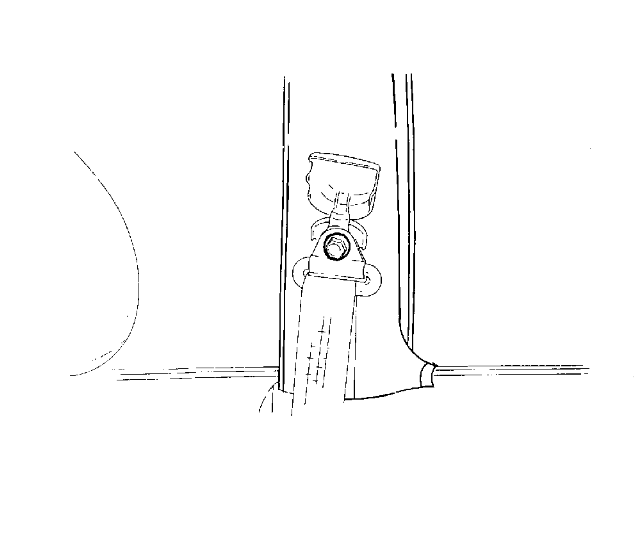


A310A004

2. Install the seat belt bracket with the screws.

   Tighten

   Tighten the seat belt bracket screws to 10 N•m (89 lb-in).

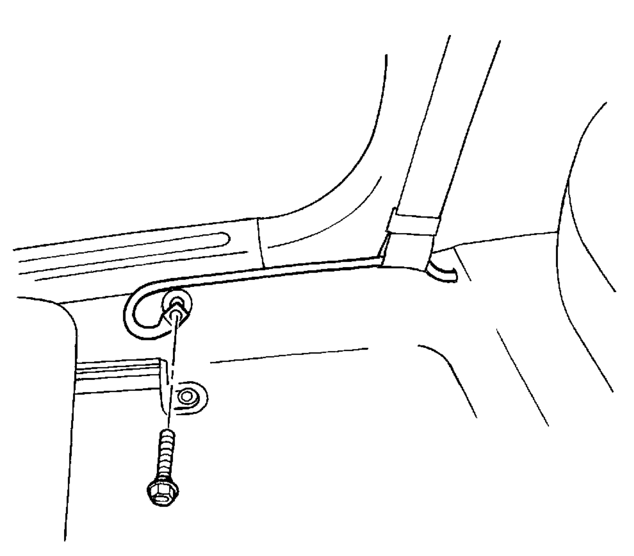


A310A003

3. Install the seat belt anchor to the upper B-pillar with the bolt.

   Tighten

   Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

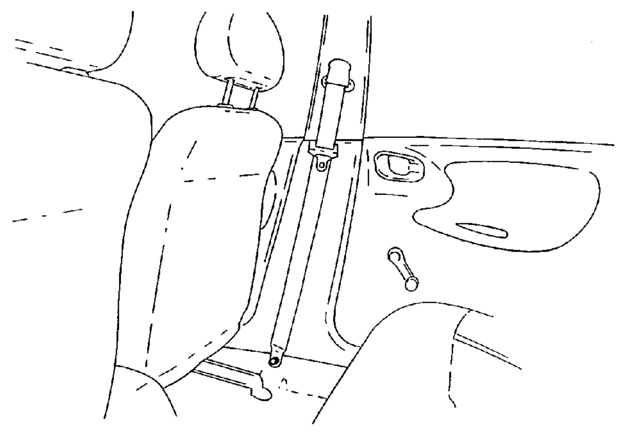


A310A002

4. Install the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
5. Install the seat belt anchor rail with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

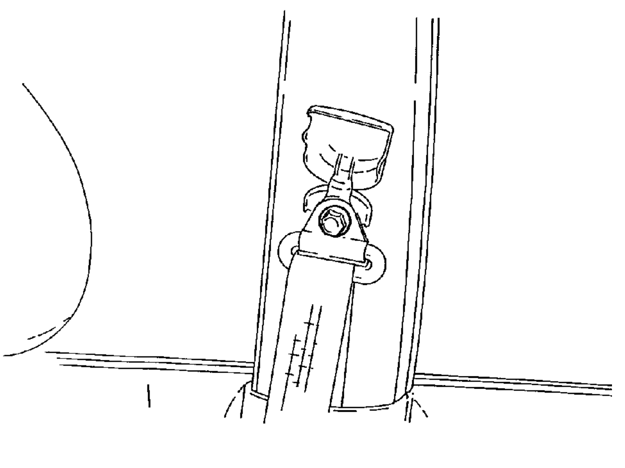


A109G006

THREE-POINT WLR/GCC FRONT SEAT BELT

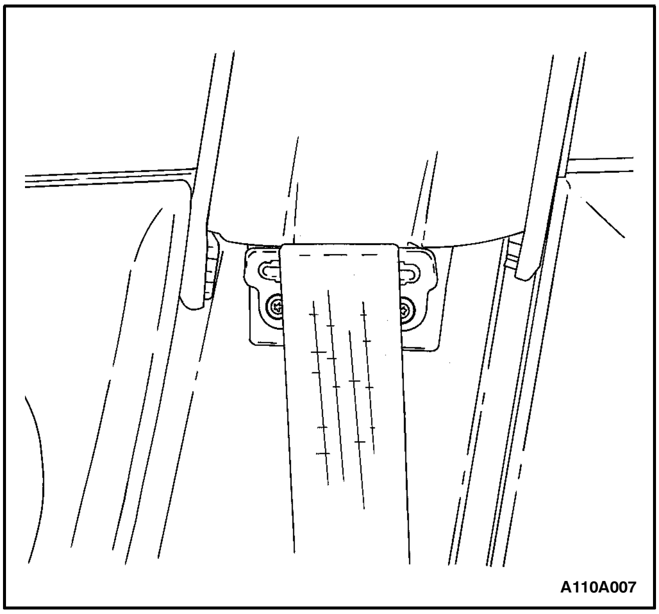
Removal Procedure

1. Remove the bolt and the seat belt anchor on the lower B-pillar.



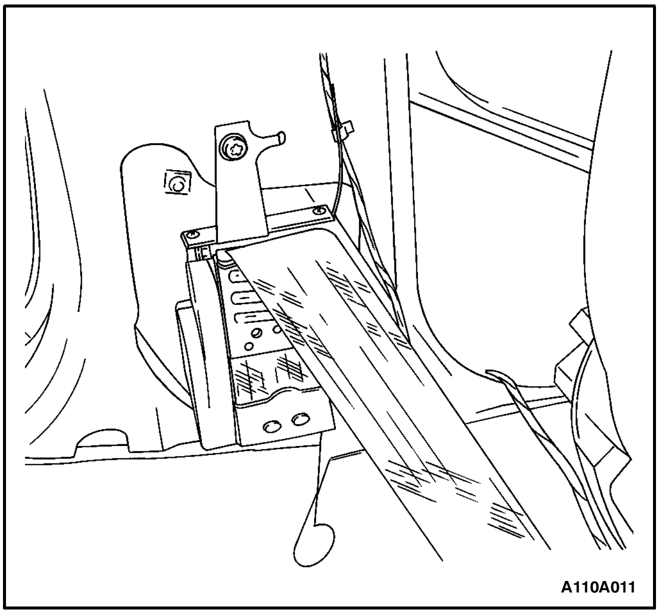
A109G022

2. Remove the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolt and the seat belt anchor on the upper B-pillar.



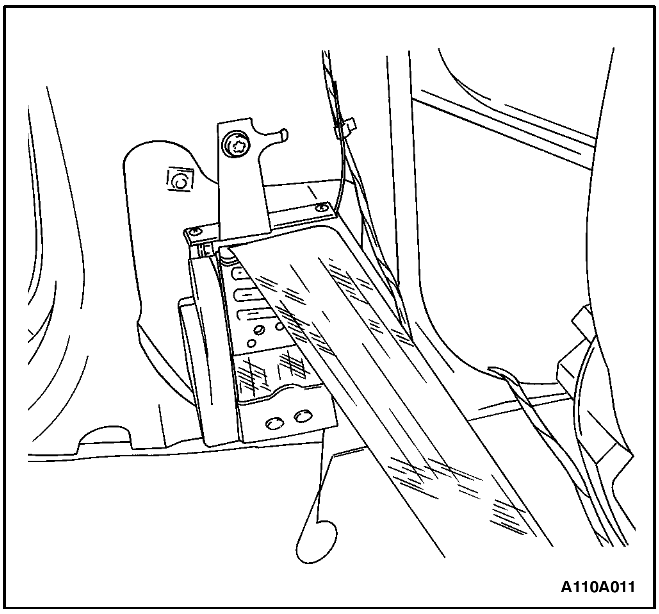
A110A007

4. Remove the screws and the seat belt bracket.



A110A011

5. Remove the screw and the seat belt retractor.



A110A011

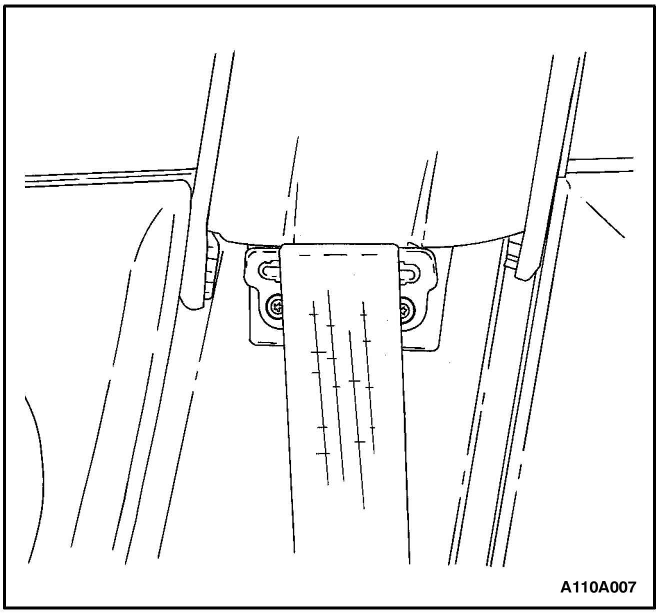
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the seat belt retractor with the screw.

   ### Tighten

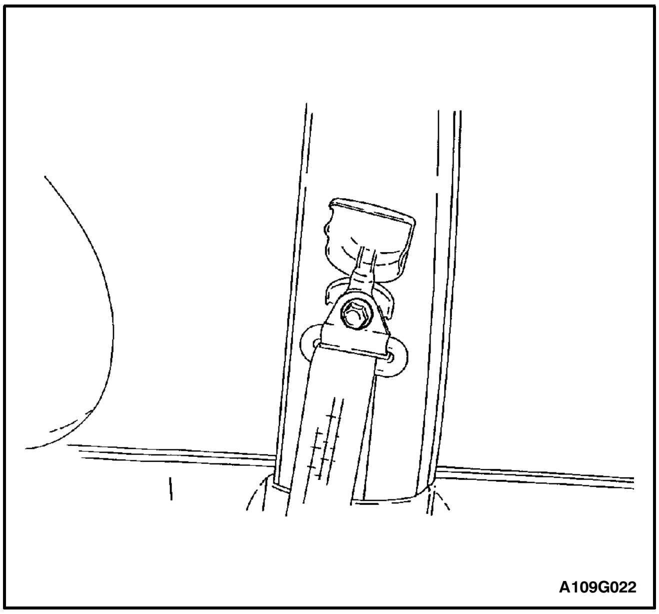
   Tighten the seat belt retractor screw to 10 N•m (89 lb-in).



2. Install the seat belt bracket with the screws.

Tighten

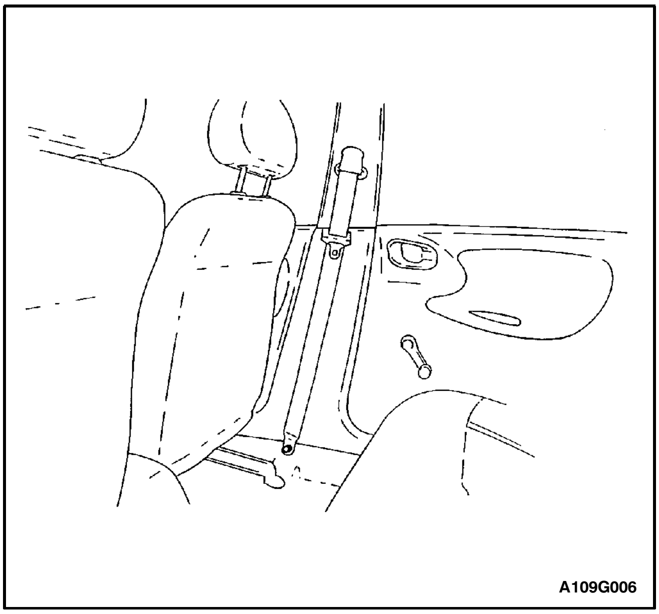
Tighten the seat belt bracket screws to 10 N•m (89 lb-in).



3. Install the seat belt anchor to the upper B-pillar with the bolt.

Tighten

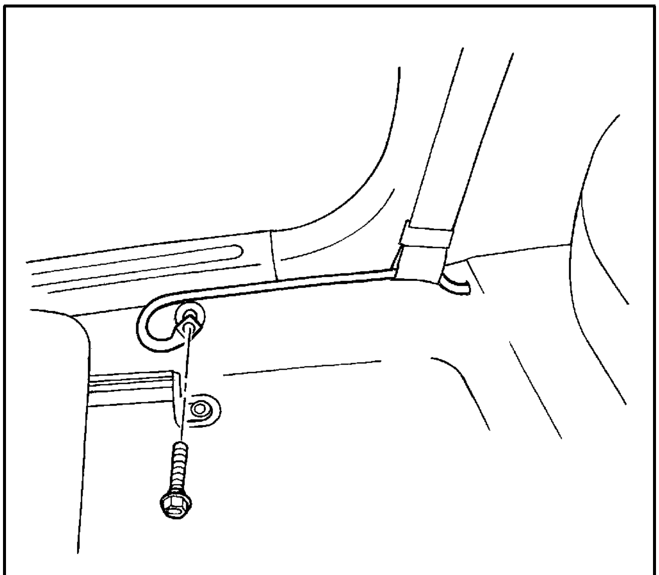
Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).



4. Install the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
5. Install the seat belt anchor to the lower B-pillar with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

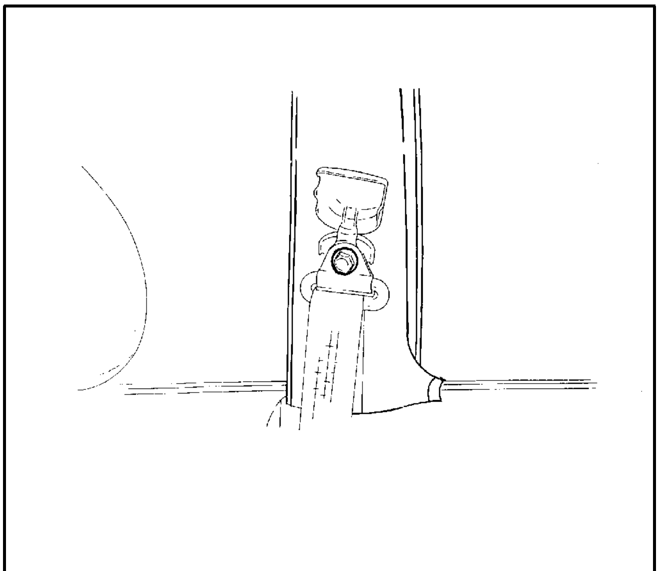


A310A002

THREE-POINT WLR/GCC FRONT SEAT BELT (THREE-DOOR HATCHBACK)

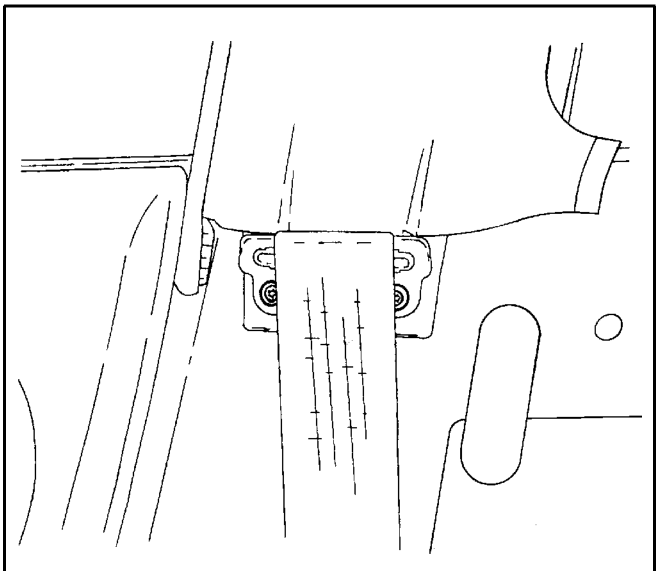
Removal Procedure

1. Remove the bolt and the seat belt anchor rail.



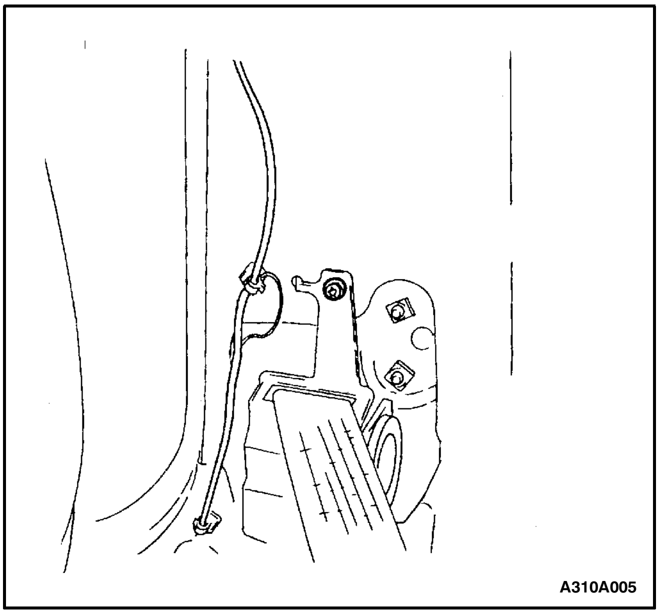
A310A003

2. Remove the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolt and the seat belt anchor on the upper B-pillar.

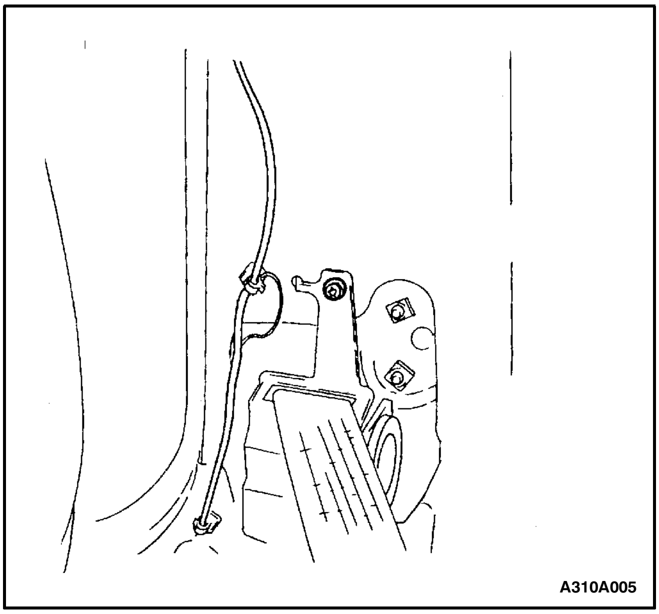


A310A004

4. Remove the screws and the seat belt bracket.



5. Remove the screw and the seat belt retractor.



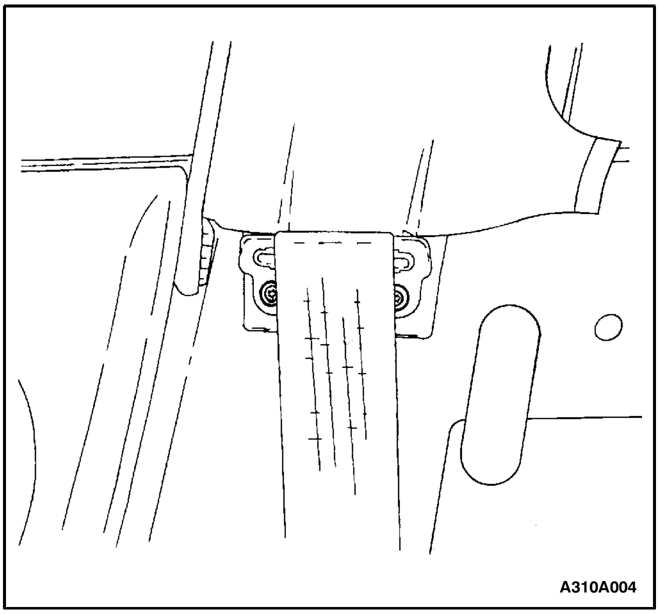
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the seat belt retractor with the screw.

   Tighten

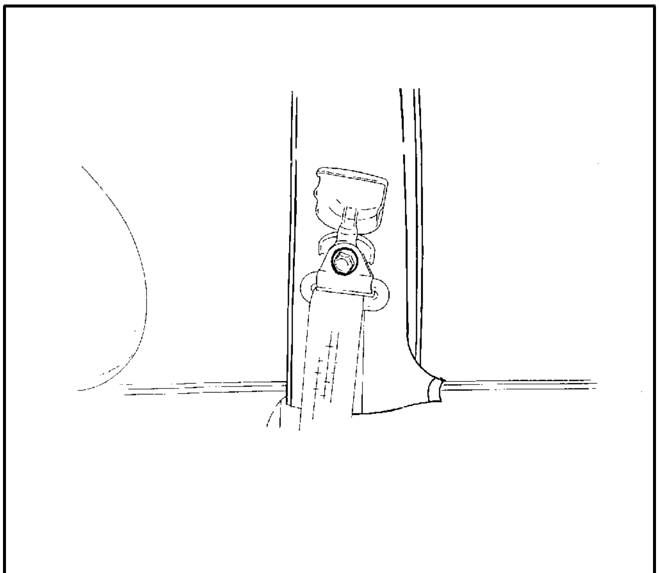
   Tighten the seat belt retractor screw to 10 N•m (89 lb-in).



2. Install the seat belt bracket with the screws.

   Tighten

   Tighten the seat belt bracket screws to 10 N•m (89 lb-in).

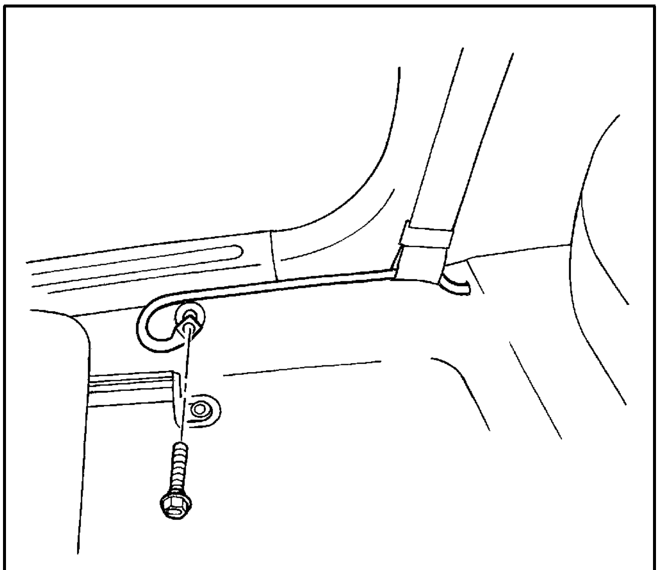


A310A003

3. Install the seat belt anchor to the upper B-pillar with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

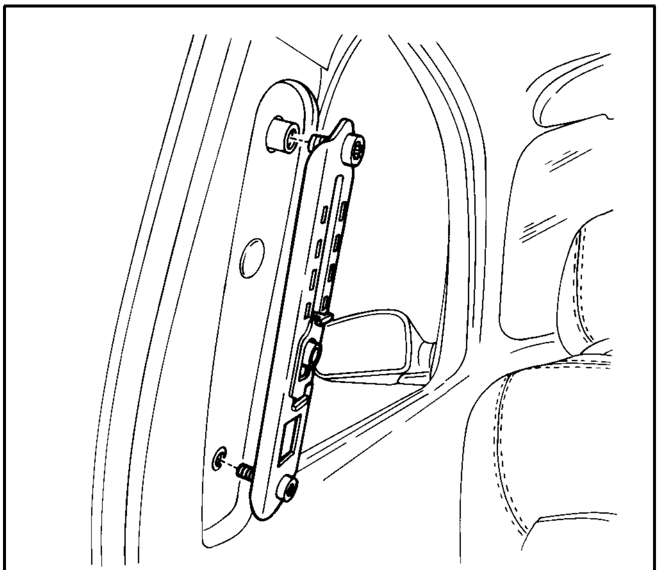


A310A002

4. Install the lower B-pillar trim panel. Refer to Section 9G, Interior Trim.
5. Install the seat belt anchor rail with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

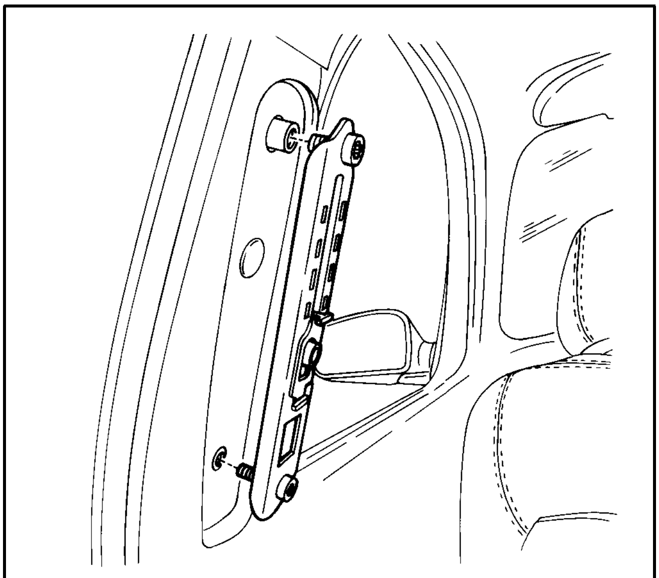


C310A001

FRONT SEAT BELT HEIGHT ADJUSTER

Removal Procedure

1. Remove the upper B-pillar trim panel. Refer to Section 9G, Interior Trim.
2. Remove the bolts and the seat belt height adjuster.


C310A001

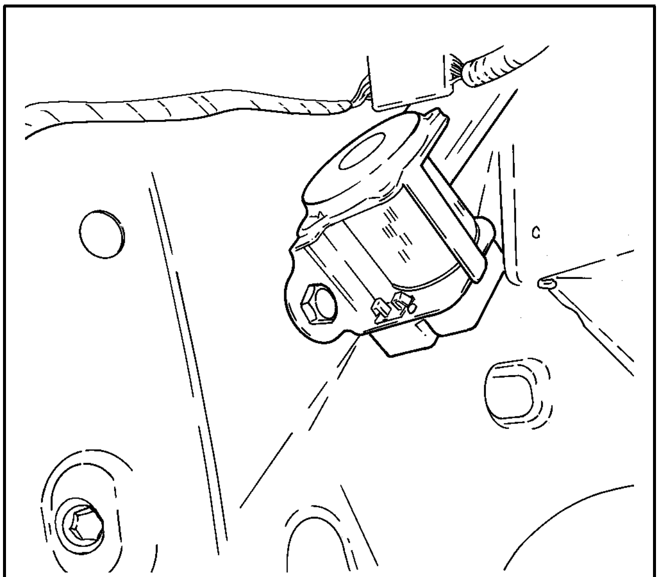
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the seat belt height adjuster with the bolts.

   Tighten

   Tighten the seat belt height adjuster bolts to 19 N•m (14 lb-ft).
2. Install the upper B-pillar trim panel. Refer to Section 9G, Interior Trim.

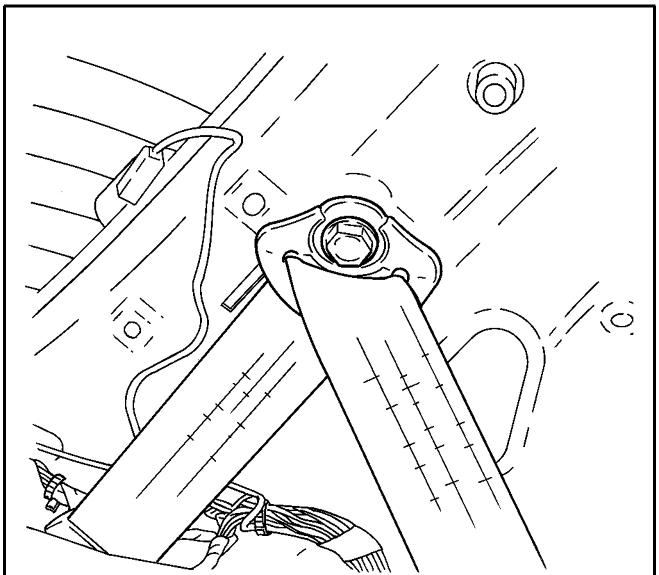

A110A001

THREE-POINT ELR REAR OUTBOARD SEAT BELT

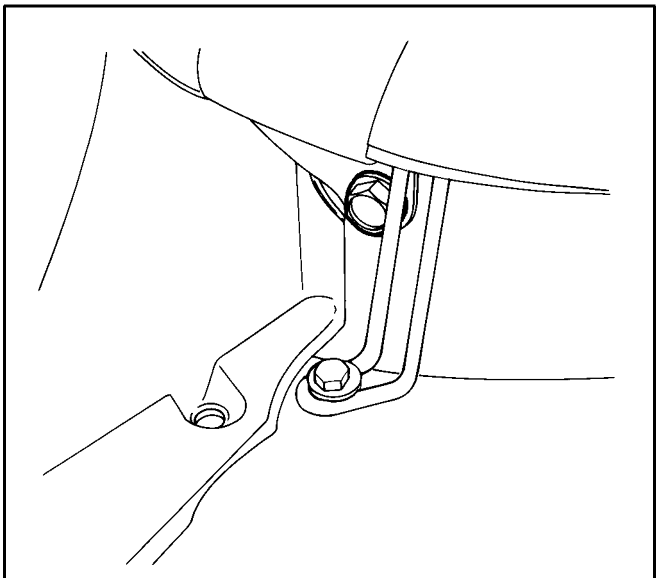
(Notchback Shown, Hatchback Similar)

Removal Procedure

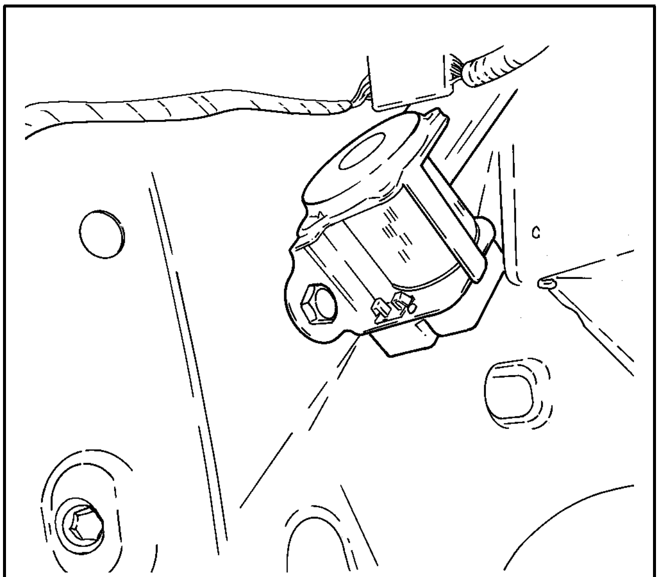
1. Open the luggage compartment.
2. Remove the luggage compartment wheelhouse trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolt and the seat belt anchor in the luggage compartment.


A110A004

4. Remove the rear seat cushion and the rear seatback. Refer to Section 9H, Seats.
5. Remove the C-pillar trim panel. Refer to Section 9G, Interior Trim.
6. Remove the bolt and the seat belt anchor on the C-pillar.


A109G023

7. Remove the bolt and the seat belt anchor on the floor.
8. Remove the seat belt.

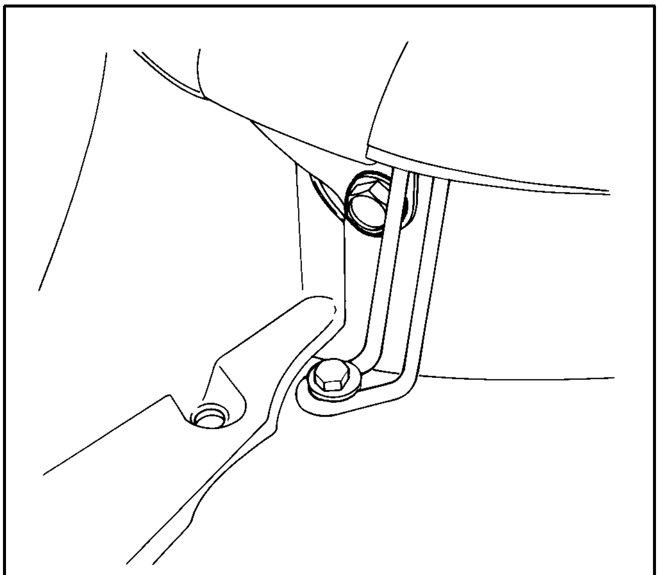

A110A001

Installation Procedure

1. Install the seat belt anchor in the luggage compartment with the bolt.

Tighten

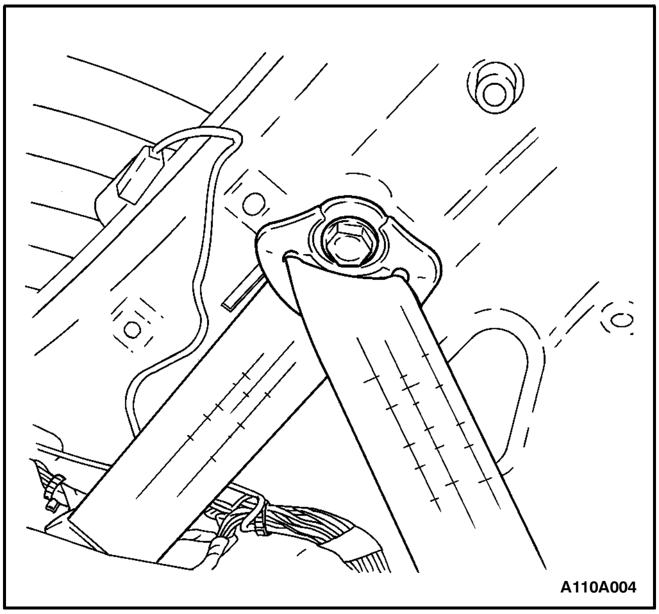
Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).


A109G023

2. Feed the free end of the seat belt from the luggage compartment through the deck lid sill plate.
3. Feed the free end of the seat belt through the C-pillar trim panel.
4. Install the seat belt anchor to the floor with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

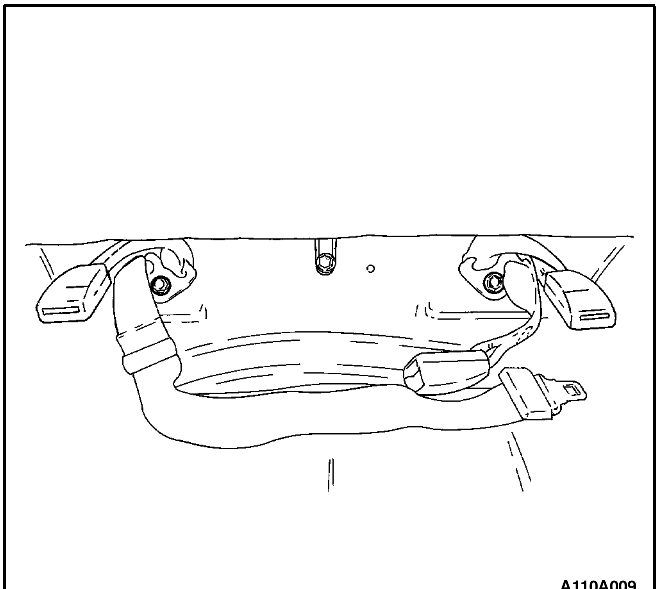


A110A004

5. Install the seat belt anchor to the C-pillar with the bolt.

   Tighten

   Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).
6. Install the C-pillar trim panel. Refer to Section 9G, Interior Trim.
7. Install the rear seat cushion and rear seatback. Refer to Section 9H, Seats.
8. Install the luggage compartment wheelhouse trim panel. Refer to Section 9G, Interior Trim.

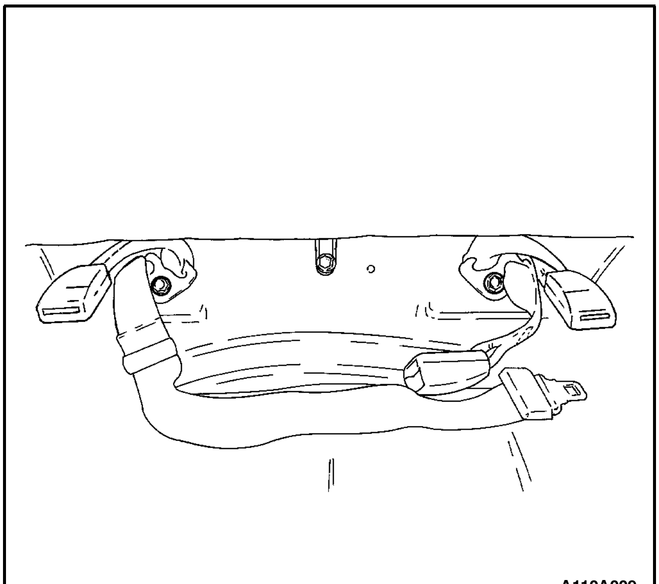


A110A009

TWO-POINT LAP REAR CENTER SEAT BELT

Removal Procedure

1. Remove the rear seat cushion. Refer to Section 9H, Seats.
2. Remove the bolts and the seat belt anchors.



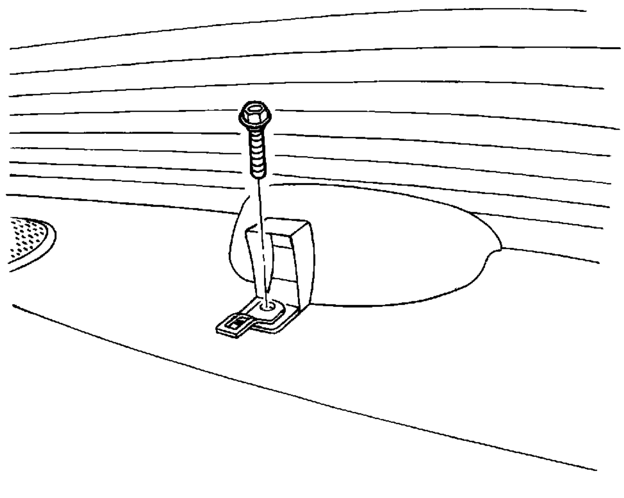
A110A009

Installation Procedure

1. Install the seat belt anchors with the bolts.

   Tighten

   Tighten the seat belt anchor bolts to 35 N•m (26 lb-ft).
2. Install the rear seat cushion. Refer to Section 9H, Seats.

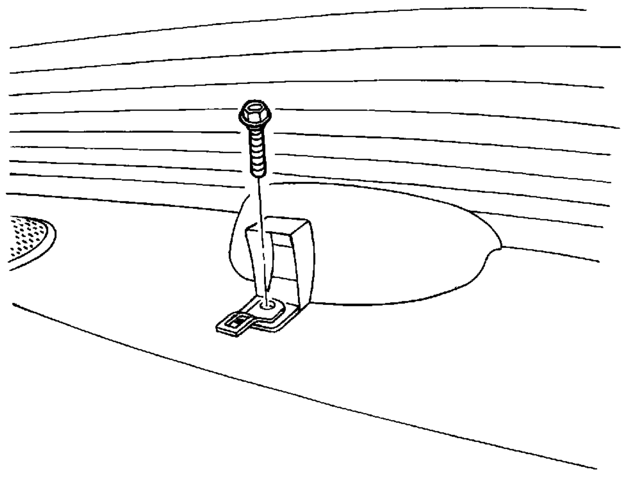


A310A001

CHILD SEAT TETHER ANCHOR

Removal Procedure

1. Open the tether anchor access cap.
2. Remove the bolt and the tether anchor.



A310A001

Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the tether anchor with the bolt.

   ### Tighten

   Tighten the child seat tether anchor bolt to 25 N•m (18 lb-ft).

2. Close the tether anchor access cap.

GENERAL DESCRIPTION AND SYSTEM OPERATION

DRIVER SEAT BELT WARNING

The driver's safety belt incorporates a safety belt reminder light in the instrument cluster to remind the driver if the safety belt is not fastened when the ignition is turned ON.

THREE-POINT WLR FRONT SEAT BELT

The three-point web locking retractor (WLR) seat belt will limit the movement of the driver and offer better protection in an accident.

THREE-POINT ELR FRONT SEAT BELT (WITH AIRBAG)

The three-point emergency locking retractor (ELR) front seat belt is always unlocked, allowing the passenger freedom of movement, except in emergencies (rapid deceleration, rapid acceleration, or hard cornering maneuvers).

THREE-POINT ELR REAR OUTBOARD SEAT BELT

The rear outboard seating positions use the three-point emergency locking retractor (ELR) seat belts. The three-point emergency locking retractor (ELR) seat belt is always unlocked, allowing the passenger freedom of movement, except in emergencies (rapid deceleration, rapid acceleration, or hard cornering maneuvers).

TWO-POINT LAP REAR CENTER SEAT BELT

The two-point lap rear center seat belt is a single continuous length of webbing. The webbing is routed from the anchor through a latch plate and into a single retractor.

OPERATIONAL AND FUNCTIONAL CHECKS

Caution:

- Keep sharp objects and potentially damaging objects away from the seat belts.
- Avoid bending or damaging any portion of the buckle or the latch plate.
- Do not bleach or dye the belt webbing. Use only mild soap and water in order to clean the belts.
- When installing the seat belt anchor bolts and the screws, start the bolts and the screws by hand in order to prevent crossthreading.
- Do not attempt any repairs on the retractor mechanisms or the covers. Replace any defective assemblies with new assemblies.
- Replace any belts that are cut or damaged in any way.

1. Inspect all seat belt anchor bolts and the screws in order to verify that they are secure.
2. Inspect the seat belt buckle. The buckle must lock and unlock easily.
3. After inserting the latch into the buckle, tug sharply on the belt. The buckle must remain locked.
4. Fully extend the shoulder belt portion to make sure that there is no twisting or tears in the belt.
5. Let the shoulder belt retract fully. The belt should retract easily.

CHILD SEAT TETHER ANCHOR

There are three child seat tether anchors located on the rear deck lid sill plate. There is one anchor for each rear seat position.

SECTION 8B

SUPPLEMENTAL INFLATABLE RESTRAINTS (SIR)

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

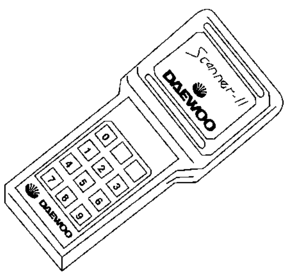
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Clock Spring Mounting Screws	3	-	27
Driver Airbag Module Mounting Bolts	14.7	-	130
Passenger Airbag Module Mounting Nuts	22	16	-
Passenger Airbag Module Mounting Bolts	12	-	106
Sensing and Diagnostic Module Mounting Bolts	9	-	80

SPECIAL TOOLS

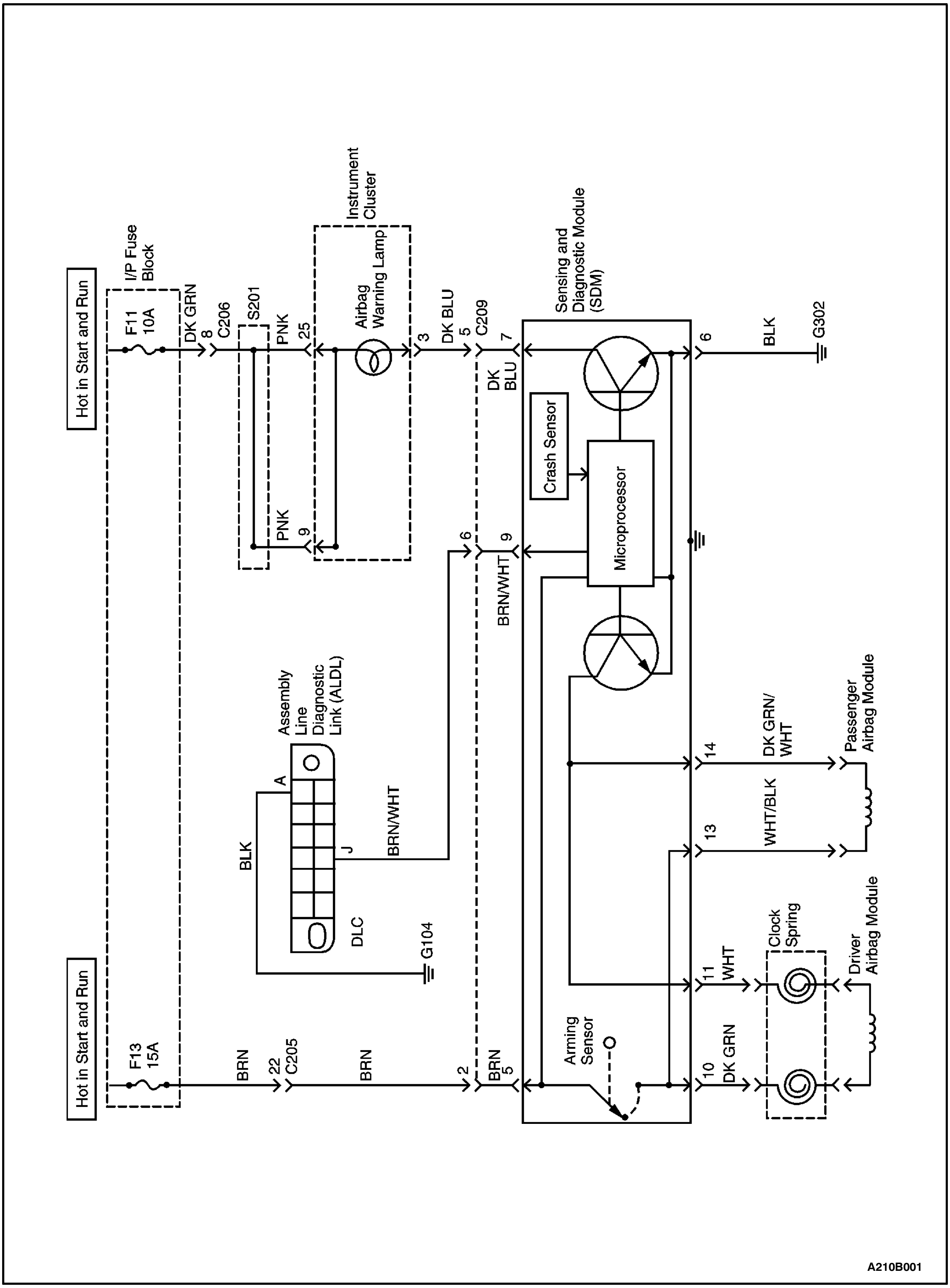
SPECIAL TOOLS TABLE

00000000	Deployment Tool
 A110B003	Scan Tool

00000000	Wiring Harness Checker

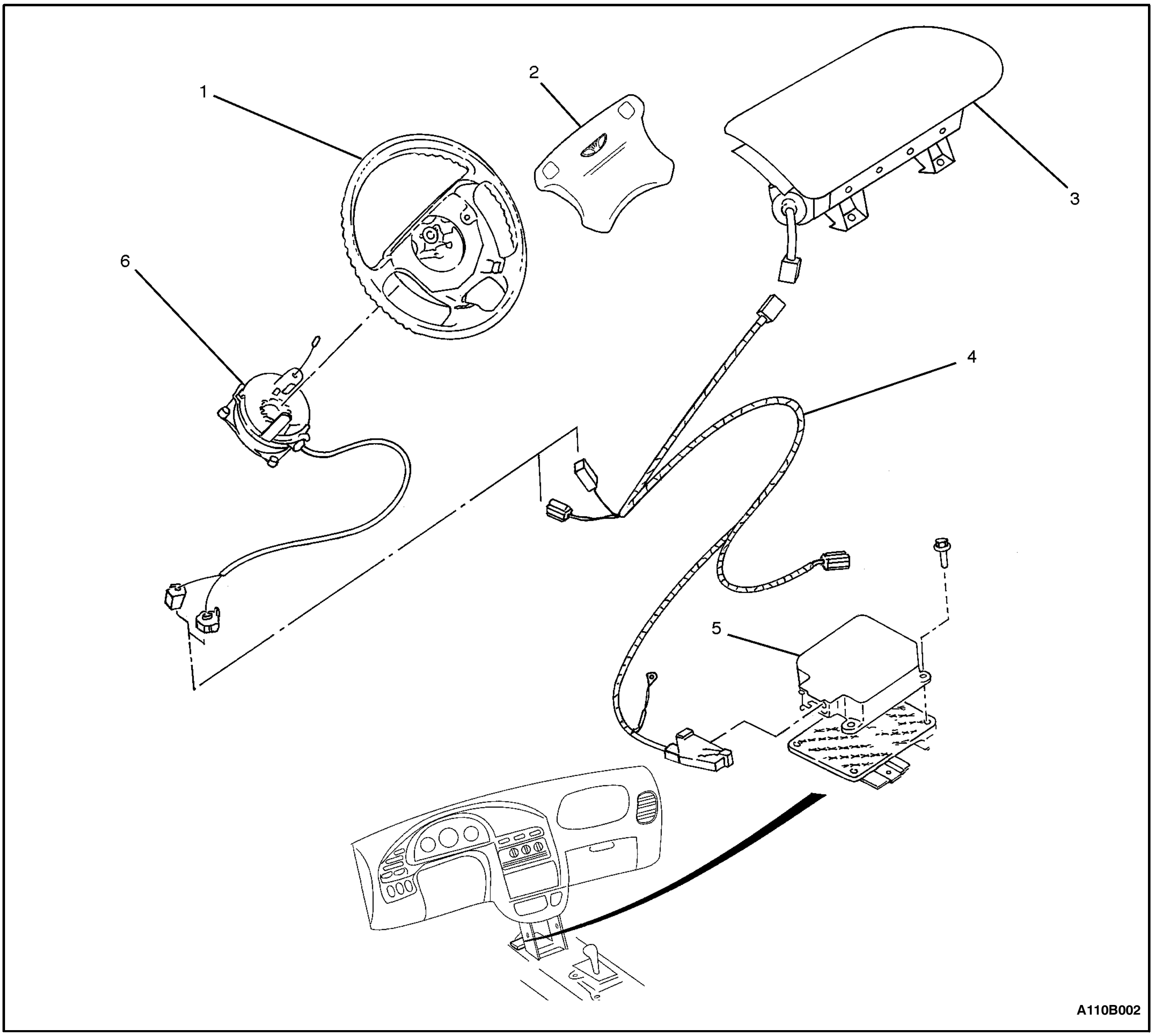
SCHEMATIC AND ROUTING DIAGRAMS

SUPPLEMENTAL INFLATABLE R5ESTRAINTS (SIR) ELECTRICAL SCHEMATIC



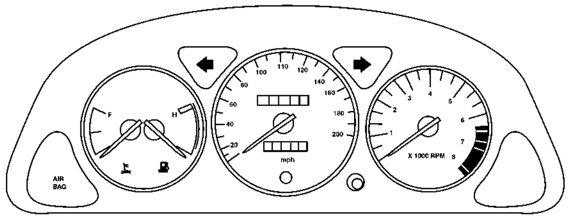
SIR COMPONENT LOCATOR

(Left-Hand Drive Shown, Right-Hand Drive Similar)



1 Steering Wheel
2 Driver Airbag Module
3 Passenger Airbag Module
4 Wiring Harness
5 Sensing and Diagnostic Module
6 Clock Spring

DIAGNOSIS



A110B006

BULB CHECK

As soon as the operating voltage is applied to the sensing and diagnostic module (SDM) ignition input, the SDM activates the warning lamp for a bulb check.

The SDM turns the lamp ON for 4 seconds, and then the SDM turns the lamp OFF.

During the bulb check, the SDM is not ready to detect a crash or deploy the supplemental inflatable restraints.

FAULT INDICATION

The sensing and diagnostic module records the system's faults in two categories:

- Current faults.
- Historic faults, which are those that were detected in the past, but are no longer active.

The warning lamp:

- Indicates a fault as soon as it occurs.
- Stays ON, even if a fault is no longer active.

A scan tool connected to the data link connector (DLC):

- Reveals the fault codes.
- Receives serial data transmission through the terminal J of the DLC.
- Receives ground through the terminal A of the DLC.

CLEARING FAULT CODES

When the sensing and diagnostic module (SDM) receives the CODE ERASE command from the scan tool, the SDM:

- Clears the entire fault memory.
- Turns OFF the warning lamp.
- Resets for fault detection.

External Fault

Service personnel can reset the SDM and turn OFF the warning lamp if the fault is an external fault.

Internal Fault

An internal fault of the SDM or a CRASH RECORDED fault code cannot be reset.

In the case of an internal fault of the SDM or a CRASH RECORDED fault code, the SDM must be replaced.

Voltage-Low Fault

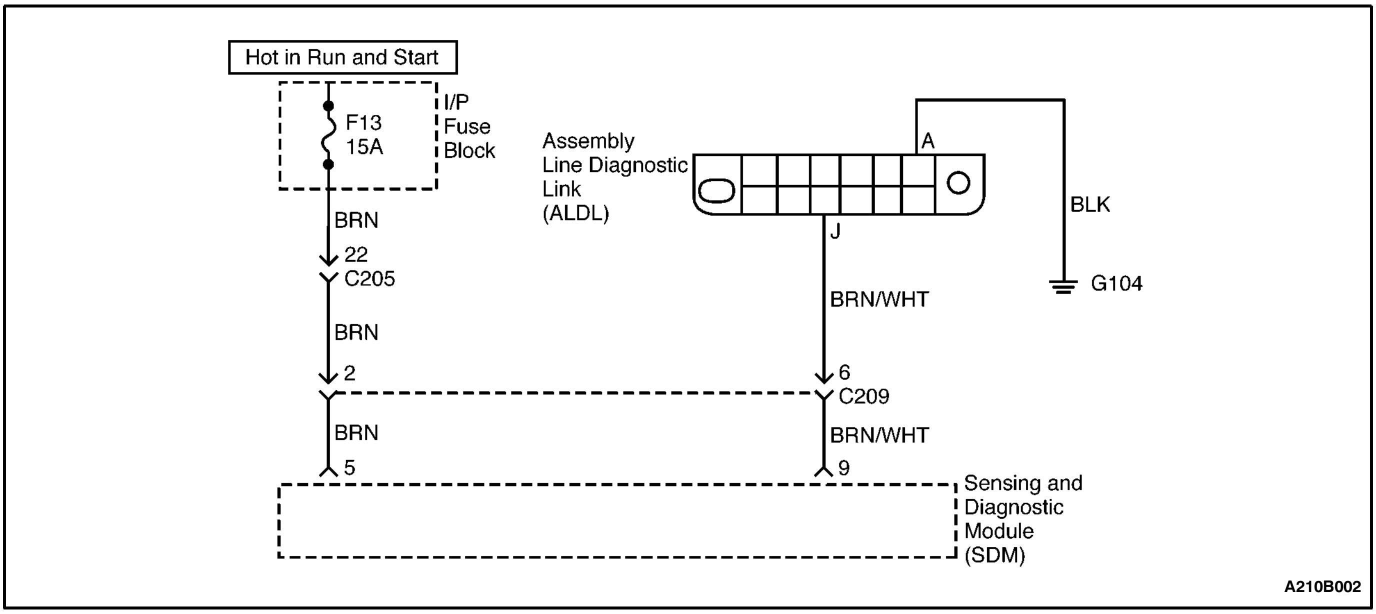
The SDM will turn OFF the VOLTAGE LOW fault as soon as the voltage recovers.

MICROPROCESSOR – INDEPENDENT LAMP ACTIVATION

If the sensing and diagnostic module (SDM) electrical connector is not properly attached, the SDM cannot function and cannot control the warning lamp.

If this fault is present, the warning lamp will operate independently from the SDM through the use of shorting bars that are built into the SDM connector.

SYSTEM CHECK



Caution: Use only the scan tool to check the airbag modules and the sensing and diagnostic module (SDM). Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: Do not attempt to repair the supplemental inflatable restraints (SIR) wiring harness. An SIR repair can create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury.

Circuit Description

When the ignition switch is turned ON, the SDM is able to send serial data from the terminal 9 of the SDM to the terminal J of the data link connector (DLC).

Diagnostic System Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect the scan tool cable to the DLC. 3. Connect the scan tool power cable to the cigar lighter socket. 4. Turn the ignition ON. 5. Wait at least 4 seconds for the SDM to finish the bulb check before continuing. 6. Select the airbag main menu on the scan tool. 7. Select "Fail Code View & Clear" from the displayed menu of the diagnostic test codes (DTC). Is the diagnostic system working?	-	Go to Step 17	Go to Step 2
2	Check fuse F13. Is the fuse F13 blown?	-	Go to Step 3	Go to Step 4

Diagnostic System Check (Cont'd)

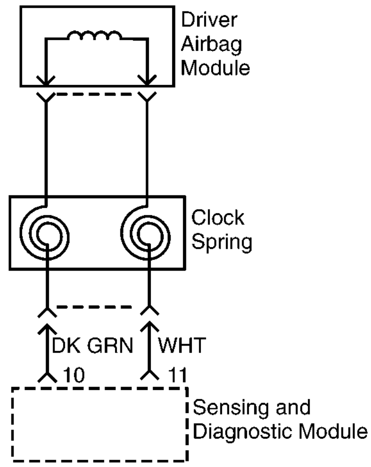
Step	Action	Value(s)	Yes	No
3	1. Disconnect the SDM connector and wait 1 minute before proceeding. 2. Check for a short to ground between fuse F13 and the SDM connector, and repair a short to ground if one was verified. 3. Replace fuse F13. Is the repair complete?.	-	Go to Step 1	-
4	Use an ohmmeter to check continuity between terminal A of the ALDL connector and ground. Does the ohmmeter show the specified value?	[0 W	Go to Step 6	Go to Step 5
5	Repair the open ALDL ground circuit. Is the repair complete?	-	Go to Step 1	-
6	Turn the ignition ON. Check the voltage at the cigar lighter positive terminal. Does the voltmeter show the specified value?	11-14 v	Go to Step 8	Go to Step 7
7	Repair the power supply for the cigar lighter socket. Is the repair complete?	-	Go to Step 1	-
8	1. Disconnect the SDM electrical connector. 2. Use an ohmmeter to check for continuity between terminal J of the ALDL and terminal 9 of the SDM connector. ● Refer to "Diagnostic Illustration 1" in this section. Does the ohmmeter show the specified value?	[0 W	Go to Step 12	Go to Step 9
9	Use an ohmmeter to check for continuity between terminal J of the ALDL and terminal 6 of connector C209. ● Refer to "Diagnostic Illustration 2" in this section. Does the ohmmeter show the specified value?	[0 W	Go to Step 11	Go to Step 10
10	Repair the serial data wire which is open between the ALDL and C209. Is the repair complete?	-	Go to Step 1	-
11	Repair the serial data wire which is open between C209 and the SDM connector. Is the repair complete?	-	Go to Step 1	-
12	Use an ohmmeter to check terminal J of the ALDL for a short to ground. Does the ohmmeter show the specified value?	[0 W	Go to Step 13	Go to Step 14
13	Repair the serial data wire which is shorted to ground. Is the repair complete?	-	Go to Step 1	-
14	1. Turn the ignition ON. 2. Use a voltmeter to determine if terminal J of the ALDL is shorted to voltage. Does the voltmeter show the specified value?	11-14 v	Go to Step 15	Go to Step 16

Diagnostic System Check (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair the serial data wire which is shorted to voltage. Is the repair complete?	-	Go to Step 1	-
16	Replace the SDM. Is the repair complete?	-	Go to Step 1	-
17	Check the scan tool display. Are there any active fault codes?	-	Go to the DTC table for the fault indicated	System OK

FAULT CODES

Fault Codes	Fault Contents
01	Driver Firing Circuit, Resistance Too High
02	Driver Firing Circuit, Resistance Too Low
03	Driver Firing Circuit, Short to Ground
04	Driver Firing Circuit, Short to Battery Ground
05	Passenger Firing Circuit, Resistance Too High
06	Passenger Firing Circuit, Resistance Too Low
07	Passenger Firing Circuit, Short to Ground
08	Passenger Firing Circuit, Short to Battery Voltage
17	Connection Between Driver Firing Circuit and Passenger Firing Circuit
23	Ignition Input Circuit, Voltage Too High
24	Ignition Input Circuit, Voltage Too Low
25	Warning Lamp Failure
31	SDM Internal Fault
32	SDM Crash Recorded



DIAGNOSTIC TROUBLE CODE (DTC) 01
DRIVER FIRING CIRCUIT, RESISTANCE TOO HIGH

Open Circuit

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the driver airbag module firing circuit. The SDM allows a very small amount of current to flow through the driver airbag module firing circuit. The SDM monitors the circuit resistance during this check.

DTC 01 Will Set When

- The combined resistance of the driver airbag module, the harness wiring, and the connector contacts is above a specified value, as with an open circuit.

Test Description

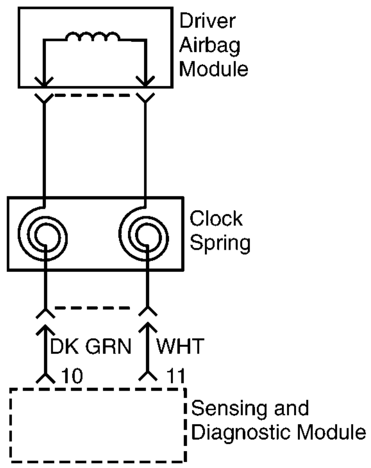
Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.

Caution: Do not attempt to repair the supplemental inflatable restraints (SIR) wiring harness. A repair can create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury.

DTC 01 – Driver Firing Circuit, Resistance Too High

Step	Action	Value(s)	Yes	No
1	Examine the wiring and the connector at the driver airbag module. Is the connector disconnected?	-	Go to Step 2	Go to Step 3
2	1. Reconnect the driver airbag module connector. 2. Reinstall the driver airbag module in the steering wheel. 3. Reconnect the negative battery terminal. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Remove the driver airbag module. 2. Place the driver airbag module in a secure position with the decorative surface facing upward. 3. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the driver airbag module. 4. Connect an ohmmeter to the terminals of the wiring harness connector for the driver airbag module. • Refer to “Diagnostic Illustration 3” in this section. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 4	Go to Step 6
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool for CODE ERASE. 4. Do the diagnostic system check. Does the code 01 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the driver airbag module. 2. Reconnect the negative battery terminal. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. Disconnect the clock spring wiring harness connector at the lower steering column. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the clock spring. 2. Connect an ohmmeter to the terminals at the SDM side of the clock spring connector. • Refer to “Diagnostic Illustration 4” in this section. Does the ohmmeter show the specified value?	[0 W	Go to Step 7	Go to Step 8
7	1. Replace the clock spring. 2. Reconnect the negative battery terminal. Is the repair complete?	-	Go to Diagnostic System Check	-
8	1. Replace the SIR wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 02
DRIVER FIRING CIRCUIT, RESISTANCE TOO LOW

Short Circuit

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the driver airbag module firing circuit. The SDM allows a very small amount of current to flow through the airbag module firing circuit. The SDM monitors the circuit resistance during this check.

DTC 02 Will Set When

- The combined resistance of the driver airbag module, the harness wiring, and the connector contacts is below a specified value, as with a short circuit between the wires to the driver airbag module.

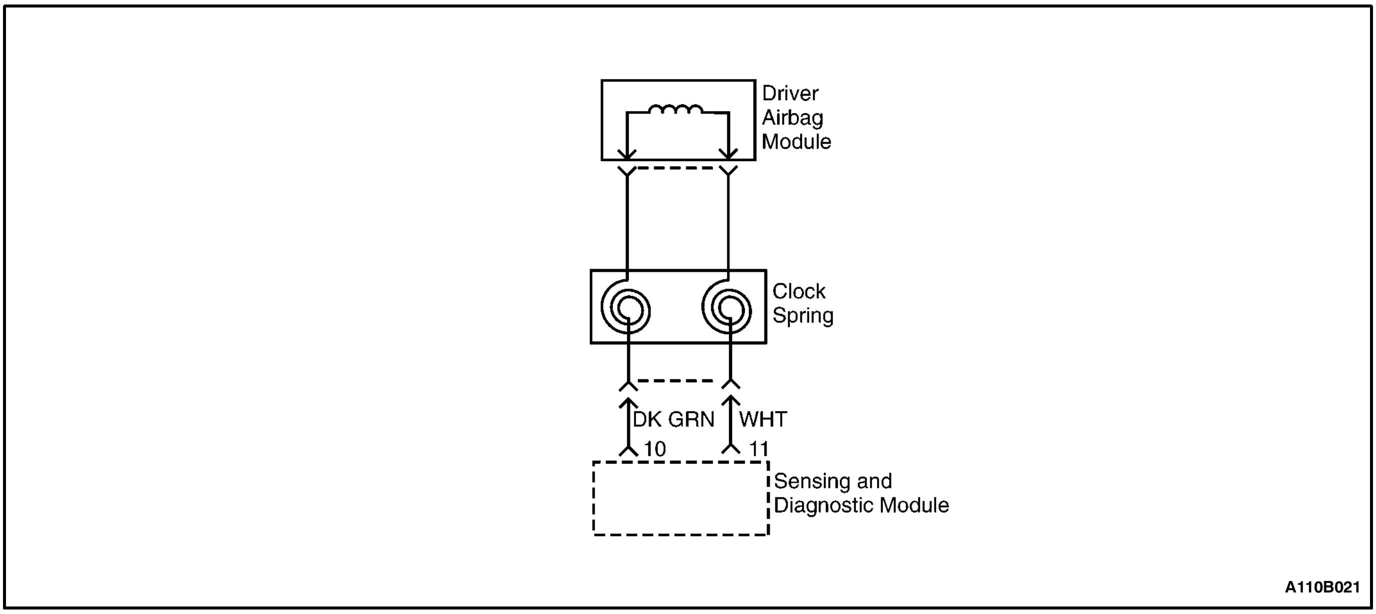
Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.

DTC 02 – Driver Firing Circuit, Resistance Too Low

Step	Action	Value(s)	Yes	No
1	1. Remove the driver airbag module. 2. Store the driver airbag module with the decorative side facing upward. 3. Connect an ohmmeter to the terminals of the wiring harness connector for the driver airbag module. • Refer to “Diagnostic Illustration 3” in this section. Does the ohmmeter show the specified value?	R	Go to Step 2	Go to Step 4
2	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool to CODE ERASE. 4. Do the diagnostic system check. Does the code 02 still show as a current fault?	-	Go to Step 3	System OK
3	1. Replace the driver airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
4	1. Disconnect the clock spring wiring harness connector at the lower steering column. 2. Connect an ohmmeter to the terminals at the SDM side of the clock spring connector. • Refer to “Diagnostic Illustration 4” in this section. Does the ohmmeter show the specified value?	R	Go to Step 5	Go to Step 6
5	1. Replace the clock spring. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. Replace the supplemental inflatable restraints (SIR) wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 03
DRIVER FIRING CIRCUIT, SHORT TO GROUND

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the driver airbag module firing circuit. The SDM allows a very small amount of current to flow through the driver airbag module firing circuit. The SDM monitors the voltage during this check.

DTC 03 Will Set When

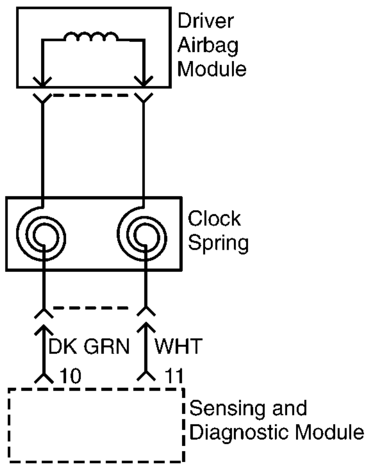
- The firing circuit is shorted to ground.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 03 – Driver Firing Circuit, Short To Ground

Step	Action	Value(s)	Yes	No
1	Visually inspect the supplemental inflatable restraints (SIR) wiring harness for damage. Is there any visible damage to the SIR harness?	-	Go to Step 2	Go to Step 3
2	1. Replace the SIR wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Remove the driver airbag module. 2. Place the driver airbag module in a secure position with the decorative surface facing upward. 3. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the driver airbag module. 4. Use an ohmmeter to check the continuity between ground and one of the terminals on the wiring harness connector for the driver airbag module. • Refer to “Diagnostic Illustration 5” in this section. Is the resistance less than the specified value?	R	Go to Step 6	Go to Step 4
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool for CODE ERASE. 4. Do the diagnostic system check. • Refer to the “Diagnostic System Check” in this section. Does the code 03 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the driver airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. Disconnect the clock spring wiring harness connector at the lower steering column. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the clock spring. 2. Using an ohmmeter, check for continuity between ground and one of the terminals on the SDM side of the clock spring connector. Is the resistance less than the specified value?	R	Go to Step 2	Go to Step 7
7	1. Replace the clock spring. 2. Reconnect the negative battery terminal. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 04
DRIVER FIRING CIRCUIT, SHORT TO BATTERY VOLTAGE

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the driver airbag module firing circuit. The SDM allows a very small amount of current to flow through the circuit. The SDM monitors voltage during this check.

DTC 04 Will Set When

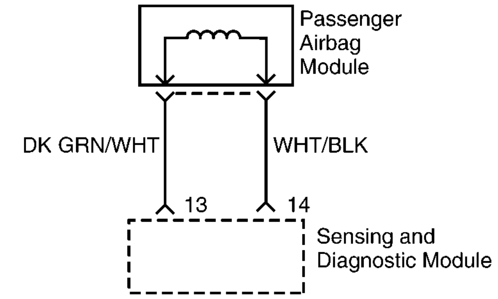
- **The firing circuit is shorted to voltage.**

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 04 – Driver Firing Circuit, Short To Battery Voltage

Step	Action	Value(s)	Yes	No
1	Visually inspect the supplemental inflatable restraints (SIR) harness for damage. Is there any visible damage to the SIR harness?	-	Go to Step 2	Go to Step 3
2	1. Replace the SIR wiring harness. 2. Reconnect the negative battery cable. Is your repair complete?	-	Go to Diagnostic System Check	-
3	1. Remove the driver airbag module. 2. Place the driver airbag module in a secure position with the decorative surface facing upward. 3. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the driver airbag module. 4. Use a multimeter to check the voltage at one of the terminals on the wiring harness connector for the driver airbag module. • Refer to "Diagnostic Illustration 6" in this section. Is the voltage greater than the specified value?	0 v	Go to Step 6	Go to Step 4
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool for CODE ERASE. 4. Do the diagnostic system check. Does the code 04 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the driver airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. Disconnect the clock spring wiring harness at the lower steering column. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the clock spring connector. 2. Using a multimeter, check the voltage at one of the terminals on the SDM side of the clock spring connector. • Refer to "Diagnostic Illustration 7" in this section. Did the voltmeter indicate the specified value?	0 v	Go to Step 7	Go to Step 2
7	1. Replace the clock spring. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 05
PASSENGER FIRING CIRCUIT, RESISTANCE TOO HIGH

Open Circuit

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the passenger airbag firing circuit. The SDM allows a very small amount of current to flow through the circuit. The SDM monitors the circuit resistance during this check.

DTC 05 Will Set When

- The combined resistance of the passenger airbag module, the harness wiring, and the connector contacts is above a specified value, as in an open circuit.

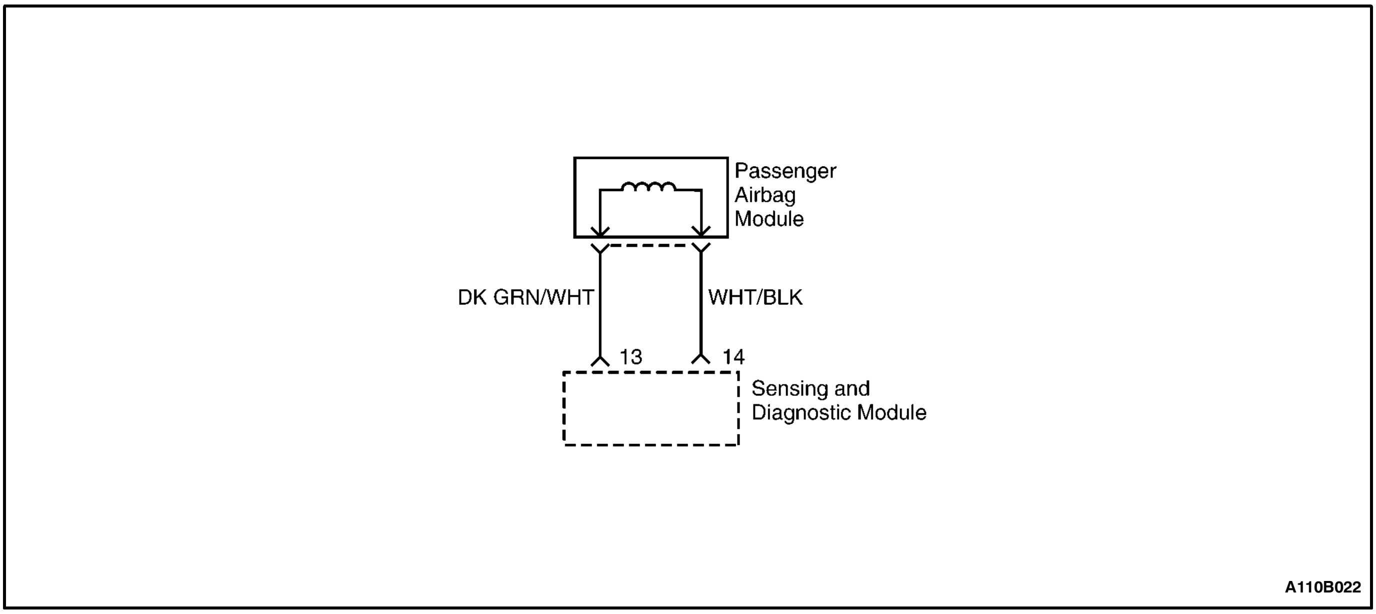
Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: Never measure the resistance of an airbag module. If the anti-deployment shorting bar on the module-side of the connector is not working properly, the meter's battery can deploy the airbag and cause injury.

DTC 05 – Passenger Firing Circuit, Resistance Too High

Step	Action	Value(s)	Yes	No
1	1. Disconnect the negative battery cable. 2. Wait 1 minute for the SDM capacitor to discharge. 3. Examine the wiring and the connector at the passenger side airbag module. Is the connector disconnected?	-	Go to Step 2	Go to Step 3
2	1. Reconnect the passenger side airbag module connector. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Disconnect the electrical connector for the passenger side airbag module. 2. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the passenger airbag module. 3. Connect an ohmmeter to the terminals on the SDM side of the wiring harness connector for the passenger side airbag module. • Refer to "Diagnostic Illustration 8" in this section. Does the ohmmeter show the specified value?	[0 W	Go to Step 4	Go to Step 6
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool for CODE ERASE. 4. Do the diagnostic system check. Does the code 05 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the passenger side airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. Replace the supplemental inflatable restraints (SIR) wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 06 PASSENGER FIRING CIRCUIT, RESISTANCE TOO LOW

Short Circuit

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the passenger airbag firing circuit. The SDM allows a very small amount of current to flow through the circuit. The SDM monitors the circuit resistance during this check.

DTC 06 Will Set When

- The combined resistance of the passenger airbag module, the harness wiring, and the connector contacts is below a specified value, as in a short circuit between the wires to the passenger airbag module.

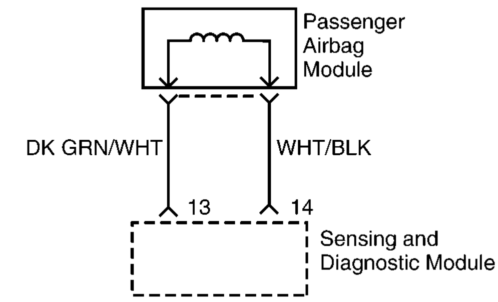
Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: Never measure the resistance of an airbag module. If the anti-deployment shorting bar on the module side of the connector is not working properly, the meter's battery could deploy the airbag and cause injury.

DTC 06 – Passenger Firing Circuit, Resistance Too Low

Step	Action	Value(s)	Yes	No
1	1. Disconnect the negative battery cable. 2. Connect an ohmmeter to the terminals of the wiring harness connector for the passenger airbag module on the SDM side of the connector. • Refer to “Diagnostic Illustration 8” in this section. Does the ohmmeter show the specified value?	R	Go to Step 2	Go to Step 4
2	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool to CODE ERASE. 4. Do the diagnostic system check. Does the code 06 still show as a current fault?	-	Go to Step 3	System OK
3	1. Replace the passenger airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
4	1. Replace the supplemental inflatable restraints (SIR) wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 07 PASSENGER FIRING CIRCUIT, SHORT TO GROUND

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will diagnose any malfunctions within itself.

After passing these tests, the SDM will check the passenger airbag firing circuit. The SDM allows a very small amount of current to flow through the circuit. The SDM monitors the voltage during this check.

DTC 07 Will Set When

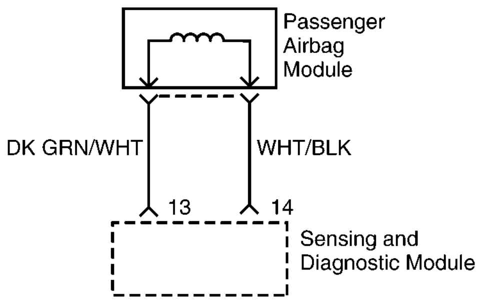
- The firing circuit is shorted to ground.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 07 Passenger Firing Circuit, Short To Ground

Step	Action	Value(s)	Yes	No
1	1. Disconnect the negative battery cable. 2. Wait 1 minute for the SDM capacitor to discharge. 3. Visually inspect the supplemental inflatable restraints (SIR) wiring harness. Is there any visible damage to the SIR harness?	-	Go to Step 2	Go to Step 3
2	1. Replace the SIR wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Disconnect the electrical connector from the passenger airbag module. 2. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the passenger side airbag module. 3. Use an ohmmeter to check the continuity between ground and one of the terminals at the SDM side of the wiring harness connector for the passenger side airbag module. • Refer to “Diagnostic Illustration 9” in this section. Is the resistance less than the specified value?	R	Go to Step 2	Go to Step 4
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool to CODE ERASE. 4. Do the diagnostic system check. Does the code 07 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the passenger side airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 08
PASSENGER FIRING CIRCUIT, SHORT TO BATTERY VOLTAGE

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the passenger airbag firing circuit. The SDM allows a very small amount of current to flow through the circuit. The SDM monitors the voltage during this check.

DTC 08 Will Set When

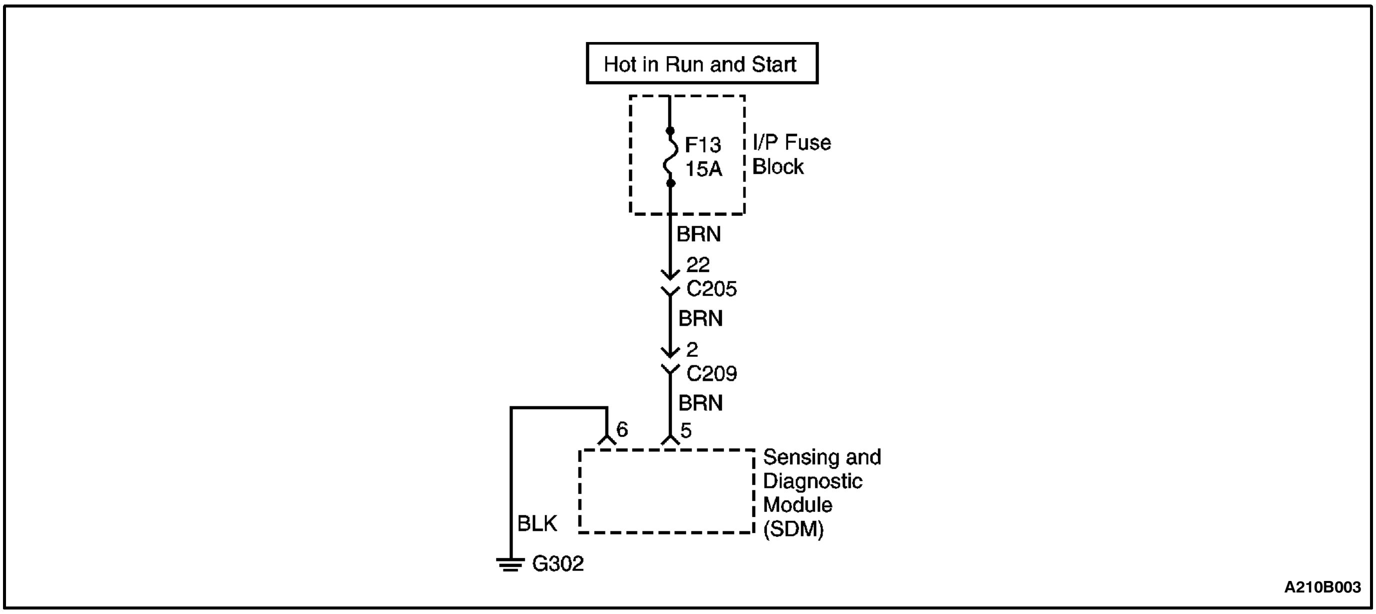
- **The firing circuit is shorted to the voltage.**

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies the reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 08 – Passenger Firing Circuit, Short To Battery Voltage

Step	Action	Value(s)	Yes	No
1	1. Disconnect the battery negative cable. 2. Wait 1 minute for the SDM capacitor to discharge. • The capacitor supplies reserve power to deploy the passenger side airbag even if the battery has been disconnected. 3. Visually inspect the supplemental inflatable restraints (SIR) wiring harness. Is there any visible damage to the SIR wiring harness?	-	Go to Step 2	Go to Step 3
2	1. Replace the SIR wiring harness. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Disconnect the electrical connector for the passenger airbag module. 2. Disconnect the electrical connector at the SDM. • The shorting bar at the disconnected SDM connector will create a complete circuit between the wires from the passenger airbag module. 3. Use a multimeter to check the voltage at one of the terminals on the SDM side of the SIR wiring harness connector for the passenger airbag module. • Refer to “Diagnostic Illustration 10” in this section. Is the voltage greater than the specified value?	0 v	Go to Step 2	Go to Step 4
4	1. Replace the SDM. 2. Reconnect the negative battery cable. 3. Set the scan tool to CODE ERASE. 4.Do the diagnostic system check. Does the code 08 still show as a current fault?	-	Go to Step 5	System OK
5	1. Replace the passenger side airbag module. 2. Reconnect the negative battery cable. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 23
IGNITION INPUT CIRCUIT, VOLTAGE TOO HIGH

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After completing the internal tests, the SDM will check its voltage supply. If the voltage supply is too high or too low, the SDM may not receive the proper information when it attempts to use a known current to test the airbag module circuits.

DTC 23 Will Set When

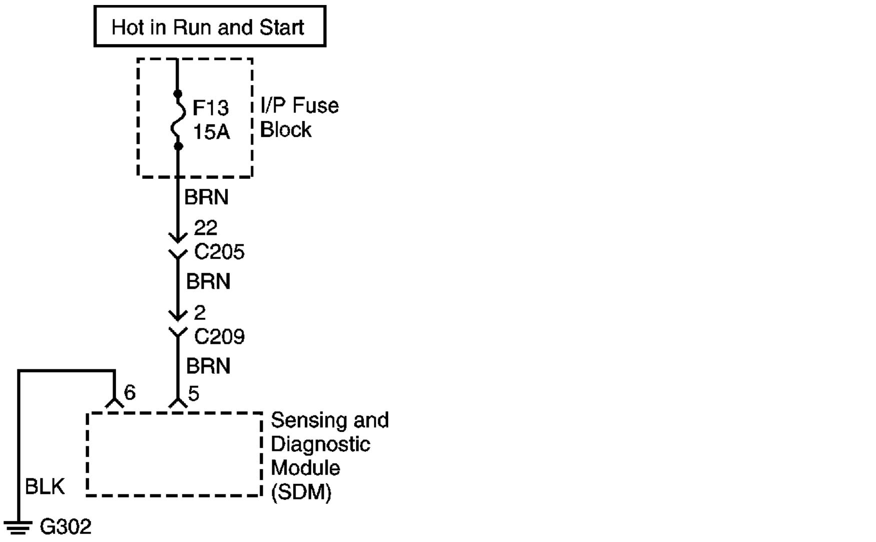
- The SDM receives voltage higher than a specified value.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 23 – Ignition Input Circuit, Voltage Too High

Step	Action	Value(s)	Yes	No
1	Check the vehicle's charging system. Is the charging system OK?	-	Go to Step 3	Go to Step 2
2	Repair the charging system. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Disconnect the negative battery cable. 2. Replace the SDM. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
IGNITION INPUT CIRCUIT, VOLTAGE TOO LOW

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After completing the internal tests, the SDM will check its voltage supply. If the voltage supply is too high or too low, the SDM may not receive the proper information when it attempts to use a known current to test the airbag module circuits.

DTC 24 Will Set When

- The SDM receives the voltage lower than a specified value.

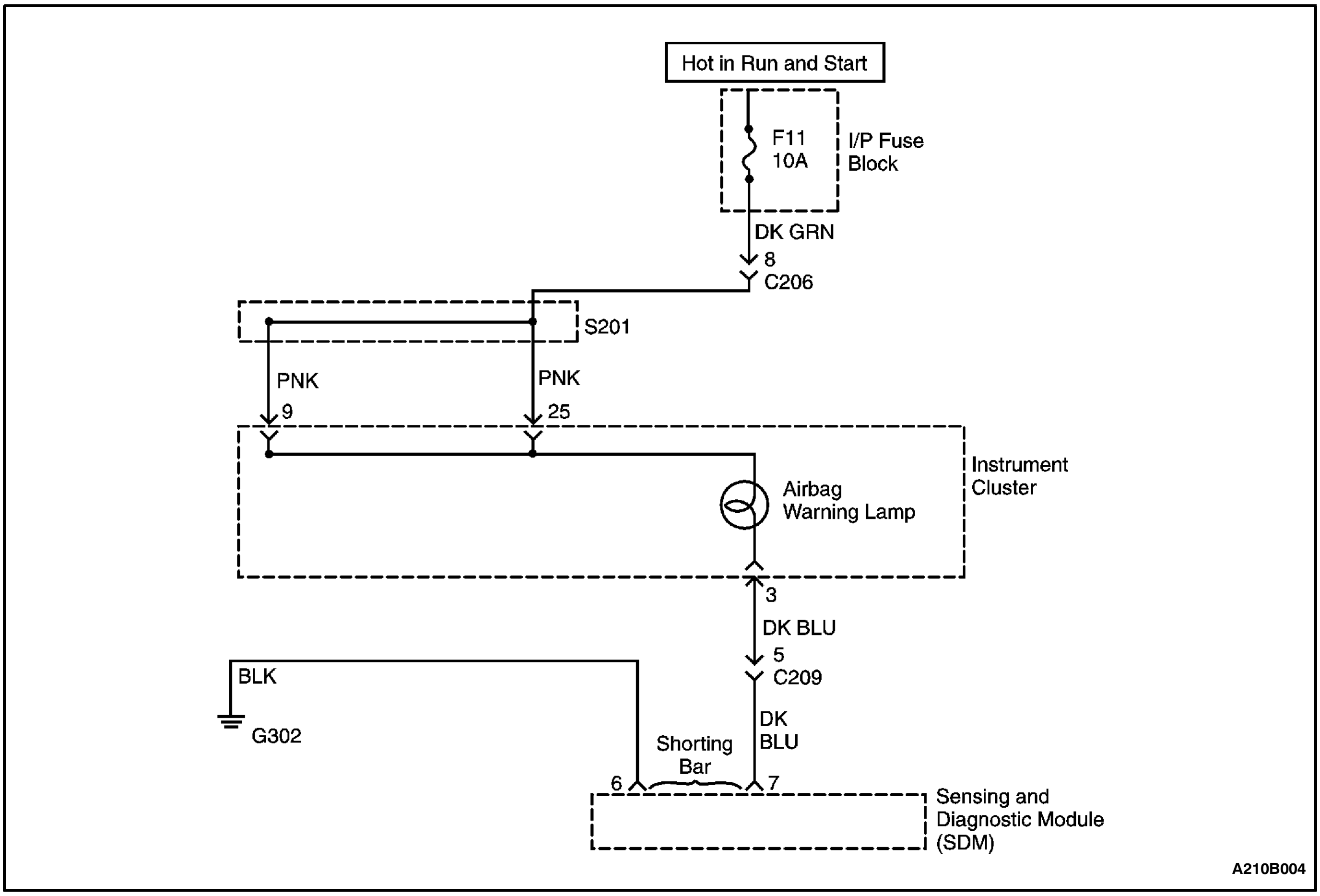
Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: As a safety precaution, disconnect the connector for the passenger airbag module. Unintentional deployment of the airbags can cause injury.

DTC 24 – Ignition Input Circuit, Voltage Too Low

Step	Action	Value(s)	Yes	No
1	Check the fuse F13. Is the fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit. 2. Repair if needed. 3. Replace the fuse. Is the repair complete?	-	Go to Diagnostic System Check	-
3	1. Turn the ignition ON. 2. Using a multimeter, check the voltage at the fuse F13. Is the battery voltage available at the fuse F13?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the power supply to the fuse F13. Is the repair complete?	-	Go to Diagnostic System Check	-
5	1. Disconnect the negative battery cable. 2. Wait one minute before proceeding 3. Disconnect the connector at the SDM. 4. Reconnect the battery. 5. Turn the ignition key ON. 6. Measure the voltage at the terminal 5 of the SDM Connector. • Refer to “Diagnostic Illustration 11” in this section. Is the voltage equal to the specified value?	11-14 v	Go to Step 6	Go to Step 7
6	1. Replace the SDM. 2. Reconnect the electrical connectors. Is the repair complete?	-	Go to Diagnostic System Check	-
7	1. Disconnect the connector C209. • The connector C209 is the connector between the instrument harness and the supplemental inflatable restraints (SIR) harness. 2. Turn the ignition ON. 3. Using a multimeter, check the voltage on the instrument harness side at the terminal 2 of the connector C209. • Refer to “Diagnostic Illustration 12” in this section. Is the voltage equal to the specified value?	11-14 v	Go to Step 8	Go to Step 9
8	1. Replace the SIR wiring harness. 2. Reconnect the battery. Is the repair complete?	-	Go to Diagnostic System Check	-
9	Repair the open circuit between the fuse F13 and the connector C209. Is the repair complete?	-	Go to Diagnostic System Check	-



DIAGNOSTIC TROUBLE CODE (DTC) 25 WARNING LAMP FAILURE

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

After passing these tests, the SDM will check the warning lamp circuit. The SDM constantly measures the voltage at the warning lamp output in order to determine if the lamp is ON or OFF at the correct time.

DTC 25 Will Set When

- The lamp is ON when it should be OFF.
- The lamp is OFF when it should be ON.

Diagnostic Aids

When the warning lamp operates correctly, the warning lamp turns ON for approximately four seconds after the ignition is first switched ON, and then The warning lamp turns OFF.

When the warning lamp operates incorrectly, the warning lamp continues to blink four times per second, demonstrating that the SDM is faulty and must be replaced.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

Caution: If the short is in the supplemental inflatable restraints (SIR) wiring harness, do not attempt to repair it. The repair might create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury. Replace the SIR wiring harness if it is damaged.

DTC 25 – Warning Lamp Failure

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the warning lamp constantly ON?	-	Go to Step 2	Go to Step 9
2	Make sure the SDM connector is attached correctly. Does the warning lamp turn OFF?	-	Go to Diagnostic System Check	Go to Step 3
3	1. Check for indications of the diagnostic trouble code (DTC) other than the code 25. 2. Go to the appropriate DTC charts and repair each additional problem. 3. Do the diagnostic system check. Does the scan tool still indicate the code 25?	-	Go to Step 4	System OK
4	Check for a short to ground between the SDM and the warning lamp using the following method: 1. Turn the ignition OFF. 2. Disconnect the connector C209. 3. Connect one ohmmeter lead to ground. 4. Touch the other ohmmeter lead to the terminal 5 of the connector C209 on the instrument harness side. • Refer to “Diagnostic Illustration 14” in this section. Does the ohmmeter indicate the specified value?	R	Go to Step 6	Go to Step 5
5	Repair the short to ground in the instrument harness. Is the repair complete?	-	Go to Diagnostic System Check	-
6	1. The connector C209 remains disconnected. 2. One lead of the ohmmeter remains connected to ground. 3. Move the ohmmeter lead at the connector C209 to the SDM side of the connector. • Refer to “Diagnostic Illustration 13” in this section. Does the ohmmeter indicate the specified value?	R	Go to Step 7	Go to Step 8
7	Replace the SDM. Is the repair complete?	-	Go to Diagnostic System Check	-
8	1. Disconnect the negative battery cable. 2. Replace the SIR wiring harness. 3. Do the diagnostic system check. Does the code 25 still show?	-	Go to Step 5	System OK
9	Check the fuse F11. Is the fuse F11 blown?	-	Go to Step 10	Go to Step 11
10	1. With the connector C209 temporarily disconnected, check for a short to ground between the fuse F11 and the warning lamp. 2. Make a repair, if needed. 3. Replace the fuse F11. Is the repair complete?	-	Go to Diagnostic System Check	-

DTC 25 – Warning Lamp Failure (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition ON. 2. Using a multimeter, check the voltage at the fuse F11. Does the multimeter show the specified value?	11-14 v	Go to Step 13	Go to Step 12
12	Repair the open power supply circuit for the fuse F11. Is the repair complete?	-	Go to Diagnostic System Check	-
13	1. Disconnect the connector C209. 2. Turn the ignition ON. 3. Using a multimeter, check the voltage on the instrument harness side of the terminal 5 of the connector C209. Does the multimeter show the specified value?	11-14 v	Go to Step 15	Go to Step 14
14	1. Check the warning lamp bulb. 2. Replace the warning lamp bulb, if needed. 3. If the bulb is good, repair the open circuit between the fuse F11 and the terminal 5 of the connector C209. Is the repair complete?	-	Go to Diagnostic System Check	-
15	1. Disconnect the negative battery terminal. 2. Wait at least 1 minute before proceeding. 3. Replace the SIR wiring harness. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 31
SDM INTERNAL FAULT

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose malfunctions within itself.

DTC 31 Will Set When

- The SDM does not pass the internal tests.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 31 – SDM Internal Fault

Step	Action	Value(s)	Yes	No
1	1. Disconnect the negative battery cable. 2. Replace the SDM. Is the repair complete?	-	Go to Diagnostic System Check	-

DIAGNOSTIC TROUBLE CODE (DTC) 32
SDM CRASH RECORDED

Circuit Description

When the ignition switch is turned ON, the sensing and diagnostic module (SDM) will perform tests to diagnose any malfunctions within itself.

DTC 32 Will Set When

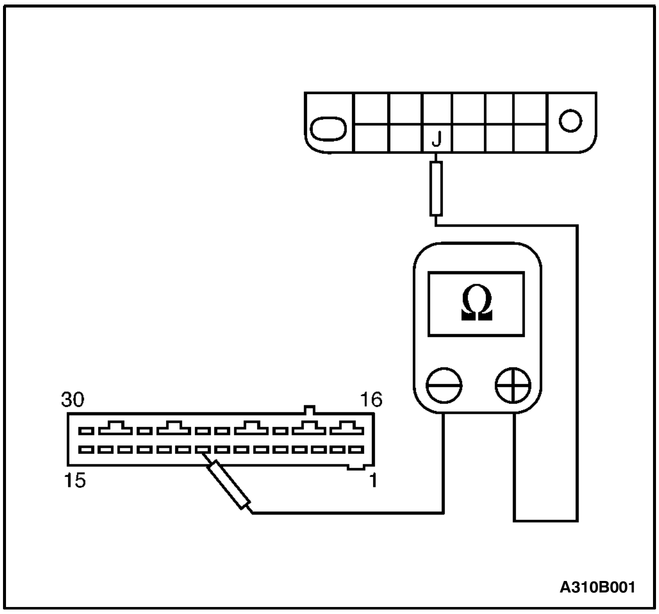
- The SDM has previously detected a crash.

Test Description

Caution: Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

DTC 32 – SDM Crash Recorded

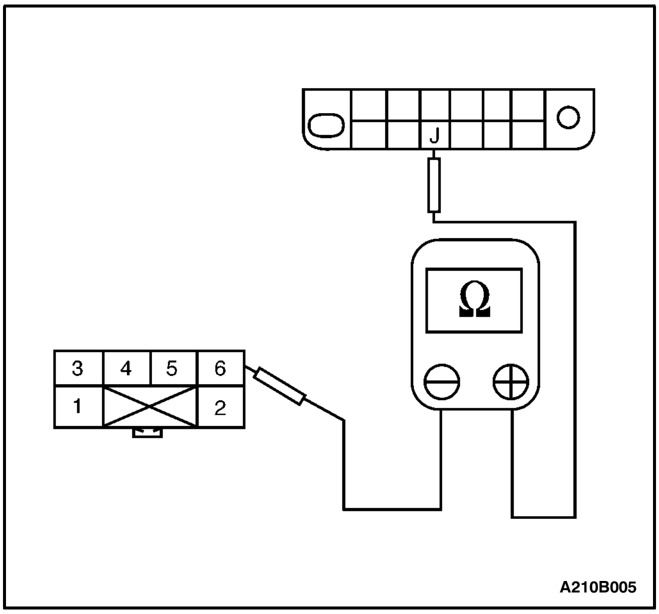
Step	Action	Value(s)	Yes	No
1	1. Disconnect the negative battery cable. 2. Replace the SDM. Is the repair complete?	-	Go to Diagnostic System Check	-



Caution: Do not use these illustrations to troubleshoot without consulting the diagnostic trouble code (DTC) charts. The DTC charts give additional safety precautions and detailed instructions for each test. Failure to follow the proper precautions can result in injury from unintended airbag deployment.

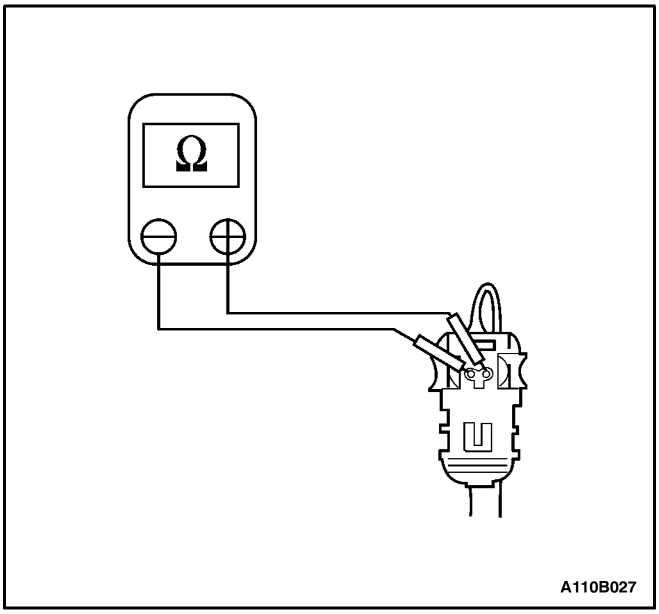
DIAGNOSTIC ILLUSTRATION 1

Checking the continuity between the terminal 9 of the sensing and diagnostic module and the terminal J of the data link connector.



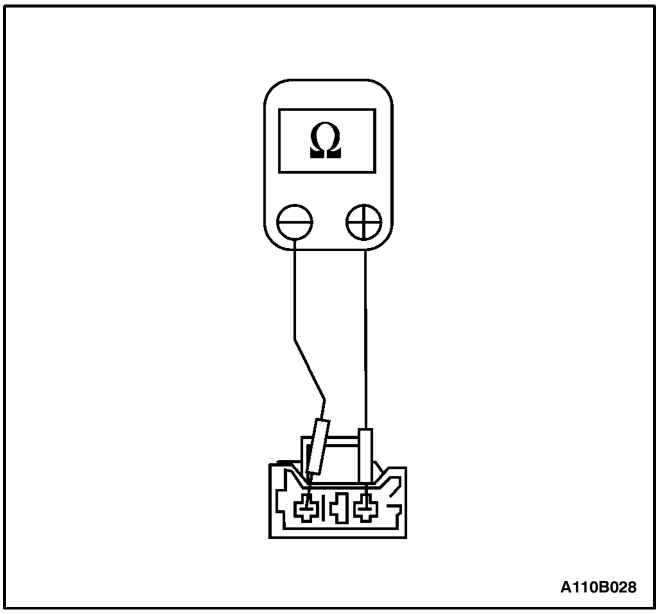
DIAGNOSTIC ILLUSTRATION 2

Checking the continuity on the instrument harness side between the terminal J of the data link connector and the terminal 6 of the connector C209.



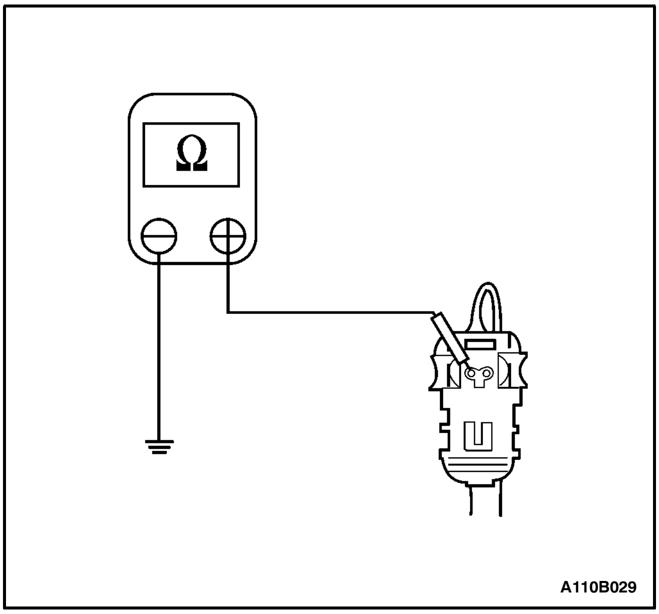
DIAGNOSTIC ILLUSTRATION 3

Measuring the wiring harness for the continuity of the driver side airbag module circuit.



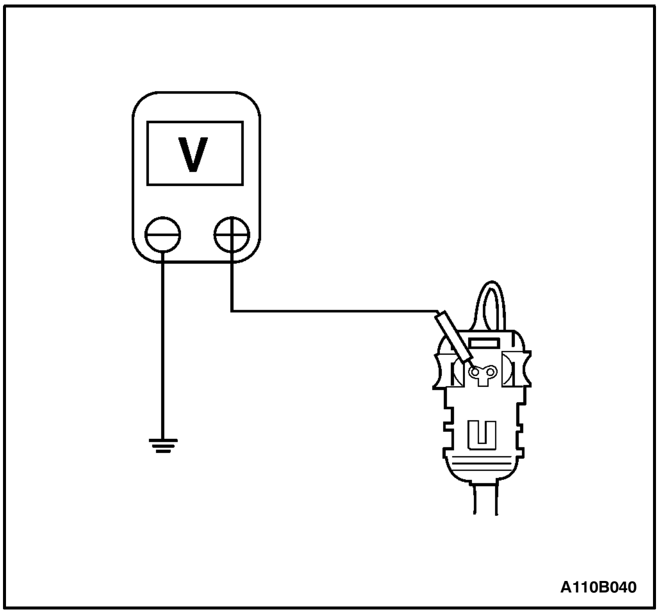
DIAGNOSTIC ILLUSTRATION 4

Checking the continuity of the driver airbag circuit on the sensing and diagnostic module (SDM) side of the clock spring connector.



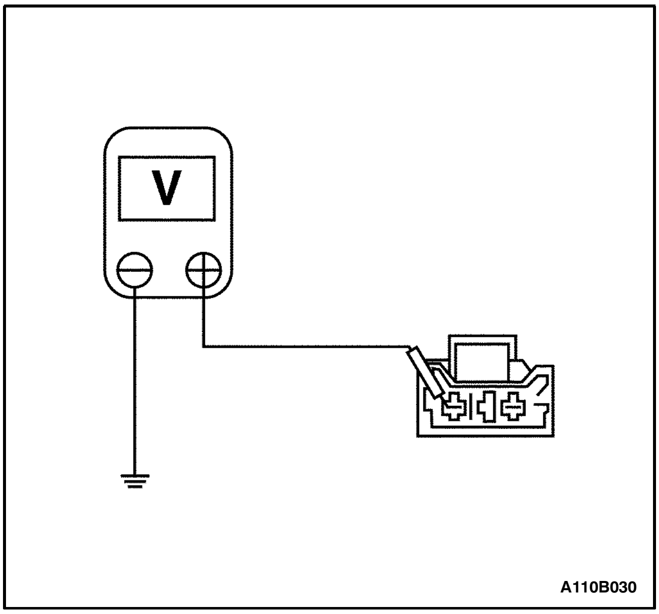
DIAGNOSTIC ILLUSTRATION 5

Checking the driver airbag circuit for a short to ground with the sensing and diagnostic module disconnected.



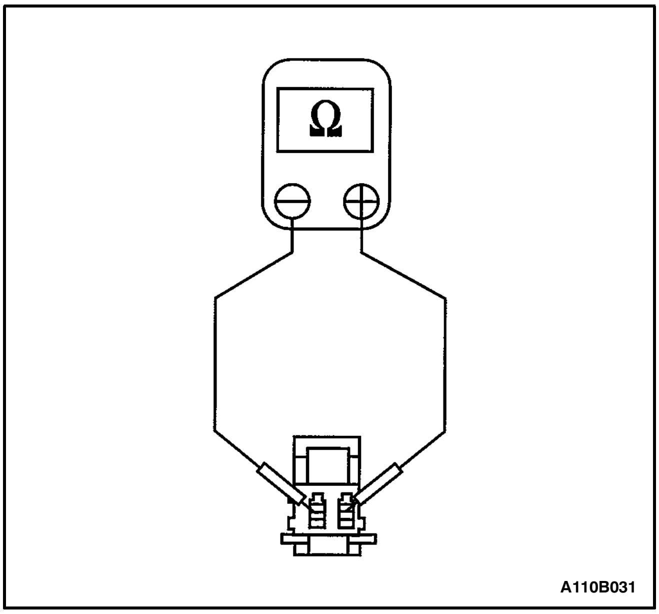
DIAGNOSTIC ILLUSTRATION 6

Checking the driver airbag circuit for a short to voltage.



DIAGNOSTIC ILLUSTRATION 7

Checking the clock spring connector for a short to voltage on the sensing and diagnostic module side.



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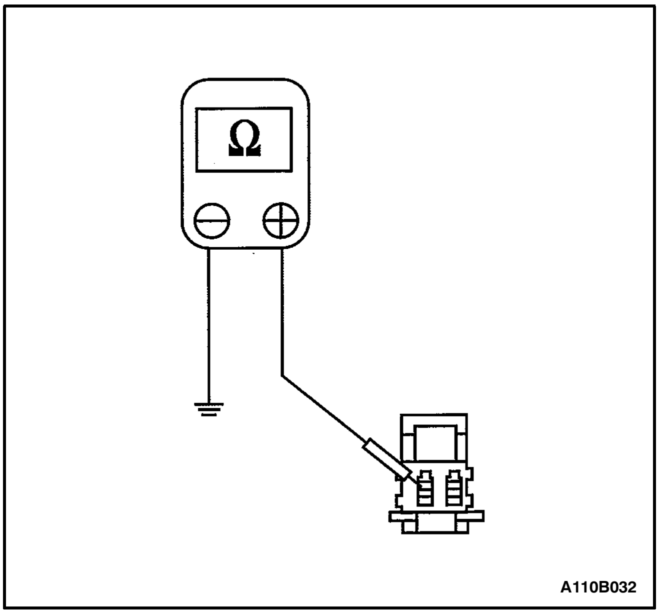
DIAGNOSTIC ILLUSTRATION 8

Checking the passenger airbag circuit continuity on the sensing and diagnostic module side of the connector.



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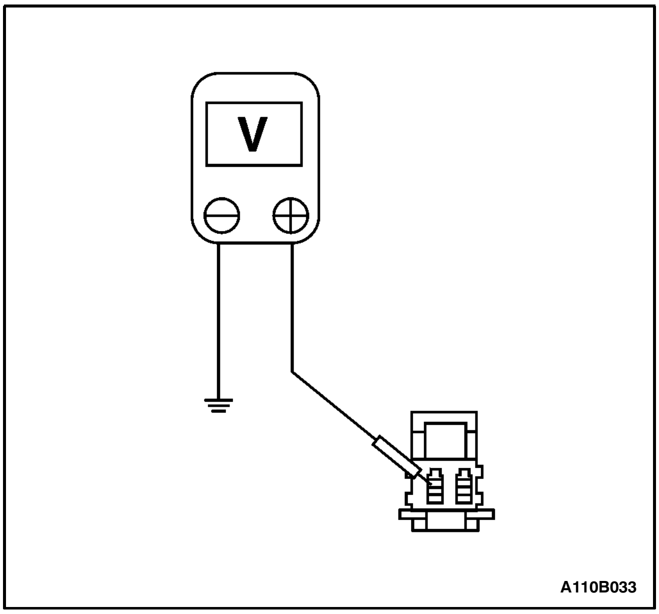
DIAGNOSTIC ILLUSTRATION 9

Checking the passenger airbag circuit for a short to ground.



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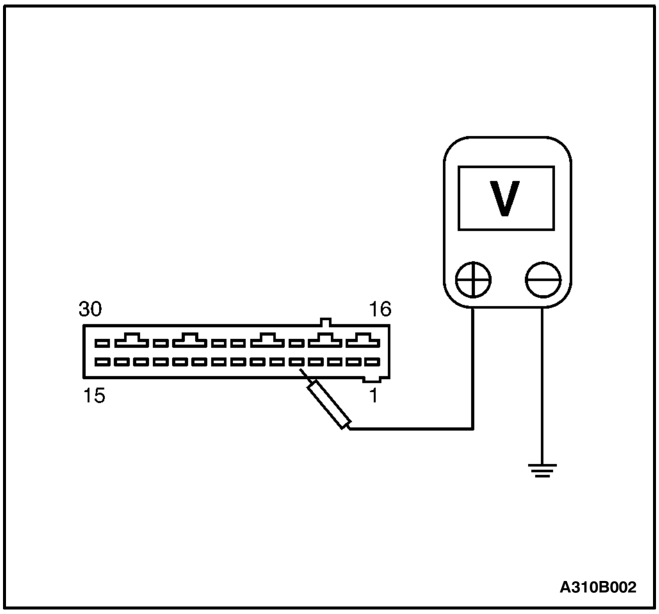
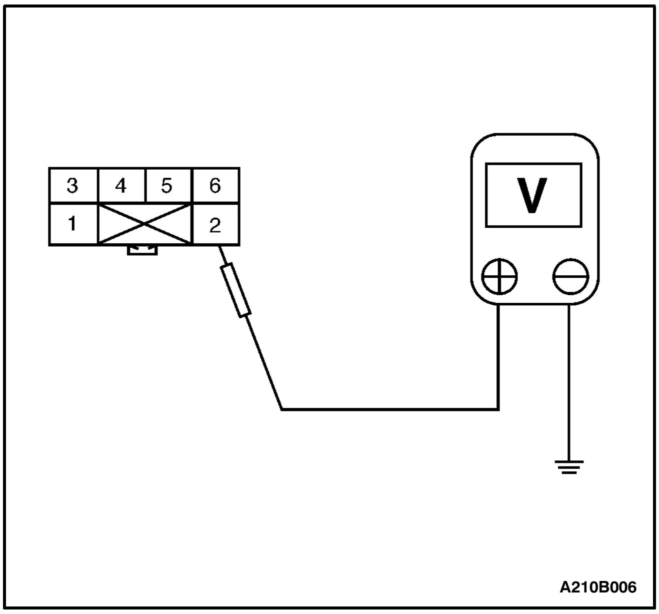
DIAGNOSTIC ILLUSTRATION 10

Checking the passenger airbag circuit for a short to voltage.



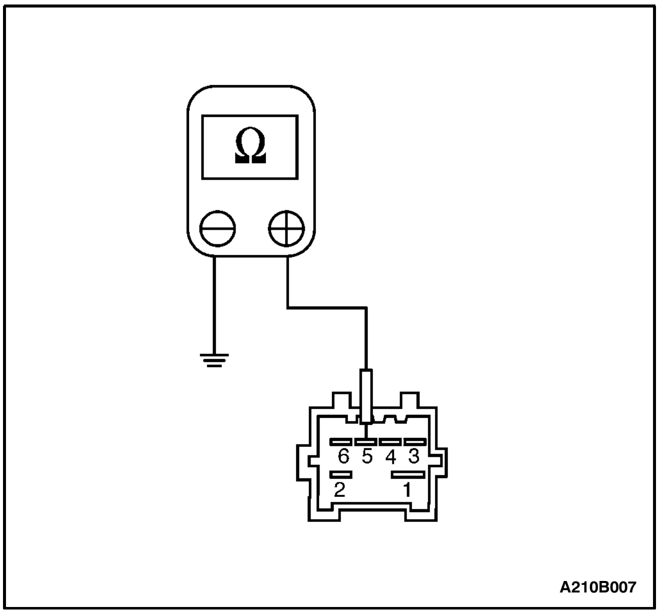
DIAGNOSTIC ILLUSTRATION 11

Checking the sensing and diagnostic module voltage supply at the terminal 5.



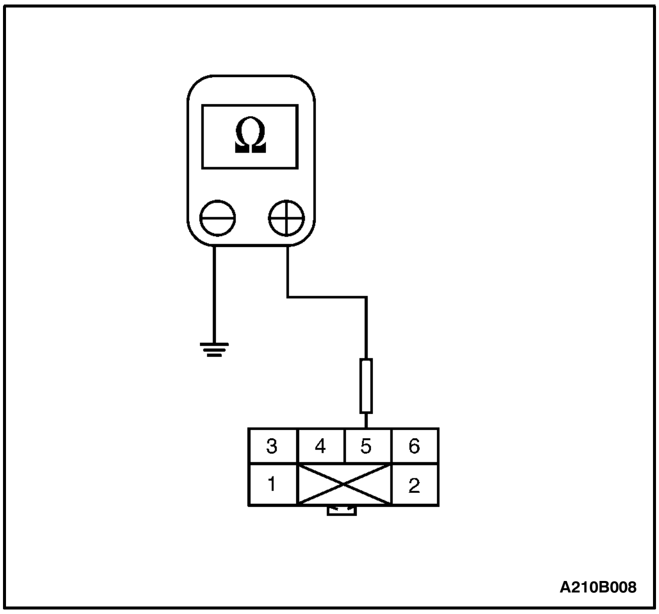
DIAGNOSTIC ILLUSTRATION 12

Checking the voltage supply on the instrument harness side at the terminal 2 of the connector C209.



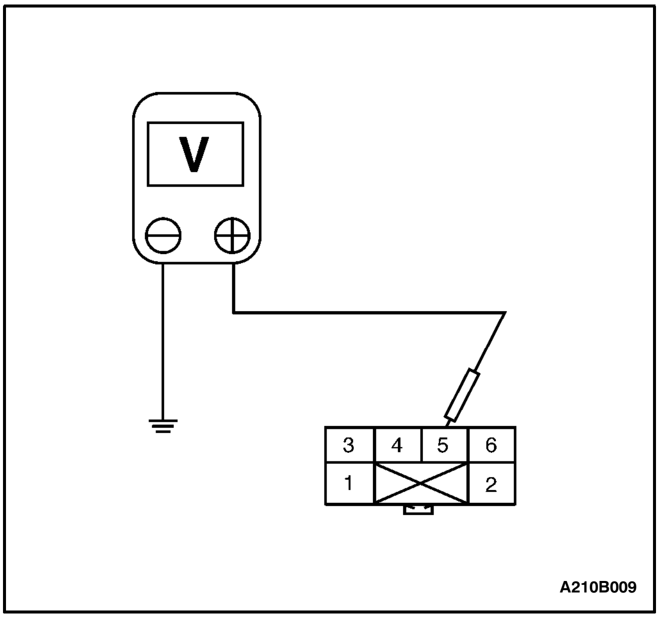
DIAGNOSTIC ILLUSTRATION 13

Checking for a short to ground on the sensing and diagnostic module side of the supplemental inflatable restraints harness at the terminal 5 of the connector C209.



DIAGNOSTIC ILLUSTRATION 14

Checking for a short to ground in the instrument harness on the instrument harness side at the terminal 5 of the connector C209.



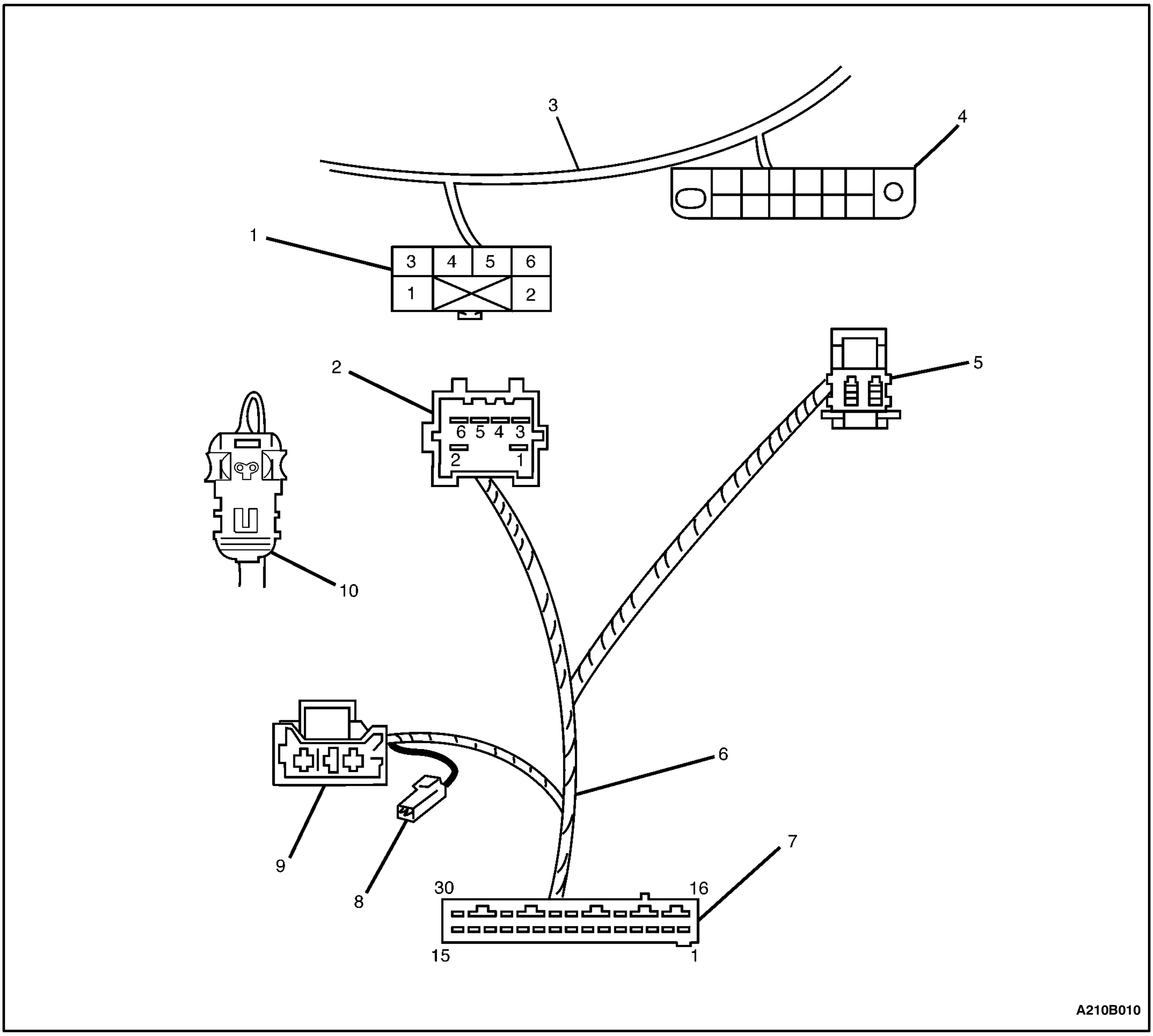
DIAGNOSTIC ILLUSTRATION 15

Checking the voltage of the warning lamp circuit on the instrument harness side at the terminal 5 of the connector C209.

DIAGNOSTIC ILLUSTRATION 16

Supplemental Inflatable Restraints (SIR) Harness And Connectors

(Left-Hand Drive Shown, Right-Hand Drive Similar)



1 Instrument Harness Connector C209
2 Supplemental Inflatable Restraints Harness Connector C209
3 Instrument Harness
4 ALDL Connector
5 Passenger Airbag Module Connector
6 Supplemental Inflatable Restraints Harness
7 Sensing and Diagnostic Module Connector
8 Horn Connector
9 Clock Spring Connector
10 Driver Airbag Module Connector

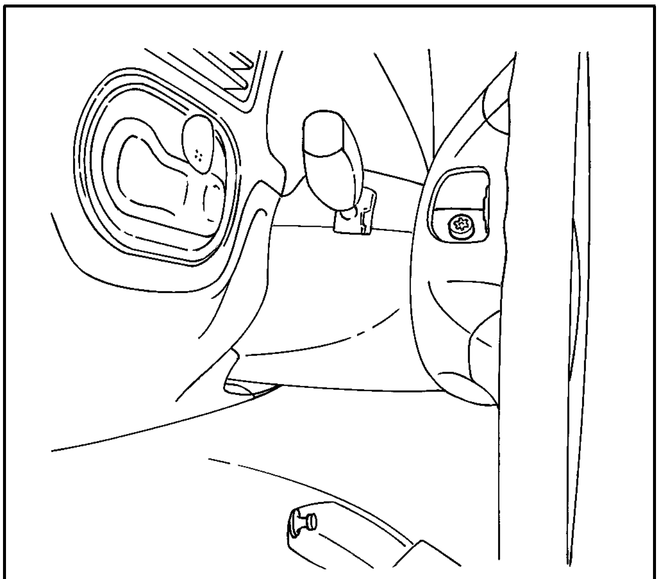
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

DRIVER AIRBAG MODULE

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure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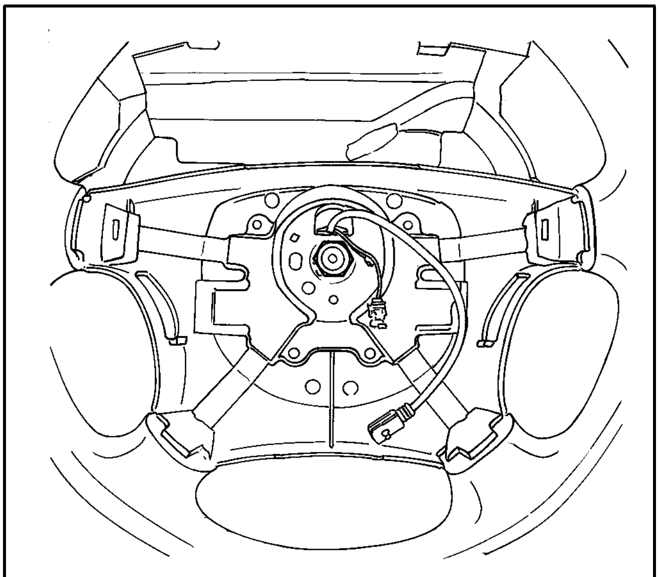
1. Disconnect the negative battery cable.
2. Position the steering wheel straight ahead.
3. Remove the driver airbag module mounting bolts, one from each side of the steering wheel.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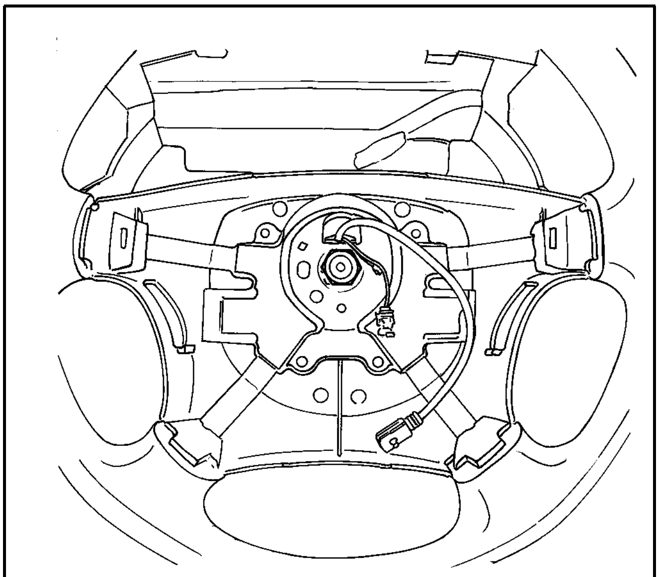
Caution: When removing an airbag module or handling a new airbag module, always keep the top of the unit facing upward. This leaves room for the module to expand if the module unexpectedly deploys. Without room for expansion, a module suddenly propelled toward a person or object can cause injury or vehicle damage.

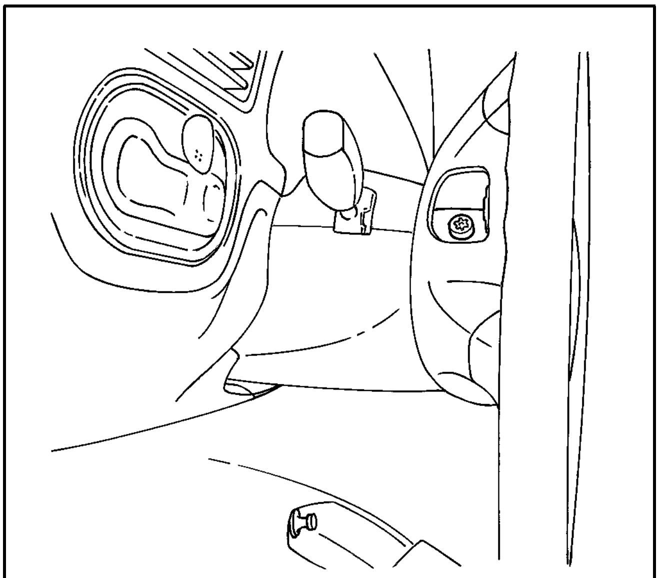
4. Disconnect the connectors from the horn terminal and the driver airbag module.
5. Remove the driver airbag module.

Installation Procedure


A105E020

Caution: When handling an airbag module, always keep the top of the unit facing upward. This leaves room for the module to expand if the module unexpectedly deploys. Without room for expansion, a module suddenly propelled toward a person or object can cause injury or vehicle damage.

1. Install the connectors to the horn terminal and the driver airbag module.

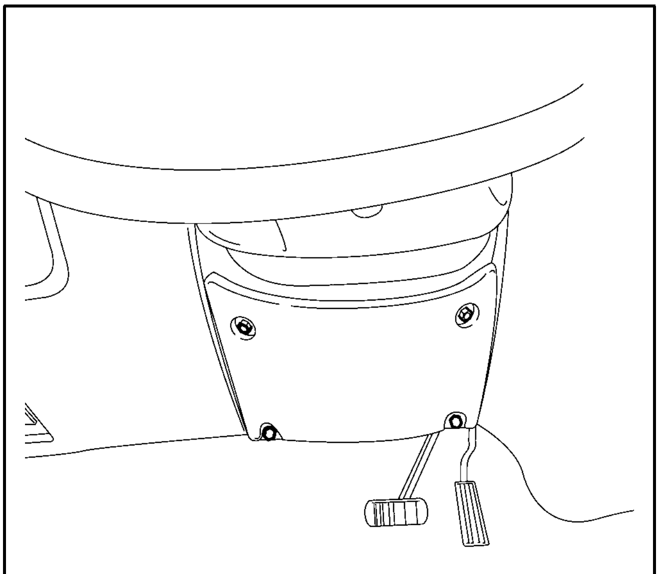

A110B009

2. Install the driver airbag module.
3. Install the driver airbag module mounting bolts, one on each side of the steering wheel.

Tighten

Tighten the driver airbag module mounting bolts to 14.7 N•m (130 lb-in).

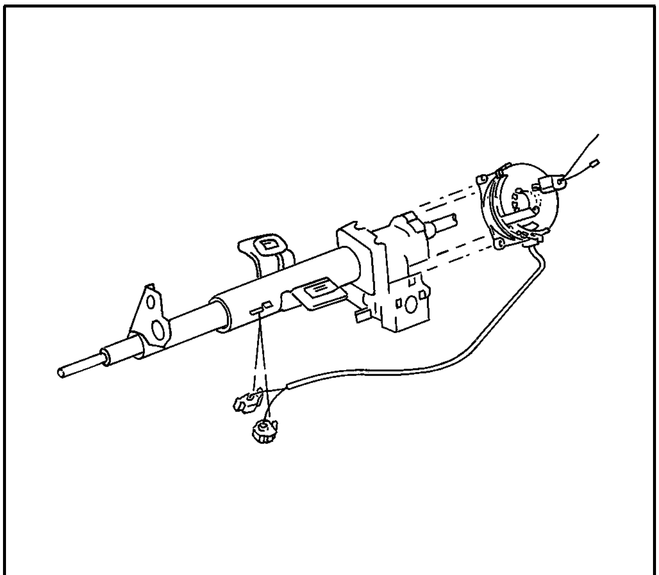
4. Connect the negative battery cable.


A110B012

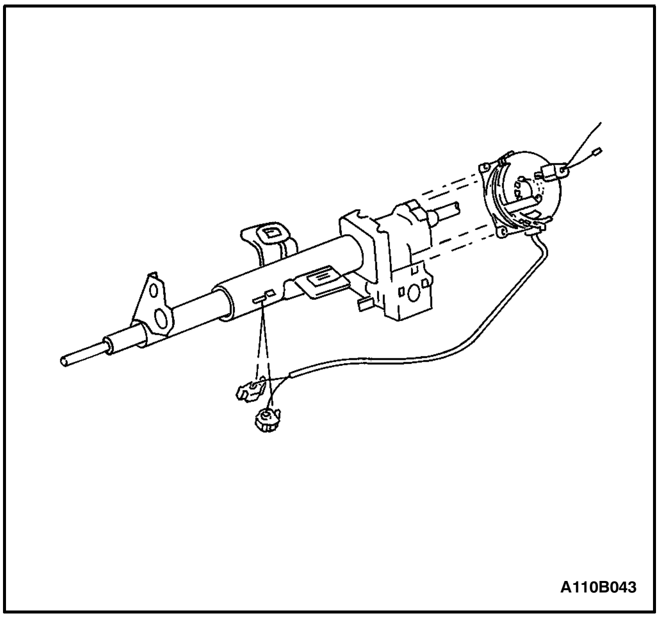
CLOCK SPRING

Removal Procedure

1. Disconnect the negative battery cable. Wait 1 minute until the capacitor inside the sensing and diagnostic module has discharged.
2. Remove the driver airbag module. Refer to "Driver Side Airbag Module" in this section.
3. Remove the steering wheel. Refer to Section 6E, Steering Wheel and Column.
4. Remove the lower steering column cover.


A110B043

5. Disconnect the connectors at the lower steering column.
6. Remove the screws and the clock spring from the steering shaft.



A110B043

Installation Procedure

Caution: If the clock spring is not properly aligned, the steering wheel may not be able to rotate completely during a turn. Restricted turning ability can cause the vehicle to crash. Improper alignment of the clock spring also may make the supplemental inflatable restraints (SIR) system inoperative, preventing the airbags from deploying during a crash. Both of these outcomes can result in injury.

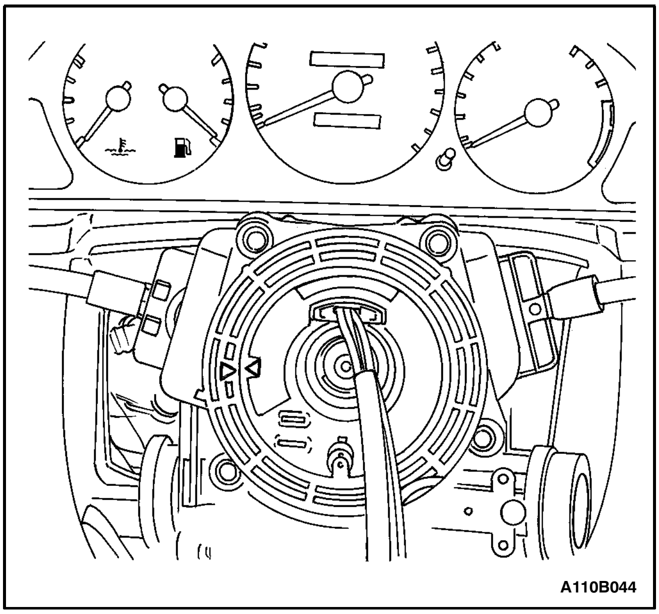
Notice: Turning the clock spring more than three turns clockwise or more than three turns counterclockwise can damage the spring.

1. Turn the front wheels straight ahead.
2. Install the clock spring with the screws.

Tighten

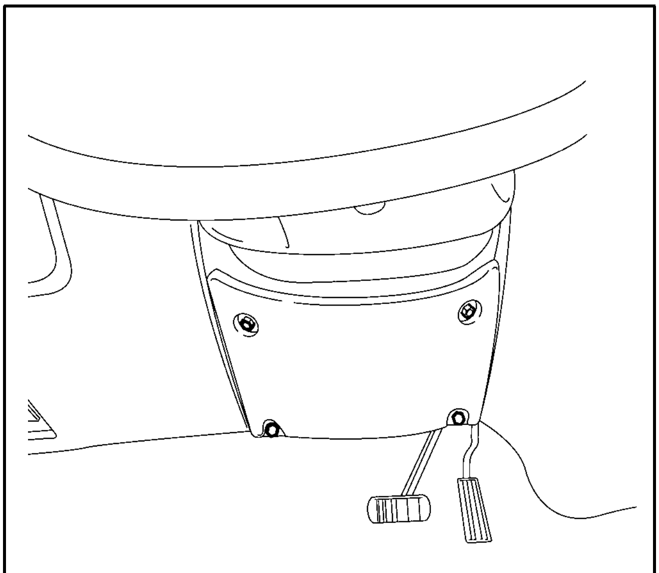
Tighten the clock spring mounting screws to 3 N•m (27 lb-in).

Important: The clock spring may come packed in material used to prevent damage to the spring during shipping or storage. Avoid installing any of the packing material with the clock spring.



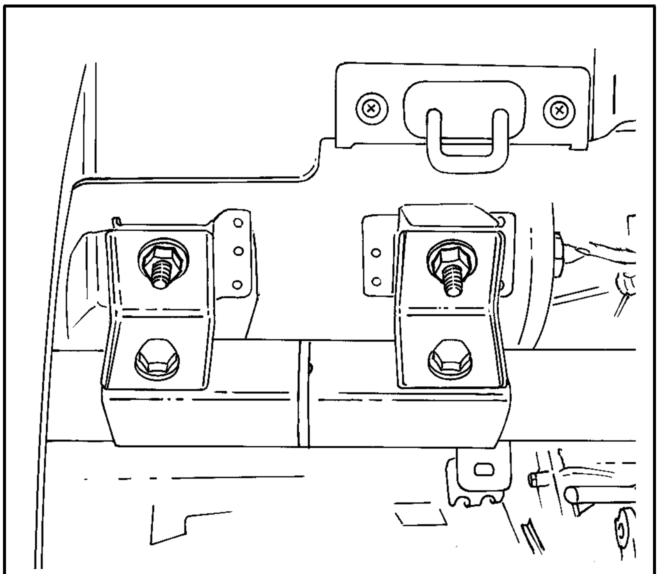
A110B044

3. Turn the label of the clock spring clockwise to lock.
4. Turn the label of the clock spring counterclockwise approximately three turns to the neutral position, with the front wheels straight ahead.
5. Properly align the pointed marks on the components of the clock spring.
6. Connect the electrical connectors on the lower steering column.



A110B012

7. Install the lower steering column cover.
8. Install the steering wheel. Refer to Section 6E, Steering Wheel and Column.
9. Connect the driver airbag module and the horn connectors.
10. Install the driver airbag module. Refer to "Driver Side Airbag Module" in this section.
11. Connect the negative battery cable.

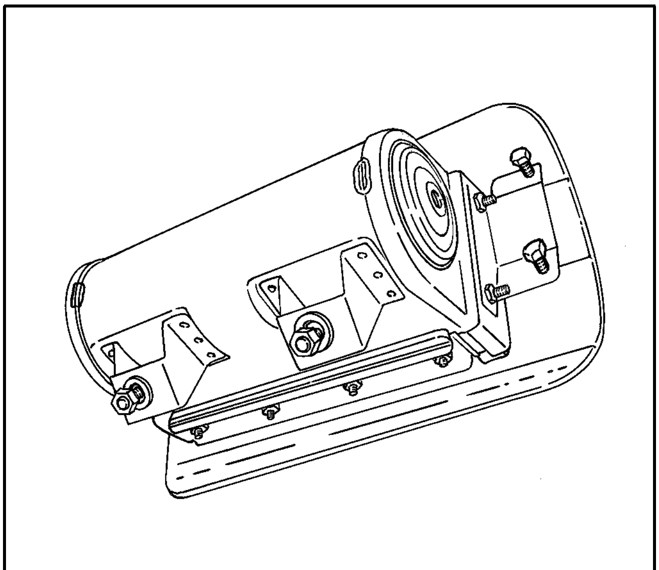


A110B018

PASSENGER AIRBAG MODULE

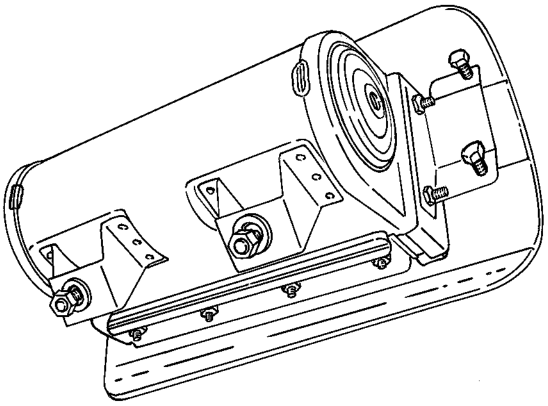
Removal Procedure

1. Remove the glove box. Refer to Section 9E, Instrumentation/Driver Information.
2. Remove the mounting nuts from beneath the passenger airbag module.



A110B019

3. Remove the mounting bolts at the sides of the passenger airbag module.
4. Disconnect the electrical connector.
5. Remove the passenger airbag module.



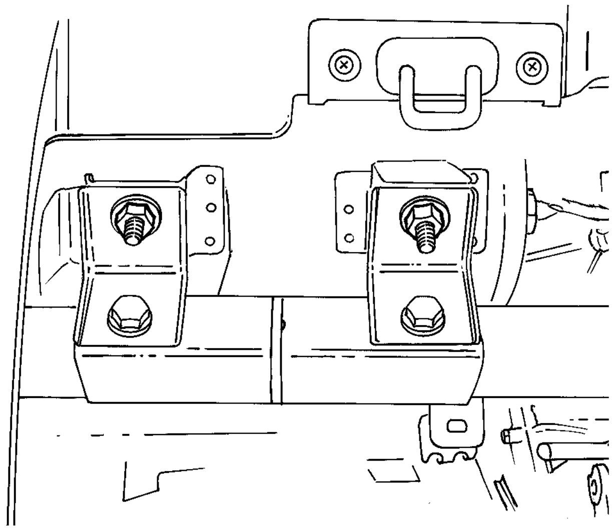
A110B019

Installation Procedure

1. Install the passenger airbag module.
2. Install the mounting bolts at the sides of the passenger side airbag module.

   Tighten

   Tighten the passenger airbag module mounting bolts to 12 N•m (106 lb-in).

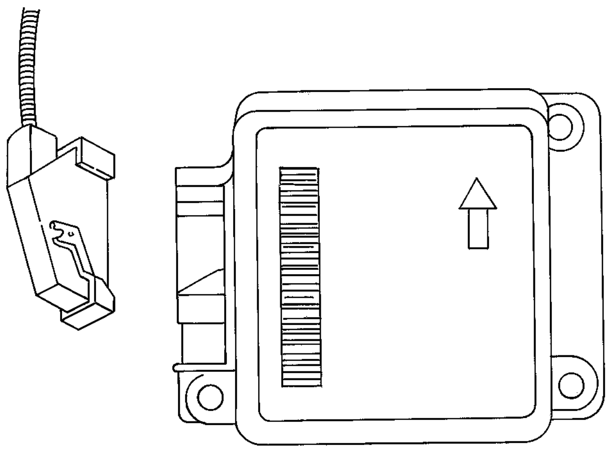


A110B018

3. Install the mounting nuts beneath the passenger airbag module.

   Tighten

   Tighten the passenger airbag module mounting nuts to 22 N•m (16 lb-ft).
4. Connect the electrical connector.
5. Install the glove box. Refer to Section 9E, Instrumentation/Driver Information.

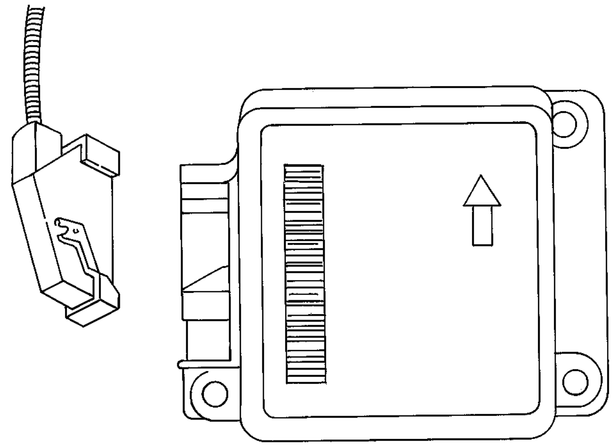


A110B015

SENSING AND DIAGNOSTIC MODULE (SDM)

Removal Procedure

1. Disconnect the negative battery.
2. Remove the rear console. Refer to Section 9G, Interior Trim.
3. Remove the front console. Refer to Section 9G Interior Trim.
4. Disconnect the sensing and diagnostic module (SDM) electrical connector.
5. Remove the SDM mounting bolts and the SDM. Do not disassemble the SDM. It has no serviceable parts.



A110B015

Installation Procedure

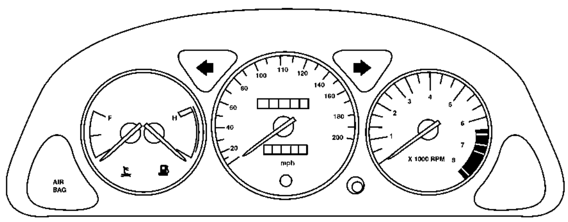
Notice: Do not install an SDM that has been dropped or has water damage, dents, cracks, or other visible defects. Attempted use of a defective SDM can result in vehicle damage.

1. Install the SDM with the mounting bolts so that the arrow on the SDM label points toward the front of the vehicle.

Tighten

Tighten the SDM mounting bolts to 9 N•m (80 lb-in).

2. Connect the SDM electrical connector.



A110B006

3. Install the front console. Refer to Section 9G, Interior Trim.
4. Install the rear console. Refer to Section 9G, Interior Trim.
5. Connect the negative battery cable.
6. Check for proper operation of the system.
   - Turn the ignition ON while watching the supplemental inflatable restraints warning lamp.
   - The warning lamp should turn ON for about 4 seconds, and then turn OFF.

AIRBAG MODULE DEPLOYMENT (IN VEHICLE)

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Deploy the airbags before disposing of them. This includes those in a whole vehicle being scrapped.

If the vehicle is still within the warranty period, contact the Daewoo regional service manager for approval or special instructions before deploying the airbag modules.

Caution: Before deploying the airbags, remove all loose objects from the airbag's expansion area.

Caution: Deploy the airbags with the vehicle doors closed and the side windows open.

Caution: Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the vehicle.

Caution: Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.

Caution: Allow a deployed airbag module to cool for at least 30 minutes before handling.

Caution: Wear the gloves and the eye protectors during the disposal process.

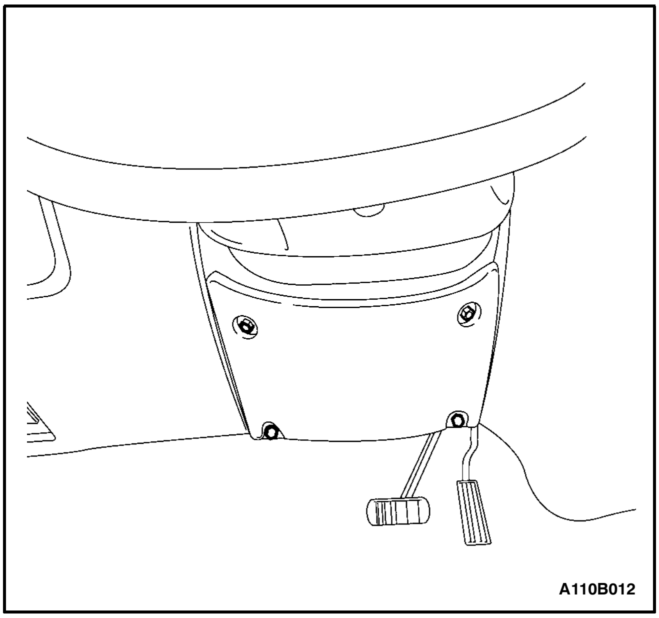
Caution: If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.

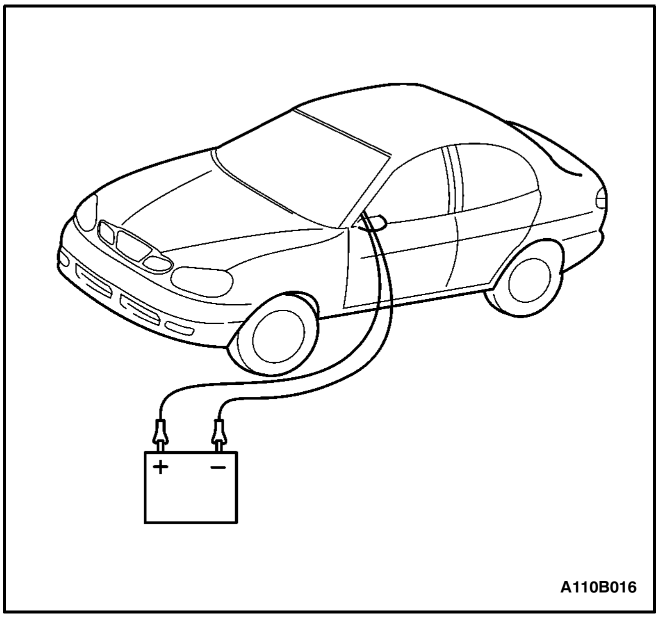
Deployment Procedure

1. Disconnect both battery cables and place the battery at least 10 meters (32.8 feet) from the vehicle.

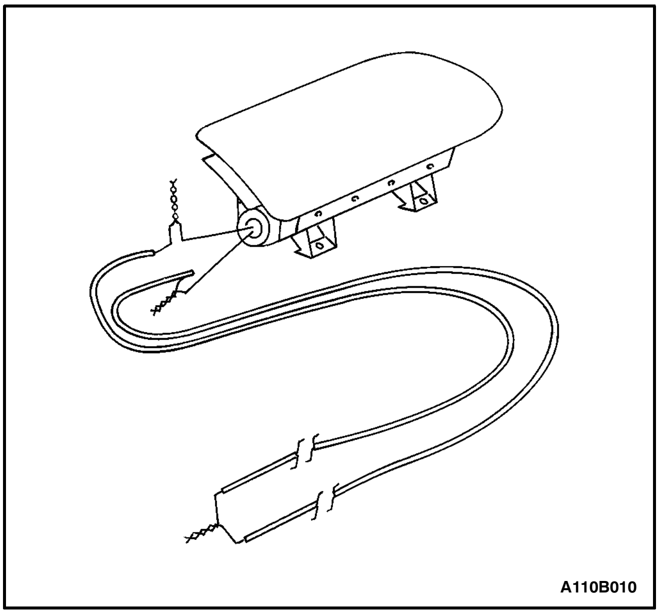
Caution: Wait 1 minute after disconnecting both battery cables to allow the capacitor inside the sensing and diagnostic module (SDM) to discharge before taking any other action. The capacitor supplies the reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.

2. Remove the lower cover from the steering column.

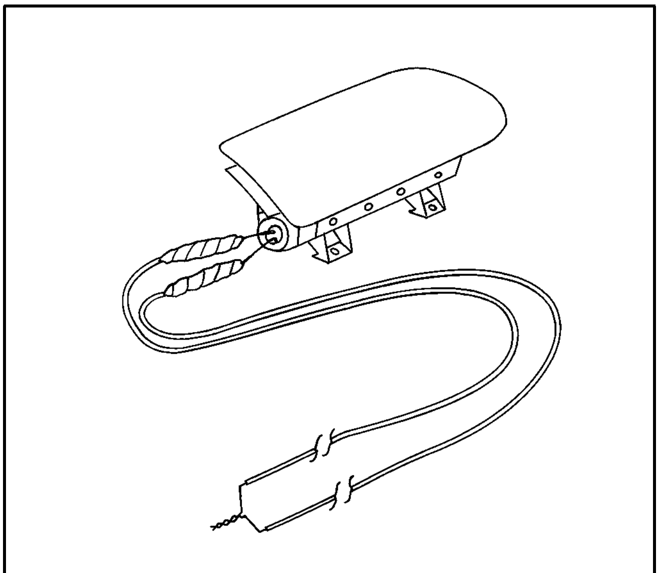




3. At the lower steering column, cut the two wires leading from the supplemental inflatable restraint (SIR) harness to the clock spring.
4. Strip 13 mm (0.5 inch) of insulation from the ends of the wires leading to the clock spring.
5. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the airbag module.
6. Strip 13 mm (0.5 inch) of insulation from the ends of these two additional wires.
7. Twist the two wires together at one end.
8. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
9. Using the free ends of the 10-meter (33-foot) wires leading to the clock spring, make two splices, one at each wire from the airbag module.
10. Wrap the splices with insulating tape.
11. Now that the free ends of the 10-meter (33-foot) wires are spliced to the airbag module wires, and the ends that are twisted together are near the deployment battery, clear the area.
12. Untwist the wires that are near the deployment battery.
13. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The airbag will deploy.

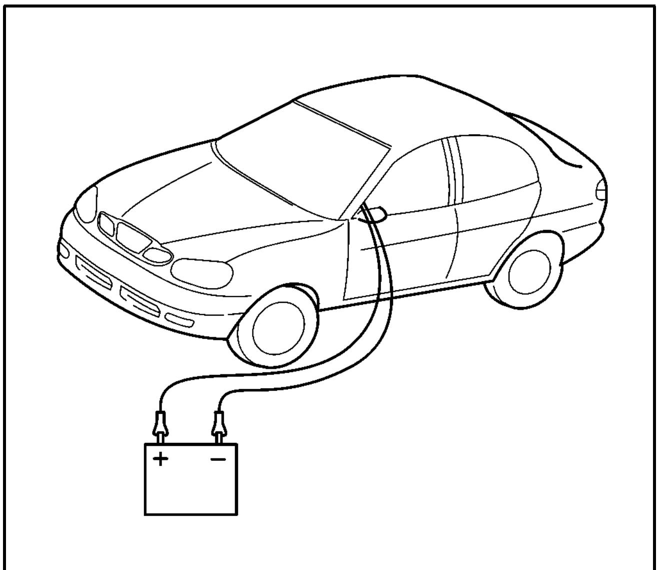


14. Repeat the procedure for the passenger airbag, cutting the wires to the passenger airbag module instead of the wires leading to the clock spring.
15. Strip 13 mm (0.5 inch) of insulation from the ends of the wires leading to the passenger airbag module.
16. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the passenger airbag module.
17. Strip 13 mm (0.5 inch) of insulation from the ends of these two additional wires.
18. Twist the two wires together at one end.
19. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
20. Using the free ends of the 10-meter (33-foot) wires to the passenger airbag module, make two splices, one at each wire from the airbag module.



A110B014

21. Wrap the splices with insulating tape.



A110B016

22. Now that the free ends of the 10-meter (33-foot) wires are spliced to the passenger airbag module wires, and the ends that are twisted together are near the deployment battery, clear the area.
23. Untwist the wires that are near the deployment battery.
24. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The passenger airbag will deploy.
25. Using the proper precautions, dispose of the deployed airbag. Refer to "Deployed Airbag Module Disposal Procedure" in this section.

AIRBAG MODULE DEPLOYMENT (OUTSIDE OF VEHICLE)

Deploy all intact airbag modules that have been

- Removed from a scrapped vehicle.
- Found to be defective.
- Found to have been damaged during transit, storage, or service.

Caution: Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the vehicle.

Caution: Do not connect the voltage source until completing all other preparations for the deployment of the airbags.

Caution: Allow a deployed airbag module to cool for at least 30 minutes before removing it from the vehicle.

Caution: Wear gloves and eye protection during the disposal process.

Caution: If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.

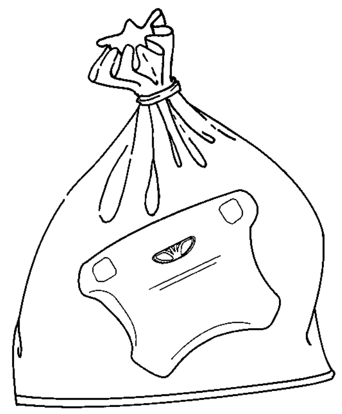
1. Position the airbag module face up, on flat ground outdoors, at least 10 meters (33 feet) from any obstacles or people.
2. Place a vehicle battery at least 10 meters (33 feet) away from the airbag module.
3. Deploy the airbag module using the deployment tool.
4. Using the proper precautions, dispose of the deployed airbag. Refer to "Deployed Airbag Module Disposal Procedure" in this section.

DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE

Caution: After an airbag module has been deployed, the surface of the airbag may contain a powdery residue. The powder lubricates the airbag as it inflates. The dust that is produced as a by-product of the deployment is unlikely to be harmful, but use the gloves and the safety glasses in order to prevent any possible irritation of the skin and the eyes.

Caution: After deployment, the metal surfaces of the airbag module will be hot. In order to avoid the risk of an injury or a fire, do not place the deployed airbag modules near any flammable objects, and allow the airbag modules to cool for 30 minutes before handling them.

Deploy an airbag before disposing of it. This includes those in a whole vehicle being scrapped.



A110B017

If the vehicle is still within the warranty period, contact the Daewoo regional service manager for approval or special instructions before deploying an airbag module.

Deployed airbag modules should be disposed of in the same manner as any other scrap parts, with the addition of the following steps:

1. Place the deployed airbag in a sturdy plastic bag.
2. Seal the plastic bag securely.
3. Wash your hands and rinse them with water after handling a deployed airbag.

GENERAL DESCRIPTION AND SYSTEM OPERATION

(Left-Hand Drive Shown, Right-Hand Drive Similar)

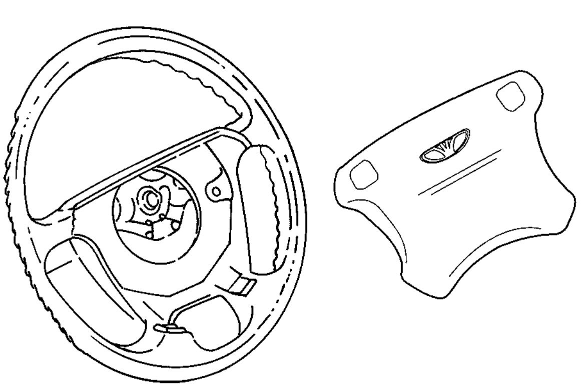
AIRBAG MODULE

Driver Airbag Module

Caution: Tampering with the driver side airbag module creates the risk of an injury from an unexpected deployment. Therefore, the driver side airbag module should never be disassembled.

The driver airbag module is under the center pad on the steering wheel.

The driver airbag module contains an ignitor charge and a gas generator to inflate the folded airbag.



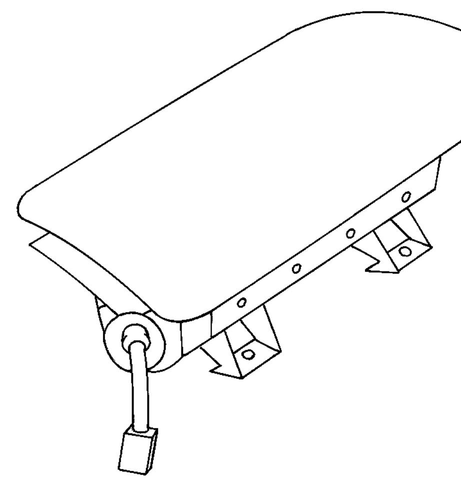
A110B020

Passenger Airbag Module

Caution: Tampering with the passenger side airbag module creates the risk of an injury from an unexpected deployment. Therefore, the passenger side airbag module should never be disassembled.

The passenger airbag module is on the passenger side of the instrument panel.

The passenger airbag module contains an ignitor charge and a gas generator to inflate the folded airbag.



A110B005

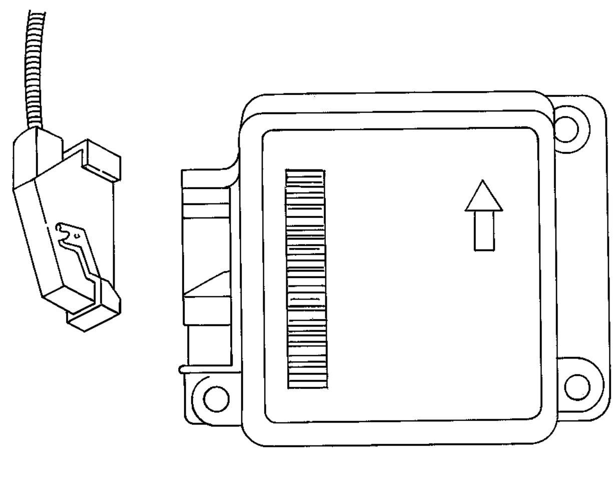
SENSING AND DIAGNOSTIC MODULE (SDM)

The SDM

- Has no user-serviceable parts.
- Is on the floor ahead of the front console assembly.
- Continuously monitors the system components.
- Records any faults which are discovered.
- Illuminates a warning lamp that alerts the driver to any faults.
- Allows the fault codes to be retrieved with a scan tool.

The SDM controls the deployment of the airbag system through the use of the

- Arming sensor.
- Capacitor.
- Crash sensor, or accelerometer.



A110B015

Arming Sensor

The arming sensor is safety device made up of a dual-contact, electro-mechanical switch that:

- Acts independently of the electronic components.
- Keeps the firing circuits for the airbags unarmed under normal driving conditions.
- Allows the airbags to deploy under the required conditions.

Capacitor

The capacitor provides reserve power.

Crash Sensor

The crash sensor, or accelerometer, electronically represents the acceleration or deceleration of the vehicle during a frontal impact. In this electronic representation, the electrical signal is proportional to the acceleration or deceleration of the vehicle.

SIR WARNING LAMP

The supplemental inflatable restraints (SIR) system includes a self-diagnostic function.

If there is a failure of the sensing and diagnostic module or the external circuits, the SIR warning lamp in the instrument cluster turns ON.

As a system check, the SIR warning lamp also turns ON when the ignition is first switched to the ON position.

Correct Functioning

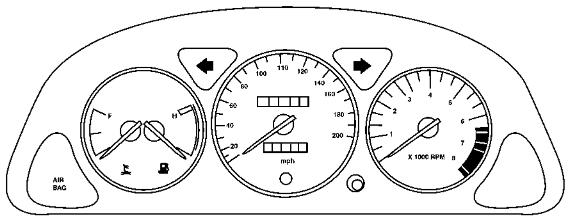
The system is working properly if:

- The SIR warning lamp turns OFF after approximately four seconds.

Faulty Functioning

The system is not working properly, meaning one of the SIR components or the wiring connector is faulty, if:

- The SIR warning lamp fails to turn ON when the ignition is first switched ON.
- The SIR warning lamp remains ON.



A110B006

CLOCK SPRING

The clock spring:

- Is on the steering column.
- Contains a coil that is the electrical contact between the steering column wiring harness and the driver side airbag module.
- Is part of the circuit for the horn.

Notice: Turning the steering wheel more than three and one-quarter turns may damage the clock spring.

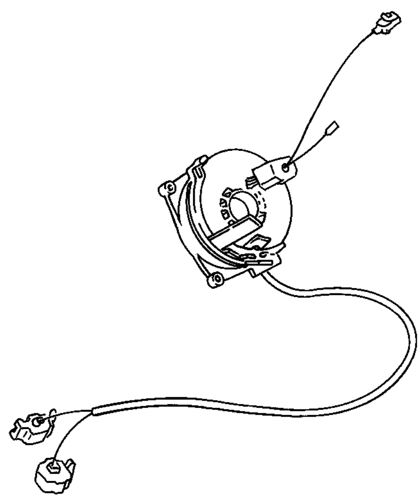
Turning the steering wheel:

- In one direction tightens the coil.
- In the opposite direction loosens the coil.
- More than three and one-quarter turns may damage the clock spring.

Caution: Disassembling the clock spring can cause injury and vehicle damage.

The clock spring should never be disassembled.

The clock spring must be replaced if the airbags have been deployed.


A110B013

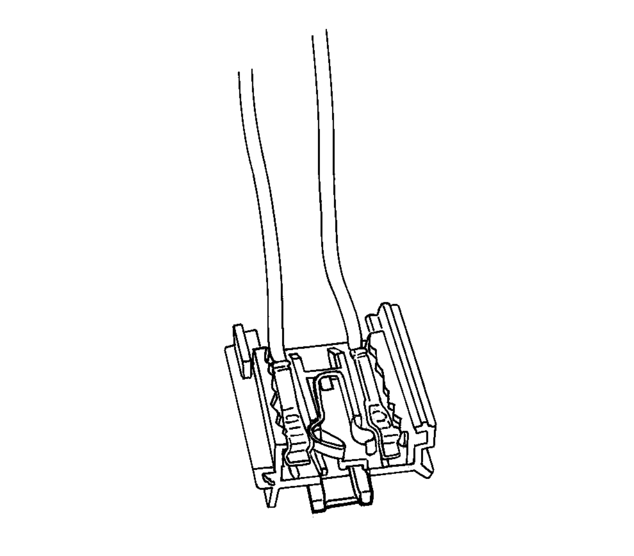
WIRING HARNESS/CONNECTORS

The connector for the sensing and diagnostic module (SDM) has a built-in shorting bar that will turn ON the warning lamp if there is a poor connection at the SDM.

As an anti-deployment mechanism, additional shorting bars are in the

- Connector for the clock spring at the lower steering column.
- Passenger airbag module connector.
- SDM connector.

When these connectors are separated, the shorting bars will short circuit any current which is applied, preventing the current from reaching the airbag modules.



A110B024

SIR SYSTEM

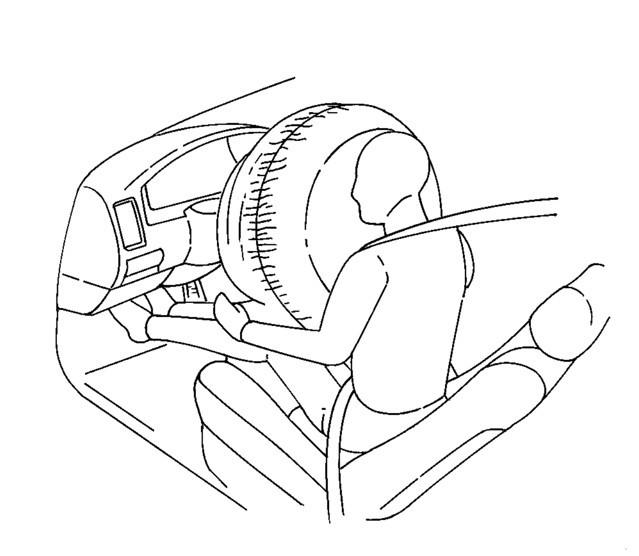
The supplemental inflatable restraints (SIR) system is a safety device used in conjunction with the seat belts.

The airbag does not replace the function of the seat belt. The driver and the passengers must always fasten their seat belts and adjust them for a proper fit.

The SIR is designed to protect the driver and the front seat passenger in the event of a significant frontal impact to the vehicle. The airbags deploy if the force is applied from a direction within 30 degrees of the vehicle's centerline.

The SIR consists of a

- Driver airbag module.
- Passenger airbag module.
- Sensing and diagnostic module.
- Steering column clock spring.
- Wiring harness.
- SIR malfunction warning lamp.



A110B007

GENERAL PRECAUTIONS

The supplemental inflatable restraints (SIR) warning lamp must illuminate when the ignition is switched ON, and then turn OFF after approximately 4 seconds.

There is a fault in the airbag system if

- The warning lamp does not turn OFF.
- The warning lamp illuminates while the vehicle is in operation.

If the warning lamp indicates there is a fault in the airbag system, assume that the SIR system may not be functional.

Caution: Failure to follow all service procedures in the correct sequence can cause the airbag system to deploy unexpectedly and possibly cause a serious injury.

Only trained personnel at franchised Daewoo dealers and authorized Daewoo service dealerships may service the airbag system.

Never attempt to disassemble, repair, or reuse the

- Airbag modules.
- Clock spring.
- Sensing and diagnostic module.
- Wiring harness.

When making SIR repairs,

- Inspect any SIR part before it is installed.
- Use only new parts.
- Do not install used SIR parts from other vehicles.
- Do not install any part that has been dropped or that has dents, cracks, or other defects.

SECTION 9A

BODY WIRING SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SCHEMATIC AND ROUTING DIAGRAMS

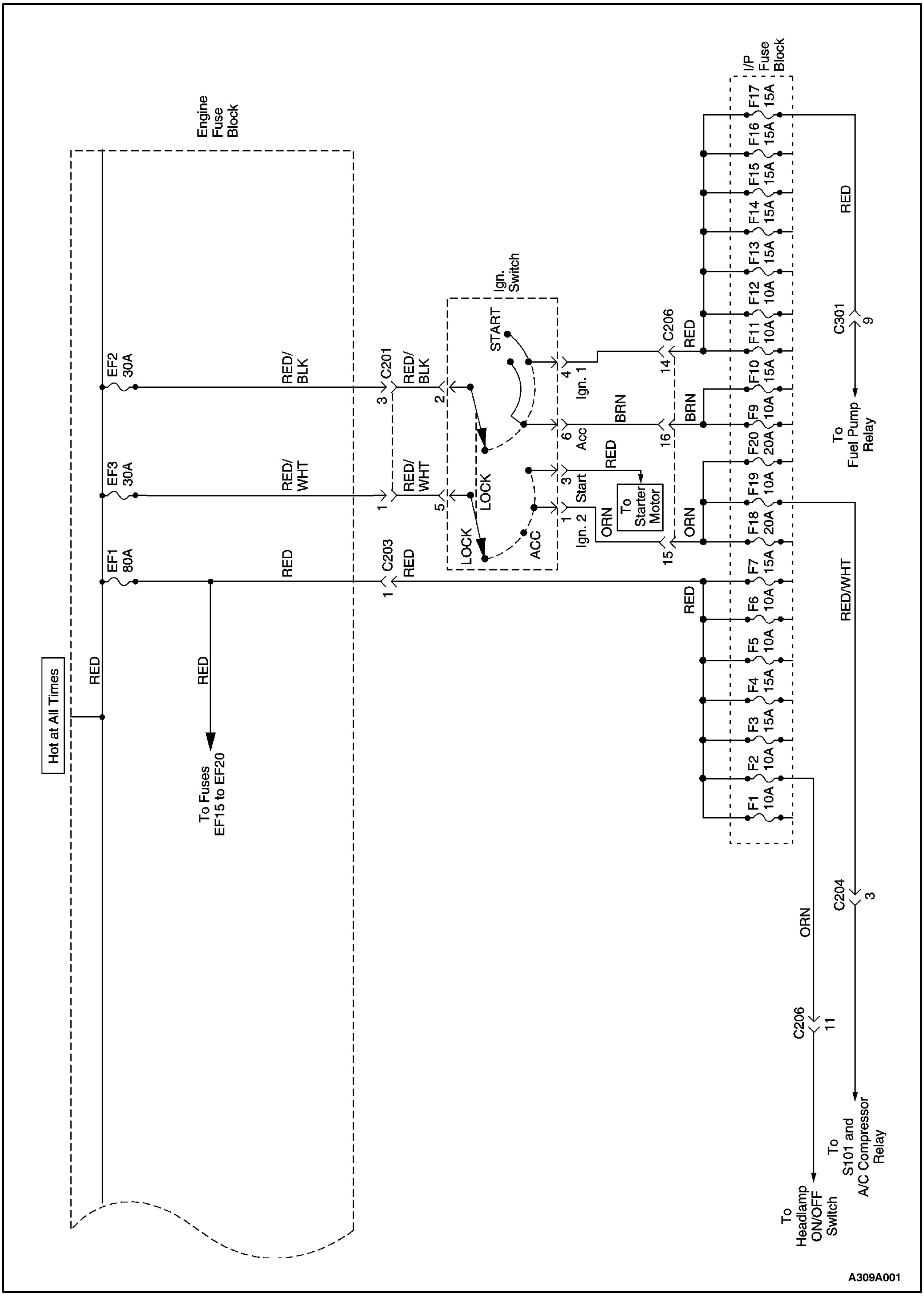
WIRE COLOR CHART

Wire Color	Abbreviation On Schematic
Green	DK GRN
Light Green	LT GRN
Blue	DK BLU
Brown	BRN
Orange	ORN
Yellow	YEL
Grey	GRY
Sky Blue	LT BLU
Red	RED
Black	BLK
Pink	PNK
White	WHT
Purple	PPL

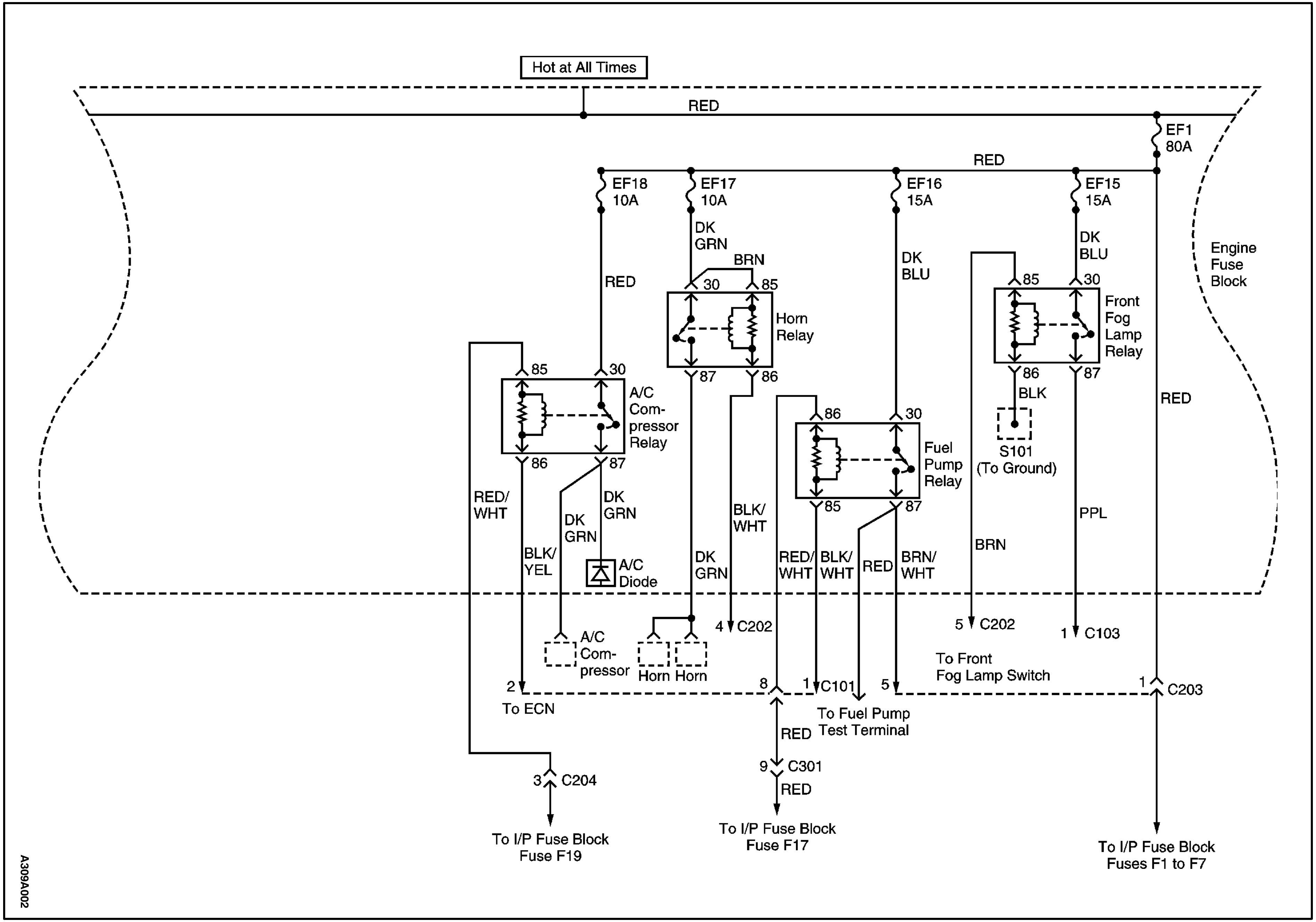
Wires With Tracers

Wire Color	Abbreviation On Schematic
Red with White Tracer	RED/WHT
Red with Black Tracer	RED/BLK
Brown with White Tracer	BRN/WHT
Black with White Tracer	BLK/WHT
Black with Yellow Tracer	BLK/YEL
Green with Black Tracer	DK GRN/BLK
Green with White Tracer	DK GRN/WHT
Light Green with Black Tracer	LT GRN/BLK
Red with Yellow Tracer	RED/YEL
Red with Blue Tracer	RED/DK BLU
Black with Brown Tracer	BLK/BRN

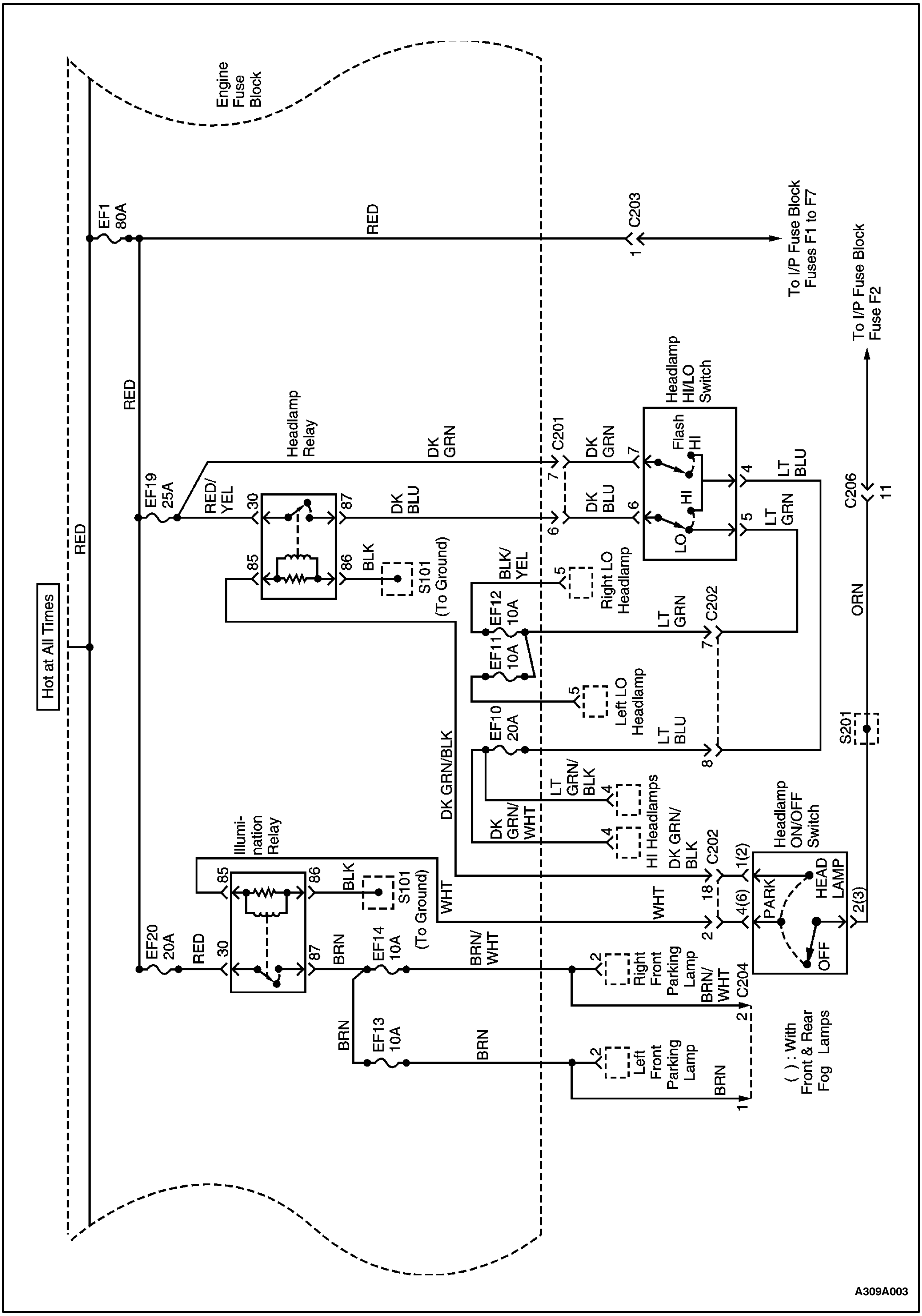
POWER DISTRIBUTION SCHEMATIC



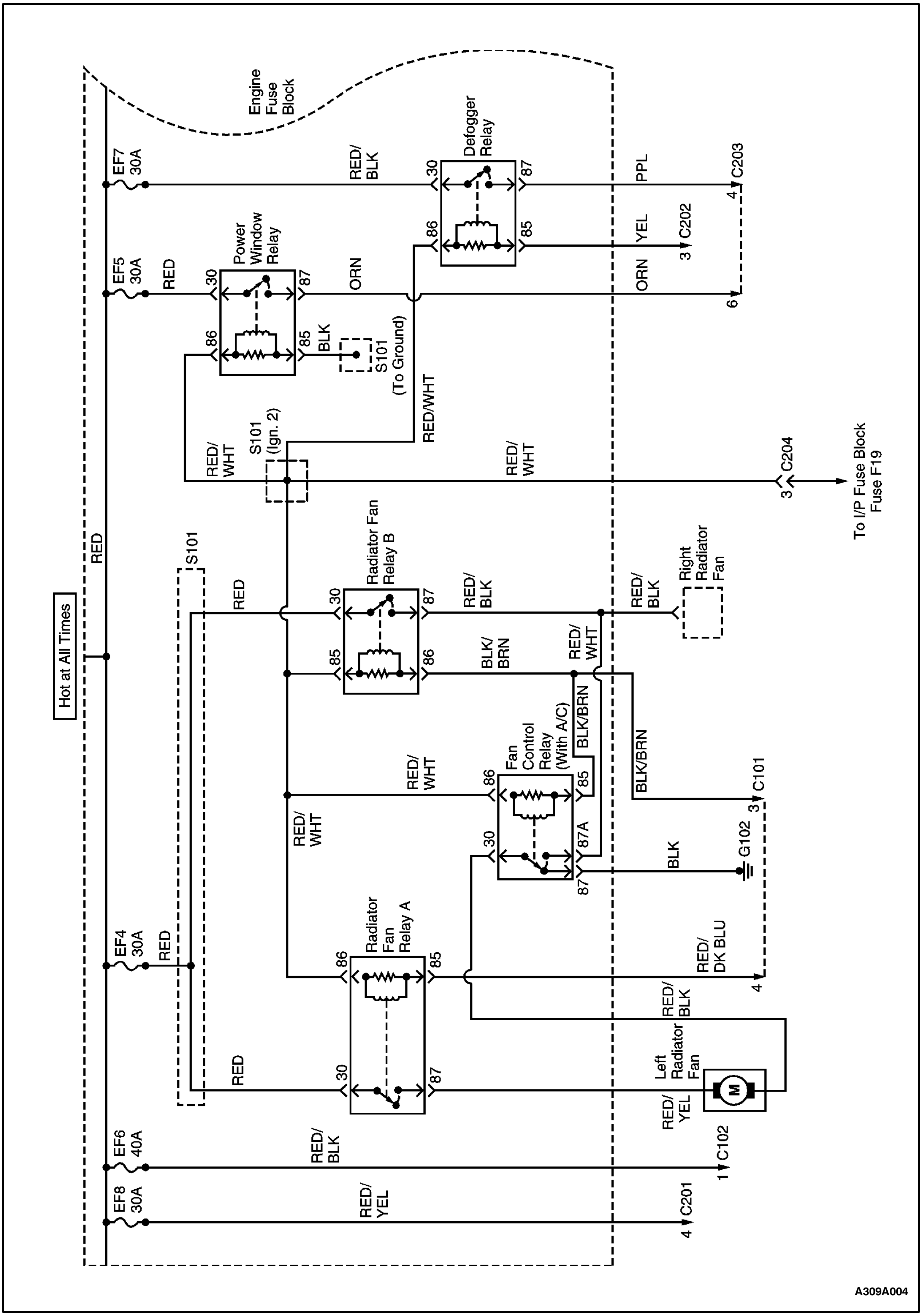
POWER DISTRIBUTION SCHEMATIC (Cont'd)



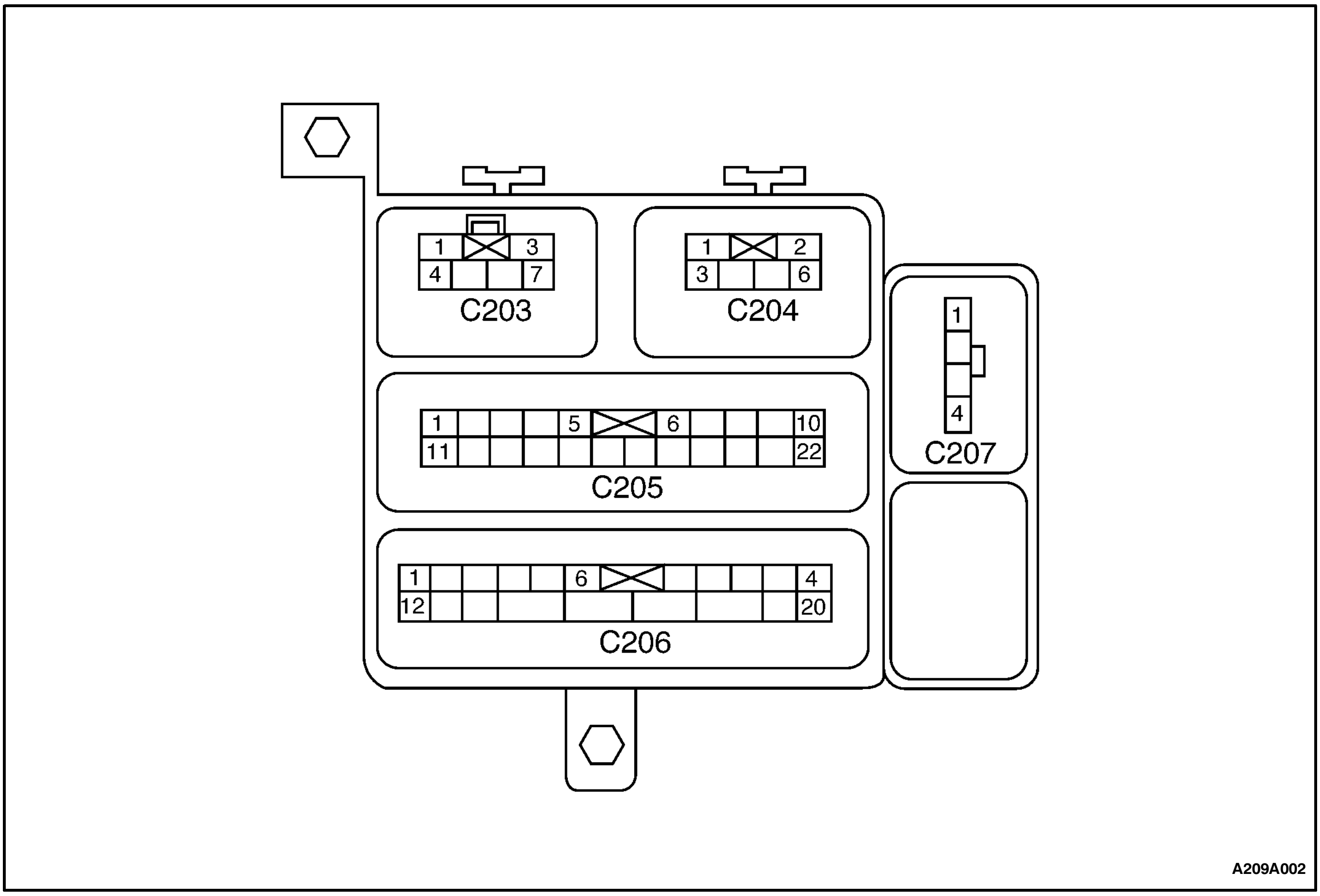
POWER DISTRIBUTION SCHEMATIC (Cont'd)

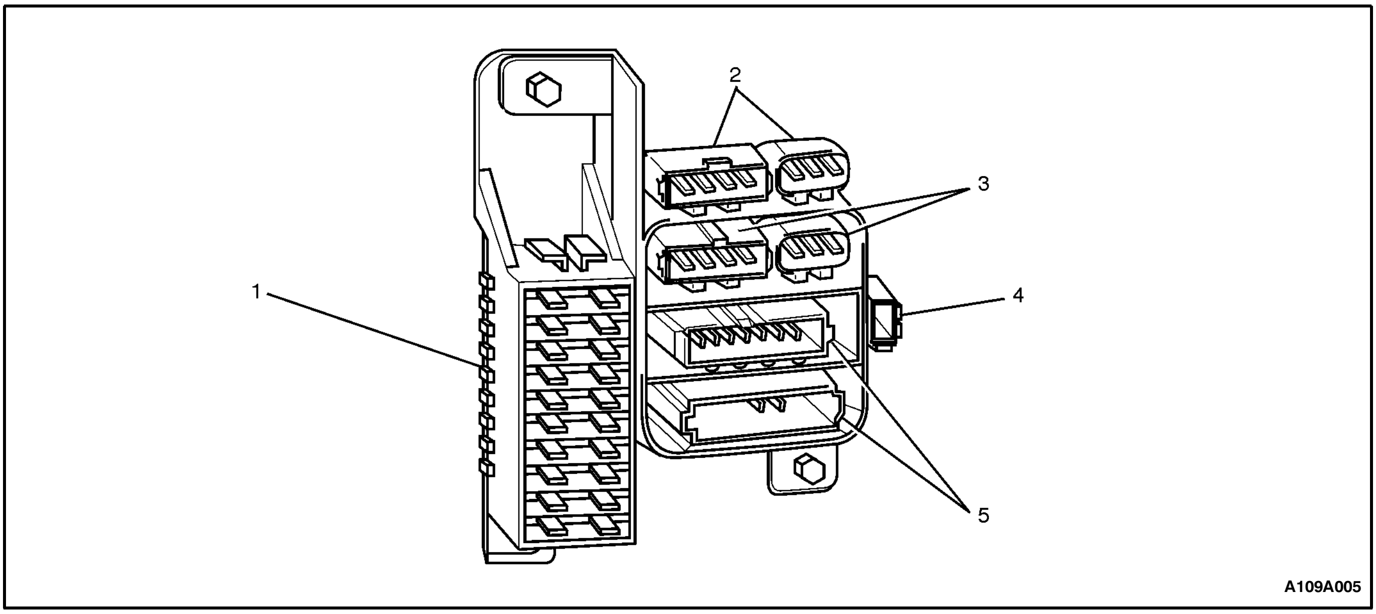


POWER DISTRIBUTION SCHEMATIC (Cont'd)



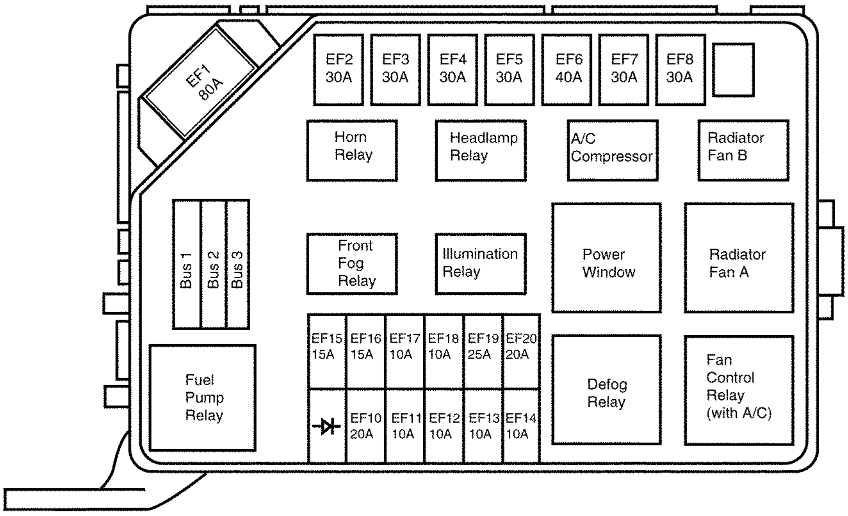
CONNECTION BOX HARNESS ROUTING





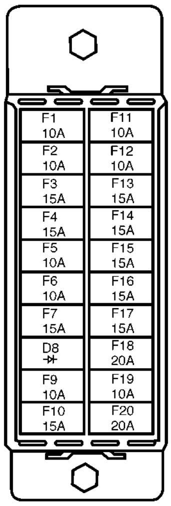
1 **Fuse Block**
2 **Front Harness to Instrument Harness**
3 **Floor Harness to Front Harness**
4 **Floor Harness to Roof Harness**
5 **Floor Harness to Instrument Harness**

FUSE BLOCK LOCATOR (ENGINE)



A209A003

FUSE BLOCK LOCATOR (PASSENGER COMPARTMENT)



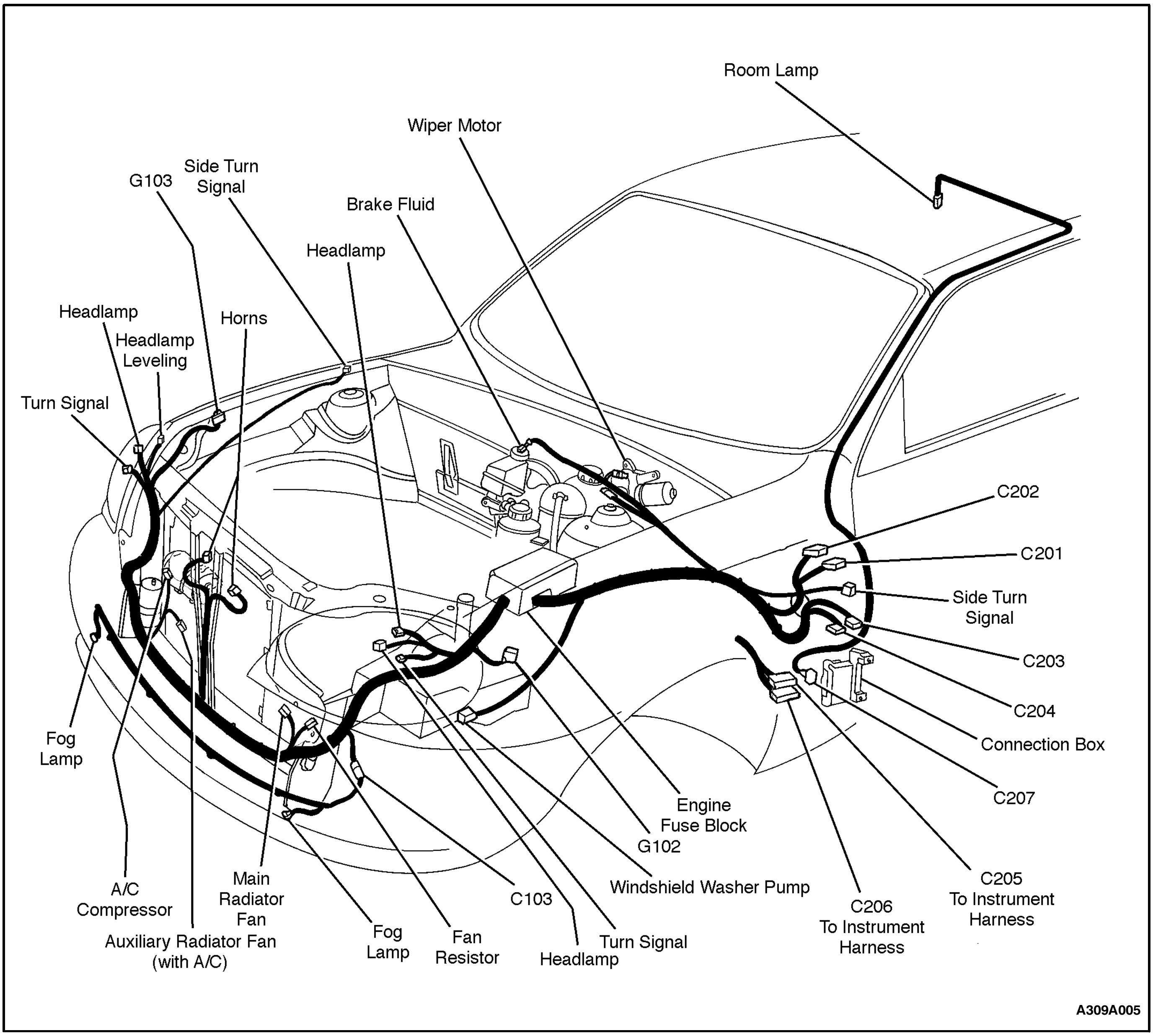
A209A004

FUSE CHART

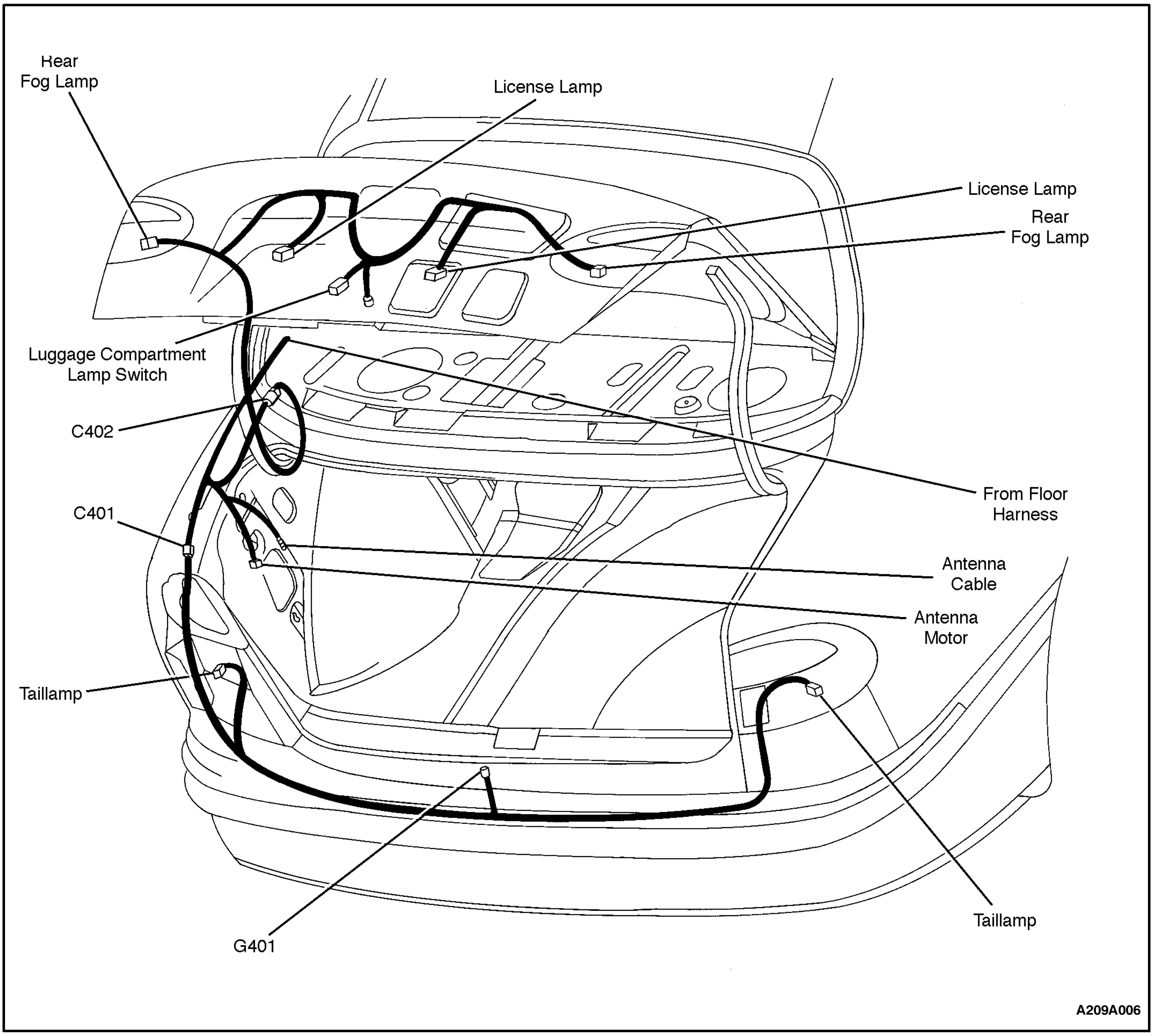
Fuse	Rating/ Source		Circuit
EF1 (Engine Fuse)	80A	BAT	Engine Fuses EF15 to EF20 and Fuses F1 to F7
EF2	30A	BAT	Ignition Switch, ACC (F9 and F10), and IGN 1 (F11 to F17)
EF3	30A	BAT	Ignition Switch, START and IGN 2 (F18, F19, F20)
EF4	30A	BAT	Radiator Fans
EF5	30A	BAT	Power Windows
EF6	40A	BAT	Antilock Brakes
EF7	30A	BAT	Rear Window Defogger
EF8	30A	BAT	Hi Blower
EF10	20A	EF19	Headlamp Hi Beam
EF11	10A	EF19	Headlamp Lo Beam (Left Side)
EF12	10A	EF19	Headlamp Lo Beam (Right Side)
EF13	10A	EF20	Tail and Illumination Lamps (Left Side), Headlamp Leveling, Rear Fog Lamps
EF14	10A	EF20	Tail and Illumination Lamps (Right Side)
EF15	15A	EF1	Front Fog Lamp
EF16	15A	EF1	Fuel Pump
EF17	10A	EF1	Horn
EF18	10A	EF1	A/C Compressor
EF19	25A	EF1	Hi Beam Passing
EF20	20A	EF1	Illumination Lamp
F1 (Fuse)	10A	EF1	Rear Fog, Room Lamp, Trunk Room Lamp
F2	10A	EF1	Clock, Door Open Warning, ALDL, Headlamp Relay, Illumination Lamp Relay, Engine Immobilizer
F3	15A	EF1	Hazard Lamp
F4	15A	EF1	Door Lock
F5	10A	EF1	ABS, ECM, TCM
F6	10A	EF1	Audio, Antenna Motor
F7	15A	EF1	Stoplamp, Center High-Mounted Stoplamp
D8 (Diode)			
F9	10A	ACC	Audio
F10	15A	ACC	Cigar Lighter
F11	10A	IGN 1	Instrument Cluster, Clock, Defog Relay, Seat Belt Switch, Engine Immobilizer
F12	10A	IGN 1	Backup Lamp
F13	15A	IGN 1	Supplemental Inflatable Restraints
F14	15A	IGN 1	Injectors, Alternator, Starter Solenoid, Transaxle Solenoids, Vehicle Speed Sensor, Tachometer, Canister Purge Solenoid
F15	15A	IGN 1	DIS Ignition Coil
F16	15A	IGN 1	Turn Signal Lamp, Mirror Switch
F17	15A	IGN 1	ECM, TCM, ABS Warning Lamp, Fuel Pump Relay, Variable Induction Geometry Solenoid
F18	20A	IGN 2	Wiper/Washer
F19	10A	IGN 2	Power Window Relay, A/C Compressor Relay, Radiator Fan Relays, Defog Relay, ABS Relay
F20	20A	IGN 2	Blower Position 1,2,3

FRONT HARNESS ROUTING

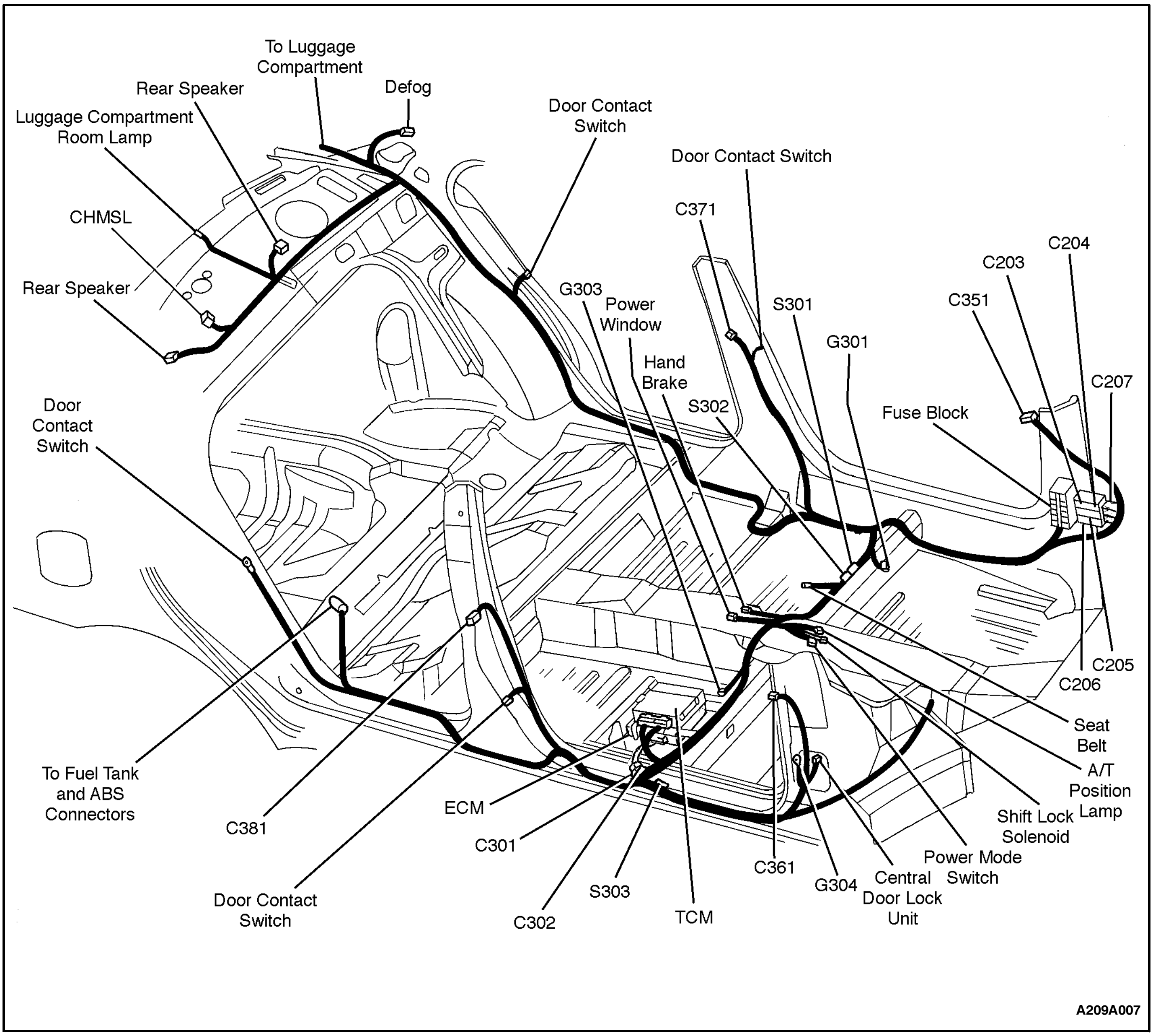
(Left-Hand Drive Shown, Right-Hand Drive Similar)



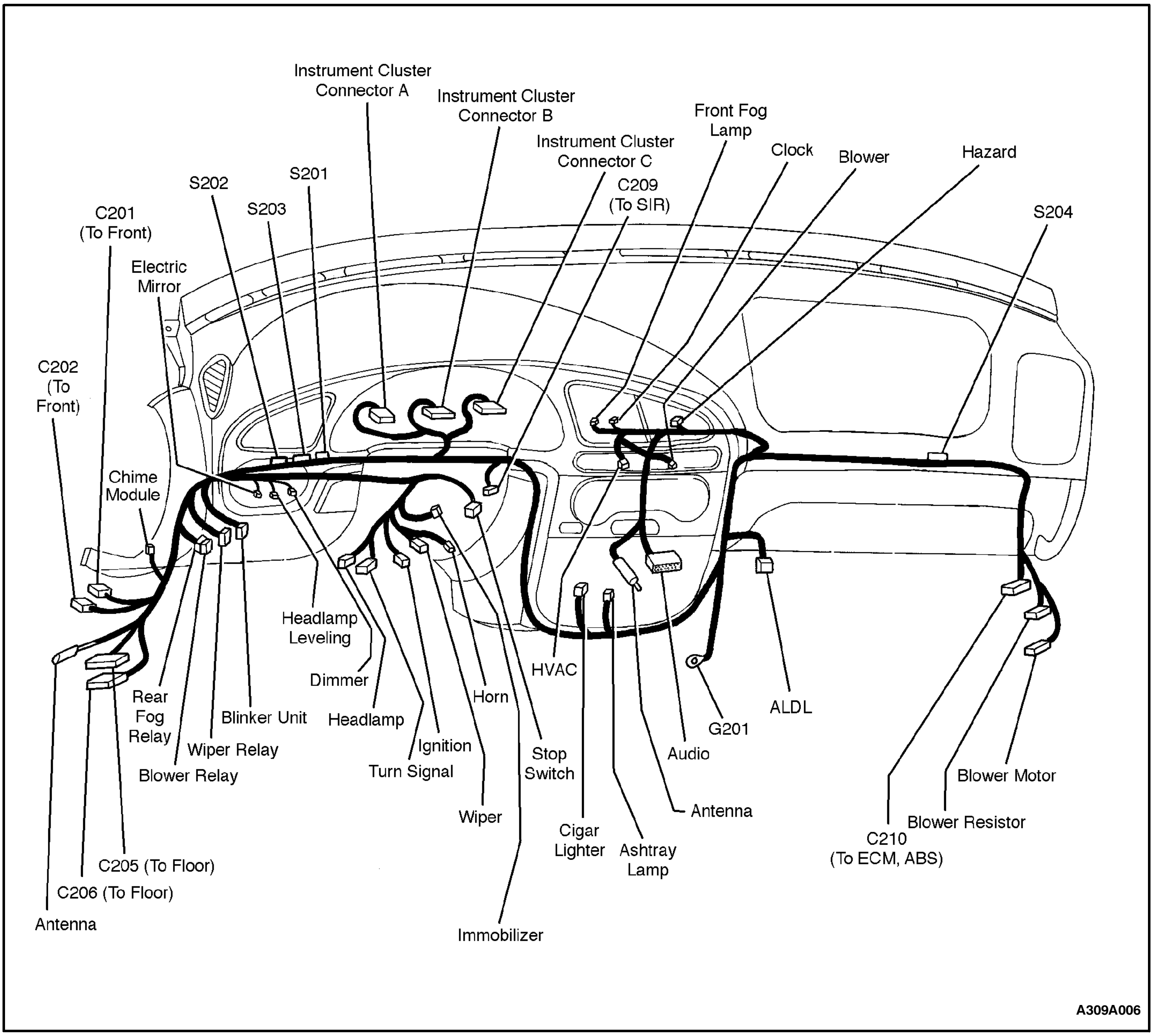
REAR HARNESS ROUTING



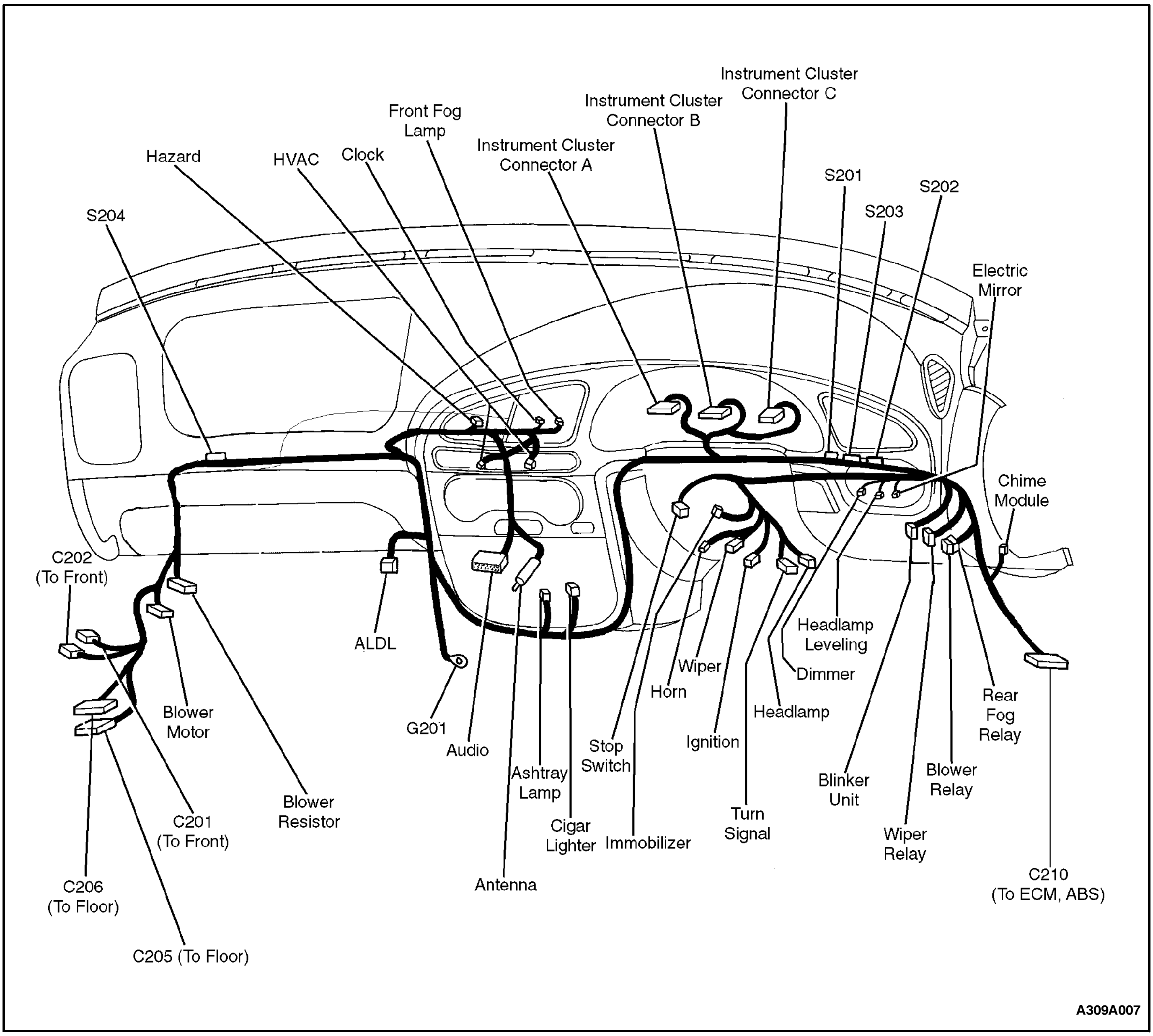
FLOOR HARNESS ROUTING



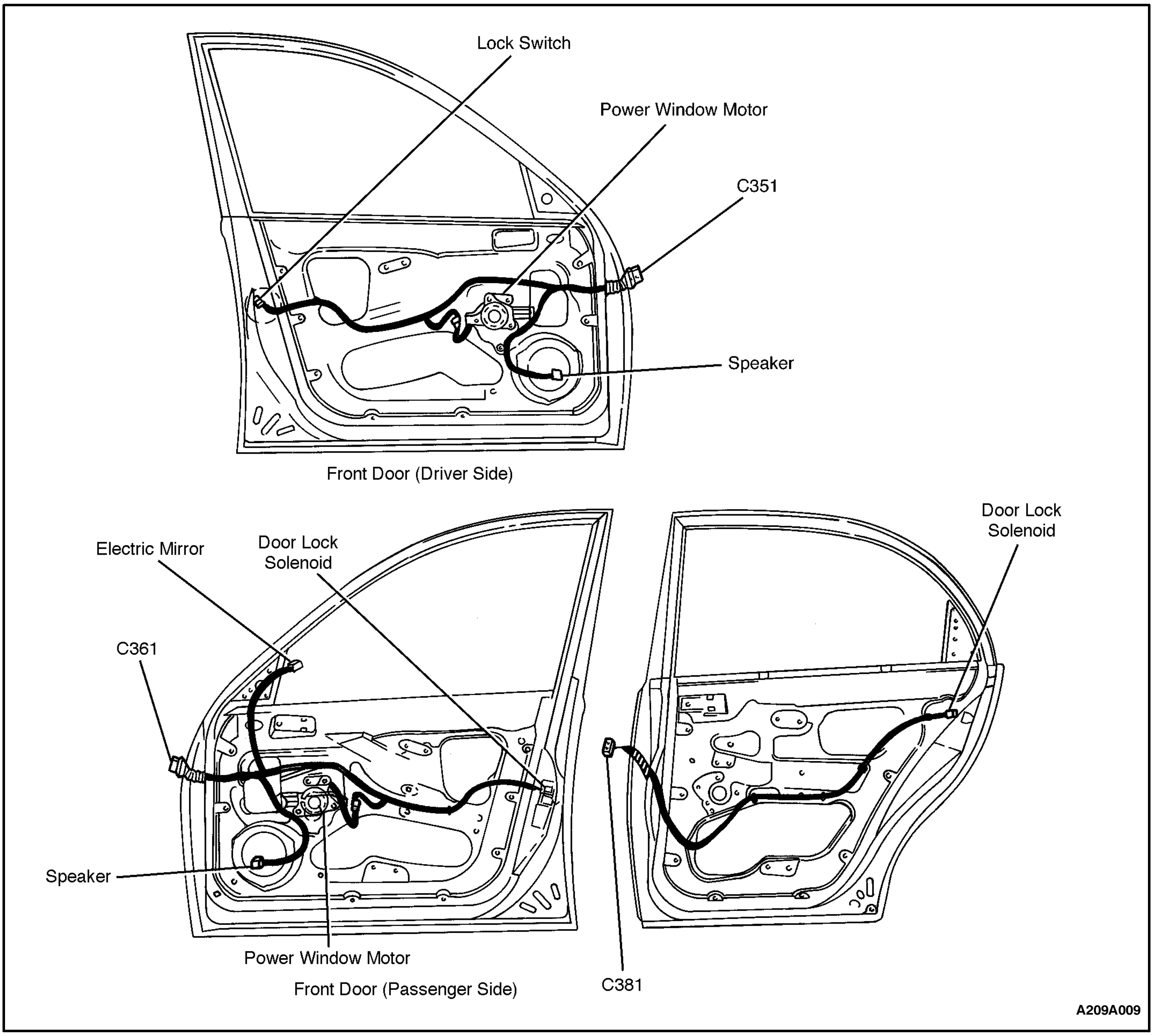
LEFT-HAND DRIVE INSTRUMENT HARNESS ROUTING



RIGHT-HAND DRIVE INSTRUMENT HARNESS ROUTING



DOOR HARNESS ROUTING



SECTION 9B

LIGHTING SYSTEMS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

BULB USAGE CHART

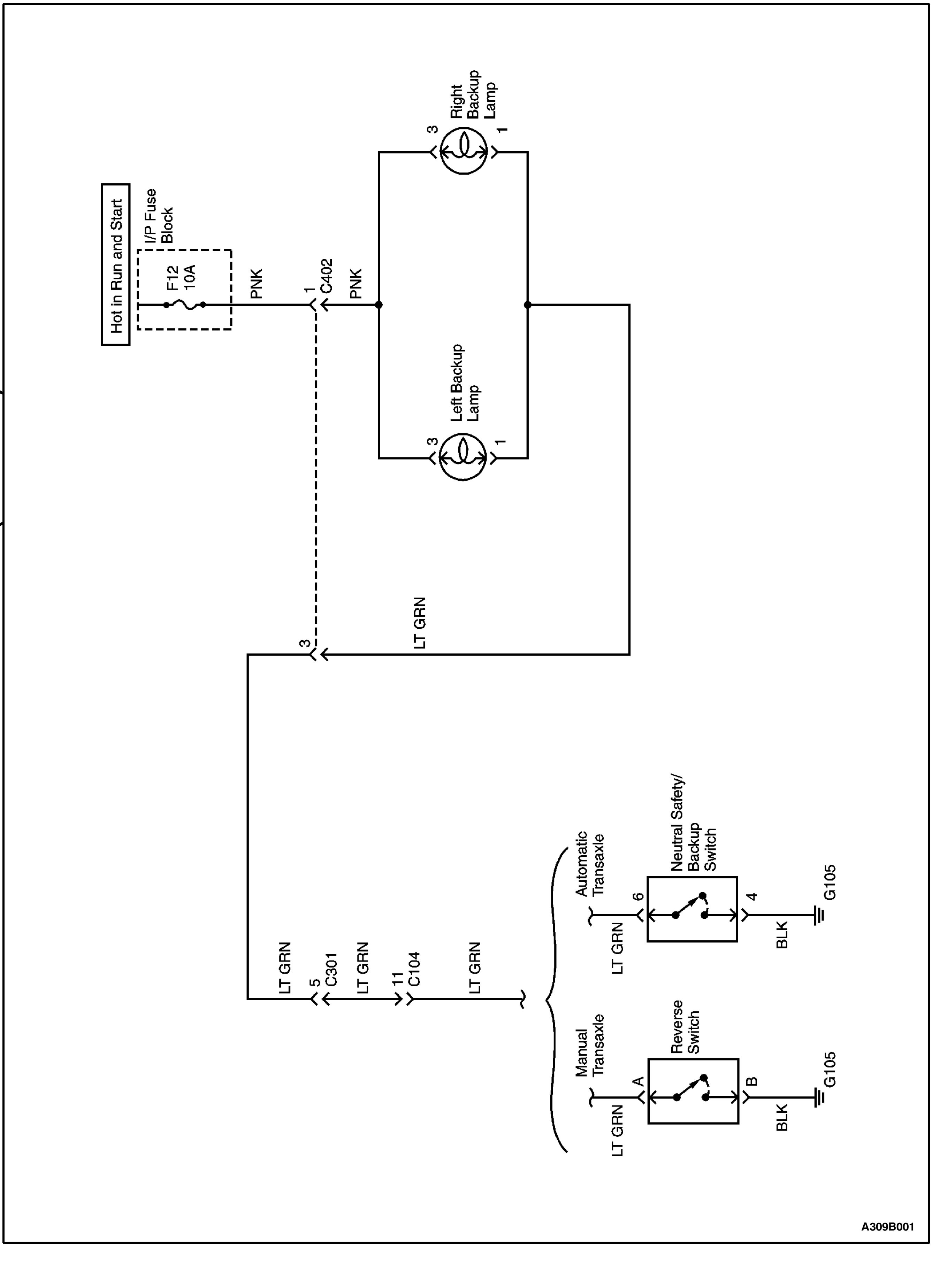
Bulb	Replacement Bulb Number
Backup Lamp	21W or 27W
Center High-Mounted Stoplamp	21W or 27W
Front Fog Lamp	55W
Headlamp	Double 65W/55W or Double 60W/55W
Interior Courtesy Lamp	10W
License Plate Lamp	5W
Luggage Compartment Lamp	10W
Park and Front Turn Signal Lamp	Double 21W/5W or Double 28W/8W
Rear Fog Lamp	21W
Rear Turn Signal Lamp	Single 21W or Single 27W
Side Turn Signal Lamp	5W
Tail and Stoplamp	Double 21W/5W or Double 28/8W

FASTENER TIGHTENING SPECIFICATIONS

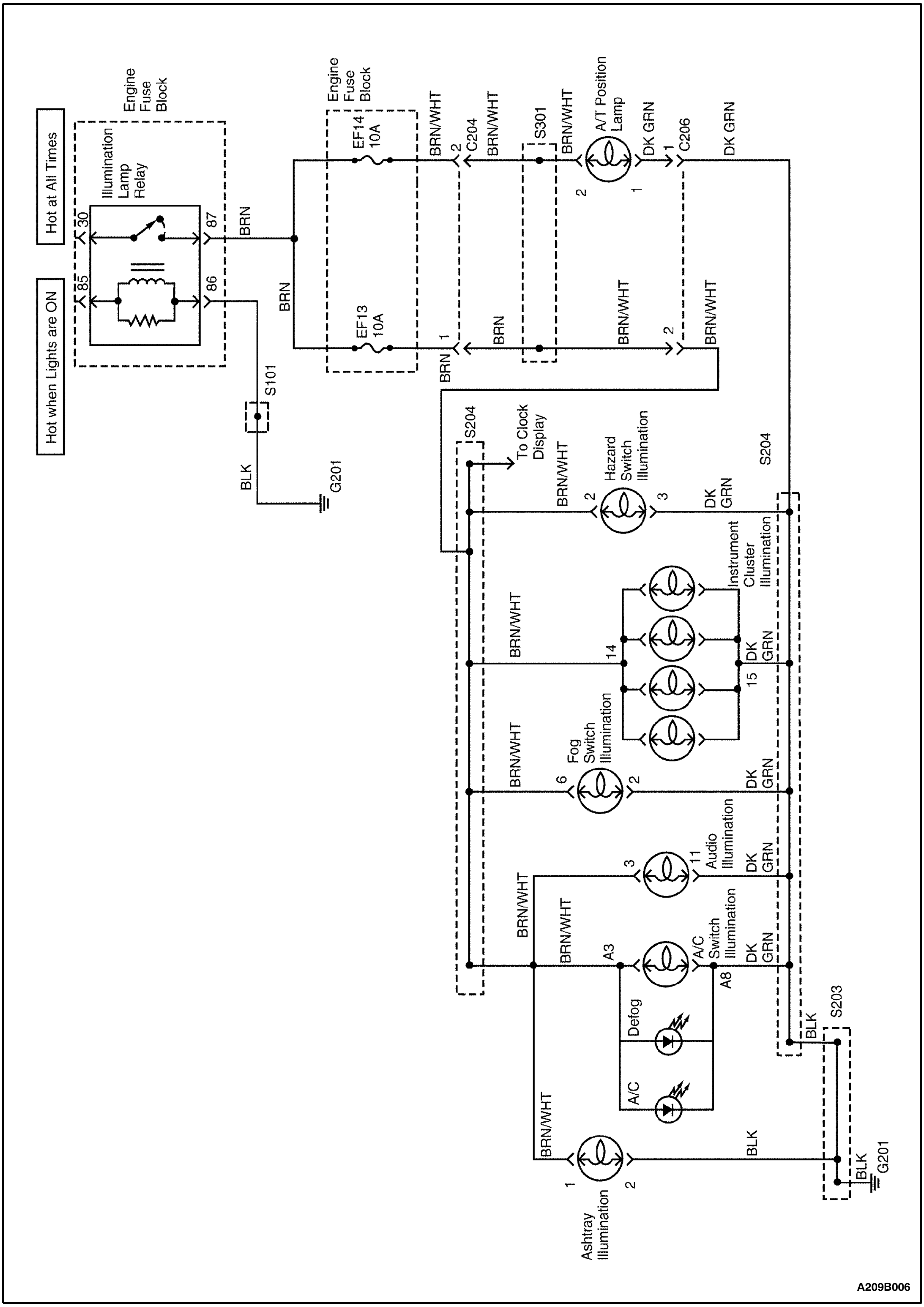
Application	N•m	Lb-Ft	Lb-In
CHMSL Mounting Nuts	3	-	27
CHMSL Mounting Screws	3	-	27
Courtesy Lamp Housing Screws	2	-	18
Cupholder Screws	2.5	-	22
Door Jamb Switch Screw	4	-	35
Front Fog Lamp Assembly Screw	3	-	27
Headlamp Assembly Bolts and Nut	5	-	44
License Plate Lamp Screws	1.5	-	13
Rear Fog/Backup Lamp Assembly Nuts	3	-	27
Taillamp Assembly Nuts	3	-	27
Taillamp Assembly Screws	3	-	27

SCHEMATIC AND ROUTING DIAGRAMS

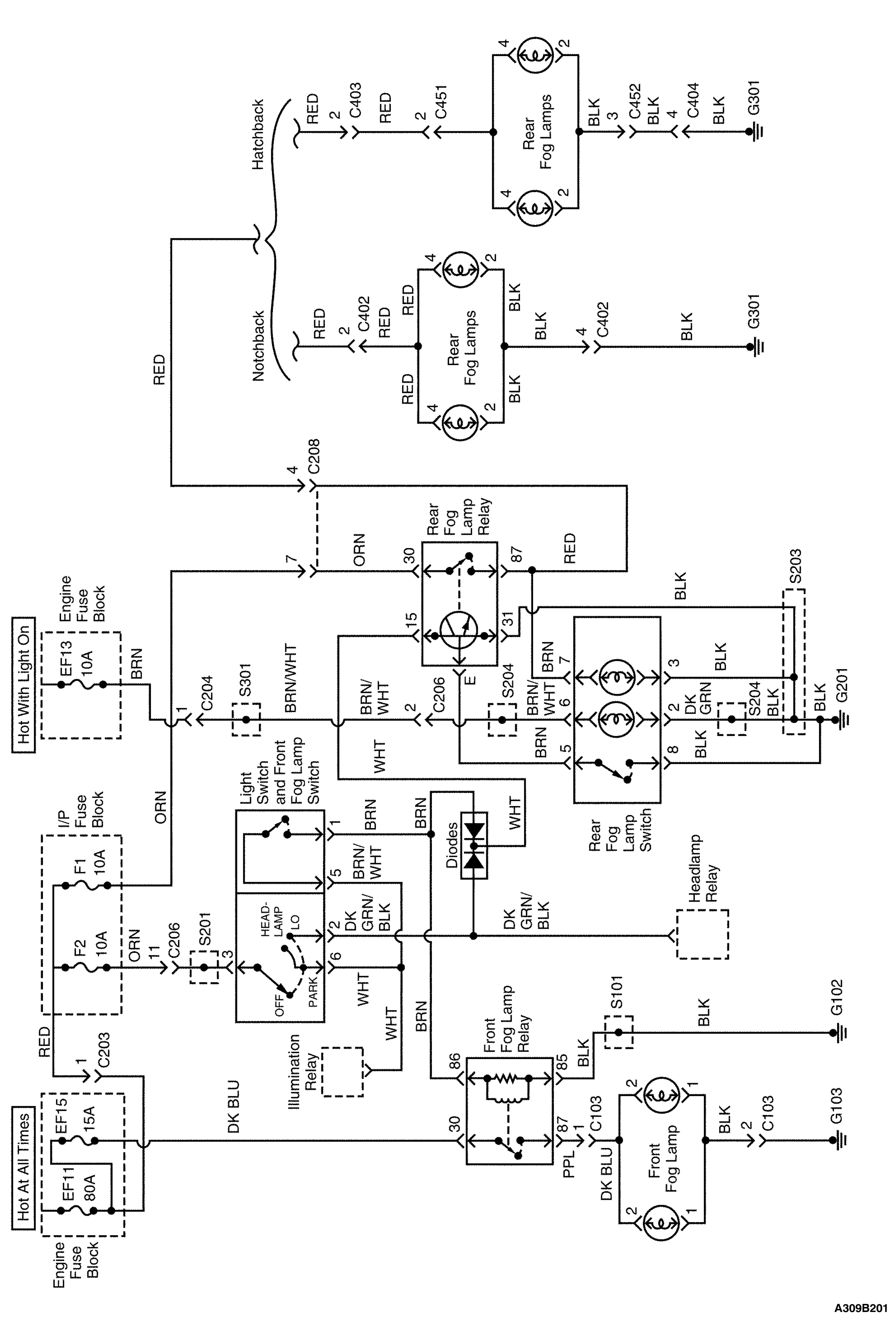
BACKUP LAMPS CIRCUIT (Notchback)



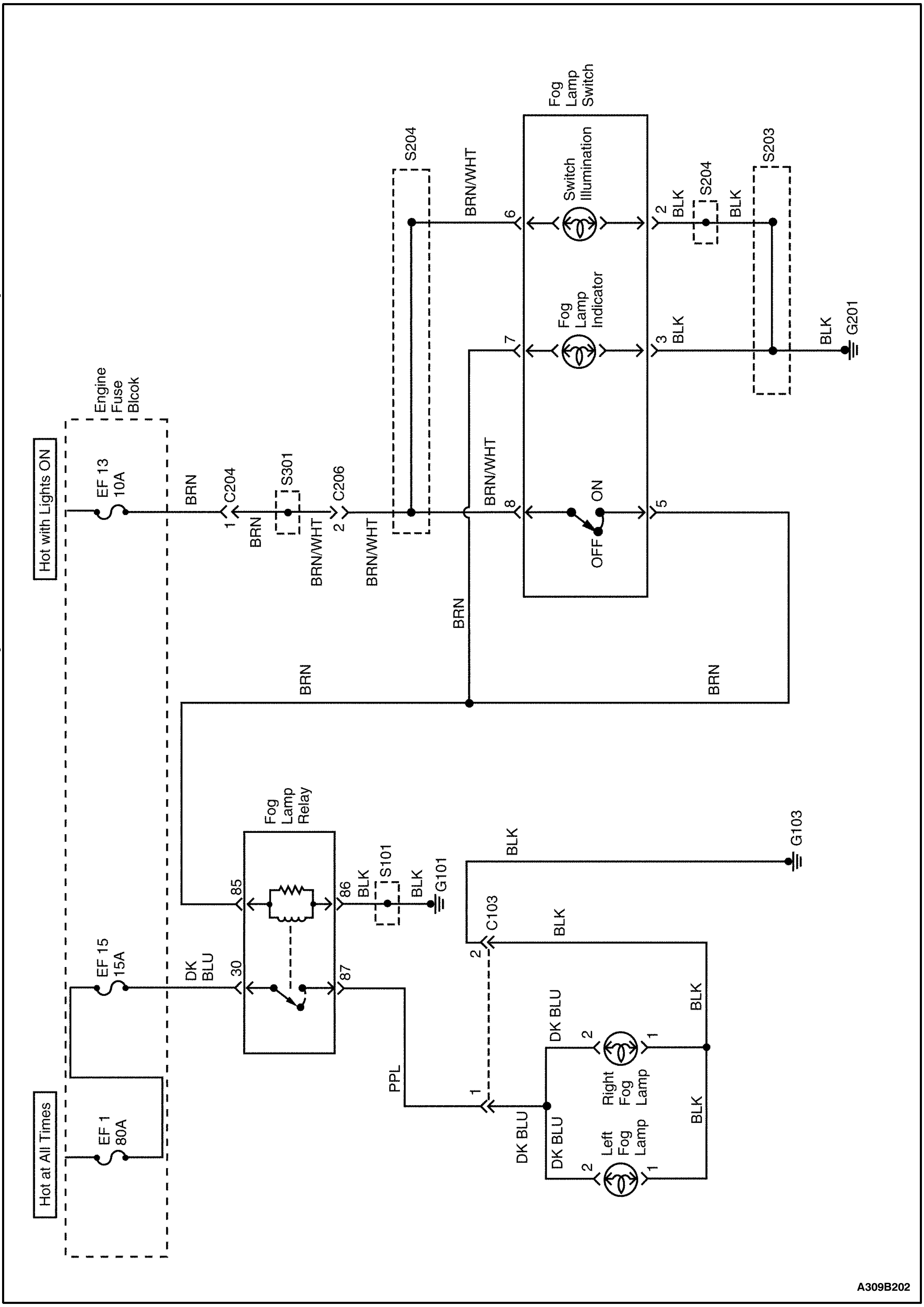
INSTRUMENTS CIRCUIT



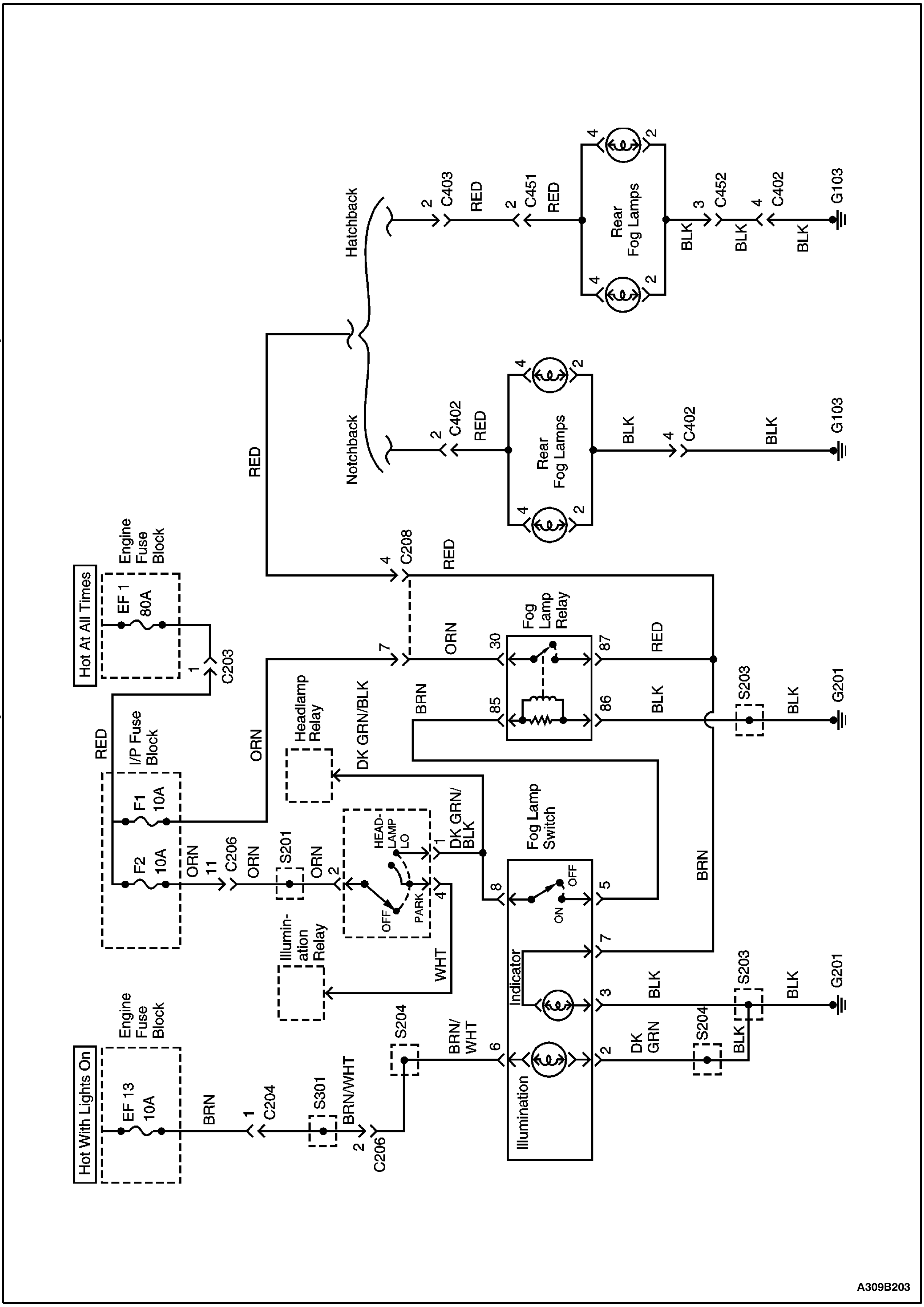
FRONT AND REAR FOG LAMPS CIRCUIT



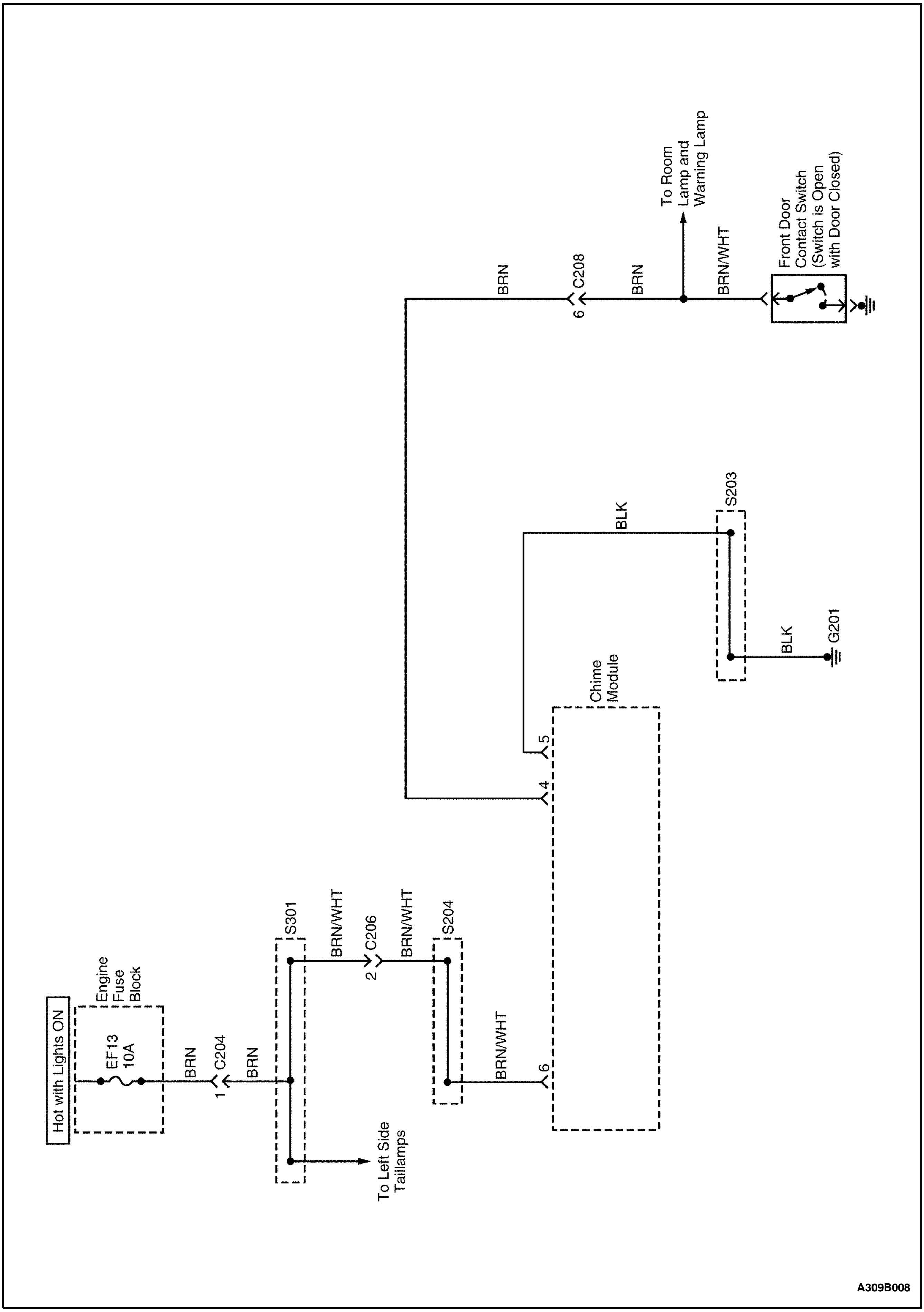
FRONT FOG LAMPS CIRCUIT (WITHOUT REAR FOGLAMPS)

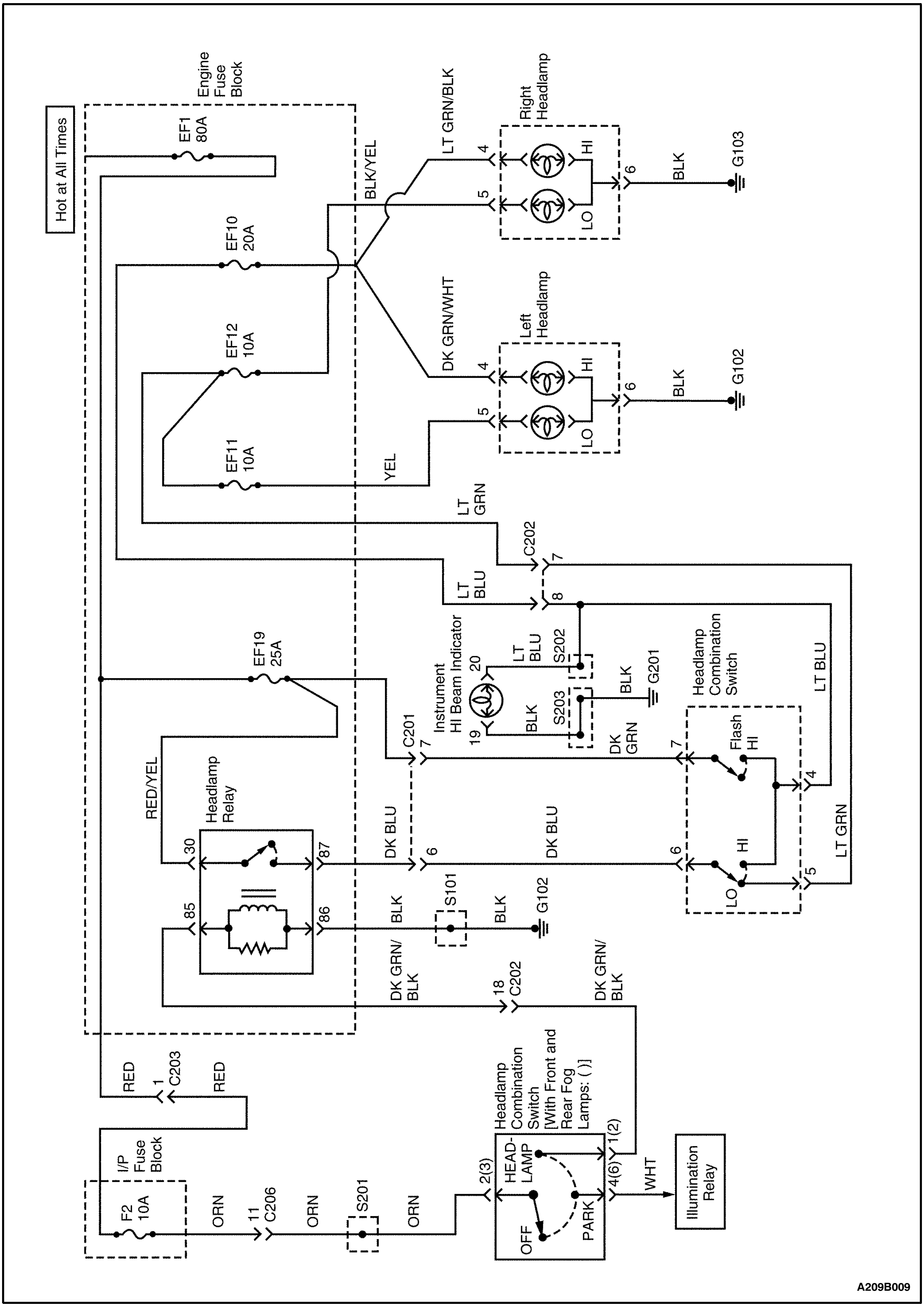


REAR FOG LAMPS CIRCUIT (WITHOUT FRONT FOG LAMPS)

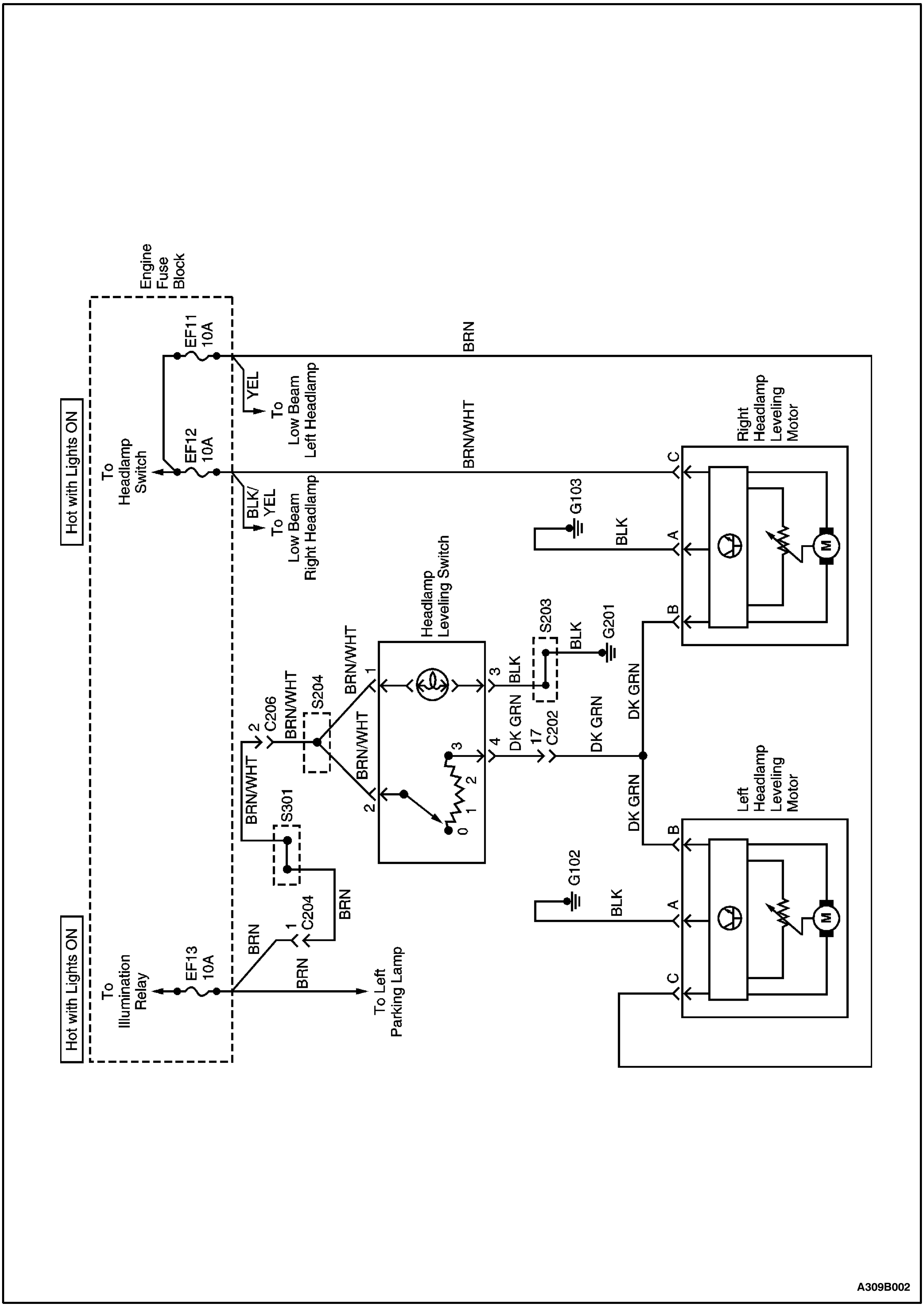


HEADLAMPS-ON REMINDER CHIME

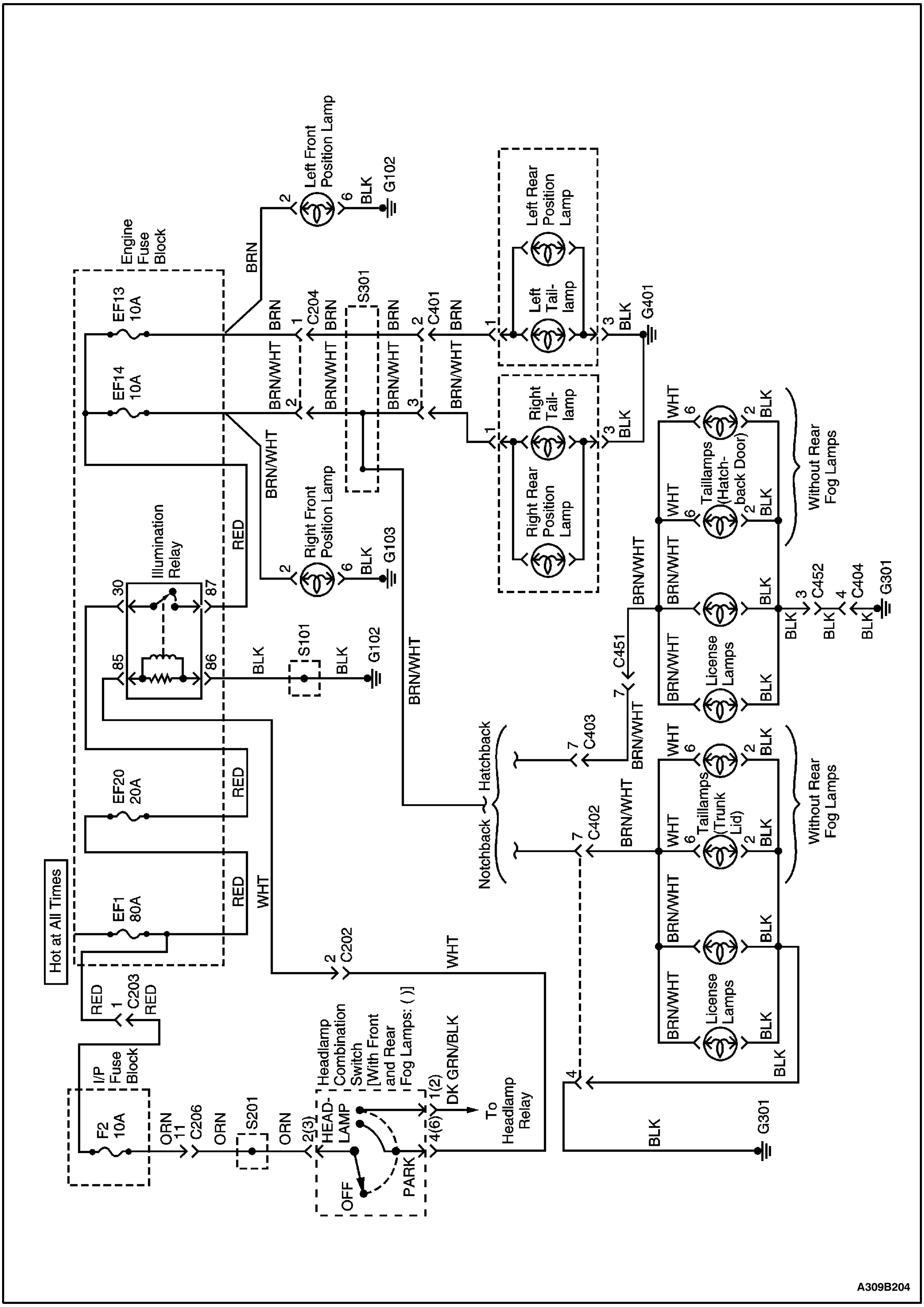



HEADLAMPS CIRCUIT
Hot at All Times
Engine Fuse Block
EF1 80A
EF10 20A
EF12 10A
EF11 10A
EF19 25A
BLK/YEL
LT GRN/BLK
DK GRN/WHT
YEL
LT GRN
LT BLU
Right Headlamp
Left Headlamp
HI
LO
BLK
G103
G102
C202
Instrument HI Beam Indicator
S202
S203
G201
Headlamp Combination Switch
Flash HI
LT BLU
LT GRN
C201
DK GRN
RED/YEL
Headlamp Relay
DK BLU
S101
DK GRN/ BLK
RED
C203
I/P Fuse Block
F2 10A
ORN
C206
S201
Headlamp Combination Switch [With Front and Rear Fog Lamps: ( )]
HEAD-LAMP
OFF
PARK
WHT
Illumination Relay
A209B009

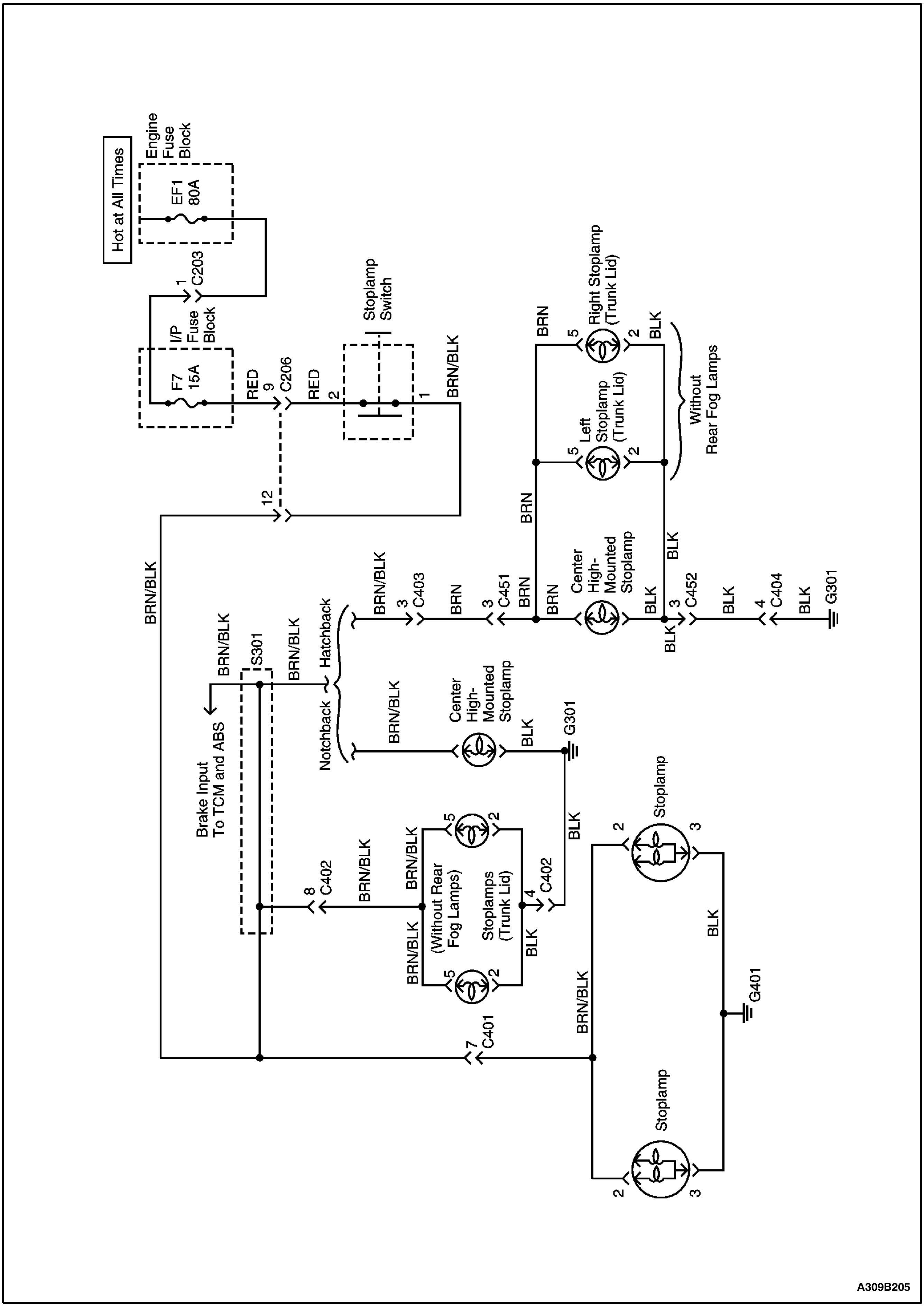
HEADLAMP LEVELING CIRCUIT



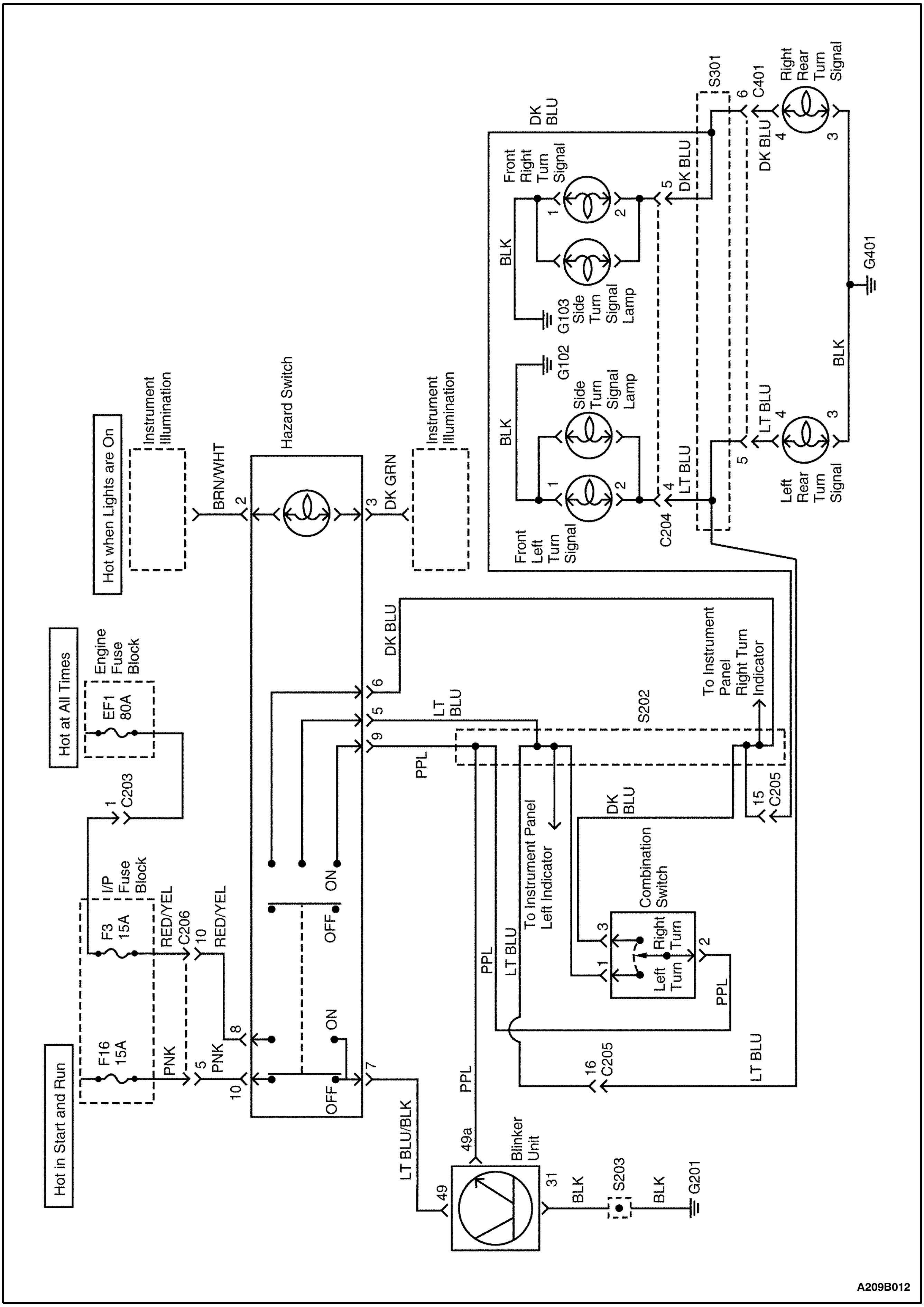
POSITION, TAIL AND LICENSE LAMPS CIRCUIT



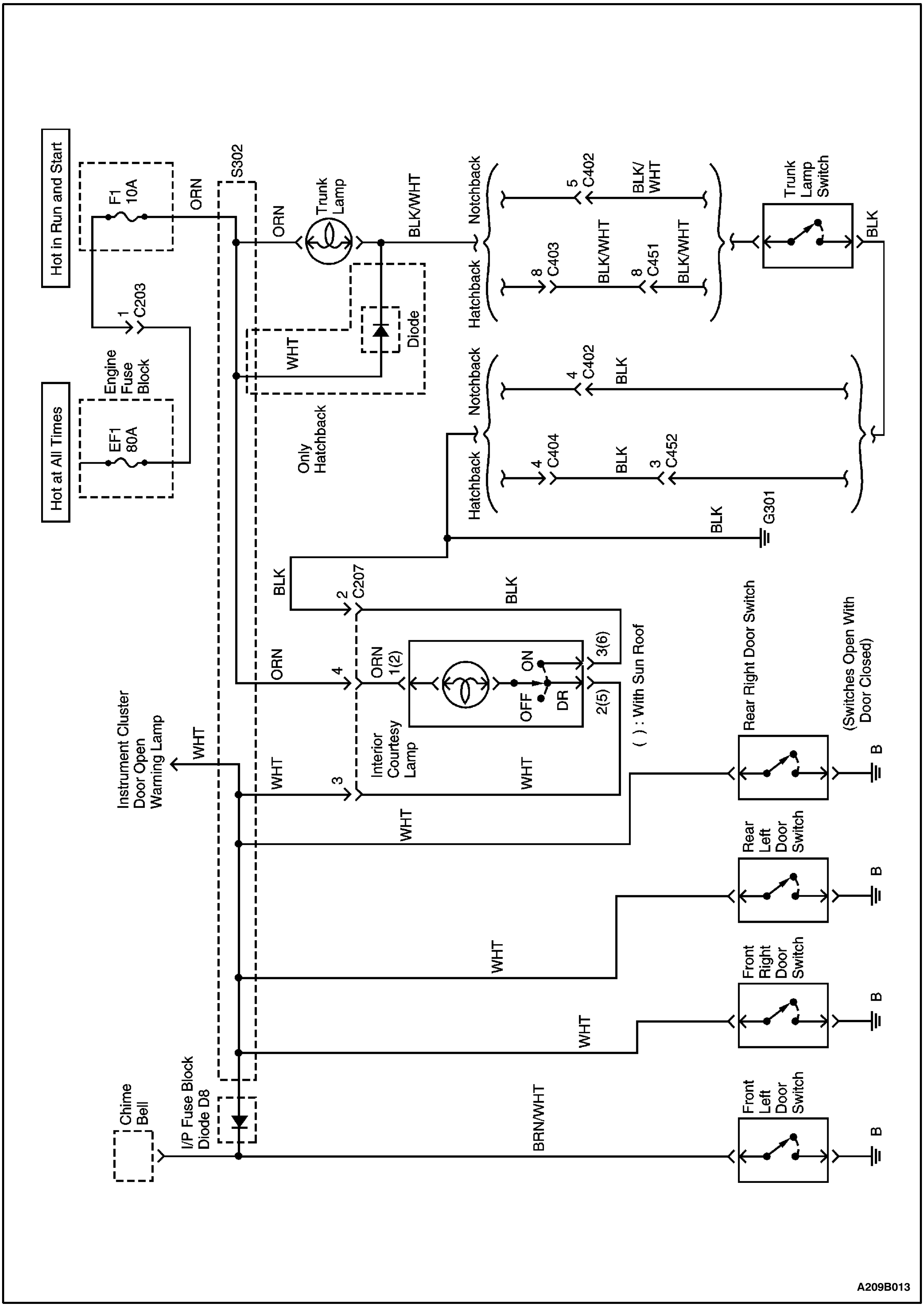
STOPLAMPS CIRCUIT



TURN AND HAZARD LAMPS CIRCUIT



INTERIOR COURTESY AND LUGGAGE COMPARTMENT LAMP CIRCUIT



DIAGNOSIS

HEADLAMPS-ON REMINDER CHIME

Diagnostic Aids: The fuse for the left-side taillamps is also part of the headlamps-on reminder chime circuit. The headlamps-on reminder chime should operate when the ignition is OFF, the headlamps or parking lamps are on, and the driver door is open.

Headlamps-On Reminder Chime Does Not Work

Step	Action	Value(s)	Yes	No
1	Turn the parking lamps on, and observe the taillamps. Are the taillamps operating correctly?	-	Go to Step 3	Go to Step 2
2	Repair the left-side taillamps before completing this diagnostic table. After the taillamps have been repaired, does the headlamps-on reminder chime work?	-	System OK	Go to Step 3
3	1. Disconnect the chime module electrical connector. 2. Turn the headlamps on. 3. Check the voltage at terminal 6 of the chime module connector. Is the voltage equal to the specified value?	11-14v	Go to Step 5	Go to Step 4
4	Repair the open circuit between fuse EF13 and terminal 6 of the chime module connector. Is the repair complete?	-	System OK	-
5	Use an ohmmeter to check the resistance between ground and terminal 5 of the chime module. Is the resistance equal to the specified value?	9 0 W	Go to Step 7	Go to Step 6
6	Repair the open circuit between ground and terminal 5 of the chime module. Is the repair complete?	-	System OK	-
7	1. Remove the driver door contact switch. 2. Remove the electrical connector from the driver door contact switch. 3. Use an ohmmeter to measure the resistance between the driver door contact switch connector and the chime module terminal 4. Does the ohmmeter indicate the specified value?	9 0 W	Go to Step 9	Go to Step 8
8	Repair the open circuit between the driver door contact switch connector and the chime module terminal 4. Is the repair complete?	-	System OK	-
9	1. Connect the electrical connector to the chime module. 2. Connect a jumper wire between ground and the connector for the driver door contact switch. 3. Turn the ignition OFF. 4. Turn the lights on. Does the headlamps-on reminder chime operate?	-	Go to Step 11	Go to Step 10
10	Replace the chime module. Is the repair complete?	-	System OK	-
11	Replace the driver door contact switch. Is the repair complete?	-	System OK	-

HEADLAMPS

Low Beam Headlamps Are Inoperative, High Beam Headlamps Are OK

Step	Action	Value(s)	Yes	No
1	Check fuses EF11 (left-side headlamps) and EF12 (right-side headlamps). Is fuse EF11 or EF12 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Check the voltage at fuses EF11 and EF12. Does the voltage available at fuses EF11 and EF12 equal the value specified?	11-14 v	Go to Step 4	Go to Step 9
4	1. Disconnect both headlamp connectors. 2. Turn the headlamps on. 3. Select the low beams. Does the voltage at each headlamp connector terminal 5 equal the value specified?	11-14 v	Go to Step 6	Go to Step 5
5	Repair the open circuit between fuses EF11 or EF12 and the low beam headlamps. Is the repair complete?	-	System OK	-
6	1. Disconnect the headlamp connectors. 2. Connect an ohmmeter between ground and either headlamp connector terminal 6. Is the resistance equal to the value specified?	0 W	Go to Step 8	Go to Step 7
7	Repair the ground circuit. Is the repair complete?	-	System OK	-
8	Replace the faulty headlamps. Is the repair complete?	-	System OK	-
9	1. Disconnect the headlamp combination switch connector C1. 2. Select the low beams. 3. Use an ohmmeter to check the continuity between terminals 6 and 5 of the headlamp combination switch. Does the ohmmeter indicate the value specified?	0 W	Go to Step 10	Go to Step 11
10	Replace the headlamp combination switch. Is the repair complete?	-	System OK	-
11	Repair the open circuit between fuses EF11 and EF12 and the headlamp combination switch connector C1 terminal 5. Is the repair complete?	-	System OK	-

High Beam Headlamps Are Inoperative, Low Beam Headlamps Are OK

Step	Action	Value(s)	Yes	No
1	Check the high beam headlamps in the “flash-to-pass” mode. Do the high beam headlamps work in the “flash-to-pass” mode?	-	Go to Step 8	Go to Step 2
2	Check fuse EF10. Is fuse EF10 blown?	-	Go to Step 3	Go to Step 4
3	1. Check for a short circuit. Repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
4	1. Turn the high beam headlamps on. 2. Check the voltage at fuse EF10. Does the voltage available at fuse EF10 equal the value specified?	11-14 v	Go to Step 5	Go to Step 9
5	1. Turn the high beam headlamps on. 2. Check the voltage at headlamp terminal 4 with the high beams selected. Does the voltage available at the headlamp connector terminal 4 equal the value specified?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuse EF10 and the high beam headlamps. Is the repair complete?	-	System OK	-
7	Replace the faulty headlamps. Is the repair complete?	-	System OK	-
8	Replace the headlamp combination switch. Is the repair complete?	-	System OK	-
9	Repair the open circuit between headlamp combination switch connector C1 terminal 4 and fuse EF10. Is the repair complete?	-	System OK	-

High Beam and Low Beam Headlamps Are Inoperative On Both Left and Right Sides

Diagnostic Aids: If there are several other symptoms, including an inoperative radiator fan, the windshield washer pump, or the left-side turn signal lamps, check ground G102.

Step	Action	Value(s)	Yes	No
1	Check fuses EF10, EF11, EF12, EF19, and F2. Are any fuses blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the low beam headlamps on. 2. Check the voltage at fuses EF11 and EF12. 3. Check the voltage at fuse EF10 with the high beams selected. Does the voltage at the headlamps equal the value specified?	11-14 v	Go to Step 4	Go to Step 9
4	1. Turn the low beam headlamps on. 2. Check the voltage at the headlamp connector terminal 5. 3. Turn the high beam headlamps on. 4. Check the voltage at headlamp connector terminal 4. Does the battery voltage available at the headlamps equal the value specified?	11-14 v	Go to Step 6	Go to Step 5
5	Repair the open circuit between fuses EF10, EF11, and EF12 and the headlamps. Is the repair complete?	-	System OK	-
6	Use an ohmmeter to check between ground and the headlamp connector terminal 6. Is the resistance equal to the specified value?	0 W	Go to Step 8	Go to Step 7
7	Repair the ground circuit. Is the repair complete?	-	System OK	-
8	1. Replace the faulty headlamps. 2. Check the charging system to make sure that the charging voltage is not excessively high. Repair if necessary. Is the repair complete?	-	System OK	-
9	Use a voltmeter to check for power to the fuses F2 and EF19. Does the voltage at fuses F2 and EF19 equal the value specified?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the power supply circuit to the fuses F2 and EF19. Is the repair complete?	-	System OK	-
11	1. Remove the headlamp relay. 2. Use a voltmeter to check the headlamp relay connector for terminal 30. Does the voltmeter indicate the value specified?	11-14 v	Go to Step 13	Go to Step 12
12	Repair the open circuit between fuse EF19 and the connector for terminal 30 of the headlamp relay. Is the repair complete?	-	System OK	-

High Beam and Low Beam Headlamps Are Inoperative On Both Left and Right Sides (Cont'd)

Step	Action	Value(s)	Yes	No
13	Temporarily substitute the illumination lamp relay in place of the headlamp relay. Do the headlamps operate with the substituted relay?	-	Go to Step 14	Go to Step 15
14	Reinstall the illumination lamp relay in its original position, and install a new headlamp relay. Is the repair complete?	-	System OK	-
15	1. Reinstall the illumination lamp relay in its original position before proceeding. 2. Before reinstalling the headlamp relay, turn the low beam switch on. 3. Use a test lamp to check the relay socket at the terminal that connects to terminal 85 of the relay. Does the test lamp illuminate?	-	Go to Step 21	Go to Step 16
16	Check the headlamp combination switch connector C2 with a voltmeter. Does the voltage at the headlamp switch connector C2, terminal 1 equal the specified value?	11-14 v	Go to Step 18	Go to Step 17
17	Repair the open circuit between fuse F2 and headlamp combination switch connector C2. Is the repair complete?	-	System OK	-
18	1. Disconnect the C2 connector for the headlamp combination switch. 2. Select the low beam headlamp position. 3. At connector C2 (on the switch side of the connector), measure with an ohmmeter between terminals 1 and 2. Is the resistance equal to the specified value?	0 W	Go to Step 20	Go to Step 19
19	Replace the headlamp combination switch. Is the repair complete?	-	System OK	-
20	Repair the open circuit between headlamp switch connector C2 and terminal 86 of the headlamp relay. Is the repair complete?	-	System OK	-
21	1. Disconnect the headlamp combination switch connector C1. 2. Select the low beams. 3. Check the resistance between switch terminals 6 and 5 with the low beams selected. 4. Select the high beams. 5. Check the resistance between switch terminals 6 and 4. Are both resistance measurements equal to the specified value?	0 W	Go to Step 22	Go to Step 19
22	Repair the open circuit between the headlamp combination switch connector C1 and the fuses EF10, EF11, and EF12. Is the repair complete?	-	System OK	-

HEADLAMP LEVELING

Headlamp Leveling Is Inoperative

Step	Action	Value(s)	Yes	No
1	Check the low beam headlamps and the parking lamps. Do the high and low beam headlamps and the parking lamps work?	-	Go to Step 3	Go to Step 2
2	Repair the low beam headlamps and the parking lamps before completing this diagnostic table. Does the leveling system operate after the headlamps and the parking lamps are repaired?	-	System OK	Go to Step 3
3	1. Disconnect the electrical connector at the inoperative headlamp leveling motor. 2. Turn the low beam headlamps on. 3. If the left headlamp leveling system is being tested, check the voltage at the BRN wire at the left headlamp leveling motor connector. If the right headlamp leveling system is being tested, check the voltage at the BRN/WHT wire at the right headlamp leveling motor connector. Does the voltmeter indicate the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open circuit between the fuse (EF12 for right side, EF11 for left side) and the headlamp leveling motor. Is the repair complete?	-	System OK	-
5	Use an ohmmeter to check continuity between the BLK wire at the headlamp leveling motor connector and ground. Does the ohmmeter indicate the specified value?	9 0 W	Go to Step 7	Go to Step 6
6	Repair the open circuit between the headlamp leveling motor connector and ground. Is the repair complete?	-	System OK	-
7	1. Turn the low beam headlamps on. 2. At the headlamp leveling motor connector, check the voltage at the DK GRN wire while the leveling adjustment is changed on the leveling switch. Does the voltage smoothly increase and decrease as the setting of the leveling switch is raised and lowered?	-	Go to Step 8	Go to Step 9
8	Replace the headlamp leveling motor. Is the repair complete?	-	System OK	-
9	1. Remove the headlamp leveling switch for testing, but do not disconnect the electrical connector. 2. Turn the low beam headlamps on. 3. Check the voltage at the BRN/WHT wires at the headlamp leveling switch connector. Is the voltage equal to the specified value?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between fuse EF13 and the headlamp leveling switch. Is the repair complete?	-	System OK	-

Headlamp Leveling Is Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the low beam headlamps on. 2. With the headlamp leveling switch removed for testing and the electrical connector still connected, check the voltage at the DK GRN wire at the headlamp leveling switch while adjusting the switch. Does the voltage smoothly rise and drop as the switch is adjusted?	-	Go to Step 12	Go to Step 13
12	Repair the open DK GRN wire between the headlamp leveling switch and the headlamp leveling motor. Is the repair complete?	-	System OK	-
13	Replace the headlamp leveling switch. Is the repair complete?	-	System OK	-

TAILLAMPS

Taillamps Do Not Work

Step	Action	Value(s)	Yes	No
1	Check the headlamps and the parking lamps. Do the headlamps and the parking lamps work?	-	Go to Step 3	Go to Step 2
2	Repair the headlamps before continuing with this chart. After the headlamps have been repaired, are the taillamps still inoperative?	-	Go to Step 3	System OK
3	1. Turn the parking lamps on. 2. Use a voltmeter to check voltage at the bulb socket positive terminal. Does voltage at the bulb socket equal the specified value?	11-14 v	Go to Step 4	Go to Step 7
4	Connect an ohmmeter between ground and the lamp socket negative terminal. Is the resistance equal to the specified value?	9 0 W	Go to Step 6	Go to Step 5
5	Repair the ground circuit for the lamps. Is the repair complete?	-	System OK	-
6	Replace the faulty bulbs. Is the repair complete?	-	System OK	-
7	Check fuses EF20, EF13, and EF14. Are any of the fuses blown?	-	Go to Step 8	Go to Step 9
8	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
9	1. Turn the headlamps on. 2. Check the voltage at fuses EF13 (left-side illumination lamp) and EF14 (right-side illumination lamp). Does the voltage at the fuses equal the specified value?	11-14 v	Go to Step 23	Go to Step 10
10	Check the voltage at fuse EF20. Does the voltage at fuse EF20 equal the specified value?	11-14 v	Go to Step 12	Go to Step 11
11	Repair the battery supply circuit to fuse EF20. Is the repair complete?	-	System OK	-
12	1. Temporarily substitute the headlamp relay for the illumination lamp relay. 2. Turn the illumination lamp switch on. Do the taillamps illuminate?	-	Go to Step 13	Go to Step 14
13	1. Return the headlamp relay to its original position. 2. Replace the illumination lamp relay. Is the repair complete?	-	System OK	-
14	1. Remove the illumination relay. 2. Use a voltmeter to check the illumination lamp relay socket at the connector for terminal 30. Is the voltage at the connector for terminal 30 of the illumination lamp relay equal to the specified value?	11-14 v	Go to Step 16	Go to Step 15

Taillamps Lamps Do Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair the open circuit between fuse EF20 and the connector for the illumination lamp relay terminal 30. Is the repair complete?	-	System OK	-
16	Connect an ohmmeter between ground and the illumination lamp relay terminal 86. Is the resistance equal to the specified value?	9 0 W	Go to Step 18	Go to Step 17
17	Repair the ground circuit for the illumination lamp relay. Is the repair complete?	-	System OK	-
18	1. Turn the illumination lamps on. 2. Check the voltage at the connector for terminal 85 of the illumination lamp relay. Is the voltage equal to the specified value?	11-14 v	Go to Step 22	Go to Step 19
19	1. Disconnect the headlamp combination switch connector C2. 2. On the disconnected switch, select the illumination lamps on position. 3. At the switch side of the connector C2, use an ohmmeter to check for continuity between terminal 1 and terminal 3. Is the resistance equal to the specified value?	9 0 W	Go to Step 21	Go to Step 20
20	Repair the open circuit between the headlamp switch connector C2 terminal 3 and terminal 85 of the illumination lamp relay. Is the repair complete?	-	System OK	-
21	Replace the headlamp switch. Is the repair complete?	-	System OK	-
22	Repair the open circuit between terminal 87 of the illumination lamp relay and fuses EF13 and EF14. Is the repair complete?	-	System OK	-
23	Repair the open circuit between the fuses EF13 and EF14 and the illumination lamps. Is the repair complete?	-	System OK	-

Stoplamps Do Not Work

Notice: When probing a bulb socket with a voltmeter or a test lamp, do not contact the side of the socket (ground) when you are testing the positive contact at the bottom of the socket. If the voltage and the ground are both available at the bulb socket, contacting both at the same time with a test probe will cause a blown fuse.

Step	Action	Value(s)	Yes	No
1	Check fuse F7. Is fuse F7 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to check the voltage at fuse F7. Is the voltage at F7 equal to the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the power supply circuit for fuse F7. Is the repair complete?	-	System OK	-
5	1. Press the brake pedal. 2. Check the positive terminals of the bulb sockets with a test lamp. Does the test lamp illuminate?	-	Go to Step 6	Go to Step 8
6	Connect an ohmmeter between ground and the stoplamp ground terminal. Is the resistance equal to the specified value?	0 W	Go to Step 8	Go to Step 7
7	Repair the ground circuit. Is the repair complete?	-	System OK	-
8	1. Disconnect the wiring connector from the stoplamp switch. 2. Press the brake pedal. 3. Use an ohmmeter to check continuity between terminals 1 and 2. Is the resistance equal to the specified value?	0 W	Go to Step 10	Go to Step 9
9	Replace the stoplamp switch. Is the repair complete?	-	System OK	-
10	1. Disconnect the stoplamp switch electrical connector. 2. Check the voltage at terminal 1. Does the voltmeter show the specified value?	11-14 v	Go to Step 12	Go to Step 11
11	Repair the open circuit between the fuse F7 and the stoplamp switch. Is the repair complete?	-	System OK	-
12	Repair the open circuit between the stoplamp switch and the stoplamps. Is the repair complete?	-	System OK	-

Center High-Mounted Stoplamp (CHMSL) Does Not Work

Step	Action	Value(s)	Yes	No
1	1. Turn the lights on. 2. Observe the taillamps. Are the taillamps on?	-	Go to Step 3	Go to Step 2
2	Repair the taillamps before completing this diagnostic table. Does the CHMSL work after the taillamps are repaired?	-	System OK	Go to Step 3
3	1. Remove the CHMSL bulb. 2. Check the CHMSL bulb. Is the lamp bulb defective?	-	Go to Step 4	Go to Step 5
4	Replace the CHMSL bulb. Is the repair complete?	-	System OK	-
5	1. Disconnect the CHMSL connector. 2. Use an ohmmeter to measure the resistance between ground and the BLK wire in the CHMSL connector. Is the resistance equal to the specified value?	9 0 W	Go to Step 7	Go to Step 6
6	Repair the open circuit between ground and the BLK wire in the CHMSL connector. Is the repair complete?	-	System OK	-
7	Repair the open circuit between the stoplamp switch and the CHMSL. Is the repair complete?	-	System OK	-

Backup Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Block the wheels. 2. Apply the parking brake to prevent the vehicle from moving. 3. Turn the ignition on. 4. Put the transaxle in reverse (R). 5. Remove one of the backup lamps from its socket. 6. Test the lamp socket positive terminal with a voltmeter. Does the battery voltage available at the backup lamp socket positive terminal equal the specified value?	11-14 v	Go to Step 3	Go to Step 2
2	Repair the open circuit between fuse F12 and the backup lamps. Is the repair complete?	-	System OK	-
3	Connect an ohmmeter between ground and the negative terminal at the bulb socket. Is the resistance equal to the specified value?	0 W	Go to Step 4	Go to Step 5
4	Replace the faulty backup lamps. Is the repair complete?	-	System OK	-
5	1. Reinstall the backup lamps. 2. Disconnect the electrical connector at the reverse switch. (On automatic transaxle (A/T) vehicles, disconnect the neutral safety/backup switch.) 3. Turn the ignition on. 4. Put the transaxle in R. 5. Use a voltmeter to check for the reverse switch terminal A. (On A/T vehicles, test terminal 6 of the neutral safety/backup switch). Does battery voltage available at terminal A (or terminal 6, if equipped with A/T) equal the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the backup lamps and the, reverse switch (or the neutral safety/backup switch if equipped with A/T). Is the repair complete?	-	System OK	-
7	1. Put the transaxle in R. 2. Use an ohmmeter to check the continuity between reverse switch terminal A and terminal B (terminals 6 and 2 on the neutral safety/backup switch, if equipped with A/T). Does the continuity between terminals A and B (terminals 6 and 2, if equipped with A/T) equal the specified value?	0 W	Go to Step 9	Go to Step 8
8	Replace the reverse switch (neutral safety/backup switch, if equipped with A/T). Is the repair complete?	-	System OK	-
9	Repair the ground circuit between the reverse switch (neutral safety/backup switch, if equipped with A/T) and ground G105. Is the repair complete?	-	System OK	-

Turn Signal Lamps and Hazard Lamps Do Not Work

Step	Action	Value(s)	Yes	No
1	Check fuses F3 and F16. Is either fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Check the voltage at fuses F16 and F3. Does the battery voltage available at both fuses F3 and F16 equal the specified value?	11-14 v	Go to Step 4	Go to Step 7
4	1. Turn the hazard switch on. 2. Remove each of the inoperative lamps from its socket. 3. Test each lamp socket positive terminal with a voltmeter. Does the battery voltage pulsing at the turn signal hazard lamp socket positive terminal equal the specified value?	11-14 v	Go to Step 5	Go to Step 9
5	At each bulb socket, use an ohmmeter to check the ground circuit. Is the resistance equal to the specified value?	[0 W	Go to Step 6	Go to Step 8
6	Replace any faulty turn signal/hazard bulbs. Is the repair complete?	-	System OK	-
7	Repair the power supply circuit to fuses. Is the repair complete?	-	System OK	-
8	Repair the open ground wires. Is the repair complete?	-	System OK	-
9	1. Turn on the hazard lamp switch. 2. Test the blinker unit connector terminal 49a with a voltmeter. Does the battery voltage pulsing at the blinker unit terminal 49a equal the specified value?	11-14 v	Go to Step 15	Go to Step 10
10	1. Turn on the hazard lamp switch. 2. Test the blinker unit connector terminal 49 with a voltmeter. Does the battery voltage available at the blinker unit terminal 49 equal the specified value?	11-14 v	Go to Step 11	Go to Step 14
11	1. Disconnect the blinker unit from the connector. 2. Use an ohmmeter to check between ground and the connector for terminal 31 of the blinker unit. Is the resistance equal to the specified value?	[0 W	Go to Step 13	Go to Step 12
12	Repair the blinker unit ground connection. Is the repair complete?	-	System OK	-
13	Replace the faulty blinker unit. Is the repair complete?	-	System OK	-
14	1. Disconnect the hazard lamp switch connector. 2. Check for voltage at terminal 8. 3. Turn the ignition ON. 4. Check for voltage at terminal 10. Does the battery voltage available at both terminals equal the specified value?	11-14 v	Go to Step 15	Go to Step 20

Turn Signal Lamps and Hazard Lamps Do Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Remove the hazard lamp switch. 2. Turn the hazard lamp switch off. 3. Check for continuity between terminals 7 and 10. 4. Turn the hazard lamp switch on. 5. Check for continuity between terminals 7 and 8. Do both tests show the specified value?	0 W	Go to Step 18	Go to Step 17
16	1. Remove the hazard lamp switch. 2. Turn the hazard lamp switch on. 3. Use an ohmmeter to check for continuity between terminals 5, 6, and 9. Does the continuity between terminals 5, 6, and 9 equal the specified value?	0 W	Go to Step 19	Go to Step 17
17	Replace the faulty hazard lamp switch. Is the repair complete?	-	System OK	-
18	Repair the open circuit between the hazard lamp switch terminal 7 and the blinker unit terminal 49. Is the repair complete?	-	System OK	-
19	Repair the open circuit between the splice S202 and splice S301. Is the repair complete?	-	System OK	-
20	Repair the open circuit between the hazard lamp switch and the fuses F3 or F16. Is the repair complete?	-	System OK	-

Hazard Lamps Do Not Operate, Turn Signals Are OK

Step	Action	Value(s)	Yes	No
1	Check fuse F3. Is fuse F3 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to check for power to fuse F3. Does the battery voltage available at fuse F3 equal the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the power supply circuit to fuse F3. Is the repair complete?	-	System OK	-
5	1. Disconnect the hazard switch connector. 2. Use a voltmeter to check power to the hazard switch terminal 8. Does the battery voltage available at connector terminal 8 equal the value specified?	11-14 v	Go to Step 6	Go to Step 9
6	1. Remove the hazard switch and disconnect it for testing. 2. Turn the hazard switch on. 3. Test with an ohmmeter between terminals 7 and 8. Is the resistance equal to the specified value?	0 W	Go to Step 7	Go to Step 10
7	1. With the hazard switch still removed and disconnected for testing, turn the hazard switch on. 2. Use an ohmmeter to check between terminals 5, 6, and 9. Is the resistance equal to the specified value?	0 W	Go to Step 8	Go to Step 10
8	Repair the open circuit between the hazard switch connector and splice S202. Is the repair complete?	-	System OK	-
9	Repair the open circuit between the hazard switch connector terminal 8 and fuse F3. Is the repair complete?	-	System OK	-
10	Replace the faulty hazard switch. Is the repair complete?	-	System OK	-

INTERIOR COURTESY AND LUGGAGE COMPARTMENT LAMPS

Interior Courtesy Lamp Inoperative

Caution: Always make sure there is an electrical load (lamp bulb, etc.) in any circuit between battery terminals. Do not make a short circuit between battery terminals with a jumper wire. Hazardous sparking would result and could cause injury.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Bulb test. Clip one end of a jumper wire to the negative battery terminal. Clip the other end of the jumper wire onto one end of the bulb. Take the free end of the bulb (the end without the jumper attached) and touch it to the positive battery terminal.

Step	Action	Value(s)	Yes	No
1	1. Remove the interior courtesy lamp bulb and inspect the filament. 2. If the filament is not broken, test the bulb using the vehicle's battery and a jumper wire. Does the bulb pass the visual and physical checks?	-	Go to Step 3	Go to Step 2
2	Replace the bulb. Is the repair complete?	-	System OK	-
3	1. Reinstall the interior courtesy lamp bulb. 2. Check fuse F1. Is fuse F1 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
5	Check fuse F1. Does the voltage at fuse F1 equal the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open power supply circuit for fuse F1. Is the repair complete?	-	System OK	-
7	1. Disconnect the interior courtesy lamp electrical connector. 2. Check the voltage at connector terminal 1. Does the voltage at connector terminal 1 equal the value specified?	11-14 v	Go to Step 8	Go to Step 9
8	Repair the open circuit between fuse F1 and the interior courtesy lamp terminal 1. Is the repair complete?	-	System OK	-
9	1. With the interior courtesy lamp disconnected, turn it to the on position. 2. Use an ohmmeter to check the resistance between ground and terminal 3 of the interior courtesy lamp connector (harness side). Is the resistance equal to the specified value?	0 W	Go to Step 10	Go to Step 11
10	Replace the interior courtesy lamp switch assembly. Is the repair complete?	-	System OK	-
11	Repair the ground circuit for the interior courtesy lamp. Is the repair complete?	-	System OK	-

Luggage Compartment Lamp Inoperative

Caution: Always make sure there is an electrical load (lamp bulb, etc.) in any circuit between battery terminals. Do not make a short circuit between battery terminals with a jumper wire. Hazardous sparking would result and could cause injury.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Bulb test. Clip one end of a jumper wire to the negative battery terminal. Clip the other end of the jumper wire onto one end of the bulb. Take the free end of the bulb (the end without the jumper attached) and touch it to the positive battery terminal.

Step	Action	Value(s)	Yes	No
1	1. Remove the luggage compartment lamp bulb and inspect the filament. 2. If the filament is not broken, test the bulb using the vehicle's battery and a jumper wire. Does the bulb pass the visual and physical check?	-	Go to Step 3	Go to Step 2
2	Replace the bulb. Is the repair complete?	-	System OK	-
3	1. Reinstall the luggage compartment lamp bulb. 2. Check fuse F1. Is fuse F1 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
5	Check fuse F1. Does the voltage at fuse F1 equal the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open power supply circuit for fuse F1. Is the repair complete?	-	System OK	-
7	1. Disconnect the luggage compartment lamp electrical connector. 2. Check the voltage at the orange wire. Does the voltage at the ORN wire equal the specified value?	11-14 v	Go to Step 8	Go to Step 9
8	Repair the open circuit between fuse F1 and the luggage compartment lamp. Is the repair complete?	-	System OK	-
9	1. Reconnect the luggage compartment lamp. 2. Remove the luggage compartment lamp switch. 3. With a voltmeter (or test lamp), test the BLK/WHT wire at the luggage compartment lamp switch. Does the voltage at the luggage compartment lamp switch equal the specified value?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the luggage compartment lamp and the luggage compartment lamp switch. Is the repair complete?	-	System OK	-
11	Use an ohmmeter to check the resistance between ground and the BLK wire at the luggage compartment lamp switch connector (harness side). Is the resistance equal to the specified value?	0 W	Go to Step 12	Go to Step 13
12	Replace the luggage compartment lamp switch. Is the repair complete?	-	System OK	-
13	Repair the ground circuit for the interior courtesy lamp. Is the repair complete?	-	System OK	-

FOG LAMPS

Diagnostic Aids

The front fog lamps will not operate unless the illumination lamps are on. If the illumination lamps are not operating, repair that problem before attempting to diagnose the fog lamps.

Front Fog Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuse EF15. Is fuse EF15 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to check fuse EF15. Does the battery voltage available at fuse EF15 equal the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open circuit from the battery to fuse EF15. Is the repair complete?	-	System OK	-
5	Remove the fog lamp relay and temporarily substitute a known good relay, such as the headlamp relay. (Do not substitute the illumination lamp relay.) Do the fog lamps work with the substituted relay?	-	Go to Step 6	Go to Step 7
6	1. Return the substituted relay to its original position. 2. Replace the inoperative fog lamp relay. Is the repair complete?	-	System OK	-
7	1. Return the substituted relay to its original position, but do not reinstall the fog lamp relay. 2. Turn on the exterior lamps and the front fog lamps. 3. Using a voltmeter, check the fog lamp relay socket at the connector for fog lamp relay terminal 30. Does the voltage available at the fog lamp relay socket equal the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between fuse EF15 and the fog lamp relay. Is the repair complete?	-	System OK	-
9	At the fog lamp relay socket, use an ohmmeter to verify that the connector for relay terminal 86 is connected to ground. Does the resistance equal the specified value?	0 W	Go to Step 11	Go to Step 10
10	Repair the ground circuit for the fog lamp relay. Is the repair complete?	-	System OK	-
11	1. Reinstall the fog lamp relay. 2. Turn ON the exterior lamps and the front fog lamps. 3. Test for voltage at terminal 1 of the fog lamp connector. Does the battery voltage available at terminal 1 of the fog lamp connector equal the specified value?	11-14 v	Go to Step 13	Go to Step 12
12	Repair the open circuit between the fog lamp relay terminal 87 and the fog lamps. Is the repair complete?	-	System OK	-

Front Fog Lamps Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
13	Use an ohmmeter (or test lamp) to check the ground at terminal 2 of the fog lamp connector. Does the resistance equal the specified value?	0 W	Go to Step 15	Go to Step 14
14	Repair the fog lamp ground circuit. Is the repair complete?	-	System OK	-
15	Replace the faulty fog lamp bulbs. Is the repair complete?	-	System OK	-

Rear Fog Lamps Do Not Work

Diagnostic Aids

The rear fog lamps will not operate unless the headlamps (or the exterior lamps and the front fog lamps) are on. If the headlamps or exterior lights are not operating, repair that problem before attempting to diagnose the rear fog lamps.

Test Description

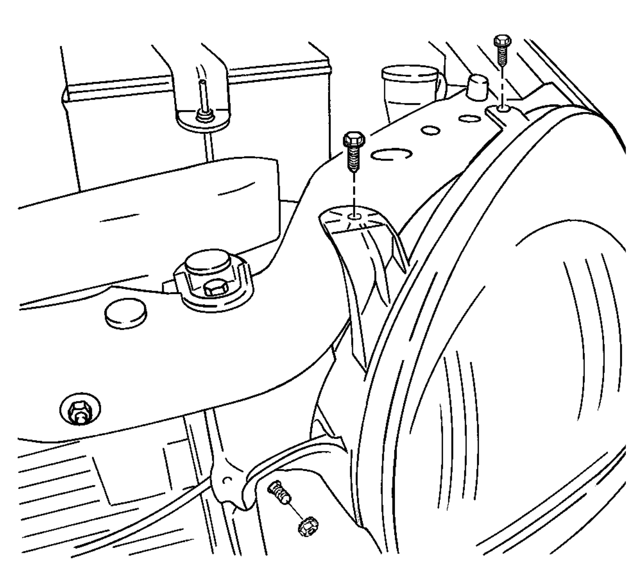
The number(s) below refer to step(s) on the diagnostic table.

10. For this test, either three, four, or five wires will indicate the specified voltage. One wire is hot at all times. The wires to the illumination relay and the headlamp relay will indicate voltage during the test because it was established that the headlamps and the exterior lamps were working before beginning this table.
14. If the wiring between terminal 2 and terminal 5 of C2 is faulty (as would be indicated if only three wires showed the specified voltage in Step 10), the diode connector will need to be located for testing. Remove the small trim plate beneath the air duct at the left side of the instrument cluster. The diode connector can be seen taped to the main instrument harness.

Step	Action	Value	Yes	No
1	Inspect fuse F1. Is fuse F1 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse F1. Is the repair complete?	-	System OK	-
3	Check the voltage at fuse F1. Is the voltage equal to the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the power supply for fuse F1. Is the repair complete?	-	System OK	-
5	1. Temporarily substitute a known good relay such as the headlamp relay or the illumination relay in place of the rear fog lamp relay. 2. Turn on headlamp switch on. 3. Turn the rear fog lamp switch on. Do the rear fog lamps work with the substituted relay?	-	Go to Step 6	Go to Step 7
6	1. Return the substituted relay to its original position. 2. Replace the rear fog lamp relay. Is the repair complete?	-	System OK	-
7	1. Return the substituted relay to its original position. 2. Before installing the rear fog lamp relay, check the voltage at terminal 30 of the relay socket. Is the voltage equal to the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between fuse F1 and the rear fog lamp relay. Is the repair complete?	-	System OK	-
9	1. Before installing the rear fog lamp relay, turn the headlamp switch on. 2. Turn on the rear fog lamps. 3. Check the voltage at terminal 86 of the rear fog lamp relay socket. Is the voltage equal to the specified value?	11-14 v	Go to Step 15	Go to Step 10

Rear Fog Lamps Do Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Remove the screws which retain the driver knee bolster, and remove the knee bolster by sliding it upward and pulling it outward. 2. Turn the steering wheel to gain access to the screws which fasten the steering column upper cover to the lower cover, and remove the screws. 3. Remove the screws which fasten the steering column lower cover, and separate and remove the steering column upper and lower covers. 4. On the left side of the steering column, locate the six-way connector C2 which is a part of the headlamp combination switch. It is not necessary to remove the switch. 5. Turn the low beam headlamps on, and turn the rear fog lamps on. 6. Backprobe all five wires in the six-way connector with a voltmeter on the switch side of connector C2. Is the voltage at all five wires approximately equal to the specified value?	11-14 v	Go to Step 11	Go to Step 12
11	Repair the open circuit between terminal 3 of headlamp combination switch C2 and terminal 85 of the rear fog lamp relay. Is the repair complete?	-	System OK	-
12	In Step 10, when the headlamps and the rear fog lamps were turned on, was the voltage approximately equal to the specified value at four of the five wires ?	11-14 v	Go to Step 13	Go to Step 14
13	Replace the headlamp combination switch. Is the repair complete?	-	System OK	-
14	Repair the open circuit or open diode in the wire harness connecting terminal 2 with terminal 5 at headlamp combination switch connector C2. Is the repair complete?.	-	System OK	-
15	1. Install the rear fog lamp relay. 2. Disconnect the fog lamp connectors. 3. Turn the headlamps on. 4. Turn the rear fog lamps on. 5. Check the voltage at the RED wires at the rear fog lamps. Is the voltage equal to the specified value?	11-14 v	Go to Step 17	Go to Step 16
16	Repair the open circuit between the rear fog lamp relay and the rear fog lamps. Is the repair complete?	-	System OK	-
17	With the rear fog lamp connectors disconnected, use an ohmmeter to check the BLK wires for continuity with ground. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 19	Go to Step 18
18	Repair the fog lamp ground circuit. Is the repair complete?	-	System OK	-
19	Replace the faulty rear fog lamps. Is the repair complete?	-	System OK	-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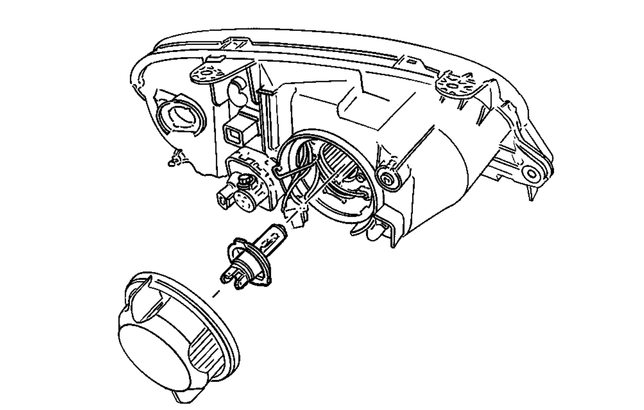
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

HEADLAMPS

Removal Procedure

1. Remove the headlamp mounting bolts and the nut.
2. Disconnect the electrical connectors.
3. Twist the turn signal bulb in order to remove it.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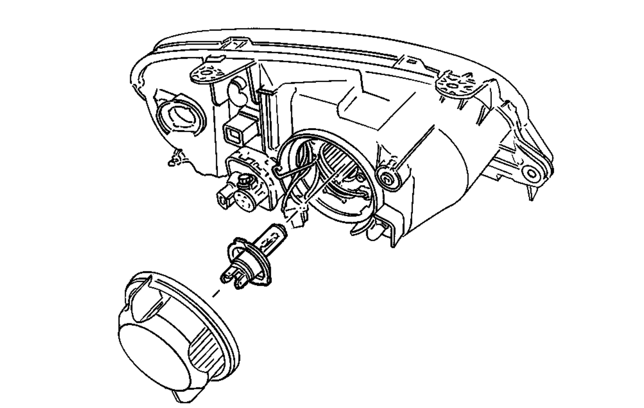
4. Remove the headlamp assembly.
5. Remove the cap concealing the headlamp bulb.
6. Disconnect the headlamp bulb electrical connector.
7. Remove the retaining wire.
8. Remove the headlamp bulb.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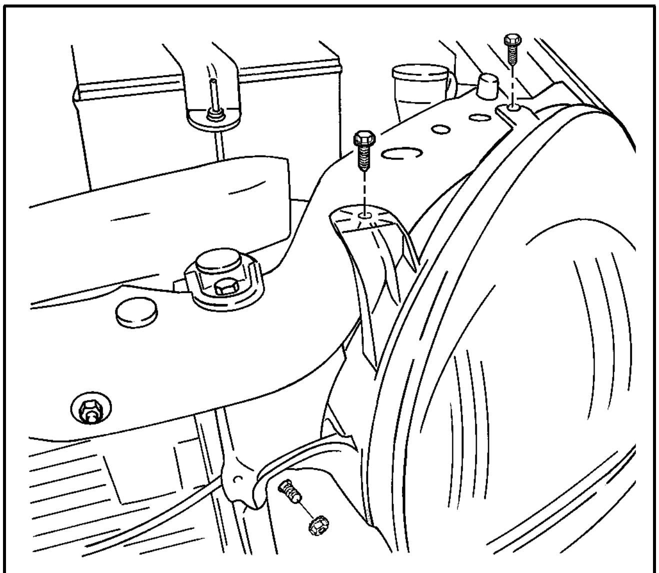
Installation Procedure

1. Install the headlamp bulb.
2. Install the retaining wire.
3. Connect the headlamp bulb electrical connector.
4. Install the cap concealing the headlamp bulb.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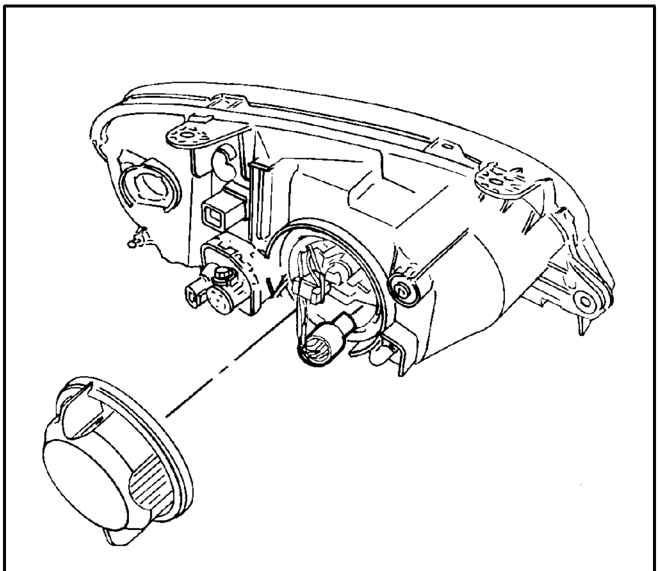
5. Install the turn signal bulb.
6. Connect the electrical connectors.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

7. Install the headlamp assembly with the bolts and the nut.

Tighten

Tighten the headlamp assembly bolts and the nut to 5 N•m (44 lb-in).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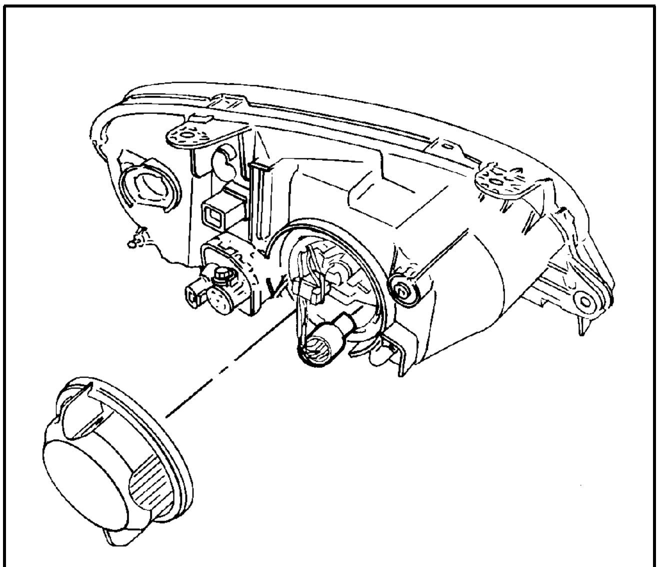
PARKING LAMPS

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the headlamp. Refer to "Headlamps" in this section.
3. Remove the parking lamp.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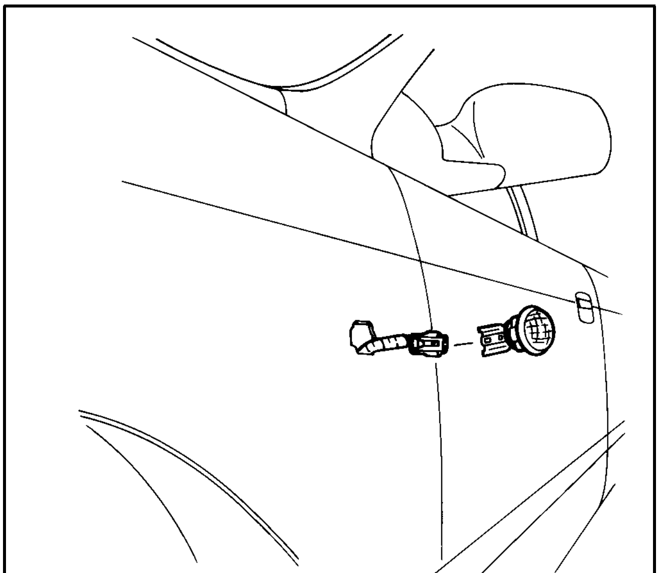
Installation Procedure

1. Install the parking lamp.
2. Install the headlamp. Refer to "Headlamps" in this section.
3. Connect the negative battery cable.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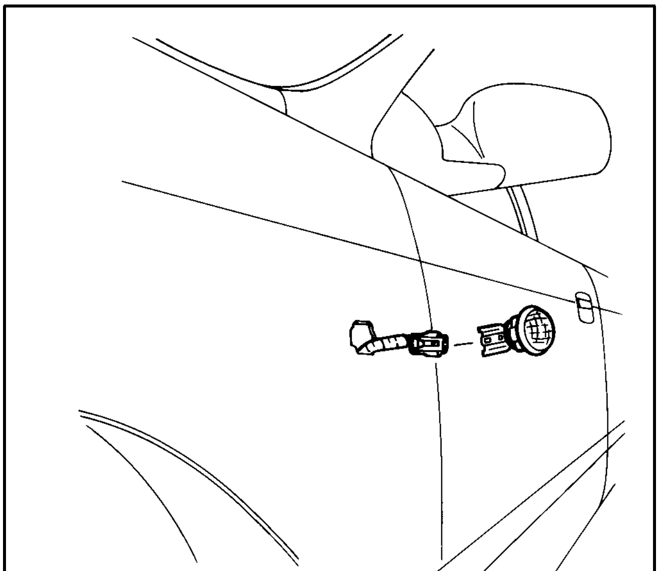
SIDE TURN SIGNAL LAMPS

Removal Procedure

1. Disconnect the negative battery cable.
2. Slide the side turn signal lamp rearward.
3. Remove the lamp.
4. Disconnect the electrical connector.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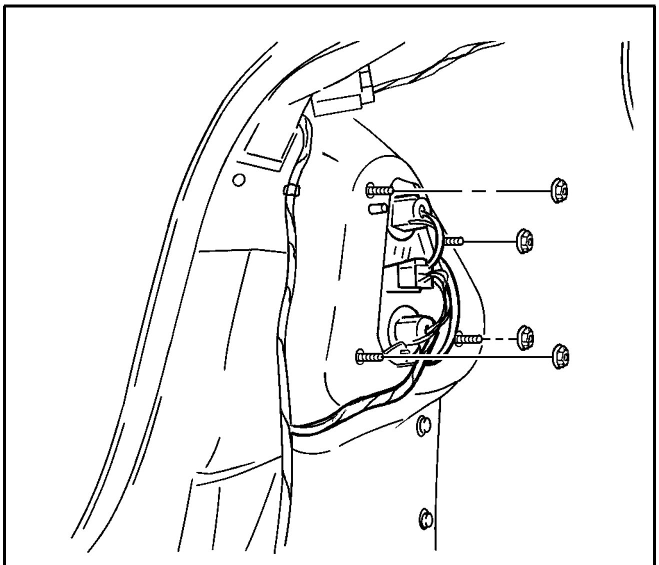
Installation Procedure

1. Connect the electrical connector.
2. Install the side turn signal lamp.
3. Connect the negative battery cable.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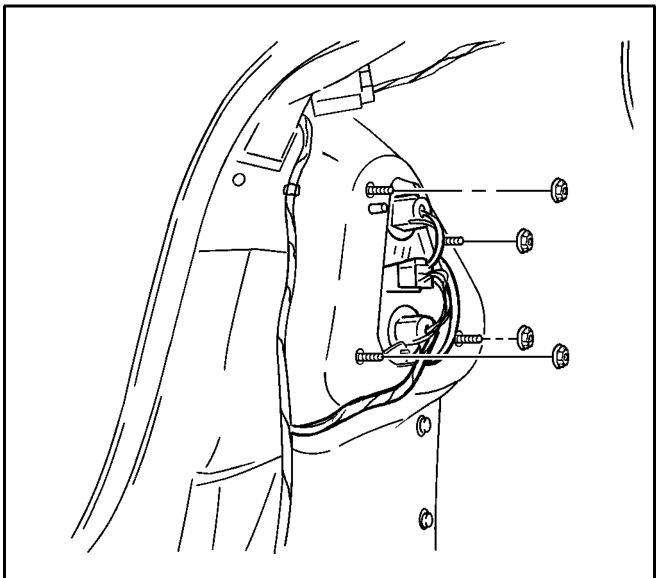
TAILLAMPS (NOTCHBACK)

Removal Procedure

1. Remove the rear quarter luggage compartment trim panel.
2. Disconnect the electrical connectors.
3. Remove the nuts and the lamp assembly.
4. Remove the bulb(s).



A309B006

Installation Procedure

1. Install the bulb(s).

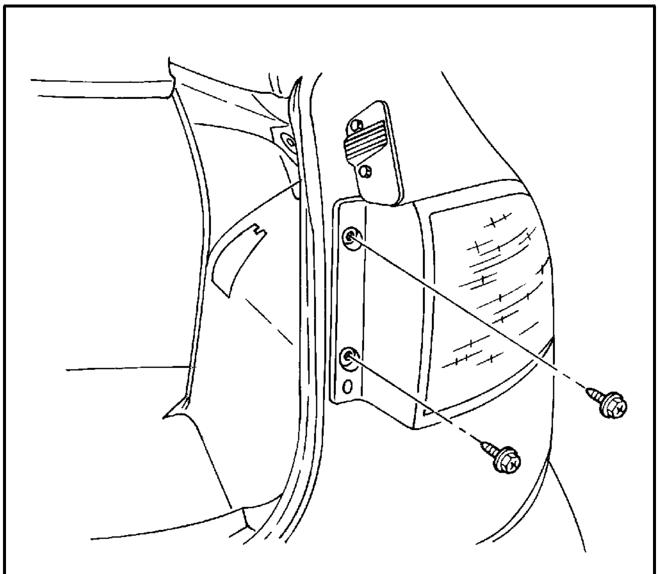
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the lamp assembly with the nuts.

Tighten

Tighten the taillamp assembly nuts to 3 N•m (27 lb-in).

3. Connect the electrical connectors.
4. Install the rear quarter luggage compartment trim panel.

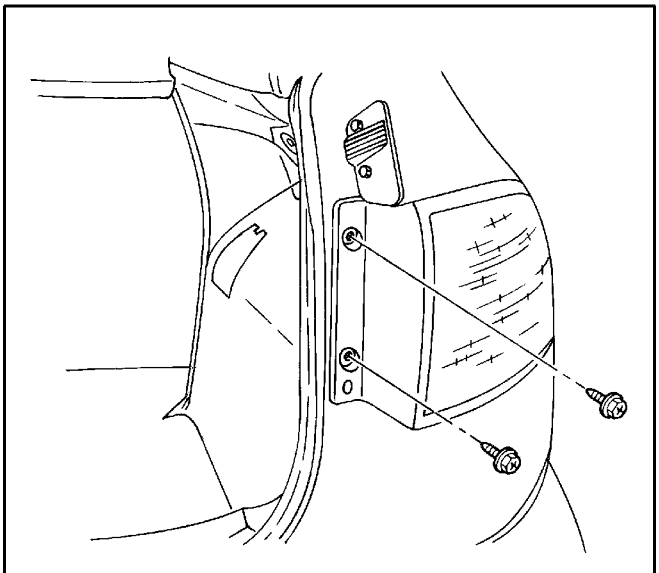


A309B011

TAILLAMPS (HATCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the taillamp assembly screws.
3. Slide the taillamp assembly toward the hatch opening and remove it.
4. Remove the bulbs.



A309B011

Installation Procedure

1. Install the bulbs.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the taillamp assembly with the screws.

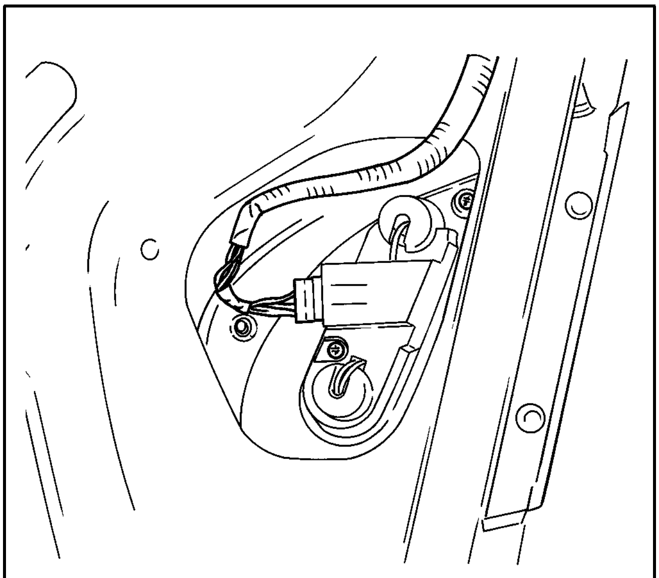
Tighten

Tighten the taillamp assembly screws to 3 N•m (27 lb-in).

3. Connect the negative battery cable.

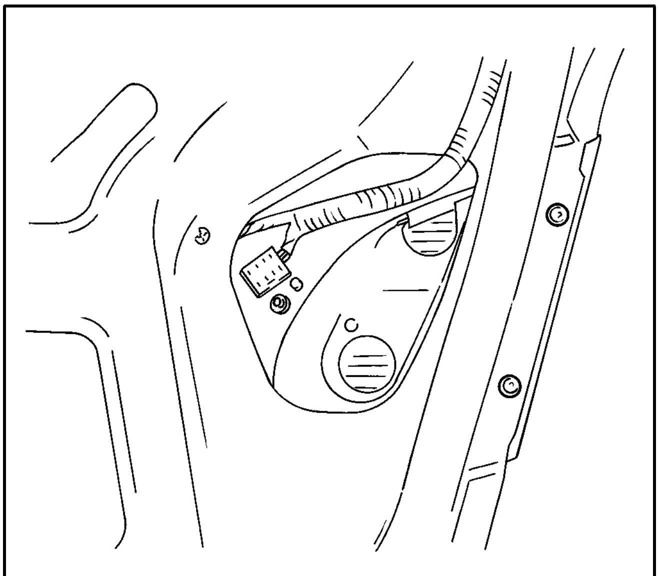
REAR FOG/BACKUP LAMPS (NOTCHBACK)

Removal Procedure



A109B018

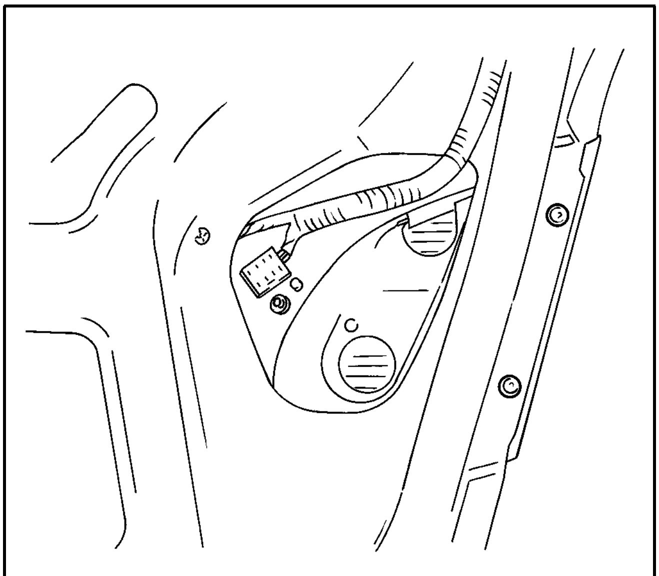
1. Disconnect the negative battery cable.
2. Open the luggage compartment lid.
3. Disconnect the electrical connector.
4. Remove the nuts and the bulb assembly from the lamp.



A109B019

5. Remove the nuts and the rear fog/backup lamp assembly from the rear deck lid.

Installation Procedure



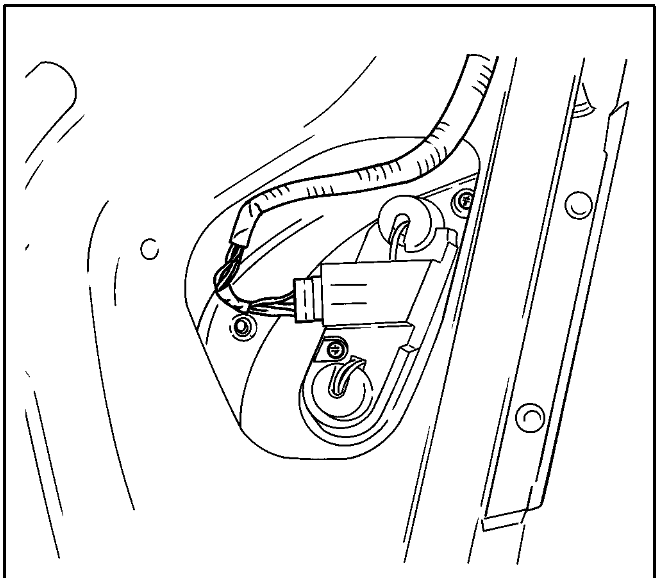
A109B019

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear fog/backup lamp assembly with the nuts.

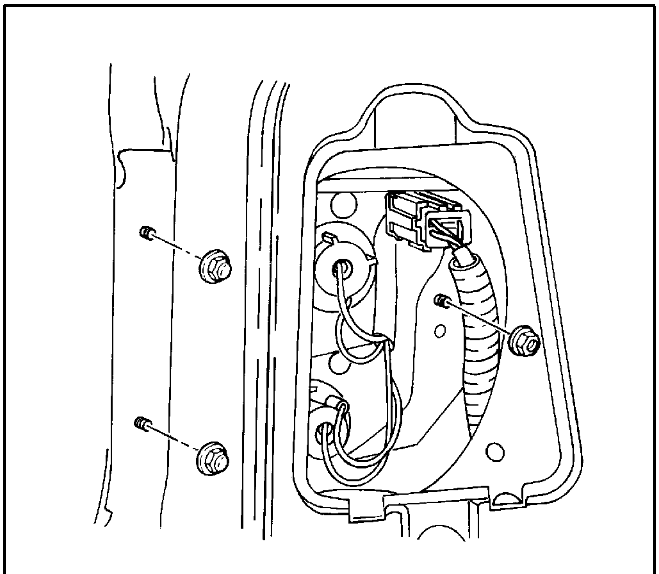
Tighten

Tighten the rear fog/backup lamp assembly nuts to 3 N•m (27 lb-in).



A109B018

2. Install the bulbs and the screws in the lamp assembly.
3. Connect the electrical connector.
4. Connect the negative battery cable.

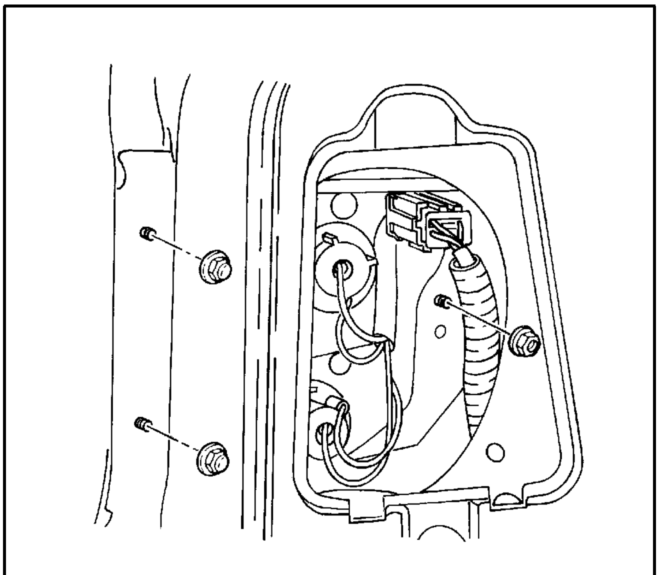


A309B012

REAR FOG/BACKUP LAMPS (HATCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Open the hatchback door.
3. Remove the rear fog/backup lamp access cover.
4. Remove the nuts and the rear fog/backup lamp assembly.
5. Disconnect the electrical connector.



A309B012

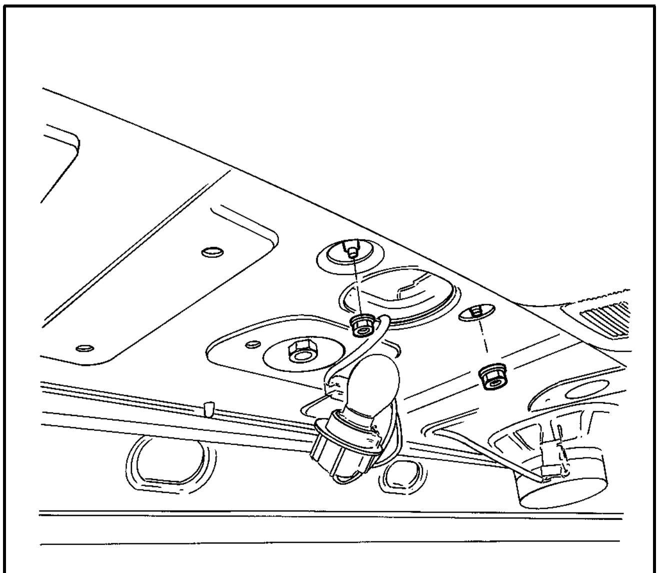
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear fog/backup lamp assembly with the nuts.

   ### Tighten

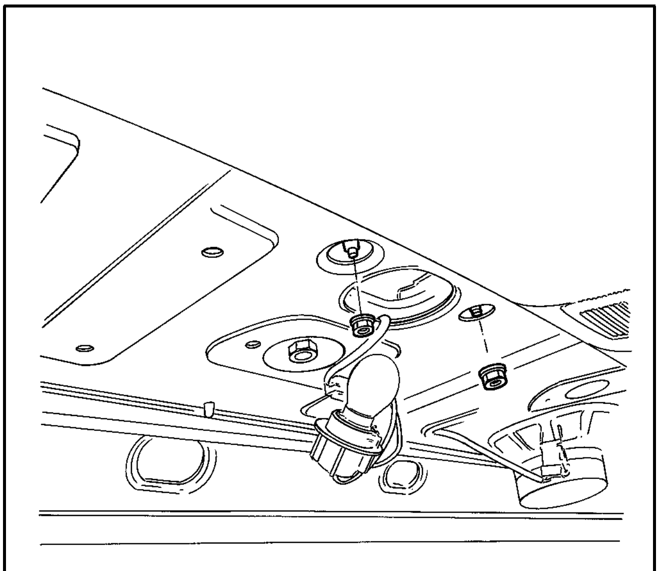
   Tighten the rear fog/backup lamp assembly nuts to 3 N•m (27lb-in).
2. Connect the electrical connector.
3. Install the rear fog/backup lamp access cover.
4. Connect the negative battery cable.


A209B002

CENTER HIGH-MOUNTED STOPLAMP (NOTCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Open the rear deck lid.
3. Remove the center high-mounted stoplamp (CHMSL) bulb.
4. Remove the nuts and the CHMSL.


A209B002

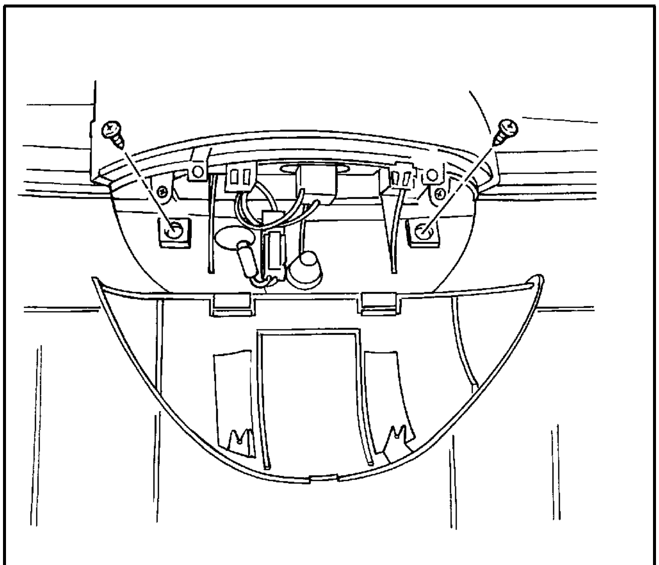
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the CHMSL with the nuts.

   Tighten

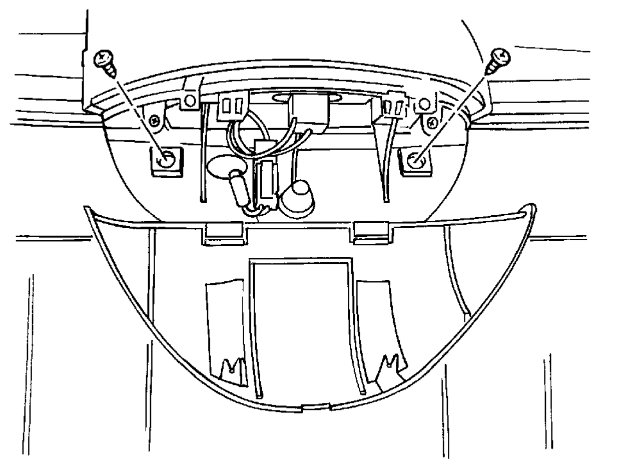
   Tighten the CHMSL mounting nuts to 3 N•m (27 lb-in).
2. Install the CHMSL bulb.
3. Connect the negative battery cable.


A309B013

CENTER HIGH-MOUNTED STOP LAMP (HATCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Open the hatchback door.
3. Pry open the CHMSL access cover with a screwdriver.
4. Disconnect the electrical connector.
5. Remove the screws and the CHMSL.


A309B013

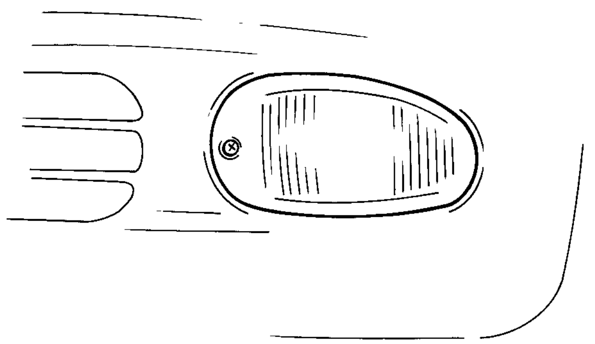
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the CHMSL with the screws.

   Tighten

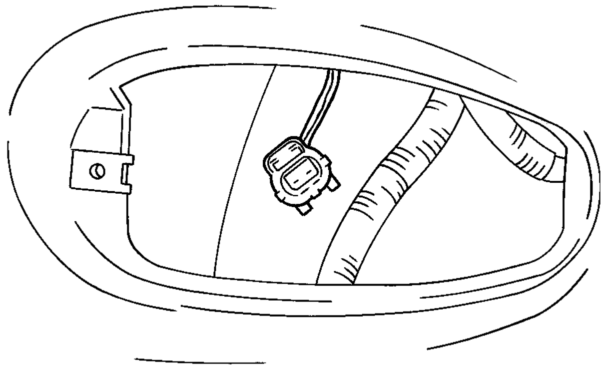
   Tighten the CHMSL mounting screws to 3 N•m (27 lb-in).
2. Connect the electrical connector.
3. Close the CHMSL access cover.
4. Connect the negative battery cable.


A109B001

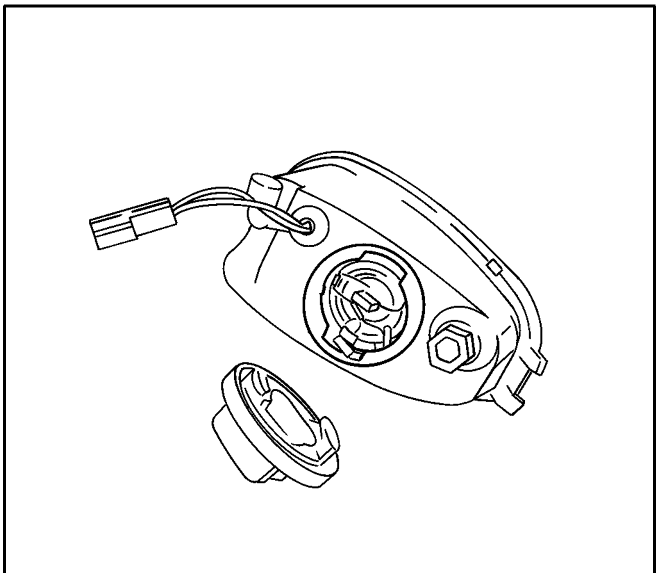
FRONT FOG LAMPS

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the screw securing the fog lamp assembly.

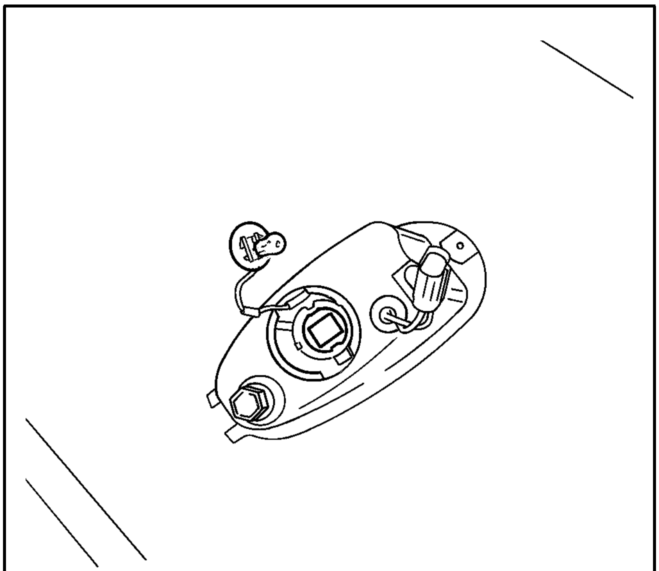

A109B002

3. Remove the fog lamp assembly.
4. Disconnect the electrical connector.



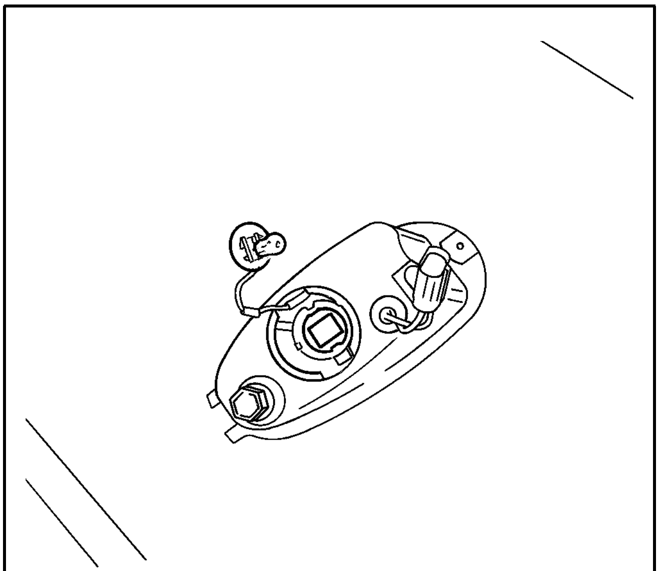
A109B003

5. Remove the fog lamp access cover.



A109B004

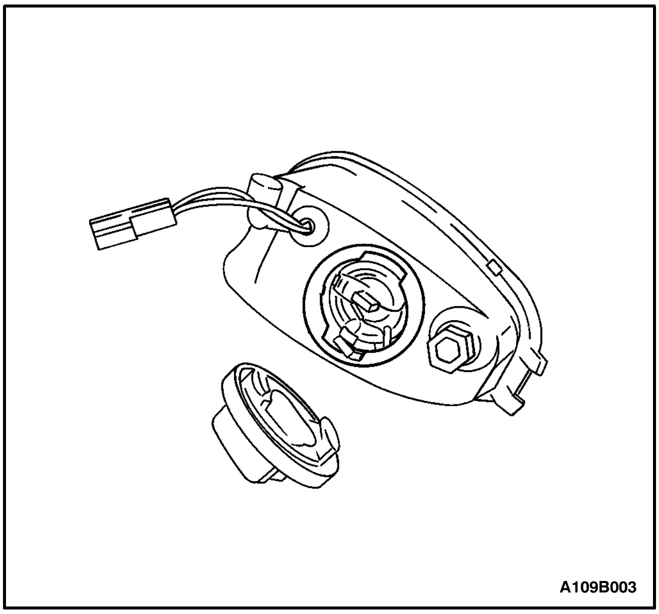
6. Remove the retaining wire.
7. Remove the bulb.



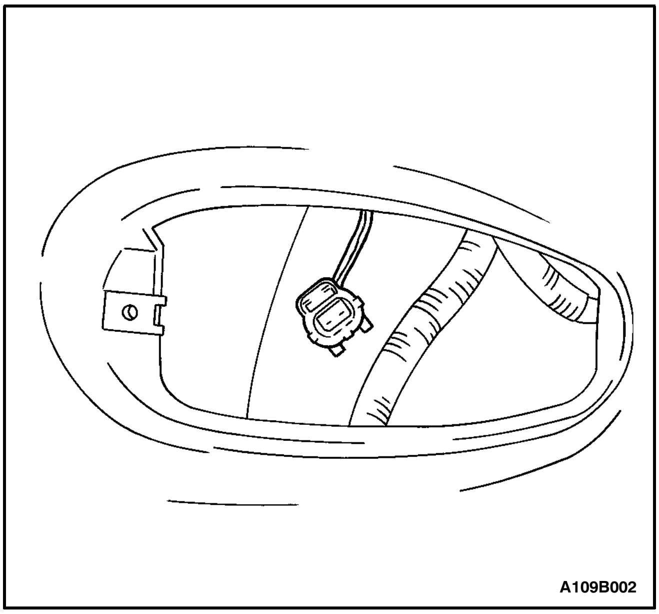
A109B004

Installation Procedure

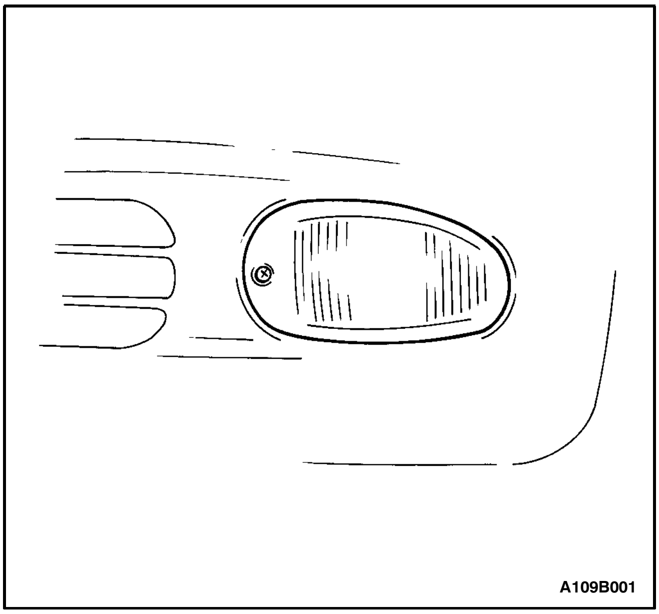
1. Install the bulb.



2. Install the retaining wire.
3. Install the fog lamp access cover.



4. Connect the electrical connector.



5. Install the fog lamp assembly.

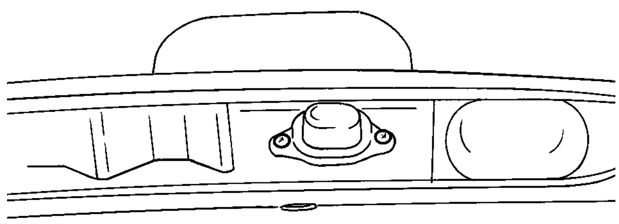
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

6. Secure the fog lamp assembly with the screw.

Tighten

Tighten the front fog lamp assembly screw to 3 N•m (27 lb-in).

7. Connect the negative battery cable.

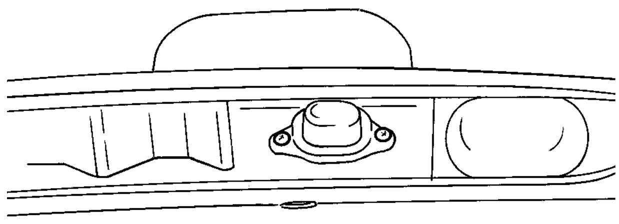

A109B005

LICENSE PLATE LAMP

(Typical)

Removal Procedure

1. Remove the screws.
2. Disconnect the electrical connector.
3. Remove the lamp assembly.
4. Remove the bulb.


A109B005

Installation Procedure

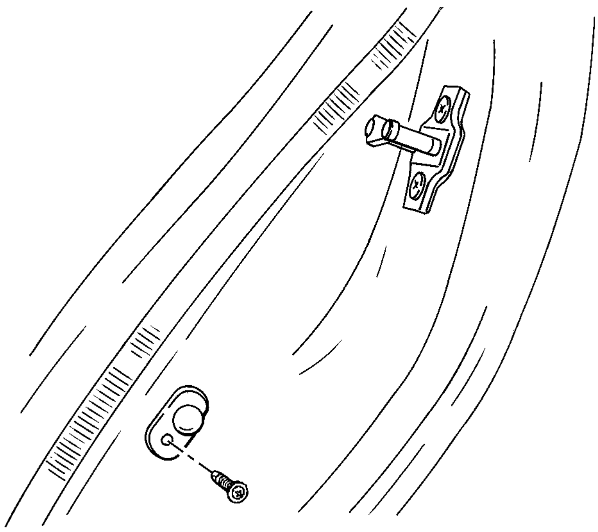
1. Install a new bulb.
2. Connect the electrical connector.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Install the lamp assembly with the screws.

   Tighten

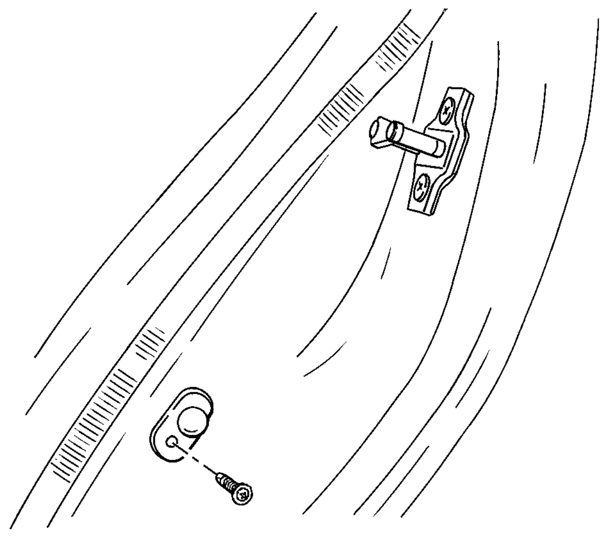
   Tighten the license plate lamp screws to 1.5 N•m (13 lb-in).


A309B007

DOOR JAMB SWITCH

Removal Procedure

1. Remove the screw and the door jamb switch.
2. Disconnect the electrical connector.


A309B007

Installation Procedure

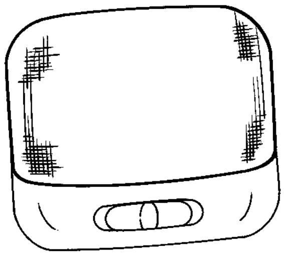
1. Connect the electrical connector.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the door jamb switch with the screw.

Tighten

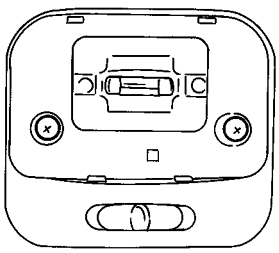
Tighten the door jamb switch screw to 4 N•m (35 lb-in).


A109B016

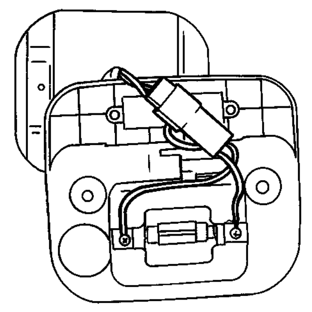
INTERIOR COURTESY LAMP

Removal Procedure

1. Disconnect the negative battery cable.
2. Pry off the courtesy lamp lens by inserting a screwdriver into the recess along the edge of the lens.

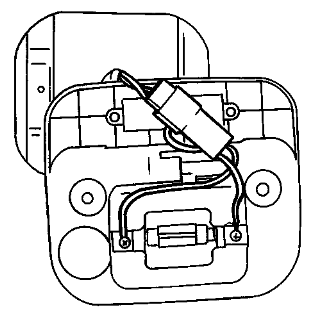

A109B014

3. Remove the screws and the courtesy lamp housing from the headliner.



A109B015

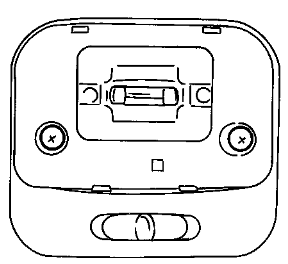
4. Disconnect the electrical connector.
5. Remove the bulb.



A109B015

Installation Procedure

1. Install a new bulb.
2. Connect the electrical connector.



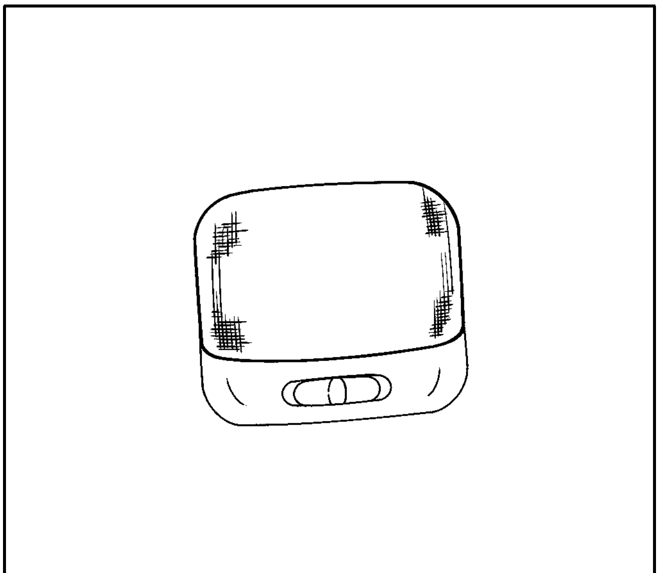
A109B014

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Install the courtesy lamp housing to the headliner with the screws.

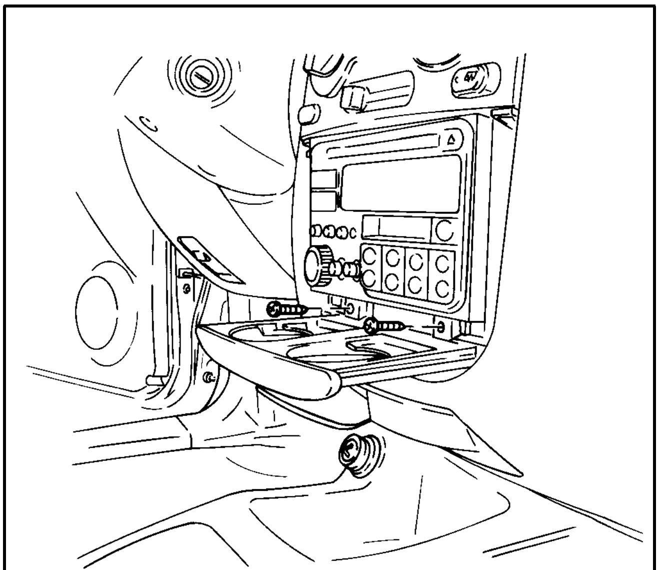
Tighten

Tighten the courtesy lamp housing screws to 2 N•m (18 lb-in).



A109B016

4. Press the courtesy lamp lens onto the housing.
5. Connect the negative battery cable.

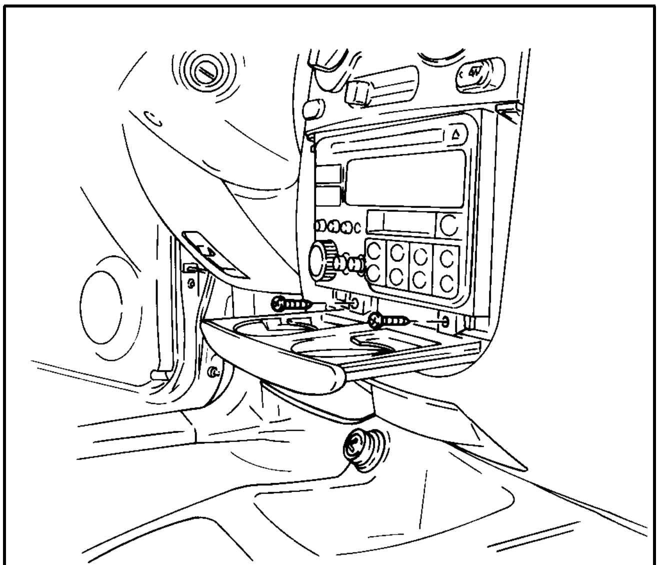


A309B010

ASHTRAY LAMP

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the audio system trim panel.
3. Remove the screws and the cupholder.
4. Remove the bulb from the ashtray housing.



A309B010

Installation Procedure

1. Install the bulb into the ashtray housing.

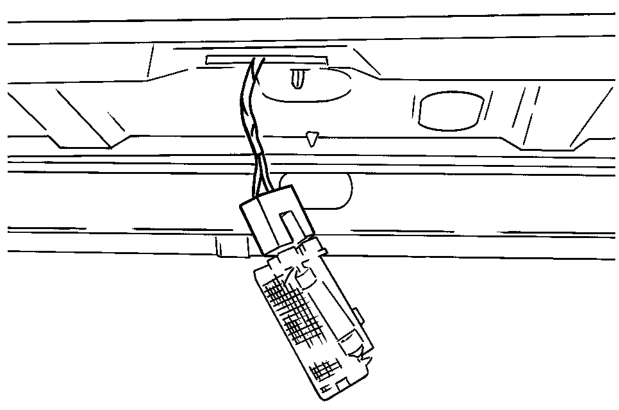
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the cupholder with the screws.

Tighten

Tighten the cupholder screws to 2.5 Nwm (22 lb-in).

3. Install the audio system trim panel.
4. Connect the negative battery cable.



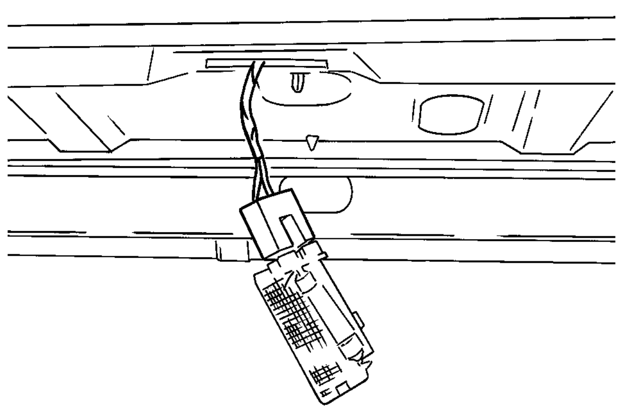
A109B017

LUGGAGE COMPARTMENT LAMP

(Typical)

Removal Procedure

1. Disconnect the negative battery cable.
2. Gently pry the luggage compartment lamp off by inserting a flathead screwdriver into the recess on the edge of the lamp.
3. Disconnect the electrical connector.
4. Remove the bulb.



A109B017

Installation Procedure

1. Install a new bulb.
2. Connect the electrical connector.
3. Insert the luggage compartment lamp into the recess and press the lens into place.
4. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

HEADLAMPS-ON REMINDER CHIME

When the headlamp switch is in the headlamps-on or parking lamps on position, voltage is applied to the audio alarm module. When the ignition switch is in ON, ACC or START, voltage is applied through the fuse block to the module. These two voltages are sensed, and the alarm assembly is not sounded.

When the ignition switch is not in ON, ACC or START, the module loses voltage. The audio alarm module senses change. If the voltage is still available, it is applied to sound the alarm. The alarm can be turned off by turning the headlamp switch off. The module no longer senses voltage from the headlamp switch, so the alarm assembly does not sound.

HEADLAMPS

The headlamps are controlled by the multifunction lever located on the left side of the steering column. They will come on with the ignition switch in any position. Turning the headlamp switch to the first position turns on the parking lamps, the license plate lamps and the instrument panel illumination. Turning the switch to the second position turns on all of the previous lamps and the headlamps. Turning the switch to the off position turns off all the lamps.

Headlamp high beams and low beams are also controlled by this lever. When the headlamps are on, pushing the lever away from the driver until the switch clicks changes the lamp from low beam to high beam. An indicator lamp on the instrument cluster assembly will come on when the high beam headlamps are on. To return the headlamps to low beam, pull the lever toward the driver.

The headlamps must be aimed for proper illumination of the road. Headlamp aim should be checked whenever a new headlamp assembly is installed, or whenever service repairs to the front end area may have disturbed the headlamp assembly or its mountings.

PARKING AND TURN SIGNAL LAMPS

The parking lamps can be turned on by turning the lighting switch to the first position. The parking lamps can be turned off by turning the switch to the off position.

When the turn signals are activated, the appropriate front, rear, and side turn signal lamps flash to signal a turn. The turn signal works only when the ignition switch is ON.

The turn signals are controlled by the light switch on the left side of the steering column. Moving the lever all the way up or down (past the detent) will turn on the front, rear, and side turn signals. When the turn is completed, the lever will return to horizontal and the turn signals will stop flashing.

For changing lanes, or for shallow turns in which the steering wheel does not turn far enough to cancel the signal, move the signal only to the first detent and hold it there. When the lever is released, it will return to horizontal and the turn signal will cancel.

FOG LAMPS

The front fog lamp switch is on the instrument panel to the right of the steering column. To use the front fog lamps, first turn on the headlamps or the parking lamps. Then push the fog lamp switch. The indicator light in the switch will illuminate to indicate that the fog lamps are on. Push the switch again to turn off the fog lamps. The indicator light will then go off.

The front fog lamps should not be used as a substitute for the headlamps.

The front fog lamps must be aimed for proper illumination of the road. Fog lamp aim should be checked when a new bulb is installed or if service or repairs in the front end area may have disturbed the fog lamp mountings.

The rear fog lamps are incorporated in the taillamp assembly and are controlled by the rear fog lamp switch on the multifunction lever on the left side of the steering column. The rear fog lamps can be turned on only when the front fog lamps or headlamps are on.

TAILLAMPS

The taillamps, stoplamps and turn signal lamps are one assembly.

Turning on either the headlamps or the parking lamps will also turn on the taillamps. When the brake pedal is pushed, the taillamps will glow brighter to serve as stoplamps.

The center high-mounted stoplamp is located in the rear window and will come on when the brake pedal is pressed.

LICENSE PLATE LAMP

The license plate lamps will come on when the headlamps or the parking lamps are on. The license plate lamps are mounted above the license plate.

INTERIOR COURTESY LAMP

The courtesy lamp is located on the headliner just behind the front seats. The lamp switch has three positions. If the switch is left in the center position, the lamp will go on whenever a door is opened and go off when it is closed. In the on position, the lamp will stay on until it is turned off. In the off position, the lamp will not come on, even when a door is opened.

ASHTRAY LAMP

An ashtray lamp is mounted above the ashtray and will come on when the parking lamps or the headlamps are turned on.

LUGGAGE COMPARTMENT LAMP

The luggage compartment lamp is located under the deck lid sill plate on the notchback. The lamp is located on the left-side wheelhouse trim panel on the hatchback. It will come on whenever the luggage compartment is opened.

BACKUP LAMPS

The backup lamps are located on the inside of the rear deck lid. They will come on when the transaxle is shifted into reverse. On a vehicle with an automatic transaxle, the backup lamps are activated by the neutral safety backup (NSBU) switch. On a vehicle with a manual transaxle, they are activated by a reverse switch which is part of the transaxle.

SECTION 9C

HORN

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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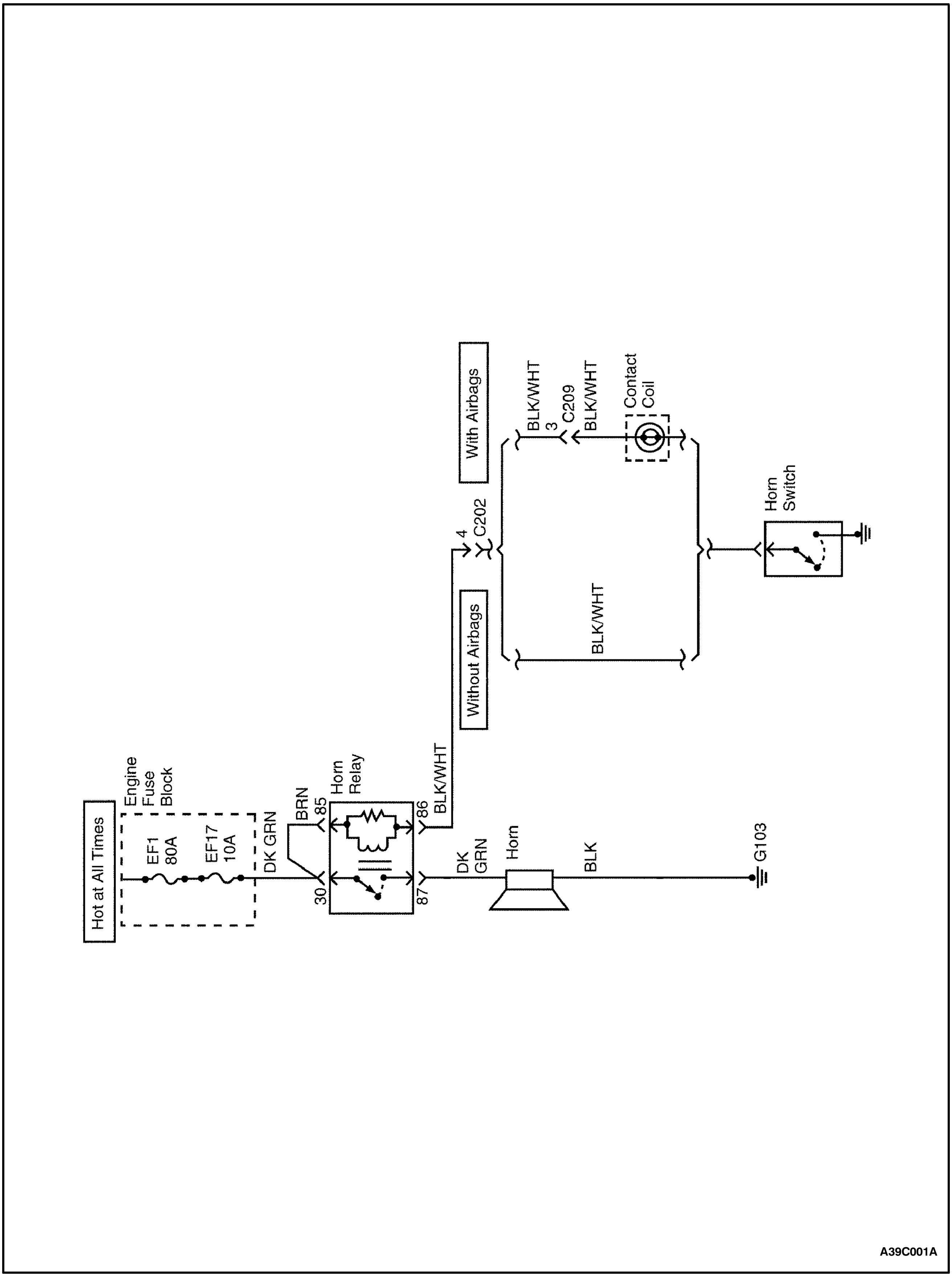
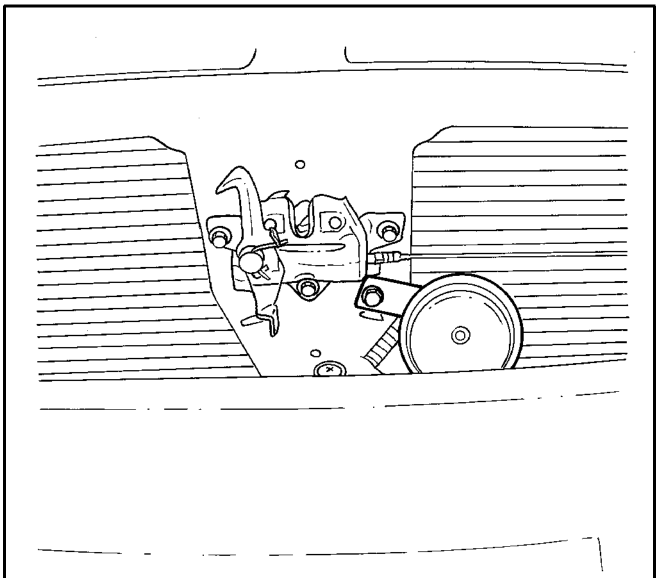
HORN WIRING SYSTEM





A109C002

MAINTENANCE AND REPAIR

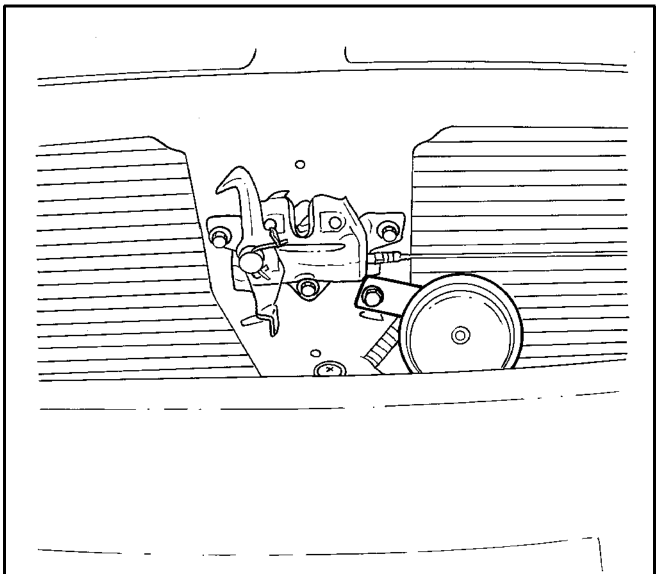
ON-VEHICLE SERVICE

HORN

(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the bolt from the horn.
3. Disconnect the electrical connector.
4. Remove the horn.



A109C002

Installation Procedure

1. Connect the electrical connector.
2. Install the horn with the bolt.

   Tighten

   Tighten the horn bolt to 9 N•m (80 lb-in).
3. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

HORN

A horn is located under the hood. It is attached near the radiator at the front of the vehicle. The horn is actuated by pressing the steering wheel pad, which grounds the horn' electrical circuit.

SECTION 9D

WIPERS / WASHER SYSTEMS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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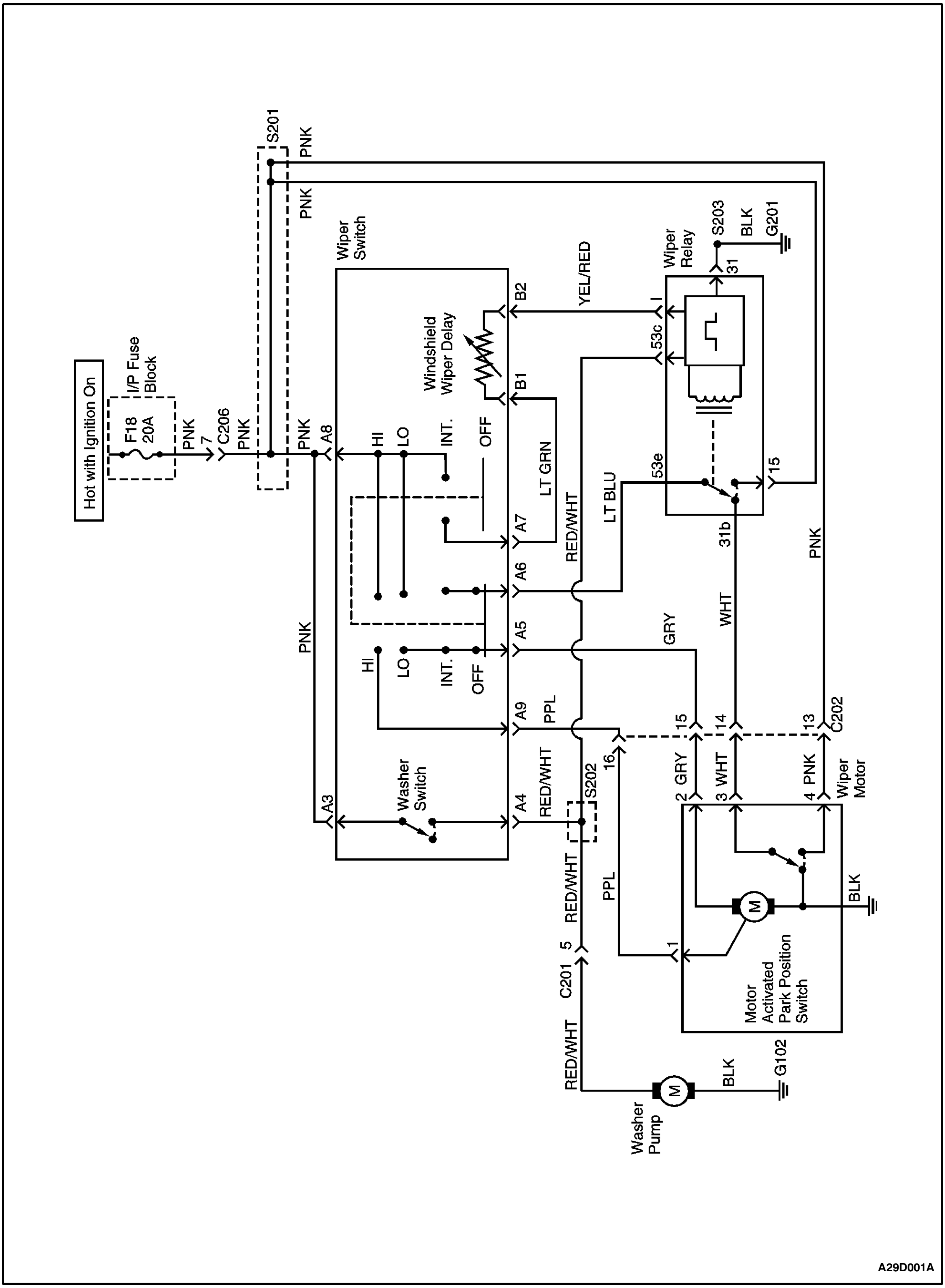
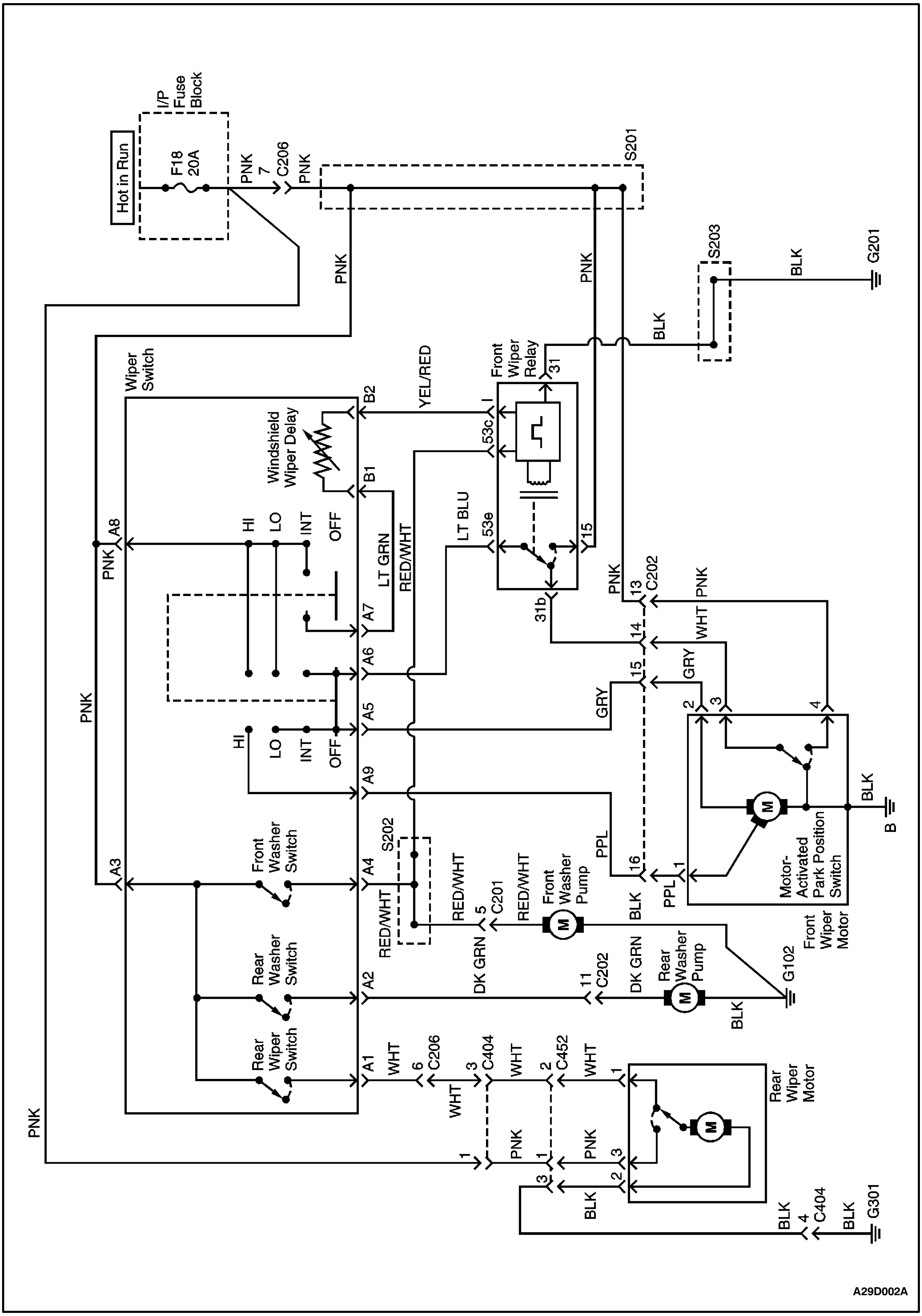
SCHEMATIC AND ROUTING DIAGRAMS

WINDSHIELD WIPERS AND WASHER SYSTEM



REAR WINDOW WIPER AND WASHER SYSTEM



DIAGNOSIS

INTERMITTENT WINDSHIELD WIPERS

Windshield Wipers Do Not Work At Any Speed

Step	Action	Value(s)	Yes	No
1	Check fuse F18. Is fuse F18 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Check the battery voltage at fuse F18. Is battery voltage available at fuse F18?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open in the power supply circuit to fuse F18. Is the repair complete?	-	System OK	-
5	1. Turn the ignition ON. 2. Turn the wiper switch to HI. Is battery voltage available at wiper motor connector terminal 1?	11-14 v	Go to Step 6	Go to Step 7
6	Replace the faulty wiper motor. Is the repair complete?	-	System OK	-
7	1. Disconnect the wiper switch connector. 2. Turn the ignition ON. 3. With a voltmeter, check for battery voltage at connector terminal 8. Is battery voltage available at the wiper switch connector terminal 8?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between wiper switch connector terminal 8 and fuse F18. Is the repair complete?	-	System OK	-
9	1. Use an ohmmeter to test the continuity of the wiper switch. 2. Turn the wiper switch to HI. Check for continuity between wiper switch terminal 8 and 9. Is there continuity between terminals 8 and 9?	0 W	Go to Step 11	Go to Step 10
10	Replace the faulty wiper switch. Is the repair complete?	-	System OK	-
11	Repair the open circuit between the wiper switch and the wiper motor. Is the repair complete?	-	System OK	-

Wipers Do Not Work On HI Speed, LO Speed OK

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Turn the wiper switch to HI. Is battery voltage available at wiper motor connector terminal 1?	11-14 v	Go to Step 2	Go to Step 3
2	Replace the faulty wiper motor. Is the repair complete?	-	System OK	-
3	1. Use an ohmmeter to test the continuity of the wiper switch. 2. Turn the wiper switch to HI. Check for continuity between the wiper switch terminal 8 and 9. Is there continuity between terminals 8 and 9?	0 W	Go to Step 5	Go to Step 4
4	Replace the faulty wiper switch. Is the repair complete?	-	System OK	-
5	Repair the open circuit between wiper switch connector terminal 9 and wiper motor connector terminal 1. Is the repair complete?	-	System OK	-

Wipers Do Not Work On LO Speed, HI Speed OK

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Turn the wiper switch to LO. Is battery voltage available at wiper motor connector terminal 2?	11-14 v	Go to Step 2	Go to Step 3
2	Replace the faulty wiper motor. Is the repair complete?	-	System OK	-
3	1. Use an ohmmeter to test the continuity of the wiper switch. 2. Turn the wiper switch to LO. Check for continuity between the wiper switch terminal 8 and 5. Is there continuity between terminals 8 and 5?	0 W	Go to Step 5	Go to Step 4
4	Replace the faulty wiper switch. Is the repair complete?	-	System OK	-
5	Repair the open circuit between the wiper switch connector terminal 5 and the wiper motor connector terminal 2. Is the repair complete?	-	System OK	-

Wipers Do Not Work On Intermittent, Other Speeds OK

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Use a voltmeter to test for battery voltage at the wiper relay connector terminal 15. Is battery voltage available at connector terminal 15?	11-14 v	Go to Step 3	Go to Step 2
2	Repair the open circuit between the wiper relay connector terminal 15 and fuse F18. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON 2. Turn the wiper switch to INT. Using a voltmeter, is battery voltage available at the wiper relay connector terminal I?	11-14 v	Go to Step 7	Go to Step 4
4	1. Turn the ignition ON. 2. Turn the wiper switch to INT. Using a voltmeter, is battery voltage available at wiper switch connector terminal A7?	11-14 v	Go to Step 6	Go to Step 5
5	Replace the wiper switch. Is the repair complete?	-	System OK	-
6	Repair the open circuit between the wiper switch connector terminal A7 and the wiper relay connector terminal I. Is the repair complete?	-	System OK	-
7	1. Turn the ignition ON. 2. Turn the wiper switch to INT. Using a voltmeter, is battery voltage pulsing at wiper relay connector terminal 53e?	11-14 v	Go to Step 11	Go to Step 8
8	Using an ohmmeter, check the wiper relay ground circuit (connector terminal 31). Is the ground circuit OK?	0 W	Go to Step 10	Go to Step 9
9	Repair the open ground circuit. Is the repair complete?	-	System OK	-
10	Replace the wiper relay. Is the repair complete?	-	System OK	-
11	1. Disconnect the wiper switch connector. 2. Turn the wiper switch to INT. 3. Using an ohmmeter, check the wiper switch. Is there continuity between terminals A5 and A6?	0 W	Go to Step 13	Go to Step 12
12	Replace the faulty wiper switch. Is the repair complete?	-	System OK	-
13	Repair the open circuit between the wiper switch and the wiper relay. Is the repair complete?	-	System OK	-

Windshield Wipers Do Not Return To Park Position

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Use a voltmeter to test the battery voltage at the wiper motor. Is battery voltage available at wiper motor connector terminal 4?	11-14 v	Go to Step 3	Go to Step 2
2	Repair the open circuit between the wiper motor and fuse F18.	-	System OK	-
3	1. Turn the ignition ON 2. Turn the wiper switch to HI. 3. Use a voltmeter to test for a pulse of battery power at the wiper motor when turning the wiper switch OFF. Is a pulse of battery voltage available at the wiper motor connector terminal 3 when the wiper switch is turned OFF?	11-14 v	Go to Step 5	Go to Step 4
4	Replace the faulty wiper motor. Is the repair complete?	-	System OK	-
5	1. Turn the ignition ON. 2. Turn the wiper switch to HI. 3. Use a voltmeter to test for a pulse of battery power at the wiper relay when turning the wiper switch OFF. Is a pulse of battery voltage available at the wiper relay connector terminal 31b when the wiper switch is turned OFF?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the wiper motor and the wiper relay. Is the repair complete?	-	System OK	-
7	1. Disconnect the wiper relay from the connector. 2. Use an ohmmeter to test the continuity of the relay. Is there continuity between wiper relay connector terminals 31b and 53e?	0 W	Go to Step 9	Go to Step 8
8	Replace the faulty wiper relay. Is the repair complete?	-	System OK	-
9	Replace the faulty wiper switch. Is the repair complete?	-	System OK	-

WINDSHIELD WASHER SYSTEM

Windshield Washer Does Not Work, Wipers Are OK

Step	Action	Value(s)	Yes	No
1	Do the windshield wipers operate when the washer switch is activated?	-	Go to Step 4	Go to Step 2
2	1. Turn the ignition ON. 2. While activating the washer switch, use a voltmeter to test for battery voltage at the windshield wiper switch. Is battery voltage available at the windshield wiper switch connector terminal 4?	11-14 v	Go to Step 8	Go to Step 3
3	Replace the windshield wiper switch. Is the repair complete?	-	System OK	-
4	Is there washer fluid in the windshield washer fluid reservoir?	-	Go to Step 6	Go to Step 5
5	Fill the windshield washer fluid reservoir. Is the repair complete?	-	System OK	-
6	Are the windshield washer hoses or the nozzles clogged or damaged?	-	Go to Step 7	Go to Step 8
7	Repair the washer hoses and the nozzles. Is the repair complete?	-	System OK	-
8	1. Turn the ignition ON. 2. With the windshield washer activated, use a voltmeter to test for battery voltage at the windshield washer pump. Is battery voltage available at the windshield washer pump ?	11-14 v	Go to Step 10	Go to Step 9
9	Repair the open circuit between the windshield washer pump and the windshield wiper switch. Is the repair complete?	-	System OK	-
10	Use an ohmmeter to check the ground circuit at the windshield washer pump. Is the ground circuit OK?	0 W	Go to Step 12	Go to Step 11
11	Repair the windshield washer pump ground circuit. Is the repair complete?	-	System OK	-
12	Replace the windshield washer pump. Is the repair complete?	-	System OK	-

REAR WINDOW WIPER (HATCHBACK)

Diagnostic Aids

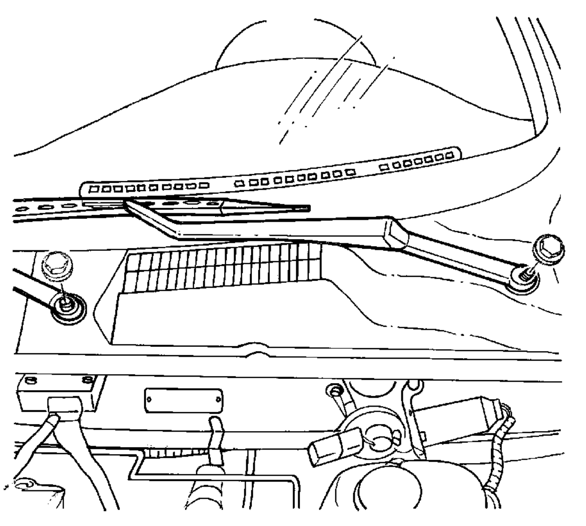
If the front wiper is operating correctly, begin the diagnostic table at Step 5. It would not be necessary to check the fuse or power supply circuit.

Rear Window Wiper (Hatchback)

Step	Action	Value	Yes	No
1	Check fuse F18. Is fuse F18 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace fuse F18. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Check the voltage at fuse F18. Does the voltage equal the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit for fuse F18. Is the repair complete?	-	System OK	-
5	1. Disconnect the rear wiper motor electrical connector. 2. Turn the ignition ON. 3. Check the voltage at the PNK wire of the rear wiper motor electrical connector. Does the voltage equal the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit for the PNK wire between fuse F18 and connector at the rear wiper motor. Is the repair complete?	-	System OK	-
7	With the rear wiper motor still disconnected, use an ohmmeter to check continuity between ground and the BLK wire of the rear wiper motor connector. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 9	Go to Step 8
8	Repair the open ground circuit for the rear wiper motor. Is the repair complete?	-	System OK	-
9	1. Turn the ignition ON. 2. Turn the rear wiper ON. 3. Check the voltage at the WHT wire at the rear wiper motor connector. Does the voltmeter indicate the specified value?	11-14 v	Go to Step 10	Go to Step 11
10	Replace the rear wiper motor. Is the repair complete?	-	System OK	-
11	1. Disconnect the wiper switch electrical connector. 2. Turn the ignition ON. 3. Check the voltage at terminal 3 (PNK). Is the voltage equal to the specified value?	11-14 v	Go to Step 13	Go to Step 12
12	Repair the open circuit between fuse F18 and the wiper switch connector terminal 3. Is the repair complete?	-	System OK	-
13	1. Connect an ohmmeter between terminals 1 and 3 of the wiper switch. 2. Observe the ohmmeter when the rear wiper switch is moved to the WIPE position. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 14	Go to Step 15
14	Repair the open circuit between terminal 1 of the wiper connector (WHT wire) and the rear wiper motor. Is the repair complete?	-	System OK	-
15	Replace the wiper switch. Is the repair complete?	-	System OK	-

REAR WINDOW WASHER SYSTEM (HATCHBACK)

Step	Action	Value	Yes	No
1	Check the washer fluid level. Is there fluid in the washer reservoir?	-	Go to Step 3	Go to Step 2
2	Fill the washer reservoir. Is the repair complete?	-	System OK	-
3	Verify that the hoses are not obstructed or leaking by disconnecting the washer hose and blowing through it toward the reservoir and also toward the nozzle. Are the hoses obstructed or leaking?	-	Go to Step 4	Go to Step 5
4	Repair or replace the hoses. Is the repair complete?	-	System OK	-
5	Check the function of the rear wiper. Does the rear wiper function correctly?	-	Go to Step 7	Go to Step 6
6	Repair the rear wiper before proceeding with this diagnostic table. Is the rear wiper repair complete?	-	Go to Step 7	-
7	1. Disconnect the electrical connector at the rear washer pump. 2. Use an ohmmeter to check continuity between the BLK wire of the rear washer pump connector and ground. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 9	Go to Step 8
8	Repair the open or the high-resistance ground connection. Is the repair complete?	-	System OK	-
9	Check the voltage at the rear washer pump connector (DK GRN wire) when the rear washer is turned ON. Is the voltage equal to the specified value?	11-14 v	Go to Step 10	Go to Step 11
10	Replace the rear washer pump. Is the repair complete?	-	System OK	-
11	1. Disconnect the wiper switch. 2. Connect an ohmmeter between terminal 2 and terminal 3 of the wiper switch. 3. Observe the ohmmeter when the switch is moved to the rear WASH position. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 12	Go to Step 13
12	Repair the open circuit between terminal 2 of the wiper switch connector and the rear washer pump. Is the repair complete?	-	System OK	-
13	Replace the wiper switch. Is the repair complete?	-	System OK	-



A309R001

MAINTENANCE AND REPAIR

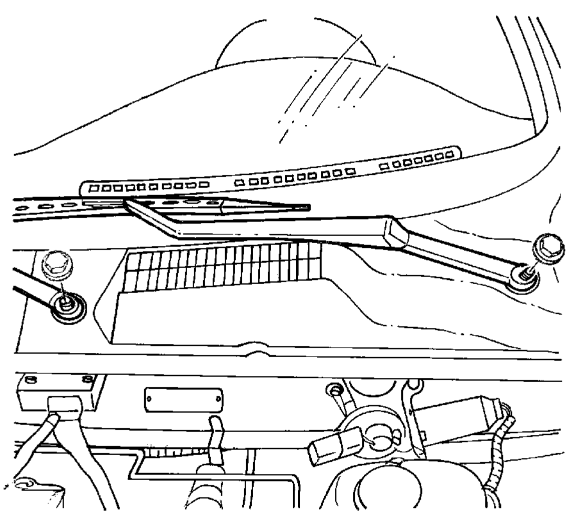
ON-VEHICLE SERVICE

WINDSHIELD WIPER ARM

(Typical)

Removal Procedure

1. Open the hood.
2. Remove the nut from the wiper arm.
3. Pull the wiper arm off.



A309R001

Installation Procedure

1. Install the wiper arm.

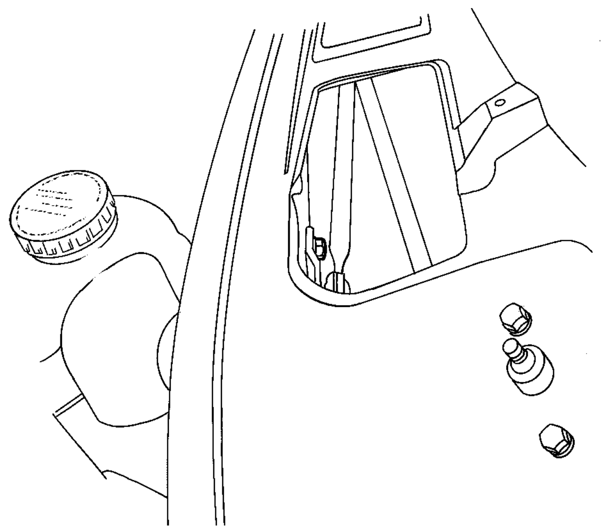
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Secure the wiper arm with the nut.

   Tighten

   Tighten the wiper arm nut to 11 N•m (97 lb-in).

3. Close the hood.



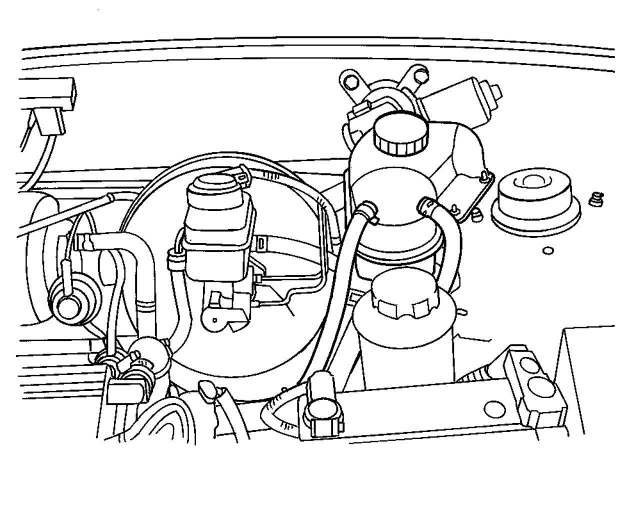
A109D003

WINDSHIELD WIPER MOTOR

(Typical)

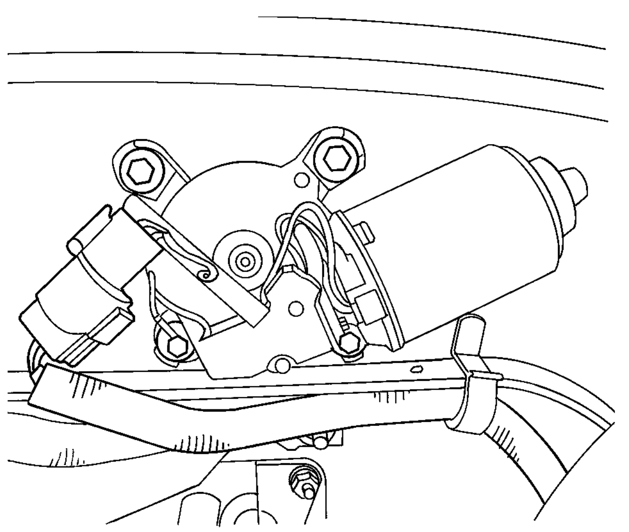
Removal Procedure

1. Disconnect the negative battery cable.
2. Put the wiper arms in the upright position.
3. Remove the left side portion of the cowl vent grille. Refer to Section 9R, Body Front End.
4. Remove the nut securing the wiper arm linkage to the motor drive shaft.



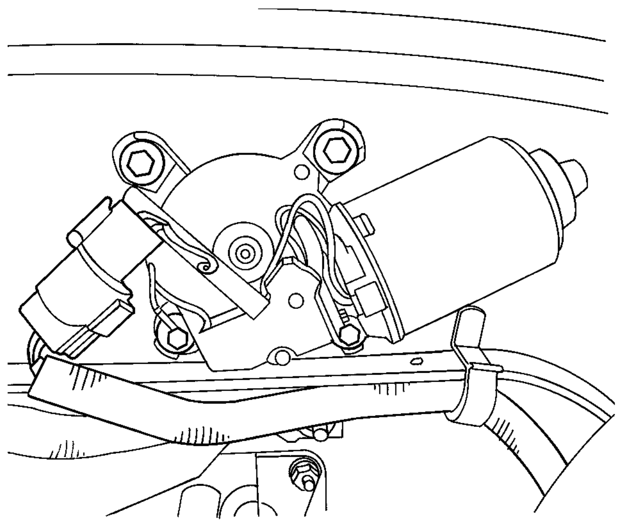
A109D011

5. Pry the wiper arm linkage off the motor drive shaft.
6. Remove the nuts and reposition the engine coolant reservoir.



A109D004

7. Disconnect the electrical connectors.
8. Remove the bolts and the wiper motor.



A109D004

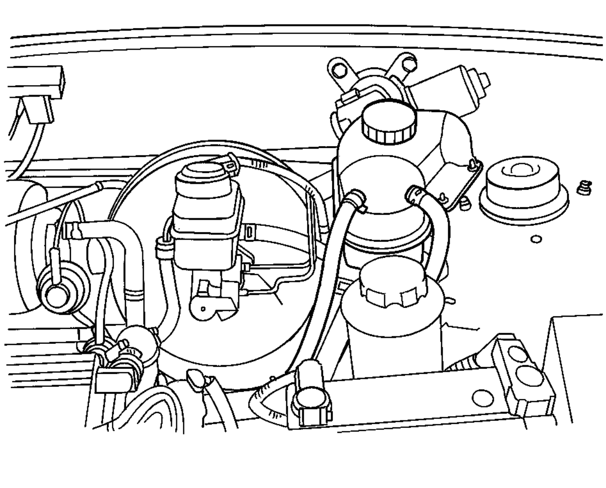
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the wiper motor with the bolts.

   ### Tighten

   Tighten the wiper motor bolts to 9 N•m (80 lb-in).
2. Connect the electrical connectors.

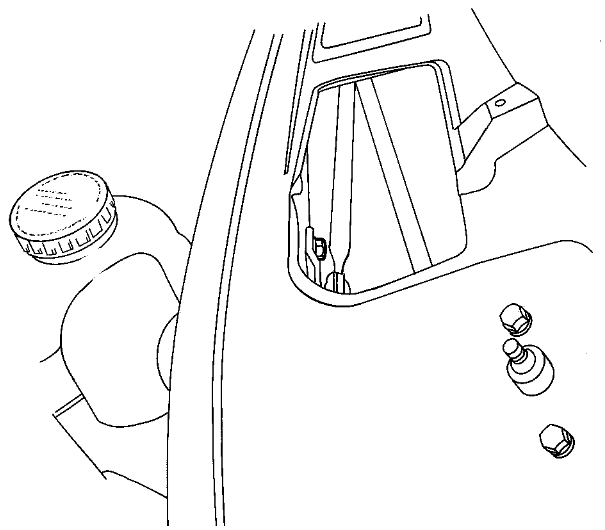


A109D011

3. Install the engine coolant reservoir with the nuts.

Tighten

Tighten the engine coolant reservoir nuts to 4 N•m (35 lb-in).



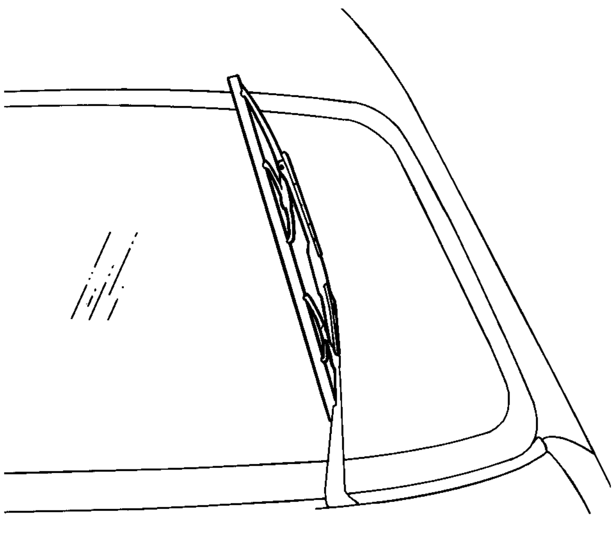
A109D003

4. Press the wiper arm linkage onto the motor drive shaft.
5. Install the wiper arm linkage to the motor drive shaft with the nut.

Tighten

Tighten the wiper arm linkage nut to 8.5 N•m (76 lb-in).

6. Install the left side portion of the cowl vent grille. Refer to Section 9R, Body Front End.
7. Connect the negative battery cable.



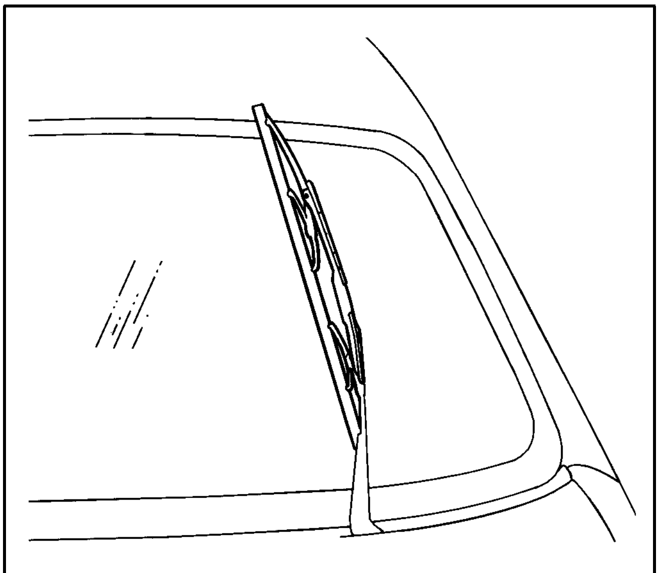
A109D007

WINDSHIELD WIPER BLADE

(Typical)

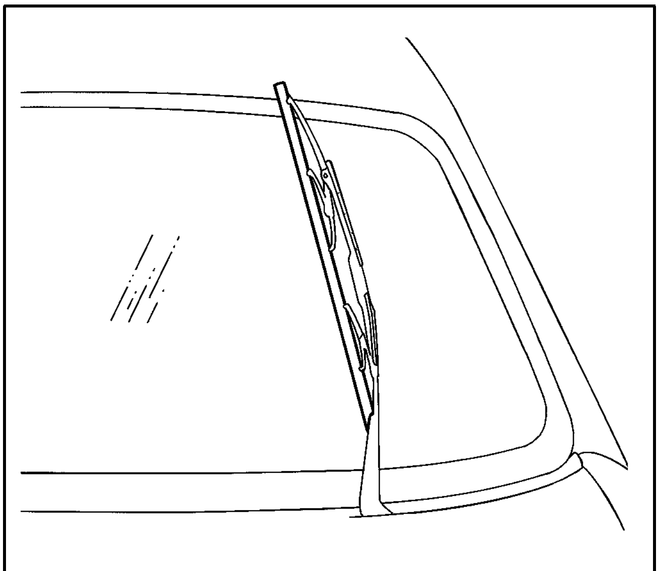
Removal Procedure

1. Rotate the wiper blade on the arm.
2. Pull the wiper blade off the arm.


A109D007

Installation Procedure

1. Push the wiper blade onto the arm.

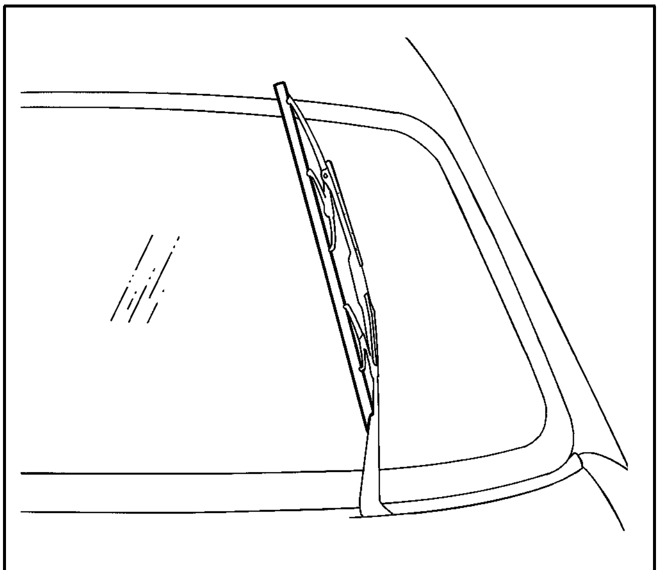

A109D006

WINDSHIELD WIPER BLADE INSERT

(Typical)

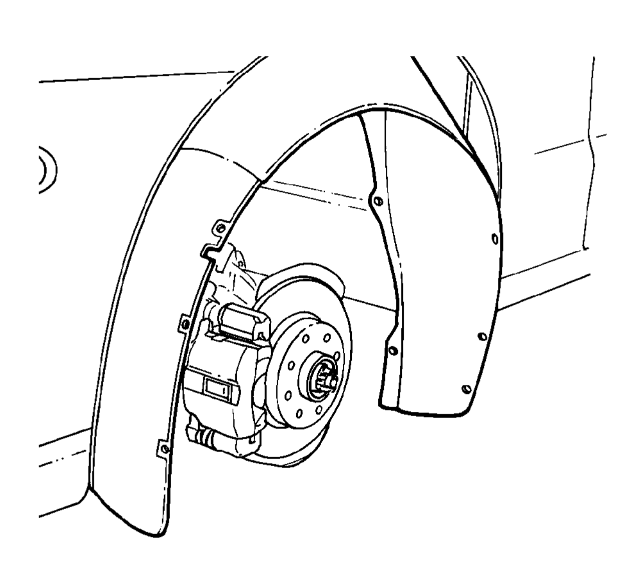
Removal Procedure

1. Slide the insert out of the wiper blade.


A109D006

Installation Procedure

1. Slide the insert into the wiper blade.



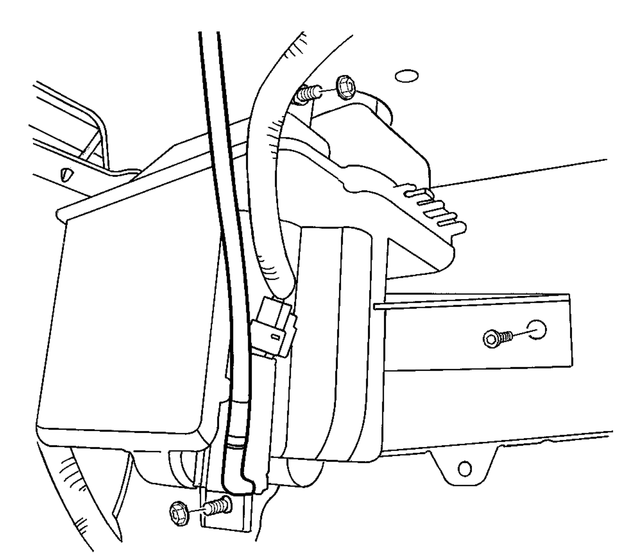
A109R002

WINDSHIELD WASHER RESERVOIR

(Typical)

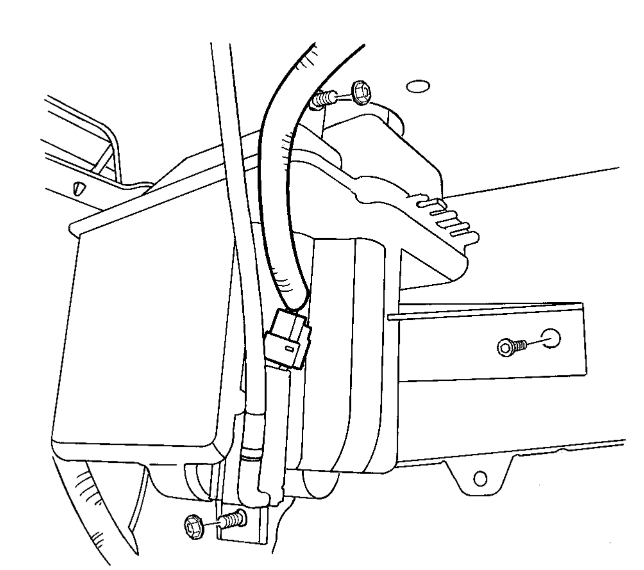
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the front left wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the screws and the front wheel well splash shield.



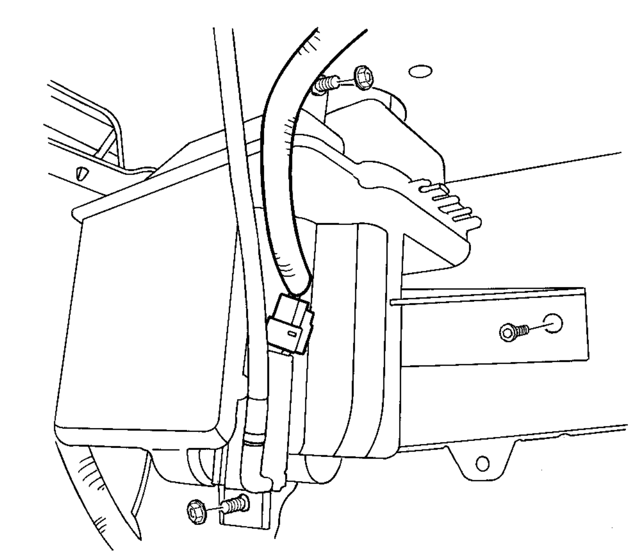
A309D003

4. Disconnect the washer hose(s) from the reservoir.



A309D004

5. Disconnect the reservoir pump electrical connector(s).
6. Remove the bolts, the nuts and the reservoir.



A309D004

Installation Procedure

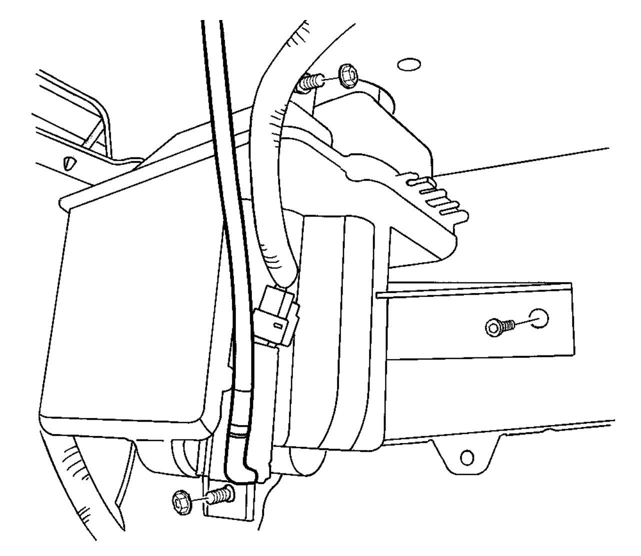
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the reservoir with the nuts and the bolts.

   Tighten

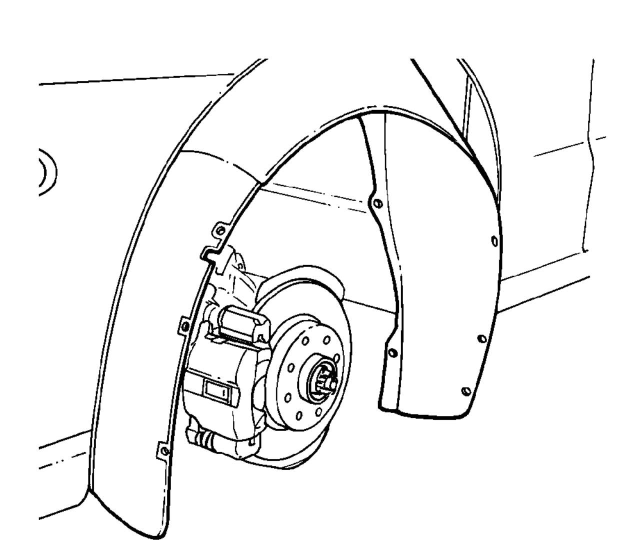
   Tighten the washer fluid reservoir nuts to 20 N•m (15 lb-ft).

   Tighten the washer fluid reservoir bolts to 20 N•m (15 lb-ft).
2. Connect the reservoir pump electrical connector(s).



A309D003

3. Connect the washer hose(s) to the reservoir.

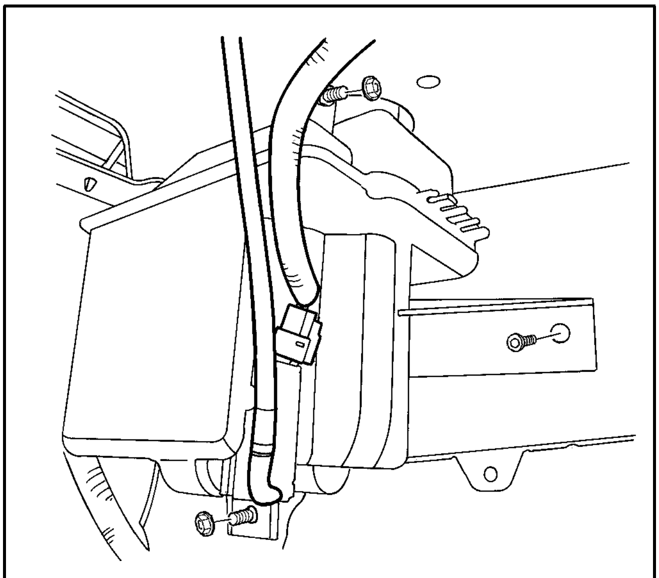


A109R002

4. Install the front wheel well splash shield with the screws.

   Tighten

   Tighten the front wheel well splash shield screws to 1.5 N•m (13 lb-in).
5. Install the front left wheel. Refer to Section 2E, Tires and Wheels.
6. Connect the negative battery cable.

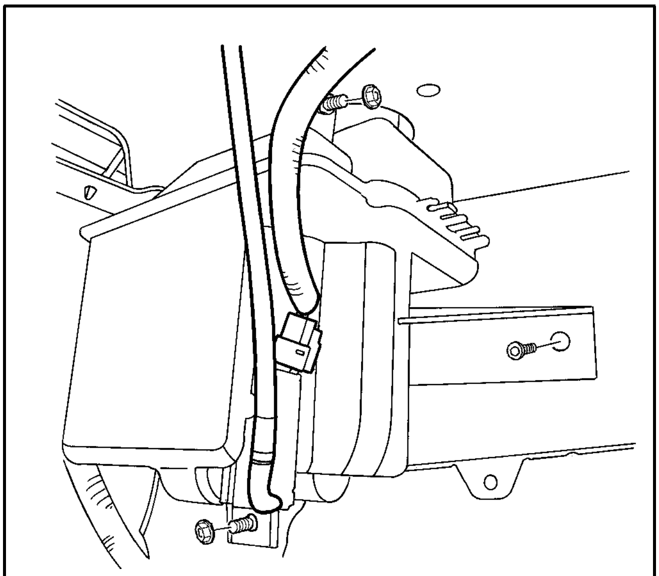

A309D005

WINDSHIELD WASHER PUMP(S)

(Typical)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the front left wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the screws and the front wheel well splash shield.
4. Disconnect the electrical connector.
5. Disconnect the washer hose.
6. Remove the washer pump.


A309D005

Installation Procedure

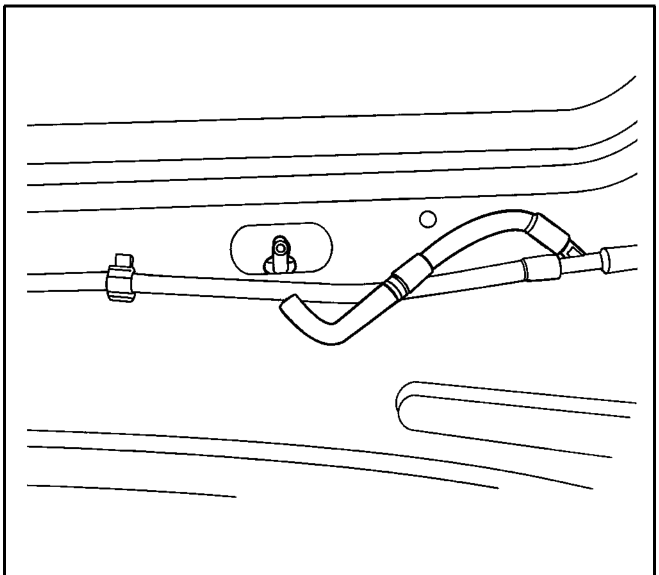
1. Install the washer pump.
2. Connect the washer hose.
3. Connect the electrical connector.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Install the front wheel well splash shield with the screws.

   Tighten

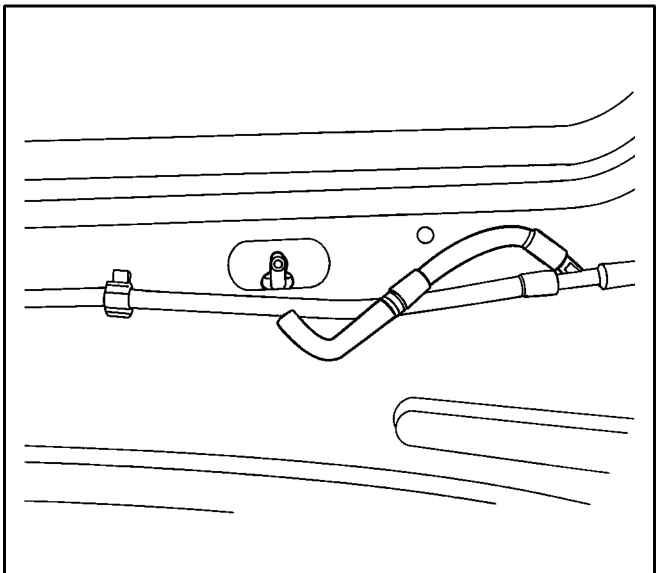
   Tighten the front wheel well splash shield screws to 1.5 N•m (13 lb-in).
5. Install the front left wheel. Refer to Section 2E, Tires and Wheels.
6. Connect the negative battery cable.


A109D009

WINDSHIELD WASHER NOZZLES

Removal Procedure

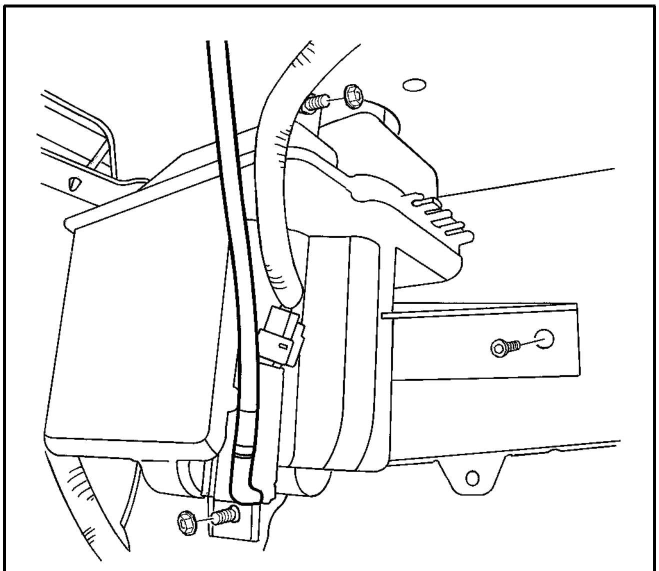
1. Open the hood.
2. Disconnect the washer hose from the nozzle.
3. Remove the nozzle from the hood.



A109D009

Installation Procedure

1. Install the nozzle onto the hood.
2. Connect the washer hose to the nozzle.
3. Close the hood.

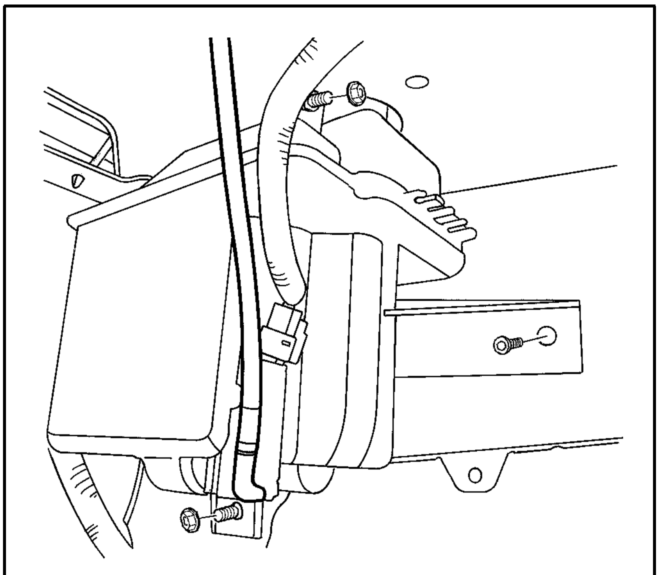


A309D003

WINDSHIELD WASHER HOSES

Removal Procedure

1. Open the hood.
2. Disconnect the windshield washer hose from the washer nozzles on the hood.
3. Remove the front left wheel. Refer to Section 2E, Tires and Wheels.
4. Remove the screws and the front wheel well splash shield.
5. Disconnect the washer hose from the washer reservoir.



A309D003

Installation Procedure

1. Connect the washer hose to the washer reservoir.

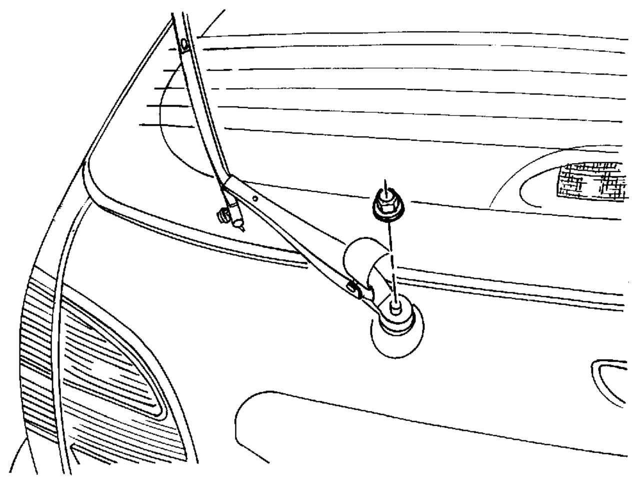
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the front wheel well splash shield with the screws.

   #### Tighten

   Tighten the wheel well splash shield screws to 1.5 N•m (13 lb-in).

3. Install the front left wheel. Refer to Section 2E, Tires and Wheels.
4. Connect the windshield washer hose to the washer nozzles on the hood.
5. Close the hood.

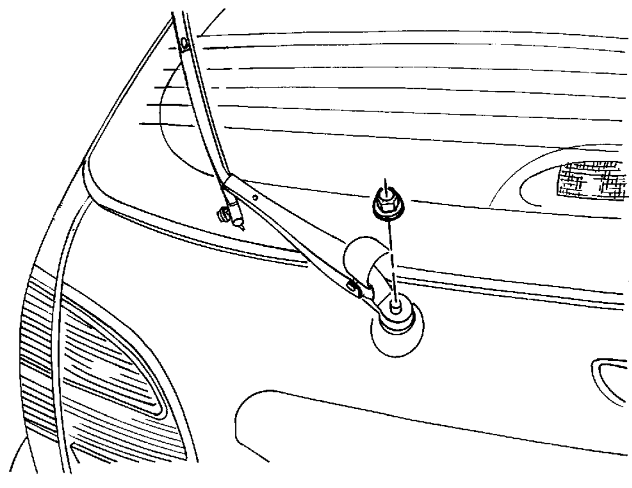


A309D006

REAR WINDOW WIPER ARM

Removal Procedure

1. Open the wiper arm access cap.
2. Remove the nut and the rear wiper arm.



A309D006

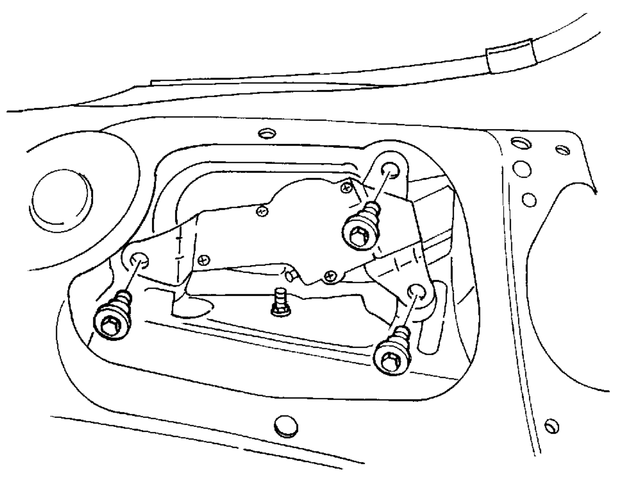
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear wiper arm with the nut.

   Tighten

   Tighten the wiper arm nut to 11 N•m (97 lb-in).
2. Close the wiper arm access cap.

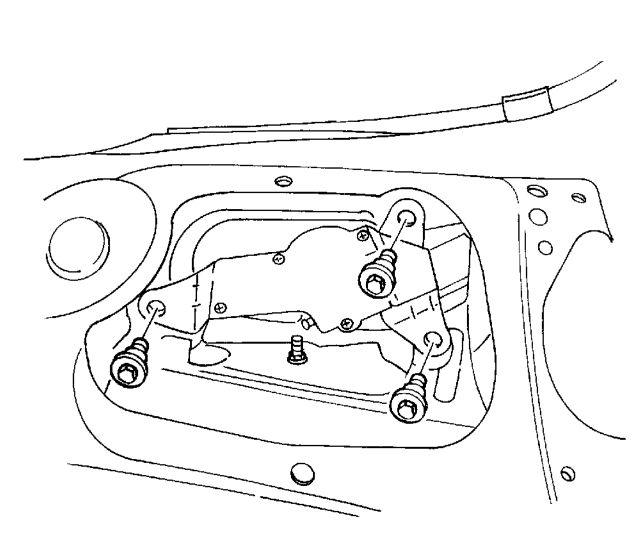


A309D007

REAR WINDOW WIPER MOTOR

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the rear window wiper arm. Refer to "Rear Window Wiper Arm" in this section.
3. Remove the hatchback door lower garnish molding. Refer to Section 9G, Interior Trim.
4. Remove the bolts and the rear wiper motor.
5. Disconnect the electrical connector.



A309D007

Installation Procedure

1. Connect the electrical connector.

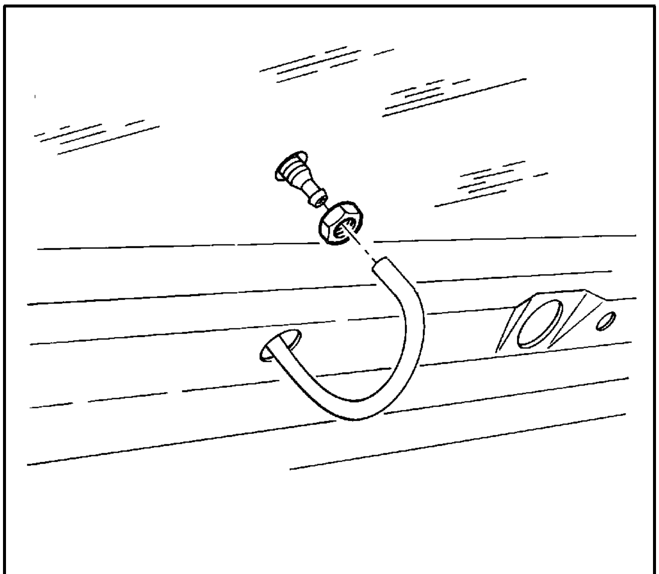
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the rear wiper motor with the bolts.

Tighten

Tighten the wiper motor bolts to 9 N•m (80 lb-in).

3. Install the hatchback door lower garnish molding. Refer to Section 9G, Interior Trim.
4. Install the rear window wiper arm. Refer to "Rear Window Wiper Arm" in this section.
5. Connect the negative battery cable.

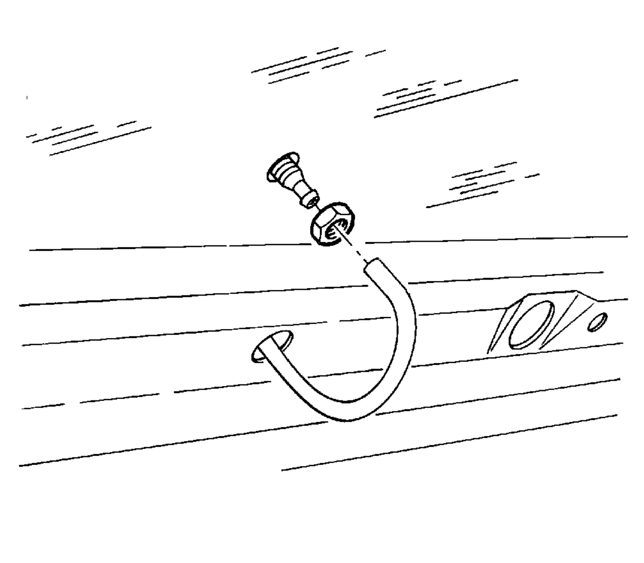


A309D008

REAR WINDOW WASHER NOZZLE

Removal Procedure

1. Remove the hatchback door upper garnish molding. Refer to Section 9G, Interior Trim.
2. Remove the washer hose from the nozzle.
3. Remove the nut and the washer nozzle.



A309D008

Installation Procedure

1. Install the washer nozzle with the nut.
2. Install the washer hose to the nozzle.
3. Install the hatchback door upper garnish molding. Refer to Section 9G, Interior Trim.

GENERAL DESCRIPTION AND SYSTEM OPERATION

WINDSHIELD WIPER SYSTEM

The windshield wiper system consists of a wiper motor, a linkage, a wiper arm and a blade, and a wiper/washer switch. The windshield wiper circuit incorporates a self-parking device which consists of a worm gear and a cam plate in order to keep the circuit complete temporarily when the switch is turned off. The wiper system is driven by a permanent magnet-type motor. The windshield wiper motor is mounted on the dash panel and is directly connected to the windshield wiper linkage.

The windshield wiper motor has two speeds, LO and HI, and also has intermittent wiper capability. The wiper switch is an integral part of the wiper/washer switch. Windshield wiper operation is actuated through the lever on the right side of the steering column.

WINDSHIELD WASHER SYSTEM

The windshield washer system is equipped with a washer fluid reservoir, a washer fluid pump, hoses, nozzles, and a wiper/washer switch. The windshield washer reservoir is mounted behind the front left wheel well splash shield. Attached to the reservoir is a washer pump, which pumps fluid through the hoses to the two nozzles mounted on the hood. The washer switch is an integral part of the wiper/washer switch. Windshield washer operation is actuated through the lever on the right side of the steering column.

REAR WINDOW WIPER/WASHER SYSTEM

The hatchback rear window wiper system consists of a wiper motor, a wiper arm, and a blade. The rear window wiper motor is located inside of the hatchback door and is directly connected to the rear window wiper. The hatchback rear window washer system is equipped with a separate washer fluid pump, hose, and nozzle. The rear window washer reservoir is mounted behind the front left wheel well splash shield. Attached to the reservoir is a washer pump, which pumps fluid through a hose to the nozzle mounted on the hatch.

SECTION 9E

INSTRUMENTATION/DRIVER INFORMATION

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

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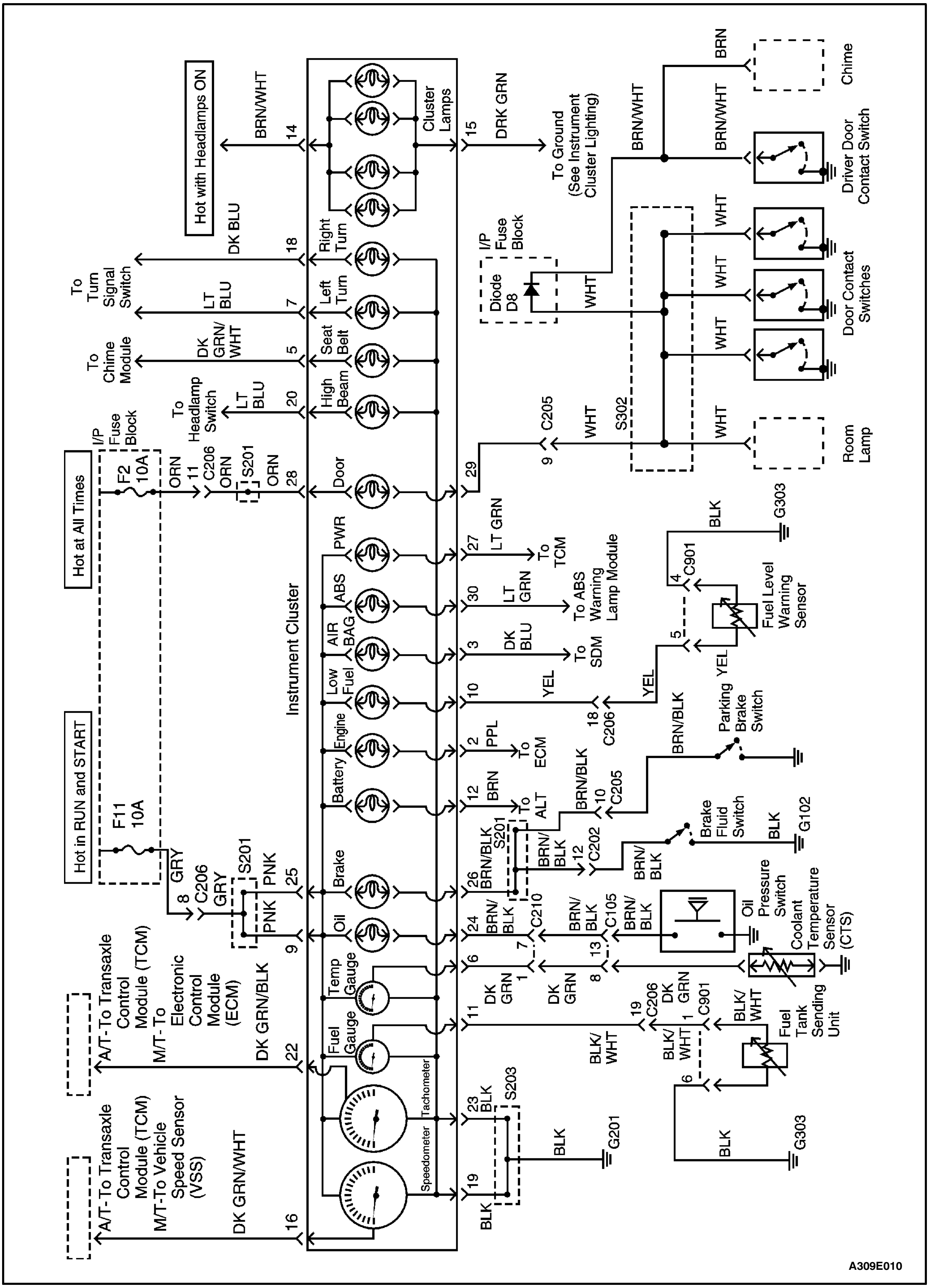
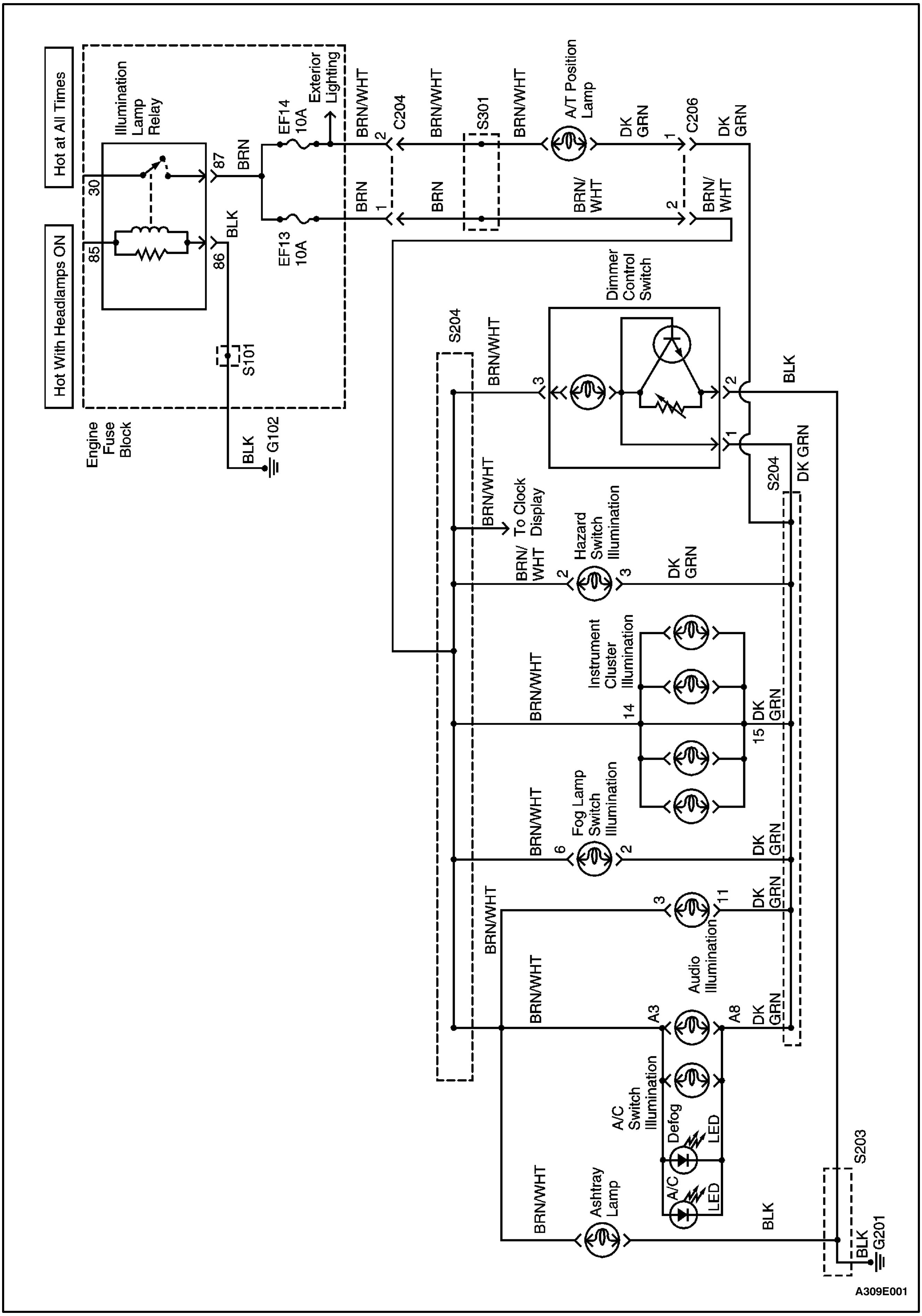
INSTRUMENT CLUSTER INDICATOR LAMPS SPECIFICATIONS

Indicator Lamp	Color	Bulb
ABS Warning	Amber	14 v 1.4 W
Airbag Warning	Red	14 v 1.4 W
Battery Charge Indicator	Red	14 v 1.4 W
Door Opening Warning	Red	14 v 1.4 W
Fasten Seat Belt Warning	Red	14 v 1.4 W
High Beam Indicator	Blue	14 v 1.4 W
Low Fuel Level Warning	Amber	14 v 1.4 W
Oil Pressure Warning	Red	14 v 1.4 W
Parking Brake Indicator and Brake Fluid Warning	Red	14 v 1.4 W
Rear Fog Lamps Indicator	Amber	14 v 1.4 W
Service Engine Soon Warning	Amber	14 v 1.4 W
Transaxle Power Mode Indicator	Amber	14 v 1.4 W
Turn Signal Indicators	Green	14 v 1.4 W

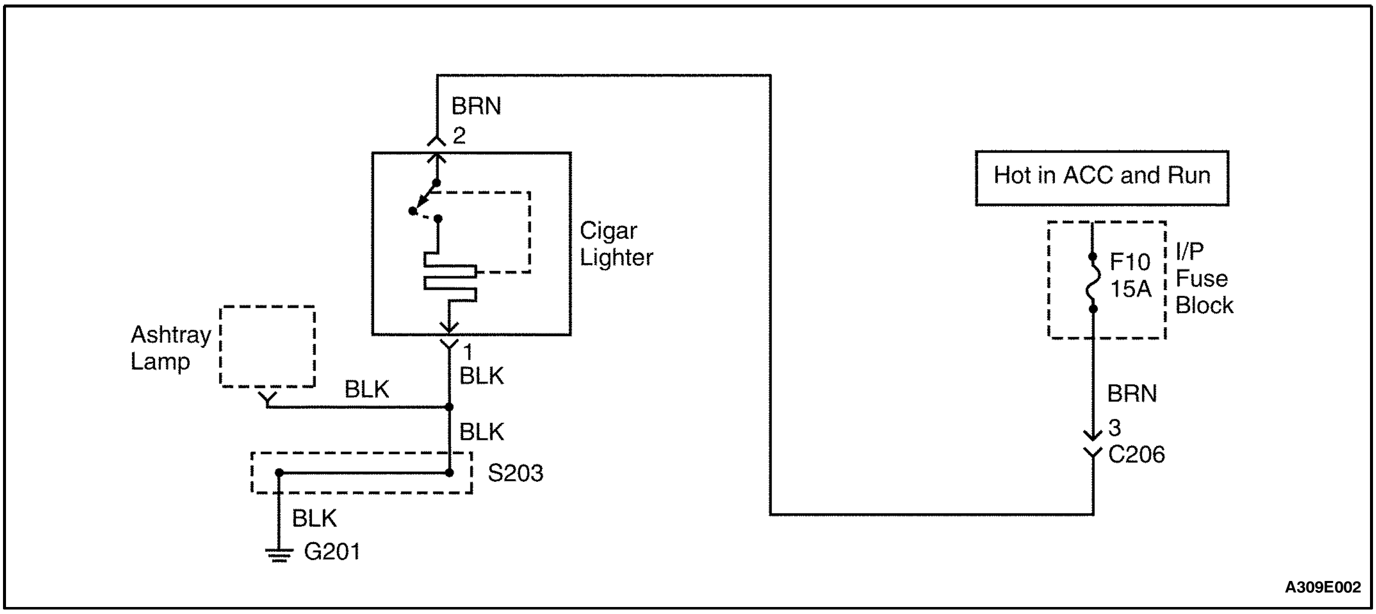
SCHEMATIC AND ROUTING DIAGRAMS



INSTRUMENT PANEL ILLUMINATION



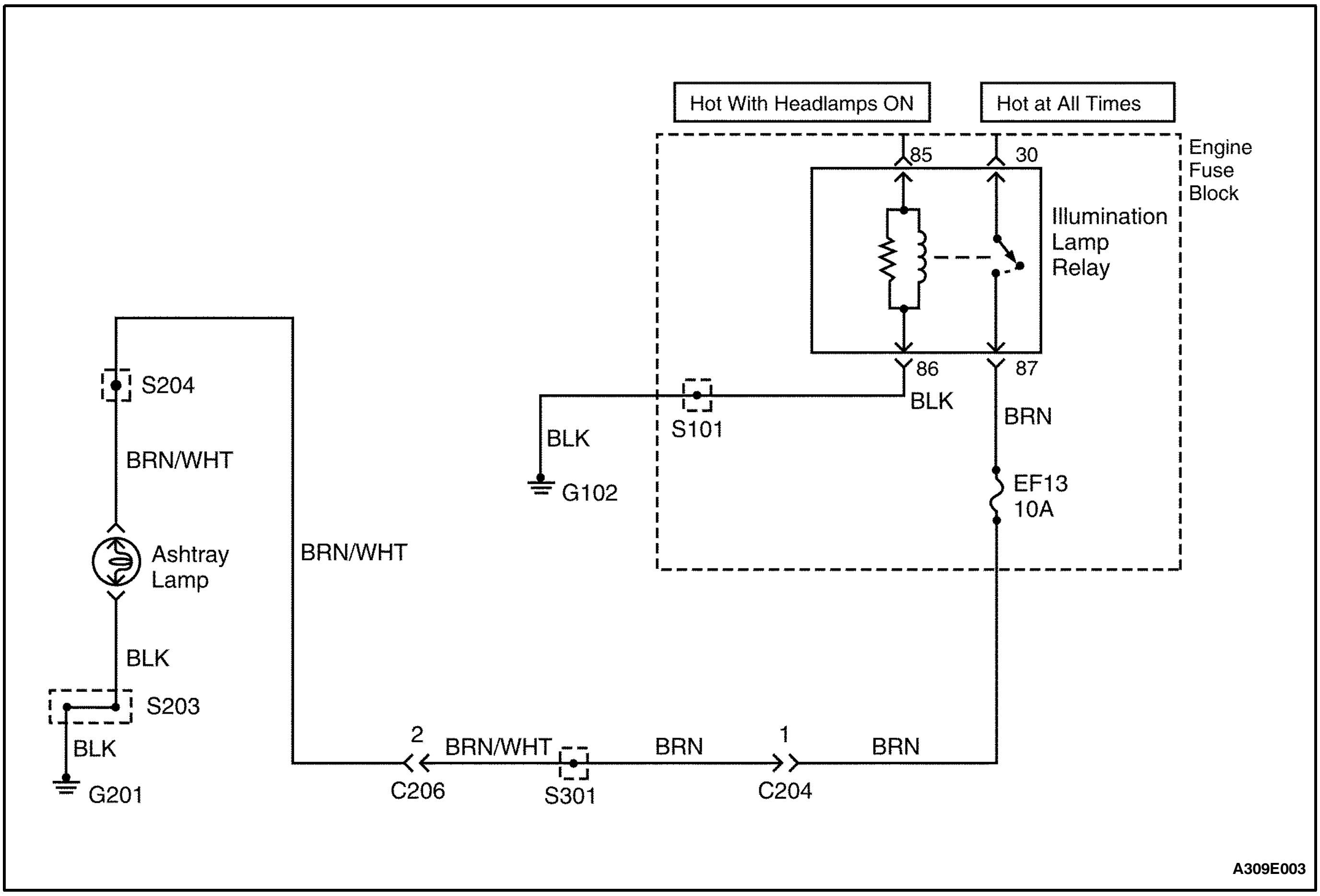
DIAGNOSIS



CIGAR LIGHTER

Cigar Lighter Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuse F10. Is the fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition key to ACC. 2. Use a voltmeter to check for voltage at fuse F10. Does the battery voltage available at the fuse F10 match the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit for fuse F10. Is the repair complete?	-	System OK	-
5	1. Remove the electrical connector from the back of the cigar lighter. 2. Turn the ignition key to ACC. 3. Use a voltmeter to check the voltage at the BRN wire. Does the battery voltage available at the BRN wire match the value specified?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuse F10 and the cigar lighter. Is the repair complete?	-	System OK	-
7	With the ignition key still in the ACC position, connect the voltmeter between the BRN and the BLK wires at the cigar lighter connector. Does the battery voltage match the value specified?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open ground circuit. Is the repair complete?	-	System OK	-
9	Replace the cigar lighter. Is the repair complete?	-	System OK	-



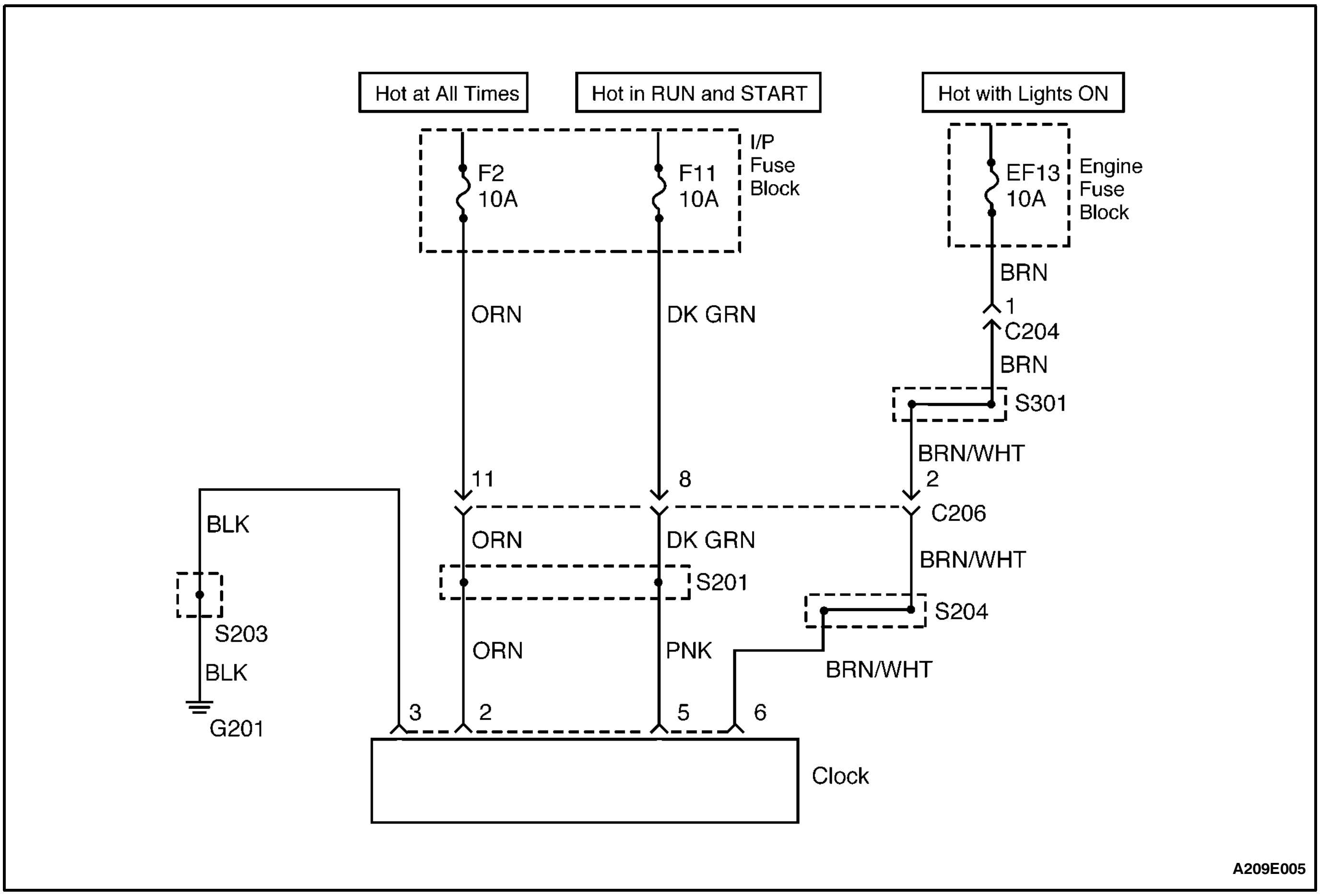
ASHTRAY

Diagnostic Aids

If power to splice S204 is lost, all of the following functions will also be lost: A/C control switch illumination, audio system illumination, headlamp reminder chime, instrument cluster illumination, and hazard switch illumination.

Ashtray Lamp Inoperative, All Other Instrument Lamps OK

Step	Action	Value(s)	Yes	No
1	1. Turn the light switch on. 2. Remove the ashtray lamp from the socket. 3. Use a voltmeter to check battery voltage available at the ashtray lamp socket. Does the battery voltage match the value specified?	11-14 v	Go to Step 3	Go to Step 2
2	Repair the open circuit between the ashtray lamp socket and splice S204. Is the repair complete?	-	System OK	-
3	1. Turn the light switch on. 2. Using an ohmmeter, check the ground circuit to the lamp socket. Does the resistance equal the value specified?	[0 W	Go to Step 5	Go to Step 4
4	Repair the open ground circuit between the ashtray lamp socket and ground G201. Is the repair complete?	-	System OK	-
5	Replace the ashtray lamp. Is the repair complete?	-	System OK	-



DIGITAL CLOCK

Digital Clock Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuses F2 and F11. Is either fuse F2 or F11 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the blown fuses. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Use a voltmeter to check battery voltage available at fuses F2 and F11. Does the voltmeter indicate the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit for the fuse. Is the repair complete?	-	System OK	-
5	Use a voltmeter to check the battery voltage available at the clock connector terminal 2. Does the voltmeter indicate the value specified?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the clock connector terminal 2 and the fuse F2. Is the repair complete?	-	System OK	-
7	Turn the ignition ON. Is battery voltage available at the clock connector terminal 5?	-	Go to Step 9	Go to Step 8

Digital Clock Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
8	Repair the open circuit between the clock connector terminal 5 and the fuse F11. Is the repair complete?	-	System OK	-
9	Check continuity between the clock connector terminal 3 and ground. Does the multimeter indicate the value specified?	0 W	Go to Step 10	Go to Step 11
10	Replace the clock. Is the repair complete?	-	System OK	-
11	Repair the open ground circuit between the clock connector terminal 3 and the ground G201. Is the repair complete?	-	System OK	-

INSTRUMENT PANEL ILLUMINATION

Instrument Panel Illumination Lamps Inoperative

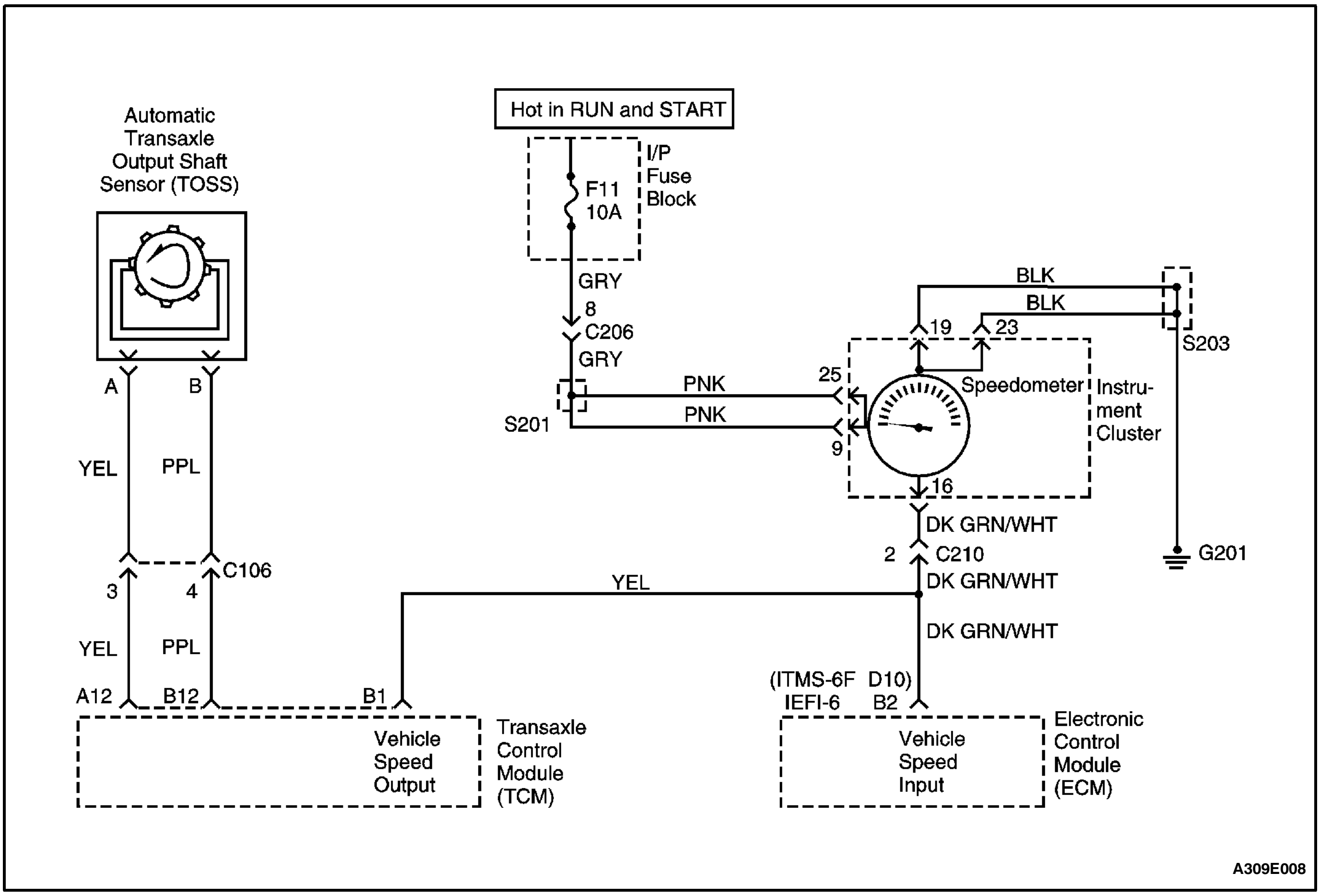
Step	Action	Value(s)	Yes	No
1	Check fuse EF13. Is fuse EF13 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the blown fuse. Is the repair complete?	-	System OK	-
3	1. Turn the lamp switch on. 2. Use a voltmeter to check battery voltage at fuse EF13. Does the battery voltage match the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit to fuse EF13. Is the repair complete?	-	System OK	-
5	Use an ohmmeter to check the resistance between ground and the BLK wire of the dimmer control switch connector. Is the resistance equal to the specified value?	0	Go to Step 7	Go to Step 6
6	Repair the open ground circuit. Is the repair complete?	-	System OK	-
7	1. Turn the lamp switch on. 2. Use a voltmeter to check for battery voltage at the BRN/WHT wire of the dimmer control switch connector. Does the battery voltage match the value specified?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between the BRN/WHT wire of the dimmer control switch connector and fuse EF13. Is the repair complete?	-	System OK	-
9	1. Disconnect the dimmer control switch. 2. Turn the lamp switch on. 3. Use a voltmeter to check for battery voltage at the DK GRN wire of the dimmer control switch connector. Does the battery voltage match the value specified?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the DK GRN wire of the dimmer control switch connector and splice S204. Is the repair complete?	-	System OK	-
11	Replace the dimmer control switch.	-	System OK	-

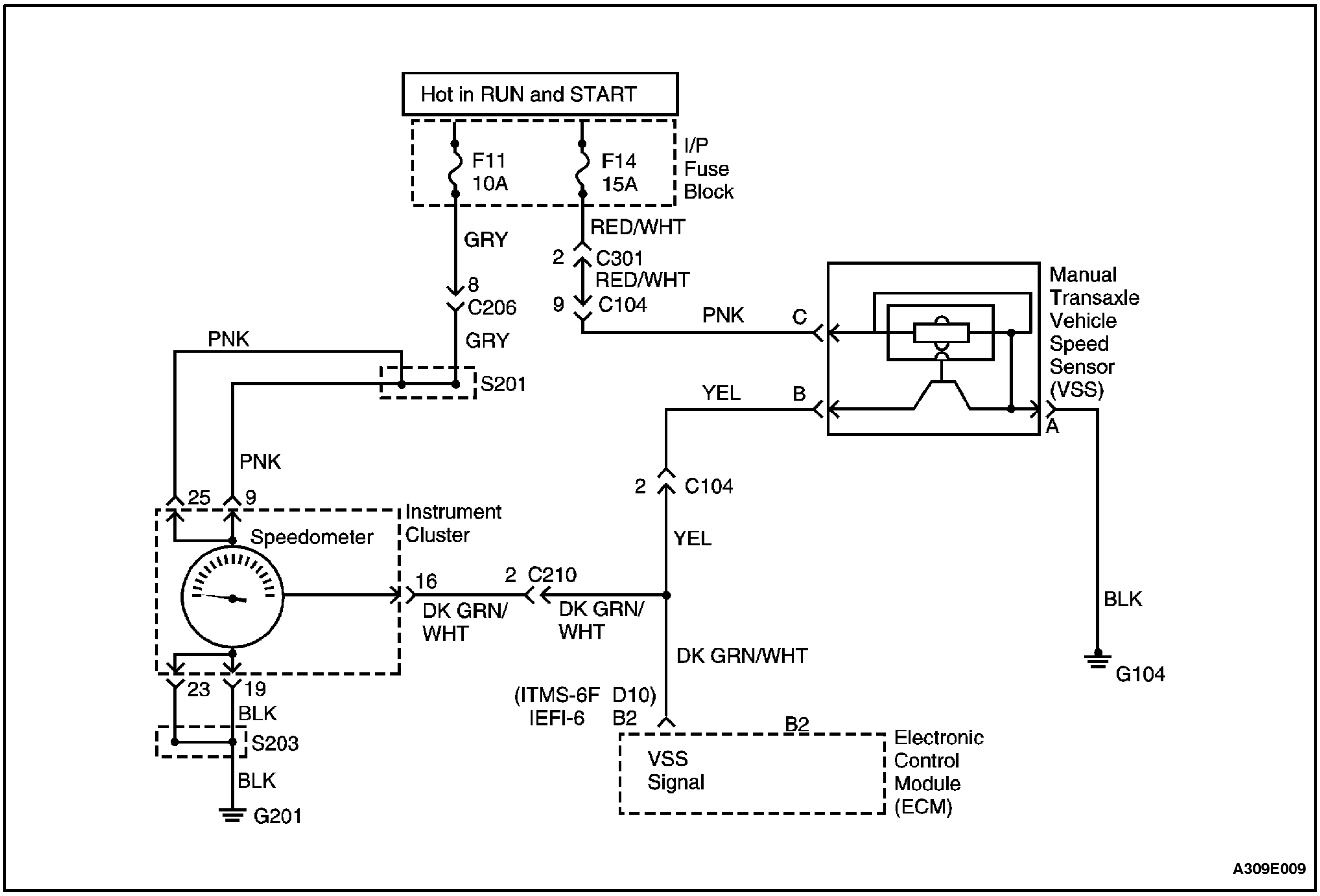
Automatic Transaxle Gear Position Illumination Lamp Inoperative, All Other Instrument Lamps OK

Notice: When probing a bulb socket with a voltmeter or a test lamp, do not allow the probe to touch both the positive and the negative contacts at the same time. This will cause a blown fuse.

Step	Action	Value(s)	Yes	No
1	Check fuse EF14. Is fuse EF14 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the blown fuse. Is the repair complete?	-	System OK	-
3	1. Turn the lamp switch on. 2. Use a voltmeter to check battery voltage available at fuse EF14. Does the battery voltage match the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open circuit power supply circuit to fuse EF14. Is the repair complete?	-	System OK	-
5	1. Turn the lamp switch on. 2. Remove the automatic transaxle position lamp. 3. Use a voltmeter to check battery voltage available at the lamp socket. Does the battery voltage match the value specified?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the automatic transaxle position lamp socket and fuse EF14. Is the repair complete?	-	System OK	-
7	1. Turn the lamp switch on. 2. Remove the automatic transaxle position lamp. 3. Use an ohmmeter to check the resistance between the ground circuit and the lamp socket. Is the resistance equal to the value specified?	[0 W	Go to Step 9	Go to Step 8
8	Repair the open ground circuit between the automatic transaxle position lamp socket and ground. Is the repair complete?	-	System OK	-
9	Replace the automatic transaxle position lamp. Is the repair complete?	-	System OK	-

BLANK


Automatic Transaxle Output Shaft Sensor (TOSS)
Hot in RUN and START
I/P Fuse Block
F11 10A
GRY
8
C206
GRY
S201
PNK
PNK
25
9
Speedometer
Instrument Cluster
BLK
BLK
19
23
S203
16
DK GRN/WHT
2
C210
DK GRN/WHT
G201
A
B
YEL
PPL
C106
3
4
YEL
PPL
YEL
DK GRN/WHT
(ITMS-6F D10)
IEFI-6 B2
A12
B12
B1
Vehicle Speed Output
Transaxle Control Module (TCM)
Vehicle Speed Input
Electronic Control Module (ECM)
A309E008


Hot in RUN and START
F11 10A
F14 15A
I/P Fuse Block
GRY
RED/WHT
2
C301
RED/WHT
9
C104
8
C206
GRY
PNK
S201
PNK
C
Manual Transaxle Vehicle Speed Sensor (VSS)
YEL
B
A
2
C104
YEL
25
9
Speedometer
Instrument Cluster
16
2
C210
DK GRN/WHT
DK GRN/WHT
DK GRN/WHT
BLK
G104
23
19
BLK
S203
BLK
G201
(ITMS-6F D10)
IEFI-6 B2
B2
VSS Signal
Electronic Control Module (ECM)
A309E009

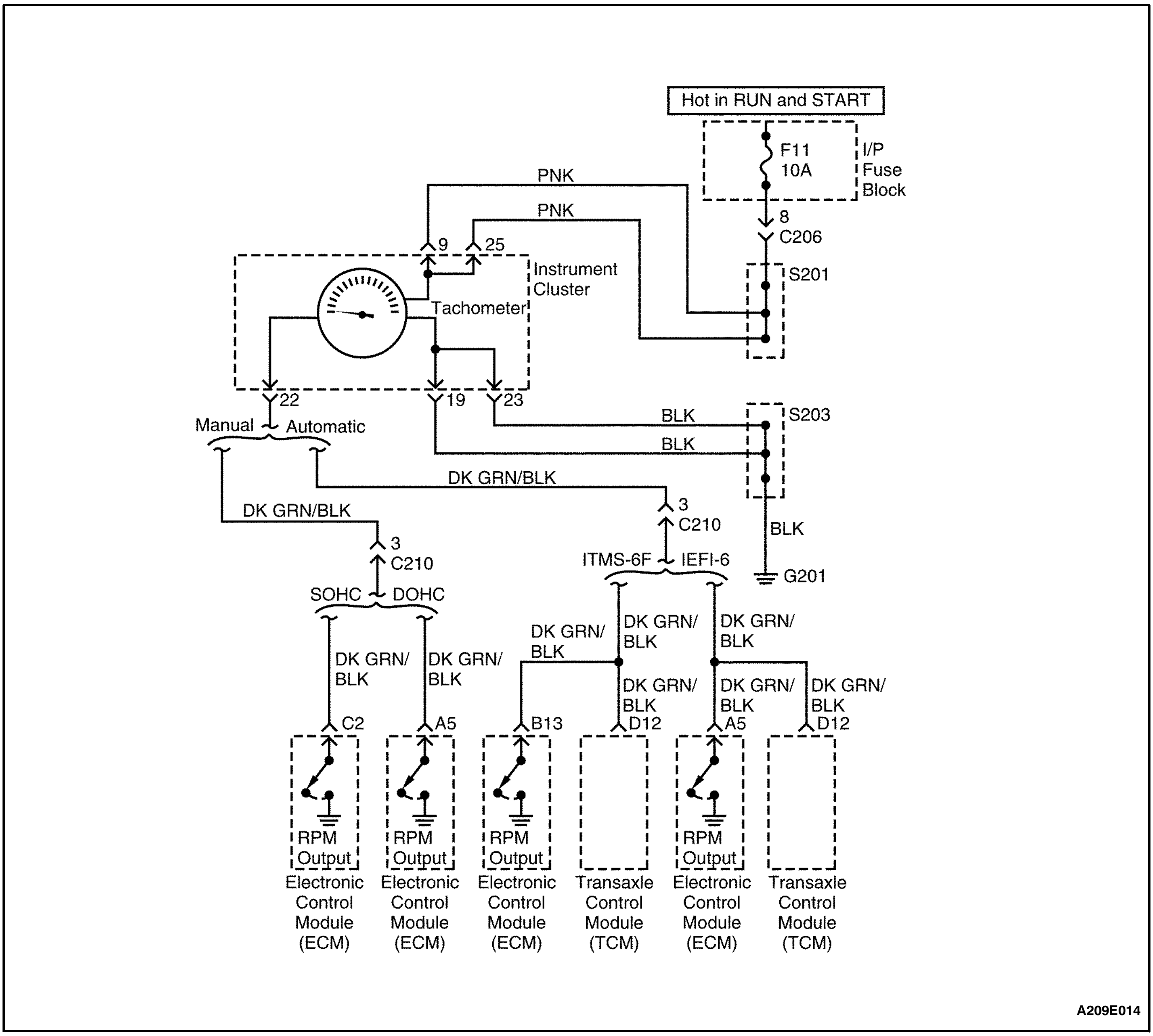
SPEEDOMETER

Speedometer Inoperative, Other Gauges and Warning Lamps Are OK

Diagnostic Aids

The 1.3L and 1.6L engines use an ITMS control module. The 1.5L uses an IEFI control module.

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool. 2. Check for engine control diagnostic trouble codes (DTCs). Is the vehicle speed sensor DTC set?	-	Go to Section 2F, Engine Controls	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the 24-pin electronic control module (ECM) connector. 3. Remove the instrument cluster. 4. Check continuity between ECM terminal B2 (D10 for the ITMS control module) and the instrument cluster connector terminal 16. Does the ohmmeter indicate the specified value?	0 W	Go to Step 4	Go to Step 3
3	Repair the open circuit between the instrument cluster connector terminal 16 and the ECM. Is the repair complete?	-	System OK	-
4	Replace the speedometer. Is the repair complete?	-	System OK	-



TACHOMETER

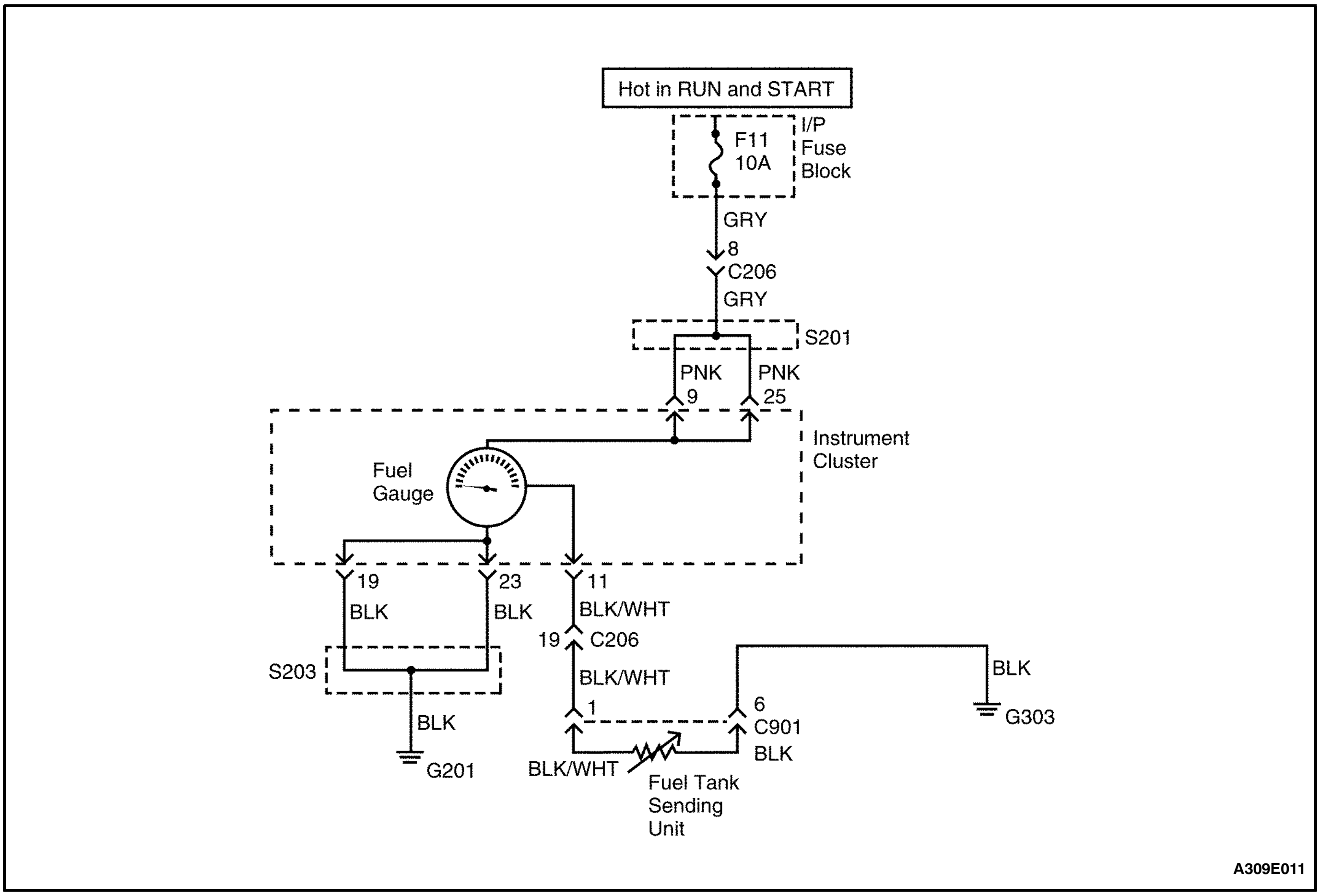
Diagnostic Aids

The tachometer and speedometer use the same connectors at the instrument cluster for power and ground. If the speedometer is working, power and ground also will be furnished to the tachometer, unless there is a bad connection or fault on the printed circuit for the instrument cluster.

The electronic control module (ECM) output terminal for revolutions per minute (rpm) is different for various transaxle and engine options.

Tachometer Does Not Work

Step	Action	Value	Yes	No
1	1. Connect a scan tool. 2. Check for diagnostic trouble codes (DTCs) for the engine and the transaxle, if the vehicle is equipped with an automatic transaxle. Are there any current DTCs recorded?	-	Go to Step 2	Go to Step 3
2	Repair any faults indicated by DTCs. Are all the DTCs cleared?	-	Go to Step 3	-
3	Turn the ignition ON. Do the warning lights come on with the ignition ON and the engine not running?	-	Go to Step 9	Go to Step 4
4	Check fuse F11. Is fuse F11 blown?	-	Go to Step 5	Go to Step 6
5	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
6	Turn the ignition ON. Check the voltage at fuse F11. Is the specified voltage available at fuse F11?	11 - 14 v	Go to Step 8	Go to Step 7
7	Repair the open power supply circuit for fuse F11. Is the repair complete?	-	System OK	-
8	Repair the open circuit between fuse F11 and the instrument cluster terminals 9 and 25. Is the repair complete?	-	System OK	-
9	1. Turn the ignition ON. 2. Check the left and the right turn signals. Does either instrument cluster turn signal indicator flash?	-	Go to Step 12	Go to Step 10
10	1. Remove the instrument cluster. 2. Use an ohmmeter to check the continuity between ground and terminals 19 and 23 of the instrument cluster connector. Does the ohmmeter indicate the specified value?	9 0 W	Go to Step 12	Go to Step 11
11	Repair the instrument cluster ground circuit. Is the repair complete?	-	System OK	-
12	Use an ohmmeter to check for continuity of the rpm output circuit between the electronic control module (ECM) and instrument cluster terminal 22. Does the ohmmeter indicate the specified value?	9 0 W	Go to Step 14	Go to Step 13
13	Repair the rpm output circuit between the ECM and the instrument cluster. Is the repair complete?	-	System OK	-
14	Replace the tachometer. Does the tachometer work?	-	System OK	Go to Step 15
15	Replace the ECM. Is the repair complete?	-	System OK	-



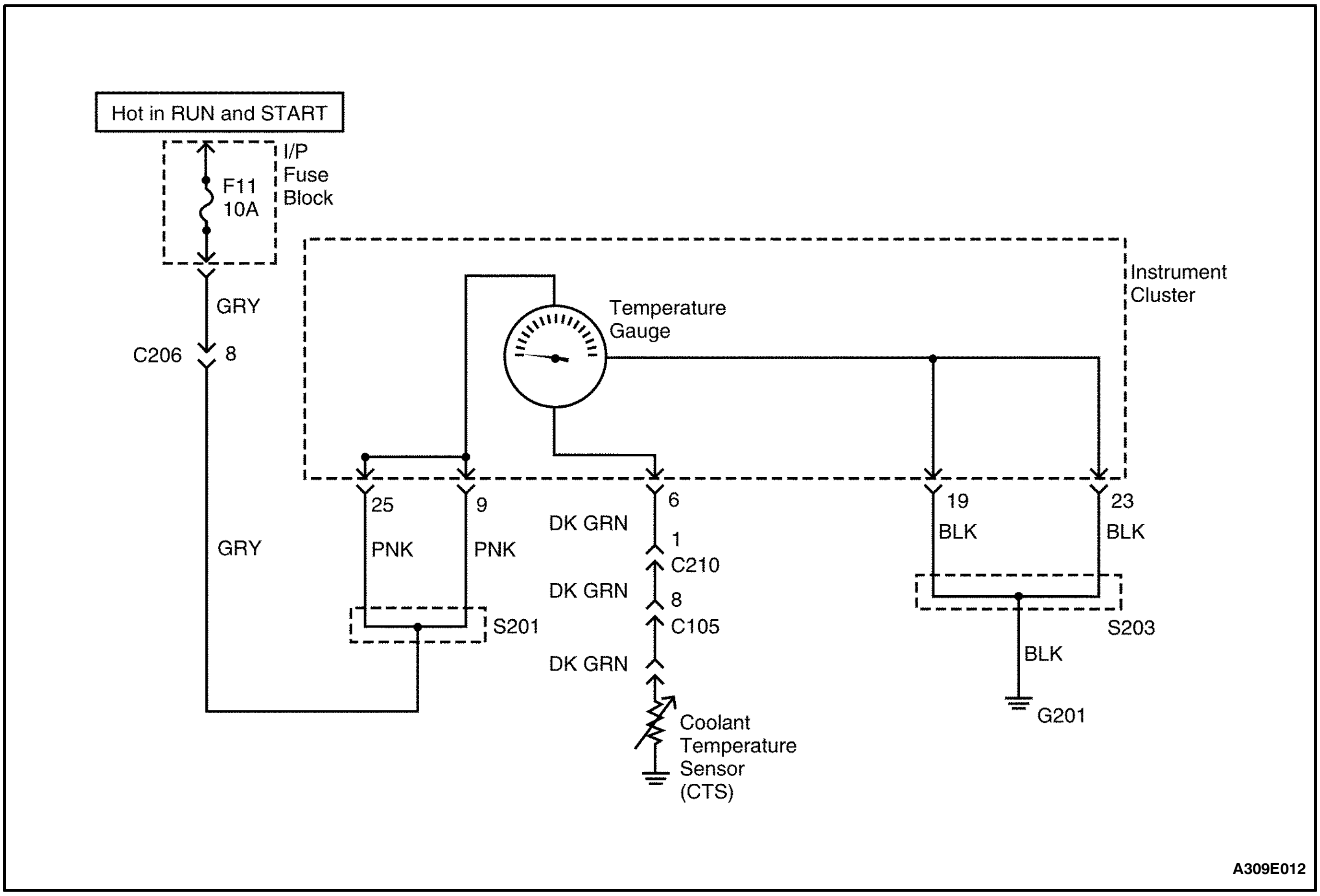
FUEL GAUGE

Fuel Gauge Inoperative

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Does the fuel gauge always indicate a full fuel tank with the ignition ON?	-	Go to Step 2	Go to Step 7
2	Disconnect the fuel tank sending unit. Does the fuel gauge change to empty?	-	Go to Step 3	Go to Step 4
3	Replace the fuel tank sending unit. Is the repair complete?	-	System OK	-
4	Check the wiring harness for a short to ground between the fuel tank sending unit and the fuel gauge. Is there a short to ground?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground. Is the repair complete?	-	System OK	-
6	Replace the fuel gauge. Is the repair complete?	-	System OK	-

Fuel Gauge Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the fuel tank sending unit electrical connector. 2. Turn the ignition ON. 3. Check the voltage at the fuel tank sending unit connector C901, terminal 1, on the floor harness side. Connector C901 is the connector between the floor wiring harness and the fuel tank wiring harness. Does the voltmeter indicate the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between the fuel gauge and the fuel tank sending unit. Is the repair complete?	-	System OK	-
9	Check continuity between the fuel tank sending unit connector C901, terminal 6, and ground. Does the multimeter indicate the specified value?	[0 W	Go to Step 11	Go to Step 10
10	Repair the open circuit or poor ground connection. Is the repair complete?	-	System OK	-
11	1. With the fuel tank sending unit electrical connector C901 disconnected, attach a jumper between ground and C901, terminal 1, on the floor harness side. 2. Turn the ignition ON. Does the fuel gauge move to full?	-	Go to Step 3	Go to Step 6



TEMPERATURE GAUGE

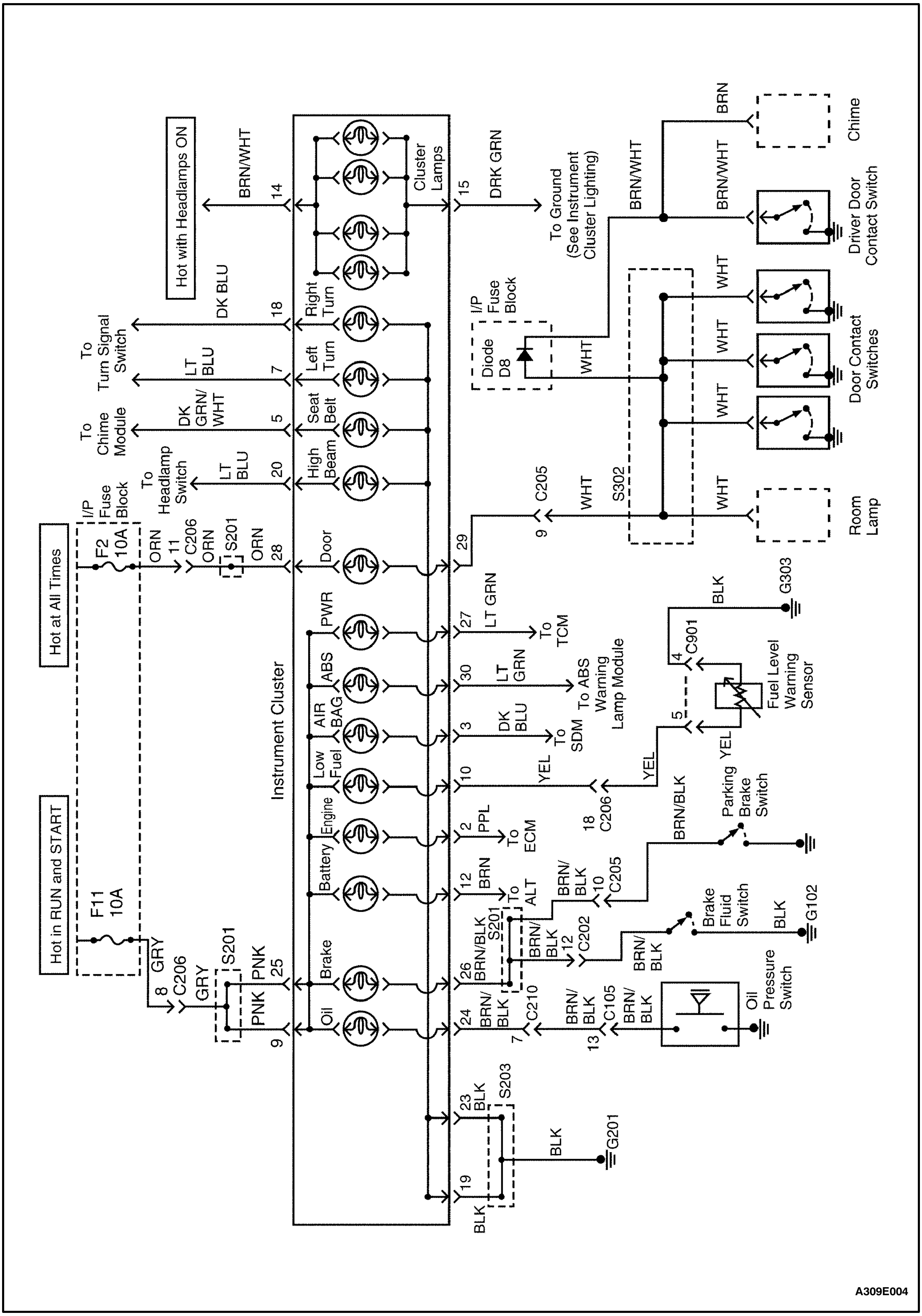
Temperature Gauge Inoperative, Other Gauges OK

Step	Action	Value(s)	Yes	No
1	Allow the engine to cool to room temperature. With the ignition ON, does the temperature gauge always read at the high end of the scale?	-	Go to Step 7	Go to Step 2
2	Disconnect the coolant temperature sensor (CTS) electrical connector. Does the temperature gauge indicator drop to the low end of the scale?	-	Go to Step 3	Go to Step 4
3	Replace the CTS. Is the repair complete?	-	System OK	-
4	Check for a short to ground between the CTS and the temperature gauge. Is there a short to ground?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground. Is the repair complete?	-	System OK	-
6	Replace the temperature gauge. Is the repair complete?	-	System OK	-

Temperature Gauge Inoperative, Other Gauges OK (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the CTS. 2. Turn the ignition ON. 3. Check the voltage at the CTS. Does the the voltage equal the value specified?	11-14 v	Go to Step 10	Go to Step 8
8	Check for an open circuit between the CTS and the temperature gauge. Is there an open circuit?	-	Go to Step 9	Go to Step 6
9	Repair the open circuit between the CTS and the temperature gauge. Is the repair complete?	-	System OK	-
10	1. Disconnect the CTS. 2. Connect a jumper wire between the CTS connector and ground. 3. Turn the ignition ON. Does the temperature gauge move to the high end of the scale?	-	Go to Step 3	Go to Step 6

INSTRUMENT CLUSTER INDICATOR LAMPS

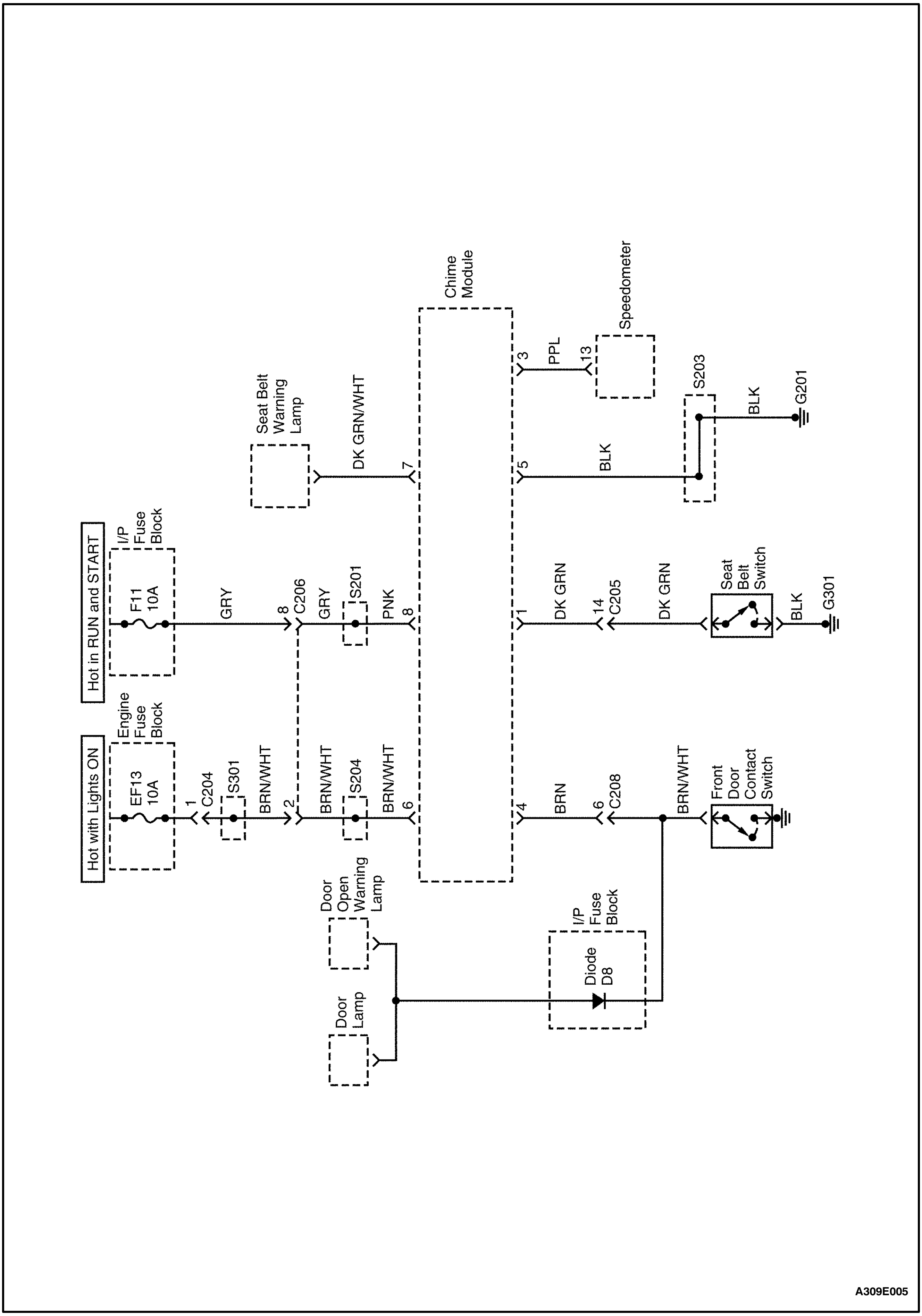


INSTRUMENT CLUSTER INDICATOR LAMPS

Instrument Panel Warning Lamps Do Not Operate

Step	Action	Value(s)	Yes	No
1	Check fuse F11. Is fuse F11 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the blown fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Check the voltage at fuse F11. Does the battery voltage match the value specified?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit to fuse F11. Is the repair complete?	-	System OK	-
5	1. Remove the instrument cluster. 2. Disconnect the instrument cluster connectors B (terminals 9-20) and C (terminals 21-30). 3. Turn the ignition ON. 4. Check the voltage at terminals 9 and 25. Does the battery voltage match the value specified?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuse F11 and the instrument cluster connectors 9 and 25. Is the repair complete?	-	System OK	-
7	Check the instrument cluster indicator lamp bulbs. Are the bulbs OK?	-	Go to Step 9	Go to Step 8
8	1. Replace any warning lamp bulbs that are defective. 2. Check the charging system to make sure the alternator is not overcharging. 3. Repair the charging system, if necessary. Is the repair complete?	-	System OK	-
9	Replace the instrument cluster. Is the repair complete?	-	System OK	-

CHIME MODULE



CHIME MODULE

Seat Belt Warning Chime Inoperative

Step	Action	Value(s)	Yes	No
1	Check the chime module connector to make sure it is connected properly. Is the connector disconnected or partially disconnected?	-	Go to Step 2	Go to Step 3
2	Connect the electrical connector for the chime module. Is the repair complete?	-	System OK	-
3	Check fuse F11. Is fuse F11 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
5	1. Turn the ignition ON. 2. Check the voltage at fuse F11. Is the specified voltage available at fuse F11?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the power supply circuit for fuse F11. Is the repair complete?	-	System OK	-
7	1. Disconnect the chime module. 2. Turn the ignition ON. 3. Check the voltage at terminal 8 of the chime module connector. Does the voltage equal the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between fuse F11 and the chime module connector. Is the repair complete?	-	System OK	-
9	With the chime module disconnected, use an ohmmeter to check continuity between terminal 5 of the chime module connector and ground. Does the ohmmeter indicate the specified value?	0	Go to Step 11	Go to Step 10
10	Repair the open circuit between terminal 5 of the chime module connector and ground. Is the repair complete?	-	System OK	-
11	1. Disconnect the chime module connector. 2. Make sure that the driver seat belt is unfastened. 3. Use an ohmmeter to check continuity between ground and terminal 1 of the chime module. Does the ohmmeter indicate the specified value?	0	Go to Step 12	Go to Step 13
12	Replace the chime module. Is the repair complete?	-	System OK	-
13	1. Disconnect the seat belt switch. 2. Make sure that the driver seat belt is unfastened. 3. Use an ohmmeter to check the continuity of the switch. Does the ohmmeter indicate the specified value?	0	Go to Step 15	Go to Step 14
14	Replace the seat belt switch. Is the repair complete?	-	System OK	-

Seat Belt Warning Chime Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
15	Use an ohmmeter to check continuity of the wire between terminal 1 of the chime module and the seat belt switch. Does the ohmmeter indicate the specified value?	0	Go to Step 17	Go to Step 16
16	Repair the open circuit between terminal 1 of the chime module and the seat belt switch. Is the repair complete?	-	System OK	-
17	Repair the open circuit between the seat belt switch connector and ground. Is the repair complete?	-	System OK	-

Door-Open Warning Chime Inoperative

Step	Action	Value(s)	Yes	No
1	Check the chime module connector to make sure it is connected properly. Is the connector disconnected or partially disconnected?	-	Go to Step 2	Go to Step 3
2	Connect the electrical connector for the chime module. Is the repair complete?	-	System OK	-
3	Check fuse F11. Is fuse F11 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
5	1. Turn the ignition ON. 2. Check the voltage at fuse F11. Is the specified voltage available at fuse F11?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the power supply circuit for fuse F11. Is the repair complete?	-	System OK	-
7	1. Disconnect the chime module. 2. Turn the ignition ON. 3. Check the voltage at terminal 8 of the chime module connector. Does the voltage equal the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between fuse F11 and the chime module connector. Is the repair complete?	-	System OK	-
9	With the chime module disconnected, use an ohmmeter to check continuity between terminal 5 of the chime module connector and ground. Does the ohmmeter indicate the specified value?	0	Go to Step 11	Go to Step 10
10	Repair the open circuit between terminal 5 of the chime module connector and ground. Is the repair complete?	-	System OK	-

Door-Open Warning Chime Inoperative (Cont'd)

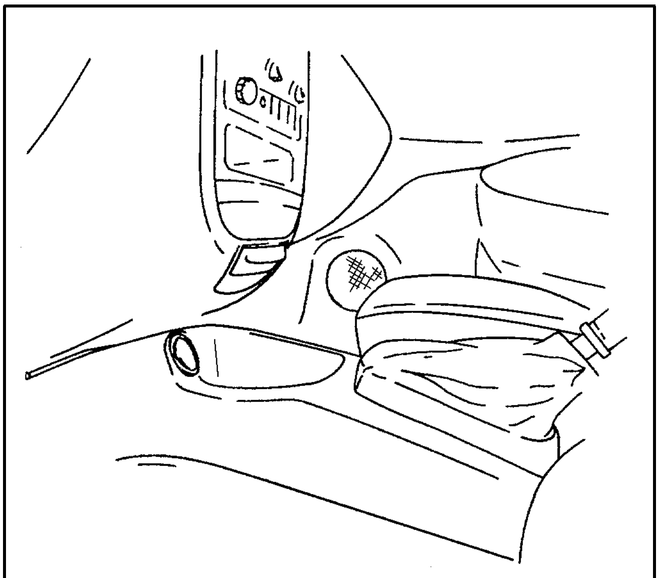
Step	Action	Value(s)	Yes	No
11	1. Disconnect the chime module connector. 2. Make sure that the driver door is open. 3. Use an ohmmeter to check continuity between ground and terminal 4 of the chime module. Does the ohmmeter indicate the specified value?	0	Go to Step 12	Go to Step 13
12	Replace the chime module. Is the repair complete?	-	System OK	-
13	1. Disconnect the front door contact switch. 2. Use an ohmmeter to check the continuity between the door contact switch and terminal 4 of the chime module. Does the ohmmeter indicate the specified value?	0	Go to Step 15	Go to Step 14
14	Repair the open circuit between the door contact switch and terminal 4 of the chime module. Is the repair complete?	-	System OK	-
15	Replace the door contact switch. Is the repair complete?	-	System OK	-

Vehicle Speed Warning Chime Inoperative

Step	Action	Value(s)	Yes	No
1	Check the speedometer to make sure it is operating properly. Is the speedometer operating properly?	-	Go to Step 3	Go to Step 2
2	Repair the speedometer. Is the repair complete?	-	System OK	-
3	Check the chime module connector to make sure it is connected properly. Is the connector disconnected or partially disconnected?	-	Go to Step 4	Go to Step 5
4	Connect the electrical connector for the chime module. Is the repair complete?	-	System OK	-
5	Check fuse F11. Is fuse F11 blown?	-	Go to Step 6	Go to Step 7
6	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
7	1. Turn the ignition ON. 2. Check the voltage at fuse F11. Is the specified voltage available at fuse F11?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the power supply circuit for fuse F11. Is the repair complete?	-	System OK	-
9	1. Disconnect the chime module. 2. Turn the ignition ON. 3. Check the voltage at terminal 8 of the chime module connector. Does the voltage equal the specified value?	11-14 v	Go to Step 11	Go to Step 10

Vehicle Speed Warning Chime Inoperative

Step	Action	Value(s)	Yes	No
10	Repair the open circuit between fuse F11 and the chime module connector. Is the repair complete?	-	System OK	-
11	With the chime module disconnected, use an ohmmeter to check continuity between terminal 5 of the chime module connector and ground. Does the ohmmeter indicate the specified value?	0	Go to Step 13	Go to Step 12
12	Repair the open circuit between terminal 5 of the chime module connector and ground. Is the repair complete?	-	System OK	-
13	1. Disconnect the chime module connector. 2. Disconnect the instrument cluster connector. 3. Use an ohmmeter to check continuity between the chime module connector terminal 3 and the instrument cluster connector terminal 13. Does the ohmmeter indicate the specified value?	0	Go to Step 14	Go to Step 15
14	Replace the chime module. Is the repair complete?	-	System OK	-
15	Replace the speedometer. Is the repair complete?	-	System OK	-


A109E004

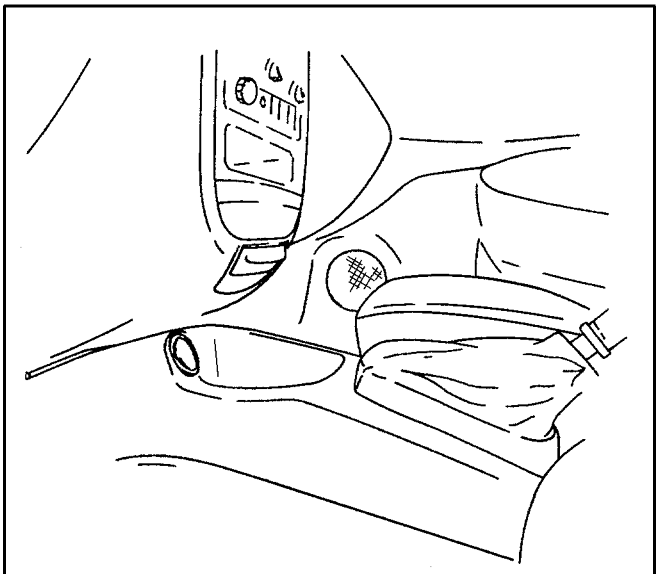
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

CIGAR LIGHTER

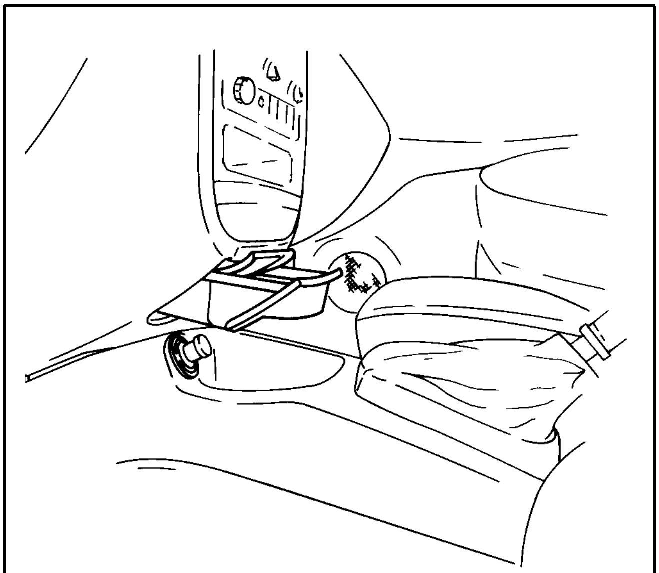
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the cigar lighter from the cigar lighter housing.
3. Remove the cigar lighter housing from the floor console.
4. Disconnect the cigar lighter electrical connector.


A109E004

Installation Procedure

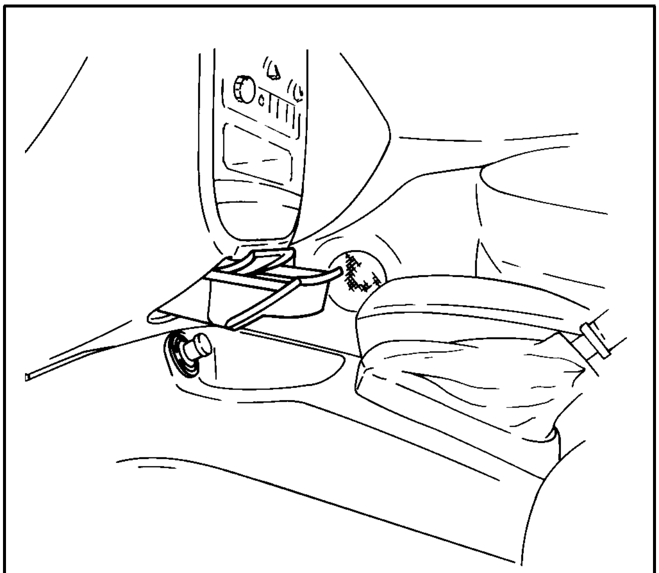
1. Connect the cigar lighter electrical connector.
2. Install the cigar lighter housing in the floor console.
3. Install the cigar lighter in the cigar lighter housing.
4. Connect the negative battery cable.


A109E001

ASHTRAY

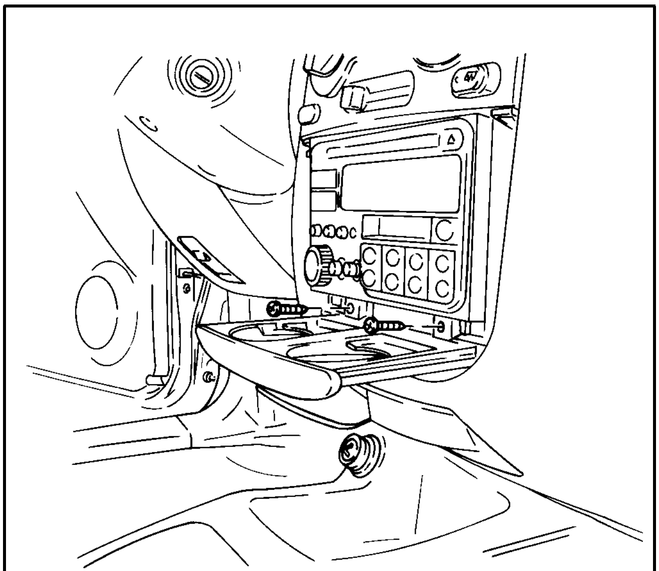
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the ashtray.
3. Disconnect the ashtray electrical connector.


A109E001

Installation Procedure

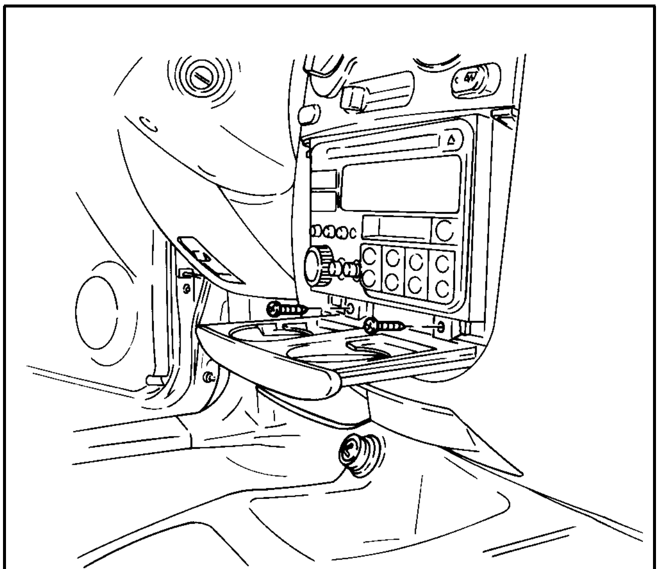
1. Connect the ashtray electrical connector.
2. Install the ashtray.
3. Connect the negative battery cable.


A309B010

CUPHOLDER

Removal Procedure

1. Remove the audio system trim panel.
2. Remove the screws and the cupholder.


A309B010

Installation Procedure

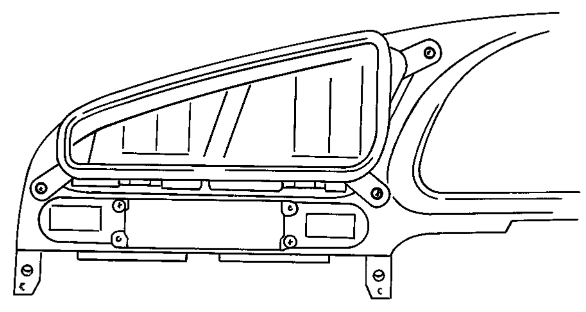
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the cupholder with the screws.

Tighten

Tighten the cupholder screws to 2.5 Nm (22 lb-in).

2. Install the audio system trim panel.

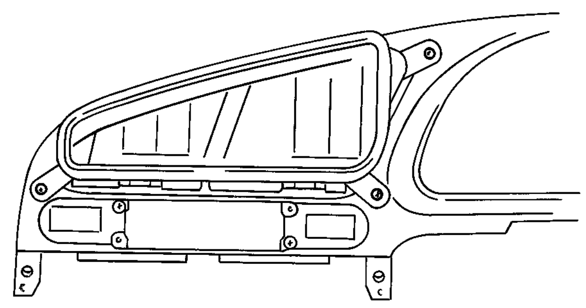


A109E010

INSTRUMENT CLUSTER TRIM PANEL VENTS

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Remove the screws and the air deflectors.



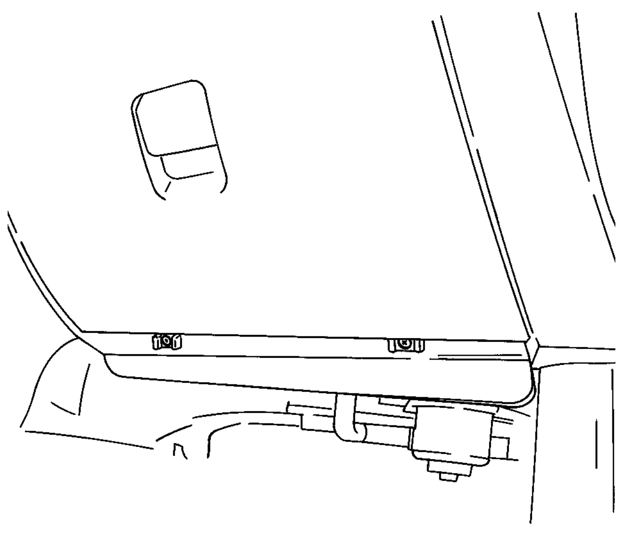
A109E010

Installation Procedure

1. Install the air deflectors with the screws.

   Tighten

   Tighten the air deflector screws to 2 N•m (18 lb-in).
2. Install the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Connect the negative battery cable.



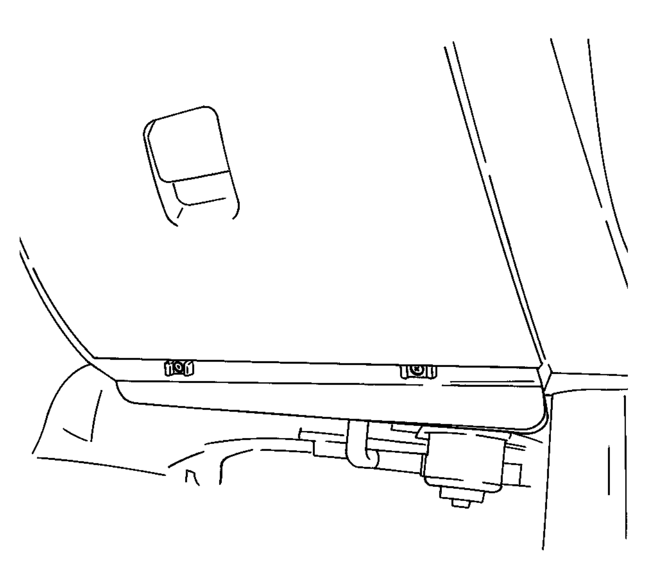
A109E003

GLOVE BOX

(Typical)

Removal Procedure

1. Remove the screws at the base of the glove box.
2. Open and remove the glove box.



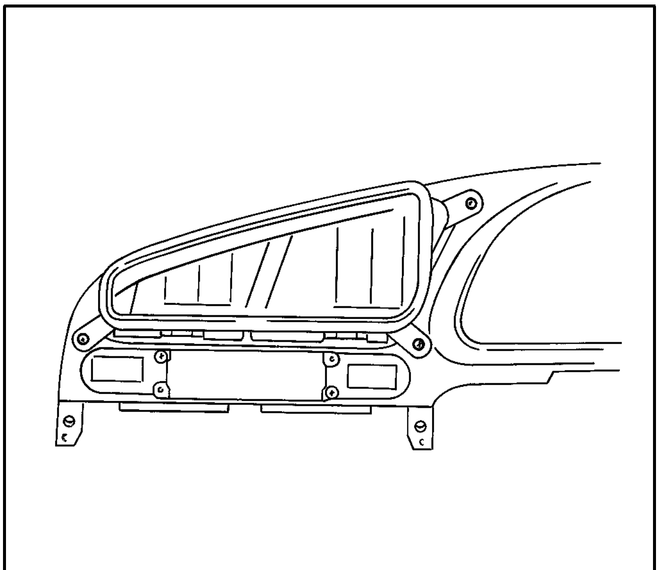
A109E003

Installation Procedure

1. Position the glove box in the instrument panel.
2. Install the glove box with the screws.

   Tighten

   Tighten the glove box screws to 5.5 N•m (49 lb-in).

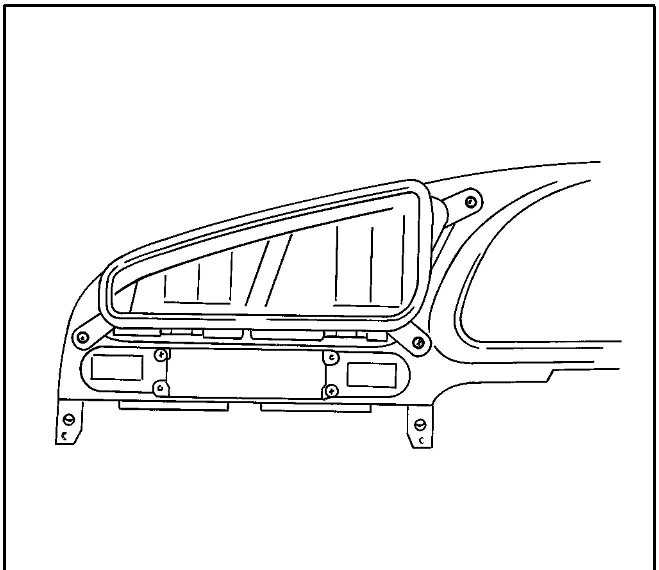


A109E013

DIGITAL CLOCK

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Remove the screws and the clock.



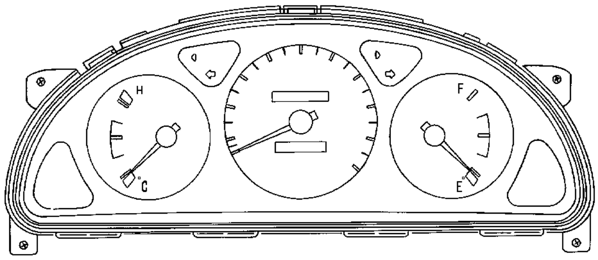
A109E013

Installation Procedure

1. Install the clock with the screws.

   Tighten

   Tighten the clock screws to 2 N•m (18 lb-in).
2. Install the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Connect the negative battery cable.

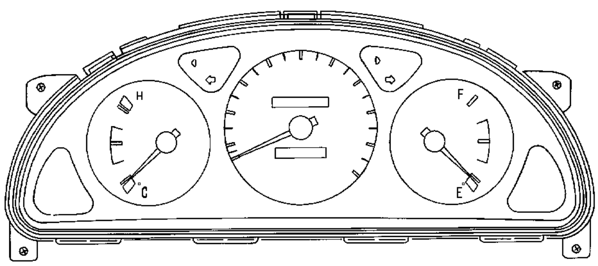


A109E016

INSTRUMENT CLUSTER (STANDARD)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Remove the screws and the instrument cluster.
4. Disconnect the electrical connectors.



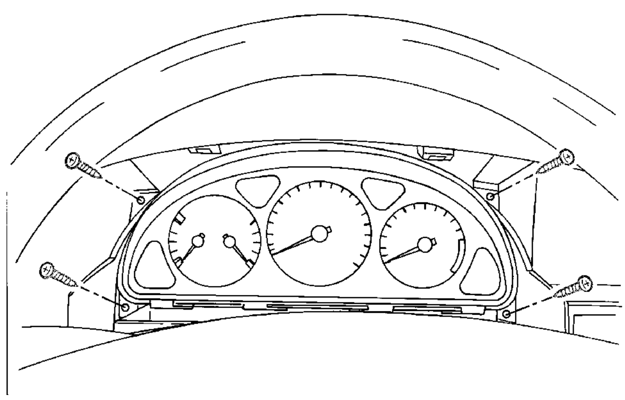
A109E016

Installation Procedure

1. Connect the electrical connectors.
2. Install the instrument cluster with the screws.

   Tighten

   Tighten the instrument cluster screws to 2 N•m (18 lb-in).
3. Install the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
4. Connect the negative battery cable.

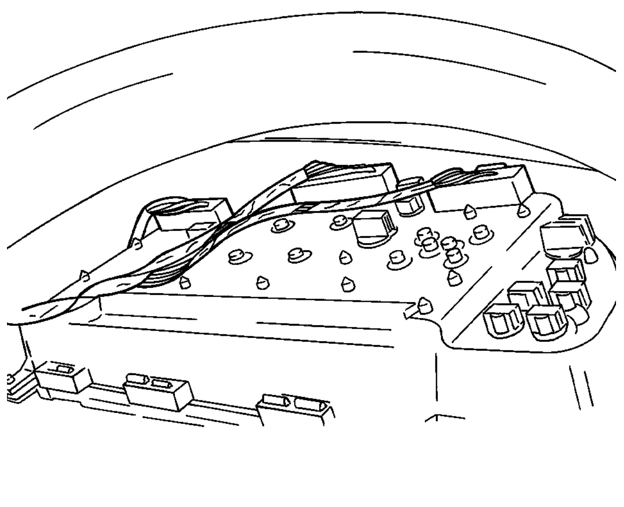


A309E006

INSTRUMENT CLUSTER (DELUXE)

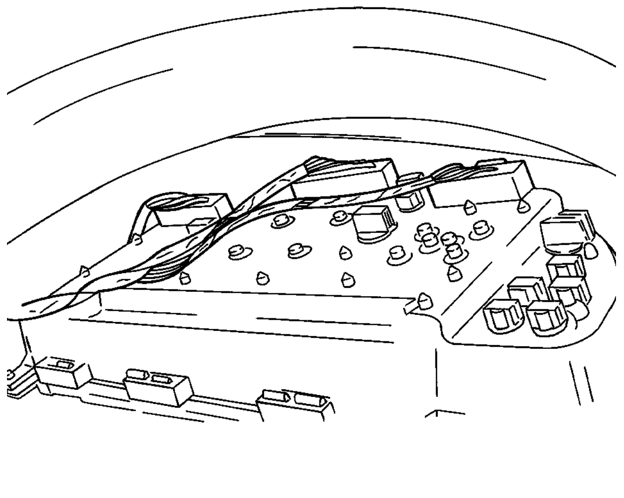
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cluster trim panel. Refer to "Instrument Cluster Trim Panel" in this section.
3. Remove the screws and the instrument cluster.



A109E026

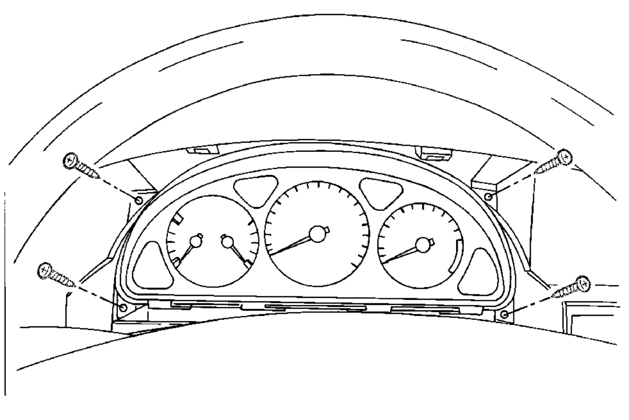
4. Disconnect the instrument cluster electrical connectors.



A109E026

Installation Procedure

1. Connect the instrument cluster electrical connectors.



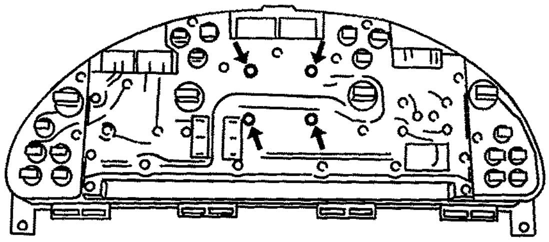
A309E006

2. Install the instrument cluster with the screws.

Tighten

Tighten the instrument cluster screws to 2 N•m (18 lb-in).

3. Install the instrument cluster trim panel. Refer to “Instrument Cluster Trim Panel” in this section.
4. Connect the negative battery cable.

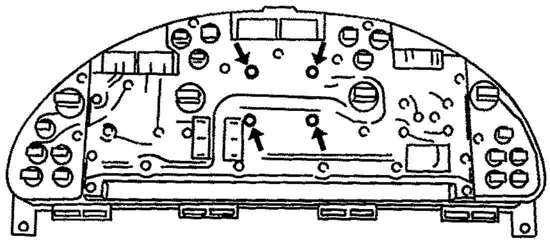


A109E006

SPEEDOMETER/ODOMETER/TRIP ODOMETER

Removal Procedure

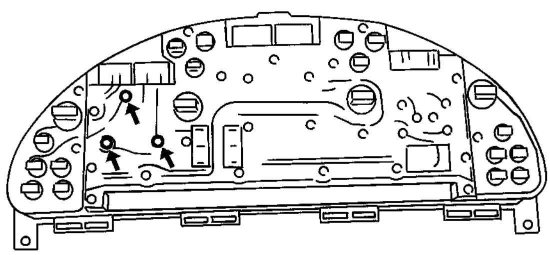
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
3. Remove the instrument cluster lens and the face plate.
4. Remove the screws and the speedometer/odometer from the instrument cluster.



A109E006

Installation Procedure

1. Install the speedometer/odometer to the instrument cluster with the screws.
2. Install the instrument cluster lens and the face plate.
3. Install the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
4. Connect the negative battery cable.

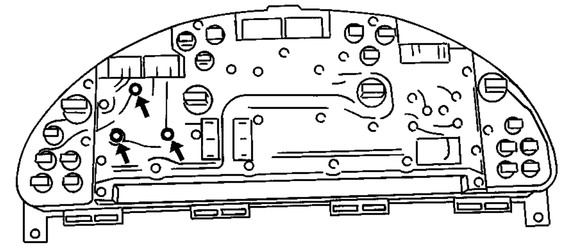


A109E011

TACHOMETER

Removal Procedure

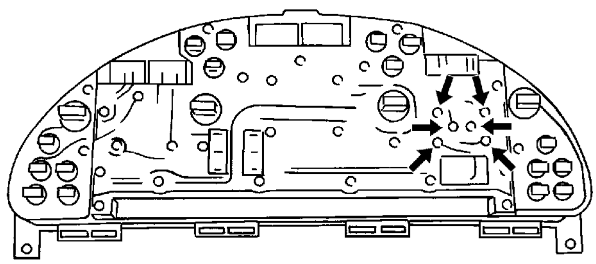
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to "Instrument Cluster (Deluxe)" in this section.
3. Remove the instrument cluster lens and the face plate.
4. Remove the screws and the tachometer from the instrument cluster.



A109E011

Installation Procedure

1. Install the tachometer to the instrument cluster with the screws.
2. Install the instrument cluster lens and the face plate.
3. Install the instrument cluster. Refer to "Instrument Cluster (Deluxe)" in this section.
4. Connect the negative battery cable.

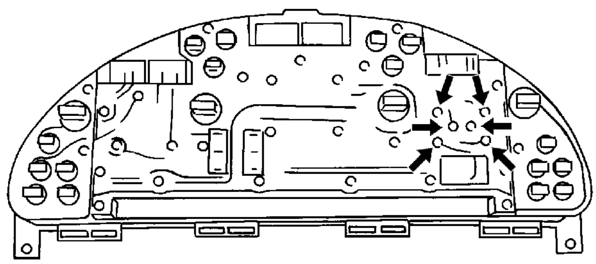


A309E007

TEMPERATURE GAUGE AND FUEL GAUGE (DELUXE CLUSTER)

Removal Procedure

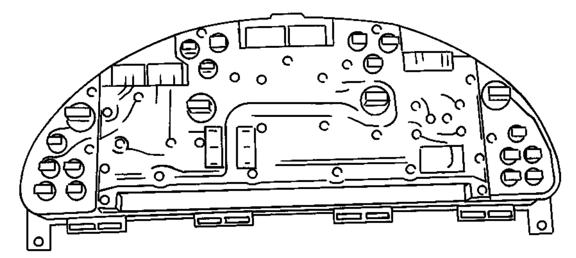
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
3. Remove the instrument cluster lens and the face plate.
4. Remove the screws, the temperature gauge, and fuel gauge from the cluster assembly.



A309E007

Installation Procedure

1. Install the temperature gauge and fuel gauge to the cluster assembly with the screws.
2. Install the instrument cluster lens and the face plate.
3. Install the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
4. Connect the negative battery cable.

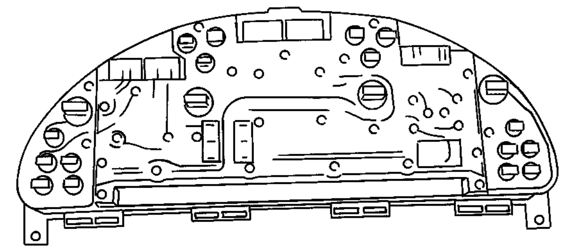


A109E014

INSTRUMENT CLUSTER INDICATOR LAMPS

Removal Procedure

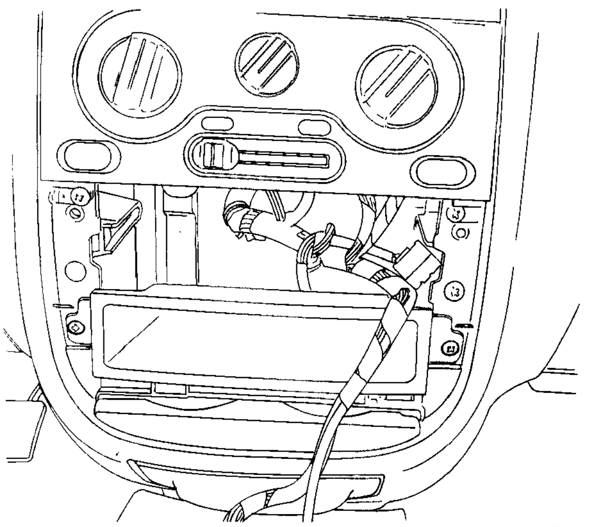
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
3. Remove the bulb from the rear of the cluster.



A109E014

Installation Procedure

1. Install the new bulb.
2. Install the instrument cluster. Refer to "Instrument Cluster (Standard)" or "Instrument Cluster (Deluxe)" in this section.
3. Connect the negative battery cable.



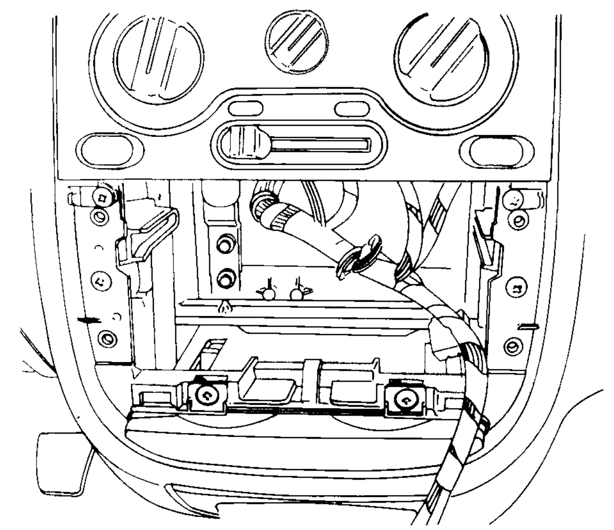
A19E030A

INSTRUMENT PANEL

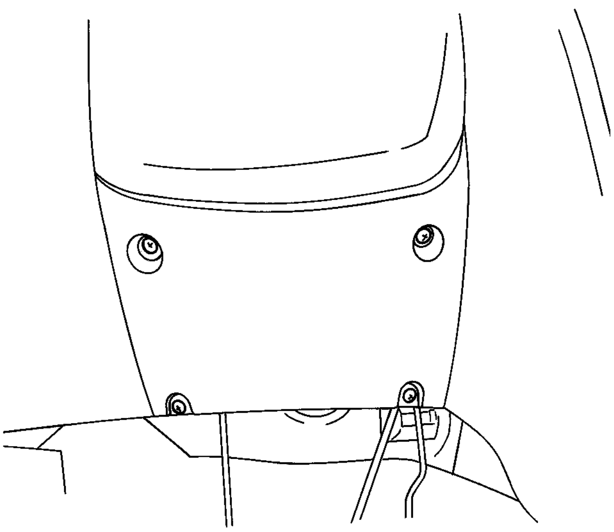
(Typical)

Removal Procedure

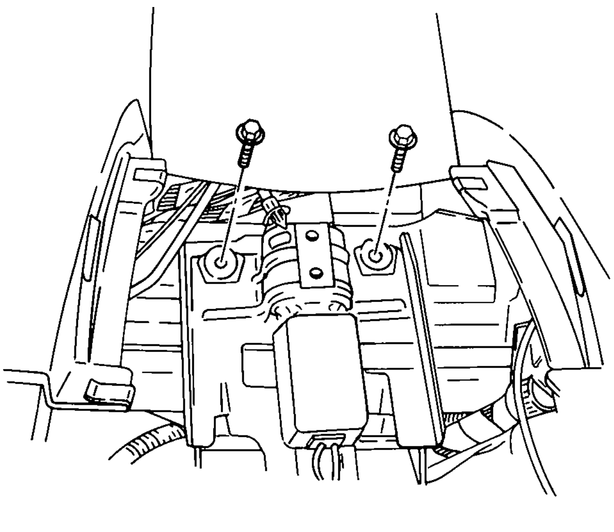
1. Disconnect the negative battery cable.
2. Remove the glove box. Refer to "Glove Box" in this section.
3. Remove the audio system. Refer to Section 9F, Audio Systems.
4. Remove the screws and the deposit box.


A19E031A

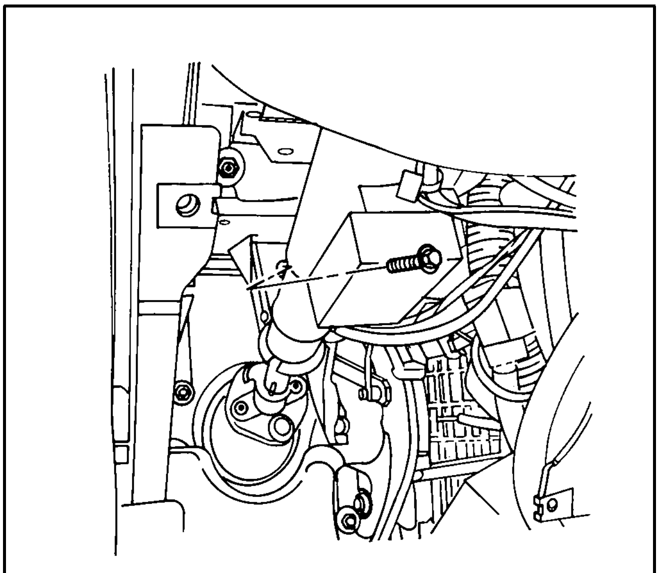
5. Remove the screws and the cupholder.


A109E019

6. Remove the instrument cluster. Refer to "Instrument Cluster (Deluxe)" or "Instrument Cluster (Standard)" in this section.
7. Remove the hood latch release handle. Refer to Section 9R, Body Front End.
8. Remove the screws and the steering column lower trim cover.

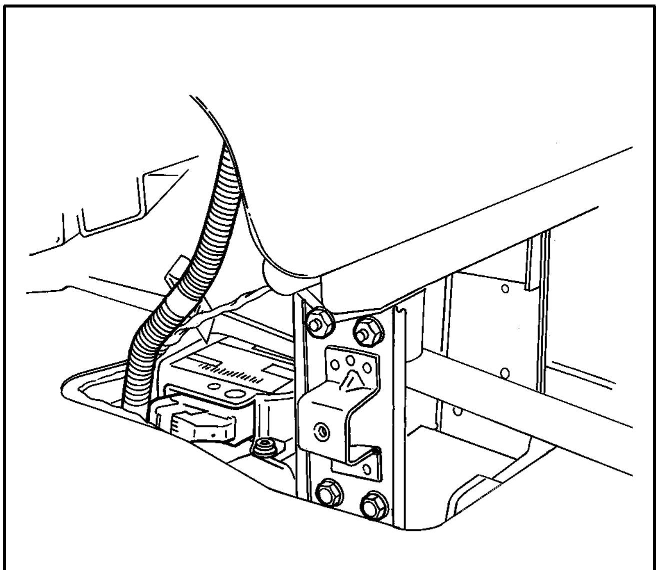

A209E010

9. Remove the nuts and the steering column U-clamp.



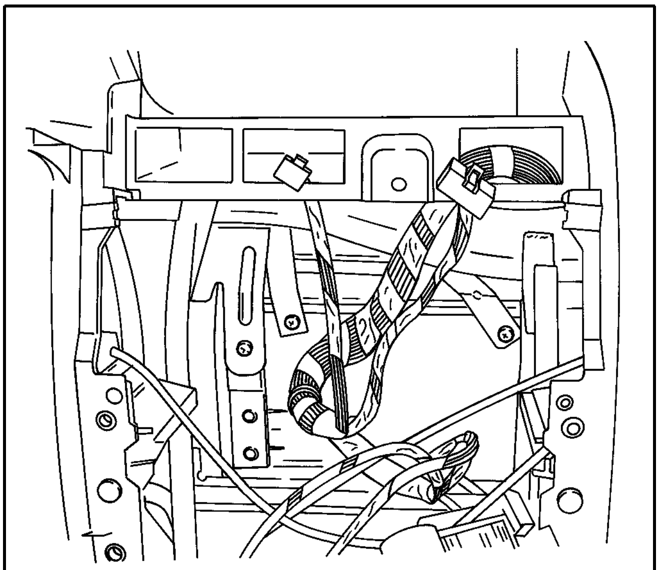
A209E011

10. Remove the nut from the steering column bracket and lower the steering column.



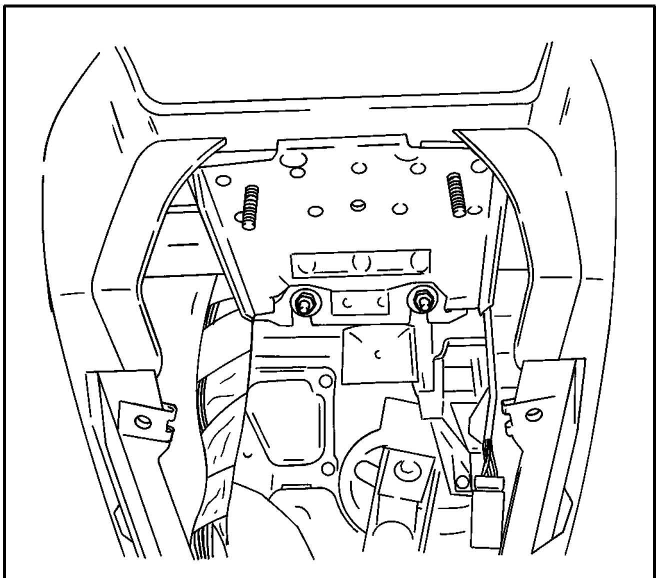
A109G009

11. Remove the floor console. Refer to Section 9G, Interior Trim.
12. Remove the nuts, the bolts, and the floor console braces.

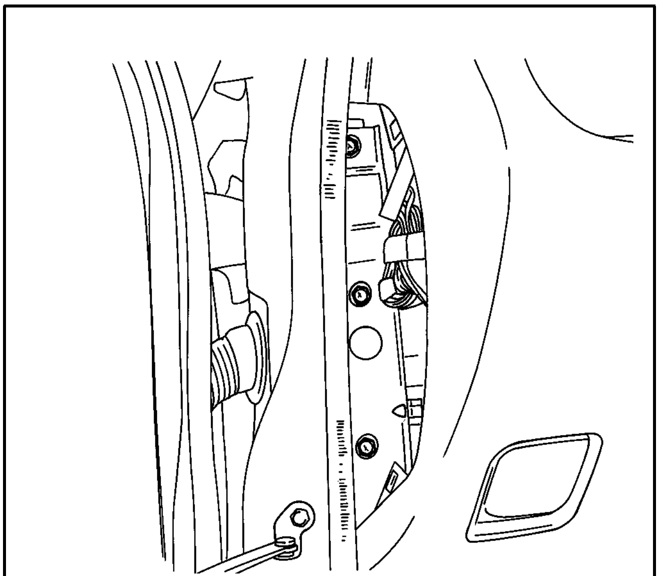


A109E022

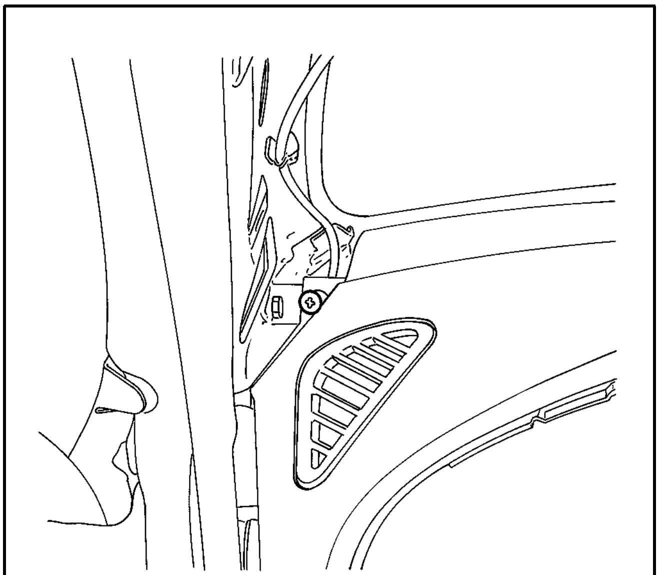
13. Remove the instrument panel bolts behind the heating, ventilation, and air conditioning (HVAC) controls.


A109E023

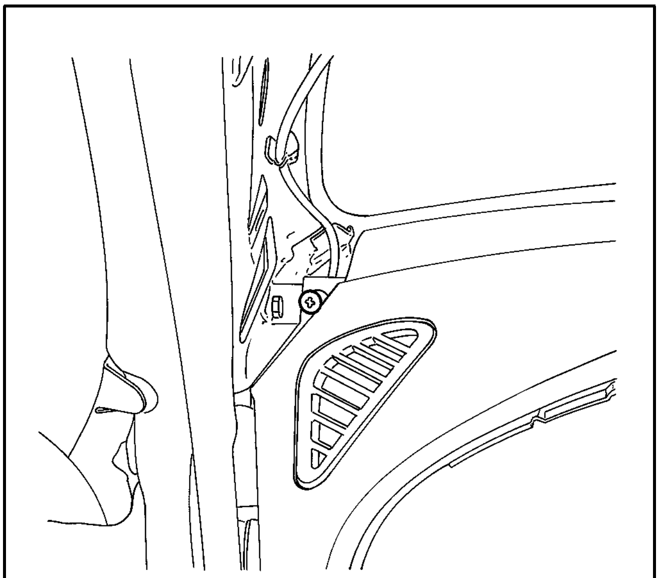
14. Remove the instrument panel nuts above the steering column.


A109E024

15. Remove the trim panels from the ends of the instrument panel to reveal the instrument panel bolts.
16. Remove the instrument panel bolts.


A109E032

17. Remove the A-pillar trim panels to reveal the instrument panel screws.
18. Remove the instrument panel end screws.
19. Disconnect the electrical connectors.
20. Remove the instrument panel from the vehicle.



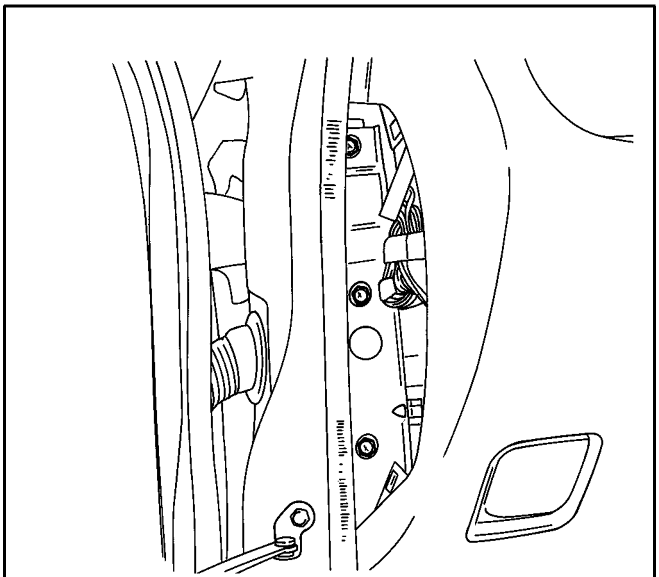
A109E032

Installation Procedure

1. Position the instrument panel in the vehicle.
2. Connect the electrical connectors.
3. Install the screws on the ends of the instrument panel.

Tighten

Tighten the instrument panel end screws to 7 N•m (63 lb-in).

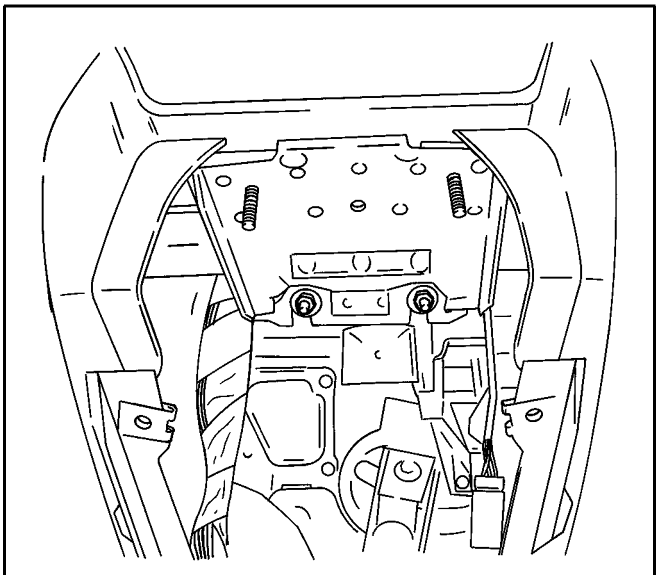


A109E024

4. Install the A-pillar trim panels.
5. Install the bolts on the ends of the instrument panel.

Tighten

Tighten the instrument panel end bolts to 22 N•m (16 lb-ft).

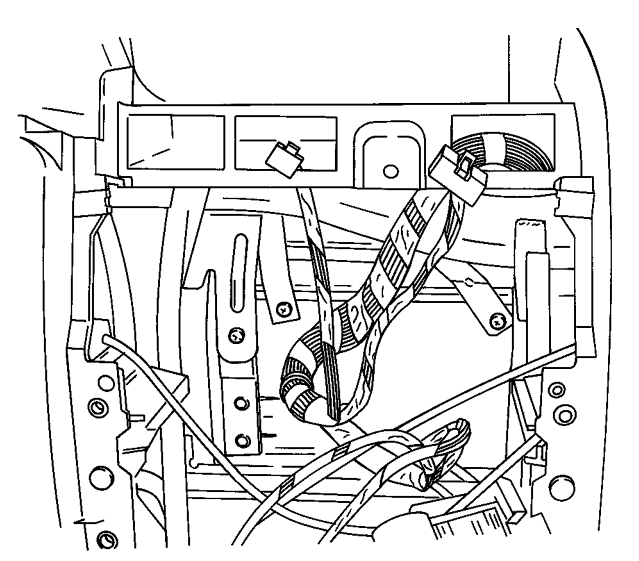


A109E023

6. Install the trim panels to the ends of the instrument panel.
7. Install the instrument panel nuts above the steering column.

Tighten

Tighten the instrument panel nuts above the steering column to 22 N•m (16 lb-ft).

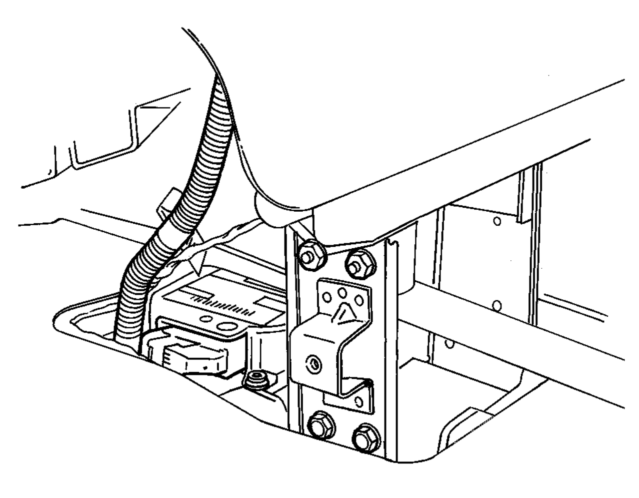


A109E022

8. Install the instrument panel bolts behind the HVAC controls.

Tighten

Tighten the instrument panel bolts behind the HVAC controls to 4 N•m (35 lb-in).



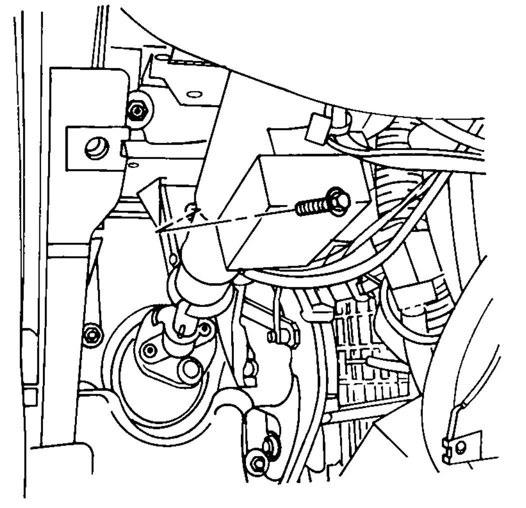
A109G009

9. Install the floor console braces with the bolts and nuts.

Tighten

Tighten the floor console brace bolts to 5 N•m (44 lb-in).

Tighten the floor console brace nuts to 5 N•m (44 lb-in).

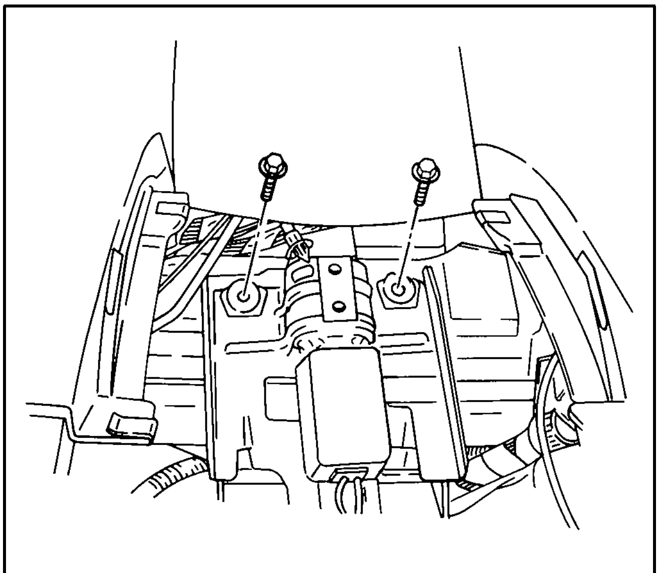


A209E011

10. Install the floor console. Refer to Section 9G, Interior Trim.
11. Reposition the steering column. Secure the steering column bracket with the nut.

Tighten

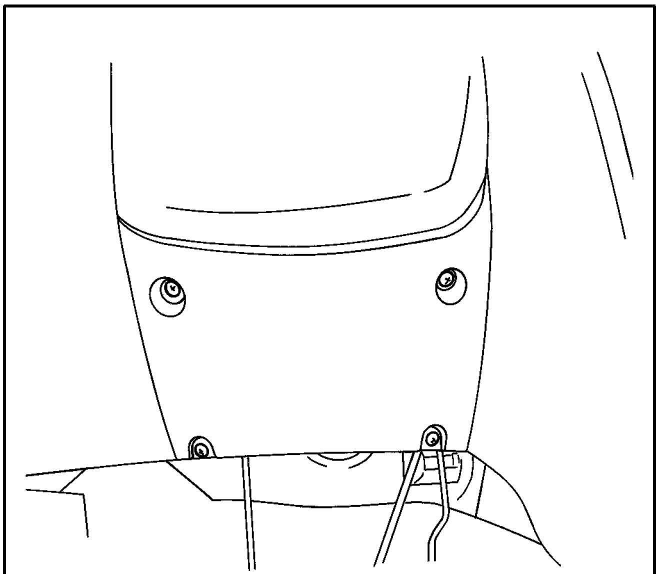
Tighten the steering column bracket nut to 22 N•m (16 lb-ft).


A209E010

12. Install the steering column U-clamp with the nuts.

Tighten

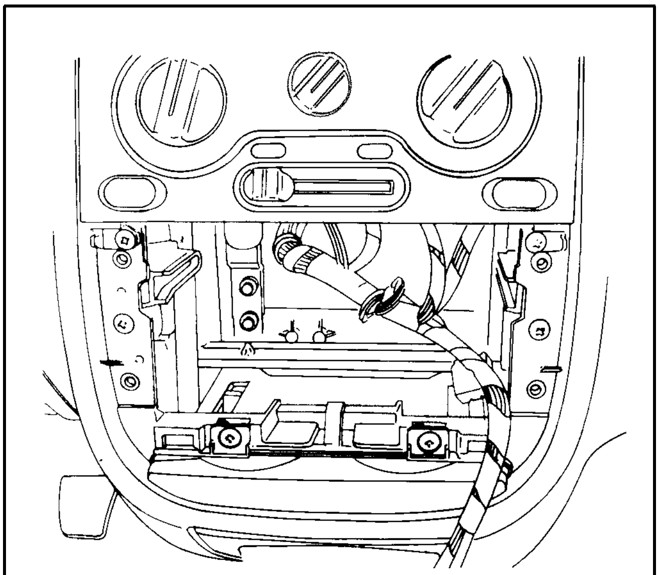
Tighten the steering column U-clamp nuts to 22 N•m (16 lb-ft).


A109E019

13. Install the steering column lower trim cover with the screws.

Tighten

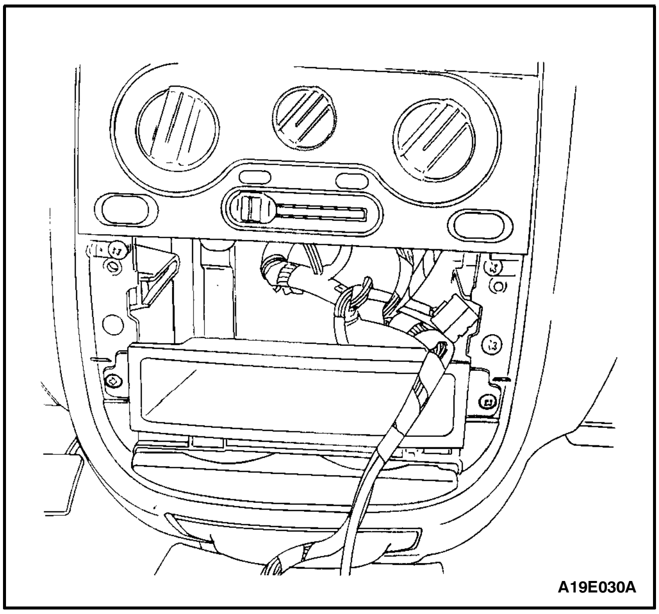
Tighten the steering column lower trim cover screws to 3 N•m (27 lb-in).


A19E031A

14. Install the hood latch release handle. Refer to Section 9R, Body Front End.
15. Install the instrument cluster. Refer to "Instrument Cluster (Deluxe)" or "Instrument Cluster (Standard)" in this section.
16. Install the cupholder with the screws.

Tighten

Tighten the cupholder screws to 2.5 N•m (22 lb-in).

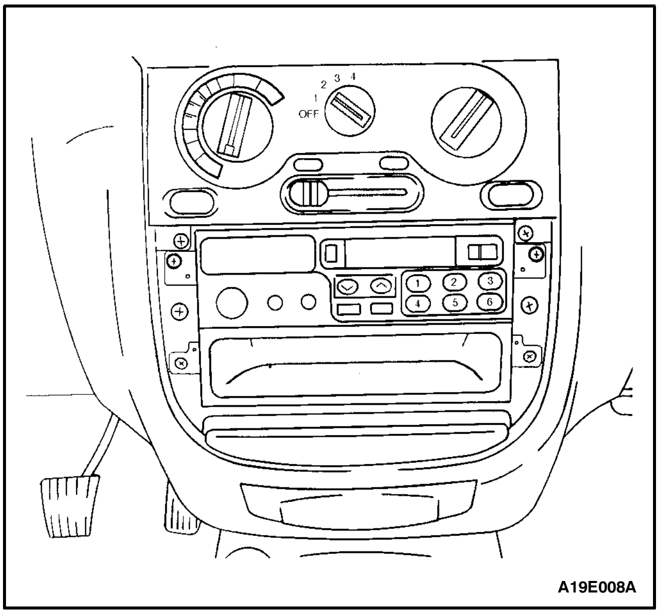


17. Install the deposit box with the screws.

Tighten

Tighten the deposit box screws to 2.5 N•m (22 lb-in).

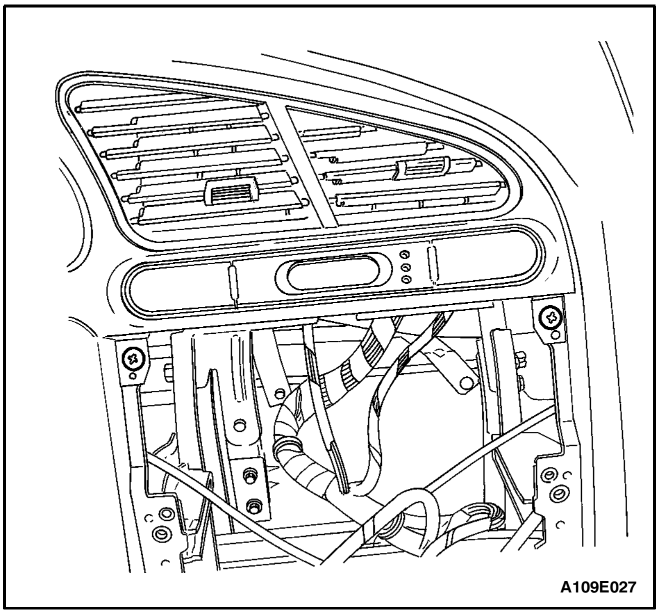
18. Install the audio system. Refer to Section 9F, Audio Systems.
19. Install the glove box. Refer to "Glove Box" in this section.
20. Connect the negative battery cable.



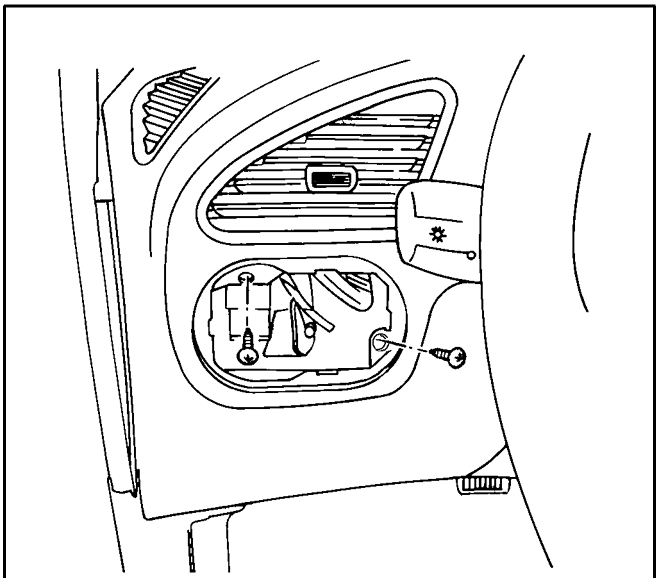
INSTRUMENT CLUSTER TRIM PANEL

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the audio system trim panel.
3. Remove the screws that secure the heating, ventilation, and air conditioning (HVAC) controls and reposition the HVAC controls.

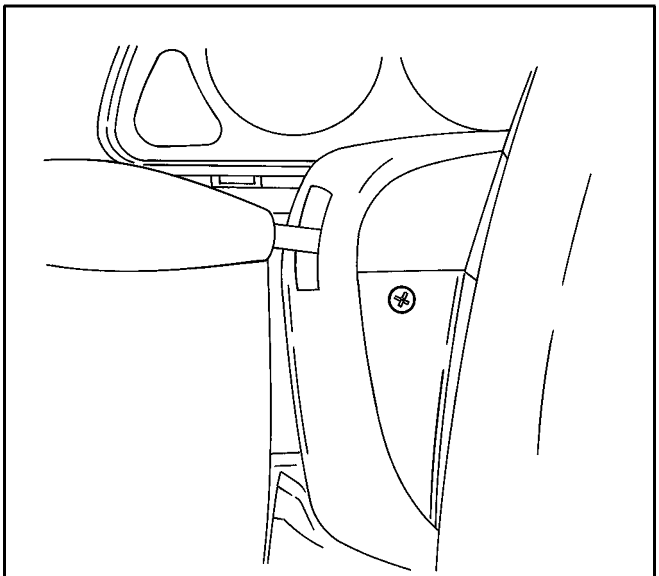


4. Remove the instrument cluster trim panel screws above the HVAC controls.



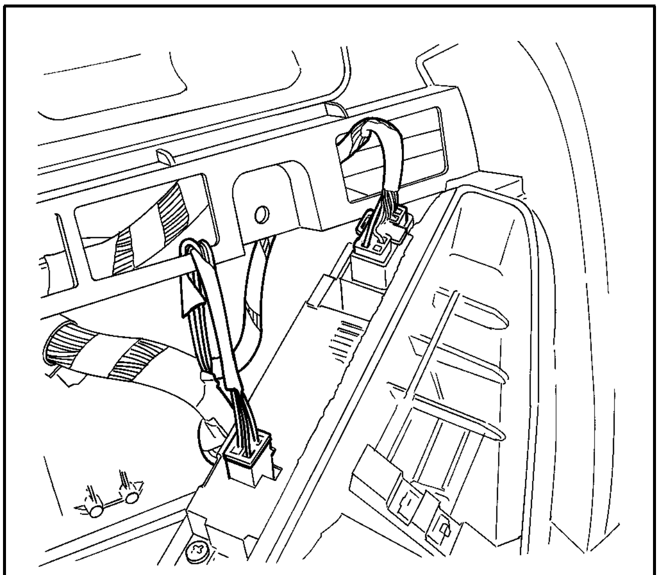
A209E012

5. Remove the instrument cluster trim panel screws above the instrument cluster.
6. Remove the left side trim panel to reveal the instrument cluster trim panel screws.
7. Remove the instrument cluster trim panel screws on the left side.



A109E009

8. Remove the screws and the steering column upper trim cover.

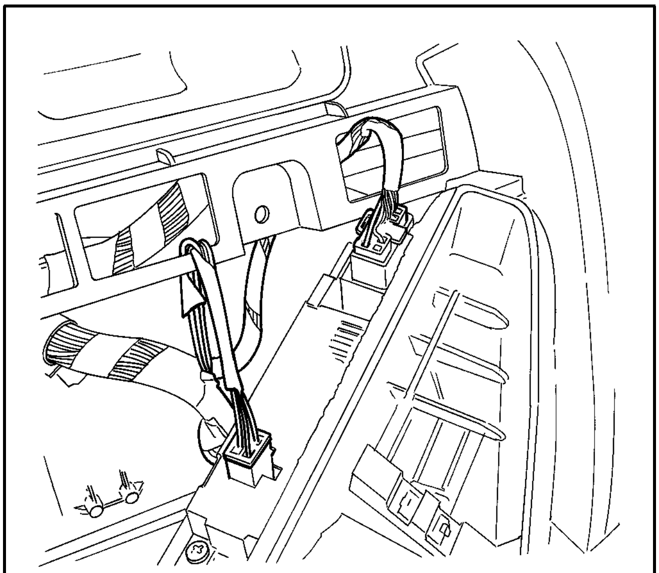


A109E029

9. Remove the instrument cluster trim panel.
10. Disconnect the electrical connectors.

Installation Procedure

1. Connect the electrical connectors.

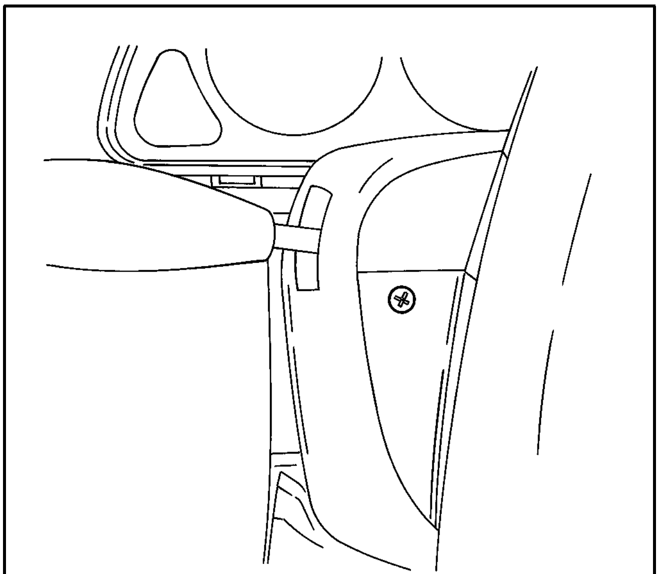


A109E029

2. Install the instrument panel.
3. Install the steering column upper trim cover with the screws.

Tighten

Tighten the steering column upper trim cover screws to 3 N•m (27 lb-in).

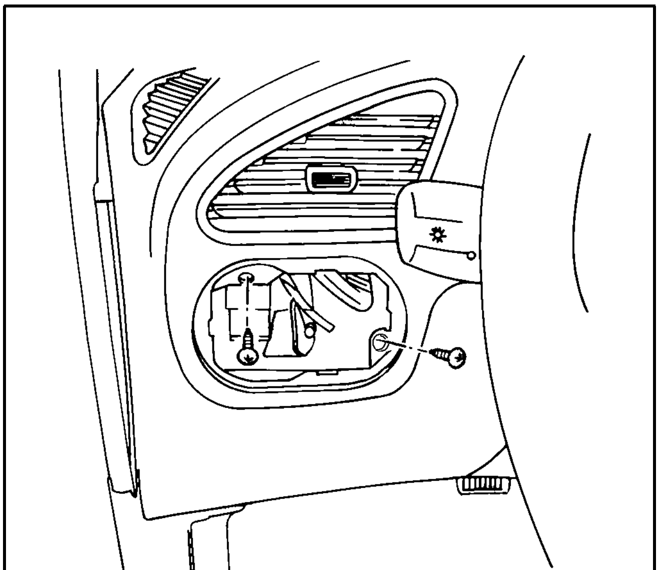


A109E009

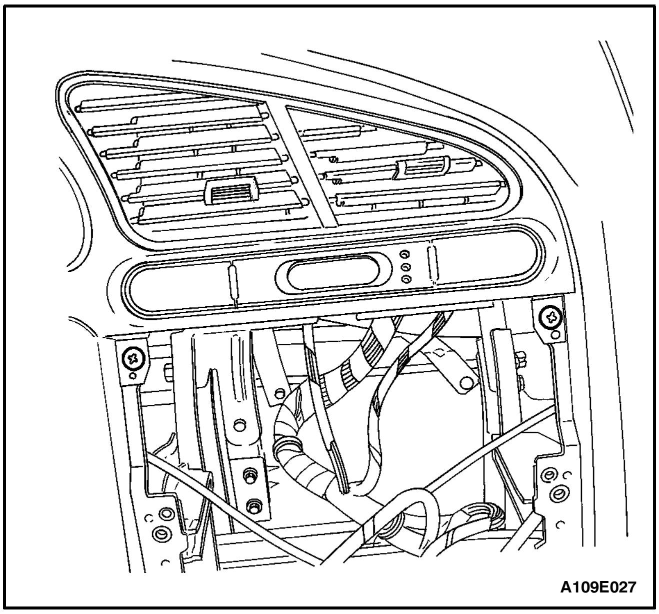
4. Install the instrument cluster trim panel screws on the left side.

Tighten

Tighten the instrument cluster trim panel screws to 2.5 N•m (22 lb-in).



A209E012



A109E027

5. Install the left side trim panel.
6. Install the instrument cluster trim panel screws above the instrument cluster.

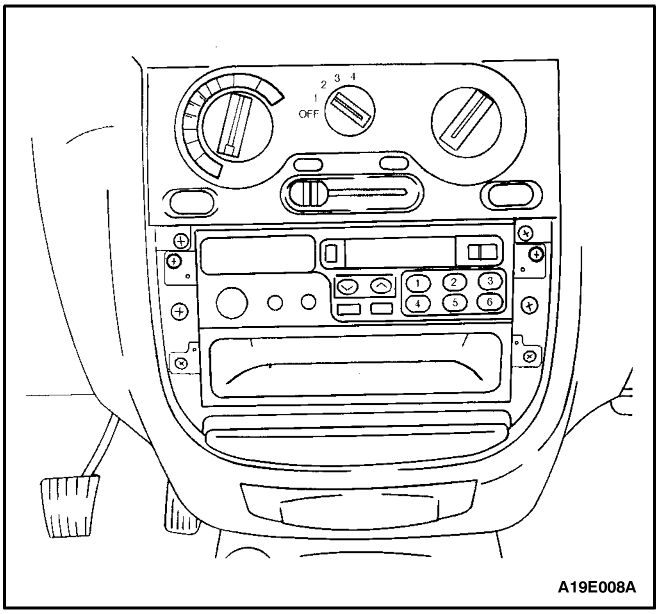
Tighten

Tighten the instrument cluster trim panel screws to 2.5 N•m (22 lb-in).

7. Install the instrument cluster trim panel screws above the HVAC controls.

Tighten

Tighten the instrument cluster trim panel screws to 2.5 N•m (22 lb-in).



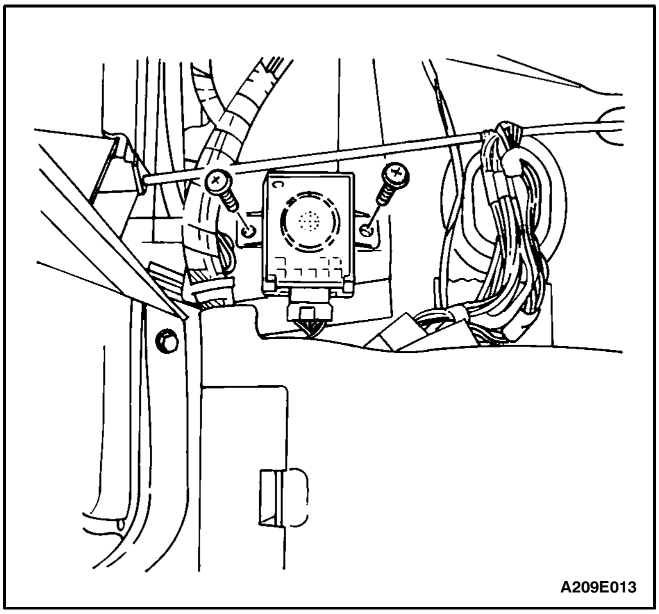
A19E008A

8. Install the HVAC controls with the screws.

Tighten

Tighten the HVAC controls screws to 4 N•m (35 lb-in).

9. Install the audio system trim panel.
10. Connect the negative battery cable.



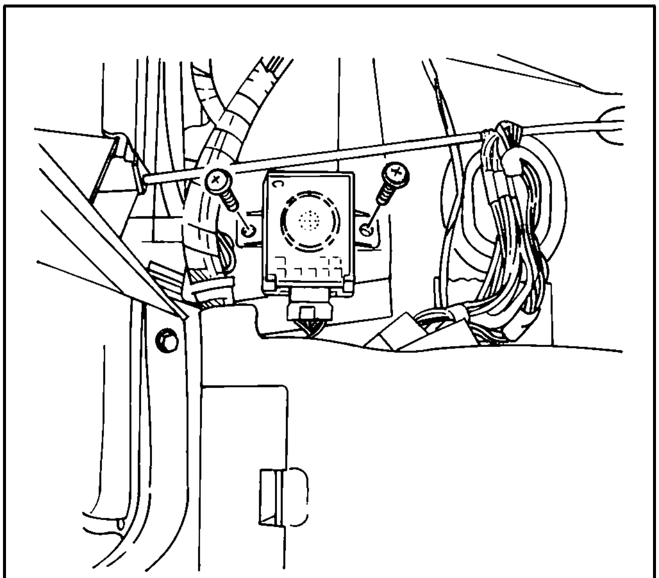
A209E013

CHIME MODULE

(Typical)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the screws and the chime module.
3. Disconnect the electrical connector.


A209E013

Installation Procedure

1. Connect the electrical connector.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the chime module with the screws.

Tighten

Tighten the chime module screws to 3.5 N•m (31 lb-in).

3. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

CIGAR LIGHTER

The cigar lighter is located in the front portion of the floor console. To use the lighter, push it in completely. When the lighter is hot, it will release itself from contact with the heating element. The lighter and the heating element can be damaged if the lighter is not allowed to release itself fully from the heating element.

ASHTRAY

The ashtray is located below the audio system. To access the ashtray, pull it out from the center console. The ashtray lamp will go on when the parking lamps or the headlamps are turned on.

INSTRUMENT PANEL VENTS

The center and the side vents in the instrument panel can be adjusted up and down and from side to side. The side vents can also be aimed toward the side windows in order to defog them.

GLOVE BOX

The glove box can be opened by pulling up on the latch handle. The glove box must be removed in order to gain access to the passenger-side airbag module.

DIGITAL CLOCK

The digital clock is located in the instrument panel, above the audio system. The clock is capable of a 12-hour or a 24-hour display.

INSTRUMENT CLUSTER (STANDARD)

The instrument cluster is located above the steering column and in the instrument cluster trim panel. The instrument cluster contains the instruments that provide the driver with vehicle performance information. The instrument cluster contains a speedometer, an odometer, a trip odometer, a temperature gauge, a fuel gauge, and several indicator lamps. For replacement of the indicator lamp bulbs contained in the instrument cluster, refer to "Instrument Cluster Indicator Lamps Specifications" and "Instrument Cluster Indicacot Lamps" in this section.

INSTRUMENT CLUSTER (DELUXE)

The instrument cluster is located above the steering column and in the instrument cluster trim panel. The instrument cluster contains the instruments that provide the driver with vehicle performance information. The instrument cluster contains a speedometer, an odometer, a trip odometer, a tachometer, a temperature gauge, a fuel gauge, and several indicator lamps. For replacement of the indicator lamp bulbs contained in the instrument cluster, refer to "Instrument Cluster Indicator Lights Specifications" and "Instrument Cluster Indicator Lamp" in this section.

SPEEDOMETER/ODOMETER/TRIP ODOMETER

The speedometer measures the speed of the vehicle in km/h (mph in some countries). It consists of an instrument cluster gauge connected to the vehicle speed sensor (VSS) on the transaxle output shaft.

The odometer measures in kilometers (miles in some countries) the total distance the vehicle has traveled since it was manufactured. It consists of an instrument cluster gauge connected to the VSS on the transaxle output shaft.

The trip odometer measures the distance the vehicle has traveled since the odometer was last reset. It consists of an instrument cluster gauge connected to the VSS on the transaxle output shaft. The trip odometer can be reset to zero at any time so that the driver can record the distance traveled from any starting point.

FUEL GAUGE

The fuel gauge consists of an instrument cluster gauge connected to a sending unit in the fuel tank.

The fuel gauge indicates the quantity of fuel in the tank only when the ignition switch is turned to ON or ACC. When the ignition is turned to LOCK or START, the pointer may come to rest at any position.

TEMPERATURE GAUGE

The temperature gauge consists of an instrument cluster gauge connected to a temperature sensor that is in contact with the circulating engine coolant.

The temperature gauge indicates the temperature of the coolant. Prolonged driving or idling in very hot weather may cause the pointer to move beyond the center of the gauge. The engine is overheating if the pointer moves into the red zone at the upper limit of the gauge.

INSTRUMENT CLUSTER INDICATOR LAMPS

The instrument cluster contains indicator lamps that indicate the functioning of certain systems or the existence of potential problems with the operation of the vehicle. The indicator lamps are replaceable. For replacement of the indicator lamps contained in the instrument cluster, refer to "Instrument Cluster Indicator Lamps Specifications" and "Instrument Cluster Indicator Lamps" in this section.

TACHOMETER (DELUXE CLUSTER)

The tachometer measures the engine's speed in terms of thousands of revolutions per minute (rpm). It consists of an instrument cluster gauge connected to a sending unit in the electronic control module.

Notice: Do not operate the engine in the red zone, or engine damage may occur.

CHIME MODULE

The chime module is located above the instrument panel fuse block and will sound in order to bring attention to one or more of the following conditions:

- The lamps are on, the door is ajar, and the ignition switch is not in ACC, ON, or START.
- The seat belt is unbuckled when the ignition switch is in ON or START.
- The door is open when the ignition switch is in ON or START.
- The vehicle's speed exceeds 120 km/h (75 mph).

SECTION 9F

AUDIO SYSTEMS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

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Audio System Screws	6	-	53
Front Speaker Screws	3	-	27
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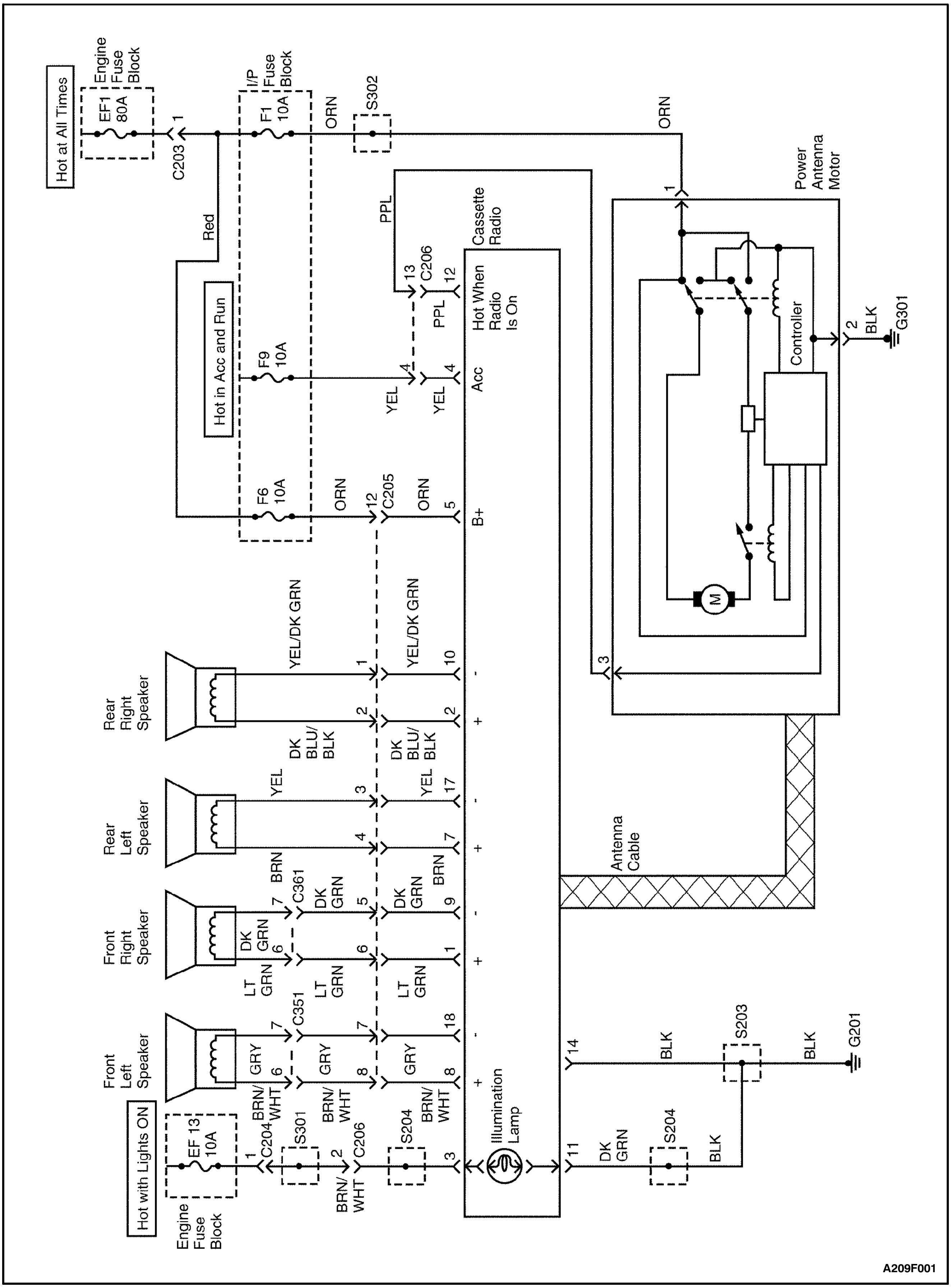
SCHEMATIC AND ROUTING DIAGRAMS

AUDIO SYSTEM CIRCUIT



DIAGNOSIS

STEREO CASSETTE AM/FM RADIO

CD Player Inoperative, AM/FM Functions OK

Step	Action	Value	Yes	No
1	Using a good-quality CD, determine if the CD player performs poorly or is inoperative. Does the CD player function correctly?	-	Go to Step 2	Go to Step 3
2	Inform the customer that the problem is with the CD, not the CD player. Has the customer been informed?	-	System OK	-
3	Check the CD player for obstructions behind the tape door. Is an obstruction found?	-	Go to Step 4	Go to Step 6
4	Check to see if the obstruction can be removed. Can the obstruction be removed?	-	Go to Step 5	Go to Step 6
5	Remove the obstruction. Is the repair complete?	-	System OK	-
6	Replace the CD player. Is the repair complete?	-	System OK	-

AM/FM Cassette Radio Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuses F6 and F9. Are fuses F6 and F9 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuses. Is the repair complete?	-	System OK	-
3	1. Use a voltmeter to test for battery voltage at fuse F1. 2. Turn the ignition ON and test for battery voltage at fuse F9. Does the battery voltage match the specified value at fuses F6 and F9?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the power supply circuit to the fuses. Is the repair complete?	-	System OK	-
5	1. Remove the cassette radio. 2. Turn the ignition ON. 3. Use a voltmeter to test for battery voltage at the audio system connector terminals 4 and 5. Does the battery voltage match the specified value at both terminals?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the audio system connector and the fuse. Is the repair complete?	-	System OK	-
7	Use an ohmmeter to test the ground circuit at the audio system connector terminal 14. Does the resistance match the specified value?	[0 W	Go to Step 9	Go to Step 8

AM/FM Cassette Radio Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
8	Repair the open ground circuit between the audio system connector and ground G201. Is the repair complete?	-	System OK	-
9	Replace the cassette radio. Is the repair complete?	-	System OK	-

Cassette Player Inoperative, AM/FM Functions OK

Step	Action	Value(s)	Yes	No
1	Verify the customer complaint. Does the cassette player destroy tapes?	-	Go to Step 5	Go to Step 2
2	Using a good-quality tape, determine whether the cassette player performs poorly or is inoperative. Does the cassette player perform poorly?	-	Go to Step 5	Go to Step 3
3	Check the cassette player for obstructions behind the tape door. Is an obstruction found?	-	Go to Step 4	Go to Step 8
4	Check to see if the obstruction can be removed using gentle force. Is the obstruction removed?	-	Go to Step 5	Go to Step 6
5	Clean the cassette player head, the capstan, and the drive system. Does the tape play properly?	-	Go to Step 7	Go to Step 6
6	Replace the cassette radio. Is the repair complete?	-	System OK	-
7	Check the cassette player for normal operation. Is the repair complete?	-	System OK	-
8	Advise the owner of a defective or worn tape. Is the repair complete?	-	System OK	-

FM Does Not Work, AM and Cassette OK

Step	Action	Value(s)	Yes	No
1	Check the audio system for normal operation. Is FM inoperative and the rest of the system operating properly?	-	Go to Step 2	System OK
2	Replace the radio. Is the repair complete?	-	System OK	-

AM Radio Does Not Work, FM and Cassette OK

Step	Action	Value(s)	Yes	No
1	1. Unplug the antenna cable from the antenna. 2. Connect the test antenna to the antenna cable. 3. Check the AM radio reception. Is the AM radio operating properly?	-	Go to Step 2	Go to Step 3
2	Replace the antenna. Is the repair complete?	-	System OK	-
3	1. Remove the cassette radio from the instrument panel. 2. Unplug the antenna cable from the audio system. 3. Plug the test cable into the audio system. 4. Check the AM radio reception. Is the AM radio operating properly?	-	Go to Step 4	Go to Step 5
4	Replace the antenna cable between the audio system and the antenna. Is the repair complete?	-	System OK	-
5	Replace the cassette radio. Is the repair complete?	-	System OK	-

SPEAKERS

Front Speakers Distorted or Inoperative, Rest of Audio System OK

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition and the radio ON. 2. Check for distorted or inoperative front speakers using the fader and the balance controls with all of the sources (AM, FM, tape, CD). Are the front speakers distorted?	-	Go to Step 2	Go to Step 4
2	Check the speaker and the door area for damage, rattles, or vibration. Is there anything loose or in the way of the speaker causing the distortion?	-	Go to Step 3	Go to Step 4
3	Make the necessary repairs to secure the component causing the distortion. Is the repair complete?	-	System OK	-
4	1. Remove the front speakers and disconnect the speaker connector. 2. Using an ohmmeter, test the speaker wires for a short to ground. Does the ohmmeter show the specified value?	R	Go to Step 6	Go to Step 5
5	Repair the short circuit between the front speaker connector and the radio connector. Is the repair complete?	-	System OK	-
6	Substitute a known good speaker for the speaker causing the distortion. Is the distortion eliminated?	-	Go to Step 7	Go to Step 8
7	Replace the speaker. Is the repair complete?	-	System OK	-
8	Replace the cassette radio. Is the repair complete?	-	System OK	-

Rear Speakers Distorted or Inoperative, Rest of Audio System OK

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition and the radio on. 2. Check for distorted or inoperative rear speakers using the fader and the balance controls with all the of the sources (AM, FM, tape, CD). Are the rear speakers distorted?	-	Go to Step 2	Go to Step 4
2	Check the speakers, the rear deck, and the trunk area for damage, rattles, or vibration. Is there anything loose or in the way of the speaker causing the distortion?	-	Go to Step 3	Go to Step 4
3	Make the necessary repairs to secure the component causing the distortion. Is the repair complete?	-	System OK	-
4	1. Disconnect the rear speakers. 2. Using an ohmmeter, test the speaker wires for a short to ground. Does the ohmmeter show the specified value?	R	Go to Step 6	Go to Step 5
5	Repair the short circuit between the rear speaker connector and the radio connector. Is the repair complete?	-	System OK	-
6	Substitute a known good speaker for the speaker causing the distortion. Is the distortion eliminated?	-	Go to Step 7	Go to Step 8
7	Replace the speaker. Is the repair complete?	-	System OK	-
8	Replace the audio system. Is the repair complete?	-	System OK	-

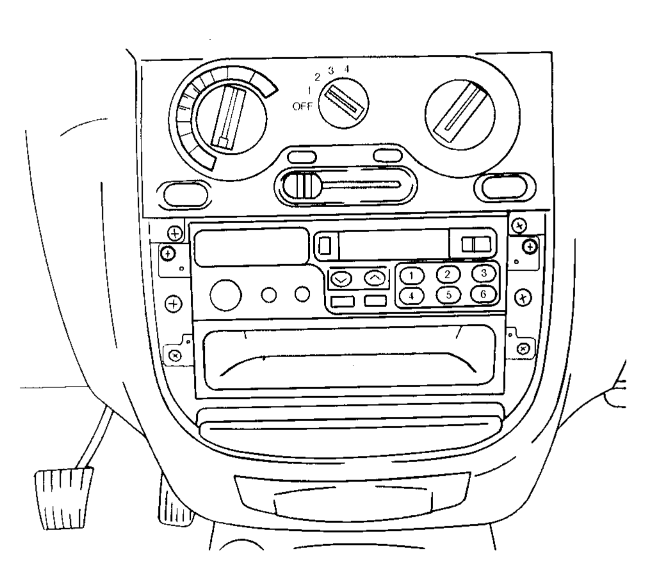
ANTENNA

Power Antenna Does Not Work

Step	Action	Value(s)	Yes	No
1	Check fuse F1. Is fuse F1 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to test for battery voltage at fuse F1. Does the battery voltage match the specified value?	11-14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit to fuse F1. Is the repair complete?	-	System OK	-
5	Use a voltmeter to test for battery voltage at power antenna connector terminal 1. Does the battery voltage match the specified value?	11-14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the power antenna connector terminal 1 and fuse F1. Is the repair complete?	-	System OK	-

Power Antenna Does Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
7	Use an ohmmeter to test the ground circuit at the power antenna connector terminal 2. Does the resistance match the specified value?	[0 W	Go to Step 9	Go to Step 8
8	Repair the open ground circuit between the power antenna connector terminal 2 and ground G301. Is the repair complete?	-	System OK	-
9	1. Turn the ignition ON. 2. Turn the radio ON. 3. Use a voltmeter to test for battery voltage at the power antenna connector terminal 3. Does the battery voltage match the specified value?	11-14 v	Go to Step 10	Go to Step 11
10	Replace the power antenna motor assembly. Is the repair complete?	-	System OK	-
11	1. Turn the ignition ON. 2. Turn the radio ON. 3. Use a voltmeter to test for battery voltage at radio terminal 12. Does the battery voltage match the specified value?	11-14 v	Go to Step 12	Go to Step 13
12	Repair the open circuit between the radio connector and the power antenna connector terminal 3. Is the repair complete?	-	System OK	-
13	Replace the cassette radio. Is the repair complete?	-	System OK	-



A19F001A

MAINTENANCE AND REPAIR

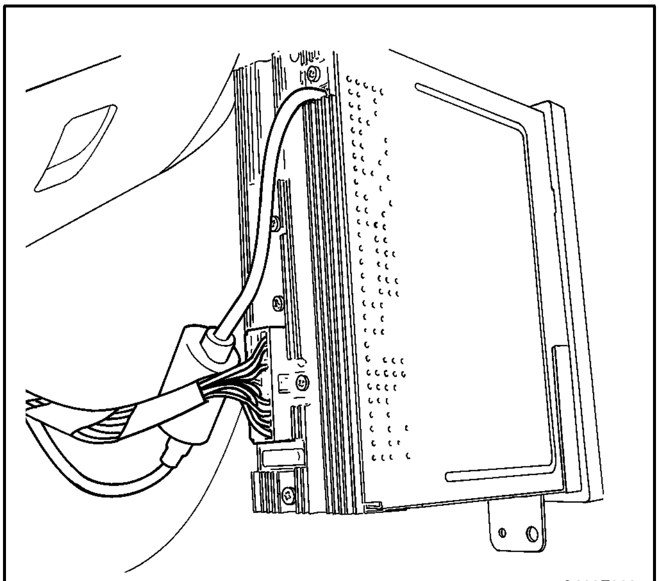
ON-VEHICLE SERVICE

AUDIO SYSTEM

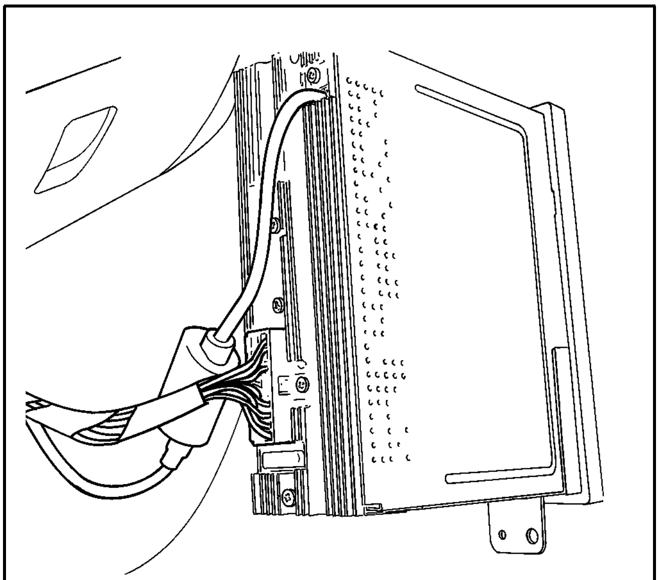
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the audio system trim plate.
3. Remove the screws and the audio system.

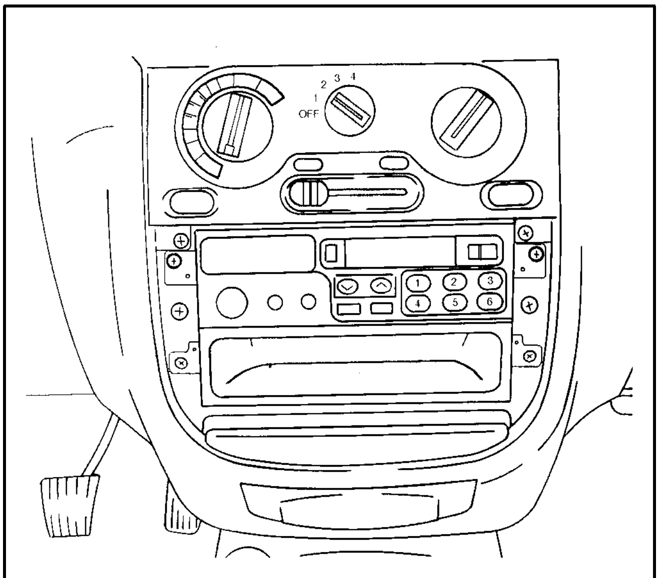

A109F002

4. Disconnect the audio system electrical connector and the antenna cable.


A109F002

Installation Procedure

1. Connect the audio system electrical connector and the antenna cable.

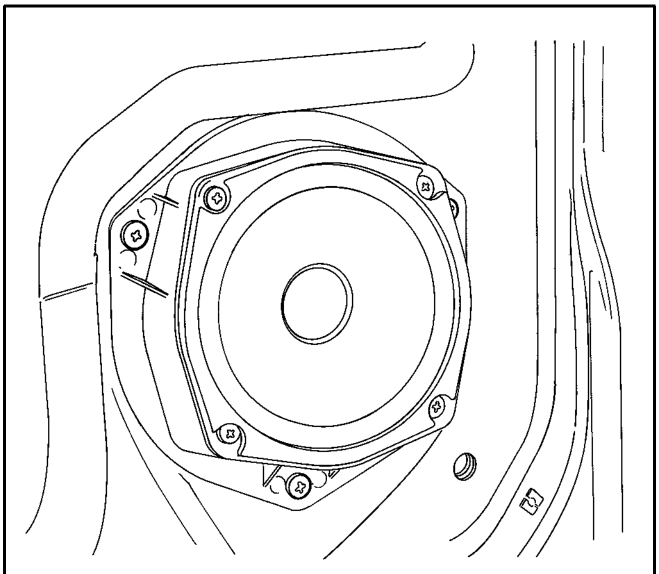


A19F001A

2. Install the audio system with the screws.

   Tighten

   Tighten the audio system screws to 6 N•m (53 lb-in).
3. Install the audio system trim plate.
4. Connect the negative battery cable.
5. Enter the audio security system four-digit code. Refer to “Audio Security System” in this section.

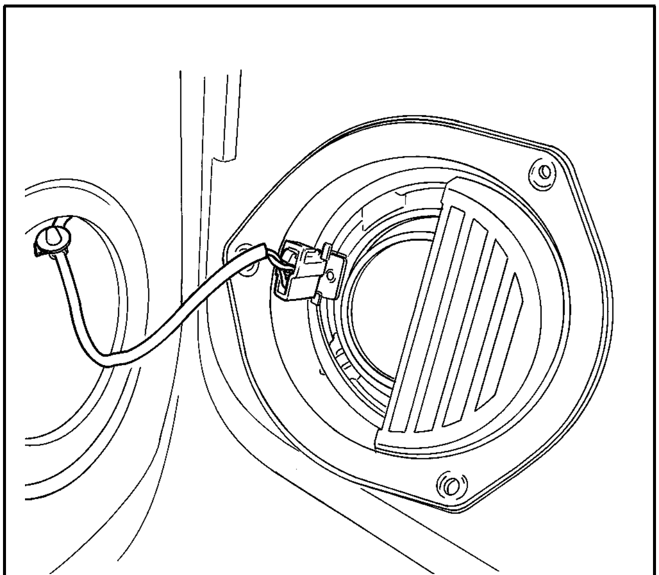


A109F003

FRONT SPEAKERS

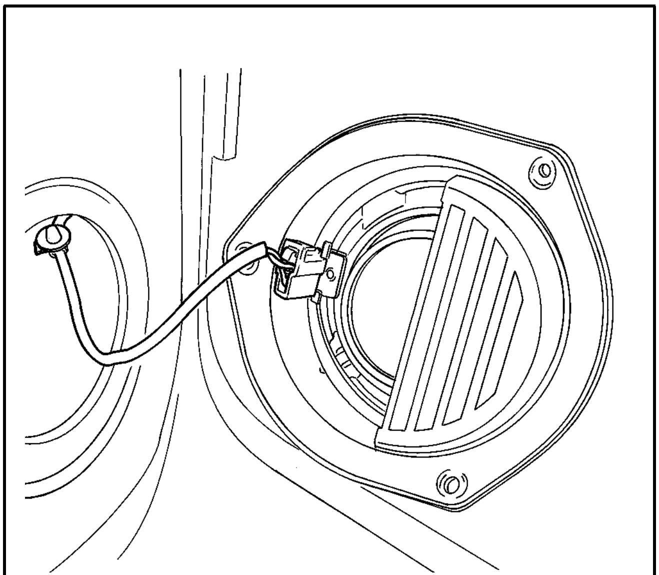
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the front door trim panel. Refer to Section 9G, Interior Trim.
3. Remove the screws and the front speaker.



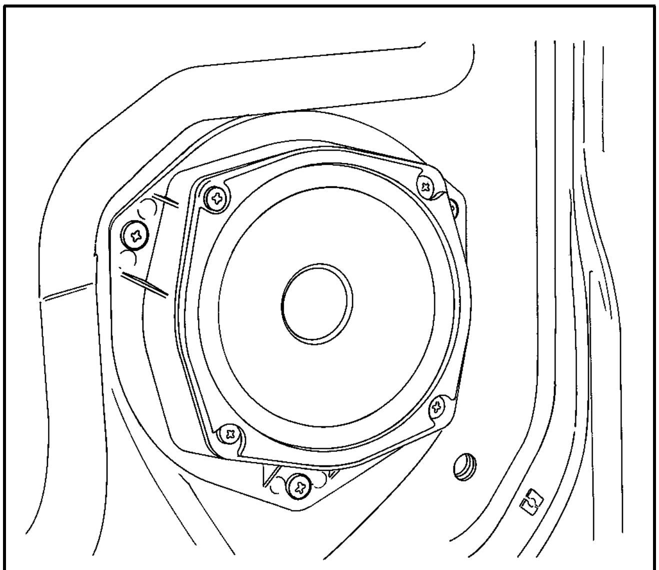
A109F004

4. Disconnect the electrical connector.


A109F004

Installation Procedure

1. Connect the electrical connector.

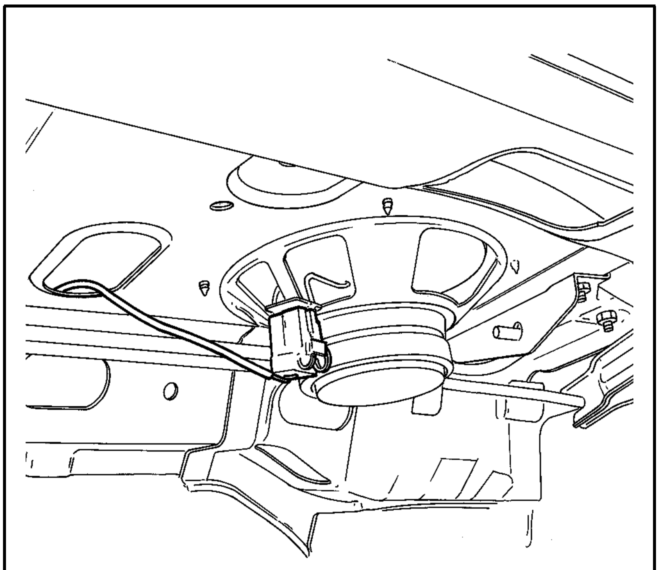

A109F003

2. Install the front speaker with the screws.

Tighten

Tighten the front speaker screws to 3 N•m (27 lb-in).

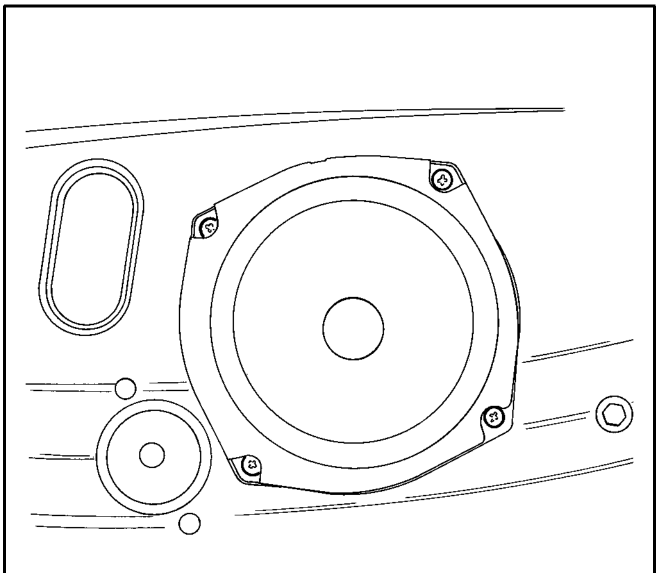
3. Install the front door trim panel. Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.


A109F006

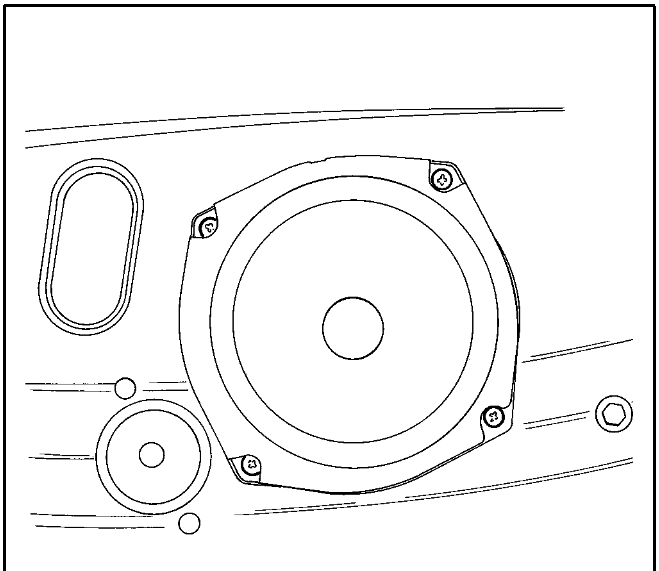
REAR SPEAKERS (NOTCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the deck lid sill plate trim cover. Refer to Section 9G, Interior Trim.
3. Disconnect the electrical connector.


A109F005

4. Remove the screws and the rear speakers.

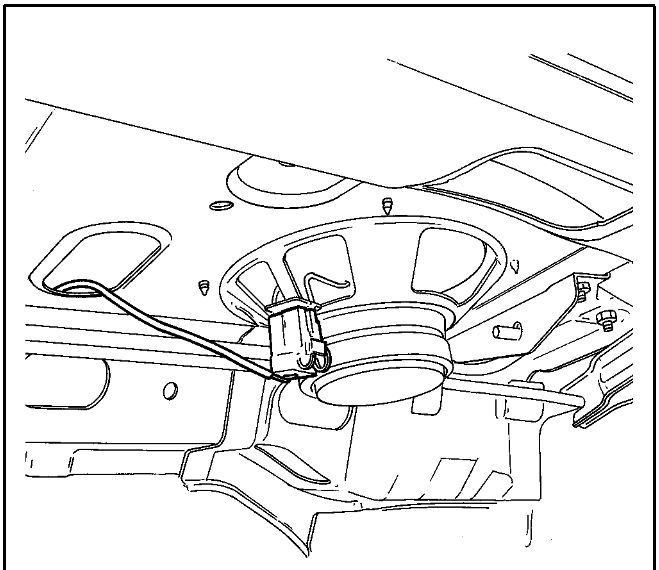

A109F005

Installation Procedure

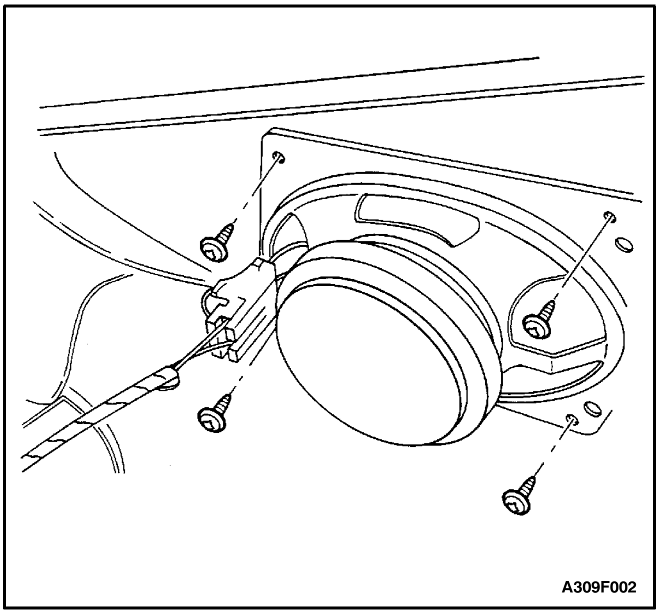
1. Install the rear speakers with the screws.

Tighten

Tighten the rear speaker screws to 3 N•m (27 lb-in).


A109F006

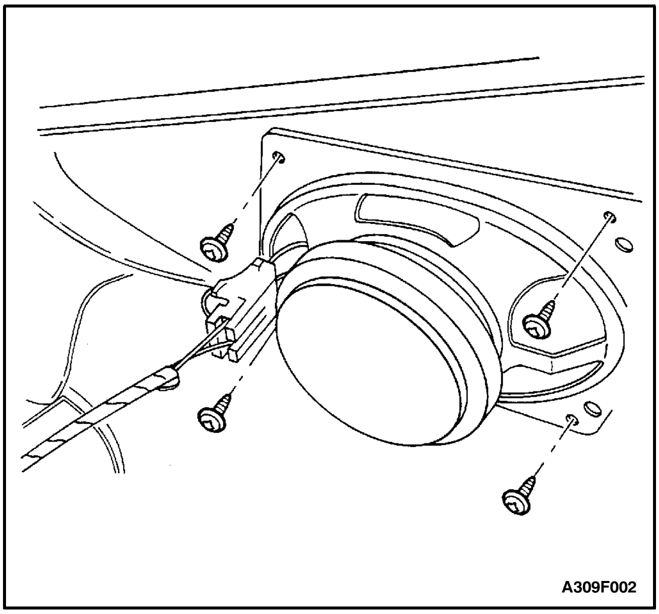
2. Connect the electrical connector.
3. Install the rear seatback and the rear seat cushion. Refer to Section 9H, Seats.
4. Connect the negative battery cable.



REAR SPEAKERS (HATCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the luggage compartment wheelhouse trim panel (hatchback). Refer to Section 9G, Interior Trim.
3. Disconnect the electrical connector.
4. Remove the screws and the rear speaker.



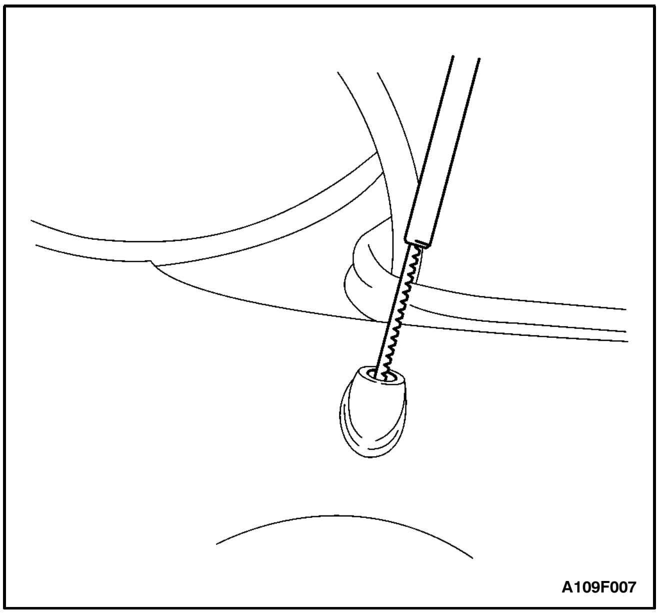
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear speaker with the screws.

   Tighten

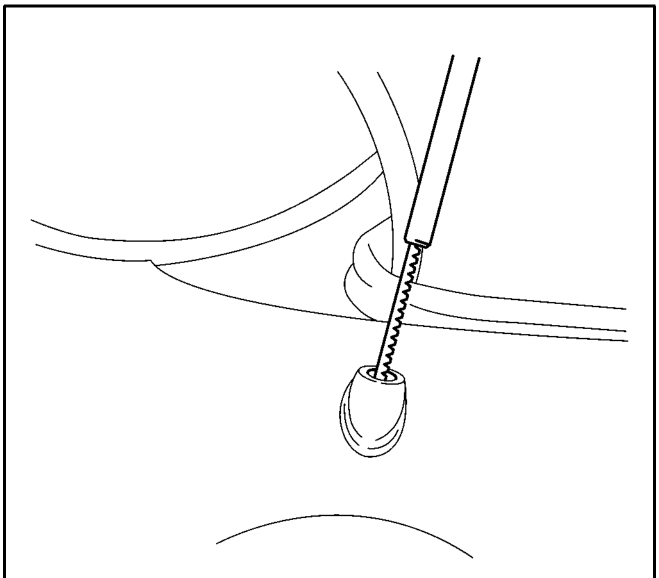
   Tighten the rear speaker screws to 3 N•m (27 lb-in).
2. Connect the electrical connector.
3. Install the luggage compartment wheelhouse trim panel (hatchback). Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.



POWER ANTENNA MAST

Removal Procedure

1. Remove the luggage compartment rear quarter trim panel. Refer to Section 9G, Interior Trim.
2. Remove the antenna cap nut.
3. Turn on the radio and remove the antenna mast and cable.



A109F007

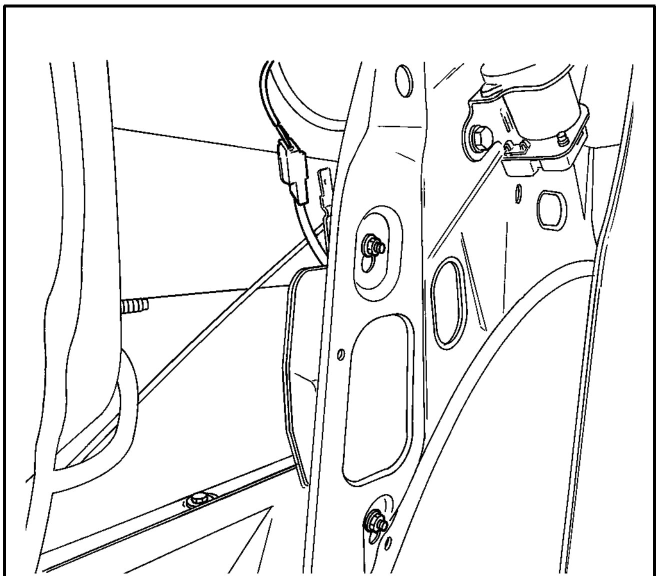
Installation Procedure

1. Install the antenna mast with the teeth of the cable facing the rear of the vehicle.
2. Turn off the radio.
3. Install the antenna cap nut.

Tighten

Tighten the antenna cap nut to 5.5 N•m (49 lb-in).

4. Install the luggage compartment rear quarter trim panel. Refer to Section 9G, Interior Trim.



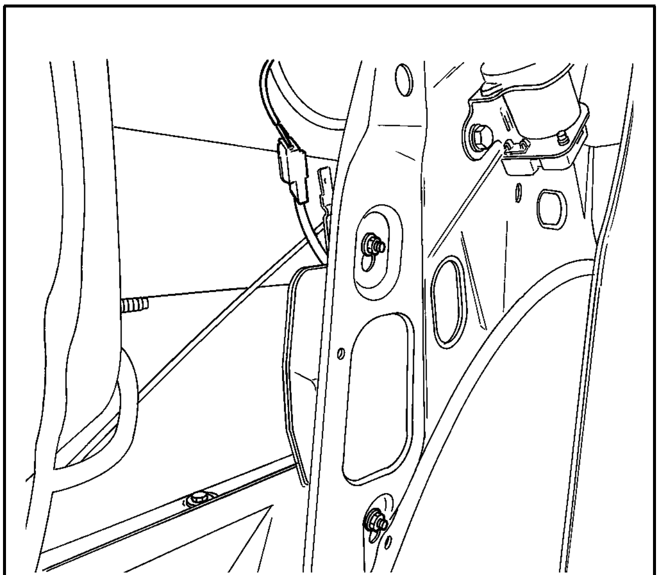
A109F008

POWER ANTENNA MOTOR/MANUAL ANTENNA

(Hatchback Shown, Notchback Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the luggage compartment rear quarter trim panel. Refer to Section 9G, Interior Trim.
3. Remove the antenna cap nut.
4. Loosen the nuts securing the antenna motor to the vehicle. (Power antenna shown, manual antenna similar).
5. Remove the antenna motor, if equipped.
6. Disconnect the electrical connectors, if equipped.



A109F008

Installation Procedure

1. Connect the electrical connectors, if equipped.
2. Install the antenna motor with the nuts. (Power antenna shown, manual antenna similar.)

Tighten

Tighten the antenna motor nuts to 4 N•m (35 lb-in).

3. Install the luggage compartment rear quarter trim panel. Refer to Section 9G, Interior Trim.
4. Install the antenna cap nut.

Tighten

Tighten the antenna cap nut to 5.5 N•m (49 lb-in).

5. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

STEREO CASSETTE AM/FM RADIO

The stereo cassette AM/FM radio and the compact disc player are offered as optional equipment. All audio systems use four speakers: two speakers mounted in the front doors and two speakers mounted in the rear deck lid sill plate.

AUDIO SECURITY SYSTEM

The audio security system is activated whenever the audio system circuit is disconnected from the battery. A four-digit security code must be entered in order for the audio system to resume functioning. The security code is stamped on a card located in the vehicle (usually in the glove box). The following security code entering procedure can be used to activate this audio security system:

1. With the ignition switch in the ACC or on position, turn the radio on. At this time, "CODE" will be shown on the radio display, accompanied by chime sounds.
2. Enter the four-digit security number using the radio preset buttons 1 through 6, (or 1 through 8 if equipped).
3. After all four digits are entered, the digits will blink three times, and the radio will be functional.

Wrong Code:

If the wrong code is entered, "ERR" will briefly appear on the display. After this "CODE" will appear, and the code entering procedure can be performed once again. If the correct code is not entered within 10 minutes, the radio should be disconnected from the battery to reset the audio system. After connecting the battery, repeat the code entering procedure.

FRONT AND REAR SPEAKERS

All audio systems use four speakers: two speakers mounted in the front doors and two speakers mounted in the rear deck lid sill plate, on the notchback. On the hatchback, the rear speakers are mounted behind the luggage compartment wheelhouse trim panel. A coaxial two-way rear speaker is offered as an option.

MANUAL ANTENNA

The manual antenna is designed to withstand most car washes without damage. The antenna can be adjusted up or down by hand. If the mast becomes slightly bent, you can straighten it by hand. The manual antenna can be replaced if it is severely bent. Manual antennas must be kept clean for good performance.

POWER ANTENNA

The power antenna is controlled by the radio. When the radio power is turned on, the antenna is extended. When the radio is turned off, either by turning the power off or by turning the ignition switch off, the antenna is retracted.

TAPE PLAYER AND CASSETTE CARE

The head and the capstan are the two parts of the tape player that should be cleaned. This service should be performed every 100 hours of cassette operation.

In order to clean the head and the capstan, use a cotton swab dipped in rubbing alcohol.

A cassette cleaning kit may also be used to clean the head and the capstan. Follow the cleaning kit instructions to clean the tape player.

Do not touch the tape head with magnetized tools. If the head becomes magnetized, it will degrade cassettes played in the player. No service is performed on the cassettes. The cassette manufacturer handles warranties of the cassettes. Store cassettes away from extreme heat and direct sunlight.

COMPACT DISC CARE

Handle discs carefully. Store the discs in protective cases away from the sun, heat, and dust. If the surface is soiled, dampen a clean, soft cloth in a solution of mild neutral detergent and wipe the disc clean. Mini discs (about 3 inches in diameter), will not eject and should not be used.

SECTION 9G

INTERIOR TRIM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

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Front Floor Console Screw	4	-	35
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Seat Belt Anchor Bolt	35	26	-
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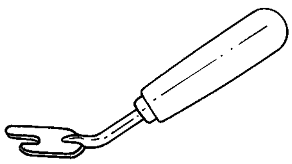
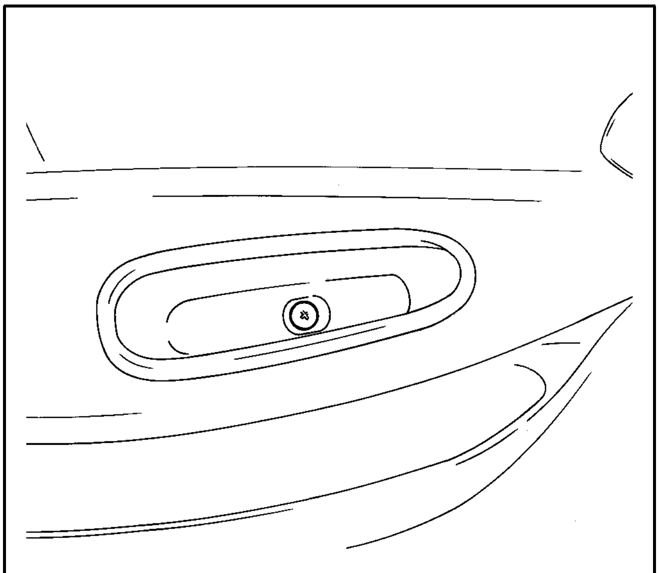
Trim Panel Screws	3	-	27

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A109G029	KM-475-B Trim Remover


A109G001

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

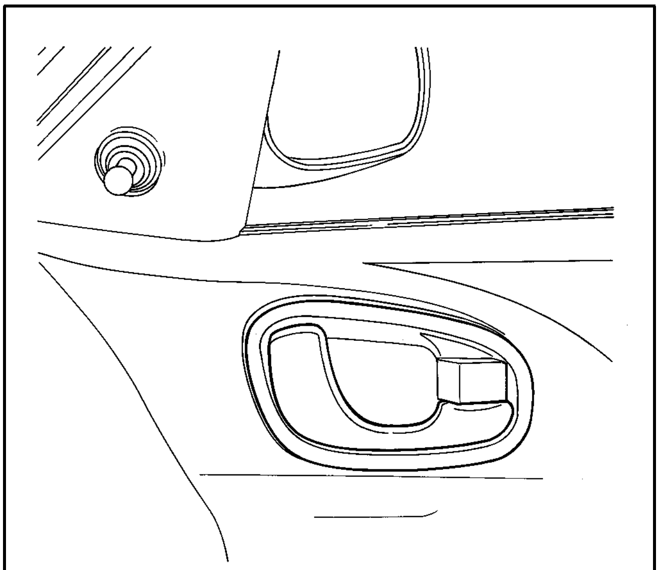
FRONT DOOR TRIM PANEL

Tools Required

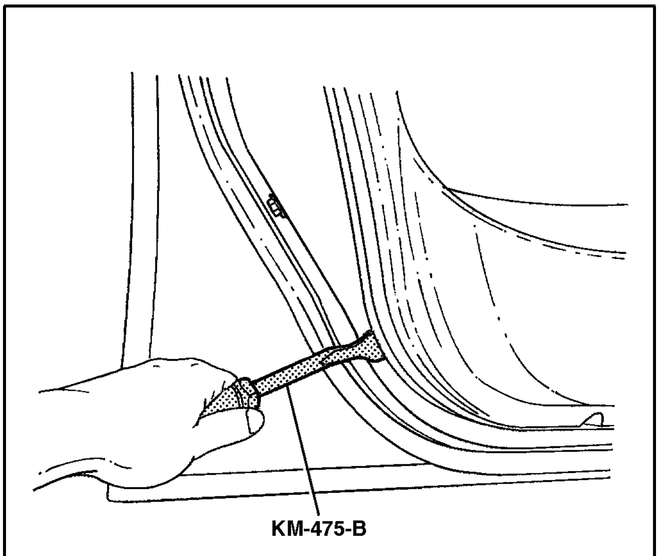
KM-475-B Trim Remover

Removal Procedure

1. Lower the front window.
2. Remove the door pull screw.

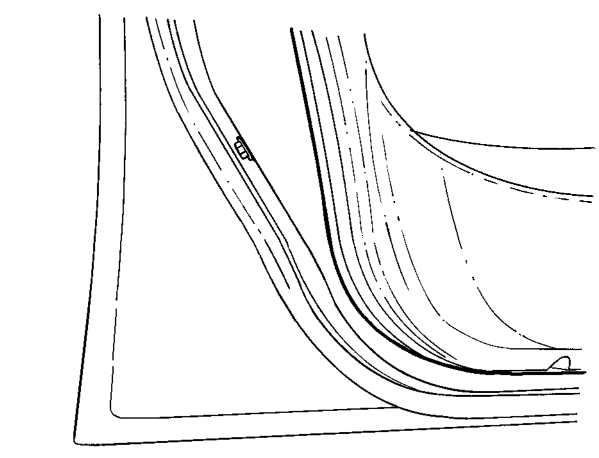

A109G002

3. Pry off the inside door handle trim bezel.



A109G003

4. Remove the screws at the base of the trim panel.
5. Pry off the trim panel using the trim remover KM-475-B.



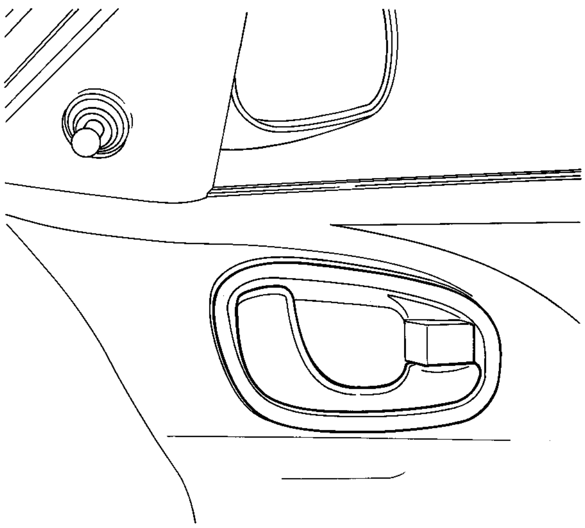
A109G030

Installation Procedure

1. Install the trim panel.
2. Install the screws at the base of the trim panel.

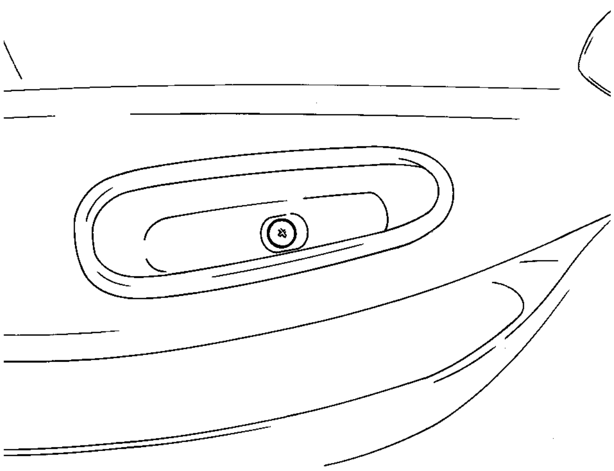
Tighten

Tighten the trim panel screws to 3 N•m (27 lb-in).



A109G002

3. Install the inside door handle trim bezel.



A109G001

4. Install the door pull screw.

Tighten

Tighten the door pull screw to 3.5 N•m (31 lb-in).

5. Raise the window.

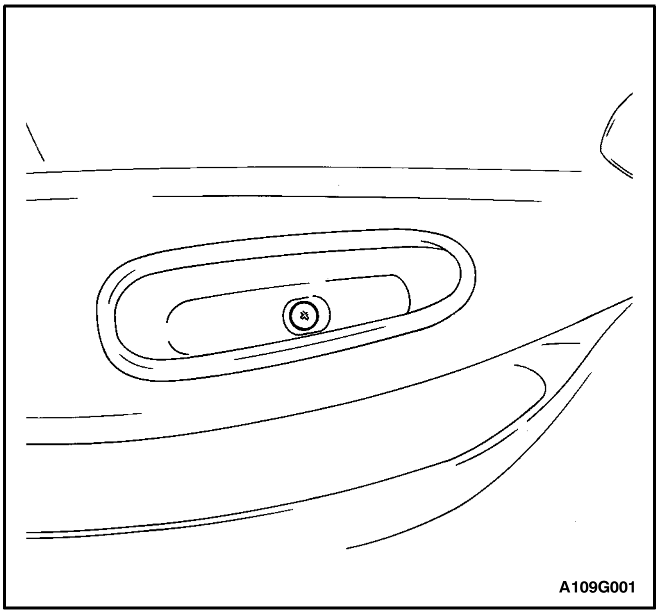
REAR DOOR TRIM PANEL

Tools Required

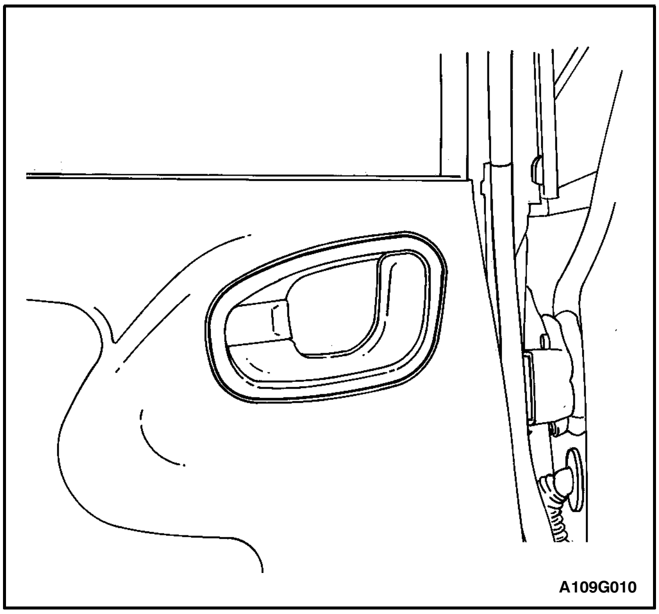
KM-475-B Trim Remover

Removal Procedure

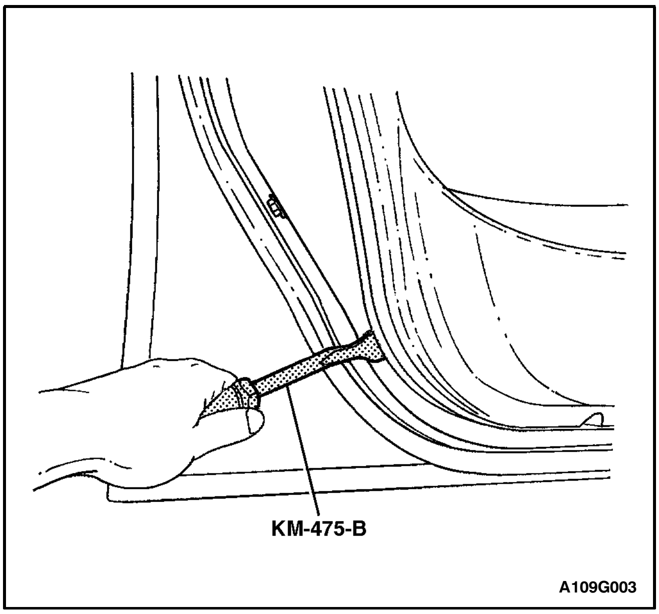
1. Lower the rear window.
2. Remove the rear window regulator handle. Refer to Section 9P, Doors.
3. Remove the door pull screw.

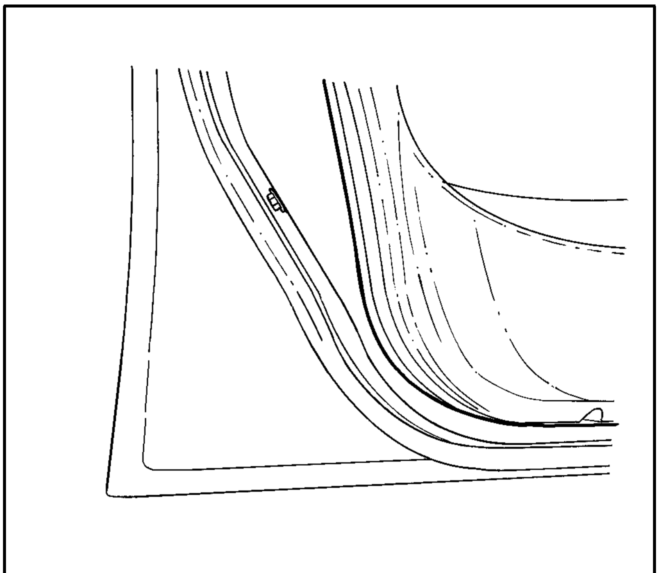


4. Pry off the inside door handle trim bezel.



5. Remove the rear door interior garnish molding.
6. Remove the screws at the base of the trim panel.
7. Pry off the trim panel using the trim remover KM-475-B.





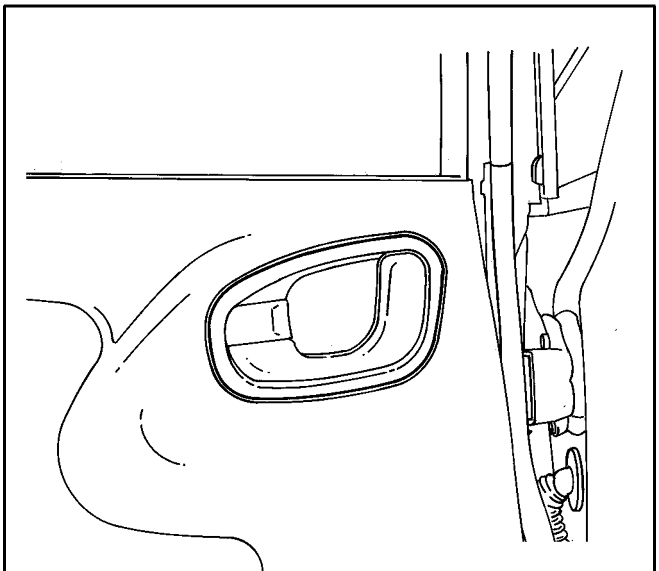
A109G030

Installation Procedure

1. Install the trim panel.
2. Install the screws at the base of the trim panel.

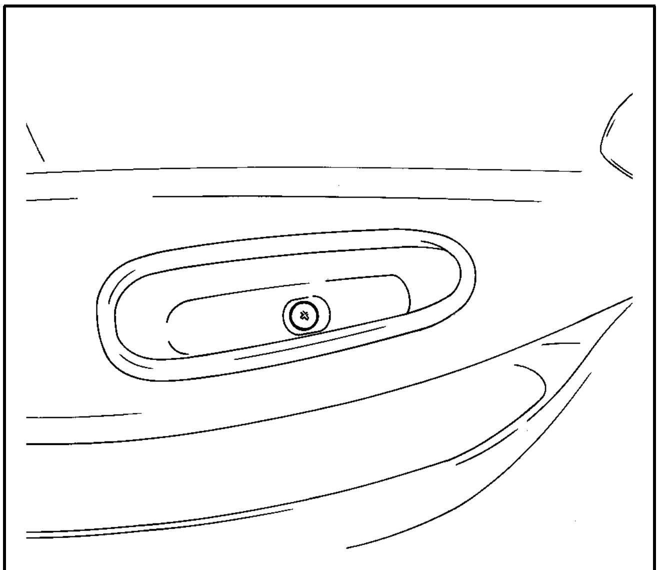
Tighten

Tighten the trim panel screws to 3 N•m (27 lb-in).



A109G010

3. Install the rear door interior garnish molding.
4. Install the inside door handle trim bezel.



A109G001

5. Install the door pull screw.

Tighten

Tighten the door pull screw to 3.5 N•m (31 lb-in).

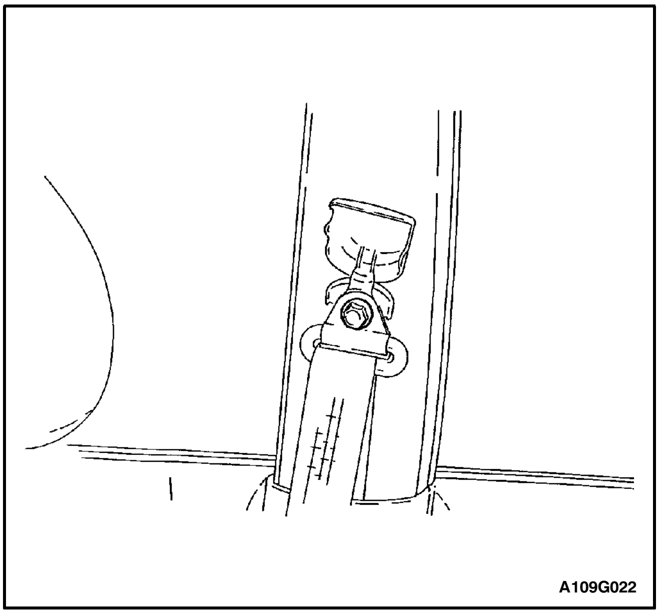
6. Install the rear window regulator handle. Refer to Section 9P, Doors.
7. Raise the window.

UPPER B-PILLAR TRIM PANEL

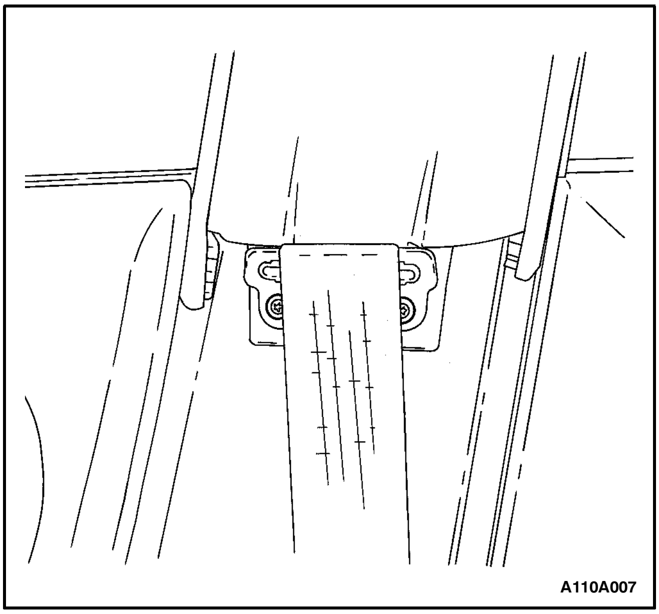
(Notchback Shown, Five-Door Hatchback Similar)

Removal Procedure

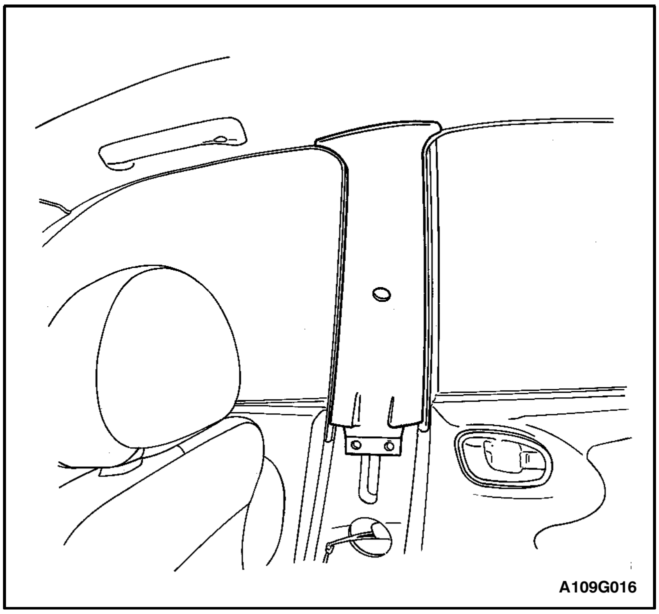
1. Remove the bolt and the upper front seat belt anchor.



2. Remove the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel" in this section.
3. Remove the screws and the seat belt bracket.

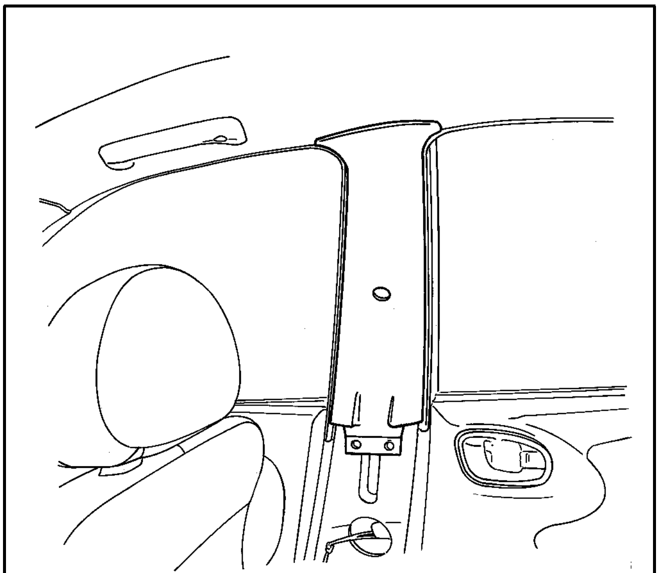


4. Pry off the upper B-pillar trim panel.



Installation Procedure

1. Install the upper B-pillar trim panel.

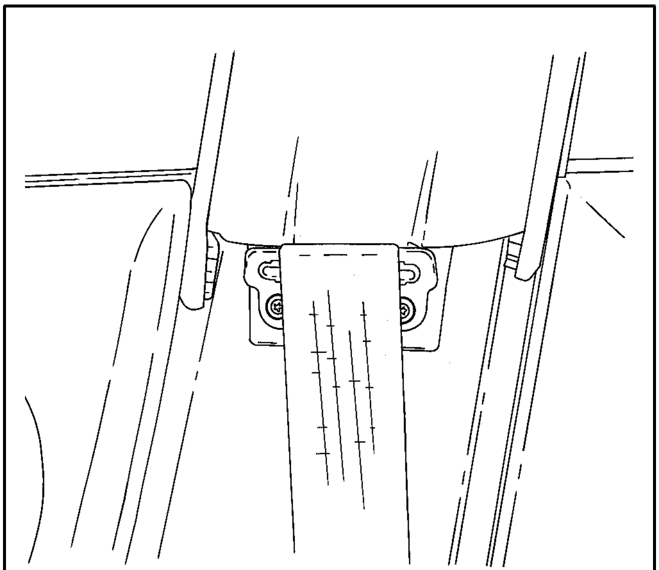


A109G016

2. Install the seat belt bracket with the screws.

Tighten

Tighten the seat belt bracket screws to 10 N•m (89 lb-in).

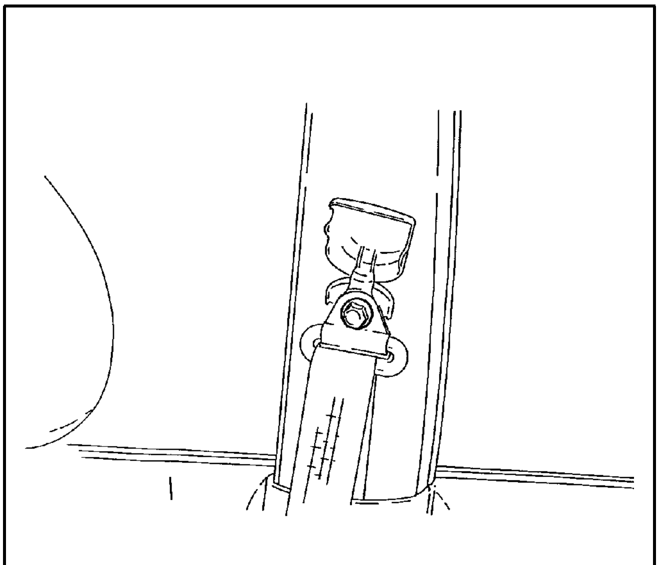


A110A007

3. Install the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel" in this section.
4. Install the upper front seat belt anchor with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

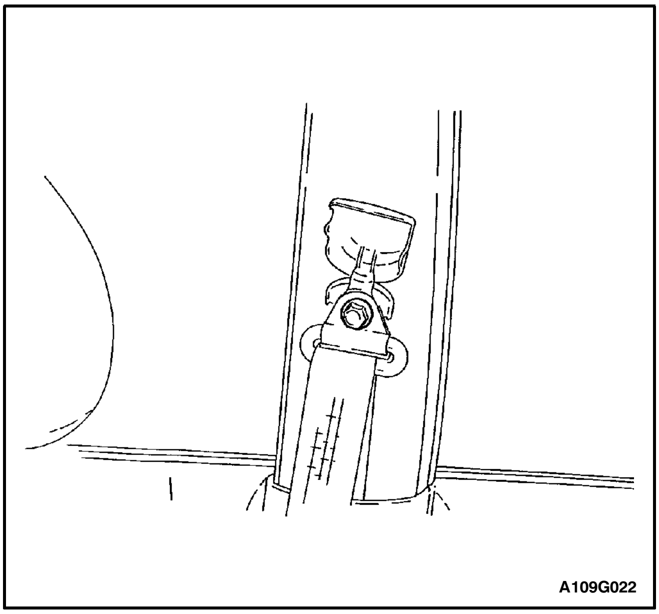


A109G022

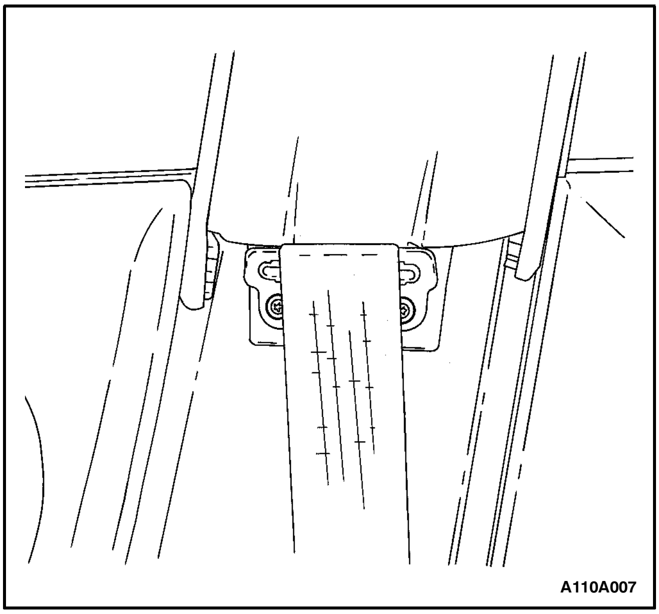
UPPER B-PILLAR TRIM PANEL (THREE-DOOR HATCHBACK)

Removal Procedure

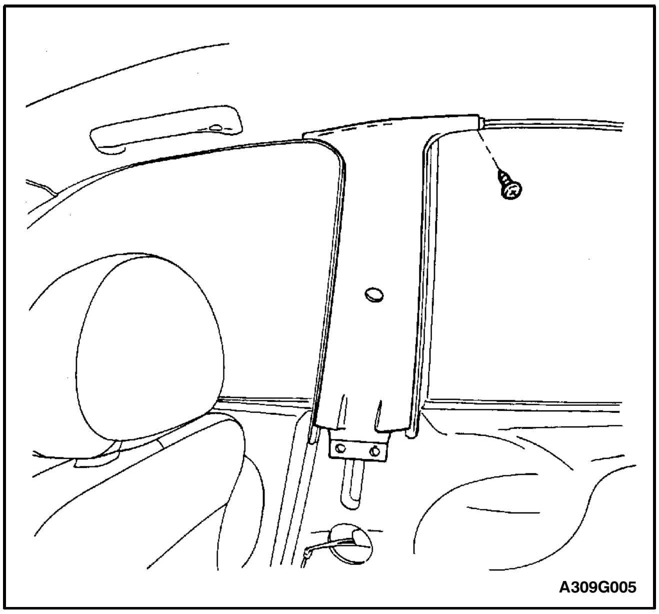
1. Remove the bolt and the upper front seat belt anchor.

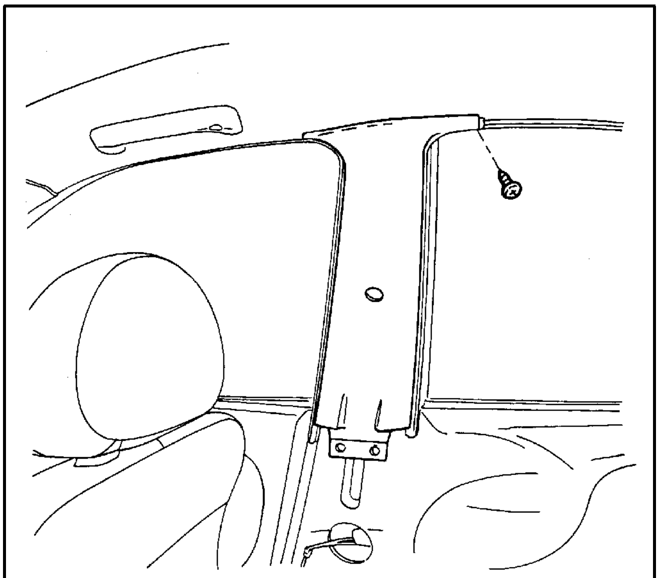


2. Remove the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel (Three-Door Hatchback)" in this section.
3. Remove the C-pillar trim panel. Refer to "C-Pillar Trim Panel (Three-Door Hatchback)" in this section.
4. Remove the screws and the seat belt bracket.



5. Remove the screw and the upper B-pillar trim panel.




A309G005

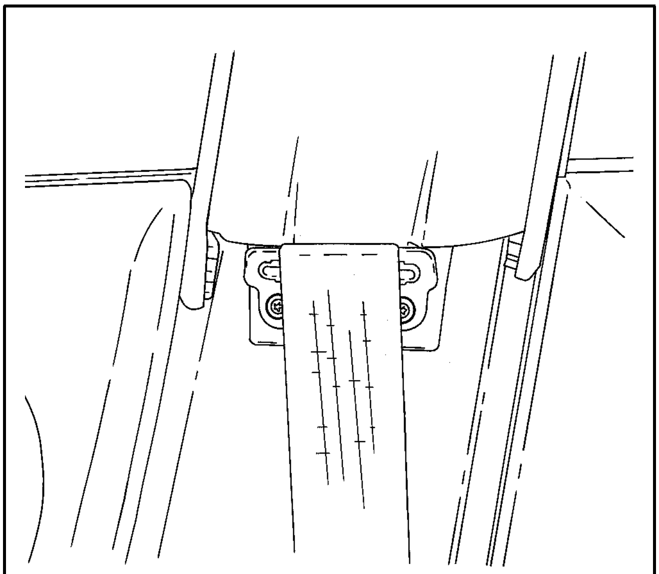
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the upper B-pillar trim panel with the screw.

   Tighten

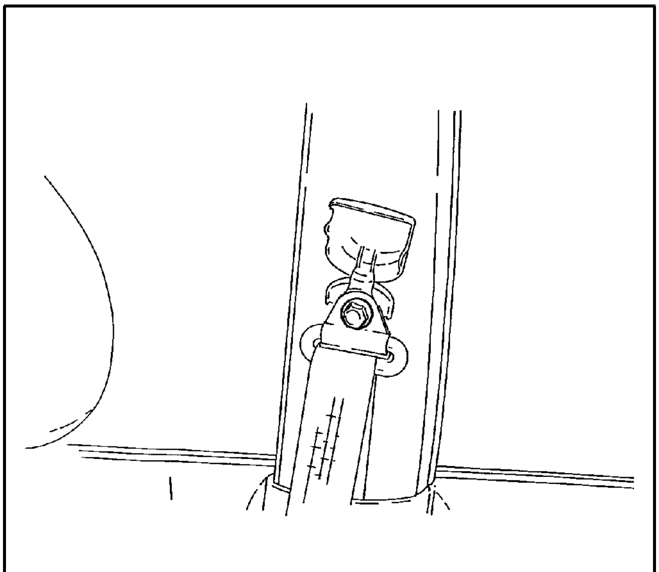
   Tighten the trim panel screw to 3 N•m (27 lb-in).


A110A007

2. Install the seat belt bracket with the screws.

   Tighten

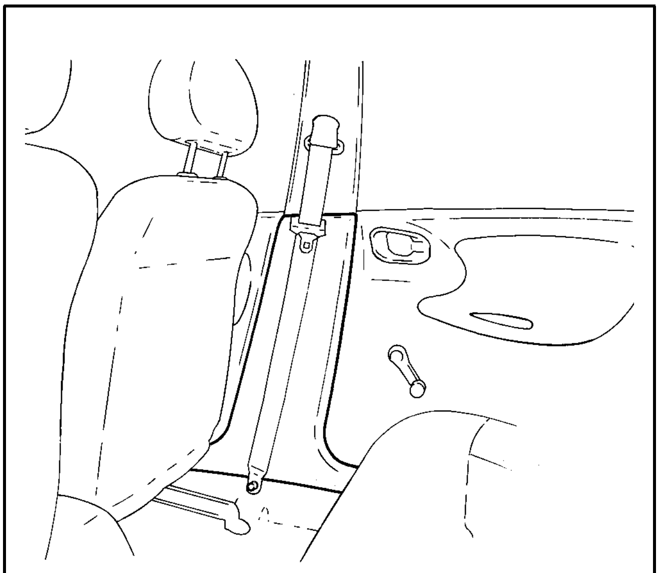
   Tighten the seat belt bracket screws to 10 N•m (89 lb-in).


A109G022

3. Install the C-pillar trim panel. Refer to "C-Pillar Trim Panel (Three-Door Hatchback)" in this section.
4. Install the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel (Three-Door Hatchback)" in this section.
5. Install the upper front seat belt anchor with the bolt.

   Tighten

   Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).



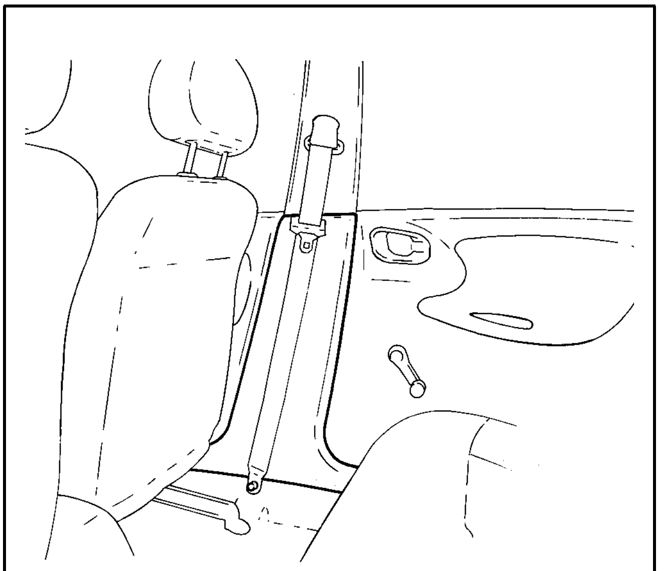
A109G012

LOWER B-PILLAR TRIM PANEL

(Notchback Shown, Five-Door Hatchback Similar)

Removal Procedure

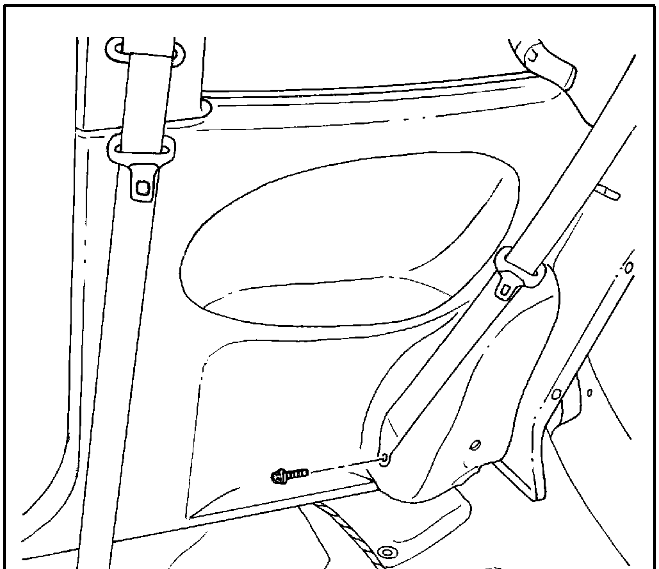
1. Reposition the rear portion of the front rocker trim panel and the front portion of the rear rocker trim panel.
2. Pry off the lower B-pillar trim panel.



A109G012

Installation Procedure

1. Install the lower B-pillar trim panel.
2. Install the front rocker trim panel.
3. Install the rear rocker trim panel to its original position.

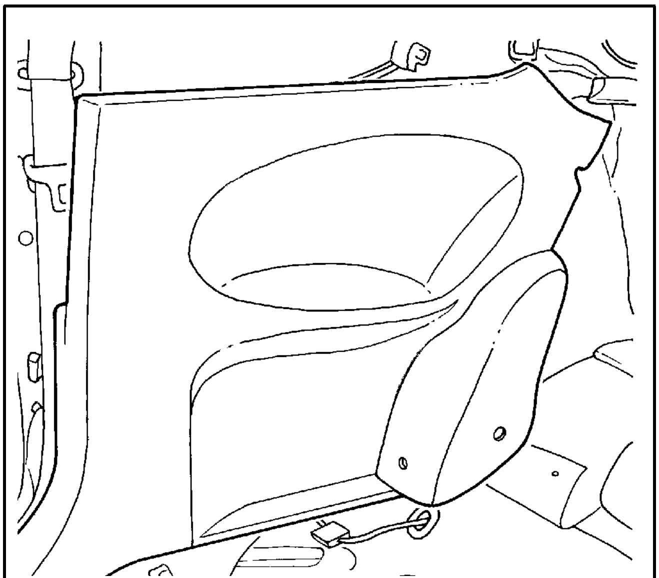


A309G006

LOWER B-PILLAR TRIM PANEL (THREE-DOOR HATCHBACK)

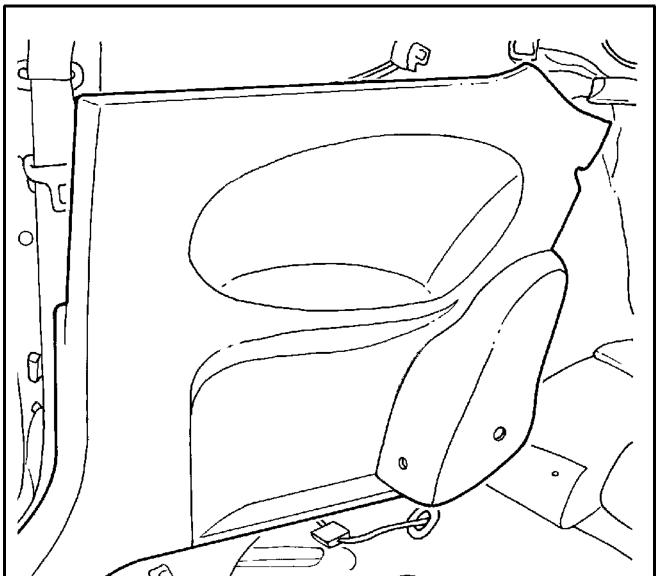
Removal Procedure

1. Reposition the rear portion of the front rocker trim panel.
2. Remove the rear seatback and the cushion. Refer to Section 9H, Seats.
3. Remove the bolt and the lower rear seat belt anchor.



A309G007

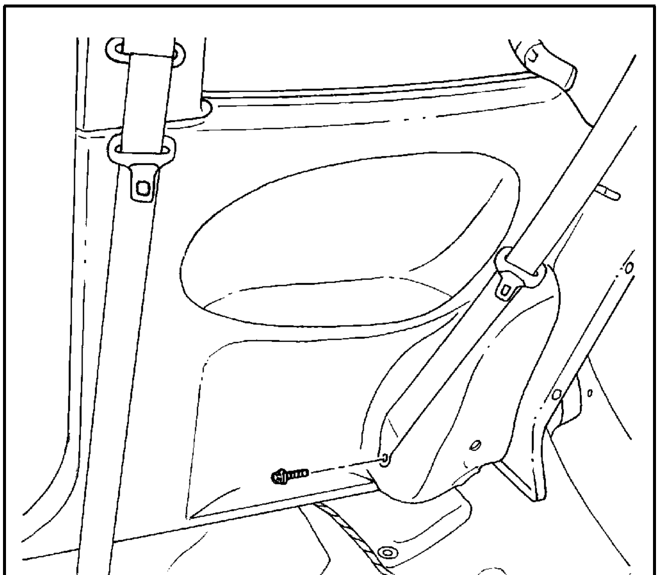
4. Remove the lower B-pillar trim panel.



A309G007

Installation Procedure

1. Install the lower B-pillar trim panel.



A309G006

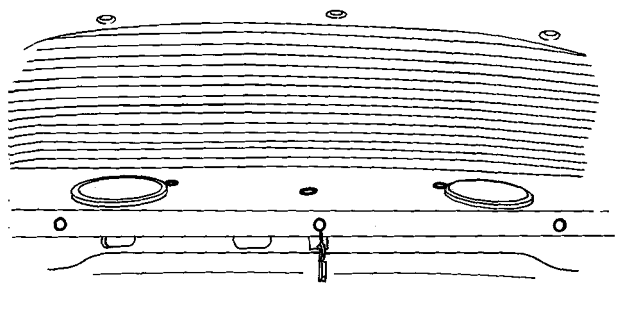
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the lower rear seat belt anchor with the bolt.

Tighten

Tighten the seat belt anchor bolt to 35 N•m (26 lb-ft).

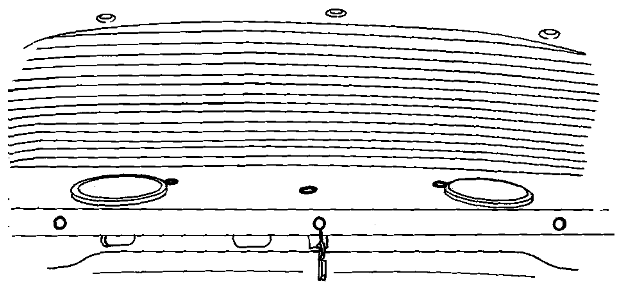
3. Install the rear seatback and the cushion. Refer to Section 9H, Seats.
4. Install the rear portion of the front rocker trim panel to the original position.


A109G011

DECK LID SILL PLATE COVER (NOTCHBACK)

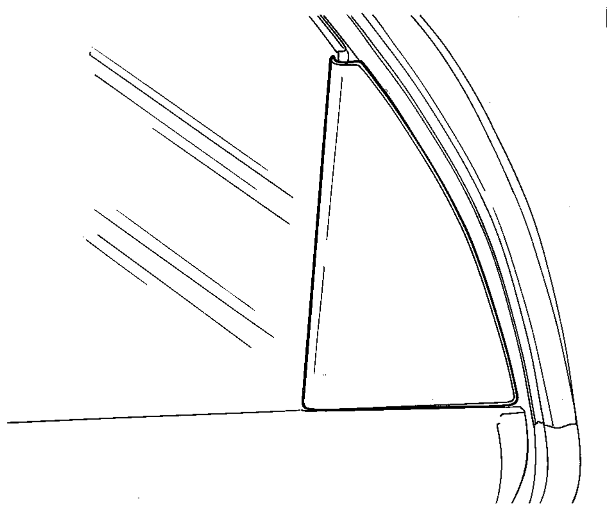
Removal Procedure

1. Remove the rear seatback. Refer to Section 9H, Seats.
2. Remove the plastic retaining clips and the deck lid sill plate cover.


A109G011

Installation Procedure

1. Install the rear deck lid sill plate cover with the plastic retaining clips.
2. Install the rear seatback. Refer to Section 9H, Seats.

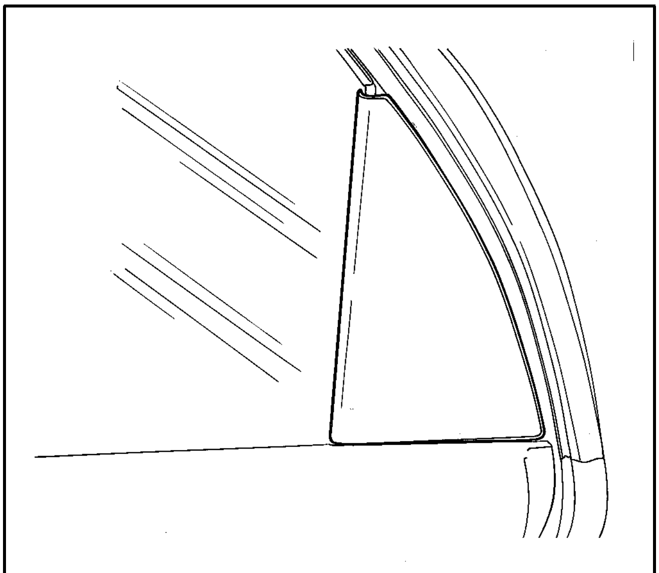

A109G004

REAR DOOR INTERIOR GARNISH MOLDING

(Notchback Shown, Five-Door Hatchback Similar)

Removal Procedure

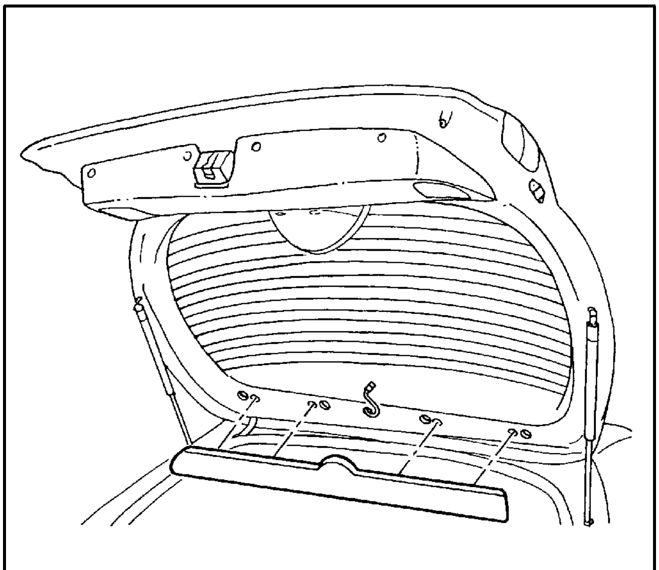
1. Pry off the rear door interior garnish molding.



A109G004

Installation Procedure

1. Install the rear door interior garnish molding.

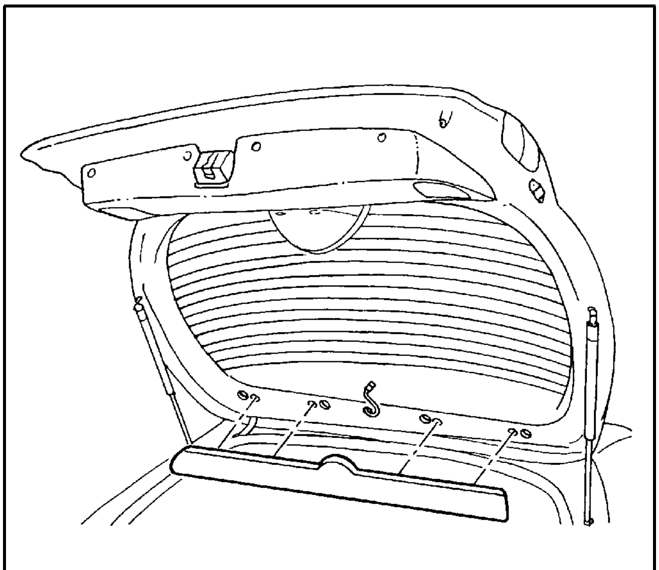


A309G009

HATCHBACK DOOR UPPER GARNISH MOLDING

Removal Procedure

1. Open the hatchback door.
2. Pry off the hatchback door upper garnish molding.



A309G009

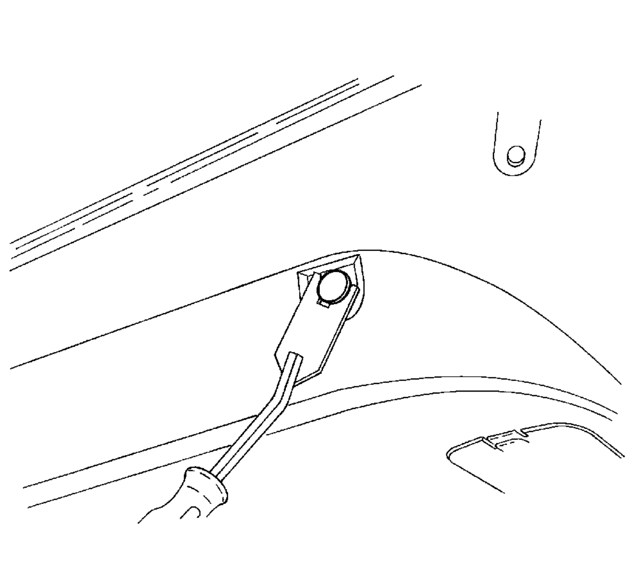
Installation Procedure

1. Install the hatchback door upper garnish molding.
2. Close the hatchback door.

HATCHBACK DOOR LOWER GARNISH MOLDING

Removal Procedure

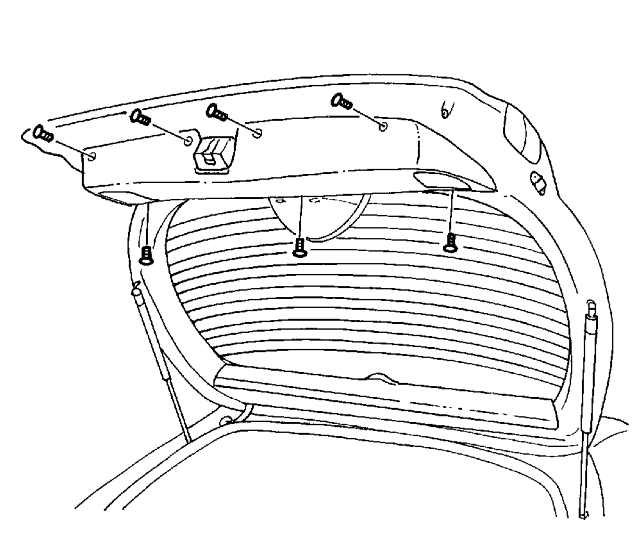
1. Open the hatchback door.
2. Remove the lower garnish molding clips using the trim remover KM-475-B.
3. Remove the lower garnish molding.



A309G010

Installation Procedure

1. Install the lower garnish molding with the clips.
2. Close the hatchback door.



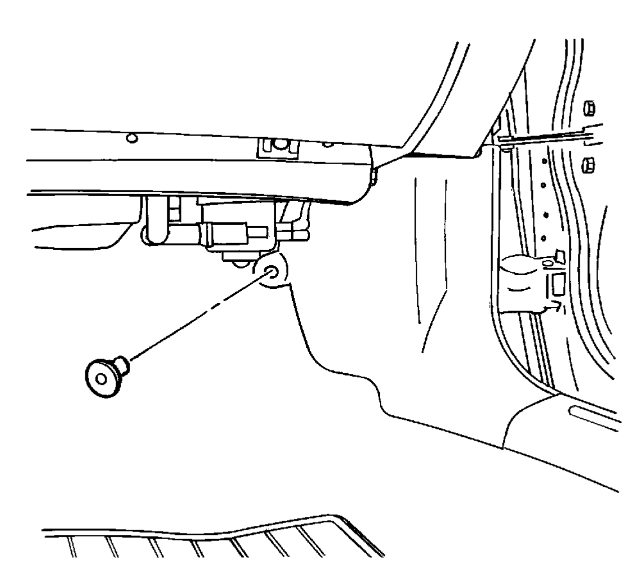
A309G011

KICK PANEL

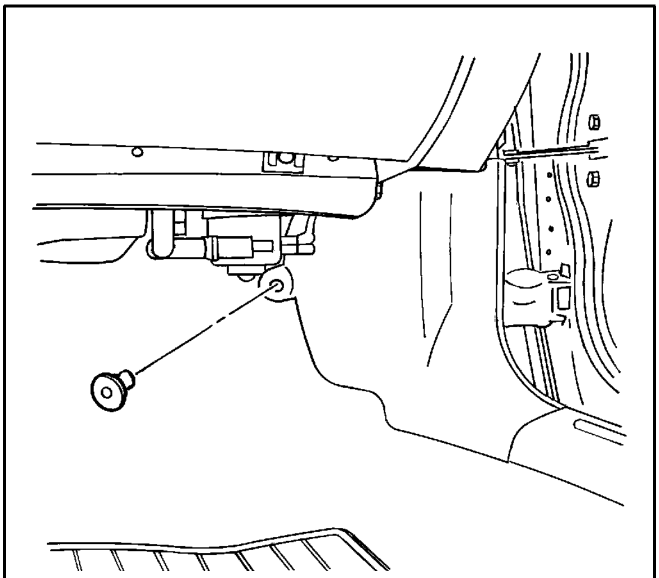
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Remove the kick panel fastener.
2. Pry off the kick panel.



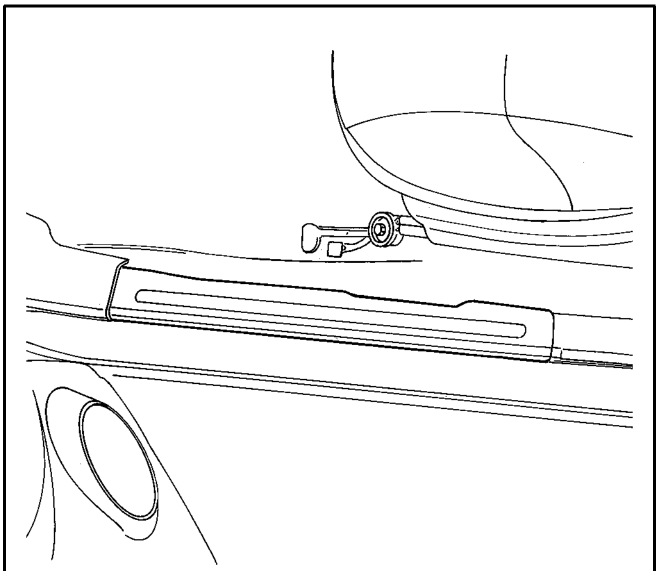
A309G001



A309G001

Installation Procedure

1. Install the kick panel.
2. Install the kick panel fastener.



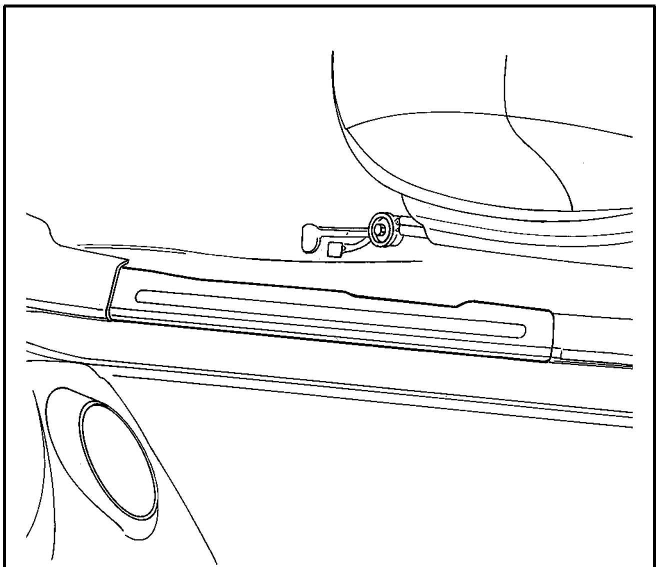
A109G019

FRONT ROCKER TRIM PANEL

(Typical)

Removal Procedure

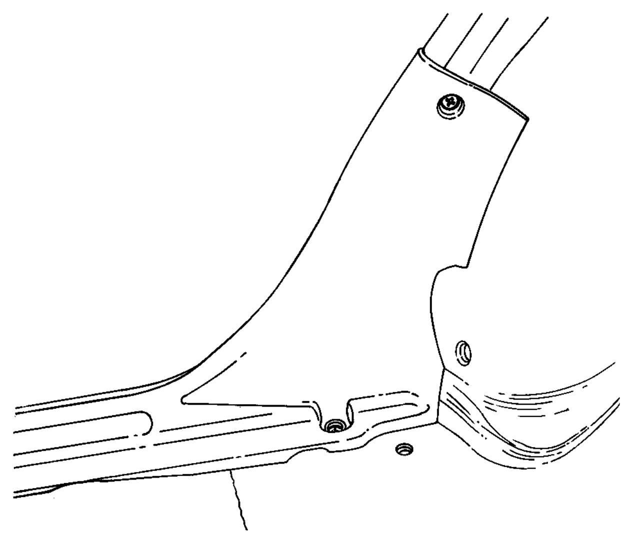
1. Pry off the front rocker trim panel.



A109G019

Installation Procedure

1. Install the front rocker trim panel.



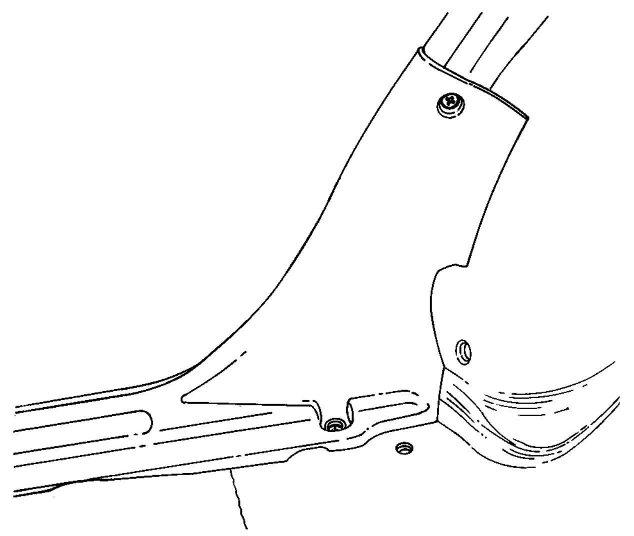
A109G005

REAR ROCKER TRIM PANEL

(Notchback Shown, Five-Door Hatchback Similar)

Removal Procedure

1. Remove the rear seat cushion and rear seatback. Refer to Section 9H, Seats.
2. Remove the screw securing the rear rocker trim panel.
3. Pry off the rear rocker trim panel.



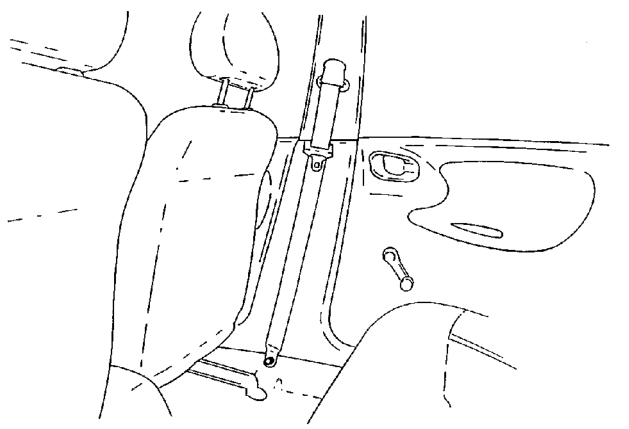
A109G005

Installation Procedure

1. Install the rear rocker trim panel.
2. Install the rear rocker trim panel with the screw.
3. Install the rear seatback with the bolt.

   Tighten

   Tighten the rear seatback bolt to 24 N•m (18 lb-ft).
4. Install the rear seat cushion. Refer to Section 9H, Seats.



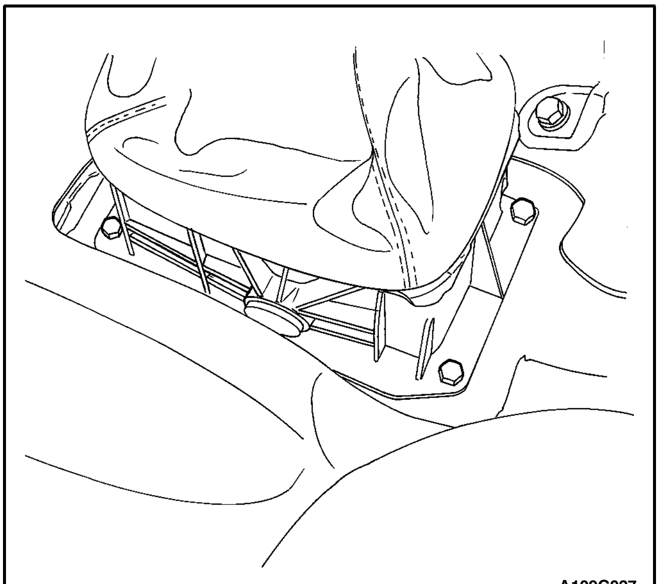
A109G006

FLOOR CARPET

(Typical)

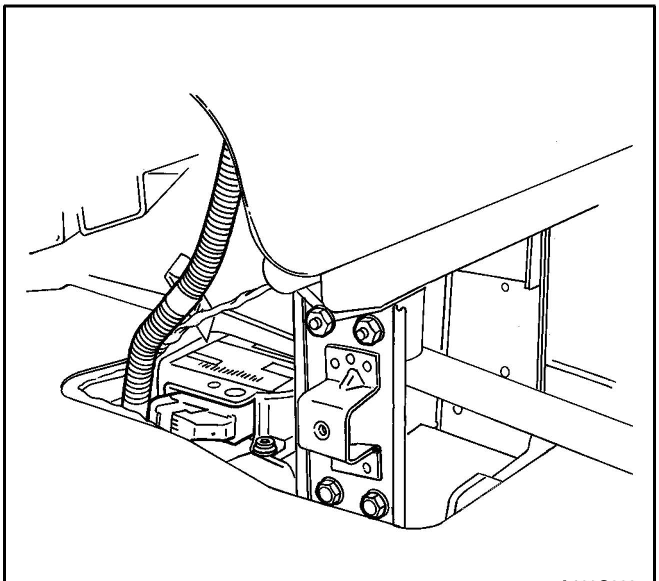
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the left and the right rear rocker trim panels. Refer to “Rear Rocker Trim Panel” in this section.
3. Remove the bolts and the left and the right lower front seat belt anchors from the B-pillar.
4. Remove the left and the right lower B-pillar trim panels. Refer to “Lower B-Pillar Trim Panel” in this section.



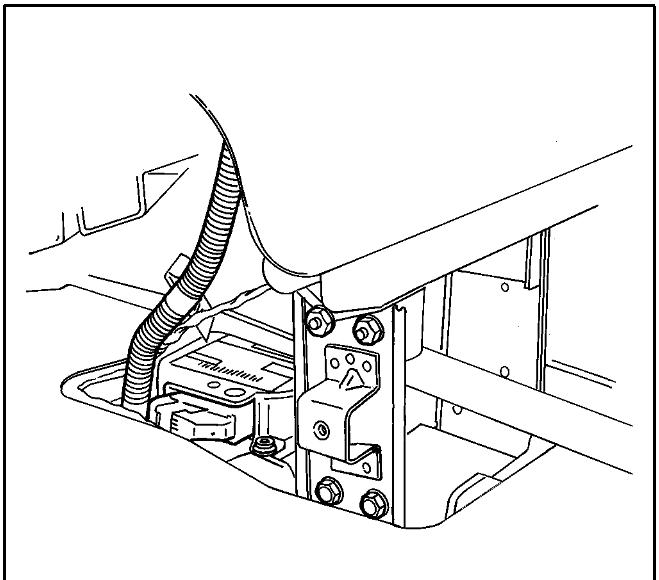
A109G027

5. Remove the front seats. Refer to Section 9H, Seats.
6. Remove the left and the right kick panels. Refer to "Kick Panel" in this section.
7. Pry off the left and the right front rocker trim panels.
8. Remove the floor console. Refer to "Floor Console" in this section.
9. Remove the gearshift housing bolts (if equipped).



A109G009

10. Reposition the gearshift housing (if equipped).
11. Remove the bolts and the nuts and the floor console braces.
12. Disconnect the airbag control module electrical connector.
13. Remove the floor carpet.



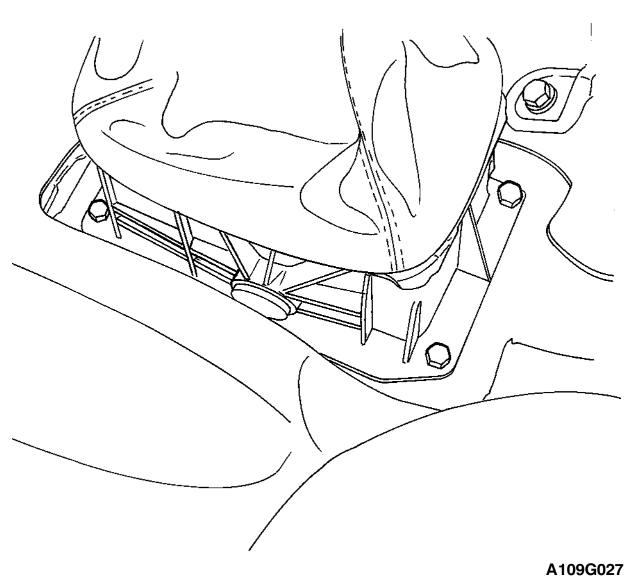
A109G009

Installation Procedure

1. Install the floor carpet.
2. Connect the airbag control module electrical connector.
3. Install the floor console braces with the bolts and the nuts.

Tighten

Tighten the floor console brace bolts to 5 N•m (44 lb-in).

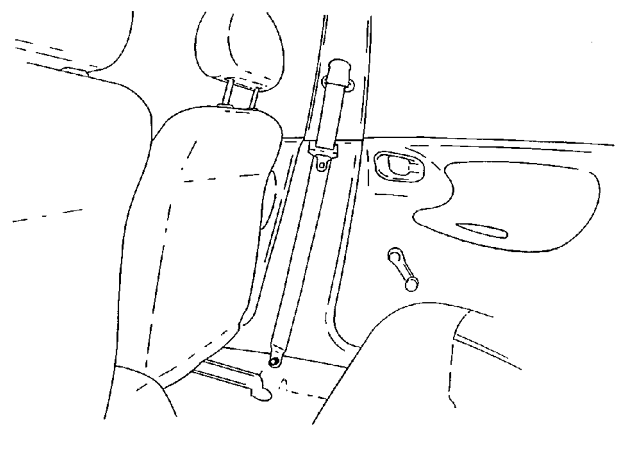


A109G027

4. Install the gearshift housing to its original position (if equipped).
5. Install the gearshift housing bolts (if equipped).

Tighten

Tighten the gearshift housing bolts to 5 N•m (44 lb-in).



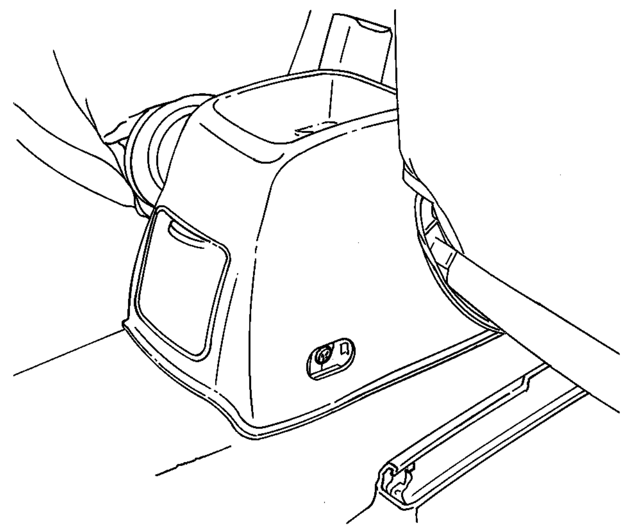
A109G006

6. Install the floor console. Refer to "Floor Console" in this section.
7. Install the left and the right front rocker trim panels.
8. Install the left and the right kick panels. Refer to "Kick Panel" in this section.
9. Install the front seats. Refer to Section 9H, Seats.
10. Install the left and the right lower B-pillar trim panels. Refer to "Lower B-Pillar Trim Panel" in this section.
11. Install the left and the right lower front seat belt anchors to the B-pillar with the bolts.

Tighten

Tighten the seat belt anchor bolts to 35 N•m (26 lb-ft).

12. Install the rear seatback. Refer to Section 9H, Seats.
13. Install the left and the right rear rocker trim panels. Refer to "Rear Rocker Trim Panel" in this section.
14. Connect the negative battery cable.



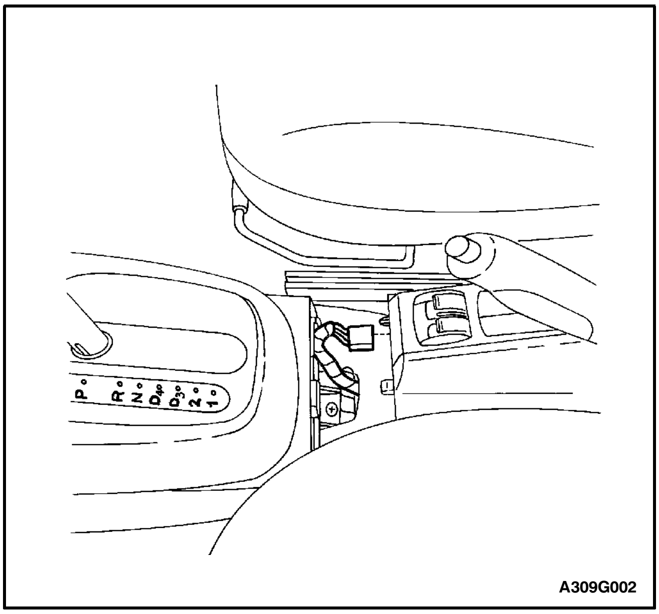
A109G007

FLOOR CONSOLE

(Typical)

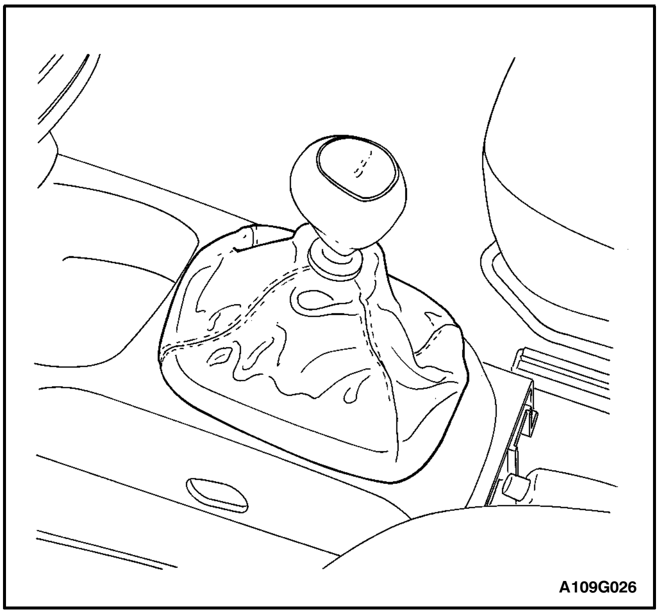
Removal Procedure

1. Disconnect the negative battery cable.
2. Slide the front seats forward.
3. Remove the screws and the rear portion of the floor console.

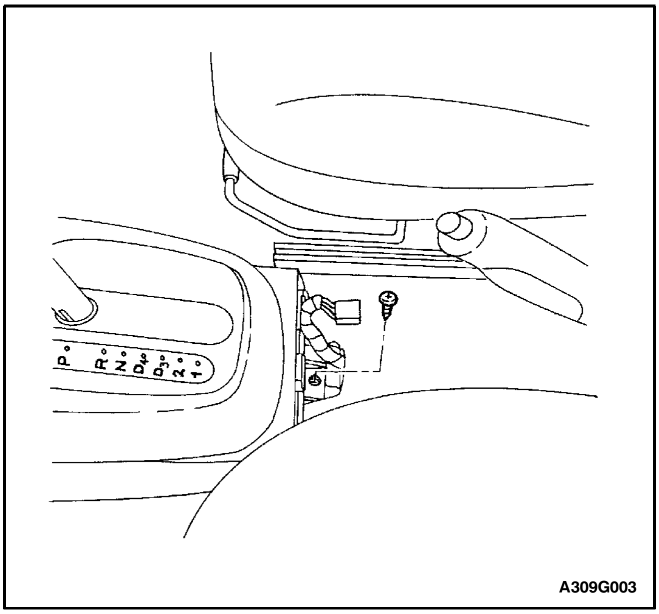


A309G002

4. Disconnect the power window controls' electrical connector.

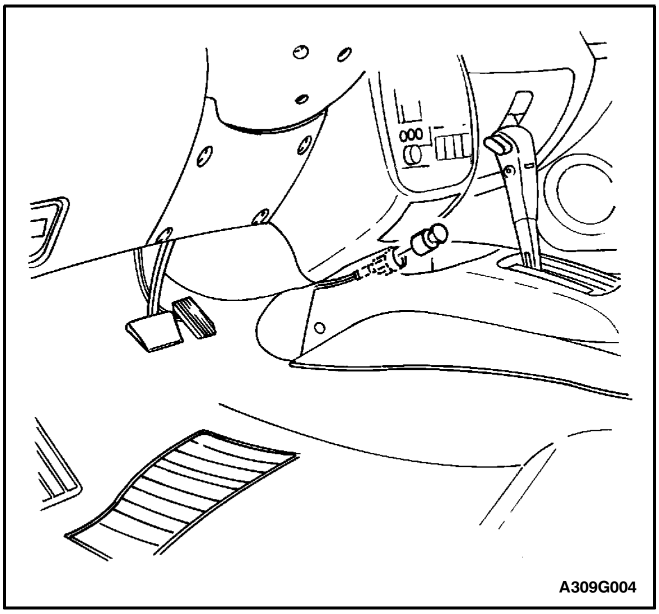

A109G026

5. Remove the gearshift lever boot (if equipped).



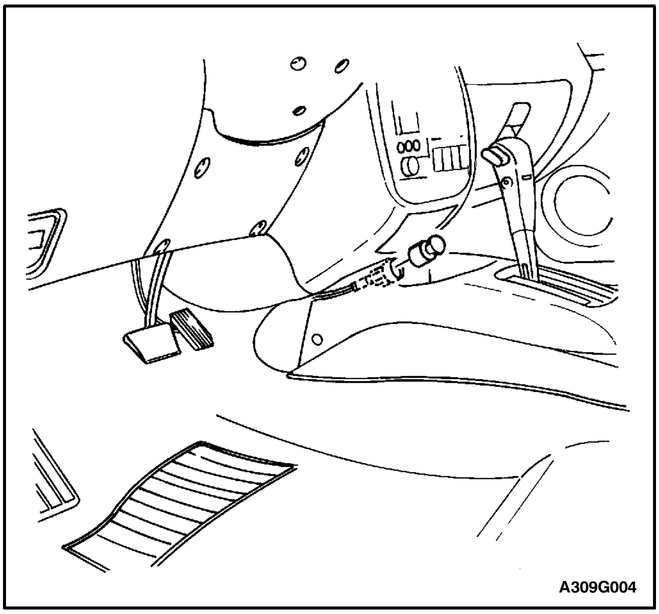
A309G003

6. Remove the screws from the front portion of the floor console.



A309G004

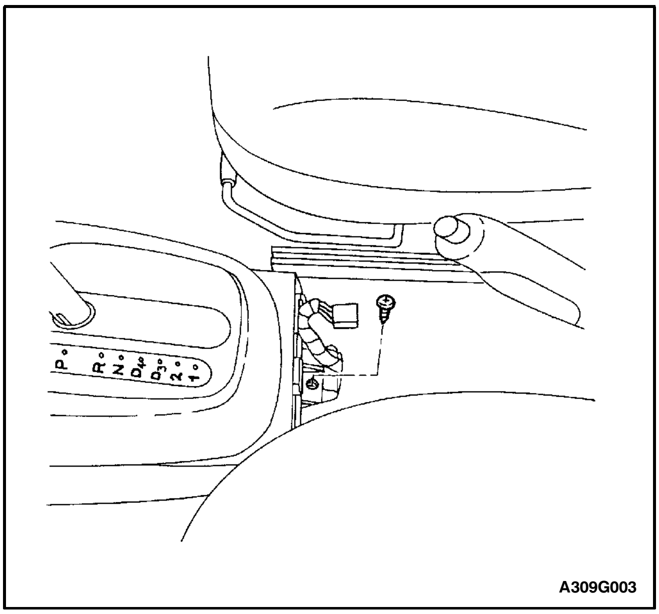
7. Disconnect the cigar lighter electrical connector.
8. Remove the front portion of the floor console.



A309G004

Installation Procedure

1. Connect the cigar lighter electrical connector.

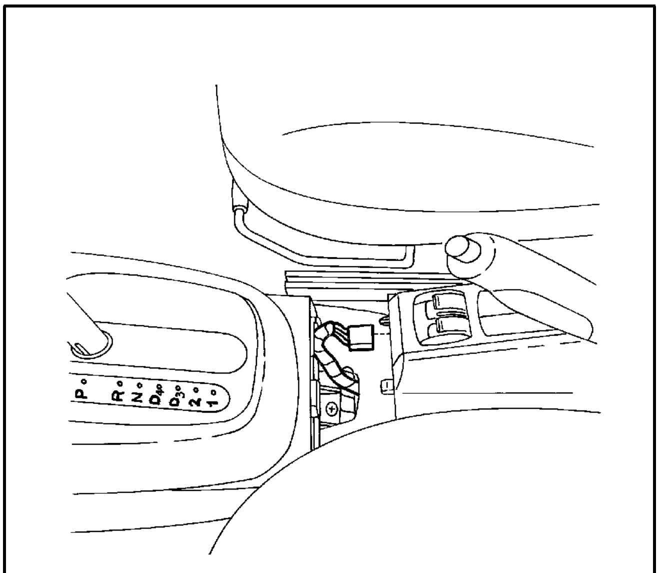


A309G003

2. Install the front portion of the floor console with the screws.

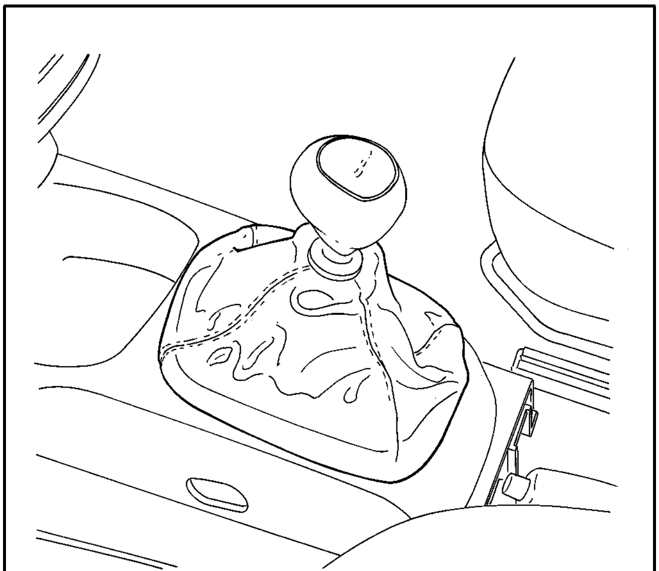
Tighten

Tighten the front floor console screws to 4 N•m (35 lb-in).



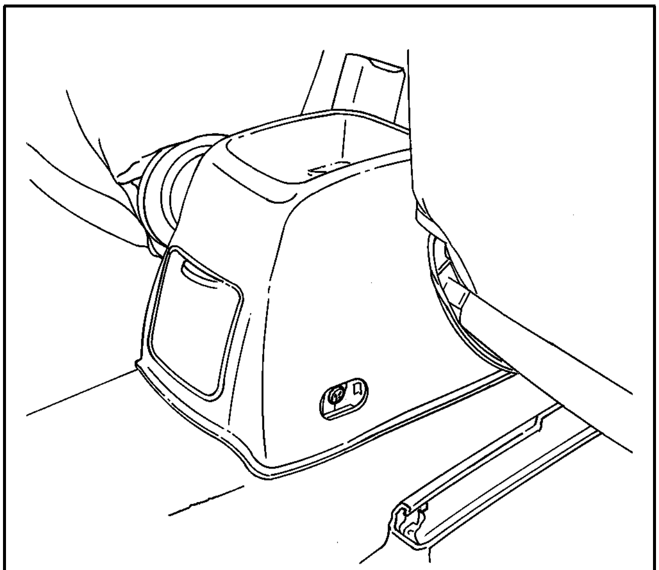
A309G002

3. Connect the power window controls' electrical connector.



A109G026

4. Install the gearshift lever boot (if equipped).



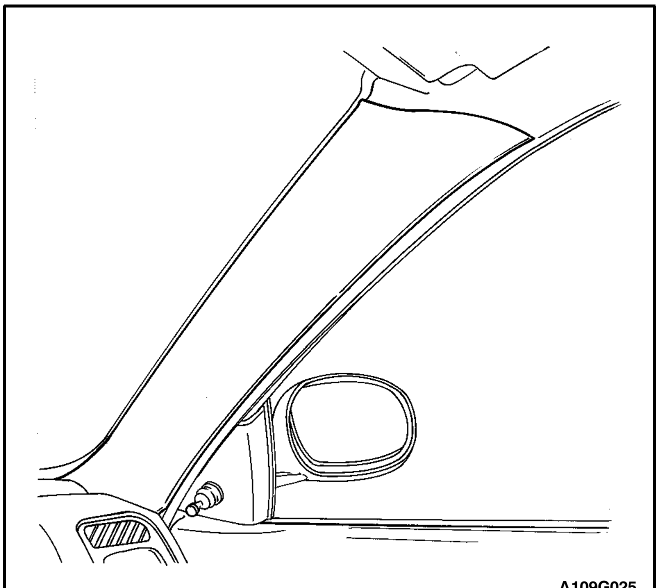
A109G007

5. Install the rear portion of the floor console with the screw.

Tighten

Tighten the rear floor console screws to 4 N•m (35 lb-in).

6. Connect the negative battery cable.

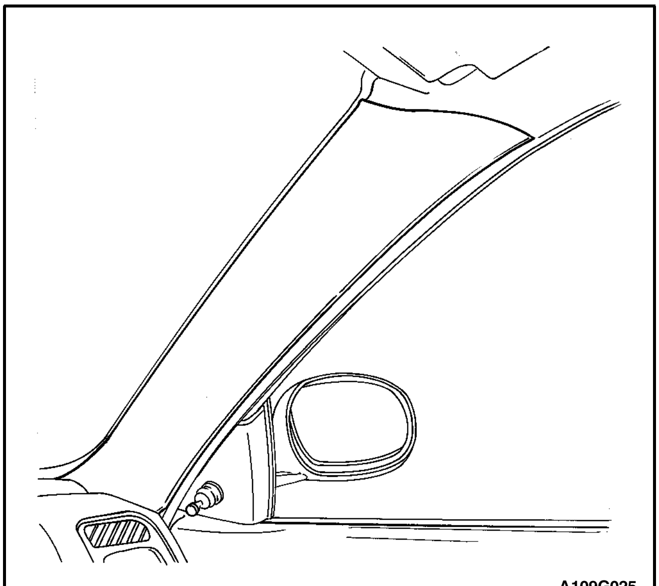


A109G025

A-PILLAR TRIM PANEL

Removal Procedure

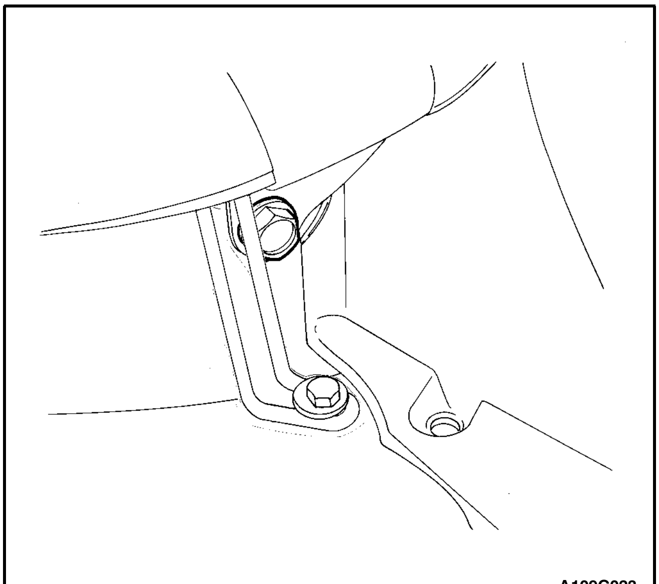
1. Pry off the A-pillar trim panel.



A109G025

Installation Procedure

1. Install the A-pillar trim panel.



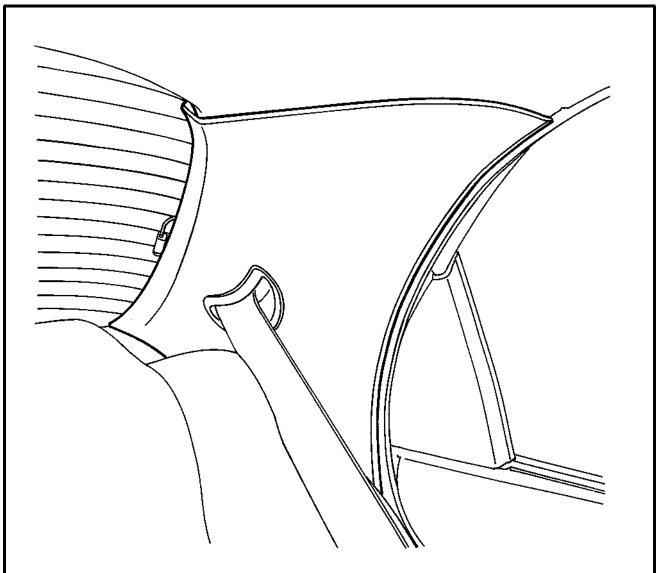
A109G023

C-PILLAR TRIM PANEL

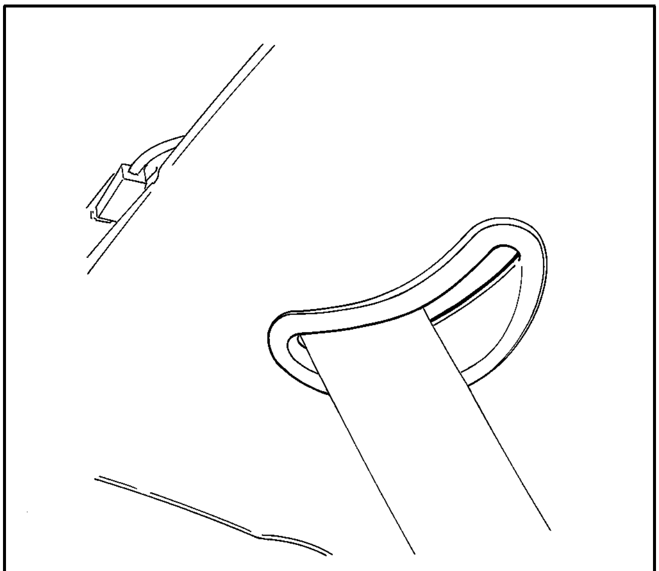
(Notchback Shown, Five-Door Hatchback Similar)

Removal Procedure

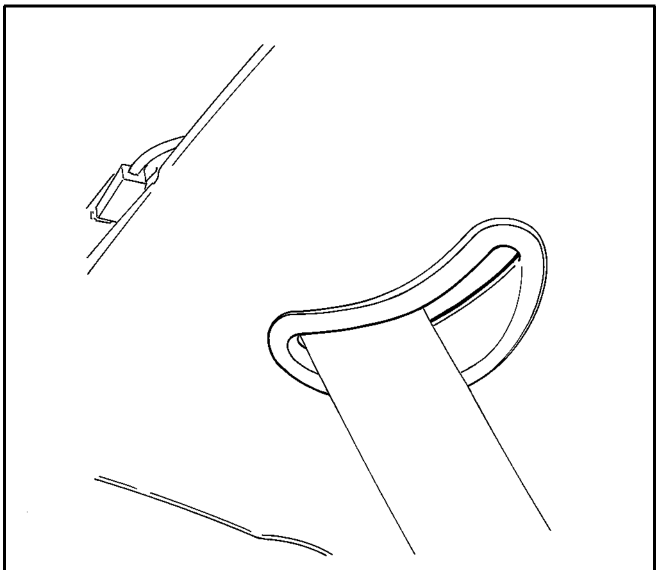
1. Remove the rear seat cushion. Refer to Section 9H, Seats.
2. Remove the bolt and the rear seat belt floor anchor.


A109G017

3. Pry off the C-pillar trim panel from the body.

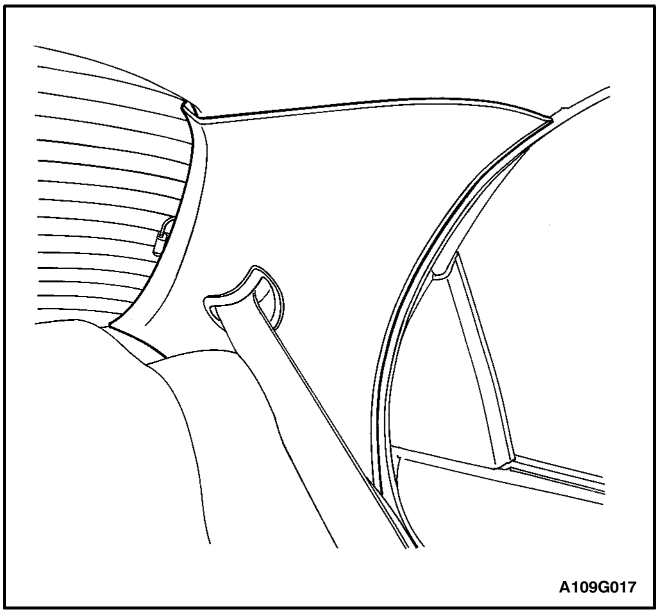

A109G024

4. Remove the seat belt trim piece.
5. Remove the C-pillar trim panel from the seat belt.

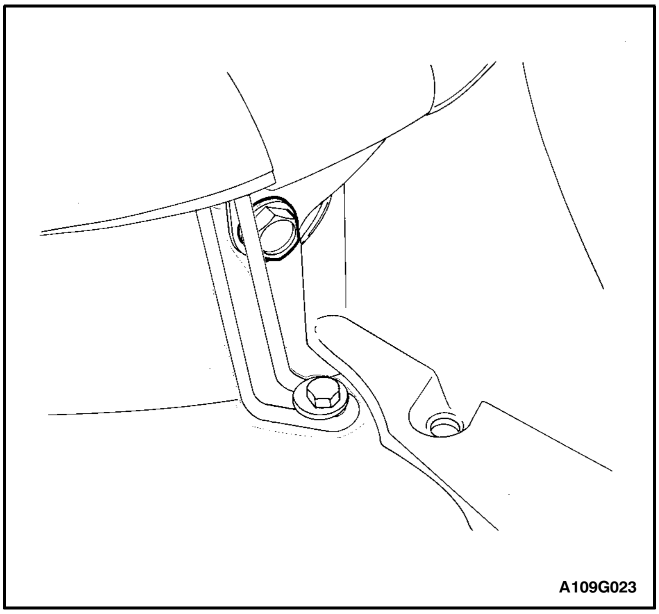

A109G024

Installation Procedure

1. Feed the seat belt through the C-pillar trim panel.
2. Install the seat belt trim piece.



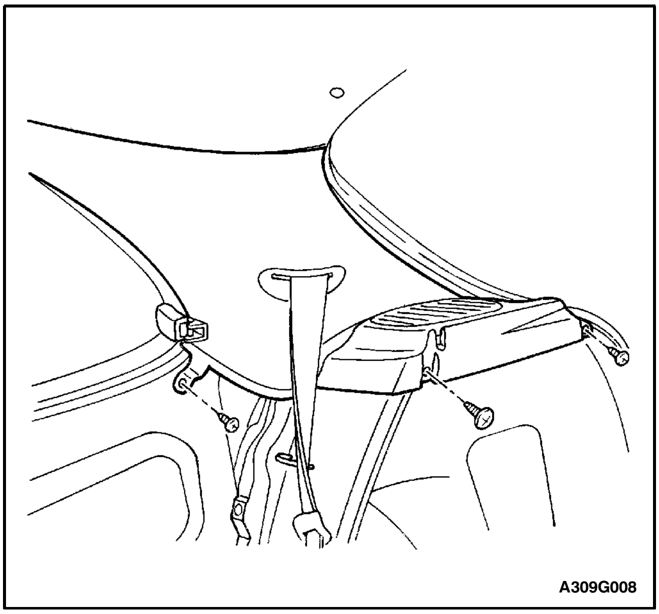
3. Install the C-pillar trim panel.



4. Install the rear seat belt floor anchor with the bolt.

   Tighten

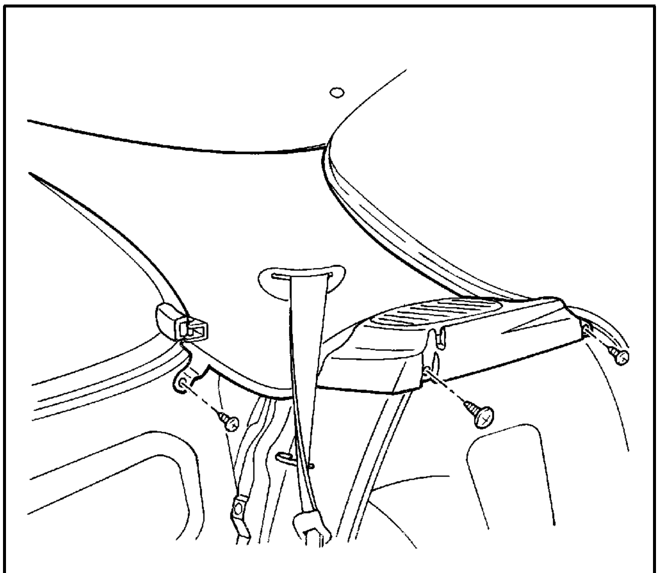
   Tighten the rear seat belt anchor bolt to 35 N•m (26 lb-ft).
5. Install the rear seat cushion. Refer to Section 9H, Seats.



C-PILLAR TRIM PANEL (THREE-DOOR HATCHBACK)

Removal Procedure

1. Remove the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel (Three-Door Hatchback)" in this section.
2. Remove the screws, the clip, and the C-pillar trim panel.
3. Remove the seat belt from the C-pillar trim panel.



A309G008

Installation Procedure

1. Feed the seat belt through the C-pillar trim panel.

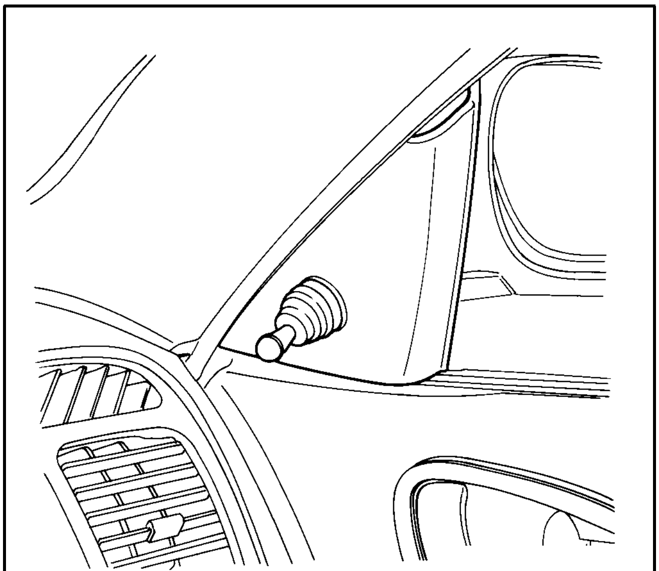
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the C-pillar trim panel with the clip and the screws.

   Tighten

   Tighten the trim panel screws to 3 N•m (27 lb-in).

3. Install the lower B-pillar trim panel. Refer to "Lower B-Pillar Trim Panel (Three-Door Hatchback)" in this section.

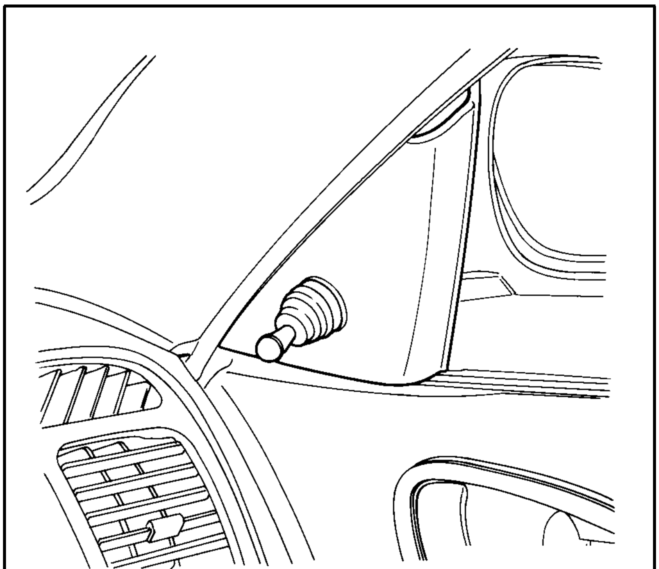


A109L001

FRONT DOOR ESCUTCHEON

Removal Procedure

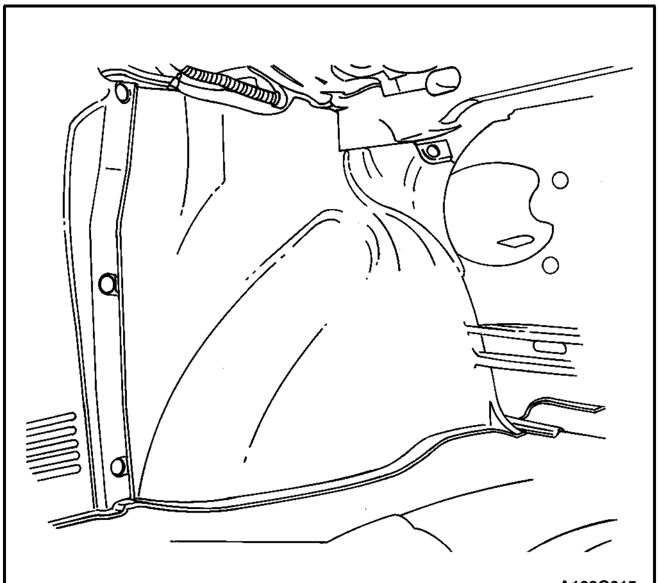
1. Pry off the escutcheon.



A109L001

Installation Procedure

1. Install the escutcheon.

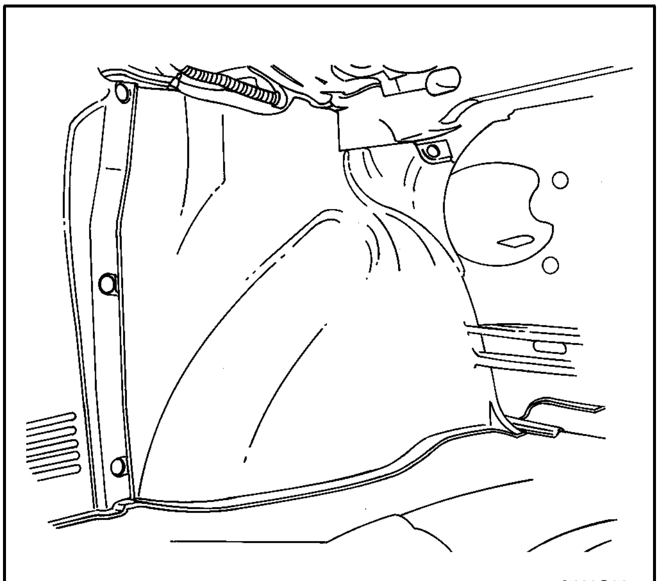


A109G015

LUGGAGE COMPARTMENT WHEELHOUSE TRIM PANEL (NOTCHBACK)

Removal Procedure

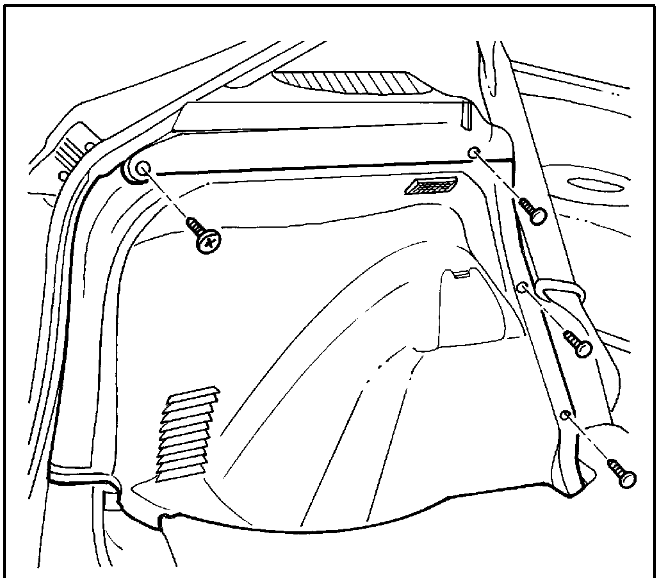
1. Remove the rear seatback. Refer to Section 9H, Seats.
2. Remove the plastic retaining clips and the rear seatback panel.
3. Remove the plastic retaining clips and the wheelhouse trim panel.



A109G015

Installation Procedure

1. Install the wheelhouse trim panel with the plastic retaining clips.
2. Install the rear seatback panel with the plastic retaining clips.
3. Install the rear seatback. Refer to Section 9H, Seats.

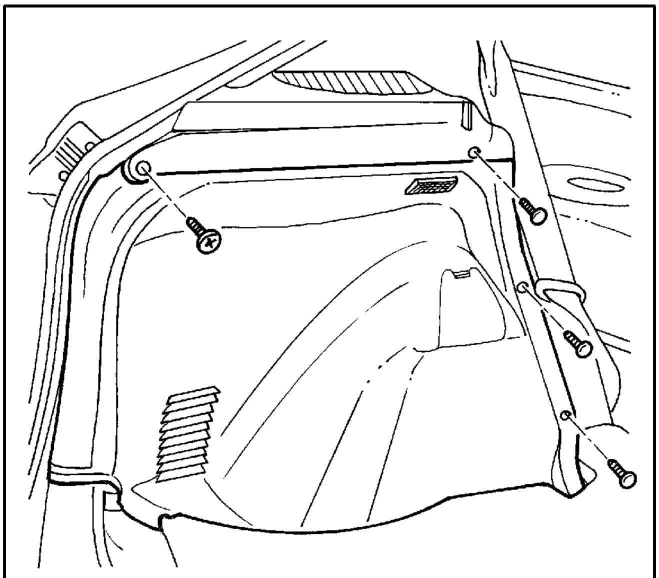


A309G012

LUGGAGE COMPARTMENT WHEELHOUSE TRIM PANEL (HATCHBACK)

Removal Procedure

1. Remove the luggage compartment rear trim panel. Refer to "Luggage Compartment Rear Trim Panel" in this section.
2. Remove the screw, the clips, and the wheelhouse trim panel.



A309G012

Installation Procedure

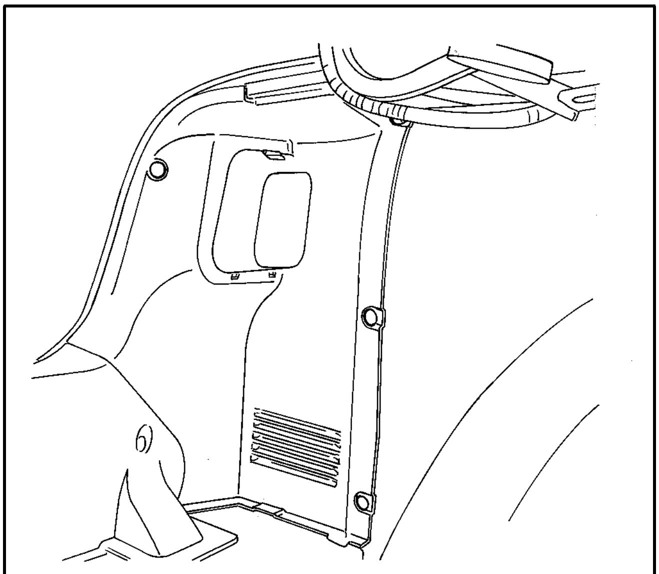
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the wheelhouse trim panel with the clips and the screw.

   Tighten

   Tighten the trim panel screw to 3 N•m (27 lb-in).

2. Install the luggage compartment rear trim panel. Refer to "Luggage Compartment Rear Trim Panel" in this section.

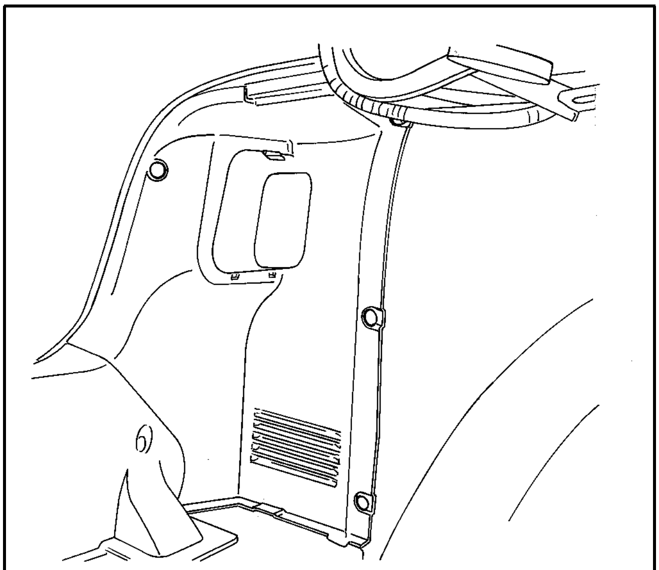


A109G021

LUGGAGE COMPARTMENT REAR QUARTER TRIM PANEL (NOTCHBACK)

Removal Procedure

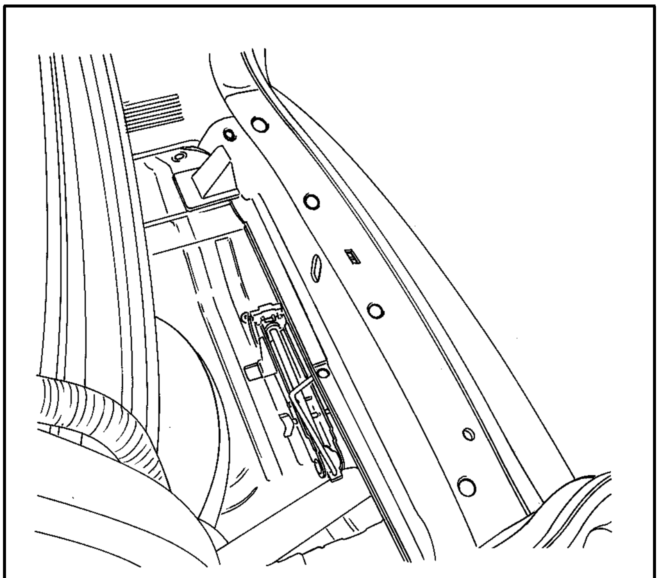
1. Remove the plastic retaining clips and the rear quarter trim panel.



A109G021

Installation Procedure

1. Install the rear quarter trim panel with the plastic retaining clips.



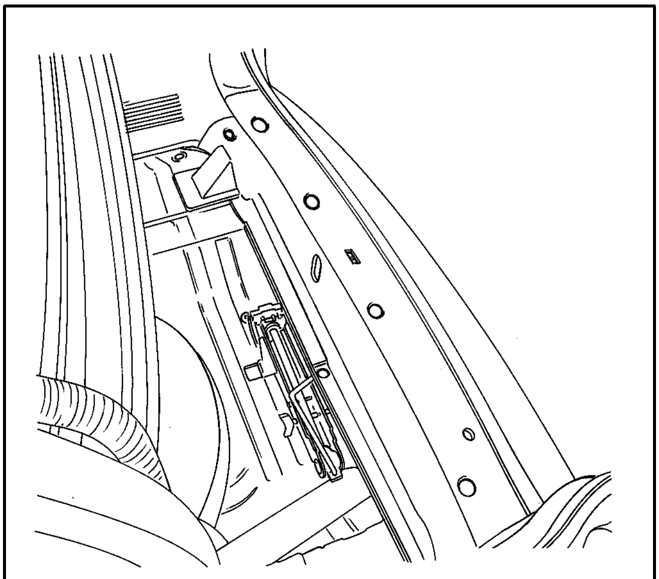
A109S013

LUGGAGE COMPARTMENT REAR TRIM PANEL

(Typical)

Removal Procedure

1. Remove the plastic retaining clips and the rear trim panel.



A109S013

Installation Procedure

1. Install the rear trim panel with the plastic retaining clips.

GENERAL DESCRIPTION AND SYSTEM OPERATION

INTERIOR TRIM PANELS

The interior trim panels are molded plastic and fasten with screws or plastic clips.

PRESSURE RELIEF VENT

When all the windows are closed and the ventilation system is on, the addition of outside air to the interior of the vehicle causes a positive pressure within the vehicle. In order to relieve the pressure, air is released through two pressure relief vents. The pressure relief vents are located at the rear quarter of the vehicle, behind the bumper fascia.

FLOOR CONSOLE

The floor console fits over the tunnel in the floor of the vehicle and extends from under the center of the instrument panel to the rear seat area. The front portion of the console contains the cigar lighter and the transaxle shift lever. The rear portion of the console contains the parking brake lever, the power window switches (if equipped), a cupholder, and an ashtray for the rear seat occupants.

The sensing and diagnostic module (SDM) for the airbag system is located under the front part of the console.

FLOOR CARPET

The molded one-piece floor carpet goes over both the front and the rear floor pans.

REAR COMPARTMENT SECURITY COVER (HATCHBACK)

A rear compartment security cover is provided on the hatchback models. The security cover is attached to the hatch and can be easily removed if more cargo space is needed.

SECTION 9H

SEATS

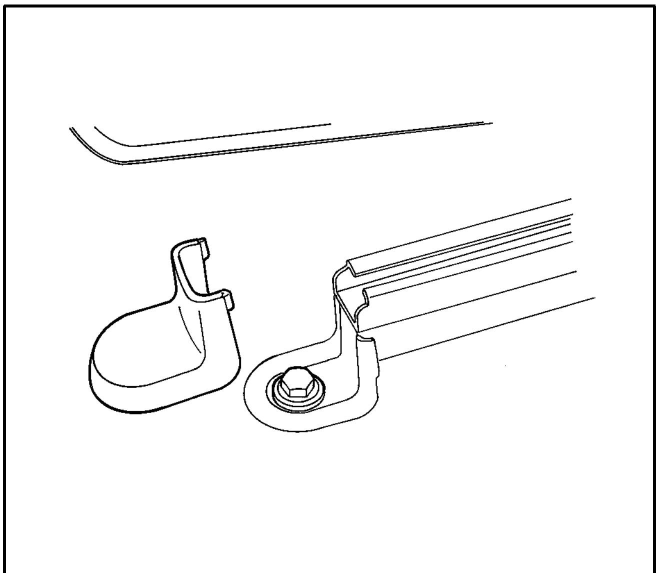
CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Height Adjustment Knob Screw	12	-	106
Front Bucket Seat Bolts	25	18	-
Front Seat Belt Buckle Bolt	45	33	-
Front Seat Cushion Trim Screw	12	-	106
Front Seat Track Bolts	17	13	-
Front Seatback Bolts	45	33	-
Lock Assembly Screws	20	15	-
Lock Striker Bolts	24	18	-
Lower Rear Seat Belt Anchor Bolt	35	26	-
Rear Seat Cushion Bolt	25	18	-
Rear Seatback Bolts	25	18	-


A109H008

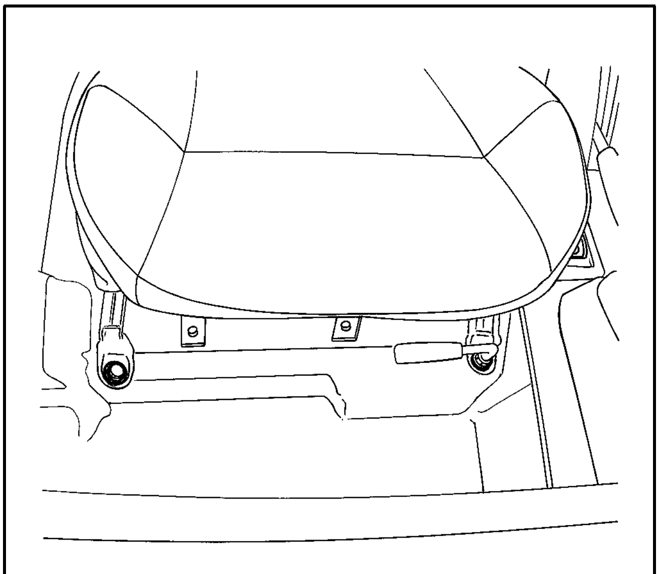
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

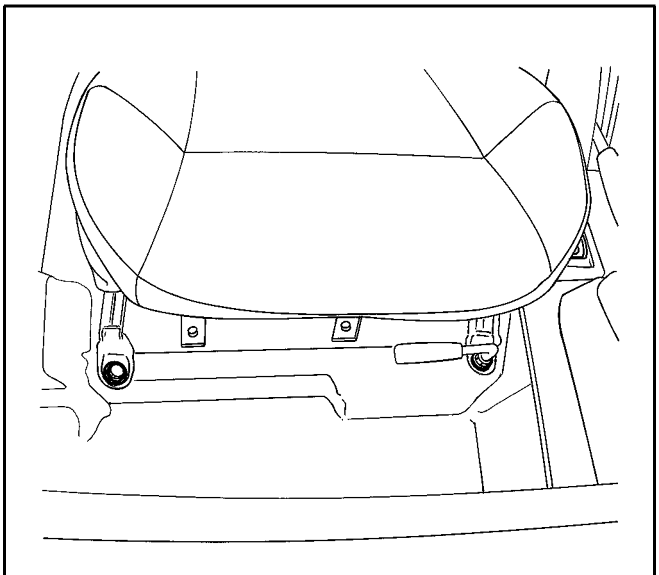
FRONT BUCKET SEATS

Removal Procedure

1. Remove the plastic caps to reveal the bolts that secure the rear portion of the front seat to the floor.
2. Remove the bolts that secure the rear portion of the seat to the floor.


A109H007

3. Remove the bolts that secure the front portion of the front seat to the floor.
4. Disconnect the electrical connector from the driver's seat.
5. Remove the seat.


A109H007

Installation Procedure

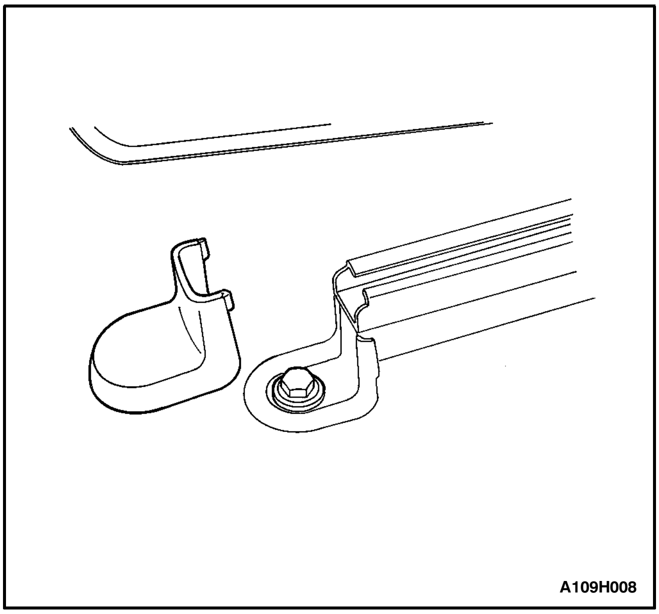
1. Install the seat.
2. Connect the electrical connector to the driver's seat.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Install the bolts into the front portion of the front seat.

Tighten

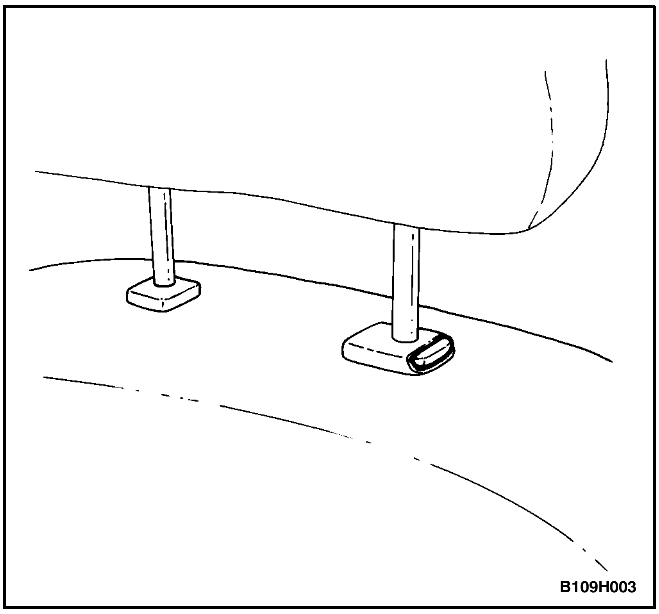
Tighten the front bucket seat bolts to 25 N•m (18 lb-ft).



4. Install the bolts into the rear portion of the front seat.

   Tighten

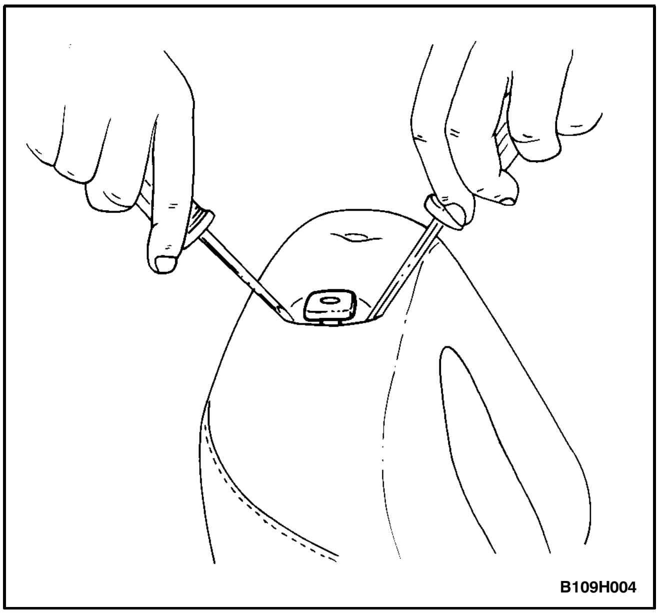
   Tighten the front bucket seat bolts to 25 N•m (18 lb-ft).
5. Install the plastic caps.



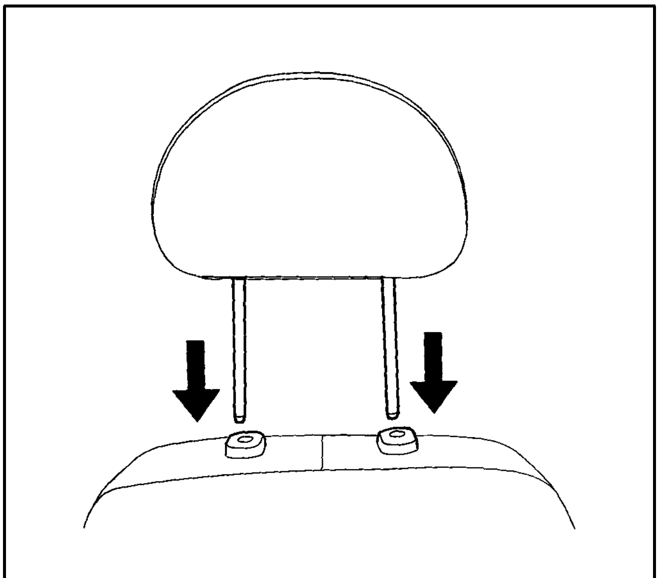
HEAD RESTRAINT

Removal Procedure

1. Press the head restraint adjust button and remove the head restraint from the seatback.



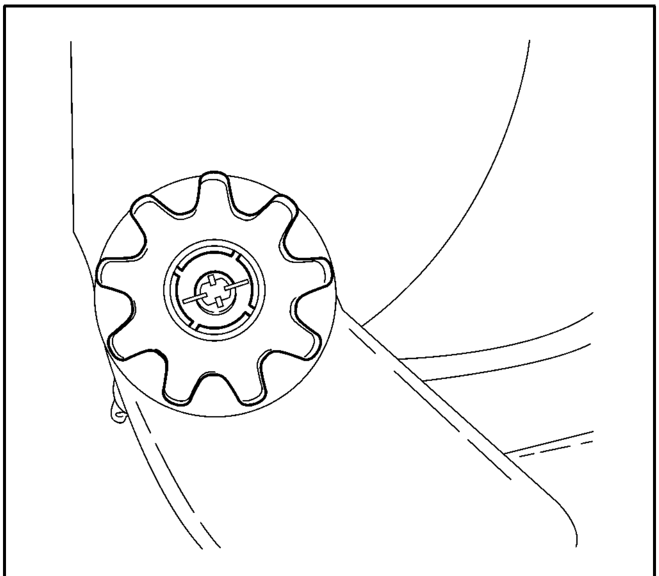
2. Insert two flathead screwdrivers down the front and the back side of the guide sleeves.
3. With the screwdrivers, press in the retaining latches and remove the guide sleeves.



A109H009

Installation Procedure

1. Install the guide sleeves into the seatback, making sure the angle of the guide sleeves is parallel to the seatback. Press down in order to engage the guide sleeve retaining latches.
2. Install the head restraint into the guide sleeves. Press down in order to engage the stop pin.



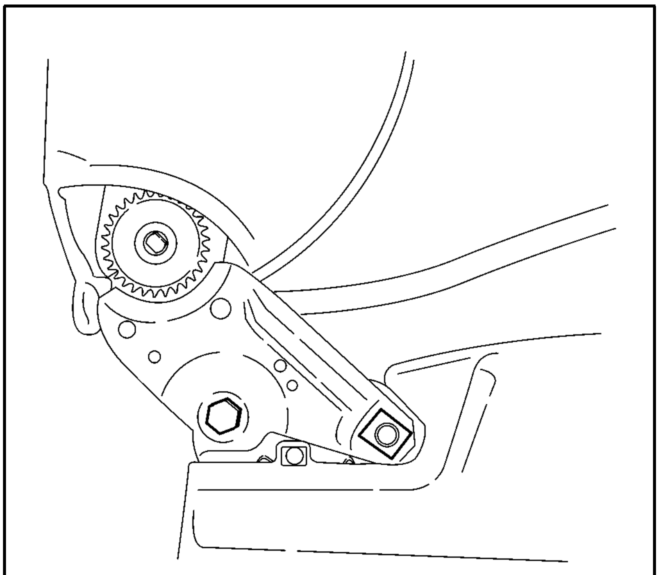
A109H011

FRONT SEATBACK

(Dial-Type Recliner Shown, Lever-Type Recliner Similar)

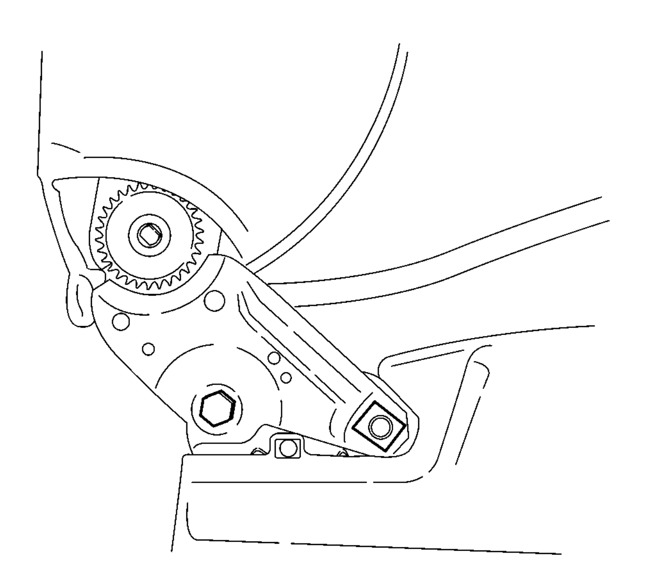
Removal Procedure

1. Remove the front bucket seat from the vehicle. Refer to "Front Bucket Seats" in this section.
2. Remove the recliner adjustment knob cap and the recliner adjustment knob (or remove the recliner adjustment lever, if equipped).



A109H012

3. Remove the bolt and seat belt buckle.
4. Remove the seat trim.
5. Remove the trim clips and the seatback bolts.
6. Remove the seatback.



A109H012

Installation Procedure

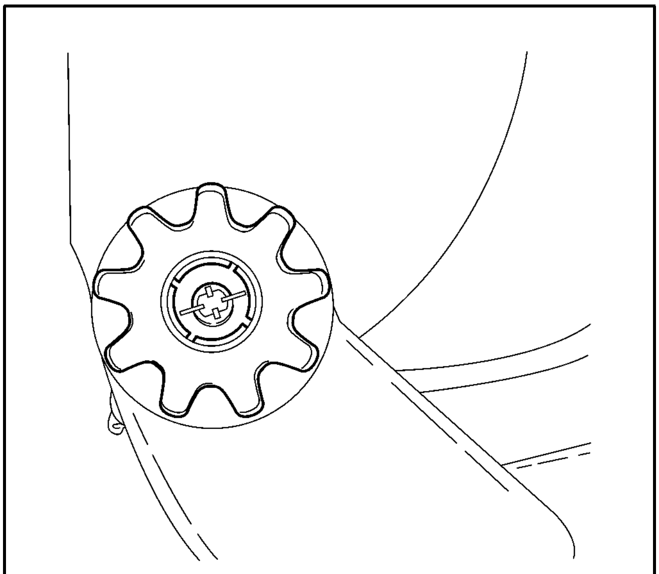
1. Install the seatback onto the seat cushion.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the trim clips and the seatback bolts.

Tighten

Tighten the front seatback bolts to 45 N•m (33 lb-ft).



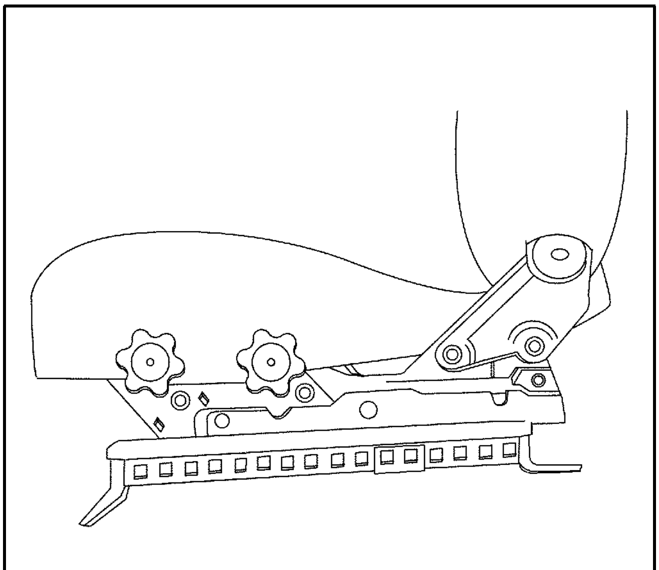
A109H011

3. Install the seat trim.
4. Install the seat belt buckle with the bolt.

Tighten

Tighten the front seat belt buckle bolt to 45 N•m (33 lb-ft).

5. Install the recliner adjustment knob and the recliner adjustment knob cap (or install the recliner adjustment lever, if equipped).
6. Install the front bucket seat in the vehicle. Refer to "Front Bucket Seats" in this section.

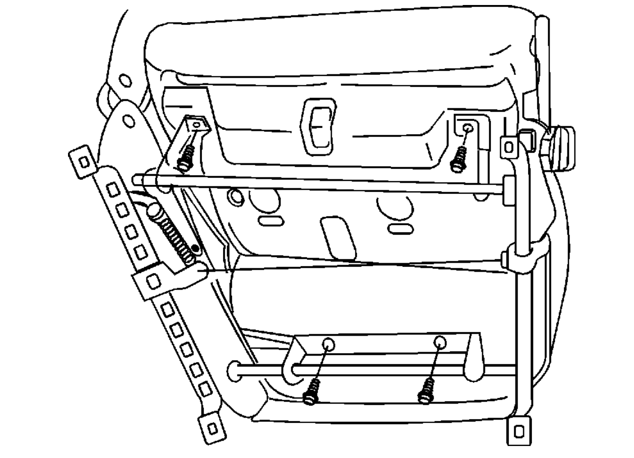


A19H014A

FRONT SEAT CUSHION

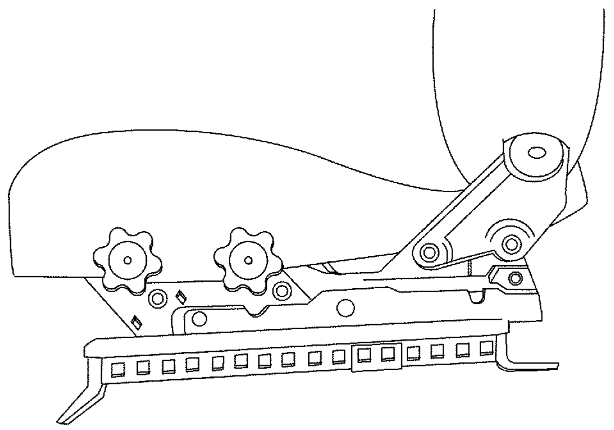
Removal Procedure

1. Remove the seatback. Refer to "Front Seatback" in this section.
2. Remove any remaining front seat cover.



C19H010A

3. Remove the seat cushion bolts.
4. Remove the cushion from the seat adjuster.



A19H014A

Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

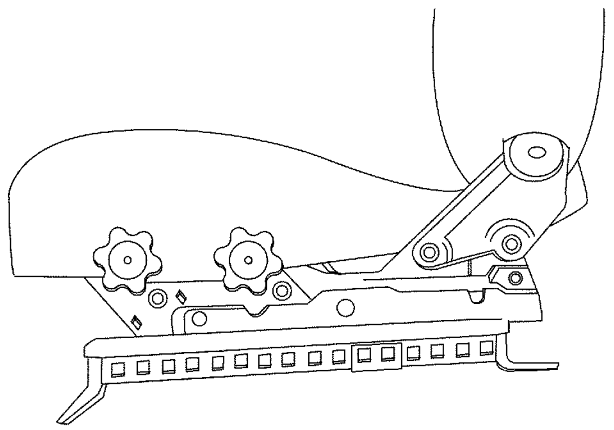
1. Install the seat cushion to the seat adjuster with the bolts.

   Tighten

   Tighten the front seat cushion bolts to 17 N•m (13 lb-ft).
2. Install the seatback. Refer to "Front Seatback" in this section.
3. Install all remaining front seat cover.

   Tighten

   Tighten the front seat cover screw to 12 N•m (106 lb-in).

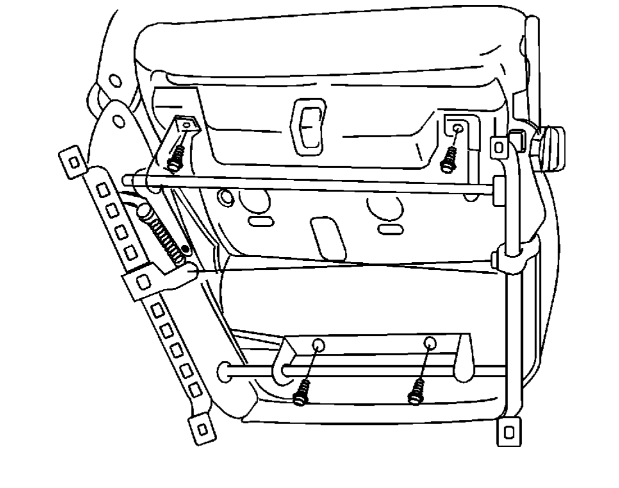


A19H014A

FRONT SEAT ADJUSTERS

Removal Procedure

1. Remove the seatback. Refer to "Front Seatback" in this section.
2. Remove any remaining seat cushion trim.
3. Remove the seat cushion bolts and the front seat adjusters from the seat cushion.



C19H010A

Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

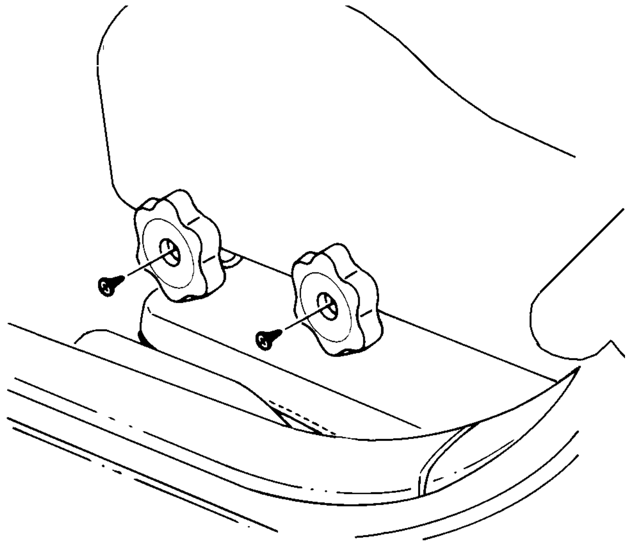
1. Install the front seat adjusters to the seat cushion with the bolts.

   Tighten

   Tighten the front seat cushion bolts to 17 N•m (13 lb-ft).
2. Install the seatback. Refer to "Front Seatback" in this section.
3. Install all remaining front seat cover.

   Tighten

   Tighten the front seat cover screw to 12 N•m (106 lb-in).

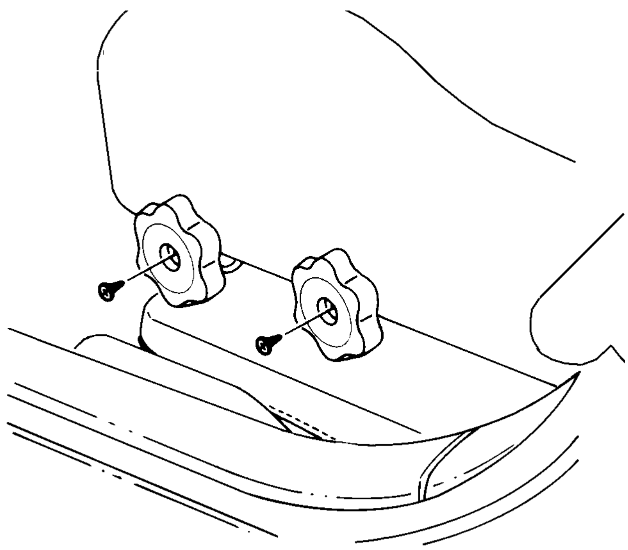


C39H001A

HEIGHT ADJUSTMENT KNOBS

Removal Procedure

1. Remove the screw and the height adjustment knob.



C39H001A

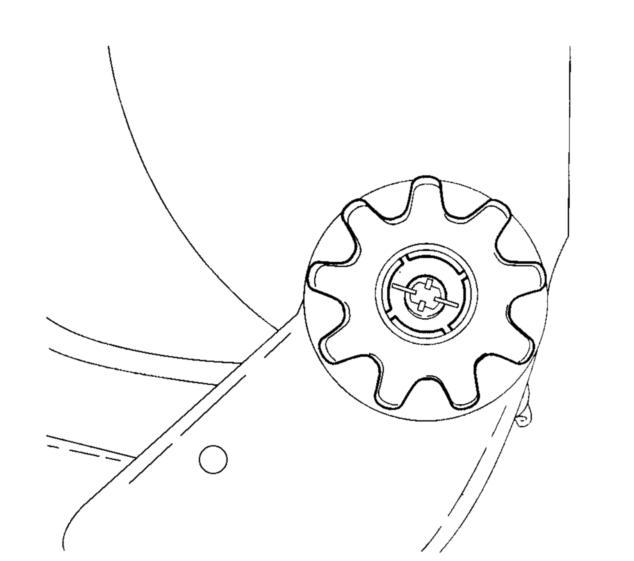
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the height adjustment knob with the screw.

   Tighten

   Tighten the front seat height adjustment knob screw to 12 N•m (106 lb-in).

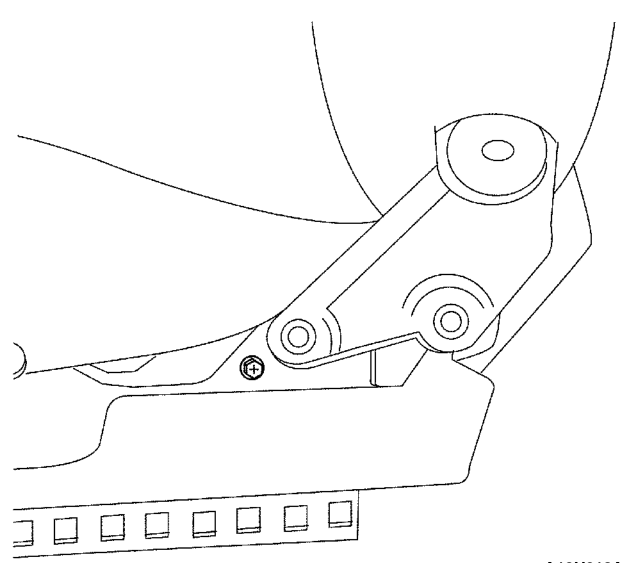


A19H011A

FRONT SEAT COVER

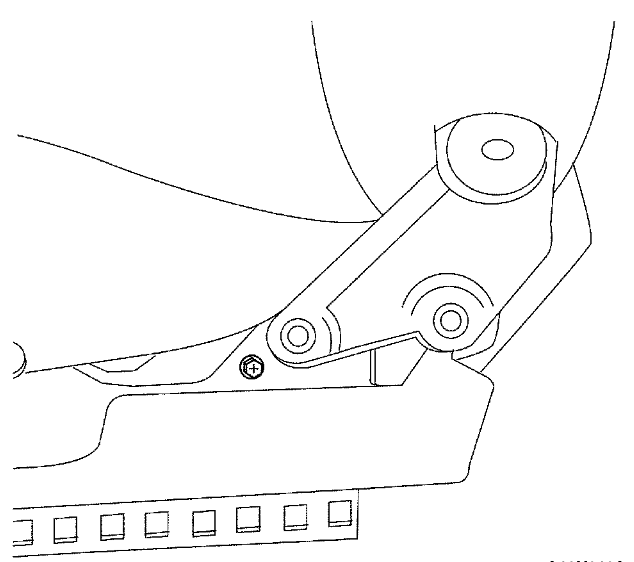
Removal Procedure

1. Remove the front bucket seat from the vehicle. Refer to "Front Bucket Seats" in this section.
2. Remove the recliner adjustment knob cap and the recliner adjustment knob.
3. Remove the upper seat cover.



A19H013A

4. Remove the screw and the lower seat cover.



A19H013A

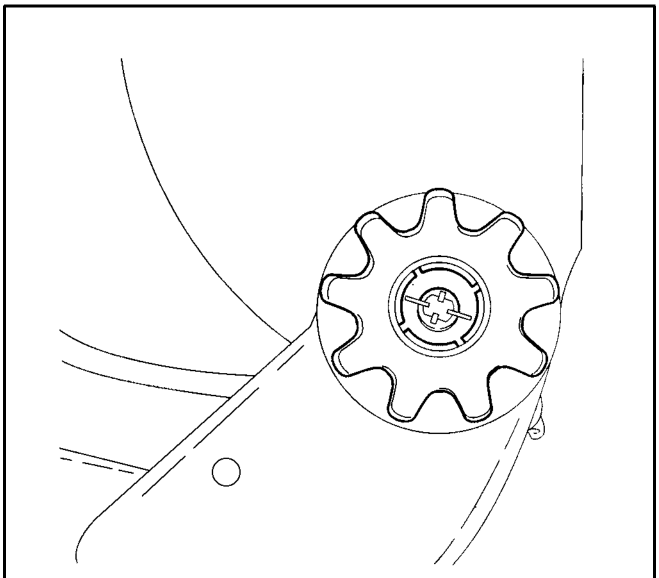
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode repidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the lower seat cover with the screw.

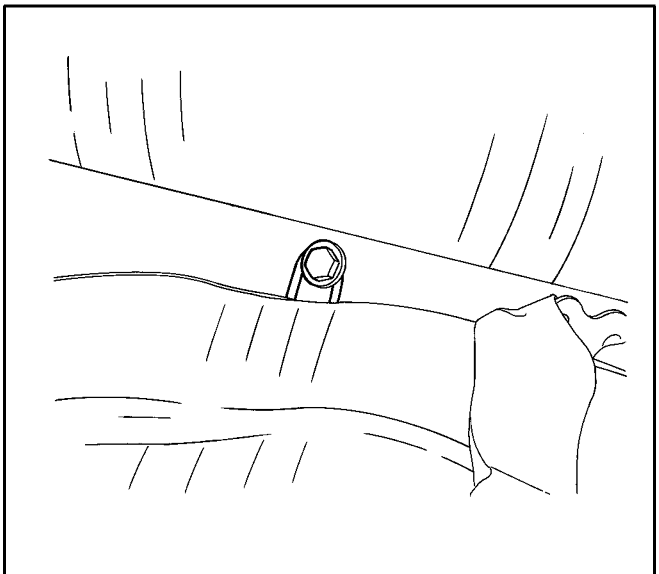
Tighten

Tighten the front seat cover screw to 12 N•m (106 lb-in).



A19H011A

2. Install the upper seat cover with new pin.
3. Install the recliner adjustment knob and the recliner adjustment cap.
4. Install the front bucket seat in the vehicle. Refer to "Front Bucket Seats" in this section.

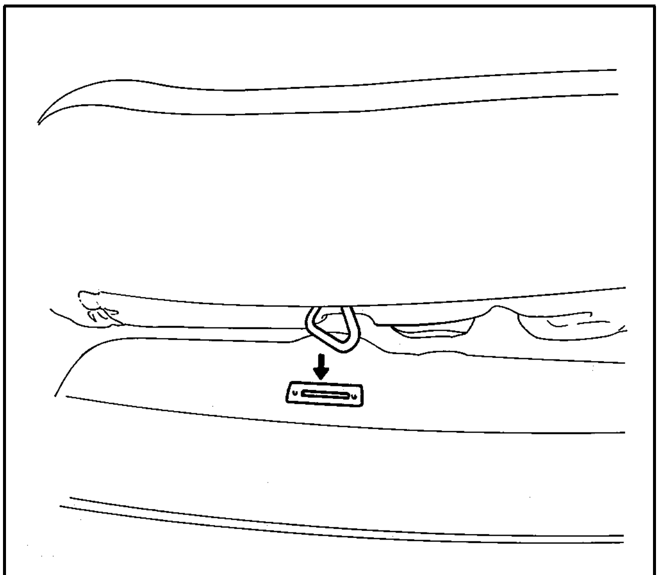


A209H003

REAR SEAT CUSHION

Removal Procedure

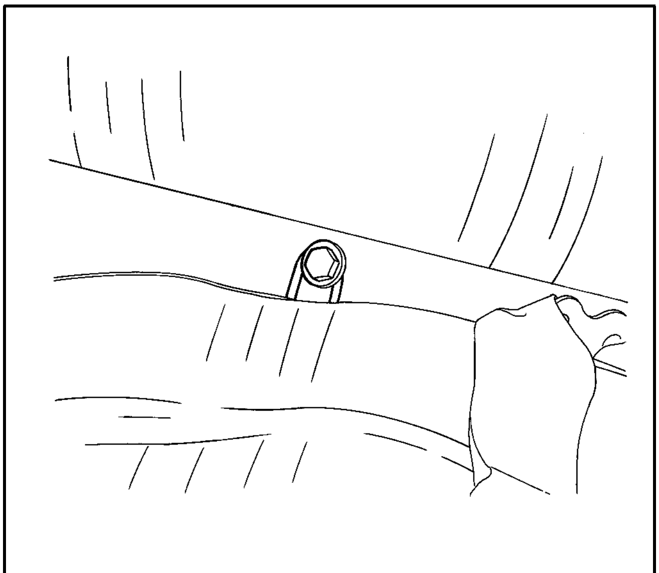
1. Remove the bolt at the base of the rear seatback.
2. Lift and remove the rear seat cushion.



A109H004

Installation Procedure

1. Insert the wire loops along the front edge of the rear seat cushion into the recesses in the floor pan.

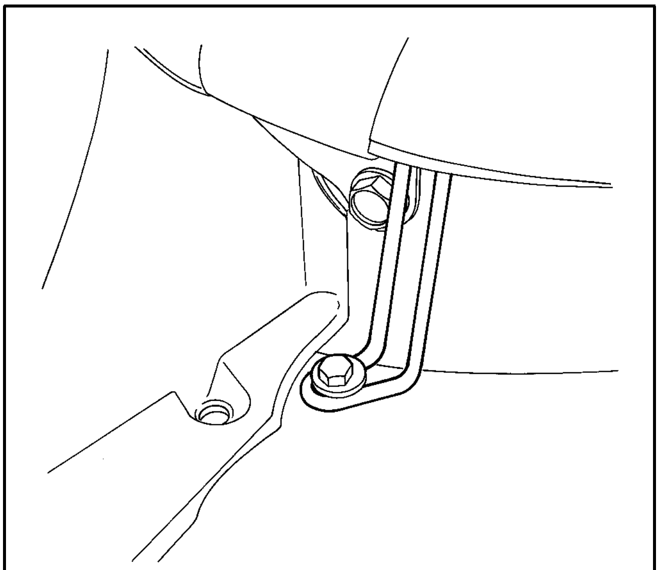


A209H003

2. Install the rear seat cushion with the bolt.

Tighten

Tighten the rear seat cushion bolt to 25 N•m (18 lb-ft).

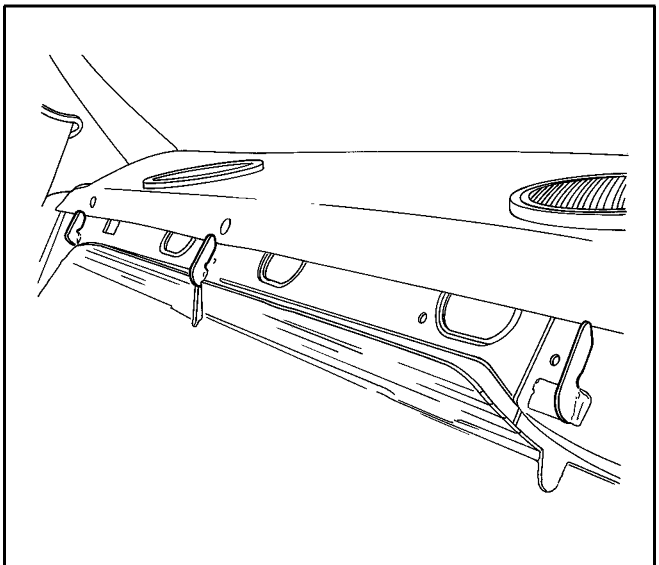


A109H001

REAR SEATBACK

Removal Procedure

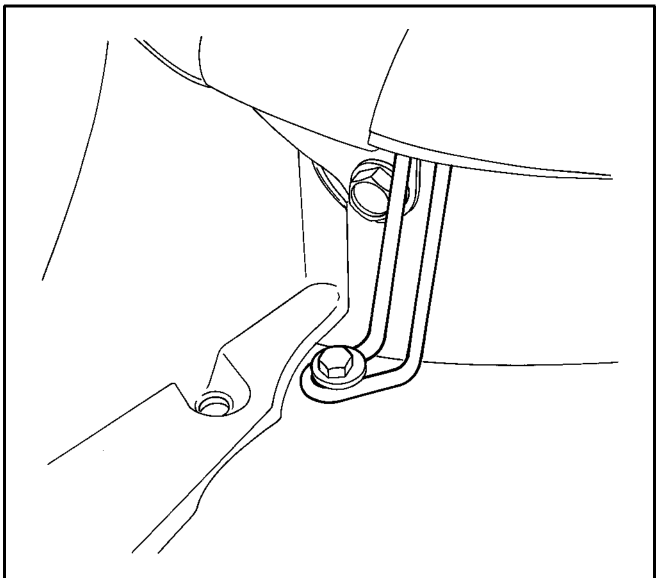
1. Remove the rear cushion. Refer to "Rear Seat Cushion" in this section.
2. Remove the bolts that secure the rear seatback.
3. Remove the rear seatback by pulling the base of the seatback out and sliding the seatback up.



A109H002

Installation Procedure

1. Install the rear seatback by inserting the metal loops over the hooks.



A109H001

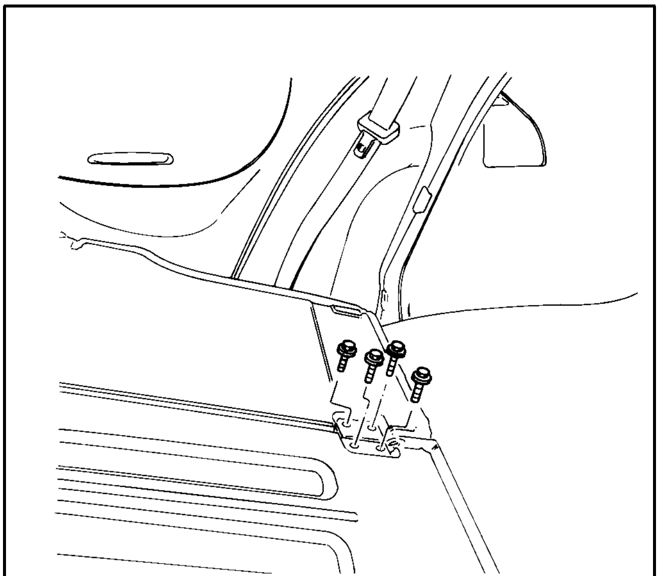
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the rear seatback with the bolts.

   Tighten

   Tighten the rear seatback bolts to 25 N•m (18 lb-ft).

3. Install the rear seat cushion. Refer to "Rear Seat Cushion" in this section.

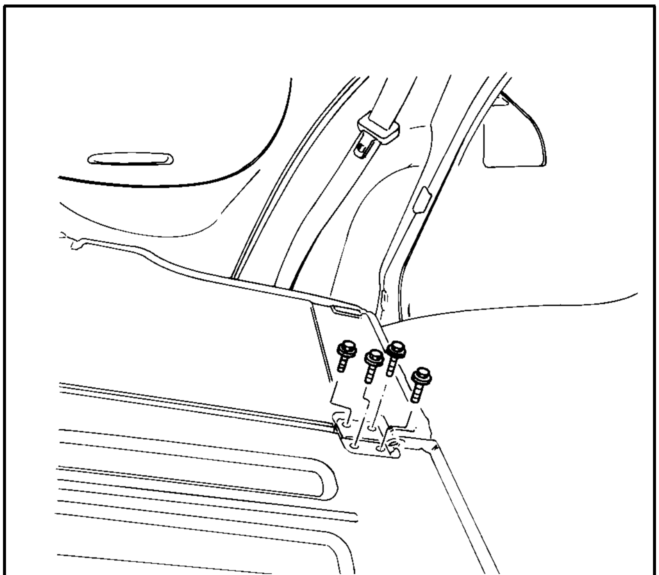


A209H002

SPLIT REAR SEATBACK

Removal Procedure

1. Lower the rear seatbacks.
2. Remove the bolts that secure the rear seatbacks to the hinges.
3. Remove the rear seatbacks by pulling the seat hinge posts out of the lower C-pillars.



A209H002

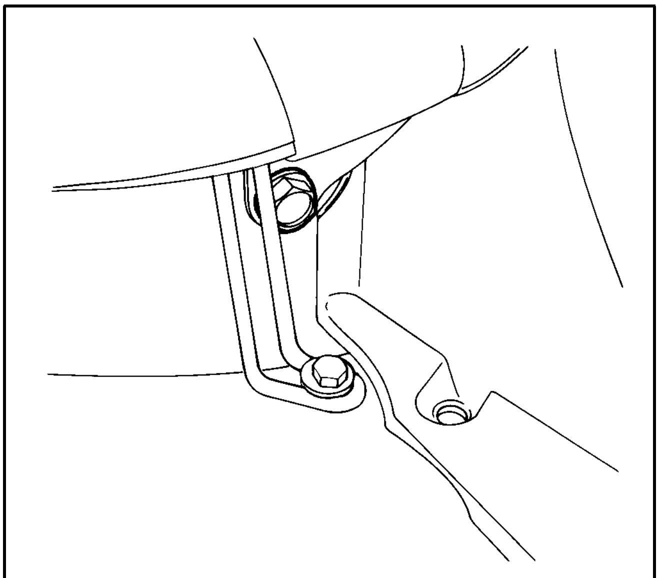
Installation Procedure

1. Install the rear seatback by inserting the seat hinge posts into the lower C-pillars.
2. Install the seatbacks to the hinges with the bolts.

   Tighten

   Tighten the rear seatback bolts to 25 N•m (18 lb-ft).

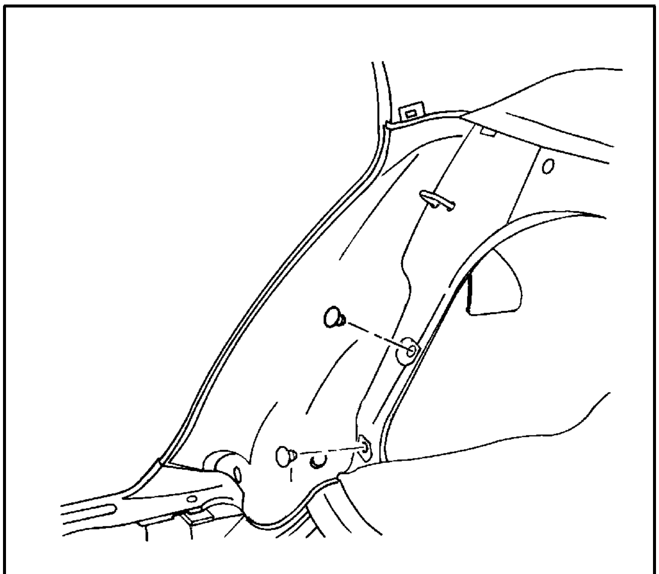
3. Raise the rear seatbacks in the upright position.


A109G023

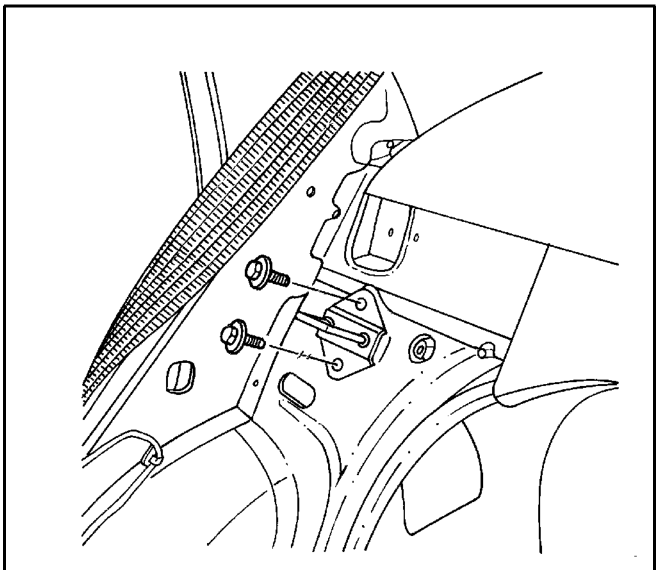
REAR SEATBACK LOCK STRIKER

Removal Procedure

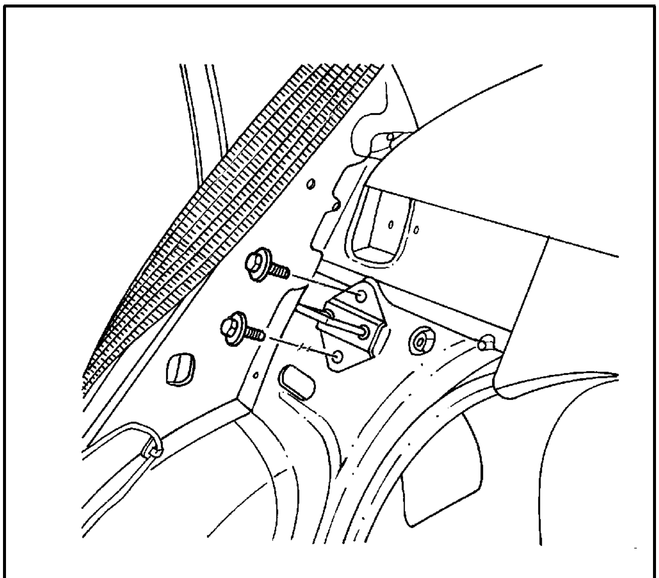
1. Remove the rear seat cushion. Refer to "Rear Seat Cushion" in this section.
2. Remove the rear seatback. Refer to "Split Rear Seatback" in this section.
3. Remove the C-pillar trim panel. Refer to Section 9G, Interior Trim.
4. Remove the bolt and the lower rear seat belt anchor.


A309H001

5. Reposition the door opening weatherstrip. Refer to Section 9P, Doors.
6. Remove the retaining clips and the lower C-pillar trim panel.


A309H002

7. Remove the bolts and the rear seatback lock striker.


A309H002

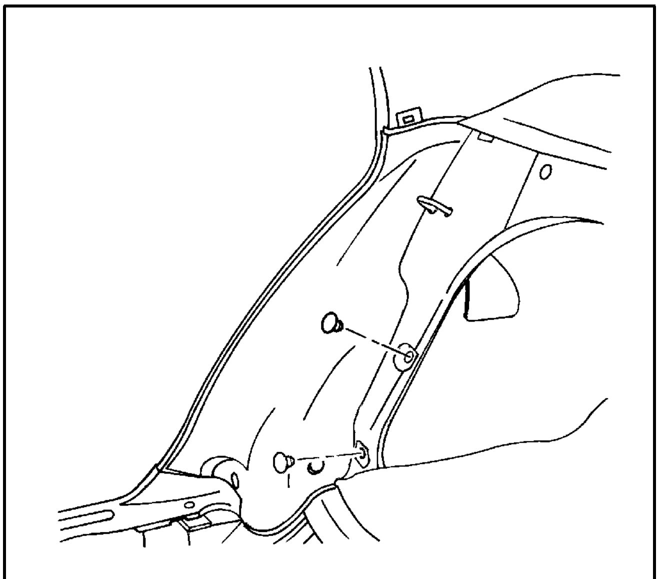
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

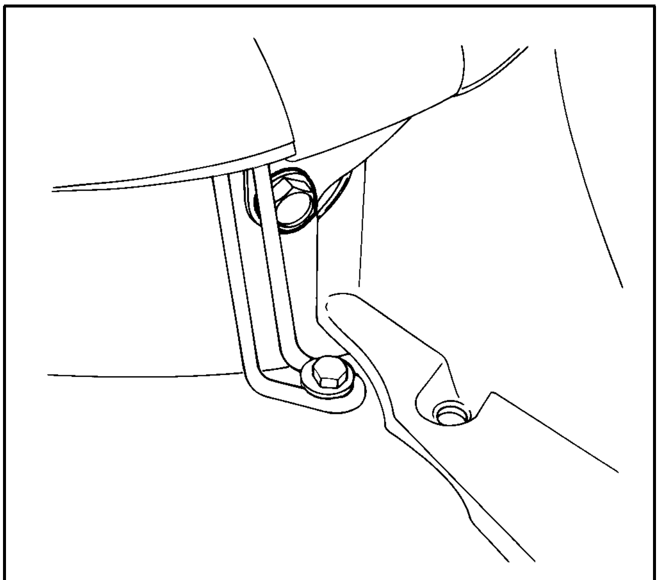
1. Install the rear seatback lock striker with the bolts.

   ### Tighten

   Tighten the lock striker bolts to 24 N•m (18 lb-ft).


A309H001

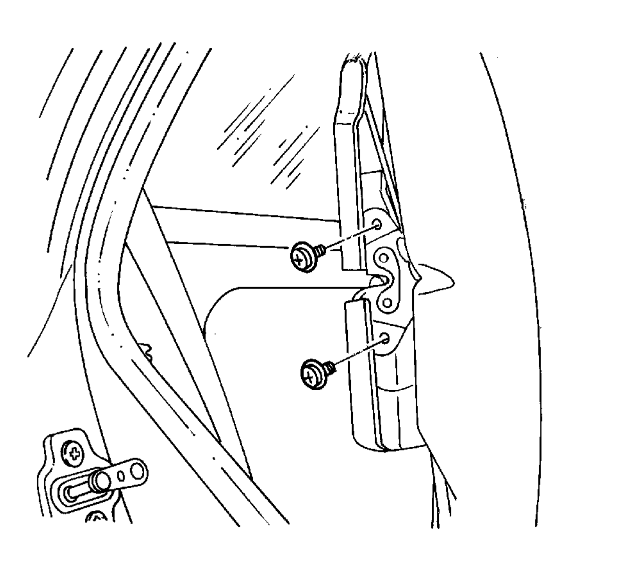
2. Install the lower C-pillar trim panel with the retaining clips.


A109G023

3. Install the door opening weatherstrip to its original position. Refer to Section 9, Doors.
4. Install the lower rear seat belt anchor with the bolt.

   ### Tighten

   Tighten the lower rear seat belt anchor bolt to 35 N•m (26 lb-ft).
5. Install the C-pillar trim panel. Refer to Section 9G, Interior Trim.
6. Install the rear seatback. Refer to “Split Rear Seatback” in this section.
7. Install the rear seat cushion. Refer to “Rear Seat Cushion” in this section.

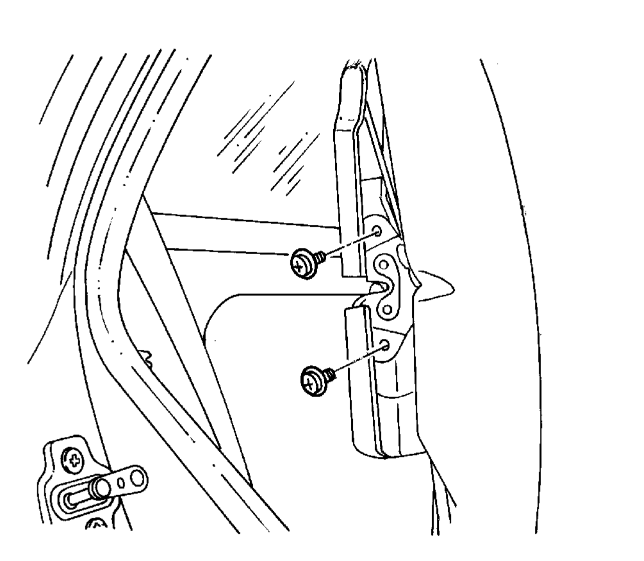


A309H003

REAR SEATBACK LOCK ASSEMBLY

Removal Procedure

1. Remove the rear seatback lock release knob.
2. Reposition the rear seatback cover.
3. Remove the screws and the lock assembly.



A309H003

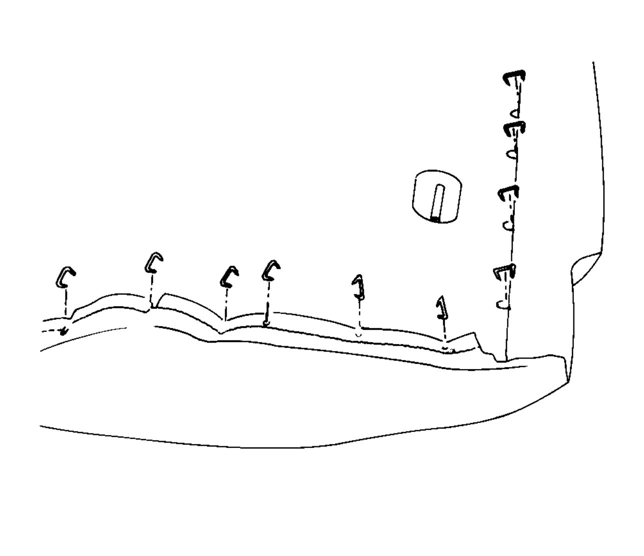
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear seatback lock assembly with the screws.

   Tighten

   Tighten the lock assembly screws to 20 N•m (15 lb-ft).
2. Install the rear seatback cover to its original position.
3. Install the rear seatback lock release knob.



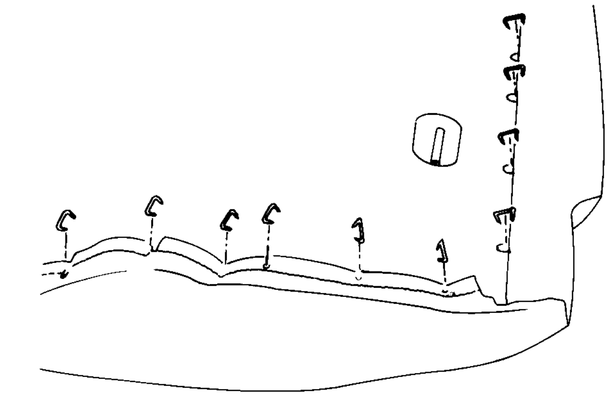
A209H001

SEAT COVERS

(Rear Seatback Cover Shown, Other Seat Covers Similar)

Removal Procedure

1. Remove the seatback and/or the seat cushion. Refer to "Front Seatback," "Front Seat Cushion," "Rear Seatback," "Split Rear Seatback," and/or "Rear Seat Cushion" in this section.
2. Remove the hog rings or the retaining clips from the seatback and/or the seat cushion.
3. Remove the seat cover from the seatback and/or the seat cushion.


A209H001

Installation Procedure

1. Install the seat cover onto the seatback and/or the seat cushion with the retaining clips or the new hog rings.
2. Install the seatback and/or the seat cushion. Refer to "Front Seatback," "Front Seat Cushion," "Rear Seatback," "Split Rear Seatback" and/or "Rear Seat Cushion" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

SEATS

Important: Do not attempt to change the designed seat position by altering the designed seat adjuster-to-floor pan anchor provisions or the seat adjuster-to-seat frame anchor provisions. Changing the seat position could affect the performance of the seat system.

This vehicle is equipped with low-backed front bucket seats with separate head restraints and a three-passenger split folding rear seat. Seat cushions and seatbacks have formed foam pads, which fit the contours of the full-panel seatback frame assembly and the designed contour of the seat cushion frame. There are no front seat forward or rearward relocation provisions provided at either the seat adjuster-to-seat frame or the seat adjuster-to-floor pan anchor attachments.

SECTION 9I

WATERLEAKS

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SPECIFICATIONS

RECOMMENDED MATERIALS FOR WATERLEAK REPAIRS

Leak Areas	Repair Materials
Windshield, back window	Urethane adhesive, caulking kit, or the equivalent
Metal joints	Brushable seam sealer which can be painted
Ventilation ducts	3M™ Auto Bedding and Glazing Compound or the equivalent
Small cracks and pin holes	3M™ Drip-Check Sealer or the equivalent
Large holes	3M™ Automotive Joint and Seam Sealer
Weatherstrips	3M™ 08011 Weatherstrip Adhesive or the equivalent
Bolts, studs, and screws	Strip caulk

WATERTEST STAND SPECIFICATIONS

Application	Description
Nozzle Type	Full jet spray nozzle #1/2 GG-25 or equivalent with a 605 included angle
Nozzle Height	Approximately 1,600 mm (63.0 in.) from the floor
Volume of Flow	14L (3.7 gal) per minute
Pressure	155 kPa (22.5 psi) measured at the nozzle
Windshield and A-Pillar Test Stand Position	Approximately 305 down, 455 toward the rear, and aimed at the corner of the windshield
B-Pillar Test Stand Position	Approximately 305 down, 455 toward the rear, and aimed at the center of the rear door
Back Window and Rear Deck Lid Test Stand Position	Approximately 305 down, 305 toward the front and aimed approximately 610 mm (24.0 in.) from the corner of the back window

DIAGNOSIS

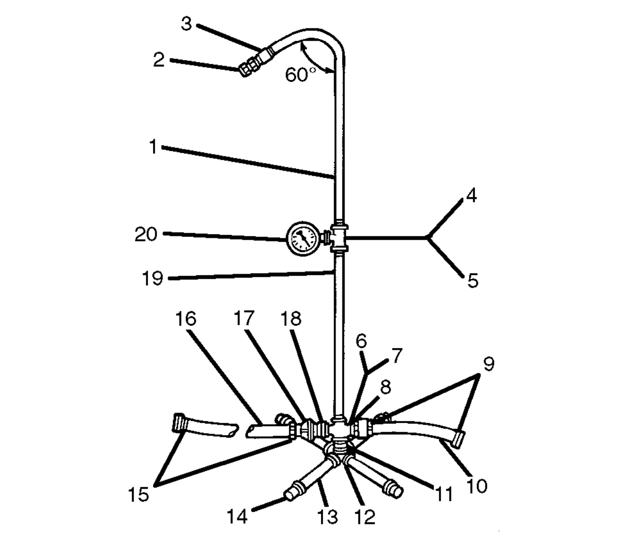
WATERLEAK DIAGNOSIS

The repair of waterleaks in the body requires proper testing and diagnosis. Repair waterleaks by adjusting the misaligned parts and using the proper repair materials. First, determine what conditions cause the leak. For example, the leak may occur only when the vehicle is parked on an incline, or water may appear only in the spare tire compartment. Second, test the area for the source of the leak using the following testing methods. If the general leak area is found, determine the exact entry point of the leak by using a water hose or an air hose. If the general leak area is not obvious, use the watertest stands to determine the area of the leak. It may be necessary to remove some interior trim panels or some parts in order to locate the leaks.

Important: It is necessary to find the origin of all the leaks before making any repairs. Random repairs may stop the leak only temporarily and may make future repairs more difficult. Continue localized testing in the general area in order to ensure that all leaks are found.

Generalized Testing

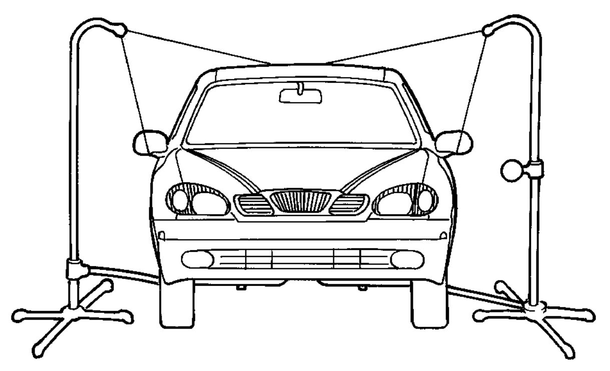
1. Set up the watertest stands.



A109I003

1 1/2-inch by 36-inch Pipe
2 Full-jet Spray Nozzle #1/2 GG-25 or Equivalent Nozzle Height at 1,600 mm to the Floor
3 1/2-inch Coupling
4 1/2-inch by 1/2-inch by 1/4-inch Reducing T (Right Only)
5 1/2-inch Coupling (Left Only)
6 1/2-inch Cross (Right Only)
7 1/2-inch Tee (Left Only)
8 1/2-inch Pipe-to-Hose Nipple (Right Only)
9 5/8-inch Female Hose Coupling
10 5/8-inch Input Hose (2 Feet Long, Right Only)
11 1/2-inch Close Nipple
12 1/2-inch Cross with Weld-on 1/2-inch Cap
13 1/2-inch by 12-inch Nipple
14 1/2-inch Cap
15 5/8-inch Female Hose Coupling
16 5/8-inch Cross Hose (12 Feet Long)
17 5/8-inch Hose Quick Connect
18 1/2-inch Pipe-to-Hose Nipple
19 1/2-inch by 30-inch Pipe (Straight)
20 1/4-inch Water Pressure Gauge (Right Only)

2. Set up the watertest stand leak test.



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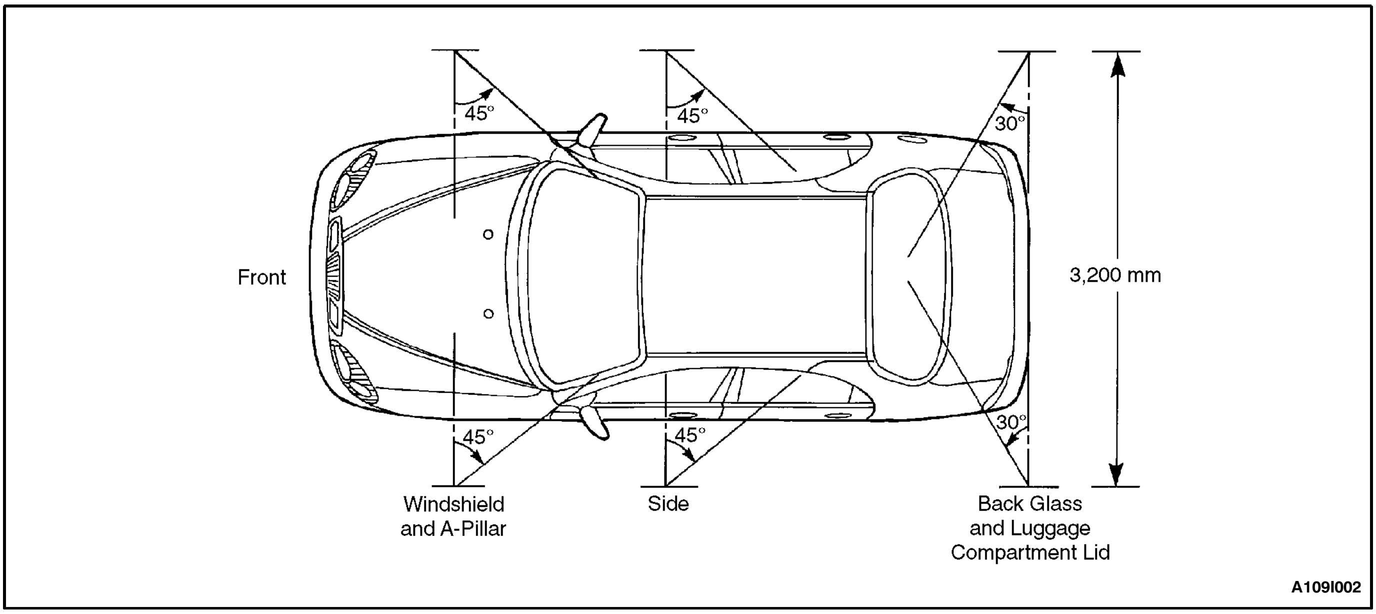
3. Perform the watertest stand leak test. Refer to "Watertest Stand Specifications" in this section.
4. If the local water pressure does not allow the required water pressure of 155 kPa (22.5 psi), move both stands closer to the vehicle so that the water spray overlaps.

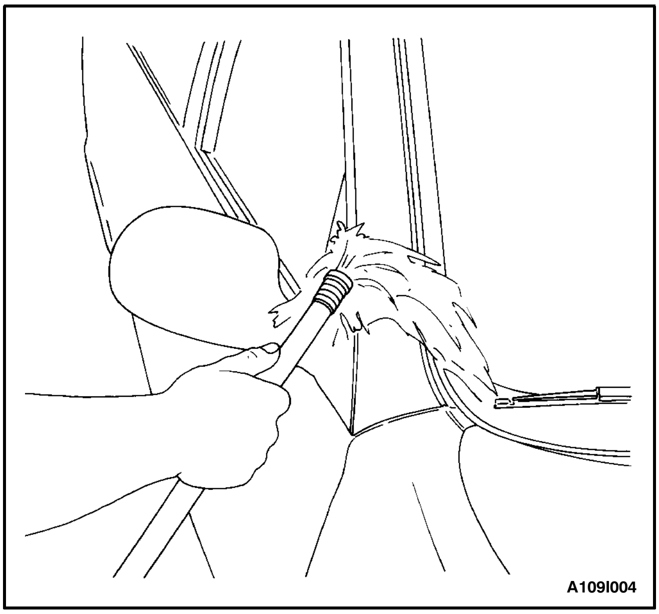


Localized Testing (Spot Test)

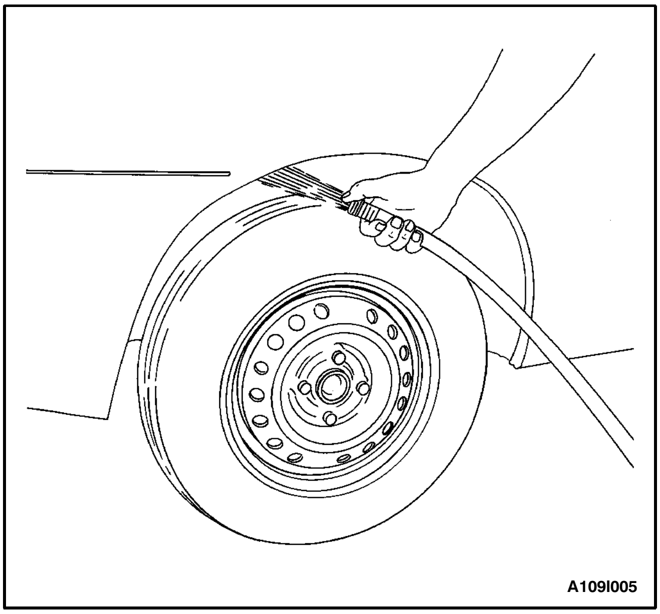
1. Do localized testing with a water hose or an air hose.
2. Begin testing by spraying the air or the water at the base of the suspected leak area. Continue spraying the air or the water upward until the leak is found.

Water Hose Test

1. Place another person inside the vehicle in order to detect the location of the leak.
2. Use a water hose without a nozzle.

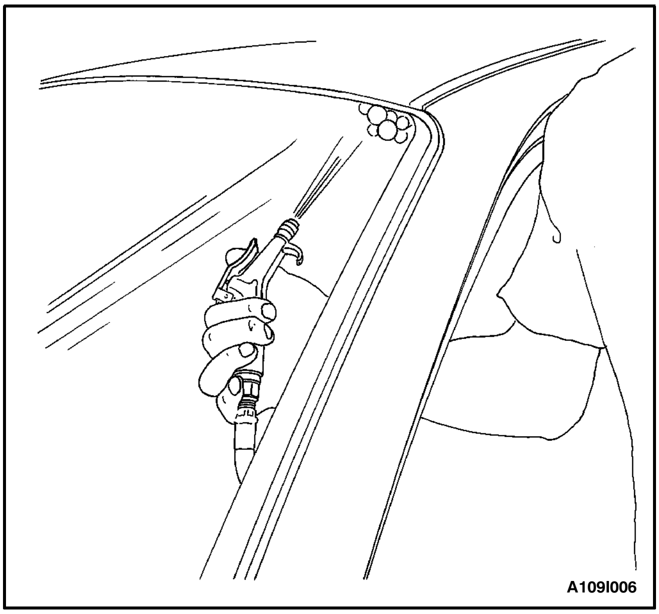


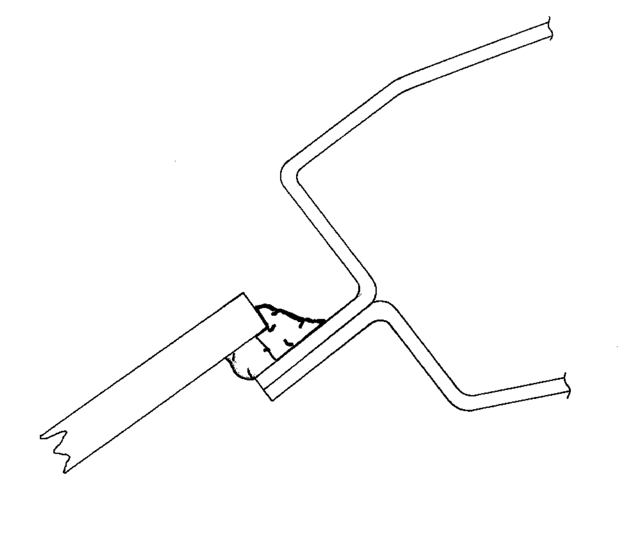
3. Begin spraying the water at the base of the suspected leak area. Continue spraying the water upward until the leak is found.



Air Hose Test

1. Apply soapy water to the outside of the vehicle in the suspected leak area.
2. Blow air from inside the vehicle. The air pressure should not exceed 205 kPa (29.7 psi).
3. Determine the location of the leaks from the bubbles formed in the soapy water.





A109I007

MAINTENANCE AND REPAIR

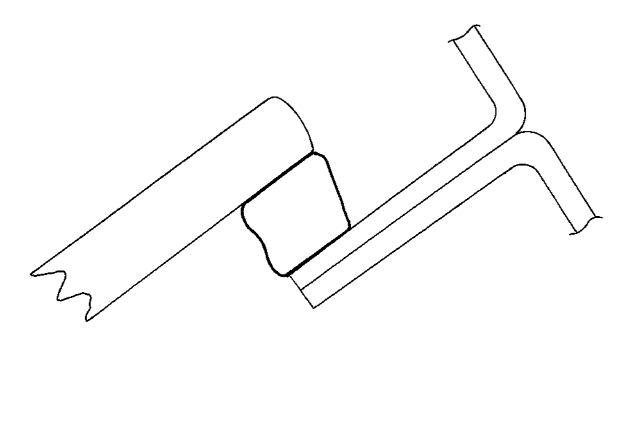
ON-VEHICLE SERVICE

WATERLEAK REPAIR

Some waterleaks around the glass can be repaired without removing the glass.

Important: This type of repair may be used only for urethane-installed glass.

1. Remove the reveal molding in the area of the leak. It may be necessary to remove the garnish molding or the trim strip lace in order to locate the leak.
2. While spraying water over the leak area, carefully push the glass outward in order to determine the size of the leak.
3. Mark the location of the leak.
4. Use water to clean any dirt from the area. Dry the area with an air hose.
5. Using a sharp knife, trim off the uneven edges of the adhesive caulking material around the leak for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.



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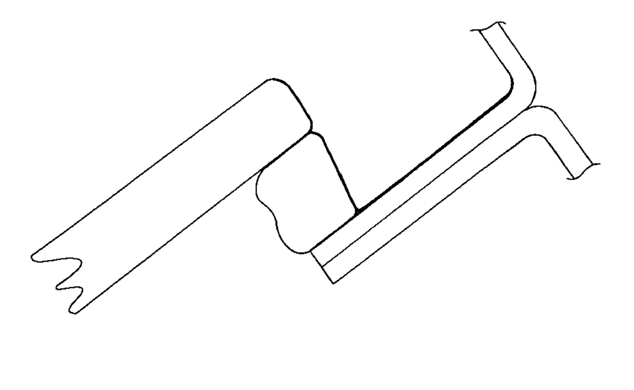
6. Using a sharp knife, trim off the uneven edges of the adhesive material around the leak 75 to 100 mm (3 to 4 inches) on both sides of the leak.



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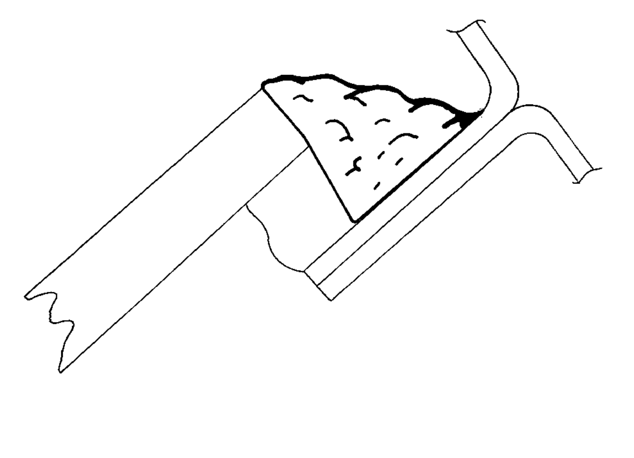
7. Prime the trimmed area with the primer.



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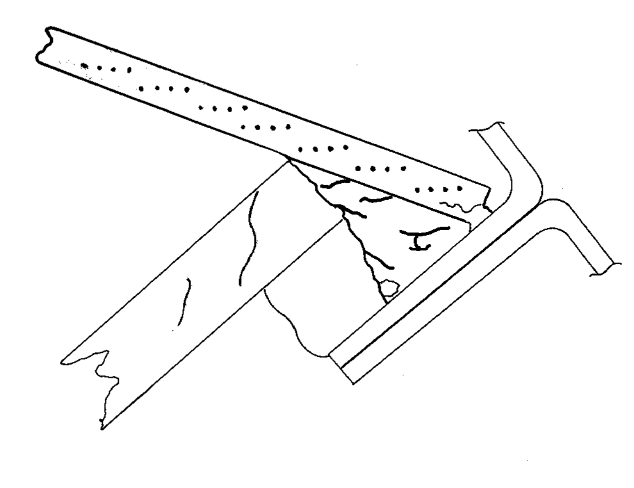
8. Allow the primer to dry for 5 minutes.
9. Apply the adhesive over the leak and for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.



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10. Immediately after applying the adhesive, use a flat stick or a similar tool to work the adhesive into the leak area and into the joint between the original material and the vehicle body in order to ensure a watertight seal.
11. Spray warm or hot water over the repaired area in order to determine if the leak was repaired. Do not run a heavy stream of water directly on the freshly-applied adhesive.
12. Install the trim strip lace if it was removed.
13. Install the garnish molding if it was removed.
14. Install the reveal molding.

Important: After the completion of any waterleak repair, re-test the area using the watertest stands. Do not use localized testing procedures on the newly-repaired areas, as the repair material may dislodge under abnormal pressure.

SECTION 9J

WINDNOISE

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DIAGNOSIS

WINDNOISE DIAGNOSIS

Caution: An assistant should drive the vehicle while the technician checks for the location of the windnoise, in order to prevent personal injury or vehicle damage.

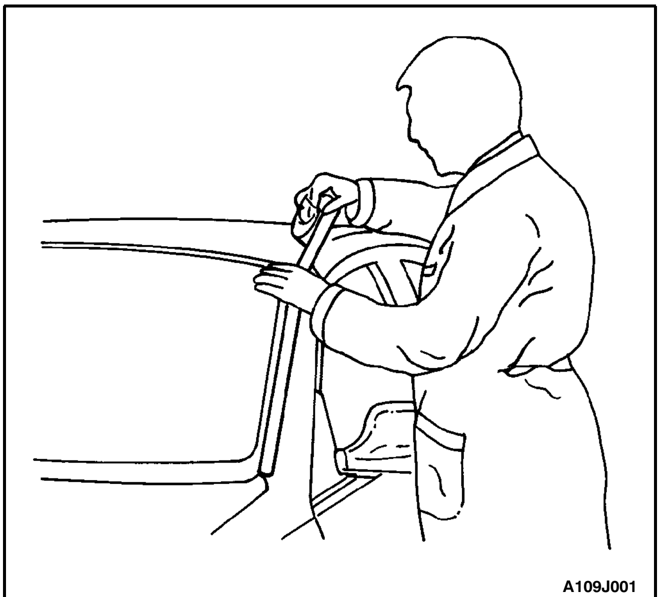
A test drive in the vehicle is necessary to accurately determine the location of the windnoise. Often there is a primary leak and secondary leaks. Failure to repair all leaks will only reduce the windnoise, not eliminate it.

During the test drive the technician should bring the following items to aid in determining the location of the windnoise.

- A mechanics stethoscope or vacuum hose
- Masking tape
- Strip caulk
- A china marking pencil
- A screwdriver

Perform the following steps in order to conduct the road test:

1. Choose a route that includes smooth straight streets that run in all four directions (north, south, east, and west).
2. Choose streets with little traffic or noise that would interfere with the test.
3. Drive the vehicle at the speeds at which the noise was noticed by the customer or until the noise is produced. Do not exceed legal speed limits.
4. The windnoise is external if any of the following conditions occur:
   - The windnoise is caused by the wind.
   - The windnoise can be heard with the door glass lowered and while the vehicle is being driven.
   - The windnoise is eliminated when tape is placed over various moldings and gaps.
5. Internal windnoise is air leaving the vehicle and should be repaired in the following manner.
   - In order to locate the leak, tape off the body lock pillar pressure relief valves. This will cause air pressure to build up inside the vehicle and enhance the windnoise.
   - Use a stethoscope or a vacuum hose to locate the leak.
   - Temporarily repair the leak with masking tape.



A109J001

   - Continue testing in order to determine if the noise has been eliminated or if other leaks exist.
   - When all leaks have been found, return to the shop and make permanent repairs with the proper alignment techniques and sealing materials.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

WINDNOISE REPAIR

Windnoise leak repairs are very similar to waterleak repairs. Refer to Section 9I, Waterleaks. The actual procedure depends on the type of seal being repaired.

Leaks around the door opening weatherstrips do not always indicate a faulty weatherstrip. A door or window adjustment may resolve the condition. Refer to Section 9P, Doors or Section 9L, Glass and Mirrors.

SECTION 9K

SQUEAKS AND RATTLES

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DIAGNOSIS

SQUEAK AND RATTLE DIAGNOSIS

Rattle Coming From the Side Rail

Checks	Action
Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.

Rattle Under Vehicle at Higher RPM

Checks	Action
Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.

Squeak From the Front of the Vehicle in Cold Weather

Checks	Action
Check the front stabilizer shaft insulators.	• While the vehicle is cold, perform a test drive and achieve full front suspension travel by driving through a dip in the road. • Remove the insulators and wrap teflon tape around the stabilizer shaft. Reinstall the insulators over the tape.

Thump From Rear of Vehicle on Bumps

Checks	Action
Check for a properly secured spare tire in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire and the tools. • Tightly secure the spare tire and all tools. • Perform a road test to verify that the noise is eliminated.

Glass Knock Coming From the Rear of the Vehicle When Driving Over Bumps

Checks	Action
Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condition. • Loosen the latch nuts and adjust the latch downward.

Rattle Coming From Door

Checks	Action
Check the door lock solenoid.	• Remove the door trim panel and check if the solenoid is loose. • Tighten the solenoid bolts.
Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.

Squeak When Operating Doors

Checks	Action
Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.

Squeak Coming From Console When Shifting Manual Transaxle (Condition Occurs In Cold Weather with a Cold Engine)

Checks	Action
Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.

Buzz From the Left Side of Instrument Panel

Checks	Action
Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on the cover with a finger and listen for a buzz. • Apply 6.35 mm (0.250 inch) by 25.4 mm (1.00 inch) felt pads to the side trim where the cover makes contact.

Squeak Coming From Instrument Cluster Trim Plate

Checks	Action
Check for rubbing of the cluster trim plate on the instrument panel.	• Test drive the vehicle in order to verify this condition. • Remove the instrument cluster trim plate and install felt tape to the edges.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

SQUEAK AND RATTLE REPAIR

Squeaks and rattles are caused by the unwanted movement between parts of a vehicle. There are three means to prevent squeaks or rattles.

- Attach the parts securely so that there is no relative motion during the operation of the vehicle.
- Separate the parts so that there is no contact during operation.
- Insulate the parts so that no squeaks or rattles occur with the movement of the parts. Low uniform friction surfaces can be used to eliminate “stick-slip” motion.

SECTION 9L

GLASS AND MIRRORS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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FASTENER TIGHTENING SPECIFICATIONS

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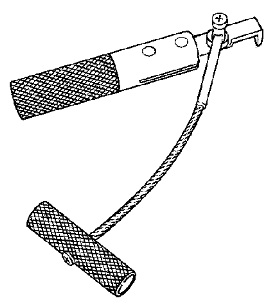
Exterior Rear Door Garnish Molding Screws	4	-	35
Door Glass Screws	7	-	62
Guide Rail Bolts	7	-	62
Movable Quarter Window Hinge Screws	4.5	-	40
Movable Quarter Window Latch Screws	4.5	-	40
Outside Rearview Mirror Assembly Screws	4.5	-	40
Rearview Mirror Mounting Screw	1.2	-	11

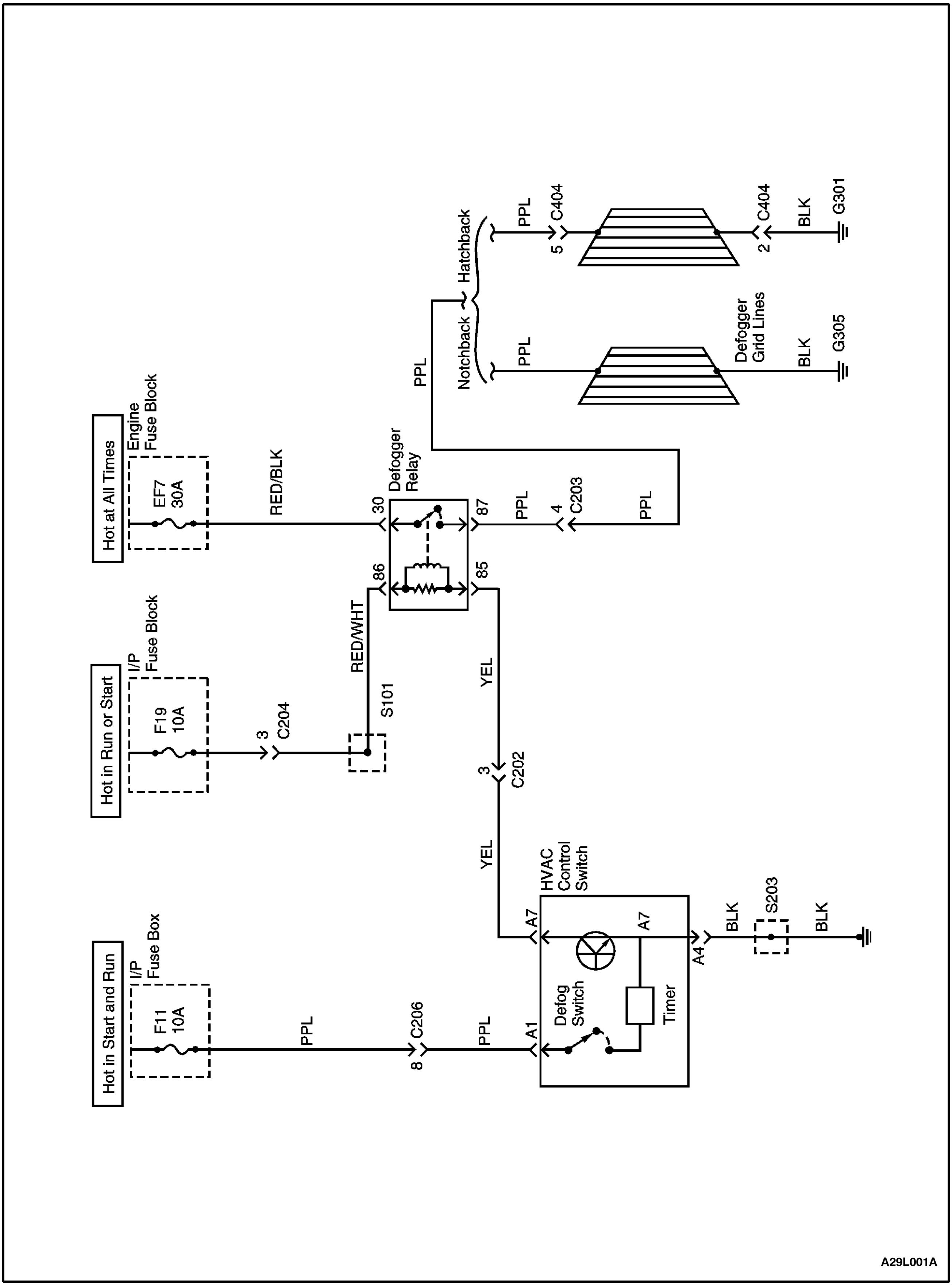
SPECIAL TOOLS

SPECIAL TOOLS TABLE

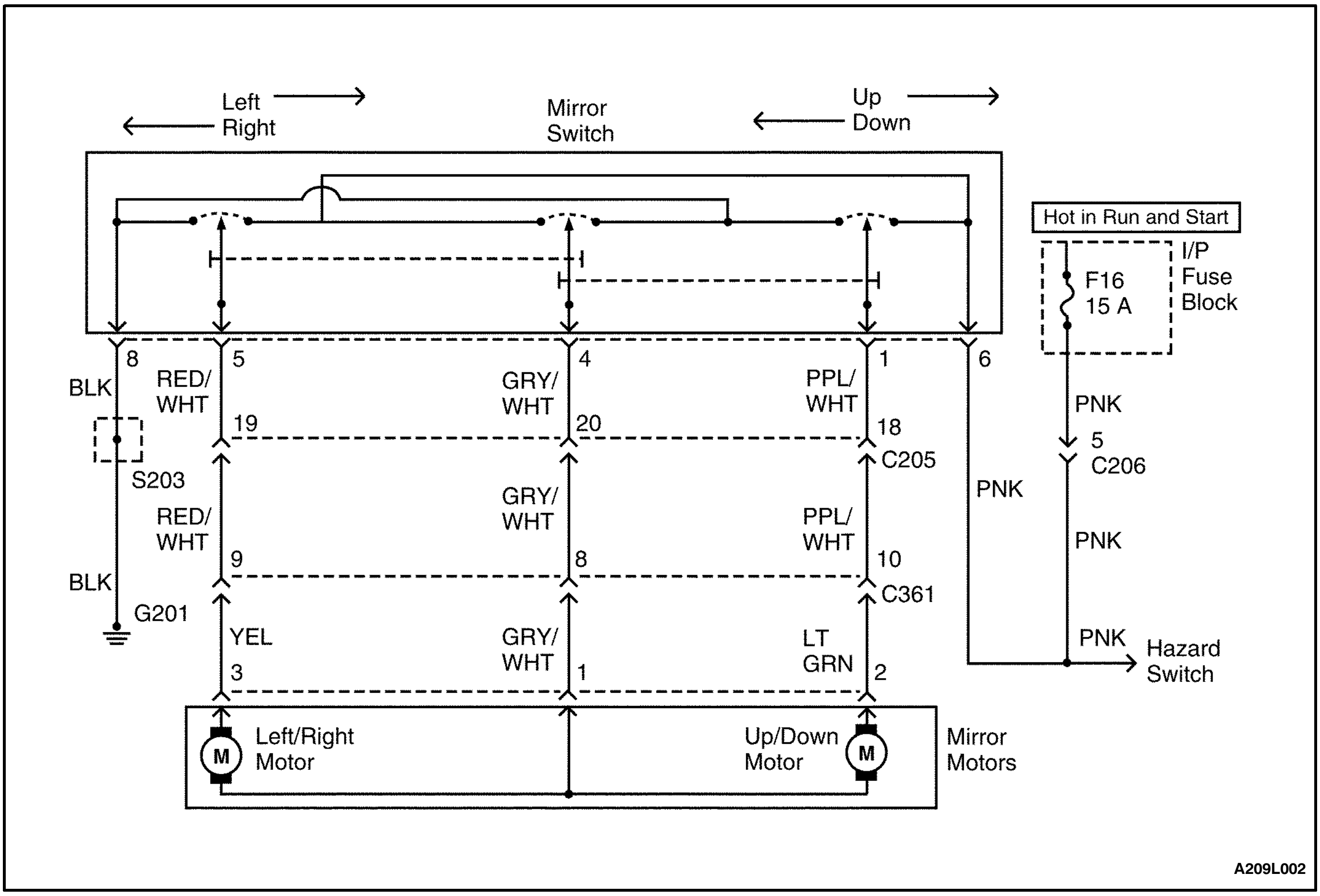
 A109L025	J-24402 Glass Sealant Remover

SCHEMATIC AND ROUTING DIAGRAMS

REAR WINDOW DEFOGGER



ELECTRIC CONTROL OUTSIDE REARVIEW MIRROR



DIAGNOSIS

TESTING REAR WINDOW DEFOGGER GRID LINE

If it has been observed during use that a grid line is inoperative, the following procedure can be used to find the break. If none of the grid lines is operating, a full system diagnosis should be completed before attempting to repair the grid lines.

1. Turn the ignition ON.
2. Turn on the rear window defogger.

Notice: Use care when touching the voltmeter terminals to a grid line. If the terminals are roughly applied, the grid line may be scratched, resulting in an open circuit.

3. From the inside of the vehicle, connect a voltmeter to each end of a grid line. The voltmeter will indicate battery voltage if the grid line is open.
4. If a grid line is found to be open, move a voltmeter terminal from one side of the grid line and retest at a point nearer to the other side of the window. Continue to retest, each time bringing one of the voltmeter terminals closer to the opposite side of the window from where it was originally connected. The break in the grid line is at the point where the voltmeter begins reading 0 volts instead of battery voltage.
5. Use a marking crayon to lightly mark the break point on the rear window. Mark the glass instead of marking directly on the grid line, and make the mark far enough from the grid line so that the mark can easily be removed without disturbing the repair.
6. Use a grid line repair kit to fix the break in the grid line. Refer to "Rear Window Defogger Grid Line Repair" in this section.

ELECTRIC CONTROL OUTSIDE REARVIEW MIRROR

Outside Rearview Mirror Does Not Adjust

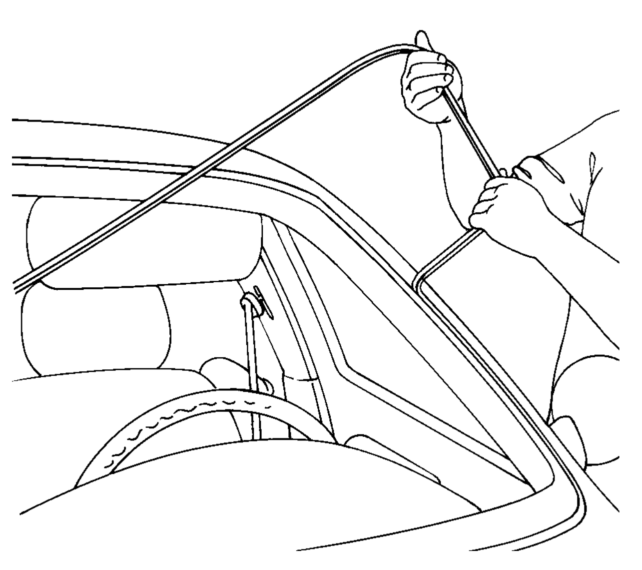
Step	Action	Value	Yes	No
1	Check the electric control mirror's left-and-right and up-and-down adjustments. Is the mirror operating for either the left-and-right or up-and-down adjustments?	-	Go to Step 12	Go to Step 2
2	Check fuse F16. Is fuse F16 blown?	-	Go to Step 3	Go to Step 4
3	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse F16. Is the repair complete?	-	System OK	-
4	1. Turn the ignition ON. 2. Check the voltage at fuse F16. Is the voltage at fuse F16 equal to the specified value?	11-14 v	Go to Step 6	Go to Step 5
5	Repair the open power supply circuit for fuse F16. Is the repair complete?	-	System OK	-
6	1. From below the instrument panel, reach up and press one of the retaining tabs for the electric control mirror switch trim panel. 2. While pressing one of the retaining tabs, pull the switch assembly away from the instrument panel so that the connector is visible. Is the connector properly connected to the electric control mirror switch?	-	Go to Step 8	Go to Step 7
7	Connect the connector to the electric control mirror switch. Is the repair complete?	-	System OK	-
8	1. Disconnect the electric control mirror switch connector. 2. Turn the ignition ON. 3. Connect a voltmeter between terminal 6 (ORN) and terminal 8 (BLK). Does the voltmeter indicate the specified value?	11-14 v	Go to Step 13	Go to Step 9
9	1. Turn the ignition ON. 2. Check the voltage at terminal 6 (ORN). Does the voltage equal the specified value?	11-14 v	Go to Step 10	Go to Step 11
10	Repair the open circuit between ground and terminal 8 (BLK). Is the repair complete?	-	System OK	-
11	Repair the open circuit between fuse F16 and the electric control mirror switch. Is the repair complete?	-	System OK	-
12	Check the left-and-right adjustment for the electric control mirror. Is the left-and-right adjustment working for the electric control mirror?	-	Go to Step 18	Go to Step 13

Outside Rearview Mirror Does Not Adjust (Cont'd)

Step	Action	Value	Yes	No
13	1. Make sure the electric control mirror switch has been reconnected. 2. On the passenger door, remove the black plastic escutcheon to expose the electric control mirror connector. 3. Disconnect the connector at the passenger door electric control mirror. 4. Connect a voltmeter between terminal 1 (GRY/WHT) and terminal 3 (YEL). 5. Observe the voltmeter while operating the electric control mirror switch to select the left-and-right adjustment. Does the voltmeter indicate the specified voltage in one direction, and the same voltage with reverse polarity when operated in the opposite direction?	11-14 v	Go to Step 17	Go to Step 14
14	1. Disconnect the electric control mirror switch connector. 2. Use an ohmmeter to measure the continuity between terminal 5 (RED/WHT) at the electric control mirror switch and terminal 3 (YEL) at the power mirror connector. 3. Use an ohmmeter to measure the continuity between terminal 4 (GRY/WHT) at the electric control mirror switch and terminal 1 (GRY/WHT) at the power mirror connector. Does the ohmmeter indicate the specified value for both measurements?	9 0 W	Go to Step 16	Go to Step 15
15	Repair the open circuit between the electric control mirror switch and the electric control mirror connector. Is the repair complete?	-	System OK	-
16	Replace the electric control mirror switch. Is the repair complete?	-	System OK	-
17	Replace the electric control mirror. Is the repair complete?	-	System OK	-
18	1. If the electric control mirror switch was previously disconnected for testing, make sure it is reconnected. 2. Disconnect the electric control mirror connector at the passenger door power mirror. 3. Connect a voltmeter between terminal 1 (GRY/WHT) and terminal 2 (LT GRN). 4. Observe the voltmeter while operating the power mirror switch to select the up-and-down adjustment. Does the voltmeter indicate the specified voltage in one direction, and the same voltage with reverse polarity when operated in the opposite direction?	-	Go to Step 17	Go to Step 19

Outside Rearview Mirror Does Not Adjust (Cont'd)

Step	Action	Value	Yes	No
19	1. Disconnect the electric control mirror switch connector. 2. Use an ohmmeter to measure the continuity between terminal 1 (PPL/WHT) at the electric control mirror switch and terminal 2 (LT GRN) at the electric control mirror connector. 3. Use an ohmmeter to measure the continuity between terminal 4 (GRY/WHT) at the electric control mirror switch and terminal 1 (GRY/WHT) at the electric control mirror connector. Does the ohmmeter indicate the specified value for both measurements?	9 0 W	Go to Step 16	Go to Step 15



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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

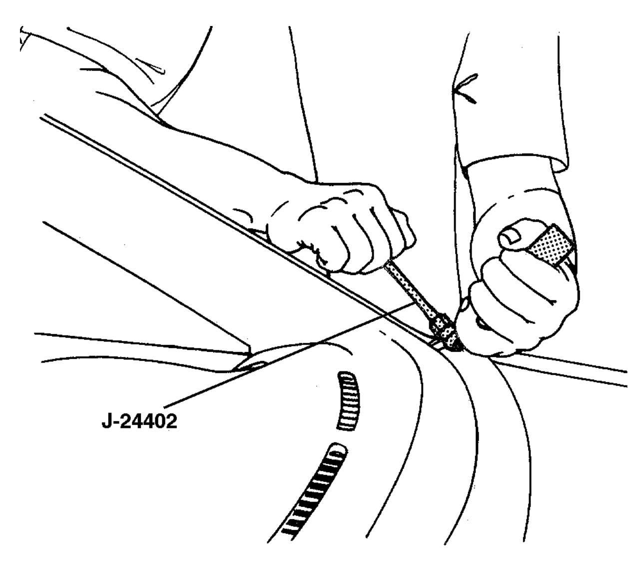
WINDSHIELD

Tools Required

J-24402 Glass Sealant Remover

Removal Procedure

1. Remove the cowl vent grille. Refer to Section 9R, Body Front End.
2. Remove the inside rearview mirror. Refer to "Inside Rearview Mirror" in this section.
3. Remove the weatherstrip around the windshield.



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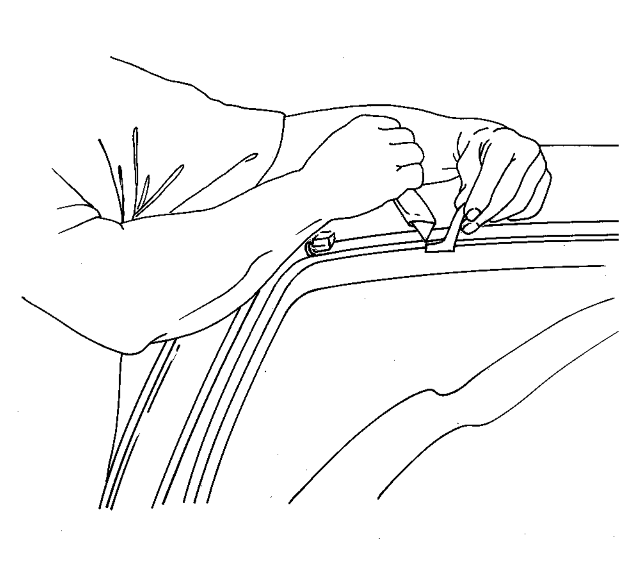
4. Using the glass sealant remover J-24402, cut the adhesive around the windshield.



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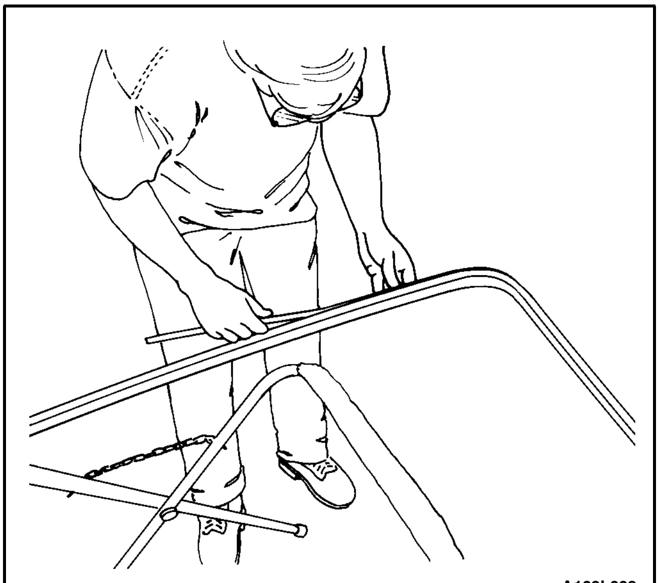
5. Remove the windshield from the vehicle.
6. Using a knife, remove the adhesive from the windshield.
7. Using a knife, remove the adhesive from the windshield frame.



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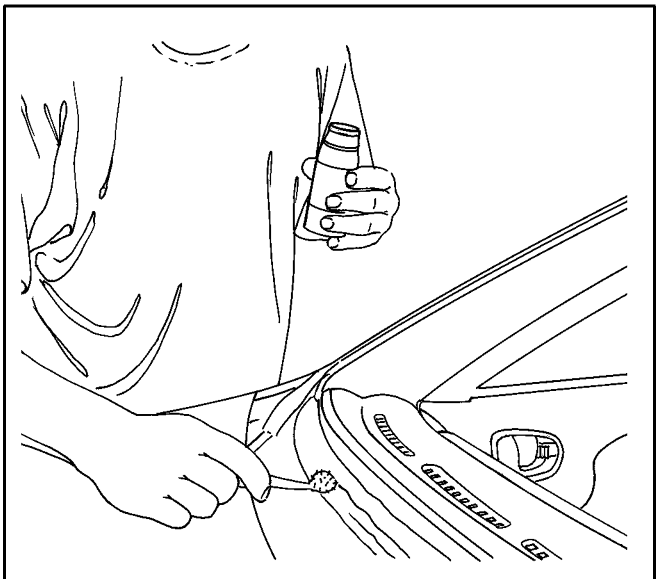
Installation Procedure

1. Install the new weatherstrip to the windshield.



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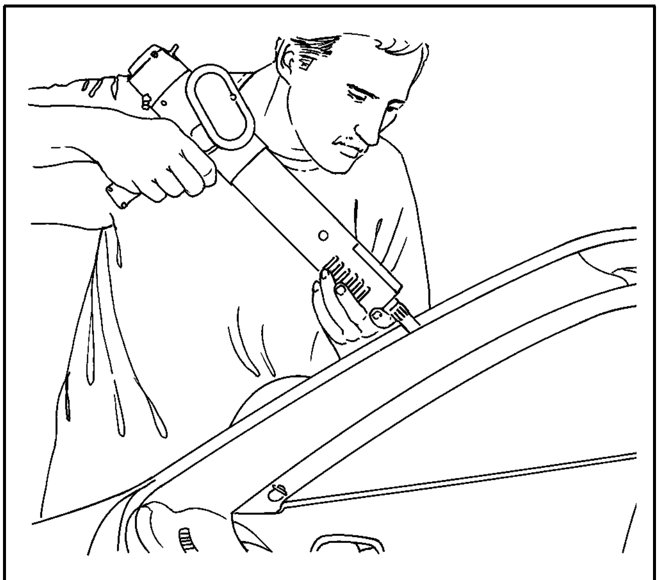
2. Apply tape to the new weatherstrip and the windshield to hold the weatherstrip in place.
3. Apply adhesive primer to the windshield frame and the perimeter of the windshield.



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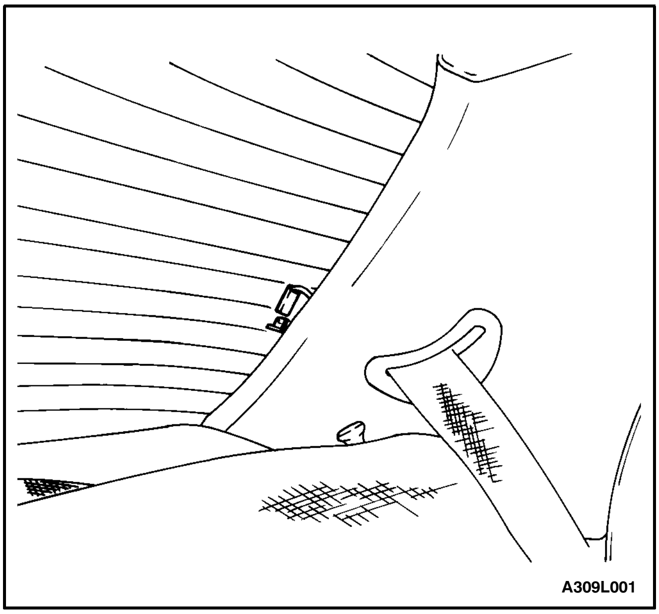
4. Apply glass adhesive to the windshield frame.
5. Install the windshield into the windshield frame.
6. Reposition the tape over the weatherstrip, the windshield, and the windshield frame to hold the windshield in place.
7. Let the adhesive dry for 24 hours.
8. Remove the tape.
9. Check for waterleaks by pouring water on the windshield. If a leak is found, dry the windshield and fill the area that leaks with adhesive. If the leak persists, remove the windshield and repeat the entire procedure.
10. Install the inside rearview mirror. Refer to "Inside Rearview Mirror" in this section.
11. Install the cowl vent grille. Refer to Section 9R, Body Front End.



REAR WINDOW GLASS

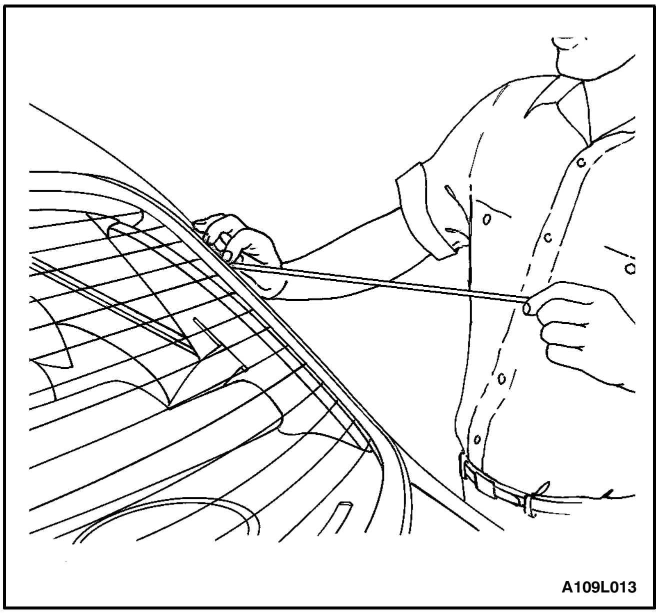
(Notchback Shown, Hatchback Similar)

Tools Required

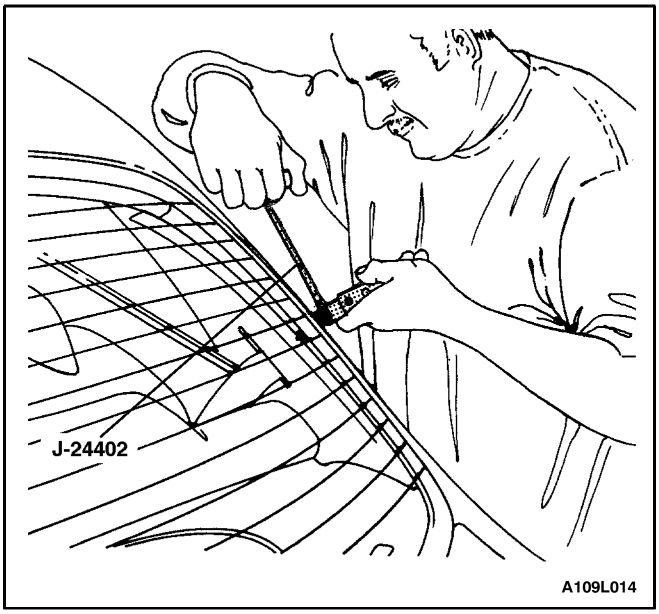
J-24402 Glass Sealant Remover

Removal Procedure

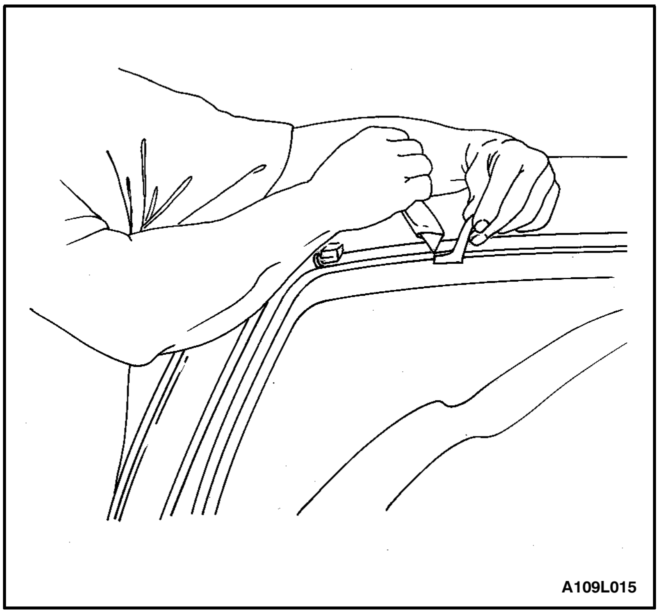
1. Disconnect the negative battery cable.
2. Disconnect the rear window defogger electrical connectors (left side electrical connector shown, right side electrical connector similar).



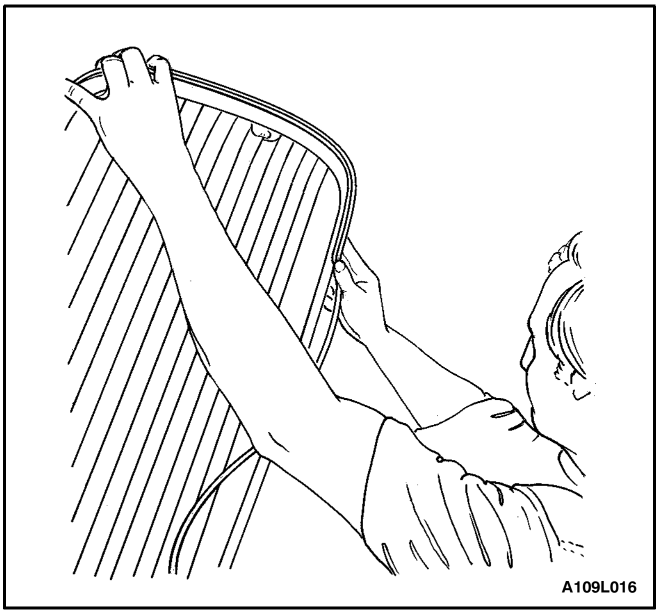
3. Remove the weatherstrip around the rear window.



4. Using the glass sealant remover J-24402, cut the adhesive around the rear window.

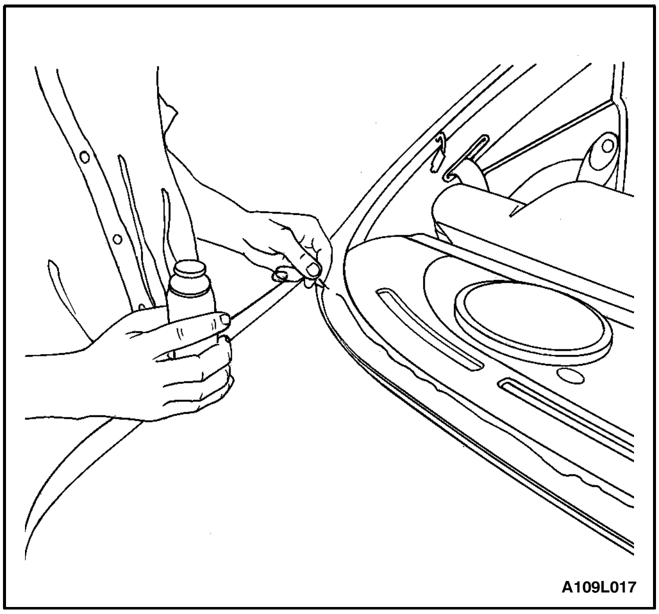


5. Remove the rear window from the vehicle.
6. Using a knife, remove the adhesive from the rear window.
7. Using a knife, remove the adhesive from the rear window frame.

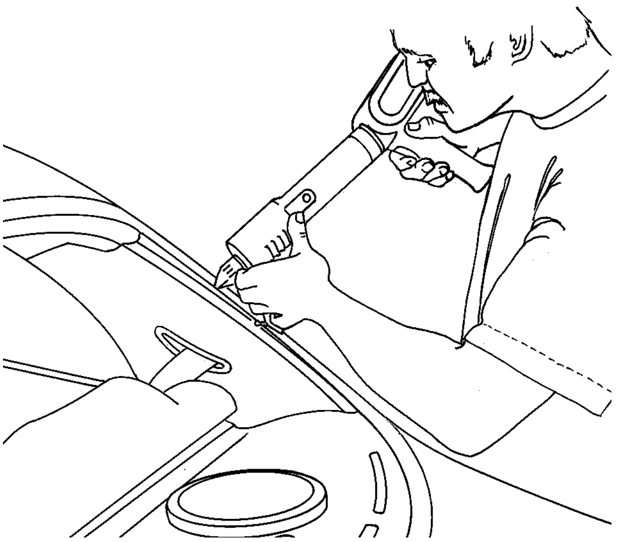


Installation Procedure

1. Install the new weatherstrip to the rear window.

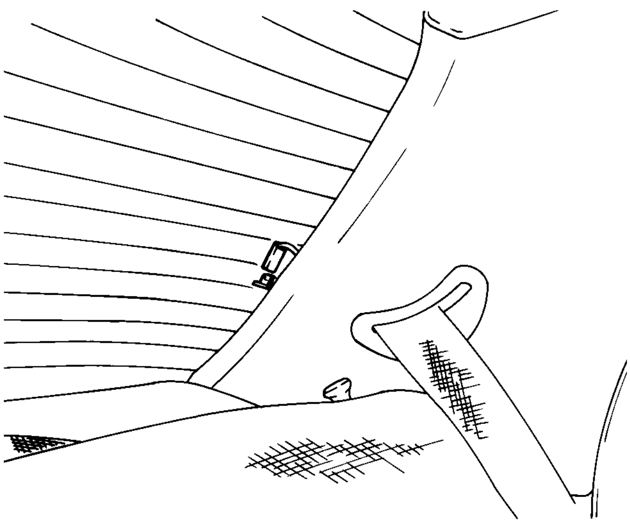


2. Apply tape to the new weatherstrip and the rear window to hold the weatherstrip in place.
3. Apply adhesive primer to the rear window frame and the perimeter of the rear window.



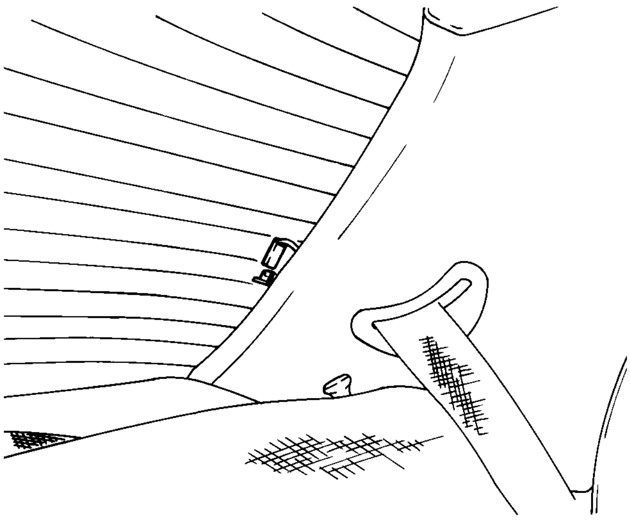
A109L018

4. Apply glass adhesive to the rear window frame.



A309L001

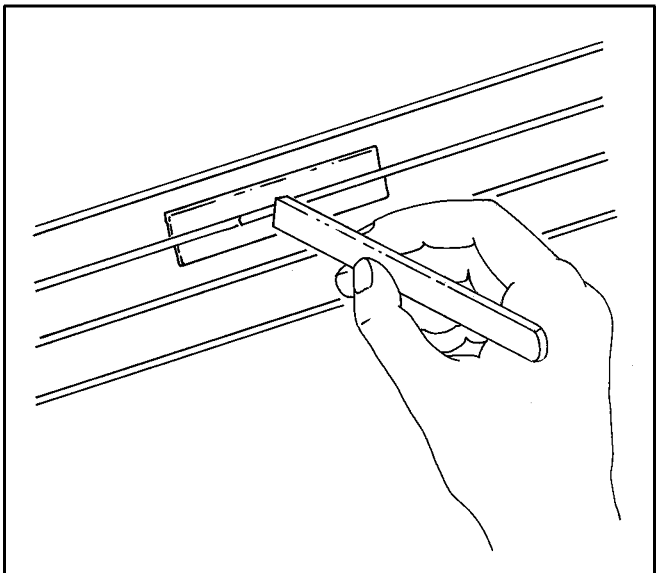
5. Install the rear window into the rear window frame.
6. Reposition the tape over the weatherstrip, the rear window, and the rear window frame to hold the rear window in place.
7. Let the adhesive dry for 24 hours.
8. Remove the tape.
9. Check for waterleaks by pouring water on the rear window. If a leak is found, dry the window and fill the area that leaks with adhesive. If the leak persists, remove the rear window and repeat the entire procedure.
10. Connect the rear window defogger electrical connectors (left side electrical connector shown, right side electrical connector similar).
11. Connect the negative battery cable.



A309L001

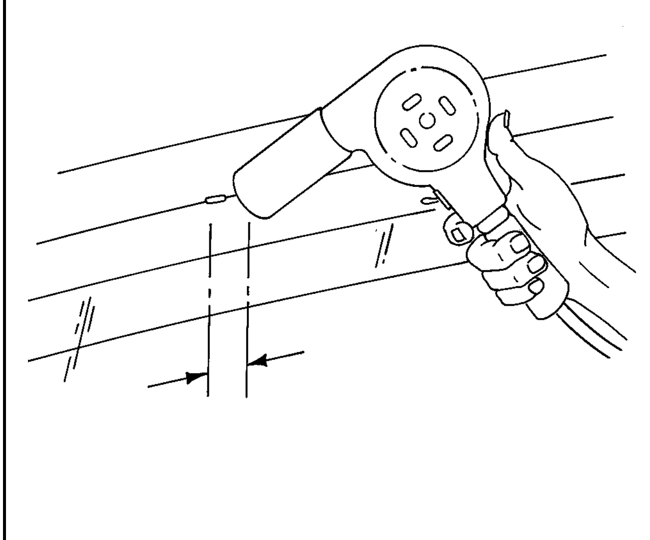
REAR WINDOW DEFOGGER GRID LINE REPAIR

1. Disconnect the negative battery cable.
2. Disconnect the rear window defogger electrical connectors (left side electrical connector shown, right side electrical connector similar).
3. Inspect the rear window defogger grid lines.
4. Mark the grid line break on the outside of the glass with a wax pencil or a crayon.
5. Use steel wool to buff the grid lines that are to be repaired. Wipe the lines clean using a cloth dampened with alcohol. Buff and clean about 6 mm (0.25 inch) beyond each side of the break in the grid line.



A109L019

6. Attach a grid line repair decal or two strips of tape above and below the repair areas.
   - A repair decal or tape must be used in order to control the width of the repair areas.
   - If a decal is used, the die-cut metered slot must be the same width as the grid line.
7. Apply the grid repair material to the repair area using a small wooden stick or a spatula. The grid repair material should be at room temperature.
8. Carefully remove the decal or the tape.

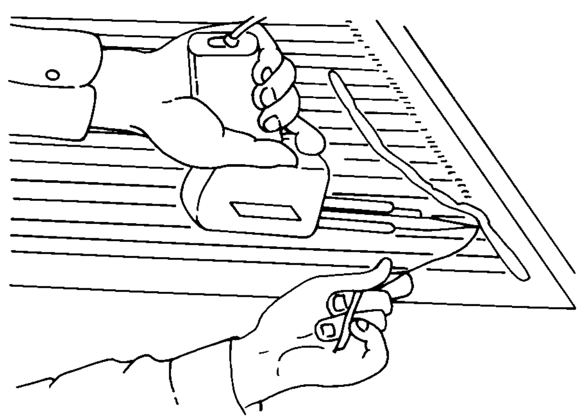


A109L020

Notice: The grid line repair material must be cured with heat. In order to avoid heat damage to the interior trim, protect the trim near the repair area where heat will be applied.

9. Heat the repair area for 1 to 2 minutes.
10. Hold the heat gun nozzle 25 mm (1 inch) from the surface. A minimum temperature of 149°C (300°F) is required.
11. Inspect the grid line repair area. If the repair appears discolored, apply a coating of tincture of iodine to the area using a pipe cleaner or a line brush. Allow the iodine to dry for about 30 seconds. Carefully wipe off the excess iodine with a lint-free cloth.
12. Connect the rear window defogger electrical connectors.
13. Test the operation of the rear window defogger in order to verify that the repair was successful.

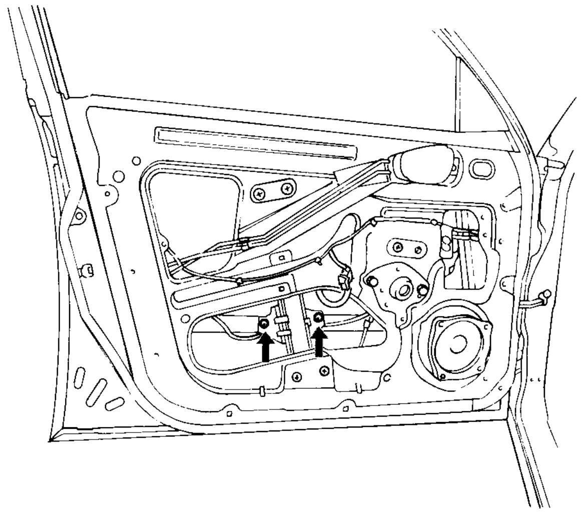
Important: At least 24 hours is required for complete curing of the repair materials. The repair area should not be physically disturbed until after that time.


A109L021

REAR WINDOW DEFOGGER BRAIDED LEAD WIRE REPAIR

The rear window defogger bus lead wire or the terminal can be reattached by resoldering. Use a solder containing 3 percent silver and a rosin flux paste.

1. The repair area should be buffed with fine steel wool before soldering the bus lead wire.
2. Apply the paste-type rosin flux in small quantities to the wire lead and the bus lead wire repair area using a brush.
3. Coat the soldering iron tip with solder. Use only enough solder to ensure a complete repair.
4. Use only enough heat to melt the solder. Do not overheat the wire when resoldering to the bus lead wire.

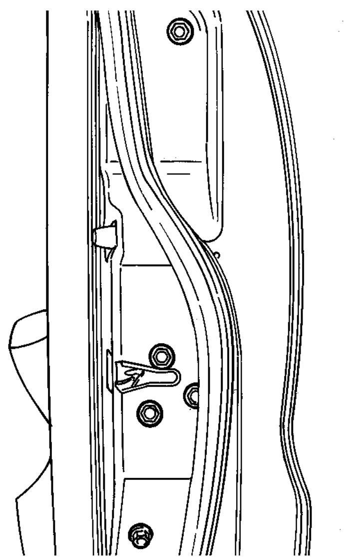

A309L002

FRONT DOOR GLASS

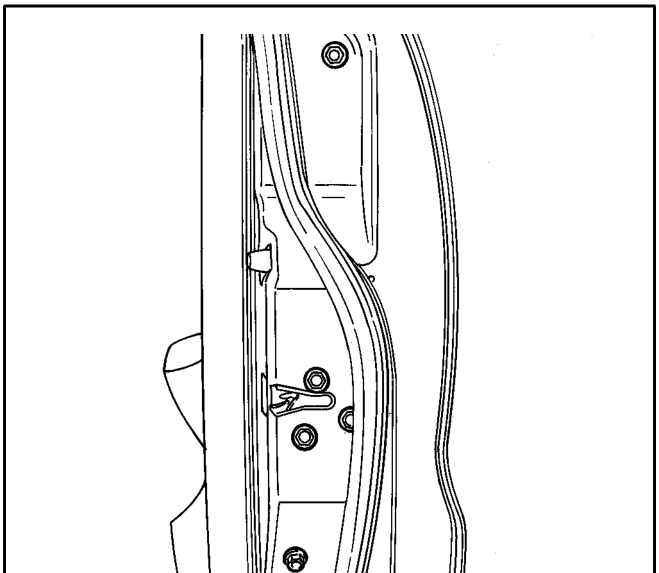
(Notchback Shown, Hatchback Similar)

Removal Procedure

1. Remove the front door trim panel. Refer to Section 9G, Interior Trim.
2. Remove the door seal trim. Refer to Section 9P, Doors.
3. Remove the outside channel molding. Refer to Section 9P, Doors.
4. Remove the screws that secure the glass to the window regulator.


A109P002

5. Remove the bolts and the guide rail.
6. Remove the glass from the door.



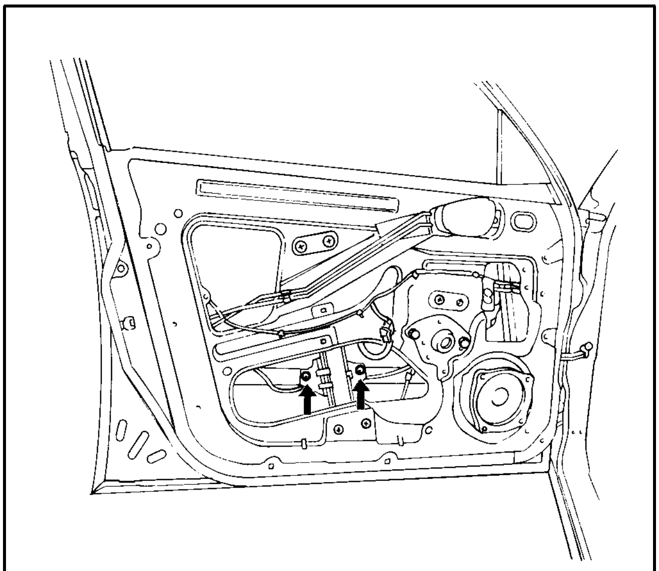
A109P002

Installation Procedure

1. Install the glass in the door.
2. Install the guide rail and the bolts.

Tighten

Tighten the guide rail bolts to 7 N•m (62 lb-in).



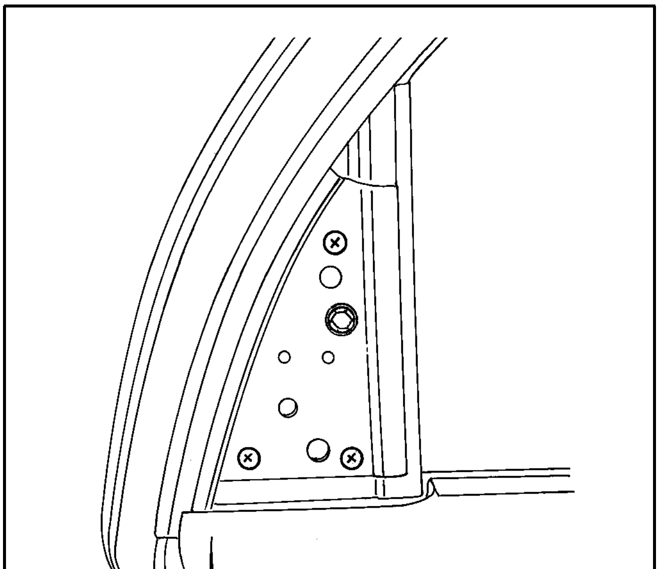
A309L002

3. Install the glass to the window regulator with the screws.

Tighten

Tighten the door glass screws to 7 N•m (62 lb-in).

4. Install the outside channel molding. Refer to Section 9P, Doors.
5. Install the door seal trim. Refer to Section 9P, Doors.
6. Install the front door trim panel. Refer to Section 9G, Interior Trim.



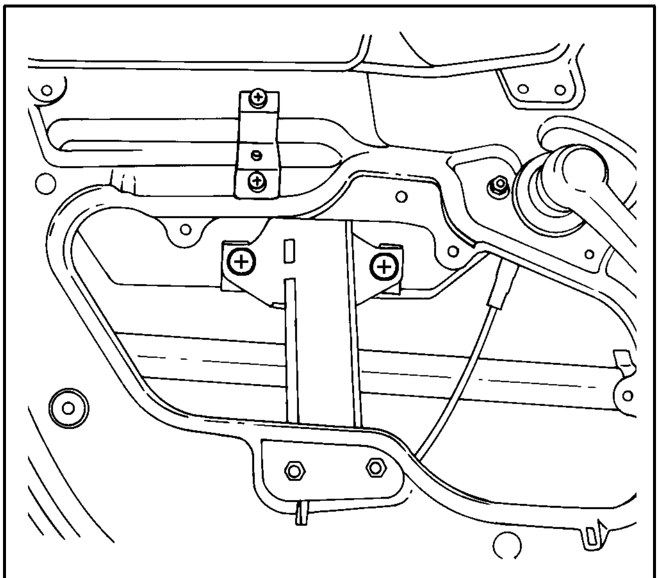
A109L003

REAR DOOR GLASS

(Notchback Shown, Five-Door Hatchback Similar)

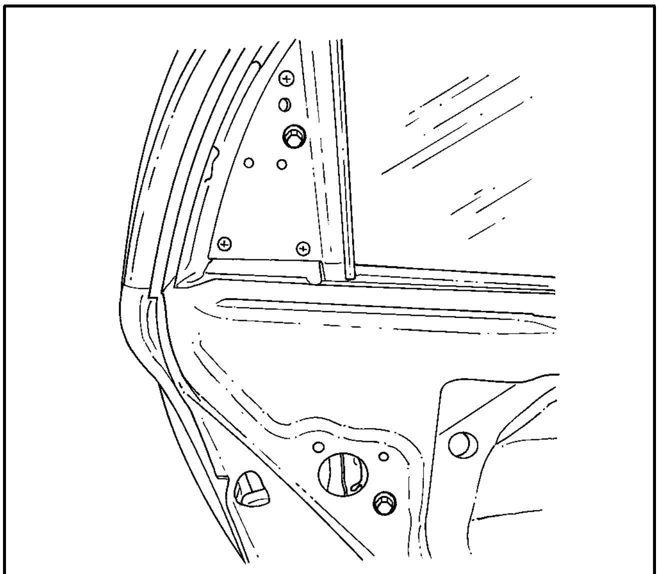
Removal Procedure

1. Remove the rear door trim panel. Refer to Section 9G, Interior Trim.
2. Remove the outside channel molding. Refer to Section 9P, Doors.
3. Remove the interior rear door garnish molding.
4. Remove the screws and the exterior rear door garnish molding.



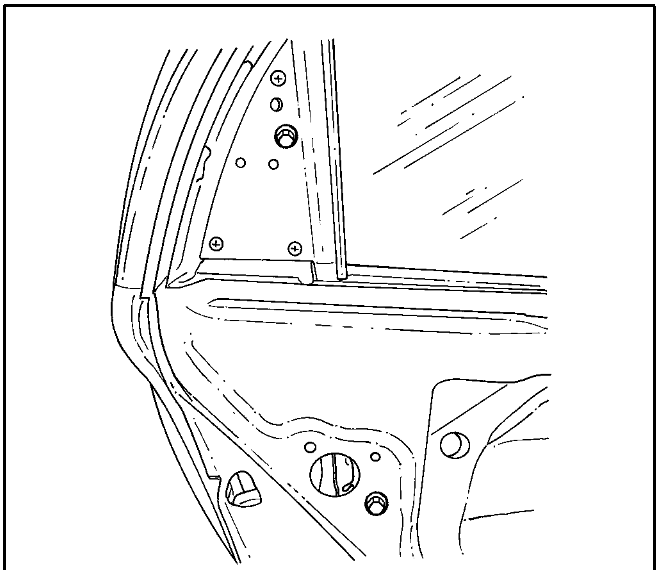
A309L003

5. Remove the door seal trim. Refer to Section 9P, Doors.
6. Remove the screws that secure the glass to the window regulator.



A109L006

7. Remove the bolts and the guide rail.
8. Remove the glass from the door.



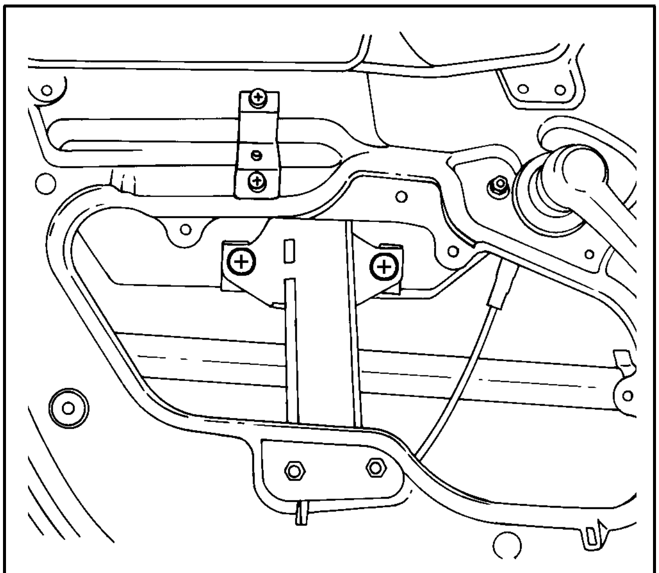
A109L006

Installation Procedure

1. Install the glass in the door.
2. Install the guide rail and the bolts.

Tighten

Tighten the guide rail bolts to 7 N•m (62 lb-in).

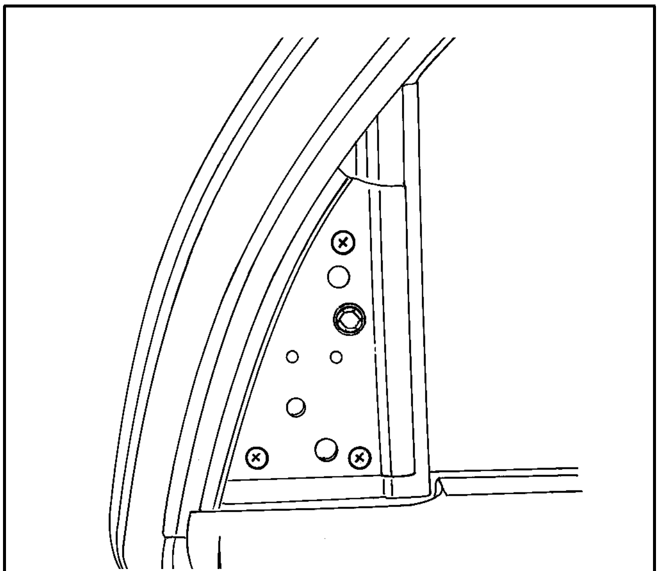


A309L003

3. Position the glass within the window regulator.
4. Install the glass screws.

Tighten

Tighten the door glass screws to 7 N•m (62 lb-in).



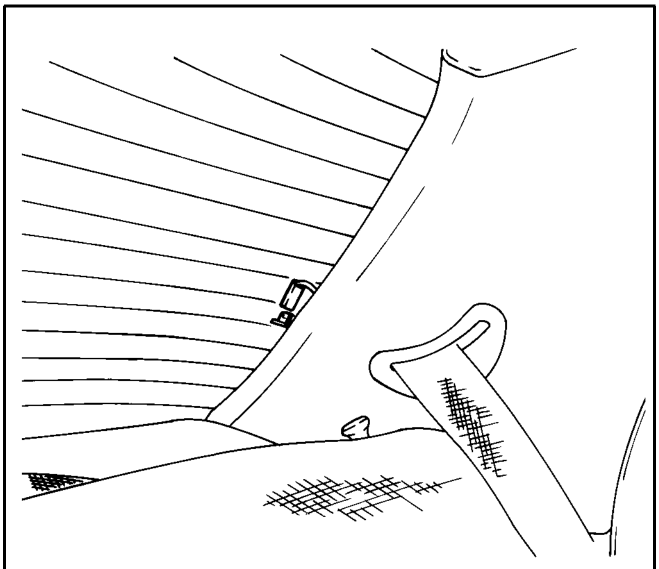
A109L003

5. Install the door seal trim. Refer to Section 9P, Doors.
6. Install the exterior rear door garnish molding with the screws.

Tighten

Tighten the exterior rear door garnish molding screws to 4 N•m (35 lb-in).

7. Install the interior rear door garnish molding.
8. Install the outside channel molding. Refer to Section 9P, Doors.
9. Install the rear door trim panel. Refer to Section 9G, Interior Trim.

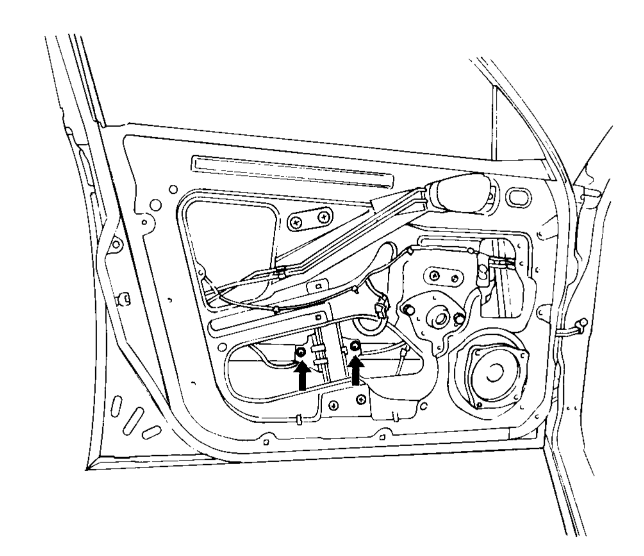


A309L001

MOVABLE QUARTER WINDOW (THREE-DOOR HATCHBACK)

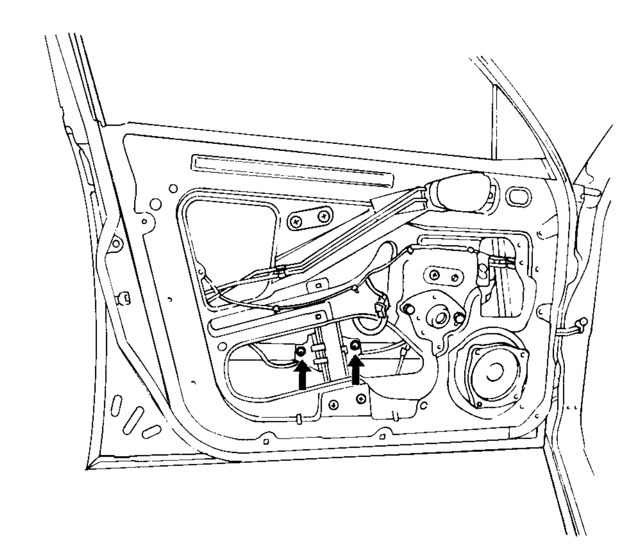
Removal Procedure

1. Remove the front seat belt height adjuster. Refer to Section 8A, Seat Belts.
2. Remove the B-pillar molding. Refer to Section 9M, Exterior Trim.
3. Remove the screws and the movable quarter window latch.



A309L002

4. Remove the screws and the movable quarter window.



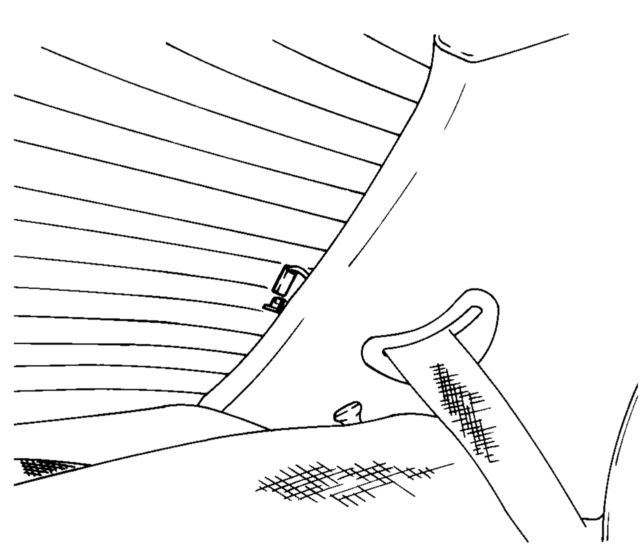
A309L002

Installation Procedure

1. Install the movable quarter window with the screws.

Tighten

Tighten the movable quarter window hinge screws to 4.5 N•m (40 lb-in).



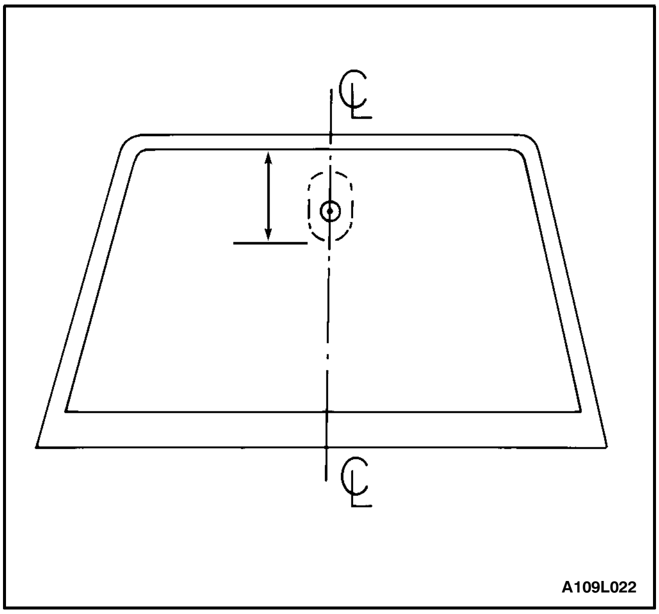
A309L001

2. Install the movable quarter window latch with the screws.

Tighten

Tighten the movable quarter window latch screws to 4.5 N•m (40 lb-in).

3. Install the B-pillar molding. Refer to Section 9M, Exterior Trim.
4. Install the front seat belt height adjuster. Refer to Section 8A, Seat Belts.



INSIDE REARVIEW MIRROR

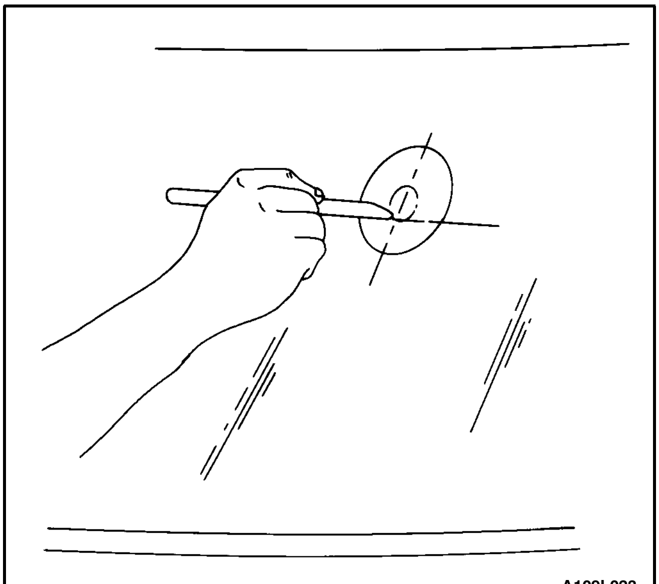
The inside rearview mirror is attached to a support which is secured to the windshield glass. The support is installed by the glass supplier using a plastic-polyvinyl butyl adhesive.

Service replacement windshield glass has the mirror support bonded to the glass assembly. In order to install a detached mirror support or install a new part, the following items will be needed.

- Loctite[Minute-Bond Adhesive
- Original or replacement mirror support
- Wax marking pencil or crayon
- Rubbing alcohol
- Clean paper towel
- Fine grit sandpaper (grit #320 or #360)
- 2 mm allen wrench

Installation Procedure

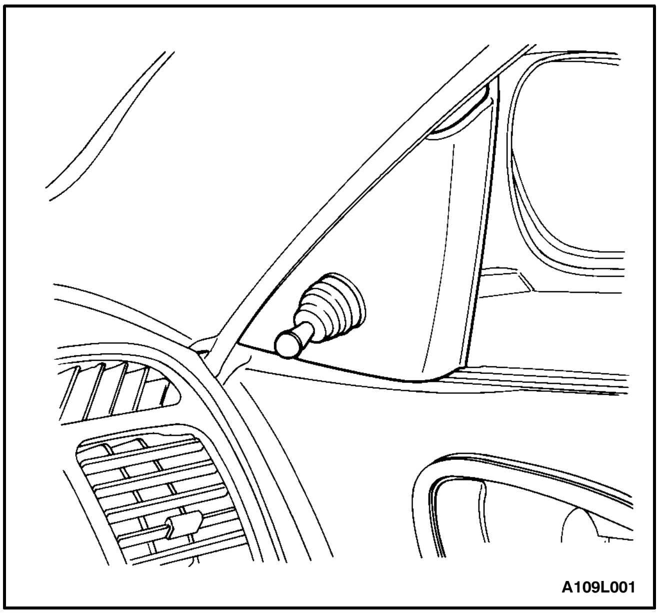
1. Measure the distance from the headliner to the bottom of where the mirror support will be mounted on the windshield.


A109L023

2. Mark this position on the outside of the glass with a wax pencil or crayon. Draw a large diameter circle on the outside of the glass around the mirror support location.
3. Clean the inside surface of the glass with paper towels and a domestic scouring cleanser, a glass cleaning solution, or a polishing compound. Rub the glass until the area is completely dry. When the area is dry, clean the area with an alcohol-saturated paper towel in order to remove any traces of scouring powder or glass cleaning solution.
4. If the mirror support is new, clean the bonding surface with fine grit sandpaper #320 or #360. If the original mirror support is being used, all traces of factory-installed adhesive must be removed prior to reinstallation.
5. Wipe the sanded mirror support with a clean paper towel saturated with rubbing alcohol. Allow the support to dry.
6. Follow the adhesive kit manufacturer's directions for adhesive application and mirror support preparation before installing the mirror support to the glass.
7. Position the mirror support to its premarked position. Use steady pressure and press the support against the glass for 30 to 60 seconds.
8. After 5 minutes, remove the excess adhesive with an alcohol-moistened towel or a glass cleaning solution.
9. Install the inside rearview mirror to the mirror support with the mounting screw.

Tighten

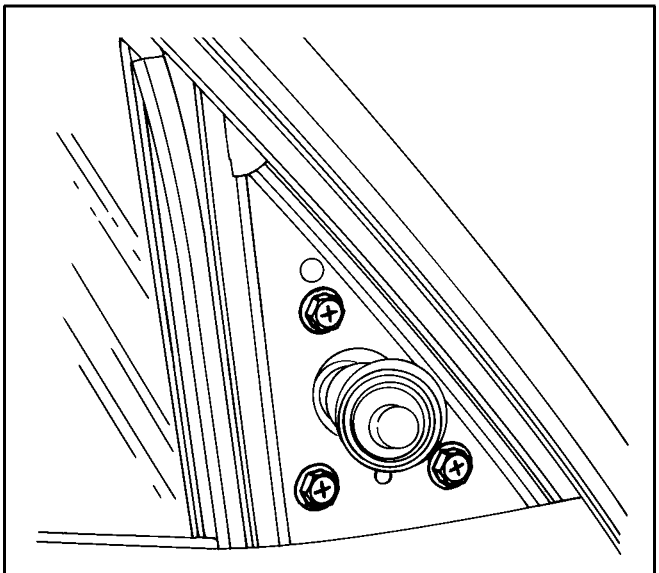
Tighten the rearview mirror mounting screw to 1.2 N•m (11 lb-in).


A109L001

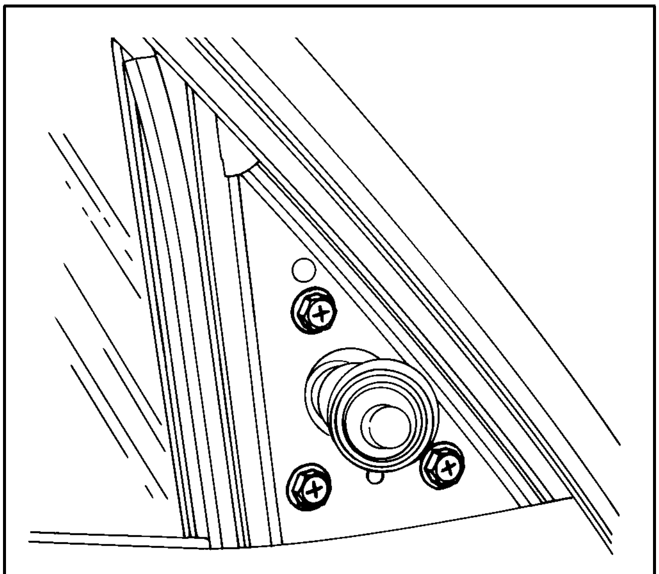
OUTSIDE REARVIEW MIRRORS

Removal Procedure

1. Remove the front door escutcheon. (Manual remote control mirror shown.)


A109L002

2 Disconnect the electric control rearview mirror electrical connector, if equipped.
3. Remove the screws and the outside rearview mirror assembly from the door. (Manual remote control mirror shown.)


A109L002

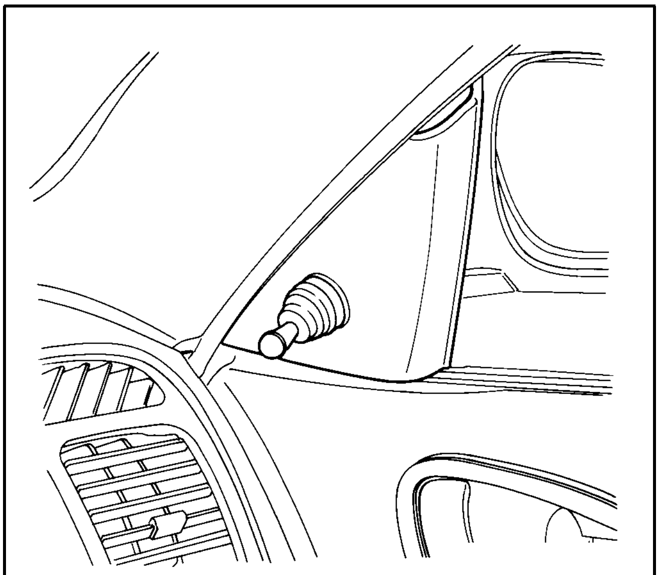
Installation Procedure

1. Install the outside rearview mirror assembly to the door with the screws.

Tighten

Tighten the outside rearview mirror assembly screws to 4.5 N•m (40 lb-in). (Manual remote control mirror shown.)

2. Connect the electric control rearview mirror electrical connector, if equipped.


A109L001

3. Install the escutcheon. (Manual remote control mirror shown.)

GENERAL DESCRIPTION AND SYSTEM OPERATION

STATIONARY GLASS

Stationary glass consists of all the glass on the vehicle which is immovable within its frame, such as the windshield glass, the back glass, and the inside rearview mirror.

INSIDE REARVIEW MIRROR

The inside rearview mirror can be manually adjusted up/down, fore/aft, and left/right. The rearview mirror pivots in two places: the ball-and-socket mirror pivot and the up/down hinge lever at the mirror support.

OUTSIDE REARVIEW MIRRORS

Two types of outside rearview mirrors are available. The driver side is equipped with a remote control mirror. On the passenger side a remote control mirror is standard, and an electric remote control mirror is optional. The electric control outside rearview mirror can be adjusted by an electric control switch on the instrument panel.

SECTION 9M

EXTERIOR TRIM

TABLE OF CONTENTS

SPECIFICATIONS

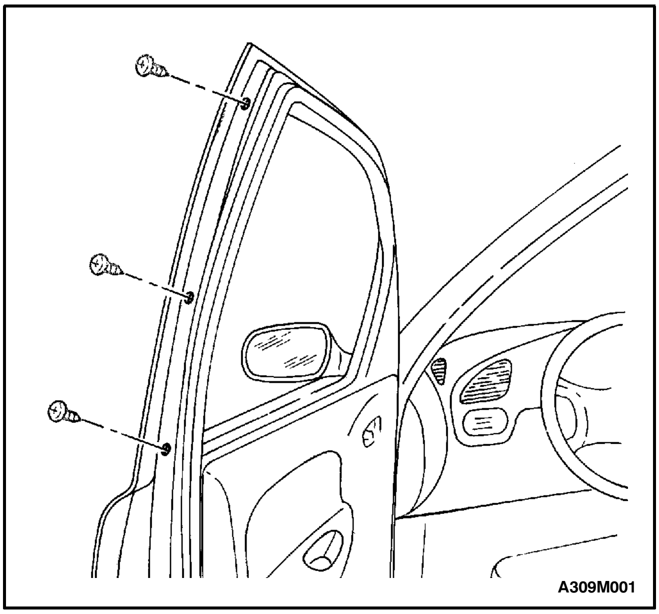
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
B-Pillar Molding Screws	1.5	-	13
Front Mud Guard Screws	1.5	-	13
Rear Mud Guard Screws	1.5	-	13

MAINTENANCE AND REPAIR

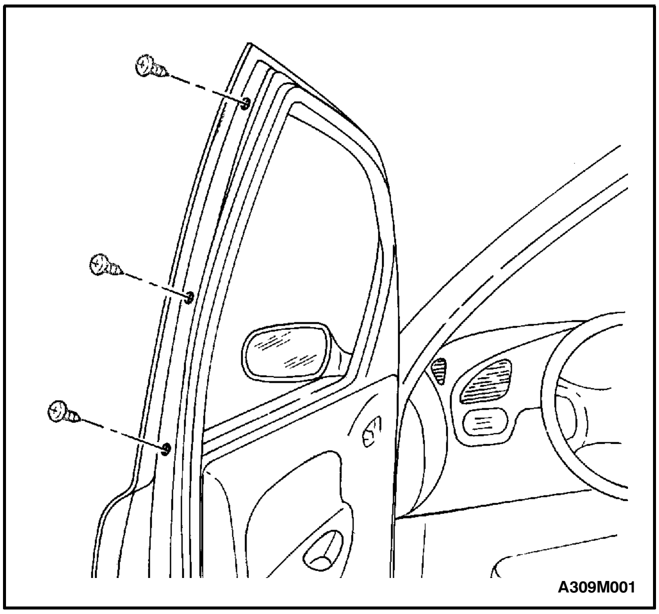
ON-VEHICLE SERVICE

B-PILLAR MOLDING (NOTCHBACK AND FIVE-DOOR HATCHBACK)



Removal Procedure

1. Move the weatherstrip aside in order to access the screws.
2. Remove the screws and the B-pillar molding.



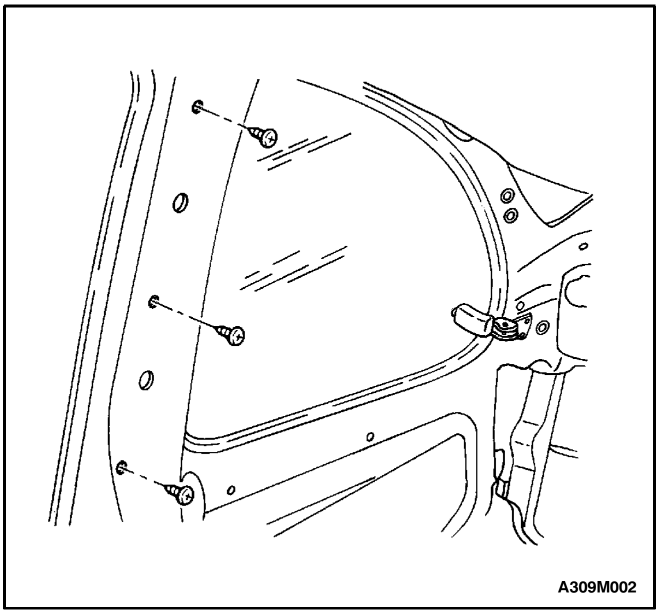
Installation Procedure

1. Install the screws and the B-pillar molding.

   Tighten

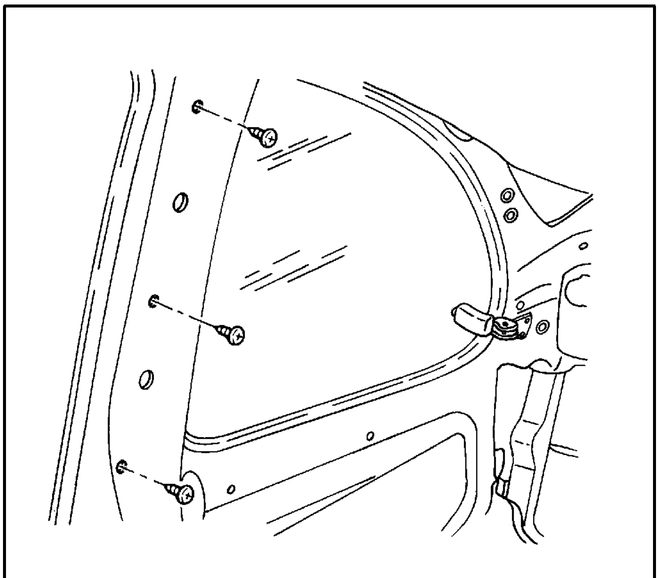
   Tighten the B-pillar molding screws to 1.5 N•m (13 lb-in).

B-PILLAR MOLDING (THREE-DOOR HATCHBACK)



Removal Procedure

1. Remove the front seat belt height adjuster. Refer to Section 8A, Seat Belts.
2. Remove the screws and the B-pillar molding.



A309M002

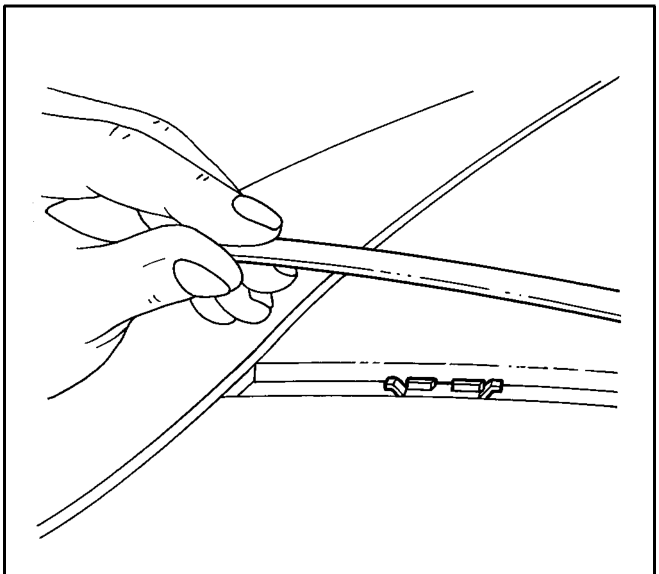
Installation Procedure

1. Install the B-pillar molding with the screws.

Tighten

Tighten the B-pillar molding screws to 1.5 N•m (13 lb-in).

2. Install the front seat belt height adjuster. Refer to Section 8A, Seat Belts.

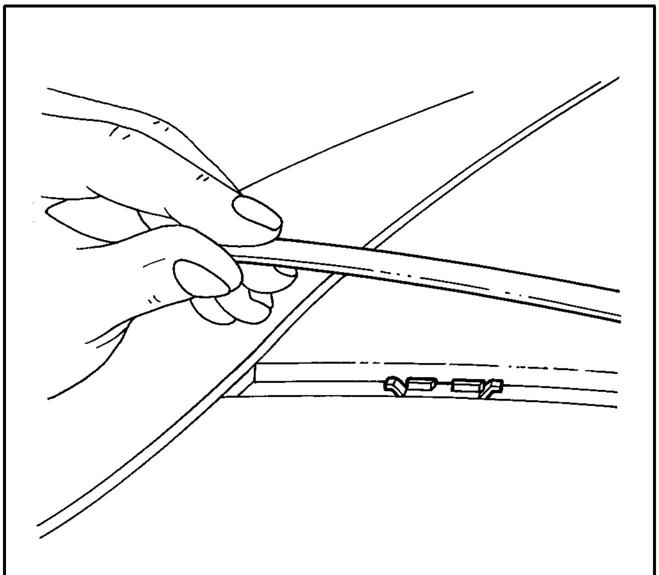


A109M002

ROOF MOLDING

Removal Procedure

1. Remove the roof molding from the plastic clips.



A109M002

Installation Procedure

1. Press the roof molding onto the plastic clips.

GENERAL DESCRIPTION AND SYSTEM OPERATION

EMBLEMS AND LETTERING

The emblems and lettering on the vehicle are attached by adhesive. The company emblem appears on the hood. The lettering, which appears in several places on the body of the vehicle, features the model, the grade, and the company name.

MUD GUARDS

Front and rear mud guards are optional equipment on all models. Mud guards will help prevent an excessive buildup of mud on the body.

SECTION 9N

FRAME AND UNDERBODY

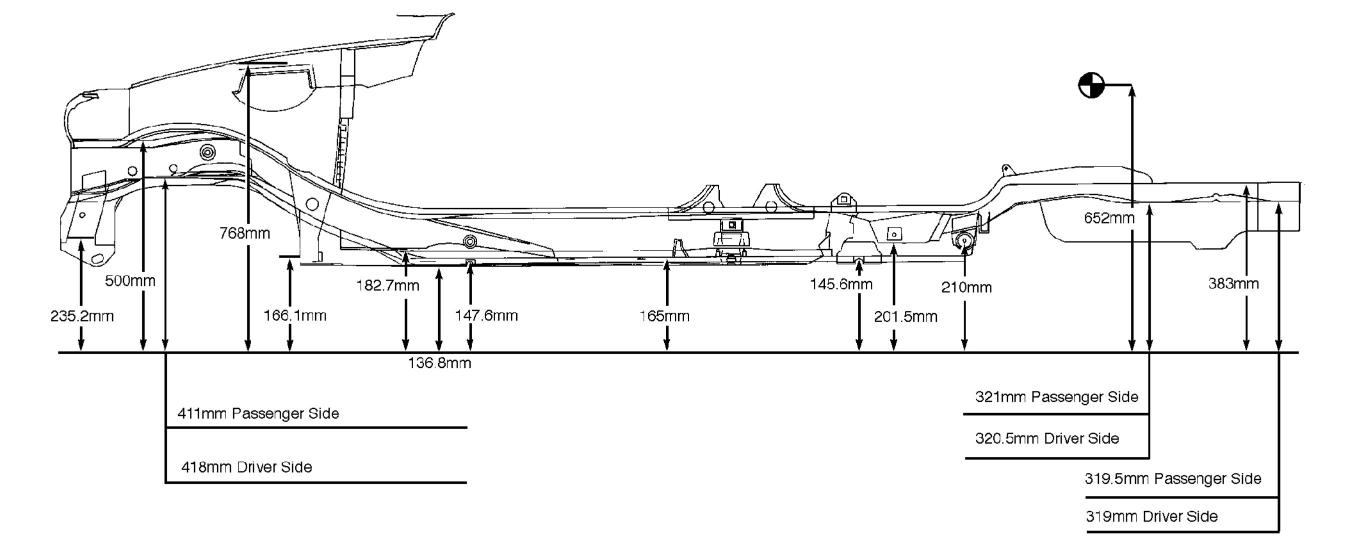
TABLE OF CONTENTS

SPECIFICATIONS

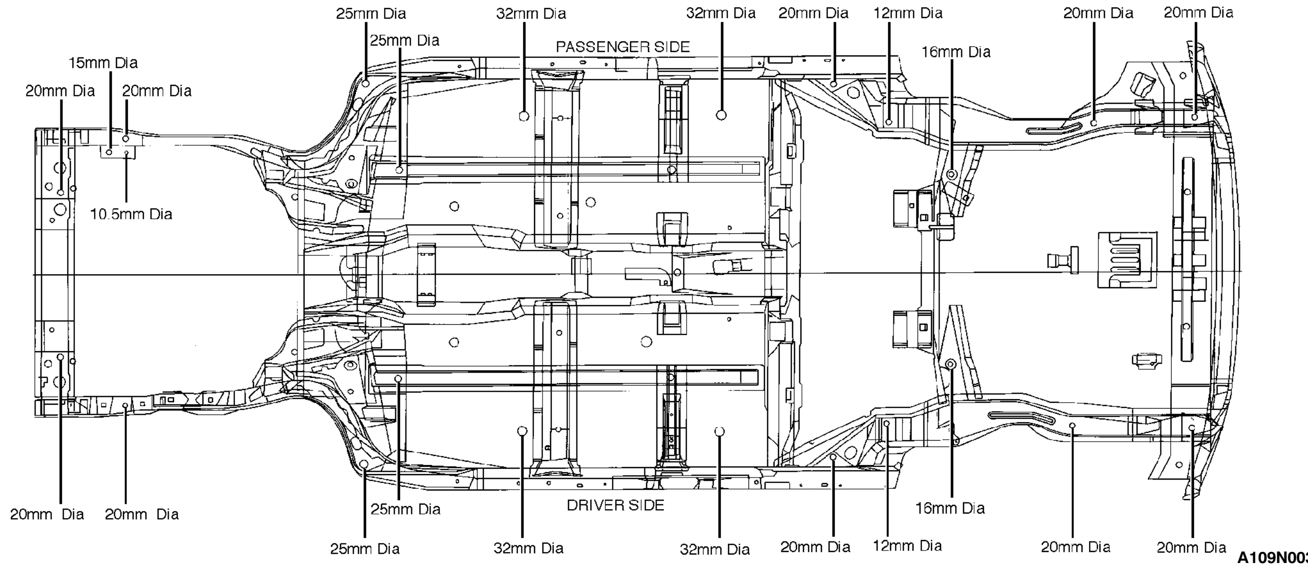
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Engine Under Cover Bolts	35	26	-
Engine Under Cover Nuts	35	26	-

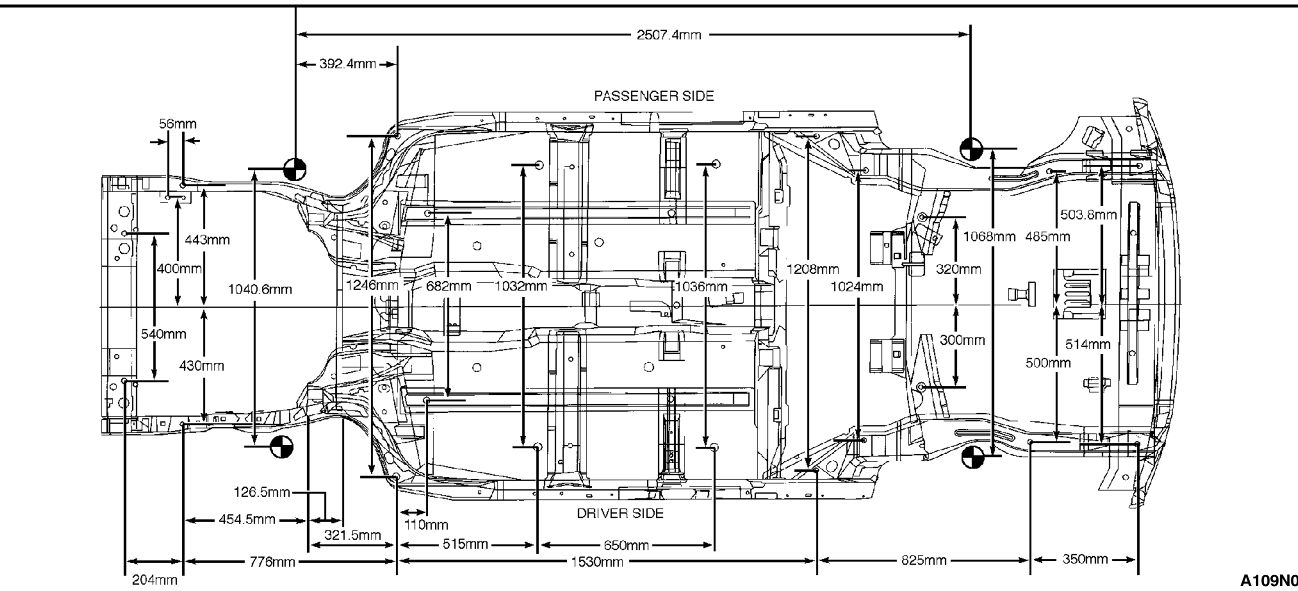
UNDERBODY DIMENSIONS (NOTCHBACK)



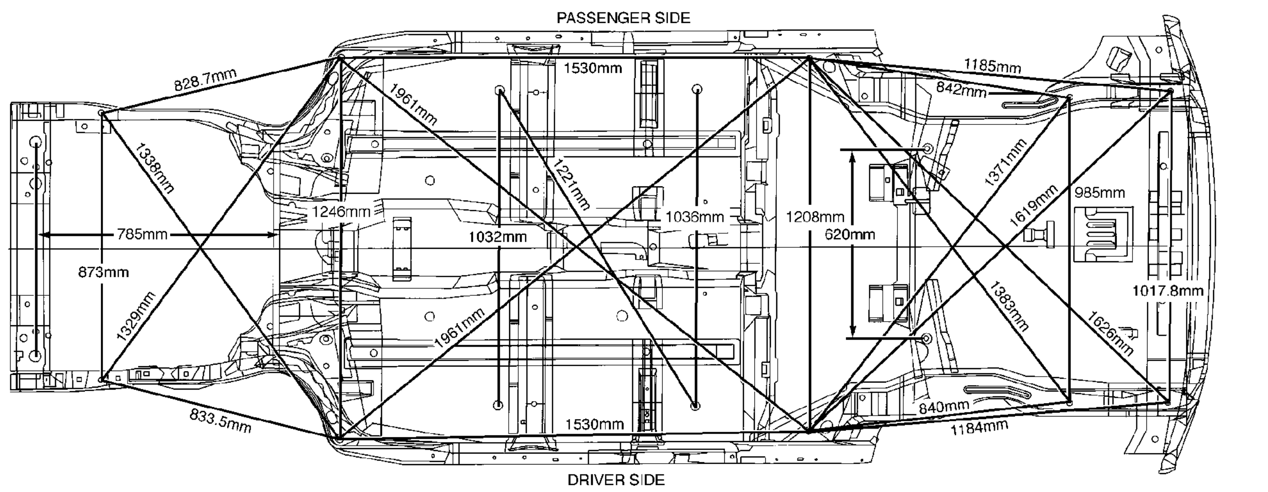
A109N002



A109N003

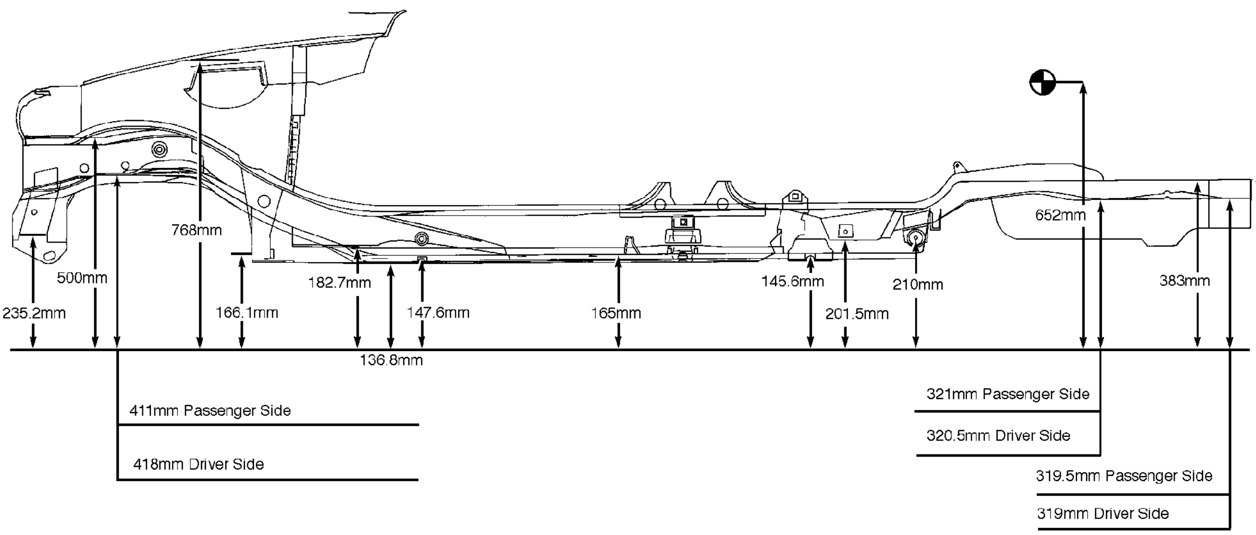


A109N004

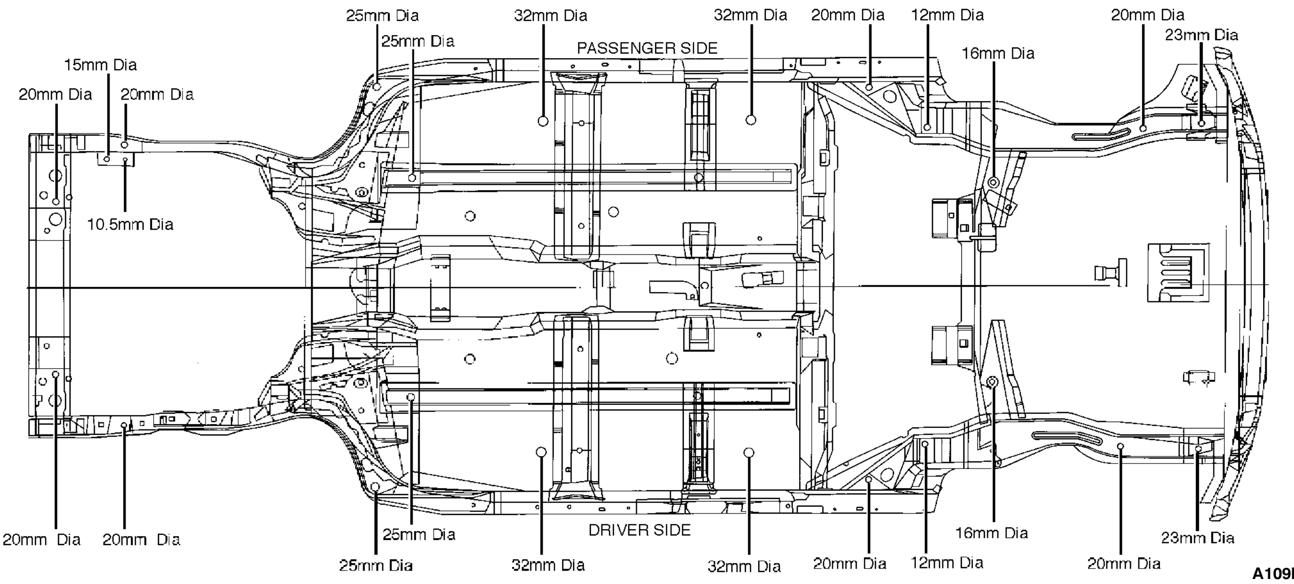


A109N005

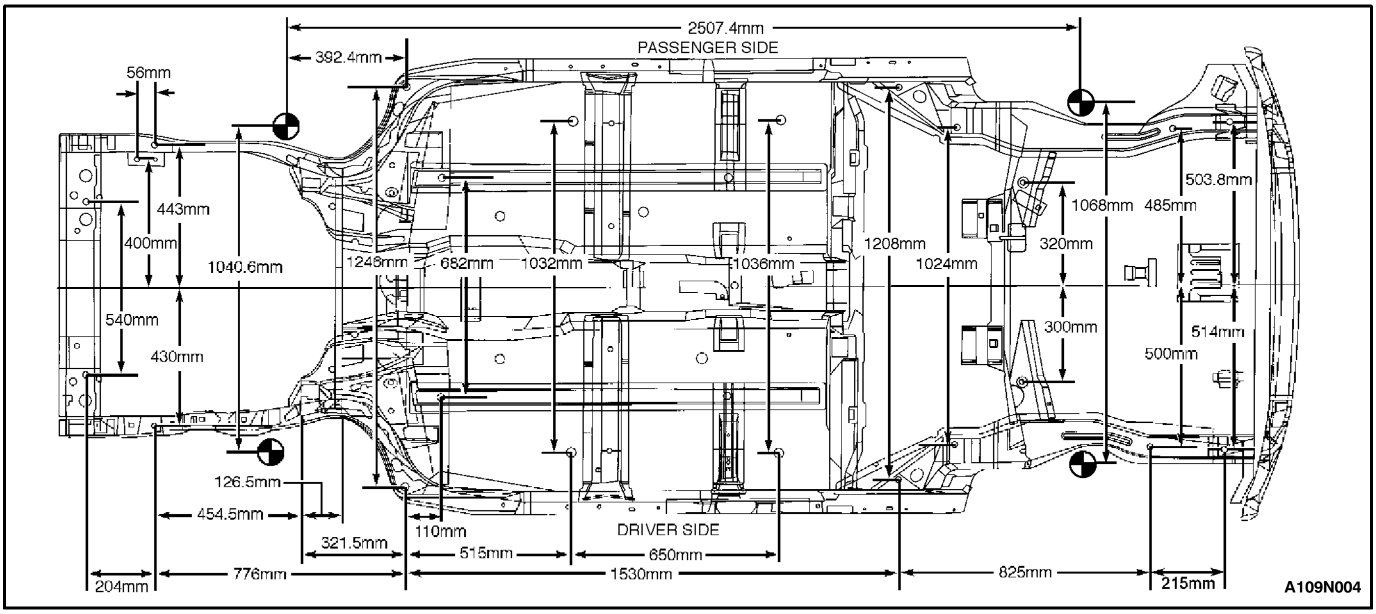
UNDERBODY DIMENSIONS (HATCHBACK)



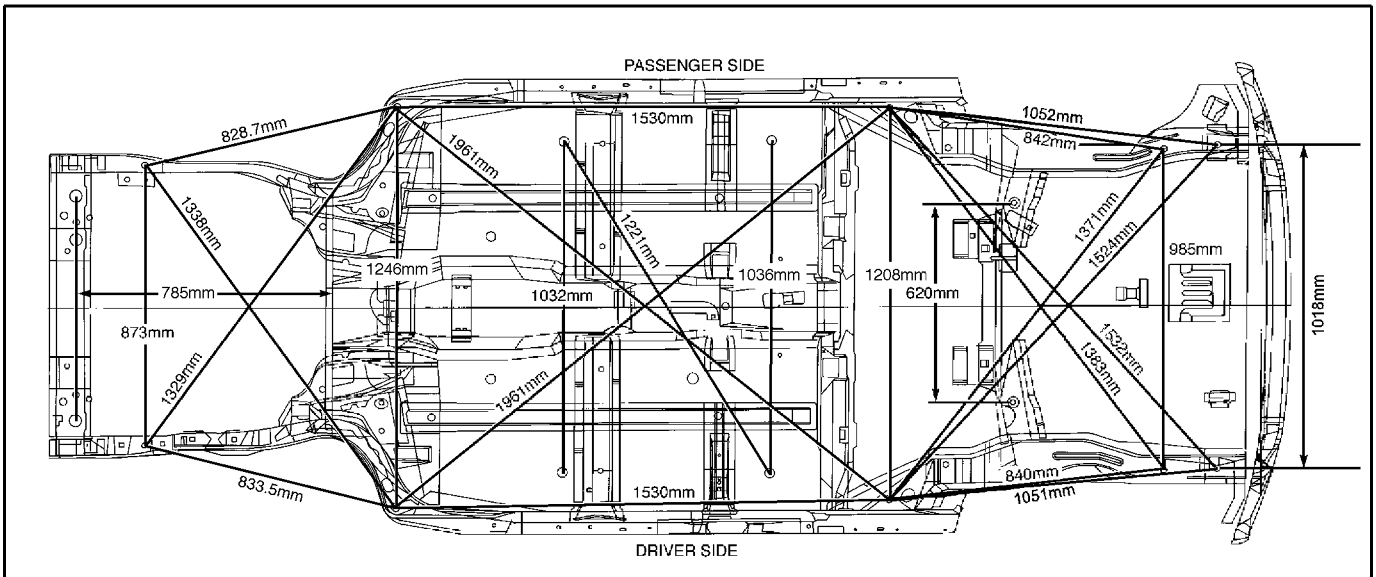
A109N002



A109N003



A109N004



A109N005

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ALIGNMENT CHECKING

An accurate method of determining the alignment of the underbody uses a measuring tram gauge. The tram gauge set used to perform the recommended measuring checks must include a vertical pointer able to reach 457 mm (18 inches).

Two types of measurements can be made with a tram gauge: direct point-to-point measurements and measurements calculated on a horizontal plane (datum line) parallel to the underbody. Point-to-point measurements are generally taken on steering and suspension engine compartment parts and simply require the vertical pointers to be set equally.

For horizontal plane measurements, the vertical pointers must be set as specified for each point to be measured.

Dimensions-to-gauge holes are measured to the center of the holes and flush to the adjacent surface metal unless otherwise specified. It is recommended that the diagonal dimensions to the cross-body be checked on both sides in order to verify the dimensional accuracy of the vehicle underbody.

FLOOR PAN INSULATORS

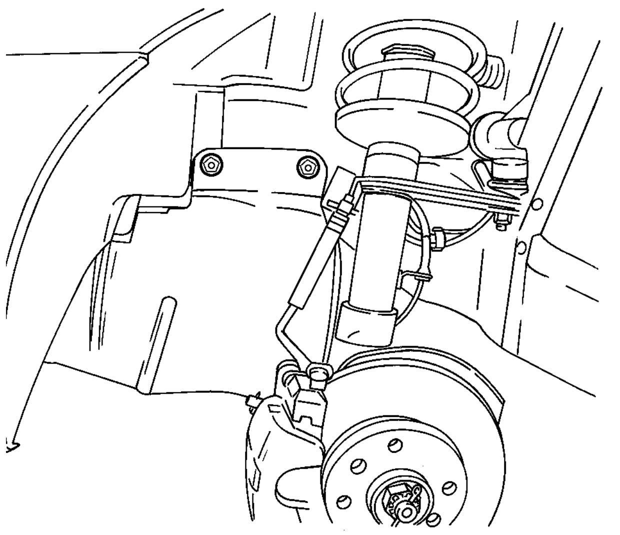
The floor pan insulators have been designed for the higher floor pan temperatures that result from the use of the catalytic converter in the exhaust system. Therefore, when servicing a vehicle, it is essential that any insulators that may have been disturbed or removed be reinstalled in the original sequence and location. Also, if an insulator needs to be replaced, use only the insulation specified for that location on the floor pan.

When servicing or replacing interior insulators, observe the following instructions.

- Install the insulators in the original position and sequence. Butt the pieces together in order to avoid gapping or overlapping.
- If it is necessary to replace an insulator, use only the specified insulation.
- Use the original part to determine the amount of replacement material required and as a template for cutting and fitting the new piece to the floor pan.
- When installing the insulator, do not enlarge any cutouts or holes that are used for the attachment of interior parts such as the instrument panel or the floor console.
- Route the cross-body harness for interior parts over the floor pan insulators. Clip it in the original location.
- Do not apply spray-on deadeners or trim adhesives to the top of the floor pan at the area directly over the catalytic converter or the muffler.

Any insulator service repair or replacement should be the same thickness, size, and location as the original installation in the vehicle.

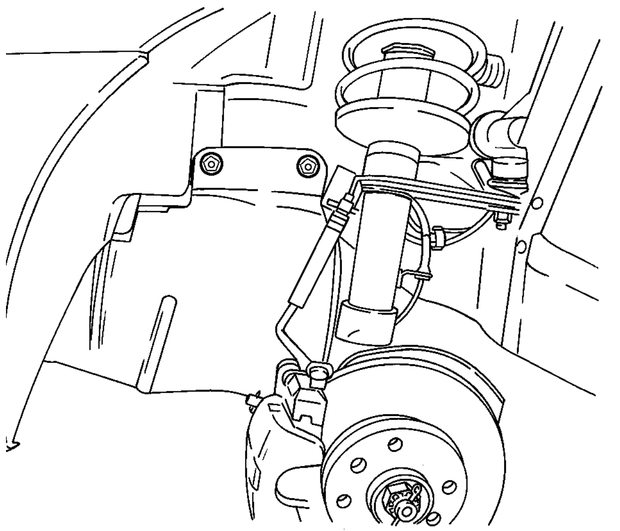
ENGINE UNDER COVERS



A109N001

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the nuts and the bolts and the engine under cover.



A109N001

Installation Procedure

1. Install the engine under cover with the bolts and nuts.

   ### Tighten

   Tighten the engine under cover bolts to 35 Nwm (26 lb-ft).

   Tighten the engine under cover nuts to 35 Nwm (26 lb-ft).
2. Install the front wheel. Refer to Section 2E, Tires and Wheels.
3. Lower the vehicle.

GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL BODY CONSTRUCTION

This vehicle is constructed with a unitized body which incorporates integral front and rear frame side rails.

The front suspension lower control arms are bolted to and retained by supports, one each on the right and left sides. The front suspension lower control arm supports are attached to the underbody with three bolts at two locations. The engine is bolted to the integral front side rails. The suspension strut towers must be dimensionally correct in relation to the remainder of the underbody in order to maintain specified suspension strut and caster/camber angles.

Since the individual underbody parts contribute directly to the overall strength of the body, it is essential to observe proper welding techniques during service repair operations. The underbody parts should be properly sealed and rustproofed whenever body repair operations destroy or damage the original sealing and rustproofing. When rustproofing critical underbody parts, use a good-quality type of air-dry primer, such as a corrosion-resistant chromate or an equivalent material. Combination-type primer/surfacers are not recommended.

ENGINE UNDER COVERS

The engine under covers are molded pieces of plastic that serve as shields for the underside of the engine. The covers help protect the engine from small rocks, gravel and other objects that would otherwise come into contact with the engine during normal driving conditions.

SECTION 9O

BUMPERS AND FASCIAS

TABLE OF CONTENTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

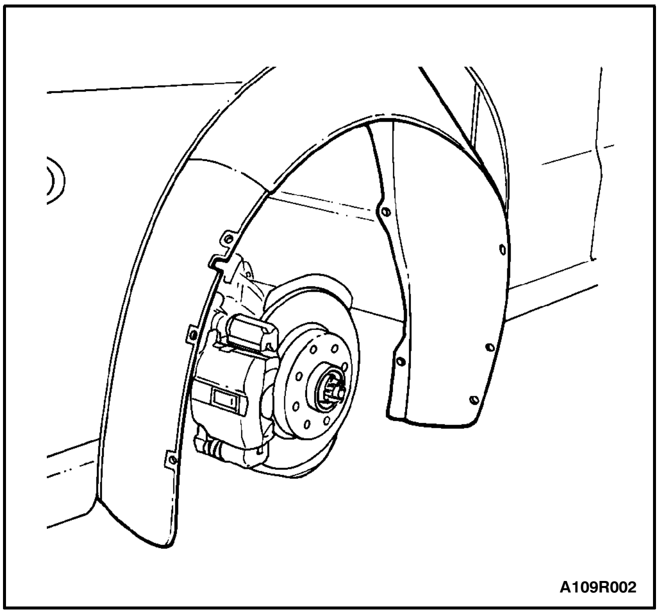
Application	N•m	Lb-Ft	Lb-In
Behind Fascia Screws	5.5	-	49
Front Bumper Impact Bar Nuts	27	20	-
Front Wheel Well Screws	1.5	-	13
Lower Rear Impact Bar Nuts	27	20	-
Luggage Compartment Fascia Bolts	5.5	-	49
Mud Guard Screws	1.5	-	13
Rear Impact Bar Nuts	27	20	-
Rear Upper Fascia Screws	5.5	-	49
Splash Shield Bolts	1.5	-	13
Splash Shield Nuts	1.5	-	13
Splash Shield Screws	1.5	-	13
Trim Panel Bolts	10	-	89

MAINTENANCE AND REPAIR

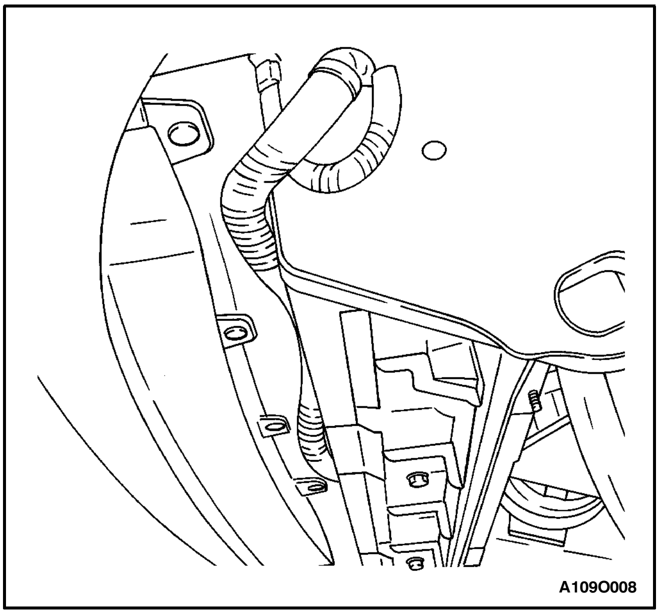
ON-VEHICLE SERVICE

FRONT BUMPER FASCIA

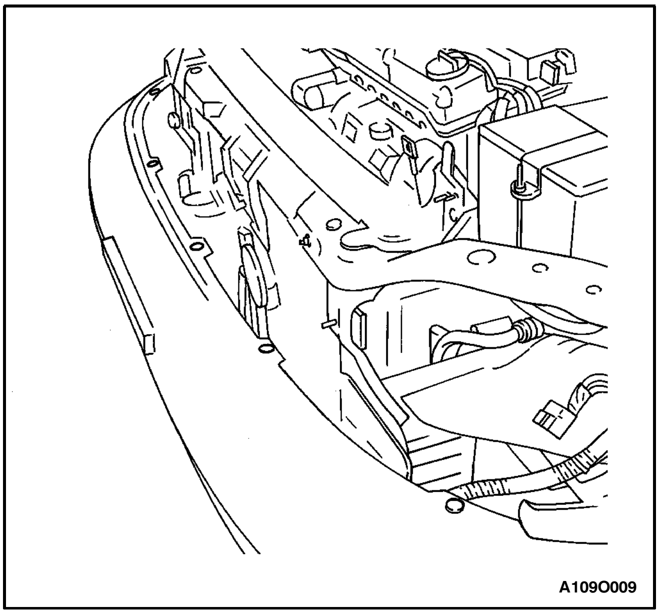
Removal Procedure



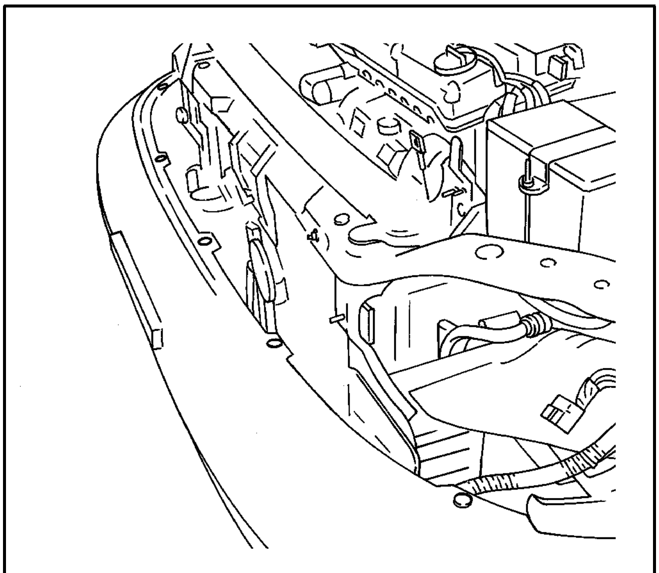
1. Disconnect the negative battery cable.
2. Remove the front wheels. Refer to Section 2E, Tires and Wheels.
3. Remove the screws, the bolts, the nuts, and the front wheel well splash shields.



4. Remove the headlamps and the front fog lamps. Refer to Section 9B, Lighting Systems.
5. Remove the screws from the wheel wells.
6. Remove the screws from behind the fascia.
7. Remove the screws from underneath the fascia.



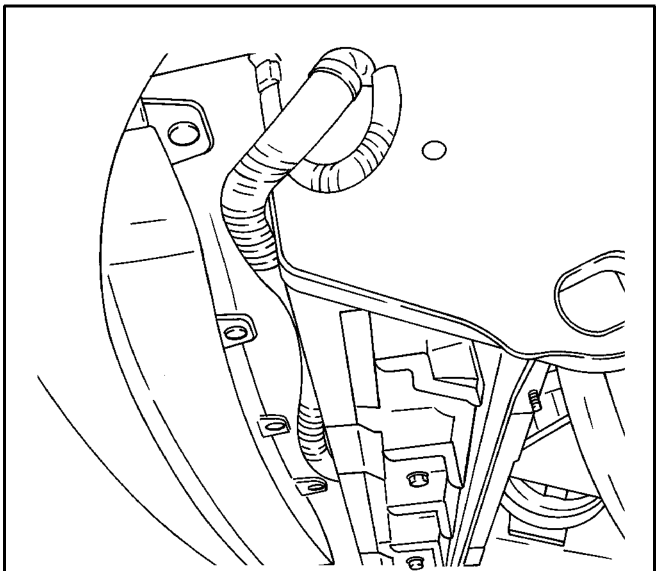
8. Remove the screws on the top of the fascia.
9. Remove the front bumper fascia.


A109O009

Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the bumper fascia.
2. Install the screws on the top of the fascia.


A109O008

3. Install the screws underneath the fascia.
4. Install the screws behind the fascia.

Tighten

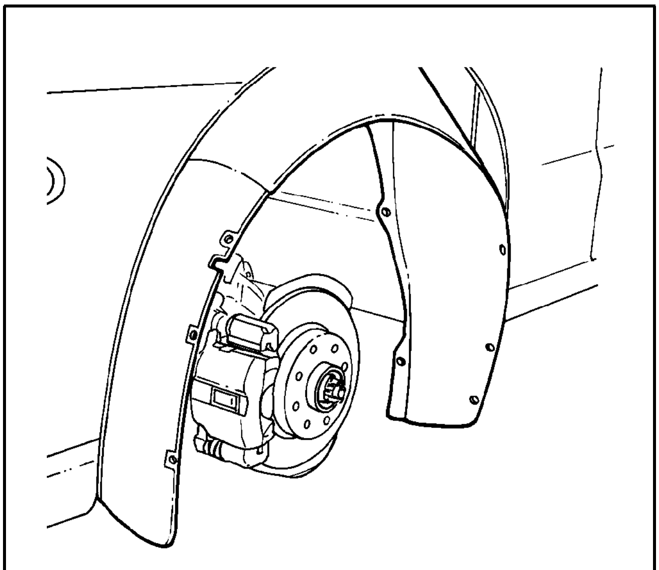
Tighten the behind fascia screws to 5.5 N•m (49 lb-in).

5. Install the screws in the wheel wells.

Tighten

Tighten the front wheel well screws to 1.5 N•m (13 lb-in).

6. Install the headlamps and the front fog lamps. Refer to Section 9B, Lighting Systems.


A109R002

7. Install the front wheel well splash shields with the screws, the bolts, and the nuts.
8. Install the front wheels. Refer to Section 2E, Tires and Wheels.

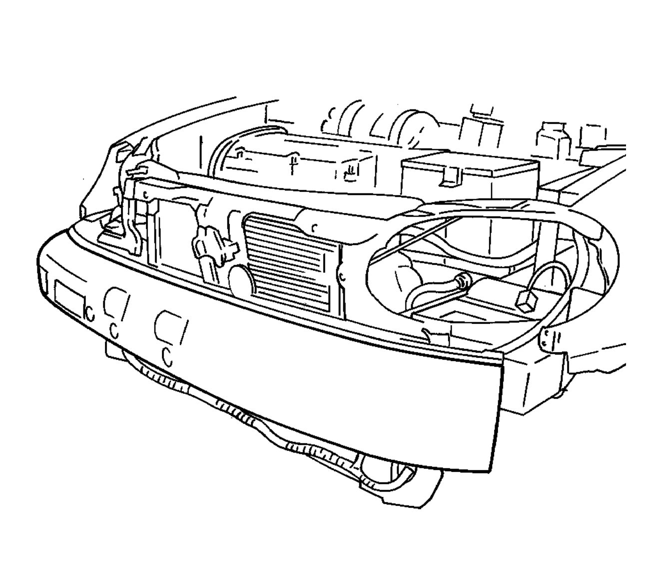
Tighten

Tighten the splash shield screws to 1.5 N•m (13 lb-in).

Tighten the splash shield bolts to 1.5 N•m (13 lb-in).

Tighten the splash shield nuts to 1.5 N•m (13 lb-in).

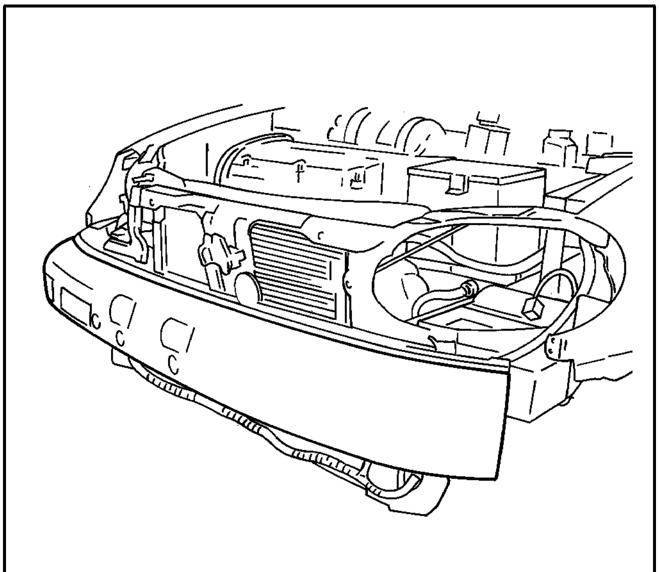
9. Connect the negative battery cable.


A109O002

FRONT BUMPER ENERGY ABSORBER

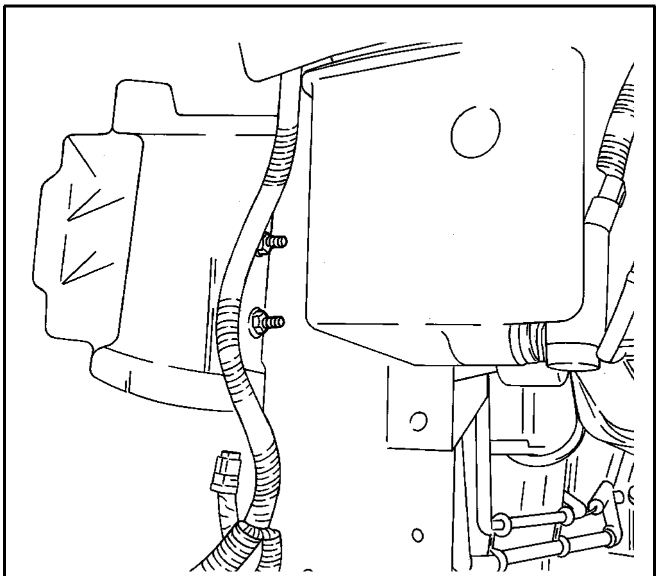
Removal Procedure

1. Remove the front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Remove the energy absorber.


A109O002

Installation Procedure

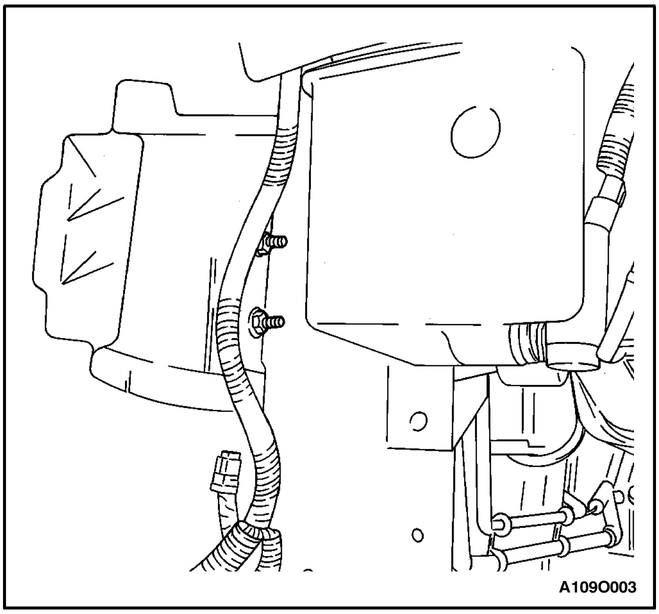
1. Install the energy absorber.
2. Install the front bumper fascia. Refer to "Front Bumper Fascia" in this section.


A109O003

FRONT BUMPER IMPACT BAR

Removal Procedure

1. Remove the front bumper energy absorber. Refer to "Front Bumper Energy Absorber" in this section.
2. Remove the nuts and the front bumper impact bar.


A109O003

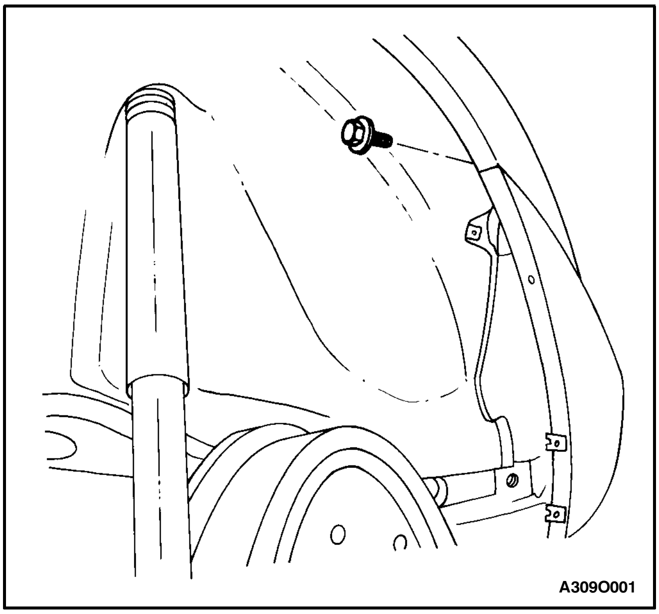
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the front bumper impact bar with the nuts.

   Tighten

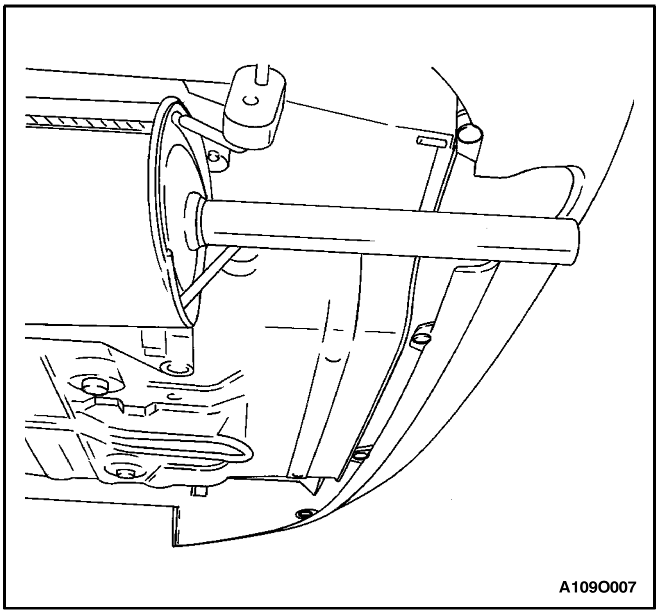
   Tighten the front bumper impact bar nuts to 27 N•m (20 lb-ft).
2. Install the front bumper energy absorber. Refer to "Front Bumper Energy Absorber" in this section.


A309O001

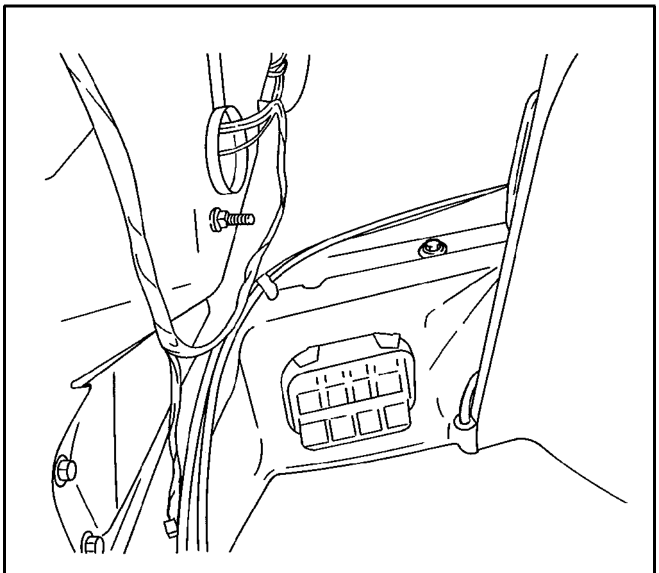
REAR BUMPER FASCIA

Removal Procedure

1. Remove the rear wheels. Refer to Section 2E, Tires and Wheels.
2. Remove the screws and the mud guards.
3. Remove the screws and the splash shields.
4. Remove the screws behind the fascia.

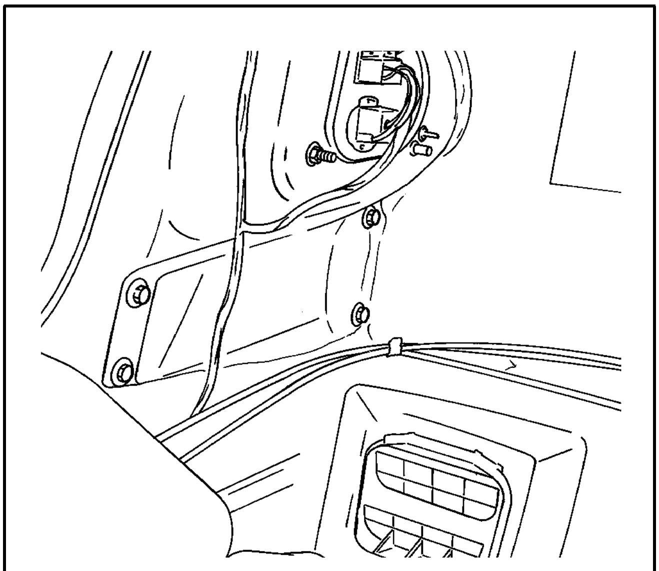

A109O007

5. Remove the screws underneath the fascia.



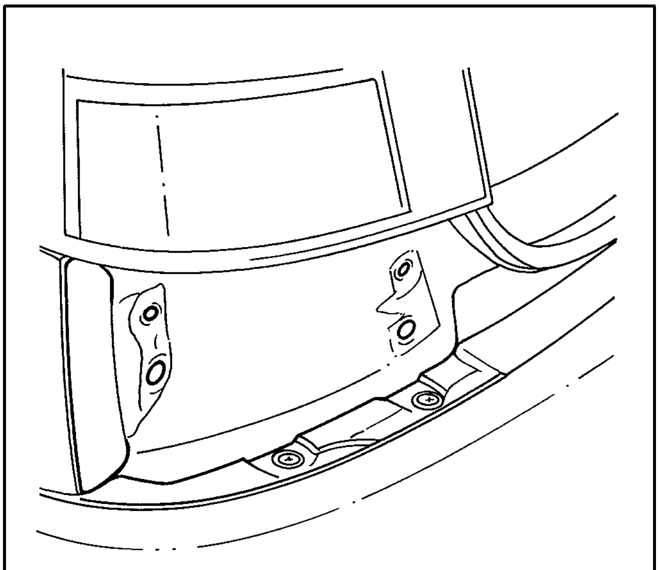
A109O010

6. Remove the luggage compartment rear quarter trim panels. Refer to Section 9G, Interior Trim.
7. Remove the bolts in the luggage compartment.



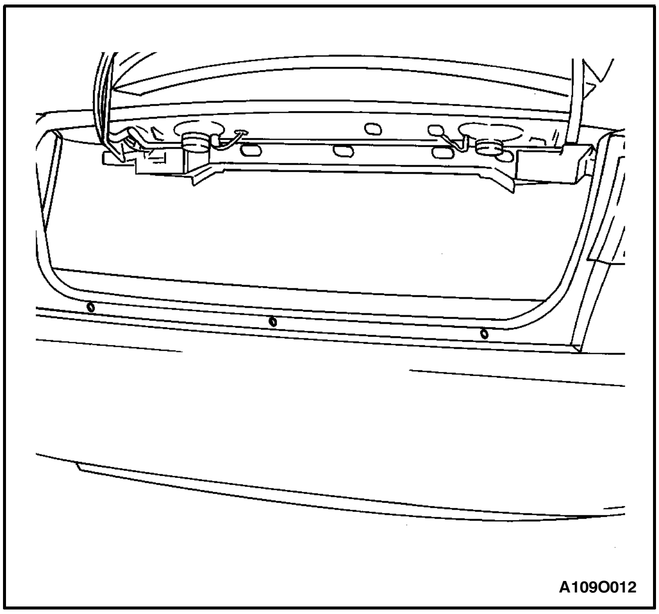
A109O011

8. Remove the bolts and the exterior trim panels beneath the taillamps.



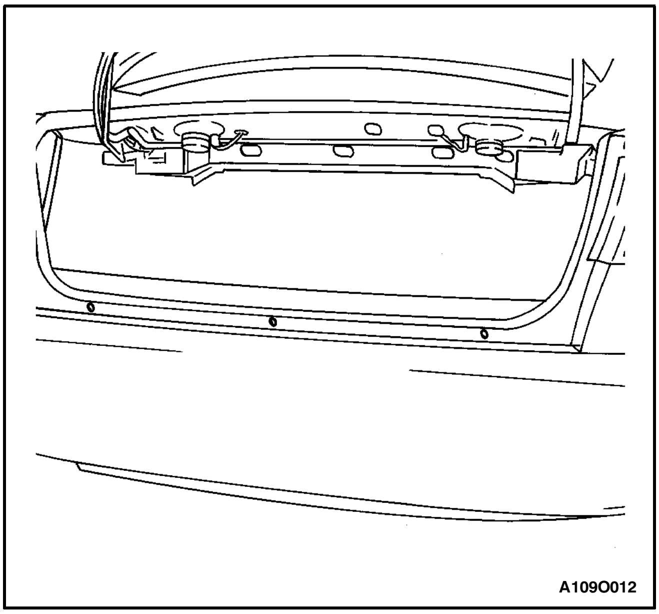
A109O006

9. Remove the fascia screws beneath the taillamps.



A109O012

10. Remove the rear upper fascia screws beneath the luggage compartment opening.
11. Remove the fascia.



A109O012

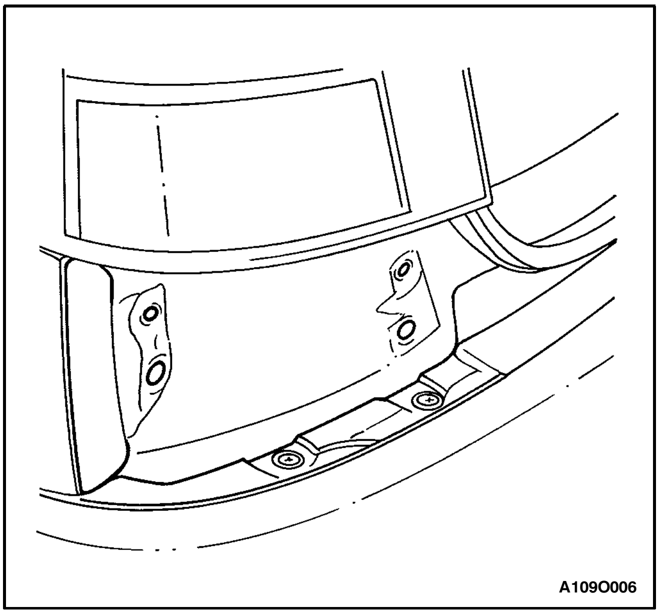
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the fascia with the rear upper fascia screws beneath the luggage compartment opening.

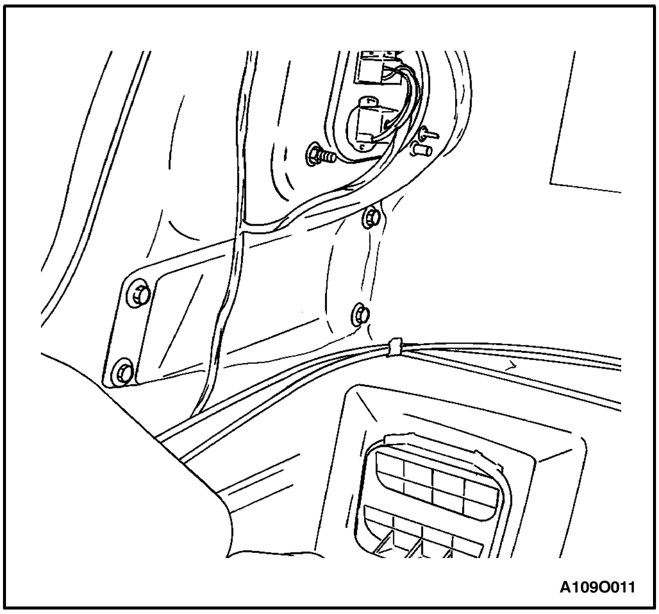
Tighten

Tighten the rear upper fascia screws to 5.5 N•m (49 lb-in).



A109O006

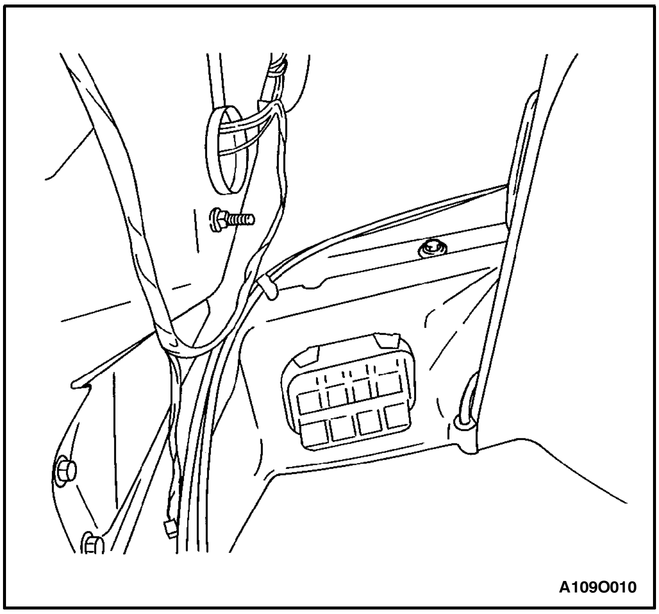
2. Install the fascia screws beneath the taillamps.



3. Install the exterior trim panels beneath the taillamps with the bolts.

Tighten

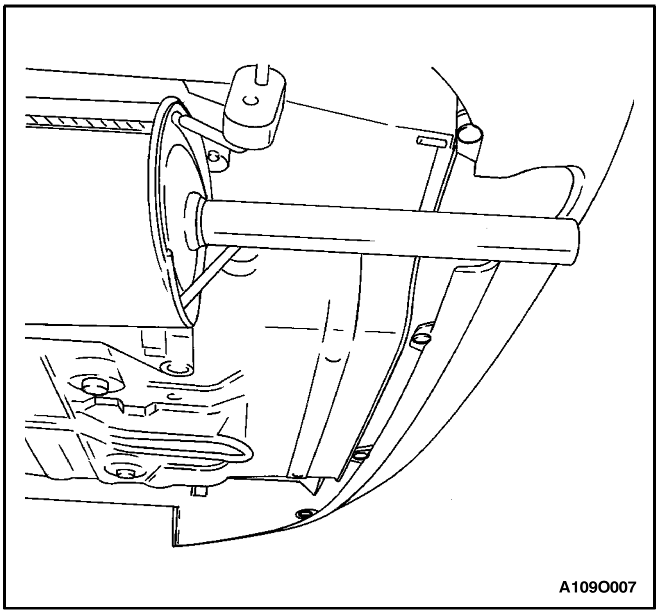
Tighten the trim panel bolts to 10 N•m (89 lb-in).



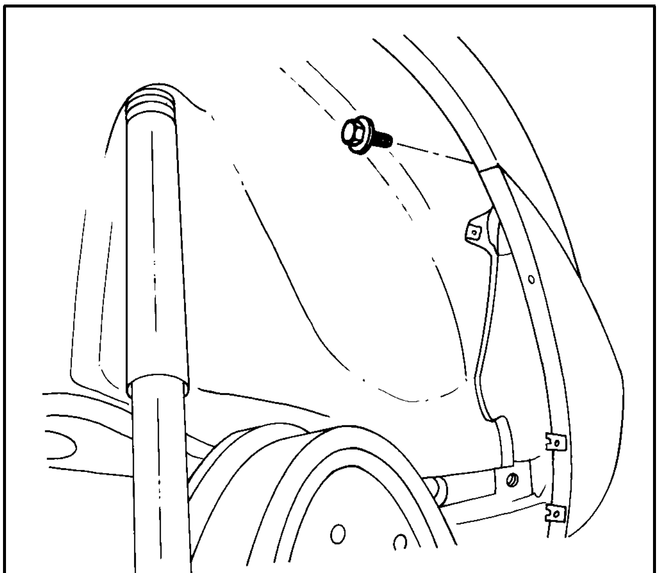
4. Install the bolts in the luggage compartment.

Tighten

Tighten the luggage compartment fascia bolts to 5.5 N•m (49 lb-in).



5. Install the luggage compartment rear quarter trim panels.Refer to Section 9G, Interior trim.
6. Install the screws underneath the fascia.



A309O001

7. Install the screws behind the fascia.

Tighten

Tighten the behind fascia screws to 5.5 N•m (49 lb-in).

8. Install the splash shields with the screws.

Tighten

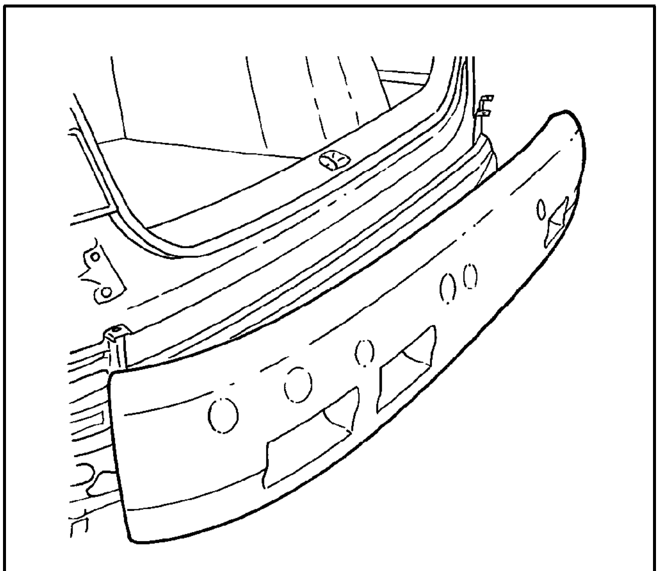
Tighten the splash shield screws to 1.5 N•m (13 lb-in).

9. Install the mud guards with the screws.

Tighten

Tighten the mud guard screws to 1.5 N•m (13 lb-in).

10. Install the rear wheels. Refer to Section 2E, Tires and Wheels.

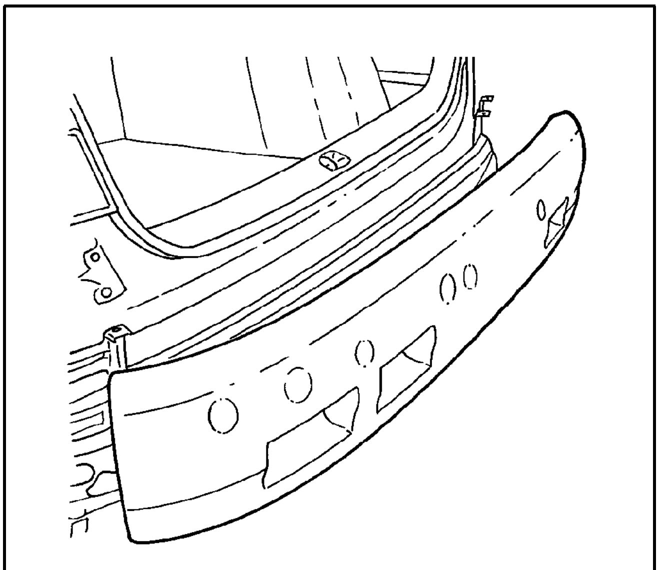


A109O001

REAR BUMPER ENERGY ABSORBER

Removal Procedure

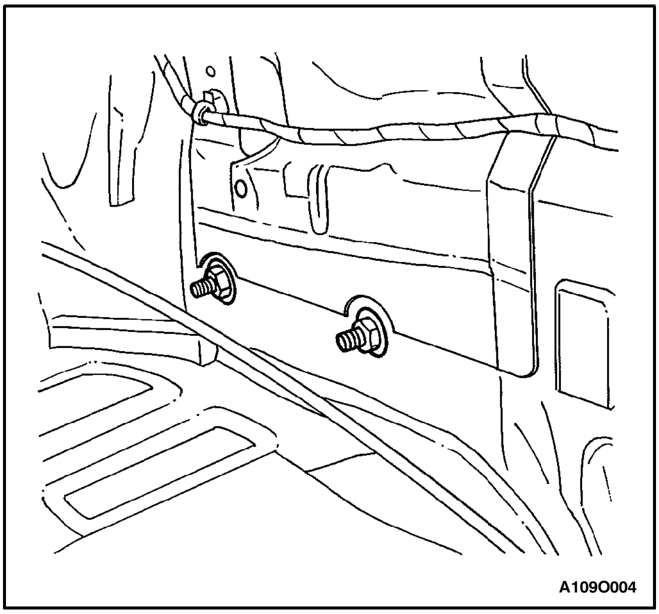
1. Remove the rear bumper fascia. Refer to "Rear Bumper Fascia" in this section.
2. Remove the energy absorber.



A109O001

Installation Procedure

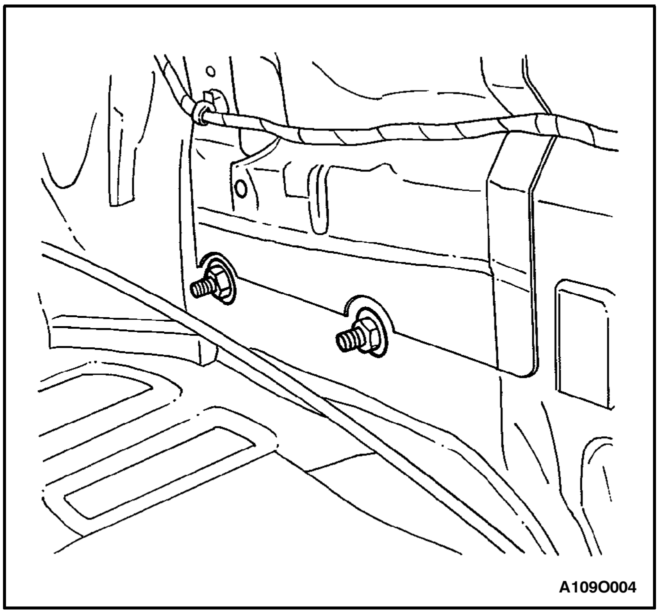
1. Install the energy absorber.
2. Install the rear bumper fascia. Refer to "Rear Bumper Fascia" in this section.



REAR BUMPER IMPACT BAR

Removal Procedure

1. Remove the rear bumper energy absorber. Refer to "Rear Bumper Energy Absorber" in this section.
2. Remove the two nuts beneath the vehicle.
3. Remove the four nuts inside the luggage compartment.
4. Disconnect the harness connector.
5. Remove the impact bar.



Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Connect the harness connector.
2. Secure the rear bumper impact bar with the four nuts inside the luggage compartment.

   Tighten

   Tighten the rear impact bar nuts to 27 N•m (20 lb-ft).
3. Install the two lower rear impact bar nuts beneath the vehicle.

   Tighten

   Tighten the two lower rear impact bar nuts to 27 N•m (20 lb-ft).
4. Install the energy absorber. Refer to "Rear Bumper Energy Absorber" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

BUMPERS

The bumper systems are designed to sustain a collision into a fixed barrier at either 8 km/h (5 mph) or 4 km/h (2.5 mph) without damage. After absorbing the energy of a collision, these bumper systems restore themselves to their original position. Both the front and the rear bumpers feature an internal foam energy absorber and a polymer fascia cover. The rear bumper fascia must be removed before access can be gained to the energy absorber and the bumper. The front bumper assembly can be removed as a whole unit or the fascia cover can be removed separately.

SECTION 9P
DOORS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

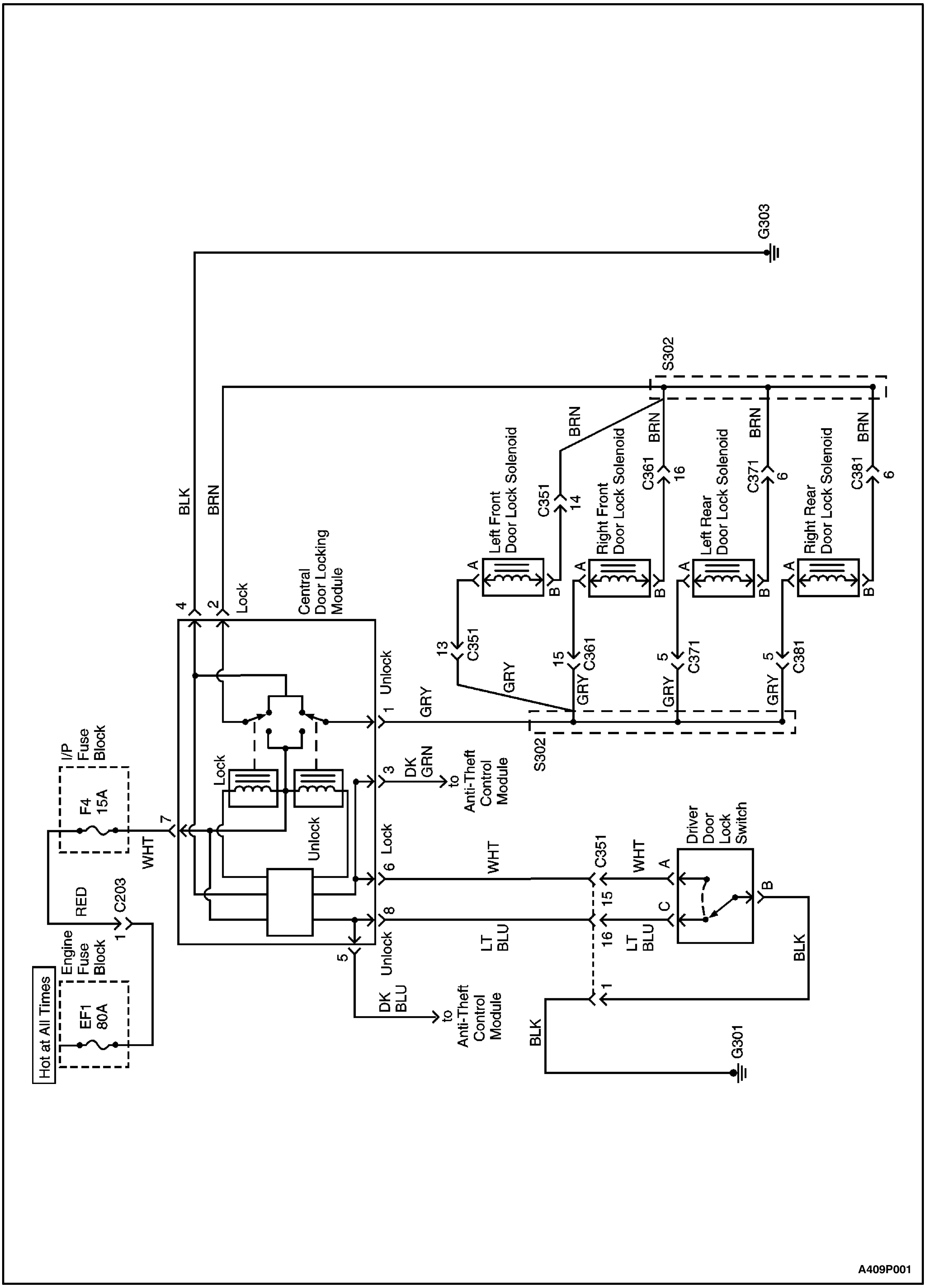
TABLE OF CONTENTS

SPECIFICATIONS
FASTENER TIGHTENING SPECIFICATIONS

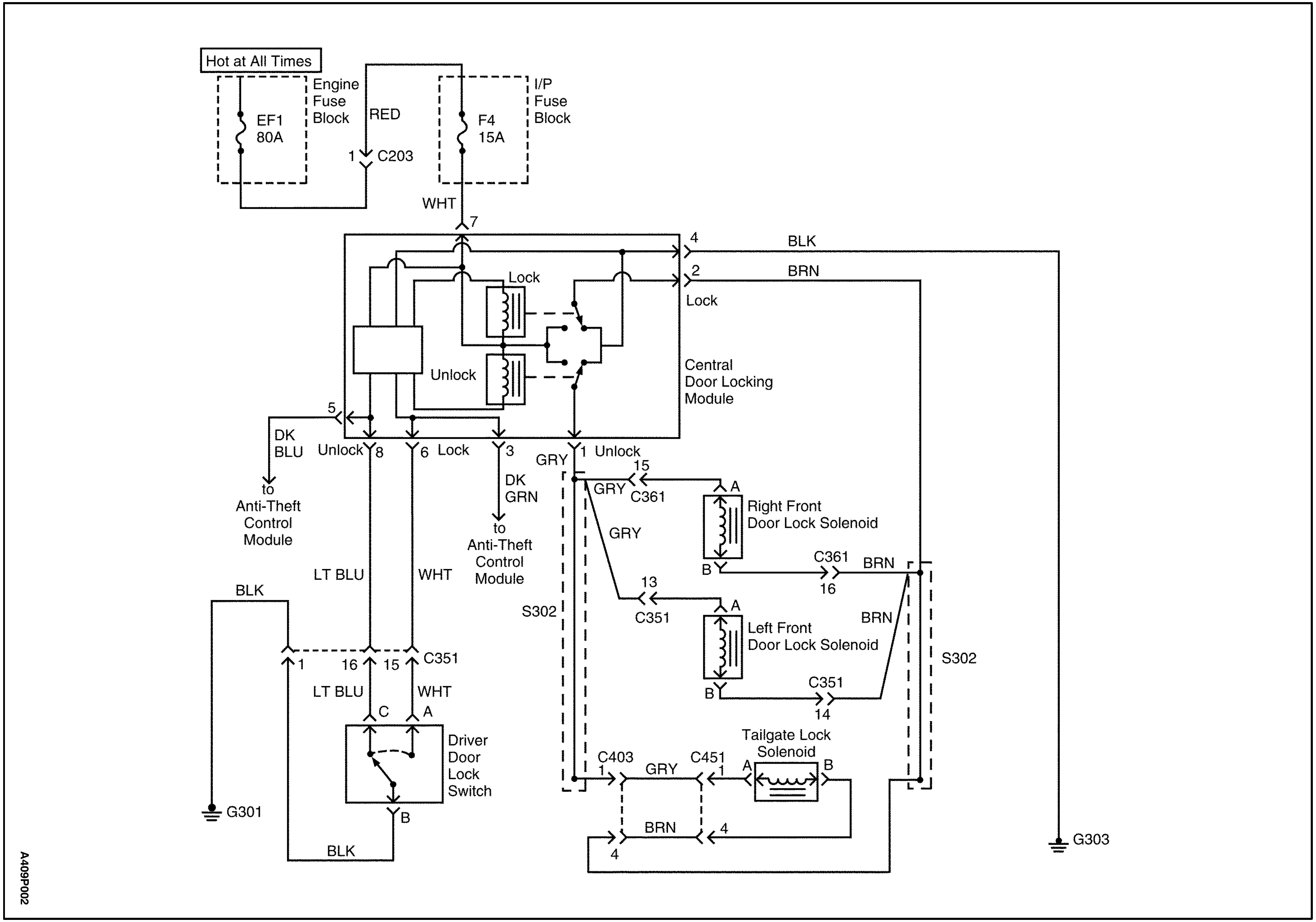
Application	N•m	Lb-Ft	Lb-In
Door Hinge-to-Body Bolt	39	29	-
Door Hinge-to-Door Bolt	15	11	-
Door Hold Open Link-to-Body Bolt	25	18	-
Door Hold Open Link-to-Door Bolt	5	-	44
Door Lock Screw	8	-	71
Door Lock Striker Screw	20	15	-
Door Pull Bracket Screw	3.5	-	31
Door Striker Screw	20	15	-
Guide Rail Bolt	7	-	62
Inside Door Handle Screw	3	-	27
Manual Window Regulator Nut	7	-	62
Outside Door Handle Bolt	4.5	-	40

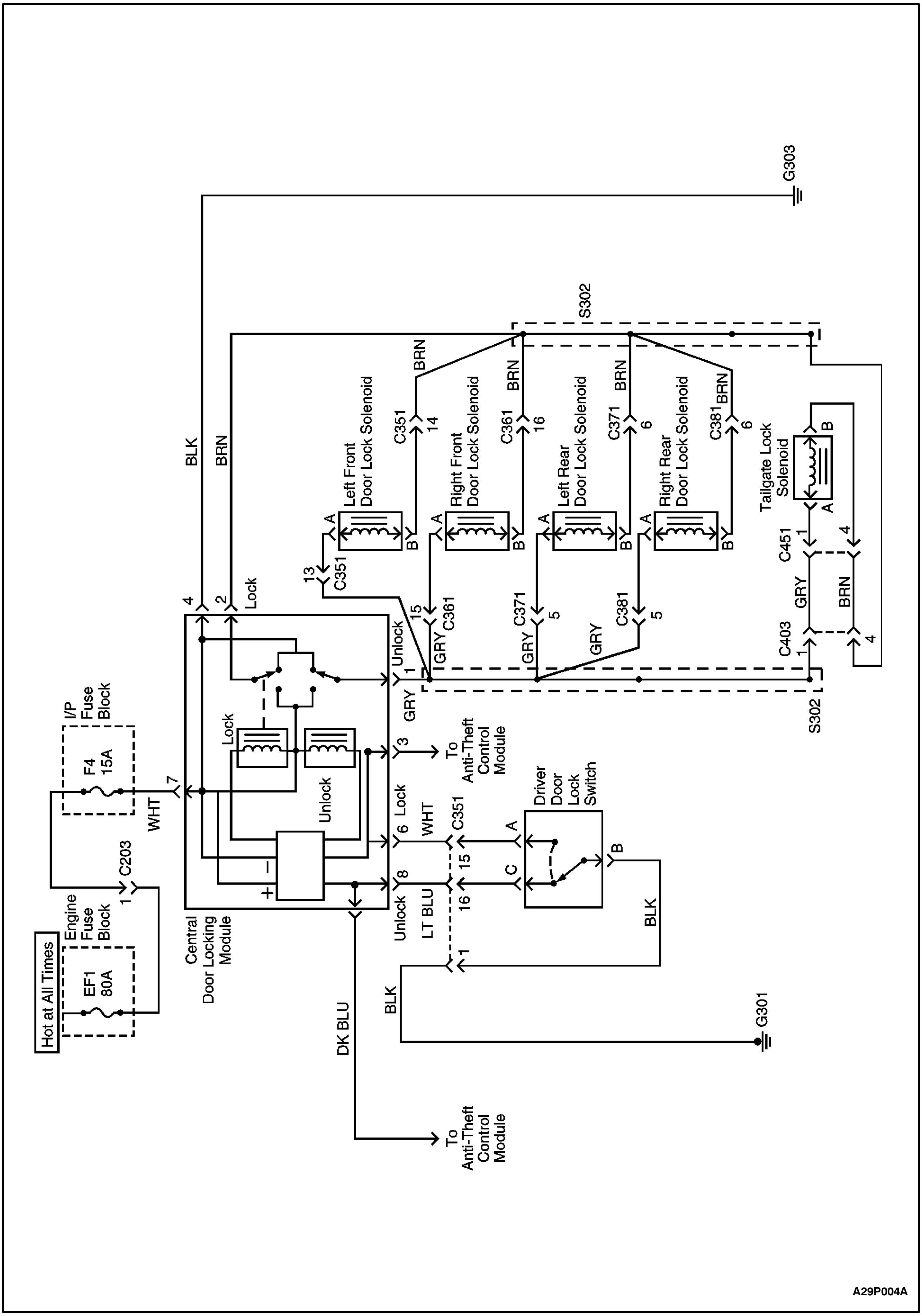
SCHEMATIC AND ROUTING DIAGRAMS

POWER DOOR LOCKS

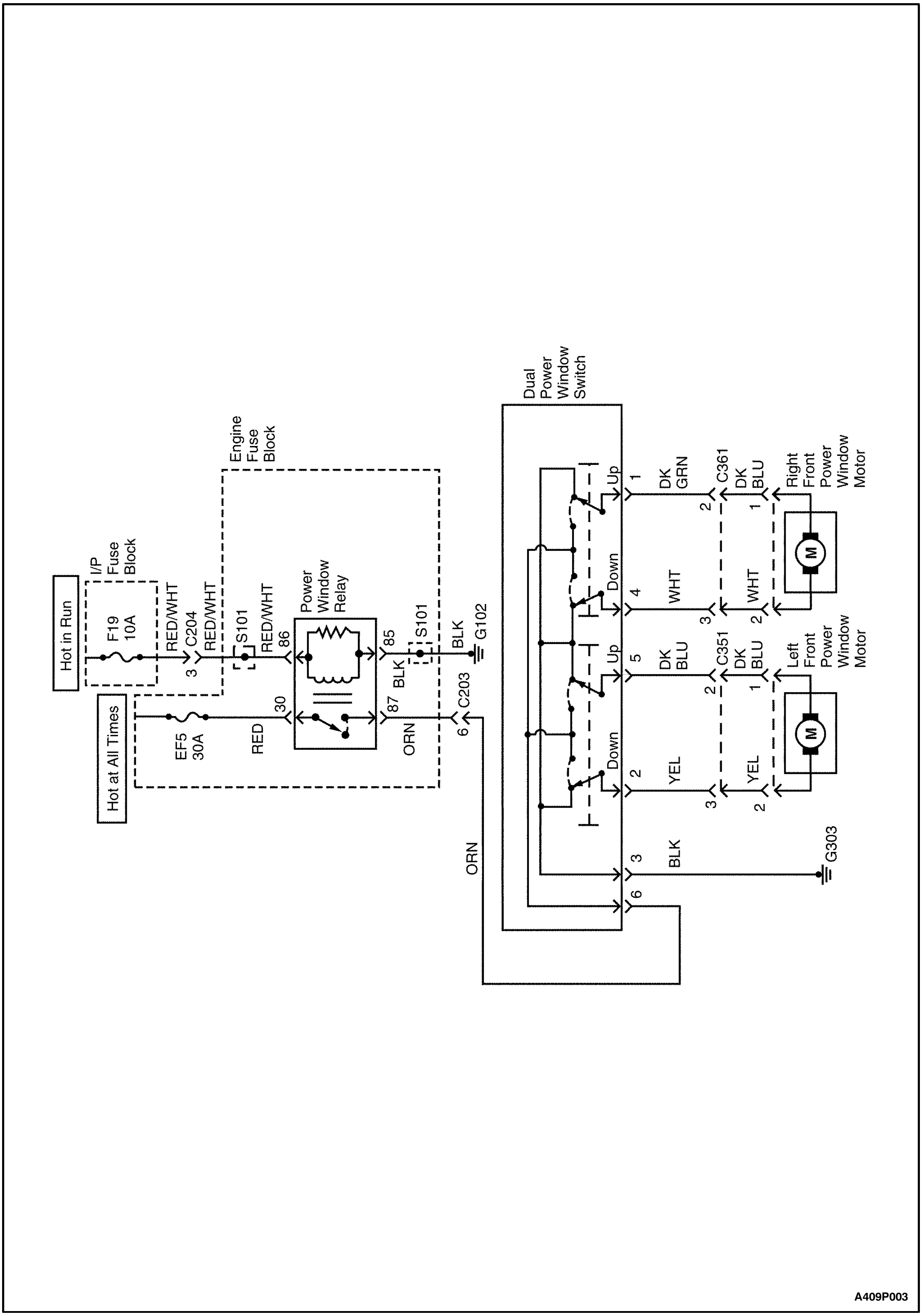


POWER DOOR LOCKS (3-DOOR HATCHBACK)

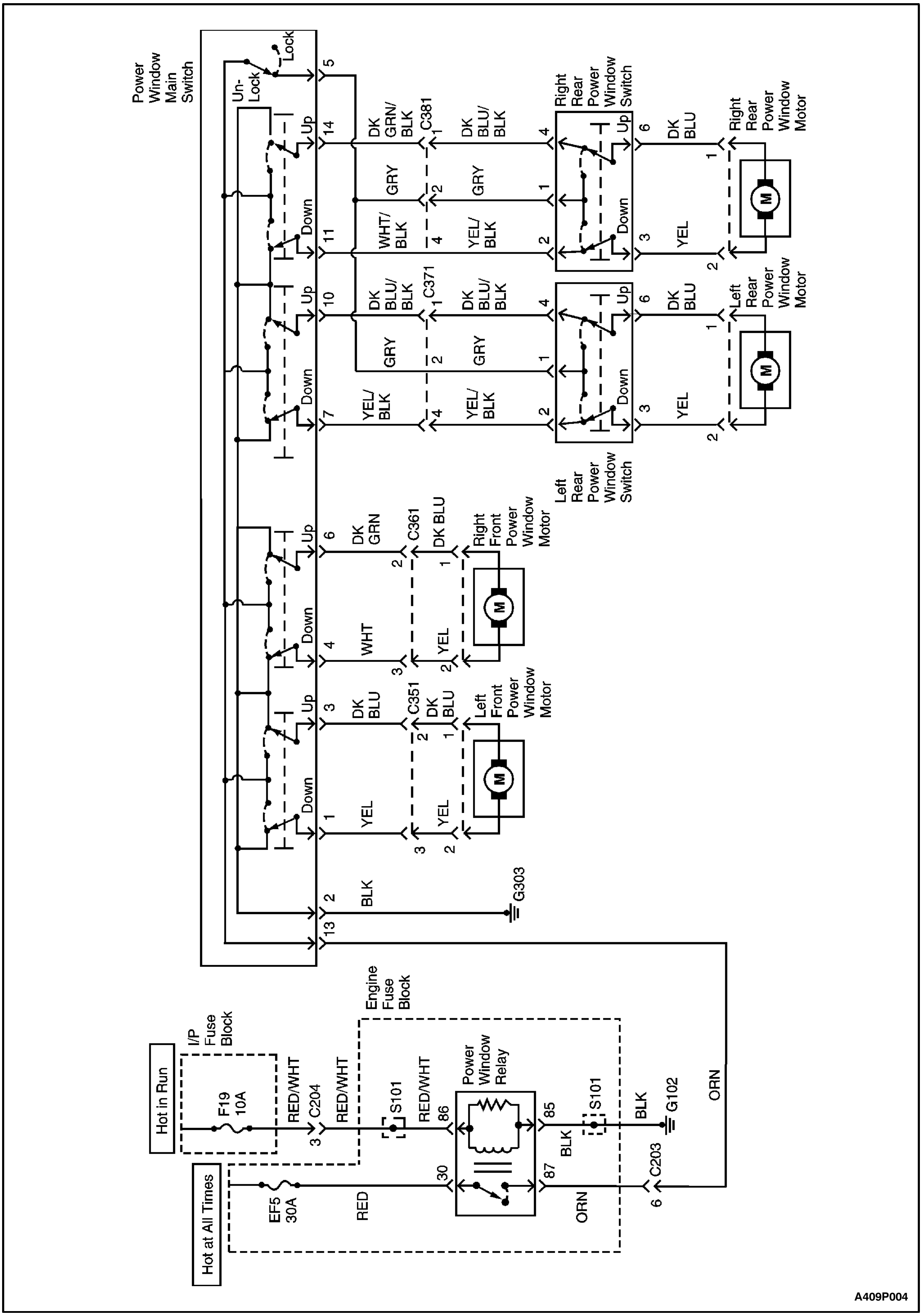



POWER DOOR LOCKS (5-DOOR HATCHBACK)
Hot at All Times
Engine Fuse Block
EF1 80A
I/P Fuse Block
F4 15A
C203
WHT
Central Door Locking Module
Lock
Unlock
BLK
BRN
G303
S302
Left Front Door Lock Solenoid
Right Front Door Lock Solenoid
Left Rear Door Lock Solenoid
Right Rear Door Lock Solenoid
Tailgate Lock Solenoid
C351
C361
C371
C381
C451
C403
GRY
To Anti-Theft Control Module
Driver Door Lock Switch
LT BLU
DK BLU
G301
A29P004A

POWER WINDOWS (FRONT ONLY)



POWER WINDOWS (FRONT AND REAR)



DIAGNOSIS

POWER WINDOWS

System With Only Front Power Windows, One or Both Windows are Inoperative

Caution: When powering the window motors directly from a battery with jumper wires, make sure one of the jumper wires contains a fuse. If the jumpers are accidentally touched together, the fuse will prevent sparking and burns from sudden terminal heating.

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Attempt to operate both power windows. Is either window working?	-	Go to Step 18	Go to Step 2
2	Visually inspect the connection at the dual power window switch. Is the electrical connector correctly attached to the switch?	-	Go to Step 4	Go to Step 3
3	Correctly attach the electrical connector to the dual power window switch. Is the repair complete?	-	System OK	-
4	1. Disconnect the electrical connector from the dual power window switch. 2. Turn the ignition ON. 3. Check the voltage at terminal 6 of the dual power window switch connector. Is the voltage equal to the specified value?	11-14 v	Go to Step 16	Go to Step 5
5	Check fuses F19 and EF5. Is either fuse blown?	-	Go to Step 6	Go to Step 7
6	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuse(s). Is the repair complete?	-	System OK	-
7	1. Turn the ignition ON. 2. Check the voltages at fuses F19 and EF5. Are both voltages equal to the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the power supply to the fuse which did not indicate battery voltage with the ignition on. Is the repair complete?	-	System OK	-
9	1. Remove the power window relay. 2. Turn the ignition ON. 3. Check the voltage at terminal 30 and terminal 86 of the power window relay socket. (Terminals of the relay socket can be identified by the markings on the bottom of the relay.) Does the voltmeter indicate the specified value at terminals 30 and 86?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the fuses and the power window relay. Is the repair complete?	-	System OK	-

System With Only Front Power Windows, One or Both Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
11	With the power window relay still removed, use an ohmmeter to check the resistance between ground and terminal 85 of the power window relay socket. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 13	Go to Step 12
12	Repair the open circuit between ground and terminal 85 of the power window relay socket. Is the repair complete?	-	System OK	-
13	1. Temporarily substitute a known good relay in place of the power window relay. 2. Attempt to operate the power windows. Do the power windows operate with the substituted relay?	-	Go to Step 14	Go to Step 15
14	1. Return the substituted relay to its original position. 2. Replace the original power window relay. Is the repair complete?	-	System OK	-
15	Repair the open circuit between the power window relay socket terminal 87 and the dual power window switch terminal 6. Is the repair complete?	-	System OK	-
16	With the dual power window switch disconnected, use an ohmmeter to check the resistance between ground and terminal 3 of the dual power window switch connector. Is the resistance equal to the specified value?	[0 W	Go to Step 18	Go to Step 17
17	Repair the open circuit between ground and terminal 3 of the dual power window switch connector. Is the repair complete?	-	System OK	-
18	1. Remove the trim panel from a door which has an inoperative power window. 2. Move a vehicle battery close enough to the door so that the window motor can be powered directly from the battery with jumper wires. 3. Disconnect the the two-pin window motor connector in the door. Important: To prevent the fuse in the jumper wire from blowing, do not touch the jumper wires together. 4. Attach a jumper wire between the battery negative terminal and one of the terminals in the two-pin window motor connector. 5. Attach a fused jumper wire between the battery positive terminal and the remaining terminal in the two-pin window motor connector. Unless the motor is at the end of its travel, the window should move with the jumpers attached. 6. To move the window in the opposite direction, reverse the jumper wire connections at the window motor connector. Does the power window operate in both directions when the motor is operated directly from a battery?	-	Go to Step 20	Go to Step 19
19	Replace the window motor. Is the repair complete?	-	System OK	-

System With Only Front Power Windows, One or Both Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
20	1. Before reconnecting the two-pin window motor connector, connect an ohmmeter between the terminals to check the resistance of the motor. 2. Record the ohmmeter reading for motor resistance. 3. Reconnect the motor connector and reinstall the door trim panel. 4. Disconnect the electrical connector from the dual power window switch. 5. At the dual power window switch connector, use an ohmmeter to check the resistance between the terminals which lead to the motor that was tested in Step 15. Is the resistance at the switch connector approximately equal to the resistance that was previously measured at the motor connector?	-	Go to Step 22	Go to Step 21
21	Repair the open circuit between the window motor and the window switch. Is the repair complete?	-	System OK	-
22	Replace the dual power window switch. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Front Windows are Inoperative

Caution: When powering the window motors directly from a battery with jumper wires, make sure one of the jumper wires contains a fuse. If the jumpers are accidentally touched together, the fuse will prevent sparking and burns from sudden terminal heating.

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Attempt to operate each front power window. Is either window working?	-	Go to Step 18	Go to Step 2
2	Visually inspect the connection at the power window main switch. Is the electrical connector correctly attached to the main switch?	-	Go to Step 4	Go to Step 3
3	Correctly attach the electrical connector to the power window main switch. Is the repair complete?	-	System OK	-
4	1. Disconnect the electrical connector from the power window main switch. 2. Turn the ignition ON. 3. Check the voltage at terminal 13 of the power window main switch connector. Is the voltage equal to the specified value?	11-14 v	Go to Step 16	Go to Step 5
5	Check fuses F19 and EF5. Is either fuse blown?	-	Go to Step 6	Go to Step 7
6	1. Check for a short circuit and repair, if necessary. 2. Replace the blown fuse(s). Is the repair complete?	-	System OK	-
7	1. Turn the ignition ON. 2. Check the voltages at fuses F19 and EF5. Are both voltages equal to the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the power supply to the fuse which did not indicate battery voltage with the ignition on. Is the repair complete?	-	System OK	-
9	1. Remove the power window relay. 2. Turn the ignition ON. 3. Check the voltage at terminal 30 and terminal 86 of the power window relay socket. (Terminals of the relay socket can be identified by the markings on the bottom of the relay.) Does the voltmeter indicate the specified value?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the fuses and the power window relay. Is the repair complete?	-	System OK	-
11	With the power window relay still removed, use an ohmmeter to check the resistance between ground and terminal 85 of the power window relay socket. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 13	Go to Step 12
12	Repair the open circuit between ground and terminal 85 of the power window relay socket. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Front Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Temporarily substitute a known good relay in place of the power window relay. 2. Attempt to operate the power windows. Do the power windows operate with the substituted relay?	-	Go to Step 14	Go to Step 15
14	1. Return the substituted relay to its original position. 2. Replace the original power window relay. Is the repair complete?	-	System OK	-
15	Repair the open circuit between the power window relay socket terminal 87 and the power window switch terminal 13. Is the repair complete?	-	System OK	-
16	With the power window main switch disconnected, use an ohmmeter to check the resistance between ground and terminal 2 of the power window switch connector. Is the resistance equal to the specified value?	[0 W	Go to Step 18	Go to Step 17
17	Repair the open circuit between ground and terminal 2 of the power window main switch connector. Is the repair complete?	-	System OK	-
18	1. Remove the trim panel from the front door which has an inoperative power window. 2. Move a vehicle battery close enough to the door so that the window motor can be powered directly from the battery with jumper wires. 3. Disconnect the the two-pin window motor connector in the door. Important: To prevent the fuse in the jumper wire from blowing, do not touch the jumper wires together. 4. Attach a jumper wire between the battery negative terminal and one of the terminals in the two-pin window motor connector. 5. Attach a fused jumper wire between the battery positive terminal and the remaining terminal in the two-pin window motor connector. Unless the motor is at the end of its travel, the window should move with the jumpers attached. 6. To move the window in the opposite direction, reverse the jumper wire connections at the window motor connector. Does the power window operate in both directions when the motor is operated directly from a battery?	-	Go to Step 20	Go to Step 19
19	Replace the window motor. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Front Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
20	1. Before reconnecting the two-pin window motor connector, connect an ohmmeter between the terminals to check the resistance of the motor. 2. Record the ohmmeter reading for motor resistance. 3. Reconnect the motor connector and reinstall the door trim panel. 4. Disconnect the electrical connector from the power window switch. 5. At the power window main switch connector, use an ohmmeter to check the resistance between the terminals which lead to the motor that was tested in Step 15. Is the resistance at the main switch connector approximately equal to the resistance that was previously measured at the motor connector?	-	Go to Step 22	Go to Step 21
21	Repair the open circuit between the window motor and the window switch. Is the repair complete?	-	System OK	-
22	Replace the power window switch. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Rear Windows are Inoperative

Caution: When powering the window motors directly from a battery with jumper wires, make sure one of the jumper wires contains a fuse. If the jumpers are accidentally touched together, the fuse will prevent sparking and burns from sudden terminal heating.

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON. 2. Make sure that the window lock position has not been selected on the power window main switch. 3. Attempt to operate each rear power window. Is either rear power window working?	-	Go to Step 18	Go to Step 2
2	Visually inspect the connection at the power window main switch. Is the electrical connector correctly attached to the main switch?	-	Go to Step 4	Go to Step 3
3	Correctly attach the electrical connector to the power window main switch. Is the repair complete?	-	System OK	-
4	1. Disconnect the electrical connector from the power window main switch. 2. Turn the ignition ON. 3. Check the voltage at terminal 13 of the power window main switch connector. Is the voltage equal to the specified value?	11-14 v	Go to Step 16	Go to Step 5
5	Check fuses F19 and EF5. Is either fuse blown?	-	Go to Step 6	Go to Step 7
6	1. Check for a short circuit and repair, if necessary. 2. Replace the blown fuse(s). Is the repair complete?	-	System OK	-
7	1. Turn the ignition ON. 2. Check the voltages at fuses F19 and EF5. Are both voltages equal to the specified value?	11-14 v	Go to Step 9	Go to Step 8
8	Repair the power supply to the fuse which did not indicate battery voltage with the ignition on. Is the repair complete?	-	System OK	-
9	1. Turn the ignition ON. 2. Remove the power window relay. 3. Check the voltage at terminal 30 and terminal 86 of the power window relay socket. (Terminals of the relay socket can be identified by the markings on the bottom of the relay.) Does the voltmeter indicate the specified value?	11-14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the fuses and the power window relay. Is the repair complete?	-	System OK	-
11	With the power window relay still removed, use an ohmmeter to check the resistance between ground and terminal 85 of the power window relay socket. Does the ohmmeter indicate the specified value?	[0 W	Go to Step 13	Go to Step 12
12	Repair the open circuit between ground and terminal 85 of the power window relay socket. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Rear Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Temporarily substitute a known good relay in place of the power window relay. 2. Attempt to operate the power windows. Do the power windows operate with the substituted relay?	-	Go to Step 14	Go to Step 15
14	1. Return the substituted relay to its original position. 2. Replace the original power window relay. Is the repair complete?	-	System OK	-
15	Repair the open circuit between the power window relay socket terminal 87 and the power window main switch terminal 13. Is the repair complete?	-	System OK	-
16	With the power window main switch disconnected, use an ohmmeter to check the resistance between ground and terminal 2 of the power window main switch connector. Is the resistance equal to the specified value?	[0 W	Go to Step 18	Go to Step 17
17	Repair the open circuit between ground and terminal 2 of the power window switch connector. Is the repair complete?	-	System OK	-
18	1. Remove the trim panel from the rear door which has an inoperative power window. 2. Move a vehicle battery close enough to the door so that the window motor can be powered directly from the battery with jumper wires. 3. Disconnect the the two-pin window motor connector in the door. Important: To prevent the fuse in the jumper wire from blowing, do not touch the jumper wires together. 4. Attach a jumper wire between the negative battery terminal and one of the terminals in the two-pin window motor connector. 5. Attach a fused jumper wire between the positive battery terminal and the remaining terminal in the two-pin power window motor connector. Unless the motor is at the end of its travel, the power window should move with the jumpers attached. 6. To move the power window in the opposite direction, reverse the jumper wire connections at the power window motor connector. Does the power window operate in both directions when the motor is operated directly from a battery?	-	Go to Step 20	Go to Step 19
19	Replace the power window motor. Is the repair complete?	-	System OK	-
20	1. Make sure the window lock on the main switch is off. 2. Turn the ignition ON. 3. At the rear power window switch connector, check the voltage at terminal 1. Is the voltage equal to the specified value?	11-14v	Go to Step 21	Go to Step 29

System With Front and Rear Power Windows, One or Both Rear Windows are Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
21	1. At the power window motor two-pin connector, use an ohmmeter to measure the resistance of the power window motor. Record the resistance. 2. Re-connect the two-pin power window motor connector. 3. Disconnect the rear power window switch connector. 4. Use an ohmmeter to measure between terminals 3 and 6 of the rear power window switch connector. Is the resistance measured at the rear power window switch connector equal to the resistance previously measured at the rear power window motor connector?	-	Go to Step 23	Go to Step 22
22	Repair the open circuit between the rear power window switch and the rear power window motor connector. Is the repair complete?	-	System OK	-
23	1. Remove the rear power window switch for testing. 2. Connect an ohmmeter between terminals 4 and 3 of the rear power window switch, and observe the ohmmeter. 3. Connect the ohmmeter between terminals 2 and 6 of the rear power window switch, and observe the ohmmeter. For both tests, did the ohmmeter indicate the specified value?	[0 W	Go to Step 25	Go to Step 24
24	Replace the rear power window switch. Is the repair complete?	-	System OK	-
25	1. With the rear power window switch removed for testing, connect an ohmmeter between terminals 1 and 3, and put the switch in the DOWN position. Observe the ohmmeter. 2. Connect the ohmmeter between terminals 1 and 6, and put the switch in the UP position and observe the ohmmeter. For both tests, did the ohmmeter indicate the specified value?	[0 W	Go to Step 26	Go to Step 24
26	1. Reconnect the rear power window switch connector. 2. Disconnect the electrical connector from the power window main switch. 3. Use an ohmmeter to measure the resistance at the power window main switch between between terminals 7 and 10 if you are testing the left rear window, or terminals 11 and 14 if you are testing the right rear window. Is the resistance equal to the resistance previously measured at the motor connector?	-	Go to Step 28	Go to Step 27
27	Repair the open circuit between the power window main switch and the rear power window switch. Is the repair complete?	-	System OK	-

System With Front and Rear Power Windows, One or Both Rear Windows are Inoperative (Cont'd)

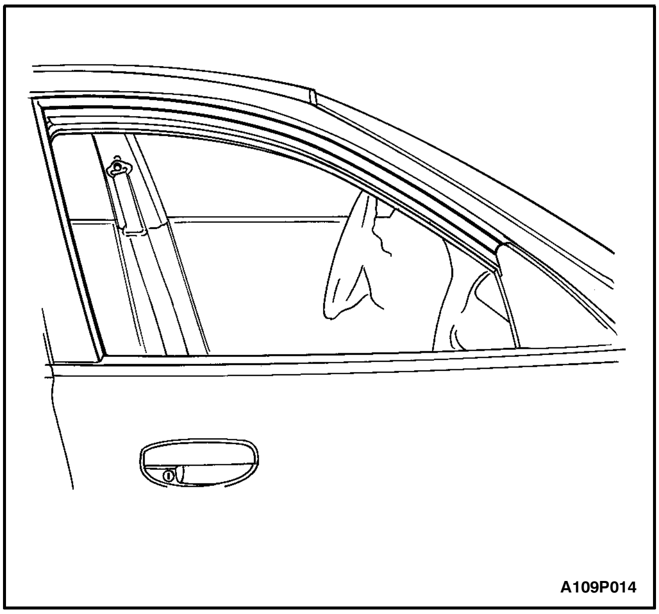
Step	Action	Value(s)	Yes	No
28	Replace the power window main switch. Is the repair complete?	-	System OK	-
29	1. Remove the power window main switch, but do not disconnect the electrical connector. 2. Make sure the window lock is off. 3. Turn the ignition ON. 4. Check the voltage at terminal 5 of the power window main switch. Is the voltage equal to the specified value?	11-14 v	Go to Step 27	Go to Step 28

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

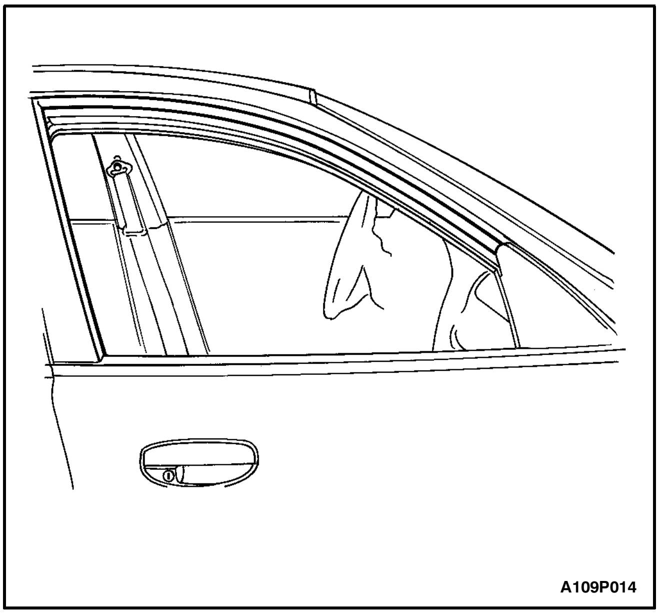
FRONT DOOR GLASS RUN

Removal Procedure



1. Remove the outside rearview mirror. Refer to Section 9L, Glass and Mirrors.
2. Remove the front door glass. Refer to Section 9L, Glass and Mirrors.
3. Remove the glass run.

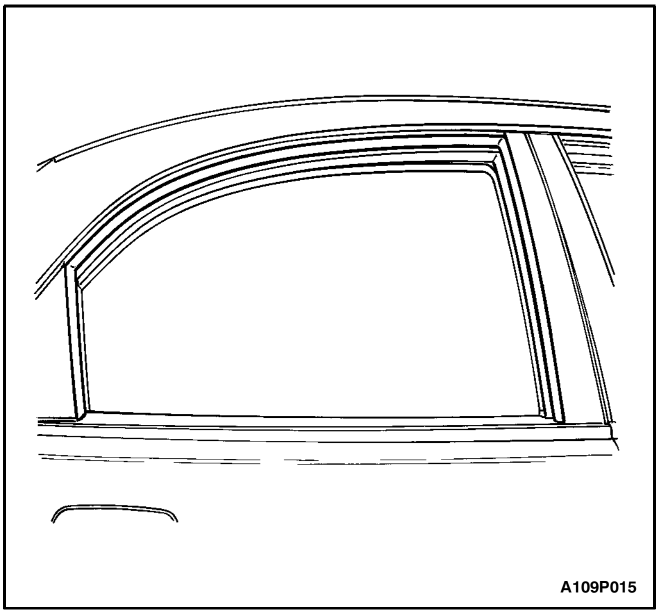
Installation Procedure



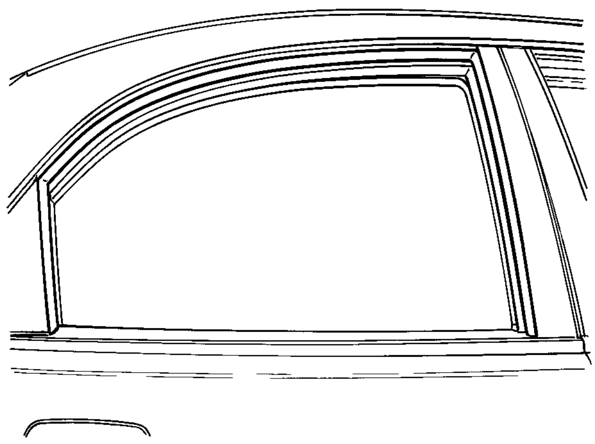
1. Install the glass run.
2. Install the front door glass. Refer to Section 9L, Glass and Mirrors.
3. Install the outside rearview mirror. Refer to Section 9L, Glass and Mirrors.

REAR DOOR GLASS RUN

Removal Procedure



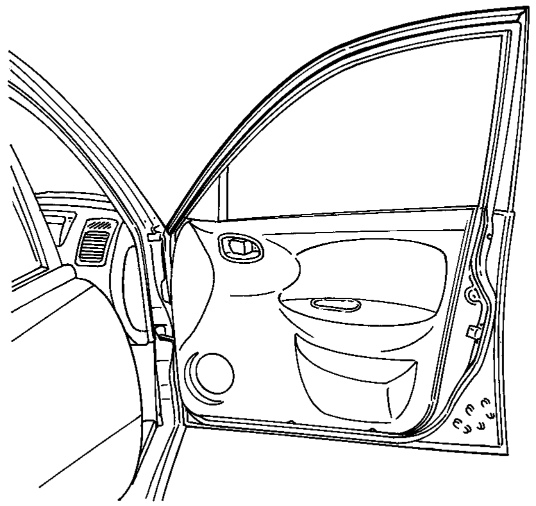
1. Remove the rear door glass. Refer to Section 9L, Glass and Mirrors.
2. Remove the rear door interior and exterior garnish trim.
3. Remove the glass run.



A109P015

Installation Procedure

1. Install the glass run.
2. Install the rear door interior and exterior garnish trim.
3. Install the rear door glass. Refer to Section 9L, Glass and Mirrors.

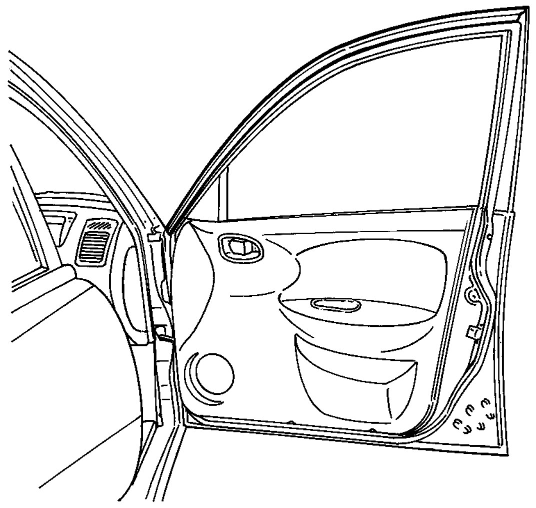


A109P016

FRONT DOOR SECONDARY WEATHERSTRIP

Removal Procedure

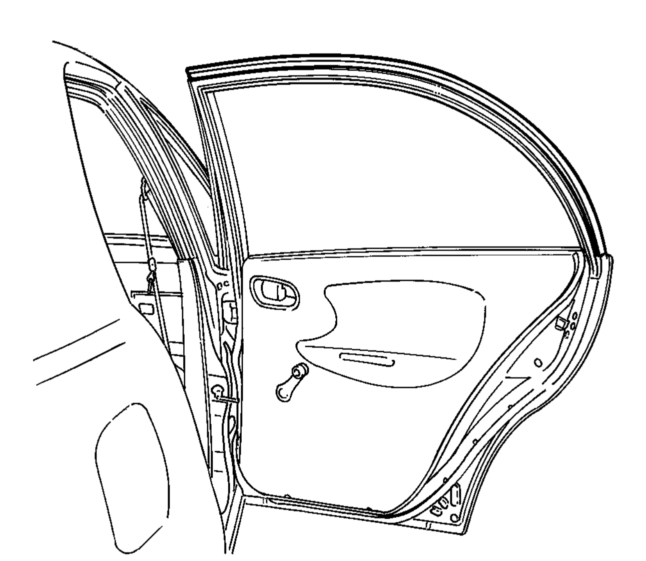
1. Remove the outside rearview mirror. Refer to Section 9L, Glass and Mirrors.
2. Remove the front door secondary weatherstrip.



A109P016

Installation Procedure

1. Install the front door secondary weatherstrip.
2. Install the outside rearview mirror. Refer to Section 9L, Glass and Mirrors.

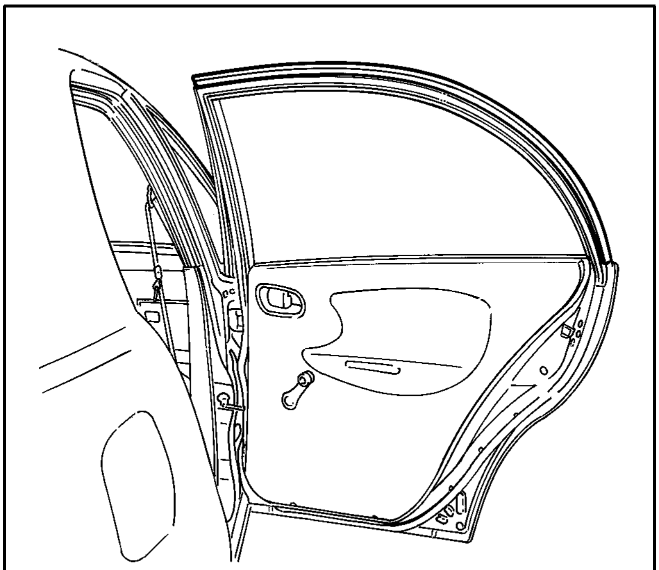


A109P017

REAR DOOR SECONDARY WEATHERSTRIP

Removal Procedure

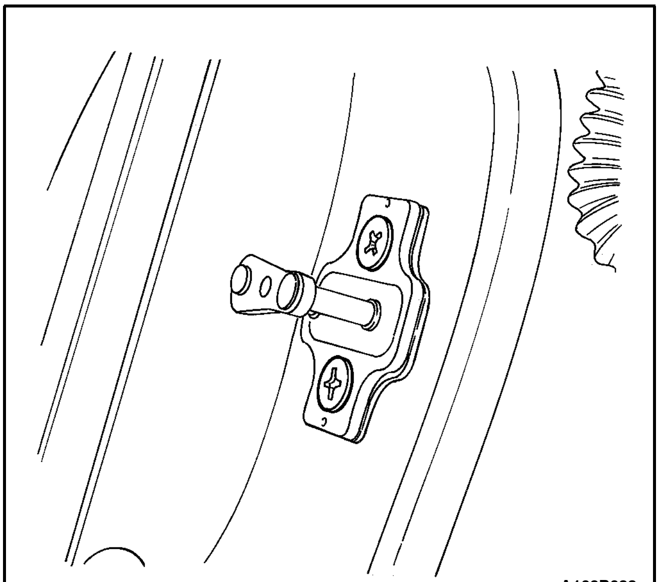
1. Remove the rear door interior and exterior garnish trim.
2. Remove the rear door secondary weatherstrip.



A109P017

Installation Procedure

1. Install the rear door secondary weatherstrip.
2. Install the rear door interior and exterior garnish trim.

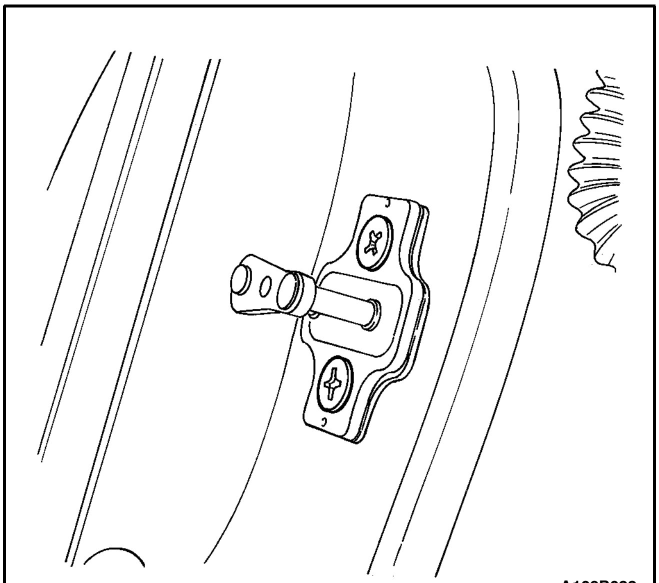


A109P022

DOOR LOCK STRIKER

Removal Procedure

1. Remove the screws and the door lock striker.



A109P022

Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the screws and the door lock striker.

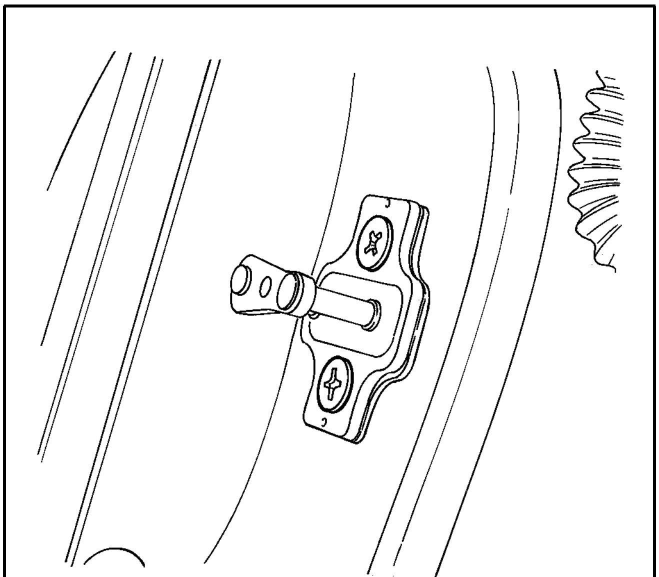
   Tighten

   Tighten the door lock striker screws to 20 N•m (15 lb-ft).

DOOR LOCK STRIKER ADJUSTMENT

Notice: The door lock striker is an important attaching part that can affect the performance of vital components and systems and can cause major repair expenses. If replacement becomes necessary, the door lock striker must be replaced by one with the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or of a substitute design. The specified torque values must be used during reassembly in order to ensure the proper retention of the part.

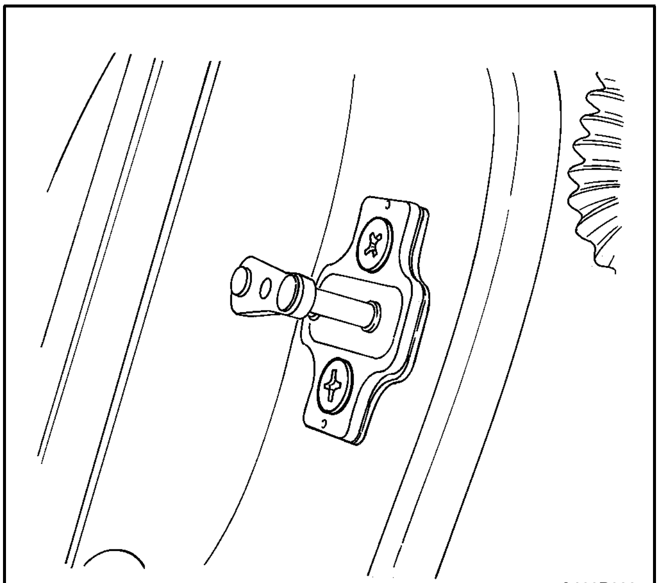
The door lock striker consists of a striker with two screws that are threaded into a tapped, floating cage plate located in the appropriate body pillar. This floating cage plate allows the striker to be easily adjusted in or out and up or down. The door is secured in the closed position when the door lock fork snaps over and engages the striker.



A109P022

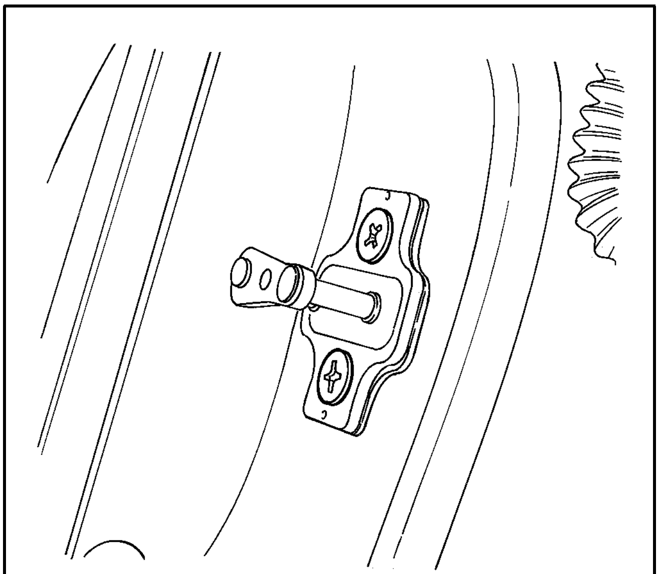
Fore/Aft Adjustment

1. The door must be properly aligned.
2. Close the door until the lock fork contacts the striker.
3. Stand next to the door opening and move the door slowly in and out, just touching the striker each time.
4. The alignment of the lock fork and the striker can be easily seen. The lock fork should be perpendicular to and fall near the middle of the striker. The lock fork should fall near the middle of the striker between the B-pillar and the end of the striker.



A109P022

5. If a fore or aft adjustment is required, use the following steps:
   5.1. Remove the striker screws.
   5.2. Remove the spacer in order to move the striker toward the rear of the vehicle.
   5.3. Add a 2 mm (0.08 inch) spacer in order to move the striker toward the front of the vehicle.
   5.4. Install the striker screws.
6. Perform the up/down or the in/out adjustment. Refer to “Up/Down or In/Out Adjustment” in this section.



A109P022

Up/Down or In/Out Adjustment

An adjustment of the striker in the up and down or in and out directions may be necessary for a number of reasons: vehicle frame damage as the result of a collision, installation of new door weatherstripping, customer complaints of excessive windnoise, or difficulty in opening or closing the door. In order to adjust the door striker in an up and down or in and out direction, perform the following procedure:

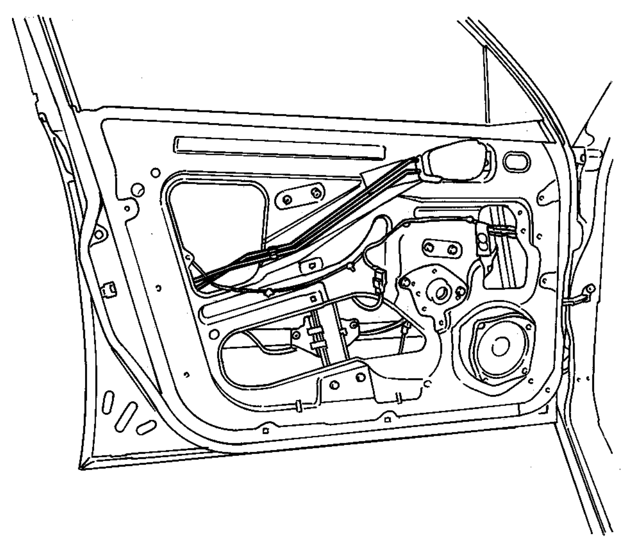
1. The door must be properly aligned.
2. Loosen the striker screws.
3. The floating cage plate can be moved slightly using the ends of the striker screws. Move the floating cage plate to the desired position.

Notice: It is important to use a flat-end rotary file in order not to damage the tapped floating cage plate. The striker screws and the tapped floating cage plate are important attaching parts that could affect the performance of vital components and systems.

4. If proper adjustment requires that the floating cage plate be moved more than is possible, use an electric hand drill and a 3/8- inch rotary file with a flat head in order to enlarge the body opening in the direction required.
5. Tighten the striker screws to the correct position.

Tighten

Tighten the door lock striker screws to 20 N•m (15 lb-ft).

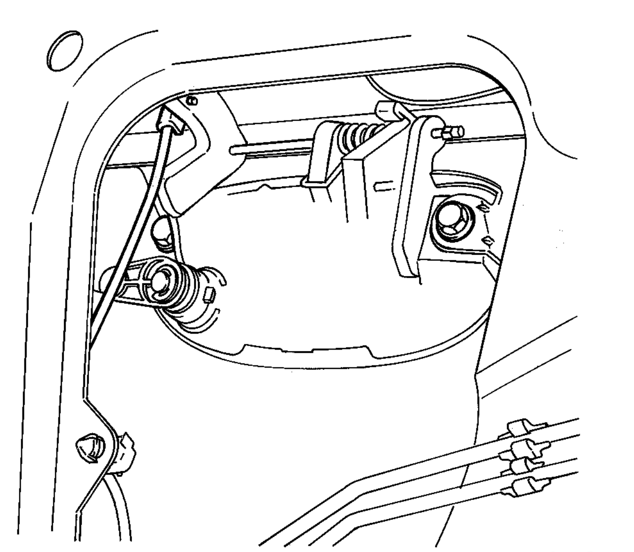


A109P003

FRONT DOOR LOCK

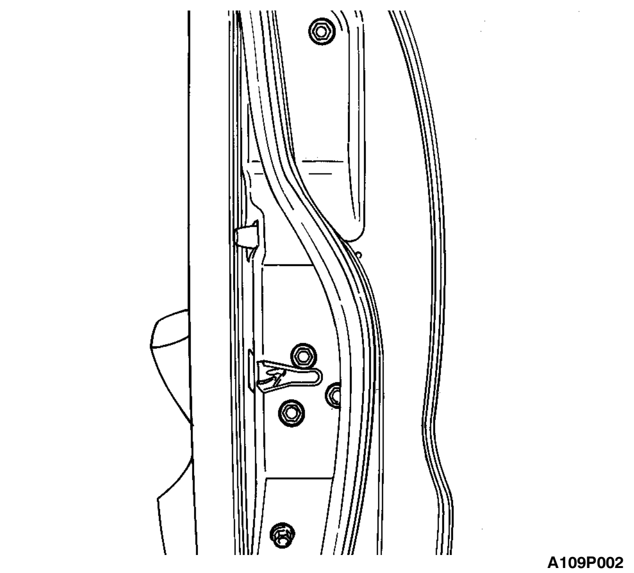
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the seal trim. Refer to "Door Seal Trim" in this section.
3. Disconnect the inside door handle and the lock rods.



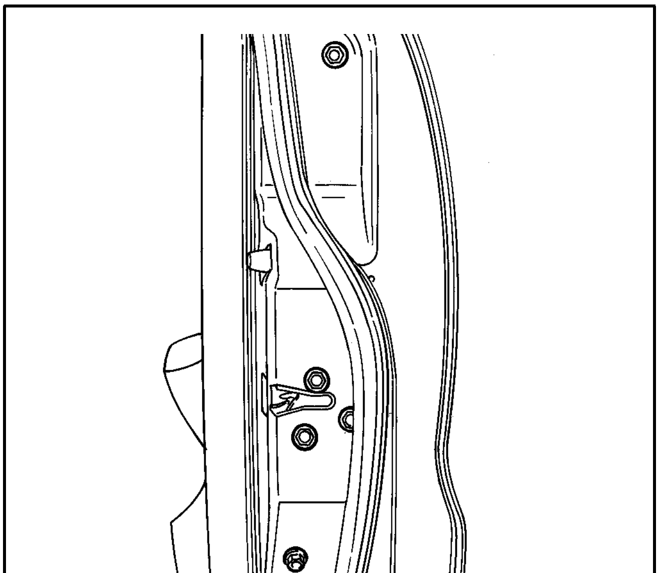
A109P004

4. Disconnect the outside door handle and the lock rods.



A109P002

5. Remove the bolts and the guide rail.
6. Remove the screws and the front door lock.
7. Disconnect the electrical connector.



A109P002

Installation Procedure

1. Connect the electrical connector.
2. Connect the inside door handle and the lock rods.
3. Connect the outside door handle and the lock rods.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

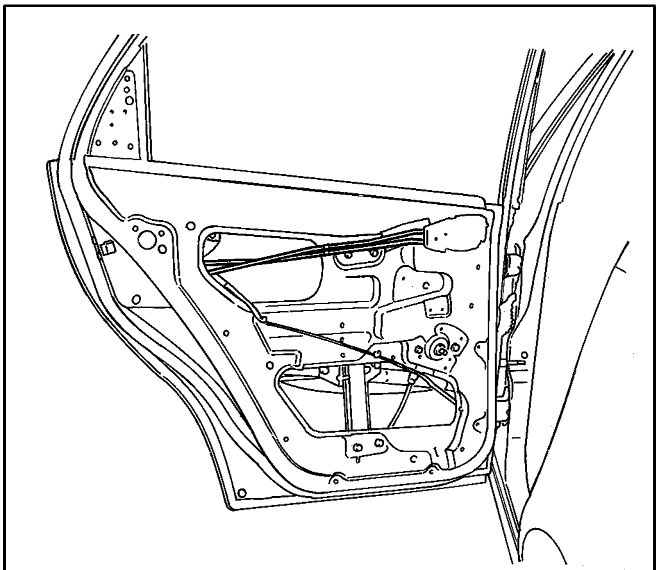
4. Install the front door lock with the screws.

   Tighten

   Tighten the front door lock screws to 8 N•m (71 lb-in).
5. Install the guide rail with the bolts.

   Tighten

   Tighten the guide rail bolts to 7 N•m (62 lb-in).
6. Install the seal trim. Refer to "Door Seal Trim" in this section.
7. Connect the negative battery cable.

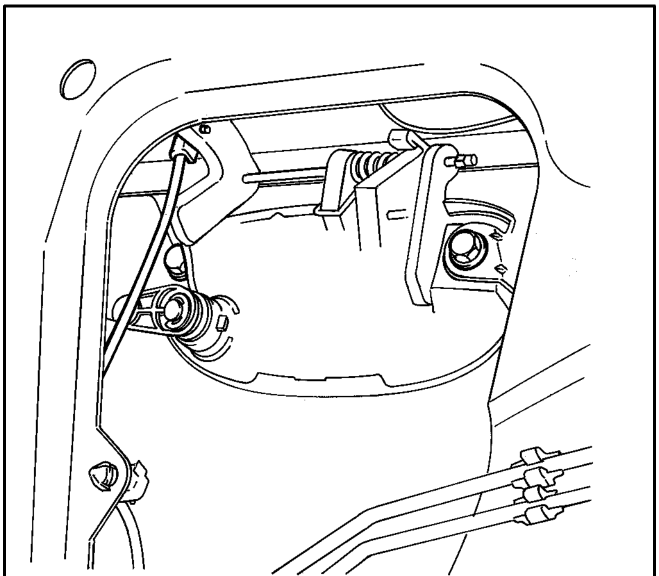


A109P012

CHILDPROOF REAR DOOR LOCK

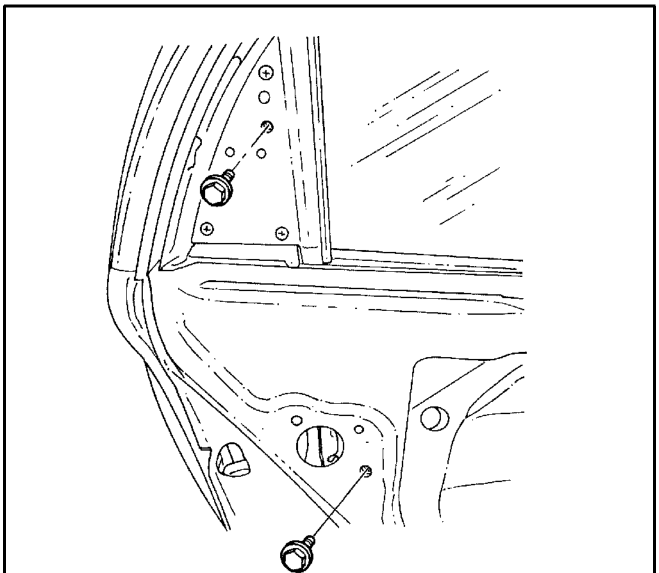
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the door seal trim. Refer to "Door Seal Trim" in this section.
3. Disconnect the inside door handle and the lock rods.

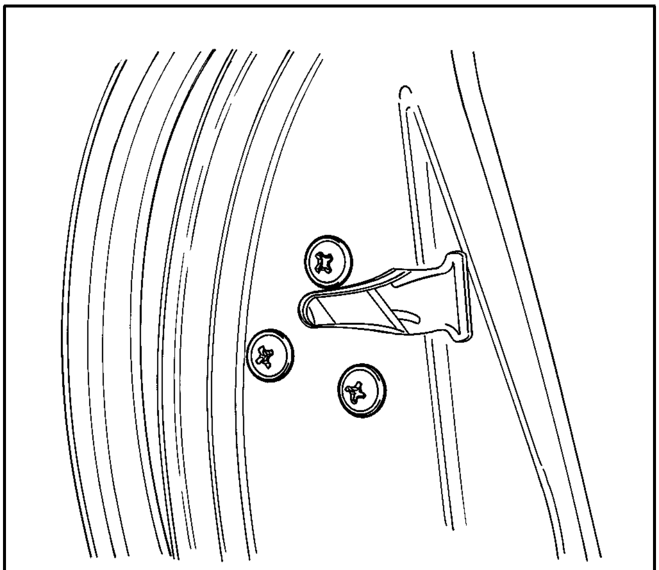


A109P004

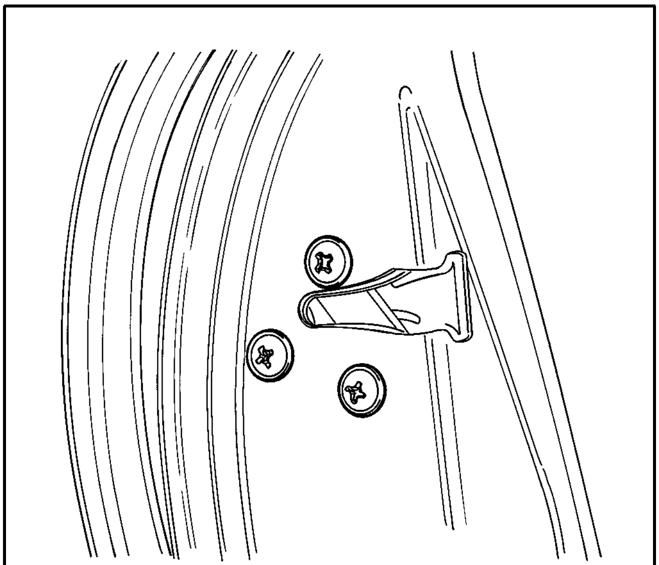
4. Disconnect the outside door handle and the lock rods.


A309P001

5. Remove the bolts and the guide rail.


A109P013

6. Remove the screws and the lock.
7. Disconnect the electrical connector.
8. Disconnect the lock rods at the lock.


A109P013

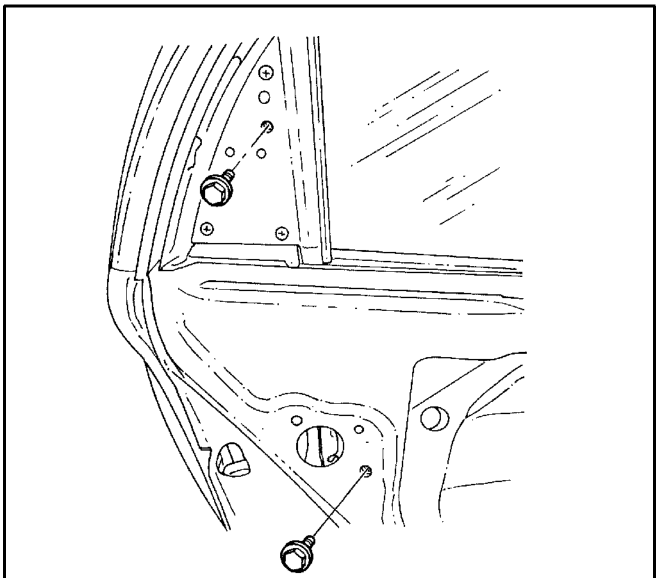
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the rear door lock with the screws.

Tighten

Tighten the rear door lock screws to 8 N•m (71 lb-in).

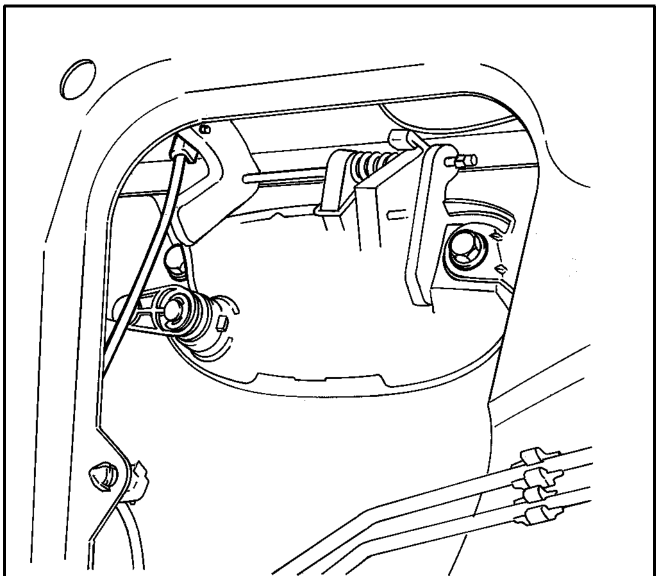


A309P001

2. Connect the electrical connector.
3. Install the guide rail with the bolts.

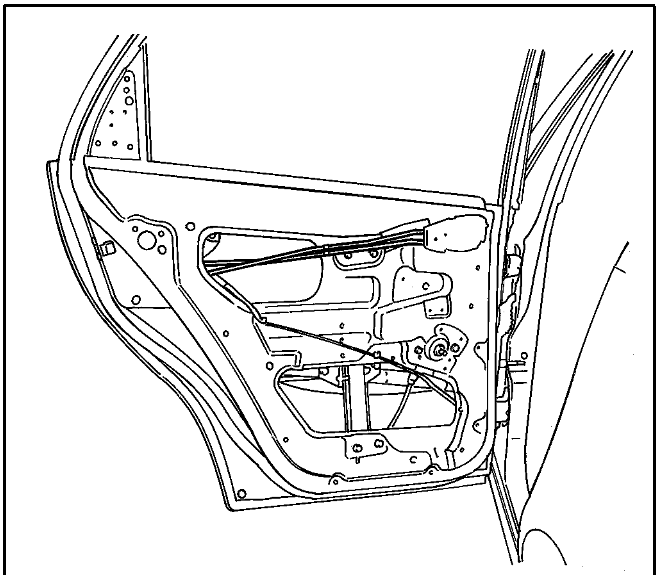
Tighten

Tighten the guide rail bolts to 7 N•m (62 lb-in).



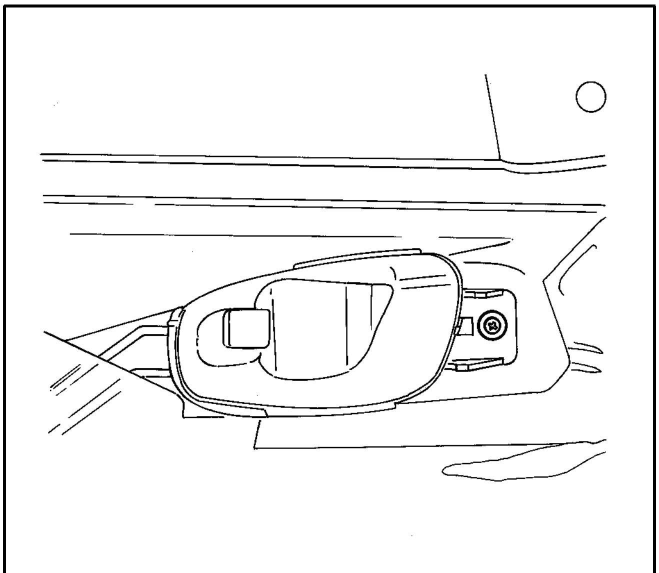
A109P004

4. Connect the outside door handle and the lock rods.



A109P012

5. Connect the inside door handle and the lock rods.
6. Install the door seal trim. Refer to "Door Seal Trim" in this section.
7. Connect the negative battery cable.

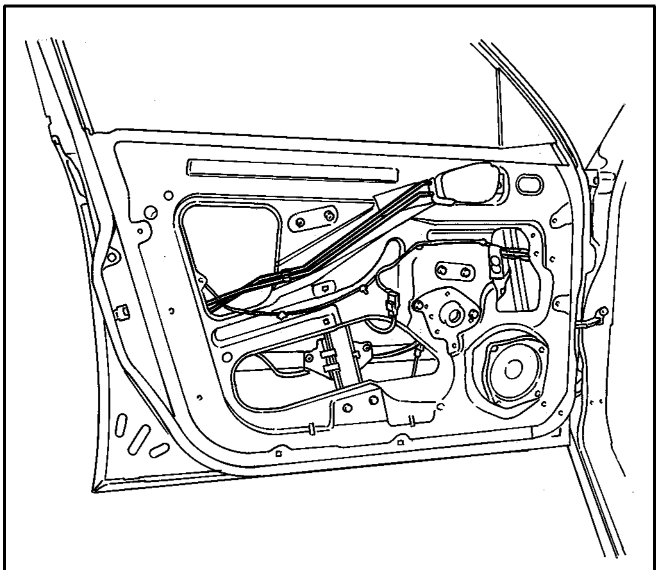


A109P024

INSIDE DOOR HANDLE

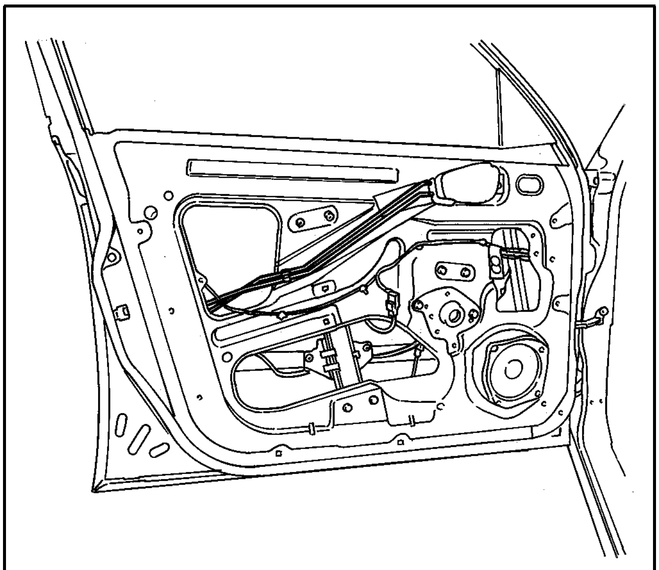
Removal Procedure

1. Remove the door seal trim. Refer to "Door Seal Trim" in this section.
2. Remove the screw securing the door handle to the door.
3. Slide the door handle forward and remove it from the door.



A109P003

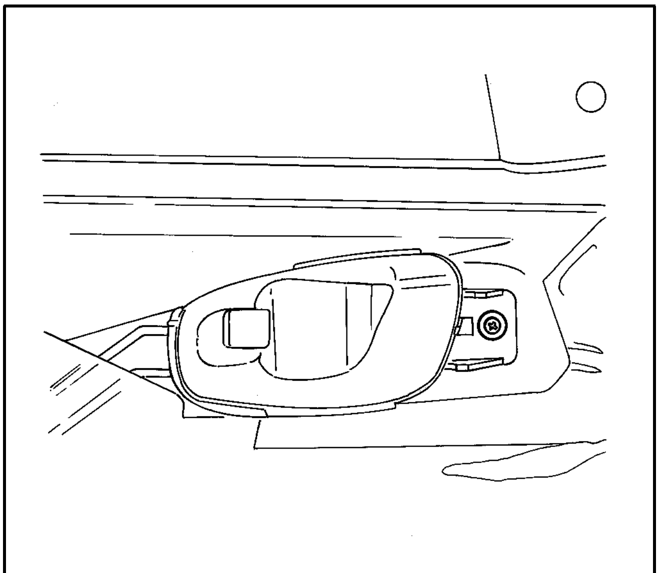
4. Disconnect the inside door handle and the lock rods.



A109P003

Installation Procedure

1. Connect the inside door handle and the lock rods.



A109P024

2. Insert the inside door handle into the slots in the door.
3. Slide the door handle rearward.

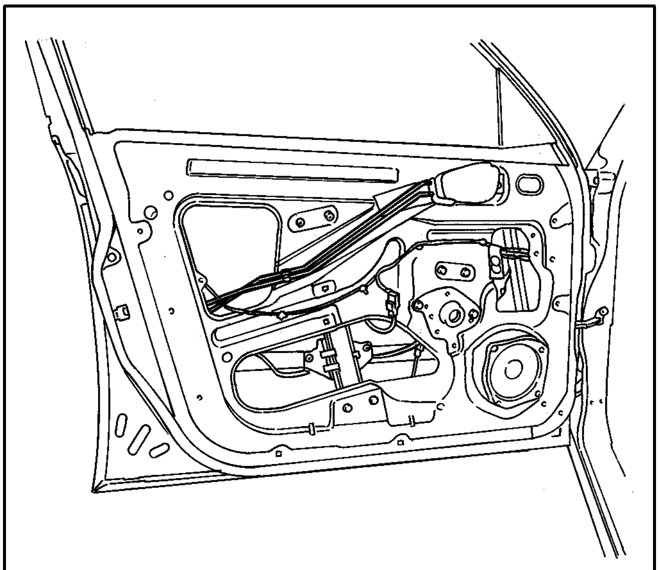
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Install the inside door handle screw.

Tighten

Tighten the inside door handle screw to 3 N•m (27 lb-in).

5. Install the door seal trim. Refer to "Door Seal Trim" in this section.

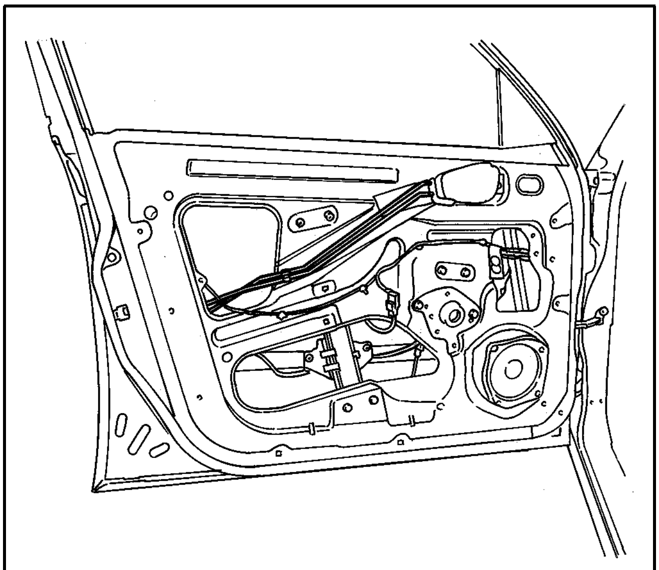


A109P003

INSIDE LOCK ROD

Removal Procedure

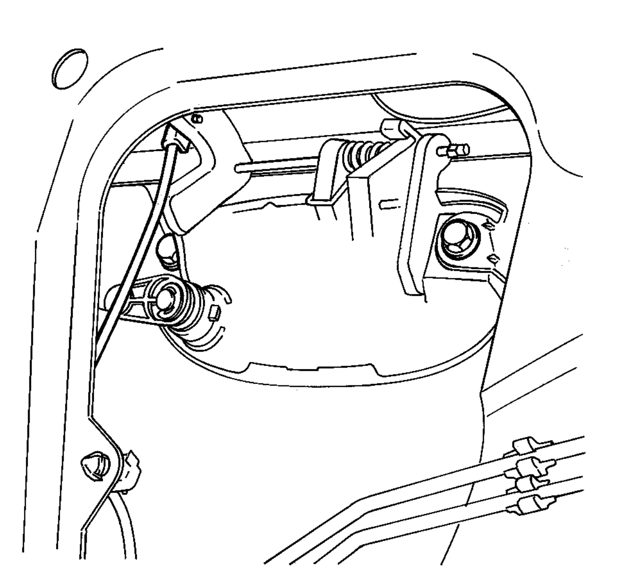
1. Remove the inside door handle. Refer to "Inside Door Handle" in this section.
2. Disconnect the inside lock rods from the door handle and the lock.



A109P003

Installation Procedure

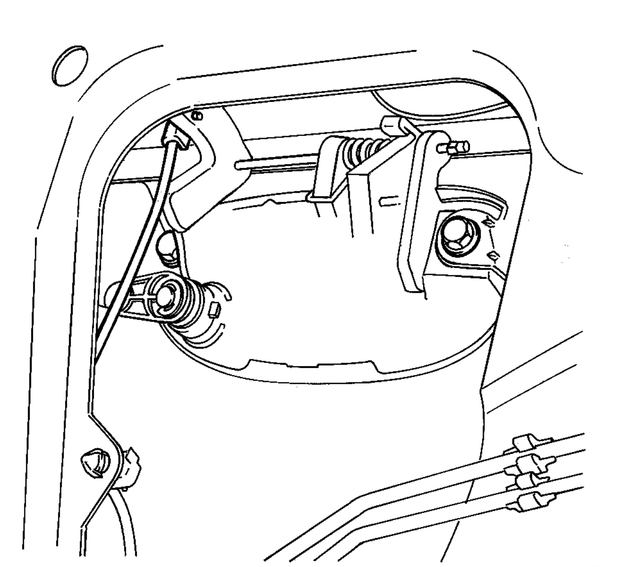
1. Connect the inside lock rods to the door handle and the lock.
2. Install the inside door handle. Refer to "Inside Door Handle" in this section.


A109P004

OUTSIDE DOOR HANDLE

Removal Procedure

1. Remove the door seal trim. Refer to "Door Seal Trim" in this section.
2. Disconnect the outside door handle and the lock rods.
3. Remove the bolts and the door handle.


A109P004

Installation Procedure

1. Connect the outside door handle and the lock rods.

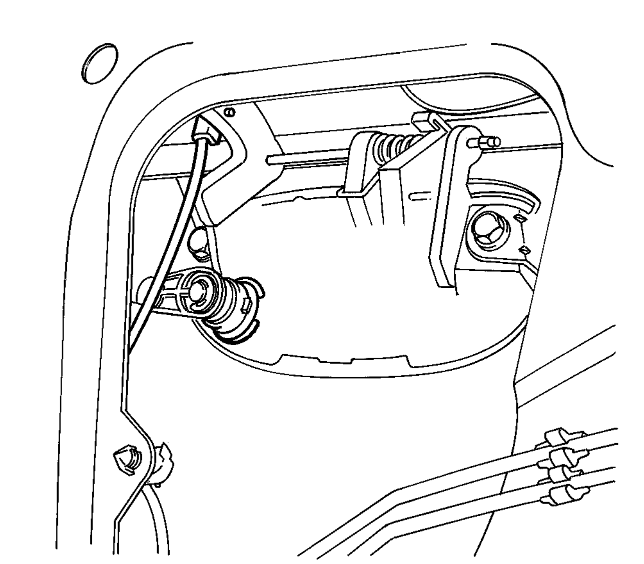
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the door handle with the bolts.

Tighten

Tighten the outside door handle bolts to 4.5 N•m (40 lb-in).

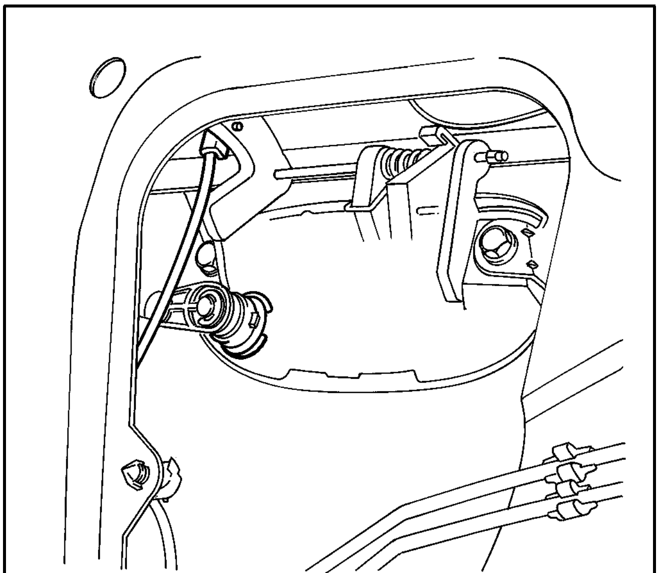
3. Install the door seal trim. Refer to "Door Seal Trim" in this section.


A109P027

DOOR LOCK CYLINDER

Removal Procedure

1. Remove the door seal trim. Refer to "Door Seal Trim" in this section.
2. Disconnect the outside door handle and the lock rods.
3. Remove the retaining clip and the lock cylinder.

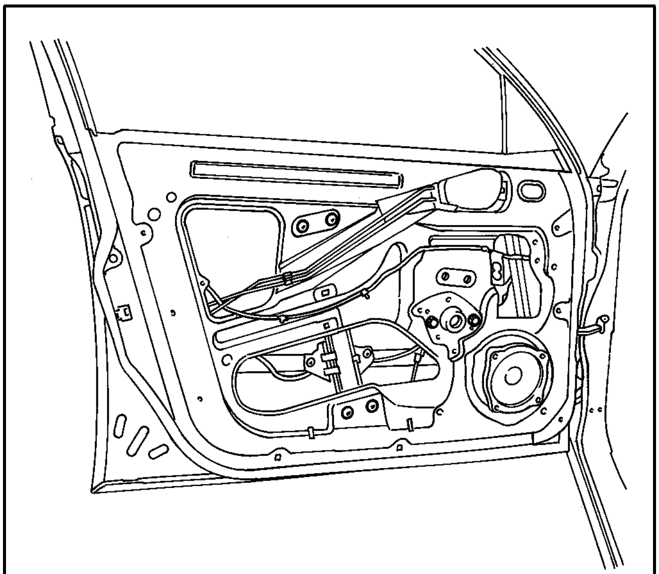

A109P027

Installation Procedure

1. Install the lock cylinder with the retaining clip.
2. Connect the outside door handle and the lock rods.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

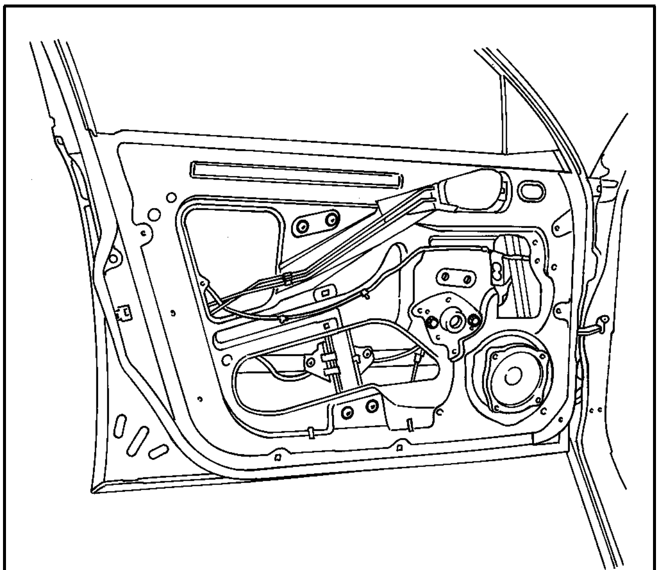
3. Install the door seal trim. Refer to "Door Seal Trim" in this section.


A109P031

MANUAL FRONT WINDOW REGULATOR

Removal Procedure

1. Remove the front door glass. Refer to Section 9L, Glass and Mirrors.
2. Remove the nuts and the window regulator.


A109P031

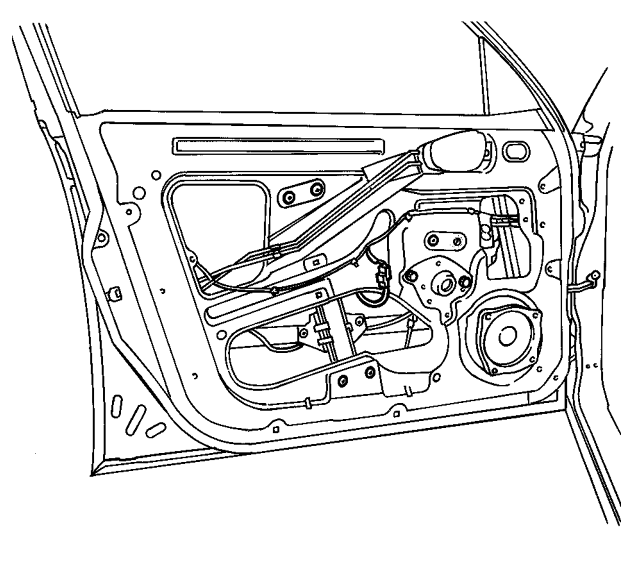
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the window regulator and the nuts.

   ### Tighten

   Tighten the window regulator nuts to 7 N•m (62 lb-in).
2. Install the front door glass. Refer to Section 9L, Glass and Mirrors.

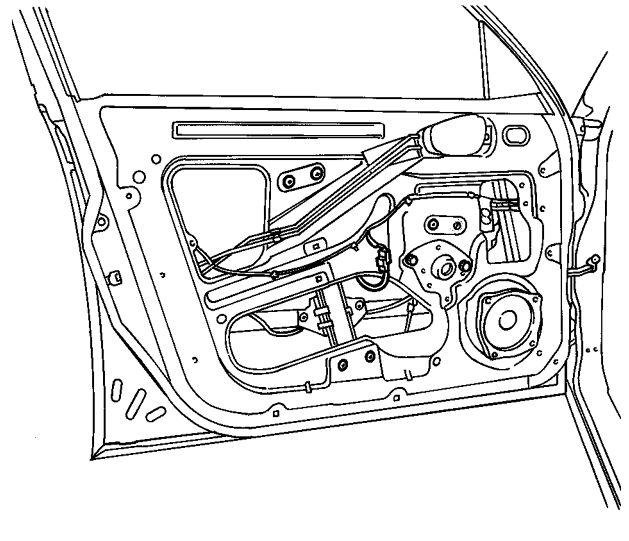


A109P005

POWER WINDOW REGULATOR

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the door glass. Refer to Section 9L, Glass and Mirrors.
3. Remove the nuts and the regulator.
4. Disconnect the electrical connector. (Front door power window regulator shown, rear door power window regulator similar.)



A109P005

Installation Procedure

1. Connect the electrical connector.

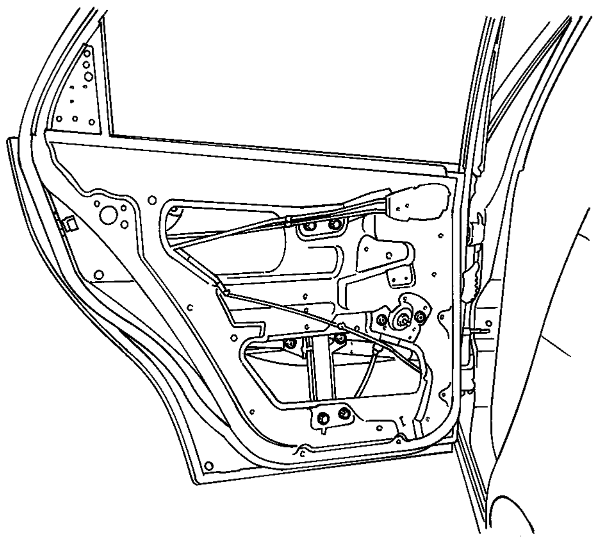
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the window regulator with the nuts.

Tighten

Tighten the window regulator nuts to 7 N•m (62 lb-in).

3. Install the front door glass. Refer to Section 9L, Glass and Mirrors.
4. Connect the negative battery cable. (Front door power window regulator shown, rear door power window regulator similar.)

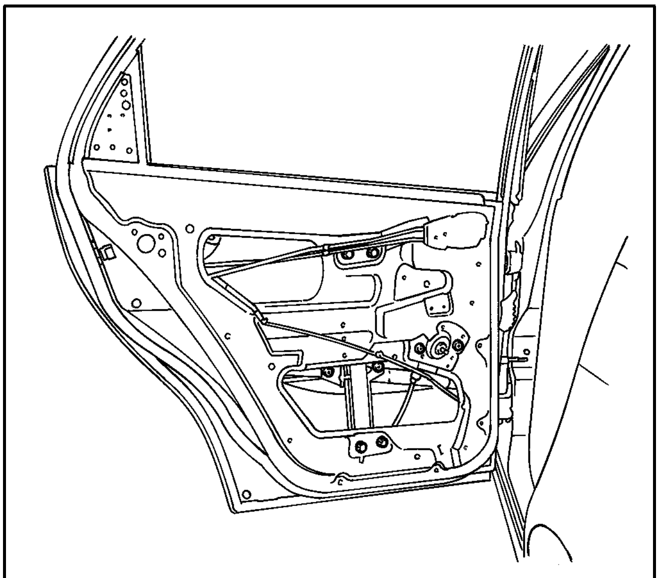


A109P028

MANUAL REAR WINDOW REGULATOR

Removal Procedure

1. Remove the rear door glass. Refer to Section 9L, Glass and Mirrors.
2. Remove the nuts and the window regulator.


A109P028

Installation Procedure

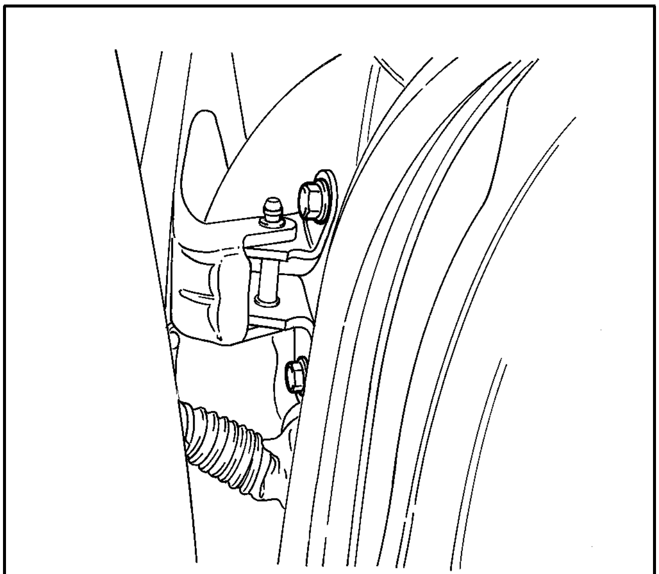
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the window regulator with the nuts.

   #### Tighten

   Tighten the window regulator nuts to 7 N•m (62 lb-in).

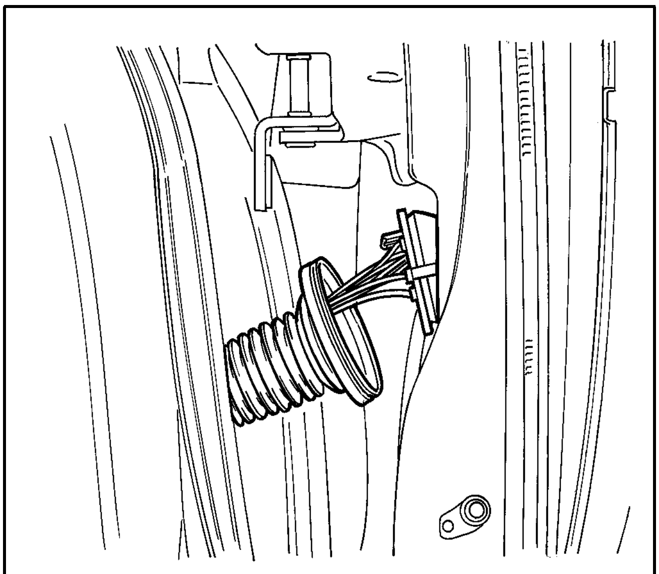
2. Install the rear door glass. Refer to Section 9L, Glass and Mirrors.


A109P023

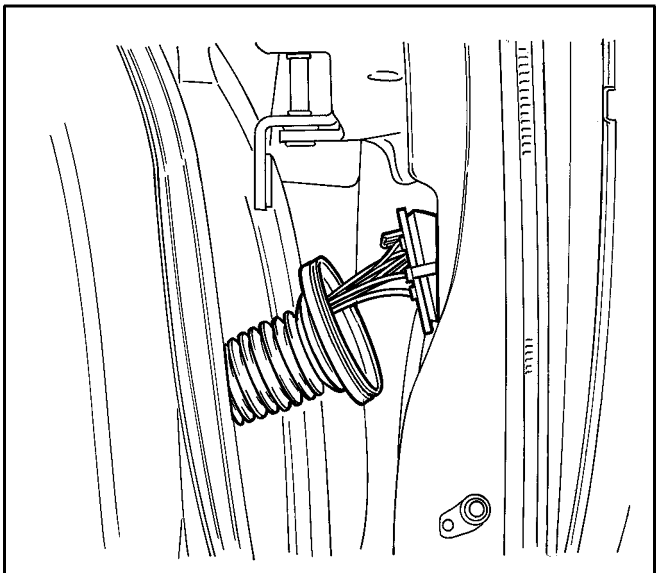
FRONT DOOR ASSEMBLY

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the door hold open link. Refer to "Door Hold Open Link" in this section.
3. Remove the body-to-door rubber grommet and the electrical wires.
4. With the aid of another technician, remove the bolts and the front door.


A109P032

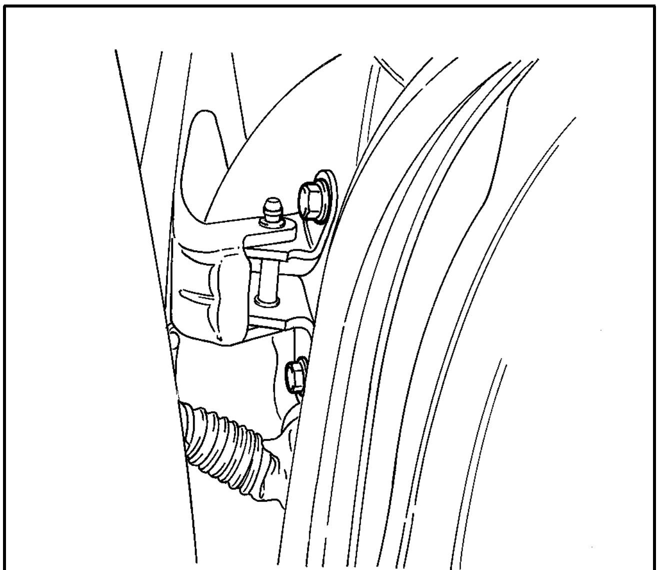
5. Disconnect the body-to-door rubber grommet and the electrical connector.



A109P032

Installation Procedure

1. Connect the electrical connector and the body-to-door rubber grommet.



A109P023

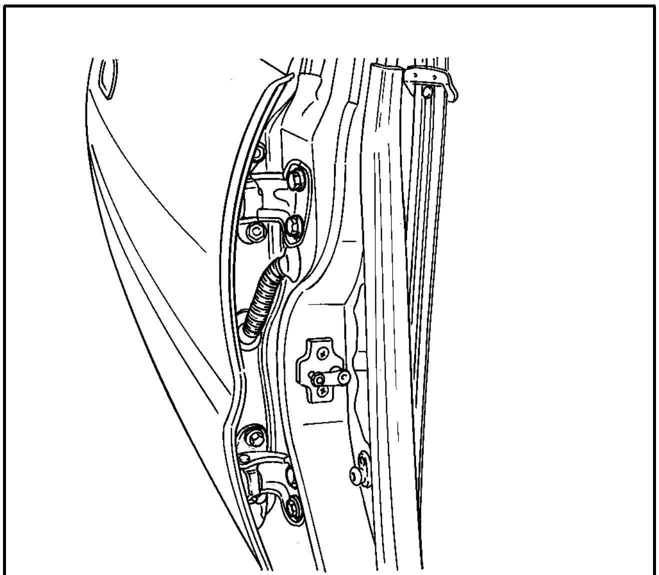
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. With the aid of another technician, lightly secure the front door with the bolts.
3. Adjust the door for proper fit.

   Tighten

   Tighten the hinge-to-body bolts to 39 N•m (29 lb-ft).

   Tighten the hinge-to-door bolts to 15 N•m (11 lb-ft).
4. Install the door hold open link. Refer to "Door Hold Open Link" in this section.
5. Connect the negative battery cable.
6. Perform the waterleak test. Refer to Section 9I, Waterleaks.
7. Check for windnoise. Refer to Section 9J, Windnoise.

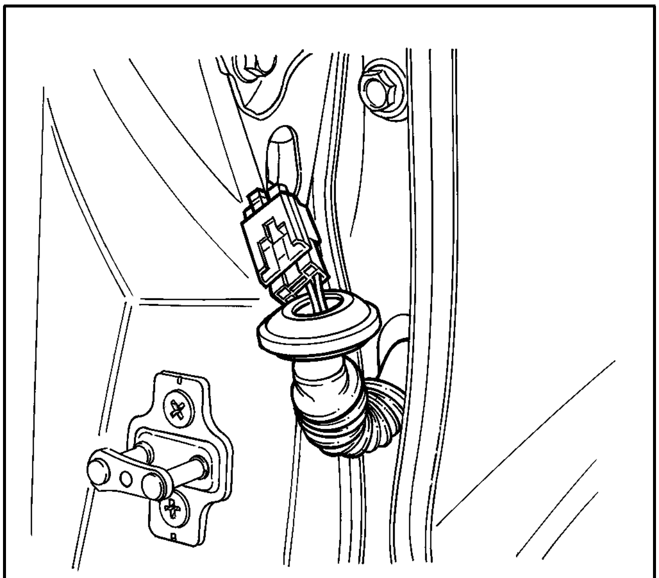


A109P011

REAR DOOR ASSEMBLY

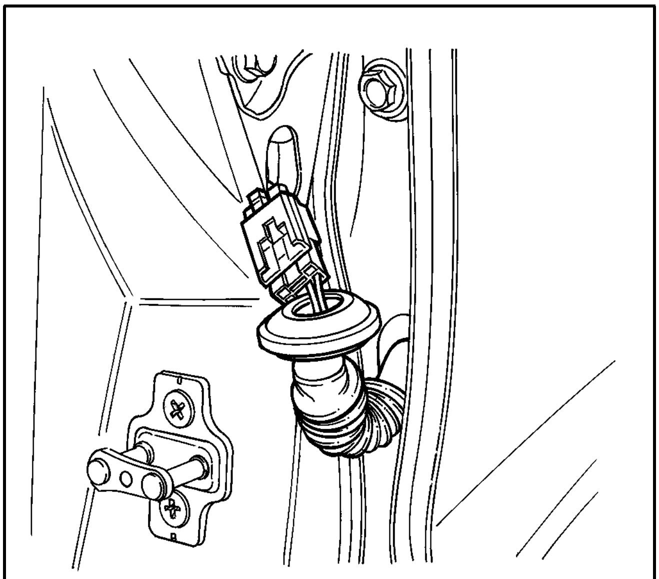
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the door hold open link. Refer to "Door Hold Open Link" in this section.
3. With the aid of another technician, remove the bolts and the rear door.



A109P006

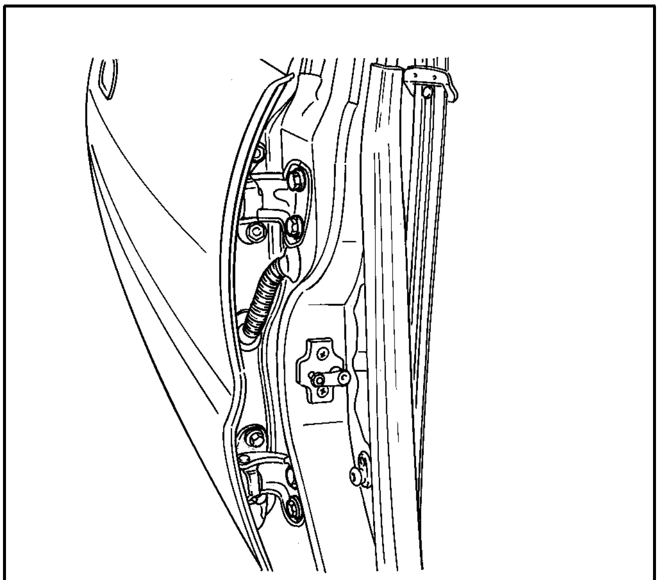
4. Disconnect the body-to-door rubber grommet and the electrical connector.



A109P006

Installation Procedure

1. Connect the body-to-door rubber grommet and the electrical connector.



A109P011

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

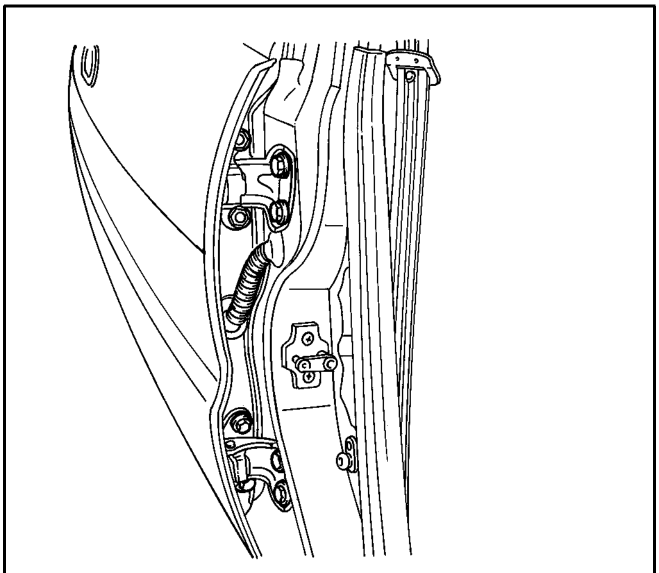
2. With the aid of another technician, lightly secure the rear door with the bolts.
3. Adjust the door for proper fit.

Tighten

Tighten the hinge-to-body bolts to 39 N•m (29 lb-ft).

Tighten the hinge-to-door bolts to 15 N•m (11 lb-ft).

4. Install the rear door hold open link. Refer to "Door Hold Open Link" in this section.
5. Connect the negative battery cable.
6. Perform the waterleak test. Refer to Section 9I, Waterleaks.
7. Check for windnoise. Refer to Section 9J, Windnoise.

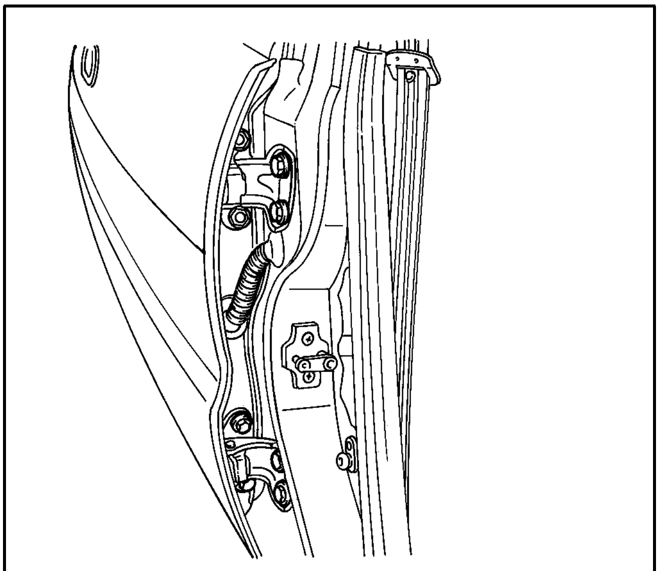


A109P007

DOOR HINGE

Removal Procedure

1. With the aid of another technician, remove the bolts and the hinge from the door and the body.



A109P007

Installation Procedure

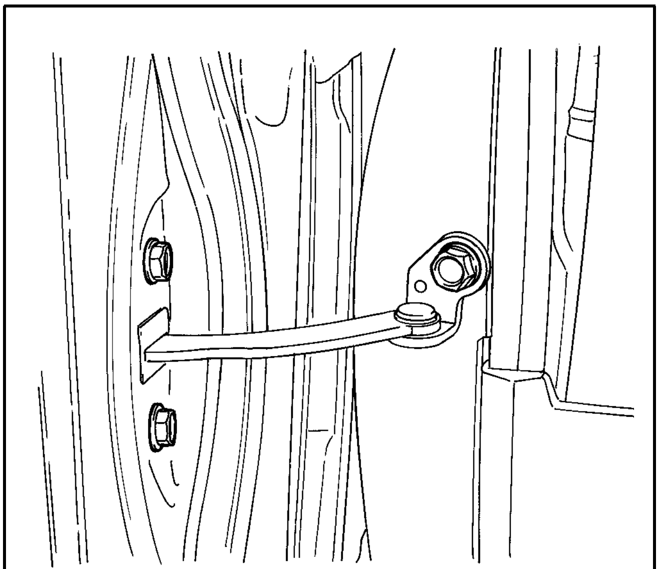
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. With the aid of another technician, install the hinge to the door and the body with the bolts.

   Tighten

   Tighten the hinge-to-body bolts to 39 N•m (29 lb-ft).

   Tighten the hinge-to-door bolts to 15 N•m (11 lb-ft).

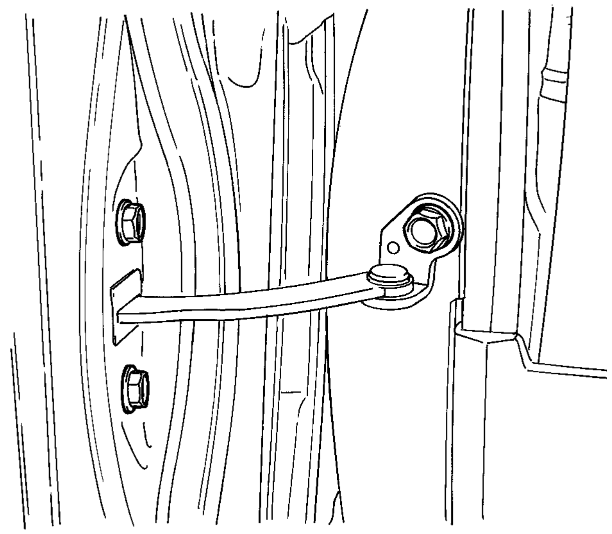


A109P010

DOOR HOLD OPEN LINK

Removal Procedure

1. Remove the door trim panel. Refer to Section 9G, Interior Trim.
2. Reposition the door seal trim.
3. Remove the bolts on the door and on the body.
4. Remove the door hold open link.



A109P010

Installation Procedure

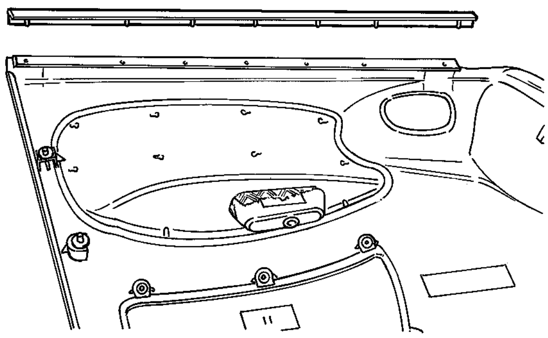
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the door hold open link to the door and the body with the bolts.

   Tighten

   Tighten the door hold open link-to-body bolts to 25 N•m (18 lb-ft).

   Tighten the door hold open link-to-door bolts to 5 N•m (44 lb-in).
2. Reposition the door seal trim.
3. Install the door trim panel. Refer to Section 9G, Interior Trim.

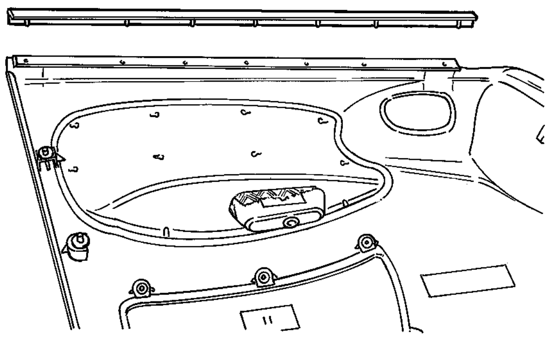


A109P018

INSIDE CHANNEL MOLDING

Removal Procedure

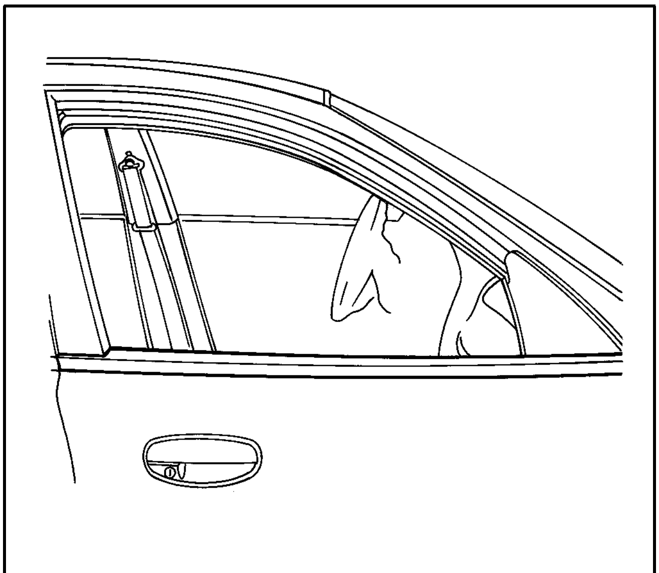
1. Remove the door trim panel. Refer to Section 9G, Interior Trim.
2. Straighten the retaining tabs in order to release the channel molding from the door trim panel.
3. Remove the channel molding.



A109P018

Installation Procedure

1. Install the channel molding onto the door trim panel.
2. Bend the retaining tabs to secure the channel molding to the door trim panel.
3. Install the door trim panel. Refer to Section 9G, Interior Trim.

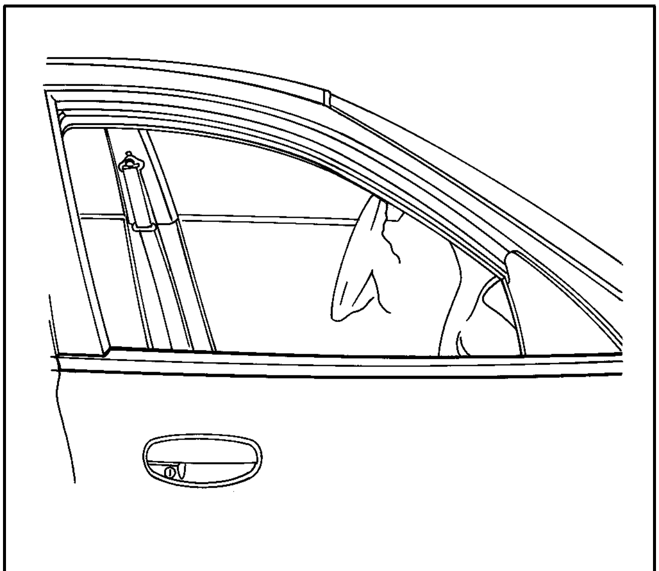


A109P019

OUTSIDE CHANNEL MOLDING

Removal Procedure

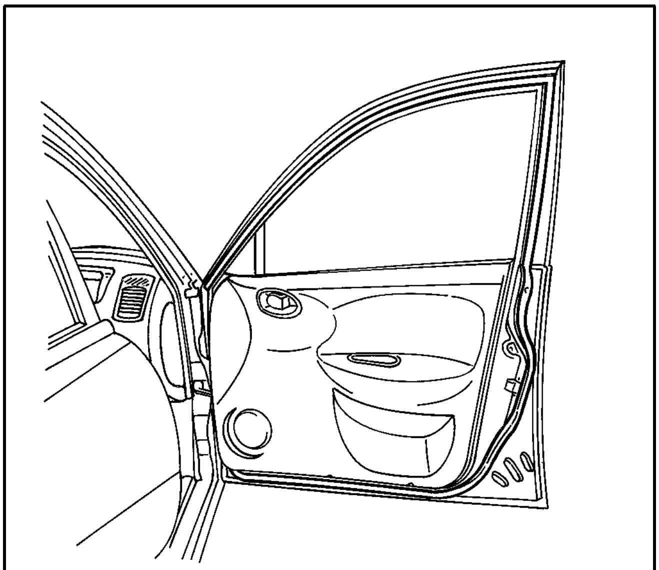
1. Lower the window completely.
2. Lift the outside channel molding off the door.



A109P019

Installation Procedure

1. Press the outside channel molding onto the door.
2. Raise the window.

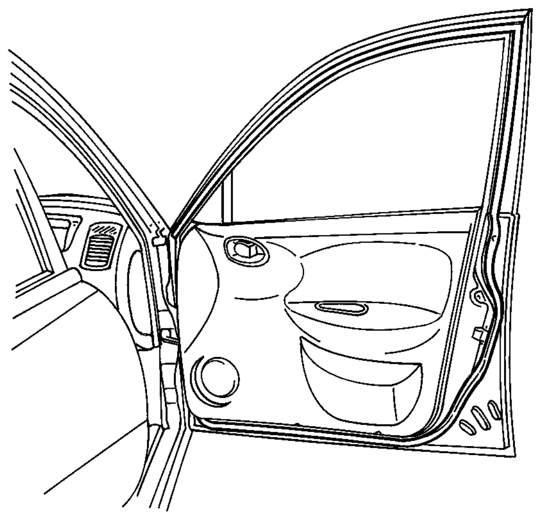


A109P020

DOOR WEATHERSTRIP

Removal Procedure

1. Remove the door hold open link-to-body bolt.
2. Remove the door weatherstrip.



A109P020

Installation Procedure

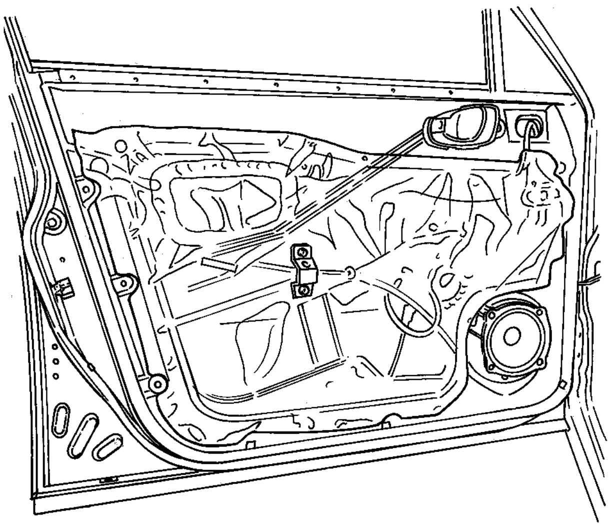
1. Install the door weatherstrip.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the door hold open link to the body with the bolt.

Tighten

Tighten the door hold open link-to-body bolt to 25 N•m (18 lb-ft).

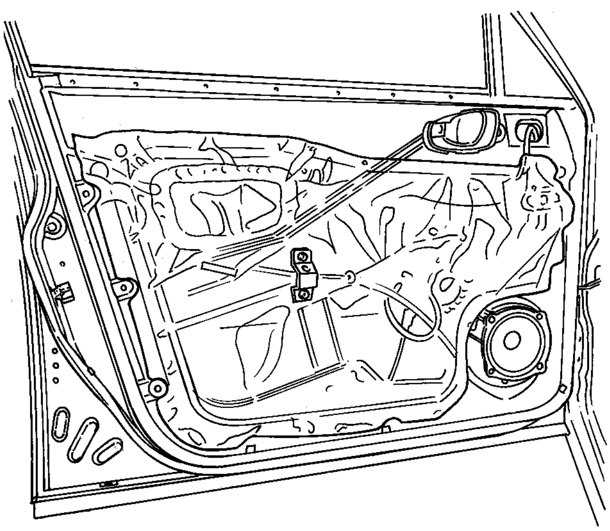


A109P001

DOOR SEAL TRIM

Removal Procedure

1. Remove the door trim panel. Refer to Section 9G, Interior Trim.
2. Remove the screws and the door pull bracket.
3. Remove the door seal trim.



A109P001

Installation Procedure

1. Install the door seal trim.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the door pull bracket with the screws.

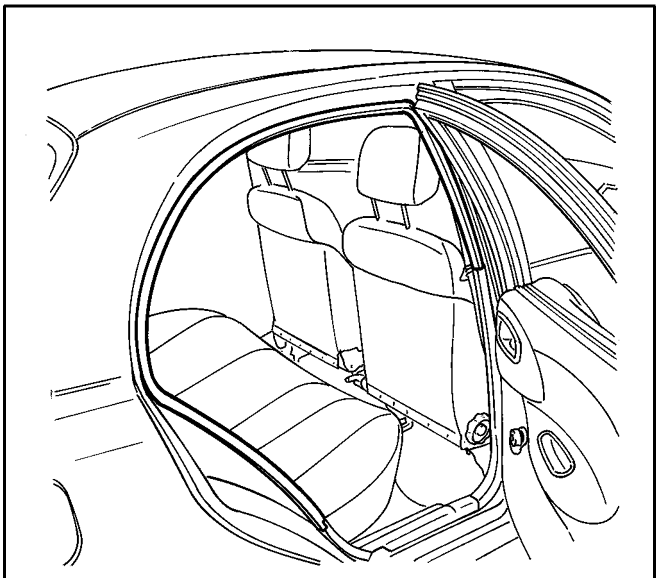
Tighten

Tighten the door pull bracket screws to 3.5 N•m (31 lb-in).

3. Install the door trim panel. Refer to Section 9G, Interior Trim.

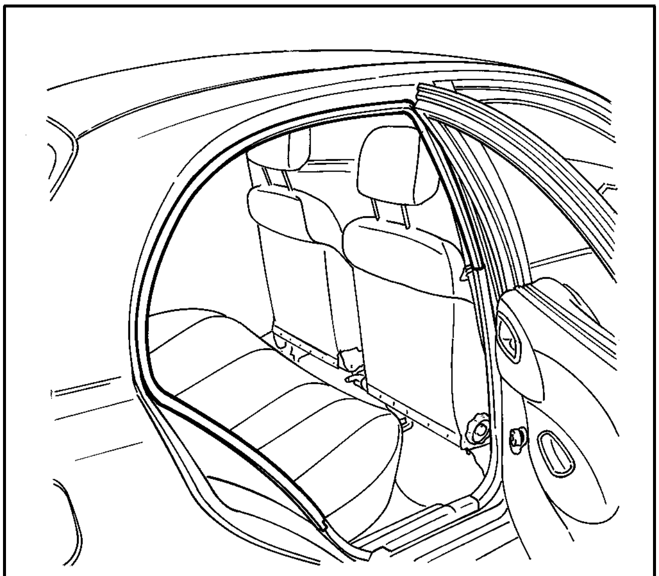
DOOR OPENING WEATHERSTRIP

Removal Procedure


A109P021

1. Remove the door opening weatherstrip.

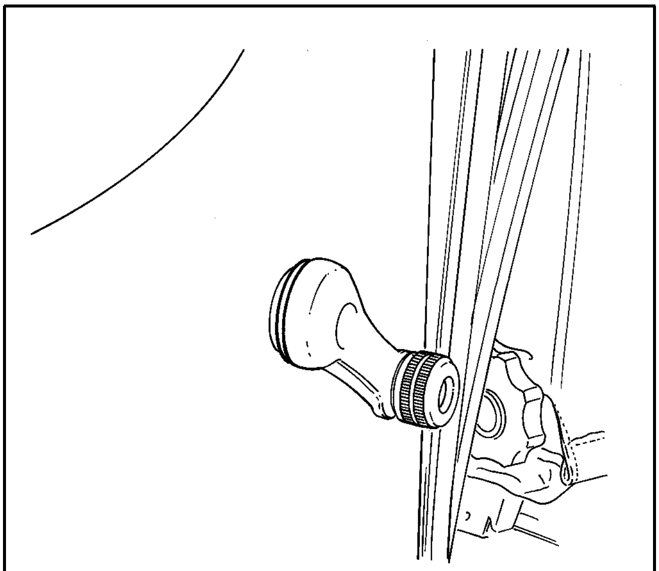
Installation Procedure


A109P021

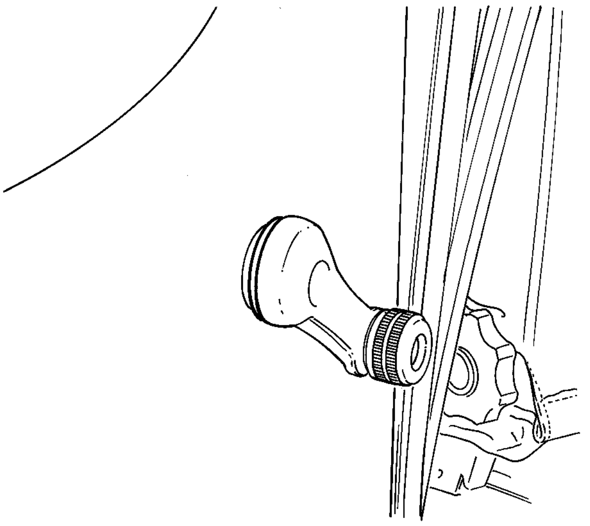
1. Install the door opening weatherstrip.

MANUAL WINDOW REGULATOR HANDLE

Removal Procedure


A109P009

1. Push the plastic ring behind the window regulator handle toward the door to reveal the metal clip.
2. Pry off the metal clip.
3. Remove the window regulator handle and the plastic ring.



A109P009

Installation Procedure

1. Install the plastic ring.
2. Install the window regulator handle.
3. Insert the metal clip.

GENERAL DESCRIPTION AND SYSTEM OPERATION

DOOR LOCK STRIKER

The front and the rear door lock strikers each consist of a striker with two screws threaded into a floating cage plate in the B-pillars and C-pillars. The door is secured in the closed position when the door lock fork snaps over and engages the striker.

CHILDPROOF REAR DOOR LOCK

The childproof rear door locks help prevent passengers, especially children, from opening the rear doors of the vehicle from the inside.

In order to activate these locks, move the levers of both rear doors to the lock position. Then, close both doors. Rear passengers will be unable to open the doors from inside of the vehicle.

In order to deactivate the childproof rear door lock, unlock the door from the inside of the vehicle and open the door from the outside. Move the lever to the unlock position. The rear door will now work normally.

POWER DOOR LOCKS

The power door locks use a solenoid that is contained in each door lock assembly. The door locks are activated by the actuator on the inside door handle or by the lock cylinder on the driver door only. When the driver door is locked or unlocked by the actuator or lock cylinder, all doors are locked or unlocked accordingly.

POWER WINDOWS

The power windows are controlled by electrical switches on the console and are operated by a motor at each window regulator. The windows are lowered by pressing the switch and raised by pulling up on the switch. The window will stop movement when the switch is released or when the window is completely open or closed.

SECTION 9Q

ROOF

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
B-Pillar Seat Belt Bolts	35	26	-
Coat Hook Screw	3.5	-	31
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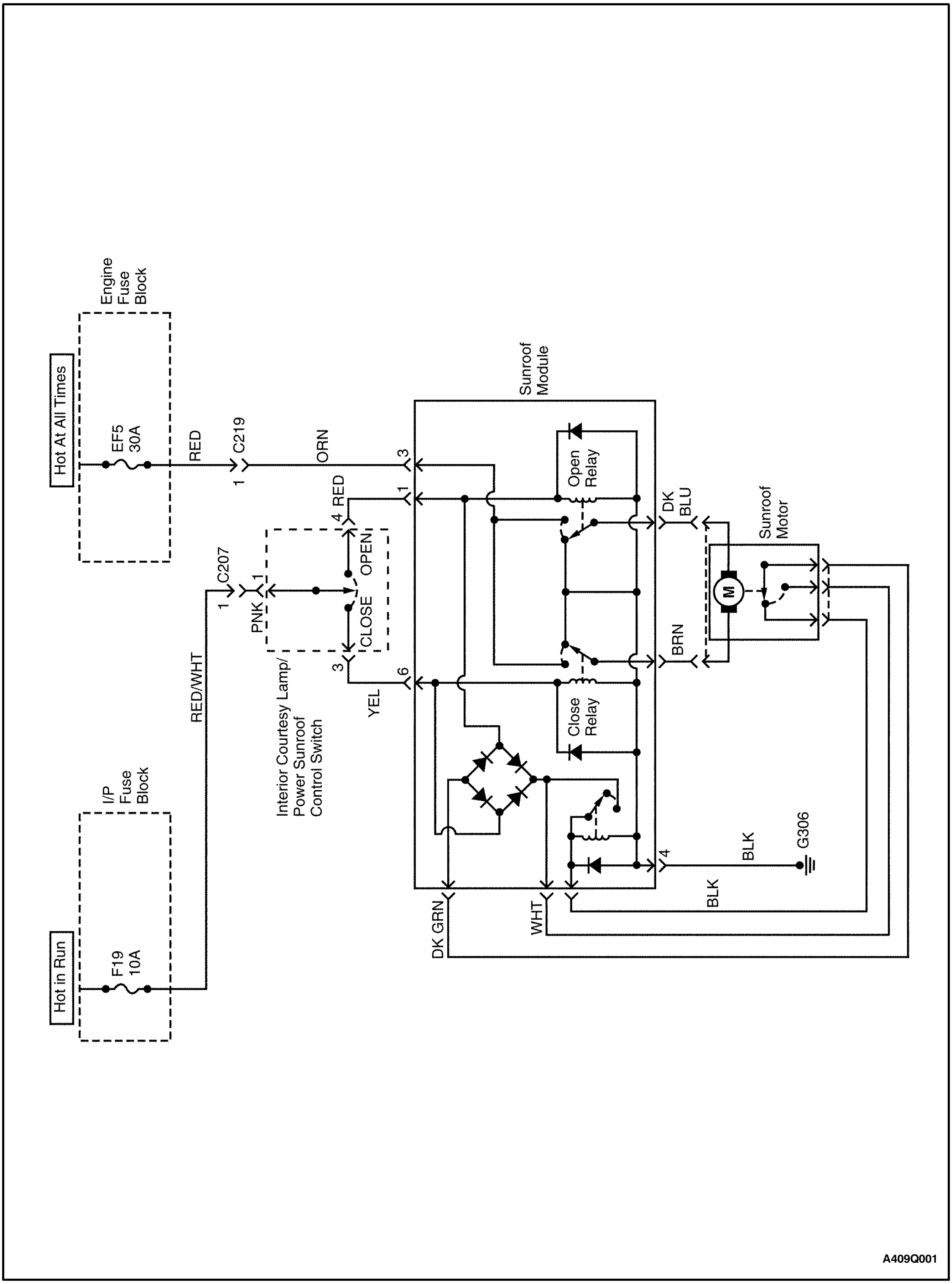
Passenger Assist Handle Screws	3.5	-	31
Sunroof Glass Screws	7	-	62
Sunroof Housing Bolts	7	-	62
Sunroof Motor Screws	5	-	44
Sun Visor Screws	1.5	-	13
Sun Visor Support Screw	1.5	-	13

SCHEMATIC AND ROUTING DIAGRAMS



DIAGNOSIS

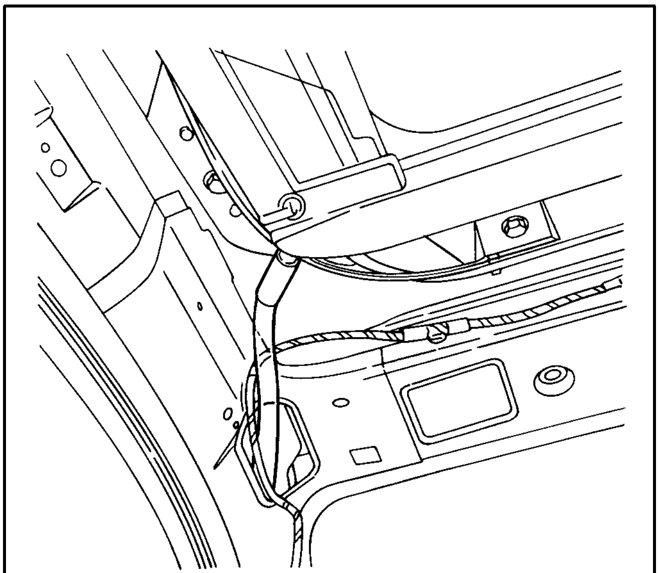
POWER SUNROOF

Power Sunroof Does Not Work

Step	Action	Value(s)	Yes	No
1	Check fuses F19 and EF5. Is either fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuse(s). Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Check the voltages at fuses F19 and EF5. Are both voltages equal to the specified value?	11-14v	Go to Step 5	Go to Step 4
4	Repair the power supply to the fuse which did not indicate battery voltage with the ignition on. Is the repair complete?	-	System OK	-
5	1. Disconnect the interior courtesy lamp/power sunroof control switch connector. 2. Turn the ignition ON. 3. Check the voltage at terminal 1 of the interior courtesy lamp/power sunroof control switch connector. Is the voltage equal to the specified value?	11-14v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuse F19 and the interior courtesy lamp/power sunroof control switch connector. Is the repair complete?	-	System OK	-
7	1. Reconnect the interior courtesy lamp/power sunroof control switch connector. 2. With the sunroof switch in the OPEN position, check the voltage at terminal 3 of the interior courtesy lamp/power sunroof control switch connector. 3. With the sunroof switch in the CLOSE position, check the voltage at terminal 4 of the interior courtesy lamp/power sunroof control switch connector. Do both voltages equal the specified value?	11-14v	Go to Step 9	Go to Step 8
8	Replace the interior courtesy lamp/power sunroof control switch. Is the repair complete?	-	System OK	-
9	1. Disconnect the 6-pin sunroof module connector. 2. With the sunroof switch in the OPEN position, check the voltage at terminal 4 of the sunroof module connector. 3. With the sunroof switch in the CLOSE position, check the voltage at terminal 6 of the sunroof module connector. Are the voltages equal to the specified value?	11-14v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the interior courtesy lamp/power sunroof control switch and the sunroof module connector. Is the repair complete?	-	System OK	-

Power Sunroof Does Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Reconnect the sunroof module. 2. Remove the sunroof motor, but leave the connectors attached. 3. Turn the ignition ON. 4. Use the sunroof switch to attempt to operate the motor in both directions. Does the motor operate?	-	Go to Step 12	Go to Step 13
12	Repair the jammed sunroof mechanism. Is the repair complete?	-	System OK	-
13	1. Disconnect both of the one-wire connectors at the sunroof motor. 2. Connect a voltmeter between the one-wire connectors, on the module side of the connectors. 3. Turn the ignition ON. 4. Turn the sunroof switch to the OPEN position and observe the voltmeter reading. 5. Turn the sunroof switch to the CLOSE position and observe the voltmeter reading. Does the voltmeter indicate the specified voltage when the switch is in either the OPEN or the CLOSE position (one of the switch positions should show reverse polarity)?	11-14v	Go to Step 15	Go to Step 14
14	Replace the sunroof module. Is the repair complete?	-	System OK	-
15	Replace the sunroof motor. Does the sunroof operate with the new motor?	-	System OK	Go to Step 14


B109Q010

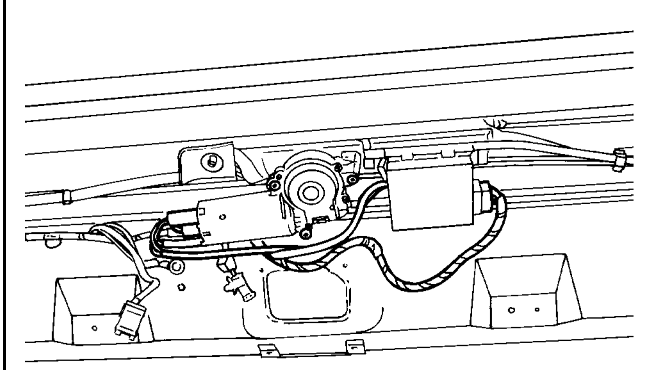
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

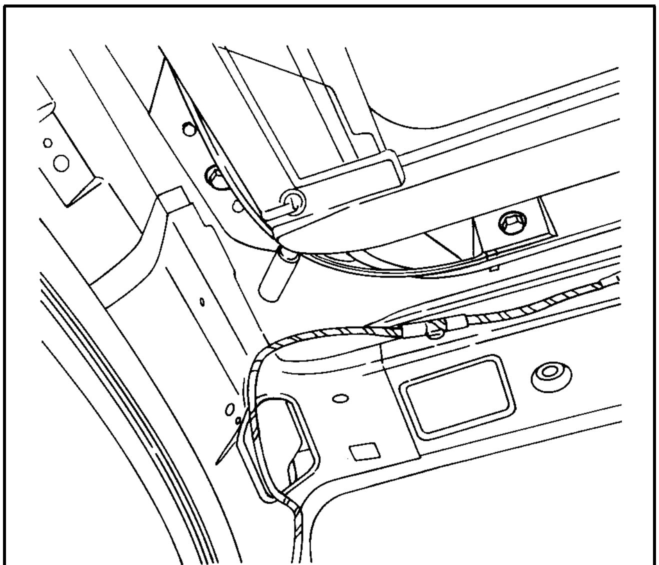
POWER SUNROOF

Removal Procedure

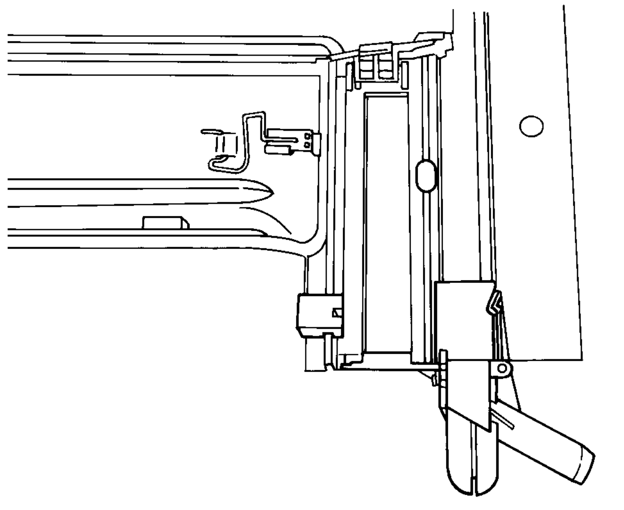
1. Disconnect the negative battery cable.
2. Remove the headliner. Refer to "Formed Headliner" in this section.
3. Remove the drain hoses.


B109Q011

4. Remove the electrical connectors.
5. Remove the screws and the motor.

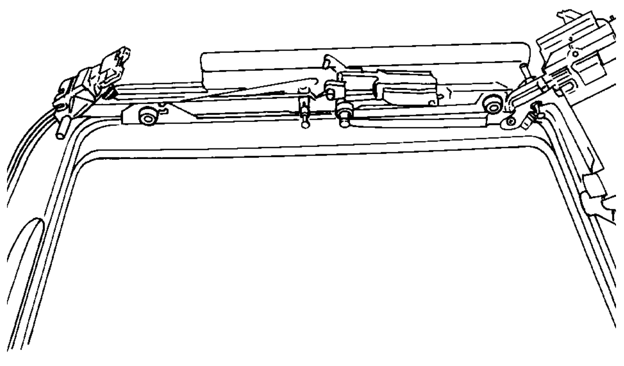

B109Q013

6. Remove the motor control module.
7. Remove the bolts and the housing from the vehicle.



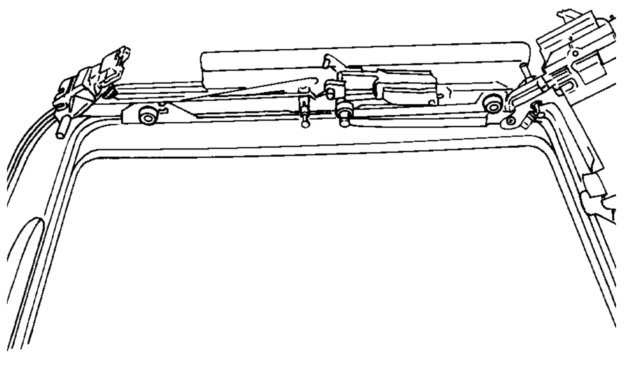
B109Q014

8. Remove the rubber end caps.
9. Remove the drain nozzles.
10. Remove the shade stops.
11. Remove the glass stops.



B109Q015

12. Remove the shade.
13. Remove the glass and the frame from the housing.
14. Remove the plastic trim.
15. Remove the screws and the glass from the frame.



B109Q015

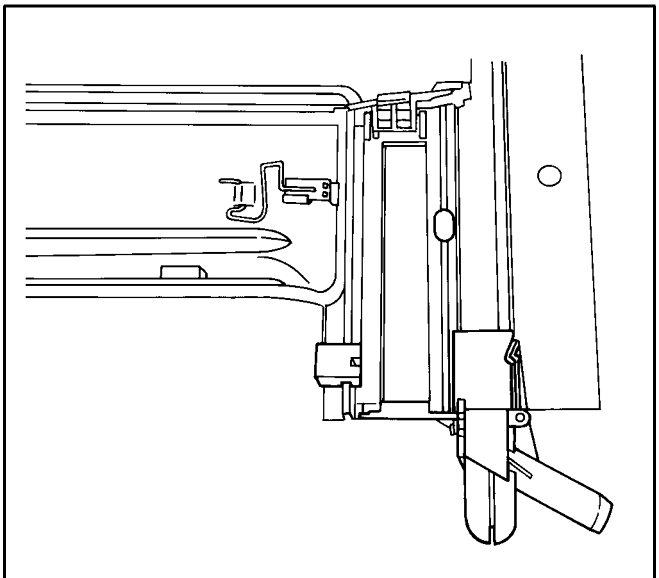
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the glass to the frame with the screws.

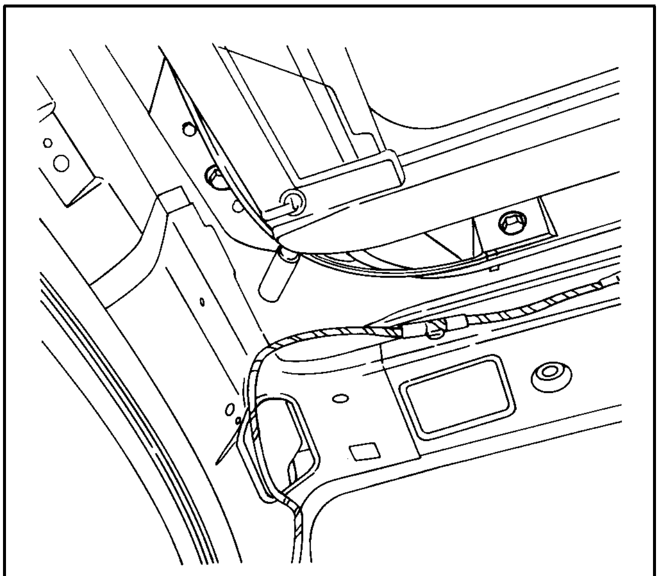
Tighten

Tighten the sunroof glass screws to 7 N•m (62 lb-in).



B109Q014

2. Install the plastic trim.
3. Install the glass and the frame to the housing.
4. Install the shade.
5. Install the glass stops.
6. Install the shade stops.
7. Install the drain nozzles.
8. Install the rubber end caps.

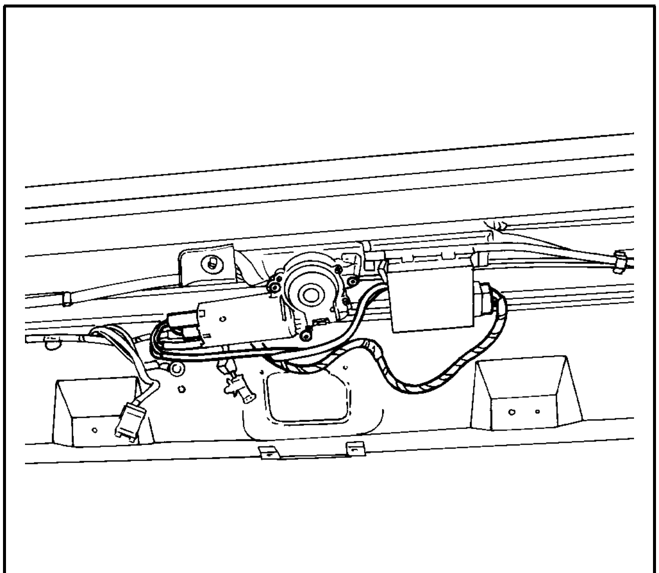


B109Q013

9. Install the housing to the roof of the vehicle with the bolts.

Tighten

Tighten the sunroof housing bolts to 7 N•m (62 lb-in).



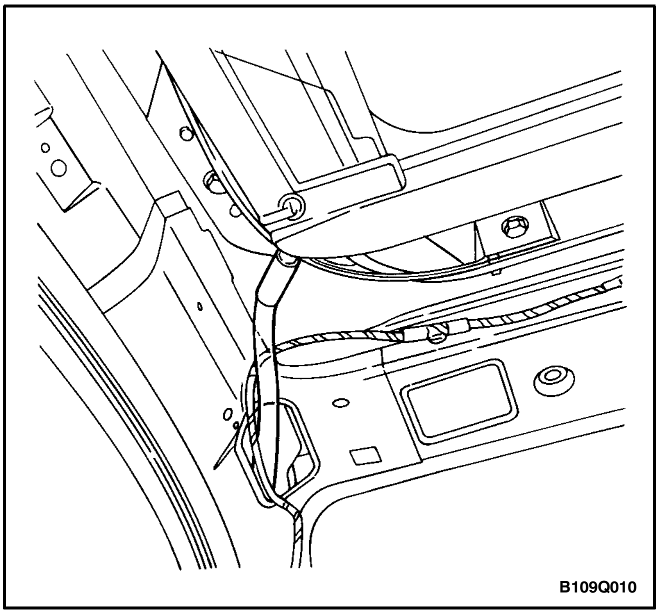
B109Q011

10. Install the motor control module.
11. Install the motor with the screws.

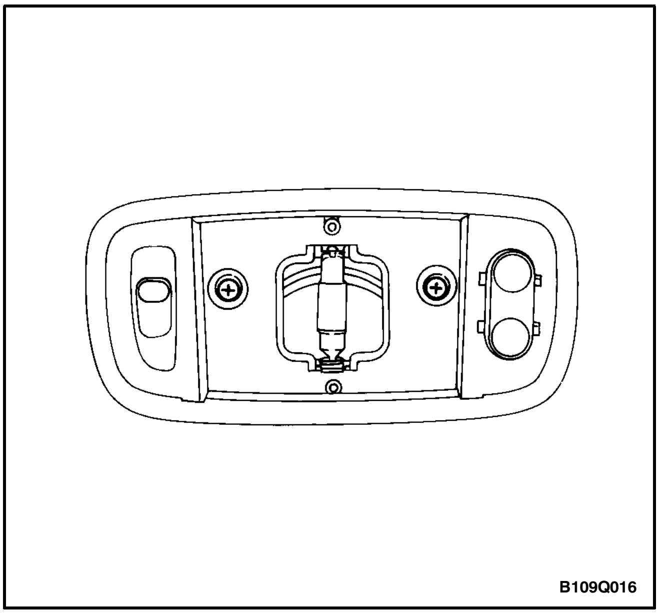
Tighten

Tighten the sunroof motor screws to 5 N•m (44 lb-in).

12. Connect the electrical connectors.



13. Install the drain hoses.
14. Install the headliner. Refer to "Formed Headliner" in this section.
15. Connect the negative battery cable.

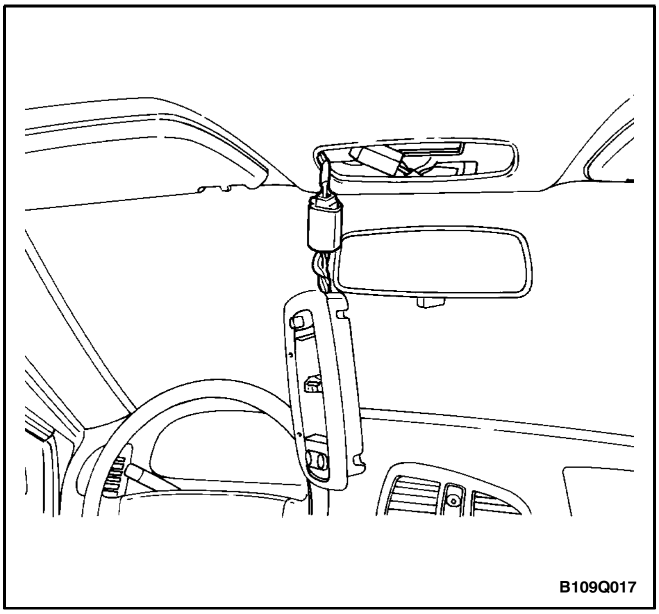


INTERIOR COURTESY LAMP/POWER SUNROOF CONTROL SWITCH

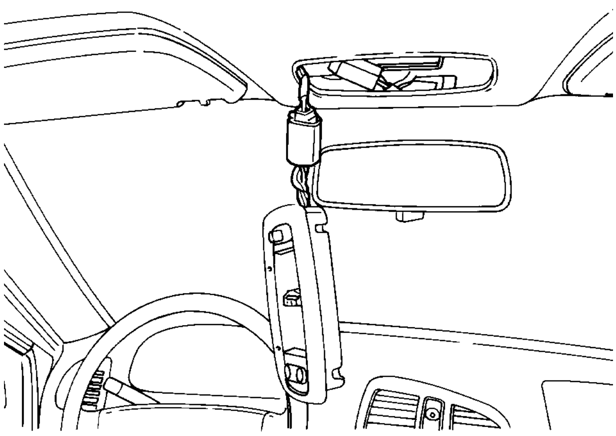
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Pry off the interior courtesy lamp lens.
3. Remove the screws and the lamp/power sunroof control switch.



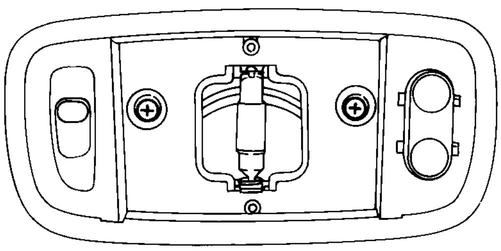
4. Disconnect the electrical connector.



B109Q017

Installation Procedure

1. Connect the electrical connector.



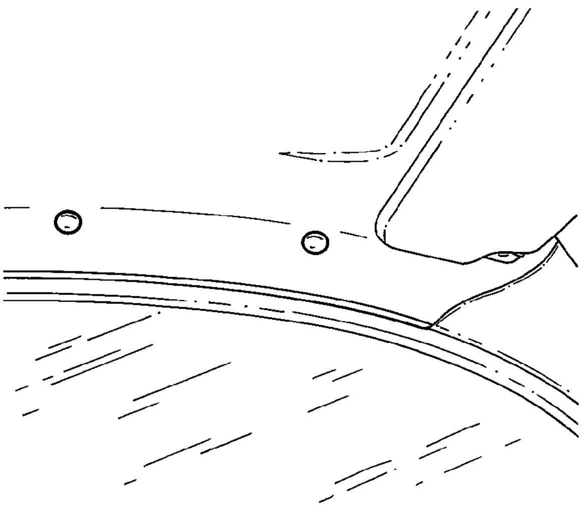
B109Q016

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the lamp/power sunroof control switch with the screws.

   Tighten

   Tighten the interior courtesy lamp/power sunroof control switch screws to 4 N•m (35 lb-in).
3. Install the interior courtesy lamp lens.
4. Connect the negative battery cable.

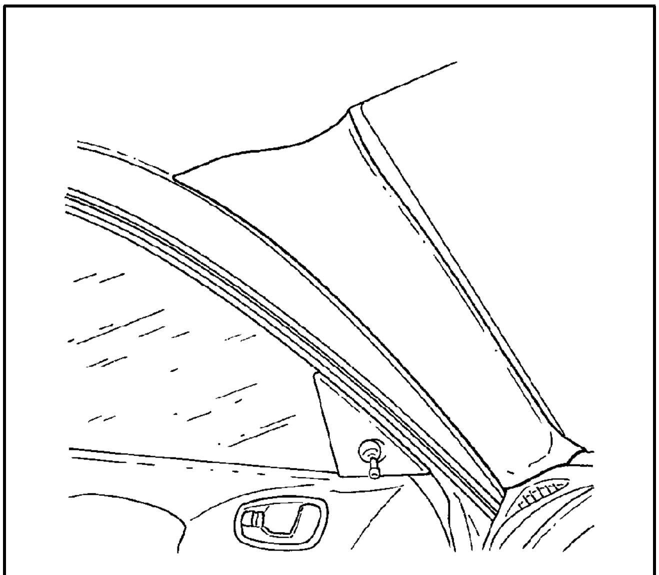


A109Q004

FORMED HEADLINER

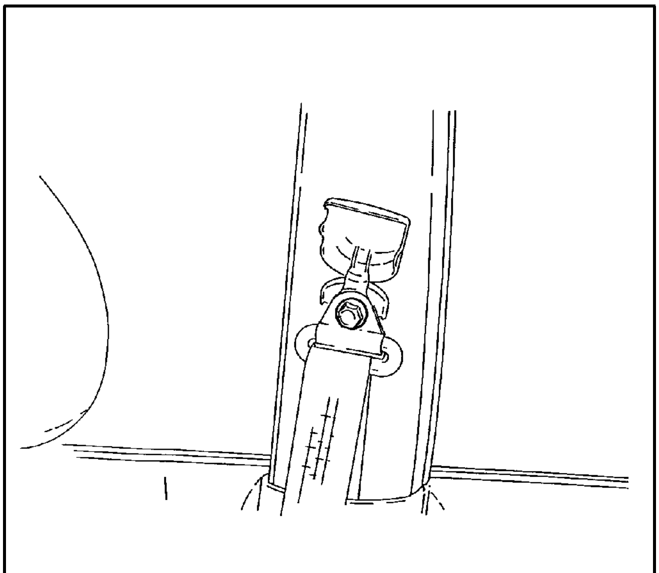
Removal Procedure

1. Remove the passenger assist handles. Refer to "Passenger Assist Handles" in this section.
2. Remove the coat hook. Refer to "Coat Hook" in this section.
3. Remove the plastic retainers in the headliner on the driver's side.



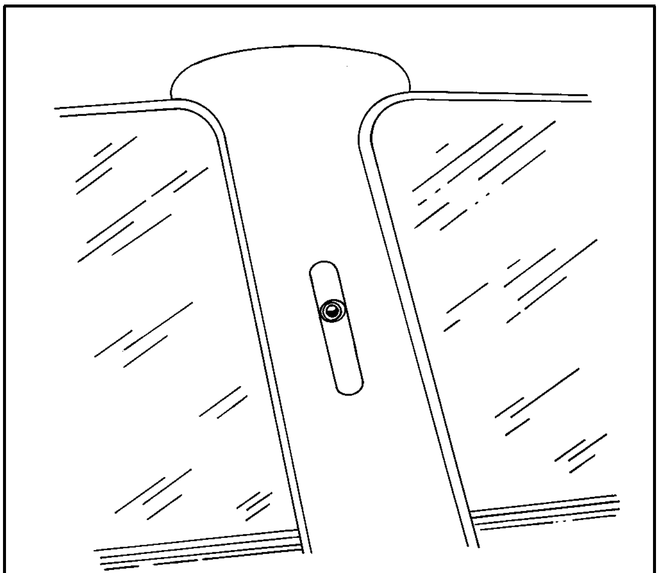
A109Q006

4. Remove the sun visors. Refer to “Sun Visors” in this section.
5. Remove the interior courtesy lamp. Refer to Section 9B, Lighting Systems.
6. Remove the left and the right A-pillar trim panels.



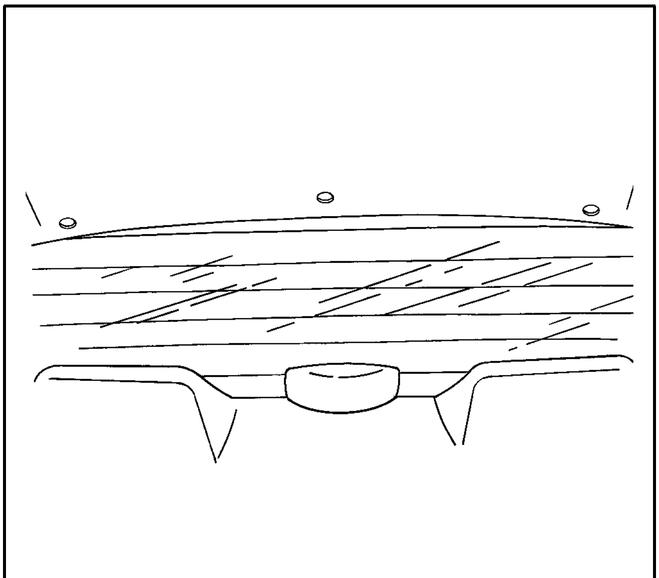
A109G022

7. Remove the bolts and the seat belt anchors from the left and the right B-pillars.



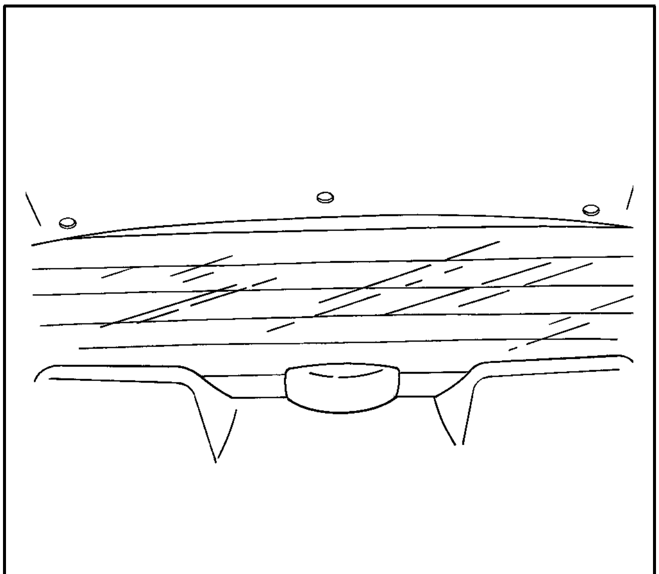
A209Q001

8. Reposition the top of the left and the right B-pillar trim panels.



A209Q002

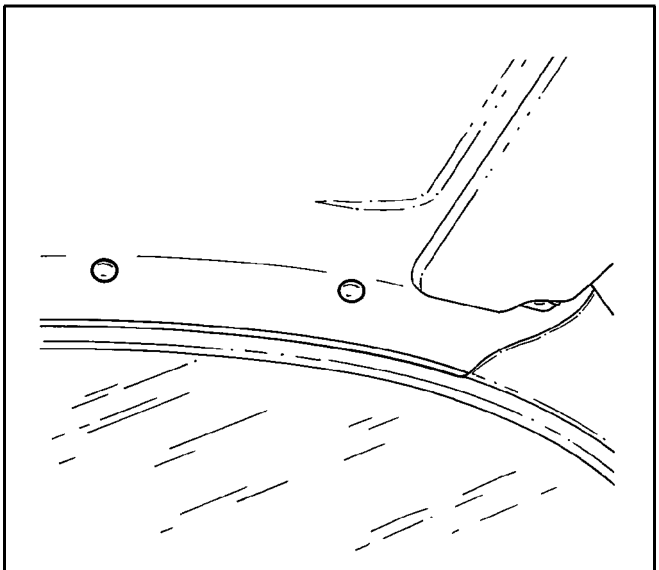
9. Remove the left and the right C-pillar trim panels.
10. Remove the sunroof molding, if equipped.
11. Remove the plastic retainers in the headliner along the rear window.
12. Slide and tilt both front seats forward.
13. Pull the headliner down and turn it 45 degrees.
14. Remove the headliner through a rear door.



A209Q002

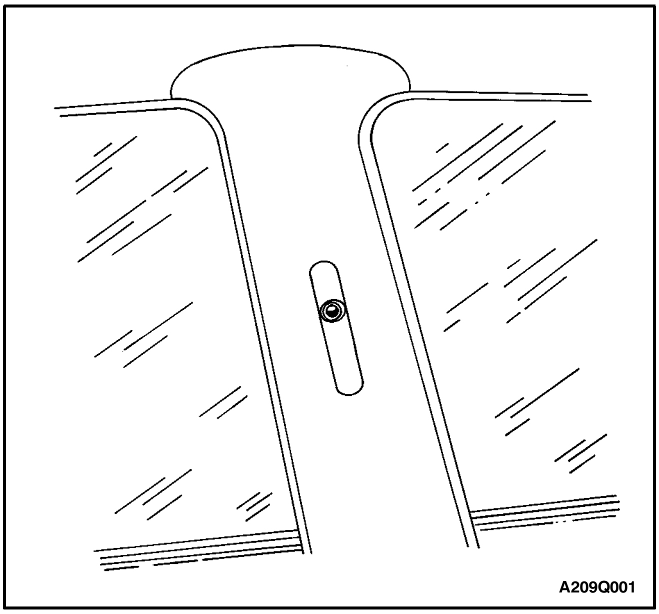
Installation Procedure

1. Recline both front seats.
2. Tilt the headliner on its side and slide it through a rear door.
3. Tilt and rotate the headliner until it is in position. Push it in place until the seals around the doors cover the edges of the headliner.
4. Install the plastic retainers along the rear window.



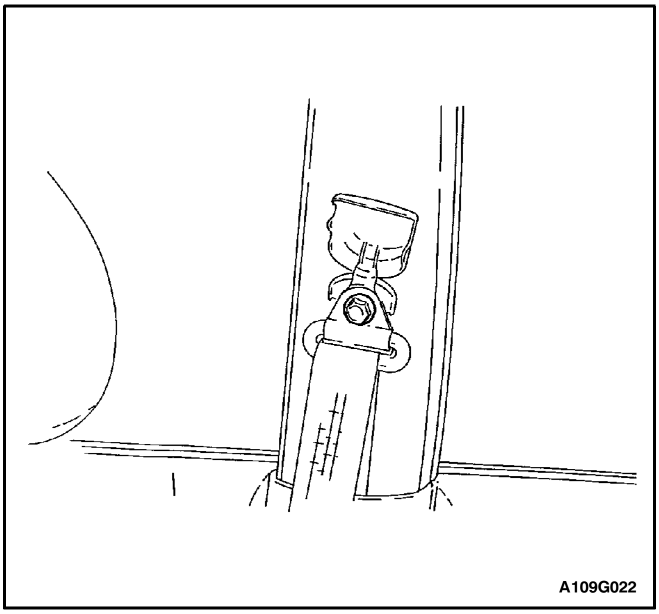
A109Q004

5. Install the plastic retainers in the headliner on the driver's side.



A209Q001

6. Install the sunroof molding, if equipped.
7. Install the left and the right C-pillar trim panels.
8. Install the top of the left and the right B-pillar trim panels to the original position.



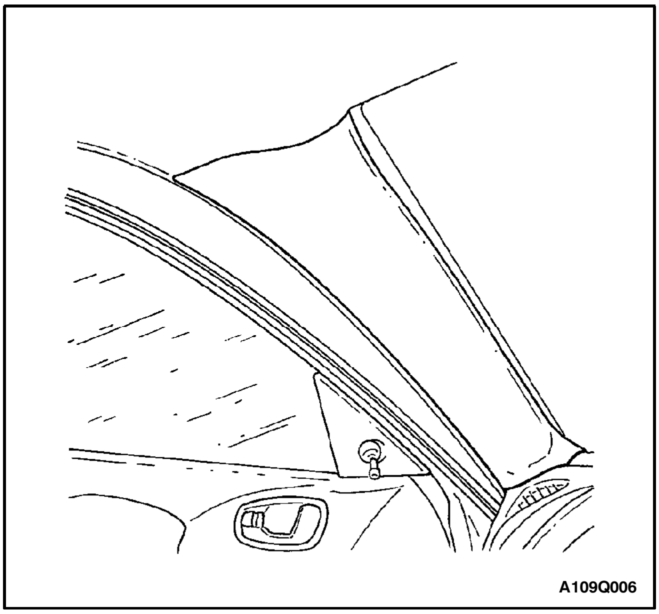
A109G022

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

9. Install the seat belt anchors with the bolts in the left and the right B-pillar panels.

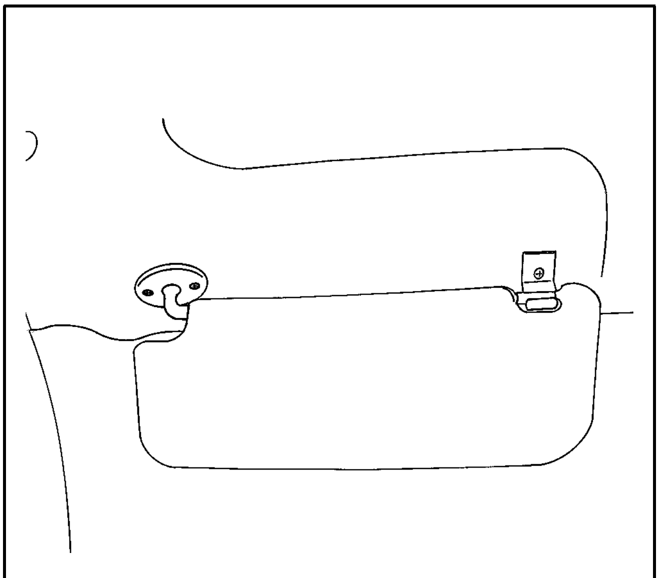
   Tighten

   Tighten the B-pillar seat belt bolts to 35 N•m (26 lb-ft).



A109Q006

10. Install the left and the right A-pillar trim panels.
11. Install the interior courtesy lamp. Refer to Section 9B, Lighting Systems.
12. Install the sun visors. Refer to “Sun Visors” in this section.
13. Install the coat hook. Refer to “Coat Hook” in this section.
14. Install the passenger assist handles. Refer to “Passenger Assist Handles” in this section.

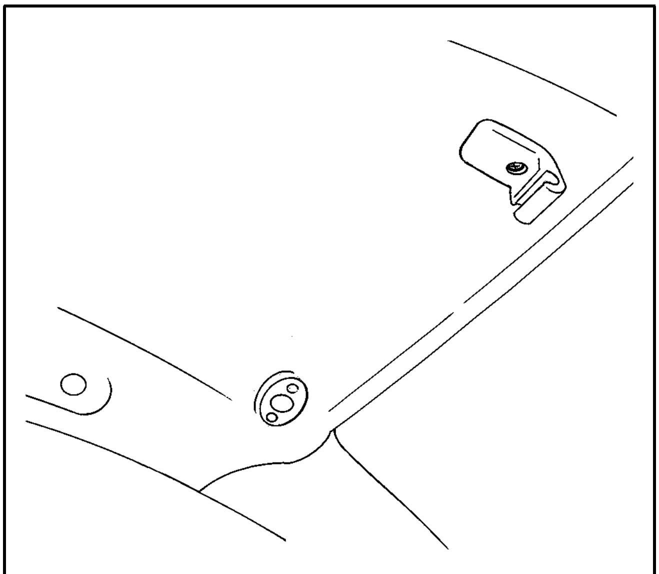


A109Q002

SUN VISORS

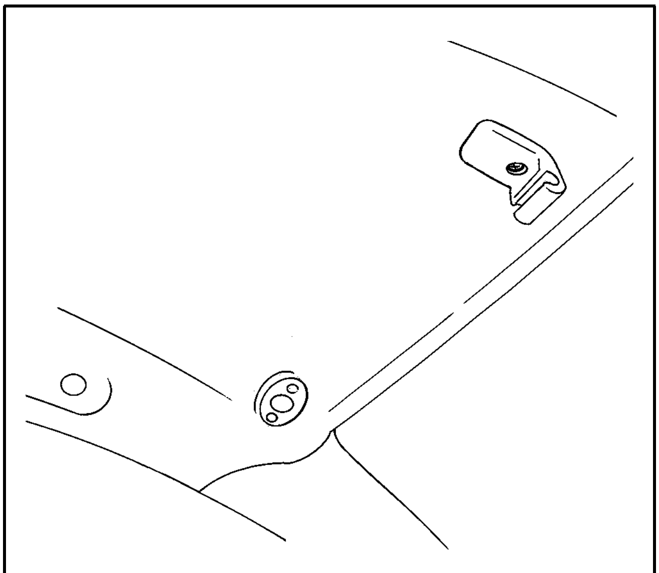
Removal Procedure

1. Remove the screws and the sun visor from the headliner.



A109Q003

2. Remove the screw and the sun visor support from the headliner.



A109Q003

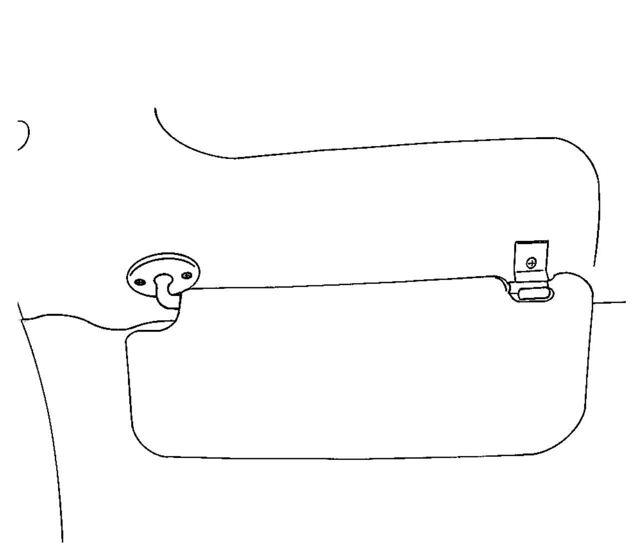
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the sun visor support to the headliner with the screw.

   Tighten

   Tighten the sun visor support screw to 1.5 N•m (13 lb-in).

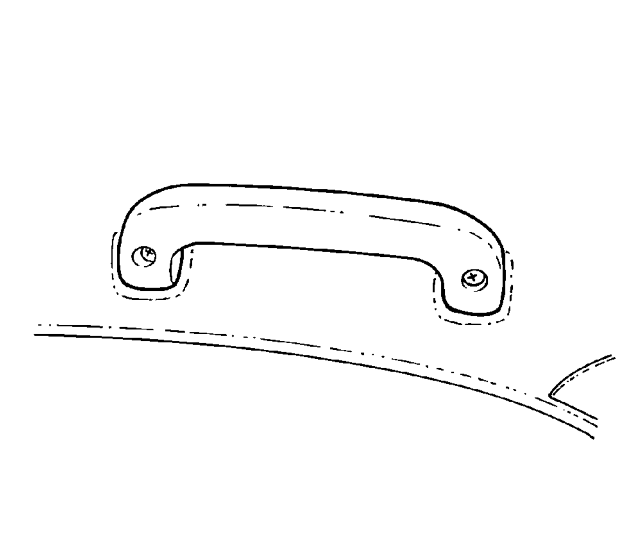


A109Q002

2. Install the sun visor to the headliner with the screws.

Tighten

Tighten the sun visor screws to 1.5 N•m (13 lb-in).

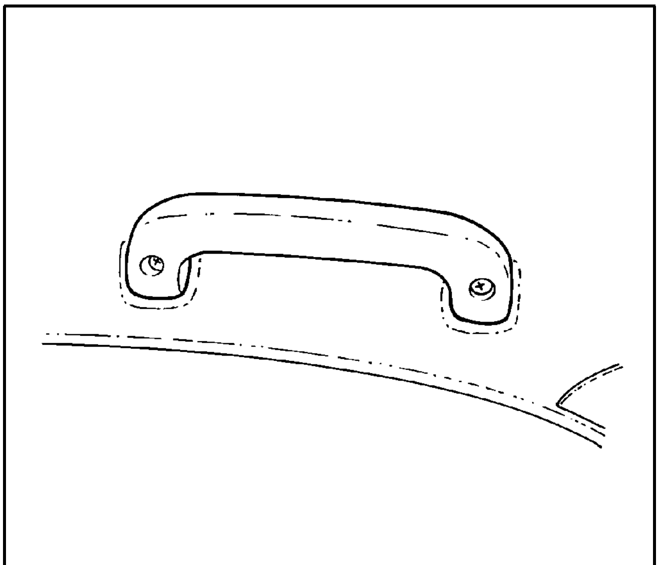


A109Q001

PASSENGER ASSIST HANDLES

Removal Procedure

1. Remove the screws and the assist handle from the headliner.



A109Q001

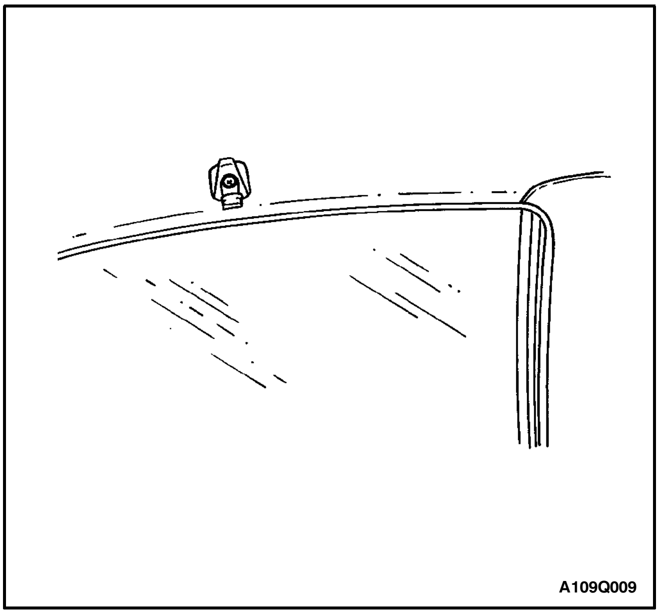
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the assist handle to the headliner with the screws.

Tighten

Tighten the passenger assist handle screws to 3.5 N•m (31 lb-in).

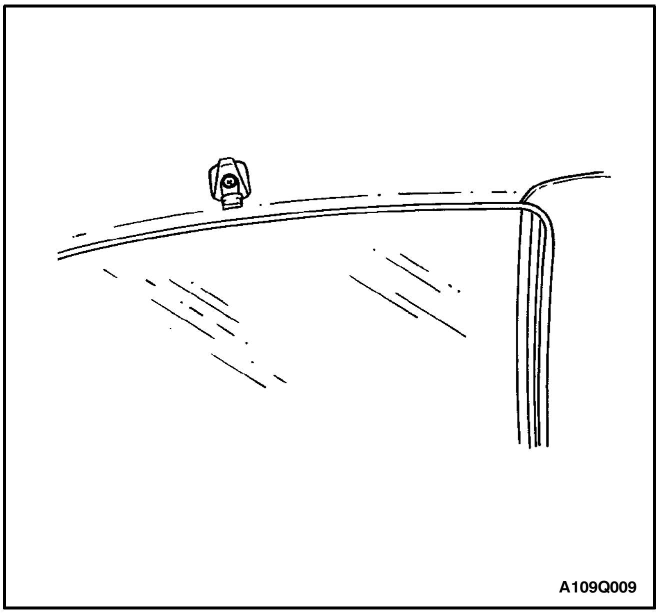


A109Q009

COAT HOOK

Removal Procedure

1. Pry open the screw cover on the coat hook.
2. Remove the screw and the coat hook from the headliner.



A109Q009

Installation Procedure

1. Install the coat hook with the screw.

   Tighten

   Tighten the coat hook screw to 3.5 N•m (31 lb-in).
2. Close the screw cover.

GENERAL DESCRIPTION AND SYSTEM OPERATION

ROOF

The roof is a one-piece painted metal unit which incorporates a single, solid headliner and two moldings, one on each side of the vehicle's roof.

The moldings, which enclose and hide the roof rail seams, are serviceable as individual units.

The one-piece formed headliner, common to both the notchback and the hatchback, consists of a molded substrate covered with a foam-backed cloth facing. The one-piece construction requires servicing the headliner as a complete assembly.

POWER SUNROOF

The sunroof is

- Intended to provide light and air through the roof of the vehicle.
- Built into the roof.
- Made of glass.
- Equipped with a sunshade that opens and closes manually.
- Powered by an electric motor.
- Controlled by a toggle switch built into the interior courtesy lamp assembly.

POWER SUNROOF CONTROL SWITCH

The power sunroof control switch is a toggle button located on the right side of the interior courtesy lamp/power sunroof control switch assembly.

Operating the Power Sunroof

The ignition must be in the ON position in order to operate the power sunroof.

Tilting the Power Sunroof Open and Closed

To tilt open the rear end of the power sunroof, press and hold the forward portion of the toggle button until the power sunroof tilts open.

To close the power sunroof from a tilted-open position, press and hold the rear portion of the toggle button until the sunroof tilts closed.

Sliding the Power Sunroof Open and Closed

To slide open the power sunroof, press the rear portion of the toggle button until the sunroof slides. If the sunshade is closed, the power sunroof will pull the sunshade open as the sunroof slides open.

To close the power sunroof from a slid-open position, press the forward portion of the toggle button until the sunroof slides closed.

SUN VISORS

The sun visors swing down in order to block out glare. They also swing to the side when they are released from the support.

PASSENGER ASSIST HANDLES

There is a passenger assist handle for each rear outboard seat and for the front passenger seat. Passengers can use these handles to assist in keeping their balance over rough roads or during sharp turns.

COAT HOOK

The coat hook is fastened to the headliner above the left-hand rear passenger seat. This position has a coat hook in the place of a passenger assist handle.

SECTION 9R

BODY FRONT END

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Fender-to-A-Pillar Bolt	8	-	71
Cowl Vent Grille Screws	2	-	18
Fender Screws (Rear of Fascia)	4	-	35
Front Bumper Fascia-to-Fender Screw	1.5	-	13
Hinge Bolts	20	15	-
Hood-to-Hinge Bolts	20	15	-
Hood Latch Screws	8	-	71
Hood Release Handle Screws	1.5	-	13
Lower Fender Bolts	8	-	71
Radiator Grille Nuts	2	-	18
Splash Shield Screws	1.5	-	13
Upper Fender Bolts	8	-	71

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

LUBRICATION

The hood hinges and the locking mechanisms require periodic lubrication for proper operation. Refer to Section 0B, General Information for the specific types and intervals of lubrication.

FASTENERS

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

Many aluminum components are used on current models. Aluminum in contact with steel may corrode rapidly if it is not protected by special finishes or isolators.

The fasteners used have a special finish which provides adequate protection from corrosion. These special fasteners differ in color in order to easily identify them from the standard metric fasteners, which are medium blue in color.

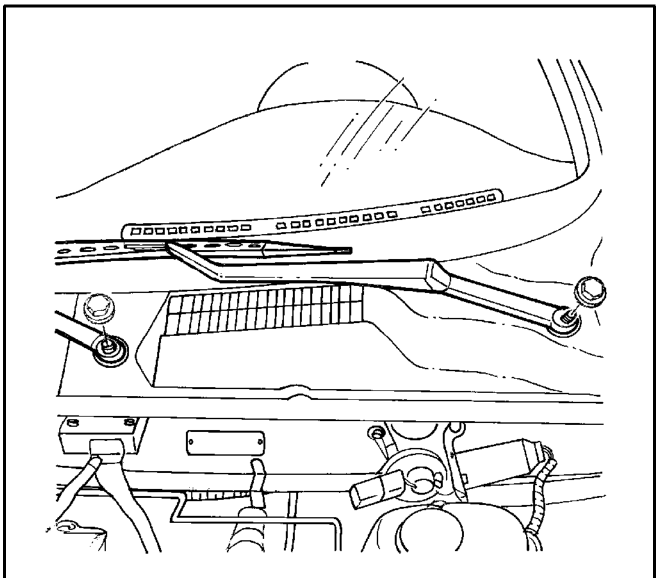
When replacing fasteners, avoid substituting otherwise similar fasteners in the same location.

ANTICORROSION MATERIALS

In order to provide rust resistance, anticorrosion materials have been applied to the interior surfaces of most of the metal panels. When you service these panels, properly re-coat them with a service-type anticorrosion material if any of the original material has been disturbed.

FRONT END SEALING

All locations where waterleaks may occur are sealed during production with high quality, durable sealers. If it becomes necessary to reseal specific areas, use a high quality sealer of medium-bodied consistency which will retain its flexible characteristics after curing and can be painted if necessary.

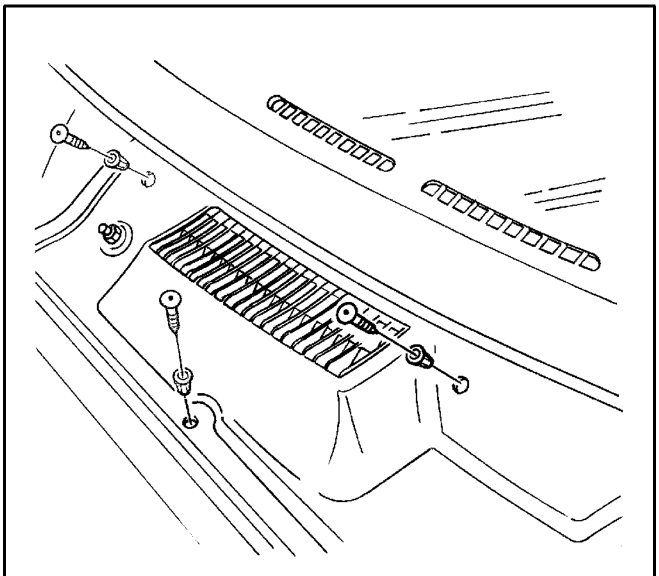


A309R001

COWL VENT GRILLE

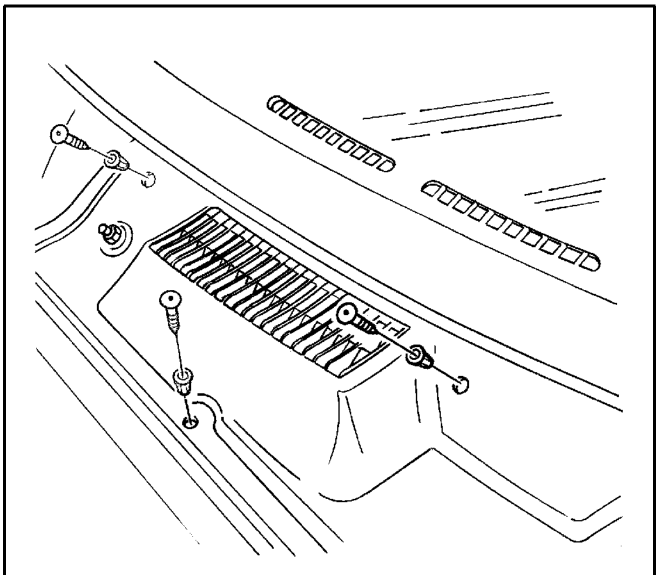
Removal Procedure

1. Raise the hood and support it with the hood prop.
2. Remove the nuts and the wiper arms.



A309R002

3. Remove the cowl vent grille screws and the two-piece grille.



A309R002

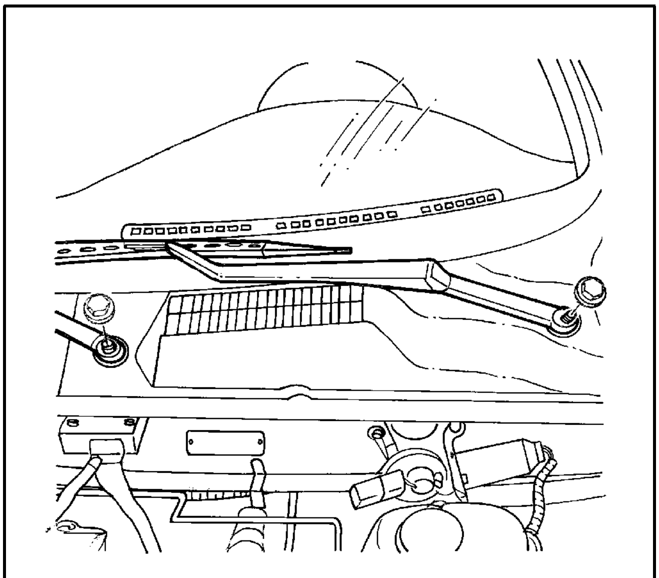
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

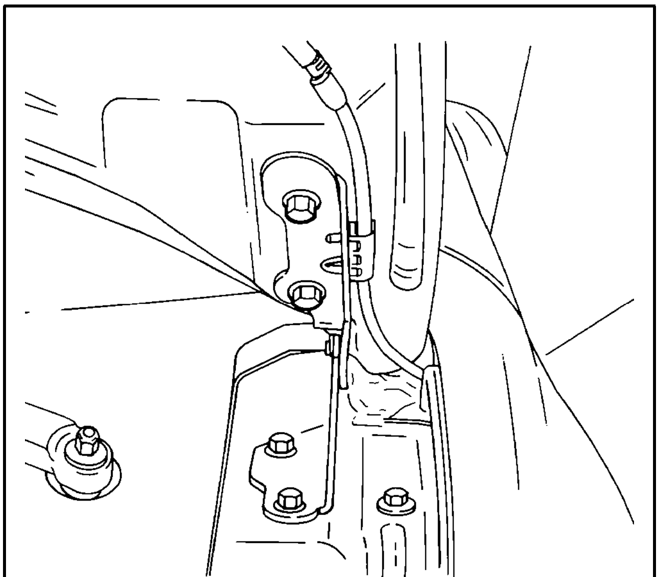
1. Install the two-piece grille and the cowl vent grille screws.

Tighten

Tighten the cowl vent grille screws to 2 N•m (18 lb-in).


A309R001

2. Install the nuts and the wiper arms.

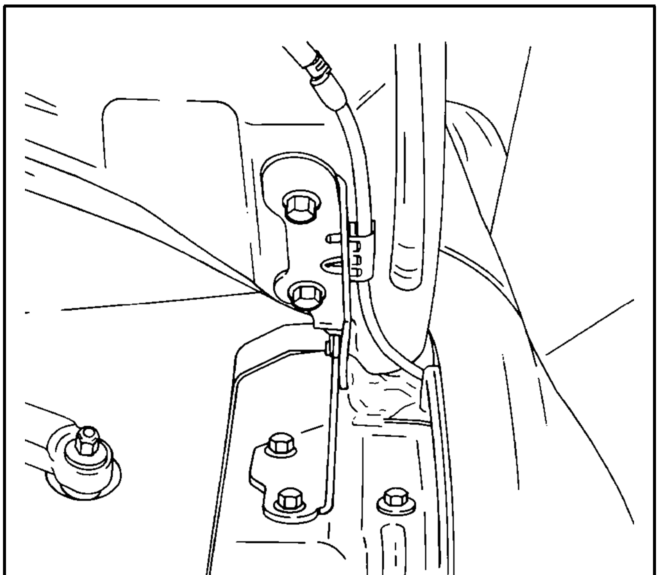

A109R010

HOOD

Removal Procedure

Important: Install protective coverings over the fenders and the windshield in order to prevent damage to the paint, the glass and the moldings when you are removing and installing the hood.

1. Raise and support the hood.
2. Mark the position of the hinge to the hood in order to aid in alignment during installation.
3. Remove the bolts retaining the hood to both hinges.
4. With the aid of another technician, remove the hood from the hinges.


A109R010

Installation Procedure

1. With the aid of another technician, position the hood in the location marked during removal.

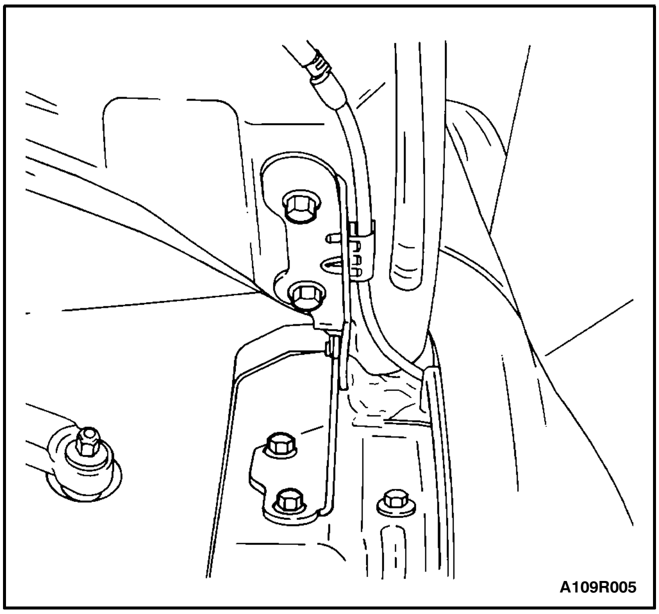
Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the two bolts securing the hood to each hinge.

Tighten

Tighten the hood-to-hinge bolts to 20 N•m (15 lb-ft).

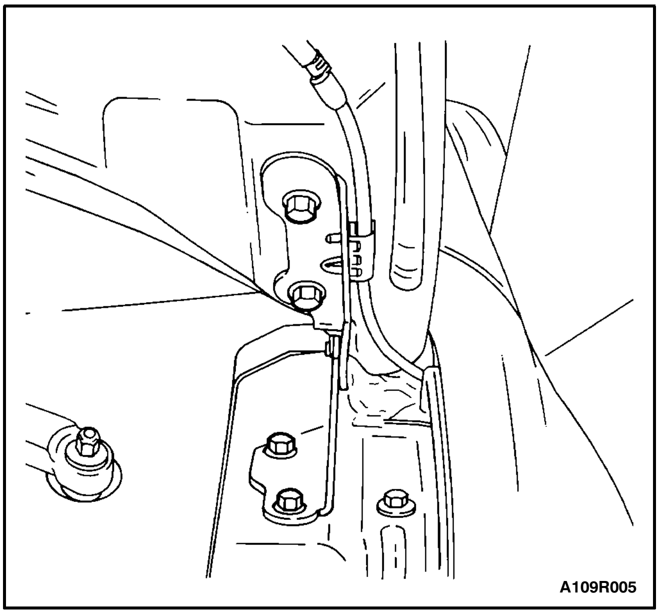
3. Inspect the hood for proper alignment.



HOOD HINGES

Removal Procedure

1. Remove the hood. Refer to “Hood” in this section.
2. Remove the bolts and the hinge.



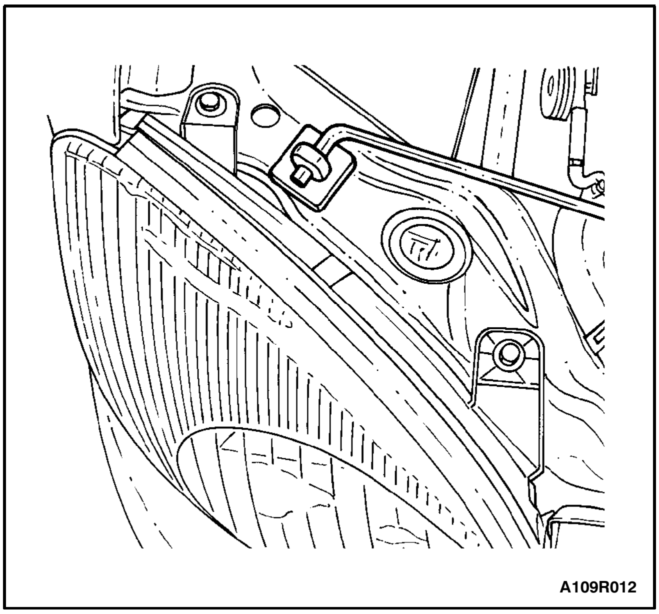
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the hinge with the bolts.

   ### Tighten

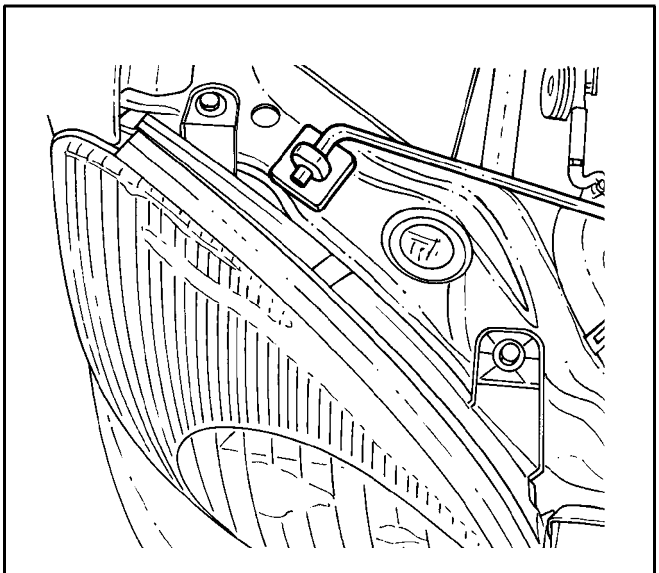
   Tighten the hinge bolts to 20 N•m (15 lb-ft).
2. Install the hood. Refer to “Hood” in this section.



HOOD PROP ROD

Removal Procedure

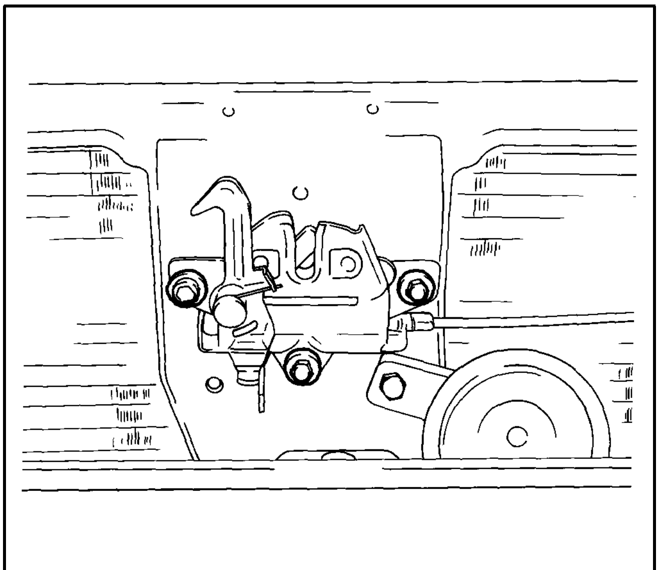
1. Support the hood in the open position.
2. Remove the hood prop rod by gently prying the base from the radiator support.



A109R012

Installation Procedure

1. Install the hood prop rod by snapping the base back into the radiator support.

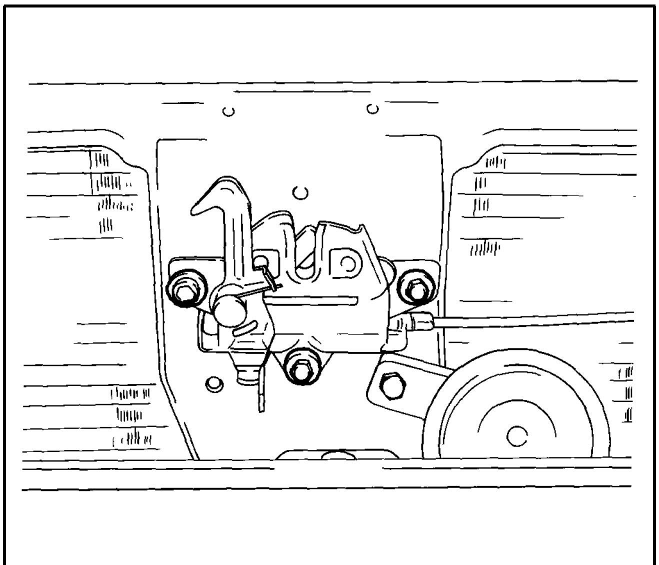


A109R003

HOOD SECONDARY LATCH

Removal Procedure

1. Open the hood.
2. Remove the screws and the hood latch.
3. Disconnect the hood release cable.



A109R003

Installation Procedure

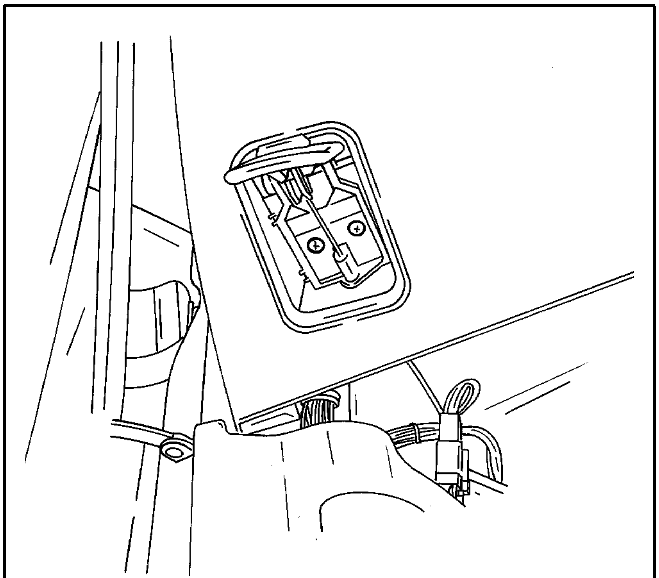
1. Connect the hood release cable to the latch.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Install the hood latch with the screws.

Tighten

Tighten the hood latch screws to 8 N•m (71 lb-in).

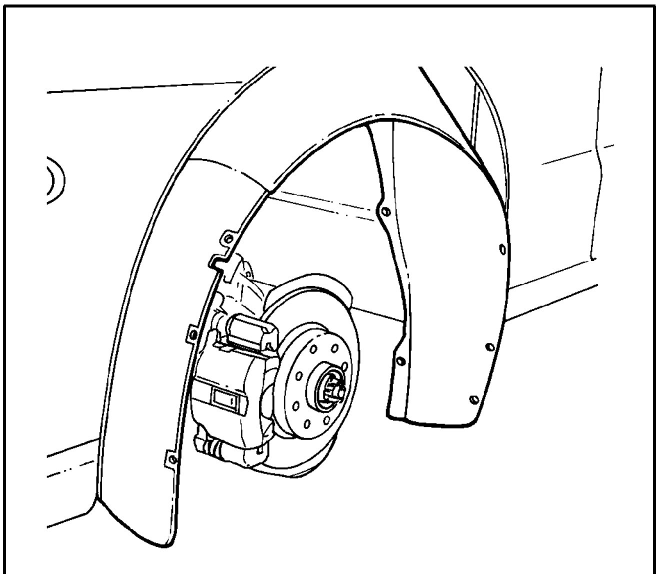


A109R001

HOOD LATCH RELEASE CABLE

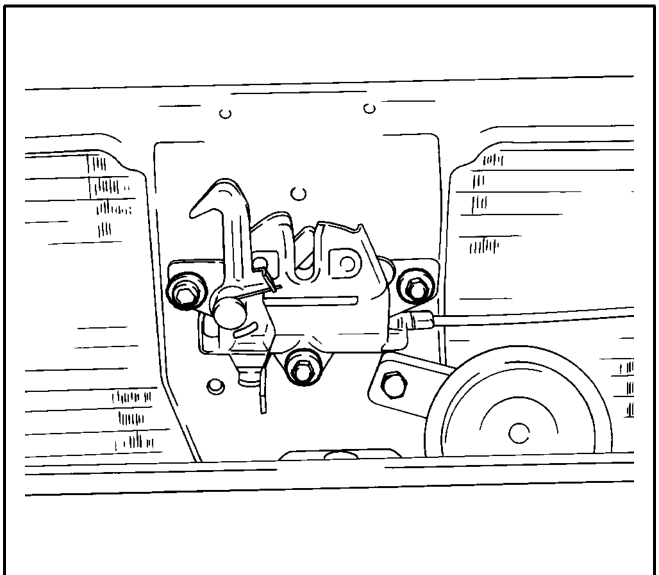
Removal Procedure

1. Pull out the hood release handle in order to access the screws.
2. Remove the screws and the hood release handle from the instrument panel.



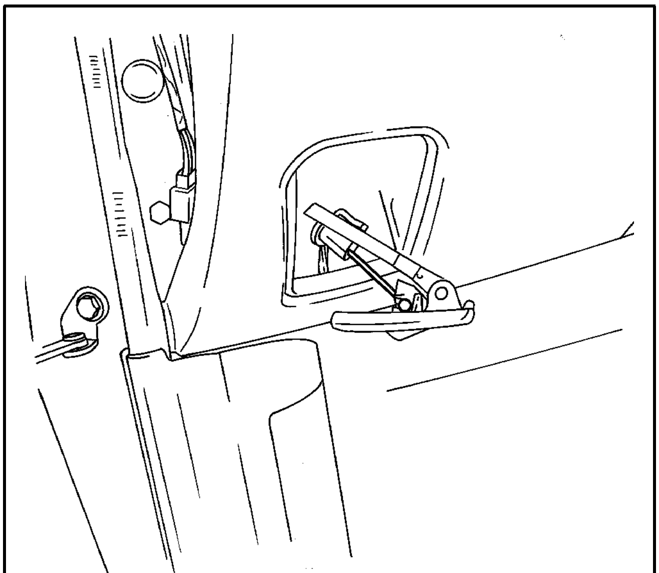
A109R002

3. Raise and suitably support the vehicle.
4. Remove the front wheel. Refer to Section 2E, Tires and Wheels.
5. Remove the screws and the splash shield.



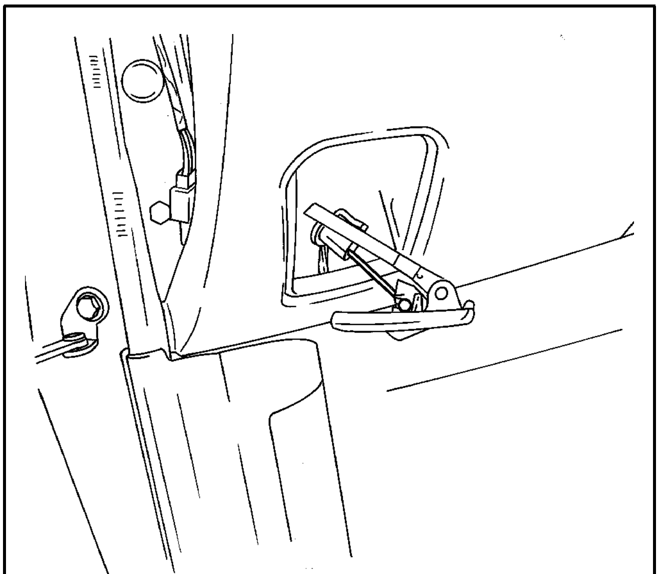
A109R003

6. Open the hood.
7. Remove the screws and the hood secondary latch.



A109R004

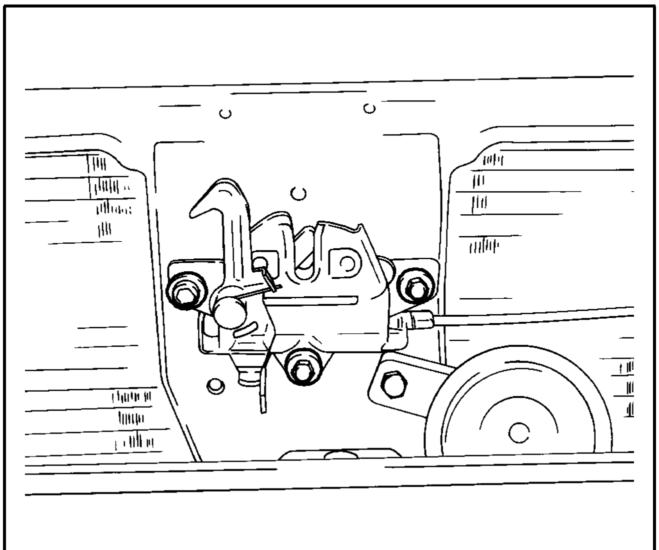
8. Remove the cable from the hood release handle.
9. Remove the cable from inside the vehicle.



A109R004

Installation Procedure

1. Install the cable from inside the vehicle.
2. Install the cable to the hood release handle.



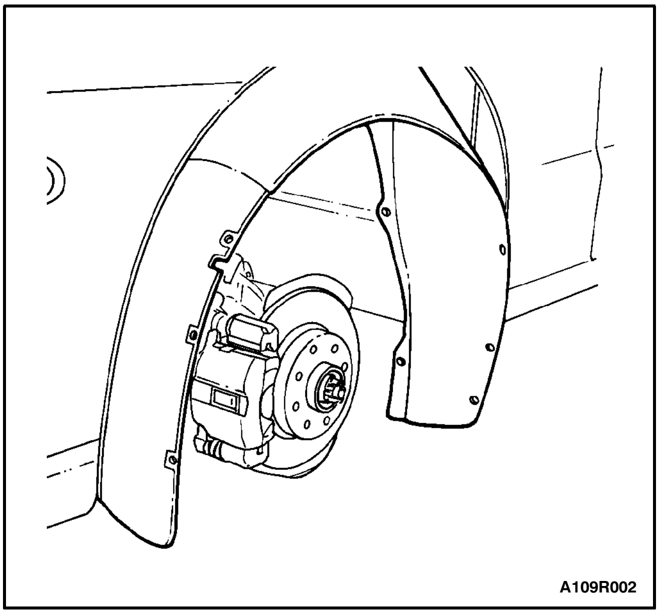
A109R003

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Install the screws and the hood secondary latch.

Tighten

Tighten the hood latch screws to 8 N•m (71 lb-in).

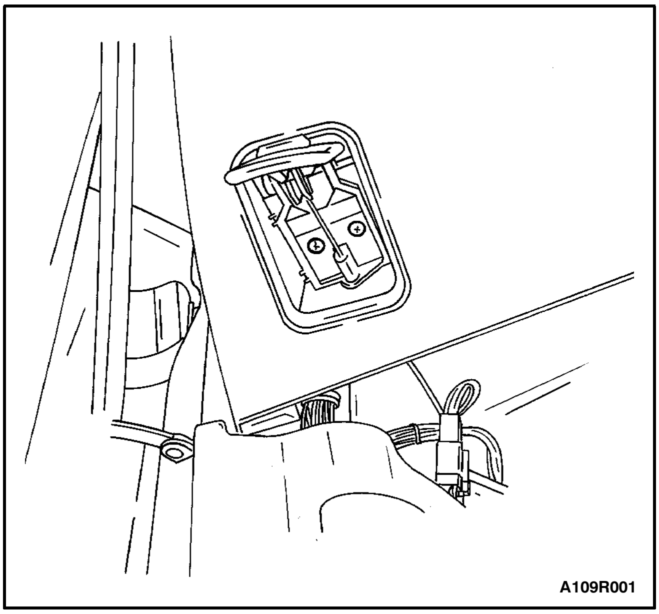


A109R002

4. Install the splash shield with the screws.

Tighten

Tighten the splash shield screws to 1.5 N•m (13 lb-in).

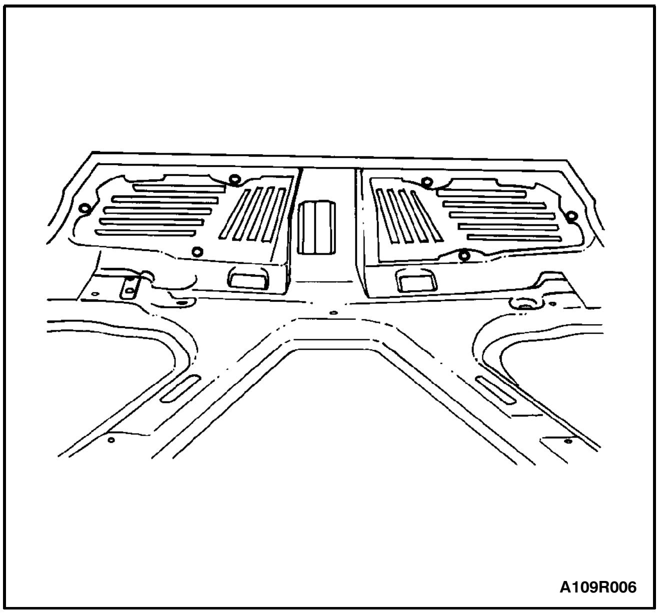


A109R001

5. Install the front wheel. Refer to Section 2E, Tires and Wheels.
6. Lower the vehicle.
7. Install the hood release handle on the instrument panel with the screws.

Tighten

Tighten the hood release handle screws to 1.5 N•m (13 lb-in).

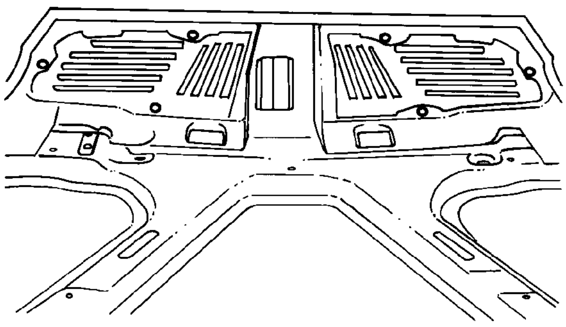


A109R006

RADIATOR GRILLE

Removal Procedure

1. Open the hood.
2. Remove the nuts and the radiator grille.


A109R006

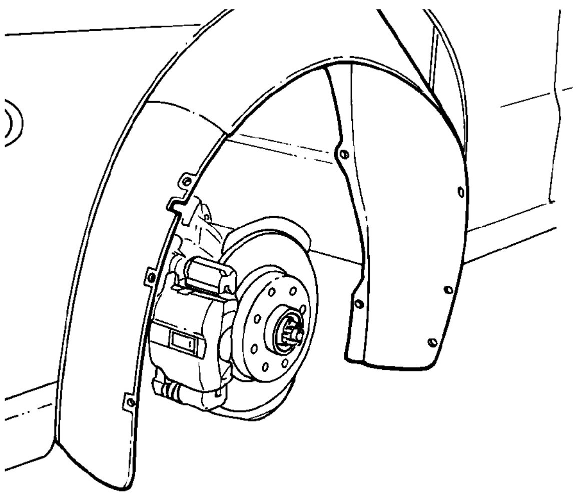
Installation Procedure

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

1. Install the radiator grille with the nuts.

Tighten

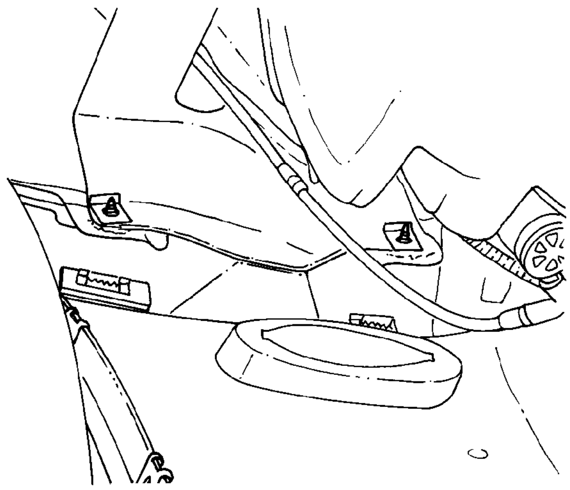
Tighten the radiator grille nuts to 2 N•m (18 lb-in).


A109R002

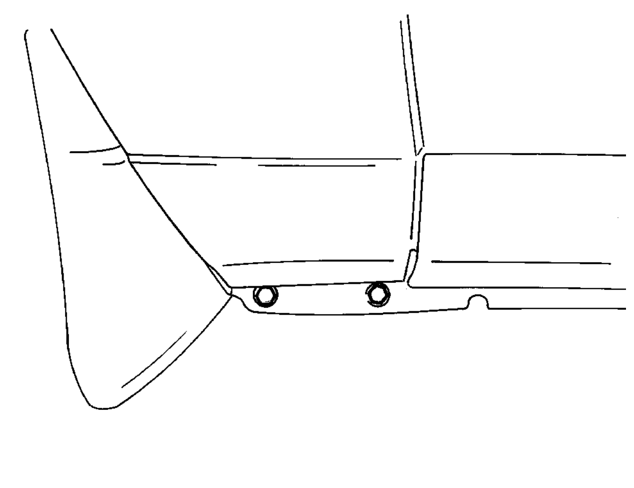
FENDER

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the bolts and the splash shield.

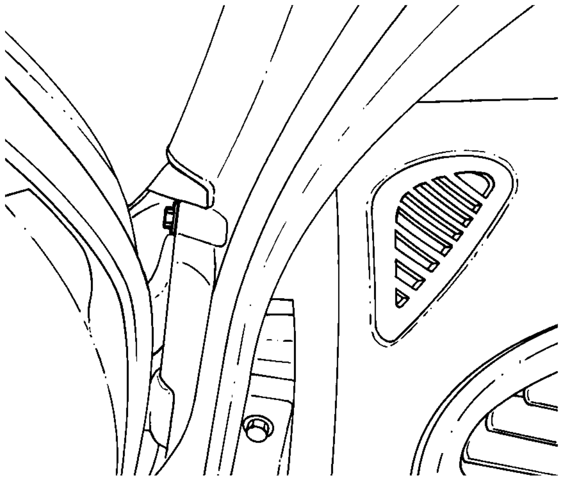

A109R007

4. Remove the screws underneath the front bumper fascia.



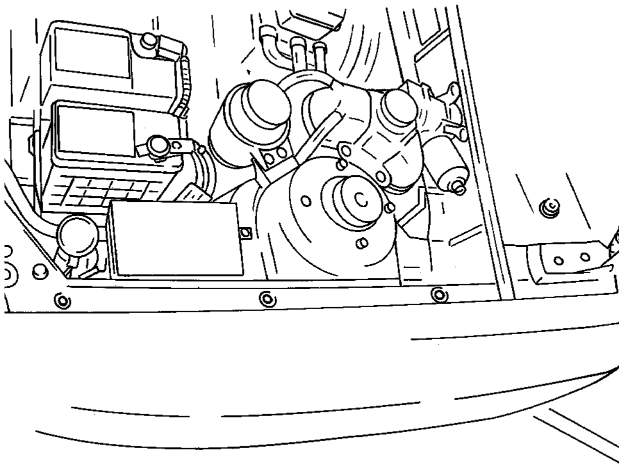
A109R008

5. Remove the screw securing the front bumper fascia to the fender.
6. Remove the bolts at the base of the fender.



A109R009

7. Open the front door. Remove the bolt at the base of the A-pillar.



A109R013

8. Open the hood.
9. Remove the headlamp. Refer to Section 9B, Lighting Systems.
10. Remove the bolts along the top of the fender.
11. Remove the fender.

Installation Procedure

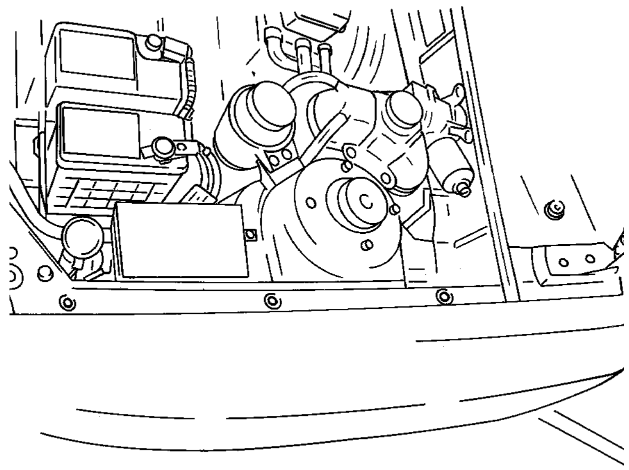
1. Install the headlamp. Refer to Section 9B, Lighting Systems.
2. Install the fender.

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Install the bolts along the top of the fender.

Tighten

Tighten the upper fender bolts to 8 N•m (71 lb-in).

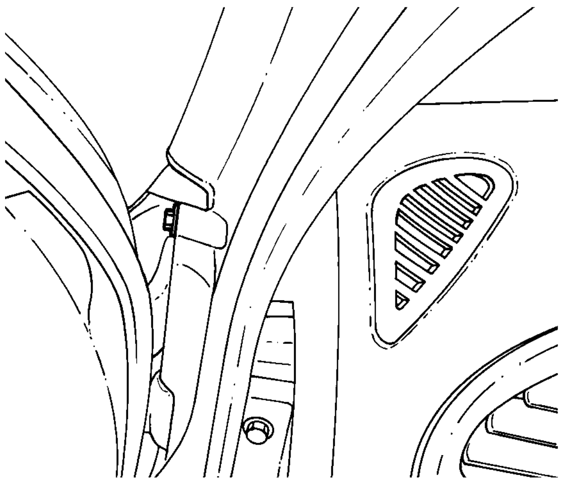


A109R013

4. Install the bolt at the base of the A-pillar.

Tighten

Tighten the fender-to-A-pillar bolt to 8 N•m (71 lb-in).

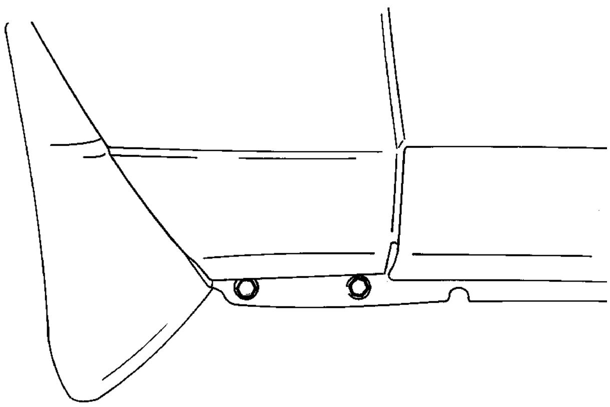


A109R009

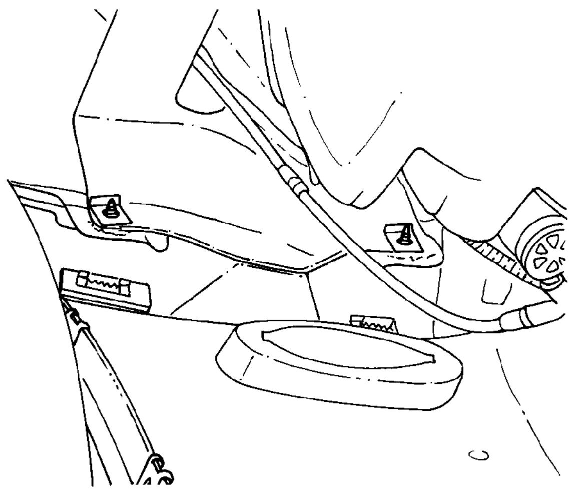
5. Install the bolts at the base of the fender.

Tighten

Tighten the lower fender bolts to 8 N•m (71 lb-in).



A109R008



A109R007

6. Secure the fender to the front bumper fascia with the screw.

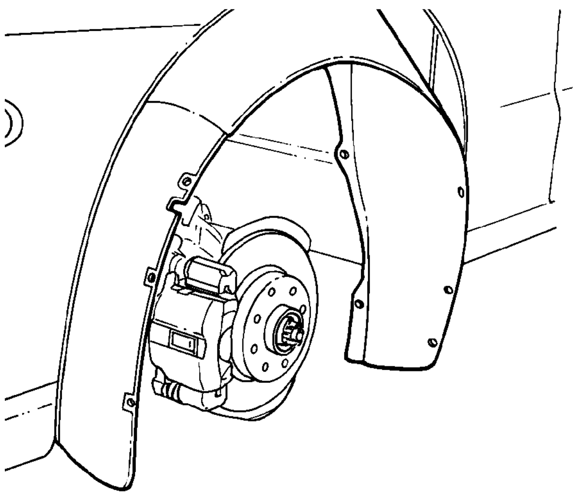
Tighten

Tighten the front bumper fascia screw to 1.5 N•m (13 lb-in).

7. Secure the fender behind the front bumper fascia with the screws.

Tighten

Tighten the fender screws to 4 N•m (35 lb-in).



A109R002

8. Install the splash shield with the screws.

Tighten

Tighten the splash shield screws to 1.5 N•m (13 lb-in).

9. Install the front wheel. Refer to Section 2E, Tires and Wheels.
10. Lower the vehicle.

GENERAL DESCRIPTION AND SYSTEM OPERATION

BODY FRONT END

This vehicle has a unitized body with a frame assembly supporting the engine and the transaxle. The fender panels and the radiator support are also integral parts of the body.

SECTION 9S

BODY REAR END

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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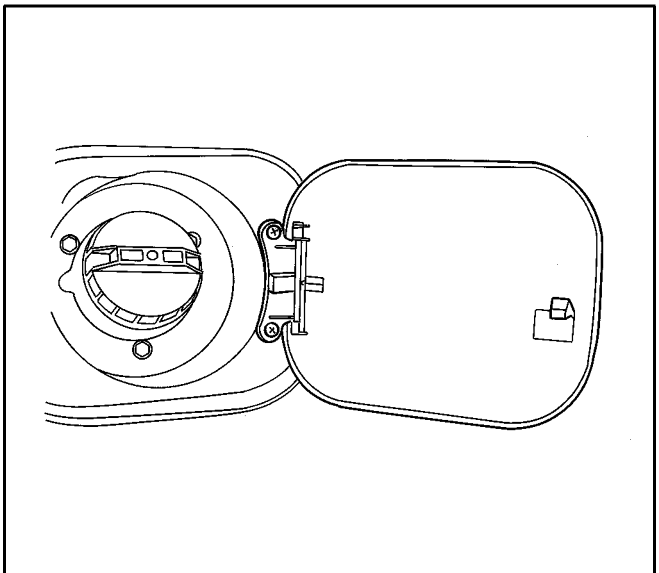
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

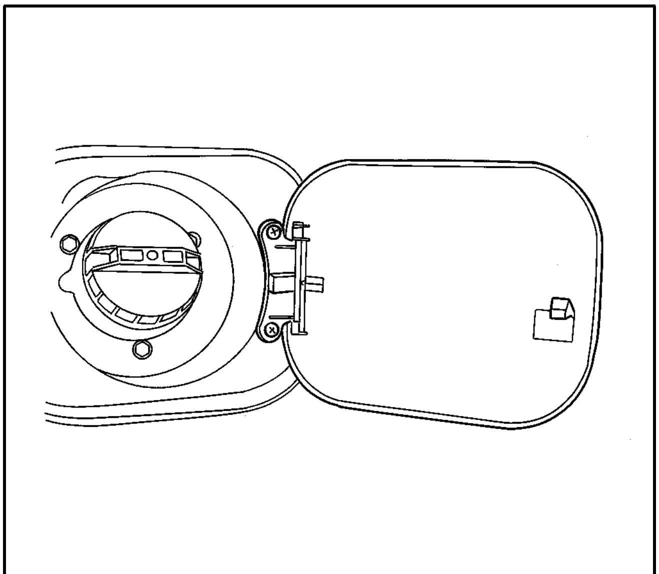
FUEL FILLER DOOR



A109S001

Removal Procedure

1. Remove the screws and the fuel filler door.



A109S001

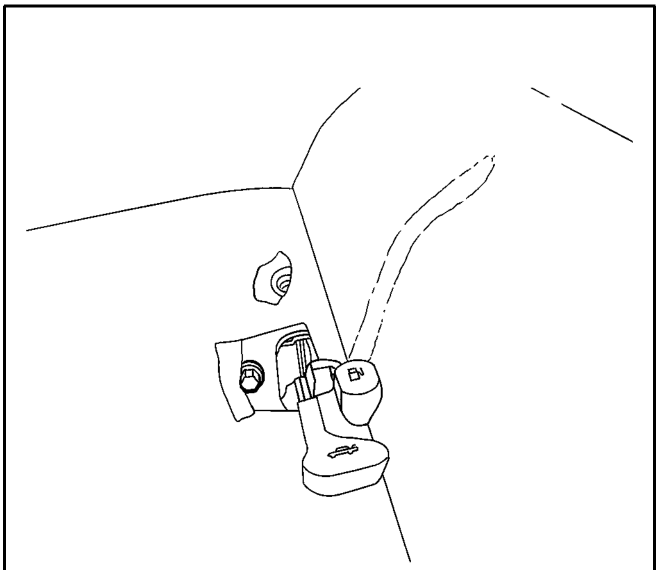
Installation Procedure

1. Install the fuel filler door with the screws.

   Tighten

   Tighten the fuel filler door screws to 3 N•m (27 lb-in).

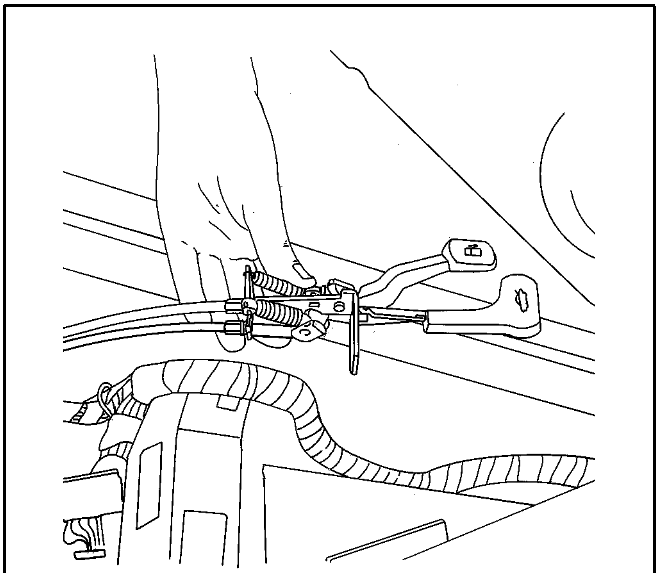
FUEL FILLER DOOR REMOTE CABLE AND HANDLE



A109S005

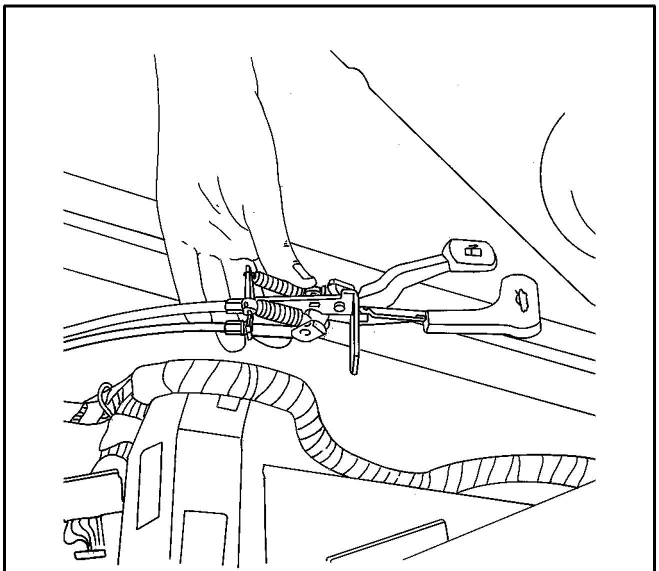
Removal Procedure

1. Open the luggage compartment.
2. Remove the left luggage compartment wheelhouse trim panel, both luggage compartment rear quarter trim panels, and the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.
3. Disconnect the cable from the fuel filler door.
4. Remove the driver front and the rear seats. Refer to Section 9H, Seats.
5. Reposition the floor carpet on the left side of the vehicle.
6. Remove the bolt and the handle.



A109S006

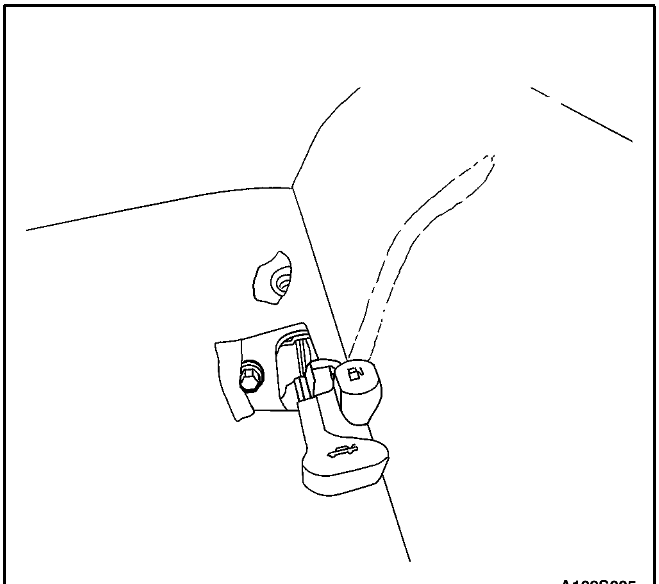
7. Disconnect the cable from the handle.
8. Remove the cable



A109S006

Installation Procedure

1. Feed the cable from the luggage compartment to the passenger compartment.
2. Connect the cable to the handle.



A109S005

3. Install the handle with the bolt.

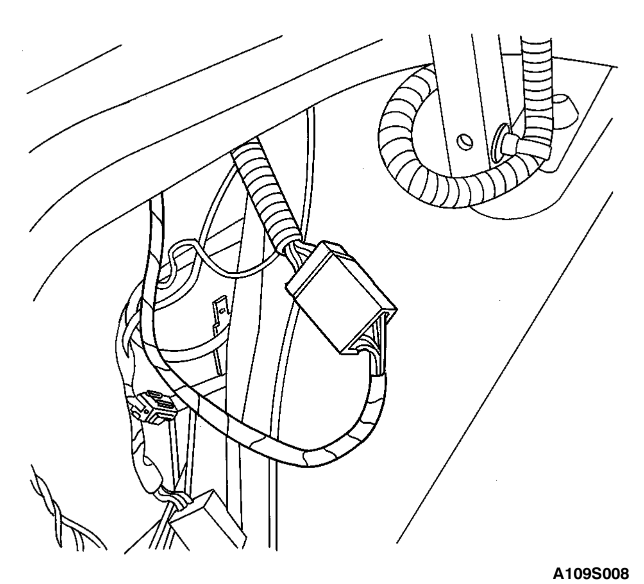
   Tighten

   Tighten the remote cable handle bolt to 8 N•m (71 lb-in).
4. Install the floor carpet to its original position.
5. Install the front and the rear seats. Refer to Section 9H, Seats.
6. Connect the cable to the fuel filler door.
7. Install the left luggage compartment wheelhouse trim panel, both luggage compartment rear quarter trim panels, and the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.

REAR DECK LID (NOTCHBACK)

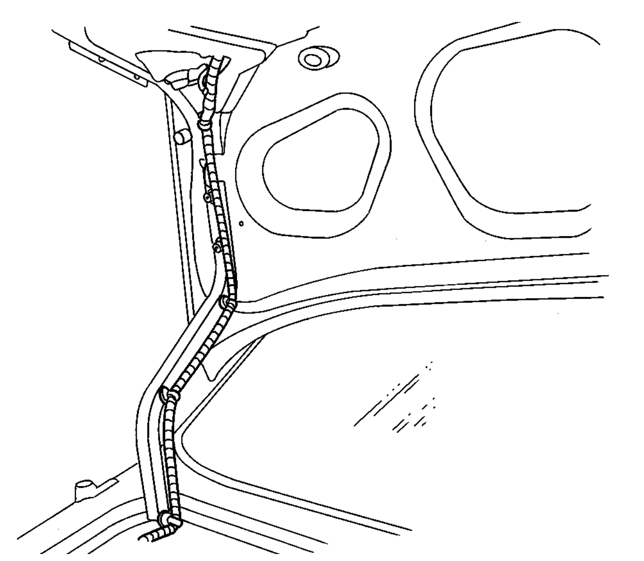
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector.



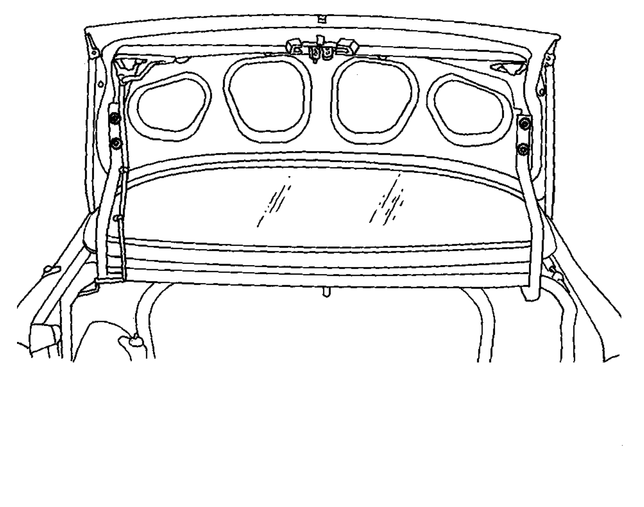
A109S008

3. Disconnect the electrical harness from the rear deck lid hinge arm.

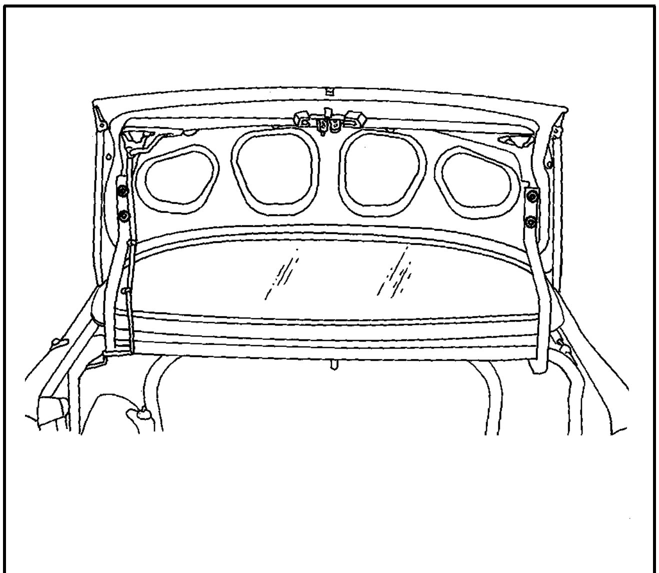


A109S009

4. Remove the bolts and the rear deck lid.



A109S010



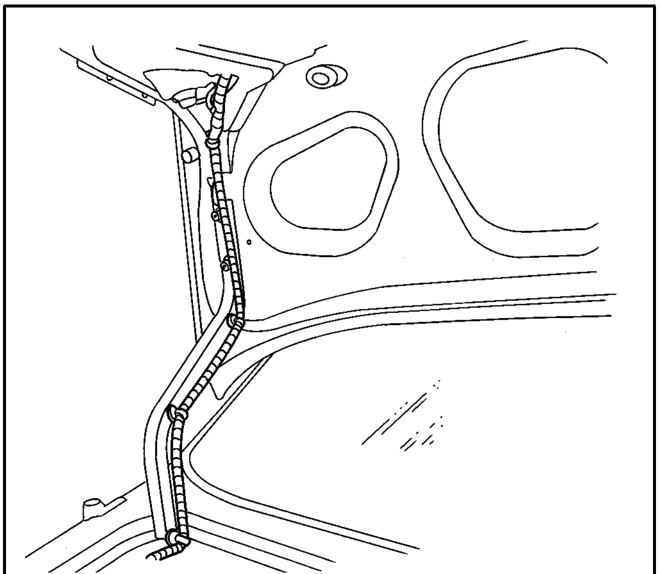
A109S010

Installation Procedure

1. Install the rear deck lid with the bolts.

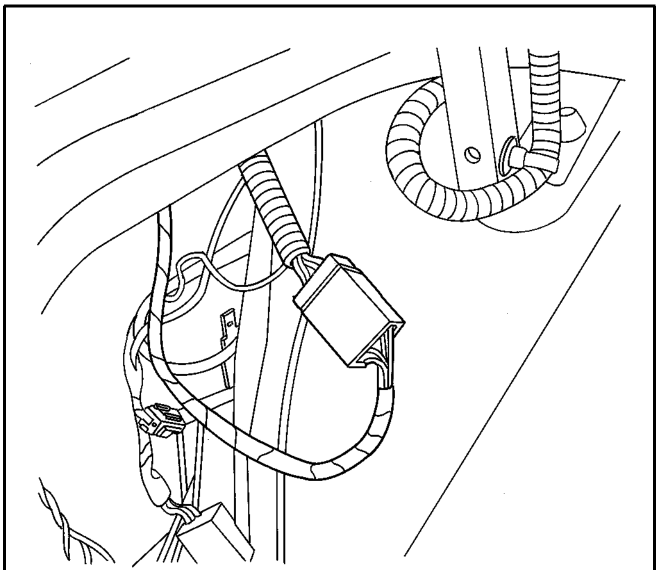
Tighten

Tighten the rear deck lid bolts to 10 N•m (89 lb-in).



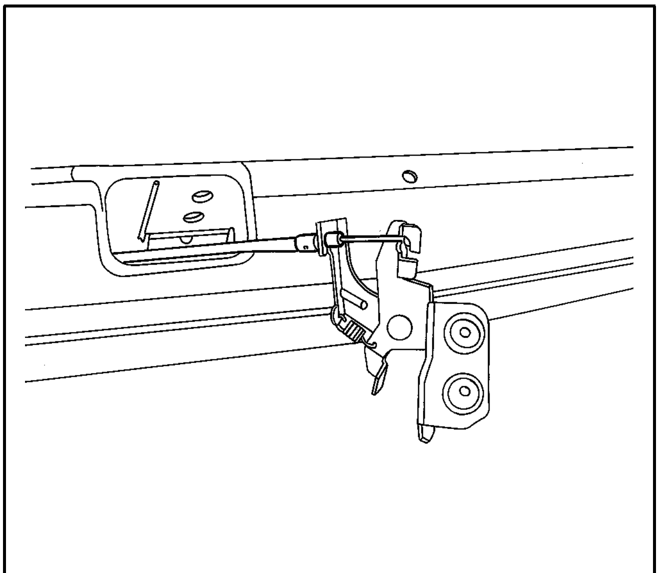
A109S009

2. Connect the electrical harness to the rear deck lid hinge arm.



A109S008

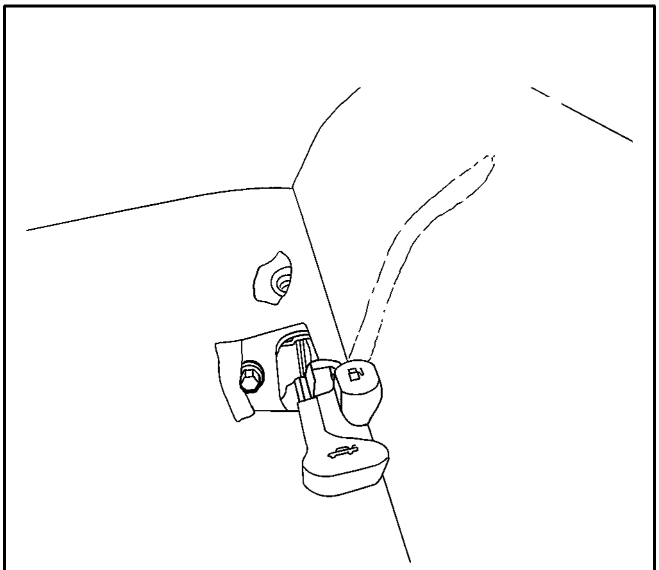
3. Connect the electrical connector.
4. Connect the negative battery cable.


A109S004

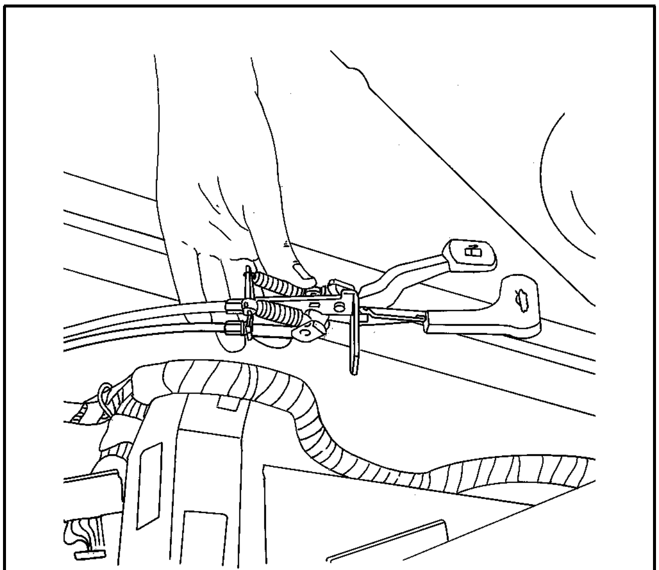
REAR DECK LID REMOTE CABLE AND HANDLE

Removal Procedure

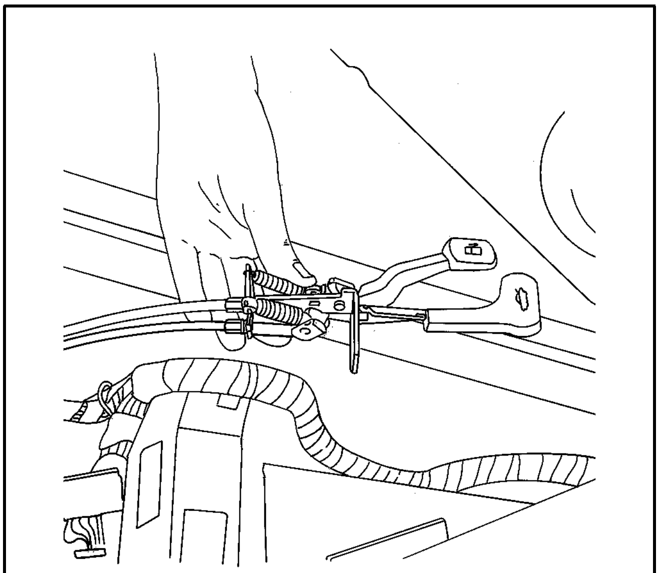
1. Open the luggage compartment.
2. Remove the luggage compartment left side wheel house, the rear quarter, and the rear trim panels. Refer to Section 9G, Interior Trim.
3. Remove the lock striker. Refer to “Luggage Compartment Lock Striker (Notchback)” in this section.
4. Disconnect the cable from the lock striker.


A109S005

5. Remove the driver front and the rear seats. Refer to Section 9H, Seats.
6. Reposition the floor carpet on the left side of the vehicle.
7. Remove the bolt and the handle.

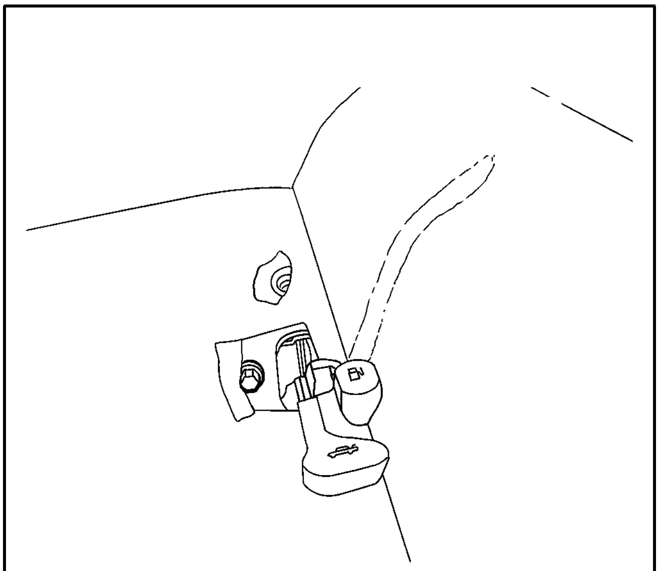

A109S006

8. Disconnect the cable from the handle.
9. Remove the cable.


A109S006

Installation Procedure

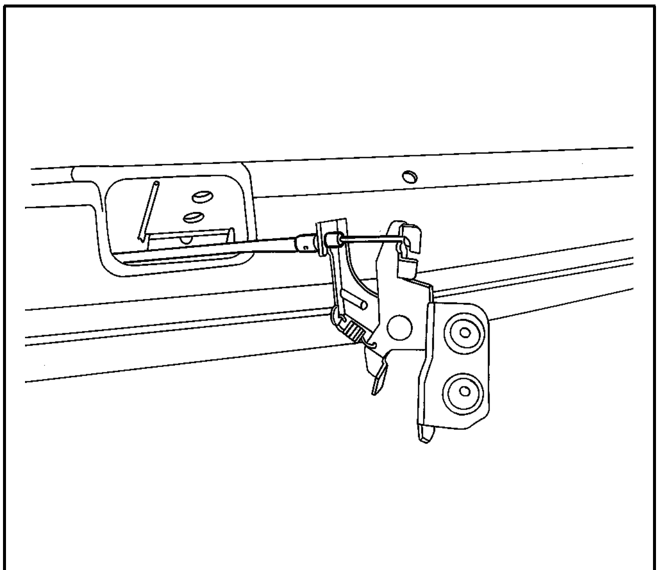
1. Feed the cable from the luggage compartment to the passenger compartment.
2. Connect the cable to the handle.


A109S005

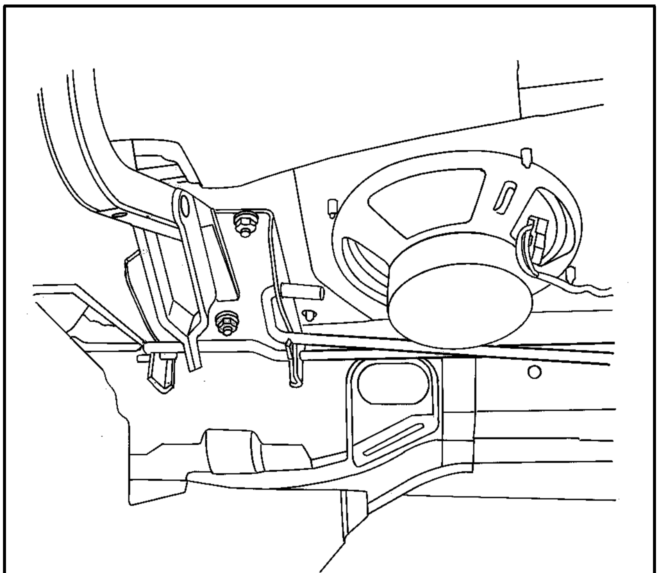
3. Install the handle with the bolt.

Tighten

Tighten the remote cable handle bolt to 8 N•m (71 lb-in).


A109S004

4. Install the floor carpet to its original position.
5. Install the front and the rear seats. Refer to Section 9H, Seats.
6. Connect the cable to the lock striker.
7. Install the lock striker. Refer to “Luggagge Compartment Lock Striker (Notchback)” in this section.
8. Install the luggage compartment left side wheel house, the rear quarter, and the rear trim panels. Refer to Section 9G, Interior Trim.

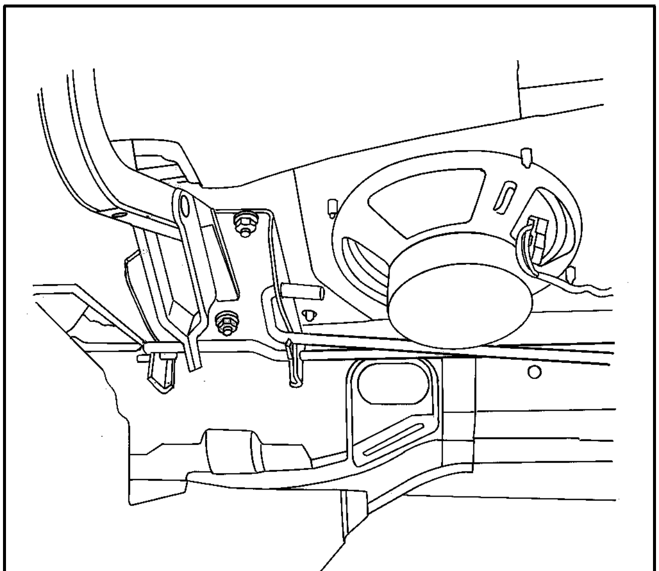


A109S012

TORQUE ROD

Removal Procedure

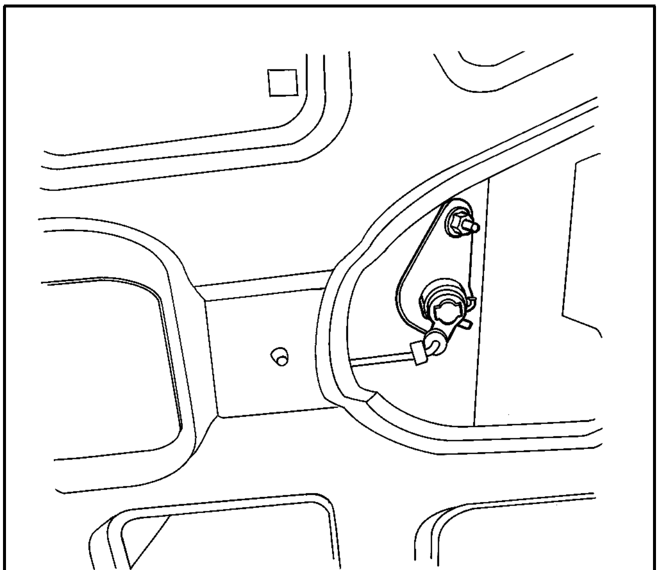
1. Remove the torque rod from the rear deck lid hinge arm.
2. Remove the torque rod from the hinges.



A109S012

Installation Procedure

1. Install the torque rod onto the hinges.
2. Install the torque rod onto the rear deck lid hinge arm.

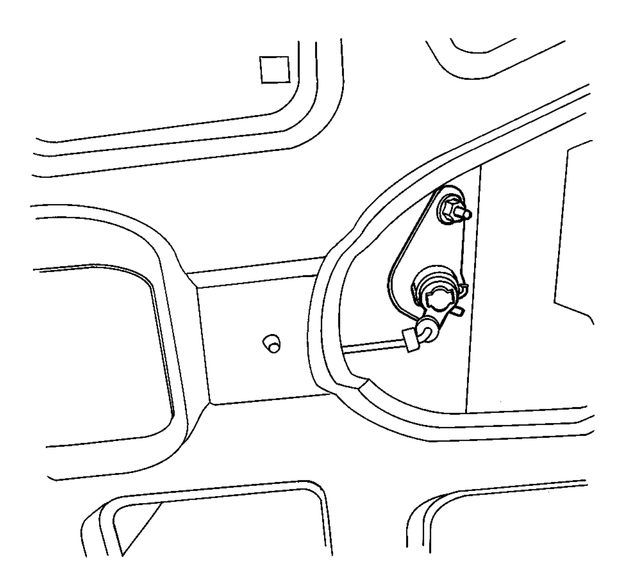


A109S003

LUGGAGE COMPARTMENT LOCK CYLINDER

Removal Procedure

1. Remove the hatchback door lower garnish molding (if equipped). Refer to Section 9G, Interior Trim.
2. Disconnect the lock rod.
3. Remove the nuts and the lock cylinder.



A109S003

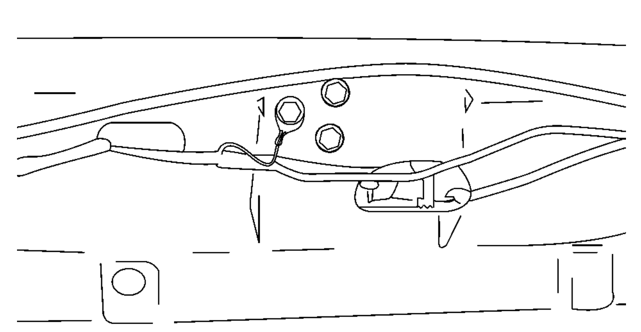
Installation Procedure

1. Install the lock cylinder with the nuts.

   Tighten

   Tighten the luggage compartment lock cylinder nuts to 3 N•m (27 lb-in).

2. Connect the lock rod.
3. Install the hatchback door lower garnish molding (if equipped). Refer to Section 9G, Interior Trim.

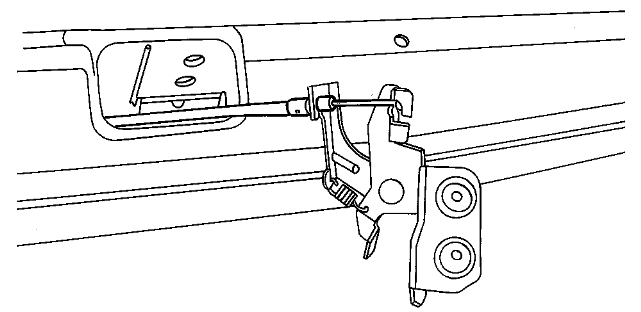


A109S007

LUGGAGE COMPARTMENT LOCK STRIKER (NOTCHBACK)

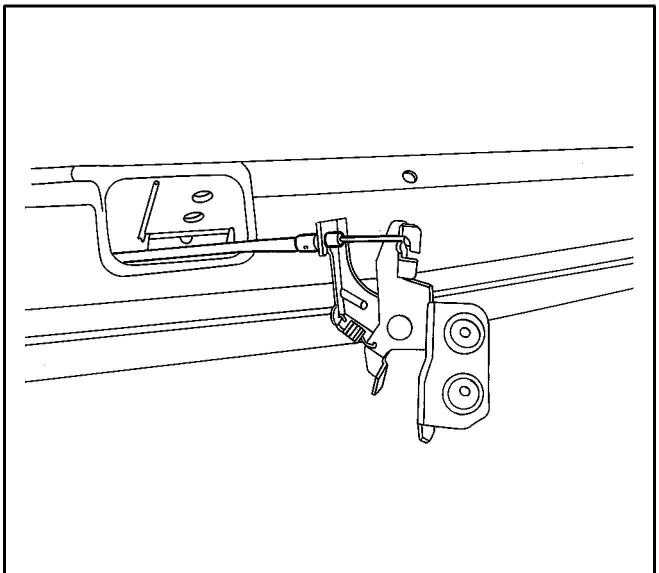
Removal Procedure

1. Open the luggage compartment.
2. Remove the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.
3. Remove the bolts that secure the lock striker.



A109S004

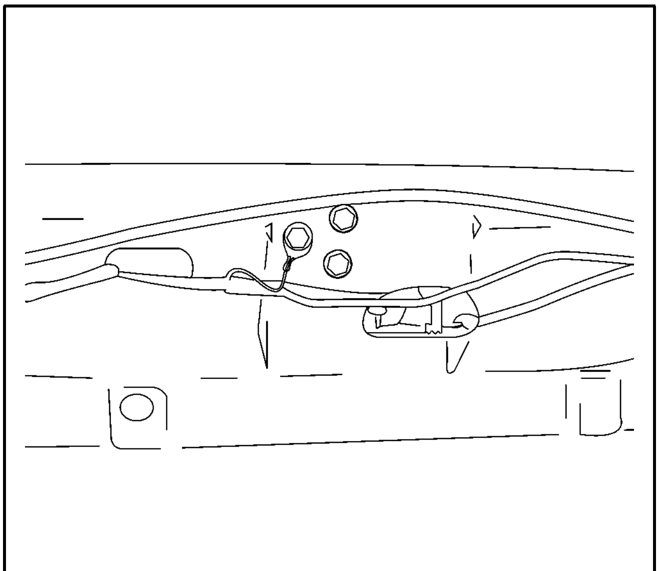
4. Pull the lock striker out.
5. Disconnect the cable from the lock striker.



A109S004

Installation Procedure

1. Connect the lock release cable.



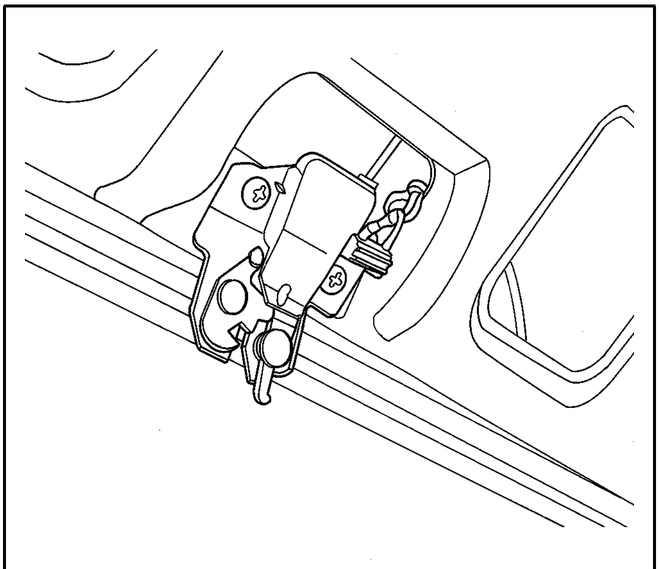
A109S007

2. Install the lock striker with the bolts.

Tighten

Tighten the luggage compartment lock striker bolts to 8 N•m (71 lb-in).

3. Install the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.

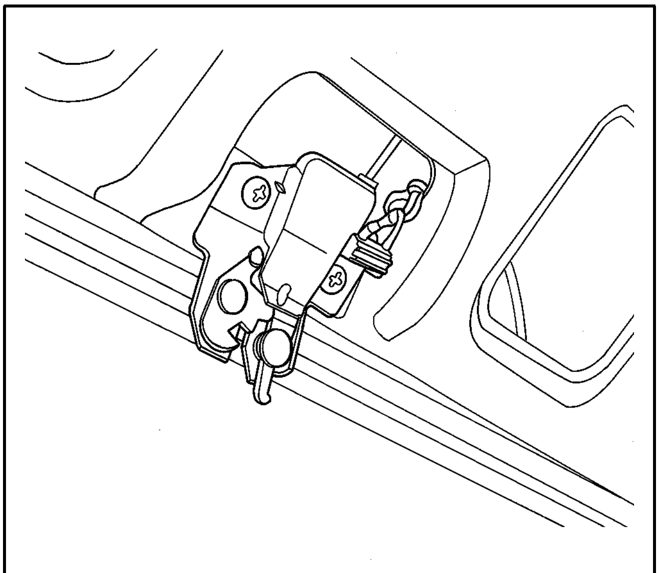


A109S002

LUGGAGE COMPARTMENT LOCK (NOTCHBACK)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the screws and the luggage compartment lock.
3. Disconnect the electrical connector.
4. Disconnect the lock rod.

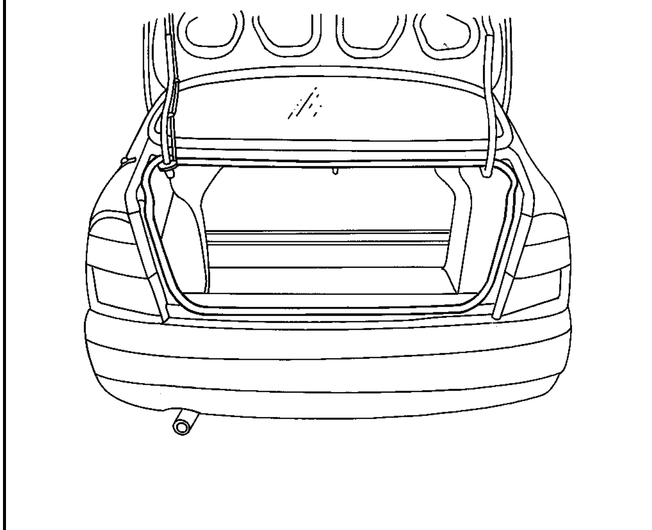

A109S002

Installation Procedure

1. Connect the lock rod.
2. Connect the electrical connector.
3. Install the luggage compartment lock with the screws.

   Tighten

   Tighten the luggage compartment lock screws to 6 N•m (53 lb-in).
4. Connect the negative battery cable.

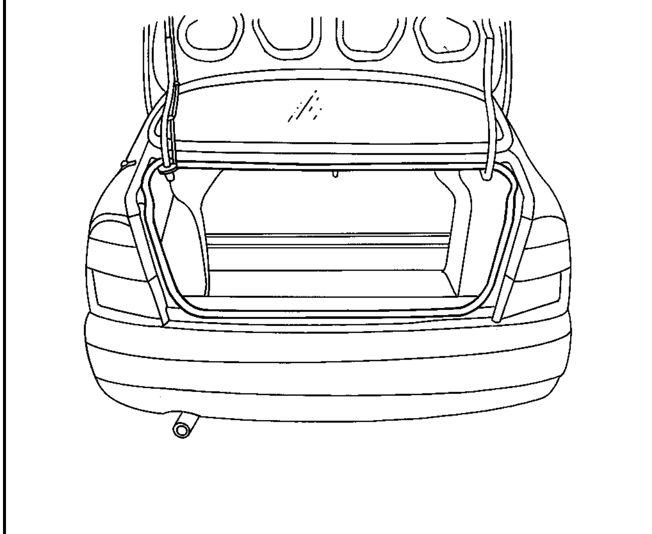

A109S014

WEATHERSTRIP

(Notchback Shown, Hatchback Similar)

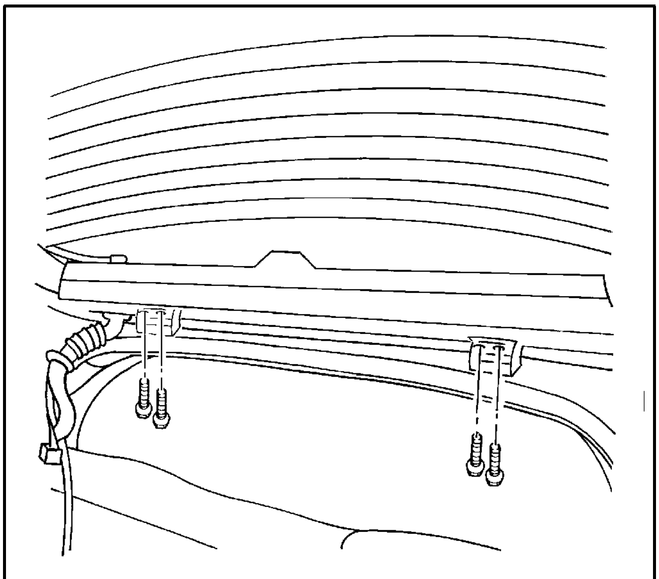
Removal Procedure

1. Open the luggage compartment lid.
2. Remove the luggage compartment rear quarter and rear trim panels. Refer to Section 9G, Interior Trim.
3. Remove the weatherstrip from around the gutter.


A109S014

Installation Procedure

1. Install the weatherstrip onto the gutter flange.
2. Inspect the weatherstrip. Make sure that the clinch is completely seated onto the flange.
3. Using a water hose without a nozzle, test the rear deck lid to make sure that no leaks are present.
4. Install the luggage compartment rear quarter and rear trim panels. Refer to Section 9G, Interior Trim.

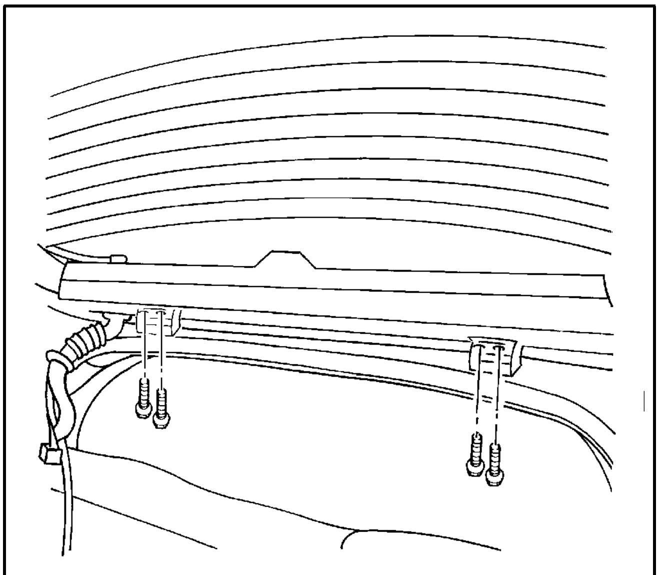


A309S003

HATCHBACK DOOR

Removal Procedure

1. Open and suitably support the hatchback door.
2. Disconnect the hatchback door grommet, the electrical connector, and the washer hose.
3. Remove the gas support assemblies from the hatchback door and the body. Refer to "Gas Support Assemblies" in this section.
4. With the aid of another technician, remove the bolts and the hatchback door from the hinges.



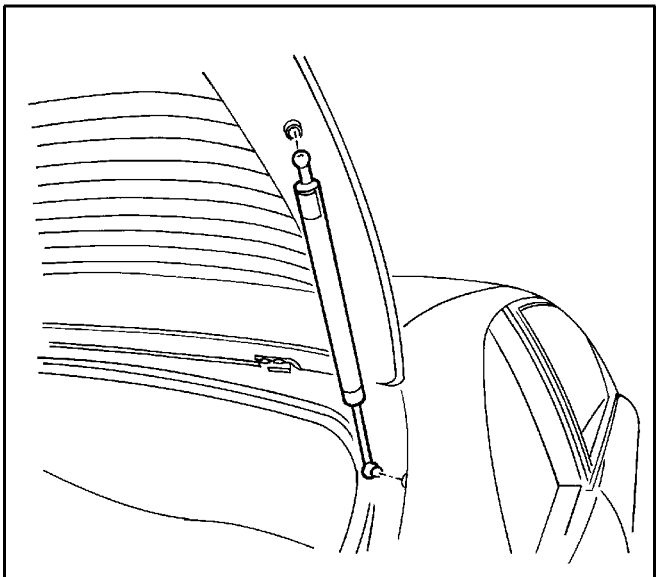
A309S003

Installation Procedure

1. With the aid of another technician, install the hatchback door to the hinges with the bolts.

   Tighten

   Tighten the hatchback door hinge bolts to 20 N•m (15 lb-ft).
2. Install the gas support assemblies to the hatchback door and the body. Refer to "Gas Support Assemblies" in this section.
3. Connect the hatchback door electrical connector, the washer hose, and the grommet.
4. Close the hatchback door.

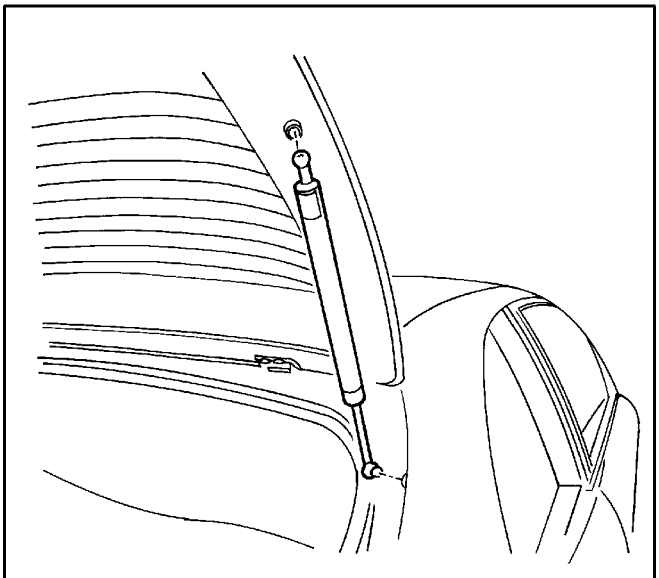


A309S004

GAS SUPPORT ASSEMBLIES

Removal Procedure

1. Open and suitably support the hatchback door.
2. Unscrew and remove the gas support assembly from the hatchback door and the body.



A309S004

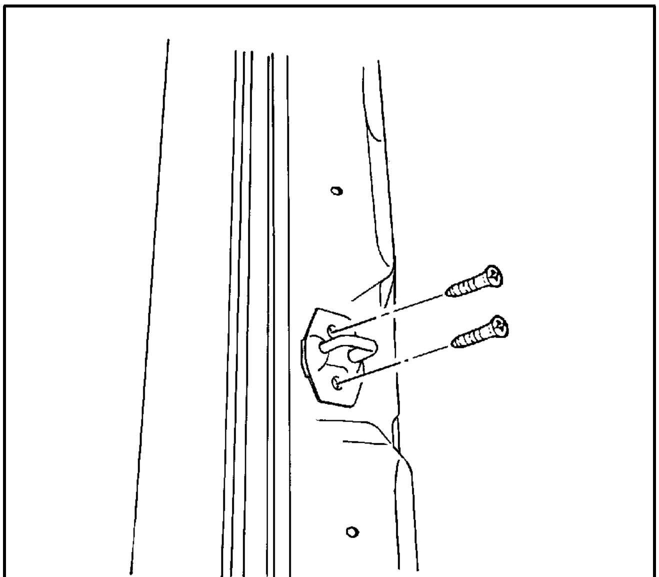
Installation Procedure

1. Install the gas support assembly onto the hatchback door and the body.

Tighten

Tighten the gas support assembly studs to 8 N•m (71 lb-in).

2. Close the hatchback door.

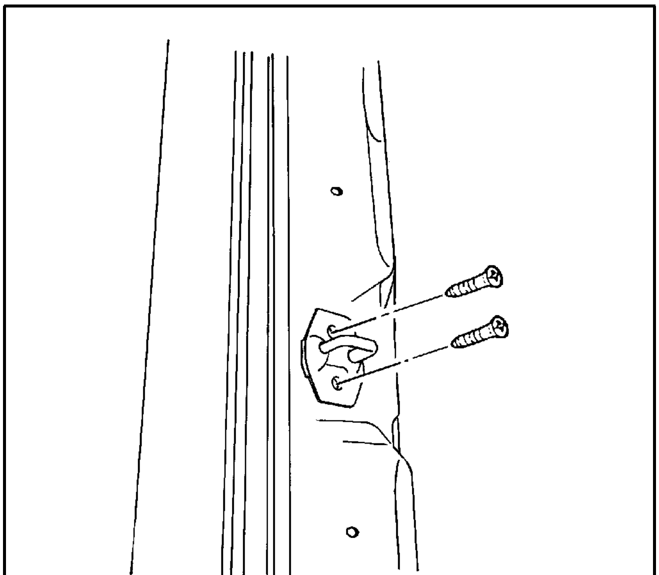


A309S001

HATCHBACK DOOR LOCK STRIKER

Removal Procedure

1. Open the hatchback door.
2. Remove the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.
3. Remove the screws that secure the lock striker.



A309S001

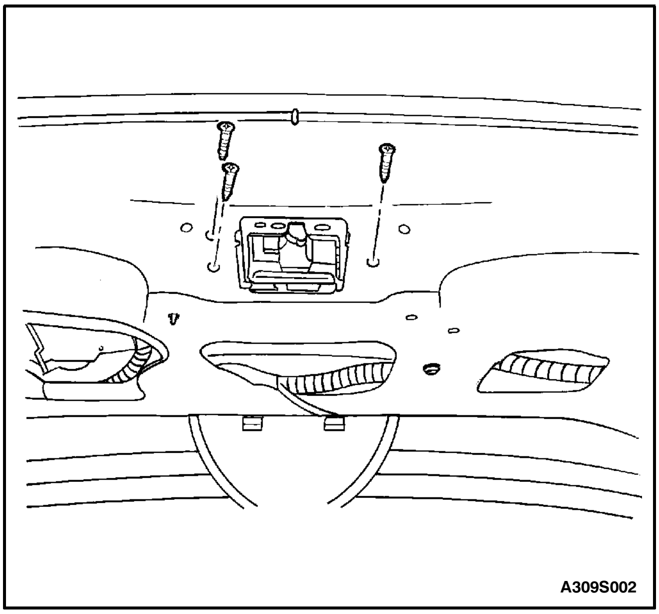
Installation Procedure

1. Install the lock striker with the screws.

Tighten

Tighten the hatchback door lock striker screws to 20 N•m (15 lb-ft).

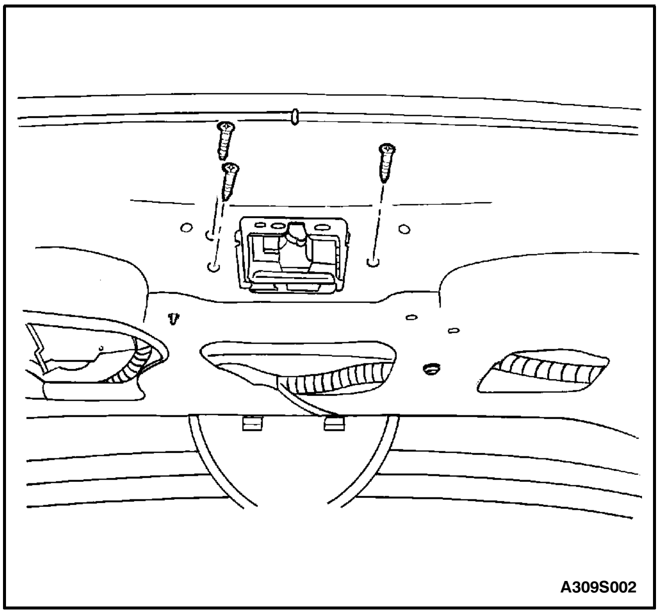
2. Install the luggage compartment rear trim panel. Refer to Section 9G, Interior Trim.
3. Close the hatchback door.



HATCHBACK DOOR LOCK

Removal Procedure

1. Open the hatchback door.
2. Remove the hatchback door lower garnish molding. Refer to Section 9G, Interior Trim.
3. Remove the screws and the hatchback lock.
4. Disconnect the lock rods.



Installation Procedure

1. Connect the lock rods.
2. Install the hatchback lock with the screws.

   ### Tighten

   Tighten the hatchback door lock screws to 6 N•m (53 lb-in).
3. Install the hatchback door lower garnish molding. Refer to Section 9G, Interior Trim.
4. Close the hatchback door.

GENERAL DESCRIPTION AND SYSTEM OPERATION

FUEL FILLER DOOR

The fuel filler door attaches to the fuel tank pocket on the right side of the vehicle.

REAR DECK LID (NOTCHBACK)

The rear deck lid consists of an inner and an outer panel hemmed around the perimeter and bonded together with structural adhesive. The torque rods assist in the opening of the rear deck lid and hold it in the open position.

HATCHBACK DOOR

The hatchback door consists of the rear hatch glass within a steel frame. The steel frame is made of an inner and an outer panel hemmed around the perimeter, and bonded together with structural adhesive. The gas support assemblies assist in the opening of the hatchback door, and can hold the door open.

FIRE EXTINGUISHER

The fire extinguisher is located in the luggage compartment. The fire extinguisher is standard in cars sold in Lebanon and Libya, and is a dealer-installed option in Brazil.

SECTION 9T

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

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IMMOBILIZER ANTI-THEFT SYSTEM

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BLANK

SECTION 9T

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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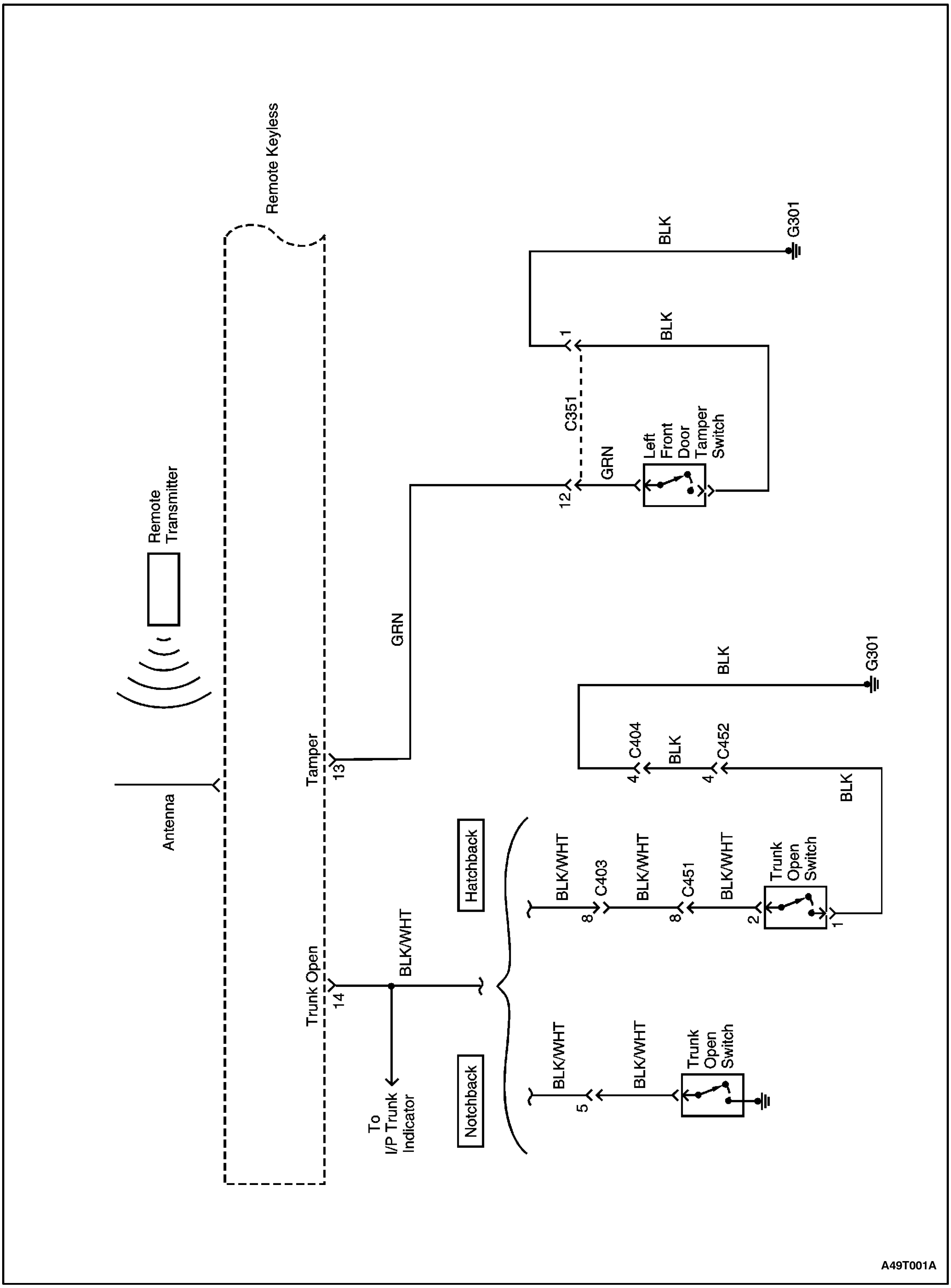
Application	N•m	Lb-Ft	Lb-In
Siren Mounting Screws	3.5	-	31

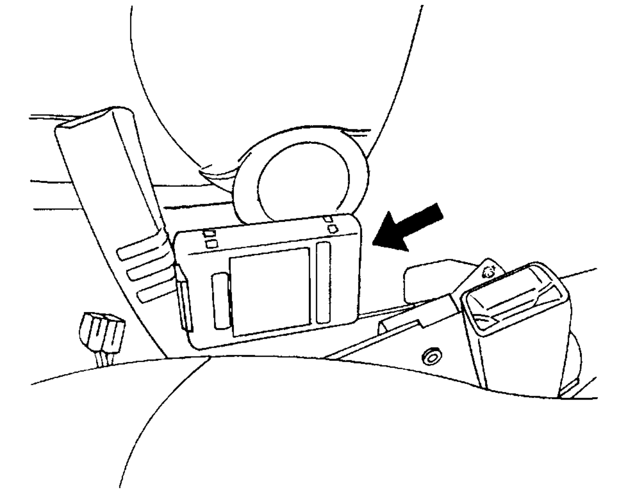
SCHEMATIC AND ROUTING DIAGRAMS



MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

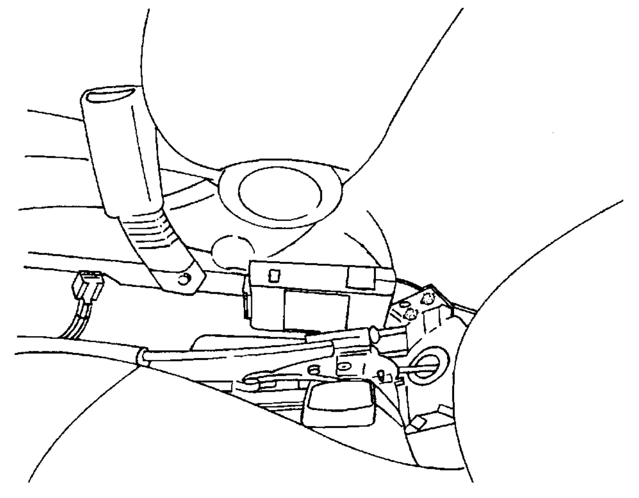
CONTROL MODULE/RECEIVER



A49T005A

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the rear portion of the floor console. Refer to Section 9G, Interior Trim.
3. Disconnect the control module/receiver electrical connector.
4. Slide the control module/receiver away from its mounting bracket.

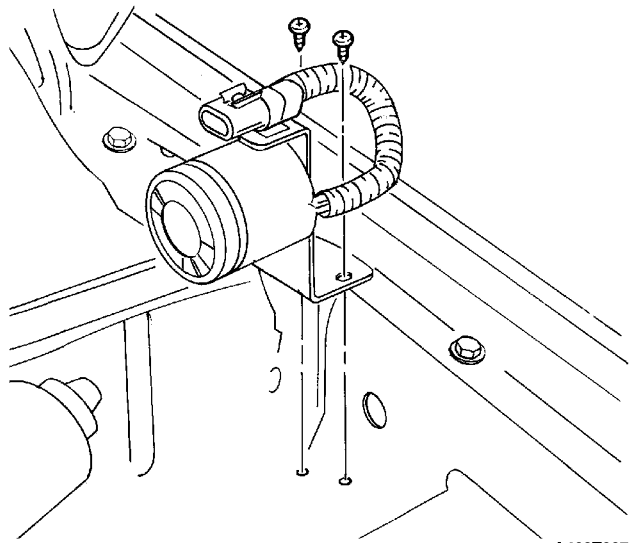


A49T006A

Installation Procedure

1. Install the control module/receiver on its mounting bracket.
2. Connect the control module/receiver electrical connector.
3. Install the floor console. Refer to Section 9G, Interior Trim.
4. Connect the negative battery cable.

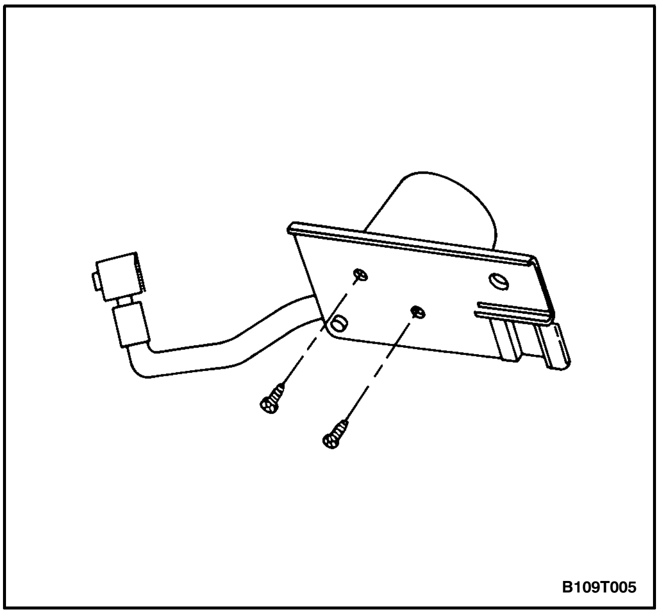
SIREN



A409T007

Removal Procedure

1. Remove the siren electrical connector.
2. Remove the siren bracket mounting screws and siren.



Installation Procedure

1. Install the siren with the mounting screws.

   Tighten

   Tighten the siren mounting screws to 3.5 N•m (31 lb-in).
2. Connect the siren electrical connector.

PASSWORD PROGRAMMING

If a transmitter is lost or damaged, the control module/receiver must be re-programmed to communicate with a new transmitter. The passwords recorded in the control module/receiver should not be deleted when power is not connected to the control module/receiver.

Each control module/receiver should be able to record five passwords. The following method is used to record new passwords in the control module/receiver:

1. Connect the scan tool to the data link connector (DLC).
2. Turn the ignition ON.
3. Use the scan tool to delete the current passwords.
4. Send the programming mode message to the control module/receiver.
5. Press any button of the transmitter to generate a data code, including a password which will be recorded by the control module/receiver. The control module/receiver will send a response message to the scan tool to indicate that the first password has been recorded.
6. Press any button of the transmitter to generate a data code, including a password which will be recorded by the control module/receiver. The control module/receiver will then send a response message to the scan tool to indicate that the second password has been recorded.
7. Press any button of the transmitter three more times until the control module/receiver has indicated to the scan tool that the third, fourth, and fifth passwords have been recorded.
8. Turn the ignition OFF.
9. Disconnect the scan tool.

The control module/receiver leaves the programming mode automatically and switches to the normal operating mode when either of the following conditions occur:

- The scan tool is disconnected from the DLC.
- Five passwords are recorded in the control module/receiver.

GENERAL DESCRIPTION AND SYSTEM OPERATION

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

The remote keyless entry and anti-theft system can perform the following functions:

- Remotely lock and unlock the vehicle doors by means of a hand-held, high-frequency transmitter.
- Sense intrusion into the vehicle.
- Activate a warning in the event of an intrusion.
- Help the driver find the vehicle in a parking area.
- Automatically re-lock the doors if the door or the trunk is not opened within 30 seconds after the vehicle has been unlocked by the remote keyless entry.
- Communicate serial data to a scan tool to help diagnose system faults.

The remote keyless entry and anti-theft system consists of the following components:

- Keyless entry and anti-theft control module/receiver.
- Security indicator.
- Trunk open switch.
- Trunk tamper switch.
- Front door tamper switches.
- Door contact switches.
- Central door lock relay.
- Turn signal bulbs.
- Siren.
- Hood open switch.

REMOTE LOCKING AND UNLOCKING

The hand-held transmitter locks and unlocks the vehicle doors by sending radio waves to the control module/receiver in the vehicle. The effective range of the transmitter varies between 5 and 10 meters, (approximately 16 to 32 feet), depending on whether or not objects, such as other vehicles are blocking the path of the radio waves.

The transmitter has a LOCK button and an UNLOCK button which only function when the ignition is OFF. Pressing the UNLOCK button has the following effects:

- The doors are unlocked.
- The turn signal bulbs flash twice.
- The control module is disarmed.

Pressing the LOCK button has the following effects:

- The doors are locked.
- The turn signal bulbs flash once.
- A “Chirp” sound is heard.
- The control module is armed.

The transmitter has a replaceable battery. The battery is designed to last at least three years before replacement is necessary.

SECURITY INDICATOR

There is a security indicator on the instrument panel. After the LOCK button of the transmitter is pressed, the module is placed in the armed mode, and the security indicator flashes. The security indicator turns ON for 0.1 second and OFF for 0.7 second. It then flashes at that frequency until the control module/receiver is disarmed.

INTRUSION SENSING

The anti-theft function is armed if the transmitter sends the LOCK message to the control module/receiver when the ignition is OFF. When the hood, door, or trunk is opened, the hood open, door contact, or trunk open switch sends a “ground” signal to the control module/receiver. Unless the control module/receiver is disarmed, the siren will be activated when the “ground” signal is received from the trunk open, hood open, or door contact switches.

The following actions disarm the anti-theft system:

- An UNLOCK message is received from the transmitter.
- Key operation is detected by the tamper switches. (The tamper switches are operated by the lock cylinders in the front driver’s door.)

The alarm will also be activated if the control module/receiver detects voltage from the ignition before either of the following conditions occur:

- An UNLOCK message is received from the transmitter.
- Key operation is indicated by the tamper switches.

SIREN

The remote keyless entry system is armed when the LOCK message is received from the transmitter when the ignition is OFF. When the system is armed, it will activate the siren and flash the turn signals for 28 seconds if any of the following conditions occur:

- Close all the windows.
- Turn the ignition key to LOCK and remove the key.
- Have all passengers get out of the vehicle.
- Close all doors, the hood and the turnk lid.
- The control module/receiver detects ignition voltage while the system is armed.

The siren will not operate if any of the following conditions occur after the system has been armed:

- The driver’s door is opened with the key.

- The UNLOCK or LOCK button on the remote transmitter is pressed within 2 seconds after the siren is activated.

VEHICLE LOCATOR

The remote keyless entry system assists the driver in locating the vehicle. When the vehicle is unlocked with the remote control, the turn signals flash twice to indicate the location of the vehicle. The duration of the flashes and the length of time between flashes is used to indicate certain vehicle conditions. Refer to "Fault or Alarm Indication" in this section.

AUTOLOCKING (SAFETY LOCK)

The remote keyless entry system features an autolocking feature. If the doors are unlocked with the remote transmitter when the control module/receiver is in the armed mode, the doors are automatically re-locked after 30 seconds unless any of the following events occur:

- A door is opened.
- The ignition is ON.
- The trunk is opened.
- The hood is opened.

CONTROL MODULE/RECEIVER

The remote keyless entry control module/receiver is contained in the floor console. The module/receiver processes signals from the remote transmitter and various switches. It activates the alarm if an intrusion is detected. The control module/receiver also has a self-diagnostic function which will display trouble codes. In order to display trouble codes, a scan tool must be connected to the data link connector (DLC).

The control module/receiver will not communicate with transmitters from other vehicles because there are over four billion possible electronic password combinations. It is highly unlikely that any transmitters will use the same password. The control module/receiver has an attached antenna to detect signals from the transmitter.

FAULT OR ALARM INDICATION

When the UNLOCK button on the remote transmitter is pressed, the control module/receiver will flash the parking lights to indicate information about the remote keyless entry and anti-theft system.

Normal Condition: If there has not been an intrusion, and no fault has been detected, the control module/receiver will signal a normal condition when the UNLOCK button is pressed. The parking lights will flash twice for 0.5 second, with a 0.5 second pause between flashes.

Fault Indication: If there is a fault in the remote keyless entry and anti-theft system, the control module/receiver will signal the fault when the UNLOCK button is pressed. The parking lights will flash twice for 1 second, with a 0.5 second pause between flashes.

Alarm Indication: If there has been an intrusion since the last time the LOCK button was pressed, the control module/receiver will signal that there has been an intrusion when the UNLOCK button is pressed. The parking lights will flash twice for 0.5 second, with a 1.5 second pause between flashes.

Alarm and fault information will be erased the next time the transmitter arms the control module/receiver by transmitting a LOCK message.

PANIC BUTTON

In addition to the LOCK and UNLOCK buttons on the transmitter, there is another button which is used to activate the siren if a threatening situation occurs while the driver is approaching the vehicle. If the panic button is held down for 2 seconds, the siren will be activated for 30 seconds, and the turn signal lamps will flash during that time.

SECTION 9T

IMMOBILIZER ANTI-THEFT SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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Application	N•m	Lb-Ft	Lb-In
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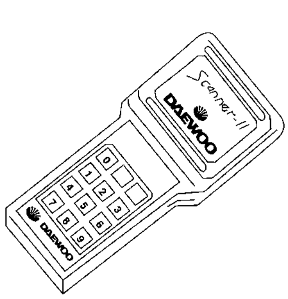
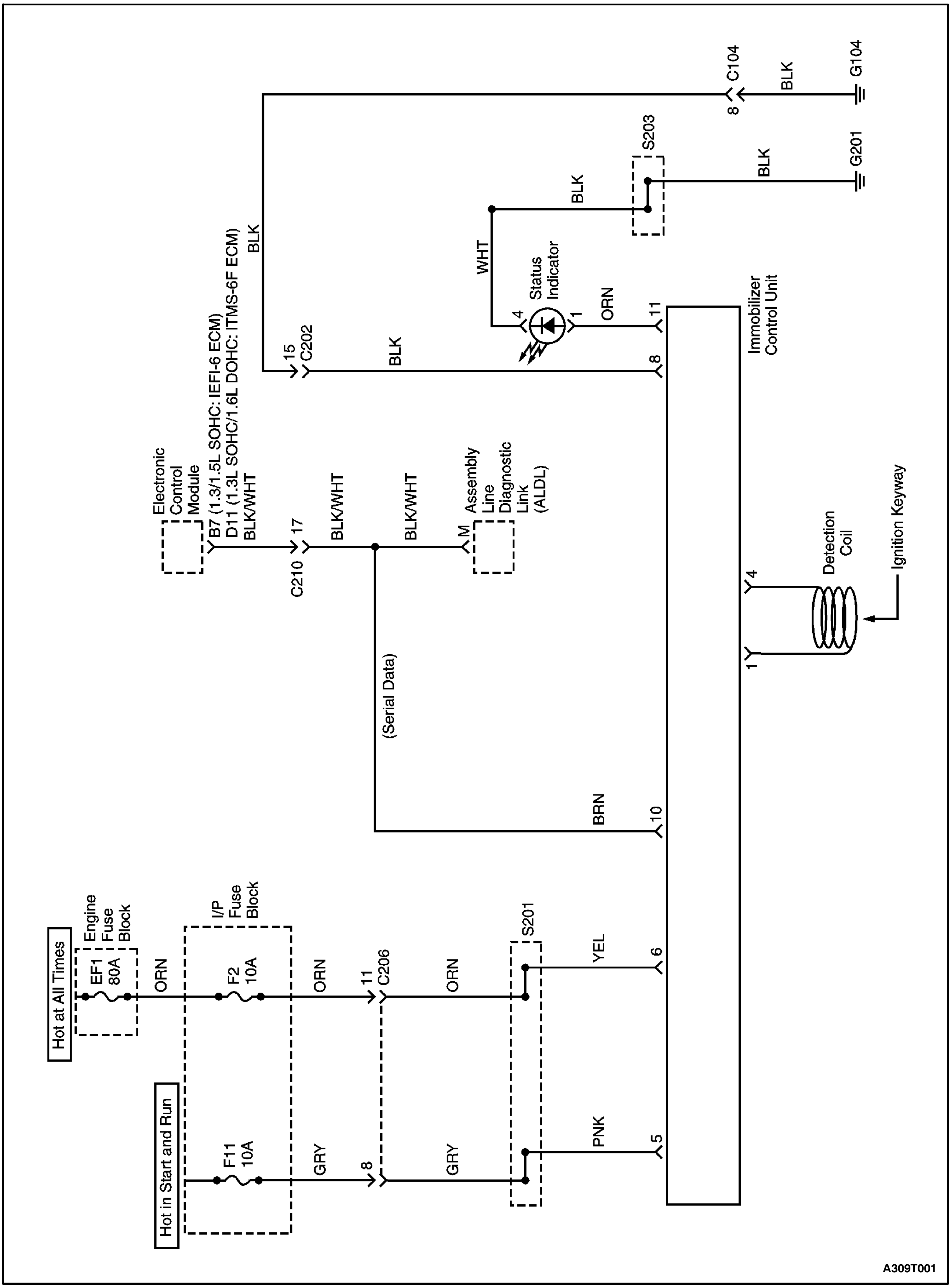
SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A110B003	Scan Tool

SCHEMATIC AND ROUTING DIAGRAMS



DIAGNOSIS

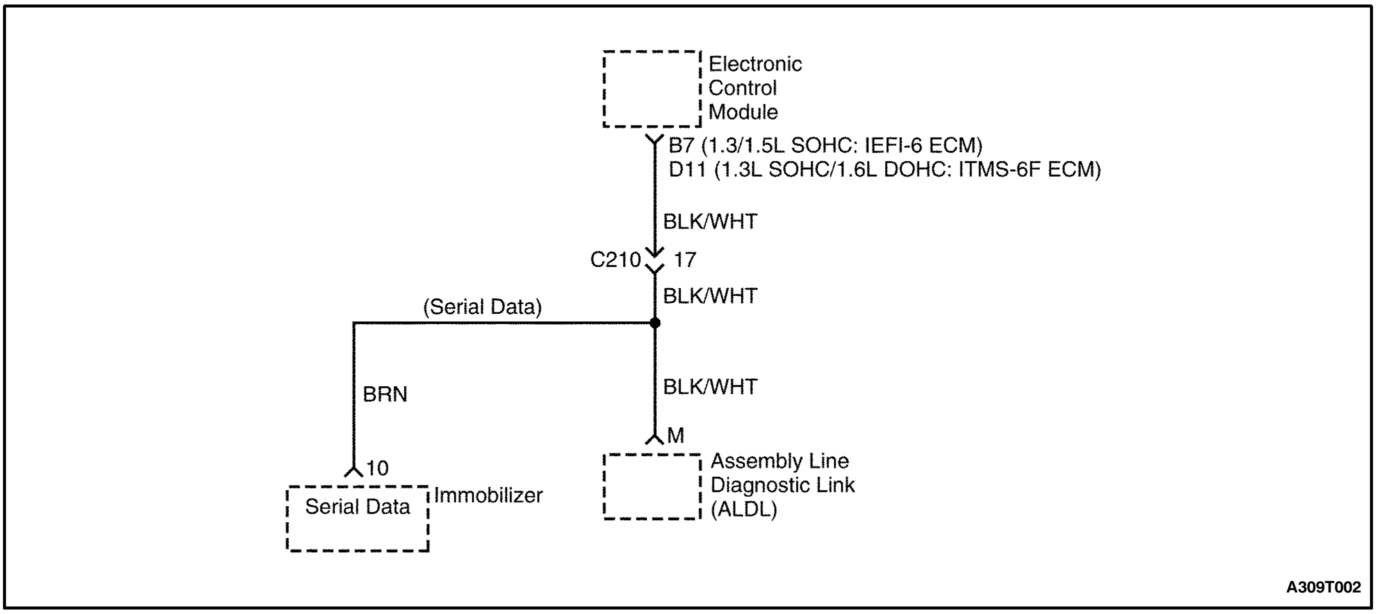
IMMOBILIZER ANTI-THEFT SYSTEM

The immobilizer anti-theft system requires diagnosis when it is not possible to start the engine. If the no-start condition occurs because of the immobilizer system, a diagnostic trouble code (DTC) 53 should be set. The immobilizer control unit monitors the detection and reading of the ignition key, and the self-test capacity is limited to those functions. Faults are communicated to a scan tool during diagnosis, but they are not stored in the immobilizer control unit's memory. Unauthorized use of a scan tool could be a method of defeating the immobilizer anti-theft system, so certain scan tool procedures require the use of a password. The following functions are password protected:

- Coding of an additional key.
- Deleting all key codes.
- Deletion of the immobilizer identification (ID) Code.
- Deletion of the electronic control module (ECM) ID Code.

The following functions do not require a password:

- Reading an ignition key to determine if the transponder is working or if a key is authorized.
- Reading the immobilizer ID code to verify that it matches the ECM ID code.



DIAGNOSTIC TROUBLE CODE (DTC) 53
ECM IMMOBILIZED ERROR

Circuit Description

When the ignition is turned ON, the key is tested by the immobilizer anti-theft system. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the memory of the immobilizer control unit. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM have been substituted to defeat the system. If the ECM receives an invalid release message, the ECM performs the following actions:

- Disables the fuel injector circuit.
- Disables the fuel pump circuit.

DTC 53 Will Set When

- The ECM does not receive the signal from the immobilizer control module within .562 second when the vehicle is stationary, or within 1.5 seconds when the vehicle is moving.
- The ECM receives an incorrect release message from the immobilizer control unit more than five times.
- The above conditions are maintained until the ignition is switched OFF.

DTC 53 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is issued.

DTC 53 ECM Immobilized Error

Step	Action	Value	Yes	No
1	Connect the scan tool using the following procedure: 1. Insert the immobilizer data cartridge into the scan tool. 2. Turn the ignition switch to the OFF position. 3. Connect the scan tool to the assembly line diagnostic link (ALDL). 4. Connect the scan tool's power cord to the cigar lighter socket. 5. Turn the ignition ON, but do not start the engine. Is communication established between the scan tool and the immobilizer control unit?	-	Go to Step 2	Go to "Communication Between Immobilizer and Test Equipment"
2	Select SYSTEM DIAGNOSIS from the scan tool menu. Does the KEY STATUS message indicate POS NR (position number) 00?	-	Go to "Key Status Errors"	Go to Step 3
3	Read the IMMO & ECM ID CODE message that was displayed after requesting SYSTEM DIAGNOSIS. Does the message ID CODE DIFFERENT appear?	-	Go to "Identification (ID) Code Reprogramming"	Go to Step 4
4	Check for an open serial data wire between the immobilizer control unit and the electronic control module (ECM). Is the circuit open?	-	Go to Step 5	Go to Step 6
5	Repair the open serial data wire between the ECM and the immobilizer control unit. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Reprogram the identification (ID) code. Refer to "Identification (ID) Code Reprogramming" in this section. Is the repair complete?	-	System OK	-

KEY STATUS ERRORS

The following KEY STATUS messages may be shown on the scan tool after commanding SYSTEM DIAGNOSIS:

- IGNITION OFF STATUS. This message informs the technician that the ignition is off during the key coding process. Turn the ignition ON during key coding, but do not start the engine.
- KEY IS OCCUPIED. Only five keys may be coded. If a new key is desired, the previous key codes must be deleted. Up to five keys may then be authorized.
- ALREADY AUTHORIZED. Key coding is being attempted with a key that is already authorized.
- ERROR NO. 001, 002, 003. There is no communication between the transponder in the ignition key and the detection coil. Follow the steps below to diagnose the problem:
    1. Try a different key. If a different key works, the problem is in the original key.
    2. If trying a different key results in the same error message, replace the detection coil.
- INVALID KEY. The communication between the immobilizer control unit and the key transponder has not validated the key. Follow the steps below to diagnose the problem:
    1. Code the key. Refer to "Key Coding Procedure" in this section.
    2. If the same message is received after key coding, check the connection of the detection coil.
    3. If the detection coil is okay, replace the immobilizer. Refer to "Immobilizer Control Unit" in this section.

- **NO TRANSPONDER DETECTED.** The fault may be in ignition key transponder, the detection coil, or the immobilizer. Follow the steps below to diagnose the problem
  1. Try a different key. If a different key works, the problem is in the original key.
  2. If trying a different key results in the same error message, check the connection of the detection coil.
  3. If the connection of the detection coil is okay, disconnect the detection coil and use an ohmmeter to check for an open detection coil.
  4. If the detection coil is not open, replace the immobilizer control unit. Refer to "Immobilizer Control Unit" in this section.

COMMUNICATION BETWEEN IMMOBILIZER AND TEST EQUIPMENT

1. Connect the test equipment as described in the Scan Tool Equipment Manual.
2. If communication between the scan tool and the test equipment is unsuccessful, wait 30 seconds and try again.
3. If communication is not successful on the second try, turn the ignition OFF and check the wire and connectors between the immobilizer control unit terminal 3 and the assembly line diagnostic link (ALDL) terminal M.
4. If the wire and connectors between the ALDL and the immobilizer control unit are okay, replace the immobilizer control unit. Refer to "Immobilizer Control Unit" in this section.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

KEY CODING PROCEDURE

1. Install the immobilizer control unit cartridge in the scan tool.
2. Turn the ignition OFF.
3. Connect the scan tool.
4. Turn the ignition ON with the key to be coded.
5. Enter the four-number password that enables service personnel to use the scan tool for coding keys.
6. A lost key can be deleted only by deleting all keys and reauthorizing the remaining keys as new keys. If a key is lost, go to the next step. If no keys have been lost, but an additional key is desired, go to Step 8.
7. Use the scan tool command DELETE ALL KEY CODES.
8. Use the scan tool command AUTHORIZE ONE ADDITIONAL KEY.
9. Repeat Steps 4, 5, and 6 until the immobilizer control unit has recorded all of the new keys or reauthorized all of the remaining keys after a deletion. The immobilizer control unit can record a maximum of five keys.
10. Return the system to the normal mode.
11. Turn OFF the ignition.
12. Turn ON the ignition.
13. Crank to start the engine.

IDENTIFICATION (ID) CODE REPROGRAMMING

Reprogram the identification (ID) code in the following situations:

- An electronic control unit is replaced.
- An engine control module (ECM) is replaced.

If a valid key has been lost, refer to "Key Coding Procedure" in this section.

Reprogramming Procedure

1. Turn the ignition OFF. Reprogramming is not allowed while the engine is running.
2. Insert the immobilizer control unit cartridge into the scan tool.
3. Do not start the vehicle, but turn the ignition ON.
4. Enter the four-number password that enables service personnel to use the scan tool for coding keys.
5. Use the scan tool to command RESET ID CODE.

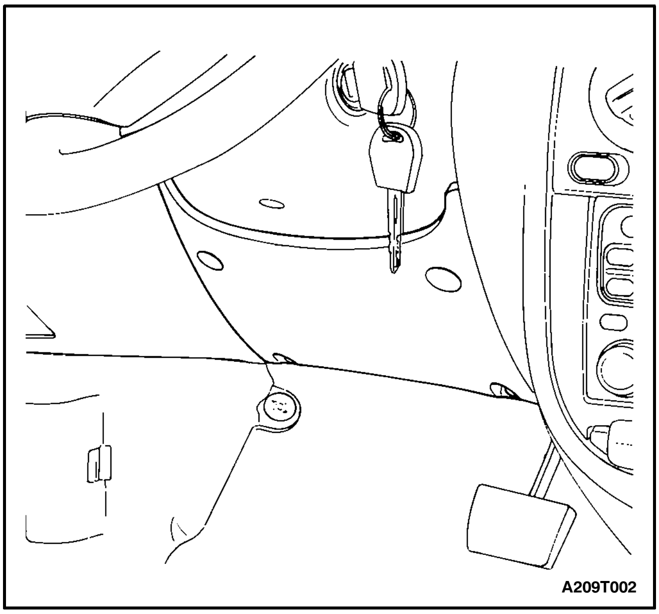
6. Turn the ignition OFF and ON again, but do not crank or start the engine. The ECM will reset the ECM ID code to match the new ID code that was calculated and sent by the immobilizer control unit when the ignition was first turned ON after the reset command.
7. Return the system to the normal mode.
8. Turn OFF the ignition.
9. Turn ON the ignition.
10. Start the engine.

After reprogramming the ID code, the scan tool SYSTEM DIAGNOSIS command can verify that the ECM ID code matches the immobilizer control unit ID code.

If the reprogramming procedure does not result in matching ID codes, check the electrical connectors for the serial data wire between the immobilizer control unit and the ECM.

IGNITION KEY TRANSPONDER

If a transponder is faulty, the ignition key must be replaced. It is not possible to install a new transponder into a key.

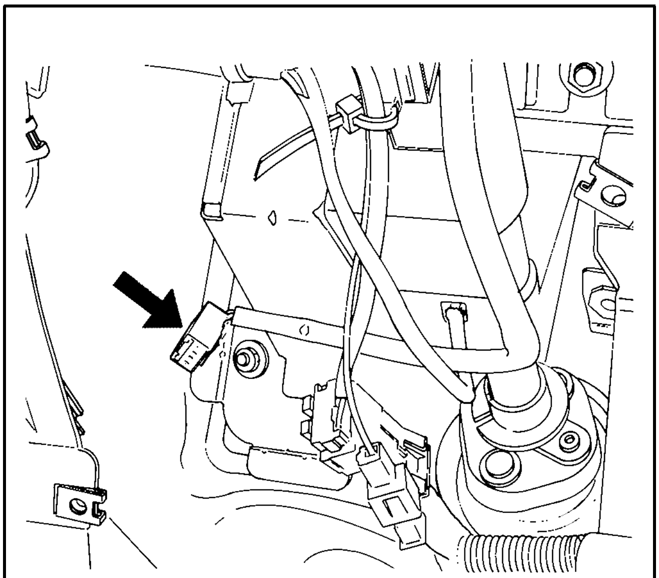


DETECTION COIL

(Left-Hand Drive Shown, Right-Hand Drive Similar)

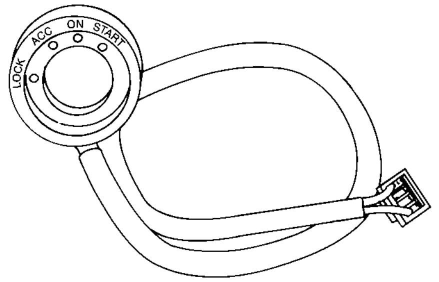
Removal Procedure

1. Remove the retaining screws from the trim panel below the steering column.



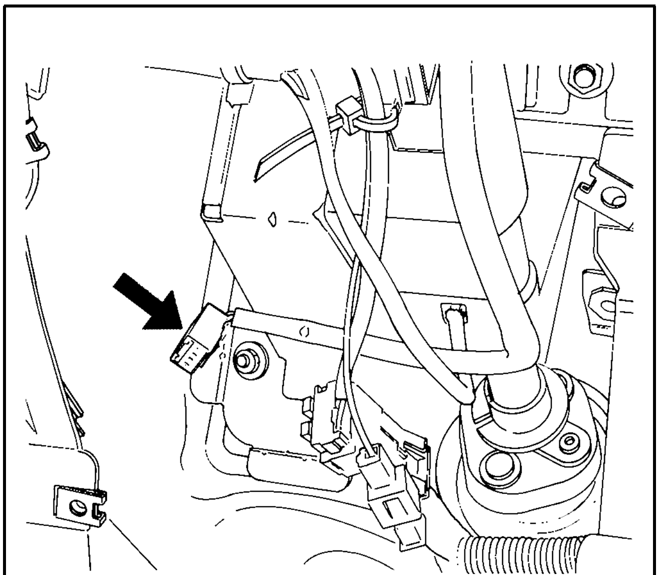
A209T004

2. Slide the trim panel upward and pull outward to remove it.
3. Remove the steering column lower cover. Refer to Section 6E, Steering Wheel and Column.
4. Disconnect the two-pin connector from the immobilizer.



A209T005

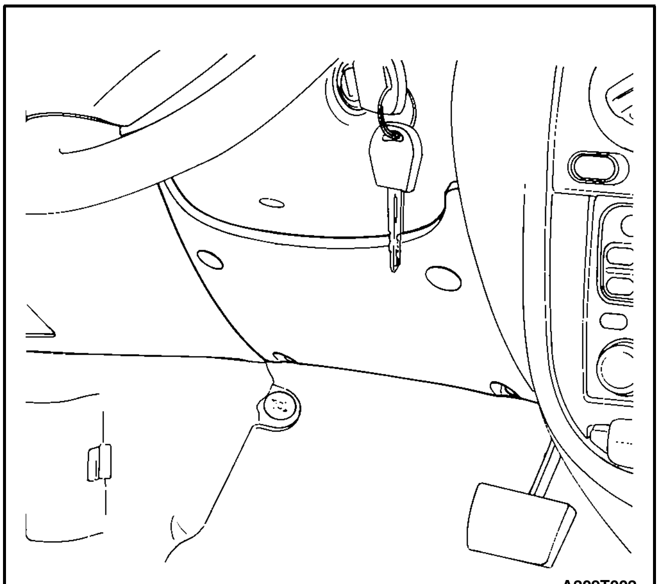
5. Pry the detection coil away from the lock cylinder. If the detection coil will be replaced with a new one, it does not matter if the key position trim ring is damaged during removal. A new trim ring is part of the new detection coil.



A209T004

Installation Procedure

1. Install the detection coil by pressing it onto the lock cylinder until it snaps in place.
2. Connect the two-pin connector to the immobilizer.

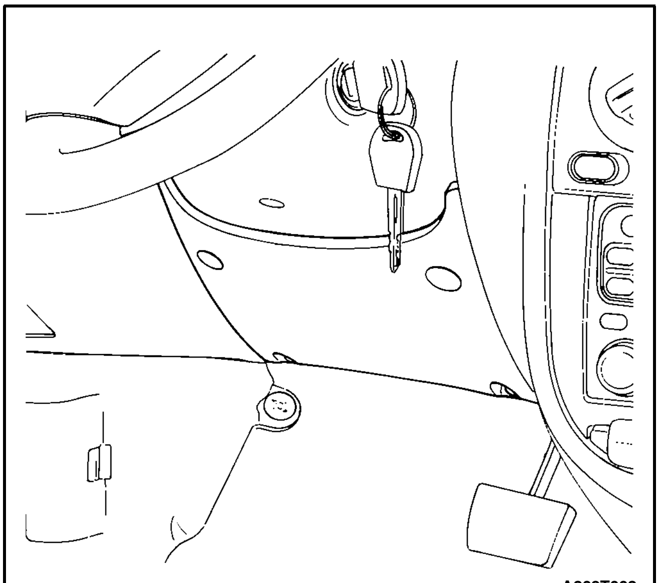


A209T002

3. Install the steering column lower cover. Refer to Section 6E, Steering Wheel and Column.
4. Install the trim panel using the retaining screws.

Tighten

Tighten the trim panel retaining screws to 3 N•m (27 lb-in).



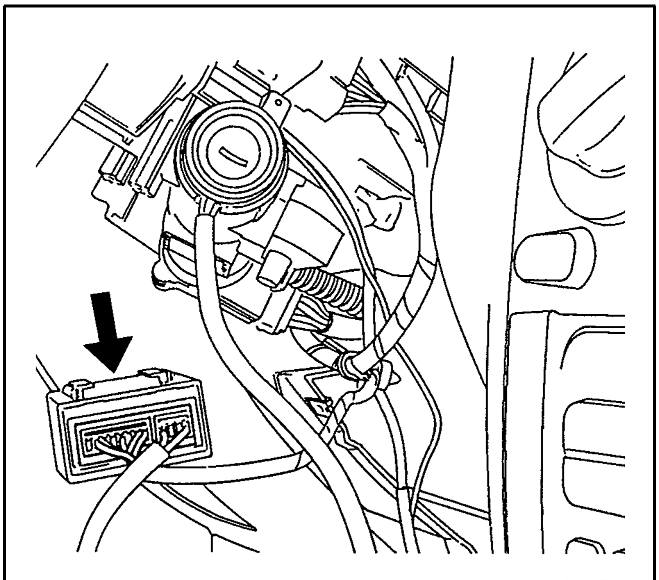
A209T002

IMMOBILIZER CONTROL UNIT

(Left-Hand Drive Shown, Right-Hand Drive Similar)

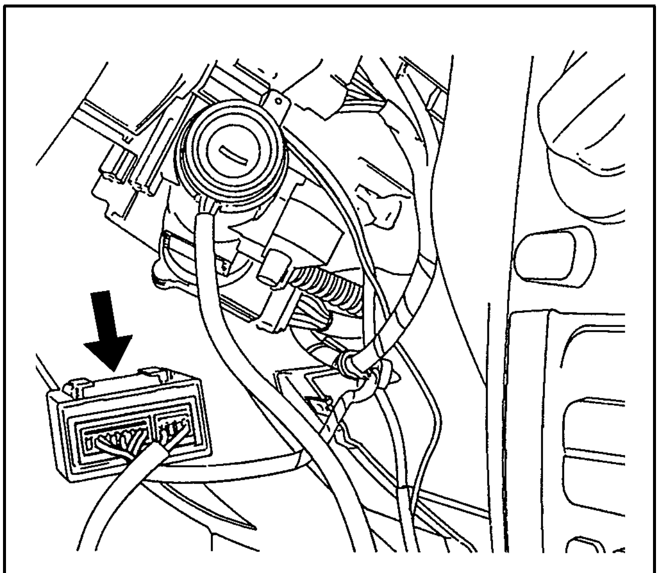
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the retaining screws from the trim panel below the steering column.



A209T008

2. Slide the trim panel upward and pull outward to remove it.
3. Cut the tie-strap which attaches the yellow supplemental inflatable restraint wires to a retaining clip. Use caution not to damage the wires or the retaining clip.
4. Slide the immobilizer control unit toward the steering wheel until it slides off its mounting bracket.
5. Disconnect the electrical connectors from the immobilizer control unit.

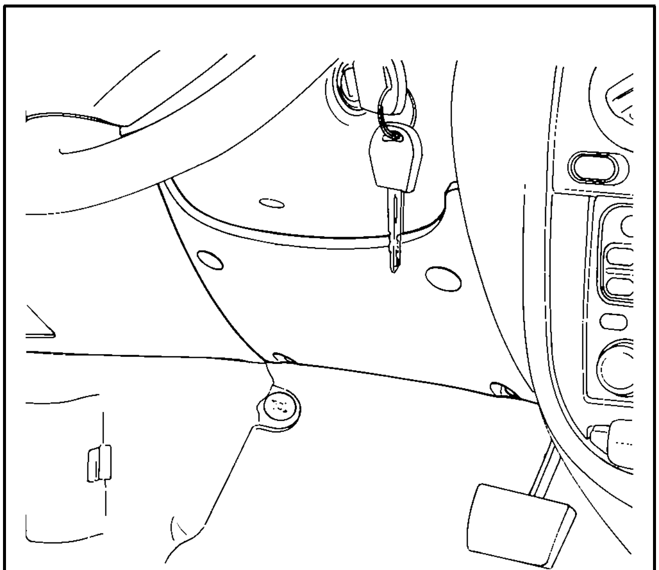


A209T008

Installation Procedure

Important: After replacing the immobilizer, the keys must be re-authorized using the key coding procedure. Refer to "Key Coding Procedure" in this section. Also, the electronic control module (ECM) identification (ID) code must be reset. Refer to "Identification (ID) Code Reprogramming" in this section.

1. Connect the electrical connectors to the immobilizer control unit.



A209T002

2. Slide the immobilizer control unit onto its mounting bracket.
3. Use a tie-strap to fasten the yellow supplemental inflatable restraint wires to the retaining clip.
4. Install the trim panel using the retaining screws.

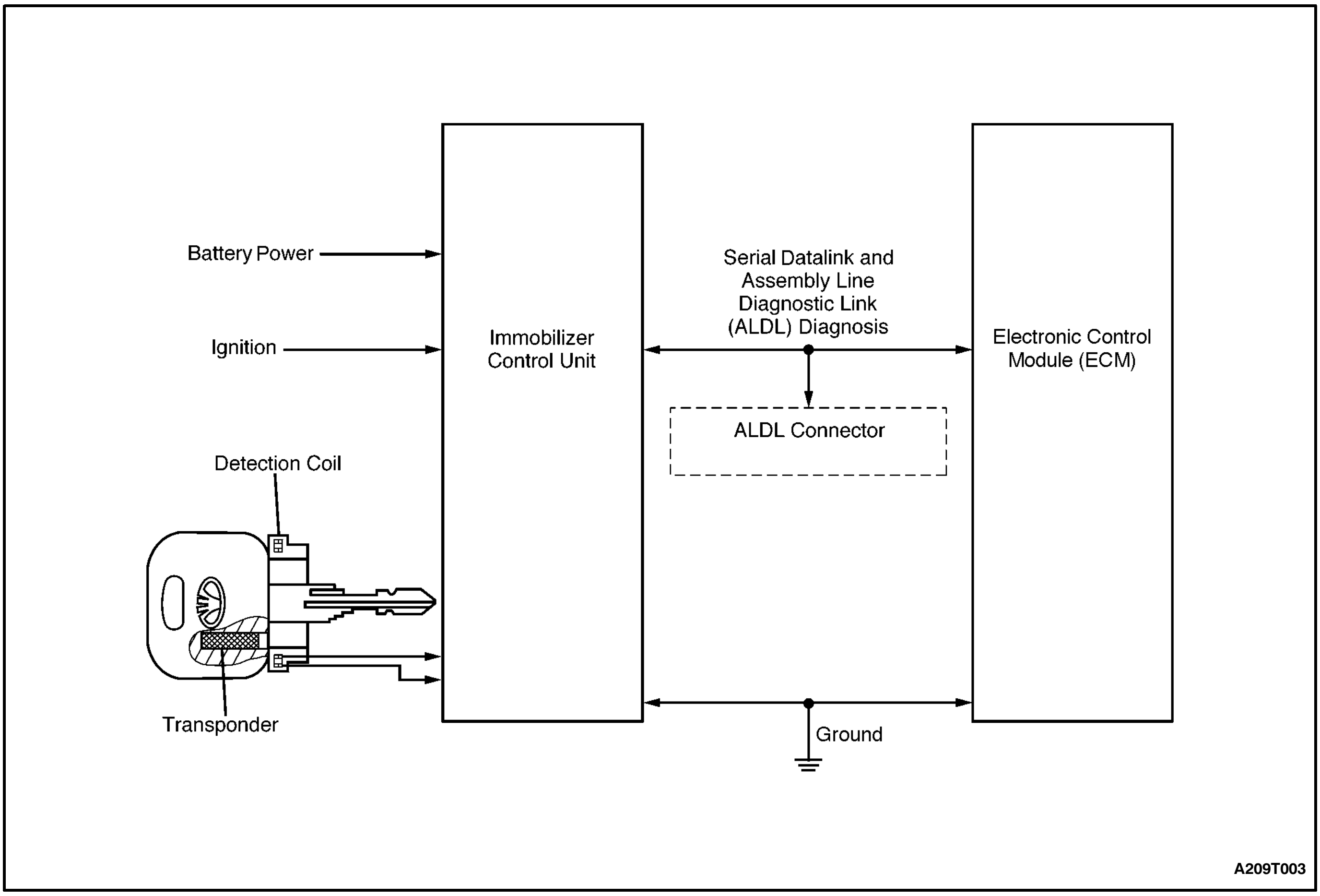
Tighten

Tighten the trim panel retaining screws to 3 N•m (27 lb-in).

5. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

IMMOBILIZER SYSTEM



The purpose of the immobilizer system is to prevent the vehicle from being stolen or driven by unauthorized users.

Authorization is accomplished by the use of an electronically coded key. When the ignition is turned ON, the key is tested by the immobilizer system. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the immobilizer control unit's memory. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM have been substituted to defeat the system. If the ECM does not receive a release message within a specified time, or if the ID codes do not match, the ECM performs the following actions:

- Disables the fuel injector circuit.
- Disables the fuel pump circuit.
- Disables the ignition coil.
- Sets Diagnostic Trouble Code (DTC) 53.

The above conditions are maintained until the ignition is switched OFF.

The immobilizer control unit system consists of the following components:

- Electronically coded keys.
- Detection coil.
- Immobilizer control unit.
- ECM.
- Instrument cluster indicator.
- Assembly line diagnostic link (ALDL) connector to provide serial data access for a scan tool.

An ECM for a vehicle without an immobilizer control unit cannot be interchanged for an ECM that is used with an immobilizer control unit system. The immobilizer control unit and the ECM must have a matching ID code. ID coding and key coding are accomplished by using a scan tool.

ELECTRONICALLY CODED KEYS

Each valid ignition key has an internal transponder which transmits a unique code. When a key is inserted into the ignition lock, the transponder is inductively coupled to the detection coil. The transponder interacts with the detection coil to generate an amplitude modulated signal which is conducted from the detection coil to the immobilizer control unit. The immobilizer control unit reads the radio frequency signal, and a release message is sent to the electronic control module, if the key is authorized.

New keys are coded by using a scan tool. Refer to "Key Coding Procedure" in this section.

DETECTION COIL

A detection coil is mounted at the ignition lock as an integral part of the key position trim ring. The wires to and from the detection coil are connected to the immobilizer. When the ignition is turned ON, the immobilizer energizes the detection coil, and the coil is coupled inductively to the transponder in the ignition key. The immobilizer sends a modulated signal to the detection coil, and the signal is changed by interaction with the internal transponder in the ignition key. The immobilizer reads the signal from the detection coil and determines whether the key is authorized.

IMMOBILIZER CONTROL UNIT

The immobilizer control unit is an electronic module in the instrument panel which verifies the validity of an ignition key when the ignition is turned ON. To accomplish its purpose, the immobilizer control unit performs the following actions:

- Learns and stores the codes of valid keys.
- Reads the radio frequency input from the ignition key.
- Compares the received code with the codes of the valid keys.
- Sends a release message to the electronic control module (ECM) if a valid key has been presented.
- Calculates and transmits identification (ID) codes within each release message.
- Controls the status indicator in the instrument cluster.
- Monitors system faults.
- Supports system test functions.

Normal Operation

When the ignition is turned ON, the immobilizer control unit tries to read the key code transmitted by the transponder in the ignition key. If a valid key is detected, the immobilizer control unit sends a release message to the ECM, and the immobilizer control unit switches to the inactive mode. The release message contains an ID code. Immobilization will be performed by the ECM if no release message is received, or if the ID code in the ECM does not match the immobilizer control unit ID code. If a non-valid key is detected, the release message is not sent to the ECM. When the driver turns the ignition OFF, the immobilizer control unit switches to the active mode.

Assembly Line Diagnostic Link (ALDL) Mode

When the ignition is on, a scan tool can switch the immobilizer control unit to the assembly line diagnostic link (ALDL) mode for the purpose of diagnostics, key coding, or ID coding.

ID Code Handling

One of 65,535 possible ID codes is stored in the immobilizer control unit's memory. The ID code can be erased by using the scan tool's RESET ID CODE command. When the immobilizer control unit calculates a new ID code, the ECM ID code must be reset to match the immobilizer control unit ID code. To reset the ID code refer to "Identification (ID) Code Reprogramming." During diagnostic procedures, the ID code can be read for comparison with the ECM ID code by using the scan tool's READ IMMOBILIZER CONTROL UNIT ID CODE command.

ELECTRONIC CONTROL MODULE (ECM)

When the electronic control module (ECM) detects that the ignition is being turned ON, the ECM waits for a release message from the immobilizer control unit. If a release message is not received within a specified time, the ECM disables the engine. The engine is also disabled if the identification (ID) code transmitted by the immobilizer control unit does not match the code stored in the ECM's memory. Immobilization remains in effect until the ignition is turned OFF or battery power is removed.

To prevent the vehicle from being driven, the ECM applies the following strategy:

- The ignition module is put in a bypass mode.
- The ECM will not create an electronic spark timing (EST) output, so no spark will be generated by the ignition coil.
- The ECM will not enable the fuel pump.
- The ECM will not enable the fuel injectors.
- The ECM sets Diagnostic Trouble Code (DTC) 53.

Serial data communication is transmitted on a single wire between the immobilizer control unit and the ECM. During diagnostic procedures or ID code changing, a scan tool is added to the communication system.

An ECM with an immobilizer control unit is not exchangeable with the ECM without an immobilizer control unit.

SERIAL DATA LINK

Serial data can be exchanged between a scan tool, electronic control module (ECM), and the immobilizer control unit. The scan tool connection is the assembly line diagnostic link (ALDL).

PERSONAL INJURY CAUTION

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as for the personal safety of the person doing the repair. There are many variations in procedures, techniques, tools and parts for servicing vehicles, as well as in the skills of the people doing the work. This manual cannot possibly anticipate all such variations and provide advice or precautions for each. Anyone who deviates from the instructions provided in this manual must ensure their own safety and preserve the safety and integrity of the vehicle. The following list contains general precautions that should always be followed while working on a vehicle.

- **Safety stands are required whenever a procedure calls for underbody work.**
- **Do not smoke when you work on a vehicle.**
- **To prevent serious burns, do not touch any hot metal parts.**
- **Set the parking brake when you work on the vehicle.**
- **Turn the ignition switch OFF unless a procedure states otherwise.**
- **The engine may operate only in a well-ventilated area.**
- **Avoid moving parts when the engine is running.**
- **Safety glasses must be worn for eye protection.**

LANOS
Service Manual

FOREWORD

This manual includes procedures for maintenance, adjustment, service operations, and removal and installation of components for the LANOS vehicle.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

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