3.0L V6

1999 Lexus RX 300

1999-2000 ENGINES
Lexus 3.0L V6

ES300, RX300

* PLEASE READ THIS FIRST *

NOTE: For engine repair procedures not covered in this article, see ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION article in the GENERAL INFORMATION section.

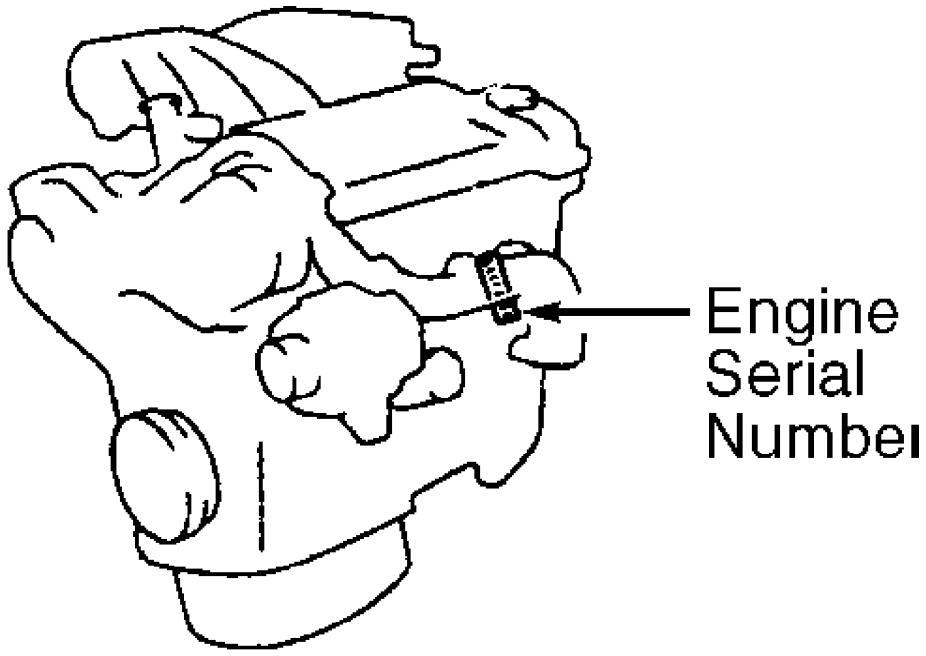
NOTE: When servicing engine, references to right and left refer to engine sides as viewed from rear of engine (drive plate end).

ENGINE IDENTIFICATION

Engine serial number is stamped on rear of cylinder block. See Fig. 1.

ENGINE IDENTIFICATION CODE

Engine	Code
3.0L V6	1MZ-FE



G94H46315

Fig. 1: Locating Engine Serial Number
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

NOTE: Adjust valve clearance with engine cold.

WARNING: To prevent air bag deployment, disconnect negative battery cable at least 90 seconds before working on vehicle.

1) Disconnect negative battery cable. On RX300, remove outer cowl top panel. Remove front upper suspension brace. On all models, drain cooling system. Remove right fender apron seal. Using 5-mm hexagon wrench, remove 3 cap nuts and remove "V" bank cover.

2) Disconnect necessary hoses and electrical connections from vacuum switching valves. Disconnect necessary electrical connections, coolant hoses and vacuum hoses for removal of air intake chamber. See Fig. 13.

3) Remove bolts, nuts, air intake chamber and gasket. See Fig. 13. Disconnect electrical connectors for removal of wiring assemblies located above valve covers. Remove bolts and wiring assemblies.

4) Remove bolts and ignition coil assemblies. Mark ignition coil installation location for reassembly reference. Remove bolts, valve covers and gaskets. Disconnect upper radiator hose. Rotate crankshaft clockwise (viewed from front of engine) so cylinder No. 1 is at TDC on compression stroke. Cylinder No. 1 is front cylinder on right side when viewed from rear of engine. See Fig. 2.

5) Ensure timing mark on crankshaft pulley aligns with "0" mark on No. 1 timing belt cover. If timing marks are not aligned, rotate crankshaft clockwise one complete revolution. Ensure intake and exhaust lifters are loose on cylinder No. 1.

NOTE: Valve clearances are checked with engine cold.

6) Using feeler gauge, measure and record valve clearance on intake valves of cylinders No. 1 and 6 and exhaust valves on cylinders No. 2 and 3. See STEP 1 in illustration. See Fig. 2.

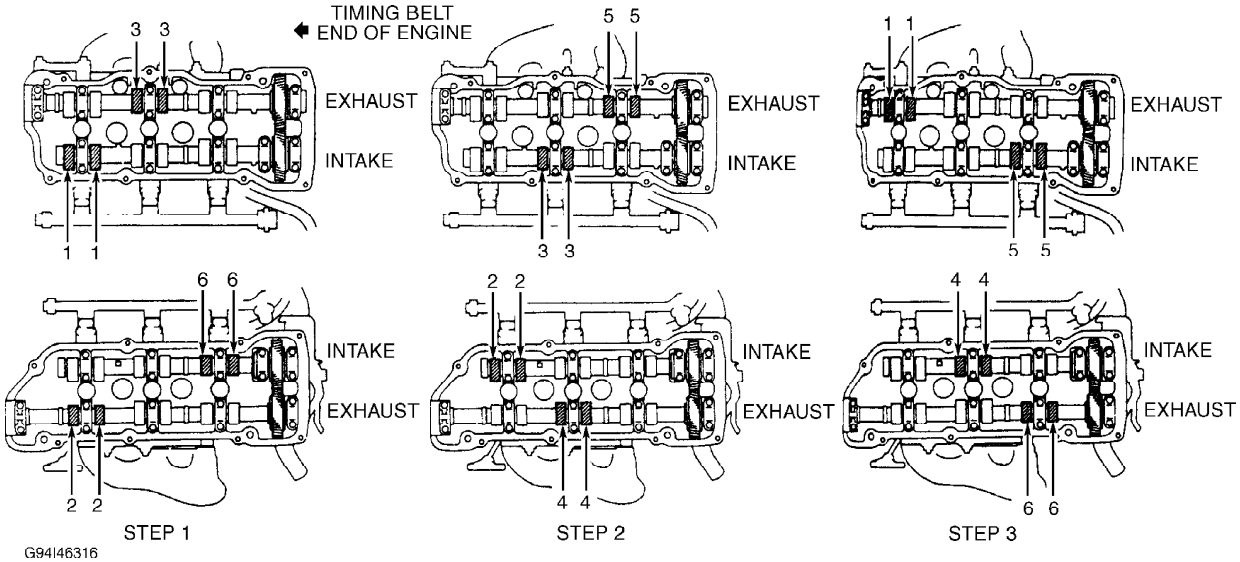


Fig. 2: Identifying Valve Adjustment Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

7) Rotate crankshaft clockwise 2/3 turn (240 degrees). Measure and record valve clearance on intake valves of cylinders No. 2

and 3 and exhaust valves on cylinders No. 4 and 5. See STEP 2 in illustration. See Fig. 2.

8) Rotate crankshaft clockwise an additional 2/3 turn (240 degrees). Measure and record valve clearance on intake valves of cylinders No. 4 and 5 and exhaust valves on cylinders No. 1 and 6. Perform STEP 3 in illustration. See Fig. 2. Ensure valve clearance is within specification. See VALVE CLEARANCE SPECIFICATIONS table.

VALVE CLEARANCE SPECIFICATIONS (1)

Application	In. (mm)
Exhaust Valve	.010-.014 (.25-.35)
Intake Valve	.006-.010 (.15-.25)

(1) - Adjust valve clearance with engine cold.

9) If valve clearance requires adjustment, rotate camshaft so lobe on valve to be adjusted faces upward, away from valve lifter. Position notch on valve lifter perpendicular to camshaft. Ensure notch is not aligned with camshaft.

10) Using Valve Clearance Adjuster Set (SST 09248-55040), remove adjusting shim. Using SST "A", push downward on valve lifter. See Fig. 3.

11) Place SST "B" between camshaft and valve lifter with side marked with a "7" or "9" in right location, depending on cylinder application. See Fig. 3. Side marked with "7" should be used on front valves on cylinders No. 1 and 2. Remove SST "A".

12) Using small screwdriver and magnet, remove adjusting shim. Measure and record thickness of removed adjusting shim. Using measured clearance and adjusting shim thickness, select proper replacement adjusting shim. See Figs. 4 - 6.

13) Install replacement adjusting shim with imprinted number on adjusting shim facing valve lifter. Recheck valve clearance. Before installing valve cover and gasket, apply sealant at front and rear areas of cylinder head. See Fig. 7.

14) Using NEW gasket, install valve cover. Install and tighten valve cover bolts to specification in several steps. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure using NEW gaskets. Tighten all fasteners to specification. Fill cooling system and adjust control cables.

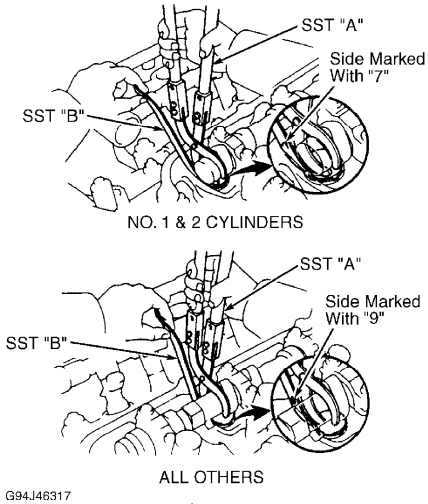


Fig. 3: Removing/Installing Valve Adjustment Shims
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Adjusting Shim Selection Chart (Exhaust)

| Measured clearance mm (in.) \ Installed shim thickness mm (in.) | 2.500 (0.0984) | 2.520 (0.0992) | 2.540 (0.1000) | 2.550 (0.1004) | 2.560 (0.1008) | 2.580 (0.1016) | 2.600 (0.1024) | 2.620 (0.1031) | 2.640 (0.1039) | 2.650 (0.1043) | 2.660 (0.1047) | 2.670 (0.1051) | 2.680 (0.1055) | 2.690 (0.1059) | 2.700 (0.1063) | 2.710 (0.1067) | 2.720 (0.1071) | 2.730 (0.1075) | 2.740 (0.1079) | 2.750 (0.1083) | 2.760 (0.1087) | 2.770 (0.1091) | 2.780 (0.1094) | 2.790 (0.1098) | 2.800 (0.1102) | 2.810 (0.1106) | 2.820 (0.1110) | 2.830 (0.1114) | 2.840 (0.1118) | 2.850 (0.1122) | 2.860 (0.1126) | 2.870 (0.1130) | 2.880 (0.1134) | 2.890 (0.1138) | 2.900 (0.1142) | 2.910 (0.1146) | 2.920 (0.1150) | 2.930 (0.1154) | 2.940 (0.1157) | 2.950 (0.1161) | 2.960 (0.1165) | 2.970 (0.1169) | 2.980 (0.1173) | 2.990 (0.1177) | 3.000 (0.1181) | 3.010 (0.1185) | 3.020 (0.1189) | 3.030 (0.1193) | 3.040 (0.1197) | 3.050 (0.1201) | 3.060 (0.1205) | 3.080 (0.1213) | 3.100 (0.1220) | 3.120 (0.1228) | 3.140 (0.1236) | 3.150 (0.1240) | 3.160 (0.1244) | 3.180 (0.1252) | 3.200 (0.1260) | 3.220 (0.1268) | 3.240 (0.1276) | 3.250 (0.1280) | 3.260 (0.1283) | 3.280 (0.1291) | 3.300 (0.1299) |
|---|---|---

Fig. 5: Exhaust Valve Adjusting Shim Selection Chart (2000 ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.
G000105S5

Adjusting Shim Selection Chart (Exhaust)

| Measured clearance mm (in.) \ Installed shim thickness mm (in.) | 2.500 (0.0984) | 2.520 (0.0992) | 2.540 (0.1000) | 2.560 (0.1004) | 2.560 (0.1008) | 2.580 (0.1016) | 2.600 (0.1024) | 2.620 (0.1031) | 2.640 (0.1039) | 2.650 (0.1043) | 2.660 (0.1047) | 2.670 (0.1051) | 2.680 (0.1055) | 2.690 (0.1059) | 2.700 (0.1063) | 2.710 (0.1067) | 2.720 (0.1071) | 2.730 (0.1075) | 2.740 (0.1079) | 2.750 (0.1083) | 2.760 (0.1087) | 2.770 (0.1091) | 2.780 (0.1094) | 2.790 (0.1098) | 2.800 (0.1102) | 2.810 (0.1106) | 2.820 (0.1110) | 2.830 (0.1114) | 2.840 (0.1118) | 2.850 (0.1122) | 2.860 (0.1126) | 2.870 (0.1130) | 2.880 (0.1134) | 2.890 (0.1138) | 2.900 (0.1142) | 2.910 (0.1146) | 2.920 (0.1150) | 2.930 (0.1154) | 2.940 (0.1157) | 2.950 (0.1161) | 2.960 (0.1165) | 2.970 (0.1169) | 2.980 (0.1173) | 2.990 (0.1177) | 3.000 (0.1181) | 3.010 (0.1185) | 3.020 (0.1189) | 3.030 (0.1193) | 3.040 (0.1197) | 3.050 (0.1201) | 3.060 (0.1205) | 3.070 (0.1213) | 3.080 (0.1213) | 3.100 (0.1220) | 3.120 (0.1228) | 3.140 (0.1236) | 3.150 (0.1240) | 3.160 (0.1244) | 3.180 (0.1252) | 3.200 (0.1260) | 3.220 (0.1268) | 3.240 (0.1276) | 3.250 (0.1280) | 3.260 (0.1283) | 3.280 (0.1291) | 3.300 (0.1299) |
|---|---|---

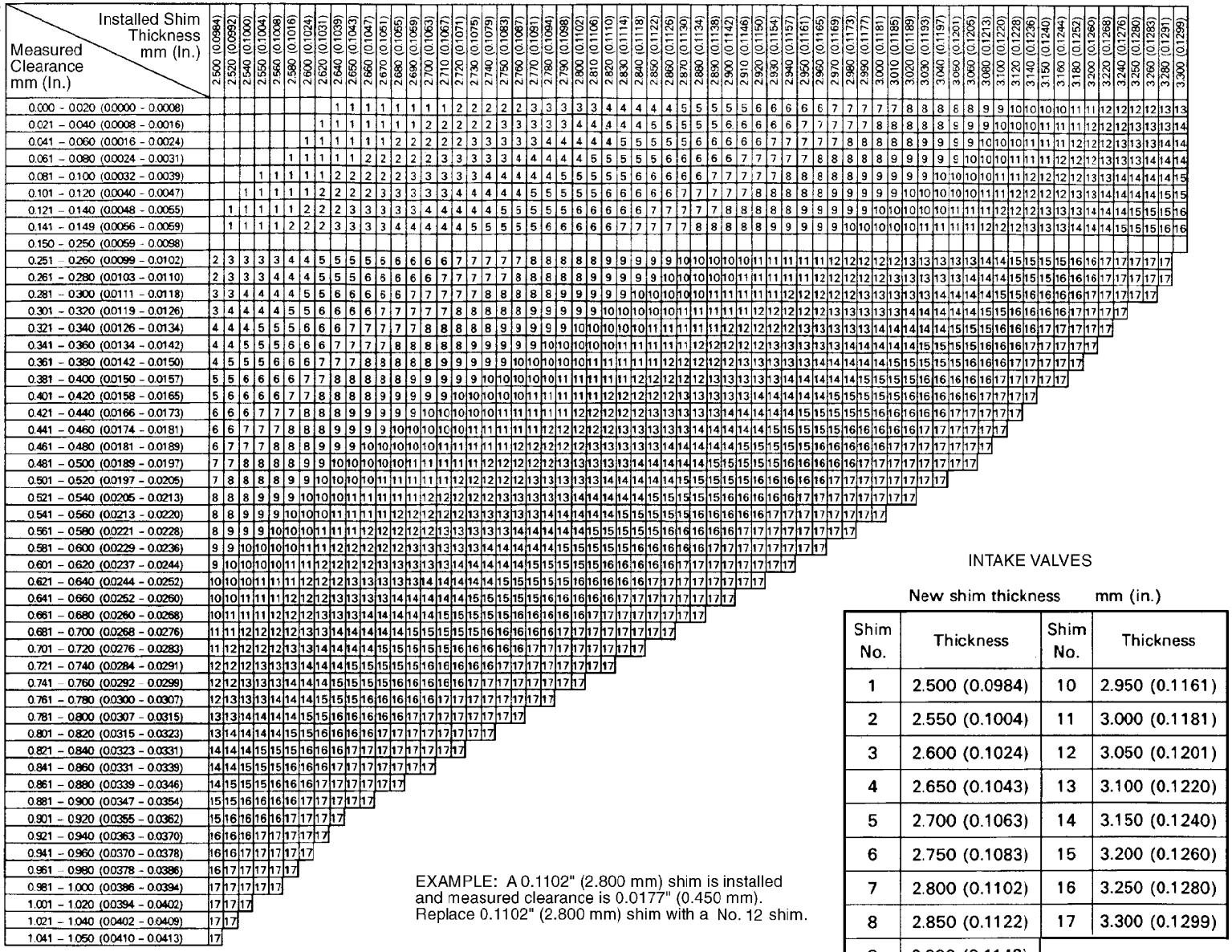


Fig. 6: Intake Valve Adjusting Shim Selection Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

EXAMPLE: A 0.1102" (2.800 mm) shim is installed and measured clearance is 0.0177" (0.450 mm). Replace 0.1102" (2.800 mm) shim with a No. 12 shim.

INTAKE VALVES

New shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness
1	2.500 (0.0984)	10	2.950 (0.1161)
2	2.550 (0.1004)	11	3.000 (0.1181)
3	2.600 (0.1024)	12	3.050 (0.1201)
4	2.650 (0.1043)	13	3.100 (0.1220)
5	2.700 (0.1063)	14	3.150 (0.1240)
6	2.750 (0.1083)	15	3.200 (0.1260)
7	2.800 (0.1102)	16	3.250 (0.1280)
8	2.850 (0.1122)	17	3.300 (0.1299)
9	2.900 (0.1142)		

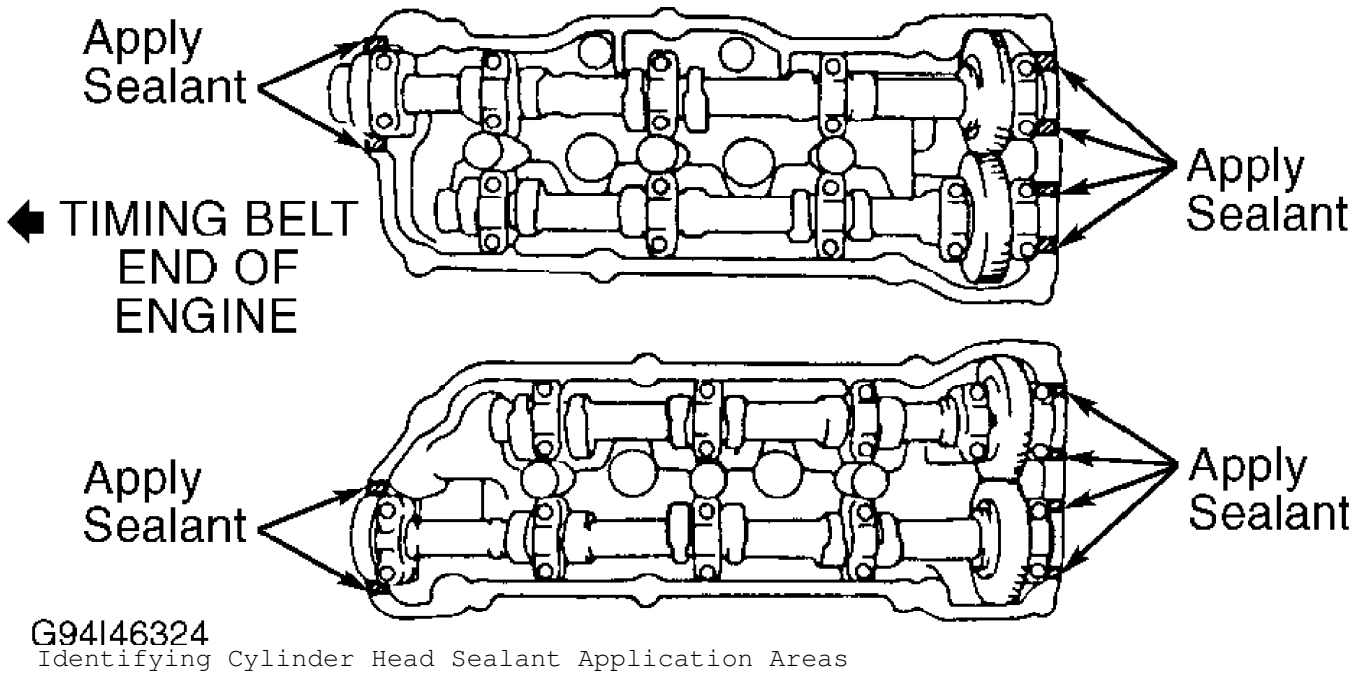


Fig. 7: Identifying Cylinder Head Sealant Application Areas
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

NOTE: For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Place mating marks on engine hood and other major assemblies before removal.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

FUEL PRESSURE RELEASE

With ignition off, disconnect negative battery cable. Place suitable container under fuel line. Cover fuel line connection with shop towel. Slowly loosen fuel line connection to release fuel pressure. Once fuel pressure is released, fuel system components may be serviced.

ENGINE

WARNING: To prevent air bag deployment, disconnect negative battery cable and wait at least 90 seconds before working on vehicle.

NOTE: Remove engine and transaxle as an assembly.

Removal (ES300)

1) Release fuel pressure. See FUEL PRESSURE RELEASE. Drain cooling system and engine oil. Remove hood. Remove battery and battery tray. Remove engine fender apron seals. Using 5-mm hexagon wrench, remove 3 cap nuts and remove "V" bank cover.

2) Disconnect accelerator cable. Remove air cleaner cap assembly and air cleaner case. Remove cruise control actuator and bracket. Remove radiator and coolant reservoir tank.

3) Remove front exhaust pipe-to-center exhaust pipe nuts. Remove front exhaust pipe-to-exhaust manifold nuts. Remove front exhaust pipe.

4) Disconnect electrical connections at ignitor and noise filter near left strut tower. Disconnect necessary coolant hoses, electrical connections, fuel lines and vacuum hoses.

5) Remove lower panel on passenger side of instrument panel. Disconnect 3 ECM connectors. Disconnect 3 engine wire connectors from ECM bracket. Disconnect grommet from cowl panel and pull engine wire harness out through firewall.

6) Remove front wheels. Remove left axle shaft lock nut. Drain transmission fluid. Disconnect tie rod end from steering knuckle. Disconnect lower ball joint from lower suspension arm. Tap axle shaft with plastic hammer to disconnect axle shaft from axle hub. Pull axle shaft outward, and separate from axle hub. Remove snap ring and remove left axle shaft. Remove right axle shaft lock nut. Remove snap ring and remove right axle shaft.

7) Disconnect A/C compressor with hoses attached and secure aside. Disconnect transmission control cable from transaxle. Disconnect power steering pump with hoses attached and secure aside. Disconnect left mounting insulator-to-transaxle bolts. Disconnect rear rear engine mounting bracket from front frame. Remove 4 bolts and engine mounting absorber. Remove front engine mounting insulator-to-front frame bolts. Attach engine sling to engine hangers.

CAUTION: DO NOT attempt to hang engine by hooking chain to any other part.

8) Remove 4 bolts, engine control rod and right mounting bracket. Remove engine and transaxle from vehicle. DO NOT hit Park Neutral Position (PNP) switch. Ensure engine is clear of all wiring, hoses and cables. Place engine and transaxle assembly onto stand. Remove front and rear mounting insulators and bracket assemblies from engine. Separate engine and transaxle.

Installation

1) Assemble engine and transaxle. Install rear and front mounting insulators. Attach engine sling to engine hangers. Tilt transaxle downward, and lower engine into engine compartment. Align right and left mountings with body bracket to ensure engine is level.

2) Temporarily install No. 2 right engine mounting bracket and engine moving control rod with 3 bolts. Tighten bolts "A", "B", "C" and "D". See Fig. 8. Install mounting insulator with 3 bolts.

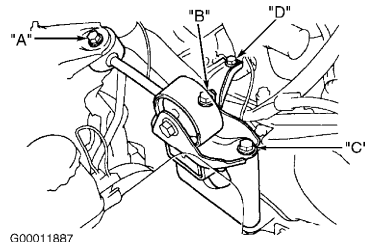


Fig. 8: Engine Mounting Bracket Bolt Tightening Sequence (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Install engine mounting absorber with 4 bolts. Connect rear and left engine mounting insulators. Remove engine sling. Connect transaxle control cable to transaxle. Install power steering pump and 2 bolts. Install drive belt. Connect power steering pressure tube with 2 nuts.

4) Install A/C compressor and drive belt adjusting bar bracket. Tighten nuts and bolt to specification. See TORQUE SPECIFICATIONS. Install drive belt. Connect A/C compressor connector. Install axle shafts in reverse order of removal.

5) Push engine wire through cowl panel. Install grommet. Connect 3 engine ECM connectors. Connect 3 cowl wire connectors to connectors on bracket. Install lower instrument panel. Connect connectors, cable clamps and hoses.

6) Temporarily install 3 new gaskets and front exhaust pipe. Install 2 bolts, 2 compression rings and 4 nuts. Tighten 4 nuts holding exhaust manifolds to front exhaust pipe. Tighten 2 bolts and 2 compression rings holding front exhaust pipe to center exhaust pipe. Install support stay with 2 bolts.

7) Install radiator, cruise control actuator and air cleaner cap assembly. Connect accelerator cable. Using 5-mm hexagon wrench, install "V" bank cover with 3 nuts. Press down "V" bank cover fastener.

8) Install engine fender apron seals. Install battery tray and battery. Install hood, and fill engine with oil and coolant. Check for leaks.

Removal (RX300)

1) Remove engine undercover. Drain coolant and engine oil. Remove hood. Remove outer cowl top panel assembly. Remove battery and battery tray. Using 5-mm hexagon wrench, remove 3 cap nuts and remove "V" bank cover. Disconnect necessary clamps and hoses, and remove air cleaner cap and case assembly.

2) Disconnect accelerator cable from throttle body. Remove cruise control actuator. Disconnect master cylinder and set aside. Disconnect engine wire from upper suspension brace. Disconnect 2 heater hoses. Remove 4 nuts and remove upper front suspension brace. Disconnect generator wire. Remove ground connections from fender aprons. Disconnect junction block connectors.

3) Disconnect brake booster vacuum hose, heater hoses and fuel inlet hose. Remove necessary vacuum hoses. Remove upper and lower radiator hoses. Disconnect 2 transmission cooler lines from transmission. Remove passenger side instrument panel lower cover. Remove glove box. Disconnect ECM connectors. Remove nuts retaining engine wire to cowl panel, and pull out engine wire harness.

4) Remove generator. Disconnect A/C compressor and set aside. Disconnect transmission shift control cable from transaxle. Remove 2 nuts from No. 2 front exhaust pipe-to-catalytic converter. Remove 2 nuts retaining No. 2 exhaust pipe-to-exhaust pipe. Remove No. 2 exhaust pipe. Remove front exhaust pipe. See Fig. 9. Remove right-side fender apron seal.

5) Disconnect stabilizer bar links. On 2WD models, remove front wheels. Remove left ABS speed sensor. Remove left axle shaft lock nut. Drain transmission fluid. Disconnect tie rod end from steering knuckle. Disconnect lower ball joint from lower suspension arm. Place mating marks on axle shaft inboard joint-to-outboard joint shafts. With brakes applied, remove 6 hex bolts from joint. Tap axle shaft with plastic hammer to disconnect axle shaft from axle hub. Pull axle shaft outward, and separate from transmission. Remove right axle shaft lock nut. Remove snap ring and remove right axle shaft.

6) On 4WD models, remove 4 nuts, bolts and washers and remove front drive shaft. On all models, remove lower bolt and disconnect steering column intermediate shaft. Disconnect vacuum hoses from front frame. Disconnect power steering hose from reservoir. Disconnect

transmission oil cooler pipe from front frame. Disconnect front fender apron liners. Attach engine sling to engine. Remove engine moving control rod and No. 2 engine mounting bracket.

7) Remove 8 bolts and 4 lower engine braces. Lower engine, transmission and front frame assembly from vehicle. Remove power steering pressure switch connector. Disconnect power steering pressure tube. Remove drive belt. Remove power steering pump. On 4WD models, remove front stabilizer and power steering gear assembly. See Fig. 10. On all models, remove front frame assembly. Remove engine mounting absorber. Remove transmission-to-left engine mounting insulator bolts. Remove rear engine mounting insulator nut, and remove front frame assembly.

8) Remove front engine mounting insulator. Remove rear engine mounting bracket. Separate engine from transaxle.

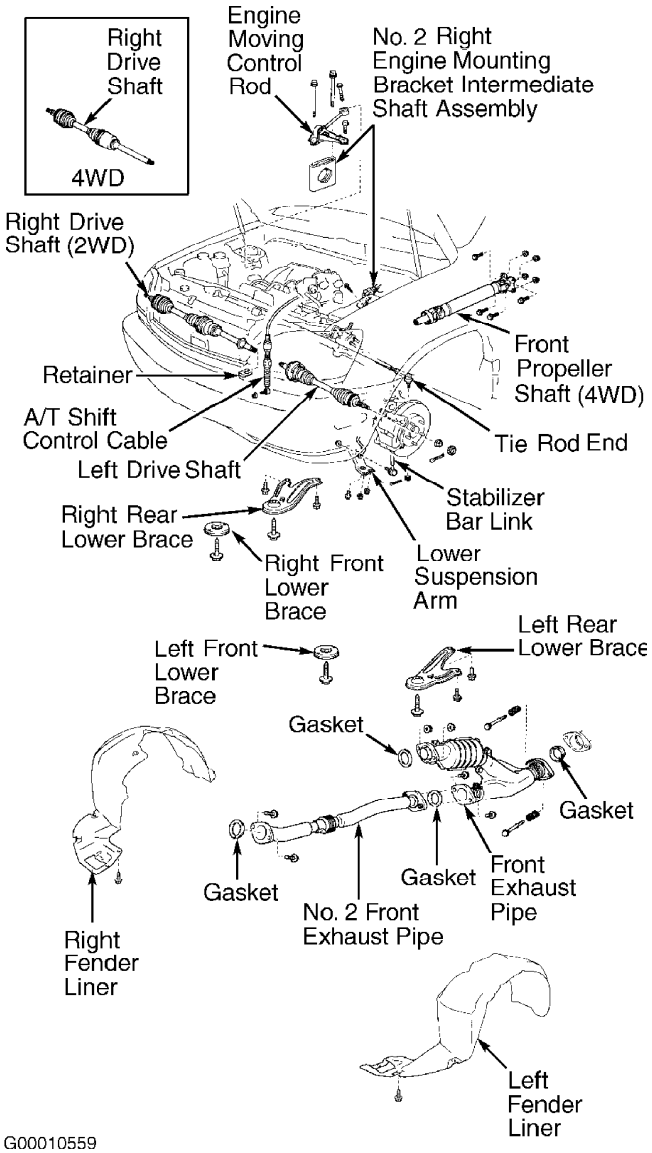


Fig. 9: Identifying Components For Engine Removal (RX300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

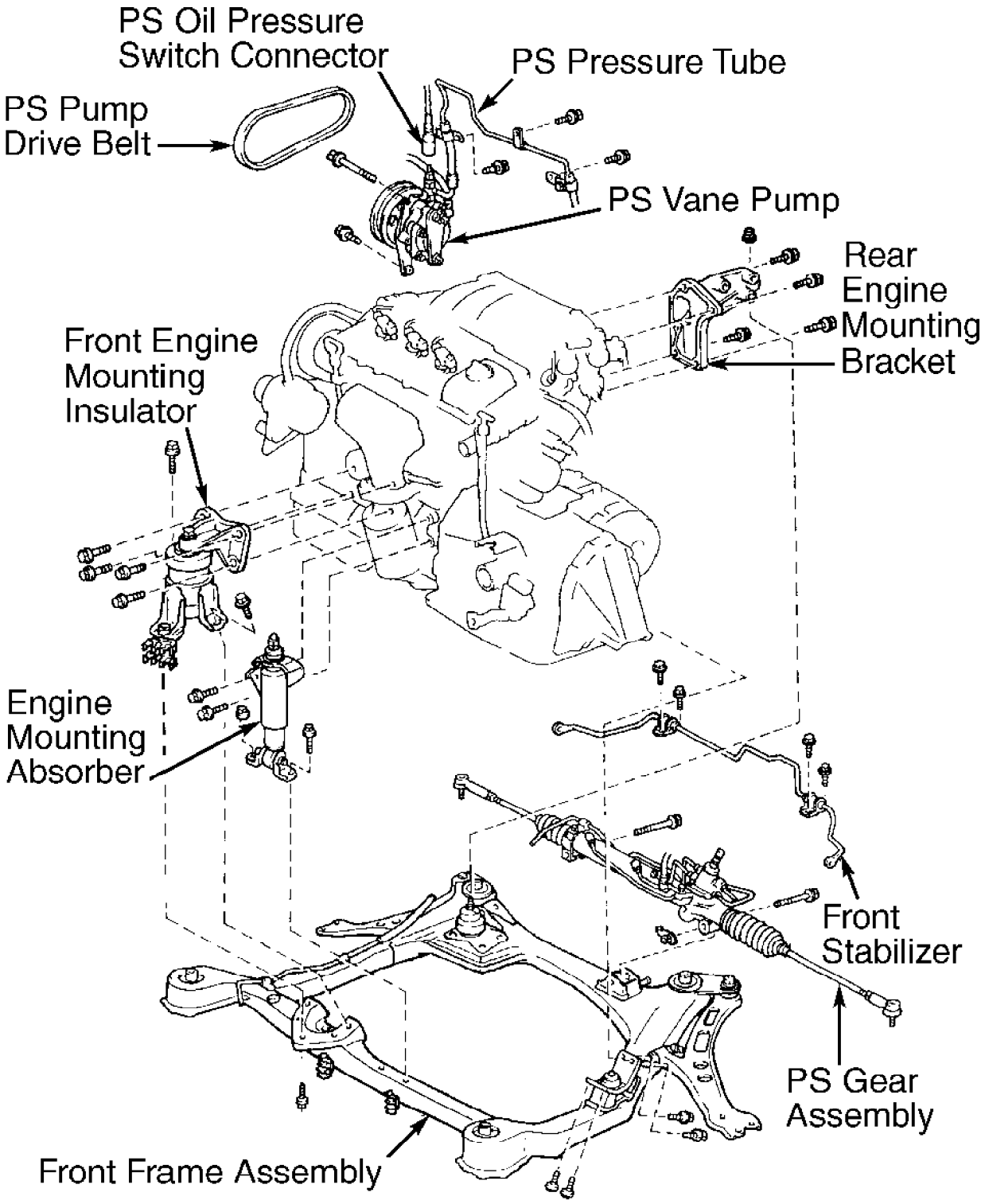


Fig. 10: Identifying Components For Engine Removal (RX300 4WD Shown, 2WD Similar - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) Install engine to transmission. Install rear engine mounting bracket with 4 bolts. Install front mounting insulator with 4 bolts. Install rear engine mounting bracket nut. Install left engine mounting insulator with 4 bolts. Install engine mounting absorber with 3 bolts. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS.

2) On 4WD models, install power steering gear and front stabilizer. On all models, install power steering pump. Install drive belt. Connect power steering pressure tube and oil pressure switch connector. Install engine sling. Raise engine and transmission into vehicle. Install 4 lower braces with 8 bolts. See Fig. 11. Tighten bolts "A" and "B" to specification. See TORQUE SPECIFICATIONS.

3) Temporarily install No. 2 right engine mounting bracket and engine moving control rod with 8 bolts. See Fig. 12. Tighten bolts "A", "B", "C" and "D" to specifications. See TORQUE SPECIFICATIONS. Remove engine sling. Connect fender liners. Connect transmission oil cooler pipe. Connect power steering hose to reservoir. Connect vacuum hoses to front frame. Connect steering intermediate shaft. To install, axle shafts, reverse removal procedure. On 4WD, connect stabilizer bar links and install drive shaft.

4) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Refill transmission fluid, engine oil and coolant. Check for leaks.

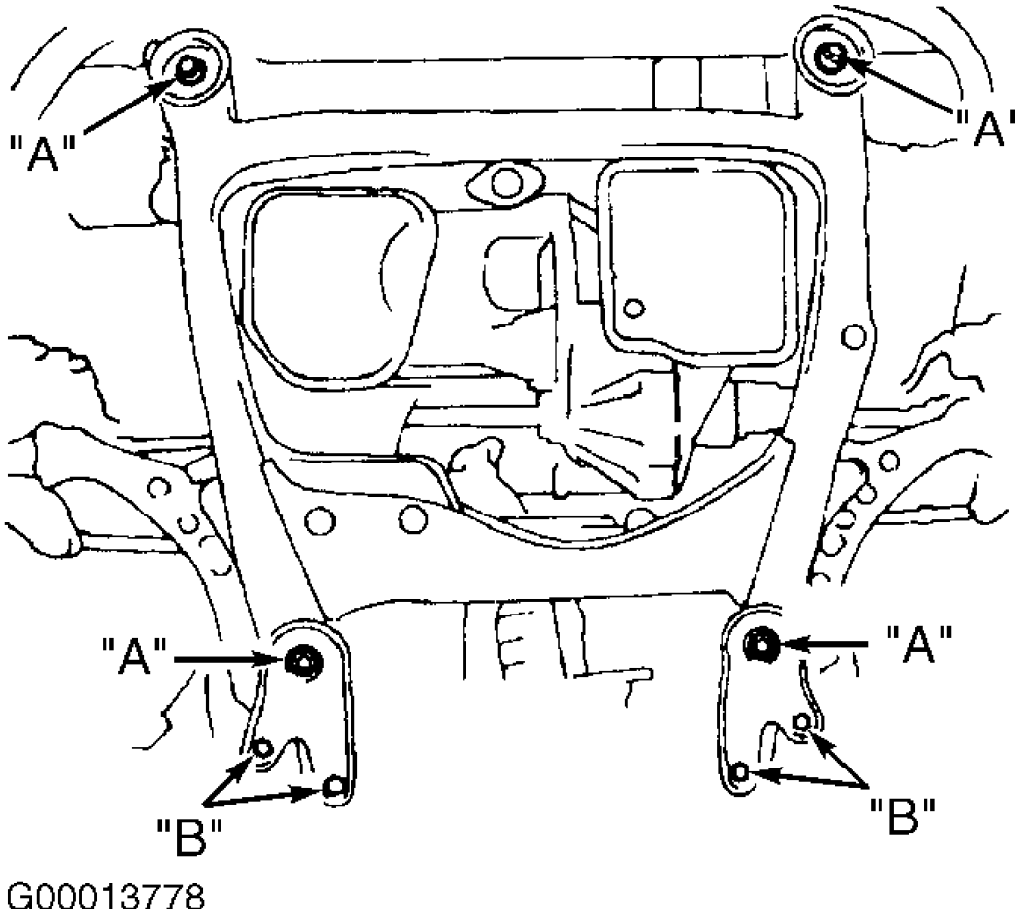
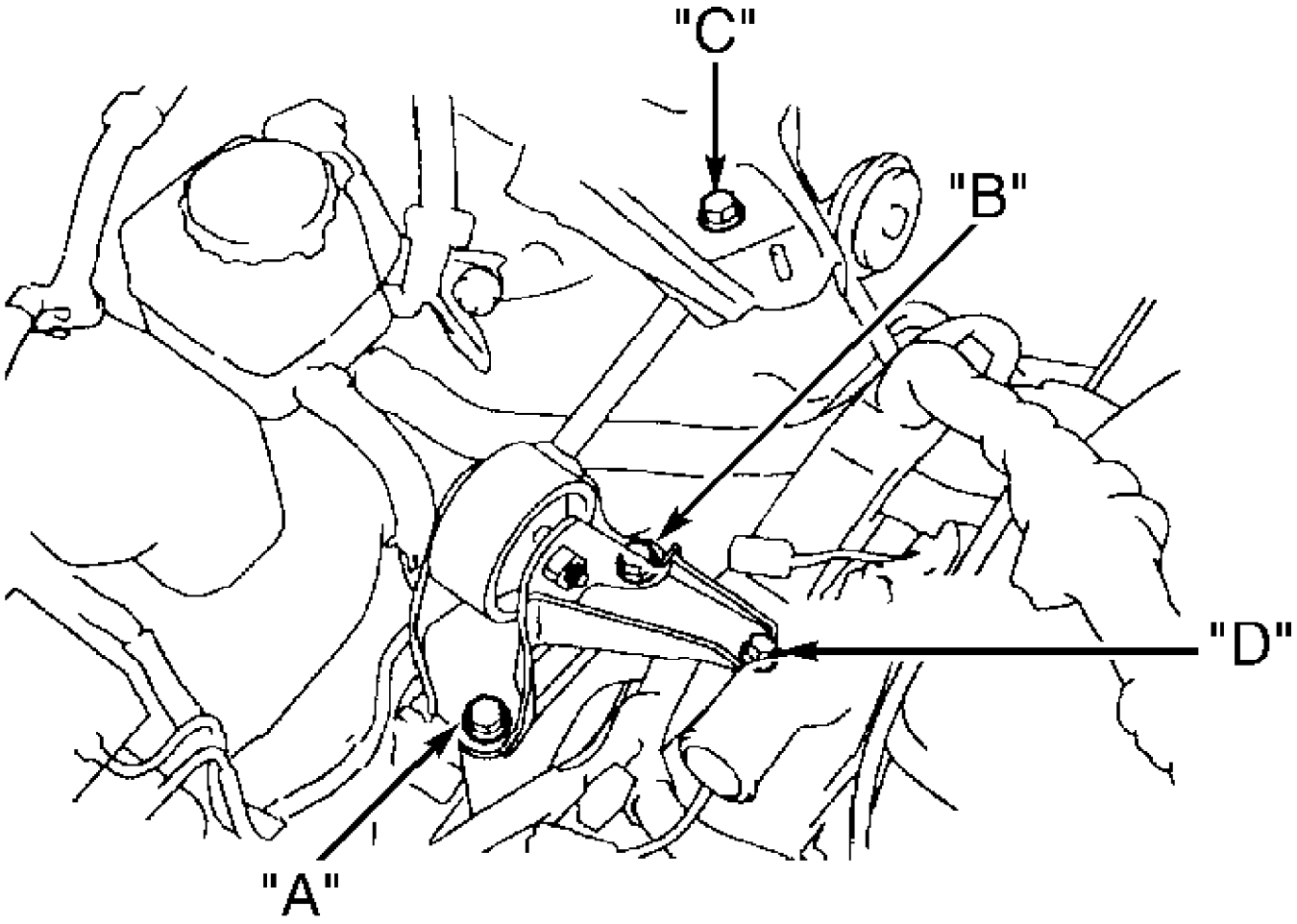


Fig. 11: Locating Attaching Bolts For Lower Braces (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G00013782

Fig. 12: Locating Attaching Bolts For No. 2 Engine Mounting Bracket & Engine Moving Control Rod (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CYLINDER HEAD & MANIFOLDS

WARNING: To prevent air bag deployment, disconnect negative battery cable and wait at least 90 seconds before working on vehicle.

Removal

1) Release fuel pressure. See FUEL PRESSURE RELEASE. Drain cooling system. On RX300, remove outer cowl top panel. On all models, remove right fender apron seal. Remove generator drive belt. Remove power steering pump. Remove front exhaust pipe.

2) Using 5-mm hexagon wrench remove 3 cap nuts from "V" bank cover and remove "V" bank cover. Remove air cleaner cap and airflow meter with air cleaner hose. Remove cruise control actuator and bracket. Disconnect necessary electrical connections, ground straps, coolant hoses, fuel lines and vacuum hoses for removal of air intake chamber. Remove 2 bolts and No. 1 engine hangar.

3) Remove nuts and air intake chamber located above intake manifold. See Fig. 13. Disconnect fuel injector connectors. Disconnect fuel inlet hose from fuel filter. Disconnect heater hose from intake manifold. Remove bolts, nuts and washer from intake mainfold and remove intake mainfold, fuel pipes and fuel injectors as an assembly.

CAUTION: DO NOT allow injectors to fall from delivery pipe when removing from intake manifold.

4) Disconnect Engine Cooling Temperature (ECT) sensor and sending unit. Disconnect ground strap connector. Disconnect upper radiator hose. Disconnect engine coolant reservoir hose. Remove bolts, nuts and plate washers. Disconnect water by-pass hose, and remove thermostat housing. Remove 2 gaskets.

5) Remove ignition coils and spark plugs. Mark ignition coil location for reassembly reference. Remove timing belt, camshaft sprockets and No. 2 idler pulley. See TIMING BELT. Disconnect 3 engine wire clamps from timing belt cover. Remove 6 bolts and No. 3 timing belt cover.

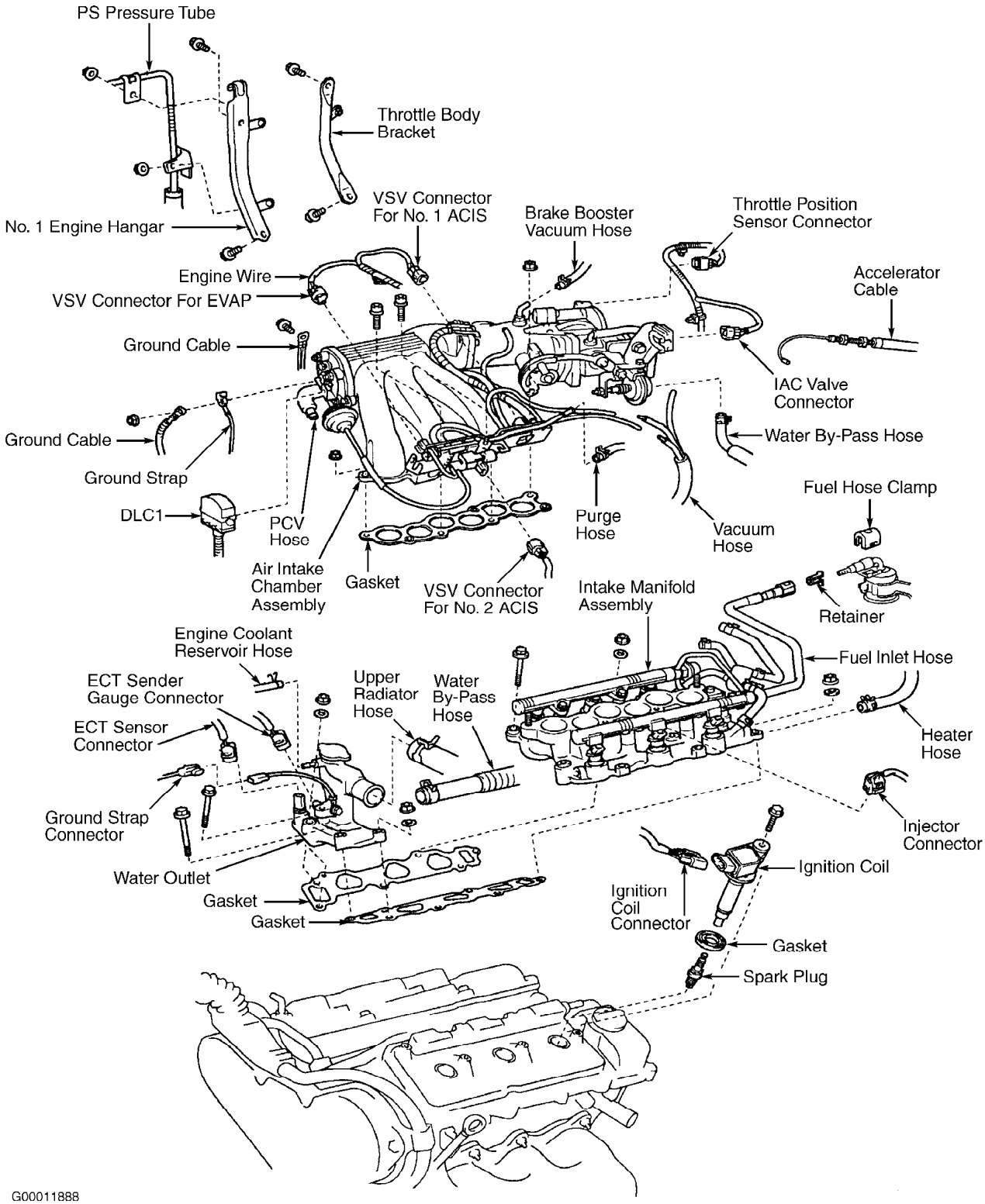
6) Remove camshaft position sensors. Remove camshaft timing oil control valves. Remove nut, and disconnect engine wire protector from right cylinder head. Disconnect engine wire protector from left cylinder head. Remove 2 bolts and remove rear plate from left cylinder head. Disconnect water inlet pipes from left cylinder head. Remove "O" ring from inlet pipe.

7) Remove power steering pump bracket from front of cylinder head. Disconnect airflow sensor connector, remove bolt and nut and remove right exhaust manifold stay. Remove 6 nuts, right exhaust manifold and gasket. Repeat procedure for left exhaust manifold.

8) Remove bolt holding oil dipstick guide to left cylinder head. Pull out dipstick guide with dipstick from No. 1 oil pan. Remove "O" ring from dipstick guide. Remove 9 bolts, cylinder head cover and gasket. See Fig. 14. Remove 2 cylinder head covers. Remove camshafts. See CAMSHAFT.

CAUTION: Cylinder head bolts must be loosened in proper sequence to prevent cylinder head warpage.

9) Using 8-mm hexagon wrench, remove recessed cylinder head bolts (one on each cylinder head). See Fig. 15. Loosen 12-point cylinder head bolts in sequence using several steps. See Fig. 15. Remove 12-point cylinder head bolts, cylinder head and cylinder head gasket.



G00011888

Fig. 13: Exploded View Of Intake Manifold & Components (ES300 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

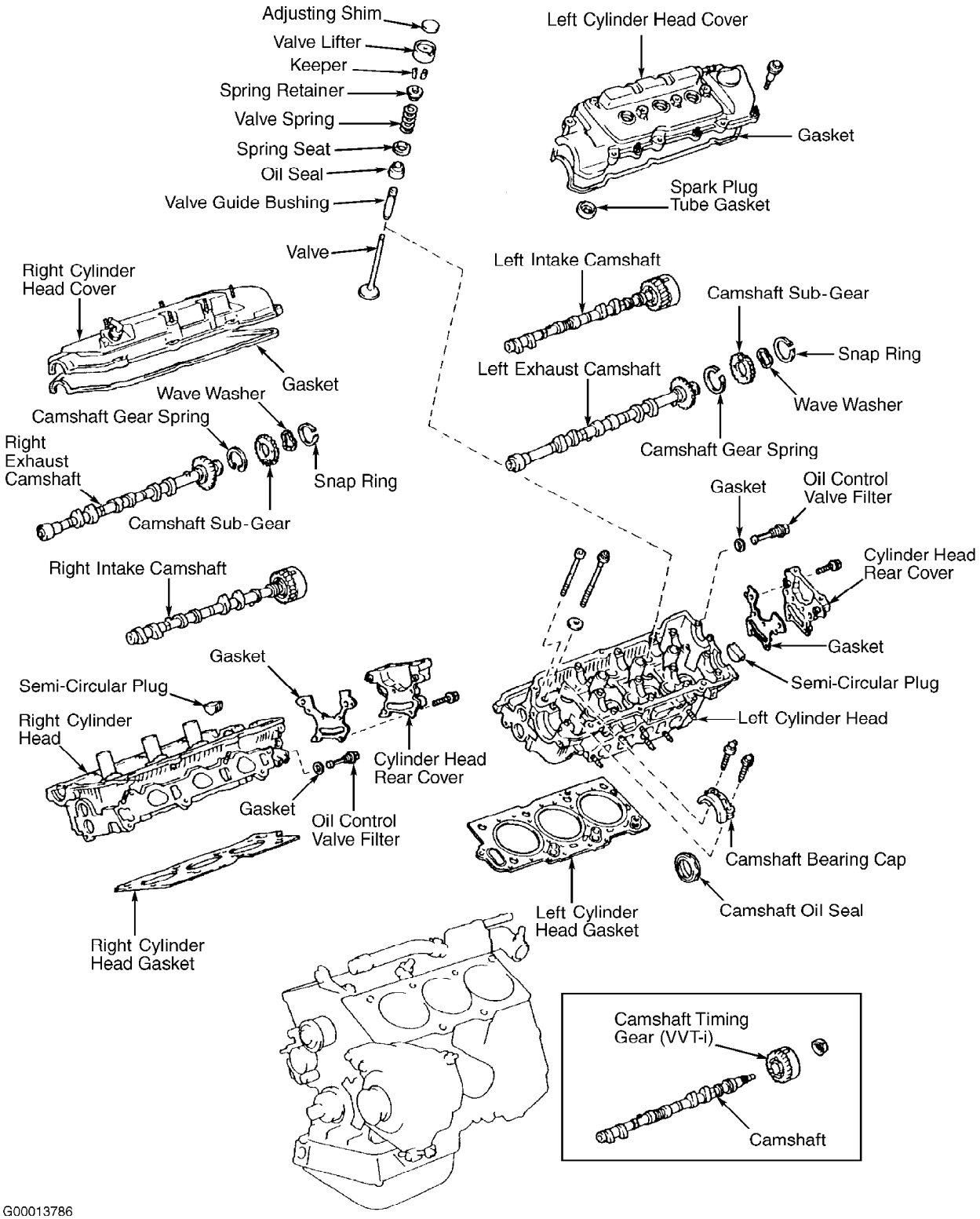
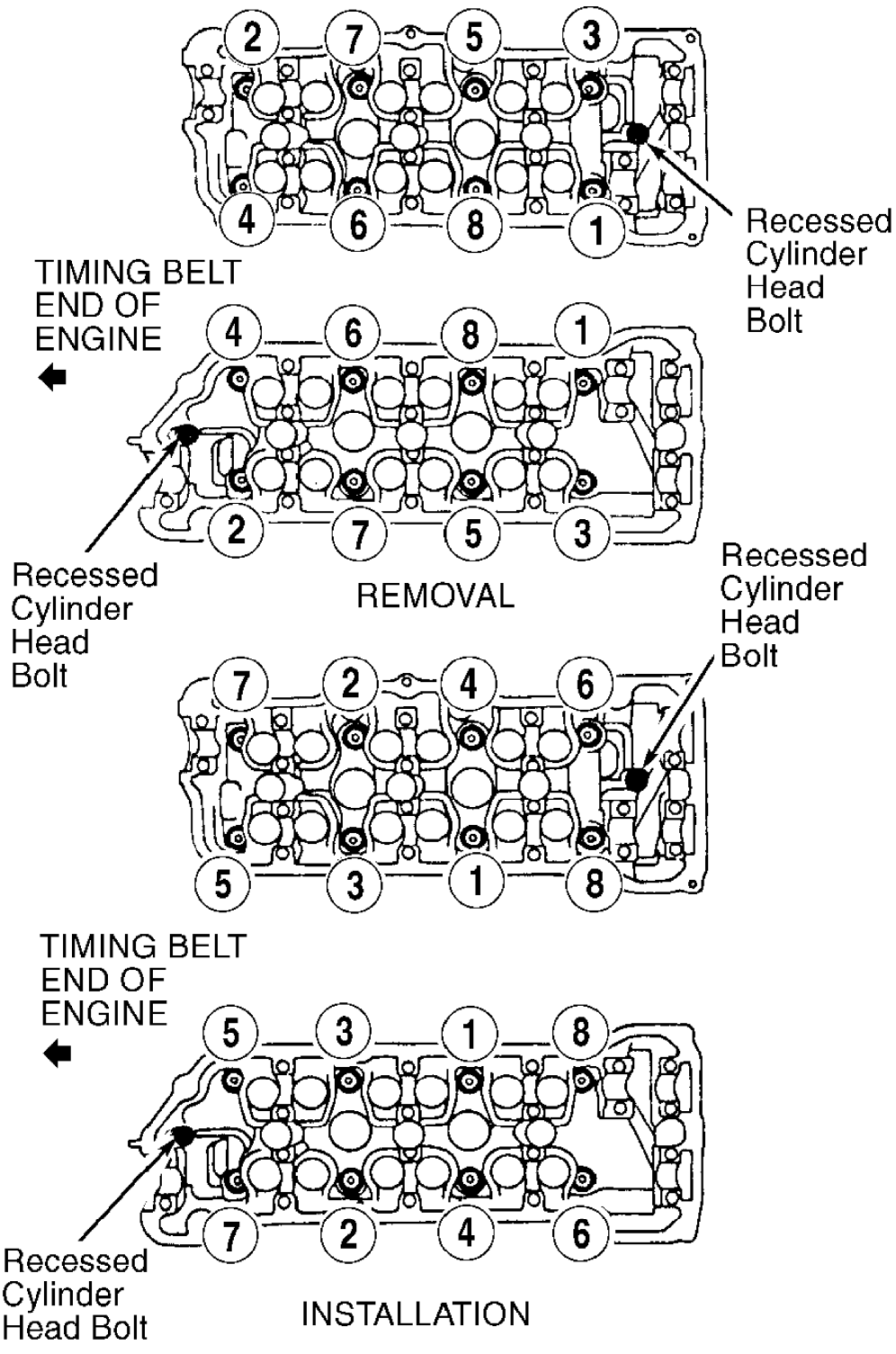


Fig. 14: Exploded View Of Cylinder Head & Components (RX300 Shown; ES300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G94B46327

Fig. 15: Cylinder Head Bolt Removal & Installation Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Inspection
1) Inspect cylinder head warpage at cylinder block and

manifold areas. Replace cylinder head if warpage exceeds specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

2) Inspect air intake chamber-to-intake manifold surface and exhaust manifold for warpage. Inspect intake manifold-to-cylinder head and air intake chamber surfaces for warpage. Replace components if warpage exceeds specification. See WARPAGE SPECIFICATIONS table.

WARPAGE SPECIFICATIONS

Application	In. (mm)
Air Intake Chamber	.0039 (.100)
Exhaust Manifold	.0196 (.498)
Intake Manifold	
Air Intake Chamber Surface	.0059 (.150)
Cylinder Head Surface	.0031 (.079)

3) Using caliper, measure 12-point cylinder head bolt diameter, just below bolt head. Replace cylinder head bolt if diameter is less than .3445" (8.750 mm).

4) Inspect cylinder block deck surface for warpage. Replace cylinder block if deck surface warpage exceeds specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS. Inspect camshaft and components. See CAMSHAFT.

5) Inspect valve lifter for damage. Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS.

Installation

1) Install NEW cylinder head gaskets on cylinder block. Ensure identification mark faces in correct direction. See Fig. 16. Ensure all holes in cylinder head gaskets align with cylinder block.

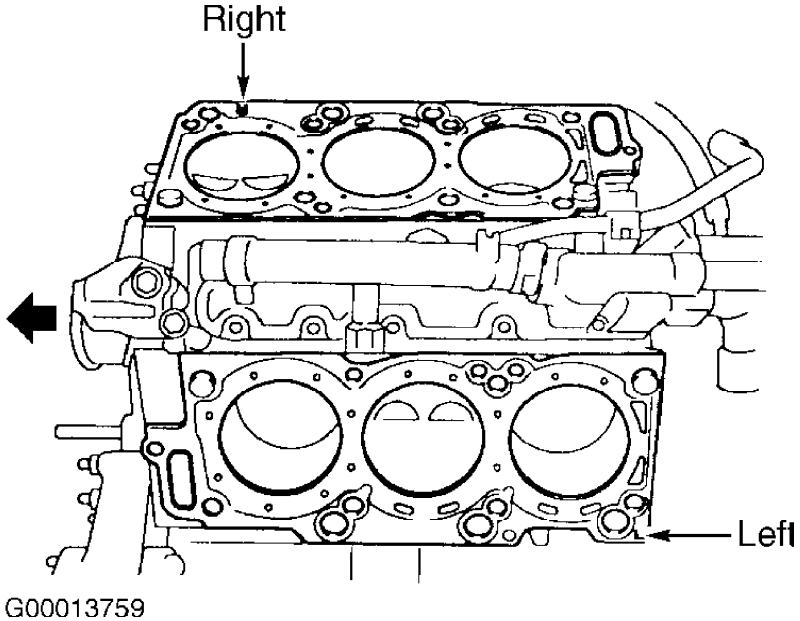


Fig. 16: Installing Cylinder Head Gaskets
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Install cylinder head. Apply engine oil onto cylinder head bolt threads and cylinder head bolt-to-cylinder head contact surfaces.

Install plate washers on bolts. Install and tighten 12-point cylinder head bolts to specification in sequence using several passes. See Fig. 15. See TORQUE SPECIFICATIONS.

3) Reference mark front cylinder head bolt head. Retighten cylinder head bolts to 90 degrees. Ensure painted mark is positioned at 90-degree angle. See Fig. 17.

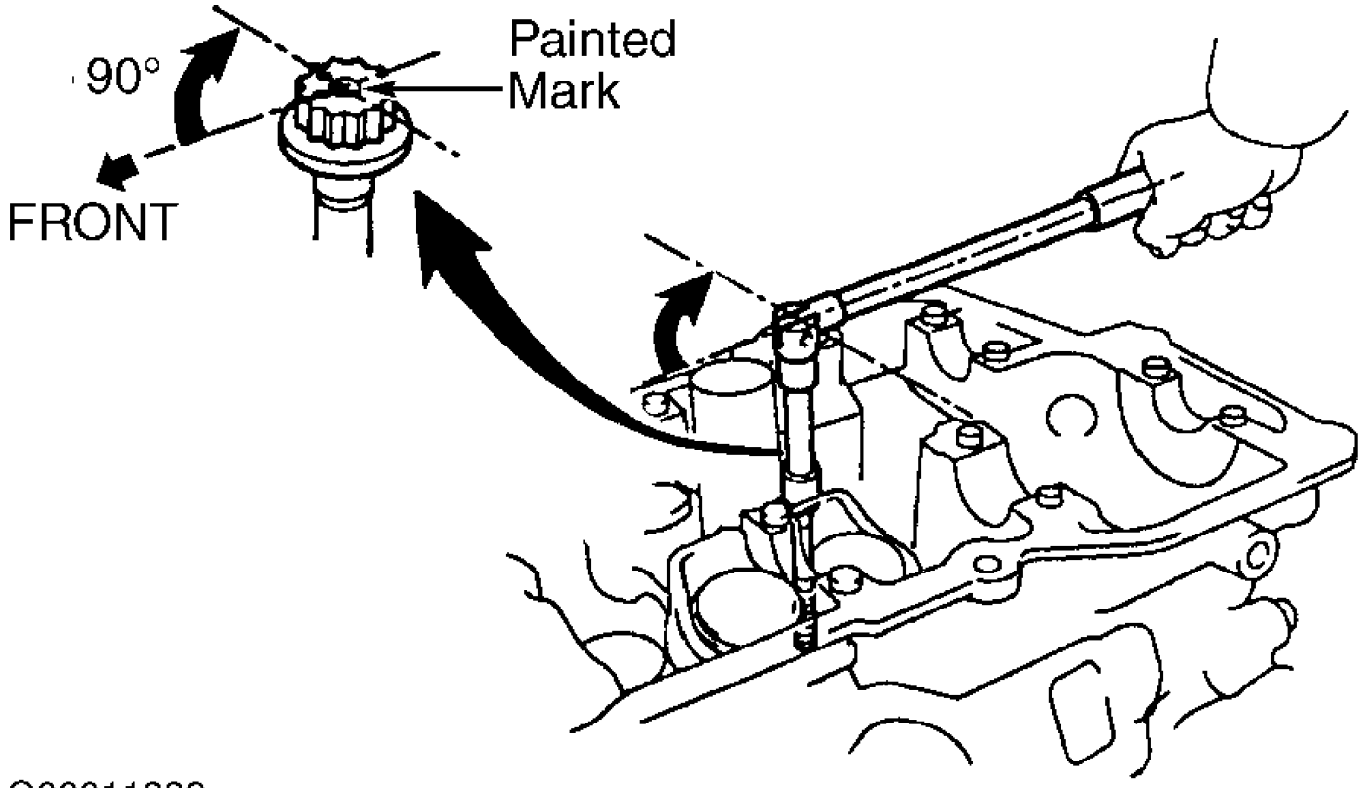


Fig. 17: Retightening Cylinder Head Bolts
Courtesy of Toyota Motor Sales, U.S.A., Inc.

4) Install recessed cylinder head bolts and tighten to specification. See TORQUE SPECIFICATIONS. Install camshafts using proper procedure. See CAMSHAFT.

5) If new cylinder head is installed, spark plug tubes must be replaced. Apply 3 bond adhesive to end of tubes. Press in spark plug tubes until tubes protrude 1.669-1.709" (42.2-43.4 mm) above cylinder head.

6) Remove old packing material. Apply sealant to grooves of semi-circular plugs and install 2 semi-circular plugs to cylinder head. Install and tighten bolts to specification. See TORQUE SPECIFICATIONS.

7) Before installing valve cover and gasket, apply sealant at front and rear areas of cylinder head. See Fig. 7. Using NEW gasket, install valve cover. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

8) To install remaining components, reverse removal procedure. If camshaft or cylinder head components are serviced, adjust valve clearance. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS. When installing intake manifold delivery pipe and injectors, tighten bolts and nuts in several passes in sequence. See Fig. 18. Tighten to specification. See TORQUE SPECIFICATIONS. Fill engine with oil and coolant. Check for leaks.

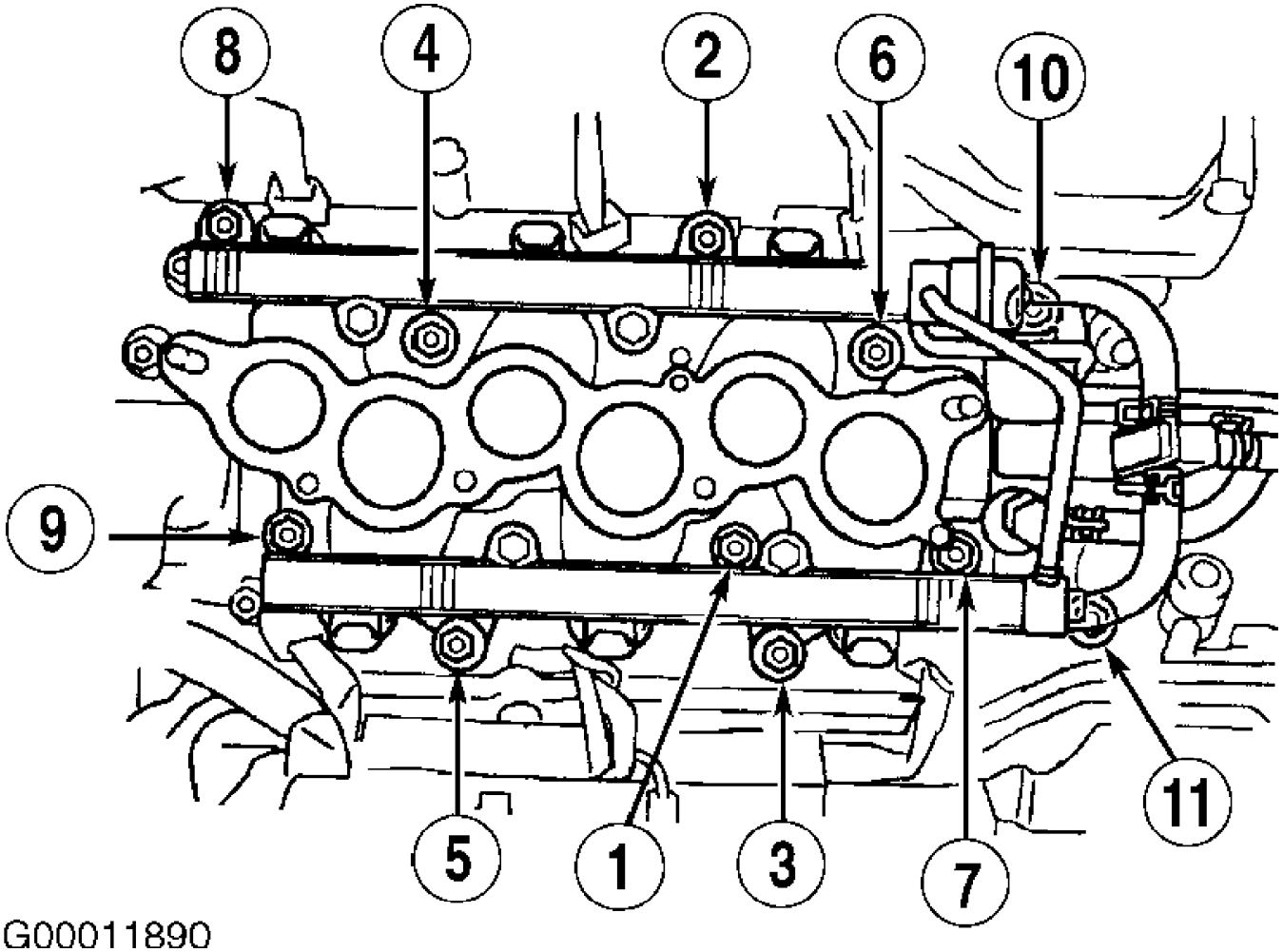


Fig. 18: Intake Manifold Bolt Tightening Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRANKSHAFT FRONT SEAL

Removal & Installation (Oil Pump Installed)

1) Remove timing belt and crankshaft sprocket. See TIMING BELT. Using a knife, cut off oil seal lip. Pry oil seal from oil pump body. DO NOT damage sealing surfaces.

2) To install, apply grease to lip of new oil seal. Using hammer and Oil Seal Installer (SST 09223-00010), install oil seal until surface is even with oil pump body. To install remaining components, reverse removal procedure.

Removal & Installation (Oil Pump Removed)

Pry oil seal from oil pump body. To install, use hammer and Oil Seal Installer (SST 09223-00010). Install oil seal until surface is even with oil pump body. Apply grease to seal lip of oil seal.

TIMING BELT

Removal

1) Disconnect negative battery cable. On RX300, remove outer cowl top panel. On all models, remove front upper suspension brace from inside engine compartment. Disconnect coolant reservoir hose from

water outlet. Raise and support vehicle. Remove passenger-side front wheel. Remove right fender apron seal. Remove accessory drive belts.

2) Disconnect ground strap connectors. Remove engine stabilizer rod, engine right mounting bracket. Remove generator bracket for access to timing belt covers.

3) Hold crankshaft pulley, and remove crankshaft pulley bolt. Using puller, remove crankshaft pulley.

4) Remove No. 1 (lower) timing belt cover. Remove timing belt guide. Remove No. 2 (upper) timing belt cover and gasket. See Fig. 19. Remove right engine mounting bracket.

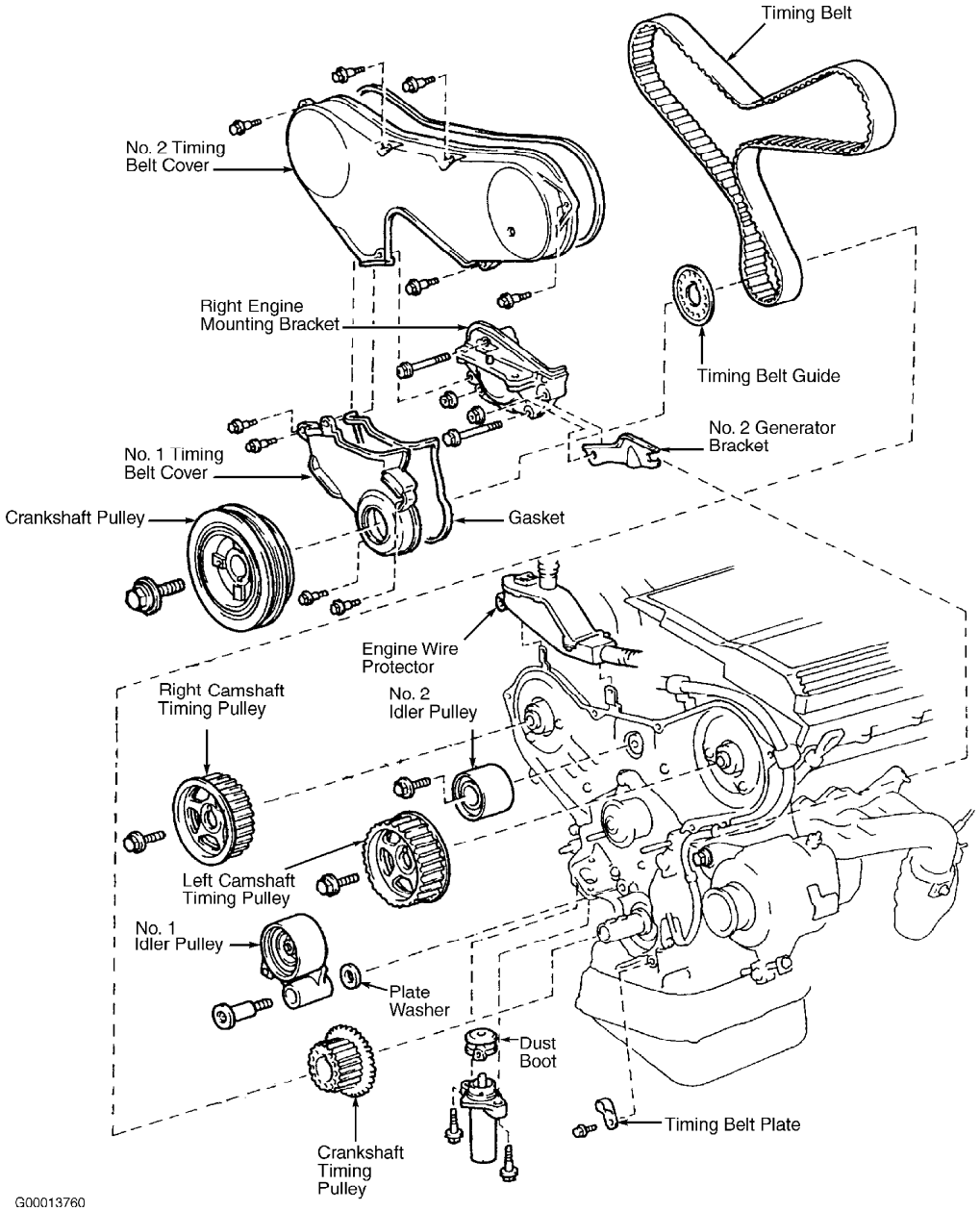


Fig. 19: Exploded View Of Timing Belt & Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

5) Temporarily install crankshaft pulley bolt in crankshaft. Using crankshaft pulley bolt, rotate crankshaft clockwise until timing

mark on crankshaft sprocket aligns with timing mark on oil pump body. See Fig. 20.

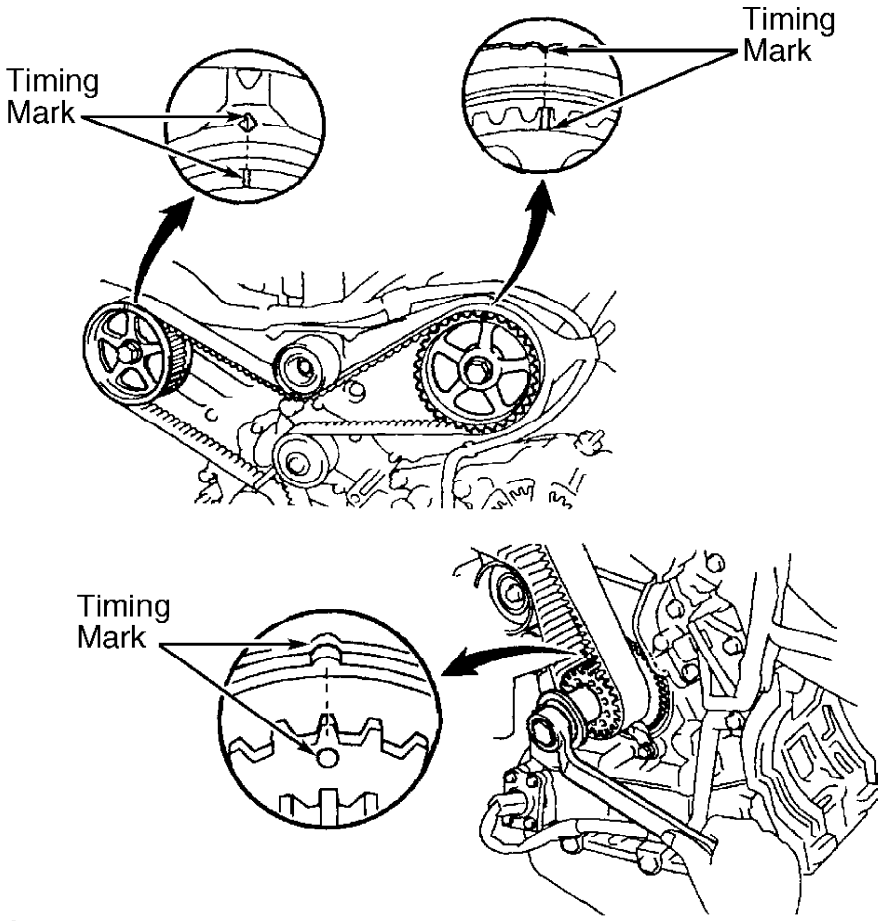
6) Ensure timing marks on camshaft sprockets are aligned with timing mark on No. 3 timing belt cover. See Fig. 20. If timing marks are not aligned, rotate crankshaft clockwise one full revolution (360 degrees). Remove crankshaft pulley bolt from crankshaft.

CAUTION: If reusing timing belt, ensure 3 reference marks and front mark are on timing belt. See Fig. 21. If marks are not apparent, place reference mark on timing belt at timing mark area on camshaft sprockets or dot area on crankshaft sprocket for reassembly reference. Place front mark on timing belt to indicate direction of timing belt installation.

7) Alternately loosen 2 bolts and remove timing belt tensioner and dust boot. See Fig. 19. Remove timing belt.

8) If removing camshaft timing sprockets, use Camshaft Sprocket Wrench (09960-10010) to hold camshaft sprocket. Using Adapter (09249-63010), remove sprocket bolt and remove camshaft sprockets.

9) If required, remove No. 1 and 2 belt idler pulleys. See Fig. 19. Remove timing belt plate near crankshaft sprocket. Using puller, remove crankshaft sprocket.



G00013763

Fig. 20: Aligning Timing Marks
Courtesy of Toyota Motor Sales, U.S.A., Inc.

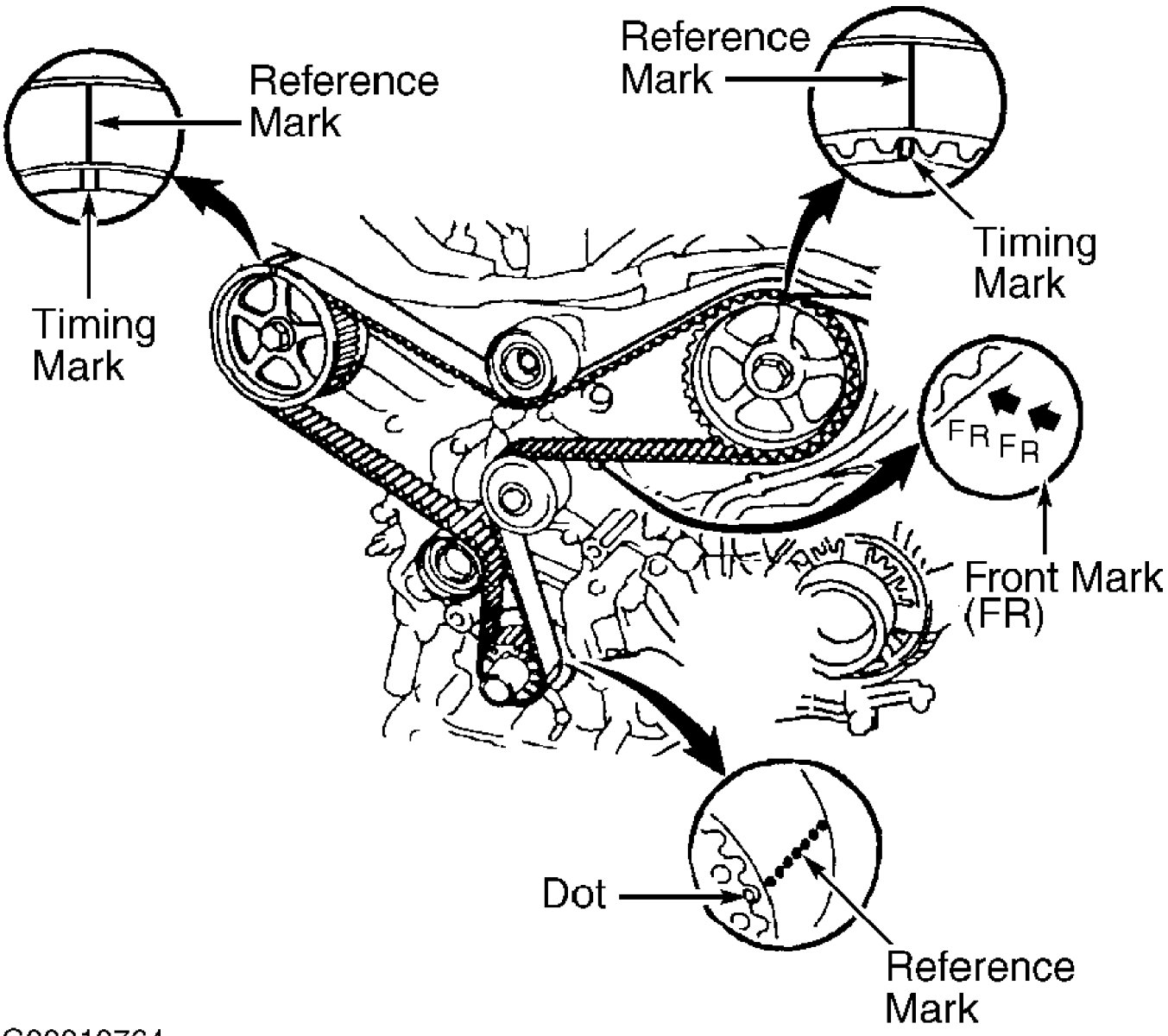


Fig. 21: Identifying Timing Belt Reference Marks & Front Mark
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Inspection

1) Inspect timing belt for damaged teeth, cracking or oil contamination. Ensure idler pulleys rotate freely. Replace damaged components.

2) Inspect timing belt tensioner for signs of oil leakage.

NOTE: Timing belt tensioner may weep a small amount of oil on rod seal under normal conditions. If excessive amount of oil exists, replace timing belt tensioner.

3) Hold timing belt tensioner body with rod facing upward and press rod against solid surface. Replace timing belt tensioner if rod moves.

4) Measure timing belt tensioner rod protrusion from end of rod to edge of timing belt tensioner housing. See Fig. 22. Replace

timing belt tensioner if distance is not .394-.425" (10.01-10.80 mm).

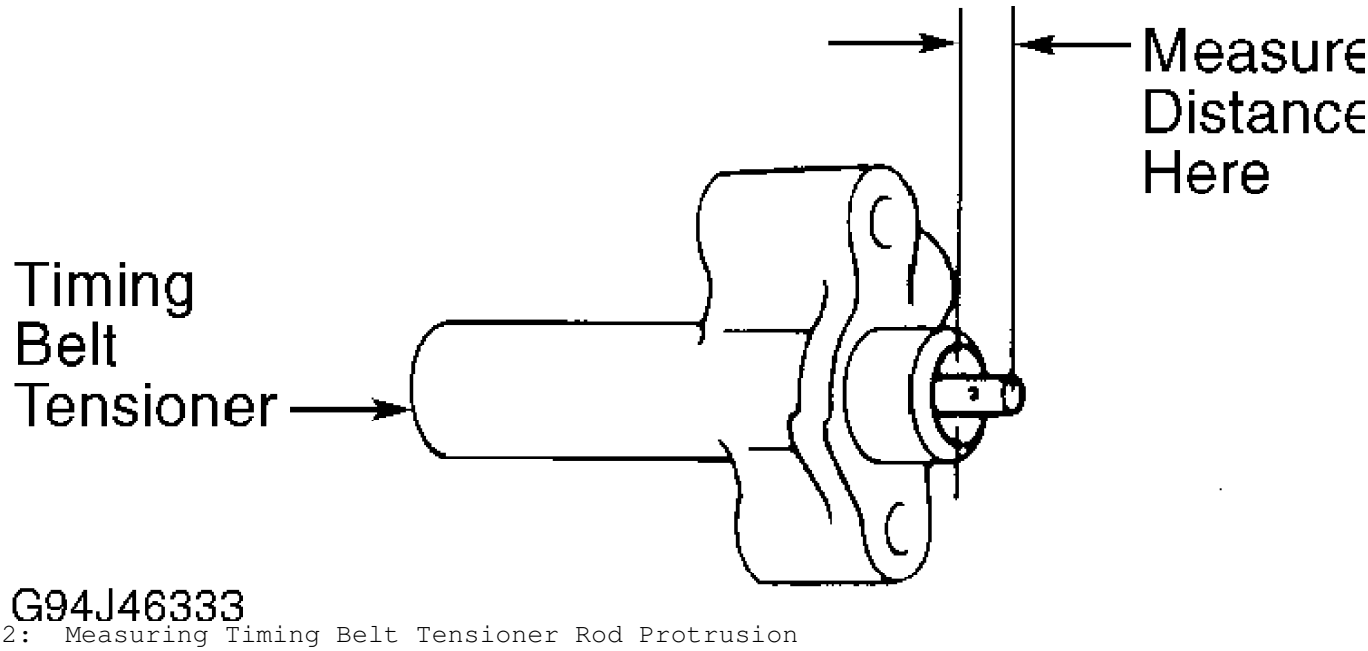


Fig. 22: Measuring Timing Belt Tensioner Rod Protrusion
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) Align crankshaft pulley set key with key groove of timing pulley and slide on timing pulley. Install crankshaft sprocket with sensor side inward.

2) Install timing belt plate. Install and tighten bolt to specification. See TORQUE SPECIFICATIONS. Install No. 1 and 2 idler pulleys (if removed). Install and tighten bolts to specification. See TORQUE SPECIFICATIONS. Ensure idler pulleys are clean and rotate smoothly.

3) If installing camshaft sprockets, ensure camshaft sprockets are installed with flange in correct direction. Install right camshaft sprocket with flange outward (away from cylinder head). Install left camshaft sprocket with flange inward (against cylinder head).

4) Align hole in camshaft sprocket with pin in camshaft, and install sprocket. Install and tighten camshaft sprocket bolt to specification. See TORQUE SPECIFICATIONS.

5) Temporarily install crankshaft pulley bolt in crankshaft. Using crankshaft pulley bolt, rotate crankshaft clockwise until timing mark on crankshaft sprocket aligns with timing mark on oil pump body. See Fig. 20.

6) Using camshaft sprocket holder, rotate each camshaft sprocket so timing mark on camshaft sprocket aligns with timing mark on No. 3 timing belt cover. See Fig. 21.

7) Align reference marks on timing belt with dot on crankshaft sprocket and timing marks on camshaft sprocket. Ensure front mark is pointing toward timing belt end of engine.

8) Install timing belt on crankshaft sprocket, water pump pulley, left camshaft sprocket, No. 2 idler pulley, right camshaft sprocket and No. 1 idler pulley. Using press, apply pressure on rod of timing belt tensioner until rod is retracted and holes in rod and housing are aligned. See Fig. 23.

9) Install hexagon wrench through holes in housing and rod to hold rod in retracted position. See Fig. 23. Release press, and install dust boot on timing belt tensioner. Install timing belt

tensioner. Install and alternately tighten bolts to specification. See TORQUE SPECIFICATIONS.

10) Remove hexagon wrench from timing belt tensioner. Rotate crankshaft clockwise until timing mark on crankshaft sprocket aligns with timing mark on oil pump body. See Fig. 20.

11) Ensure timing mark on each camshaft sprocket is aligned with timing mark on No. 3 timing belt cover. See Fig. 21. If all timing marks are not aligned, remove and reinstall timing belt. Remove crankshaft pulley bolt.

12) Using NEW gaskets, install No. 1 and 2 timing belt covers. Install engine wire protector clamps to No. 3 timing belt cover. Install and tighten bolts to specification. See TORQUE SPECIFICATIONS.

13) Align and install crankshaft pulley. Install and tighten crankshaft pulley bolt to specification. See TORQUE SPECIFICATIONS.

14) To install remaining components, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS.

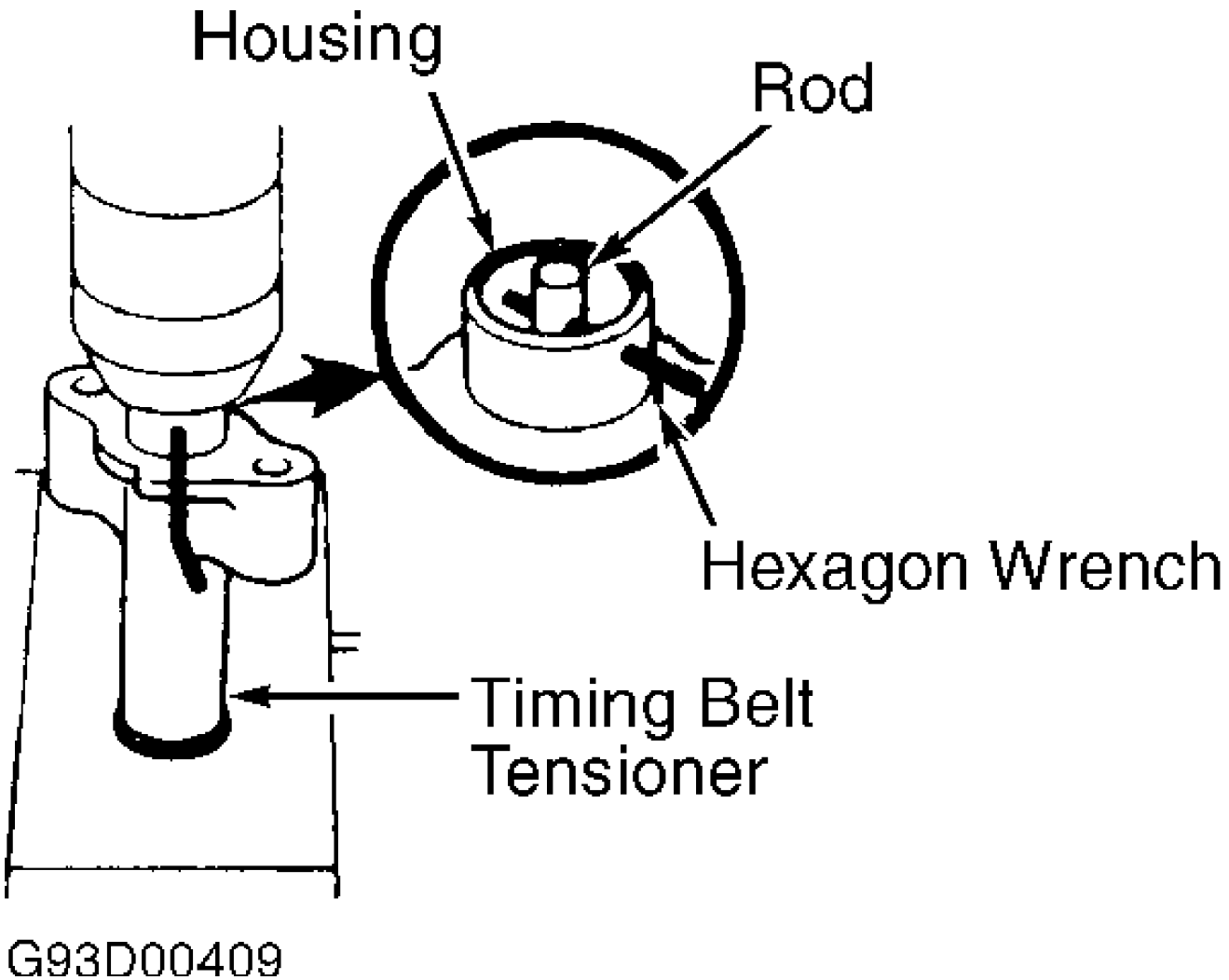


Fig. 23: Retracting Timing Belt Tensioner Rod
Courtesy of Toyota Motor Sales, U.S.A., Inc.

VALVE LIFTER

Removal

Remove camshaft. See CAMSHAFT. Note location of adjusting shims and valve lifters for reassembly reference. Remove adjusting shims and valve lifters from cylinder head.

Inspection

Inspect components for damage. Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS.

Installation

To install, reverse removal procedure. Ensure components are installed in original location. If camshaft, adjusting shim or valve lifter are replaced, check valve clearance. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS.

CAMSHAFT

WARNING: To prevent air bag deployment, disconnect negative battery cable and wait at least 90 seconds before working on vehicle.

NOTE: When servicing camshafts, reference to right and left components are as viewed from rear of engine.

1) Release fuel pressure. See FUEL PRESSURE RELEASE. Drain cooling system. On RX300, remove outer cowl top panel. On all models, remove right fender apron seal. Remove generator drive belt. Remove power steering pump. Remove front exhaust pipe.

2) Using 5-mm hexagon wrench remove 3 cap nuts from "V" bank cover and remove "V 'bank cover. Remove air cleaner cap and airflow meter with air cleaner hose. Remove cruise control actuator and bracket. Disconnect necessary electrical connections, ground straps, coolant hoses, fuel lines and vacuum hoses for removal of air intake chamber. Remove 2 bolts and No. 1 engine hangar.

3) Remove nuts and air intake chamber located above intake manifold. See Fig. 13. Disconnect fuel injector connectors. Disconnect fuel inlet hose from fuel filter. Disconnect heater hose from intake manifold. Remove bolts, nuts and washer from intake mainfold and remove intake mainfold, fuel pipes and fuel injectors as an assembly.

CAUTION: DO NOT allow injectors to fall from delivery pipe when removing from intake manifold.

4) Disconnect Engine Cooling Temperature (ECT) sensor and sending unit. Disconnect ground strap connector. Disconnect upper radiator hose. Disconnect engine coolant reservoir hose. Remove bolts, nuts and plate washers. Disconnect water by-pass hose, and remove thermostat housing. Remove 2 gaskets.

5) Remove ignition coils and spark plugs. Mark ignition coil location for reassembly reference. Remove timing belt, camshaft sprockets and No. 2 idler pulley. See TIMING BELT. Disconnect 3 engine wire clamps from timing belt cover. Remove 6 bolts and No. 3 timing belt cover.

6) Remove camshaft position sensors. Remove camshaft timing oil control valves. Remove nut, and disconnect engine wire protector from right cylinder head. Disconnect engine wire protector from left cylinder head. Remove 2 bolts and remove rear plate from left cylinder head. Disconnect water inlet pipes from left cylinder head. Remove "O" ring from inlet pipe.

7) Remove power steering pump bracket from front of cylinder head. Disconnect airflow sensor connector, remove bolt and nut and remove right exhaust manifold stay. Remove 6 nuts, right exhaust

manifold and gasket. Repeat procedure for left exhaust manifold.

8) Remove bolt holding oil dipstick guide to left cylinder head. Pull out dipstick guide with dipstick from No. 1 oil pan. Remove "O" ring from dipstick guide. Remove 9 bolts, cylinder head cover and gasket. See Fig. 14. Remove 2 cylinder head covers.

9) To remove right-side camshafts, align timing marks (2 dots) on camshaft gears by rotating intake camshaft using hexagonal area of camshaft. To remove left camshafts, align timing marls (1 dot) on camshaft gears by rotating intake camshaft using hexagonal area of camshaft. See Fig. 24.

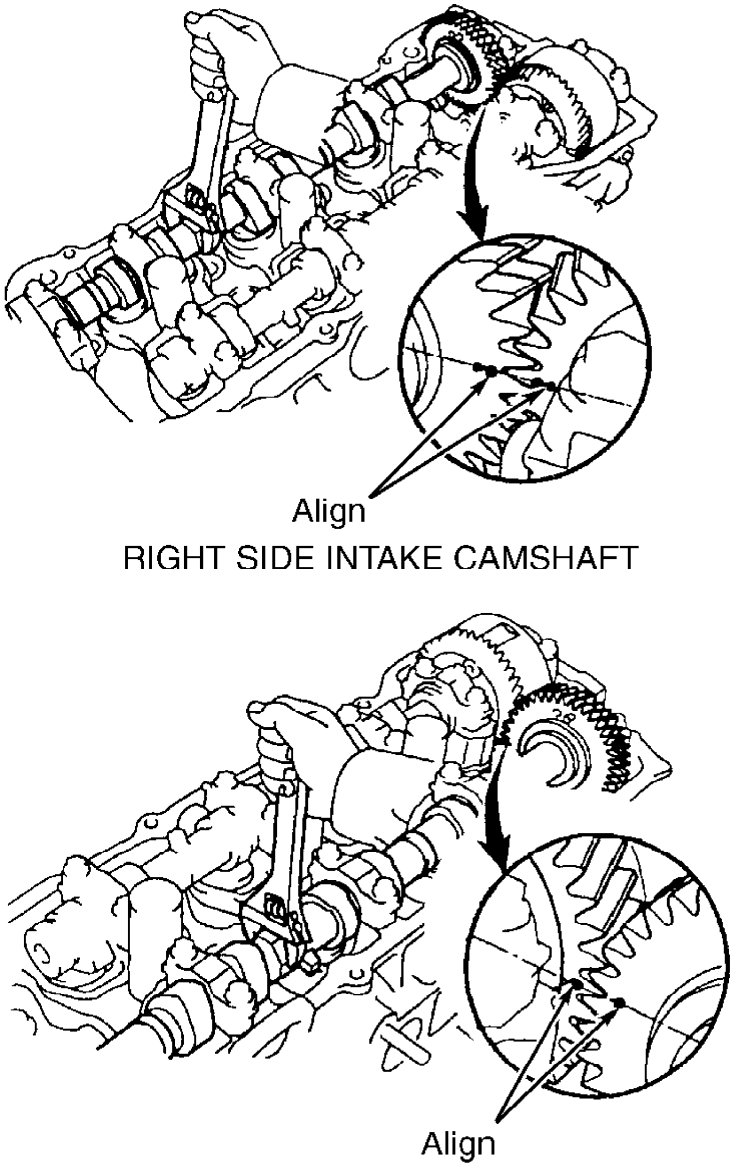


Fig. 24: Aligning Camshaft Timing Marks
Courtesy of Toyota Motor Sales, U.S.A., Inc.

10) On exhaust camshafts, secure sub-gear on exhaust camshaft to main gear with 6 x 1.0 x 20 mm service bolt "A". See Fig. 25.

Before removing camshaft bearing cap bolts, ensure torsional spring force of sub-gear is held by service bolt "A".

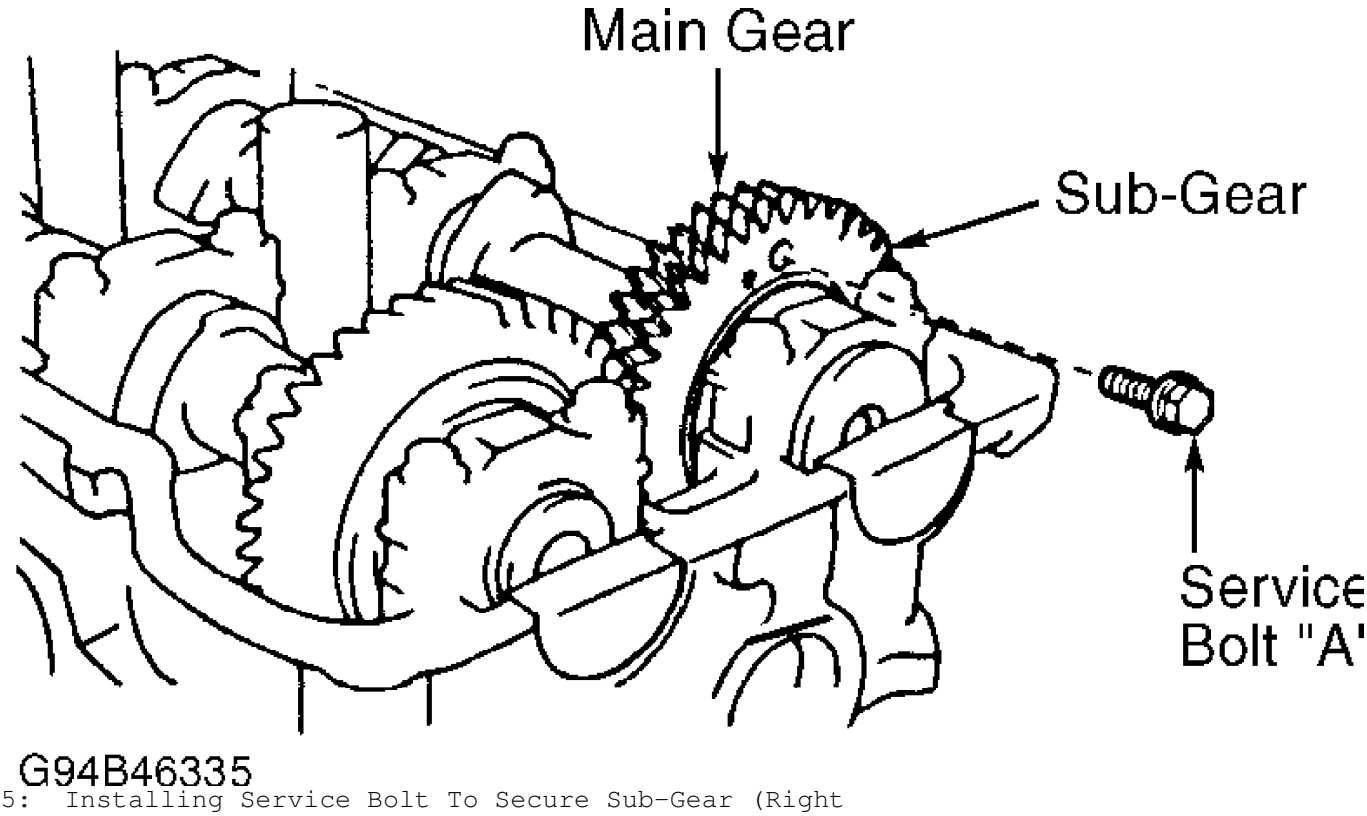


Fig. 25: Installing Service Bolt To Secure Sub-Gear (Right Cylinder Head Shown; Left Cylinder Head Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

11) Remove intake camshaft bearing cap bolts in sequence using several steps. See Fig. 28. Remove camshaft bearing caps and intake camshaft.

CAUTION: Camshaft bearing cap bolts must be removed in proper sequence to prevent damage to cylinder head and camshaft thrust surfaces.

12) Remove exhaust camshaft bearing cap bolts in sequence using several steps. See Fig. 28. Remove camshaft bearing caps, exhaust camshaft and oil seal.

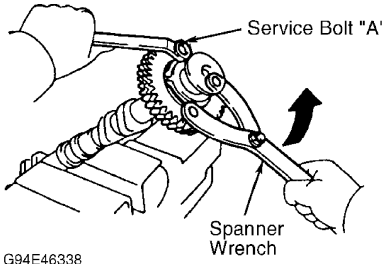


Fig. 26: Disassembling & Reassembling Exhaust Camshaft
Courtesy of Toyota Motor Sales, U.S.A., Inc.

13) If disassembling exhaust camshaft gear, mount hexagonal area of camshaft in soft-jaw vise. Using Spanner Wrench (SST 09960-

10010), rotate sub-gear counterclockwise and remove service bolt "A". See Fig. 26. Remove snap ring, wave washer, sub-gear and gear spring. See Fig. 27.

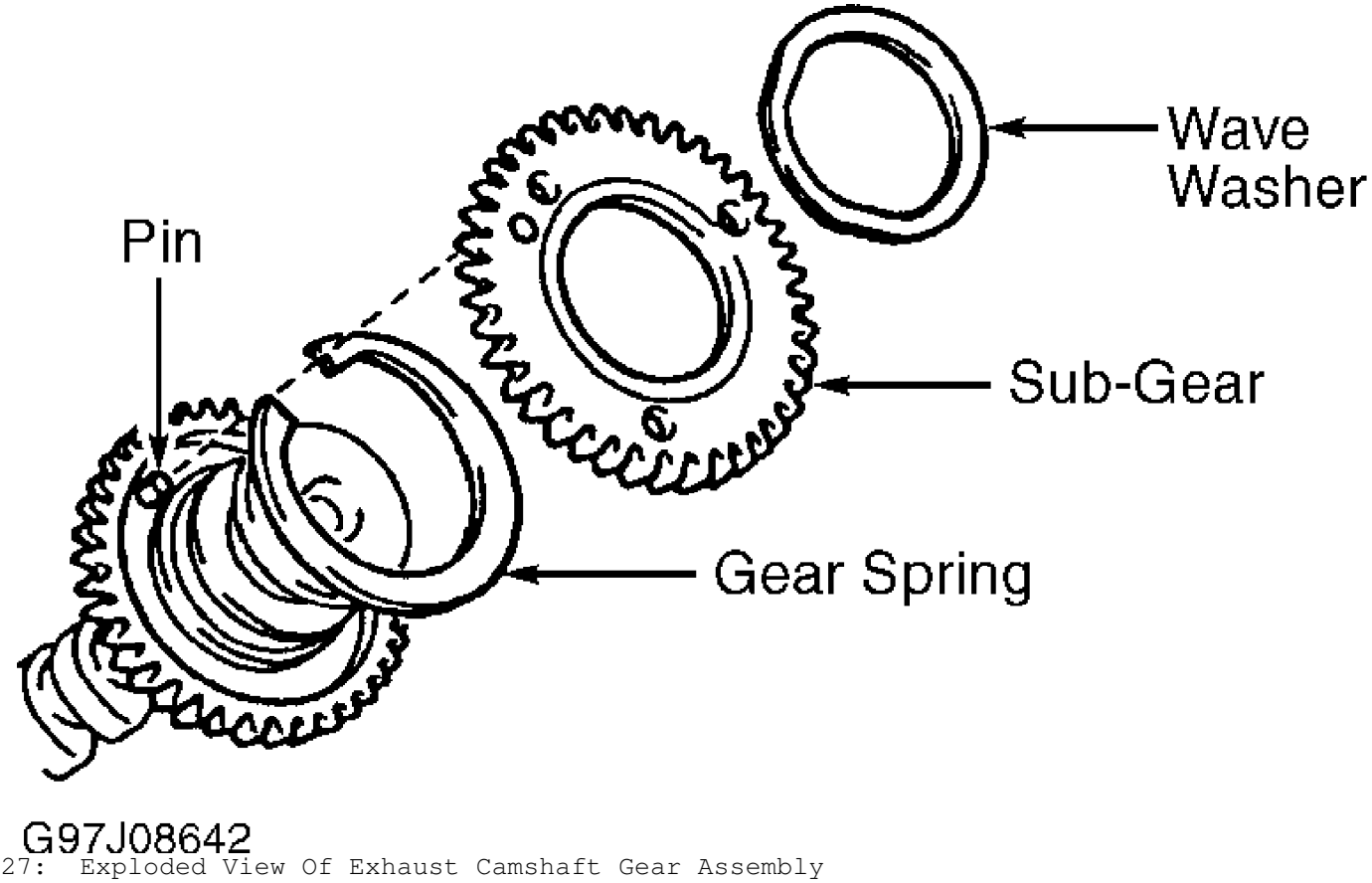


Fig. 27: Exploded View Of Exhaust Camshaft Gear Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

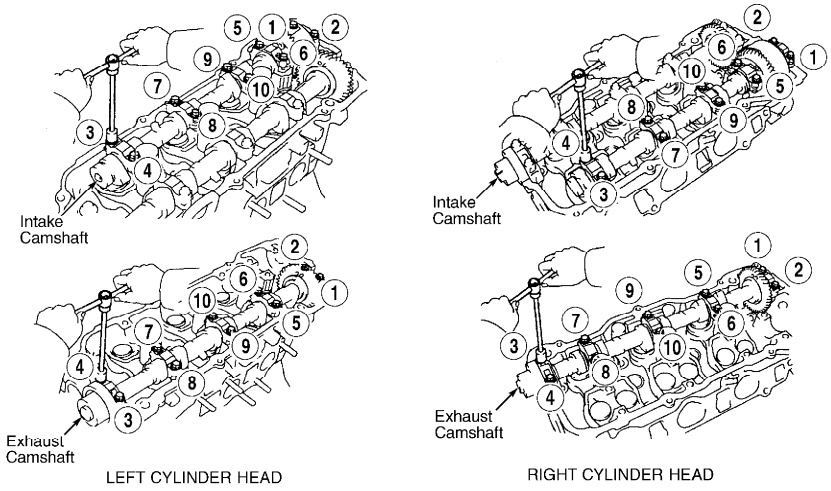


Fig. 28: Camshaft Bearing Cap Bolt Removal Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Inspection

1) Inspect components for damage. Check camshaft journal

diameter, lobe height and journal runout. Replace camshaft if not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS.

2) Install camshaft in cylinder head. Using Plastigage, check camshaft oil clearance. Tighten camshaft bearing cap bolts to specification in sequence when checking oil clearance. DO NOT rotate camshaft. See TORQUE SPECIFICATIONS.

3) Remove bearing caps and measure Plastigage. Replace camshaft and/or cylinder head if oil clearance is not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS.

4) Check camshaft end play with camshaft bearing cap bolts tightened to specification. Replace camshaft and/or cylinder head if end play is not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS.

5) Install both camshafts without sub-gear installed on exhaust camshaft. Tighten camshaft bearing cap bolts to specification. Check gear backlash between camshaft gears.

6) Replace camshaft if gear backlash exceeds specification. See CAMSHAFT table under ENGINE SPECIFICATIONS. Measure distance between ends of gear spring. Replace gear spring if distance between ends of gear spring is not .712-.740" (18.08-18.80 mm).

Installation

1) If reassembling exhaust camshaft, install gear spring so ends contact pins on main gear and sub-gear. See Fig. 27. Install gear spring, camshaft sub-gear, wave washer and snap ring. Using spanner wrench, rotate sub-gear counterclockwise until holes in main gear and sub-gear are aligned. Install service bolt "A". See Fig. 26.

2) Apply engine oil to thrust surfaces and journals of camshafts. Install exhaust camshaft in cylinder head. Rotate exhaust camshaft so timing marks (2 dots) on right cylinder head, or (1 dot) on left cylinder head are positioned at 90-degree angle to cylinder head. See Fig. 29.

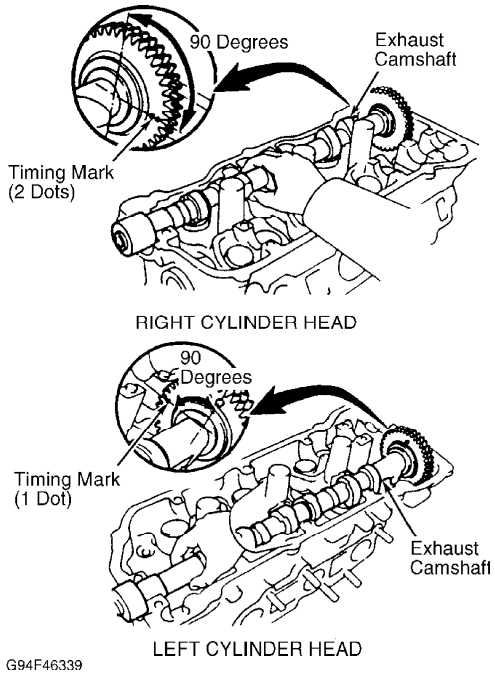


Fig. 29: Positioning Exhaust Camshafts
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Apply grease to seal lip on NEW oil seal. Install oil seal on exhaust camshaft. Apply sealant on No. 1 exhaust camshaft bearing

cap at bearing cap-to-cylinder head surface.

4) Install exhaust camshaft bearing caps in numerical order. Ensure arrow on top of camshaft bearing cap is pointing toward timing belt end of engine. See Fig. 30.

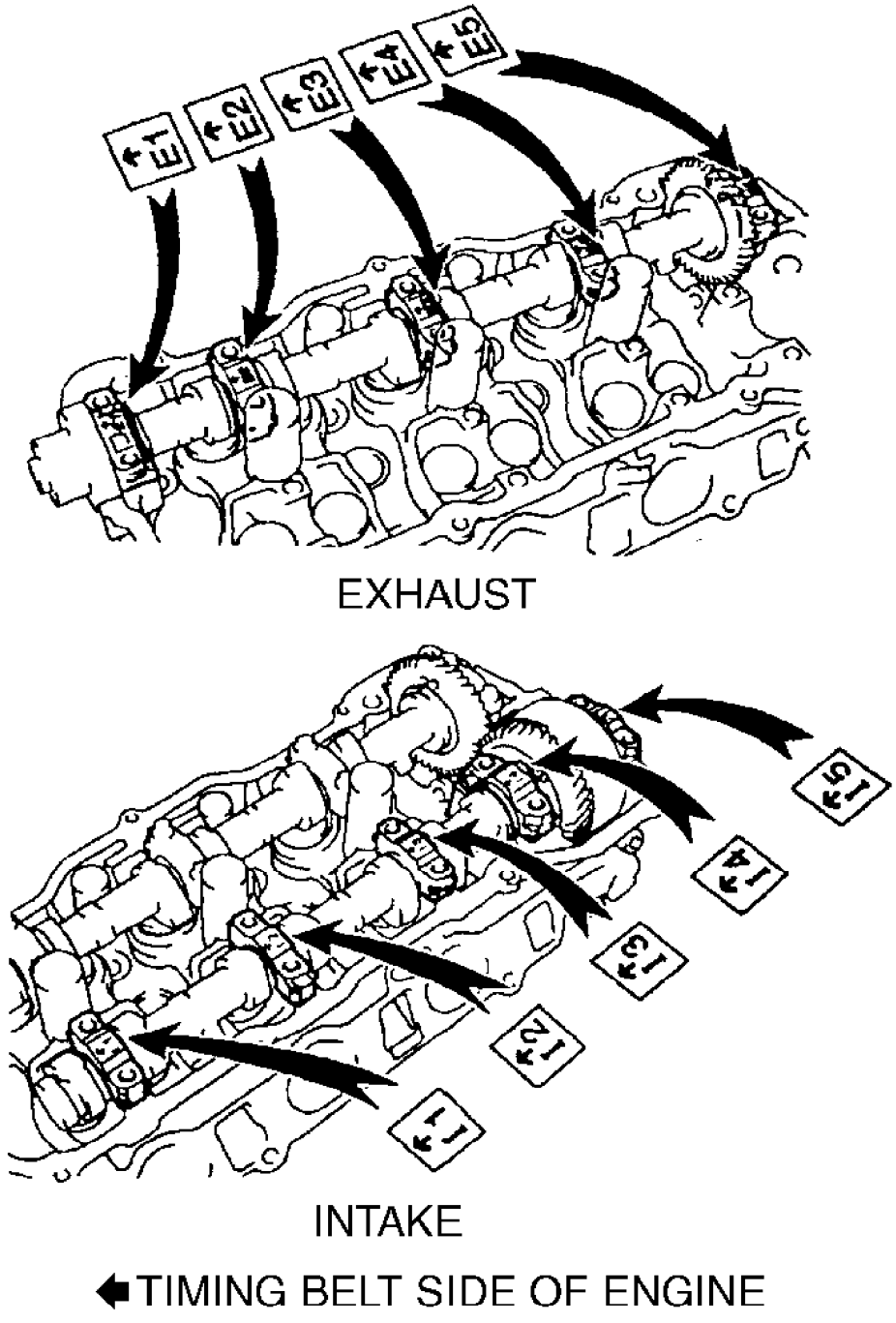


Fig. 30: Identifying Camshaft Bearing Caps (Right Cylinder Head Shown; Left Cylinder Head Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

5) Coat camshaft bearing cap bolt-to-camshaft bearing cap

surface and bolt threads with engine oil. Install and tighten exhaust camshaft bearing cap bolts to specification in sequence using several steps. See Fig. 31. See TORQUE SPECIFICATIONS.

6) When installing intake camshaft in cylinder head, rotate camshafts so timing marks align (2 dots on right cylinder head, 1 dot on left cylinder head). See Fig. 24.

7) Install intake camshaft bearing caps in numerical order. Ensure arrow on top of camshaft bearing cap is pointing toward timing belt end of engine. See Fig. 30.

8) Coat camshaft bearing cap bolt-to-camshaft bearing cap surface, and bolt threads with engine oil. Install and tighten intake camshaft bearing cap bolts to specification in sequence using several steps. See Fig. 31. See TORQUE SPECIFICATIONS.

CAUTION: Ensure service bolt "A" is removed from sub-gear on exhaust camshafts.

9) Remove service bolt "A" from exhaust camshaft. Check and adjust valve clearance. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS.

10) Apply sealant to grooves of semi-circular plugs and install in cylinder head (if removed). Before installing valve cover and gasket, apply sealant at front and rear areas of cylinder head. See Fig. 7.

11) Using NEW gasket, install valve cover. Install and tighten valve cover bolts to specification in several steps. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure using NEW gaskets. Tighten all fasteners to specification. Fill cooling system and adjust control cables.

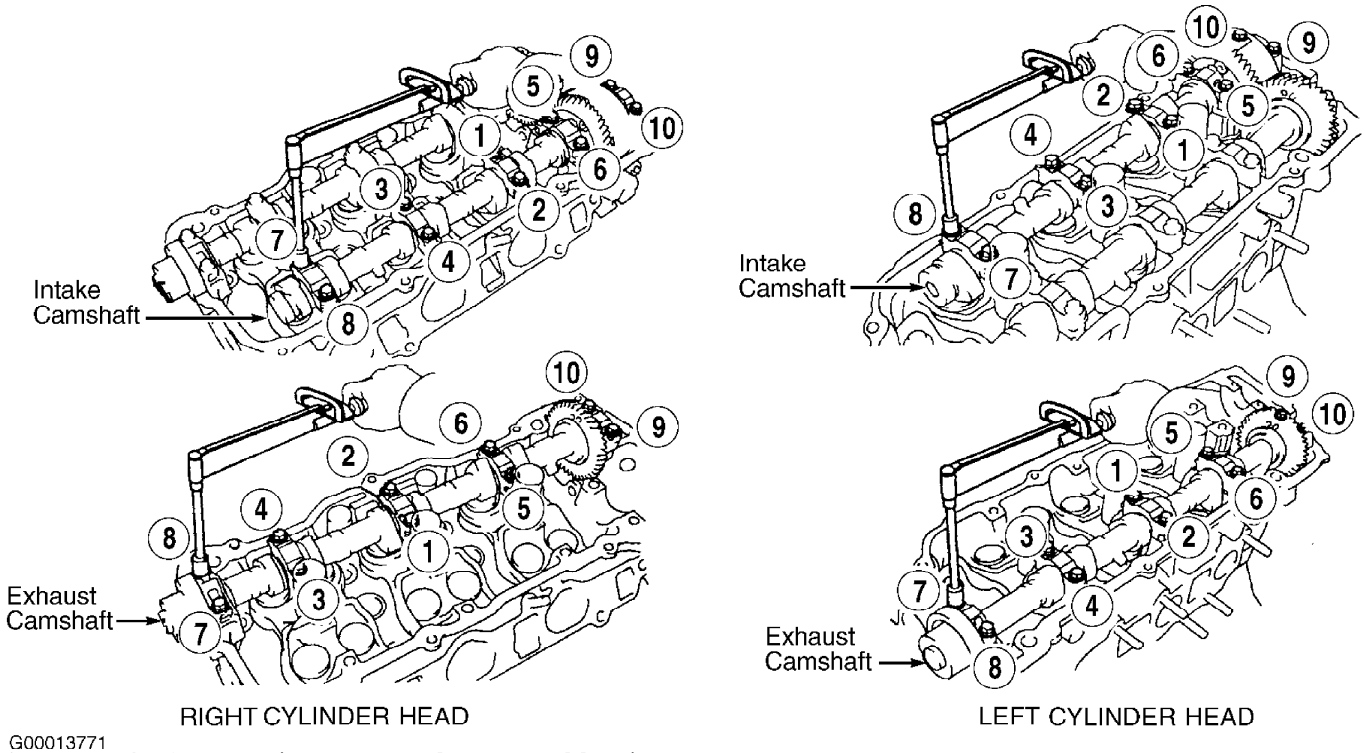


Fig. 31: Camshaft Bearing Cap Bolt Installation Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRANKSHAFT REAR OIL SEAL

Removal

Remove transaxle and drive plate. See TRANSMISSION REMOVAL & INSTALLATION article in TRANSMISSION SERVICING. Using a knife, cut off oil seal lip. Pry oil seal from crankshaft rear oil seal housing. DO NOT damage sealing surfaces.

Installation

1) Ensure all sealing surfaces are clean. Apply grease to lip of new oil seal. Using Oil Seal Installer (SST 09223-15030), install oil seal in crankshaft rear oil seal housing until oil seal is even with housing surface.

2) Apply Loctite to drive plate bolts. Install and tighten drive plate bolts to specification in a crisscross pattern. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure.

WATER PUMP

Removal

1) Disconnect negative battery cable. Drain cooling system. Remove timing belt, camshaft sprockets and No. 2 idler pulley. See TIMING BELT.

2) Remove No. 3 (rear) timing belt cover. Remove bolts, nuts, water pump and gasket.

Installation

To install, reverse removal procedure using NEW gaskets. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Ensure proper procedure is followed when installing timing belt. Fill cooling system.

OIL PAN

Removal

1) Disconnect negative battery cable. On RX300, remove outer cowl top panel. Remove front upper suspension brace inside engine compartment. On all models, raise and support vehicle. Drain engine oil. Remove right front wheel and fender apron seal. Remove generator and A/C compressor from engine. Remove power steering drive belt and adjusting strut. Remove front exhaust pipe from between exhaust manifolds and catalytic converter. On RX300, remove catalytic converter.

2) On ES300, remove oil level sensor from lower corner of engine block. On all models, remove timing belt. See TIMING BELT. Remove timing pulleys and No. 3 timing belt cover. Remove A/C compressor and housing bracket.

3) Remove No. 2 oil pan bolts and nuts. Install Seal Cutter (SST 09032-00100) between No. 1 and 2 oil pans. Carefully tap seal cutter around No. 2 oil pan to loosen seal. DO NOT damage sealing surfaces. Remove No. 2 oil pan.

4) Remove oil strainer and gasket. See Fig. 32. Remove 2 bolts and flywheel housing undercover located at rear of No. 1 oil pan. Remove exhaust pipe stay, if equipped. Remove 19 bolts. Using screwdriver, remove oil pan by prying portions between cylinder block and oil pan. Remove No. 1 oil pan.

NOTE: DO NOT damage contact surfaces of cylinder block and oil pan.

5) Remove baffle plate from No. 1 oil pan. Remove crankshaft position sensor. See Fig. 32.

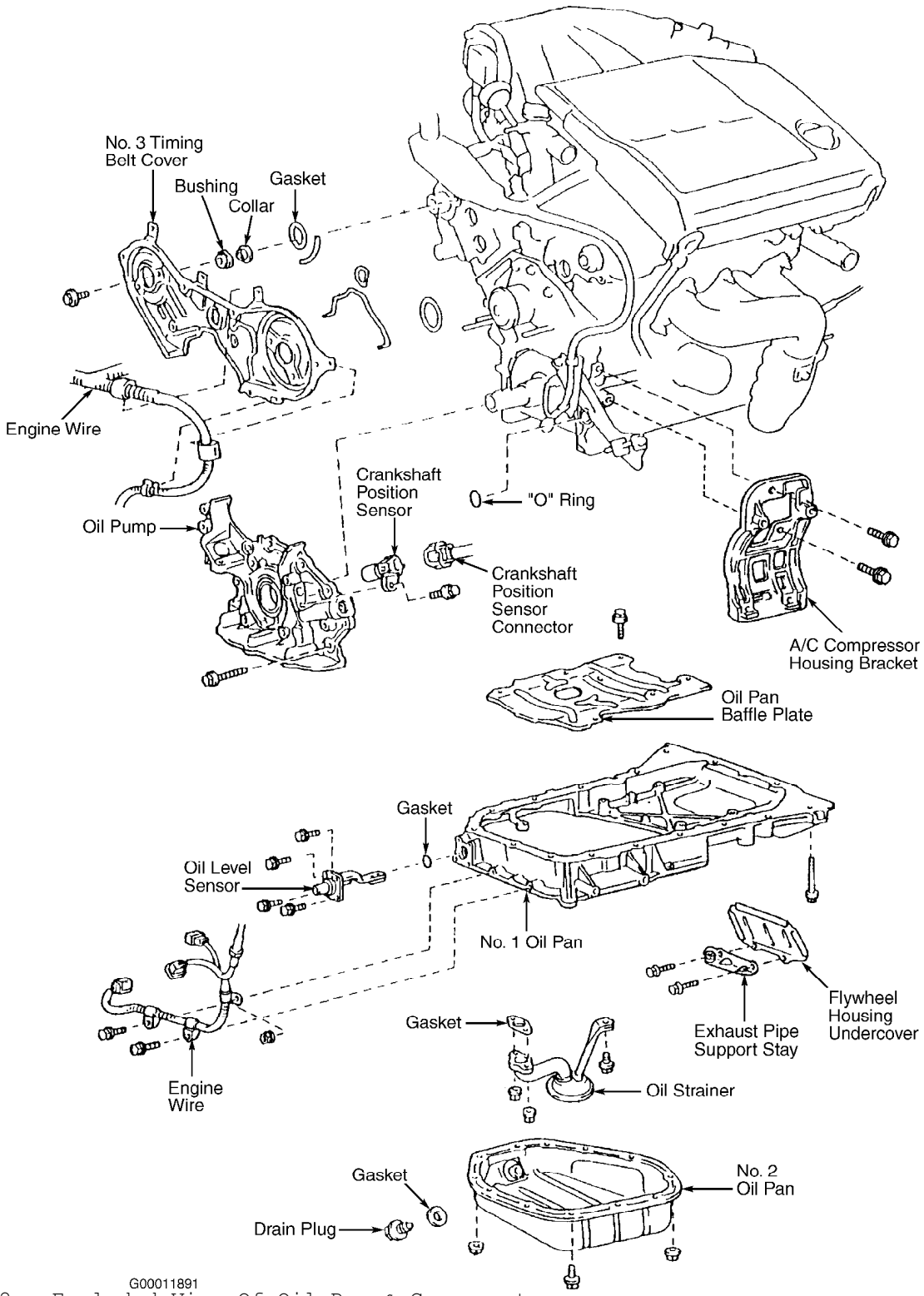


Fig. 32: Exploded View Of Oil Pan & Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) Install crankshaft position sensor. Install baffle plate

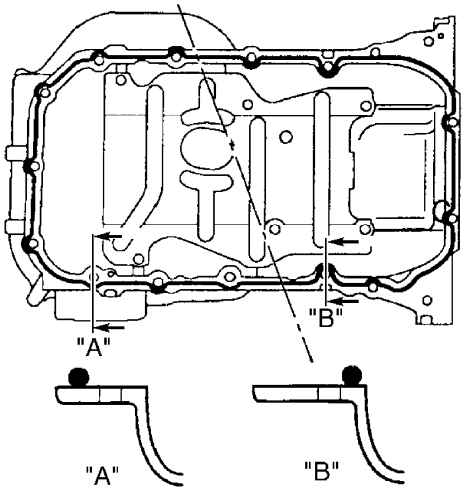
on No. 1 oil pan (if necessary). Install and tighten bolts to specification. See TORQUE SPECIFICATIONS.

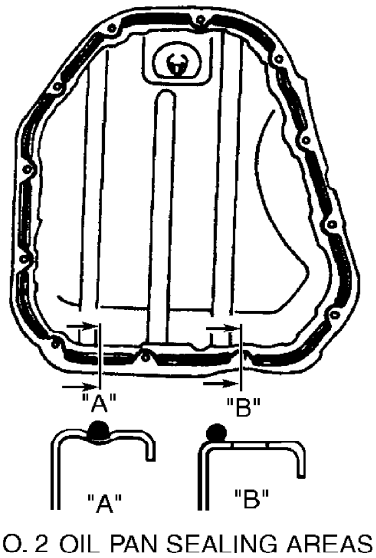
2) Ensure sealing surfaces are clean. Apply Seal Packing (08826-00080) or equivalent to No. 1 oil pan. See Fig. 33. Install oil pan and tighten bolts to specifications. See TORQUE SPECIFICATIONS.

3) Install flywheel housing undercover and exhaust pipe support stay, if equipped. Install oil strainer.

4) Apply seal packing to No. 2 oil pan. See Fig. 33. Ensure seal width is 3.0-4.0 mm. Install No. 2 oil pan with 19 bolts. Tighten to specification. See TORQUE SPECIFICATIONS.

5) Install NEW gasket to oil level sensor. Install oil level sensor. Install and tighten bolts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure.





G00013772

Fig. 33: Identifying Oil Pan Sealant Application Areas
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OVERHAUL

CYLINDER HEAD

Cylinder Head

1) Inspect cylinder head warpage at cylinder block and manifold surfaces. Replace cylinder head if warpage exceeds specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

2) Using Plastigage, check camshaft oil clearance. Install camshaft in cylinder head. Tighten camshaft bearing caps using proper tightening sequence. See Fig. 31.

3) Replace camshaft and/or cylinder head if oil clearance is not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS.

4) Check camshaft end play with camshaft bearing cap bolts tightened to specification. Replace camshaft and/or cylinder head if end play is not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS.

5) Ensure valve lifter bore diameter is within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS.

6) If installing spark plug tubes in new cylinder head, apply sealant on cylinder head end of spark plug tube. Using press, install spark plug tube until distance between top surface of spark plug tube and camshaft bearing cap surface of cylinder head is 1.669-1.709" (42.40-43.40 mm).

7) If installing PCV pipe in new cylinder head, use hammer and wooden block. PCV pipes are installed between exhaust camshaft and outer edge of cylinder head. Install PCV pipe until top of pipe is even with valve cover gasket surface on cylinder head.

Valve Springs

Ensure valve spring free length, pressure and out-of-square are within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.

Valve Stem Oil Seals

Intake valve stem oil seal is Light Brown, and exhaust valve stem oil seal is Gray. Lubricate valve stem oil seal with engine oil. Install valve stem oil seal using Oil Seal Installer (SST 09201-41020).

Valve Guides

1) Ensure valve guide inside diameter is within specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. Replace valve guide if inside diameter exceeds specification.

2) To replace valve guide, heat cylinder head to 176-212°F (80-100°C). Using hammer and Valve Guide Remover/Installer (SST 09201-01055), drive valve guide from camshaft side of cylinder head.

3) Measure cylinder head valve guide bore inside diameter. If bore inside diameter is .4053-.4060" (10.295-10.312 mm), use standard valve guide. If bore inside diameter is .4073-.4080" (10.345-10.363 mm), use oversize valve guide.

4) If bore inside diameter exceeds .4060" (10.313 mm), machine valve guide bore to .4073-.4080" (10.345-10.363 mm) for oversize valve guide. If bore I.D. exceeds .4080" (10.363 mm), replace cylinder head.

CAUTION: Exhaust valve guide is 1.594" (40.50 mm) long and intake valve guide is 1.358" (34.49 mm) long. Ensure proper length valve guide is installed.

5) To install valve guide, heat cylinder head to 176-212°F (80-100°C). Using hammer and valve guide remover/installer, drive valve guide in from camshaft side of cylinder head until valve guide

installed height is within specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. Valve guide installed height is measured from top of valve guide to cylinder head surface, right next to valve guide.

6) Using .216" (5.48 mm) reamer, ream valve guide to obtain specified valve stem-to-guide oil clearance. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

Valve Seat

Ensure valve seat angle and seat width are within specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. Valve seat replacement information is not available from manufacturer.

Valves

Ensure minimum refinish length, stem diameter and valve margin are within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS. Replace valve if not within specification.

Valve Seat Correction Angles

Use 30-degree and 45-degree stones to lower valve seat contact area. Use 75-degree and 45-degree stones to raise valve seat contact area.

VALVE TRAIN

Valve Lifters

Ensure valve lifter diameter, bore diameter and oil clearance are within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS. Replace components if not within specification.

Camshaft

Using "V" blocks and dial indicator, check camshaft runout. Ensure camshaft journal diameter and out-of-round are within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS. Replace camshaft if not within specification.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1) Ensure connecting rod and connecting rod cap are marked with matching cylinder number for reassembly reference. Piston and connecting rod must be installed in cylinder block with front mark on piston facing timing belt end of engine. See Fig. 34.

2) Before disassembling piston and connecting rod, try to move piston back and forth on piston pin. Replace piston and piston pin if any movement is felt.

3) When removing piston from connecting rod, remove snap rings from piston. Heat piston to 140°F (60°C) in water. Remove piston pin using a brass drift and plastic-face hammer. Separate piston from connecting rod. Ensure piston pin diameter is within specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

4) Ensure connecting rod piston pin bushing bore diameter, crankpin bore diameter, bend and twist are within specification. See CONNECTING RODS table under ENGINE SPECIFICATIONS.

NOTE: Crankpin bore diameter is identified by size mark ("1", "2", "3" or "4") stamped on connecting rod. See Fig. 36.

5) Piston pin bushing can be replaced in connecting rod if bore diameter is not within specification. Use Bushing Remover/Installer (SST 09222-30010) and press to replace bushing.

6) Ensure bushing oil hole aligns with connecting rod oil

hole. Hone bushing to obtain correct piston pin-to-rod clearance. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

7) Use caliper to measure outside diameter of connecting rod bolt, just above threads. Replace connecting rod bolt if outside diameter is less than .276" (7.01 mm).

8) To reassemble, install piston on connecting rod with front mark on top of piston aligned with front mark on connecting rod. See Fig. 34. Install NEW snap ring in piston. Ensure ends of snap ring are not aligned with piston pin cutout area of piston.

NOTE: With piston at 140°F (60°C), piston pin should be able to be pressed into piston using thumb pressure.

9) Heat piston to 140°F (60°C) in water. Coat piston pin with engine oil. Install piston pin and remaining NEW snap ring. Ensure ends of snap ring are not aligned with piston pin cutout area of piston.

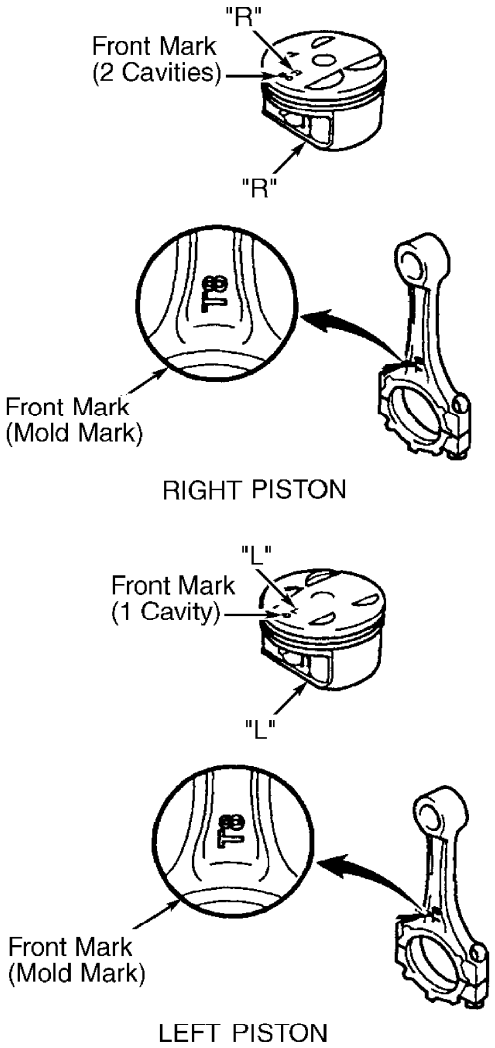


Fig. 34: Identifying Front Marks & Aligning Connecting Rod With Piston
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fitting Pistons

1) To determine piston-to-cylinder clearance, measure piston skirt diameter at .913" (23.20 mm) from top of piston at 90-degree angle to piston pin.

2) Ensure piston diameter is within specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

3) Measure cylinder bore diameter at .39" (10.0 mm) from top and bottom of cylinder bore and at middle of cylinder bore. Ensure cylinder bore diameter is within specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.

4) Determine piston-to-cylinder clearance. Replace piston or cylinder block if clearance is not within specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

Piston Rings

Ensure piston ring end gap and side clearance are within specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS. Position piston rings with ring end gaps in proper areas with identification mark on piston ring toward top of piston. See Fig. 35.

NOTE: No. 1 compression ring may contain a 1R or "T" identification mark and No. 2 compression ring may contain a 2R or 2T identification mark. Ensure proper ring is installed in correct location.

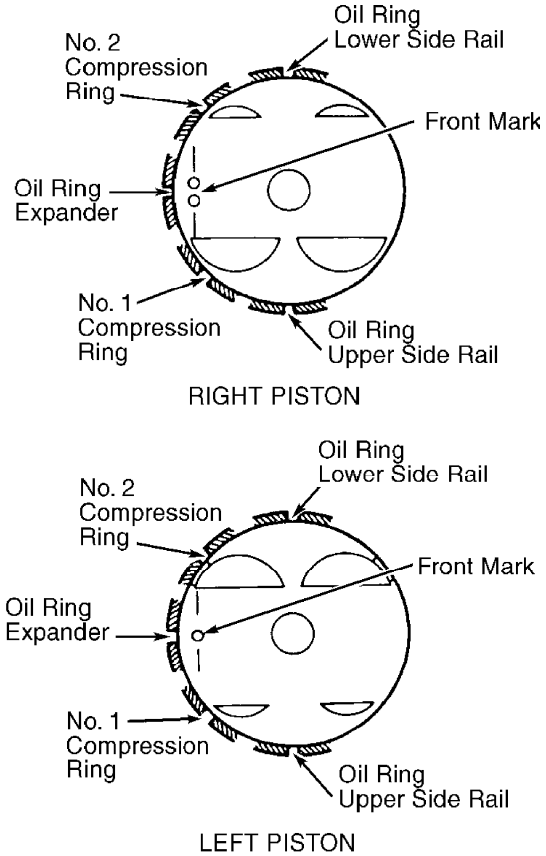


Fig. 35: Positioning Piston Rings
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rod Bearings

1) Ensure connecting rod and connecting rod cap are marked

with matching cylinder number for reassembly reference. Piston and connecting rod must be installed in cylinder block with front mark facing timing belt end of engine. See Fig. 34.

2) Connecting rod and back of rod bearing are stamped with size mark ("1", "2", "3" or "4"). See Fig. 36. Size marks on connecting rod and rod bearing must be the same. Rod bearing thickness is determined by size mark. See ROD BEARING SPECIFICATIONS table.

NOTE: If replacing rod bearing, ensure size mark on replacement rod bearing is the same as size mark on original rod bearing. Ensure size mark is also the same as that stamped on connecting rod.

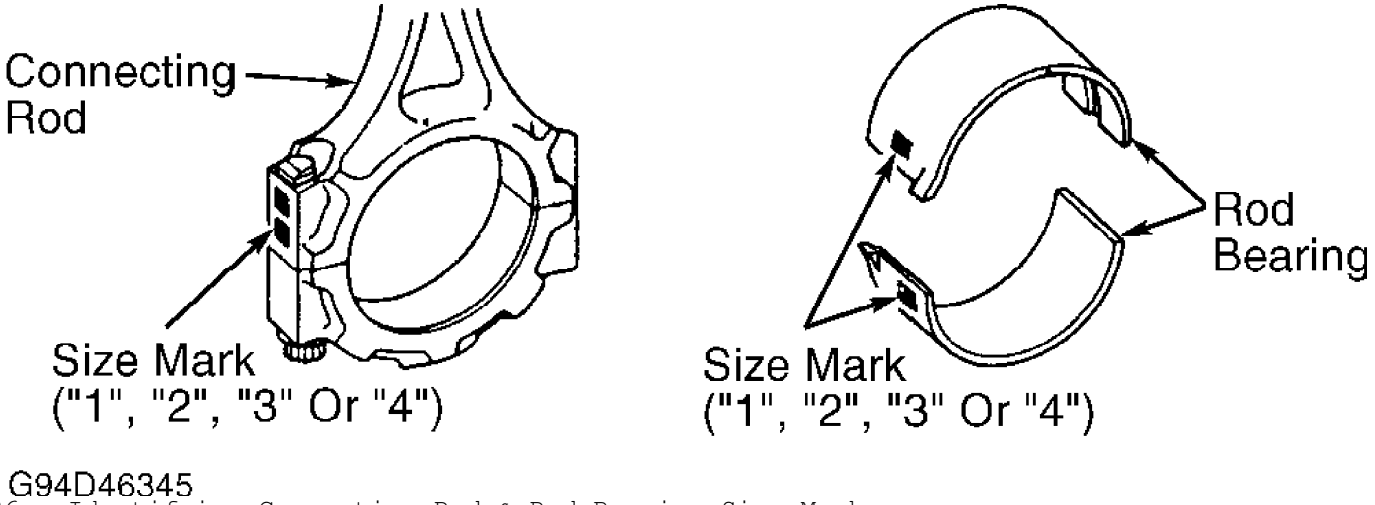


Fig. 36: Identifying Connecting Rod & Rod Bearing Size Marks
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Use caliper to measure outside diameter of connecting rod bolt, just above threads. Replace connecting rod bolt if outside diameter is less than .276" (7.01 mm).

4) Ensure piston and connecting rod are installed in cylinder block with front mark facing timing belt end of engine. Ensure protrusion on connecting rod cap is facing timing belt end of engine. See Fig. 34.

5) Coat threads and bolt head-to-connecting rod cap contact surface on connecting rod bolts with engine oil before tightening to specification. See TORQUE SPECIFICATIONS.

6) Ensure bearing oil clearance and connecting rod side play are within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS and CONNECTING RODS tables under ENGINE SPECIFICATIONS.

ROD BEARING SPECIFICATIONS

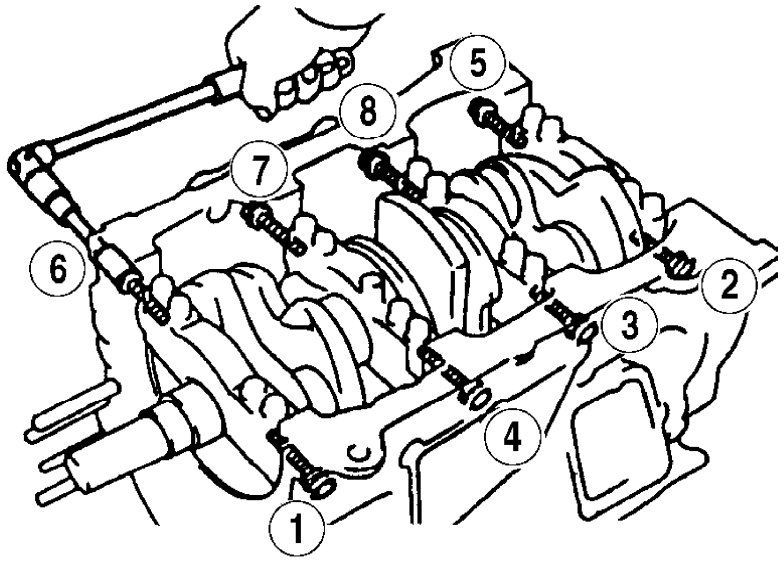
Bearing Size Mark	Thickness - In. (mm)
"1"	.0584-.0585 (1.484-1.487)
"2"	.0585-.0587 (1.487-1.490)
"3"	.0587-.0588 (1.490-1.493)
"4"	.0588-.0589 (1.493-1.496)

Crankshaft & Main Bearings

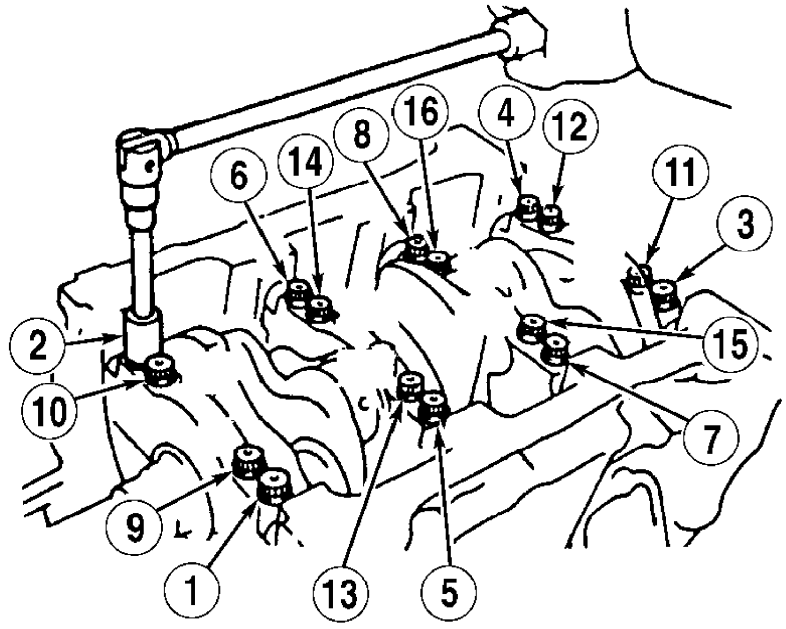
1) Remove main bearing cap side bolts (hexagon bolts) from side of cylinder block in sequence. Perform STEP 1 in illustration. See Fig. 37. Remove main bearing caps side bolts and seal washers.

2) Remove main bearing cap-to-cylinder block bolts (12-point bolts) from cylinder block in sequence. Perform STEP 2 in illustration. See Fig. 37.

3) Note location of main bearing caps. Main bearing caps are numbered on top of cap for location with No. 1 at timing belt end of engine and No. 4 at drive plate end. Arrow on top of main bearing cap must point toward timing belt end of engine. Remove main bearing caps, crankshaft, main bearings and thrust bearings.



STEP 1



STEP 2

G94E46346

Fig. 37: Main Bearing Bolt Removal Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

4) Cylinder block main bearing bore inside diameter is determined by size mark stamped on front of cylinder block. See

Fig. 38. Left size mark indicates No. 1 main bearing bore and far right size mark indicates No. 4 main bearing bore.

5) Crankshaft journal diameter is identified by size mark located on crankshaft counterweight. See Fig. 38. Ensure journal diameter, taper and out-of-round are within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.

6) Main bearing size mark is located on side of main bearing. See Fig. 38. If replacing main bearing, ensure size mark on replacement main bearing is the same as size mark on original main bearing.

7) If size mark on original main bearing cannot be obtained, use size marks on cylinder block and crankshaft to determine size mark of main bearing to be used. See Fig. 39. Main bearing thickness is identified by size mark on back of bearing. See MAIN BEARING SPECIFICATIONS table.

MAIN BEARING SPECIFICATIONS

Size Mark	Bearing Thickness - In. (mm)
"1"	.0979-.0980 (2.486-2.489)
"2"	.0980-.0981 (2.489-2.492)
"3"	.0981-.0982 (2.492-2.495)
"4"	.0982-.0983 (2.495-2.498)
"5"	.0983-.0985 (2.498-2.501)
"6"	.0985-.0986 (2.501-2.504)
"7"	.0986-.0987 (2.504-2.507)

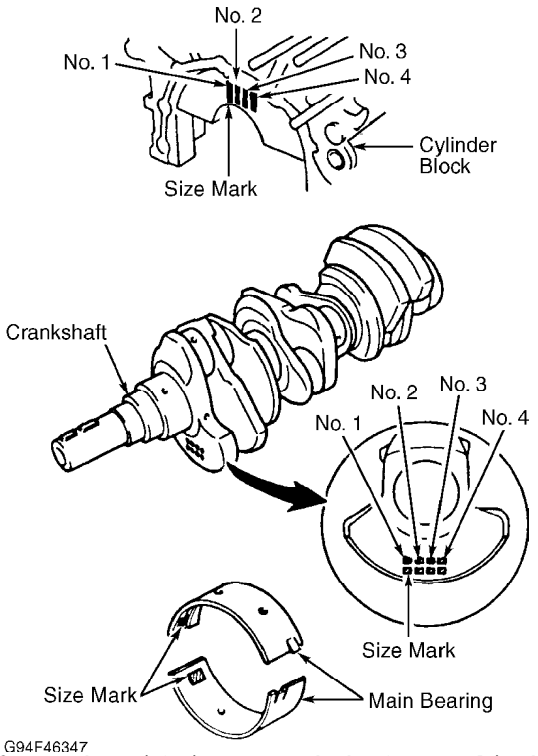


Fig. 38: Identifying Crankshaft, Cylinder Block & Main Bearing Size Marks
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Crankshaft number mark	Cylinder block number mark																
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
00	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5
01	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5
02	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6
03	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6	6
04	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6
05	3	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6
06	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6
07	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6
08	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7
09	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7
10	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7
11	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7
12	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7

EXAMPLE: Cylinder block "06" , Crankshaft "08"
= Use bearing "5"

MAIN BEARINGS NO. 1 & 4

Crankshaft number mark	Cylinder block number mark																
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
00	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3
01	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3
02	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4
03	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4
04	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4
05	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4
06	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4
07	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4
08	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5
09	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5
10	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5
11	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5
12	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5

EXAMPLE: Cylinder block "06" , Crankshaft "08"
= Use bearing "3"

MAIN BEARINGS NO. 2 & 3

G97B08643

Fig. 39: Main Bearing Selection Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

8) Use Plastigage to check main bearing oil clearance. Coat threads of main bearing bolts and bolt head-to-main bearing cap area

with engine oil. Install wide main bearings in No. 1 and 4 positions, and narrow main bearings in No. 2 and 3 bearing locations.

9) Ensure all main bearings installed in cylinder block contain oil holes. Lower main bearings, installed in main bearing caps, do not have oil holes.

10) Install thrust bearings on No. 2 main bearing in cylinder block and main bearing cap with grooved sides facing outward, toward crankshaft. Install crankshaft and main bearing caps.

CAUTION: Main bearing caps must be installed with arrow on top of cap pointing toward timing belt end of engine. Ensure main bearing caps are installed in numerical order, with No. 1 at timing belt end of engine and No. 4 at drive plate end.

11) Install and tighten main bearing cap-to-cylinder block bolts (12-point bolts) to specification in sequence using several steps. Perform STEP 1 in illustration. See Fig. 40. See TORQUE SPECIFICATIONS.

NOTE: NEW seal washers must be installed on main bearing cap side bolts (hexagon bolts) during final assembly.

12) Install and tighten main bearing cap side bolts (hexagon bolts) to specification in sequence using several steps. Perform STEP 2 in illustration. See Fig. 40. See TORQUE SPECIFICATIONS.

13) Check crankshaft end play using a dial indicator while prying crankshaft forward and rearward. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS. Replace thrust bearing if crankshaft end play is not within specification.

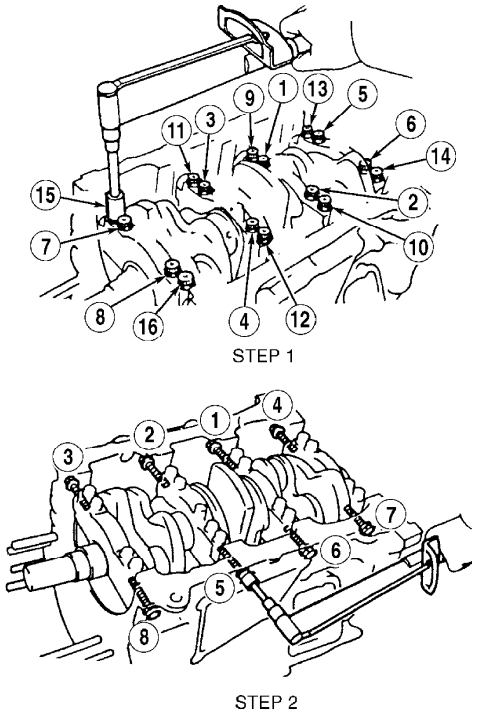


Fig. 40: Main Bearing Cap Bolt Installation Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Cylinder Block

1) Inspect cylinder block deck surface warpage. Replace

cylinder block if deck warpage exceeds specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.

2) Measure cylinder bore diameter at .39" (10.0 mm) from top and bottom of cylinder bore and at middle of cylinder bore. Replace cylinder block if cylinder bore diameter is not within specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.

3) Ensure main bearing bore inside diameter is within specification with main bearing caps installed and bolts tightened to specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS. See TORQUE SPECIFICATIONS.

NOTE: Main bearing bore inside diameter is determined by size mark stamped on front of cylinder block. See Fig. 38.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Oil pump provides pressurized engine lubrication.

Crankcase Capacity

Crankcase capacity with oil filter change is 5.0 qts. (4.7L).

Oil Pressure

With engine at normal operating temperature, oil pressure should be at least 4.3 psi (0.3 kg/cm^2) at idle, and 43-78 psi (3.0-5.5 kg/cm^2) at 3000 RPM.

OIL PUMP

Removal & Disassembly

Remove No. 1 and 2 oil pans. See OIL PAN under REMOVAL & INSTALLATION. Remove 9 bolts, oil pump and "O" ring. Remove oil pump body cover and oil pump components. See Fig. 41.

Inspection

1) Inspect components for damage. Coat relief valve with engine oil. Ensure relief valve slides freely in bore on oil pump body. Install drive and driven rotors in oil pump body. Ensure both rotors are installed in oil pump body with identification mark (triangle mark) facing oil pump body cover.

2) Using feeler gauge, measure driven rotor-to-oil pump body clearance. Replace rotor assembly or oil pump body if clearance exceeds specification. See OIL PUMP SPECIFICATIONS table.

3) Using feeler gauge, measure clearance between tip of both rotors. Replace rotor assembly if clearance exceeds specification. See OIL PUMP SPECIFICATIONS table.

4) Place straightedge across oil pump body, above both rotors. Using feeler gauge, measure rotor end clearance between straightedge and rotor surface. Replace rotor assembly or oil pump body if clearance exceeds specification. See OIL PUMP SPECIFICATIONS table.

OIL PUMP SPECIFICATIONS

Application	In. (mm)
Driven Rotor-To-Oil Pump Body Clearance	
Standard	.0098-.0128 (.250-.325)
Wear Limit	.0152 (.386)
Rotor End Clearance	
Standard	.0012-.0035 (.030-.090)

Wear Limit	.0059 (.150)
Rotor Tip Clearance	
Standard	.0043-.0094 (.109-.240)
Wear Limit	.0138 (.350)

Reassembly & Installation

1) To reassemble, reverse disassembly procedure. Ensure both rotors are installed in oil pump body with identification mark (triangle mark) facing oil pump body cover. Install oil pump body cover.

2) Using NEW gasket, install and tighten relief valve plug to specification. See TORQUE SPECIFICATIONS. Using Oil Seal Installer (SST 09223-00010), install crankshaft front seal (if removed) until surface is even with oil pump body. Coat seal lip with grease.

3) To install, apply sealant on rear of oil pump. Install NEW "O" ring on cylinder block. Install oil pump. Ensure splined teeth on drive rotor of oil pump engages with splines on crankshaft.

4) Install and tighten bolts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure.

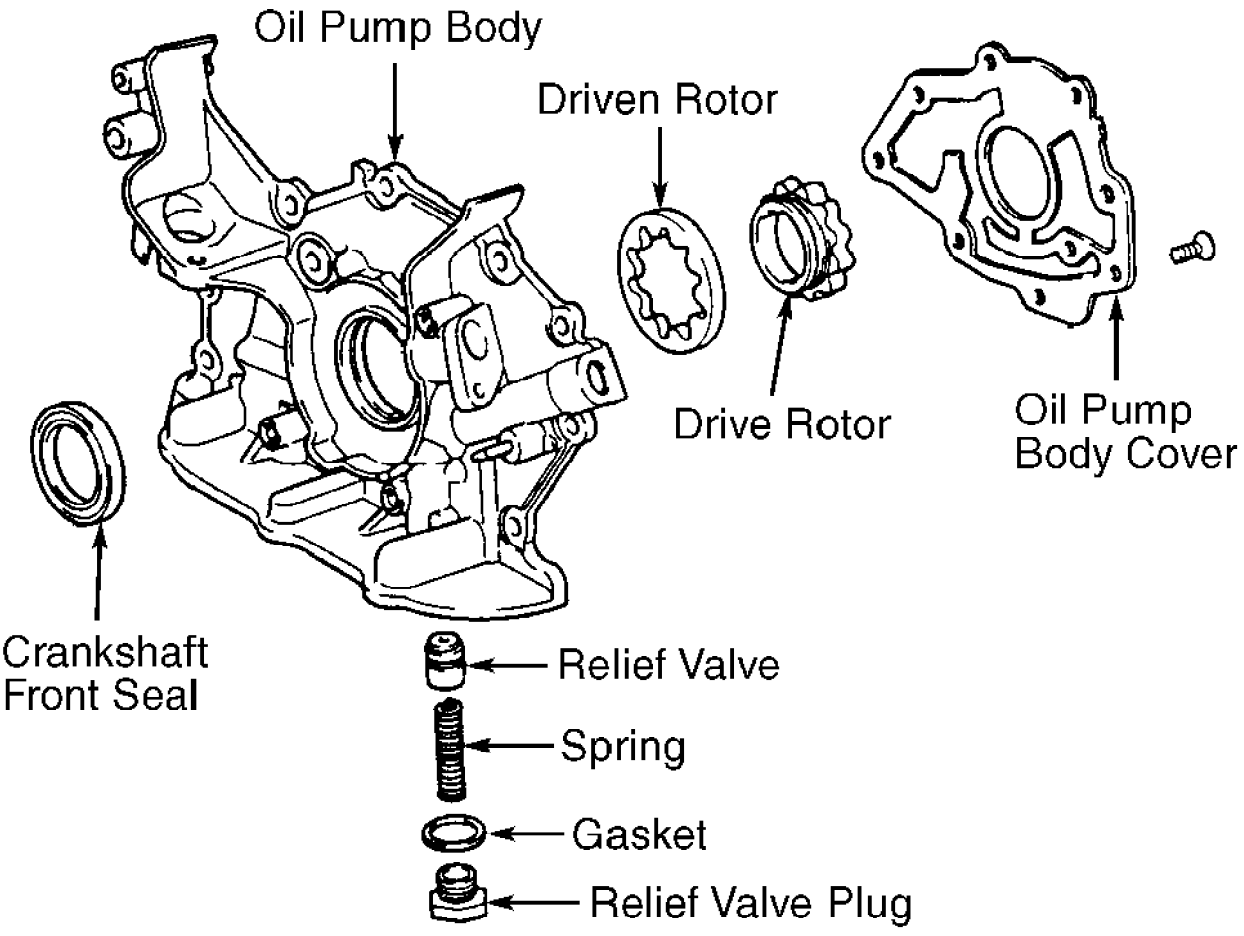


Fig. 41: Exploded View Of Oil Pump
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bolts/Nuts	
Bolt "A"	18 (24)
Bolt "B"	13 (18)
Bolt "C"	18 (24)
Air Intake Chamber Bolt/Nut	32 (43)
Air Intake Chamber Support Bolt	14 (19)
Axle Shaft Bearing Retainer Bolt	24 (33)
Axle Shaft Nut	217 (294)
Ball Joint-To-Lower Control Arm Bolt/Nut	94 (127)
Brake Booster Vacuum Hose	32 (43)
Camshaft Bearing Cap Bolt (1)	12 (16)
Camshaft Sprocket Bolt	94 (127)
Camshaft Timing Gear Nut	110 (149)
Connecting Rod Bolt	
Step 1	18 (24)
Step 2	Additional 90 Degrees
Coolant Inlet Pipe Bracket Bolt	14 (19)
Coolant Outlet Housing Bolt/Nut	11 (15)
Crankshaft Pulley Bolt	159 (216)
Cylinder Head Bolt (2)	
12-Point Bolt	
Step 1	40 (54)
Step 2	Additional 90 Degrees
Recessed Bolts	13 (18)
Drain Plug	33 (45)
Drain Union	29 (39)
Drive Plate Bolt	61 (83)
Engine Mount-To-Transaxle Bolt	47 (64)
Engine Mounting Bracket-To-Cylinder Block Bolt	21 (28)
Engine Stabilizer Rod Bolt	47 (64)
Exhaust Manifold Nut	36 (49)
Exhaust Manifold Support Bracket Bolt	25 (34)
Front Engine Mounting Insulator	59 (80)
Front Engine Mounting Insulator	47 (64)
Front Exhaust Pipe-To-Exhaust Manifold Nut	46 (62)
Front Stabilizer Bolts (RX300)	15 (19)
Fuel Inlet Line-To-Fuel Filter Banjo Bolt	21 (28)
Ground Cable Strap Nut	10 (14)
Intake Air Chamber Nuts	32 (43)
Intake Air Control Valve-To-Air Intake Chamber Nut	11 (15)
Intake Manifold Bolt/Nut	11 (15)
Knock Sensor	29 (39)
Left Engine Mounting Insulator Bolts (RX300)	47 (64)
Lower Frame Brace Bolts (RX300) (3)	
Bolt "A"	134 (181)
Bolt "B"	24 (33)
Main Bearing Cap-To-Cylinder Block	
12-Point Bolts (4) (5)	
Step 1	16 (22)
Step 2	Additional 90 Degrees
Main Bearing Cap Side Bolts (4) (5)	20 (27)
No. 1 Engine Hanger Bolt	29 (39)
No. 1 Oil Pan-To-Cylinder Block Bolt	
10-mm Bolt	(6)
12-mm Bolt	14 (19)
No. 1 Oil Pan-To-Transaxle Bolt	27 (37)
No. 2 Right Side Engine Mounting Bracket	
ES300 (7)	

Bolts "A", "B" & "C"	47 (64)
Bolt "D"	23 (32)
RX300 (8)	
Bolts "A", "B" & "C"	47 (64)
Bolt "D"	23 (32)
No. 2 Fuel Pipe Union Bolt	24 (33)
Oil Filter Union	22 (30)
Oil Plug	33 (45)
Oil Pump Bolt	
10-mm Bolt	(6)
12-mm Bolt	14 (19)
Oxygen Sensor	33 (44)
Power Steering Gear Bolts/Nut (RX300)	134 (182)
Power Steering Pressure Tube Bolt	29 (39)
Power Steering Pump Bolt	32 (43)
Power Steering Pump Bracket-To-Cylinder Head Bolt	32 (43)
Rear Engine Mount-To-Crossmember Nut	48 (65)
Rear Engine Mounting Bracket Nut (RX300)	64 (87)
Rear Engine Mounting Insulator	47 (64)
Right Engine Mount Brace Bolt	23 (31)
Right Engine Mounting Bracket Bolts	
Bolt "A"	47 (64)
Bolt "B"	47 (64)
Bolt "C"	47 (64)
Bolt "D"	23 (31)
Spark Plug	13 (18)
Stabilizer Bar Link-To-Lower Control Arm Nut	29 (39)
Throttle Body Bolt/Nut	14 (19)
Tie Rod Nut	36 (49)
Timing Belt Idler Pulleys	
No. 1 Idler Pulley Bolt	25 (34)
No. 2 Idler Pulley Bolt	32 (43)
Timing Belt Tensioner Bolt	20 (27)
Water Inlet Pipe Bolt	14 (19)
Water Outlet Mounting Bolts/Nuts	11 (15)
Water Seal Plate Bolt	13 (18)
Wheel Lug Nut	76 (103)

	INCH Lbs. (N.m)
Baffle Plate Bolt	69 (7.8)
Camshaft Position Sensor Bolt	71 (8.0)
Crankshaft Rear Oil Seal Housing Bolt	71 (8.0)
Cylinder Block Side Cover Bolts/Nuts	78 (8.8)
Cylinder Head Rear Plate Bolt	69 (7.8)
Delivery Pipe Bolt	89 (10.0)
Drive Plate Cover Bolt	69 (7.8)
No. 1 & 2 Timing Belt Cover Bolt	74 (8.4)
No. 2 Oil Pan Bolt/Nut	69 (7.8)
No. 3 Timing Belt Cover Bolt	74 (8.4)
Oil Level Sensor Bolt	69 (7.8)
Oil Pump Pick-Up Tube Bolt/Nut	69 (7.8)
Oil Strainer Bolt	69 (7.8)
Timing Belt Plate Bolt	69 (7.8)
Water Pump Bolt/Nut	69 (7.8)

(1) - Tighten bolts to specification in sequence. See Fig. 31.
(2) - Tighten bolts to specification in sequence. See Fig. 15.
(3) - See Fig. 11.
(4) - Tighten main bearing cap-to-cylinder block 12-point bolts first, and then tighten main bearing cap side bolts on outside of cylinder block.
(5) - Tighten bolts to specification in sequence. See Fig. 40.

(6) - Tighten bolts to 69 INCH lbs. (7.8 N.m).
(7) - See Fig. 8.
(8) - See Fig. 12.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Specification
Displacement	183 Cu. In. (3.0L)
Bore	3.44" (87.4 mm)
Stroke	3.27" (83.0 mm)
Compression Ratio	10.5:1
Fuel System	SFI

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0016-.0095 (.040-.241)
Wear Limit	.0118 (.300)
Runout	.0024 (.061)
Main Bearings	
Journal Diameter (1)	
Size Mark "00"	2.40157 (610000)
Size Mark "01"	2.40153 (60.9990)
Size Mark "02"	2.40149 (60.9980)
Size Mark "03"	2.40145 (60.9970)
Size Mark "04"	2.40141 (60.9960)
Size Mark "05"	2.40137 (60.9950)
Size Mark "06"	2.40133 (60.9940)
Size Mark "07"	2.40129 (60.9930)
Size Mark "08"	2.40125 (60.9918)
Size Mark "09"	2.40121 (60.9907)
Size Mark "10"	2.40117 (60.9897)
Size Mark "11"	2.40114 (60.9890)
Size Mark "12"	2.40109 (60.9876)
Journal Out-Of-Round	.0008 (.020)
Journal Taper	.0008 (.020)
Oil Clearance	
Standard	
Journals No. 1 & 4	.0006-.0013 (.015-.033)
Journals No. 2 & 3	.0010-.0018 (.025-.046)
Wear Limit	
Journals No. 1 & 4	.0020 (.050)
Journals No. 2 & 3	.0024 (.061)
Connecting Rod Bearings	
Crankpin Journal Diameter	2.0862-2.0866 (52.989-53.000)
Journal Out-Of-Round	.0008 (.020)
Journal Taper	.0008 (.020)
Oil Clearance	
Standard	.0015-.0025 (.038-.064)
Wear Limit	.0031 (.080)

(1) - Main bearing journal diameter is determined by size mark on the crankshaft. See Fig. 38.

CONNECTING RODS

CONNECTING RODS

Application	In. (mm)
Bore Diameter	
Pin Bushing Bore	.8663-.8667 (22.004-22.014)
Crankpin Bore (1)	
Size Mark "1"	2.2047-2.2050 (56.000-56.007)
Size Mark "2"	2.2050-2.2052 (56.007-56.012)
Size Mark "3"	2.2052-2.2054 (56.012-56.017)
Size Mark "4"	2.2054-2.2057 (56.017-56.024)
Maximum Bend	.0020 Per 3.940 (.050 Per 100.00)
Maximum Twist	.0059 Per 3.940 (.150 Per 100.00)
Side Play	
Standard	.0059-.0118 (.150-.300)
Wear Limit	.0138 (.350)

(1) - Crankpin bore diameter is identified by size mark on connecting rod. See Fig. 36.

PISTONS, PINS & RINGS

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	
Standard	.0033-.0042 (.084-.106)
Wear Limit	.0051 (.130)
Diameter	3.4412-3.4416 (87.406-87.416)
Pins	
Diameter	.8660-.8664 (21.996-22.006)
Piston Fit	(1)
Rod Fit (Oil Clearance)	
Standard	.0002-.0004 (.005-.010)
Wear Limit	.0020 (.050)
Rings	
No. 1	
End Gap	
Standard	.0098-.0138 (.250-.350)
Maximum	.0374 (.950)
Side Clearance	.0008-.0028 (.020-.071)
No. 2	
End Gap	
Standard	.0138-.0177 (.350-.450)
Maximum	.0413 (1.050)
Side Clearance	.0008-.0024 (.020-.061)
No. 3 (Oil)	
End Gap	
Standard	.0059-.0157 (.150-.400)
Maximum	.0394 (1.001)

(1) - Piston pin should slide in piston using thumb pressure with piston heated to 140°F (60°C).

CYLINDER BLOCK

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.4449-3.4453 (87.500-87.511)
Maximum Diameter	3.4457 (87.520)
Main Bearing Bore Inside Diameter (1)	
Size Mark "00"	2.59842 (66.0000)
Size Mark "01"	2.59846 (66.0010)
Size Mark "02"	2.59850 (66.0020)
Size Mark "03"	2.59854 (66.0030)
Size Mark "04"	2.59858 (66.0040)
Size Mark "05"	2.59862 (66.0050)
Size Mark "06"	2.59866 (66.0060)
Size Mark "07"	2.59870 (66.0070)
Size Mark "08"	2.59873 (66.0080)
Size Mark "09"	2.59877 (66.0090)
Size Mark "10"	2.59881 (66.0100)
Size Mark "11"	2.59885 (66.0110)
Size Mark "12"	2.59889 (66.0120)
Size Mark "13"	2.59893 (66.0130)
Size Mark "14"	2.59897 (66.0140)
Size Mark "15"	2.59901 (66.0150)
Size Mark "16"	2.59904 (66.0160)
Maximum Deck Warpage	.0028 (.071)

(1) - Main bearing bore inside diameter is determined by size mark on cylinder block. See Fig. 38.

VALVES & VALVE SPRINGS

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.7382" (94.950 mm)
Stem Diameter	.2154-.2159" (5.470-5.485 mm)
Exhaust Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.7362" (94.900 mm)
Stem Diameter	.2152-.2157" (5.465-5.480 mm)
Valve Springs	
Free Length	1.7913" (45.500 mm)
Out-Of-Square	.079" (2.01 mm)
Pressure	
Valve Closed	42-46 Lbs. @ 1.331 In. (19-21 kg @ 33.80 mm)

CYLINDER HEAD

CYLINDER HEAD

Application	Specification
Maximum Warpage	
Cylinder Block Surface	.0039" (.100 mm)
Manifold Surface	.0039" (.100 mm)
Valve Seats	
Intake Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Exhaust Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Valve Guides	
Intake Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4053-.4060" (10.295-10.312 mm)
Oversize Valve Guide	.4073-.4080" (10.345-10.363 mm)
Valve Guide I.D.	.2169-.2177" (5.510-5.530 mm)
Valve Guide Installed Height	.437-.453" (11.10-11.50 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0010-.0024" (.025-.061 mm)
Wear Limit	.0031" (.080 mm)
Exhaust Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4053-.4060" (10.295-10.312 mm)
Oversize Valve Guide	.4073-.4080" (10.345-10.363 mm)
Valve Guide I.D.	.2169-.2177" (5.510-5.530 mm)
Valve Guide Installed Height	
Exhaust	.350-.366" (8.90-9.30 mm)
Intake	.437-.453 (11.10-11.50)
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026" (.030-.066 mm)
Wear Limit	.0039" (.100 mm)

CAMSHAFT

CAMSHAFT

Application	In. (mm)
End Play	
Standard	.0016-.0035 (.040-.090)
Wear Limit	.0047 (.120)
Journal Diameter	1.0613-1.0620 (26.957-26.975)
Journal Runout	.0024 (.061)
Oil Clearance	
Intake	
Standard	.0014-.0028 (.035-.071)
Wear Limit	.0039 (.100)
Exhaust	
Standard	.0010-.0024 (.025-.060)
Wear Limit	.0035 (.090)
Lobe Height	
Intake	
Standard	1.6902-1.6942 (42.931-43.032)
Wear Limit	1.6776 (41.961)
Exhaust	
Standard	1.6836-1.6876 (42.763-42.865)
Wear Limit	1.6776 (41.961)
Gear Backlash	
Standard	.0008-.0079 (.020-.201)
Wear Limit	.0188 (.300)

VALVE LIFTERS

VALVE LIFTERS

Application	In. (mm)
Bore Diameter	1.2205-1.2212 (31.000-31.018)
Lifter Diameter	1.2191-1.2195 (30.965-30.975)
Oil Clearance	
Standard	.0009-.0020 (.023-.050)
Wear Limit	.0028 (.071)

ABBREVIATIONS

1999 Lexus RX 300

GENERAL INFORMATION

COMMONLY USED ABBREVIATION

"A" ABBREVIATION TABLE

"A" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
A	Amperes
A/C	Air Conditioning
A/T	Automatic Transmission/Transaxle
AAP	Auxiliary Accelerator Pump
AB	Air Bleed
ABCV	Air Bleed Control Valve
ABDC	After Bottom Dead Center
ABRS	Air Bag Restraint System
ABS	Anti-Lock Brake System
AC	Alternating Current
ACC	A/C Clutch Compressor
ACCS	A/C Cycling Switch
ACCUM	Accumulator
ACCY	Accessory
ACT	Air Charge Temperature Sensor
ACV	Thermactor Air Control Valve
ADJ	Adjust or Adjustable
ADV	Advance
AFS	Airflow Sensor
AI	Air Injection
AIR or A.I.R.	Air Injection Reactor
AIS	Air Injection System
ALCL	Assembly Line Communications Link
ALDL	Assembly Line Diagnostic Link
ARC	Automatic Ride Control
ASCD	Automatic Speed Control Device
ASCS	Air Suction Control Solenoid
ASD	Auto Shutdown
ASDM	Air Bag System Diagnostic Module
ASV	Air Suction Valve
ATC	Automatic Temperature Control
ATDC	After Top Dead Center
ATF	Automatic Transmission Fluid
ATS	Air Temperature Sensor
AXOD	Automatic Transaxle Overdrive
Abs.	Absolute
Accy.	Accessory
Alt.	Alternator or Altitude
Amp.	Ampere
Assy.	Assembly
Auto.	Automatic
Aux.	Auxiliary
Avg.	Average

"B" ABBREVIATION TABLE

"B" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
B/P	Backpressure
BAC	By-Pass Air Control
BAP	Barometric Absolute Pressure Sensor
BARO	Barometric
BBDC	Before Bottom Dead Center
BCM	Body Control Module
BDC	Bottom Dead Center
BHP	Brake Horsepower
BLK	Black
BLU	Blue
BMAP	Barometric & Manifold Absolute Pressure Sensor
BOO	Brake On-Off Switch
BP	Barometric Pressure sensor
BPS	Barometric Pressure Sensor
BPT	Backpressure Transducer
BRN	Brown
BTDC	Before Top Dead Center
BTU	British Thermal Unit
BVSV	Bimetallic Vacuum Switching Valve
Baro.	Barometric
Batt.	Battery
Bbl.	Barrel (Example: 4-Bbl.)
Blst.	Ballast
Blwr.	Blower
Brkr.	Breaker

"C" ABBREVIATION TABLE

"C" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
° C	Celsius (Degrees)
C(3) I	Computer Controlled Coil Ignition
C(4)	Computer Controlled Catalytic Converter
CANP	Canister Purge solenoid
CARB	California Air Resources Board
CAT	Catalytic Converter
CB	Circuit Breaker
CBD	Closed Bowl Distributor
CBVV	Carburetor Bowl Vent Valve
cc	Cubic Centimeter
CCC	Computer Command Control
CCD	Computer Controlled Dwell
CCM	Central Control Module
CCO	Converter Clutch Override
CCOT	Cycling Clutch Orifice Tube
CCW	Counterclockwise
CDI	Capacitor Discharge Ignition
CEC	Computerized Engine Control
CFI	Central Fuel Injection
CID	Cubic Inch Displacement
CID	Cylinder Identification sensor
CIS	Continuous Injection System
CIS-E	Continuous Injection System-Electronic
CKT	Circuit
CLR	Clear
CNG	Compressed Natural Gas

CO	Carbon Monoxide
CO2	Carbon Dioxide
CONV	Convertible
CP	Canister Purge
CPA	Connector Position Assurance
CPS	Crank Position Sensor
CTS	Coolant Temperature Sensor
CV	Check Valve or Constant Velocity
CVC	Constant Vacuum Control
CW	Clockwise
CYL or Cyl.	Cylinder
Calif.	California
Carb.	Carburetor
Chrg.	Charging
Circ.	Circuit
Cntrl.	Control
Comp.	Compressor or Compartment
Conn.	Connector
Cont.	Continued
Conv.	Convertible or Converter
Cu. In.	Cubic Inch
Cyl.	Cylinder

"D" ABBREVIATION TABLE

"D" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
"D"	Drive
DBC	Dual Bed Catalyst
DC	Direct Current or Discharge
DDD	Dual Diaphragm Distributor
DERM	Diagnostic Energy Reserve Module
DFI	Digital Fuel Injection
DIC	Driver Information Center
DIS	Direct Ignition System
DIS	Distributorless Ignition System
DIST	Distribution
DISTR	Distributor
DK BLU	Dark Blue
DK GRN	Dark Green
DME	Digital Motor Electronics (Motronic System)
DOHC	Double Overhead Cam
DOT	Department of Transportation
DP	Dashpot
DRB-II	Diagnostic Readout Box
DVOM	Digital Volt/Ohm Meter (see VOM)
Def.	Defogger or Defroster
Def.	Defrost
Defog.	Defogger
Diag.	Diagnostic
Dist.	Distributor or Distribution
Dr.	Door

"E" ABBREVIATION TABLE

"E" ABBREVIATION TABLE

ABBREVIATION	DEFINITION

EAC	Electric Assist Choke
EACV	Electric Air Control Valve
EBCM	Electronic Brake Control Module
ECA	Electronic Control Assembly
ECAT	Electronically Controlled Automatic Transaxle
ECM	Electronic Control Module
ECT	Engine Coolant Temperature Sensor
ECU	Electronic Control Unit or Engine Control Unit
EDF	Electric Drive Fan relay assembly
EDIS	Electronic Distributorless Ignition System
EEC	Electronic Engine Control
EECS	Evaporative Emission Control System
EEPROM	Electronically Erasable PROM
EFE	Early Fuel Evaporation
EFI	Electronic Fuel Injection
EGO	Exhaust Gas Oxygen sensor (see HEGO)
EGR	Exhaust Gas Recirculation system
EGRC	EGR Control solenoid or system
EGRV	EGR Vent solenoid or system
EMR	Emission Maintenance Reminder Module
ESA	Electronic Spark Advance
ESC	Electronic Spark Control
EST	Electronic Spark Timing
ETR	Emergency Tensioning Retractor
EVAP	Fuel Evaporative System
EVIC	Electronic Vehicle Information Center
EVO	Electronic Variable Orifice
EVP	EGR Valve Position Sensor
EVR	EGR Valve Regulator
EVRV	Electronic Vacuum Regulator Valve
Elect.	Electronic
Eng.	Engine
Evap.	Evaporative
Exc.	Except

"F" ABBREVIATION TABLE

"F" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
° F	Fahrenheit (Degrees)
F/B	Fuse Block
FBC	Feedback Carburetor
FI	Fuel Injector or Fuel Injection
FICD	Fast Idle Control Device
FIPL	Fuel Injector Pump Lever
FP	Fuel Pump
FPM	Fuel Pump Monitor
FPR-VSV	Fuel Pressure Regulator Vacuum Switching Valve
FWD	Front Wheel Drive
Fed.	Federal
Ft. Lbs.	Foot Pounds

"G" ABBREVIATION TABLE

"G" ABBREVIATION TABLE

ABBREVIATION	DEFINITION

g	grams
GND or GRND	Ground
GRN	Green
GRY	Gray
Ga.	Gauge
Gals.	gallons
Gov.	Governor

"H" ABBREVIATION TABLE

"H" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
H/D	Heavy Duty
HAC	High Altitude Compensation
HC	Hydrocarbons
HEDF	High Speed Electro Drive Fan relay or circuit
HEGO	Heated Exhaust Gas Oxygen Sensor
HEGOG	HEGO Ground circuit
HEI	High Energy Ignition
HLDT	Headlight
HO	High Output
HP	High Performance
HSC	High Swirl Combustion
HSO	High Specific Output
HTR	Heater
HVAC	Heating
Headlt.	Headlight
Hg	Mercury
Hgt.	Height
Htr.	Heater
Hz	Hertz (Cycles Per Second)

"I" ABBREVIATION TABLE

"I" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
I.D.	Inside Diameter
IAC	Idle Air Control
IACV	Idle Air Control Valve
IC	Integrated Circuit
ID	Identification
IDM	Ignition Diagnostic Monitor
IGN	Ignition system or circuit
ILC	Idle Load Compensator
In. Hg	Inches of Mercury
INCH Lbs.	Inch Pounds
INFL REST	Inflatable Restraint
INJ	Injector or Injection
IP	Instrument Panel
IPC	Instrument Panel Cluster
ISA	Idle Speed Actuator
ISC	Idle Speed Control
ISS	Idle Stop Solenoid
ITS	Idle Tracking Switch
IVSV	Idle Vacuum Switching Valve

Ign.	Ignition
In.	Inches
Inj.	Injector

"J" ABBREVIATION TABLE

"J" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
J/B	Junction Block

"K" ABBREVIATION TABLE

"K" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
k/ohms	1000 ohms (kilo as in k/ohms)
kg	Kilograms (weight)
kg/cm²	Kilograms Per Square Centimeter
KAM	Keep Alive Memory
KAPWR	Keep Alive Power
KM/H	Kilometers Per Hour
KOEO	Key On Engine Off
KOER	Key On Engine Running
KS	Knock Sensor

"L" ABBREVIATION TABLE

"L" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
L	Liter(s)
L/D	Light Duty
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left Hand
LOS	Limited Operation Strategy
LT BLU	Light Blue
LT GRN	Light Green
LUS	Lock-Up Solenoid
Lbs.	Pounds
Lt(s).	Light(s)
Lugg.	Luggage

"M" ABBREVIATION TABLE

"M" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
mA	Milliamps
mV	Millivolts
mfd.	Microfarads

mm	Millimeters
M/T	Manual Transaxle or Transmission
MA PFI	Mass Air Sequential Port Fuel Injection system
MA or MAF	Mass Airflow
MAF	Mass Air Flow sensor
MAFS	Mass Airflow Sensor
MAP	Manifold Absolute Pressure sensor
MAT	Manifold Air Temperature
MCU	Microprocessor Control Unit
MCV	Mixture Control Valve
MEM-CAL	Memory Calibration Chip
MFI	Multiport Fuel Injection
MIL	Malfunction Indicator Light
MLP	Manual Lever Position
MPFI	Multi Point Fuel Injection
MPH	Miles Per Hour
MPI	Multi-Point (Fuel) Injection
Man.	Manual
Mech.	Mechanical
Mem.	Memory
Mtr.	Motor

"N" ABBREVIATION TABLE

"N" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
N.m	Newton-Meter
NA	Not Available
NDS	Neutral Drive Switch
NGS	Neutral Gear Switch
NOx	Oxides of Nitrogen
NPS	Neutral Pressure Switch
No.	Number
Nos.	Numbers

"O" ABBREVIATION TABLE

"O" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
O	Oxygen
O.D.	Outside Diameter
O/S	Oversize
O2	Oxygen
OC	Oxidation Catalyst
OCC	Output Circuit Check
OD	Overdrive
ODO	Odometer
OHC	Overhead Camshaft
ORG	Orange
OSC	Output State Check
Opt.	Option or Optional
oz.	Ounce
ozs.	Ounces

"P" ABBREVIATION TABLE

"P" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
"P"	Park
P/C	Printed Circuit
P/N	Park/Neutral
P/S	Power Steering
PAV	Pulse Air Valve
PC-SOL	Purge Control Solenoid
PCM	Powertrain Control Module
PCS	Purge Control Solenoid
PCSDM	Passenger Compartment Sensor/Diagnostic Module
PCV	Positive Crankcase Ventilation
PFE	Pressure Feedback EGR sensor or circuit
PFI	Port Fuel Injection (see MA SEFI)
PGM-CARB	Programmed Carburetor
PGM-FI	Programmed Fuel Injection
PIP	Profile Ignition Pickup
PNK	Pink
PPL	Purple
PRNDL	Park Reverse Neutral Drive Low
PROM	Programmable Read-Only Memory
psi	Pounds Per Square Inch
PSPS	Power Steering Pressure Switch
PTC	Positive Temperature Coefficient
PTO	Power Take-Off
PWR GND	Power Ground circuit
Pkg.	Package
Press.	Pressure
Prog.	Programmed or Programmable
Pts.	Pints
Pwr.	Power

"Q" ABBREVIATION TABLE

"Q" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
Qts.	Quarts

"R" ABBREVIATION TABLE

"R" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
RABS	Rear Anti-Lock Brake System
RAC	Remote Accessory Control
RAM	Random Access Memory
RAP	Retained Accessory Power
RECIRC	Recirculation
RED	Red
RH	Right Hand
ROM	Read Only Memory
RPM	Revolutions Per Minute

RVB	Rear Vacuum Break
RWAL	Rear Wheel Anti-Lock Brake
RWD	Rear Wheel Drive
Recirc.	Recirculate or Recirculation
Reg.	Regulator
Rly.	Relay

"S" ABBREVIATION TABLE

"S" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
SAW	Spark Angle Word
SBC	Single Bed Converter
SBEC	Single Board Engine Controller
SC	Super Charged
SCC	Spark Control Computer
SCS	Air Suction Control Solenoid
SDM	Supplemental Restraint System Diagnostic Module
SDU	SRS Diagnostic Unit
SEN	Sensor
SES	Service Engine Soon
SFI	Sequential (Port) Fuel Injection
SIG RTN	Signal Return circuit
SIL	Shift Indicator Light
SIR	Supplemental Inflatable Restraint
SMEC	Single Module Engine Controller
SOHC	Single Overhead Cam
SOL or Sol.	Solenoid
SPFI	Sequential Port Fuel Injection
SPK	Spark Control
SPOUT	Spark Output Signal
SRS	Supplemental Restraint System (Air Bag)
SS 3/4-4/3	Shift Solenoid circuit
SSI	Solid State Ignition
STAR	Self-Test Automatic Readout
STI	Self Test Input circuit
STO	Self-Test Output
SUB-O2	Sub Oxygen Sensor
Sen. or Sens.	Sensor
Sol.	Solenoid
Sprchg.	Supercharger
Strg.	Steering
Susp.	Suspension
Sw.	Switch
Sys.	System

"T" ABBREVIATION TABLE

"T" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
T.V.	Throttle Valve
TAB	Thermactor Air By-Pass
TAC	Thermostatic Air Cleaner
TAD	Thermactor Air Diverter
TAN	Tan
TBI	Throttle Body Injection

TCC	Torque Converter Clutch
TCCS	Toyota Computer Control System
TDC	Top Dead Center
TDCL	Total Diagnostic Communication Link
TFI	Thick Film Ignition system
TGS	Top Gear Switch (cancels SIL in top gear)
THERMAC	Thermostatic Air Cleaner
THS	Transmission Hydraulic Switch
TP/TPS	Throttle Position Sensor
TPI	Tuned Port Injection
TPS	Throttle Position Sensor/Switch
TS	Temperature Sensor
TSB	Technical Service Bulletin
TTS	Transmission Temperature Switch
TV	Thermovalve
TWC	Three-Way Catalyst
Temp.	Temperature
Trans.	Transaxle/Transmission

"V" ABBREVIATION TABLE

"V" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
V	Valve
VAF	Vane Air Flow sensor or circuit
VAPS	Variable Assist Power Steering
VAT	Vane Air Temperature
VATS	Vehicle Anti-Theft System
VBATT	Vehicle Battery Voltage
VCC	Viscous Converter Clutch
VIN	Vehicle Identification Number
VIO	Violet
VLR	Volt Loop Reserve
VM	Vacuum Modulator
VM	Vane Meter
VOM	Volt-Ohmmeter (Analog)
VPWR	Vehicle Power supply voltage (10-14 volts)
VREF	Voltage Reference (ECA supplied reference voltage
VRV	Vacuum Regulator Valve
VSC	Vehicle Speed Control sensor or signal
VSS	Vehicle Speed Sensor or signal
VSV	Vacuum Switching Valve
Vac.	Vacuum
Volt.	Voltage

"W" ABBREVIATION TABLE

"W" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
W/	With
W/O	Without
WAC	WOT A/C Cut-off switch or circuit
WAC	Wide Open Throttle A/C Switch
WHT	White
WOT	Wide Open Throttle
YEL	Yellow

A/C COMPRESSOR REFRIGERANT OIL CHECKING

1999 Lexus RX 300

1999 GENERAL SERVICING
A/C Compressor Refrigerant Oil Checking
GEN. SERVICING

All Models

* PLEASE READ THIS FIRST *

NOTE: Always refer to underhood A/C specification label in engine compartment or A/C compressor label while servicing A/C system. If A/C specification label differ, always use underhood label specifications.

COMPRESSOR APPLICATION

COMPRESSOR APPLICATION

Application	Compressor
Acura	
Integra	Nippondenso 10-Cyl.
2.3CL & 3.0CL	Nippondenso 10-Cyl.
3.2TL	Nippondenso 10-Cyl.
3.5RL	Nippondenso 10-Cyl.
SLX	Harrison HD6/HT6 6-Cyl.
Audi	
A4	
4-Cyl. Engine	Zexel 6-Cyl.
V6 Engine	Nippondenso
A6	Nippondenso
A8	Nippondenso
BMW	Nippondenso Or Seiko-Seiki
Honda	
Accord	
2.3L	Nippondenso 10-Cyl.
3.0L	Nippondenso 10-Cyl.
Civic	Sanden Scroll Or Nippondenso
CR-V	Keihin Scroll SP-10
Odyssey	Nippondenso 10-Cyl.
Passport	Zexel DKV-14D Rotary Vane
Prelude	Keihin SP10
Hyundai	
Accent & Sonata	Halla FX-15 10-Cyl.
Elantra & Tiburon	Halla HS-15 10-Cyl.
Infiniti	
G20	Zexel DKV-14D
I30	Calsonic V6 6-Cyl.
Q45	Calsonic V6 6-Cyl.
QX4	Calsonic V6 6-Cyl.
Isuzu	
Amigo & Rodeo	Zexel DKV-14D Rotary Vane
Hombre	
2.2L	Harrison V7
4.3L	Harrison HD6/HT6 6-Cyl.
Oasis	Nippondenso 10-Cyl.
Trooper	Harrison HD6/HT6 6-Cyl.
Vehi-Cross	Zexel DKV-14D Rotary Vane
Jaguar	
XK8	Nippondenso 10-Cyl.

XJR & XJ8 ..... Nippondenso 10-Cyl.

Kia

Sephia ..... (1)

Sportage ..... Zexel 5-Cyl.

Land Rover

Discovery ..... Nippondenso 10PA17 10-Cyl.

Range Rover ..... Nippondenso

Lexus

Except LX470 ..... Nippondenso 10PA20 10-Cyl.

LX470 ..... Nippondenso 10PA17 10-Cyl.

Mazda

B2500, B3000 & B4000 ..... Ford FS-10 10-Cyl.

Millenia ..... Panasonic Rotary Vane

MX-5 Miata ..... Nippondenso

626 ..... Sanden

Protege ..... Panasonic Rotary Vane

Mercedes-Benz

"C" Class ..... Nippondenso ND6CA17 6-Cyl. Or Nippondenso 7SB16 7-Cyl.

CLK 320 & CLK 430 ..... Nippondenso 7SB16 7-Cyl.

"E" Class ..... Nippondenso 7SB16 7-Cyl.

ML Class ..... Nippondenso 7SB16 7-Cyl.

"S" Class ..... Nippondenso 10PA20 10-Cyl.

SL 500 ..... Nippondenso 7SB16 7-Cyl.

SLK ..... Nippondenso 7SB16 7-Cyl.

Mitsubishi

Diamante ..... Sanden MSC90C Scroll

Eclipse

2.0L Non-Turbo ..... Nippondenso 10PA17C 10-Cyl.

2.0L Turbo & 2.4L ..... Sanden MSC105CVS Scroll

Galant ..... Sanden MSC90C12 Scroll

Mirage ..... Sanden MSC90 Scroll

Montero ..... Nippondenso 10PA15 10-Cyl.

Montero Sport ..... Sanden MSC105C Scroll

3000GT ..... Sanden MSC105 Scroll

Nissan

Altima ..... Zexel DKV-14C Rotary Vane

Frontier ..... Zexel DKV-14C Rotary Vane

Maxima ..... Calsonic V6 6-Cyl.

Pathfinder ..... Calsonic V6 6-Cyl.

Quest ..... Ford FS-10 10-Cyl.

Sentra & 200SX ..... Zexel DKV-14D Rotary Vane

Porsche

Boxster ..... Nippondenso 7SB16 7-Cyl.

911 ..... Nippondenso 7SB16 7-Cyl.

Saab

9-3 ..... Sanden TRS105R 3211 Scroll

9-5 ..... Nippondenso 7SB16 7-Cyl.

Subaru

Forester ..... Zexel CR-14 Rotary Vane

Impreza ..... Zexel CR-14 Rotary Vane

Legacy ..... Zexel DKV-14G 5-Rotary Vane

Suzuki

Esteem & Swift ..... Nippondenso 10-Cyl.

Vitara & Grand Vitara ..... Seiko-Seiki

Toyota

Avalon ..... Nippondenso 10PA17C 10-Cyl.

Camry & Camry Solara ..... Nippondenso 10PA17C 10-Cyl.

Celica ..... Nippondenso 10PA17C 10-Cyl.
Or Nippondenso 10PA17C/VC 10-Cyl.

Corolla ..... Nippondenso 10PA15 10-Cyl.

Land Cruiser ..... Nippondenso 10-Cyl.

RAV4 ..... Nippondenso 10PA15 10-Cyl.

Sienna	Nippondenso 10PA17 10-Cyl.
Tacoma	Nippondenso 10PA17 10-Cyl.
4Runner	Nippondenso 10-Cyl.
Volkswagen	
Beetle, Golf, GTI & Jetta	Sanden SD7-V16 7-Cyl.
Passat	
1.8L 4-Cyl.	Zexel DCW-17D 6-Cyl.
2.8L VR6	Nippondenso 7SB-16C
Volvo	
C70, S70 & V70	Zexel DKS-15CH 6-Cyl.
S80	Zexel DKS-17CH 6-Cyl.

(1) - Information not available from manufacturer. Check underhood A/C specification label or A/C compressor label.

REFRIGERANT OIL & R-134a REFRIGERANT CAPACITY

REFRIGERANT OIL & R-134a REFRIGERANT CAPACITY

Application	(1) Oil Ounces	Refrigerant Ounces
Acura		
Integra	(2) 4.7	22.9-24.7
SLX	8.0	21.2
2.3CL	(2) 5.3	21.1-22.9
3.0CL	(2) 5.3	22.9-24.7
3.2TL	(2) 4.3	21-23
3.5RL	(2) 4.7	24.7-26.5
Audi		
A4		
Nippondenso	6.9-10.1	23.0-24.8
Zexel 6-Cyl.	7.8-9.2	23.0-24.8
A6	8.5	26.2-29.8
BMW		
3-Series	3.4-4.8	34.4-36.0
5-Series	(3)	(3)
7-Series	4.7-6.1	53.9-55.5
Honda		
Accord	(2) 5.3	21-23
Civic		
Sanden	(2) 4.3-5.1	21.1-22.9
Nippondenso	(2) 4.7-5.2	21.1-22.9
CR-V	(2) 4.3	22.9-24.7
Odyssey		
With Rear A/C	(2) 5.3-5.8	28.1-29.9
Without Rear A/C	(2) 5.3-5.8	21.1-22.9
Passport	(2) 5.0	22.9
Prelude	(2) 4.3-5.1	24.7-26.5
Hyundai		
Accent	5.7-6.3	23.7-24.0
Elantra	5.7-6.3	24-25.8
Sonata	7.0-7.7	24.7-26.5
Tiburon	5.1	24-25.8
Infiniti		
G20	6.8	19.4-22.9
I30	6.8	21.1-24.6
Q45	6.8	21.1-24.6
QX4	6.8	21.2-24.7
Isuzu		
Amigo & Rodeo	(2) 5.0	22.9
Hombre		

2.2L	9.0		30.0-32.0
4.3L	8.0		30.0-32.0
Oasis			
With Rear A/C	(2) 5.3-5.8		28.1-29.9
Without Rear A/C	(2) 5.3-5.8		21.1-22.9
Trooper	8.0		21.2
Vehi-Cross	5.0		22.8
Jaguar			
XJR & XJ8	(2) 5.4-6.8		21.9-23.6
XK8	(2) 5.4-6.8		21.9-25.3
Kia			
Sephia	6.0		22.9-26.5
Sportage	(3)		25.0
Land Rover			
Discovery			
With Rear A/C	6.1		40.6
Without Rear A/C	6.1		31.7
Range Rover	5.1		44.1
Lexus			
ES300	(2) 4.1		26.5-29.9
GS300 & GS400	(2) 4.1		19.4-22.9
LS400	(2) 4.8		22.9-35.5
LX470	(2) 4.1		34.2-37.3
RX300	(2) 4.1		19.4-22.9
SC300 & SC400	(2) 4.1		31.7-35.3
Mazda			
B2500, B3000 & B4000	7.0		30.0
Millenia	(2) 5.9		26.5
MX-5 Miata	(2) 5.1		21.2
Protege	(2) 4.1		21.2
626	(2) 8.1		26.5
Mercedes-Benz			
"C" Class	5.2		33.5
CLK Class	(2) 5.4		43
"E" Class	(2) 5.4		43
ML Class	(2) 5.4		27.2
"S" Class			
With Rear A/C	(2) 4.1		50.0
Without Rear A/C	(2) 4.1		43.0
SL 500	(2) 5.4		43.0
SLK Class	(2) 5.4		32.0
Mitsubishi			
Diamante	5.7-6.4		23.0-24.3
Eclipse			
2.0L Non-Turbo	(2) 2.7-4.1		24.7-26.1
2.0L Turbo & 2.4L	(2) 5.7-6.4		24.7-26.1
Galant	(2) 4.1		23.6-25.0
Mirage	(2) 4.1		19.6-21.0
Montero	(2) 4.1		21.0-23.0
Montero Sport	(2) 5.7		23.0-24.0
3000GT	(2) 8.6-11.0		26.0-28.0
Nissan			
Altima	6.8		24.7-28.2
Frontier	6.8		21.2-24.7
Maxima	6.8		21.2-24.7
Pathfinder	6.8		21.1-24.6
Quest			
With Rear A/C	11.0		54.0
Without Rear A/C	7.0		32.0
Sentra & 200SX	6.8		21.1-24.6
Porsche			
Boxster	6.1-7.1		30.0
911	4.7		29.6

Saab			
9-3	5.0		27.1
9-5	4.9		33.0-34.0
Subaru			
Forester	5.8		19.4-22.8
Impreza	4.2		19.4-22.6
Legacy	(3)		21.0-24.0
Suzuki			
Esteem	9.1		21.2
Vitara & Grand Vitara	4.0		17.5-21.0
Swift	3.0		19.4
Toyota			
Avalon	(2) 3.4-4.1		28.2-31.8
Camry & Camry Solara	(2) 4.9		26.5-30.0
Celica	(2) 4.1		21.2-24.7
Corolla	(2) 4.1		21.2-24.7
Land Cruiser			
With Rear A/C	7.3		37.2-40.8
Without Rear A/C	7.3		19.4-30.0
RAV4	(2) 4.1		22.9-22.9
Sienna			
Without Rear A/C	(2) 4.1		26.5-29.9
With Rear A/C (4-Door)	(2) 4.1		42.3-45.9
With Rear A/C (5-door)	(2) 4.1		45.9-49.4
Tacoma	4.8		19.4-22.9
4Runner	8.9		21.2-24.7
Volkswagen			
Beetle	4.6		24.7-26.5
Golf & Jetta	3.9		28.0-29.8
Passat	8.5		23.0-24.8
Volvo			
C70, S70 & V70	6.8		26.4
S80	7.0		35.2

(1) - Total system capacity, unless otherwise noted.
(2) - Compressor refrigerant oil capacity.
(3) - Information not available from manufacturer. Check underhood A/C system specification label or A/C compressor label.

REFRIGERANT OIL

Only new, moisture-free refrigerant oil should be used in the air conditioning system. This oil is highly refined and dehydrated so moisture content is less than 10 parts per million. The oil container must be tightly closed at all times when not in use, or moisture from the air will be absorbed into the refrigerant oil.

SERVICING PRECAUTIONS

DISCHARGING SYSTEM

Discharge A/C system, using approved refrigerant recovery/recycling equipment that meets SAE J2210 requirements. Always follow recovery/recycling equipment manufacturer's instructions. After refrigerant recovery process is completed, replace any refrigerant oil removed with the same amount of new refrigerant oil.

DISCONNECTING LINES & FITTINGS

After system is discharged, carefully clean area around all

fittings to be opened. Always use 2 wrenches when tightening or loosening fittings. Some refrigerant lines are connected with a coupling. Special tools may be required to disconnect lines. Cap or plug all openings as soon as lines are removed. DO NOT remove shipping caps from replacement components until ready to install.

CONNECTING LINES & FITTINGS

NOTE: Ensure all replacement component connections match connections of system being worked on.

Always use a new gasket or "O" ring when connecting lines or fittings. Coat "O" ring with refrigerant oil and ensure it is not twisted during installation. Always use two wrenches to prevent damage to lines and fittings.

PLACING SYSTEM IN OPERATION

After component service or replacement has been completed and all connections have been made, thoroughly evacuate system with a vacuum pump. Charge system with proper amount of refrigerant and perform leak test. See REFRIGERANT OIL & REFRIGERANT SPECIFICATIONS article for system capacities. Ensure there are no leaks at any fitting that has been opened. After system has been leak tested, check system performance.

CALSONIC

V6

Infiniti & Nissan

1) If possible, before checking and adjusting oil level, operate A/C system. If A/C system can be operated properly and/or there are no excessive refrigerant oil leaks, go to next step. If A/C system cannot be operated properly and/or there is an excessive refrigerant oil leak, go to step 3).

2) Start engine and operate at 1200 RPM. Turn A/C or AUTO switch on. Set blower motor speed to maximum. If desired, set temperature control so intake air temperature is 77-86°F (25-30°C). Connect manifold gauge set to A/C system. Ensure high-side pressure is 85 psi (6.0 kg/cm²) or more. If necessary, cover front of condenser to increase pressure, if necessary. Operate A/C system for 10 minutes. Stop engine and go to next step.

3) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Measure amount of oil recovered during A/C system discharge procedure. Remove compressor from vehicle. Drain, measure, and discard refrigerant oil from old compressor through compressor drain plug. Remove drain plug from replacement compressor and drain oil into a clean container.

4) Replace compressor oil drain plug and tighten to 13 ft. lbs. (18 N.m). Add refrigerant oil to replacement compressor, through suction port, equal to amount drained from old compressor plus amount recovered during discharge procedure. If any other A/C system components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (INFINITI & NISSAN - CALSONIC V6) table.

COMPONENT REFRIGERANT OIL CAPACITIES (INFINITI & NISSAN - CALSONIC V6)

Component	Ounces
Compressor	(1)

Condenser	2.5
Evaporator	2.5
Receiver-Drier	(2) 0.2
Refrigerant Leak	(3) 1.0
System Total	6.8

(1) - Ensure replacement compressor contains refrigerant oil equal to amount drained from old compressor, plus amount recovered during discharge procedure.
(2) - Add to replacement compressor through suction port.
(3) - Add refrigerant oil only if a large refrigerant oil leak has occurred.

FORD & HALLA

FORD FS-10 10-CYLINDER

NOTE: Replacement compressor may be shipped with refrigerant oil. Drain refrigerant oil from replacement compressor into a clean, dry container. Return specified amount of refrigerant oil back into replacement compressor.

Mazda (B2500, B3000 & B4000)

1) Slowly discharge system. Remove A/C compressor. Drain, measure and discard old compressor oil from suction and discharge ports. Rotate compressor shaft 6-8 times while draining oil.

2) If amount drained from old compressor is 3.0-5.0 ounces, add amount drained plus one ounce of new refrigerant oil to replacement compressor.

3) If amount drained is less than 3.0 ounces, add 3.0 ounces of refrigerant oil. If amount drained is greater than 5.0 ounces, add 5.0 ounces of refrigerant oil. Use new "O" rings on refrigerant lines. Install A/C compressor. Evacuate and charge A/C system. Perform leak test.

4) When replacing other A/C system components, add specified amount of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - FORD FS-10 10-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - FORD FS-10 10-CYL.)

Component	Ounces
Accumulator	(1)
Condenser	(2) 1.0
Evaporator	(2) 3.0
Other A/C System Components	2.0

(1) - Drill two 1/2" holes in bottom of old accumulator. Drain, measure and discard old oil. Add refrigerant oil equal to amount drained from old accumulator, plus 2.0 ounces to replacement accumulator.
(2) - Add specified amount of refrigerant oil to inlet of condenser or accumulator.

Nissan (Quest)

1) If possible, before checking and adjusting oil level, operate A/C system. If A/C system can be operated properly and there are no excessive refrigerant oil leaks, go to next step. If A/C system cannot be operated properly and/or there is an excessive refrigerant oil leak, go to step 3).

2) Start engine and operate at 1200 RPM. Turn A/C or AUTO switch on. Turn recirculation switch off. Set blower motor speed to maximum. If desired, set temperature control so intake air temperature is 77-86°F (25-30°C). Operate A/C system for 10 minutes. Stop engine and go to next step.

3) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Measure amount of oil recovered during A/C system discharge procedure. Remove compressor from vehicle. Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a separate, clean container.

4) Add refrigerant oil to replacement compressor, through suction port, equal to amount drained from old compressor plus amount recovered during discharge procedure. If any other A/C system components are replaced, add new refrigerant oil to system as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (NISSAN - FORD FS-10 10-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (NISSAN - FORD FS-10 10-CYL.)

Component	Ounces
Accumulator	(1) 2.0
Compressor	(2)
Condenser	(3) 2.5
Evaporator	(3) 2.5
Refrigerant Lines	(4) 1.0-1.7

(1) - If accumulator and compressor are being replaced at the same time, add additional specified amount of refrigerant oil to compressor. If only accumulator is being replaced, add specified amount of refrigerant oil to accumulator.
(2) - Ensure replacement compressor contains refrigerant oil equal to amount drained from old compressor, plus amount recovered during discharge procedure.
(3) - Slowly add specified amount of refrigerant oil to low-pressure side of component.
(4) - Add only if a large refrigerant oil leak is indicated.

HALLA FX-15 10-CYLINDER

Hyundai

Whenever replacing any A/C system component or when a large refrigerant leak has occurred, add refrigerant oil to maintain original total amount. On all models, when replacing A/C system components, add specified amount of refrigerant oil to component. See COMPONENT REFRIGERANT OIL CAPACITIES (HYUNDAI - HALLA FX-15 10-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (HYUNDAI - HALLA FX-15 10-CYL.)

Component	Ounces
Accumulator	
Sonata	2.7
Compressor	
Accent, Elantra & Tiburon	1.0
Sonata	(1)
Condenser	
Accent	0.8
Elantra & Tiburon	1.4
Sonata	1.0

Evaporator	
Accent	1.3
Elantra, Sonata & Tiburon	1.6
Receiver-Drier	
Accent	1.3
Elantra & Tiburon	1.2
Refrigerant Line (2)	
Accent	0.5
Elantra, Sonata & Tiburon	(1)
System Total	
Accent, Elantra & Tiburon	5.7-6.3
Sonata	7.0-7.7

(1) - Specification not available from manufacturer.
(2) - Add amount specified for each line replaced.

HARRISON (DELPHI THERMAL)

HD6/HT6 6-CYLINDER

Acura (SLX) & Isuzu (Hombre 4.3L & Trooper)

1) If possible, operate A/C system before checking refrigerant oil level. Open engine hood and all doors. Turn A/C on and set blower motor to high speed. Start engine and operate at 800-1000 RPM for at least 20 minutes. Turn engine off and go to next step. If A/C system cannot be operated, go to step 4).

2) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor from vehicle. Drain and measure refrigerant oil from old compressor through suction and discharge ports. Inspect refrigerant oil for contamination. If oil volume has increased, oil color has changed, or debris is present, receiver-drier must be replaced.

3) If less than 3.0 ounces of refrigerant oil is drained from old compressor, inspect A/C system for oil leaks. Repair or replace components as necessary. Add 3.0 ounces of refrigerant oil to replacement compressor. If more than 3.0 ounces of refrigerant oil is drained from old compressor, add refrigerant oil to replacement compressor equal to amount drained from old compressor.

4) If A/C system cannot be operated, discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor. Drain and measure refrigerant oil from old compressor through suction and discharge ports. Inspect refrigerant oil for contamination. If oil volume has increased, oil color has changed, or debris is present, receiver-drier must be replaced.

5) If more than 3.0 ounces is drained from old compressor, add refrigerant oil to replacement compressor equal to amount drained from old compressor. Install compressor and go to step 8).

6) If less than 3.0 ounces of refrigerant oil is drained from old compressor, add 3.0 ounces of refrigerant oil to replacement compressor and install on vehicle. Evacuate and charge A/C system. Open engine hood and all doors. Turn A/C on and set blower motor to high speed. Start engine and operate at 800-1000 RPM for at least 20 minutes to stabilize system. Turn engine off and go to next step.

7) Remove replacement compressor from vehicle. Drain and measure refrigerant oil. If more than 3.0 ounces is drained from compressor, add refrigerant oil to compressor equal to amount drained. If less than 3.0 ounces of refrigerant oil is drained from replacement compressor, add 3.0 ounces of refrigerant oil to compressor. Go to next step.

8) If replacing other A/C system components, add specified amount of refrigerant oil to component. See COMPONENT REFRIGERANT OIL

CAPACITIES (ACURA & ISUZU - HARRISON HD6/HT6 6-CYL.) table. Evacuate, charge, and leak test A/C system. Ensure A/C system is operating properly.

COMPONENT REFRIGERANT OIL CAPACITIES (ACURA & ISUZU - HARRISON HD6/HT6 6-CYL.)

Component	Ounces
Compressor	(1)
Condenser	1.0
Evaporator	1.7
Receiver-Drier	1.0
Refrigerant Line	0.3

(1) - Drain and measure refrigerant oil from old compressor. If old compressor had less than 3.0 ounces, add 3.0 ounces of refrigerant oil to replacement compressor. If old compressor had more than 3.0 ounces, add refrigerant oil equal to amount drained from old compressor.

V7 7-CYLINDER

Isuzu (Hombre 2.2L)

A replacement compressor is shipped with 9 ounces of refrigerant oil. Drain oil from old compressor through oil drain plug and measure oil. Remove refrigerant oil from replacement compressor through oil drain plug and save. Add refrigerant oil equal to amount drained from old compressor, to replacement compressor. If any other major components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (ISUZU - HARRISON V7 7-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (ISUZU - HARRISON V7 7-CYL.)

Component	Ounces
Condenser	1.0
Evaporator	1.7
Receiver-Drier	1.0
Refrigerant Lines	0.3

KEIHIN

SCROLL

Honda

1) Replacement compressor is shipped with 4.3 ounces of refrigerant oil. Drain, measure, and discard oil from old compressor. Drain shipping refrigerant oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor. DO NOT drain more than 1.7 ounces of refrigerant oil from replacement compressor.

2) If replacement compressor is shipped without refrigerant oil, add same amount of refrigerant oil to replacement compressor that was drained from old compressor. If any other major components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (HONDA - KEIHIN SCROLL) table.

COMPONENT REFRIGERANT OIL CAPACITIES (HONDA - KEIHIN SCROLL)

Component	Ounces
Compressor	(1) 4.3
Condenser	0.8
Evaporator	1.3
Leak Repair	0.8
Receiver-Drier	0.3
Refrigerant Lines	0.3

(1) - Drain shipping oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor.

NIPPONDENSO

ROTARY VANE

Mazda

Replacement compressor is shipped with 6.8 ounces of refrigerant oil. Drain, measure, and discard oil from old compressor. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.5 ounce. If other system components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - NIPPONDENSO ROTARY VANE) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - NIPPONDENSO ROTARY VANE)

Component	Ounces
Compressor	6.8
Condenser	1.0
Evaporator	1.4
Receiver-Drier	0.3
Refrigerant Lines	0.3

SCROLL, 6-CYL., 7-CYL. OR 10-CYL.

Acura, Honda & Isuzu

1) Replacement compressors are shipped with a specific amount of refrigerant oil. Drain, measure, and discard oil from old compressor.

2) Remove refrigerant oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor. See COMPONENT REFRIGERANT OIL CAPACITIES (ACURA, HONDA & ISUZU - NIPPONDENSO) table. If no oil is drained from old compressor, DO NOT drain more than 1.7 ounces from replacement compressor.

3) If replacement compressor is shipped without refrigerant oil, add refrigerant oil to replacement compressor equal to amount of oil drained from old compressor. When any other component is replaced, add refrigerant oil to component as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (ACURA, HONDA & ISUZU - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (ACURA, HONDA & ISUZU - NIPPONDENSO)

Component	Ounces
Compressor (1)	

Acura		
Integra		4.7
2.3CL & 3.0CL		5.3
3.2TL		4.3
3.5RL		4.7
Honda		
Accord & Odyssey		5.3
Isuzu		
Oasis		5.3
Condenser		
Acura		
Except 3.5RL		0.8
3.5RL		1.0
Honda		
Accord		0.8
Odyssey		1.0
Isuzu		
Oasis		1.0
Evaporator		
Acura		
Integra, 2.3CL, 3.0CL & 3.5RL		1.3
3.2TL		1.7
Honda		
Accord & Odyssey	(2)	1.3
Isuzu		
Oasis	(2)	1.3
Receiver-Drier		
Acura		
Integra, 2.3CL, 3.0CL & 3.5RL		0.3
3.2TL		0.5
Honda		
Accord & Odyssey		0.3
Isuzu		
Oasis		0.3
Leak Repair		
Acura		
Integra, 2.3CL, 3.0CL, 3.2TL & 3.5RL		0.8
Honda		
Accord & Odyssey	(2)	0.8
Isuzu		
Oasis	(2)	0.8
Refrigerant Line Or Hose		
Acura		
Integra, 2.3CL, 3.0CL & 3.5RL		0.3
3.2TL		0.7
Honda		
Accord		0.8
Odyssey	(2)	0.3
Isuzu		
Oasis	(2)	0.3

(1) - Ensure replacement compressor contains same amount of refrigerant oil that was drained from old compressor. On Acura and Honda models, DO NOT drain more than 1.7 ounces of refrigerant oil from replacement compressor.
(2) - On Oasis and Odyssey, when replacing any rear A/C system component, drain and measure refrigerant oil from old component. Fill replacement component with refrigerant oil equal to amount drained from old component.

Audi
1) Discharge A/C system, using approved refrigerant

recovery/recycling equipment. Remove compressor from vehicle. Replacement compressor is shipped with refrigerant oil.

2) Drain, measure and discard oil from old compressor. Drain refrigerant oil from replacement compressor and add oil equal to amount drained from old compressor, but not less than 2.7 ounces. Remainder of oil specified can be added to replacement accumulator or evaporator if necessary.

3) After adding oil to compressor, rotate compressor shaft about 10 times to circulate oil in compressor to prevent compressor damage. If any other major components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (AUDI - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (AUDI - NIPPONDENSO)

Component	Ounces
Compressor	(1) 2.7
Condenser	(2) 0.3
Evaporator	(2) 0.7
Receiver-Drier	(2) 1.0
Refrigerant Lines	(2) 0.3
System Total	(1) 6.9-10.1

(1) - Drain shipping oil from replacement compressor. Add refrigerant oil to replacement compressor equal to amount drained from old compressor, but not less than 2.7 ounces.
(2) - Plus amount drained from old component.

BMW

Drain, measure, and discard oil from old compressor. Drain shipping oil from replacement compressor into a clean container. Add refrigerant oil to replacement compressor equal to amount drained from old compressor. If any other major components are replaced, add refrigerant oil as necessary.

NOTE: On Jaguar, to avoid spilling refrigerant oil, install blanking plugs to compressor ports after removing refrigerant lines.

Jaguar

1) If there has been a refrigerant loss because of a burst line for example, go to next step. If reinstalling an existing compressor, remove blanking plugs and drain, measure and discard old refrigerant oil from compressor. Using refrigerant oil, flush compressor and drain thoroughly. Fill compressor with refrigerant oil equal to amount drained from compressor, plus amount recovered during refrigerant recovery.

2) Remove blanking plugs and drain, measure and discard refrigerant oil from old compressor. Fill replacement compressor with refrigerant oil equal to amount drained from old compressor. Install blanking plugs to compressor ports. When replacing components, add specified amounts of refrigerant oil, plus amount recovered during refrigerant recovery. See COMPONENT REFRIGERANT OIL CAPACITIES (JAGUAR - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (JAGUAR - NIPPONDENSO)

Component	Ounces
Condenser	(1) 1.4
Evaporator	(1) 1.4

Receiver-Drier	(2)

(1) - Plus amount recovered during refrigerant recovery.
(2) - Only add amount recovered during refrigerant recovery.

Land Rover

1) Replacement compressor is shipped with 6.1 ounces of refrigerant oil. Drain, measure, and discard oil from old compressor. Rotate compressor shaft to assist in complete draining. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.7 ounce. Install sealing caps to compressor inlet and outlet ports until refrigerant lines are installed.

2) If a sudden refrigerant loss has occurred, such as a burst line, most of the refrigerant oil will be lost. Remove compressor and drain refrigerant oil. Rotate compressor shaft to assist in complete draining. Add 4.4 ounces of refrigerant oil to compressor and install sealing caps to compressor ports until refrigerant lines are installed. If any other major components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (LAND ROVER - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (LAND ROVER - NIPPONDENSO)

Component	Ounces
Condenser	1.4
Evaporator	2.7
Receiver-Drier	0.7
Refrigerant Line	0.7
System Total	
Discovery	6.1
Range Rover	5.1
Sudden Discharge	
Discovery	(1) 4.4
Range Rover	(1) 3.4

(1) - Add to replacement compressor.

Lexus

After refrigerant recovery process is completed, amount of refrigerant oil removed from old compressor must be measured and same amount added to replacement compressor. When replacing components, add specified amount of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (LEXUS - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (LEXUS - NIPPONDENSO)

Component	Ounces
Compressor	
ES300, SC300 & SC400	4.1
GS300 & GS400	(1)
LS400	4.8
LX470	(1)
RX300	(1)
Condenser	
ES300	(2) 1.4-1.7
GS300, GS400, LS400, LX470 & RX300	(3) 1.4
SC300 & SC400	(2) 1.4
Evaporator	

ES300, GS300, GS400, LS400, LX470 & RX300	(3)	1.4
SC300 & SC400	(2)	1.4
Receiver-Drier		
ES300 & RX300	(3)	0.7
LS400	(3)	0.3
SC300 & SC400	(2)	0.3

(1) - Information not available from manufacturer. Refer to underhood A/C system specification label or A/C compressor label.
(2) - Add amount specified of refrigerant oil to compressor.
(3) - Add amount specified of refrigerant oil to component.

Mercedes-Benz

1) Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a clean container. Add refrigerant oil to replacement compressor equal to amount drained from old compressor, plus 0.7 ounce.

2) If a sudden refrigerant discharge greater than 1.4 ounces has occurred, add 1.4 ounces of refrigerant oil after repairs. If a slow refrigerant leak less than 1.4 ounces has occurred, add 0.7 ounce of refrigerant oil after repairs. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MERCEDES-BENZ - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MERCEDES-BENZ - NIPPONDENSO)

Component		Ounces
Compressor		(1)
Condenser	(2)	0.7
Evaporator		1.4
Receiver-Drier		0.3
Leak Repair	(3)	1.4
Pressure Or Suction Lines	(4)	0.7

(1) - Ensure replacement compressor contains refrigerant equal to amount drained from old compressor plus 0.7 ounce.
(2) - On vehicles equipped with rear A/C, add 0.7 ounce of refrigerant oil to system when replacing rear condenser.
(3) - Approximate amount of refrigerant oil lost when system is suddenly discharged.
(4) - When replacing rear A/C lines, add specified amount of refrigerant oil for each line replaced.

Mitsubishi

Replacement compressor is shipped with refrigerant oil. Drain, measure, and discard refrigerant oil from old compressor. Drain refrigerant oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MITSUBISHI - NIPPONDENSO 10-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MITSUBISHI - NIPPONDENSO 10-CYL.)

Component	Ounces
Compressor (1)	
Eclipse 2.0L Non-Turbo	3.4
Montero	4.1

Condenser	1.4
Evaporator	1.4
Receiver-Drier	0.3
Suction Hose	0.3

(1) - If replacement compressor is shipped without refrigerant oil, add same amount of refrigerant oil to replacement compressor that was drained from old compressor.

Porsche

After refrigerant recovery/recycling process is completed, measure amount of refrigerant oil removed from system. Add refrigerant oil equal to amount removed from A/C system, plus amount specified for each component replaced. See COMPONENT REFRIGERANT OIL CAPACITIES (PORSCHE - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (PORSCHE - NIPPONDENSO)

Component	Ounces
Compressor	1.7
Condenser	(1) 1.4
Evaporator	0.7
Leak Repair	(2) 2.0
Receiver-Drier With Refrigerant Lines	1.0

(1) - Boxster has two condensers, one located under each headlight. Capacity of each condenser is 0.7 ounce.
(2) - Approximate amount of refrigerant oil lost when system is suddenly discharged.

Saab

The A/C system is filled with a specified amount of compressor oil. The compressor must be topped off with the specified amount. See COMPONENT REFRIGERANT OIL CAPACITIES (SAAB 9-5 - NIPPONDENSO) table. Topping off should be carried out on the high-pressure side of the compressor.

COMPONENT REFRIGERANT OIL CAPACITIES (SAAB 9-5 - NIPPONDENSO)

Component	Ounces
Compressor	(1) 1.7
Condenser	1.0
Expansion Valve	0.5
Evaporator	1.0
Receiver-Drier	1.0
Refrigerant Lines	0.5

(1) - To avoid an excessive amount of oil in the A/C system, shipping oil must be drained from compressor before it is installed.

Suzuki

Replacement compressor is shipped with 3.4 ounces of refrigerant oil. Drain 1.4 ounces of refrigerant oil from replacement compressor before installing. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - NIPPONDENSO)

Component	Ounces
Compressor	3.4
Condenser	(1) 0.7-1.0
Evaporator	(2)
Refrigerant Line	(2)
Receiver-Drier	(1) 0.3

(1) - Add refrigerant oil to compressor suction-side of component.
(2) - Drain, measure, and discard refrigerant oil from component. Add refrigerant oil to replacement component equal to amount removed from old component.

Toyota

After refrigerant recovery process is completed, drain old compressor and measure amount of refrigerant oil removed. Add same amount drained from old compressor to replacement compressor. When replacing components, add specified amounts of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (TOYOTA - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (TOYOTA - NIPPONDENSO)

Component	Ounces
Compressor	
Avalon, Camry, Camry Solara, Celica, Corolla, RAV4 & Sienna	4.1
Land Cruiser	(1)
Tacoma	(1)
4Runner	(1)
Condenser	
Avalon, Camry Solara, Corolla, Land Cruiser & RAV4	(3) 1.4
Camry, Sienna & 4Runner	(2) 1.4-1.7
Celica	(2) 1.4
Tacoma	(3) 1.4-1.7
Evaporator	
Avalon, Camry Solara, Corolla, Land Cruiser & RAV4	(3) 1.4
Camry & 4Runner	(2) 1.4-1.7
Celica	(2) 1.4
Sienna (Front/Rear)	(4) 1.4
Tacoma	(3) 1.4-1.7
Receiver-Drier	
Avalon, Corolla & Tacoma	(3) 0.7
Camry & Camry Solara	(2) 0.7
Celica	(2) 0.3
Land Cruiser	(1)
RAV4	(3) 0.3
Sienna & 4Runner	(2) 0.7

(1) - Information is not available from manufacturer. Refer to underhood A/C system specification label.
(2) - Add specified amount of refrigerant oil to compressor.
(3) - Add specified amount of refrigerant oil to component.
(4) - When replacing either a front or a rear evaporator, add amount specified to replacement evaporator.

Volkswagen

Recover refrigerant using approved recovery/recycling equipment. Replacement compressor is shipped with refrigerant oil equal to system requirement. After refrigerant recovery process is completed, flush A/C system. Install replacement compressor and

replace receiver-drier. It is not necessary to add additional oil. If other components are replaced without compressor replacement, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - NIPPONDENSO) table.

COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - NIPPONDENSO)

Component	Ounces
Compressor	4.2
Condenser	0.8
Evaporator	1.7
Low-Pressure Refrigerant Line	0.8
Receiver-Drier	0.8
System Total	8.5

PANASONIC

ROTARY VANE

Mazda

Replacement compressor is shipped with 5.9 ounces of refrigerant oil. Drain, measure, and discard oil from old compressor. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.4-0.6 ounce. If other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - PANASONIC) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - PANASONIC)

Component	Ounces
Compressor	5.9
Condenser	
Millenia	0.7
Protege	1.0
Evaporator	
Protege	1.0
Millenia	1.7
Receiver-Drier	0.3
Refrigerant Lines	
Protege	0.2
Millenia	0.3

SANDEN

SCROLL

Honda (Civic)

1) Replacement compressors are shipped with refrigerant oil. Drain and measure oil from old compressor. Remove refrigerant oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor. DO NOT drain more than 1.7 ounces of refrigerant oil from replacement compressor.

2) If replacement compressor is shipped without refrigerant oil, add the same amount of refrigerant oil to replacement compressor that was drained from the old compressor. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT

OIL CAPACITIES (HONDA - SANDEN SCROLL) table.

COMPONENT REFRIGERANT OIL CAPACITIES (HONDA - SANDEN SCROLL)

Component	Ounces
Compressor	4.3
Condenser	0.7
Evaporator	0.7
Leak Repair	0.8
Receiver-Drier	0.3
Refrigerant Lines	0.3

Mazda (Protege & 626)

1) On all models, drain, measure and discard oil from old compressor.

2) On Protege, replacement compressor is shipped with 4.1 ounces of refrigerant oil. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.2-0.3 ounce.

3) On 626, replacement compressor is shipped with 8.1 ounces of refrigerant oil. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.5 ounce.

4) On all models, if other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - SANDEN SCROLL) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MAZDA - SANDEN SCROLL)

Component	Ounces
Accumulator	0.5
Compressor	8.1
Condenser	0.8
Evaporator	1.7
Refrigerant Lines	0.3

Mitsubishi

Replacement compressor is shipped with refrigerant oil. Drain, measure, and discard refrigerant oil from old compressor. Drain refrigerant oil from replacement compressor equal to difference between amount drained from old compressor and amount shipped in replacement compressor. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (MITSUBISHI - SANDEN SCROLL) table.

COMPONENT REFRIGERANT OIL CAPACITIES (MITSUBISHI - SANDEN SCROLL)

Component	Ounces
Compressor (1)	
Diamante, Eclipse 2.0L Turbo & 2.4L & Galant	5.7-6.4
Mirage	4.4
Stealth & 3000GT	5.4
Condenser	
Diamante, Eclipse 2.0L Turbo & 2.4L, Galant, Mirage & 3000GT	0.5
Montero Sport	0.7
Evaporator	
Diamante, Eclipse 2.0L Turbo & 2.4L, Galant, Mirage & 3000GT	2.0

Montero Sport	1.7
Receiver-Drier	
Diamante, Eclipse 2.0L Turbo & 2.4L, Galant, Mirage, Montero Sport & 3000GT	0.3
Refrigerant Lines	
Diamante, Eclipse 2.0L Turbo & 2.4L, Galant, Mirage, Montero Sport & 3000GT	0.3

(1) - If replacement compressor is shipped without refrigerant oil, add same amount of refrigerant oil to replacement compressor that was drained from old compressor.

Saab

The A/C system is filled with a specified amount of compressor oil. The compressor must be topped off with the specified amount. See COMPONENT REFRIGERANT OIL CAPACITIES (SAAB 9-3 - SANDEN SCROLL) table. Topping off should be carried out on the high-pressure side of the compressor.

COMPONENT REFRIGERANT OIL CAPACITIES (SAAB 9-3 - SANDEN SCROLL)

Component	Ounces
Compressor	(1) 1.7
Condenser	1.0
Expansion Valve	0.5
Evaporator	1.0
Receiver-Drier	1.0
Refrigerant Lines	0.5

(1) - To avoid an excessive amount of oil in the A/C system, shipping oil must be drained from compressor before it is installed.

7-CYLINDER

Range Rover

1) Replacement compressor is shipped with 5.1 ounces of refrigerant oil. Drain, measure, and discard oil from old compressor. Rotate compressor shaft to ensure complete draining. Drain refrigerant oil from replacement compressor equal to amount drained from old compressor, plus 0.7 ounce. Install sealing caps to compressor until refrigerant lines are installed.

2) If a sudden refrigerant loss has occurred, such as a burst line, most of the refrigerant oil will be lost. Remove compressor and drain and discard refrigerant. Rotate compressor shaft to assist in complete draining. Add 3.4 ounces of refrigerant oil to compressor and install sealing caps. If any other major components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (RANGE ROVER - SANDEN 7-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (RANGE ROVER - SANDEN 7-CYL.)

Component	Ounces
Condenser	1.4
Evaporator	2.7
Receiver-Drier	0.7
Refrigerant Line	0.7
System Total	5.1
Sudden Discharge	(1) 3.4

(1) - Add oil to replacement compressor.

Suzuki

Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a clean container. Add refrigerant oil to replacement compressor equal to amount removed from old compressor. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - SANDEN 7-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - SANDEN 7-CYL.)

Component	Ounces
Compressor	3.0
Condenser	(1) 0.7-1.0
Evaporator	(2)
Refrigerant Line	(2)
Receiver-Drier	(1) 0.3

(1) - Add refrigerant oil to compressor suction-side of replacement component.
(2) - Drain, measure, and discard refrigerant oil from component. Add refrigerant oil to replacement component equal to amount removed from old component.

Volvo

Compressor oil checking procedures are not available from manufacturer.

Volkswagen

Recover refrigerant using approved recovery/recycling equipment. Replacement compressor is shipped with refrigerant oil equal to system requirement. After refrigerant recovery process is completed, flush A/C system. Install replacement compressor and replace receiver-drier. It is not necessary to add additional oil. If other components are replaced without compressor replacement, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - SANDEN 7-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - SANDEN 7-CYL.)

Component	Ounces
Compressor	2.3
Condenser	0.5
Evaporator	1.0
Low-Pressure Refrigerant Line	0.5
Receiver-Drier	0.5
System Total	4.0-5.0

SEIKO-SEIKI

ROTARY VANE

BMW

Drain and measure oil from old compressor. Remove shipping oil from replacement compressor. Add refrigerant oil to replacement compressor equal to amount drained from old compressor. If any other

major components are replaced, add refrigerant oil as necessary.

Suzuki

Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a clean container. Add refrigerant to replacement compressor equal to amount removed from old compressor. If any other components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - SEIKO-SEIKI) table.

COMPONENT REFRIGERANT OIL CAPACITIES (SUZUKI - SEIKO-SEIKI)

Component	Ounces
Compressor	5.1
Condenser	(1) 0.7-1.0
Evaporator	(2)
Refrigerant Line	(2)
Receiver-Drier	(1) 0.3

(1) - Add refrigerant oil to compressor suction-side of replacement component.
(2) - Drain, measure and discard refrigerant oil from component. Add refrigerant oil to replacement component equal to amount removed from old component.

ZEXEL

ROTARY VANE

Honda (Passport) & Isuzu (Amigo, Rodeo & Vehi-Cross)

1) If A/C system cannot be operated, go to step 4). If possible, operate A/C system before checking refrigerant oil level. Open engine hood and all doors. Turn A/C on and set blower motor to high speed. Start engine and operate it at 800-1000 RPM for at least 20 minutes. Turn engine off and go to next step.

2) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor from vehicle. Drain and measure refrigerant oil from old compressor through suction and discharge ports. Inspect refrigerant oil for contamination. If oil volume has increased, oil color has changed, or debris is present, receiver-drier must be replaced.

3) If less than 3.0 ounces of refrigerant oil is drained from old compressor, inspect A/C system for oil leaks. Repair or replace components as necessary. Add 3.0 ounces of refrigerant oil to replacement compressor. If more than 3.0 ounces of refrigerant oil is drained from old compressor, add refrigerant oil to replacement compressor equal to amount drained from old compressor.

4) If A/C system cannot be operated, discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor. Drain and measure refrigerant oil from old compressor through suction and discharge ports. Inspect refrigerant oil for contamination. If oil volume has increased, oil color has changed, or debris is present, receiver-drier must be replaced.

5) If more than 3.0 ounces is drained from old compressor, add refrigerant oil to replacement compressor equal to amount drained from old compressor. Install compressor and go to step 8).

6) If less than 3.0 ounces of refrigerant oil is drained from old compressor, add 3.0 ounces of refrigerant oil to replacement compressor and install on vehicle. Evacuate and charge A/C system. Open engine hood and all doors. Turn A/C on and set blower motor to

high speed. Start engine and operate at 800-1000 RPM for at least 20 minutes to stabilize system. Turn engine off and go to next step.

7) Remove replacement compressor from vehicle. Drain and measure refrigerant oil. If more than 3.0 ounces is drained from compressor, add refrigerant oil to compressor equal to amount drained. If less than 3.0 ounces of refrigerant oil is drained from replacement compressor, add 3.0 ounces of refrigerant oil to compressor. Go to next step.

8) If replacing other A/C system components, add specified amount of refrigerant oil to component. See COMPONENT REFRIGERANT OIL CAPACITIES (HONDA & ISUZU - ZEXEL ROTARY VANE) table. Evacuate, charge, and leak test A/C system. Ensure A/C system is operating properly.

COMPONENT REFRIGERANT OIL CAPACITIES (HONDA & ISUZU - ZEXEL ROTARY VANE)

Component	Ounces
Compressor	5.0
Condenser	1.0
Evaporator	1.7
Receiver-Drier	1.0
Refrigerant Lines	0.3

Infiniti (G20) & Nissan

1) If possible, before checking and adjusting oil level, operate A/C system. If A/C system can be operated properly and there are no excessive refrigerant oil leaks, go to next step. If A/C system cannot be operated properly and/or there is an excessive refrigerant oil leak, go to step 3).

2) Start engine and operate at 1200 RPM. Turn A/C switch on. Set blower motor speed to maximum. If desired, set temperature control so intake air temperature is 77-86°F (25-30°C). Turn recirculation switch off. Operate A/C system for 10 minutes. Stop engine and go to next step.

3) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Measure amount of oil recovered during A/C system discharge procedure. Remove compressor from vehicle. Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a separate, clean container.

4) Add refrigerant oil to replacement compressor through suction port equal to amount drained from old compressor, plus amount recovered during discharge procedure. If any other A/C system components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (INFINITI (G20) & NISSAN - ZEXEL ROTARY VANE) table for specified amount.

COMPONENT REFRIGERANT OIL CAPACITIES (INFINITI (G20) & NISSAN - ZEXEL ROTARY VANE)

Component	Ounces
Compressor	(1)
Condenser	2.5
Evaporator	2.5
Receiver-Drier	(2) 0.2
Refrigerant Lines (3)	1.0

(1) - Ensure replacement compressor contains refrigerant oil equal to amount drained from old compressor, plus amount recovered during

discharge procedure.
(2) - Add to replacement compressor through suction port.
(3) - Add refrigerant oil to replacement line only if a large refrigerant leak has occurred.

Kia

A specific compressor oil checking procedure is not available from manufacturer. If replacing other A/C system components, add specified amount of refrigerant oil to component. See COMPONENT REFRIGERANT OIL CAPACITIES (KIA - ZEXEL ROTARY VANE) table. Evacuate, charge, and leak test A/C system. Ensure A/C system is operating properly.

COMPONENT REFRIGERANT OIL CAPACITIES (KIA - ZEXEL ROTARY VANE)

Component	Ounces
Compressor	(1)
Condenser	1.0
Evaporator	(1)
Receiver-Drier	N/A
Sephia	0.3
Sportage	1.0
Refrigerant Lines	(1)

(1) - Specification is not available from manufacturer. Refer to underhood A/C specification label or A/C compressor label.

Subaru (Legacy)

1) If possible, before checking and adjusting oil level, operate A/C system. If A/C system cannot be operated, go to step 3). Install manifold gauge set. Start engine and operate at 1500 RPM. Turn A/C on. Set air source to recirculate and blower motor speed to maximum.

2) Ensure evaporator intake air temperature is greater than 80°F (27°C). Ensure refrigerant discharge pressure is greater than 85 psi (6.0 kg/cm²). After operating system for 10 minutes, stop engine and go to next step.

3) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Close low-side valve until high-side pressure is less than 50 psi (3.5 kg/cm²), then open low-side valve and complete system discharge.

4) Remove compressor from vehicle. Drain, measure, and discard refrigerant oil from old compressor. Drain shipping oil from replacement compressor into a separate, clean container.

5) Add refrigerant oil to replacement compressor equal to amount drained from old compressor. Ensure that at least 0.7 ounce of refrigerant oil is added to replacement compressor. If any other A/C system components are replaced, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (SUBARU - ZEXEL ROTARY VANE) table.

COMPONENT REFRIGERANT OIL CAPACITIES (SUBARU - ZEXEL ROTARY VANE)

Component	Ounces
Compressor	(1)
Condenser	0.07
Evaporator	3.9
Receiver-Drier	0.2
Refrigerant Hose	0.03

(1) - Ensure replacement compressor contains refrigerant oil equal to amount drained from old compressor, but at least amount 0.7 ounce.

6-CYLINDER

Audi

1) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor from vehicle. Measure amount of refrigerant oil removed during recovery process. Add the same amount of refrigerant oil removed to A/C system.

2) Add 1.0 ounce of refrigerant oil when replacing accumulator. When replacing condenser, add amount drained from old condenser, plus 0.3 ounce of refrigerant oil. When replacing evaporator, add amount drained from old evaporator, plus 0.7 ounce of refrigerant oil.

Volkswagen

Recover refrigerant using approved recovery/recycling equipment. Replacement compressor is shipped with refrigerant oil equal to system requirement. After refrigerant recovery process is completed, flush A/C system. Install replacement compressor and replace receiver-drier. It is not necessary to add additional oil. If other components are replaced without compressor replacement, add refrigerant oil as specified. See COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - ZEXEL 6-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (VOLKSWAGEN - ZEXEL 6-CYL.)

Component	Ounces
Compressor	4.2
Condenser	0.8
Evaporator	1.7
Low-Pressure Refrigerant Line	0.8
Receiver-Drier	0.8
System Total	8.5

Volvo

Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor from vehicle. Drain, measure, and discard oil from old compressor. Add refrigerant oil to replacement compressor equal to amount drained from old compressor, but not less than 2.4 ounces. If any A/C system components are replaced, add specified amount of refrigerant oil to component. See COMPONENT REFRIGERANT OIL CAPACITIES (VOLVO - ZEXEL 6-CYL.) table.

COMPONENT REFRIGERANT OIL CAPACITIES (VOLVO - ZEXEL 6-CYL.)

Component	Ounces
Condenser	
C70, S70 & V70	0.7
Evaporator	
C70, S70 & V70	1.7
Receiver-Drier	
C70, S70 & V70	3.0
Refrigerant Lines	
C70, S70 & V70	0.7
System Total	
C70, S70 & V70	6.8

S80 ..... 6.1

A/C COMPRESSOR SERVICING

1999 Lexus RX 300

1999 GENERAL SERVICING
A/C Compressor Servicing

All Models

A/C COMPRESSOR APPLICATIONS

NOTE: Always refer to underhood A/C specification label in engine compartment or A/C compressor label while servicing A/C system. If A/C specification label and COMPRESSOR APPLICATION specifications differ, always use underhood label specifications.

COMPRESSOR APPLICATION

Application	Compressor
Acura	
Integra	Nippondenso 10-Cyl.
2.3CL & 3.0CL	Nippondenso 10-Cyl.
3.2TL	Nippondenso 10-Cyl.
3.5RL	Nippondenso 10-Cyl.
SLX	Harrison HD6/HT6 6-Cyl.
Audi	
A4	
4-Cyl. Engine	Zexel 6-Cyl.
V6 Engine	Nippondenso
A6	Nippondenso
A8	Nippondenso
BMW	Nippondenso Or Seiko-Seiki
Honda	
Accord	
2.3L	Nippondenso 10-Cyl.
3.0L	Nippondenso 10-Cyl.
Civic	Sanden Scroll Or Nippondenso
CR-V	Keihin Scroll SP-10
Odyssey	Nippondenso 10-Cyl.
Passport	Zexel DKV-14D Rotary Vane
Prelude	Keihin SP10
Hyundai	
Accent & Sonata	Halla FX-15 10-Cyl.
Elantra & Tiburon	Halla HS-15 10-Cyl.
Infiniti	
G20	Zexel DKV-14D
I30	Calsonic V6 6-Cyl.
Q45	Calsonic V6 6-Cyl.
QX4	Calsonic V6 6-Cyl.
Isuzu	
Amigo & Rodeo	Zexel DKV-14D Rotary Vane
Hombre	
2.2L	Harrison V7
4.3L	Harrison HD6/HT6 6-Cyl.
Oasis	Nippondenso 10-Cyl.
Trooper	Harrison HD6/HT6 6-Cyl.
Vehi-Cross	Zexel DKV-14D Rotary Vane
Jaguar	
XK8	Nippondenso 10-Cyl.
XJR & XJ8	Nippondenso 10-Cyl.
Kia	
Sephia	(1)

Sportage ..... Zexel 5-Cyl.
Land Rover
Discovery ..... Nippondenso 10PA17 10-Cyl.
Range Rover ..... Nippondenso
Lexus
Except LX470 ..... Nippondenso 10PA20 10-Cyl.
LX470 ..... Nippondenso 10PA17 10-Cyl.
Mazda
B2500, B3000 & B4000 ..... Ford FS-10 10-Cyl.
Millenia ..... Panasonic Rotary Vane
MX-5 Miata ..... Nippondenso
626 ..... Sanden
Protege ..... Panasonic Rotary Vane
Mercedes-Benz
"C" Class ..... Nippondenso ND6CA17 6-Cyl. Or Nippondenso 7SB16 7-Cyl.
CLK 320 & CLK 430 ..... Nippondenso 7SB16 7-Cyl.
"E" Class ..... Nippondenso 7SB16 7-Cyl.
ML Class ..... Nippondenso 7SB16 7-Cyl.
"S" Class ..... Nippondenso 10PA20 10-Cyl.
SL 500 ..... Nippondenso 7SB16 7-Cyl.
SLK ..... Nippondenso 7SB16 7-Cyl.
Mitsubishi
Diamante ..... Sanden MSC90C Scroll
Eclipse
2.0L Non-Turbo ..... Nippondenso 10PA17C 10-Cyl.
2.0L Turbo & 2.4L ..... Sanden MSC105CVS Scroll
Galant ..... Sanden MSC90C12 Scroll
Mirage ..... Sanden MSC90 Scroll
Montero ..... Nippondenso 10PA15 10-Cyl.
Montero Sport ..... Sanden MSC105C Scroll
3000GT ..... Sanden MSC105 Scroll
Nissan
Altima ..... Zexel DKV-14C Rotary Vane
Frontier ..... Zexel DKV-14C Rotary Vane
Maxima ..... Calsonic V6 6-Cyl.
Pathfinder ..... Calsonic V6 6-Cyl.
Quest ..... Ford FS-10 10-Cyl.
Sentra & 200SX ..... Zexel DKV-14D Rotary Vane
Porsche
Boxster ..... Nippondenso 7SB16 7-Cyl.
911 ..... Nippondenso 7SB16 7-Cyl.
Saab
9-3 ..... Sanden TRS105R 3211 Scroll
9-5 ..... Nippondenso 7SB16 7-Cyl.
Subaru
Forester ..... Zexel CR-14 Rotary Vane
Impreza ..... Zexel CR-14 Rotary Vane
Legacy ..... Zexel DKV-14G 5-Rotary Vane
Suzuki
Esteem & Swift ..... Nippondenso 10-Cyl.
Vitara & Grand Vitara ..... Seiko-Seiki
Toyota
Avalon ..... Nippondenso 10PA17C 10-Cyl.
Camry & Camry Solara ..... Nippondenso 10PA17C 10-Cyl.
Celica ..... Nippondenso 10PA17C 10-Cyl.
Or Nippondenso 10PA17C/VC 10-Cyl.
Corolla ..... Nippondenso 10PA15 10-Cyl.
Land Cruiser ..... Nippondenso 10-Cyl.
RAV4 ..... Nippondenso 10PA15 10-Cyl.
Sienna ..... Nippondenso 10PA17 10-Cyl.
Tacoma ..... Nippondenso 10PA17 10-Cyl.
4Runner ..... Nippondenso 10-Cyl.

Volkswagen	
Beetle, Golf, GTI & Jetta	Sanden SD7-V16 7-Cyl.
Passat	
1.8L 4-Cyl.	Zexel DCW-17D 6-Cyl.
2.8L VR6	Nippondenso 7SB-16C
Volvo	
C70, S70 & V70	Zexel DKS-15CH 6-Cyl.
S80	Zexel DKS-17CH 6-Cyl.

(1) - Information not available from manufacturer. Check underhood A/C specification label or A/C compressor label.

NOTE: Due to the variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

CALSONIC

CLUTCH COIL

NOTE: Subaru recommends replacing compressor as an assembly if there is a clutch or compressor shaft seal failure.

Removal

1) Using Clutch Disc Wrench (J-41260), remove clutch plate bolt. Using Clutch Disc Puller (J-38874), remove clutch plate. Insert clutch disc puller pins into clutch disc holes. Rotate holder clockwise to lock it into clutch disc. Tighten clutch disc puller center bolt and remove clutch disc plate and shims. Remove pulley assembly snap ring. See Fig. 1.

2) Using a 2-jaw puller, remove pulley assembly. Position puller jaws onto edge of pulley to prevent pulley groove from being deformed. Remove clutch coil harness clip, clutch coil snap ring, and clutch coil.

Installation

1) Ensure clutch disc and pulley contact surfaces are clean and free of excessive grooving and/or excessive heat damage. Check clutch coil for loose connection or cracked insulation. Replace components as necessary. Replace clutch disc and pulley assembly as a set.

2) Align clutch coil pin with hole in front head of compressor. Install clutch coil harness clip and clutch coil snap ring. Using hand press and Pulley Installer (J-41261), install pulley assembly. Install pulley assembly snap ring. Install original shim(s) and clutch disc. Using Clutch Disc Wrench (J-41260), install and tighten center bolt to 10 ft. lbs. (14 N.m). Ensure pulley turns smoothly.

3) Using a feeler gauge check clutch plate and pulley assembly air gap. Air gap should be 0.012-0.024" (0.30-0.60 mm). If air gap is incorrect, add or remove shims as necessary.

4) Install compressor and any other components. Evacuate and charge A/C system. Operate A/C system and engage and disengage A/C compressor clutch about 30 times to break in replacement clutch disc and pulley assembly.

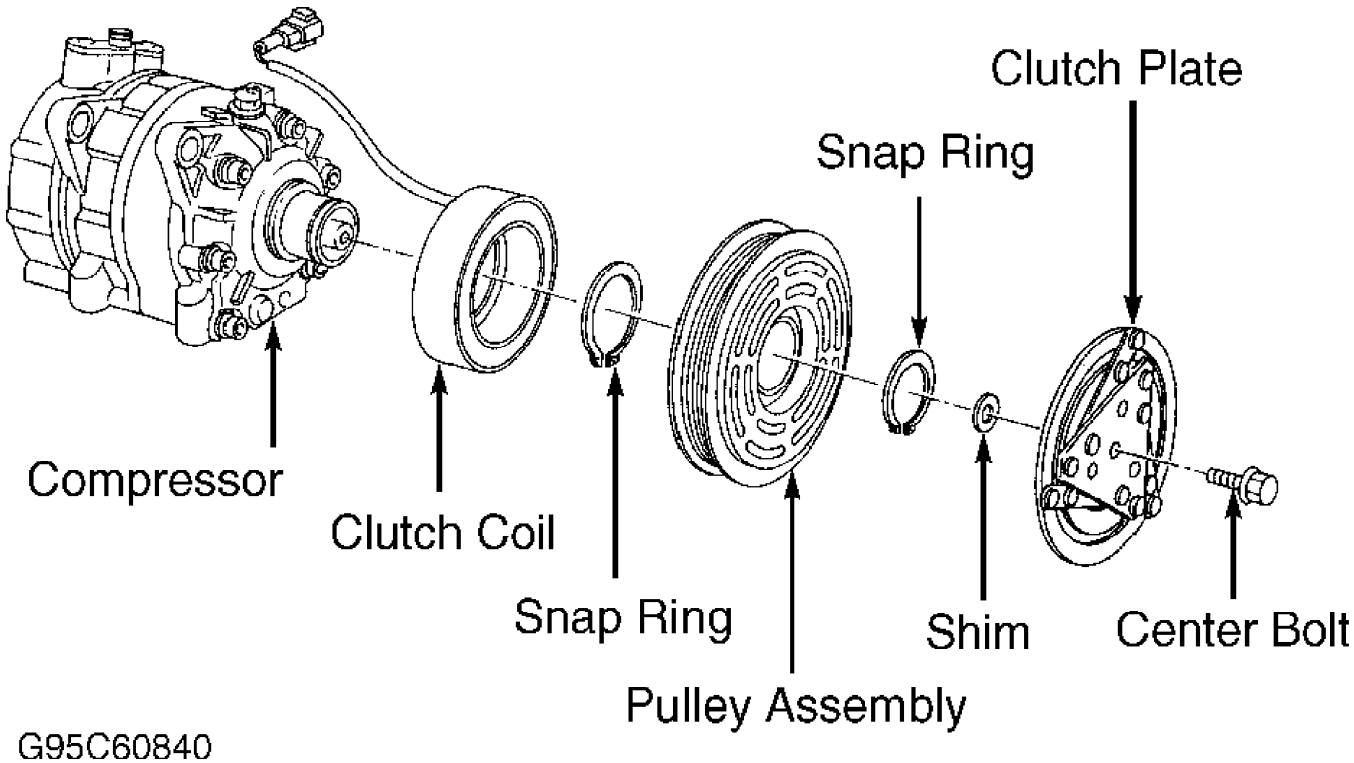


Fig. 1: Exploded View Of Compressor (Calsonic V6)
Courtesy of Nissan Motor Co.

FORD FS-10 & HALLA FX-15

CLUTCH COIL

Removal

1) Hold clutch plate stationary and remove clutch plate center bolt. Remove clutch plate. If clutch plate cannot be removed by hand, use an 8 x 1.25-mm bolt threaded into clutch plate to remove clutch plate and shim(s). See Fig. 2. Mark position of clutch coil electrical connector.

2) Remove pulley snap ring and pulley assembly. Position appropriate shaft protector over compressor nose opening. Position jaws of a 2-jaw puller behind back edge of clutch coil. Position puller forcing screw on center of shaft protector and remove clutch coil from compressor.

Installation

1) Ensure clutch coil mounting surface is clean. Place clutch coil over compressor nose opening with clutch coil electrical connector correctly positioned. Position appropriate clutch coil installing adapter over compressor nose opening and inner radius of clutch coil.

2) Position forcing screw of puller on center of installing adapter. Position jaws of puller on rear side of compressor front mounts and tighten forcing screw. Ensure clutch coil bottoms against front head of compressor all around clutch coil outer diameter.

3) Install pulley assembly. Install snap ring with bevel side of snap ring facing out. Install shim(s) and clutch plate. Install a new clutch plate bolt and tighten to 97-123 INCH lbs. (11-14 N.m).

4) On Nissan Quest, install dial indicator at clutch plate and set to zero. Energize clutch coil and measure air gap between

clutch plate and pulley. Air gap should be 0.020-0.33" (0.45-0.85 mm).

5) On Hyundai and Mazda, use a feeler gauge to check air gap between clutch plate and pulley at 3 places around pulley. On Hyundai, air gap should be 0.016-0.024" (0.41-61 mm).

6) On Mazda, air gap should be 0.014-0.033" (0.35-0.84 mm). On all models, if air gap is incorrect, add or remove shims as necessary.

SHAFT SEAL

Removal

1) Hold clutch plate stationary and remove clutch plate center bolt. Remove clutch plate. If clutch plate cannot be removed by hand, use an 8 x 1.25-mm bolt threaded into clutch plate to remove clutch plate and shim(s). See Fig. 2.

2) Remove shaft seal felt from nose of compressor. Thoroughly clean seal area of compressor using low-pressure compressed air and a lint-free cloth. Remove compressor shaft seal internal snap ring. Position shaft seal remover over compressor shaft.

3) Push shaft seal remover downward against seal. Ensure end of shaft seal remover is engaged with inside of seal. Hold hex part of seal remover and rotate shaft seal remover handle clockwise to expand remover tip inside seal. Pull shaft seal from compressor.

Installation

1) Lubricate shaft seal protector and shaft seal with refrigerant oil. Install shaft seal on shaft seal protector so lip seal is toward compressor (large end of shaft seal protector).

2) Install shaft seal protector on compressor shaft. Using shaft seal installer, push shaft seal down seal protector until seal is seated.

3) Remove shaft seal installer and protector. Install a new shaft seal snap ring and shaft seal felt. Install shim(s) and clutch plate. Install a new clutch plate bolt and tighten to 97-123 INCH lbs. (11-14 N.m).

4) Use a feeler gauge to check air gap between clutch plate and pulley at 3 places around pulley. On Hyundai Accent, air gap should be 0.016-0.024" (0.41-61 mm).

5) On all other models, air gap should be 0.014-0.033" (0.35-0.84 mm). If air gap is incorrect, add or remove shims as necessary.

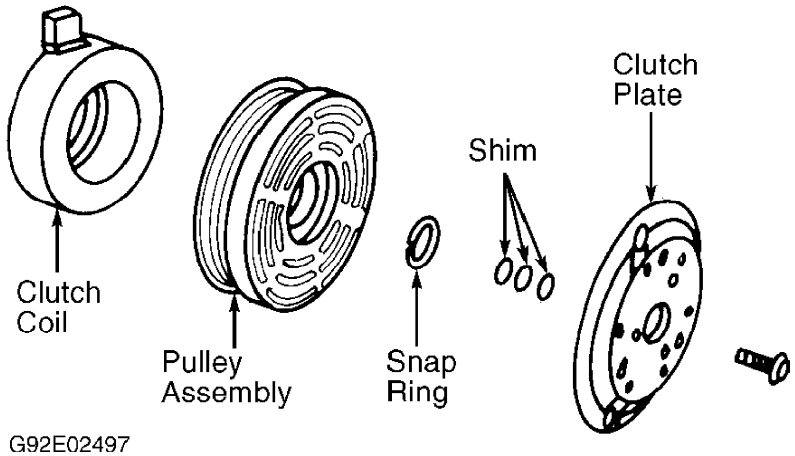


Fig. 2: Exploded View Of Compressor Clutch (Ford FS-10 Shown; Halla FX-15 Is Similar)
Courtesy of Mazda Motors Corp.

HARRISON HD6/HT6 6-CYLINDER

CLUTCH COIL & BEARING ASSEMBLY

CAUTION: DO NOT hammer on compressor shaft or clutch hub to remove clutch plate. Internal compressor damage will result.

Removal

1) Remove compressor from vehicle. Place compressor in Holding Fixture (J-33026). Using Clutch Plate/Hub Remover/Installer (J-33013-B), remove compressor clutch plate and hub. See Fig. 3.

2) Position remover/installer center screw forcing tip flat against compressor shaft and thread remover/installer into hub. End of shaft will be damaged if forcing tip is not flat. Hold remover/installer body and turn center screw into remover/installer body and remove clutch plate and hub. Remove shaft key from compressor shaft.

3) Remove snap ring. Install Pulley/Bearing Puller Guide (J-33023-A) on front head. Position Pulley/Bearing Puller (J-41552) into inner circle of slots on pulley. Turn puller clockwise until engaged in pulley slots. Tighten puller screw against puller guide until pulley is removed.

4) Disconnect clutch coil connector. Scribe match marks on compressor and clutch coil connector for installation reference. Install Puller Pilot Adapter (J-33023-A) on front head of compressor. Install Puller Crossbar (J-8433-1), Puller Legs (J-33025), and Forcing Screw (J-8433-3). Tighten puller forcing screw against pilot adapter and remove clutch coil. See Fig. 3.

Installation

1) Align clutch reference marks made during removal. Position Clutch Coil Installer (J-33024) over internal opening of clutch coil housing and align with front head of compressor. Position Puller Crossbar (J-8433-1) and Through-Bolts (J-33026) so Forcing Screw (J-8433-3) is centered in clutch coil installer center hole. Ensure through-bolts are fully threaded into holding fixture.

2) Tighten forcing screw against installer to press clutch coil onto compressor front head. Ensure clutch coil and installer stay aligned during installation. When clutch coil is fully seated on front head, stake front head and clutch coil. Using a 1/8" (3.2 mm) punch, stake clutch coil inner ring in 3 places, 120 degrees apart. Stake size should be 1/2 the area of punch tip and 0.010-0.015" (0.28-0.38 mm) deep.

3) Position Pulley/Bearing Installer (J-33017) and Pulley/Bearing Puller Guide (J-33023-A) over inner race of pulley bearing. Position Puller Crossbar (J-8433-1) and Through-Bolts (J-33026) so Forcing Screw (J-8433-3) is centered over puller guide. Ensure through-bolts are fully threaded into holding fixture.

4) Tighten forcing screw against puller guide to press pulley and bearing assembly onto front head of compressor. Ensure puller guide and front head of compressor stay aligned during installation. Install snap ring.

5) Install shaft key into clutch plate and hub. Ensure shaft key protrudes about 1/8" (3.2 mm) out of keyway. Ensure friction surfaces of clutch plate and pulley are clean. Ensure shaft key and keyway in hub are aligned and position clutch plate and hub onto compressor shaft.

6) Install Clutch Plate/Hub Remover/Installer (J-33013-B) with forcing screw in installation position. Body of remover/installer should be backed off from hub enough to allow forcing screw to be threaded onto compressor shaft.

7) Hold forcing screw and tighten installer body to press hub

onto compressor shaft. Before pressing clutch plate and hub to final position, remove installer and ensure shaft key is still in keyway. Continue pressing clutch plate and hub until air gap between friction surfaces is 0.020-0.030" (0.51-0.76 mm).

CAUTION: When installing clutch plate and hub, if forcing screw is fully threaded onto end of compressor shaft or installer body is held and forcing screw is rotated, the shaft key will bind and break the clutch hub.

SHAFT SEAL

NOTE: It is not necessary to replace compressor shaft seal because of small amounts of refrigerant oil seepage. Replace compressor shaft seal when a refrigerant leak is detected.

Removal

1) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Loosen and reposition compressor in mounting bracket. Remove clutch plate and hub assembly. See CLUTCH COIL & BEARING ASSEMBLY. See Fig. 3.

2) Remove shaft seal snap ring. Thoroughly clean all surfaces around seal including inside of compressor neck and exposed parts of seal, snap ring groove, and compressor shaft. Insert shaft Seal Remover/Installer (J-23128-A) into shaft seal. Hand-tighten seal remover/installer handle clockwise to seat inside seal. Remove shaft seal by turning and pulling seal remover/installer.

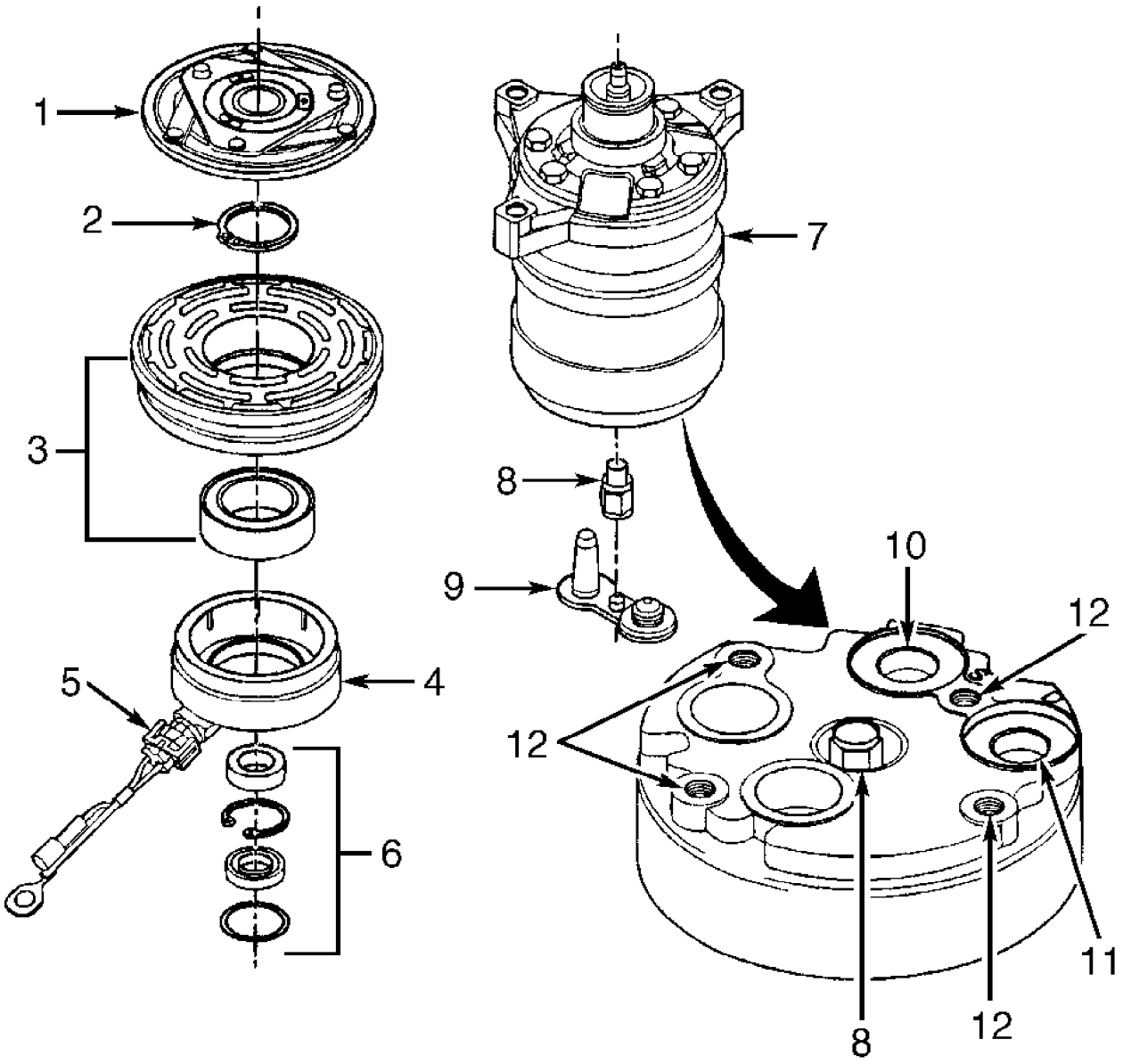
3) Using "O" Ring Remover (J-9553-01), remove "O" ring. Ensure shaft and inside of compressor neck are clean and free of foreign material. Thoroughly clean "O" ring groove in front head.

Installation

1) Lubricate new "O" ring with refrigerant oil and install using "O" Ring Installer (J-33011). Expand seal using shaft "O" ring installer. Insert installer into compressor until it bottoms. Move slide on installer downward until "O" ring is released into lower groove. Rotate installer to seat "O" ring and remove installer.

2) Lubricate shaft seal with refrigerant oil. Install shaft seal onto Seal Remover/Installer (J-23128-A). Install shaft seal so flared side of lip seal is installed toward compressor. Install Seal Protector (J-34614) into shaft seal lip and position seal protector over compressor shaft.

3) Push shaft seal into compressor using a rotary motion until seal bottoms. Use care to not move "O" ring. Remove installer. Install new snap ring with flat side against seal. Using seal remover/installer, push snap ring into snap ring groove. Clean excess refrigerant oil from compressor shaft and neck. Install clutch plate and hub assembly onto compressor shaft. See CLUTCH COIL & BEARING ASSEMBLY.



1. Clutch Plate & Hub
2. Snap Ring
3. Pulley & Bearing Assembly
4. Clutch Coil Assembly
5. Clutch Coil Connector
6. Shaft Seal Components
7. Compressor
8. High-Pressure Relief Valve
9. Shipping Cap
10. Suction Port
11. Discharge Port
12. Mounting Boss

G98A04098

Fig. 3: Exploded View Of Compressor (Harrison HD6/HT6 6-Cyl.)
Courtesy of Isuzu Motor Co.

HARRISON V7 7-CYLINDER

CLUTCH COIL & BEARING ASSEMBLY

CAUTION: DO NOT hammer on compressor shaft or clutch hub to remove clutch plate. Internal compressor damage will result.

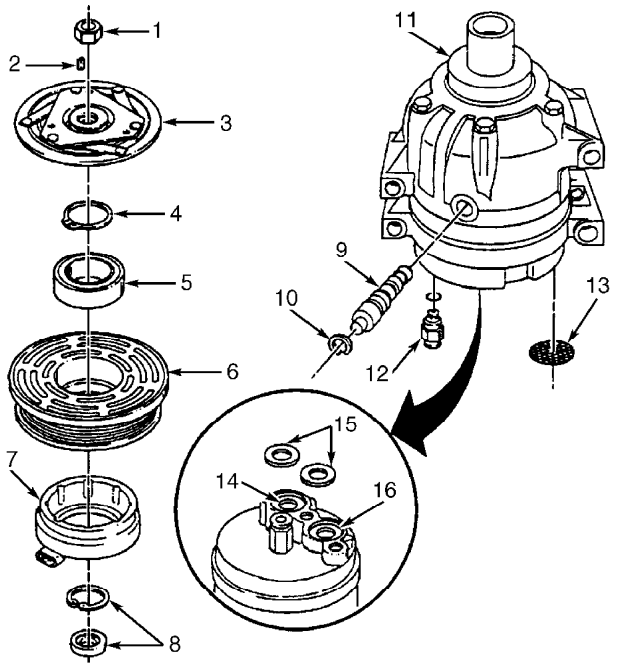
Removal

1) Remove compressor from vehicle. Place compressor in Holding Fixture (J-41790). Use Clutch Plate Spanner (J-33027) to hold clutch plate. Remove compressor shaft nut.

2) Use Clutch Plate Remover/Installer (J-33013-B) to remove compressor clutch plate and hub. See Fig. 4. Hold remover body and turn center screw into remover body to remove clutch plate and hub. Ensure forcing tip on remover/installer center screw is flat or end of shaft/axial plate will be damaged. Remove key from compressor shaft.

3) Remove snap ring. Install Puller Pilot/Guide (J-33023-A) on front head. Position Pulley and Bearing Puller (J-41552) into inner circle of slots on pulley. Turn puller clockwise in slots to engage puller tangs with pulley. Tighten puller forcing screw against puller pilot/guide and remove pulley.

4) Disconnect clutch coil lead. Scribe marks on compressor and clutch coil for installation reference. Install Puller Pilot/Guide (J-33023-A) on front head. Remove clutch coil using puller pilot/guide and 2-jaw puller. Position puller jaws under edge of clutch coil.



1. Nut
2. Key
3. Clutch Plate
4. Snap Ring
5. Pulley Assembly Bearing
6. Pulley Assembly
7. Clutch Coil
8. Snap Ring Shaft Seal
9. Compressor Control Valve
10. Snap Ring
11. Compressor
12. High-Pressure Relief Valve
13. Suction Port Filter Screen
14. Suction Port
15. Seal Washer
16. Discharge Port

G98J04111

Fig. 4: Exploded View Of Compressor (Harrison V7 7-Cyl.)
Courtesy of General Motors Corp.

Installation

1) Align reference marks made during removal. Using Puller

Adapter (J-33024) and 2-jaw puller, press clutch coil onto compressor. Position puller jaws under compressor mounting bosses. Ensure clutch coil and installer stay lined up during installation.

2) Position pulley on compressor. Place Bearing Installer (J-33017) and Clutch Plate Remover/Installer (J-33013-B) over inner race of bearing. Place Adapter (J-42126) onto remover/installer and reposition center forcing screw into the opposite end of the remover/installer.

3) Back body of remover/installer off enough to allow center forcing screw to be threaded onto end of compressor shaft several turns. Hold center forcing screw while turning hex portion of remover/installer several turns. DO NOT allow center forcing screw to turn. Continue turning remover/installer until pulley bearing is pressed onto compressor enough to clear snap ring groove. Install snap ring with chamfer side facing up. Install key in clutch plate, allowing key to protrude about 1/8" (3.2 mm) from rear of clutch plate.

4) Install clutch plate on compressor shaft. Hold center forcing screw and turn hex portion of remover/installer several turns to press clutch plate onto compressor. Remove remover/installer and ensure key is still in keyway. Reinstall remover/installer and check air gap before installing clutch plate to its final position. Air gap between friction surfaces should be 0.015" (0.38 mm). Using spanner, install compressor shaft nut. Tighten shaft nut to 13 ft. lbs. (18 N. m). Check components for proper rotation.

SHAFT SEAL

Removal

1) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove compressor from vehicle. Remove clutch plate and hub assembly. See CLUTCH COIL & BEARING ASSEMBLY. See Fig. 4.

2) Remove shaft seal snap ring. Ensure all surfaces around seal are clean. Insert Shaft Seal Remover/Installer (J-42136) into shaft seal. Rotate handle clockwise to seat seal remover/installer in seal. Remove shaft seal. Ensure shaft and inside of compressor neck are clean and free of foreign material. Thoroughly clean "O" ring groove in front head.

Installation

1) Install Shaft Seal Protector (J-34614) over compressor shaft. With shaft seal protector in place, lubricate shaft seal with refrigerant oil and install on to Shaft Seal Remover/Installer (J-34614).

2) Push shaft seal into compressor using a rotary motion until seal bottoms. Install new snap ring with flat side against seal. Install clutch plate and hub assembly onto compressor shaft. See CLUTCH COIL & BEARING ASSEMBLY.

KEIHIN SCROLL

CLUTCH COIL

NOTE: If compressor shaft seal leaks, replace compressor.

Removal

Hold clutch plate and remove shaft bolt. Remove clutch plate and adjustment shim(s). See Fig. 5. Remove pulley snap ring and discard. Position universal 2-jaw puller to back of pulley and Driver Adapter (07947-6340300) to center of pulley. If puller jaws are located on belt area, pulley will be damaged. Remove pulley. Remove

clutch coil snap ring and discard. Disconnect clutch coil wiring harness and remove clutch coil.

Installation

1) Install clutch coil in reverse order of removal. Ensure wire side is facing down and pin on clutch coil boss is aligned with hole in compressor housing. Ensure snap ring is properly seated. Properly route and connect clutch coil wiring harness.

2) Install shims the same thickness as originally removed. Position pulley over clutch coil. Using Hub Guide (07965-6920500), press pulley onto compressor boss. Maximum press load is 5690 psi (400 kg/cm^2) or 882 lbs. (400 kg). If pulley does not press on straight, remove pulley and inspect pulley and compressor boss for damage or burrs.

3) Hold clutch plate and tighten shaft nut to 13 ft. lbs. (18 N.m). Ensure air gap between clutch plate and pulley is 0.014-0.026" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary.

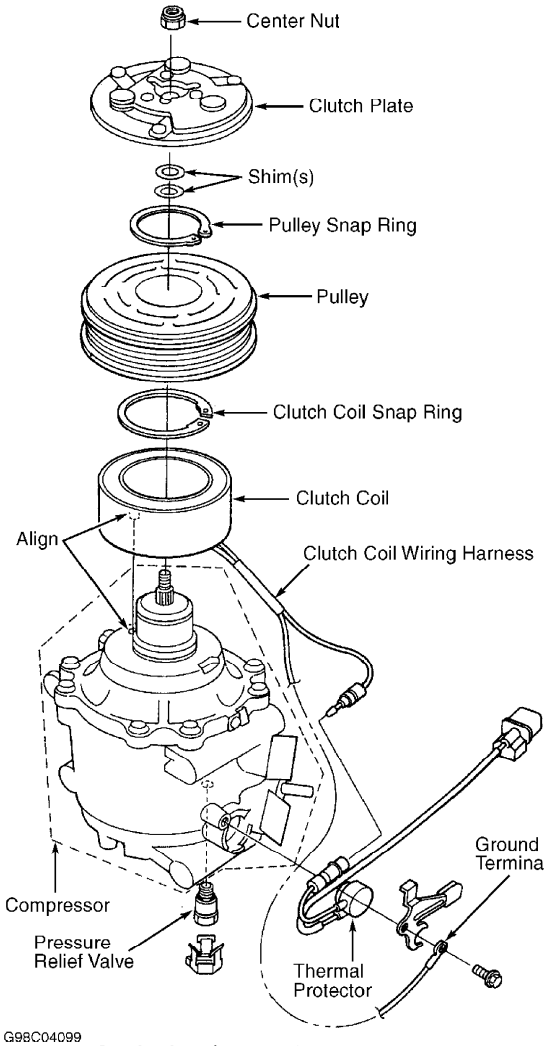


Fig. 5: Exploded View Of Compressor (Keihin Scroll)
Courtesy of American Honda Motor Co., Inc.

NIPPONDENSO

CLUTCH COIL

NOTE: Due to the variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced. Land Rover and Jaguar compressor servicing procedures are not available from manufacturer.

Removal (Acura, BMW, Honda & Isuzu)

On Acura and Honda, using Clutch Plate Holder (J-37872), hold clutch plate stationary and remove compressor shaft bolt. On BMW, using Clutch Plate Holder (64-5-090), hold clutch plate stationary and remove compressor shaft bolt. On all models, remove clutch plate and shims. Remove snap ring and pulley. Remove clutch coil wiring harness from compressor. Remove snap ring and clutch coil. See Fig. 6, 7 or 8.

Installation

1) To install, reverse removal procedure. Use NEW snap rings. Ensure snap rings are installed with beveled side facing out and fully seated in snap ring groove. Install clutch coil with wire facing downward. Apply thread lock to compressor shaft bolt. Tighten shaft bolt to 117 INCH lbs. (13 N.m).

2) On Acura and Honda, ensure air gap between clutch plate and pulley is 0.014-0.026" (0.36-0.66 mm). On BMW, ensure air gap between clutch plate and pulley is 0.020-0.031" (0.50-0.80 mm). If air gap is incorrect, add or remove shim(s) as necessary.

Removal (Mazda Miata)

1) Hold clutch plate using Clutch Holder (00007-10331) and remove shaft bolt. Install Clutch Disc Remover (4992-02-020) and remove clutch plate and shim(s). See Fig. 6, 7 or 8.

2) Remove pulley snap ring and tap pulley (with bearing) off of compressor. Remove screw for clutch coil lead. Mark position of clutch coil. Remove clutch coil snap ring and clutch coil.

Installation

To install, reverse removal procedure. Tighten shaft bolt to 97-142 INCH lbs. (11-16 N.m). Ensure pulley-to-clutch plate clearance is 0.014-0.025" (0.35-0.64 mm). If clearance is incorrect, add or remove shim(s) as necessary.

Removal (Mercedes-Benz & Mitsubishi)

1) Hold clutch plate stationary. Remove clutch plate center bolt and clutch plate. If clutch plate cannot be removed by hand, tighten an 8-mm or 10-mm bolt into clutch plate center bolt hole to remove clutch plate.

2) Remove shim(s) and pulley snap ring from compressor shaft. Tap pulley using a plastic hammer and remove pulley from compressor shaft. See Fig. 6, 7 or 8. Remove retaining screw for clutch coil lead. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Ensure clutch coil pin is aligned with hole in compressor housing. Ensure clutch coil lead is positioned properly. Ensure snap rings are installed with beveled side facing out. Tighten shaft bolt to 10-13 ft. lbs. (14-17 N.m).

2) Check air gap between clutch plate and pulley. Position dial indicator on clutch plate. Energize clutch coil and zero dial indicator. De-energize clutch coil and measure air gap (clutch plate movement). Ensure air gap between clutch plate and pulley is 0.014-0.026" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary. Ensure pulley rotates freely.

Removal (Porsche)

1) Hold clutch plate stationary using a strap wrench. Remove clutch plate center nut or bolt. Insert a M8 x 40 mm bolt with threaded end machined to a 7/32" (5.5 mm) cone. Tighten bolt until clutch plate can be removed.

2) Remove shim(s) and pulley snap ring from compressor shaft. Remove pulley using a plastic hammer. If pulley cannot be removed by hand, use a puller. See Fig. 6, 7 or 8. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

To install, reverse removal procedure. Ensure snap rings are installed with beveled side facing out. Tighten shaft bolt to 10 ft. lbs. (14 N.m). Ensure air gap between clutch plate and pulley is 0.014-0.026" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary.

NOTE: On 911 use a feeler gauge to measure air gap. On Boxster, position a dial indicator on clutch plate. To check air gap, energize clutch coil and zero dial indicator. De-energize clutch coil and measure air gap. Ensure air gap is as specified.

Removal (Volkswagen)

Hold clutch plate stationary using a strap wrench. Remove clutch plate center bolt. See Fig. 6, 7 or 8. Remove clutch plate using 2 screwdrivers to pry clutch plate off compressor shaft. Remove shims and pulley snap ring. Remove pulley using a 2-jaw or 3-jaw puller. Position puller jaws onto edge of pulley to prevent pulley groove from being deformed. Remove clutch coil harness clip, clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Ensure clutch coil pin is aligned with hole in compressor housing. Ensure clutch coil lead is positioned properly. Ensure snap rings are installed with beveled side facing out. Tighten clutch plate shaft bolt to 11 ft. lbs. (15 N.m).

2) Check air gap between clutch plate and pulley. Position dial indicator on clutch plate. Energize clutch coil and zero dial indicator. De-energize clutch coil and measure air gap (clutch plate movement). Ensure air gap between clutch plate and pulley is 0.016-0.024" (0.41-0.61 mm). If air gap is incorrect, add or remove shim(s) as necessary.

Removal (All Others)

1) Hold clutch plate stationary, and remove clutch plate center nut or bolt. On Lexus and Toyota, remove clutch plate using Clutch Plate Remover (07112-66040). On other models, remove clutch plate using a 2-jaw or 3-jaw puller.

2) On all models, remove shim(s) and pulley snap ring. See Figs. 6, 7, or 8. Tap pulley off compressor shaft using a plastic hammer. If pulley cannot be removed, use a 2-jaw or 3-jaw puller. Position puller jaws onto edge of pulley to prevent pulley groove from being deformed. Disconnect clutch coil lead. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Ensure clutch coil is positioned correctly. Ensure new snap rings are installed with beveled side facing out. On Lexus and Toyota, tighten clutch plate center bolt to 115 INCH lbs. (13 N.m). On all other models, tighten

shaft bolt (or nut) to 11-15 ft. lbs. (15-20 N.m).

2) On Lexus and Toyota, ensure air gap between clutch plate and pulley is 0.014-0.026" (0.35-0.65 mm). On all other models, ensure air gap between clutch plate and pulley is 0.016-0.024" (0.41-0.61 mm). On all models, if air gap is incorrect, add or remove shim(s) as necessary.

NOTE: On some compressors, it is necessary to use a dial indicator on clutch plate to check air gap. Energize clutch coil and zero dial indicator. De-energize clutch coil and measure air gap. Ensure air gap is as specified.

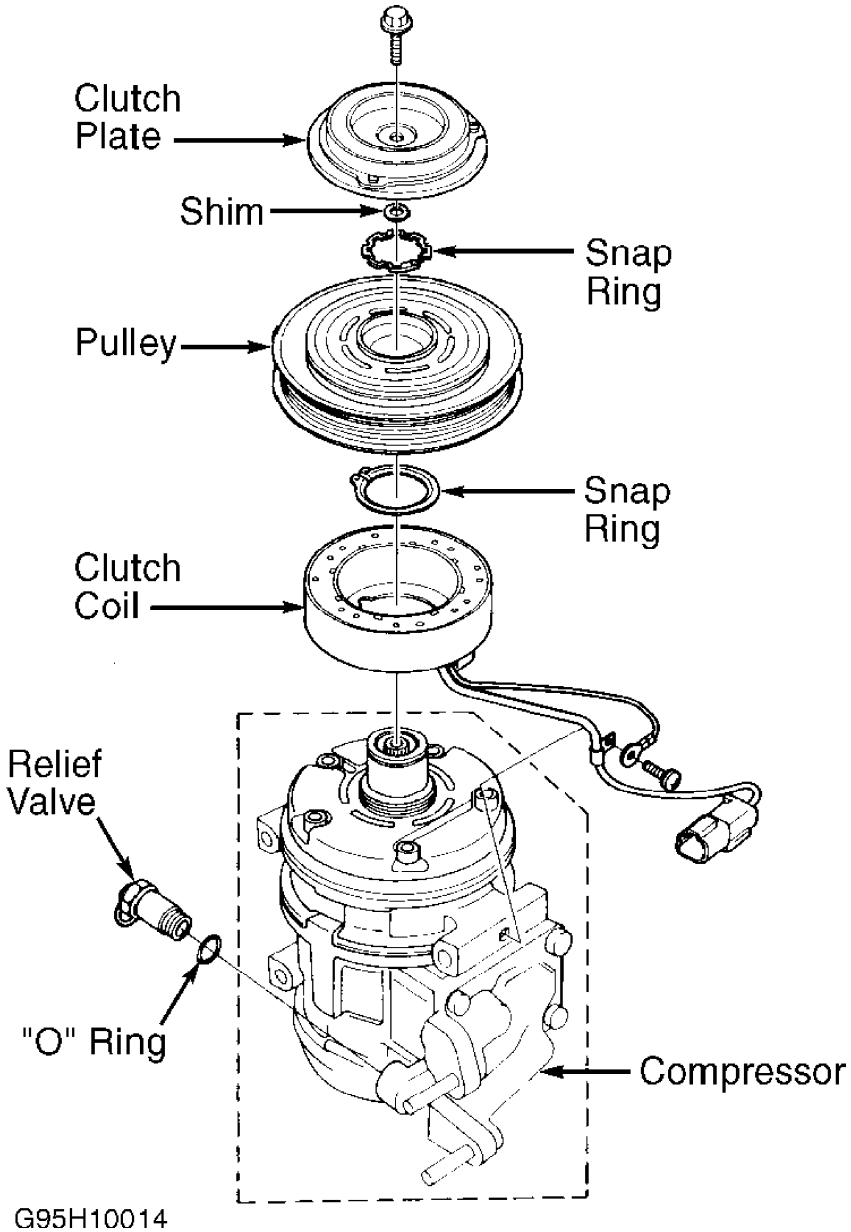


Fig. 6: Exploded View Of Compressor (Nippondenso 10-Cyl. - Honda Shown; Others Are Similar)
Courtesy of American Honda Motor Co., Inc.

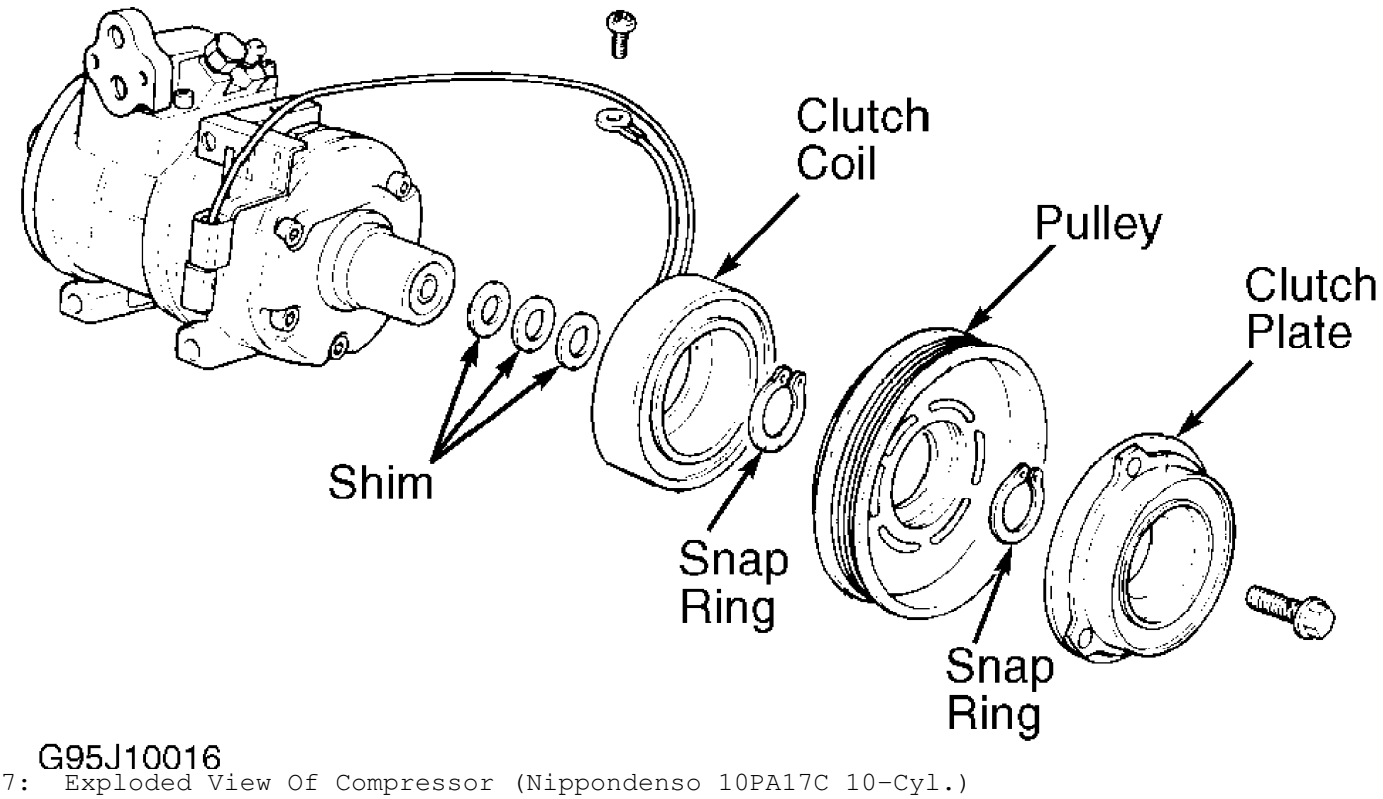


Fig. 7: Exploded View Of Compressor (Nippondenso 10PA17C 10-Cyl.)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

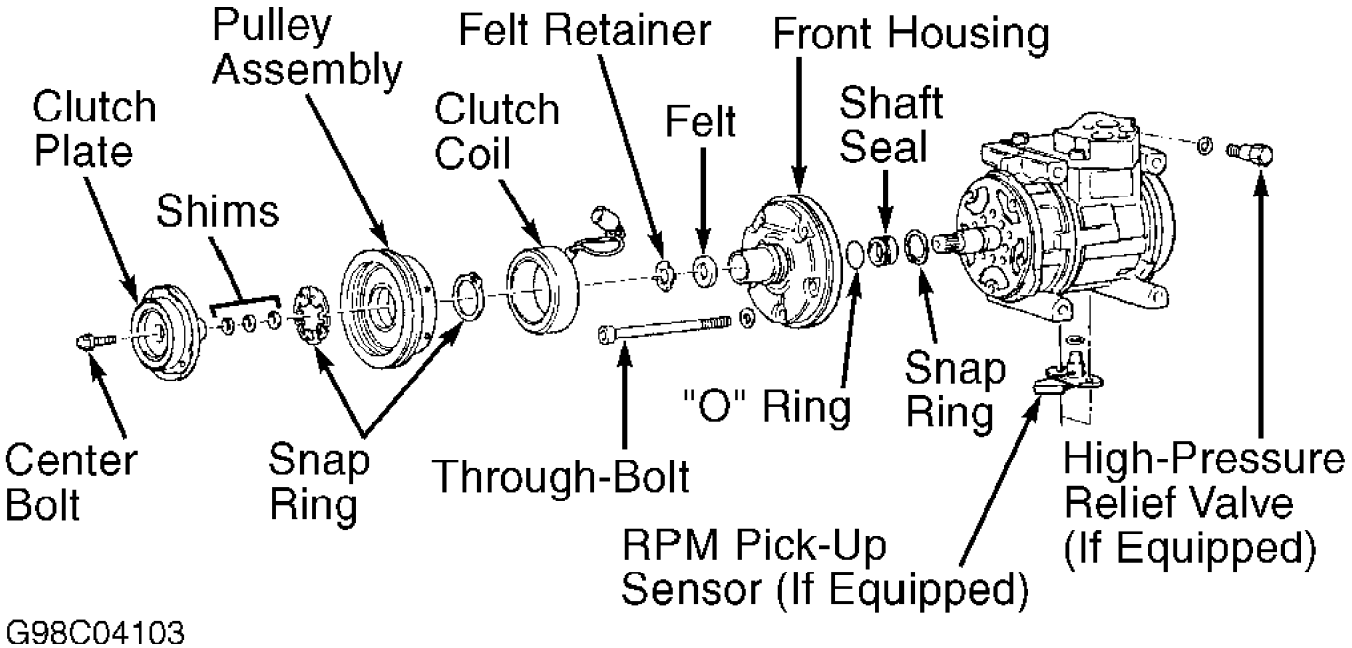


Fig. 8: Exploded View Of Compressor (Nippondenso 10PA17C 10-Cyl. Shown; 10PA15 & 10PA20 Are Similar)
Courtesy of Mitsubishi Motor Sales of America.

SHAFT SEAL

NOTE: Most manufacturers does not provide compressor shaft seal

replacement procedure. If shaft seal oil leak is excessive and/or refrigerant is leaking, compressor must be replaced. A small amount of refrigerant oil leakage from compressor shaft seal is normal.

CAUTION: On Mitsubishi, secure rear housing to compressor body using a vise before removing front housing through-bolts. Compressor rear housing may separate from compressor body, spilling refrigerant oil.

Removal (Mitsubishi)

1) Remove clutch coil. See CLUTCH COIL. See Fig. 8. Position compressor in a vise so compressor rear housing is secured to compressor body. Remove front housing through-bolts and front housing.

2) Using a flat-blade screwdriver, remove felt retainer and felt from front housing. Remove shaft seal snap ring. Using a flat-blade screwdriver, remove shaft seal and "O" ring. See Fig. 8.

Installation

1) Inspect compressor shaft and front housing bore for damage and/or excessive wear. Ensure "O" ring and shaft seal seat are clean. Apply refrigerant oil to compressor side of front housing bore. Lubricate "O" ring and shaft seal with refrigerant oil. Using a 21-mm socket, install shaft seal with "O" ring side facing away from compressor. Install shaft seal snap ring. See Fig. 8.

2) Install felt into felt retainer. Using a 14-mm deep socket, install felt and felt retainer. Lubricate compressor shaft. Install front housing using care not damage shaft seal lip. See Fig. 8 .

3) Alternately tighten front housing through-bolts to 19 ft. lbs. (26 N.m). Install clutch plate center bolt. Using an INCH-lb. torque wrench, ensure compressor breakaway torque is 43 INCH lbs. (4.9 N.m) or less. To complete installation, reverse removal procedure. Ensure air gap between clutch plate and pulley is correct. See CLUTCH COIL.

PANASONIC ROTARY VANE

CLUTCH COIL

Removal (Mazda)

Hold clutch disc stationary and remove shaft bolt. See Fig. 9 . Remove clutch disc and shim(s) from shaft. Remove pulley snap ring and remove pulley using a puller if necessary. Remove screw from clutch coil lead. Remove screws and clutch coil.

Installation

To install, reverse removal procedure. Tighten shaft bolt to 11 ft. lbs. (15 N.m). Ensure air gap is 0.016-0.023" (0.41-0.58 mm). If air gap is incorrect, add or remove shim(s) as necessary.

THERMAL PROTECTOR

Removal (Mazda)

Remove 2 compressor head cover rear bolts and then 4 upper head cover bolts. Remove thermal protector snap ring and push thermal protector out from its back side. DO NOT pull on wiring harness. See Fig. 9.

Installation

1) Ensure thermal protector "O" ring groove in compressor head cover is free of foreign material. Apply refrigerant oil to "O"

ring and install into "O" ring groove. Install thermal protector with wiring harness leads horizontal to head cover. Install thermal protector snap ring with chamfered edge facing thermal protector.

2) Apply refrigerant oil to head cover lower "O" ring and install with top side faces upward. Apply clean refrigerant oil to rear "O" ring and install in head cover. Carefully install head cover onto compressor. Tighten 2 rear head cover bolts to 115-159 INCH lbs. (13-18 N.m). Tighten 4 lower head cover bolts to 80-106 INCH lbs. (9-12 N.m) in a diagonal pattern.

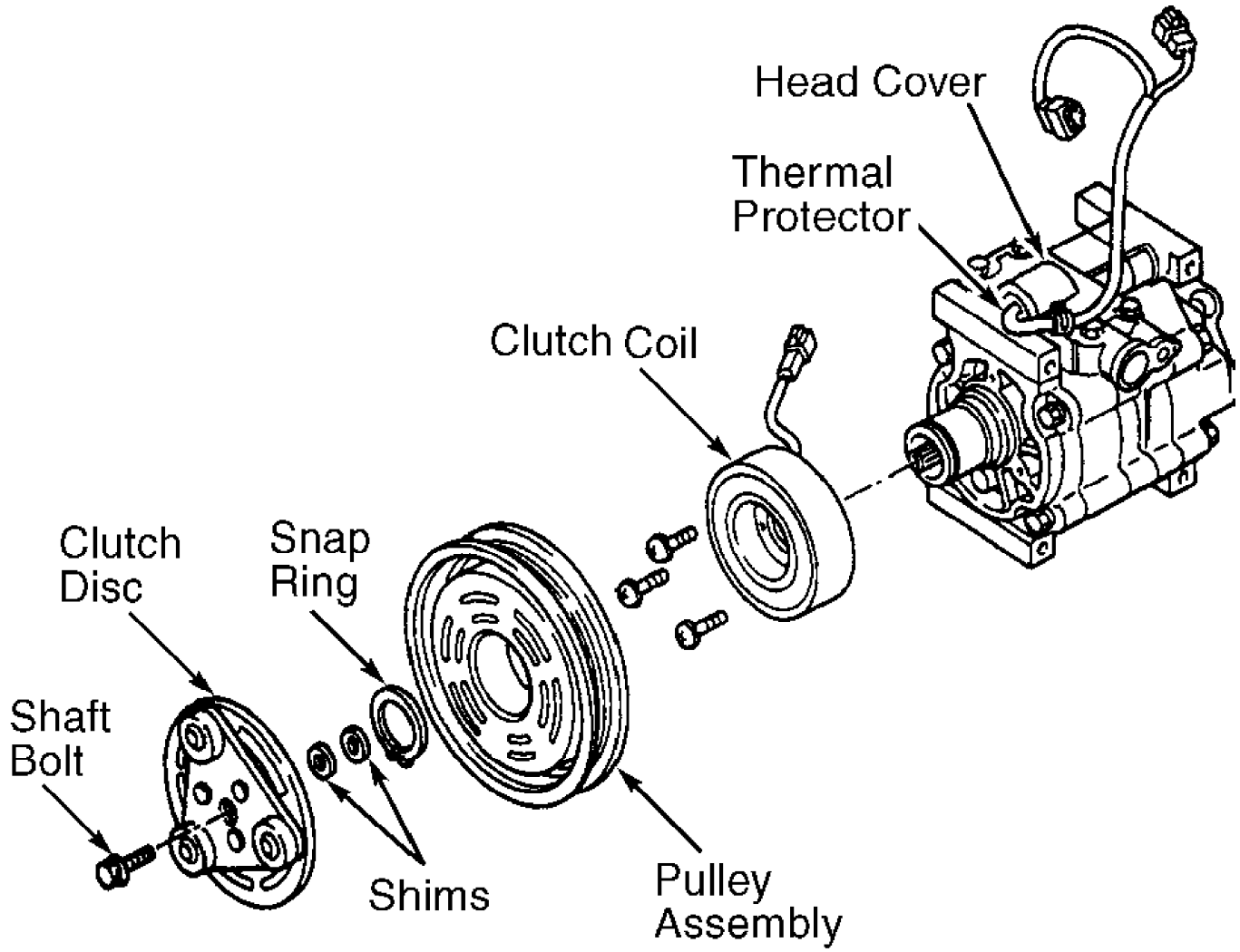


Fig. 9: Exploded View Of Compressor (Panasonic)
Courtesy of Mazda Motors Corp.

SANDEN SCROLL

CLUTCH COIL & SHAFT SEAL

NOTE: Range Rover Sanden compressor servicing procedures are not available from manufacturer.

NOTE: Due to the variety of clutch and shaft seal configurations,

obtain appropriate A/C compressor service tools for compressor being serviced.

Removal (Mitsubishi)

1) Remove drive belt pulley (if equipped). Hold clutch plate using Pliers (MB991367) and Bolts (MB991386). Use a ratchet and socket to remove clutch hub nut.

2) Remove clutch plate. See Fig. 11 or 12. Remove snap ring with internal snap ring pliers. Remove clutch hub (rotor). Remove snap ring and clutch coil.

3) Using an awl, remove bearing cover and retainer. Using Bearing Remover (MB991456), engage bearing grooves. Place base of bearing remover over remover arms and tighten nut.

4) Tighten bearing remover bolt to withdraw bearing from compressor. Engage grooves of Shaft Seal Remover/Installer (MB991458) and pull straight up on shaft seal.

Installation

1) To install shaft seal, ensure front housing is free of foreign objects. Lubricate Shaft Seal Protector (MB991459) and place over compressor shaft. Lubricate shaft seal and install using shaft seal remover/installer. Remove shaft seal protector.

2) Using a 21-mm socket or Drift (MB991301), carefully press bearing onto compressor shaft. Install clutch coil so that alignment pin is engaged. Install clutch coil snap ring with tapered side facing out.

3) Align armature plate with crankshaft spline. Tighten shaft nut to 12 ft. lbs. (16 N.m). Using feeler gauge, ensure air gap between pressure plate and pulley is 0.02-0.03" (0.5-0.8 mm) on Diamante and 0.016-0.024" (0.4-0.6 mm) on all other models. If air gap is incorrect, add or remove shim(s) as necessary.

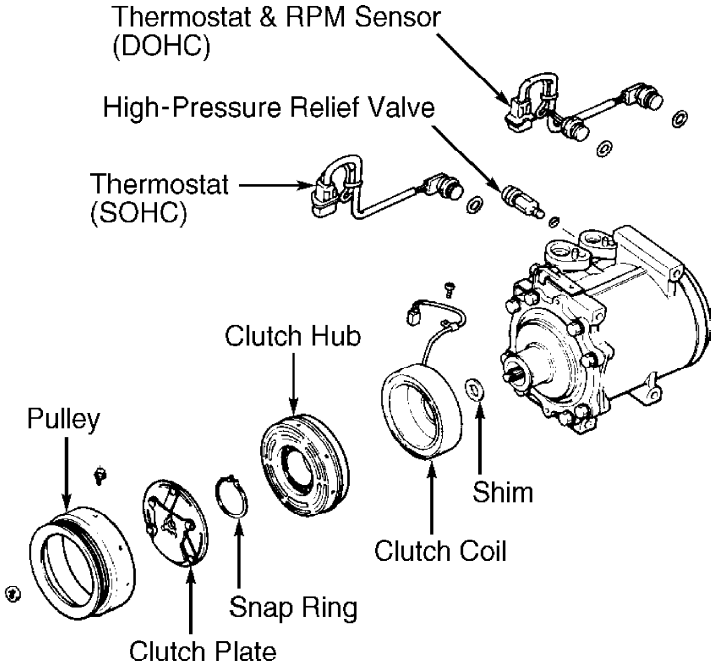


Fig. 10: Exploded View Of Compressor (Sanden MSC105 Scroll Shown; MSC90C Is Similar)
Courtesy of Mitsubishi Motor Sales of America.

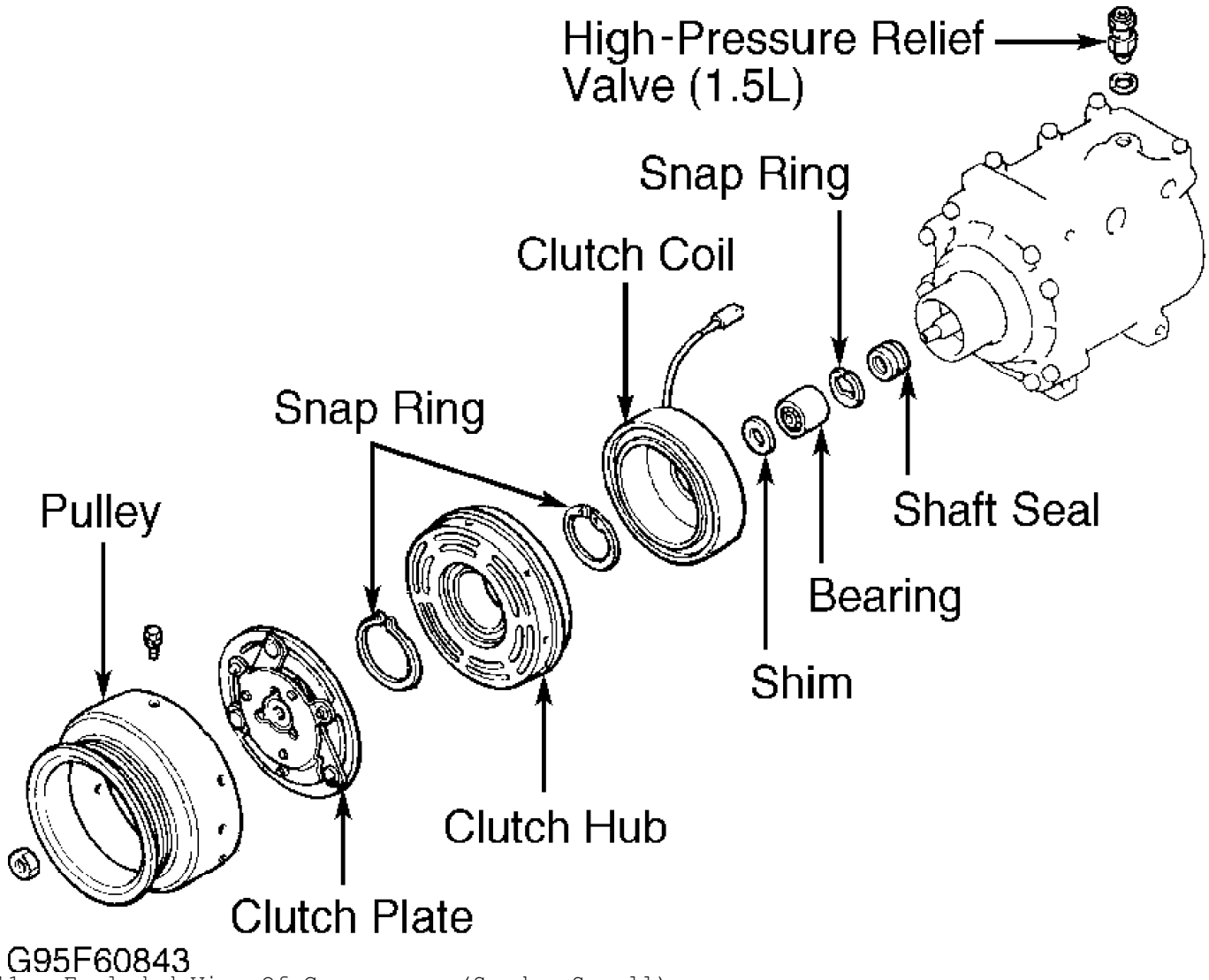


Fig. 11: Exploded View Of Compressor (Sanden Scroll)
Courtesy of Mitsubishi Motor Sales of America.

Removal (Honda)

1) Remove shaft nut while holding clutch plate with Clutch Holder (J-37872). Remove pressure plate and shim(s). Remove snap ring.

2) Using universal puller attached to outer diameter of pulley, and Driver (07947-6340300) in center of pulley, remove pulley. DO NOT engage puller on belt area. Hold puller in place and tighten screw to remove pulley. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Align lug on clutch coil with hole in compressor. Install snap ring with chamfered side facing out. Position pulley squarely over coil. Using Hub Guide (07945-6920500), press pulley onto compressor boss. Maximum press load is 5690 psi (400 kg/cm^2) or 882 lbs. (400 kg).

2) Tighten shaft nut to 13 ft. lbs. (18 N.m). Using feeler gauge, ensure air gap between pressure plate and pulley is 0.014-0.026" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary.

NOTE: If shaft seal leaks, replace compressor.

Removal (Mazda)

1) Remove compressor shaft nut while holding clutch plate with Clutch Holder (49-B061-010). Remove clutch pressure plate and shim(s). If clutch pressure plate cannot be removed by hand, use Pressure Plate Remover (49-B061-013).

2) Remove pulley assembly snap ring. Install a 2-jaw puller to outer diameter of pulley and a 1.0" (25 mm) socket to compressor boss, and remove pulley. DO NOT engage puller on belt area. Hold puller in place and tighten screw to remove pulley. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Align lug on clutch coil with hole in compressor. Install snap ring with chamfered side facing out. Position pulley squarely over coil. Ensure compressor boss and inside area of pulley bearing are clean and free of foreign material. Using Pulley Installer (49-G032-311), press pulley onto compressor boss.

2) Tighten compressor shaft nut to 14 ft. lbs. (19 N.m). Using feeler gauge, ensure air gap between clutch pressure plate and pulley is 0.014-0.025" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary.

SANDEN 7-CYLINDER

CLUTCH COIL & BEARING

Removal (Jaguar)

1) Using 3 bolts, attach Puller (JD166-1) to clutch plate. While holding clutch plate with puller, remove shaft nut. Install puller bolt in center of puller, and tighten bolt to remove clutch plate.

2) Remove adjustment shim(s) and Woodruff key. Remove pulley snap ring. Install threaded Adapter (JD166-5), onto compressor shaft. Engage Collets (JD166-5) to inner diameter of pulley and attach Puller (JD166-1) to collets.

3) Install puller bolt in center of puller, and tighten bolt to remove pulley. Press bearing out of drive belt pulley. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

To install clutch coil and bearing, reverse removal procedure. Tighten shaft nut. Ensure air gap is 0.016-0.031" (0.40-0.80 mm). If air gap is incorrect, add or remove shim(s) as necessary.

Removal (Volkswagen)

1) Remove compressor shaft nut while holding clutch plate with two 1/4" (6 mm) bolts and Spanner Wrench (Mastercool 90901). Remove clutch plate using two 1/4" (6 mm) bolts and Puller (Mastercool 90902). Remove pulley assembly lock ring. See Fig. 12. Using a 2-jaw puller, remove pulley assembly. Position puller jaws onto edge of pulley to prevent pulley groove from being deformed.

2) If replacing pulley bearing, remove bearing snap ring. Using Thrust Plates (VW401 and VW402), Thrust Bushing (VW412) and Thrust Tube (VW455), press bearing out of pulley. Mark position of clutch coil. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Ensure clutch coil

is positioned correctly and install snap ring. Using Thrust Plates (VW401 and VW402) and Thrust Bushings (VW412 and VW473), press bearing into pulley until fully seated. Install bearing snap ring.

2) Using Thrust Plates (VW401 and VW402) and Thrust Bushings (VW412 and VW441), press pulley assembly onto compressor shaft. Install pulley assembly lock ring. Install clutch plate and compressor shaft nut. Tighten compressor shaft nut until the air gap is 0.028" (0.71 mm).

3) To check air gap, position a depth gauge on edge of pulley and measure distance to clutch plate. Using a fused jumper wire, energize clutch coil and measure distance from edge of pulley to clutch plate again. Air gap is the difference between first and second measurement. Ensure air gap is 0.028" (0.71 mm). To adjust air gap, tighten or loosen compressor shaft nut.

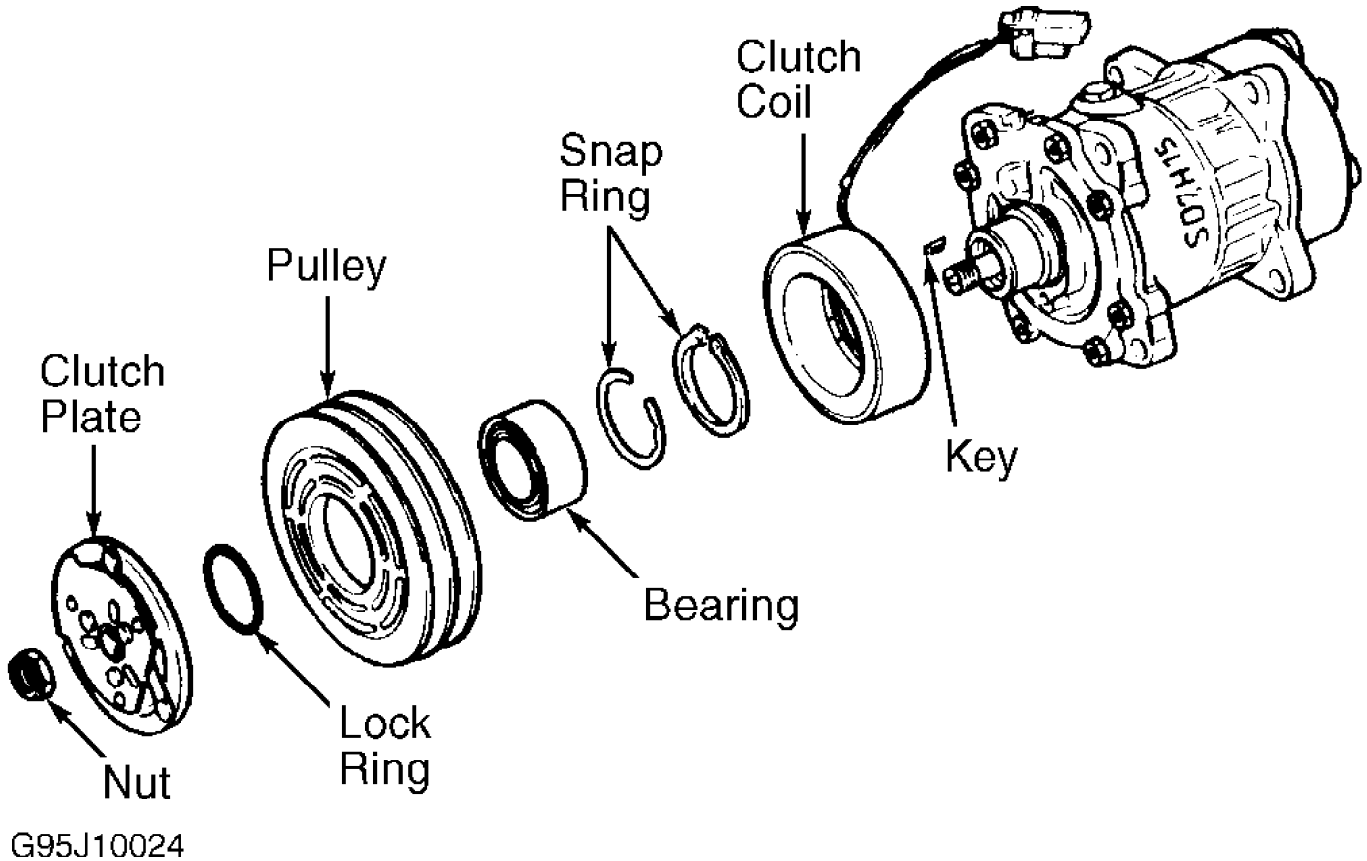


Fig. 12: Exploded View Of Compressor (Sanden 7-Cyl.)
Courtesy of Volkswagen United States, Inc.

SHAFT SEAL

Removal (Jaguar)

1) Using 3 bolts, attach Puller (JD166-1) to clutch plate. While holding clutch plate with puller, remove shaft nut. Install puller bolt in center of puller, and tighten bolt to remove clutch plate.

2) Remove Woodruff key, felt seal, and seal seat snap ring. Engage Seal Seat Remover/Installer (JD167) to seal seat, and remove seal seat. Engage Seal Remover/Installer (JD168) to shaft seal, and remove shaft seal.

Installation

Lubricate shaft seal protector and shaft seal with refrigerant oil. Using seal remover/installer, install shaft seal. Lubricate seal seat "O" ring with refrigerant oil, and install seal seat. To complete installation, reverse removal procedure.

NOTE: On Volkswagen, shaft seal removal and installation procedure is not available from manufacturer.

CLUTCH COIL

Removal (Suzuki)

1) Remove compressor shaft nut and discard, while holding clutch plate with Clutch Holder (09920-55810). Remove clutch plate using Clutch Plate Remover (09930-35210). Remove shaft key and shim(s). See Fig. 13.

2) Remove pulley snap ring. Install a 2-jaw puller to outer diameter of pulley and Shaft Protector (09951-65510) to compressor boss, and remove pulley. DO NOT engage puller on belt area. Hold puller in place and tighten screw to remove pulley. Disconnect clutch coil lead from compressor housing. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Align lug on clutch coil with hole in front housing of compressor. Install snap ring with chamfered side facing out. Position pulley squarely over coil. Ensure compressor boss and inside area of pulley bearing are clean and free of foreign material. Using Pulley Installer (09951-15510), press pulley onto compressor boss. Install pulley snap ring.

2) Install shim(s) and shaft key. Install clutch plate using a plastic hammer and a tube with an inside diameter more than 0.34" (8.5 mm) and an outside diameter less than 0.75" (19 mm). Using feeler gauge, ensure air gap between clutch plate and pulley is 0.014-0.025" (0.35-0.65 mm). If air gap is incorrect, add or remove shim(s) as necessary. Connect clutch coil lead to compressor housing. Hold clutch plate and tighten compressor shaft nut to 13 ft. lbs. (18 N.m).

SHAFT SEAL

Removal (Suzuki)

Remove clutch plate, pulley and clutch coil. See CLUTCH COIL. Remove felt ring, shaft key and shaft seal snap ring. See Fig. 13. Insert Seal Remover/Installer (09990-48230) into seal seat and twist remover to engage seal. Pull up on remover/installer and remove seal.

Installation

1) Using refrigerant oil, lubricate Shaft Seal Protector (09990-58240) and install over compressor shaft. Using refrigerant oil, lubricate shaft seal lips and outer "O" ring. Install shaft seal over protector with "O" ring toward compressor. Ensure lips of shaft seal point toward compressor.

2) Using Seal Remover/Installer (09990-48230) and hand pressure, slowly install shaft seal until upper face of seal is lower than snap ring groove. Install snap ring with chamfered side facing compressor. Install shaft key and felt ring. To complete installation, reverse removal procedure.

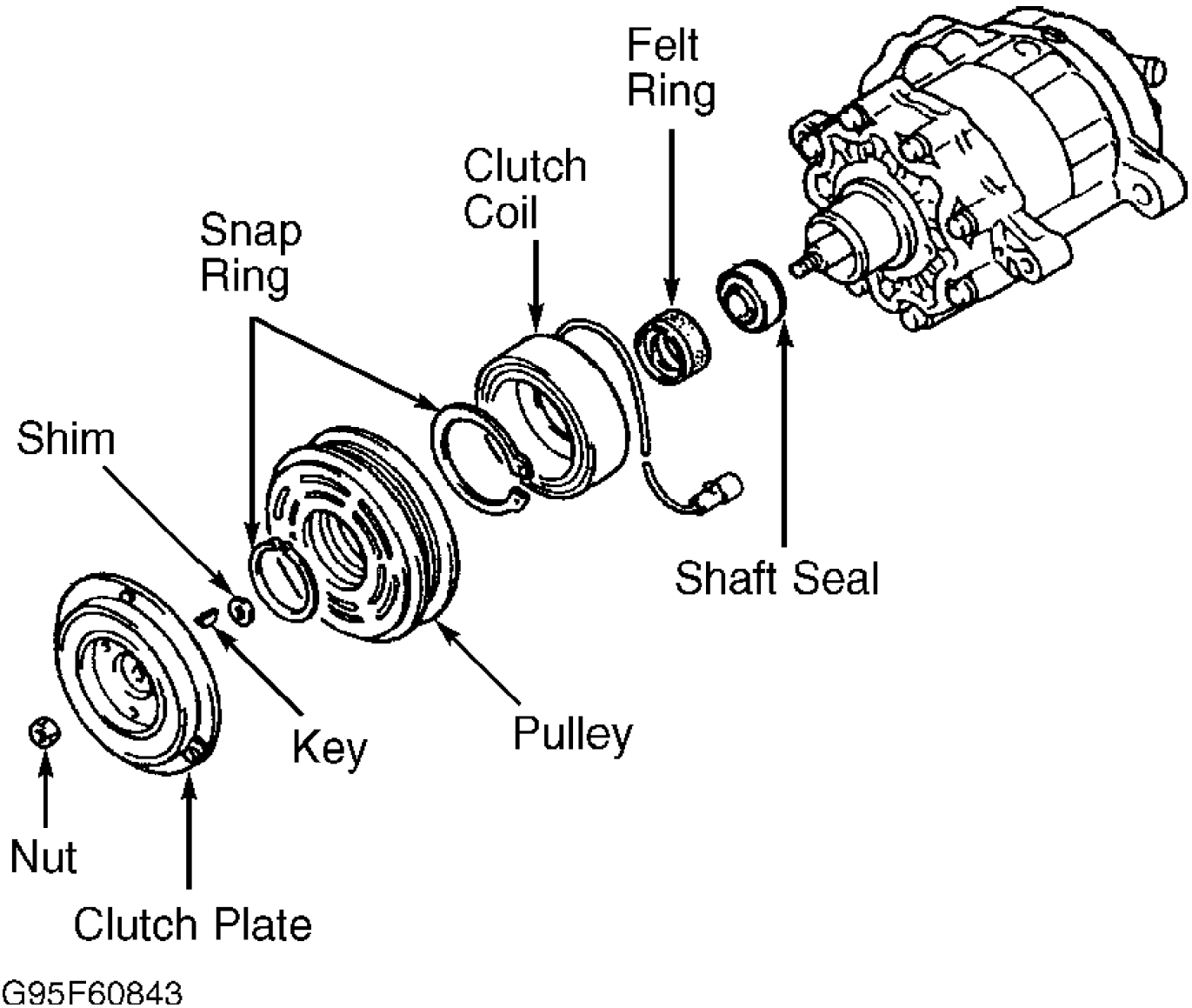


Fig. 13: Exploded View Of Compressor (Sanden SD7B10 7-Cyl.)
Courtesy of Suzuki of America, Corp.

SEIKO-SEIKI ROTARY VANE

CLUTCH COIL

Removal (BMW)

Using Clutch Plate Holder (64-5-020), hold clutch plate stationary and remove compressor shaft bolt. Remove clutch plate and shims. Remove pulley snap ring. Using a 3-jaw puller attached between clutch coil and pulley, remove pulley. Disconnect clutch coil wiring harness. Remove snap ring and clutch coil.

Installation

Install clutch coil with wire facing downward. Use new snap ring. Ensure snap ring is installed with beveled side facing out and fully seated in snap ring groove. Install pulley using Pulley Driver (33-1-020) and plastic hammer. Install shims and clutch plate and

shaft bolt. Ensure air gap between clutch plate and pulley is 0.020-0.031" (0.50-0.80 mm). If air gap is incorrect, add or remove shim(s) as necessary.

Removal (Suzuki)

1) Remove compressor shaft bolt and washer, while holding clutch plate with Clutch Holder (09991-06020). Remove clutch plate using Clutch Plate Remover (09991-06030). Remove shim(s) and felt ring. See Fig. 14.

2) Remove pulley snap ring. Install a 2-jaw puller to outer diameter of pulley and remove pulley. DO NOT engage puller on belt area. Hold puller in place and tighten screw to remove pulley. Disconnect clutch coil lead from compressor housing. Remove clutch coil snap ring and clutch coil.

Installation

1) To install, reverse removal procedure. Align lug on clutch coil with hole in front housing of compressor. Install snap ring with chamfered side facing out. Connect clutch coil lead to compressor housing. Install felt ring and shim(s). See Fig. 14.

2) Position pulley squarely over coil. Ensure compressor boss and inside area of pulley bearing are clean and free of foreign material. Using Pulley Installer (09991-06010), press pulley onto compressor boss. Install pulley snap ring.

3) Install clutch plate. Using feeler gauge, ensure air gap between clutch plate and pulley is 0.012-0.020" (0.30-0.50 mm). If air gap is incorrect, add or remove shim(s) as necessary. Hold clutch plate and tighten NEW compressor shaft bolt to 10 ft. lbs. (13 N.m).

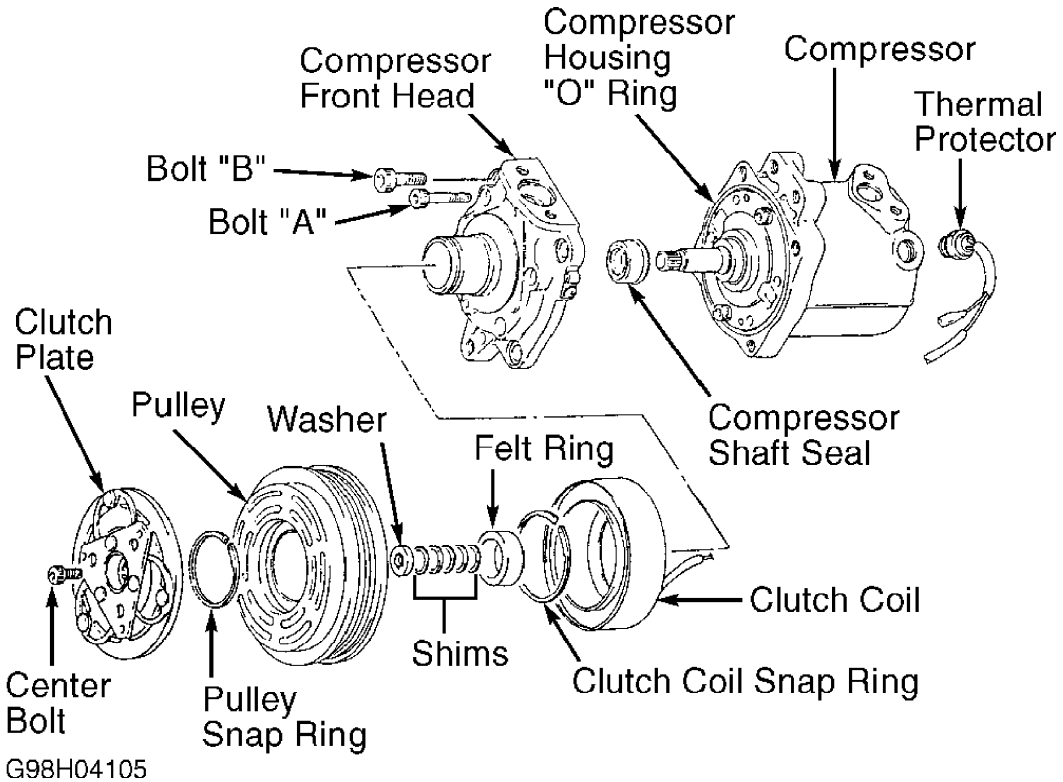


Fig. 14: Exploded View Of Compressor (Seiko-Seiki Rotary Vane) Courtesy of Suzuki of America, Corp.

SHAFT SEAL

NOTE: BMW does not provide compressor shaft seal replacement procedure. If shaft seal oil leak is excessive and/or refrigerant is leaking, compressor must be replaced. A small amount of refrigerant oil leakage from compressor shaft seal is normal.

Removal (Suzuki)

Remove clutch plate, pulley and clutch coil. See CLUTCH COIL. Remove 8 compressor front head bolts. Push on compressor shaft while pulling on front head, using care not to remove cylinder from compressor housing. Remove compressor shaft seal from front head. See Fig. 14.

Installation

1) Using refrigerant oil, lubricate shaft seal lips and outer "O" ring. Using Seal Remover/Installer (09991-06050) and hand pressure, install shaft seal into front head with shaft seal "O" ring toward compressor. Using refrigerant oil, lubricate Shaft Seal Protector (09991-06040) and install over compressor shaft.

2) Install compressor housing "O" ring to compressor housing. Align compressor front head with compressor housing and install. Tighten front head bolts "A" first and then front head bolts "B" in a crisscross pattern. See Fig. 14. Tighten bolts "A" to 10 ft. lbs. (13 N.m) and bolts "B" to 17 ft. lbs. (23 N.m). Remove shaft seal protector. To complete installation, reverse removal procedure.

ZEXEL ROTARY VANE

CLUTCH COIL & BEARING

NOTE: Subaru recommends replacing compressor as an assembly if there is a clutch or compressor shaft seal failure.

Removal (Honda, Isuzu & Kia)

1) Using clutch disc/plate holder, remove clutch disc/plate bolt. Using puller and forcing screw, remove clutch disc/plate. See Fig. 15 or 16.

2) Remove shim(s) and snap ring. On DKV-14D compressor, use pulley puller pilot to protect compressor shaft. On all models, use a puller to remove pulley. Remove screw for clutch coil lead. Remove 3 clutch coil screws and clutch coil.

Installation

1) To install, reverse removal procedure. Align clutch coil pin with hole in front head of compressor and install clutch coil. Tighten clutch coil screws to 44 INCH lbs. (5 N.m). Using pulley installer and drive handle, tap pulley onto compressor. On all models, install new snap ring.

2) On DKV-14D compressor, tighten clutch plate bolt to 113 INCH lbs. (13 N.m) Using feeler gauge, ensure air gap between clutch plate and pulley is 0.012-0.024" (0.30-0.60 mm). If air gap is incorrect, add or remove shim(s) as necessary.

NOTE: On Kia, shaft seal servicing procedure is not available from manufacturer.

Removal (Nissan)

1) Hold clutch disc using clutch disc holder and remove center bolt. Using Clutch Disc Puller (J-38874), remove clutch disc and adjustment shim(s).

2) Remove snap ring. Remove pulley using Pilot (J-39023) and universal 2-jaw puller. Position puller jaws onto edge of pulley to

prevent pulley groove from being deformed. Remove clutch coil lead, 3 clutch coil retaining screws, and clutch coil. See Fig. 15 or 16.

Installation

1) Ensure clutch disc and pulley contact surfaces are clean and free of excessive grooving and/or excessive heat damage. Check clutch coil for loose connection or cracked insulation. Replace components as necessary. Replace clutch disc and pulley assembly as a set.

2) Align pin in clutch coil with hole in front head of compressor. Ensure coil lead is installed in original position. Install and tighten coil screws. Press pulley onto compressor using Pulley Installer (J-39024) and a hand press. Install pulley snap ring and adjustment shim(s).

3) Install clutch disc and tighten center bolt to 9-11 ft. lbs. (11-15 N.m). Ensure pulley rotates freely. Using a feeler gauge, ensure air gap between clutch disc and pulley is 0.012-0.024" (0.30-0.61 mm). If air gap is not as specified, add or remove shim(s) as necessary.

4) Install compressor and any other components. Evacuate and charge A/C system. Operate A/C system and break-in clutch disc and pulley assembly by engaging and disengaging clutch 30 times during engine operation.

NOTE: Compressor shaft seal servicing procedure is not available from manufacturer. If removed, tighten thermal protector to 11-13 ft. lbs. (15-18 N.m).

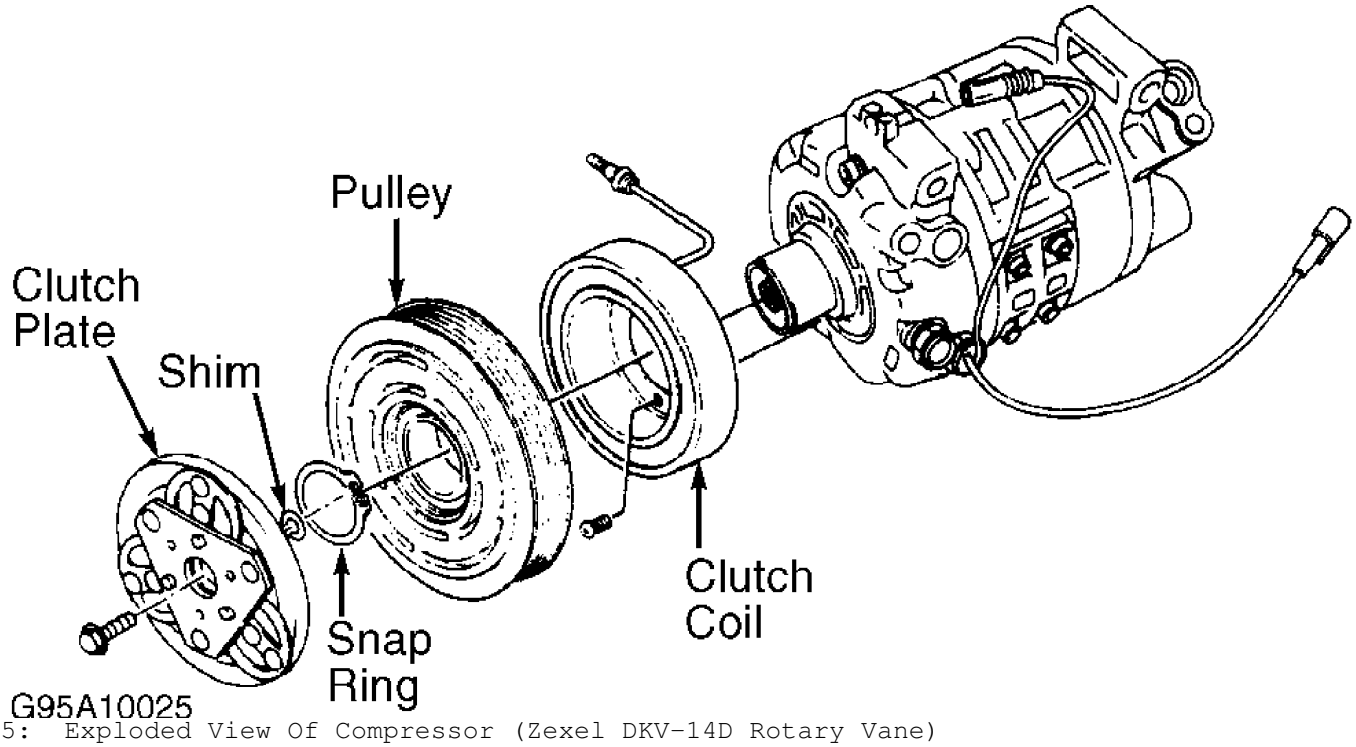


Fig. 15: Exploded View Of Compressor (Zexel DKV-14D Rotary Vane) Courtesy of Isuzu Motor Co.

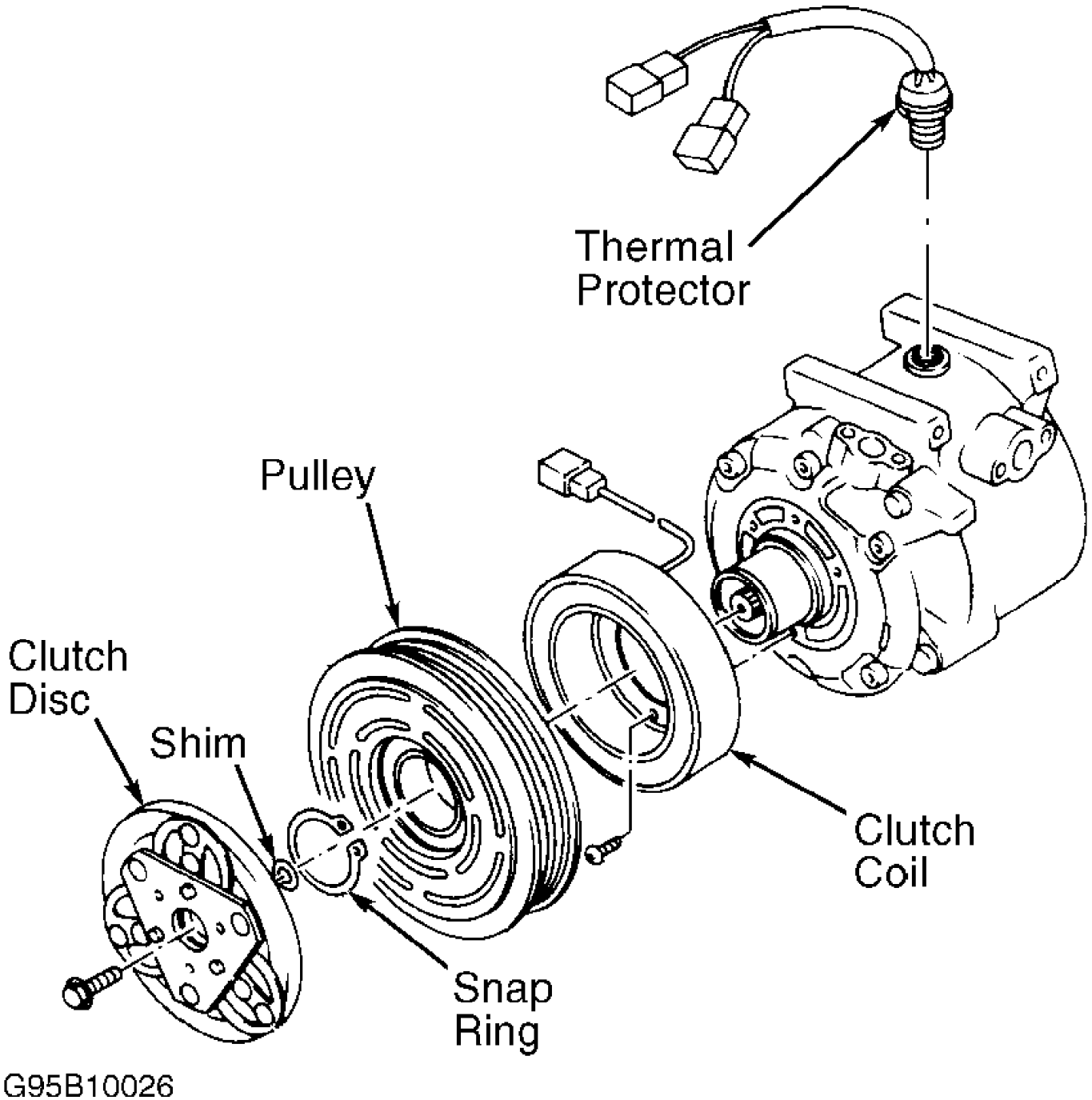


Fig. 16: Exploded View Of Compressor (Zexel DKV-14C Rotary Vane)
Courtesy of Nissan Motor Co., U.S.A.

ZEXEL 6-CYLINDER

CLUTCH COIL & BEARING

NOTE: Subaru recommends replacing compressor as an assembly if there is a clutch coil, pulley bearing or compressor shaft seal failure.

Removal (Audi & Volkswagen)

1) Using Spanner Wrench (44-4), hold clutch plate stationary and remove compressor shaft bolt. Remove clutch plate and shim(s) using Puller (VAG 1719) and Spanner Wrench (3212). See Fig. 17. Remove pulley snap ring.

2) Place Spacer (VAG 1719/1) onto pulley hub. Attach 2-Jaw Puller (US 1078) to outer diameter of pulley and remove pulley. Remove snap ring, bearing, and clutch coil as necessary.

Installation

Ensure clutch coil lug fits into hole on compressor housing. Using Installer (VAG 1719/2) and a plastic hammer, press pulley on and install snap ring. Install shim(s) and clutch plate. Tighten compressor shaft bolt to 11 ft. lbs. (15 N.m). Using a feeler gauge, ensure air gap between pulley and clutch plate is 0.012-0.024" (0.30-0.61 mm). If air gap is incorrect, add or remove shim(s) as necessary.

Removal (Volvo)

1) Using Clutch Plate Holder (999-5596-5), hold clutch plate stationary and remove compressor shaft nut. Remove clutch plate and shim(s) using Puller (999-5597-3). Keep shims in the order in which they were removed. See Fig. 17.

2) Remove pulley snap ring. Using Puller (999-5598-1) and Adapter (999-5599-3 or 999-5618-7), remove pulley. Mark position of clutch coil for installation. Disconnect electrical lead. Remove clutch coil snap ring and clutch coil, as necessary.

Installation

1) Install clutch coil and snap ring. Ensure clutch coil electrical lead is properly positioned on compressor housing. Position pulley on compressor. Using Puller (999-5598-1) and Adapter (999-5519-5 or 999-5600-5), press pulley onto compressor and install snap ring.

2) Install shims in reverse order of removal and clutch plate. Hold clutch plate stationary and tighten compressor shaft nut to 11 ft. lbs. (15 N.m). Using a feeler gauge, ensure air gap between pulley and clutch plate is 0.012-0.020" (0.30-0.50 mm). If air gap is incorrect, add or remove shims as necessary.

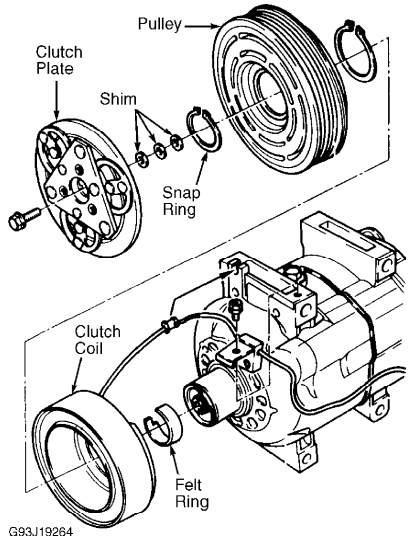


Fig. 17: Exploded View Of Compressor (Zexel 6-Cylinder - Audi Shown; Volvo Is Similar)
Courtesy of Audi of America, Inc.

A/C SYSTEM GENERAL SERVICING

1999 Lexus RX 300

1999 GENERAL SERVICING
A/C System General Servicing
GEN. SERVICING

All Models

USING R-12 & R-134a REFRIGERANT

HANDLING/SAFETY PRECAUTIONS

1) Always work in a well-ventilated, clean area. Avoid breathing refrigerant vapors. Exposure may irritate eyes, nose and throat. Refrigerant is colorless and is invisible as a gas. Refrigerant is heavier than oxygen and will displace oxygen in a confined area.

2) The A/C system high pressure can cause severe injury to eyes and skin if a hose were to burst. Always wear eye protection, gloves and other protective clothing when working around A/C system and refrigerant.

3) Refrigerant evaporates quickly when exposed to atmosphere, freezing anything it contacts. If liquid refrigerant contacts eyes or skin (frostbite), DO NOT rub eyes or skin. Immediately flush affected area with cool water for 15 minutes and consult a doctor or hospital.

4) Never use R-134a in combination with compressed air for leak testing. Pressurized R-134a in the presence of oxygen (air concentrations greater than 60 percent by volume) may form a combustible mixture. DO NOT introduce compressed air into R-134a containers (full or empty), A/C system components or service equipment.

5) DO NOT expose A/C system components to high temperatures, steam cleaning for example, as excessive heat will cause refrigerant/system pressure to increase. Never expose refrigerant directly to open flame. If refrigerant needs to be warmed, place bottom of refrigerant tank in warm water. Water temperature MUST NOT exceed 125°F (52°C).

CAUTION: When R-134a is exposed to an open flame, drawn into engine, or detected with a Halide (propane) leak tester, a poisonous gas is formed. Keep work areas well ventilated.

6) Use care when handling refrigerant containers. DO NOT drop, strike, puncture or incinerate containers. Use Department Of Transportation (DOT) approved, DOT 4BW or DOT 4BA refrigerant containers.

7) Never overfill refrigerant containers. The safe filling level of a refrigerant container MUST NOT exceed 60 percent of the container's gross weight rating. Store refrigerant containers at temperature less than 125°F (52°C).

8) R-134a refrigerant is sold and stored in 30- or 50-pound Light Blue containers, while Freon (R-12) is stored in White colored containers.

9) Refrigerant R-12 and R-134a must never be mixed, as they and their desiccants and lubricants are not compatible. If refrigerants are mixed, system cross-contamination or A/C system component failure may occur. Always use separate servicing and refrigerant recovery/recycling equipment.

10) Follow equipment manufacturer instructions of all service equipment to be used. The Material Safety Data Sheet (MSDS), provided by refrigerant manufacturer/suppliers, contains valuable information

regarding the safe handling of refrigerants.

11) Before connecting refrigerant lines always lubricate "O" rings with refrigerant oil.

12) Always plug or cap A/C system refrigerant lines and component connections as soon as possible to protect components from moisture and/or dust. DO NOT remove plugs or caps until ready to install component.

13) Always use a back-up wrench when tightening or loosening fittings.

IDENTIFYING R-134a SYSTEMS & COMPONENTS

To prevent refrigerant cross-contamination, use the following methods to identify R-134a based systems and components.

Fittings & "O" Rings

All R-134a based A/C systems use 1/2" - 16 ACME threaded fittings (identifiable by square threads) and quick-connect service couplings. See Fig. 1. Besides the use of these fittings, most manufacturers will use Green colored "O" rings in R-134a systems.

Underhood A/C Specification Labels

Most R-134a based systems will be identified through the use of underhood labels, or with R-134a refrigerant clearly printed on labels. See Figs. 2 and 3. Labels may be located on underside of hood, compressor, firewall and/or strut supports. The underhood label used on Ford Motor Co. vehicles is Yellow. Before servicing an A/C system, always determine which refrigerant is being used.

Other Means Of Identification

Refrigerant R-134a, when viewed through a sight glass, may have a "milky" appearance due to the mixture of refrigerant and lubricating oil. As the refrigerant and oil DO NOT exhibit a "clear" sight glass on a properly charged A/C system, most R-134a systems have no sight glass.

Audi, Mercedes-Benz and Volkswagen use Green bands/labels on condenser, refrigerant lines, receiver-drier and expansion valve. On Lexus A/C systems, hoses and line connectors have a groove, a White line and "R-134a" marked on them. See Fig. 4.

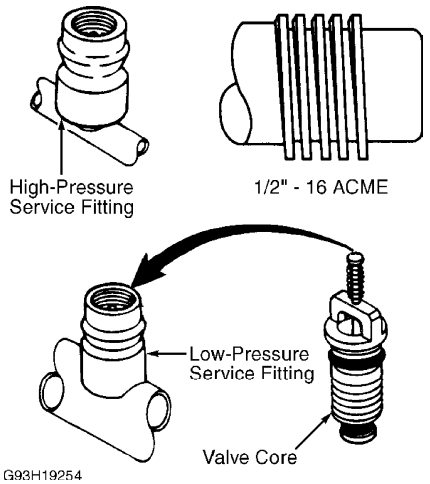


Fig. 1: Identifying R-134a Fittings & Quick-Connect Service Couplings
Courtesy of Audi of America, Inc.

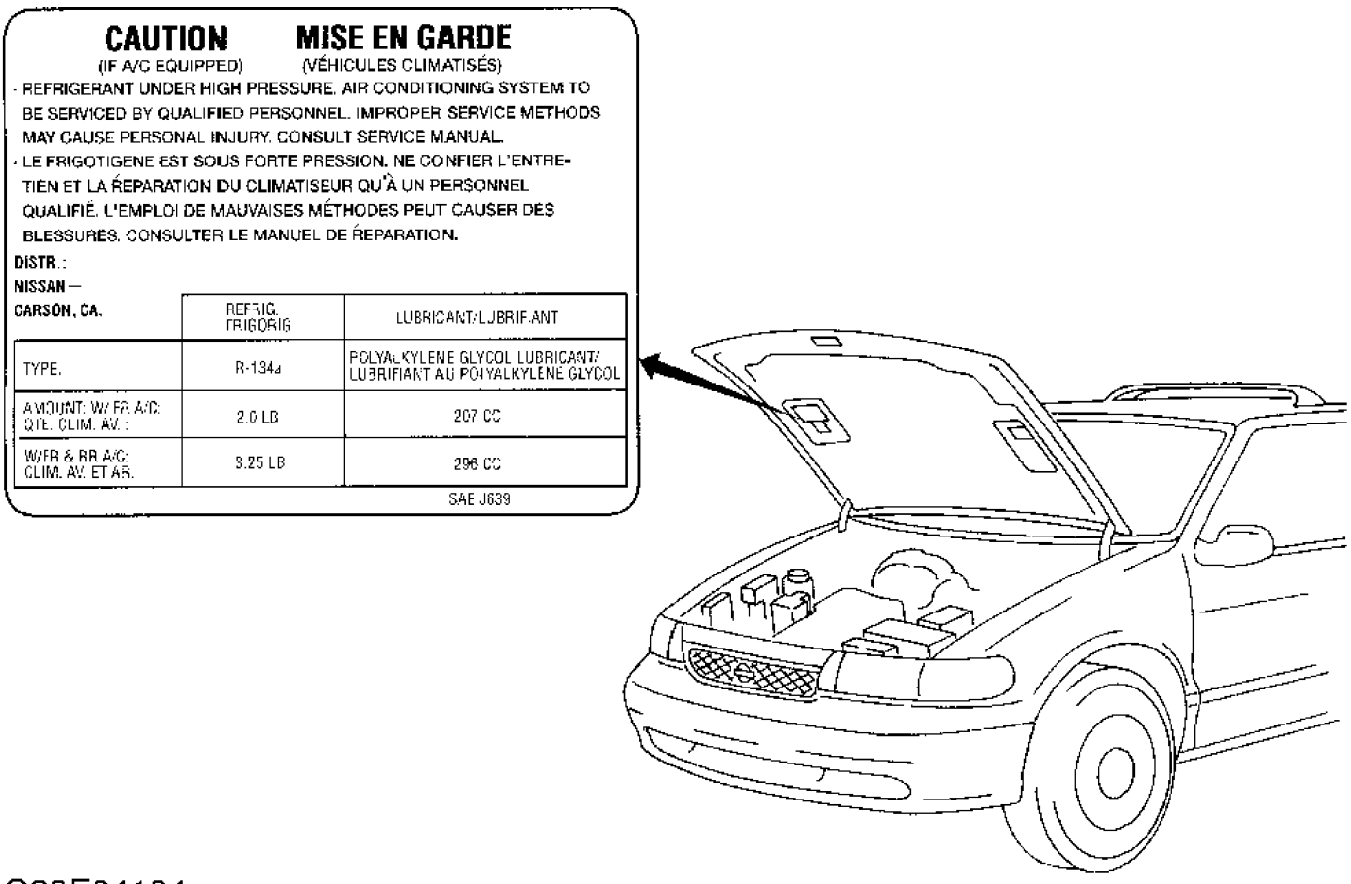


Fig. 2: Underhood A/C Specification Label (Typical)
Courtesy of Nissan Motor Co., U.S.A.

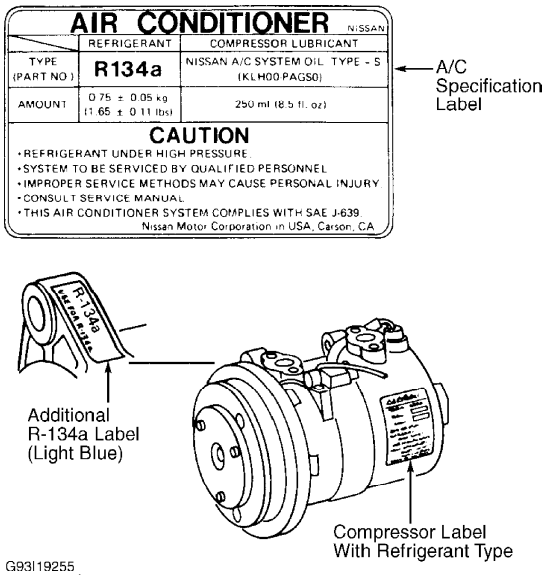


Fig. 3: A/C Specification Labels Located On Compressor (Typical)
Courtesy of Nissan Motor Co., U.S.A.

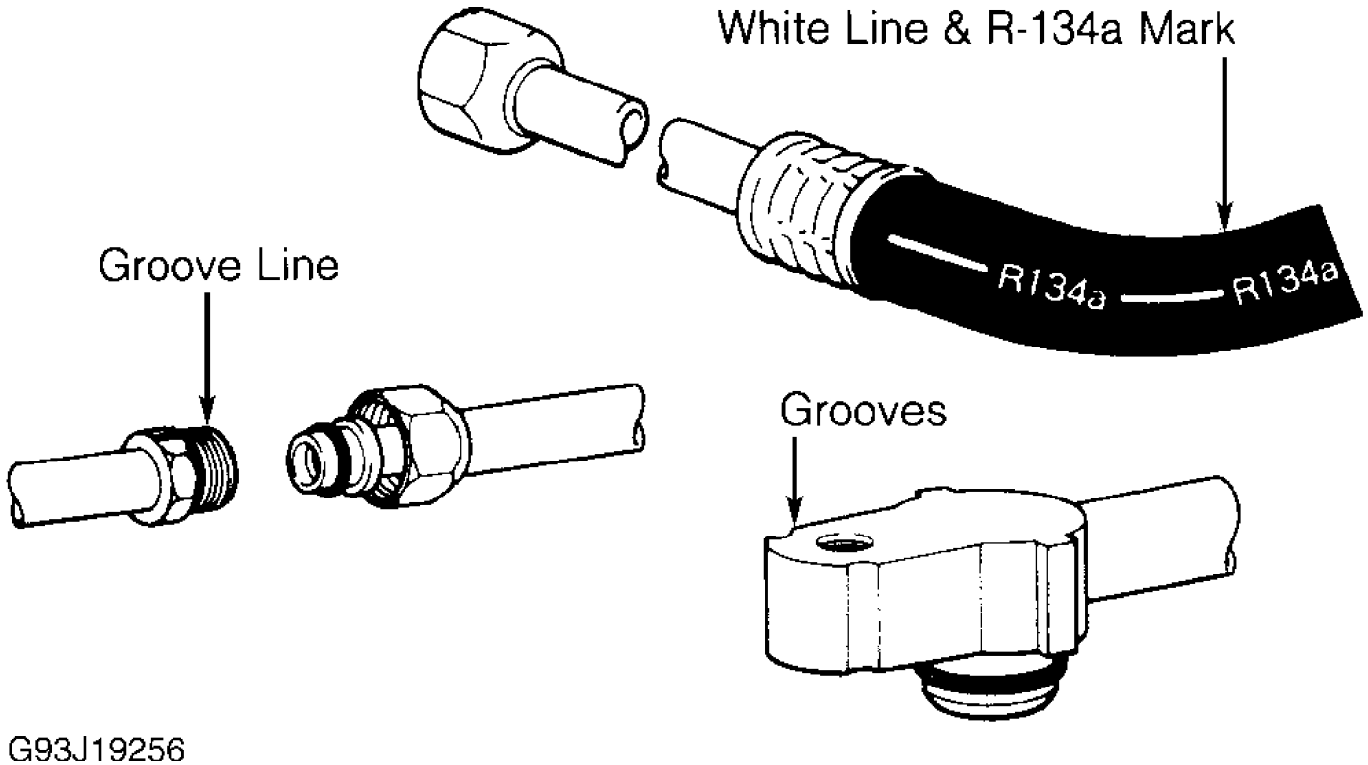


Fig. 4: Identifying R-134a Hose & Line Connectors (Lexus)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REFRIGERANT OILS

NOTE: PAG oils absorb moisture very rapidly, 2.3-5.6 percent by weight, as compared to a mineral oil absorption rate of 0.005 percent by weight.

Use ONLY the specified oil for the appropriate system or A/C compressor. Always check vehicle underhood A/C specification label or A/C compressor label before adding refrigerant oil to A/C compressor/system. See Figs. 2 and 3. Always use refrigerant oil specified on vehicle underhood A/C specification label if different from the following list:

Acura
Use DENSO ND-Oil 8 (Part No. 38897-PR7-A01).

Audi
Use SP-10 PAG oil (Part No. G 052 300 A2) on Nippondenso compressors and SP-10 PAG oil (Part No. G 052 154 A2) on Zexel compressors.

BMW
Use Polyalkylene Glycol Oil (Part No. 81-22-9-407-724).

Honda
On Harrison HD6/HT6 compressor, use PAG oil specified on underhood A/C specification label or A/C compressor label. On Keihin compressor, use SP-10 Oil (Part No. 38897-P13-A01AH). On Nippondenso compressor, use DENSO ND-Oil 8 (Part No. 38897-PR7-A01AH or 38899-PR7-A01). On Zexel DKV-14D compressor, use AIPDN Oil (Part No. 2-90188-301-0).

Hyundai
Use Daphne Hermetic FD46XG PAG oil.

Infiniti & Nissan
Use Type "F" Refrigerant Oil (Part No. KLH00-PAGQU) on Ford compressors. Use Type "R" Refrigerant Oil (Part No. KLH00-PAGR0) with Zexel rotary vane compressors. Use Type "S" Refrigerant Oil (Part No. KLH00-PAGS0) with Calsonic V6 compressors.

Isuzu
On Harrison compressors use PAG oil specified on underhood A/C specification label or A/C compressor label. On Nippondenso compressor, use DENSO ND-Oil 8 (Part No. 38897-PR7-A01AH). On Zexel DKS-17CH compressor, use PAG Oil (Part No. 2-90188-300-0). On Zexel DKV-14D compressor, use AIPDN Oil (Part No. 2-90188-301-0).

Jaguar
Use specified PAG refrigerant oil. See underhood A/C specification label and/or A/C compressor label.

Kia
On Sportage, use ZXL-200 PG PAG oil. Check underhood A/C specification label and/or A/C compressor label.

Land Rover
Use ND-Oil 8 refrigerant oil. Check underhood A/C specification label and/or A/C compressor label.

Lexus & Toyota
Use ND-Oil 8 refrigerant oil (Part No. 38899-PR7-003 or 08885-09109). Check underhood A/C specification label and/or A/C compressor label.

Mazda
Use ATMOS GU-10, DENSO OIL-9, ND-Oil 8, SP-10 or SP-20 PAG refrigerant oil. Use SUN ISCO 5GS on Ford FS-10 compressors. Check underhood A/C specification label and/or A/C compressor label.

Mercedes-Benz
Use PAG oil (Part No. 001 989 08 03). Check underhood A/C specification label and/or A/C compressor label.

Mitsubishi
Use DENSO/ND-Oil 8 refrigerant oil on Nippondenso compressors. Use SUN PAG 56 refrigerant oil on Sanden compressors.

Porsche
Use ND-Oil 8 refrigerant oil. Check underhood A/C specification label and/or A/C compressor label.

Saab
Use ND8 SK-20 refrigerant oil. Check underhood A/C specification label and/or A/C compressor label.

Subaru
Use ZXL200PG (DH-PR) type "R" (Part No. K0010FS100) refrigerant oil. Check underhood A/C specification label and/or A/C compressor label.

Suzuki
Use PAG oil. Check underhood A/C specification label and/or A/C compressor label.

Volkswagen

On Nippondenso compressors, use PAG Oil (Part No. G052 300 A2). On Sanden compressors, use SP-10 PAG Oil (Part No. G052 154 A2). On Zexel compressors, use PAG Oil (Part No. G052 154 A2 or G052 200 A2).

Volvo

Use PAG Oil (Part No. 11 61 407-0) on Zexel compressors. Check underhood A/C specification label and/or A/C compressor label.

SERVICE EQUIPMENT

A/C systems using R-134a refrigerant and PAG lubricants cannot use R-12 refrigerant or mineral oil lubricants. R-134a refrigerant is NOT compatible or interchangeable with R-12 refrigerant. Separate sets of hoses, manifold gauge sets and recovery/recycling equipment are required to service the different systems. This is necessary to avoid cross-contaminating and damaging A/C system. A single set of A/C service equipment cannot be cleaned thoroughly enough to be used with both types of refrigerant.

All equipment used to service A/C systems using R-134a must be U.L. listed and certified to meet SAE standard J2210. The service hoses on the manifold gauge set must have manual (turn wheel) or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

For identification purposes, R-134a service hoses must have a Black stripe along its length and be clearly labeled SAE J2196/R-134a. The low pressure test hose is Blue with a Black stripe. The high pressure test hose is Red with a Black stripe, and the center test hose is Yellow with a Black stripe.

R-134a manifold gauge sets can be identified by one or all of the following: Labeled FOR USE WITH R-134a on set, labeled HFC-134a or R-134a on gauge face, or by a Light Blue color on gauge face. In addition, pressure/temperature scales on R-134a gauge sets are different from R-12 manifold gauge sets.

SYSTEM SERVICE VALVES

SCHRADER-TYPE VALVES

NOTE: Although similar in construction and operation to a tire valve, NEVER replace a Schrader-type valve with a tire valve.

Schrader valve is similar in construction and operation to a tire valve. When a test gauge hose with built-in valve core depressor is attached, Schrader stem is pushed inward to the open position and allows system pressure to reach gauge.

If test hose does not have a built-in core depressor, an adapter must be used. Never attach hose or adapter to Schrader valve unless it is first connected to manifold gauge set.

Refrigerant R-12 Schrader-type valve cores have TV5 thread size. Refrigerant R-134a Schrader-type valve cores use M6 (Metric) threads. See Fig. 1.

SERVICE VALVE LOCATIONS

SERVICE VALVE LOCATIONS

Vehicle	High	Low
Acura		

Integra	(1)		(2)
SLX	(3)		(4)
2.3CL	(3)		(4)
3.0CL	(1)		(4)
3.2TL	(1)		(4)
3.5RL	(6)		(4)
Audi			
Except A8	(7)		(7)
A8	(16)		(4)
BMW	(8)		(9)
Honda			
Accord	(1)		(4)
Civic	(10)		(10)
CR-V	(11)		(2)
Odyssey	(10)		(10)
Passport	(12)		(13)
Prelude	(1)		(2)
Hyundai			
Accent	(3)		(5)
Elantra	(14)		(4)
Sonata	(14)		(4)
Tiburon	(14)		(4)
Infiniti	(14)		(4)
Isuzu			
Amigo & Rodeo	(12)		(13)
Hombre	(3)		(4)
Oasis	(10)		(10)
Trooper	(3)		(4)
Vehi-Cross	(11)		(13)
Jaguar	(6)		(4)
Kia	(3)		(4)
Land Rover			
Discovery	(3)		(4)
Range Rover	(8)		(4)
Lexus			
ES300, GS300, GS400, SC300 & SC400	(16)		(4)
LS400	(6)		(4)
LX470	(10)		(4)
RX300	(16)		(8)
Mazda			
B2300, B3000 & B4000	(14)		(6)
Miata	(8)		(4)
Millenia	(14)		(4)
Protege	(3)		(4)
626	(15)		(4)
Mercedes-Benz	(16)		(6)
Mitsubishi			
Diamante	(3)		(4)
Eclipse	(3)		(4)
Galant	(3)		(4)
Mirage	(3)		(4)
Montero	(6)		(6)
Montero Sport	(3)		(4)
3000GT	(1)		(4)
Nissan			
Altima	(3)		(4)
Frontier	(14)		(4)
Maxima	(14)		(4)
Pathfinder	(14)		(4)
Quest	(11)		(17)
Sentra & 200SX	(3)		(4)
Porsche			

Boxster	(8)	(9)
911	(8)	(9)
Saab	(6)	(2)
Subaru	(18)	(18)
Suzuki		
Esteem	(14)	(4)
Vitara & Grand Vitara	(6)	(2)
Swift	(3)	(4)
Toyota		
Avalon	(1)	(4)
Camry, Camry Solara & Celica	(16)	(4)
Corolla	(14)	(4)
Land Cruiser	(10)	(4)
RAV4	(10)	(13)
Sienna	(6)	(2)
Tacoma	(7)	(7)
4Runner	(16)	(7)
Volkswagen		
Except Beetle	(7)	(7)
Beetle	(20)	(20)
Volvo		
C70, S70 & V70	(19)	(19)
S80	(20)	(20)

(1) - On high pressure line, near receiver-drier.
(2) - On low pressure line, near top of condenser.
(3) - On high pressure line, between accumulator/receiver-drier and evaporator.
(4) - On low pressure line, between evaporator and compressor.
(5) - On low pressure line, near compressor.
(6) - On top of accumulator/receiver-drier.
(7) - On thin evaporator inlet (high pressure) line or thick outlet (low pressure) line.
(8) - On high pressure hose/line.
(9) - On low pressure hose/line.
(10) - On top of condenser, on right side.
(11) - On Honda CR-V, on high pressure outlet at compressor. See Fig. 5. On Honda Passport or Isuzu Rodeo, on high pressure (thin) line, at rear of engine compartment. See Fig. 6.
(12) - On high pressure outlet at compressor. On Honda CR-V, see Fig. 5.
(13) - On low pressure (thick) line, at rear of engine compartment.
(14) - On high pressure line, between compressor and condenser.
(15) - On high pressure hose/line between condenser and evaporator.
(16) - In front of condenser.
(17) - On low pressure line, between accumulator and compressor.
(18) - On high and low pressure lines, near compressor.
(19) - On low pressure line, near receiver-drier. Volvo uses only one service valve.
(20) - Information is not available from manufacturer.

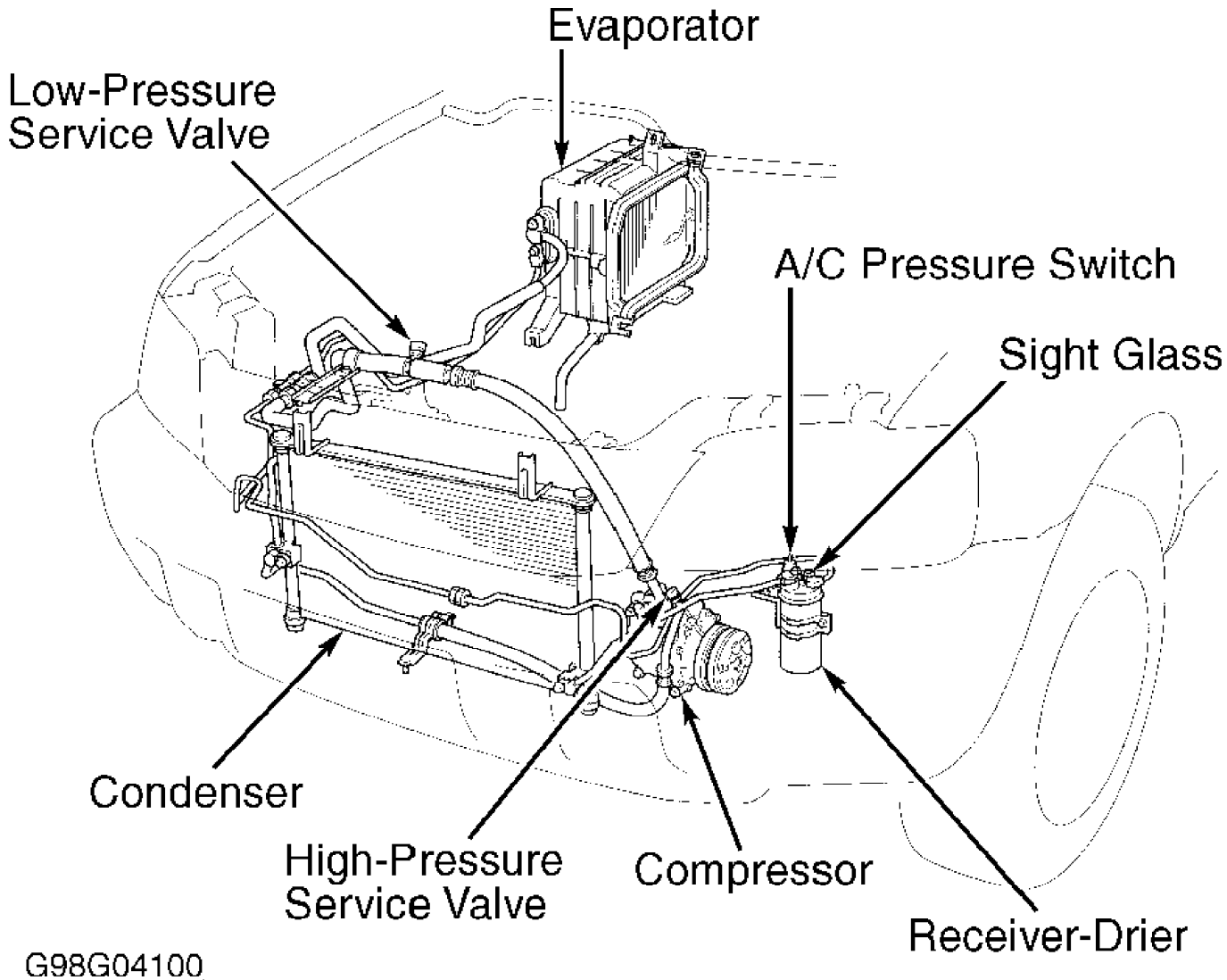
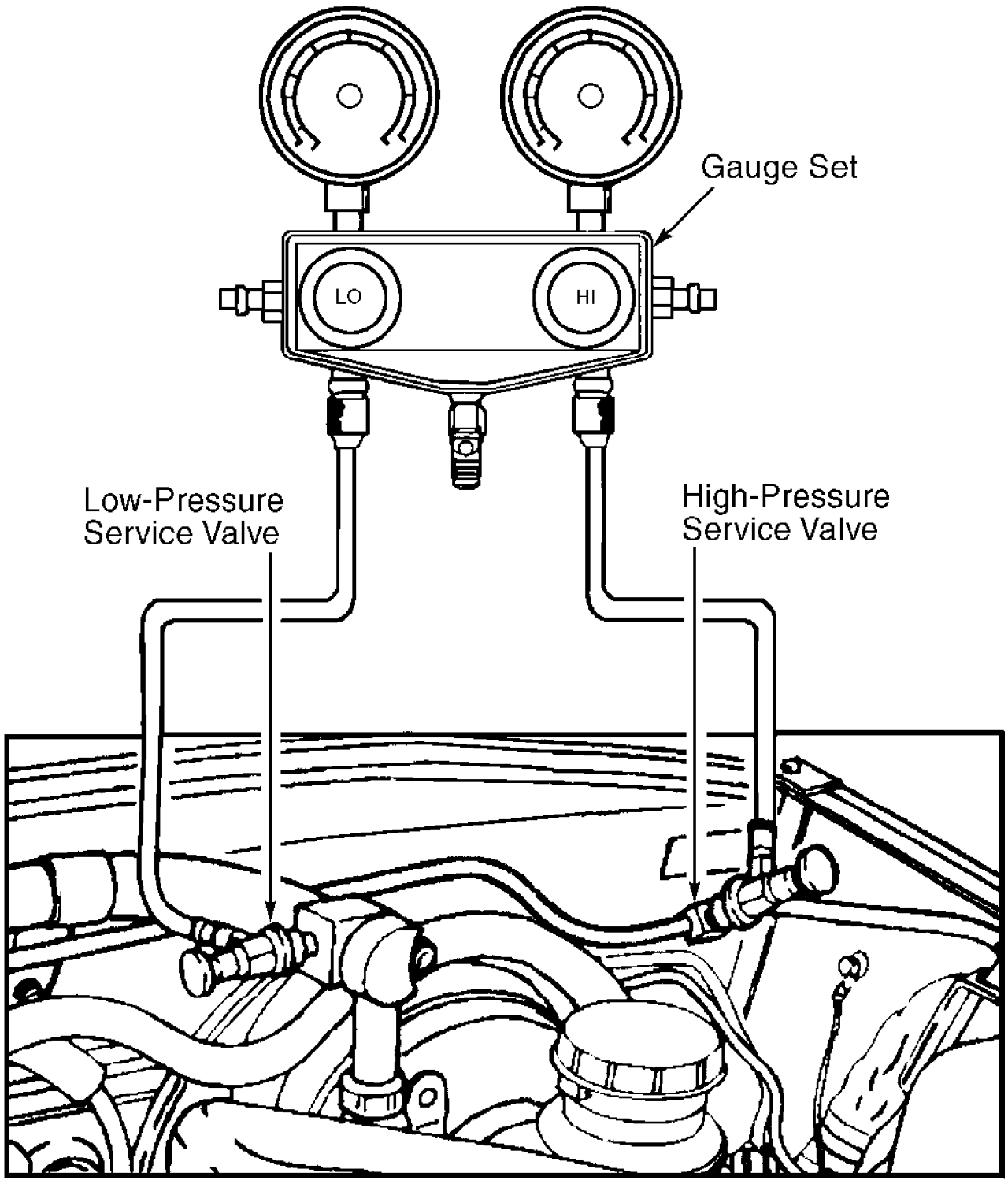


Fig. 5: Locating A/C System Components (CR-V)
Courtesy of American Honda Motor Co., Inc.



98I04101

Fig. 6: Locating Service Valves (Passport & Rodeo)
Courtesy of American Honda Motor Co., Inc.

REFRIGERANT RECOVERY/RECYCLING

Refrigerant recovery/recycling equipment is used to remove refrigerant from vehicle's A/C system without polluting atmosphere. To remove and recycle refrigerant, connect the recovery/recycling equipment and following the equipment manufacturer's instructions.

Removed refrigerant is filtered, dried and stored in a tank within the recovery/recycling equipment until it is ready to be pumped back into vehicle A/C system. With refrigerant stored in the recovery/recycling equipment, A/C system can be opened without polluting atmosphere.

NOTE: Separate sets of hoses, gauges and refrigerant recovery/recycling equipment MUST be used for R-12 and R-134a based systems. DO NOT mix R-12 and R-134a refrigerants, as their refrigerant oils and desiccants are not compatible. It is NOT possible to clean equipment thoroughly enough to prevent cross-contamination of A/C systems. On systems with R-134a refrigerant, use Polyalkylene Glycol (PAG) wax-free refrigerant oil.

* A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
A/C-Heater System Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

CONTENTS

Motorist Assurance Program (MAP)

OVERVIEW
OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

Heating, Ventilation and Air Conditioning

ACCUMULATORS
ACTUATORS (ELECTRICAL)
ACTUATORS (VACUUM)
AIR CONDITIONING FITTINGS
AIR CONDITIONING HOSES
AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES
AIR CONTROL DOORS
AIR DAMS (EXTERNAL)
AIR DISTRIBUTION SYSTEM
BELTS
BLEND DOORS
BLOWER FANS (BLOWER WHEEL OR SQUIRREL CAGE)
BLOWER MOTORS
BLOWER RESISTORS
BLOWER SWITCHES
CABIN AIR FILTERS
CIRCUIT BREAKERS
COMPRESSOR CLUTCH ASSEMBLIES
COMPRESSORS
CONDENSER AIR SEALS
CONDENSER FAN MOTORS
CONDENSERS
CONNECTORS
CONTROL CABLES
CONTROL HEADS (FUNCTION SELECTORS)
CONTROL LINKAGES
CONTROL MODULES
COOLANT
COOLING FAN BLADES
COOLING FAN CLUTCHES
COOLING FAN MOTORS
EVAPORATOR DRAIN TUBES
EVAPORATOR PRESSURE REGULATORS (EPRS)
EVAPORATORS
EXPANSION VALVES
FUNCTION SELECTORS
FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS
FUSIBLE LINKS
GASKETS
HEATER CASES
HEATER CONTROL VALVES
HEATER CORES

HEATER HOSES
HIGH PRESSURE RELIEF VALVES (HPRV)
IDLERS
IN-LINE FILTERS
METAL FITTINGS
METAL LINES
MIX AND AIR CONTROL DOORS (BLEND DOORS)
O-RINGS
ORIFICE TUBES
PILOT-OPERATED ABSOLUTES (POAS)
PLENUMS
PRESSURE CONTROL VALVES
PRESSURE SENSORS
PULLEYS
RADIATORS
RECEIVER-DRIERS
REFRIGERANT
REFRIGERANT OIL
RELAYS
SEALS
SERVICE PORTS
SPRING LOCK COUPLINGS
SUCTION THROTTLING VALVES (STVS)
SWITCHES (ELECTRICAL)
TENSIONERS
THERMISTORS AND PRESSURE SENSORS
THERMOSTATS AND HOUSINGS
VACUUM HOSES AND TUBES
VACUUM RESERVOIRS
VACUUM TUBES
VALVES IN RECEIVER (VIRS)
WATER PUMPS (ELECTRIC AUXILIARY)
WIRING HARNESSES AND CONNECTORS

MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW

The Motorist Assurance Program is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems. Further, revisions to all of these inspection communication standards

are continually republished. In addition to these, standards for Drive Train and Transmissions have recently been promulgated. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through MAP/BBB-CARE and other non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October, 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UICS in communicating the results of their inspection to their customers. To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing method has been incorporated which includes the "mystery shopping" of outlets.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW Suite 700
Washington, DC 20005
Phone (202) 712-9042 Fax (202) 216-9646
January 1999

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience,

or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

Example:
An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

Example:
A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

Example:
An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

Example:
The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial

service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 - Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

HEATING, VENTILATION, AND AIR CONDITIONING

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

CAUTION: Before working on any air conditioning system, be sure to review current local, state, federal, and EPA regulations regarding charging, recycling, and disposal of refrigerant.

ACCUMULATORS

ACCUMULATOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Beyond vehicle manufacturer's service interval	3	Suggest replacement.
Dessicant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement.
Dessicant bag deteriorated	A	(1) Require replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Tubing connection leaking	A	Require repair or replacement.

(1) - Inspect system to determine effects of dessicant bag deterioration.

ACTUATORS (ELECTRICAL)

ACTUATOR (ELECTRICAL) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	1	(1) Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	1	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

ACTUATORS (VACUUM)

ACTUATOR (VACUUM) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of

			hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted, affecting performance	A	.....	(1) Require repair or replacement.
Connector melted, not affecting performance	2	.....	(1) Suggest repair or replacement.
Connector missing	C	.....	Require replacement.
Inoperative	A	.....	(2) Require replacement.
Leaking (vacuum)	A	..	Require repair or replacement.
Linkage bent, affecting performance	A	...	Require repair or replacement of linkage.
Linkage bent, not affecting performance	2	...	Suggest repair or replacement of linkage.
Linkage binding, affecting performance	A	...	Require repair or replacement of linkage.
Linkage binding, not affecting performance	1	...	Suggest repair or replacement of linkage.
Linkage broken	A	...	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	...	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	...	Suggest repair or replacement of linkage.
Linkage missing	C	.....	Require replacement.
Linkage noisy	2	..	Suggest repair or replacement.
Missing	C	.....	Require replacement.
Noisy	2	..	Suggest repair or replacement.
Out of adjustment	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

AIR CONDITIONING FITTINGS

See AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES.

AIR CONDITIONING HOSES

See AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES.

AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES

AIR CONDITIONING METAL LINE, HOSE AND FITTING ASSEMBLY INSPECTION

Condition	Code	Procedure

Abrasion damage, affecting structural integrity	A	Require repair or replacement.
Abrasion damage, not affecting structural integrity		No service suggested or required.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Clamp corroded, not reusable	1	Suggest replacement.
Connected incorrectly	A	Require repair.
Corroded, affecting structural integrity	A	Require replacement.
Corroded, not affecting structural integrity		No service suggested or required.
Cracked	A	Require repair or replacement.
Fitting type incorrect (such as compression fitting)	B	Require replacement.
Flange leaking	A	Require repair or replacement.
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Melted	1	Suggest repair or replacement.
Missing	C	Require replacement.
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement.
Protective sleeves damaged	2	Suggest replacement of sleeves.
Protective sleeves missing	C	Require replacement of sleeves.
Restricted, affecting performance	A	Require repair or replacement.
Routed incorrectly	2	Require repair.
Swollen	1	Suggest replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Type incorrect	1	Suggest repair or replacement.

AIR CONTROL DOORS

See PLENUMS.

AIR DAMS (EXTERNAL)

AIR DAM (EXTERNAL) INSPECTION

Condition	Code	Procedure

Application incorrect, affecting air conditioning system performance	A	..	Require repair or replacement.
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Bent, affecting air conditioning system performance	A	..	Require repair or replacement.
Blocked, affecting air conditioning system performance	A	..	Require repair or replacement.
Broken, affecting air conditioning system performance	A	..	Require repair or replacement.
Cracked, affecting air conditioning system performance	A	..	Require repair or replacement.
Loose, affecting air conditioning system performance	A	.....	Require repair.
Loose, not affecting air conditioning system performance	2	.....	Suggest repair.
Missing, affecting air conditioning system performance	C	.....	Require replacement.

AIR DISTRIBUTION SYSTEM

See PLENUMS.

BELTS

BELT INSPECTION

Condition	Code		Procedure
Alignment incorrect	B	.....	(1) Further inspection required.
Cracked	1	.....	Suggest replacement.
Frayed	1	.....	Suggest replacement.
Missing	C	.....	Require replacement.
Noisy	2	.....	(2) Further inspection required.
Plies separated	A	.....	Require replacement.
Serpentine belt routed incorrectly	B	.....	Require repair.
Tension out of specification	B	.....	Require adjustment or replacement.
Worn beyond adjustment range	B	.....	Require replacement.

Condition	Code	Procedure
Worn so it contacts bottom of pulley	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.

BLEND DOORS

See PLENUMS.

BLOWER FANS (BLOWER WHEEL OR SQUIRREL CAGE)

BLOWER FAN (BLOWER WHEEL OR SQUIRREL CAGE) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Application incorrect	B	Require repair or replacement.
Broken	A	Require replacement.
Cracked	A	Require replacement
Distorted	A	Require replacement.
Fins missing	C	Require replacement.
Hub separated	A	Require replacement.
Inoperative	A	(1) Require replacement.
Mounting loose	A	Require repair or replacement.
Noisy	2	Suggest replacement.
Out of balance	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

BLOWER MOTORS

BLOWER MOTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not		

affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Current draw out of specification	B	Require repair or replacement.
Inoperative	A	(2) Require replacement.
Missing	C	Require replacement.
Motor speed insufficient	2	Suggest repair or replacement.
Noisy	2	Suggest replacement.
Rotation incorrect for application	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Vibration	1	Suggest replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Check fan motor/controls. Inoperative includes intermittent operation or out of OEM specification.

BLOWER RESISTORS

BLOWER RESISTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Conductor exposed	A	Require replacement.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	1	(1) Suggest repair or replacement.

Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Insulation overheated	A	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

BLOWER SWITCHES

See SWITCHES.

CABIN AIR FILTERS

CABIN AIR FILTER INSPECTION

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement.
Maintenance intervals	3	Suggest replacement.
Missing	C	Require replacement.

CIRCUIT BREAKERS

See FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS.

COMPRESSOR CLUTCH ASSEMBLIES

COMPRESSOR CLUTCH ASSEMBLY INSPECTION

Condition	Code	Procedure
Air gap incorrect	B	Require repair or replacement.
Bearing seized	A	Require replacement of bearing or assembly.
Bearing worn, affecting performance	A	Require replacement of bearing or assembly.
Coil shows signs of overheating	1	Suggest replacement of coil.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted,		

affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Hub broken	A	Require replacement.
Hub cracked	B	Require replacement.
Hub loose on shaft	A	Require replacement.
Hub scored, affecting performance	A	Require replacement.
Hub warped, affecting performance	A	Require replacement.
Inoperative	A	(2) Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Slips	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Will not disengage	A	Require repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

COMPRESSORS

COMPRESSOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.

Bracket broken, affecting performance	A		Require replacement.
Bracket broken, not affecting performance			No service suggested or required.
Bracket corroded, affecting performance	A		Require repair or replacement.
Bracket corroded, not affecting performance	2		Suggest repair or replacement.
Bracket cracked, affecting performance	A		Require repair or replacement.
Bracket cracked, not affecting performance	1		Suggest repair or replacement.
Bracket holes elongated, affecting performance	A		Require repair or replacement.
Bracket holes elongated, not affecting performance			No service suggested or required.
Bracket loose, affecting performance	A		Require repair or replacement.
Bracket loose, not affecting performance	1		Suggest repair or replacement.
Bracket missing	C		Require replacement.
Housing broken, affecting performance	A		Require repair or replacement.
Housing broken, not affecting performance			No service suggested or required.
Housing cracked, affecting performance	A		Require repair or replacement.
Housing cracked, not affecting performance	1		Suggest repair or replacement.
Inoperative	A		(1) Require repair or replacement.
Leaking	A		Require repair or replacement.
Noisy	2		(2) Suggest repair or replacement.
Threads damaged	A		Require repair or replacement.
Threads stripped (threads missing)	A		Require replacement.
Tubing connection leaking	A		Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Compressor noise can also be caused by low oil level, state of charge, air contamination, or type of refrigerant.

CONDENSER AIR SEALS

CONDENSER AIR SEAL INSPECTION

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

CONDENSER FAN MOTORS

See COOLING FAN MOTORS.

CONDENSERS

CONDENSER INSPECTION

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement.
Abrasion damage, not affecting structural integrity		No service suggested or required.
Air flow obstruction, affecting performance	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent, affecting performance	A	Require repair or replacement.
Bent, not affecting performance		No service suggested or required.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance		No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	Require repair or replacement.
Bracket holes elongated, not affecting performance		No service suggested or required.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Corroded, not affecting structural integrity		No service suggested or

			required.
Fitting type incorrect (such as compression fitting)	B	.....	Require replacement.
Flange leaking	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Restricted internally	A	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

CONNECTORS

See WIRING HARNESSES AND CONNECTORS.

CONTROL CABLES

CONTROL CABLE INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Binding	A	..	Require repair or replacement.
Bracket bent, affecting performance	A	..	Require repair or replacement.
Bracket bent, not affecting performance	..	.....	No service suggested or required.
Bracket broken, affecting performance	A	.....	Require replacement.
Bracket broken, not affecting performance	..	.....	No service suggested or required.
Bracket corroded, affecting performance	A	..	Require repair or replacement.
Bracket corroded, not affecting performance	2	..	Suggest repair or replacement.
Bracket cracked, affecting performance	A	..	Require repair or replacement.
Bracket cracked, not affecting performance	1	..	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	..	Require repair or replacement.
Bracket holes elongated, not affecting performance	..	.....	No service suggested or required.
Bracket loose, affecting performance	A	..	Require repair or replacement.
Bracket loose, not affecting performance	1	..	Suggest repair or replacement.
Bracket missing	C	.....	Require replacement.
Broken	A	..	Require repair or replacement.
Cracked	2	..	Suggest repair or replacement.

Disconnected	A	..	Require repair or replacement.
Kinked	2	..	Suggest repair or replacement.
Melted	A	.....	(1) Require repair or replacement.
Missing	C	.....	Require replacement.
Out of adjustment	B	.....	(2) Require repair or replacement.
Routed incorrectly	2	.....	Suggest repair.
Seized	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.

CONTROL HEADS (FUNCTION SELECTORS)

CONTROL HEAD (FUNCTION SELECTOR) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Connector broken	A	.. Require repair or replacement.
Connector (Weatherpack type) leaking	A	.. Require repair or replacement.
Connector melted, affecting performance	A	..... (1) Require repair or replacement.
Connector melted, not affecting performance	2	..... (1) Suggest repair or replacement.
Connector missing	C	..... Require replacement.
Contaminated	2	.... Suggest require replacement.
Leaking	A	.. Require repair or replacement.
Malfunctioning	A	..... (2) Require repair or replacement.
Melted, affecting performance	A	..... (1) Require repair or replacement.
Melted, not affecting performance	..	..... No service suggested or required.
Terminal broken	A	.. Require repair or replacement.
Terminal burned, affecting performance	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance	A	.. Require repair or replacement.
Terminal corroded, not affecting performance	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.

Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Wire lead burned	A	..	Require repair or replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, or failure to perform all functions.

CONTROL LINKAGES

CONTROL LINKAGE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	.. Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	. Require repair or replacement of hardware.
Bent	A	. Require repair or replacement.
Binding	A	. Require repair or replacement.
Bracket bent, affecting performance	A	. Require repair or replacement.
Bracket bent, not affecting performance	..	..... No service suggested or required.
Bracket broken, affecting performance	A	..... Require replacement.
Bracket broken, not affecting performance	..	..... No service suggested or required.
Bracket corroded, affecting performance	A	. Require repair or replacement.
Bracket corroded, not affecting performance	2	. Suggest repair or replacement.
Bracket cracked, affecting performance	A	. Require repair or replacement.
Bracket cracked, not affecting performance	1	. Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	. Require repair or replacement.
Bracket holes elongated, not affecting performance	..	..... No service suggested or required.
Bracket loose, affecting performance	A	. Require repair or replacement.
Bracket loose, not affecting performance	1	. Suggest repair or replacement.
Bracket missing	C	..... Require replacement.
Broken	A	..... Require replacement.
Cracked	A	. Require repair or replacement.
Disconnected	A	. Require repair or replacement.

Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	(1) Require repair or replacement.
Seized	A	Require repair or replacement.

(1) - Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.

CONTROL MODULES

NOTE: Includes, but not limited to: IRCM, Coolant Fan Control Module (CFCM), AC Controller, Amplifier, Programmers, Control Heads, Power Modules, etc.

CONTROL MODULE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Code set (if applicable)	A	(1) Further inspection required.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	(2) Require repair or replacement.
Connector melted, not affecting performance	2	(2) Suggest repair or replacement.
Connector missing	A	Require repair.
Contaminated	A	(3) Require repair or replacement.
Inoperative	B	(4) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) – Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).
(2) – Determine cause and correct prior to repair or replacement of part.
(3) – Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement. Check for accepted cleaning procedure.
(4) – Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable.

COOLANT

COOLANT INSPECTION

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement.
Contaminated	B	(1) Require replacement or recycling. Further inspection required.
Level incorrect	B	(2) Require filling to proper level.
Maintenance intervals	3	(3) Suggest replacement.
Mixture incorrect	B	Require correction or replacement.
Type incorrect	B	Require replacement.

(1) – Determine source of contamination and require correction prior to coolant replacement.
(2) – Determine source of incorrect level and suggest repair.
(3) – The system should be drained and/or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.

COOLING FAN BLADES

COOLING FAN BLADE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.

Bent	A	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.

COOLING FAN CLUTCHES

NOTE: Some lateral movement, measured at the fan blade tip, may be normal.

COOLING FAN CLUTCH INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearing noisy	A	Require replacement.
Bearing worn	A	Require replacement.
Fastener loose	A	Require repair or replacement of fastener.
Inoperative	A	(1) Require replacement.
Leaking	1	Suggest replacement.
Seized	A	Require replacement.
Slips (insufficient fan speed)	A	Require replacement.
Thermal control incorrect	B	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

COOLING FAN MOTORS

COOLING FAN MOTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.

Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Hydraulic fan motor leaking	A	Require repair or replacement.
Inoperative	A	(2) Require replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Rotation incorrect for application	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Vibration	1	Suggest replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Check fan motor/controls. Inoperative includes intermittent operation or out of OEM specification.

EVAPORATOR DRAIN TUBES

EVAPORATOR DRAIN TUBE INSPECTION

Condition	Code	Procedure
Disconnected	A	Require repair.
Leaking	A	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Routed incorrectly	B	Require repair.

EVAPORATOR PRESSURE REGULATORS (EPRS)

EVAPORATOR PRESSURE REGULATOR (EPR) INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

EVAPORATORS

EVAPORATOR INSPECTION

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement.
Abrasion damage, not affecting structural integrity		No service suggested or required.
Air flow obstruction, affecting performance	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance		No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	Require repair or replacement.
Bracket holes elongated, not affecting performance		No service suggested or required.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Corroded, not affecting structural integrity		No service suggested or required.
Evaporator foam seal leaking	A	Require replacement.
Evaporator foam seal missing	C	Require replacement.
Fitting type incorrect		

Condition	Code	Procedure
(such as compression fitting)	B	Require replacement.
Flange leaking	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Restricted internally	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

EXPANSION VALVES

EXPANSION VALVE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Corroded internally	1	Suggest replacement.
Filter screen torn	A	Require replacement of screen.
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require replacement.
Restricted	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Expansion valve operation may be affected by capillary tube location, corrosion, and insulation tape. Inoperative includes intermittent operation.

FUNCTION SELECTORS

See CONTROL HEADS (FUNCTION SELECTORS).

FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

FUSE, FUSIBLE LINK AND CIRCUIT BREAKER INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Blown	A	(1) Require replacement.
Corroded, affecting performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(2) Require replacement.
Insulation damaged,		

conductors exposed	A	..	Require repair or replacement.
Insulation damaged, conductors not exposed .	1	..	Suggest repair or replacement.
Missing	C	.....	Require replacement.
Routed incorrectly	B	.....	Require repair.
Secured incorrectly	B	.....	Require repair.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance ..	1	..	Suggest repair or replacement.

(1) - Determine cause and correct prior to replacement of part.
(2) - Inoperative includes intermittent operation.

FUSIBLE LINKS

See FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS.

GASKETS

GASKET INSPECTION

Condition	Code		Procedure
Leaking	A	.....	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

HEATER CASES

See PLENUMS.

HEATER CONTROL VALVES

HEATER CONTROL VALVE INSPECTION

Condition	Code		Procedure
Application incorrect ...	B	.....	Require replacement.
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement

			of hardware.
Binding	2	..	Suggest repair or replacement.
Coolant leak	A	..	Require repair or replacement.
Disconnected	A	..	Require repair or replacement.
Malfunctioning	A	.....	(1) Require repair or replacement.
Missing	C	.....	Require replacement.
Restricted	A	..	Require repair or replacement.
Seized	A	..	Require repair or replacement.
Vacuum leak	A	..	Require repair or replacement.

(1) - Includes inoperative, intermittent operation, or failure to perform all functions.

HEATER CORES

HEATER CORE INSPECTION

Condition	Code		Procedure
Air flow obstruction	A	..	Require repair or replacement.
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	..	Require repair or replacement of hardware.
Connection leaking	A	..	Require repair or replacement.
Corroded	1	..	Suggest repair or replacement.
Disconnected	A	..	Require repair or replacement.
Fins damaged, affecting performance	A	..	Require repair or replacement.
Fins damaged, not affecting performance	..	.....	No service suggested or required.
Internal restrictions, affecting performance	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.

HEATER HOSES

HEATER HOSE INSPECTION

Condition	Code		Procedure
Application incorrect	B	.....	Require replacement.
Connected incorrectly	A	.....	Require repair.
Corroded, not reusable	1	.....	Suggest replacement.
Cracked	A	..	Require repair or replacement.
Hard (brittle)	1	..	Suggest repair or replacement.
Inner fabric (webbing) damaged	A	.....	Require replacement.
Insufficient clamping force, allowing hose to leak	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Maintenance intervals	3	.....	Suggest replacement.

Melted	1	..	Suggest repair or replacement.
Missing	C	.....	Require replacement.
Outer covering damaged	1	.....	Suggest replacement.
Outer covering damaged to the extent that the inner fabric is visible	A	.....	Require replacement.
Protective sleeves damaged	2	.	Suggest replacement of sleeves.
Protective sleeves missing	2	.	Suggest replacement of sleeves.
Restricted, affecting performance	A	..	Require repair or replacement.
Restricted, not affecting performance	2	..	Suggest repair or replacement.
Routed incorrectly	2	.....	Suggest repair.
Safety clip missing	C	.....	Require replacement.
Spongy	1	..	Suggest repair or replacement.
Stripped	A	.....	Require replacement.
Surface cracks (dry-rotted)	1	..	Suggest repair or replacement.
Swollen	B	.....	Require replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Type incorrect	1	..	Suggest repair or replacement.

HIGH PRESSURE RELIEF VALVES (HPRV)

HIGH PRESSURE RELIEF VALVE (HPRV) INSPECTION

Condition	Code	Procedure
Inoperative	A	..... (1) Require repair or replacement.
Leaking	A	.. Require repair or replacement.
Missing	C	..... Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

IDLERS

See TENSIONERS.

IN-LINE FILTERS

IN-LINE FILTER INSPECTION

Condition	Code	Procedure
Connection leaking	B	.. Require repair or replacement.
Leaking	A	.. Require repair or replacement.
Restricted	A	..... Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

METAL FITTINGS

See AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES.

METAL LINES

See AIR CONDITIONING METAL LINES, HOSES AND FITTING ASSEMBLIES.

MIX AND AIR CONTROL DOORS (BLEND DOORS)

See PLENUMS.

O-RINGS

O-RING INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

ORIFICE TUBES

ORIFICE TUBE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Bypassing internally	A	Require repair or replacement.
Filter screen torn	A	Require replacement.
Installation incorrect	B	Require repair.
Restricted	A	Require repair or replacement.

PILOT-OPERATED ABSOLUTES (POAS)

PILOT-OPERATED ABSOLUTE (POA) INSPECTION

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement.
Fitting damaged	B	Require repair or replacement.
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

PLENUMS

PLENUM INSPECTION

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement.
Air control door leaking	A	Require repair or replacement.
Air control door seized	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Cracked	2	Suggest repair or replacement.
Drain hole restricted	A	Require repair.
Drain plugged	A	Require repair.
Duct disconnected	A	Require repair or replacement.
Duct leaking	A	Require repair or replacement.
Duct missing	C	Require replacement.
Duct restricted	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Noisy	2	Suggest cleaning or repair.
Odor	2	Suggest cleaning or repair.
Restricted	A	Require cleaning, repair, or replacement.

PRESSURE CONTROL VALVES

See:

* EVAPORATOR PRESSURE REGULATORS (EPRS)
* HIGH PRESSURE RELIEF VALVES (HPRV)
* PILOT-OPERATED ABSOLUTES (POAS)
* SUCTION THROTTLING VALVES (STVS)
* VALVES IN RECEIVER (VIRS)

PRESSURE SENSORS

See THERMISTORS AND PRESSURE SENSORS.

PULLEYS

PULLEY INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not		

functioning	A	Require repair or replacement of hardware.
Bearing noisy	2	Suggest replacement.
Bearing seized	A	Require repair or replacement.
Bearing worn	1	Suggest replacement.
Cracked	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Pulley damaged, affecting belt life	A	Require replacement.

RADIATORS

RADIATOR INSPECTION

Condition	Code	Procedure
Air flow obstruction	A	Require repair.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connection leaking	A	Require repair or replacement.
Corroded	1	Suggest repair or replacement.
Drain inoperative	A	Require repair or replacement.
Fins damaged, affecting performance	A	Require repair or replacement.
Fins damaged, not affecting performance		No service suggested or required.
Internal oil cooler leaking	A	Require repair or replacement.
Internal restrictions	B	Require repair or replacement.
Leaking	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.
Tubes damaged, affecting performance	A	Require repair or replacement.
Tubes damaged, not affecting performance		No service suggested or required.

RECEIVER-DRIERS

NOTE: For VIRs, see VALVES IN RECEIVER (VIRS).

RECEIVER-DRIER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware		

missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Contaminated, affecting performance	A	.....	Require replacement.
Dessicant bag deteriorated	A	.....	(1) Require replacement. Further inspection required.
Dessicant at the end of its useful life (saturated with moisture)	1	..	Suggest repair or replacement.
Fusible plug leaking	A	....	Require replacement of plug.
Leaking	A	.....	Require replacement.
Pressure relief device leaking	A	.	Require replacement of pressure relief device.
Restricted	A	..	Require repair or replacement.
Sight glass no longer transparent	2	...	Suggest replacement of drier.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Tubing connection leaking	A	..	Require repair or replacement.

(1) - Inspect system to determine effects of dessicant bag deterioration.

REFRIGERANT

NOTE: Refrigerants include any SNAP (Significant New Alternative Policy)-approved blends.

REFRIGERANT INSPECTION

Condition	Code	Procedure
Contaminated (other than refrigerant blends)	B	Require service to remove contamination.
Different types of refrigerants in the same system (other than refrigerant blends)	B	Require repair.
Overcharged	B	Require repair.
Refrigerant type does not match fittings and label	B	Require repair.
Undercharged	B	Require repair.

REFRIGERANT OIL

REFRIGERANT OIL INSPECTION

Condition	Code	Procedure
Contaminated	1	Require repair or replacement.
Overfilled	B	Require repair.

Condition	Code	Procedure
Underfilled	B	Require repair.

RELAYS

RELAY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Housing broken	A	Require replacement.
Housing cracked	2	Suggest replacement.
Inoperative	A	(1) Require replacement.
Melted, affecting performance	A	(2) Require repair or replacement.
Melted, not affecting performance	2	(2) Suggest repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

SEALS

SEAL INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

SERVICE PORTS

SERVICE PORT INSPECTION

Condition	Code	Procedure
Application does not match refrigerant type	B	Require replacement.
Leaking	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Valve cap leaking	A	Require repair or replacement of cap.
Valve cap missing	C	Require replacement of valve cap.
Valve core sticking	B	Require repair or replacement.

SPRING LOCK COUPLINGS

SPRING LOCK COUPLING INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

SUCTION THROTTLING VALVES (STVS)

SUCTION THROTTLING VALVE (STV) INSPECTION

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement.
Fitting damaged	B	Require repair or replacement.
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

SWITCHES (ELECTRICAL)

SWITCH (ELECTRICAL) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Malfunctioning	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	(3) Require replacement.
Out of adjustment	B	Require repair or replacement.
Pressure switch leaking	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Won’t return	A	Require repair or replacement.
Worn	1	Suggest replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, or failure to perform all functions.
(3) - Missing includes high pressure cut-off switches not installed during a retrofit from R12 to R134a.

TENSIONERS

TENSIONER INSPECTION

Condition	Code	Procedure

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearing worn	1	Suggest replacement.
Belt tension incorrect	B	Require adjustment or repair.
Bracket cracked	A	Require repair or replacement.
Housing cracked	A	Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Pulley damaged, affecting belt life	A	Require replacement.
Seized	A	Require repair or replacement.

THERMISTORS AND PRESSURE SENSORS

NOTE: Includes, but not limited to, In-Car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.

THERMISTOR AND PRESSURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Calibration incorrect	B	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require repair or replacement.
Missing	C	Require replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.

Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

THERMOSTATS AND HOUSINGS

THERMOSTAT AND HOUSING INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware corroded	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Cracked	A	Require replacement.
Housing corroded	1	Suggest replacement of housing.
Inoperative	A	(1) Require replacement.
Installation incorrect	B	Require repair or replacement.
Leaking	A	Require repair or replacement.
Thermostat missing	C	Require replacement of thermostat.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

VACUUM HOSES AND TUBES

VACUUM HOSE AND TUBE INSPECTION

Condition	Code	Procedure
Disconnected	A	Require repair.
Leaking	A	Require repair or replacement.
Melted	A	Require repair replacement.
Missing	C	Require replacement.
Oil-soaked (spongy)	1	Suggest replacement.
Restricted	A	Require repair or replacement.

Routing incorrect	B	..... Require repair.
Surface cracks (dry-rotted)	1	..... Suggest replacement.

VACUUM RESERVOIRS

VACUUM RESERVOIR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Check valve leaking internally	A	..... Require replacement.
Leaking	A	.. Require repair or replacement.
Missing	C	..... Require replacement.
Restricted	A	.. Require repair or replacement.

VACUUM TUBES

See VACUUM HOSES AND TUBES.

VALVES IN RECEIVER (VIRS)

VALVE IN RECEIVER (VIR) INSPECTION

Condition	Code	Procedure
Application incorrect ...	B	..... Require replacement.
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Bracket bent, affecting performance	A	.. Require repair or replacement.
Bracket bent, not affecting performance		..... No service suggested or required.
Bracket broken, affecting performance	A	..... Require replacement.
Bracket broken, not affecting performance		..... No service suggested or required.
Bracket corroded, affecting performance ..	A	.. Require repair or replacement.
Bracket corroded, not affecting performance ..	2	.. Suggest repair or replacement.
Bracket cracked, affecting performance	A	.. Require repair or replacement.

Bracket cracked, not affecting performance	1	..	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	..	Require repair or replacement.
Bracket holes elongated, not affecting performance			No service suggested or required.
Bracket loose, affecting performance	A	..	Require repair or replacement.
Bracket loose, not affecting performance	1	..	Suggest repair or replacement.
Bracket missing	C		Require replacement.
Connection damaged	B	..	Require repair or replacement.
Contaminated, affecting performance	A		Require replacement.
Corroded internally	1		Suggest replacement.
Dessicant bag deteriorated	A		(1) Require replacement. Further inspection required.
Dessicant at the end of its useful life (saturated with moisture)	1	..	Suggest repair or replacement.
Filter screen torn	A	..	Require replacement of screen.
Fitting damaged	B	..	Require repair or replacement.
Fusible plug leaking	A	....	Require replacement of plug.
Inoperative	A		(2) Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Pressure relief device leaking	A	.	Require replacement of pressure relief device.
Restricted	A	..	Require repair or replacement.
Sight glass no longer transparent	2	...	Suggest replacement of drier.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A		Require replacement.
Tubing connection leaking	A	..	Require repair or replacement.

(1) - Inspect system to determine effects of dessicant bag deterioration.
(2) - Inoperative includes intermittent operation or out of OEM specification.

WATER PUMPS (ELECTRIC AUXILIARY)

WATER PUMP (ELECTRIC AUXILIARY) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C		Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.

Condition	Code	Procedure
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Vibration	1	Suggest replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

WIRING HARNESSES AND CONNECTORS

WIRING HARNESS AND CONNECTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Circuit open	A	Require repair or replacement.
Circuit resistance (voltage drop) out of		

specification	A	Require repair or replacement.
Circuit shorted	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Diode open	A	Require repair or replacement.
Diode shorted	A	Require repair or replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Protective shield (conduit) melted	B	(1) Require replacement.
Protective shield (conduit) missing	C	Require replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Voltage drop out of specification	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

A/C-HEATER SYSTEM

1999 Lexus RX 300

1999 AUTOMATIC A/C-HEATER SYSTEMS
LEXUS

RX300

SPECIFICATIONS

SPECIFICATIONS

Application	Specification
Compressor Type	Nippondenso 10-Cyl.
Compressor Belt Tension	
New Belt	165 lbs. (74.8 kg)
Used Belt	88 lbs. (39.9 kg)
Compressor Oil Capacity	4.1 ozs.
Refrigerant (R-134a) Capacity	21.2-24.7 ozs.
System Operating Pressures	
Low Side	21-36 psi (1.5-2.5 kg/cm^2)
High Side	199-214 psi (14-15 kg/cm^2)

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures in AIR BAG SYSTEM SAFETY article in GENERAL SERVICING.

CAUTION: When battery is disconnected, radio will go into anti-theft protection mode. Obtain radio anti-theft protection code from owner prior to servicing vehicle.

DESCRIPTION & OPERATION

The automatic A/C-heater system automatically maintains the temperature set by driver. The system features automatic fan speed and airflow control, and automatically selects the most suitable fan speed and airflow to control temperature.

AUTOMATIC A/C-HEATER SYSTEM CONTROLS

The AUTO button selects automatic operation of A/C-heater system. Push the OFF button to run A/C-heater system off. The outer ring on the AUTO button (TEMP control knob) is used to set desired passenger compartment temperature.

The MODE button is used to manually select airflow. Panel, bi-level, floor, and floor/windshield manual selections may be made. The outer ring on the MODE button (fan speed control knob) is used to set blower fan speed.

The air intake control (recirculated/fresh air) button is used to switch air intake between fresh air and recirculated air. When LED is on, system is operating in recirculated air mode. With LED off, fresh air is selected.

Manual selection of the A/C-heater system may be made by pressing the A/C button. If the A/C compressor is inoperative, the LED on the A/C button will blink.

When FRONT windshield defrost button is pushed, the A/C-heater system operates in fresh air mode. If button is pushed again, the system returns to last mode used.

SELF-DIAGNOSTICS

The A/C-heater control assembly monitors system circuits and stores codes in memory if problems are detected. All codes are stored in memory except Code 22. Malfunction is current if Code 22 is displayed. To retrieve stored codes, see RETRIEVING CODES.

RETRIEVING CODES

NOTE: The following code retrieval procedure is performed using A/C-heater control assembly indicators. Codes may also be retrieved using scan tool. Follow scan tool manufacturer's instructions to retrieve codes.

1) While pressing and holding AUTO button and air intake control button, turn ignition on. Indicators will flash on and off at one-second intervals, 4 times in succession, as an indicator check. Press OFF button to cancel indicator check.

2) After indicator check is complete, system will enter self-diagnostic mode. Stored trouble codes will appear in sequence. See AUTOMATIC A/C-HEATER SYSTEM TROUBLE CODES table.

3) Press A/C switch to display codes one at a time. Press OFF button to exit self-diagnostics.

AUTOMATIC A/C-HEATER SYSTEM TROUBLE CODES

Code	Condition/Affected Circuit
00	Normal
B1411/11 (1)	Room Temperature Sensor Circuit
B1412/12 (2)	Ambient Temperature Sensor Circuit
B1413/13	Evaporator Temperature Sensor Circuit
B1421/21 (3)	Solar Sensor Circuit
B1422/22 (4)	Compressor Lock Sensor Circuit
B1423/23	Abnormal Refrigerant Pressure (Pressure Switch Circuit)
B1431/31	Air Mix Damper Position Sensor Circuit
B1432/32	Air Inlet Damper Position Sensor Circuit
B1433/33	Air Outlet Damper Position Sensor Circuit
B1441/41	Air Mix Damper Control Servomotor Circuit
B1442/42	Air Inlet Damper Control Servomotor Circuit
B1443/43	Air Outlet Damper Control Servomotor Circuit

(1) - If in-vehicle temperature is -4°F (-20°C) or less, code may set even though system is normal.
(2) - If outside air temperature is -58°F (-50°C) or less, code may set even though system is normal.
(3) - If testing is done in a dark area, code may set even though system is normal. Shine a light at solar sensor and recheck codes.
(4) - Malfunction is current.

CLEARING CODES

Remove ECU-B fuse from underhood junction block for 10 seconds or longer to clear memory. After installing fuse, verify only normal code (Code 00) appears.

ACTUATOR CHECK

1) Perform RETRIEVING CODES. When system enters self-diagnostic mode, press air intake control button. Each mode door,

motor, and relay will operate at one-second intervals. Press A/C button to display codes one at a time and to step through checks one at a time.

2) Check airflow and temperature by hand. Each display code is associated with a system operating condition. 1Press OFF button to cancel actuator check mode.

Step No.	Display code	Conditions					
		Blower motor	Air flow vent	Max. cool damper	Air inlet damper	Magnetic clutch	Air mix damper
1	0	0	FACE	0% open	FRESH	OFF	Cool side (-10% open)
2	1	1	↑	↑	↑	↑	↑
3	2	17	↑	100% open	R/F (54.5% open)	ON	↑
4	3	↑	↑	↑	↑	↑	↑
5	4	↑	↑	↑	(RECIRC)	↑	Cool/Hot (50% open)
6	5	↑	BI-LEVEL*1 (52.0% open)	↑	↑	↑	↑
7	6	↑	FOOT*2 (31.0% open)	↑	↑	↑	Hot side (110% open)
8	7	↑	↑	↑	↑	↑	↑
9	8	↑	FOOT/DEF	↑	↑	↑	↑
10	9	31	DEF	↑	↑	↑	↑

*1: There is air leakage from defroster.

*2: There is no air leakage from defroster.

G99B05084

Fig. 1: Identifying Actuator Check Display Codes
Courtesy of Toyota Motor Sales, U.S.A, Inc.

CODE B1411/11: IN-VEHICLE TEMPERATURE SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.

2) Backprobe A/C ECU connector terminal C13-3 (Green/Red wire) with positive voltmeter lead, and terminal C13-9 (Green/White wire) with negative voltmeter lead. Measure voltage while heating sensor. See ROOM TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS table.

3) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test room (in-vehicle) temperature sensor. See ROOM

TEMPERATURE SENSOR under TESTING. Replace sensor as necessary. If sensor is okay, go to next step.

4) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU. Retest system.

ROOM TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Volts
77 (25)	1.8-2.2
104 (40)	1.2-1.6

(1) - As temperature increases, voltage should gradually decrease.

CODE B1412/12: AMBIENT TEMPERATURE SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.

2) Backprobe A/C ECU connector terminal C14-7 (Black/Red wire) with positive voltmeter lead, and terminal C14-16 (White/Red wire) with negative voltmeter lead. Measure voltage while heating ambient (outside) temperature sensor. See OUTSIDE TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS table.

3) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test outside temperature sensor. See AMBIENT TEMPERATURE SENSOR under TESTING. Replace sensor as necessary. If sensor is okay, go to next step.

4) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU. Retest system.

OUTSIDE TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Volts
77 (25)	1.35-1.75
104 (40)	0.85-1.25

(1) - As temperature increases, voltage should gradually decrease.

CODE B1413/13: EVAPORATOR TEMPERATURE SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.

2) Backprobe A/C ECU connector terminal C12-1 (Green/Yellow wire) with positive voltmeter lead, and terminal C12-9 (Black/Yellow wire) with negative voltmeter lead.

3) Measure evaporator temperature sensor voltage at specified temperature. See EVAPORATOR TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS table.

4) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test evaporator temperature sensor. See EVAPORATOR TEMPERATURE SENSOR under TESTING. Replace sensor as necessary. If sensor is okay, go to next step.

5) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

EVAPORATOR TEMPERATURE SENSOR CIRCUIT VOLTAGE SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Volts
32 (0)	2.0-2.4
59 (15)	1.4-1.8

(1) - As temperature increases, voltage should gradually decrease.

CODE B1421/21: SOLAR SENSOR CIRCUIT (PASSENGER SIDE)

NOTE: If testing is done in a dark area, code may set even though system is normal. Shine a bright light at solar sensor and recheck for code.

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.
2) Backprobe A/C ECU connector terminal C13-15 (Yellow/Black wire) with positive voltmeter lead, and terminal C13-16 (Blue wire) with negative voltmeter lead. Measure sensor circuit voltage. See SOLAR SENSOR CIRCUIT VOLTAGE SPECIFICATIONS table.
3) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test solar sensor. See SOLAR SENSOR under TESTING. Replace sensor as necessary. If sensor is okay, go to next step.
4) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

SOLAR SENSOR CIRCUIT VOLTAGE SPECIFICATIONS

Condition	(1) Volts
Sensor Subjected To Bright Light	0.8-4.3
Sensor Covered By Cloth	Less Than 0.8

(1) - As light intensity decreases, voltage should increase.

CODE B1422/22: COMPRESSOR LOCK SENSOR CIRCUIT

1) Locate Engine Control Module (ECM) in engine compartment. Leave harness connectors attached. Start engine. Press AUTO button to ON position.
2) Backprobe ECM connector terminal E5-10 (White/Blue wire) with positive voltmeter lead and connect negative voltmeter lead to ground. Battery voltage (10-14 volts) should exist.
3) If battery voltage exists, no problem is indicated at this time. If battery voltage does not exist, test compressor (A/C magnetic clutch) lock sensor. See COMPRESSOR LOCK SENSOR under TESTING. If sensor is okay, go to next step. Replace sensor as necessary.
4) Inspect wiring harness and connectors between A/C ECU, ECM, and compressor lock sensor. Repair harness and connectors as necessary. If wiring harness and connectors are okay, temporarily substitute known-good ECM and/or A/C ECU, and retest system.

CODE B1423/23: PRESSURE SWITCH CIRCUIT

1) Locate Engine Control Module (ECM) in engine compartment. Leave harness connectors attached. Connect manifold gauge set to A/C system service valves. Turn ignition on.
2) Backprobe ECM connector terminal E9-2 (Red/Yellow wire)

with positive voltmeter lead and connect negative voltmeter lead to ground. The pressure switch circuit wiring changes from a Red/Yellow wire to a Green Red wire.

3) Start engine. Press A/C button to ON position. Battery voltage should exist with refrigerant pressure greater than 28 psi (2.0 kg/cm²) and less than 455 psi (32 kg/cm²). If voltage is as specified, no problem is indicated at this time.

4) If voltage is not as specified, test pressure switch. See PRESSURE SWITCH under TESTING. If switch is okay, go to next step. Replace pressure switch as necessary.

5) Inspect wiring harness and connectors between pressure switch, ECM and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good ECM and/or A/C ECU, then retest system.

CODE B1431/31: AIR MIX DAMPER POSITION SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.

2) Backprobe A/C ECU connector terminal C12-6 (Orange wire) with positive voltmeter lead, and terminal C12-9 (Black/Yellow wire) with negative voltmeter lead.

3) Measure sensor circuit voltage while changing set temperature to activate air mix damper. See AIR MIX DAMPER POSITION SENSOR SPECIFICATIONS table.

AIR MIX DAMPER POSITION SENSOR SPECIFICATIONS

Set Temperature	(1) Volts
Maximum Cool	3.5-4.5
Maximum Hot	0.5-1.5

(1) - As set temperature increases, voltage should gradually decrease.

4) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test air mix damper position sensor. See AIR MIX DAMPER CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. If position sensor is defective, replace air mix damper control servomotor. If position sensor is okay, go to next step.

5) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

CODE B1432/32: AIR INLET DAMPER POSITION SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.

2) Backprobe A/C ECU connector terminal C13-11 (Gray wire) with positive voltmeter lead, and terminal C13-1 (Black/White wire) with negative voltmeter lead.

3) Measure sensor voltage while pressing air intake control (recirculated/fresh air) button to change air inlet between recirculated air and fresh air. As servomotor operates, note voltage. See AIR INLET DAMPER POSITION SENSOR SPECIFICATIONS table.

4) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test air inlet door position sensor. See AIR INLET DAMPER CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. If air inlet door position sensor is defective, replace air inlet door servomotor. If position sensor is okay, go to next step.

5) Inspect wiring harness and connectors between sensor and A/C control assembly. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

AIR INLET DAMPER POSITION SENSOR SPECIFICATIONS

Position	(1) Volts
Recirculated Air	3.5-4.5
Fresh Air	0.5-1.5

(1) - As door moves from recirculated air position toward fresh air position, voltage should gradually decrease.

CODE B1433/33: AIR OUTLET DAMPER POSITION SENSOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on.
2) Backprobe A/C ECU connector terminal C12-3 (Lt. Green/Red wire) with positive voltmeter lead, and terminal C12-9 (Black/Yellow wire) with negative voltmeter lead.
3) Measure sensor circuit voltage while air outlet damper (air vent mode) control servomotor is moved from vent to defrost position. As servomotor operates, note voltage. See AIR OUTLET DAMPER POSITION SENSOR SPECIFICATIONS table.
4) If voltage is as specified, temporarily substitute a known-good A/C ECU, then retest system. If voltage is not as specified, test air outlet damper position sensor. See AIR OUTLET CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. If position sensor is okay, go to next step. If air outlet damper position sensor is defective, replace air outlet control servomotor.
5) Inspect wiring harness and connectors between sensor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

AIR OUTLET DAMPER POSITION SENSOR SPECIFICATIONS

Position	(1) Volts
Vent	3.5-4.5
Defrost	0.5-1.5

(1) - As door moves from defrost position toward vent position, voltage should gradually increase.

CODE B1441/41: AIR MIX DAMPER CONTROL SERVOMOTOR CIRCUIT

1) Warm engine to normal operating temperature. After system enters self-diagnostic mode, perform ACTUATOR CHECK. Press A/C switch button to enter step mode and display codes. See AIR MIX DAMPER AIRFLOW table. Air mix damper operation should be as specified.
2) If air mix damper functions as specified, no problem is indicated at this time. If air mix damper does not function as specified, test air mix damper control servomotor. See AIR MIX DAMPER CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. Replace servomotor as necessary. If servomotor is okay, go to next step.
3) Inspect wiring harness and connectors between servomotor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

AIR MIX DAMPER AIRFLOW

Code	Air Mix Damper	Expected Result
0-3	Fully Closed	Cool Air Comes Out
4-5	Half Open	Blend (Cool/Hot) Air Comes Out
6-9	Fully Open	Hot Air Comes Out

CODE B1442/42: AIR INLET DAMPER CONTROL SERVOMOTOR CIRCUIT

1) Warm engine to normal operating temperature. After system enters self-diagnostic mode, perform ACTUATOR CHECK. Press A/C button to enter step mode and display codes. See AIR INLET DAMPER AIRFLOW table. Air inlet damper operation should be as specified.

2) If air inlet damper functions as specified, no problem is indicated at this time. If air inlet damper does not function as specified, test air inlet damper control servomotor. See AIR INLET DAMPER CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. Replace servomotor as necessary. If servomotor is okay, go to next step.

3) Inspect wiring harness and connectors between servomotor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

AIR INLET DAMPER AIRFLOW

Code	Damper Position
0-1	Fresh Air
2	Fresh/Recirculated Air
3-5	Recirculated Air
6-9	Fresh Air

CODE B1443/43: AIR OUTLET DAMPER CONTROL SERVOMOTOR CIRCUIT

1) Warm engine to normal operating temperature. After system enters self-diagnostic mode, perform ACTUATOR CHECK. Press A/C button to enter step mode and display codes. See AIR OUTLET DAMPER AIRFLOW table. Air outlet damper operation should be as specified.

2) If air outlet damper functions as specified, no problem is indicated at this time. If air outlet damper does not function as specified, test air outlet damper control servomotor. See AIR OUTLET DAMPER CONTROL SERVOMOTOR & POSITION SENSOR under TESTING. Replace servomotor as necessary. If servomotor is okay, go to next step.

3) Inspect wiring harness and connectors between servomotor and A/C ECU. Repair as necessary. If wiring harness and connectors are okay, temporarily substitute a known-good A/C ECU, then retest system.

AIR OUTLET DAMPER AIRFLOW

Code	Airflow Mode
0-4	Face
5	Bi-Level
6-7	Foot
8	Foot/Defrost
9	Defrost

TESTING

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures in AIR BAG SYSTEM SAFETY article in GENERAL SERVICING.

A/C SYSTEM PERFORMANCE

1) Fully open doors. Start and run engine at 1500 RPM. Set blower control switch to highest speed. Turn A/C system on. Observe sight glass on liquid tube (in front of condenser) and ensure no bubbles are present. If necessary, charge A/C system.

2) Ensure ambient temperature at air inlet is 86-95°F (30-35°C). Connect manifold gauge set to A/C system service valves. Place air selection switch to recirculated air position.

3) Start and run engine at 2000 RPM. Set blower control switch to highest speed. Turn A/C system on and set temperature control dial to cool position. Ensure system operating pressures are within specifications. See SPECIFICATIONS.

AIR INLET DAMPER CONTROL SERVOMOTOR & POSITION SENSOR

Servomotor

1) Remove blower motor unit. See AIR INLET CONTROL SERVOMOTOR & BLOWER UNIT. Unplug air mix control servomotor connector. Apply battery voltage to air mix control servomotor connector terminal No. 6 (Red wire). Connect terminal No. 7 (Brown/White wire) to ground. Servomotor lever should move smoothly to REC (recirculated air) position.

2) Transpose power and ground leads. Servomotor lever should move smoothly to FRS (fresh air) position. If servomotor does not function as specified, replace servomotor.

Position Sensor

1) Unplug air mix control servomotor connector. Measure resistance between air mix damper control servomotor terminal No. 1 (Violet/White wire) and terminal No. 3 (Black/White wire). See Fig. 2. Sensor resistance should be 4200-7800 ohms.

2) While actuating air inlet damper control servomotor, measure resistance between air mix damper control servomotor terminal No. 1 (Violet/White wire) and terminal No. 5 (Gray wire). Sensor resistance should be 3100-5800 ohms in REC position, and 800-1600 ohms in FRS position. Replace servomotor if resistance is not as specified.

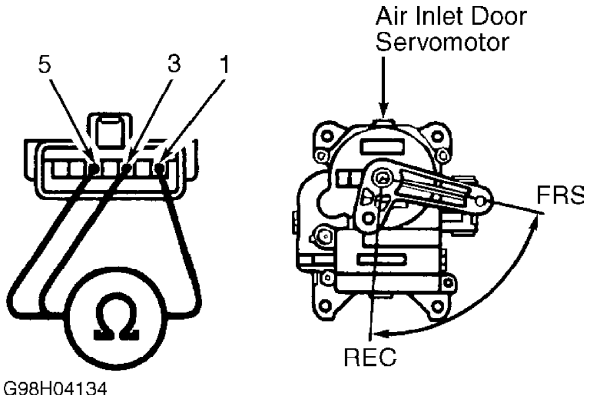


Fig. 2: Testing Air Inlet Damper Control Servomotor Position Sensor
Courtesy of Toyota Motor Sales, U.S.A, Inc.

AIR MIX DAMPER CONTROL SERVOMOTOR & POSITION SENSOR

Servomotor

1) Unplug air mix control servomotor connector. Apply battery voltage to air mix control servomotor connector terminal No. 6 (Yellow wire). Connect terminal No. 7 (Yellow/Green wire) to ground. Servomotor lever should move smoothly to HOT position (motor lever upward at 45 degrees).

2) Transpose power and ground leads. Servomotor lever should move smoothly to COOL position (motor lever pointing toward motor connector). If servomotor does not function as specified, replace servomotor.

Position Sensor

1) Unplug air mix control servomotor connector. Measure resistance between air mix damper control servomotor terminal No. 1 (Green/Black wire) and terminal No. 3 (Black/Yellow wire). Sensor resistance should be 4200-7800 ohms.

2) While actuating air mix damper control servomotor, measure resistance between air mix damper control servomotor terminal No. 1 (Green/Black wire) and terminal No. 5 (Orange wire). Sensor resistance should be 3600-6800 ohms in COOL position, and 500-1100 ohms in HOT position. Replace servomotor if resistance is not as specified.

AIR OUTLET DAMPER CONTROL SERVOMOTOR & POSITION SENSOR

Servomotor

1) Unplug air outlet damper (vent mode) control servomotor connector. Apply battery voltage to air outlet damper control servomotor connector terminal No. 6 (Lt. Green/Black wire). Connect terminal No. 7 (White wire) to ground. See Fig. 3. Servomotor lever should move smoothly to face position.

2) Transpose power and ground leads. Servomotor lever should move smoothly to defrost position. If servomotor does not function as specified, replace servomotor.

Position Sensor

1) Unplug air outlet damper control servomotor connector. Measure resistance between air outlet damper control servomotor terminal No. 1 (Black/Yellow wire) and terminal No. 3 (Green/Black wire). Sensor resistance should be 4200-7800 ohms.

2) While actuating air outlet damper control servomotor, measure resistance between air outlet damper control servomotor terminal No. 1 (Black/Yellow wire) and terminal No. 5 (Light Green/Red wire). Sensor resistance should be 3600-6800 ohms in FACE position, and 500-1100 ohms in DEF (defrost) position. Replace servomotor if resistance is not as specified.

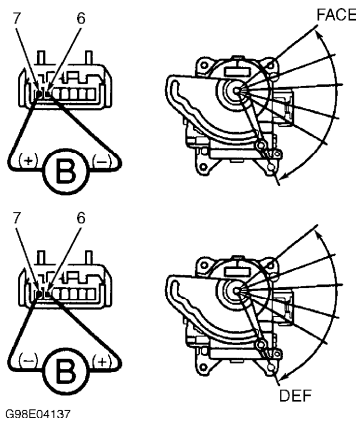


Fig. 3: Testing Air Outlet Damper Control Servomotor
Courtesy of Toyota Motor Sales, U.S.A, Inc.

AMBIENT TEMPERATURE SENSOR

Remove clip and ambient temperature sensor from front bumper reinforcement. Unplug ambient temperature sensor connector. Measure sensor resistance while heating sensor. See AMBIENT TEMPERATURE SENSOR SPECIFICATIONS table. If resistance is not as specified, replace sensor.

AMBIENT TEMPERATURE SENSOR SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Ohms
77 (25)	1600-1800
122 (50)	500-700

(1) - As temperature increases, resistance should gradually decrease.

BACK-UP POWER SOURCE CIRCUIT

Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Measure voltage between A/C ECU terminal C14-3 (White/Blue wire) and ground. Battery voltage should exists. If necessary, check power source circuit and ECU-B fuse (in engine compartment junction block). See WIRING DIAGRAMS.

BLOWER MOTOR CIRCUIT

1) Remove A/C ECU (combination meter ECU), leaving harness connectors attached. Turn ignition on. Operate blower motor. Measure voltage between A/C ECU terminal C14-4 (Red/Blue wire) and ground. Voltage should be 1-3 volts.

2) Remove blower motor. See BLOWER MOTOR under REMOVAL & INSTALLATION. Apply battery voltage to blower motor terminal No. 2 (Red wire) and ground terminal No. 1 (Black wire). Blower motor should operate smoothly.

3) Remove blower motor control relay, leaving harness connector attached. Turn ignition on and run blower motor at high speed. Continuity should exist between blower motor control relay 3-pin connector terminal No. 1 (White/Black wire) and ground. Battery voltage should exist at terminal No. 1 (Red wire) and terminal No. 3 (Blue/Red wire). Terminal No. 2 (Pink/Blue wire) should have 1-3 volts. If test results are not as specified, repair circuit or replace components as necessary.

NOTE: Battery voltage should also exist between blower motor control relay 2-pin connector terminal No. 1 (Red wire) and terminal No. 2 (Black wire).

COMPRESSOR CIRCUIT

1) Start engine. Press AUTO button. Press A/C button on and off, and measure voltage between Engine Control Module (ECM) connector terminal E9-6 (Lt. Green/Black wire) and ground. With A/C switch on, 10-14 volts should be present. With A/C switch off, zero volts should exist. If voltage is as specified, replace ECM and/or A/C ECU. If voltage is as specified, go to next step.

2) Apply battery voltage to A/C compressor clutch terminal No. 3 (Black/Yellow wire) and ground compressor body to energize compressor clutch coil. If clutch coil energizes, go to next step. If clutch coil does not energize, replace compressor clutch coil.

3) Check wiring harness and connectors between A/C compressor and A/C compressor (magnetic) clutch relay. See WIRING DIAGRAMS. Check wiring harness and connectors between A/C compressor (magnetic) clutch relay and ECM, and between ECM and A/C ECU. Repair wiring and connectors as necessary. If wiring harness and connectors are okay, replace ECM and/or A/C ECU.

COMPRESSOR LOCK SENSOR

Raise and support vehicle. Unplug compressor lock sensor connector, located at compressor. Measure resistance between sensor terminal No. 1 (White/Blue wire) and terminal No. 2 (Brown wire) at specified temperatures. See COMPRESSOR LOCK SENSOR SPECIFICATIONS table. Replace sensor if resistance is not as specified.

COMPRESSOR LOCK SENSOR SPECIFICATIONS

Sensor Temperature °F (°C)	Ohms
68 (20)	990-1210
212 (100)	1280-1550

CONDENSER FAN

Disconnect condenser fan motor connector. Connect battery and ammeter to connector. Ensure condenser fan motor rotates smoothly and ammeter reading is 8.3-11.3 amps at 68°F (20°C).

EVAPORATOR TEMPERATURE SENSOR

1) Remove instrument panel. See INSTRUMENT PANEL. Remove air duct from evaporator unit. Remove aspirator hose bolt. Disconnect sensor and carefully pry out evaporator sensor. Carefully detach sensor from bracket plate.

2) Measure evaporator temperature sensor resistance at specified temperature. See EVAPORATOR TEMPERATURE SENSOR SPECIFICATIONS table.

EVAPORATOR TEMPERATURE SENSOR SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Ohms
32 (0)	4500-5200
59 (15)	2000-2700

(1) - As temperature increases, resistance should gradually decrease.

EXPANSION VALVE

Ensure A/C system is fully charged. Install manifold gauge set. Start and run engine at 1500 RPM for at least 5 minutes. Ensure high pressure reading is 199-228 psi (14-16 kg/cm^2). If low pressure reading drops to 0 psi (0 kg/cm^2), replace expansion valve. See EXPANSION VALVE under REMOVAL & INSTALLATION.

PRESSURE SWITCH

A/C Compressor Clutch Control Circuit

1) Locate pressure switch in front of condenser (below high-pressure service valve). Connect A/C manifold gauge set. Set blower

control switch to highest speed. Turn A/C system on and set temperature control dial to cool position.

2) With pressure switch disconnected, check continuity between pressure switch terminal No. 1 (at top) and terminal No. 4 (toward front bumper). Continuity should exist if high pressure is between 370 psi (26 kg/cm²) and 455 psi (32 kg/cm²). Continuity should exist if low pressure is between 28 psi (2.0 kg/cm²) and 33 psi (2.3 kg/cm²). If continuity is not as specified, replace pressure switch.

Condenser Fan Control Circuit

1) Locate pressure switch in front of condenser (below high-pressure service valve). Connect A/C manifold gauge set. Set blower control switch to highest speed. Turn A/C system on and set temperature control dial to cool position. With pressure switch disconnected, check continuity between pressure switch terminal No. 2 (toward condenser) and terminal No. 3 (at bottom).

2) On vehicles without towing package, no continuity should exist if pressure is between 178 psi (12.5 kg/cm²) and 220 psi (15.5 kg/cm²).

3) On vehicles with towing package, no continuity should exist if pressure is between 199 psi (14.0 kg/cm²) and 256 psi (18.0 kg/cm²). If continuity is not as specified, replace pressure switch.

RELAYS

A/C Compressor Clutch Relay

Remove A/C compressor (magnetic) clutch relay. Relay is located in underhood fuse/relay block. Ensure continuity exists between relay terminals No. 1 and 2. See Fig. 4. Connect battery voltage and ground between terminals No. 1 and 2. If continuity is not present between relay terminals No. 3 and 5 with battery voltage connected, replace compressor clutch relay.

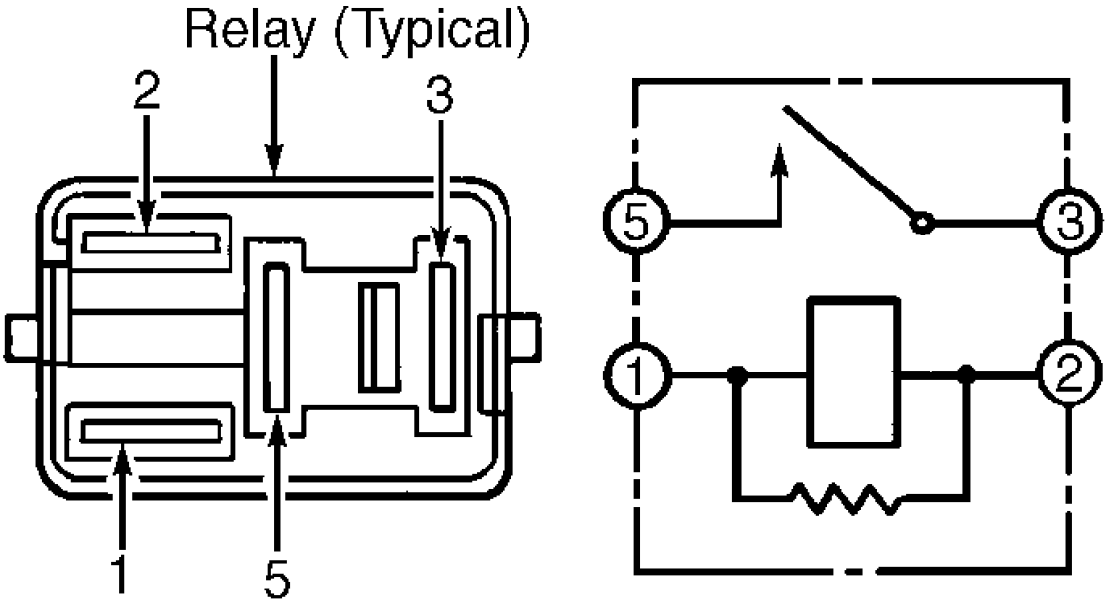


Fig. 4: Identifying A/C Compressor Clutch Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A, Inc.

Heater (Main) Relay

1) Remove heater (main) relay. Relay is located on relay

block, under left side of instrument panel. Check for continuity between terminals No. 3 and 5. See Fig. 5. Continuity should not exist. Check for continuity between terminals No. 1 and 2, and terminals No. 3 and 4. Continuity should exist.

2) Connect battery voltage to terminal No. 1. Connect terminal No. 2 to ground. Check for continuity between terminals No. 3 and 5. Continuity should exist. Replace relay if it does not operate as specified.

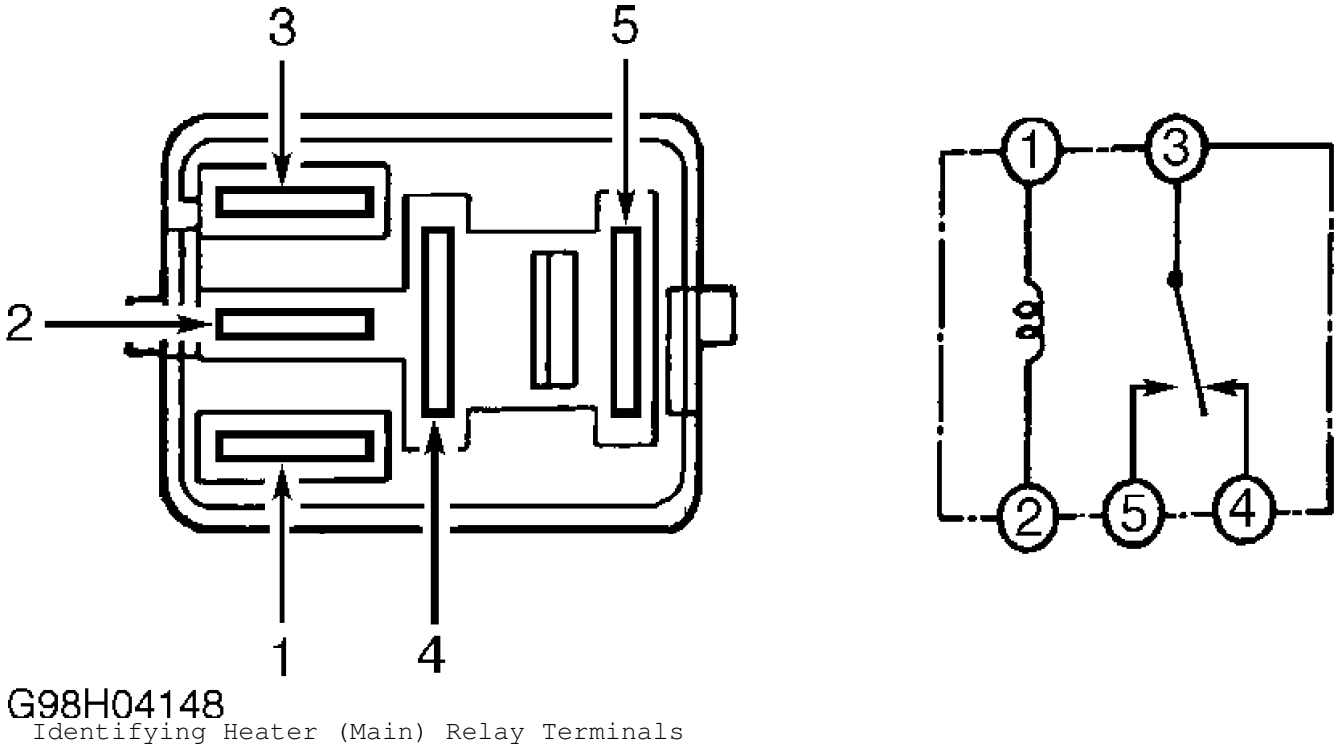


Fig. 5: Identifying Heater (Main) Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A, Inc.

ROOM TEMPERATURE SENSOR

Unplug room (in-vehicle) temperature sensor under left side of instrument panel. Measure sensor resistance while heating sensor. See ROOM TEMPERATURE SENSOR SPECIFICATIONS table. If resistance is not as specified, replace room temperature sensor.

ROOM TEMPERATURE SENSOR SPECIFICATIONS

Sensor Temperature °F (°C)	(1) Ohms
77 (25)	1610-1780
122 (50)	550-650

(1) - As temperature increases, resistance should gradually decrease.

SOLAR SENSOR

1) Remove solar sensor and unplug sensor harness connector. Cover sensor with cloth. Connect positive lead of ohmmeter to sensor terminal No. 1 (Blue wire), and negative lead to terminal No. 2 (Yellow/Black wire). Measure and record resistance between sensor terminals.

2) Remove cloth. Subject sensor to bright light. Measure sensor resistance again. See SOLAR SENSOR RESISTANCE SPECIFICATIONS table. If resistance is not as specified, replace sensor.

SOLAR SENSOR RESISTANCE SPECIFICATIONS

Condition	(1) Ohms
Sensor Covered By Cloth	No Continuity
Sensor Subjected To Bright Light	About 4000

(1) - As light intensity decreases, resistance should increase.

REMOVAL & INSTALLATION

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures in AIR BAG SYSTEM SAFETY article in GENERAL SERVICING.

AIR FILTER

Removal & Installation

Remove passenger's side lower finish panel. Remove air filter cover. Remove air filter and frame. Remove air filter from frame. To install, reverse removal procedure.

A/C-HEATER CONTROL PANEL

Removal & Installation

1) Remove lower center cluster (center console) finish panel. Remove 4 bolts and center cluster finish panel (integration control panel). Remove 3 screws and display panel. Remove 4 screws and radio.

2) Remove 6 screws and panel ECU. Remove 15 screws and A/C-heater control panel. Remove knobs and plate from control panel. To install, reverse removal procedure.

A/C COMPRESSOR

Removal & Installation

1) If possible, run engine at idle with A/c on fro about 10 minutes. Stop engine and disconnect negative battery cable. Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove A/C compressor drive belt.

2) Disconnect refrigerant lines at A/C compressor. Disconnect wiring harness and remove generator. Remove drive belt adjusting bar bracket. Remove 3 bolts and A/C compressor. To install, reverse removal procedure.

AIR INLET CONTROL SERVOMOTOR & BLOWER UNIT

Removal & Installation

1) Disable air bag system. See AIR BAG SYSTEM SAFETY article in GENERAL SERVICING. Remove right side cowl trim. Remove right front door scuff plate. Remove passenger's side undercover.

2) Open glove box door. Pry out air bag connect cover plate (inside glove box). Disconnect air bag connector. Remove passenger's side lower panel. Remove CD changer (if equipped). Remove 2 bolts, 2 nuts, and passenger's air bag assembly.

3) Remove 3 screws and air duct. Disconnect blower unit wiring harness and detach wiring harness clamps. Remove nut (on bottom

right), screw (at bottom middle), bolts (on left side), and blower unit

4) Release clips and remove air filter cover. Remove air filter and filter case. Remove 3 screws and blower motor. Remove 3 screws and air inlet control servomotor. To install, reverse removal procedure.

BLOWER MOTOR

Removal & Installation

Remove passenger's side undercover. Disconnect wiring harness at blower motor. Remove 3 screws and blower motor. To install, reverse removal procedure.

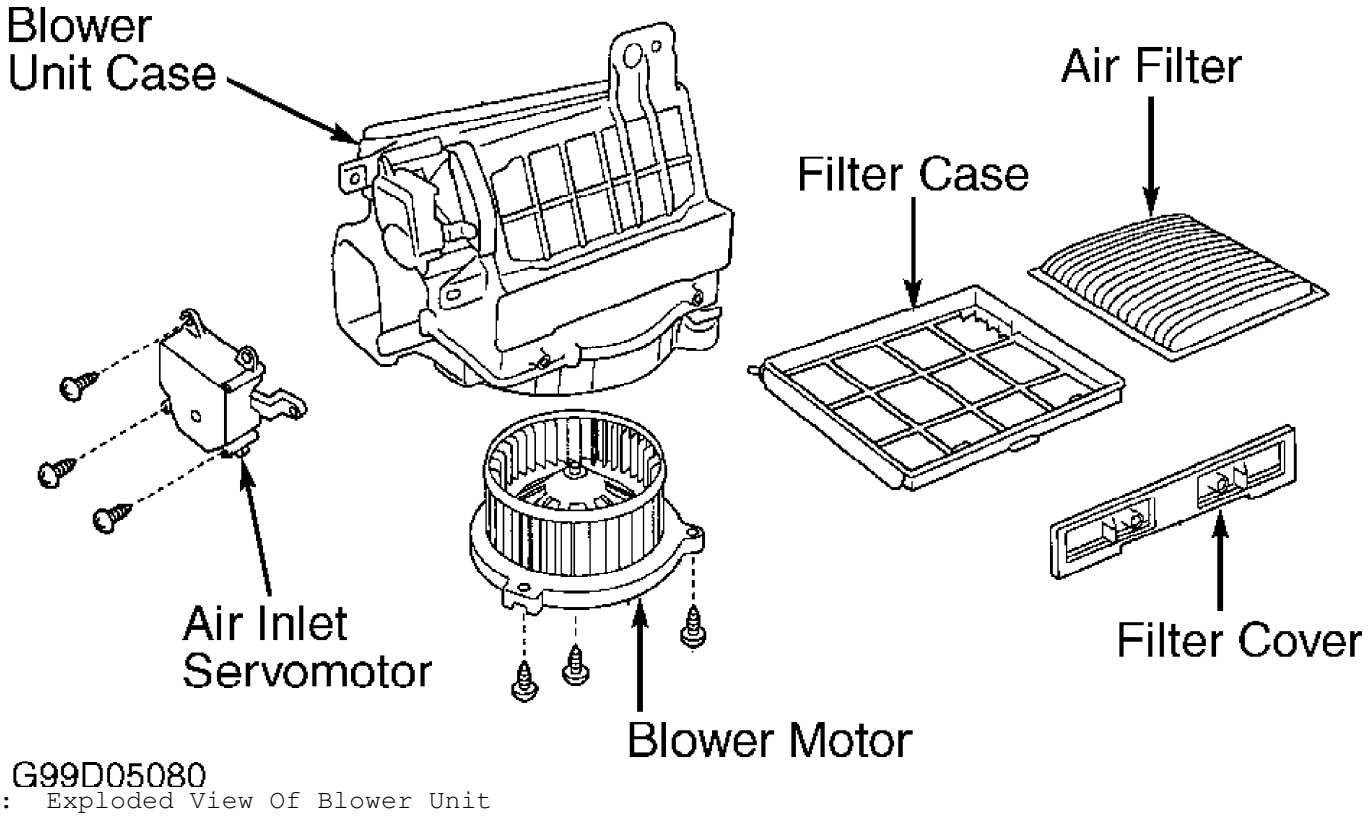


Fig. 6: Exploded View Of Blower Unit
Courtesy of Toyota Motor Sales, U.S.A, Inc.

CONDENSER

Removal & Installation

1) Discharge A/C system, using refrigerant recovery/recycling equipment. Remove 7 clips and radiator upper seal. remove front bumper. Disconnect refrigerant lines from right side of condenser. Remove condenser from vehicle.

2) To install, reverse removal procedure. If installing a new condenser, add 1.4 ounces of refrigerant oil to new condenser. Lubricate "O" rings with refrigerant oil.

EVAPORATOR UNIT

Removal & Installation

1) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove wiper arms. Remove weatherstrip,

and left and right cowl vents. Remove 5 bolts and wiper link assembly. Remove engine hood. Remove outer front cowl top panel.

2) Remove instrument panel and instrument panel reinforcement. See INSTRUMENT PANEL. Disconnect refrigerant lines and heater hoses (at cowl).

3) Remove blower motor unit. See AIR INLET CONTROL SERVOMOTOR & BLOWER UNIT. Release clips and remove lower defrost nozzle and heater register center duct. Remove center console air duct.

4) Disconnect wiring harness connector. Remove 2 nuts (right side), 2 bolts (left side), and evaporator unit. To install, reverse removal procedure. Ensure drain hose is properly installed.

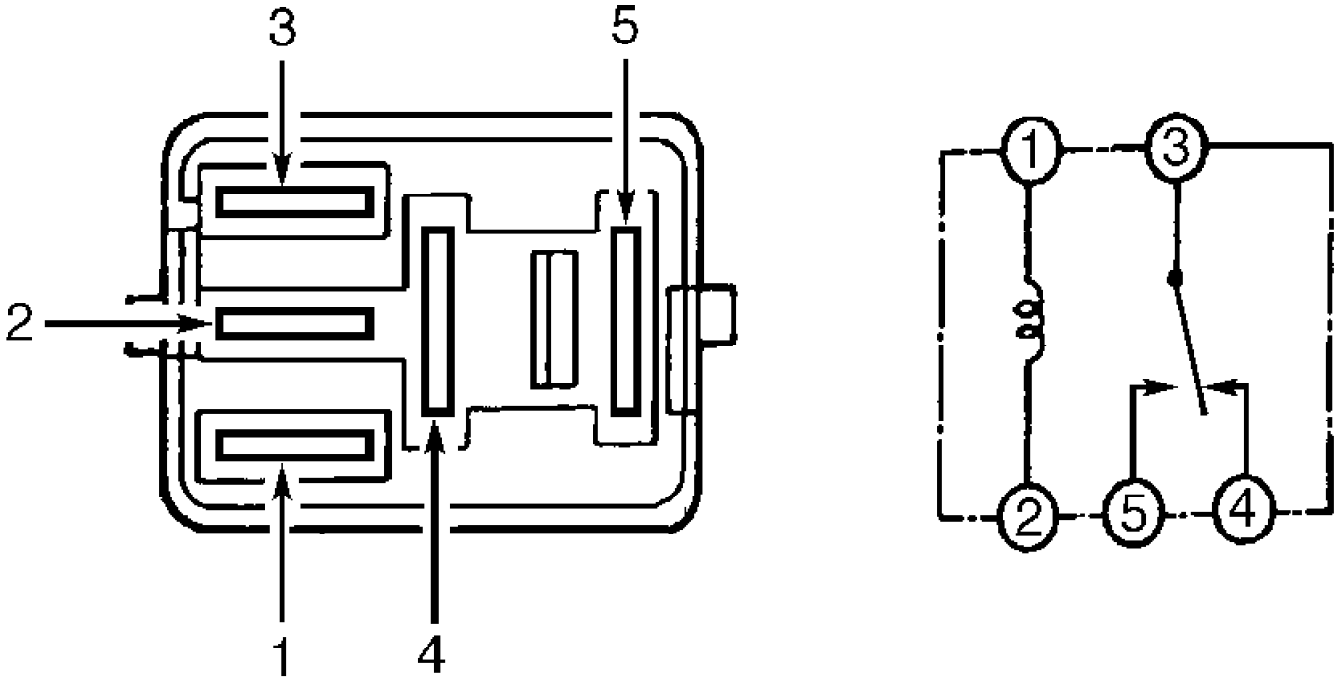


Fig. 7: Exploded View Of Evaporator Unit
Courtesy of Toyota Motor Sales, U.S.A, Inc.

EXPANSION VALVE

Removal & Installation

1) Discharge A/C system, using approved refrigerant recovery/recycling equipment. Remove instrument panel. See INSTRUMENT PANEL. Remove packing around expansion valve.

2) Using a 5 mm Allen wrench, remove bolts and expansion valve tubing. Remove expansion valve from tube connector. To install, reverse removal procedure. Lubricate "O" rings with refrigerant oil.

INSTRUMENT PANEL

NOTE: Four bolt sizes, two screw sizes, and two nut sizes are used to retain instrument panel components. Note size and shape of bolt, nut, and screw during removal.

Removal & Installation

1) Ensure front wheels are in straight-ahead position. Disable air bag system. See AIR BAG SYSTEM SAFETY article in GENERAL SERVICING. Remove instrument panel side panels. Remove front door scuff plates. Remove front door opening trim.

2) Remove "A" pillar garnish molding. Remove cowl side trim. Remove speaker panels from top of instrument panel safety pad. Disconnect wiring harness connectors. Remove passenger's side undercover.

3) Open glove box door. Pry out air bag connect cover plate (inside glove box). Disconnect air bag connector. Remove passenger's side lower panel. Remove CD changer (if equipped). Remove 2 bolts, 2 nuts, and passenger's air bag assembly.

4) Remove steering wheel lower covers. Loosen driver's air bag Torx screws until groove along screw circumference catches on screw case. Pull out steering wheel pad and disconnect air bag connector. Remove driver's side air bag (steering wheel pad).

5) Disconnect steering wheel connector. Remove steering wheel nut. Using puller, remove steering wheel. Remove trim plate surrounding ignition lock cylinder. Remove driver's side lower instrument finish panel (disconnect hood opener control cable).

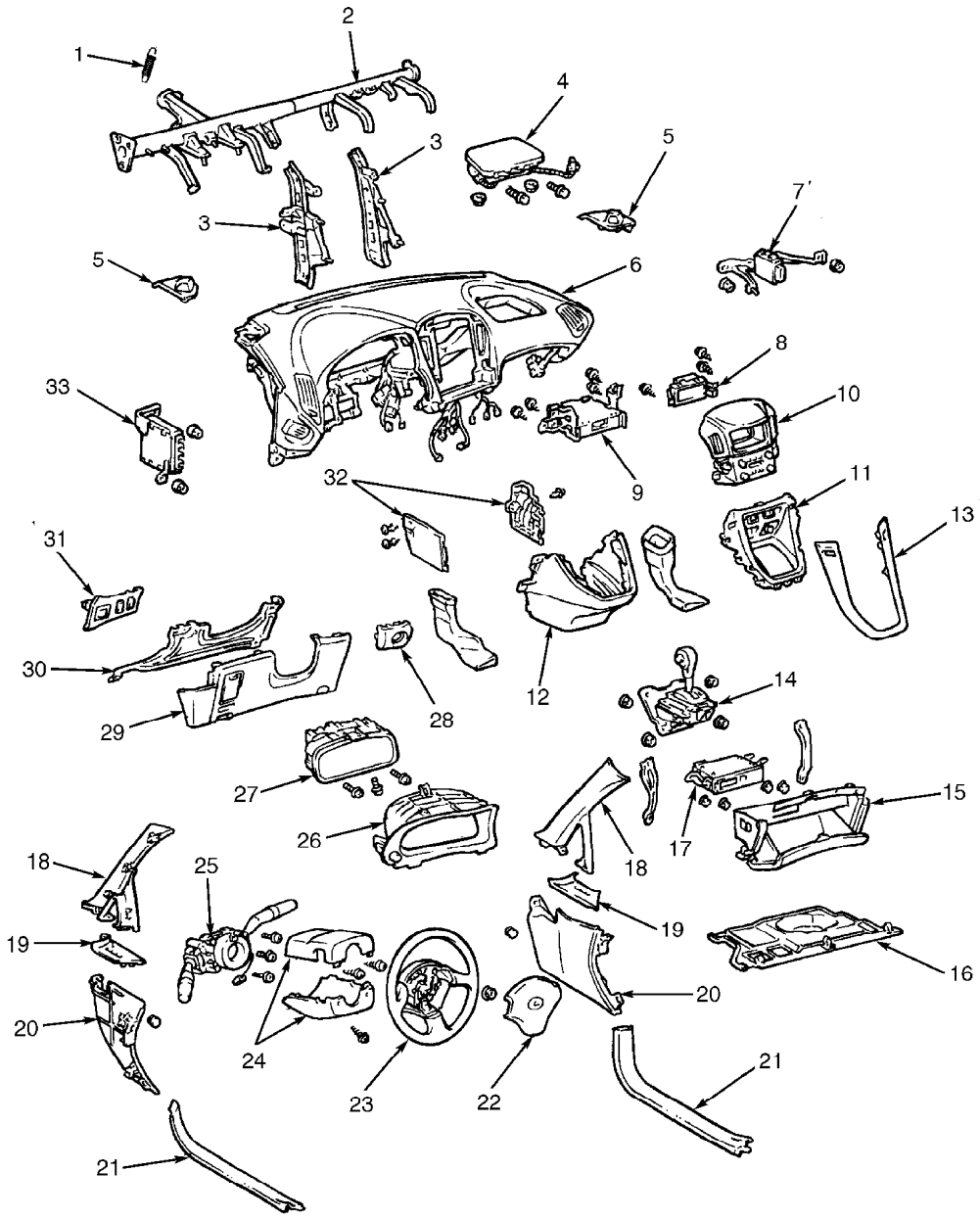
6) Remove driver's side lower instrument panel insert. Remove steering column upper and lower covers. Disconnect 3 wing harness connectors. Disconnect air bag connector. Remove 3 screws and combination switch with spiral cable (clockspring).

7) Loosen hose clamp and disconnect steering column intermediate shaft sub-assembly. Remove steering column universal joint bolts. Remove 4 nuts and steering column assembly.

8) Remove lower center cluster (center console) finish panel. Remove center floor carper covers. Remove lower center finish panel. Remove 4 screws and center cluster finish panel. Remove 2 screws and instrument cluster finish panel. Remove combination meter (instrument cluster). Remove 2 bolts and lower retainers.

9) Disconnect shift control link from floor shift assembly. Disconnect wiring harness connectors. Remove 4 nuts and floor shift assembly. Remove air ducts. Remove instrument panel safety pad. Remove left and right center braces.

10) Remove 2 nuts and body control unit. Remove 2 nuts and Anti-Lock Brake System (ABS) control unit. Remove pedal and return spring. Remove instrument panel junction block. Remove 4 nuts, 4 bolts, and instrument panel reinforcement. To install, reverse removal procedure.



1. Pedal Return Spring
2. Instrument Panel Reinforcement
3. Center Brace
4. Passenger's Air Bag
5. Speaker Panel
6. Instrument Panel Safety Pad
7. Anti-Lock Brake System (ABS) ECU
8. Display Panel
9. Radio
10. Center Cluster Finish Panel
11. Lower Center Cluster Finish Panel
12. Lower Center Finish Panel
13. Trim Ornament
14. Floor Shift Assembly
15. Passenger's Side Lower Panel
16. Passenger's Side Undercover
17. CD Changer (If Equipped)
18. "A" Pillar Garnish Molding
19. Instrument Panel Side Panel
20. Cowl Side Trim
21. Scuff Plate
22. Steering Wheel Pad (Driver's Air Bag)
23. Steering Wheel
24. Steering Column Covers
25. Combination Switch/Spiral Cable Assembly
26. Instrument Cluster Finish Panel
27. Instrument Cluster
28. Trim Plate
29. Driver's Side Lower Finish Panel
30. Lower Insert
31. Lower Cluster Finish Panel
32. Center Floor Carpet Covers
33. Body ECU

G99J05083

Fig. 8: Exploded View Of Instument Panel & Reinforcement
Courtesy of Toyota Motor Sales, U.S.A, Inc.

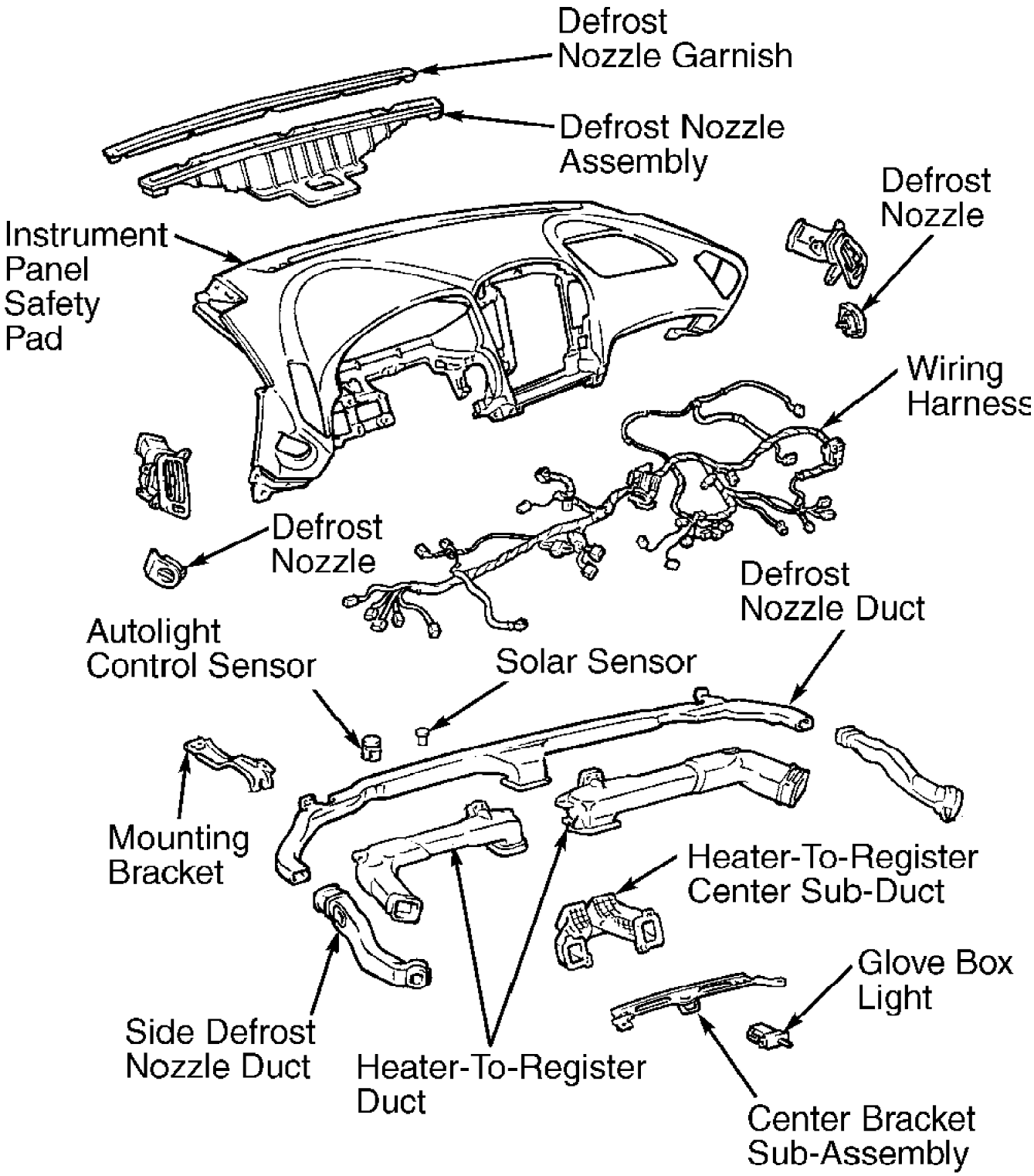


Fig. 9: Exploded View Of Instrument Panel Pad & Ducts
Courtesy of Toyota Motor Sales, U.S.A, Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bolts	18 (25)
Drive Belt Adjusting Bar Bracket Bolt/Nut	18 (25)
Passenger's Air Bag Bolts	15 (20)
Suction Line (Pipe Joint)	24 (32)
Wiper Arm Nuts	15 (20)
	INCH Lbs. (N.m)
Expansion Valve Tubing Bolts	48 (5.4)
Passenger's Air Bag Nuts	50 (5.6)
Refrigerant Lines	84 (10.0)
Wiper Motor Assembly Bolts	62 (7.0)

WIRING DIAGRAMS

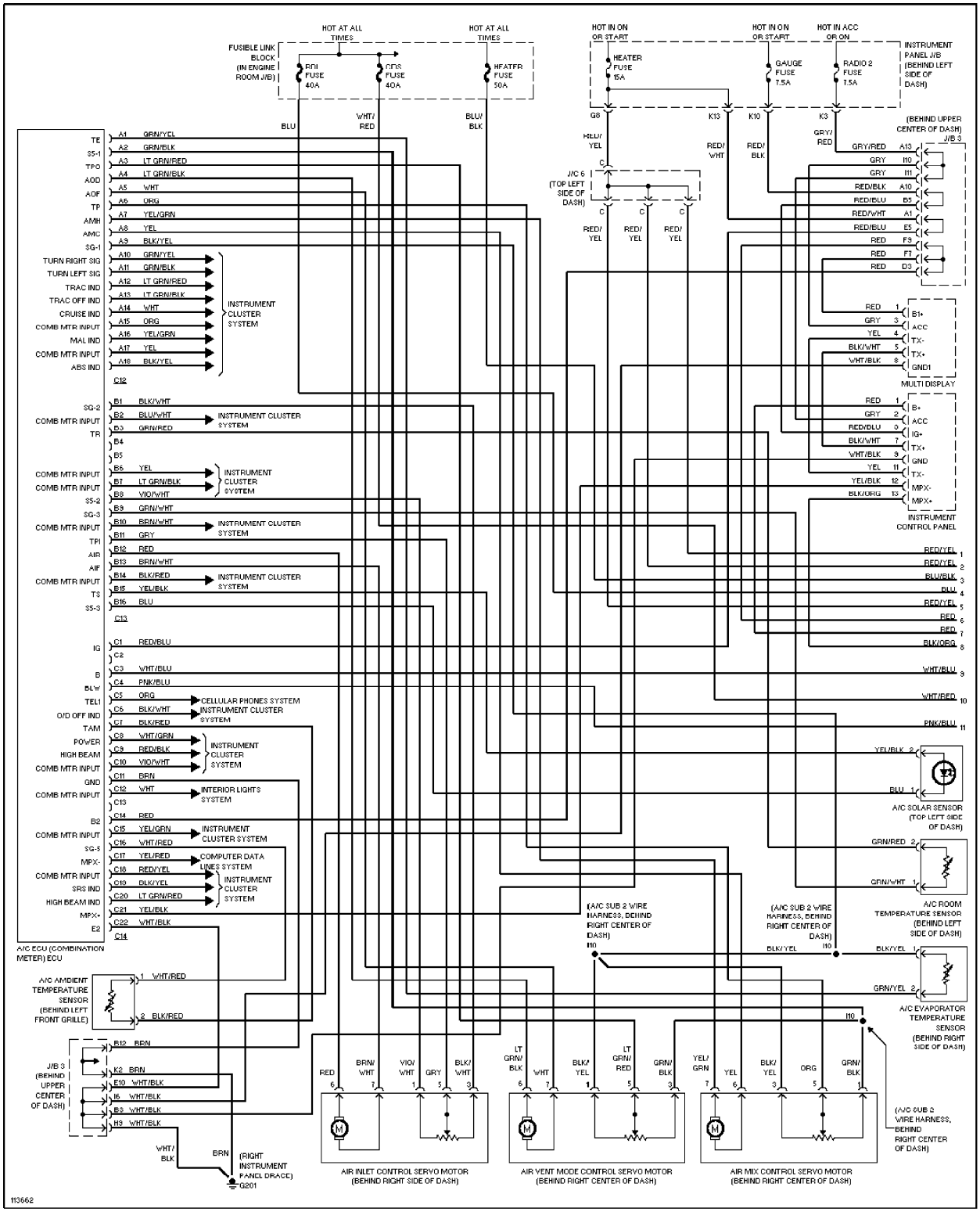


Fig. 10: Automatic A/C-Heater System Wiring Diagram (RX300 - 1 Of 2)

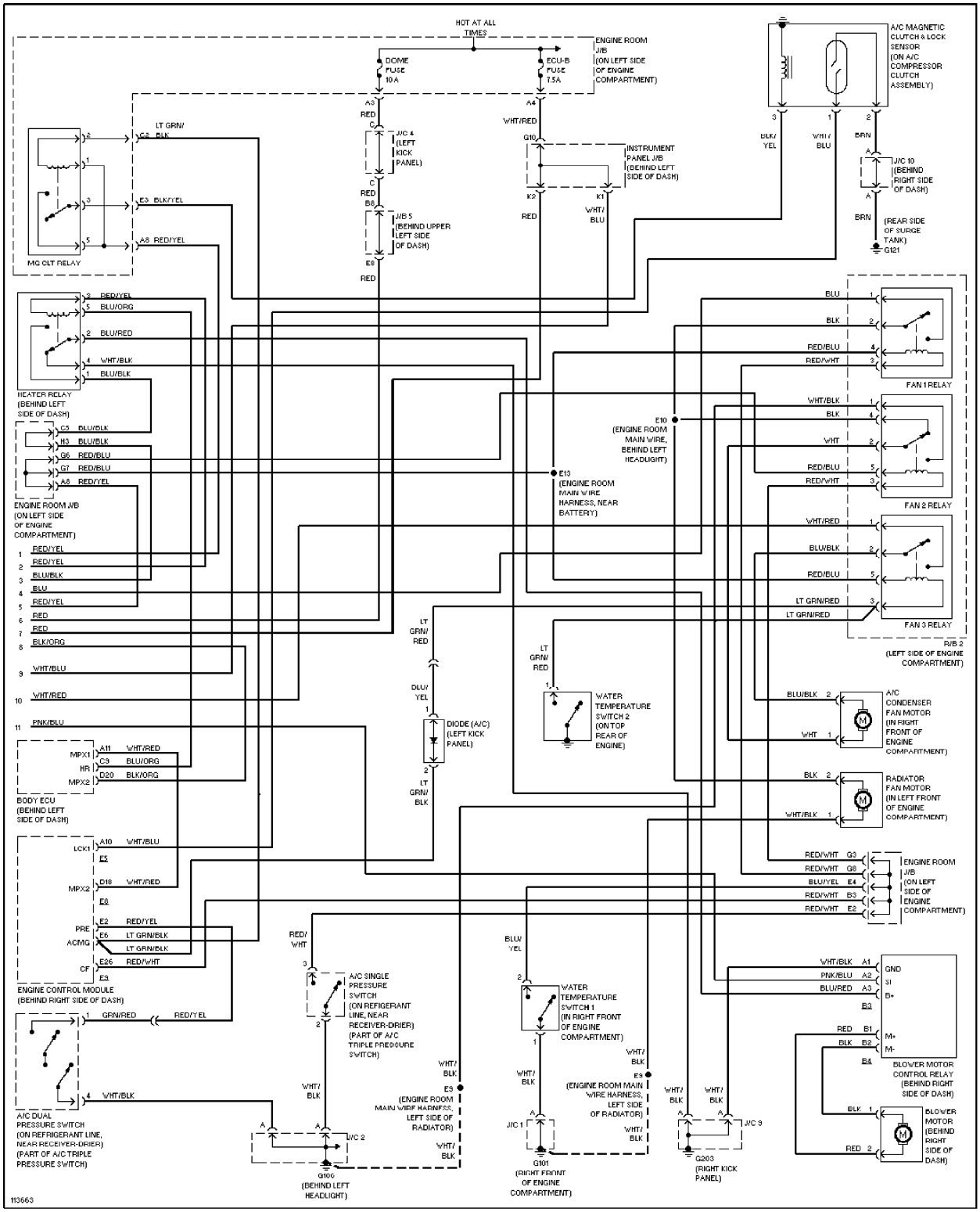


Fig. 11: Automatic A/C-Heater System Wiring Diagram (RX300 - 2 Of 2)

AIR BAG RESTRAINT SYSTEM

1999 Lexus RX 300

1999 AIR BAG RESTRAINT SYSTEMS
Lexus

RX300

DESCRIPTION & OPERATION

* PLEASE READ THIS FIRST *

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all WARNINGS and SERVICE PRECAUTIONS.

Supplemental Restraint System (SRS), also known as air bag system, is designed to provide increased accident protection for driver and passenger by deploying air bags in a front-end or side collision. The air bag system is designed to be used in conjunction with 3-point safety belts.

The air bag system includes the following components: driver-side air bag module, passenger-side air bag module, spiral cable, right and left front seat air bag modules, right and left front seat belt pretensioners, AIR BAG warning light, air bag sensor assembly (air bag center sensor), right and left side air bag sensor assemblies (air bag side sensor), right and left front air bag sensors (air bag front sensor) and associated wiring harnesses. See Fig. 1.

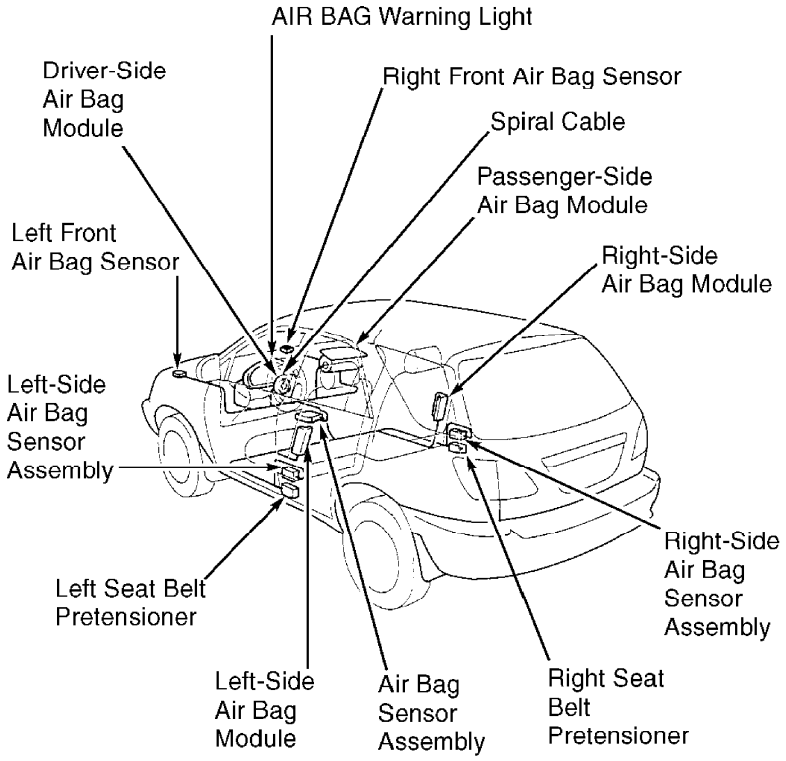


Fig. 1: Locating Restraint System Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

AIR BAG SENSOR ASSEMBLY

The air bag sensor assembly is located on the floor inside lower center finish panel. It consists of an air bag sensor, safing sensor and diagnosis, ignition and drive circuits. It receives signals from the air bag sensor, front air bag sensor and side air bag sensor and determines whether air bag modules must be deployed or not.

DRIVER-SIDE AIR BAG MODULE

The driver-side air bag and inflator is stored in the steering wheel pad. It contains a squib, igniter charge and gas generant and inflates the air bag when instructed by air bag sensor assembly.

FRONT AIR BAG SENSOR

The front air bag sensors are mounted inside right and left front side members. When sensor detects impact of sufficient force (above a predetermined limit), contacts inside the sensor close, sending a signal to the air bag sensor assembly.

PASSENGER-SIDE AIR BAG MODULE

The passenger-side air bag and inflator is stored in the instrument panel above glove box. It contains a squib, igniter charge and gas generant and inflates the air bag when instructed by air bag sensor assembly.

SEAT BELT PRETENSIONER

The seat belt pretensioner system is a component of the front outer seat belt. It contains a squib, gas generant, wire and piston and operates in the event of a front-end collision.

SIDE AIR BAG MODULE

The side air bag and inflator is stored in the outboard side of each front seat back. It contains a squib, igniter charge and gas generant and inflates the air bag when instructed by respective side air bag sensor assembly.

SIDE AIR BAG SENSOR ASSEMBLY

The side air bag sensor assembly is mounted in right and left center pillar. It consists of an air bag sensor, safing sensor and diagnosis circuit. It sends signals to the air bag sensor assembly which determines whether side air bag module must be deployed or not.

SPIRAL CABLE

The spiral cable is attached to combination switch and is used as electrical joint between chassis wiring harness and driver-side air bag module. Spiral cable is also known as clockspring.

SYSTEM OPERATION CHECK

Turn ignition switch to ACC or ON position. AIR BAG warning light should come on for about 6 seconds and then go out. If AIR BAG warning light does not operate as specified, go to DIAGNOSIS & TESTING .

SERVICE PRECAUTIONS

Observe the following precautions when servicing air bag system:

* Disable air bag system before servicing any air bag system or steering column component. Failure to do this could result in accidental air bag deployment and possible personal injury. See DISABLING & ACTIVATING AIR BAG SYSTEM.
* When diagnosing air bag system, always check for diagnostic trouble codes before disconnecting battery.
* After turning ignition switch to LOCK position and disconnecting negative battery cable, wait at least 90 seconds before working on air bag system. Air bag system is equipped with a back-up power source that may allow air bag to deploy until 90 seconds after disconnecting negative battery cable.
* If vehicle was in a minor collision but air bags did not deploy, inspect all system components for any sign of damage, and replace as necessary.
* Never use air bag system components from another vehicle. Replace air bag system components with new parts.
* Remove air bag sensor assembly and side air bag sensors, if repairing the vehicle requires impacting (shocking) the vehicle.
* Never disassemble or repair air bag sensor assembly, passenger-side air bag module, side air bag module or driver-side air bag module.
* Replace dropped, cracked, dented or otherwise damaged components.
* DO NOT expose air bag sensor assembly or driver-side, passenger-side or side air bag module directly to heat or flame.
* When diagnosing electrical circuits, use a volt/ohm meter with high impedance (10,000 ohms minimum).
* Information labels are attached to air bag components. Follow all notices on labels.
* After work on air bag system is complete, check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.
* Always wear safety glasses when servicing or handling air bag.
* When placing a live air bag on a bench or other surface, always face air bag and trim cover up and away from surface. This will reduce motion of module if it is accidentally deployed.
* After deployment, air bag surface may contain deposits of sodium hydroxide, which irritates skin. Always wear safety glasses, rubber gloves, and long-sleeved shirt during clean-up. After clean-up, wash hands using mild soap and water.
* Carry a live air bag module with trim cover (air bag) pointed away from your body to minimize injury in case accidental deployment.
* If air bag system is not fully functional for any reason, vehicle should not be driven until system is repaired and again becomes operational. DO NOT remove bulbs, modules, sensors or other components, or in any way disable system from operating normally. If air bag system is not functional, park vehicle until it is repaired and functions properly.

DISABLING & ACTIVATING AIR BAG SYSTEM

* PLEASE READ THIS FIRST *

WARNING: Back-up power supply maintains air bag system voltage for about 90 seconds after battery is disconnected. After disabling air bag system, wait at least 90 seconds before servicing air bag system to prevent accidental air bag deployment and possible personal injury.

DISABLING SYSTEM

For Component Replacement

Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds before starting any work on vehicle.

For Diagnosis & Testing

1) Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove driver-side air bag module. See DRIVER-SIDE AIR BAG MODULE under REMOVAL & INSTALLATION. Disconnect passenger-side air bag module connector, accessible by removing glove box door finish plate. See Fig. 2.

2) Disconnect air bag sensor assembly connectors. See AIR BAG SENSOR ASSEMBLY under REMOVAL & INSTALLATION. Disconnect right and left seat belt pretensioner connectors. See SEAT BELT PRETENSIONER under REMOVAL & INSTALLATION. Disconnect right-side and left-side air bag module connectors. See SIDE AIR BAG MODULE under REMOVAL & INSTALLATION.

3) Disconnect right and left-side air bag sensor connectors. See SIDE AIR BAG SENSOR under REMOVAL & INSTALLATION. Disconnect right and left front air bag sensor connectors. See FRONT AIR BAG SENSOR under REMOVAL & INSTALLATION.

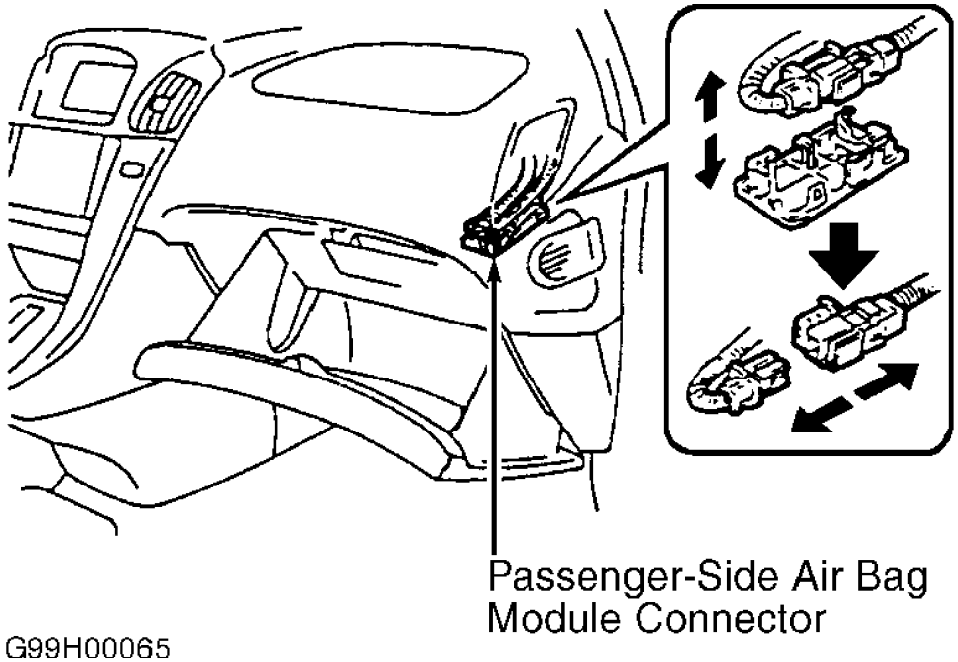


Fig. 2: Disconnecting Passenger-Side Air Bag Module
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ACTIVATING SYSTEM

For Component Replacement

Ensure ignition switch is in LOCK position. Reconnect negative battery cable. Perform SYSTEM OPERATION CHECK.

For Diagnosis & Testing

1) Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Install driver-side air bag module. Reconnect passenger-side air bag module connector. Connect air bag sensor assembly connectors.

2) Connect right and left seat belt pretensioner connectors. Connect right and left-side air bag module connectors. Connect right and left-side air bag sensor connectors. Connect right and left front air bag sensor connectors. Reconnect negative battery cable. Perform SYSTEM OPERATION CHECK.

DISPOSAL PROCEDURES

* PLEASE READ THIS FIRST *

WARNING: Undeployed air bags contain substances that can cause illness or injury if improperly handled. Disposing of an undeployed air bag may violate federal, state and/or local laws. If scrapping vehicle, air bag must be deployed while still mounted in vehicle. DO NOT deploy air bags inside vehicle unless vehicle is to be scrapped. Wear gloves and safety glasses when handling air bag. Seal deployed air bag in a vinyl bag and dispose of it like any other part.

ON-VEHICLE DEPLOYMENT (SCRAPPED VEHICLES ONLY)

Driver-Side & Passenger-Side Air Bag Module

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Ensure steering wheel, driver-side air bag and passenger-side air bag modules are not loose. If components are loose, remove and deploy air bag(s) using OFF-VEHICLE DEPLOYMENT procedure.

2) If deploying driver-side air bag module, remove lower steering column cover and disconnect Yellow spiral cable connector on rear of air bag module. If deploying passenger-side air bag, disconnect Yellow passenger-side air bag connector, accessible by removing glove box door finish plate. See Fig. 2.

3) For driver-side air bag, connect Deployment Tool (09082-00700) to spiral cable connector. For passenger-side air bag, connect Deployment Tools (09082-00700 and 09082-00760) to air bag connector. On both modules, position deployment tool at least 33 feet from front of vehicle. Close all doors and windows of vehicle.

4) Connect deployment tool Red clip to positive battery terminal and Black clip to negative battery terminal. Ensure no one is inside vehicle or within 33 feet of vehicle. Press activation switch to deploy air bag. Because of heat, DO NOT touch air bag for at least 30 minutes after deployment. Scrap vehicle with air bag(s) still installed.

Side Air Bag Module

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Ensure seat back is not loose. If components are loose, remove and deploy air bag(s) using OFF-VEHICLE DEPLOYMENT procedure. Disconnect appropriate side air bag connector, located under seat.

2) Connect Deployment Tools (09082-00700 and 09082-00750) to side air bag connector located under appropriate front seat cushion. Position deployment tool at least 33 feet from front of vehicle. Close all doors and windows of vehicle. Connect deployment tool Red clip to

positive battery terminal and Black clip to negative battery terminal.

3) Ensure no one is inside vehicle or within 33 feet of vehicle. Press activation switch to deploy air bag. Because of heat, DO NOT touch air bag for at least 30 minutes after deployment. Scrap vehicle with air bag(s) still installed.

Seat Belt Pretensioner

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Ensure seat belt pretensioner is not loose. If components are loose, remove and deploy using OFF-VEHICLE DEPLOYMENT procedure. Disconnect appropriate seat belt pretensioner connector. See SEAT BELT PRETENSIONER under REMOVAL & INSTALLATION.

2) Connect Deployment Tools (09082-00700 and 09082-00740) to appropriate seat belt pretensioner connector. Position deployment tool at least 33 feet from front of vehicle. Close all doors and windows of vehicle. Connect deployment tool Red clip to positive battery terminal and Black clip to negative battery terminal.

3) Ensure no one is inside vehicle or within 33 feet of vehicle. Press activation switch to deploy air bag. Because of heat, DO NOT touch air bag for at least 30 minutes after deployment. Scrap vehicle with air bag(s) still installed.

OFF-VEHICLE DEPLOYMENT

Driver-Side Air Bag Module

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Remove driver-side air bag module. See DRIVER-SIDE AIR BAG MODULE under REMOVAL & INSTALLATION.

2) Install 2 bolts (6 mm X 35 mm) with washers into holes located in rear of air bag module and tighten bolts by hand. DO NOT overtighten bolts. Wrap strong wire at least twice around each bolt. See Fig. 3. Ensure no slack is present in wire. If slack is present, or wire is not strong enough, driver-side air bag module may become loose due to shock when air bag deploys.

3) Position driver-side air bag module on rim of a scrap tire and wheel assembly with pad side facing upward. See Fig. 4. Securely tie air bag module to wheel rim through lug nut holes. Place a large cardboard box (weighted with at least 44 lbs. at sides) or at least 3 scrap tires on top of wheel which air bag module is attached. Each tire must exceed 7.87" (185 mm) wide and 14.17" (360 mm) diameter.

4) Connect Deployment Tools (09082-00700 and 09082-00760) to air bag module connector. Position deployment tool at least 33 feet away from air bag module. Press activation switch to deploy air bag. Because of heat, wait 30 minutes before handling driver-side air bag module. Seal deployed air bag in vinyl bag and dispose of in usual manner.

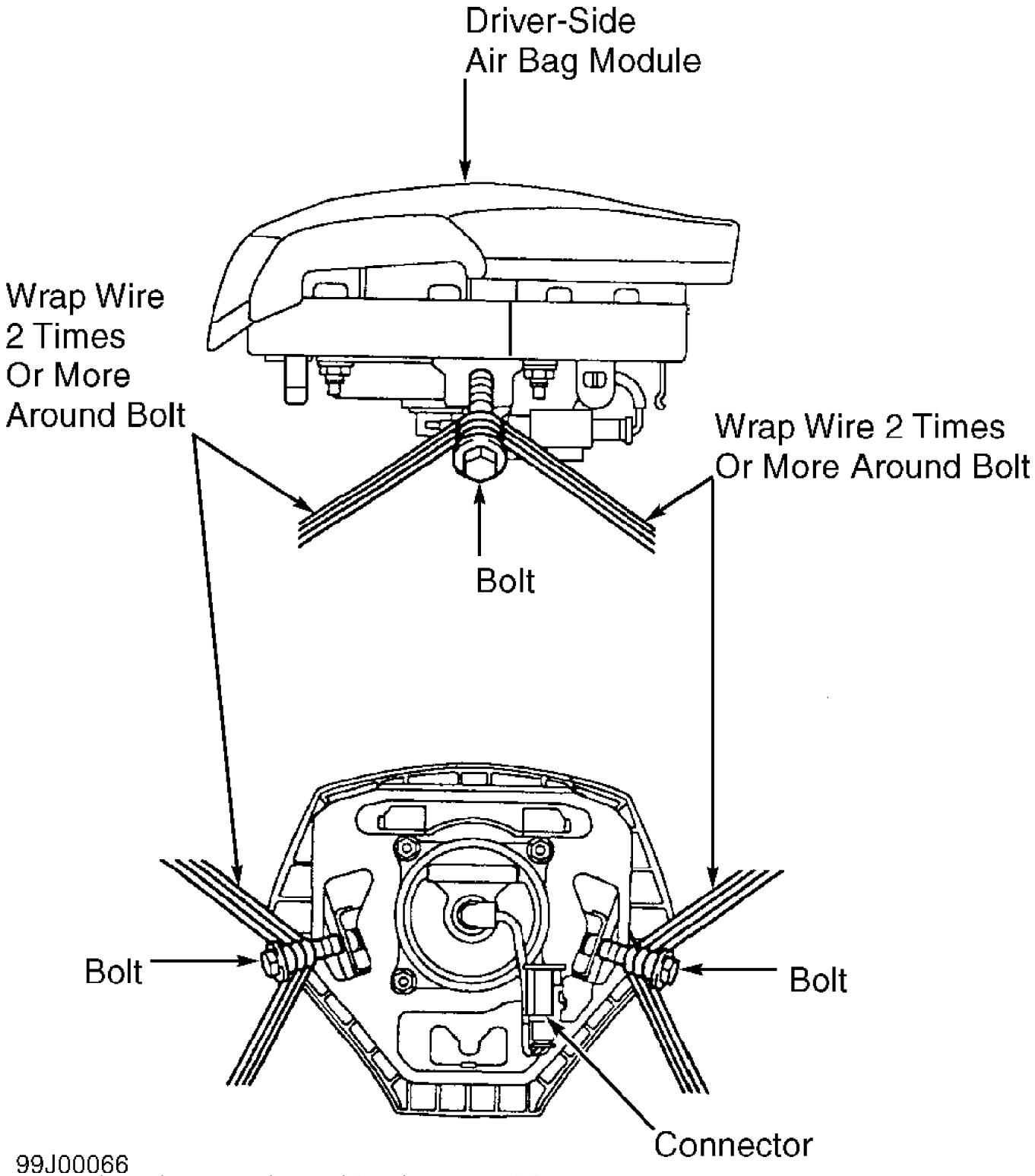


Fig. 3: Securing Wire To Driver-Side Air Bag Module
Courtesy of Toyota Motor Sales, U.S.A., Inc.

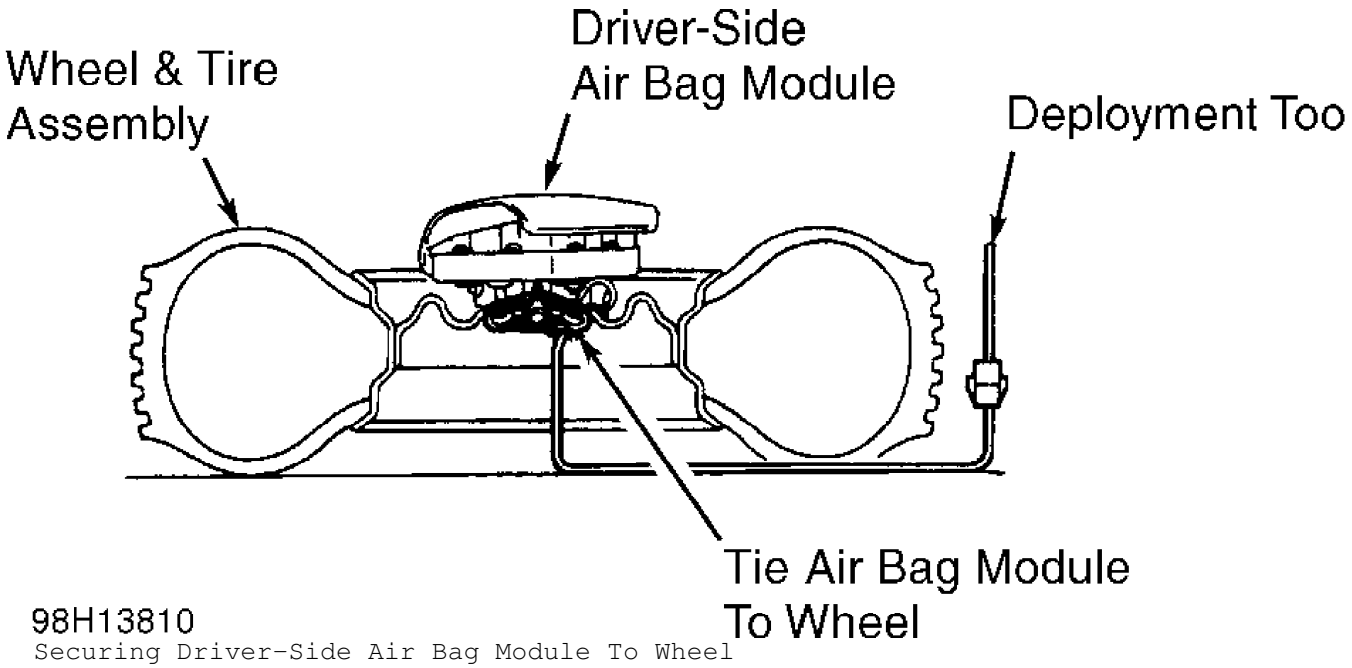


Fig. 4: Securing Driver-Side Air Bag Module To Wheel
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Passenger-Side Air Bag Module

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Remove passenger-side air bag. See PASSENGER-SIDE AIR BAG under REMOVAL & INSTALLATION.

2) Install 2 nuts on right and left side of passenger-side air bag module. Position air bag inside a scrap tire with deployment side facing inside of tire. Tire must exceed 7.87" (185 mm) wide and 14.17" (360 mm) diameter. Secure air bag module with strong wire wound around tire, nuts and module mounting brackets. See Fig. 5. Place this tire between 4 other tires (top tire should have wheel installed). Securely tie all tires together with wire.

3) Connect Deployment Tools (09082-00700 and 09082-00760) to passenger-side air bag connector. Position deployment tool at least 33 feet away from passenger-side air bag. Press activation switch to deploy passenger-side air bag. Because of heat, wait 30 minutes before handling passenger-side air bag. Seal deployed air bag in vinyl bag and dispose of in usual manner.

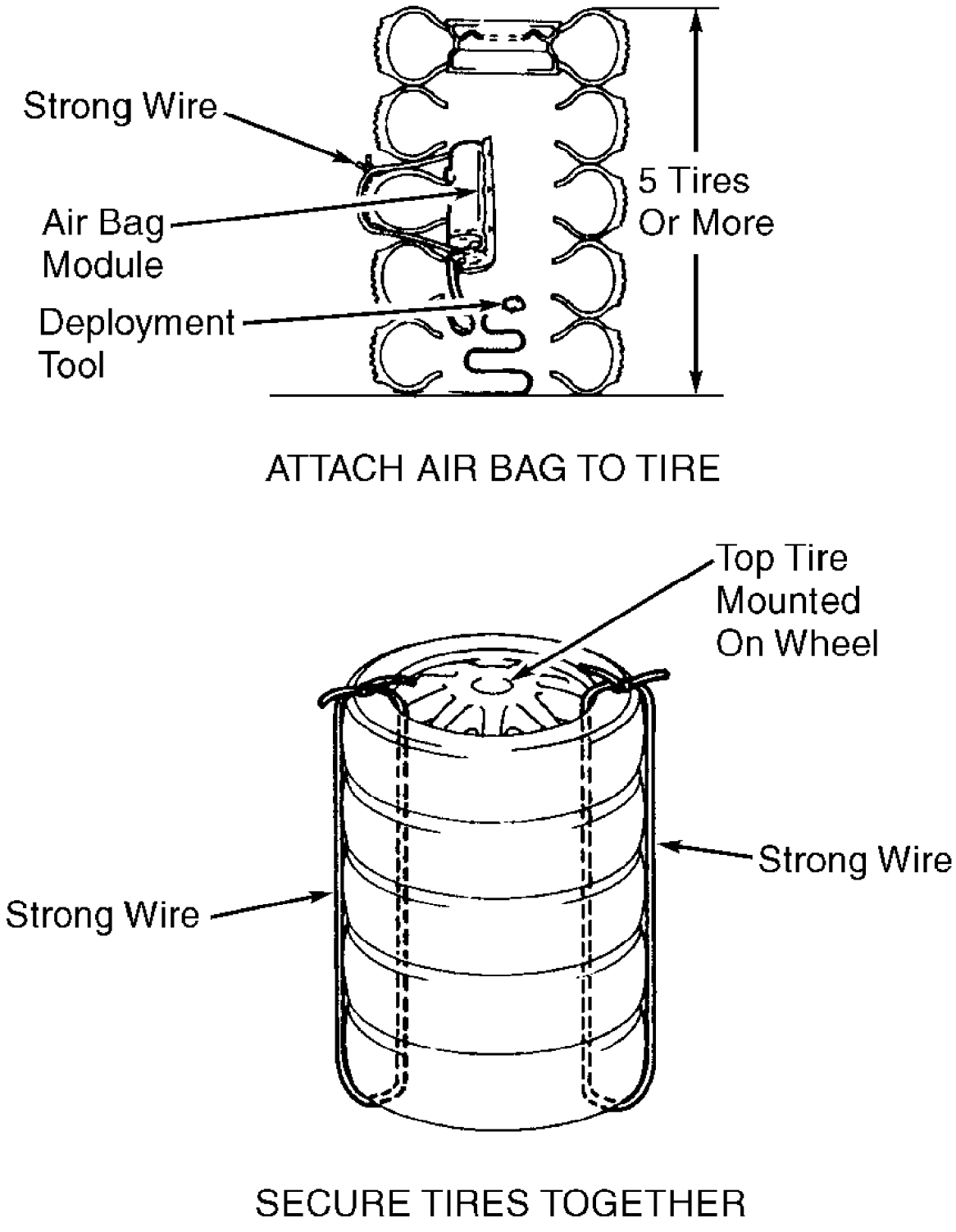


Fig. 5: Preparing Passenger-Side Air Bag For Module Deployment
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Side Air Bag Module

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect

negative battery cable. Remove appropriate side air bag. See SIDE AIR BAG under REMOVAL & INSTALLATION. Install 2 nuts on stud located on rear side of air bag module. Wrap strong wire at least twice around each stud. See Fig. 6. Ensure no slack is present in wire.

2) Position side air bag inside a scrap tire with deployment side facing inside of tire and secure with strong wire. Place this tire between 4 other tires (top tire should have wheel installed). Securely tie all tires together with strong wire. See Fig. 5.

3) Connect Deployment Tools (09082-00700 and 09082-00750) to side air bag connector. Position deployment tool at least 33 feet away from side air bag. Press activation switch to deploy side air bag. Because of heat, wait 30 minutes before handling side air bag. Seal deployed air bag in vinyl bag and dispose of in usual manner.

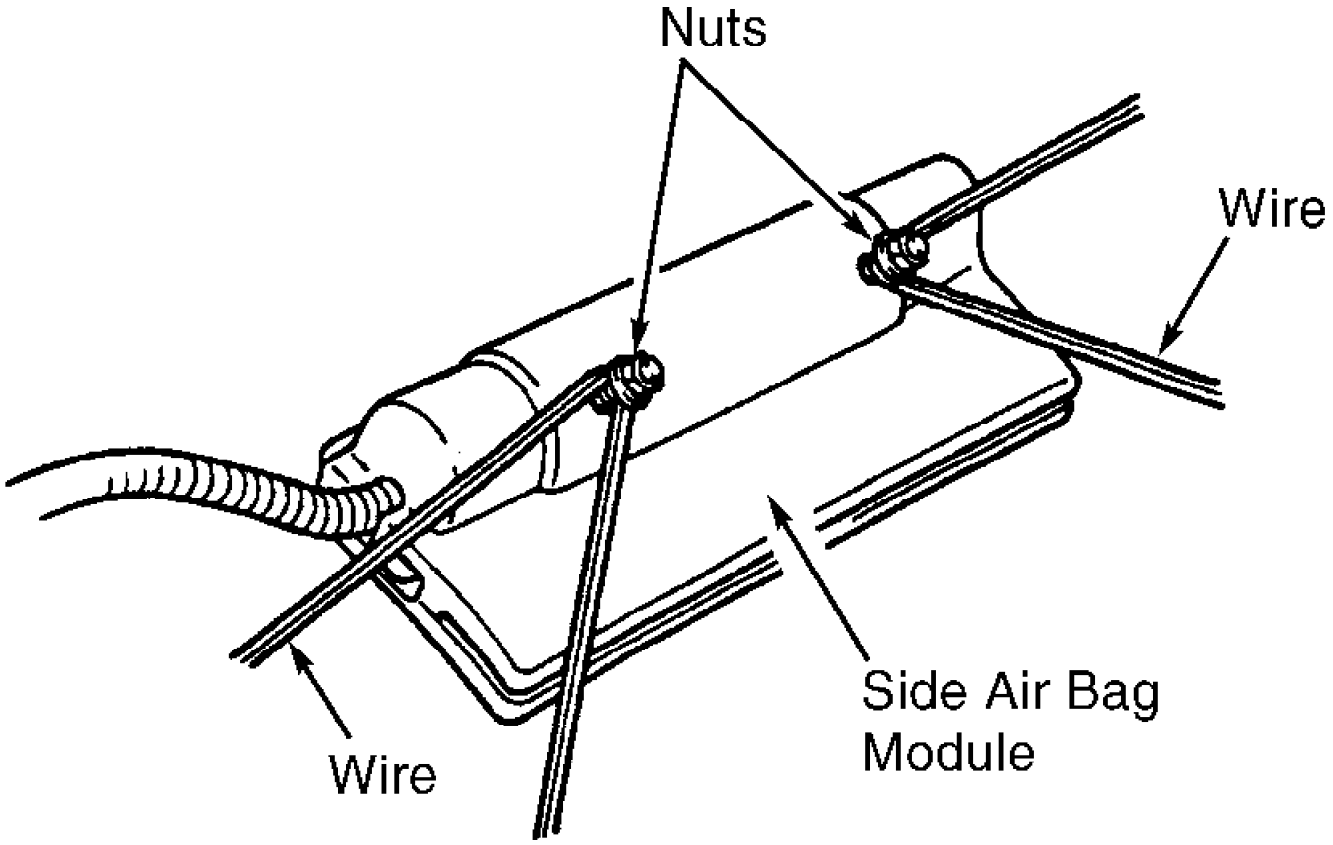


Fig. 6: Securing Wire To Side Air Bag Module
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Pretensioner

1) Before proceeding, see SERVICE PRECAUTIONS. Disconnect negative battery cable. Remove appropriate seat belt pretensioner. See SEAT BELT PRETENSIONER under REMOVAL & INSTALLATION.

2) Connect Deployment Tools (09082-00700 and 09082-00740) to seat belt pretensioner connector. Position seat belt pretensioner on ground and cover with wheel and tire assembly. See Fig. 7. Position deployment tool at least 33 feet away from seat belt pretensioner. Press activation switch to deploy seat belt pretensioner. Because of heat, wait 30 minutes before handling. Seal deployed pretensioner in vinyl bag and dispose of in usual manner.

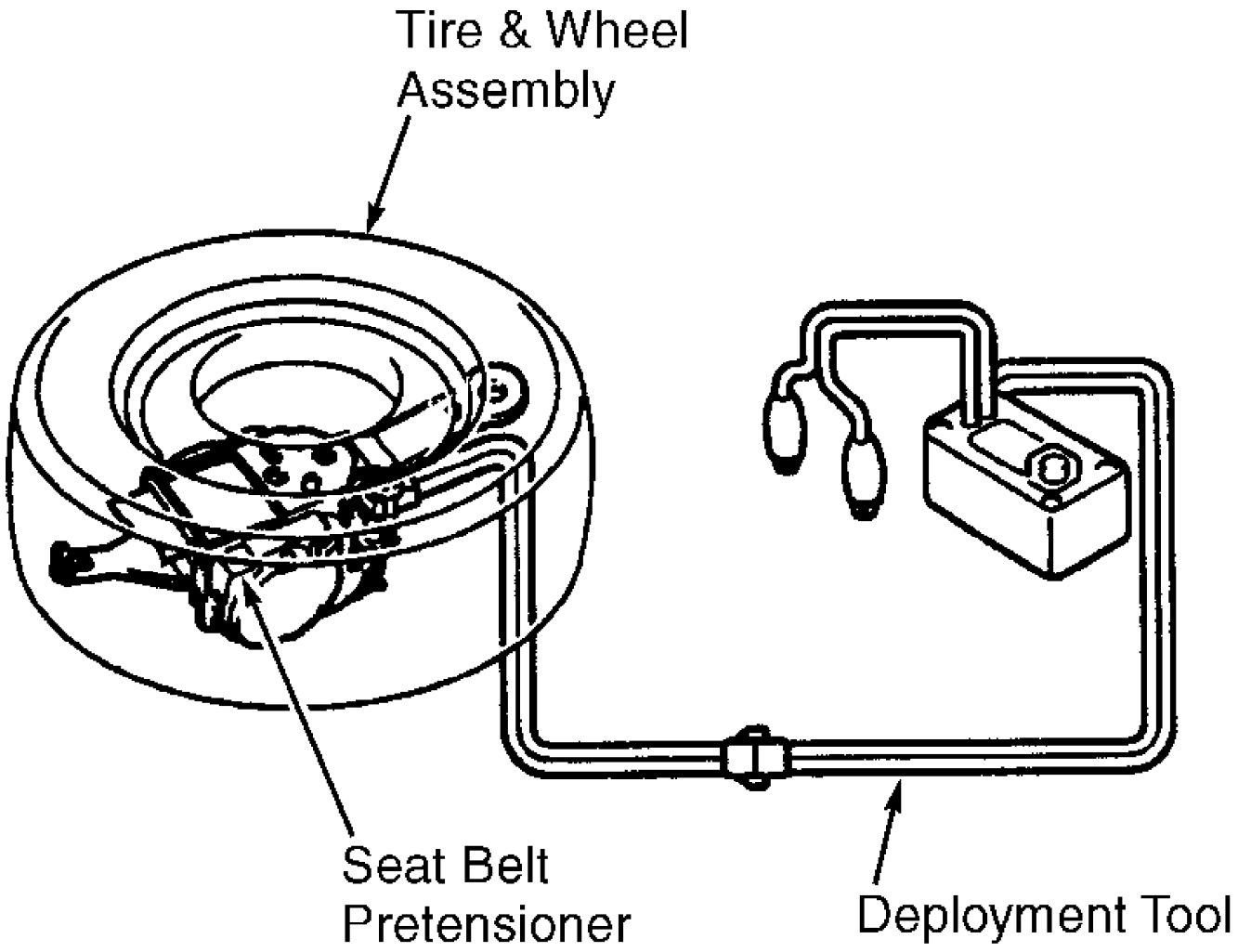


Fig. 7: Deploying Seat Belt Pretensioner
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POST-COLLISION INSPECTION

When a vehicle has been involved in a collision, certain components of the passive restraint system must be inspected or replaced. See PASSIVE RESTRAINT SYSTEM INSPECTION article in the GENERAL INFORMATION section for post-collision inspection information.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Failure to follow air bag service precautions may result in air bag deployment and personal injury. See SERVICE PRECAUTIONS. After component replacement, perform a system operational check to ensure proper system operation. See SYSTEM OPERATION CHECK.

AIR BAG SENSOR ASSEMBLY

Removal & Installation

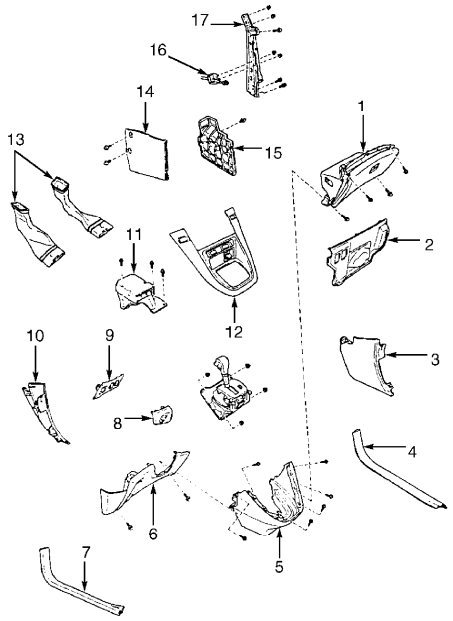
1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Air bag sensor is located on the floor inside lower center finish panel. See Figs. 1 and 8.

2) Remove left front door scuff plate. See Fig. 8. Remove clip and left cowl side trim. Remove lower finish plate. Remove lower center finish panel. Remove 2 bolts and lower finish panel. Disconnect hood lock control cable.

3) Remove right front door scuff plate. Remove clip and right cowl side trim. Remove No. 2 under cover. Remove 2 bolts, 2 screws and lower No. 2 panel. Remove center lower finish panel. Remove 3 clips and right center floor carpet cover. Remove 6 screws and lower center finish panel.

4) Disconnect shift control cable. Disconnect 3 electrical connectors. Remove 4 nuts and floor shift assembly. Remove 2 nuts and shift control cable bracket. Remove 2 nuts, 3 bolts and No. 1 brace. Remove air ducts. Disconnect air bag sensor assembly connectors. Remove 3 Torx screws and air bag sensor assembly.

5) To install, reverse removal procedure. Tighten air bag sensor assembly screws to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.



1. Lower No. 2 Panel
2. No. 2 Under Cover
3. Right Cowl Side Trim
4. Right Front Door Scuff Plate
5. Lower Center Finish Panel
6. Lower Finish Panel
7. Left Front Door Scuff Plate
8. Lower Finish Panel Plate
9. Lower Cluster Finish Panel
10. Left Cowl Side Trim
11. Air Bag Sensor Assembly
12. Center Lower Cluster Finish Panel
13. Air Duct
14. Left Center Floor Carpet Cover
15. Right Center Floor Carpet Cover
16. Shift Control Cable
17. No. 1 Brace

99B00067

Fig. 8: Removing Air Bag Sensor Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DRIVER-SIDE AIR BAG MODULE

NOTE: If steering wheel horn button contact place is deformed, DO NOT repair. Replace steering wheel assembly.

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Ensure front wheels are in straight-ahead position.

2) Remove screw covers from back side of steering wheel for access to air bag module retaining screws. See Fig. 9. Loosen Torx screws until groove around screw circumference catches on screw case.

3) Pull driver-side air bag module from steering wheel and disconnect air bag module connector. Place air bag module on a flat surface with pad cover facing up.

4) To install, reverse removal procedure. Tighten air bag module screws to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

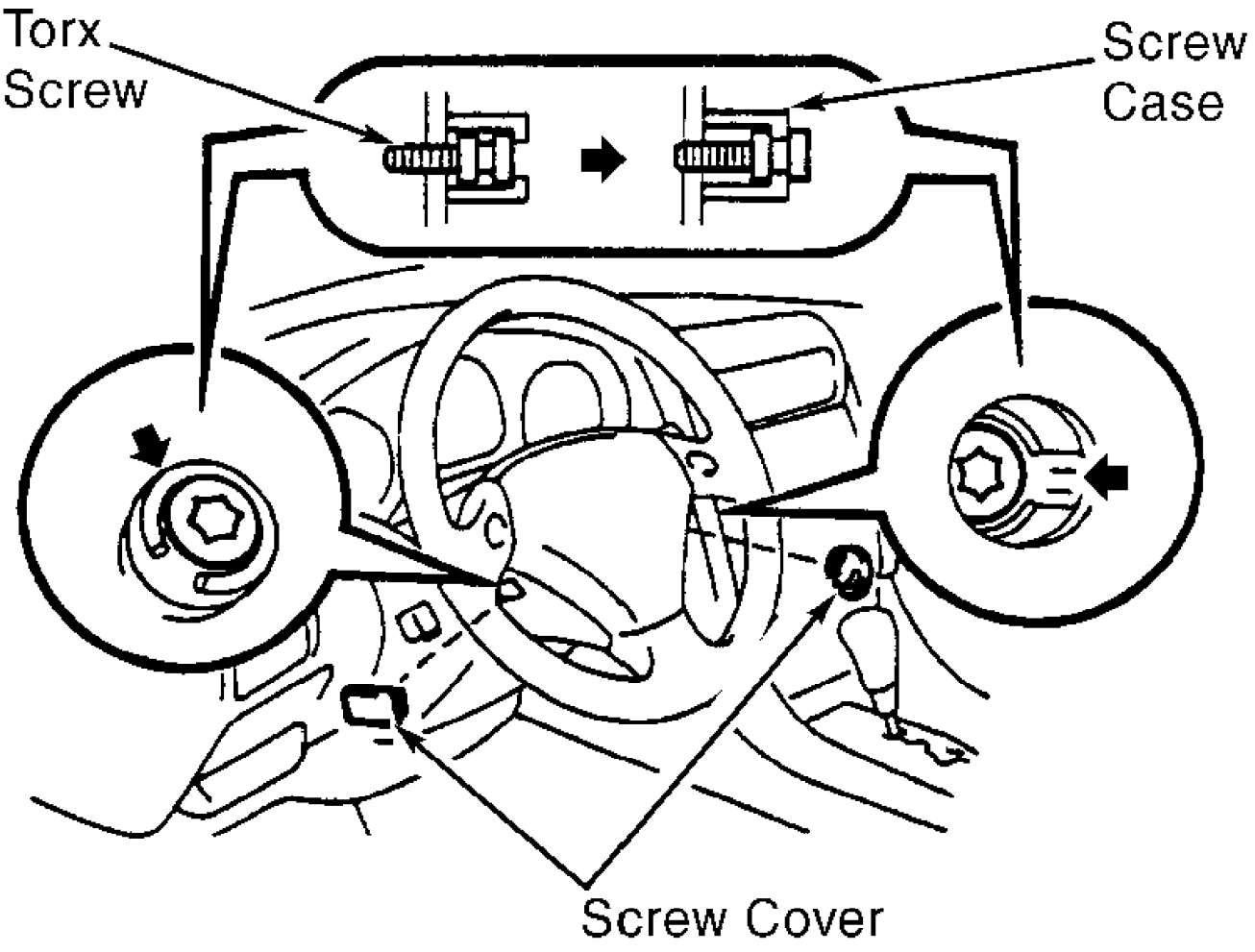


Fig. 9: Removing Driver-Side Air Bag Module
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FRONT AIR BAG SENSOR

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds.

2) For left front air bag sensor, remove battery hold-down, battery, battery box and tray. Disconnect left front air bag sensor connector. Remove 2 bolts and remove sensor. For right front air bag sensor, disconnect right front air bag sensor connector. Remove 2 bolts and remove sensor.

3) To install, reverse removal procedure. Tighten front air bag sensor bolts to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

PASSENGER-SIDE AIR BAG MODULE

NOTE: If instrument panel or instrument panel reinforcement is deformed or cracked, DO NOT repair. Always replace with new parts.

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Pry out glove box door finish plate, disconnect passenger-side air bag module harness connector. See Fig. 2 . Remove right front door scuff and right cowl side trim.

2) Remove lower finish panel. See Fig. 10. Remove 2 bolts and 2 screws and remove lower No. 2 panel. Remove 4 nuts and CD changer (if equipped). Remove 2 bolts and 2 nuts and passenger-side air bag module. Place air bag module on a flat surface with pad cover facing up.

3) To install, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS. When properly installed, there should be no interference between instrument panel and air bag module. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

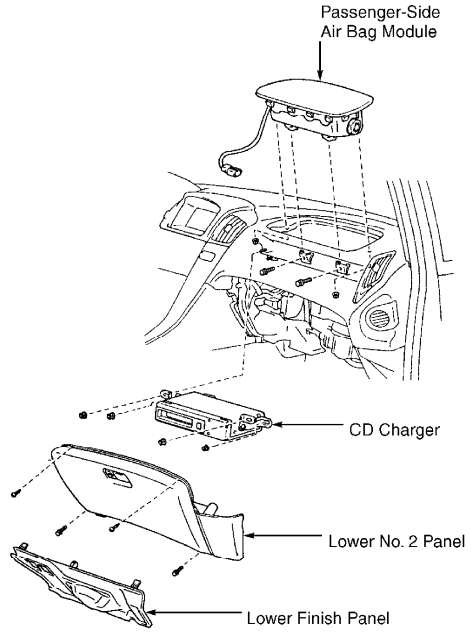


Fig. 10: Removing Passenger-Side Air Bag Module
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SIDE AIR BAG MODULE

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove 4 seat track bolts. Move front seat fully forward. Disconnect Yellow side air bag module connector and power seat connector. Remove front seat.

2) Remove cap, bolt and armrest. See Fig. 11. Remove headrest and headrest supports. Pry seatback board from top of seatback. Lift upward on seatback board to disengage hooks on bottom of seatback board. Remove all hog rings. Disengage hook on seatback cover. Remove 2 screws, 2 hooks and remove seatback cover with pad from seatback frame.

3) Tape tip of screwdriver and pry off 2 power seat switch knobs. Remove 4 screws and front seat cushion shield and front power adjuster shield. Remove 3 screws and front seat cushion inner shield. Remove side air bag module wire harness from seat cushion assembly. Remove 4 bolts and seat cushion assembly.

4) Remove 3 screws and reclining adjuster inside cover. Remove side air bag module wire harness from reclining adjuster inside cover. Remove 2 nuts and side air bag module. Place air bag module on a flat surface with deployment side facing up.

5) To install, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

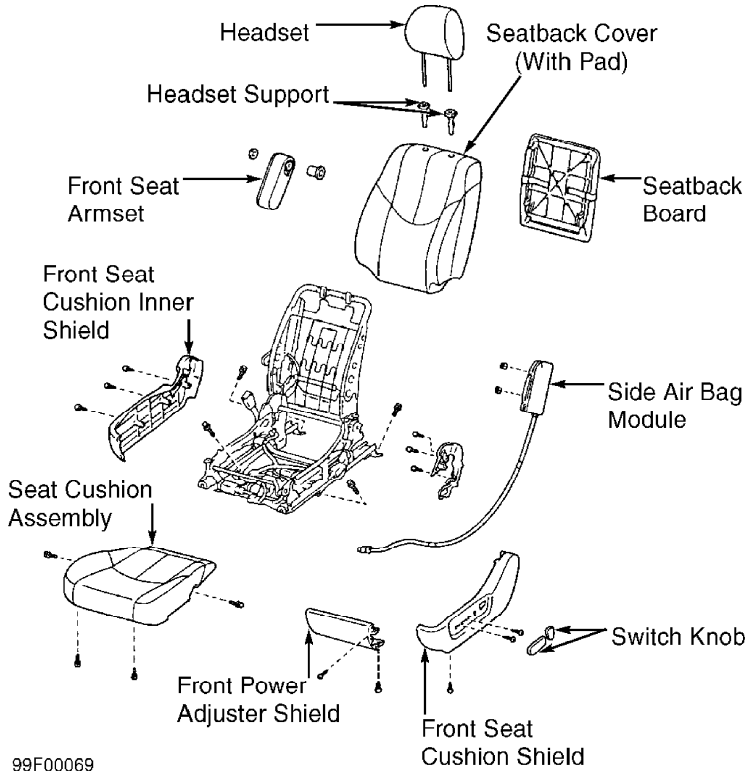


Fig. 11: Removing Side Air Bag Module (Left Seat Shown; Right Seat Is Similar) Courtesy of Toyota Motor Sales, U.S.A., Inc.

SIDE AIR BAG SENSOR ASSEMBLY

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove front and rear door scuff plates and center pillar lower garnish. See Fig. 12. Disconnect pretensioner connector and retractor switch connectors.

2) Remove 2 bolts and pretensioner/retractor assembly. Disconnect side air bag sensor assembly connector. Using Torx wrench (T40), remove 3 screws and side air bag sensor assembly.

3) To install, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

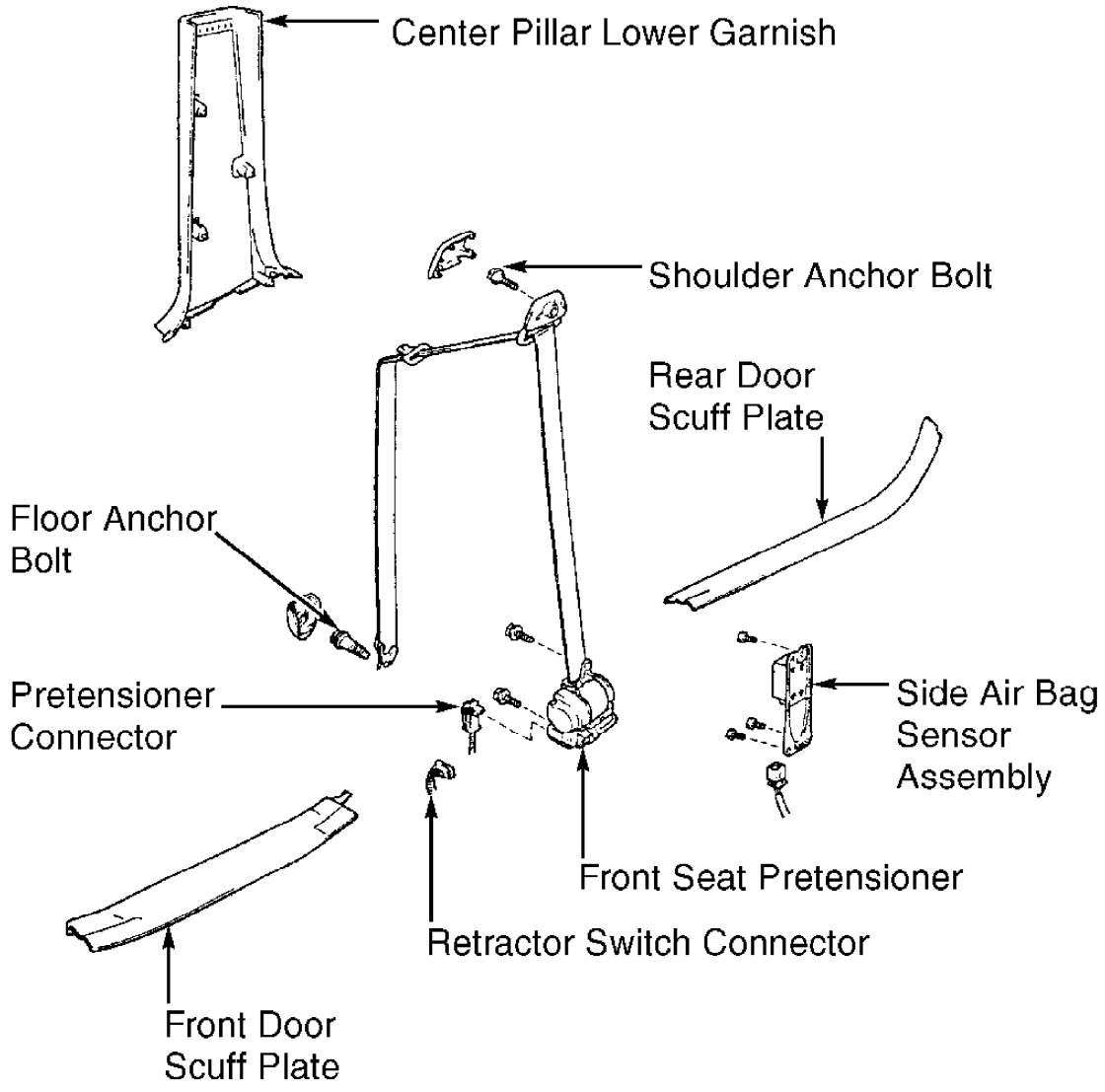


Fig. 12: Removing Seat Belt Pretensioner & Side Air Bag Sensor Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SEAT BELT PRETENSIONER

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove front and rear door scuff plates. See Fig. 12.

2) Remove center pillar lower garnish. Disconnect pretensioner connector and retractor switch connectors. Remove bolt and shoulder anchor. Remove bolt and floor anchor. Remove 2 bolts and pretensioner/retractor assembly.

3) To install, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

SPIRAL CABLE

Removal

Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove driver-side air bag module. See DRIVER-SIDE AIR BAG MODULE. Remove steering wheel. See STEERING WHEEL. Remove lower finish panel assembly. Remove upper and lower steering column covers. Remove 4 screws and spiral cable from combination switch.

WARNING: Spiral cable mating marks must be properly aligned or steering wheel may not turn completely, or flat cable inside spiral cable may be severed, disabling air bag system.

Installation

To install, reverse removal procedure. Ensure front wheels are in straight-ahead position and spiral cable is properly aligned. See SPIRAL CABLE under ADJUSTMENTS. Tighten fasteners to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

STEERING WHEEL

Removal & Installation

1) Before proceeding, see SERVICE PRECAUTIONS. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Ensure front wheels are in straight-ahead position.

2) Remove driver-side air bag module. See DRIVER-SIDE AIR BAG MODULE. Remove steering wheel retaining nut. Place match marks on steering wheel and steering column shaft for reassembly reference. Using appropriate puller, pull steering wheel from steering column shaft.

3) To install, reverse removal procedure. Ensure front wheels are in straight-ahead position and spiral cable is properly aligned. See SPIRAL CABLE under ADJUSTMENTS. Tighten steering wheel retaining nut to specification. See TORQUE SPECIFICATIONS. Check AIR BAG warning light to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

ADJUSTMENTS

SPIRAL CABLE

Ensure front wheels are in straight-ahead position. Turn spiral cable counterclockwise until it becomes difficult to turn. Turn

spiral cable clockwise about 3 turns and align Red mating marks. See Fig. 13.

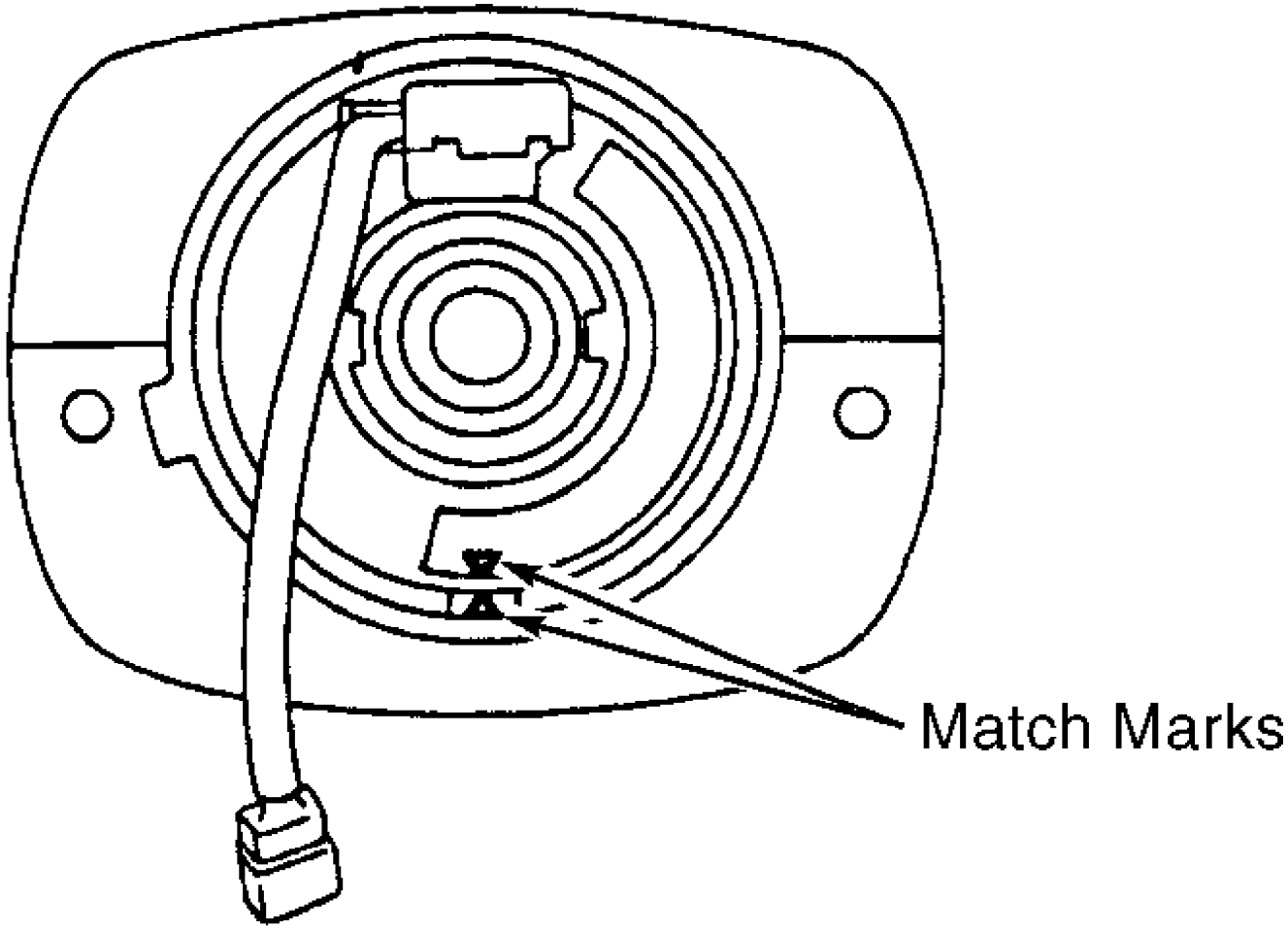


Fig. 13: Adjusting Spiral Cable
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Air Bag Sensor Assembly Screw	15 (20)
Armrest Bolt	27 (37)
Front Air Bag Sensor Bolt	15 (20)
Passenger-Side Air Bag Module Bolt	15 (20)
Pretensioner lower Bolt	30 (41)
Seat Belt Floor Anchor Bolt	31 (42)
Seat Belt Shoulder Anchor Bolt	31 (42)
Seat Cushion Bolts	13 (18)
Seat Track Bolts	27 (37)
Side Air Bag Sensor Screw	15 (20)
Steering Wheel Retaining Nut	26 (35)

	INCH Lbs. (N.m)
Driver-Side Air Bag Module Screw	63 (7.1)
Passenger-Side Air Bag Module Nut	50 (5.6)
Pretensioner Upper Bolt	65 (7.4)
Side Air Bag Module Nut	49 (5.5)

DIAGNOSIS & TESTING

AIR BAG WARNING LIGHT CHECK

Turn ignition switch to ACC or ON position. If AIR BAG warning comes on for about 6 seconds and then goes off, system is functioning properly. If AIR BAG warning light comes on and does not go off or flashes, Diagnostic Trouble Code (DTC) is stored in air bag sensor assembly memory. Proceed to RETRIEVING CODES. If AIR BAG warning light responds in any other way, go to DIAGNOSTIC TESTS.

RETRIEVING CODES

CAUTION: If jumper wire is incorrectly connected between terminals of Data Link Connector 1 (DLC1), system may be damaged. Use Diagnosis Check Wire (09843-18020) when connecting terminals of DLC1.

Using Diagnosis Check Wire

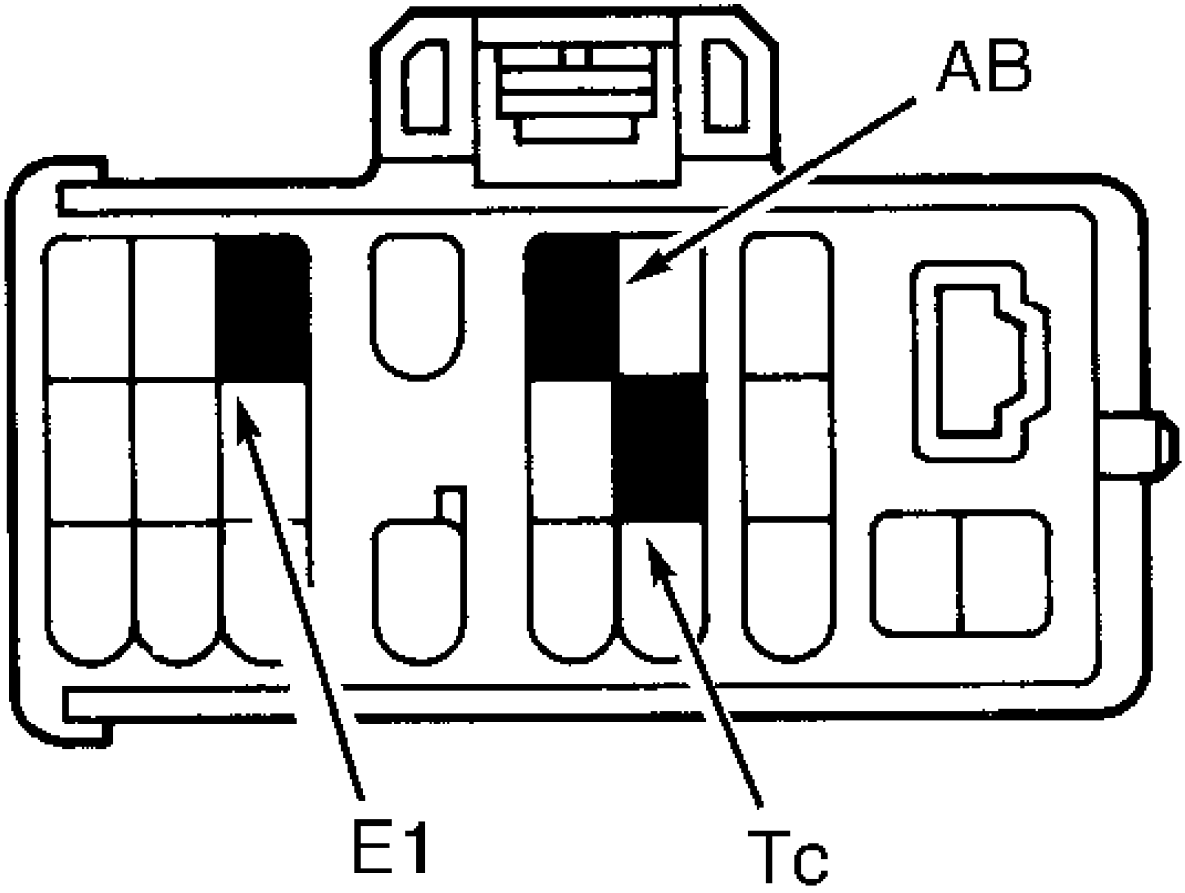
1) Turn ignition switch to ACC or ON position. Wait about 20 seconds. Using Diagnosis Check Wire (09843-18020), connect terminals Tc and E1 of Data Link Connector 1 (DLC1). DLC1 is located at left of engine compartment near junction box. See Fig. 14.

2) If AIR BAG warning light flashes 2 times per second, system is normal (normal code). If AIR BAG warning light does not flash Diagnostic Trouble Codes (DTCs) or flashes DTCs without DLC1 connection, proceed to DTCS NOT DISPLAYED under DIAGNOSTIC TESTS or DTCS CONTINUOUSLY DISPLAYED under DIAGNOSTIC TESTS. If AIR BAG warning light is on continuously and DTC is normal (flashes 2 times per second), source voltage is low. Go to SOURCE VOLTAGE DROP under DIAGNOSTIC TESTS.

3) If AIR BAG warning light flashes, count number of flashes to determine DTCs that are set. For example, DTC 12 is: FLASH, 1.5-second pause, FLASH, FLASH. If more than one DTC is displayed, a 2.5-second pause will occur between each DTC. Lowest numbered DTC will be displayed first, followed by next higher number DTC until all DTCs have been displayed.

4) After all DTCs are displayed, a 4-second pause will occur, and DTC display will be repeated. See appropriate DTC under DIAGNOSTIC TESTS. After repairing, clear DTCs. See CLEARING CODES.

NOTE: If DTCs other than those listed under DIAGNOSTIC TESTS are displayed, replace the air bag sensor assembly. If the air bag warning light does not function as described, proceed to appropriate test under DIAGNOSTIC TESTS.



97A04828

Fig. 14: Identifying Data Link Connector 1 (DLC1) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Using Lexus Hand-Held Tester

Install Lexus hand-held tester to DLC1. DLC1 is located at left of engine compartment near junction box. See Fig. 14. Read DTC by following prompts on tester. See tester operator's manual for instructions.

CLEARING CODES

Using Jumper Wire

1) Use 2 jumper wires. Connect one end of first jumper wire to DLC1 terminal Tc and one end of second jumper wire to DLC1 terminal AB. See Fig. 14. Turn ignition switch to ACC or ON position. Wait about 6 seconds.

NOTE: When alternately grounding terminals Tc and AB, release ground from one terminal and immediately ground the other terminal within 0.2 second. If time interval exceeds 0.2 second, DTCs will not be cleared.

2) Starting with jumper wire connected to terminal Tc, apply body ground alternately to terminal Tc and terminal AB twice each, in cycles of 1/2 to 1 1/2 seconds (sequence is: Tc, AB, Tc, AB). Finally, keep applying body ground to terminal Tc until AIR BAG warning light

flashes quickly, indicating DTCs are cleared.

Using Lexus Hand-Held Tester

Connect Lexus hand-held tester to DLC1. DLC1 is located at left of engine compartment near junction box. Clear DTCs by following prompts on tester. See tester operator's manual for instructions.

RELEASING SHORTING SPRING

NOTE: Perform this procedure only if you were sent here from DIAGNOSTIC TESTS.

1) Air bag squib circuit consists of circuit between air bag sensor assembly and air bag. If voltage is accidentally applied across squib circuit (as when testing, for example), air bag will deploy.

2) To prevent accidental deployment, squib circuit connectors contain a spring-loaded shorting bar (shorting spring). When squib circuit connector is disconnected, shorting spring automatically shorts squib circuit positive and negative circuits together. This prevents air bag deployment if voltage is accidentally applied across squib circuit.

3) When connector halves are attached, shorting bar is in released position (no continuity exists between terminals). When connector is disconnected, shorting bar is engaged (continuity exists between terminals).

4) Some testing procedures require shorting spring to be in released position with connector disconnected (this is opposite of its normal position). To hold shorting spring in released position, obtain a piece of paper that is same thickness as male terminal blade that slides under shorting spring when the connector is connected. See Fig. 15.

CAUTION: If paper thicker than male terminal is used, connector terminal could be damaged. Damaged connector terminal could result in system fault. Always use paper that is same thickness as male terminal.

5) With squib circuit connector disconnected, insert paper into female terminal, sliding it under shorting spring. This lifts spring, breaking circuit and allowing test procedure to be performed.

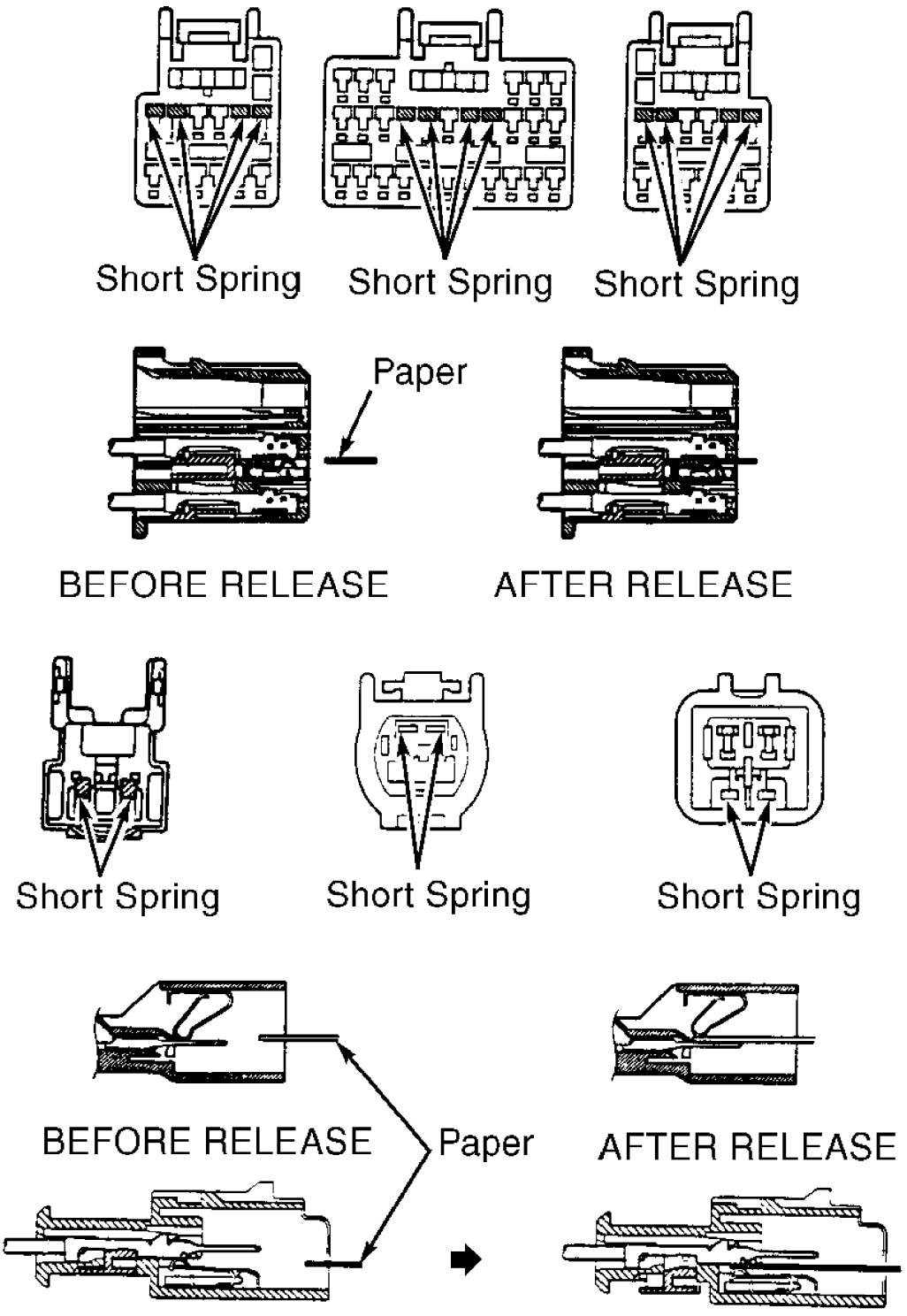


Fig. 15: Releasing Shorting Spring
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TESTS

* PLEASE READ THIS FIRST *

WARNING: Failure to follow air bag service precautions may result in air bag deployment and personal injury. See SERVICE PRECAUTIONS. After component replacement, perform system operational check to ensure proper system operation. See SYSTEM OPERATION CHECK.

CAUTION: Ensure ignition switch is in LOCK position before disconnecting or connecting negative battery cable. If ignition switch is in ACC or ON position when negative battery cable is disconnected or connected, air bag sensor assembly may be damaged. To prevent damage to connector terminals, DO NOT probe terminal ends. Instead, backprobe terminals (probe terminal where wire enters harness connector).

NOTE: In the following tests, the term squib and module may be used interchangeably.

AIR BAG WARNING LIGHT DOES NOT ILLUMINATE

Description

AIR BAG warning light is located in instrument cluster. When air bag system is normal, AIR BAG warning light illuminates for about 6 seconds after ignition switch is turned from LOCK to ACC or ON position, and turns off automatically. If a malfunction is present in air bag system, AIR BAG warning light illuminates to inform operator of malfunction. When Data Link Connector 1 (DLC1) terminals Tc and E1 are connected together, a Diagnostic Trouble Code (DTC) is displayed by flashing of AIR BAG warning light.

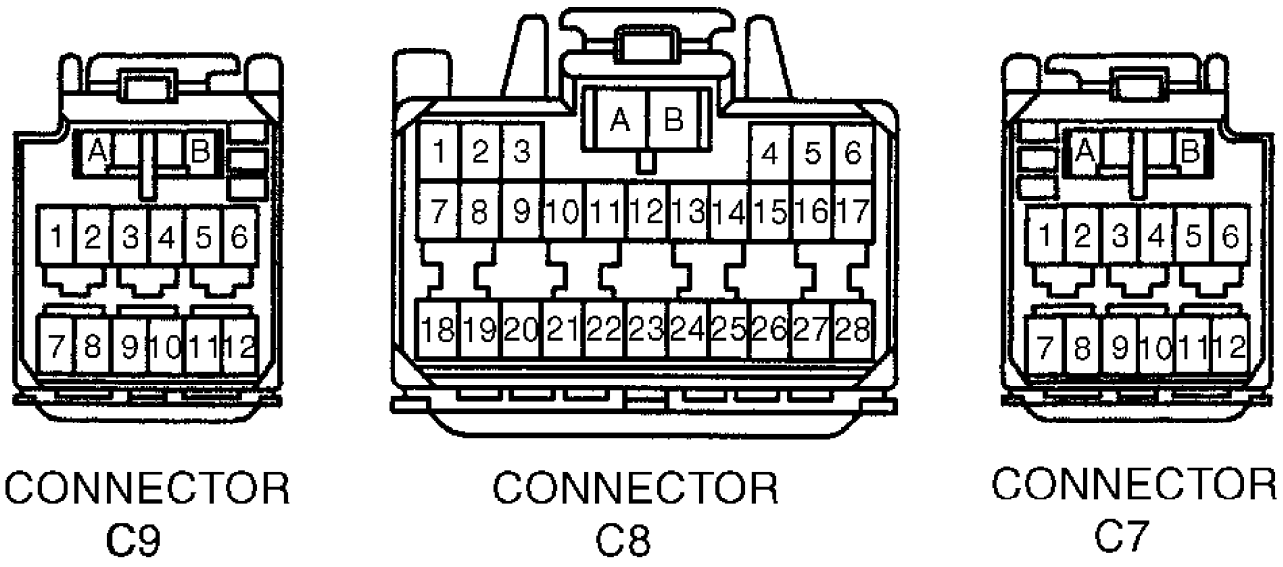
Diagnostic Procedure

1) Remove SRS-B fuse and check continuity across fuse blades. SRS-B fuse is located in instrument panel fuse block at left side of instrument panel. If fuse is faulty, replace fuse and go to step 4). If fuse is okay, reinstall fuse and go to next step.

2) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable. Turn ignition switch to ACC or ON position. Measure voltage between ground and air bag sensor assembly connector C8, terminal No. 2 (circuit LA, Black/Yellow wire). See Fig. 16. If 10-14 volts is not present, repair AIR BAG warning light bulb or circuit. See WIRING DIAGRAMS. If 10-14 volts is present, go to next step.

3) Turn ignition switch to LOCK position. Disconnect negative battery cable. Reconnect 3 air bag sensor assembly connectors. Leave all other components disconnected. Reconnect negative battery cable and wait at least 2 seconds. Turn ignition switch to ACC or ON position. If AIR BAG warning light operation is okay, system operation is normal at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If AIR BAG warning light does not come on, check for poor connection at air bag sensor assembly connector C8, terminal No. 3 (Black/Yellow wire). If connection is okay, replace air bag sensor assembly.

4) Recheck SRS-B fuse. If fuse is blown, check harness between SRS-B fuse and AIR BAG warning light. If fuse is okay, check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.



98A08204

Fig. 16: Identifying Air Bag Sensor Assembly Connectors
Courtesy of Toyota Motor Sales, U.S.A., Inc.

AIR BAG WARNING LIGHT IS ILLUMINATED WITH IGNITION OFF

Description

AIR BAG warning light is located in instrument cluster. When air bag system is normal, AIR BAG warning light illuminates for about 6 seconds after ignition switch is turned from LOCK to ACC or ON position, and turns off automatically. If a malfunction is present in air bag system, AIR BAG warning light illuminates to inform operator of malfunction. When Data Link Connector 1 (DLC1) terminals Tc and E1 are connected together, a Diagnostic Trouble Code (DTC) is displayed by flashing of AIR BAG warning light.

Diagnostic Procedure

Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable. Perform SYSTEM OPERATION CHECK. If AIR BAG warning light does not illuminate, replace air bag sensor assembly. If AIR BAG warning light is still illuminated, repair AIR BAG warning light circuit Black/Yellow wire or circuit AB (Black/Yellow wire) leading to the DLC1. See WIRING DIAGRAMS.

AIR BAG WARNING LIGHT INTERMITTENT

If AIR BAG warning light comes on intermittently, perform following tests to simulate driving conditions. If problem cannot be found, replace all components including wiring harness.

* Wiggle-test wiring harness.

* Apply heat to components with a hair dryer.
* Spray water onto entire vehicle (not directly onto electrical components) to simulate humidity.

DTCS NOT DISPLAYED

NOTE: Use following procedure if DTCs are not displayed or air bag warning light stays on when jumper wire is connected between terminals Tc and E1 of DLC1.

Description

When DLC1 terminals Tc and E1 are connected together, air bag sensor assembly is set in Diagnostic Trouble Code (DTC) output mode. DTC is displayed by flashing of AIR BAG warning light.

Diagnostic Procedure

1) Turn ignition switch from LOCK to ACC or ON position. If AIR BAG warning light does not illuminate for about 6 seconds, repair AIR BAG warning light circuit. See WIRING DIAGRAMS. If AIR BAG warning light illuminates for about 6 seconds, go to next step.

2) Measure voltage between DLC1 terminals Tc and E1. See Fig. 16. If 10-14 volts is present, go to step 4). If 10-14 volts is not present, go to next step.

3) Measure voltage between ground and DLC1 terminal Tc. If 10-14 volts is present, repair harness between ground and DLC1 terminal E1. See WIRING DIAGRAMS. If 10-14 volts is not present, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable and wait at least 90 seconds. Access and disconnect air bag sensor assembly connector C8 (center connector). See AIR BAG SENSOR ASSEMBLY under REMOVAL & INSTALLATION. Connect one end of jumper wire to harness side of air bag sensor assembly connector C8, terminal No. 15 (Circuit Tc, Pink/Black wire). See Fig. 16. Leave other end of jumper wire disconnected. Reconnect air bag sensor assembly connector with jumper wire connected. Connect negative battery cable and turn ignition switch to ACC or ON position. Wait at least 20 seconds. Connect unconnected end of jumper wire to ground. If AIR BAG warning light does not illuminate, replace air bag sensor assembly. If AIR BAG warning light illuminates, check Pink/Black wire between air bag sensor assembly and DLC1.

DTCS CONTINUOUSLY DISPLAYED

NOTE: Use following procedure if DTCs are displayed without connecting jumper wire between terminals Tc and E1 of DLC1.

Description

When DLC1 terminals Tc and E1 are connected together, air bag sensor assembly is set in Diagnostic Trouble Code (DTC) output mode. DTC is displayed by flashing of AIR BAG warning light.

Diagnostic Procedure

1) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Access and disconnect air bag sensor assembly connector C8 (center connector). See AIR BAG SENSOR ASSEMBLY under REMOVAL & INSTALLATION.

2) Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 15 (circuit Tc, Pink/Black wire). See Fig. 16. If resistance is more than one megohm, replace air bag sensor assembly. If resistance is less than one megohm, replace harness and connector.

SOURCE VOLTAGE DROP

Description

The air bag sensor assembly is equipped with a voltage-increase circuit to allow system operation in case source (battery) voltage drops below minimum. When battery voltage drops, voltage-increase circuit functions to increase voltage of air bag system to normal voltage.

The malfunction display for this circuit is different from other air bag system circuits. When source voltage drop is detected and no other DTCs are present, the AIR BAG warning light remains illuminated constantly. Source voltage drop is not recorded in air bag sensor assembly as a malfunction, and when source voltage returns to normal, AIR BAG warning light will turn off.

Diagnostic Procedure

1) Turn ignition switch to LOCK position. Disable air bag system. See DISABLING SYSTEM under DISABLING AND ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.

2) Turn ignition switch to ON position. Turn on electrical accessories (defogger, wipers, headlights, blower motor, etc.). Measure voltage between ground and air bag sensor assembly connector C8, terminals No. 3 (circuit IG2, Black/Orange wire) and No. 4 (circuit ACC, Gray wire) individually. See Fig. 16. Turn electrical accessories off. If voltage is 10-14 volts, go to next step. If voltage is not 10-14 volts, check harness between battery and air bag sensor assembly and check battery and charging system.

3) Turn ignition switch to LOCK position. Activate air bag system. See ACTIVATING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Turn ignition switch to ON position. Turn on electrical accessories again. If AIR BAG warning light goes out, system operation is normal at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If AIR BAG warning light does not go out, check for DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC is displayed, go to appropriate DTC. If normal code is displayed (2 flashes per second), replace air bag sensor assembly.

DTC 11/B0102: DRIVER-SIDE AIR BAG SQUIB CIRCUIT SHORT TO GROUND

Description

The driver-side air bag squib circuit consists of the air bag sensor assembly, spiral cable and driver-side air bag module. The squib causes the air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 11/B0102 could be caused by a short to ground in squib circuit, squib malfunction, spiral cable malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 11/B0102 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Black wire on spiral cable side of upper spiral cable connector. See WIRING DIAGRAMS . If resistance is more than one megohm, go to next step. If resistance is less than one megohm, go to step 5).

3) Reconnect air bag sensor assembly connector C8 (center connector). Connect jumper wire between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. Connect

negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 11/B0102 is displayed, replace air bag sensor assembly. If DTC 11/B0102 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect spiral cable upper connector (to driver-side air bag module). Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 11/B0102 is displayed, replace driver-side air bag module. If DTC 11/B0102 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

5) Disconnect lower spiral cable connector. Measure resistance between ground and Yellow/Black wire on spiral cable side of upper spiral cable connector. If resistance is more than one megohm, replace wiring harness between spiral cable and air bag sensor assembly. If resistance is less than one megohm, replace spiral cable.

DTC 12/B0103: DRIVER-SIDE AIR BAG SQUIB CIRCUIT SHORT TO BATTERY

Description

The driver-side air bag squib circuit consists of the air bag sensor assembly, spiral cable and driver-side air bag module. The squib causes air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 12/B0103 could be caused by a short to battery in squib circuit, squib malfunction, spiral cable malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 12/B0103 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Connect negative battery cable.

2) Turn ignition switch to ON position. Measure voltage between ground and Yellow/Black wire on spiral cable side of upper spiral cable connector. See WIRING DIAGRAMS. If voltage is less than one volt, go to next step. If voltage more than one volt, go to step 5).

3) Disconnect negative battery cable. Wait 90 seconds. Reconnect air bag sensor assembly connector C8 (center connector). Connect jumper wire between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 12/B0103 is displayed, replace air bag sensor assembly. If DTC 12/B0103 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative

battery cable. Wait at least 90 seconds. Reconnect upper spiral cable connector (to driver-side air bag module). Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 12/B0103 is displayed, replace driver-side air bag module. If DTC 12/B0103 is not displayed, go to next step.

5) Turn ignition switch to LOCK position. Disconnect lower spiral cable connector. Measure voltage between ground and Yellow/Black wire on spiral cable side of upper spiral cable connector. If voltage is less than one volt, replace wiring harness between spiral cable and air bag sensor assembly. If voltage is more than one volt, replace spiral cable.

DTC 13/B0100: SHORT IN DRIVER-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The driver-side air bag squib circuit consists of the air bag sensor assembly, spiral cable and driver-side air bag module. The squib causes driver-side air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 13/B0100 could be caused by a short between D+ (Yellow/Black wire) and D− (Yellow wire) in squib circuit, squib malfunction, spiral cable malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 13/B0100 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring mechanism on air bag sensor assembly connector C8. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. See WIRING DIAGRAMS. If resistance is less than one megohm, go to step 5). If resistance is more than one megohm, go to next step.

3) Connect air bag sensor assembly connector C8 (center connector). Connect jumper wire between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 13/B0100 is displayed, replace air bag sensor assembly. If DTC 13/B0100 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect upper spiral cable connector to driver-side air bag module. Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS

& TESTING. If DTC 13/B0100 is displayed, replace driver-side air bag module. If DTC 13/B0100 is not displayed, the system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

5) Disconnect lower spiral cable connector. Release shorting spring on lower spiral cable connector. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. If resistance is less than one megohm, replace spiral cable. If resistance is more than one megohm, go to next step.

6) Release shorting spring on air bag sensor assembly connector C8. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Black wire and Yellow wire on air bag sensor assembly side of lower spiral cable connector. If resistance less than one megohm, replace harness between air bag sensor assembly and spiral cable. If resistance is more than one megohm, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

DTC 14/B0101: OPEN IN DRIVER-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The driver-side air bag squib circuit consists of the air bag sensor assembly, spiral cable and driver-side air bag module. The squib causes driver-side air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 14/B0101 could be caused by a open in D+ (Yellow/Black wire) or D— (Yellow wire) in squib circuit, squib malfunction, spiral cable malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 14/B0101 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. See WIRING DIAGRAMS. If resistance is more than one ohm, go to step 5). If resistance is less than one ohm, go to next step.

3) Connect air bag sensor assembly connector C8. Connect jumper wire between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 14/B0101 is displayed, replace air bag sensor assembly. If DTC 14/B0101 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect upper spiral cable connector to driver-side air bag module. Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 14/B0101 is displayed, replace driver-side air bag module. If DTC 14/B0101 is not displayed, the system is

functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

5) Disconnect connector lower spiral cable connector. Measure resistance between Yellow/Black wire and Yellow wire on spiral cable side of upper spiral cable connector. If resistance is more than one ohm, replace spiral cable. If resistance is less than one ohm, go to next step.

6) Measure resistance between Yellow/Black wire and Yellow wire on air bag sensor assembly side of lower spiral cable connector. If resistance more than one ohm, replace harness between air bag sensor assembly and spiral cable. If resistance is less than one ohm, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

DTC 15/B1156 & B1157: RIGHT FRONT AIR BAG SENSOR MALFUNCTION

Description

The front air bag sensor circuit consists of the air bag sensor assembly and front air bag sensor.

Possible Causes

DTC 15/B1156 or B1157 could be causes by an open or short circuit between front air bag sensor and air bag sensor assembly, short to battery in front air bag sensor circuit, or front air bag sensor malfunction.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Leave right front air bag sensor connected.

2) Measure resistance between air bag sensor assembly connector C8, terminals No. 6 (circuit SR+, Black/White wire) and No. 5 (circuit SR—, Brown/White wire). See Fig. 16. If resistance is 754-886 ohms, go to next step. If resistance is not 754-886 ohms, go to step 6).

3) Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 6 (circuit SR+, Black/White wire). If resistance is more than one megohm, go to next step. If resistance is less than one megohm, go to step 9).

4) Connect negative battery cable. Wait 2 seconds. Measure voltage between ground and air bag sensor assembly connector C8, terminals No. 6 (circuit SR+, Black/White wire). If voltage is less than one volt, go to next step. If voltage is more than one volt, go to step 11).

5) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Connect air bag sensor assembly connector C8 (center connector). Connect negative battery cable. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 15/B1156 or B1157 is displayed, replace air bag sensor assembly. If DTC 15/B1156 or B1157 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT under DIAGNOSTIC TESTS.

6) Disconnect right front air bag sensor connector. Measure resistance across sensor terminals. If resistance is 754-886 ohms, go to next step. If resistance is not 754-886 ohms, replace right front air bag sensor.

NOTE: Front air bag sensor circuit Brown/White wire becomes Black wire at sub-harness connector. Front air bag sensor circuit

Black/White wire becomes White wire at sub-harness connector.

7) Disconnect right front air bag sensor circuit Yellow, 2-pin sub-harness connector. Sub-harness connector is located behind right hick panel. Measure resistance between White wire (circuit SR+) and Black wire (circuit SR—) of front air bag sensor harness connector. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace sub-harness between front air bag sensor and kick panel connector.

8) Connect jumper wire between White wire (circuit SR+) and Black wire (circuit SR—) on front air bag sensor side of kick panel sub-harness connector. Measure resistance between White wire (circuit SR+) and Black wire (circuit SR—) of front air bag sensor harness connector. If resistance is more than one ohm, repair or replace sub-harness between front air bag sensor and kick panel connector. If resistance is less than one ohm, repair or replace harness between air bag sensor assembly and sub-harness kick panel connector.

9) Disconnect right front air bag sensor connector. Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 6 (circuit SR+, Black/White wire). Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 5 (circuit SR—, Brown/White wire). If resistance is less than one megohm, replace right front air bag sensor. If resistance is more than one megohm, go to next step.

10) Disconnect right front air bag sensor circuit Yellow, 2-pin sub-harness connector. Sub-harness connector is located behind right hick panel. Measure resistance between ground and White wire (circuit SR+) and Black wire (circuit SR—) on front air bag sensor side of sub-harness kick panel connector individually. If resistance is more than one megohm, repair or replace harness between air bag sensor assembly and kick panel connector. If resistance is less than one megohm, repair or replace sub-harness between front air bag sensor and kick panel connector.

11) Disconnect right front air bag sensor connector. Measure voltage between ground and air bag sensor assembly connector C8, terminal No. 6 (circuit SR+, Black/White wire). Measure voltage between ground and air bag sensor assembly connector C8, terminal No. 5 (circuit SR—, Brown/White wire). If voltage is more than one volt, go to next step. If voltage is less than one volt, replace right front air bag sensor.

12) Disconnect right front air bag sensor circuit Yellow, 2-pin sub-harness connector. Sub-harness connector is located behind right hick panel. Measure voltage between ground and White wire (circuit SR+) and Black wire (circuit SR—) on front air bag sensor side of sub-harness kick panel connector individually. If voltage is more than one volt, repair or replace sub-harness between front air bag sensor and kick panel connector. If voltage is less than one volt, repair or replace harness between air bag sensor assembly and kick panel connector.

DTC 16/B1158 & B1159: LEFT FRONT AIR BAG SENSOR MALFUNCTION

Description

The front air bag sensor circuit consists of the air bag sensor assembly and front air bag sensor.

Possible Causes

DTC 16/B1158 or B1159 could be causes by an open or short circuit between front air bag sensor and air bag sensor assembly, short to battery in front air bag sensor circuit, or front air bag sensor malfunction.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Leave left front air bag sensor connected.

2) Measure resistance between air bag sensor assembly connector C8, terminals No. 11 (circuit SL+, White/Red wire) and No. 12 (circuit SL—, Brown wire). See Fig. 16. If resistance is 754-886 ohms, go to next step. If resistance is not 754-886 ohms, go to step 6).

3) Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 11 (circuit SL+, White/Red wire). If resistance is more than one megohm, go to next step. If resistance is less than one megohm, go to step 7).

4) Connect negative battery cable. Wait 2 seconds. Measure voltage between ground and air bag sensor assembly connector C8, terminals No. 11 (circuit SL+, White/Red wire). If voltage is less than one volt, go to next step. If voltage is more than one volt, go to step 8).

5) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Connect left front air bag sensor and air bag sensor assembly connectors. Connect negative battery cable. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 16/B1158 or B1159 is displayed, replace left front air bag sensor. If DTC 16/B1158 or B1159 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT under DIAGNOSTIC TESTS.

NOTE: Front air bag sensor circuit Brown wire becomes Black wire at short connector. Front air bag sensor circuit White/Red wire becomes White wire at short connector. Short connector is located high under left side of instrument panel and is not included in manufacturer's diagnostics.

6) Disconnect left front air bag sensor connector. Measure resistance across sensor terminals. If resistance is 754-886 ohms, repair or replace harness or connector between front air bag sensor and air bag sensor assembly. If resistance is not 754-886 ohms, replace left front air bag sensor.

7) Disconnect right front air bag sensor connector. Measure resistance between ground and air bag sensor assembly connector C8, terminal No. 11 (circuit SL+, White/Red wire). If resistance is less than one megohm, repair or replace harness or connector between front air bag sensor and air bag sensor assembly. If resistance is more than one megohm, replace left front air bag sensor.

8) Disconnect left front air bag sensor connector. Measure voltage between ground and air bag sensor assembly connector C8, terminals No. 11 (circuit SL+, White/Red wire) and No. 12 (circuit SL—, Brown wire) individually. If voltage is more than one volt, repair or replace harness or connector between front air bag sensor and air bag sensor assembly. If voltage is less than one volt, replace left front air bag sensor.

DTC 31/B1100: AIR BAG SENSOR ASSEMBLY MALFUNCTION

Description

The air bag sensor assembly consists of an air bag sensor, safing sensor, drive circuit, diagnosis circuit and ignition control circuit. The air bag sensor assembly receives signals from air bag sensor, judges whether or not the air bag must be deployed and detects

system malfunction.

Possible Causes
DTC 31/B1100 could be caused by a air bag sensor assembly malfunction.

NOTE: If a DTC other than DTC 31/B1100 is displayed at same time as DTC 31/B1100, repair fault indicated by DTC other than DTC 31/B1100 before using this procedure.

Diagnostic Procedure
1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.
2) Turn ignition switch to ON position. Measure voltage between ground and air bag sensor assembly connector C8, terminals No. 3 (circuit IG2, Black/Orange wire) and No. 4 (circuit ACC, Gray wire) individually. See Fig. 16. If voltage is more than 16 volts, check battery and charging system operation. If voltage is less than 16 volts, go to next step.
3) Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Repeat at least 5 times. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 31/B1100 is displayed, replace air bag sensor assembly. If DTC 31/B1100 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

DTC 32/B1140: RIGHT-SIDE AIR BAG SENSOR ASSEMBLY MALFUNCTION

Description
The side air bag sensor assembly consists of the air bag sensor, diagnosis circuit and lateral deceleration sensor. The side air bag sensor assembly receives signals from lateral deceleration sensor, judges whether or not the air bag must be deployed and detects system malfunction.

Possible Causes
DTC 32/B1140 could be caused by a right-side air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 32/B1140 are displayed, disregard them.

Diagnostic Procedure
1) Turn ignition switch to ACC or On position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 32/B1140 is not displayed, go to step 8). If DTC 32/B1140 is displayed, go to next step.
2) Access right-side air bag sensor assembly. See SIDE AIR BAG SENSOR ASSEMBLY under REMOVAL & INSTALLATION. Ensure right-side air bag sensor assembly harness connector is properly connected and secure. Reconnect if necessary. Go to next step.
3) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.
4) Disconnect right-side air bag sensor assembly connector. Connect jumper wire between right-side air bag sensor assembly harness connector terminals No. 2 (circuit SSR+, Blue/Yellow wire) and No. 4 (circuit ESR, Gray wire). See WIRING DIAGRAMS. Measure resistance

between air bag sensor assembly connector C9, terminals No. 10 (circuit SSR+, Blue/Yellow wire) and No. 7 (circuit ESR, Gray wire). See Fig. 16. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between right-side air bag sensor assembly and air bag sensor assembly.

5) Connect jumper wire between right-side air bag sensor assembly harness connector terminals No. 1 (circuit VUPR, Pink wire) and No. 3 (circuit FSR, Light Green wire). See WIRING DIAGRAMS. Measure resistance between air bag sensor assembly connector C9, terminals No. 12 (circuit VUPR, Pink wire) and No. 9 (circuit FSR, Light Green wire). See Fig. 16. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between right-side air bag sensor assembly and air bag sensor assembly.

6) Measure resistance between ground and air bag sensor assembly harness connector C9, terminals No. 12 (circuit VUPR, Pink wire), No. 10 (circuit SSR+, Blue/Yellow wire) and No. 9 (circuit FSR, Light Green wire) individually. See Fig. 16. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between right-side air bag sensor assembly and air bag sensor assembly.

7) Connect negative battery cable. Turn ignition switch to ACC or ON position. Measure voltage between ground and air bag sensor assembly harness connector C9, terminals No. 12 (circuit VUPR, Pink wire), No. 10 (circuit SSR+, Blue/Yellow wire), No. 9 (circuit FSR, Light Green wire) and No. 7 (circuit ERS, Gray wire) individually. See Fig. 16. If voltage is less than one volt, turn ignition switch to LOCK position, disconnect negative battery cable and go to next step. If voltage is more than one volt, repair or replace harness or connector between right-side air bag sensor assembly and air bag sensor assembly. See WIRING DIAGRAMS.

8) Ensure negative battery cable is disconnected. Reconnect front air bag sensor connector. Reconnect air bag sensor assembly connector C9. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 32/B1140 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 32/B1140 is displayed, replace right-side air bag sensor assembly.

DTC 33/B1141: LEFT-SIDE AIR BAG SENSOR ASSEMBLY MALFUNCTION

Description

The side air bag sensor assembly consists of the air bag sensor, diagnosis circuit and lateral deceleration sensor. The side air bag sensor assembly receives signals from lateral deceleration sensor, judges whether or not the air bag must be deployed and detects system malfunction.

Possible Causes

DTC 33/B1141 could be caused by a left-side air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 33/B1141 are displayed, disregard them.

Diagnostic Procedure

1) Turn ignition switch to ACC or On position. Wait at least

20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 33/B1141 is not displayed, go to step 8). If DTC 33/B1141 is displayed, go to next step.

2) Access left-side air bag sensor assembly. See SIDE AIR BAG SENSOR ASSEMBLY under REMOVAL & INSTALLATION. Ensure left-side air bag sensor assembly harness connector is properly connected and secure. Reconnect if necessary. Go to next step.

3) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

4) Disconnect left-side air bag sensor assembly connector. Connect jumper wire between left-side air bag sensor assembly harness connector terminals No. 2 (circuit SSL+, Blue/White wire) and No. 4 (circuit ESL, Gray/Blue wire). See WIRING DIAGRAMS. Measure resistance between air bag sensor assembly connector C7, terminals No. 9 (circuit SSL+, Blue/White wire) and No. 12 (circuit ESL, Gray/Blue wire). See Fig. 16. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between left-side air bag sensor assembly and air bag sensor assembly.

5) Connect jumper wire between left-side air bag sensor assembly harness connector terminals No. 1 (circuit VUPL, Pink/Blue wire) and No. 3 (circuit FSL, Light Green/Black wire). See WIRING DIAGRAMS. Measure resistance between air bag sensor assembly connector C7, terminals No. 7 (circuit VUPL, Pink/Blue wire) and 10 (circuit FSL, Light Green/Black wire). See Fig. 16. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between left-side air bag sensor assembly and air bag sensor assembly.

6) Measure resistance between ground and air bag sensor assembly harness connector C7, terminals No. 7 (circuit VUPL, Pink/Blue wire), No. 9 (circuit SSL+, Blue/White wire) and No. 10 (circuit FSL, Light Green/Black wire) individually. See Fig. 16. If resistance is more than one megohm, to next step. If resistance is less than one megohm, repair or replace harness or connector between left-side air bag sensor assembly and air bag sensor assembly. See WIRING DIAGRAMS.

7) Connect negative battery cable. Turn ignition switch to ACC or ON position. Measure voltage between ground and air bag sensor assembly harness connector C7, terminals No. 7 (circuit VUPL, Pink/Blue wire), No. 9 (circuit SSL+, Blue/White wire), No. 10 (circuit FSL, Light Green/Black wire) and No. 12 (circuit ESL, Gray/Blue wire) individually. See Fig. 16. If voltage is less than one volt, turn ignition switch to LOCK position, disconnect negative battery cable and go to next step. If voltage is more than one volt, repair or replace harness or connector between left-side air bag sensor assembly and air bag sensor assembly. See WIRING DIAGRAMS.

8) Ensure negative battery cable is disconnected. Reconnect air bag sensor connector C7. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 33/B1141 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 33/B1141 is displayed, replace left-side air bag sensor assembly.

DTC 41/B0112: SHORT TO GROUND IN RIGHT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 41/B0112 could be caused by a short to ground in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 41/B0112 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Red wire on air bag sensor assembly side of right-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between right-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) on air bag sensor assembly side of right-side air bag module harness connector. See WIRING DIAGRAMS. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 41/B0112 is not displayed, go to next step. If DTC 41/B0112 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect right-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 41/B0112 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 41/B0112 is displayed, replace right-side air bag module.

DTC 42/B0113: SHORT TO BATTERY IN RIGHT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 42/B0113 could be caused by a short to battery in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 42/B0113 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.

2) Measure voltage between ground and Yellow/Red wire (circuit SFR+) on air bag sensor assembly side of right-side air bag module harness connector. See WIRING DIAGRAMS. If voltage is less than one volt, go to next step. If voltage is more than one volt, repair or replace harness or connector between right-side air bag module and air bag sensor assembly.

3) Disconnect negative battery cable. Wait at least 90 seconds. Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) of air bag sensor assembly side of right-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 42/B0113 is not displayed, go to next step. If DTC 42/B0113 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect right-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 42/B0113 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 42/B0113 is displayed, replace side air bag module.

DTC 43/B0110: SHORT IN RIGHT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 43/B0110 could be caused by a short between Yellow/Red (circuit SFR+) and Yellow/Green (circuit SFR—) wires in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 43/B0110 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring on air bag sensor assembly connector C9. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) on air bag sensor assembly side of right-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between

right-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) on air bag sensor assembly side of right-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 43/B0110 is not displayed, go to next step. If DTC 43/B0110 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect right-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 43/B0110 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 43/B0110 is displayed, replace right-side air bag module.

DTC 44/B0111: OPEN IN RIGHT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 44/B0111 could be caused by a open in Yellow/Red (circuit SFR+) and Yellow/Green (circuit SFR—) wires in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 44/B0111 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) on air bag sensor assembly side of right-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between right-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFR+) and Yellow/Green wire (circuit SFR—) on air bag sensor assembly side of right-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 44/B0111 is not displayed, go to next step. If DTC 44/B0111 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect right-side air bag

module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 44/B0111 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 44/B0111 is displayed, replace side air bag module.

DTC 45/B0117: SHORT TO GROUND IN LEFT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 45/B0117 could be caused by a short to ground in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 45/B0117 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Red wire (circuit SFL+) on air bag sensor assembly side of left-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between left-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C7 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 45/B0117 is not displayed, go to next step. If DTC 45/B0117 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect left-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 45/B0117 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 45/B0117 is displayed, replace left-side air bag module.

DTC 46/B0118: SHORT TO BATTERY IN LEFT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 46/B0118 could be caused by a short to battery in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 46/B0118 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.

2) Turn ignition switch to ACC or ON position. Measure voltage between ground and Yellow/Red wire (circuit SFL+) on air bag sensor assembly side of left-side air bag module harness connector. See WIRING DIAGRAMS. If voltage is less than one volt, go to next step. If voltage is more than one volt, repair or replace harness or connector between left-side air bag module and air bag sensor assembly.

3) Disconnect negative battery cable. Wait at least 90 seconds. Reconnect air bag sensor assembly connector C7 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 46/B0118 is not displayed, go to next step. If DTC 46/B0118 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect left-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 46/B0118 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 46/B0118 is displayed, replace left-side air bag module.

DTC 47/B0115: SHORT IN LEFT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 47/B0115 could be caused by a short between Yellow/Red (circuit SFL+) and Yellow/Green (circuit SFL—) wires in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 47/B0115 are

displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring on air bag sensor assembly connector C7. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between left-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C7 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 47/B0115 is not displayed, go to next step. If DTC 47/B0115 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect left-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 47/B0115 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 47/B0115 is displayed, replace left-side air bag module.

DTC 48/B0116: OPEN IN LEFT-SIDE AIR BAG MODULE SQUIB CIRCUIT

Description

The side air bag module squib circuit consists of the air bag sensor assembly and side air bag module. The squib circuit causes the side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 48/B0116 could be caused by a open in Yellow/Red (circuit SFL+) and Yellow/Green (circuit SFL—) wires in side air bag squib circuit, side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 48/B0116 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between left-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C7 to air bag

sensor assembly. Connect jumper wire between Yellow/Red wire (circuit SFL+) and Yellow/Green wire (circuit SFL—) on air bag sensor assembly side of left-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 48/B0116 is not displayed, go to next step. If DTC 48/B0116 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect left-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 48/B0116 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 48/B0116 is displayed, replace left-side air bag module.

DTC 51/B0107: PASSENGER-SIDE AIR BAG SQUIB CIRCUIT SHORT TO GROUND

Description

The passenger-side air bag squib circuit consists of the air bag sensor assembly and passenger-side air bag module. The squib causes the air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 51/B0107 could be caused by a short to ground in squib circuit, squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 51/B0107 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Red wire on air bag sensor assembly side of passenger-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between passenger-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C8 (center connector). Connect jumper wire between Yellow/Red wire and Yellow/Green wire on air bag sensor assembly side of passenger-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 51/B0107 is displayed, replace air bag sensor assembly. If DTC 51/B0107 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side air bag module connector. Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least

20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 51/B0107 is displayed, replace passenger-side air bag module. If DTC 51/B0107 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

DTC 52/B0108: PASSENGER-SIDE AIR BAG SQUIB CIRCUIT SHORT TO BATTERY

Description

The passenger-side air bag squib circuit consists of the air bag sensor assembly and passenger-side air bag module. The squib causes air bag to deploy when all deployment conditions are satisfied.

Possible Causes

DTC 52/B0108 could be caused by a short to battery in squib circuit, squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 52/B0108 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Connect negative battery cable.

2) Turn ignition switch to ON position. Measure voltage between ground and Yellow/Red wire on air bag sensor assembly side of passenger-side air bag module harness connector. See WIRING DIAGRAMS. If voltage is less than one volt, go to next step. If voltage more than one volt, repair or replace harness or connector between passenger-side air bag module and air bag sensor assembly.

3) Disconnect negative battery cable. Wait 90 seconds. Reconnect air bag sensor assembly connector C8 (center connector). Connect jumper wire between Yellow/Red wire and Yellow/Green wire on air bag sensor assembly side of passenger-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 52/B0108 is displayed, replace air bag sensor assembly. If DTC 52/B0108 is not displayed, go to next step.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side air bag module harness connector. Reconnect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve codes. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 52/B0108 is displayed, replace passenger-side air bag module. If DTC 52/B0108 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT.

DTC 53/B0105: SHORT IN PASSENGER-SIDE AIR BAG SQUIB CIRCUIT

Description

The passenger-side air bag squib circuit consists of the air bag sensor assembly and passenger-side air bag module. The squib

circuit causes the passenger-side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 53/B0105 could be caused by a short in Yellow/Red (circuit P+) and Yellow/Green (circuit P—) wires in passenger-side air bag squib circuit, passenger-side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 53/B0105 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring on air bag sensor assembly connector C8 (center connector). See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Red wire (circuit P+) and Yellow/Green wire (circuit P—) on air bag sensor assembly side of passenger-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is more than one megohm, go to next step. If resistance is less than one megohm, repair or replace harness or connector between passenger-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C8 to air bag sensor assembly. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 53/B0105 is not displayed, go to next step. If DTC 53/B0105 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 53/B0105 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 53/B0105 is displayed, replace passenger-side air bag module.

DTC 54/B0106: OPEN IN PASSENGER-SIDE AIR BAG SQUIB CIRCUIT

Description

The passenger-side air bag squib circuit consists of the air bag sensor assembly and passenger-side air bag module. The squib circuit causes the passenger-side air bag to deploy when deployment conditions are satisfied.

Possible Causes

DTC 54/B0106 could be caused by an open in Yellow/Red (circuit P+) and Yellow/Green (circuit P—) wires in passenger-side air bag squib circuit, passenger-side air bag squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 54/B0106 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Red wire (circuit P+) and Yellow/Green wire (circuit P—) on air bag sensor assembly side of passenger-side air bag module harness connector. See WIRING DIAGRAMS. If resistance is less than one ohm, go to next step. If resistance is more than one ohm, repair or replace harness or connector between passenger-side air bag module and air bag sensor assembly.

3) Reconnect air bag sensor assembly connector C8 to air bag sensor assembly. Connect jumper wire between Yellow/Red wire (circuit P+) and Yellow/Green wire (circuit P—) on air bag sensor assembly side of passenger-side air bag module harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 54/B0106 is not displayed, go to next step. If DTC 54/B0106 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side air bag module connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 54/B0106 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 54/B0106 is displayed, replace passenger-side air bag module.

DTC 61/B0132: SHORT TO GROUND IN PASSENGER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The seat belt pretensioner squib circuit consists of the air bag sensor assembly and passenger-side seat belt pretensioner. The squib circuit causes the seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 61/B0132 could be caused by a short to ground in Yellow/Black (circuit PR+) and Yellow (circuit PR—) wires in seat belt pretensioner squib circuit, seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 61/B0132 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Black wire (circuit PR+) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is less than one megohm, repair or replace harness or connector between passenger-side seat belt pretensioner and air bag sensor assembly. If resistance is more than one megohm, go to next step.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire

(circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner squib harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 61/B0132 is not displayed, go to next step. If DTC 61/B0132 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 61/B0132 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 61/B0132 is displayed, replace passenger-side seat belt pretensioner.

DTC 62/B0133: SHORT TO BATTERY IN PASSENGER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The seat belt pretensioner squib circuit consists of the air bag sensor assembly and passenger-side seat belt pretensioner. The squib circuit causes the seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 62/B0133 could be caused by a short to battery in Yellow/Black (circuit PR+) and Yellow (circuit PR—) wires in seat belt pretensioner squib circuit, seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 62/B0133 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.

2) Measure voltage between ground and Yellow/Black wire (circuit PR+) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If voltage is more than one volt, repair or replace harness or connector between passenger-side seat belt pretensioner and air bag sensor assembly. If voltage is less than one volt, go to next step.

3) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect air bag sensor assembly connectors C9 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 62/B0133 is not displayed, go to next step. If DTC

62/B0133 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 62/B0133 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 62/B0133 is displayed, replace passenger-side seat belt pretensioner.

DTC 63/B0130: SHORT IN PASSENGER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The passenger-side seat belt pretensioner squib circuit consists of the air bag sensor assembly and passenger-side seat belt pretensioner. The squib circuit causes the passenger-side seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 63/B0130 could be caused by a short between Yellow/Black (circuit PR+) and Yellow (circuit PR—) wires in passenger-side seat belt pretensioner squib circuit, passenger-side seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 63/B0130 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring on air bag sensor assembly connector C9. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Black wire (circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is less than one megohm, repair or replace harness or connector between passenger-side seat belt pretensioner and air bag sensor assembly. If resistance is more than one megohm, go to next step.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 63/B0130 is not displayed, go to next step. If DTC 63/B0130 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20

seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 63/B0130 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 63/B0130 is displayed, replace passenger-side seat belt pretensioner.

DTC 64/B0131: OPEN IN PASSENGER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The passenger-side seat belt pretensioner squib circuit consists of the air bag sensor assembly and passenger-side seat belt pretensioner. The squib circuit causes the passenger-side seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 64/B0131 could be caused by an open in Yellow/Black (circuit PR+) or Yellow (circuit PR—) wires in passenger-side seat belt pretensioner squib circuit, passenger-side seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 64/B0131 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Black wire (circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is more than one ohm, repair or replace harness or connector between passenger-side seat belt pretensioner and air bag sensor assembly. If resistance is less than one ohm, go to next step.

3) Reconnect air bag sensor assembly connector C9 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PR+) and Yellow wire (circuit PR—) on air bag sensor assembly side of passenger-side seat belt pretensioner harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 64/B0131 is not displayed, go to next step. If DTC 64/B0131 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect passenger-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 64/B0131 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 64/B0131 is displayed, replace passenger-side seat belt pretensioner.

DTC 71/B0137: SHORT TO GROUND IN DRIVER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The seat belt pretensioner squib circuit consists of the air bag sensor assembly and driver-side seat belt pretensioner. The squib circuit causes the seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 71/B0137 could be caused by a short to ground in Yellow/Black (circuit PL+) and Yellow (circuit PL—) wires in seat belt pretensioner squib circuit, seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 71/B0137 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between ground and Yellow/Black wire (circuit PL+) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is less than one megohm, repair or replace harness or connector between driver-side seat belt pretensioner and air bag sensor assembly. If resistance is more than one megohm, go to next step.

3) Reconnect air bag sensor assembly connectors C7 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PL+) and Yellow wire (circuit PL—) on air bag sensor assembly side of driver-side seat belt pretensioner squib harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 71/B0137 is not displayed, go to next step. If DTC 71/B0137 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect driver-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 71/B0137 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 71/B0137 is displayed, replace driver-side seat belt pretensioner.

DTC 72/B0138: SHORT TO BATTERY IN DRIVER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The seat belt pretensioner squib circuit consists of the air bag sensor assembly and driver-side seat belt pretensioner. The squib circuit causes the seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 72/B0138 could be caused by a short to battery in Yellow/Black (circuit PL+) and Yellow (circuit PL—) wires in seat belt pretensioner squib circuit, seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 72/B0138 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM. Reconnect negative battery cable.

2) Measure voltage between ground and Yellow/Black wire (circuit PL+) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If voltage is more than one volt, repair or replace harness or connector between driver-side seat belt pretensioner and air bag sensor assembly. If voltage is less than one volt, go to next step.

3) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect air bag sensor assembly connectors C7 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PL+) and Yellow wire (circuit PL—) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 72/B0138 is not displayed, go to next step. If DTC 72/B0138 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect driver-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 72/B0138 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 72/B0138 is displayed, replace driver-side seat belt pretensioner.

DTC 73/B0135: SHORT IN DRIVER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The driver-side seat belt pretensioner squib circuit consists of the air bag sensor assembly and driver-side seat belt pretensioner. The squib circuit causes the driver-side seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 73/B0135 could be caused by a short between Yellow/Black (circuit PL+) and Yellow (circuit PL—) wires in driver-side seat belt pretensioner squib circuit, driver-side seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 73/B0135 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Release shorting spring on air bag sensor assembly connector C7. See RELEASING SHORTING SPRING under DIAGNOSIS & TESTING. Measure resistance between Yellow/Black wire (circuit PL+) and Yellow

wire (circuit PL—) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is less than one megohm, repair or replace harness or connector between driver-side seat belt pretensioner and air bag sensor assembly. If resistance is more than one megohm, go to next step.

3) Reconnect air bag sensor assembly connector C7 to air bag sensor assembly. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 73/B0135 is not displayed, go to next step. If DTC 73/B0135 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect driver-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 73/B0135 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 73/B0135 is displayed, replace driver-side seat belt pretensioner.

DTC 74/B0136: OPEN IN DRIVER-SIDE SEAT BELT PRETENSIONER SQUIB CIRCUIT

Description

The driver-side seat belt pretensioner squib circuit consists of the air bag sensor assembly and driver-side seat belt pretensioner. The squib circuit causes the driver-side seat belt pretensioner to deploy when deployment conditions are satisfied.

Possible Causes

DTC 74/B0136 could be caused by an open in Yellow/Black (circuit PL+) or Yellow (circuit PL—) wires in driver-side seat belt pretensioner squib circuit, driver-side seat belt pretensioner squib malfunction or air bag sensor assembly malfunction.

NOTE: During testing, if DTCs other than DTC 74/B0136 are displayed, disregard them.

Diagnostic Procedure

1) Disable air bag system. See DISABLING SYSTEM under DISABLING & ACTIVATING AIR BAG SYSTEM.

2) Measure resistance between Yellow/Black wire (circuit PL+) and Yellow wire (circuit PL—) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. See WIRING DIAGRAMS. If resistance is more than one ohm, repair or replace harness or connector between driver-side seat belt pretensioner and air bag sensor assembly. If resistance is less than one ohm, go to next step.

3) Reconnect air bag sensor assembly connector C7 to air bag sensor assembly. Connect jumper wire between Yellow/Black wire (circuit PL+) and Yellow wire (circuit PL—) on air bag sensor assembly side of driver-side seat belt pretensioner harness connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK

position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 74/B0136 is not displayed, go to next step. If DTC 74/B0136 is displayed, replace air bag sensor assembly.

4) Turn ignition switch to LOCK position. Disconnect negative battery cable. Wait at least 90 seconds. Reconnect driver-side seat belt pretensioner connector. Connect negative battery cable. Wait at least 2 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Clear DTCs. See CLEARING CODES under DIAGNOSIS & TESTING. Turn ignition switch to LOCK position. Wait at least 20 seconds. Turn ignition switch to ACC or ON position. Wait at least 20 seconds. Retrieve DTCs. See RETRIEVING CODES under DIAGNOSIS & TESTING. If DTC 74/B0136 is not displayed, system is functioning properly at this time. Check for intermittent fault. See AIR BAG WARNING LIGHT INTERMITTENT. If DTC 74/B0136 is displayed, replace driver-side seat belt pretensioner.

WIRING DIAGRAMS

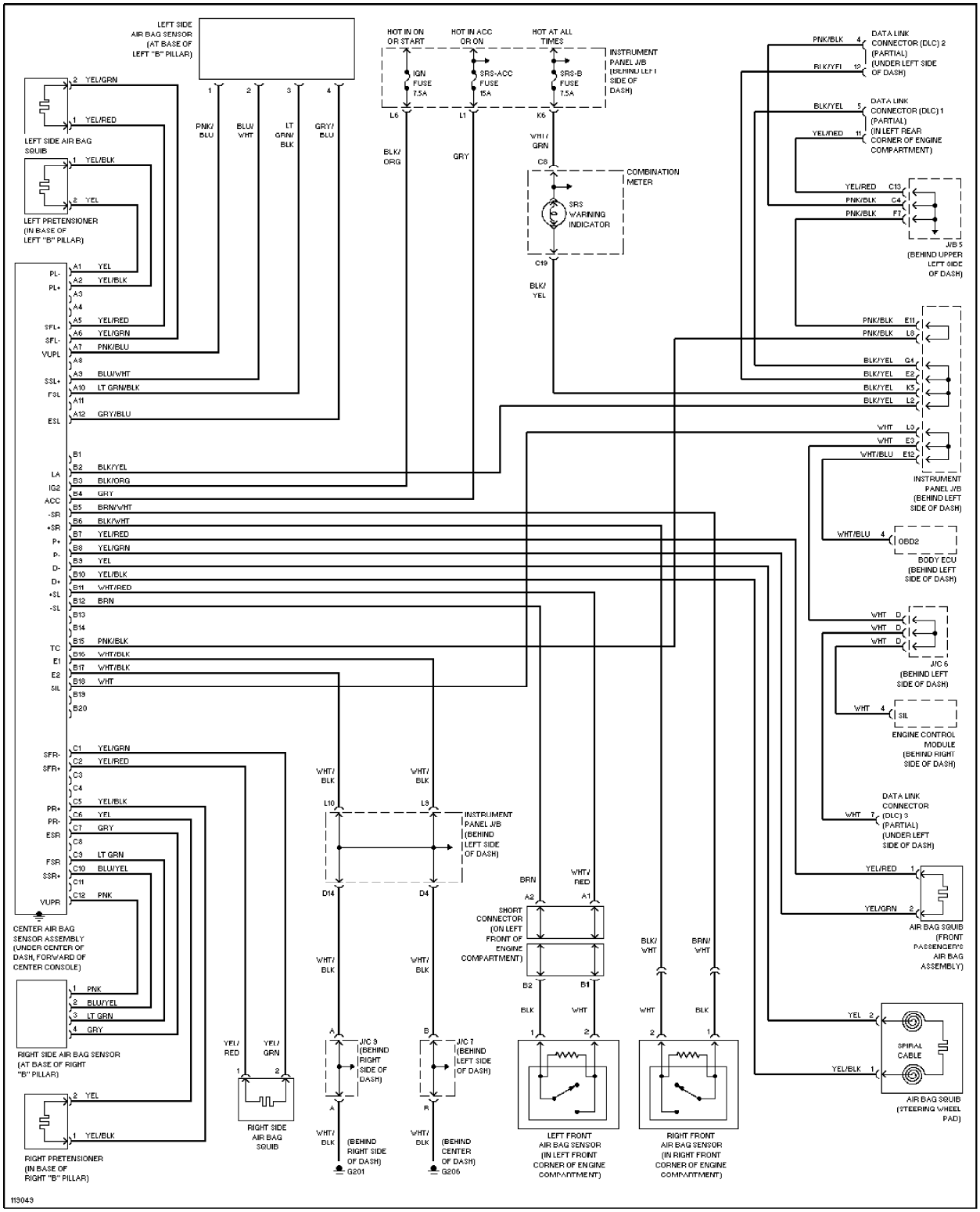


Fig. 17: Air Bag System Wiring Diagram (RX300)

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

1999 Lexus RX 300

GENERAL INFORMATION
Anti-Lock Brake Safety Precautions

* PLEASE READ THIS FIRST *

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

WARNING: Failure to depressurize ABS could lead to physical injury.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Failure to depressurize ABS could lead to physical injury.

* NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
* NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
* DO NOT attempt to bleed hyudarulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
* Only use specially designed brake hoses/lines on ABS equipped vehicles.
* DO NOT tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
* DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* DO NOT contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
* When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
* ONLY use rocommended brake fluids. DO NOT use silicone brake fluids in an ABS equipped vehicle.
* When instlling transmittion devices (CB's, telephones, etc.) on ABS equipped vehicles, DO NOT locate the antenna near the ABS control unit (or any control unit).
* Disconnect all on-board computers, when using electric welding equipment.
* DO NOT expose the ABS control unit to prolonged periods of high heat (185 °F/85°C for 2 hours is generally considered a maximum limit).

ANTI-LOCK BRAKE SYSTEM - W/O TRACTION CONTROL

1999 Lexus RX 300

1999-2000 BRAKES
Lexus Anti-Lock - Without Traction Control

RX300

DESCRIPTION

Anti-Lock Brake System (ABS) controls fluid pressures to each individual front brake caliper and rear brake calipers during a panic stop to prevent wheel lock-up. System consists of actuator, solenoid relay, pump motor relay, Electronic Control Unit (ECU), and a speed sensor at each wheel. See Fig. 1. If a system fault occurs, the ECU stores a self-diagnostic code(s) that can be retrieved to diagnose malfunction.

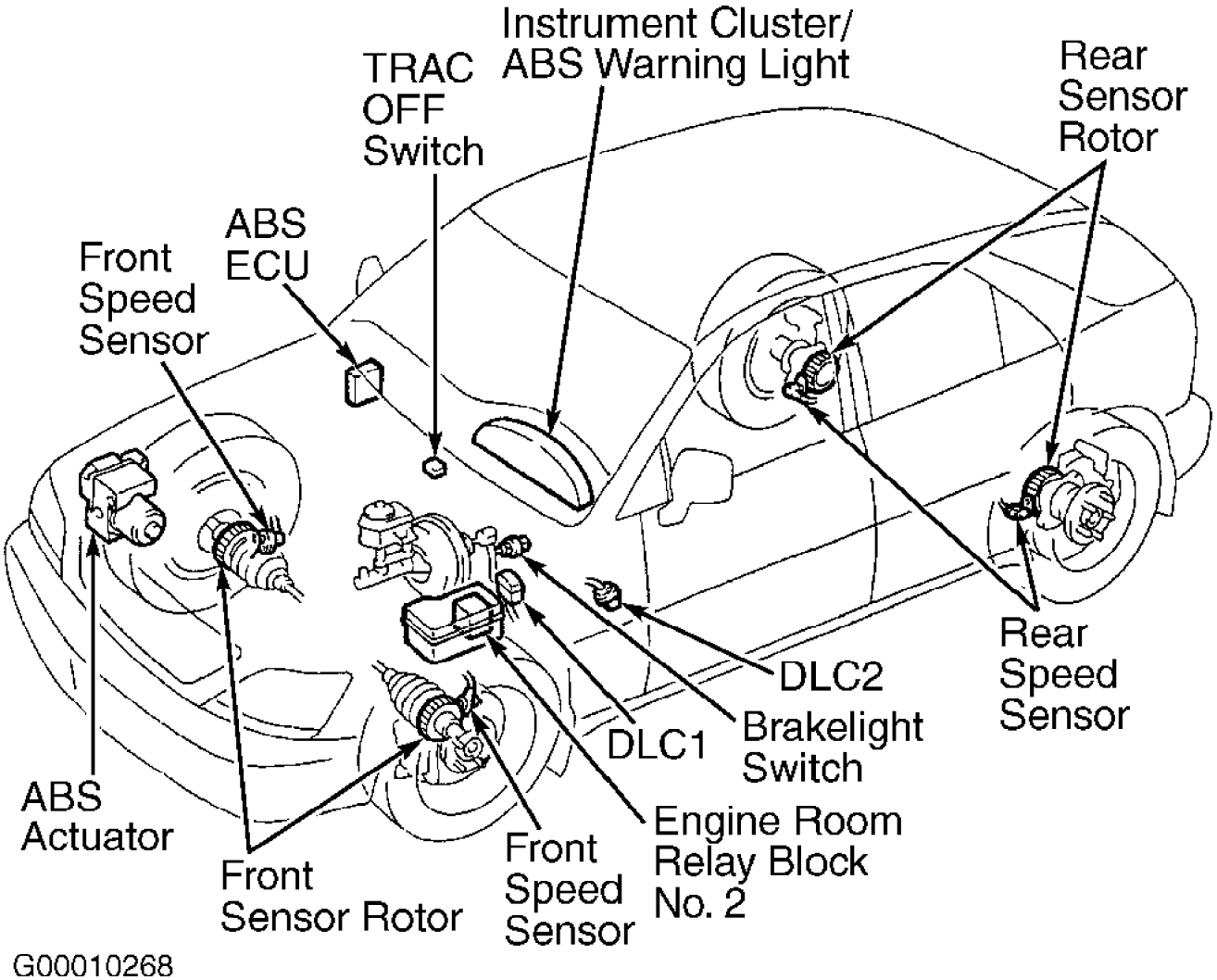


Fig. 1: Identifying ABS Component Locations
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: For more information on brakes system, see DISC article.

OPERATION

With vehicle moving, AC signals are sent from individual wheel speed sensors to ECU. ECU monitors brakelight switch to determine when brake pedal is depressed. With brake pedal depressed, ECU uses speed sensor signals to determine vehicle deceleration.

During panic stop (as determined by ECU), ECU activates solenoid valves inside actuator. Solenoid valves are cycled to apply, release or maintain hydraulic pressure to each wheel in any combination.

An ABS warning light, located on instrument panel, illuminates for 3 seconds as a bulb test when ignition is turned on. A primary check is performed after each engine start and initial time vehicle speed exceeds 6 MPH. Actuator noise should be heard as vehicle speed exceeds 6 MPH. If brake pedal is depressed before vehicle speed exceeds 6 MPH, primary check will not occur until brake pedal is released.

During normal driving conditions, ABS functions like a standard brake system. When wheel lock-up is detected, brake pedal may pulsate and steering wheel and vehicle body may vibrate (this is normal). Pulsation or vibration will continue until ABS function is no longer needed or vehicle is stopped.

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

BLEEDING BRAKE SYSTEM

CAUTION: Brake fluid will damage painted surfaces. If brake fluid contacts a painted surface, wipe off immediately and clean with alcohol. Use only DOT 3 brake fluid from a sealed container. DO NOT mix brake fluid with any other type.

1) Brake bleeding procedure is same procedure used to bleed non-ABS systems. If master cylinder was rebuilt or reservoir ran dry, bleed master cylinder first.

2) To bleed master cylinder, disconnect brake lines from master cylinder. Slowly depress brake pedal and hold. Block off master cylinder holes and release brake pedal. Repeat this procedure 3-4 times.

3) Ensure master cylinder reservoir is full of brake fluid. Connect vinyl tube to caliper bleeder screw and insert other end of tube into a clear container 1/4 full of brake fluid.

4) Slowly pump brake pedal several times. While depressing brake pedal, loosen bleed screw until fluid starts to flow, and then close bleed screw. Repeat operation until no bubbles are present in fluid. Tighten bleed screw to 73 INCH lbs. (8.3 N.m). Bleed brake system in sequence. See BRAKELINE BLEEDING SEQUENCE table.

BRAKELINE BLEEDING SEQUENCE

Application	Sequence
All Models	RR, LR, RF & LF

SERVICING

BRAKE FLUID REPLACEMENT

Brake fluid replacement is recommended every 2 years or 30, 000 miles, whichever occurs first. Use SAE J 1703 or DOT 3 brake fluid.

TROUBLE SHOOTING

ABS DOES NOT OPERATE

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Retrieve Diagnostic Trouble Codes (DTC). See DIAGNOSTIC TROUBLE CODE IDENTIFICATION under DIAGNOSIS & TESTING. If any DTCs are present, perform appropriate diagnostic test. If no DTCs are present, check IG power source circuit. See DTC 41: IG POWER SUPPLY CIRCUIT under DIAGNOSTIC TESTS. Check speed sensor circuits. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table under DIAGNOSIS & TESTING. Check ABS actuator. See ABS ACTUATOR CHECK under COMPONENT TESTS. If ABS actuator is not okay, check hydraulic system for leakage. If all preceding tests are okay and ABS still does not operate, replace ABS ECU.

ABS DOES NOT OPERATE EFFICIENTLY

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Retrieve Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are present, perform appropriate diagnostic test. If no DTCs are present, check speed sensor circuits. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table under DIAGNOSIS & TESTING. Check brakelight switch circuits. See DTC 49: BRAKELIGHT SWITCH CIRCUIT under DIAGNOSTIC TESTS. Check ABS actuator. See ABS ACTUATOR CHECK under DIAGNOSIS & TESTING. If ABS actuator is not okay, check hydraulic system for leakage. If all preceding tests are okay and ABS still does not operate efficiently, replace ABS ECU.

ABS WARNING LIGHT ABNORMAL

Check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Check Anti-Lock Brake System (ABS) Electronic Control Unit (ECU). See ABS WARNING LIGHT DOES NOT TURN OFF (ABS ECU MALFUNCTION) under SYSTEM TESTS.

DIAGNOSTIC TROUBLE CODE DIAGNOSTICS INOPERATIVE

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU

malfunction.

Check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Check Tc terminal circuit. See Tc TERMINAL CIRCUIT under SYSTEM TESTS. If all preceding tests are okay, replace ABS ECU.

SPEED SENSOR DIAGNOSTICS INOPERATIVE

Check Ts terminal circuit. See Tc TERMINAL CIRCUIT under SYSTEM TESTS. Check ABS ECU. See ABS WARNING LIGHT DOES NOT TURN OFF (ABS ECU MALFUNCTION) under SYSTEM TESTS.

DIAGNOSIS & TESTING

RETRIEVING DIAGNOSTIC TROUBLE CODES

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

NOTE: Ensure battery is in good condition and is fully charged. DO NOT start engine when retrieving codes. If codes cannot be retrieved, perform ABS WARNING LIGHT CIRCUIT and Ts TERMINAL CIRCUIT tests under SYSTEM TESTS. If problem remains, replace ABS ECU.

Turn ignition on. Ensure ABS warning light illuminates for 3 seconds and turns off. If ABS warning light does not illuminate, see ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. If ABS warning light flashes or stays on constantly, retrieve Diagnostic Trouble Codes (DTC). See USING LEXUS SCAN TOOL or USING ABS WARNING LIGHT.

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2). DLC2 is located under left side of instrument panel. See Fig. 2. Turn ignition on. Using scan tool screen prompts, retrieve DTCs. Identify DTC and perform appropriate diagnostic test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table. After replacing or repairing malfunctioning components, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES.

Using ABS Warning Light

1) Disconnect short pin from Data Link Connector No. 1 (DLC1). See Fig. 3. DLC1 is located on left side of engine compartment, near junction block. Using a fused jumper wire or Service Connector (SST 09843-18020), connect terminals Tc and E1 of Data Link Connector No. 1 (DLC1) or Data Link Connector No. 2 (DLC2). See Fig. 2 . DLC2 is located under left side of instrument panel.

2) Turn ignition on. If a malfunction is detected, ABS light will begin to flash a 2-digit DTC after 4 seconds. ABS light will flash first digit, followed by a 1.5-second pause and then second digit.

3) Count number of flashes to obtain digits of 2-digit code. If 2 or more codes are stored, a 2.5-second pause will separate codes. If 2 or more malfunctions are indicated at the same time lowest numbered DTC will be displayed first. Identify DTC and perform appropriate diagnostic test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table.

4) If ABS is functioning properly a normal code will be set. During normal code, 2 seconds will elapse, and then ABS light will blink once every .25 second.

5) After replacing or repairing malfunctioning components, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES. Turn ignition off. Remove fused jumper wire or Service Connector (SST 09843-18020), from DLC1 or DLC2 connector.

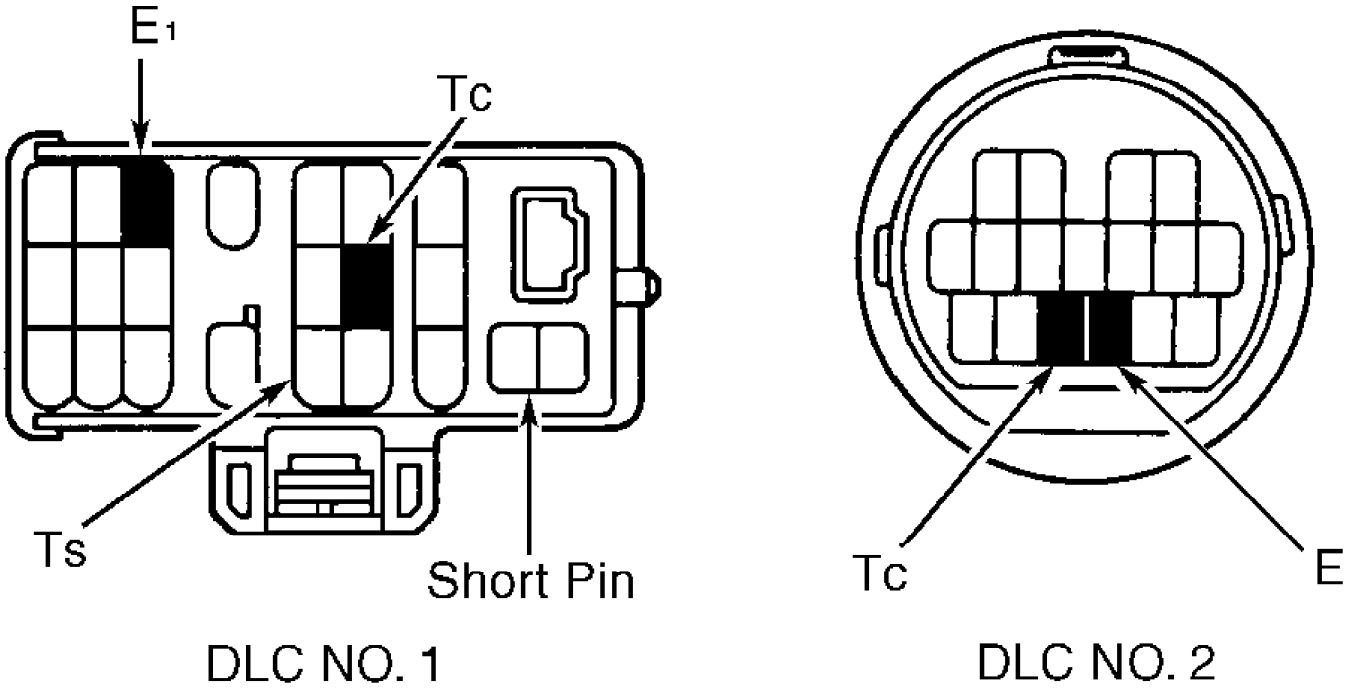


Fig. 2: Identifying Data Link Connector (DLC) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

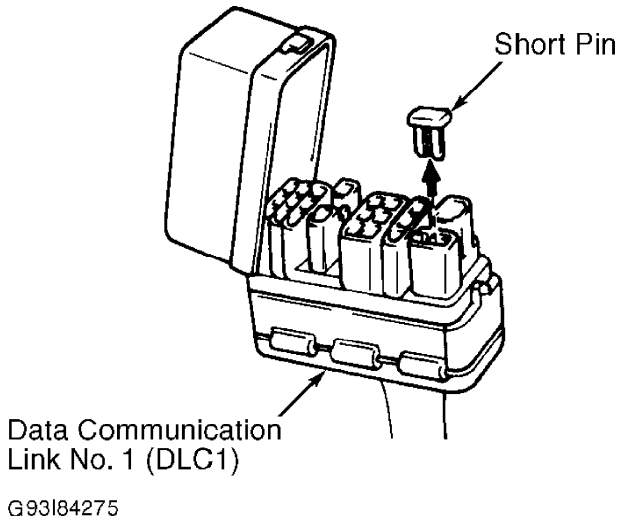


Fig. 3: Locating Short Pin
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DTC	Description
11	ABS Solenoid Relay Circuit
12	ABS Solenoid Relay Circuit
13	ABS Motor Relay Circuit
14	ABS Motor Relay Circuit
22	Right Front ABS Actuator Solenoid Circuit
22	Left Front ABS Actuator Solenoid Circuit
23	Right Rear ABS Actuator Solenoid Circuit
24	Left Rear ABS Actuator Solenoid Circuit
31	Right Front Wheel Speed Sensor Circuit
32	Left Front Wheel Speed Sensor Circuit
33	Right Rear Wheel Speed Sensor Circuit
34	Left Rear Front Wheel Speed Sensor Circuit
41	IG Power Supply Circuit
49	Brakelight Switch Circuit
51	ABS Pump Motor Lock
71 (1)	Right Front Speed Sensor Signal Voltage Low
72 (1)	Left Front Speed Sensor Signal Voltage Low
73 (1)	Right Rear Speed Sensor Signal Voltage Low
74 (1)	Left Rear Speed Sensor Signal Voltage Low
75 (1)	Abnormal Change In Output Signal From Right Front Speed Sensor
76 (1)	Abnormal Change In Output Signal From Left Front Speed Sensor
77 (1)	Abnormal Change In Output Signal From Right Rear Speed Sensor
78 (1)	Abnormal Change In Output Signal From Left Rear Speed Sensor

(1) - See SPEED SENSOR DIAGNOSTIC CODE IDENTIFICATION table.

CLEARING DIAGNOSTIC TROUBLE CODES

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2), located under left side of instrument panel. Turn ignition on. Start engine. ABS warning light should blink once every .13 second. If ABS warning light does not blink, check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Drive vehicle at 28 MPH or greater for several seconds in a straight line. Stop vehicle. Using scan tool screen prompts, retrieve DTCs. Identify DTC and probable cause. See SPEED SENSOR DIAGNOSTIC CODE IDENTIFICATION table. Repair as necessary.

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2). DLC2 is located under left side of instrument panel. Turn ignition on. Using scan tool screen prompts, clear DTCs.

Without Scan Tool

1) Remove short pin from Data Link Connector No. 1 (DLC1). See Fig. 3. DLC1 is located on left side of engine compartment, near junction block. Using a fused jumper wire or Service Connector (SST 09843-18020), connect terminals Tc and E1 of DLC1 or Data Link Connector No. 2 (DLC2). See Fig. 2. DLC2 is located under left side of instrument panel.

2) Turn ignition on. With vehicle stopped, press brake pedal 8 or more times within 5 seconds. DTCs should now be cleared. Verify ABS light goes out after 3 seconds. Verify ABS DTCs have been cleared and normal code is present. During normal code, 2 seconds will elapse, and then ABS warning light will blink once every .25 second. Turn

ignition off. Remove fused jumper wire or Service Connector (SST 09843-18020), from DLC1 or DLC2. Connect short pin in DLC1.

SPEED SENSOR SIGNAL CHECK

NOTE: Information for clearing speed sensor diagnostic codes is not available from manufacturer. It may be possible to clear these codes by disconnecting battery cable or by using procedure for CLEARING DIAGNOSTIC TROUBLE CODES.

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2), located under left side of instrument panel. Turn ignition on. Start engine. ABS warning light should blink once every .13 second. If ABS warning light does not blink, check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Drive vehicle at 28 MPH or greater for several seconds in a straight line. Stop vehicle. Using scan tool screen prompts, retrieve DTCs. Identify DTCs and probable cause. See SPEED SENSOR DIAGNOSTIC CODE IDENTIFICATION table. Repair as necessary.

Without Scan Tool

1) Turn ignition off. Using a fused jumper wire or Service Connector (SST 09843-18020), connect Data Link Connector No. 1 (DLC1) connector terminals Ts and E1. See Fig. 3. DLC1 is located on left side of engine compartment, near junction block. Start engine. ABS light should blink once every .13 second. If ABS light does not blink, check ABS light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS.

2) Drive vehicle at 28 MPH or greater for several seconds in a straight line. Stop vehicle. Using another fused jumper wire or Service Connector (SST 09843-18020), connect DLC1 connector terminals Tc and E1. There should now be 2 jumper wires. See Fig. 2.

3) Observe ABS warning light. If system is normal, ABS light will blink every .25 second. If system is malfunctioning, ABS light will flash codes. Identify DTC and probable cause. See SPEED SENSOR DIAGNOSTIC CODE IDENTIFICATION table. Repair as necessary. Turn ignition off. Remove fused jumper wires or Service Connectors (SST 09843-18020), from DLC1 connector.

SPEED SENSOR DIAGNOSTIC CODE IDENTIFICATION

DTC	Description	Probable Cause
71	Right Front Speed Sensor Signal Voltage Low	Defective Right Front Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
72	Left Front Speed Sensor Signal Voltage Low	Defective Left Front Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
73	Right Rear Speed Sensor Signal Voltage Low	Defective Right Rear Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
74	Left Rear Speed Sensor Signal Voltage Low	Defective Left Rear Speed Sensor, Incorrect Sensor Installation Or Defective

			Sensor Rotor
75	.....	Abnormal Change In Output Signal Voltage From Right Front Speed Sensor	Defective Right Front Sensor Rotor
76	.....	Abnormal Change In Output Signal Voltage From Left Front Speed Sensor	Defective Left Front Sensor Rotor
77	.....	Abnormal Change In Output Signal Voltage From Right Rear Speed Sensor	Defective Right Rear Sensor Rotor
78	.....	Abnormal Change In Output Signal Voltage From Left Rear Speed Sensor	Defective Left Rear Sensor Rotor

DIAGNOSTIC TESTS

DTC 11 OR 12: ABS SOLENOID RELAY CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

Relay supplies power to each ABS solenoid. After ignition switch is turned on, relay turns on if initial check is okay.

DTC 11 is set when ABS solenoid relay is on, ABS ECU detects 9.5-18.0 volts at terminal No. 13 (Black/Red wire) at A22 connector, and relay contact is off for 0.2 second. See Fig. 4.

DTC 11 is also set when ignition is on, IG1 circuit voltage is less than 9.5 volts at terminal No. 13 (Black/Red wire) at ABS ECU A22 connector and relay contact is not on.

DTC 12 is set when ABS solenoid relay is off and immediately after ignition is turned on, ABS ECU detects relay contact is on for more than .2 second. If trouble occurs in ABS solenoid relay circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS control. Possible causes are as follows:

* ABS Solenoid Relay
* ABS Solenoid Relay Circuit
* ABS ECU

Diagnosis & Repair

1) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Measure voltage between terminals No. 1 (power circuit) and 2 (ground circuit) at ABS solenoid relay connector in relay block. See Fig. 5. If voltage is 10-14 volts, go to next step. If voltage is not 10-14 volts, repair ground or power circuit to ABS solenoid relay. See WIRING DIAGRAMS. Repair as necessary.

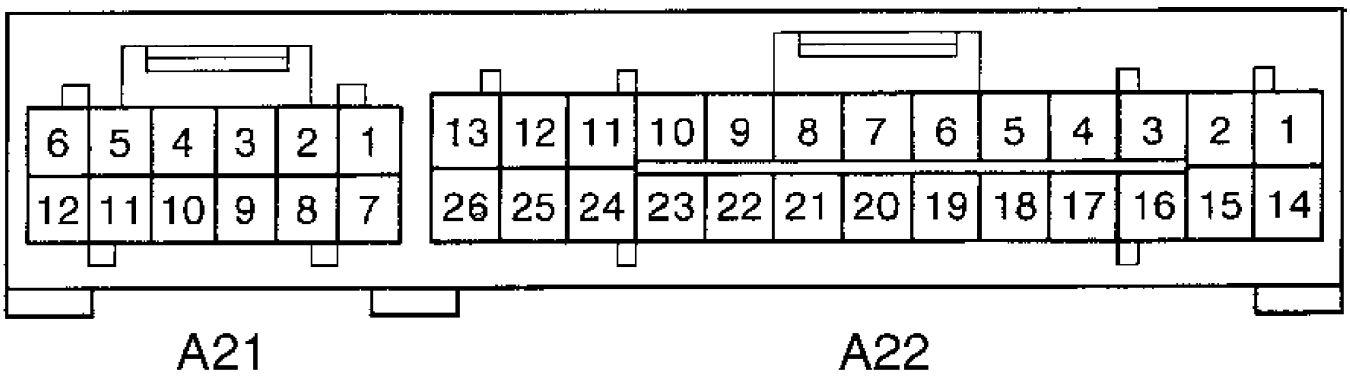


Fig. 4: Identifying ABS ECU Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

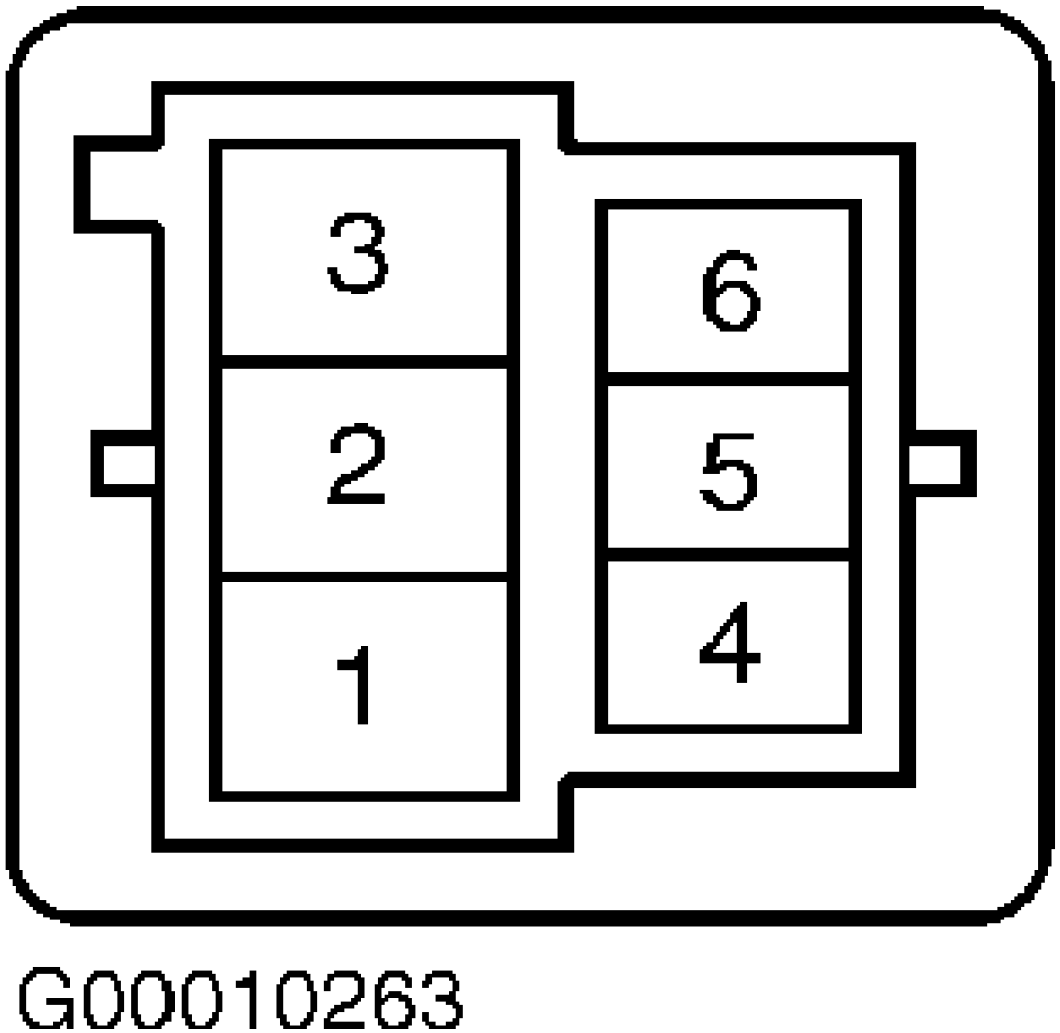


Fig. 5: Identifying ABS Solenoid Relay Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Disconnect ABS actuator connectors, located behind right front fender liner. See Fig. 1. Disconnect ABS ECU connectors, located

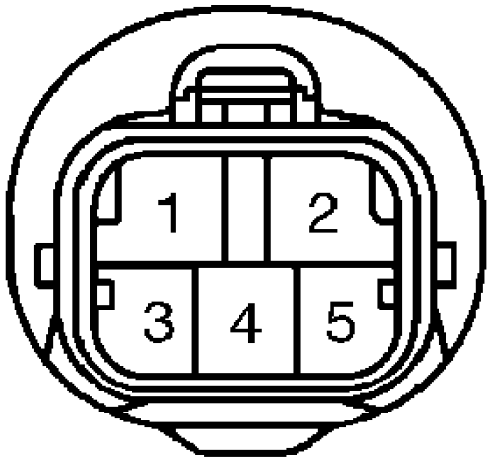
behind right kick panel. Using ohmmeter, check continuity of Blue/Yellow wire between terminal No. 3 at ABS solenoid relay connector and terminal No. 4 at ABS actuator A5 Gray 5-pin harness connector. See Figs. 5 and 6. If continuity does not exist, repair open in Blue/White wire. If continuity exists, go to next step.

3) Check continuity of Black/Orange wire between terminal No. 14 at ABS ECU A22 connector and terminal No. 6 at ABS actuator A6 Black 8-pin harness connector. See Figs. 4 and 7. If continuity does not exist, repair open in Black/Orange wire. If continuity exists, measure resistance between terminals No. 2 and 3 at ABS actuator A5 Gray 5-pin harness connector (component side). If resistance is about 33 ohms, go to next step. If resistance is not about 33 ohms, replace ABS actuator.

4) Using ohmmeter, check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 2 and 3. See Fig. 8. Continuity should not exist between relay terminals No. 1 and 3. Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

5) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal No. 6. See Fig. 8. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

6) Check for open or short in wiring harness between ABS solenoid relay connector in engine compartment No. 3 relay block and ABS ECU connectors. Repair wiring as necessary. If wiring is okay, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If same DTC resets, check for loose, damaged or corroded connector terminals. Repair as necessary. If connectors are okay, replace ABS ECU.



G98D07593

Fig. 6: Identifying ABS Actuator A5 Gray 5-Pin Harness Connector Terminals (Harness Side Shown)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

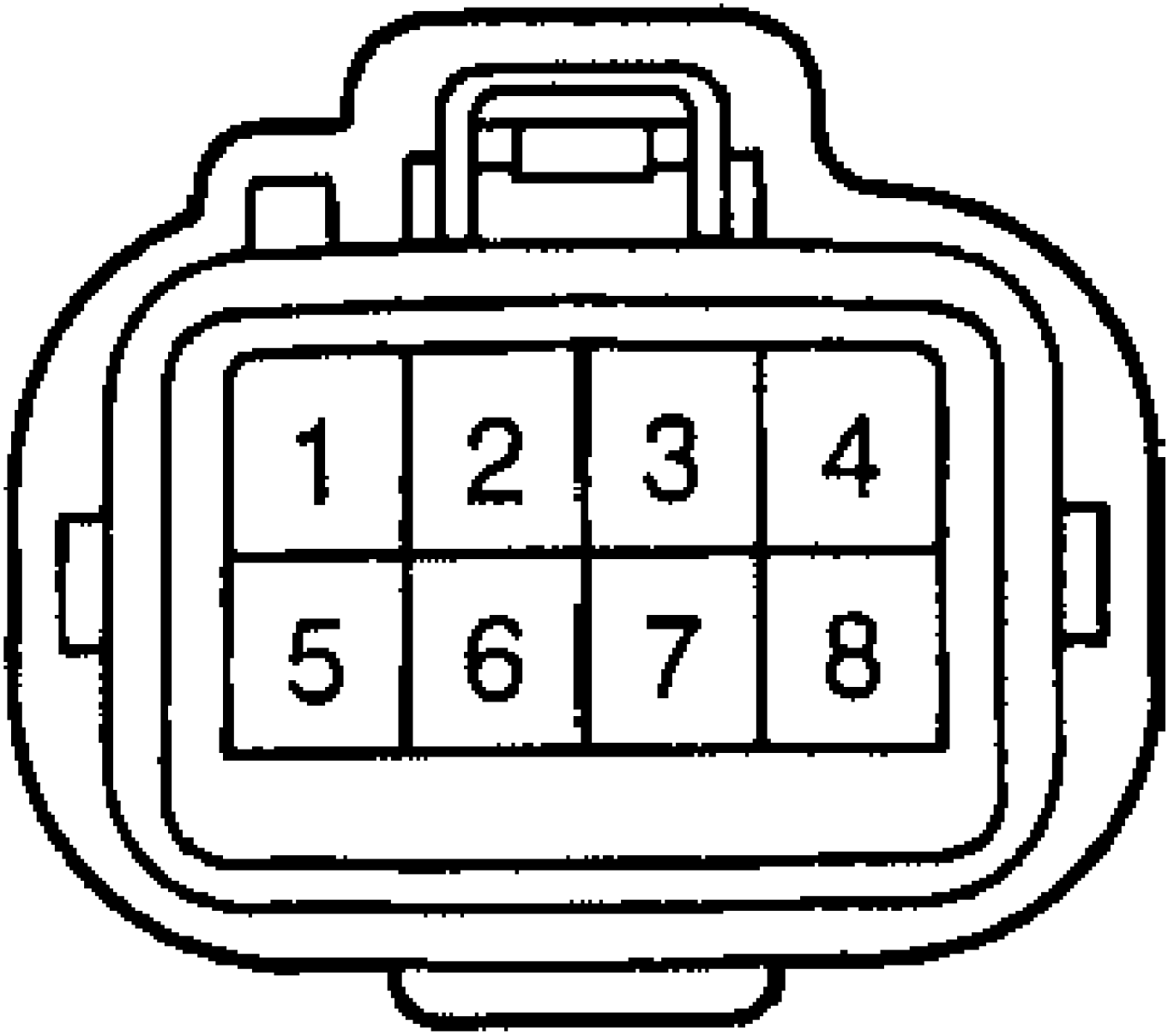
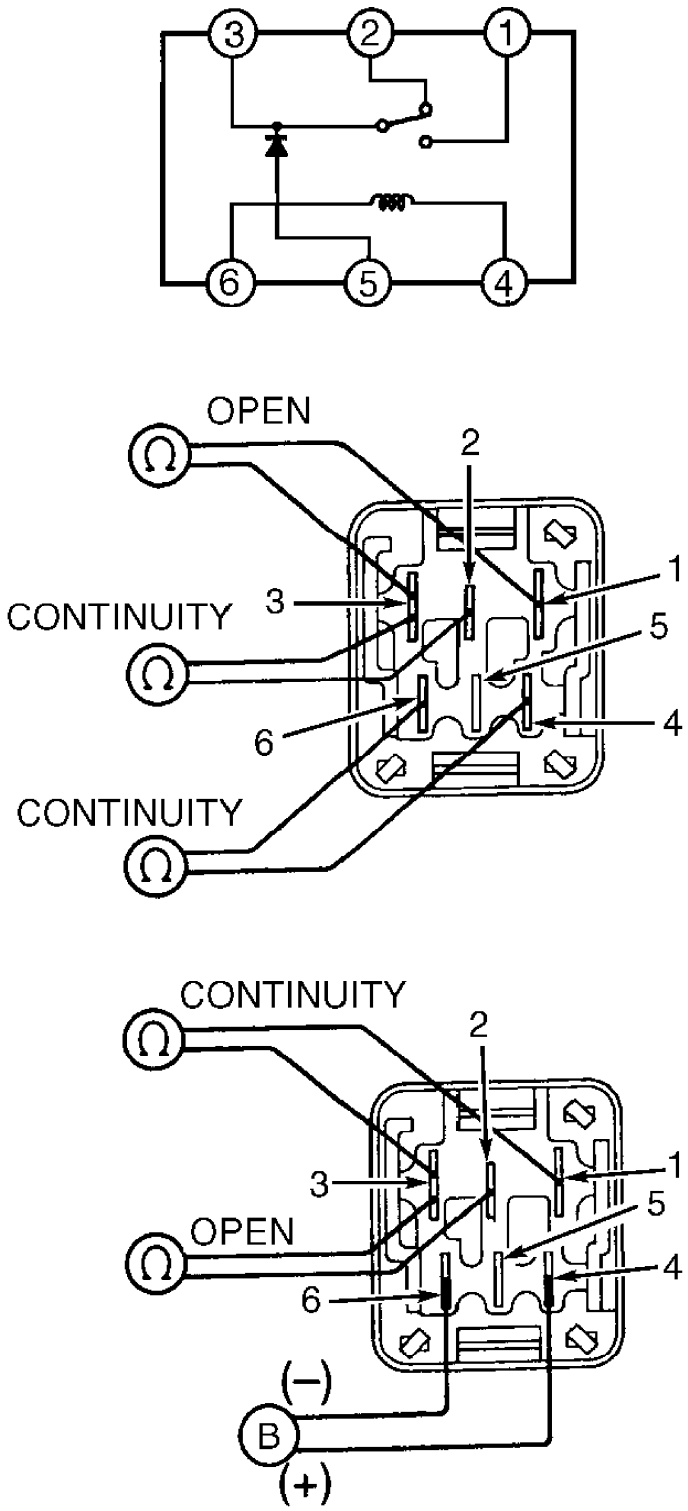


Fig. 7: Identifying ABS Actuator A6 Black 8-Pin Harness Connector Terminals (Harness Side Shown)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G98H07585

Fig. 8: Testing ABS Solenoid Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 13 OR 14: ABS MOTOR RELAY CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

ABS motor relay supplies power to ABS pump motor. When ABS is activated, ABS ECU switches motor relay on and operates ABS pump motor. Diagnostic Trouble Code (DTC) 13 is set when ABS motor relay malfunctions. DTC 13 will also set if after ABS motor relay is on and ABS motor relay monitor does not detect an on signal.

DTC 14 is set when ABS motor relay is off and ABS motor relay monitor is on for 2 seconds or more. If a fault occurs in ABS motor relay circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibits ABS. Possible causes are as follows:

* ABS Motor Relay
* ABS Motor Relay Circuit
* ABS ECU

Diagnosis & Testing

1) Remove ABS motor relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Measure voltage between ground and terminal No. 1 at ABS motor relay connector in relay block. See Fig. 9. If voltage is 10-14 volts, go to next step. If voltage is not 10-14 volts, repair power circuit to ABS motor relay.

2) Disconnect ABS actuator connectors, located behind right front fender liner. See Fig. 1. Disconnect ABS ECU connectors, located behind right kick panel. Using ohmmeter, check continuity of Blue/White wire between terminal No. 2 at ABS motor relay connector and terminal No. 2 at ABS actuator A5 Gray 5-pin harness connector. See Figs. 6 and 9. If continuity does not exist, repair open in Blue/White wire. If continuity exists, go to next step.

3) Check continuity of Red/Blue wire between terminal No. 10 at ABS ECU A21 connector and terminal No. 3 at ABS actuator A5 Gray 5-pin harness connector. See Figs. 4 and 6. If continuity does not exist, repair open in Red/Blue wire. If continuity exists, check resistance between ABS actuator terminals No. 2 and 3 at ABS actuator A5 Gray 5-pin harness connector (component side). If resistance is about 33 ohms, go to next step. If resistance is not about 33 ohms, replace ABS actuator.

4) Using ohmmeter, check for continuity between ABS motor relay terminals. Continuity should exist between terminals No. 3 and 5. Continuity should not exist between relay terminals No. 1 and 2. See Fig. 10. Measure resistance between relay terminals No. 3 and 4. If resistance is about 62 ohms, go to next step. If resistance is not about 62 ohms, replace ABS motor relay.

5) Using jumper wires, apply battery voltage to ABS motor relay terminal No. 3 and ground relay terminal No. 5. Check for continuity between ABS motor relay terminals No. 1 and 2. See Fig. 10. If continuity exists, go to next step. If continuity does not exist, replace ABS motor relay.

6) Check for open or short in wiring harness between ABS motor relay connector in engine compartment No. 2 relay block and ABS ECU connectors. Repair wiring as necessary. If wiring is okay, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If same DTC resets, check for loose, damaged or corroded connector terminals.

Repair as necessary. If connectors are okay, replace ABS ECU.

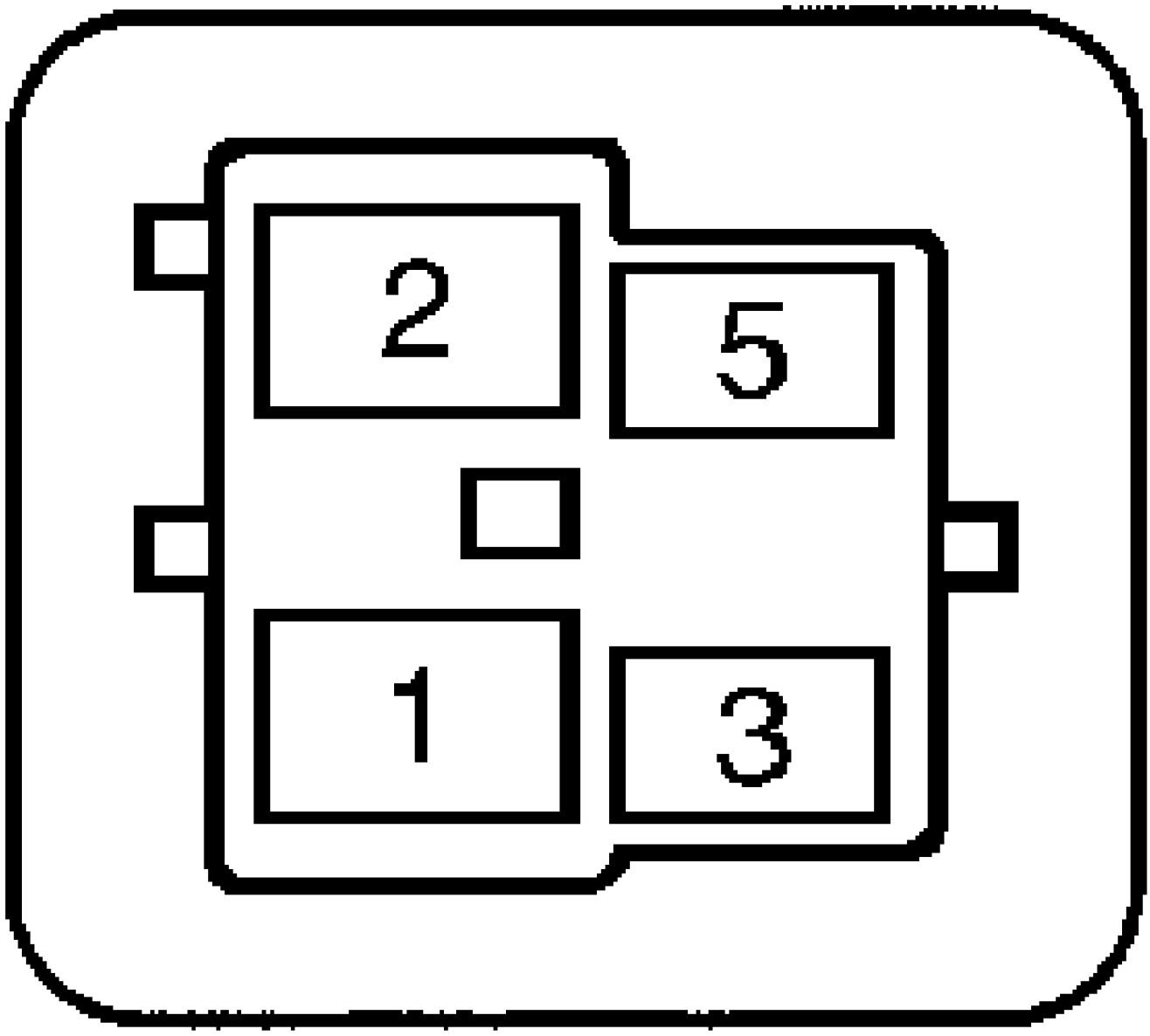


Fig. 9: Identifying ABS Motor Relay Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

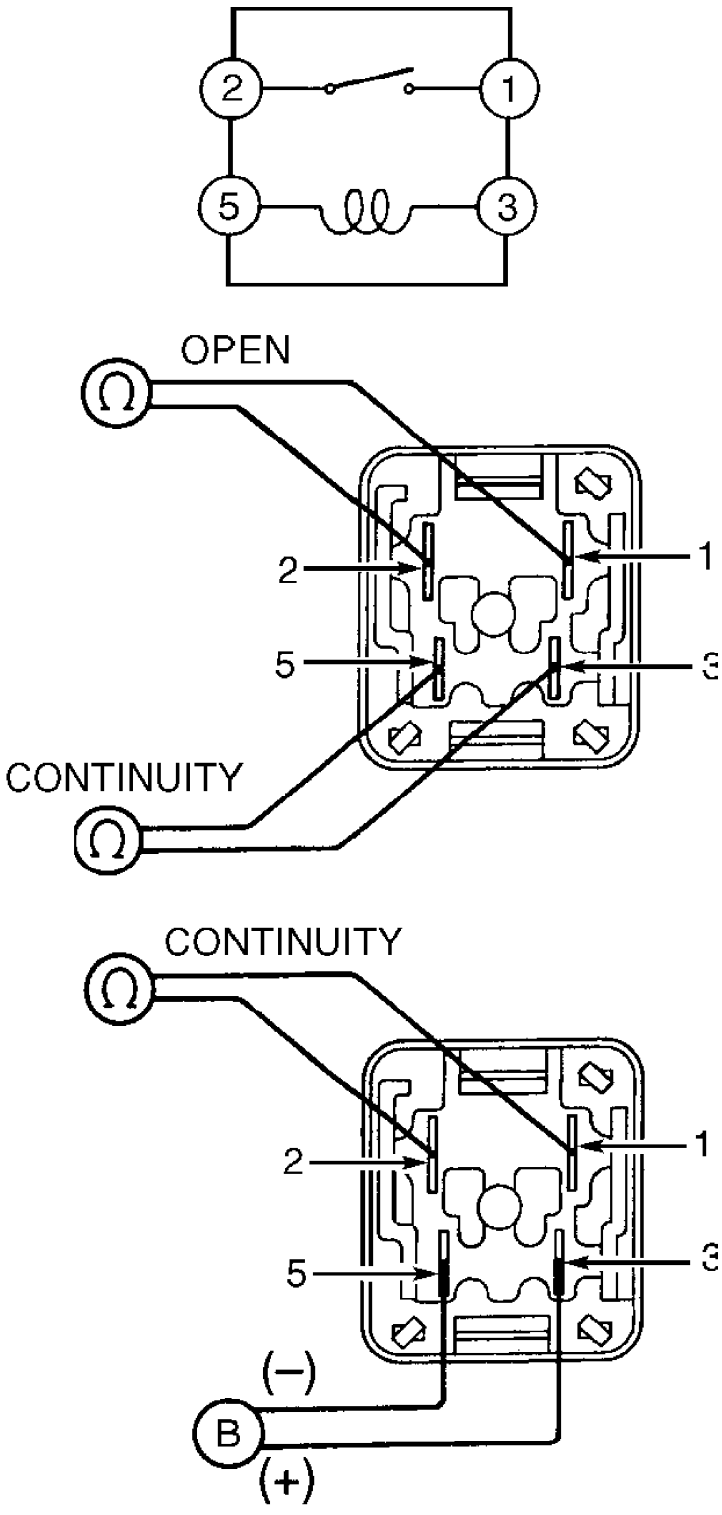


Fig. 10: Testing ABS Motor Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 21: RIGHT FRONT ABS ACTUATOR SOLENOID CIRCUIT DTC 22: LEFT FRONT ABS ACTUATOR SOLENOID CIRCUIT DTC 23:

RIGHT REAR ABS ACTUATOR SOLENOID CIRCUIT DTC 24:
LEFT REAR ABS ACTUATOR SOLENOID CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

ABS actuator solenoid turns on when signal is received from ABS ECU. ABS actuator solenoid controls fluid pressure acting on brake cylinders controlling braking force. DTC 21 is set when ABS ECU detects an open or short in ABS actuator solenoid wire circuit SFRR or SFRH for more than .05 second or more. See WIRING DIAGRAMS.

DTC 22 is set when ABS ECU detects an open or short in ABS actuator solenoid wire circuit SFLR or SFLH for more than .05 second or more. DTC 23 is set when ABS ECU detects an open or short in ABS actuator solenoid wire circuit SRRR or SRRH for more than .05 second or more.

DTC 24 is set when ABS ECU detects an open or short in ABS actuator solenoid wire circuit SRLR or SRLH for more than .05 second or more. If fault occurs in ABS actuator solenoid circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS control. Possible causes are as follows:

* ABS Actuator
* Open Or Shorted Circuit
* ABS ECU

Diagnosis & Repair

1) Disconnect ABS actuator connectors, located behind right front fender liner. Using ohmmeter, measure resistance between terminal No. 4 (Blue/Yellow wire) of A5 Gray 5-pin ABS actuator connector (component side) and every terminal at ABS actuator 8-pin connector (component side). See Figs. 6 and 7. See ABS ACTUATOR RESISTANCE SPECIFICATIONS table. If all resistance readings are as specified, go to next step. If any resistance reading is not as specified, replace ABS actuator.

2) Check for open or short in wiring harness between ABS ECU and ABS actuator. Repair as necessary. See WIRING DIAGRAMS. If wiring is okay, clear DTCs and retest. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If DTC still exist, check for loose connectors. If connectors are okay, replace ABS ECU.

ABS ACTUATOR RESISTANCE SPECIFICATIONS

ABS/TRAC Actuator Connector A6 Terminals No. (1)	Ohms
2, 5, 11 & 15	8.8
1, 6, 12 & 14	4.3

(1) - Resistance is measured between ABS actuator terminal No. 4 (Blue/Yellow wire) of A5 Gray 5-pin connector and each ABS actuator A6 Black 8-pin connector terminal listed.

DTC 31: RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible causes are as follows:

* Right Front Speed Sensor
* Right Front Speed Sensor Circuits
* Right Front Speed Sensor Rotor
* ABS ECU

Diagnosis & Repair

1) Remove right front fender liner. Disconnect right front speed sensor connector. Using ohmmeter, measure resistance between right front speed sensor terminals. If resistance is 1400-1800 ohms, go to next step. If resistance is not 1400-1800 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at right front speed sensor. If continuity does not exist in both readings, go to next step. If continuity exists in any reading, replace speed sensor.

3) Disconnect ABS ECU connectors, located behind right kick panel. Measure resistance of Violet wire between right front speed sensor harness connector and terminal No. 3 at ABS ECU A21 connector. See Fig. 4. Also measure resistance of Pink wire between right front speed sensor harness connector and terminal No. 9 at ABS ECU A21 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Violet wire or Pink wire.

4) Check continuity between ground and terminals No. 3 (Violet wire) and No. 9 (Pink wire) at ABS ECU A21 connector. See Fig. 4. If continuity does not exist in both readings, reconnect ABS ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Violet wire or Pink wire between right speed sensor and ABS ECU.

5) Check right front speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between right front sensor and right front steering knuckle. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 3 (Violet wire) at ABS ECU A21 connector. See Fig. 4. Drive vehicle about 19 MPH and check speed sensor signal

waveform. SeeFig. 11. If waveform is not as indicated, go to next step. If waveform is as indicated, replace ABS ECU.

7) Turn ignition off. Remove right front axle shaft. See AXLE SHAFTS - AWD & FWD - RX300 article in DRIVE AXLES. Inspect speed sensor rotor on axle shaft for scratches, missing teeth or other damage. Replace speed sensor rotor as necessary. Remove right front speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS ECU.

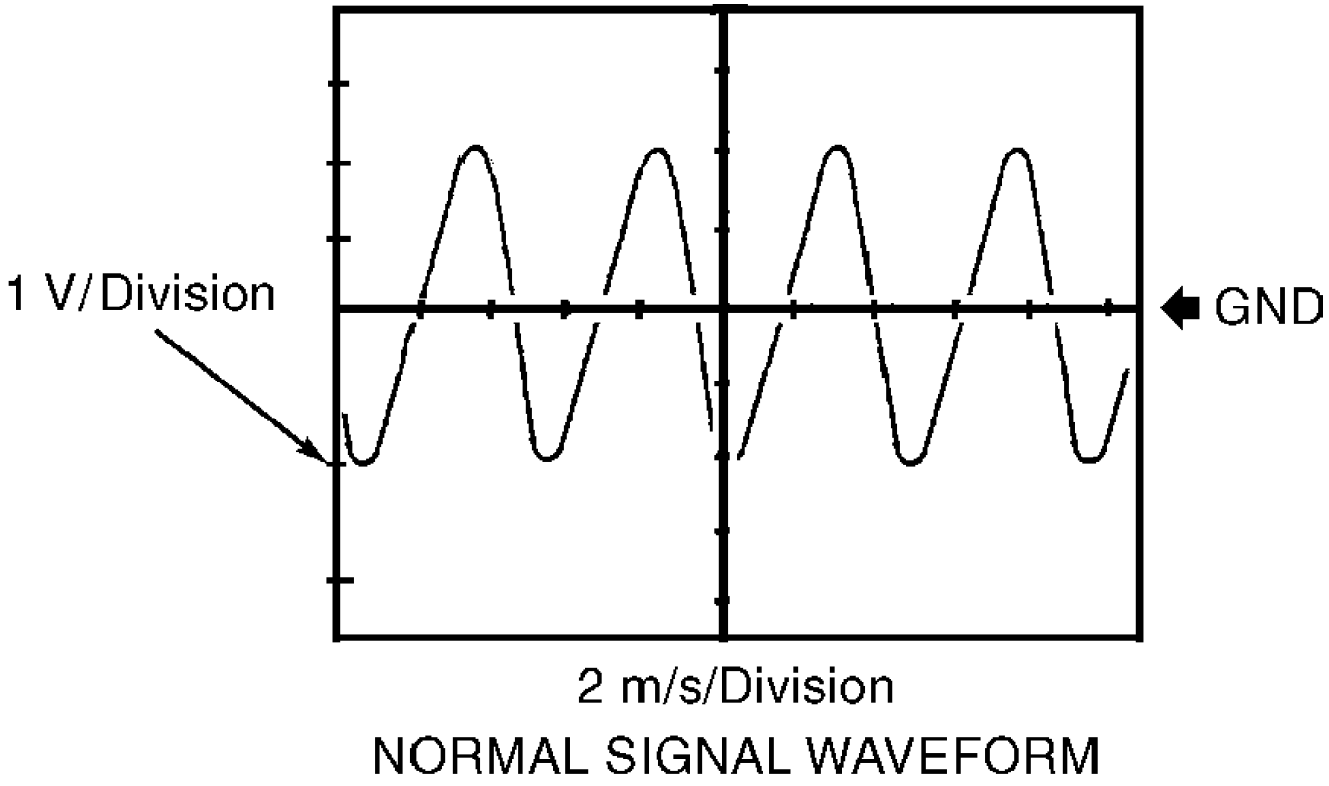


Fig. 11: Identifying Normal Speed Sensor Signal Waveform
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 32: LEFT FRONT WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS ECU for 15 seconds with vehicle speed 6 MPH or

more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible causes are as follows:

* Left Front Speed Sensor
* Left Front Speed Sensor Circuits
* Left Front Speed Sensor Rotor
* ABS ECU

Diagnosis & Repair

1) Remove left front fender liner. Disconnect left front speed sensor connector. Using ohmmeter, measure resistance between left front speed sensor terminals. If resistance is 1400-1800 ohms, go to next step. If resistance is not 1400-1800 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at left front speed sensor. If continuity does not exist in both readings, go to next step. If continuity exists in any reading, replace speed sensor.

3) Disconnect ABS ECU connectors, located behind right kick panel. Measure resistance of Blue wire between left front speed sensor harness connector and terminal No. 2 at ABS ECU A21 connector. See Fig. 4. Also measure resistance of Light Green wire between left front speed sensor harness connector and terminal No. 8 at ABS ECU A21 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Blue wire or Light Green wire.

4) Check continuity between ground and terminals No. 2 (Blue wire) and No. 8 (Light Green wire) at ABS ECU A21 connector. See Fig. 4. If continuity does not exist in both readings, reconnect ABS ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Blue wire or Light Green wire between left front speed sensor and ABS ECU.

5) Check left front speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between left front sensor and left front steering knuckle. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 8 (Light Green wire) at ABS ECU A21 connector. See Fig. 4. Drive vehicle about 19 MPH and check speed sensor signal waveform. See Fig. 11. If waveform is not as indicated, go to next step. If waveform is as indicated, replace ABS ECU.

7) Turn ignition off. Remove left front axle shaft. See AXLE SHAFTS - AWD & FWD - RX300 article in DRIVE AXLES. Inspect speed sensor rotor on axle shaft for scratches, missing teeth or other damage. Replace speed sensor rotor as necessary. Remove left front speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS ECU.

DTC 33: RIGHT REAR WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible causes are as follows:

* Right Rear Speed Sensor
* Right Rear Speed Sensor Circuits
* Right Rear Speed Sensor Rotor
* ABS ECU

Diagnosis & Repair

1) Remove rear seat, scuff plate and rear seat side molding. Disconnect right rear speed sensor connector. Using ohmmeter, measure resistance between right rear speed sensor terminals. If resistance is 1500-1700 ohms, go to next step. If resistance is not 1500-1700 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at right rear speed sensor. If continuity does not exist, go to next step. If continuity exists, replace speed sensor.

3) Disconnect ABS ECU connectors, located behind right kick panel. Measure resistance of Gray/Red wire between right rear speed sensor harness connector and terminal No. 10 at ABS ECU A22 connector. See Fig. 4. Also measure resistance of Blue wire between right rear speed sensor harness connector and terminal No. 23 of ABS ECU A22 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Gray/Red wire or Blue wire.

4) Check continuity between ground and terminals No. 10 (Gray/Red wire) and No. 23 (Blue wire) at ABS ECU A22 connector. See Fig. 4. If continuity does not exist in both readings, reconnect ABS ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Gray/Red wire or Blue wire between right rear speed sensor and ABS ECU.

5) Check right rear speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between right rear sensor and rear axle carrier. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 10 (Gray/Red wire) at ABS ECU A22 connector. See Fig. 4. Drive vehicle about 19 MPH and check speed sensor signal waveform. See Fig. 11. If waveform is not as indicated, go to next step. If waveform is as indicated, replace ABS ECU.

7) Remove right rear hub assembly. See appropriate REAR article in SUSPENSION. Inspect speed sensor rotor for scratches, missing teeth or other damage. Replace as necessary. Remove right rear speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION.

Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS ECU.

DTC 34: LEFT REAR WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible causes are as follows:

* Left Rear Speed Sensor
* Left Rear Speed Sensor Circuits
* Left Rear Speed Sensor Rotor
* ABS ECU

Diagnosis & Repair

1) Remove rear seat, scuff plate and rear seat side molding. Disconnect left rear speed sensor connector. Using ohmmeter, measure resistance between left rear speed sensor terminals. If resistance is 1500-1700 ohms, go to next step. If resistance is not 1500-1700 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at left rear speed sensor. If continuity does not exist, go to next step. If continuity exists, replace speed sensor.

3) Disconnect ABS ECU connectors, located behind right kick panel. Measure resistance of Blue/White wire between left rear speed sensor harness connector and terminal No. 9 at ABS ECU A22 connector. See Fig. 4. Also measure resistance of Blue/Yellow wire between left rear speed sensor harness connector and terminal No. 22 at ABS ECU A22 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Blue/White wire or Blue/Yellow wire.

4) Check continuity between ground and terminals No. 9 (Blue/White wire) and No. 22 (Blue/Yellow wire) at ABS ECU A22 connector. See Fig. 4. If continuity does not exist in both readings, reconnect ABS ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Blue/White wire or Blue/Yellow wire between left rear sensor and ABS ECU.

5) Check left rear speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between left rear sensor and rear axle carrier. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 22 (Blue/Yellow wire) at ABS ECU A22 connector. See Fig. 4. Drive vehicle about 19 MPH and check speed sensor signal waveform. See Fig. 11. If waveform is not as indicated, go to next step. If waveform is as indicated, replace ABS ECU.

7) Remove left rear hub assembly. See REAR article in SUSPENSION. Inspect speed sensor rotor for scratches, missing teeth or other damage. Replace as necessary. Remove left rear speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS ECU.

DTC 41: IG POWER SUPPLY CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

Voltage is supplied from ignition switch to ABS ECU and actuators. Diagnostic Trouble Code (DTC) is set when 9.5 volts is detected on ABS ECU A22 connector terminal No. 13 (Black/Red wire) and vehicle speed is at 1.9 MPH or more. See Fig. 4.

If fault occurs in power supply circuit, ABS ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible causes are as follows:

* Battery
* Regulator
* Power Supply Circuit
* ABS ECU

Diagnosis & Repair

1) Inspect ECU-IG fuse (15-amp) in instrument panel junction block. Instrument panel junction block is located behind lower finish panel left of steering column. If fuse is okay, go to next step. If fuse is blown, inspect circuit between junction block and ABS ECU for short.

2) Check voltage at battery. If voltage is not 10-14 volts, check charging system. See appropriate GENERATORS & REGULATORS article in STARTING & CHARGING SYSTEMS. Repair as necessary. If voltage is 10-14 volts, remove ABS ECU but do not disconnect connectors. ABS ECU is located behind right kick panel. Backprobing, measure voltage between terminal No. 13 (Black/Red wire) and terminals No. 12 (White/Black wire) and No. 25 (Black/White wire) at ABS ECU A22. See Fig. 4. If any voltage reading is not 10-14 volts, go to next step. If all voltage readings are 10-14, replace ABS ECU.

3) Measure resistance between ground and terminals No. 12 (White wire) and No. 25 at ABS ECU A22 connector. See Fig. 4. If both resistance readings are one ohm of less, ground circuits are okay. Check for open in wiring harness between battery and ABS ECU. Repair wiring harness as necessary. If any resistance reading is more than one ohm, repair open in appropriate White/Black wire.

DTC 49: BRAKELIGHT SWITCH CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is

suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

Diagnostic Trouble Code (DTC) is set when ABS system is not operating, ABS ECU detects 9.5-18.0 volts on IG1 circuit, and an open exists in brakelight switch circuit for .3 second or more. Possible causes are as follows:

* Brakelight Switch
* Brakelight Switch Circuit
* ABS ECU

Diagnosis & Repair

1) Check brakelight operation. If brakelights are functioning properly, go to next step. If brakelights are not functioning properly, check brakelight bulbs, brakelight switch and circuits. See appropriate wiring diagram in EXTERIOR LIGHTS article in ACCESSORIES & EQUIPMENT. Repair as necessary.

2) Remove ABS ECU but do not disconnect connector. See ABS ECU under REMOVAL & INSTALLATION. Depress brake pedal. Backprobing, measure voltage between ground and terminal No. 5 (Green/Red wire) at ABS ECU A22 connector. See Fig. 4. If voltage is not 8-14 volts, go to next step. If voltage is 8-14 volts, check ABS actuator using Actuator Checker (SST 09990-00150). See ABS ACTUATOR CHECK under COMPONENT TESTS. If ABS actuator is not okay, check hydraulic circuit for leakage.

3) Check for open in STP circuit between terminal No. 5 (Green/Red wire) and terminal No. 1 (Green/White wire) at brakelight switch. Repair as necessary. If wire is okay, replace ABS ECU.

DTC 51: ABS PUMP MOTOR LOCK

Description

Diagnostic Trouble Code (DTC) is set when ABS pump motor is not operating normally. If fault occurs in ABS pump motor, Anti-Lock Brake System (ABS) performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS. Possible cause is failed pump motor.

Diagnosis & Testing

Disconnect ABS actuator connectors, located behind right front fender liner. See Fig. 1. Using jumper wires, apply battery voltage to terminal No. 2 (Blue/White wire) and ground terminal No. 1 (White/Black wire) at ABS actuator A5 Gray 5-pin connector (component side). See Fig. 6. If pump motor running noise can be heard, check for open circuit between ABS motor relay, ABS actuator and ABS ECU. If pump motor running noise cannot be heard, replace ABS actuator.

SYSTEM TESTS

ABS WARNING LIGHT DOES NOT TURN OFF (ABS ECU MALFUNCTION)

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

Problem occurs when ABS ECU internal malfunction is detected. Possible cause is a malfunctioning ABS ECU. If fault occurs in power

source circuit, ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS.

Diagnosis & Repair

1) Check for Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Go to appropriate DTC test procedure. Clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Go to next step.

2) Ensure DTC normal code (no DTCs) is present. If normal code is not present, go to step 8). If normal code is present, go to next step.

3) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Continuity should exist between relay terminals No. 2 and 3. See Fig. 8. Continuity should not exist between relay terminals No. 1 and 3.

4) Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

5) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal 6. See Fig. 8. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

6) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 5 and negative lead to terminal No. 3. Check for continuity. If continuity exists, go to step 8). If continuity does not exist, go to next step.

7) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 3 and negative lead to terminal No. 5. Check for continuity. If continuity does not exist, replace ABS solenoid relay. If continuity exists, go to next step.

8) Check for short in Violet wire between ABS solenoid relay and Data Link Connector No. 1 (DLC1). DLC1 is located on left side of engine compartment, near junction block. Repair wiring as necessary.

9) Check if ABS warning light turns off. If ABS warning light does not turn off, go to next step. If ABS warning light turns off, check for open or short in Black/Red wire between terminal No. 13 at ABS ECU A22 connector and ECU-IG fuse (15-amp). See Fig. 4. ECU-IG fuse is located in instrument panel junction block. Instrument panel junction block is located behind lower finish panel left of steering column.

10) Using voltmeter, check battery voltage. If battery voltage is 10-14 volts, go to next step. If battery voltage is not 10-14 volts, check charging system. See appropriate GENERATORS & REGULATORS article in STARTING & CHARGING SYSTEMS.

11) Turn ignition switch off. Disconnect ABS ECU connector. ABS ECU is located behind right kick panel. See Fig. 1. Turn ignition on. Check if ABS warning light turns off. If ABS warning light turns off, replace ABS ECU. If ABS warning light does not turn off, check for short in wiring harness between ABS warning light, DLC1, DLC2 and ABS ECU. DLC1 is located on left side of engine compartment, near junction block. DLC2 is located under left side of instrument panel.

ABS WARNING LIGHT CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is

suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

If a fault is detected by ABS ECU, ABS ECU will illuminate ABS warning light, prohibit ABS operation and set appropriate Diagnostic Trouble Code (DTC).

Diagnosis & Repair

1) If light is illuminated constantly, go to step 7). If light does not illuminate, check GAUGE fuse, ABS warning light bulb, instrument cluster and wiring. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. If components are okay, go to next step.

2) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Continuity should exist between relay terminals No. 2 and 3. See Fig. 8. Continuity should not exist between relay terminals No. 1 and 3. Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

3) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal 6. See Fig. 8. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

4) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 5 and negative lead to terminal No. 3. Check for continuity. If continuity exists, go to step 6). If continuity does not exist, go to next step.

5) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 3 and negative lead to terminal No. 5. Check for continuity. If continuity does not exist, replace ABS solenoid relay. If continuity exists, go to next step.

6) Check for open in wire harness between ground, ABS solenoid relay and Data Link Connector No. 1 (DLC1). DLC1 is located on left side of engine compartment, near junction block.

7) Retrieve Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are set, repair appropriate DTC. If no DTCs are set, remove short pin from DLC1. See Fig. 3. If ABS warning light turns off, go to next step. If ABS warning light stays on, check for short in Black/Yellow wire between terminal No. 11 at ABS ECU A22 connector, DLC1 and ABS warning light. See WIRING DIAGRAMS.

8) Check ABS solenoid relay. Go to step 2). Replace relay as necessary. ABS solenoid relay is okay, check for short in Violet wire between ABS solenoid relay and DLC1.

TC TERMINAL CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

Connecting between Data Link Connector No. 1 (DLC1) terminals Tc and E1 causes ABS ECU to display DTCs by flashing ABS warning light.

Diagnosis & Repair

Turn ignition on. Using voltmeter, check voltage between terminals Tc and E1 of DLC1 or Data Link Connector No. 2 (DLC2). See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. DLC2 is located under left side of instrument panel. If voltage is 10-14, circuit is okay. Connect a fused jumper wire or Service Connector (SST 09843-18020) between terminals Tc and E1 at DLC1 or DLC2. Check ABS warning light. If ABS warning light does not blink, ABS ECU may be faulty. If voltage is not 10-14 volts, check for open or short in circuits between ABS ECU, DLC1 or DLC2, and between DLC1 or DLC2 and ground. Repair wiring as necessary. If wiring is okay, replace ABS ECU.

TS TERMINAL CIRCUIT

CAUTION: If Anti-Lock Brake System (ABS) Electronic Control Unit (ECU) replacement is necessary during testing, always ensure ABS ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS ECU malfunction.

Circuit Description

This sensor check circuit detects abnormalities in speed sensor signal that cannot be detected with Diagnostic Trouble Codes (DTC) check. Connect Data Link Connector No. 1 (DLC1) terminal Ts to terminal E1 to start the check.

Diagnosis & Repair

Turn ignition on. Using a voltmeter, check voltage between terminals Ts and E1 at DLC1 connector. See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. If voltage is 10-14 volts, circuit is okay. Connect a fused jumper wire or Service Connector (SST 09843-18020) between terminals Ts and E1 at DLC1 connector. Check ABS warning light. If ABS warning light does not blink, ABS ECU may be faulty. If voltage is not 10-14 volts, check for open or short in wire harness circuits between ABS ECU, DLC1 and between DLC1 and ground. Repair wiring as necessary. If wiring is okay, replace ABS ECU.

COMPONENT TESTS

ABS ACTUATOR CHECK

NOTE: ABS Actuator Checker (SST 09990-00150) is needed to perform actuator check.

1) Turn ignition off. Ensure battery voltage is 10-14 volts. Disconnect ABS actuator electrical connectors. Connect ABS Actuator Checker (SST 09990-00150) positive and negative power cables to vehicle battery. Connect sub-wire Harness (SST 09990-00250, SST 09990-00300 and SST 09990-00360) to ABS actuator connectors. Connect ABS Actuator Checker (SST 09990-00150) to sub-wire harness. See Fig. 12. Connect Black cable of sub-wire harness to ground.

2) Place SHEET "A" (SST 09990-00163) on ABS actuator checker. Start engine and run at idle. Turn selector switch of ABS actuator checker to FRONT RH position. See Fig. 13.

3) Press MOTOR switch for a few seconds. Depress and hold brake pedal down until step 4) is completed.

NOTE: DO NOT keep MAIN switch pressed for more than 10 seconds.

4) Press POWER switch, and ensure brake pedal does not go down. Release POWER switch. Brake pedal should go down. Press MOTOR switch for a few seconds, and ensure brake pedal returns. Release brake pedal.

5) Press MOTOR switch for a few seconds then release. Depress brake pedal and hold down for 15 seconds. With brake pedal depressed, press MOTOR switch for a few seconds. Ensure brake pedal does not pulsate. Replace ABS actuator if actuator does not test as specified. See ABS ACTUATOR under REMOVAL & INSTALLATION. Release brake pedal.

6) Repeat steps 3)-5) for FRONT LH and REAR RH positions of selector switch. See Fig. 13. When inspecting REAR LH position, it does not matter which selector switch position ABS actuator checker is in. When inspecting REAR LH, push REAR LH switch instead of POWER switch.

7) After all wheels are checked, press MOTOR switch for a few seconds. Turn engine off. Remove actuator checker, SHEET "A" and sub-wire harness. Reconnect actuator harness connectors. Clear Diagnostic Trouble Codes (DTC). See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING.

8) If actuator does not operate as specified, check ABS solenoid and ABS motor relay operation. See DTC 11 OR 12: ABS SOLENOID RELAY CIRCUIT and DTC 13 OR 14: ABS MOTOR RELAY CIRCUIT. Replace relays as necessary and recheck actuator operation.

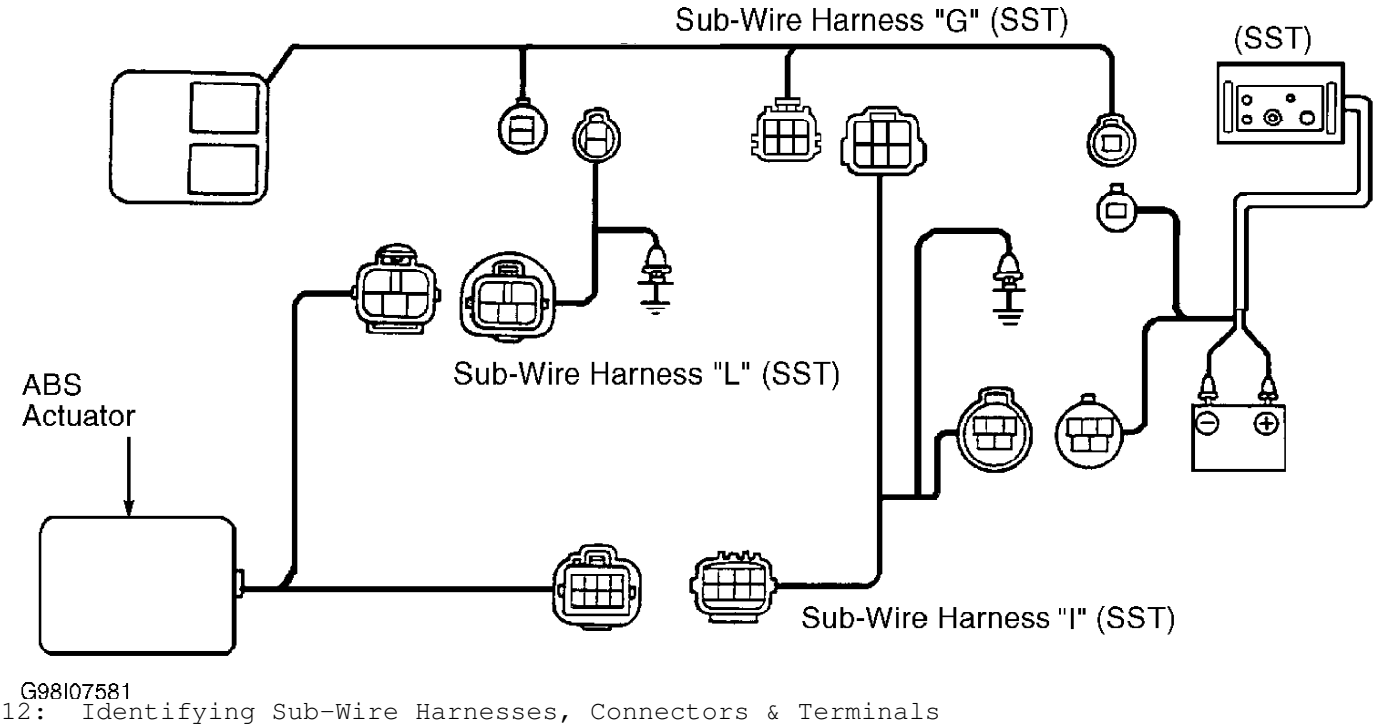


Fig. 12: Identifying Sub-Wire Harnesses, Connectors & Terminals For ABS Actuator Checker
Courtesy of Toyota Motor Sales, U.S.A., Inc.

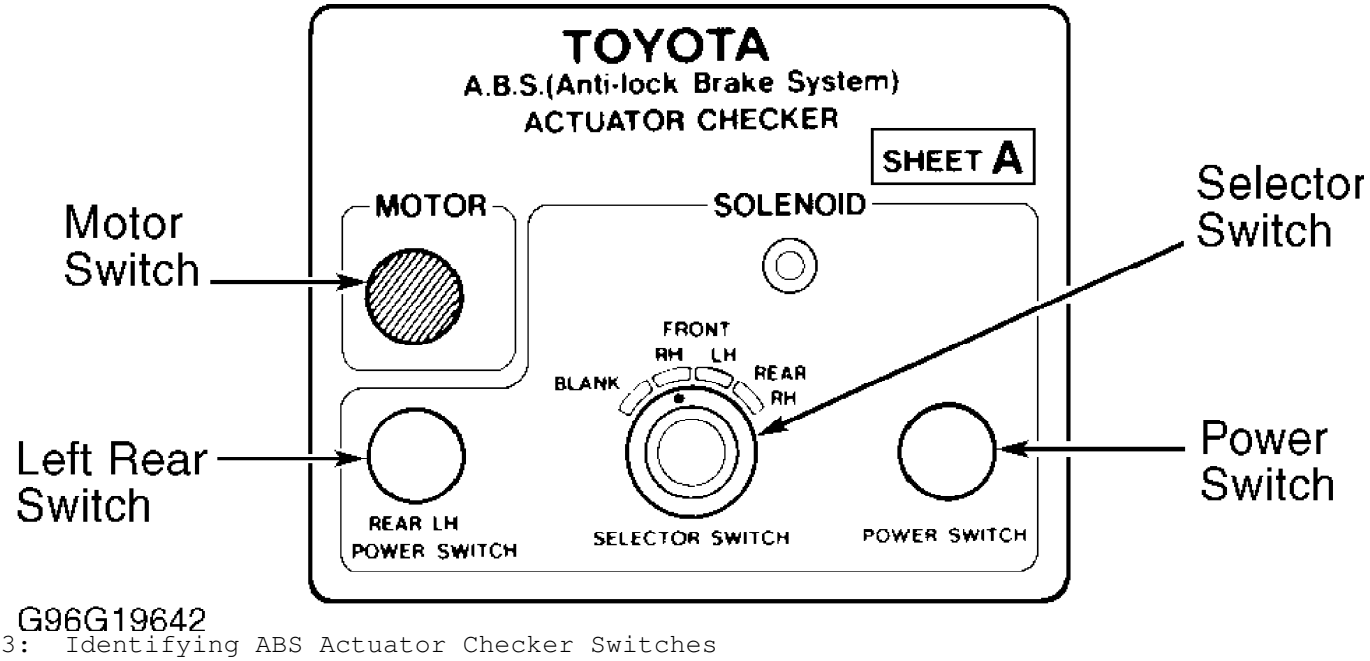


Fig. 13: Identifying ABS Actuator Checker Switches
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Hydraulic system may be under high pressure. Use caution when opening hydraulic system.

ABS ECU

Removal & Installation

Turn ignition off. Disconnect negative battery cable. Remove right front kick panel. See Fig. 1. Unplug connectors from ABS ECU. Remove ABS ECU. To install, reverse removal procedure.

ABS ACTUATOR

Removal & Installation

Remove right front fender liner. Remove power steering tube clamp bracket bolt. Disconnect 6 brake lines front ABS actuator. See Fig. 14. Disconnect ABS actuator connectors. Remove bolts nuts and ABS actuator assembly. Remove nuts and ABS actuator from bracket. Remove holders and cushions from ABS actuator. To install, reverse removal procedure. Tighten all bolts and nut to specification. See TORQUE SPECIFICATIONS. Bleed brake system. See BLEEDING BRAKE SYSTEM. Check system for leakage.

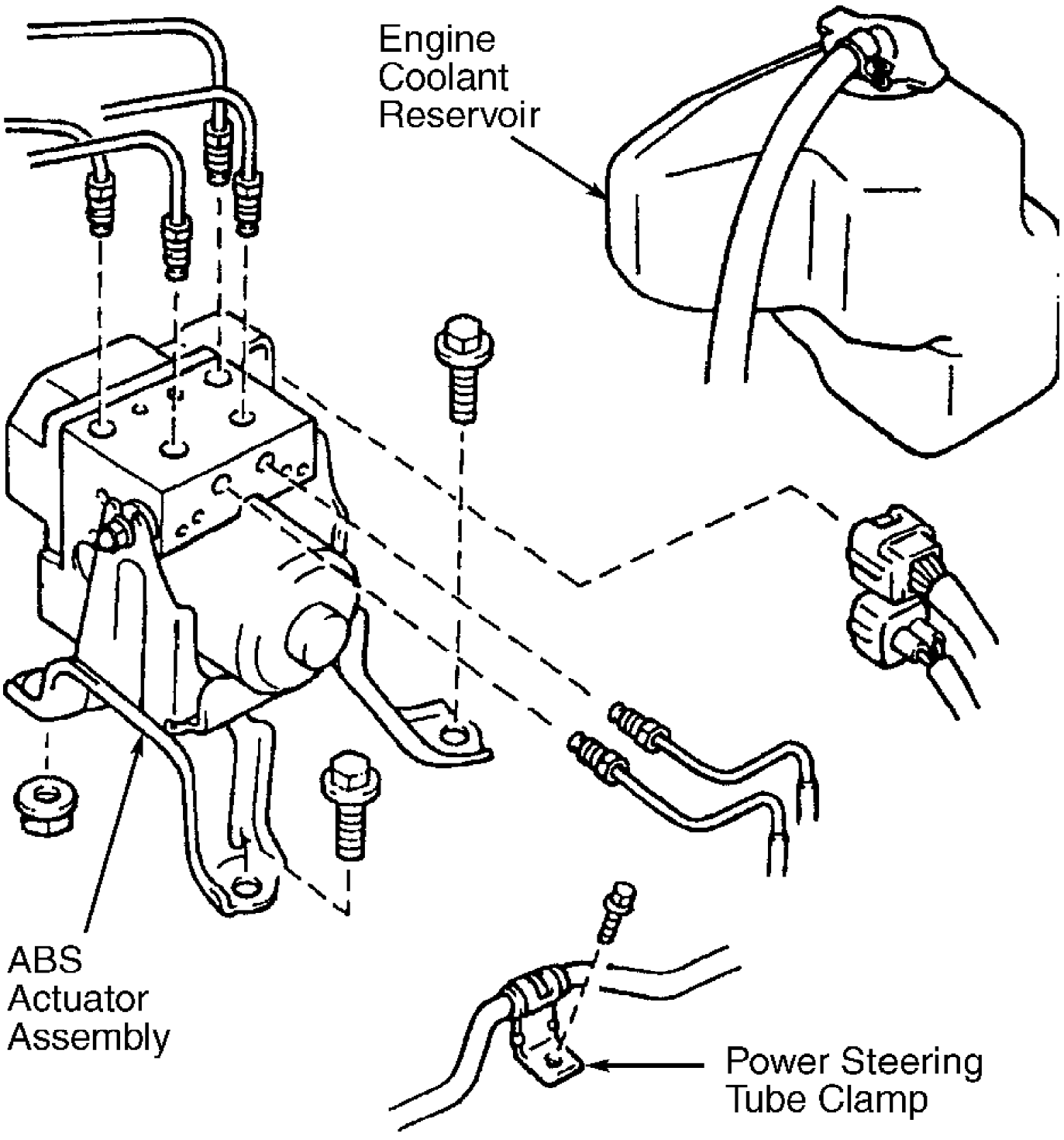


Fig. 14: Removing ABS Actuator
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SPEED SENSOR ROTOR

Removal & Installation (Front)

Front speed sensor rotor is an integral part of outboard CV

joint. To replace sensor rotor, the front axle shaft must be removed. See AXLE SHAFTS - AWD & FWD - RX300 article in DRIVE AXLES.

Removal & Installation (Rear)

On 2WD models, rear speed sensor rotor is an integral part of rear hub. To replace sensor rotor, rear hub must be removed. See appropriate REAR article in SUSPENSION. On AWD models, rear speed sensor rotor is an integral part of outboard CV. To replace sensor rotor, the rear axle shaft must be removed. See AXLE SHAFTS - AWD & FWD - RX300 article in DRIVE AXLES.

WHEEL SPEED SENSOR

Removal & Installation (Front)

Remove fender liner. Disconnect speed sensor connector. Remove bolts, wiring harness and speed sensor harness clamp from vehicle body and strut. Remove speed sensor bolt from steering knuckle. Remove speed sensor. To install, reverse removal procedure. Tighten speed sensor bolt to specification. See TORQUE SPECIFICATIONS. Check speed sensor signal after installation. See SPEED SENSOR SIGNAL CHECK under COMPONENT TESTS.

Removal & Installation (Rear)

Remove rear seat, scuff plate and rear seat molding. Disconnect speed sensor connector. Pull out sensor wire harness with grommet. Remove 2 clamp bolts holding sensor wiring harness to vehicle body and strut. Remove speed sensor from axle carrier. To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check speed sensor signal after installation. See SPEED SENSOR SIGNAL CHECK under COMPONENT TESTS.

OVERHAUL

ABS ACTUATOR

DO NOT overhaul or disassemble actuator assembly. If actuator is defective, replace entire assembly.

ADJUSTMENTS

For adjustment procedures, see DISC article.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Actuator Bracket Bolts	14 (19)
Brake Pedal Push Rod Lock Nut	19 (25)
Brakeline Fittings	11 (15)
Cushion Nuts	10 (14)
Speed Sensor Harness-To-Strut Clamp Bolt	21 (29)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
Actuator Mounting Nuts	48 (5.4)
Parking Brake Cable Lock Nut	48 (5.4)
Speed Sensor Harness-To-Body Clamp Bolt	48 (5.4)

WIRING DIAGRAMS

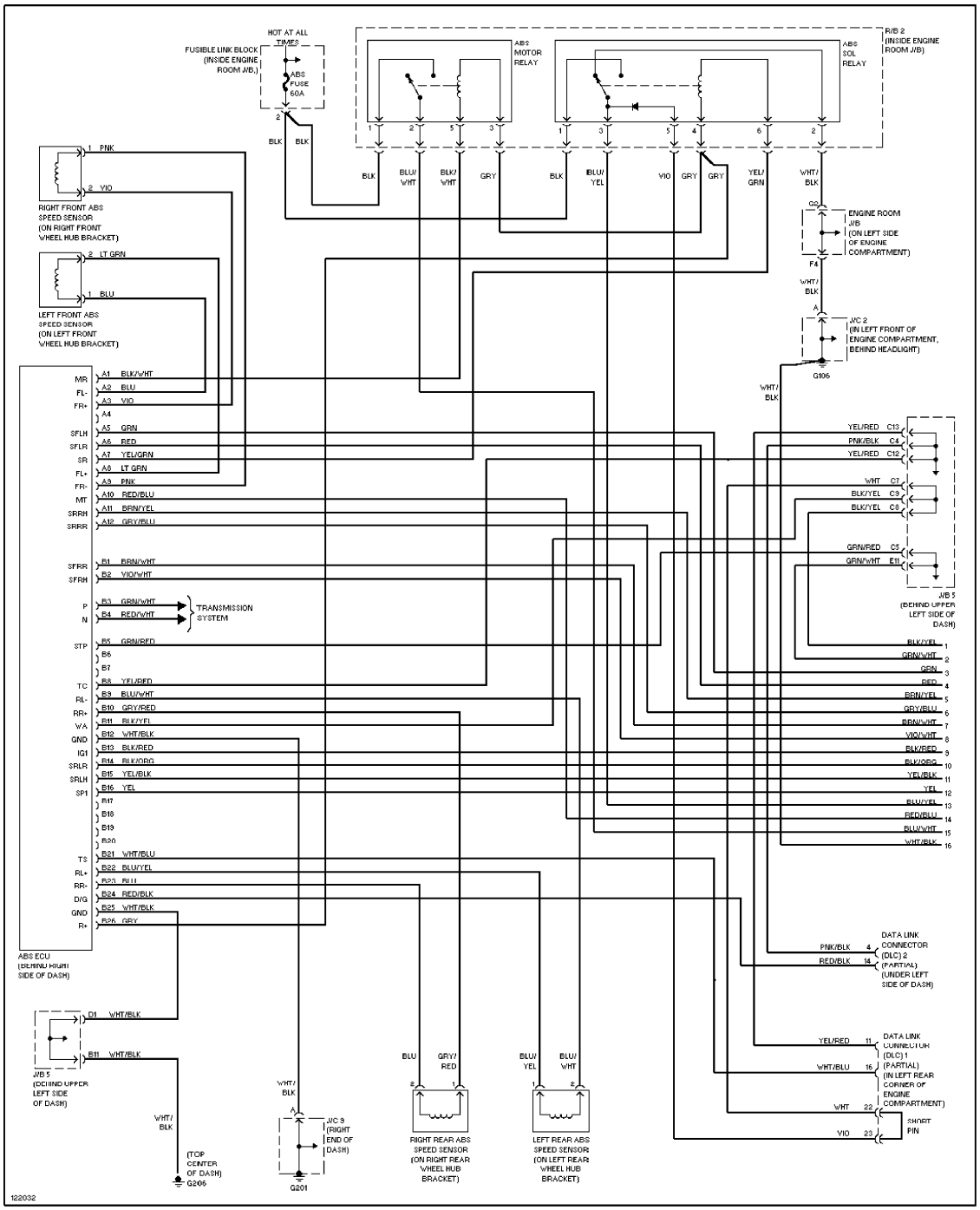


Fig. 15: Anti-Lock Brake System Without Traction Control Wiring Diagram (1999-2000 RX300 - 1 Of 2)

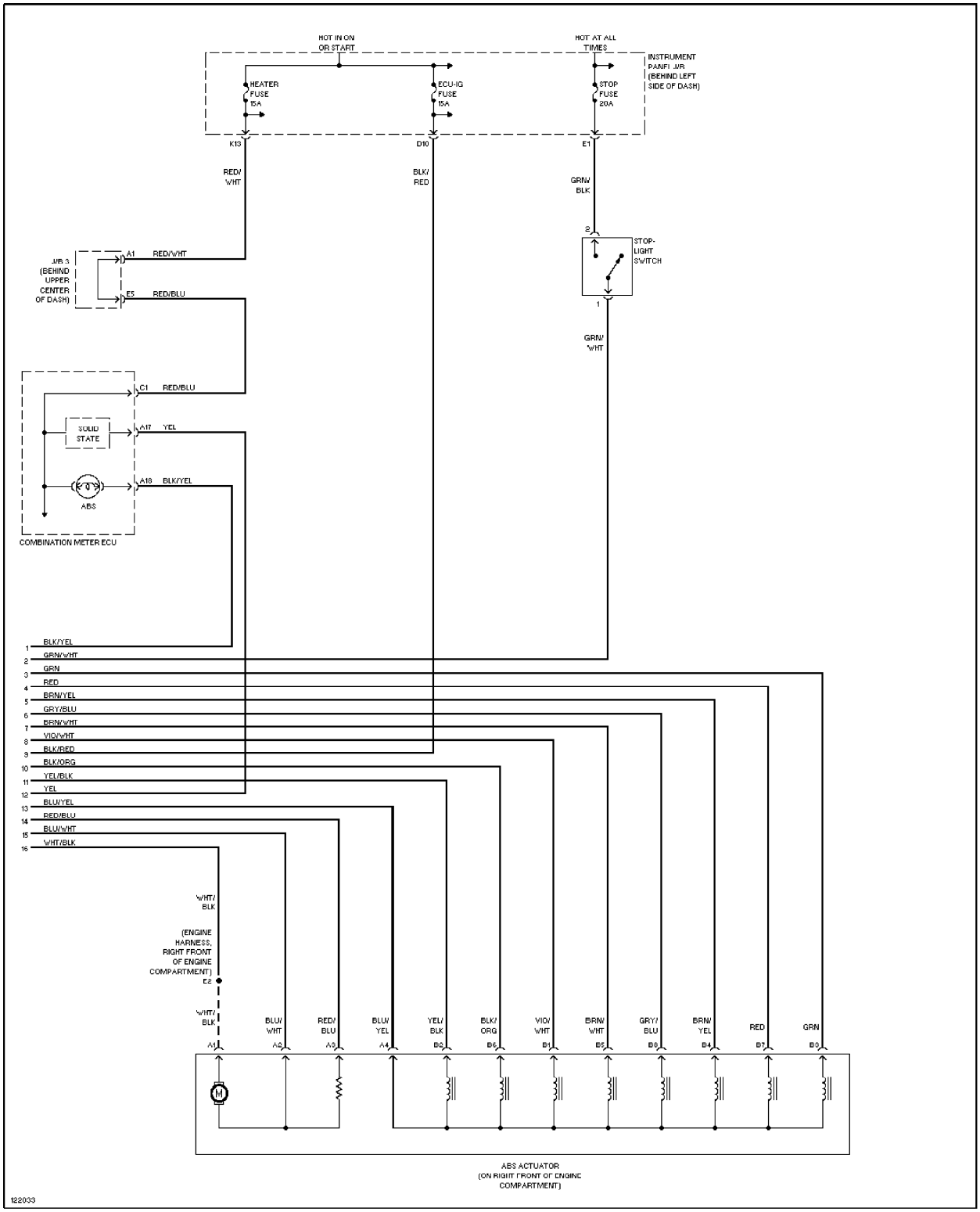


Fig. 16: Anti-Lock Brake System Without Traction Control Wiring Diagram (1999-2000 RX300 - 2 Of 2)

ANTI-LOCK BRAKE SYSTEM W/TRACTION CONTROL

1999 Lexus RX 300

1999-2000 BRAKES
Lexus Anti-Lock - With Traction Control

RX300

DESCRIPTION

Anti-Lock Brake System (ABS) controls fluid pressures to each individual front brake caliper and rear brake calipers during a panic stop to prevent wheel lock-up. System consists of actuator, solenoid relay, pump motor relay, ABS/Traction Control Electronic Control Unit (ABS/TRAC ECU), and a speed sensor at each wheel. See Fig. 1. If a system fault occurs, the ABS/TRAC ECU stores a self-diagnostic code(s) that can be retrieved to diagnose malfunction. TRAC system is integrated with the ABS. TRAC helps avoid slippage of driving wheels during acceleration. System maintains optimal driving control during changing road surface conditions upon acceleration.

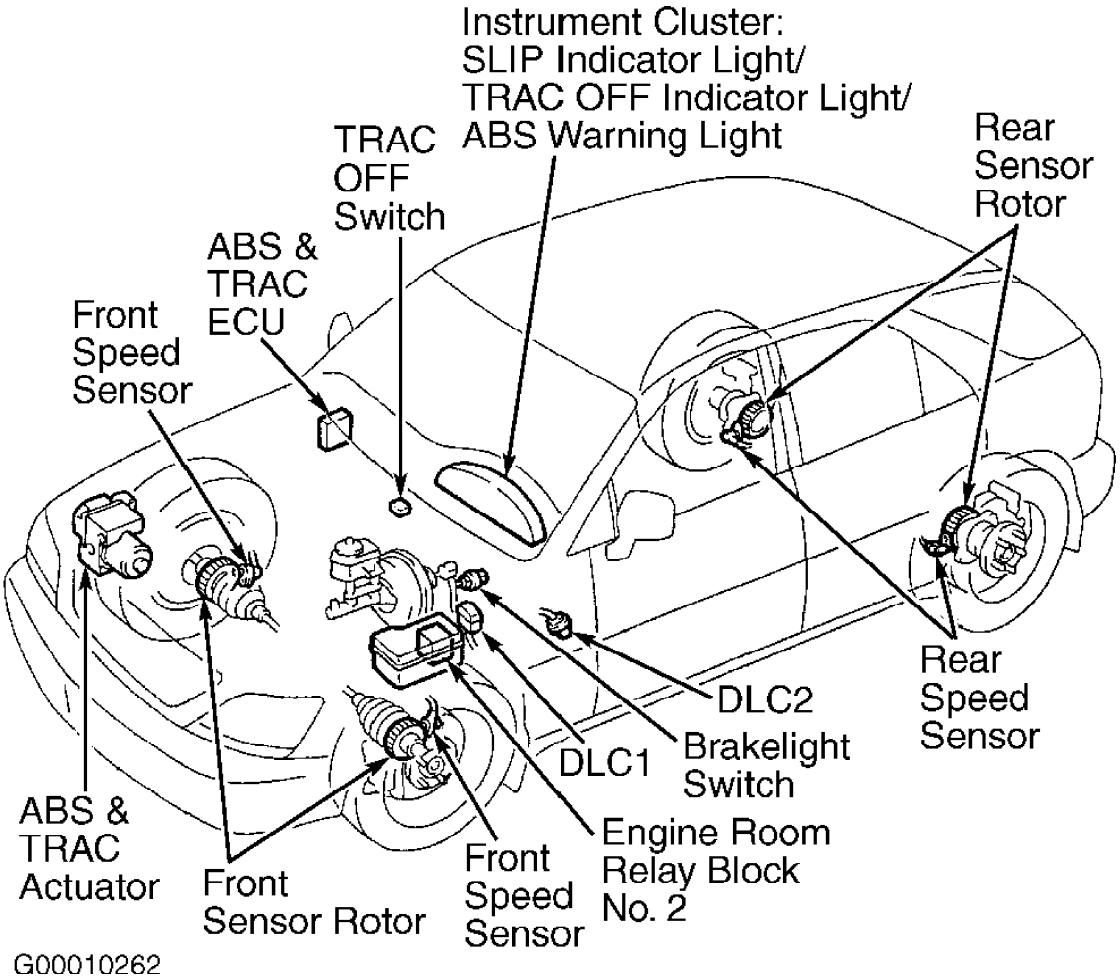


Fig. 1: Locating ABS Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

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

OPERATION

With vehicle moving, AC signals are sent from individual wheel speed sensors to Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU). ECU monitors brakelight switch to determine when brake pedal is depressed. With brake pedal depressed, ABS/TRAC ECU uses speed sensor signals to determine vehicle deceleration.

During panic stop (as determined by ABS/TRAC ECU), ABS/TRAC ECU activates solenoid valves inside actuator. Solenoid valves are cycled to apply, release or maintain hydraulic pressure to each wheel in any combination.

An ABS warning light, located on instrument panel, illuminates for 3 seconds as a bulb test when ignition is turned on. A primary check is performed after each engine start and initial time vehicle speed exceeds 6 MPH. Actuator noise should be heard as vehicle speed exceeds 6 MPH. If brake pedal is depressed before vehicle speed exceeds 6 MPH, primary check will not occur until brake pedal is released.

During normal driving conditions, ABS functions like a standard brake system. When wheel lock-up is detected, brake pedal may pulsate and steering wheel and vehicle body may vibrate (this is normal). Pulsation or vibration will continue until ABS function is no longer needed or vehicle is stopped.

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

BLEEDING BRAKE SYSTEM

BLEEDING PROCEDURE

CAUTION: Brake fluid will damage painted surfaces. If brake fluid contacts a painted surface, wipe off immediately and clean with alcohol. Use only DOT 3 brake fluid from a sealed container. DO NOT mix brake fluid with any other type.

1) Brake bleeding procedure is same procedure used to bleed non-ABS systems. If master cylinder was rebuilt or reservoir ran dry, bleed master cylinder first.

2) To bleed master cylinder, disconnect brake lines from master cylinder. Slowly depress brake pedal and hold. Block off master cylinder holes and release brake pedal. Repeat this procedure 3-4 times.

3) Ensure master cylinder reservoir is full of brake fluid. Connect vinyl tube to caliper bleed screw and insert other end of tube in a clear container 1/4 full of brake fluid.

4) Slowly pump brake pedal several times. While depressing brake pedal, loosen bleed screw until fluid starts to flow, and then close bleed screw. Repeat operation until no bubbles are present in fluid. Tighten bleed screw to 73 INCH lbs. (8.3 N.m). Bleed brake system in sequence. See BRAKELINE BLEEDING SEQUENCE table.

BRAKELINE BLEEDING SEQUENCE

Application	Sequence
All Models	RR, LR, RF & LF

SERVICING

BRAKE FLUID REPLACEMENT

Brake fluid replacement is recommended every 2 years or 30, 000 miles, whichever occurs first. Use SAE J 1703 or DOT 3 brake fluid.

TROUBLE SHOOTING

ABS DOES NOT OPERATE

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Retrieve Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are present, perform appropriate diagnostic test. If no DTCs are present, check IG power source circuit. See DTC 41: IG POWER SUPPLY CIRCUIT under DIAGNOSTIC TESTS. Check speed sensor circuits. Perform appropriate wheel speed sensor circuit test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table under DIAGNOSIS & TESTING. Check ABS/TRAC actuator. See ABS/TRAC ACTUATOR CHECK under COMPONENT TESTS. If ABS/TRAC actuator is not okay, check hydraulic system for leakage. If all preceding tests are okay and ABS still does not operate, replace ABS/TRAC ECU.

ABS DOES NOT OPERATE EFFICIENTLY

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Retrieve Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are present, perform appropriate diagnostic test. If no DTCs are present, check speed sensor circuit. Perform appropriate wheel speed sensor circuit test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table under DIAGNOSIS & TESTING. Check brakelight switch circuits. See DTC 49: BRAKELIGHT SWITCH CIRCUIT under DIAGNOSTIC TESTS. Check ABS/TRAC actuator. See ABS/TRAC ACTUATOR CHECK under COMPONENT TESTS. If ABS/TRAC actuator is not okay, check hydraulic system for leakage. If all preceding tests are okay and ABS still does not operate efficiently, replace ABS/TRAC ECU.

ABS WARNING LIGHT ABNORMAL

Check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Check Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU). See ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION) under SYSTEM TESTS.

DIAGNOSTIC TROUBLE CODE DIAGNOSTICS INOPERATIVE

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Check TRAC OFF warning light circuit. See TRAC OFF WARNING LIGHT (TRAC CUT SWITCH CIRCUIT) under SYSTEM TESTS. Check Tc terminal circuit. See Tc TERMINAL CIRCUIT under SYSTEM TESTS. If all preceding tests are okay, replace ABS/TRAC ECU.

SPEED SENSOR DIAGNOSTICS INOPERATIVE

Check Ts terminal circuit. See Ts TERMINAL CIRCUIT under SYSTEM TESTS. Check ABS/TRAC ECU. See ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION) under SYSTEM TESTS.

TRAC INOPERATIVE

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Retrieve Diagnostic Trouble Codes (DTC). Go to appropriate DTC for diagnostic procedure. Check IG power source circuit. See DTC 41: IG POWER SUPPLY CIRCUIT under DIAGNOSTIC TESTS. Check hydraulic system for leakage. Check speed sensor circuit. Perform appropriate wheel speed sensor circuit test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table under DIAGNOSIS & TESTING. If all preceding tests are okay, replace ABS/TRAC ECU.

SLIP WARNING LIGHT ABNORMAL

Check SLIP warning light circuit. See SLIP WARNING LIGHT CIRCUIT under SYSTEM TESTS.

TRAC OFF WARNING LIGHT ABNORMAL

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Check TRAC OFF warning light circuit and TRAC cut switch circuit. See TRAC OFF WARNING LIGHT (TRAC CUT SWITCH CIRCUIT) under SYSTEM TESTS.

DIAGNOSIS & TESTING

RETRIEVING DIAGNOSTIC TROUBLE CODES

NOTE: Ensure battery is in good condition and is fully charged. DO NOT start engine when retrieving codes. If codes cannot be retrieved, perform ABS WARNING LIGHT CIRCUIT and

Tc TERMINAL CIRCUIT tests under SYSTEM TESTS. If problem remains, replace ABS/TRAC ECU.

Turn ignition on. Ensure ABS, TRAC OFF and SLIP warning lights illuminate for 3 seconds. If ABS, TRAC OFF or SLIP warning light does not illuminate, see ABS WARNING LIGHT CIRCUIT , SLIP WARNING LIGHT CIRCUIT or TRAC OFF WARNING LIGHT (TRAC CUT SWITCH CIRCUIT) tests under SYSTEM TESTS. If ABS or TRAC OFF warning lights flash or stay on constantly, retrieve Diagnostic Trouble Codes (DTC). See USING ABS WARNING LIGHT or USING LEXUS SCAN TOOL.

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2) , located under left side of instrument panel. See Fig. 2. Turn ignition on. Using scan tool screen prompts, retrieve DTCs. Identify DTC and perform appropriate diagnostic test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table. After replacing or repairing malfunctioning components, clear DTCs, see CLEARING DIAGNOSTIC TROUBLE CODES.

Using ABS Warning Light

1) Using a fused jumper wire or Service Connector (SST 09843-18020), connect terminals Tc and E1 of Data Link Connector No. 1 (DLC1) or Data Link Connector No. 2 (DLC2). See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. DLC2 is located under left side of instrument panel.

2) Turn ignition on. If a malfunction is detected, ABS or TRAC OFF warning light will begin to flash a 2-digit Diagnostic Trouble Code (DTC) after 4 seconds. Warning light will flash first digit, followed by a 1.5-second pause and then second digit.

3) Count number of flashes to obtain digits of 2-digit code. If 2 or more codes are stored, a 2.5-second pause will separate codes. If 2 or more malfunctions are indicated at the same time lowest numbered DTC will be displayed first. Identify DTC and perform appropriate diagnostic test. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table.

4) If ABS/TRAC system is functioning properly, a normal code will be set. During normal code, 2 seconds will elapse, and then ABS warning light will blink once every .25 second.

5) After replacing or repairing malfunctioning components, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES. Turn ignition off. Remove fused jumper wire or Service Connector (SST 09843-18020), from DLC1.

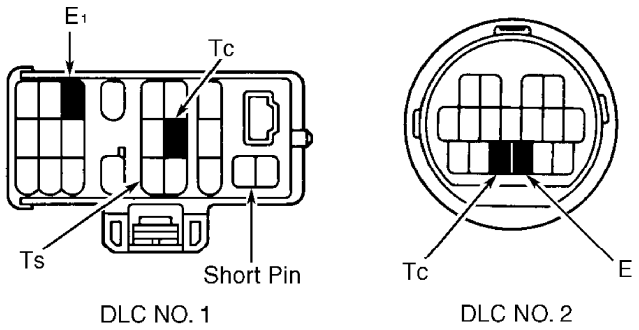


Fig. 2: Identifying Data Link Connector (DLC) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DTC	Description
11	ABS Solenoid Relay Circuit
12	ABS Solenoid Relay Circuit
13	ABS Motor Relay Circuit
14	ABS Motor Relay Circuit
21	Right Front ABS/TRAC Actuator Solenoid Circuit
22	Left Front ABS/TRAC Actuator Solenoid Circuit
23	Right Rear ABS/TRAC Actuator Solenoid Circuit
24	Left Rear ABS/TRAC Actuator Solenoid Circuit
25	Open Or Short In SMC1 Circuit
26	Open Or Short In SMC2 Circuit
27	Open Or Short In SRC1 Circuit
28	Open Or Short In SRC2 Circuit
31	Right Front Wheel Speed Sensor Circuit
32	Left Front Wheel Speed Sensor Circuit
33	Right Rear Wheel Speed Sensor Circuit
34	Left Rear Wheel Speed Sensor Circuit
41	IG Power Supply Circuit
43 (1)	ABS Control System Malfunction
44 (1)	NE Signal Circuit
49	Brakelight Switch Circuit
51	ABS Pump Motor Lock
53 (1)	ECM Communication Circuit Malfunction
61 (1)	Engine Control System Malfunction
71 (2)	Right Front Speed Sensor Signal Voltage Low
72 (2)	Left Front Speed Sensor Signal Voltage Low
73 (2)	Right Rear Speed Sensor Signal Voltage Low
74 (2)	Left Rear Speed Sensor Signal Voltage Low
75 (2)	Abnormal Change In Output Signal From Right Front Speed Sensor
76 (2)	Abnormal Change In Output Signal From Left Front Speed Sensor
77 (2)	Abnormal Change In Output Signal From Right Rear Speed Sensor
78 (2)	Abnormal Change In Output Signal From Left Rear Speed Sensor

(1) - TRAC OFF warning light will blink when DTC is set.
(2) - Identify DTC and probable cause. Repair as necessary. See SPEED SENSOR DIAGNOSTIC TROUBLE CODE IDENTIFICATION table.

CLEARING DIAGNOSTIC TROUBLE CODES

NOTE: Anti-Lock Brake System (ABS) Diagnostic Trouble Codes (DTC) can be cleared by disconnecting negative battery terminal but vehicle computer and energy systems may lose memory data.

Using Lexus Scan Tool

On 1999 models, connect scan tool to Data Link Connector No. 2 (DLC2) , located under left side of instrument panel. On 2000 models, connect scan tool to 16-pin Data Link Connector No. 3 (DLC3) , located under left side of instrument panel. On all models, turn ignition on. Using scan tool screen prompts, clear DTCs.

Without Scan Tool

1) Using a fused jumper wire or Service Connector (SST 09843-18020), connect terminals Tc and E1 of Data Link Connector No. 1 (DLC1). See Fig. 2. DLC1 is located on left side of engine compartment, near junction block.

2) Turn ignition on. With vehicle stopped, press brake pedal

8 or more times within 5 seconds. DTCs should now be cleared. Verify ABS DTCs have been cleared and normal code is present. During normal code, 2 seconds will elapse, and then ABS warning light will blink once every .25 second. Turn ignition off. Remove fused jumper wire or Service Connector (SST 09843-18020), from DLC1.

SPEED SENSOR SIGNAL CHECK

NOTE: Information for clearing speed sensor Diagnostic Trouble Codes (DTC) is not available from manufacturer. It may be possible to clear these DTCs by disconnecting negative battery cable or by using procedure for CLEARING DIAGNOSTIC TROUBLE CODES.

Using Lexus Scan Tool

Connect scan tool to Data Link Connector No. 2 (DLC2), located under left side of instrument panel. Turn ignition on. Start engine. ABS warning light should blink once every .13 second. If ABS warning light does not blink, check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS. Drive vehicle at 28 MPH or greater for several seconds in a straight line. Stop vehicle. Using scan tool screen prompts, retrieve DTCs. Identify DTC and probable cause. See SPEED SENSOR DIAGNOSTIC TROUBLE CODE IDENTIFICATION table. Repair as necessary.

Without Scan Tool

1) Turn ignition off. Using a fused jumper wire or Service Connector (SST 09843-18020), connect Data Link Connector No. 1 (DLC1) terminals Ts and E1. See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. Start engine. ABS warning light should blink once every .13 second. If ABS warning light does not blink, check ABS warning light circuit. See ABS WARNING LIGHT CIRCUIT under SYSTEM TESTS.

2) Drive vehicle at 28 MPH or greater for several seconds in a straight line. Stop vehicle. Using another fused jumper wire or Service Connector (SST 09843-18020), connect DLC1 terminals Tc and E1. There should now be 2 jumper wires. See Fig. 2.

3) Observe ABS warning light. If system is normal, ABS warning light will blink every .25 second. If system is malfunctioning, ABS warning light will flash codes. Identify DTC and probable cause. See SPEED SENSOR DIAGNOSTIC TROUBLE CODE IDENTIFICATION table. Repair as necessary. Turn ignition off. Remove fused jumper wires or Service Connectors (SST 09843-18020), from DLC1.

SPEED SENSOR DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DTC	Description	Probable Cause
71	Right Front Speed Sensor Signal Voltage Low	Defective Right Front Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
72	Left Front Speed Sensor Signal Voltage Low	Defective Left Front Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
73	Right Rear Speed Sensor Signal Voltage Low	Defective Right Rear Speed Sensor, Incorrect Sensor Installation Or Defective Sensor Rotor
74	Left Rear Speed Sensor Signal Voltage Low	Defective Left Rear Speed Sensor, Incorrect Sensor Installation Or

		Defective Sensor Rotor
75	Abnormal Change In Output Signal Voltage From Right Front Speed Sensor	Defective Right Front Sensor Rotor
76	Abnormal Change In Output Signal Voltage From Left Front Speed Sensor	Defective Left Front Sensor Rotor
77	Abnormal Change In Output Signal Voltage From Right Rear Speed Sensor	Defective Right Rear Sensor Rotor
78	Abnormal Change In Output Signal Voltage From Left Rear Speed Sensor	Defective Left Rear Sensor Rotor

DIAGNOSTIC TESTS

* PLEASE READ THIS FIRST *

CAUTION: When battery is disconnected, vehicle computer and energy systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

DTC 11 OR 12: ABS SOLENOID RELAY CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

ABS solenoid relay supplies power to each ABS/TRAC actuator solenoid. After ignition switch is turned on, and system performed initial check, relay turns on if initial check is okay. Diagnostic Trouble Code (DTC) 11 is set when ABS solenoid relay malfunctions. DTC 11 will also set if after solenoid relay is on, ABS/TRAC ECU does not detect 8 volts or more at terminal No. 10 (Black/Yellow wire) of A18 connector. See Fig. 3.

DTC 12 is set when ABS solenoid relay is off before main routine has been performed, and ABS/TRAC ECU does not detect 8 volts or more at A18 connector terminal No. 10 (Black/Yellow wire) for 2.04 seconds or more. If trouble occurs in ABS solenoid relay circuit, ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* ABS Solenoid Relay
* ABS Solenoid Relay Circuit
* ABS/TRAC ECU

Diagnosis & Repair

1) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Measure voltage between terminals No. 1 (power circuit) and 2 (ground circuit) at ABS solenoid relay connector in relay block. See Fig. 4. If voltage is 10-14 volts, go to next step. If voltage is not 10-14 volts, repair ground or power circuit to ABS solenoid relay. See WIRING DIAGRAMS.

2) Disconnect ABS/TRAC actuator connectors, located behind right front fender liner. See Fig. 1. Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Using ohmmeter, check continuity of Blue/Yellow wire between terminal No. 3 at ABS solenoid relay connector and terminal No. 4 at ABS/TRAC actuator A7 Gray 5-pin harness connector. See Figs. 4 and 5. If continuity does not exist, repair open in Blue/White wire. If continuity exists, go to next step.

3) Check continuity of Black/Yellow wire between terminal No. 10 at ABS/TRAC ECU A18 connector and terminal No. 5 at ABS/TRAC actuator A7 Gray 5-pin harness connector. See Figs. 3 and 5. If continuity does not exist, repair open in Black/Yellow wire. If continuity exists, check resistance between terminals No. 4 and 5 at ABS/TRAC actuator A7 Gray 5-pin harness connector. If resistance is about 33 ohms, go to next step. If resistance is not about 33 ohms, replace ABS/TRAC actuator.

4) Using ohmmeter, check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 2 and 3. See Fig. 6. Continuity should not exist between relay terminals No. 1 and 3. Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

5) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal No 6. See Fig. 6. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

6) Check for open or short in wiring harness between ABS solenoid relay connector in engine compartment No. 3 relay block and ABS/TRAC ECU A18 connector. Repair wiring as necessary. If wiring is okay, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If same DTC resets, check for loose, damaged or corroded connector terminals. Repair as necessary. If connectors are okay, replace ABS/TRAC ECU.

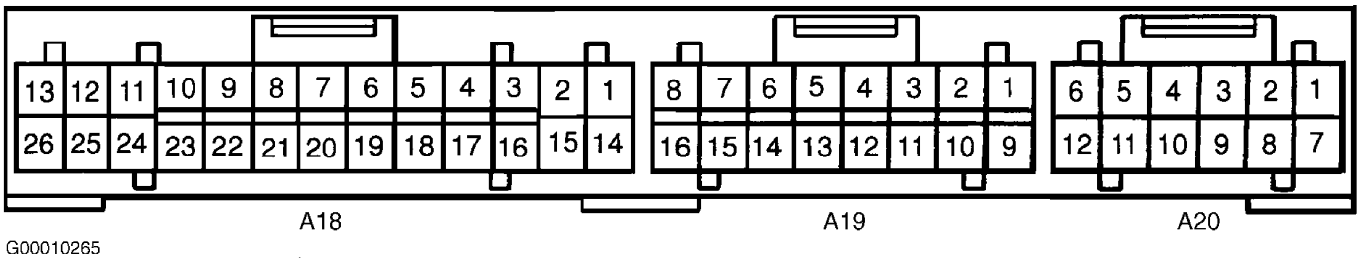
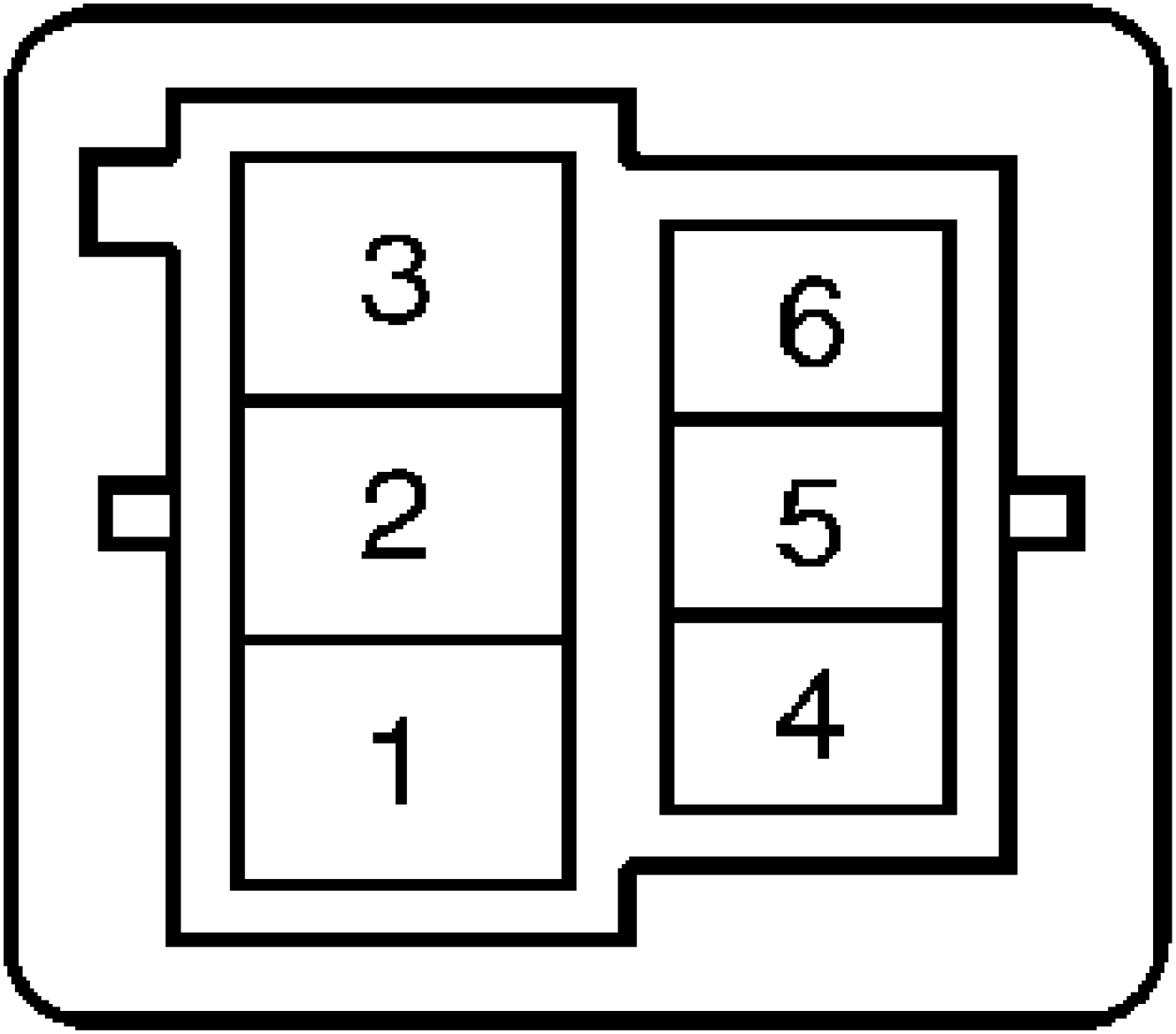
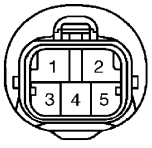


Fig. 3: Identifying ABS/TRAC ECU Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



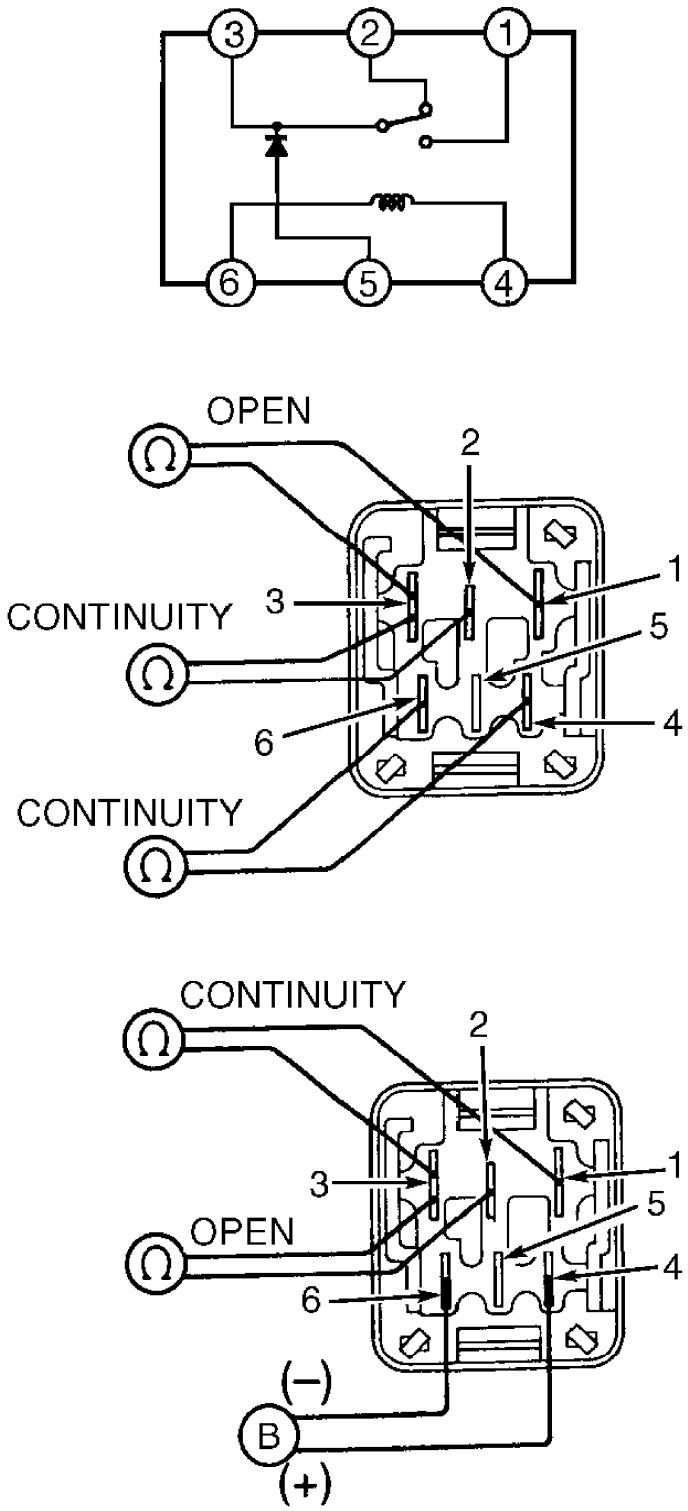
G00010263

Fig. 4: Identifying ABS Solenoid Relay Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G98D07593

Fig. 5: Identifying ABS/TRAC Actuator A7 Gray 5-Pin Harness Connector Terminals (Harness Side Shown)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G98H07585

Fig. 6: Testing ABS Solenoid Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 13 OR 14: ABS MOTOR RELAY CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

ABS motor relay supplies power to ABS/TRAC pump motor. When ABS is activated, ABS/TRAC ECU switches motor relay on and operates ABS/TRAC pump motor. Diagnostic Trouble Code (DTC) 13 is set when ABS motor relay malfunctions. DTC 13 will also set if after ABS motor relay is on and ABS motor relay monitor does not detect an on signal.

DTC 14 is set when ABS motor relay is off and ABS motor relay monitor is on for 2 seconds or more. If a fault occurs in ABS motor relay circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibits ABS and TRAC. Possible causes are:

* ABS Motor Relay
* ABS Motor Relay Circuit
* ABS/TRAC ECU

Diagnosis & Testing

1) Remove ABS motor relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Measure voltage between ground and terminal No. 1 at ABS motor relay connector in relay block. See Fig. 7. If voltage is 10-14 volts, go to next step. If voltage is not 10-14 volts, repair power circuit to ABS motor relay. See WIRING DIAGRAMS.

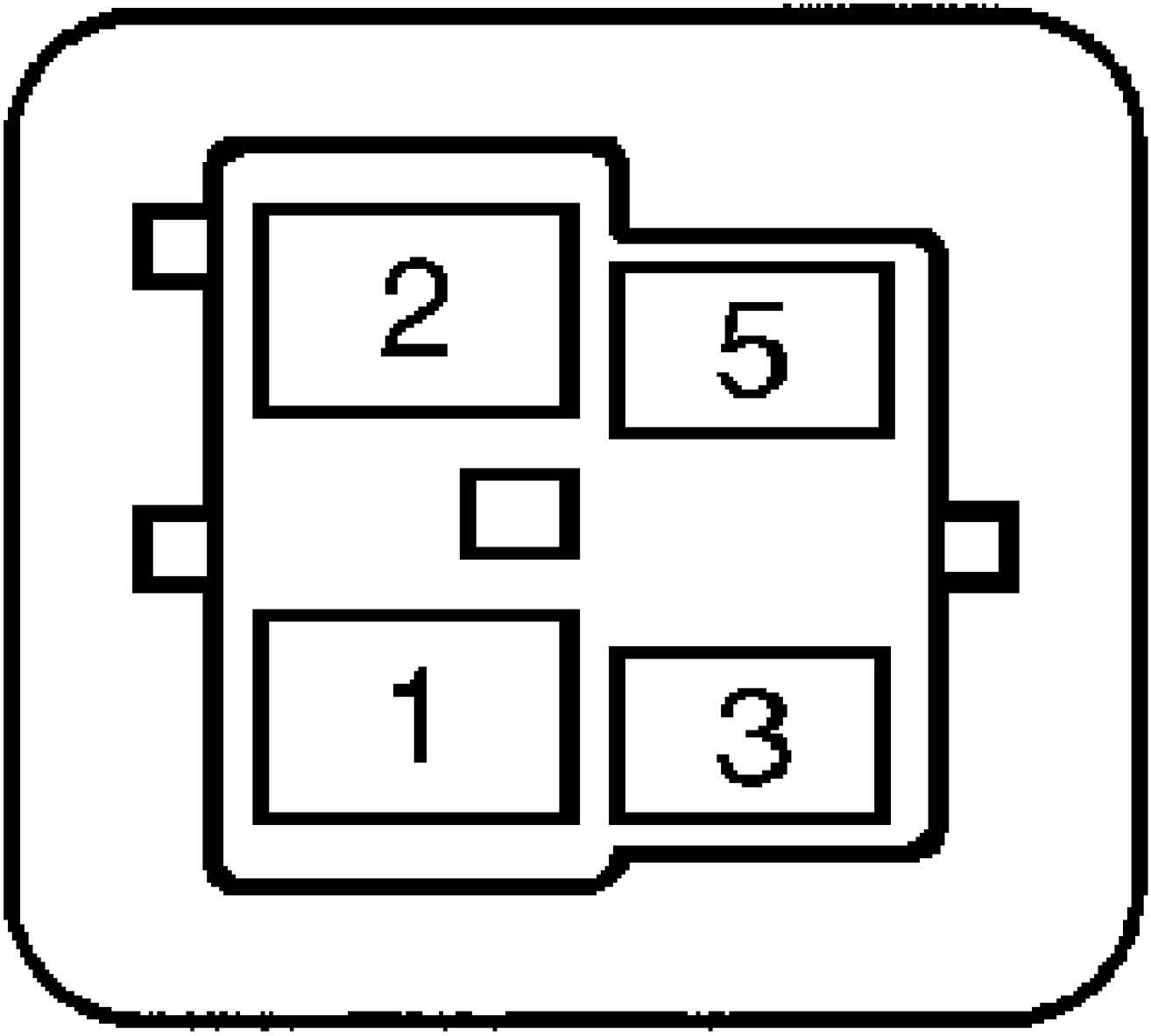
2) Disconnect ABS/TRAC actuator connectors, located behind right front fender liner. See Fig. 1. Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Using ohmmeter, check continuity of Blue/White wire between terminal No. 2 at ABS motor relay connector and terminal No. 2 at ABS/TRAC actuator A7 Gray 5-pin harness connector. See Figs. 5 and 7. If continuity does not exist, repair open in Blue/White wire. If continuity exists, go to next step.

3) Check continuity of Red/Blue wire between terminal No. 14 at ABS/TRAC ECU A18 connector and terminal No. 3 at ABS/TRAC actuator A7 Gray 5-pin harness connector. See Figs. 3 and 5. If continuity does not exist, repair open in Red/Blue wire. If continuity exists, check resistance between ABS/TRAC actuator terminals No. 2 and 3. If resistance is about 33 ohms, go to next step. If resistance is not about 33 ohms, replace ABS/TRAC actuator.

4) Using ohmmeter, check for continuity between ABS motor relay terminals. Continuity should exist between terminals No. 3 and 5. Continuity should not exist between relay terminals No. 1 and 2. See Fig. 8. Measure resistance between relay terminals No. 3 and 4. If resistance is about 62 ohms, go to next step. If resistance is not about 62 ohms, replace ABS motor relay.

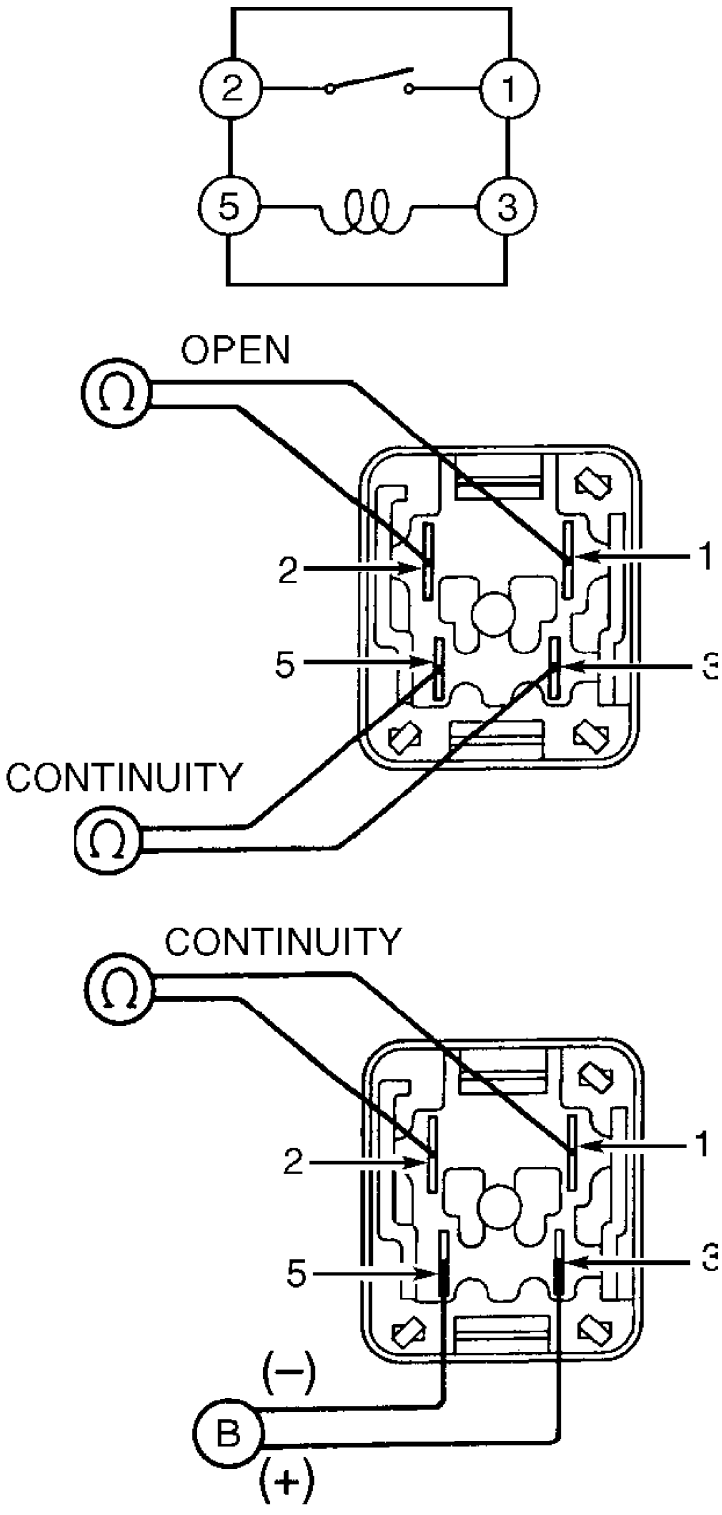
5) Using jumper wires, apply battery voltage to ABS motor relay terminal No. 3 and ground relay terminal No. 5. Check for continuity between ABS motor relay terminals No. 1 and 2. See Fig. 8. If continuity exists, go to next step. If continuity does not exist, replace ABS motor relay.

6) Check for open or short in wiring harness between ABS motor relay connector in engine compartment No. 3 relay block and ABS/TRAC ECU A18 connector. Repair wiring as necessary. If wiring is okay, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If same DTC resets, check for loose, damaged or corroded connector terminals. Repair as necessary. If connectors are okay, replace ABS/TRAC ECU.



G00010264

Fig. 7: Identifying ABS Motor Relay Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G00010266

Fig. 8: Testing ABS Motor Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 21: RIGHT FRONT ABS/TRAC ACTUATOR SOLENOID CIRCUIT DTC
22: LEFT FRONT ABS/TRAC ACTUATOR SOLENOID CIRCUIT

DTC 23: RIGHT REAR ABS/TRAC ACTUATOR SOLENOID CIRCUIT DTC 24: LEFT REAR ABS/TRAC ACTUATOR SOLENOID CIRCUIT DTC 25: OPEN OR SHORT IN SMC1 CIRCUIT DTC 26 OPEN OR SHORT IN SMC2 CIRCUIT DTC 27: OPEN OR SHORT IN SRC1 CIRCUIT DTC 28: OPEN OR SHORT IN SRC2 CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

ABS/TRAC actuator solenoid turns on when signal is received from ABS/TRAC ECU. ABS/TRAC actuator solenoid controls fluid pressure acting on brake cylinders controlling braking force. Diagnostic Trouble Code (DTC) is set when ABS solenoid relay is on, recovery prohibit run pulse is not being output, ABS/TRAC ECU detects 8 volts or more at A89 connector terminal No. 10, and ABS/TRAC actuator solenoid output has not changed for .48 second or more.

DTC will also set when ABS/TRAC actuator solenoid is on, pressure holding ABS/TRAC actuator solenoid monitor voltage is more than one volt or pressure reduction ABS/TRAC actuator solenoid monitor voltage is more than 1.5 volts. DTC will also set when ABS/TRAC actuator solenoid is on, and ABS/TRAC ECU detects -1 volt or more at A18 connector terminal No. 10.

If a fault occurs in ABS/TRAC actuator solenoid circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* ABS/TRAC Actuator
* Open Or Shorted Circuit
* ABS/TRAC ECU

Diagnosis & Repair

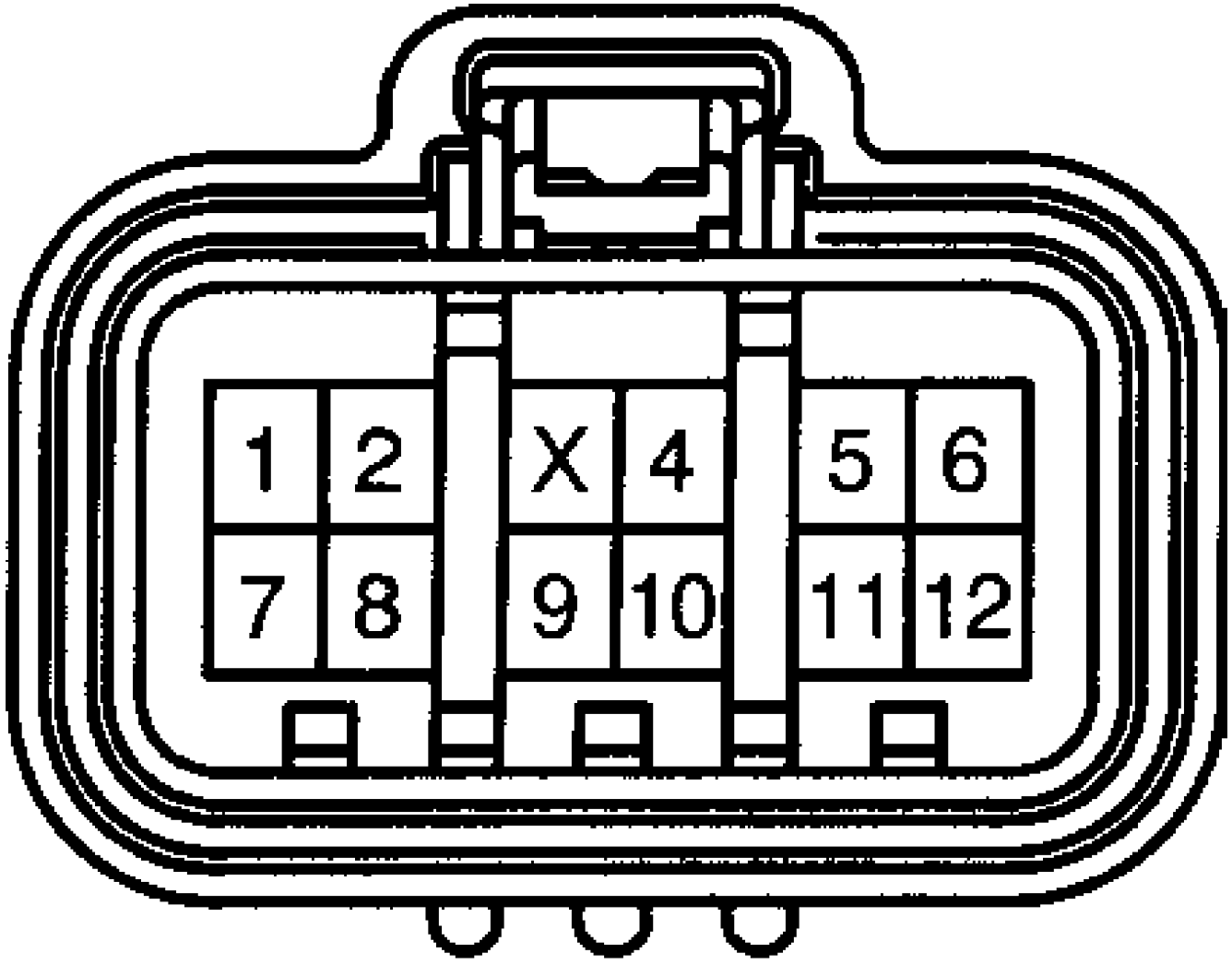
1) Disconnect ABS/TRAC actuator connectors, located behind right front fender liner. Using ohmmeter, measure resistance between ABS/TRAC actuator terminals. Measure resistance between terminal No. 4 (Blue/Yellow wire) of 5-pin connector and every terminal at ABS/TRAC actuator 12-pin connector. See Figs. 5 and 9. If all resistance readings are as specified, go to next step. See ABS/TRAC ACTUATOR RESISTANCE SPECIFICATIONS table. If any resistance reading is not as specified, replace ABS/TRAC actuator.

2) Check for open or short in wiring harness between ABS/TRAC ECU and ABS/TRAC actuator. See WIRING DIAGRAMS. Repair wiring as necessary. If wiring is okay, clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If same DTC resets, check for loose, damaged or corroded connector terminals. Repair as necessary. If connectors are okay, replace ABS/TRAC ECU.

ABS/TRAC ACTUATOR RESISTANCE SPECIFICATIONS

ABS/TRAC Actuator Connector A8 Terminals No. (1)	Ohms
1, 8, 9, 10, 11 & 12	8.8
3, 4, 5 & 6	4.3
2 & 7	8.6

(1) - Resistance is measured between ABS/TRAC actuator terminal No. 4 (Blue/Yellow wire) of 5-pin connector and each ABS/TRAC actuator 12-pin connector terminal listed.



G98C12924

Fig. 9: Identifying ABS/TRAC Actuator A8 Black 12-Pin Connector Terminals (Harness Side Shown)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 31: RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal.

See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS/TRAC ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS/TRAC ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* Right Front Speed Sensor
* Right Front Speed Sensor Circuits
* Right Front Speed Sensor Rotor
* ABS/TRAC ECU

Diagnosis & Repair

1) Remove right front fender liner. Disconnect right front speed sensor connector. Using ohmmeter, measure resistance between right front speed sensor terminals. If resistance is 1400-1800 ohms, go to next step. If resistance is not 1400-1800 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at right front speed sensor. If continuity does not exist in both readings, go to next step. If continuity exists in any reading, replace speed sensor.

3) Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Measure resistance of Violet wire between right front speed sensor harness connector and terminal No. 17 at ABS/TRAC ECU A18 connector. See Fig. 3. Also measure resistance of Pink wire between right front speed sensor harness connector and terminal No. 18 at ABS/TRAC ECU A18 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Violet wire or Pink wire.

4) Check continuity between ground and terminals No. 17 (Violet wire) and No. 18 (Pink wire) at ABS/TRAC ECU A18 connector. See Fig. 3. If continuity does not exist in both readings, reconnect ABS/TRAC ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Violet wire or Pink wire between right speed sensor and ABS/TRAC ECU.

5) Check right front speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between right front sensor and right front steering knuckle. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS/TRAC ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 17 (Violet wire) at ABS/TRAC ECU A18 connector. See Fig. 3. Drive vehicle about 19 MPH and check speed sensor signal waveform. If waveform is not as indicated, go to next step. See Fig. 10. If waveform is as indicated, replace ABS/TRAC ECU.

7) Turn ignition off. Remove right front axle shaft. See AWD & FWD AXLE SHAFTS - RX300 article in DRIVE AXLES. Inspect speed sensor rotor on axle shaft for scratches, missing teeth or other damage. Replace speed sensor rotor as necessary. Remove right front speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check

speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS/TRAC ECU.

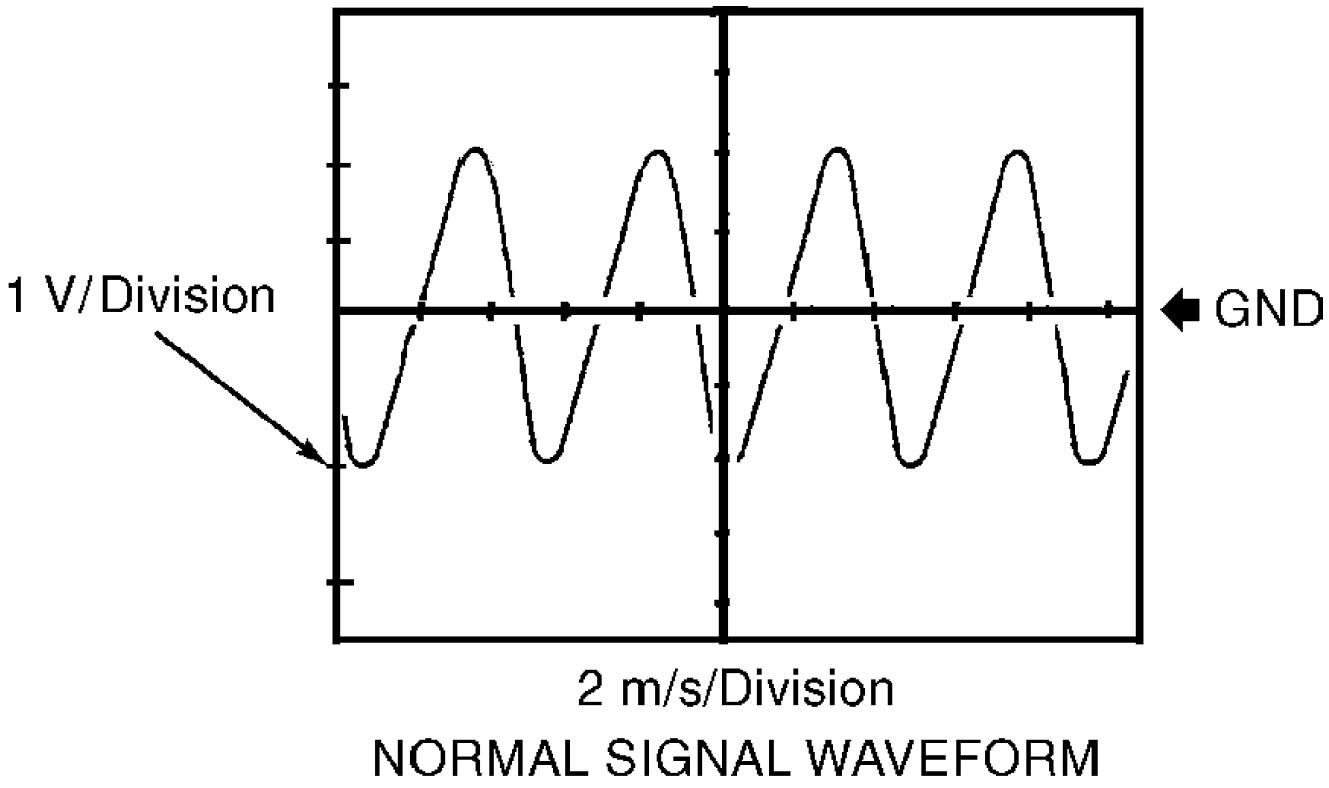


Fig. 10: Identifying Normal Speed Sensor Signal Waveform
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 32: LEFT FRONT WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS/TRAC ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS/TRAC ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid

relay and prohibiting ABS and TRAC. Possible causes are:

* Left Front Speed Sensor
* Left Front Speed Sensor Circuits
* Left Front Speed Sensor Rotor
* ABS/TRAC ECU

Diagnosis & Repair

1) Remove left front fender liner. Disconnect left front speed sensor connector. Using ohmmeter, measure resistance between left front speed sensor terminals. If resistance is 1400-1800 ohms, go to next step. If resistance is not 1400-1800 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at left front speed sensor. If continuity does not exist in both readings, go to next step. If continuity exists in any reading, replace speed sensor.

3) Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Measure resistance of Blue wire between left front speed sensor harness connector and terminal No. 4 at ABS/TRAC ECU A18 connector. See Fig. 3. Also measure resistance of Light Green wire between left front speed sensor harness connector and terminal No. 5 at ABS/TRAC ECU A18 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Blue wire or Light Green wire.

4) Check continuity between ground and terminals No. 4 (Blue wire) and No. 5 (Light Green wire) at ABS/TRAC ECU A18 connector. See Fig. 3. If continuity does not exist in both readings, reconnect ABS/TRAC ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Blue wire or Light Green wire between left front speed sensor and ABS/TRAC ECU.

5) Check left front speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between left front sensor and left front steering knuckle. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS/TRAC ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 5 (Light Green wire) at ABS/TRAC ECU A18 connector. See Fig. 3. Drive vehicle about 19 MPH and check speed sensor signal waveform. If waveform is not as indicated, go to next step. See Fig. 10. If waveform is as indicated, replace ABS/TRAC ECU.

7) Turn ignition off. Remove left front axle shaft. See AWD & FWD AXLE SHAFTS - RX300 article in DRIVE AXLES. Inspect speed sensor rotor on axle shaft for scratches, missing teeth or other damage. Replace speed sensor rotor as necessary. Remove left front speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS/TRAC ECU.

DTC 33: RIGHT REAR WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS/TRAC ECU

as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS/TRAC ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* Right Rear Speed Sensor
* Right Rear Speed Sensor Circuits
* Right Rear Speed Sensor Rotor
* ABS/TRAC ECU

Diagnosis & Repair

1) Remove rear seat, scuff plate and rear seat side molding. Disconnect right rear speed sensor connector. Using ohmmeter, measure resistance between right rear speed sensor terminals. If resistance is 1500-1700 ohms, go to next step. If resistance is not 1500-1700 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at right rear speed sensor. If continuity does not exist, go to next step. If continuity exists, replace speed sensor.

3) Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Measure resistance of Gray/Red wire between right rear speed sensor harness connector and terminal No. 9 at ABS/TRAC ECU A19 connector. See Fig. 3. Also measure resistance of Blue wire at right rear speed sensor harness connector and Red/Black wire at terminal No. 10 of ABS/TRAC ECU A19 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Gray/Red wire, Blue wire or Red/Black wire.

4) Check continuity between ground and terminals No. 9 (Gray/Red wire) and No. 10 (Red/Black wire) at ABS/TRAC ECU A19 connector. See Fig. 3. If continuity does not exist in both readings, reconnect ABS/TRAC ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Gray/Red wire or Red/Black wire between right rear speed sensor and ABS/TRAC ECU.

5) Check right rear speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between right rear sensor and rear axle carrier. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS/TRAC ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 9 (Gray/Red wire) at ABS/TRAC ECU A19 connector. See Fig. 3. Drive vehicle about 19 MPH and check speed sensor signal waveform. If waveform is not as indicated, go to next step. See Fig. 10. If waveform is as indicated, replace ABS/TRAC ECU.

7) Remove right rear hub assembly. See appropriate REAR article in SUSPENSION. Inspect speed sensor rotor for scratches, missing teeth or other damage. Replace as necessary. Remove right rear speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS/TRAC ECU.

DTC 34: LEFT REAR WHEEL SPEED SENSOR CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing,

always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

NOTE: After each repair procedure has been completed, reconnect all components. Verify speed sensor signal. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Circuit Description

Speed sensor at each wheel sends an AC signal to ABS/TRAC ECU as the 48-tooth rotor passes a permanent magnet sensor. Frequency of AC signal changes with wheel speed.

Diagnostic Trouble Code (DTC) is set when no speed sensor pulses are input to ABS/TRAC ECU for 15 seconds with vehicle speed 6 MPH or more. Momentary interruption of speed sensor signal occurs at least 7 times during cycle of ignition switch. DTC will also set if abnormal speed sensor signal fluctuation lasts for more than 5 seconds with vehicle speed of 12 MPH or more.

If fault occurs in speed sensor circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* Left Rear Speed Sensor
* Left Rear Speed Sensor Circuits
* Left Rear Speed Sensor Rotor
* ABS/TRAC ECU

Diagnosis & Repair

1) Remove rear seat, scuff plate and rear seat side molding. Disconnect left rear speed sensor connector. Using ohmmeter, measure resistance between left rear speed sensor terminals. If resistance is 1500-1700 ohms, go to next step. If resistance is not 1500-1700 ohms, replace speed sensor.

2) Using ohmmeter, check for continuity between ground and each terminal at left rear speed sensor. If continuity does not exist, go to next step. If continuity exists, replace speed sensor.

3) Disconnect ABS/TRAC ECU connectors, located behind right kick panel. Measure resistance of Blue/White wire between left rear speed sensor harness connector and terminal No. 1 at ABS/TRAC ECU A19 connector. See Fig. 3. Also measure resistance of Blue/Yellow wire between left rear speed sensor harness connector and terminal No. 2 at ABS/TRAC ECU A19 connector. If both resistance readings are less than 5 ohms, go to next step. If any resistance reading is 5 ohms or more, repair open in Blue/White wire or Blue/Yellow wire.

4) Check continuity between ground and terminals No. 1 (Blue/White wire) and No. 2 (Blue/Yellow wire) at ABS/TRAC ECU A19 connector. See Fig. 3. If continuity does not exist in both readings, reconnect ABS/TRAC ECU connectors and go to next step. If continuity exists in any reading, repair short to ground in Blue/White wire or Blue/Yellow wire between left rear sensor and ABS/TRAC ECU.

5) Check left rear speed sensor installation. Ensure speed sensor retaining bolt is tightened to 71 INCH lbs. (8 N.m). Ensure no clearance exists between left rear sensor and rear axle carrier. Repair or replace as necessary.

6) Reconnect all connectors. Remove ABS/TRAC ECU, but do not disconnect connectors. Backprobing, connect oscilloscope between ground and terminal No. 2 (Blue/Yellow wire) at ABS/TRAC ECU A19 connector. See Fig. 3. Drive vehicle about 19 MPH and check speed sensor signal waveform. If waveform is not as indicated, go to next step. See Fig. 10. If waveform is as indicated, replace ABS/TRAC ECU.

7) Remove left rear hub assembly. See appropriate REAR

article in SUSPENSION. Inspect speed sensor rotor for scratches, missing teeth or other damage. Replace as necessary. Remove left rear speed sensor. See WHEEL SPEED SENSOR under REMOVAL & INSTALLATION. Check speed sensor tip for damage. Replace speed sensor as necessary. If speed sensor rotor and speed sensor are okay, replace ABS/TRAC ECU.

DTC 41: IG POWER SUPPLY CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

Voltage is supplied from ignition switch to ABS/TRAC ECU and actuators. Diagnostic Trouble Code (DTC) is set when IG1 signal voltage remains less than 9.5 volts when vehicle speed is at 1.9 MPH or more for 10 seconds or more.

DTC is set when ABS solenoid or ABS motor relay monitor is malfunctioning, IG1 signal voltage is more than 17 volts for 1.2 seconds or more, or becomes more than 17 volts in 2.16 seconds. If fault occurs in power supply circuit, ABS/TRAC ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible causes are:

* Battery
* Regulator
* Power Supply Circuit
* ABS/TRAC ECU

Diagnosis & Repair

1) Inspect ECU-IG fuse (15-amp) in instrument panel junction block. Instrument panel junction block is located behind lower finish panel left of steering column. If fuse is okay, go to next step. If fuse is blown, inspect circuit between junction block and ABS/TRAC ECU for short.

2) Check voltage at battery. If voltage is not 10-14 volts, check charging system. See appropriate GENERATORS & REGULATORS article in STARTING & CHARGING SYSTEMS. Repair as necessary. If voltage is 10-14 volts, remove ABS/TRAC ECU but do not disconnect connectors. ABS/TRAC ECU is located behind right kick panel. Backprobing, measure voltage between terminal No. 8 (Black/Red wire) at ABS/TRAC ECU A19 connector and the following terminals; No. 15 (White/Black wire) at ABS/TRAC ECU A18 connector, No. 9 (White/Black wire) at ABS/TRAC ECU A20 connector and No. 10 (White/Black wire) at ABS/TRAC ECU A20 connector. See Fig. 3. If any voltage reading is not 10-14 volts, go to next step. If all voltage readings are 10-14 volts, replace ABS/TRAC ECU.

3) Measure resistance between ground and White/Black wires at the following terminals; No. 15 at ABS/TRAC ECU A18 connector, No. 9 at ABS/TRAC ECU A20 connector and No. 10 at ABS/TRAC ECU A20 connector. See Fig. 3. If all resistance readings are one ohm of less, ground circuits are okay. Check for open in wiring harness between battery and ABS/TRAC ECU. Repair wiring harness as necessary. If any resistance reading is more than one ohm, repair open in appropriate White/Black wire.

DTC 43: ABS CONTROL SYSTEM MALFUNCTION

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing,

always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

Diagnostic Trouble Code (DTC) is set when TRAC system is not functioning, ABS DTCs are output but TRAC DTCs are not output for one second or more. DTC is set when open or short exists in ABS solenoid relay circuit, ABS motor relay circuit, ABS solenoid circuit or TRAC solenoid circuit.

DTC is set when ABS/TRAC ECU detects high or low voltage at terminal No. 8 (Black/Red wire) at A19 connector. Speed sensor is malfunctioning. Pump motor is locked. Possible cause is ABS control system.

Diagnosis & Repair

Retrieve DTCs. See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are set, perform appropriate diagnostic tests. If ABS warning light remains on, check connectors and circuits between ABS warning light and ABS/TRAC ECU. Repair wiring as necessary.

DTC 44: NE SIGNAL CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

ABS/TRAC ECU monitors engine speed signal at terminal No. 15 (Blue/Orange wire) at ABS/TRAC ECU A19 connector. Diagnostic Trouble Code (DTC) is set when TRAC system is on and ABS/TRAC ECU receives engine speed signal of 0 RPM for 2.4 seconds or more. DTC is also set when TRAC system is off, shift lever is in any position except Park or Neutral, vehicle speed is 30 MPH or more and ABS/TRAC ECU receives engine speed signal of 0 RPM for 10 seconds or more. Possible causes are:

* NEO Signal Circuit
* Engine Control Module
* ABS/TRAC ECU

Diagnosis & Repair

1) Disconnect Engine Control Module (ECM) and ABS/TRAC ECU connectors. ECM is located behind glove box. ABS/TRAC ECU is located behind right kick panel. See Fig. 1. Check for an open or short in Blue/Orange wire between terminal No. 16 at ECM E7 connector and terminal No. 15 at ABS/TRAC ECU A19 connector. Repair wiring as necessary. If Blue/Orange wire is okay, go to next step.

2) Reconnect ECM and ABS/TRAC ECU connectors. Backprobing, measure voltage between ground and terminal No. 15 (Blue/Orange wire) ABS/TRAC ECU A19 connector. See Fig. 3. Turn ignition on. Voltage should be 3-6 volts or less than one volt. Turn engine on and allow it to idle. Voltage should be pulsating about 2-3 volts. If voltage is as specified, go to next step. If voltage is not as specified, check ABS/TRAC ECU. See ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION) under SYSTEM TESTS. If ABS/TRAC ECU is okay, check ECM. See SELF-DIAGNOSTICS - INTRODUCTION article in ENGINE PERFORMANCE.

3) Clear DTCs. See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Test drive vehicle and retrieve codes. See

RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If DTCs still exist, check for loose, damaged or corroded connector terminals. Repair as necessary.

DTC 49: BRAKELIGHT SWITCH CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

Diagnostic Trouble Code (DTC) is set when ABS/TRAC ECU detects 9.5-17.0 volts, and an open exists in brakelight switch circuit for 3 seconds or more. Possible causes are:

* Brakelight Switch
* Brakelight Switch Circuit
* ABS/TRAC ECU

Diagnosis & Repair

1) Check brakelight operation. If brakelights are functioning properly, go to next step. If brakelights are not functioning properly, check brakelight bulbs, brakelight switch and circuits. See appropriate wiring diagram in EXTERIOR LIGHTS article in ACCESSORIES & EQUIPMENT. Repair as necessary.

2) Remove ABS/TRAC ECU but do not disconnect connectors. ABS/TRAC ECU is located behind right kick panel. See Fig. 1. Depress brake pedal. Backprobing, measure voltage between ground and terminal No. 16 (Green/Red wire) at ABS/TRAC ECU A19 connector. See Fig. 3. If voltage is not 8-14 volts, go to next step. If voltage is 8-14 volts, check ABS/TRAC ECU. See ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION) under SYSTEM TESTS.

3) Check for open in Green/Red wire at terminal No. 16 of ABS/TRAC ECU A19 connector and Green/White wire at brakelight switch connector. Repair wiring as necessary. If Green/Red and Green/White wires are okay, check ABS actuator using Actuator Checker (SST 09990-00150). See ABS/TRAC ACTUATOR CHECK under COMPONENT TESTS. If ABS actuator is not okay, check hydraulic circuit for leakage.

DTC 51: ABS PUMP MOTOR LOCK

Circuit Description

Diagnostic Trouble Code (DTC) is set when ABS pump motor is not operating normally. If fault occurs in ABS pump motor, Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC. Possible cause is failed pump motor.

Diagnosis & Testing

Disconnect ABS/TRAC actuator connectors, located behind right front fender liner. See Fig. 1. Using jumper wires, apply battery voltage to terminal No. 2 (Blue/White wire) and ground terminal No. 1 (White/Black wire) at ABS/TRAC actuator A7 connector (component side). See Fig. 5. If pump motor running noise can be heard, check for open circuit between ABS motor relay, ABS/TRAC actuator and ABS/TRAC ECU. If pump motor running noise cannot be heard, replace ABS/TRAC actuator.

DTC 53: ECM COMMUNICATION CIRCUIT MALFUNCTION

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

ABS/TRAC ECU uses this circuit to send TRAC control information to Engine Control Module (ECM). ECM uses this circuit to send engine control information to ABS/TRAC ECU. Diagnostic Trouble Code (DTC) is set when ABS/TRAC ECU detects a ECM data communication malfunction. Possible causes are:

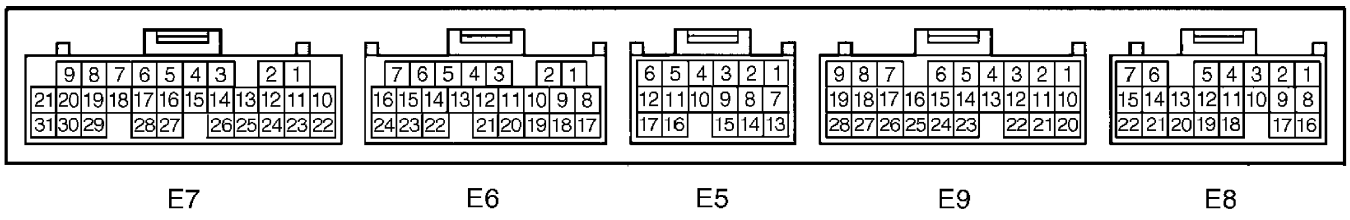
* Data Communication Circuits
* Engine Control Module
* ABS/TRAC ECU

Diagnosis & Repair

Disconnect Engine Control Module (ECM) and ABS/TRAC ECU connectors. ECM is located behind glove box. ABS/TRAC ECU is located behind right kick panel. See Fig. 1. Check for open or short in specified wires between ECM and ABS/TRAC ECU. See IDENTIFYING ECM COMMUNICATION CIRCUITS table. See Figs. 3 and 11. Repair wiring as necessary. If wires are okay, check ABS/TRAC ECU. See ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION) under SYSTEM TESTS. If ABS/TRAC ECU is okay, check ECM. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

IDENTIFYING ECM COMMUNICATION CIRCUITS

Wire Color	ECM Connector (Terminal No.)	ABS/TRAC ECU Connector (Terminal No.)
Gray	E8 (13)	A19 (13)
Red/Yellow	E8 (14)	A19 (6)
Blue/Orange	E9 (16)	A15 (15)
Pink/Blue	E8 (20)	A19 (5)
Brown/White	E8 (21)	A19 (14)



G99F51321

Fig. 11: Identifying Electronic Control Module (ECM) Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 61: ENGINE CONTROL SYSTEM MALFUNCTION

Circuit Description

Diagnostic Trouble Code (DTC) is set when TRAC system is turned on, ABS/TRAC ECU detects normal Engine Control Module (ECM) communication, ECM is providing engine self-diagnostic information, and engine speed is 500 RPM of more for .48 seconds or more.

DTC is also on when ABS/TRAC ECU detects normal ECM

communication, ECM is providing engine self-diagnostic information, engine speed is 500 RPM of more for one second or more, and ECM records DTC. If fault occurs in engine control system, ABS/TRAC ECU performs a fail safe function prohibiting TRAC control. Possible cause is engine control system.

Diagnosis & Repair

Check for engine control system Diagnostic Trouble Codes (DTC). See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE. If engine control system DTCs are set, repair DTCs as necessary. If Malfunction Indicator Light (MIL) remains on, check connectors and circuits between MIL and ECM.

SYSTEM TESTS

ABS WARNING LIGHT DOES NOT TURN OFF (ABS/TRAC ECU MALFUNCTION)

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

Problem occurs when ABS/TRAC ECU internal malfunction is detected. Possible cause is a malfunctioning ABS/TRAC ECU. If fault occurs in power source circuit, ECU performs a fail safe function, turning off current to ABS solenoid relay and prohibiting ABS and TRAC.

Diagnosis & Repair

1) Check for Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Go to appropriate DTC test procedure. Clear DTCs and check if DTC normal code is present. Go to next step.

2) If normal code is not present, go to step 9). If normal code is present, go to next step.

3) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Continuity should exist between relay terminals No. 2 and 3. See Fig. 6. Continuity should not exist between relay terminals No. 1 and 3.

4) Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

5) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal 6. See Fig. 6. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

6) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 5 and negative lead to terminal No. 3. Check for continuity. If continuity exists, go to step 9). If continuity does not exist, go to next step.

7) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 3 and negative lead to terminal No. 5. Check for continuity. If continuity does not exist, replace ABS solenoid relay. If continuity exists, go to next step.

8) Check for short in Violet wire between ABS solenoid relay and Data Link Connector No. 1 (DLC1). DLC1 is located on left side of engine compartment, near junction block. Repair wiring as necessary.

9) Check if ABS warning light turns off. If ABS warning light does not turn off, go to next step. If ABS warning light turns off, check for open or short in Black/Red wire between terminal No. 8 at ABS/TRAC ECU A19 connector and ECU-IG fuse (15-amp). See Fig. 3. ECU-IG fuse is located in instrument panel junction block. Instrument panel junction block is located behind lower finish panel left of steering column.

10) Using voltmeter, check battery voltage. If battery voltage is 10-14 volts, go to next step. If battery voltage is not 10-14 volts, check charging system. See appropriate GENERATORS & REGULATORS article in STARTING & CHARGING SYSTEMS.

11) Turn ignition switch off. Disconnect ABS/TRAC ECU connector. ABS/TRAC ECU is located behind right kick panel. See Fig. 1 . Turn ignition on. Check if ABS warning light turns off. If ABS warning light turns off, replace ABS/TRAC ECU. If ABS warning light does not turn off, check for short in wire harness circuits between ABS warning light, DLC1, DLC2 and ABS/TRAC ECU. DLC1 is located on left side of engine compartment, near junction block. DLC2 is located under left side of instrument panel.

ABS WARNING LIGHT CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

If a fault is detected by ABS/TRAC ECU, ABS/TRAC ECU will illuminate ABS warning light, prohibit ABS operation and set appropriate Diagnostic Trouble Codes (DTC).

Diagnosis & Repair

1) If ABS warning light is illuminated constantly, go to step 7). If ABS warning light does not illuminate, check fuse, ABS warning light bulb, instrument cluster and wiring. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. If components are okay, go to next step.

2) Remove ABS solenoid relay from engine compartment No. 2 relay block. Relay block is located on left side of engine compartment. Continuity should exist between relay terminals No. 2 and 3. See Fig. 6. Continuity should not exist between relay terminals No. 1 and 3. Measure resistance between relay terminals No. 4 and 6. Resistance should be about 80 ohms. If all preceding tests are as specified, go to next step. If any preceding test is not as specified, replace ABS solenoid relay.

3) Using jumper wires, apply battery voltage to relay terminal No. 4 and ground relay terminal 6. See Fig. 6. Check for continuity between ABS solenoid relay terminals. Continuity should exist between relay terminals No. 1 and 3. Continuity should not exist between relay terminals No. 2 and 3. If all preceding tests are as specified, go to next step. If any preceding tests are not as specified, replace ABS solenoid relay.

4) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 5 and negative lead to terminal No. 3. Check for continuity. If continuity exists, go to step 6). If continuity does not exist, go to next step.

5) Connect positive lead of ohmmeter to ABS solenoid relay terminal No. 3 and negative lead to terminal No. 5. Check for

continuity. If continuity does not exist, replace ABS solenoid relay. If continuity exists, go to next step.

6) Check for open in wire harness circuits between ground, ABS solenoid relay and Data Link Connector No. 1 (DLC1). DLC1 is located on left side of engine compartment, near junction block.

7) Retrieve Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. If any DTCs are set, repair appropriate DTC. If no DTCs are set, check ABS warning light. If warning light turns off, go to next step. If warning light stays on, check for short in Black/Yellow wire between terminal No. 4 at ABS/TRAC ECU A19 connector, DLC1 and ABS warning light. See Fig. 3. DLC1 is located on left side of engine compartment, near junction block.

8) Check ABS solenoid relay. Go to step 2). Replacerelay as necessary. If ABS solenoid relay is okay, check for short in Violet wire between ABS solenoid relay and DLC1.

SLIP WARNING LIGHT CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

SLIP warning light blinks during TRAC system operation.

Diagnosis & Repair

1) Check SLIP warning light operation. If SLIP warning light does not properly, check instrument cluster wiring harness for open and short circuits. See WIRING DIAGRAMS in appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. Repair or replace as necessary. If SLIP warning light operation is okay, go to next step.

2) Check for short or open in Light Green/Red wire between terminal No. 3 at ABS/TRAC ECU A19 connector and terminal No. 12 at instrument cluster 18-pin connector. Repair wiring as necessary. If wire is okay, replace ABS/TRAC ECU.

TRAC OFF WARNING LIGHT (TRAC CUT SWITCH CIRCUIT)

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

TRAC OFF warning light will illuminate when TRAC system is turned off. If a fault is detected, ABS/TRAC ECU will illuminate TRAC OFF warning light and set appropriate DTC.

Diagnosis & Repair

1) Check for Diagnostic Trouble Codes (DTC). See RETRIEVING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING. Go to appropriate DTC test procedure. Repair as necessary. Clear DTCs.

2) Remove TRAC OFF control switch. TRAC OFF switch is located at lower right side of steering wheel. Disconnect TRAC OFF switch connector. Check continuity between TRAC OFF switch terminals No. 1 and 4. See Fig. 12. With TRAC OFF switch pushed in, continuity should exist. With TRAC OFF switch released, continuity should not exist. If continuity is not as specified, replace TRAC OFF switch. If continuity is as specified, go to next step.

3) Disconnect ABS/TRAC ECU A19 connector. ABS/TRAC ECU is located behind right kick panel. See Fig. 1. Check for short or open in Black wire between terminal No. 11 at ABS/TRAC ECU A19 connector and terminal No. 4 at TRAC OFF switch connector. See Figs. 3 and 12. Also check for open in White/Black wire between ground and terminal No. 1 at TRAC OFF switch connector. Ground terminal is located at right instrument panel brace. Repair as necessary. If wires are okay, go to next step.

4) Check TRAC OFF warning light operation. If TRAC OFF warning light operation is okay, go to next step. If TRAC OFF warning light does not properly, check instrument cluster wiring harness for open and short circuits. See WIRING DIAGRAMS in appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. Repair or replace as necessary.

5) Check for short or open in Light Green/Black wire between terminal No. 12 at ABS/TRAC ECU A19 connector and terminal No. 13 at instrument cluster 18-pin connector. Repair wiring as necessary. If wire is okay, replace ABS/TRAC ECU.

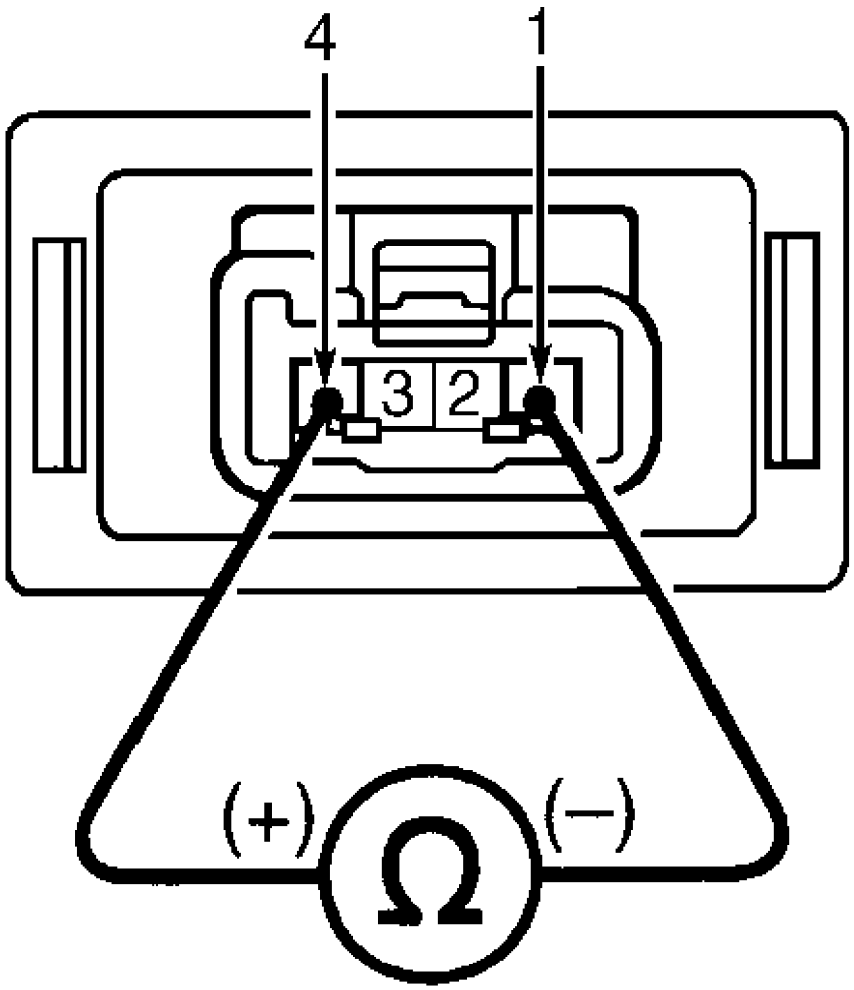


Fig. 12: Identifying TRAC OFF Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TC TERMINAL CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

Connecting between Data Link Connector No. 1 (DLC1) terminals Tc and E1 causes ABS/TRAC ECU to display DTCs by flashing ABS and TRAC OFF warning light.

Diagnosis & Repair

Turn ignition on. Using voltmeter, check voltage between terminals Tc and E1 of DLC1 or Data Link Connector No. 2 (DLC2). See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. DLC2 is located under left side of instrument panel. If voltage is 10-14, circuit is okay. Connect a fused jumper wire or Service Connector (SST 09843-18020) between terminals Tc and E1 at DLC1 or DLC2. Check ABS warning light. If ABS warning light does not blink, ABS/TRAC ECU may be faulty. If voltage is not 10-14 volts, check for open or short in circuits between ABS/TRAC ECU, DLC1 or DLC2, and between DLC1 or DLC2 and ground. Repair wiring as necessary. If wiring is okay, replace ABS/TRAC ECU.

TS TERMINAL CIRCUIT

CAUTION: If Anti-Lock Brake System/Traction Control Electronic Control Unit (ABS/TRAC ECU) replacement is necessary during testing, always ensure ABS/TRAC ECU connectors and ground circuit are okay. If either is suspect, repair and repeat testing to confirm ABS/TRAC ECU malfunction.

Circuit Description

This sensor check circuit detects abnormalities in speed sensor signal that cannot be detected with Diagnostic Trouble Codes (DTC) check. Connect Data Link Connector No. 1 (DLC1) terminal Ts to terminal E1 to start the check.

Diagnosis & Repair

Turn ignition on. Using a voltmeter, check voltage between terminals Ts and E1 at DLC1 connector. See Fig. 2. DLC1 is located on left side of engine compartment, near junction block. If voltage is 10-14 volts, circuit is okay. Connect a fused jumper wire or Service Connector (SST 09843-18020) between terminals Ts and E1 at DLC1 connector. Check ABS warning light. If ABS warning light does not blink, ABS/TRAC ECU may be faulty. If voltage is not 10-14 volts, check for open or short in wire harness circuits between ABS/TRAC ECU, DLC1 and between DLC1 and ground. Repair wiring as necessary. If wiring is okay, replace ABS/TRAC ECU.

COMPONENT TESTS

ABS/TRAC ACTUATOR CHECK

NOTE: ABS Actuator Checker (SST 09990-00150) is needed to perform actuator check.

1) Turn ignition off. Ensure battery voltage is 10-14 volts. Disconnect ABS/TRAC actuator connectors, located behind right front fender liner. Connect ABS Actuator Checker (SST 09990-00150) positive and negative power cables to vehicle battery. Connect sub-wire Harness (SST 09990-00250, SST 09990-00360 and SST 09990-00450) to ABS/TRAC

actuator connectors.

2) Connect FR TRC connector to White connector at sub-wire harness. See Fig. 13. Connect ABS actuator checker to sub-wire harness. Connect Black cable of sub-wire harness to ground.

3) Place SHEET "A" (SST 09990-00163) on ABS/TRAC actuator checker. Start engine and operate it at idle. Turn selector switch of ABS/TRAC actuator checker to FRONT RH position. See Fig. 14.

4) Press MOTOR switch for a few seconds. Depress and hold brake pedal down until step 5) is completed.

NOTE: DO NOT keep POWER switch pressed for more than 10 seconds.

5) Press POWER switch, and ensure brake pedal does not go down. Release POWER switch. Brake pedal should go down. Press MOTOR switch for a few seconds, and ensure brake pedal returns. Release brake pedal.

6) Press MOTOR switch for a few seconds then release it. Depress and hold brake pedal down for 15 seconds. With brake pedal depressed, press MOTOR switch for a few seconds. Ensure brake pedal does not pulsate. Replace ABS/TRAC actuator if it does not test as specified. See ABS/TRAC ACTUATOR under REMOVAL & INSTALLATION. Release brake pedal.

7) Repeat steps 4)-6) for FRONT LH and REAR RH positions of selector switch. See Fig. 14. When inspecting REAR LH position, it does not matter which selector switch position ABS/TRAC actuator checker is in. When inspecting REAR LH, push REAR LH switch instead of POWER switch.

8) After all wheels are checked, press MOTOR switch for a few seconds. Turn engine off. Remove actuator checker, SHEET "A" and sub-wire harness. Reconnect actuator harness connectors. Clear Diagnostic Trouble Codes (DTC). See CLEARING DIAGNOSTIC TROUBLE CODES under DIAGNOSIS & TESTING.

9) If actuator does not operate as specified, check ABS solenoid and ABS motor relay operation. See DTC 11 OR 12: ABS SOLENOID RELAY CIRCUIT and DTC 13 OR 14: ABS MOTOR RELAY CIRCUIT. Replace relays as necessary and recheck actuator operation.

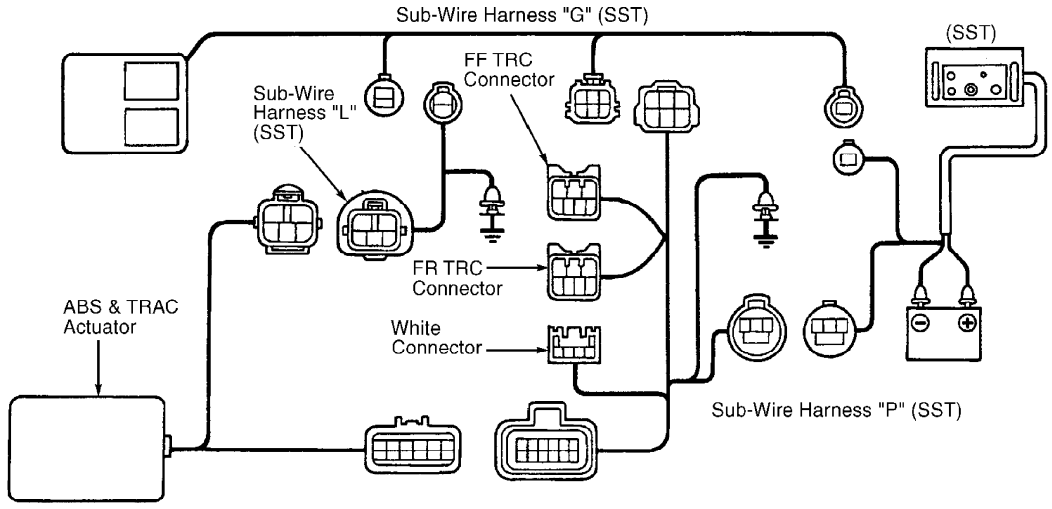


Fig. 13: Identifying Sub-Wire Harnesses, Connectors & Terminals For ABS/TRAC Actuator Checker
Courtesy of Toyota Motor Sales, U.S.A., Inc.

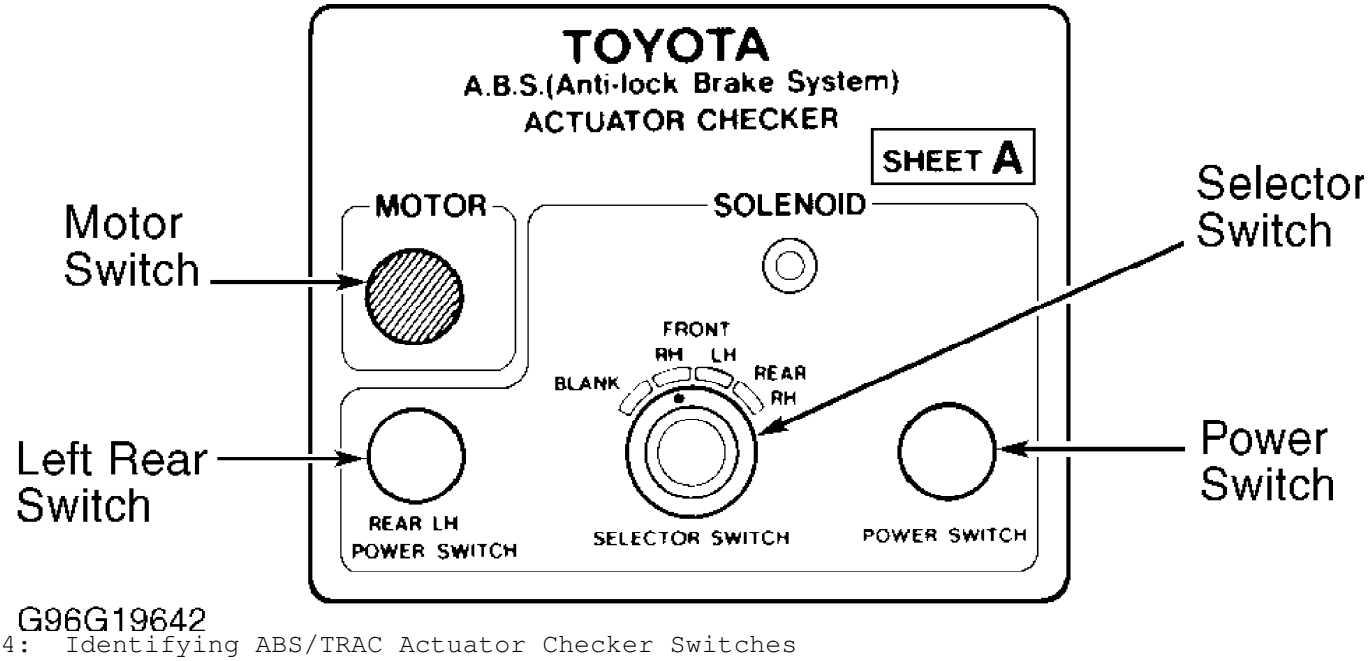


Fig. 14: Identifying ABS/TRAC Actuator Checker Switches
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Hydraulic system may be under high pressure. Use caution when opening hydraulic system.

ABS/TRAC ECU

Removal & Installation

Turn ignition off. Disconnect negative battery cable. Remove right front kick panel. SeeFig. 1. Disconnect ABS/TRAC ECU connectors. Remove ABS/TRAC ECU. To install, reverse removal procedure.

ABS/TRAC ACTUATOR

Removal & Installation

Remove right front fender liner. Remove power steering tube clamp bracket bolt. Remove coolant reservoir. Disconnect 6 brake lines front ABS/TRAC actuator. See Fig. 15. Disconnect ABS/TRAC actuator connectors. Remove bolts nuts and ABS/TRAC actuator assembly. Remove nuts and ABS/TRAC actuator from bracket. Remove holders and cushions from ABS/TRAC actuator. To install, reverse removal procedure. Tighten all bolts and nut to specification. See TORQUE SPECIFICATIONS. Bleed brake system. See BLEEDING BRAKE SYSTEM. Check system for leakage.

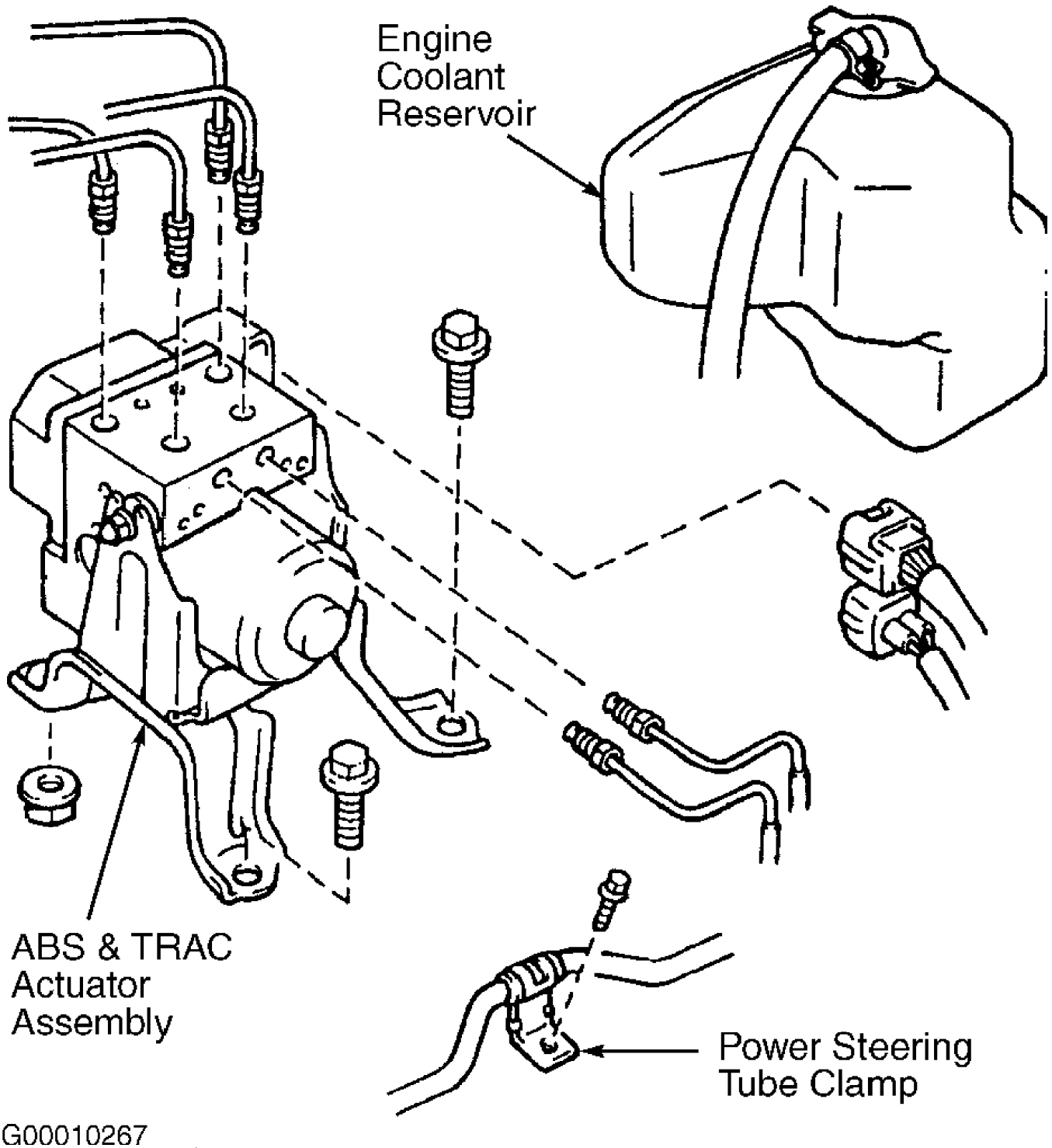


Fig. 15: Removing ABS/TRAC Actuator
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SPEED SENSOR ROTOR

Removal & Installation (Front)

Front speed sensor rotor is an integral part of outboard CV joint. To replace sensor rotor, the front axle shaft must be removed.

See AXLE SHAFTS - RX300 AWD & FWD article in DRIVE AXLES.

Removal & Installation (Rear)

On 2WD models, rear speed sensor rotor is an integral part of rear hub. To replace sensor rotor, rear hub must be removed. See appropriate REAR article in SUSPENSION. On AWD models, rear speed sensor rotor is an integral part of outboard CV. To replace sensor rotor, the rear axle shaft must be removed. See AXLE SHAFTS - RX300 AWD & FWD article in DRIVE AXLES.

WHEEL SPEED SENSOR

Removal & Installation (Front)

Remove fender liner. Disconnect speed sensor connector. Remove bolts, wiring harness and speed sensor harness clamp from vehicle body and strut. Remove speed sensor bolt from steering knuckle. Remove speed sensor. To install, reverse removal procedure. Tighten speed sensor bolt to specification. See TORQUE SPECIFICATIONS. Check speed sensor signal after installation. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

Removal & Installation (Rear)

Remove rear seat, scuff plate and rear seat molding. Disconnect speed sensor connector. Pull out sensor wire harness with grommet. Remove 2 clamp bolts holding sensor wiring harness to vehicle body and strut. Remove speed sensor from axle carrier. To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check speed sensor signal after installation. See SPEED SENSOR SIGNAL CHECK under DIAGNOSIS & TESTING.

OVERHAUL

ABS/TRAC ACTUATOR

DO NOT overhaul or disassemble actuator assembly. If actuator is defective, replace entire assembly.

ADJUSTMENTS

For adjustment procedures, see DISC article.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Actuator Bracket Bolts	14 (19)
Brake Pedal Push Rod Lock Nut	19 (25)
Brakeline Fittings	11 (15)
Cushion Nuts	10 (14)
Speed Sensor Harness-To-Strut Clamp Bolt	21 (29)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
Actuator Mounting Nuts	48 (5.4)
Parking Brake Cable Lock Nut	48 (5.4)
Speed Sensor Harness-To-Body Clamp Bolt	48 (5.4)
Speed Sensor Mounting Bolt	71 (8.0)

WIRING DIAGRAMS

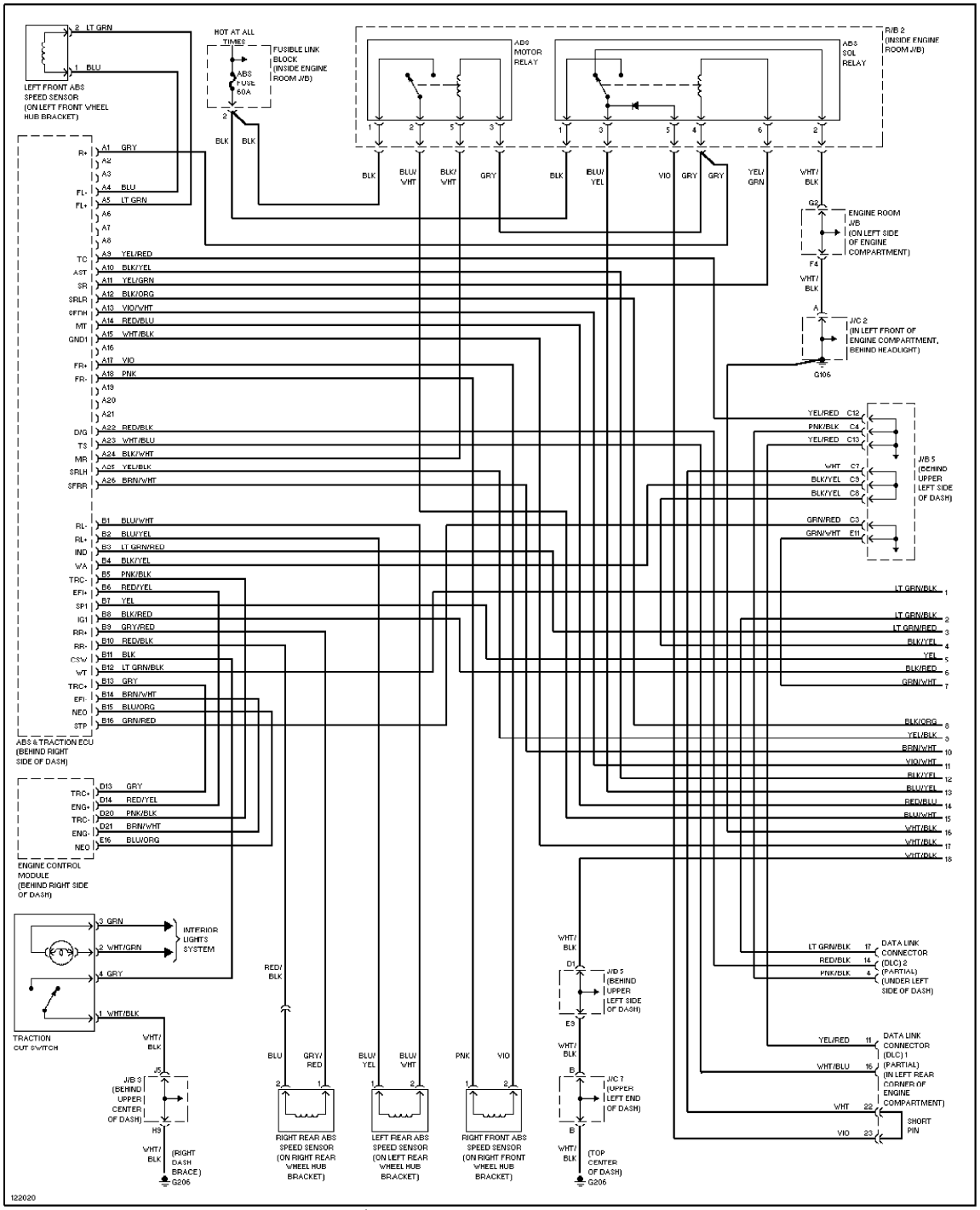


Fig. 16: Anti-Lock Brake System/Traction Control Wiring Diagram (1999-2000 RX300 - 1 Of 2)

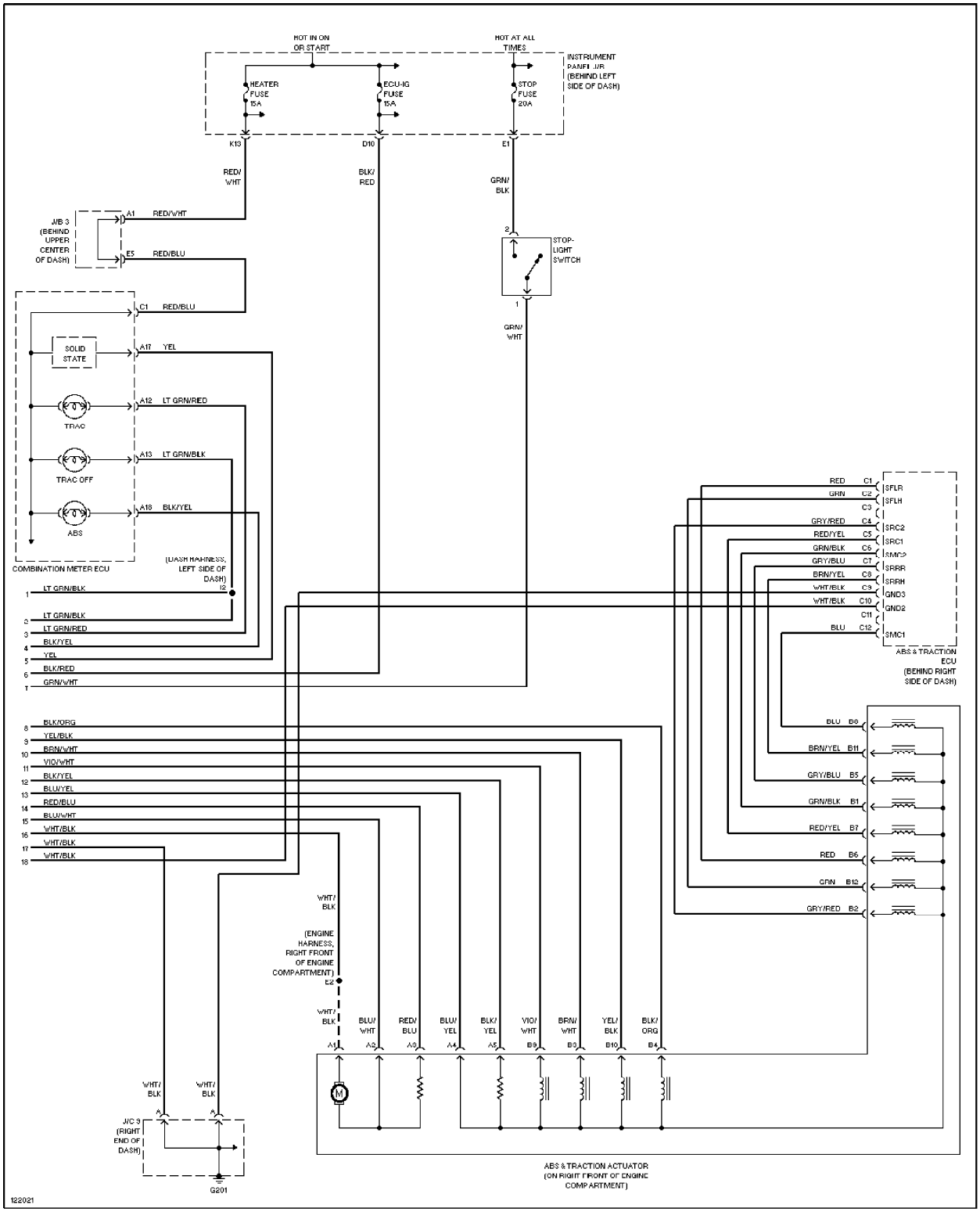


Fig. 17: Anti-Lock Brake System/Traction Control Wiring Diagram (1999-2000 RX300 - 2 Of 2)

ANTI-THEFT SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Anti-Theft Systems
LEXUS

RX300

DESCRIPTION

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

When anti-theft system is set (armed), system locks all doors, flashes headlights and taillights, and sounds alarm if one of following conditions occur. See Fig. 1.

* Any door (including back door) or engine hood is forcibly opened.
* Battery cable is disconnected, and then reconnected.
* System receives panic signal from remote keyless entry system.

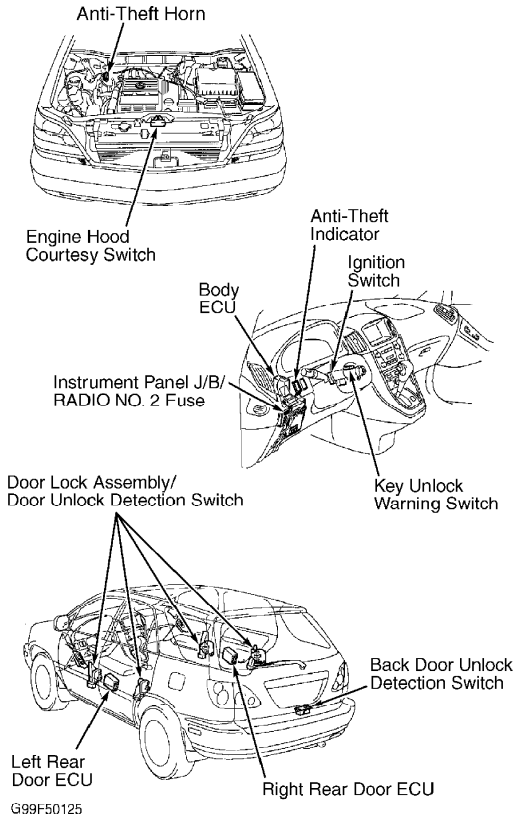


Fig. 1: Anti-Theft System Component Locations
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OPERATION

ACTIVE MODE

Setting (Arming) Anti-Theft System

Remove ignition key from ignition switch. Close all doors (including back door) and engine hood. Use one of following methods to lock vehicle:

* Using key, lock left or right front door (all doors are locked through key-interlinked lock operation).
* Lock all doors using remote keyless entry system.
* With rear doors locked and one front door locked, close and lock other front door by hand (without key) using door lock switch.

After doors are locked using one of these methods, anti-theft indicator on left side of instrument panel will light continuously for about 30 seconds. After 30 seconds, anti-theft indicator will blink once per second. When system is set, doors cannot be locked or unlocked using door lock control switch.

Canceling Anti-Theft System Setting (No Alarm)

When system is set (armed), but alarm is not sounding, use one of following methods to cancel system setting:

* Unlock left or right front door using key.
* Unlock all doors using remote keyless entry system.
* Insert key in ignition switch and turn to ON position (this is operative only when anti-theft system has not been triggered).

Canceling Anti-Theft System Setting (Alarm Sounding)

When system is set (armed) and alarm is sounding, use one of following methods to cancel system setting:

* Unlock left or right door with key.
* Unlock doors using remote keyless entry system.
* Insert key into ignition cylinder and turn to ON position.
* Wait about one minute after alarm has sounded. After one minute, anti-theft system will automatically reset in about 2 seconds if all doors are closed.

Checking Anti-Theft System Warning (Alarm) Operation

Ensure anti-theft system is set and indicator is blinking. When engine hood is opened or any door is unlocked without using key, vehicle horns and anti-theft horn will sound, and headlights and taillights will flash for about one minute. If any door is unlocked and key is not in ignition switch when alarm is sounding, anti-theft system will automatically lock door.

PASSIVE MODE

Setting (Arming) Anti-Theft System

The system will automatically set 30 seconds after following methods are performed:

* Remove ignition key from ignition switch.
* Exit vehicle, and close all doors.

After performing these methods, anti-theft indicator on left side of instrument panel will light continuously for about 30 seconds. After 30 seconds, anti-theft indicator will blink once per second. When system is set, doors cannot be locked or unlocked using door lock

control switch.

PROGRAMMING

PASSIVE MODE

NOTE: Initial mode is passive mode off. If there is a different signal in middle of programming, signal is invalid.

Programming Passive Mode Off

Remove ignition key from ignition key cylinder. Ensure all doors (including back door) and engine hood are closed and unlocked. Perform all of following methods within 30 seconds:

* Lock or unlock any door with key or remote keyless entry system.
* Open driver door.
* Lock and unlock driver door lock knob 3 times.

After performing method listed above, system should start force lock after 2 seconds. Perform all of following methods within 20 seconds:

* Unlock driver door lock knob.
* Close and open driver door 2 times.
* Lock and unlock driver door lock knob.

After performing method listed above, system should start force lock after 2 seconds. Passive mode should now be off.

Programming Passive Mode On

Remove ignition key from key cylinder. Ensure all doors, engine hood and luggage compartment door are closed and unlocked. Perform all of following methods within 30 seconds:

* Lock or unlock any door with key or remote keyless entry system.
* Open driver door.
* Lock and unlock driver door lock knob 3 times.

After performing method listed above, system should start force lock after 2 seconds. Perform all of following methods within 20 seconds:

* Unlock driver door lock knob.
* Close and open driver door 4 times.
* Lock and unlock driver door lock knob.

After performing method listed above, system should start force lock after 2 seconds. Passive mode should now be on.

TROUBLE SHOOTING

NOTE: For anti-theft system trouble shooting, see TROUBLE SHOOTING in BODY CONTROL SYSTEMS - RX300 article.

CIRCUIT TESTS

NOTE: For anti-theft system circuit tests, see CIRCUIT TESTS in BODY CONTROL SYSTEMS - RX300 article.

COMPONENT TESTS

NOTE: For anti-theft system component tests, see COMPONENT TESTS in BODY CONTROL SYSTEMS - RX300 article.

WIRING DIAGRAMS

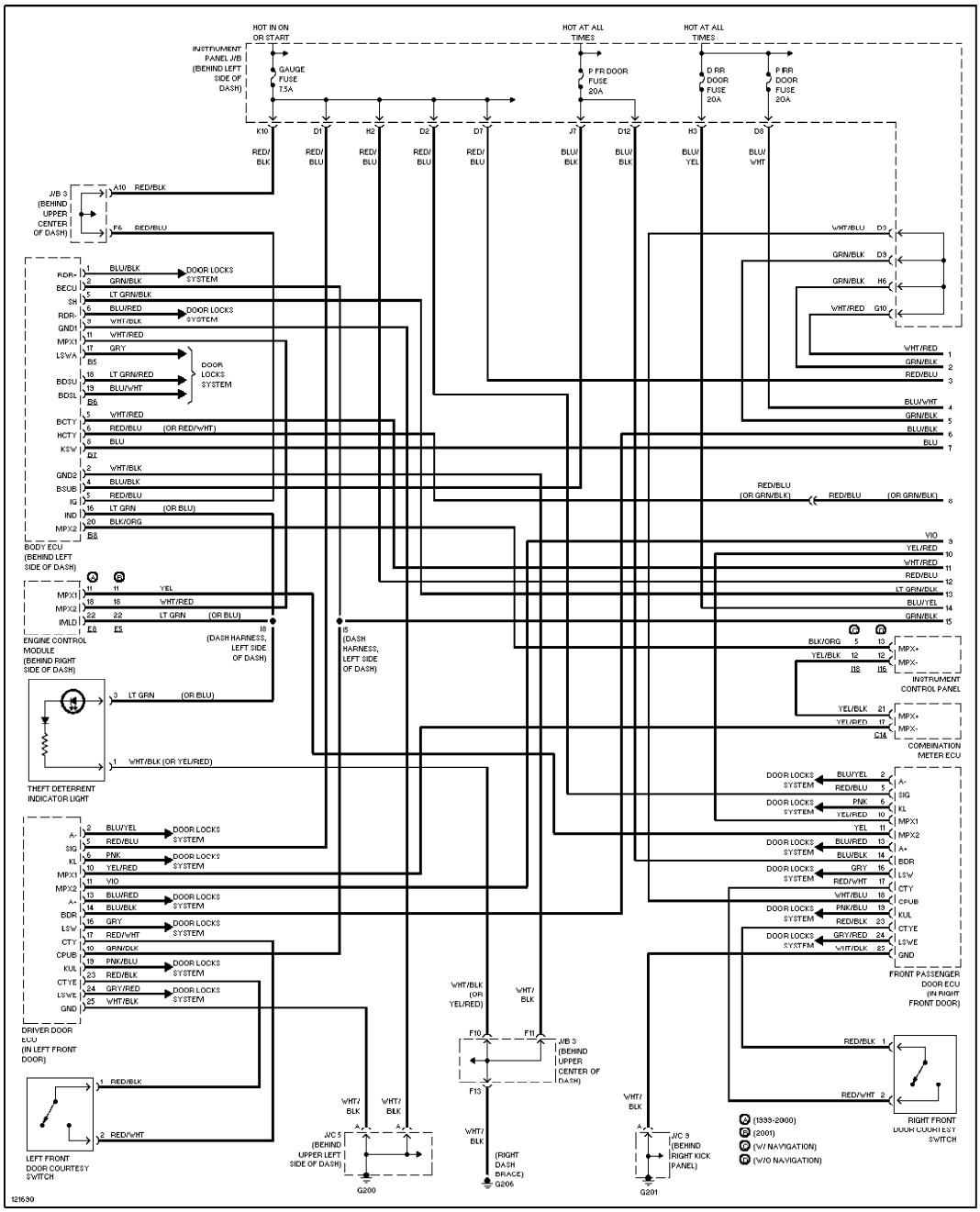


Fig. 2: Anti-Theft System Wiring Diagram (RX300 - 1 Of 2)

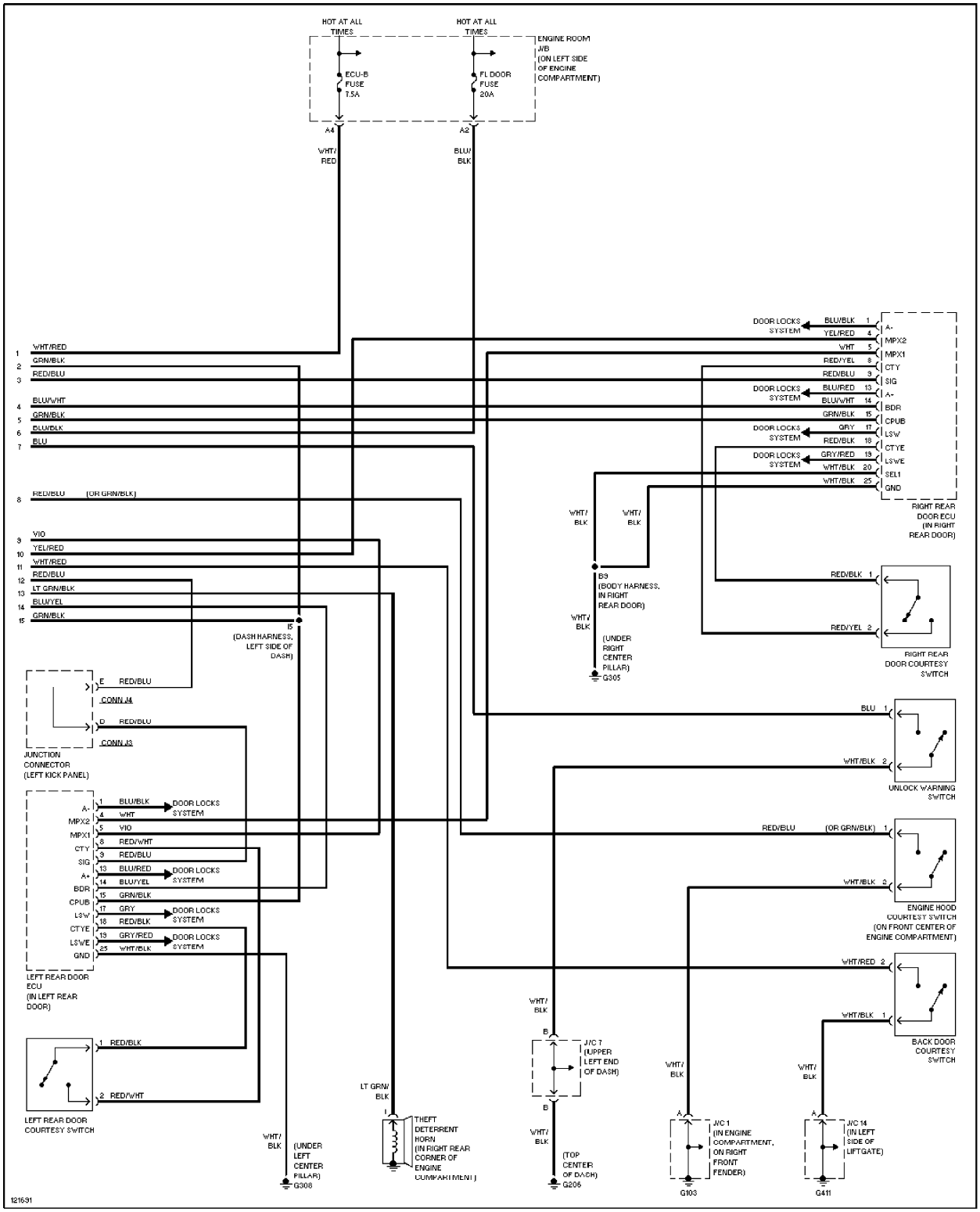


Fig. 3: Anti-Theft System Wiring Diagram (RX300 - 2 Of 2)

AUTO TRANS DIAGNOSIS - U140E & U140F

1999 Lexus RX 300

1999 AUTOMATIC TRANSMISSIONS
Lexus U140E & U140F Electronic Controls

APPLICATION

TRANSAXLE APPLICATIONS

Vehicle Application	Transaxle Model
ES300	U140E
RX300	U140E & U140F

CAUTION: All models are equipped with a Supplemental Restraint System (SRS). When servicing vehicle, use care to avoid accidental air bag deployment. All SRS electrical connections are Yellow. SRS-related components are located in steering column, center console, instrument panel and seats. DO NOT use electrical test equipment on these circuits. If necessary, deactivate SRS before servicing components. See AIR BAG SERVICING article in APPLICATIONS & IDENTIFICATION.

DESCRIPTION

The U140E and U140F automatic transaxles are electronically controlled. Transaxle shifting and torque converter lock-up are controlled by an Electronic Control Module (ECM).

ECM receives information from various input devices and uses this information to control shift solenoids for transaxle shifting and torque converter lock-up.

An Overdrive (OD) switch is mounted on the shift lever. When OD switch is depressed to ON position, transaxle will shift into 4th gear when shift lever is in "D" position, and OD OFF light on instrument panel will go off. When OD switch is released to OFF position, transaxle will shift into 3rd gear, and OD OFF light will illuminate.

Transaxle is equipped with a shift lock and key lock system. Shift lock system prevents shift lever from being moved from Park unless brake pedal is depressed. In case of a malfunction, shift lever can be released by depressing shift lock override button, located near shift lever. Key lock system prevents ignition key from being moved from ACC to LOCK position on ignition switch unless shift lever is in Park. For more information on shift lock and key lock system, see TOYOTA SHIFT LOCK SYSTEM article.

OPERATION

ELECTRONIC CONTROL MODULE (ECM)

ECM receives information from various input devices and uses this information to control shift solenoids and torque converter lock-up. ECM contains a self-diagnostic system, which will store a Diagnostic Trouble Code (DTC) if failure or problem exists in the electronic control system.

DTC can be retrieved to determine transaxle problem area. See SELF-DIAGNOSTIC SYSTEM. ECM is located behind glove compartment.

ECM INPUT DEVICES

Park/Neutral Position (PNP) Switch

PNP switch delivers an input signal to ECM to indicate shift lever position. PNP switch is located on side of transaxle, below solenoid connector.

Throttle Position (TP) Sensor

TP sensor delivers an input signal to ECM indicating throttle position. TP sensor is located on side of throttle body.

Vehicle Speed Sensor (VSS)

Vehicle speed signal is delivered to ABS ECU by ABS wheel speed sensors. ABS ECU converts signals into a 4-pulse signal and outputs signal to instrument cluster. Instrument cluster converts signal to a more precise waveform and outputs signal to ECM. Speed sensors are located at each wheel.

Brakelight Switch

Brakelight switch delivers input signal to ECM, indicating vehicle braking. Brakelight switch is located on brake pedal support.

Overdrive (OD) Switch

OD switch provides an input signal to ECM to indicate when overdrive is selected by vehicle operator. When OD switch is depressed to ON position, transaxle will shift into 4th gear when shift lever is in "D" position, and OD OFF light on instrument panel will go off. When OD switch is released to OFF position, transaxle will shift into 3rd gear, and OD OFF light will come on. OD switch is mounted on shift lever.

Engine Coolant Temperature (ECT) Sensor

Engine coolant temperature sensor delivers input signal to ECM, indicating engine coolant temperature. ECT sensor is located at right rear corner of engine, near upper radiator hose.

Cruise Control Electronic Control Unit (ECU)

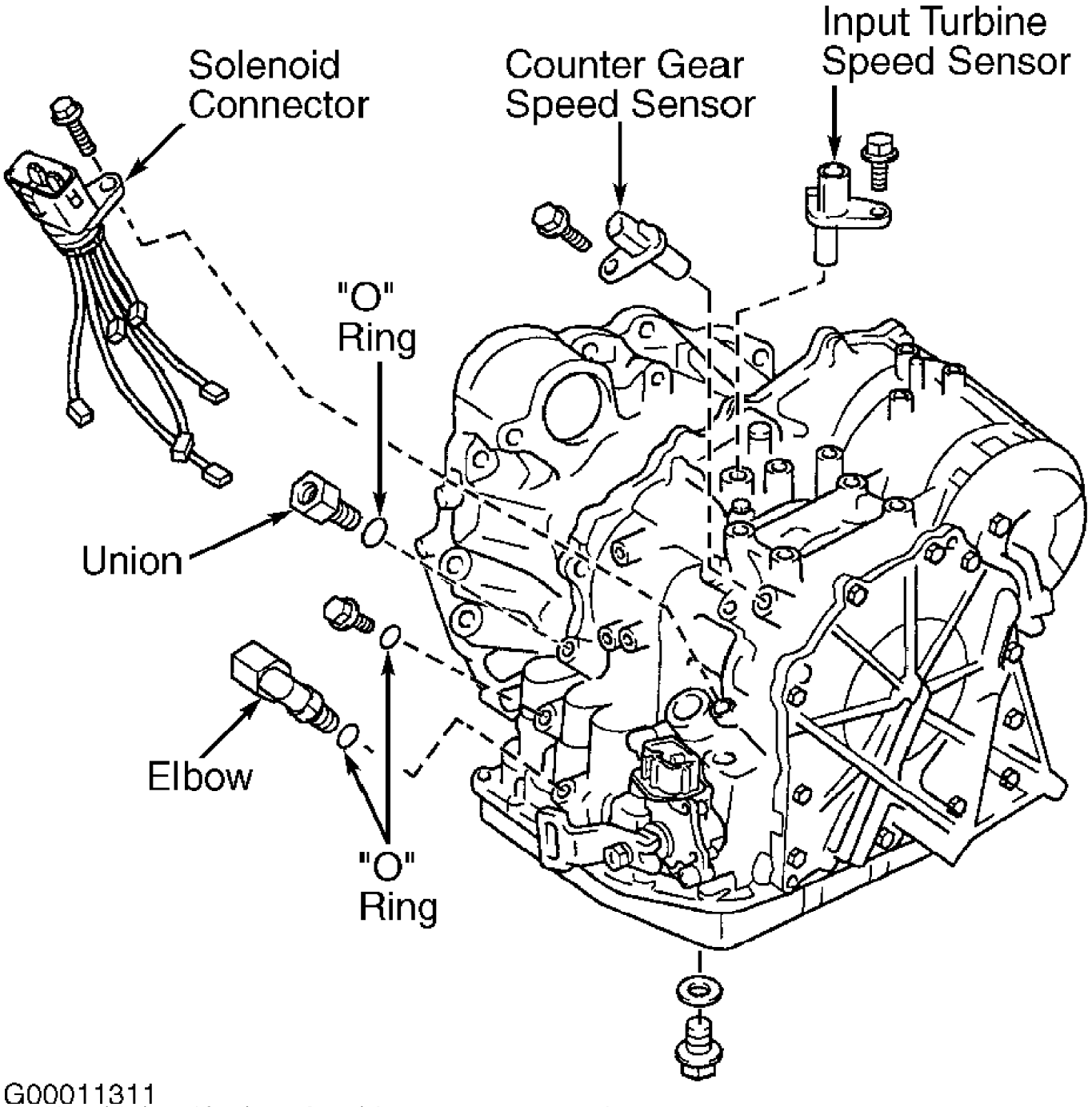
Cruise control ECU delivers an input signal to control overdrive operation in accordance with vehicle speed when cruise control is operating. When in overdrive with cruise control on, if vehicle speed drops 3 MPH less than set speed, overdrive is released to prevent reduction in vehicle speed. Once vehicle speed is more than set speed, overdrive is resumed. Cruise control ECU is located behind instrument panel on passenger side of vehicle.

Input Turbine Speed Sensor

Input turbine speed sensor detects rotation of input shaft. By comparing input turbine speed sensor signal and counter gear speed sensor signal, ECM detects shift timing of gears and controls engine torque and hydraulic pressure in response to various conditions, resulting in smooth transaxle shifting. See Fig. 1.

Counter Gear Speed Sensor

Counter gear speed sensor detects rotation of counter drive gear. By comparing counter gear speed sensor signal and input turbine speed sensor signal, ECM detects shift timing of gears and controls engine torque and hydraulic pressure in response to various conditions, resulting in smooth transaxle shifting. See Fig. 1.



G00011311

Fig. 1: Identifying 10-Pin Solenoid Connector & Speed Sensor Locations
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Automatic Transaxle Fluid (ATF) Temperature Sensor

ATF temperature sensor, located on wiring harness inside transaxle oil pan, converts fluid temperature into a resistance value, which is input to ECM. See Fig. 2.

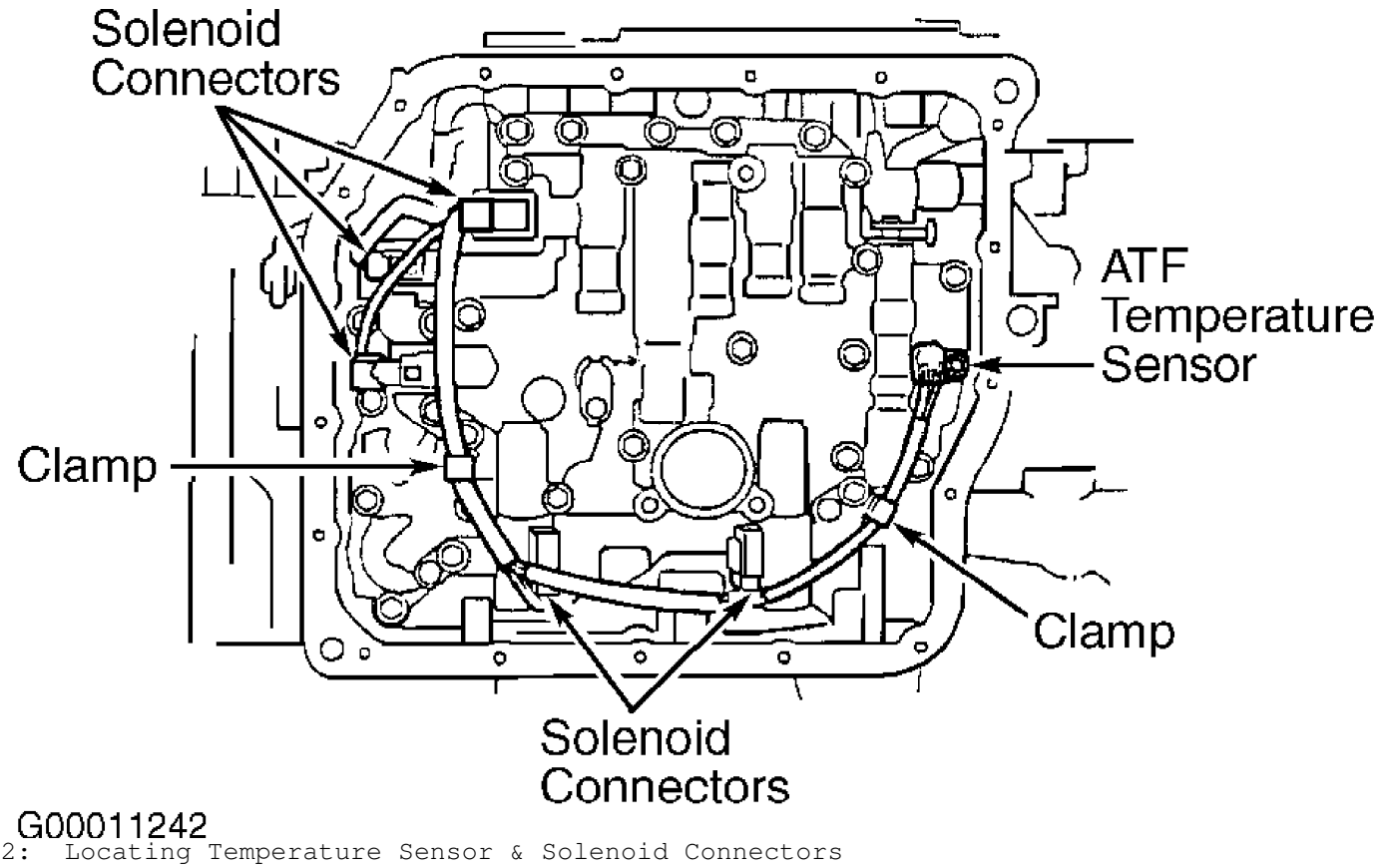


Fig. 2: Locating Temperature Sensor & Solenoid Connectors
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ECM OUTPUT DEVICES

Shift Solenoids SL1, SL2 & S4

ECM controls transaxle shifting by delivering an output signal to operate proper shift solenoid. Solenoids are located on transaxle valve body. See Fig. 3. Solenoids are operated in accordance with shift lever position. If a solenoid malfunctions, ECM defaults transaxle to a designated gear. See Fig. 4.

NOTE: ECM provides a fail-safe system which places transaxle in a designated gear depending on which solenoid fails. In some gears, fail-safe system will not be activated and transaxle will shift to the failsafe gear. See Fig. 4.

Shift Solenoid DSL

ECM uses signals from TP sensor, airflow meter and crankshaft position sensor to monitor torque converter lock-up engagement condition. ECM compares torque converter lock-up engagement condition with lock-up schedule in ECM memory to detect a malfunction with valve body, torque converter clutch or shift solenoid DSL. Shift solenoid DSL controls hydraulic pressure acting on lock-up relay valve, which contains torque converter clutch lock-up. Shift solenoid DSL is located on transaxle valve body. See Fig. 3.

Shift Solenoid SLT

ECM controls line pressure by sending a predetermined duty ratio to shift solenoid SLT, modulating line pressure and generating throttle pressure. Shift solenoid SLT is used to precisely and minutely modulate and generate line pressure according to accelerator

pedal effort, or engine power output detected. Shift solenoid SLT is located on transaxle valve body. See Fig. 3.

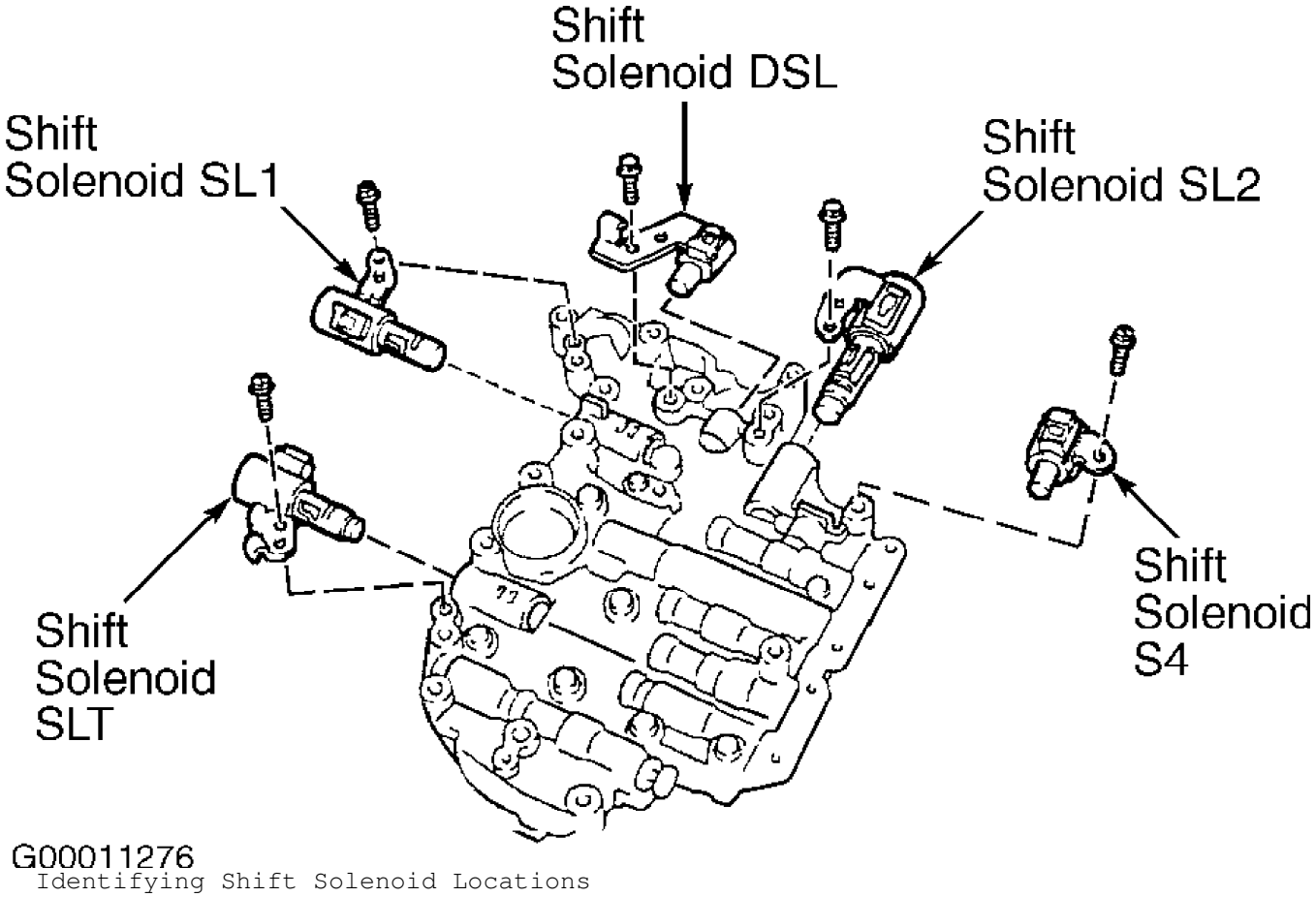


Fig. 3: Identifying Shift Solenoid Locations
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NORMAL				SHIFT SOLENOID SL1 MALFUNCTIONING								SHIFT SOLENOID SL2 MALFUNCTIONING			
				Driving at 3rd or O/D				Driving at 1st or 2nd							
Solenoid Valve			Gear	Solenoid Valve			Gear	Solenoid Valve			Gear	Solenoid Valve			Gear
SL1	SL2	S4		SL1	SL2	S4		SL1	SL2	S4		SL1	SL2	S4	
ON	ON	OFF	1st	X	ON → OFF	OFF	3rd	X	ON	OFF	2nd	ON → OFF	X	OFF	3rd
OFF	ON	OFF	2nd	X	ON → OFF	OFF	3rd	X	ON	OFF	2nd	OFF	X	OFF	3rd
	OFF	OFF	3rd	X	OFF	OFF	3rd	X	OFF → ON	OFF → ON	3rd		X	OFF	3rd
	OFF	ON	O/D	X	OFF	ON	O/D	X	OFF → ON	ON	3rd		X	ON	O/D

SHIFT SOLENOID S4 MALFUNCTIONING				SHIFT SOLENOID SL1 & SL2 MALFUNCTIONING				SHIFT SOLENOID SL1 & S4 MALFUNCTIONING							
								Driving at 3rd or O/D				Driving at 1st or 2nd			
Solenoid Valve			Gear	Solenoid Valve			Gear	Solenoid Valve			Gear	Solenoid Valve			Gear
SL1	SL2	S4		SL1	SL2	S4		SL1	SL2	S4		SL1	SL2	S4	
ON	ON	X	1st	X	X	OFF	3rd	X	ON → OFF	X	3rd	X	ON	X	2nd
OFF	ON	X	2nd	X	X	OFF	3rd	X	ON → OFF	X	3rd	X	ON	X	2nd
	OFF	X	3rd	X	X	OFF	3rd	X	OFF	X	3rd	X	OFF → ON	X	2nd
	OFF	X	3rd	X	X	ON	O/D	X	OFF	X	3rd	X	OFF → ON	X	2nd

SHIFT SOLENOID SL2 & S4 MALFUNCTIONING				SHIFT SOLENOID SL1, SL2 & S4 MALFUNCTIONING			
Solenoid Valve			Gear	Solenoid Valve			Gear
SL1	SL2	S4		SL1	SL2	S4	
ON → OFF	X	X	3rd	X	X	X	3rd
OFF	X	X	3rd	X	X	X	3rd
	X	X	3rd	X	X	X	3rd
	X	X	3rd	X	X	X	3rd

G00011314

Fig. 4: Checking Shift Solenoid Operation
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SELF-DIAGNOSTIC SYSTEM

SYSTEM DIAGNOSIS

NOTE: Before testing transaxle, ensure fluid level is correct and shift cables are properly adjusted. Ensure engine starts with shift lever in Park and Neutral to ensure proper adjustment of park/neutral position switch. Transaxle must first be tested by checking for stored trouble codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES.

ECM monitors transaxle operation and contains a self-diagnostic system which stores trouble codes if transaxle electronic control system failure or problem exists. Malfunction Indicator Light (MIL) on instrument panel will illuminate to warn driver a malfunction has occurred.

RETRIEVING DIAGNOSTIC TROUBLE CODES

NOTE: On all models, trouble codes are a 4-digit code. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION table. Trouble codes can only be retrieved using scan tool connected to 16-pin Data Link Connector (DLC3). See Fig. 5. DLC3 is located under instrument panel, near steering column. See Fig. 6. When trouble code is present, Malfunction Indicator Light (MIL), located on instrument panel will light. To retrieve trouble codes using scan tool, follow scan tool manufacturer's operating instructions.

NOTE: Once repairs have been performed, codes must be cleared from ECM memory. See CLEARING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM.

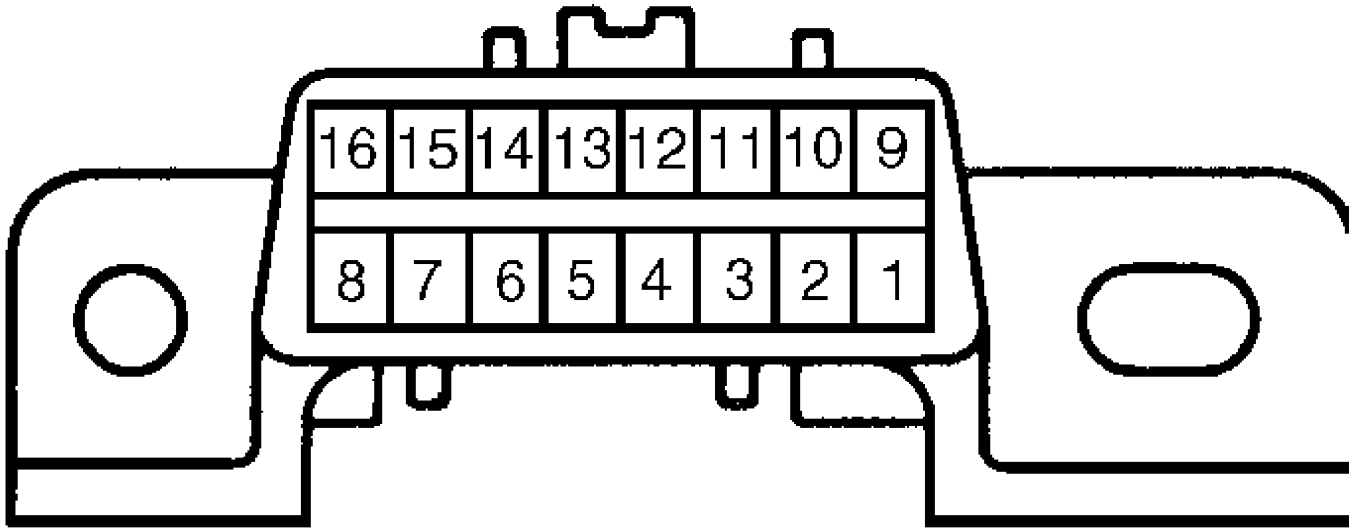


Fig. 5: Identifying Data Link Connector (DLC3) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

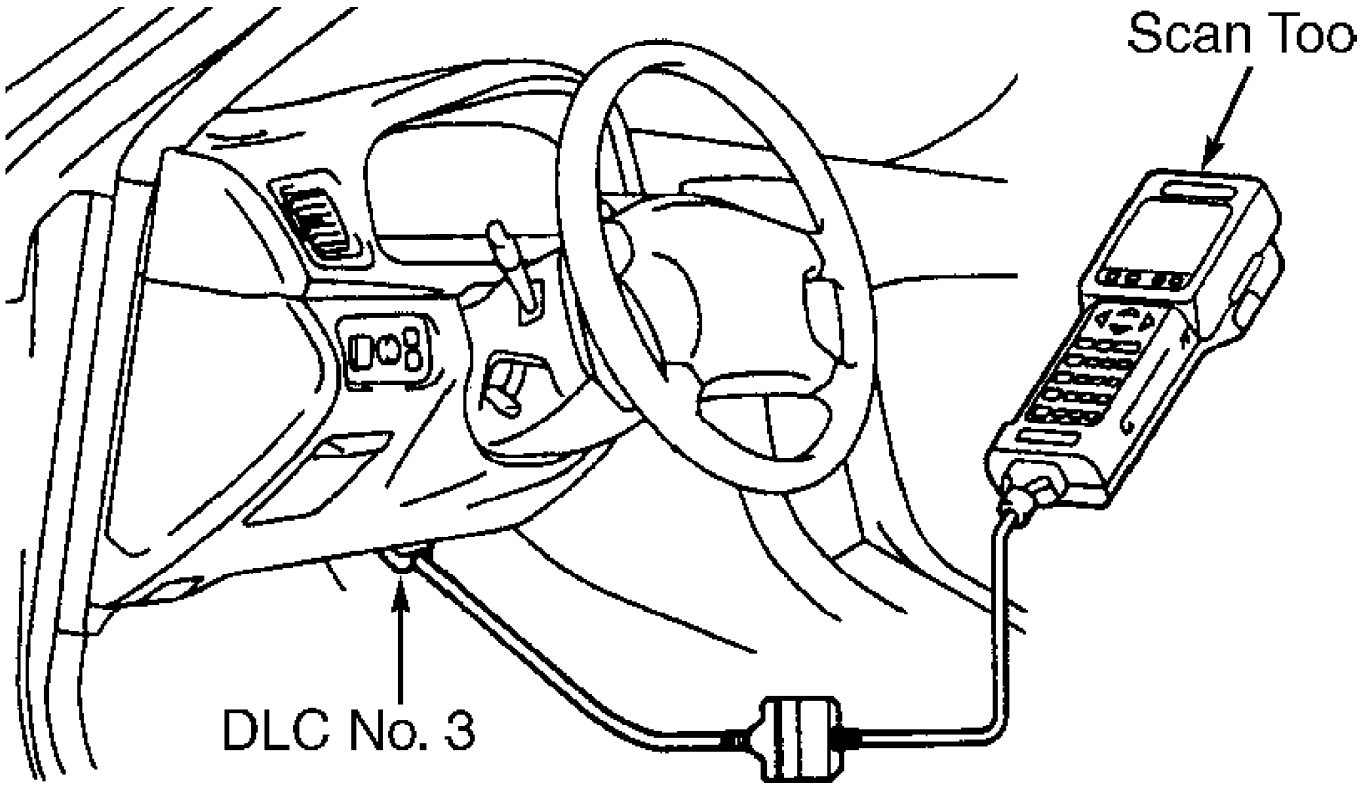


Fig. 6: Connecting Scan Tool To DLC3
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CLEARING DIAGNOSTIC TROUBLE CODES

All Models

Trouble codes can only be cleared using scan tool connected to 16-pin Data Link Connector (DLC3). See Fig. 5. DLC3 is located under instrument panel, near steering column. See Fig. 6.

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DTC	(1) Probable Cause
P0500	Vehicle Speed Sensor
P0710	ATF Temperature Sensor
P0750	(2) Shift Solenoid SL1
P0753	Shift Solenoid SL1 Circuit Malfunction
P0755	(2) Shift Solenoid SL2
P0758	Shift Solenoid SL2 Circuit Malfunction
P0765	(2) Shift Solenoid S4
P0768	Shift Solenoid S4 Circuit Malfunction
P0770	(2) Shift Solenoid DSL
P0773	(2) Shift Solenoid DSL Circuit Malfunction
P1520	Brakelight Switch
P1725	Input Turbine Speed Sensor
P1730	Counter Gear Speed Sensor
P1760	Shift Solenoid SLT
P1780	Park/Neutral Position Switch Malfunction

(1) - Check listed component for probable cause. Check wiring and connections of specified component.
(2) - To diagnose this DTC, see appropriate solenoid test under COMPONENT TESTS.

DIAGNOSTIC TESTS

* PLEASE READ THIS FIRST *

When trouble shooting transaxle, first check for stored trouble codes and repair as necessary. If no trouble codes exist, perform manual shift test to determine if problem area is in electrical circuits or a mechanical transaxle problem. See MANUAL SHIFT TEST.

NOTE: For DTC P0750, P0755, P0765 and P0770 diagnosis, see appropriate solenoid test under COMPONENT TESTS.

DTC P0500: VEHICLE SPEED SENSOR (VSS)

Circuit Description

Anti-Lock Brake System (ABS) wheel speed sensors detects wheel speed and sends signals to ABS ECU. The ABS ECU converts signals into a 4-pulse signal and outputs signal to instrument cluster. Instrument cluster converts signal to a more precise waveform and outputs signal to ECM. ECM determines vehicle speed based on frequency of these pulse signals. DTC is set when ECM does not detect any VSS signal while vehicle is in motion. Possible causes are:

* Faulty wheel speed sensors.
* Open or short in VSS circuit.
* Faulty instrument cluster.
* Faulty ECM.

Diagnosis & Repair Procedure

1) Test drive vehicle and check operation of speedometer. If speedometer is not operating correctly, repair speedometer as necessary. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. If speedometer is operating correctly, go to next step.

2) Access ECM, located behind glove box. Disconnect appropriate ECM connector for terminal SPD (Violet/White wire). See WIRING DIAGRAMS. Using a DVOM, check continuity between ground and appropriate ECM connector at terminal No. 22 (SPD). If continuity does not exist, check and repair harness or connector as needed. If continuity exists, go to next step.

3) Turn ignition switch to ON position. Using a DVOM, measure voltage between ground and appropriate ECM connector at terminal No. 22 (SPD). If voltage is 9-14 volts, check for open in wiring harness or connector between junction connector (16-pin) behind glove box and combination meter. Repair as necessary. If wiring harness and connector are okay, replace ECM. If voltage is not 9-14 volts, check for open in wiring harness or connector between junction connector behind glove box and ECM. Repair as necessary. If wiring is okay, replace ECU and retest system.

DTC P0710: AUTOMATIC TRANSAXLE FLUID (ATF) TEMPERATURE SENSOR

Circuit Description

ATF temperature sensor converts fluid temperature into a resistance value which is input to ECM. DTC is set when temperature

sensor resistance is less than 79 ohms, or after engine has been operating for 15 minutes or more, temperature sensor resistance is more than 156 k/ohms. Either condition must be set for .5 second or more. Possible causes are:

* Open or short in ATF temperature sensor circuit.
* ATF temperature sensor malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Raise and support vehicle. Disconnect 10-pin solenoid connector, located above PNP switch on side of transaxle. See Fig. 1. Remove transaxle oil pan. Disconnect all solenoid connectors at solenoids. See Fig. 2. Remove transaxle wiring harness from transaxle. Submerge ATF temperature sensor in water.

2) Heat water while measuring sensor resistance between solenoid connector terminals No. 1 and 6. See Fig. 7. At 77°F (25°C), resistance should be 3.5 k/ohms. At 231°F (110°C), resistance should be 231-263 ohms.

3) If resistance is not as specified, replace ATF temperature sensor. Sensor is part of transaxle internal wiring harness. If resistance is as specified, check and repair wiring harness and connector between ATF temperature sensor and ECM. If wiring harness and connector are okay, replace ECM.

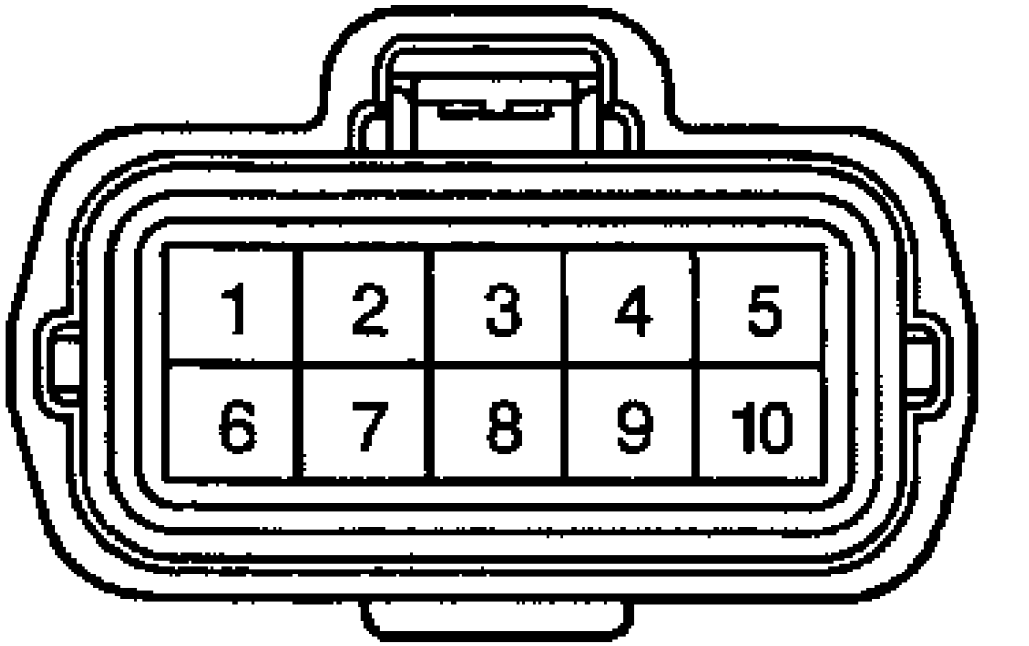


Fig. 7: Identifying Solenoid Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC P0753: SHIFT SOLENOID SL1

Circuit Description

Shifting from 1st to overdrive is performed in combination with on and off cycle of shift solenoids SL1 and SL2. Solenoids are controlled by ECM. If an open or short circuit occurs in either solenoid, DTC will set. ECM controls remaining shift solenoids to allow vehicle to operate and ensure smooth transaxle shifting. See Fig. 4. ECM checks for an open or short circuit when solenoid is energized (duty cycle exceeds 75 percent), and when solenoid is not energized (duty cycle is less than 3 percent). Possible causes are:

* Open or short in solenoid circuit.
* Shift solenoid malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Using a DVOM, check resistance between terminal SL1+ and SL1- at ECM connector. See Figs. 9 and 10.

2) Resistance should be 5.1-5.5 ohms. If resistance is as specified, replace ECM. If resistance is not as specified, disconnect 10-pin solenoid connector, located above PNP switch on side of transaxle. See Fig. 1. Check circuit continuity between ECM connector terminal SL1+ and solenoid connector terminal No. 5, and between ECM connector terminal SL1- and solenoid connector terminal No. 10. See Fig. 7.

3) If continuity exists, check shift solenoid SL2 for malfunction. See appropriate solenoid test under COMPONENT TESTS. If continuity does not exist, check and repair wiring harness or connector between solenoid connector and ECM.

DTC P0758: SHIFT SOLENOID SL2

Circuit Description

Shifting from 1st to overdrive is performed in combination with on and off cycle of shift solenoids SL1 and SL2. Solenoids are controlled by ECM. If an open or short circuit occurs in either solenoid, DTC will set. ECM controls remaining shift solenoids to allow vehicle to operate and ensures smooth transaxle shifting. See Fig. 4. ECM checks for an open or short circuit when solenoid is energized (duty cycle exceeds 75 percent), and when solenoid is not energized (duty cycle is less than 3 percent). Possible causes are:

* Open or short in solenoid circuit.
* Shift solenoid malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Using a DVOM, check resistance between terminal SL2+ and SL2- at ECM connector. See Figs. 9 and 10.

2) Resistance should be 5.1-5.5 ohms. If resistance is as specified, replace ECM. If resistance is not as specified, disconnect 10-pin solenoid connector, located above PNP switch on side of transaxle. See Fig. 1. Check circuit continuity between ECM connector terminal SL2+ and solenoid connector terminal No. 4, and between ECM connector terminal SL2- and solenoid connector terminal No. 9. See Fig. 7.

3) If continuity exists, check shift solenoid SL1 for malfunction. See appropriate solenoid test under COMPONENT TESTS. If continuity does not exist, check and repair wiring harness or connector between solenoid connector and ECM.

DTC P0768: SHIFT SOLENOID S4

Circuit Description

Shifting from 1st to overdrive is performed in combination with on and off cycle of shift solenoids SL1 and SL2. Solenoids are controlled by ECM. If an open or short circuit occurs in either solenoid, ECM controls remaining shift solenoids to allow vehicle to operate and ensures smooth transaxle shifting. See Fig. 4. ECM checks for an open or short circuit in shift solenoid S4. DTC will set when ECM detects solenoid is energized and resistance is 8 ohms or less, or when solenoid is not energized and solenoid resistance is 100 k/ohms or more. Possible causes are:

* Open or short in solenoid circuit.
* Shift solenoid malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Using a DVOM, check resistance between ground and terminal S4 at ECM connector. See Figs. 9 and 10.

2) Resistance should be 11-15 ohms. If resistance is as specified, replace ECM. If resistance is not as specified, disconnect 10-pin solenoid connector, located above PNP switch on side of transaxle. See Fig. 1. Check circuit continuity between ECM connector terminal S4 and solenoid connector terminal No. 8. See Fig. 7.

3) If continuity exists, check shift solenoid S4 for malfunction. See appropriate solenoid test under COMPONENT TESTS. If continuity does not exist, check and repair wiring harness or connector between solenoid connector and ECM.

DTC P0773: SHIFT SOLENOID DSL

Circuit Description

Shift solenoid DSL is controlled by ECM to control hydraulic pressure acting on lock-up relay valve, which controls torque converter clutch lock-up. DTC will set if ECM detects an open or short circuit when solenoid resistance is 8 ohms or less with solenoid energized, or 100 k/ohms or more with solenoid not energized. If ECM detects a malfunction, shift solenoid DSL is turned off. Possible causes are:

* Open or short in solenoid circuit.
* Shift solenoid malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Disconnect 10-pin solenoid connector, located above PNP switch on side of transaxle. See Fig. 1. Using a DVOM, check circuit continuity between ECM connector terminal DSL and solenoid connector terminal No. 3. See Figs. 7, 9 and 10. If continuity exists, go to next step. If continuity does not exist, check and repair wiring harness or connector as needed.

2) Raise and support vehicle. Remove transaxle oil pan. Disconnect shift solenoid DSL connector. See Fig. 3. Remove solenoid. Using a DVOM, check resistance between solenoid body and solenoid connector terminal. Resistance should be 11-15 ohms. If resistance is not as specified, replace solenoid. If resistance is as specified, go to next step.

3) Connect jumper wire from positive battery post to solenoid connector terminal and negative battery post to solenoid body. If solenoid does not operate, replace shift solenoid DSL. If solenoid operates, check and repair wiring harness or connector as necessary.

DTC P1520: BRAKELIGHT SWITCH

Circuit Description

When brake pedal is depressed, brakelight switch sends a signal to ECM. If transaxle is in lock-up mode, ECM cancels lock-up operation and prevents engine stall. DTC will set if ECM detects brakelight switch signal does not turn off during driving. Possible causes are:

* Open or short in brakelight switch circuit.
* Brakelight switch malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Turn ignition switch to ON position. Using a DVOM, measure voltage between ground and ECM connector E7, terminal No. 15 for ES300, or ECM connector E8, terminal No. 15 for RX300. See Figs. 9 and 10.

2) On both models, with brake pedal depressed, voltage should be 7.5-14 volts. With brake pedal released, voltage should be less than 1.5 volts. If voltage is not as specified, go to next step. If voltage is as specified, problem is intermittent. Check wiring harness and connector.

3) If voltage is not as specified, check brakelight switch. See BRAKELIGHT SWITCH under COMPONENT TESTS. If brakelight switch is okay, check circuit between brakelight switch and ECM. If circuit is okay, replace ECM.

DTC P1725: INPUT TURBINE SPEED SENSOR

NOTE: Sensor may also be referred to as NT revolution sensor.

Circuit Description

Input turbine speed sensor detects rotation speed of input shaft. By comparing input turbine speed sensor signal and counter gear speed sensor signal, ECM detects shift timing of gears and controls engine torque and hydraulic pressure in response to various conditions to ensure smooth transaxle shifting. DTC will set if ECM detects vehicle speed of 20 MPH or more, transaxle is in 2nd, 3rd or OD gear, shift solenoids and PNP switch status is normal, and input shaft speed is less than 300 RPM. Possible causes are:

* Open or short in speed sensor circuit.
* Speed sensor malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Using a DVOM, check resistance between ECM connector terminals NT+ and NT-. See Figs. 9 and 10. Resistance should be 560-680 ohms. If resistance is as specified, replace ECM. If resistance is not as specified, go to next step.

2) Remove input turbine speed sensor from transaxle. See Fig. 1. Check resistance between speed sensor terminals. Resistance should be 560-680 ohms. Connect a DVOM to speed sensor terminals.

3) Measure voltage when a magnet is put close to tip of speed sensor, then taken away quickly. See Fig. 8. Voltage generated should be intermittent and extremely low. If resistance and voltage are not as specified, replace speed sensor. If resistance and voltage are as specified, check and repair wiring harness or connector between speed sensor and ECM.

DTC P1730: COUNTER GEAR SPEED SENSOR

NOTE: Sensor may also be referred to as NC revolution sensor.

Circuit Description

Counter gear speed sensor detects rotation of counter drive gear. By comparing input turbine sensor speed signal and counter gear speed sensor signal, ECM detects shift timing of gears and controls engine torque and hydraulic pressure in response to various conditions to ensure smooth transaxle shifting. DTC will set if ECM detects vehicle speed of 20 MPH or more, transaxle is in 2nd, 3rd or OD gear, shift solenoids and PNP switch status is normal, and counter drive gear speed is less than 300 RPM. Possible causes are:

* Open or short in speed sensor circuit.
* Speed sensor malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Disconnect appropriate ECM connector. Using a DVOM, check resistance between ECM connector terminals NC+ and NC-. See Figs. 9 and 10. Resistance should be 560-680 ohms. If resistance is as specified, replace ECM. If resistance is not as specified, go to next step.

2) Remove counter gear speed sensor from transaxle. See Fig. 1. Check resistance between speed sensor terminals. Resistance should be 560-680 ohms. Connect a DVOM to speed sensor terminals.

3) Measure voltage when a magnet is put close to tip of speed sensor, then taken away quickly. See Fig. 8. Voltage generated should be intermittent and extremely low. If resistance and voltage are not as specified, replace speed sensor. If resistance and voltage are as specified, check and repair wiring harness or connector between speed sensor and ECM.

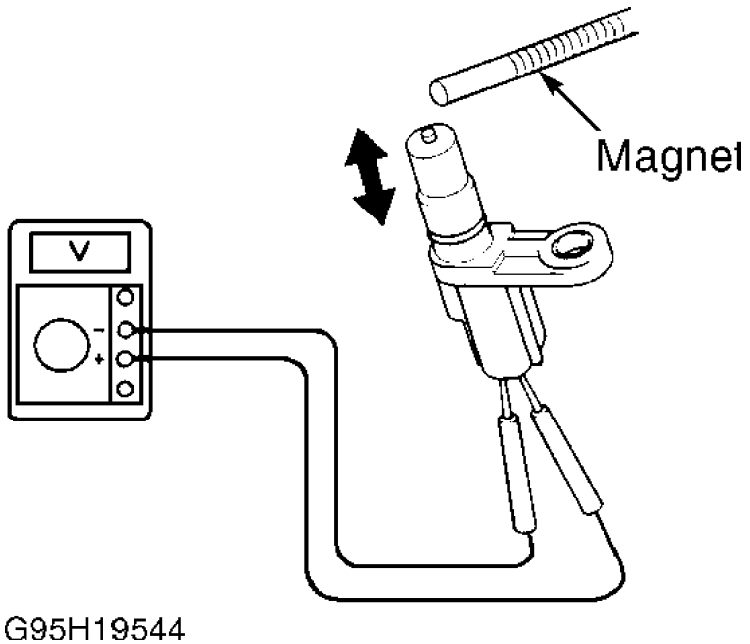


Fig. 8: Testing No. 2 Speed Sensor
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC P1760: SHIFT SOLENOID SLT

Circuit Description

Throttle pressure applied to primary regulator valve, which modulates line pressure, causes shift solenoid SLT to precisely and minutely modulate and generate line pressure according to accelerator pedal effort, or engine power output detected. This reduces line pressure and provides smooth transaxle shifts. Upon receiving throttle valve opening angle signal, ECM controls line pressure by sending a predetermined duty cycle to shift solenoid SLT, modulating line pressure and generating throttle pressure. Duty cycle is ratio of period of continuity in one cycle. Shift solenoid SLT is located on transaxle valve body. See Fig. 3. DTC will set if voltage at ECM terminal SLT- is zero volts or 12 volts for one second or more. Possible causes are

* Open or short in solenoid circuit.
* Solenoid malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Raise and support vehicle. Remove transaxle oil pan. Disconnect shift solenoid SLT connector. See Fig. 3. Using a DVOM, measure resistance between solenoid terminals. If resistance is 5.0-5.6 ohms, go to next step. If resistance is not 5.0-5.6 ohms, replace solenoid.

2) Connect positive lead with 8-10 watt bulb from battery to terminal No. 1 (Orange wire) of solenoid. Connect negative lead to terminal No. 2 of solenoid. With power supplied to solenoid, ensure solenoid valve moves outward. With power disconnected, ensure solenoid valve moves inward.

3) If solenoid does not operate as described, replace solenoid. If solenoid operates as described, check and repair wiring harness or connector between solenoid and ECM. If wiring harness and connector are okay, replace ECM.

DTC P1780: PARK/NEUTRAL POSITION (PNP) SWITCH

Circuit Description

PNP switch detects shift lever position and sends a signal to ECM. If signal is not sent to ECM, ECM defaults transaxle to "D" position. DTC will set when ECM detects 2 or more circuits are on, vehicle has been driven for 30 seconds or more at 44 MPH or more, engine speed is 1500-2500 RPM and PNP switch is on ("N" position). Possible causes are:

* Short in PNP switch circuit.
* PNP switch malfunction.
* ECM malfunction.

Diagnosis & Repair Procedure

1) Access ECM, located behind glove compartment. Turn ignition switch to ON position. Using a DVOM, measure voltage at terminals NSW, "2", "L" and "R" of appropriate ECM harness connector between terminal and body ground with gear selector in each shift position. See Figs. 9 and 10.

NOTE: Voltage in "R" position will decrease slightly due to back-up light operation.

2) Ensure 10-14 volts is present at NSW terminal at ECM harness connector in all shift positions. Ensure 10-14 volts is present at "2", "L" and "R" terminals at ECM harness connector with gear selector in "2", "L" and "R" position.

3) If voltage is not as specified, check park/neutral

position switch. See PARK/NEUTRAL POSITION (PNP) SWITCH under COMPONENT TESTS. If switch is okay, check and repair wiring harness or connector between battery and PNP switch, and between PNP switch and ECM. If wiring harness and connector are okay, replace ECM.

MANUAL SHIFT TEST

NOTE: Perform manual shift test if no trouble codes exist. Manual shift test determines if problem is in electrical circuits or is a mechanical transaxle problem.

1) Ensure ignition is off. Disconnect 10-pin solenoid connector, located above park/neutral position switch on transaxle.
2) Road test vehicle and ensure transaxle gear changes corresponds with shift lever position. See GEAR APPLICATION table. If abnormality exists, a mechanical transaxle problem may exist. Turn ignition off.
3) Reconnect solenoid connector. Clear trouble codes from ECM memory, as disconnecting solenoid connector will set a trouble code. See CLEARING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM.

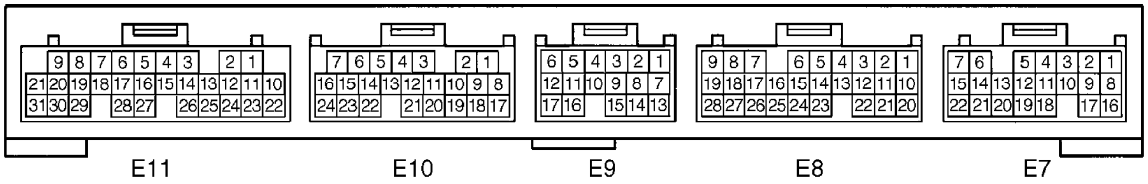
GEAR APPLICATION

Shift Lever Position	Gear
"D"	Overdrive
"2"	3rd
"L"	1st
"R"	Reverse
"P"	Park

CIRCUIT TESTS

ECM VOLTAGES

Access ECM, located behind glove compartment. Turn ignition switch to ON position. Using a DVOM, backprobe ECM harness connector. Check voltage between selected terminals. See Figs. 9 and 10. Voltage should be as specified.



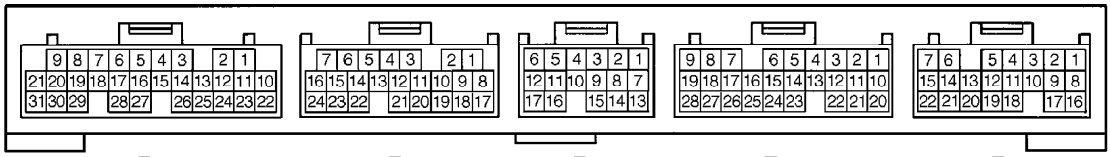
COMPONENT CONNECTOR VIEW

Symbols (Terminals No.)	Wire Color	Condition	(Component)	STD Voltage (V)
SL1+ (E11–20) ↔ SL1− (E11–19)	B–Y ↔ Y	IG ON	(Shift Solenoid SL1)	10 – 14
		1st or 2nd gear	(Shift Solenoid SL1)	10 – 14
		3rd or O/D gear	(Shift Solenoid SL1)	Below 1
SL2+ (E11–9) ↔ SL2− (E11–8)	P–L ↔ W–L	IG ON	(Shift Solenoid SL2)	Below 1
		1st or 2nd gear	(Shift Solenoid SL2)	10 – 14
		3rd or O/D gear	(Shift Solenoid SL2)	Below 1
DSL (E11–7) ↔ Body ground	V ↔ Body ground	IG ON	(Shift Solenoid DSL)	Below 1
		Vehicle driving under lock–up position	(Shift Solenoid DSL)	10 – 14
NC+ (E11–24) ↔ NC− (E11–23)	R ↔ G	Engine is running	(Counter Gear Speed Sensor)	Pulse signal is output Below 1 ↔ 4 – 5
NT+ (E9–5) ↔ NT− (E9–4)	L ↔ L–G	Engine is running	(Input Turbine Speed Sensor)	Pulse signal is output Below 1 ↔ 4 – 5
SLT+ (E9–3) ↔ SLT− (E9–2)	L–R ↔ G–Y	IG ON	(Shift Solenoid SLT)	10 – 14
OD1 (E8–24) ↔ E1 (E10–17)	Y–B ↔ BR	IG ON	(Cruise Control ECU)	10 – 14
OD2 (E8–10) ↔ E1 (E10–17)	G–O ↔ BR	O/D switch ON	(OD Switch)	10 – 14
		O/D switch OFF	(OD Switch)	Below 1
L (E9–13) ↔ E1 (E10–17)	G–O ↔ BR	IG ON and Shift lever in L position	(PNP Switch)	10 – 14
		IG ON and Shift lever in position other than L	(PNP Switch)	Below 1
2 (E9–14) ↔ E1 (E10–17)	G–Y ↔ BR	IG ON and Shift lever in 2 position	(PNP Switch)	10 – 14
		IG ON and Shift lever in position other than 2	(PNP Switch)	Below 1
R (E9–8) ↔ E1 (E10–17)	R–B ↔ BR	IG ON and Shift lever in R position	(PNP Switch)	10 – 14
		IG ON and Shift lever in position other than R	(PNP Switch)	Below 1
D (E9–16) ↔ E1 (E10–17)	G–R ↔ BR	IG ON and Shift lever in D position	(PNP Switch)	10 – 14
		IG ON and Shift lever in position other than D	(PNP Switch)	Below 1
NSW (E8–20) ↔ E1 (E10–17)	B–W ↔ BR	IG ON and Shift lever in P or N	(PNP Switch)	10 – 14
		IG ON and Shift lever in position other than P or N	(PNP Switch)	Below 1
THO (E10–13) ↔ E2 (E10–18)	B ↔ BR	IG ON and ATF temperature 110 °C (230 °F)	(ATF Temp. Sensor)	Below 1
S4 (E9–1) ↔ E1 (E10–17)	L–B ↔ BR	IG ON	(Shift Solenoid S4)	Below 1
		IG ON and O/D gear	(Shift Solenoid S4)	10 – 14

NOTE: The letter "L" under Wire Color represents Blue.

G00011312

Fig. 9: Identifying ECM Connector Terminals, Wire Colors & Pin Voltages (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



COMPONENT CONNECTOR VIEW

Symbols (Terminals No.)	Wire Color	Condition	(Component)	STD Voltage (V)
SL1+ ↔ SL–1 (E7–20 ↔ E7–19)	L–B ↔ L–W	IG ON	(Shift Solenoid SL1)	10 ~ 14
		1st or 2nd gear	(Shift Solenoid SL1)	10 ~ 14
		3rd or O/D gear	(Shift Solenoid SL1)	Below 1
SL2+ ↔ SL2– (E7–9 ↔ E7–8)	R–B ↔ R–W	IG ON	(Shift Solenoid SL2)	Below 1
		1st or 2nd gear	(Shift Solenoid SL2)	10 ~ 14
		3rd or O/D gear	(Shift Solenoid SL2)	Below 1
DSL (E7–7) ↔ Body ground	R–L ↔ Body ground	IG ON	(Shift Solenoid DSL)	Below 1
		Vehicle driving under lock–up position	(Shift Solenoid DSL)	10 ~ 14
NC+ ↔ NC– (E7–24 ↔ E7–23)	R ↔ G	Engine is running	(Counter Gear Speed Sensor)	Pulse signal is output Below 1 ↔ 4 ~ 5
NT+ ↔ NT– (E5–5 ↔ E5–4)	L ↔ L–G	Engine is running	(Input Turbine Speed Sensor)	Pulse signal is output Below 1 ↔ 4 ~ 5
SLT+ ↔ SLT– (E5–3 ↔ E5–2)	W–L ↔ B–Y	IG ON	(Shift Solenoid SLT)	10 ~ 14
OD1 ↔ E1 (E9–24 ↔ E6–17)	Y–G ↔ BR	IG ON	(Cruise Control ECU)	10 ~ 14
OD2 ↔ E1 (E9–10 ↔ E6–17)	G–O ↔ BR	O/D switch ON	(OD Switch)	10 ~ 14
		O/D switch OFF	(OD Switch)	Below 1
L ↔ E1 (E5–13 ↔ E6–17)	G–O ↔ BR	IG ON and Shift lever in L position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than L	(PNP Switch)	Below 1
2 ↔ E1 (E5–14 ↔ E6–17)	G–Y ↔ BR	IG ON and Shift lever in 2 position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than 2	(PNP Switch)	Below 1
R ↔ E1 (E5–8 ↔ E6–17)	R–B ↔ BR	IG ON and Shift lever in R position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than R	(PNP Switch)	Below 1
D ↔ E1 (E5–16 ↔ E6–17)	G–R ↔ BR	IG ON and Shift lever in D position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than D	(PNP Switch)	Below 1
N ↔ E1 (E5–7 ↔ E6–17)	R–W ↔ BR	IG ON and Shift lever in N position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than N	(PNP Switch)	Below 1
P ↔ E1 (E5–9 ↔ E6–17)	G–W ↔ BR	IG ON and Shift lever in P position	(PNP Switch)	10 ~ 14
		IG ON and Shift lever in position other than P	(PNP Switch)	Below 1
THO ↔ E2 (E6–13–E6–18)	G–Y ↔ BR	IG ON and ATF temperature 110 °C (230 °F)	(ATF Temp. Sensor)	Below 1
S4 ↔ E1 (E5–1 ↔ E6–17)	R–Y ↔ BR	IG ON	(Shift Solenoid S4)	Below 1
		IG ON and O/D gear	(Shift Solenoid S4)	10 ~ 14

NOTE: The letter "L" under Wire Color represents Blue.

G00011313

Fig. 10: Identifying ECM Connector Terminals, Wire Colors & Pin Voltages (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OVERDRIVE CANCEL SIGNAL

1) Access ECM, located behind glove compartment. Turn ignition switch to ON position. Using a DVOM, measure voltage (backprobe) between terminal OD1 of appropriate ECM harness connector and ground. If 10-14 volts is present, substitute known good ECM and retest. If voltage is not as specified, go to next step.

2) Turn ignition off. Disconnect cruise control ECU harness connector, located behind instrument panel on passenger side of vehicle. Turn ignition on. Measure voltage between terminal OD and ground. See Fig. 11. If 10-14 volts is present, replace cruise control ECU and retest. If 10-14 volts is not present, check and repair circuit between cruise control ECU and ECM.

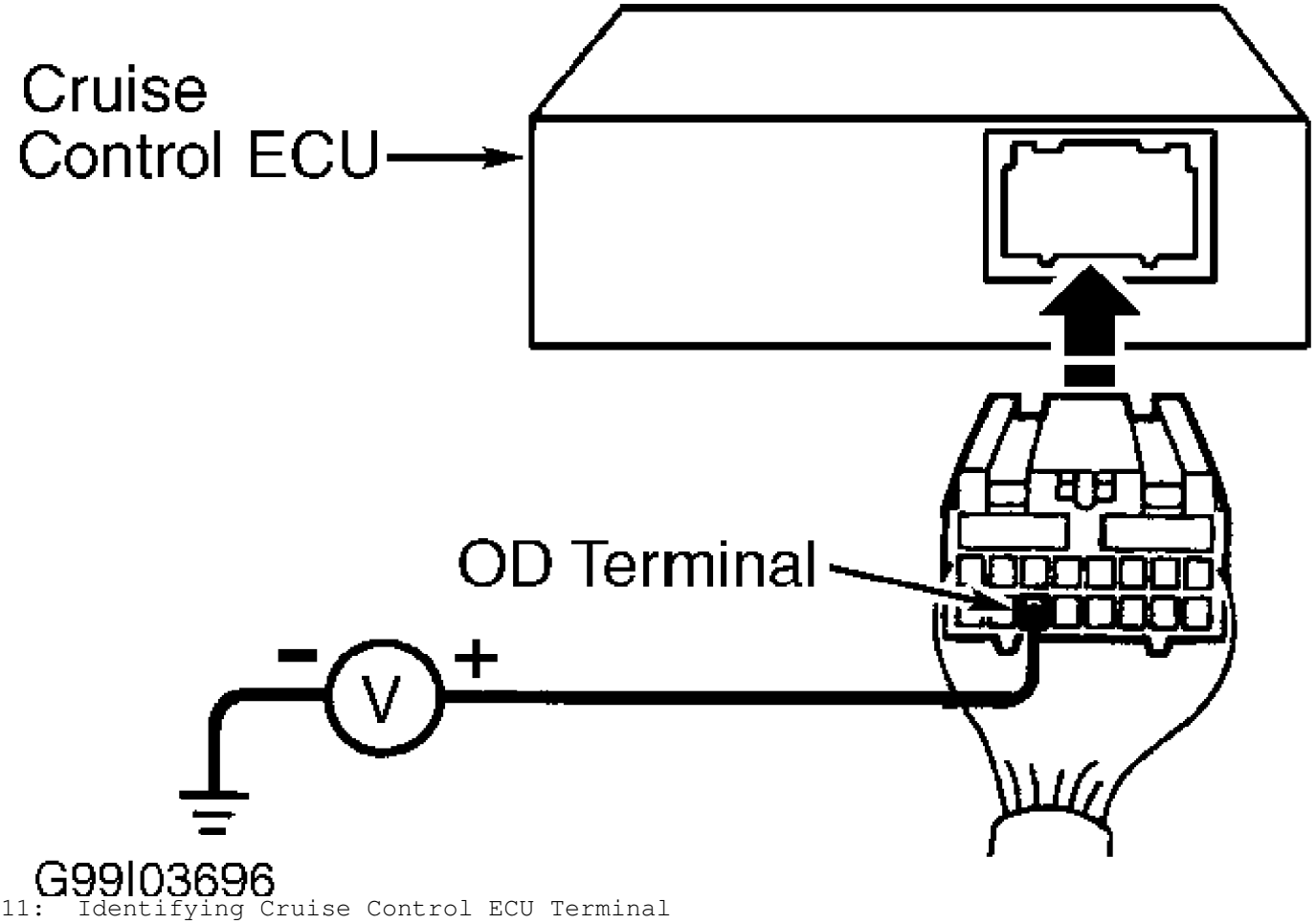


Fig. 11: Identifying Cruise Control ECU Terminal

COMPONENT TESTS

SHIFT SOLENOIDS SL1, SL2 & S4

NOTE: The following information can also be used to diagnose DTCs P0750, P0755 and P0765. For testing of shift solenoid SLT, see DTC P1760: SHIFT SOLENOID SLT.

1) Raise and support vehicle. Remove transaxle oil pan. Remove shift solenoid(s). See Fig. 3. Using a DVOM, check resistance between shift solenoid SL1 and SL2 terminals. On shift solenoid S4, check resistance between ground and solenoid terminal. On shift

solenoids SL1 and SL2, resistance should be 5.1-5.5 ohms. On shift solenoid S4, resistance should be 11-15 ohms. On all solenoids, if resistance is not as specified, replace solenoid.

2) To check shift solenoids SL1 and SL2 operation, connect positive lead with 23 watt bulb from battery to terminal No. 1 (White wire on shift solenoid SL1, or Yellow wire on shift solenoid SL2) of solenoid. Connect negative lead to terminal No. 2 of solenoid. With power supplied to solenoid, ensure solenoid valve moves outward. With power disconnected, ensure solenoid valve moves inward. Replace solenoid if operating sound cannot be heard. If solenoid operates, diagnose valve body malfunction.

3) To check shift solenoid S4 operation, connect positive lead with 23 watt bulb from battery to solenoid terminal. Connect negative lead to solenoid body. With power supplied to solenoid, ensure solenoid valve moves outward. With power disconnected, ensure solenoid valve moves inward. Replace solenoid if operating sound cannot be heard. If solenoid operates, diagnose valve body malfunction.

SHIFT SOLENOID DSL

NOTE: The following information can also be used to diagnose DTC P0770. For testing of shift solenoid SLT, see DTC P1760: SHIFT SOLENOID SLT.

1) Raise and support vehicle. Remove transaxle oil pan. Remove shift solenoid DSL. See Fig. 3. Connect battery voltage to solenoid. Apply 71 psi (5 kg/cm^2) of compressed air to solenoid with battery voltage connected. See Fig. 12.

2) With battery voltage connected, air should not pass through solenoid. Disconnect voltage to solenoid. Ensure air does pass through solenoid. Replace solenoid as necessary.

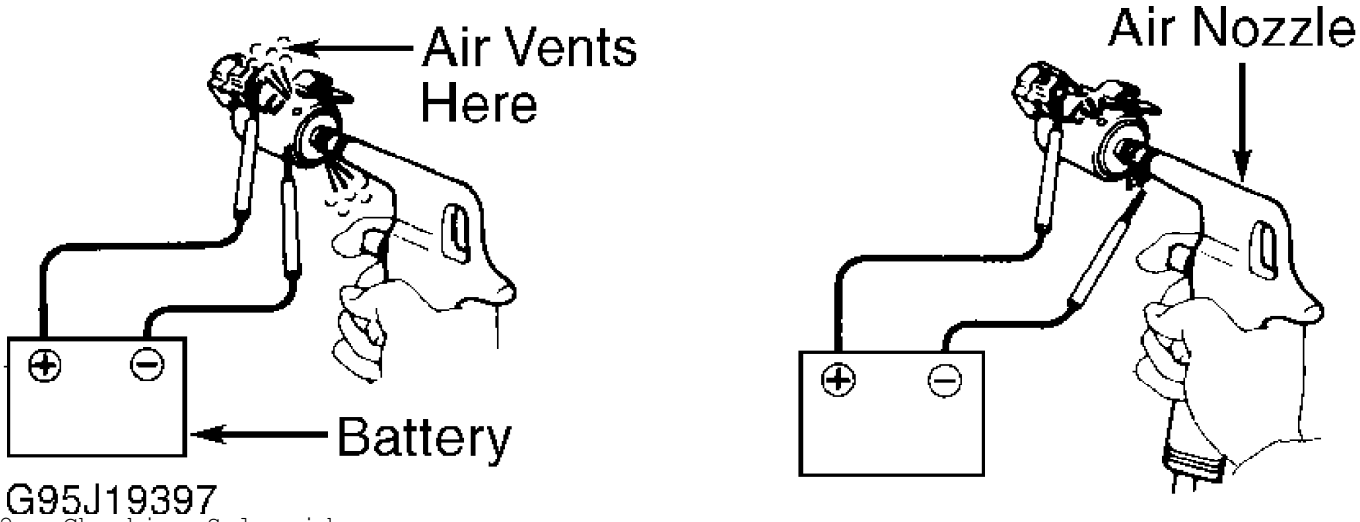
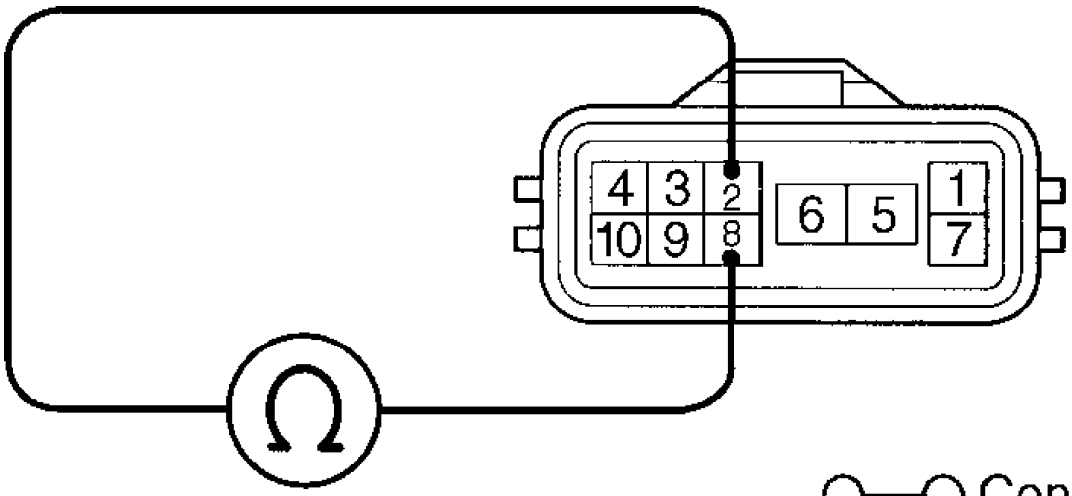


Fig. 12: Checking Solenoids
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARK/NEUTRAL POSITION (PNP) SWITCH

Disconnect harness connector at park/neutral position switch. Switch is located on side of transaxle. Using ohmmeter, check for continuity between specified terminals in accordance with shift lever position. See Fig. 13. Replace PNP switch if continuity is not as specified. If switch is okay, check and repair wiring harness or connector between PNP switch and ECM.



Continuity

Shift Position \ Terminal	5	6	2	7	8	9	10	3	4
P	○—○		○—○						
R			○	—	○				
N	○—○		○	—	—	○			
D			○	—	—	—	○		
2			○	—	—	—	—	○	
L			○	—	—	—	—	—	○

G96J21179

Fig. 13: Testing Park/Neutral Position Switch
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE CONVERTER LOCK-UP TEST

NOTE: Refer to appropriate SHIFT SPEED SPECIFICATION table in LEXUS U140E & U140F OVERHAUL article for lock-up shift speeds.

Road test vehicle. Increase vehicle speed until lock-up should occur. To confirm lock-up operation, very lightly depress brake pedal with left foot and release while maintaining constant speed. Monitor vehicle tachometer. Transaxle should downshift into 3rd gear and then upshift into lock-up once brake pedal is released.

OVERDRIVE (OD) SWITCH

Disconnect electrical connector from Overdrive (OD) switch, located on shift lever. Using a DVOM, ensure continuity exists between terminals No. 2 and 4 on ES300 (terminals No. 1 and 3 on RX300 at same connector terminal locations) with switch released (OFF) position. See Fig. 14. Ensure no continuity exists with switch depressed (ON) position. Replace switch if defective.

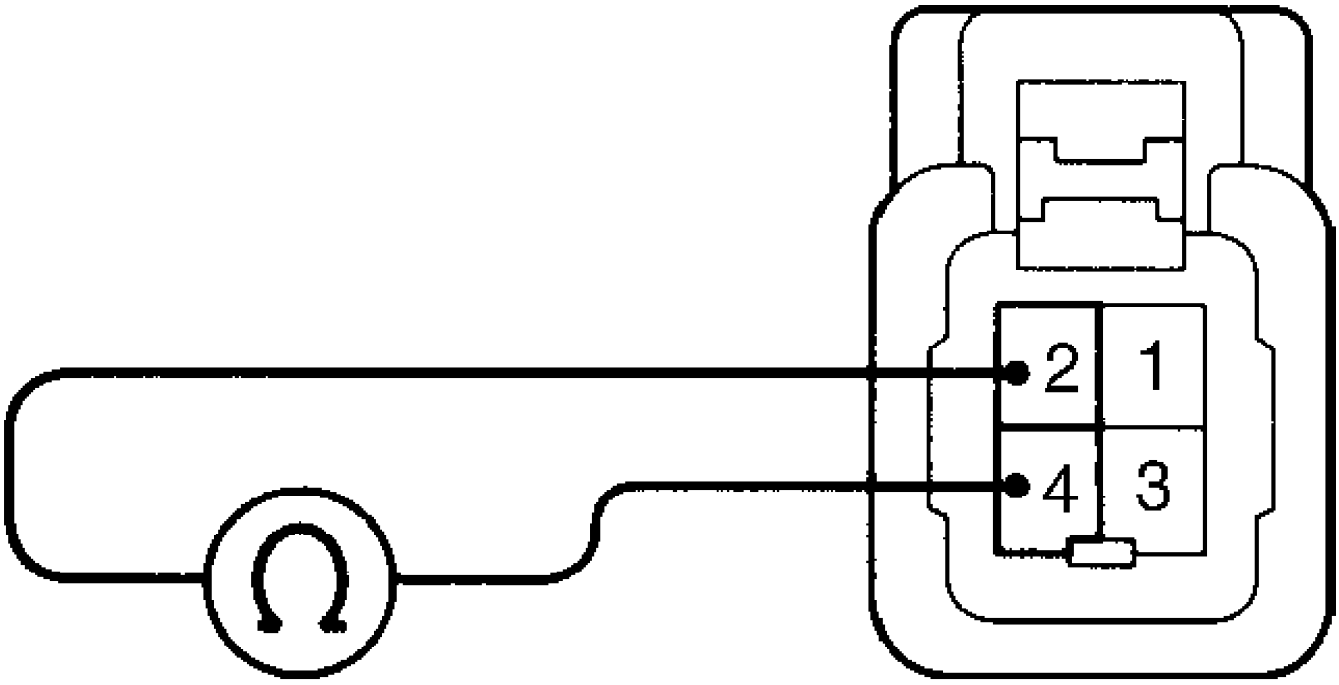


Fig. 14: Identifying Overdrive (OD) Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

BRAKELIGHT SWITCH

Disconnect electrical connector from brakelight switch, located near brake pedal. Using ohmmeter, ensure continuity exists between switch terminals No. 1 and 2 with brake pedal depressed. See Fig. 15. Continuity should exist between terminals No. 3 and 4 with pedal released. Replace switch if continuity is not as specified.

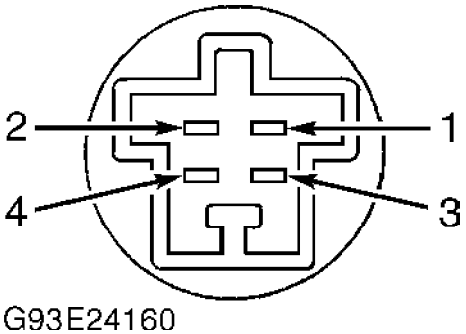


Fig. 15: Identifying Brakelight Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

SHIFT SOLENOIDS

Removal & Installation

Shift solenoids are located on transaxle valve body. Raise and support vehicle. Remove transaxle oil pan. Disconnect electrical connector on shift solenoid. Remove bolt and shift solenoid. To install, reverse removal procedure. Install NEW "O" ring on shift solenoid.

OVERDRIVE (OD) SWITCH

Overdrive (OD) switch is mounted on shift lever. Replacement information is not available from manufacturer.

PARK/NEUTRAL POSITION (PNP) SWITCH

Removal

1) Park/neutral position switch is located on side of transaxle. Remove lock nut, washer and manual lever from control shaft. See Fig. 16.

2) Bend up tabs on lock washer. Remove lock nut, lock washer and seal from control shaft. Remove retaining bolts and park/neutral position switch.

Installation

1) Install switch on control shaft. Loosely install park/neutral position switch retaining bolts. Install seal and lock washer. Install lock nut and tighten to 62 INCH lbs. (7 N.m). Bend tabs on lock washer over against lock nut.

2) Ensure parking brake is applied. Temporarily install manual lever on control shaft. Place shift lever in Neutral. Remove manual lever. Rotate switch and align reference mark on switch with groove. See Fig. 16. Hold switch in this position. Tighten retaining bolts to 48 INCH lbs. (5.4 N.m). To install remaining components, reverse removal procedure. Tighten manual lever nut to 11 ft. lbs. (15 N.m).

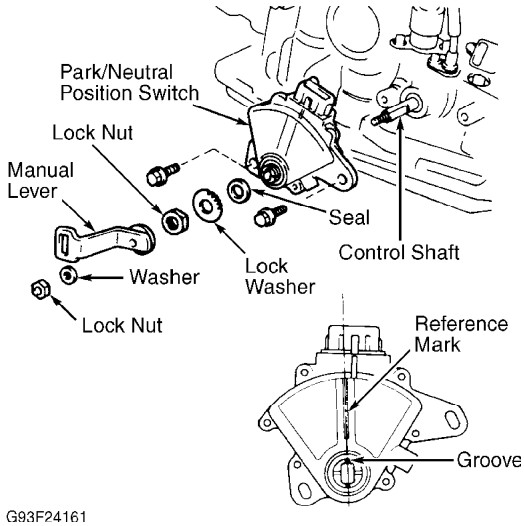


Fig. 16: Removing & Installing Neutral Start Switch
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SPEED SENSORS

Removal & Installation

Speed sensors are located on top of transaxle. See Fig. 1. Disconnect electrical connector. Remove bolt and speed sensor. To install, reverse removal procedure. Install NEW "O" ring on speed sensor. Tighten bolt to 100 INCH lbs. (11.3 N.m).

ELECTRONIC COMPONENT SPECIFICATIONS

COMPONENT RESISTANCE SPECIFICATIONS

Application	Ohms Resistance
Counter Gear & Input Turbine Speed Sensor	560-680
Shift Solenoids DSL & S4	11-15
Shift Solenoid SLT	5.0-5.6
Shift Solenoids SL1 & SL2	5.1-5.5

WIRING DIAGRAMS

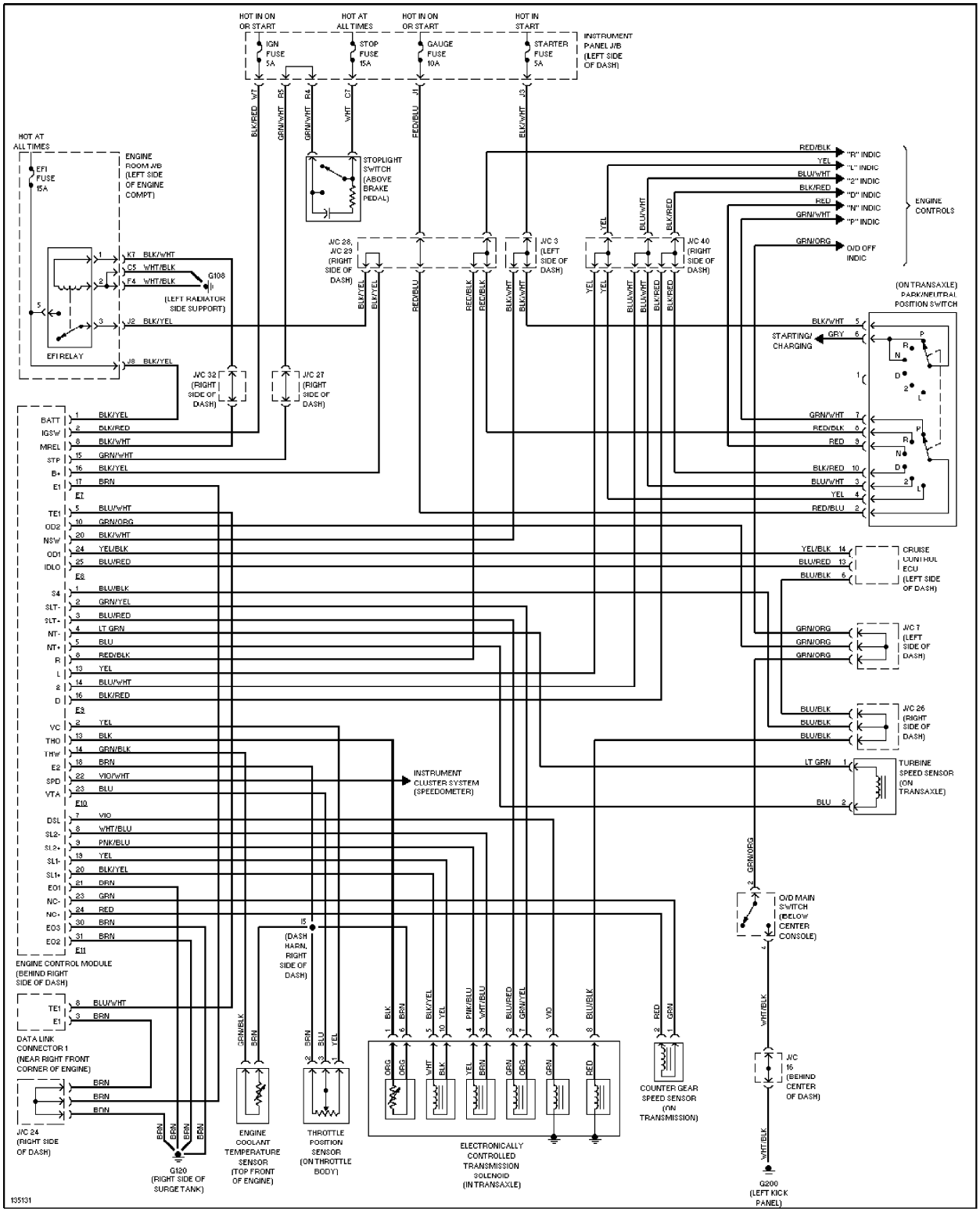


Fig. 17: Transmission Wiring Diagram (1999 ES300)

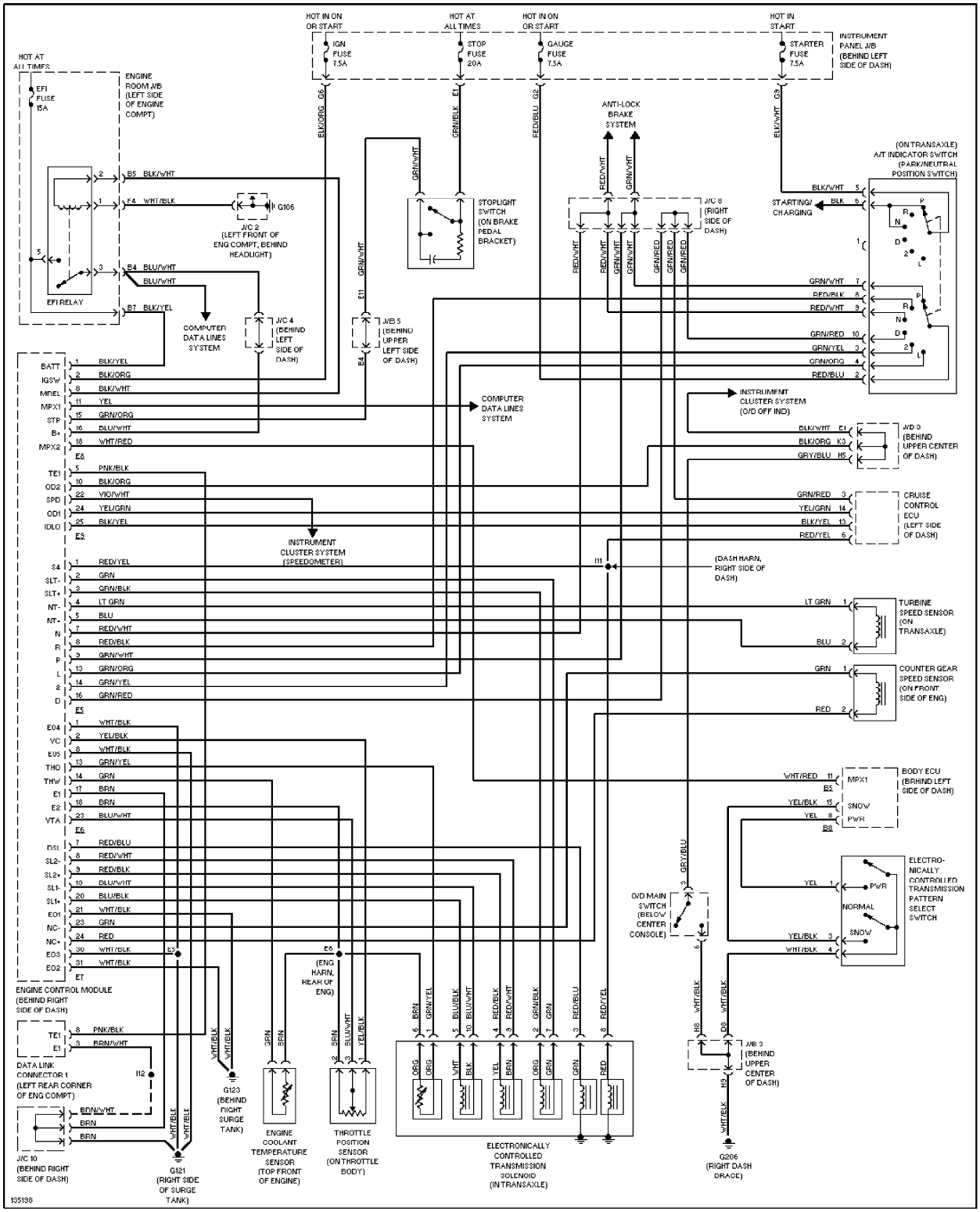


Fig. 18: Transmission Wiring Diagram (1999 RX300)

AUTOMATIC HEADLIGHTS

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Automatic Headlights
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

* PLEASE READ THIS FIRST *

NOTE: Some models incorporate a multiplex control system. Before proceeding, ensure multiplex control system operation is okay, and no Diagnostic Trouble Codes (DTC) are set. See appropriate MULTIPLEX CONTROL SYSTEMS article.

DESCRIPTION & OPERATION

When headlight switch is in AUTO position, system automatically illuminates low-beam headlights (and taillights) when needed. During daylight hours, the system automatically turns headlights off. If driver leaves headlight switch in AUTO position and turns ignition off, headlights will turn off when driver's door is opened. If headlights illuminate too early or too late, system sensitivity can be adjusted. See AUTOMATIC LIGHT CONTROL SENSOR under ADJUSTMENTS.

When intensity of light decreases sufficiently, light sensor internally grounds coil circuit of headlight relay (through headlight switch), causing headlight relay contacts to close and supply power to headlights. When intensity of light increases sufficiently, light sensor interrupts the internal connection.

When driver's door is open, light sensor detects closed contacts in door courtesy switch. Light sensor uses this signal to turn headlights off, if headlight switch is in AUTO position when ignition is turned off.

On GS300, GS400 and LS400 models, automatic headlight system is controlled by driver's door ECU and body control ECU.

COMPONENT LOCATIONS

ES300

Automatic Light Control Sensor
On top left side of instrument panel.

Headlight Fuses
In fuse/relay block, near left front shock tower.

Headlight Relay
In fuse/relay block, near left front shock tower.

Integration Relay
In fuse/relay block, behind left side of instrument panel.

Taillight Relay
In fuse/relay block, behind left side of instrument panel.

GS300 & GS400

Automatic Light Control Sensor
On top left side of instrument panel.

Body Control ECU No. 2
Behind driver-side kick panel.

Driver's Door ECU
Behind driver's door panel.

Headlight Fuses
In underhood junction blocks No. 1 and 2.

Headlight Relay
In underhood junction block No. 1.

Left & Right-Side Light Control ECU
Behind left & right-side headlights.

Taillight Relay
In fuse/relay block, near driver-side kick panel.

LS400

Automatic Light Control Sensor
On top left side of instrument panel.

Body Control ECU
Behind left side of instrument panel.

Driver's Door ECU
Behind driver's door panel.

Headlight Fuses
In fuse/relay block, near left front shock tower.

Headlight Relay
In fuse/relay block, near left front shock tower.

Taillight Relay
In fuse/relay block, behind left side of instrument panel.

LX470

Automatic Light Control Sensor
On top right side of instrument panel.

Body Control ECU
Behind center of instrument panel, above radio.

Headlight Fuses
In fuse/relay block, near left front shock tower.

Headlight Relay
In fuse/relay block, near left front shock tower.

Taillight Relay
In fuse/relay block, near driver-side kick panel.

RX300

Automatic Light Control Sensor
On top left side of instrument panel.

Headlight Fuses
In fuse/relay block, near left front shock tower.

Headlight Relay
In fuse/relay block, near left front shock tower.

Taillight Relay
In fuse/relay block, behind left side of instrument panel.

SC300 & SC400

Automatic Light Control Sensor
On top left side of instrument panel.

Headlight Fuses
In fuse/relay block, near left front shock tower.

Headlight Relay
In fuse/relay block, near left front shock tower.

Integration Relay
In fuse/relay block, behind left-side kick panel.

Taillight Relay
In fuse/relay block, near driver-side kick panel.

ADJUSTMENTS

AUTOMATIC LIGHT CONTROL SENSOR

NOTE: Adjust automatic light control sensor if headlights illuminate too early or too late. Adjustment information for GS300, GS400 and RX300 models is not available from manufacturer.

NOTE: Adjustment on LS400 requires Lexus hand-held tester and appropriate software. Follow tester manufacturer's instructions.

ES300, SC300 & SC400
If headlights illuminate too early, turn sensitivity knob on sensor counterclockwise. See Fig. 1. If headlights illuminate too late, turn adjuster clockwise.

LX470
If headlights illuminate too early, turn sensitivity knob on sensor clockwise. See Fig. 1. If headlights illuminate too late, turn adjuster counterclockwise.

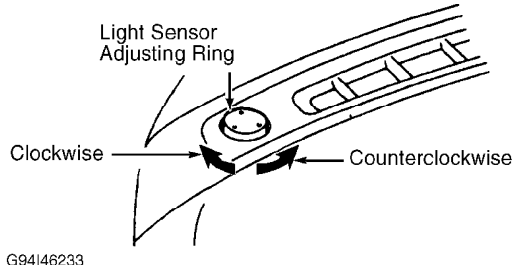


Fig. 1: Adjusting Automatic Light Control Sensor (SC300 & SC400 Shown; ES300 & LX470 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SYSTEM OPERATION TEST

1) Turn ignition on. Turn light control switch to AUTO position. Gradually cover automatic light control sensor. Headlights and instrument cluster lights should illuminate. Gradually uncover automatic light control sensor. Lights should turn off.

2) Gradually cover automatic light control sensor. Wait for lights to illuminate. Lights should turn off under any of the following conditions:

* Light control switch is turned to OFF position.
* Automatic light control sensor is exposed.
* Ignition is turned off and driver's door is opened.

3) Turn ignition off. Open driver's door (leave it open). Turn light control switch to AUTO position. Cover automatic light control sensor. Ensure lights illuminate when ignition is turned on.

4) If operation is as specified, but complaint is headlight illumination is too early or too late, adjustment is required. See AUTOMATIC LIGHT CONTROL SENSOR under ADJUSTMENTS. If system is inoperative or operation is abnormal, check system circuits and components. See CIRCUIT TESTS and COMPONENT TESTS.

CIRCUIT TESTS

* PLEASE READ THIS FIRST *

NOTE: For headlight system circuit tests not included, see appropriate wiring diagram in HEADLIGHT SYSTEMS or DAYTIME RUNNING LIGHTS articles.

AUTOMATIC LIGHT CONTROL SENSOR CIRCUIT

NOTE: Testing information for RX300 is not available from manufacturer.

1) Turn ignition off. Disconnect automatic light control sensor harness connector. Check circuit values at appropriate terminals of automatic light control sensor harness connector. See Figs. 2-4. Ensure circuit values are as specified. See appropriate SENSOR CIRCUIT VALUES table. If circuit values are as specified, go to next step. If circuit values are not as specified, check and repair affected circuit. See appropriate wiring diagram in HEADLIGHT SYSTEMS article.

2) Reconnect automatic light control sensor harness connector. Turn ignition on. Turn light control switch to AUTO position, and ensure vehicle surroundings are bright. Check circuit values by backprobing at appropriate terminals of automatic light control sensor harness connector. See Figs. 2-7. Ensure circuit values are as specified. See appropriate SENSOR CIRCUIT VALUES table. If circuit values are as specified, replace automatic light control sensor. If circuit values are not as specified, check and repair affected circuit. See appropriate wiring diagram in HEADLIGHT SYSTEMS article.

SENSOR CIRCUIT VALUES - HARNESS DISCONNECTED (ES300)

Tester Connection	Condition	Circuit Value
4 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage

4 & Ground	Ignition Switch in ON Position	5.2-9.0 Volts
5 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
5 & Ground	Ignition Switch in ON Position	Battery Voltage
6 & Ground	Constant	Continuity

SENSOR CIRCUIT VALUES - HARNESS CONNECTED (ES300)

Tester Connection	Condition	Circuit Value
5 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
5 & Ground	Ignition Switch In ON Position	9.5 Volts Or Greater
6 & Ground	Constant	Continuity

SENSOR CIRCUIT VALUES - HARNESS DISCONNECTED (GS300 & GS400)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
1 & Ground	Ignition Switch In ON Position	Battery Voltage
3 & Ground	Constant	Continuity
4 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
4 & Ground	Ignition Switch In ON Position	5.2-9.0 Volts

SENSOR CIRCUIT VALUES - HARNESS CONNECTED (GS300 & GS400)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
1 & Ground	Ignition Switch In ON Position	9.5 Volts Or Greater
3 & Ground	Constant	Continuity

SENSOR CIRCUIT VALUES - HARNESS DISCONNECTED (LS400)

Tester Connection	Condition	Circuit Value
4 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
4 & Ground	Ignition Switch in ON Position	5.2-9.0 Volts
5 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage

5 & Ground	Ignition Switch in ON Position	Battery Voltage
6 & Ground	Constant	Continuity

SENSOR CIRCUIT VALUES - HARNESS CONNECTED (LS400)

Tester Connection	Condition	Circuit Value
4 & Ground	Sensor Covered	Taillights & Headlights On
5 & Ground	Ignition Switch In LOCK Or ACC Position	One Volt Or Less
5 & Ground	Ignition In ON Position	9.5 Volts Or Greater
6 & Ground	Constant	One Volt Or Less

SENSOR CIRCUIT VALUES - HARNESS DISCONNECTED (LX470)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition Switch In ON Position	Battery Voltage
1 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
2 & Ground	Constant	Battery Voltage
3 & Ground	Driver's Door Courtesy Switch In OFF Position	No Continuity
3 & Ground	Driver's Door Courtesy Switch In ON Position	Continuity
5 & Ground	Light Control Switch In HEAD Position	Continuity
6 & Ground	Light Control Switch In AUTO Position	Continuity
7 & Ground	Light Control Switch In TAIL Position	Continuity

SENSOR CIRCUIT VALUES - HARNESS CONNECTED (LX470)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition Switch In ON Position	10 Volts Or Greater
1 & Ground	Ignition Switch In OFF Position	One Volt Or Less
3 & Ground	Driver's Door Courtesy Switch in OFF Position	9 Volts Or Greater
3 & Ground	Driver's Door Courtesy Switch in ON Position	One Volt Or Less

5 & Ground	Light Control Switch In FLASH Position	0.3 Volt Or Less
5 & Ground	Vehicle In Direct Sun Light	1.8 Volts Or Less
7 & Ground	Vehicle In Direct Sun Light	1.5 Volts Or Less

SENSOR CIRCUIT VALUES - HARNESS DISCONNECTED (SC300 & SC400)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
1 & Ground	Ignition Switch In ON Or START Position	Battery Voltage
2 & Ground	Constant	Battery Voltage
3 & Ground	Door Courtesy Switch In OFF Position	No Continuity
3 & Ground	Door Courtesy Switch In ON Position	Continuity
4 & Ground	Light Control Switch In OFF, TAIL Or HEAD Position	No Continuity
4 & Ground	Light Control Switch In AUTO Position	Continuity
5 & Ground	Light Control Switch In OFF Or TAIL Position	No Continuity
5 & Ground	Light Control Switch In HEAD Position	Continuity
6 & Ground	Light Control Switch In OFF Position	No Continuity
6 & Ground	Light Control Switch In TAIL Or HEAD Position	Continuity

SENSOR CIRCUIT VALUES - HARNESS CONNECTED (SC300 & SC400)

Tester Connection	Condition	Circuit Value
4 & Ground	Ignition On, Light Control Switch In AUTO Position & Sensor Covered (Gradually)	Taillights Illuminate Before Headlights



Fig. 2: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Disconnected (ES300, LS400 & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

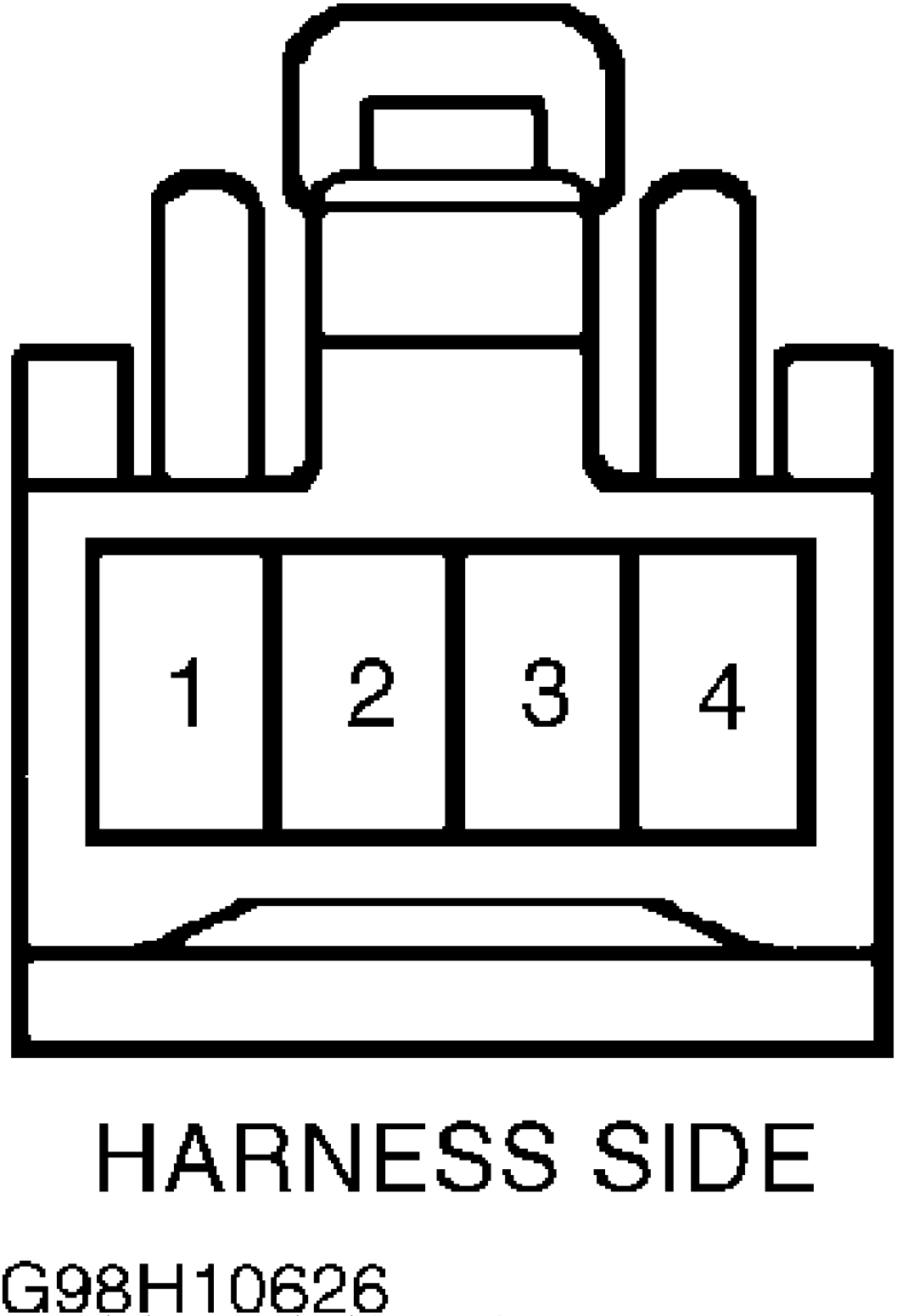


Fig. 3: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Disconnected (GS300, GS400 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

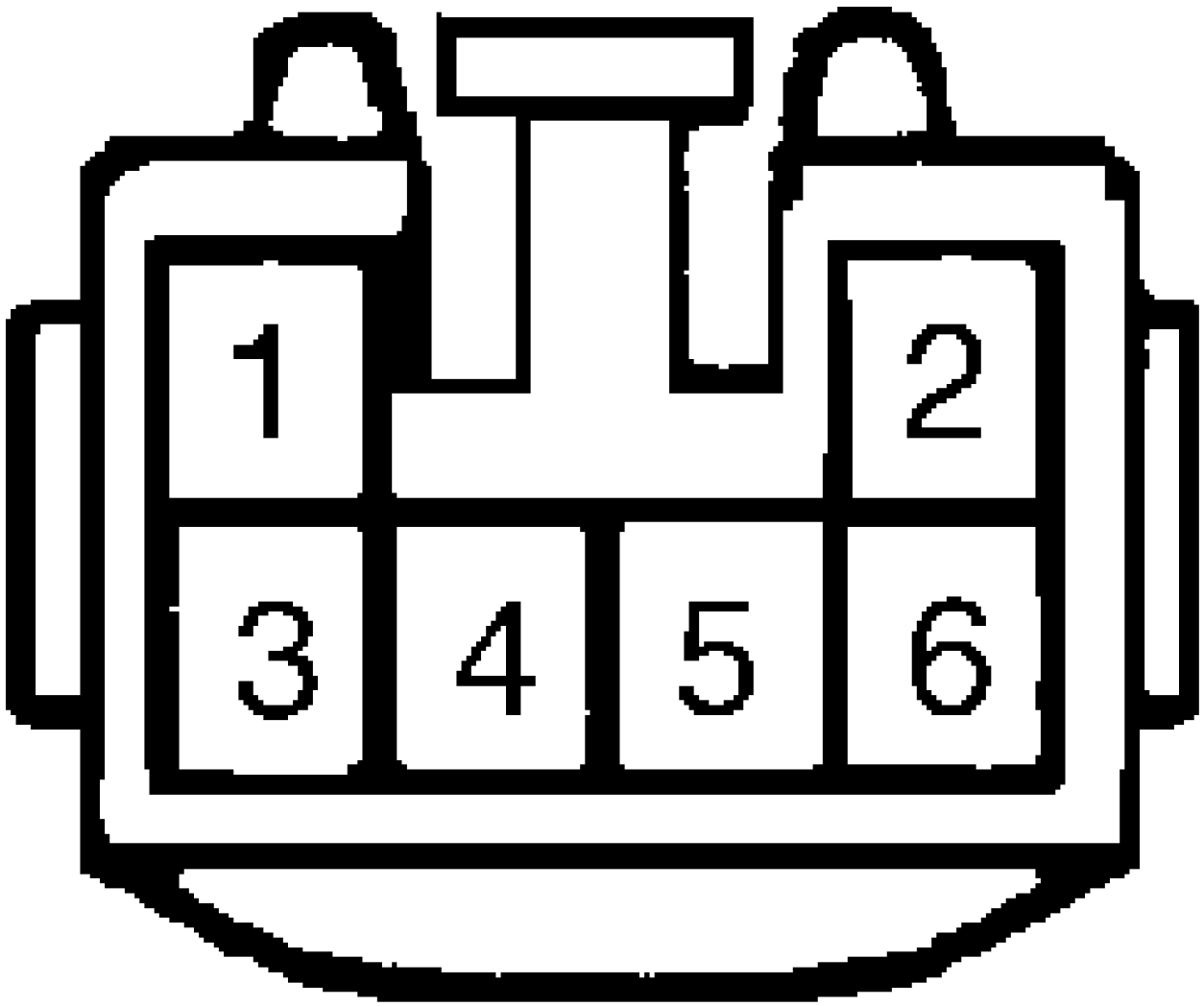
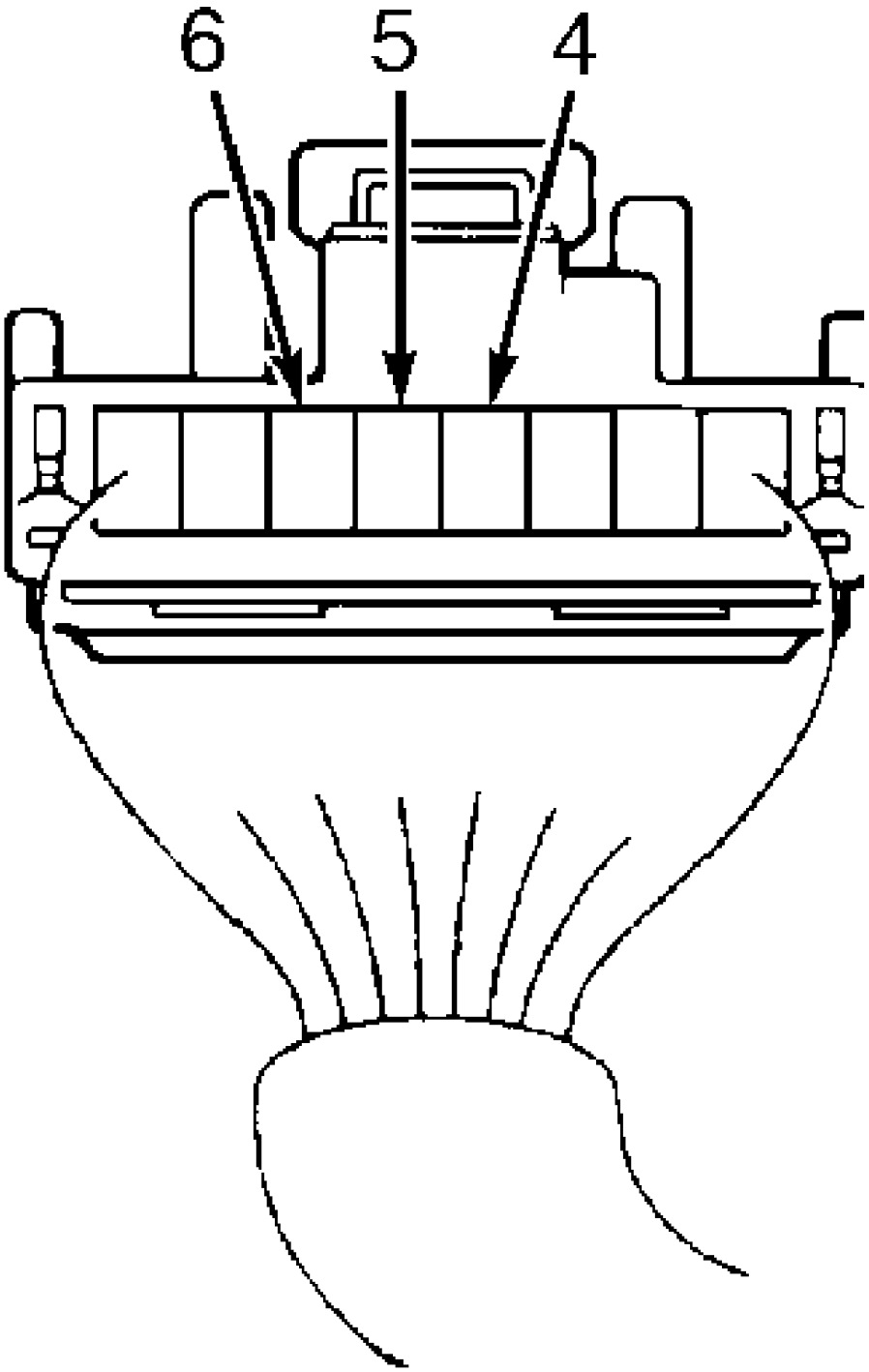


Fig. 4: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Disconnected (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G98J10636

Fig. 5: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Connected (ES300, LS400 & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

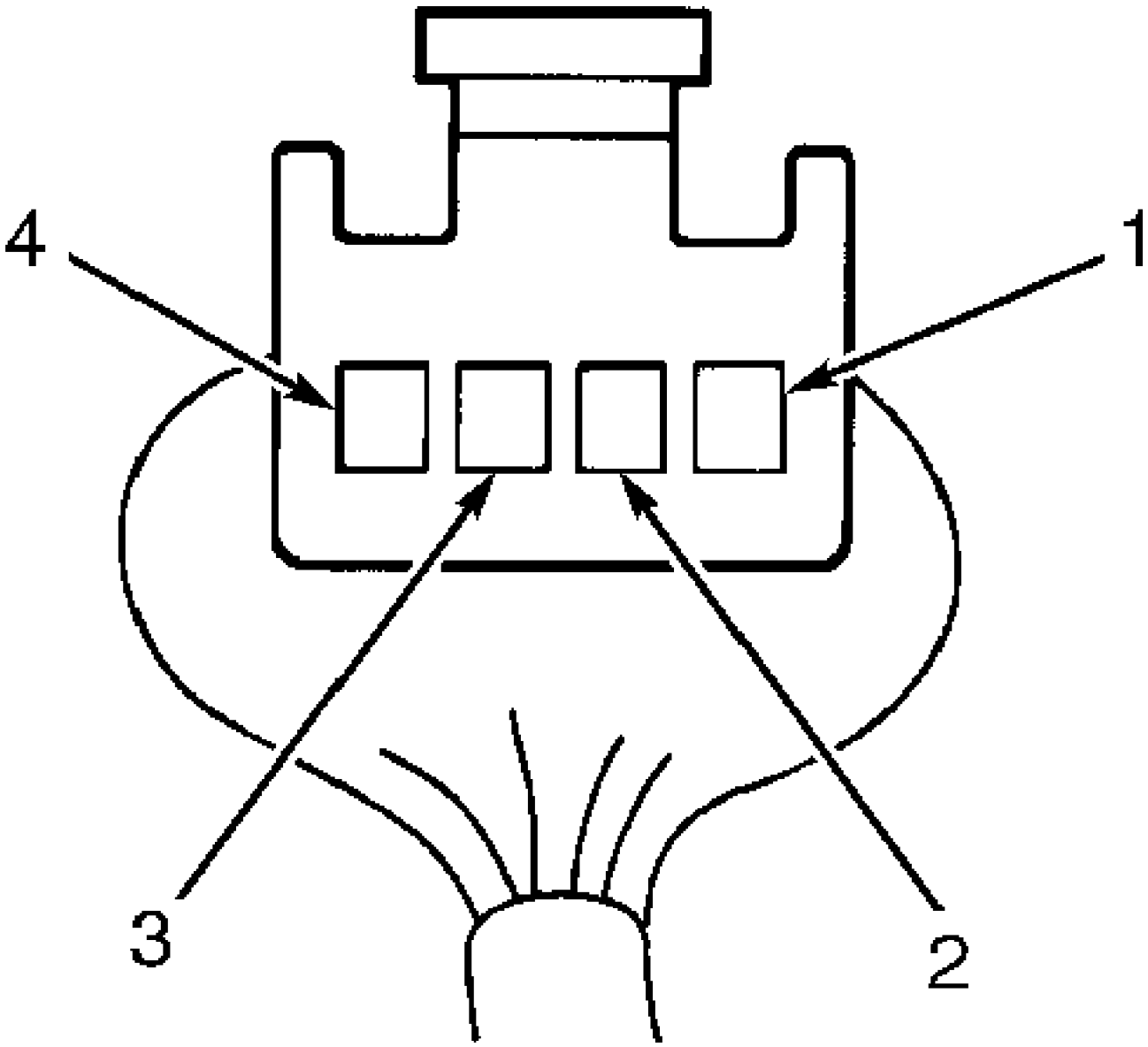


Fig. 6: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Connected (GS300, GS400 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

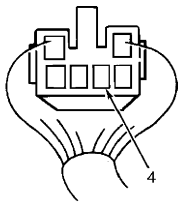


Fig. 7: Identifying Automatic Light Control Sensor Harness Connector Terminals - Harness Connected (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMBINATION SWITCH CIRCUIT

With combination switch connected, check circuit values by backprobing appropriate connector terminal on back side of harness connector. See Figs. 8-10. Ensure circuit values are as specified. See appropriate COMBINATION SWITCH CIRCUIT VALUES table. If circuit values are not as specified, repair as necessary. See appropriate wiring diagram in HEADLIGHT SYSTEMS article.

COMBINATION SWITCH CIRCUIT VALUES (ES300 & RX300)

Tester Connection	Condition	Circuit Value
7 & Ground	Dimmer Switch In LOW BEAM Position	No Voltage
7 & Ground	Dimmer Switch In HIGH BEAM Or FLASH Position	Battery Voltage
8 & Ground	Dimmer Switch In LOW BEAM Or HIGH BEAM Position	No Voltage
8 & Ground	Dimmer Switch In FLASH Position	Battery Voltage
12 & Ground	Light Control Switch In OFF, TAIL Or HEAD Position	No Voltage
12 & Ground	Light Control Switch In AUTO Position	Battery Voltage
13 & Ground	Light Control Switch In OFF Or TAIL Position	No Voltage
13 & Ground	Light Control Switch In HEAD Position	Battery Voltage
14 & Ground	Light Control Switch In OFF Position	No Voltage
14 & Ground	Light Control Switch In TAIL Or HEAD Position	Battery Voltage
16 & Ground	Constant	Continuity
17 & Ground	Dimmer Switch In HIGH BEAM Or FLASH Position	No Voltage
17 & Ground	Dimmer Switch In LOW BEAM Position	Battery Voltage

COMBINATION SWITCH CIRCUIT VALUES (GS300 & GS400)

Tester Connection	Condition	Circuit Value
13 & Ground	Light Control Switch In OFF, TAIL Or HEAD Position	No Voltage
13 & Ground	Light Control Switch In AUTO Position	Battery Voltage
14 & Ground	Light Control Switch In OFF Or TAIL Position	No Voltage
14 & Ground	Light Control Switch In HEAD Position	Battery Voltage
15 & Ground	Light Control Switch In OFF Position	No Voltage

15 & Ground	Light Control Switch In TAIL Or HEAD Position	Battery Voltage

COMBINATION SWITCH CIRCUIT VALUES (LS400)

Tester Connection	Condition	Circuit Value
1 & Ground	Ignition On & Turn Signal Switch In LEFT Turn Position	Battery Voltage
3 & Ground	Ignition On & Turn Signal Switch In RIGHT Turn Position	Battery Voltage
8 & Ground	Light Control Switch In HEAD Position; Dimmer Switch In LOW Position	No Voltage
8 & Ground	Dimmer Switch In FLASH Position Or Light Control Switch In HEAD Position; Dimmer Switch In HIGH Position	Battery Voltage
12 & Ground	Light Control Switch In HEAD Position; Dimmer Switch In HIGH Or FLASH Position	No Voltage
12 & Ground	Light Control Switch In HEAD Position; Dimmer Switch In LOW Position	Battery Voltage
18 & Ground	Light Control Switch In HEAD Position; Dimmer Switch In HIGH Or FLASH Position	No Voltage
18 & Ground	Light Control Switch In HEAD Position; Dimmer Switch In LOW Position	Battery Voltage

COMBINATION SWITCH CIRCUIT VALUES (LX470)

Tester Connection	Condition	Circuit Value
13 & Ground	Light Control Switch In OFF Or TAIL Position	Battery Voltage
13 & Ground	Light Control Switch In HEAD Position	No Voltage
14 & Ground	Light Control Switch In OFF Position	Battery Voltage
14 & Ground	Light Control Switch In TAIL Or HEAD Position	No Voltage
16 & Ground	Constant	Continuity

COMBINATION SWITCH CIRCUIT VALUES (SC300 & SC400)

Tester Connection	Condition	Circuit Value
B4 & Ground	Constant	Continuity
B7 & Ground	Constant (Except Light Control Switch In FLASH Position)	Battery Voltage

B9 & Ground	Light Control Switch In OFF Or TAIL Position	No Voltage
B9 & Ground	Light Control Switch In HEAD Position	Battery Voltage
B18 & Ground	Constant	Continuity

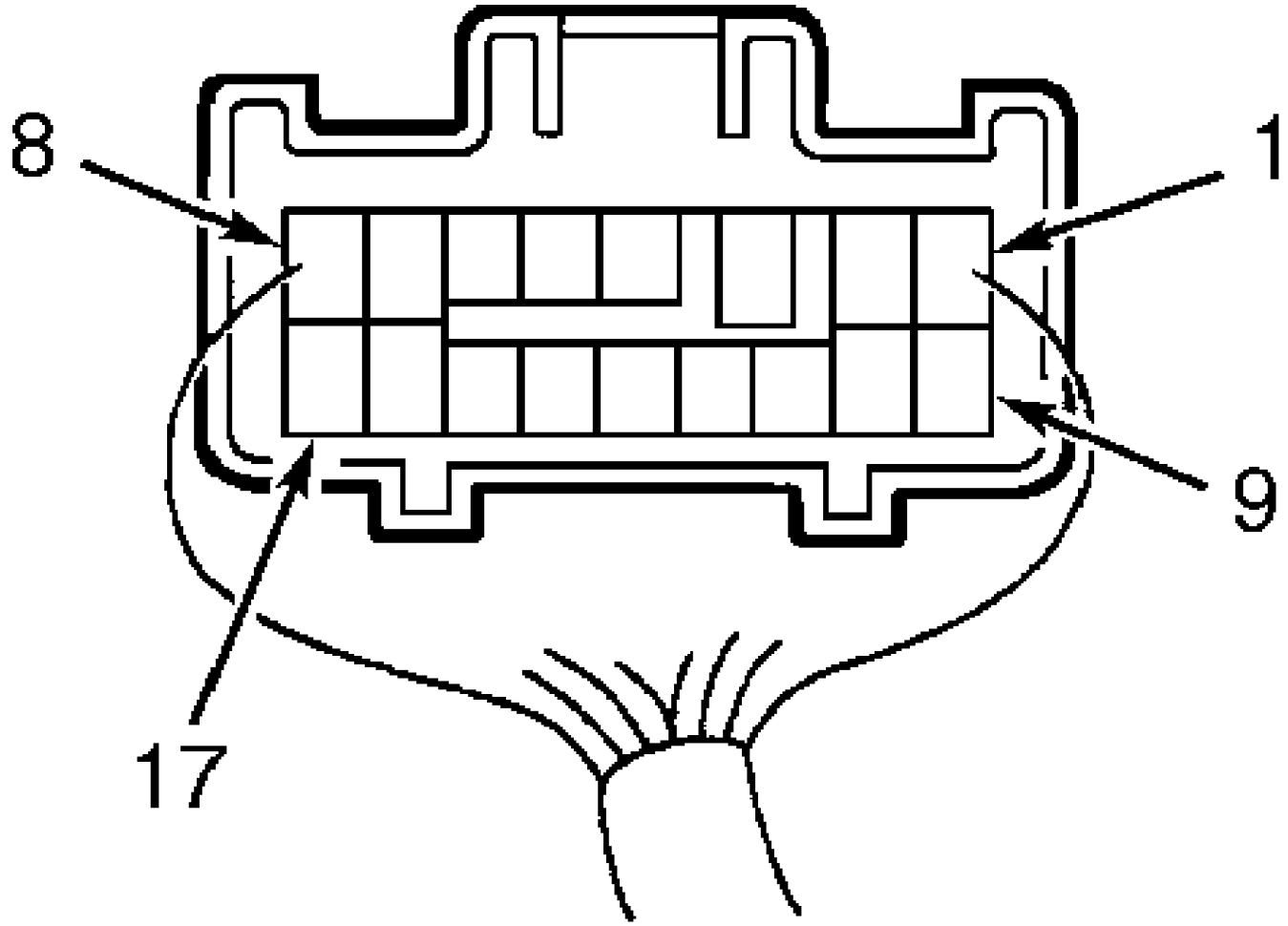


Fig. 8: Identifying Combination Switch Harness Connector Terminals - Harness Side (ES300, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

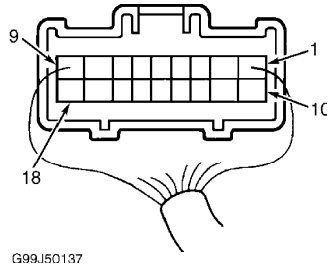


Fig. 9: Identifying Combination Switch Harness Connector Terminals - Harness Side (GS300, GS400 & LS400)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

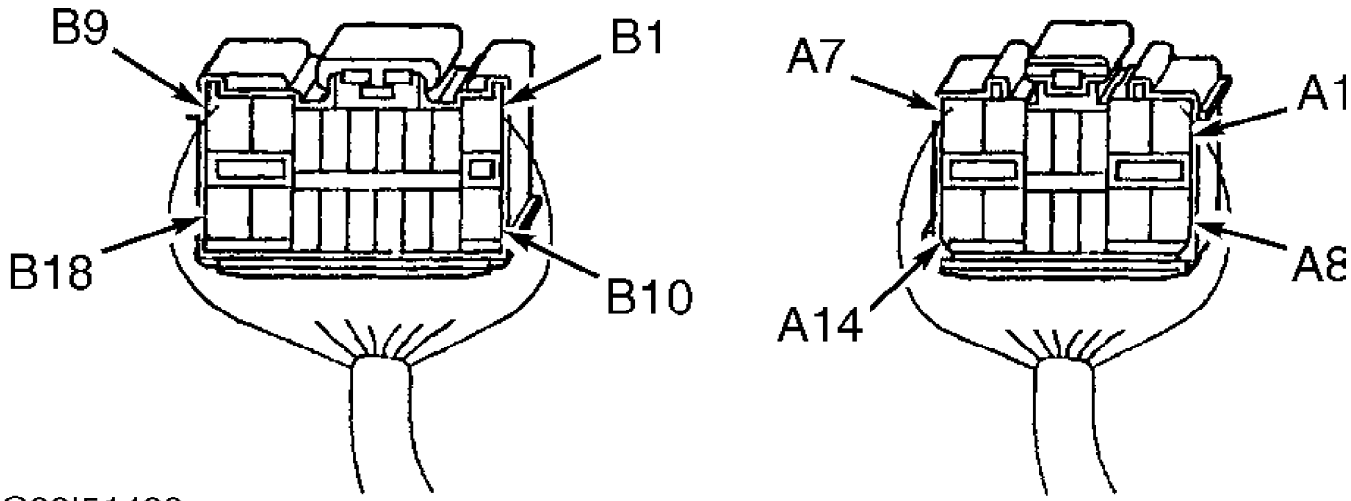


Fig. 10: Identifying Combination Switch Harness Connector Terminals - Harness Side (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

INTEGRATION RELAY CIRCUIT

NOTE: GS300, GS400, LS400, LX470 and RX300 are not equipped with an integration relay.

ES300, SC300 & SC400

Remove integration relay. See COMPONENT LOCATIONS. Check circuit values at appropriate connector terminals of integration relay. See Figs. 11-13. Ensure circuit values are as specified. See appropriate INTEGRATION RELAY CIRCUIT VALUES table. If circuit values are as specified, replace integration relay. If circuit values are not as specified, repair circuit as necessary. See appropriate wiring diagram in HEADLIGHT SYSTEMS article.

INTEGRATION RELAY CIRCUIT VALUES (ES300 - JUNCTION BLOCK SIDE)

Tester Connection	Condition	Circuit Value
1 & Ground	Constant	Battery Voltage
2 & Ground	Constant	Battery Voltage
4 & Ground	All Doors Closed (Except Driver's Door)	No Continuity
4 & Ground	One Door Open (Except Driver's Door)	Continuity
5 & Ground	Key Unlock Warning Switch In OFF Position	No Continuity
5 & Ground	Key Unlock Warning Switch In ON Position	Continuity
6 & Ground	Driver's Door Closed	No Continuity
6 & Ground	Driver's Door Open	Continuity
7 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage

7 & Ground	Ignition Switch In ON Position	Battery Voltage
8 & Ground	Seat Belt Unfastened	No Continuity
8 & Ground	Seat Belt Fastened	Continuity
9 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
9 & Ground	Ignition Switch In ON Position	Battery Voltage
10 & Ground	Constant	Continuity
11 & Ground	Ignition Switch In LOCK Position	No Voltage
11 & Ground	Ignition Switch In ACC or ON Position	Battery Voltage

INTEGRATION RELAY CIRCUIT VALUES (ES300 - HARNESS SIDE)

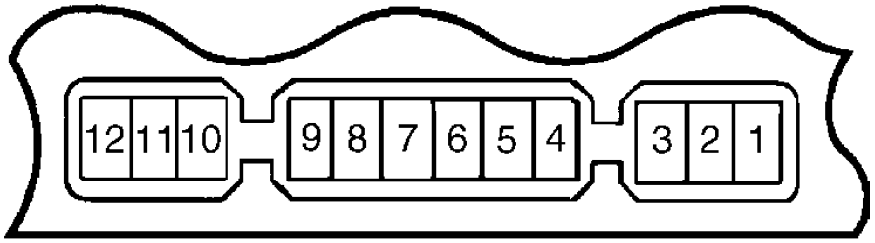
Tester Connection	Condition	Circuit Value
A1 & Ground	Constant	Battery Voltage
A3 & Ground	Constant	Continuity
A5 & Ground	Driver’s Door Closed	No Continuity
A5 & Ground	Driver’s Door Open	Continuity
A6 & Ground	Passenger’s Door Closed	No Continuity
A6 & Ground	Passenger’s Door Open	Continuity
A7 & Ground	Passenger’s Door Closed	No Continuity
A7 & Ground	Passenger’s Door Open	Continuity
A8 & Ground	Engine Running	Battery Voltage
A9 & Ground	Rear Door Closed	No Continuity
A9 & Ground	Rear Door Open	Continuity
A11 & A12	Constant	Continuity
A12 & A25	Constant	Continuity
A13 & Ground	Light Control Switch In AUTO Position	No Continuity
A13 & Ground	Light Control Switch In OFF, TAIL Or HEAD Position	Continuity
A14 & Ground	Light Control Switch In OFF Position	No Continuity
A14 & Ground	Light Control Switch In HI Or FLASH Position	Continuity
A15 & Ground	Trunk Compartment Closed	No Continuity
A15 & Ground	Trunk Compartment Open	Continuity
A16 & Ground	Door Lock Manual Switch In OFF Or UNLOCK Position	No Continuity

A16 & Ground	Door Lock Manual Switch In LOCK Position	Continuity
A17 & Ground	Door Lock Manual Switch In OFF Or LOCK Position	No Continuity
A17 & Ground	Door Lock Manual Switch In UNLOCK Position	Continuity
A18 & Ground	Driver's & Passenger's Door Key Lock/Unlock Switch In OFF Or UNLOCK Position	No Continuity
A18 & Ground	Driver's & Passenger's Door Key Lock/Unlock Switch In LOCK Position	Continuity
A19 & Ground	Driver's Door Key Lock/Unlock Switch In OFF Or LOCK Position	No Continuity
A19 & Ground	Driver's Door Key Lock/Unlock Switch In UNLOCK Position	Continuity
A20 & Ground	Passenger's Door Key Lock/Unlock Switch In OFF Or LOCK Position	No Continuity
A20 & Ground	Passenger's Door Key Lock/Unlock Switch In UNLOCK Position	Continuity
A22 & Ground	Parking Brake Switch In OFF Position	No Continuity
A22 & Ground	Parking Brake Switch In ON Position	Continuity
A24 & Ground	Brake Fluid Level Float Up	No Continuity
A24 & Ground	Brake Fluid Level Float Down	Continuity
B2 & Ground	Light Control Switch In OFF Position	No Continuity
B2 & Ground	Light Control Switch In TAIL Or HEAD Position	Continuity
B5 & Ground	Light Control Switch In OFF Or TAIL Position	Continuity
B5 & Ground	Light Control Switch In HEAD Position	Continuity

INTEGRATION RELAY CIRCUIT VALUES (SC300 & SC400)

Tester Connection	Condition	Circuit Value
A1 & Ground	Constant	Battery Voltage
A2 & Ground	Constant	Battery Voltage
A4 & Ground	Passenger's Courtesy Switch OFF	No Continuity
A4 & Ground	Passenger's Courtesy Switch ON	Continuity
A5 & Ground	Ignition Key Removed	No Continuity

A5 & Ground	Ignition Key Inserted	Continuity
A6 & Ground	Driver’s Courtesy Switch OFF	No Continuity
A6 & Ground	Driver’s Courtesy Switch ON	Continuity
A7 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
A7 & Ground	Ignition Switch In ON Position	Battery Voltage
A8 & Ground	Seat Belt Fastened	No Continuity
A8 & Ground	Seat Belt Unfastened	Continuity
A9 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
A9 & Ground	Ignition Switch In ON Position	Battery Voltage
A10 & Ground	Constant	Continuity
A11 & Ground	Ignition Switch In LOCK Position	No Voltage
A11 & Ground	Ignition Switch In ON Or ACC Position	Battery Voltage
B2 & Ground	Passenger’s Door Key Lock/Unlock Switch In OFF Or LOCK Position	No Continuity
B2 & Ground	Passenger’s Door Key Lock/Unlock Switch In UNLOCK Position	Continuity
B3 & Ground	Driver’s Door Key Lock/Unlock Switch In OFF Or LOCK Position	No Continuity
B3 & Ground	Driver’s Door Key Lock/Unlock Switch In UNLOCK Position	Continuity
B4 & Ground	Light Control Switch In OFF Position	No Continuity
B4 & Ground	Light Control Switch In TAIL Or HEAD Position	Continuity
B7 & Ground	Light Control Switch In OFF Or TAIL Position	No Continuity
B7 & Ground	Light Control Switch In HEAD Position	Continuity



G98F10640

Fig. 11: Identifying Integration Relay Junction Block Terminals (ES300)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

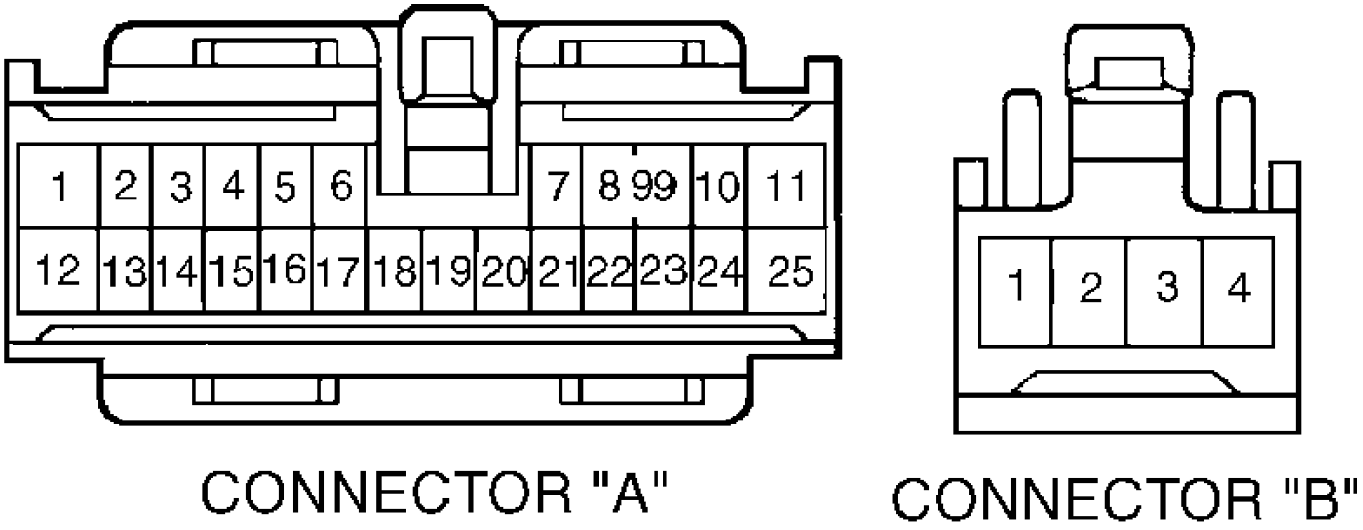


Fig. 12: Identifying Integration Relay Harness Connector Terminals (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

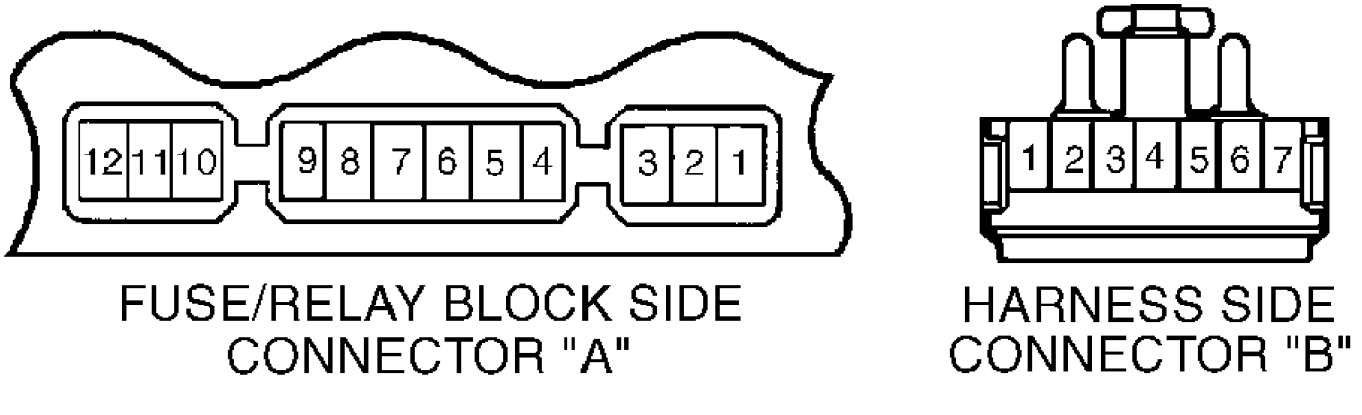


Fig. 13: Identifying Integration Relay Harness & Fuse/Relay Block Connector Terminals (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPONENT TESTS

* PLEASE READ THIS FIRST *

NOTE: For light control switch and relay testing, see COMPONENT TESTS in STEERING COLUMN SWITCHES article.

AUTOMATIC LIGHT CONTROL SENSOR

NOTE: See AUTOMATIC LIGHT CONTROL SENSOR CIRCUIT under CIRCUIT TESTS.

BODY CONTROL ECU (GS300, GS400 & LS400)

NOTE: See appropriate BODY CONTROL SYSTEMS article.

DRIVER'S DOOR ECU (GS300, GS400 & LS400)

NOTE: See appropriate MULTIPLEX CONTROL SYSTEMS article.

LIGHT CONTROL ECU (GS300 & GS400)

NOTE: Information is not available from manufacturer.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

AUTOMATIC LIGHT CONTROL SENSOR

Removal & Installation
Remove instrument panel. See appropriate INSTRUMENT PANELS article. Remove automatic light control sensor. To install, reverse removal procedure.

COMBINATION SWITCH

NOTE: See REMOVAL & INSTALLATION in STEERING COLUMN SWITCHES article.

WIRING DIAGRAMS

NOTE: See appropriate wiring diagrams in HEADLIGHT SYSTEMS or DAYTIME RUNNING LIGHTS articles.

AXLE SHAFTS - FRONT & REAR

1999 Lexus RX 300

1999-2000 AXLE SHAFTS
Lexus

RX300 AWD & FWD

DESCRIPTION

RX300 front axle shaft uses inner and outer CV joints. On the right side, an inboard and outboard axle shaft is used, supported by a bearing. On FWD vehicles, front axle shaft is bolted to a side flange which is splined to the differential. See Fig. 1. On AWD vehicles, front axle shaft is splined to differential. See Fig. 8. On AWD vehicles, rear axle shaft consists of a shaft with inner and outer CV joint at each end. Rear axle shaft is bolted to a side flange which is splined to the differential. See Fig. 10. On all vehicles, CV joints are enclosed by CV joint boots, which maintain lubrication and prevent contaminants from entering joints.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

REMOVAL, DISASSEMBLY, REASSEMBLY & INSTALLATION

FRONT AXLE SHAFTS (FWD)

CAUTION: To prevent damage to axle hub bearing, DO NOT subject hub bearing to vehicle weight with axle shaft removed. If vehicle must be moved with axle shaft removed, install a bolt, nut, a small washer (outboard) and a large washer/bearing retainer (inboard) in place of axle shaft.

CAUTION: DO NOT damage ABS speed sensor rotor serrations on drive shaft.

1) Remove cotter pin, cap and axle shaft lock nut. Raise and support vehicle. Remove front wheel(s). Remove fender apron flap. Drain differential fluid. Remove bolt and ABS speed sensor.

2) Disconnect tie rod end from steering knuckle. Disconnect lower ball joint from lower control arm. Mark differential flange, axle shaft and center shaft for reassembly reference. Remove differential-to-axle shaft mounting bolts.

3) Using plastic hammer, disconnect axle shaft from axle hub. Push front axle hub outward, away from axle shaft. Using pry bar, remove left axle shaft. See Fig. 2. Remove right axle shaft bearing lock bolt and snap ring. See Fig. 3. Remove right axle shaft.

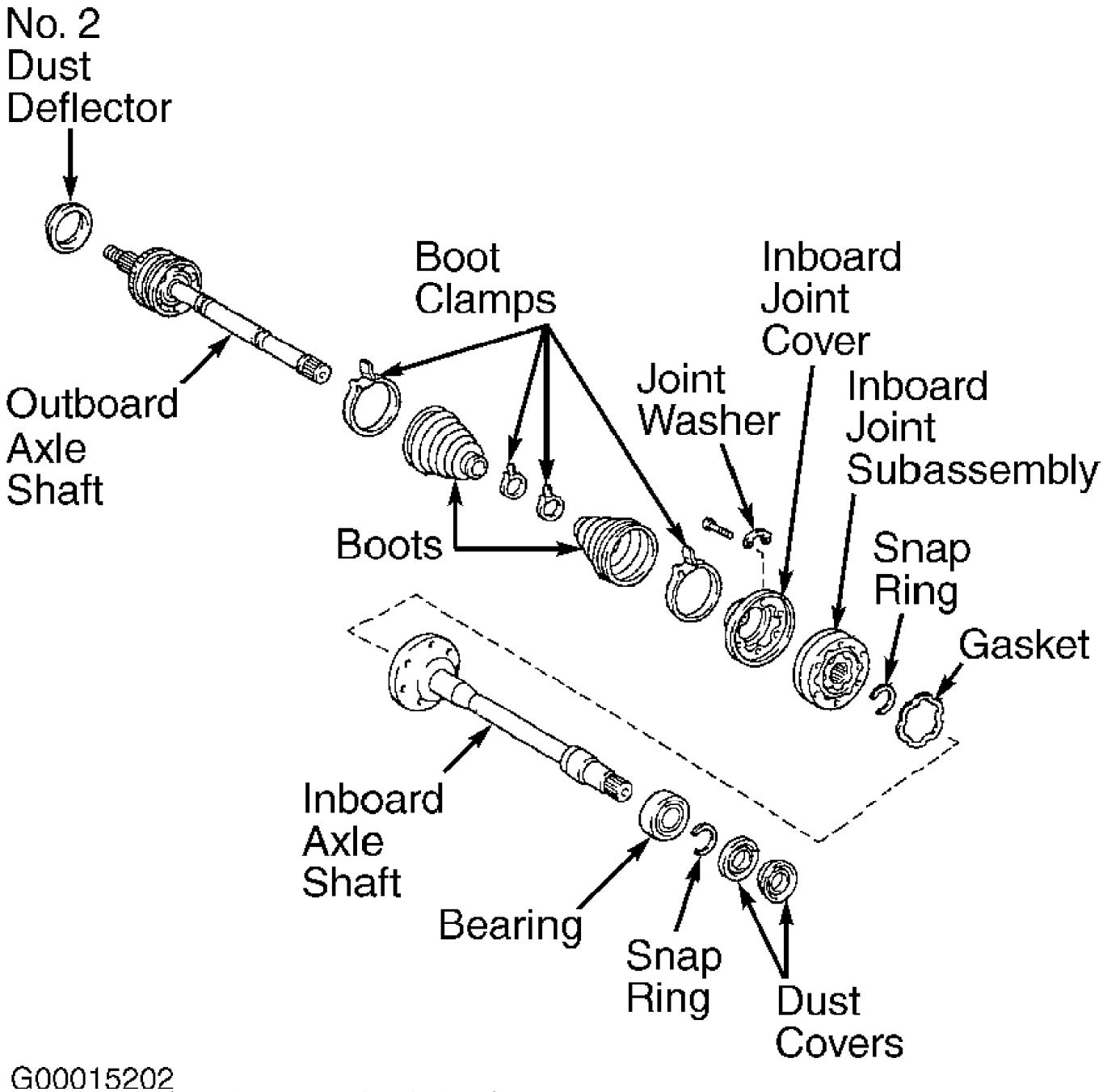


Fig. 1: Exploded View Of Front Axle Shaft (2WD)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

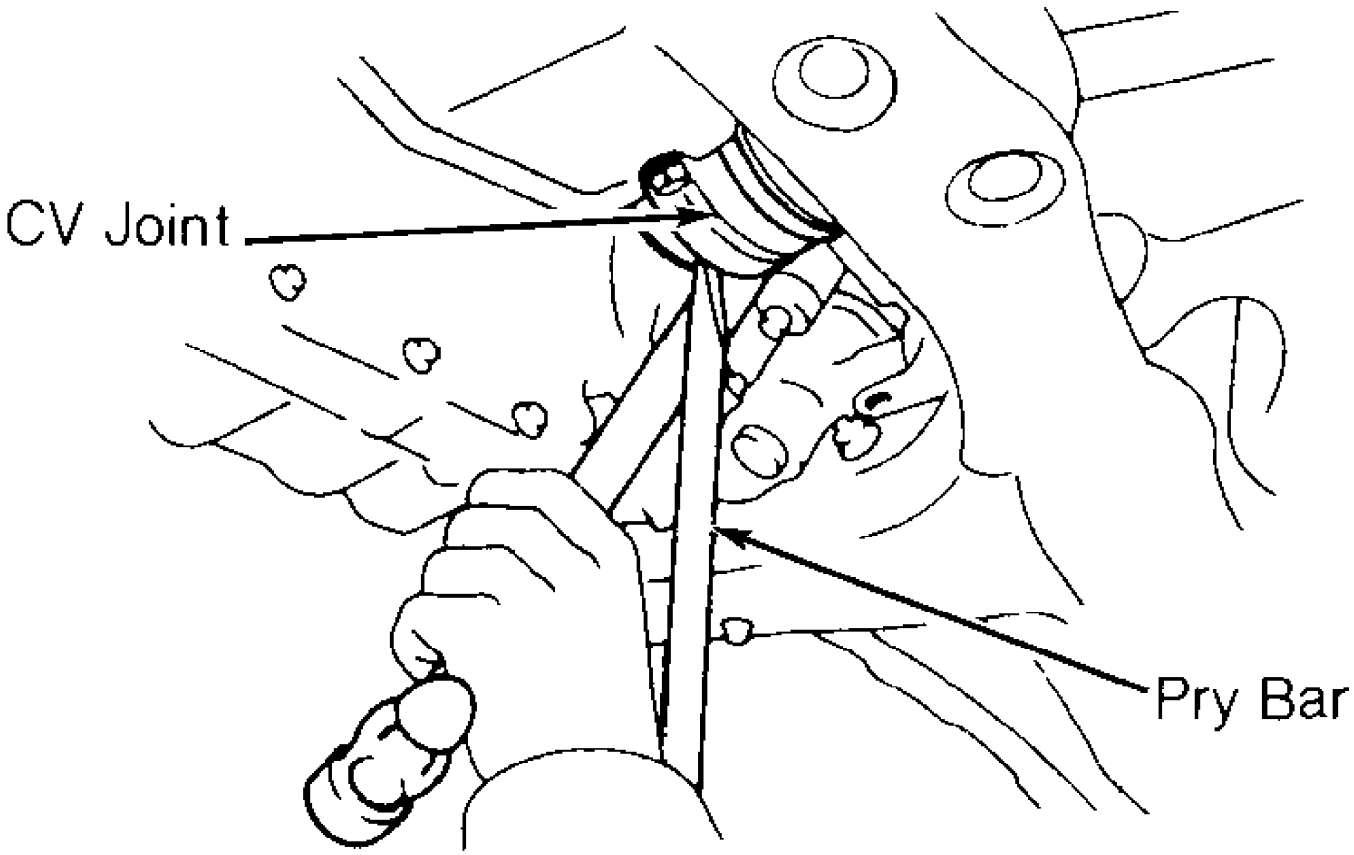


Fig. 2: Removing Axle Shaft Assembly From Differential
Courtesy of Toyota Motor Sales, U.S.A., Inc.

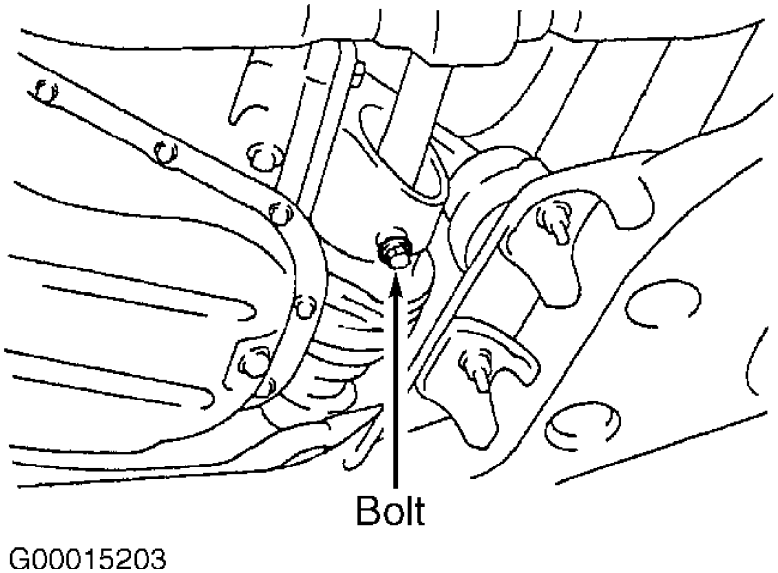


Fig. 3: Removing & Installing Bearing Lock Bolt
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Inspection & Disassembly
1) Check for and record any play or roughness in outboard

axle shaft. Ensure inboard axle shaft slides smoothly in thrust direction. Ensure inboard axle shaft does not have excessive play in radial direction. Remove inboard and outboard CV joint boot clamps.

2) Place match marks on inboard and outboard axle shafts for reassembly reference. Using appropriate socket, remove 6 bolts and 3 washers. Remove inboard axle shaft and gasket from outboard axle shaft. Use bolts, nuts and washers to keep inboard CV joint together. Tighten bolts by hand to avoid scratching flange surface.

3) Place match marks on inboard CV joint subassembly and outboard axle shaft for reassembly reference. See Fig. 4. Remove snap ring. Slide inboard CV joint boot toward outboard CV joint. Using a 17-mm socket and press, remove inboard joint subassembly from outboard axle shaft. Remove bolts, nuts and washers.

4) Using a screwdriver and hammer, pry around perimeter of inboard joint cover. Remove inboard joint subassembly from inboard joint cover. See Fig. 1. When lifting inboard joint, hold onto inner and outer race. Slide out 2 boots and 4 clamps. Using a screwdriver, remove dust cover from left axle shaft. On right axle shaft, use press to remove transaxle side dust cover. Remove snap ring. Use press to remove bearing. Remove snap ring. Mount outboard axle shaft in soft-jaw vise. Using a screwdriver and hammer, remove No. 2 dust deflector.

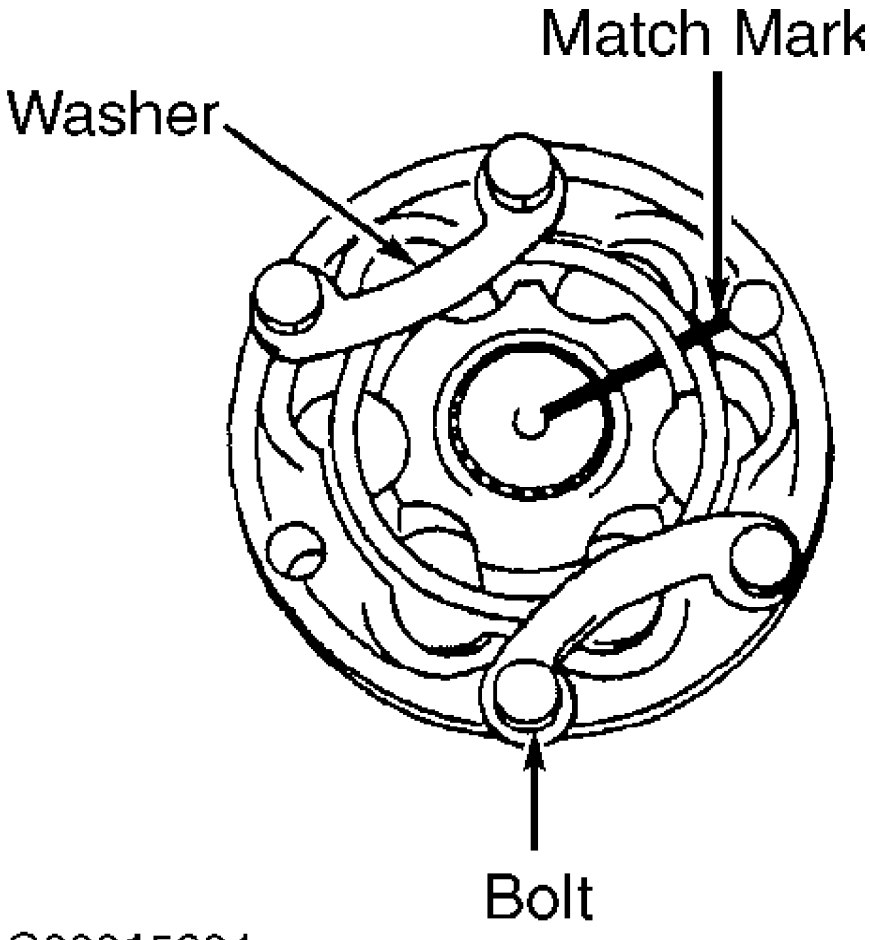


Fig. 4: Marking Inboard Joint Subassembly-To-Outboard Axle Shaft Position
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) Using appropriate adapter and press, install NEW No. 2 dust deflector onto outboard axle shaft. On right axle shaft, install NEW snap ring on inboard axle shaft. Using a press and extension bar, install NEW bearing and snap ring. Using a press, install NEW dust covers on inboard axle shaft.

2) Ensure distance between bearing and dust cover is .040-.080" (1.00-2.00 mm). Ensure distance between end of axle shaft and transaxle side dust cover is 4.33-4.37" (110.00-111.00 mm). See Fig. 5 . Using a press, install NEW dust cover on left axle shaft.

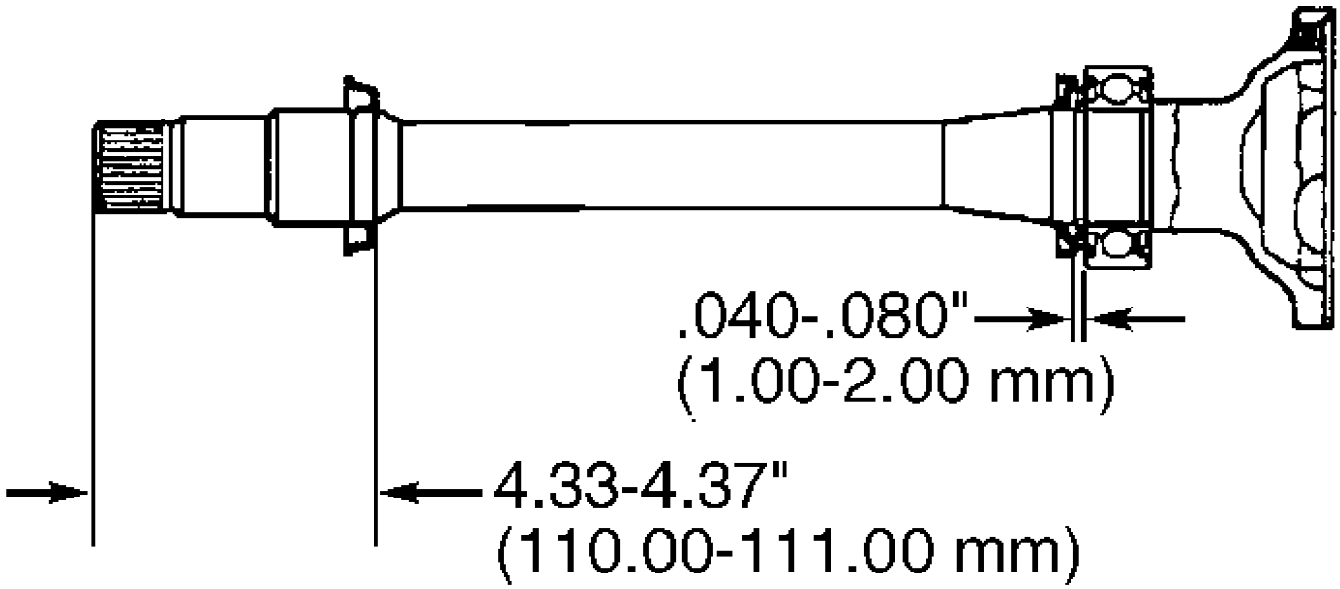


Fig. 5: Measuring Dust Cover Position
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) On all axle shafts, wrap axle shaft splines with vinyl tape to protect boot from damage during reassembly. Slide NEW boots and clamps onto axle shaft. Using cleaning solvent, clean contact surfaces of any dirt or gasket material. Apply a bead of gasket sealant, about .039-.071" (1.00-1.80 mm) in diameter, around inside edge of bolt holes on inboard joint cover.

4) Align cover bolt holes with inboard joint subassembly, then insert bolts. Using a plastic hammer, tap rim of inboard joint cover into place in a star pattern. See Fig. 6. Use bolts, nuts and washers to keep inboard joint subassembly together.

5) Align match marks made during removal on inboard joint subassembly and outboard axle shaft. Using a brass bar and hammer, tap inboard joint subassembly onto outboard axle shaft. Ensure brass bar is touching inner race, not cage. Install snap ring. Ensure outer race does not separate.

6) Pack inboard axle shaft with 1.5-1.9 oz. (43-53 g) of grease. Install boot to outboard axle shaft. Pack outboard CV joint with 5.3-5.6 oz. (150-160 g) of grease. Install boot to inboard joint. Pack inboard CV joint with 3.2-3.5 oz. (90-100 g) of grease. Assemble boots onto joints, ensuring both boots are on shaft groove. Ensure boots are not stretched or contracted. Ensure axle shaft length is 17.82-22.15" (452.7-562.7 mm). See Fig. 7. Install boot clamps.

7) Remove bolts, nuts and washers holding inboard joint subassembly together. Align match marks made during disassembly on inboard axle shaft to outboard axle shaft. Install NEW gasket on

inboard axle shaft. Install inboard axle shaft to outboard axle shaft. Install 3 washers and 6 bolts, and tighten to specification. See TORQUE SPECIFICATIONS.

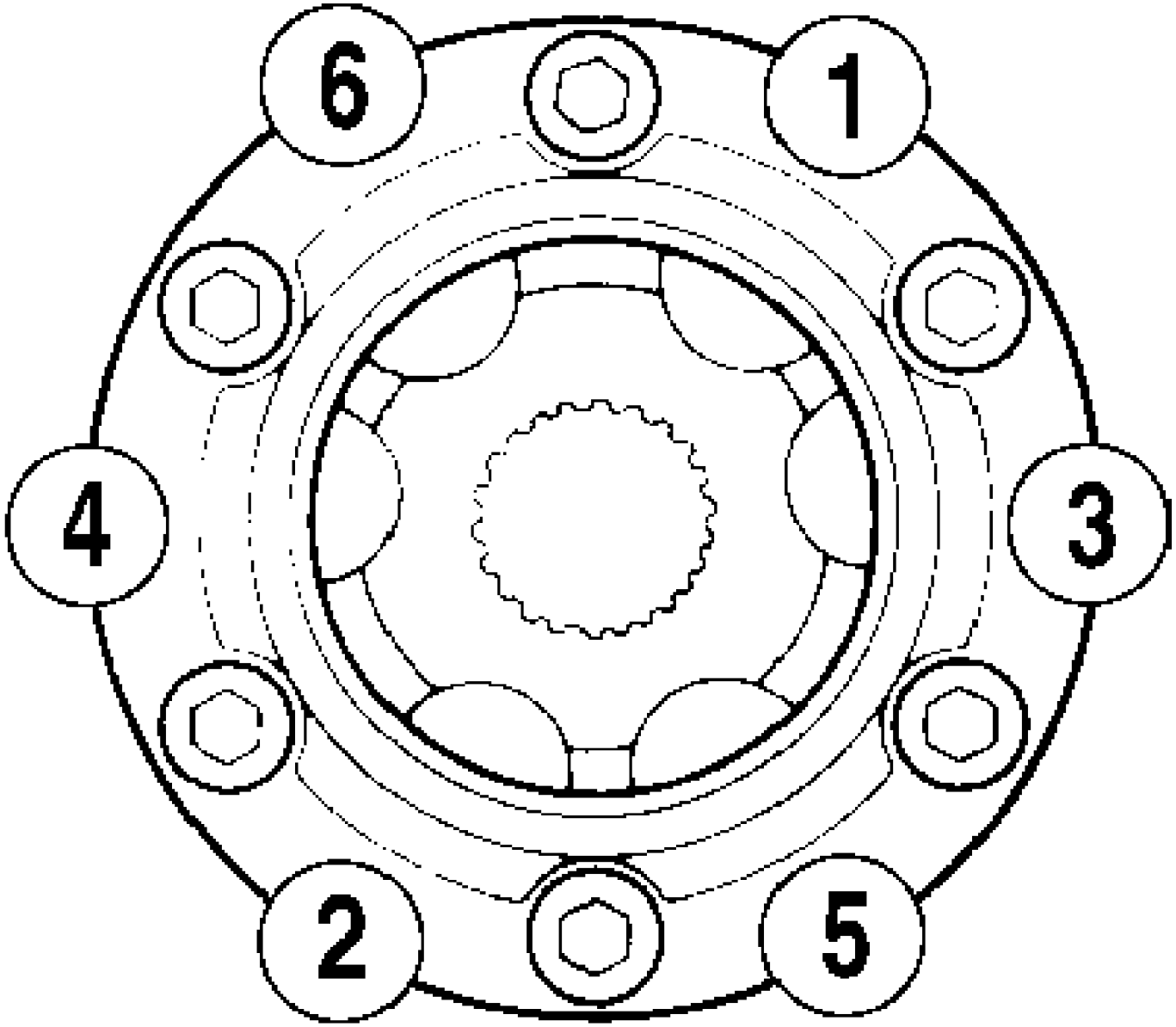


Fig. 6: Installing Inboard Joint Cover
Courtesy of Toyota Motor Sales, U.S.A., Inc.

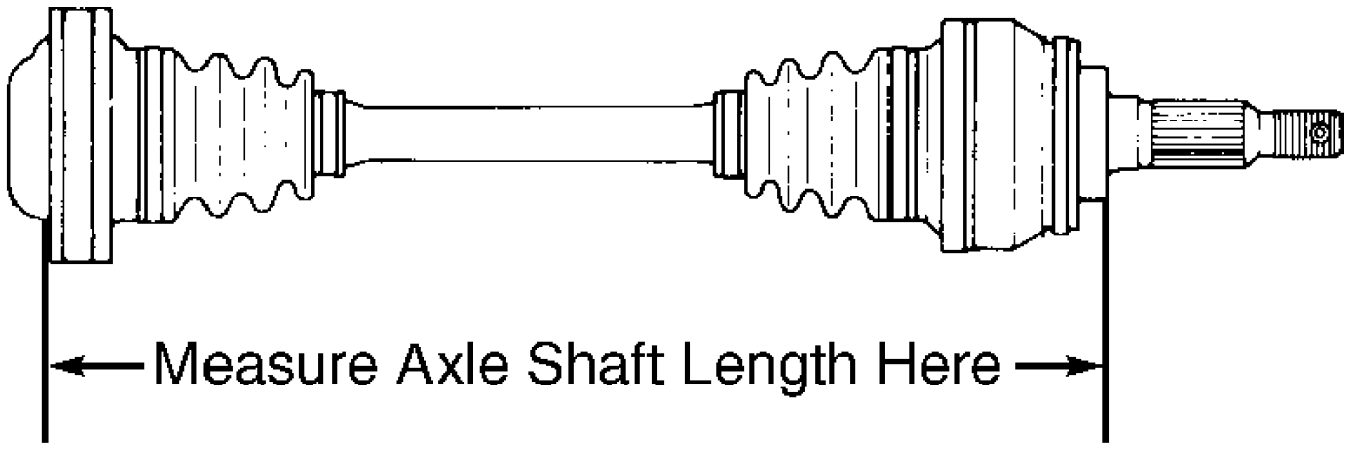


Fig. 7: Measuring Axle Shaft Length (2WD Front & 4WD Rear)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) Check seals at both ends of axle shaft and, if necessary, replace prior to installation. Lubricate transaxle seal lip with transaxle fluid. Install axle shaft onto differential flange. Install axle shafts into wheel hub, and tighten nuts to specification.

2) To complete axle shaft installation, reverse removal procedure. Tighten nuts and bolts to specification. To ensure proper engagement of snap ring, attempt to pull axle shaft out of differential by hand. Ensure axle shaft axial play is .079-.118" (2.00-3.00 mm).

FRONT AXLE SHAFTS (AWD)

CAUTION: To prevent damage to axle hub bearing, DO NOT subject hub bearing to vehicle weight with axle shaft removed. If vehicle must be moved with axle shaft removed, install a bolt, nut, a small washer (outboard) and a large washer/bearing retainer (inboard) in place of axle shaft.

CAUTION: DO NOT damage ABS speed sensor rotor serrations on axle shaft.

Removal

1) Remove cotter pin, cap and axle shaft lock nut. Raise and support vehicle. Remove front wheel(s). Remove fender apron flap. Drain differential fluid. Remove bolt and ABS speed sensor.

2) Disconnect tie rod end from steering knuckle. Disconnect lower ball joint from lower control arm. Using plastic hammer, disconnect axle shaft from axle hub. Push front axle hub outward, away from axle shaft. Using a slide hammer, remove axle shaft from differential.

Inspection & Disassembly

1) Check for and record any play or roughness in outboard axle shaft. Ensure inboard axle shaft slides smoothly in a thrust direction. Ensure inboard axle shaft does not have excessive play in radial direction. Remove inboard and outboard CV joint boot clamps. See Fig. 8.

2) Place match marks on inboard and outboard axle shafts for reassembly reference. DO NOT use punch to mark components. Using a

screwdriver, remove snap ring. Remove inboard axle shaft from outboard axle shaft. Place match marks on outboard axle shaft, inner race and cage. See Fig. 8. Remove 6 balls. Slide cage toward outboard CV joint.

3) Remove snap ring. Using a brass drift and hammer, drive inner race off axle shaft. DO NOT damage inner race. Remove cage, boot clamps and boots. Using a screwdriver, remove dust cover from left axle shaft.

4) Using appropriate adapter and press, remove dust cover from right axle shaft. Remove outer snap ring from inboard axle shaft. Mount outboard axle shaft in soft-jaw vise. Using a screwdriver and hammer, remove No. 2 dust deflector. DO NOT damage ABS speed sensor rotor.

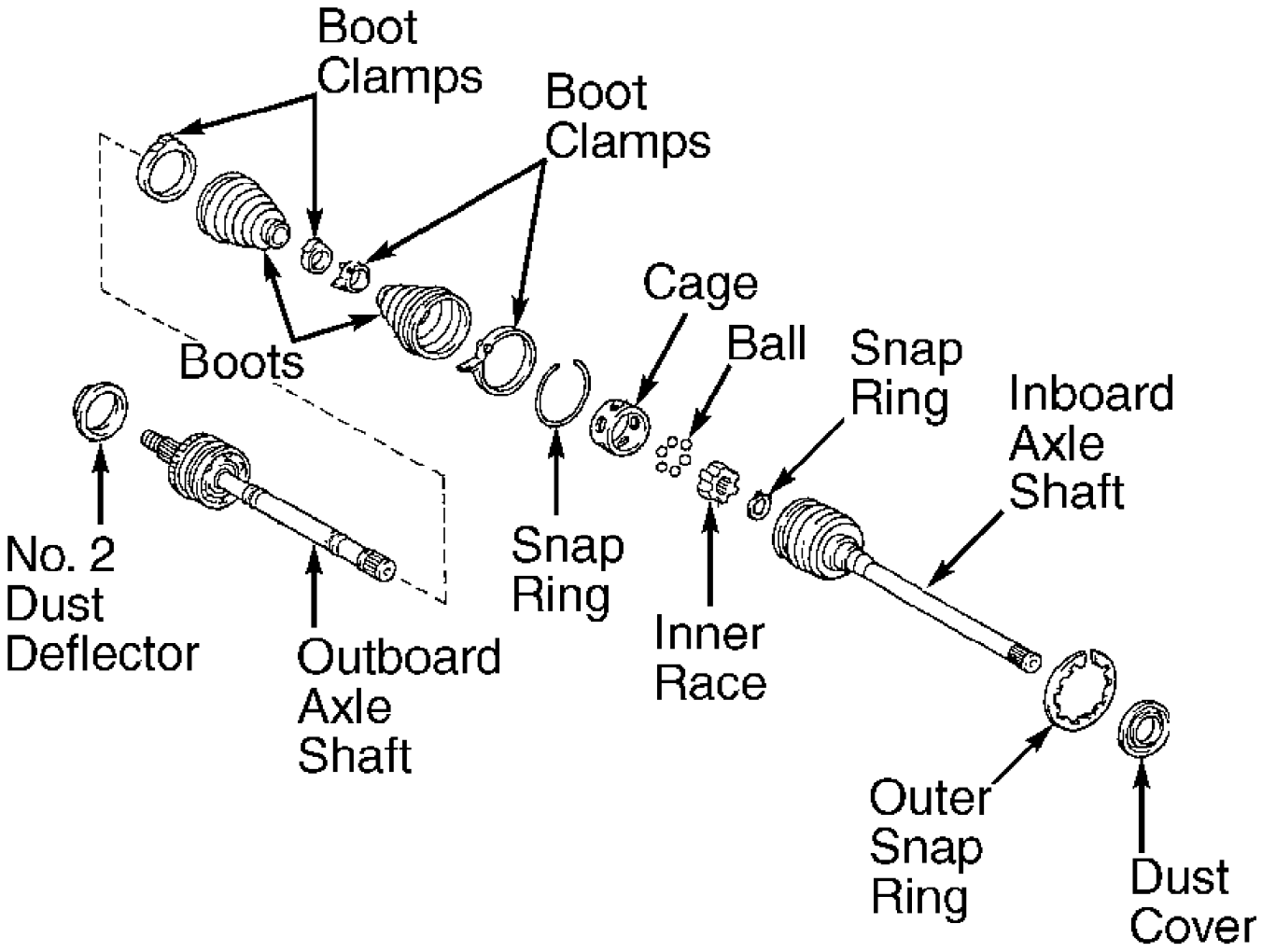


Fig. 8: Exploded View Of Front Axle Shaft (AWD)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

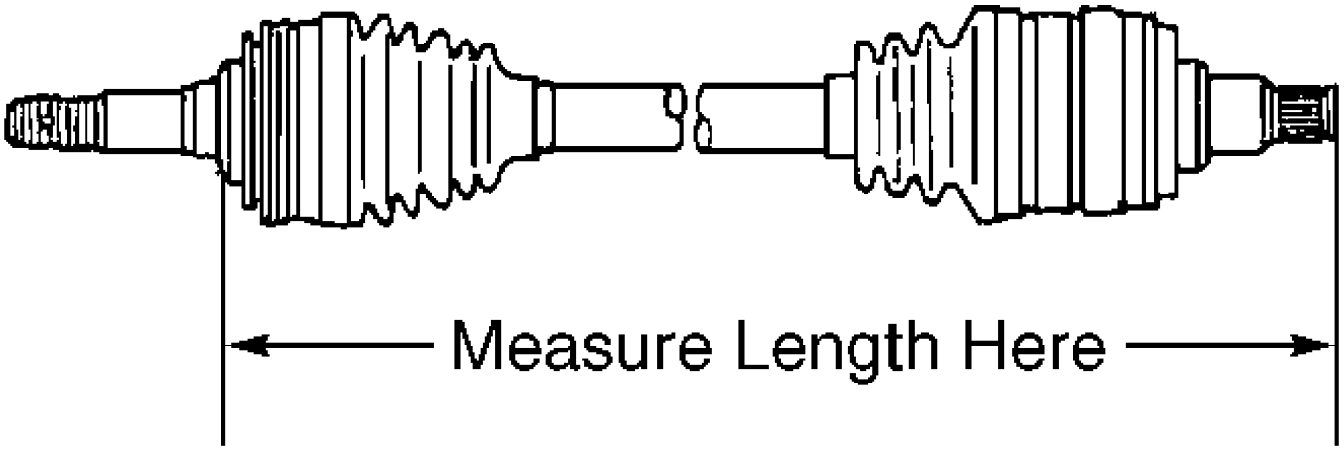
1) Using appropriate adapter and press, install NEW No. 2 dust deflector onto outboard axle shaft. Install NEW outer snap ring onto inboard axle shaft. Install dust cover. On both axle shafts, wrap axle shaft splines with vinyl tape to protect boot from damage during reassembly. Slide NEW boots and clamps onto axle shaft.

2) Align match marks and install cage onto outboard axle shaft. Smaller diameter of cage must face outboard CV joint. Align

match marks on inner race and outboard axle shaft. Using a brass drift and hammer, tap inner race onto outboard axle shaft. DO NOT damage inner race.

3) Install NEW snap ring. Align match marks on cage and inner race. Apply grease to 6 balls, and install into cage. Install cage to inner race. Pack outboard axle shaft and boot with 4.1-4.8 oz. (115-135 g) of grease. Install boot to outboard axle shaft. Pack inboard axle shaft and boot with 3.4-4.1 oz. (9-115 g) of grease. Install boot to inboard axle shaft.

4) Align match marks and install inboard axle shaft to outboard axle shaft. Install NEW snap ring. Assemble boots onto joints, ensuring both boots are on shaft groove. Ensure boots are not stretched or contracted. Ensure left axle shaft length is 22.09-22.25" (561.2-565.2 mm) and right axle shaft length is 35.94-36.09" (912.8-916.8 mm). See Fig. 9.



G00015206

Fig. 9: Measuring Front Axle Shaft Length (AWD)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) Check seals at both ends of axle shaft and, if necessary, replace prior to installation. Lubricate transaxle seal lip with transaxle fluid. Install axle shaft into differential. Install axle shafts into wheel hub, and tighten nuts to specification.

2) To complete axle shaft installation, reverse removal procedure. Tighten nuts and bolts to specification. To ensure proper engagement of snap ring, attempt to pull axle shaft out of differential by hand. Ensure axle shaft axial play is .079-.118" (2.00-3.00 mm).

REAR AXLE SHAFTS (AWD)

Removal

CAUTION: To prevent damage to axle hub bearing, DO NOT subject hub bearing to vehicle weight with axle shaft removed. If vehicle must be moved with axle shaft removed, install a bolt, nut, a small washer (outboard) and a large washer/bearing retainer (inboard) in place of axle shaft.

CAUTION: DO NOT damage ABS speed sensor rotor serrations on drive shaft.

Remove cotter pin, cap and axle shaft lock nut. Raise and support vehicle. Remove rear wheel(s). Remove bolt and ABS speed sensor. Mark differential flange and axle shaft for reassembly reference. Remove differential-to-axle shaft mounting bolts, nuts and washers. Remove axle shaft.

Inspection & Disassembly

1) Check for and record any play or roughness in outboard axle shaft. Ensure inboard joint housing slides smoothly in a thrust direction. Ensure inboard joint housing does not have excessive play in radial direction. Remove inboard and outboard CV joint boot clamps. See Fig. 10.

2) Place match marks on inboard joint housing and outboard axle shaft for reassembly reference. DO NOT use punch. Remove inboard joint housing from outboard axle shaft. Remove snap ring. Place match marks on outboard axle shaft and tripod. DO NOT use punch.

3) Using a brass drift and hammer, drive tripod off outboard axle shaft. DO NOT hammer on roller portion of tripod. Remove boots. Mount outboard axle shaft in soft-jawed vise. Using a screwdriver and hammer, remove No. 2 dust deflector from axle shaft. DO NOT damage ABS speed sensor rotor.

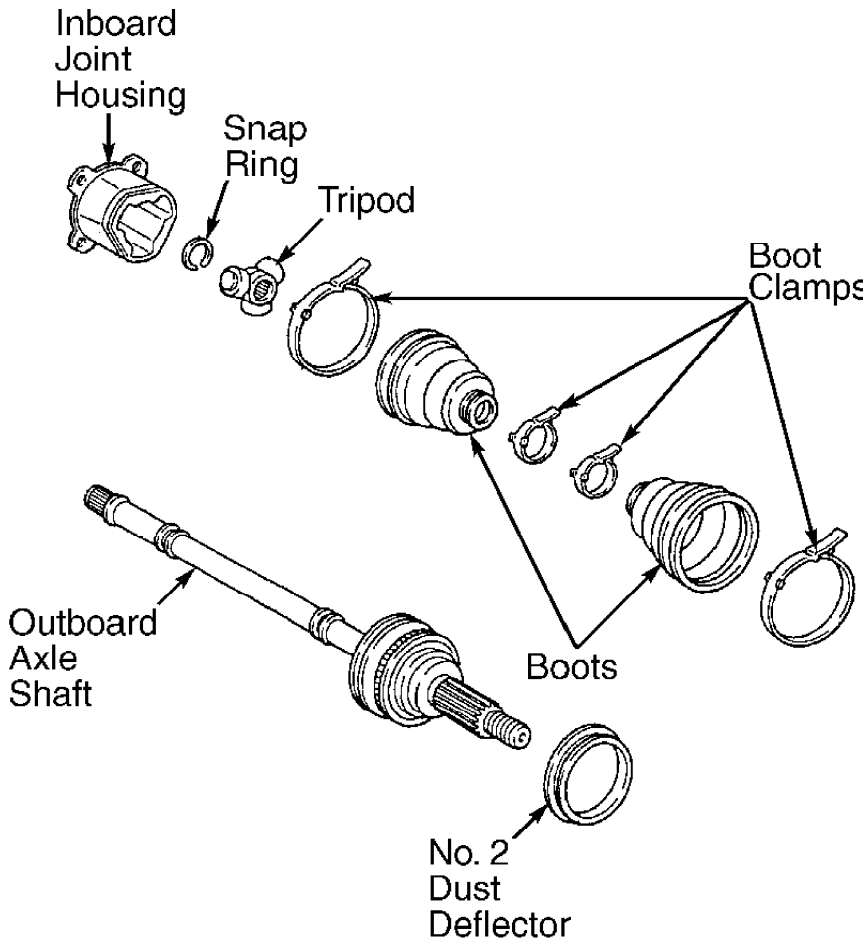


Fig. 10: Exploded View Of Rear Axle Shaft (4WD)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) Using appropriate adapter and press, install NEW No. 2

dust deflector onto outboard axle shaft. On both axle shafts, wrap axle shaft splines with vinyl tape to protect boot from damage during reassembly. Slide NEW boots and clamps onto axle shaft.

2) Align match marks and install tripod, with beveled side of tripod axial spline toward outboard joint. Using a brass drift and hammer, tap tripod onto outboard axle shaft. Install NEW snap ring. Pack inboard joint housing and boot with 7.58-7.94 oz. (215-225 g) of grease. Align match marks, and install inboard joint housing onto outboard axle shaft.

3) Pack outboard axle shaft and boot with 3.77-4.13 oz. (107-117 g) of grease. Install boot to outboard axle shaft. Assemble boots onto joints, ensuring both boots are on shaft groove. Ensure boots are not stretched or contracted. Ensure axle shaft length is 23.89-24.29" (607.0-617.0 mm). See Fig. 7.

Installation

Check seals at differential end of axle shaft and, if necessary, replace prior to installation. Install axle shaft onto differential. Install axle shafts into wheel hub, and tighten nuts to specification. To complete axle shaft installation, reverse removal procedure. Tighten nuts and bolts to specification.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
ABS Speed Sensor Bolt (AWD Rear)	15 (20)
Axle Shaft Joint Bolt	48 (65)
Front Axle Lock Nut	
AWD Rear	160 (217)
FWD	217 (294)
Front Axle Lock Bolt (FWD)	24 (32)
Lower Ball Joint-To-Control Arm Bolt	94 (127)
Rear Inboard Joint Housing Nut (AWD)	51 (69)
Tie Rod Nut	36 (49)
Upper Steering Knuckle Bolt	156 (211)
Wheel Lug Nut	76 (103)
	INCH Lbs. (N.m)
ABS Speed Sensor Bolt (FWD)	71 (8.0)

BODY CONTROL SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Body Control Systems
LEXUS

RX300

DESCRIPTION & OPERATION

The body control system controls the following systems: power door locks, remote keyless entry (wireless controls), anti-theft, rear wiper/washer, automatic light control and illuminated entry.

TROUBLE SHOOTING

NOTE: Prior to trouble shooting, ensure no problems exist in multiplex communications. If problems exist, repair multiplex control system before trouble shooting. See appropriate MULTIPLEX CONTROL SYSTEMS article.

NOTE: Check circuits and components in listed order. If circuits or components are okay, return to trouble shooting and identify next circuit to be checked.

SYMPTOM DIAGNOSIS (DOOR LOCK CONTROL SYSTEM)

Problem	Inspect
Lock Or Unlock Cannot Be Operated With Door Lock Control Switch	(2) Driver Door ECU, (2) Passenger Door ECU, (3) Body Control ECU
Door Key Link Function Does Not Operate	(2) Driver Door ECU, (2) Passenger Door ECU, (3) Body Control ECU
Key Confinement Prevention Function Does Not Operate	(1) Key Unlock Warning Switch Circuit, (3) Body Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.
(3) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.

SYMPTOM DIAGNOSIS (WIRELESS DOOR LOCK CONTROL SYSTEM)

Problem	Inspect
Wireless Door Lock Control System Does Not Operate	(1) Wireless Door Lock Transmitter, (2) Wireless Door Lock Tuner Circuit, (2) Key Unlock Warning Switch Circuit, (3) Body Control ECU
Lock Or Unlock Function Does Not Operate	(2) Driver Door Unlock

	Detection Switch Circuit, (2) Passenger Door Unlock Detection Switch Circuit, (2) Left Rear Door Unlock Detection Switch Circuit, (2) Right Rear Door Unlock Detection Switch Circuit, (4) Driver Door ECU, (4) Passenger Door ECU, (4) Left Rear Door ECU, (4) Right Rear Door ECU, (3) Body Control ECU
Auto Lock Function Operates When Any Door Is Opened Within 30 Seconds After Unlocking All Doors With Wireless Door Lock Control System	(2) Driver Door Courtesy Light & Courtesy Switch Circuit, (2) Passenger Door Courtesy Light & Courtesy Switch Circuit, (2) Left Rear Door Courtesy Light & Courtesy Switch Circuit, (2) Right Rear Door Courtesy Light & Courtesy Switch Circuit, (4) Driver Door ECU, (4) Passenger Door ECU, (4) Left Rear Door ECU, (4) Right Rear Door ECU, (3) Body Control ECU
Wireless Door Lock Operates, But Buzzer Does Not Sound	(2) Wireless Door Lock Buzzer Circuit, (3) Body Control ECU
Buzzer Sounds, But Wireless Door Lock Function Does Not Operate	(3) Body Control ECU

(1) - Check transmitter operation.
(2) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(3) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.
(4) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

SYMPTOM DIAGNOSIS (ANTI-THEFT SYSTEM)

Problem	Inspect
System Cannot Be Set	(1) Anti-Theft Indicator Circuit, (1) Key Unlock Warning Switch Circuit, (1) Driver Door Courtesy Light & Courtesy Switch Circuit, (1) Passenger Door Courtesy Light & Courtesy Switch Circuit, (1) Left Rear Door Courtesy Light & Courtesy Switch Circuit, (1) Right Rear Door Courtesy Light & Courtesy Switch Circuit, (1) Driver Door Unlock Detection

	Switch Circuit, (1) Passenger Door Unlock Detection Switch Circuit, (1) Left Rear Door Unlock Detection Switch Circuit, (1) Right Rear Door Unlock Detection Switch Circuit, (1) Engine Hood Courtesy Switch Circuit, (1) Back Door Courtesy Switch Circuit, (2) Driver Door ECU, (2) Passenger Door ECU, (2) Left Rear Door ECU, (2) Right Rear Door ECU, (3) Body Control ECU
System Cannot Be Canceled When Ignition Is In ON Position	(1) Key Unlock Warning Switch Circuit, (4) Ignition Switch Circuit, (3) Body Control ECU
System Does Not Cancel When Back Door Is Opened With Key	(1) Back Door Key Lock & Unlock Switch Circuit, (3) Body Control ECU
Headlights Do Not Operate Properly With System	(1) Headlight Relay Circuit, (3) Body Control ECU
Taillights Do Not Operate Properly With System	(1) Taillight Relay Circuit, (3) Body Control ECU
Anti-Theft Horn & Standard Horn Does Not Sound	(1) Anti-Theft Horn Circuit, (1) Standard Horn Circuit, (3) Body Control ECU
Hazards Do Not Operate Properly With System	(1) Hazard Switch Circuit, (3) Body Control ECU
During Warning Condition, System Cannot Be Canceled By Unlocking Door With Key	(1) Driver Door Key Lock & Unlock Switch Circuit, (1) Passenger Door Key Lock & Unlock Switch Circuit, (2) Driver Door ECU, (2) Passenger Door ECU, (3) Body Control ECU
During Warning Condition, System Cannot Be Canceled By Unlocking Door With Transmitter	(5) Wireless Door Lock Transmitter, (1) Wireless Door Lock Tuner Circuit, (3) Body Control ECU
During Warning Condition, System Cannot Be Canceled By Turning Ignition To ACC Or ON Position Using Key	(4) Ignition Switch Circuit, (1) Key Unlock Warning Switch Circuit, (3) Body Control ECU
Horns Sounded For More Than 60 Seconds	(3) Body Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.
(3) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.
(4) - Check ignition switch. See STEERING COLUMN SWITCHES article.
(5) - Check transmitter operation.

SYMPTOM DIAGNOSIS (REAR WIPER/WASHER SYSTEM)

Problem	Inspect
Rear Wipers Do Not Operate	(1) Wiper/Washer Switch Circuit, (1) Rear Wiper Motor Circuit, (2) Body Control ECU
Rear Washers Do Not Operate	(1) Wiper/Washer Switch Circuit, (1) Rear Washer Motor Circuit, (3) Wiring Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.
(3) - Check wiring harness for opens or shorts. See WIRING DIAGRAMS in appropriate WIPER/WASHER SYSTEMS article. Repair or replace as necessary, and retest system operation.

SYMPTOM DIAGNOSIS (LIGHT CONTROL SYSTEM)

Problem	Inspect
Automatic Light Control Does Not Operate	(1) Light Sensor Circuit, (1) Headlight Control Switch Circuit, (2) Body Control ECU
Automatic Turn Off Does Not Operate	(1) Driver Door Courtesy Switch Circuit, (3) Ignition Switch, (2) Driver Door ECU, (4) Body Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.
(3) - Check ignition switch. See STEERING COLUMN SWITCHES article.
(4) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.

SYMPTOM DIAGNOSIS (ILLUMINATED ENTRY CONTROL SYSTEM)

Problem	Inspect
Illuminated Entry Does Not Operate Properly	(1) Illumination Circuit, (2) Body Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more

than one circuit test is listed, perform tests in order listed.
(2) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.

SYMPTOM DIAGNOSIS (MISCELLANEOUS)

Problem	Inspect
A/C Control Panel & Multi Display Does Not Deteriorate	(1) Rheostat Light Control Circuit, (2) Body Control ECU
Body Control ECU Does Not Operate	(1) ECU Power Source Circuit, (2) Body Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.

CIRCUIT TESTS

* PLEASE READ THIS FIRST *

NOTE: Perform circuit tests in order listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

NOTE: If LEXUS scan tool is available for the following circuit tests, connect scan tool to Data Link Connector 3 (DLC3) located under left side of instrument panel.

ANTI-THEFT HORN CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Connect a jumper wire between DLC1 connector terminals E1 and Tc. See Fig. 1. Using scan tool, operate anti-theft horn in ACTIVE TEST. If anti-theft horn does not operate, go to next step. If anti-theft horn operates, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check anti-theft horn. See ANTI-THEFT HORN under COMPONENT TESTS. Replace anti-theft horn as necessary. Retest system operation. If anti-theft horn is okay, go to next step.

3) Check circuits for faults between anti-theft horn and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

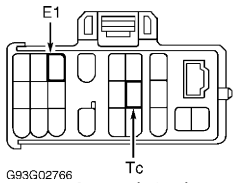


Fig. 1: Identifying DLC1 Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ANTI-THEFT INDICATOR CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Connect a jumper wire between DLC1 connector terminals E1 and Tc. See Fig. 1. Using scan tool, operate anti-theft indicator in ACTIVE TEST. If anti-theft indicator does not operate, go to next step. If anti-theft indicator operates, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check anti-theft indicator. See ANTI-THEFT INDICATOR under COMPONENT TESTS. Replace anti-theft indicator as necessary. Retest system operation. If anti-theft indicator is okay, go to next step.

3) Check circuits for faults between anti-theft indicator, body control ECU and ground. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

BACK DOOR KEY LOCK & UNLOCK SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check back door key lock and unlock switch using DATA LIST. If back door key lock and unlock switch is faulty, go to next step. If back door key lock and unlock switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check back door key lock and unlock switch. See DOOR KEY LOCK & UNLOCK SWITCH under COMPONENT TESTS. Replace switch as necessary. Retest system operation. If switch is okay, go to next step.

3) Check circuits for faults between back door key lock and unlock switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

DRIVER DOOR COURTESY LIGHT & COURTESY SWITCH CIRCUIT

1) Open and close driver door while observing driver door courtesy light operation. If driver door courtesy light does not illuminate when door is opened and go out when door is closed, go to next step. If driver door courtesy light operates as specified, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check driver door courtesy light. See DOOR COURTESY LIGHT under COMPONENT TESTS. Replace driver door courtesy light as necessary. Retest system operation. If driver door courtesy light is okay, go to next step.

3) Check driver door courtesy switch. See DOOR COURTESY SWITCH under COMPONENT TESTS. Replace driver door courtesy switch as necessary. Retest system operation. If driver door courtesy switch is okay, go to next step.

4) Check circuits for faults between driver door courtesy light, driver door courtesy switch and driver door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

DRIVER DOOR KEY LOCK & UNLOCK SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check for DTC B1222. If DTC B1222 is retrieved, go to next step. If DTC B1222 is not retrieved, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check driver door key lock and unlock switch. See DOOR KEY LOCK & UNLOCK SWITCH under COMPONENT TESTS. Replace switch as necessary. Retest system operation. If switch is okay, go to next step.
3) Check circuits for faults between driver door key lock and unlock switch and driver door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

DRIVER DOOR LOCK MOTOR CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate driver door lock motor in ACTIVE TEST. If door lock motor does not operate, go to next step. If door lock motor operates properly, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check driver door lock motor. See DOOR LOCK MOTOR under COMPONENT TESTS. Replace door lock motor as necessary. Retest system operation. If door lock motor is okay, go to next step.
3) Check circuits for faults between driver door lock motor and driver door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

DRIVER DOOR UNLOCK DETECTION SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check driver door unlock detection switch using DATA LIST. If door unlock detection switch is faulty, go to next step. If door unlock detection switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check driver door unlock detection switch. See DOOR UNLOCK DETECTION SWITCH under COMPONENT TESTS. Replace door unlock detection switch (motor assembly) as necessary. Retest system operation. If switch is okay, go to next step.
3) Check circuits for faults between driver door unlock detection switch and driver door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

DRIVER SEAT BELT BUCKLE SWITCH

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check driver seat belt buckle switch using DATA LIST. If driver seat belt buckle switch is faulty, go to

next step. If driver seat belt buckle switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check driver seat belt buckle switch. See SEAT BELT BUCKLE SWITCH under COMPONENT TESTS. Replace driver seat belt buckle switch as necessary. Retest system operation. If driver seat belt buckle switch is okay, go to next step.

3) Check circuits for faults between driver seat belt buckle switch, body control ECU and ground. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

ECU POWER SOURCE CIRCUIT

1) Check condition of RR WIP, RADIO NO. 2, P FR DOOR, and GAUGE fuses located in instrument panel junction block, under left side of instrument panel. If fuses are okay, go to next step. If fuse(s) are faulty, replace appropriate fuse and retest system operation.

2) Turn ignition on. Using a voltmeter, measure voltage between the following ECU connector terminals. See Fig. 2.

* Connector B5, terminal No. 8 (WIG) and connector B5, terminal No. 9 (GND1).
* Connector B8, terminal No. 18 (ACC) and connector B5, terminal No. 9 (GND1).
* Connector B8, terminal No. 5 (IG) and connector B5, terminal No. 9 (GND1).
* Connector B5, terminal No. 8 (WIG) and connector B8, terminal No. 2 (GND2).
* Connector B8, terminal No. 18 (ACC) and connector B8, terminal No. 2 (GND2).
* Connector B8, terminal No. 5 (IG) and connector B8, terminal No. 2 (GND2).

If voltages are not 10-14 volts, go to next step. If voltages are 10-14 volts, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

3) Turn ignition off. Disconnect body control ECU connector (located under left side of instrument panel). Turn ignition on. Using a voltmeter, measure voltage between the following ECU connector terminals.

* Connector B8, terminal No. 4 (BSUB) and connector B5, terminal No. 9 (GND1).
* Connector B5, terminal No. 2 (BECU) and connector B5, terminal No. 9 (GND1).
* Connector B8, terminal No. 4 (BSUB) and connector B8, terminal No. 2 (GND2).
* Connector B5, terminal No. 2 (BECU) and connector B8, terminal No. 2 (GND2).

If voltages are not 10-14 volts, go to next step. If voltages are 10-14 volts, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

4) Check circuits for faults between body ground and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, check and repair circuits between body control ECU and battery. Retest system operation.

ENGINE HOOD COURTESY SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start

test from step 2).

1) Using scan tool, check engine hood courtesy switch using DATA LIST. If engine hood courtesy switch is faulty, go to next step. If engine hood courtesy switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check engine hood courtesy switch. See ENGINE HOOD COURTESY SWITCH under COMPONENT TESTS. Replace engine hood courtesy switch as necessary. Retest system operation. If switch is okay, go to next step.
3) Check circuits for faults between engine hood courtesy switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

HAZARD SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate hazard switch in ACTIVE TEST. If hazard switch does not operate (hazard lights do not operate), go to next step. If hazard switch operates (hazard lights operate), go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check hazard switch. See HAZARD SWITCH under COMPONENT TESTS. Replace hazard switch as necessary. Retest system operation. If hazard switch is okay, go to next step.
3) Check circuits for faults between hazard switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

HEADLIGHT CONTROL SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check headlight control switch using DATA LIST. If headlight switch is faulty, go to next step. If headlight switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.
2) Check headlight control switch. See STEERING COLUMN SWITCHES article. Replace headlight control switch as necessary. Retest system operation. If headlight control switch is okay, go to next step.
3) Check circuits for faults between headlight control switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

HEADLIGHT RELAY CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate headlight relay in ACTIVE TEST. If headlight relay does not operate (headlights do not illuminate), go to next step. If headlight relay operates (headlights illuminate), go to next test listed in appropriate SYMPTOM DIAGNOSIS table under

TROUBLE SHOOTING.

2) Check headlight relay. See HEADLIGHT RELAY under COMPONENT TESTS. Replace headlight relay as necessary. Retest system operation. If headlight relay is okay, go to next step.

3) Check circuits for faults between headlight relay, body control ECU and battery. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

ILLUMINATION CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate interior lights in ACTIVE TEST. If interior lights do not operate properly, go to next step. If interior lights operate properly, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Using an ohmmeter, check continuity of bulb in question. Replace light as necessary and retest system operation. If light is okay, go to next step.

3) Check circuits for faults between interior lights, body control ECU and battery. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

KEY UNLOCK WARNING SWITCH CIRCUIT

1) Check key unlock warning switch. See STEERING COLUMN SWITCHES article. Replace switch as necessary. Retest system operation. If switch is okay, go to next step.

2) Check circuits for faults between key unlock warning switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

LEFT REAR DOOR COURTESY LIGHT & COURTESY SWITCH CIRCUIT

1) Open and close left rear door while observing left rear door courtesy light operation. If left rear door courtesy light does not illuminate when door is opened and go out when door is closed, go to next step. If left rear door courtesy light operates as specified, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check left rear door courtesy light. See DOOR COURTESY LIGHT under COMPONENT TESTS. Replace left rear door courtesy light as necessary. Retest system operation. If left rear door courtesy light is okay, go to next step.

3) Check left rear door courtesy switch. See DOOR COURTESY SWITCH under COMPONENT TESTS. Replace left rear door courtesy switch as necessary. Retest system operation. If left rear door courtesy switch is okay, go to next step.

4) Check circuits for faults between left rear door courtesy light, left rear door courtesy switch and left rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

LEFT REAR DOOR LOCK MOTOR CIRCUIT

1) Check left rear door lock motor. See DOOR LOCK MOTOR under

COMPONENT TESTS. Replace door lock motor as necessary. Retest system operation. If door lock motor is okay, go to next step.

2) Check circuits for faults between left rear door lock motor and left rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

LEFT REAR DOOR UNLOCK DETECTION SWITCH CIRCUIT

1) Check left rear door unlock detection switch. See DOOR UNLOCK DETECTION SWITCH under COMPONENT TESTS. Replace door unlock detection switch (motor assembly) as necessary. Retest system operation. If switch is okay, go to next step.

2) Check circuits for faults between left rear door unlock detection switch and left rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

LIGHT SENSOR CIRCUIT

NOTE: LEXUS scan tool must be used for this test.

1) Using scan tool, check light sensor output frequency. If light sensor output frequency is 47-1200 Hertz, go to next step. If light sensor output frequency is not 47-1200 Hertz, replace light sensor and retest system operation.

2) Check circuits for faults between light sensor and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, check body control ECU pin voltages. See BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. Replace as necessary and retest system operation.

PARKING BRAKE SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check parking brake switch using DATA LIST. If parking brake switch is faulty, go to next step. If parking brake switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check parking brake switch. See PARKING BRAKE SWITCH under COMPONENT TESTS. Replace parking brake switch as necessary. Retest system operation. If parking brake switch is okay, go to next step.

3) Check circuits for faults between parking brake switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

PASSENGER DOOR COURTESY LIGHT & COURTESY SWITCH CIRCUIT

1) Open and close passenger door while observing passenger door courtesy light operation. If passenger door courtesy light does not illuminate when door is opened and go out when door is closed, go to next step. If passenger door courtesy light operates as specified, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check passenger door courtesy light. See DOOR COURTESY LIGHT under COMPONENT TESTS. Replace passenger door courtesy light as necessary. Retest system operation. If passenger door courtesy light is okay, go to next step.

3) Check passenger door courtesy switch. See DOOR COURTESY SWITCH under COMPONENT TESTS. Replace passenger door courtesy switch as necessary. Retest system operation. If passenger door courtesy switch is okay, go to next step.

4) Check circuits for faults between passenger door courtesy light, passenger door courtesy switch and passenger door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

PASSENGER DOOR KEY LOCK & UNLOCK SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check for DTC B1224. If DTC B1224 is retrieved, go to next step. If DTC B1224 is not retrieved, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check passenger door key lock and unlock switch. See DOOR KEY LOCK & UNLOCK SWITCH under COMPONENT TESTS. Replace switch as necessary. Retest system operation. If switch is okay, go to next step.

3) Check circuits for faults between passenger door key lock and unlock switch and passenger door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

PASSENGER DOOR LOCK CONTROL SWITCH CIRCUIT

Passenger door lock control switch is part of passenger door ECU. To check passenger door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

PASSENGER DOOR LOCK MOTOR CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate passenger door lock motor in ACTIVE TEST. If door lock motor does not operate, go to next step. If door lock motor operates properly, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check passenger door lock motor. See DOOR LOCK MOTOR under COMPONENT TESTS. Replace door lock motor as necessary. Retest system operation. If door lock motor is okay, go to next step.

3) Check circuits for faults between passenger door lock motor and passenger door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

PASSENGER DOOR UNLOCK DETECTION SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check passenger door unlock detection switch using DATA LIST. If door unlock detection switch is faulty, go to next step. If door unlock detection switch is okay, go to next test

listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check passenger door unlock detection switch. See DOOR UNLOCK DETECTION SWITCH under COMPONENT TESTS. Replace door unlock detection switch (motor assembly) as necessary. Retest system operation. If switch is okay, go to next step.

3) Check circuits for faults between passenger door unlock detection switch and passenger door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

POWER WINDOW MASTER SWITCH/DRIVER DOOR LOCK CONTROL SWITCH CIRCUIT

Power window master switch/driver door lock control switch is part of driver door ECU. To check driver door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

REAR INTERIOR LIGHT & BACK DOOR COURTESY SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check back door courtesy switch using DATA LIST. If back door courtesy switch is faulty, go to next step. If back door courtesy switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check back door courtesy switch. See BACK DOOR COURTESY SWITCH under COMPONENT TESTS. Replace back door courtesy switch as necessary. Retest system operation. If switch is okay, go to next step.

3) Check circuits for faults between back door courtesy switch and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

REAR WASHER MOTOR CIRCUIT

Disconnect washer motor 3-pin connector. Using a voltmeter, measure voltage between terminal No. 2 (Blue/White wire) and ground. See WIRING DIAGRAMS. If battery voltage is present, check washer motor. See appropriate WIPER/WASHER SYSTEMS article. Replace washer motor as necessary. Retest system operation. If battery voltage is not present, check wire harness, connectors and 10-amp WASHER fuse located in instrument panel junction block, under left side of instrument panel. Repair or replace as necessary. Retest system operation.

REAR WIPER MOTOR CIRCUIT

Rear wiper motor circuit testing information is not available from manufacturer. To check rear wiper motor, go to appropriate WIPER/WASHER SYSTEMS article.

RHEOSTAT LIGHT CONTROL CIRCUIT

Rheostat light control circuit testing information is not available from manufacturer. To check rheostat light control, go to appropriate INSTRUMENT PANELS article.

RIGHT REAR DOOR COURTESY LIGHT & COURTESY SWITCH CIRCUIT

1) Open and close right rear door while observing right rear door courtesy light operation. If right rear door courtesy light does not illuminate when door is opened and go out when door is closed, go to next step. If right rear door courtesy light operates as specified, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check right rear door courtesy light. See DOOR COURTESY LIGHT under COMPONENT TESTS. Replace right rear door courtesy light as necessary. Retest system operation. If right rear door courtesy light is okay, go to next step.

3) Check right rear door courtesy switch. See DOOR COURTESY SWITCH under COMPONENT TESTS. Replace right rear door courtesy switch as necessary. Retest system operation. If right rear door courtesy switch is okay, go to next step.

4) Check circuits for faults between right rear door courtesy light, right rear door courtesy switch and right rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

RIGHT REAR DOOR LOCK MOTOR CIRCUIT

1) Check right rear door lock motor. See DOOR LOCK MOTOR under COMPONENT TESTS. Replace door lock motor as necessary. Retest system operation. If door lock motor is okay, go to next step.

2) Check circuits for faults between right rear door lock motor and right rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

RIGHT REAR DOOR UNLOCK DETECTION SWITCH CIRCUIT

1) Check right rear door unlock detection switch. See DOOR UNLOCK DETECTION SWITCH under COMPONENT TESTS. Replace door unlock detection switch (motor assembly) as necessary. Retest system operation. If switch is okay, go to next step.

2) Check circuits for faults between right rear door unlock detection switch and right rear door ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

STANDARD HORN CIRCUIT

1) Check standard horn. See STANDARD HORN under COMPONENT TESTS. Replace standard horn as necessary. Retest system operation. If standard horn is okay, go to next step.

2) Check circuits for faults between horn relay, body control ECU and battery. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

STOPLIGHT SWITCH CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, check stoplight switch using DATA LIST. If stoplight switch is faulty, go to next step. If stoplight switch is okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check stoplight switch. See STOPLIGHT SWITCH under

COMPONENT TESTS. Replace stoplight switch as necessary. Retest system operation. If stoplight switch is okay, go to next step.

3) Check circuits for faults between stoplight switch, body control ECU and battery. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

TAILLIGHT RELAY CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate taillight relay in ACTIVE TEST. If taillight relay does not operate (taillights do not operate), go to next step. If taillight relay operates (taillights operate), go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check taillight relay. See TAILLIGHT RELAY under COMPONENT TESTS. Replace taillight relay as necessary. Retest system operation. If taillight relay is okay, go to next step.

3) Check circuits for faults between taillight relay, body control ECU and battery. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

WIPER/WASHER SWITCH CIRCUIT

Wiper/washer switch circuit testing information for rear wiper system is not available from manufacturer. To check wiper/washer switch, go to appropriate WIPER/WASHER SYSTEMS article.

WIRELESS DOOR LOCK BUZZER CIRCUIT

NOTE: If LEXUS scan tool is available, start test from step 1). If this scan tool is not available, start test from step 2).

1) Using scan tool, operate wireless door lock buzzer in ACTIVE TEST. If wireless door lock buzzer does not operate, go to next step. If wireless door lock buzzer operates, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check wireless door lock buzzer. See WIRELESS DOOR LOCK BUZZER under COMPONENT TESTS. Replace wireless door lock buzzer as necessary. Retest system operation. If buzzer is okay, go to next step.

3) Check circuits for faults between wireless door lock buzzer and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary. If circuits are okay, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

WIRELESS DOOR LOCK TUNER CIRCUIT

1) Using scan tool, check for DTC 42. If DTC 42 is not retrieved, go to next step. If DTC 42 is retrieved, check for faults in Blue wire between wireless door lock tuner and body control ECU. See WIRING DIAGRAMS. Repair or replace as necessary.

2) Check circuits for faults between wireless door lock tuner and body control ECU. See WIRING DIAGRAMS. Repair or replace circuits as necessary. If circuits are okay, go to next step.

3) Replace original wireless door lock tuner with known-good unit and ensure it recovers normally. If tuner recovers normally,

original wireless door lock tuner failed. If tuner does not recover normally, go to next test listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

COMPONENT TESTS

ANTI-THEFT HORN

Disconnect anti-theft horn connector (located in right rear corner of engine compartment). Connect battery positive lead to terminal No. 1 (Light Green/Black wire) and negative battery lead to horn body. See WIRING DIAGRAMS. If horn does not operate, replace horn. If horn operates, repair or replace wire harness and connectors between anti-theft horn, body control ECU and ground.

ANTI-THEFT INDICATOR

Disconnect indicator light 3-pin connector. Connect battery positive lead to terminal No. 3 (Light Green wire) and negative battery lead to terminal No. 1 (White/Black wire). See WIRING DIAGRAMS. If indicator light does not come on, replace light control rheostat and retest system operation. If indicator light comes on, repair or replace wire harness and connectors between indicator light and body control ECU.

BACK DOOR COURTESY SWITCH

Remove back door courtesy switch. Using an ohmmeter, check continuity between back door courtesy switch terminals. Continuity should exist with switch pin released. Continuity should not exist with switch pin pressed. If continuity is not as specified, replace courtesy switch and retest system operation.

BODY CONTROL ECU PIN VOLTAGE TESTS

NOTE: Perform this procedure only after performing tests listed in appropriate SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING and system still does not operate properly. See TROUBLE SHOOTING.

Turn ignition on. Using DVOM, measure voltage by backprobing between the following body control ECU connector terminals. See Fig. 2 . If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, replace body control ECU.

B5-1 (Blue/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door motor activated to lock, voltage should be less than one volt. With back door motor not operated, voltage should be 10-14 volts.

B5-2 (Gray/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
During all conditions, voltage should be 10-14 volts.

B5-3 (Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With rear wiper switch in OFF position, voltage should be less than one volt. With rear wiper switch in ON position and ignition switch in ON position, voltage should be 10-14 volts.

B5-4 (Blue/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in OFF position, voltage should be less than one volt. With ignition switch in ON position, voltage should be 10-14 volts.

B5-5 (Light Green/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With anti-theft system set, back door key lock and unlock switch off and back door open, voltage should change from 10-14 volts to less than one volt.

B5-6 (Blue/Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door lock motor activated to unlock, voltage should be less than one volt. With back door lock motor not operated, voltage should be 10-14 volts.

B5-7 (Blue/Orange Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With rear wiper operated, voltage should be 10-14 volts. With rear wiper stopped, voltage should be less than one volt.

B5-8 (Blue/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in OFF position, voltage should be less than one volt. With ignition switch in ON position, voltage should be 10-14 volts.

B5-9 (White/Black Wire) & Body Ground
During all conditions, voltage should be less than one volt.

B5-12 (Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With light control switch in OFF or TAIL position, voltage should be 10-14 volts. With light control switch in HEAD position, voltage should be less than one volt.

B5-14 (Gray/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With engine running and parking brake switch in OFF position, voltage should be less than one volt. With engine running and parking brake switch in ON position or light control switch in HEAD position, voltage should be 10-14 volts.

B5-15 (Red/Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With light control switch in OFF or TAIL position, voltage should be 10-14 volts. With light control switch in HEAD position, voltage should be less than one volt.

B5-16 (Gray/Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With light control switch in OFF position, voltage should be 10-14 volts. With light control switch in TAIL or HEAD position, voltage should be less than one volt.

B5-17 (Green Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door locked, voltage should be 10-14 volts. With back door unlocked, voltage should be less than one volt.

B6-4 (Pink Wire) & B5-9 (White/Black Wire); B8-2 (White/Black

Wire)
With light control switch in any position except AUTO, voltage should be less than one volt. With light control switch in AUTO position, voltage should be 10-14 volts.

B6-5 (Red/White Wire) & Body Ground
With headlight dimmer switch in LOW position, voltage should be 10-14 volts. With headlight dimmer switch in HI or FLASH position, voltage should be less than one volt.

B6-7 (Gray/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With headlight dimmer switch in LOW position and fog light switch in OFF position, voltage should be 10-14 volts. With headlight dimmer switch in LOW position and fog light switch in ON position, voltage should be less than one volt.

B6-10 (White/Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With horn switch in OFF position, voltage should be 10-14 volts. With horn switch in ON position, voltage should be less than one volt.

B6-15 (Blue/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With wireless door lock operated, voltage should be 4-5 volts. With wireless door lock not operated, voltage should change from 4-5 volts to less than one volt.

B6-18 (Light Green/Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door key lock and unlock switch in OFF or LOCK position, voltage should be 10-14 volts. With back door key lock and unlock switch in UNLOCK position, voltage should be less than one volt.

B6-19 (Blue/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door key lock and unlock switch in OFF or UNLOCK position, voltage should be 10-14 volts. With back door key lock and unlock switch in LOCK position, voltage should be less than one volt.

B7-2 (Gray Wire) & B7-3 (Light Green Wire)
With wireless door lock buzzer sounding, voltage should be 10-14 volts. With wireless door lock buzzer not sounding, voltage should be less than one volt.

B7-5 (White/Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With back door courtesy light switch in OFF position (closed), voltage should be 10-14 volts. With back door courtesy light switch in ON position (open), voltage should be less than one volt.

B7-6 (White/Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With engine hood courtesy light switch in OFF position (closed), voltage should be 10-14 volts. With engine hood courtesy light switch in ON position (open), voltage should be less than one volt.

B7-7 (Gray/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With driver’s seat belt buckle switch in OFF position (belt

fastened), voltage should be 10-14 volts. With driver's seat belt buckle switch in ON position (belt unfastened), voltage should be less than one volt.

B7-8 (Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With key inserted in ignition, voltage should be less than one volt. With key not inserted in ignition, voltage should be 10-14 volts.

B7-9 (Blue/Orange Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and blower motor not operating, voltage should 10-14 volts. With ignition switch in ON position and blower motor operating, voltage should be less than one volt.

B7-10 (Red/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With each door open, voltage should be less than 2 volts. With all doors closed, voltage should be 10-14 volts.

B7-12 (Green/Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and rear wiper switch in OFF, WASH1 or INT position, voltage should be 10-14 volts. With ignition switch in ON position and rear wiper switch in ON or WASH2 position, voltage should be less than one volt.

B7-13 (Blue/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and rear wiper switch in OFF, ON or INT position, voltage should be 10-14 volts. With ignition switch in ON position and rear wiper switch in WASH1 or WASH2 position, voltage should be less than one volt.

B7-17 (Red/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and brake fluid warning switch in ON position, voltage should be less than one volt. With ignition switch in ON position and brake fluid warning switch in OFF position, voltage should be 10-14 volts.

B7-18 (Gray/Orange Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With stoplight switch in OFF position, voltage should be less than one volt. With stoplight switch in ON position, voltage should be 10-14 volts.

B7-19 (Red/Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and parking brake switch in OFF position, voltage should be 10-14 volts. With ignition switch in ON position and parking brake switch in ON position, voltage should be less than one volt.

B7-20 (Red Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With headlight dimmer switch in LOW or HI position, voltage should be 10-14 volts. With headlight dimmer switch in FLASH position, voltage should be less than one volt.

B7-21 (Green/Red Wire) & B5-9 (White/Black Wire); B8-2

(White/Black Wire)
With ignition switch in ON position and rear wiper switch in any position except INT, voltage should be 10-14 volts. With ignition switch in ON position and rear wiper switch in INT position, voltage should be less than one volt.

B8-2 (White/Black Wire) & Body Ground
During all conditions, voltage should be less than one volt.

B8-4 (Blue/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
During all conditions, voltage should be 10-14 volts.

B8-5 (Red/Blue Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ACC or OFF position, voltage should be less than one volt. With ignition switch in ON position, voltage should be 10-14 volts.

B8-6 (Brown/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With fog light switch in OFF position, voltage should be 10-14 volts. With fog light switch in ON position, voltage should be less than one volt.

B8-7 (Gray/White Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in ON position and light control switch in OFF position, voltage should be 10-14 volts. With ignition switch in ON position and light control switch in TAIL position, voltage should be less than one volt.

B8-11 (Light Green/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With hazard warning switch in OFF position, voltage should be 10-14 volts. With hazard warning switch in ON position, voltage should be less than one volt.

B8-15 (Yellow/Black Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With pattern select switch in SNOW position, voltage should be less than one volt. With pattern select switch in any position except SNOW and ignition switch in ON position, voltage should be 10-14 volts.

B8-16 (Light Green Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With anti-theft indicator light illuminated, voltage should be 3-6 volts. Without anti-theft indicator light illuminated, voltage should be less than one volt.

B8-17 (Brown/Yellow Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With rear defogger switch in OFF position, voltage should be 10-14 volts. With rear defogger switch in ON position, voltage should be less than one volt.

B8-18 (Green Wire) & B5-9 (White/Black Wire); B8-2 (White/Black Wire)
With ignition switch in OFF position, voltage should be less than one volt. With ignition switch in ACC position, voltage should be 10-14 volts.

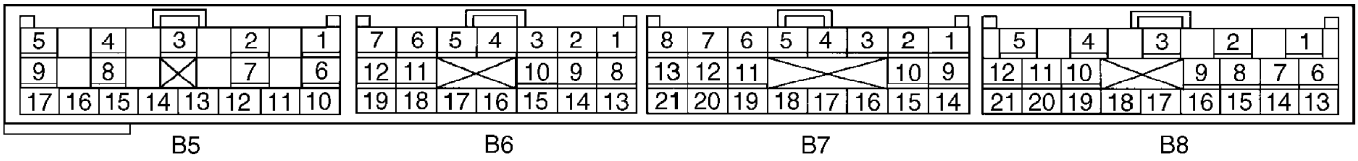


Fig. 2: Identifying Body Control ECU Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DOOR COURTESY LIGHT

Remove door courtesy light. Using an ohmmeter, check continuity between courtesy light bulb terminals. Continuity should exist. If continuity does not exist, replace courtesy light bulb and retest system operation.

DOOR COURTESY SWITCH

Remove door courtesy switch. Using an ohmmeter, check continuity between courtesy switch terminals. Continuity should exist with switch pin released. Continuity should not exist with switch pin pressed. If continuity is not as specified, replace courtesy switch and retest system operation.

DOOR KEY LOCK & UNLOCK SWITCH

Back Door

1) Remove door trim panel and service hole cover. Disconnect 3-pin electrical connector from door key lock and unlock switch. Connect ohmmeter between terminals No. 1 (White/Black wire) and No. 2 (Blue/White wire) of door key lock and unlock switch connector (component side). See WIRING DIAGRAMS. When door is locked, continuity should exist. When door is unlocked, continuity should not exist.

2) Connect ohmmeter between terminals No. 1 (White/Black wire) and No. 3 (Light Green/Red wire) of door key lock and unlock switch connector (component side). When door is unlocked, continuity should exist. When door is locked, continuity should not exist. If continuity is not as specified, replace door key lock and unlock switch and retest system operation.

Left Front Door

1) Remove door trim panel and service hole cover. Disconnect 6-pin electrical connector from door lock motor. Connect ohmmeter between terminals No. 3 (Gray/Red wire) and No. 5 (Pink wire) of door lock motor connector (component side). See WIRING DIAGRAMS. When door is locked, continuity should exist. When door is unlocked, continuity should not exist.

2) Connect ohmmeter between terminals No. 3 (Gray/Red wire) and No. 6 (Pink/Blue wire) of door lock motor connector (component side). When door is unlocked, continuity should exist. When door is locked, continuity should not exist. If continuity is not as specified, replace door key lock and unlock switch and retest system operation.

Right Front Door

1) Remove door trim panel and service hole cover. Disconnect 6-pin electrical connector from door lock motor. Connect ohmmeter between terminals No. 3 (Gray wire) and No. 2 (Pink wire) of door lock motor connector (component side). See WIRING DIAGRAMS. When door is locked, continuity should exist. When door is unlocked, continuity should not exist.

2) Connect ohmmeter between terminals No. 3 (Gray wire) and

No. 1 (Pink/Blue wire) of door lock motor connector (component side). When door is unlocked, continuity should exist. When door is locked, continuity should not exist. If continuity is not as specified, replace door key lock and unlock switch and retest system operation.

DOOR LOCK MOTOR

Back Door

Remove door trim panel and service hole cover. Disconnect 4-pin electrical connector from door lock motor. Connect positive battery lead to door lock motor connector (component side) terminal No. 3 (Blue/Red wire) and negative battery lead to terminal No. 2 (Blue/Black wire). See WIRING DIAGRAMS. Door lock link should move to unlock position. Reverse battery leads (polarity). Door lock link should move to lock position. If door lock motor does not operate as specified, replace door lock motor and retest system operation.

Left Front Door

Remove door trim panel and service hole cover. Disconnect 6-pin electrical connector from door lock motor. Connect positive battery lead to door lock motor connector (component side) terminal No. 1 (Blue/Yellow wire) and negative battery lead to terminal No. 2 (Blue/Red wire). See WIRING DIAGRAMS. Door lock link should move to unlock position. Reverse battery leads (polarity). Door lock link should move to lock position. If door lock motor does not operate as specified, replace door lock motor and retest system operation.

Left Rear Door

Remove door trim panel and service hole cover. Disconnect 4-pin electrical connector from door lock motor. Connect positive battery lead to door lock motor connector (component side) terminal No. 1 (Blue/Black wire) and negative battery lead to terminal No. 2 (Blue/Red wire). See WIRING DIAGRAMS. Door lock link should move to unlock position. Reverse battery leads (polarity). Door lock link should move to lock position. If door lock motor does not operate as specified, replace door lock motor and retest system operation.

Right Front Door

Remove door trim panel and service hole cover. Disconnect 6-pin electrical connector from door lock motor. Connect positive battery lead to door lock motor connector (component side) terminal No. 5 (Blue/Yellow wire) and negative battery lead to terminal No. 6 (Blue/Red wire). See WIRING DIAGRAMS. Door lock link should move to unlock position. Reverse battery leads (polarity). Door lock link should move to lock position. If door lock motor does not operate as specified, replace door lock motor and retest system operation.

Right Rear Door

Remove door trim panel and service hole cover. Disconnect 4-pin electrical connector from door lock motor. Connect positive battery lead to door lock motor connector (component side) terminal No. 3 (Blue/Black wire) and negative battery lead to terminal No. 4 (Blue/Red wire). See WIRING DIAGRAMS. Door lock link should move to unlock position. Reverse battery leads (polarity). Door lock link should move to lock position. If door lock motor does not operate as specified, replace door lock motor and retest system operation.

DOOR UNLOCK DETECTION SWITCH

Left Front Door

1) Remove door trim panel and service hole cover. Disconnect electrical connector from door lock motor. Connect ohmmeter between door lock motor connector (component side) terminals No. 4 (Gray wire)

and No. 3 (Green/Red wire). See WIRING DIAGRAMS.
2) When door is locked, continuity should not exist. When door is unlocked, continuity should exist. If continuity is not as specified, replace door unlock detection switch and retest system operation.

Left Rear Door
1) Remove door trim panel and service hole cover. Disconnect electrical connector from door lock motor. Connect ohmmeter between door lock motor connector (component side) terminals No. 3 (Gray wire) and No. 4 (Green/Red wire). See WIRING DIAGRAMS.
2) When door is locked, continuity should not exist. When door is unlocked, continuity should exist. If continuity is not as specified, replace door unlock detection switch and retest system operation.

Right Front Door
1) Remove door trim panel and service hole cover. Disconnect electrical connector from door lock motor. Connect ohmmeter between door lock motor connector (component side) terminals No. 3 (Gray wire) and No. 4 (Green/Red wire). See WIRING DIAGRAMS.
2) When door is locked, continuity should not exist. When door is unlocked, continuity should exist. If continuity is not as specified, replace door unlock detection switch and retest system operation.

Right Rear Door
1) Remove door trim panel and service hole cover. Disconnect electrical connector from door lock motor. Connect ohmmeter between door lock motor connector (component side) terminals No. 2 (Gray wire) and No. 1 (Green/Red wire). See WIRING DIAGRAMS.
2) When door is locked, continuity should not exist. When door is unlocked, continuity should exist. If continuity is not as specified, replace door unlock detection switch and retest system operation.

ENGINE HOOD COURTESY SWITCH

Remove engine hood courtesy switch. Using an ohmmeter, check continuity between engine hood courtesy switch terminals. Continuity should exist with switch pin released. Continuity should not exist with switch pin pressed. If continuity is not as specified, replace courtesy switch and retest system operation.

HAZARD SWITCH

Remove hazard switch. With hazard switch in OFF position, continuity should exist between switch terminals No. 5 and 6. See Fig. 3. With hazard switch in ON position, continuity should exist between terminals No. 5 and 6. With hazard switch in either position, continuity should exist between terminals No. 8 and 9 (illumination circuit). If continuity is not as specified, replace hazard switch and retest system operation.

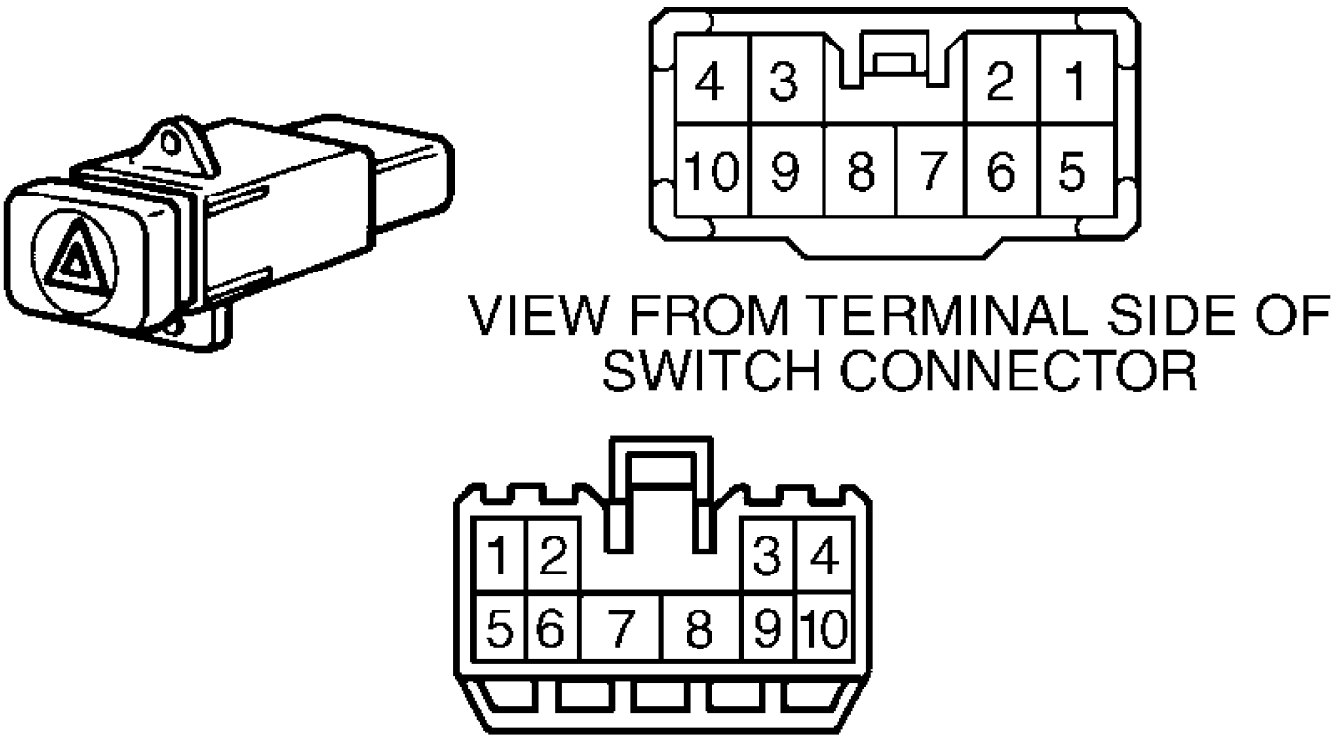


Fig. 3: Identifying Hazard Switch Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

HEADLIGHT RELAY

Remove headlight relay (located in junction block, on left side of engine compartment). Using an ohmmeter, check continuity between relay terminals. Continuity should exist between terminals No. 3 and 4. See Fig. 4. Apply battery voltage and ground between terminals No. 3 and 4. Continuity should exist between terminals No. 1 and 2. If continuity is not as specified, replace headlight relay and retest system operation.

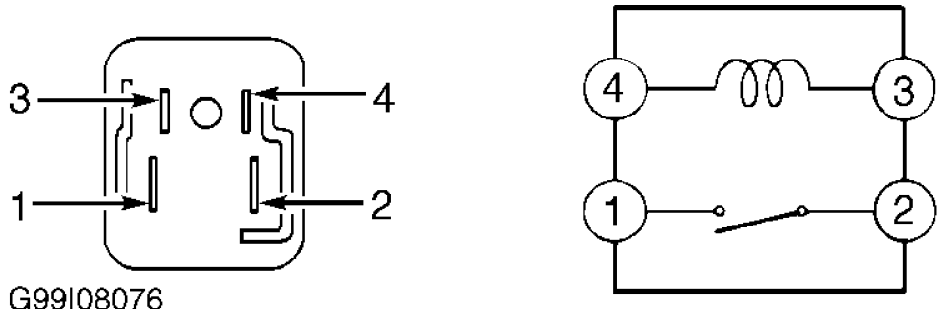


Fig. 4: Identifying Headlight Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARKING BRAKE SWITCH

Disconnect parking brake switch connector (located on parking brake). Using an ohmmeter, check continuity between parking brake switch terminal and switch body. With switch pin released (switch on), continuity should exist. With switch pin pressed (switch off), continuity should not exist. If continuity is not as specified, replace parking brake switch and retest system operation.

SEAT BELT BUCKLE SWITCH

Disconnect 4-pin driver-side seat belt buckle switch connector. Check for continuity between buckle switch 4-pin connector (component side) terminals No. 1 (Green/White wire) and No. 4 (White/Black wire). See WIRING DIAGRAMS. With belt fastened, continuity should exist. With belt unfastened, continuity should not exist. If continuity is not as specified, replace seat belt buckle switch and retest system operation.

STANDARD HORN

Disconnect both standard horn connectors (located behind center of grille and behind left-side of front bumper). Connect battery positive lead to terminal No. 1 (Green/White wire) and negative battery lead to horn body. See WIRING DIAGRAMS. If horn does not operate, replace horn. If horn operates, repair or replace wire harness and connectors between horn and horn relay.

STOPLIGHT SWITCH

Disconnect stoplight switch connector (located on brake pedal support). Using an ohmmeter, check continuity between stoplight switch terminals. With switch pin released (brake pedal pressed), continuity should exist between terminals No. 1 and 2, and continuity should not exist between terminals No. 3 and 4. See Fig. 5. With switch pin pressed (brake pedal released), continuity should exist between terminals No. 3 and 4, and continuity should not exist between terminals No. 1 and 2. If continuity is not as specified, replace stoplight switch and retest system operation.

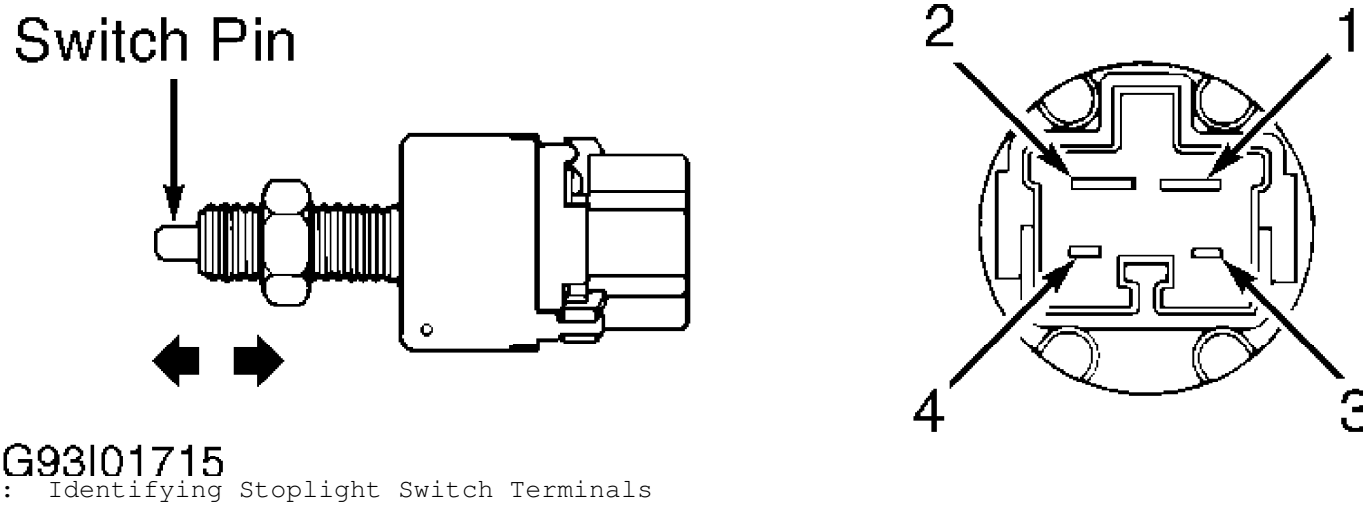


Fig. 5: Identifying Stoplight Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TAILLIGHT RELAY

Remove taillight relay (located in instrument panel junction block, behind left side of instrument panel). Using an ohmmeter, check

continuity between relay terminals. Continuity should exist between terminals No. 1 and 2. See Fig. 6. Apply battery voltage and ground between terminals No. 1 and 2. Continuity should exist between terminals No. 3 and 5. If continuity is not as specified, replace taillight relay and retest system operation.

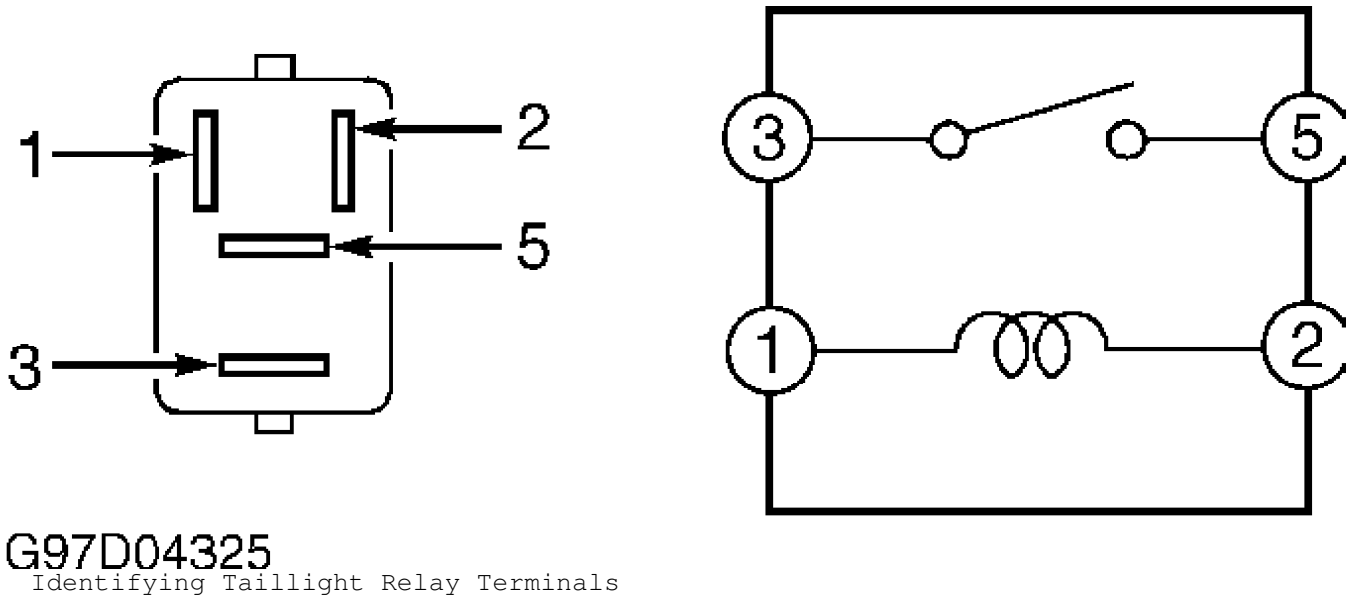


Fig. 6: Identifying Taillight Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WIRELESS DOOR LOCK BUZZER

Disconnect wireless door lock buzzer connector (located in left front corner of engine compartment). Connect ohmmeter positive lead to terminal No. 1 (Light Green wire) and negative ohmmeter lead to terminal No. 2 (Gray wire). See WIRING DIAGRAMS. Resistance should be one k/ohm. If resistance is not as specified, replace wireless door lock buzzer and retest system operation.

WIRING DIAGRAMS

NOTE: For body control system wiring diagram, see appropriate wiring diagram in MULTIPLEX CONTROL SYSTEMS - RX300 article.

* BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Brake Systems - January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes & Models

CONTENTS

OVERVIEW OF MOTORIST ASSURANCE PROGRAM
OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

ACCELEROMETERS (G SENSOR OR LATERAL)
ACCUMULATORS
ANCHOR PINS
ANTI-LOCK BRAKE SYSTEMS
BACKING PLATES
BRAKE FLUID
BRAKE FRICTION MATERIAL
BRAKE PADS
BRAKE PEDALS
BRAKE SHOES
BRAKE SHOE HARDWARE
BRAKE STOPLIGHT SWITCHES
BULB SOCKETS
BULBS AND LEDS
CALIPER HARDWARE
CALIPERS
CONTROLLERS
DIGITAL RATIO AXLE CONTROLLERS AND BUFFERS (DRAC AND DRAB)
DISABLE SWITCHES
DRUMS
ELECTRICAL PUMPS AND MOTORS
ELECTRONIC CONTROLLERS
FLUID
FLUID LEVEL SENSOR SWITCHES
FOUR WHEEL DRIVE SWITCHES
FRICTION MATERIAL
G SENSORS
HOSES
HYDRAULIC MODULATORS
HYDRO-BOOSTERS
HYDRO-ELECTRIC BOOSTERS (POWERMASTER)
IGNITION DISABLE SWITCHES
LATERAL ACCELERATION SWITCHES
LEDS
LENSES
MASTER CYLINDERS
MODULATORS
MOTORS
PARKING BRAKE SWITCHES
PARKING BRAKE SYSTEMS
PADS
PEDAL TRAVEL SWITCHES
PEDALS
POWERMASTER
PUMPS
PRESSURE DIFFERENTIAL SWITCHES
PRESSURE SWITCHES
RELAYS
ROTORS

SELF-ADJUSTING SYSTEMS
SHOE HARDWARE
SHOES
SOCKETS
SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)
STEEL BRAKE LINES
STOPLIGHT SWITCHES
SWITCHES
TIRES
TOOTHED RINGS (TONE WHEEL)
VACUUM BOOSTERS
VACUUM HOSES
VALVES
WHEEL ATTACHING HARDWARE
WHEEL BEARINGS, RACES AND SEALS
WHEEL CYLINDERS
WIRING HARNESSES

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above, standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program

adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

Example:
An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional

failure.

Example:
A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

Example:
An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

Example:
The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement
A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement
1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 – To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 – To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 – Technician's recommendation based on substantial and

informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

BRAKES

SERVICE PROCEDURES REQUIRED & SUGGESTED FOR PROPER VEHICLE OPERATION

Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.

ACCELEROMETERS (G SENSOR OR LATERAL)

ACCELEROMETER INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Loose	B	Require repair or replacement.
Missing	C	Require replacement.
Out of position	B	Require re-positioning to vehicle manufacturer's specifications.
Output signal incorrect	B	Require replacement.

ACCUMULATORS

ACCUMULATOR INSPECTION

Condition	Code	Procedure
Leaking	B	Require replacement.
Missing	C	Require replacement.
Pre-charge incorrect	B	Require replacement.

ANCHOR PINS

See BACKING PLATES.

ANTI-LOCK BRAKE SYSTEMS

NOTE: Anti-lock brakes are an integral part of the brake system. It is essential that the anti-lock brakes function properly when brake service is performed.

Anti-lock brake systems are commonly referred to as "ABS" and will be referred to as "ABS" throughout these guidelines. Some ABS components also function as part of a traction control system (TCS).

WARNING: When diagnosing and servicing high pressure components, observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.

NOTE: Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into the wiring harness.

NOTE: Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components. EMI can result in improper system operation.

BACKING PLATES

BACKING PLATE INSPECTION

Condition	Code	Procedure
Anchor pin bent	B	Require repair or replacement.
Anchor pin broken	A	Require replacement.
Anchor pin worn, affecting structural integrity	B	Require replacement.
Backing plate bent	B	Require repair or replacement.
Backing plate broken	A	Require replacement.
Backing plate cracked	B	Require repair or replacement.
Corroded, affecting structural integrity	A	Require replacement.
Loose	B	Require repair or replacement.
Missing	C	Require replacement.
Shoe lands worn	A	Require repair or replacement.

BRAKE FLUID

CAUTION: Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS.

DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid required for the brake system is stamped on the master cylinder cover.

BRAKE FLUID INSPECTION

Condition	Code	Procedure
Beyond service interval	3	Suggest flushing and refilling with correct fluid.
Brake fluid type incorrect	B	Require flushing and refilling with correct fluid.
Contaminated, for example, fluid other than brake fluid present	A or B	(1) Require service.
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling with correct fluid.
Rubber master cylinder cover gasket distorted and gummy	A	(2) Require replacement of gasket.

(1) - If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to:

* Remove all components having rubber parts from the system.

* Flush lines with denatured alcohol or brake cleaner
* Repair or replace all components having rubber parts
* Flush and fill with correct brake fluid. (Code A)

If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid. (Code B)

(2) - This condition may indicate contaminated brake fluid.

BRAKE FRICTION MATERIAL

See FRICTION MATERIAL.

BRAKE PADS

See FRICTION MATERIAL.

BRAKE PEDALS

BRAKE PEDAL INSPECTION

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement.
Broken	A	Require repair or replacement.
Pedal pad missing	C	Require replacement of pedal pad.
Pedal pad worn	1	Suggest replacement.
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings.

BRAKE SHOES

See FRICTION MATERIAL.

BRAKE SHOE HARDWARE

See also SELF-ADJUSTING SYSTEMS.

BRAKE SHOE HARDWARE INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Distorted	A	Require replacement.
Missing	C	Require replacement.
Surfaces rust-pitted	1	Suggest replacement.
Worn, affecting performance	A	Require replacement.

BRAKE STOPLIGHT SWITCHES

BRAKE STOPLIGHT INSPECTION

Condition	Code	Procedure

Condition	Code	Procedure
Bent	B	Require replacement.
Broken	A	Require replacement.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require replacement.
Connector missing	C	Require replacement.
Missing	C	Require replacement.
Out of adjustment	B	Require adjustment or replacement.
Output signal incorrect	B	Require replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause and correct prior to replacement of part.
(2) - Determine cause and correct prior to repair or replacement of part.

BULB SOCKETS

BULB SOCKET INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require repair or replacement.
Bulb seized in socket	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Connector broken	A	Require repair or replacement.
Connector missing	C	Require replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(2) Require repair or replacement.
Corroded, affecting		

performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Leaking	A	Require repair or replacement.
Melted	A	(2) Require replacement.
Shorted	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of socket.
(2) - Determine cause and correct prior to repair or replacement of part.

BULBS AND LEDS

NOTE: Copied from Electrical UIGs and modified. Does not include soldered-in components.

BULB AND LED INSPECTION

Condition	Code	Procedure
Application incorrect	B	(1) Require replacement.
Base burned, affecting performance	A	(2) Require repair or replacement.
Base burned, not affecting performance	2	(2) Suggest repair or replacement.
Base corroded, affecting performance	A	Require repair or replacement.
Base corroded, not affecting performance	2	Suggest repair or replacement.
Base loose, affecting performance	B	Require repair or replacement.
Base loose, not affecting performance	1	Suggest repair or replacement.
Burned out	A	Require replacement.
Intermittent	A	Require replacement.
Missing	C	Require replacement.
Seized in socket	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	(2) Suggest repair or replacement.
Terminal corroded,		

affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Application incorrect includes wrong bulb coating or color.
(2) - Determine cause and correct prior to repair or replacement of part.

CALIPER HARDWARE

CALIPER HARDWARE INSPECTION

Condition	Code	Procedure
Bent	A	Require repair or replacement.
Broken	A	Require repair or replacement.
Corroded, affecting performance	A	Require repair or replacement.
Dust boots on slider pin (bolt) missing	C	Require replacement of boots.
Dust boots on slider pin (bolt) torn	A	Require replacement of boots.
Missing	C	Require replacement.
Shim bent	A	(1) Require removal or replacement.
Shim (OE standard) missing	C	(2) Require replacement.
Shim out of position	B	(1) Require removal or replacement.
Shim worn	A	(1) Require removal or replacement.
Slider pin (bolt) bent	B	Require replacement of slider pin or bolt and lubricants.
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants.
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require replacement.

(1) - Removal is acceptable if shim is not OE.
(2) - Aftermarket shims may be suggested to reduce noise.

CALIPERS

You are not required to replace or rebuild calipers in axle sets. However, when replacing or rebuilding a caliper due to the conditions that follow, you may suggest servicing, rebuilding, or replacement of the other caliper (on the same axle) for improved performance and preventive maintenance (for example, the part is close to the end of its useful life, replacing the caliper may extend pad life, or contribute to more balanced braking).

CAUTION: When installing loaded calipers, it is required that friction material be matched in axle sets for consistent braking characteristics.

CALIPER INSPECTION

Condition	Code	Procedure
Bleeder port damaged	A	Require repair or replacement of caliper.
Bleeder screw broken off in caliper	A	(1) Require repair or replacement of caliper.
Bleeder screw plugged	A	(1) Require repair or replacement of bleeder screw.
Bleeder screw seized	A	(2) Require replacement of caliper.
Casting corroded, affecting structural integrity	A	Require replacement.
Casting damaged, affecting structural integrity	A	Require replacement.
Dust boot around caliper torn	A	Require replacement of dust boot.
Leaking	A	Require repair or replacement.
Mounting pin threads damaged	A	Require repair or replacement of component with damaged threads.
Mounting pin threads stripped in caliper bracket (threads missing)	A	Require repair or replacement of caliper bracket.
Mounting pin threads stripped in steering knuckle (threads missing)	A	Require repair or replacement of steering knuckle.
Mounting pin threads stripped (threads missing)	A	Require repair or replacement of component with stripped threads.
Parking brake cable support, lever, or return spring bent	A	Require replacement of parts.
Parking brake cable support, lever, or return spring broken	A	Require replacement of parts.
Parking brake mechanism in caliper inoperative	A	Require repair or replacement.
Piston corroded (pitted or peeling chrome plating)	B	Require replacement of piston and rebuilding or replacement of caliper.
Piston damaged, affecting performance	B	Require replacement of piston and rebuilding or replacement of caliper.

Piston damaged, not affecting performance	.. ..	No service suggested or required.
Piston finish worn off	.. B ...	Require replacement of piston and rebuilding or replacement of caliper.
Piston sticking	..... A	Require rebuilding or replacement of caliper.
Slide mechanism sticking	..... A ...	Require repair or replacement of slide mechanism.

(1) - Only required if the hydraulic system must be opened.
(2) - Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.

CONTROLLERS

See ELECTRONIC CONTROLLERS.

DIGITAL RATIO AXLE CONTROLLERS AND BUFFERS (DRAC AND DRAB)

DIGITAL RATIO AXLE CONTROLLER AND BUFFER INSPECTION

Condition	Code	Procedure
Connector broken	..... A ..	Require repair or replacement.
Connector (Weatherpack type) leaking	..... A ..	Require repair or replacement.
Connector melted	..... A	(1) Require replacement.
Connector missing	..... C	Require replacement.
Missing	..... C	Require replacement.
Output signal incorrect	. B ..	Require repair or replacement.
Terminal burned, affecting performance	..... A	(2) Require repair or replacement.
Terminal burned, not affecting performance	.. 2 ..	Suggest repair or replacement.
Terminal corroded, affecting performance	.. A ..	Require repair or replacement.
Terminal corroded, not affecting performance	.. 2 ..	Suggest repair or replacement.
Terminal loose, affecting performance	..... B ..	Require repair or replacement.
Terminal loose, not affecting performance	.. 1 ..	Suggest repair or replacement.

(1) - Determine cause and correct prior to replacement of part.
(2) - Determine cause and correct prior to repair or replacement of part.

DISABLE SWITCHES

See SWITCHES.

DRUMS

Determine the need to recondition based upon individual drum conditions that follow. Friction material replacement does not require

drum reconditioning unless other justifications exist. DO NOT recondition new drums unless they are being pressed or bolted onto an existing hub. It is not necessary to replace drums in axle sets. However, when replacing or reconditioning a drum due to the conditions that follow, you may suggest reconditioning of the other drum on the same axle to eliminate uneven braking behavior. Always wash drums after servicing or before installing.

DRUM INSPECTION

Condition	Code	Procedure
Balance weight missing		No service suggested or required.
Bell-mouthed, affecting performance	A	Require reconditioning or replacement.
Cooling fin broken		No service suggested or required.
Cracked	B	Require replacement.
Drum diameter is greater than OEM "machine to" specifications but less than "discard at" specifications, and the drum does not require reconditioning	1	(1) Suggest replacement.
Drum diameter will exceed OEM "machine to" specifications after required reconditioning	B	(2) Require replacement.
Hard-spotted	2	Suggest reconditioning or replacement.
Measured diameter is greater than OEM discard specifications	B	Require replacement.
Out-of-round (runout), affecting performance	A	Require reconditioning or replacement.
Out-of-round (runout), exceeding manufacturer's specifications	B	Require reconditioning or replacement.
Scored	B	Require reconditioning or replacement.
Surface threaded due to improper machining	B	Require reconditioning or replacement.
Tapered, affecting performance	A	Require reconditioning or replacement.

(1) - Only applies to vehicles for which OEM "machine to" specifications exist. If OEM does not supply "machine to" specifications, the drum may be worn to discard specifications.
(2) - If OEM does not supply "machine to" specifications, you may machine to discard specifications.

Copied fuel pump conditions from engine UIGs & deleted pulsator from leaking conditions.

ELECTRICAL PUMP AND MOTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require replacement.
Inoperative	A	(3) Require repair or replacement.
Leaking externally	A	Require repair or replacement.
Leaking internally	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specifications.

ELECTRONIC CONTROLLERS

ELECTRONIC CONTROLLER INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Code set (if applicable)	A	(1) Further inspection required.
Connector broken	A	Require repair or replacement.
Connector melted	A	(2) Require repair or replacement.
Connector missing	A	Require repair.
Contaminated	A	Require repair or replacement.
Inoperative	B	Require repair or replacement. (3) Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).
(2) - Determine cause and correct prior to repair or replacement of part.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable. Check for accepted cleaning procedure.

FLUID

See BRAKE FLUID.

FLUID LEVEL SENSOR SWITCHES

See SWITCHES.

FOUR WHEEL DRIVE SWITCHES

See SWITCHES.

FRICTION MATERIAL

NOTE: Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses.

CAUTION: It is required that friction material be matched in axle sets for consistent braking characteristics.

FRICTION MATERIAL INSPECTION

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	(1) Require replacement.
Cracked through	B	Require replacement.
Flaking or chunking	B	Require replacement.
Glazed (shiny)	..	No service suggested or required.
Grooves or ridges	..	(2) No service suggested or required.
Permanently attached hardware bent	A	Require replacement.
Permanently attached hardware broken	A	Require replacement.
Permanently attached hardware loose	A	Require replacement.
Permanently attached hardware missing	C	Require replacement.
Permanently attached hardware seized	A	Require repair or replacement.
Rivets loose	B	Require replacement.
Separating from backing	B	Require replacement.
Shoe table or web bent	B	Require replacement.
Shoe table or web cracked	A	Require replacement.
Shoe table or web worn, affecting performance	A	Require replacement.
Surface cracking	..	No service suggested or required. Further inspection may be necessary to determine cause.
Tapered wear	B	(3) Suggest replacement.
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	..	(4) Replacement of friction material not suggested or required. Further inspection required. See CALIPERS and CALIPER HARDWARE.
Wear indicator device (electronic) contacts rotor	B	(5) Require replacement of appropriate parts.
Wear indicator device		

(mechanical) bent	(6)	Further inspection required.
Wear indicator device (mechanical) broken	(6)	Further inspection required.
Wear indicator device (mechanical) contacts rotor	(6)	Further inspection required.
Worn close to minimum specifications 1	(7)	Suggest replacement.
Worn to, or below minimum specifications ..... B		Require replacement.

(1) - Identify and repair cause of contamination prior to replacing friction material.
(2) - When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.
(3) - Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require replacement of pads and correction of cause.
(4) - Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.
(5) - The pad wear indicator light may come on due to other electrical problems.
(6) - Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested.
(7) - When the part appears to be close to the end of its useful life, replacement may be suggested.

G SENSORS

See ACCELEROMETERS.

HOSES

HOSE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A ...	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A ...	Require repair or replacement of hardware.
Blistered	B	Require replacement.
Fitting threads damaged .	A ..	Require repair or replacement.
Fitting threads stripped (threads missing)	A	Require replacement.
Incorrectly secured	B	Require repair.
Inner fabric (webbing) cut	B	Require replacement.

Leaking	A	Require replacement.
Missing	C	Require replacement.
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	B	Require repair.

HYDRAULIC MODULATORS

NOTE: Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.

HYDRAULIC MODULATOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require replacement.
Connector missing	C	Require replacement.
Disabled	A	Require repair or replacement.
Electrical failure	A	Require repair or replacement.
External leak	A	Require repair or replacement.
Housing cracked	B	Require repair or replacement.
Inoperative (2)	A	Require repair or replacement.
Internal leak	A	Require repair or replacement.
Missing	C	Require replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Valve stuck	A	Require repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.

Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

HYDRO-BOOSTERS

NOTE: Hydro-boosters and hydro-electric boosters are combined.

HYDRO-BOOSTER INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require replacement.
Connector missing	C	.....	Require replacement.
Does not apply assist, or inadequate assist	A	..	Require repair or replacement.
Leaking	B	..	Require repair or replacement.
Leaks fluid at fitting	B	.....	Require tightening or replacement.
Leaks fluid at unit	B	..	Require repair or replacement.
Leaks fluid from pressure hose(s)	B	.	Require replacement of hose(s).
Leaks fluid into passenger compartment	B	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

(1) - Determine cause and correct prior to replacement of part.

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

See HYDRO-BOOSTERS.

IGNITION DISABLE SWITCHES

See SWITCHES.

LATERAL ACCELERATION SWITCHES

See ACCELEROMETERS.

LEDS

See BULBS AND LEDS.

LENSES

LENSE INSPECTION

Condition	Code	Procedure
Application incorrect	A	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken, affecting performance	A	Require replacement.
Broken, not affecting performance	..	No service suggested or required.
Cracked	A	Require replacement.
Discolored	A	Require replacement.
Leaking	A	Require repair or replacement.
Melted, affecting performance	A	Require replacement.
Melted, not affecting performance	2	Suggest replacement.
Missing	C	Require replacement.

MASTER CYLINDERS

MASTER CYLINDER INSPECTION

Condition	Code	Procedure
Brake fluid leaking from rear of master cylinder bore	B	Require repair or replacement.
Brake pedal drops intermittently	A	(1) Require repair or replacement.
Fluid level low	..	(2) Further inspection required.
Internal valve failure	A	Require repair or replacement.
Master cylinder leaking brake fluid internally	A	Require repair or replacement.
Piston does not return	A	Require repair or replacement.
Ports plugged	A	Require repair or replacement.

Condition	Code	Procedure
Rubber master cylinder cover gasket distorted and gummy	A	(3) Require replacement of the gasket.

(1) - This condition may be normal on some vehicles equipped with anti-lock brakes.
(2) - Refer to OEM procedures for adjusting low fluid level. Inspect for brake hydraulic system leaks and friction material wear.
(3) - This condition may indicate contaminated brake fluid. See BRAKE FLUID.

MODULATORS

See HYDRAULIC MODULATORS.

MOTORS

See ELECTRICAL PUMPS AND MOTORS.

PARKING BRAKE SWITCHES

See SWITCHES.

PARKING BRAKE SYSTEMS

NOTE: The parking brake is an integral part of the brake system. It is important that the parking brake function properly when brake service is performed.

PARKING BRAKE SYSTEM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Cable improperly adjusted	B	Require cable adjustment.
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly.
Cable sticking	A	Require cable lubrication.
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly.
Inoperative (1)	A	Require replacement of inoperative parts.
Parking brake parts bent	B	Require repair or replacement of bent parts.

Condition	Code	Procedure
Parking brake parts broken	A	Require replacement of broken parts.
Parking brake parts missing	C	Require replacement of missing parts.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Inoperative includes intermittent operation.

PADS

See FRICTION MATERIAL.

PEDAL TRAVEL SWITCHES

See SWITCHES.

PEDALS

See BRAKE PEDALS.

POWERMASTER

See HYDRO-BOOSTERS.

PUMPS

See ELECTRICAL PUMPS AND MOTORS.

PRESSURE DIFFERENTIAL SWITCHES

See SWITCHES.

PRESSURE SWITCHES

See SWITCHES.

RELAYS

NOTE: Copied from Electrical UIGs

RELAY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Housing broken	A	Require replacement.
Housing cracked	2	Suggest replacement.
Inoperative (1)	A	Require replacement.
Missing	C	Require replacement.

Terminal broken	A ..	Require repair or replacement.
Terminal burned, affecting performance ..	A	(2) Require repair or replacement.
Terminal burned, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A ..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal loose, affecting performance	B ..	Require repair or replacement.
Terminal loose, not affecting performance ..	1 ..	Suggest repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

ROTORS

Determine the need to recondition based upon individual rotor conditions that follow. Friction material replacement does not require rotor reconditioning unless other justifications exist. DO NOT recondition new rotors unless they are being pressed or bolted onto an existing hub. It is not necessary to replace rotors in axle sets. However, when replacing or reconditioning a rotor due to the conditions that follow, you may suggest reconditioning of the other rotor on the same axle to eliminate uneven braking behavior.

Determine the need to replace based upon the individual rotor conditions that follow. Reconditioning is defined as machining and block sanding, or block sanding only. Block sanding is defined as using 120-150 grit sandpaper with moderate to heavy force for 60 seconds per side. Always wash rotors after servicing or before installing.

ROTOR INSPECTION

Condition	Code	Procedure
Corrosion affecting structural integrity ...	A	(1) Require replacement.
Cracked	B	Require replacement.
Hard spots	2	Suggest reconditioning or replacement of rotor according to OEM specifications.
Lateral runout (wobble) exceeds OEM specifications	B	Require re-indexing, reconditioning, or replacement according to specifications.
Measured thickness is less than OEM discard specifications	B	Require replacement.
Rotor thickness is less than OEM "machine to" specifications but thicker than "discard at" specifications, and the rotor does not require reconditioning	1	(2) Suggest replacement.

Rotor thickness will be less than OEM "machine to" specifications after required reconditioning	B	(3) Require replacement.
Surface is rust-pitted	B	Require reconditioning or replacement of rotor according to OEM specifications.
Surface is scored	B	(4) Require reconditioning or replacement of rotor according to OEM specifications.
Thickness variation (parallelism) exceeds OEM specifications	B	Require reconditioning or replacement of rotor according to OEM specifications.

(1) - Examples of severe corrosion are: composite plate separated from friction surfaces and cooling fins cracked or missing.
(2) - Only applies to vehicles for which OEM "machine to" specifications exist. If OEM does not supply "machine to" specifications, the rotor may be worn to discard specifications.
(3) - If OEM does not supply "machine to" specifications, you may machine to discard specifications.
(4) - Scoring is defined as grooves or ridges in the friction contact surface. Some vehicle manufacturers require machining when scoring exceeds their allowable specifications.

SELF-ADJUSTING SYSTEMS

SELF-ADJUSTING SYSTEM INSPECTION

Condition	Code	Procedure
Bent	A	Require repair or replacement of bent part.
Broken	A	Require repair or replacement of broken part.
Inoperative	A	(1) Require repair or replacement of inoperative parts.
Missing	C	Require replacement of missing part.
Star wheel does not turn freely	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation.

SHOE HARDWARE

See BRAKE SHOE HARDWARE.

SHOES

See FRICTION MATERIAL.

SOCKETS

See BULB SOCKETS.

SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)

NOTE: Copied Vehicle Speed Sensors from Engine UIGs & added Air Gap incorrect, loose, and wire lead misrouted. For "contaminated" removed coolant & fuel examples from note.

SPEED SENSOR INSPECTION

Condition	Code	Procedure
Air gap incorrect	B	(1) Require adjustment or replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(2) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(3) Require repair or replacement.
Inoperative	B	(4) Require repair or replacement. Further inspection required.
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications.
Leaking	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Sensor housing cracked	2	Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors		

exposed	B ..	Require repair or replacement.
Wire lead corroded	A ..	Require repair or replacement.
Wire lead misrouted	B .	Require re-routing according to vehicle manufacturer's specifications.
Wire lead open	A ..	Require repair or replacement.
Wire lead shorted	A ..	Require repair or replacement.

(1) - If a sensor is not adjustable, further inspection is required to identify and correct cause.
(2) - Determine cause and correct prior to repair or replacement of part.
(3) - Determine source of contamination, such as metal particles or water. Require repair or replacement.
(4) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

STEEL BRAKE LINES

STEEL BRAKE LINE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A ...	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A ...	Require repair or replacement of hardware.
Corroded, affecting structural integrity ...	A	Require replacement.
Fitting incorrect (for example, compression fitting)	B	Require replacement.
Flare type incorrect	B ..	Require repair or replacement.
Leaking	A ..	Require repair or replacement.
Line material incorrect (copper, etc.)	B	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	B	Require routing correction.
Rust-pitted	1	Suggest replacement.
Threads damaged	A ..	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

STOPLIGHT SWITCHES

See BRAKE STOPLIGHT SWITCHES.

SWITCHES

NOTE: Copied from Electrical UIGs & added "float saturated" from old fluid level sensor switches.

STEEL BRAKE LINE INSPECTION

Condition	Code	Procedure

Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Float saturated	A	Require replacement.
Leaking	A	Require repair or replacement.
Malfunctioning	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	Require replacement.
Out of adjustment	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Won’t return	A	Require repair or replacement.
Worn	1	Suggest replacement.

(1) – Determine cause and correct prior to repair or replacement of part.
(2) – Includes inoperative, intermittent operation, or failure to perform all functions.

TIRES

Consult the vehicle owner’s manual or vehicle placard for

correct size, speed ratings, and inflation pressure of the original tires.

TIRE INSPECTION

Condition	Code	Procedure
Tire diameter incorrect, affecting ABS or TCS	A	Require replacement.
Tire pressure incorrect, affecting ABS or TCS	A	Require repair or replacement.
Tire size incorrect, affecting ABS or TCS	A	Require replacement.

TOOTHED RINGS (TONE WHEEL)

NOTE: Copied from Drivetrain UIGs.

If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

TOOTHED RING INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Bent	B	Require replacement.
Contaminated, affecting performance	A	Require repair. Identify and correct cause.
Cracked	B	Require replacement.
Loose	A	Require replacement of worn parts.
Missing	C	Require replacement.
Number of teeth incorrect	B	Require replacement.
Teeth broken	A	Require replacement.
Teeth damaged, affecting performance	A	Require replacement.

VACUUM BOOSTERS

VACUUM BOOSTER INSPECTION

Condition	Code	Procedure
Applies too much assist (oversensitive)	A	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Auxiliary vacuum pump inoperative	A	(1) Require repair or

		replacement.
Check valve grommet deteriorated, affecting performance	A	.. Require replacement of grommet.
Check valve grommet deteriorated, not affecting performance ..	1	. Suggest replacement of grommet.
Check valve inoperative .	A	..... (2) Require repair or replacement.
Check valve leaking	A	.... Require replacement of check valve.
Check valve missing	C	.... Require replacement of check valve.
Check valve noisy	2	..... Suggest replacement.
Connector broken	A	.. Require repair or replacement.
Connector (Weatherpack type) leaking	A	.. Require repair or replacement.
Connector melted	A	..... (3) Require replacement.
Connector missing	C	..... Require replacement.
Leaking	A	..... Require replacement.
Terminal burned, affecting performance	A	..... (3) Require repair or replacement.
Terminal burned, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	.. Require repair or replacement.
Terminal corroded, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.
Terminal loose, not affecting performance ..	1	.. Suggest repair or replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Vacuum hose filter leaking	A	.. Require replacement of filter.
Vacuum hose filter restricted	A	.. Require replacement of filter.
Wire lead burned	A	.. Require repair or replacement.
Wire lead conductors exposed	B	.. Require repair or replacement.
Wire lead open	A	.. Require repair or replacement.
Wire lead shorted	A	.. Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Inoperative includes intermittent operation.
(3) - Determine cause and correct prior to replacement of part.

VACUUM HOSES

See HOSES.

VALVES

VALVE INSPECTION

Condition	Code	Procedure
Attaching hardware		

broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Leaking	B	.. Require repair or replacement.
Linkage bent (rear load valves)	A	... Require repair or replacement of linkage.
Linkage broken (rear load valves)	A	... Require repair or replacement of linkage.
Linkage disconnected (rear load valves)	C	... Require repair or replacement of linkage.
Pressure out of specification	B	..... Require adjustment. If not possible, require replacement.
Seized	A	..... Require replacement.
Sticking	A	.. Require repair or replacement.
Terminal burned, affecting performance ..	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	.. Require repair or replacement.
Terminal corroded, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.
Terminal loose, not affecting performance ..	1	.. Suggest repair or replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Wire lead burned	A	.. Require repair or replacement.
Wire lead conductors exposed	B	.. Require repair or replacement.
Wire lead open	A	.. Require repair or replacement.
Wire lead shorted	A	.. Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

WHEEL ATTACHING HARDWARE

For conditions noted below, also check condition of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHING HARDWARE INSPECTION

Condition	Code	Procedure

Bent	A	Require replacement.
Broken	A	(1) Require replacement.
Loose	B	Require repair or replacement of affected component.
Lug nut flats rounded	A	Require replacement of nut.
Lug nut installed backward	B	Require repair.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut seized	A	Require replacement of nut and/or stud.
Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.
Threads stripped (threads missing)	A	Require replacement of component with stripped threads.

(1) - Some manufacturers require replacement of all studs on any wheel if two or more studs or nuts on the same wheel are broken or missing.

WHEEL BEARINGS, RACES AND SEALS

NOTE: Grease seal replacement is required if seal is removed. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

WHEEL BEARINGS, RACES AND SEALS INSPECTION

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube.
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require replacement of bearing assembly.
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly	B	Require replacement of bearing assembly.
Seal leaking	A	(1) Require replacement of seal and inspection of bearings.
Spindle worn	B	Require replacement of spindle and bearings.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.

WHEEL CYLINDERS

You are not required to replace or rebuild wheel cylinders in axle sets. However, when rebuilding or replacing a wheel cylinder due to the conditions that follow, you may suggest rebuilding or replacement of the other wheel cylinder (on the same axle) for preventive maintenance, for example, the part is close to the end of its useful life.

Determine the need to rebuild or replace based upon the individual wheel cylinder conditions that follow.

WHEEL CYLINDER INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require replacement of bent parts.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded parts.
Attaching hardware loose	A	Require repair or replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bleeder port damaged (if non-repairable)	A	Require replacement.
Bleeder screw broken off in wheel cylinder (if non-repairable)	A	(1) Require replacement.
Bleeder screw plugged	A	(1) Require repair or replacement of bleeder screw.
Bleeder screw seized	A	(2) Require replacement.
Bore corroded (pitted)	B	Require replacement.
Bore grooved	A	Require replacement.
Bore oversized	B	Require replacement.
Dust boot missing	C	Require replacement of dust boot.
Dust boot torn	A	(3) Require replacement of dust boot.
Leaking	A	(4) Require rebuilding or replacement.
Piston corroded, affecting performance	B	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston finish worn off	B	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston stuck in bore	A	Require replacement of wheel cylinder.
Loose	B	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Only required if the hydraulic system must be opened.
(2) - Seized is defined as bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.
(3) - Inspect for conditions related to wheel cylinder.
(4) - Leaking is defined as a drop or more. Dampness is normal.

WIRING HARNESSES

NOTE: Copied from Electrical UIGs.

WIRING HARNESS INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Open	A	Require repair or replacement.
Protective shield (conduit) melted	2	(1) Suggest repair or replacement.
Protective shield (conduit) missing	2	Suggest repair or replacement.
Resistance (voltage drop) out of specification	A	Require repair or replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Shorted	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Voltage drop out of specification	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

BRAKE SYSTEM

1999 Lexus RX 300

1999-2000 BRAKES
Lexus Disc

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION & OPERATION

Hydraulically operated disc brakes are used on front and rear of vehicle, along with a mechanically operated parking brake. The shoe-and-drum parking brake system operates inside rear brake rotors.

BLEEDING BRAKE SYSTEM

* PLEASE READ THIS FIRST *

NOTE: Use only SAE J1703 or FMVSS No. 116 DOT 3 brake fluid.

BLEEDING PROCEDURES

WARNING: On Traction Control System (TRAC), brake fluid is under high pressure, and may cause personal injury. When repairing master cylinder or TRAC system, bleed air out of TRAC system.

Brake System

1) ABS bleeding procedure is the same for all systems. On models without TRAC, if master cylinder reservoir is empty or is suspected of containing air, bleed master cylinder first. On models with TRAC, bleed TRAC system first. See TRACTION CONTROL SYSTEM (ES300 & RX300), TRACTION CONTROL SYSTEM (GS300 & GS400), TRACTION CONTROL SYSTEM (LS400) or TRACTION CONTROL SYSTEM (SC300 & SC400).

2) Ensure master cylinder reservoir is full of brake fluid. Connect vinyl tube to caliper bleeder plug, and insert other end of tube in a clear container 1/2 full of brake fluid.

3) Slowly depress brake pedal several times. While depressing brake pedal, loosen bleeder plug until fluid starts to flow, and then close bleeder screw. Repeat operation until no bubbles are present in fluid. Tighten bleeder screw to 74 INCH lbs. (8.3 N.m). See BRAKELINE BLEEDING SEQUENCE.

NOTE: If master cylinder has been disassembled, is new or if reservoir has run dry, bleed master cylinder before bleeding wheels.

BRAKELINE BLEEDING SEQUENCE

Application	Sequence
All Models	RR, LR, RF & LF

Traction Control System (ES300 & RX300)

Disconnect brake lines from master cylinder. Slowly depress brake pedal and hold it. Block off outlet plugs with your fingers, and release brake pedal. Repeat 3 or 4 times.

Traction Control System (GS300 & GS400)

1) Disconnect 2 connectors from hydraulic brake booster. Connect Actuator Checker (09990-00150) to hydraulic brake booster side

wire harness via Sub-Wire Harness (09990-00480). See Fig. 1.

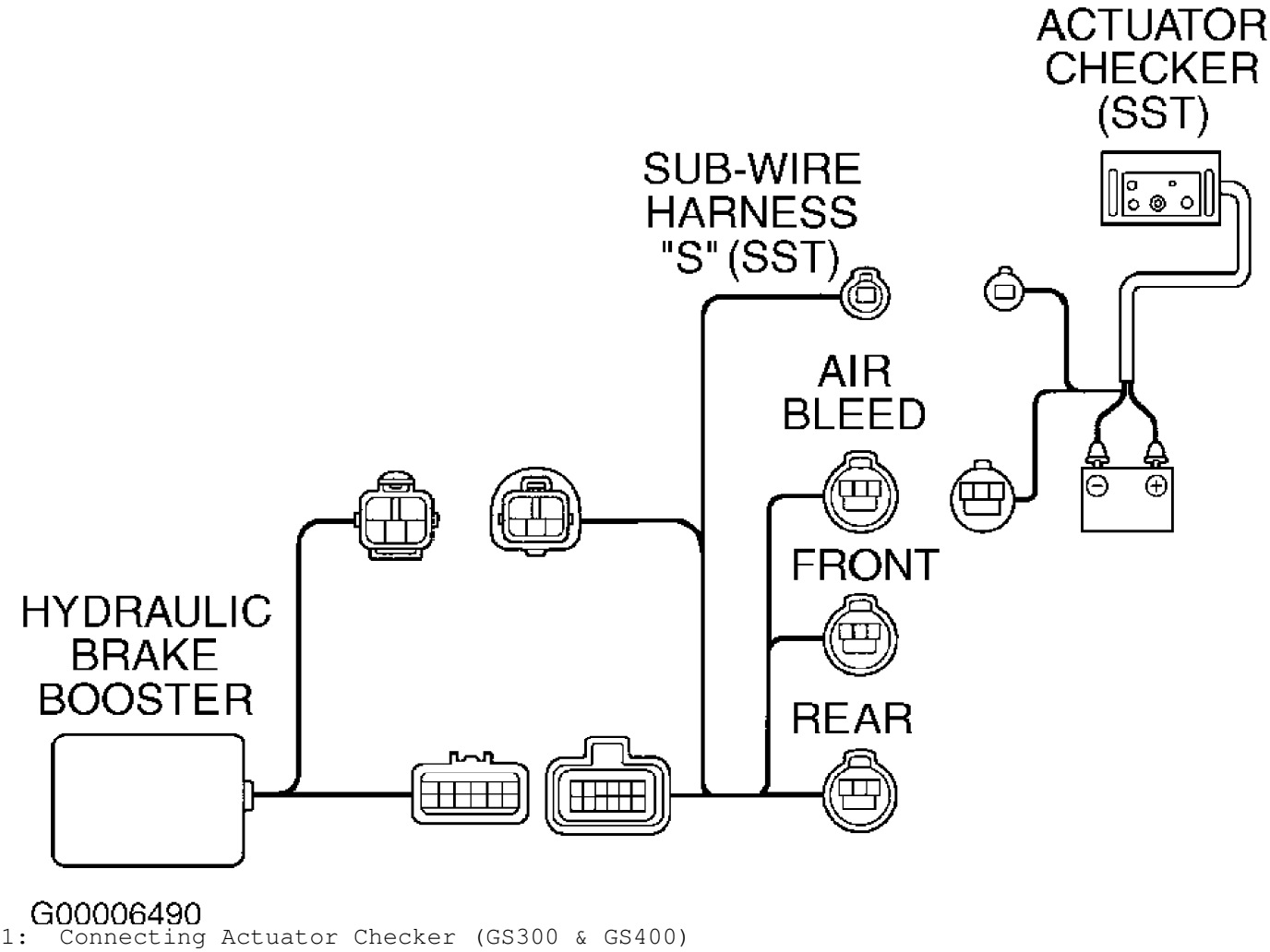


Fig. 1: Connecting Actuator Checker (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Connect Red cable of checker to battery positive terminal and Black cable to negative terminal. Turn ignition switch to OFF position, and depress brake pedal more than 40 times. Turn ignition to ON, check that pump stops after 30-40 seconds. If pump does not stop, repeat step.

3) Depress brake pedal more than 20 times with ignition on, and bleed right and left front calipers. Hold and depress brake pedal, then bleed right and left rear wheel caliper.

NOTE: DO NOT keep MAIN switch pushed in for more than 10 seconds. When operating it continuously, set interval for more than 20 seconds.

4) Bleed right front brake line. Turn selector switch of actuator checker to FRONT RH position. Push and hold in MAIN push switch. Depress brake pedal and hold it to bleed right front brake caliper. Repeat until there are no more air bubbles in fluid.

5) Bleed left front brake line. Turn selector switch of actuator checker to FRONT LH position. Push and hold in MAIN push switch. Depress brake pedal and hold it to bleed left front brake caliper. Repeat until there are no more air bubbles in fluid.

6) Bleed rear brake line. Push and hold in SUB LH and SUB RH switches. Bleed right and left rear brake caliper. Repeat until there are no more air bubbles in fluid.

7) Disconnect actuator connector and sub-wire harness from actuator. Connect 2 connectors to hydraulic brake booster. Clear DTC.

Traction Control System (LS400)

1) Ensure master cylinder reservoir is full of brake fluid. Slowly depress brake pedal and hold it. Block off outlet plugs with your fingers, and release brake pedal. Repeat 3 or 4 times.

2) Turn ignition off. Connect vinyl tube to bleeder screw of TRAC actuator. Loosen bleeder screw. Start engine and allow TRAC pump to operate until all air has been bled from actuator side. Tighten bleeder screw to 74 INCH lbs. (8.4 N.m) and turn engine off.

Traction Control System (SC300 & SC400)

Ensure master cylinder reservoir is full of brake fluid. Turn ignition off. Connect vinyl tube to bleeder screw of TRAC actuator. Loosen bleeder screw. Start engine and allow TRAC pump to operate until all air has been bled from actuator side. Tighten bleeder screw to 74 INCH lbs. (8.4 N.m) and turn engine off.

ADJUSTMENTS

BRAKE PEDAL HEIGHT & FREE PLAY

1) Measure pedal height from floor board to face of pedal pad. See BRAKE PEDAL HEIGHT & FREE PLAY SPECIFICATIONS. If pedal height is incorrect, go to next step.

2) On ES300, LS400 and RX300, remove undercover panel, lower pad and air duct. On all models, disconnect stoplight switch connector. Loosen stoplight switch lock nut, and remove stoplight switch. Loosen brake pedal-to-power brake unit push rod lock nut.

3) Adjust pedal height by turning brake pedal push rod. Tighten push rod lock nut to 19 ft. lbs. (25 N.m).

4) Install brake light switch. On ES300, LS400 and RX300, install undercover panel, lower pad and air duct.

NOTE: If clearance between stoplight switch threaded shaft and brake pedal stopper is incorrect, correct brake pedal free play. If brake pedal free play is still not correct, another problem exists in brake system.

5) STOP engine and depress brake pedal several times until power brake unit is depleted. Push brake pedal by hand until a second point of resistance is felt, then measure pedal free play. Ensure pedal free play is as specified. See BRAKE PEDAL HEIGHT & FREE PLAY SPECIFICATIONS.

BRAKE PEDAL HEIGHT & FREE PLAY SPECIFICATIONS

Application	In. (mm)
Brake Pedal Height	
ES300	5.984-6.378 (152.0-162.0)
GS300 & GS400	5.906-6.299 (150.0-160.0)
LS400	5.268-5.661 (133.8-143.8)
RX300	7.598-7.992 (193.0-203.0)
SC300 & SC400	5.92-6.31 (150.4-160.4)
Brake Pedal Free Play	
GS300 & GS400	.008-.079 (.20-2.0)
All Other Models	0.04-0.24 (1.0-6.0)

POWER BRAKE UNIT PUSH ROD

1) Adjust power brake unit push rod length before installing new master cylinder or power brake unit. Install master cylinder gasket. Place Master/Booster Push Rod Measurer (SST 09737-00010) on gasket and lower pin until it touches master cylinder piston.

2) Without moving pin, invert master/booster push rod measurer, and set it on power brake unit. Measure clearance between power brake unit push rod and pin. Clearance should be zero. If clearance is not zero, adjust power brake unit push rod length until push rod lightly touches pin head.

PARKING BRAKE

ES300

1) With a force of 66 lbs. (30 kg), push down on parking brake pedal while counting clicks. If 3-6 clicks are not counted, parking brake requires adjustment.

2) Remove console upper panel and console box. Ensure parking brake pedal is released. Hold screw end of No. 4 cable. DO NOT rotate. Loosen lock nut. Hold parking brake cable, and turn adjusting hexagon until pedal travel is correct.

3) Holding adjusting hexagon, tighten lock nut to 48 INCH lbs. (5.4 N.m). Install console box and console upper panel.

GS400 & GS300

1) With a force of 66 lbs. (30 kg), push down on parking brake pedal while counting clicks. If 7-9 clicks are not counted, parking brake requires adjustment.

2) Loosen lock nut, and turn adjusting nut until pedal travel is correct. Tighten lock nut to 48 INCH lbs. (5.4 N.m).

LS400

1) With a force of 66 lbs. (30 kg), push down on parking brake pedal while counting clicks. If 5-7 clicks are not counted, parking brake requires adjustment.

2) To adjust parking brake shoe clearance, loosen adjuster lock nut and adjuster until parking brake travel is correct. If adjustment cannot be made within range of travel of adjuster, remove drive shaft, and make an adjustment at pull rod.

RX300

1) With a force of 66 lbs. (30 kg), push down on parking brake while counting clicks. If 5-7 clicks are not counted, parking brake requires adjustment.

2) Ensure parking pedal is released. Hold turnbuckle and loosen lock nut on brake cable. To adjust parking brake pedal travel, rotate turnbuckle until 5-7 can be counted on parking brake pedal. Hold turn buckle and tighten lock nut to 44 INCH lbs. (5.0 N.m).

SC300 & SC400

1) With a force of 44 lbs. (20 kg), pull up on parking brake lever while counting clicks. If 5-8 clicks are not counted, parking brake requires adjustment.

2) Remove cup holder. Using socket driver and spanner wrench, remove adjusting lock nut. Turn adjusting nut until lever travel is correct. Install adjusting lock nut. Using socket driver and spanner wrench, tighten adjusting lock nut to 48 INCH lbs. (5.4 N.m).

TESTING

POWER BRAKE UNIT

Release parking brake. With engine running, depress brake pedal and measure pedal reserve distance. Reserve distance is distance from floor pan to brake pedal when fully depressed. See MINIMUM BRAKE PEDAL RESERVE DISTANCE SPECIFICATIONS table. If reserve distance is incorrect, check brake booster for leaks and/or booster push rod out of adjustment.

MINIMUM BRAKE PEDAL RESERVE DISTANCE SPECIFICATIONS

Application	(1) In. (mm)
ES300 & LS400	2.76 (70)
GS300 & GS400 (2)	3.66 (93)
RX300	4.80 (122)
SC300 & SC400	3.50 (89)

(1) - With 110 lbs. (50 kg) applied.
(2) - With 44 lbs. (20 kg) applied.

REMOVAL & INSTALLATION

FRONT BRAKE PADS

Removal

NOTE: DO NOT disconnect flexhose.

1) Raise and support vehicle. Remove wheels. Check brake pads for minimum thickness. See DISC BRAKE SPECIFICATIONS. Hold bottom sliding pin, and remove installation bolt. Without disconnecting flexhose, lift bottom of brake caliper up, and wire aside. See Figs. 2 ,3 or 4. On RX300, remove bolt and flexhose from shock absorber.

2) Remove 2 anti-squeal springs, 2 brake pads, 4 anti-squeal shims, 4 pad support plates and pad wear indicator plate. On LS400, disconnect pad wire wear indicator from the inside pad. On all models, check rotors for minimum thickness and lateral runout.

Installation

1) Install NEW wear indicators on brake pads. Apply disc brake grease to both sides of inner anti-squeal shim. Install 2 anti-squeal shims on each pad. Install 2 anti-squeal springs. Install 2 pads with wear indicator plates facing down. Install brake pads. On LS400, connect pad wire wear indicator to inside pad using a NEW clip. On RX300, install flexhose and bolt to shock absorber.

2) Remove 25 percent of brake fluid from reservoir. Compress pistons into caliper bore. Install caliper over brake pad assembly onto slide pins. Hold sliding pin and tighten caliper installation bolts to specification. See TORQUE SPECIFICATIONS. Check brake reservoir fluid level and ensure correct brake operation.

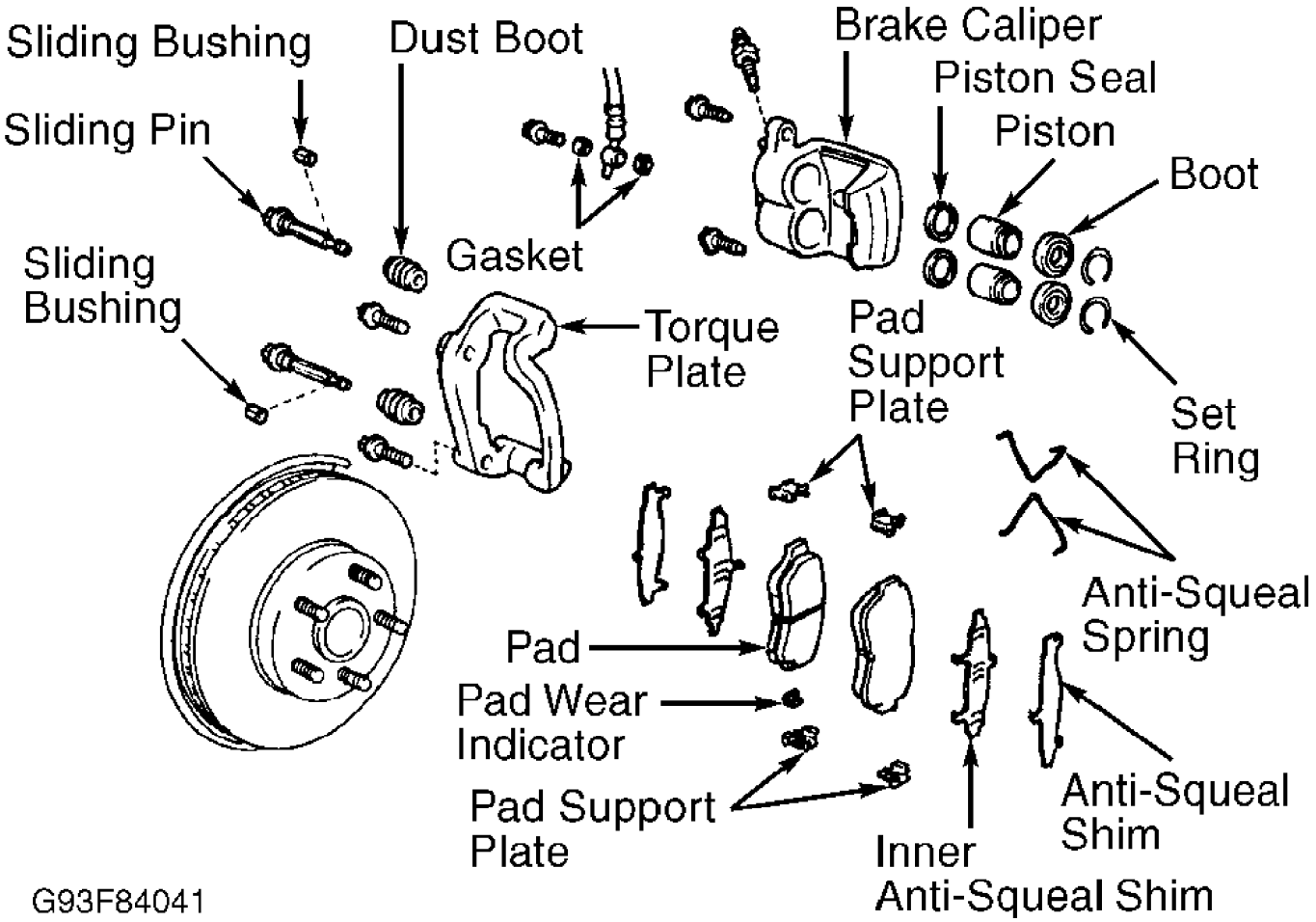


Fig. 2: Exploded View Of Front Disc Brake Assembly (SC300 & SC400 Shown; GS300 & GS400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

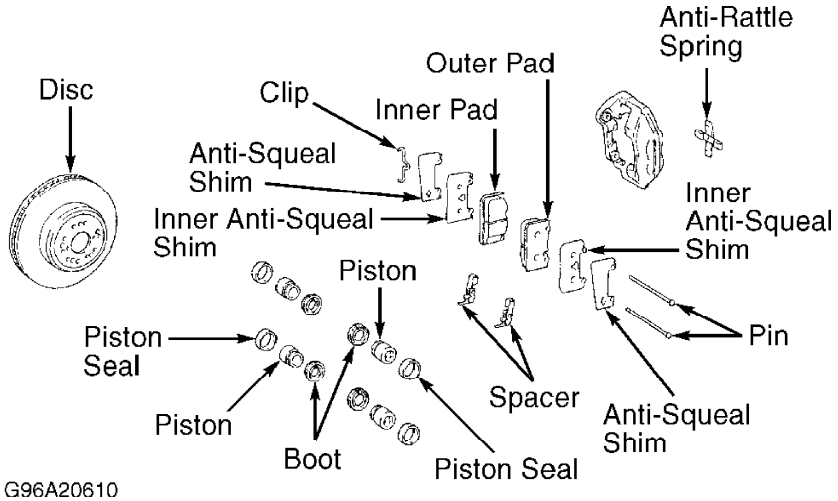


Fig. 3: Exploded View Of Front Disc Brake Assembly (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

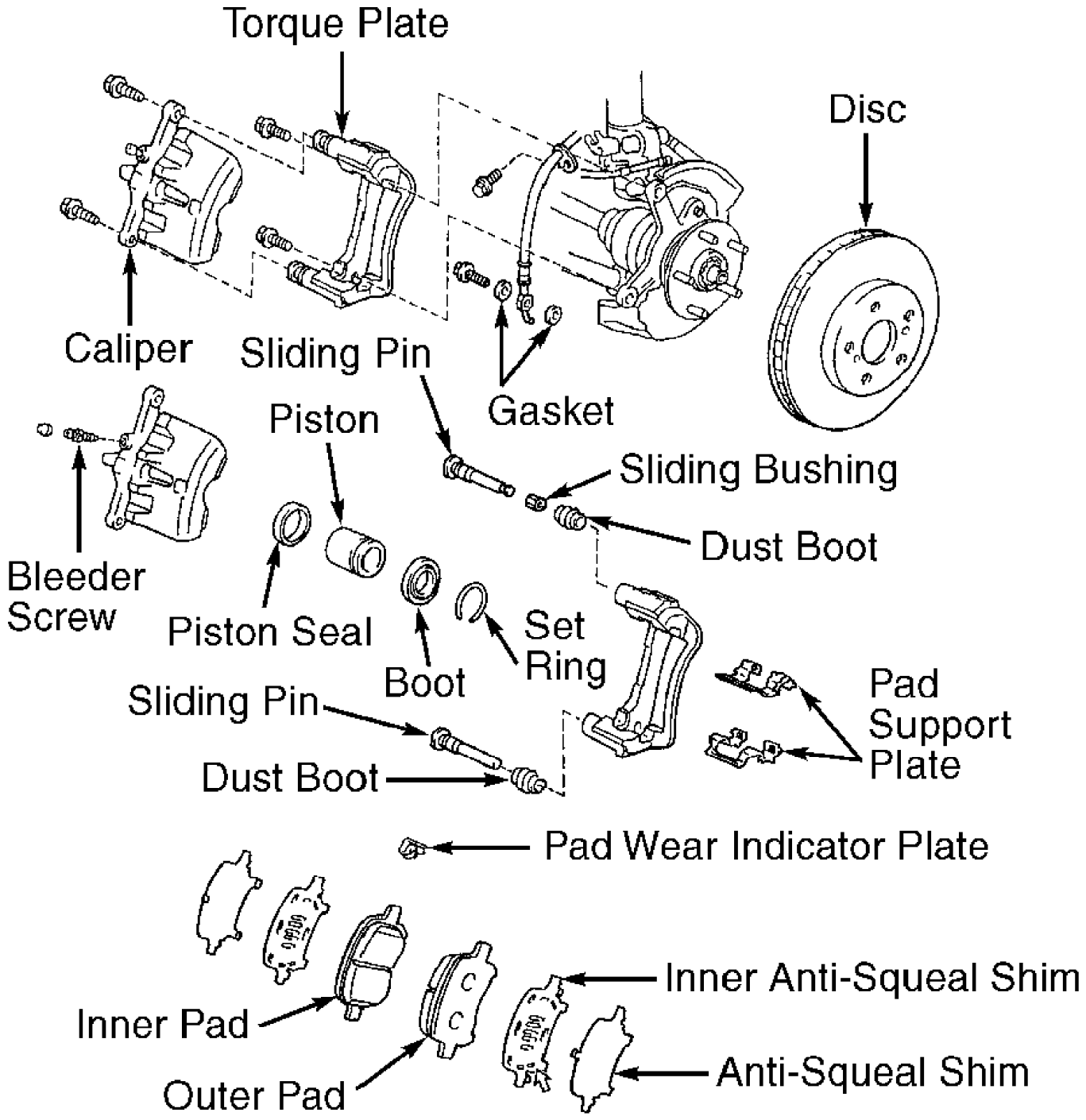


Fig. 4: Exploded View Of Front Disc Brake Assembly (ES300 & RX300) Courtesy of Toyota Motor Sales, U.S.A., Inc.

FRONT BRAKE CALIPER

Removal

1) Raise and support vehicle. Remove front wheels. Disconnect flexhose from caliper and cap hose. Remove union bolt and 2 gaskets

from caliper. See Figs. 2, 3 or 4.

2) Remove 2 caliper installation bolts. Remove caliper from torque plate. Remove pads, anti-squeal shims and support plates.

Installation

To install, reverse removal procedure. Tighten installation bolts to specification. See TORQUE SPECIFICATIONS.

FRONT BRAKE ROTOR

Removal

Raise and support vehicle. Remove wheel. Remove caliper attaching bolts. Remove front brake caliper and pads. See FRONT BRAKE PADS. Check rotor thickness and runout. Before measuring rotor runout, confirm that hub bearing play is within specification. See DISC BRAKE SPECIFICATIONS. Remove rotor.

Installation

Place rotor on hub. Install caliper attaching bolts, and tighten to specification. See TORQUE SPECIFICATIONS. Remove some brake fluid from brake reservoir. Compress caliper pistons. Install caliper over brake pad assembly (onto slide pins). Hold slide pins and tighten installation bolts to specification. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure.

REAR BRAKE PADS

Removal

1) Raise and support vehicle. Remove rear wheels. Check brake pad thickness. See DISC BRAKE SPECIFICATIONS.

2) On ES300 and RX300 2WD, remove flexhose bracket from shock absorber. On all models, hold bottom sliding pin and remove installation bolt. Without disconnecting flexhose, lift bottom of brake caliper up, and suspend it using wire.

3) Remove 2 brake pads, 4 anti-squeal shims and 4 pad support plates. See Figs. 5,67 or 8. Check rotors for minimum thickness and lateral runout.

Installation

1) Remove 25 percent of brake fluid from reservoir. Compress piston in caliper bore. Apply disc brake grease to both sides of inner anti-squeal shim. Install 2 anti-squeal shims onto each pad. Install pad support plates onto brake pads with pad wear indicators facing upward.

2) Install caliper over slide pin(s). Hold sliding pin and tighten installation bolts. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Check brake reservoir fluid level and ensure correct brake operation.

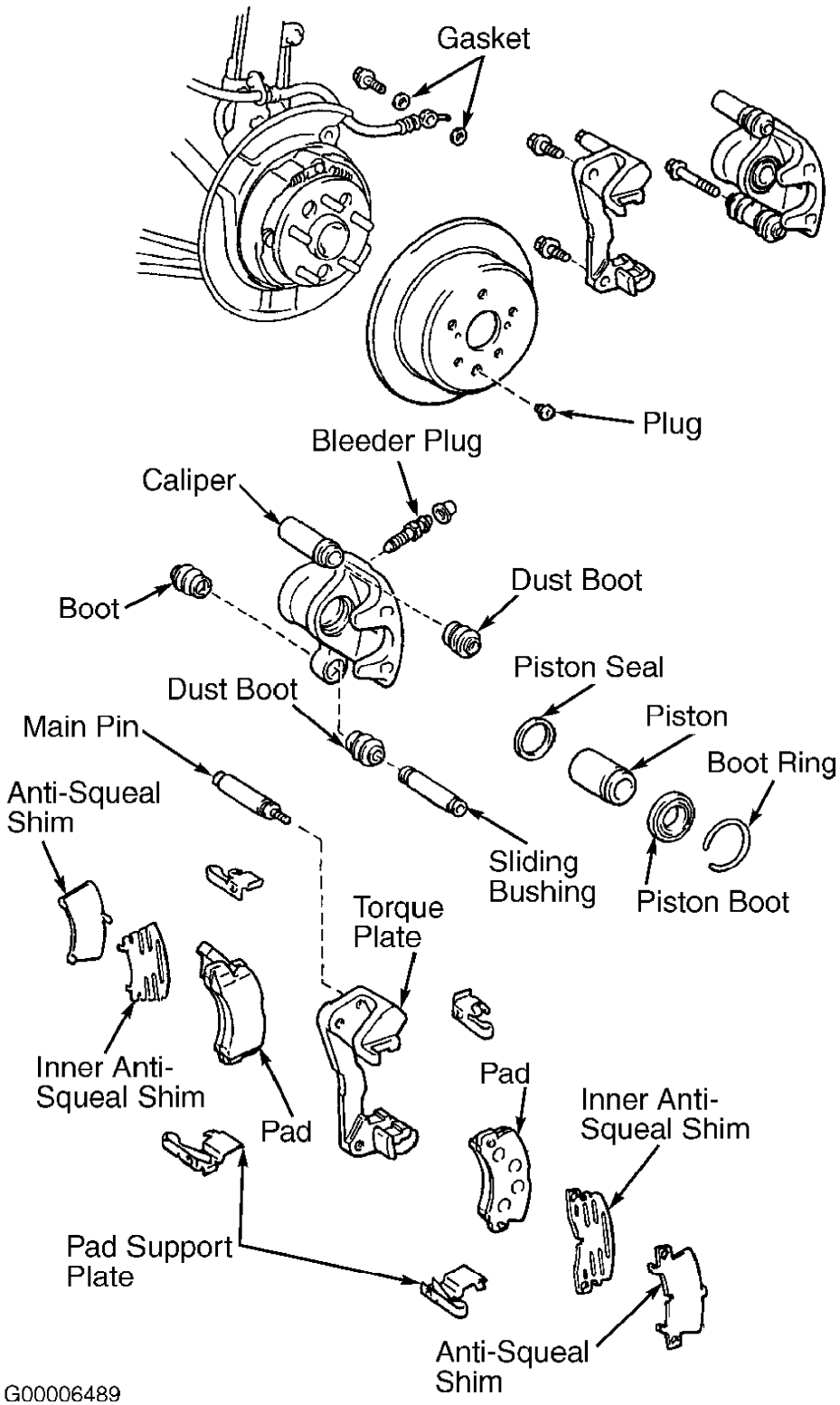


Fig. 5: Exploded View Of Rear Disc Brake Assembly (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

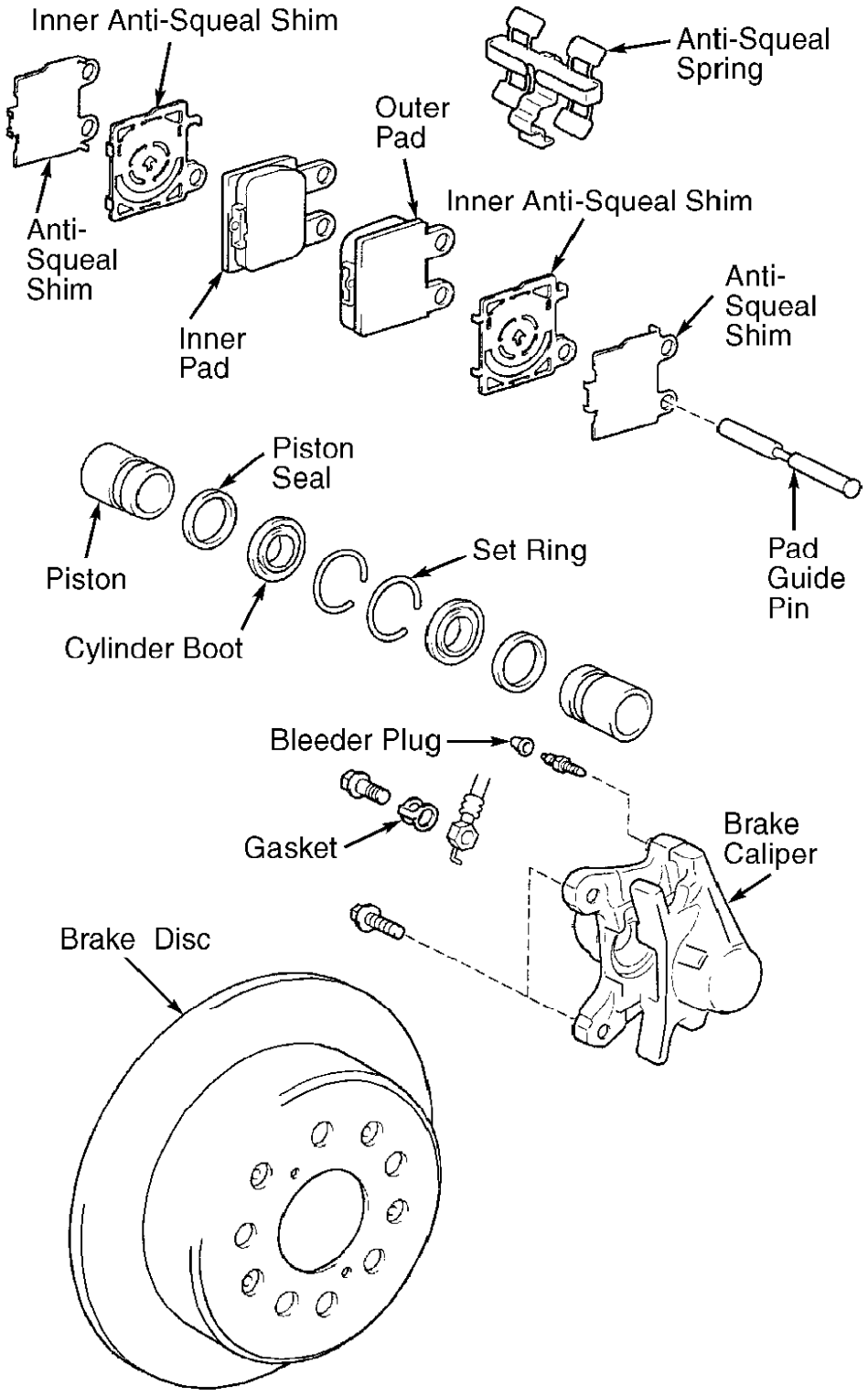


Fig. 6: Exploded View Of Rear Disc Brake Assembly (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

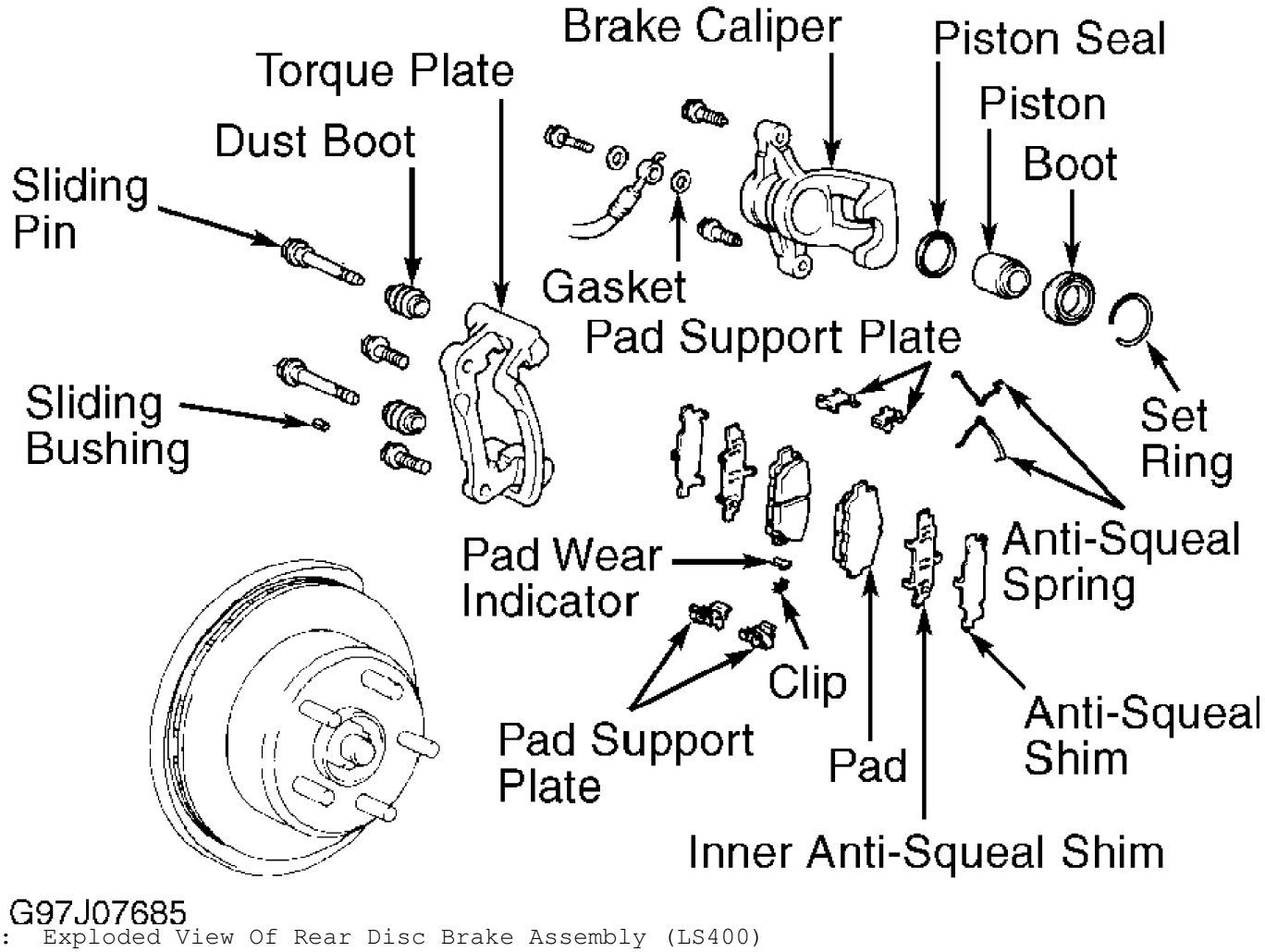


Fig. 7: Exploded View Of Rear Disc Brake Assembly (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

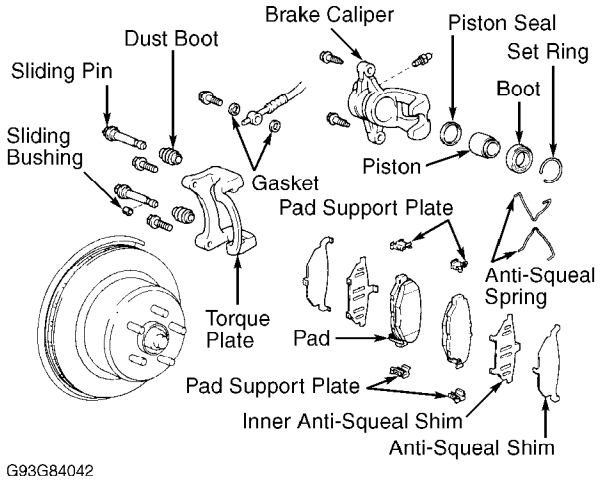


Fig. 8: Exploded View Of Rear Disc Brake Assembly (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REAR BRAKE CALIPER

Removal

1) Raise and support vehicle. Remove rear wheels. Remove union bolt and 2 gaskets. Disconnect flexhose from caliper.

2) To remove caliper, hold sliding pin and remove 2 installation bolts. Remove caliper from torque plate. Remove anti-squeal springs, brake pads with anti-squeal shims and support plates.

Installation

To install, reverse removal procedure. Bleed brake system. See BLEEDING PROCEDURES. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

REAR BRAKE ROTOR

Removal

Raise and support vehicle. Remove rear wheels. Remove caliper attaching bolts. Remove rear caliper and pads. See REAR BRAKE PADS. Check rotor minimum thickness and lateral runout. See DISC BRAKE SPECIFICATIONS. Remove rotor.

Installation

1) Place rotor on rear hub. Install caliper torque plate, and tighten bolts to specification. See TORQUE SPECIFICATIONS. Remove some brake fluid from reservoir. Compress caliper pistons.

2) Install caliper over brake pad assembly (onto sliding pins). Hold sliding pins and tighten bolts. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure.

MASTER CYLINDER

CAUTION: On Traction Control System (TRAC), brake fluid is under high pressure, and could spray out with great force.

NOTE: GS300 and GS400 models DO NOT have a master cylinder unit. These models have a hydraulic brake booster unit.

Removal

1) Remove air cleaner cover with air cleaner housing (if equipped). On RX300, disconnect reservoir assembly from bracket. On all models, disconnect fluid level warning switch connector. Using syringe, remove brake fluid from reservoir.

2) Disconnect brakelines from master cylinder. Remove master cylinder and gasket.

Installation

To install, reverse removal procedure. Tighten mounting nuts and brakelines to specification. See TORQUE SPECIFICATIONS. Bleed brake and TRAC systems (if equipped). See BLEEDING BRAKE SYSTEM.

POWER BRAKE UNIT

Removal (ES300 & RX300)

1) Remove air cleaner cover with air cleaner hose. Remove master cylinder. See MASTER CYLINDER.

2) Disconnect vacuum hose from power brake unit. Remove pedal return spring. Remove clip and clevis pin. Remove power brake booster, gasket and clevis.

Installation

1) Install brake booster and NEW gasket. Install and tighten booster bolts to 9 ft. lbs (13 N.m). Install clevis, and tighten lock nut to 19 ft. lbs (25 N.m). Install clevis pin into clevis and brake pedal. Install clip to clevis pin. Install pedal return spring.

2) Ensure power brake unit push rod length is correct. See POWER BRAKE UNIT PUSH ROD under ADJUSTMENTS. Install master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION.

3) Connect vacuum hose to brake booster. Fill brake reservoir with brake fluid and bleed brake system. See BLEEDING BRAKE SYSTEM. Check for fluid leakage. Ensure brake pedal height is correct. See BRAKE PEDAL HEIGHT & FREE PLAY under ADJUSTMENTS.

Removal (GS300 & GS400)

NOTE: Before starting procedure, turn ignition off. Depress brake pedal more than 40 times to deplete booster pressure. DO NOT turn ignition on until booster is reinstalled.

1) Using syringe, draw fluid from hydraulic brake booster. Remove No. 1 under cover, end pad and No. 1 safety pad. Remove No. 7 heater-to-register duct.

2) Disconnect 4 brake lines from booster. Disconnect left front wheel brake line from flexhose. Remove 2 brake line clamps.

3) Disconnect level warning switch connector. Disconnect 4 electrical connectors. Remove pedal return spring, clip and clevis pin. Remove locknut and remove clevis. Remove hydraulic brake booster assembly.

Installation

To install, reverse removal procedure. Fill brake reservoir with brake fluid and bleed brake system. See BLEEDING BRAKE SYSTEM. Check for fluid leakage.

Removal (LS400)

1) Remove master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION.

2) Remove No. 1 under cover, No. 1 safety pad and No. 2 heater-to-register duct. Remove tilt and telescopic ECU with power steering ECU. Remove clip and return spring.

3) Remove clevis pin. Remove vacuum hose. Remove booster installation nuts and clevis. Pull out brake booster and gasket.

Installation

1) Install brake booster and NEW gasket. Install and tighten booster installation nuts to 9 ft. lbs. (13 N.m). Install clevis pin into clevis and brake pedal. Install clip to clevis pin. Install pedal return spring.

2) Ensure power brake unit push rod length is correct. See POWER BRAKE UNIT PUSH ROD under ADJUSTMENTS. Install master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION.

3) Fill brake reservoir with brake fluid and bleed brake system. See BLEEDING BRAKE SYSTEM. Check for fluid leakage. Ensure brake pedal height is correct. See BRAKE PEDAL HEIGHT & FREE PLAY under ADJUSTMENTS.

Removal (SC300 & SC400)

1) Remove master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION. Remove vacuum hose from brake booster.

2) Remove No. 1 under cover and No. 1 lower finish panel. Remove return spring, clip and clevis pin. Remove booster installation nuts and clevis. Remove booster and gasket.

Installation

1) Install booster and NEW gasket. Install and tighten booster installation nuts to 9 ft. lbs. (12 N.m). Install clevis into operating rod. Insert clevis pin into clevis and brake pedal. Install clip into clevis pin. Install pedal return spring. Install vacuum

hose.

2) Ensure power brake unit push rod length is correct. See POWER BRAKE UNIT PUSH ROD under ADJUSTMENTS. Install master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION.

3) Fill brake reservoir with brake fluid and bleed brake system. See BLEEDING BRAKE SYSTEM. Check for fluid leakage. Ensure brake pedal height is correct. See BRAKE PEDAL HEIGHT & FREE PLAY under ADJUSTMENTS. Install lower finish panels and No. 1 under cover.

PARKING BRAKE

Removal

1) Remove rear wheels. Remove 2 mounting bolts and remove disc brake assembly. Support disc brake assembly so that flexhose is not stretched. Using paint, place match marks on disc and hub for installation reference. Remove disc brake rotor. If disc brake rotor cannot be removed, remove adjustor hole plug and loosen parking brake shoe adjustment.

2) Remove 2 parking brake shoe return springs. See Fig. 9. Remove shoe strut with spring. Remove front shoe hold-down cup, spring, backing plate and pin. Remove front and rear shoes, adjuster and tension springs. Remove rear shoe hold-down cup, spring, pin and backing plate. Remove cable from parking brake lever.

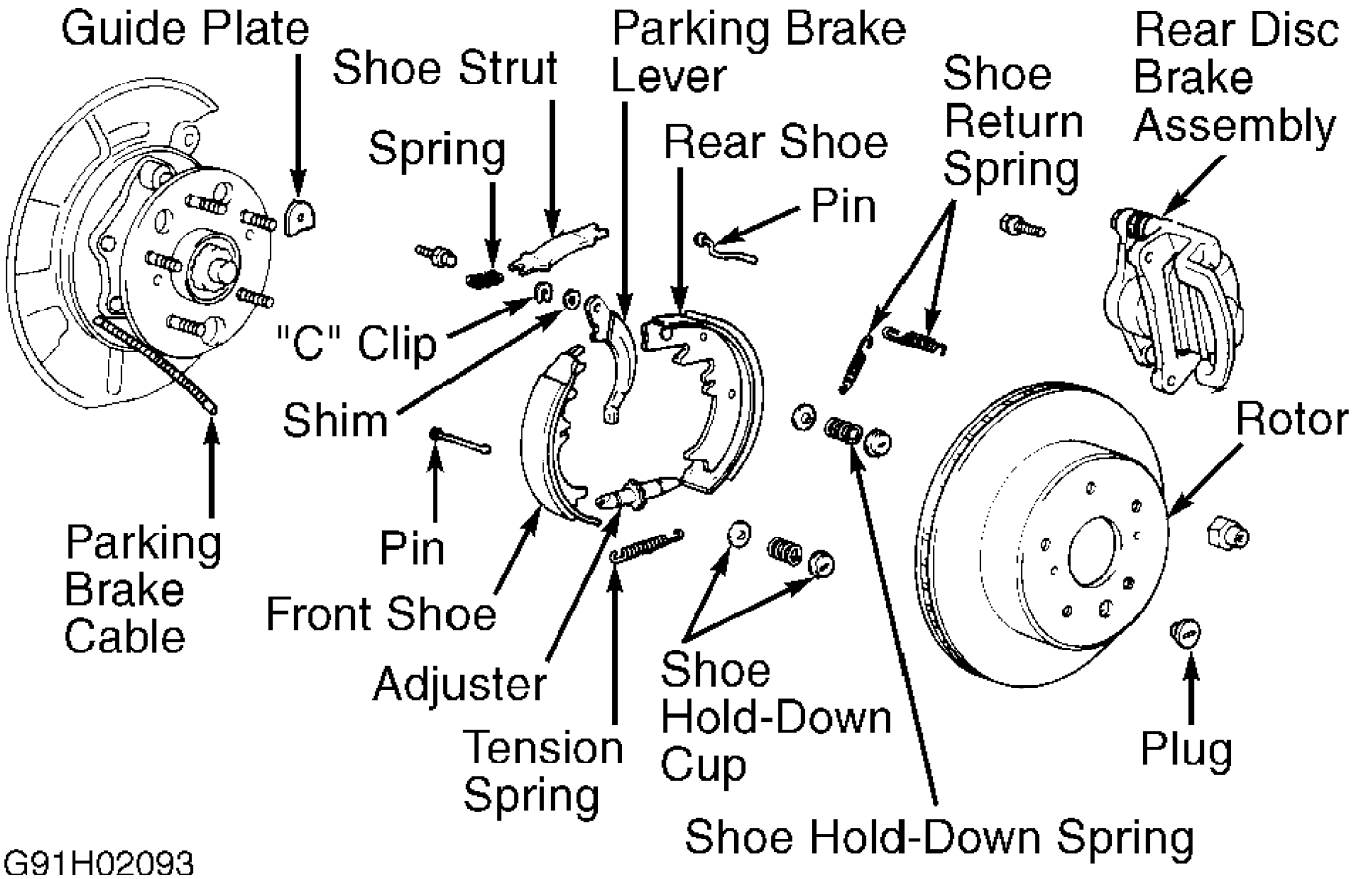


Fig. 9: Exploded View Of Parking Brake Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Inspection

Check parking shoe lining thickness. See PARKING BRAKE SPECIFICATIONS. Check parking brake drum inside

diameter. Measure shoe to parking brake lever clearance. Ensure clearance is .0138" (.35 mm). If clearance is not as specified, remove parking lever retaining "C" clip. Select correct size shim.

Installation

On all models except GS300, GS400 and LS400, install parking brake shoe lever with new "C" clip. On all models, to complete installation, reverse removal procedure.

PARKING BRAKE SPECIFICATIONS

Application	In. (mm)
ES300 & RX300	
Brake Shoe Thickness	
Standard	.079 (2.0)
Minimum	.039 (1.0)
Brake Drum Inside Diameter	
Standard	6.69 (170)
Maximum	6.73 (171)
GS300, GS400, LS400, SC300 & SC400	
Brake Shoe Thickness	
Standard	.098 (2.5)
Minimum	.039 (1.0)
Brake Drum Inside Diameter	
Standard	7.48 (190)
Maximum	7.52 (191)

OVERHAUL

MASTER CYLINDER

NOTE: The GS300 and GS400 do not have a master cylinder unit. These models use a hydraulic brake booster unit.

Disassembly (Except ES300 & RX300 With TRAC)

1) Using a screwdriver, remove master cylinder boot. Turn reservoir cap to the OPEN side and remove it. Remove strainer. Remove master cylinder. See MASTER CYLINDER under REMOVAL & INSTALLATION. Place master cylinder in a soft-jaw vise. Remove brake reservoir set screw. Remove brake fluid reservoir. Remove 2 grommets. See Fig. 10.

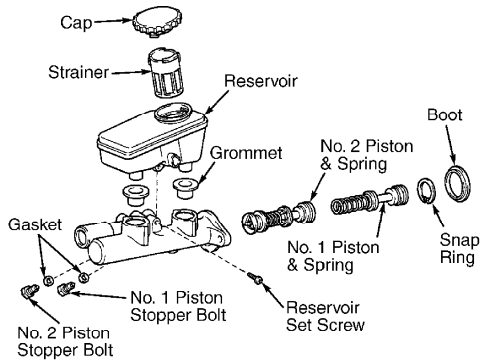


Fig. 10: Exploded View Of Master Cylinder (SC300 & SC400 Shown; Other Models Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Push in piston using screwdriver, and remove straight pins

by turning over cylinder body. On SC300 and SC400 models, remove No. 1 piston stopper bolt and gasket. Remove No. 2 piston stopper bolt. See Fig. 10. On all models, remove 2 pistons and springs by hand, pulling straight out, not on an angle. DO NOT score cylinder wall when removing piston and spring. If piston binds, place a rag and 2 wooden blocks on a work bench. To remove No. 1 piston and spring, lightly tap master cylinder against blocks.

Cleaning & Inspection

Wash all parts in clean brake fluid or alcohol. Inspect parts for wear. Inspect master cylinder for rust and scoring. Replace defective parts as needed, or replace master cylinder.

Reassembly

Apply brake assembly lubricant to rubber parts before assembly. To reassemble, reverse disassembly procedure.

Disassembly (ES300 & RX300 With TRAC)

1) Using pliers, slide 2 clips, and remove reservoir hoses from reservoir. Remove cap, strainer and clip from reservoir. Remove brake reservoir set screw, and pull out union. Remove 2 grommets. See Figs. 11 or 12.

2) On RX300 models with ABS, place master cylinder in a soft-jaw vise. Remove brake fluid reservoir. Using a screwdriver, push No. 1 piston inward and remove piston stopper bolt, gasket and snap ring. See Fig. 11. Pulling straight out, remove No. 1 piston and spring from cylinder bore. Lightly tap cylinder flange against black edges until No. 2 piston and spring drop out of cylinder.

3) On RX300 models with TRAC, using screwdriver, push piston inward, and remove 2 straight pins by turning cylinder body. Remove 2 pistons by hand, pulling straight out.

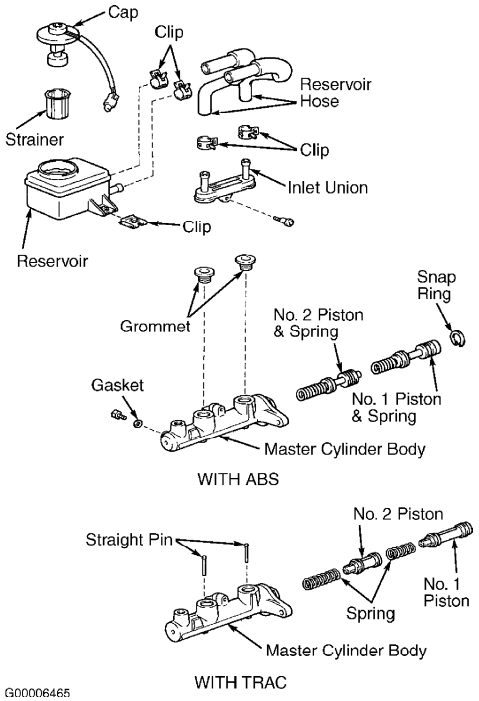


Fig. 11: Exploded View Of Master Cylinder (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

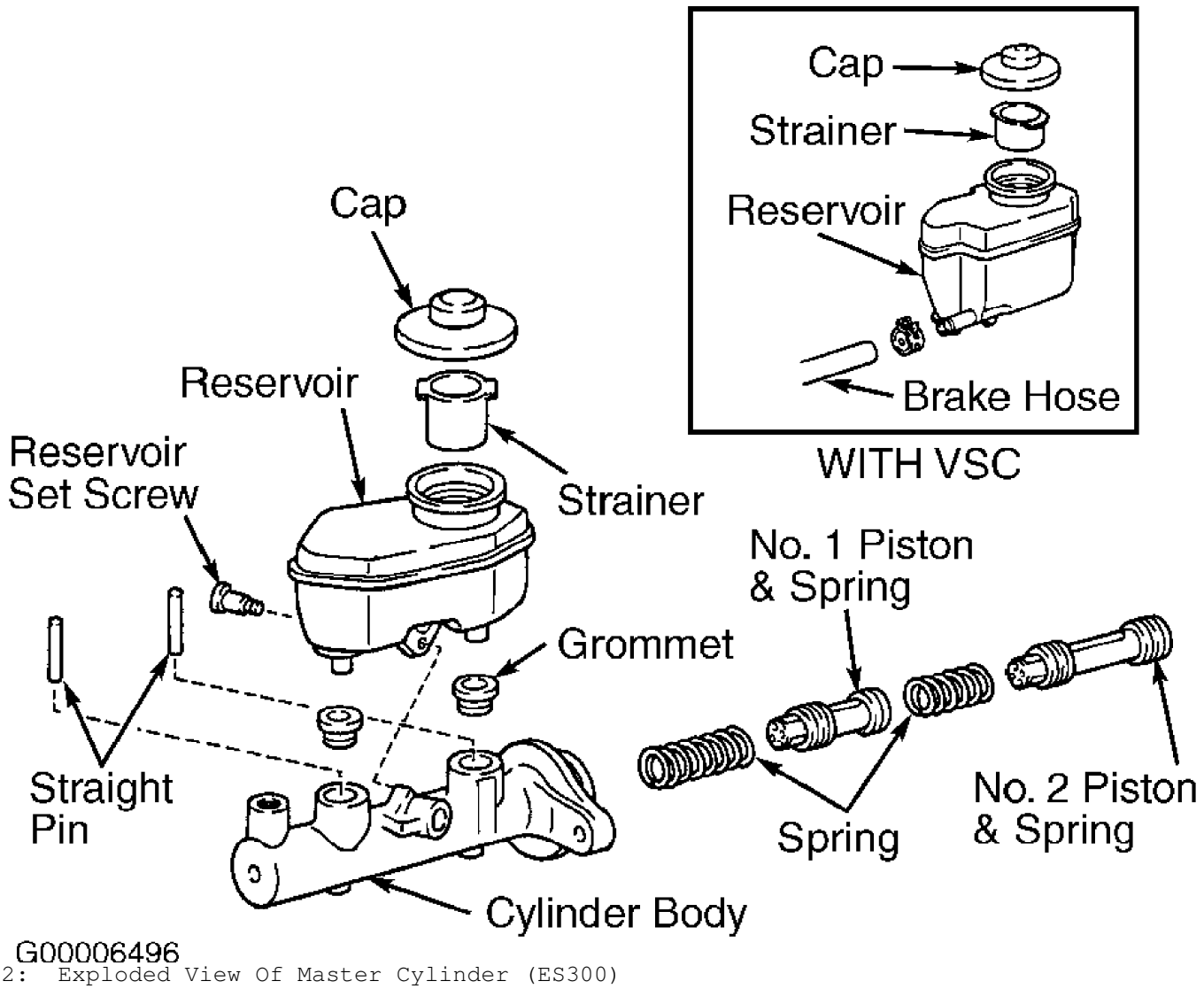


Fig. 12: Exploded View Of Master Cylinder (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Cleaning & Inspection

Wash all parts in clean brake fluid or alcohol. Inspect parts for wear. Inspect master cylinder for rust and scoring. Replace defective parts as needed, or replace master cylinder.

Reassembly

To reassemble, reverse disassembly procedure. Apply brake assembly lubricant to rubber parts before assembly. Install master cylinder with NEW gasket. To complete installation, reverse removal procedure. Bleed brake system. See BLEEDING BRAKE SYSTEM.

HYDRAULIC BRAKE BOOSTER

NOTE: Hydraulic brake booster is only used on GS300 and GS400. To aid in disassembly and reassembly, use illustration. See Fig. 13.

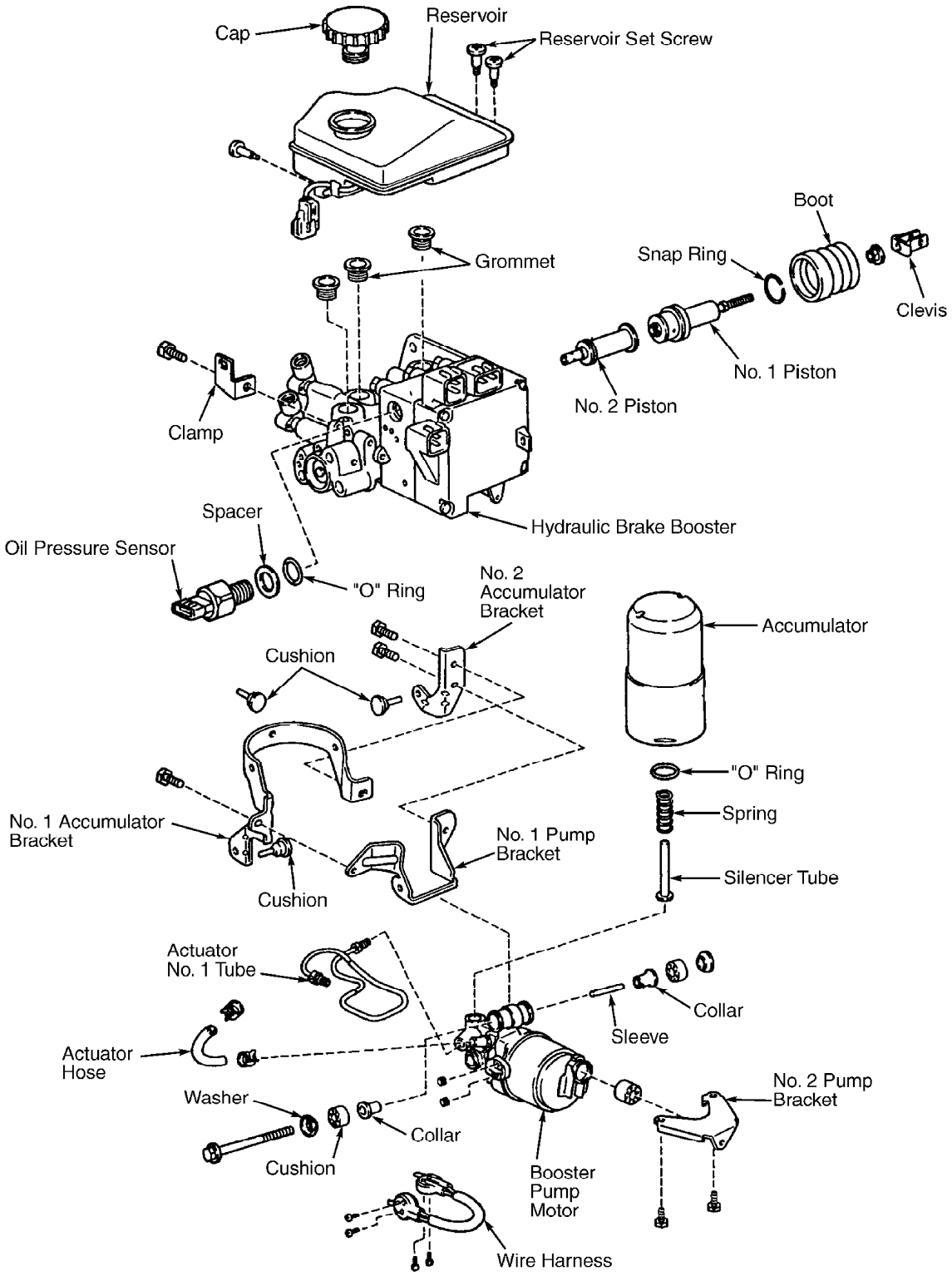


Fig. 13: Exploded View Of Hydraulic Brake Booster
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly

1) Place brake booster in vise. Remove reservoir cap. Remove

3 set screws, and pull out reservoir. Remove 3 grommets. Remove cylinder boot. Using 30 mm deep socket wrench, remove oil pressure sensor, spacer and "O" ring.

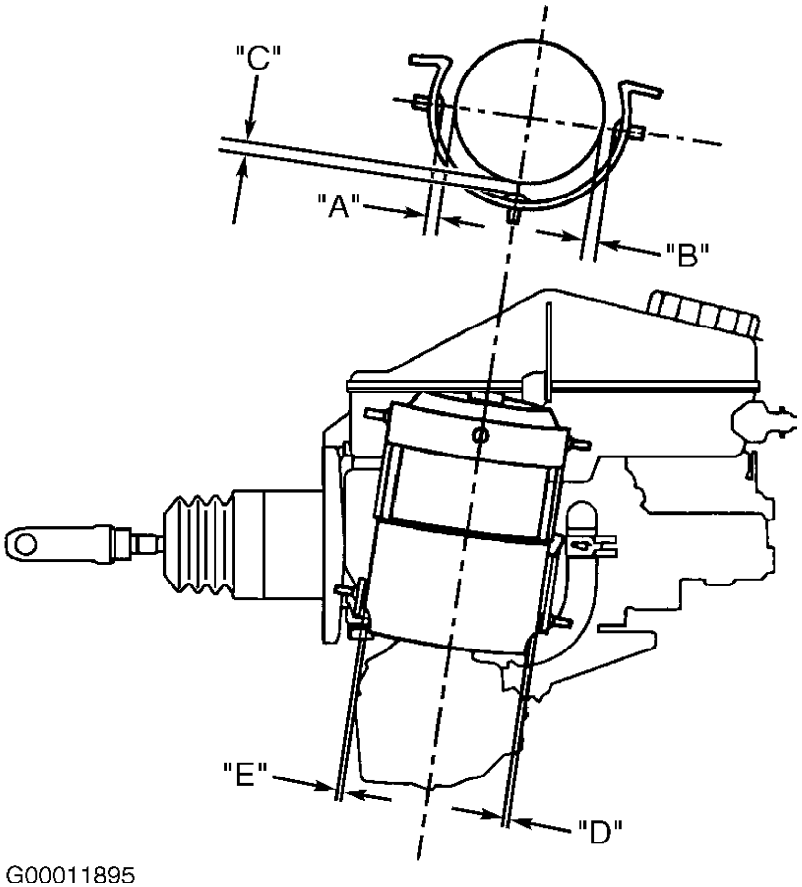
2) Pressing piston in with screwdriver, use pin to push snap ring from the hole in body, then remove it. Remove No. 1 and No. 2 piston, pulling straight out, not at an angle. Disconnect actuator hose. Remove 3 bolts, 2 hangers and clamp.

3) Remove brake actuator tube No. 1. Remove 2 screws and disconnect accumulator coil lead wire from booster assembly. Using 5 mm socket hexagon wrench, remove 3 bolts, No. 1 and No. 2 accumulator brackets, booster pump and accumulator with No. 1 pump bracket. Remove bolt and No. 1 pump bracket. Remove 2 washers, 3 cushions, 2 collars and sleeve. Remove 2 bolts and No. 2 pump bracket.

4) Place cloth around booster and place booster pump in vise. Using Remover (09318-12010), remove accumulator. Remove silencer tube. Remove spring and "O" ring. Ensure no foreign matter enters pump.

Reassembly

To install accumulator bracket, adjust clearances "A", "B", "D" and "E". Using thickness gauge, ensure clearances correspond to each value and are in "C" range. SeeFigs. 14 and 15. To complete reassembly, reverse disassembly procedure. After installation, fill brake reservoir with brake fluid. Bleed brake system and check for leaks. See BLEEDING BRAKE SYSTEM.



G00011895

Fig. 14: Adjusting Accumulator Bracket Clearances (1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

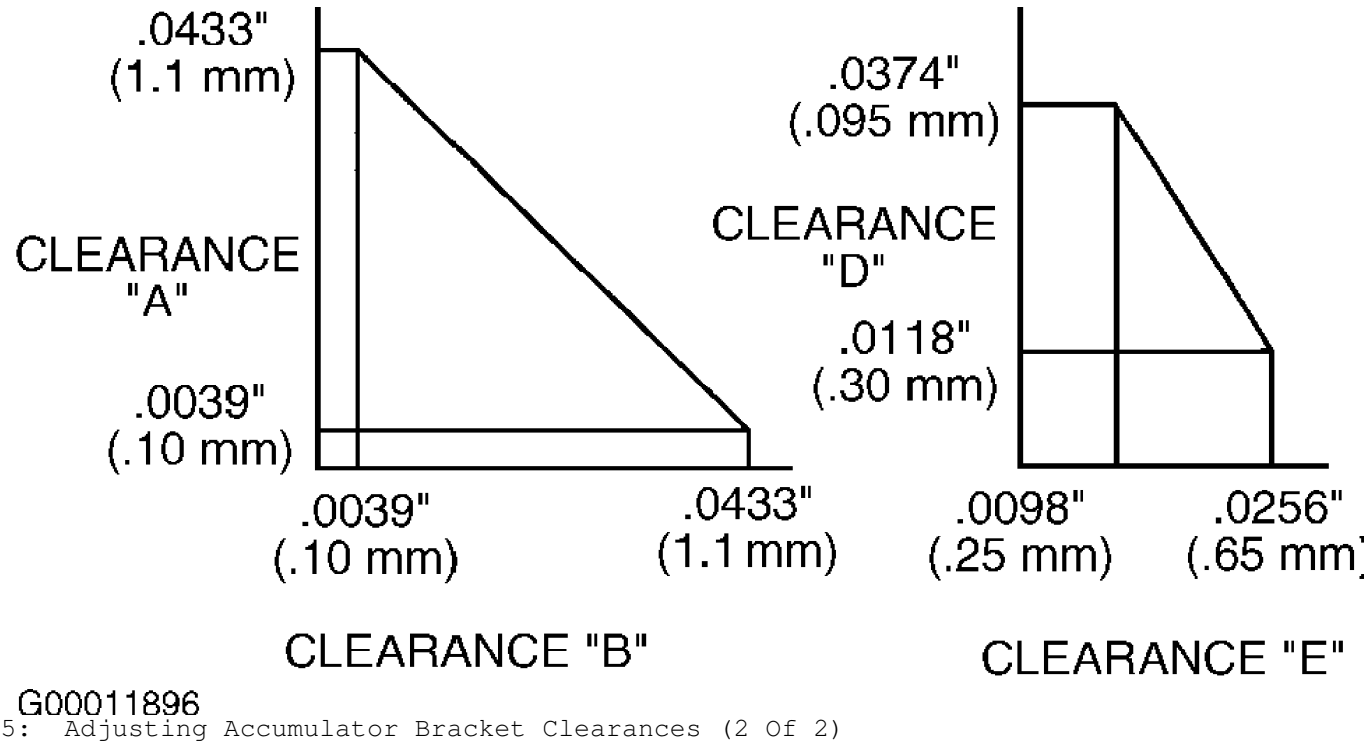


Fig. 15: Adjusting Accumulator Bracket Clearances (2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CALIPER

Disassembly

1) Remove brake caliper from vehicle. See FRONT BRAKE CALIPER or REAR BRAKE CALIPER under REMOVAL & INSTALLATION. Using a screwdriver, remove caliper cylinder boot set ring from caliper piston.

CAUTION: Do not place fingers in front of piston when using compressed air.

2) Support caliper between blocks of wood. Use compressed air to push piston from caliper bore into cloth. Remove piston seal from caliper. Remove sliding pins and dust boots.

Cleaning & Inspection

Wash all parts in clean brake fluid or alcohol. Inspect parts for wear. Inspect brake caliper bore and piston for rust and scoring. Replace defective parts as needed, or replace brake caliper.

Reassembly

1) Apply brake assembly lubricant to seal lips and caliper piston. Install piston seal in caliper cylinder. Install piston seal and piston in caliper bore. Install cylinder boot and set ring in caliper.

2) Install dust boots and sliding bushing. Ensure boots are seated securely in appropriate groove. To complete installation, reverse removal procedure. Bleed brake system. See BLEEDING BRAKE SYSTEM.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Brakeline-To-Master Cylinder	11 (15)
Caliper Installation Bolts	
ES300 & RX300	
Front	87 (118)
Rear	25 (34)
GS300 & GS400	
Front	25 (34)
Rear	77 (104)
LS400, SC300 & SC400	
Front & Rear	25 (34)
Flexhose-To-Brake Caliper Union Bolt	22 (30)
Push Rod Lock Nut	18 (25)
Sliding Bushing Bolt	14 (19)
Torque Plate Bolts	
ES300 & RX300	
Front	79 (107)
Rear	34 (47)
GS300, GS400, LS400, SC300 & SC400	
Front	87 (118)
Rear	77 (104)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
Bleeder Screw	
All Except ES300 & RX300	96 (11)
ES300 & RX300	74 (8)
Booster Installation Bolts	
All Except ES300, LS400 & RX300	8(12)
ES300, LS400 & RX300	9 (13)
Master Cylinder-To-Power Brake Unit Nuts	9 (13)
Parking Brake Adjustment Lock Nut	48 (5)
Reservoir Set Screw	
Except LS400	16 (2)
LS400	16 (2)
Stopper Bolt (Master Cylinder)	
ES300, RX300, SC300 & SC400	7 (10)
LS400	11 (15)

DISC BRAKE SPECIFICATIONS

DISC BRAKE SPECIFICATIONS

Application	In. (mm)
Brake Pad Thickness	
LS400	
Front	
Standard	.472 (12.00)
Minimum	.039 (1.00)
Rear	
Standard	.394 (10.00)
Minimum	.039 (1.00)
Except LS400	
Front	
Standard	.413 (10.5)
Minimum	.039 (1.00)
Rear	

Standard	.394 (10.00)
Minimum	.039 (1.00)
Front Disc Rotor	
ES300, LS400 & RX300	
Standard Thickness	1.102 (28.0)
Minimum Thickness	1.024 (26.0)
Disc Runout (1)	.002 (.05)
GS300, GS400, SC300 & SC400	
Standard Thickness	1.26 (32.0)
Minimum Thickness	1.181 (30.0)
Disc Runout (1)	.002 (.05)
Rear Disc Rotor	
ES300 & RX300	
Standard Thickness	.394 (10.0)
Minimum Thickness	.354 (9.0)
Disc Runout (1)	.0059 (.150)
GS300 & GS400	
Standard Thickness	.472 (12)
Minimum Thickness	.413 (10.5)
Disc Runout (1)	.002 (.05)
LS400, SC300 & SC400	
Standard Thickness	.63 (16.0)
Minimum Thickness	.591 (15.0)
Disc Runout (1)	.002 (.05)

(1) - Measured .39" (10.0 mm) from outer edge of rotor.

COMPRESSOR APPLICATIONS

1999 Lexus RX 300

2000-01 GENERAL SERVICING
Compressor Applications

NOTE: Always refer to underhood A/C specification label in engine compartment or A/C compressor label while servicing A/C system. If A/C specification label and MITCHELL(R) specifications differ, always use underhood label specifications.

COMPRESSOR APPLICATION

Application	Compressor
Acura	
Integra	Nippondenso 10-Cyl.
MDX	(1)
3.2CL	Denso 10-Cyl.
3.2TL	Nippondenso 10-Cyl.
3.5RL	Nippondenso 10-Cyl.
Audi	
A4 & S4	
4-Cyl. Engine	Zexel 6-Cyl.
6-Cyl. Engine	(1) Nippondenso
A6 & Allroad	(1)
TT	Sanden SD-17
BMW	(1)
Honda	
Accord	Nippondenso 10-Cyl.
Civic	Sanden Scroll Or Nippondenso
CR-V	Keihin Scroll
Insight	(1)
Odyssey	Nippondenso 10-Cyl.
Passport	Zexel DKV-14C Rotary Vane
Prelude	Keihin Scroll
S2000	Keihin Scroll
Hyundai	
Accent	Halla HS-15 10-Cyl.
Elantra	Halla HS-15 10-Cyl. Or Nippondenso 10PA15C
Santa Fe	Halla HS-18
Sonata	(1)
Tiburon	Halla HS-15 10-Cyl.
XG300	(1)
Infiniti	
G20	Zexel DKV-14D
I30	Calsonic V6 6-Cyl.
Q45	Calsonic V6 6-Cyl.
QX4	Calsonic V6 6-Cyl.
Isuzu	
Amigo, Rodeo & Rodeo	Zexel DKV-14G Rotary Vane
1999-2000 Hombre	
2.2L Engine	Harrison V7 7-Cyl.
4.3L Engine	Harrison HT6/HP6 6-Cyl.
Trooper	Harrison HD6/HT6 6-Cyl.
Vehi-CROSS	Zexel DKV-14G Rotary Vane
Jaguar	
XJR & XJ8	Nippondenso 10-Cyl.
XKR & XK8	Nippondenso 10-Cyl.
S-Type	FVS90 Variable Scroll
Kia	

Optima	(1)
Rio	(1)
Sephia & Spectra	(1)
Sportage	Zexel 5-Cyl.
Land Rover	
1999 Discovery	Nippondenso 10PA17 10-Cyl.
1999-01 Discovery Series II	Nippondenso 10PA17 10-Cyl.
Range Rover	
Up To 1999	Sanden TRS105N
From 1999 & Diesel	Nippondenso 10PA17 10-Cyl.
Lexus	
ES 300	Nippondenso 10PA20 10-Cyl.
GS 300, GS 400 & GS 430	Nippondenso 10PA20 10-Cyl.
IS 300	Nippondenso 10S15
LS 400	Nippondenso 10PA20 10-Cyl.
LS 430	Nippondenso 7SBU16
LX 470	Nippondenso 10PA17 10-Cyl.
RX 300	Nippondenso 10-Cyl.
SC 300 & SC400	Nippondenso 10PA20 10-Cyl.
Mazda	
B2300, B2500, B3000 & B4000	Ford FS-10 10-Cyl.
Millenia	(1)
MPV	Nippondenso 10-Cyl.
MX-5 Miata	(1) Rotary Vane
Protege	Panasonic Rotary Vane
Tribute	Ford FS-10 10-Cyl.
626	(1) Sanden
Mercedes-Benz	
C230, C280 & C43	Nippondenso 6CA17 6-Cyl. Or 7SB16 7-Cyl.
C240 & C320	Nippondenso 7SEU1
C230 Kompressor	Nippondenso 7SB16 7-Cyl.
CLK 320, CLK 430 & CLK 55	Nippondenso 7SB16 7-Cyl.
E320, E430 & E55	Nippondenso 7SB16 7-Cyl.
ML 20, ML 430 & ML 55	Nippondenso 7SB16 7-Cyl.
S430, S500 & S55	Nippondenso 7SE16
SL 500	Nippondenso 10PA17 10-Cyl. Or Sanden TRS105
SLK 230 & SLK 320	Nippondenso 7SB16 7-Cyl.
Mitsubishi	
Diamante	Sanden MSC90C Scroll
Eclipse	Sanden MSC90C Scroll
Galant	Sanden MSC90C Scroll
Mirage	Sanden MSC90 Scroll
Montero	Nippondenso 10PA15 10-Cyl. Or Sanden MSC105C Scroll
Montero Sport	Sanden MSC105C Scroll
Nissan	
Altima	Zexel DKV-14C Rotary Vane
Frontier	Zexel DKV-14C Rotary Vane
Maxima	Calsonic V6 6-Cyl.
Pathfinder	Calsonic V6 6-Cyl.
Quest	Ford FS-10 10-Cyl.
Sentra	Zexel DKV-11G Rotary Vane
Xterra	Zexel DKV-14C Rotary Vane
Porsche	
Boxster	Nippondenso 7SB16 7-Cyl.
911	Nippondenso 7SB16 7-Cyl.
Saab	
9-3	Sanden TRS105R 3211 Scroll
9-5	Nippondenso 7SB16 7-Cyl.
Subaru	
Forester	

2000 Models	Zexel CR-14 Rotary Vane
2001 Models	Zexel KC50G Rotary Vane
Impreza	Zexel CR-14 Rotary Vane
Legacy & Outback	Zexel DKV-14G 5-Vane
Suzuki	
Esteem	Seiko-Seiki Rotary Vane
Grand Vitara & Vitara	(1) Seiko-Seiki Rotary Vane Or Denso
Swift	Sanden SD7B10 7-Cyl.
Toyota	
Avalon	Nippondenso 10S17 10-Cyl.
Camry & Camry Solara	Nippondenso 10PA17C 10-Cyl.
Celica	(1)
Corolla	Nippondenso 10PA15 10-Cyl.
ECHO	SCS06 Scroll
Highlander	Nippondenso 10S17 10-Cyl.
Land Cruiser	Nippondenso 10PA20 10-Cyl.
MR2	SCS06 Scroll
Prius	SCS06 Scroll
RAV4	
2000 Models	(1)
2001 Models	Nippondenso 10S15
Sequoia	Nippondenso 10S20
Sienna	Nippondenso 10PA17 10-Cyl.
Tacoma	Nippondenso 10PA17 10-Cyl.
4Runner	Nippondenso 10-Cyl.
Volkswagen	
Beetle	Sanden SD7-V16 7-Cyl.
Cabrio, Golf, GTI & Jetta	Sanden SD7-V16 7-Cyl.
EuroVan	Sanden SD7-V16 7-Cyl.
Passat	Nippondenso 7SB-16C Or Zexel DCW-17D
Volvo	
C70, S70 & V70	Zexel DKS-15CH Or DKS-17CH 6-Cyl.
S40 & V40	(1)
S60 & S80	Zexel DKS-17CH 6-Cyl.

(1) - Information is not available from manufacturer. Check underhood A/C specification label or A/C compressor label.

COMPUTER RELEARN PROCEDURES

1999 Lexus RX 300

1999 GENERAL INFORMATION
Computer Relearn Procedures

Imported Cars and Light Trucks

INTRODUCTION

BODY CONTROLS

Vehicles equipped with body, air conditioning, anti-lock brake or memory computers may require a computer relearn procedure after components are replaced or the vehicle battery is disconnected. Vehicle computers memorize and store vehicle information and operation selections. When the vehicle battery is disconnected, this memory may be lost, requiring relearning or resetting. Depending on the vehicle and how it is equipped, the following memories may exist:

* Seat position.
* Tilt/telescoping steering wheel position.
* Mirror position.
* Radio presets and anti-theft code.
* Clock.
* Remote keyless entry custom features.
* Door key lock entry custom features.
* Power window or sunroof operation.

These do not affect vehicle operation. For systems that do not affect operation, see appropriate article for relearn procedures. Other computer relearn procedures are required for vehicle or system operation. These may include:

* Initial control unit programming.
* Traction control yaw sensor initializing.
* Multiplex communication.
* Anti-theft system or engine immobilizer system passwords.

ENGINE CONTROLS

Vehicles equipped with powertrain computers may require a computer relearn procedure after the vehicle battery is disconnected. Vehicle computers memorize and store vehicle operation patterns for optimum driveability and performance. When the vehicle battery is disconnected, this memory is lost, which may result in a driveability problem. Depending on the vehicle and how it is equipped, the following driveability problems may exist:

* Rough or unstable idle.
* Hesitation or stumble.
* Rich or lean running.
* Poor fuel mileage.
* Harsh or poor transmission/transaxle shift quality.

Default data is used until NEW data from each key start is stored. As the computer restores its memory from each new key start, driveability is restored.

Driveability problems may occur during the computer relearn stage. To accelerate computer relearn process after battery removal and installation, specified computer relearn procedures should be

performed. See appropriate procedures for specified manufacturer.

ACURA

ALL MODELS

After disconnecting battery or replacing ECM/PCM, drive vehicle to enable ECM/PCM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM/PCM completes relearn function.

INTEGRA, 2.3CL, 3.0CL, 3.5RL & 3.2TL

ECM/PCM Reset Procedure
Using Honda PGM Tester or OBD-II scan tool, clear ECM/PCM memory. Follow manufacturer's instructions. To reset ECM/PCM without scan tool, turn ignition off. Remove BACK UP or CLOCK/RADIO (7.5-amp) fuse from underhood fuse/relay box for 10 seconds.

NOTE: If no DTCs exist and SCS is connected, MIL will stay illuminated with ignition on.

Final Procedure
This procedure must be performed after any trouble shooting. Remove Service Check Connector (SCS) connector, if connected. Perform ECM/PCM reset procedure. Turn ignition off. Disconnect scan tool.

Known-Good ECM/PCM Substitution
On models equipped with engine immobilizer system, acquire key cut from non-immobilizer key blank. Remove ECM/PCM from test vehicle. Install a known-good ECM/PCM from donor vehicle into test vehicle. Tape donor vehicle's ignition key head-to-head to test vehicle's temporary key. ECM/PCM will recognize code from donor vehicle's key and allow test vehicle to be started.

ECM/PCM Replacement
ECM/PCM is part of engine immobilizer system. Replacement ECM/PCM must have immobilizer code rewritten, using Honda PGM Tester. To perform rewrite procedure requires the vehicle, all master keys, all valet keys and a Honda PGM Tester with an immobilizer program card. Any key not learned during rewrite will not start vehicle. Follow Honda PGM Tester instructions. For more information, see appropriate IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

AUDI

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

A4 1.8L TURBO & A6

NOTE: On A4 1.8L turbo and A6 models, it is necessary to generate a readiness code if PCM memory is cleared or PCM is disconnected from battery voltage.

1.8L Turbo Readiness Code
VAG 1551 scan tool is necessary for clearing codes. Follow

manufacturer's instructions for clearing codes. After clearing codes, it is necessary to generate a PCM readiness code. A readiness code resets specific values to zero. Follow scan tool manufacturer's instructions for generating a readiness code.

NOTE: On A4 1.8L turbo and A6 models, it is necessary to adapt the throttle valve control module to ECM if ECM memory is cleared or ECM is disconnected from battery voltage. Turn ignition on (engine off) for 10 seconds.

PCM CODING (ALL MODELS)

NOTE: VAG 1551 scan tool is necessary to perform PCM coding.

If Powertrain Control Module (PCM) is replaced it is necessary to code new PCM. If new PCM is not properly coded, the following problems may occur:

* Driveability problems (i.e. harsh shifting).
* Increased fuel consumption.
* Increased exhaust emissions.
* Reduction in transmission life.
* Malfunctions not present are stored in PCM memory.
* Not all PCM functions are carried out (i.e. EVAP system operation).

Following manufacturer's instructions, connect VAG 1551 scan tool to vehicle. Following manufacturer's instructions, access PCM coding information using VAG 1551 scan tool. For PCM coding options, see appropriate ECM CODING OPTIONS table.

As an example, a properly coded PCM for an A4 model with EGR system, All Wheel Drive (AWD), and Automatic Transmission (A/T) would look like 01251 on the VAG 1551 scan tool.

NOTE: After coding PCM and starting engine for first time, allow engine to idle for several minutes so PCM can go through a learn function. Idle speed may be erratic while PCM is learning.

ECM CODING OPTIONS (A4 1.8L TURBO)

Application/Code	Option
Country/Emissions	
06	USA Equipped EVAP Leak Detection Pump
Drivetrain/Auxiliary Function	
0	Front Wheel Drive Without Traction Control
1	Front Wheel Drive With Traction Control
2	All Wheel Drive Without Traction Control
3	All Wheel Drive With Traction Control
Transmission	
0	5-Speed Manual Transmission
5	Automatic Transmission 01V
Vehicle Type	
1	A4

ECM CODING OPTIONS (A4 2.8L)

Application/Code	Option
Country/Emissions	
01	Vehicle With EGR
Drivetrain/Auxiliary Function	
0	Front Wheel Drive Without Traction Control
1	Front Wheel Drive With Traction Control
2	All Wheel Drive Without Traction Control
Transmission	
0	5-Speed Manual Transmission
5	Automatic Transmission 01V
Vehicle Type	
1	A4

ECM CODING OPTIONS (A6)

Application/Code	Option
Country/Emissions	
06	USA Equipped EVAP Leak Detection Pump
Drivetrain/Auxiliary Function	
0	Front Wheel Drive Without Traction Control
1	Front Wheel Drive With Traction Control
2	All Wheel Drive Without Traction Control
3	All Wheel Drive With Traction Control
Transmission	
0	5-Speed Manual Transmission
5	Automatic Transmission 01V
Vehicle Type	
2	A6

BMW

ALL MODELS

NOTE: When DME/Motronic control unit is disconnected or its power supply interrupted, all stored intermittent DTCs as well as substitute values are cleared/lost. Current hard DTCs cannot be cleared.

After disconnecting battery or replacing DME/Motronic control unit, drive vehicle to enable DME/Motronic control unit to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until DME/Motronic control unit completes relearn function. System Readiness Test (SRT) information not available from manufacturer.

COMPONENT ACTIVATION

Use BMW MoDIC (hand-held scan tester), BMW Service Tester

(Sun 2013 Engine Analyzer) and applicable BMW diagnostic software to activate components. Select DRIVE COMPONENTS MODE (D300). Detailed information on this mode is displayed on screen.

HONDA

ALL MODELS

After disconnecting battery or replacing ECM/PCM, drive vehicle to enable ECM/PCM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM/PCM completes relearn function.

ECM/PCM Reset Procedure

Using Honda PGM Tester or OBD-II scan tool, clear ECM/PCM memory. Follow manufacturer's instructions. To reset ECM/PCM without scan tool, turn ignition off. Remove BACK UP or CLOCK/RADIO (7.5-amp) fuse from underhood fuse/relay box for 10 seconds.

NOTE: If no DTCs exist and SCS is connected, MIL will stay illuminated with ignition on.

Final Procedure

This procedure must be performed after any trouble shooting. Remove Service Check Connector (SCS) connector, if connected. Perform ECM/PCM reset procedure. Turn ignition off. Disconnect scan tool.

ACCORD, CR-V, ODYSSEY, PASSPORT & PRELUDE

Known-Good ECM/PCM Substitution

On models equipped with engine immobilizer system, acquire key cut from non-immobilizer key blank. Remove ECM/PCM from test vehicle. Install known-good ECM/PCM from donor vehicle into test vehicle. Tape donor vehicle's ignition key head-to-head to test vehicles temporary key. ECM/PCM will recognize code from donor vehicle's key and allow test vehicle to be started.

ECM/PCM Replacement

ECM/PCM is part of immobilizer system. Replacement ECM/PCM must have immobilizer code rewritten, using Honda PGM Tester. To perform rewrite procedure requires the vehicle, all master keys, all valet keys and a Honda PGM Tester with an immobilizer program card. Any key not learned during rewrite will not start vehicle. Follow Honda PGM Tester instructions. For more information, see appropriate IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

HYUNDAI

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

INFINITI

ECM PROGRAMMING

ECM is a part of Nissan Anti-Theft System (NATS). Replacement ECM must have immobilizer code rewritten, using CONSULT tester. To perform rewrite procedure requires the vehicle, all keys and a CONSULT

tester with a NATS Program Card (E960U). Any key not learned during rewrite will not start vehicle. Follow CONSULT tester instructions.

ISUZU

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

AMIGO & RODEO

NOTE: Refer to latest Isuzu Technical Communication System (ITCS) information for reprogramming or flashing procedures.

NOTE: The 3.2L engine two different PCMs, one for manual transmission and one for automatic transmission applications.

EEPROM Programming Procedure

Connect scan tool and retrieve information from PCM. Turn ignition off. Ensure battery is fully charged. Download latest program and calibration from ITCS. Turn ignition on. Reconnect scan tool and program PCM. Start engine and run engine for at least one minute. Check for DTCs. If PCM does not program, check all PCM connections and retry. If PCM still cannot be reprogrammed, replace PCM.

2.2L Engine Tooth Error Learn Procedure

1) Ensure all fluid levels are normal, engine is at operating temperature and no camshaft and/or crankshaft sensor DTCs exist before performing this procedure. Place vehicle in PARK or Neutral. Block drive wheels. Turn off all accessories.

2) Using scan tool, enable Tooth Error Learn procedure. This will limit RPM. Depress brake. Depress and hold throttle fully (100 percent) until correction is learned or number of attempts to learn has been exceeded. Release throttle as soon as engine speed decreases. After throttle is released, RPM will not be limited. Do not depress throttle fully after releasing.

HOMBRE

NOTE: Read all procedures listed to determine why and when each procedure is to be performed before proceeding.

Electronically Erasable Programmable Read Only Memory (EEPROM) Programming (2.2L Engine)

1) If Powertrain Control Module (PCM) was replaced, the EEPROM in the PCM must be programmed. If EEPROM is not programmed, a Diagnostic Trouble Code (DTC) will be set in the PCM. Perform EEPROM programming using the Techline equipment manufacturer’s instructions and latest applicable software for the vehicle.

2) Once EEPROM is reprogrammed, the Crankshaft Position (CKP) sensor variation learn procedure must be performed using proper procedure.

Electronically Erasable Programmable Read Only Memory (EEPROM) Programming (4.3L Engine)

1) If Vehicle Control Module (VCM) was replaced, the EEPROM in the VCM must be programmed. If EEPROM is not programmed, a Diagnostic Trouble Code (DTC) will be set in the VCM.

2) Ensure battery is fully charged. Ensure cable is properly

connected on Data Link Connector (DLC). Turn ignition on. Perform EEPROM programming using the Techline equipment manufacturer's instructions and latest applicable software for the vehicle.

3) Once EEPROM has been reprogrammed, Crankshaft Position (CKP) sensor variation learn procedure and password learn procedure must be performed using proper procedure. Once Crankshaft Position (CKP) sensor variation learn procedure and password learn procedure are performed, perform powertrain On-Board Diagnostic (OBD) system check. See POWERTRAIN ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

NOTE: If EEPROM programming fails, ensure all electrical connections on VCM are okay. Check Techline for latest software. If EEPROM programming still fails, replace VCM.

Crankshaft Position (CKP) Sensor Variation Learn Procedure (2.2L & 4.3L Engines)

1) Procedure must be performed if any of the following have been done:

* EEPROM was reprogrammed.
* If crankshaft position sensor was removed or replaced.
* Vehicle Control Module (VCM) was replaced.

2) Connect scan tool to Data Link Connector (DLC). Apply parking brake. Block rear wheels. Ensure hood is closed.

3) Place transmission in Park (A/T models) or Neutral (M/T models). Start engine and warm engine until engine coolant temperature is at least 150°F (65°C). Ensure all accessories are off.

4) Apply service brakes. With engine idling, use scan tool to select and enable CKP sensor variation learn procedure.

5) Gradually accelerate engine to 4000 RPM. Quickly release throttle to idle position once CKP sensor variation learn procedure is obtained and engine starts to decelerate. Once CKP sensor variation values are learned, the VCM will return engine control to the operator and engine will respond to throttle position.

CAUTION: Ensure throttle is quickly released to idle position once CKP sensor variation learn procedure fuel cut off is obtained and engine starts to decelerate.

6) If CKP sensor variation learn procedure was completed, turn ignition off for at least 15 seconds and remove scan tool. If CKP sensor variation learn procedure was not completed, a DTC P1336 should be stored in the VCM. Perform test procedures for DTC P1336 and repair as necessary. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

Password Learn Procedure For Anti-Theft System (2.2L Engine)

1) Password learn procedure must be performed if Truck Body Controller (TBC) or passlock sensor is replaced. A password is communicated between TBC and Powertrain Control Module (PCM) to provide engine operation. If TBC has been replaced, the PCM must learn the password from the TBC. If password learn procedure is not performed, a Diagnostic Trouble Code (DTC) may be set in the PCM when attempting to start the engine.

2) Attempt to start engine and then leave ignition on. DO NOT turn ignition off. The SECURITY indicator light will flash for 4 seconds and then remain on steady for about 10 minutes and then turn off. SECURITY indicator light is located on center of instrument panel, just above the turn signal indicators. Once SECURITY indicator light turns off, turn ignition off.

NOTE: If PCM has been replaced, the Electronically Erasable Programmable Read Only Memory (EEPROM) should be programmed. When EEPROM has been programmed, the PCM will learn the password when ignition is initially turned on. Password learn procedure is not required when replacing the PCM and EEPROM is programmed.

3) Repeat step 2) two more times. When SECURITY indicator light turns off on the third ignition cycle, attempt to start the engine. If engine starts, the password learn procedure is complete. If password is not learned, a Diagnostic Trouble Code (DTC) may be set in PCM. Perform test procedures for specified DTC and repair as necessary. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

Password Learn Procedure For Anti-Theft System (4.3L Engine)

1) Password learn procedure must be performed if Vehicle Control Module (VCM), Truck Body Controller (TBC) or passlock sensor has been replaced. A password is communicated between TBC and VCM to provide engine operation. If VCM has been replaced, the VCM must learn the password from the TBC.

2) Attempt to start engine. Engine will start and then stall. After engine stalls, leave ignition on for 10 minutes. After engine stalls the SECURITY indicator light will come on for 10 minutes and then go off. The SECURITY indicator light is located on center of instrument panel, just above the turn signal indicators.

NOTE: Ensure battery is fully charged before proceeding. Ensure steps are followed in correct order or procedure may need to be repeated.

3) After SECURITY indicator light goes off, turn ignition off for 30 seconds. Attempt to start engine and then leave ignition on. After engine has stalled, leave ignition on for 10 minutes. SECURITY indicator light will come on for 10 minutes and then go off. After SECURITY indicator light goes off, turn ignition off for 30 seconds.

4) Attempt to start engine and then leave ignition on. After engine has stalled, leave ignition on for 10 minutes. SECURITY indicator light will come on for 10 minutes and then go off.

5) Turn ignition off for 30 seconds. Turn ignition on and wait 30 seconds. Attempt to start engine. If engine starts, password learn procedure is complete. If engine does not start, ensure procedure was properly followed. If procedure was properly followed, check for DTCs. If any DTCs exist, perform test procedures for specified DTC and repair as necessary. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

Vehicle Driveability Computer Relearn Procedure (2.2L Engine)

Manufacturer does not provide a specific computer relearn procedure for obtaining proper driveability. If vehicle battery was disconnected or Powertrain Control Module (PCM) was replaced, driving the vehicle will enable the PCM to perform a computer relearn procedure for obtaining proper driveability. Inform customer that driveability may differ from what they are accustomed to until the PCM completes the computer relearn procedure.

Vehicle Driveability Computer Relearn Procedure (4.3L Engine)

Manufacturer does not provide a specific computer relearn procedure for obtaining proper driveability. If vehicle battery was disconnected or Vehicle Control Module (VCM) was replaced, driving the vehicle will enable the VCM to perform a computer relearn procedure for obtaining proper driveability. Inform customer that driveability

may differ from what they are accustomed to until the VCM completes the computer relearn procedure.

OASIS

See Odyssey computer relearn procedures under HONDA.

TROOPER

Ensure battery is fully charged. Download latest software from Techline. Turn ignition on. Connect vehicle interface module and program PCM. If PCM does not program, check all PCM connections and retry. If PCM still cannot be reprogrammed, replace PCM.

JAGUAR

KEY TRANSPONDER MODULE (KTM) SYNCHRONIZATION

If ECM or KTM is replaced, synchronization must be performed or vehicle will not start. Load latest software in Jaguar Portable Diagnostic Unit (1051 for XK8, 1055 for V8 XJ Series). Access diagnostics. Select VEHICLE SETUP. Select INITIALIZE IMMOBILIZATION to synchronize the ECM and KTM.

ECM RELEARN

CAUTION: DO NOT exceed engine speeds or time durations listed.

Start engine and allow to reach operating temperature. Press A/C button to turn climate control system off. Apply parking brake. Apply brakes and shift transmission to DRIVE. Allow engine to idle for 2 minutes. Gradually raise engine speed to 950 RPM and hold for 45 seconds. Raise engine speed to 1200 RPM and hold for 45 seconds. Raise engine speed to 1500 RPM and hold for 30 seconds. Allow engine to return to idle. Place shifter in PARK. Turn engine off.

KIA

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

LAND ROVER

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

LEXUS

* PLEASE READ THIS FIRST *

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

IGNITION KEY REGISTRATION (IMMOBILIZER EQUIPPED)

NOTE: This procedure MUST be performed only when NEW Engine Control Module (ECM) is installed. A new ECM is in automatic registration mode, and up to 3 ignition key identification codes may be registered in ECM at one time. In automatic registration mode, the last ignition key to be registered becomes the sub-key.

1) Ensure SECURITY indicator light is flashing. SECURITY indicator light is located on center of instrument panel, just above the air outlets above radio.
2) Insert ignition key into ignition lock cylinder. Note that SECURITY indicator light should now remain on steady.
3) Once ignition key registration is under way, SECURITY indicator light should turn off. After ignition key registration is complete, SECURITY indicator light should come on steady. Remove ignition key.
4) The SECURITY indicator light should flash when ignition key is removed from ignition lock cylinder if registration is complete and system is operating normally. If ignition key registration was not completed with ECM in automatic registration mode, a code 2-1 will be displayed by SECURITY indicator light. When inserting an ignition key that is already registered, code 2-2 will be displayed by indicator light.
5) If programming additional ignition keys, repeat process starting with step 1). If additional ignition keys do not need programming, procedure is complete. SECURITY indicator light should go off once last ignition key (sub-key) is registered.
6) To complete automatic registration mode, depress and release brake pedal at least 5 times within 15 seconds, or request automatic registration mode completion by using Toyota scan tool connected to Data Link Connector (DLC) No. 3.

VEHICLE SKID CONTROL (ZERO POINT CALIBRATION)

NOTE: When running rear wheels on a chassis dynamometer or on a hoist, always turn TRAC and VSC system off.

LS400
After replacing ECU or yaw rate sensor, perform following procedure without moving or jarring vehicle. Ensure shifter is in PARK position. Reconnect battery. Turn ignition on and wait 15 seconds to allow sensor to zero point calibrate. For 5.5 seconds, the CHECK VSC indicator is illuminated. For the entire 15 seconds, the VSC OFF indicator is illuminated.

MAZDA

IMMOBILIZER SYSTEM (626)

NOTE: A valid key must be available when replacing PCM or immobilizer unit, or both components must be replaced. When replacing an immobilizer system component, all working keys need to be reprogrammed into system. Replacing PCM or immobilizer unit will erase previously programmed keys.

Key Replacement Or Addition (Customer Supplied 2 Or More Valid Keys)
1) Cut new transponder equipped key(s). Using 1st key, turn ignition to ON position, then to LOCK position 5 times. Turn 1st key to ON position. SECURITY light should illuminate. Turn 1st key to LOCK

position. SECURITY light should go out.

2) Using 2nd key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn 2nd key to LOCK position and remove key.

3) Repeat step 2) with 1st key. Repeat step 2) with new key. Repeat step 2) with each new or valid key, up to 8 keys total. Wait 30 seconds, program will quit automatically.

Key Replacement Or Addition (Customer Supplied Only One Or No Valid Keys)

1) Cut new transponder equipped key(s). Using new key, turn ignition to ON position, then to LOCK position 5 times. Turn new key to ON position. SECURITY light should be flashing at a 300 millisecond interval. Turn new key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to a 1.2 second interval.

2) Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with new key. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.

3) Using new 2nd key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new 2nd key to LOCK position and remove key.

4) Repeat step 3) with valid key or new 3rd key. Repeat step 3) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically.

NOTE: When replacing steering lock, coil and keys should be replaced as a set.

Steering Lock Replacement (Customer Supplied 2 Or More Valid Keys)

1) Remove old steering lock. Remove steering lock coil. Install steering lock and steering lock coil. Connect harness connectors.

2) Insert valid 1st key into old steering lock. Insert new key into new steering lock. Turn new key to ON position, then to LOCK position 5 times. Turn new key to ON position. SECURITY light should illuminate. Turn new key to LOCK position. SECURITY light should go out.

3) Remove valid 1st key from old steering lock. Place valid 2nd key in old steering lock. Using new key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position.

4) Disconnect coil connector from old steering lock and connect to new steering lock. Using new key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.

5) Repeat step 4) with each new key. Wait 30 seconds, program will quit automatically. Complete installation of steering lock.

Steering Lock Replacement (Customer Supplied Only One Or No Valid Keys)

1) Replace steering lock. Using new key, turn ignition to ON position, then to LOCK position 5 times. Turn new key to ON position. SECURITY light should be flashing at a 300 millisecond interval. Turn new key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to a 1.2 second interval.

2) Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with new key. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.

3) Using new 2nd key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new

2nd key to LOCK position and remove key.
4) Repeat step 3) with new 3rd key. Wait 30 seconds, program will quit automatically.

NOTE: When customer does not supply any valid keys, PCM must also be replaced.

Immobilizer Unit (Customer Supplied At Least One Valid Key)
1) Cut new transponder equipped key(s). Replace immobilizer unit. Using valid key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn valid key to LOCK position and remove key.
2) Using new key or valid 2nd key, turn ignition to ON position, then to LOCK position 5 times. Turn new key or valid 2nd key to ON position. SECURITY light should be flashing at a 300 millisecond interval. Turn new key or valid 2nd key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to a 1.2 second interval.
3) Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with new key or valid 2nd key. Using new key or valid 2nd key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key or valid 2nd key to LOCK position and remove key.
4) Using original valid key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn original valid key to LOCK position and remove key.
5) Repeat step 4) with additional valid key or new 3rd key. Repeat step 3) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically.

NOTE: When customer does not supply any valid keys, immobilizer unit must also be replaced.

PCM (Customer Supplied 2 Or More Valid Keys)
1) Cut new transponder equipped key(s), if necessary. Replace PCM. Using valid 1st key, turn ignition to ON position. SECURITY light should illuminate for 1-2 seconds. Turn valid key to LOCK position.
2) Using valid 1st key, turn ignition to ON position, then to LOCK position 6 times. Ensure 6th turning is done within one second. Remove valid 1st key.
3) Using valid 2nd key, turn ignition to ON position. SECURITY light should illuminate for 1-2 seconds. Turn valid 2nd key to LOCK position and remove key.
4) Using valid 1st key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn valid 1st key to LOCK position and remove key.
5) Repeat step 4) with additional valid key or new 3rd key. Repeat step 4) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically.

PCM (Customer Supplied Only One Valid Key)
1) Cut new transponder equipped key(s), if necessary. Replace PCM. Using new 1st key, turn ignition to ON position. SECURITY light should illuminate for 1-2 seconds. Turn new 1st key to LOCK position.
2) Using new 2nd key, turn ignition to ON position, then LOCK position 6 times. Ensure 6th turning is done within one second. SECURITY light should be flashing at a 300 millisecond interval. Wait about 5 minutes until SECURITY light flashing has decreased to a 1.2 second interval.
3) Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Using new 2nd key, turn ignition to ON position. SECURITY light should illuminate for 1-2

seconds. Turn new 2nd key to LOCK position and remove key.

4) Using valid key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn valid key to LOCK position and remove key.

5) Repeat step 4) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically. After reprogramming is complete, clear DTCs with New Generation Star (NGS) tester.

NOTE: Keys may be new or valid. If errors occur during reprogramming in steps 1) or 2), start over from step 1). If errors occur during step 3), go to REPROGRAM ERROR RECOVERY.

Immobilizer Unit & PCM

1) Cut new transponder equipped key(s), if necessary. Replace immobilizer unit and PCM. Using 1st key, turn ignition to ON position. SECURITY light should illuminate and then go out. Turn 1st key to LOCK position and remove key. SECURITY light should flash in single pulses repeatedly.

2) Using 2nd key, turn ignition to ON position. SECURITY light should illuminate and then go out. Turn 2nd key to LOCK position and remove key. SECURITY light should flash in double pulses repeatedly.

3) Using 3rd key, turn ignition to ON position. SECURITY light should illuminate and then go out. Turn 3rd key to LOCK position and remove key. SECURITY light should flash in triple pulses repeatedly.

4) Repeat step 3) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically. After reprogramming is complete, clear DTCs with NGS tester.

Reprogram Error Recovery

1) Using 1st key, start engine. After SECURITY light illuminates for 1-2 seconds, turn 1st key to LOCK position. Using 1st key, turn ignition to ON position, then LOCK position 5 times.

2) Using 1st key, turn ignition to ON position. SECURITY light should illuminate. Turn 1st key to LOCK position and remove key. SECURITY light should go out.

3) Using 2nd key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn 2nd key to LOCK position and remove key.

4) Repeat step 3) with 1st key. Repeat step 3) with 3rd key. Repeat step 3) with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically. After reprogramming is complete, clear DTCs with NGS tester.

Inputting Code Word

1) Code word is comprised of 8 digits from 1-9. The code word is part of immobilizer unit from manufacturer. To obtain code word, call manufacturer with immobilizer unit serial number.

2) The immobilizer unit code word is input into PCM by cycling ignition key and counting number of SECURITY light flashes. Wait about 5 minutes until SECURITY light flashing has decreased to a 1.2 second interval. Input code word with SECURITY light sequence.

3) Turn ignition to ON position for number of flashes of first code word digit. Turn ignition to LOCK position for at least one flash and less than 30 seconds. Repeat procedure for each code word digit. When code word is registered correctly, SECURITY light will stop flashing and stay illuminated. Continue immobilizer system reprogram procedure.

PROGRAMMING PCM (B2500, B3000, B4000 & 626)

NOTE: Before performing PCM programming procedure, check for any

applicable Technical Service Bulletins (TSBs) that may apply to vehicle.

Description

Electronically Erasable Programmable Read Only Memory (EEPROM) is contained in an Integrated Circuit (IC) inside of Powertrain Control Module (PCM). The EEPROM contains the vehicle strategy and any calibration information specific to vehicle. The IC is reprogrammable and at times may become necessary to reprogram or reflash the entire contents. This is usually due to an after production strategy change or the Vehicle Identification (VID) block has been previously reprogrammed and has reached its limit. The VID block can be tailored to accommodate various hardware changes made since vehicle production. This procedure can only be performed using Ford's Service Bay Technical System (SBTS).

A replacement PCM will have a label stating PROGRAMMING REQUIRED. This indicates that it is necessary to retrieve VID data from the original PCM before removing PCM from vehicle. This procedure can be performed using New Generation Star (007-00500) tester. See FLASH VEHICLE IDENTIFICATION (VID) BLOCK PROCEDURE. If original PCM is nonfunctional, it will be necessary to manually reprogram VID block. This procedure can only be performed using Ford's Service Bay Technical System (SBTS).

Flash Vehicle Identification (VID) Block Procedure

1) To perform this procedure NGS tester, Ford Service Function (FSF) card and NGS Flash Cable (007-00531) must be used. Plug flash cable into scan tool. Plug other end of flash cable into Data Link Connector (DLC). From the scan tool main menu, select SERVICE BAY FUNCTIONS, PCM-POWERTRAIN CONTROL MODULE and then PROGRAMMABLE MODULE INSTALLATION.

2) The NGS tester display should show 2 selections. The first is selection is for the old PCM information to be retrieved and stored. The second selection is for restoring the new PCM with information that has been retrieved from the old PCM. Follow display instructions or refer to instruction sheet included with FSF card. If Vehicle Identification (VID) block has been reprogrammed previously, NGS tester will display a message indicating the need to reflash entire Integrated Circuit (IC). This procedure can only be performed using Ford's Service Bay Technical System (SBTS).

MERCEDES-BENZ

ECM VERSION CODING

NOTE: Hand Held Tester (HHT) is necessary for performing version coding.

The Engine Control Module (ECM) has a version coding feature. Coding must be performed when a new ECM is installed. Version coding can be performed automatically or manually using Hand Held Tester (HHT).

Automatic Coding

Before removing Engine Control Module (ECM), using HHT, read and store existing version code. After installation of new module, download previous version code using HHT.

Manual Coding

If version code number cannot be read, vehicle equipment and version must be determined. A corresponding code number must be

obtained from spare parts microfiche and manually entered with HHT. The following version data must be obtained for coding:

* Vehicle model
* Engine
* Transmission
* Non-catalytic converter
* Country version
* 19 MPH (30 km/h) limitation

ENABLING CODE FUNCTION FOR RADIO

NOTE: Code must be obtained from customer. When vehicle is shipped new, a CODE CARD is included with the owner's manual.

NOTE: Audio 10 models are identified by similar controls on each side of display and a cassette player above display.

Audio 10 Models (CLK, E & SLK Class)

After reconnecting radio, turn ignition on. CODE will be displayed. Enter code number using right side control knob. After selecting correct code, press right side control knob to confirm. Radio will turn on if code entered is correct.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 10 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 60 minutes. Radio and ignition switch must remain on during the waiting period.

NOTE: Audio 30 models are identified by station controls on right side of display and no cassette or CD player in unit.

Audio 30 Models (CLK, E & SLK Class)

After reconnecting radio, turn ignition on. CODE will be displayed. Enter code number using station select buttons on right side of display. After selecting correct code, press one of left side arrow buttons to confirm. Radio will turn on if code entered is correct.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 10 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 60 minutes. Radio and ignition switch must remain on during the waiting period.

Becker Radio (CL, S & SL Class)

Turn ignition on. Turn radio on. Press buttons No. 1 and No. 6 or buttons No. 1 and RDS (classic) simultaneously within 8 seconds after switching radio on. CODE will be displayed on radio. Enter customer supplied code number using station number keys on radio. Confirm correct code is displayed by pressing TUNE/AUTO button. Radio will turn on if correct code is entered.

Panasonic Exquisite Radio (CL, S & SL Class)

Turn ignition on. Turn radio on. Press buttons No. 1 and No. 6 simultaneously longer than 3 seconds. CODE will be displayed on radio. Enter customer supplied code number using station number keys on radio. Confirm correct code is displayed by pressing TUNE/AUTO button. Radio will turn on if correct code is entered.

Radio With Navigation Control Module (CL, S & SL Class)

Turn ignition on. Turn navigation control unit on. Press

buttons No. 1 and No. 6 simultaneously within 8 minutes after switching unit on. CODE will be displayed. Enter customer supplied code number using station number keys on unit. Confirm correct code is displayed by pressing cursor keys or SCAN button. Unit will turn on if correct code is entered.

Radio With 4-Digit Fixed Code (CL, S & SL Class)

Turn ignition on. Turn radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. Confirm correct code by pressing SEEK button. Unit will turn on if correct code is entered.

If wrong code is entered 3 times, code entry is denied for 15 minutes. If wrong code is entered 9 times, code entry is denied for 24 hours. Radio and ignition switch must remain on during the waiting period.

Radio & Radio With Navigation Control Module With 5-Digit Fixed Code (CL, S & SL Class)

Turn ignition on. Turn navigation control unit or radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. On radios, confirm correct code by pressing TUNE, AUTO/SEEK or SC button. On navigation control unit, confirm correct code by pressing ENTER button. Unit will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 10 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 30 minutes. Radio and ignition switch must remain on during the waiting period.

Radio (ML Class)

Turn ignition on. Turn radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. Confirm correct code by pressing seek forward or seek back buttons. Unit will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio and code will need to be researched and entered again. If wrong code is entered 3 times, code entry is denied for 10 minutes. If wrong code is entered 9 times, code entry is denied for 60 minutes. Radio and ignition switch must remain on during the waiting period.

PROGRAMMING SUPPLEMENTAL RESTRAINT SYSTEM (SRS) CONTROL MODULE

CAUTION: When programming control module, avoid interrupting control module voltage supply. Damage to control module may result. Control module parameters can only be set once. DO NOT connect Hand-Held Tester (HHT) to Data Link Connector (DLC) with ignition on. Damage to HHT may result.

NOTE: Hand-Held Tester (6511 0001 99) is necessary to set control module parameters.

After replacing control module, when ignition is turned on, SRS warning light will continuously blink or stay on, indicating that control module parameters need to be programmed. Turn ignition off. Connect HHT to DLC. DLC is located in right rear corner of engine compartment. It may be necessary to use Adapter (140 589 1463 00) to connect HHT to DLC. Follow HHT prompts to program replacement control module. Currently all control modules are programmed with the same

parameters. After control module parameters are set, SRS warning light will go out.

MITSUBISHI

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

NISSAN

* PLEASE READ THIS FIRST *

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

ECM PROGRAMMING

ECM is a part of Nissan Anti-Theft System (NATS). Replacement ECM must have immobilizer code rewritten, using CONSULT. To perform rewrite procedure requires the vehicle, all keys and a CONSULT tester with a NATS Program Card (E960U). Any key not learned during rewrite will not start vehicle. Follow CONSULT tester instructions.

PORSCHE

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

BOXSTER

NOTE: Ensure all codes are correct before entering. Codes cannot be changed.

Alarm/Drive Block Control Unit Programming

1) If control unit requires replacement, new control unit must be coded. It will be necessary to obtain immobilizer (drive block) code and teaching code from Porsche Cars North America (PCNA) prior to replacement. To obtain codes, complete code request form (Technical Bulletin, Boxster bulletin group 9, number 9801) from nearest Porsche dealer. Proof of ownership (valid title or registration) is required. Original transponders can be reused, but require recoding to new control unit.

2) Install control unit. Connect Porsche System Tester 2 and turn on. Select BOXSTER and begin control unit search sequence. Select ALARM SYSTEM, TEACHING FUNCTIONS AND IMMOBILIZER. Enter 16-digit immobilizer code obtained from PCNA and press ENTER. Confirm code entry by pressing F7.

ECM Programming

1) If ECM requires replacement, new ECM must be coded. It will be necessary to obtain ECM programming code and immobilizer code from Porsche Cars North America (PCNA) prior to replacement. To obtain

codes, complete code request form (Technical Bulletin, Boxster bulletin group 9, number 9801) from nearest Porsche dealer. Proof of ownership (valid title or registration) is required.

2) Connect Porsche System Tester 2 and turn on. Select BOXSTER and begin control module search sequence. Select DME CONTROL UNIT, CONTROL UNIT PROGRAMMING AND READ OUT CONTROL UNIT. Install new ECM. Select PROGRAM CONTROL UNIT.

NOTE: During programming, ensure all accessories are off, A/C heater is turned off and battery is fully charged. Ensure all codes are correct before entering. Codes cannot be changed.

3) Press ENTER. Enter 6-digit programming code obtained from PCNA. Confirm correct entry and press F7. Enter 6-digit code again. Confirm correct entry and press F7.

4) Enter 16 zeros for old immobilizer code and press F7. Enter 16-digit immobilizer code obtained from PCNA and press F7. Select data record OBD-II CONTROL MODULE and press enter. After confirmation, program will run. After programming is complete, turn ignition off. Turn ignition on. Turn off Porsche system tester 2.

5) After programming, fault code DTC 108 will be stored. If vehicle is Tiptronic transmission equipped, DTC 100 will also be stored. These codes are due to programming, and should be cleared.

SAAB

CRANKSHAFT POSITION RELEARN

If power supply to ECM has been interrupted, crankshaft position sensor must be relearned by ECM. Accelerate vehicle to 6000 RPM, then decelerate to 2000 RPM. Repeat 5 times.

ECM

Drive vehicle at varying engine loads and RPM for 5 minutes.

SUBARU

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

SUZUKI

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

TOYOTA

IGNITION KEY REGISTRATION (IMMOBILIZER EQUIPPED)

NOTE: This procedure MUST be performed only when a NEW Engine Control Module (ECM) is installed. A new ECM is in automatic registration mode, and up to 3 ignition key identification

codes may be registered in ECM at one time. In automatic registration mode, the last ignition key to be registered becomes the sub-key.

NOTE: On Avalon and Camry models without engine immobilizer systems, new ECM must be programmed to non-immobilizer setting. See NON-IMMOBILIZER PROGRAMMING (AVALON & CAMRY).

1) Ensure SECURITY indicator light is flashing. SECURITY indicator light is located on center of instrument panel, just above the air outlets above radio.
2) Insert ignition key into ignition lock cylinder. Note that SECURITY indicator light should now remain on steady.
3) Once ignition key registration is under way, SECURITY indicator light should turn off. After ignition key registration is complete, SECURITY indicator light should come on steady. Remove ignition key.
4) SECURITY indicator light should flash when ignition key is removed from ignition lock cylinder if registration is complete and system is operating normally. If ignition key registration was not completed with ECM in automatic registration mode, code 2-1 will be displayed by SECURITY indicator light. When inserting an ignition key that is already registered, a code 2-2 will be displayed by indicator light.
5) If programming additional ignition keys, repeat process starting with step 1). If additional ignition keys do not need programming, procedure is complete. SECURITY indicator light should go off once last ignition key (sub-key) is registered.
6) To complete automatic registration mode, depress and release brake pedal at least 5 times within 15 seconds, or request automatic registration mode completion by using Toyota scan tool connected to Data Link Connector (DLC) No. 3.

NON-IMMOBILIZER PROGRAMMING (AVALON & CAMRY)

Ensure vehicle is not equipped with engine immobilizer system. Install new ECM. Turn ignition on for more than 2 seconds. Turn ignition to ACC or LOCK. Repeat ignition on/off cycle 4 times. Ensure ignition stays on more than 2 seconds on fourth time or vehicle will not start and ECM is permanently damaged. When ignition is on for more than 2 seconds the fourth time, "without engine immobilizer" code will be registered in ECM.

VOLKSWAGEN

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

BEETLE

NOTE: Do not turn ignition off during ECM programming procedure.

ECM Programming (1.9L Engine)
Prior to removing original ECM, print out ECM identification. Connect Scan Tool (VAG 1551/1552) using Adapter cable (VAG 1551/3) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Print out ECM identification by pressing PRINT button. Press right arrow button. Press 0 and 6 buttons

to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input. Turn ignition off.

Remove original ECM and install new ECM. Connect scan tool (VAG 1551/1552). Turn ignition on. Press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Press right arrow button. Press 0 and 7 buttons to select FUNCTION 07: CODE CONTROL MODULE. Press "Q" button to enter input. Enter appropriate code for vehicle. See ECM CODES (BEETLE 1.9L) table. Turn ignition off, then on. Clear DTCs.

ECM CODES (BEETLE 1.9L)

Vehicle	Code
A/T w/ABS	00001
M/T w/AS	00002
A/T w/o ABS	00004

ECM Programming (2.0L Engine)

Prior to removing original ECM, print out ECM identification. Connect Scan Tool (VAG 1551/1552) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Print out ECM identification by pressing PRINT button. Press right arrow button. Press 0 and 6 buttons to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input. Turn ignition off.

Remove original ECM and install new ECM. Connect scan tool (VAG 1551/1552). Turn ignition on. Press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Press right arrow button. Press 0 and 7 buttons to select FUNCTION 07: CODE CONTROL MODULE. Press "Q" button to enter input. Enter appropriate code for vehicle. See ECM CODES (BEETLE 2.0L) table. If code entered is incorrect, scan tool will display function is not recognized and problems will result. If code is correct, press right arrow button. Press 0 and 6 buttons to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input. Turn ignition off. Perform ECM To TCM matching. See ECM TO TCM MATCHING (2.0L ENGINE).

ECM CODES (BEETLE 2.0L)

Vehicle	Code
M/T w/ABS	00000
A/T w/ABS	00001
M/T w/o ABS	00040
A/T w/o ABS	00041

NOTE: Perform ECM To TCM matching if battery is disconnected or if TCM is disconnected or replaced.

ECM To TCM Matching (2.0L Engine)

Ensure no DTCs exist, battery is fully charged and cruise control is operating properly (if equipped). Turn all accessories off. Connect Scan Tool (VAG 1551/1552) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Press right arrow button.

Press 0 and 4 buttons to select FUNCTION 04: BASIC SETTING. Press "Q" button to enter input. Press 0, 6 and 0 buttons to select DISPLAY GROUP 60. Press "Q" button to enter input. Scan tool should display SYSTEM IN BASIC SETTING 60, followed by four zones numbered 1

through 4. Operate throttle through full range while observing scan tool. ECM stores these values in memory. If values are not as specified, check TCM. See appropriate SYSTEM & COMPONENT TESTING article in ENGINE PERFORMANCE.

If BASIC SETTING is interrupted, check throttle cable adjustment and throttle plate for deposits to ensure throttle is able to return to fully closed position. If throttle is okay, check TCM. See appropriate SYSTEM & COMPONENT TESTING article in ENGINE PERFORMANCE. After procedure is complete (minimum of 30 seconds), press right arrow button. Press 0 and 6 buttons to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input. Turn ignition off.

CABRIO, GOLF, GTI & JETTA

NOTE: If appropriate code is not displayed or ECM has been replaced, ECM must be coded. Do not turn ignition off during ECM programming procedure.

ECM Programming (2.0L Engine)

1) Connect Scan Tool (VAG 1551/1552) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ENGINE ELECTRONICS. Press "Q" to confirm input. Press 1 and 1 buttons to select LOGIN PROCEDURE FUNCTION 11. Press "Q" to confirm input. Press 0, 1, 2, 8 and 3 to input LOG-IN CODE. Press "Q" to confirm input. Press 0 and 7 buttons to select CODE CONTROL MODULE. Press "Q" to confirm input.

2) Enter appropriate vehicle code, 00000 for manual transmission equipped Golf or Jetta, 00001 for automatic transmission equipped Golf or Jetta, 00002 for manual transmission equipped Cabrio, 00003 for automatic transmission equipped Cabrio. Press right arrow button. Press 0 and 6 buttons to select END OUTPUT. Press "Q" to confirm input. Turn ignition off.

ECM Programming (2.8L VR6 Engine)

1) Connect Scan Tool (VAG 1551/1552) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ENGINE ELECTRONICS. Press "Q" to confirm input. Press 1 and 1 buttons to select LOGIN PROCEDURE FUNCTION 11. Press "Q" to confirm input. Press 0, 1, 2, 8 and 3 to input log-in code. Press "Q" to confirm input. Press 0 and 7 buttons to select CODE CONTROL MODULE. Press "Q" to confirm input.

2) Enter appropriate vehicle code, 00000 for manual transmission equipped Golf or Jetta, 00001 for automatic transmission equipped Golf or Jetta. Press right arrow button. Press 0 and 6 buttons to select END OUTPUT. Press "Q" to confirm input. Turn ignition off.

PASSAT

NOTE: If appropriate code is not displayed or ECM has been replaced, ECM must be coded.

ECM Programming (2.8L V6 Engine)

1) Connect Scan Tool (VAG 1551/1552) to data link connector. Turn ignition on. Press 0 and 1 buttons to select ENGINE ELECTRONICS. Press 1 and 1 buttons to select LOGIN PROCEDURE FUNCTION 11. Press "Q" to confirm input. Press 0, 1, 2, 8 and 3 to input log-in code. Press "Q" to confirm input. Press 0 and 7 buttons to select CODE CONTROL MODULE. Press "Q" to confirm input.

2) Enter appropriate vehicle code, 00000 for manual transmission equipped vehicles, 00001 for automatic transmission equipped vehicles. Press right arrow button. Press 0 and 6 buttons to select END OUTPUT. Press "Q" to confirm input. Turn ignition off.

VOLVO

ALL MODELS

ECM Programming

When replacing Transmission Module (TM) or Engine Control Module (ECM), use Volvo System Tester to clear DTCs and reset adaptive functions. Follow manufacturer's instructions and tester prompts.

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that he/she may experience driveability different from what they are accustomed to until ECM completes relearn function.

COOLING SYSTEM SPECIFICATIONS

1999 Lexus RX 300

1999-2000 ENGINE COOLING
Lexus Specifications

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

COOLING SYSTEM BLEEDING

ES300, GS300, GS400, LX470, & SC300

1) Ensure engine is cool. Remove radiator cap. Remove 3 drain plugs on engine and radiator, then drain coolant. Close drain plugs.

NOTE: DO NOT use alcohol type coolant. Use coolant which includes more than 50 percent ethylene-glycol, but not more than 70 percent.

2) Slowly add coolant until system is full. Install radiator cap. Start engine, and open heater water valve. Maintain engine speed at 2000-2500 RPM, and warm engine. Stop engine, and allow engine to cool. Check system for leaks.

LS400 & SC400

1) Remove V-bank cover. Remove radiator cap from radiator reservoir. Remove water fill plug from throttle body. Remove 3 drain plugs on engine and radiator, then drain coolant. Close drain plugs, and tighten to 9 ft. lbs. (12.7 N.m).

NOTE: Ensure coolant mixture contains plain water. Use of coolant which includes more than 50 percent ethylene-glycol is recommended, but not more than 70 percent.

2) Slowly add coolant mixture to throttle body until system is full. Install fill plug, and tighten to 33 ft. lbs. (45 N.m). Slowly add more coolant mixture into radiator reservoir until system is full. Install radiator cap.

3) Bring engine speed to 2000-2500 RPM. Recheck coolant level at coolant reservoir tank, and add as necessary. Check system for leaks.

RX 300

1) Remove engine undercover. Remove radiator cap. Loosen radiator and engine drain plugs. Drain coolant. Close drain plugs. On 2WD models, tighten right engine drain plug to 61 INCH lbs. (7.0 N.m). On 4WD models, tighten right and left engine drain plugs to 9 ft. lbs (13 N.m).

NOTE: DO NOT use alcohol type coolant. Mix coolant with demineralized water or distilled water.

2) Slowly add coolant until system is full. Use only ethylene-glycol engine coolant, and mix accordingly. Install radiator cap. Start engine and bleed air from cooling system.

3) If necessary, refill coolant into reservoir up to FULL line. Check engine coolant for leaks. Reinstall engine undercover.

SPECIFICATIONS

BELT ADJUSTMENT

BELT ADJUSTMENT TENSION

Application	Lbs. (kg)
ES300	
Generator	
New Belt	170-180 (77-81)
Used Belt	95-135 (43-61)
Power Steering Pump	
New Belt	150-185 (68-85)
Used Belt	95-135 (43-61)
GS300, GS400, LS400, SC300 & SC400	
Serpentine Belt	(1)
LX470	
A/C & Generator	
New Belt	(1)
Used Belt	(1)
RX 300	
Generator	
New Belt	170-180 (77-81)
Used Belt	70-110 (31-49)
Power Steering Pump	
New Belt	150-185 (68-83)
Used Belt	95-135 (43-61)

(1) - Equipped with automatic belt tensioner.

COOLING SYSTEM SPECIFICATIONS

COOLING SYSTEM SPECIFICATIONS

Application	Specification
Coolant Replacement Interval	(1)
Coolant Capacity (2)	
ES300	9.7 Qts. (9.2L)
GS300	8.1 Qts. (7.7L)
GS400	9.8 Qts. (9.3L)
LS400 & SC400	11.6 Qts. (11.0L)
LX470	
With Front Heater	15.6 Qts. (14.8L)
With Front & Rear Heater	16.3 Qts. (15.3L)
RX 300	9.5 Qts. (9.0L)
SC300	9 Qts. (8.5L)
Radiator Cap	
Standard Pressure	17.8 psi
Minimum Pressure	11.4
Thermostat Opening Temperature	176-183°F (80-84°C)

(1) - Information not available from manufacturer.
(2) - Includes heater core capacity.

CRUISE CONTROL SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Cruise Control Systems
LEXUS

ES300 & RX300

DESCRIPTION

Cruise control system uses an electric actuator to hold throttle open, maintaining desired vehicle speed. System is controlled by Cruise Control Electronic Control Unit (ECU). Cruise control system is equipped with self-diagnostics. See Figs. 1 and 2.

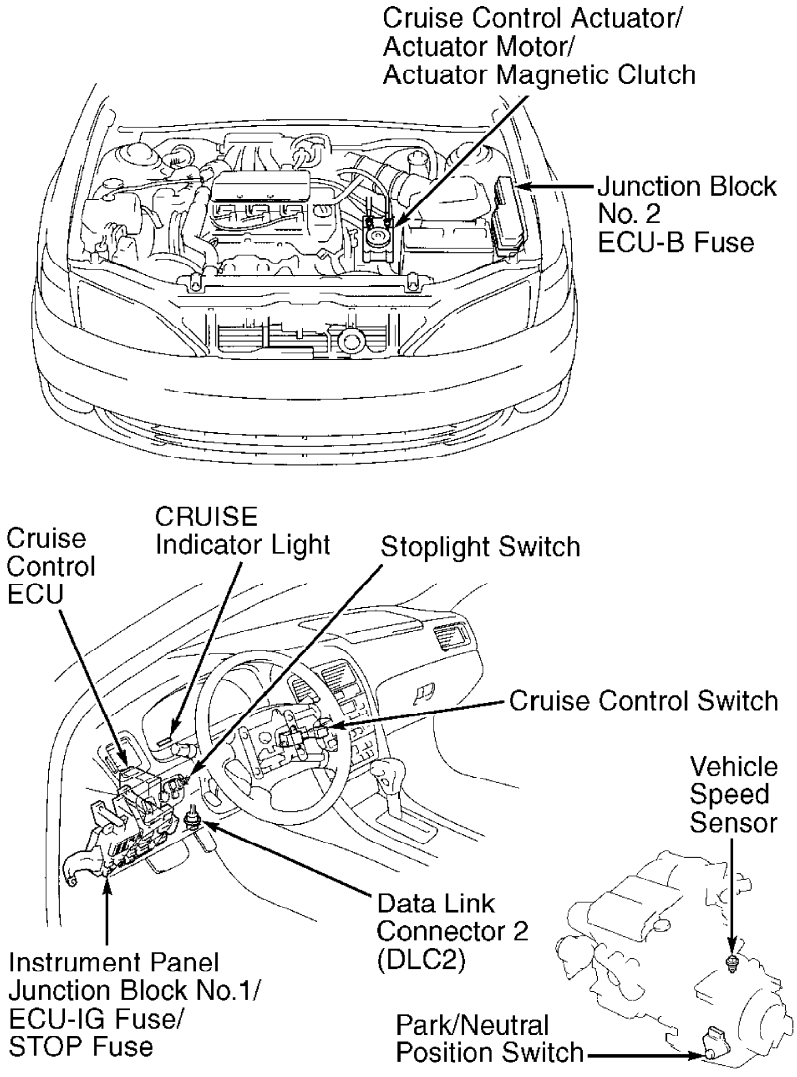


Fig. 1: Cruise Control Component Locations (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

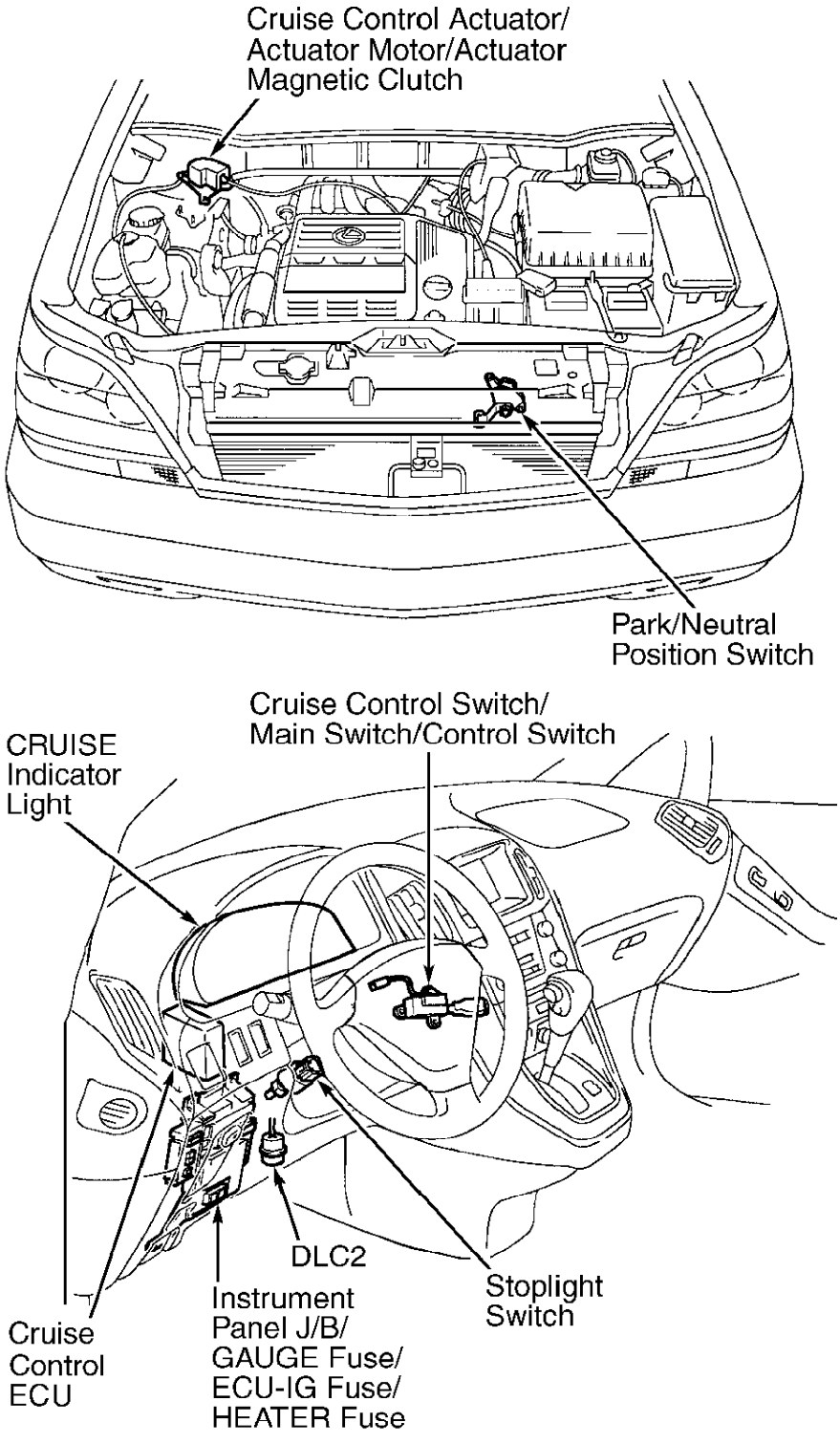


Fig. 2: Cruise Control Component Locations (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OPERATION

COMPONENTS & FUNCTIONS

Cruise Control Electronic Control Unit (ECU)
Cruise control ECU controls actuator based on various inputs.

Actuator
Actuator consists of a bi-directional electric motor, magnetic clutch, potentiometer (rotary angle sensor) and control arm. Control arm is connected to actuator cable which moves throttle plate. Electric motor responds to on-off duty cycle signals from cruise control ECU. When motor operates, control arm moves. Cruise control ECU monitors rotary angle of control arm by applying a reference voltage to potentiometer.
A magnetic clutch connects motor shaft to control arm when cruise control ECU turns magnetic clutch on. If any of following conditions occur, cruise control ECU turns magnetic clutch off, disengaging motor shaft from control arm:

* Cruise main switch is turned off.
* CANCEL switch is turned on.
* Brake pedal is pressed.
* Parking brake is applied.
* Vehicle speed decreases to less than 25 MPH.
* Difference between actual and set speeds is 10 MPH.
* Stoplight switch circuit malfunction.
* Actuator motor malfunctions.
* Vehicle speed sensor malfunctions.
* Circuit problem occurs.

CRUISE Indicator Light
CRUISE indicator light on instrument cluster illuminates when main switch is turned on. When this light is on, speed can be set.

Cruise Control Switch
Cruise control switch (located on right side of steering column) consists of main switch and control switches. Main switch is power switch for cruise control system. If main switch is on when ignition is turned off, main switch is also turned off. Main switch remains off even when ignition is turned on again.

Parking Brake Switch
If parking brake is applied, contacts in parking brake switch close and cruise control ECU cancels set speed.

Stoplight Switch
If brake pedal is pressed, cruise control ECU cancels set speed and removes power supply from magnetic clutch in actuator.

Vehicle Speed Sensor
Instrument cluster senses when microswitch contacts inside speed sensor open and close (4 times per revolution). Cruise control ECU receives speed signal from instrument cluster.

Self-Diagnostics
If a system fault occurs, cruise control ECU will store a Diagnostic Trouble Code (DTC) that can be retrieved to aid in diagnosis.

ADJUSTMENTS

ACTUATOR CONTROL CABLE

Ensure actuator, control cable and throttle link are installed properly, and cable and link are connected correctly. Ensure actuator and throttle link operate smoothly. Ensure cable is not too loose or too tight. Free play should be less than .39" (10 mm). If control cable is very loose, vehicle will lose speed while driving uphill. If control cable is too tight, idle RPM will increase.

SYSTEM TESTS

* PLEASE READ THIS FIRST *

NOTE: Set speed is automatically canceled if difference between actual vehicle speed and set speed exceeds 10 MPH, or if vehicle speed decreases to less than 25 MPH.

If system does not operate as specified, diagnosis by symptom. See TROUBLE SHOOTING.

SYSTEM OPERATION

Engaging Cruise System (Check CRUISE Indicator Light)

Turn ignition on. Turn cruise main switch on (press button on end of lever located on right side of steering column). CRUISE indicator light on instrument cluster should illuminate indicating speed can now be set.

SET

Drive vehicle at speed less than 25 MPH. Attempt to set speed by moving lever downward (SET/COAST). Speed should not set. Accelerate to greater than 25 MPH. Set desired speed. Cruise should set to desired speed.

COAST

While cruising at set speed, move lever downward (SET/COAST). Vehicle speed should gradually decrease. Release lever when new desired speed is attained. When difference between actual speed and set speed is less than 3 MPH, momentarily move lever downward to decrease set speed in one MPH increments (tap down function).

CANCEL

Use any of the following methods to cancel set speed:

* Pull lever forward.
* Press brake pedal.
* Press cruise main switch button off.
* Shift transmission to any position except Drive (A/T).
* Vehicle speed decreases to less than 25 MPH.
* Difference between actual and set speeds is 10 MPH.

RESUME

To resume set speed after canceling, push lever upward (RES/ACC). Vehicle should return to previous speed. Set speed will not resume if vehicle speed has decreased to less than 25 MPH.

ACCEL

While cruising at set speed, move lever upward (RES/ACC). Vehicle speed should gradually increase. Release lever when new desired speed is attained. When difference between actual speed and set speed is less than 3 MPH, momentarily move lever upward to increase set speed in one MPH increments (tap up function).

TROUBLE SHOOTING

NOTE: If problem is intermittent, check for faulty wiring and components by wiggling wiring harnesses and components (DO NOT vigorously wiggle relays).

1) Ensure actuator cable is not too loose (may cause vehicle to lose speed when driving uphill) or too tight (causes high idle speed).

2) Check for Diagnostic Trouble Codes (DTCs). See RETRIEVING DTCS under SELF-DIAGNOSTIC SYSTEM. If any DTCs are set, perform appropriate procedure under DIAGNOSTIC TESTS. If no DTCs are set, go to SYMPTOM DIAGNOSIS table.

3) If cruise control ECU is suspected of not receiving an input from a switch or vehicle speed sensor, check input signal circuits. See INPUT SIGNAL CIRCUITS under CIRCUIT TESTS. If problem is still present after all testing, replace cruise control ECU.

SYMPTOM DIAGNOSIS

Problem	Inspect
Speed Cannot Be Set Or Unwanted Canceling	
No DTCs Are Set (Normal DTC)	(1) Main Switch Circuit (Cruise Control Switch), (2) Vehicle Speed Sensor, (2)(3) Control Switch Circuit (Cruise Control Switch), (1) Stoplight Switch Circuit, (1) Park/Neutral Position Switch Circuit, (2) Actuator Motor Circuit, (4) Actuator Control Cable, (5) Cruise Control ECU
DTC Does Not Display	(1) ECU Power Source Circuit, (5) Cruise Control ECU
Actual Speed Differs From Set Speed	(4) Actuator Control Cable, (2) Vehicle Speed Signal Abnormal, (1) Electronically Controlled Transmission Communication Circuit, (2) Actuator Motor Circuit, (2) Idle Signal Circuit (Main Throttle Position Sensor), (5) Cruise Control ECU
Shifts Between 3rd Gear & Overdrive Uphill (Hunting)	(1) Electronically Controlled Transmission Communication Circuit, (5) Cruise Control ECU
Speed Setting Does Not Cancel	
When Brake Pedal Is Pressed	(4) Actuator Control Cable, (1) Stoplight Switch Circuit, (2) Actuator Motor Circuit, (5) Cruise Control ECU
When Shifting Into Neutral	(4) Actuator Control Cable, (1) Park/Neutral Position Switch Circuit, (2) Actuator Motor Circuit, (5) Cruise Control ECU
Cruise Control Switch	
Does Not Operate	(4) Actuator Control Cable,

	(2)(3) Control Switch Circuit, (2) Actuator Motor Circuit, (5) Cruise Control ECU
At Speeds Less Than 25 MPH Speed Can Be Set Or CANCEL Does Not Operate	(4) Actuator Control Cable, (2) Vehicle Speed Signal Abnormal, (2) Actuator Motor Circuit, (5) Cruise Control ECU
Poor Response In ACC & RES	(4) Actuator Control Cable, (1) Electronically Controlled Transmission Communication Circuit, (2) Actuator Motor Circuit, (5) Cruise Control ECU
Overdrive Does Not RESUME	(1) Electronically Controlled Transmission Communication Circuit, (5) Cruise Control ECU
DTC Memory Is Erased	(5) Cruise Control ECU
Cannot Be Displayed Or Are Displayed When Should Not Be	(1) Diagnostic Circuit, (5) Cruise Control ECU
CRUISE Indicator Light Remains Illuminated Or Will Not Illuminate	(1) Cruise Main Indicator Light Switch Circuit, (5) Cruise Control ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Perform appropriate DTC test under DIAGNOSTIC TESTS. See DIAGNOSTIC TROUBLE CODE (DTC) DEFINITION table.
(3) - On ES300 only.
(4) - Inspect actuator control cable. See ACTUATOR CONTROL CABLE under ADJUSTMENTS.
(5) - Perform CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.

SELF-DIAGNOSTIC SYSTEM

RETRIEVING DTCS

Using Scan Tool

Follow LEXUS or OBDII scan tool instructions to retrieve DTCs.

Using Jumper Wire

1) Turn ignition on. Turn cruise main switch on. If CRUISE indicator light illuminates, leave ignition on and go to next step. If CRUISE indicator light does not illuminate, go to CRUISE INDICATOR LIGHT CIRCUIT under CIRCUIT TESTS.

2) To retrieve DTCs, turn cruise main switch off. Ensure ignition is on. Connect Jumper Wire (09843-18020) between terminals Tc and E1 of Data Link Connector 2 (DLC2) located under left side of instrument panel. See Fig. 3. Observe CRUISE indicator light for DTC display and check as follows:

* CRUISE Indicator Light Does Not Illuminate
  See CRUISE INDICATOR LIGHT CIRCUIT under CIRCUIT TESTS.

* CRUISE Indicator Light Flashes Steadily
  No DTCs set ("normal" DTC).
* CRUISE Indicator Light Flashes DTCs
  See DIAGNOSTIC TROUBLE CODE (DTC) DEFINITION table. Go to appropriate DTC under DIAGNOSTIC TESTS.

After checking for DTCs, disconnect jumper wire and turn ignition off.

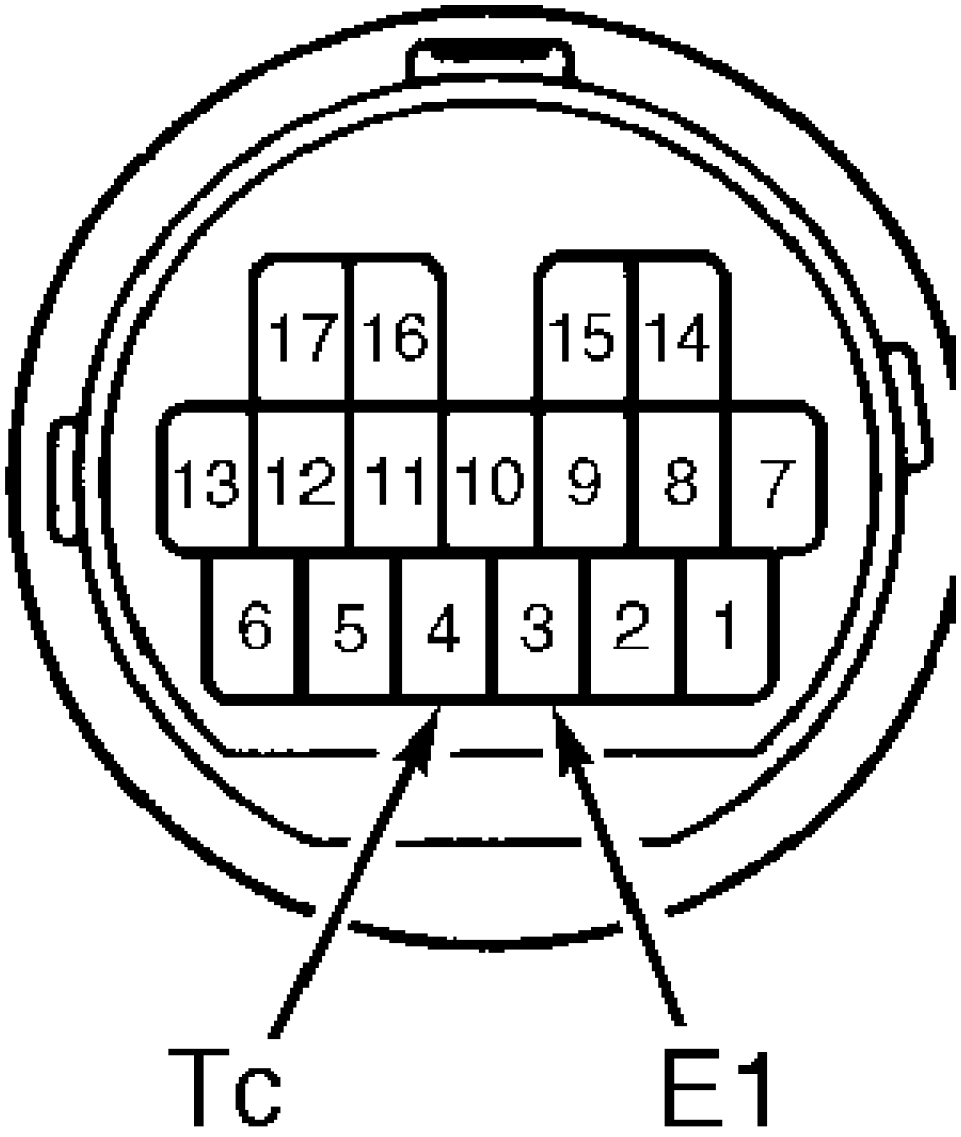


Fig. 3: Identifying Data Link Connector 2 (DLC2) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TROUBLE CODE (DTC) DEFINITION

DTC	Definition
11	Shorted Actuator Motor Circuit
12	Actuator Magnetic Clutch Circuit
14	Actuator Mechanical Malfunction
15	Open Actuator Motor Circuit
21	Open Vehicle Speed Sensor Circuit
23	Vehicle Speed Signal Abnormal
32 (1)	Control Switch Circuit
41	(2) Cruise Control ECU
42	(3) Source Voltage Drop
51	Idle Signal Circuit

(1) - On ES300 only.
(2) - Perform CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS.
(3) - Perform ECU POWER SOURCE CIRCUIT TEST under CIRCUIT TESTS.

CLEARING DTCS

Using Scan Tool
Follow LEXUS or OBDII scan tool instructions to clear DTCs.

Using Cruise Control Switch
1) Drive vehicle at less than 10 MPH. On ES300, connect Jumper Wire (09843-18020) between terminals Tc and E1 of Data Link Connector 1 (DLC1) located in engine compartment, on rear of intake manifold. On RX300, connect Jumper Wire (09843-18020) between terminals Tc and E1 of Data Link Connector 1 (DLC1) located in engine compartment, in left rear corner, behind fuse/relay block. See Fig. 4.
2) On all models, pull cruise control lever toward CANCEL. With cruise control lever in CANCEL position, turn on cruise control main switch 5 times within 3 seconds. To ensure DTCs have cleared, attempt to retrieve DTCs. If normal DTC is displayed, DTCs have cleared.

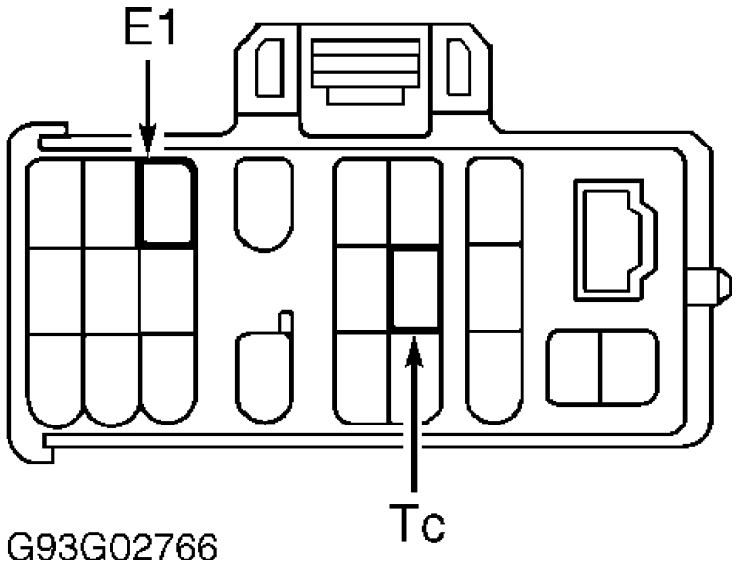


Fig. 4: Identifying Data Link Connector 1 (DLC1) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TESTS

* PLEASE READ THIS FIRST *

CAUTION: If cruise control ECU replacement is instructed in following testing, always ensure ECU harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm cruise control ECU malfunction.

DTC 11 OR 15: ACTUATOR MOTOR CIRCUIT

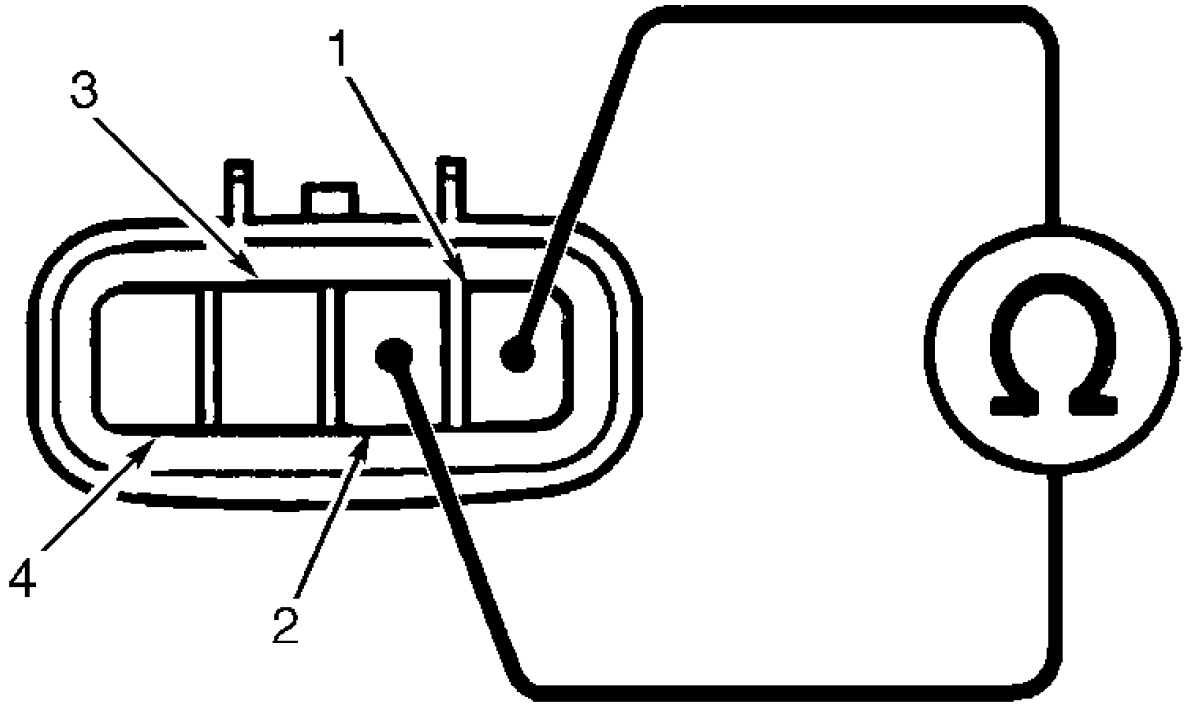
Circuit Description

Actuator motor is operated by signals from cruise control ECU. Acceleration and deceleration signals are transmitted by changes in the duty ratio. Duty ratio is the ratio of the period of continuity in one cycle.

Diagnosis & Repair

1) Turn ignition off. Disconnect electrical connector from actuator. Ensure clutch plate is not fully open or fully closed. Using ohmmeter, measure resistance between actuator terminals No. 1 and 2. See Fig. 5. If resistance is 4.2 ohms or less, replace actuator. If resistance is greater than 4.2 ohms, go to next step.

2) Check wiring and connectors between actuator and cruise control ECU. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.



G98B03419

Fig. 5: Identifying Actuator Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 12: ACTUATOR MAGNETIC CLUTCH CIRCUIT

Circuit Description

Circuit turns on magnetic clutch inside actuator during cruise control operation according to signal from cruise control ECU. If malfunction occurs in actuator or speed sensor during cruise operation, rotor shaft between motor and control plate is released. When brake pedal is pressed, stoplight switch turns on, supplying power to stoplight switch. Power supply to magnetic clutch is mechanically cut and magnetic clutch is turned off. ECU turns safety magnetic clutch off when driving downhill if vehicle speed exceeds set speed by 9 MPH. If vehicle later drops to within 6 MPH above set speed, then cruise control at set speed is resumed.

Diagnosis & Repair

1) Turn ignition off. Check STOP fuse in instrument panel junction block No. 1 located under left side of instrument panel. If fuse is blown, replace STOP fuse. If fuse is okay, go to next step.

2) Disconnect stoplight switch connector located on brake pedal bracket. Using ohmmeter, check continuity between stoplight switch terminals No. 1 and 2 with switch pin released (brake pedal depressed) See Fig. 6. Continuity should exist. Check continuity between stoplight switch terminals No. 3 and No. 4 with switch pin pressed (brake pedal released). Continuity should exist. If continuity is as specified, go to next step. If continuity is not as specified, replace stoplight switch.

3) Disconnect electrical connector from actuator. Using ohmmeter, measure resistance between actuator terminals No. 3 and 4. See Fig. 5. If resistance is less than 34.65 ohms or greater than 42. 35 ohms, replace actuator. If resistance is 34.65-42.35 ohms, go to next step.

4) Check wiring and connectors between actuator and cruise control ECU. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

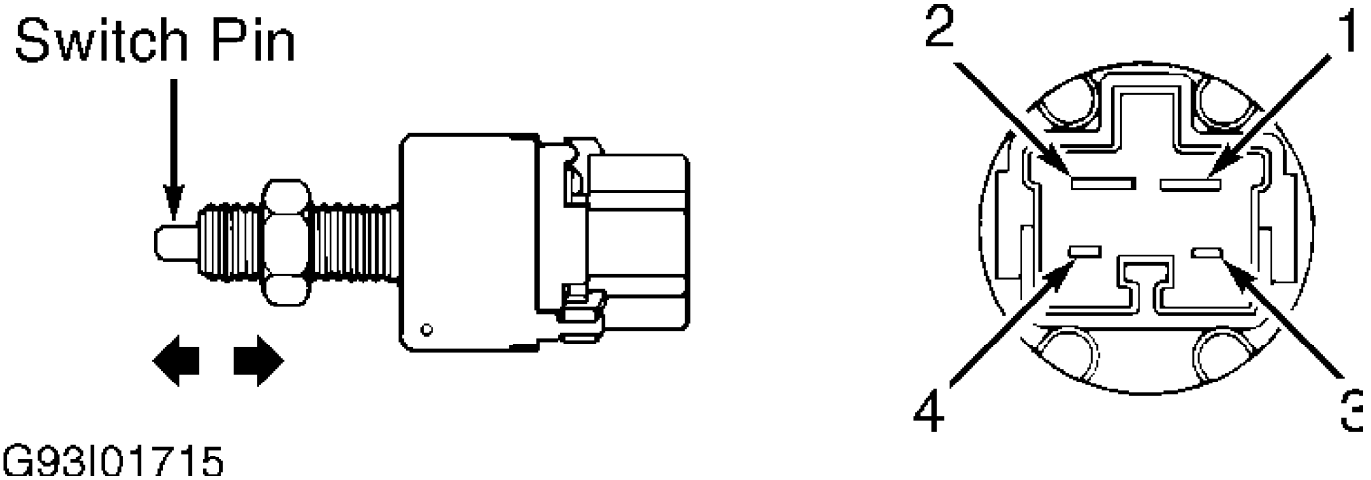


Fig. 6: Identifying Stoplight Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 14: ACTUATOR MECHANICAL MALFUNCTION

Circuit Description

Circuit detects the rotation position of the actuator control plate and sends a signal to cruise control ECU.

CAUTION: DO NOT reverse polarity to actuator terminals No. 3 and 4.

Damage will result.

Diagnosis & Repair

1) Turn ignition off. Disconnect electrical connector from actuator. Manually move control plate on actuator back and forth. If control plate does not move freely, replace actuator. If control plate moves freely, turn magnetic clutch on by applying battery voltage to actuator terminals No. 3 (positive lead) and No. 4 (negative lead). See Fig. 5. Attempt to move control plate. If control plate moves, replace actuator. If control plate does not move, go to next step.

2) Operate actuator motor (move control arm) by applying battery voltage to terminals No. 1 and 3 (positive lead), and ground to terminals No. 2 and 4 (negative lead). Motor should move to fully open position. Apply battery voltage to terminals No. 2 and 3 (positive lead), and ground to terminals No. 1 and 4 (negative lead) to move control arm in opposite direction (fully closed position). As control arm moves fully in either direction, limit switches in actuator should stop control arm from moving. If actuator does not operate as specified, replace actuator. If actuator operates as specified, go to next step.

3) Check wiring and connectors between actuator and cruise control ECU. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

DTC 21: OPEN VEHICLE SPEED SENSOR CIRCUIT

Circuit Description

Vehicle speed sensor circuit is sent to cruise control ECU as vehicle speed signal. For each rotation of shaft, vehicle speed sensor sends a 4-pulse signal through the instrument cluster which is converted inside the instrument cluster and sent to the cruise control ECU. ECU calculates the vehicle speed from this pulse frequency.

Diagnosis & Repair

1) Ensure cruise control ECU is receiving input signal from vehicle speed sensor, through instrument cluster. See INPUT SIGNAL CIRCUITS under CIRCUIT TESTS. If input signal circuit is not okay, go to next step. If input signal circuit is okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

2) Check speedometer operation. See appropriate INSTRUMENT PANELS article. Replace instrument cluster as necessary. If speedometer operates, check wiring and connectors between instrument cluster, cruise control ECU and vehicle speed sensor. See WIRING DIAGRAMS. Repair or replace as necessary. If wiring and connectors are okay, check vehicle speed sensor. See appropriate INSTRUMENT PANELS article. Replace as necessary. If vehicle speed sensor is okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

DTC 23: VEHICLE SPEED SIGNAL ABNORMAL

Circuit Description

Vehicle speed sensor circuit is sent to cruise control ECU as vehicle speed signal. For each rotation of shaft, vehicle speed sensor sends a 4-pulse signal through the instrument cluster which is converted inside the instrument cluster and sent to the cruise control ECU. ECU calculates the vehicle speed from this pulse frequency.

Diagnosis & Repair

Check vehicle speed sensor. See appropriate INSTRUMENT PANELS

article. Replace as necessary. If vehicle speed sensor is okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

DTC 32: CRUISE CONTROL SWITCH CIRCUIT (ES300)

Circuit Description

Circuit carries the SET/COAST, RESUME/ACCEL and CANCEL signals (each voltage) to cruise control ECU.

Diagnosis & Repair

1) Ensure cruise control ECU is receiving input signals from cruise control switch. See INPUT SIGNAL CIRCUITS under CIRCUIT TESTS. If input signal circuits are not okay, go to next step. If input signal circuits are okay, check for intermittent condition (poor connections, etc.).

2) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. Using DVOM, measure voltage between ground and terminal No. 10 of cruise control ECU connector with cruise control switch in specified position. See Fig. 8. See CRUISE CONTROL SWITCH INPUT VOLTAGE (ES300) table. If voltage is not as specified, go to next step. If voltage is as specified, check for intermittent condition (poor connections, etc.). If connections are okay, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

3) Remove steering wheel pad. See AIR BAG RESTRAINT SYSTEMS article. Disconnect electrical connector from cruise control switch. Using ohmmeter, measure resistance between cruise control switch terminals No. 3 and 4 with cruise control switch in specified position. See Fig. 7. See CRUISE CONTROL SWITCH RESISTANCE (ES300) table.

4) If resistance is not as specified, replace cruise control switch. If resistance is as specified, check wiring and connectors between cruise control switch, cruise control ECU and ground connection. Repair or replace as necessary. If wiring and connectors are okay, recheck input signals from cruise control switch. See INPUT SIGNAL CIRCUITS under CIRCUIT TESTS. If no problem is found, system is okay. If input signals are faulty, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

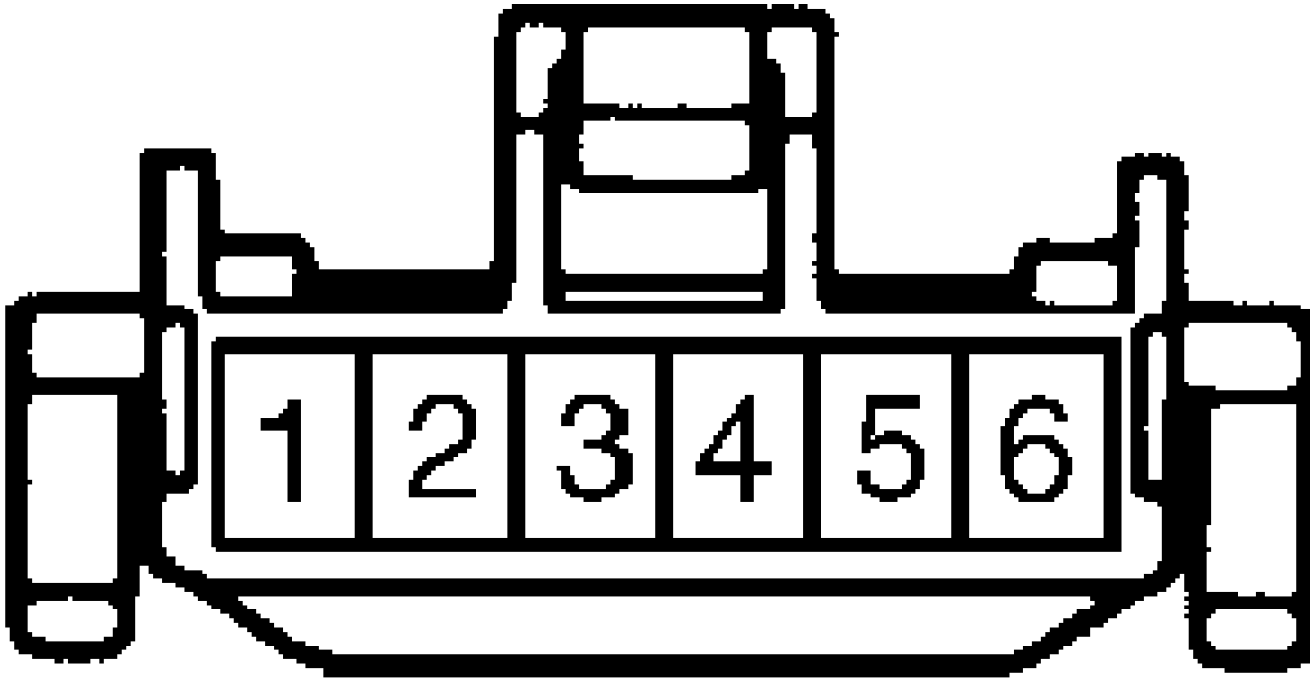
CRUISE CONTROL SWITCH INPUT VOLTAGE (ES300)

Switch Position	Voltage
Neutral	10-16
RES/ACC	0.6-2.3
SET/COAST	1.9-4.7
CANCEL	3.4-7.2

CRUISE CONTROL SWITCH RESISTANCE (ES300)

Switch Position	Ohms
Neutral	No Continuity

RES/ACC	50-80
SET/COAST	180-220
CANCEL	400-440



G93J00249

Fig. 7: Identifying Cruise Control Switch Terminals (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC 51: IDLE SIGNAL CIRCUIT

Circuit Description

Signal is sent to the cruise control ECU when idle switch is turned on. ECU uses this signal to correct the discrepancy between throttle valve position and actuator position sensor values to enable accurate cruise control at set speed. If idle switch malfunctions, problem symptoms also occur in engine and should be inspected.

Diagnosis & Repair

1) Remove cruise control ECU, leaving electrical connector attached. Disconnect Engine Control Module (ECM) connector. Turn ignition on. Using DVOM, measure voltage between ground and terminal No. 13 of cruise control ECU connector with throttle valve fully closed and fully open. See Fig. 8. Voltage should be 10-16 volts with throttle wide open, and less than 1.5 volts with throttle closed.

2) If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

3) Check wiring and connectors between ECM and Throttle Position Sensor (TPS). Repair or replace as necessary. If wiring and connectors are okay, check TPS circuit. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE. Repair as necessary. If

circuit is okay, go to next step.

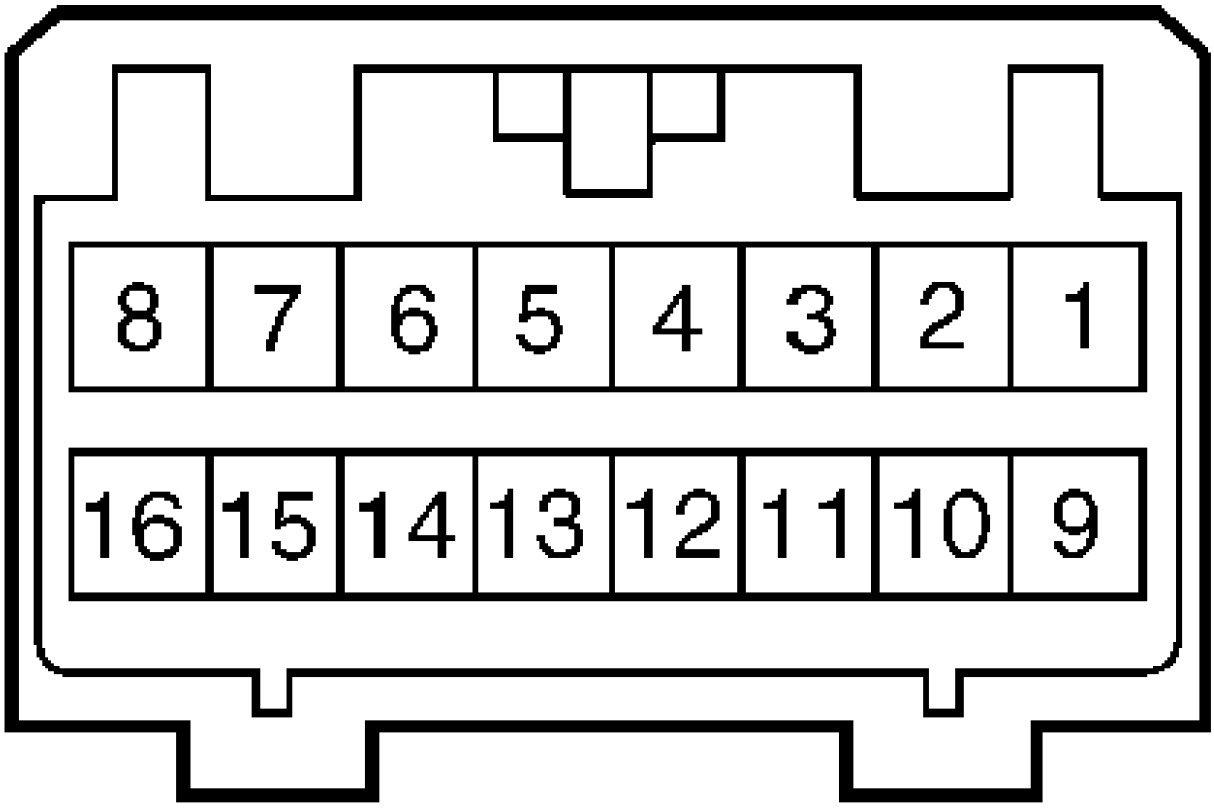
4) Disconnect TPS connector. Using ohmmeter, measure resistance between TPS terminals with throttle closed and wide open. See Fig. 9. See THROTTLE POSITION SENSOR RESISTANCE table. If resistance is not as specified, replace TPS. If resistance is as specified, go to next step.

5) Check wiring and connectors between ECM and cruise control ECU. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

THROTTLE POSITION SENSOR RESISTANCE

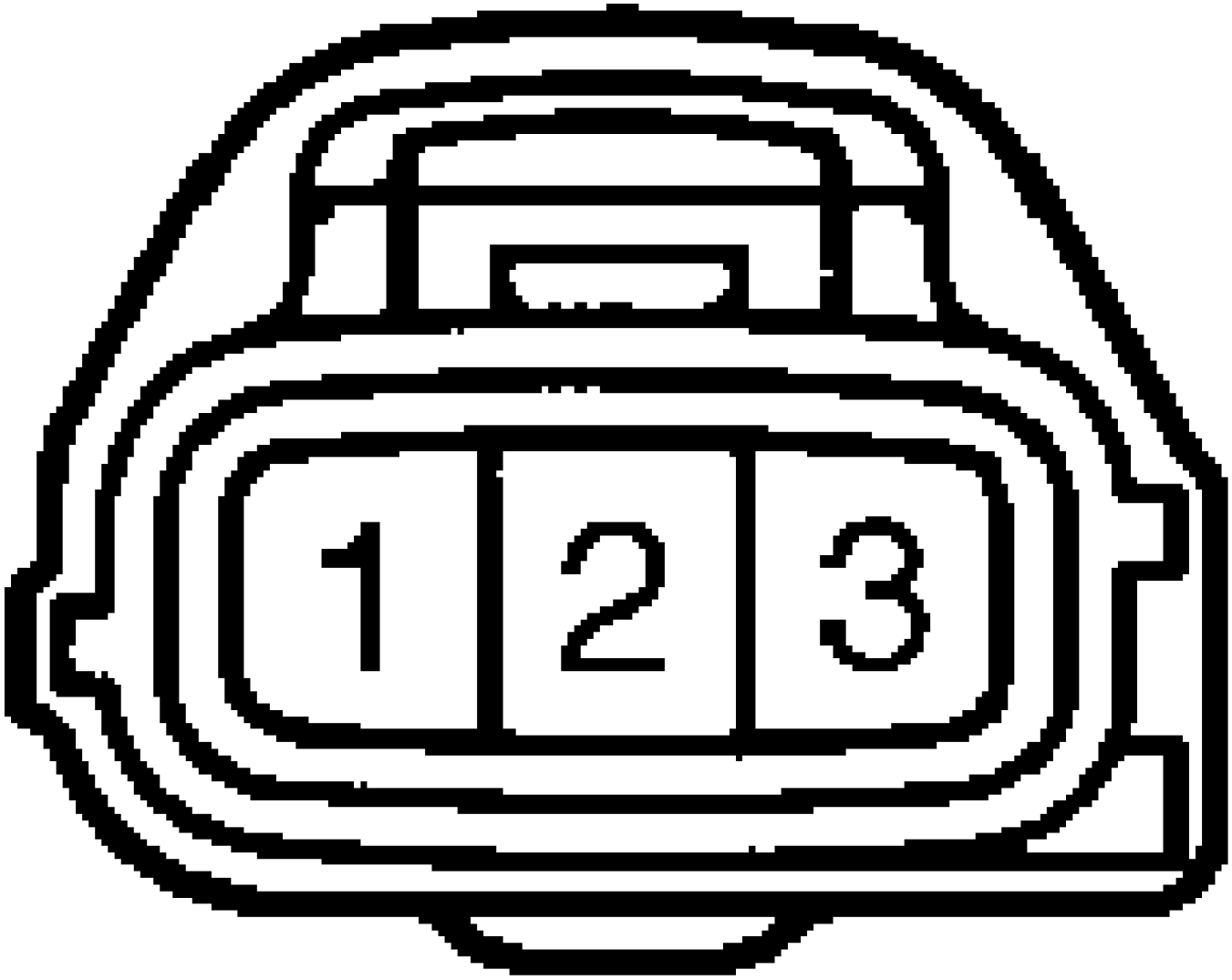
Throttle Position	Terminals No. (1)	Ohms
Always	1 & 2	2500-5900
Throttle Closed	2 & 3	2000-10,200
Throttle Open	2 & 3	200-6300

(1) - See Fig. 9.



G97D07300

Fig. 8: Identifying Cruise Control ECU Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



98D03420

Fig. 9: Identifying Throttle Position Sensor (TPS) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CIRCUIT TESTS

* PLEASE READ THIS FIRST *

NOTE: Perform circuit tests in order listed in SYMPTOM DIAGNOSIS

table under TROUBLE SHOOTING.

CRUISE CONTROL MAIN SWITCH CIRCUIT

1) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. On ES300, measure voltage (backprobe) between cruise control ECU connector terminal No. 11 and ground. See Fig. 8. On RX300, measure voltage (backprobe) between cruise control ECU connector terminal No. 10 and ground.

2) On all models, with main cruise control switch button released, voltage should be 10-16 volts. With main cruise control switch button pressed, voltage should be less than 0.5 volt. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

3) Remove steering wheel pad. Disconnect electrical connector from cruise control switch. On ES300, check continuity between terminals No. 3 and 5 of cruise control switch connector. See Fig. 7. On RX300, check continuity between terminals No. 4 and 5 of cruise control switch connector.

4) On all models, with main cruise control switch button released, continuity should not exist. With main cruise control switch button pressed, continuity should exist. If continuity is not as specified, replace cruise control switch. If continuity is as specified, check wiring and connectors between cruise control ECU and cruise control switch. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

CRUISE INDICATOR LIGHT CIRCUIT

1) Turn ignition on. Measure voltage (backprobe) between cruise control ECU connector terminal No. 4 and ground. See Fig. 8. With main cruise control switch button released, voltage should be 10-16 volts. With main cruise control switch button pressed, voltage should be less than 1.2 volts. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check instrument cluster. See appropriate INSTRUMENT PANELS article. Replace instrument cluster as necessary. If instrument cluster is okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

DIAGNOSIS CIRCUIT

1) Turn ignition on. Measure voltage between terminals Tc and E1 of Data Link Connector 2 (DLC2) located under left side of instrument panel. See Fig. 3. Voltage should be 10-16 volts. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Check wiring and connectors between DLC2, cruise control ECU and ground connection. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL

ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

ECU POWER SOURCE CIRCUIT

Circuit Description

Cruise control ECU power source circuit supplies power to actuator and sensors. Cruise control ECU is grounded internally (through case) and externally (through a ground wire).

Diagnosis & Repair

1) Check ECU-IG fuse located in instrument panel junction block No. 1, under left side of instrument panel. If fuse is blown, repair short in all wiring and components connected to ECU-IG fuse. If fuse is okay, go to next step.

2) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. Measure voltage (backprobe) between cruise control ECU connector terminals No. 9 (battery voltage) and 16 (ground). See Fig. 8. Voltage should be 10-16 volts. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

3) Measure resistance (backprobe) between cruise control ECU connector terminal No. 16 and ground. See Fig. 8. If resistance is one ohm or greater, repair or replace wiring or connectors between cruise control ECU and ground connection. If resistance is less than one ohm, repair or replace wiring or connectors between cruise control ECU and battery.

ELECTRONICALLY CONTROLLED TRANSMISSION COMMUNICATION CIRCUIT

1) Warm engine to operating temperature. Drive vehicle to ensure overdrive operates. If overdrive does not operate, repair transmission before continuing test. If overdrive operates, go to next step.

2) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. Disconnect electrical connector from cruise control ECU. Measure voltage (backprobe) between cruise control ECU connector terminal No. 14 and ground. See Fig. 8. Voltage should be 10-16 volts. If voltage is as specified, go to next step. If voltage is not as specified, go to step 5).

3) Connect cruise control ECU connector. Warm engine to operating temperature. Test drive vehicle and have an assistant measure voltage (backprobe) between cruise control ECU connector terminal No. 6 and ground while operating overdrive switch. See Fig. 8 . With overdrive switch on, voltage should be 8-14 volts. With overdrive switch off, voltage should be less than 0.5 volt. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

4) Check wiring and connectors between cruise control ECU and electronically controlled transmission solenoid. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

5) Check wiring and connectors between cruise control ECU and Engine Control Module (ECM). Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

INPUT SIGNAL CIRCUITS

NOTE: When more than one signal is input to cruise control ECU, lowest numbered code is displayed first.

Use this procedure to determine whether cruise control ECU is receiving input signals from various switches and vehicle speed sensor. Enter diagnostic mode, and check if CRUISE indicator light responds as indicated. See ENTERING DIAGNOSTIC MODE.

Entering Diagnostic Mode

1) To enter diagnostic mode for switches, turn ignition on and go to next step. To enter diagnostic mode for vehicle speed sensor, raise and support vehicle. Start engine and place gear selector in Drive. Go to next step.

2) While holding control control switch in SET/COAST or RES/ACC position, turn cruise main switch on (press button on end of lever). After a short pause (about 3 seconds), CRUISE indicator light should repeatedly flash 2 or 3 times. This indicates diagnostic mode has been entered. Release control switch lever to its normal (neutral) position. Check input signals. See CHECKING INPUT SIGNALS.

Checking Input Signals

1) To check input signals for switches, go to next step. To check input signals for vehicle speed sensor, go to step 3).

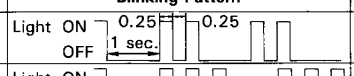
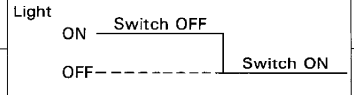
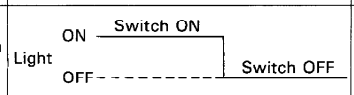
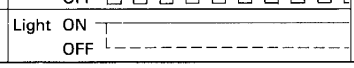
2) Leave ignition on. Operate appropriate switch as specified (SET/COAST, step No. 1; RES/ACC, step No. 2; CANCEL, stoplight and park/neutral position, step No. 3), and observe CRUISE indicator light. See Fig. 10. If CRUISE indicator light flashes as specified, related switch circuit is okay. If CRUISE indicator light does not flash as specified, go to step 4).

3) Operate vehicle at specified speed (greater or less than 25 MPH; step No. 4), and observe CRUISE indicator light. See Fig. 10. If CRUISE indicator light flashes as specified, vehicle speed sensor circuit is okay. If CRUISE indicator light does not flash as specified, go to next step.

4) Cruise control ECU is not receiving input signal due to a faulty circuit. Repair circuit as necessary. If circuit is okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU. Exit diagnostic mode. See EXITING DIAGNOSTIC MODE.

Exiting Diagnostic Mode

Turn cruise main switch off (press button on end of lever).

No.	Operation Method	CRUISE MAIN Indicator Light Blinking Pattern	Diagnosis
1	Turn SET/COAST switch ON.		SET/COAST switch circuit is normal.
2	Turn RES/ACC switch ON.		RES/ACC switch circuit is normal.
3	Turn CANCEL switch ON.		CANCEL switch circuit is normal.
	Turn stop light switch ON. (Depress brake pedal)		Stop light switch circuit is normal.
	Turn park/neutral position switch OFF. (Shift to except D position)		Park/neutral position switch circuit is normal.
4	Drive at 25 MPH (40 KM/H) or higher.		Speed sensor is normal.
	Drive at 25 MPH (40 KM/H) or below.		

G96E07386

Fig. 10: Input Signal Diagnostic Mode Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARK/NEUTRAL POSITION SWITCH CIRCUIT

1) Check starter operation. If starter operates with gear selector in any position except Park and Neutral, check starter circuit. See STARTERS article in STARTING & CHARGING SYSTEMS. If starter operates with gear selector in Park and Neutral only, go to next step.

2) Check park/neutral position switch input signal circuit. See INPUT SIGNAL CIRCUITS. If input signal circuit is not okay, go to next step. If input signal circuit is okay, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

3) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. Measure voltage (backprobe) between cruise control ECU connector terminal No. 3 and ground with gear selector in specified position. See Fig. 8. With selector in Drive, voltage should be 10-16 volts. With selector in any other position than Drive, voltage should be less than one volt. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

4) Check wiring and connectors between cruise control ECU and park/neutral position switch. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

STOPLIGHT SWITCH CIRCUIT

1) Check stoplight operation. If stoplights do not operate, repair stoplight circuit. If stoplights operate, check stoplight switch input signal circuit. See INPUT SIGNAL CIRCUITS. If input signal circuit is not okay, go to next step. If input signal circuit is okay, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

2) Remove cruise control ECU, leaving electrical connector attached. Turn ignition on. Measure voltage (backprobe) between cruise control ECU connector terminal No. 2 and ground while pressing and releasing brake pedal. See Fig. 8. With brake pedal pressed, voltage should be 10-16 volts. With brake pedal released, voltage should be less than one volt. If voltage is not as specified, go to next step. If voltage is as specified, perform next procedure listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

3) Check wiring and connectors between cruise control ECU and stoplight switch. Repair or replace as necessary. If wiring and connectors are okay, check cruise control ECU. See CRUISE CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS. If cruise control ECU is defective, replace ECU.

COMPONENT TESTS

CRUISE CONTROL ECU PIN VOLTAGE TESTS

Turn ignition on. Using DVOM, measure voltage by backprobing between the following cruise control ECU connector terminals. See Fig. 8. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, replace cruise control ECU.

Terminals No. 2 & 16

Brake pedal pressed, voltage should be 10-16 volts. Brake pedal released, voltage should be less than one volt.

Terminals No. 3 & 16

Gear selector in Drive, voltage should be 10-16 volts. Gear selector in any other position than Drive, voltage should be less than one volt.

Terminals No. 4 & 16

Ignition on, cruise control main switch on, voltage should be less than 1.2 volts. Ignition on, cruise control main switch off, voltage should be 10-16 volts.

Terminals No. 5 & 16

Ignition on, voltage should be 10-16 volts. Ignition on, DLC terminals Tc and E1 connected, voltage should be less than one volt.

Terminals No. 6 & 16

While driving in overdrive, voltage should be less than one volt. While driving in 3rd gear (overdrive off), voltage should be 10-16 volts.

Terminals No. 7 & 16

Driving with cruise control on and COAST switch held on, voltage should be 9-15 volts. Driving with cruise control on and ACC switch held on, voltage should be less than one volt.

Terminals No. 8 & 16

Driving with cruise control on, voltage should be 9-15 volts. Driving with cruise control off, voltage should be less than one volt.

Terminals No. 9 & 16

Ignition on, voltage should be 10-16 volts.

Terminals No. 10 & 16

Ignition on, voltage should be 10-16 volts. Ignition on, CANCEL switch held on, voltage should be 4.2-8.8 volts. Ignition on, SET/COAST switch held on, voltage should be 2.5-6.3 volts. Ignition on, RES/ACC switch held on, voltage should be 0.8-3.7 volts.

Terminals No. 11 & 16 (ES300 Only)

Ignition on, cruise control main switch on, voltage should be less 0.5 volt. Ignition on, cruise control main switch off, voltage should be 10-16 volts.

Terminals No. 12 & 16

Engine running, vehicle stopped, voltage should be less than 1.5 volts or 4.7-16 volts. While driving (pulse generated), voltage should be 3-7 volts.

Terminals No. 13 & 16

Ignition on, throttle valve fully closed, voltage should be less than 1.5 volts. Ignition on, throttle valve fully open, voltage should be 10-16 volts

Terminals No. 14 & 16

Driving with cruise control on and overdrive on, voltage should be 10-16 volts. Driving with cruise control on and overdrive off (3rd gear), voltage should be less than one volt.

Terminals No. 15 & 16

Driving with cruise control on and ACC switch held on, voltage should be 9-15 volts. Driving with cruise control on and COAST switch held on, voltage should be less than one volt.

Terminal No. 16 & Body Ground

During all conditions, voltage should be less than one volt.

REMOVAL & INSTALLATION

NOTE: Removal and installation procedures are not available from manufacturer.

WIRING DIAGRAMS

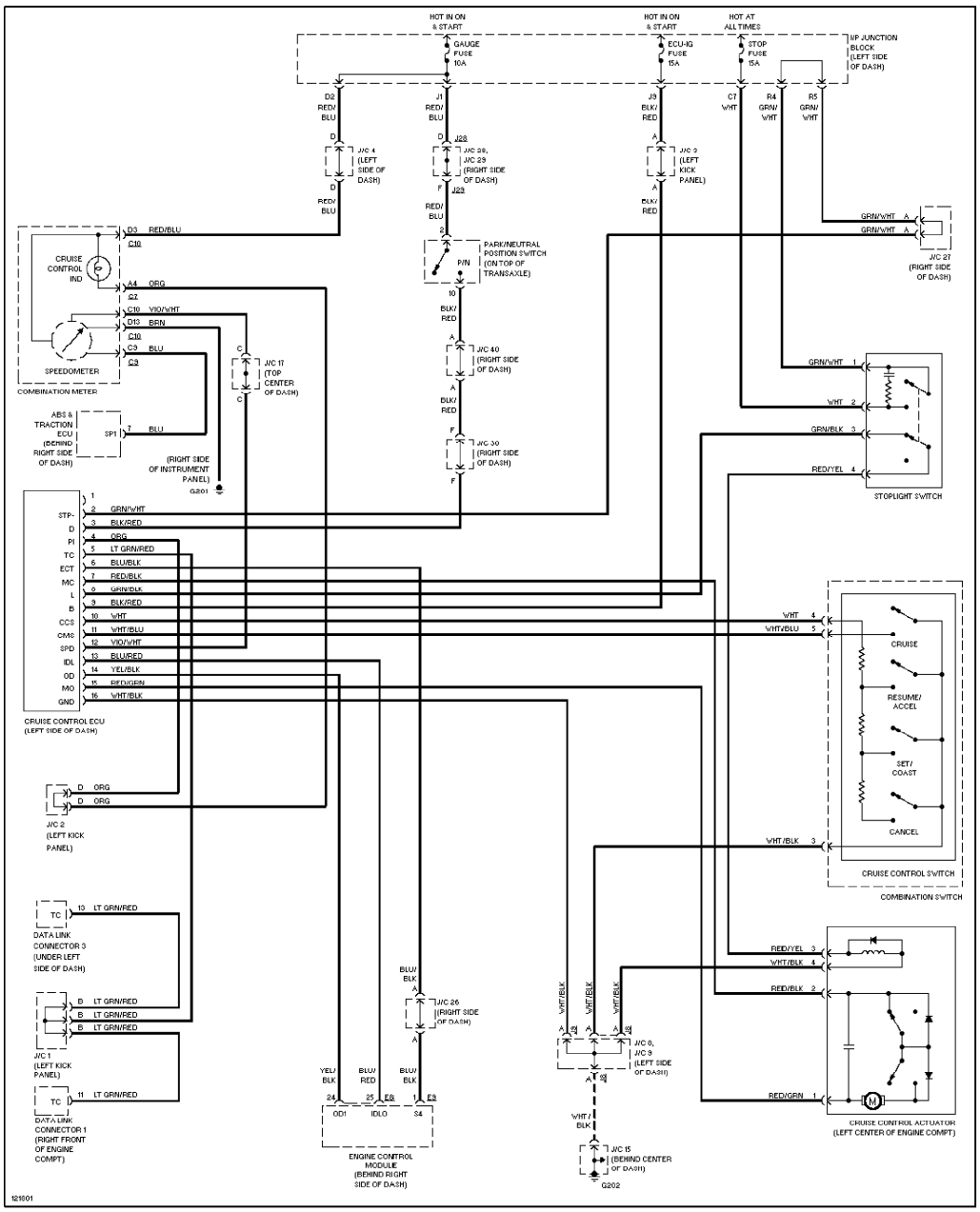


Fig. 11: Cruise Control System Wiring Diagram (ES300)

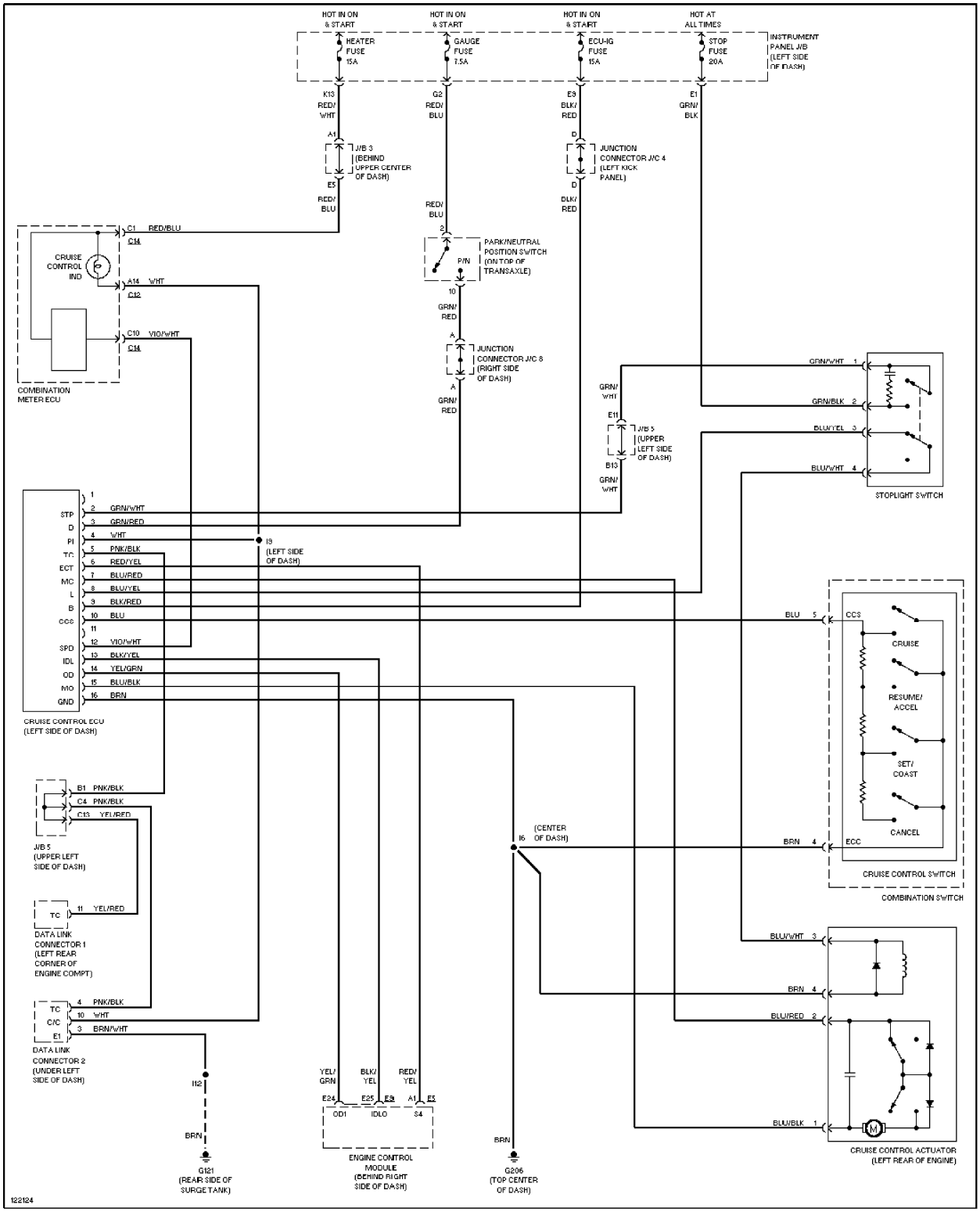


Fig. 12: Cruise Control System Wiring Diagram (RX300)

DOOR LOCKS, TRUNK LID & FUEL DOOR - POWER

1999 Lexus RX 300

1999-2000 ACCESSORIES & EQUIPMENT
Lexus Power Door Locks, Trunk Lid & Fuel Door

RX300

DESCRIPTION

POWER DOOR LOCKS

All doors can be locked and unlocked from either front door using control switch or door key. When you unlock driver's door with door key, if you turn key once, only driver's door will unlock. If you turn key twice within 3 seconds, all doors will unlock.

KEY CONFINEMENT PREVENTION SYSTEM

If driver leaves key in ignition, opens door, then tries to lock doors using control switch (on door panel), system will not allow doors to be locked. This prevents key from being locked inside vehicle.

OPERATION

POWER DOOR LOCKS

Door Key Switch (Door Key Lock & Unlock Switch)
This switch is part of door key cylinder. When lock cylinder is turned to LOCK or UNLOCK position, contacts inside this switch close.

Door Lock Control Switch
All doors can be locked and unlocked using control switch on driver's side or passenger's side.

Door Lock Motors
Each door contains a door lock motor (an electric actuator) that locks and unlocks door. Door lock motor assembly contains a door unlock detection switch and a door open detection switch.

Door Unlock Detection Switch
This switch is part of door lock motor assembly. When door is unlocked, switch is closed. When door is locked, switch is open.

Key Unlock Warning Switch
This switch is part of ignition switch. When key is in ignition, switch is closed. If system senses that switch is closed, it prevents door locks from being operated if driver's door is open (key confinement prevention system).

Front & Rear Door ECUs
Front and rear door ECUs supply power to door lock motors based on inputs from various switches.

FUEL DOOR RELEASE

Fuel Door Release Motor
This is an electric actuator that unlocks fuel door.

Fuel Door Release Opener Switch

Opener switch handle is on left side of instrument panel next to trunk lid main switch. To activate fuel door release motor, pull opener switch handle.

COMPONENT LOCATIONS

NOTE: For component locations, see Fig. 1.

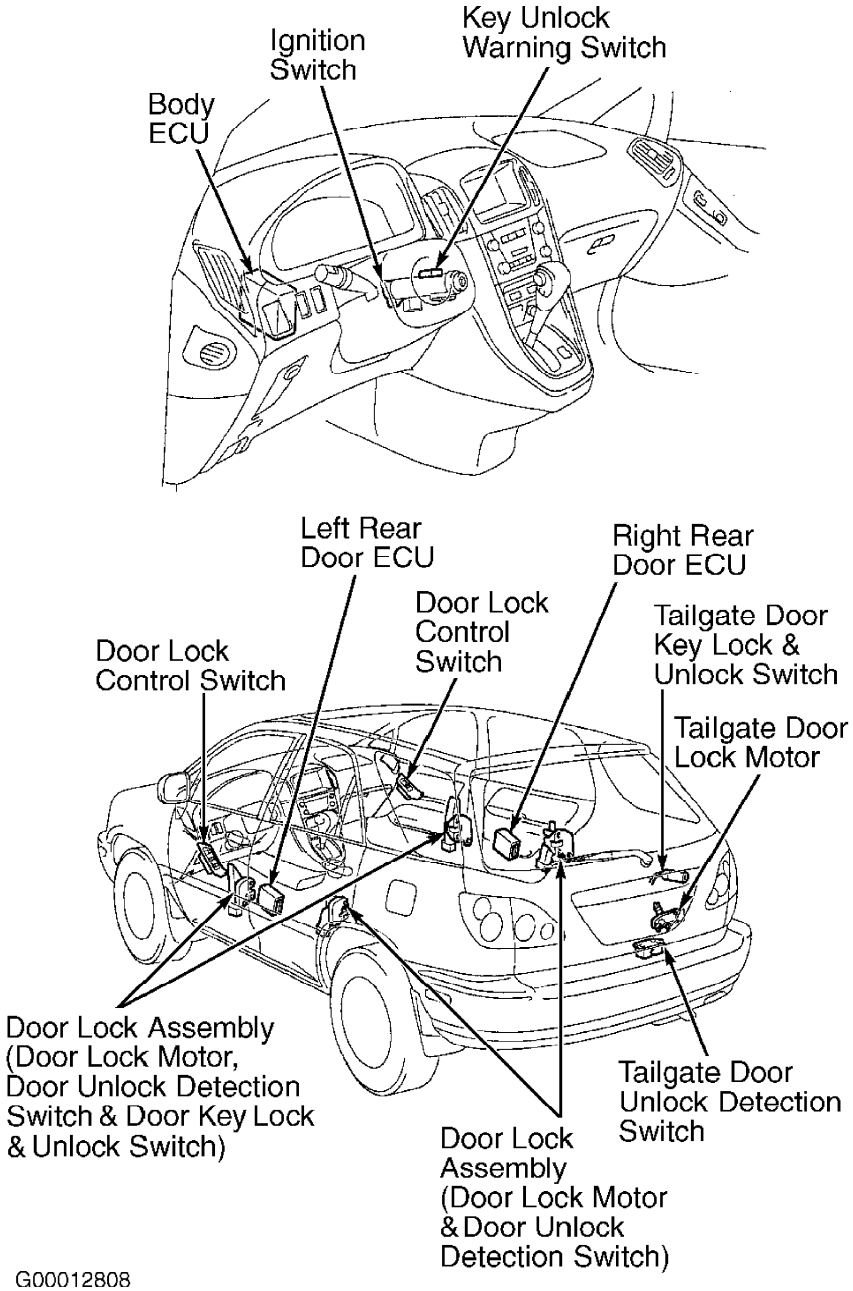


Fig. 1: Locating Power Door Locks & Tailgate Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING in BODY CONTROL SYSTEMS - RX300 article.

COMPONENT TESTS

NOTE: For additional testing, see BODY CONTROL SYSTEMS - RX300 article.

DRIVER'S DOOR LOCK MOTOR

Disconnect driver's door lock motor 6-pin connector. See Fig. 2. Connect battery positive voltage to connector terminal No. 1 and negative battery voltage to connector terminal No. 2. Door lock link should move to UNLOCK position. Reverse polarity and check if door lock link moves to LOCK position. Replace door lock assembly as necessary.

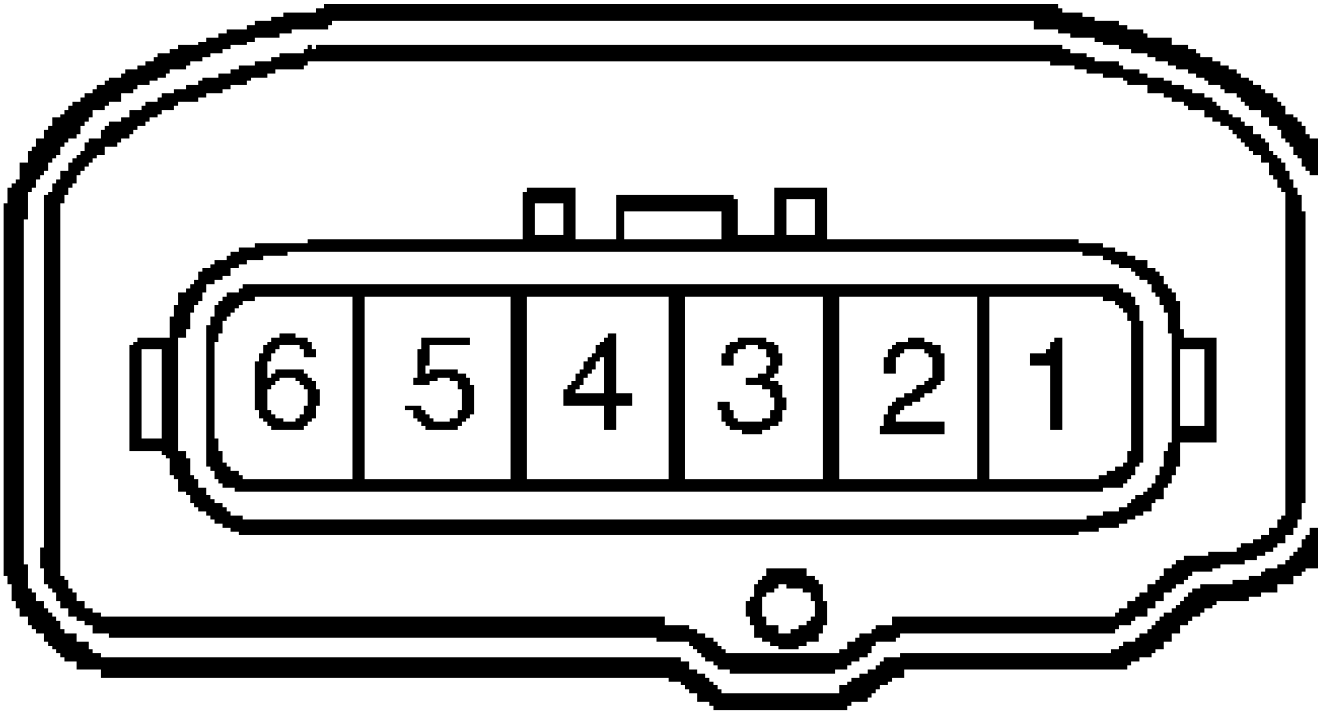


Fig. 2: Identifying 6-Pin Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DRIVER'S DOOR KEY LOCK & UNLOCK SWITCH

Disconnect driver's door key lock and unlock switch 6-pin connector. See Fig. 2. Put switch in LOCK position. Check continuity between switch terminals No. 3 and 5. Continuity should be present. Put switch in UNLOCK position. Check continuity between switch terminals No. 3 and 6. Continuity should be present. With switch in OFF position, no continuity should be present between any terminals. Replace switch as necessary.

DRIVER'S DOOR POSITIVE TEMPERATURE COEFFICIENT (PTC) THERMISTOR

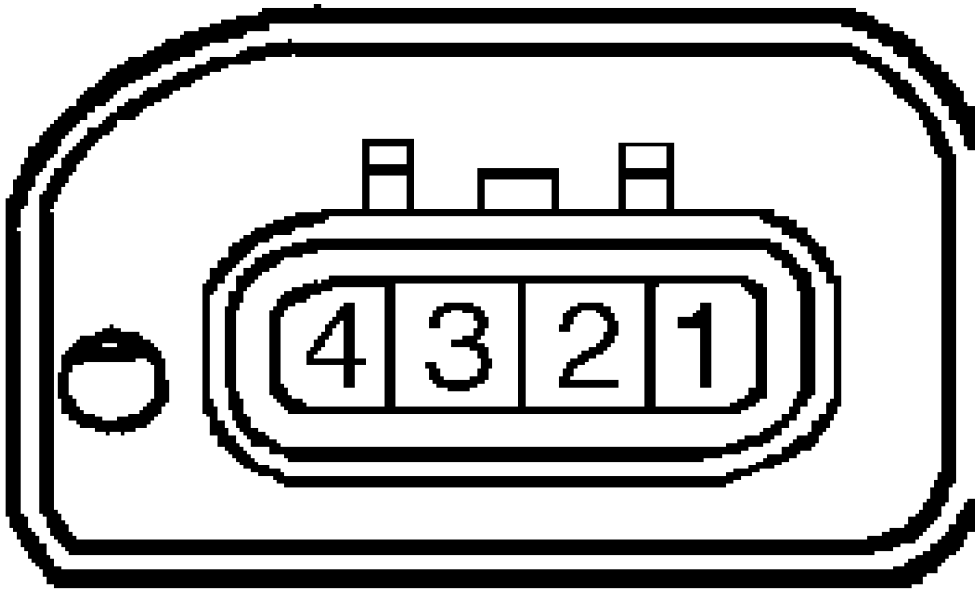
Disconnect driver's door lock 6-pin connector. See Fig. 2. Connect negative battery voltage to lock terminal No. 2. Connect positive battery voltage to ammeter. Connect ammeter negative probe to terminal No. 1. Current should change from about 3.2 amps to less than .5 amps within 20-70 seconds. Disconnect leads. About one minute later, connect positive battery voltage to switch terminal No. 2, and connect negative battery voltage to switch terminal No. 1. Door lock should move to LOCK position. If lock does not operate as specified, replace door lock assembly.

FRONT DOOR UNLOCK DETECTION SWITCH

Disconnect front door unlock detection switch 6-pin connector. See Fig. 2. Put switch in OFF (door set to lock) position. No continuity should be present between any terminals. Put switch in ON (door set to unlock) position. Continuity should be present between switch terminals No. 3 and 4. Replace switch as necessary.

LEFT REAR DOOR LOCK MOTOR

Disconnect left rear door lock motor 4-pin connector. See Fig. 3. Connect battery positive voltage to connector terminal No. 1 and negative battery voltage to connector terminal No. 2. Door lock link should move to UNLOCK position. Reverse polarity and check if door lock link moves to LOCK position. Replace door lock assembly as necessary.



G00012807

Fig. 3: Identifying 4-Pin Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LEFT REAR DOOR POSITIVE TEMPERATURE COEFFICIENT (PTC) THERMISTOR

Disconnect left rear door lock 4-pin connector. See Fig. 3. Connect negative battery voltage to lock terminal No. 2. Connect positive battery voltage to ammeter. Connect ammeter negative probe to terminal No. 1. Current should change from about 3.2 amps to less than .5 amps within 20-70 seconds. Disconnect leads. About one minute later, connect positive battery voltage to switch terminal No. 2, and connect negative battery voltage to switch terminal No. 1. Door lock should move to LOCK position. If lock does not operate as specified, replace door lock assembly.

PASSENGER'S DOOR KEY LOCK & UNLOCK SWITCH

Disconnect passenger's door key lock and unlock switch 6-pin connector. See Fig. 2. Put switch in LOCK position. Check continuity between switch terminals No. 2 and 4. Continuity should be present. Put switch in UNLOCK position. Check continuity between switch terminals No. 1 and 4. Continuity should be present. With switch in OFF position, no continuity should be present between any terminals. Replace switch as necessary.

PASSENGER'S DOOR LOCK MOTOR

Disconnect passenger's door lock motor 6-pin connector. See Fig. 2. Connect battery positive voltage to connector terminal No. 5 and negative battery voltage to connector terminal No. 6. Door lock link should move to UNLOCK position. Reverse polarity and check if door lock link moves to LOCK position. Replace door lock assembly as necessary.

PASSENGER'S DOOR POSITIVE TEMPERATURE COEFFICIENT (PTC) THERMISTOR

Disconnect passenger's front door lock 6-pin connector. See Fig. 2. Connect negative battery voltage to lock terminal No. 6. Connect positive battery voltage to ammeter. Connect ammeter negative probe to terminal No. 5. Current should change from about 3.2 amps to less than .5 amps within 20-70 seconds. Disconnect leads. About one minute later, connect positive battery voltage to switch terminal No. 6, and connect negative battery voltage to switch terminal No. 5. Door lock should move to LOCK position. If lock does not operate as specified, replace door lock assembly.

REAR DOOR UNLOCK DETECTION SWITCH

Disconnect rear door unlock detection switch 4-pin connector. See Fig. 3. Put switch in OFF (door set to lock) position. No continuity should be present between any terminals. Put switch in ON (door set to unlock) position. Continuity should be present between switch terminals No. 1 and 2 (left side) or terminals No. 3 and 4 (right side). Replace switch as necessary.

RIGHT REAR DOOR LOCK MOTOR

Disconnect right rear door lock motor 4-pin connector. See Fig. 3. Connect battery positive voltage to connector terminal No. 3 and negative battery voltage to connector terminal No. 4. Door lock link should move to UNLOCK position. Reverse polarity and check if door lock link moves to LOCK position. Replace door lock assembly as necessary.

RIGHT REAR DOOR POSITIVE TEMPERATURE COEFFICIENT (PTC)

THERMISTOR

Disconnect right rear door lock 4-pin connector. See Fig. 3. Connect negative battery voltage to lock terminal No. 4. Connect positive battery voltage to ammeter. Connect ammeter negative probe to terminal No. 3. Current should change from about 3.2 amps to less than .5 amps within 20-70 seconds. Disconnect leads. About one minute later, connect positive battery voltage to switch terminal No. 4, and connect negative battery voltage to switch terminal No. 3. Door lock should move to LOCK position. If lock does not operate as specified, replace door lock assembly.

TAILGATE DOOR KEY LOCK & UNLOCK SWITCH

Disconnect tailgate door key lock and unlock switch 3-pin connector. See Fig. 4. Put switch in LOCK position. Check continuity between switch terminals No. 1 and 2. Continuity should be present. Put switch in UNLOCK position. Check continuity between switch terminals No. 1 and 3. Continuity should be present. With switch in OFF position, no continuity should be present between any terminals. Replace switch as necessary.

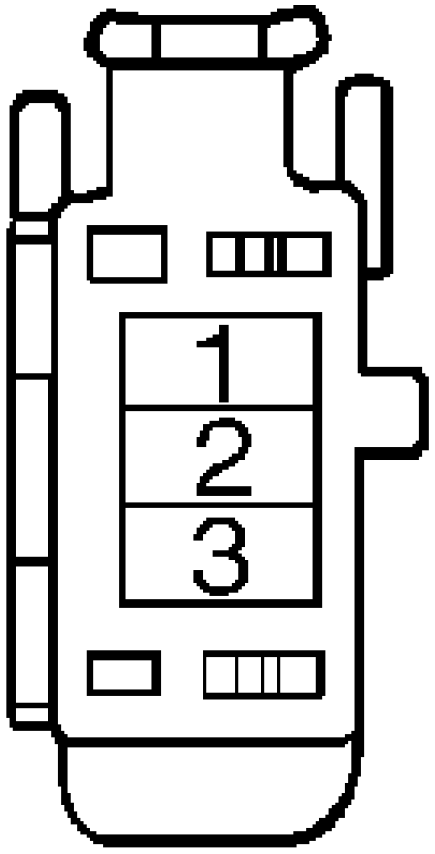


Fig. 4: Identifying 3-Pin Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TAILGATE DOOR LOCK MOTOR

Disconnect tailgate door lock motor 4-pin connector. See Fig. 3. Connect battery positive voltage to connector terminal No. 3 and negative battery voltage to connector terminal No. 2. Door lock link should move to UNLOCK position. Reverse polarity and check if door lock link moves to LOCK position. Replace door lock assembly as necessary.

TAILGATE DOOR UNLOCK DETECTION SWITCH

Disconnect rear door unlock detection switch 4-pin connector. See Fig. 3. Put switch in OFF (door set to lock) position. No continuity should be present between any terminals. Put switch in ON (door set to unlock) position. Continuity should be present between switch terminals No. 1 and 4. Replace switch as necessary.

TAILGATE POSITIVE TEMPERATURE COEFFICIENT (PTC) THERMISTOR

Disconnect tailgate door lock 4-pin connector. See Fig. 3. Connect negative battery voltage to lock terminal No. 2. Connect positive battery voltage to ammeter. Connect ammeter negative probe to terminal No. 3. Current should change from about 3.2 amps to less than .5 amps within 20-70 seconds. Disconnect leads. About one minute later, connect positive battery voltage to switch terminal No. 2, and connect negative battery voltage to switch terminal No. 3. Door lock should move to LOCK position. If lock does not operate as specified, replace door lock assembly.

REMOVAL & INSTALLATION

DOOR LOCK MOTOR

Removal & Installation

Remove door trim panel and service hole cover. Disconnect electrical connectors. Remove door lock motor assembly. To install, reverse removal procedure.

DOOR LOCK CONTROL SWITCH

Removal & Installation

Using a screwdriver with a protected (taped) tip, push in on clip at front outside edge of switch panel. Push switch panel forward and remove it from armrest base. Disconnect electrical connectors. To install, reverse removal procedure.

WIRING DIAGRAMS

NOTE: For power door lock system wiring diagram, see WIRING DIAGRAMS in REMOTE KEYLESS ENTRY SYSTEMS - RX300 article.

* DRIVETRAIN SYSTEMS UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Drivetrain/Transmission Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

CONTENTS

OVERVIEW OF MOTORIST ASSURANCE PROGRAM
OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

Drive/Power Train Assemblies

AUTOMATIC TRANSMISSION/TRANSAXLE ASSEMBLIES
DIFFERENTIAL AND FINAL DRIVE ASSEMBLIES
MANUAL TRANSMISSION/TRANSAXLE ASSEMBLIES
TRANSFER CASE ASSEMBLIES

Drive/Power Train Components

ACTUATORS (ELECTRICAL)
ACTUATORS (VACUUM)
AXLES
BEARINGS AND RACES
BELL CRANKS
BELL HOUSINGS
BUSHINGS (EXTERNAL)
CABLES (SPEEDOMETER)
CABLES (TV, DETENT AND SHIFT)
CARRIER BEARINGS
CLUTCH CABLES AND CABLE HOUSINGS
CLUTCH DISCS (MANUAL TRANSMISSION)
CLUTCH FORKS
CLUTCH LINKAGES (MECHANICAL)
CLUTCH MASTER CYLINDERS
CLUTCH PEDALS
CLUTCH PIVOTS
CLUTCH PRESSURE PLATES
CLUTCH RELEASE BEARINGS
CLUTCH SLAVE CYLINDERS (CONCENTRIC)
CLUTCH SLAVE CYLINDERS (CONVENTIONAL OR EXTERNAL)
COMPANION FLANGES
CONNECTORS
COOLER BYPASS VALVES
COOLER LINES
COOLERS
CV JOINTS
DIP STICK TUBES
DIP STICKS (FLUID LEVEL INDICATORS)
DOWEL PINS, GUIDES AND PILOT HOLES
DRIVE SHAFT FLANGES
DRIVE SHAFTS AND HALF SHAFTS
DUST BOOTS
ENGINE MOUNTS
EXCITER RINGS
FILLER TUBES
FILTERS AND SCREENS

FLANGES
FLEX PLATES
FLUID LEVEL INDICATORS
FLUIDS AND LUBRICANTS
FLYWHEELS
FORCE MOTORS
GUIDES
HALF SHAFTS
HOSES, LINES AND TUBES
HOUSINGS (BELL, CASE, TAIL (EXTENSION) AND AUXILIARY)
INTERMEDIATE SHAFT SUPPORT BEARINGS
KEY INTERLOCK SYSTEMS
LIMITED SLIPS
LINES
LINKAGES (EXTERNAL)
LOCKING HUB ASSEMBLIES
LOCKING HUB CONTROL KNOBS
LUBRICANTS
METAL-CLAD SEALS
METALASTIC JOINTS
MODULATOR PINS
MODULATORS
MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)
ODOMETER DRIVES (MECHANICAL)
ODOMETER HEADS (MECHANICAL)
OIL PANS
PANS
PILOT HOLES
PRESSURE PLATES
PRESSURE SWITCHES
RACES
RUBBER JOINTS (METALASTIC)
SCREENS
SEALS
SEALS (METAL-CLAD)
SELECTOR INTERLOCK SYSTEMS
SERVOS
SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS)
SENSORS
SIDE COVERS
SLIP YOKES
SOLENOIDS
SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)
SPEEDOMETER-DRIVEN GEAR HOUSINGS
SPEEDOMETER/ODOMETER DRIVES (MECHANICAL)
SPEEDOMETER/ODOMETER HEADS (MECHANICAL)
SPEEDOMETERS AND ODOMETERS (ELECTRONIC)
SWITCHES
TONE WHEELS
TOOTHED RINGS (TONE WHEELS)
TORQUE CONVERTERS
TRANSAXLE MOUNTS
TRANSDUCERS (TRANSMISSION)
TRANSMISSION COOLERS
TRANSMISSION MOUNTS
TRANSMISSION PANS
TRANSMISSION RANGE INDICATORS (PRNDL)
TUBES
UNIVERSAL JOINTS (CARDON OR CROSS TYPE)
VACUUM CONTROLS
VACUUM HOSES
VACUUM MOTORS
VACUUM-OPERATED SWITCHES

VEHICLE SPEED SENSORS
VENTS
VIBRATION DAMPERS
WHEEL ATTACHMENT HARDWARE
WHEEL SPEED SENSORS
WIRING HARNESSES AND CONNECTORS
YOKES AND SLIP YOKES

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems. Further, revisions to all of these inspection were recently published. Further, revisions to all of these inspection communication standards are continually republished. In addition to these, standards for Drive Train and Transmissions have recently been promulgated. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through MAP/BBB-CARE and other non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October, 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UICS in communicating the results of their inspection to their customers. To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing method

has been incorporated which includes the "mystery shopping" of outlets.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW Suite 700
Washington, DC 20005
Phone (202) 712-9042 Fax (202) 216-9646

January 1999

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

Example:
An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

Example:
A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

Example:
An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

Example:
The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 – To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 – To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 – Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

DRIVE/POWER TRAIN ASSEMBLIES

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

NOTE: Whenever transmission or drivetrain service is performed that affects the suspension alignment, for example, removing the engine cradle, it is required that the alignment be checked and corrected if necessary.

AUTOMATIC TRANSMISSION/TRANSAXLE ASSEMBLIES

AUTOMATIC TRANSMISSION/TRANSAXLE ASSEMBLY INSPECTION

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service. (1)	A	(2) Require repair or replacement of the automatic transmission/transaxle assembly.

(1) - It is Required that the torque converter and all other failure related components be inspected for cause and condition.
(2) - For components not requiring removal of the assembly, refer to the component listing in this document.

DIFFERENTIAL AND FINAL DRIVE ASSEMBLIES

NOTE: Does not include half shafts.

DIFFERENTIAL AND FINAL DRIVE ASSEMBLY INSPECTION

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service. (1)	A	Require repair or replacement of the differential assembly.

(1) - For components not requiring removal of the assembly, refer to the component listing in this document.

MANUAL TRANSMISSION/TRANSAXLE ASSEMBLIES

MANUAL TRANSMISSION/TRANSAXLE ASSEMBLY INSPECTION

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service. (1)	A	Require repair or replacement of the manual transmission/transaxle assembly.

(1) - For components not requiring removal of the assembly,

refer to the component listing in this document.

TRANSFER CASE ASSEMBLIES

TRANSFER CASE ASSEMBLY INSPECTION

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service. (1)	A	Require repair or replacement of the transfer case differential assembly.

(1) - For components not requiring removal of the assembly, refer to the component listing in this document.

DRIVE TRAIN/COMPONENTS

The conditions listed for the components included in this section assume that the problem has been isolated to the specific component through proper testing.

ACTUATORS (ELECTRICAL)

ACTUATOR (ELECTRICAL) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	1	(1) Suggest repair or

			replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	1	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

ACTUATORS (VACUUM)

ACTUATOR (VACUUM) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted, affecting performance	A	(1) Require repair or replacement.
Connector melted, not affecting performance	2	(1) Suggest repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Leaking (vacuum)	A	Require repair or replacement.
Linkage bent, affecting performance	A	Require repair or replacement of linkage.
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage.
Linkage binding, affecting performance	A	Require repair or replacement of linkage.
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage broken	A	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage.

Linkage missing	C	....	Require replacement.
Linkage noisy	2	..	Suggest repair or replacement.
Missing	C	....	Require replacement.
Noisy	2	..	Suggest repair or replacement.
Out of adjustment	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

AXLES

AXLE INSPECTION

Condition	Code		Procedure
Bent	A	....	Require replacement.
Broken	A	....	Require replacement.
End play exceeds specifications	B	..	Require repair or replacement.
Flange bent	A	....	Require replacement.
Flange threads stripped	A	..	Require repair or replacement.
Twisted	A	....	Require replacement.
Worn, affecting performance	A	....	Require replacement.

BEARINGS AND RACES

NOTE: When replacing or repacking bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

BEARING AND RACE INSPECTION

Condition	Code		Procedure
Bearing end-play exceeds specifications	B	..	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require replacement of bearing assembly.
Bearing rollers, balls or races are worn, pitted, or			

feel rough when rotated as an assembly	B	Require replacement of bearing assembly.

BELL CRANKS

BELL CRANK INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require repair or replacement.
Broken	A	Require repair or replacement.
Cracked	A	Require repair or replacement.
Missing	C	Require replacement.
Worn, affecting performance	A	Require repair or replacement.

BELL HOUSINGS

See HOUSINGS (BELL, CASE, TAIL (EXTENSION) AND AUXILIARY).

BUSHINGS (EXTERNAL)

BUSHING (EXTERNAL) INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace bushing.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace bushing.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace bushing.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace bushing.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace bushing.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace bushing.

Condition	Code	Procedure
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace bushing.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace bushing.
Binding	A	Require repair or replacement.
Contaminated	1	Suggest replacement.
Deteriorated, affecting performance	A	Require repair or replacement.
Distorted, affecting performance	A	Require repair or replacement.
Missing	A	Require replacement.
Noisy	2	(1) Further inspection required.
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement.
Seized	A	Require replacement.
Shifted (out of position)	B	Require repair or replacement.
Split	A	Require replacement.
Surface cracking (weather-checked)	..	No service suggested or required.
Worn, affecting performance	A	Require repair or replacement.
Worn close to the end of its useful life	1	Suggest replacement.

(1) - If noise isolated to bushing, suggest repair or replacement.

CAUTION: Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.

CABLES (SPEEDOMETER)

CABLE (SPEEDOMETER) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require repair or replacement.
Binding	A	Require repair or replacement.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance	..	No service suggested or

			required.
Bracket broken, affecting performance	A	.....	Require replacement.
Bracket broken, not affecting performance	..	.....	No service suggested or required.
Bracket corroded, affecting performance	A	..	Require repair or replacement.
Bracket corroded, not affecting performance	2	..	Suggest repair or replacement.
Bracket cracked, affecting performance	A	..	Require repair or replacement.
Bracket cracked, not affecting performance	1	..	Suggest repair or replacement.
Bracket loose, affecting performance	A	..	Require repair or replacement.
Bracket loose, not affecting performance	1	..	Suggest repair or replacement.
Bracket missing	C	.....	Require replacement.
Broken	A	.....	Require replacement.
Cracked	A	..	Require repair or replacement.
Disconnected	A	..	Require repair or replacement.
Kinked	A	..	Require repair or replacement.
Melted	A	.....	(1) Require repair or replacement.
Missing	C	.....	Require replacement.
Noisy	2	..	Suggest repair or replacement.
Routed incorrectly	2	.....	Suggest repair.
Seized	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

CABLES (TV, DETENT AND SHIFT)

CABLE (TV, DETENT AND SHIFT) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Bent	A	..	Require repair or replacement.
Binding	A	..	Require repair or replacement.
Bracket bent, affecting performance	A	..	Require repair or replacement.
Bracket bent, not affecting performance	..	.....	No service suggested or required.
Bracket broken, affecting performance	A	.....	Require replacement.
Bracket broken, not affecting performance	..	.....	No service suggested or required.
Bracket corroded, affecting performance	A	..	Require repair or replacement.

Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require repair or replacement.
Disconnected	A	Require repair or replacement.
Frayed	A	Require replacement.
Kinked	A	Require repair or replacement.
Melted	A	(1) Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	(2) Require repair or replacement.
Routed incorrectly	2	Suggest repair.
Seized	A	Require repair or replacement.
Self-adjuster inoperative	A	Require repair or replacement of self-adjuster.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Cable replacement is required if it cannot be adjusted within specifications.

CARRIER BEARINGS

See INTERMEDIATE SHAFT SUPPORT BEARINGS.

CLUTCH CABLES AND CABLE HOUSINGS

CLUTCH CABLE AND CABLE HOUSING INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Cable bent	A	Require replacement.
Cable binding	A	Require repair or replacement.
Cable mounting loose	B	Require repair or replacement.
Cable out of adjustment	B	Require repair or replacement.
Frayed	B	Require replacement.
Housing heat-damaged	1	Suggest replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require replacement.

CLUTCH DISCS (MANUAL TRANSMISSION)

CLUTCH DISC (MANUAL TRANSMISSION) INSPECTION

Condition	Code	Procedure
Backing plate cracked	A	Require replacement.
Broken	A	Require replacement.
Contaminated with oil	A	Require replacement.
Damper cushion broken	A	Require replacement.
Damper cushion collapsed	A	Require replacement.
Damper spring collapsed	A	Require replacement.
Damper spring missing	C	(1) Require replacement.
Friction material cracked through	B	Require replacement.
Friction material flaking or chunking	B	Require replacement.
Friction material surface cracking	B	No service suggested or required.
Grooved	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required.
Ridged	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required.
Splines worn, affecting performance	A	Require replacement.
Warped	A	Require replacement.
Wear exceeds specifications (where applicable)	B	Require replacement.
Worn close to the end of its useful life	1	Suggest replacement.
Worn, affecting performance	A	Require replacement.

(1) - Not all clutch discs have springs in all spring chambers on the disc.

CLUTCH FORKS

CLUTCH FORK INSPECTION

Condition	Code	Procedure
Bent	B	Require replacement.
Broken	A	Require repair or replacement.
Cracked	B	Require repair or replacement.
Worn close to the end of its useful life	1	Suggest replacement.
Worn, affecting performance	A	Require replacement.

CLUTCH LINKAGES (MECHANICAL)

See LINKAGES (EXTERNAL).

CLUTCH MASTER CYLINDERS

CLUTCH MASTER CYLINDER INSPECTION

Condition	Code	Procedure
Cover gasket distorted	A	Require replacement of cover gasket.
Cover gasket gummy	A	Require replacement of cover gasket.
Cylinder leaking fluid from rear of bore	A	Require repair or replacement.
Cylinder leaking fluid internally	A	Require replacement.
Dust boot missing	C	Require replacement of dust boot.
Dust boot punctured	A	Require replacement of dust boot.
Dust boot torn	A	Require replacement of dust boot.
Fluid level incorrect	B	Require fluid level adjustment.
Housing damaged, affecting performance	A	Require repair or replacement.
Master cylinder has residue in reservoir (make parallel w/brakes when they are done)	2	(1) Further inspection required.
Threads damaged	A	Require repair replacement
Threads stripped (threads missing)	A	Require replacement.

(1) - DO NOT replace master cylinder unless it exhibits conditions listed for replacement. You may suggest fluid change according to OEM service intervals.

CLUTCH PEDALS

CLUTCH PEDAL INSPECTION

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement.
Broken	A	Require repair or replacement.
Pedal pad missing	C	Require replacement of pedal pad.
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings.

CLUTCH PIVOTS

CLUTCH PIVOT INSPECTION

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require repair or replacement.
Cracked	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn close to the end of its useful life	1	Suggest replacement.
Worn, affecting performance	A	Require replacement.

CLUTCH PRESSURE PLATES

See PRESSURE PLATES.

CLUTCH RELEASE BEARINGS

CLUTCH RELEASE BEARING INSPECTION

Condition	Code	Procedure
Collar broken	A	Require replacement.
Cracked	A	Require replacement.
Rough when rotated as an assembly	B	Require replacement.
Seized	A	Require replacement.
Wear exceeds specifications	B	Require replacement.
Worn close to the end of its useful life	1	Suggest replacement.
Worn, affecting performance	A	Require replacement.

CLUTCH SLAVE CYLINDERS (CONCENTRIC)

CLUTCH SLAVE CYLINDER (CONCENTRIC) INSPECTION

Condition	Code	Procedure
Bearing rough when rotated as an assembly	B	Require replacement.
Bearing seized	A	Require replacement.
Bleeder pipe leaks	A	Require repair or replacement.
Carrier assembly worn, affecting performance	A	Require replacement.
Collar broken	A	Require replacement.
Cracked	A	Require replacement.
Housing leaks	A	Require replacement.
Inoperative	A	Require replacement.
Release binding	A	Require replacement.
Spring broken	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require replacement.

CLUTCH SLAVE CYLINDERS (CONVENTIONAL OR EXTERNAL)

CLUTCH SLAVE CYLINDER (CONVENTIONAL OR EXTERNAL) INSPECTION

Condition	Code	Procedure
Binding	A	Require repair or replacement.
Bleeder port damaged (not repairable)	A	(1) Require replacement.
Bleeder port damaged (repairable)	A	(1) Require repair.
Bleeder screw broken off in slave cylinder	A	(1) Require replacement.
Bleeder screw seized	A	(2) Require replacement.
Bore corroded (pitted)	B	Require replacement.
Bore grooved	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Only required if the hydraulic system must be opened.
(2) - Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing it has been made.

COMPANION FLANGES

See YOKES AND SLIP YOKES.

CONNECTORS

See WIRING HARNESSES AND CONNECTORS.

COOLER BYPASS VALVES

COOLER BYPASS VALVE INSPECTION

Condition	Code	Procedure
Inoperative	A	Require replacement.
Installed incorrectly	A	Require repair.
Leaking	A	Require repair or replacement.
Restricted	A	Require repair or replacement.

COOLER LINES

COOLER LINE INSPECTION

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement.
Abrasion damage, not affecting structural integrity		No service suggested or required.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Clamp corroded, not reusable	1	Suggest replacement.
Connected incorrectly	A	Require repair.
Corroded, affecting structural integrity	A	Require replacement.
Corroded, not affecting structural integrity	..	No service suggested or required.
Cracked	A	Require repair or replacement.
Fitting type incorrect (such as compression fitting)	B	Require replacement.
Flange leaking	A	Require repair or replacement.
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Melted	1	Suggest repair or replacement.
Missing	C	Require replacement.
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement.
Protective sleeves damaged	2	Suggest replacement of sleeves.
Protective sleeves missing	C	Require replacement of sleeves.
Restricted, affecting performance	A	Require repair or replacement.
Routed incorrectly	2	Require repair.
Swollen	1	Suggest replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Type incorrect	1	Suggest repair or replacement.

COOLERS

See TRANSMISSION COOLERS.

CV JOINTS

CV JOINT INSPECTION

Condition	Code	Procedure
Bearing, bushing or seal surface worn, affecting performance	A	Require repair or replacement.
Boot clamp broken	A	Require repair or replacement of clamp.
Boot clamp loose	A	Require repair or replacement of clamp.
Boot clamp missing	C	Require repair or replacement of clamp.
Boot leaking	A	Require replacement of CV boot.
Boot surface cracked,		

not leaking	2	. Suggest replacement of CV boot.
Cage broken	A	... Require repair or replacement of CV joint.
Housing damaged to the extent that it no longer performs its intended function	A	..... (1) Require repair or replacement of CV joint.
Housing worn to the extent that it no longer performs its intended function ..	A	..... (1) Require repair or replacement of CV joint.
Holes elongated	A	..... Require replacement.
Internal parts binding ..	A	.. Require repair or replacement.
Internal parts worn	A	.. Require repair or replacement.
Lubricant missing	C	... Require cleaning, inspection, and repacking of CV joint.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

(1) - Housing assembly may appear blue in color from normal manufacturing process of heat-treating the housing.

DIP STICK TUBES

DIP STICK TUBE INSPECTION

Condition	Code	Procedure
Broken	A	.. Require repair or replacement.
Checkball missing	C	.. Suggest repair or replacement.
Cracked	A	.. Require repair or replacement.
Hold down bracket broken	A	.. Require repair or replacement.
Hold down bracket missing	C	..... Require replacement.
Leaking	A	.. Require repair or replacement.
Missing	C	..... Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

DIP STICKS (FLUID LEVEL INDICATORS)

DIP STICK (FLUID LEVEL INDICATOR) INSPECTION

Condition	Code	Procedure
Application incorrect ...	B	..... Require replacement.
Broken	A	..... Require replacement.
Compressed	A	.. Require repair or replacement.
Missing	C	..... Require replacement.
Modified	A	..... Require replacement.
Stretched	A	.. Require repair or replacement.

DOWEL PINS, GUIDES AND PILOT HOLES

DOWEL PIN, GUIDE AND PILOT HOLE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement.
Cracked	A	Require repair or replacement.
Distorted	A	Require repair or replacement.
Missing	C	Require replacement.
Positioned incorrectly	B	Require repair or replacement.
Stepped	A	Require repair or replacement.
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement.

DRIVE SHAFT FLANGES

See COMPANION FLANGES.

DRIVE SHAFTS AND HALF SHAFTS

DRIVE SHAFT AND HALF SHAFT INSPECTION

Condition	Code	Procedure
Balance weight missing	C	Require repair or replacement.
Bearing cap bore distorted	A	Require repair or replacement.
Bent	A	Require replacement.
Bolt holes elongated	A	Require repair or replacement.
Bushing or seal surface worn, affecting performance	A	Require repair or replacement.
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug.
Out of balance	A	Require repair or replacement.
Retainer strap bent	A	Require replacement of retainer strap.
Slip yoke broken	A	Require replacement.
Splines worn, affecting performance	A	Require replacement.
Splines worn close to the end of their useful life	1	Suggest replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
U-bolt damaged, affecting performance	A	Require replacement of U-bolts.
Yoke damaged, affecting performance	A	Require repair or replacement.

DUST BOOTS

NOTE: Does not include CV boots.

DUST BOOT INSPECTION

Condition	Code	Procedure
Cracked, not leaking	1	Suggest replacement.
Missing	C	Require replacement.
Leaking	A	Require repair or replacement.

Torn	A	Require replacement.

ENGINE MOUNTS

See MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION).

EXCITER RINGS

See TOOTHED RINGS (TONE WHEELS).

FILLER TUBES

See DIP STICK TUBES.

FILTERS AND SCREENS

FILTER AND SCREEN INSPECTION

Condition	Code	Procedure
At service interval	3	Suggest replacement.
Bent	A ..	Require repair or replacement.
Exceeding service interval	3	Suggest replacement.
Missing	C	Require replacement.
Near service interval ...	3	Suggest replacement.
Restricted	A	(1) Require repair or replacement.
Torn	A	Require replacement.
Worn, affecting performance (metal or nylon screen type)	A ..	Require repair or replacement.

(1) - Further inspection may be required to determine the source of restriction or contamination.

FLANGES

See COMPANION FLANGES.

FLEX PLATES

FLEX PLATE INSPECTION

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement.
Bent, not affecting performance	.. ..	No service suggested or required.
Bolt or stud holes elongated	B	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require replacement.
Ring gear worn close to the end of its useful life	1	Suggest replacement.
Ring gear worn to the extent that it no longer		

performs its intended function	A	Require replacement.
Weights missing	A	Require replacement.

FLUID LEVEL INDICATORS

See DIP STICKS (FLUID LEVEL INDICATORS).

FLUIDS AND LUBRICANTS

FLUID AND LUBRICANT INSPECTION

Condition	Code	Procedure
Application incorrect	B	(1) Require replacement.
At service interval	3	Suggest replacement.
Beyond service interval	3	Suggest replacement.
Burned	..	(2) Further inspection required.
Contaminated, for example, fluid other than hydraulic fluid present	A or B	(3)(4) Require service.
Exceeding service interval	3	Suggest replacement.
Hydraulic fluid incorrect	B	(5) Require service.
Level incorrect	B	Require correction of fluid level.
Near service interval	3	Suggest replacement.
Rubber master cylinder cover gasket distorted and gummy	A	(3) Require service.
Varnished	..	(6) Further inspection required.

(1) - Determine and correct cause.
(2) - Fluid that is burned indicates a serious problem. Determine and correct the cause.
(3) - If a fluid other than hydraulic fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines with denatured alcohol or hydraulic cleaner, 3) repair or replace all components having rubber parts, and 4) bleed and flush with correct hydraulic fluid. (Code A)
(4) - If a fluid other than hydraulic fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct hydraulic fluid. (Code B)
(5) - If a fluid other than specification hydraulic fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.
(6) - Fluid that is varnished may indicate a serious problem. Determine and correct the cause.

FLYWHEELS

NOTE: Clutch disc replacement does not necessitate flywheel reconditioning, unless other conditions justify the reason to do so.

FLYWHEEL INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Cracked (other than mounting area)	A	(1) Require resurfacing or replacement.
Cracks in mounting area	B	Require replacement.
Hard spots	B	Require repair or replacement.
Ring gear broken	A	Require replacement of ring gear.
Ring gear teeth worn, affecting performance	A	Require replacement of ring gear.
Runout exceeds specifications	B	Require repair or replacement.
Scored	B	Require repair or replacement.
Surface cracks after resurfacing to manufacturer's minimum specifications	B	Require replacement.
Wear exceeds specifications	B	Require replacement.
Worn close to the end of its useful life	1	Suggest replacement.
Worn, affecting performance	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Some manufacturers allow slight surface cracking in the friction surface.

FORCE MOTORS

See ACTUATORS (ELECTRICAL).

GUIDES

See DOWEL PINS, GUIDES AND PILOT HOLES.

HALF SHAFTS

See DRIVE SHAFTS AND HALF SHAFTS.

HOSES, LINES AND TUBES

HOSE, LINE AND TUBE INSPECTION

Condition	Code	Procedure

Application incorrect	B	Require replacement.
Connected incorrectly	A	Require repair.
Corroded, not reusable	1	Suggest replacement.
Cracked	A	Require replacement.
Dry-rotted	1	Suggest repair or replacement.
Hard	1	Suggest repair or replacement.
Inner fabric (webbing) damaged	A	Require replacement.
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Maintenance intervals	3	Suggest replacement.
Melted	1	Suggest repair or replacement.
Missing	C	Require replacement.
Outer covering damaged	1	Suggest replacement.
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement.
Protective sleeves damaged	2	Suggest replacement of sleeves.
Protective sleeves missing	2	Suggest replacement of sleeves.
Restricted, affecting performance	A	Require repair or replacement.
Restricted, not affecting performance	2	Suggest repair or replacement.
Routed incorrectly	2	Suggest replacement.
Safety clip missing	C	Require replacement.
Spongy	1	Suggest repair or replacement.
Stripped	A	Require replacement.
Swollen	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Type incorrect	1	Suggest repair or replacement.

HOUSINGS (BELL, CASE, TAIL (EXTENSION) AND AUXILIARY)

HOUSING (BELL, CASE, TAIL (EXTENSION) AND AUXILIARY) INSPECTION

Condition	Code	Procedure
Bearing race loose in bore	A	Require repair or replacement.
Broken, affecting performance	A	Require repair or replacement.
Cracked	A	Require repair or replacement.
Dowel pin holes worn, affecting performance	A	(1) Require repair or replacement.
Machined surfaces damaged, affecting performance	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require repair or replacement.

(1) - See DOWEL PINS, GUIDES AND PILOT HOLES.

INTERMEDIATE SHAFT SUPPORT BEARINGS

INTERMEDIATE SHAFT SUPPORT BEARING INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	A	Require replacement of bearing assembly.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance	..	No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance	..	No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	Require repair or replacement.
Bracket holes elongated, not affecting performances)	..	No service suggested or required.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Cracked	..	Require replacement.
Rough (brinelling, spalling)	A	Require replacement.
Rubber deteriorated, affecting performance	A	Require replacement.
Seized	A	Require replacement.

KEY INTERLOCK SYSTEMS

See SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS).

LIMITED SLIPS

See DIFFERENTIAL AND FINAL DRIVE ASSEMBLIES.

LINES

See HOSES, LINES AND TUBES.

LINKAGES (EXTERNAL)

LINKAGE (EXTERNAL) INSPECTION

Condition	Code	Procedure
Components missing	C	Require replacement of missing components.
Linkage bent, affecting performance	A	Require repair or replacement of linkage.
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage.
Linkage binding, affecting performance	A	Require repair or replacement of linkage.
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage broken	A	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage missing	C	Require replacement.
Linkage noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement.

LOCKING HUB ASSEMBLIES

LOCKING HUB ASSEMBLY INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require repair or replacement.
Loose	A	Require repair or replacement.
Seized in any position	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation.

LOCKING HUB CONTROL KNOBS

LOCKING HUB CONTROL KNOB INSPECTION

Condition	Code	Procedure

Damaged, affecting performance	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Worn, affecting performance	A	.....	Require replacement.

LUBRICANTS

See FLUIDS AND LUBRICANTS.

METAL-CLAD SEALS

See SEALS.

METALASTIC JOINTS

See RUBBER JOINTS (METALASTIC).

MODULATOR PINS

MODULATOR PIN INSPECTION

Condition	Code		Procedure
Application incorrect ...	B	.....	Require replacement.
Missing	C	.....	Require replacement.

MODULATORS

MODULATOR INSPECTION

Condition	Code		Procedure
Bent, affecting performance	A	.....	Require replacement.
Contaminated (water, fuel, etc.)	A	.....	(1) Require replacement.
Housing cracked	A	.....	Require replacement.
Inoperative	A	.....	(2) Require replacement.
Leaking fluid externally	A	..	Require repair or replacement.
Leaking fluid internally	A	.....	Require replacement.
Leaking vacuum	A	.....	Require replacement.
Nipple broken	A	.....	Require replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

(1) - Further inspection is required to determine the cause of the contamination.
(2) - Inoperative includes intermittent operation or out of OEM specification.

MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)

MOUNT (ENGINE, TRANSAXLE AND TRANSMISSION) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require replacement.
Leaking (hydraulic mount)	A	Require replacement.
Mounting hole worn, affecting performance	A	Require replacement.
Mounting hole worn, not affecting performance		No service suggested or required.
Rubber deteriorated, affecting performance	A	Require replacement.
Rubber deteriorated, not affecting performance		No service suggested or required.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

ODOMETER DRIVES (MECHANICAL)

See SPEEDOMETER/ODOMETER DRIVES (MECHANICAL).

ODOMETER HEADS (MECHANICAL)

See SPEEDOMETER/ODOMETER HEADS (MECHANICAL).

OIL PANS

See TRANSMISSION PANS.

PANS

See TRANSMISSION PANS.

PILOT HOLES

See DOWEL PINS, GUIDES AND PILOT HOLES.

PRESSURE PLATES

PRESSURE PLATE INSPECTION

Condition	Code	Procedure
Balance weight missing	C	Require replacement.
Broken	A	Require replacement.
Contact surface distorted	B	Require replacement.
Cracks	B	Require replacement.
Fingers bent	A	Require replacement.
Hard spots	B	Require replacement.

Scored	B	Require replacement.
Spring rate less than specifications	B	Require replacement.
Worn, affecting performance	A	Require replacement.
Worn beyond specifications	B	Require replacement.
Worn close to the end of its useful life	1	Suggest replacement.

PRESSURE SWITCHES

See SWITCHES.

RACES

See BEARINGS AND RACES.

RUBBER JOINTS (METALASTIC)

These joints may be found on half and/or drive shafts. They are usually found on European vehicles featuring a three-lug drive flange. They may be equipped with a centering ball or pin.

RUBBER JOINT (METALASTIC) INSPECTION

Condition	Code	Procedure
Drive flange bent	A	Require repair or replacement.
Drive flange damaged, affecting performance	A	Require replacement.
Rubber drive joint cracked	2	Suggest replacement.
Rubber drive joint damaged, affecting performance	A	Require replacement.
Rubber drive joint split between mounting holes	A	Require replacement.
Rubber drive joint torn at mounting holes	A	Require replacement.
Rubber drive joint weather-cracked	..	No service suggested or required.

SCREENS

See FILTERS AND SCREENS.

SEALS

SEAL INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged

vent may force fluid past the seal.

SEALS (METAL-CLAD)

See SEALS.

SELECTOR INTERLOCK SYSTEMS

See SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS).

SERVOS

See ACTUATORS (VACUUM).

SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS)

See:
ACTUATORS (ELECTRICAL)
CABLES
LINKAGES (EXTERNAL)
SWITCHES

SENSORS

SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require repair or replacement.
Leaking (vacuum/fluid/air)	A	Require replacement.
Out of adjustment	B	(3) Further inspection required.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting		

performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of specification.
(3) - Follow OEM recommended adjustment procedures. Repair or replace if out of specification.

SIDE COVERS

See TRANSMISSION PANS.

SLIP YOKES

See YOKES AND SLIP YOKES.

SOLENOIDS

See:
ACTUATORS (ELECTRICAL)
ACTUATORS (VACUUM)

SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)

SPEED SENSOR (ELECTRONIC WHEEL AND VEHICLE) INSPECTION

Condition	Code		Procedure
Air gap incorrect	B	.....	(1) Require adjustment or replacement.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware threads damaged	A	...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(2) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Contaminated	A	.....	(3) Require repair or replacement.
Inoperative	B	.....	(4) Require repair or replacement. Further inspection required.
Leaking	A	..	Require repair or replacement.
Loose	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Resistance out of			

specification	B	Require repair or replacement.
Sensor housing cracked	2	Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - If a sensor is not adjustable, further inspection is required to identify and correct cause.
(2) - Determine cause and correct prior to repair or replacement of part.
(3) - Determine source of contamination, such as metal particles or water. Require repair or replacement.
(4) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

SPEEDOMETER-DRIVEN GEAR HOUSINGS

See SPEEDOMETER/ODOMETER DRIVES (MECHANICAL).

SPEEDOMETER/ODOMETER DRIVES (MECHANICAL)

SPEEDOMETER/ODOMETER DRIVE (MECHANICAL) INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Inoperative	A	(1) Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Teeth broken	A	Require repair or replacement.

Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Worn close to the end of its useful life	1	.....	Suggest replacement.
Worn, affecting performance	A	.....	Require replacement.

(1) - Inoperative includes intermittent operation.

SPEEDOMETER/ODOMETER HEADS (MECHANICAL)

SPEEDOMETER/ODOMETER HEAD (MECHANICAL) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Lens broken	A	.....	(1) Require repair or replacement.
Lens cloudy	2	.....	(1) Suggest repair or replacement.
Lens missing	C	.....	(1) Require repair or replacement.
Malfunctioning	A	.....	(2) Require repair or replacement.
Noisy	2	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

(1) - If lens is available as a separate part, require replacement of lens only.
(2) - Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.

SPEEDOMETERS AND ODOMETERS (ELECTRONIC)

SPEEDOMETER AND ODOMETER (ELECTRONIC) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack			

type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Leaking	A	Require replacement.
Lens broken	A	(2) Require repair or replacement.
Lens cloudy	2	(2) Suggest repair or replacement.
Lens missing	C	(2) Require repair or replacement.
Malfunctioning	A	(3) Require repair or replacement.
Mechanical head noisy	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - If lens is available as a separate part, require replacement of lens only.
(3) - Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.

SWITCHES

SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or

			replacement.
Cracked, affecting performance	A	..	Require repair or replacement.
Cracked, not affecting performance	1	..	Suggest repair or replacement.
Leaking	A	..	Require repair or replacement.
Malfunctioning	A	.....	(2) Require repair or replacement.
Melted, affecting performance	A	.....	(1) Require repair or replacement.
Melted, not affecting performance	2	.....	(1) Suggest repair or replacement.
Missing	C	.....	Require replacement.
Out of adjustment	B	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Won't return	A	..	Require repair or replacement.
Worn	1	.....	Suggest replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, or failure to perform all functions.

TONE WHEELS

See TOOTHED RINGS (TONE WHEELS).

TOOTHED RINGS (TONE WHEELS)

If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

TOOTHED RING (TONE WHEEL) INSPECTION

Condition	Code		Procedure
Alignment incorrect	B	..	Require repair or replacement.
Bent	B	.....	Require replacement.
Contaminated, affecting performance	A	....	Require repair. Identify and correct cause.
Cracked	B	.....	Require replacement.
Loose	A	.....	Require replacement of worn parts.
Missing	C	.....	Require replacement.
Number of teeth			

Condition	Code	Procedure
incorrect	B	Require replacement.
Teeth broken	A	Require replacement.
Teeth damaged, affecting performance	A	Require replacement.

TORQUE CONVERTERS

TORQUE CONVERTER INSPECTION

Condition	Code	Procedure
Converter clutch lock-up operation is faulty	A	Require replacement.
Cover shell damaged, affecting performance	A	Require replacement.
Does not meet stall speed specification	B	Require replacement.
End play exceeds specifications	B	Require replacement.
Hub broken	A	Require replacement.
Hub cracked	A	Require replacement.
Internal component failure	A	Require replacement.
Leaking	A	Require repair or replacement.
Pilot broken	A	Require replacement.
Pilot worn, affecting performance	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Weights missing	C	Require replacement.

TRANSAXLE MOUNTS

See MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION).

TRANSDUCERS (TRANSMISSION)

See SENSORS.

TRANSMISSION COOLERS

TRANSMISSION COOLER INSPECTION

Condition	Code	Procedure
Air flow obstruction	A	Require repair.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connection leaking	A	Require repair or replacement.
Contaminated	A	Require repair or replacement.
Corroded	1	Suggest repair or replacement.
Fins damaged, affecting		

performance	A	..	Require repair or replacement.
Fins damaged, not affecting performance			No service suggested or required.
Internal restrictions ...	B	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require repair or replacement.
Tubes damaged, affecting performance	A	..	Require repair or replacement.
Tubes damaged, not affecting performance			No service suggested or required.

TRANSMISSION MOUNTS

See MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION).

TRANSMISSION PANS

TRANSMISSION PAN INSPECTION

Condition	Code		Procedure
Bent, interfering with filter or other internal components	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.

TRANSMISSION RANGE INDICATORS (PRNDL)

TRANSMISSION RANGE INDICATOR (PRNDL) INSPECTION

Condition	Code		Procedure
Binding	A	..	Require repair or replacement.
Broken	A	..	Require repair or replacement.
Components missing	C	..	Require replacement of missing components.
Loose, affecting performance	A	..	Require repair or replacement.
Out of adjustment	A	.....	Require repair.
Worn, affecting performance	A	..	Require repair or replacement.

TUBES

See HOSES, LINES AND TUBES.

UNIVERSAL JOINTS (CARDON OR CROSS TYPE)

UNIVERSAL JOINT (CARDON OR CROSS TYPE) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.

Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearing cap distorted	B	Require replacement.
Binding	A	Require replacement.
Cross (trunion) worn, affecting performance	A	Require replacement.
Double cardon centering ball damaged	A	Require replacement.
Double cardon centering ball worn, affecting performance	A	Require replacement.
Double cardon centering spring broken	A	Require replacement.
Double cardon centering spring missing	C	Require replacement.
Double cardon centering spring weak	A	Require replacement.
End cap seal cracked	2	Suggest replacement.
End cap seal missing	C	Require replacement of seal.
Grease fitting broken	A	(1) Require replacement of grease fitting.
Grease fitting missing	C	(2) Require replacement of grease fitting.
Rust-colored powder around end cap seals	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require replacement.

(1) - A broken grease fitting does not require replacement of the U-Joint.
(2) - A missing grease fitting does not require replacement of the U-Joint.

VACUUM CONTROLS

See ACTUATORS (VACUUM).

VACUUM HOSES

See HOSES, LINES AND TUBES.

VACUUM MOTORS

See ACTUATORS (VACUUM).

VACUUM-OPERATED SWITCHES

See SWITCHES.

VEHICLE SPEED SENSORS

See SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE).

VENTS

VENT INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Missing	C	Require replacement.
Plugged	A	(1) Require repair or replacement.

(1) - A plugged vent may force fluid past the seal.

VIBRATION DAMPERS

VIBRATION DAMPER INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Missing	C	Require replacement.
Out of position	B	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

WHEEL ATTACHMENT HARDWARE

NOTE: For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHMENT HARDWARE INSPECTION

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	(1) Require replacement.
Loose	B	Require repair or replacement of affected component.
Lug nut installed backward	B	Require repair or replacement.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut rounded	A	(2) Require replacement of nut.
Lug nut seized	A	(2) Require replacement of nut.
Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) - Only required if removing wheel.

WHEEL SPEED SENSORS

See SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE).

WIRING HARNESSES AND CONNECTORS

WIRING HARNESS AND CONNECTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Open	A	Require repair or replacement.
Protective shield (conduit) melted	2	(1) Suggest repair or replacement.
Protective shield (conduit) missing	2	Suggest repair or replacement.
Resistance (voltage drop) out of specification	A	Require repair or replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Shorted	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Transmission connector leaking		See TRANSMISSION ASSEMBLY.
Voltage drop out of specification	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

YOKES AND SLIP YOKES

YOKE AND SLIP YOKE INSPECTION

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement.
Bent	A	Require replacement.
Bolt holes elongated	A	Require repair or replacement.
Bushing or seal surface worn, affecting performance	A	Require repair or replacement.
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug.
Retainer strap bent	A	Require replacement of retainer strap.
Slip yoke broken	A	Require replacement.
Splines worn, affecting performance	A	Require replacement.
Splines worn close to the end of their useful life	1	Suggest replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
U-bolt damaged, affecting performance	A	Require replacement of U-bolts.
Yoke damaged, affecting performance	A	Require repair or replacement.

ELECTRICAL COMPONENT LOCATOR

1999 Lexus RX 300

1999 ELECTRICAL COMPONENT LOCATION
Lexus Electrical Components

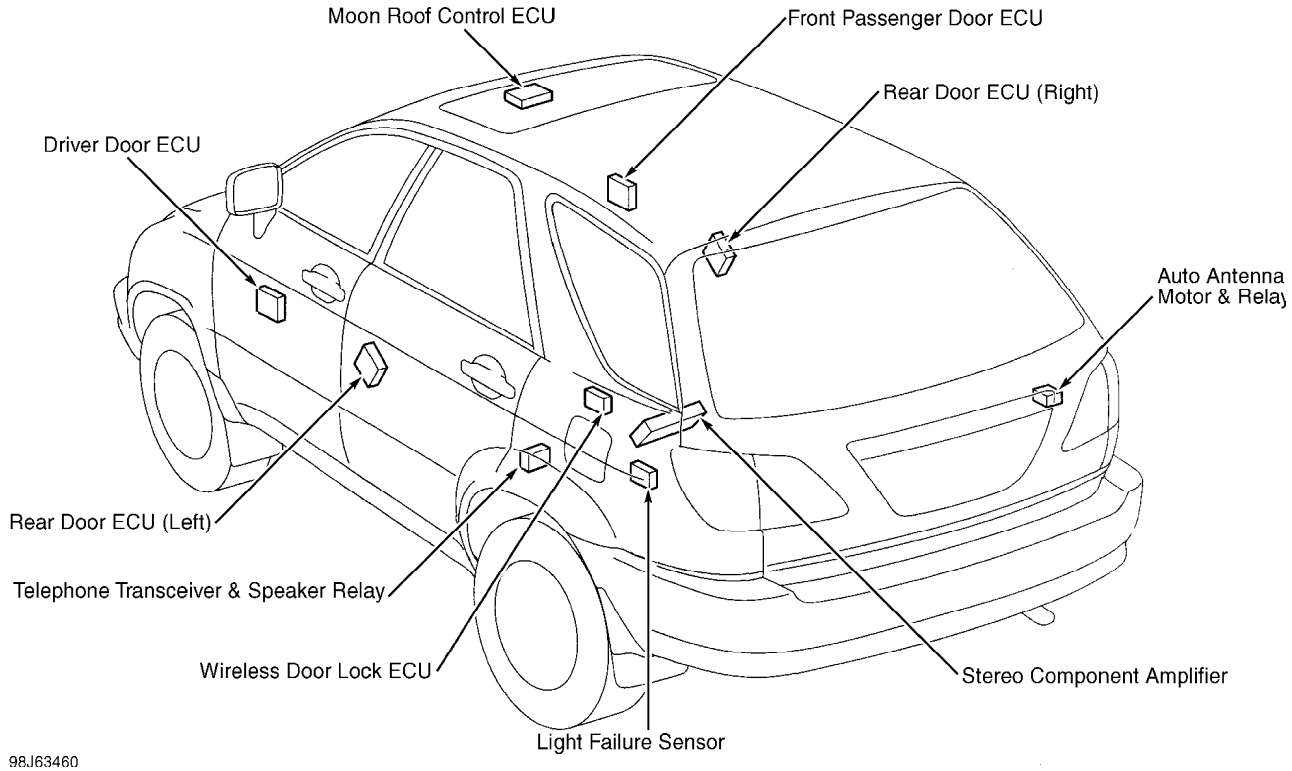
Lexus; RX300

SAFETY PRECAUTION

WARNING: When working on vehicles equipped with Supplemental Restraint System (SRS), never apply electrical voltage to the system. This could cause the SRS (air bag) to be deployed.

BUZZERS, RELAYS & TIMERS

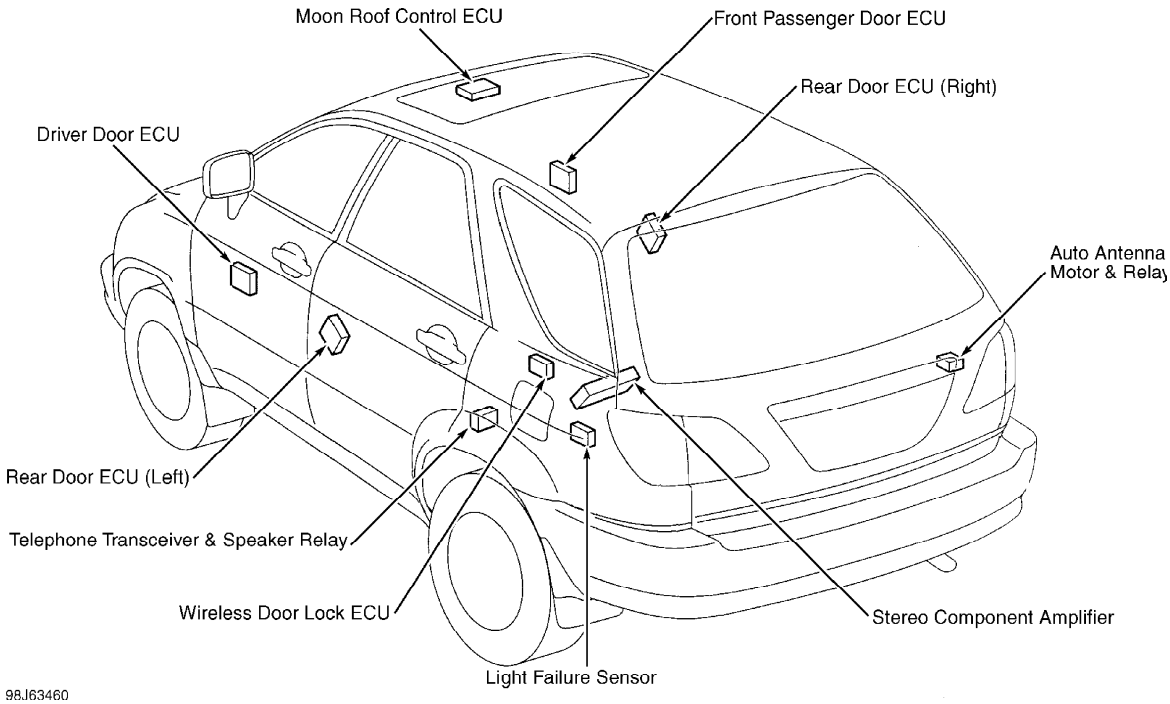
Component	Component Location
ABS MOTOR Relay	In R/B No. 2.
ABS SOL Relay	In R/B No. 2.
ACC Relay	In instrument panel J/B.
A/F HEATER Relay	In R/B No. 2.



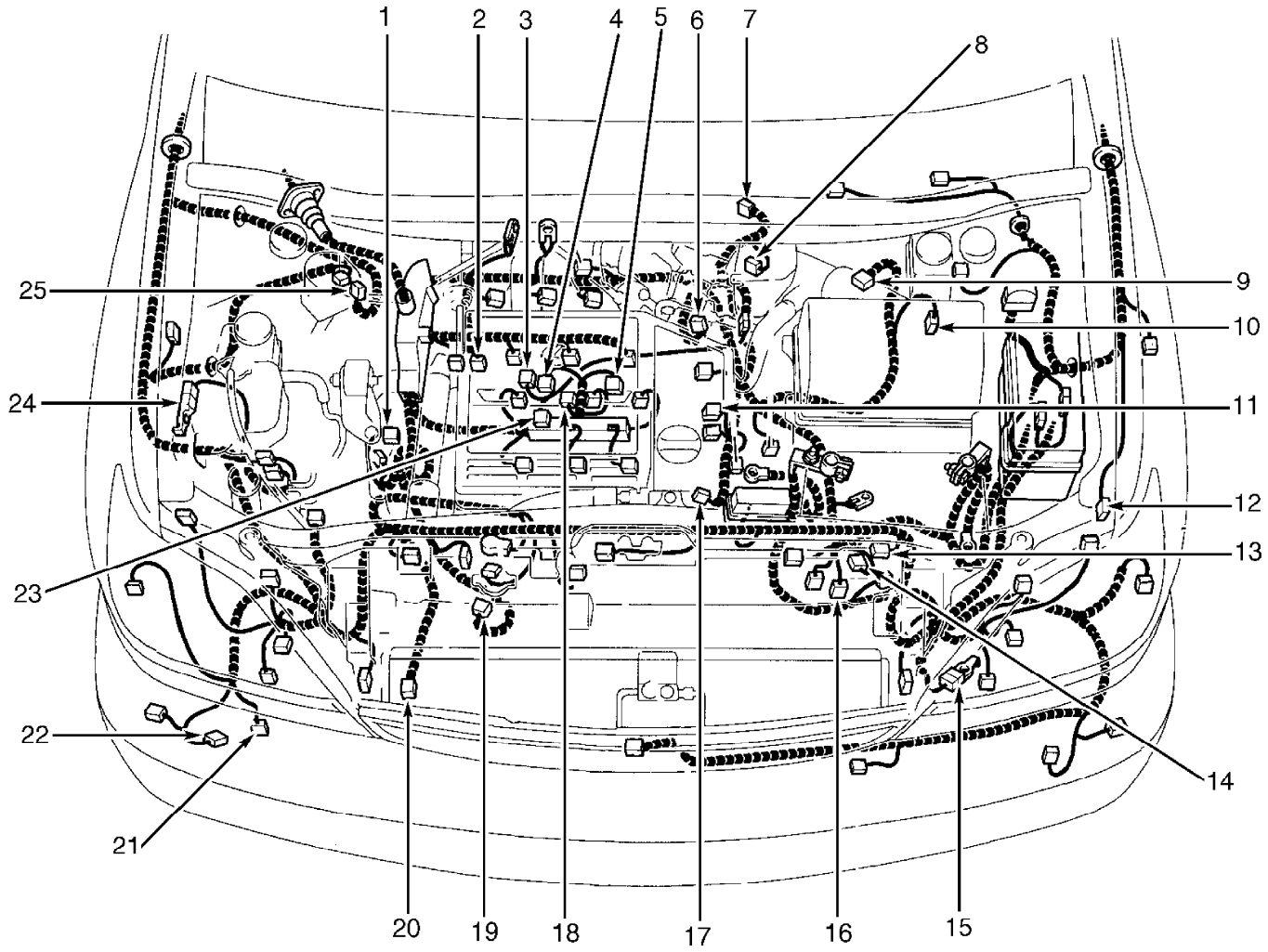
98J63460

Auto Antenna Motor & Relay	In right side of luggage compartment.
Circuit Opening Relay	In R/B No. 1.

DRL NO. 2 Relay	In R/B No. 3.
DRL NO. 3 Relay	In R/B No. 3.
DRL NO. 4 Relay	In R/B No. 3.
EFI Relay	In engine room J/B.
Engine Main Relay	In R/B No. 1.
FAN NO. 1 Relay	In R/B No. 2.
FAN NO. 2 Relay	In R/B No. 2.
FAN NO. 3 Relay	In R/B No. 2.
Foglight Relay	In instrument panel J/B.
HEADLAMP Relay	In engine room J/B.
HORN Relay	In engine room J/B.
MG CLT Relay	In engine room J/B.
Mirror Heater Relay	In R/B No. 1.
RR DEF Relay	In engine room J/B.
STARTER Relay	In engine room J/B.
Taillight Relay	In instrument panel J/B.



Telephone Transceiver & Speaker Relay	On left side of luggage compartment.



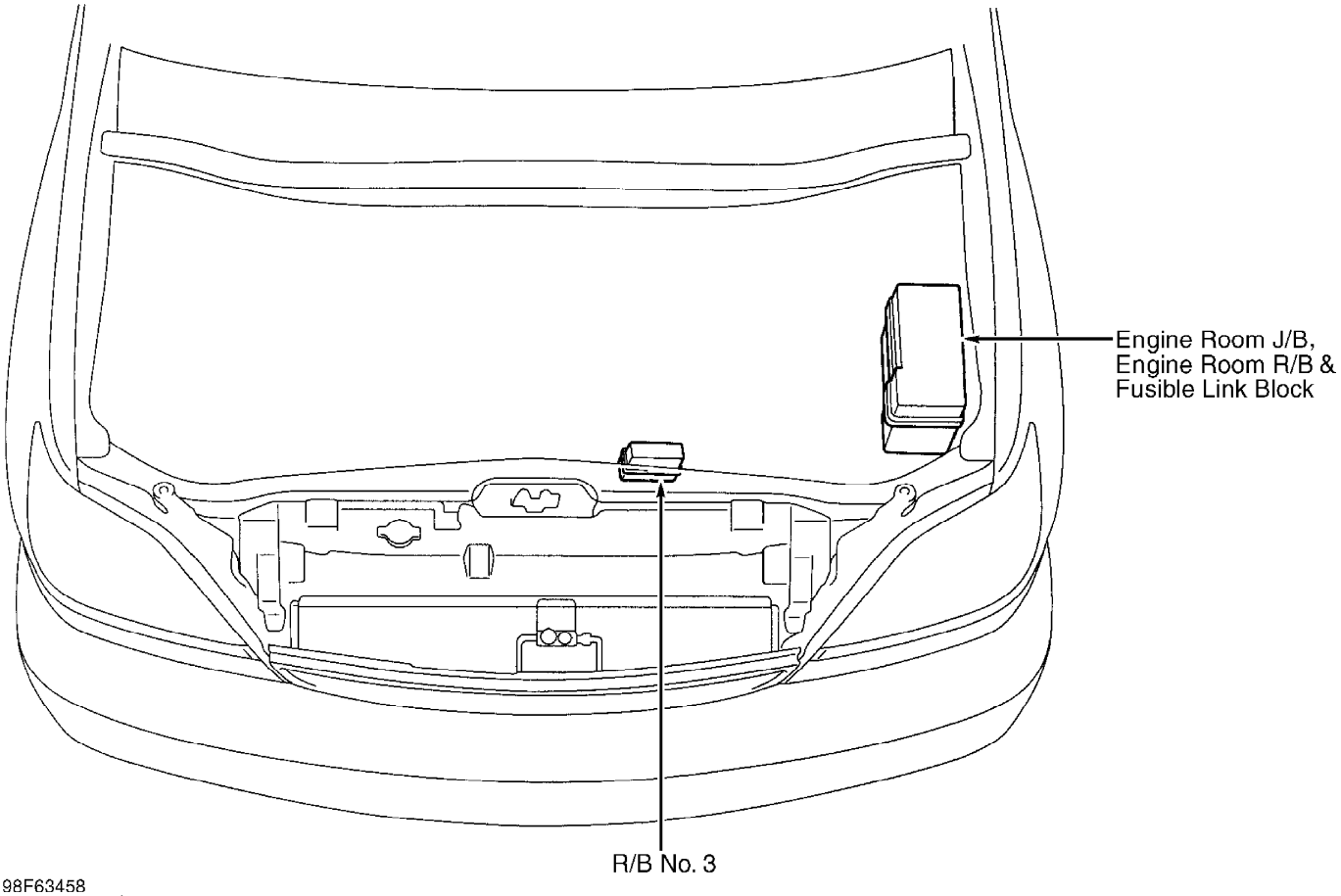
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

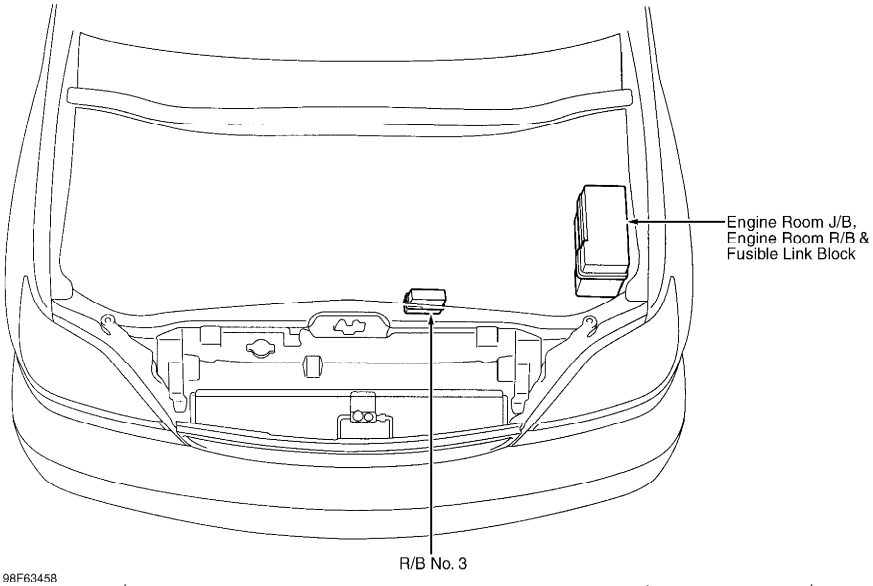
Wireless Door Lock Buzzer	In left front corner of engine compartment.

CIRCUIT PROTECTION DEVICES

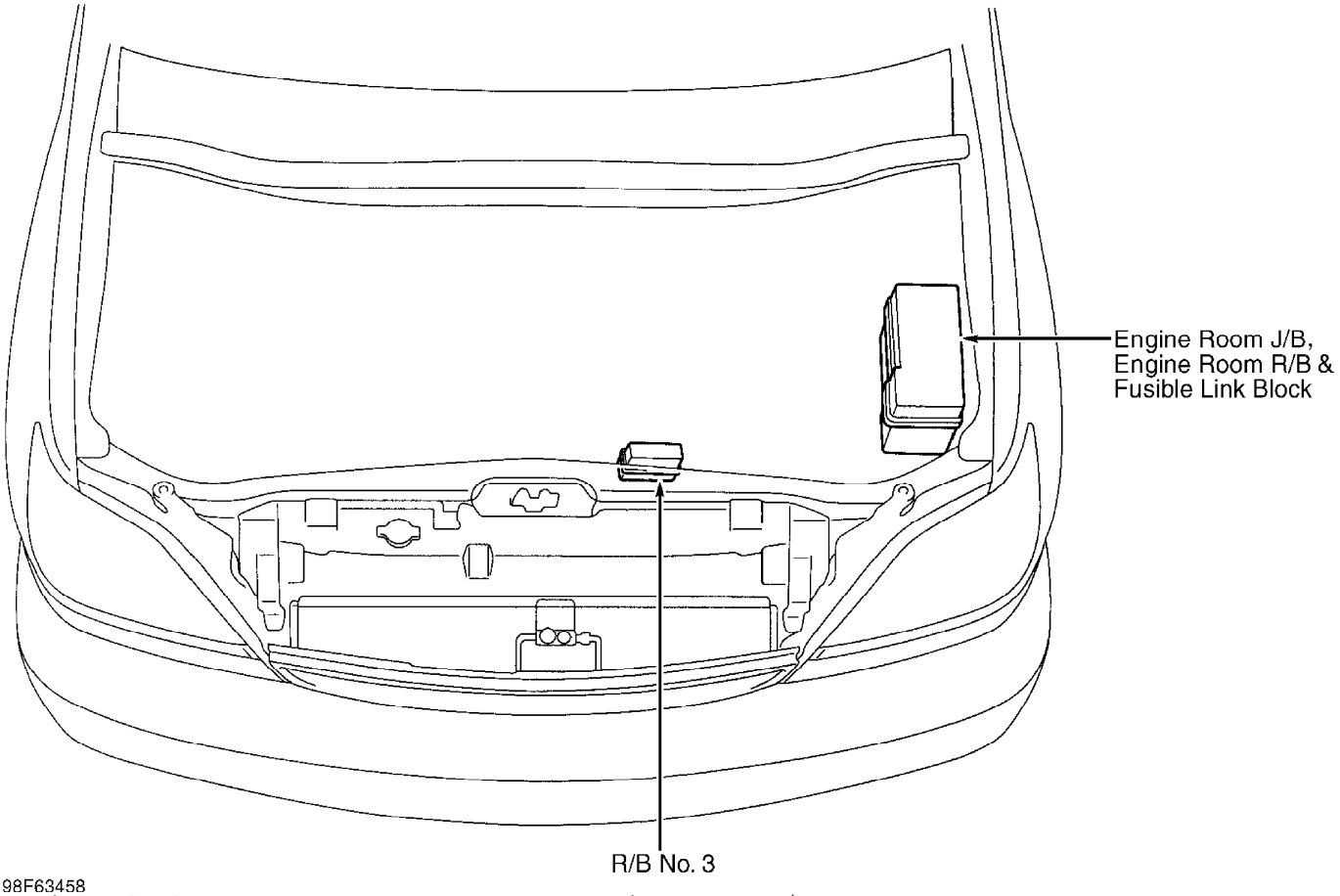
Component	Component Location



Engine Room J/B	On left side of engine compartment.

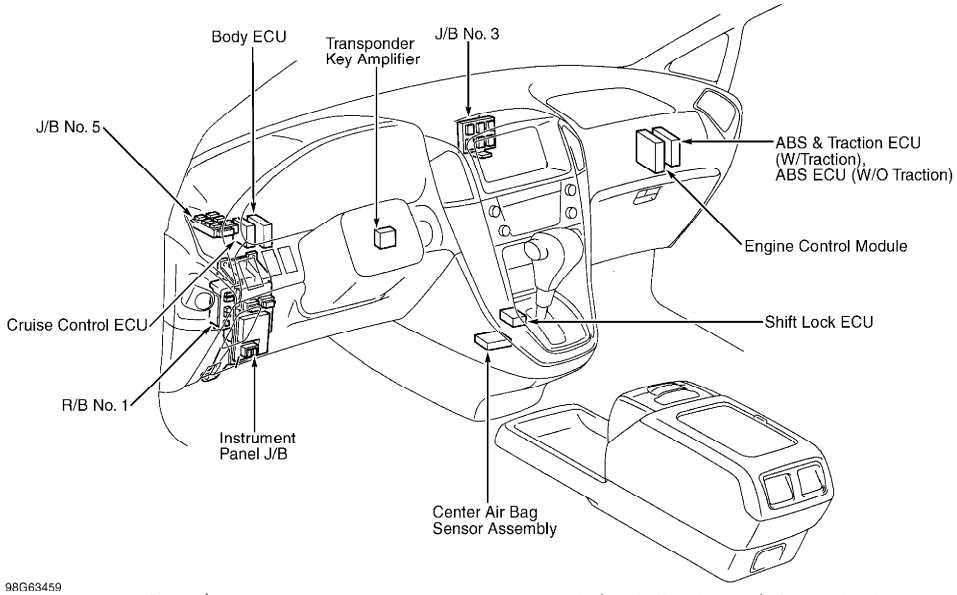


Engine Room R/B	In engine room J/B.



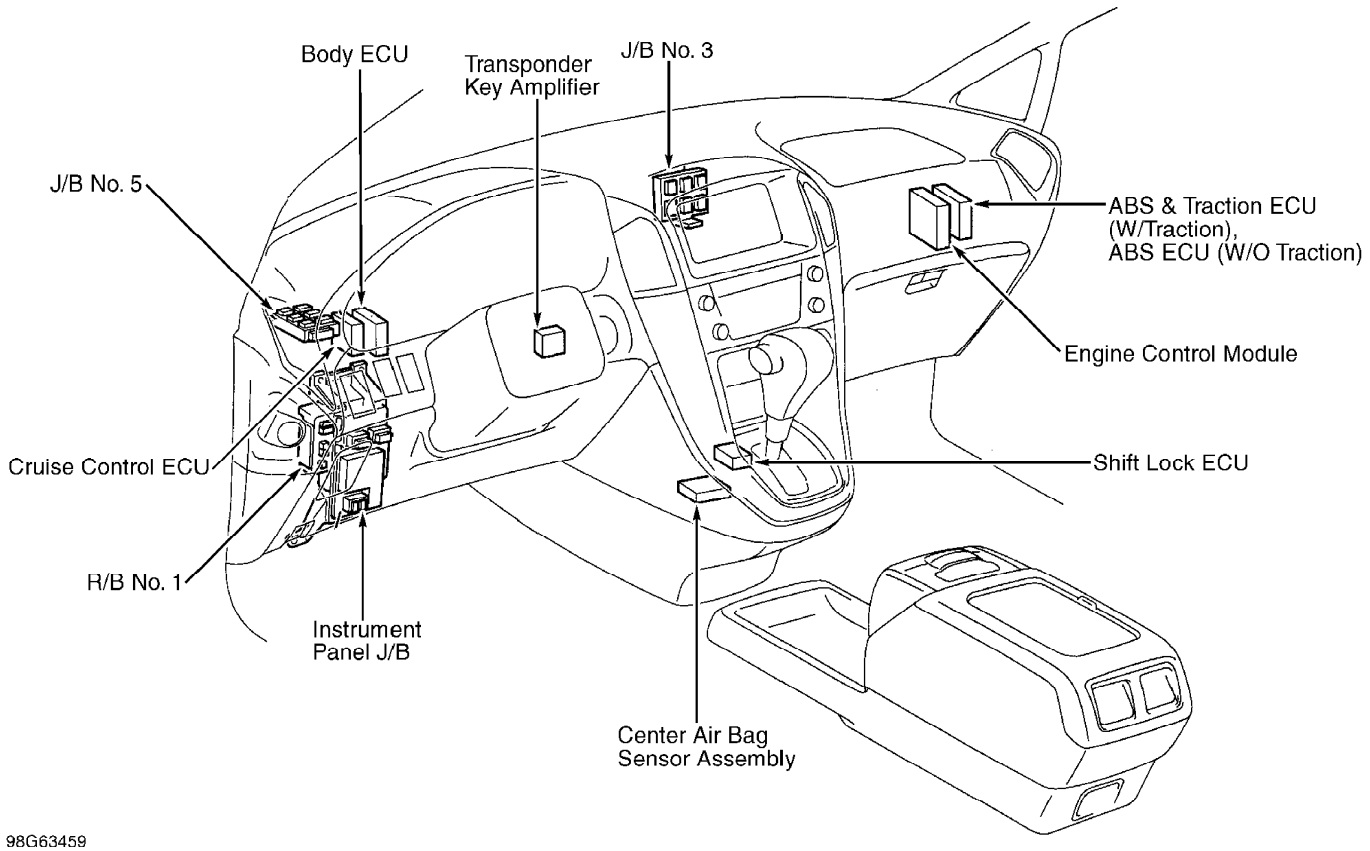
98F63458

Fusible Link Block — In engine room J/B.

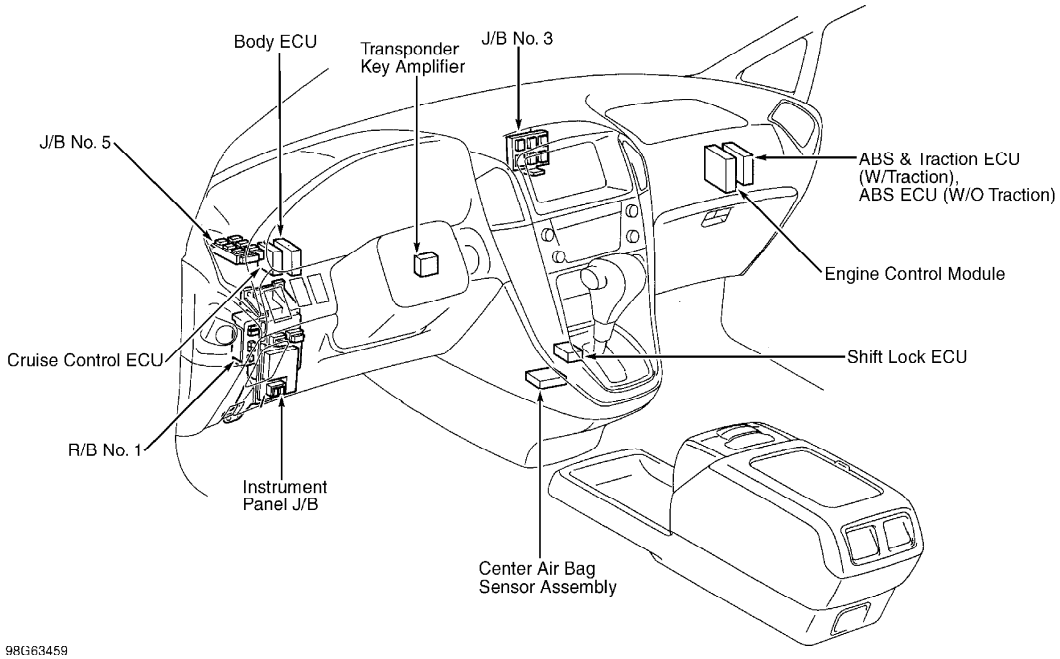


98G63459

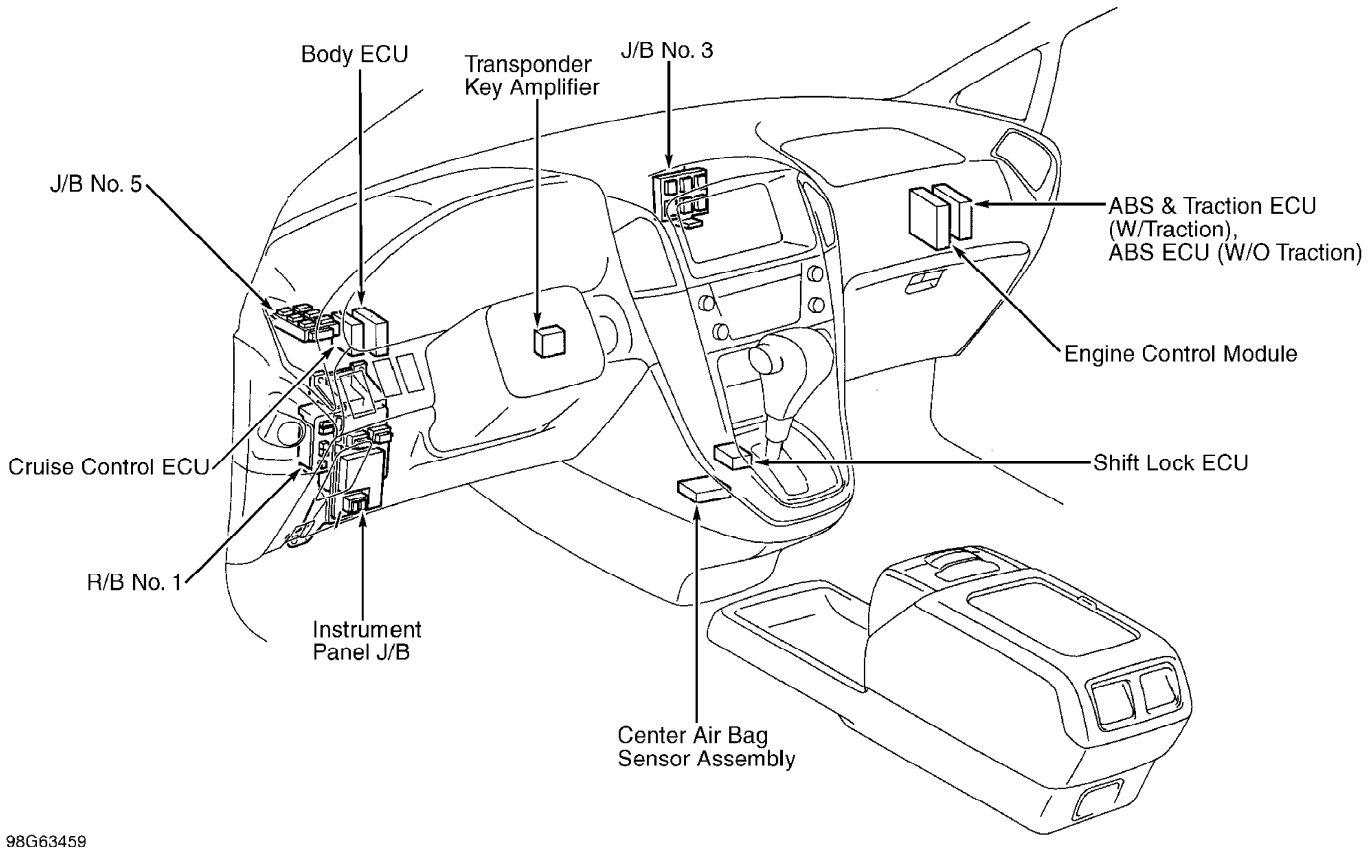
Instrument Panel J/B — Behind left side of dash.



J/B No. 3 Behind upper center of dash.

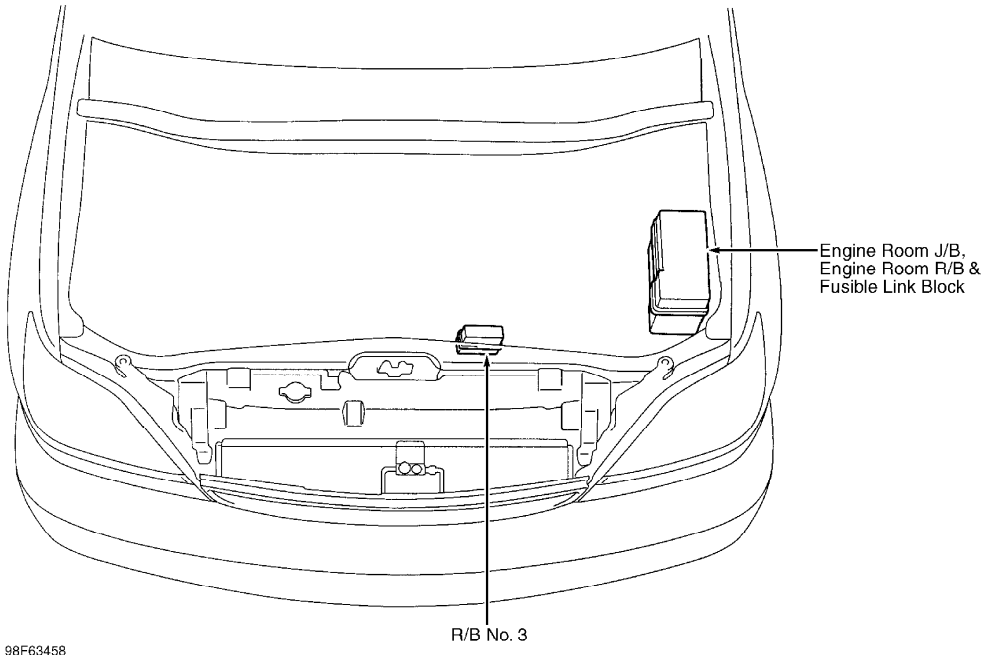


J/B No. 5 Behind upper left side of dash.



98G63459

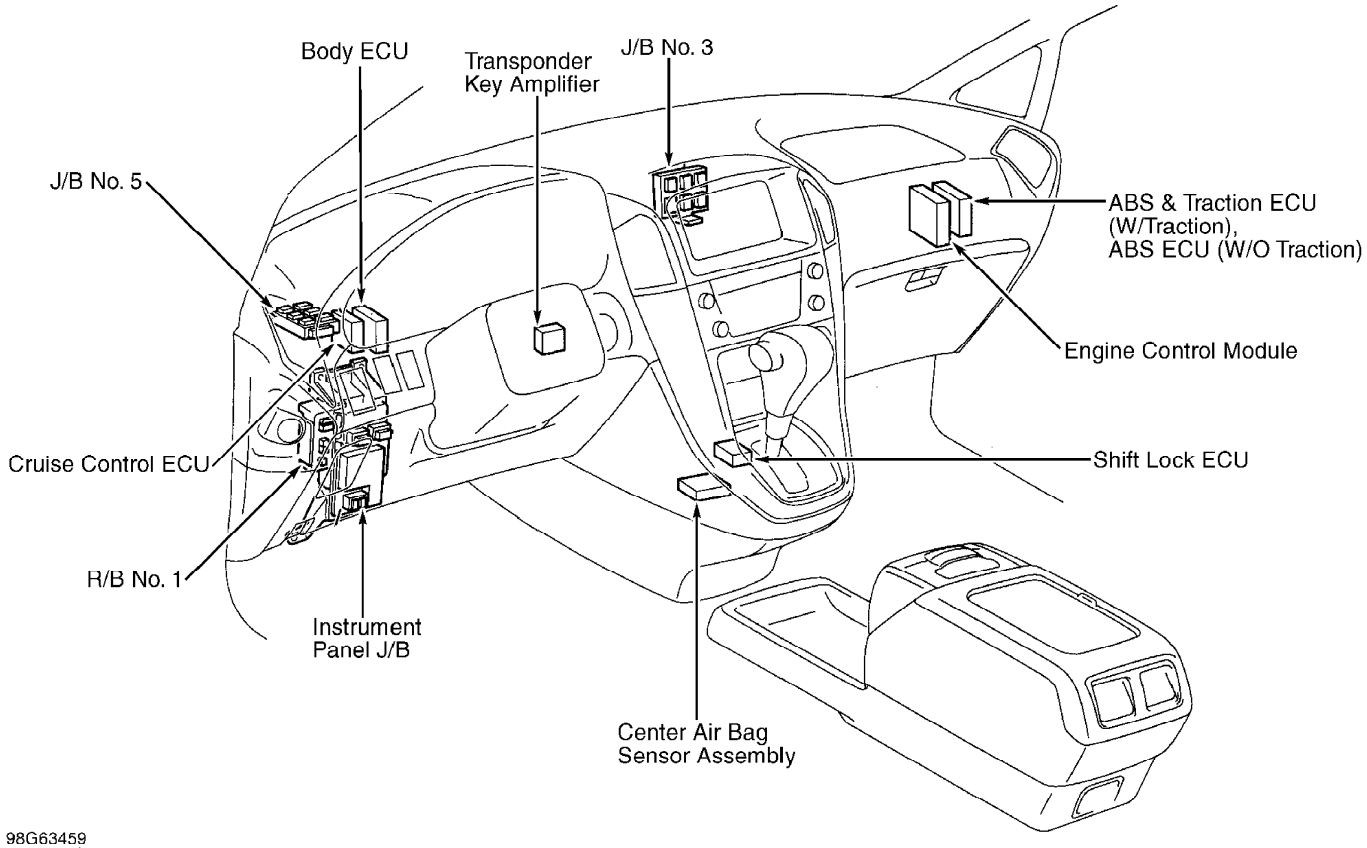
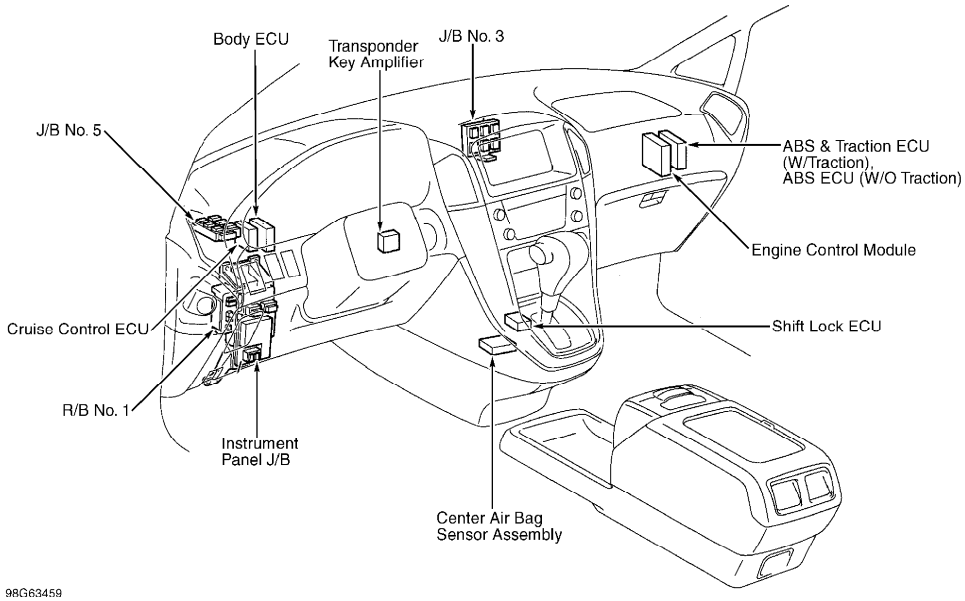
R/B No. 1	Behind left side of dash.

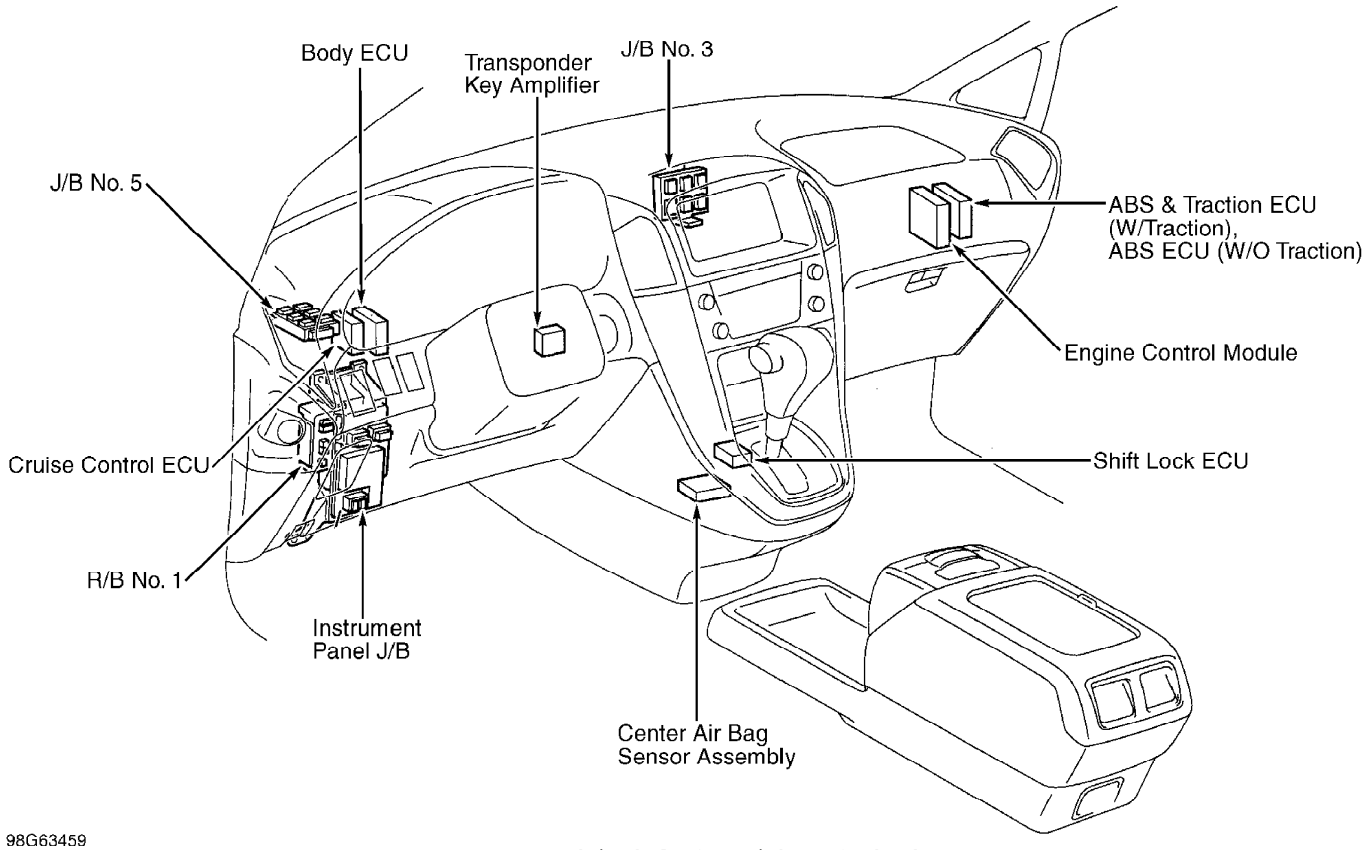


98F63458

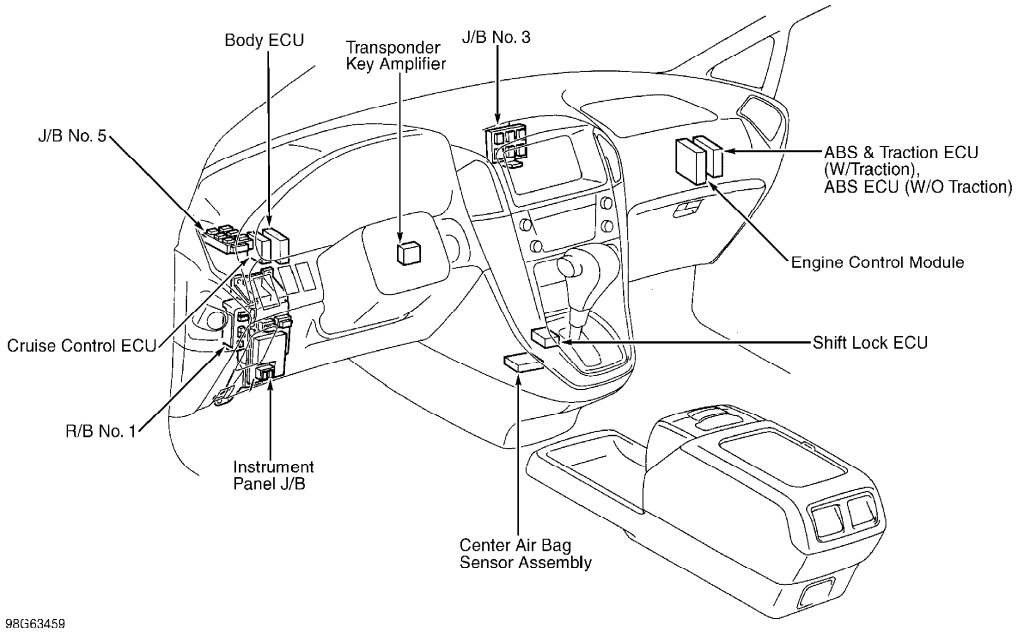
R/B No. 3	On front center of engine compartment, on radiator support.

CONTROL UNITS

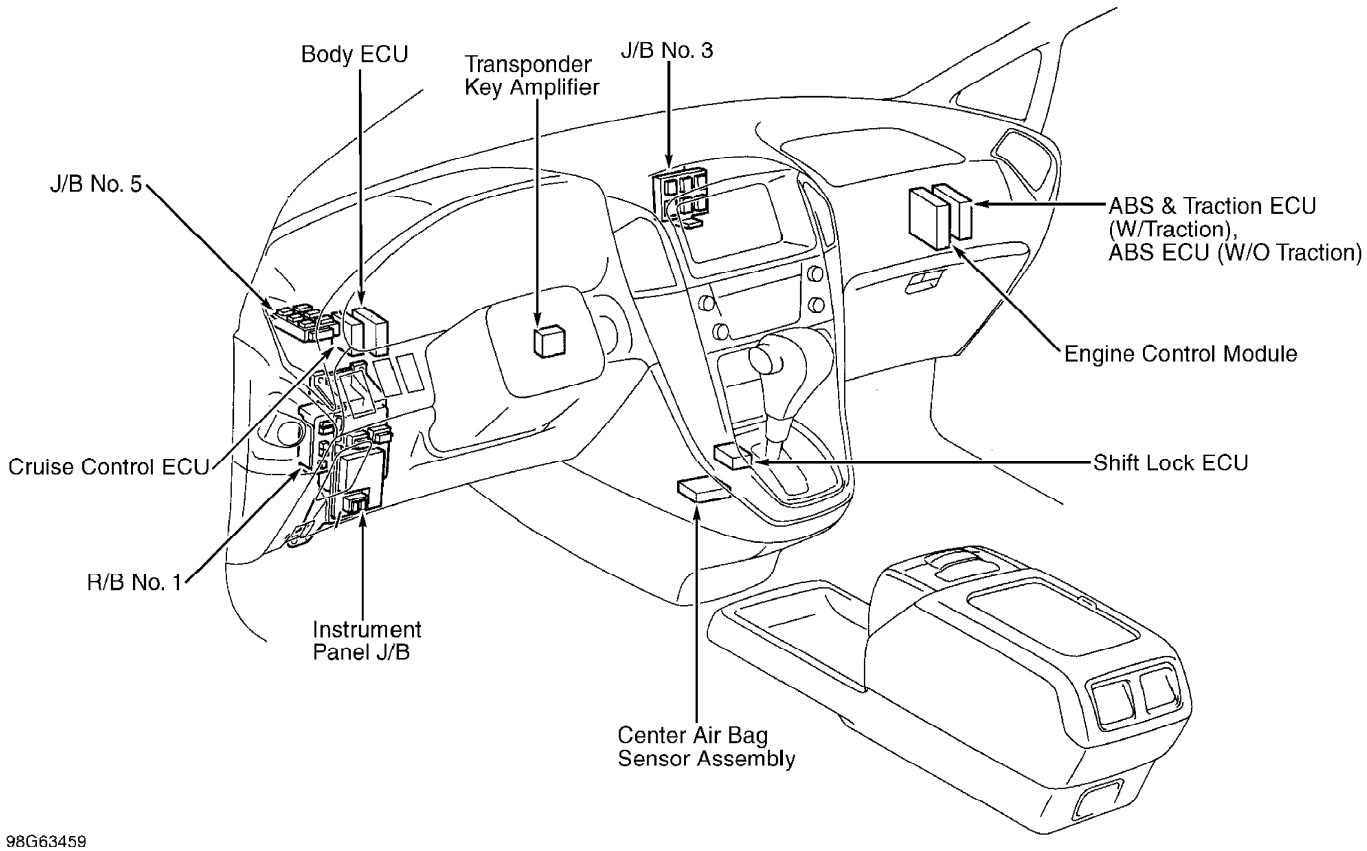
Component	Component Location
 98G63459	
ABS ECU (W/O Traction)	Behind right side of dash.
 98G63459	
ABS & Traction ECU (W/Traction)	Behind right side of dash.



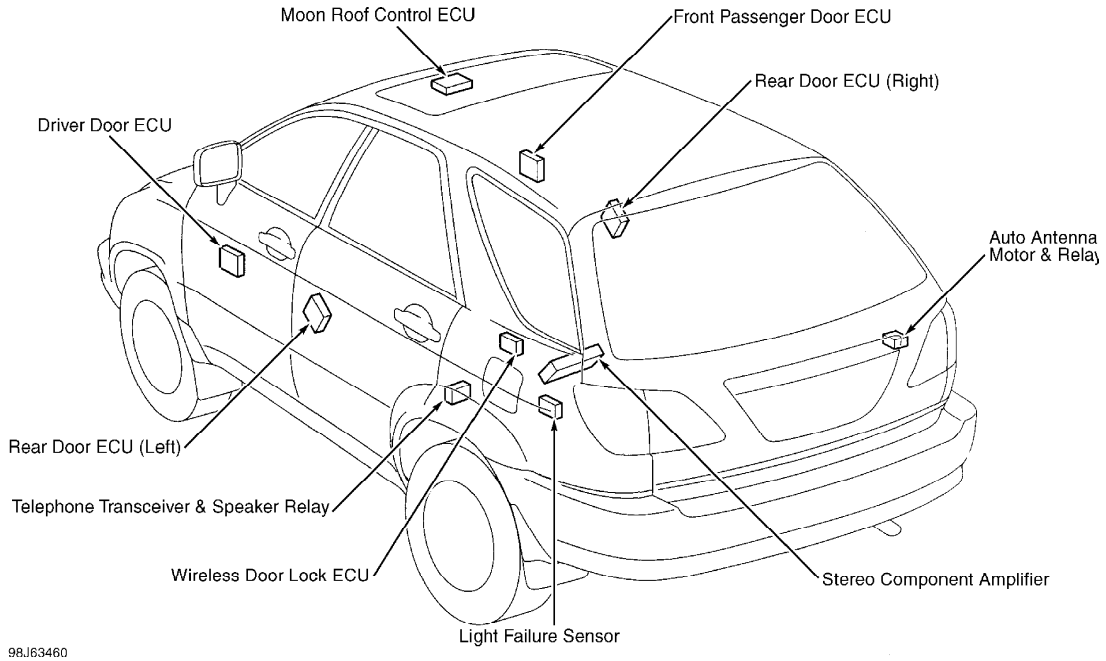
Body ECU | Behind left side of dash.



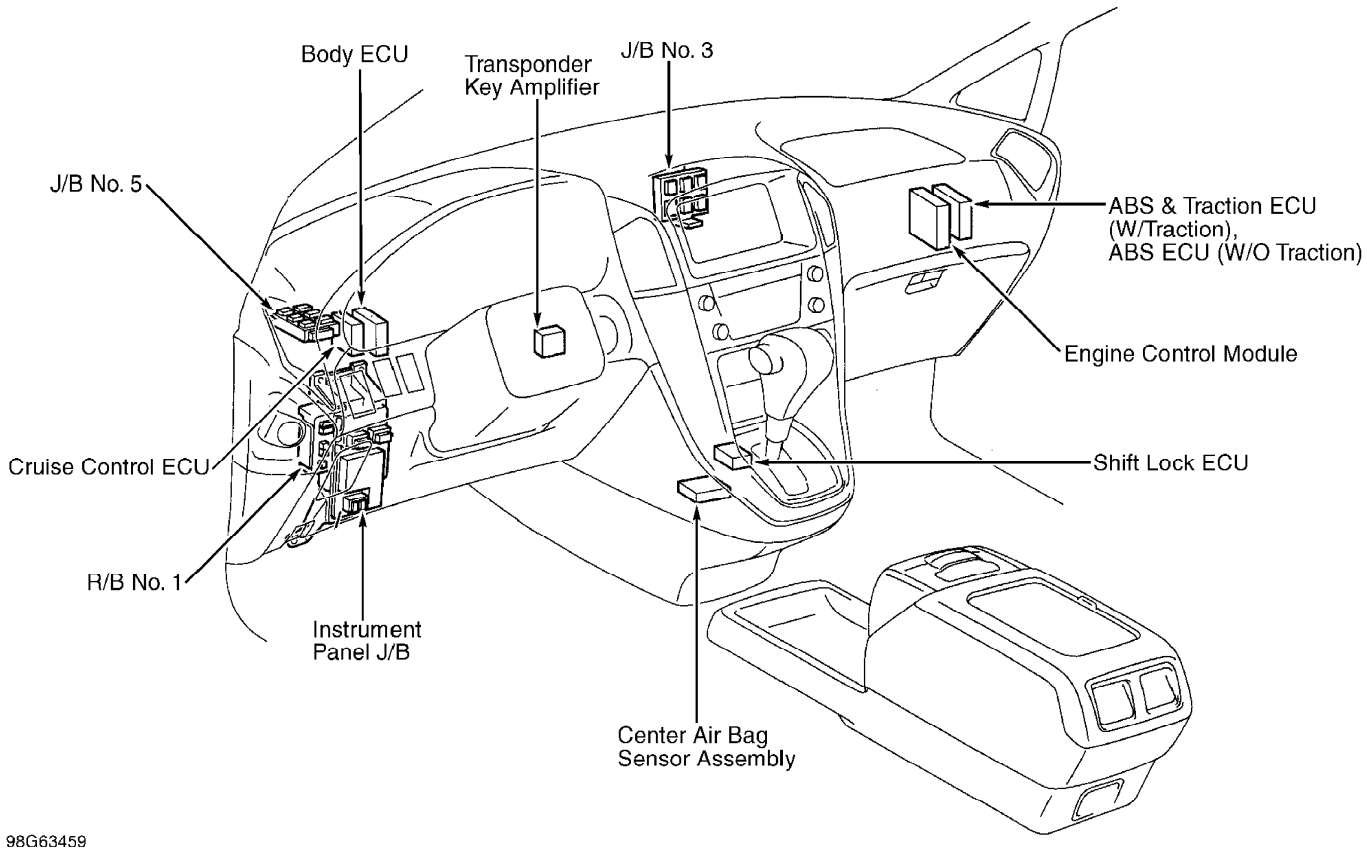
Center Air Bag Sensor Assembly | Under center of dash, forward of center console.



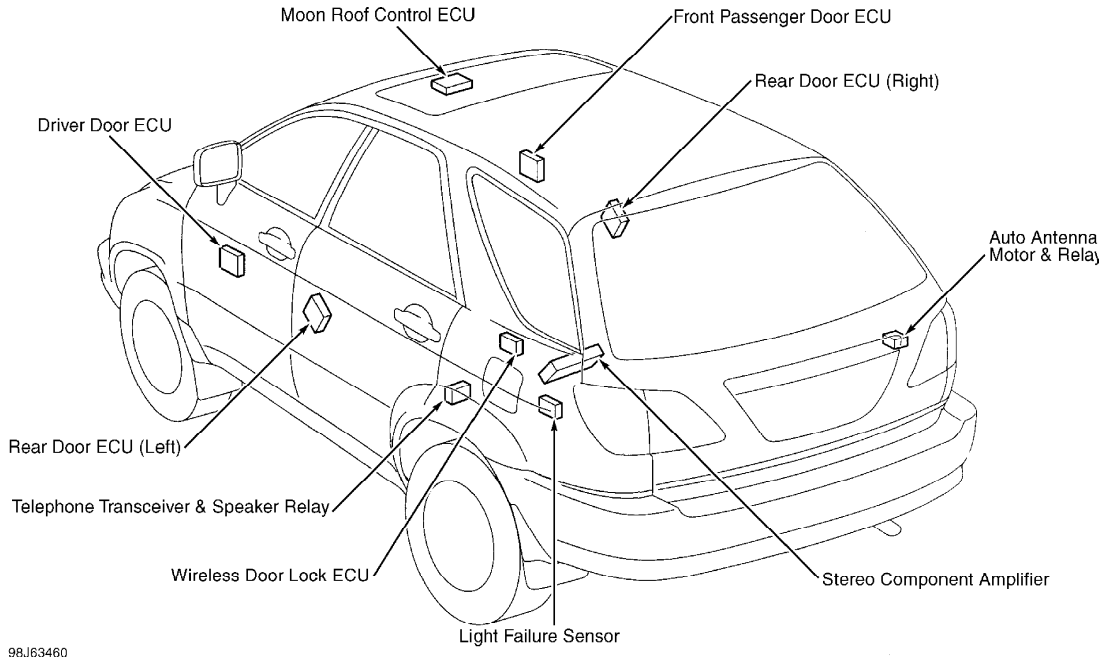
Cruise Control ECU — Behind left side of dash.



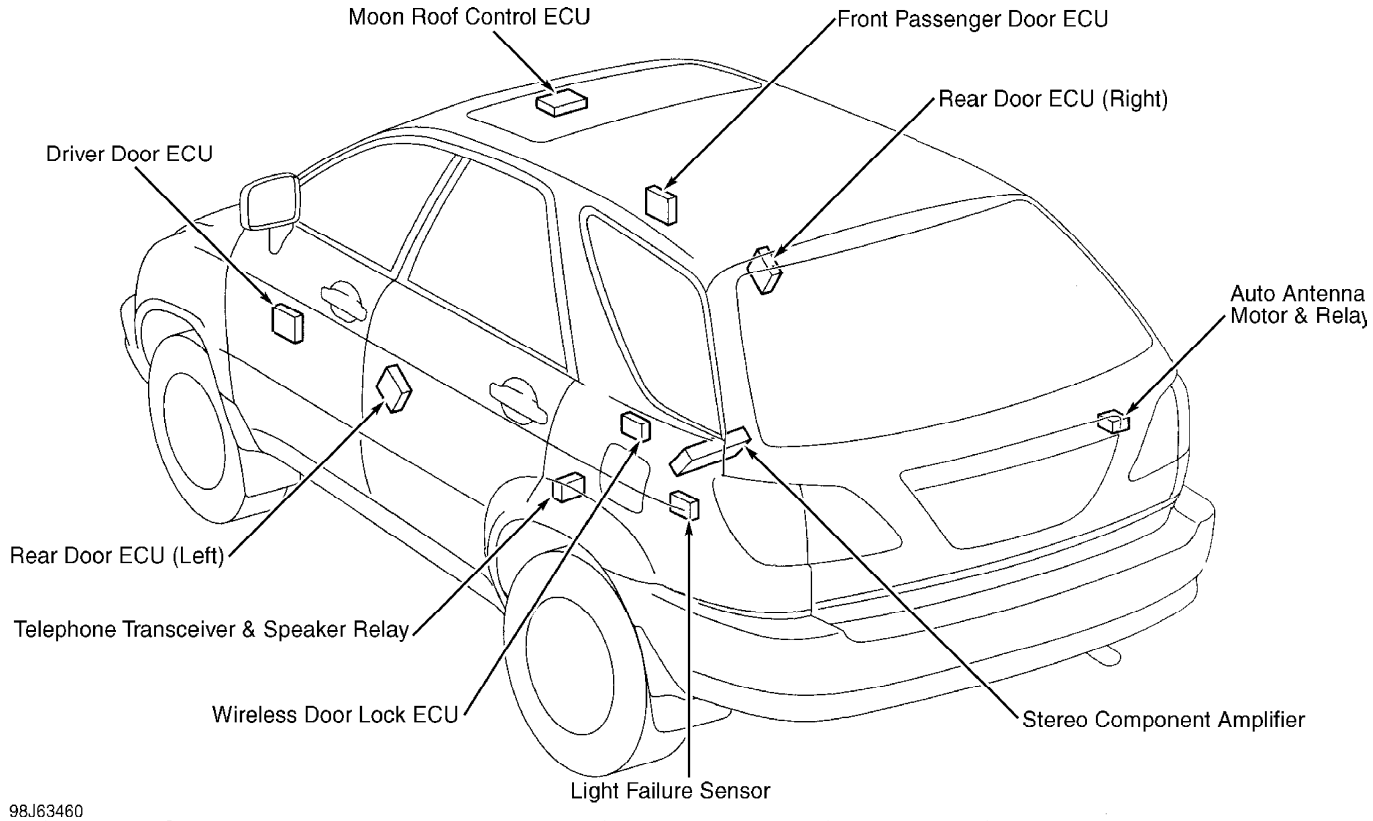
Driver Door ECU — In left front door.



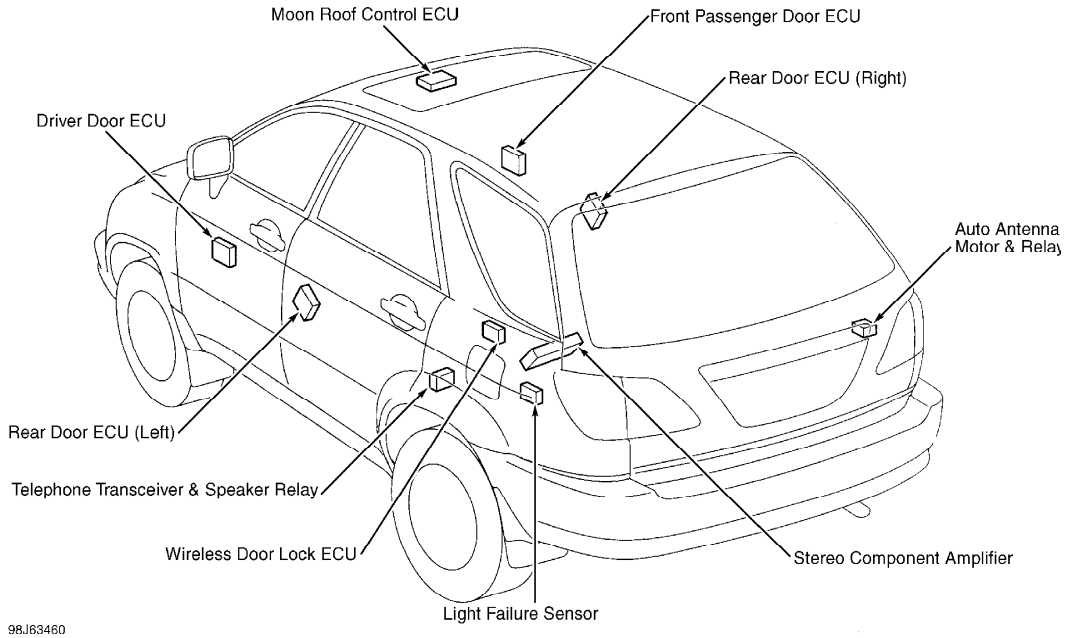
Engine Control Module — Behind right side of dash.



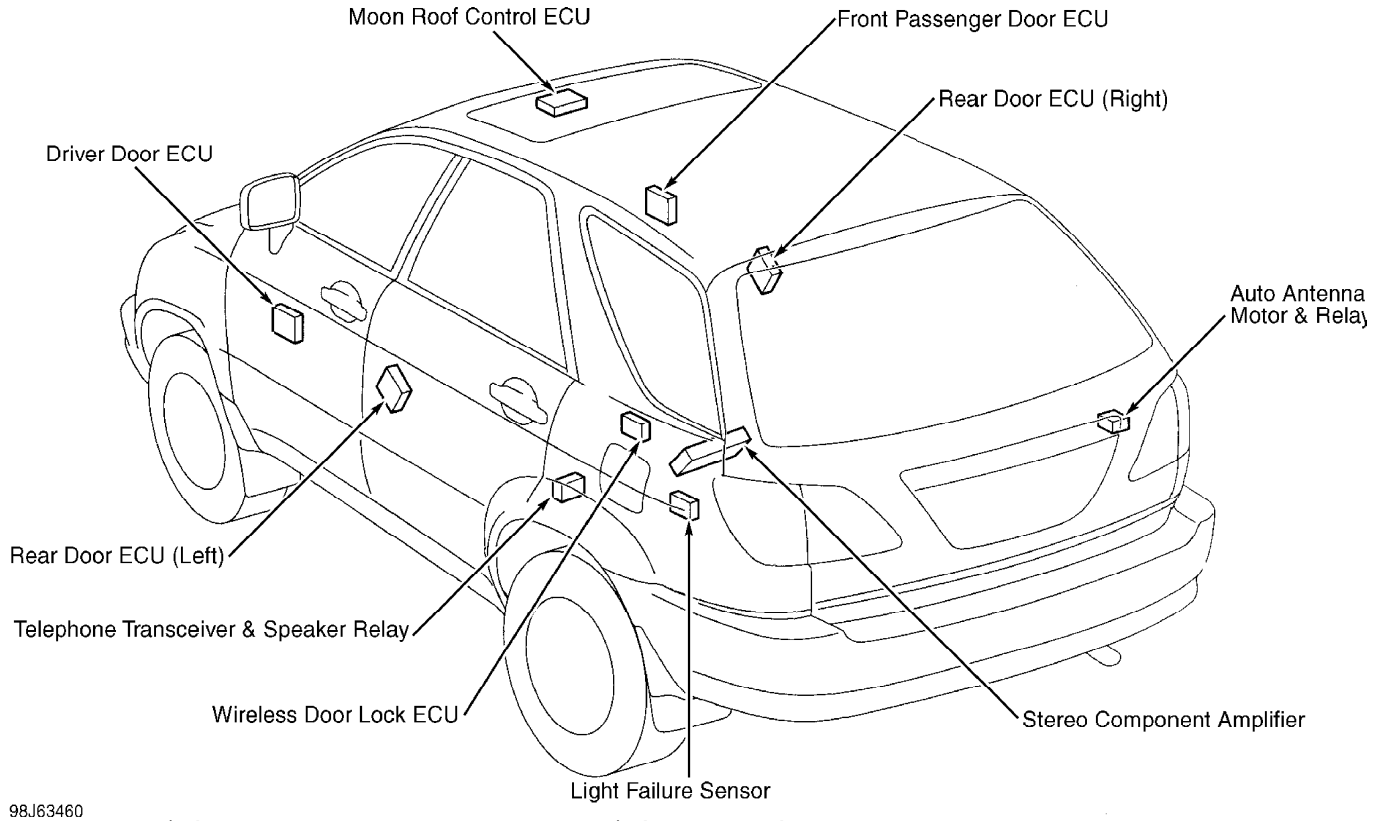
Front Passenger Door ECU — In right front door.



Moon Roof Control ECU	On front center of moon roof.
Power Seat ECU	Under driver's seat.

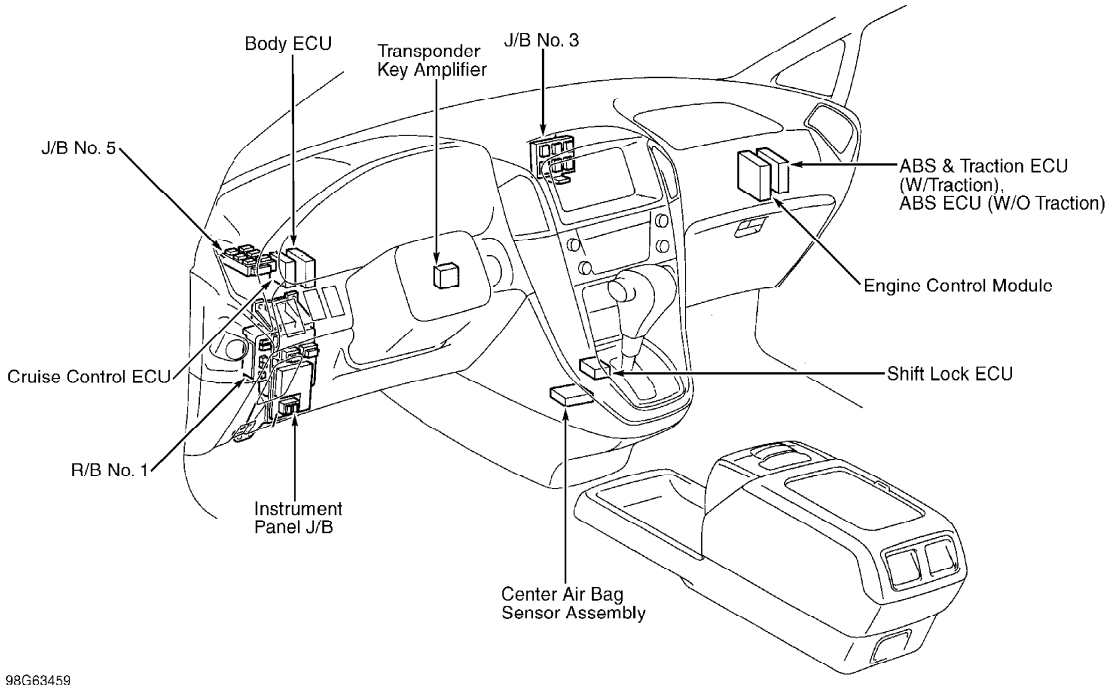


Rear Door ECU (Left)	In left rear door.



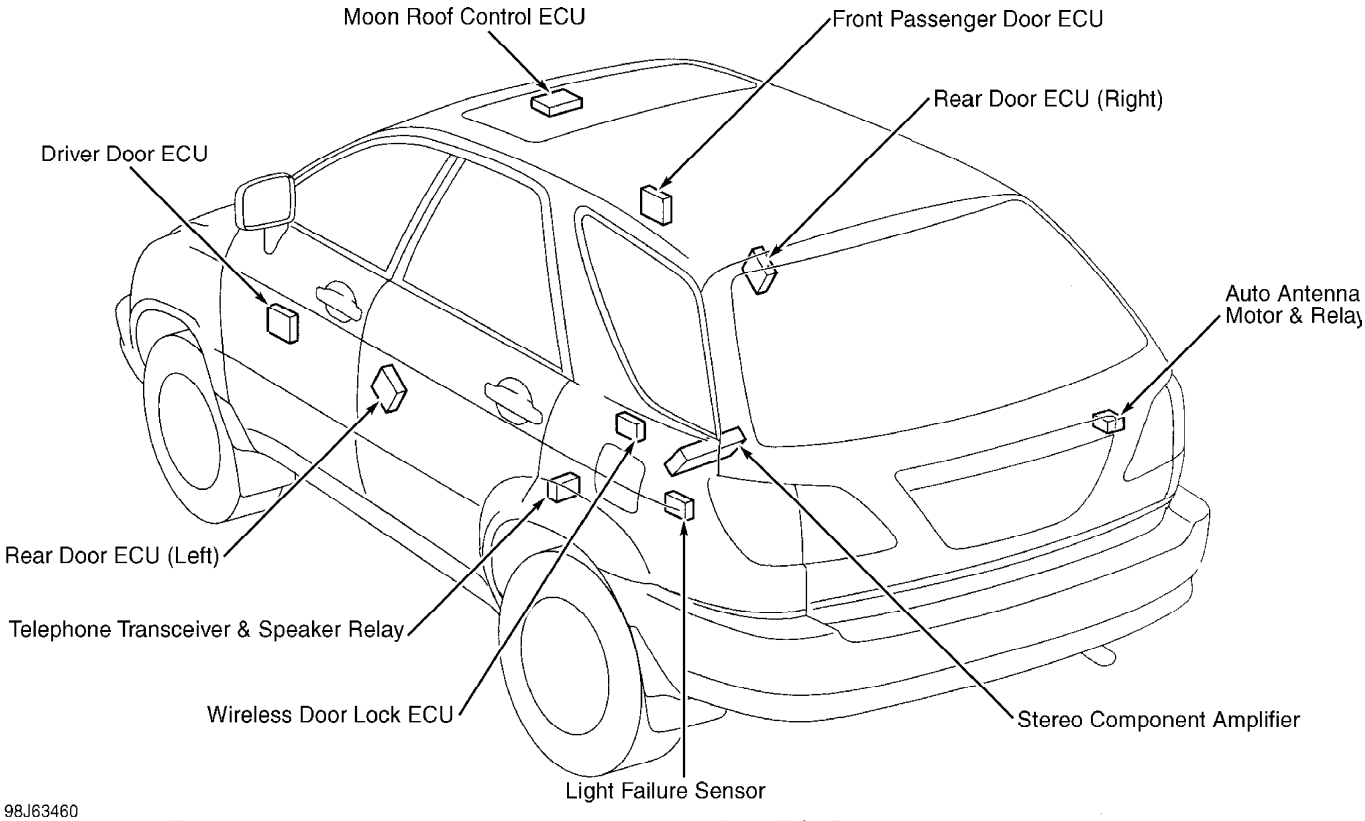
98J63460

Rear Door ECU (Right)	In right rear door.



98G63459

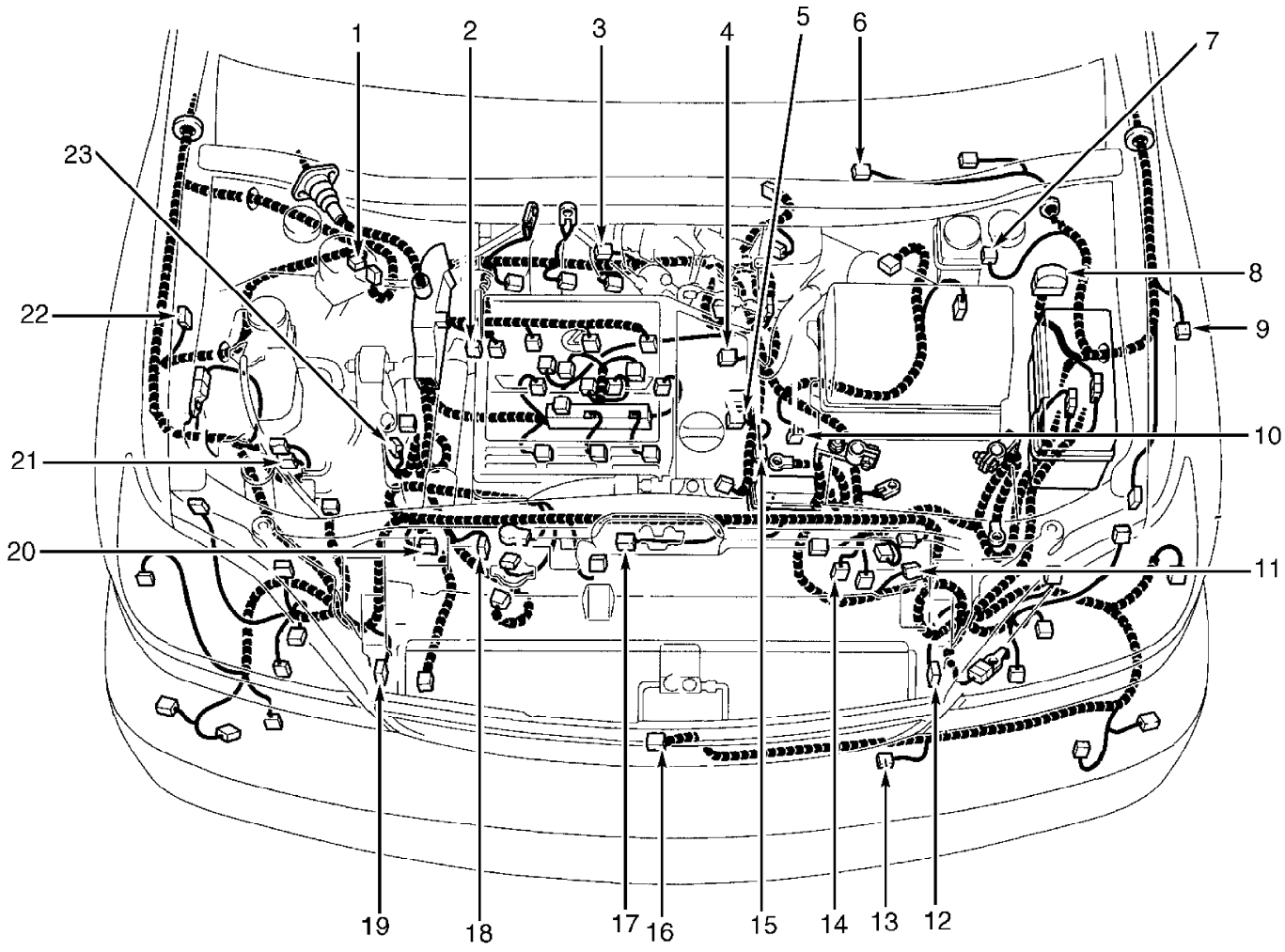
Shift Lock ECU	Under center console, beside shift lever.



Wireless Door Lock ECU	In center of vehicle.

MOTORS

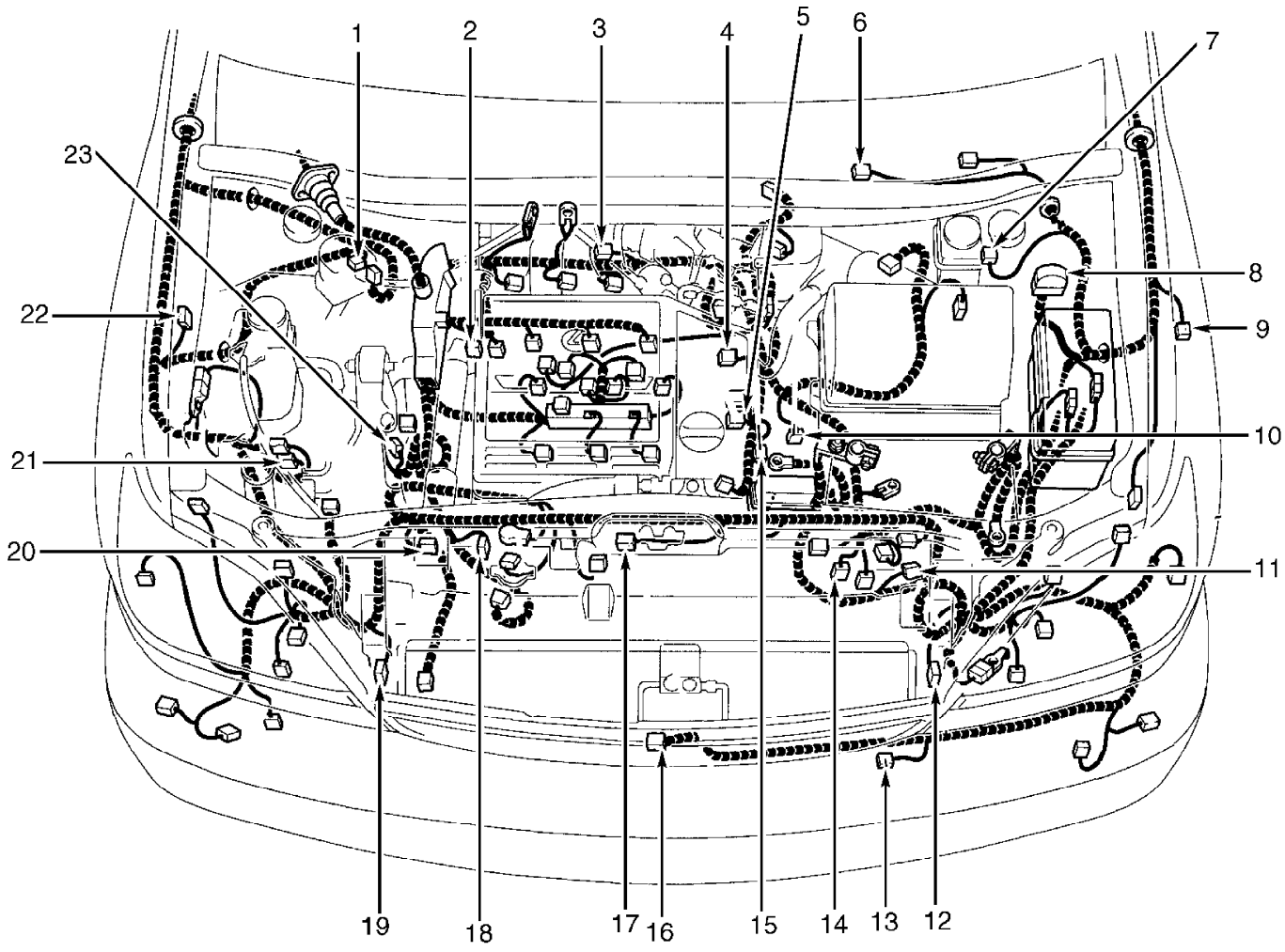
Component	Component Location



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

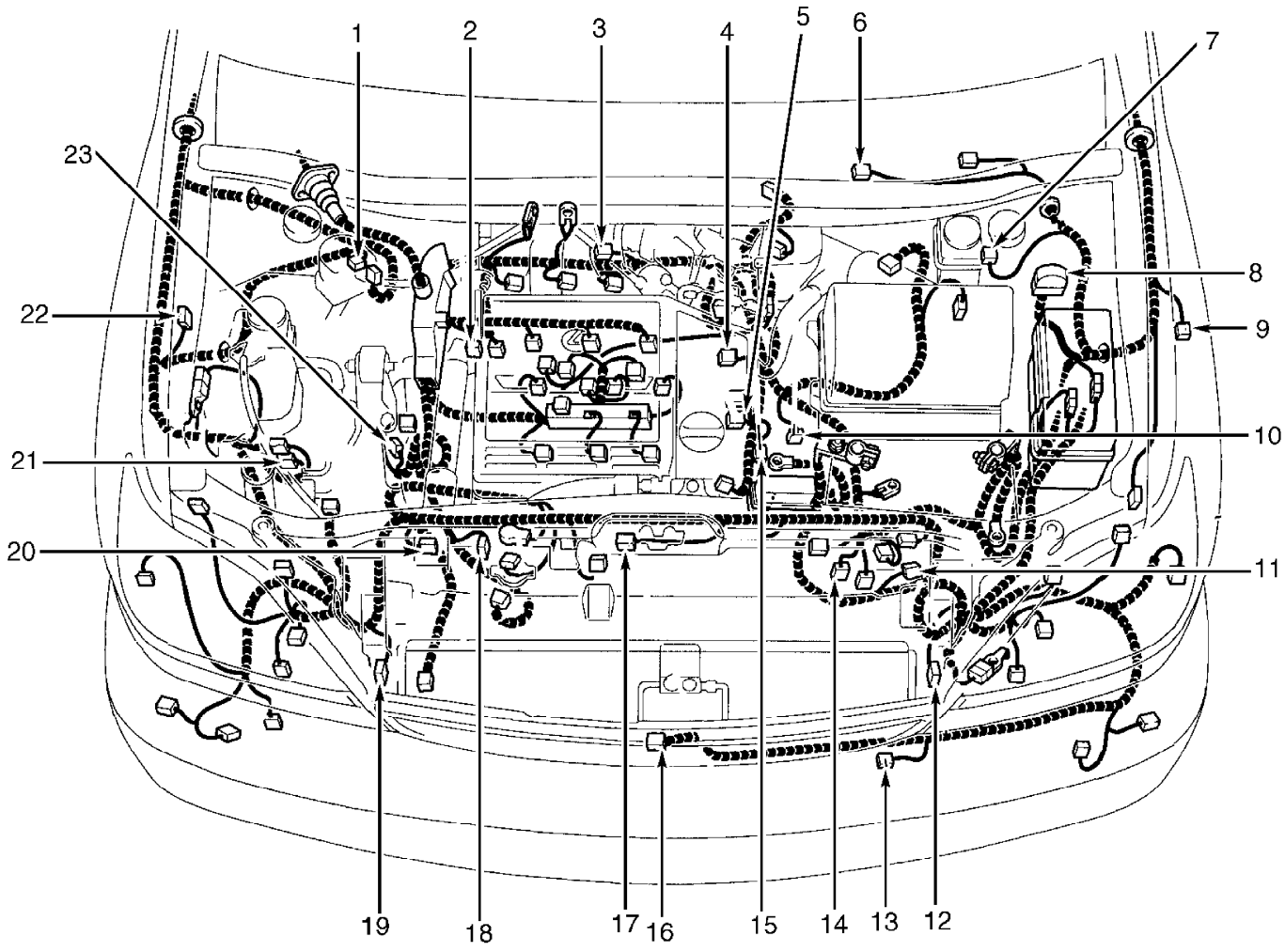
ABS Actuator (W/O Traction)	On right front of engine compartment.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

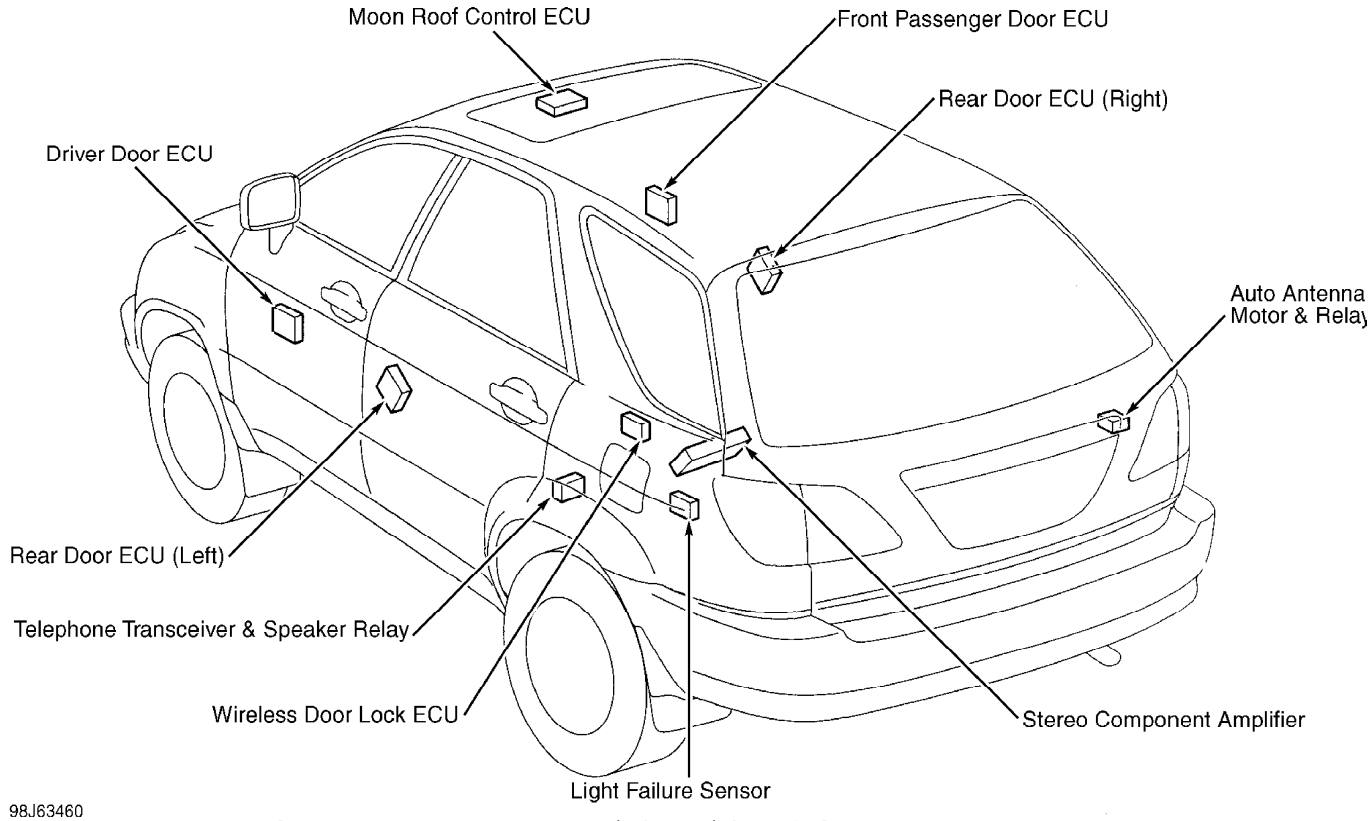
ABS & Traction Actuator (W/Traction)	On right front of engine compartment.



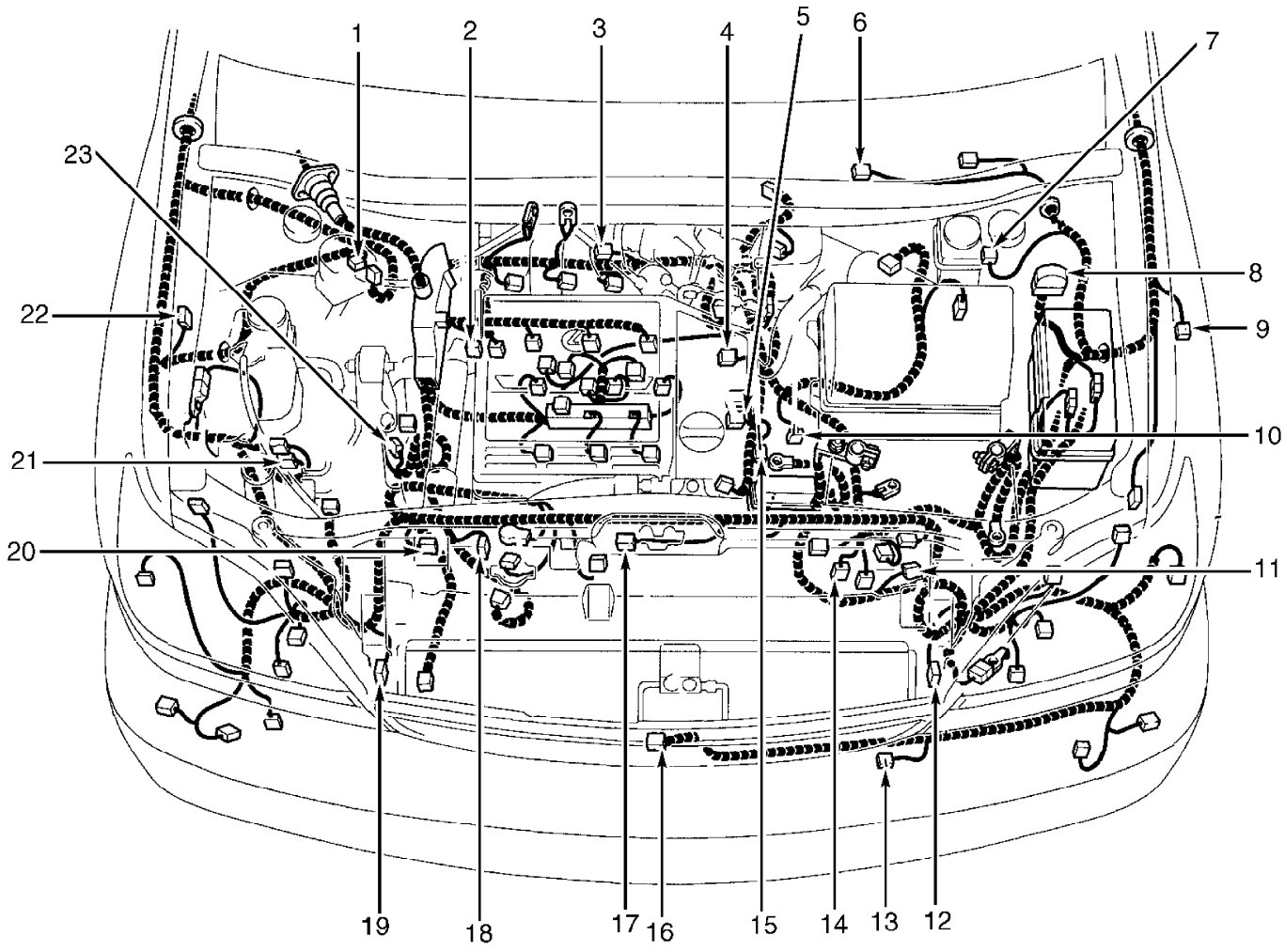
1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

A/C Condenser Fan Motor	In right front of engine compartment.



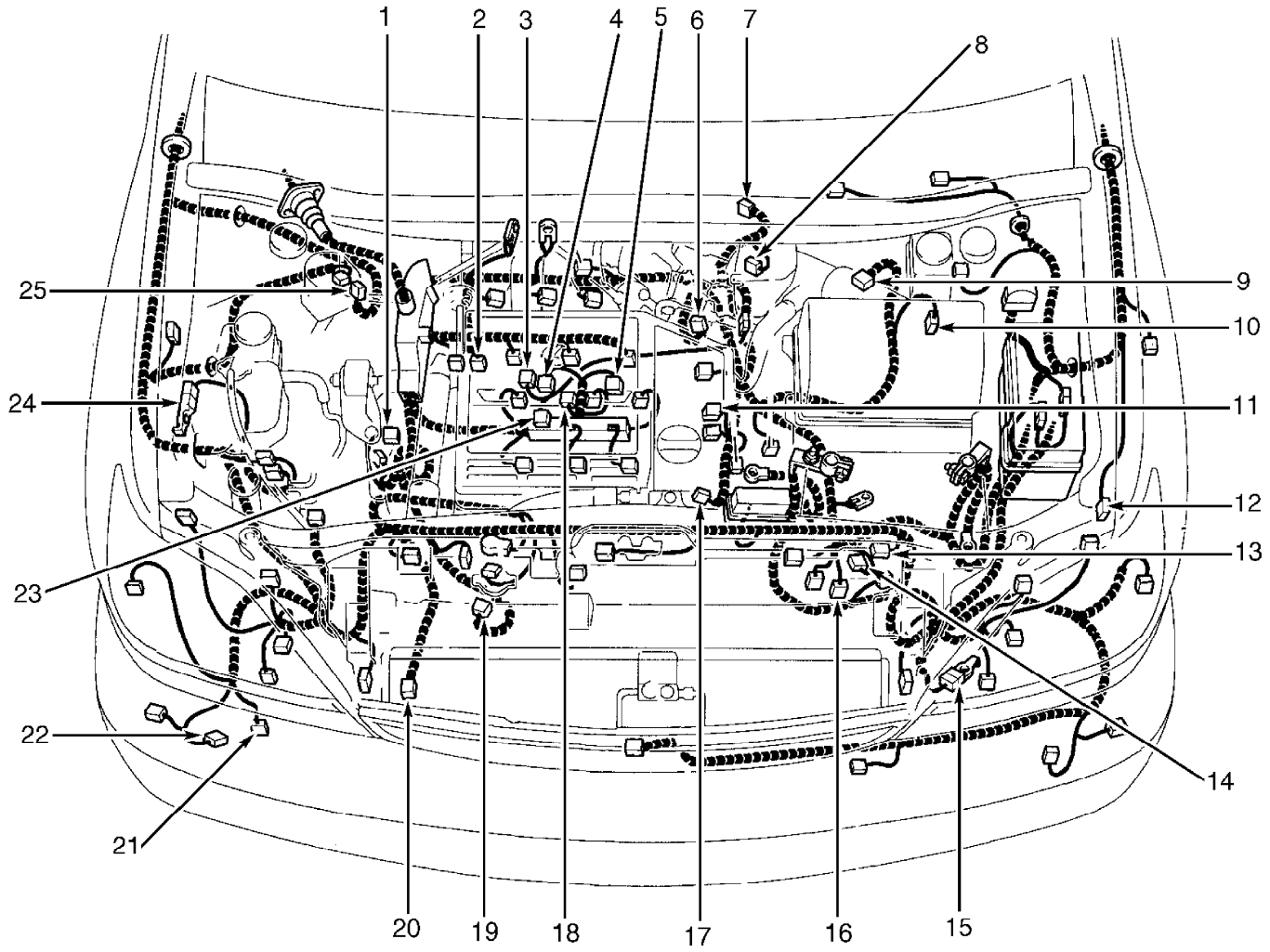
Auto Antenna Motor & Relay	In right side of luggage compartment.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

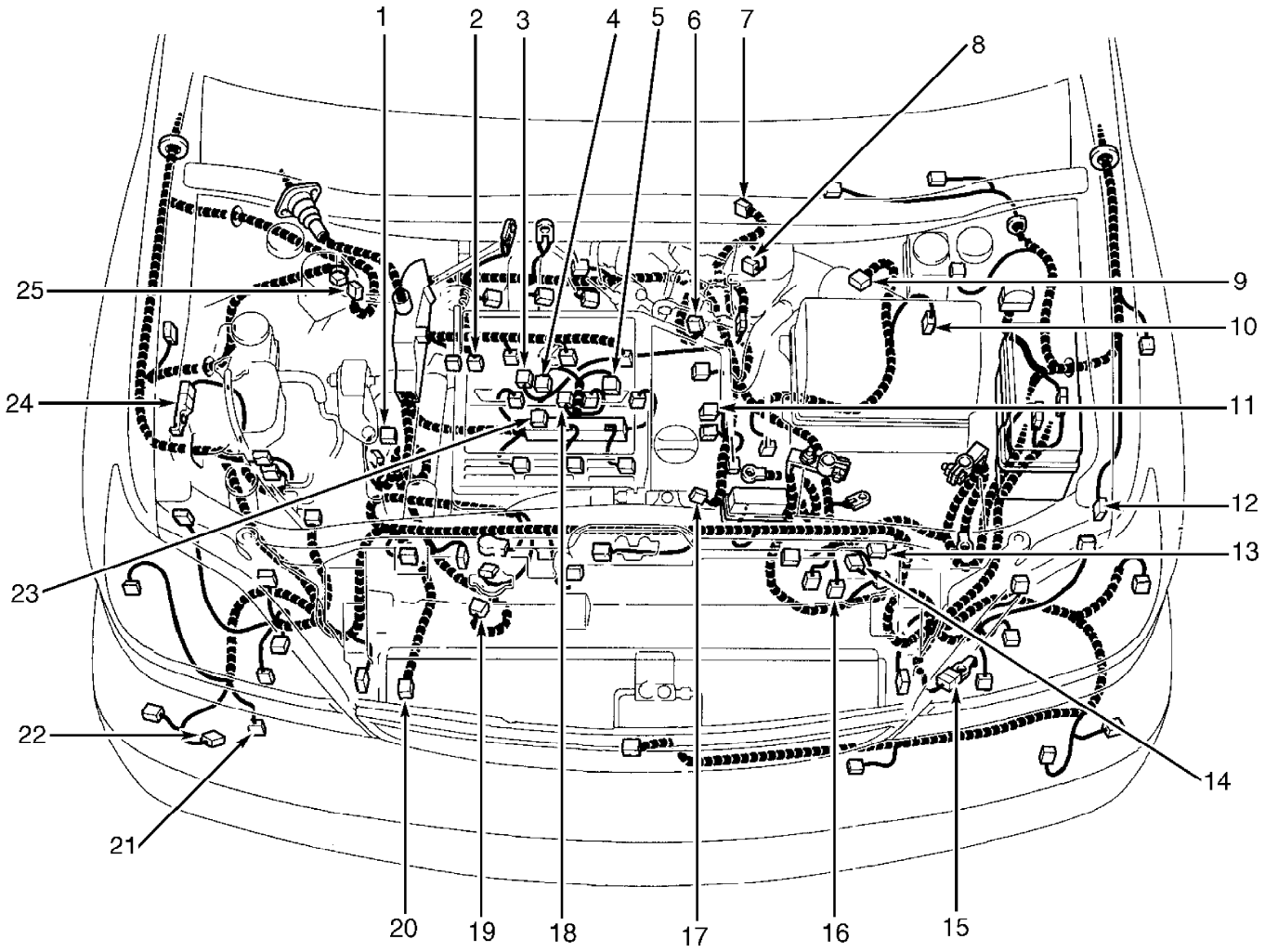
Front Wiper Motor	On left side of firewall.
Fuel Pump & Fuel Sender (Main)	On top of fuel tank.
Fuel Sender (Sub)	Under center of vehicle.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Radiator Fan Motor	In left front of engine compartment.
Rear Wiper Motor	In center of liftgate.



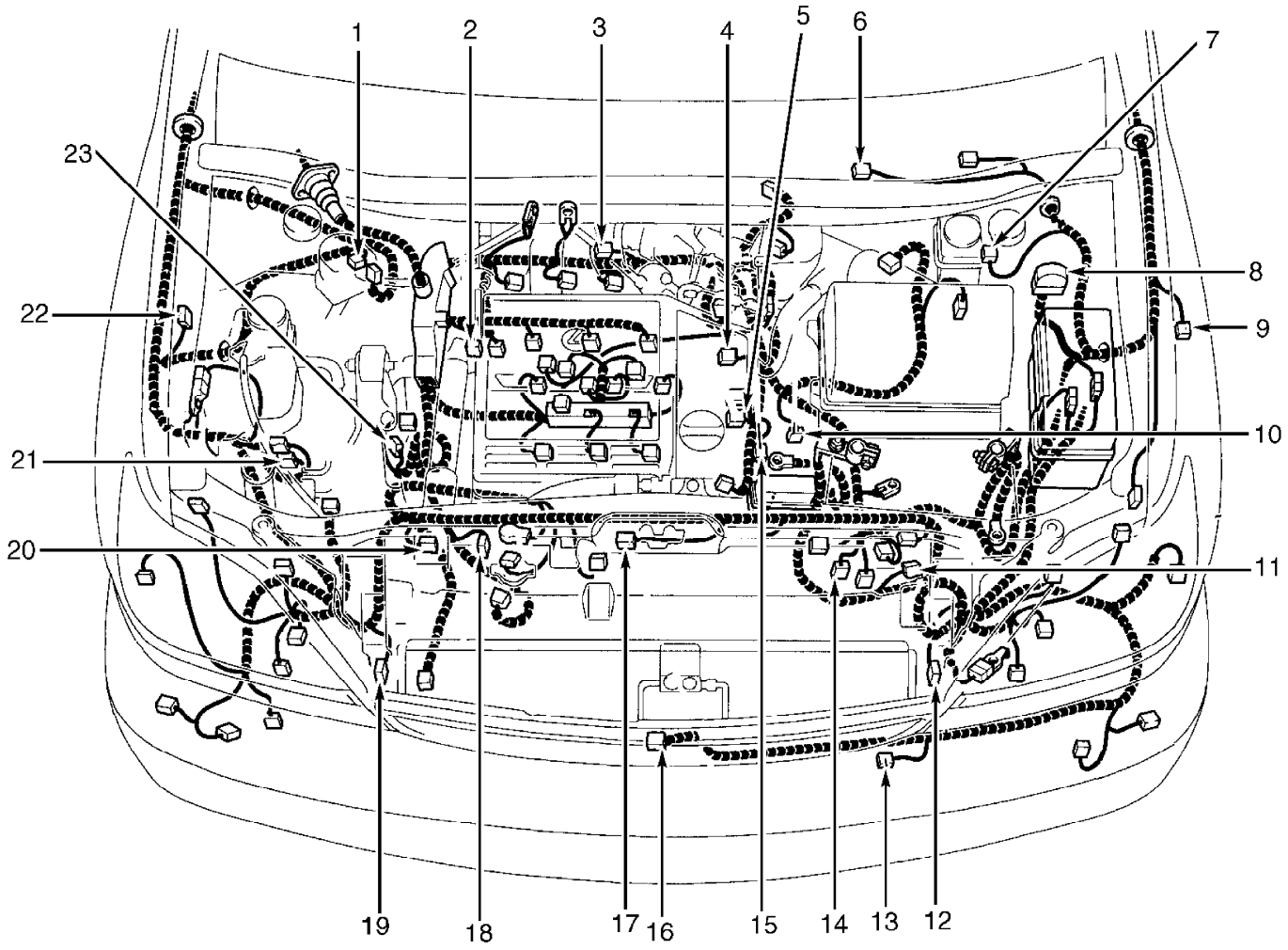
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Washer Motor	Bottom of windshield washer reservoir.

SENDING UNITS & SENSORS

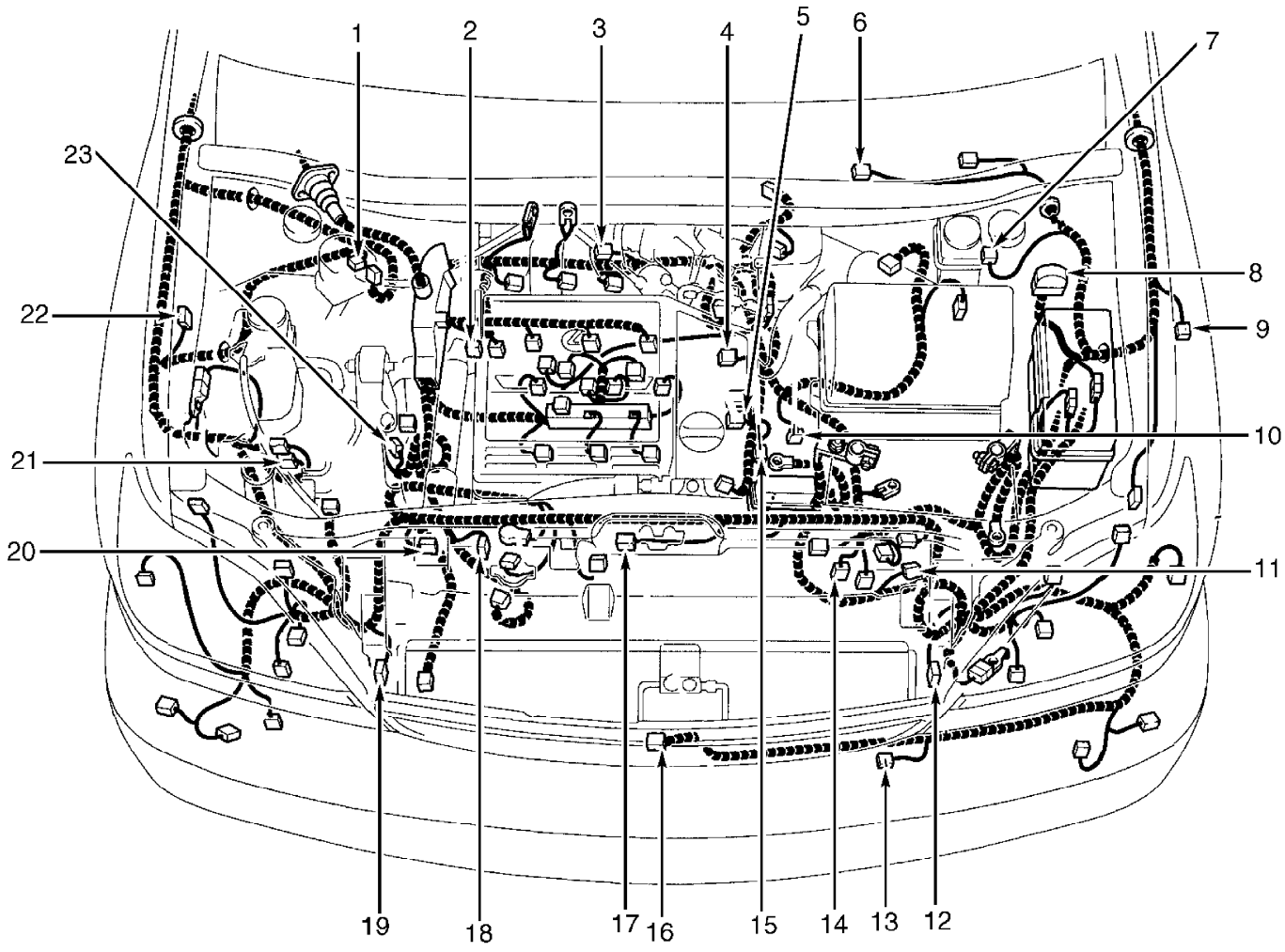
Component	Component Location



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

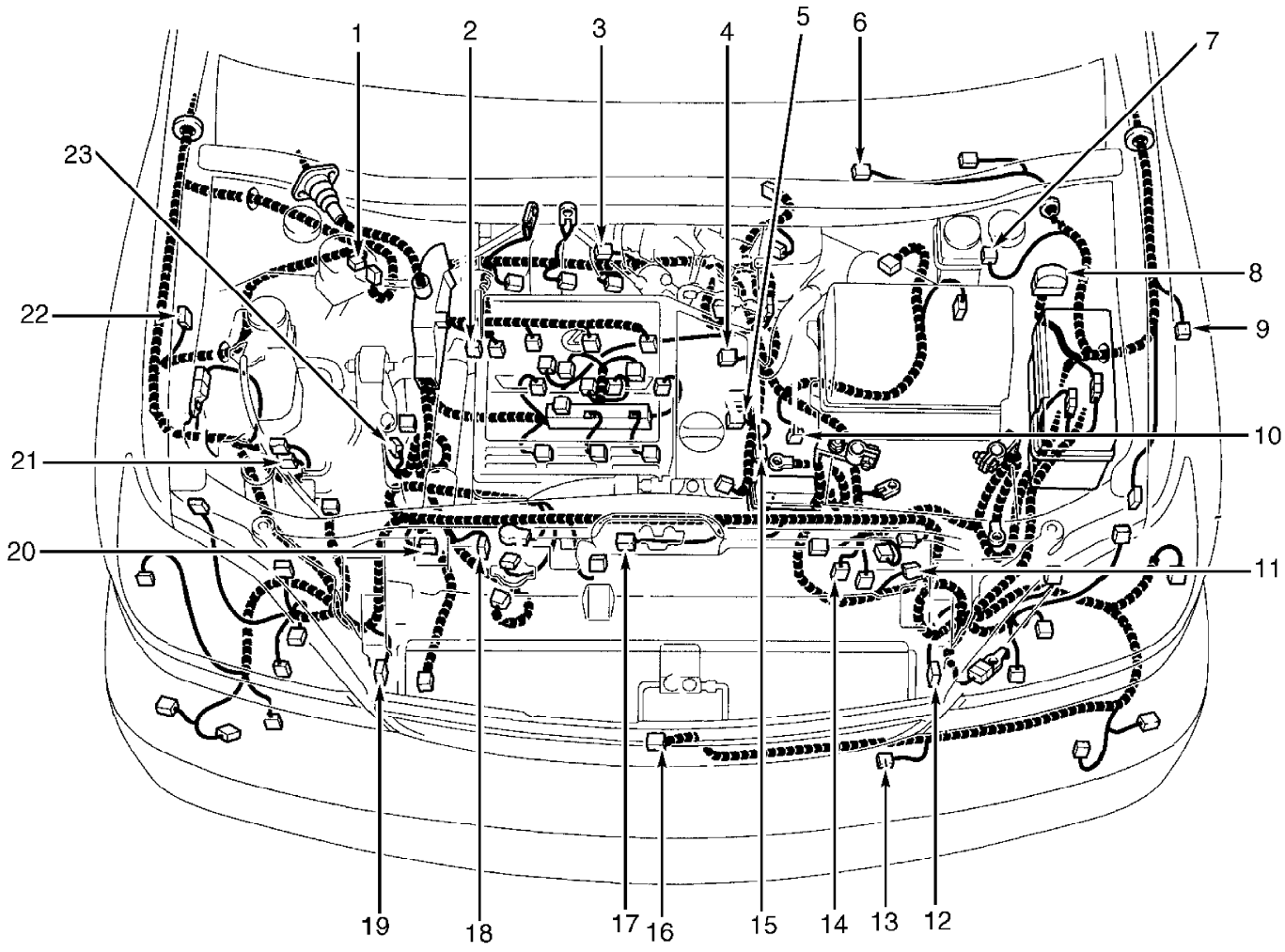
ABS Speed Sensor (Left Front)	On left front wheel hub bracket.
ABS Speed Sensor (Left Rear)	On left rear wheel hub bracket.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

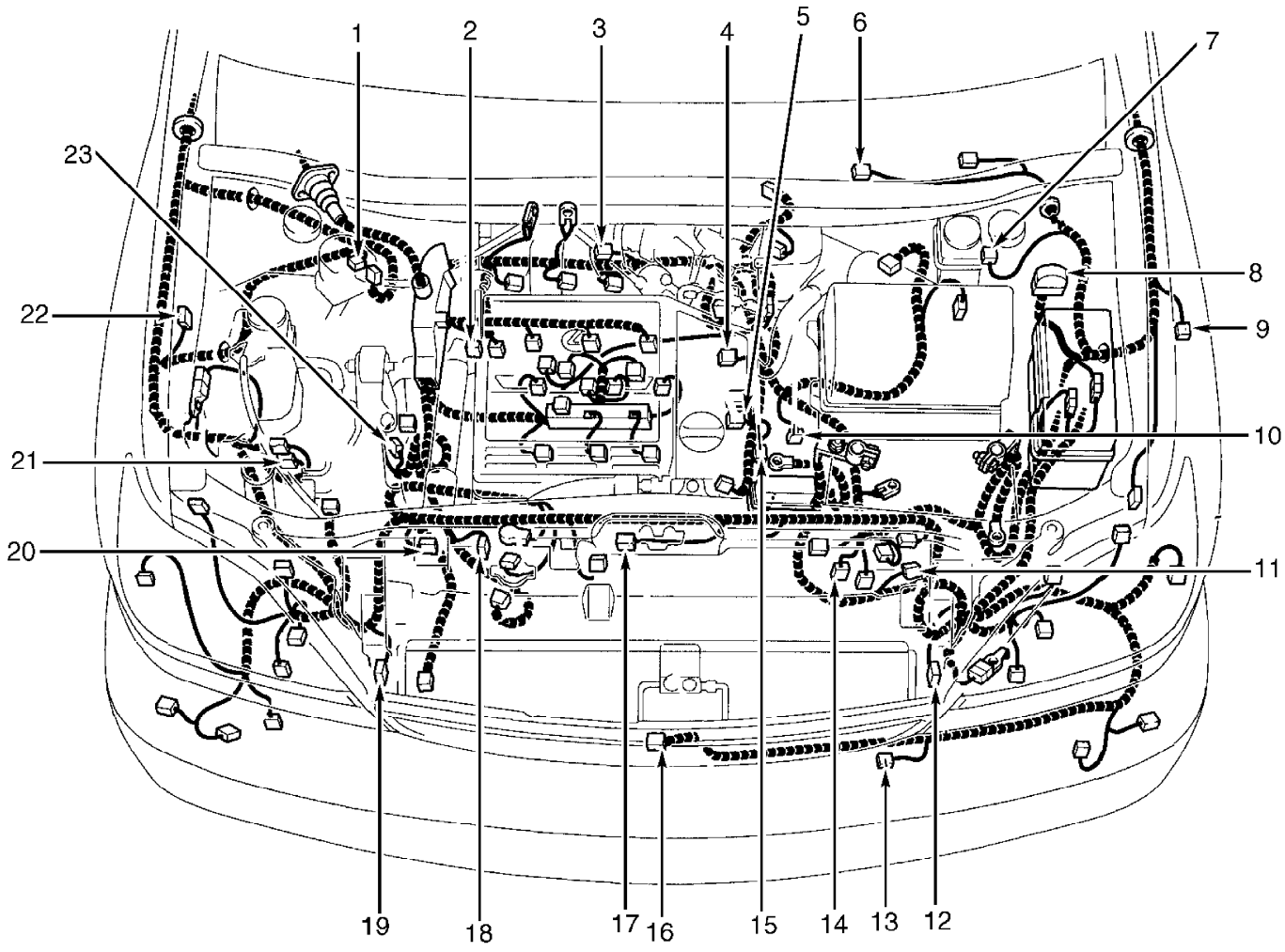
ABS Speed Sensor (Right Front)	On right front wheel hub bracket.
ABS Speed Sensor (Right Rear)	On right rear wheel hub bracket.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

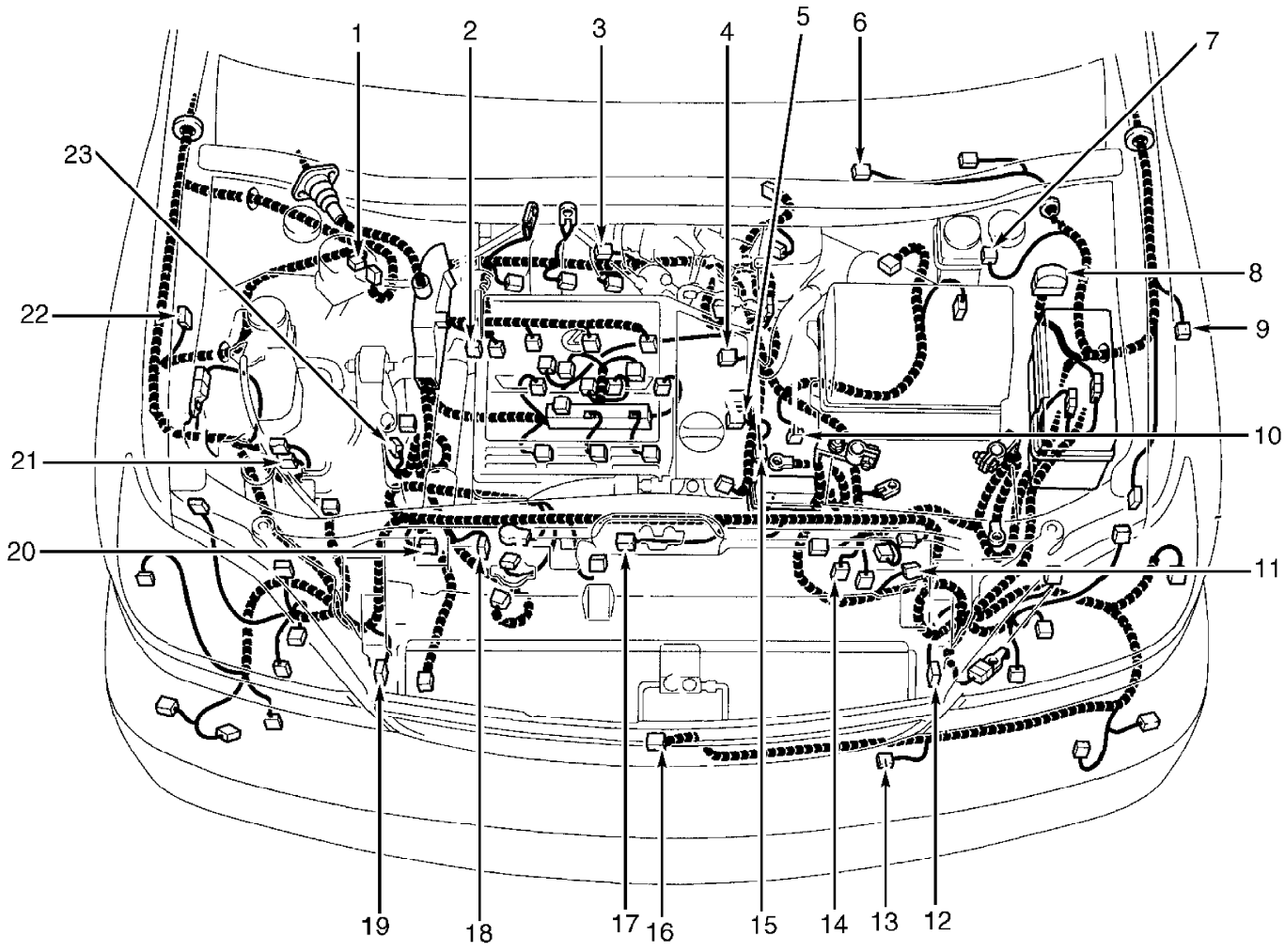
A/C Ambient Temperature Sensor	Behind left front grille.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

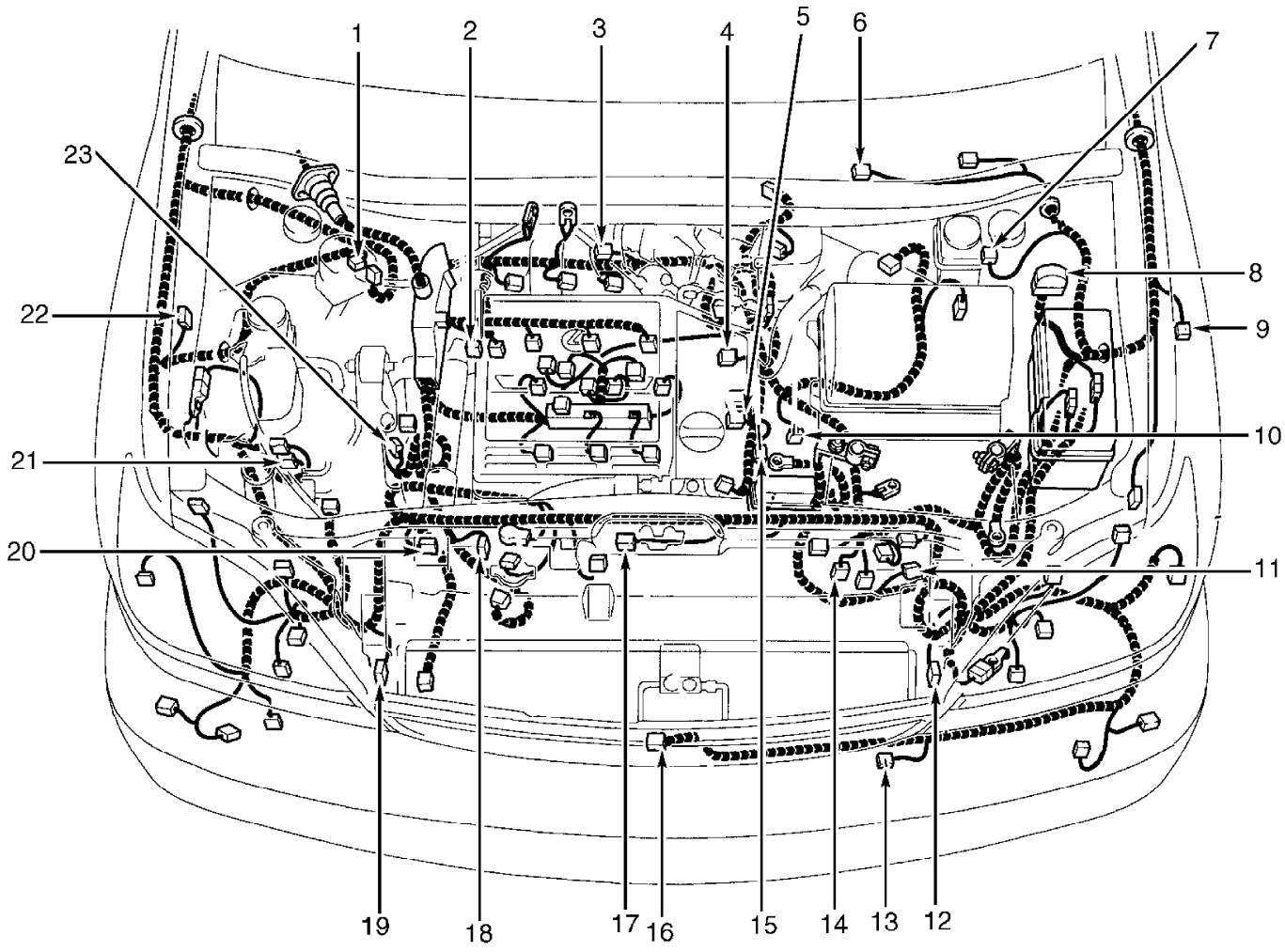
A/C Magnetic Clutch & Lock Sensor	On A/C compressor assembly.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

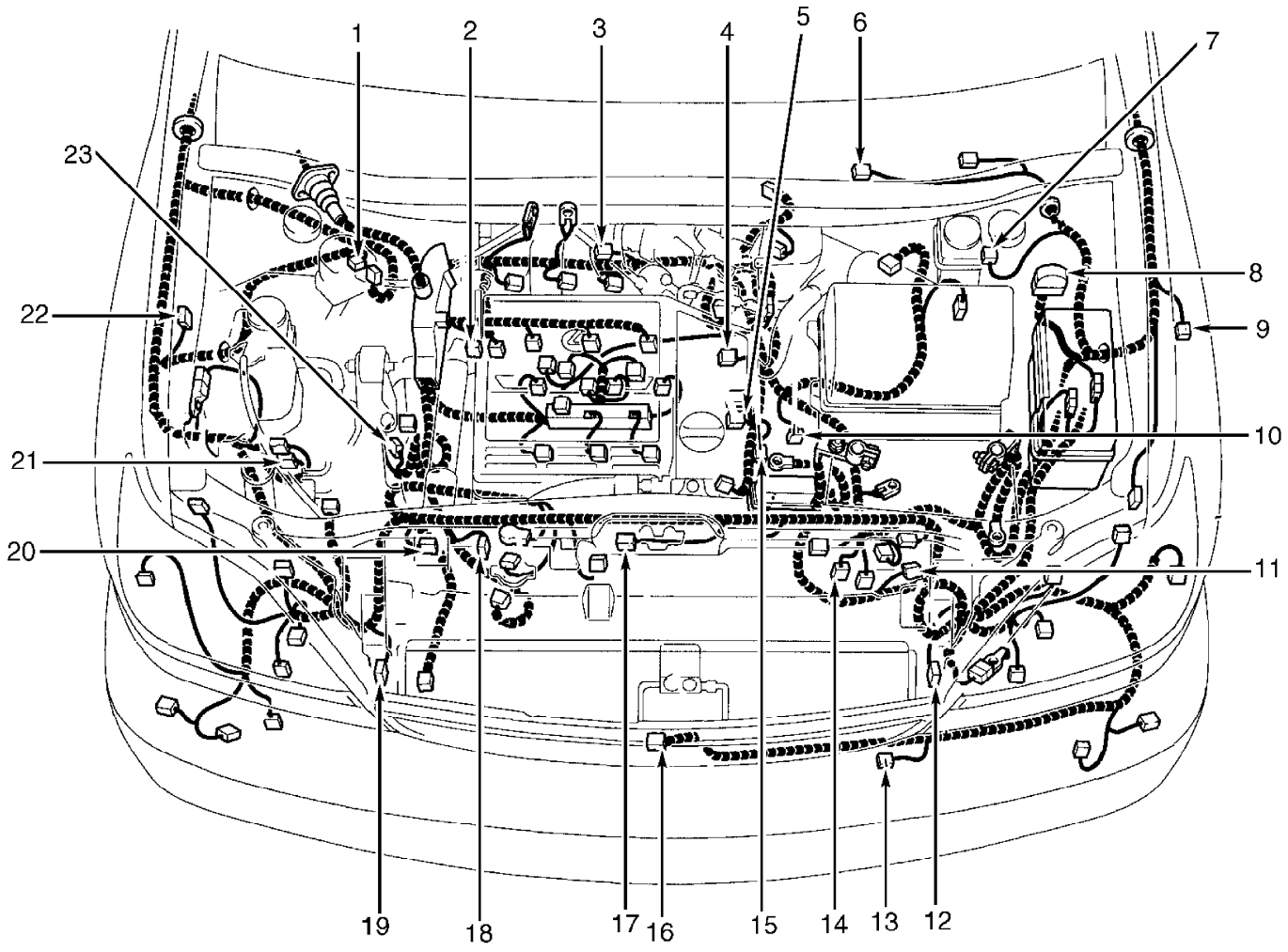
Air Bag Sensor (Left Front)	In left front corner of engine compartment.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

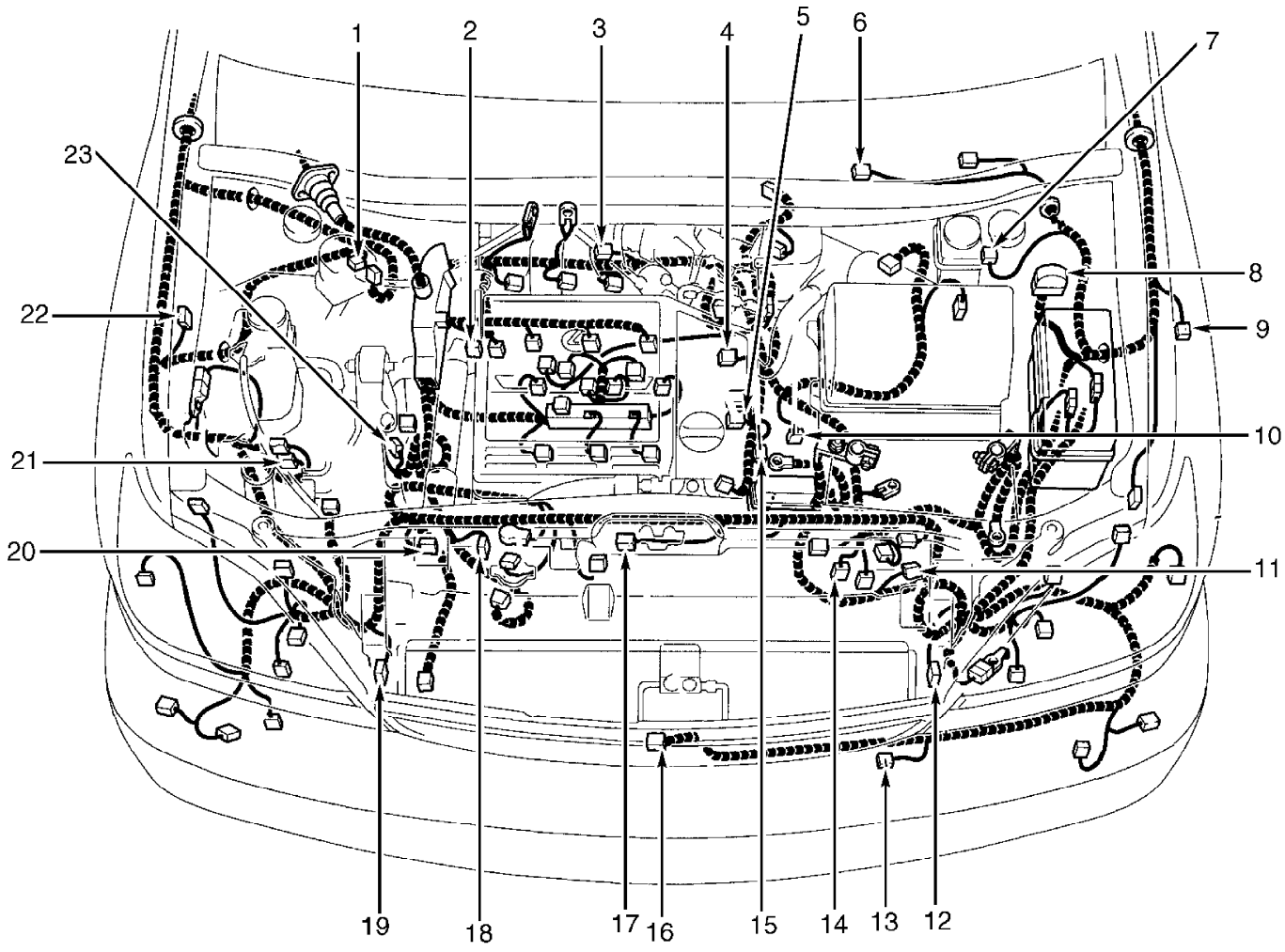
Air Bag Sensor (Right Front)	In right front corner of engine compartment.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

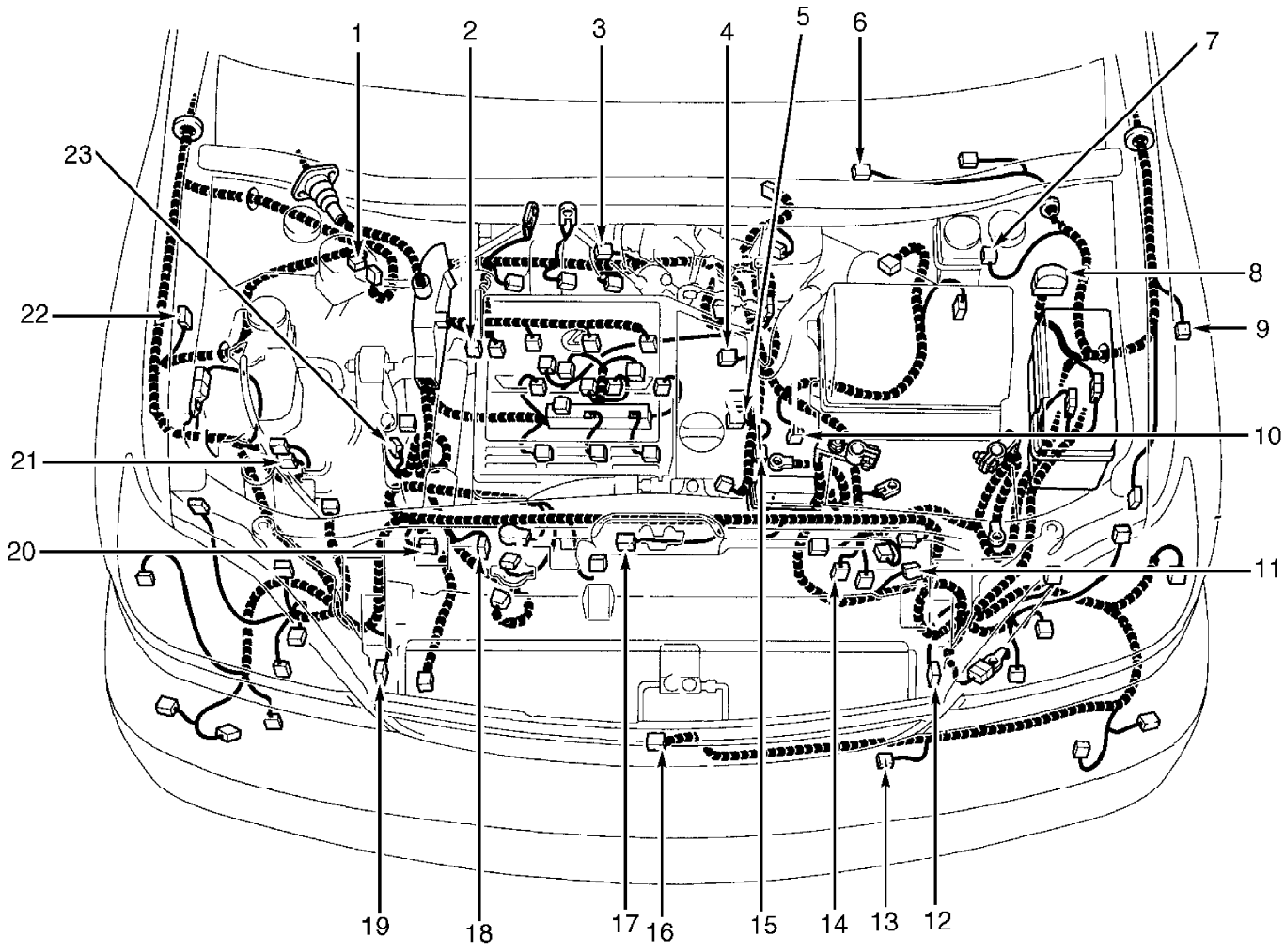
Air Fuel Ratio Sensor (Bank 1 Sensor 1)	In right exhaust manifold.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

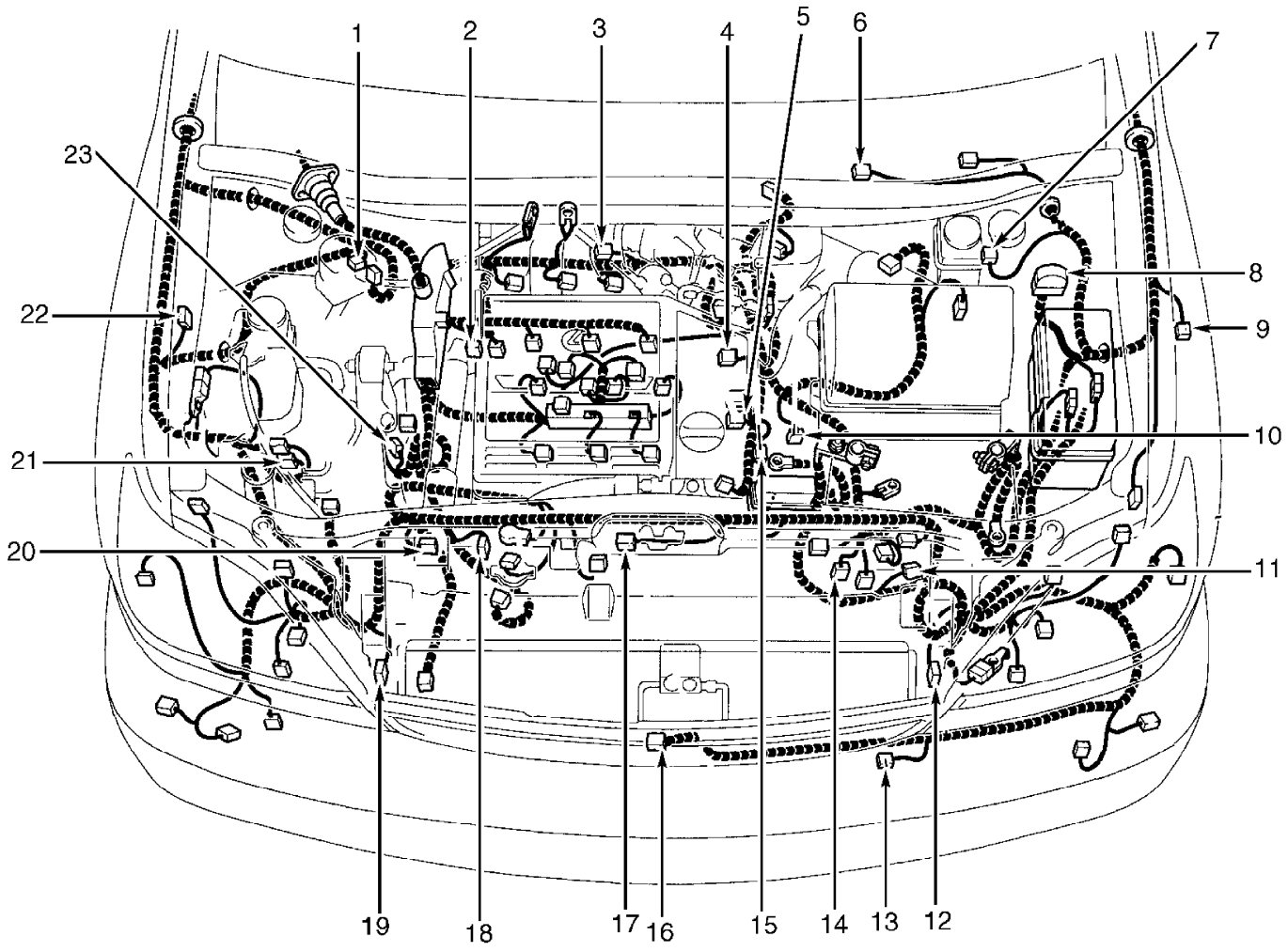
Air Fuel Ratio Sensor (Bank 2 Sensor 1)	In left exhaust manifold.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

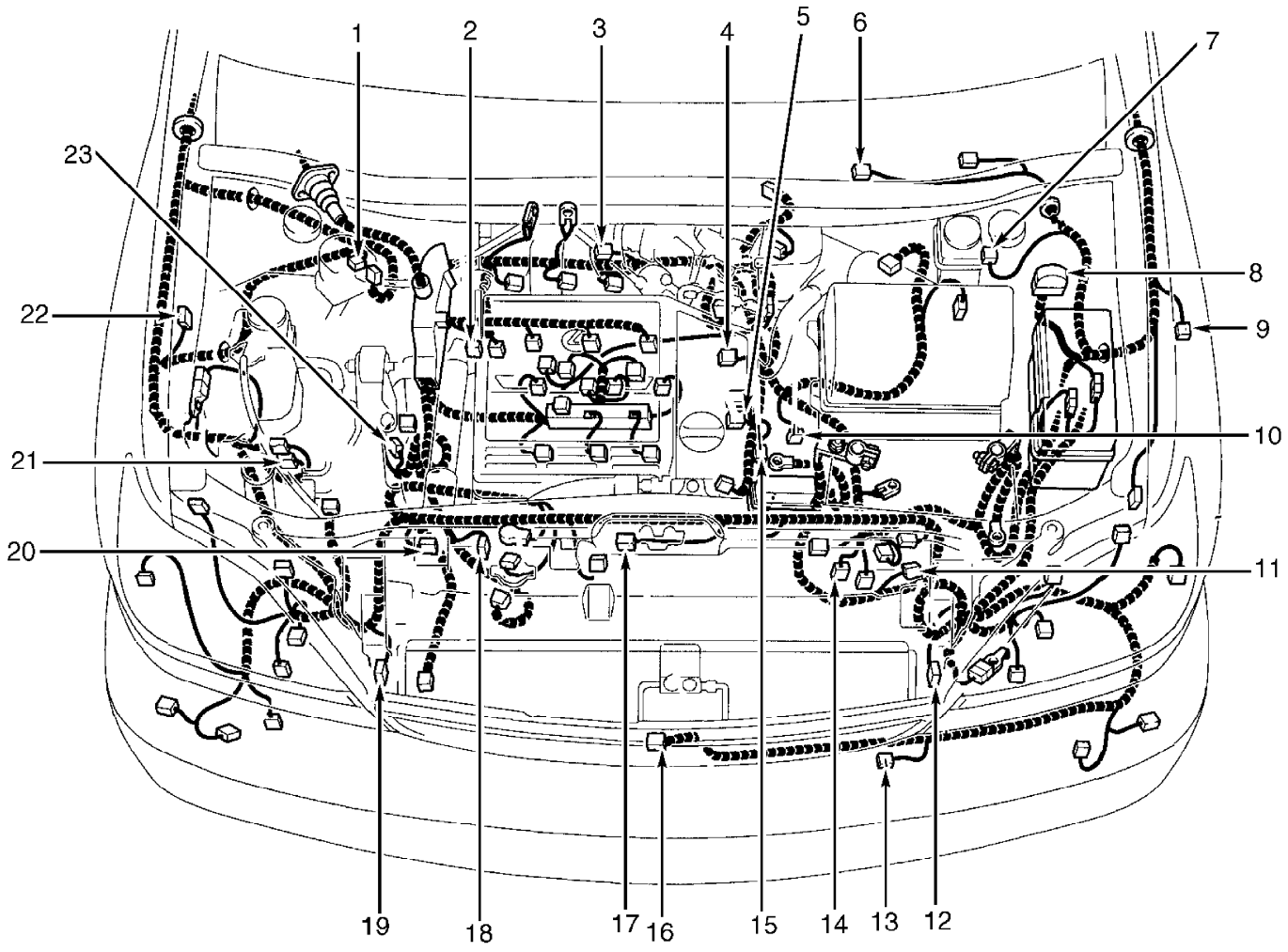
Counter Gear Speed Sensor	On front side of engine.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

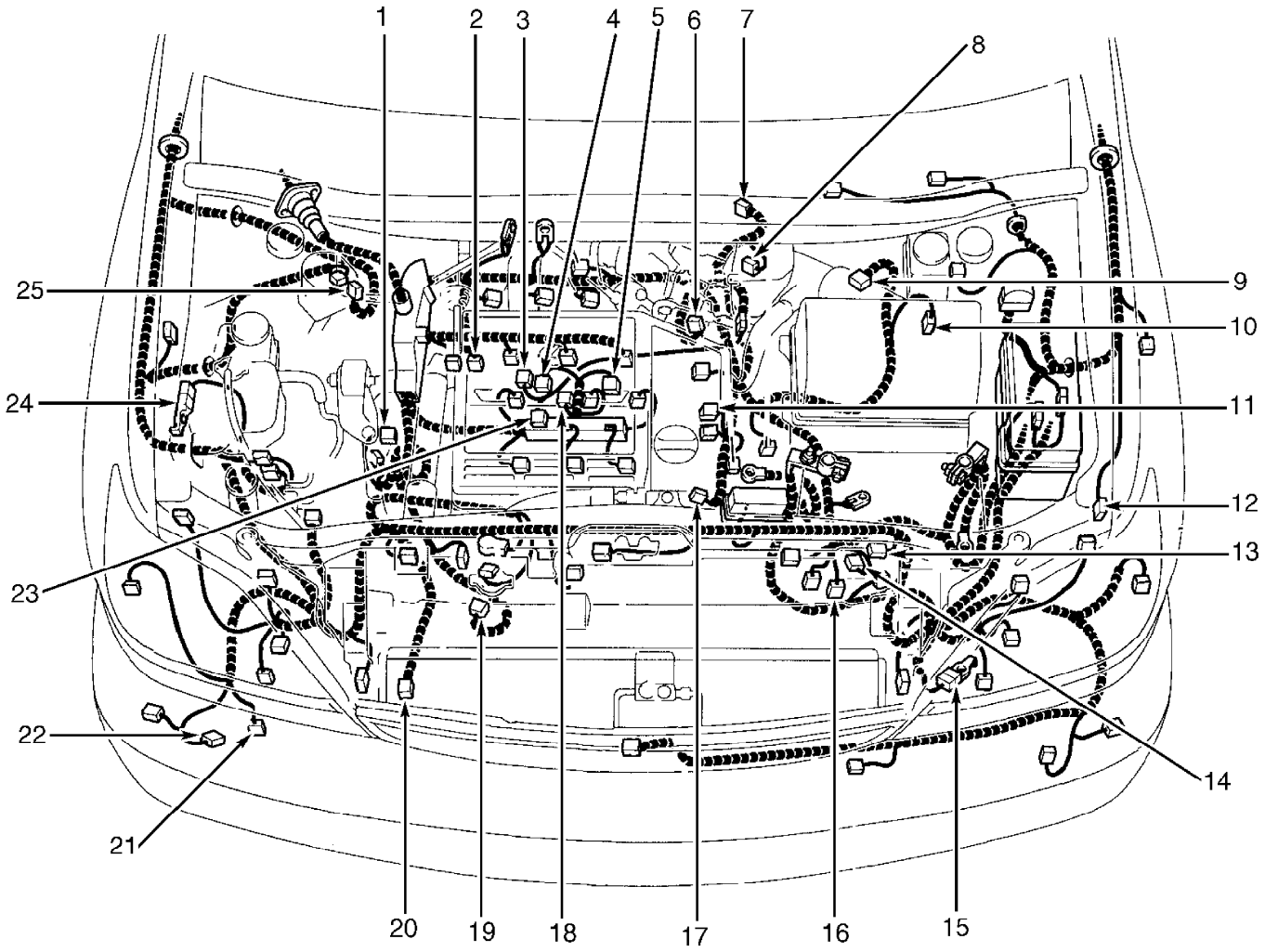
Crankshaft Position Sensor	On front side of engine.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

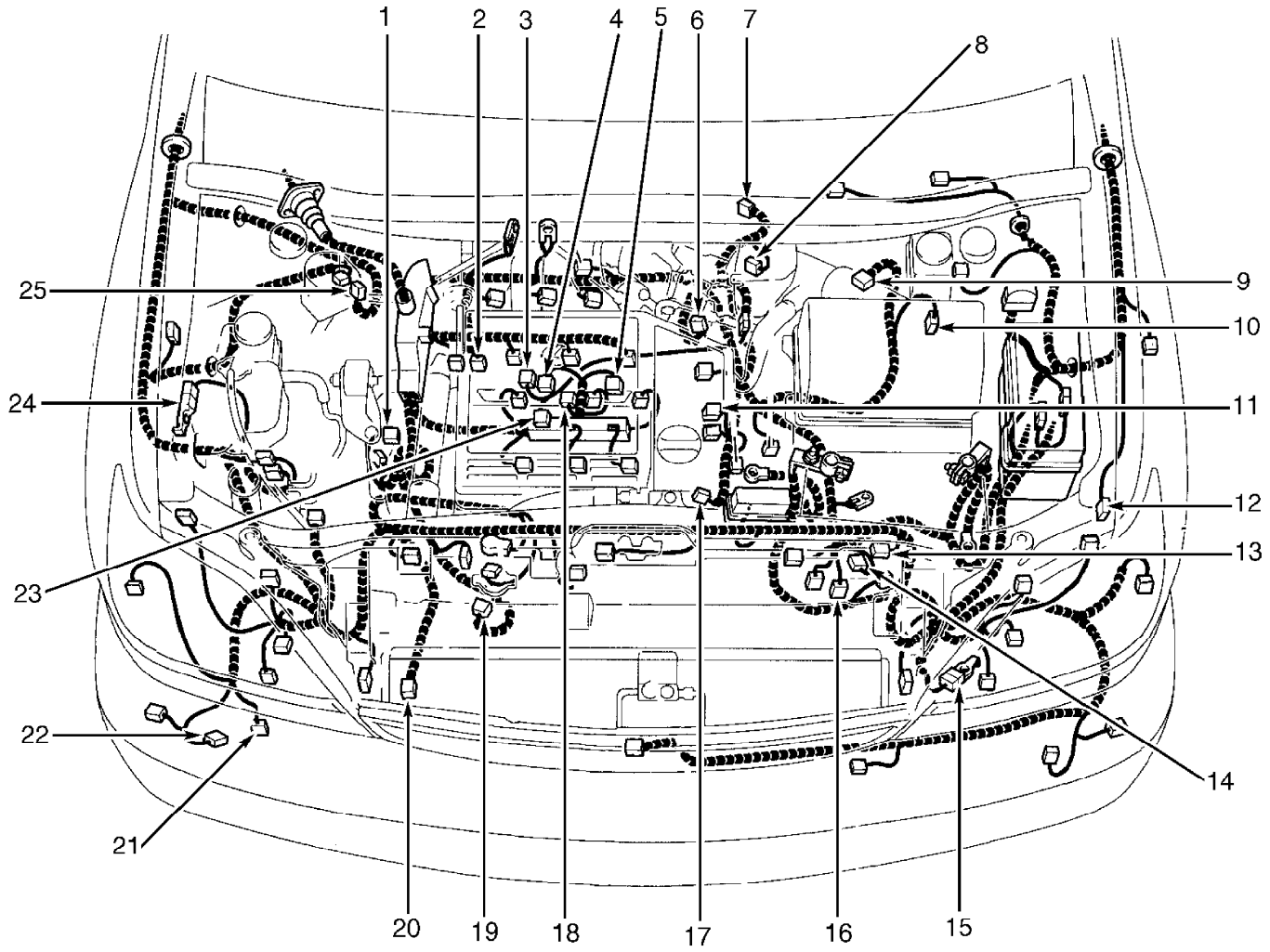
Engine Coolant Temperature Sensor	On top front of engine.
Heated Oxygen Sensor (Bank 1 Sensor 2)	In exhaust, rear of catalytic converter.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

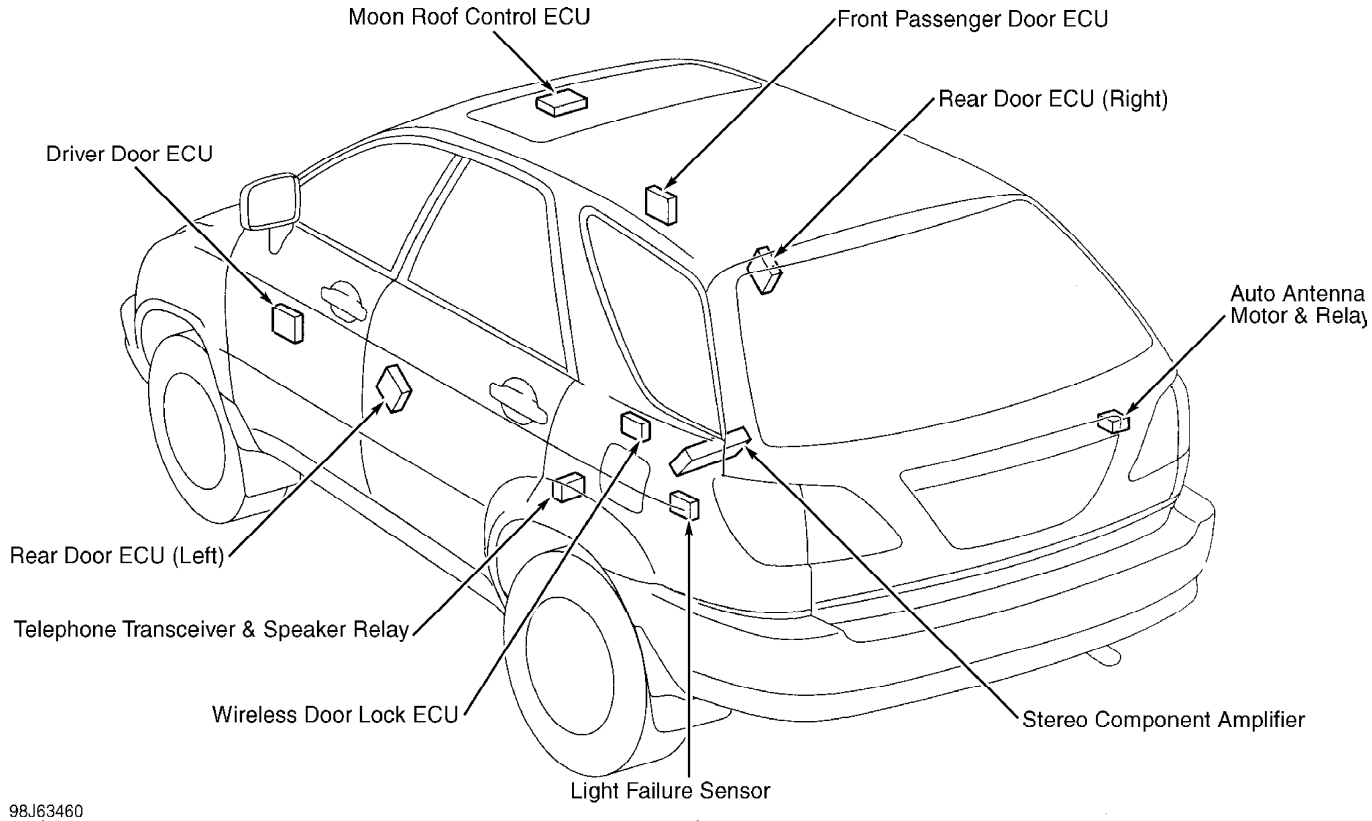
Knock Sensor No. 1	On top right side of engine, under intake manifold.



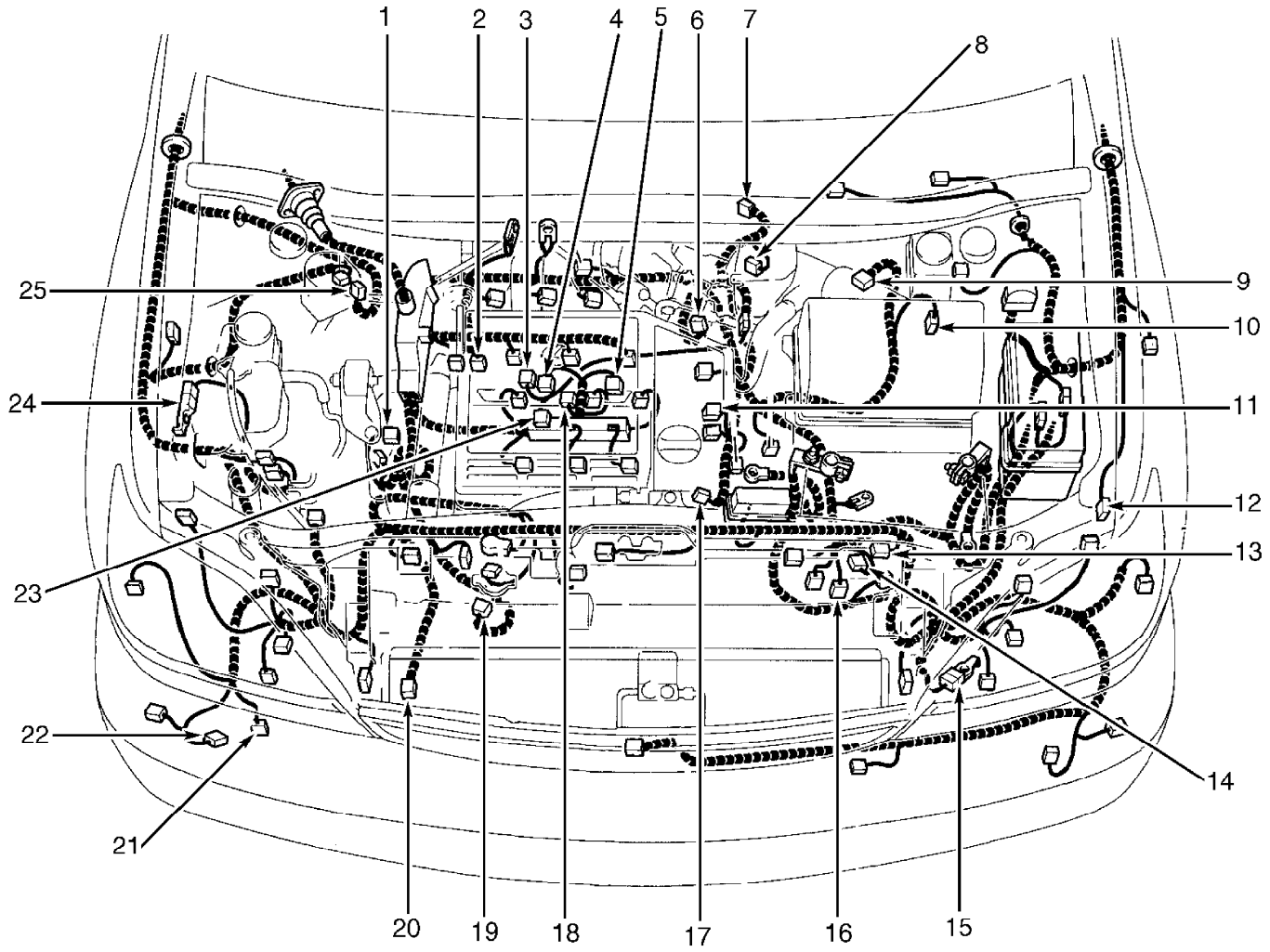
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Knock Sensor No. 2	On top left side of engine, under intake manifold.



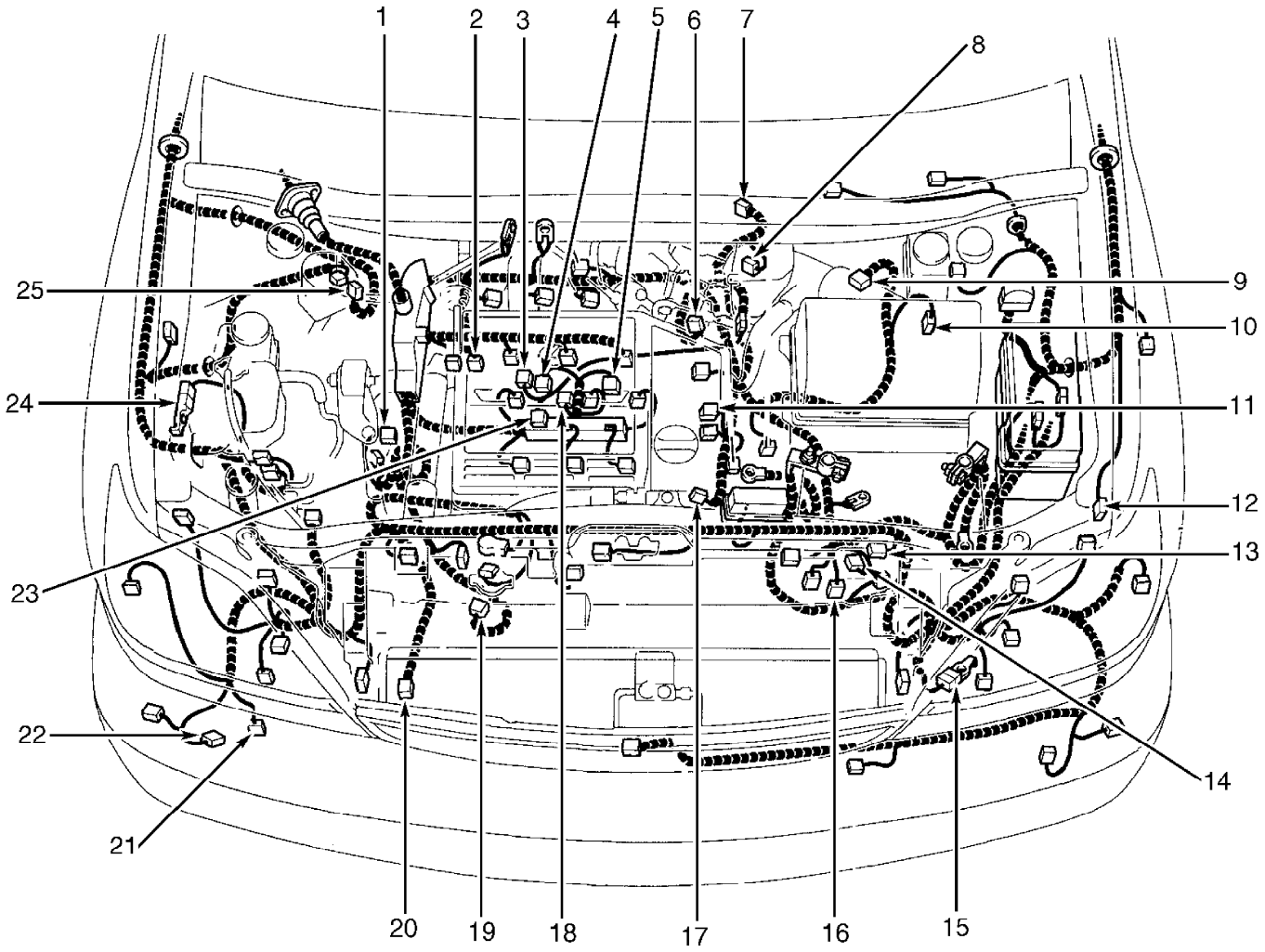
Light Failure Sensor	In left side of luggage compartment.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

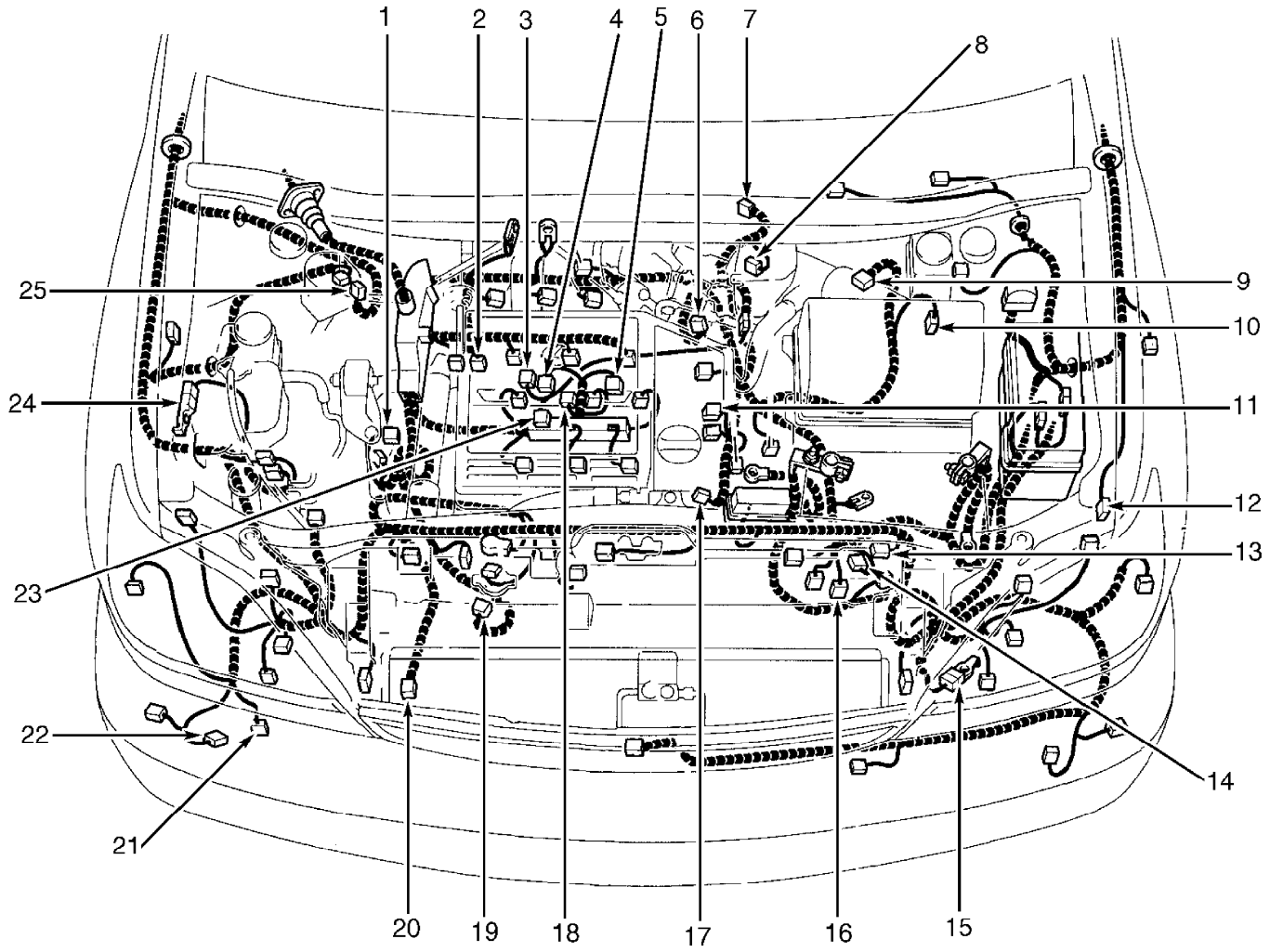
Mass Airflow (MAF) Meter	Near air cleaner housing, on air duct.
Seat Belt Warning Occupant Detection Sensor	Under passenger's seat.
Side Air Bag Sensor (Left/Right)	At base of respective "B" pillar.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

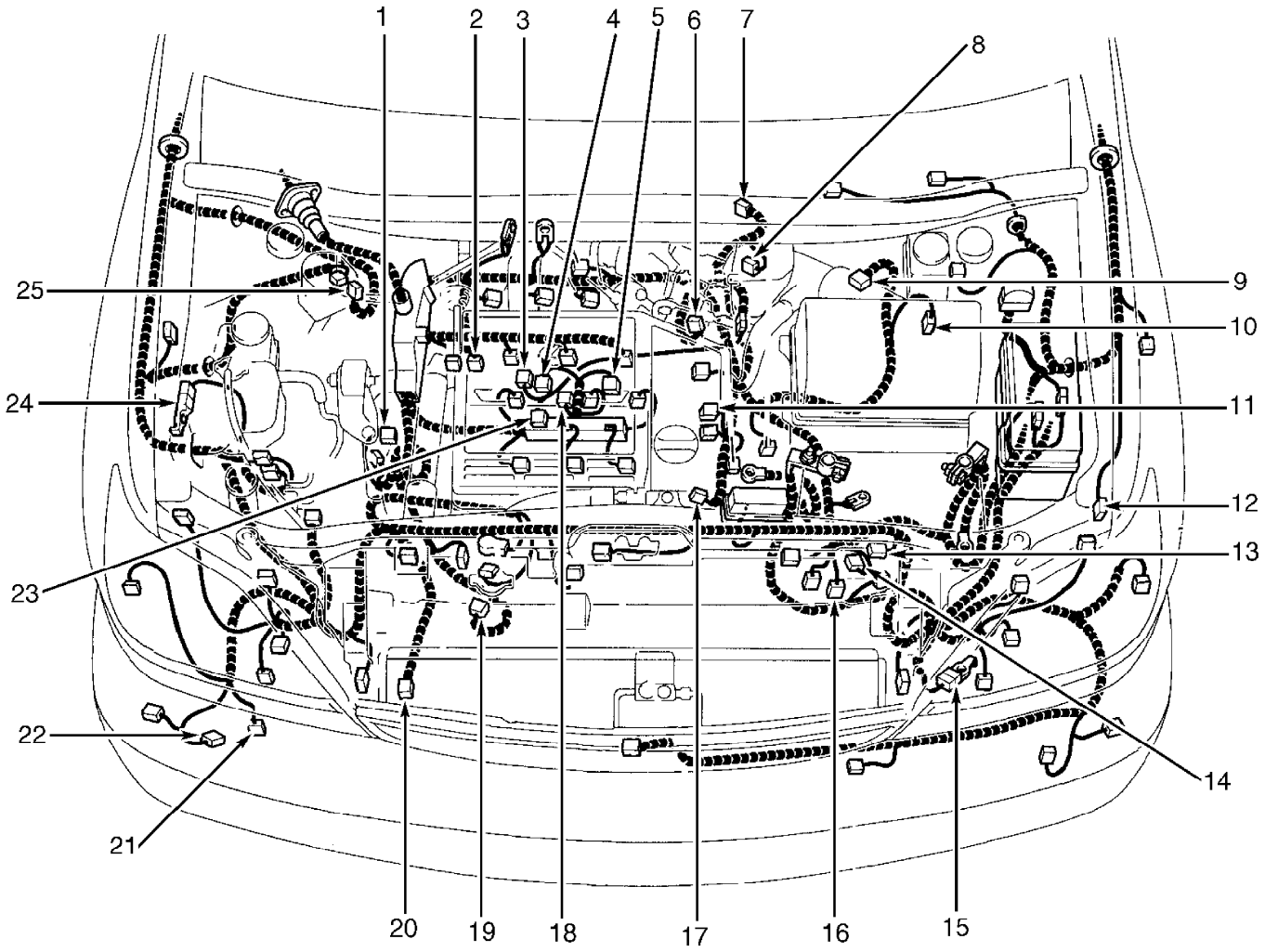
Throttle Position Sensor	On throttle body.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

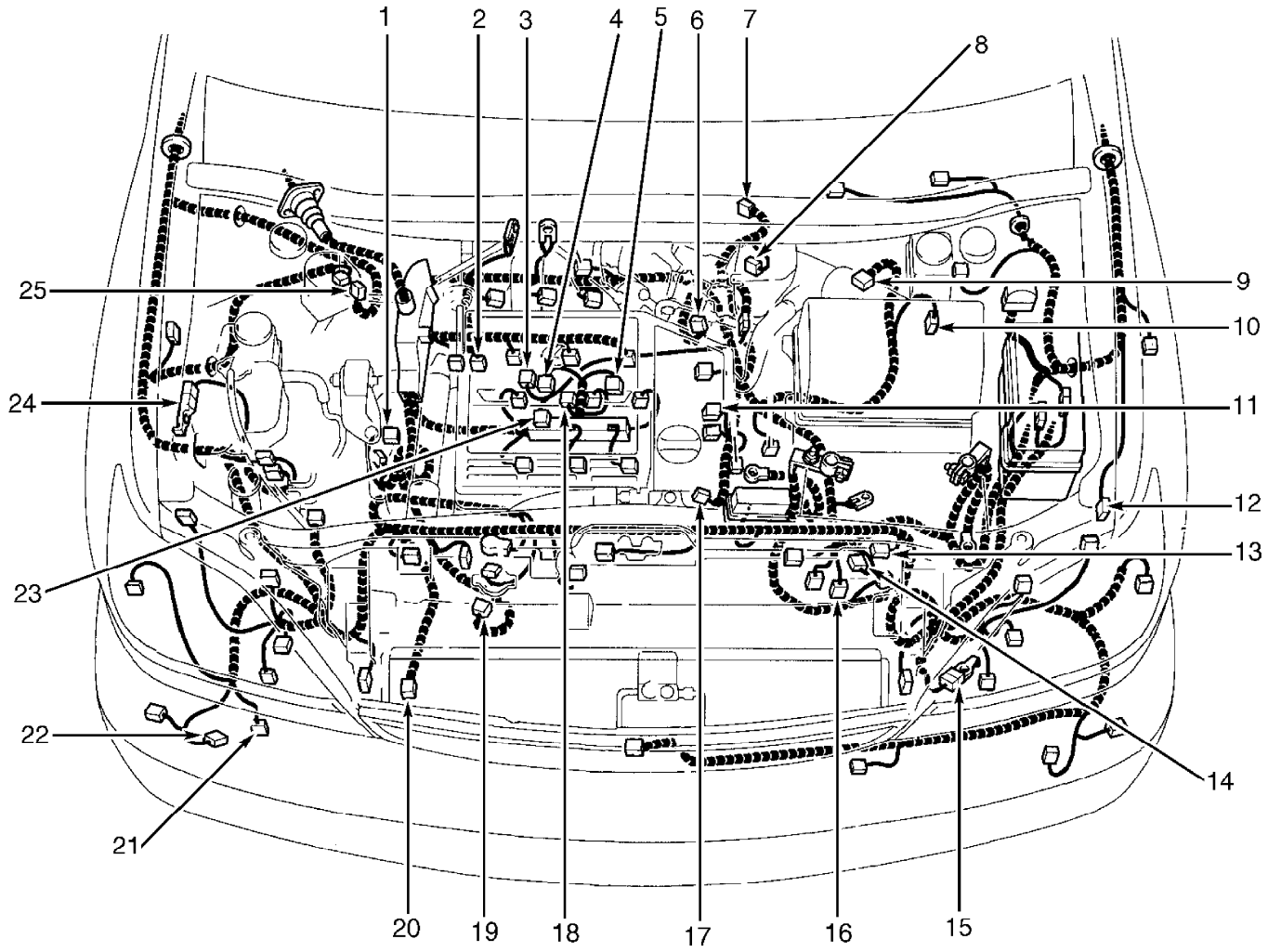
Turbine Speed Sensor	On transaxle housing.
Vapor Pressure Sensor	Under center rear of vehicle.
VSV (Vapor Pressure Sensor)	Under center rear of vehicle.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

VVT Sensor (Left) On left rear of engine.



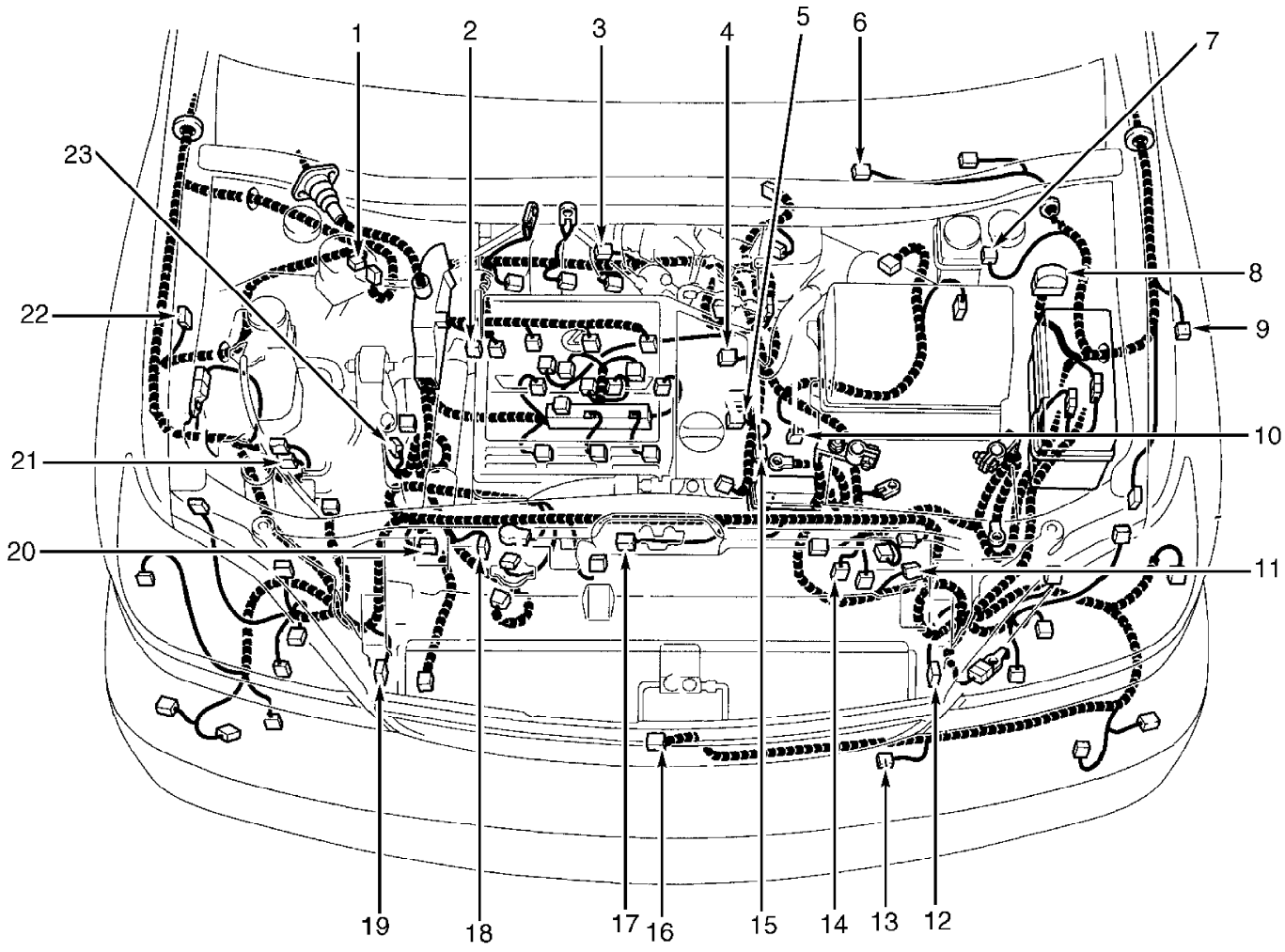
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

VVT Sensor (Right)	On right rear of engine.

SOLENOIDS & SOLENOID VALVES

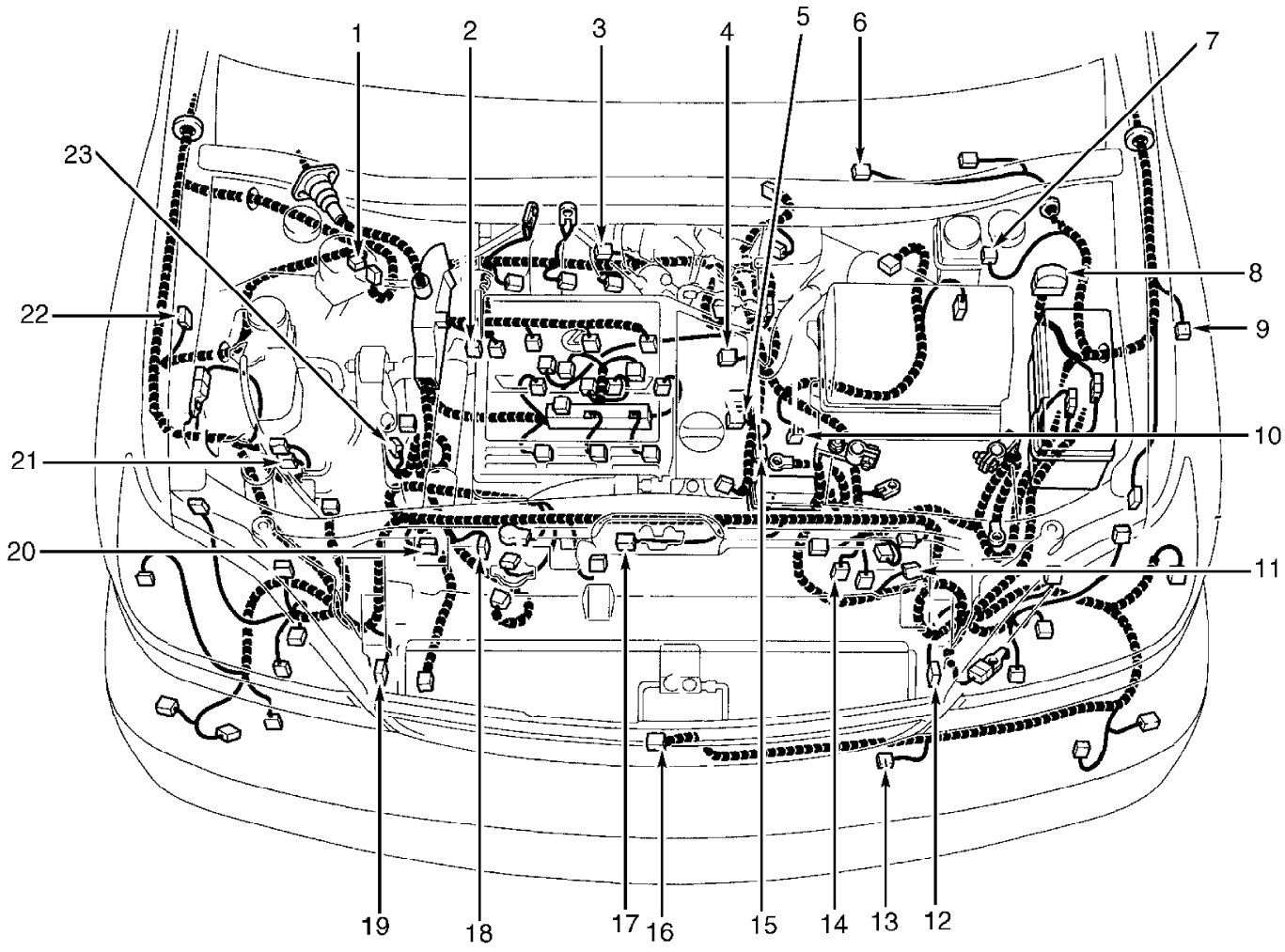
Component	Component Location



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

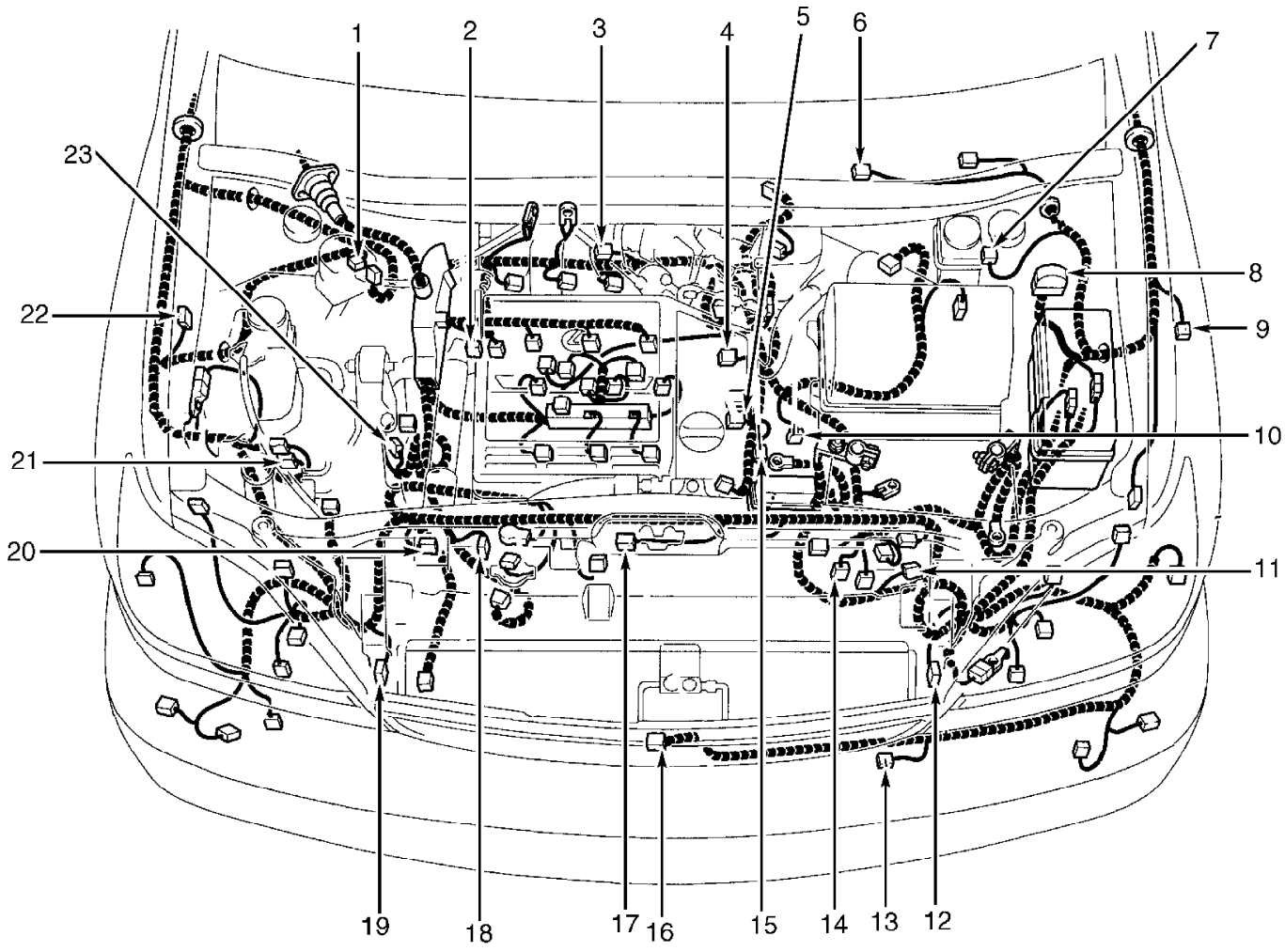
Camshaft Timing Oil Control Valve (Left)	On top left rear of engine.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

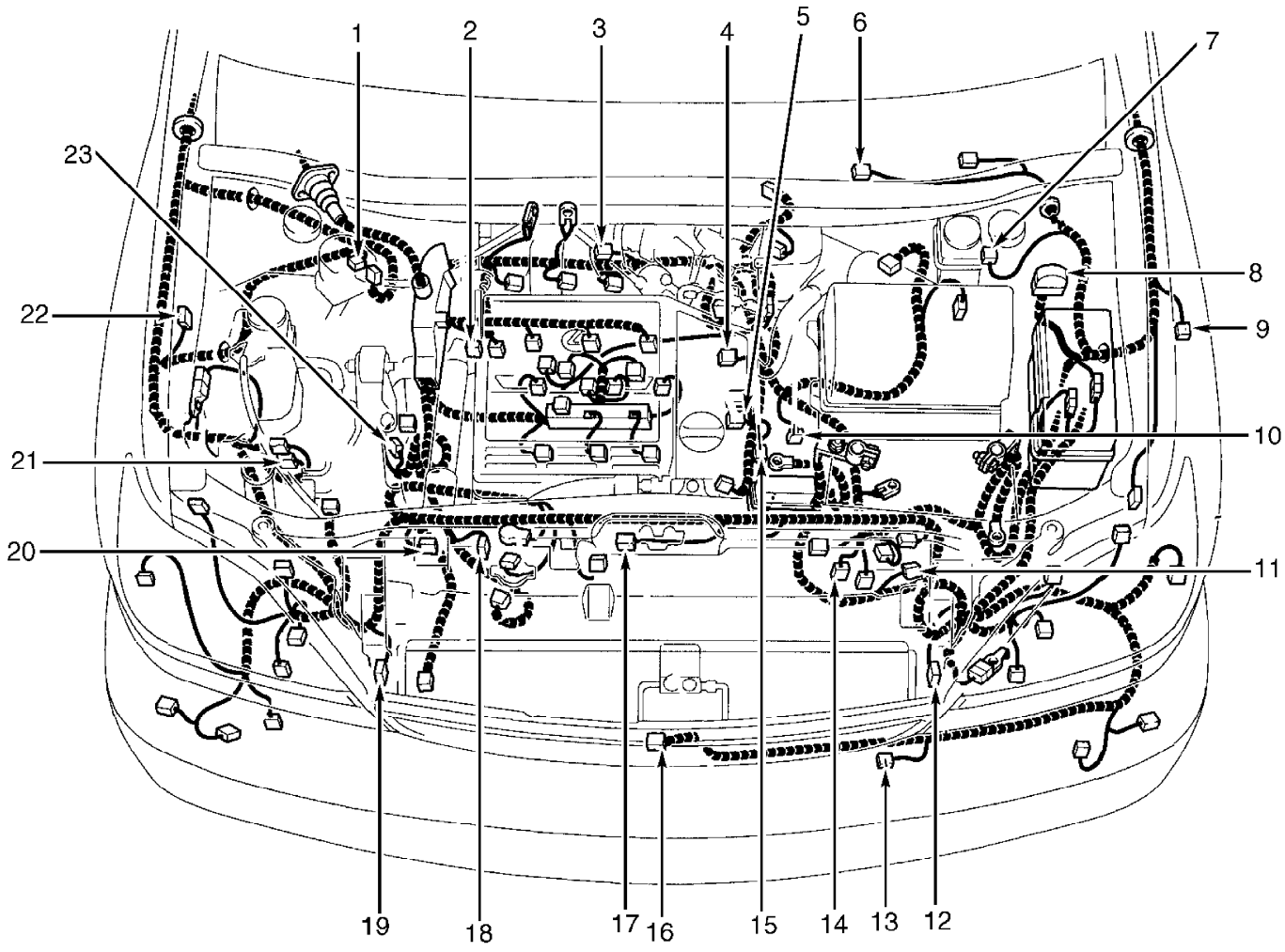
Camshaft Timing Oil Control Valve (Right)	On top right rear of engine.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

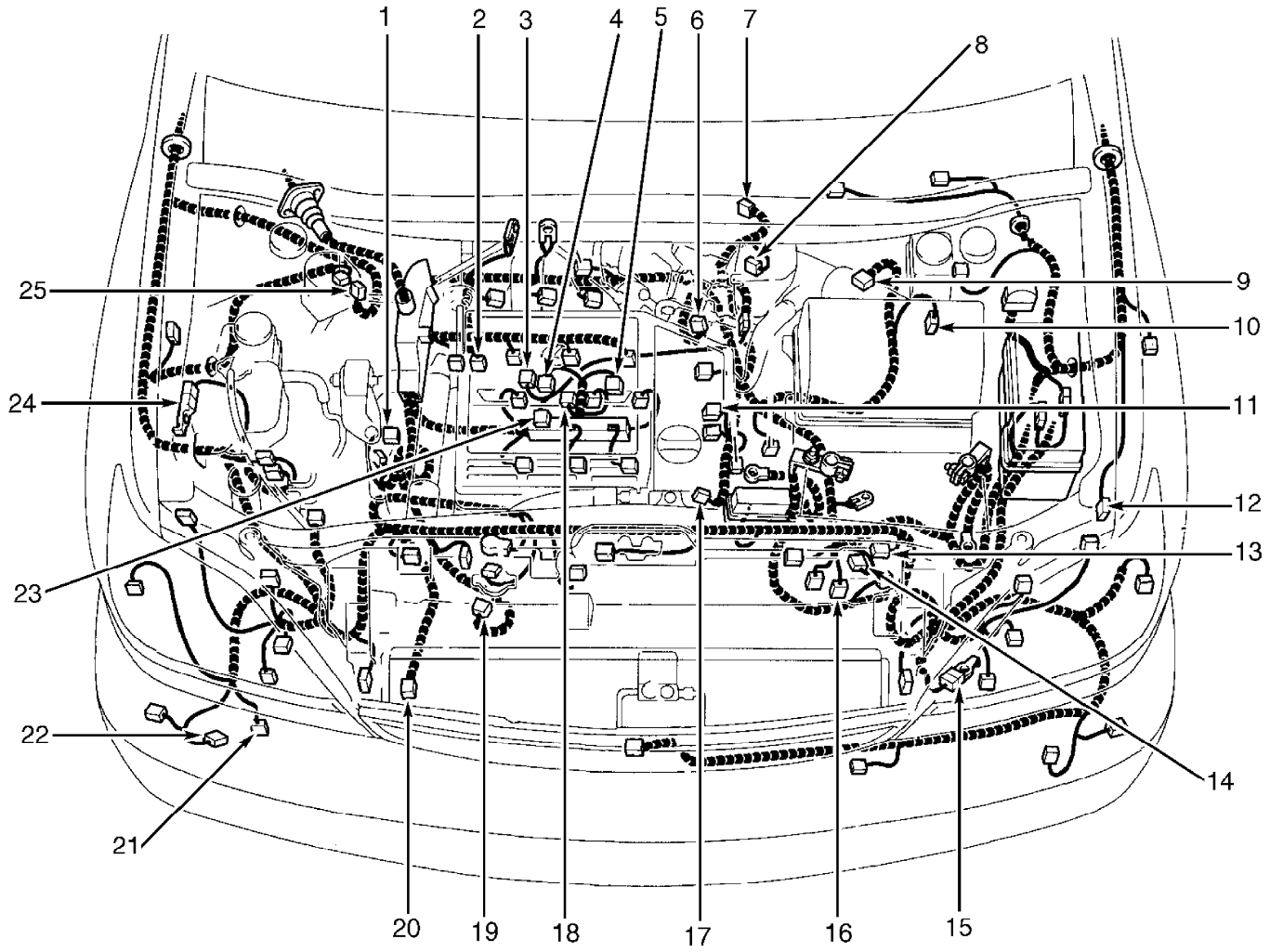
Cruise Control Actuator	On left rear of engine.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

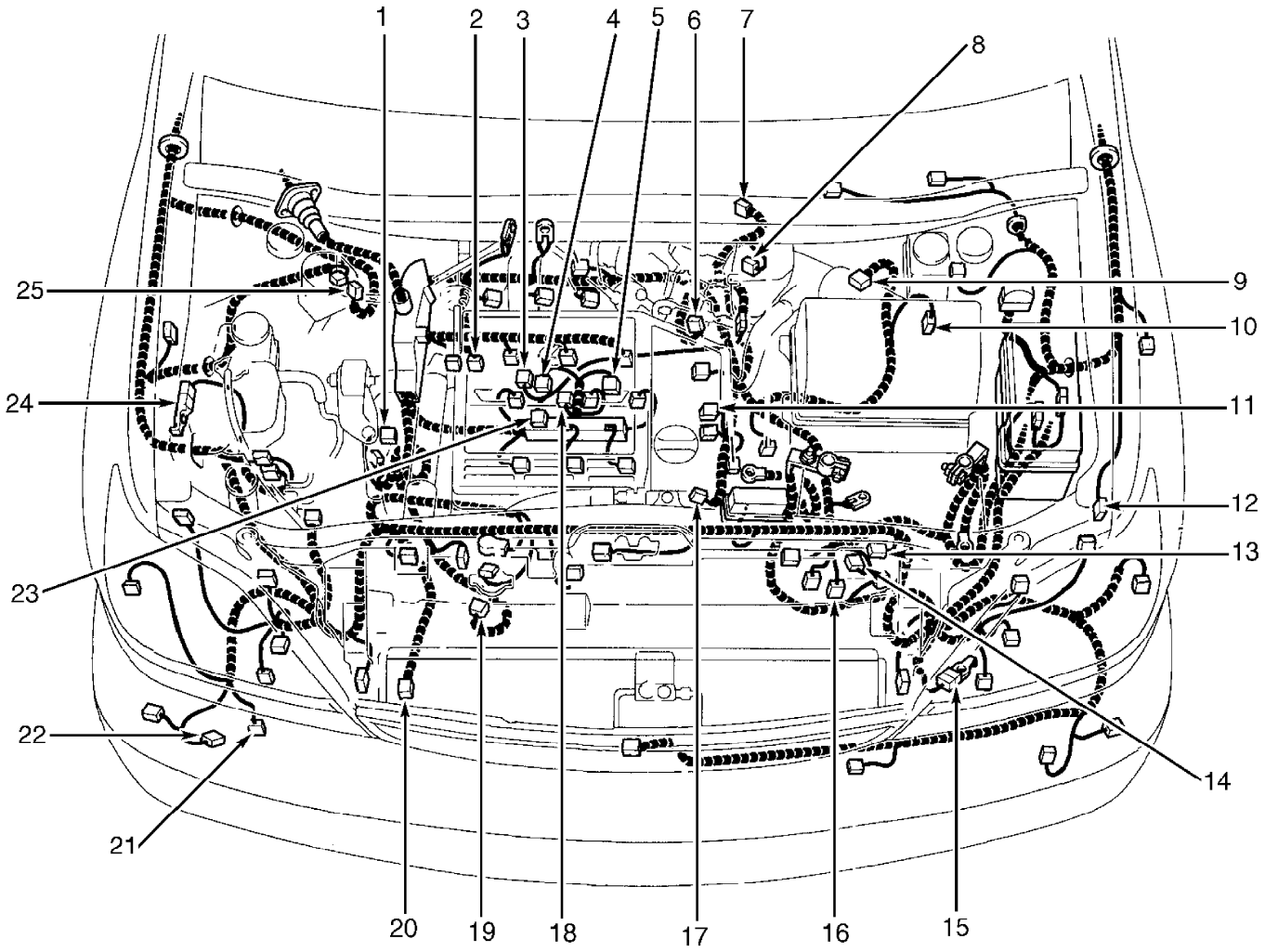
Electronically Controlled Transmission Solenoid	In transaxle.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

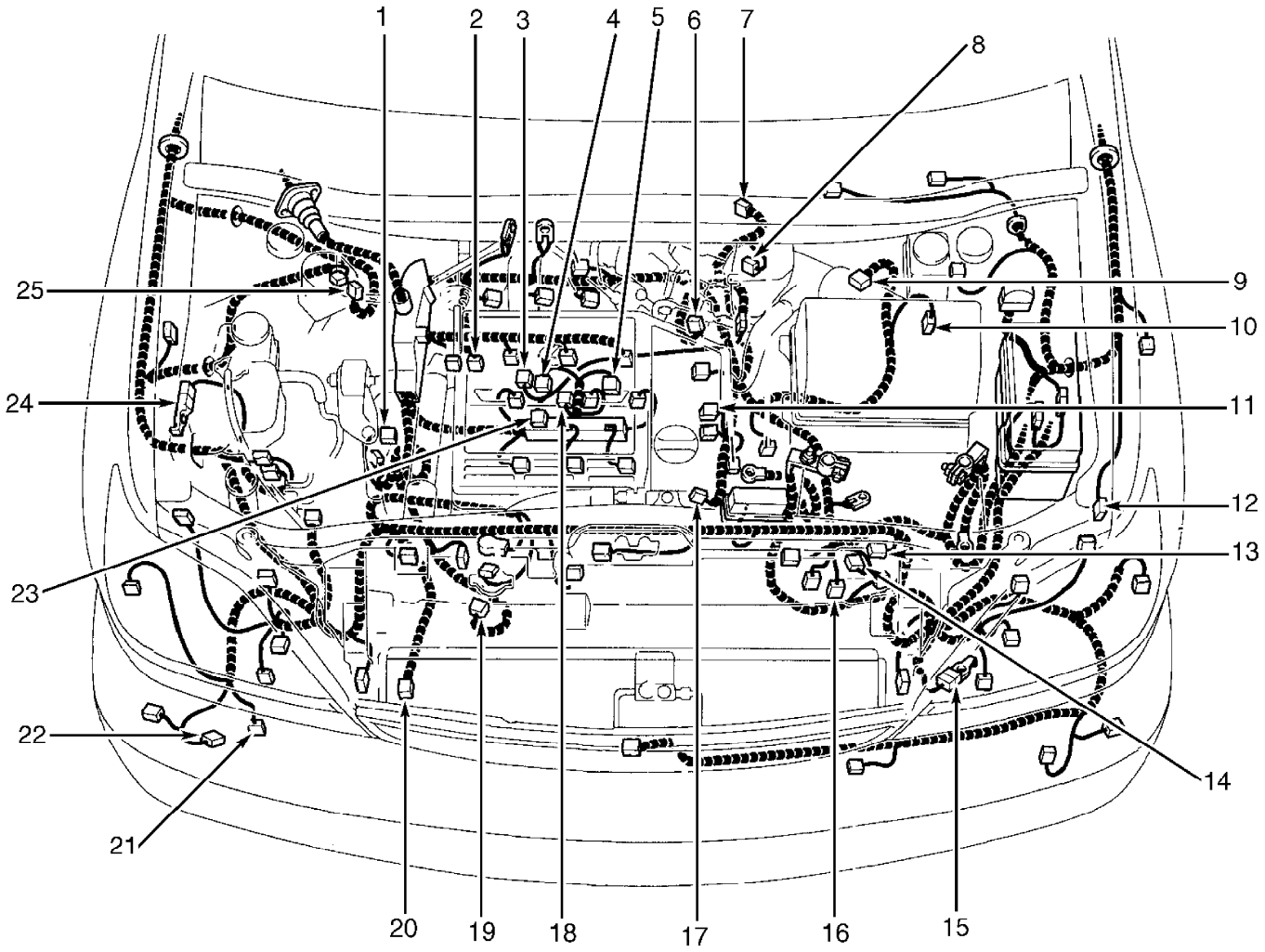
Idle Air Control Valve	On top right rear of engine.
Tension Reducer Solenoid (Left/Right)	At base of respective "B" pillar.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

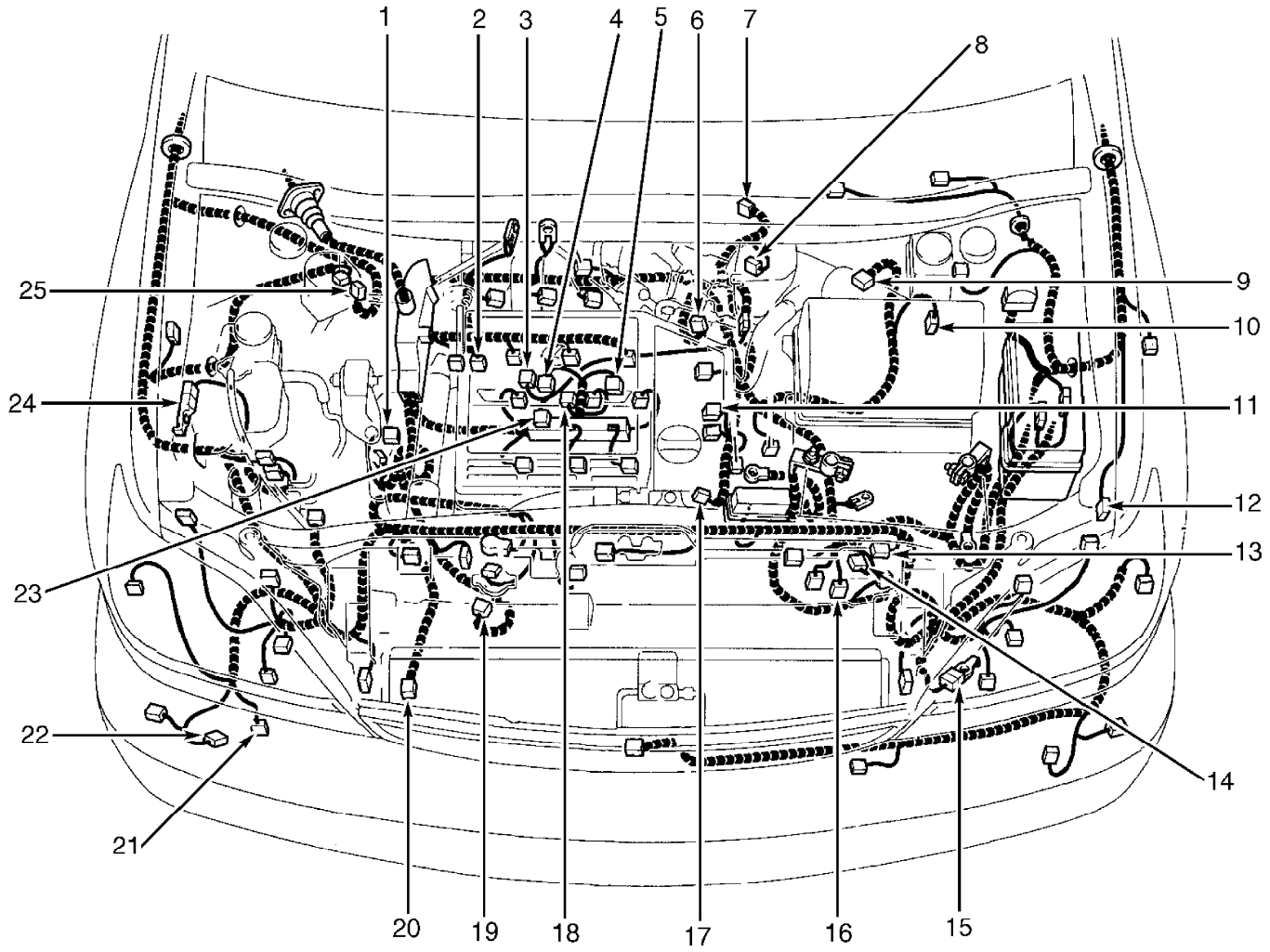
VSV (ACIS No. 1) On top center of engine.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

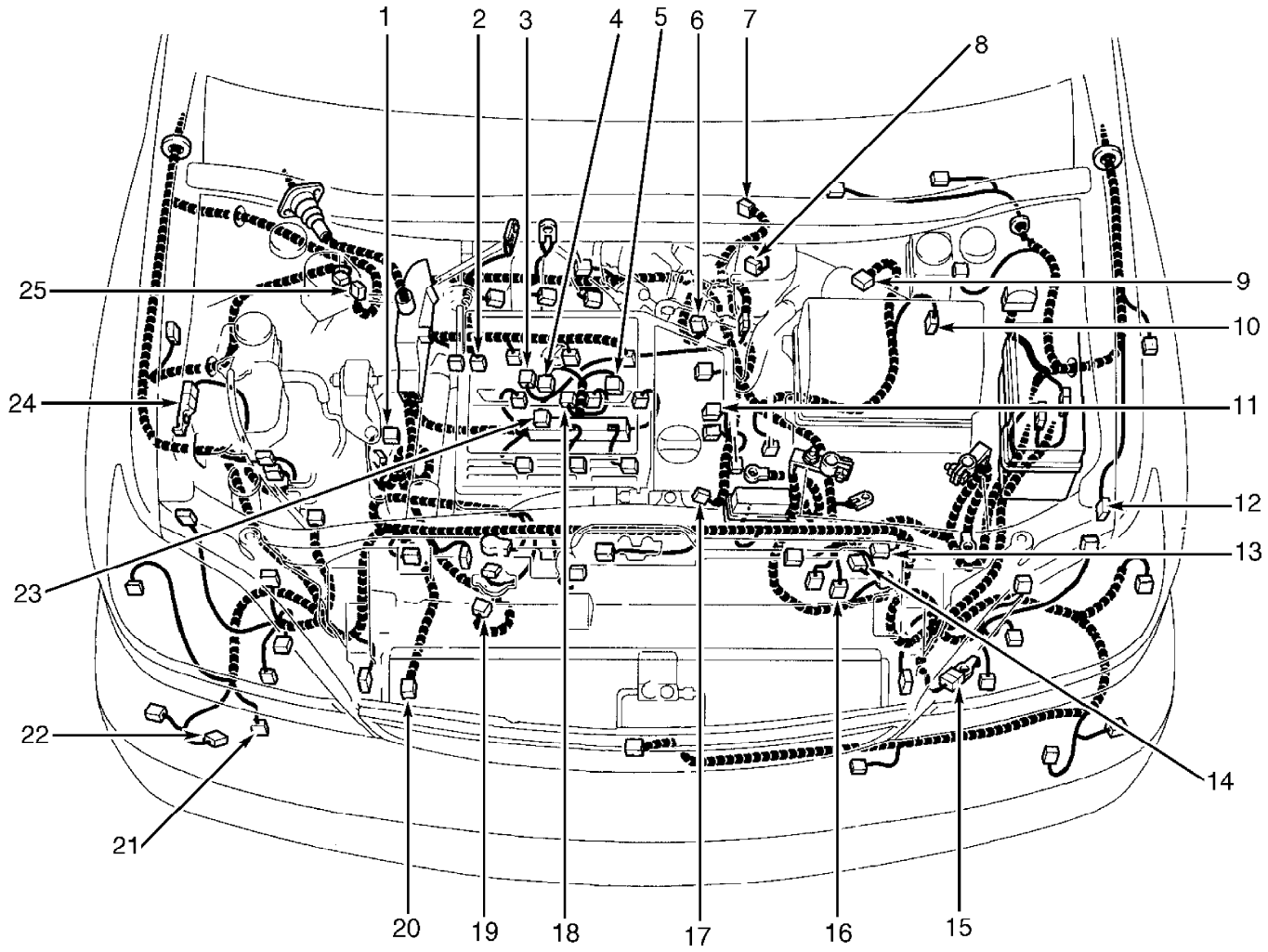
VSV (ACIS No. 2) On top center of engine.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

VSV (ACM)	On right front center of engine compartment.



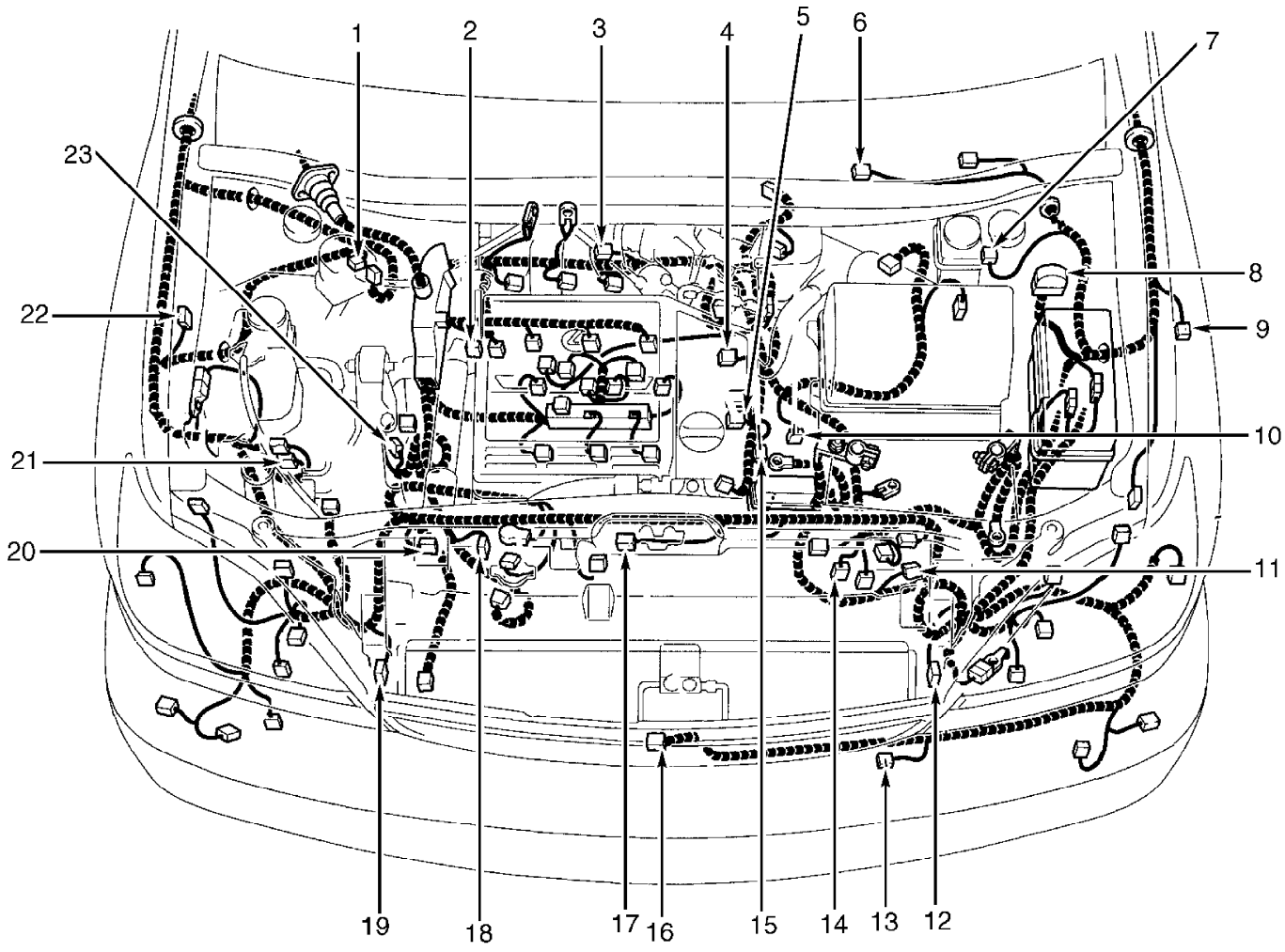
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

VSV (EVAP)	On top center of engine.

SWITCHES

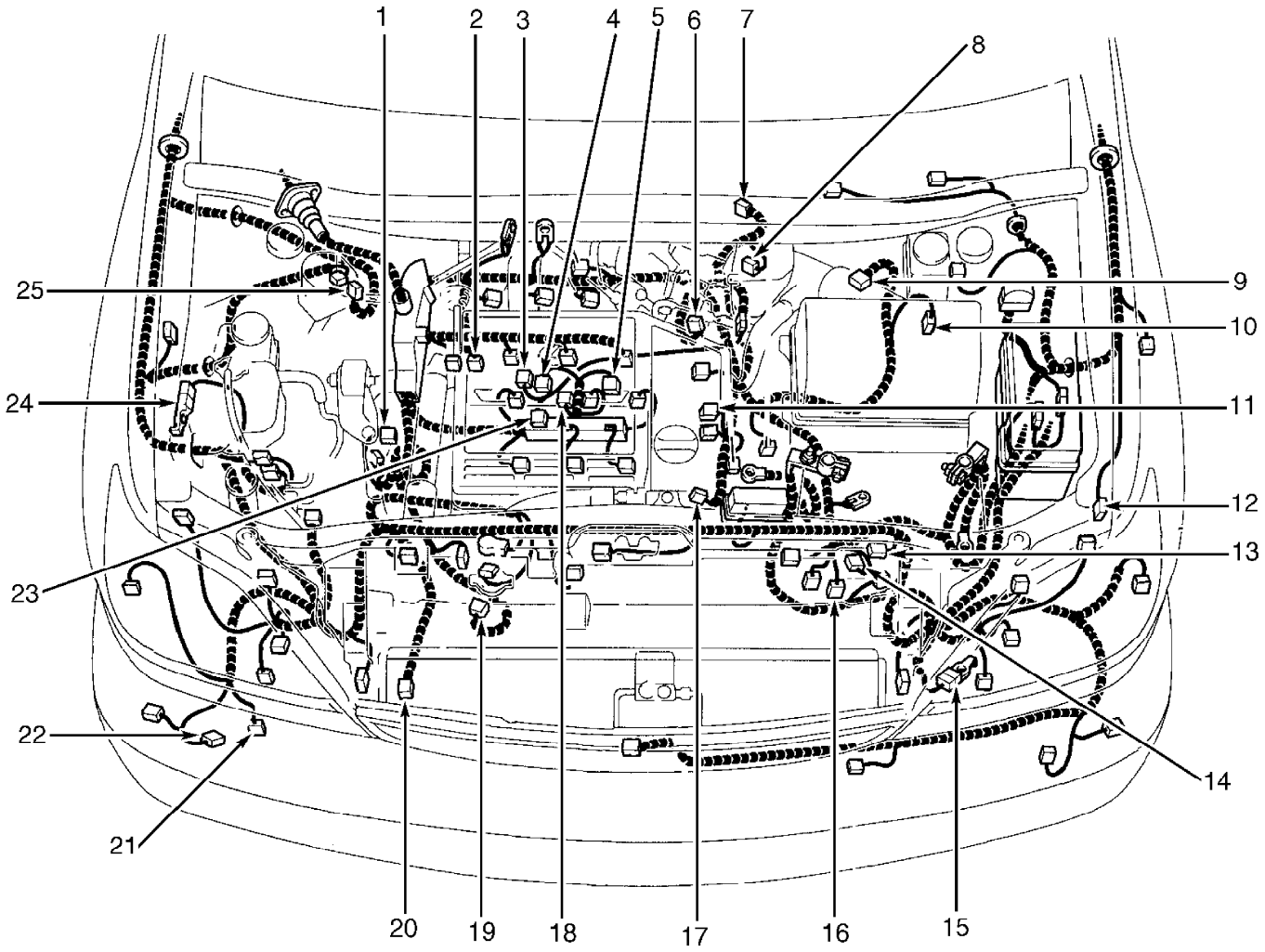
Component	Component Location



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

A/C Triple Pressure Switch	On refrigerant line, near receiver-drier.

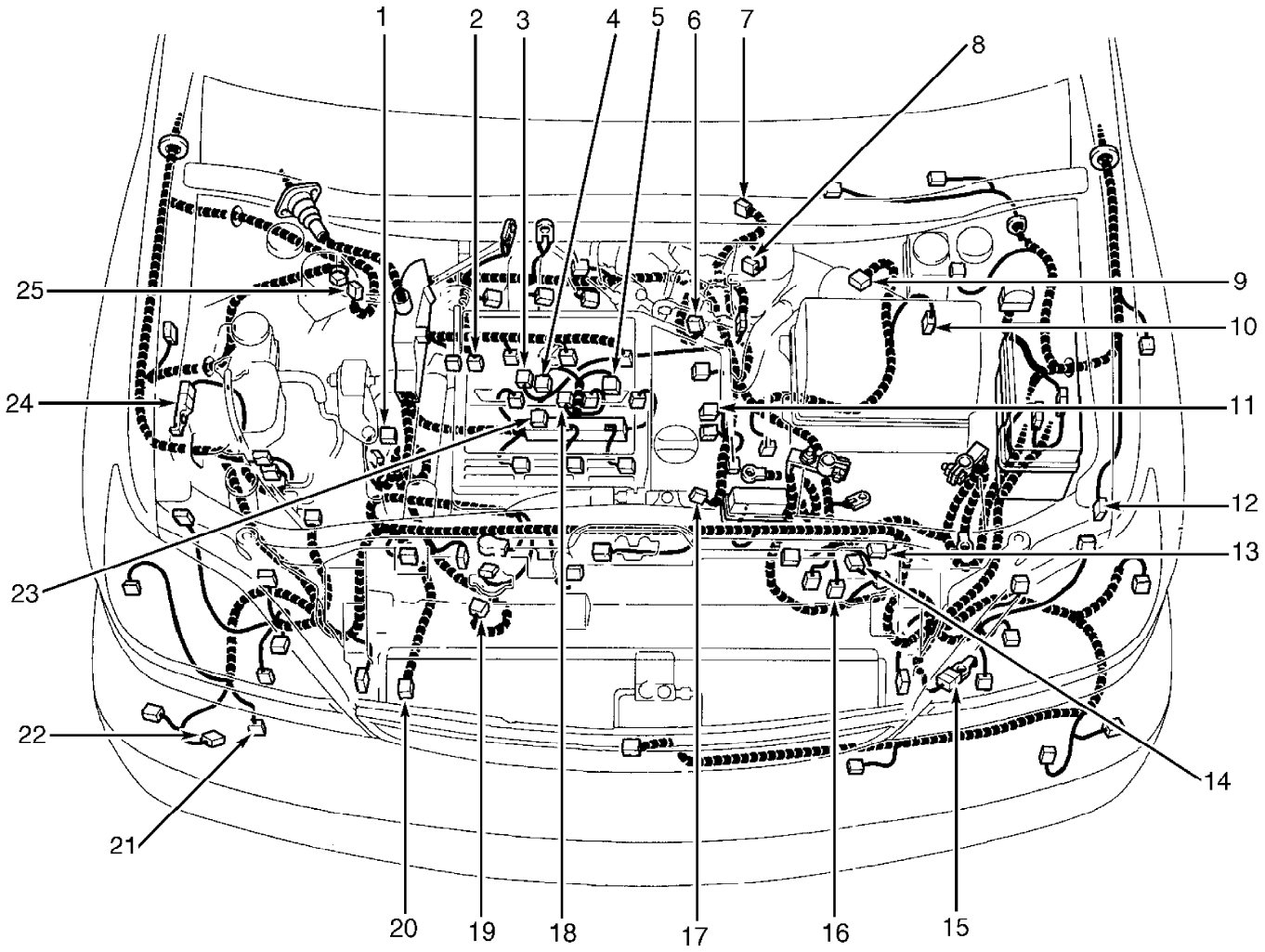


1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

A/T Indicator Switch

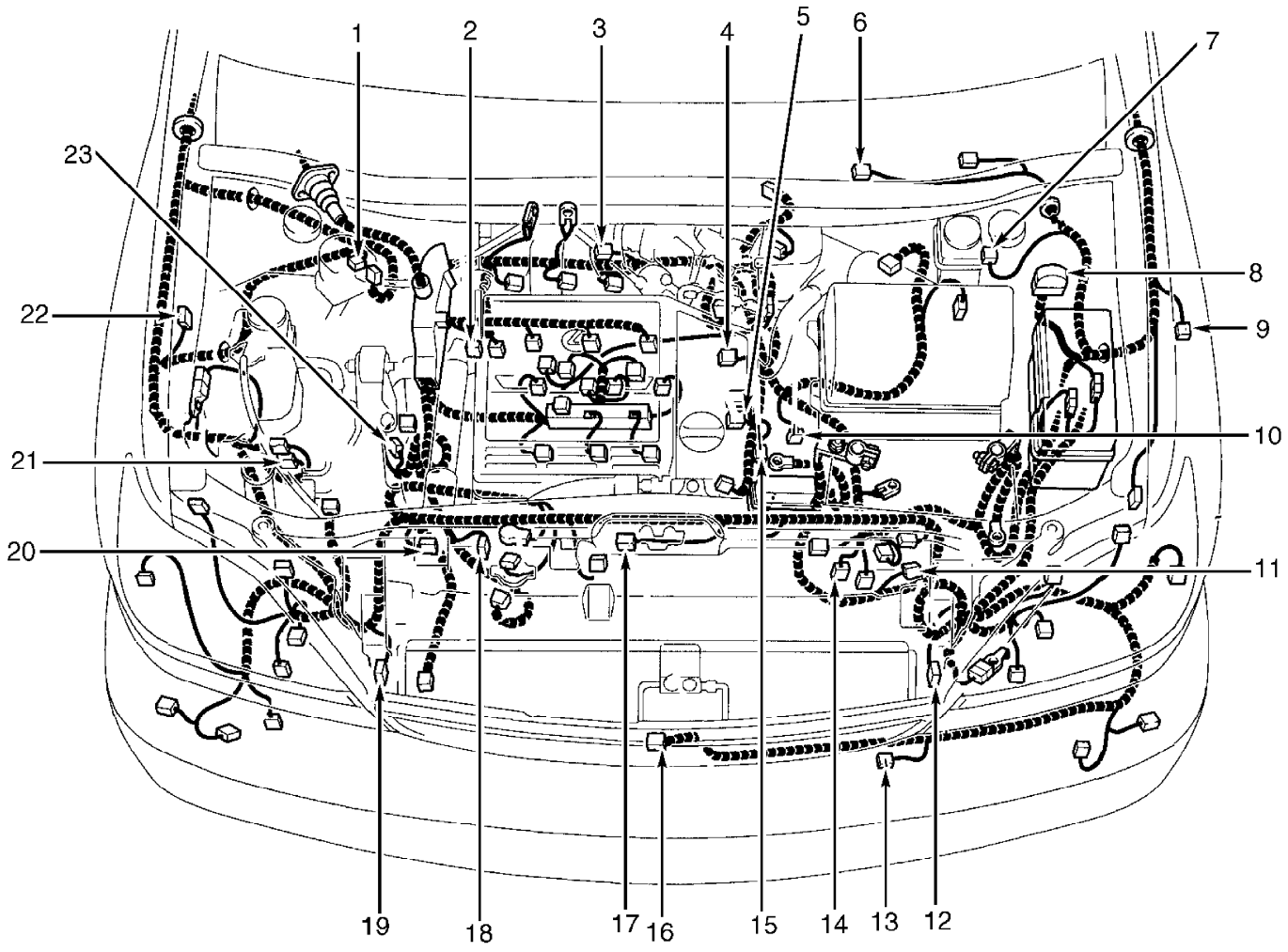
Integral to park/neutral position switch.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

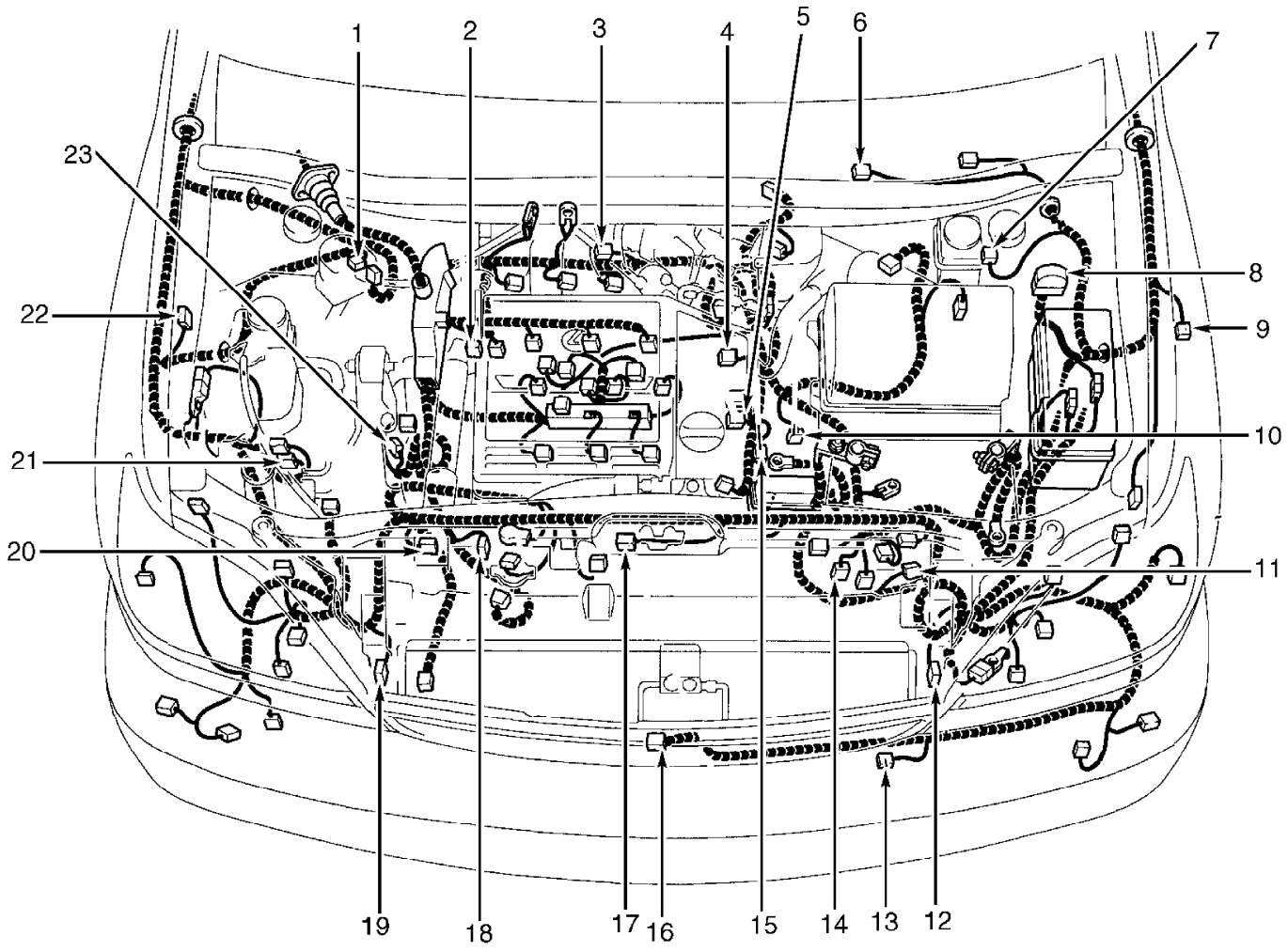
Back-Up Light Switch — Integral to park/neutral position switch.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

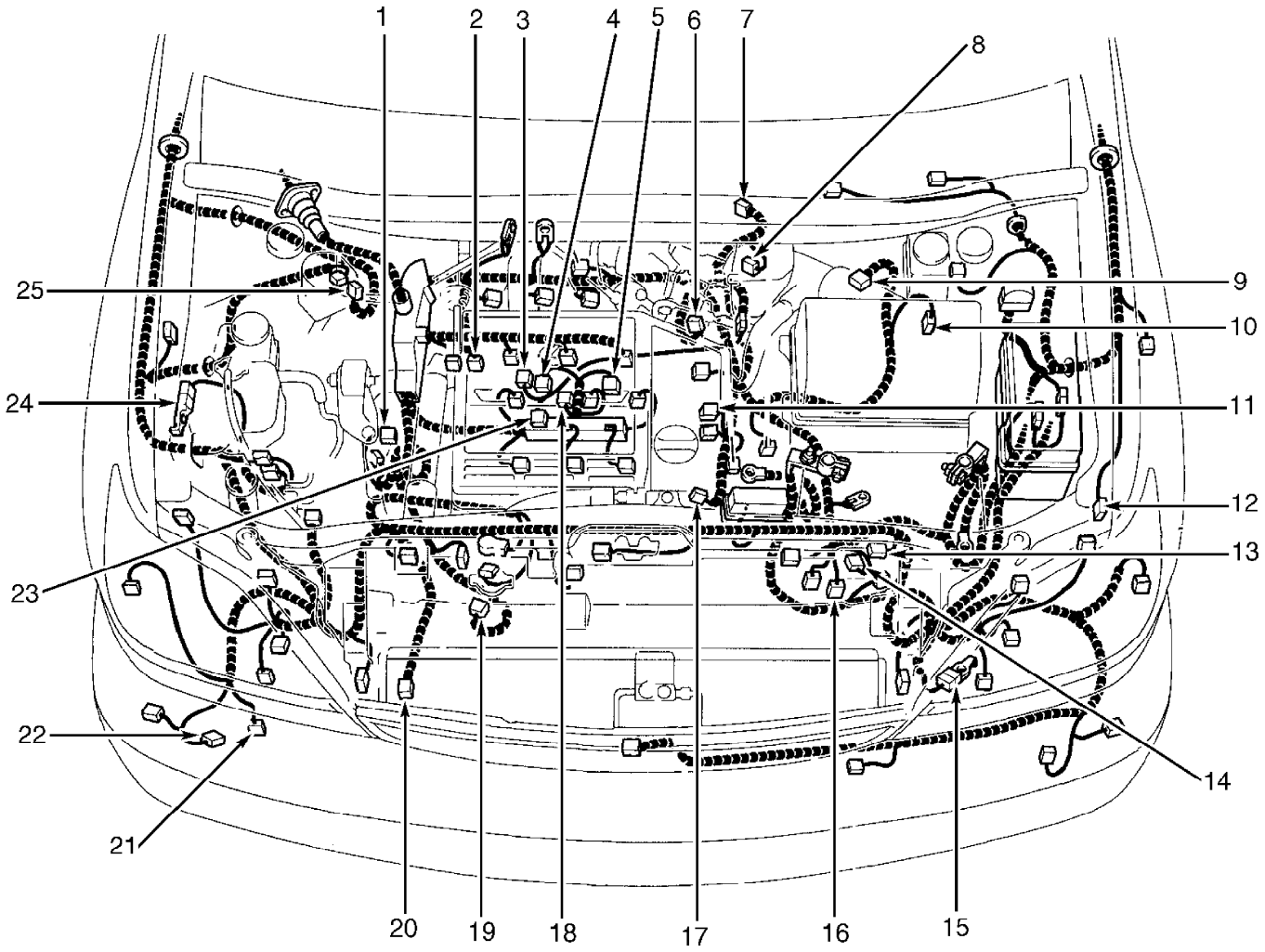
Brake Fluid Level Switch	In brake fluid reservoir.
Buckle Switch (Left/Right)	On respective seat belt buckle.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

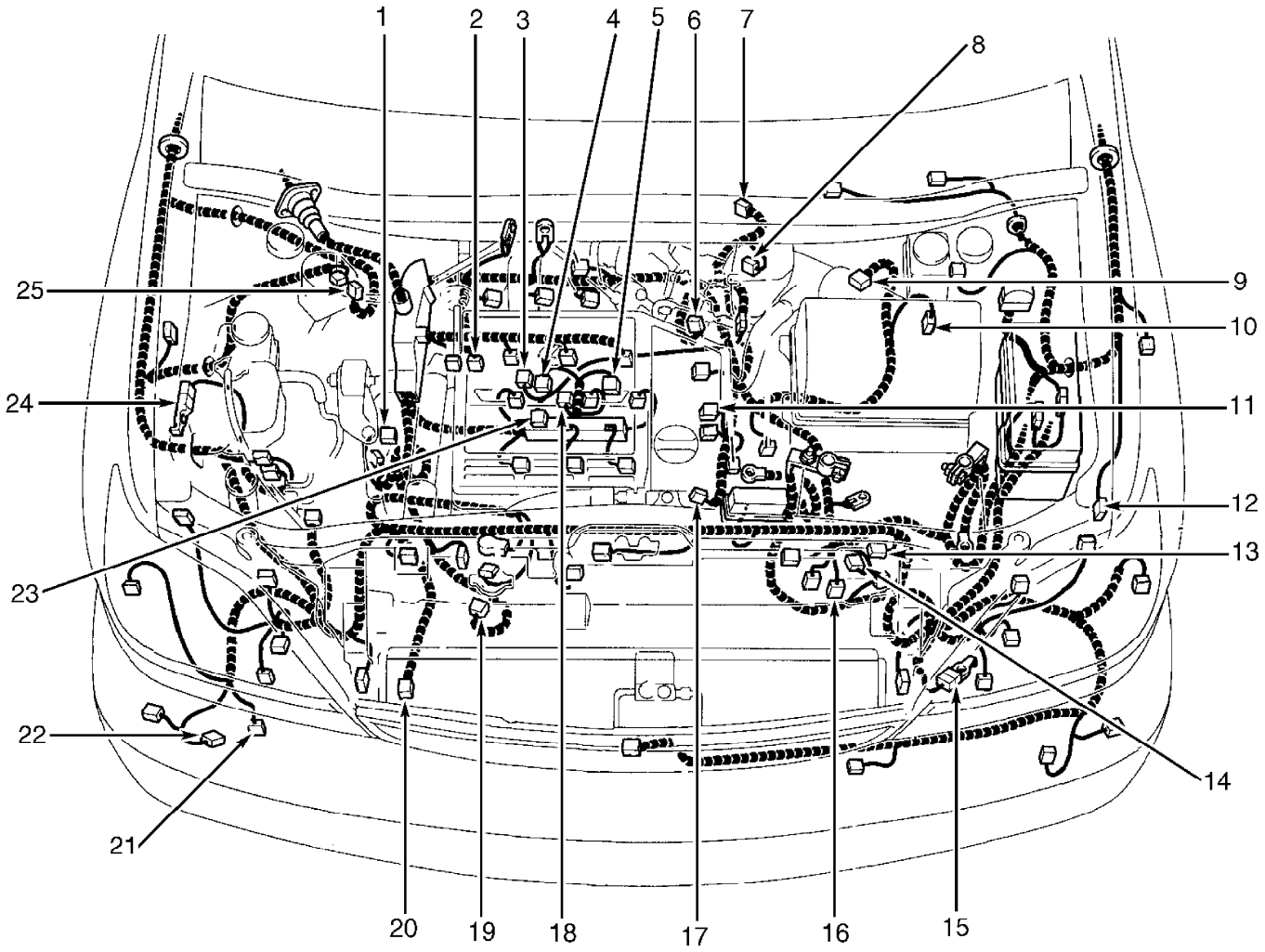
Engine Hood Courtesy Switch	On front center of engine compartment.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

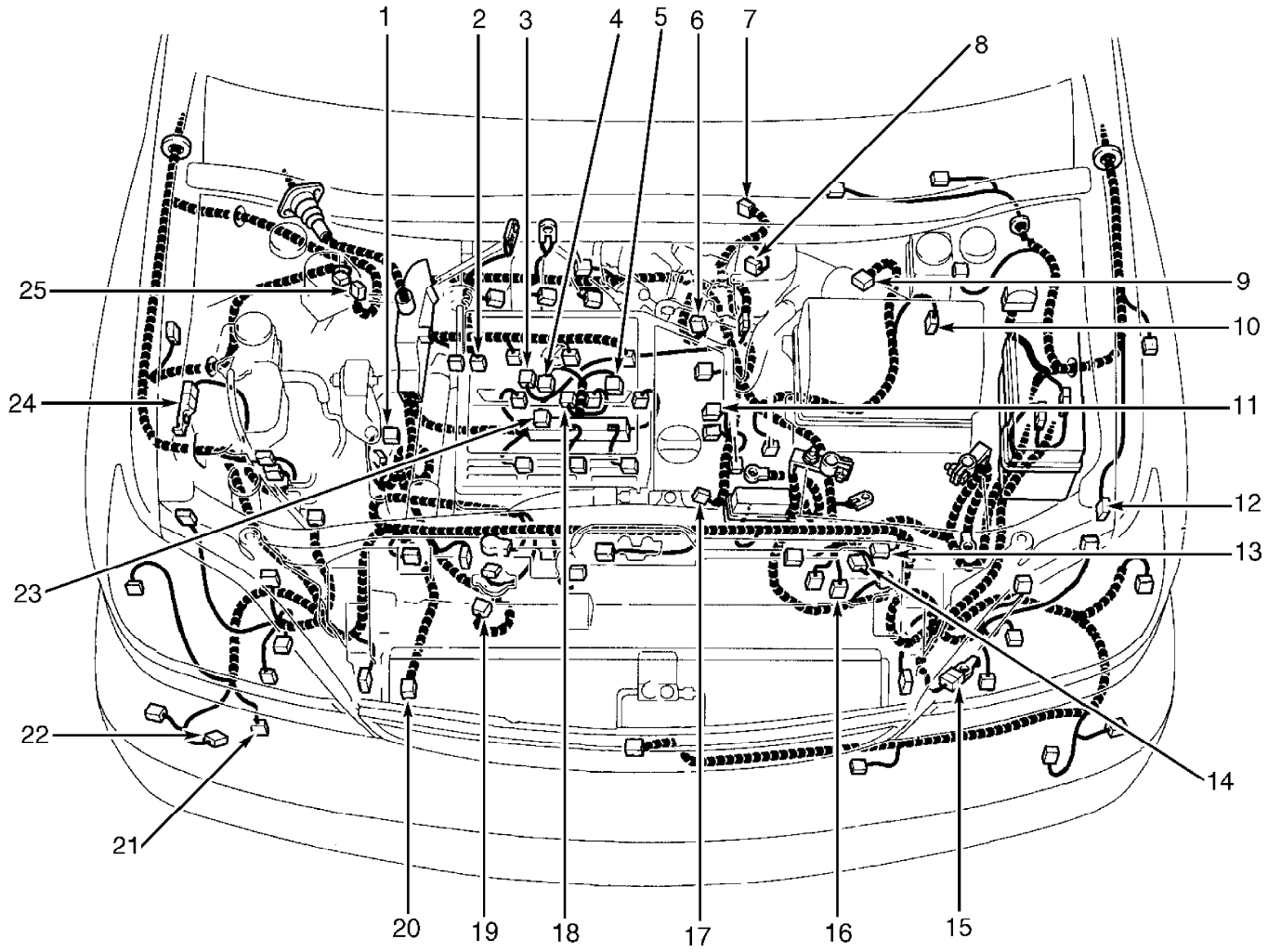
Oil Pressure Switch	On left front corner of engine.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

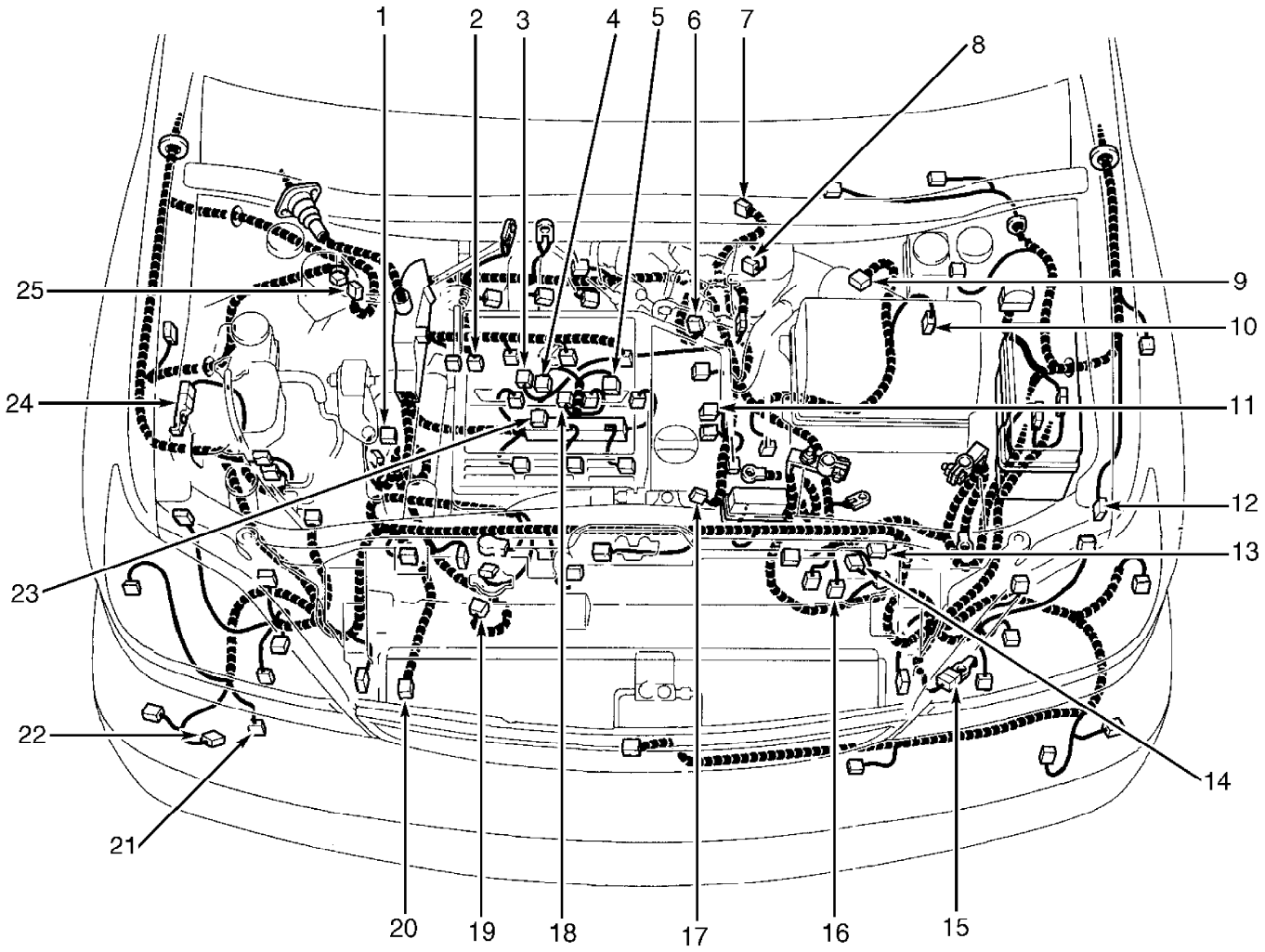
Park/Neutral Position Switch On transaxle.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

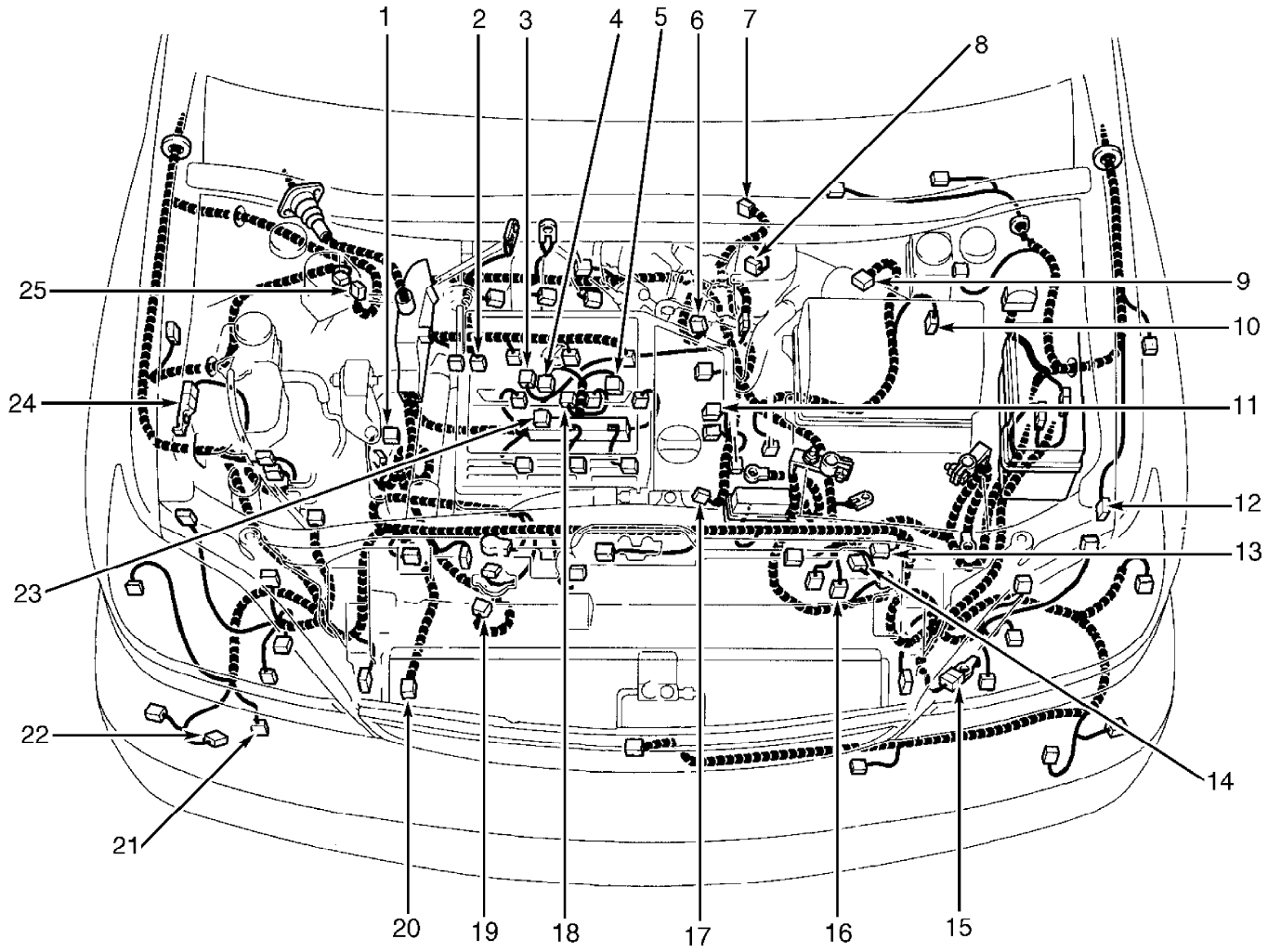
Power Steering Oil Pressure Switch	In right rear of engine compartment.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

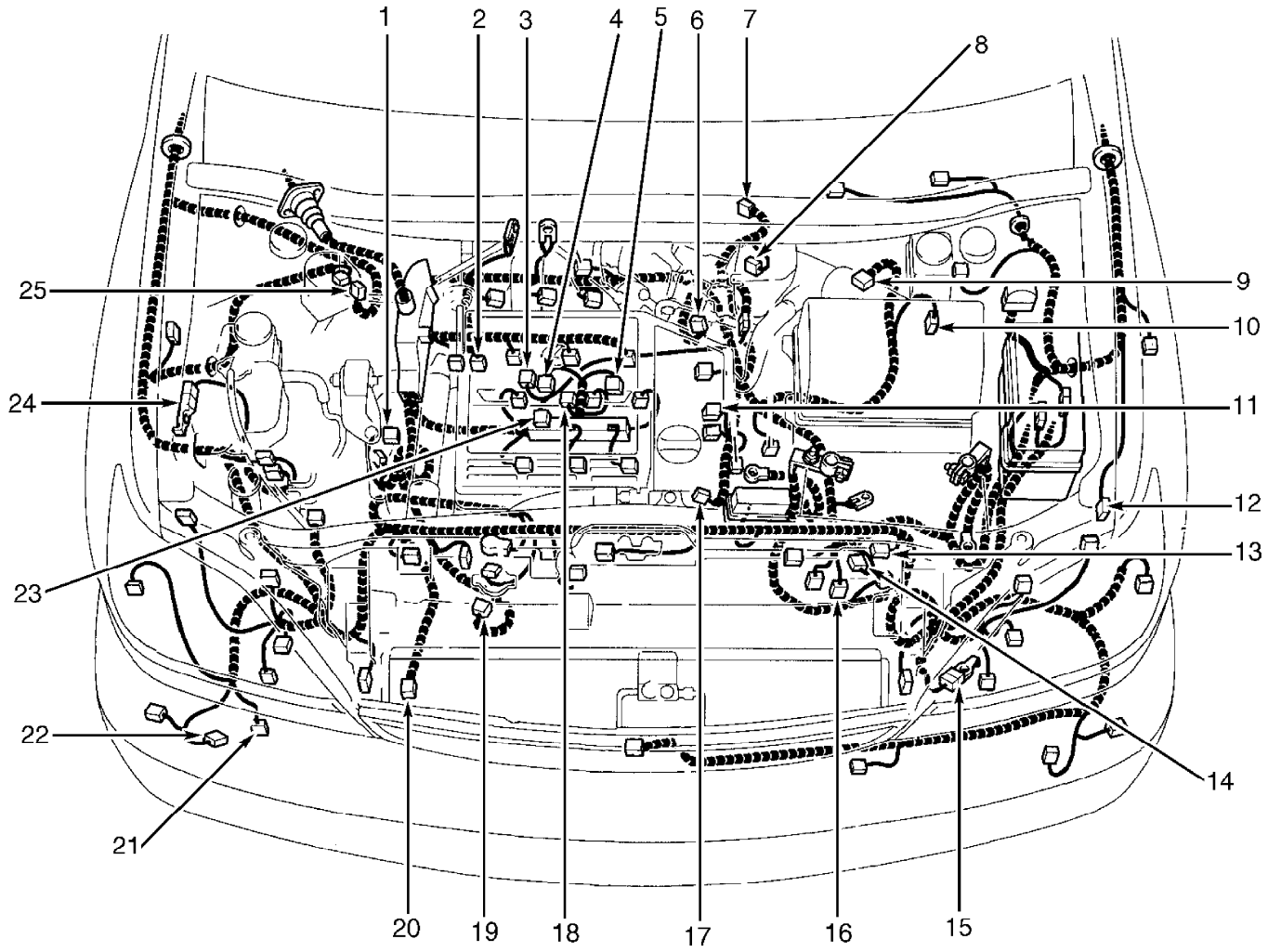
Washer Level Warning Switch	In right front corner of engine compartment.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Water Temperature Switch No. 1	In right front of engine compartment.



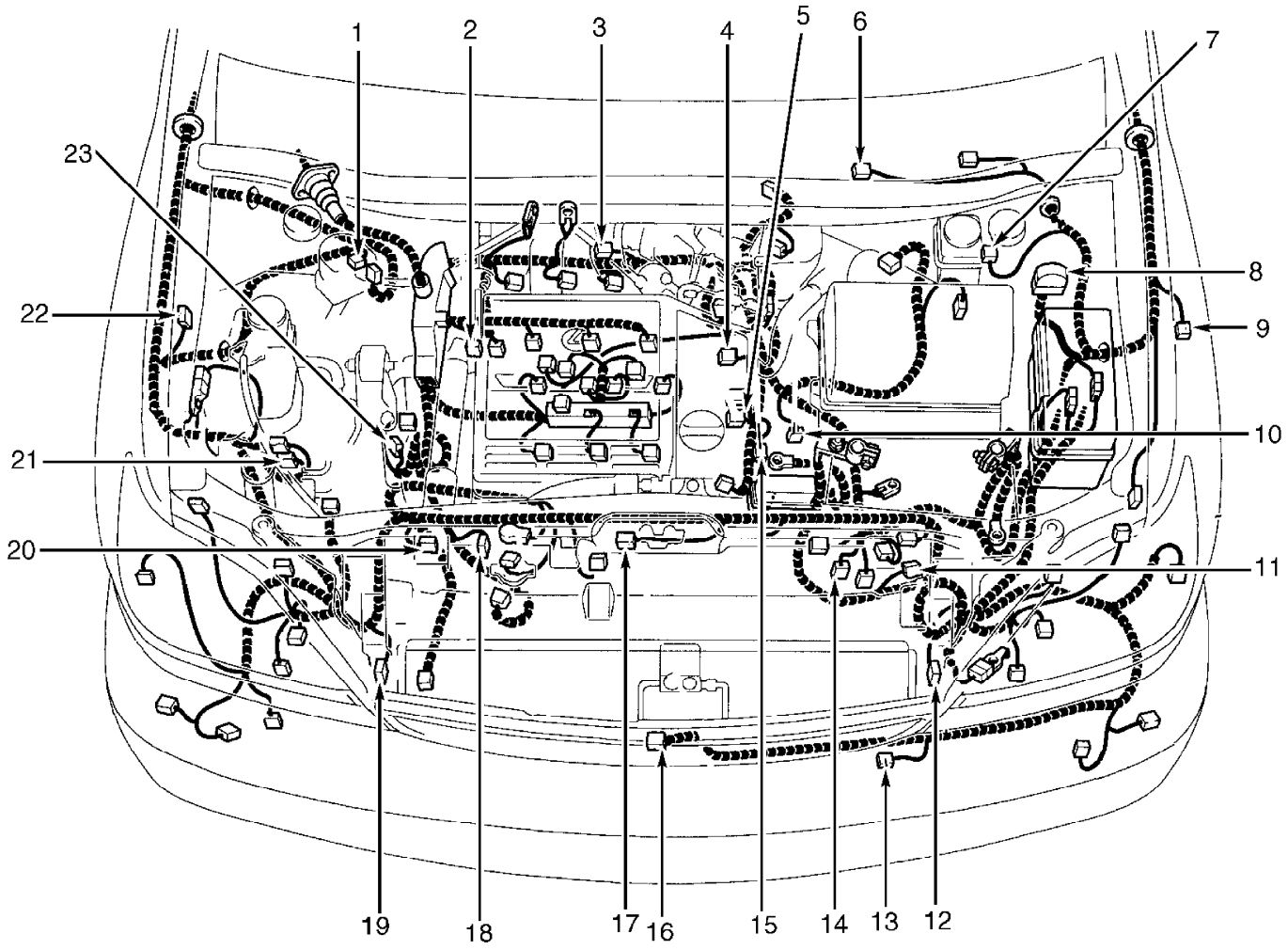
1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Water Temperature Switch No. 2	On top rear of engine.

MISCELLANEOUS

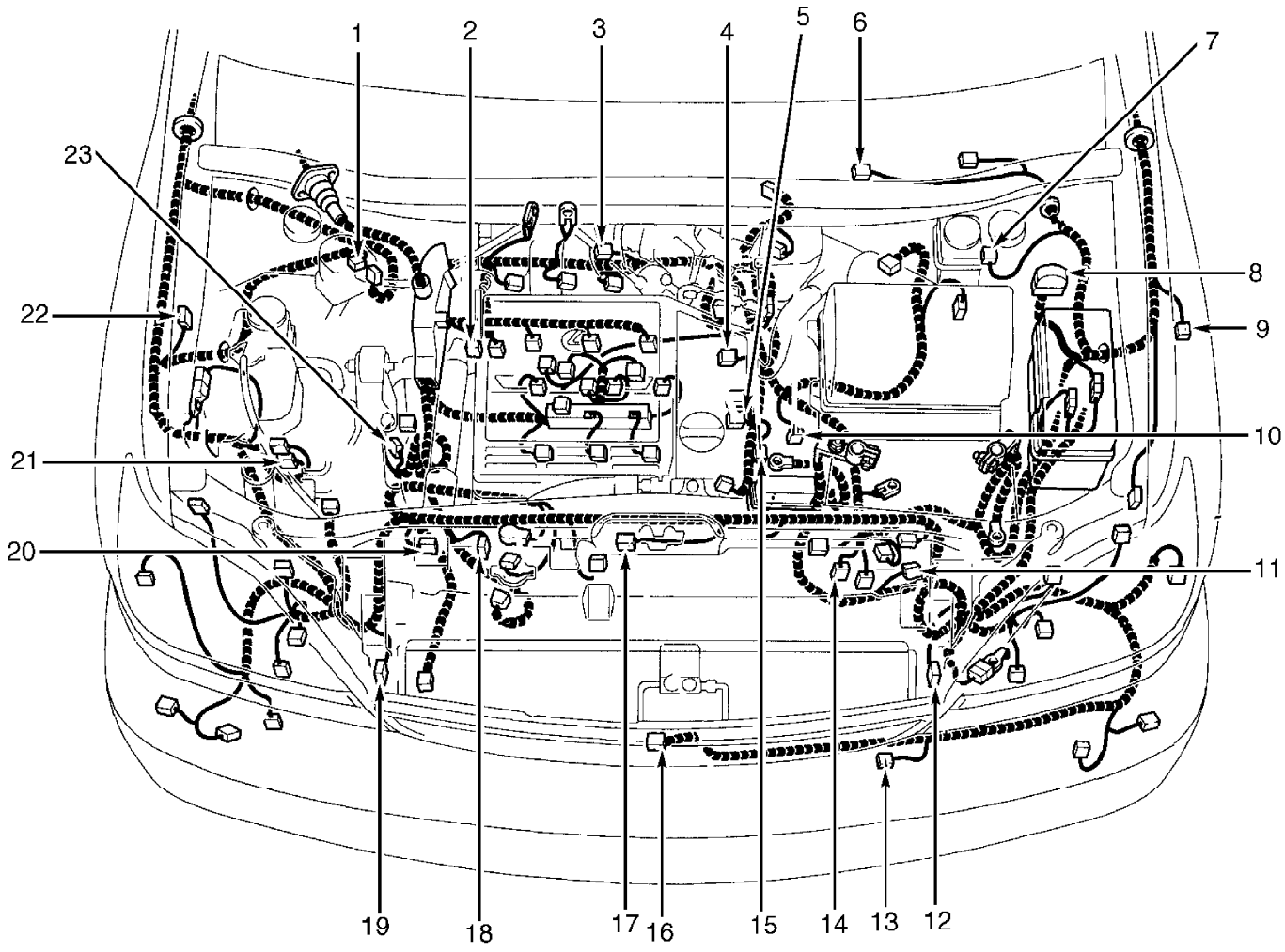
Component	Component Location



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

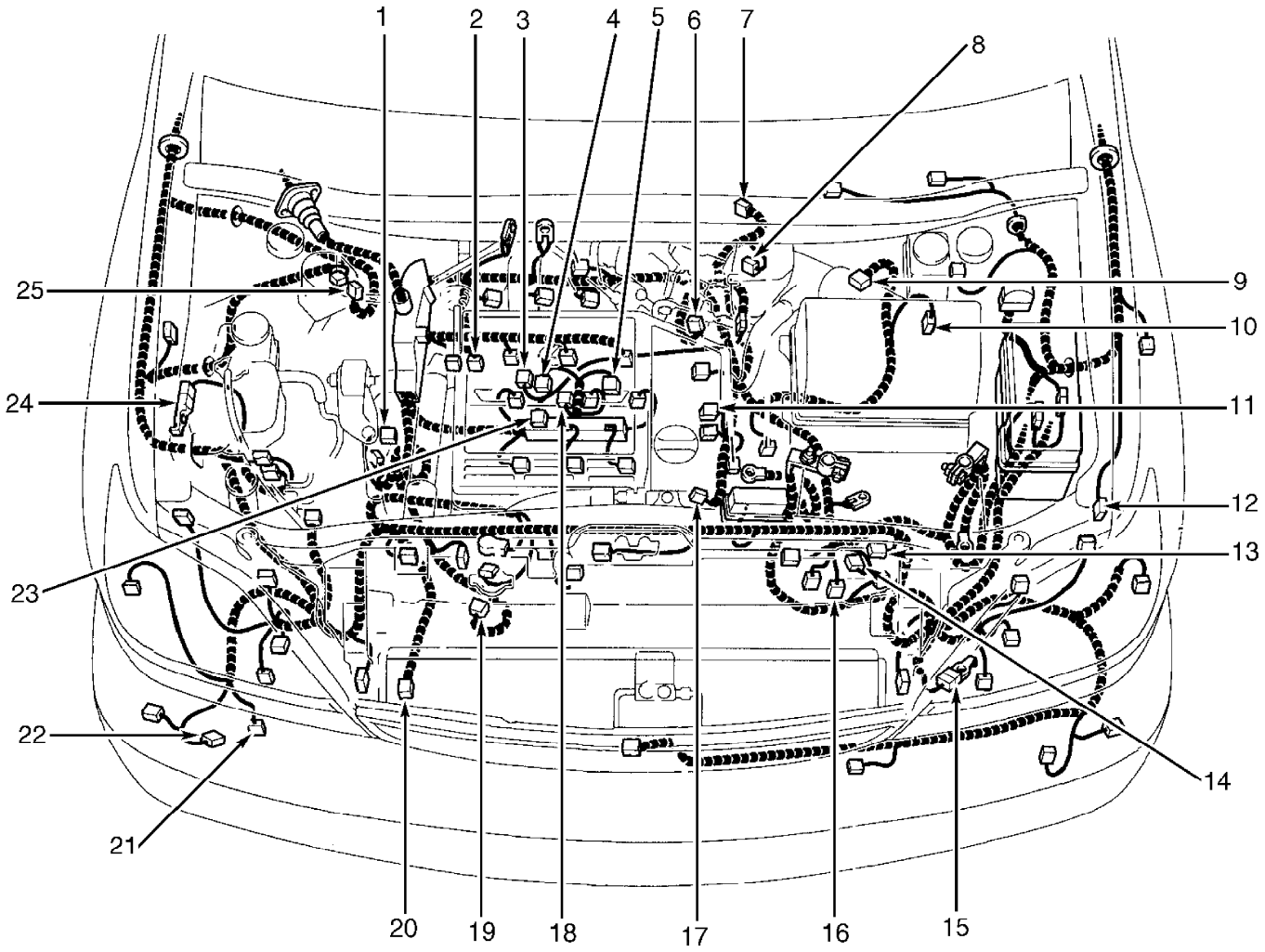
Data Link Connector (DLC) No. 1	In left rear corner of engine compartment.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

98D63456

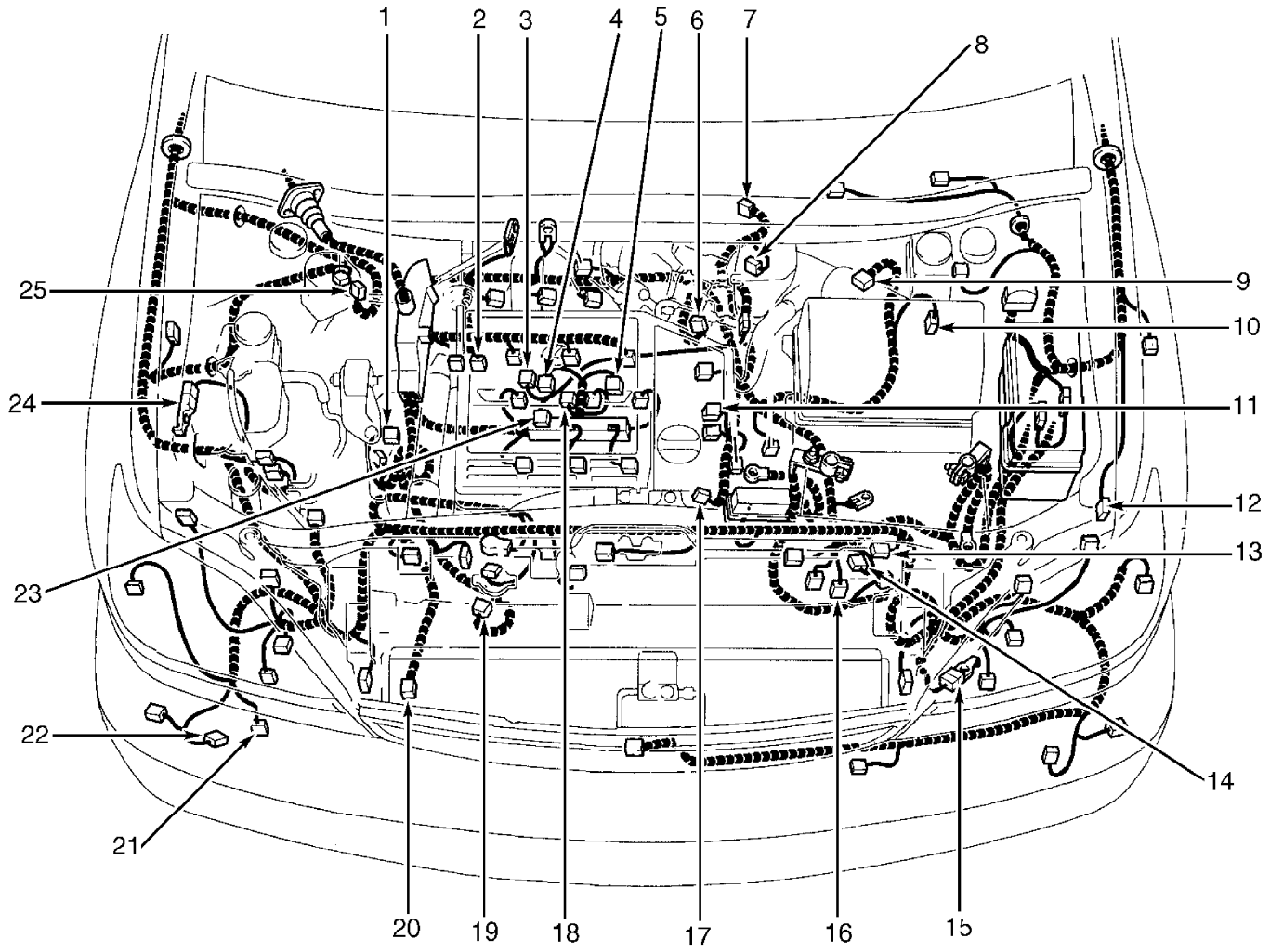
Daytime Running Light Resistor	On left front of engine compartment.
Diode (Rear Interior Light)	In rear center of roof.
Ignition Coil & Ignitor	On top of each respective cylinder.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Junction Connector No. 1	In engine compartment, on right front fender.

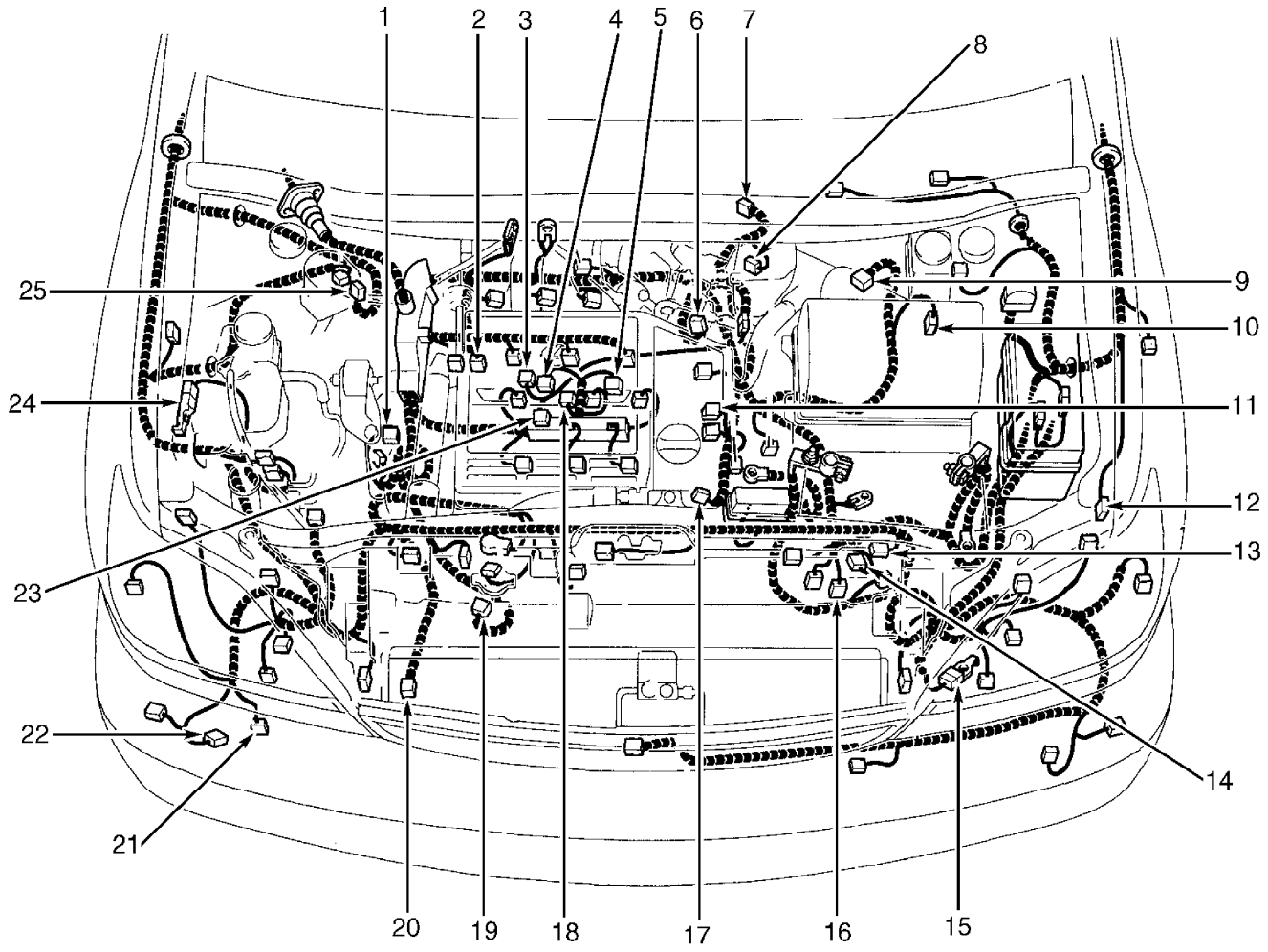


1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Junction Connector No. 2	In left front of engine compartment, behind headlight.
Junction Connector No. 11, 12 & 15	In left side of luggage compartment.
Junction Connectors No. 13 & 14	In left side of liftgate.
Junction Connectors No. 16 & 17	Under driver’s seat.

Junction Connector No. 18	Under passenger's seat.
Noise Filter (DEF)	In center of liftgate.

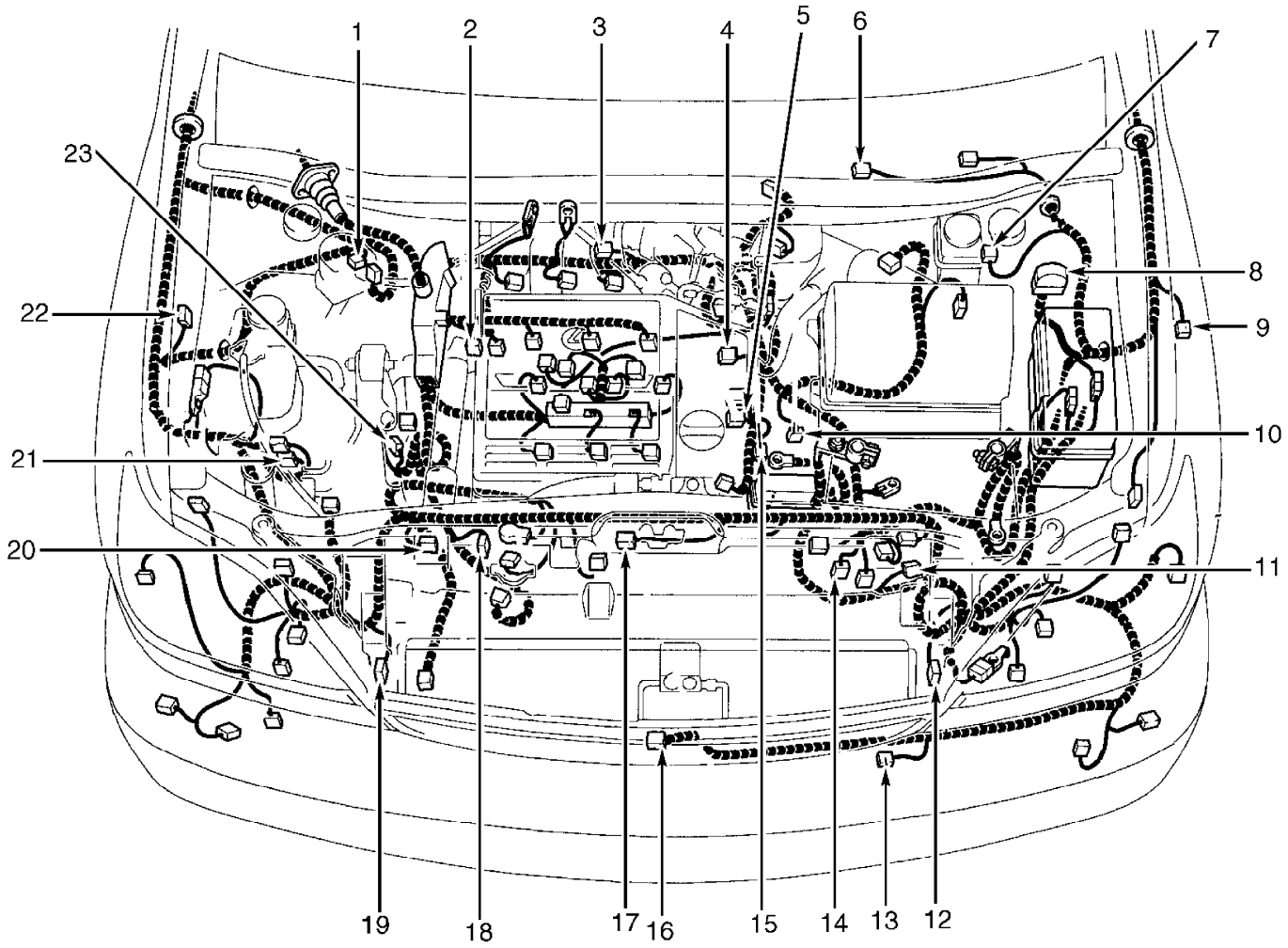


1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Noise Filter (Ignition System)	In left rear of engine compartment, near air cleaner housing.
Pretensioner (Left/Right)	In base of respective "B"

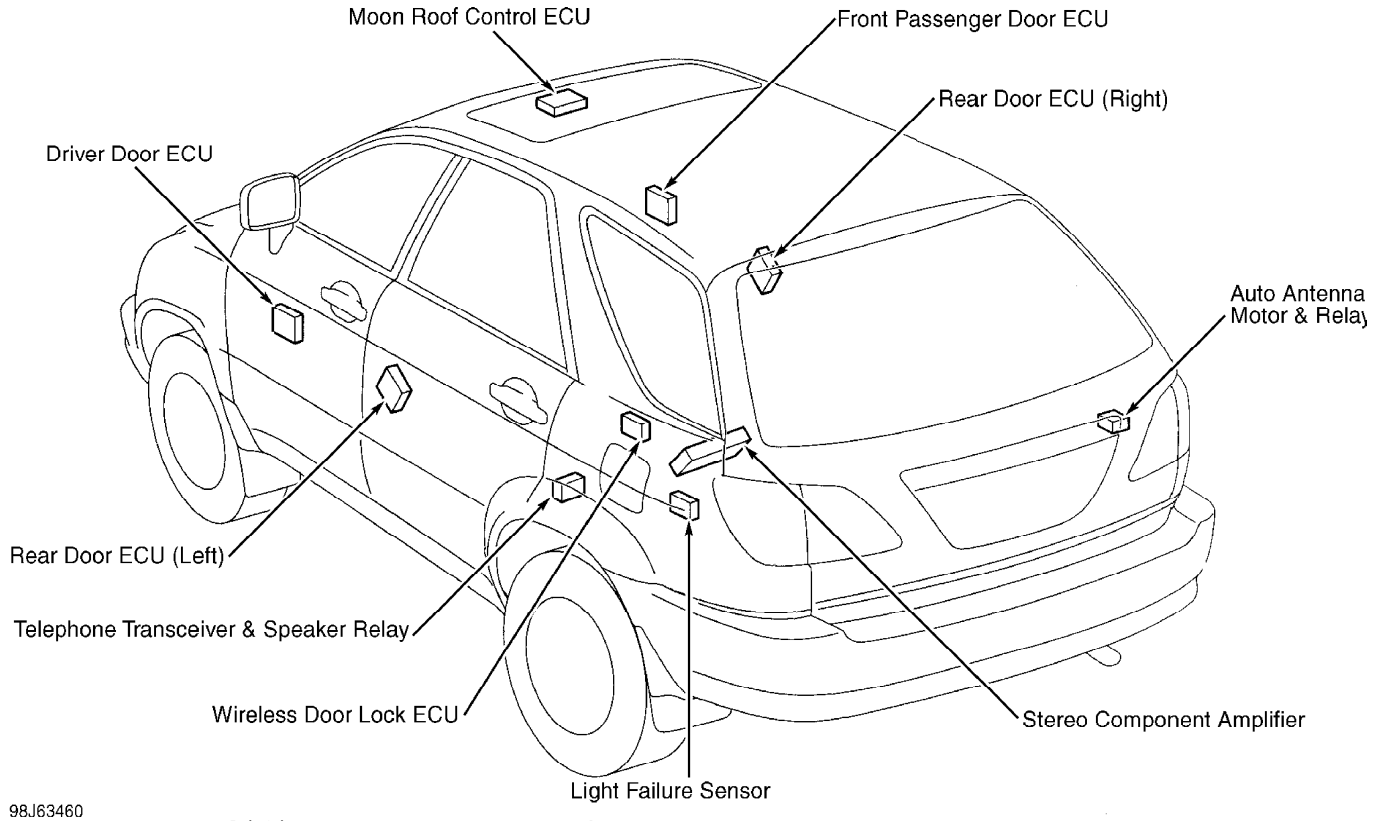
pillar.



1. Crankshaft Position Sensor
2. Engine Coolant Temperature Sensor
3. Air Fuel Ratio Sensor (Bank 1, Sensor 1)
4. Camshaft Timing Oil Control Valve (Right)
5. Camshaft Timing Oil Control Valve (Left)
6. Front Wiper Motor
7. Brake Fluid Level Switch
8. Data Link Connector (DLC) No. 1
9. ABS Speed Sensor (Left Front)
10. Cruise Control Actuator
11. Daytime Running Light Resistor Or Short Connector
12. Air Bag Sensor (Left Front)
13. A/C Ambient Temperature Sensor
14. Electronically Controlled Transmission Solenoid
15. Air Fuel Ratio Sensor (Bank 2, Sensor 1)
16. A/C Triple-Pressure Switch
17. Engine Hood Courtesy Switch
18. A/C Magnetic Clutch & Lock Sensor
19. Air Bag Sensor (Front Right)
20. A/C Condenser Fan Motor
21. ABS Actuator (W/O Traction) Or ABS & Traction Actuator (W/Traction)
22. ABS Speed Sensor (Front Right)
23. Counter Gear Speed Sensor

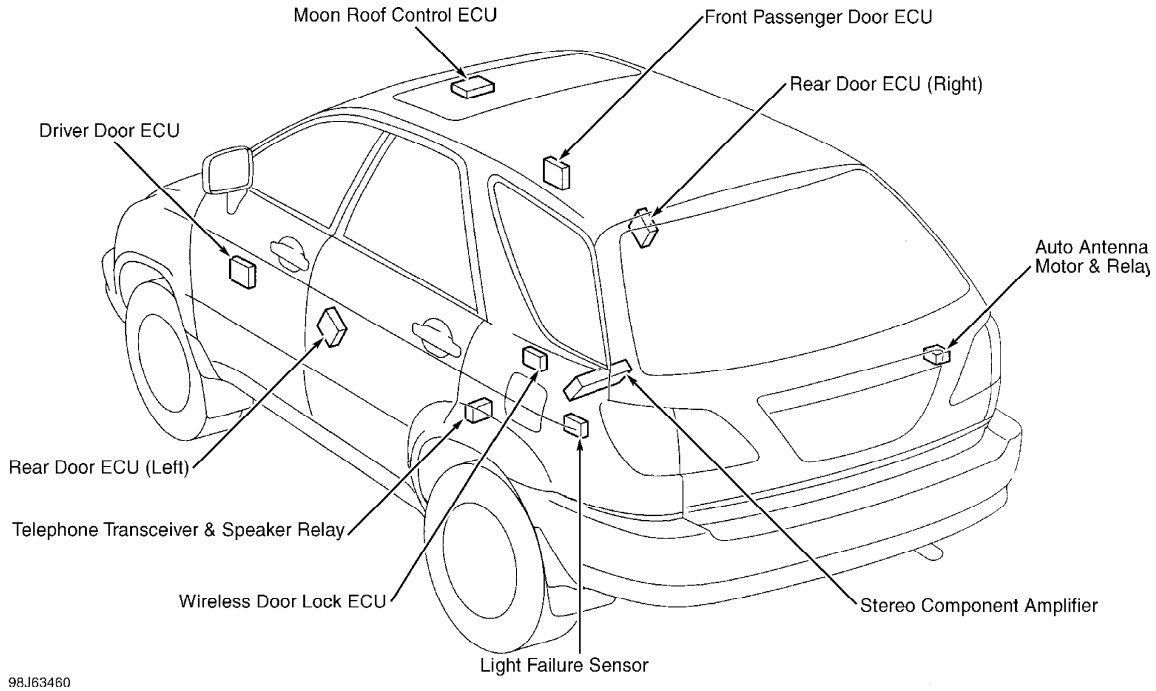
98D63456

Short Connector	On left front of engine compartment.



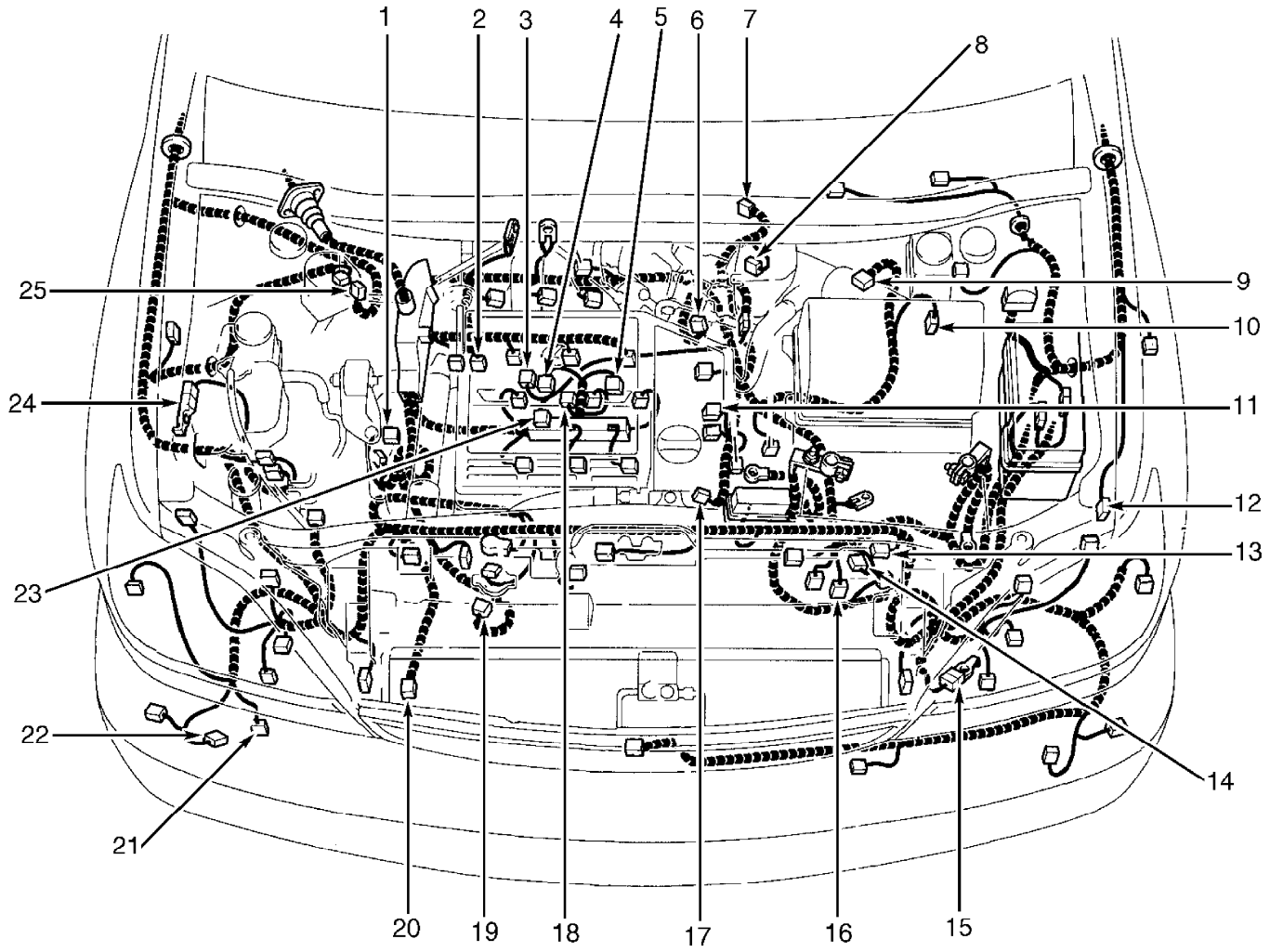
98J63460

Stereo Component Amplifier	Under rear seat.



98J63460

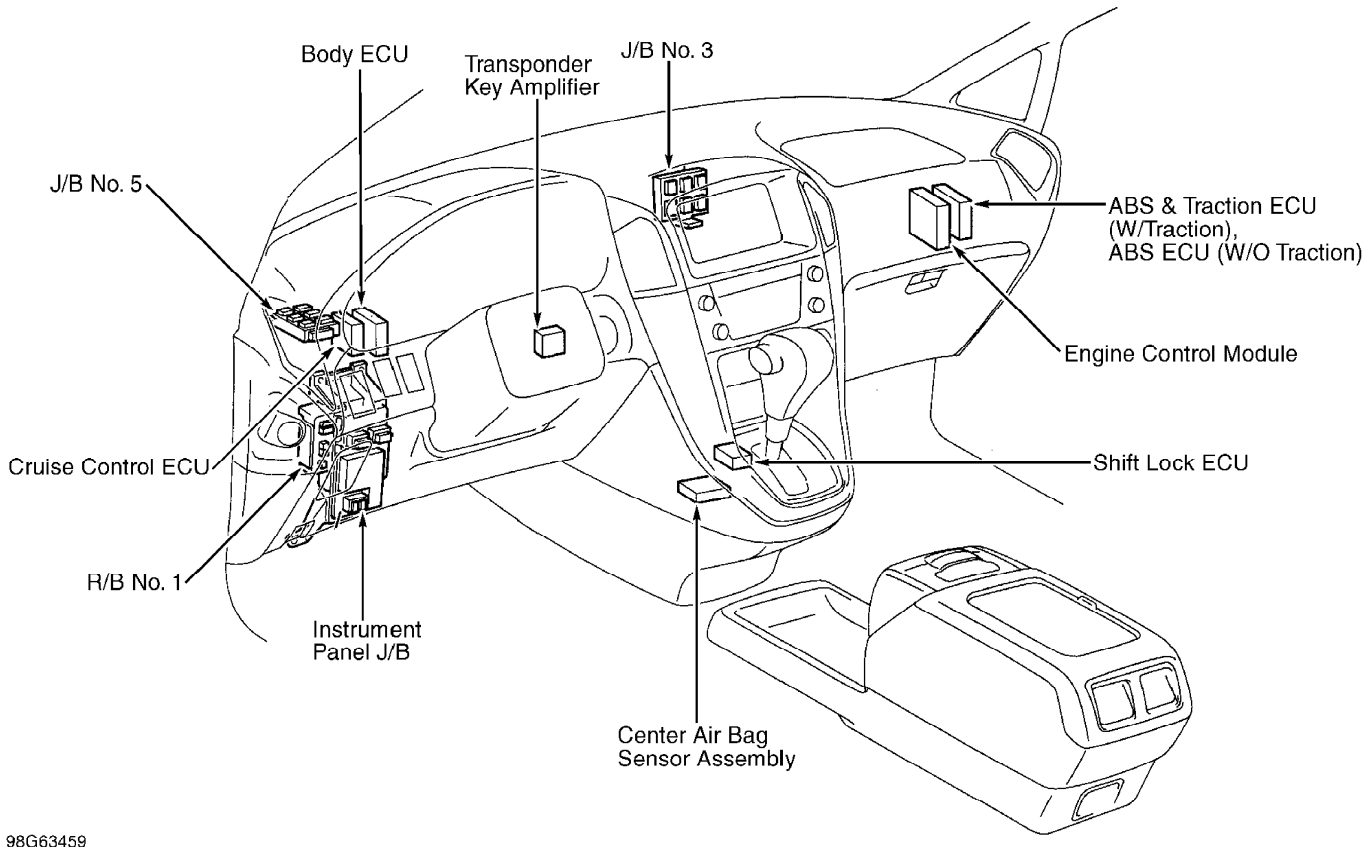
Telephone Transceiver & Speaker Relay	On left side of luggage compartment.



1. Oil Pressure Switch
2. Power Steering Oil Pressure Switch
3. Knock Sensor No. 1
4. VSV (EVAP)
5. VSV (ACIS No. 1)
6. VVT Sensor (Right)
7. Idle Air Control Valve
8. Throttle Position Sensor
9. Mass Airflow (MAF) Meter
10. Noise Filter (Ignition System)
11. Water Temperature Switch No. 2
12. Wireless Door Lock Buzzer
13. Radiator Fan Motor
14. Turbine Speed Sensor
15. Junction Connector No. 2
16. Park/Neutral Position Switch, A/T Indicator Switch, Back-Up Light Switch
17. VVT Sensor (Left)
18. VSV (ACIS No. 2)
19. VSV (ACM)
20. Water Temperature Switch No. 1
21. Washer Motor
22. Washer Level Warning Switch
23. Knock Sensor No. 2
24. Junction Connector No. 1
25. Theft Deterrent Horn

98E63457

Theft Deterrent Horn	In right rear corner of engine compartment.



Transponder Key Amplifier	Behind left side of dash.

* ELECTRICAL SYSTEM UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Electrical System January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

CONTENTS

OVERVIEW OF MOTORIST ASSURANCE PROGRAM
OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

ACTUATOR MOTORS (SOLENOIDS) (ELECTRIC)
ACTUATOR MOTORS (VACUUM)
AIR BAGS
ALTERNATORS AND GENERATORS
AMPLIFIERS
ANTENNAS
BATTERIES
BATTERY CABLES
BATTERY CABLES
BATTERY HOLD DOWN HARDWARE
BATTERY TRAYS AND HOLD DOWN HARDWARE
BATTERY WIRES
BELTS
BULB SOCKETS
BULBS, SEALED BEAMS AND LEDS
CD PLAYERS
CIGARETTE LIGHTER ASSEMBLIES
CIRCUIT BREAKERS
CLUTCH SWITCHES
CONNECTORS
CONTROL MODULES
CRUISE CONTROL BRAKE SWITCHES
CRUISE CONTROL CABLES
CRUISE CONTROL CLUTCH SWITCHES
CRUISE CONTROL LINKAGES AND CABLES
CRUISE CONTROL RESERVOIRS
CRUISE CONTROL TUBES
CRUISE CONTROL VACUUM DUMP RELEASE VALVES
CRUISE CONTROL VACUUM HOSES, TUBES AND RESERVOIRS
CRUISE CONTROL VEHICLE SPEED SENSORS
DEFOGGERS
DEFROSTERS
DELAYS
DIMMERS
ELECTRIC HEATERS
EQUALIZERS
FUSE BLOCKS
FUSE BOXES AND BLOCKS
FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS
FUSIBLE LINKS
GAUGES
GENERATORS
GROUND CABLES AND STRAPS
GROUND STRAPS
HEADLIGHT ADJUSTERS
HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS)
HORNS AND SIRENS
IGNITION SWITCHES
INDICATOR LIGHTS

KEYLESS ENTRY KEYPADS AND TRANSMITTERS
KEYLESS ENTRY TRANSMITTERS
LEDS
LENSES
MICROPHONES
MIRRORS (ELECTROCHROMATIC AND HEATED)
MOTORS
NEUTRAL SAFETY SWITCHES
ODOMETERS
ODOMETERS, SPEEDOMETERS AND TACHOMETERS (CABLE-DRIVEN)
PULLEYS
RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS
RELAY BOXES
RELAYS
SEALED BEAMS
SEAT HEATERS
SECURITY ALARM SENSORS
SIRENS
SOLENOIDS
SPEAKERS AND MICROPHONES
SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES
SPEEDOMETER CABLES
SPEEDOMETERS
STARTERS
SUB-WOOFER VOLUME CONTROLS
SWITCHES
TACHOMETER CABLES
TACHOMETERS
TAPE PLAYERS AND CD PLAYERS
TENSIONERS
TIMERS
TIRE PRESSURE SENSORS
TRANSCEIVERS
TRANSDUCERS
VACUUM ACCUMULATORS (RESERVOIRS)
VACUUM RESERVOIRS
VOLTAGE REGULATORS
WASHER FLUID LEVEL SENDERS
WASHER PUMPS
WIPER ARMS AND BLADES
WIPER BLADES
WIPER HOSES AND NOZZLES
WIPER LINKAGES
WIPER NOZZLES
WIPER PUMP RESERVOIRS
WIRING HARNESSES AND CONNECTORS

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and

dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above, standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection

of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested." In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and the conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A - Part no longer performs intended purpose
B - Part does not meet a design specification (regardless of performance)
C - Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 - Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

ELECTRICAL SYSTEMS

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

NOTE: When working on electrical systems, if a potentially hazardous condition is observed, require repair or replacement of affected components prior to performing further work.

ACTUATOR MOTORS (SOLENOIDS) (ELECTRIC)

ACTUATOR MOTOR (SOLENOIDS) (ELECTRIC) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Linkage bent, affecting performance	A	Require repair or replacement of linkage.

Condition	Code	Procedure
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage.
Linkage binding, affecting performance	A	Require repair or replacement of linkage.
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage broken	A	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage missing	C	Require replacement.
Linkage noisy	2	Suggest repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	1	(1) Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	1	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

ACTUATOR MOTORS (VACUUM)

ACTUATOR MOTOR (VACUUM) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.

Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Leaking (vacuum)	A	Require repair or replacement.
Linkage bent, affecting performance	A	Require repair or replacement of linkage.
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage.
Linkage binding, affecting performance	A	Require repair or replacement of linkage.
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage broken	A	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage missing	C	Require replacement.
Linkage noisy	2	Suggest repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

AIR BAGS

For all air bag components and conditions, refer to vehicle manufacturer's specifications for diagnosis and parts replacement.

ALTERNATORS AND GENERATORS

NOTE: If components have been added that increase vehicle electrical load requirement (for example, sound systems, air conditioning, alarm systems, etc.), charging system output must meet the increased demand.

ALTERNATOR AND GENERATOR INSPECTION

Condition	Code	Procedure
Alternator output meets OEM specification but is insufficient for add-on electrical load	2	Suggest upgrade of alternator or removal of excess electrical load.
Alternator's rated output is below OEM specification	B	Require replacement.
Attaching hardware		

broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware non-functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Diode inoperative	A	.....	(2) Require repair or replacement.
Housing broken, affecting performance	A	..	Require repair or replacement.
Housing broken, not affecting performance ..	..	.....	No service suggested or required.
Housing cracked, affecting performance	A	..	Require repair or replacement.
Housing cracked, not affecting performance ..	1	..	Suggest repair or replacement.
Inoperative	A	.....	(2) Require repair or replacement.
Noisy	2	..	Suggest repair or replacement.
Pulley incorrect	B	.....	Require replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance ..	1	..	Suggest repair or replacement.
Terminal resistance (voltage drop) out of specification	A	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Voltage drop out of specification	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

AMPLIFIERS

See
RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS.

ANTENNAS

ANTENNA INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require replacement.
Bent	2	Suggest repair or replacement.
Binding	2	Suggest repair or replacement.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Missing	C	Require replacement.
Motor runs continuously	A	Require or replacement.
Power antenna noisy	2	Suggest repair or replacement.
Sticking	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of specification.

BATTERIES

Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

Definition of Terms

* Battery Performance Testing
  Testing that determines whether or not a battery meets both

vehicle OEM and battery manufacturer's specifications.

* Cold Cranking Amp (CCA) Rating
  The number of amperes a new, fully charged battery at 0° F (-17.8° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

* Cranking Amps (CA)
  The number of amperes a new, fully charged battery, typically at 32° F (0° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

* OEM Cranking Amps
  The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

BATTERY INSPECTION

Condition	Code	Procedure
Battery frozen	..	(1) Further inspection required.
Case leaking	A	Require replacement.
Casing swollen	A	(2) Further inspection required.
Circuit open internally	A	Require replacement.
Electrolyte contamination	A	(2) Further inspection required.
Electrolyte discoloration	A	(2) Further inspection required.
Fails to accept and hold charge	A	(3) Require replacement.
Fluid level low	B	(4) Further inspection required.
Out of performance specification for battery	B	(5) Require replacement.
Out of specification for application	B	(5) Require replacement.
Post (top or side) burned, affecting performance	A	(6) Require repair or replacement.
Post (top or side) burned, not affecting performance	2	(6) Suggest repair or replacement.
Post (top or side) corroded, affecting performance	A	Require repair.
Post (top or side) corroded, not affecting performance	2	Suggest repair.
Post (top or side) loose	A	Require replacement.
Post (top or side) melted, affecting performance	A	(6) Require repair or replacement.
Post (top or side) melted, not affecting		

performance	2	(6) Suggest repair or replacement.
Specific gravity low	B	(7) Further inspection required.
State of charge low	A	(7) Further inspection required.
Top dirty	2	Suggest cleaning battery.
Top wet	A	(8) Require cleaning battery. Further inspection required.
Vent cap loose	A	Require repair or replacement of vent cap.
Vent cap missing	C	Require replacement of vent cap.

(1) - DO NOT attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.
(2) - No service suggested or required unless the battery fails performance test, in which case, require replacement.
(3) - This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.
(4) - Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.
(5) - The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.
(6) - Determine cause and correct prior to repair or replacement of part.
(7) - Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.
(8) - Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.

BATTERY CABLES

See BATTERY CABLES, WIRES AND CONNECTORS.

BATTERY CABLES, WIRES AND CONNECTORS

BATTERY CABLE, WIRE AND CONNECTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or

			replacement.
Connector missing	C	.....	Require replacement.
Insulation damaged, conductors exposed	A	.....	(2) Require repair or replacement.
Insulation damaged, conductors not exposed .	1	.....	Suggest replacement.
Open	A	..	Require repair or replacement.
Protective shield (conduit) melted	2	.....	(1) Suggest repair or replacement.
Protective shield (conduit) missing	2	..	Suggest repair or replacement.
Resistance (voltage drop) out of specification ...	A	..	Require repair or replacement.
Routed incorrectly	B	.....	Require repair.
Secured incorrectly	B	.....	Require repair.
Shorted	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance ..	1	..	Suggest repair or replacement.
Voltage drop out of specification	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.

BATTERY HOLD DOWN HARDWARE

See BATTERY TRAYS AND HOLD DOWN HARDWARE.

BATTERY TRAYS AND HOLD DOWN HARDWARE

BATTERY TRAY AND HOLD DOWN HARDWARE INSPECTION

Condition	Code		Procedure
Battery improperly secured	2	.....	Suggest repair.
Bent, affecting performance	A	..	Require repair or replacement.
Bent, not affecting performance	..	.....	No service suggested or required.
Broken, affecting performance	A	..	Require repair or replacement.
Broken, not affecting performance	..	.....	No service suggested or required.

Corroded, affecting performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Water drain clogged	A	Require repair.

BATTERY WIRES

See BATTERY CABLES, WIRES AND CONNECTORS.

BELTS

BELT INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	(1) Further inspection required.
Cracked	1	Suggest replacement.
Frayed	1	Suggest replacement.
Missing	C	Require replacement.
Noisy	2	(2) Further inspection required.
Plies separated	A	Require replacement.
Tension out of specification	B	Require adjustment or replacement.
Worn beyond adjustment range	B	Require replacement.
Worn so it contacts bottom of pulley	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.

BULB SOCKETS

BULB SOCKET INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bulb seized in socket	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or

			replacement.
Burned, not affecting performance	2	.....	(1) Suggest repair or replacement.
Broken	A	..	Require repair or replacement.
Connector broken	A	..	Require repair or replacement.
Connector missing	C	.....	Require replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Corroded, affecting performance	A	..	Require repair or replacement.
Corroded, not affecting performance	2	..	Suggest repair or replacement.
Leaking	A	..	Require repair or replacement.
Melted	A	.....	(2) Require replacement.
Shorted	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of socket.
(2) - Determine cause and correct prior to replacement of part.

BULBS, SEALED BEAMS AND LEDS

NOTE: Does not include soldered-in components.

BULB, SEALED BEAM AND LED INSPECTION

Condition	Code	Procedure
Adjustment out of specification	B	.. Require repair or replacement.
Application incorrect	B	..... (1) Require replacement.
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Base burned, affecting performance	A	..... (2) Require repair or replacement.
Base burned, not affecting performance	2	..... (2) Suggest repair or

			replacement.
Base corroded, affecting performance	A	..	Require repair or replacement.
Base corroded, not affecting performance	2	..	Suggest repair or replacement.
Base leaking	A	..	Require repair or replacement.
Base loose, affecting performance	B	..	Require repair or replacement.
Base loose, not affecting performance	1	..	Suggest repair or replacement.
Base melted	A	.....	(2) Require replacement.
Bracket bent, affecting performance	A	..	Require repair or replacement.
Bracket bent, not affecting performance	..	.....	No service suggested or required.
Bracket broken, affecting performance	A	.....	Require replacement.
Bracket broken, not affecting performance	..	.....	No service suggested or required.
Bracket corroded, affecting performance	A	..	Require repair or replacement.
Bracket corroded, not affecting performance	2	..	Suggest repair or replacement.
Bracket cracked, affecting performance	A	..	Require repair or replacement.
Bracket cracked, not affecting performance	1	..	Suggest repair or replacement.
Bracket loose, affecting performance	A	..	Require repair or replacement.
Bracket loose, not affecting performance	1	..	Suggest repair or replacement.
Bracket missing	C	.....	Require replacement.
Burned out	A	.....	Require replacement.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(2) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Corroded, affecting performance	A	..	Require repair or replacement.
Corroded, not affecting performance	2	..	Suggest repair or replacement.
Cracked	A	.....	Require replacement.
Intermittent	A	.....	Require replacement.
Lamp base melted	A	.....	(2) Require replacement.
Leaking	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Seized in socket	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	.....	(2) Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting			

performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.

(1) - Application incorrect includes wrong bulb coating or color.
(2) - Determine cause and correct prior to repair or replacement of part.

CD PLAYERS

See TAPE PLAYERS AND CD PLAYERS.

CIGARETTE LIGHTER ASSEMBLIES

CIGARETTE LIGHTER ASSEMBLY INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Inoperative	A	.....	(1) Require repair or replacement.
Loose	A	..	Require repair or replacement.
Missing	2	.....	Suggest replacement.
Sticking	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

CIRCUIT BREAKERS

See FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS.

CLUTCH SWITCHES

See SWITCHES.

CONNECTORS

See WIRING HARNESSES AND CONNECTORS.

CONTROL MODULES

CONTROL MODULE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Code set (if applicable)	A	(1) Further inspection required.
Connector broken	A	Require repair or replacement.
Connector melted	A	(2) Require repair or replacement.
Connector missing	A	Require repair.
Contaminated	A	(3) Require repair or replacement.
Inoperative	B	(4) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Refer to manufacturer’s diagnostic trouble code procedure

and require repair or replacement of affected component(s).
(2) - Determine cause and correct prior to repair or replacement of part.
(3) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(4) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

CRUISE CONTROL BRAKE SWITCHES

See SWITCHES.

CRUISE CONTROL CABLES

See CRUISE CONTROL LINKAGES AND CABLES.

CRUISE CONTROL CLUTCH SWITCHES

See SWITCHES.

CRUISE CONTROL LINKAGES AND CABLES

CRUISE CONTROL LINKAGE AND CABLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require repair or replacement.
Binding	A	Require repair or replacement.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance		No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not		

affecting performance	1	..	Suggest repair or replacement.
Bracket missing	C	.....	Require replacement.
Broken	A	.....	Require replacement.
Cracked	A	..	Require repair or replacement.
Disconnected	A	..	Require repair or replacement.
Kinked	A	..	Require repair or replacement.
Melted	A	.....	(1) Require repair or replacement.
Missing	C	.....	Require replacement.
Noisy	2	..	Suggest repair or replacement.
Out of adjustment	B	.....	(2) Require repair or replacement.
Routed incorrectly	2	.....	Suggest repair.
Seized	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.

CRUISE CONTROL RESERVOIRS

See CRUISE CONTROL VACUUM HOSES, TUBES AND RESERVOIRS.

CRUISE CONTROL TUBES

See CRUISE CONTROL VACUUM HOSES, TUBES AND RESERVOIRS.

CRUISE CONTROL VACUUM DUMP RELEASE VALVES

CRUISE CONTROL VACUUM DUMP RELEASE VALVE INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Broken	A	..	Require repair or replacement.
Inoperative	A	.....	(1) Require replacement.
Leaking	2	.....	Suggest replacement.
Out of adjustment	B	.....	(2) Further inspection required.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.

CRUISE CONTROL VACUUM HOSES, TUBES AND RESERVOIRS

CRUISE CONTROL VACUUM HOSE, TUBE AND RESERVOIR INSPECTION

Condition	Code	Procedure

Leaking	A	Require repair or replacement.
Melted	A	Require replacement.
Missing	C	Require replacement.
Oil-soaked (spongy)	1	Suggest replacement.
Restricted	A	Require repair or replacement.
Surface cracks (dry-rotted)	1	Suggest replacement.

CRUISE CONTROL VEHICLE SPEED SENSORS

CRUISE CONTROL VEHICLE SPEED SENSOR INSPECTION

Condition	Code	Procedure
Air gap incorrect	B	(1) Require adjustment to vehicle manufacturer's specifications.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require replacement.
Housing cracked	A	Require replacement.
Internal resistance does not meet specifications	B	(2) Require replacement.
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications.
Loose	B	(3) Require adjustment to vehicle manufacturer's specifications.
Missing	C	Require replacement.
Output signal incorrect	B	(2) Require repair or replacement.
Surface contaminated	2	Suggest cleaning; identify and correct source.
Tip bent	B	Require replacement.
Tip broken	B	Require replacement.
Tip missing	B	Require replacement.
Wire lead burned	A	Require replacement.
Wire lead conductors exposed	B	Require replacement.
Wire lead corroded	A	Require replacement.
Wire lead open	A	Require replacement.
Wire lead shorted	A	Require replacement.

(1) - If a sensor is not adjustable, further inspection is required to identify and correct cause.
(2) - Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.
(3) - Some integral bearing assemblies with sensors may require replacement.

DEFOGGERS

See
HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS).

DEFROSTERS

See
HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS).

DELAYS

DELAY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

DIMMERS

DIMMER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM

specification.

ELECTRIC HEATERS

See HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS).

EQUALIZERS

See RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS.

FUSE BLOCKS

See FUSE BOXES AND BLOCKS.

FUSE BOXES AND BLOCKS

FUSE BOX AND BLOCK INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken, affecting performance	A	Require replacement.
Broken, not affecting performance	..	No service suggested or required.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Cover missing	C	Require replacement of cover.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Melted, affecting performance	A	(1) Require replacement.
Melted, not affecting performance	2	(1) Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.

Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

FUSE, FUSIBLE LINK AND CIRCUIT BREAKER INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Blown	A	(1) Require replacement.
Corroded, affecting performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(2) Require replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Missing	C	Require replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation.

FUSIBLE LINKS

See FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS.

GAUGES

NOTE: Includes odometers, speedometers and tachometers (except cable-driven).

GAUGE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Leaking	A	Require replacement.
Lens broken	A	(2) Require repair or replacement.
Lens cloudy	2	(2) Suggest repair or replacement.
Lens missing	C	(2) Require repair or replacement.
Malfunctioning	A	(3) Require repair or replacement.
Mechanical head noisy	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - If lens is available as a separate part, require replacement of lens only.
(3) - Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.

GENERATORS

See ALTERNATORS AND GENERATORS.

GROUND CABLES AND STRAPS

GROUND CABLE AND STRAP INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Corroded, affecting performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Insulation damaged, exposing conductors	2	Suggest replacement.
Loose	A	Require repair.
Missing	C	Require replacement.
Open	A	Require repair or replacement.
Resistance high	A	Require repair or replacement.
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement.
Voltage drop out of specification	B	Require repair or replacement.

GROUND STRAPS

See GROUND CABLES AND STRAPS.

HEADLIGHT ADJUSTERS

HEADLIGHT ADJUSTER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent, preventing adjustment	A	Require repair or replacement.
Broken	A	Require repair or replacement.
Indicator broken	A	Require replacement.
Indicator missing	C	Require replacement.
Missing	C	Require replacement of adjusters.
Seized	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS)

HEATING ELEMENT (DEFROSTER, DEFOGGER, ELECTRIC HEATER AND SEAT) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

HORNS AND SIRENS

HORN AND SIREN INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Inoperative	A	.....	(2) Require repair or replacement.
Missing	C	.....	Require replacement.
Out of adjustment	B	.....	Require adjustment.
Sound quality poor	A	..	Require repair or replacement. Further inspection required.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Wire lead burned	A	..	Require repair or replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation.

IGNITION SWITCHES

See SWITCHES.

INDICATOR LIGHTS

INDICATOR LIGHT INSPECTION

Condition	Code		Procedure
Does not come on during bulb check	..	.....	(1) Further inspection required.
Fails to function properly during test mode	..	.....	(1) Further inspection required.
On constantly	..	.....	(1) Further inspection required.
On intermittently	..	.....	(1) Further inspection required.

(1) - See service manual for further information.

KEYLESS ENTRY KEYPADS AND TRANSMITTERS

KEYLESS ENTRY KEYPAD AND TRANSMITTER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Malfunctioning	A	(2) Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.

KEYLESS ENTRY TRANSMITTERS

See KEYLESS ENTRY KEYPADS AND TRANSMITTERS.

LEDS

See BULBS, SEALED BEAMS AND LEDS.

LENSES

LENSE INSPECTION

Condition	Code	Procedure
Adjustment out of		

specification	B	..... Require repair.
Application incorrect ...	A	..... Require replacement.
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Broken, affecting performance	A	..... Require replacement.
Broken, not affecting performance.....	..	..... No service suggested or required.
Cracked	A	..... Require replacement.
Discolored	A	..... Require replacement.
Leaking	A	.. Require repair or replacement.
Melted, affecting performance	A	..... Require replacement.
Melted, not affecting performance	2	..... Suggest replacement.
Missing	C	..... Require replacement.

MICROPHONES

See SPEAKERS AND MICROPHONES.

MIRRORS (ELECTROCHROMATIC AND HEATED)

MIRROR (ELECTROCHROMATIC AND HEATED) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Broken	A	.. Require repair or replacement.
Connector broken	A	.. Require repair or replacement.
Connector melted	A	..... (1) Require repair or replacement.
Connector missing	C	..... Require replacement.
Cracked	A	..... Require replacement.
Inoperative	A	..... (2) Require replacement.
Missing	C	..... Require replacement.
Terminal broken	A	.. Require repair or replacement.
Terminal burned, affecting performance	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	.. Require repair or replacement.
Terminal corroded, not affecting performance ..	2	.. Suggest repair or replacement.

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation.

MOTORS

MOTOR INSPECTION

Condition	Code	Procedure
Amperage draw out of specification	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bracket bent	A	Require repair or replacement.
Bracket broken	A	Require repair or replacement.
Bracket cracked	A	Require repair or replacement.
Bracket holes elongated, affecting performance	A	Require repair or replacement.
Bracket holes elongated, not affecting performance		No service suggested or required.
Bracket missing	C	Require replacement.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Drive mechanism damaged, affecting performance	A	(2) Require repair or replacement.
Drive mechanism damaged, not affecting performance	2	(2) Suggest repair or replacement.
Fails to disengage	A	Require repair or replacement.
Housing broken, affecting performance	2	Suggest repair or replacement.
Housing broken, not affecting performance		No service suggested or required.
Housing cracked, affecting performance	A	Require repair or replacement.

Housing cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(3) Require repair or replacement.
Linkage bent, affecting performance	A	Require repair or replacement of linkage.
Linkage bent, not affecting performance		No service suggested or required.
Linkage binding, affecting performance	A	Require repair or replacement of linkage.
Linkage binding, not affecting performance	2	Suggest repair or replacement of linkage.
Linkage broken	A	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage.
Linkage missing	C	Require replacement.
Linkage noisy	2	Suggest repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	(4) Further inspection required.
Resistance out of specification	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Further inspection required to determine cause.
(3) - Inoperative includes intermittent operation.
(4) - Follow OEM recommended adjustment procedures. Repair or replace if out of specification.

NEUTRAL SAFETY SWITCHES

See SWITCHES.

ODOMETERS

See GAUGES.

ODOMETERS, SPEEDOMETERS AND TACHOMETERS (CABLE-DRIVEN)

ODOMETER, SPEEDOMETER AND TACHOMETER (CABLE-DRIVEN) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Drive cable broken	A	Require replacement.
Drive cable noisy	2	Suggest repair or replacement.
Inoperative	A	(2) Further inspection required.
Leaking	A	Require replacement.
Lens broken	A	(3) Require repair or replacement.
Lens cloudy	2	(3) Suggest repair or replacement.
Lens missing	C	(3) Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - If lens is available as a separate part, require replacement of lens only.
(3) - Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.

PULLEYS

PULLEY INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require replacement.
Cracked	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Pulley damaged, affecting belt life	A	Require replacement.

RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS

RECEIVER, AMPLIFIER, EQUALIZER AND SUB-WOOFER VOLUME CONTROL INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Malfunctioning	A	(2) Require repair or replacement.
Missing	C	Require replacement.
Sound quality poor	A	(3) Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not		

affecting performance	1	..	Suggest repair or replacement.
Wire lead burned	A	..	Require repair or replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.
(3) - Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.

RELAY BOXES

RELAY BOX INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken, affecting performance	A	Require replacement.
Broken, not affecting performance	..	No service suggested or required.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Cover missing	C	Require replacement of cover.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Melted, affecting performance	A	(1) Require replacement.
Melted, not affecting performance	2	(1) Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.

Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

RELAYS

RELAY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Housing broken	A	Require replacement.
Housing cracked	2	Suggest replacement.
Inoperative	A	(1) Require replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

SEALED BEAMS

See BULBS, SEALED BEAMS AND LEDS.

SEAT HEATERS

See HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS).

SECURITY ALARM SENSORS

SECURITY ALARM SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

SIRENS

See HORNS AND SIRENS.

SOLENOIDS

See ACTUATOR MOTORS (SOLENOIDS) (ELECTRIC).

NOTE: For starter solenoids that are integral to the starter assembly, see STARTERS.

NOTE: For starter relays, see RELAYS.

SPEAKERS AND MICROPHONES

SPEAKER AND MICROPHONE INSPECTION

Condition	Code	Procedure
Application incorrect	A	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Membrane torn	A	Require replacement.
Missing	C	Require replacement.
Polarity reversed	A	Require repair.
Sound quality poor	A	(3) Require repair or replacement. Further inspection required.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.
(3) - Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.

SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES

SPEEDOMETER AND TACHOMETER LINKAGE AND CABLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require repair or replacement.
Binding	A	Require repair or replacement.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance	..	No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance	..	No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require repair or replacement.
Disconnected	A	Require repair or replacement.
Kinked	A	Require repair or replacement.
Melted	A	(1) Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Routed incorrectly	2	Suggest repair.
Seized	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

SPEEDOMETER CABLES

See SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES.

SPEEDOMETERS

See GAUGES.

STARTERS

NOTE: To prevent misdiagnosis, care should be taken to

eliminate the possibilities of mechanical problems or high resistance in power and/or ground circuits.

STARTER INSPECTION

Condition	Code	Procedure
Amperage draw does not meet OEM specifications	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	(1) Require repair or replacement of hardware.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance		No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket holes elongated, affecting performance	A	Require repair or replacement.
Bracket holes elongated, not affecting performance)		No service suggested or required.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Drive gear damaged, affecting performance	A	(2) Require repair or replacement.
Drive gear damaged, not affecting performance	2	(2) Suggest repair or replacement.
Fails to disengage	A	Require repair or replacement.
Housing broken, affecting performance	2	Require repair or replacement.
Housing broken, not affecting performance		No service suggested or required.
Housing cracked, affecting performance	A	Require repair or replacement.
Housing cracked, not affecting performance	2	Suggest repair or replacement.

Inoperative	A	(3) Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Shimmed incorrectly	B	Require repair.
Starter shaft bushing missing	C	(4) Require replacement.
Starter shaft bushing worn, affecting performance	A	Require replacement.
Starter shaft bushing worn, not affecting performance	1	Suggest replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(5) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Inspect block or bell housing mounting surface.
(2) - Further inspection required to determine cause. Require inspection of ring gear.
(3) - Inoperative includes intermittent operation.
(4) - Bushing may be in bell housing.
(5) - Determine cause and correct prior to repair or replacement of part.

SUB-WOOFER VOLUME CONTROLS

See RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS.

SWITCHES

SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or

			replacement.
Burned, not affecting performance	2	.....	(1) Suggest repair or replacement.
Cracked, affecting performance	A	..	Require repair or replacement.
Cracked, not affecting performance	1	..	Suggest repair or replacement.
Leaking	A	..	Require repair or replacement.
Malfunctioning	A	.....	(2) Require repair or replacement.
Melted, affecting performance	A	.....	(1) Require repair or replacement.
Melted, not affecting performance	2	.....	(1) Suggest repair or replacement.
Missing	C	.....	Require replacement.
Out of adjustment	B	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Won't return	A	..	Require repair or replacement.
Worn	1	.....	Suggest replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, or failure to perform all functions.

TACHOMETER CABLES

See SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES.

TACHOMETERS

See GAUGES.

TAPE PLAYERS AND CD PLAYERS

TAPE PLAYER AND CD PLAYER INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not			

functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Malfunctioning	A	(2) Require repair or replacement.
Missing	C	Require replacement.
Skips	A	Require repair or replacement.
Sound quality poor	A	(3) Require repair or replacement.
Speed incorrect	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.
(3) - Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.

TENSIONERS

TENSIONER INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearings worn	1	Suggest replacement.
Belt tension incorrect	B	Require adjustment or repair.
Cracked	2	Suggest replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.

Pulley damaged, affecting belt life	A	Require replacement.
Seized	A	Require repair or replacement.

TIMERS

TIMER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require repair or replacement.
Burned, affecting performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Inoperative	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

TIRE PRESSURE SENSORS

TIRE PRESSURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Inoperative	A	(1) Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

TRANSCEIVERS

TRANSCEIVER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Malfunctioning	A	(2) Require repair or replacement.
Missing	C	Require replacement.
Sound quality poor	A	(3) Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead burned	A	Require repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.

Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.
(3) - Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.

TRANSDUCERS

TRANSDUCER INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Drive mechanism damaged, affecting performance	A	.....	(2) Require repair or replacement.
Drive mechanism damaged, not affecting performance	2	.....	(2) Suggest repair or replacement.
Inoperative	A	.....	(3) Require repair or replacement.
Leaking (vacuum/fluid/air)	A	.....	Require replacement.
Linkage bent, affecting performance	A	...	Require repair or replacement of linkage.
Linkage bent, not affecting performance	..	.....	No service suggested or required.
Linkage binding, affecting performance	A	...	Require repair or replacement of linkage.
Linkage binding, not affecting performance	2	...	Suggest repair or replacement of linkage.
Linkage broken	A	...	Require repair or replacement of linkage.
Linkage loose, affecting performance	A	...	Require repair or replacement of linkage.
Linkage loose, not affecting performance	1	...	Suggest repair or replacement

			of linkage.
Linkage missing	C	.....	Require replacement.
Linkage noisy	2	..	Suggest repair or replacement.
Out of adjustment	B	.....	(4) Further inspection required.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance ..	1	..	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Further inspection required to determine cause.
(3) - Inoperative includes intermittent operation or out of specification.
(4) - Follow OEM recommended adjustment procedures. Repair or replace if out of specification.

VACUUM ACCUMULATORS (RESERVOIRS)

VACUUM ACCUMULATOR (RESERVOIR) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Leaking	A	..	Require repair or replacement.

VACUUM RESERVOIRS

See VACUUM ACCUMULATORS (RESERVOIRS).

VOLTAGE REGULATORS

VOLTAGE REGULATOR INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - NOTE: Inoperative includes intermittent operation or out of OEM specification.

WASHER FLUID LEVEL SENDERS

WASHER FLUID LEVEL SENDER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

WASHER PUMPS

WASHER PUMP INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Connector broken	A	.. Require repair or replacement.
Connector melted	A	..... (1) Require repair or replacement.
Connector missing	C	..... Require replacement.
Inoperative	A	..... (2) Require repair or replacement.
Leaking externally	A	.. Require repair or replacement.
Leaking internally	A	.. Require repair or replacement.
Noisy	2	.. Suggest repair or replacement.
Resistance out of specification	B	.. Require repair or replacement.
Terminal broken	A	.. Require repair or replacement.
Terminal burned, affecting performance	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance	A	.. Require repair or replacement.
Terminal corroded, not affecting performance	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.
Terminal loose, not affecting performance	1	.. Suggest repair or replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Wire lead conductors exposed	B	.. Require repair or replacement.
Wire lead corroded	A	.. Require repair or replacement.
Wire lead open	A	.. Require repair or replacement.
Wire lead shorted	A	.. Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

(2) - Inoperative includes intermittent operation.

WIPER ARMS AND BLADES

NOTE: Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.

WIPER ARM AND BLADE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Attaching socket stripped	A	Require replacement.
Bent	A	Require repair or replacement.
Loose	2	Suggest repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Size incorrect	2	Suggest replacement.
Tension insufficient	B	Require repair or replacement.
Torn	A	Require replacement.
Worn, affecting performance	A	Require replacement.
Worn, not affecting performance	1	Suggest replacement.

WIPER BLADES

See WIPER ARMS AND BLADES.

WIPER HOSES AND NOZZLES

WIPER HOSE AND NOZZLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Blocked	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Oil-soaked (spongy)	1	Suggest replacement.
Spray pattern incorrect	2	Suggest repair or replacement.
Surface cracks (dry-rotted)	1	Suggest replacement.

WIPER LINKAGES

WIPER LINKAGE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Attaching stud stripped	A	Require replacement.
Bent	A	Require repair or replacement.
Inoperative	A	(1) Require replacement.
Loose	2	Suggest repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Tension insufficient	B	Require repair or replacement.
Worn, affecting performance	A	Require replacement.
Worn, not affecting performance	1	Suggest replacement.

(1) - Inoperative includes intermittent operation.

WIPER NOZZLES

See WIPER HOSES AND NOZZLES.

WIPER PUMP RESERVOIRS

WIPER PUMP RESERVOIR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Cap missing	C	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

WIRING HARNESSES AND CONNECTORS

WIRING HARNESS AND CONNECTOR INSPECTION

Condition	Code	Procedure

Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Insulation damaged, conductors exposed	A	Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Open	A	Require repair or replacement.
Protective shield (conduit) melted	2	(1) Suggest repair or replacement.
Protective shield (conduit) missing	2	Suggest repair or replacement.
Resistance (voltage drop) out of specification	A	Require repair or replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Shorted	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Voltage drop out of specification	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

ELECTROSTATIC DISCHARGE WARNING - BASIC INFORMATION

1999 Lexus RX 300

GENERAL INFORMATION
Electrostatic Discharge (ESD) Warning - Basic Information

All Makes amd Models

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only.

INTRODUCTION

All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. 1 may be used on schematics to indicate which components are ESD sensitive. See Fig. 1. Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.

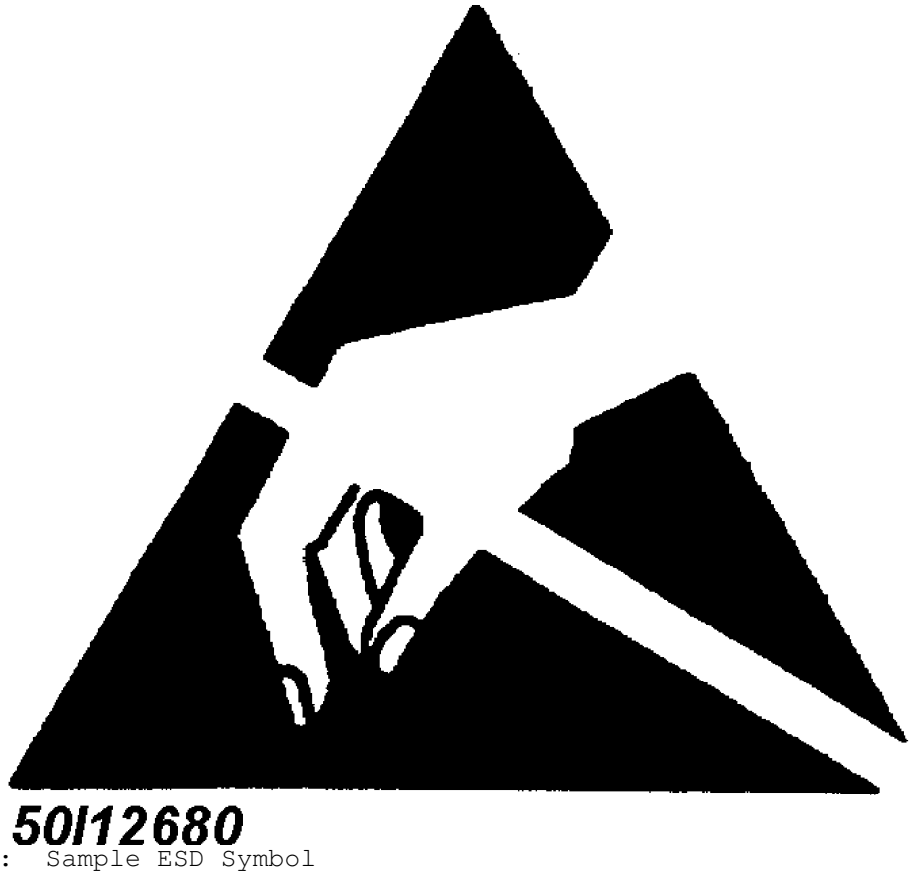


Fig. 1: Sample ESD Symbol

HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES

When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1) Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2) Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3) DO NOT open the package of a new part until it is time to install the part.
4) Before removing the part from its package, ground the package to a known good ground source.

CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES

1) Solid State circuits in electronic devices are shown greatly simplified in schematics. See Fig. 2. Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.

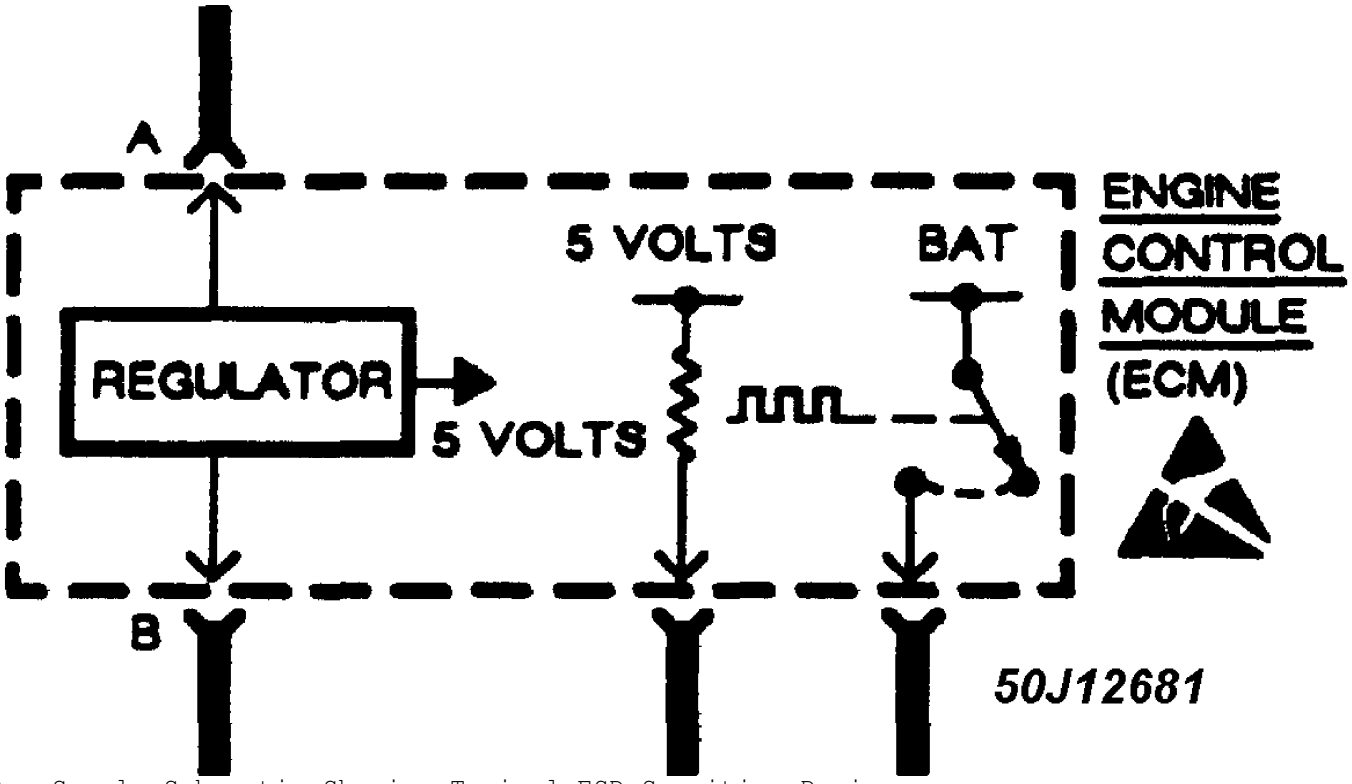


Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device

2) Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3) When using a voltmeter, be sure to connect the ground lead first.

EMISSION CONTROL VISUAL INSPECTION PROCEDURES

1999 Lexus RX 300

GENERAL INFORMATION
Emission Control Visual Inspection Procedures

All Models

* PLEASE READ THIS FIRST *

This article is provided for general information only. Not all information applies to all makes and models. For more complete information, see appropriate article(s) in the ENGINE PERFORMANCE Section.

EMISSION CONTROL LABELS

The vehicle manufacturer's emission control label, also known as the underhood tune-up label or Vehicle's Underhood Emission Control System (VECI) label, is located in the engine compartment. Information regarding year model of vehicle, engine size, number of cylinders, emission equipment or type, engine tune-up specifications, whether vehicle was manufactured for sale in California or is a Federal vehicle, vacuum hose routing schematic, etc., can be found on this label. See Fig. 1.

In addition to the VECI label, some emission control inspection and maintenance programs may require an additional label to be affixed to the vehicle in special circumstances. For example, in California, a Bureau Of Automotive Repair (BAR) engine label may be affixed to the left door post. A BAR engine label is only used when the vehicle has an engine change, approved modification or is a Specially Constructed (SPCN) or an acceptable Gray market vehicle. Check your state's emission control inspection and maintenance laws to determine if a similar label is used.

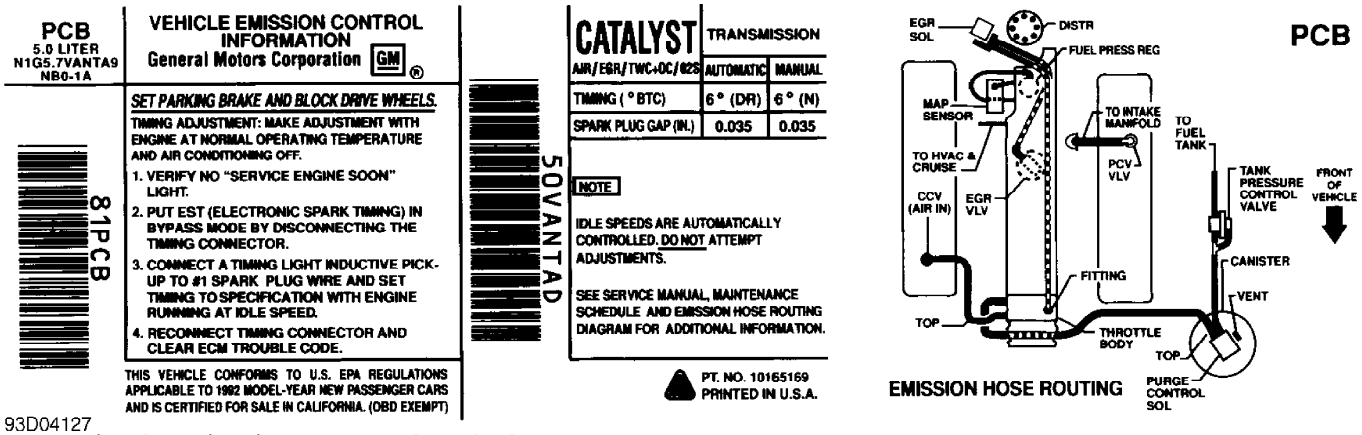


Fig. 1: Typical Emission Control Label
Courtesy of General Motors Corp.

EMISSION CONTROL VISUAL INSPECTION

* PLEASE READ THIS FIRST *

NOTE: The following emission control visual inspection procedures should be used as a guide only. When performing a visual inspection, always follow your state's recommended

inspection procedures.

A visual inspection is made to determine if any required emission control devices are missing, modified or disconnected. Missing, modified or disconnected systems must be made fully operational before a vehicle can be certified.

POSITIVE CRANKCASE VENTILATION (PCV)

PCV controls the flow of crankcase fumes into the intake manifold while preventing gases and flames from traveling in the opposite direction. PCV is either an open or closed system. See Fig. 2 .

Ensure PCV system is installed as required. Verify valve, required hoses, connections, flame arresters, etc., are present, routed properly and in serviceable condition.

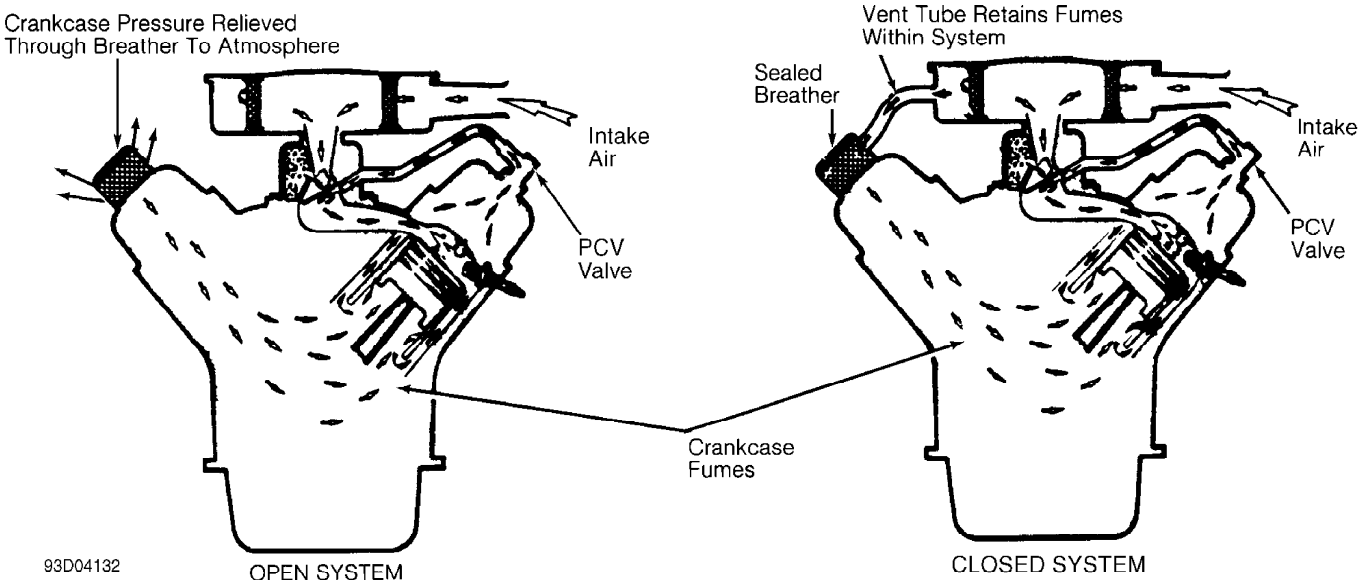


Fig. 2: Typical Open & Closed Type PCV System

THERMOSTATIC AIR CLEANER (TAC)

The TAC supplies warm air to air intake during cold engine operation. This system is active during cold engine warm-up only. Under all other operating conditions, air cleaner function is the same as any non-thermostatic unit.

Ensure required exhaust shroud, hot air duct, vacuum hoses and air cleaner components are present and installed properly. See Fig. 3. Ensure any required thermostatic vacuum switches are in place and vacuum hoses are installed and in serviceable condition. Also ensure air cleaner lid is installed right side up. Check for oversized air filter elements and for additional holes in the air cleaner housing.

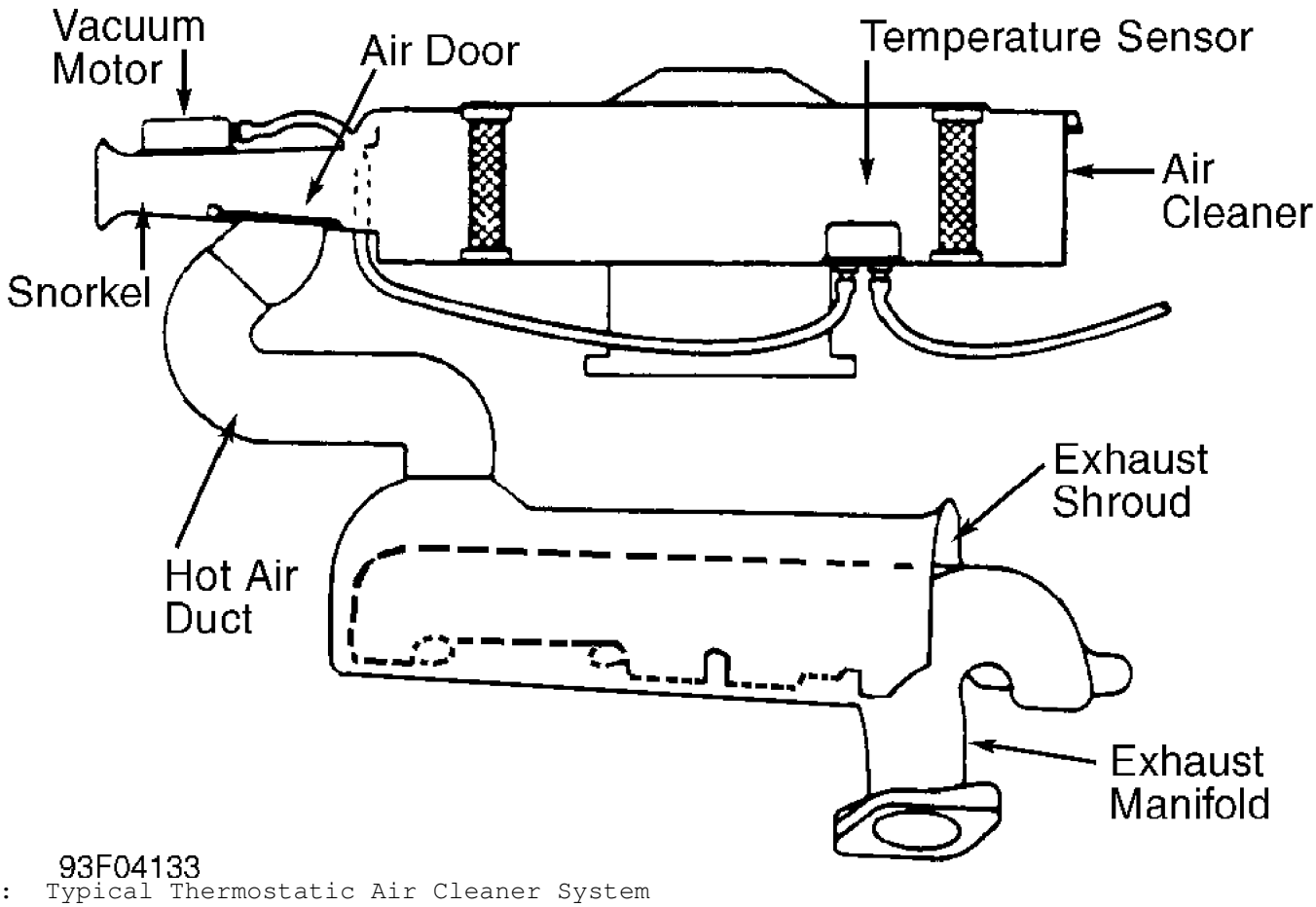


Fig. 3: Typical Thermostatic Air Cleaner System

FUEL EVAPORATIVE SYSTEM (EVAP)

The EVAP system allows for proper fuel system ventilation while preventing fuel vapors from reaching the atmosphere. This means that vapors must be caught and stored while the engine is off, which is when most fuel evaporation occurs. When the engine is started, these fuel vapors can be removed from storage and burned. In most systems, storage is provided by an activated charcoal (or carbon) canister. See Fig. 4. On a few early systems, charcoal canisters are not used. Instead, fuel vapors are vented into the PCV system and stored inside the crankcase.

The main components of a fuel evaporation system are a sealed fuel tank, a liquid-vapor separator and vent lines to a vapor-storing canister filled with activated charcoal. The filler cap is normally not vented to the atmosphere, but is fitted with a valve to allow both pressure and vacuum relief.

Although a few variations do exist between manufacturers, basic operation is the same for all systems. Check for presence of vapor storage canister or crankcase storage connections when required. Ensure required hoses, solenoids, etc., are present and connected properly. Check for proper type fuel tank cap. Check for any non-OEM or auxiliary fuel tanks for compliance and the required number of evaporation canisters.

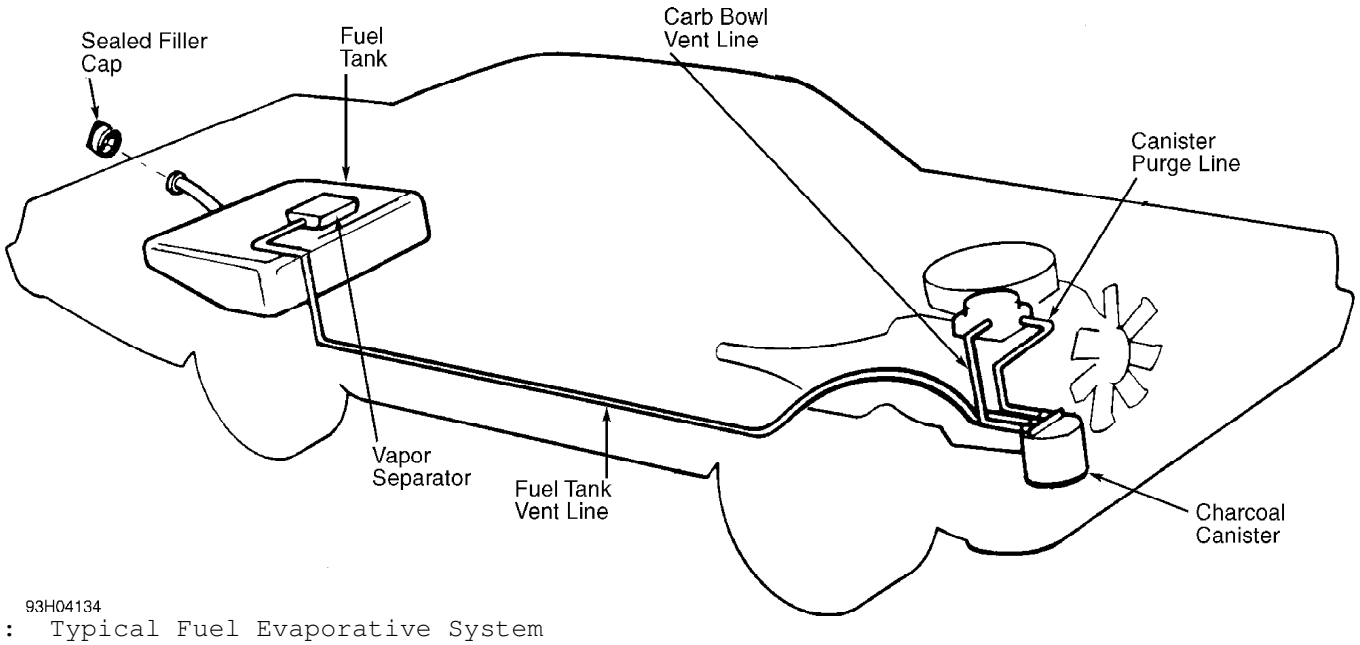


Fig. 4: Typical Fuel Evaporative System

CATALYTIC CONVERTERS

Oxidation Catalyst (OC)

This type of converter is the most common. It may use pellets or monolith medium, depending upon application. See Fig. 5. Platinum and palladium (or platinum alone) are used as catalyst in this type of converter.

Visually check for presence of catalytic converter(s). Check for external damage such as severe dents, removed or damaged heat shields, etc. Also check for pellets or pieces of converter in the tailpipe.

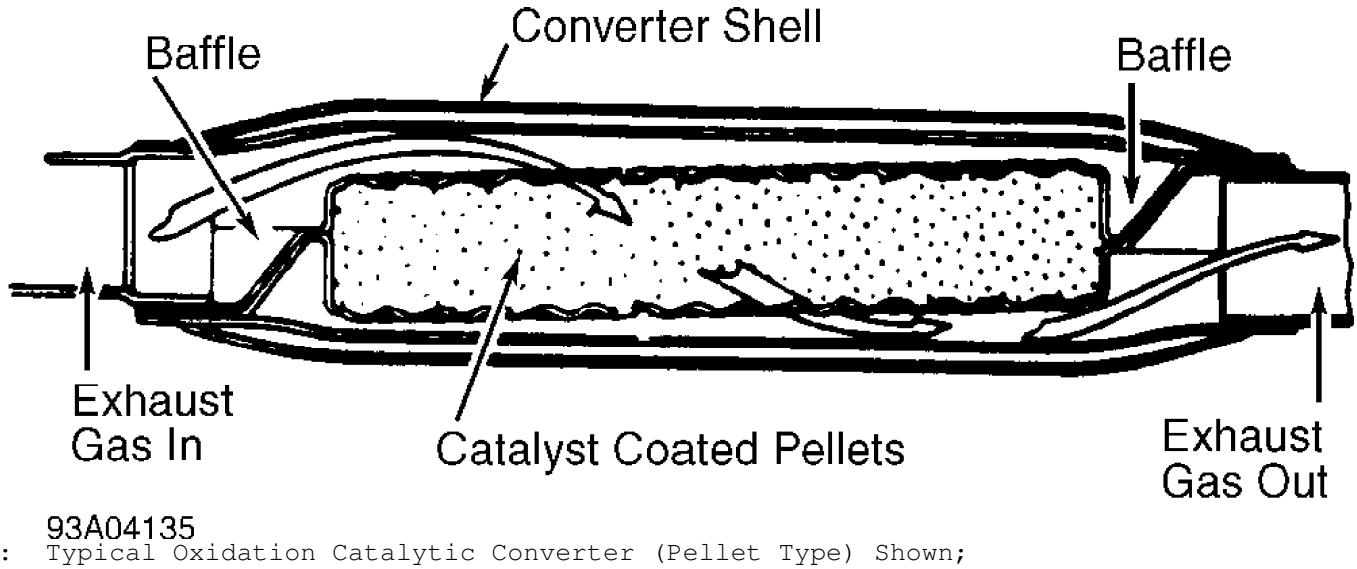


Fig. 5: Typical Oxidation Catalytic Converter (Pellet Type) Shown; Typical Three-Way Catalytic Converter Is Similar
Courtesy of General Motors Corp.

Three-Way Catalyst (TWC)

This type of converter is nearly identical to a conventional

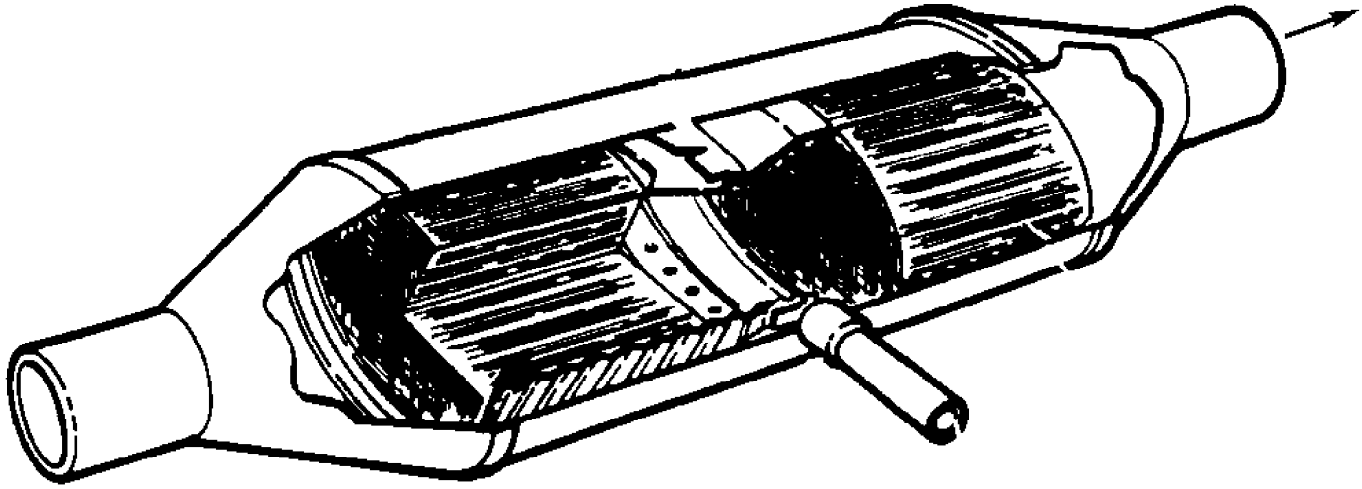
converter with the exception of the catalyst. See Fig. 5. The TWC converter uses rhodium, with or without platinum, as its catalyst. Rhodium helps reduce NOx emissions, as well as HC and CO.

Visually check for presence of catalytic converter(s). Also check for presence of any required air supply system for the oxidizing section of the converter. Check for external damage such as severe dents, removed or damaged heat shields, etc. Check for pellets or pieces of converter in the tailpipe.

Three-Way Catalyst + Oxidation Catalyst (TWC + OC)

This system contains a TWC converter and an OC converter in a common housing, separated by a small air space. See Fig. 6. The 2 catalysts are referred to as catalyst beds. Exhaust gases pass through the TWC first. The TWC bed performs the same function as it would as a separate device, reducing all 3 emissions. As exhaust gases leave the bed, they pass through the air space and into the second (OC) converter catalyst bed.

Visually check for presence of catalytic converter(s). Check for external damage such as severe dents, removed or damaged heat shields, etc. Check for pellets or pieces of converter in the tailpipe.



93C04136

Fig. 6: Typical Three-Way + Oxidation Catalytic Converter
Courtesy of General Motors Corp.

FILL PIPE RESTRICTOR (FR)

A fuel tank fill pipe restrictor is used to prohibit the introduction of leaded fuel into the fuel tank. Unleaded gasoline pump dispensers have a smaller diameter nozzle to fit fuel tank of vehicle requiring the use of unleaded fuel (vehicles equipped with catalytic converter).

Visually inspect fill pipe restrictor(s) for tampering, i.e., restrictor is oversize or the flapper is non-functional. If vehicle is equipped with an auxiliary fuel tank, ensure auxiliary fuel tank is also equipped with a fill pipe restrictor.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Single Diaphragm EGR Valve

This type uses a single diaphragm connected to the valve by a shaft. Diaphragm is spring-loaded to keep valve closed in the absence of vacuum. As throttle valves open and engine speed increases, vacuum is applied to the EGR vacuum diaphragm, opening the EGR valve. This vacuum signal comes from a ported vacuum source. Variations in the vacuum signal control the amount of exhaust gas that is recirculated. See Fig. 7.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed switches, etc., (if applicable) are not by-passed or modified. Ensure vacuum hose(s) to EGR valve is not plugged.

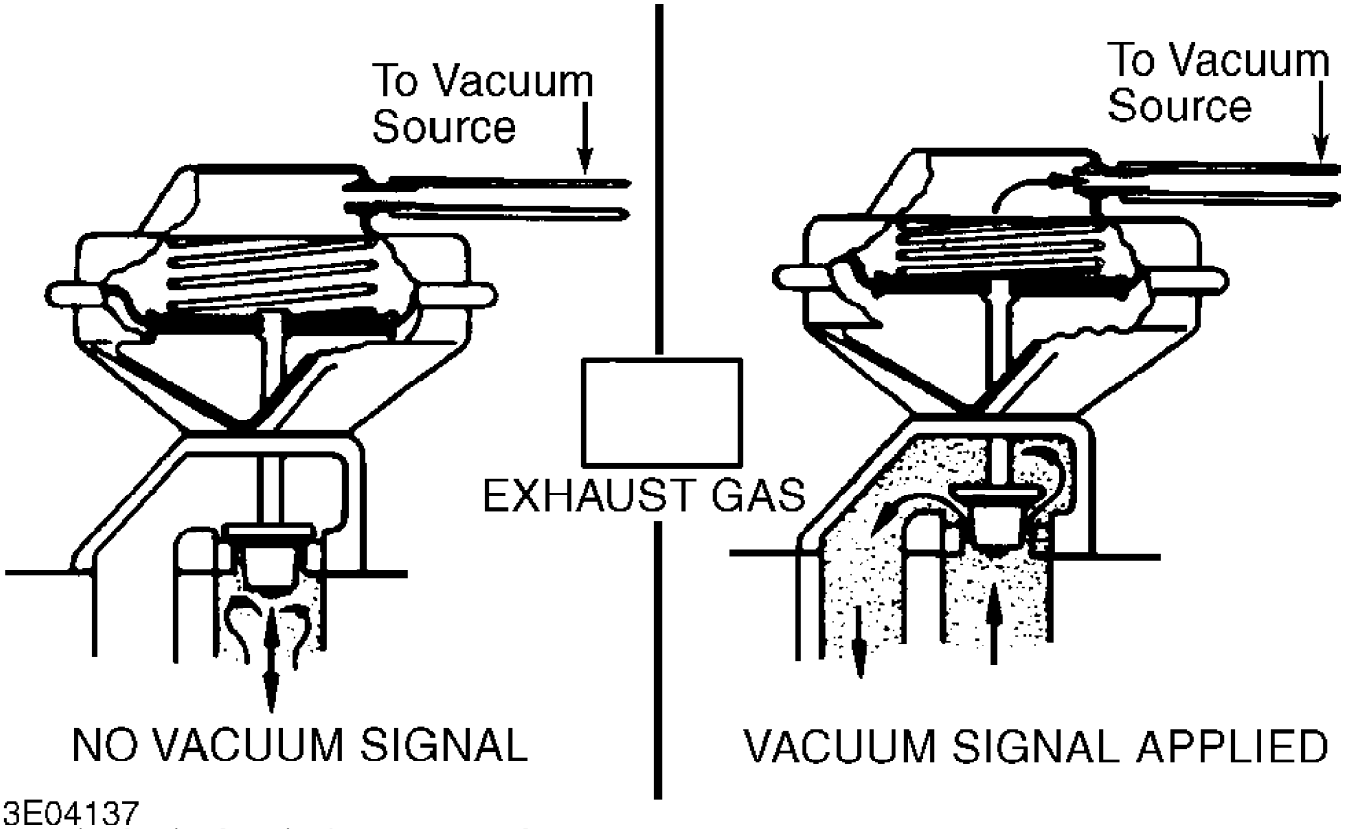


Fig. 7: Typical Single Diaphragm EGR Valve
Courtesy of General Motors Corp.

Dual Diaphragm EGR Valve

This type uses 2 diaphragms with different effective areas and 2 vacuum sources. Although similar to the single diaphragm type, the second diaphragm is added below the upper diaphragm and is rigidly attached to the valve seat. See Fig. 8. These diaphragms form a vacuum chamber which is connected to manifold vacuum.

During highway cruising when manifold vacuum is high in the center chamber, manifold vacuum tends to pull the valve closed. However, the vacuum signal applied to the top side of the upper diaphragm overcomes the downward spring force and the manifold vacuum pull, due to the diaphragm's larger piston. This regulates the amount of EGR.

When manifold vacuum is low during acceleration, the higher vacuum signal opens the valve, permitting more EGR. When manifold vacuum is high during highway cruising, the valve is only partially opened, reducing the amount of EGR.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed switches, etc., (if applicable) are not by-passed or modified. Ensure vacuum hose(s) to EGR valve is not plugged.

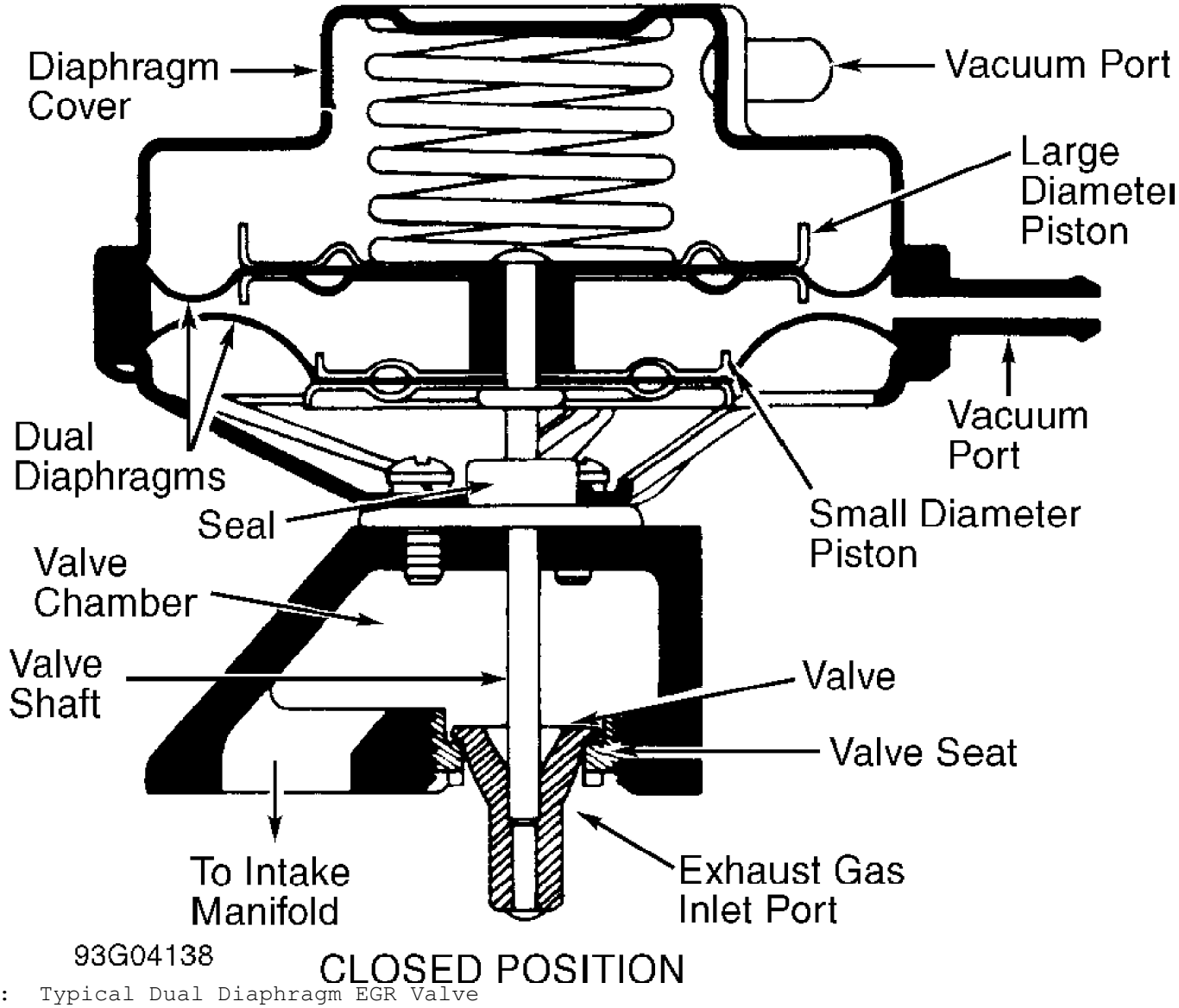


Fig. 8: Typical Dual Diaphragm EGR Valve
Courtesy of General Motors Corp.

Positive Backpressure EGR (BP/EGR) Valve

This type uses both engine vacuum and exhaust backpressure to control the amount of EGR. It provides more recirculation during heavy engine loads than the single diaphragm EGR valve.

A small diaphragm-controlled valve inside EGR valve acts as a pressure regulator. The control valve gets an exhaust backpressure signal through the hollow valve shaft. This exhaust backpressure exerts a force on bottom of control valve diaphragm. The diaphragm plate contains 6 bleed holes to bleed air into the vacuum chamber when backpressure valve is in open position. See Fig. 9.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed

switches, etc., (if applicable) are not by-passed or modified. Ensure vacuum hose(s) to EGR valve is not plugged.

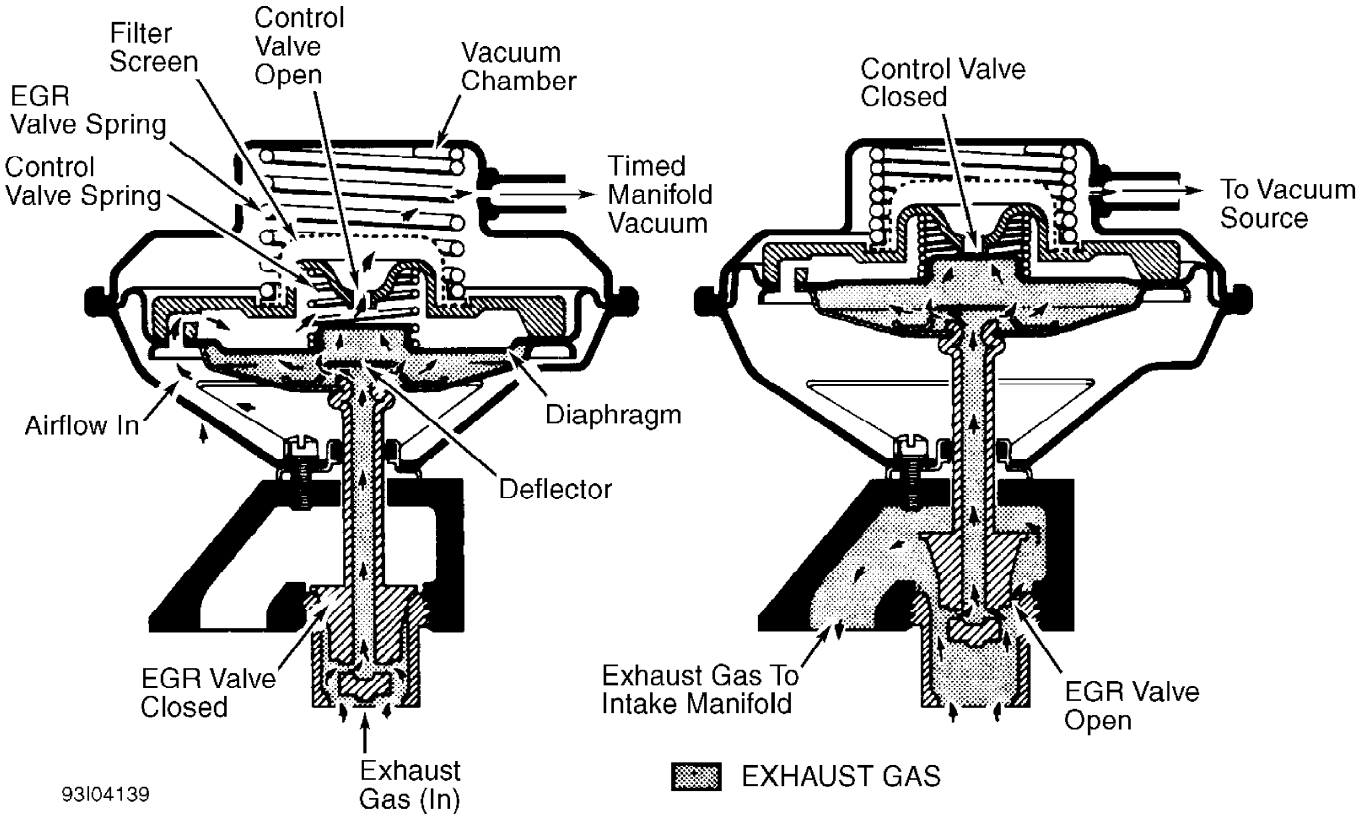


Fig. 9: Typical Positive Backpressure EGR Valve
Courtesy of General Motors Corp.

Negative Backpressure EGR (BP/EGR) Valve

This type has the same function as the positive BP/EGR valve except valve is designed to open with a negative exhaust backpressure. The control valve spring in the transducer is placed on the bottom side of the diaphragm. See Fig. 10.

When ported vacuum is applied to the main vacuum chamber, partially opening the valve, the vacuum signal from the manifold side (reduced by exhaust backpressure) is transmitted to the hollow stem of the valve. See Fig. 10. This enables the signal to act on the diaphragm, providing a specific flow. Thus, the EGR flow is a constant percentage of engine airflow.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed switches, etc., (if applicable) are not by-passed or modified. Ensure vacuum hose(s) to EGR valve is not plugged.

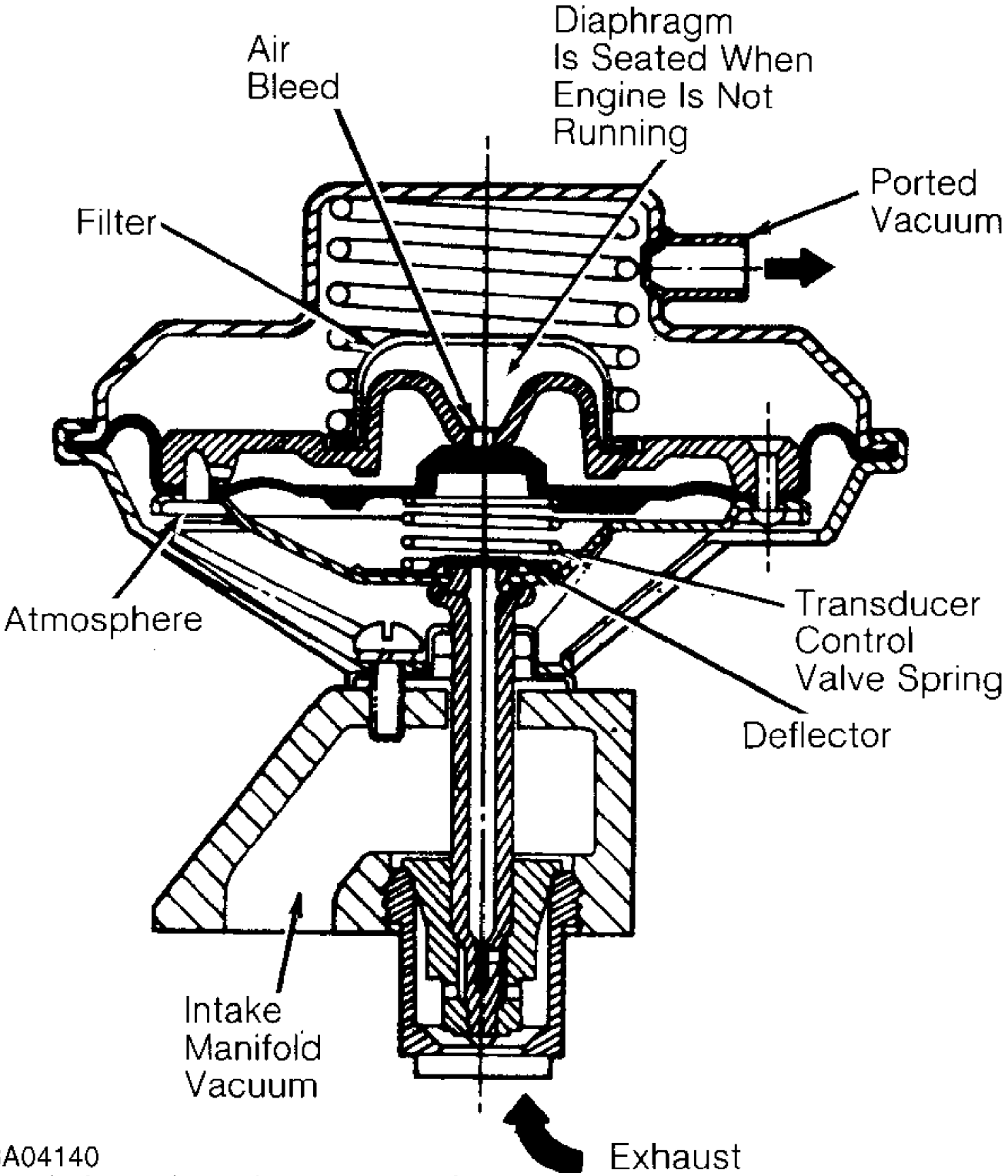


Fig. 10: Typical Negative Backpressure EGR Valve
Courtesy of General Motors Corp.

Digital EGR Valve

The digital EGR valve operates independently of engine manifold vacuum. This valve controls EGR flow through 3 orifices.

These 3 orifices are opened and closed by electric solenoids. The solenoids are, in turn, controlled by the Electronic Control Module (ECM). When a solenoid is energized, the armature with attached shaft and swivel pintle is lifted, opening the orifice. See Fig. 11.

The ECM uses inputs from the Coolant Temperature Sensor (CTS), Throttle Position Sensor (TPS) and Mass Airflow (MAF) sensors to control the EGR orifices to make 7 different combinations for precise EGR flow control. At idle, the EGR valve allows a very small amount of exhaust gas to enter the intake manifold. This EGR valve normally operates above idle speed during warm engine operation.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed switches, etc., (if applicable) are not by-passed or modified. Ensure vacuum hose(s) to EGR valve is not plugged. Ensure electrical connector to EGR valve is not disconnected.

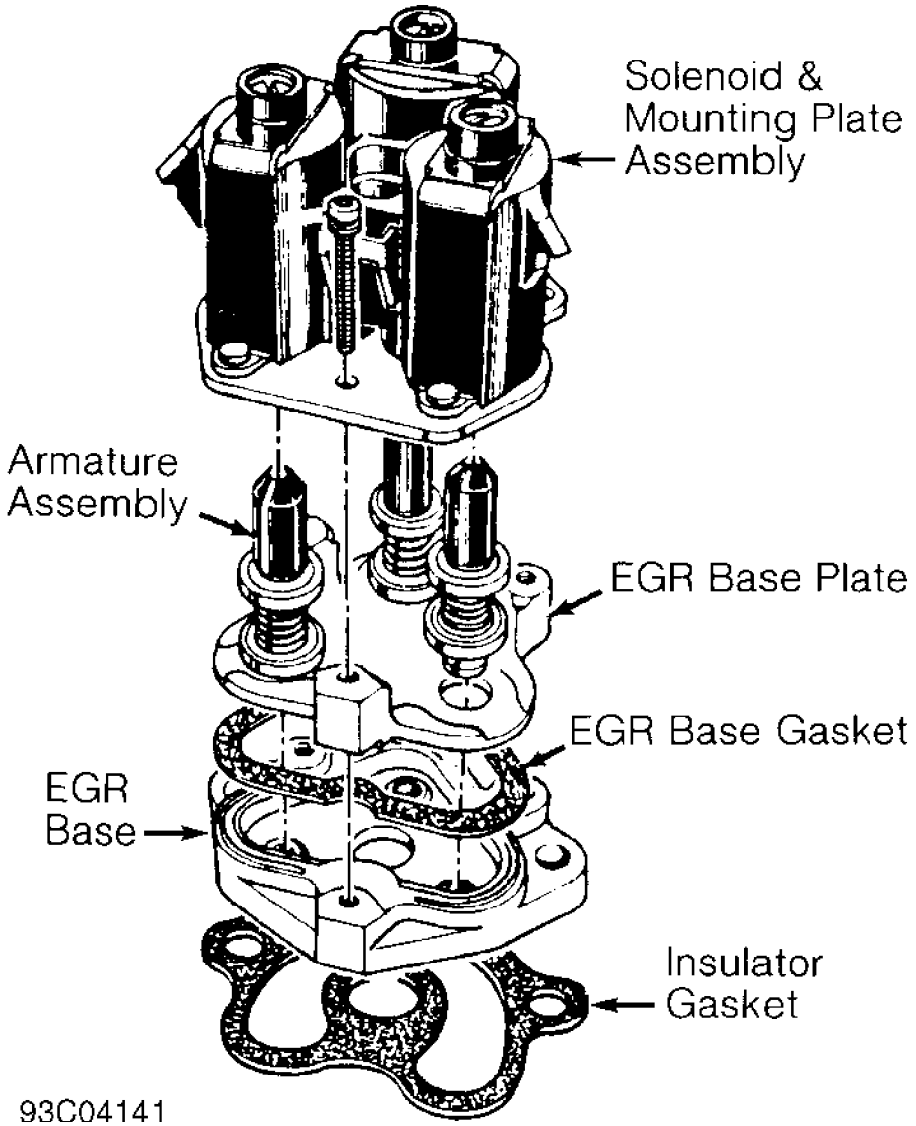


Fig. 11: Typical Digital EGR Valve
Courtesy of General Motors Corp.

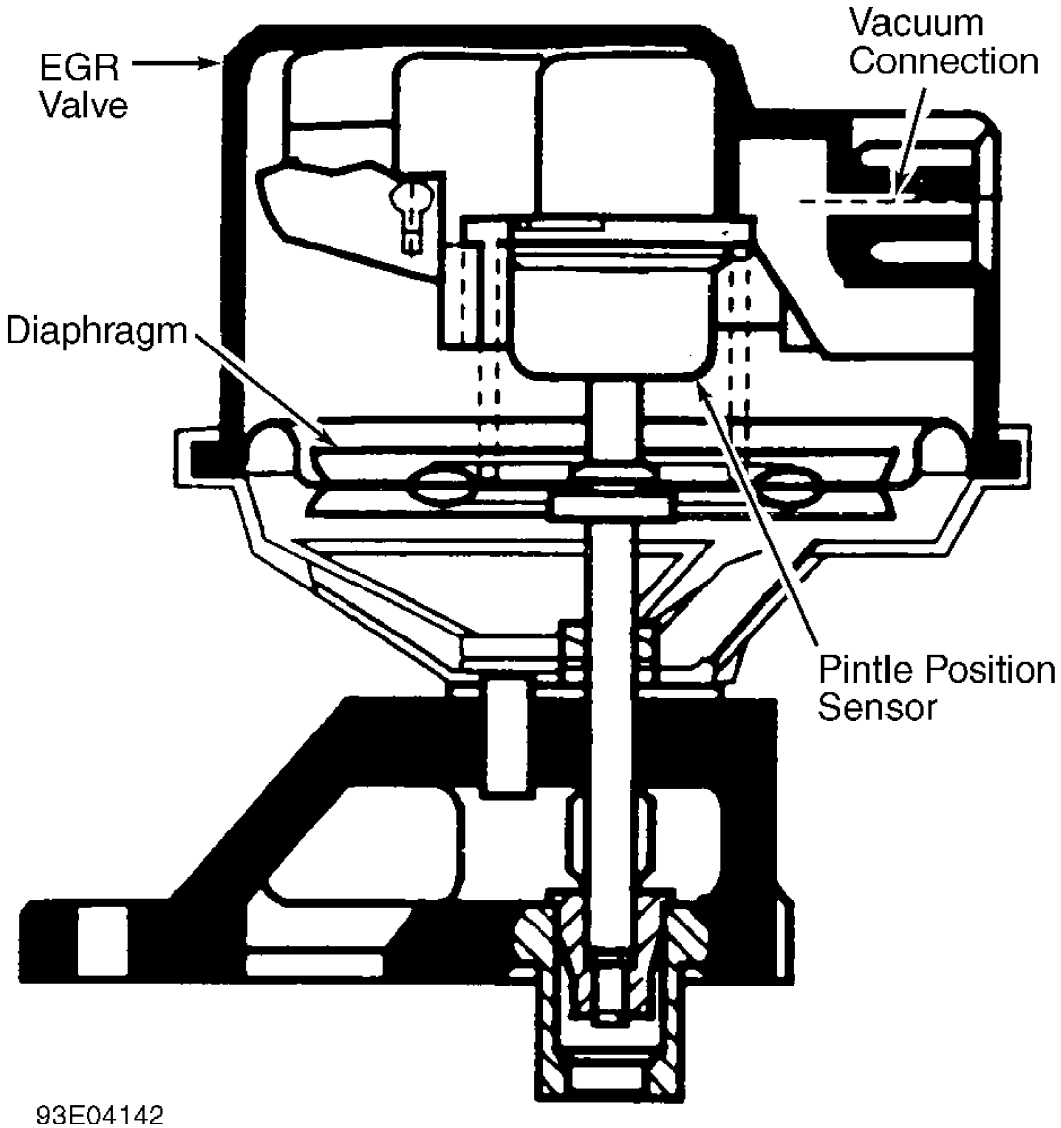
Integrated Electronic EGR Valve

This type functions similar to a ported EGR valve with a

remote vacuum regulator. The internal solenoid is normally open, which causes the vacuum signal to be vented off to the atmosphere when EGR is not controlled by the Electronic Control Module (ECM). The solenoid valve opens and closes the vacuum signal, controlling the amount of vacuum applied to the diaphragm. See Fig. 12.

The electronic EGR valve contains a voltage regulator, which converts ECM signal and regulates current to the solenoid. The ECM controls EGR flow with a pulse width modulated signal based on airflow, TPS and RPM. This system also contains a pintle position sensor, which works similarly to a TPS sensor. As EGR flow is increased, the sensor output increases.

Verify EGR valve is present and not modified or purposely damaged. Ensure thermal vacuum switches, pressure transducers, speed switches, etc., (if applicable) are not by-passed or modified. Ensure electrical connector to EGR valve is not disconnected.



93E04142

Fig. 12: Cutaway View Of Typical Integrated Electronic EGR Valve
Courtesy of General Motors Corp.

Spark control systems are designed to ensure the air/fuel mixture is ignited at the best possible moment to provide optimum efficiency and power and cleaner emissions.

Ensure vacuum hoses to the distributor, carburetor, spark delay valves, thermal vacuum switches, etc., are in place and routed properly. On Computerized Engine Controls (CEC), check for presence of required sensors (O2, MAP, CTS, TPS, etc.). Ensure they have not been tampered with or modified.

Check for visible modification or replacement of the feedback carburetor, fuel injection unit or injector(s) with a non-feedback carburetor or fuel injection system. Check for modified emission-related components unacceptable for use on pollution-controlled vehicles.

AIR INJECTION SYSTEM (AIS)

Air Pump Injection System (AP)

The air pump is a belt-driven vane type pump, mounted to engine in combination with other accessories. The air pump itself consists of the pump housing, an inner air cavity, a rotor and a vane assembly. As the vanes turn in the housing, filtered air is drawn in through the intake port and pushed out through the exhaust port. See Fig. 13.

Check for missing or disconnected belt, check valve(s), diverter valve(s), air distribution manifolds, etc. Check air injection system for proper hose routing.

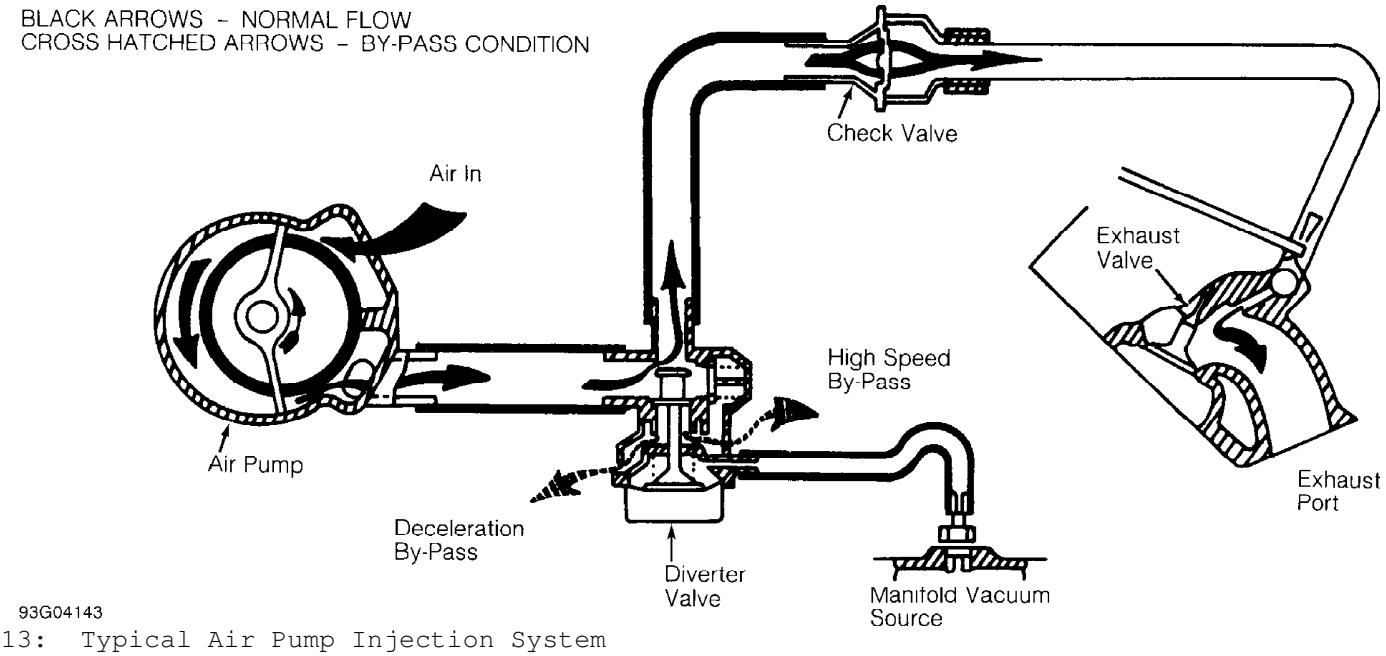


Fig. 13: Typical Air Pump Injection System
Courtesy of General Motors Corp.

Pulsed Secondary Air Injection (PAIR) System

PAIR eliminates the need for an air pump and most of the associated hardware. Most systems consists of air delivery pipe(s), pulse valve(s) and check valve(s). The check valve prevents exhaust gases from entering the air injection system. See Fig. 14.

Ensure required check valve(s), diverter valve(s), air distribution manifolds, etc., are present. Check air injection system for proper hose routing.

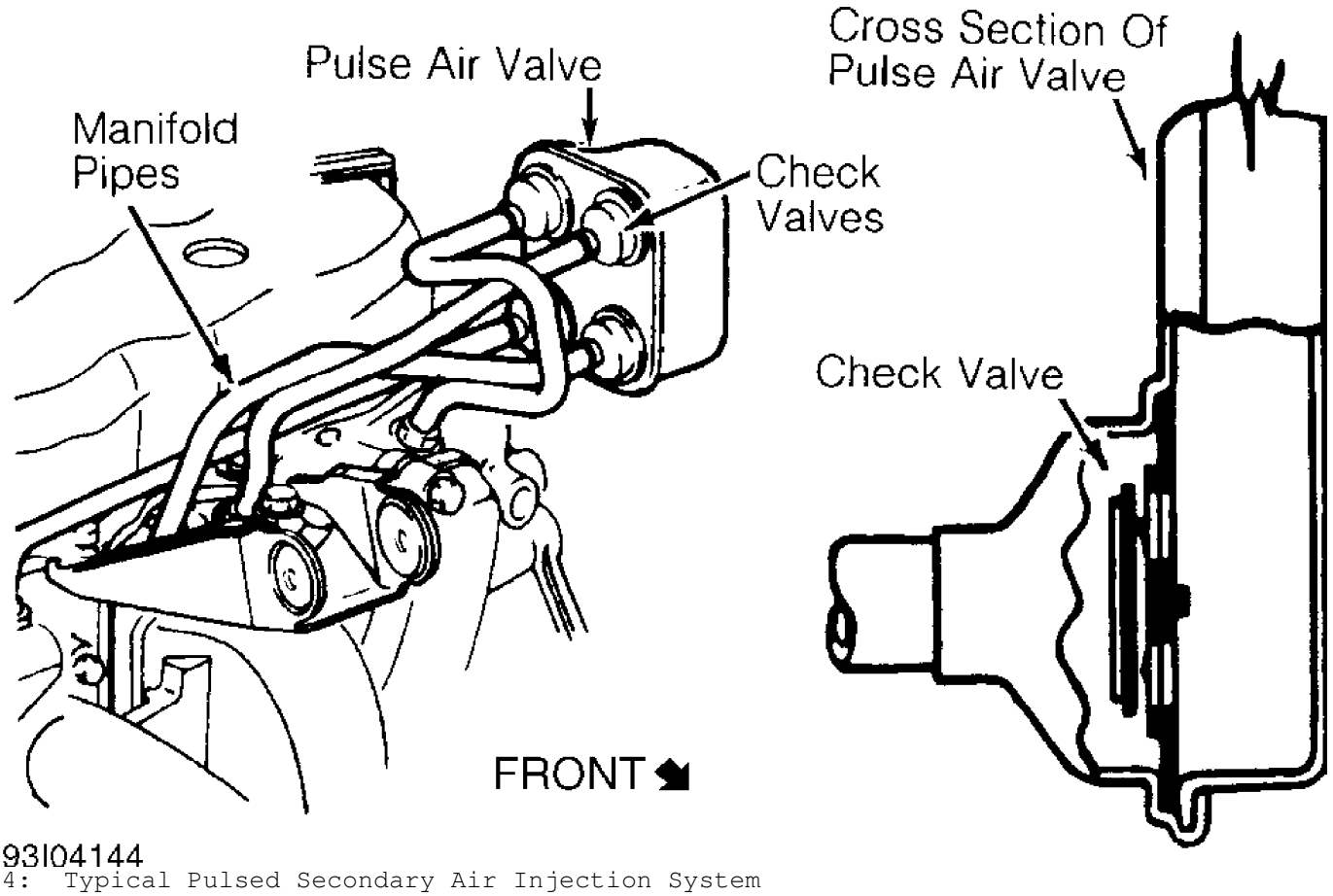


Fig. 14: Typical Pulsed Secondary Air Injection System
Courtesy of General Motors Corp.

OXYGEN SENSOR (O2)

The O2 sensor is mounted in the exhaust system where it monitors oxygen content of exhaust gases. Some vehicles may use 2 O2 sensors. The O2 sensor produces a voltage signal which is proportional to exhaust gas oxygen concentration (0-3%) compared to outside oxygen (20-21%). This voltage signal is low (about .1 volt) when a lean mixture is present and high (1.0 volt) when a rich mixture is present.

As ECM compensates for a lean or rich condition, this voltage signal constantly fluctuates between high and low, crossing a reference voltage supplied by the ECM on the O2 signal line. This is referred to as cross counts. A problem in the O2 sensor circuit should set a related trouble code.

COMPUTERIZED ENGINE CONTROLS (CEC)

The CEC system monitors and controls a variety of engine/vehicle functions. The CEC system is primarily an emission control system designed to maintain a 14.7:1 air/fuel ratio under most operating conditions. When the ideal air/fuel ratio is maintained, the catalytic converter can control oxides of nitrogen (NOx), hydrocarbon (HC) and carbon monoxide (CO) emissions.

The CEC system consists of the following sub-systems: Electronic Control Module (ECM), input devices (sensors and switches) and output signals.

EARLY FUEL EVAPORATION (EFE)

The EFE valve is actuated by either a vacuum actuator or a bimetal spring (heat-riser type). The EFE valve is closed when engine is cold. The closed valve restricts exhaust gas flow from the exhaust manifold. This forces part of the exhaust gas to flow up through a passage below the carburetor. As the exhaust gas quickly warms the intake mixture, distribution is improved. This results in better cold engine driveability, shorter choke periods and lower emissions.

Ensure EFE valve in exhaust manifold is not frozen or rusted in a fixed position. On vacuum-actuated EFE system, check EFE thermal vacuum valve and check valve(s). Also check for proper vacuum hose routing. See Fig. 15.

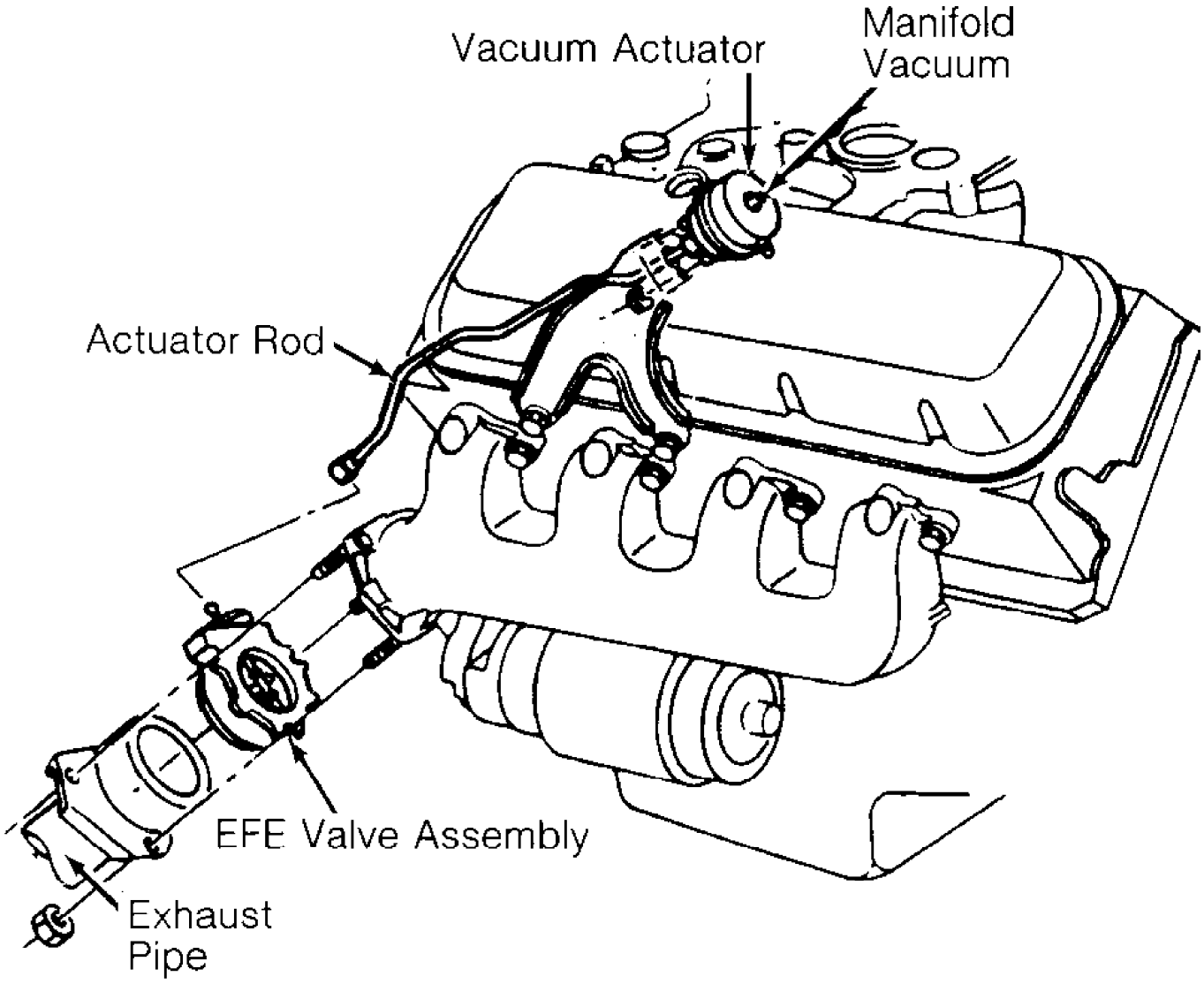


Fig. 15: Typical Vacuum-Actuated EFE System
Courtesy of General Motors Corp.

EMISSION MAINTENANCE REMINDER LIGHT (EMR) (IF EQUIPPED)

If equipped, the EMR light (some models may use a reminder flag) reminds vehicle operator that an emission system maintenance is required. This indicator is activated after a predetermined time/mileage.

When performing a smog check inspection, ensure EMR indicator is not activated. On models using an EMR light, light should glow when ignition switch is turned to ON position and should turn off when engine is running.

If an EMR flag is present or an EMR light stays on with engine running, fail vehicle and service or replace applicable emission-related components. To reset an EMR indicator, refer to appropriate MAINTENANCE REMINDER LIGHTS in the MAINTENANCE section.

MALFUNCTION INDICATOR LIGHT (MIL)

The Malfunction Indicator Light (MIL) is used to alert vehicle operator that the computerized engine control system has detected a malfunction (when it stays on all the time with engine running). On some models, the MIL may also be used to display trouble codes.

As a bulb and system check, malfunction indicator light will glow when ignition switch is turned to ON position and engine is not running. When engine is started, light should go out.

ENGINE COOLING FAN

1999 Lexus RX 300

1999-2000 ENGINE COOLING
Lexus Electric Cooling Fans

ES300, GS300, GS400, LS400, LX470, RX300, SC300

ELECTRIC COOLING FAN

Electric cooling fans are energized by coolant temperature switch and/or A/C pressure switch. For specific system controls, see WIRING DIAGRAMS.

COMPONENT TESTS

* PLEASE READ THIS FIRST *

NOTE: Testing information is not available for all models.

COOLING FAN MOTOR

1) Disconnect cooling fan motor connector. Connect battery negative terminal to cooling fan motor terminal. Connect ammeter lead to other cooling fan motor terminal.
2) Connect other ammeter lead to battery positive terminal. Cooling fan should operate smoothly. Check ammeter reading while cooling fan is in operation. Amperage draw should be 8.5-11.5 amps.

COOLING FAN RELAYS NO. 1, 2 & 3

ES300
1) Remove cooling fan relay from underhood relay block. Relays are marked FAN NO. 1, FAN NO. 2 and FAN NO. 3. On all relays, ensure continuity is present between relay terminals No. 1 and 2 (Nippondenso), or terminals No. 85 and 86 (Bosch). For relays No. 1 and 2, ensure there is continuity between relay terminals No. 3 and 4 (Nippondenso), or terminals No. 30 and 87a (Bosch). For relay No. 3, ensure there is no continuity between terminals No. 3 and 5. If continuity measurements are not to specification, replace cooling fan relay. If continuity measurements are to specification, go to next step.
2) For relay No. 1, apply battery voltage and ground across relay terminals No. 1 and 2 (Nippondenso) or terminals No. 5 and 86 (Bosch). There should be no continuity between terminals No. 3 and 4 (Nippondenso) or terminals No. 30 and 87a (Bosch). Replace relay as necessary.
3) For relay No. 2, apply battery voltage and ground across terminals No. 1 and 2. There should be no continuity between terminals No. 3 and 4, and continuity should exist between terminals No. 3 and 5. Replace relay as necessary.
4) For relay No. 3, apply battery voltage and ground across terminals No. 1 and 2. There should be no continuity between terminals No. 3 and 5. Replace relay as necessary.

GS300 & GS400
1) Remove cooling fan relay from underhood relay block. Relays are marked FAN NO. 1, FAN NO. 2 and FAN NO. 3. On all relays, ensure continuity is present between relay terminals No. 1 and 2. For relays No. 1 and 2, ensure there is continuity between relay terminals No. 3 and 4. For relay No. 3, ensure there is no continuity between

terminals No. 3 and 5. If continuity measurements are not to specification, replace cooling fan relay. If continuity exists as described, go to next step.

2) For relay No. 1, apply battery voltage and ground across relay terminals No. 1 and 2. There should be no continuity between terminals No. 3 and 4. Replace relay as necessary.

3) For relay No. 2, apply battery voltage and ground across terminals No. 1 and 2. There should be continuity between terminals No. 3 and 4, and no continuity between terminals No. 3 and 5. Replace relay as necessary.

4) For relay No. 3, apply battery voltage and ground across terminals No. 1 and 2. There should be continuity between terminals No. 3 and 5. Replace relay as necessary.

RX300

1) Relays are marked FAN NO. 1, FAN NO. 2 and FAN NO. 3. On all relays, ensure continuity is present between relay terminals No. 3 and 5. For relays No. 1 and 3, ensure there is continuity between relay terminals No. 1 and 2. For relay No. 2, ensure there is no continuity between terminals No. 1 and 2. If continuity measurements are not to specification, replace cooling fan relay. If continuity exists as described, go to next step.

2) For relay No. 1, apply battery voltage across relay terminals No. 3 and 5. There should be continuity between terminals No. 1 and 2.

3) For relay No. 2, apply battery voltage across relay terminals No. 3 and 5. There should be no continuity between terminals No. 2 and 4.

4) For relay No. 3, apply battery voltage across relay terminals No. 3 and 5. There should be continuity between terminals No. 1 and 2.

COOLING FAN MAIN RELAY

GS300 & GS400

1) Remove cooling fan main relay from underhood relay block. Using an ohmmeter, check for continuity between relay terminals No. 3 and 5. Continuity should be present. If no continuity is present, check for continuity between terminals No. 2 and 4. Continuity should be present. Check for continuity between relay terminals No. 1 and 2. No continuity should be present. If continuity is not as specified, replace cooling fan main relay.

2) If continuity is as specified, apply battery voltage and ground across relay terminals No. 3 and 5. Using an ohmmeter, check that continuity does not exist between terminals No. 2 and 4. Continuity should exist between relay terminals No. 1 and 2. If continuity is not as specified, replace cooling fan main relay.

COOLING FAN TEMPERATURE SWITCH

GS300 & GS400

1) Drain engine coolant. Remove temperature switch from lower left side of radiator. Heat temperature switch in water. Using ohmmeter, ensure continuity does not exist between switch terminals when water temperature is greater than 200°F (93°C).

2) Cool temperature switch in water. Using ohmmeter, ensure continuity exists between switch terminals when water temperature is less than 181°F (83°C). Replace temperature switch if continuity is not as specified.

ES300 & RX300

1) Drain engine coolant. Remove No. 1 ECT switch. Using ohmmeter, ensure there is no continuity between terminals when coolant

temperature is greater than 98°C (201° F). If continuity exists, replace switch.

2) Ensure there is continuity between terminals when temperature is less than 88° C (190° F). If there is no continuity, replace switch. Reinstall No. 1 ECT switch.

3) Remove No. 2 ECT switch. Using ohmmeter, ensure there is no continuity between terminals when coolant temperature is greater than 94° C (201° F). If continuity exists, replace switch.

4) Ensure there is continuity between terminals when coolant temperature is less than 83° C (181° F). If there is no continuity, replace switch. Reinstall No. 2 ECT switch. Refill engine coolant. Start engine, and check for coolant leaks.

WIRING DIAGRAMS

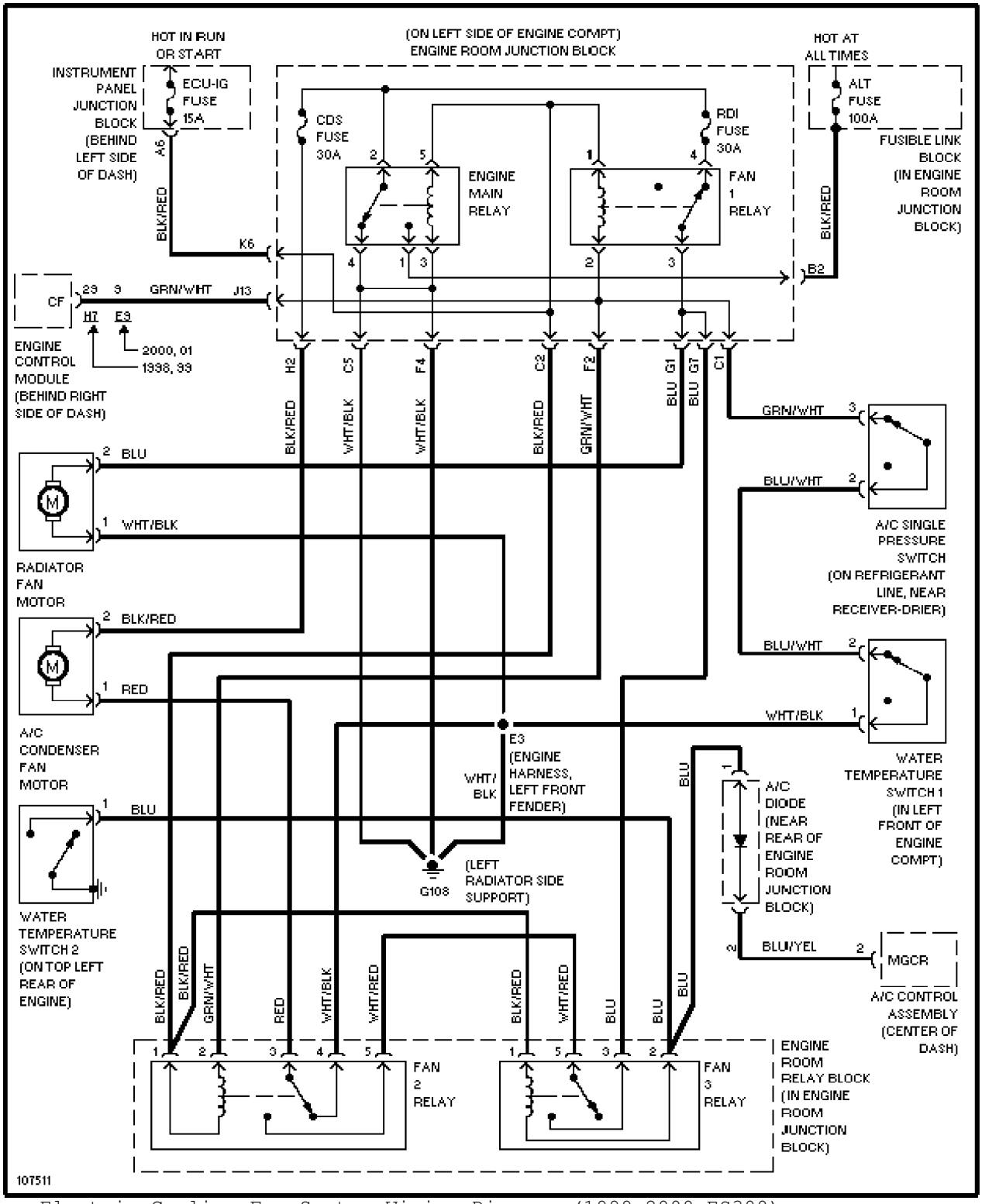


Fig. 1: Electric Cooling Fan System Wiring Diagram (1999-2000 ES300)

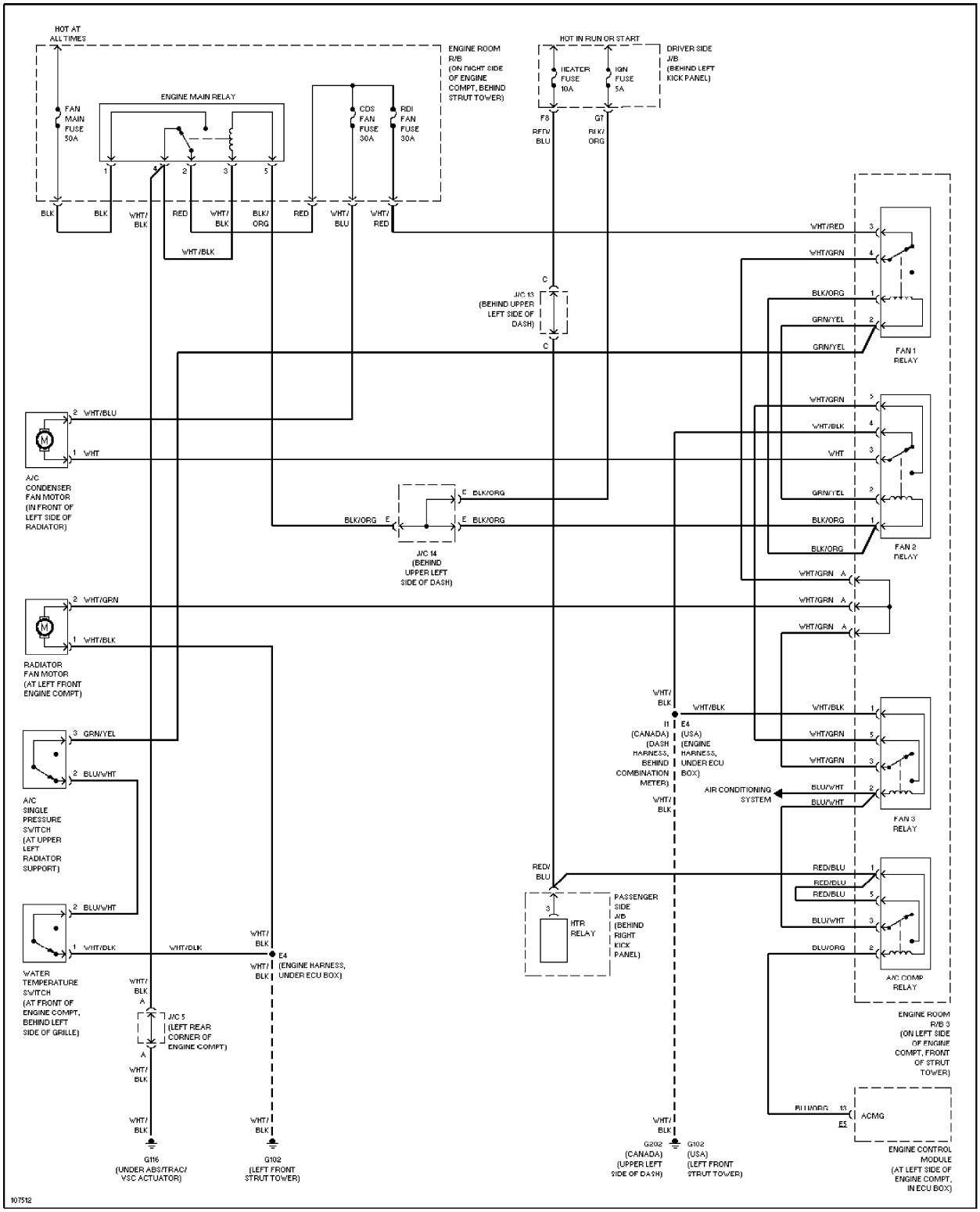


Fig. 2: Electric Cooling Fan System Wiring Diagram (1999-2000 GS300 & GS400)

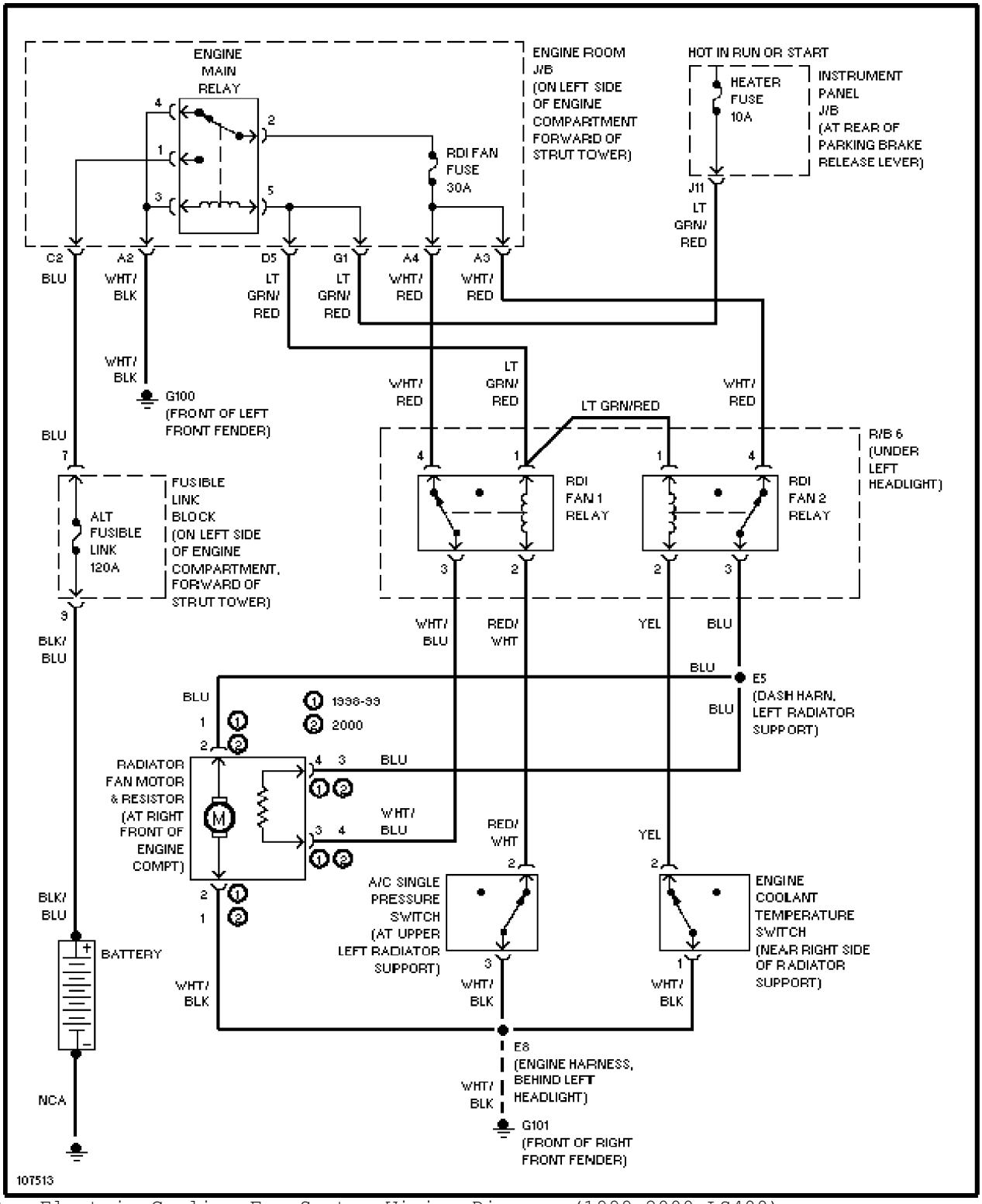


Fig. 3: Electric Cooling Fan System Wiring Diagram (1999-2000 LS400)

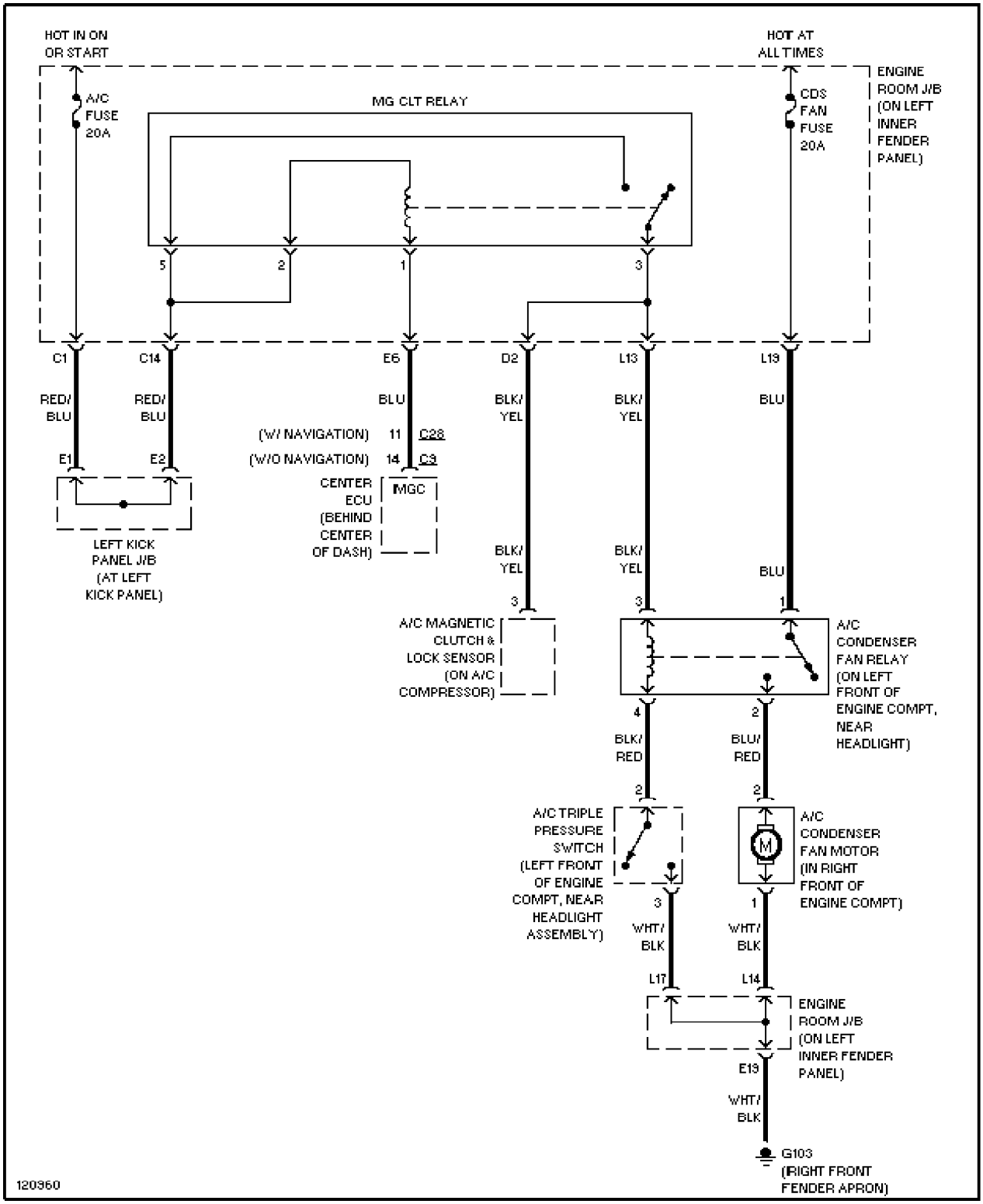


Fig. 4: Electric Cooling Fan System Wiring Diagram (1999-2000 LX470)

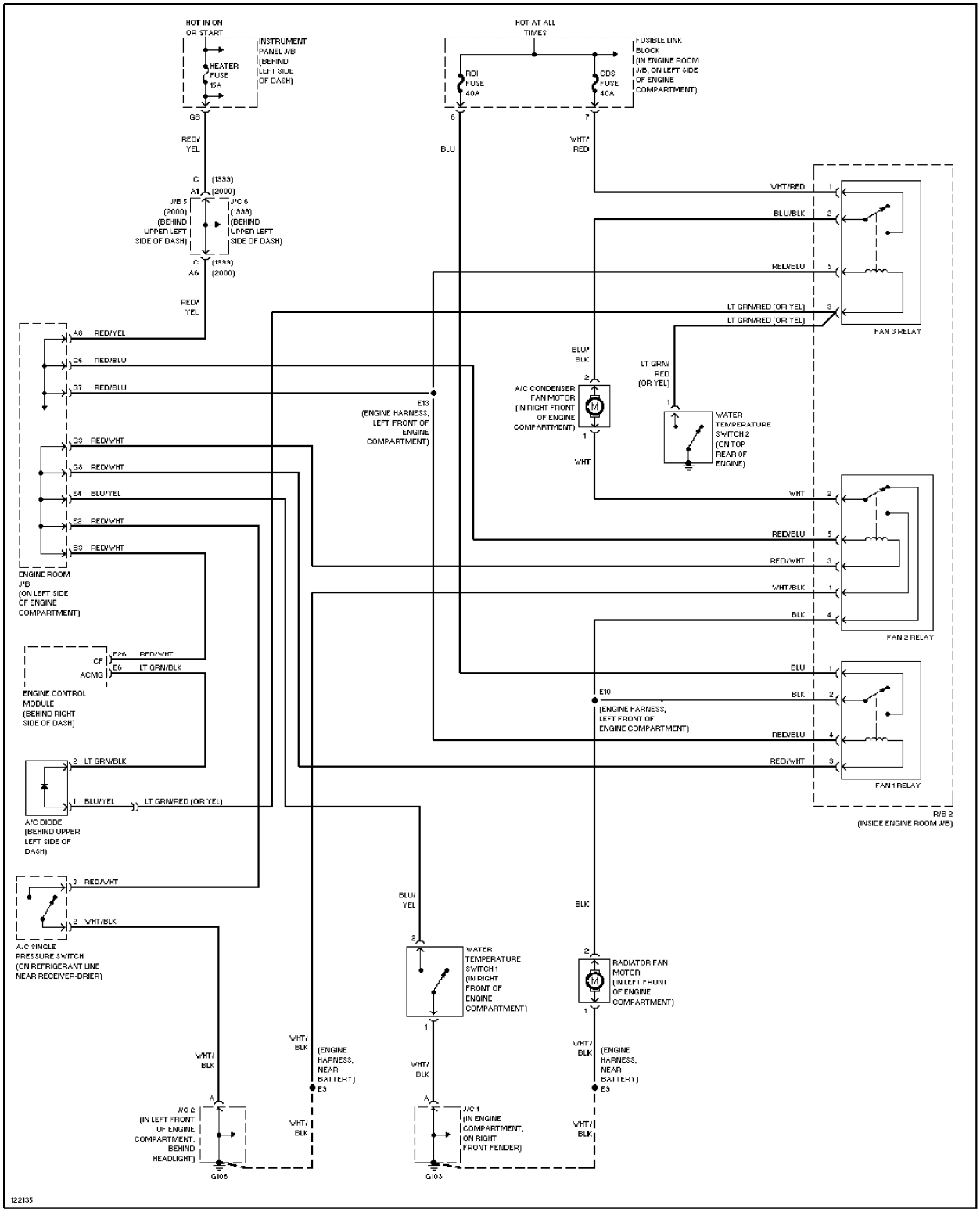


Fig. 5: Electric Cooling Fan System Wiring Diagram (1999-2000 RX300)

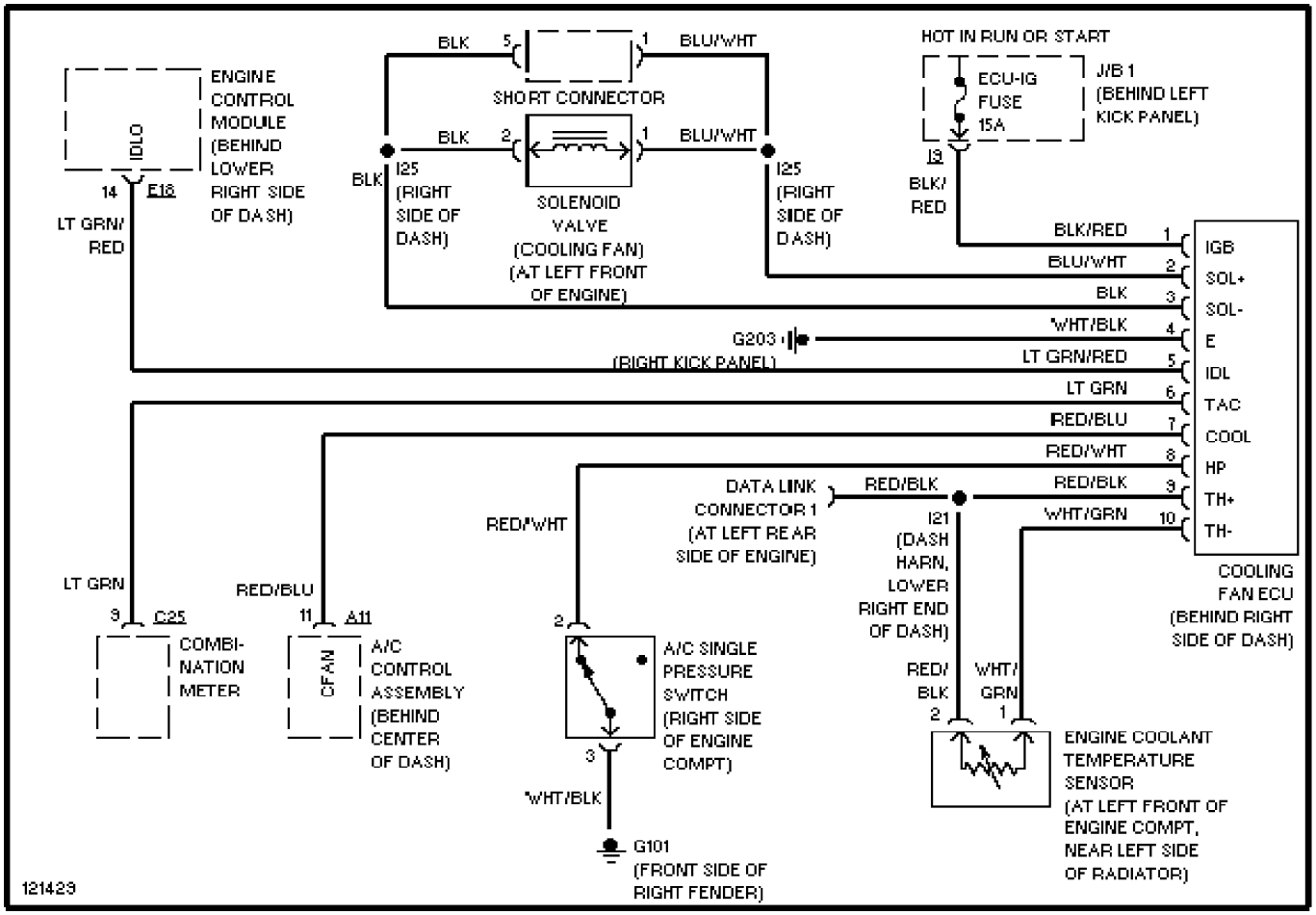


Fig. 6: Electric Cooling Fan System Wiring Diagram (2000 SC300 & SC400)

ENGINE IMMOBILIZER SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Engine Immobilizer Systems
LEXUS

RX300

DESCRIPTION & OPERATION

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

The engine immobilizer system consists of an Engine Control Module (ECM), transponder key coil, transponder key amplifier and key with built-in transponder chip. See Fig. 1. When ignition key is inserted in ignition, the transponder chip in the key transmits an electronic code to the transponder key coil. The signal is amplified, and read by the ECM. The engine will start only when the key code is the same as the code registered in the ECM. System is reset each time key is removed from ignition switch.

If a problem exists in the engine immobilizer system, a Diagnostic Trouble Code (DTC) may be stored in the Engine Control Module (ECM), but the Malfunction Indicator Light (MIL) on instrument cluster will not illuminate.

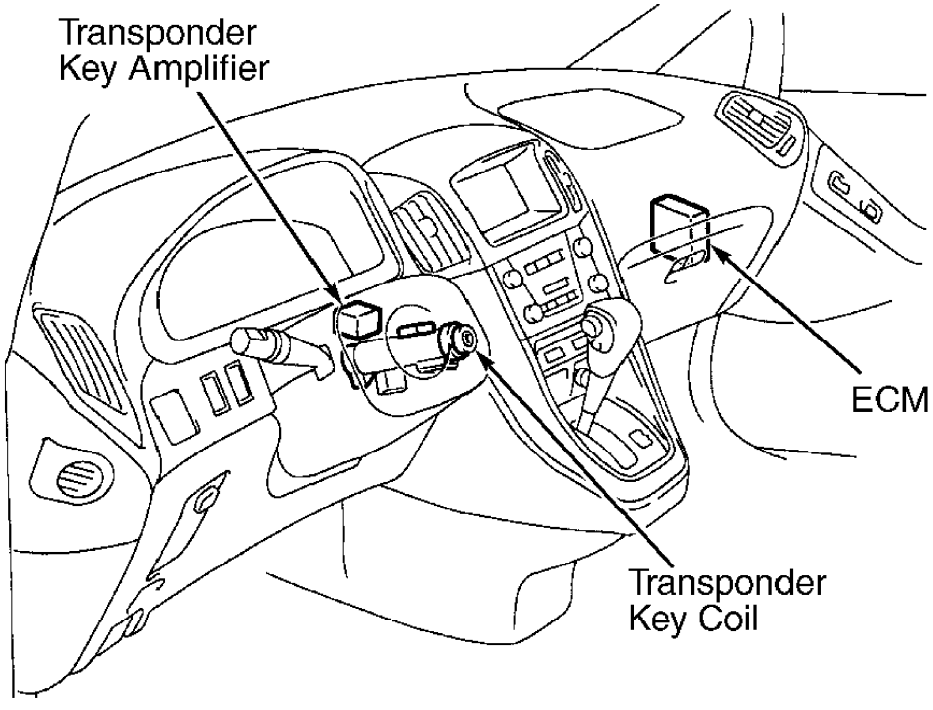


Fig. 1: Identifying Engine Immobilizer System Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PROGRAMMING

NEW TRANSPONDER KEY CODE

NOTE: This must be done when new ECM is installed. The new ECM is in automatic key code registration mode. Up to 3 key codes can be registered at one time. In automatic registration mode, last key registered becomes sub-key.

NOTE: Master key is a Black key that opens all locks. Sub-key is a Gray key that will not open trunk, trunk main switch and glove box.

1) Security indicator will flash until first key is inserted into ignition switch. Insert NEW key in ignition switch. Security indicator should illuminate.
2) Once key registration is under way, security indicator should turn off. After key registration is complete, security indicator should illuminate. Remove NEW key.
3) If programming additional keys, repeat process starting with step 1). If additional keys do not need programming, procedure is complete. Security indicator should go out once last key (sub-key) is registered. Depress and release brake pedal at least 5 times within 15 seconds, or request automatic registration mode completion using LEXUS scan tool.
4) After registration is complete and system is operating normally, when ignition key is removed from ignition lock cylinder, security indicator should flash indicating system is properly functioning. If a key is not inserted into ignition switch with ECM in automatic registration mode, security indicator will remain illuminated indicating keys have not been registered. If ignition key registration can not be completed with Engine Control Module (ECM) in automatic registration mode, a code 2-1 will be displayed by security indicator, and when inserting the already registered ignition key, a code 2-2 will be displayed by security indicator.

ADDITIONAL MASTER KEY

NOTE: Additional master key may be registered by 2 different methods: using brake pedal and accelerator pedal, or using LEXUS scan tool. It is possible to register up to 7 master key codes including the already registered key code.

Using Brake & Accelerator Pedal
1) Insert registered master key in ignition.
2) Perform this step within 15 seconds. Depress and release accelerator pedal 5 times.
3) Perform this step within 20 seconds. Depress and release brake pedal 6 times. Remove master key from ignition.
4) Perform this step within 10 seconds. Insert new key to be registered in ignition.
5) Perform this step within 10 seconds. Depress and release accelerator pedal one time. Security indicator should flash.
6) After one minute, additional master key is registered. Security indicator should turn off. If programming additional keys, repeat process starting with step 4). If additional keys do not need programming, remove master key from ignition. Depress and release brake pedal at least once after security indicator has been out for 10 seconds to complete registration mode.

Using LEXUS Scan Tool
1) Insert registered master key in ignition.
2) Perform this step within 2 minutes. Select master key registration using LEXUS scan tool.

3) Perform this step within 20 seconds. Remove master key.
4) Perform this step within 10 seconds. Insert master key to be registered in ignition. Security indicator should flash. After one minute, additional master key is registered. Security indicator should turn off.
5) If programming additional keys, repeat process starting with step 4). If additional keys do not need programming, remove master key from ignition. Depress and release brake pedal at least once after security indicator has been out for 10 seconds to complete registration mode.

ADDITIONAL SUB-KEY

NOTE: Additional sub-key may be registered by 2 different methods: using brake pedal and accelerator pedal, or using LEXUS scan tool. It is possible to register up to 3 sub-key codes including the already registered key code.

Using Brake & Accelerator Pedal
1) Insert registered master key in ignition.
2) Perform this step within 15 seconds. Depress and release accelerator pedal 4 times.
3) Perform this step within 20 seconds. Depress and release brake pedal 5 times. Remove master key from ignition.
4) Perform this step within 10 seconds. Insert new key to be registered in ignition.
5) Perform this step within 10 seconds. Depress and release accelerator pedal one time. Security indicator should flash.
6) After one minute, additional sub-key is registered. Security indicator should turn off. If programming additional keys, repeat process starting with step 4). If additional keys do not need programming, remove master key from ignition. Depress and release brake pedal at least once after security indicator has been out for 10 seconds to complete registration mode.

Using LEXUS Scan Tool
1) Insert registered master key in ignition.
2) Perform this step within 2 minutes. Select sub-key registration using LEXUS scan tool.
3) Perform this step within 20 seconds. Remove master key.
4) Perform this step within 10 seconds. Insert key to be registered in ignition. Security indicator should flash. After one minute, additional sub-key is registered. Security indicator should turn off.
5) If programming additional keys, repeat process starting with step 4). If additional keys do not need programming, remove master key from ignition. Depress and release brake pedal at least once after security indicator has been out for 10 seconds to complete registration mode.

ERASURE OF TRANSPONDER KEY CODE

NOTE: There are 2 different methods to erase the transponder key code: using brake pedal and accelerator pedal, or using LEXUS scan tool. All other master and sub-key codes are deleted leaving the master key code which was used when performing the operation. When using the ignition key which was used before deleting, it is necessary to register the code again.

Using Brake & Accelerator Pedal
1) Insert master key in ignition.
2) Perform this step within 15 seconds. Depress and release accelerator pedal 6 times.

3) Perform this step within 20 seconds. Depress and release brake pedal 7 times. Security indicator should flash.
4) Perform this step within 10 seconds. Remove master key. Security indicator should flash. Procedure is now completed. Key code should now be erased. If key cannot be removed from ignition, key code deletion is canceled. Security indicator will turn off. Repeat procedure from step 1).

Using LEXUS Scan Tool
1) Insert master key in ignition.
2) Perform this step within 2 minutes. Request key code deletion from LEXUS scan tool. Security indicator should flash.
3) Perform this step within 10 seconds. Remove master key.
4) Procedure is now completed. Key code should now be erased. If key cannot be removed from ignition, key code deletion is canceled. Security indicator will turn off. Repeat procedure from step 1).

TROUBLE SHOOTING

NOTE: Perform immobilizer system self-diagnostics before performing trouble shooting. See DIAGNOSTIC PROCEDURE under SELF-DIAGNOSTIC SYSTEM.

TROUBLE SHOOTING SYMPTOMS

Problem	Inspect
Immobilizer Not Set (Engine Starts W/Incorrect Key Codes)	(1) ECM
Engine Does Not Start	(2) Key; (1) Wiring Harness; (3) Transponder Key Coil; Amplifier; (1) ECM
Security Indicator Is Always On	(4) Security Indicator; (1) Wiring Harness; (1) ECM
Security Indicator Always On (Although Code Has Been Registered In Automatic Registration Mode)	(1) Wiring Harness; (3) Transponder Key Coil; Amplifier; (1) ECM
Security Indicator Is Off (When Immobilizer DTC Is Output)	(1) Wiring Harness; Transponder Key Coil; Amplifier; (1) ECM
Security Indicator Is Off (When Immobilizer DTC Is Not Output)	(1) Wiring Harness; (1) ECM
Security Indicator Is Flashing Abnormally	(1) Wiring Harness; (1) ECM

(1) - Check for opens or shorts in wiring. See WIRING DIAGRAMS. Perform ECM PIN VOLTAGE TESTS under COMPONENT TESTS. Repair or replace components as necessary.
(2) - Ensure key used to start engine is registered. Also check to see if vehicle will start with other registered keys.
(3) - Check transponder key coil. See TRANSPONDER KEY COIL under COMPONENT TESTS.
(4) - Complete automatic registration mode. See NEW TRANSPONDER KEY CODE under PROGRAMMING.

SELF-DIAGNOSTIC SYSTEM

DIAGNOSTIC PROCEDURE

Using Scan Tool

Connect LEXUS or OBDII scan tool to Data Link Connector 3 (DLC3) located under left side of instrument panel. Turn ignition switch to ON position. Using scan tool, check DTCs and freeze frame data. If DTC 99 is retrieved, see TROUBLE SHOOTING SYMPTOMS table under TROUBLE SHOOTING. If any other DTCs are retrieved, see ENGINE IMMOBILIZER DTC DEFINITIONS table. Each DTC will be displayed in order, starting with lowest DTC. Erase DTCs using scan tool, disconnecting battery or removing EFI fuse.

Using Jumper Wire

Turn ignition switch to ON position. Locate Data Link Connector 1 (DLC1) in engine compartment, in left rear corner, behind fuse/relay block. Using a fused jumper wire, connect Data Link Connector 1 (DLC1) terminal No. 11 (Tc) and terminal No. 3 (E1). See Fig. 2. Read Malfunction Indicator Light (MIL) in instrument cluster. If DTC 99 is retrieved, see TROUBLE SHOOTING SYMPTOMS table under TROUBLE SHOOTING. If any other DTCs are retrieved, see ENGINE IMMOBILIZER DTC DEFINITIONS table. Each DTC will be displayed in order, starting with lowest DTC. After checking DTCs, disconnect jumper wire to turn off display. Erase DTCs by disconnecting battery or removing EFI fuse.

ENGINE IMMOBILIZER DTC DEFINITIONS

DTC	Definition
B2785	Ignition Switch On Malfunction
B2786	Ignition Switch Off Malfunction
B2791	Key Unlock Warning Switch Off Malfunction
B2795	Unmatched Key Code
B2796	No Communication In Immobilizer System
B2797	Communication Malfunction No. 1
B2798	Communication Malfunction No. 2

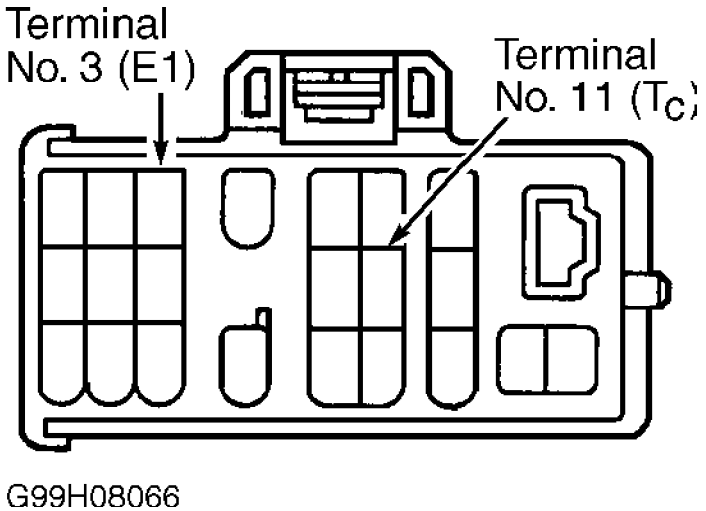


Fig. 2: Identifying Data Link Connector 1 (DLC1) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DIAGNOSTIC TESTS

DTC B2785 OR B2786: IGNITION SWITCH OFF MALFUNCTION OR IGNITION SWITCH ON MALFUNCTION

1) Remove glove compartment to gain access to ECM connectors. Turn ignition switch to ON position. Using a voltmeter, measure voltage by backprobing between ECM connector E8 terminal No. 16 (Blue/White wire) and ECM connector E6 terminal No. 17 (Brown wire). See Fig. 4. If voltage is 9-14 volts, proceed to next test listed in TROUBLE SHOOTING SYMPTOMS table under TROUBLE SHOOTING. If voltage is not 9-14 volts, go to next step.

2) Check circuits and connectors for faults between ECM connector E6 terminal No. 17 (Brown wire) and chassis ground. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuit and connector are okay, go to next step.

3) Remove EFI main relay from engine compartment fuse/relay block located on left inner fender, near shock tower. Using an ohmmeter, check continuity between EFI main relay terminals No. 1 and 2. See Fig. 3. Continuity should exist. Check continuity between terminals No. 3 and 5. Continuity should not exist. Apply battery voltage and ground between terminals No. 1 and 2. Continuity should exist between terminals No. 3 and 5. If continuity is not as specified, replace relay and retest system operation. If continuity is as specified, go to next step.

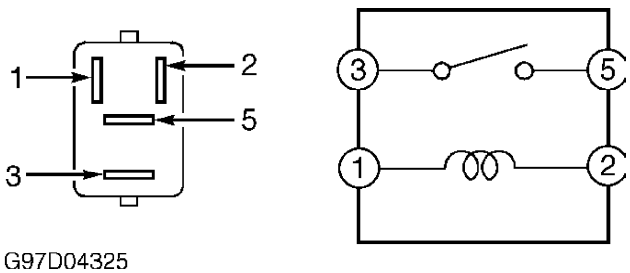
4) Remove EFI fuse from engine compartment fuse/relay block located on left inner fender, near shock tower. Using an ohmmeter, check continuity of fuse. If fuse is okay, go to next step. If fuse is blown, check for short to ground in Black/Yellow wire between fuse and ECM. Repair as necessary and retest system operation.

5) Check circuits and connectors for faults between EFI main relay, battery and ECM. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuits and connectors are okay, go to next step.

6) Remove IGN fuse from instrument panel junction block located behind left kick panel. Using an ohmmeter, check continuity of fuse. If fuse is okay, go to next step. If fuse is blown, check for short to ground in Black/Red wire between fuse and ignition switch. Repair as necessary and retest system operation.

7) Check ignition switch. See appropriate STEERING COLUMN SWITCHES article. Replace ignition switch as necessary, and retest system operation. If ignition switch is okay, go to next step.

8) Check circuits and connectors for faults between ignition switch, EFI main relay and ground. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuits and connectors okay, check ECM. See ECM PIN VOLTAGE TESTS under COMPONENT TESTS. If ECM is defective, replace ECM and retest system operation.



G97D04325

Fig. 3: Identifying EFI Main Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B2791: KEY UNLOCK WARNING SWITCH OFF MALFUNCTION

1) Check key unlock warning switch. See KEY UNLOCK WARNING SWITCH under COMPONENT TESTS. Replace key unlock warning switch as necessary, and retest system operation. If key unlock warning switch is okay, go to next step.

2) Check circuits and connectors for faults between key unlock warning switch and ECM. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuits and connectors are okay, check ECM. See ECM PIN VOLTAGE TESTS under COMPONENT TESTS. If ECM is defective, replace ECM and retest system operation.

DTC B2795: UNMATCHED KEY CODE

DTC B2795 is output when a key that has not been registered is inserted into ignition switch. If this DTC is output, clear DTC. Check all customer keys until key is found that is not registered. Register this key. See appropriate key programming procedure under PROGRAMMING.

DTC B2796: NO COMMUNICATION IN IMMOBILIZER SYSTEM

1) Check transponder key coil. See TRANSPONDER KEY COIL under COMPONENT TESTS. Replace transponder key coil as necessary, and retest system operation. If transponder key coil is okay, go to next step.

2) Check circuits and connectors for faults between transponder key amplifier and ECM. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuits and connectors are okay, go to next step.

3) Replace transponder key amplifier. Check system operation. If system operates normally after replacing original transponder key amplifier, no further testing is required. If system still does not operate normally after replacing original transponder key amplifier, check ECM. See ECM PIN VOLTAGE TESTS under COMPONENT TESTS. If ECM is defective, replace ECM and retest system operation.

DTC B2797: COMMUNICATION MALFUNCTION NO. 1

1) Insert registered key into ignition switch. Using an oscilloscope or LEXUS scan tool, check for noise interference at ECM connector E9 terminal No. 28 (Violet wire). See Fig. 4. If no noise is detected, go to next step. If noise is detected, find where noise interference is coming from, and repair as necessary. Retest system operation.

2) Replace transponder key amplifier. Check system operation. If system operates normally after replacing original transponder key amplifier, no further testing is required. If system still does not operate normally after replacing original transponder key amplifier, check ECM. See ECM PIN VOLTAGE TESTS under COMPONENT TESTS. If ECM is defective, replace ECM and retest system operation.

DTC B2798: COMMUNICATION MALFUNCTION NO. 2

1) Check transponder key coil. See TRANSPONDER KEY COIL under COMPONENT TESTS. Replace transponder key coil as necessary, and retest system operation. If transponder key coil is okay, go to next step.

2) Check circuits and connectors for faults between transponder key amplifier and ECM. See WIRING DIAGRAMS. Repair or replace wiring as necessary, and retest system operation. If circuits and connectors are okay, go to next step.

3) Replace transponder key amplifier. Check system operation. If system operates normally after replacing original transponder key amplifier, no further testing is required. If system still does not

operate normally after replacing original transponder key amplifier, check ECM. See ECM PIN VOLTAGE TESTS under COMPONENT TESTS. If ECM is defective, replace ECM and retest system operation.

COMPONENT TESTS

ECM PIN VOLTAGE TESTS

Turn ignition switch to ON position. Using a voltmeter, check voltage between specified terminals of ECM. See Fig. 4. See ECM TERMINAL VOLTAGE SPECIFICATIONS table. If voltage is not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, replace ECM.

ECM TERMINAL VOLTAGE SPECIFICATIONS

Voltage Between Terminals	Voltage
E9-18 (Green Wire) & E6-17 (Brown Wire)	10-14
E9-19 (Purple Wire) & E6-17 (Brown Wire)	10-14
E9-23 (Blue Wire) & E6-17 (Brown Wire)	10-14
E9-28 (Violet Wire) & E6-17 (Brown Wire)	10-14

KEY UNLOCK WARNING SWITCH

Disconnect key unlock warning switch 2-pin connector (located in steering column, near ignition switch). With key in ignition, check continuity between switch terminals No. 1 and 2. Continuity should exist. With key removed from ignition, check continuity between terminals No. 1 and 2. Continuity should not exist. If continuity is not as specified, replace key unlock warning switch.

TRANSPONDER KEY COIL

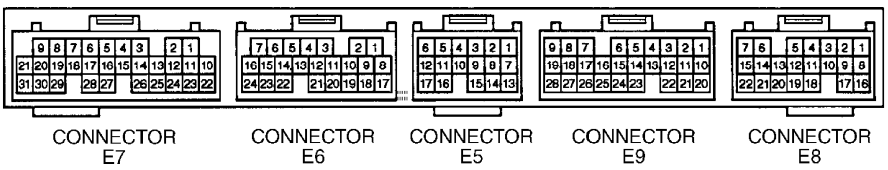
Check continuity between transponder key coil terminals No. 1 and 2. If continuity does not exist, replace transponder key coil.

REMOVAL & INSTALLATION

NOTE: Removal and installation procedures not available from manufacturer.

WIRING DIAGRAMS

NOTE: For RX300 wiring diagrams, see ENGINE PERFORMANCE article in WIRING DIAGRAMS.



G99B08068

Fig. 4: Identifying ECM Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION

1999 Lexus RX 300

Engine Overhaul Procedures - General Information
ALL PISTON ENGINES

* PLEASE READ THIS FIRST *

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE IDENTIFICATION

The engine may be identified from its Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with manufacturer.

INSPECTION PROCEDURES

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.

Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

MAGNETIC PARTICLE INSPECTION

Magnaflux & Magnaglo

Magnaflux is an inspection technique used to locate material flaws and stress cracks. The part in question is subjected to a strong magnetic field. The entire part, or a localized area, can be magnetized. The part is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption in the magnetic field. The dry powder method of Magnaflux can be used in normal light. A crack will appear as an obvious bright line.

Fluorescent liquid is used in conjunction with a blacklight in a second Magnaflux system called Magnaglo. This type of inspection demands a darkened room. The crack will appear as a glowing line in this process. Both systems require complete demagnetizing upon

completion of the inspection. Magnetic particle inspection applies to ferrous materials only.

PENETRANT INSPECTION

Zyglo

The Zyglo process coats the material with a fluorescent dye penetrant. The part is often warmed to expand cracks that will be penetrated by the dye. When the coated part is subjected to inspection with a blacklight, a crack will glow brightly. Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

Dye Check

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

ULTRASONIC INSPECTION

If an expensive part is suspected of internal cracking, Ultrasonic testing is used. Sound waves are used for component inspection.

X-RAY INSPECTION

This form of inspection is used on highly stressed components. X-ray inspection maybe used to detect internal and external flaws in any material.

PRESSURE TESTING

Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes in the head and injecting air or water into the open passage. Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

CLEANING PROCEDURES

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

BEAD BLASTING

Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and

rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from components after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

CHEMICAL CLEANING

Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning of aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be lift in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

COMPONENT CLEANING

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

SHEET METAL PARTS

Examples of sheet metal parts are the rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

INTAKE & EXHAUST MANIFOLDS

Using solvent cleaning or bead blasting, clean manifolds for inspection. If the intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, the sheet metal oil shield must be removed for proper cleaning and inspection. Ensure that all manifold parting surfaces are flat and free of burrs.

CYLINDER HEAD REPLACEMENT

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped), should be removed only when the engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to the corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See Fig. 1. Remove cylinder head.

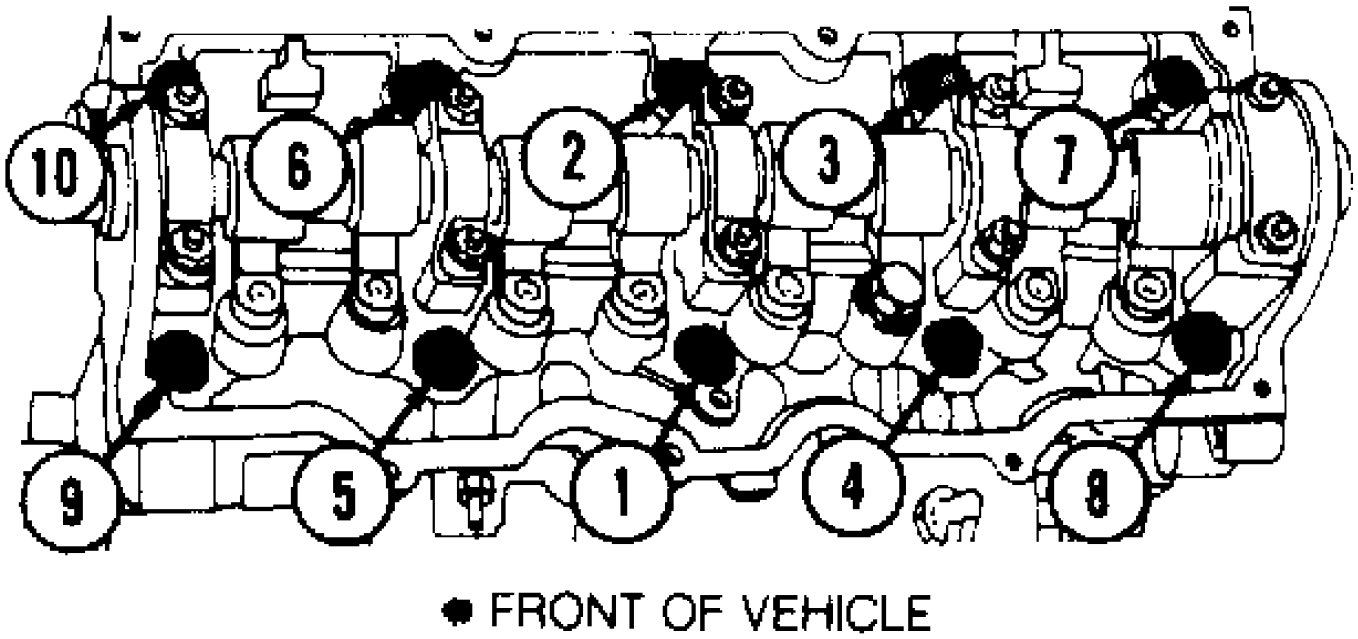


Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence This Graphic For General Information Only

INSTALLATION

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

Install head gasket on cylinder block. Some manufacturer's may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to water passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See Fig. 1. Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

NOTE: Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

VALVE ADJUSTMENT

Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Different length push rods can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

On overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at push rod end of rocker arm. Ensure that the valve to be adjusted is riding on the heel of the cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

CYLINDER HEAD OVERHAUL

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

DISASSEMBLY

Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See Fig. 2.

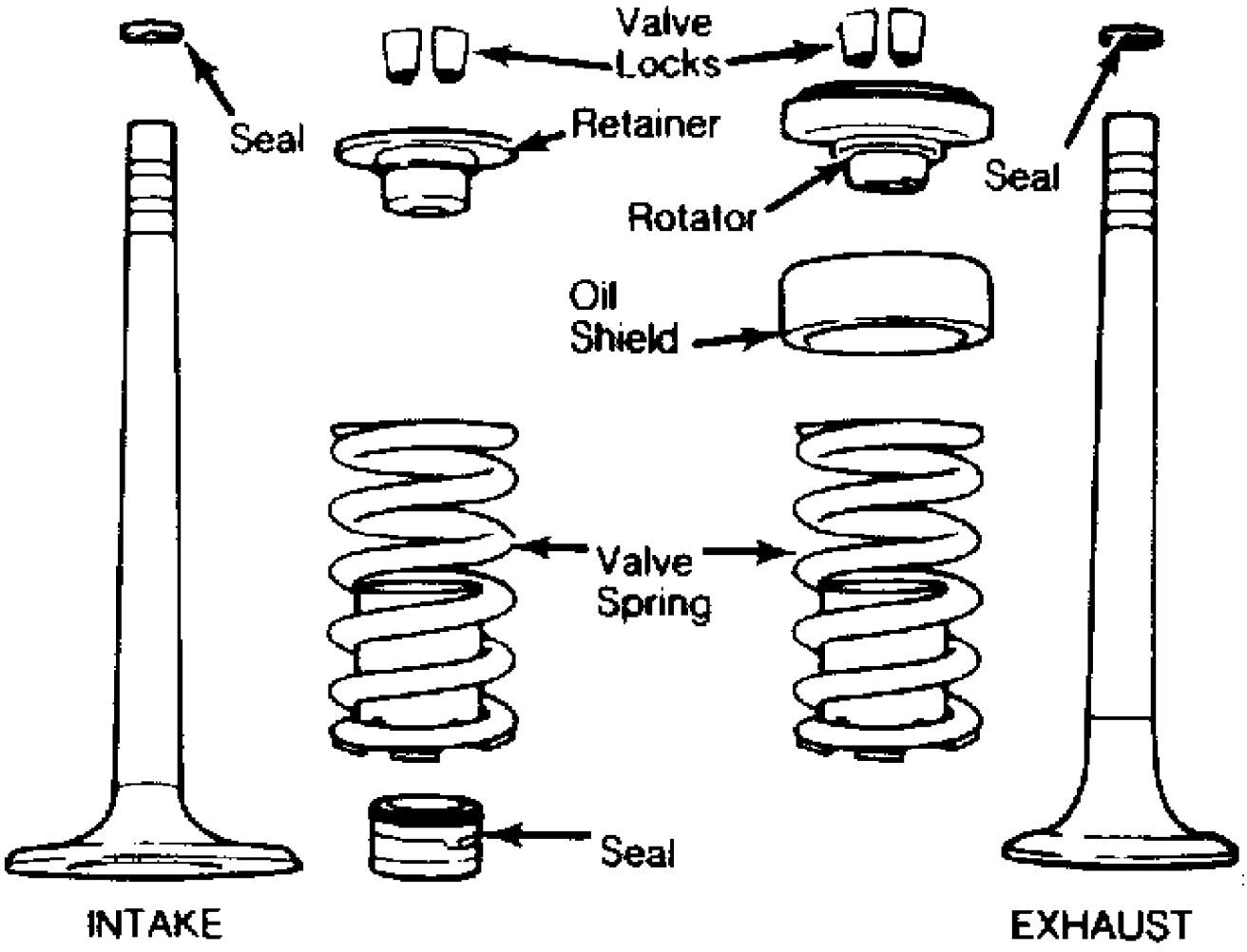


Fig. 2: Exploded View of Intake & Exhaust Valve Assemblies - Typical
This Graphic For General Information Only

CLEANING & INSPECTION

Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal centerline and across the head at several points. See Fig. 3.

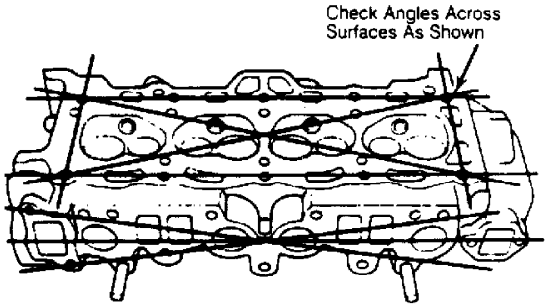


Fig. 3: Checking Cylinder Head for Warpage - Typical
This Graphic For General Information Only

On cast cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary with manufacturer.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than manufacturer's specifications.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold.

Using oil stone, remove burrs or scratches from all sealing surfaces.

VALVE SPRINGS

Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring, indicates that spring surge has occurred. Replace springs showing evidence of these conditions.

Inspect valve springs for squareness using a 90 degree straightedge. See Fig. 4. Replace valve spring if out-of-square exceeds manufacturer's specification.

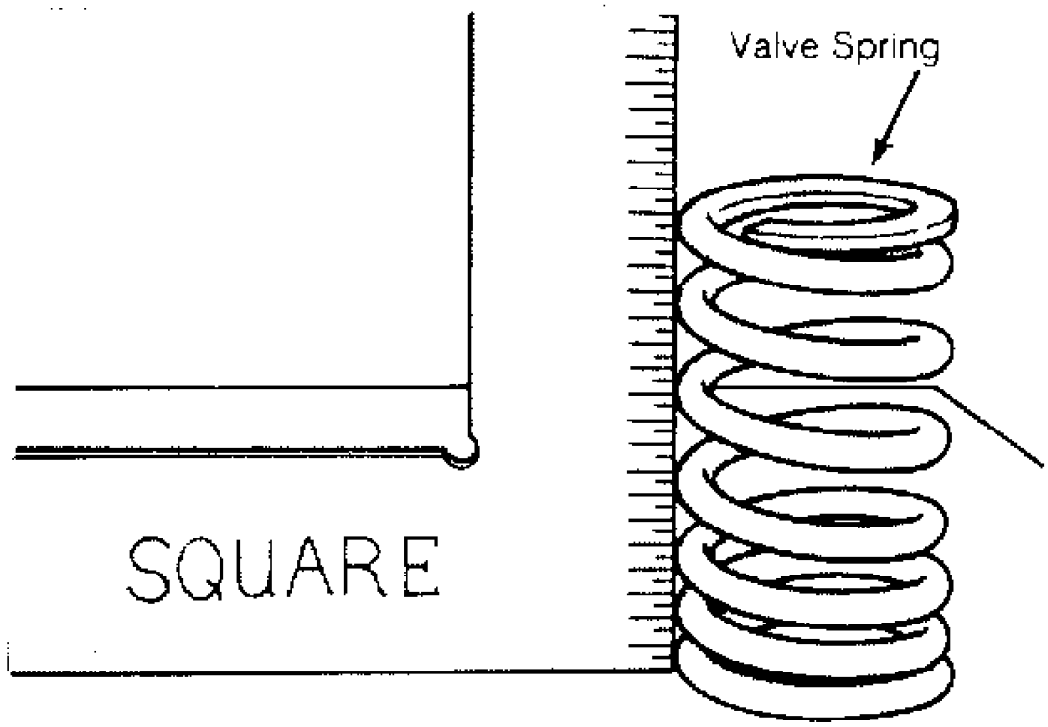


Fig. 4: Checking Valve Spring Squareness - Typical
This Graphic For General Information Only

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve

spring tester, test valve spring pressure at installed and compressed heights. See Fig. 5.

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head.

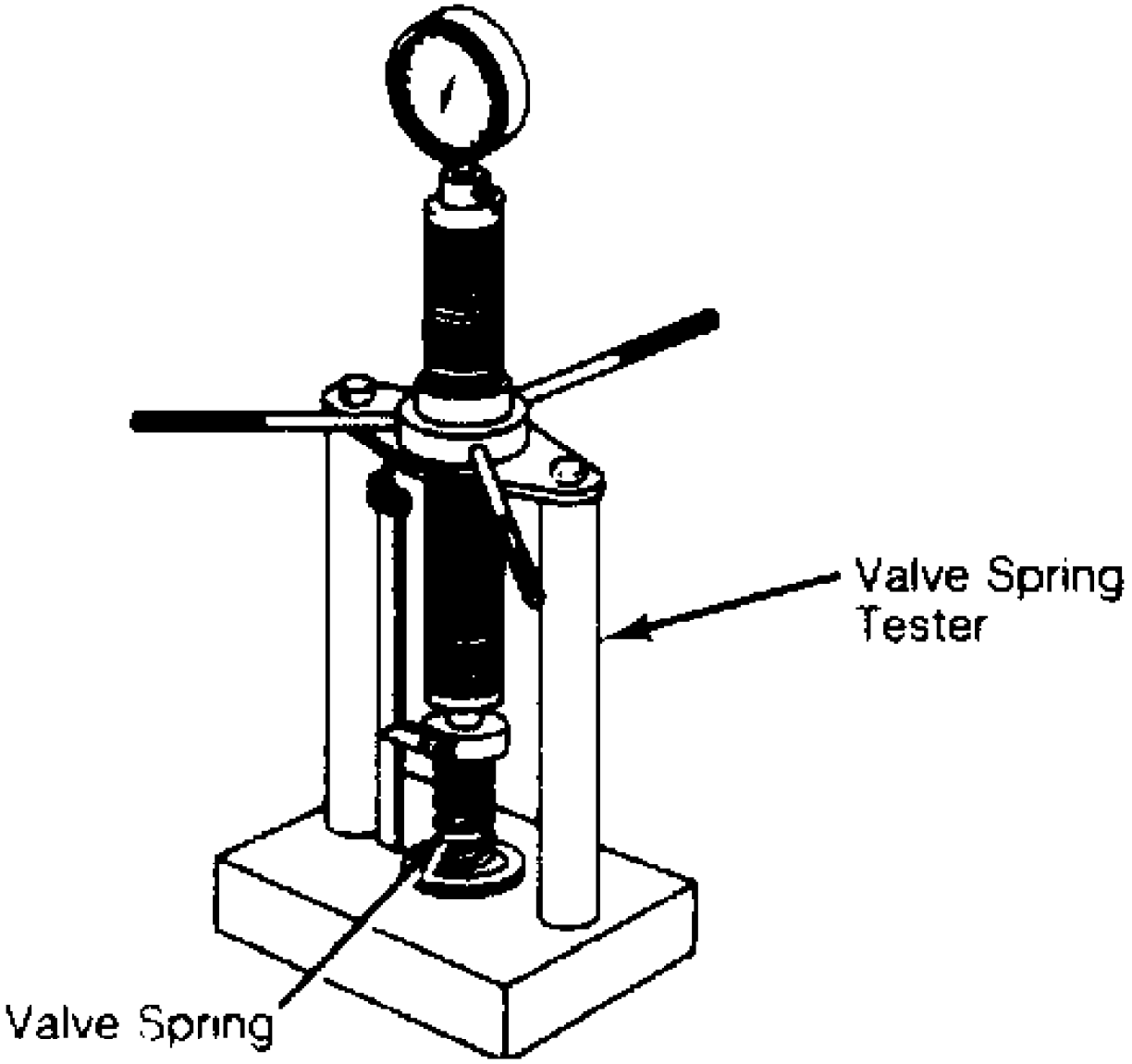


Fig. 5: Checking Valve Spring Pressure - Typical
This Graphic For General Information Only

VALVE GUIDE

Measuring Valve Guide Clearance

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specifications. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See Fig. 6.

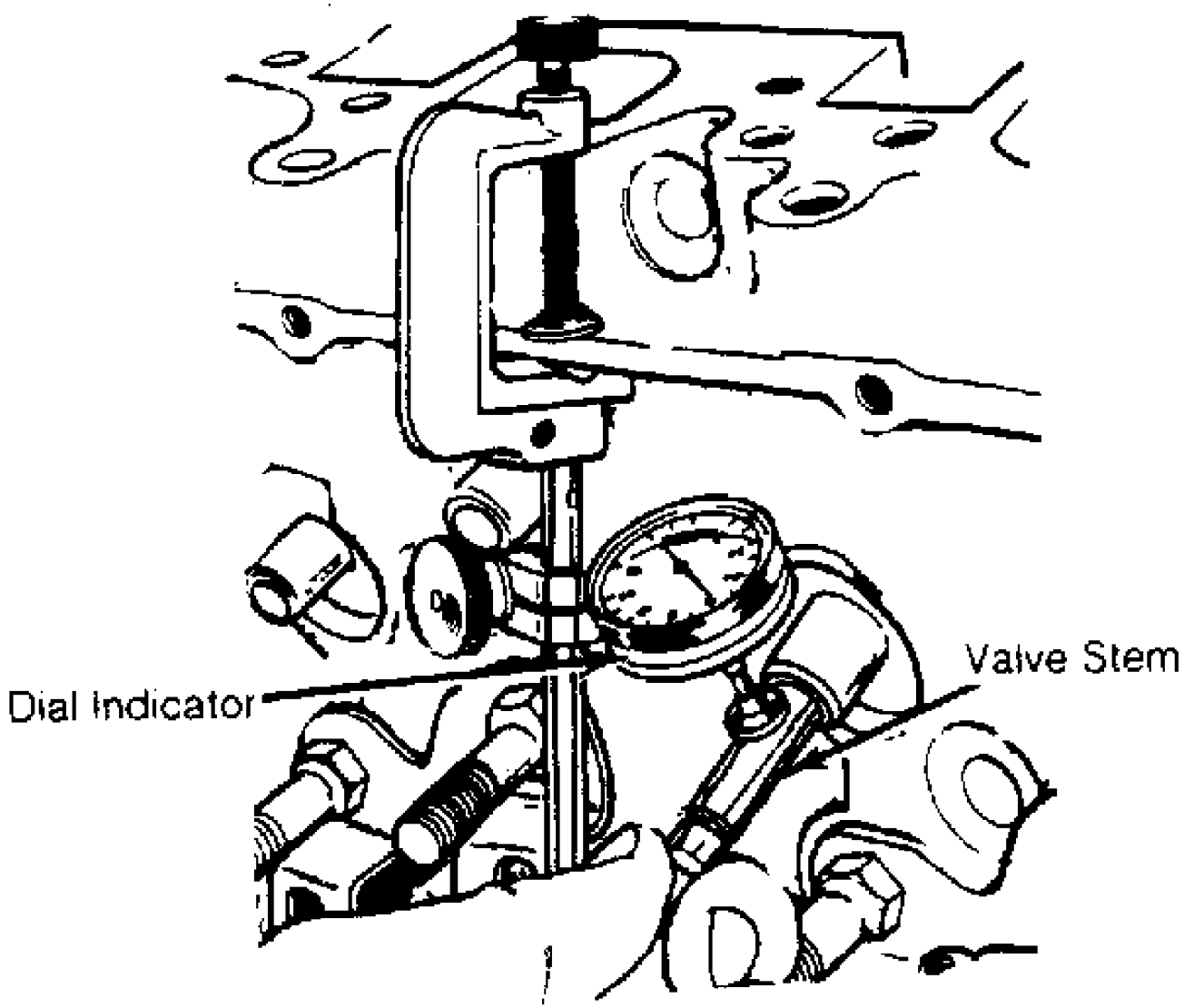


Fig. 6: Measuring Valve Stem-to-Guide Clearance - Typical
This Graphic For General Information Only

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

Reaming Valve Guide

Select proper reamer for valve stem. Reamer must be of proper length to provide clean cut through entire length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See Fig. 7.

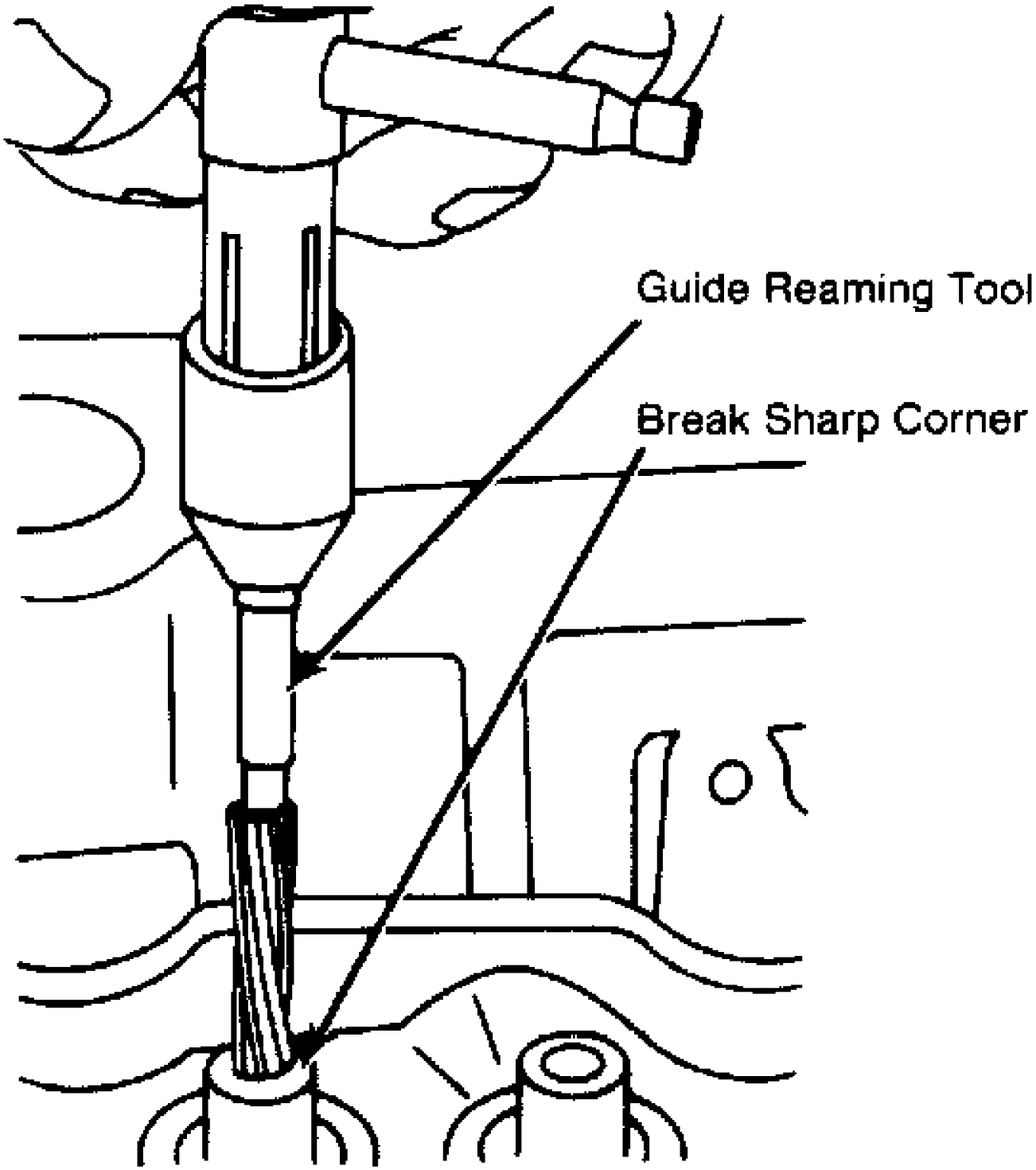


Fig. 7: Reaming Valve Guides - Typical
This Graphic For General Information Only

Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in place, depending upon

cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See Fig. 8. Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Guide is sometimes chilled in dry ice before installation. Combination of a heated head and chilled guide insures a tight guide fit upon assembly. The new guide must be reamed to specification.

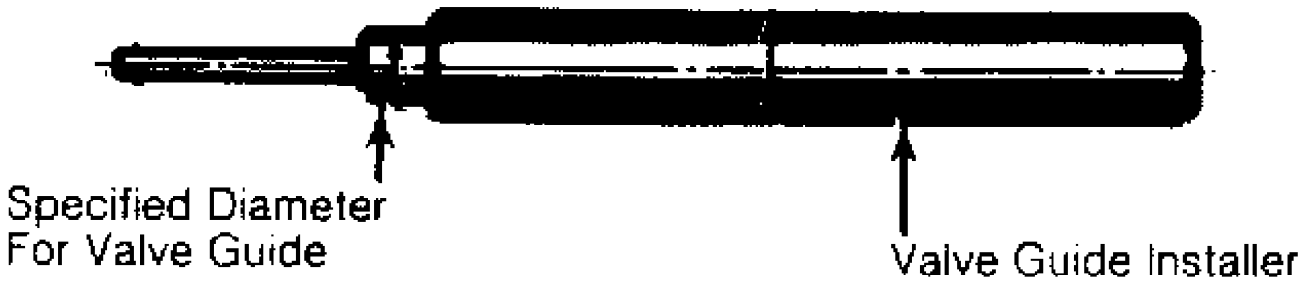


Fig. 8: Typical Valve Guide Remover & Installer
This Graphic For General Information Only

VALVES & VALVE SEATS

Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be grounded. See Fig. 9.

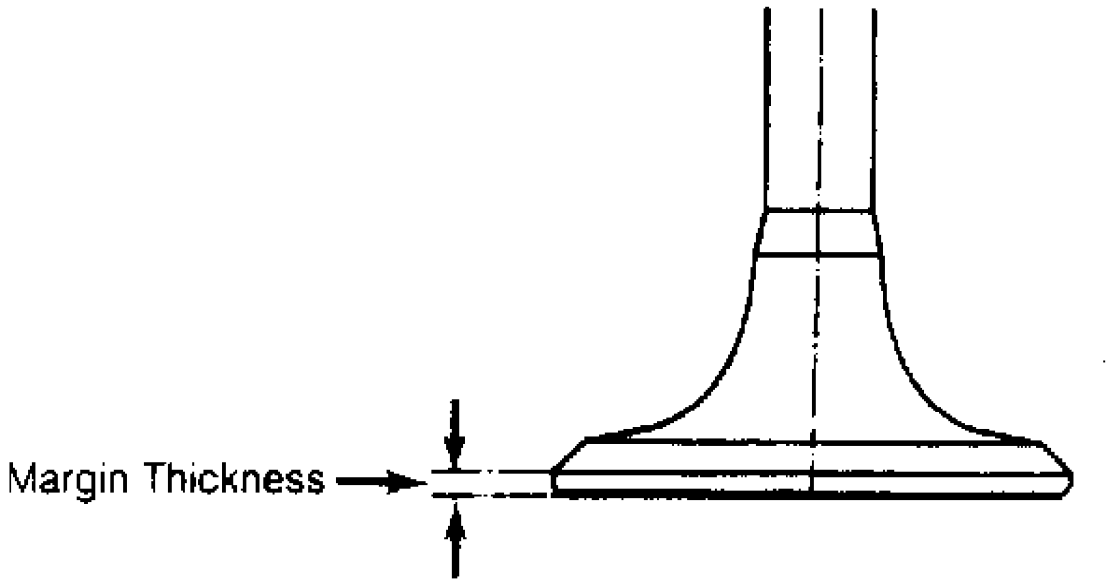


Fig. 9: Measuring Valve Head Margin - Typical
This Graphic For General Information Only

If valve margin is less than specification, this will burn the valves. Valve must be replaced. Due to minimum margin dimensions

during manufacture, some new type valves cannot be reground.

Resurface valve on proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle.

Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve grinding machine.

Valve Lapping

During valve lapping of recent designed valves, be sure to follow manufacturers recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve to valve seat concentricity should be checked. See VALVE SEAT CONCENTRICITY.

CAUTION: Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.

Valve Seat Grinding

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Grinding stones with 30 and 60 degree angles are used to center and narrow the valve seat as required. See Fig. 10.

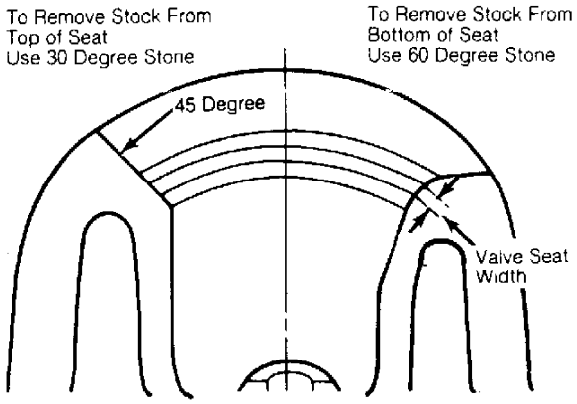


Fig. 10: Adjusting Valve Seat Width - Typical
This Graphic For General Information Only

Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out

the old insert and machining an oversize insert bore. Replacement oversize insert is usually chilled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with the seat.

REASSEMBLY

Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See Fig. 11. Distance must be within specifications.

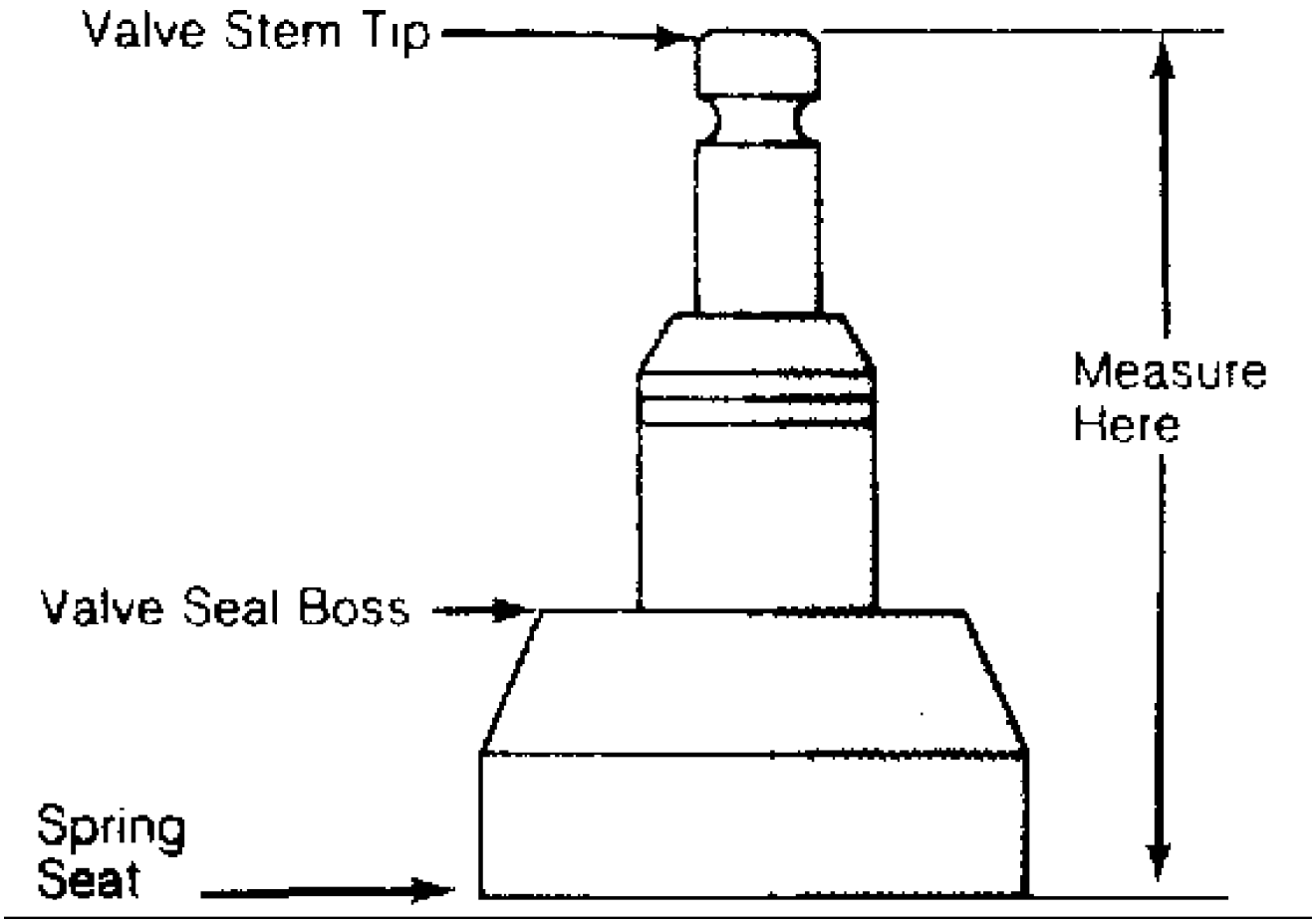


Fig. 11: Measuring Valve Stem Installed Height - Typical
This Graphic For General Information Only

Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more

than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.

VALVE STEM OIL SEALS

Valve stem oil seals must be installed on valve stem. See Fig. 2. Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Replacement (On Vehicle)

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cm^2) to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversized valves have been installed, oversized oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

VALVE SPRING INSTALLED HEIGHT

Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specifications. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See Fig. 12.

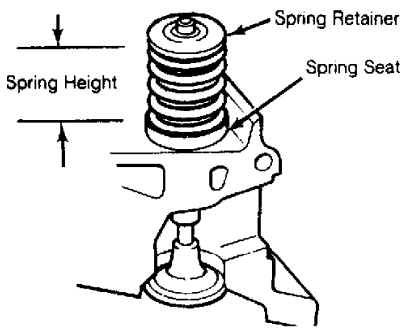


Fig. 12: Measuring Valve Spring Installed Height - Typical
This Graphic For General Information Only

ROCKER ARMS & ASSEMBLIES

Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat the stud threads with Loctite and install. Tighten to specification.

Pressed in stud can be removed using a stud puller. Ream the stud bore to proper specification and press in a new oversize stud. Pressed in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point can be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arms in original locations. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

Pushrods

Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow pushrods must be internally cleaned to ensure oil passage to the rocker arms is cleaned. Check the pushrod for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect bends in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

LIFTERS

Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Hydraulic lifter assemblies must be installed in original locations. Remove the rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See Fig. 13.

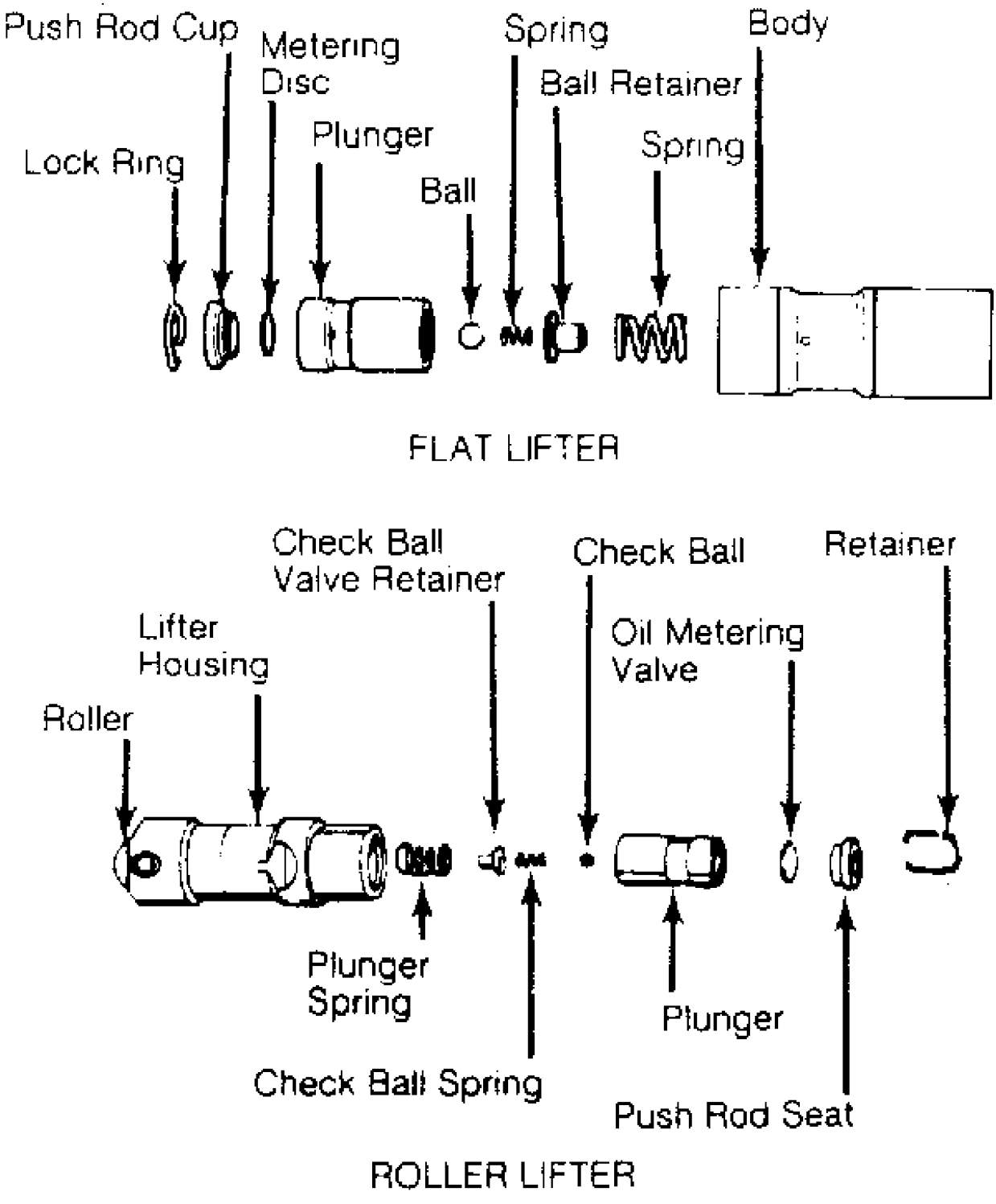


Fig. 13: Typical Hydraulic Valve Lifter Assemblies - Typical
This Graphic For General Information Only

On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not

interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. of cylinder block. Some models offer oversized lifters. Replace lifter if damaged.

If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See Fig. 13. Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

Mechanical Lifters

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See VALVE ADJUSTMENT in this article.

PISTONS, CONNECTING RODS & BEARINGS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

RIDGE REMOVAL

Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring locations.

With the piston at bottom dead center, place a rag in the bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge

using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

PISTON & CONNECTING ROD REMOVAL

Note top of piston. Some pistons may contain a notch, arrow or be marked "FRONT". Piston must be installed in proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap. Install stud protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

PISTON & CONNECTING ROD

Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer’s recommendations to avoid piston distortion or breakage.

Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons using wire brush.

Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturers specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

PISTON & CYLINDER BORE FIT

Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See CYLINDER BLOCK in this article. Using dial bore gauge, measure cylinder bore. Measure piston at right angle to piston pin in center of piston skirt area. Subtract piston diameter from cylinder bore diameter. The difference is piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

ASSEMBLING PISTON & CONNECTING ROD

Install proper fitted piston on connecting rod for proper cylinder. Ensure piston marking on top of piston marked is in correspondence with connecting rod and cap number. See Fig. 14.

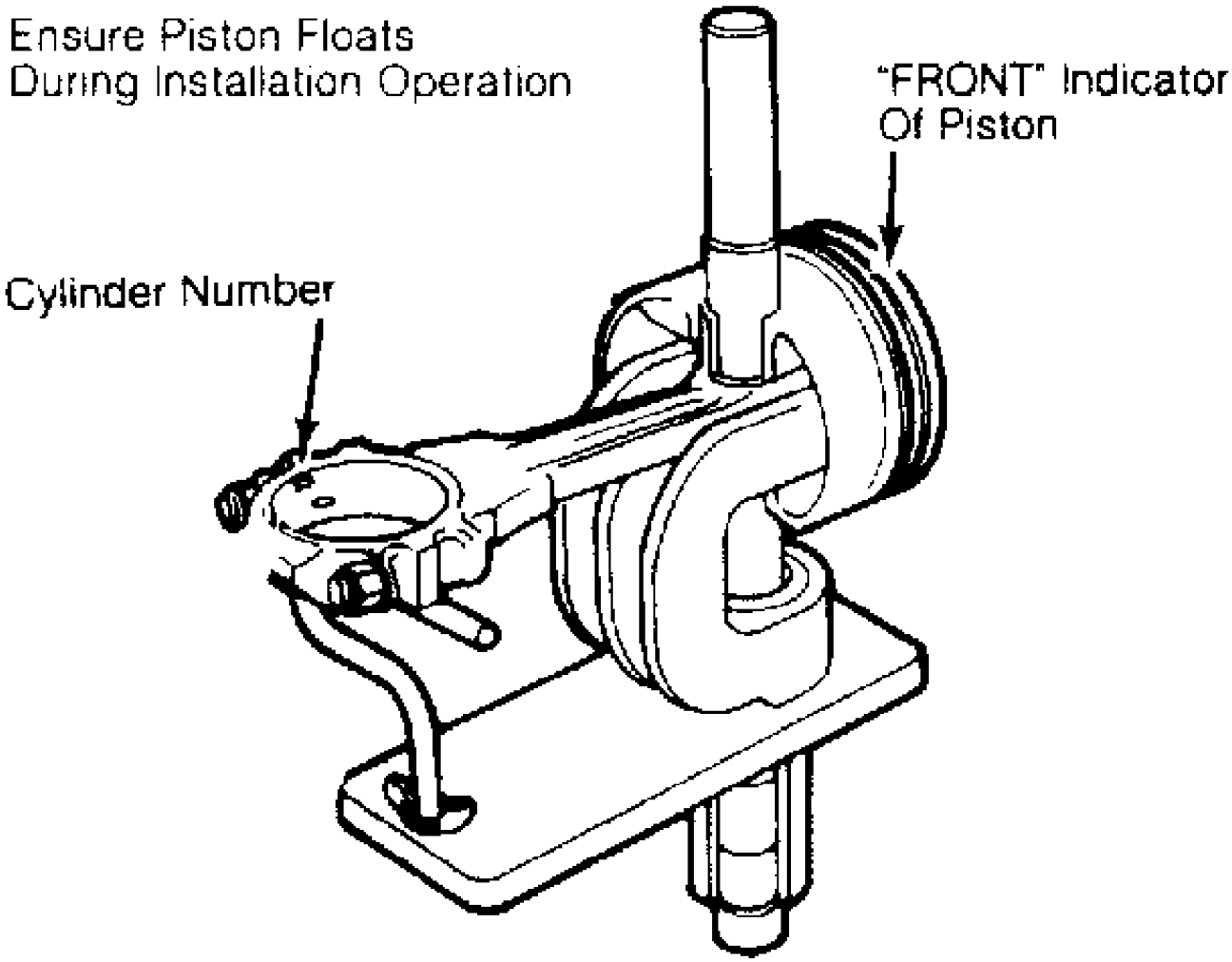


Fig. 14: Piston Pin Installation - Typical
This Graphic For General Information Only

Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.

CHECKING PISTON RING CLEARANCES

Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

Using feeler gauge, check ring end gap. See Fig. 15. Piston ring end gap must be within specification. Ring breakage will occur with insufficient ring end gap.

On some manufacturers, insufficient ring end gap may be corrected by using a fine file while other manufacturers recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.

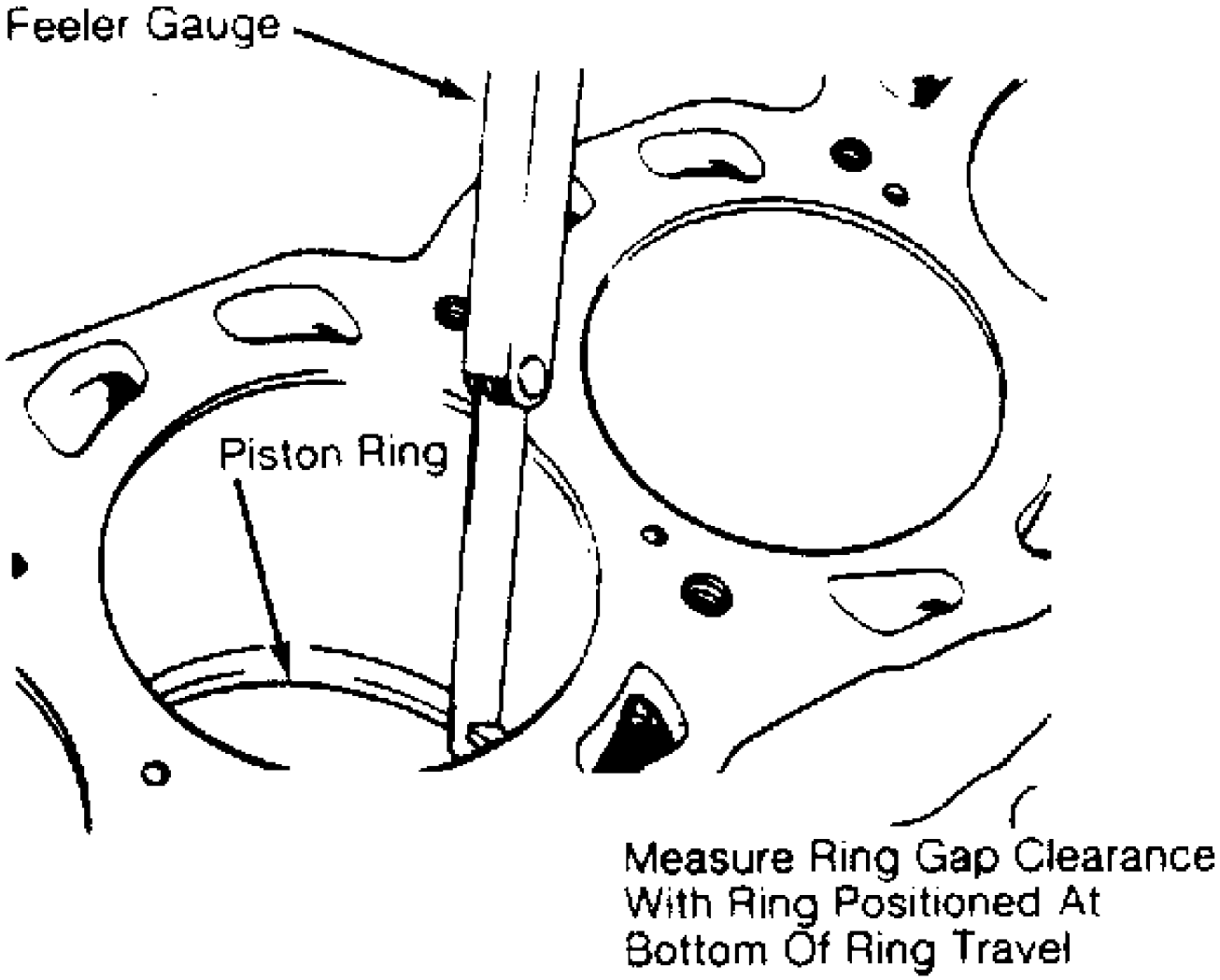


Fig. 15: Checking Piston Ring End Gap - Typical
This Graphic For General Information Only

For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversized piston rings (if available). Normal practice is to replace piston.

PISTON & CONNECTING ROD INSTALLATION

Cylinders must be honed prior to piston installation. See CYLINDER HONING under CYLINDER BLOCK in this article.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturers recommendations. See Fig. 16. Lubricate pistons, rings and cylinder walls.

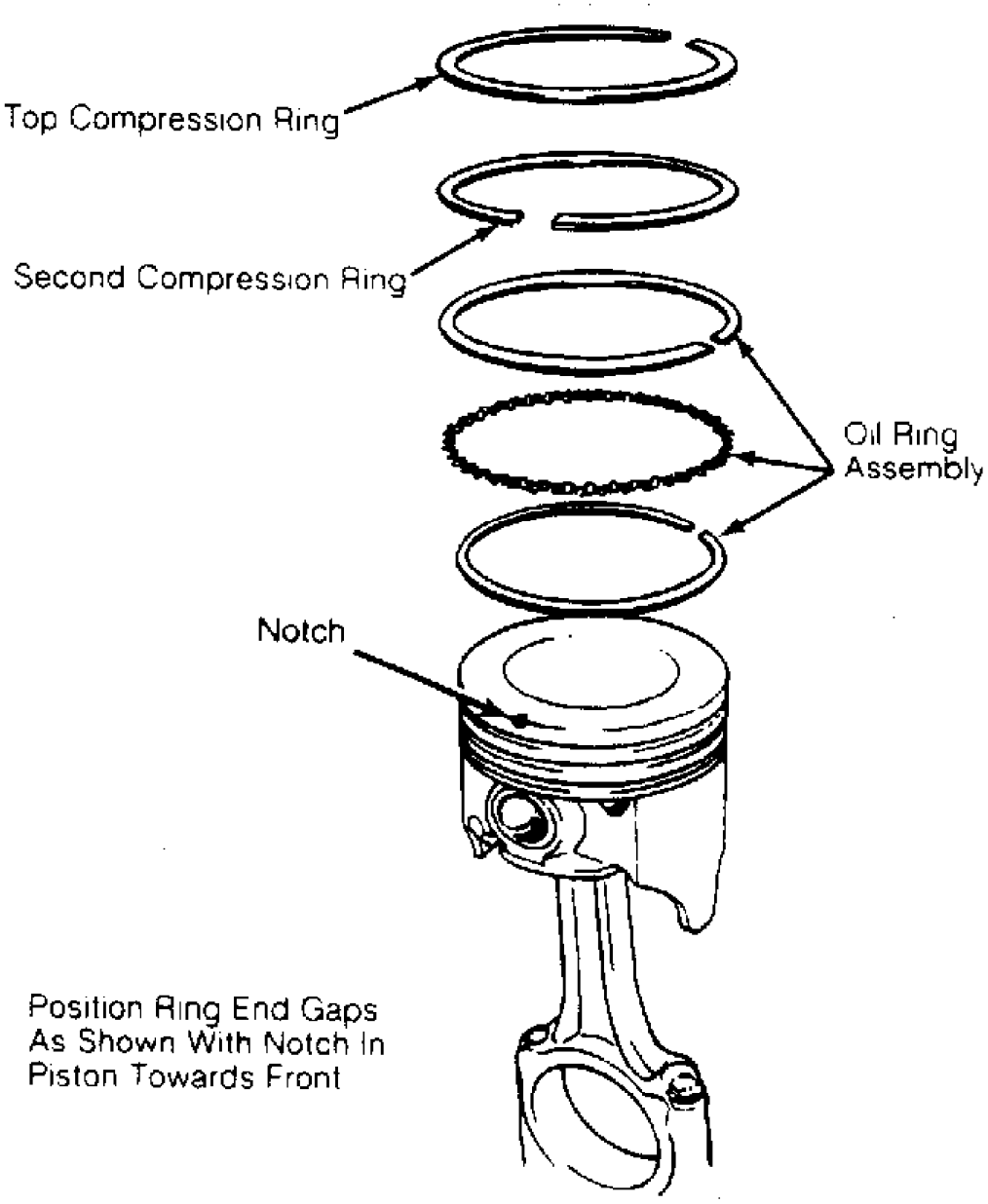


Fig. 16: Typical Piston Ring End Gap Positioning - Typical This Graphic For General Information Only

Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors

over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or "FRONT" mark is toward front of engine. See Fig. 17.

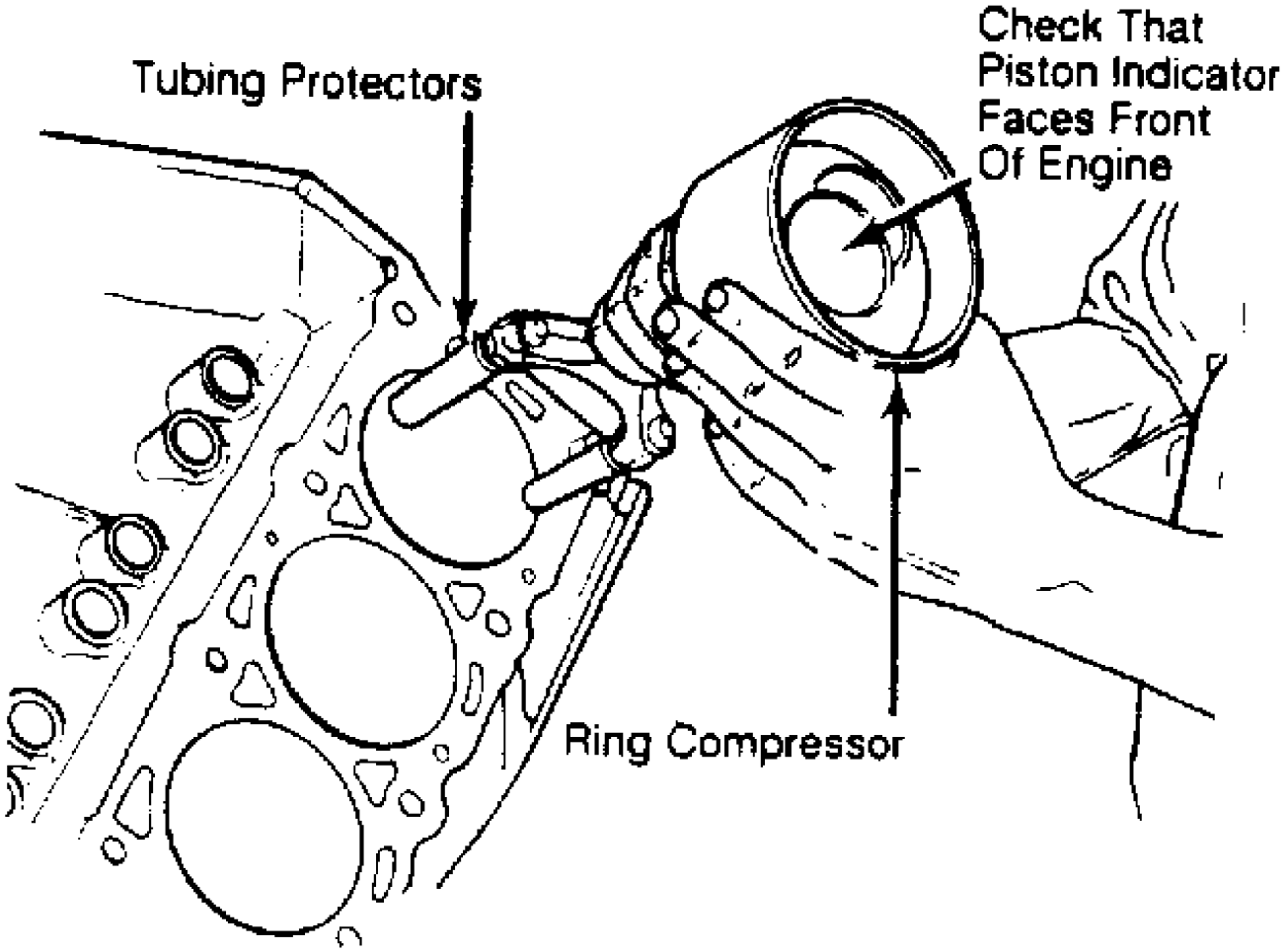


Fig. 17: Installing Piston & Connecting Rod Assembly - Typical
This Graphic For General Information Only

Carefully tap piston into cylinder until rod bearing is seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See MAIN & CONNECTING ROD BEARING CLEARANCE in this article.

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See CONNECTING ROD SIDE CLEARANCE in this article.

CONNECTING ROD SIDE CLEARANCE

Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance between side of connecting rod and crankshaft. See Fig. 18. Clearance must be within specifications.

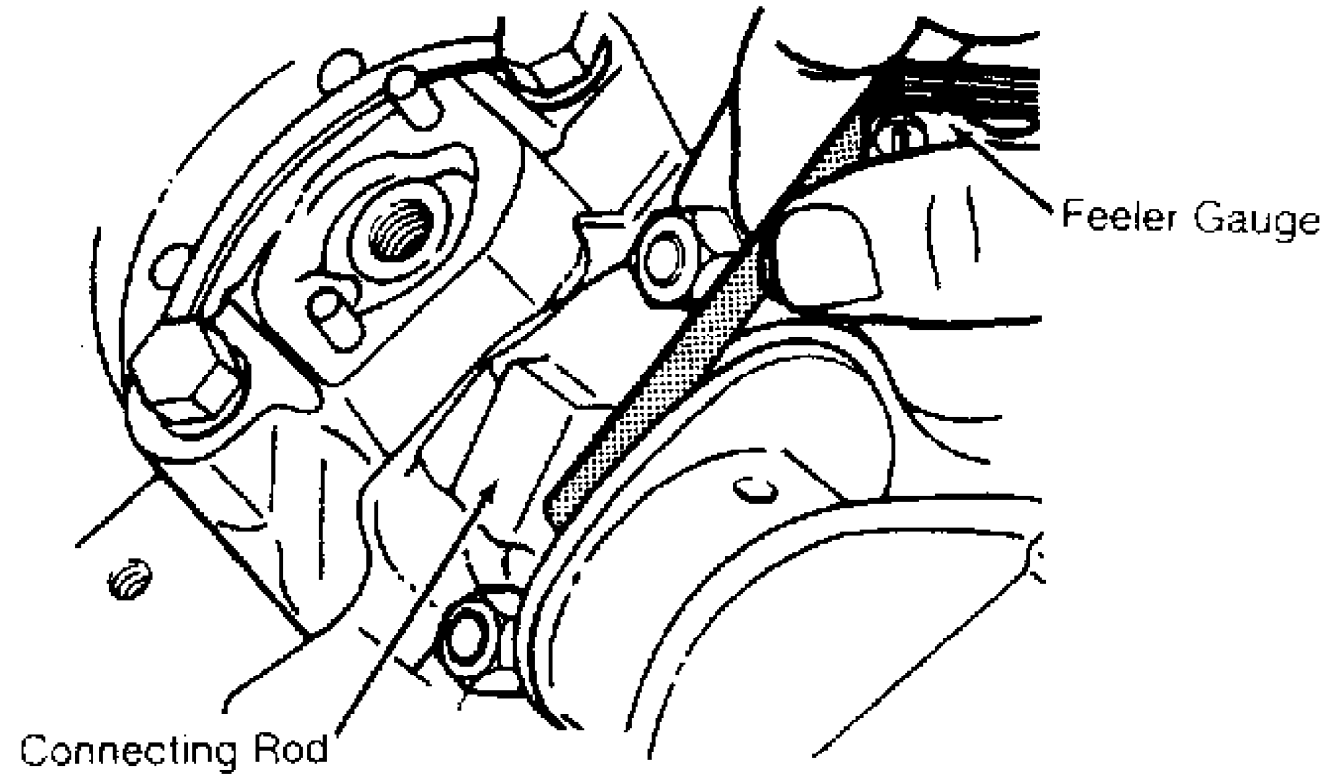


Fig. 18: Measuring Connecting Rod Side Clearance - Typical
This Graphic For General Information Only

Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.

MAIN & CONNECTING ROD BEARING CLEARANCE

Plastigage Method

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in original location. Tighten bolts to specification.

CAUTION: DO NOT rotate crankshaft while Plastigage is installed. Bearing clearance will not be obtained if crankshaft is rotated.

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See Fig. 19. Rotate crankshaft 90 degrees. Repeat procedure. this is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.

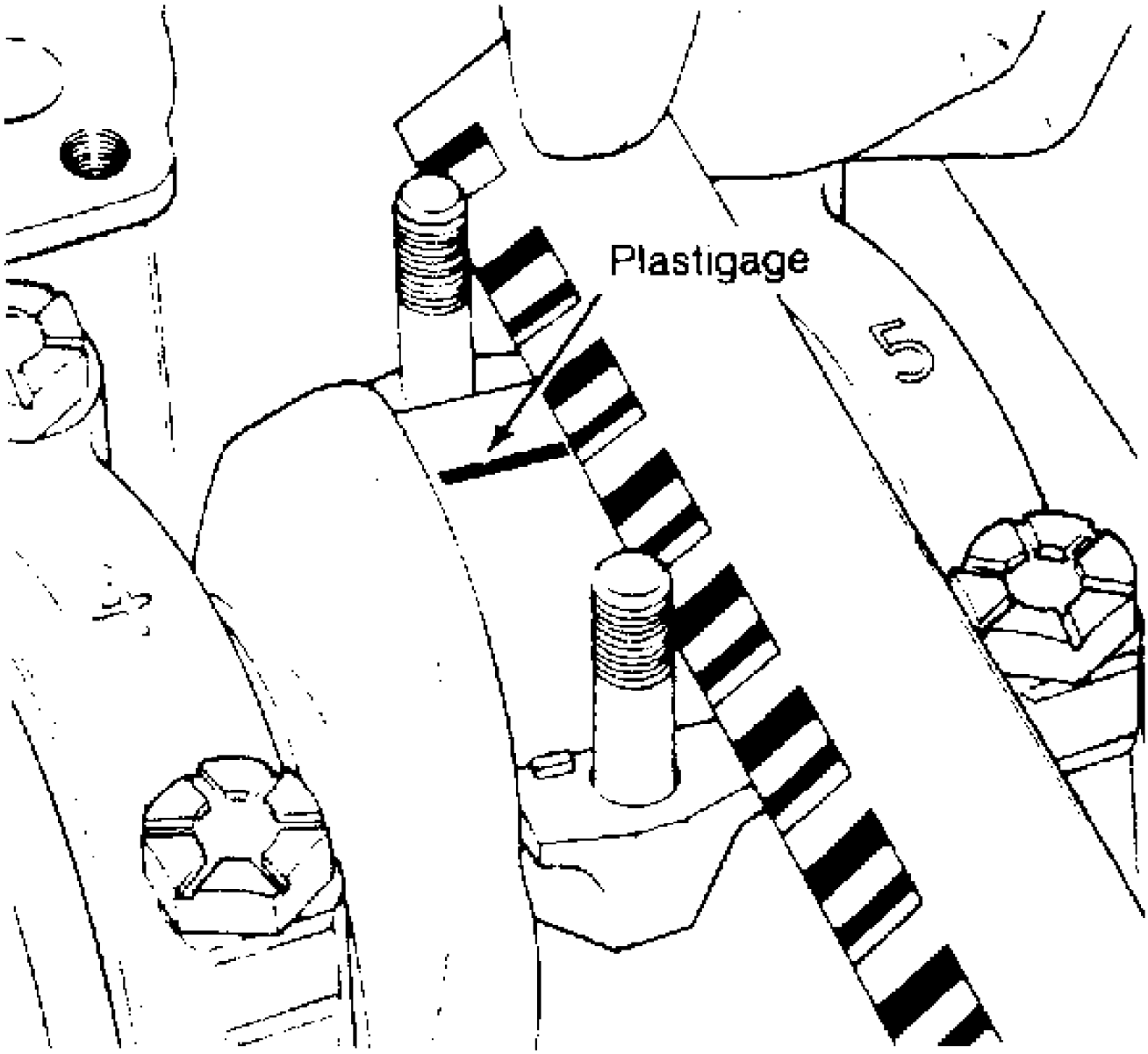


Fig. 19: Measuring Bearing Clearance - Typical
This Graphic For General Information Only

Micrometer & Telescopic Gauge Method

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See CLEANING & INSPECTION under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bore diameter. This is the bearing clearance.

CRANKSHAFT & MAIN BEARINGS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on it which must face front of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

CLEANING & INSPECTION

Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt, and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Check that oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See Fig. 20. Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

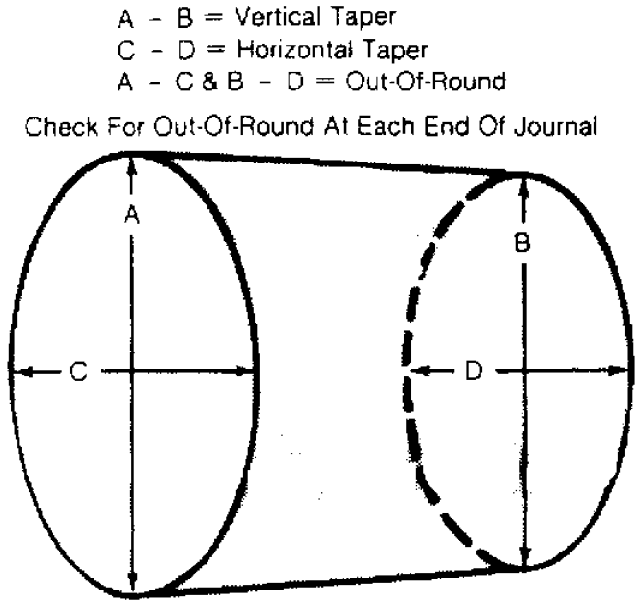


Fig. 20: Measuring Crankshaft Journal - Typical
This Graphic For General Information Only

Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator

with tip resting on the main bearing journal area. See Fig. 21. Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.

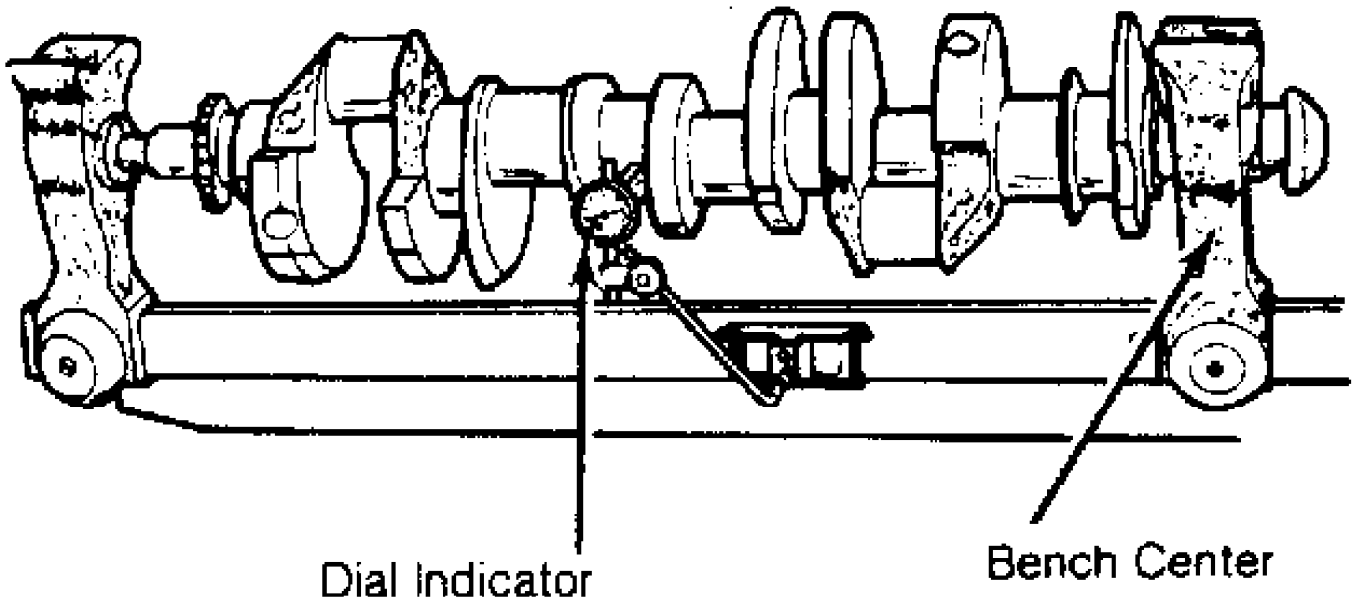


Fig. 21: Measuring Crankshaft Main Bearing Journal Runout - Typical This Graphic For General Information Only

INSTALLATION

Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See MAIN & CONNECTING ROD BEARING CLEARANCE in this article.

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Thrust bearing must be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tighten to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See CRANKSHAFT END PLAY in this article.

CRANKSHAFT END PLAY

Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero.

Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversized thrust bearings.

Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See Fig. 22.

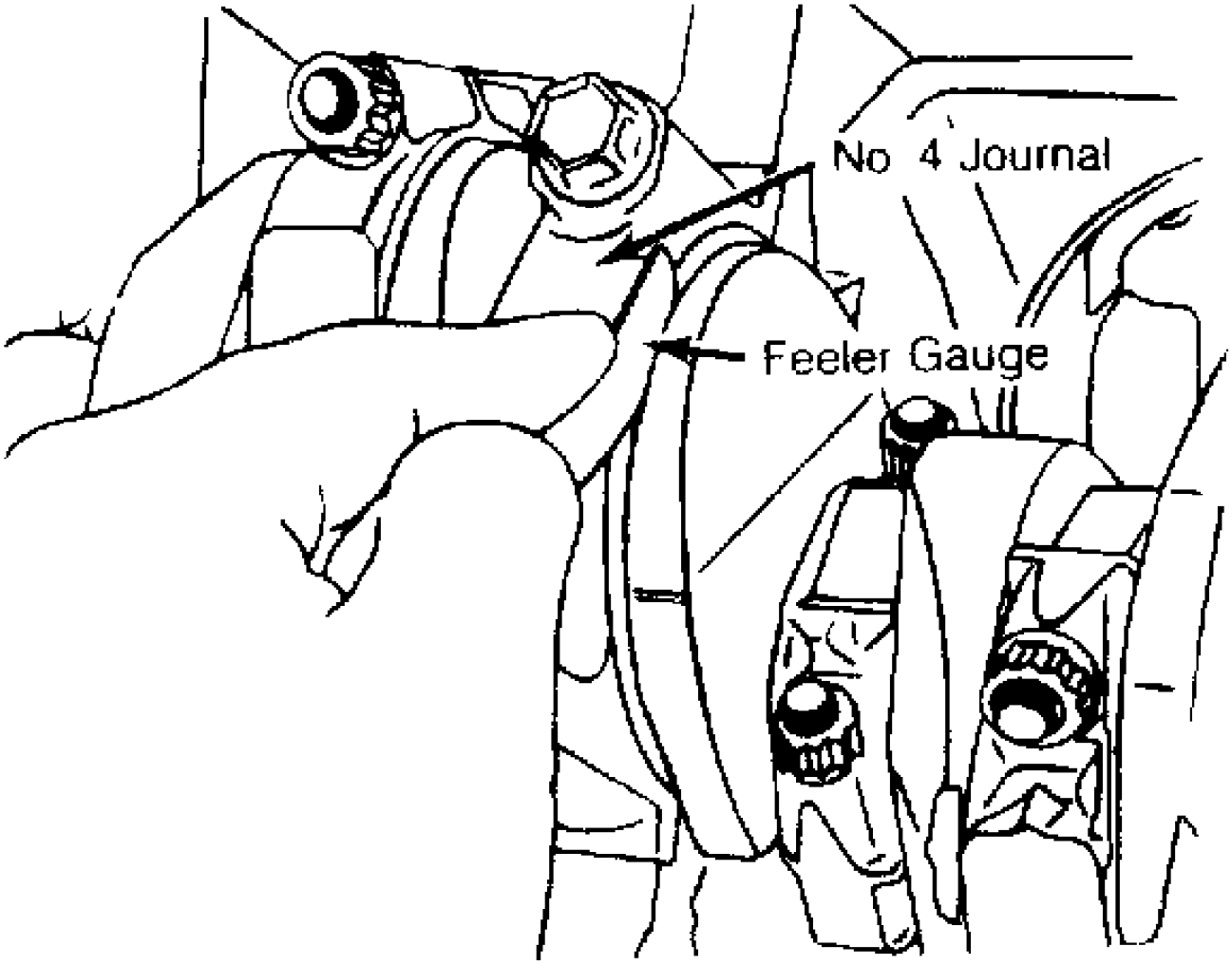


Fig. 22: Checking Crankshaft End Play - Typical
This Graphic For General Information Only

Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversized thrust bearings.

CYLINDER BLOCK

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

BLOCK CLEANING

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil galley plugs, freeze plugs and cam bearings prior to block cleaning.

BLOCK INSPECTION

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of the cylinders, the main bearing saddles, near expansion plugs and between the cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

CYLINDER BORE INSPECTION

Inspect the bore for scuffing or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block centerline. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

CYLINDER HONING

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20w engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

DECK WARPAGE

Check deck for damage or warped head sealing surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and

length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

DECK HEIGHT

Distance from the crankshaft centerline to the block deck is termed the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from the crankshaft journal to the block deck, parallel to the cylinder centerline.

Add one half of the main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specifications, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at the same time.

MAIN BEARING BORE & ALIGNMENT

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along centerline of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance is present.

EXPANSION PLUG REMOVAL & INSTALLATION

Removal

Drill a hole in the center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Use a wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

OIL GALLERY PLUG REMOVAL & INSTALLATION

Removal

Remove threaded oil gallery plugs using the appropriate wrench. Soft, press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are driven in place with a hammer and drift.

CAMSHAFT

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

CLEANING & INSPECTION

Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90 degrees to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specifications. Replace camshaft if cam lobes or bearing journals are not within specifications.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

CAMSHAFT BEARINGS

Removal & Installation

Remove the camshaft rear plug. The camshaft bearing remover is assembled with its shoulder resting on the bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

CAMSHAFT INSTALLATION

Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. Check end play.

CAMSHAFT END PLAY

Using dial indicator, check end play. Position dial indicator on front of engine block. Position indicator tip against camshaft. Push camshaft toward rear of engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on manufacturer.

TIMING CHAINS & BELTS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING CHAINS

Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See Fig. 23. Replace timing chain and gears if not within specification.

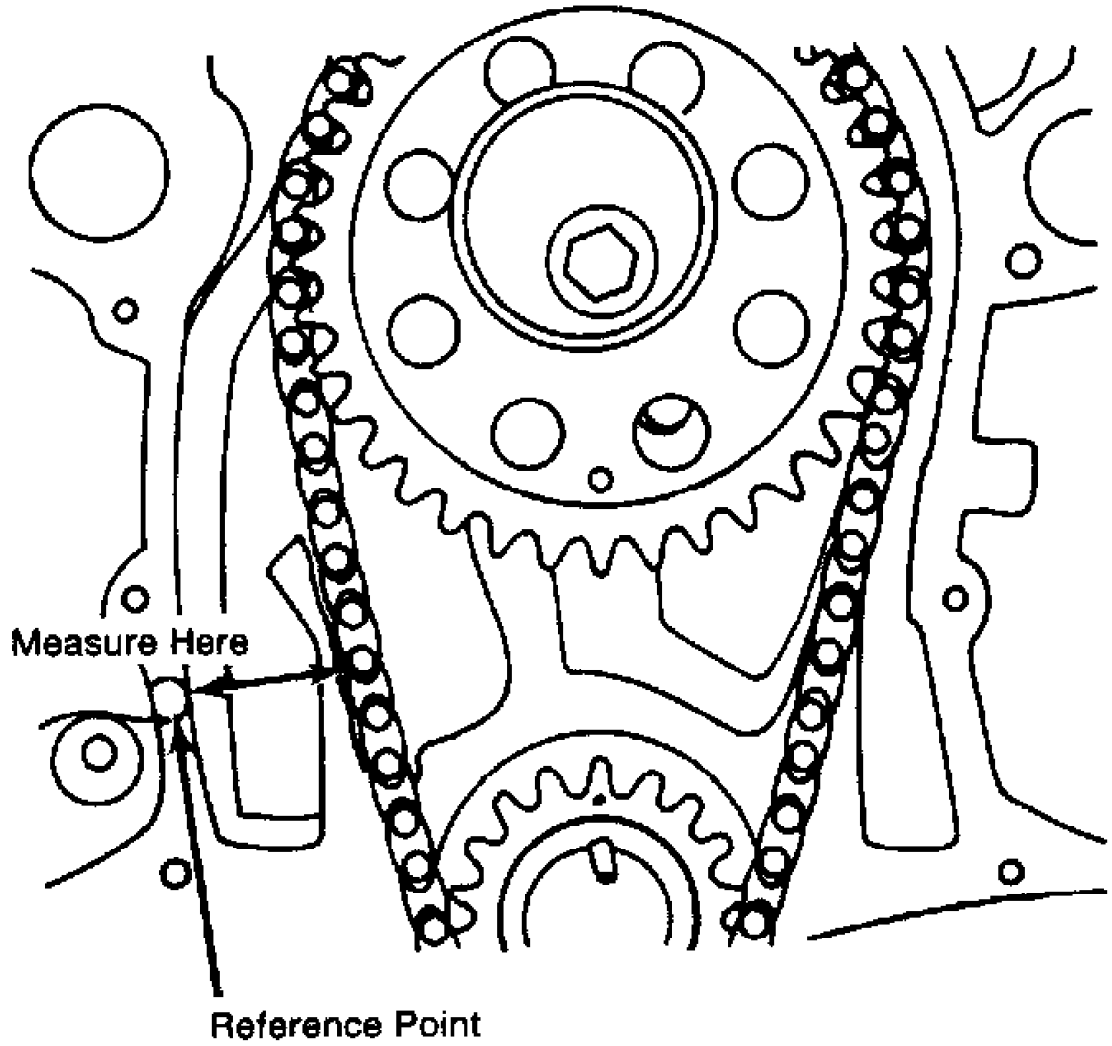


Fig. 23: Measuring Timing Chain Stretch - Typical
This Graphic For General Information Only

Timing chains must be installed so that timing marks on camshaft gear and crankshaft gear are aligned according to

manufacturer. See Fig. 24.

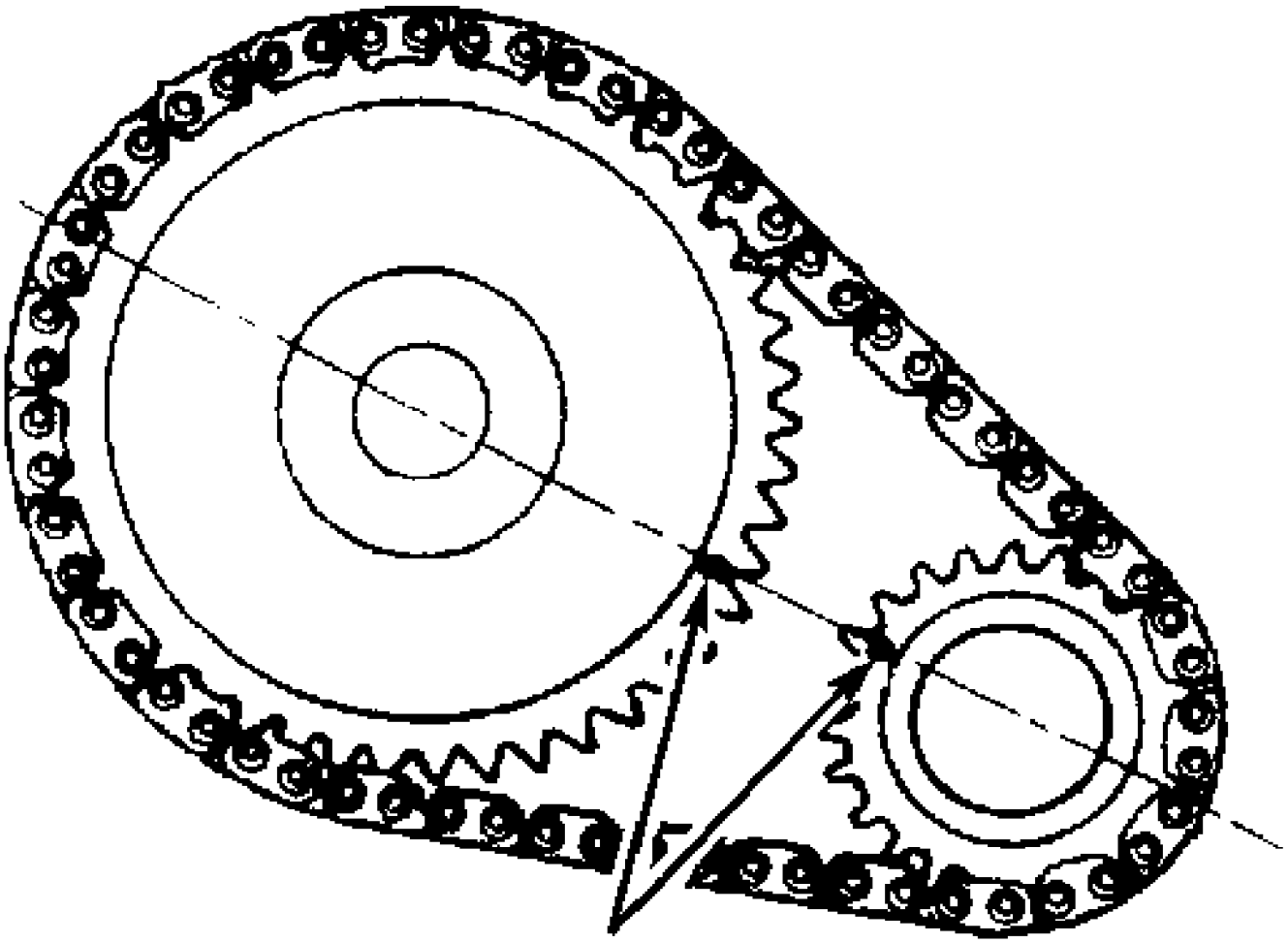


Fig. 24: Timing Gear Mark Alignment - Typical
This Graphic For General Information Only

TIMING BELTS

Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head and timing belt is installed. See Fig. 25.

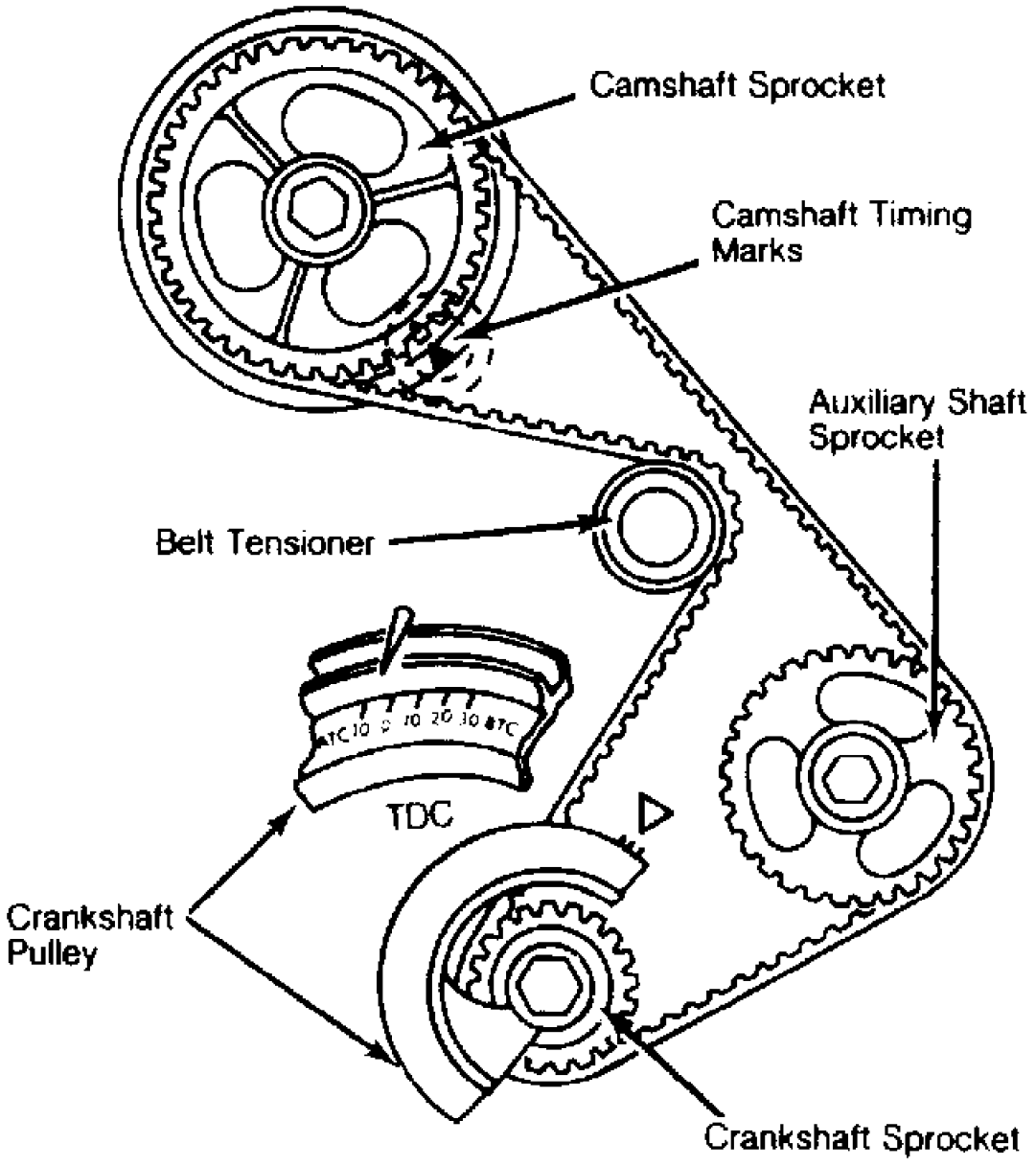


Fig. 25: Timing Belt Sprocket Alignment - Typical
This Graphic For General Information Only

TENSION ADJUSTMENTS

If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains. Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See Fig. 26.

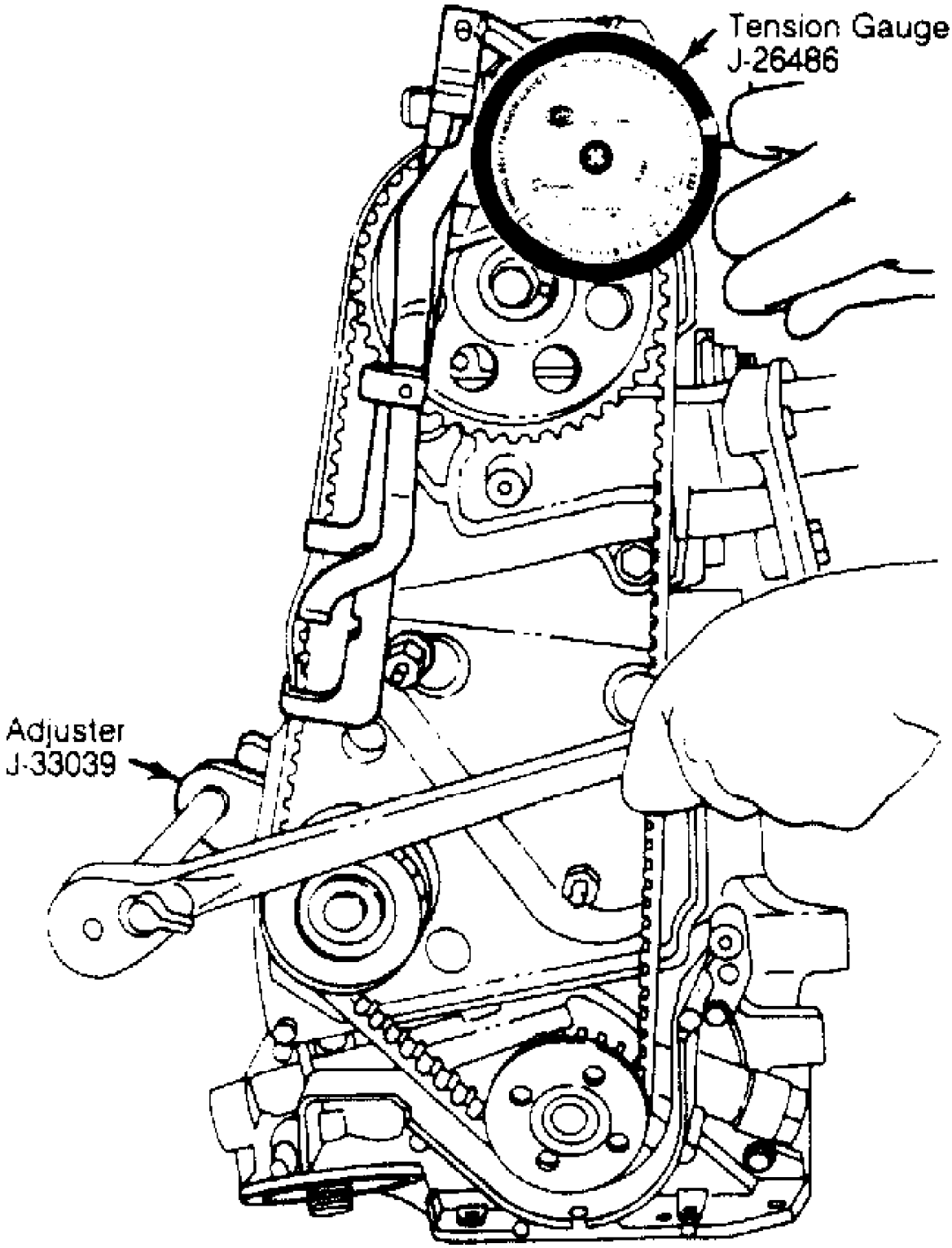


Fig. 26: Timing Belt Tension Adjustment - Typical
This Graphic For General Information Only

TIMING GEARS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING GEAR BACKLASH & RUNOUT

On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceed specifications, replace camshaft and/or crankshaft gear.

REAR MAIN OIL SEAL

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

INSTALLATION

One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See Fig. 27.

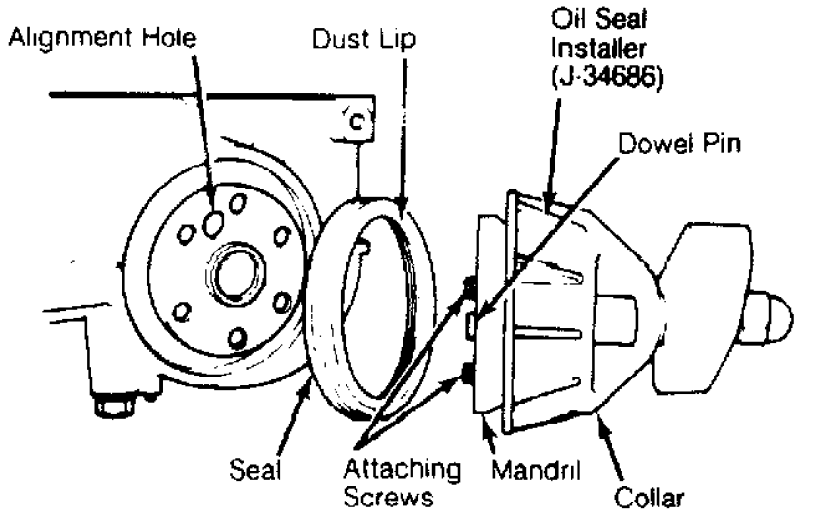


Fig. 27: Installing Typical One-Piece Oil Seal
This Graphic For General Information Only

Rope Type Seal

For rope type rear main oil seal installation, press seal

lightly into its seat. Using seal installer, fully seat seal in bearing cap or cylinder block.

Trim seal ends even with block parting surface. Some applications require sealer to be applied on main bearing cap prior to installation. See Fig. 28.

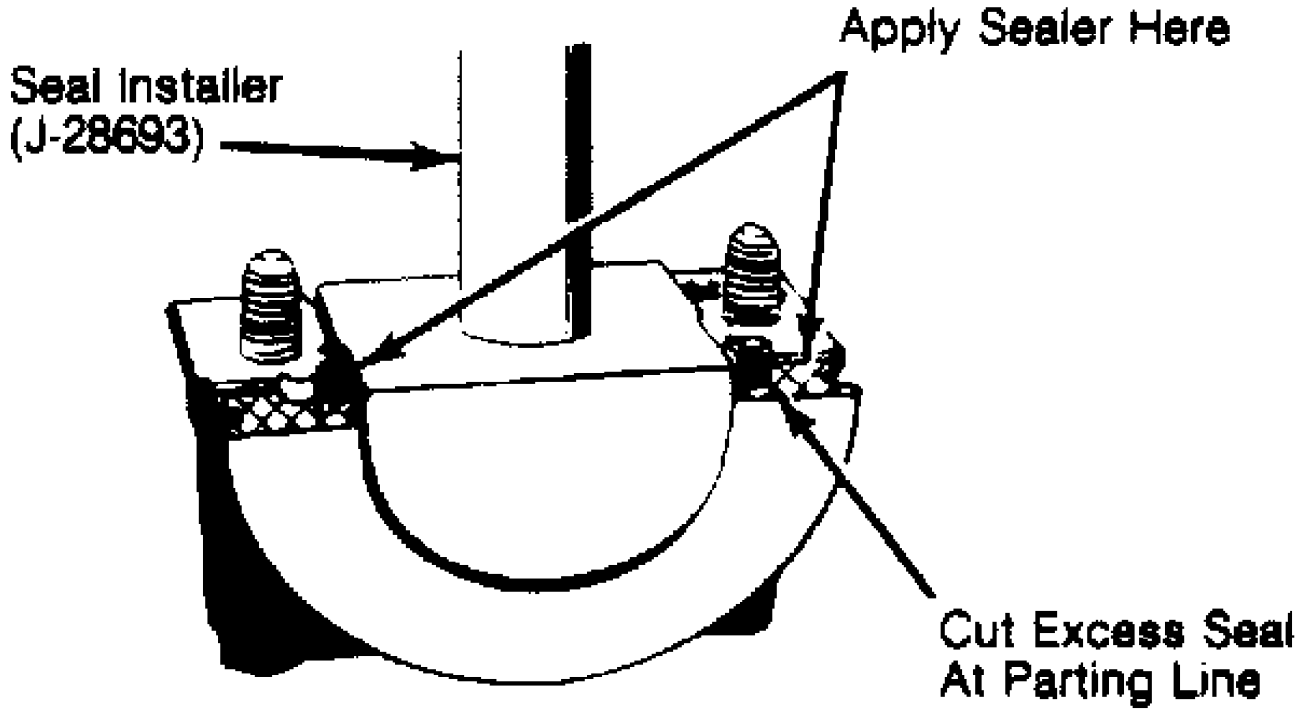


Fig. 28: Typical Rope Seal Installation
This Graphic For General Information Only

Split-Rubber Type Seal

Follow manufacturers procedures when installing split-rubber type rear main oil seals. Installation procedures vary with engine type. See appropriate ENGINE article in this section. See Fig. 29.

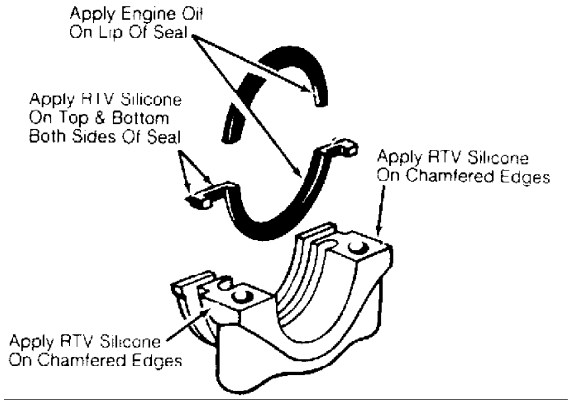


Fig. 29: Typical Split-Rubber Seal Installation
This Graphic For General Information Only

OIL PUMP

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ROTOR-TYPE

Oil pump rotors must be marked for location prior to removal. See Fig. 30. Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace components if worn or damaged.

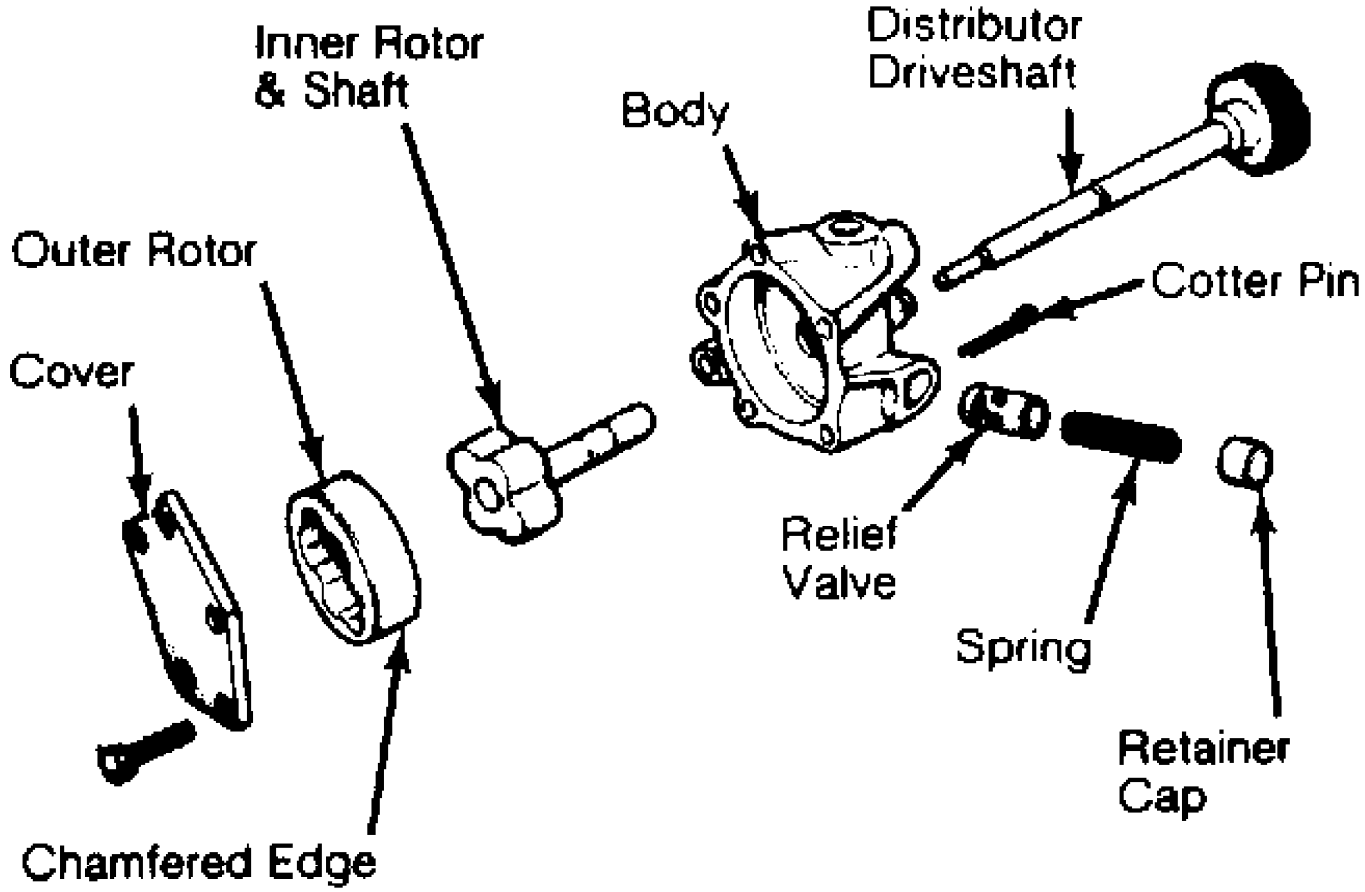


Fig. 30: Typical Rotor Type Oil Pump
This Graphic For General Information Only

Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See Fig. 31. Replace shaft and both rotors if clearance exceeds specifications.

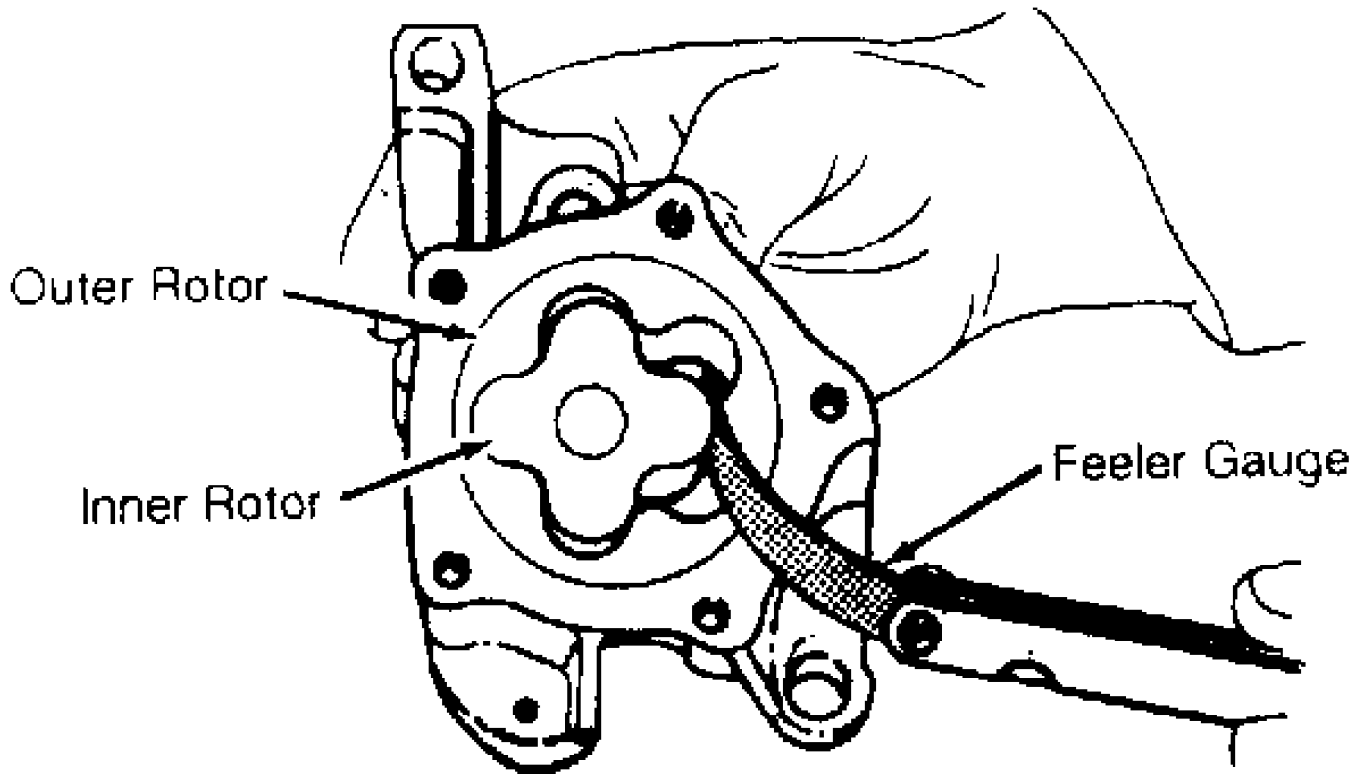


Fig. 31: Measuring Rotor Clearance - Typical
This Graphic For General Information Only

Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.

GEAR TYPE

Oil pump gears must be marked for location prior to removal. See Fig. 32. Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear.

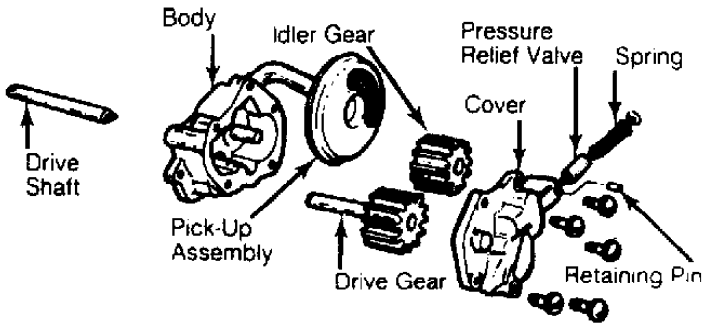


Fig. 32: Typical Gear Type Oil Pump
This Graphic For General Information Only

Measure gear diameter and length. Measure gear housing cavity depth and diameter. See Fig. 33. Replace components if worn or

damaged.

Pump cover wear is measured using a straightedge and feeler gauge. Pump is to be replaced if warpage or wear exceeds specifications or mating surface of pump cover is scratched or grooved.

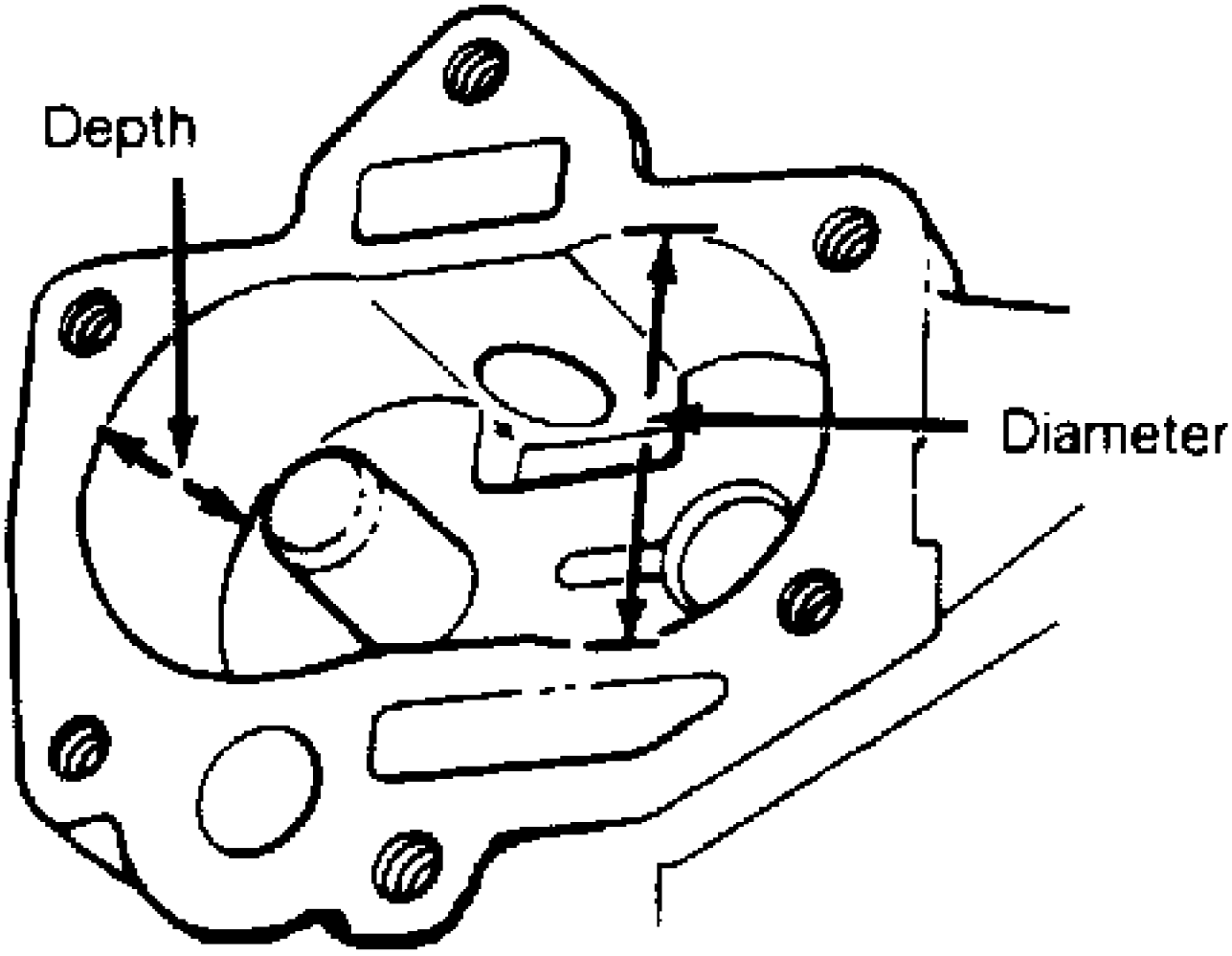


Fig. 33: Measuring Oil Pump Gear Cavity - Typical
This Graphic For General Information Only

BREAK-IN-PROCEDURE

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE PRE-OILING

Engine pre-oiling should be done prior to operation to prevent engine damage. A lightly oiled pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. DO NOT crank engine for more than 30 seconds to avoid starter motor damage.

Ensure oil pressure has reached the most distant point from the oil pump. Reinstall oil pressure sending unit. Reconnect ignition system.

INITIAL START-UP

Start the engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

CAMSHAFT

Break-in procedure is required when a new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturers recommendations.

PISTON RINGS

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are produced obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer’s recommended break-in procedure.

FINAL ADJUSTMENTS

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust carburetion or injection idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer’s recommended break-in procedure and maintenance schedule for new engines.

NOTE: Some manufacturer’s require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

* ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Engine Performance and Maintenance January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

CONTENTS

Motorist Assurance Program (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM
OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

Engine Assemblies

CYLINDER HEAD ASSEMBLIES
LONG BLOCK ASSEMBLIES
SHORT BLOCK ASSEMBLIES

Engine Components

ACCELERATOR PEDAL POSITION SENSORS
ACCESSORY BELTS
ACCESSORY PULLEYS
ACTUATORS
AIR CONDITIONING CYCLING SWITCHES
AIR CONDITIONING PRESSURE SENSORS
AIR DUCTS AND TUBES
AIR FILTER ELEMENTS
AIR FILTER GASKETS
AIR FILTER HOUSINGS AND GASKETS
AIR FUEL RATIO SENSORS
AIR INJECTION CONTROL SOLENOIDS
AIR PLENUMS
AIR PUMP BELTS
AIR PUMPS (ELECTRIC-DRIVEN)
AIR TUBES
ASPIRATOR, CHECK AND DECEL VALVES
BAFFLES
BALLAST PRIMARY SUPPLY RESISTOR WIRES
BALLAST RESISTORS AND PRIMARY SUPPLY RESISTOR WIRES
BAROMETRIC PRESSURE SENSORS
BATTERIES
BATTERY CABLES, WIRES AND CONNECTORS
BATTERY CONNECTORS
BATTERY TRAYS AND HOLD DOWN HARDWARE
BATTERY WIRES
BELT-DRIVEN AIR PUMPS
BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)
BELT TENSIONERS (ACCESSORY AND CAM BELTS)
BOOST CONTROL MECHANISMS
CAMSHAFT POSITION SENSORS
CARBURETORS AND CHOKES
CASTING CORE PLUGS AND EXPANSION PLUGS
CHARGE AIR COOLERS "INTERCOOLERS" (CAC)
CHECK VALVES

CHOKES
CLUTCH PEDAL POSITION SWITCHES
COLD START INJECTORS
CONNECTORS
COOLANT
COOLANT RECOVERY TANKS
COOLING FAN MOTOR MODULES
COOLING FAN MOTOR RELAYS AND MODULES
COOLING FAN MOTOR RESISTORS
COOLING FAN MOTOR SENSORS AND SWITCHES
COOLING FAN MOTOR SWITCHES
COOLING FAN MOTORS
CRANKSHAFT POSITION SENSORS
DECEL VALVES
DEFLECTORS
DIP STICKS AND TUBES
DIP STICK TUBES
DISTRIBUTOR ADVANCES AND RETARDERS (MECHANICAL AND VACUUM)
DISTRIBUTOR BOOTS AND SHIELDS
DISTRIBUTOR CAPS
DISTRIBUTOR RETARDERS (MECHANICAL AND VACUUM)
DISTRIBUTOR ROTORS
DISTRIBUTOR SHIELDS
DISTRIBUTORS
EARLY FUEL EVAPORATION VALVES (HEAT RISER ASSEMBLIES)
EGR COOLERS
EGR EXHAUST MANIFOLD PASSAGES
EGR INTAKE AND EXHAUST MANIFOLD PASSAGES
EGR PLATES AND COOLERS
ELECTRONIC SPARK CONTROL MODULES
ELECTRONIC TRANSMISSION CONTROL DEVICES
ELECTRONIC TRANSMISSION FEEDBACK DEVICES
ENGINE COOLANT TEMPERATURE SENSORS
ENGINE COOLING SYSTEMS
ENGINE COVERS (OIL PAN, VALVE COVER, TIMING COVER)
ENGINE OIL
ENGINE OIL CANISTERS
ENGINE OIL COOLERS (EXTERNAL)
ENGINE OIL DRAIN PLUGS AND GASKETS
ENGINE OIL FILTERS AND CANISTERS
ENGINE OIL GASKETS
ENGINE OIL PRESSURE GAUGES (MECHANICAL)
EVAPORATIVE EMISSION (EVAP) CANISTER FILTERS
EVAPORATIVE EMISSION (EVAP) CANISTER PURGE DEVICES
EVAPORATIVE EMISSION (EVAP) CANISTERS
EVAPORATIVE EMISSION (EVAP) FEEDBACK DEVICES
EXHAUST GAS RECIRCULATION DEVICES
EXHAUST GAS RECIRCULATION FEEDBACK DEVICES
EXPANSION PLUGS
FAN CONTROL SENSORS
FUEL
FUEL ACCUMULATORS AND DAMPERS
FUEL AND COLD START INJECTORS
FUEL DAMPERS
FUEL DELIVERY CHECK VALVES
FUEL DISTRIBUTORS (BOSCH CIS)
FUEL FILLER NECKS AND RESTRICTORS
FUEL FILTERS
FUEL INJECTORS
FUEL LEVEL SENDERS7
FUEL PRESSURE REGULATORS
FUEL PUMPS (IN-TANK AND EXTERNAL, ELECTRICAL OR MECHANICAL)
FUEL RAILS

FUEL RESTRICTORS
FUEL TANKS
GAS CAPS
GASKETS
GROMMETS (VALVE COVER)
HARMONIC DAMPERS
HEATER CONTROL VALVES
HEATER CORES
HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS
HOSE CLAMPS
HOSE CONNECTORS
HOSE COUPLERS
HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY PASS, HEATER, RECOVERY TANK AND OIL COOLERS)
HOUSINGS
IDLE AIR CONTROLS
IDLE SPEED CONTROL ACTUATORS
IGNITION BOOTS
IGNITION COIL TOWERS
IGNITION COILS
IGNITION CONTROL MODULES (ICM)
IGNITION SWITCHES
IGNITION TERMINALS
IGNITION WIRES, BOOTS, COIL TOWERS AND TERMINALS (SECONDARY)
IN-TANK FUEL STRAINERS
INERTIA FUEL SHUT-OFF SWITCHES
INTAKE AIR TEMPERATURE SENSORS
INTAKE MANIFOLDS
INTERCOOLERS
KNOCK SENSORS
LIQUID VAPOR SEPARATORS
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSORS
MASS AIR FLOW (MAF) SENSORS
METAL AIR MANIFOLDS AND PIPES
METAL AIR PIPES
MIX CONTROL SOLENOIDS
MOTOR MOUNTS
O-RINGS, GASKETS, SEALS AND SPRING LOCKS
O2 SENSORS
OIL PRESSURE SENDING UNITS
OIL PUMP PICK-UP SCREENS
OIL PUMPS
PARK NEUTRAL POSITION SWITCHES
PCV BREATHER ELEMENTS
PCV ORIFICES
PCV VALVES
PICK-UP ASSEMBLIES (INCLUDES MAGNETIC, HALL EFFECT AND OPTICAL)
POWER STEERING PRESSURE SENSORS
POWERTRAIN CONTROL MODULES (PCM) AND PROM
POWERTRAIN CONTROL PROM
PRESSURIZED EXPANSION TANK CAPS
RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS
RADIATOR FAN BLADES
RADIATOR FAN CLUTCHES
RADIATORS
ROLL OVER VALVES
SEALING COMPOUNDS
SEALS
SECONDARY AIR INJECTION SYSTEM MANAGEMENT DEVICES
SENSORS AND ACTUATORS
SHROUDS, BAFFLES AND DEFLECTORS
SPARK PLUGS

SPRING LOCKS
SUPER CHARGERS
SWITCHES
THERMAL VACUUM VALVES
THERMOSTATIC AIR DOOR ASSEMBLIES
THERMOSTATS AND HOUSINGS
THROTTLE BODIES
THROTTLE CABLES
THROTTLE LINKAGES AND CABLES
THROTTLE POSITION SENSORS
THROTTLE POSITION SWITCHES
TIMING BELT SPROCKETS
TIMING BELTS
TORQUE STRUTS
TRANSMISSION RANGE SWITCHES
TUBE CLAMPS
TUBE CONNECTORS
TUBE COUPLERS
TUBES
TURBO CHARGERS
VACUUM CONNECTIONS
VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)
VACUUM REGULATOR SOLENOIDS
VACUUM TUBES
VEHICLE SPEED SENSORS
VOLUME AIR FLOW SENSORS
WASTE GATE CONTROL SOLENOIDS
WASTE GATES AND BOOST CONTROL MECHANISMS
WATER PUMPS (ELECTRIC)
WATER PUMPS (NON-ELECTRIC)
WIRING HARNESSES AND CONNECTORS

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above,

standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested." In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer’s best interest, and at his or her choice given the options available.

This section lists the various parts and the conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience,

or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 - Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

ENGINE ASSEMBLIES

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

CYLINDER HEAD ASSEMBLIES

NOTE: A Cylinder Head Assembly is a cylinder head fitted with valves, associated springs, retainers, and on overhead camshaft cylinder heads (OHC), camshaft, camshaft bearings, lash adjusters, tappets and rockers.

CYLINDER HEAD ASSEMBLY INSPECTION

Condition	Code	Procedure
Adjustable valve lash is out of specification ...	B	Require repair.
Internal component failure (any component)	A	(1) Require repair or replacement of cylinder head assembly.

(1) - It is Required that all other failure related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience).

Example:
If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V-type engine.

LONG BLOCK ASSEMBLIES

NOTE: A Long Block Assembly is a short block assembly together with a cylinder head assembly and all those components fitted within the rocker or cam cover, and timing cover (the whole presented as an assembly). A rebuilt or new oil pump, or kit shall be supplied or fitted as appropriate.

LONG BLOCK ASSEMBLY INSPECTION

Condition	Code	Procedure
Internal component failure (any component)	A	(1) Require repair or replacement of the long block assembly.

(1) – It is Required that all other failure related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience).

Example:
If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V-type engine.

SHORT BLOCK ASSEMBLIES

NOTE: A Short Block Assembly is a cylinder block and all those components contained within the limits of the block deck or decks, the pan rail, the block rear face and the timing cover (where fitted), including the crankshaft.

SHORT BLOCK ASSEMBLY INSPECTION

Condition	Code	Procedure
Any internal component failure	A	(1) Require repair or replacement of the short block assembly.

(1) – It is Required that all other failure related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience).

Example:
If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V-type engine.

ENGINE COMPONENTS

ACCELERATOR PEDAL POSITION SENSORS

ACCELERATOR PEDAL POSITION SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

ACCESSORY BELTS

ACCESSORY BELT INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	(1) Further inspection required.
Cracked	1	Suggest replacement.
Frayed	1	Suggest replacement.

Missing	C	Require replacement.
Noisy	2	(2) Further inspection required.
Plies separated	A	Require replacement.
Tension out of specification	B	Require adjustment or replacement.
Worn beyond adjustment range	B	Require replacement.
Worn so it contacts bottom of pulley	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.

ACCESSORY PULLEYS

ACCESSORY PULLEY INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require replacement.
Cracked	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Pulley damaged, affecting belt life	A	Require replacement.

ACTUATORS

See SENSORS AND ACTUATORS.

AIR CONDITIONING CYCLING SWITCHES

AIR CONDITIONING CYCLING SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.

Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

AIR CONDITIONING PRESSURE SENSORS

AIR CONDITIONING PRESSURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.

Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

AIR DUCTS AND TUBES

AIR DUCT AND TUBE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require repair or replacement.

AIR FILTER ELEMENTS

AIR FILTER ELEMENT INSPECTION

Condition	Code	Procedure
Leaking	A	Require replacement.
Paper filter element oil-soaked	A	(1) Require replacement.
Maintenance intervals	3	Suggest replacement to comply with vehicle's OEM recommended service intervals.
Melted	A	Required replacement.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require replacement.
Water-contaminated	A	(1) Require replacement.

(1) - Further inspection required to determine cause.

AIR FILTER GASKETS

See AIR FILTER HOUSINGS AND GASKETS.

AIR FILTER HOUSINGS AND GASKETS

AIR FILTER HOUSING AND GASKET INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

AIR FUEL RATIO SENSORS

AIR FUEL RATIO SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware threads damaged	A	...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Contaminated	A	.....	(2) Require repair or replacement.
Inoperative	B	.....	(3) Require repair or replacement. Further inspection required.
Leaking	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Resistance out of specification	B	..	Require repair or replacement.
Restricted, affecting performance	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

AIR INJECTION CONTROL SOLENOIDS

AIR INJECTION CONTROL SOLENOID INSPECTION

Condition	Code	Procedure

Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

AIR PLENUMS

AIR PLENUM INSPECTION

Condition	Code	Procedure
Integrated air or fuel control components		

inoperative	A	(1) Require repair or replacement.
Internal air or fuel components damaged, affecting performance ..	A ...	Require repair or replacement of component.
Internal air or fuel components damaged, not affecting performance	.....	No service suggested or required.
Internal air or fuel components missing	C	Require replacement of component.
Leaking	A ..	Require repair or replacement.
Restricted	A ..	Require repair or replacement.
Threads damaged	A ..	Require repair or replacement.
Threads stripped (threads missing)	A ..	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

AIR PUMP BELTS

AIR PUMP BELT INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	(1) Further inspection required.
Cracked	1	Suggest replacement.
Frayed	1	Suggest replacement.
Maintenance intervals ...	3 ...	Suggest replacement to comply with vehicle OEM recommended service intervals.
Missing	C	Require replacement.
Noisy	2	(2) Further inspection required.
Plies separated	A	Require replacement.
Tension out of specification	B	Require adjustment or replacement.
Worn beyond adjustment range	B	Require replacement.
Worn so it contacts bottom of pulley	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.

AIR PUMPS (ELECTRIC-DRIVEN)

AIR PUMP (ELECTRIC-DRIVEN) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A ...	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of

			hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Inoperative	A	.....	(2) Require replacement.
Leaking	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Noisy	2	.....	Suggest replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

AIR TUBES

See AIR DUCTS AND TUBES.

ASPIRATOR, CHECK AND DECEL VALVES

ASPIRATOR, CHECK AND DECEL VALVE INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Inoperative	A	.....	(1) Require repair or replacement.
Leaking	A	.....	Require replacement.
Melted, affecting performance	A	.....	Require replacement.
Melted, not affecting			

performance	..	No service suggested or required.
Missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

BAFFLES

See SHROUDS, BAFFLES AND DEFLECTORS.

BALLAST PRIMARY SUPPLY RESISTOR WIRES

See BALLAST RESISTORS AND PRIMARY SUPPLY RESISTOR WIRES.

BALLAST RESISTORS AND PRIMARY SUPPLY RESISTOR WIRES

BALLAST RESISTOR AND PRIMARY SUPPLY RESISTOR WIRE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Conductor exposed	A	Require replacement.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Insulation overheated	A	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

BAROMETRIC PRESSURE SENSORS

BAROMETRIC PRESSURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable;

check for accepted cleaning procedure.

BATTERIES

Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

Definition of Terms

* Battery Performance Testing
  Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

* Cold Cranking Amp (CCA) Rating
  The number of amperes a new, fully charged battery at 0° F (-17.8° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

* Cranking Amps (CA)
  The number of amperes a new, fully charged battery, typically at 32° F (0° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

* OEM Cranking Amps
  The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

BATTERY INSPECTION

Condition	Code	Procedure
Battery frozen		(1) Further inspection required.
Case leaking	A	Require replacement.
Casing swollen	A	(2) Further inspection required.
Circuit open internally	A	Require replacement.
Electrolyte contamination	A	(2) Further inspection required.
Electrolyte discoloration	A	(2) Further inspection required.
Fails to accept and hold charge	A	(3) Require replacement.
Fluid level low	B	(4) Further inspection required.
Out of performance specification for battery	B	(5) Require replacement.
Out of specification for application	B	(5) Require replacement.
Post (top or side) burned, affecting performance	A	(6) Require repair or replacement.
Post (top or side) burned, not affecting performance	2	(6) Suggest repair or

			replacement.
Post (top or side) corroded, affecting performance	A	.....	Require repair.
Post (top or side) corroded, not affecting performance	2	.....	Suggest repair.
Post (top or side) loose	A	.....	Require replacement.
Post (top or side) melted, affecting performance	A	.....	(6) Require repair or replacement.
Post (top or side) melted, not affecting performance	2	.....	(6) Suggest repair or replacement.
Specific gravity low	B	.....	(7) Further inspection required.
State of charge low	A	.....	(7) Further inspection required.
Top dirty	2	.....	Suggest cleaning battery.
Top wet	A	...	(8) Require cleaning battery. Further inspection required.
Vent cap loose	A	...	Require repair or replacement of vent cap.
Vent cap missing	C	.....	Require replacement of vent cap.

(1) - DO NOT attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.
(2) - No service suggested or required unless the battery fails performance test, in which case, require replacement.
(3) - This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.
(4) - Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test.
(5) - The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.
(6) - Determine cause and correct prior to repair or replacement of part.
(7) - Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.
(8) - Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.

BATTERY CABLES, WIRES AND CONNECTORS

BATTERY CABLE, WIRE AND CONNECTOR INSPECTION

Condition	Code	Procedure
Application incorrect ...	B ..	Require repair or replacement.

Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Insulation damaged, conductors exposed	A	(2) Require repair or replacement.
Insulation damaged, conductors not exposed	1	Suggest replacement.
Open	A	Require repair or replacement.
Protective shield (conduit) melted	2	(1) Suggest repair or replacement.
Protective shield (conduit) missing	2	Suggest repair or replacement.
Resistance (voltage drop) out of specification	A	Require repair or replacement.
Routed incorrectly	B	Require repair.
Secured incorrectly	B	Require repair.
Shorted	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Voltage drop out of specification	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.

BATTERY CONNECTORS

See BATTERY CABLES, WIRES AND CONNECTORS.

BATTERY TRAYS AND HOLD DOWN HARDWARE

BATTERY TRAY AND HOLD DOWN HARDWARE INSPECTION

Condition	Code	Procedure
Battery improperly		

secured	2	Suggest repair.
Bent, affecting performance	A	Require repair or replacement.
Bent, not affecting performance		No service suggested or required.
Broken, affecting performance	A	Require repair or replacement.
Broken, not affecting performance		No service suggested or required.
Corroded, affecting performance	A	Require repair or replacement.
Corroded, not affecting performance	2	Suggest repair or replacement.
Cracked, affecting performance	A	Require repair or replacement.
Cracked, not affecting performance	1	Suggest repair or replacement.
Missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Water drain clogged	A	Require repair.

BATTERY WIRES

See BATTERY CABLES, WIRES AND CONNECTORS.

BELT-DRIVEN AIR PUMPS

BELT-DRIVEN AIR PUMP INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Inoperative	A	(1) Require replacement.
Leaking	A	Require replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Pulley alignment incorrect	B	Require repair or replacement.
Pulley bent	A	Require replacement.
Pulley cracked	A	Require replacement.
Pulley loose	A	Require repair or replacement.
Pulley missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)

BELT IDLER ASSEMBLY (ACCESSORY AND CAM BELT) INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearings worn	1	Suggest replacement.
Cracked	2	Suggest replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Seized	A	Require repair or replacement.

BELT TENSIONERS (ACCESSORY AND CAM BELTS)

BELT TENSIONER (ACCESSORY AND CAM BELT) INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearings worn	1	Suggest replacement.
Belt tension incorrect	B	Require adjustment or repair.
Cracked	2	Suggest replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Pulley damaged, affecting belt life	A	Require replacement.
Seized	A	Require repair or replacement.

BOOST CONTROL MECHANISMS

See WASTE GATES AND BOOST CONTROL MECHANISMS.

CAMSHAFT POSITION SENSORS

CAMSHAFT POSITION SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

CARBURETORS AND CHOKES

NOTE: Proper operation of a carburetor includes the ability to control air/fuel mixtures during all phases or driving operation to comply with all federal and local emissions standards. Adjustments are to be considered repairs.

CARBURETOR AND CHOKE INSPECTION

Condition	Code	Procedure
Air/fuel control incorrect	B	Require repair or replacement.

Application incorrect	B	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Components binding	A	Require repair or replacement.
Components damaged, affecting operation or performance	A	Require repair or replacement.
Components missing	C	Require replacement of components.
Contaminated	A	(1) Require repair or replacement. Further inspection required.
Controlling linkages binding	A	Require repair or replacement of linkage.
Leaking	A	Require repair or replacement.
Mechanical operation incorrect	B	Require repair or replacement.
Operating incorrectly	B	Require repair or replacement.

(1) - Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.

CASTING CORE PLUGS AND EXPANSION PLUGS

CASTING CORE PLUG AND EXPANSION PLUG INSPECTION

Condition	Code	Procedure
Leaking	A	Require replacement.
Material type incorrect	2	Suggest replacement.

CHARGE AIR COOLERS "INTERCOOLERS" (CAC)

CHARGE AIR COOLER "INTERCOOLER" (CAC) INSPECTION

Condition	Code	Procedure
Air-to-air intercooler leaking, affecting boost performance	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking coolant	A	Require repair or replacement.

Missing	C	Require replacement.
Restricted, affecting performance	A	Require repair or replacement.

CHECK VALVES

See ASPIRATOR, CHECK AND DECEL VALVES.

CHOKES

See CARBURETORS AND CHOKES.

CLUTCH PEDAL POSITION SWITCHES

CLUTCH PEDAL POSITION SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or

replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

COLD START INJECTORS

See FUEL AND COLD START INJECTORS.

CONNECTORS

See WIRING HARNESSES AND CONNECTORS.

COOLANT

COOLANT INSPECTION

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement.
Contaminated	B	(1) Require replacement or recycling. Further inspection required.
Level low	B	(2) Require filling to proper level.
Maintenance intervals	3	(3) Suggest replacement.
Mixture incorrect	B	Require correction or replacement.
Type incorrect	B	Require replacement.

(1) - Determine source of contamination and require correction prior to coolant replacement.
(2) - Determine source of incorrect level and suggest repair.
(3) - The system should be drained and/or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.

COOLANT RECOVERY TANKS

COOLANT RECOVERY TANK INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require repair or replacement.
Missing (if original equipment)	C	Require replacement.

COOLING FAN MOTOR MODULES

See COOLING FAN MOTOR RELAYS AND MODULES.

COOLING FAN MOTOR RELAYS AND MODULES

COOLING FAN MOTOR RELAY AND MODULE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Housing cracked	2	Suggest repair or replacement.
Malfunctioning	A	(2) Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, failure to perform all functions, or out of OEM specification.

COOLING FAN MOTOR RESISTORS

COOLING FAN MOTOR RESISTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Missing	C	Require replacement.
Open	A	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Shorted	A	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

COOLING FAN MOTOR SENSORS AND SWITCHES

COOLING FAN MOTOR SENSOR AND SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

COOLING FAN MOTOR SWITCHES

See COOLING FAN MOTOR SENSORS AND SWITCHES.

COOLING FAN MOTORS

COOLING FAN MOTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Hydraulic fan motor leaking	A	Require repair or replacement.
Inoperative	A	(2) Require replacement.

Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Rotation incorrect for application	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Vibration	1	Suggest replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Check fan motor/controls. Inoperative includes intermittent operation or out of OEM specification.

CRANKSHAFT POSITION SENSORS

CRANKSHAFT POSITION SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	Require repair or replacement.
Inoperative	B	Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or

		replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

DECEL VALVES

See ASPIRATOR, CHECK AND DECEL VALVES.

DEFLECTORS

See SHROUDS, BAFFLES AND DEFLECTORS.

DIP STICKS AND TUBES

DIP STICK AND TUBE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Bent	2	Suggest repair or replacement.
Broken, affecting performance (for example, fuel mixture)	A	Require repair or replacement.
Broken, not affecting performance	2	Suggest repair or replacement.
Leaking, affecting performance (for example, fuel mixture)	A	Require repair or replacement.
Leaking, not affecting performance	2	Suggest repair or replacement.
Missing	C	Require replacement.

DIP STICK TUBES

See DIP STICKS AND TUBES.

DISTRIBUTOR ADVANCES AND RETARDERS (MECHANICAL AND VACUUM)

DISTRIBUTOR ADVANCE AND RETARDER (MECHANICAL AND VACUUM) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding	A	Require repair or replacement.
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require replacement.
Out of specification	B	Require repair or replacement.

(1) - Inoperative includes intermittent operation.

DISTRIBUTOR BOOTS AND SHIELDS

DISTRIBUTOR BOOT AND SHIELD INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Deteriorated	A	Require replacement.
Leaking	A	Require replacement.
Missing	A	Require replacement.
Torn	A	Require replacement.

DISTRIBUTOR CAPS

DISTRIBUTOR CAP INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Arcing	A	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.

Burned	A	Require replacement.
Carbon button missing	A	Require replacement.
Carbon button worn, affecting performance	A	Require replacement.
Carbon button worn, not affecting performance	1	Suggest replacement.
Carbon-tracked	A	Require replacement.
Cracked	A	Require replacement.
Loose	2	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal eroded, affecting performance	A	Require repair or replacement.
Terminal eroded, not affecting performance		No service suggested or required.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

DISTRIBUTOR RETARDERS (MECHANICAL AND VACUUM)

See DISTRIBUTOR ADVANCES AND RETARDERS (MECHANICAL AND VACUUM).

DISTRIBUTOR ROTORS

DISTRIBUTOR ROTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Carbon-tracked	A	Require replacement.
Contact burned	A	Require replacement.
Corroded	1	Suggest replacement.
Eroded	1	Suggest replacement.
Loose	A	Require repair or replacement.
Out of specification	B	Require replacement.

DISTRIBUTOR SHIELDS

See DISTRIBUTOR BOOTS AND SHIELDS.

DISTRIBUTORS

DISTRIBUTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bushings worn, affecting performance	A	Require repair or replacement.
Bushings worn, not affecting performance	1	Suggest repair or replacement.
Cam lobes worn, affecting performance	A	Require repair or replacement.
Cam lobes worn, not affecting performance	1	Suggest repair or replacement.
Gear broken	A	Require repair or replacement.
Gear worn, affecting performance	A	Require replacement.
Gear worn, not affecting performance		No service suggested or required.
Integrated pickup triggering device loose	A	Require repair or replacement.
Integrated pickup triggering device magnetism incorrect	A	Require repair or replacement.
Leaking oil internally	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Pickup triggering device (reluctor) broken	A	Require repair or replacement.
Pickup triggering device (reluctor) loose	A	Require repair or replacement.
Pickup triggering device (reluctor) weak	A	Require repair or replacement.
Reluctor (pickup triggering device) broken	A	Require repair or replacement.
Reluctor (pickup triggering device) loose	A	Require repair or replacement.
Reluctor (pickup triggering device) weak	A	Require repair or replacement.
Shaft bent	A	Require replacement.
Thrust washer broken	A	Require repair or replacement.
Thrust washer missing	C	Require repair or replacement.
Thrust washer worn, affecting performance	A	Require repair or replacement.
Thrust washer worn, not affecting performance	1	Suggest repair or replacement.

EARLY FUEL EVAPORATION VALVES (HEAT RISER ASSEMBLIES)

EARLY FUEL EVAPORATION VALVE (HEAT RISER ASSEMBLY) INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement of affected parts.
Diaphragm inoperative	A	(1) Further inspection required.
Leaking	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Seized	A	Require replacement of affected parts.
Spring broken	B	Require replacement of spring(s).
Spring inoperative	A	(2) Require replacement of spring(s).

(1) - Inoperative includes intermittent operation or out of OEM specification. If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heat riser.
(2) - Inoperative includes intermittent operation or out of OEM specification.

EGR COOLERS

See EGR PLATES AND COOLERS.

EGR EXHAUST MANIFOLD PASSAGES

See EGR INTAKE AND EXHAUST MANIFOLD PASSAGES.

EGR INTAKE AND EXHAUST MANIFOLD PASSAGES

EGR INTAKE AND EXHAUST MANIFOLD PASSAGE INSPECTION

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.

EGR PLATES AND COOLERS

EGR PLATE AND COOLER INSPECTION

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require repair or replacement.

ELECTRONIC SPARK CONTROL MODULES

ELECTRONIC SPARK CONTROL MODULE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	A	Require repair.
Contaminated	A	(2) Require repair or replacement.
Leaking	A	Require repair or replacement.
Malfunctioning	A	(3) Require repair or replacement.
Missing	C	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement of source.
(3) - Includes inoperative, intermittent operation, failure to perform all functions, or out of OEM specification.

ELECTRONIC TRANSMISSION CONTROL DEVICES

ELECTRONIC TRANSMISSION CONTROL DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Leaking	A	Require repair or replacement.
Malfunctioning	A	(3) Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Includes inoperative, intermittent operation, failure to perform all functions, or out of OEM specification.

ELECTRONIC TRANSMISSION FEEDBACK DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

ENGINE COOLANT TEMPERATURE SENSORS

ENGINE COOLANT TEMPERATURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of

OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

ENGINE COOLING SYSTEMS

NOTE: Overheating, poor engine performance, and insufficient cabin heat can be affected by, but are not limited to, all of the components in the engine cooling system.

ENGINE COVERS (OIL PAN, VALVE COVER, TIMING COVER)

ENGINE COVER (OIL PAN, VALVE COVER, TIMING COVER) INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement.
Attaching hardware loose	A	Require repair or replacement.
Attaching hardware missing	C	Require replacement.
Baffle loose	2	Suggest repair or replacement.
Baffle missing	C	Require replacement.
Bent, affecting performance	A	Require repair or replacement.
Bent, not affecting performance	..	No service suggested or required.
Cracked (not leaking)	2	Suggest repair or replacement.
Leaking externally	A	Require repair or replacement.
Leaking internally, causing fluid contamination	A	Require repair or replacement.
Missing	C	Require replacement.
Restricted passage	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.

ENGINE OIL

ENGINE OIL INSPECTION

Condition	Code	Procedure
Contaminated	A	(1) Require replacement of oil and filter.
Level high	B	Determine source of incorrect level and require repair.
Level low	B	Determine source of incorrect level and require repair.
Maintenance intervals	3	Suggest replacement to comply with vehicle's OEM recommended service intervals.

(1) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water when changing oil. Require repair or replacement.

ENGINE OIL CANISTERS

See ENGINE OIL FILTERS AND CANISTERS.

ENGINE OIL COOLERS (EXTERNAL)

ENGINE OIL COOLER (EXTERNAL) INSPECTION

Condition	Code	Procedure
Air flow restriction	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bypassed	A	Require repair or replacement.
Connection leaking	A	Require repair or replacement.
Corroded	1	Suggest repair or replacement.
Fins damaged, affecting performance	A	Require repair or replacement.
Fins damaged, not affecting performance	2	Suggest repair or replacement.
Fluid flow restrictions	A	Require repair or replacement.
Internal restrictions, affecting performance	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Missing	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

ENGINE OIL DRAIN PLUGS AND GASKETS

ENGINE OIL DRAIN PLUG AND GASKET INSPECTION

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Threads damaged	A	(1) Require repair or replacement.

(1) - Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.

ENGINE OIL FILTERS AND CANISTERS

ENGINE OIL FILTER AND CANISTER INSPECTION

Condition	Code	Procedure
Bulged	A	(1) Require replacement. Further inspection required.
Canister attaching hardware broken	A	Require repair or replacement of hardware.
Canister attaching hardware loose	A	Require repair.

Condition	Code	Procedure
Canister attaching hardware missing	C	Require replacement.
Canister attaching hardware not functioning	A	Require repair or replacement of hardware.
Center tube collapsed	A	(2) Require replacement. Further inspection required.
Contaminated	A	(3) Require replacement of oil and filter.
Dented	2	(4) Suggest replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Maintenance intervals	3	Suggest replacement to comply with vehicle's OEM recommended service intervals.

(1) - Inspect pressure relief valve.
(2) - Inspect bypass.
(3) - Determine cause of contamination, such as engine coolant, fuel, metal particles, or water when changing oil. Require repair or replacement.
(4) - Determine cause, such as broken motor mount.

ENGINE OIL GASKETS

See ENGINE OIL DRAIN PLUGS AND GASKETS.

ENGINE OIL PRESSURE GAUGES (MECHANICAL)

ENGINE OIL PRESSURE GAUGE (MECHANICAL) INSPECTION

Condition	Code	Procedure
Indicates out of range	B	(1) Further inspection required.
Inoperative	A	(2) Further inspection required.
Leaking	A	Require repair or replacement.
Reads inaccurately	2	Suggest repair or replacement.

(1) - Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge.
(2) - Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge. Inoperative includes intermittent operation, out of OEM specification, or out of range. Further inspection required to determine cause.

EVAPORATIVE EMISSION (EVAP) CANISTER FILTERS

EVAPORATIVE EMISSION (EVAP) CANISTER FILTER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Maintenance interval	3	Suggest replacement to comply with OEM recommended service interval.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require replacement.
Restricted, not affecting performance	1	Suggest replacement.
Water-contaminated	A	Require replacement.

EVAPORATIVE EMISSION (EVAP) CANISTER PURGE DEVICES

EVAPORATIVE EMISSION (EVAP) CANISTER PURGE DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads		

missing)	A	Require replacement.
Wire lead conductors exposed	B ..	Require repair or replacement.
Wire lead corroded	A ..	Require repair or replacement.
Wire lead open	A ..	Require repair or replacement.
Wire lead shorted	A ..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

EVAPORATIVE EMISSION (EVAP) CANISTERS

EVAPORATIVE EMISSION (EVAP) CANISTER INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require replacement.
Missing	C	Require replacement.
Saturated	A	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

EVAPORATIVE EMISSION (EVAP) FEEDBACK DEVICES

EVAPORATIVE EMISSION (EVAP) FEEDBACK DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A ...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A ...	Require repair or replacement of hardware.
Connector broken	A ..	Require repair or replacement.
Connector (Weatherpack type) leaking	A ..	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A ..	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of		

specification	B	..	Require repair or replacement.
Restricted, affecting performance	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

EXHAUST GAS RECIRCULATION DEVICES

EXHAUST GAS RECIRCULATION DEVICE INSPECTION

Condition	Code		Procedure
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware threads damaged	A	...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Contaminated	A	.....	(2) Require repair or replacement.
Inoperative	B	.....	(3) Require repair or replacement. Further inspection required.

Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Restricted, not affecting performance	1	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

EXHAUST GAS RECIRCULATION FEEDBACK DEVICES

EXHAUST GAS RECIRCULATION FEEDBACK DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.

Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Restricted, not affecting performance	1	Suggest repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

EXPANSION PLUGS

See CASTING CORE PLUGS AND EXPANSION PLUGS.

FAN CONTROL SENSORS

FAN CONTROL SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware		

threads stripped (threads missing)	A	... Require repair or replacement of hardware.
Connector broken	A	.. Require repair or replacement.
Connector (Weatherpack type) leaking	A	.. Require repair or replacement.
Connector melted	A	..... (1) Require repair or replacement.
Connector missing	C	..... Require replacement.
Contaminated	A	..... (2) Require repair or replacement.
Inoperative	B	..... (3) Require repair or replacement. Further inspection required.
Leaking	A	.. Require repair or replacement.
Missing	C	..... Require replacement.
Resistance out of specification	B	.. Require repair or replacement.
Restricted, affecting performance	A	.. Require repair or replacement.
Terminal broken	A	.. Require repair or replacement.
Terminal burned, affecting performance	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	.. Require repair or replacement.
Terminal corroded, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.
Terminal loose, not affecting performance ..	1	.. Suggest repair or replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Wire lead conductors exposed	B	.. Require repair or replacement.
Wire lead corroded	A	.. Require repair or replacement.
Wire lead open	A	.. Require repair or replacement.
Wire lead shorted	A	.. Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

FUEL

FUEL INSPECTION

Condition	Code	Procedure
Contaminated	B	..... (1) Require repair or replacement.
Fuel incorrect	B	..... (2) Require flushing of system.

(1) - Determine of source of contamination. Require repair or replacement.
(2) - If a fuel other than specification fuel is present in the system, the required service is to flush and fill with the correct fuel.

FUEL ACCUMULATORS AND DAMPERS

FUEL ACCUMULATOR AND DAMPER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connections leaking	A	Require repair or replacement.
Inoperative	A	(1) Require replacement.
Leaking	A	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

FUEL AND COLD START INJECTORS

NOTE: You are not required to replace injectors in sets. However, you may suggest replacement of all injectors for preventive maintenance.

FUEL AND COLD START INJECTOR INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Flow restricted	B	Require repair or replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Resistance out of		

specification	B	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation, out of OEM specification. Some components may be serviceable.

FUEL DAMPERS

See FUEL ACCUMULATORS AND DAMPERS.

FUEL DELIVERY CHECK VALVES

FUEL DELIVERY CHECK VALVE INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require replacement.
Leaking externally	A	Require repair or replacement.
Missing	C	Require replacement.
Pressure leaking (bleeds down)	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

FUEL DISTRIBUTORS (BOSCH CIS)

FUEL DISTRIBUTOR (BOSCH CIS) INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	(2) Require repair or replacement. Further inspection required.

(1) - Inoperative includes intermittent operation.
(2) - Some components may be serviceable; check for accepted

cleaning procedure.

FUEL FILLER NECKS AND RESTRICTORS

FUEL FILLER NECK AND RESTRICTOR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Restricted	2	Suggest repair or replacement.

FUEL FILTERS

FUEL FILTER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require repair or replacement.
Maintenance interval	3	Suggest replacement to comply with OEM recommended service interval.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require replacement.
Restricted, not affecting performance	1	Suggest replacement.
Water-contaminated	2	Suggest replacement.

FUEL INJECTORS

FUEL INJECTOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware		

threads stripped (threads missing)	A ..	Require repair or replacement of hardware.
Connector broken	A .	Require repair or replacement.
Connector (Weatherpack type) leaking	A .	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A .	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B .	Require repair or replacement.
Restricted, affecting performance	A .	Require repair or replacement.
Restricted, not affecting performance	2 .	Suggest repair or replacement.
Terminal broken	A .	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2 .	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A .	Require repair or replacement.
Terminal corroded, not affecting performance ..	2 .	Suggest repair or replacement.
Terminal loose, affecting performance	B .	Require repair or replacement.
Terminal loose, not affecting performance ..	1 .	Suggest repair or replacement.
Threads damaged	A .	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B .	Require repair or replacement.
Wire lead corroded	A .	Require repair or replacement.
Wire lead open	A .	Require repair or replacement.
Wire lead shorted	A .	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

FUEL LEVEL SENDERS

FUEL LEVEL SENDER INSPECTION

Condition	Code	Procedure
Attaching hardware		

broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Inoperative	A	.....	(1) Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.
(2) - Determine cause and correct prior to repair or replacement of part.

FUEL PRESSURE REGULATORS

FUEL PRESSURE REGULATOR INSPECTION

Condition	Code		Procedure
Contaminated	2	.....	(1) Suggest repair or replacement. Further inspection required.
Inoperative	B	.....	(2) Require repair or replacement.
Leaking (internally or externally)	A	..	Require repair or replacement.
Pressure out of specification	B	..	Require repair or replacement.
Vapor bypass restricted	A	..	Require repair or replacement.

(1) - Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination. Require repair or replacement.
(2) - Inoperative includes intermittent operation or out of OEM specification.

FUEL PUMPS (IN-TANK AND EXTERNAL, ELECTRICAL OR MECHANICAL)

FUEL PUMP (IN-TANK AND EXTERNAL, ELECTRICAL OR MECHANICAL) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require replacement.
Inoperative	A	(3) Require repair or replacement.
Leaking externally (includes pulsator)	A	Require repair or replacement.
Leaking internally (includes pulsator)	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination. Require repair or replacement.
(3) - Inoperative includes intermittent operation.

FUEL RAILS

FUEL RAIL INSPECTION

Condition	Code	Procedure

Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Contaminated	A	(1) Require replacement.
Leaking	A	Require repair or replacement.
Restricted	A	Require repair or replacement.
Rust-pitted	1	Suggest replacement.

(1) - Determine source of contamination. Require repair or replacement.

FUEL RESTRICTORS

See FUEL FILLER NECKS AND RESTRICTORS.

FUEL TANKS

FUEL TANK INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Baffles loose	A	Require repair or replacement.
Contaminated	A	(1) Require repair.
Corroded internally	A	Require repair or replacement.
Distorted, affecting performance	B	Require replacement.
Distorted, not affecting performance	..	No service suggested or required.
Leaking	A	Require repair or replacement.

(1) - Determine source of contamination. Require repair or replacement.

GAS CAPS

GAS CAP INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Fails to maintain proper pressure	A	Require replacement.
Gaskets missing	C	Require replacement.
Leaking	A	Require replacement.

Missing	C	.....	Require replacement.
Plugged (vacuum and pressure relief)	A	.....	Require replacement.
Seals missing	C	.....	Require replacement.

GASKETS

GASKET INSPECTION

Condition	Code	Procedure
Leaking	A	..... (1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

GROMMETS (VALVE COVER)

GROMMET (VALVE COVER) INSPECTION

Condition	Code	Procedure
Leaking	2	..... (1) Suggest repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

HARMONIC DAMPERS

HARMONIC DAMPER INSPECTION

Condition	Code	Procedure
Application incorrect	B	..... Require replacement.
Attaching hardware broken	A	.. Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	.. Require repair or replacement of hardware.
Cracked	A	..... Require replacement.
Dented (fluid type only)	A	..... Require replacement.
Keyway distorted	A	. Require repair or replacement.
Leaking (Fluid damper only)	A	..... Require replacement.
Loose	A	..... Require replacement.
Noisy	A	..... Require replacement.
Outer ring slipped out of position	A	..... Require replacement.
Positioned incorrectly	A	. Require repair or replacement.
Rubber damping material deteriorated	1	..... Suggest replacement.
Seal surface worn, causing a leak	A	. Require repair or replacement.

Threads damaged	A	. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

HEATER CONTROL VALVES

HEATER CONTROL VALVE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Bypassed	A	..... Require replacement.
Coolant leak	A	.. Require repair or replacement.
Malfunctioning	A	..... (1) Require repair or replacement.
Missing	C	..... Require replacement.
Restricted	A	.. Require repair or replacement.
Vacuum leak	A	.. Require repair or replacement.

(1) - Includes inoperative, intermittent operation, or failure to perform all functions.

HEATER CORES

HEATER CORE INSPECTION

Condition	Code	Procedure
Air flow restriction	A	.. Require repair or replacement.
Attaching hardware broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Bypassed	A	.. Require repair or replacement.
Connection leaking	A	.. Require repair or replacement.
Corroded	1	.. Suggest repair or replacement.
Fins damaged, affecting performance	A	.. Require repair or replacement.
Fins damaged, not affecting performance ..	2	.. Suggest repair or replacement.
Internal restrictions, affecting performance ..	A	.. Require repair or replacement.
Leaking	A	.. Require repair or replacement.
Missing	C	..... Require replacement.

HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS

NOTE: When replacing fuel lines and hoses, replace with product that meets or exceeds OEM design specifications.

HOSE AND TUBE COUPLER, CONNECTOR AND CLAMP INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Connected incorrectly	A	Require repair.
Corroded, not reusable	1	Suggest replacement.
Cracked	A	Require replacement.
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Safety clip missing (not leaking)	C	Require replacement of safety clip.
Stripped	A	Require replacement.

HOSE CLAMPS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

HOSE CONNECTORS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

HOSE COUPLERS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY PASS, HEATER, RECOVERY TANK AND OIL COOLERS)

HOSE AND TUBE (FUEL LINE, RADIATOR, VACUUM, BY PASS, HEATER, RECOVERY TANK AND OIL COOLER) INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Connected incorrectly	A	Require repair.
Corroded, not reusable	1	Suggest replacement.
Cracked	A	Require replacement.
Dry-rotted	1	Suggest repair or replacement.
Hard	1	Suggest repair or replacement.
Inner fabric (webbing) damaged	A	Require replacement.
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Maintenance intervals	3	Suggest replacement.
Melted	1	Suggest repair or replacement.
Missing	C	Require replacement.
Outer covering damaged	1	Suggest replacement.
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement.
Protective sleeves		

damaged	2	Suggest replacement of sleeves.
Protective sleeves missing	2	Suggest replacement of sleeves.
Restricted, affecting performance	A	Require repair or replacement.
Restricted, not affecting performance	2	Suggest repair or replacement.
Routed incorrectly	2	Suggest repair or replacement.
Safety clip missing	C	Require replacement.
Spongy	1	Suggest repair or replacement.
Stripped	A	Require replacement.
Swollen	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Type incorrect	1	Suggest repair or replacement.

HOUSINGS

See THERMOSTATS AND HOUSINGS.

IDLE AIR CONTROLS

IDLE AIR CONTROL INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.

Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

IDLE SPEED CONTROL ACTUATORS

IDLE SPEED CONTROL ACTUATOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded,		

affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

IGNITION BOOTS

See IGNITION WIRES, BOOTS, COIL TOWERS AND TERMINALS (SECONDARY).

IGNITION COIL TOWERS

See IGNITION WIRES, BOOTS, COIL TOWERS AND TERMINALS (SECONDARY).

IGNITION COILS

IGNITION COIL INSPECTION

Condition	Code		Procedure
Arcing	A	.....	Require replacement.
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Corroded, affecting performance	A	.....	Require replacement.
Corroded, not affecting performance	2	.....	Suggest replacement.
Distorted	..	....	(2) No service suggested or

			required.
Inoperative	A		(3) Require replacement.
Oil leaking	A		Require replacement.
Out of specification	B		Require replacement.
Terminal broken	A		Require repair or replacement.
Terminal burned, affecting performance	A		(1) Require repair or replacement.
Terminal burned, not affecting performance	2		Suggest repair or replacement.
Terminal corroded, affecting performance	A		Require repair or replacement.
Terminal corroded, not affecting performance	2		Suggest repair or replacement.
Terminal loose, affecting performance	B		Require repair or replacement.
Terminal loose, not affecting performance	1		Suggest repair or replacement.
Wire lead conductors exposed	B		Require repair or replacement.
Wire lead corroded	A		Require repair or replacement.
Wire lead open	A		Require repair or replacement.
Wire lead shorted	A		Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Distortion may be the result of overheating; coil should be tested.
(3) - Inoperative includes intermittent operation.

IGNITION CONTROL MODULES (ICM)

IGNITION CONTROL MODULE (ICM) INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Code set (if applicable)	A	(1) Further inspection required.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(2) Require repair or replacement.
Connector missing	A	Require repair.
Contaminated	A	(3) Require repair or replacement.
Leaking	A	Require repair or replacement.
Malfunctioning	A	(4) Require repair or replacement.
Missing	C	Require replacement.

Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).
(2) - Determine cause and correct prior to repair or replacement of part.
(3) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(4) - Includes inoperative, intermittent operation, or failure to perform all functions.

IGNITION SWITCHES

See SWITCHES.

IGNITION TERMINALS

See IGNITION WIRES, BOOTS, COIL TOWERS AND TERMINALS (SECONDARY).

IGNITION WIRES, BOOTS, COIL TOWERS AND TERMINALS (SECONDARY)

NOTE: You are not required to replace ignition wires in sets. However, you may suggest replacement of the entire secondary wire set for preventive maintenance.

IGNITION WIRE, BOOT, COIL TOWER AND TERMINAL (SECONDARY) INSPECTION

Condition	Code		Procedure
Application incorrect	B	.....	Require replacement.
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Carbon-tracked	A	.....	Require replacement.

Corroded	1	Suggest repair or replacement.
Insulation leaking (shorted)	A	Require repair or replacement.
Metal heat shield bent	2	Suggest repair or replacement.
Missing	C	Require replacement.
Oil-soaked (spongy)	1	Suggest replacement.
Resistance incorrect	B	Require replacement.
Routed incorrectly	2	(1) Suggest repair.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

(1) - If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.
(2) - Determine cause and correct prior to repair or replacement of part.

IN-TANK FUEL STRAINERS

IN-TANK FUEL STRAINER INSPECTION

Condition	Code	Procedure
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Torn	A	Require replacement.

INERTIA FUEL SHUT-OFF SWITCHES

INERTIA FUEL SHUT-OFF SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require replacement.
Inoperative	A	(3) Require repair or

			replacement.
Missing	C		Require replacement.
Terminal broken	A		Require repair or replacement.
Terminal burned, affecting performance	A		(1) Require repair or replacement.
Terminal burned, not affecting performance	2		Suggest repair or replacement.
Terminal corroded, affecting performance	A		Require repair or replacement.
Terminal corroded, not affecting performance	2		Suggest repair or replacement.
Terminal loose, affecting performance	B		Require repair or replacement.
Terminal loose, not affecting performance	1		Suggest repair or replacement.
Wire lead conductors exposed	B		Require repair or replacement.
Wire lead corroded	A		Require repair or replacement.
Wire lead open	A		Require repair or replacement.
Wire lead shorted	A		Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification.

INTAKE AIR TEMPERATURE SENSORS

INTAKE AIR TEMPERATURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting		

performance	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

INTAKE MANIFOLDS

INTAKE MANIFOLD INSPECTION

Condition	Code		Procedure
Corroded, affecting sealability	A	..	Require repair or replacement.
Integrated air or fuel control components inoperative	A	.....	(1) Require repair or replacement.
Internal air or fuel components damaged, affecting performance	A	...	Require repair or replacement of component.
Internal air or fuel components damaged, not affecting performance	..	.....	No service suggested or required.
Internal air or fuel components missing	C	.....	Require replacement of component.
Leaking	A	..	Require repair or replacement.
Out of specification	B	.....	Require replacement.
Restricted	A	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require repair or replacement.

Warped	B	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

INTERCOOLERS

See CHARGE AIR COOLERS "INTERCOOLERS" (CAC).

KNOCK SENSORS

KNOCK SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or

replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

LIQUID VAPOR SEPARATORS

LIQUID VAPOR SEPARATOR INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require repair or replacement.
Leaking	A	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSORS

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.

Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

MASS AIR FLOW (MAF) SENSORS

MASS AIR FLOW (MAF) SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not		

affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

METAL AIR MANIFOLDS AND PIPES

METAL AIR MANIFOLD AND PIPE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require repair of injection tube or replacement of manifold.
Corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold.
Leaking	A	Require repair of injection tube or replacement of manifold.
Loose	A	Require repair.
Missing	C	Require replacement.
Restricted	A	Require replacement of injection tube or manifold.
Threads damaged	A	Require repair.
Threads stripped (threads missing)	A	Require replacement.

METAL AIR PIPES

See METAL AIR MANIFOLDS AND PIPES.

MIX CONTROL SOLENOIDS

MIX CONTROL SOLENOID INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.

(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

MOTOR MOUNTS

MOTOR MOUNT INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Broken	A	Require replacement.
Leaking (hydraulic mount)	A	Require replacement.
Mounting hole worn, affecting performance	A	Require replacement.
Mounting hole worn, not affecting performance	..	No service suggested or required.
Rubber deteriorated, affecting performance	A	Require replacement.
Rubber deteriorated, not affecting performance	..	No service suggested or required.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

O-RINGS, GASKETS, SEALS AND SPRING LOCKS

O-RING, GASKET, SEAL AND SPRING LOCK INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

O2 SENSORS

O2 SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.

Attaching hardware threads stripped (threads missing)	A	..	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	..	(1) Require repair or replacement.
Connector missing	C	..	Require replacement.
Contaminated	A	..	(2) Require repair or replacement.
Inoperative	B	..	(3) Require repair or replacement. Further inspection required.
Leaking	A	..	Require repair or replacement.
Missing	C	..	Require replacement.
Resistance out of specification	B	..	Require repair or replacement.
Restricted, affecting performance	A	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	..	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

OIL PRESSURE SENDING UNITS

OIL PRESSURE SENDING UNIT INSPECTION

Condition	Code		Procedure
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.

Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require repair or replacement.
Leaking	A	Require replacement.
Output signal incorrect	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification.

OIL PUMP PICK-UP SCREENS

OIL PUMP PICK-UP SCREEN INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bypass stuck	A	Require repair or replacement.
Cracked	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Positioned incorrectly	A	Require repair or replacement.
Restricted	A	Require repair or replacement.
Screen torn	A	Require replacement.

OIL PUMPS

OIL PUMP INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement

			of hardware.
Attaching hardware missing	C		Require replacement of hardware.
Attaching hardware not functioning	A		Require repair or replacement of hardware.
Broken	A		Require repair or replacement.
Housing cracked	A		Require repair or replacement.
Leaking	A		Require repair or replacement.
Pressure relief valve stuck	A		Require repair or replacement.
Seized	A		Require repair or replacement.
Worn beyond specifications	B		Require repair or replacement.

PARK NEUTRAL POSITION SWITCHES

PARK NEUTRAL POSITION SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.

Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) – Determine cause and correct prior to repair or replacement of part.
(2) – Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) – Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

PCV BREATHER ELEMENTS

PCV BREATHER ELEMENT INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Leaking	A	Require replacement.
Maintenance intervals	3	Suggest replacement to comply with vehicle's OEM recommended service intervals.
Melted	A	Required replacement.
Missing	C	Require replacement.
Restricted, affecting performance	A	Require replacement.
Restricted, not affecting performance	1	Suggest replacement.
Water-contaminated	A	Require replacement.

PCV ORIFICES

PCV ORIFICE INSPECTION

Condition	Code	Procedure
Leaking	A	Require replacement.
Maintenance interval	3	Suggest repair or replacement to comply with OEM recommended service intervals.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.

PCV VALVES

PCV VALVE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Grommet broken	A	Require repair or replacement of grommet.
Grommet missing	C	Require replacement of grommet.
Grommet not functioning	A	Require repair or replacement of grommet.
Inoperative	A	(1) Require replacement.
Leaking	A	Require replacement.
Maintenance interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals.
Missing	C	Require replacement.
Restricted	A	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

PICK-UP ASSEMBLIES (INCLUDES MAGNETIC, HALL EFFECT AND OPTICAL)

PICK-UP ASSEMBLY (MAGNETIC, HALL EFFECT AND OPTICAL) INSPECTION

Condition	Code	Procedure
Adjustment incorrect	B	Require repair.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	B	(2) Require replacement.
Oil-soaked	A	Require replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded,		

affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) – Determine cause and correct prior to repair or replacement of part.
(2) – Inoperative includes intermittent operation or out of OEM specification. Refer to OEM recommended service' procedures.

POWER STEERING PRESSURE SENSORS

POWER STEERING PRESSURE SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.

Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

POWERTRAIN CONTROL MODULES (PCM) AND PROM

POWERTRAIN CONTROL MODULE (PCM) AND PROM INSPECTION

Condition	Code		Procedure
Application incorrect	B	.....	Require replacement.
Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware threads damaged	A	...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	...	Require repair or replacement of hardware.
Code set (if applicable)	A	.....	(1) Further inspection required.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(2) Require repair or replacement.
Connector missing	A	.....	Require repair.
Contaminated	A	.....	(3) Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Malfunctioning	A	.....	(4) Require repair or replacement.
Missing	C	.....	Require replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(2) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.

Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) – Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).
(2) – Determine cause and correct prior to repair or replacement of part.
(3) – Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(4) – Includes inoperative, intermittent operation, failure to perform all functions, or out of OEM specification.

POWERTRAIN CONTROL PROM

See POWERTRAIN CONTROL MODULES (PCM) AND PROM.

PRESSURIZED EXPANSION TANK CAPS

See RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS.

RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS

RADIATOR CAP AND PRESSURIZED EXPANSION TANK CAP INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Coolant recovery check valve inoperative	A	(1) Require replacement.
Fails to maintain proper pressure	B	Require replacement.
Gasket missing	C	Require replacement of gasket.
Missing	C	Require replacement.
Seal missing	C	Require replacement of seal.

(1) – Inoperative includes intermittent operation or out of OEM specification.

RADIATOR FAN BLADES

RADIATOR FAN BLADE INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Attaching hardware		

Condition	Code	Procedure
broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.

RADIATOR FAN CLUTCHES

NOTE: Some lateral movement, measured at the fan blade tip, may be normal.

RADIATOR FAN CLUTCH INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bearing noisy	A	Require replacement.
Bearing worn	A	Require replacement.
Fastener loose	A	Require repair or replacement of fastener.
Inoperative	A	(1) Require replacement.
Leaking	1	Suggest replacement.
Seized	A	Require replacement.
Slips (insufficient fan speed)	A	Require replacement.
Thermal control incorrect	B	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

RADIATORS

RADIATOR INSPECTION

Condition	Code	Procedure
Air flow restriction	A	Require repair.
Application incorrect	B	Require replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.

Attaching hardware not functioning	A	..	Require repair or replacement of hardware.
Connection leaking	A	..	Require repair or replacement.
Corroded	1	..	Suggest repair or replacement.
Fins damaged, affecting performance	A	..	Require repair or replacement.
Fins damaged, not affecting performance	2	..	Suggest repair or replacement.
Internal oil cooler leaking	A	..	Require repair or replacement.
Internal restrictions, affecting performance	B	..	Require repair or replacement.
Internal restrictions, not affecting performance	2	..	Suggest repair or replacement.
Leaking	A	..	Require repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require repair or replacement.
Tubes damaged, affecting performance	A	..	Require repair or replacement.
Tubes damaged, not affecting performance	..	..	No service suggested or required.

ROLL OVER VALVES

ROLL OVER VALVE INSPECTION

Condition	Code	Procedure
Inoperative	A	(1) Require replacement.
Leaking	A	Require replacement.
Missing	C	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

SEALING COMPOUNDS

SEALING COMPOUND INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

SEALS

SEAL INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and

repair or replace as necessary.

SECONDARY AIR INJECTION SYSTEM MANAGEMENT DEVICES

SECONDARY AIR INJECTION SYSTEM MANAGEMENT DEVICE INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or

replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

SENSORS AND ACTUATORS

NOTE: Conditions pertaining to the sensors and actuators listed in this section may be found under the name of the sensor or actuator.

SENSOR ABBREVIATION TABLE

Sensor	Abbreviation
Accelerator Pedal Position Sensor	APP
Air Conditioning Cycling Switch	AC
Air Conditioning Pressure Sensor	..
Air Fuel Ratio Sensor	..
Barometric Pressure Sensor	BARO
Camshaft Position Sensor	CMP
Clutch Pedal Position Switch	CPP
Cooling Fan Motor Sensors and Switches	..
Crankshaft Position Sensor	CKP
Electronic Transmission Feedback Devices	..
Engine Coolant Temperature Sensor	ECT
Evaporative Emission feedback devices	..
Exhaust Gas Recirculation feedback devices	..
Fan Control Sensor	FC
Intake Air Temperature Sensor	IAT
Knock Sensor	KS
Manifold Absolute Pressure Sensor	MAP
Mass Air Flow Sensor	MAF
O2 Sensor	O2S
Park Neutral Position Switch	PNP
Power Steering Pressure Sensor	PSP
Thermal Vacuum Valve	TVV
Throttle Position Sensor	TP Sensor
Throttle Position Switch	..
Transmission Range Switch	TR Switch
Vehicle Speed Sensor	VSS
Volume Air Flow Sensor	VAF

ACTUATOR ABBREVIATION TABLE

Actuator	Abbreviation
Air Injection Control Solenoid	..
Electronic Transmission control devices	..
Evaporative Emission Canister	EVAP
Purge Device	..
Exhaust Gas Recirculation Device	EGR
Fuel Injector	..
Idle Air Control	IAC
Idle Speed Control Actuator	ISC
Mix Control Solenoid	MC Solenoid
Secondary Air Injection System Management Device	AIR, PAIR
Vacuum Regulator Solenoid	..
Waste Gate Control Solenoid	..

SHROUDS, BAFFLES AND DEFLECTORS

SHROUD, BAFFLE AND DEFLECTOR INSPECTION

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent, affecting cooling system performance	A	Require repair or replacement.
Blocked, affecting cooling system performance	A	Require repair or replacement.
Broken, affecting cooling system performance	A	Require repair or replacement.
Cracked, affecting cooling system performance	A	Require repair or replacement.
Loose, affecting cooling system performance	A	Require repair.
Loose, not affecting cooling system performance	2	Suggest repair.
Missing, affecting cooling system performance	C	Require replacement.

SPARK PLUGS

NOTE: You are not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.

SPARK PLUG INSPECTION

Condition	Code	Procedure
Application incorrect	B	Require replacement.
Electrode eroded	1	Suggest replacement.
Fouled	A	(1) Require repair or replacement.
Gap incorrect	B	Require repair or replacement.
Insulation broken	A	Require replacement
Insulator cracked	A	Require replacement.
Leaking compression	A	Require repair or replacement.
Maintenance interval	3	Suggest replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause of fouling and suggest repair.

SPRING LOCKS

SPRING LOCK INSPECTION

Condition	Code	Procedure
Leaking	A	(1) Require repair or replacement.

(1) - Require inspection of mating and sealing surface and repair or replace as necessary.

SUPER CHARGERS

SUPER CHARGER INSPECTION

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Bearing noisy	A	Require replacement.
Bearing worn	A	Require replacement.
Boost pressure incorrect	A	(1) Require repair or replacement.
Clearance out of specification	B	Require repair or replacement.
Leaking	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Boost pressure problems may be caused by other systems or components.

SWITCHES

SWITCH INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding, affecting performance	A	Require repair or replacement.
Binding, not affecting performance	2	Suggest repair or replacement.
Broken	A	Require repair or replacement.
Burned, affecting		

performance	A	(1) Require repair or replacement.
Burned, not affecting performance	2	(1) Suggest repair or replacement.
Cracked, affecting performance	A ..	Require repair or replacement.
Cracked, not affecting performance	1 ..	Suggest repair or replacement.
Leaking	A ..	Require repair or replacement.
Malfunctioning	A	(2) Require repair or replacement.
Melted, affecting performance	A	(1) Require repair or replacement.
Melted, not affecting performance	2	(1) Suggest repair or replacement.
Missing	C	Require replacement.
Out of adjustment	B ..	Require repair or replacement.
Terminal broken	A ..	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A ..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal loose, affecting performance	B ..	Require repair or replacement.
Terminal loose, not affecting performance ..	1 ..	Suggest repair or replacement.
Won't return	A ..	Require repair or replacement.
Worn	1	Suggest replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Includes inoperative, intermittent operation, or failure to perform all functions.

THERMAL VACUUM VALVES

THERMAL VACUUM VALVE INSPECTION

Condition	Code	Procedure
Connector broken	A ..	Require repair or replacement.
Connector (Weatherpack type) leaking	A ..	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A ..	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of		

specification	B ..	Require repair or replacement.
Restricted, affecting performance	A ..	Require repair or replacement.
Terminal broken	A ..	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A ..	Require repair or replacement.
Terminal corroded, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal loose, affecting performance	B ..	Require repair or replacement.
Terminal loose, not affecting performance ..	1 ..	Suggest repair or replacement.
Threads damaged	A ..	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B ..	Require repair or replacement.
Wire lead corroded	A ..	Require repair or replacement.
Wire lead open	A ..	Require repair or replacement.
Wire lead shorted	A ..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

THERMOSTATIC AIR DOOR ASSEMBLIES

THERMOSTATIC AIR DOOR ASSEMBLY INSPECTION

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A ...	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Binding	A ..	Require repair or replacement.
Leaking	A ..	Require repair or replacement.
Missing	C	Require replacement.
Seized	A ..	Require repair or replacement.

THERMOSTATS AND HOUSINGS

THERMOSTAT AND HOUSING INSPECTION

Condition	Code	Procedure
Application incorrect ...	B	Require replacement.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware corroded	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Housing corroded	1	Suggest replacement of housing.
Inoperative	A	(1) Require replacement.
Installation incorrect	B	Require repair or replacement.
Leaking	A	Require repair or replacement.
Thermostat missing	C	Require replacement of thermostat.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

THROTTLE BODIES

THROTTLE BODY INSPECTION

Condition	Code	Procedure
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Leaking	A	Require repair or replacement.
Restricted	A	(3) Require repair.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.
Throttle shaft binding, affecting performance	A	Require repair or replacement.
Throttle shaft worn, affecting performance	A	Require repair or replacement.

Throttle shaft worn, not affecting performance	1	Suggest repair or replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Some components may be serviceable; check for accepted cleaning procedure.

THROTTLE CABLES

See THROTTLE LINKAGES AND CABLES.

THROTTLE LINKAGES AND CABLES

THROTTLE LINKAGE AND CABLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require repair or replacement.
Binding	A	Require repair or replacement.
Bracket bent, affecting performance	A	Require repair or replacement.
Bracket bent, not affecting performance		No service suggested or required.
Bracket broken, affecting performance	A	Require replacement.
Bracket broken, not affecting performance		No service suggested or required.
Bracket corroded, affecting performance	A	Require repair or replacement.
Bracket corroded, not affecting performance	2	Suggest repair or replacement.
Bracket cracked, affecting performance	A	Require repair or replacement.
Bracket cracked, not affecting performance	1	Suggest repair or replacement.
Bracket loose, affecting performance	A	Require repair or replacement.
Bracket loose, not affecting performance	1	Suggest repair or replacement.
Bracket missing	C	Require replacement.
Broken	A	Require replacement.
Cracked	A	Require repair or replacement.

Disconnected	A	Require repair or replacement.
Kinked	A	Require repair or replacement.
Melted	A	Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	(1) Require repair or replacement.
Routed incorrectly	2	Suggest repair.
Seized	A	Require repair or replacement.

(1) - Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.

THROTTLE POSITION SENSORS

THROTTLE POSITION SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.

Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

THROTTLE POSITION SWITCHES

THROTTLE POSITION SWITCH INSPECTION

Condition	Code		Procedure
Attaching hardware missing	C	..	Require replacement of hardware.
Attaching hardware threads damaged	A	..	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	..	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	..	(1) Require repair or replacement.
Connector missing	C	..	Require replacement.
Inoperative	B	..	(2) Require repair or replacement. Further inspection required.
Missing	C	..	Require replacement.
Resistance out of specification	B	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	..	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	..	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

TIMING BELT SPROCKETS

TIMING BELT SPROCKET INSPECTION

Condition	Code	Procedure
Alignment incorrect	B	Require repair.
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Bent	A	Require replacement.
Cracked	A	Require replacement.
Key damaged	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Pulley damaged, affecting belt life	A	Require replacement.
Sprocket damaged, affecting belt life	A	Require repair or replacement.
Sprocket loose	B	Require repair or replacement.
Sprocket-to-shaft alignment incorrect	B	Require repair or replacement.

TIMING BELTS

TIMING BELT INSPECTION

Condition	Code	Procedure
Adjustment incorrect	2	(1) Suggest adjustment.
Alignment incorrect	B	(2) Further inspection required.
Broken	A	Require replacement.
Cam timing out of specification	B	Require repair.
Cracked	1	Suggest replacement.
Fluid-soaked	1	Suggest replacement. Further inspection required.
Frayed	1	Suggest replacement.
Maintenance intervals	3	Suggest replacement to comply with vehicle OEM recommended service intervals.
Missing	C	(3) Require replacement.
Noisy	2	(4) Further inspection required. See note below.
Plies separated	A	Require replacement.
Tension out of		

Condition	Code	Procedure
specification	B	Require adjustment or replacement.
Teeth missing	A	Require replacement.

(1) - Inspect belt tensioners, pulleys, and cover.
(2) - Determine cause of incorrect alignment and require repair.
(3) - CAUTION: Internal engine damage may result from timing belt damage/failure.
(4) - Determine cause of noise and suggest repair.

TORQUE STRUTS

TORQUE STRUT INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Binding	A	Require replacement.
Body dented	A	(1) Further inspection required.
Body punctured	A	Require replacement.
Bushing deteriorated, affecting performance	A	Require replacement.
Bushing deteriorated, not affecting performance	..	No service suggested or required.
Bushings missing	C	Require replacement.
Bushings separated from mounting eye	1	Suggest replacement.
Damping (none)	A	Require replacement.
Leaking oil, enough for fluid to be running down the body	A	Require replacement.
Missing	C	Require replacement.
Noisy	2	(2) Further inspection required.
Piston rod bent	A	Require replacement.
Piston rod broken	A	Require replacement.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Require replacement of units where dents restrict strut piston rod movement. If dents don't restrict movement, no service is suggested or required.
(2) - If noise is isolated to shock or strut, suggest replacement.

TRANSMISSION RANGE SWITCHES

TRANSMISSION RANGE SWITCH INSPECTION

Condition	Code	Procedure

Attaching hardware missing	C	.....	Require replacement of hardware.
Attaching hardware threads damaged	A	...	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	...	Require repair or replacement of hardware.
Connector broken	A	..	Require repair or replacement.
Connector (Weatherpack type) leaking	A	..	Require repair or replacement.
Connector melted	A	.....	(1) Require repair or replacement.
Connector missing	C	.....	Require replacement.
Contaminated	A	.....	(2) Require repair or replacement.
Inoperative	B	.....	(3) Require repair or replacement. Further inspection required.
Leaking	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Resistance out of specification	B	..	Require repair or replacement.
Terminal broken	A	..	Require repair or replacement.
Terminal burned, affecting performance	A	.....	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	..	Suggest repair or replacement.
Terminal corroded, affecting performance	A	..	Require repair or replacement.
Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Threads damaged	A	..	Require repair or replacement.
Threads stripped (threads missing)	A	.....	Require replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

TUBE CLAMPS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

TUBE CONNECTORS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

TUBE COUPLERS

See HOSE AND TUBE COUPLERS, CONNECTORS AND CLAMPS.

TUBES

See HOSES AND TUBES (FUEL LINES, RADIATOR, BY PASS, HEATER, RECOVERY TANK AND OIL COOLERS).

TURBO CHARGERS

TURBO CHARGER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Boost pressure incorrect	A	(1) Require repair or replacement.
Leaking	A	Require repair or replacement.
Noisy	2	Suggest repair or replacement.
Oil seal (internal) leaking	A	Require repair or replacement.
Vibrates	A	Require repair or replacement.

(1) - Boost pressure problems may be caused by other systems or components.

VACUUM CONNECTIONS

See VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC).

VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)

VACUUM HOSE, TUBE AND CONNECTION (NON-METALLIC) INSPECTION

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Melted	A	Require replacement.
Missing	C	Require replacement.
Oil-soaked (spongy)	1	Suggest replacement.
Restricted	A	Require repair or replacement.
Surface cracks (dry-rotted)	1	Suggest replacement.

VACUUM REGULATOR SOLENOIDS

VACUUM REGULATOR SOLENOID INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

VACUUM TUBES

See VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC).

VEHICLE SPEED SENSORS

VEHICLE SPEED SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or

replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

VOLUME AIR FLOW SENSORS

VOLUME AIR FLOW SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.
Wire lead shorted	A	Require repair or replacement.

(1) - Determine cause and correct prior to repair or

replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

WASTE GATE CONTROL SOLENOIDS

WASTE GATE CONTROL SOLENOID INSPECTION

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware threads damaged	A	Require repair or replacement of hardware.
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware.
Connector broken	A	Require repair or replacement.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Contaminated	A	(2) Require repair or replacement.
Inoperative	B	(3) Require repair or replacement. Further inspection required.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Resistance out of specification	B	Require repair or replacement.
Restricted, affecting performance	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance	2	Suggest repair or replacement.
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	2	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Wire lead conductors exposed	B	Require repair or replacement.
Wire lead corroded	A	Require repair or replacement.
Wire lead open	A	Require repair or replacement.

Wire lead shorted	A ..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.
(3) - Inoperative includes intermittent operation or out of OEM specification. Some components may be serviceable; check for accepted cleaning procedure.

WASTE GATES AND BOOST CONTROL MECHANISMS

WASTE GATE AND BOOST CONTROL MECHANISM INSPECTION

Condition	Code	Procedure
Boost pressure incorrect	A	(1) Require repair or replacement. Further inspection required.
Leaking	A ..	Require repair or replacement.

(1) - Incorrect boost pressure includes intermittent operation or out of OEM specification.

WATER PUMPS (ELECTRIC)

WATER PUMP (ELECTRIC) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A ...	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A ...	Require repair or replacement of hardware.
Connector broken	A ..	Require repair or replacement.
Connector (Weatherpack type) leaking	A ..	Require repair or replacement.
Connector melted	A	(1) Require repair or replacement.
Connector missing	C	Require replacement.
Inoperative	A	(2) Require replacement.
Leaking	A ..	Require repair or replacement.
Missing	C	Require replacement.
Noisy	2	Suggest replacement.
Rotation incorrect for application	B ..	Require repair or replacement.
Terminal broken	A ..	Require repair or replacement.
Terminal burned, affecting performance	A	(1) Require repair or replacement.
Terminal burned, not affecting performance ..	2 ..	Suggest repair or replacement.
Terminal corroded, affecting performance ..	A ..	Require repair or replacement.

Terminal corroded, not affecting performance	2	..	Suggest repair or replacement.
Terminal loose, affecting performance	B	..	Require repair or replacement.
Terminal loose, not affecting performance	1	..	Suggest repair or replacement.
Vibration	1	....	Suggest replacement.
Wire lead conductors exposed	B	..	Require repair or replacement.
Wire lead corroded	A	..	Require repair or replacement.
Wire lead open	A	..	Require repair or replacement.
Wire lead shorted	A	..	Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.
(2) - Check fan motor/controls. Inoperative includes intermittent operation or out of OEM specification.

WATER PUMPS (NON-ELECTRIC)

WATER PUMP (NON-ELECTRIC) INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require repair or replacement of hardware.
Attaching hardware corroded	A	...	Require repair or replacement of hardware.
Attaching hardware missing	C	....	Require replacement of hardware.
Attaching hardware not functioning	A	...	Require repair or replacement of hardware.
Corrosion (internal) is excessive, affecting performance	A	....	Require replacement.
Corrosion (internal) is excessive, not affecting performance	2	.	Suggest cooling system service.
Inoperative	A	.....	(1) Require replacement.
Leaking	A	....	Require replacement.
Noisy	A	....	Require replacement.
Rotation incorrect for application	B	..	Require repair or replacement.
Shaft bent	A	....	Require replacement.

(1) - Inoperative includes intermittent operation or out of OEM specification.

WIRING HARNESSES AND CONNECTORS

WIRING HARNESS AND CONNECTOR INSPECTION

Condition	Code		Procedure
Application incorrect	B	..	Require repair or replacement.
Attaching hardware			

broken	A	... Require repair or replacement of hardware.
Attaching hardware missing	C	..... Require replacement of hardware.
Attaching hardware not functioning	A	... Require repair or replacement of hardware.
Connector broken	A	.. Require repair or replacement.
Connector (Weatherpack type) leaking	A	.. Require repair or replacement.
Connector melted	A	..... (1) Require repair or replacement.
Connector missing	C	..... Require replacement.
Insulation damaged, conductors exposed	A	.. Require repair or replacement.
Insulation damaged, conductors not exposed .	1	..... Suggest replacement.
Open	A	.. Require repair or replacement.
Protective shield (conduit) melted	2	..... (1) Suggest repair or replacement.
Protective shield (conduit) missing	2	.. Suggest repair or replacement.
Resistance (voltage drop) out of specification ...	A	.. Require repair or replacement.
Routed incorrectly	B	..... Require repair.
Secured incorrectly	B	..... Require repair.
Shorted	A	.. Require repair or replacement.
Terminal broken	A	.. Require repair or replacement.
Terminal burned, affecting performance	A	..... (1) Require repair or replacement.
Terminal burned, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal corroded, affecting performance ..	A	.. Require repair or replacement.
Terminal corroded, not affecting performance ..	2	.. Suggest repair or replacement.
Terminal loose, affecting performance	B	.. Require repair or replacement.
Terminal loose, not affecting performance ..	1	.. Suggest repair or replacement.
Voltage drop out of specification	A	.. Require repair or replacement.

(1) - Determine cause and correct prior to repair or replacement of part.

* EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Exhaust Systems January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

CONTENTS

Motorist Assurance Program (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM
OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

Exhaust

CATALYTIC CONVERTERS
EXHAUST AND TAIL PIPES
EXHAUST CONNECTIONS
HANGERS
HEAT RISERS (MECHANICAL EFE DEVICES)
HEAT SHIELDS
MANIFOLDS (CAST AND TUBE TYPE)
MECHANICAL EFE DEVICES
MUFFLERS AND RESONATORS

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above, standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested." In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer’s best interest, and at his or her choice given the options available.

This section lists the various parts and the conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer’s recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the

function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 – To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 – To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)

4 - Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

EXHAUST

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

WARNING: Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.

NOTE: Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.

CATALYTIC CONVERTERS

CAUTION: Before working on an exhaust system, review EPA regulations on removing and replacing catalytic converters.

NOTE: Any time a converter has failed, further diagnosis is required to determine the reason(s) for converter failure.

CATALYTIC CONVERTER INSPECTION

Condition	Code	Procedure
Air injection tube broken	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube burnt	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube leaking	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube loose	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube restricted	A	Require repair or replacement of injection tube or replacement of catalytic converter.

Condition	Code	Procedure
Air injection tube threads damaged	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube threads stripped (threads missing)	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Body cracked	B	Require repair or replacement.
Converter empty	A	Require repair or replacement.
Converter fill plug missing	C	Require repair or replacement.
Converter missing	C	Require replacement.
Exhaust gases leaking	A	Require repair or replacement.
Flanges leaking	A	Require repair or replacement of flanges.
Inlet pipes cracked	B	Require repair or replacement.
Internal rattle (except pellet-type)	2	(1) Further inspection required.
Mounting brackets that are part of converter broken	A	Require repair or replacement.
Obvious overheating	..	(2) Require testing of converter.
Outlet pipes cracked	B	Require repair or replacement.
Pieces of catalyst material found downstream	1	Suggest replacement.
Plugged	A	(3) Require replacement.
Testing has determined that existing converter has been lead-poisoned, contaminated, or failed testing	A	Require repair or replacement.

(1) - If the converter is breaking up, suggest converter replacement. If an object has fallen into the converter, remove the object.
(2) - Overheating is caused by something other than the converter. Further diagnosis is required to determine the cause of the overheating.
(3) - Determine cause and correct to ensure that new converter will not become plugged.

EXHAUST AND TAIL PIPES

NOTE: For pipes with resonators, also see MUFFLERS AND RESONATORS.

EXHAUST AND TAIL PIPE INSPECTION

Condition	Code	Procedure
Bracket broken	A	Require repair or replacement.
Pipe bent out of position	B	Require repair or replacement.
Pipe broken	A	Require repair or replacement.
Pipe cracked	B	Require repair or replacement.
Pipe leaking	A	Require replacement.

Pipe missing	C	Require replacement.
Pipe plugged	A	Require replacement.
Pipe weak due to corrosion, but no leaks present	1	Suggest replacement.
Weld broken	A ..	Require repair or replacement.

EXHAUST CONNECTIONS

EXHAUST CONNECTION INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement of hardware.
Clamp broken	A	Require replacement.
Clamp loose	A .	Require repair or replacement.
Clamp missing	C	Require replacement.
Corroded, affecting structural integrity ...	1	Suggest replacement.
Incorrect type (i.e. flange, ball & socket etc.)	B	Require replacement.
Leaking	A	Require repair.
Loose	A	Require repair.

HANGERS

HANGER INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement.
Corroded, affecting structural integrity ...	1	Suggest replacement.
Incorrect type	B	Require replacement.
Loose	A ..	Require repair or replacement.
Missing	C	Require replacement.
Out of position	B ..	Require repair or replacement.
Rubber deteriorated	1	Suggest replacement.

HEAT RISERS (MECHANICAL EFE DEVICES)

HEAT RISER (MECHANICAL EFE DEVICE) INSPECTION

Condition	Code	Procedure
Broken	A	Require replacement of affected parts.
Diaphragm inoperative ...	A	(1) Require replacement.
Leaking	A ..	Require repair or replacement.
Noisy	2 ...	Suggest repair or replacement of affected parts.
Seized	A ...	Require repair or replacement of affected parts.
Spring broken	B	Require replacement of spring(s).
Spring inoperative	A	Require replacement of spring(s).

(1) - If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heat riser.

HEAT SHIELDS

HEAT SHIELD INSPECTION

Condition	Code	Procedure
Bent	B	Require repair or replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	1	Suggest replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.

MANIFOLDS (CAST AND TUBE TYPE)

MANIFOLD (CAST AND TUBE TYPE) INSPECTION

Condition	Code	Procedure
Air injection tube in manifold broken	A	Require repair or replacement of injection tube or replacement of manifold.
Air injection tube in manifold corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold.
Air injection tube in manifold leaking	A	Require repair or replacement of injection tube or replacement of manifold.
Air injection tube in manifold loose	A	Require repair.
Air injection tube in manifold restricted	A	Require replacement of injection tube or manifold.
Air injection tube in manifold threads damaged	A	Require repair of injection tube or manifold.
Air injection tube in manifold threads stripped (threads missing)	A	Require replacement of injection tube or manifold.
Bolt broken	A	Require replacement of bolts.
Bolt loose	A	Require tightening or replacement of bolts.
Bolt missing	C	Require replacement of bolts.
Corroded, affecting sealability	A	Require repair or replacement.
Cylinder head threads stripped	A	Require repair or replacement of cylinder head.
Gasket leaking	A	Require tightening or

			replacement of gasket.
Heat stove bent	B	.....	(1) Require repair or replacement of stove.
Heat stove broken	A	.....	(1) Require replacement of stove.
Heat stove corroded, affecting structural integrity	1	.....	(1) Suggest replacement of stove.
Heat stove missing	C	.....	(1) Require replacement of stove.
Manifold broken	A	..	Require repair or replacement.
Manifold cracked	B	..	Require repair or replacement.
Manifold warped	A	..	Require repair or replacement.
Out of specification	B	..	Require repair or replacement.
Stud broken	A	....	Require replacement of stud.
Stud missing	C	....	Require replacement of stud.
Stud threads damaged	A	...	Require repair or replacement of stud.
Stud threads stripped (threads missing)	A	....	Require replacement of stud.

(1) - Stove may not be available separately; this may require replacement of manifold.

MECHANICAL EFE DEVICES

See HEAT RISERS (MECHANICAL EFE DEVICES).

MUFFLERS AND RESONATORS

MUFFLER AND RESONATOR INSPECTION

Condition	Code		Procedure
Body shell distorted, affecting performance or structural integrity ...	A	.....	Require replacement.
Corrosion hole	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Mounting bracket broken .	A	..	Require repair or replacement.
Mounting bracket cracked	B	..	Require repair or replacement.
Nipple cracked	A	..	Require repair or replacement.
Nipple loose	B	.....	Require replacement.
Outer wrap peeling (exhaust not leaking) ..	1	.....	Suggest replacement.
Plugged	A	.....	Require replacement.
Puncture (other than a drain hole)	A	.....	Require replacement.
Rattling or knocking noise from inside muffler	B	.....	Require replacement.
Seam open (exhaust leaking)	A	.....	Require replacement.
Sound quality unsatisfactory	2	..	Suggest replacement to address customer need and/or request.
Split (exhaust leaking) .	A	.....	Require replacement.
Weak due to corrosion, but no leaks present	1	.....	Suggest replacement.

GEAR TOOTH CONTACT PATTERNS

1999 Lexus RX 300

GENERAL INFORMATION
Gear Tooth Contact Patterns

*** PLEASE READ THIS FIRST ***

The following article is for GENERAL INFORMATION purposes only. Information does not SPECIFICALLY apply to all years, makes and models, but is to be used as a general reference guide.

INSPECTION

PRELIMINARY INSPECTION

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing, and check backlash at several points around ring gear. Backlash must be within specifications at all points. If no defects are found, check gear tooth contact pattern.

GEAR TOOTH CONTACT PATTERN

NOTE: Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.

1) Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate ring gear until clear tooth contact pattern is obtained.

2) Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear and pinion must be maintained within specified limits, until correct tooth pattern is obtained.

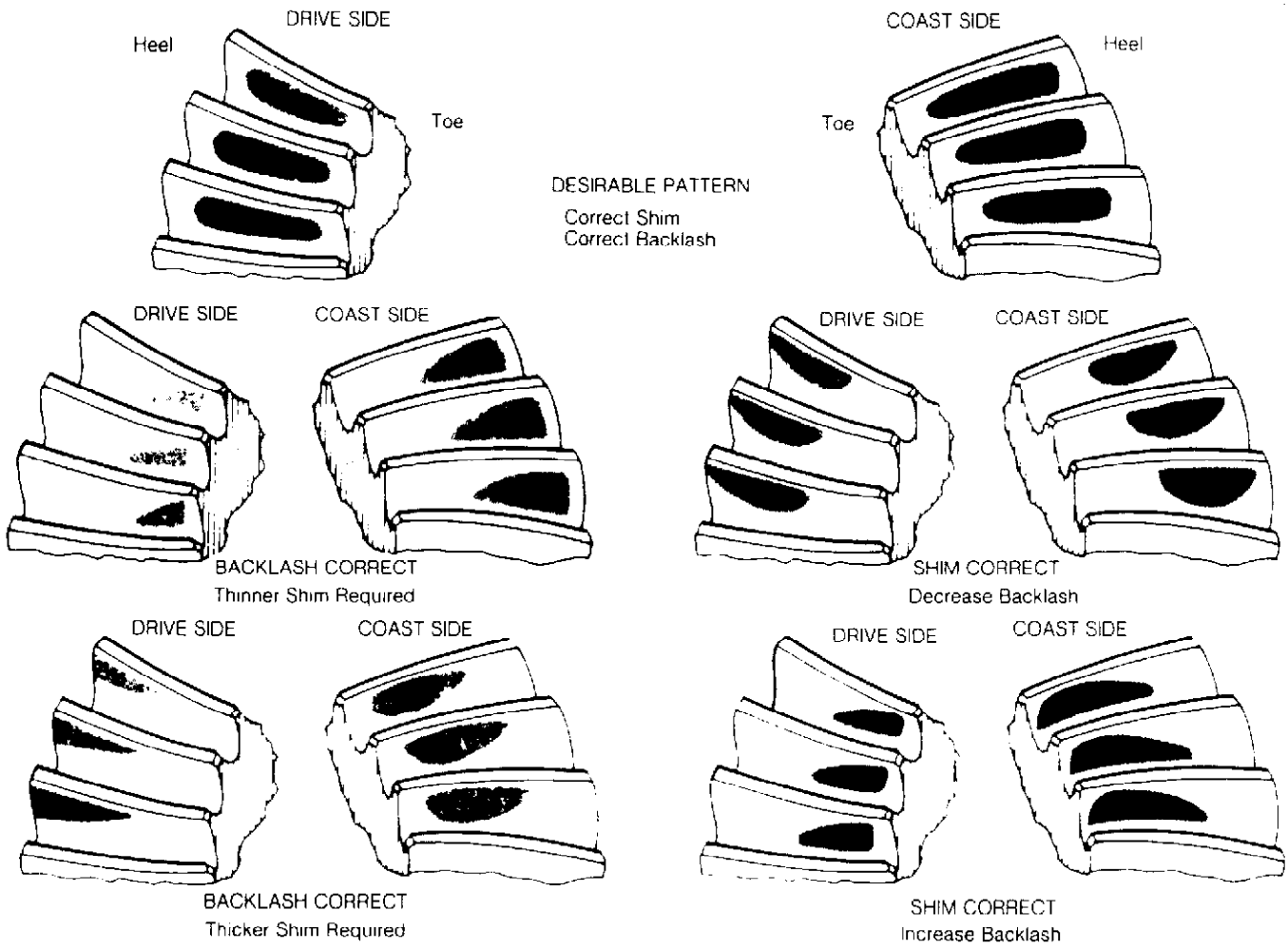


Fig. 1: Drive Axle Gear Tooth Patterns

ADJUSTMENTS

GEAR BACKLASH & PINION SHIM CHANGES

NOTE: Backlash is adjusted by either moving shims from one side of differential case to the other or by turning adjusting nuts on which side bearing races ride. Changing of pinion shims alters the distance from face of pinion of centerline of ring gear.

1) With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.

2) With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.

3) With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Drive pattern moves toward heel and top of tooth, and coast pattern moves toward heel and top of tooth.

4) With no change in pinion shim thickness, decrease in

backlash moves ring gear closer to pinion gear. Drive pattern moves toward toe and bottom of tooth, and coast pattern moves toward toe and bottom of tooth.

GENERAL COOLING SYSTEM SERVICING

1999 Lexus RX 300

GENERAL INFORMATION
General Cooling System Servicing

* PLEASE READ THIS FIRST *

The following article is for general information only. Information may not apply to all years, makes and models. See specific article in the ENGINE COOLING section.

DESCRIPTION

The basic liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the block and cylinder head.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines will have 2, one in each bank of cylinders.

CLEANING

A good cleaning compound removes most rust and scale. Follow manufacturer's instructions in the use of cleaner. If considerable rust and scale has to be removed, cooling system should be flushed. Clean radiator air passages with compressed air.

FLUSHING

CAUTION: Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.

Back Flushing
Back flushing is an effective means of removing cooling system rust and scale. The radiator, engine and heater core should be flushed separately.

Radiator
To flush radiator, connect flushing gun to water outlet of radiator and disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

Engine
To flush engine, remove thermostat and replace housing. Connect flushing gun to water outlet of engine. Flush using short air bursts until water runs clean.

Heater Core
Flush heater core as described for radiator. Ensure heater control valve is set to maximum heat position before flushing heater.

REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

TESTING

THERMOSTAT

1) Visually inspect thermostat for corrosion and proper sealing of valve and seat. If okay, suspend thermostat and thermometer in a 50/50 mixture of coolant and water. See Fig. 1. Do not allow thermostat or thermometer to touch bottom of container. Heat water until thermostat just begins to open.

2) Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully opened temperature. If either reading is not to specification, replace thermostat.

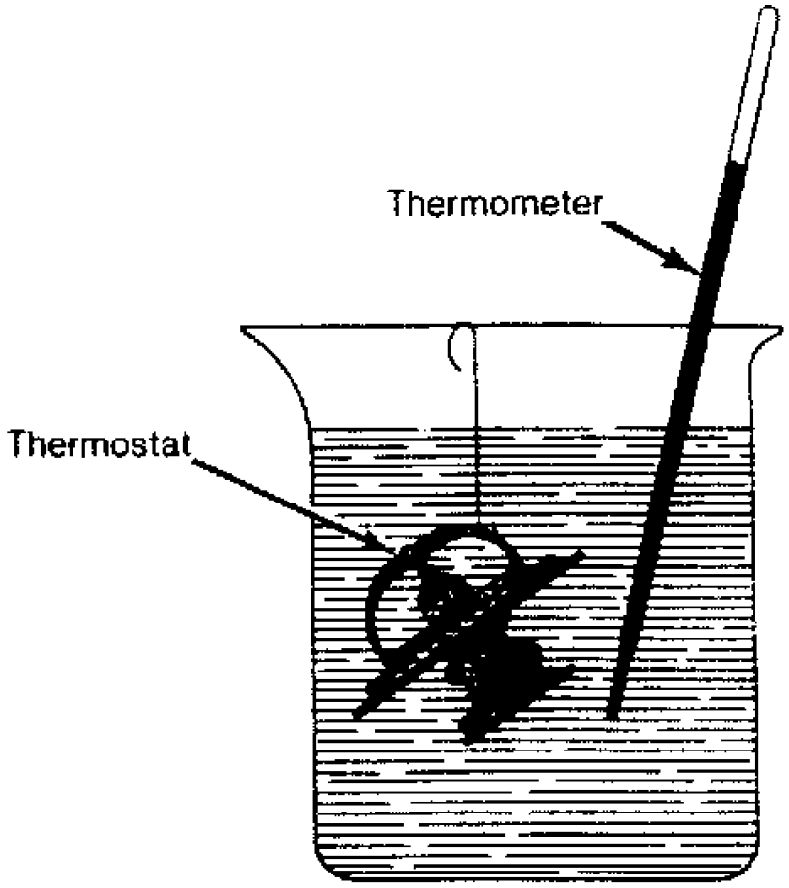


Fig. 1: Testing Thermostat in Anti-Freeze/Water Solution

PRESSURE TESTING

A pressure tester is used to check both radiator cap and

complete cooling system. Test components as follows, following tool manufacturer's instructions.

Radiator Cap

Visually inspect radiator cap, then dip cap into water and connect to tester. Pump tester to bring pressure to upper limit of cap specification. If cap fails to hold pressure, replace cap.

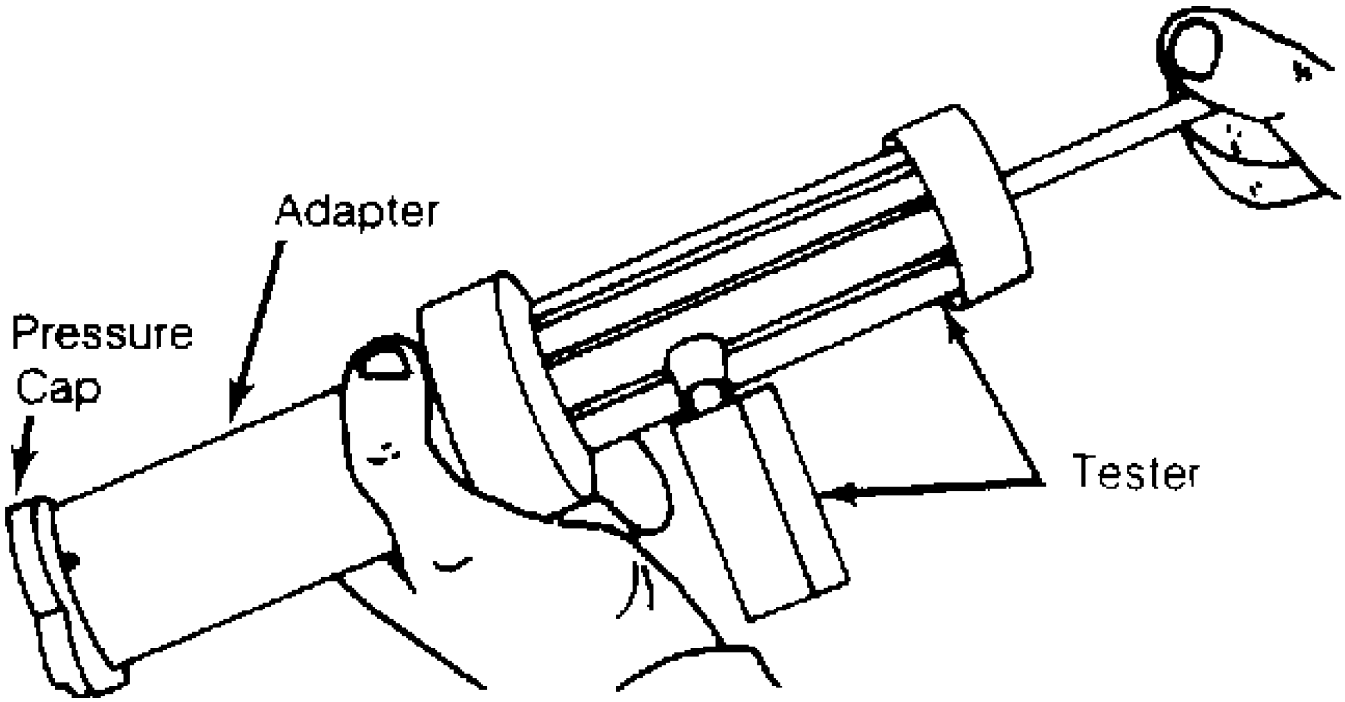


Fig. 2: Testing Radiator Pressure Cap

Cooling System

1) With engine off, wipe radiator filler neck seat clean. Fill radiator to correct level. Attach tester to radiator and pump until pressure is at upper level of radiator rating.

2) If pressure drops, inspect for external leaks. If no leaks are apparent, detach tester and run engine until normal operating temperature is reached. Reattach tester and observe. If pressure builds up immediately, a possible leak exists from a faulty head gasket or crack in head or block.

NOTE: Pressure may build up quickly. Release any excess pressure or cooling system damage may result.

3) If there is no immediate pressure build up, pump tester to within system pressure range (on radiator cap). Vibration of gauge pointer indicates compression or combustion leak into cooling system. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer should stop or decrease vibration when leaking cylinder is shorted.

GENERATOR & REGULATOR

1999 Lexus RX 300

1999 STARTING & CHARGING SYSTEMS
Generators & Regulators
LEXUS

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION & OPERATION

Nippondenso 3-phase generator uses 3 positive and 3 negative diodes to rectify current. Charging system voltage is controlled by an internal Integrated Circuit (IC) voltage regulator. See WIRING DIAGRAMS.

ADJUSTMENTS

BELT TENSION

ES300

Check belt tension using Burroughs Tension Gauge (BT-33-73F) at longest belt run. For a new belt, tension should be 170-180 lbs. (77-82 kg). For a used belt, tension should be 95-135 lbs. (43-61 kg). Adjust belt tension if necessary.

RX300

Check belt tension using Burroughs Tension Gauge (BT-33-73F) at longest belt run. For a new belt, tension should be 170-180 lbs. (77-82 kg). For a used belt, tension should be 70-110 lbs. (32-50 kg). Adjust belt tension if necessary.

Except ES300 & RX300

Apply 22 lbs. (10 kg) force to top belt run. Belt tensioner should move downward, and pointer on belt tensioner should fall within area "A" (used belt) or area "B" (new belt). See Fig. 1 or 2. If pointer does not fall within specified area, replace belt or belt tensioner as necessary.

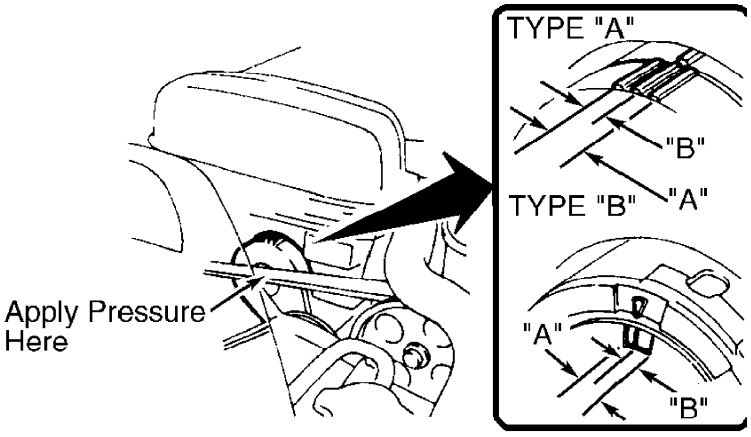


Fig. 1: Checking Drive Belt Tension (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

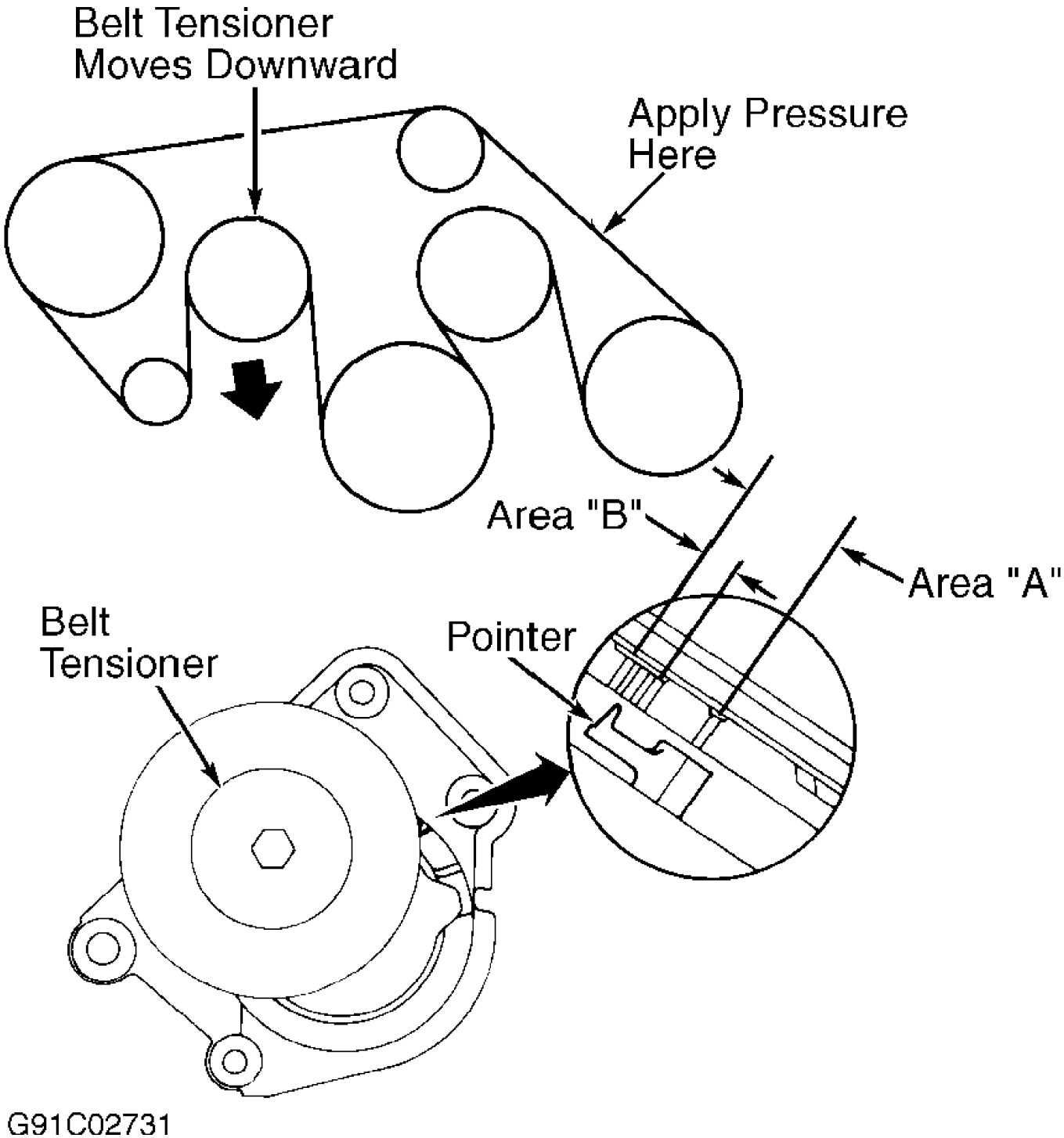


Fig. 2: Checking Drive Belt Tension (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

ON-VEHICLE TESTING

GENERATOR OUTPUT

1) Connect charging system test equipment following manufacturer's instructions. Check charging system output voltage at 2000 RPM. See GENERATOR OUTPUT SPECIFICATIONS table. If output voltage is high, replace voltage regulator and retest. If output voltage is low, go to next step. If output voltage is correct, go to step 3).

2) If output voltage is low, by-pass regulator (full field generator) by grounding terminal "F" at back of generator. See Fig. 3, 4 or 5. Recheck charging system output voltage. See GENERATOR OUTPUT SPECIFICATIONS table. If output voltage is high, replace voltage regulator and recheck. If output voltage remains low, repair or replace generator.

3) With engine at 2000 RPM, place the heater blower switch on highest setting and turn on headlights (high beam). Ammeter reading should be 30 amps or more. If amperage output is less than 30 amps, repair or replace generator.

GENERATOR OUTPUT SPECIFICATIONS

Application	Amps	Volts
ES300, GS300, GS400 & SC300	10 Or Less	13.2-14.8
LS400 & SC400	10 Or Less	(1) 13.7-14.8
RX300	10 Or Less	13.5-15.1

(1) - Measured at 77°F (25°C) and 2000 RPM.

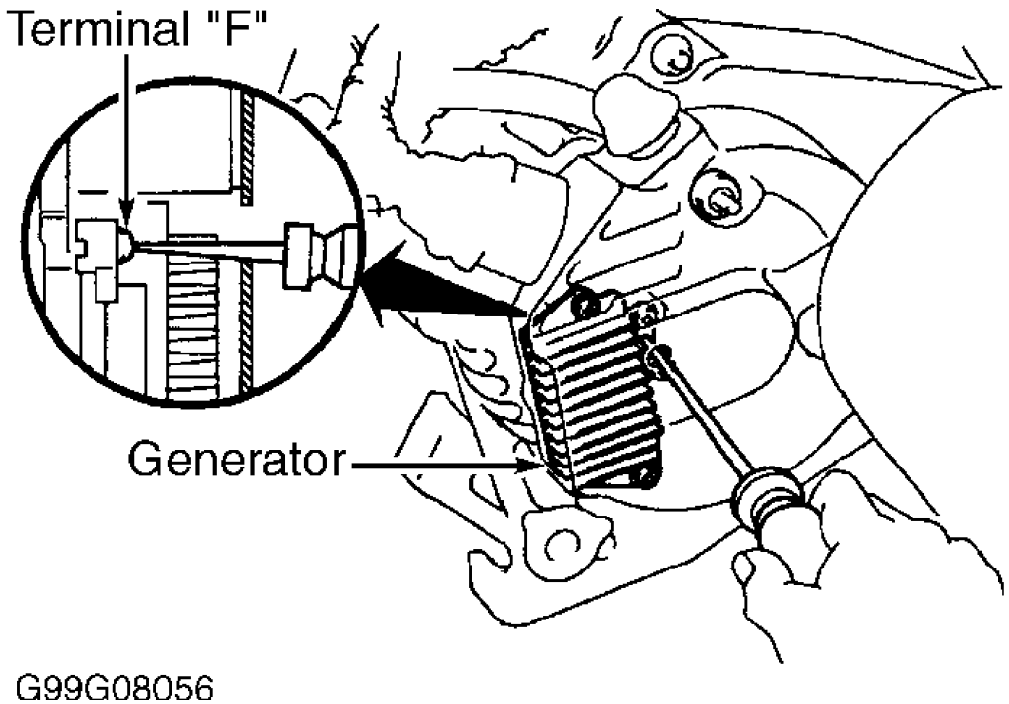
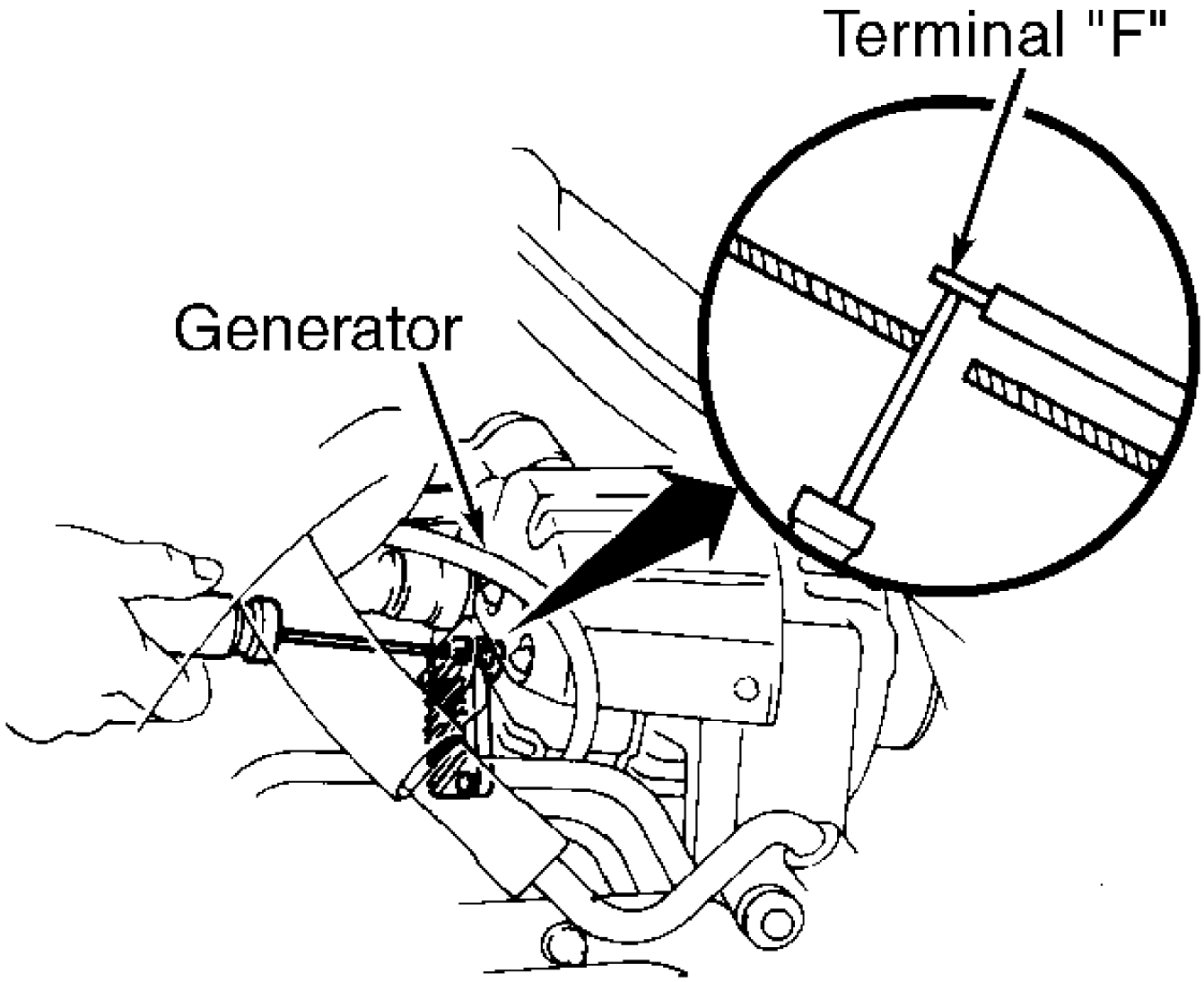
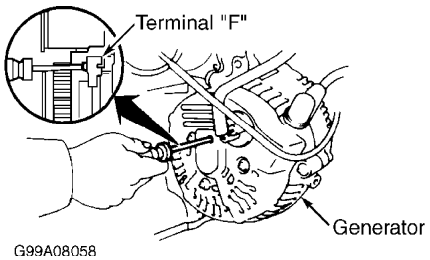


Fig. 3: Full Fielding Generator (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G99I08057

Fig. 4: Full Fielding Generator (LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G99A08058

Fig. 5: Full Fielding Generator (SC300 Shown; GS300 & GS400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

BENCH TESTING

BRUSHES

Check brushes for cracks and a minimum exposed length of .059" (1.5 mm). Replace complete brush holder assembly if brushes are damaged or worn.

ROTOR

1) Check rotor for open field windings by measuring resistance across slip rings. Resistance should be within specifications. See ROTOR RESISTANCE SPECIFICATIONS table. Check rotor for short circuit to ground by connecting ohmmeter between one slip ring and rotor. Continuity should not exist. If resistance and continuity are not as specified, replace rotor.

2) Check slip rings for wear or damage. Turn rotor/slip rings on lathe if necessary. Ensure slip ring diameter is not less than .504" (12.8 mm). Check bearing and replace if necessary.

ROTOR RESISTANCE SPECIFICATIONS

Application	(1) Ohms
ES300, LS400, RX300 & SC300	2.1-2.5
GS300 & GS400	2.2-2.4
SC400	2.7-3.1

(1) - Measured at 68°F (20°C).

STATOR

Using ohmmeter, check continuity between stator leads. Continuity should exist between all stator leads. Check continuity between stator lead and generator housing. Continuity should not exist. If continuity is not as specified, replace stator.

DIODE ASSEMBLY

1) Place diode (rectifier) assembly on bench. Connect ohmmeter positive lead to positive (+) terminal and negative lead to each rectifier terminal. See Fig. 6. Reverse ohmmeter leads and check again. Continuity should exist in only one direction.

2) Connect ohmmeter positive lead to each rectifier terminal and negative lead to each negative (-) terminal. Reverse ohmmeter leads and check again. Continuity should exist in only one direction. If continuity is not as specified, replace diode assembly.

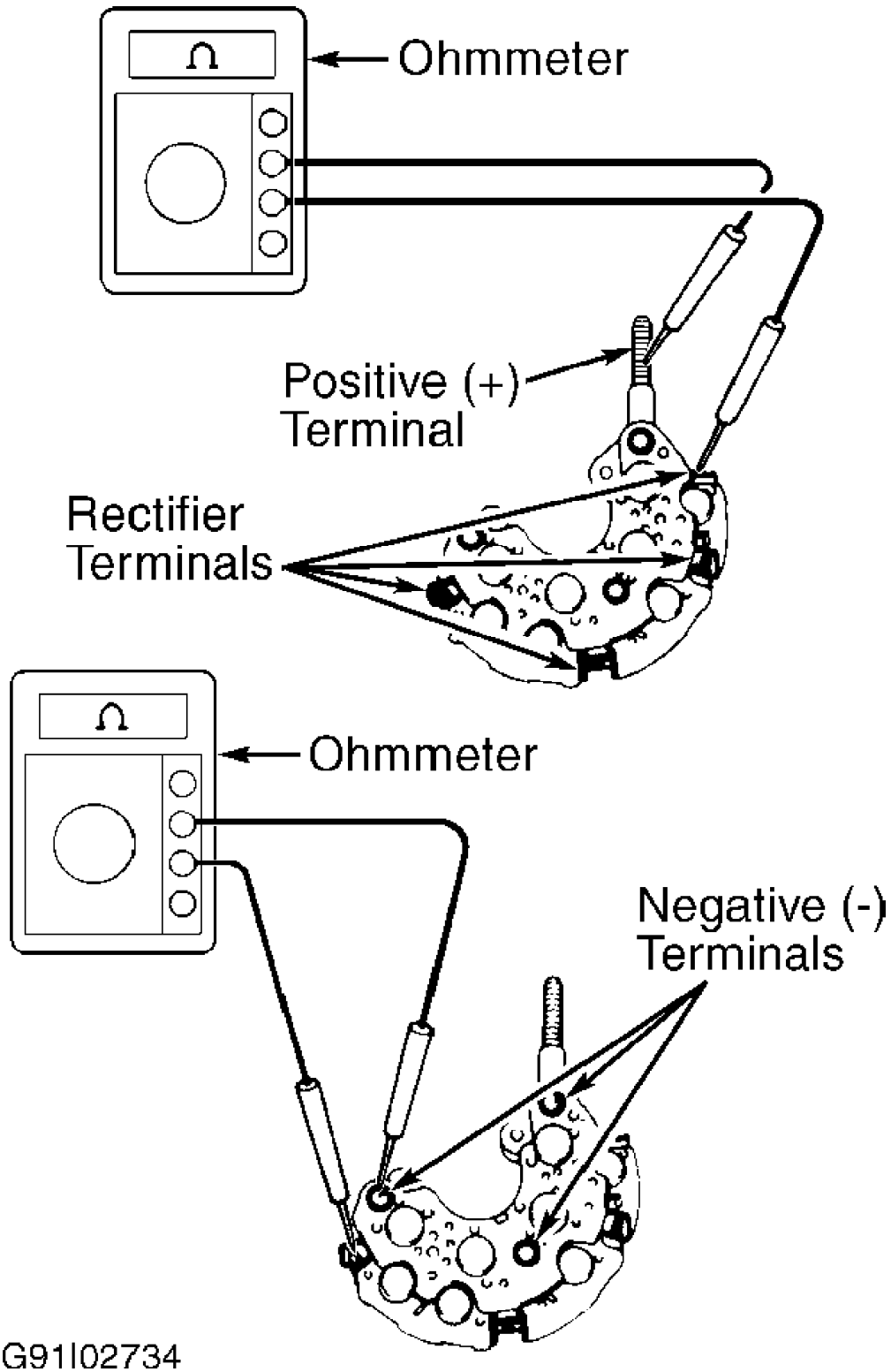


Fig. 6: Testing Diode Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OVERHAUL

NOTE: Use illustration for overhaul procedure. See Fig. 7 or 8.

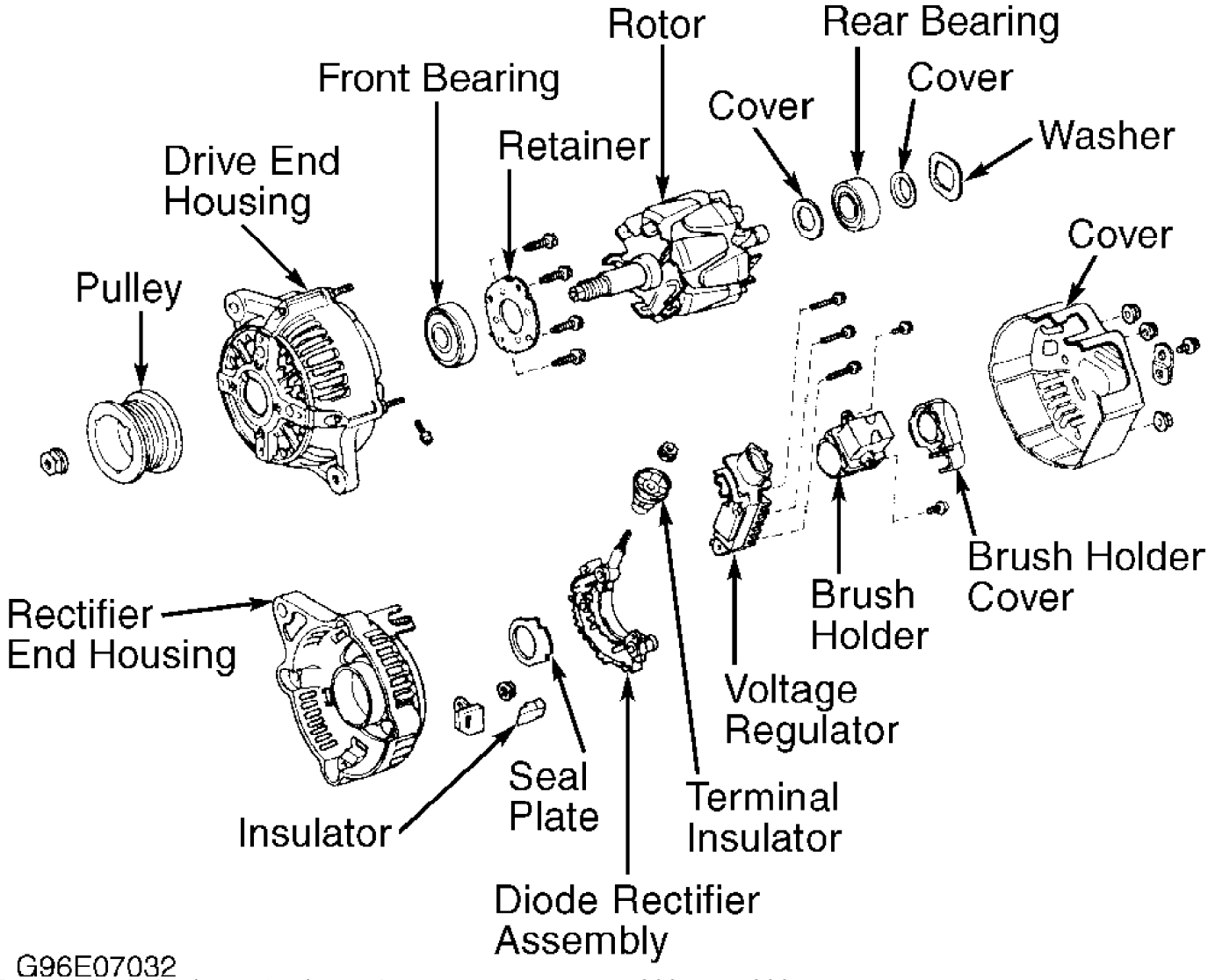
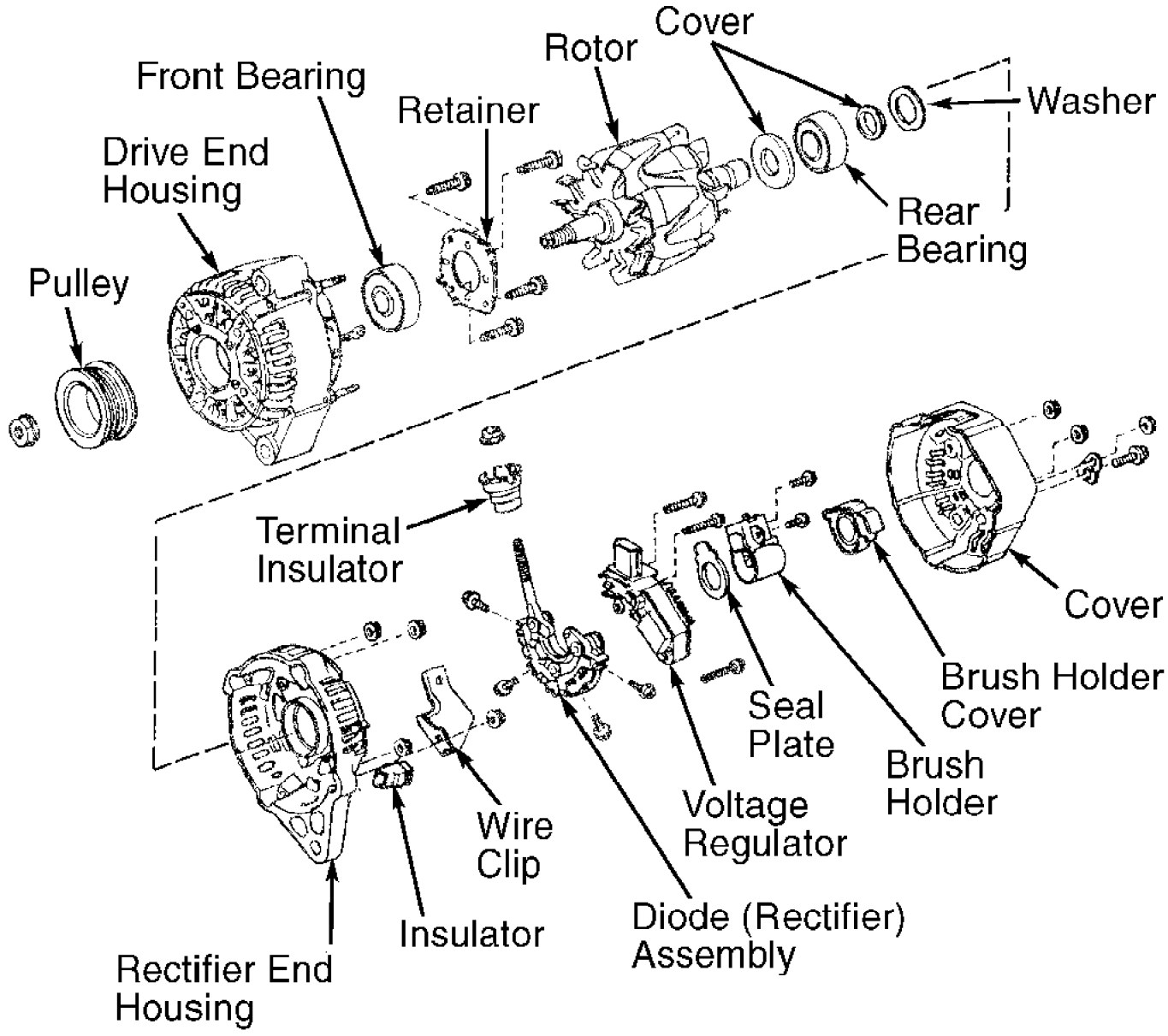


Fig. 7: Exploded View Of Nippondenso Generator (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G96G07033

Fig. 8: Exploded View Of Nippondenso Generator (GS300 & GS400 Shown; LS400, SC300 & SC400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
ES300 & RX300	
Generator Lock Bolt	13 (18)
Generator Pivot Bolt	41 (56)
GS300, GS400, LS400, SC300 & SC400	
Generator Mounting Bolt/Nut	29 (39)

WIRING DIAGRAMS

NOTE: For LX470 information, see WIRING DIAGRAMS in GENERATORS & REGULATORS article in TOYOTA.

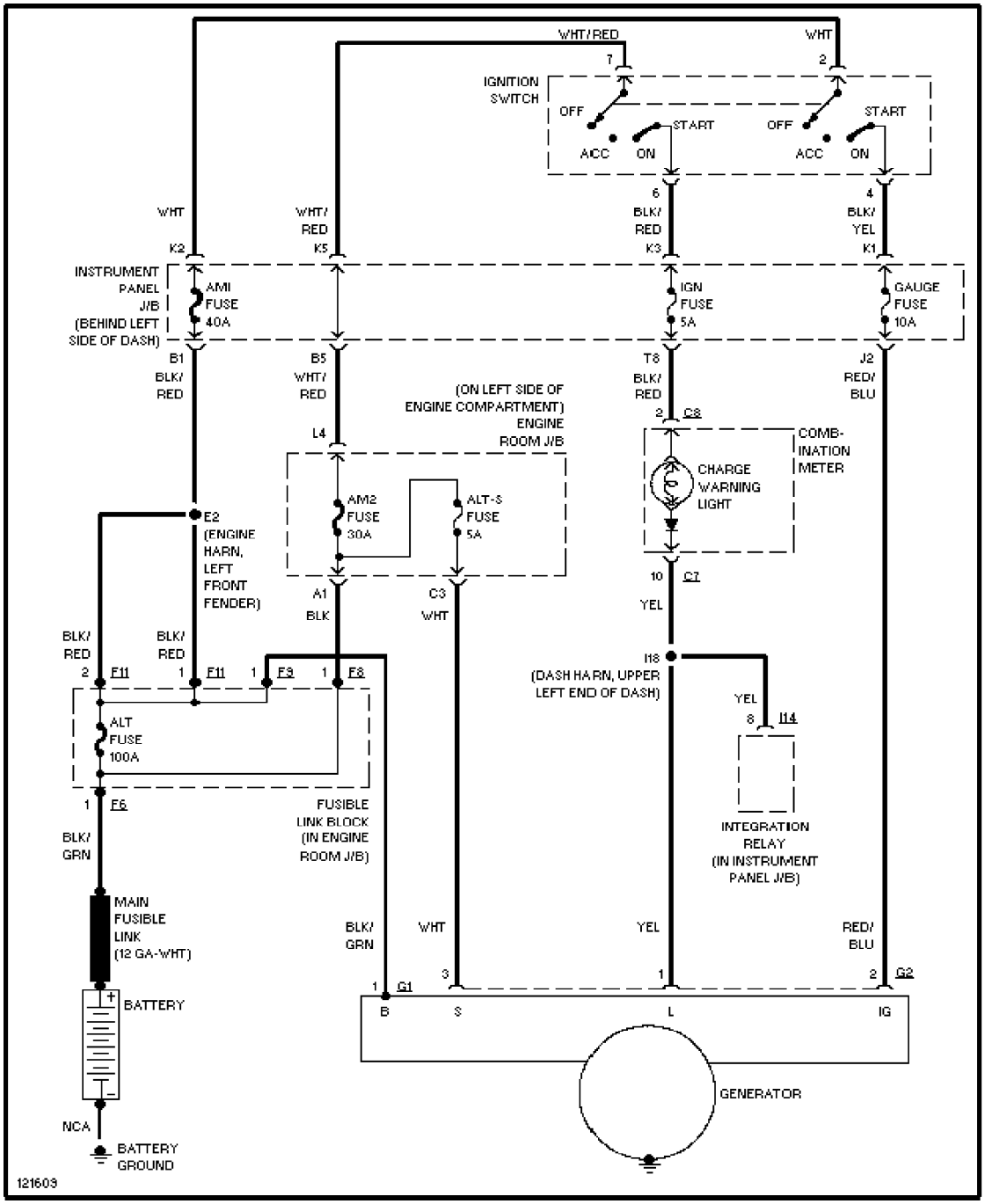


Fig. 9: Charging System Wiring Diagram (ES300)

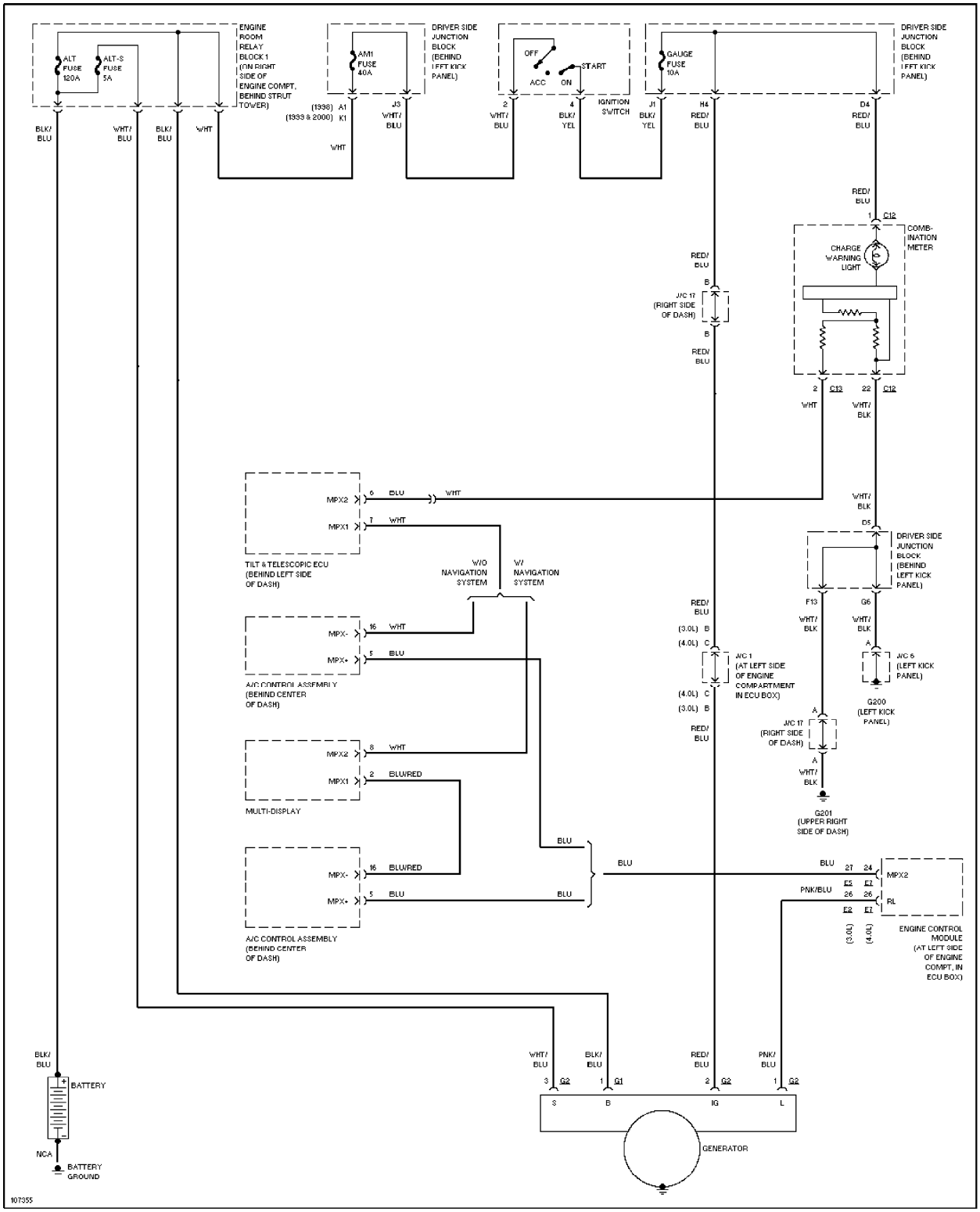


Fig. 10: Charging System Wiring Diagram (GS300 & GS400)

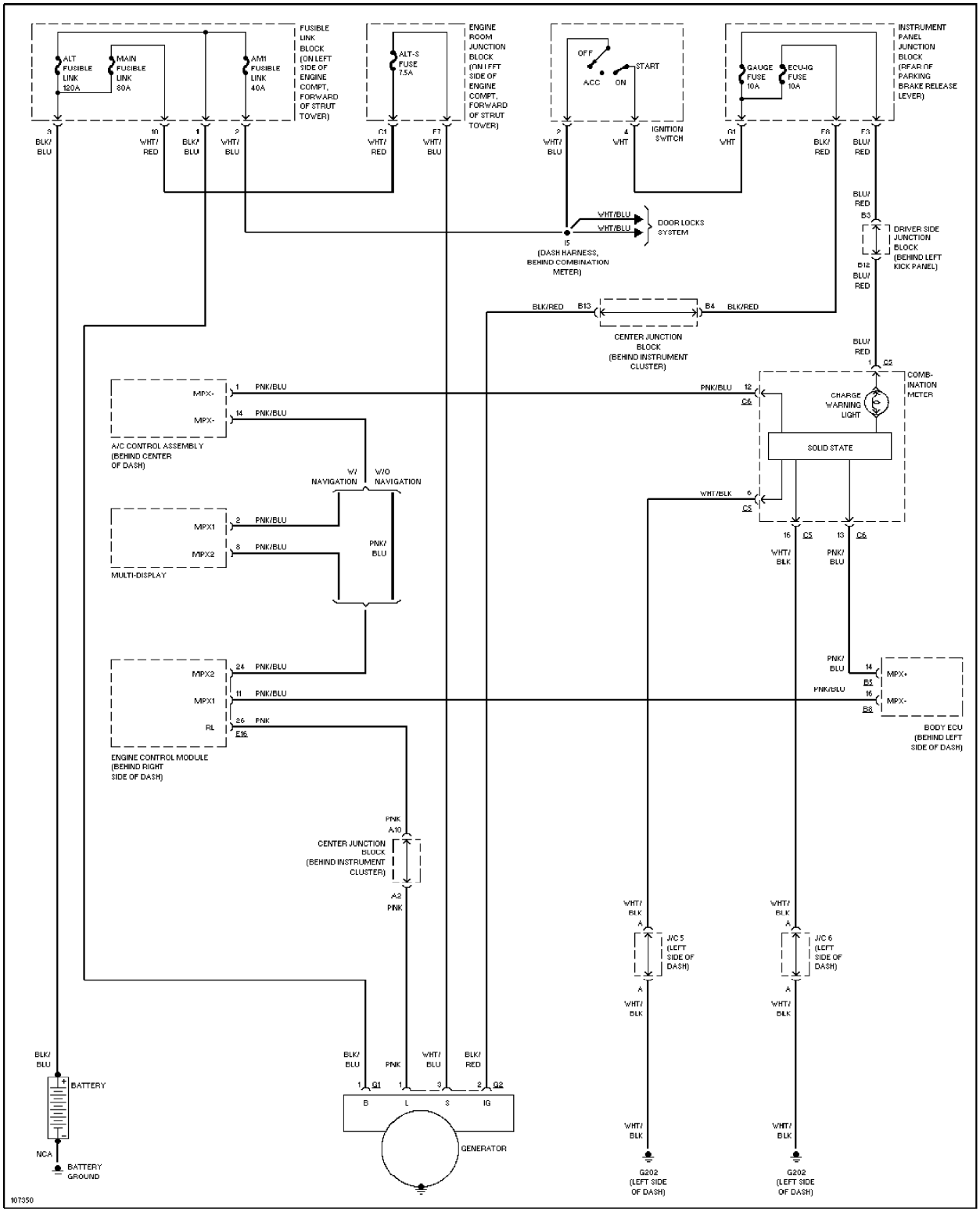


Fig. 11: Charging System Wiring Diagram (LS400)

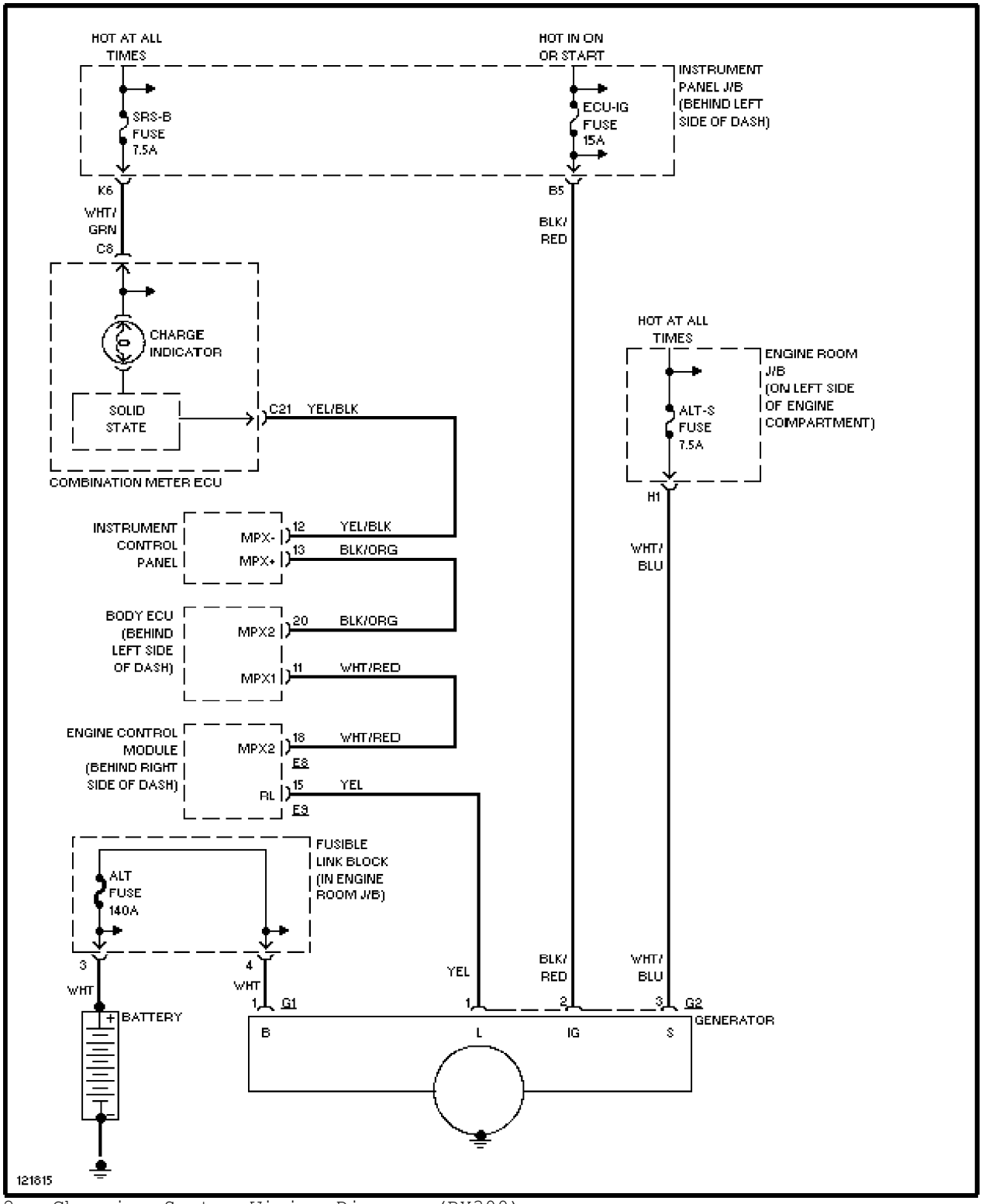


Fig. 12: Charging System Wiring Diagram (RX300)

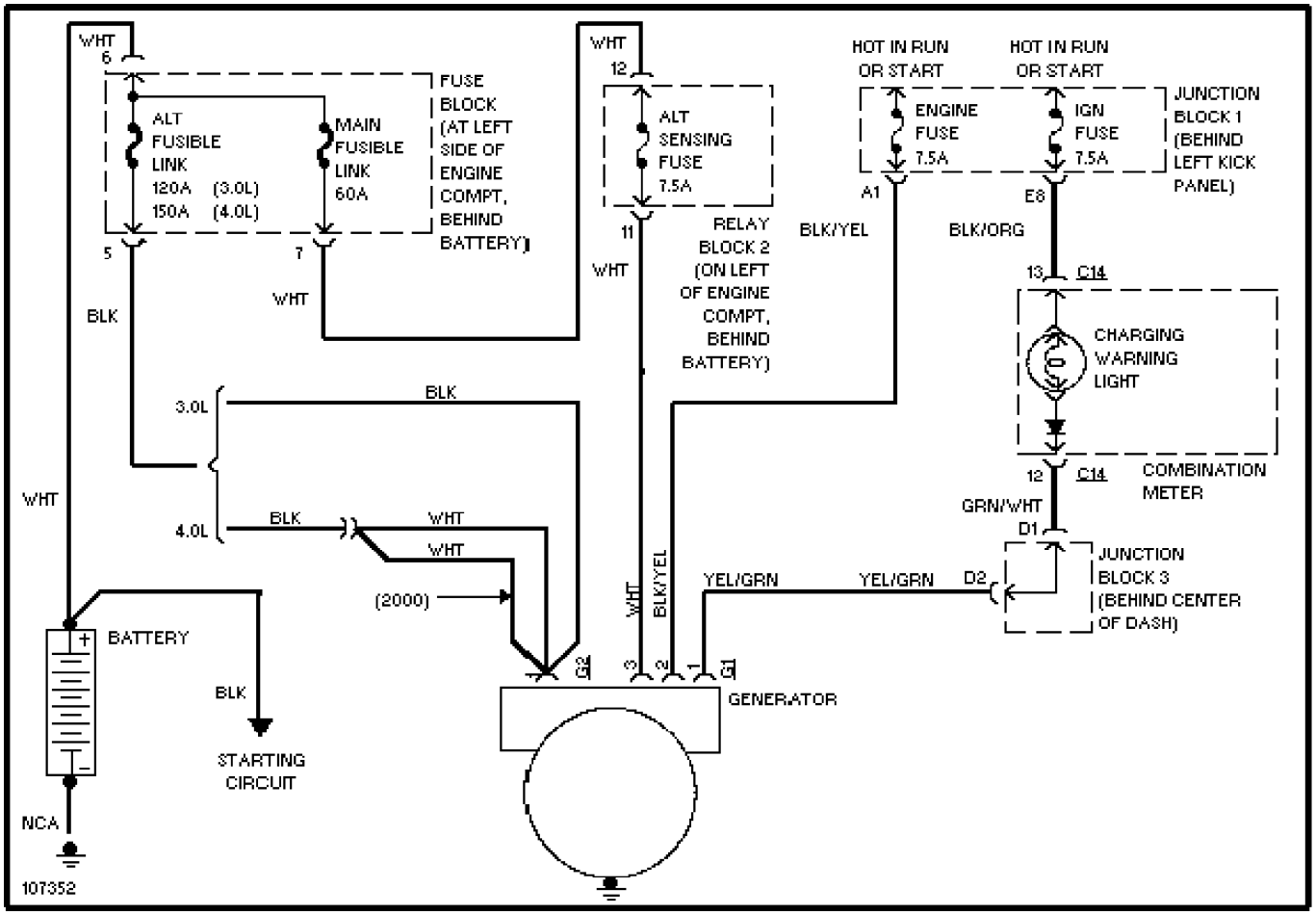


Fig. 13: Charging System Wiring Diagram (SC300 & SC400)

HOW TO USE SYSTEM WIRING DIAGRAMS

1999 Lexus RX 300

GENERAL INFORMATION
Using Wiring Diagrams

All Models

INTRODUCTION

This CD obtains wiring diagrams and technical service bulletins, containing wiring diagram changes from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today the majority of these diagrams follow a much improved format, which permits space for internal switch details.

Wiring diagrams are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Components locations are identified on the wiring diagrams. Any wires that don't connect directly to a component are identified on the diagram to indicate where they go.

COLOR ABBREVIATIONS

COLOR ABBREVIATIONS TABLE

Color	Normal	Optional
Black	BLK	BK
Blue	BLU	BU
Brown	BRN	BN
Clear	CLR	CR
Dark Blue	DK BLU	DK BU
Dark Green	DK GRN	DK GN
Green	GRN	GN
Gray	GRY	GY
Light Blue	LT BLU	LT BU
Light Green	LT GRN	LT GN
Orange	ORG	OG
Pink	PNK	PK
Purple	PPL	PL
Red	RED	RD
Tan	TAN	TN
Violet	VIO	VI
White	WHT	WT
Yellow	YEL	YL

IDENTIFYING WIRING DIAGRAM ABBREVIATIONS

NOTE: Abbreviations used on these diagrams are normally self-explanatory. If necessary see ABBREVIATIONS

article in GENERAL INFORMATION.

IDENTIFYING WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbol are used in these diagrams. The illustration below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

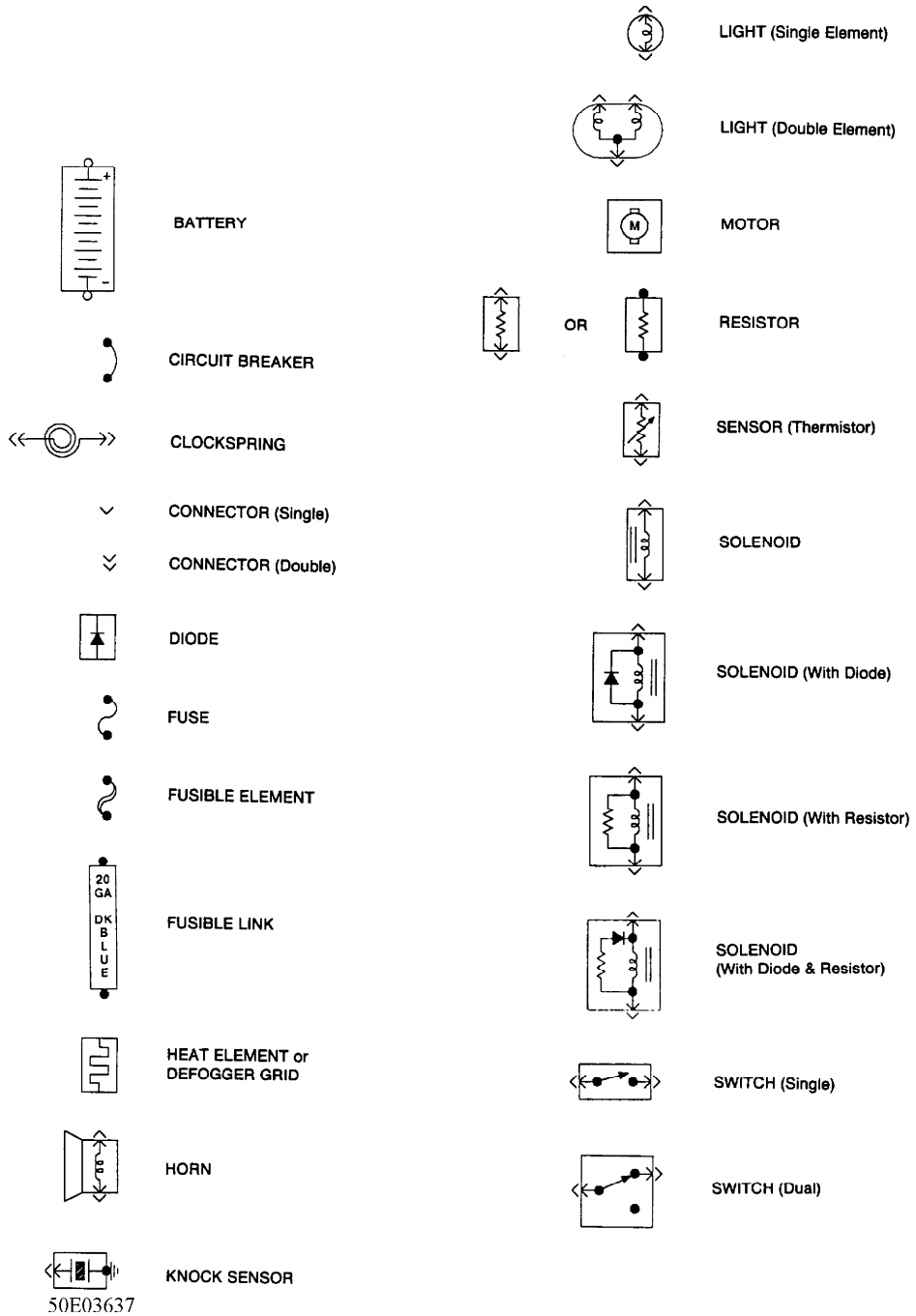


Fig. 1: Identifying Wiring Diagram Symbols

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS TABLE

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes
	Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System
	Starters
Autolamp Control Relay	Headlight Systems
	Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance
	Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights
	Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer
	Anti-Theft System
	Daytime Running Lights
	Engine Performance
	Headlight Systems
	Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels

Brake On/Off (BOO) Switch ..... Cruise Control Systems
Engine Performance
Shift Interlock Systems
Buzzer Module ..... Warning Systems
Camshaft Position (CMP) Sensor ..... Engine Performance
Central Control Module ..... Anti-Theft System
Clockspring ..... Air Bag Restraint System
Cruise Control Systems
Steering Column Switches
Clutch Pedal Position Switch ..... Starters
Clutch Start Switch ..... Starters
Combination Meter ..... Analog Instrument Panels
Constant Control Relay Module (CCRM) ..... Engine Performance
Electric Cooling Fans
Convenience Center ..... Power Distribution
Illumination/Interior Lights
Convertible Top Motor ..... Power Convertible Top
Convertible Top Switch ..... Power Convertible Top
Crankshaft Position (CKP) Sensor ..... Engine Performance
Cruise Control Module ..... Cruise Control Systems
Cruise Control Switch ..... Cruise Control Systems
Condenser Fan Relay(s) ..... Electric Cooling Fans
Data Link Connector (DLC) ..... Engine Performance
Daytime Running Lights Module ..... Daytime Running Lights
Exterior Lights
Defogger Relay ..... Rear Window Defogger
Diagnostic Energy Reserve Module (DERM) ... Air Bag Restraint System
Discriminating Sensor (Air Bag) ..... Air Bag Restraint System
Distributor ..... Engine Performance
Door Lock Actuators ..... Power Door Locks
Remote Keyless Entry
Door Lock Relay(s) ..... Power Door Locks
Electrochromic Mirror ..... Power Mirrors
Electronic Level Control (ELC)
Height Sensor ..... Electronic Suspension
Electronic Level Control (ELC) Module ..... Electronic Suspension
Engine Coolant Temperature (ECT)
Sending Unit ..... Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor ..... Engine Performance
Engine Control Module ..... Engine Performance
Generators & Regulators
Starters
ETACS ECU ..... Warning Systems
Power Windows
Remote Keyless Entry
Evaporative (EVAP) Emissions Canister ..... Engine Performance
EVAP Canister Purge Solenoid ..... Engine Performance
EVAP Canister Vent Solenoid ..... Engine Performance
Exhaust Gas Recirculation (EGR) Valve ..... Engine Performance
Fuel Tank Vacuum Sensor ..... Engine Performance
Fog Lights ..... Headlight Systems
Daytime Running Lights
Fog Light Relay ..... Headlight Systems
Daytime Running Lights
Fuel Door Release Solenoid ..... Power Fuel Door Release
Fuel Gauge Sending Unit ..... Analog Instrument Panels
Fuel Injectors ..... Engine Performance
Fuel Pump ..... Engine Performance
Fuel Pump Relay ..... Engine Performance
Power Distribution
Fuse/Relay Block ..... Power Distribution
Fusible Links ..... Power Distribution
Generators & Regulators

Starters
Generator ..... Generators & Regulators
Engine Performance
Power Distribution
Generic Electronic Module (GEM) ..... Body Control Modules
Electronic Suspension
Glow Plug Relay ..... Engine Performance
Glow Plugs ..... Engine Performance
Grounds ..... Ground Distribution
Headlight Door Module ..... Headlight Doors
Headlight Relay ..... Headlight Systems
Daytime Running Lights
Headlights ..... Headlight Systems
Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S) ..... Engine Performance
Heated Windshield Control Module ..... Heated Windshields
Height Sensor ..... Electronic Suspension
Horns ..... Steering Column Switches
Horn Relay ..... Steering Column Switches
Idle Air Control (IAC) Motor/Valve ..... Engine Performance
Ignition Coil(s) ..... Engine Performance
Ignition Key Lock Cylinder ..... Anti-Theft System
Ignition Module ..... Engine Performance
Ignition Switch ..... Power Distribution
Engine Performance
Generators & Regulators
Starters
Illuminated Entry Module ..... Illumination/Interior Lights
Illumination Lights ..... Illumination/Interior Lights
Impact Sensor ..... Air Bag Restraint System
Inertia Fuel Shutoff Switch ..... Engine Performance
Inhibit Relay ..... Starters
Instrument Cluster ..... Analog Instrument Panels
Intake Air Temperature (IAT) Sensor ..... Engine Performance
Interior Lights ..... Illumination/Interior Lights
Interlock Switch ..... Starters
Junction Block ..... Power Distribution
Keyless Entry Receiver ..... Remote Keyless Entry
Key Reminder Switch ..... Starters
Knock Sensor ..... Engine Performance
Lamp Control Module ..... Exterior Lights
License Plate Lamp ..... Exterior Lights
Lighting Control Module ..... Lighting Control Modules
Anti-Theft System
Daytime Running Lights
Headlight Systems
Lower Relay ..... Power Convertible Top
Malfunction Indicator Light (MIL) ..... Engine Performance
Instrument Panels
Manifold Absolute Pressure (MAP) Sensor ..... Engine Performance
Mass Airflow (MAF) Sensor ..... Engine Performance
Mega Fuse ..... Generators & Regulators
Memory Seat/Mirror Module ..... Memory Systems
Mirror Defogger ..... Rear Window Defogger
Moon Roof Motor ..... Power Moon Roof
Moon Roof Relay ..... Power Moon Roof
Multi-Function Control Module ..... Warning Systems
Neutral Safety Switch ..... Starters
Oil Level Switch ..... Engine Performance
Oil Pressure Switch/Sending Unit ..... Analog Instrument Panels
Engine Performance
Overhead Console ..... Overhead Console
Oxygen Sensor(s) (O2S) ..... Engine Performance

Parking Brake Switch ..... Analog Instrument Panels
Park Lights ..... Exterior Lights
Park/Neutral Position Switch ..... Starters
Engine Performance
Anti-Theft System
Body Control Module
Perimeter Lighting Control Relay ..... Exterior Lights
Power Amplifier ..... Power Antennas
Power Antenna Module ..... Power Antennas
Power Antenna Motor ..... Power Antennas
Power Distribution Center ..... Power Distribution
Generators & Regulators
Starters
Power Door Lock Motors ..... Power Door Locks
Power Mirror Motors ..... Power Mirrors
Memory Systems
Power Sliding Door Controller ..... Power Sliding Side Door
Power Seat Motors ..... Power Seats
Memory Systems
Power Steering Pressure Switch ..... Engine Performance
Power Top Motor ..... Power Convertible Top
Power Top Relay(s) ..... Power Convertible Top
Powertrain Control Module ..... Engine Performance
Analog Instrument Panels
Cruise Control Systems
Data Link Connectors
Generators & Regulators
Starters
Power Window Motors ..... Power Windows
Power Window Relay(s) ..... Power Windows
Radiator Fan Motor(s) ..... Electric Cooling Fans
Radiator Fan Relay(s) ..... Engine Performance
Electric Cooling Fans
Rainsense Module ..... Wiper/Washer Systems
Raise Relay ..... Power Convertible Top
Remote Anti-Theft Personality (RAP) Module ..... Anti-Theft System
Starters
Warning Systems
Seat Belt Pretensioners ..... Air Bag Restraint System
Seat Belt Retractor Solenoid ..... Passive Restraints
Seat Belt Switch ..... Air Bag Restraint System
Passive Restraints
Shift Interlock Solenoid ..... Shift Interlock Systems
Shift Lock Actuator ..... Shift Interlock Systems
Side Marker Lights ..... Exterior Lights
SIR Coil Assembly (Clockspring) ..... Air Bag Restraint System
Slip Ring (Clockspring) ..... Air Bag Restraint System
Steering Column Switches
SRS Control Module ..... Air Bag Restraint System
Starter Motor ..... Starters
Starter Interrupt Relay ..... Starters
Starter Solenoid ..... Starters
Starter Relay ..... Starters
Steering Wheel Position Sensor ..... Anti-Lock Brakes
Stoplights ..... Exterior Lights
Stoplight Switch ..... Engine Performance
Cruise Control Systems
Anti-Lock Brakes
Sun Roof ECU ..... Power Sun Roof
Sun Roof Motor ..... Power Sun Roof
Sun Roof Position Sensor ..... Power Sun Roof
Taillights ..... Exterior Lights
Throttle Position (TP) Sensor ..... Engine Performance

Torque Converter Clutch Solenoid/Switch ..... Engine Performance
Traction Control Switch ..... Anti-Lock Brakes
Trailer Tow Connector ..... Exterior Lights
Trailer Tow Relay ..... Exterior Lights
Transmission/Transaxle ..... Engine Performance
Transmission Control Module (TCM) ..... Engine Performance
Starters
Transmission Range Sensor ..... Starters
Back-Up Lights
Engine Performance
Transmission Range Switch ..... Back-Up Lights
Engine Performance
Anti-Theft System
Turn Signal Flasher ..... Exterior Lights
Turn Signal Lights ..... Exterior Lights
Twilight Sentinel Switch ..... Headlight Systems
Daytime Running Lights
Vapor Canister Leak Detection Pump ..... Engine Performance
Vehicle Control Module (VCM) ..... Engine Performance
Vehicle Dynamic Module ..... Electronic Suspension
Vehicle Speed Control Servo ..... Cruise Control Systems
Vehicle Speed Sensor ..... Data Link Connectors
Analog Instrument Panels
Cruise Control Systems
Electronic Suspension
Voltage Regulator ..... Generators & Regulators
Water-In-Fuel Sensor ..... Engine Performance
Analog Instrument Panels
Wheel Speed Sensors ..... Anti-Lock Brakes
Window Timer Module ..... Power Convertible Top
Windshield Intermittent Wiper Relay ..... Wiper/Washer Systems
Windshield Washer Motor ..... Wiper/Washer Systems
Wiper Motor ..... Wiper/Washer Systems

INSTRUMENT PANEL

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Instrument Panels
LEXUS

RX300

DESCRIPTION & OPERATION

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

Instrument cluster uses analog (needle-type) speedometer, tachometer and gauges. A circuit plate on back of instrument cluster conducts current between components and receives data from other control units. See Fig. 1.

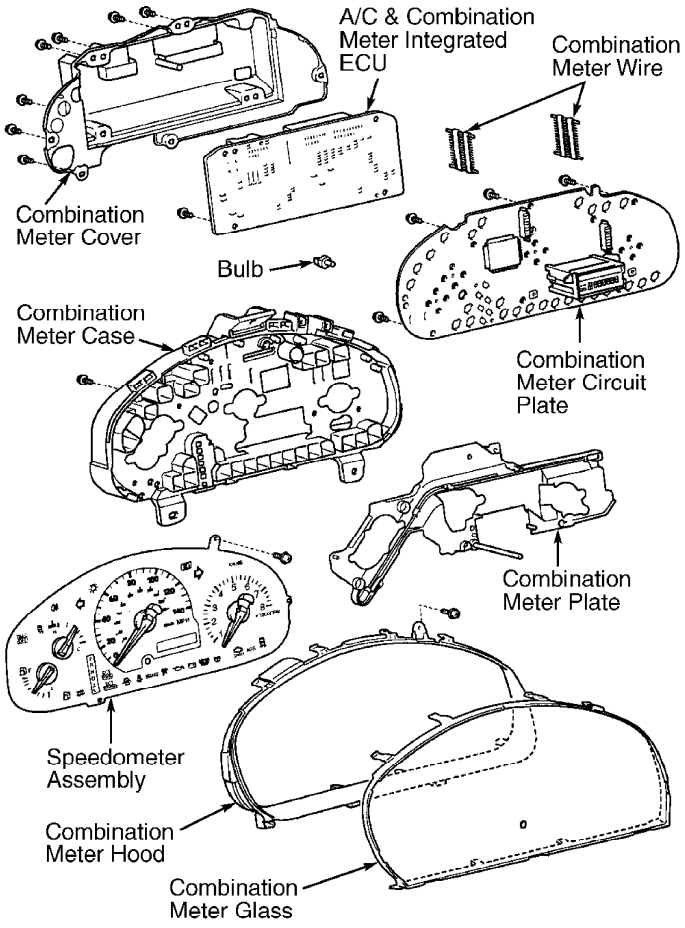


Fig. 1: Exploded View Of Instrument Cluster
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPONENT LOCATIONS

ABS ECU
Behind right side of instrument panel.

Body ECU
Behind left side of instrument panel.

Brake Fluid Level Warning Switch
In brake fluid reservoir.

Data Link Connector No. 3 (DLC3)
Under instrument panel, below steering column.

DOME Fuse (10-Amp)
In junction block at left side of engine compartment.

Door Unlock Detection Switch
Integral with each door lock assembly.

ECM
Behind right side of instrument panel.

ECU-B Fuse (7.5-Amp)
In junction block at left side of engine compartment.

HEATER Fuse (15-Amp)
In instrument panel junction block.

Ignition Coil & Igniter
On top of each respective cylinder.

Instrument Panel Junction Block
Behind left side of instrument panel.

Light Failure Sensor
Left side of luggage compartment.

Low Oil Pressure Warning Switch
On left front corner of engine.

Main Fuel Gauge Sending Unit
On top of fuel tank.

Occupant Detection Sensor
Under passenger's seat.

Parking Brake Switch
On parking brake pedal support bracket.

Park/Neutral Position (PNP) Switch
On transaxle.

Seat Belt Buckle Switch
On respective seat belt buckle.

Sub Fuel Gauge Sending Unit
On top of fuel tank.

Washer Fluid Level Warning Switch
In right front corner of engine compartment.

TROUBLE SHOOTING

Verify customer complaint. Perform a visual inspection, checking for open fuses, disconnected or damaged wire harnesses and components. Ensure all fluid levels are correct. Repair or replace items as necessary and recheck.

Verify proper multiplex control system operation and ensure no Diagnostic Trouble Codes (DTC) are present. See MULTIPLEX CONTROL SYSTEMS - RX300 article. Repair as necessary. If no DTCs are present, diagnose by symptom. See appropriate SYMPTOM DIAGNOSIS table.

SYMPTOM DIAGNOSIS (GAUGES)

Symptom	Inspect
Speedometer Inoperative Or Abnormal Operation	(1) Speedometer Circuit, (2) ABS ECU
Tachometer Inoperative Or Abnormal Operation	(1) Tachometer Circuit, (1) Igniter Signal Circuit
Fuel Gauge Inoperative Or Abnormal Operation	(1) Fuel Gauge Circuit, (3) Wire Harness, (4) Instrument Cluster
Engine Coolant Temperature Gauge Inoperative Or Abnormal Operation	(1) Engine Coolant Temperature Gauge Circuit, (3) Wire Harness, (4) Instrument Cluster

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See ANTI-LOCK BRAKES article in WIRING DIAGRAMS.
(3) - Inspect wire harness and repair as necessary. See WIRING DIAGRAMS.
(4) - See INSTRUMENT CLUSTER under CIRCUIT TESTS.

SYMPTOM DIAGNOSIS (INDICATORS & WARNING LIGHTS)

Symptom	Inspect
Shift Indicator Light Does Not Illuminate	(1) Bulb Circuit, (2) A/T Shift Indicator Light Switch, (2) Transmission Control Switch
Open Door Warning Light Does Not Illuminate	(1) Bulb Circuit, (3) Door Courtesy Switch
Driver's Seat Belt Warning Light Does Not Illuminate	(1) Bulb Circuit, (4) Driver's Buckle Switch Circuit
Passenger's Seat Belt Warning Light Does Not Illuminate	(1) Bulb Circuit, (4) Passenger's Buckle Switch Circuit
Low Oil Pressure Warning Light Does Not Illuminate	(1) Bulb Circuit, (3) Low Oil Pressure Warning Light Switch

Discharge Warning Light Does Not Illuminate	(1) Bulb Circuit, (5) Generator
Brake Warning Light Does Not Illuminate	(1) Bulb Circuit, (3) Parking Brake Switch, (3) Brake Fluid Level Warning Switch, (3) Instrument Cluster
Headlight Indicator Light Does Not Illuminate	(1) Bulb Circuit, (6) Headlight & Taillight System, (3) Instrument Cluster
CRUISE MAIN Indicator Light Does Not Illuminate	(1) Bulb Circuit, (7) Cruise Control Switch, (3) Instrument Cluster
ECT SNOW Indicator Light Does Not Illuminate	(1) Bulb Circuit, (2) ECT Pattern Indicator Signal, (3) Instrument Cluster
ECT PWR Indicator Light Does Not Illuminate	(1) Bulb Circuit, (2) ECT Pattern Indicator Signal, (3) Instrument Cluster
TRAC OFF Indicator Light Does Not Illuminate	(1) Bulb Circuit, (8) ABS, TRAC & VSC ECU, (3) Instrument Cluster
Washer Level Warning Light Does Not Illuminate	(1) Bulb Circuit, (3) Window Washer Level Warning Switch, (3) Instrument Cluster
Rear Lights Warning Light Does Not Illuminate	(1) Bulb Circuit, (1) Light Failure Sensor Circuit, (3) Instrument Cluster
Engine Oil Level Warning Light Does Not Illuminate	(1) Bulb Circuit, (9) Engine Oil Level Warning Sensor, (3) Instrument Cluster
All Indicator & Warning Lights Do Not Illuminate	(1) Bulb Circuit, (1) Combination Meter ECU Power Source Circuit, (3) Instrument Cluster

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS.
(3) - See appropriate test under COMPONENT TESTS.
(4) - See appropriate BODY CONTROL SYSTEMS article.
(5) - See GENERATORS & REGULATORS article in STARTING & CHARGING SYSTEMS.
(6) - See appropriate wiring diagram in EXTERIOR LIGHTS article.
(7) - See appropriate CRUISE CONTROL SYSTEMS article.
(8) - See ANTI-LOCK BRAKES article in WIRING DIAGRAMS.
(9) - Testing information is not available from manufacturer.

CIRCUIT TESTS

BULB CIRCUIT

NOTE: If Lexus hand-held tester is not available, begin testing with step 2).

1) Connect Lexus hand-held tester to Data Link Connector No. 3 (DLC3). With tester in ACTIVE TEST mode, operate appropriate indicator/warning light. If light operation is okay, perform next check listed in appropriate symptom diagnosis table. See TROUBLE SHOOTING. If light operation is not okay, go to next step.

2) Remove bulb in question. Using DVOM, check for continuity between bulb terminals. If continuity is present, go to next step. If continuity is not present, replace bulb.

3) Check combination meter circuit plate. See INSTRUMENT CLUSTER under COMPONENT TESTS. Repair as necessary. If combination meter circuit plate is okay, replace A/C and combination meter integrated ECU. See Fig. 1.

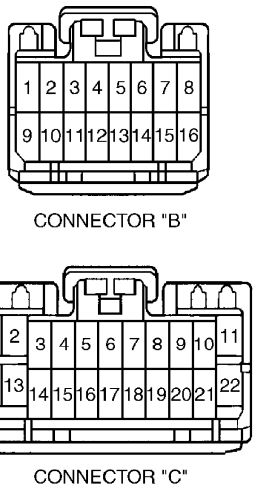
COMBINATION METER ECU POWER SOURCE CIRCUIT

NOTE: Combination meter is also known as instrument cluster.

1) Check HEATER fuse (15-amp) and ECU-B fuse (7.5-amp). Replace if necessary. If fuses are okay, go to next step.

2) Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. With wire harnesses disconnected, measure voltage between ground and terminals No. 1 and 3 of harness connector "C". See Fig. 2. If battery voltage is present, perform next check listed in appropriate symptom diagnosis table. See TROUBLE SHOOTING. If battery voltage is not present, go to next step.

3) Check for open in harness or connector between GND terminal of combination meter and chassis ground. See WIRING DIAGRAMS. Repair as necessary. If circuit is okay, repair faulty circuit between combination meter and battery.



G99B51517

Fig. 2: Identifying Instrument Cluster Harness Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DOOR COURTESY SWITCH CIRCUIT

Driver & Passenger Doors

Locate door courtesy switch to be tested. One switch is located in each door lock assembly (total of 4 switches). Disconnect 2-pin door courtesy switch connector. Using DVOM, measure voltage between terminal No. 2 (Red/White wire or Red/Yellow wire) and ground. Ensure battery voltage is present at all times. If battery voltage is not present, check power source or circuit. See WIRING DIAGRAMS. Repair as necessary.

Rear Door (Luggage Compartment)

1) Disconnect 2-pin harness connector from rear door lock motor assembly. Using DVOM, measure voltage between ground and terminal No. 1 (White/Black wire) at vehicle side of harness connector. Ensure battery voltage is present with luggage compartment door opener switch in ON position, and no voltage is present with switch in OFF position. Go to next step.

2) Measure voltage between ground and terminal No. 2 (White/Red wire) at vehicle side of harness connector. Ensure battery voltage is present at all times. If voltage is not as specified, check power source or circuit. See WIRING DIAGRAMS. Repair as necessary.

ENGINE COOLANT TEMPERATURE GAUGE CIRCUIT

NOTE: If Lexus hand-held tester is not available, begin testing with step 2).

1) Connect Lexus hand-held tester to Data Link Connector No. 3 (DLC3). With tester in ACTIVE TEST mode, operate engine coolant temperature gauge. If engine coolant temperature gauge needle moves as commanded by tester, replace A/C and combination meter integrated ECU. See Fig. 1. If engine coolant temperature gauge needle does not move as commanded by tester, go to next step.

2) Check for engine control DTCs. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE. If DTCs P0115 or P0116 are set, repair as necessary. If DTCs are not set, go to next step.

3) Check engine coolant temperature gauge. See ENGINE COOLANT TEMPERATURE GAUGE under COMPONENT TESTS. Repair as necessary. If engine coolant temperature gauge is okay, replace combination meter circuit plate. See Fig. 1.

FUEL GAUGE CIRCUIT

NOTE: If Lexus hand-held tester is not available, begin testing with step 2).

1) Connect Lexus hand-held tester to Data Link Connector No. 3 (DLC3). With tester in ACTIVE TEST mode, operate fuel gauge. If fuel gauge needle moves as commanded by tester, replace A/C and combination meter integrated ECU. See Fig. 1. If fuel gauge needle does not move as commanded by tester, go to next step.

2) Check fuel gauge sending unit. See FUEL GAUGE SENDING UNIT under COMPONENT TESTS. Repair as necessary. If fuel gauge sending unit is okay, go to next step.

3) Check for short to battery voltage in harness or connector between A/C and combination meter integrated ECU and fuel gauge sending unit. Repair as necessary. If circuits are okay, go to next step.

4) Check fuel gauge. See FUEL GAUGE under COMPONENT TESTS. Repair as necessary. If fuel gauge is okay, replace combination meter circuit plate. See Fig. 1.

IGNITER SIGNAL CIRCUIT

With Lexus Hand-Held Tester

1) Using tester connected to Data Link Connector No. 3 (DLC3), enter DATALIST mode. Test drive vehicle and check tachometer parameter. If parameter value changes with engine speed, replace combination meter. If parameter value does not change, go to next step.

2) Check harness and connector between combination meter and ECM. Repair as necessary. If circuits are okay, repair ignition coil and/or wire harness.

Without Lexus Hand-Held Tester

1) Check harness and connector between combination meter and ECM. Repair as necessary. If circuits are okay, go to next step.

2) Check igniter circuit. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE. Repair as necessary. If igniter circuit is okay, replace combination meter.

INSTRUMENT CLUSTER CIRCUIT

Disconnect instrument cluster harness connectors "B" and "C". See Fig. 2. Using DVOM, check circuit values at appropriate instrument cluster harness connectors and ensure values are as specified. See INSTRUMENT CLUSTER CIRCUIT VALUES table. If circuit values are not as specified, repair appropriate circuit as necessary. See WIRING DIAGRAMS.

INSTRUMENT CLUSTER CIRCUIT VALUES

Tester Connection	Condition	Circuit Value
B2 & Ground	Washer Level Warning Switch ON	Continuity
B6 & B7	Light Control Rheostat In Full Right Position	8-12 K/Ohms
	Light Control Rheostat In Full Left Position	Zero Ohms
B10 & B7	Constant	8-12 K/Ohms
B14 & B7	Light Control Rheostat In Full Left Position	No Continuity
C1 & Ground	Ignition Switch In OFF Or ACC Position	Zero Volts
	Ignition Switch In ON Position	Battery Voltage
C3 & Ground	Constant	Battery Voltage
C8 & Ground	Constant	Battery Voltage
C9 & Ground	Light Control Switch In HI Or FLASH Position	Battery Voltage
C11 & Ground	Constant	Continuity
C12 & Ground	Light Control Switch In TAIL Or HEAD Position	Battery Voltage
C14 & Ground	Constant	Battery Voltage
C15 & Ground	Fuel Tank Full	4 Ohms
	Fuel Tank Empty	107 Ohms
C20 & Ground	Light Control Switch In HI Or FLASH Position	Continuity
C22 & Ground	Constant	Continuity

LIGHT FAILURE SENSOR CIRCUIT

NOTE: Light failure sensor may also be known as light failure relay.

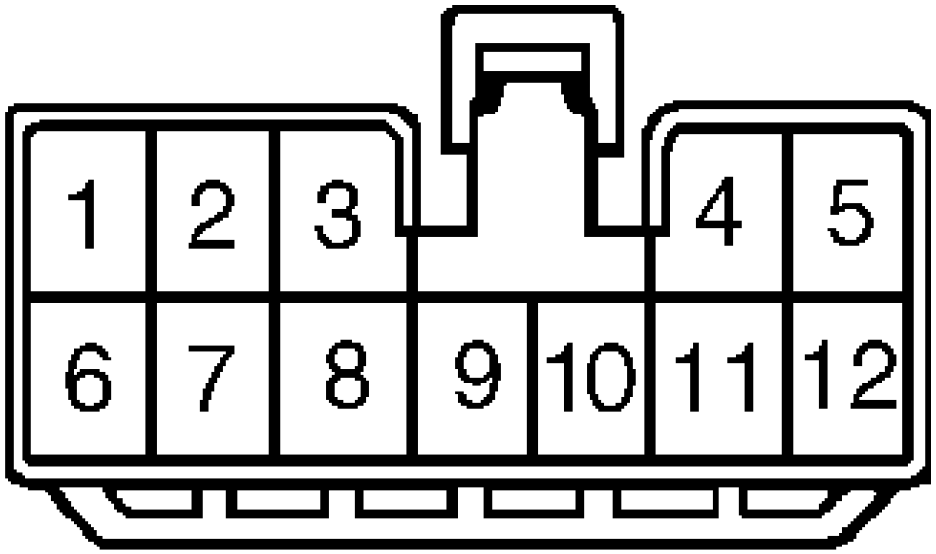
Disconnect 12-pin harness connector from light failure

sensor. Check circuit values between ground and terminals on vehicle harness side of connector. See Fig. 3. Ensure circuit values are as specified. See LIGHT FAILURE SENSOR CIRCUIT VALUES table. If circuit values are as specified, replace light failure sensor. If circuit values are not as specified, check and repair related components or wiring harness as necessary. See COMPONENT TESTS and/or WIRING DIAGRAMS.

LIGHT FAILURE SENSOR CIRCUIT VALUES

Tester Connection	Condition	Circuit Value
1 & Ground	Constant	(1) Continuity
2 & Ground	Constant	(1) Continuity
3 & Ground	Light Control Switch In OFF Position	No Voltage
3 & Ground	Light Control Switch In TAIL Or HEAD Position	Battery Voltage
4 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
4 & Ground	Ignition Switch In ON Position	Battery Voltage
7 & Ground	Stoplight Switch In OFF Position	No Voltage
7 & Ground	Stoplight Switch In ON Position	Battery Voltage
8 & Ground	Ignition Switch In LOCK Or ACC Position	No Voltage
8 & Ground	Ignition Switch In ON Position	Battery Voltage
9 & Ground	Constant	(1) Continuity
11 & Ground	Constant	Continuity

(1) - Continuity is present due to bulb in circuit.



G96I07864

Fig. 3: Identifying Light Failure Sensor Harness Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARKING BRAKE SWITCH CIRCUIT

NOTE: See BODY CONTROL SYSTEMS - RX300 article.

SPEEDOMETER CIRCUIT

NOTE: If Lexus hand-held tester is not available, begin testing with step 2).

1) Connect Lexus hand-held tester to Data Link Connector No. 3 (DLC3). With tester in ACTIVE TEST mode, operate speedometer. If speedometer needle moves as commanded by tester, replace A/C and combination meter integrated ECU. See Fig. 1. If speedometer needle does not move as commanded by tester, check for ABS DTCs. See ANTI-LOCK BRAKES article in WIRING DIAGRAMS. If any DTCs from DTC 31 to DTC 35 are set, repair as necessary. If no DTCs are set, go to next step.

2) Check for open or short in harness or connector between A/C and combination meter integrated ECU and ABS ECU. Repair as necessary. If circuits are okay, go to next step.

3) Check speedometer. See SPEEDOMETER under COMPONENT TESTS. Repair as necessary. If speedometer is okay, replace combination meter circuit plate. See Fig. 1.

TACHOMETER CIRCUIT

NOTE: If Lexus hand-held tester is not available, begin testing with step 2).

1) Connect Lexus hand-held tester to Data Link Connector No. 3 (DLC3). With tester in ACTIVE TEST mode, operate tachometer. If tachometer needle moves as commanded by tester, replace A/C and combination meter integrated ECU. See Fig. 1. If tachometer needle does not move as commanded by tester, go to next step.

2) Check igniter signal circuit. See IGNITER SIGNAL CIRCUIT. Repair as necessary. If igniter signal circuit is okay, go to next step.

3) Check tachometer. See TACHOMETER under COMPONENT TESTS. Repair as necessary. If tachometer is okay, replace combination meter circuit plate. See Fig. 1.

COMPONENT TESTS

BRAKE FLUID LEVEL WARNING SWITCH

Remove brake fluid reservoir cap and strainer. Disconnect brake fluid level warning switch connector. Using DVOM, check for continuity between switch terminals. Ensure continuity is not present with switch float up, and present with switch float down. If continuity is not as specified, replace brake fluid level warning switch.

BRAKE WARNING LIGHT

Disconnect brake fluid level warning switch connector. Release parking brake. Using jumper wire, connect harness side of switch terminals together. Start engine. Ensure brake warning light illuminates. If brake warning light does not illuminate, check bulb and circuit. See BULB CIRCUIT under CIRCUIT TESTS. Repair as necessary.

DOOR COURTESY SWITCH

Driver & Passenger Doors

Locate door courtesy switch to be tested. One switch is located in each door lock assembly (total of 4 switches). Disconnect 2-pin door courtesy switch connector. With door lock open, check for continuity between door courtesy switch terminals. Ensure continuity is present. Continuity should not be present with door lock closed. If continuity is not as specified, replace faulty door lock assembly.

Rear Door (Luggage Compartment)

Locate rear door courtesy switch. Switch is located in rear door lock motor assembly. Disconnect 2-pin rear door courtesy switch connector. Using DVOM, check for continuity between terminal No. 2 (White/Red wire) and ground. Ensure continuity is present only when switch is in ON position. If battery voltage is not present, replace rear door lock motor assembly.

ENGINE COOLANT TEMPERATURE GAUGE

1) Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Disassemble instrument cluster to access engine coolant temperature gauge terminals on back of speedometer assembly.

2) Ensure engine coolant temperature gauge needle is against COLD stop. Using DVOM, measure resistance between gauge terminals. See Fig. 4. Ensure resistance is as specified. See ENGINE COOLANT TEMPERATURE GAUGE RESISTANCE table. If resistance is not as specified, replace engine coolant temperature gauge.

ENGINE COOLANT TEMPERATURE GAUGE RESISTANCE

Tester Connection	Ohms
"A" & "B"	140-185
"C" & "D"	130-175

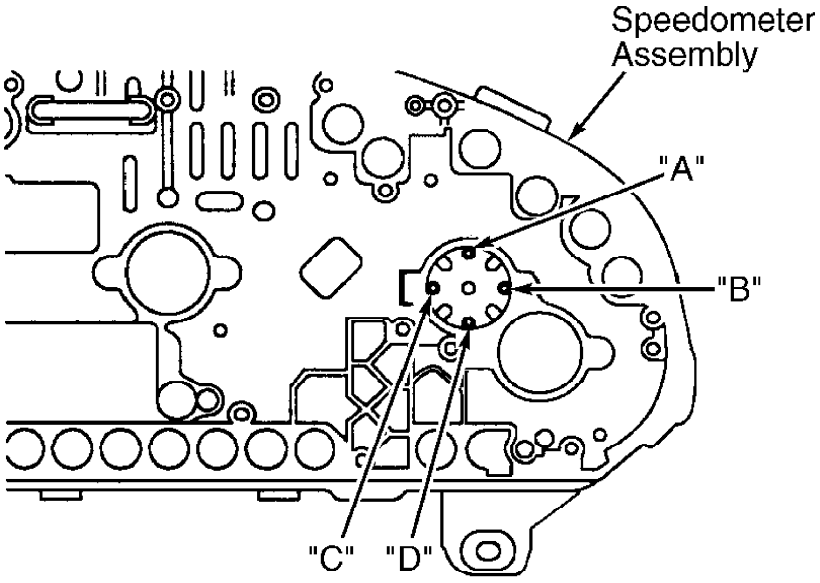


Fig. 4: Identifying Engine Coolant Temperature Gauge Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL GAUGE

On-Vehicle

1) Disconnect 5-pin main fuel gauge sending unit harness connector. Disconnect negative battery cable for 30 seconds, and then reconnect. Turn ignition on. Ensure fuel gauge indicates EMPTY. Turn ignition off, reconnect harness connector and go to next step.

2) Disconnect 2-pin sub fuel gauge sending unit harness connector. Disconnect negative battery cable for 30 seconds, and then reconnect. Turn ignition on. Ensure fuel gauge indicates EMPTY. If operation is not as specified, check fuel gauge resistance. See RESISTANCE CHECK.

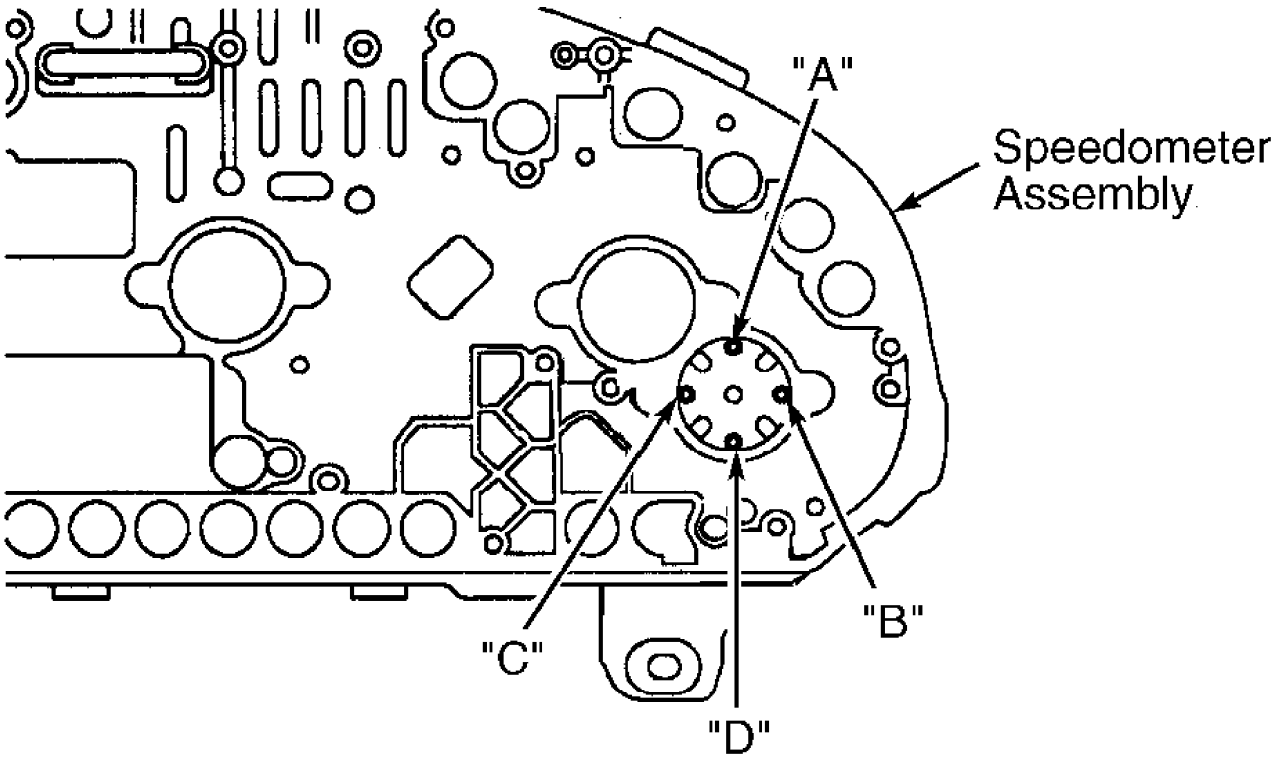
Resistance Check

1) Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Disassemble instrument cluster to access fuel gauge terminals on back of speedometer assembly.

2) Ensure fuel gauge needle is against EMPTY stop. Using DVOM, measure resistance between fuel gauge terminals. See Fig. 5. Ensure resistance is as specified. See FUEL GAUGE RESISTANCE table. If resistance is not as specified, replace fuel gauge.

FUEL GAUGE RESISTANCE

Tester Connection	Ohms
"A" & "B"	140-185
"C" & "D"	130-175



G99D51519

Fig. 5: Identifying Fuel Gauge Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL GAUGE SENDING UNIT

Main Sending Unit

Disconnect 5-pin main fuel gauge sending unit harness connector. Using DVOM, measure resistance between terminals No. 1 and 2. See Fig. 6. Ensure resistance is as specified in each float position. See MAIN FUEL GAUGE SENDING UNIT RESISTANCE table. If resistance is not as specified, replace main fuel gauge sending unit.

MAIN FUEL GAUGE SENDING UNIT RESISTANCE

Float Position	Distance From Top Of Sending Unit - In. (mm)	Ohms (Approx.)
FULL	.362-.598 (9.2-15.2)	1.0-3.0
EMPTY	4.244-4.480 (107.8-113.8)	42.3-44.3

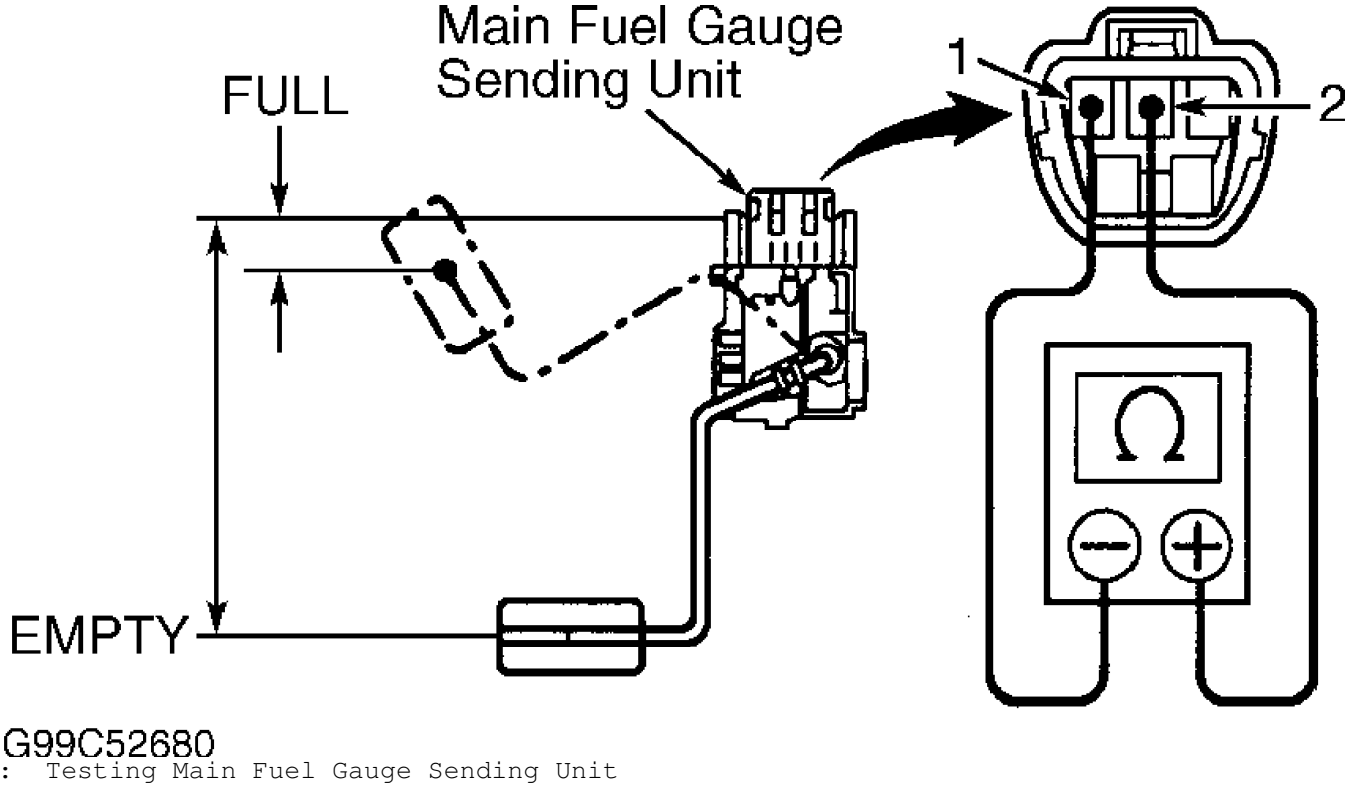


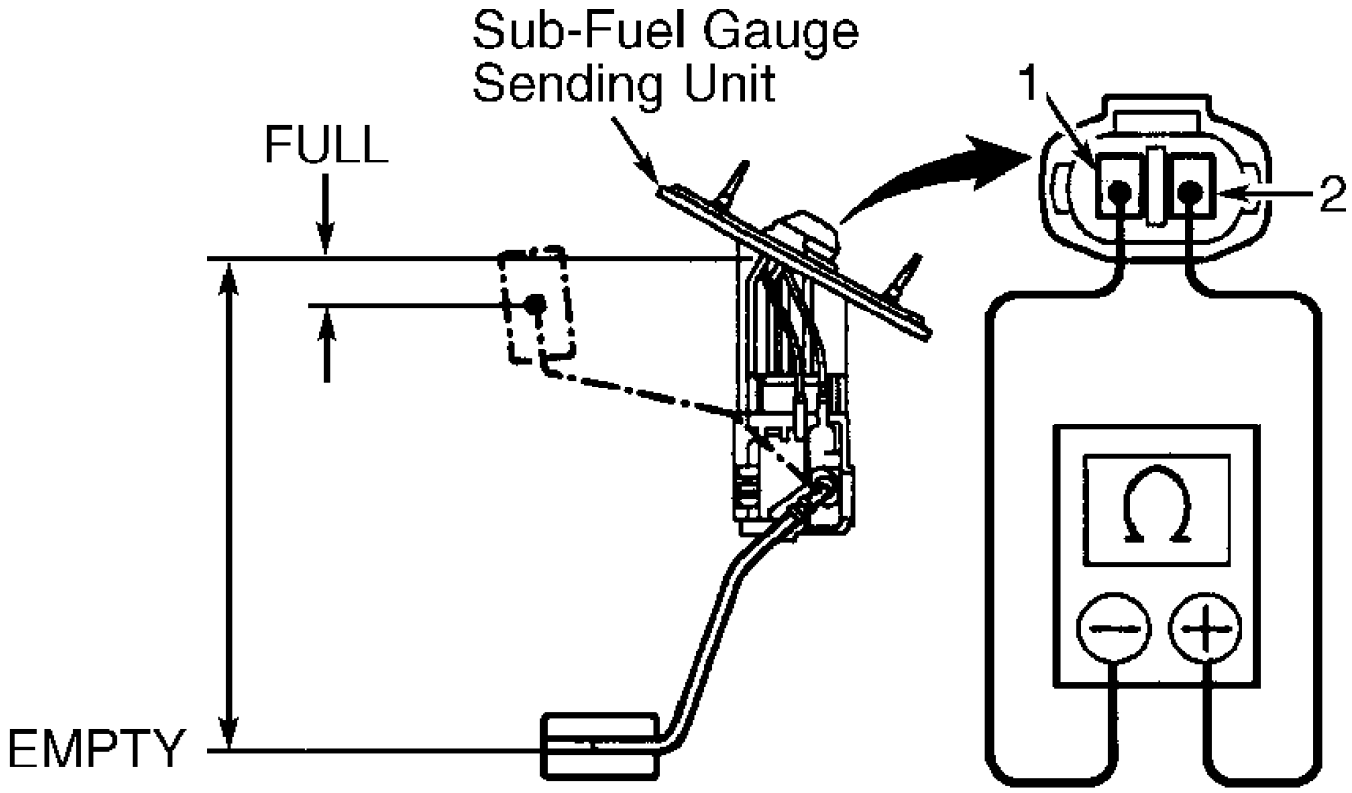
Fig. 6: Testing Main Fuel Gauge Sending Unit
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Sub Sending Unit

Disconnect 2-pin sub fuel gauge sending unit harness connector. Using DVOM, measure resistance between terminals No. 1 and 2. See Fig. 7. Ensure resistance is as specified in each float position. See SUB FUEL GAUGE SENDING UNIT RESISTANCE table. If resistance is not as specified, replace sub fuel gauge sending unit.

SUB FUEL GAUGE SENDING UNIT RESISTANCE

Float Position	Distance From Top Of Sending Unit - In. (mm)	Ohms (Approx.)
FULL	.319-.555 (8.1-14.1)	1.0-3.0
EMPTY	6.165-6.402 (156.6-162.6)	42.3-44.3

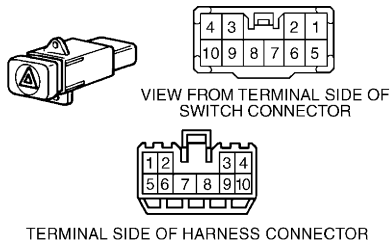


G99D52681

Fig. 7: Testing Sub Fuel Gauge Sending Unit
Courtesy of Toyota Motor Sales, U.S.A., Inc.

HAZARD WARNING SWITCH

Remove hazard warning switch. With hazard warning switch in ON position, continuity should be present between switch terminals No. 5 and 6. See Fig. 8. With hazard warning switch in OFF position, continuity should not be present between terminals No. 5 and 6. With hazard warning switch in either position, continuity should be present between terminals No. 8 and 9 (illumination circuit). If continuity is not as specified, replace hazard warning switch.



G92B01199

Fig. 8: Identifying Hazard Warning Switch & Harness Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

INSTRUMENT CLUSTER

Combination Meter ECU Circuit

Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Using DVOM, check for continuity between appropriate instrument cluster connector terminals. See Fig. 9. Ensure continuity is as specified. See COMBINATION METER ECU CIRCUIT VALUES table. If continuity is not as specified, check and replace appropriate bulb as necessary. If bulb is okay, replace instrument cluster.

COMBINATION METER ECU CIRCUIT VALUES

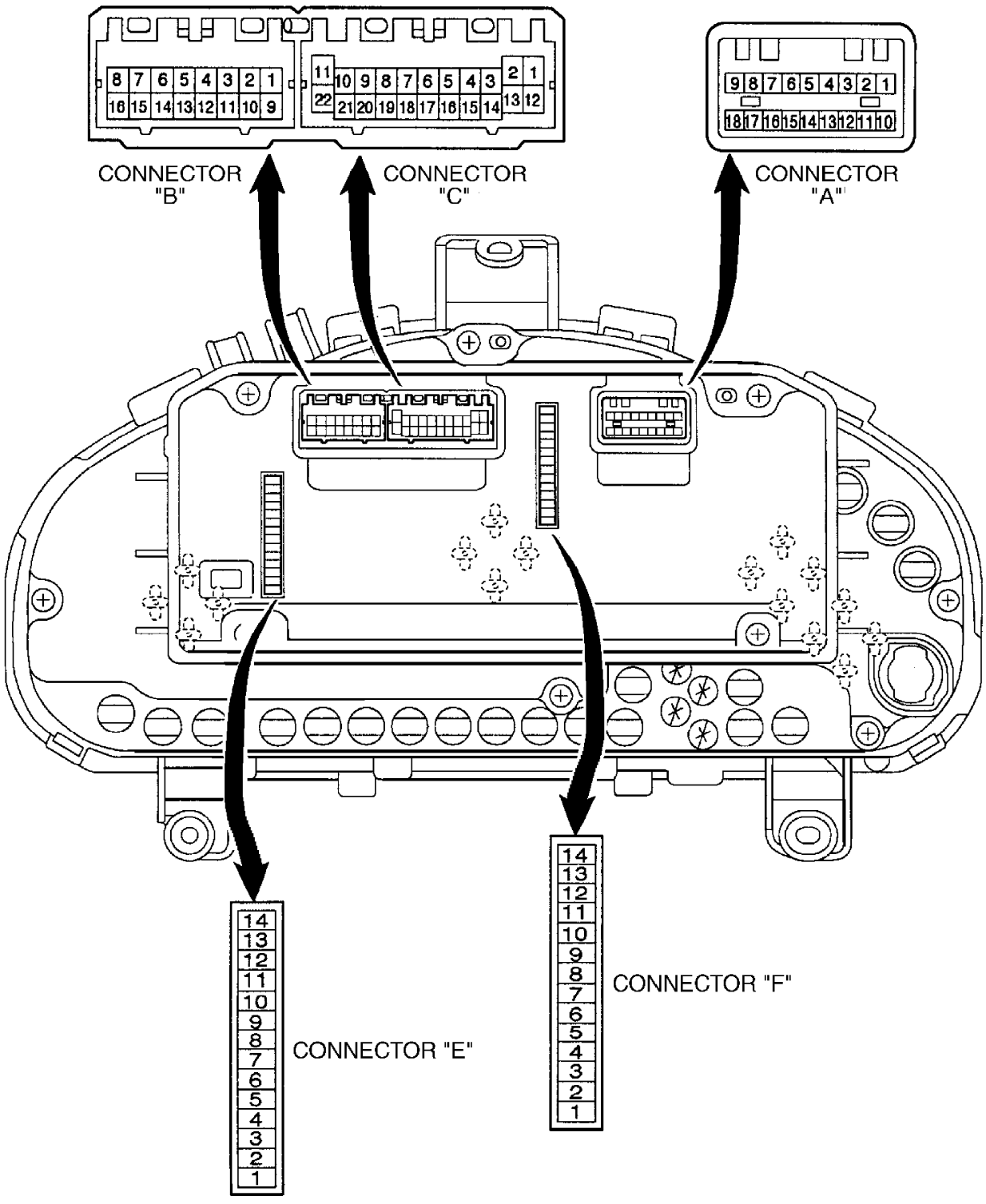
Tester Connection	Indicator/Warning Light	Circuit Value
F1 & E11, E12, E13	Right Turn	Continuity
F2 & E11, E12, E13	Left Turn	Continuity
F3 & E3, E4	SLIP	Continuity
F4 & E3, E4	TRAC OFF	Continuity
F5 & E3, E4	CRUISE MAIN	Continuity
F6 & E3, E4	MIL	Continuity
F7 & E3, E4	ABS	Continuity
F8 & F10	HI-Beam	Continuity
F9 & F14	SRS	Continuity
F12 & E3, E4	O/D OFF	Continuity
F13 & E3, E4	Washer Level	Continuity

Instrument Panel Integration ECU Circuit

Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Using DVOM, check for continuity between appropriate instrument cluster connector terminals. See Fig. 9. Ensure continuity is as specified. See INSTRUMENT PANEL INTEGRATION ECU CIRCUIT VALUES table. If continuity is not as specified, replace instrument cluster.

INSTRUMENT PANEL INTEGRATION ECU CIRCUIT VALUES

Tester Connection	Circuit Value
E1 & C14	Continuity
E2 & C14	Continuity
E3 & C1	Continuity
E4 & C1	Continuity
E11 & C22	Continuity
E12 & C22	Continuity
E13 & C22	Continuity
E14 & C11	Continuity
F1 & A10	Continuity
F2 & A11	Continuity
F3 & A12	Continuity
F4 & A13	Continuity
F5 & A14	Continuity
F6 & A16	Continuity
F7 & A18	Continuity
F8 & C9	Continuity
F9 & C20	Continuity
F10 & C8	Continuity
F12 & C6	Continuity
F13 & B2	Continuity
F14 & C19	Continuity



G99E52682

Fig. 9: Identifying Instrument Cluster Connector Terminals (Component Side)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LIGHT CONTROL RHEOSTAT

Remove light control rheostat. Measure resistance between light control rheostat terminals No. 1 and 4. See Fig. 10. Resistance should decrease from 10 k/ohms to zero ohms when rheostat knob is turned clockwise. If resistance is not as specified, replace light control rheostat.

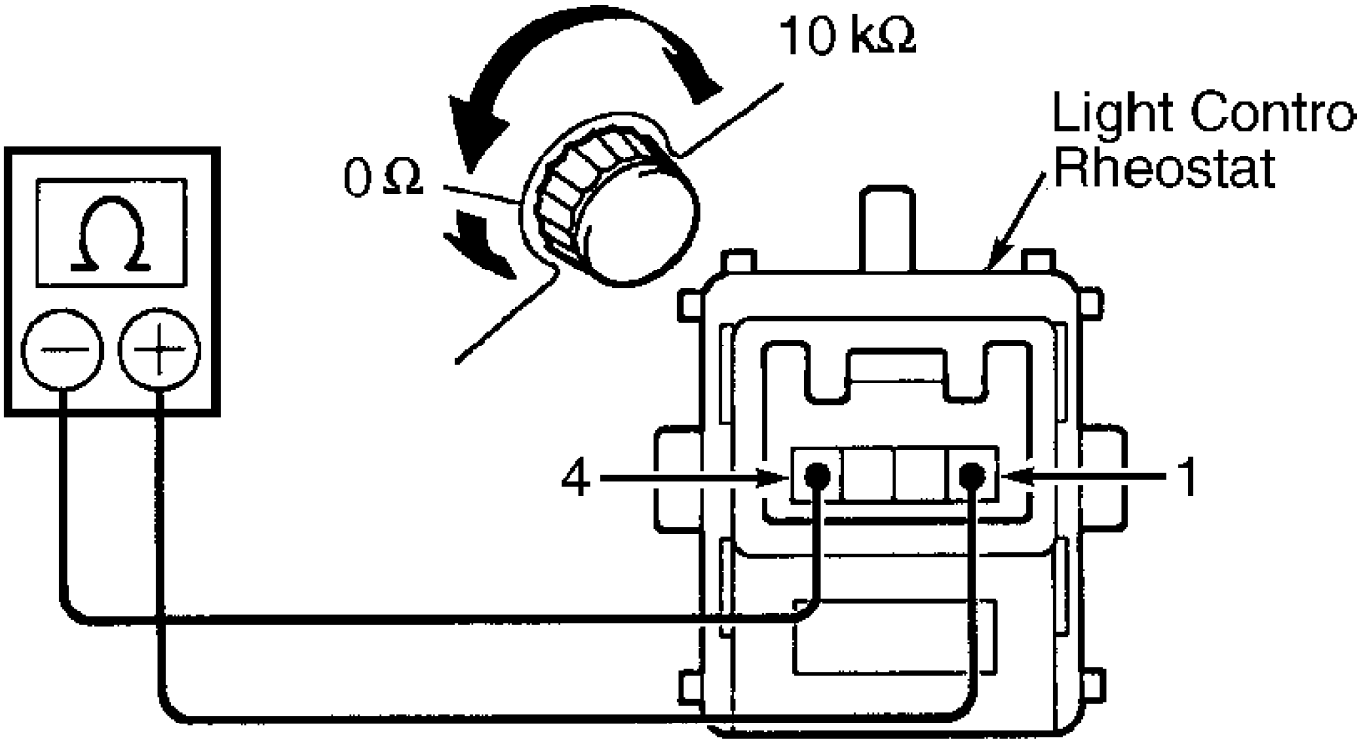


Fig. 10: Testing Light Control Rheostat
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LOW OIL PRESSURE WARNING LIGHT

Disconnect low oil pressure warning switch connector. Using jumper wire, ground harness side of switch terminal. Turn ignition on. Ensure low oil pressure warning light illuminates. If light does not illuminate, check bulb and circuit. See BULB CIRCUIT under CIRCUIT TESTS. Repair as necessary.

LOW OIL PRESSURE WARNING SWITCH

NOTE: Ensure engine oil pressure is greater than 3.5 psi (.25 kg/cm^2).

Disconnect low oil pressure warning switch connector. Using DVOM, ensure continuity is present between switch terminal and ground with engine off, and not present with engine running. If continuity is not as specified, replace low oil pressure warning switch.

OCCUPANT DETECTION SENSOR

Disconnect 2-pin occupant detection sensor harness connector located under passenger's seat. Check for continuity between sensor

terminals. Continuity should be present only when pressing on sensor. If continuity is not as specified, replace occupant detection sensor.

OPEN DOOR WARNING LIGHT

Disconnect appropriate door courtesy switch connector. Using jumper wire, jumper connector terminal to ground. Ensure open door warning light illuminates. If warning light does not illuminate, check bulb and circuit. See BULB CIRCUIT under CIRCUIT TESTS.

PARKING BRAKE SWITCH

Disconnect parking brake switch connector. Using DVOM, check for continuity between switch terminal and switch body. Ensure continuity is present with switch pin released, and not present with switch pin pushed in. If continuity is not as specified, check switch ground point or replace switch as necessary.

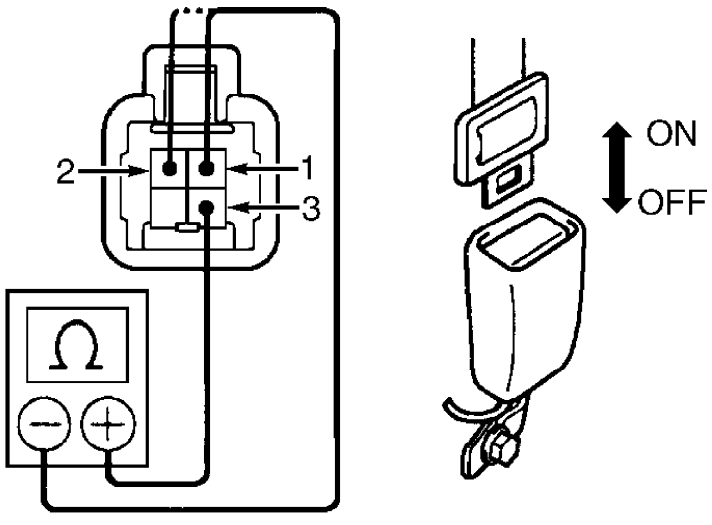
REAR LIGHTS WARNING LIGHT

Disconnect 12-pin harness connector from light failure sensor. Using jumper wire, ground terminal No. 3 at harness side of connector. See Fig. 3. Start engine. Ensure rear lights warning light illuminates. If light does not illuminate, check bulb and circuit. See BULB CIRCUIT under CIRCUIT TESTS. Repair as necessary.

SEAT BELT BUCKLE SWITCH

Driver's Side

Disconnect seat belt buckle switch connector. Connector is located at base of inner seat belt. Using DVOM, ensure continuity is present between switch terminals No. 2 and 3 with seat belt fastened. See Fig. 11. Ensure continuity is not present between switch terminals No. 1 and 3 with seat belt unfastened. If continuity is not as specified, replace seat belt buckle switch.



G99G52684

Fig. 11: Testing Seat Belt Buckle Switch (Driver's Side)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Passenger's Side

Disconnect seat belt buckle switch connector. Connector is

located at base of inner seat belt. Using DVOM, ensure continuity is present between switch terminals No. 1 and 4 with seat belt fastened. See Fig. 12. Ensure continuity is not present between switch terminals No. 2 and 4 with seat belt unfastened. If continuity is not as specified, replace seat belt buckle switch.

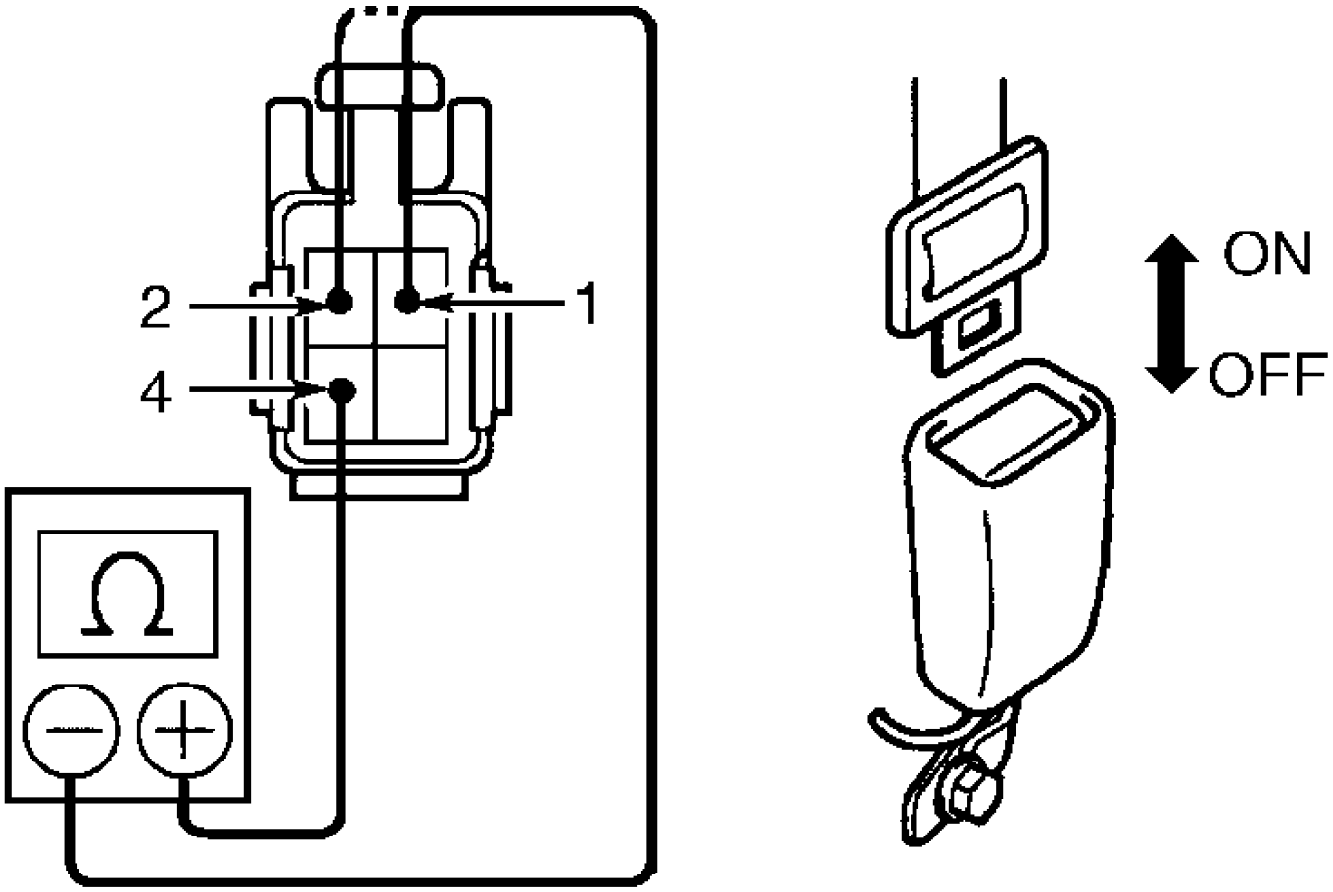


Fig. 12: Testing Seat Belt Buckle Switch (Passenger's Side)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SEAT BELT WARNING LIGHT

Disconnect seat belt buckle switch connector. Connector is located at base of inner seat belt. Using jumper wire, jumper appropriate terminals together at harness connector. See Fig. 13. Turn ignition on. If warning light illuminates, bulb and circuit are okay. If warning light does not illuminate, check wire harness. See WIRING DIAGRAMS. Repair as necessary. If wire harness is okay, check bulb. See BULB CIRCUIT under CIRCUIT TESTS.

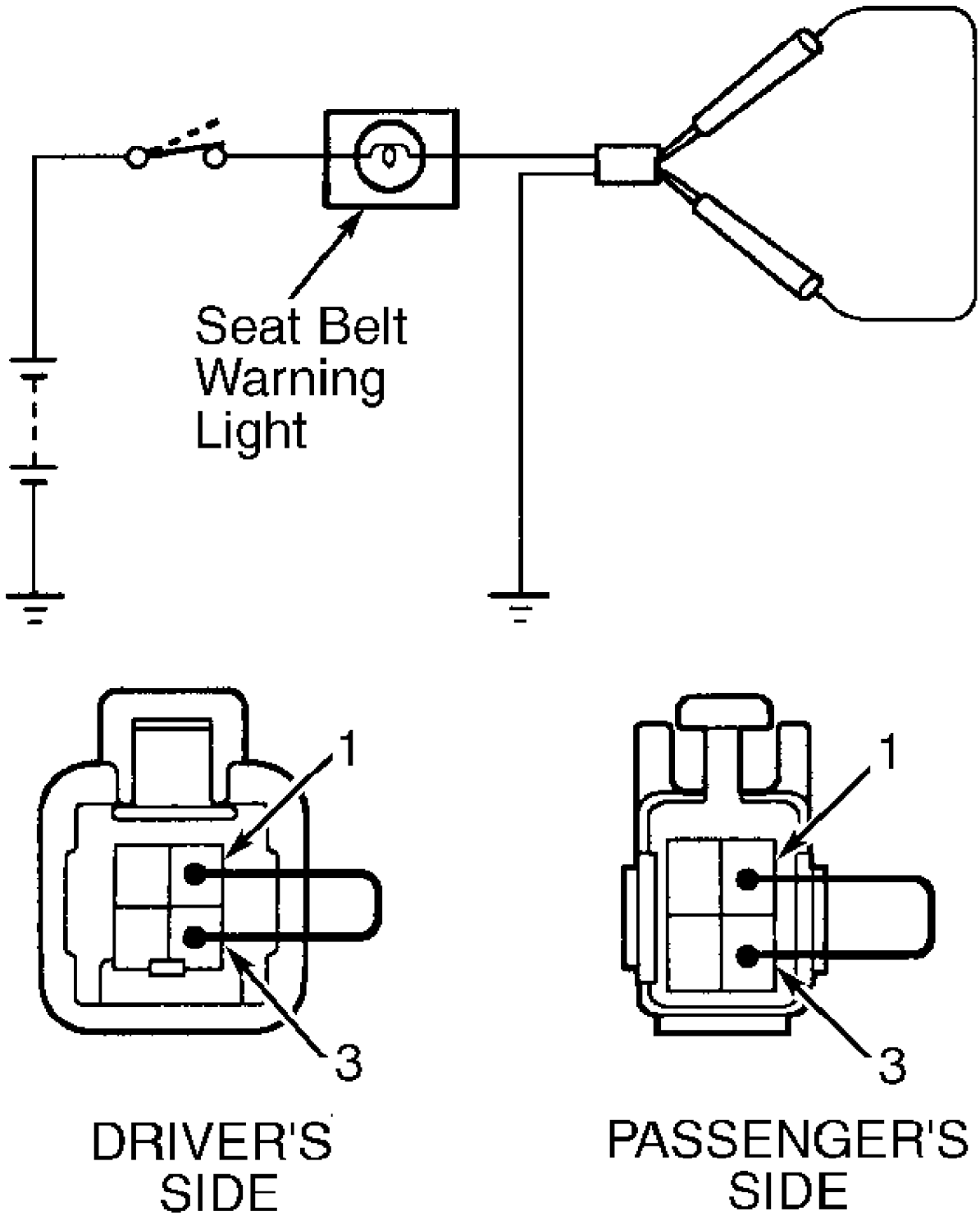


Fig. 13: Identifying Seat Belt Buckle Switch Harness Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SPEEDOMETER

On-Vehicle

Ensure tires are of correct size and are inflated properly. Place vehicle on standard speedometer tester. Compare tester reading with speedometer reading at listed vehicle speeds. See SPEEDOMETER TEST table. If vehicle speedometer readings are not within allowable range, replace speedometer.

SPEEDOMETER TEST

Vehicle Speed (Actual MPH)	Allowable Range (Indicated MPH)
20	18-24
40	38-44
60	56-66
80	78-88
100	98-110
120	118-132

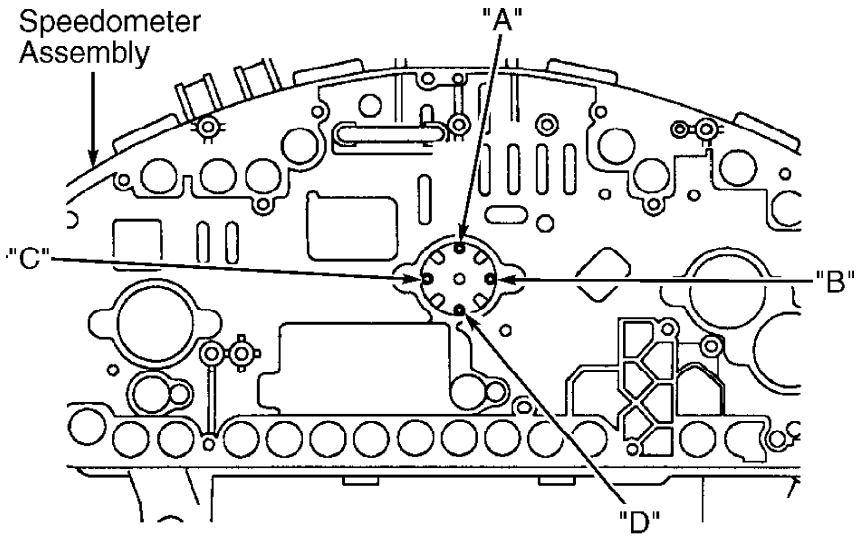
Resistance Check

1) Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Disassemble instrument cluster to access speedometer terminals on back of speedometer assembly.

2) Ensure speedometer needle is against zero MPH stop. Using DVOM, measure resistance between speedometer terminals. See Fig. 14. Ensure resistance is as specified. See SPEEDOMETER RESISTANCE table. If resistance is not as specified, replace speedometer.

SPEEDOMETER RESISTANCE

Tester Connection	Ohms
"A" & "B"	140-185
"C" & "D"	130-175



G99J52687

Fig. 14: Identifying Speedometer Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TACHOMETER

On-Vehicle

Connect a test tachometer to ignition system. Start engine and compare vehicle tachometer reading to test tachometer reading. If vehicle tachometer reading is outside allowable range, replace tachometer. See TACHOMETER TEST table.

TACHOMETER TEST

Engine Speed (Actual RPM)	Allowable Range (Indicated RPM)
700	630-770
1000	900-1100
2000	1850-2150
3000	2800-3200
4000	3800-4200
5000	4800-5200
6000	5750-6250
7000	6700-7300

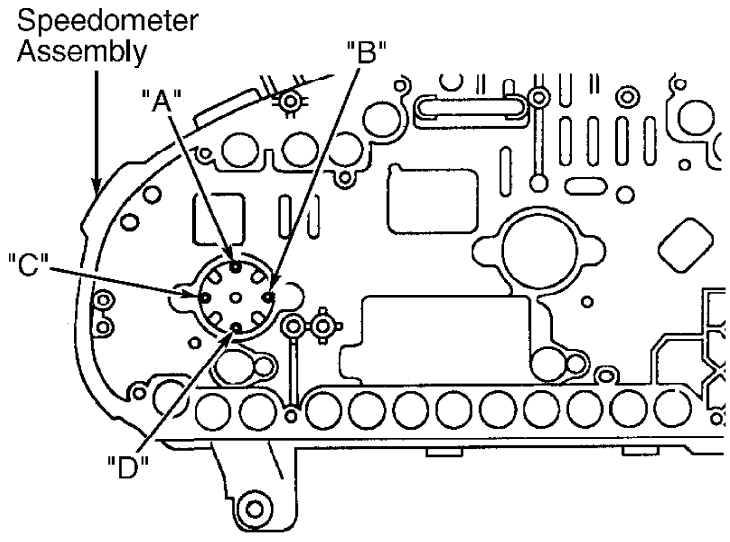
Resistance Check

1) Remove instrument cluster. See INSTRUMENT CLUSTER under REMOVAL & INSTALLATION. Disassemble instrument cluster to access tachometer terminals on back of speedometer assembly.

2) Ensure tachometer needle is against zero RPM stop. Using DVOM, measure resistance between tachometer terminals. See Fig. 15. Ensure resistance is as specified. See TACHOMETER RESISTANCE table. If resistance is not as specified, replace tachometer.

TACHOMETER RESISTANCE

Tester Connection	Ohms
"A" & "B"	140-185
"C" & "D"	130-175



G99A52688

Fig. 15: Identifying Tachometer Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WINDOW WASHER LEVEL WARNING LIGHT

Disconnect 2-pin window washer level switch connector. Using jumper wire, jumper switch terminal No. 1 (Blue/White wire) to ground. If warning light illuminates, bulb and circuit are okay. If warning light does not illuminate, check circuit. See WIRING DIAGRAMS. Repair as necessary. If circuit is okay, check bulb. See BULB CIRCUIT under CIRCUIT TESTS.

WASHER FLUID LEVEL WARNING SWITCH

Disconnect washer fluid level warning switch 2-pin connector. Check for continuity between switch terminals. With float up, continuity should not be present. With float down, continuity should be present. If continuity is not as specified, replace washer fluid level warning switch.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

NOTE: Steering wheel removal may be necessary to access instrument cluster. See AIR BAG RESTRAINT SYSTEMS article.

INSTRUMENT CLUSTER

Removal & Installation

1) Disconnect negative battery cable. Remove steering wheel, if necessary. Remove 2 retaining screws from under top of instrument cluster finish panel. Using a screwdriver protected with tape, gently pry instrument cluster finish panel outward to release clips securing lower portion.

2) Pull instrument cluster finish panel outward and remove. Remove 3 instrument cluster retaining screws. Pull instrument cluster outward and disconnect harness connectors. Remove instrument cluster. For disassembly of instrument cluster, refer to illustration. See Fig. 1. To install, reverse removal procedure.

WIRING DIAGRAMS

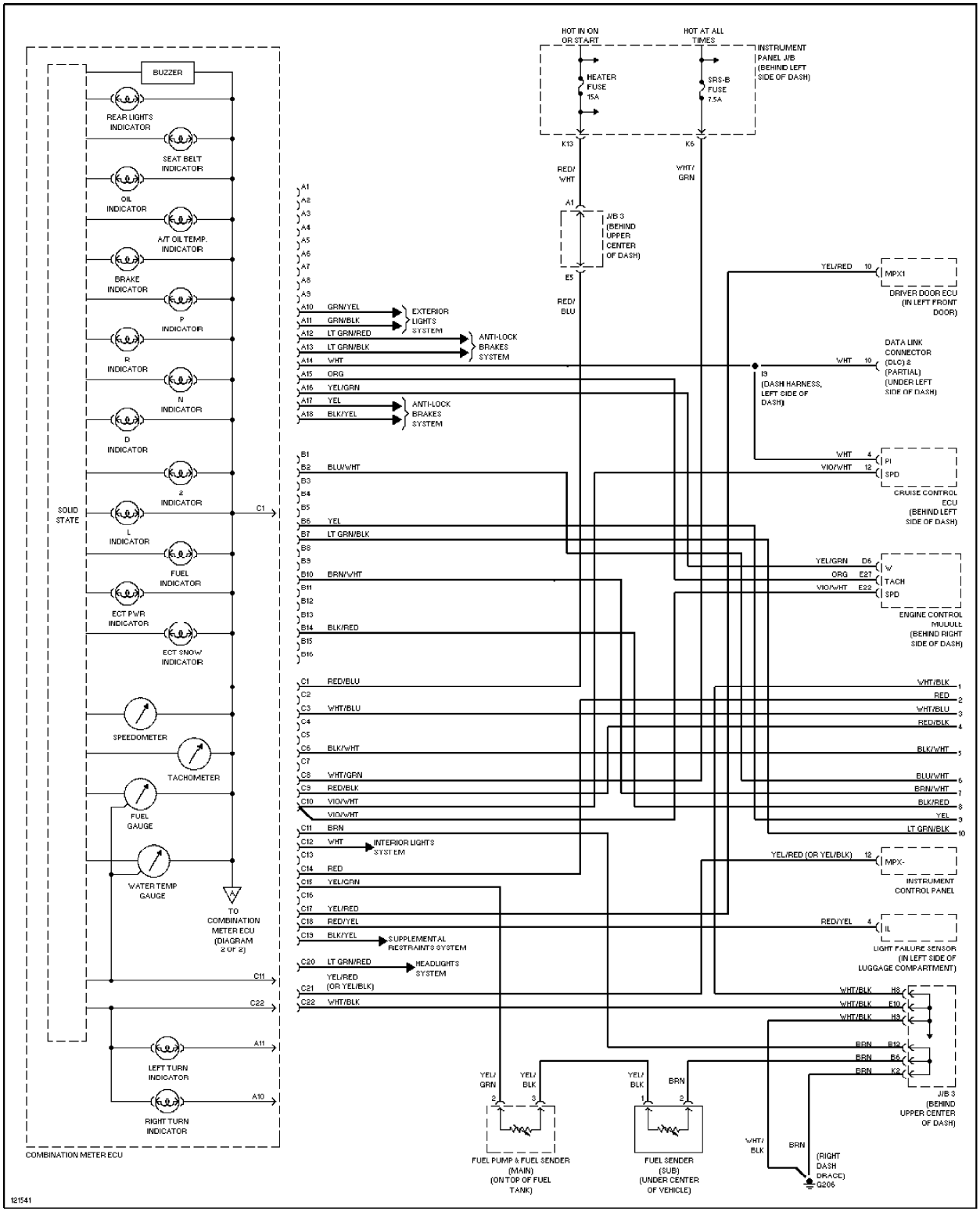


Fig. 16: Instrument Panel Wiring Diagram (RX300 - 1 Of 2)

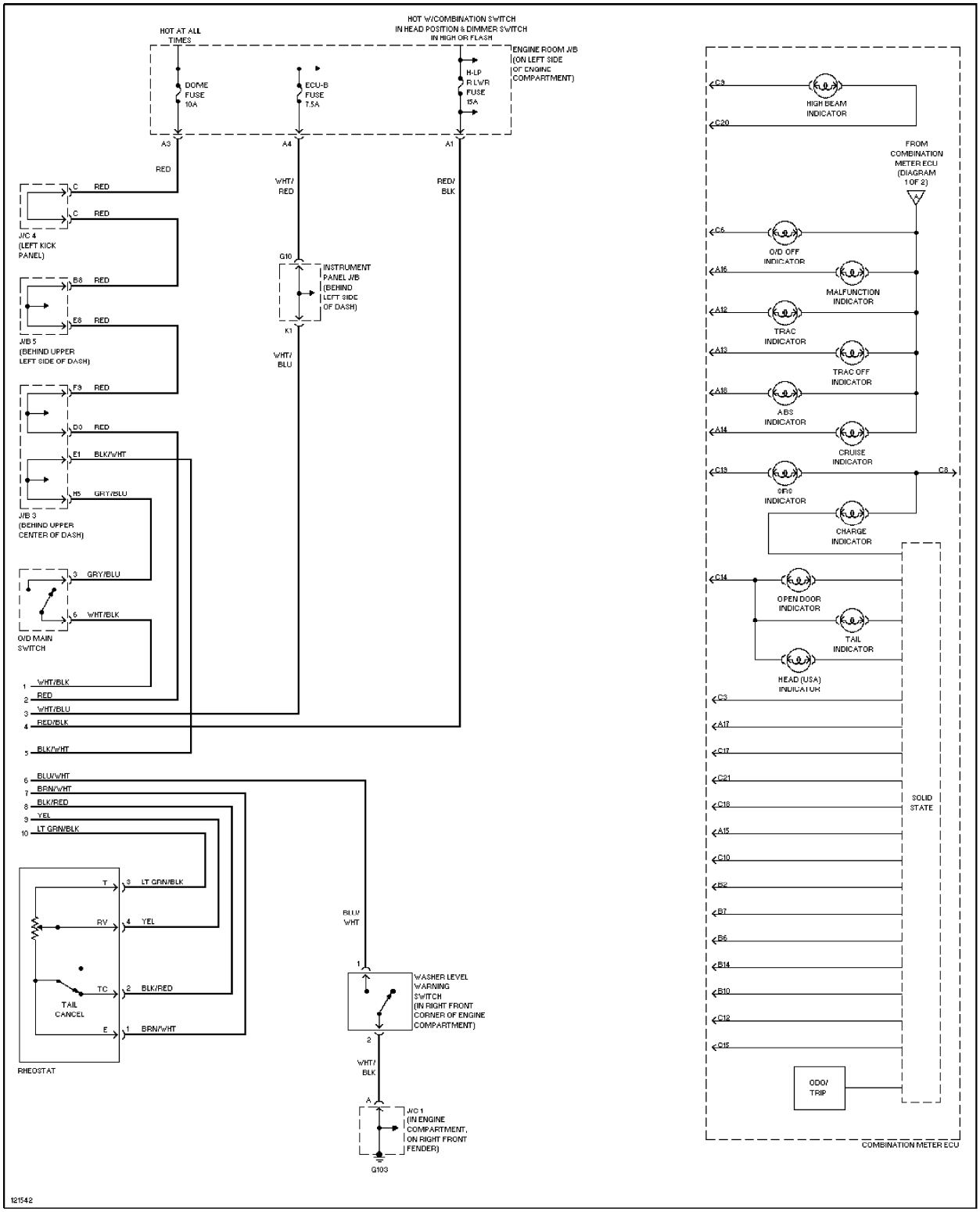


Fig. 17: Instrument Panel Wiring Diagram (RX300 - 2 Of 2)

KEYLESS ENTRY SYSTEM - REMOTE

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Remote Keyless Entry Systems

RX300

DESCRIPTION & OPERATION

The remote keyless entry system allows the doors to be locked and unlocked by low-power electrical waves emitted from a hand-held transmitter. Pushing the transmitter UNLOCK button once will deactivate the theft deterrent system and unlock driver's door. Pushing the UNLOCK button again within 3 seconds will unlock the other doors and sound 2 chirps. Interior lights will also illuminate if interior light switch is in DOOR position. However, these functions do not operate if ignition switch is in ON position. If doors are not opened within 30 seconds, all the doors will automatically relock.

Pushing the transmitter LOCK button once will lock all doors, sound one chirp and flash turn signals. If any door is not fully closed when LOCK button is pressed, door lock buzzer will sound for 10 seconds. To stop buzzer, ensure all doors are closed completely and push transmitter LOCK button again. If the transmitter PANIC button is pressed continuously for about one second, the panic alarm will sound. To stop panic alarm, push any transmitter button. However, this function does not operate if ignition switch is in ON position. To ensure doors are locked when walking away from vehicle, push transmitter LOCK button once again. If doors were already locked, turn signal lights will flash. The transmitter can also be used to operate windows and moon roof.

All remote keyless entry system functions can be programmed to fit customer needs (by dealer only).

COMPONENT LOCATIONS

COMPONENT LOCATIONS

Component	Location
Body ECU	Behind Left Side Of Instrument Panel
Door ECU	Inside Each Door
Door Key Lock/Unlock Switch	Integral With Right & Left Front Door Lock Motors
Door Unlock Detection Switch	Integral With Each Door Lock Motor
D RR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
ECU-B Fuse (7.5-Amp)	In Engine Compartment Junction Block
Engine Compartment Junction Block	Left Side Of Engine Compartment, Next To Strut Tower
Engine Control Module (ECM)	Behind Right Side Of Instrument Panel, Above Glove Box
FL DOOR Fuse (20-Amp)	In Engine Compartment Junction Block
GAUGE Fuse (7.5-Amp)	In Instrument Panel Junction Block
Instrument Panel Junction Block	Behind Driver's Kick Panel
Key Unlock Warning Switch	Integral With Ignition Switch
P FR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
P RR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
Wireless Door Lock Buzzer	Behind Left-Side Headlight, Next To Engine Compartment Junction Block
Wireless Door Lock ECU	In Rear Luggage Area, Behind Left Rear Quarter Panel

TRANSMITTER PROGRAMMING

NOTE: The remote keyless entry system is equipped with 2 transmitters, having 2 unique vehicle access codes programmed into the wireless door lock ECU.

MODES OF REGISTRATION (PROGRAMMING)

There are 4 registration modes:

Add Mode
Adds a transmitter without erasing existing transmitter codes. Four transmitter codes can be registered at one time. If number of registered codes exceeds 4, previously registered codes are erased in order, starting with first registered code.

Rewrite Mode
Erases all previously registered transmitter codes and reprogram new transmitters.

Confirmation Mode
Informs user of number of existing transmitter codes already programmed in system.

Prohibition Mode
Erases all existing registered transmitter codes and cancels wireless door lock operation. Use this function if transmitter is lost or stolen.

REGISTRATION OF RECOGNITION CODE

1) To begin programming, remove key from ignition switch. Ensure driver's door is open and unlocked, and all other doors are closed. Insert key into ignition switch, and then remove it. Go to next step.
2) Complete the following in 40 seconds or less: press door lock switch to LOCK position, and then within one second, press door lock switch to UNLOCK position. Repeat procedure continuously until door locks have been locked and unlocked 5 times. Close, and then open driver's door. Go to next step.
3) Complete the following in 40 seconds or less: repeat procedure in step 2), except for closing and opening driver's door. Insert key into ignition switch. To enter desired mode, turn ignition switch to ON position and back to LOCK position (one cycle), within one second, the specified number of times. See REGISTRATION MODE SELECTION table. Remove key from ignition switch. Go to next step.

REGISTRATION MODE SELECTION

Registration Mode	No. Of Ignition Switch Cycles
Add	1
Rewrite	2
Confirmation	3
Prohibition	5

4) If any mode other than confirmation mode is selected, go to next step. If confirmation mode was selected, door locks will cycle 0-4 times depending on how many transmitter codes are stored in ECU.

Example: two stored codes equals 2 door lock/unlock cycles. Registration of confirmation code is complete after door locks cycle.

5) Complete the following in 40 seconds or less: if add mode, rewrite mode or prohibition mode is selected, to confirm proper initiation, door locks will automatically cycle one time for add mode, 2 times for rewrite mode and 5 times for prohibition mode. Press transmitter LOCK and UNLOCK buttons simultaneously for at least 1.5 seconds, and then within 3 seconds, press any transmitter button for at least one second. Go to next step.

6) If within 3 seconds, door locks cycle one time, new transmitter code has been successfully accepted. Go to next step. If door locks cycle 2 times, new transmitter code was not accepted. To program an additional transmitter or to make a second attempt, return to step 5) within 40 seconds.

7) Registration of recognition codes is complete under any of the following conditions:

* Forty seconds has elapsed since wireless door lock ECU has responded.
* Driver's door is closed.
* Key is inserted into ignition key cylinder.
* Four recognition codes are registered at one time.

TROUBLE SHOOTING

NOTE: The remote keyless entry system is part of body control system. For additional information and remote keyless entry system trouble shooting, see BODY CONTROL SYSTEMS - RX300 article.

NOTE: Trouble shooting is based on the assumption that basic power door lock functions are operating correctly. Also ensure anti-theft system operates normally, and check transmitter battery condition.

Verify customer complaint. Perform a visual inspection, checking for open fuses, disconnected or damaged wire harnesses and components. Repair or replace items as necessary and recheck. If no problems are found, diagnose by symptom. See SYMPTOM TESTS.

SYMPTOM TESTS

NOTE: Before proceeding with symptom testing, ensure multiplex system is operating properly. See MULTIPLEX CONTROL SYSTEMS - RX300 article.

REMOTE TRANSMITTER INOPERATIVE

1) Remove key from ignition switch. Ensure all doors are closed and locked. While standing outside vehicle near driver's door, point transmitter toward vehicle. Press door LOCK button, and then UNLOCK button on transmitter for about one second. If doors do not lock and unlock properly, go to next step. If doors lock and unlock properly, system is okay at this time.

2) Observe transmitter LED while pressing transmitter LOCK and UNLOCK buttons. If transmitter LED illuminates when transmitter LOCK and UNLOCK buttons are pressed, go to step 4). If transmitter LED does not illuminate when transmitter LOCK and UNLOCK buttons are pressed, go to next step.

3) Replace transmitter battery. Check transmitter functions. If transmitter still does not operate properly, go to next step. If

transmitter operates properly with new battery, system is okay.

4) Remove key from ignition switch. Ensure all doors are closed and locked. Go to next step.

5) Perform the following within 35 seconds: insert key into ignition switch, and then remove it. Insert key once more. Turn ignition on, and then off one time within 5 seconds. Within 30 seconds, turn ignition on and off 9 additional times. Buzzer should chirp, indicating successful entry into diagnostic mode. If buzzer chirps and system enters diagnostic mode as specified, go to next step. If system does not enter diagnostic mode regardless of buzzer operation, go to step 9).

6) Press LOCK button on transmitter. Buzzer should produce a short chirp about every .5 second. Press UNLOCK button on transmitter. Buzzer should produce 2 short chirps about every .5 second. Press PANIC button on transmitter. Buzzer should produce a long chirp about every .5 second. If buzzer operation is as specified, go to next step. If buzzer produces a long continuous chirp, go to step 11). If buzzer does not produce any chirp, go to step 12).

7) While standing about 3 feet from vehicle, press any transmitter button for 20 seconds (buzzer should chirp continuously), and then press button again. If buzzer operates as specified, other body control systems are at fault (transmitter and wireless door lock ECU are okay). See BODY CONTROL SYSTEMS - RX300 article. If buzzer does not operate as specified, go to next step.

8) Transmitter or wireless door lock ECU is faulty. Repeat step 7) using a known-good transmitter. Replace original transmitter if necessary. If problem still exists, check wireless door lock ECU. See WIRELESS DOOR LOCK ECU RECEIVER CIRCUIT under CIRCUIT TESTS. Repair as necessary.

9) Repeat step 5), ensuring procedures are performed correctly. If buzzer operation is normal, but still does not enter diagnostic mode, go to next step. If buzzer still does not chirp, check wireless door lock buzzer. See WIRELESS DOOR LOCK BUZZER under COMPONENT TESTS. Repair as necessary.

10) Insert key into ignition switch. Using DVOM, check for continuity between ground and terminal No. 8 (Blue wire) at body ECU harness connector "C". See WIRING DIAGRAMS. Continuity should be present. If continuity is not present, repair key unlock warning switch or circuit as necessary.

11) Program transmitter. See TRANSMITTER PROGRAMMING. Retest system operation.

12) Repeat step 6) using a known-good transmitter. If transmitter operates, replace original transmitter. If transmitter does not operate, go to next step.

NOTE: The following step checks for wireless door lock signal error. For additional information on retrieving and diagnosing body ECU Diagnostic Trouble Codes (DTC), see MULTIPLEX CONTROL SYSTEMS - RX300 article.

13) Using jumper wire, connect terminals Tc and E1 of DLC1 together. If DTC B1242/42 is present, repair short circuit in Blue wire between terminal No. 4 of wireless door lock ECU and terminal No. 16 of body ECU harness connector "B". See WIRING DIAGRAMS. If DTC B1242/42 is not present, go to next step.

14) Using DVOM, measure voltage between ground and terminal No. 16 (Blue wire) at body ECU harness connector "B" without operating transmitter. See WIRING DIAGRAMS. If battery voltage is present, go to next step. If battery voltage is not present, repair open in Blue wire.

15) Remove key from ignition switch. Ensure all doors are closed and locked. Using DVOM, measure voltage between ground and terminal No. 3 (Blue/Yellow wire) at wireless door lock ECU. See

WIRING DIAGRAMS. Voltage should be 4.5-5.5 volts. Voltage should be zero volts when transmitter is operated. If voltage is as specified, go to next step. If voltage is not as specified, repair open in Blue/Yellow wire between terminal No. 3 of wireless door lock ECU and terminal No. 15 of body ECU harness connector "B".

16) Using DVOM, check for continuity between chassis ground and terminal No. 1 (White/Black wire) at wireless door lock ECU. See WIRING DIAGRAMS. If continuity is present, wireless door lock ECU is faulty. If continuity is not present, repair open or poor connection in White/Black wire.

CIRCUIT TESTS

WIRELESS DOOR LOCK BUZZER CIRCUIT

NOTE: See BODY CONTROL SYSTEMS - RX300 article.

WIRELESS DOOR LOCK ECU RECEIVER CIRCUIT

NOTE: For additional wireless door lock ECU receiver circuit testing, see BODY CONTROL SYSTEMS - RX300 article.

Harness Connector Disconnected

Disconnect wireless door lock ECU harness connector. Using DVOM, ensure continuity is constant between ground and terminal No. 1 (White/Black wire) of harness connector. See Fig. 1. If circuit value is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. Repair as necessary.

Harness Connector Connected

1) Connect wireless door lock ECU harness connector. Remove key from ignition switch. Using DVOM, measure voltage (backprobe) between ground and terminal No. 3 of harness connector. See Fig. 1. Ensure voltage is less than one volt intermittently. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. If voltage is as specified, go to next step.

2) Using DVOM, measure voltage (backprobe) between ground and terminal No. 4 of harness connector. See Fig. 1. Ensure voltage is 4.5-5.5 volts with remote transmitter off, and less than one volt with remote transmitter operating. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. If voltage is as specified, go to next step.

3) Using DVOM, measure voltage (backprobe) between ground and terminal No. 5 of harness connector. See Fig. 1. Ensure voltage is 4.5-5.5 volts with remote transmitter off, and less than one volt with remote transmitter operating. If voltage is as specified, wireless door lock ECU is faulty. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS.

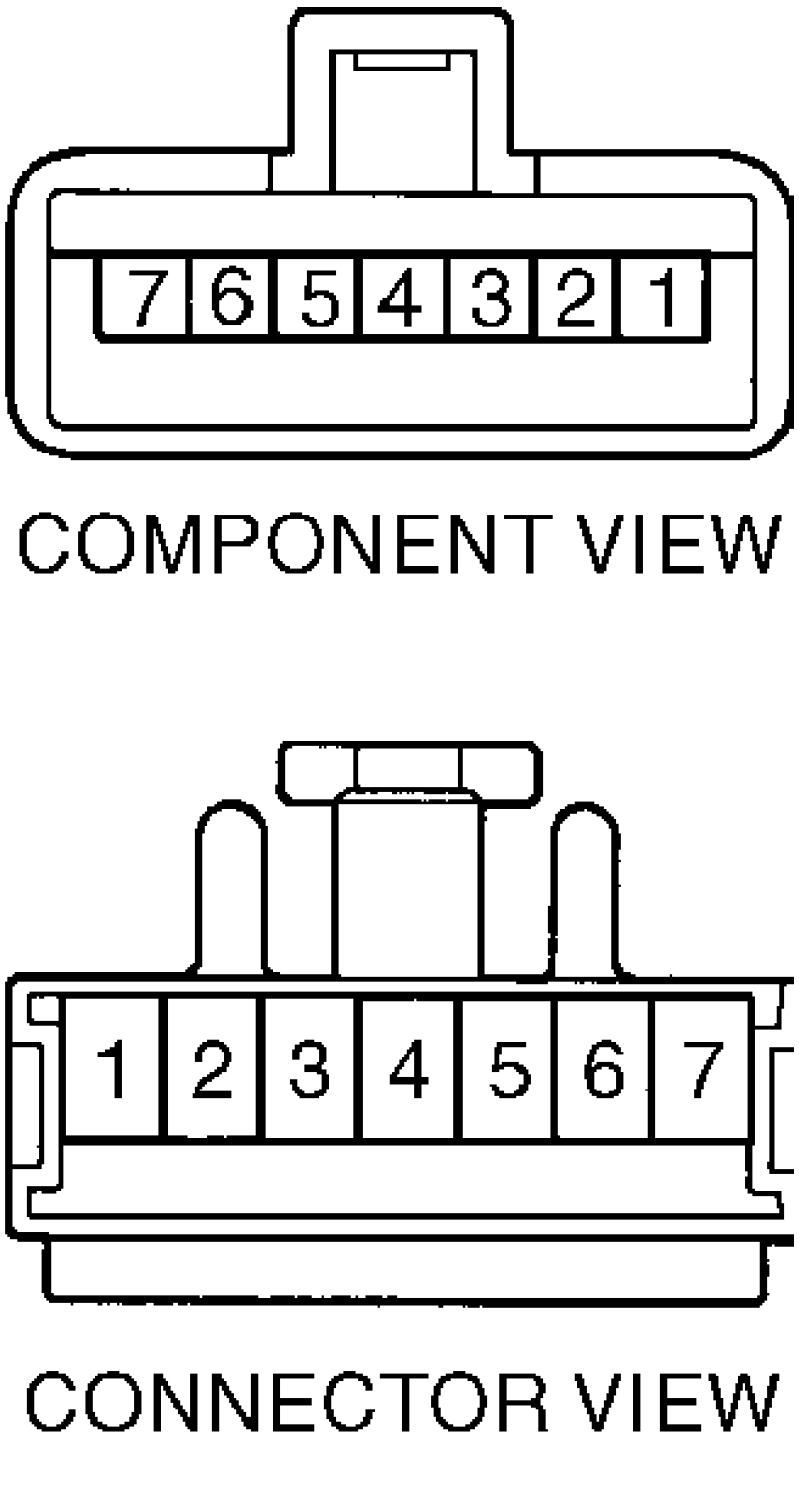


Fig. 1: Identifying Wireless Door Lock ECU Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPONENT TESTS

WIRELESS DOOR LOCK BUZZER

Disconnect door lock buzzer connector. Using DVOM, check for continuity between buzzer terminals. Resistance should be about 1000 ohms. If resistance is not as specified, replace door lock buzzer.

REMOVAL & INSTALLATION

Manufacturer does not provide a step-by-step procedure for removing and installing remote keyless entry system components. For remote keyless entry system component locations, see COMPONENT LOCATIONS.

WIRING DIAGRAMS

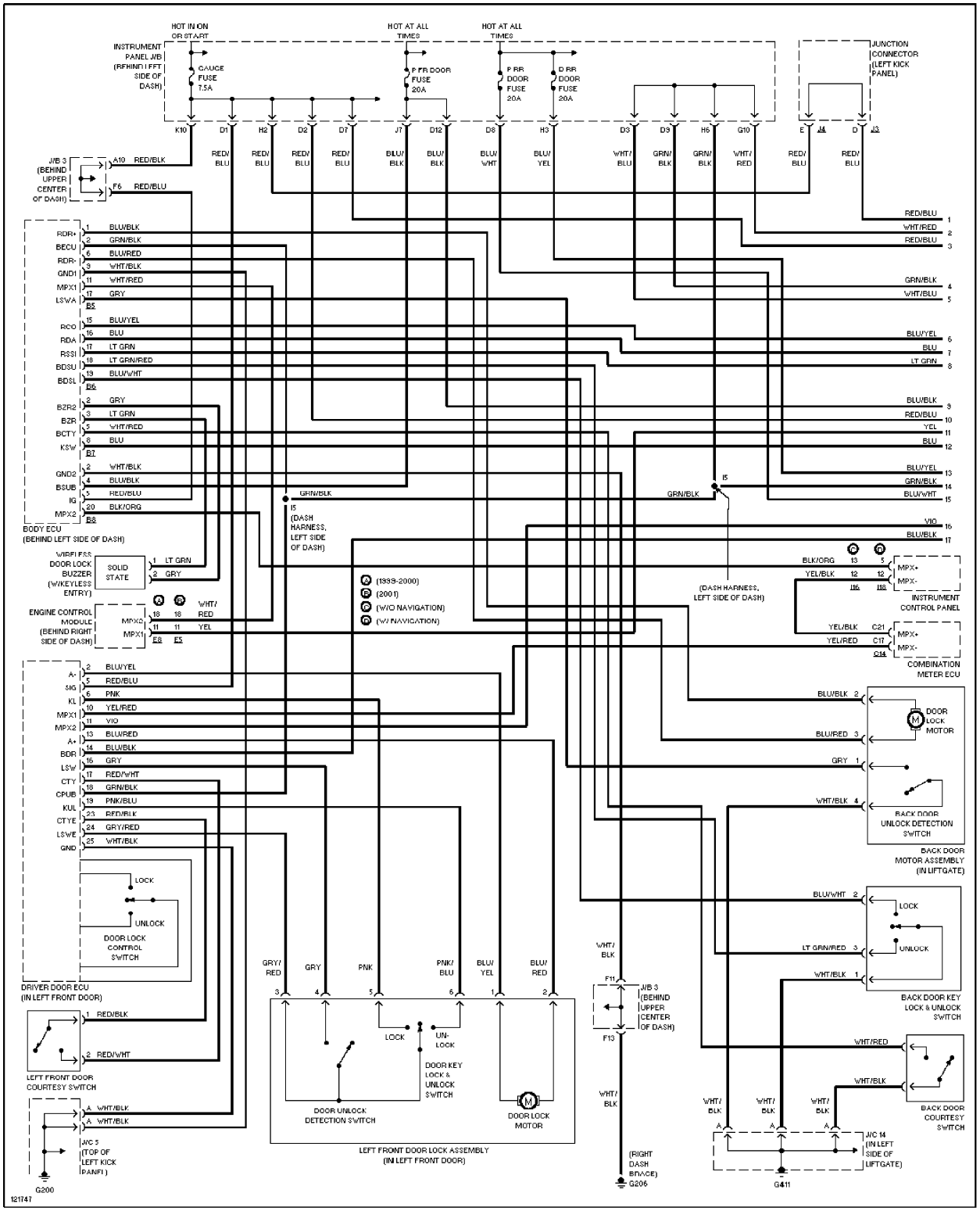


Fig. 2: Power Door Lock/Remote Keyless Entry System Wiring Diagram (RX300 - 1 Of 2)

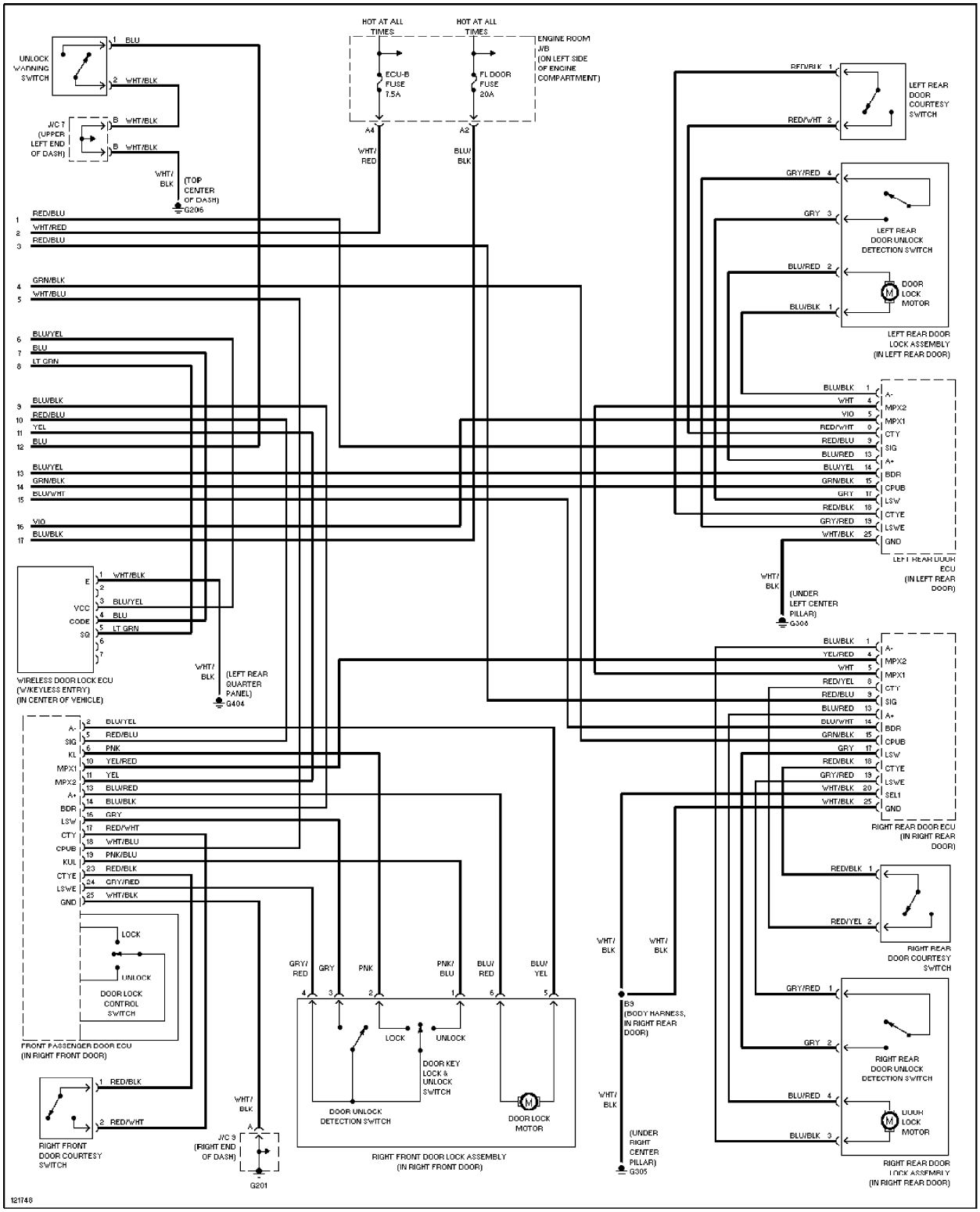


Fig. 3: Power Door Lock/Remote Keyless Entry System Wiring Diagram (RX300 - 2 Of 2)

KEYLESS ENTRY SYSTEM - REMOTE

1999 Lexus RX 300

1999-2000 ACCESSORIES & EQUIPMENT
Lexus Remote Keyless Entry Systems

RX300

DESCRIPTION & OPERATION

The remote keyless entry system allows the doors to be locked and unlocked by low-power electrical waves emitted from a hand-held transmitter. Pushing the transmitter UNLOCK button once will deactivate the theft deterrent system and unlock driver's door. Pushing the UNLOCK button again within 3 seconds will unlock the other doors and sound 2 chirps. Interior lights will also illuminate if interior light switch is in DOOR position. However, these functions do not operate if ignition switch is in ON position. If doors are not opened within 30 seconds, all the doors will automatically relock. See Fig. 1.

Pushing the transmitter LOCK button once will lock all doors, sound one chirp and flash turn signals. If any door is not fully closed when LOCK button is pressed, door lock buzzer will sound for 10 seconds. To stop buzzer, ensure all doors are closed completely and push transmitter LOCK button again. If the transmitter PANIC button is pressed continuously for about one second, the panic alarm will sound. To stop panic alarm, push any transmitter button. However, this function does not operate if ignition switch is in ON position. To ensure doors are locked when walking away from vehicle, push transmitter LOCK button once again. If doors were already locked, turn signal lights will flash. The transmitter can also be used to operate windows and moon roof.

All remote keyless entry system functions can be programmed to fit customer needs (by dealer only).

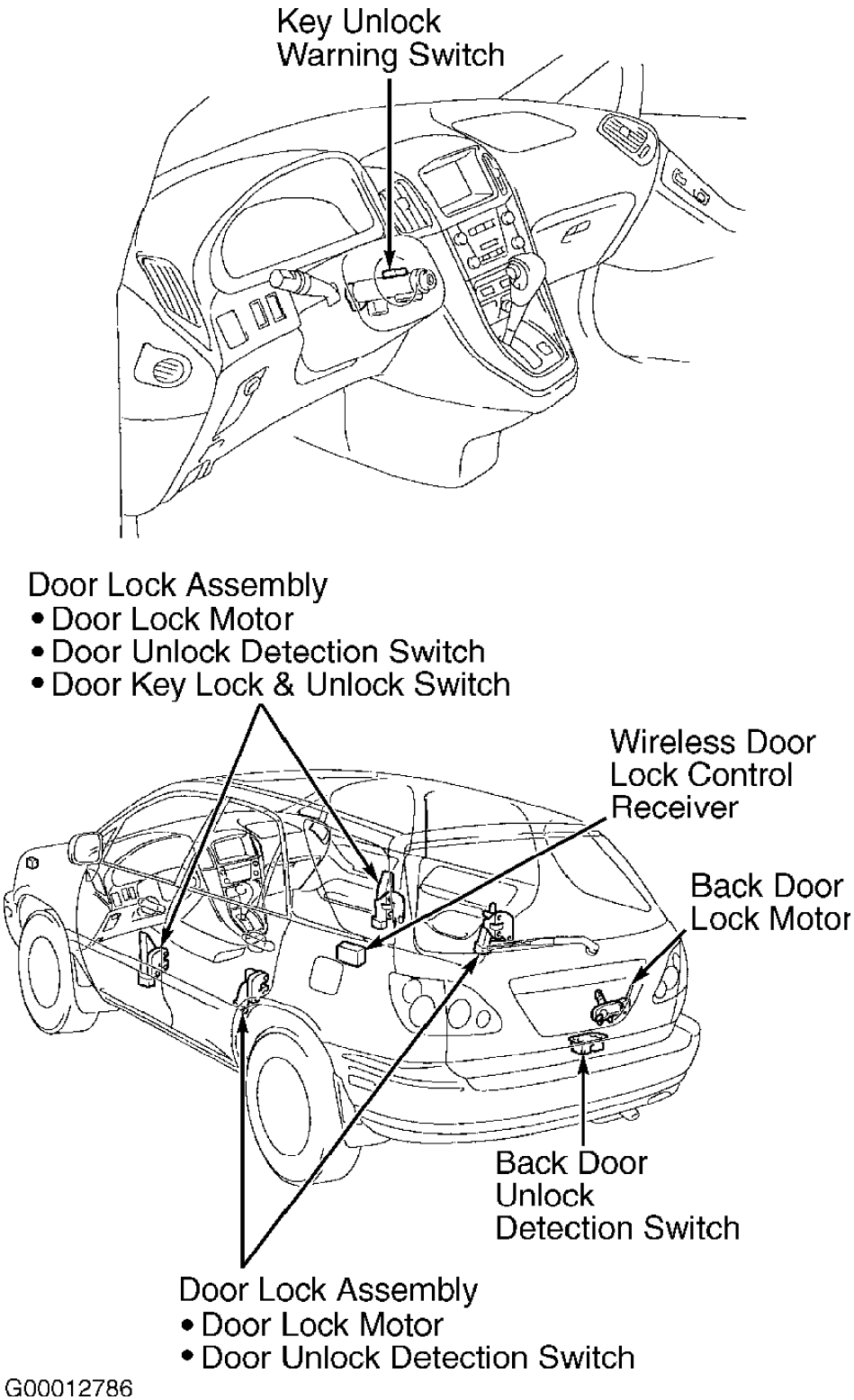


Fig. 1: Remote Keyless Entry System Component Locations
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPONENT LOCATIONS

COMPONENT LOCATIONS

Component	Location
Body ECU	Behind Left Side Of Instrument Panel
Door ECU	Inside Each Door
Door Key Lock/Unlock Switch	Integral With Right & Left Front Door Lock Motors
Door Unlock Detection Switch	Integral With Each Door Lock Motor
D RR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
ECU-B Fuse (7.5-Amp)	In Engine Compartment Junction Block
Engine Compartment Junction Block	Left Side Of Engine Compartment, Next To Strut Tower
Engine Control Module (ECM)	Behind Right Side Of Instrument Panel, Above Glove Box
FL DOOR Fuse (20-Amp)	In Engine Compartment Junction Block
GAUGE Fuse (7.5-Amp)	In Instrument Panel Junction Block
Instrument Panel Junction Block	Behind Driver's Kick Panel
Key Unlock Warning Switch	Integral With Ignition Switch
P FR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
P RR DOOR Fuse (20-Amp)	In Instrument Panel Junction Block
Wireless Door Lock Buzzer	Behind Left-Side Headlight, Next To Engine Compartment Junction Block
Wireless Door Lock ECU	In Rear Luggage Area, Behind Left Rear Quarter Panel

PROGRAMMING

* PLEASE READ THIS FIRST *

NOTE: The remote keyless entry system is equipped with 2 transmitters, having 2 unique vehicle access codes programmed into the wireless door lock ECU.

MODES OF REGISTRATION

There are 4 registration (programming) modes:

Add Mode - Adds a transmitter without erasing existing transmitter codes. Four transmitter codes can be registered at one time. If number of registered codes exceeds 4, previously registered codes are erased in order, starting with first registered code.

Rewrite Mode - Erases all previously registered transmitter codes and reprogram new transmitters.

Confirmation Mode - Informs user of number of existing transmitter codes already programmed in system.

Prohibition Mode - Erases all existing registered transmitter codes and cancels wireless door lock operation. Use this function if transmitter is lost or stolen.

REGISTRATION OF RECOGNITION CODE

1) To begin programming, remove key from ignition switch. Ensure driver's door is open and unlocked, and all other doors are closed. Insert key into ignition switch, and then remove it. Go to next step.

2) Complete the following in 40 seconds or less: press door lock switch to LOCK position, and then within one second, press door lock switch to UNLOCK position. Repeat procedure continuously until

door locks have been locked and unlocked 5 times. Close, and then open driver's door. Go to next step.

3) Complete the following in 40 seconds or less: repeat procedure in step 2), except for closing and opening driver's door. Insert key into ignition switch. To enter desired mode, turn ignition switch to ON position and back to LOCK position (one cycle), within one second, the specified number of times. See REGISTRATION MODE SELECTION table. Remove key from ignition switch. Go to next step.

REGISTRATION MODE SELECTION

Registration Mode	No. Of Ignition Switch Cycles
Add	1
Rewrite	2
Confirmation	3
Prohibition	5

4) If any mode other than confirmation mode is selected, go to next step. If confirmation mode was selected, door locks will cycle 1-4 times depending on how many transmitter codes are stored in ECU. Example: two stored codes equals 2 door lock/unlock cycles. Registration of confirmation code is complete after door locks cycle.

5) Complete the following in 40 seconds or less: if add mode, rewrite mode or prohibition mode is selected, to confirm proper initiation, door locks will automatically cycle one time for add mode, 2 times for rewrite mode and 5 times for prohibition mode. Press transmitter LOCK and UNLOCK buttons simultaneously for at least 1.5 seconds, and then within 3 seconds, press any transmitter button for at least one second. Go to next step.

6) If within 3 seconds, door locks cycle one time, new transmitter code has been successfully accepted. Go to next step. If door locks cycle 2 times, new transmitter code was not accepted. To program an additional transmitter or to make a second attempt, return to step 5) within 40 seconds.

7) Registration of recognition codes is complete under any of the following conditions:

* Forty seconds has elapsed since wireless door lock ECU has responded.
* Driver's door is closed.
* Key is inserted into ignition key cylinder.
* Four recognition codes are registered at one time.

TROUBLE SHOOTING

NOTE: The remote keyless entry system is part of body control system. For additional information and remote keyless entry system trouble shooting, see BODY CONTROL SYSTEMS - RX300 article.

NOTE: Trouble shooting is based on the assumption that basic power door lock functions are operating correctly. Also ensure anti-theft system operates normally, and check transmitter battery condition.

Verify customer complaint. Perform a visual inspection, checking for open fuses, disconnected or damaged wire harnesses and components. Repair or replace items as necessary and recheck. If no problems are found, diagnose by symptom. See SYMPTOM TESTS.

SYMPTOM TESTS

* PLEASE READ THIS FIRST *

NOTE: Before proceeding with symptom testing, ensure multiplex system is operating properly. See MULTIPLEX CONTROL SYSTEMS - RX300 article.

REMOTE TRANSMITTER INOPERATIVE

1) Remove key from ignition switch. Ensure all doors are closed and locked. While standing outside vehicle near driver's door, point transmitter toward vehicle. Press door LOCK button, and then UNLOCK button on transmitter for about one second. If doors do not lock and unlock properly, go to next step. If doors lock and unlock properly, system is okay at this time.

2) Observe transmitter LED while pressing transmitter LOCK and UNLOCK buttons. If transmitter LED illuminates when transmitter LOCK and UNLOCK buttons are pressed, go to step 4). If transmitter LED does not illuminate when transmitter LOCK and UNLOCK buttons are pressed, go to next step.

3) Replace transmitter battery. Check transmitter functions. If transmitter still does not operate properly, go to next step. If transmitter operates properly with new battery, system is okay.

4) Remove key from ignition switch. Ensure all doors are closed and locked. Go to next step.

5) Perform the following within 35 seconds: insert key into ignition switch, and then remove it. Insert key once more. Turn ignition on, and then off one time within 5 seconds. Within 30 seconds, turn ignition on and off 9 additional times. Buzzer should chirp, indicating successful entry into diagnostic mode. If buzzer chirps and system enters diagnostic mode as specified, go to next step. If system does not enter diagnostic mode regardless of buzzer operation, go to step 9).

6) Press LOCK button on transmitter. Buzzer should produce a short chirp about every .5 second. Press UNLOCK button on transmitter. Buzzer should produce 2 short chirps about every .5 second. Press PANIC button on transmitter. Buzzer should produce a long chirp about every .5 second. If buzzer operation is as specified, go to next step. If buzzer produces a long continuous chirp, go to step 11). If buzzer does not produce any chirp, go to step 12).

7) While standing about 3 feet from vehicle, press any transmitter button for 20 seconds (buzzer should chirp continuously), and then press button again. If buzzer operates as specified, other body control systems are at fault (transmitter and wireless door lock ECU are okay). See BODY CONTROL SYSTEMS - RX300 article. If buzzer does not operate as specified, go to next step.

8) Transmitter or wireless door lock ECU is faulty. Repeat step 7) using a known-good transmitter. Replace original transmitter if necessary. If problem still exists, check wireless door lock ECU. See WIRELESS DOOR LOCK ECU RECEIVER CIRCUIT under CIRCUIT TESTS. Repair as necessary.

9) Repeat step 5), ensuring procedures are performed correctly. If buzzer operation is normal, but still does not enter diagnostic mode, go to next step. If buzzer still does not chirp, check wireless door lock buzzer. See WIRELESS DOOR LOCK BUZZER under COMPONENT TESTS. Repair as necessary.

10) Insert key into ignition switch. Using DVOM, check for continuity between ground and terminal No. 8 (Blue wire) at body ECU harness connector "C". See WIRING DIAGRAMS. Continuity should be present. If continuity is not present, repair key unlock warning

switch or circuit as necessary.

11) Program transmitter. See PROGRAMMING. Retest system operation.

12) Repeat step 6) using a known-good transmitter. If transmitter operates, replace original transmitter. If transmitter does not operate, go to next step.

NOTE: The following step checks for wireless door lock signal error. For additional information on retrieving and diagnosing body ECU Diagnostic Trouble Codes (DTCs), see MULTIPLEX CONTROL SYSTEMS - RX300 article.

13) Using jumper wire, connect terminals Tc and E1 of DLC1 together. If DTC B1242/42 is present, repair short circuit in Blue wire between terminal No. 4 of wireless door lock ECU and terminal No. 16 of body ECU harness connector "B". See WIRING DIAGRAMS. If DTC B1242/42 is not present, go to next step.

14) Using DVOM, measure voltage between ground and terminal No. 16 (Blue wire) at body ECU harness connector "B" without operating transmitter. See WIRING DIAGRAMS. If battery voltage is present, go to next step. If battery voltage is not present, repair open in Blue wire.

15) Remove key from ignition switch. Ensure all doors are closed and locked. Using DVOM, measure voltage between ground and terminal No. 3 (Blue/Yellow wire) at wireless door lock ECU. See WIRING DIAGRAMS. Voltage should be 4.5-5.5 volts. Voltage should be zero volts when transmitter is operated. If voltage is as specified, go to next step. If voltage is not as specified, repair open in Blue/Yellow wire between terminal No. 3 of wireless door lock ECU and terminal No. 15 of body ECU harness connector "B".

16) Using DVOM, check for continuity between chassis ground and terminal No. 1 (White/Black wire) at wireless door lock ECU. See WIRING DIAGRAMS. If continuity is present, wireless door lock ECU is faulty. If continuity is not present, repair open or poor connection in White/Black wire.

CIRCUIT TESTS

WIRELESS DOOR LOCK BUZZER CIRCUIT

NOTE: See BODY CONTROL SYSTEMS - RX300 article.

WIRELESS DOOR LOCK ECU RECEIVER CIRCUIT

NOTE: For additional wireless door lock ECU receiver circuit testing, see BODY CONTROL SYSTEMS - RX300 article.

Harness Connector Disconnected

Disconnect wireless door lock ECU harness connector. Using DVOM, ensure continuity is constant between ground and terminal No. 1 (White/Black wire) of harness connector. See Fig. 2. If circuit value is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. Repair as necessary.

Harness Connector Connected

1) Connect wireless door lock ECU harness connector. Remove key from ignition switch. Using DVOM, measure voltage (backprobe) between ground and terminal No. 3 of harness connector. See Fig. 2. Ensure voltage is less than one volt intermittently. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. If voltage is as specified, go to next step.

2) Using DVOM, measure voltage (backprobe) between ground and

terminal No. 4 of harness connector. See Fig. 2. Ensure voltage is 4.5-5.5 volts with remote transmitter off, and less than one volt with remote transmitter operating. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS. If voltage is as specified, go to next step.

3) Using DVOM, measure voltage (backprobe) between ground and terminal No. 5 of harness connector. See Fig. 2. Ensure voltage is 4.5-5.5 volts with remote transmitter off, and less than one volt with remote transmitter operating. If voltage is as specified, wireless door lock ECU is faulty. If voltage is not as specified, inspect circuit and related components. See WIRING DIAGRAMS.

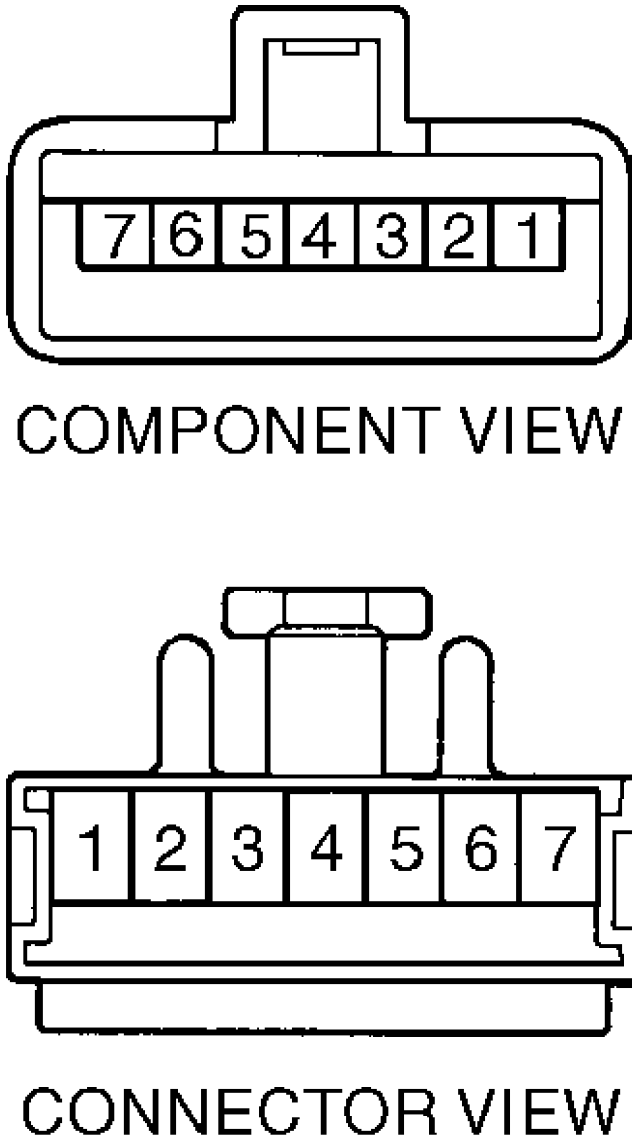


Fig. 2: Identifying Wireless Door Lock ECU Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPONENT TESTS

WIRELESS DOOR LOCK BUZZER

Disconnect door lock buzzer connector. Using DVOM, check for continuity between buzzer terminals. Resistance should be about 1000 ohms. If resistance is not as specified, replace door lock buzzer.

REMOVAL & INSTALLATION

Manufacturer does not provide a step-by-step procedure for removing and installing remote keyless entry system components. See COMPONENT LOCATIONS.

WIRING DIAGRAMS

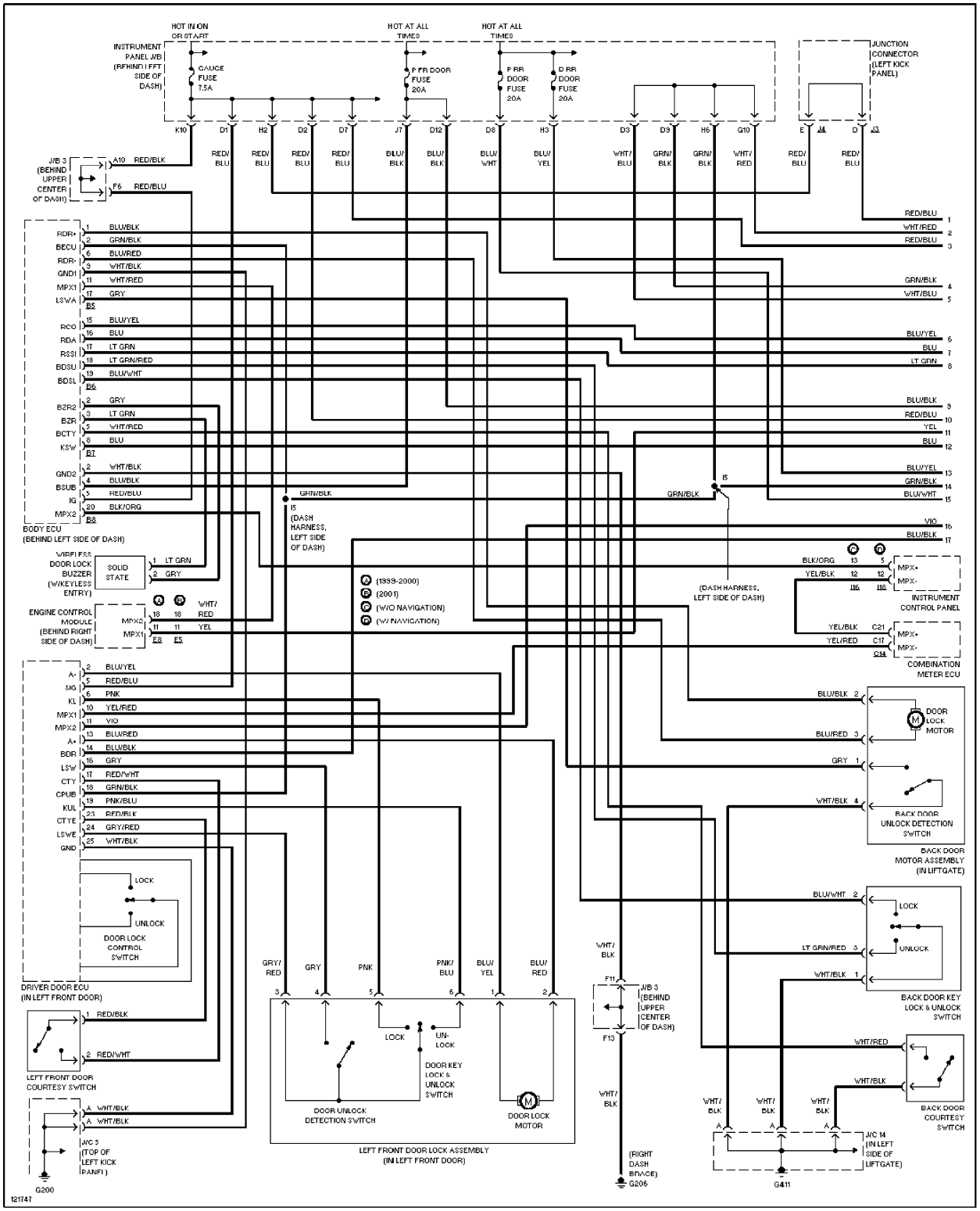


Fig. 3: Power Door Lock/Remote Keyless Entry System Wiring Diagram (RX300 - 1 Of 2)

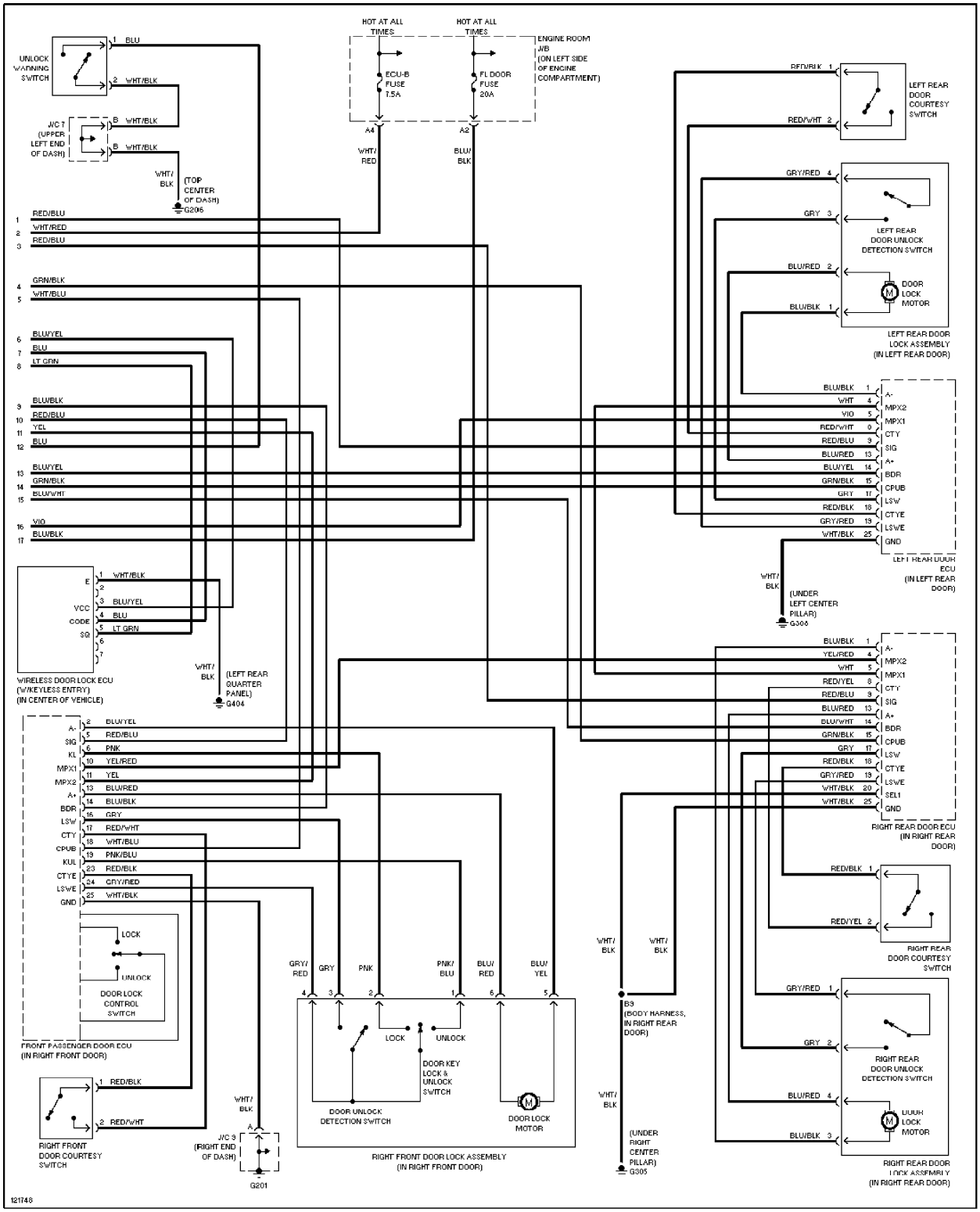


Fig. 4: Power Door Lock/Remote Keyless Entry System Wiring Diagram (RX300 - 2 Of 2)

METRIC CONVERSIONS

1999 Lexus RX 300

GENERAL INFORMATION

METRIC CONVERSIONS

METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to doubling the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple. Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

* A meter is slightly longer than a yard (about 40 inches).
* An aspirin tablet is about one centimeter across (.4 inches).
* A millimeter is about the thickness of a dime.

VOLUME

Cubic meters and centimeters are used to measure volume, just as we normally think of cubic feet and inches. Liquid volume measurements include the liter and milliliter, like the English quarts or ounces.

* One teaspoon is about 4 cubic centimeters.
* A liter is about one quart.
* A liter is about 61 cubic inches.

WEIGHT

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

* A kilogram is about 2.2 pounds.
* An ounce is about 28 grams.

TORQUE

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long).

Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one

meter long with force of one Newton applied). Some conversions are:

* A meter kilogram is about 7.2 foot pounds.
* A foot pound is about 1.4 Newton-meters.
* A centimeter kilogram (cmkg) is equal to .9 inch pounds.

PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter (kg/cm^2). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

* Atmospheric pressure at sea level is about 14.7 psi.
* Atmospheric pressure at sea level is about 1 bar.
* Atmospheric pressure at sea level is about 1 kg/cm^2.
* One pound per square inch is about 7 kPa.

CONVERSION FACTORS

CONVERSION FACTORS

TO CONVERT	TO	MULTIPLY BY
LENGTH		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers(Km)	Miles	.62137
AREA		
Square Centimeters (cm^2)	Square Inches	.155
Square Inches	Square Centimeters	6.45159
VOLUME		
Cubic Centimeters	Cubic Inches	.06103
Cubic Inches	Cubic Centimeters	16.38703
Liters	Cubic Inches	61.025
Cubic Inches	Liters	.01639
Liters	Quarts	1.05672
Quarts	Liters	.94633
Liters	Pints	2.11344
Pints	Liters	.47317
Liters	Ounces	33.81497
Ounces	Liters	.02957
WEIGHT		
Grams	Ounces	.03527
Ounces	Grams	28.34953
Kilograms	Pounds	2.20462
Pounds	Kilograms	.45359
WORK		
Centimeter Kilograms	Inch Pounds	.8676
Pounds/Sq. Inch	Kilograms/Sq.Centimeter	.07031
Bar	Pounds/Sq. Inch	14.504

Pounds/Sq. Inch	Bar	.06895
Atmosphere	Pounds/Sq. Inch	14.696
Pounds/Sq. Inch	Atmosphere	.06805
TEMPERATURE		
Centigrade Degrees	Fahrenheit Degrees	(°Cx(9)/5)+32
Fahrenheit Degrees	Centigrade Degrees	(°F-32)x(5)/9

CONVERSION FACTORS (Cont.)

INCHES	DECIMALS	mm
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984
3/32	.094	2.381
7/64	.109	2.778
1/8	.125	3.175
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	.250	6.350
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.992
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447

25/32	.....	.781	.....	19.844
51/64	.....	.797	.....	20.241
13/16	.....	.813	.....	20.638
53/64	.....	.828	.....	21.034
27/32	.....	.844	.....	21.431
55/64	.....	.859	.....	21.828
7/8	.....	.875	.....	22.225
57/64	.....	.891	.....	22.622
29/32	.....	.906	.....	23.019
59/64	.....	.922	.....	23.416
15/16	.....	.938	.....	23.813
61/64	.....	.953	.....	24.209
31/32	.....	.969	.....	24.606
63/64	.....	.984	.....	25.003
1	.....	1.000	.....	25.400

MIRRORS - POWER

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Power Mirrors
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

DESCRIPTION & OPERATION

Power mirrors are controlled by a dual control switch on left side of instrument panel or on driver's door armrest (SC300 and SC400). Position of select switch determines whether left or right mirror will be adjusted. Directional switch directs current to mirror motors. Mirror and motor are serviced as an assembly. Mirror defogger is an integral part of mirror. See REAR WINDOW & SIDE MIRROR DEFOGGERS article.

On GS300, GS400, LS400, LX470, SC300 and SC400, mirror position can be stored in memory. Position can be recalled by pressing a button on driver's door. On GS300, GS400 and LS400, mirror memory is stored in the driver door ECU and body control ECU. On LX470, mirror memory is stored in the instrument ECU. On SC300 and SC400, mirror memory is stored in the tilt and telescopic ECU.

On GS300, GS400, LS400, LX470, RX300, SC300 and SC400, inside rear view mirror and side mirrors have electro chromic glass. When switch at bottom of interior rear view mirror frame is activated, mirror surface changes from bright to dark to reduce glare. Mirror will only change when key is in ignition.

NOTE: ES300 and RX300 are not available with memory mirror system.

COMPONENT LOCATIONS

Body Control ECU No. 1 (GS300 & GS400)
On right kick panel junction block.

Body Control ECU No. 2 (GS300 & GS400)
On left kick panel junction block.

Body Control ECU (LS400)
Behind left side of instrument panel, near junction block.

Door ECU (GS300, GS400 & LS400)
In respective door, near switches.

Instrument ECU (LX470)
Behind top center of instrument panel.

Power Seat ECU (GS300, GS400, LS400 & LX470)
Under driver's seat.

Remote Control Mirror ECU (LX470)
In driver's door.

Remote Control Mirror ECU (SC300 & SC400)
Behind left side of instrument panel, near steering column.

Tilt & Telescopic ECU (GS300, GS400 & LS400)
Behind left side of instrument panel, near steering column.

Tilt & Telescopic ECU (LX470)

Behind right kick panel, near junction block.

Tilt & Telescopic ECU (SC300 & SC400)
Behind left side of instrument panel.

TROUBLE SHOOTING

ELECTRO CHROMIC REAR VIEW & SIDE MIRRORS

GS300, GS400, RX300, SC300 & SC400
Check ECU-IG fuse, electro chromic mirror and wiring harness.

LS400
Check PWR-IG fuse, electro chromic mirror and wiring harness.

LX470
Check GAUGE fuse, electro chromic mirror and wiring harness.

MIRROR DEFOGGER

NOTE: See REAR WINDOW & SIDE MIRROR DEFOGGERS article.

POWER MIRRORS WITHOUT MEMORY

NOTE: Check circuits and components in listed order. If circuits or components are okay, return to trouble shooting and identify next circuit to be checked.

SYMPTOM DIAGNOSIS (ES300, LS400 & RX300)

Problem	Inspect
Mirror Does Not Operate	CIG Fuse (ES300); RADIO NO. 2 Fuse (LS400 & RX300); (1) Mirror Switch; (1) Mirror Motor; (2) Wire Harness
Mirror Operates Abnormally	(1) Mirror Switch; (1) Mirror Motor; (2) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.

SYMPTOM DIAGNOSIS (GS300 & GS400)

Problem	Inspect
Mirror Does Not Operate	(1) Mirror Switch; (2) Wire Harness; (3) Body Control ECU No. 2; (4) Driver & Passenger Door ECU
Mirror Operates Abnormally	(1) Mirror Switch; (1) Mirror Motor; (2) Wire Harness; (3) Body Control ECU No. 2; (4) Driver & Passenger Door ECU

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.

(2) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.
(3) - See appropriate BODY CONTROL SYSTEMS article.
(4) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

SYMPTOM DIAGNOSIS (SC300 & SC400)

Problem	Inspect
Mirror Does Not Operate	RADIO NO. 2 Fuse; DOME Fuse; (1) Mirror Switch; (1) Mirror Motor; (1) Remote Control Mirror ECU; (2) Wire Harness
Mirror Operates Abnormally	(1) Mirror Switch; (1) Mirror Motor; (1) Remote Control Mirror ECU; (2) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.

POWER MIRROR WITH MEMORY

NOTE: Prior to trouble shooting, ensure no problems exist in multiplex communications. If problems exist, repair multiplex control system before trouble shooting. See appropriate MULTIPLEX CONTROL SYSTEMS article.

NOTE: Check circuits and components in listed order. If circuits or components are okay, return to trouble shooting and identify next circuit to be checked.

SYMPTOM DIAGNOSIS (GS300 & GS400)

Problem	Inspect
Both Right & Left Mirrors Do Not Operate	(1) Mirror Switch; (2) Wire Harness; (3) Body Control ECU No. 2
Only One Side Of Mirror Does Not Operate	(1) Mirror Motor; (2) Wire Harness; (4) Driver & Passenger Door ECU
Mirror Does Not Return To Memorized Position	(1) Mirror Position Sensor (Position Is Not Set); (2) Wire Harness; (5) Power Seat ECU
Memorized Position Is Moved	(1) Mirror Position Sensor (Position Is Not Set); (2) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.
(3) - See appropriate BODY CONTROL SYSTEMS article.
(4) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.
(5) - See appropriate wiring diagram in POWER SEATS - WITH MEMORY

article.

SYMPTOM DIAGNOSIS (LS400)

Problem	Inspect
Both Right & Left Mirrors Do Not Operate	RADIO NO. 2 Fuse; (1) Mirror Switch; (2) Tilt & Telescopic ECU; (3) Multiplex Communication Circuit; (4) Wire Harness
Only One Side Of Mirror Does Not Operate	(5) Driver Door ECU; (5) Passenger Door ECU; (1) Mirror Motor; (4) Wire Harness
Mirror Does Not Return To Memorized Position	(1) Driving Position Memory (Position Is Not Set); (1) Driving Position Memory & Return Switch; (5) Driver Door ECU; (3) Multiplex Communication Circuit; (4) Wire Harness
Memorized Position Is Moved	(1) Driving Position Memory (Position Is Not Set); (4) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate POWER TILT STEERING COLUMN SYSTEMS article.
(3) - See appropriate MULTIPLEX CONTROL SYSTEMS article.
(4) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.
(5) - See appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

SYMPTOM DIAGNOSIS (LX470)

Problem	Inspect
Both Right & Left Mirrors Do Not Operate	MIRR Fuse; (1) Mirror Switch; CIGAR Fuse; ECU-IG Fuse; (2) Body Control ECU; (3) Wire Harness
Only One Side Of Mirror Does Not Operate	(1) Mirror Motor; (3) Wire Harness; (2) Body Control ECU
Mirror Does Not Return To Memorized Position	(1) Mirror Position Sensor (Position Is Not Set); (3) Wire Harness; (2) Body Control ECU
Memorized Position Is Moved	(1) Mirror Position Sensor (Position Is Not Set); (3) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.

(2) - See appropriate BODY CONTROL SYSTEMS article.
(3) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.

SYMPTOM DIAGNOSIS (SC300 & SC400)

Problem	Inspect
Mirror Does Not Return To Memorized Position	(1) Driving Position Memory (Position Is Not Set); (1) Driving Position Memory & Return Switch; (2) Tilt & Telescopic ECU; (1) Remote Control Mirror ECU; (1) Mirror Position Sensor; (3) Wire Harness
Memorized Position Is Moved	(1) Remote Control Mirror ECU; (1) Mirror Position Sensor; (3) Wire Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - See appropriate POWER TILT STEERING COLUMN SYSTEMS article.
(3) - Check for opens or shorts in wiring. See WIRING DIAGRAMS.

CIRCUIT TESTS

DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT (WITH MEMORY)

GS300, GS400 & LS400

Disconnect driver's door ECU harness connector. Check for continuity between specified driver's door ECU harness connector terminals and driving position memory and return switch harness connector terminals. See WIRING DIAGRAMS. See appropriate DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY table. If continuity is not as specified, check driving position memory and return switch. See DRIVING POSITION MEMORY & RETURN SWITCH (WITH MEMORY) under COMPONENT TESTS.

DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (GS300 & GS400)

Switch Terminal	Driver Door ECU Terminal	Continuity
1 (BRN/WHT)	16 (BRN/WHT)	Yes
3 (PNK)	15 (PNK)	Yes
5 (PNK/BLK)	14 (PNK/BLK)	Yes
7 (GRY)	4 (GRY)	Yes

DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (LS400)

Switch Terminal	Driver Door ECU Terminal	Continuity
3 (BRN/WHT)	16 (BRN/WHT)	Yes
4 (GRY)	4 (GRY)	Yes
6 (PNK/BLK)	14 (PNK/BLK)	Yes
7 (PNK)	15 (PNK)	Yes

LX470

Disconnect instrument ECU harness connector. Check for continuity between specified instrument ECU harness connector terminals and driving position memory and return switch harness connector terminals. See WIRING DIAGRAMS. See DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (LX470) table. If continuity is not as specified, check driving position memory and return switch. See DRIVING POSITION MEMORY & RETURN SWITCH (WITH MEMORY) under COMPONENT TESTS.

DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (LX470)

Switch Terminal	Instrument ECU Terminal	Continuity
1 (BLU)	17 (LT BLU)	Yes
2 (YEL)	7 (LT BLU)	Yes
3 (WHT/BLK)	(1)	Yes
4 (RED)	8 (LT BLU)	Yes

(1) - Check for continuity between switch and body ground.

SC300 & SC400

Disconnect tilt and telescopic ECU harness connector. Check for continuity between specified tilt and telescopic ECU harness connector terminals and driving position memory and return switch harness connector terminals. See WIRING DIAGRAMS. See DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (SC300 & SC400) table. If continuity is not as specified, repair wiring harness as necessary. If continuity is as specified, check driving position memory and return switch. See DRIVING POSITION MEMORY & RETURN SWITCH (WITH MEMORY) under COMPONENT TESTS.

DRIVING POSITION MEMORY & RETURN SWITCH CIRCUIT CONTINUITY (SC300 & SC400)

Switch Terminal	Tilt & Telescopic ECU Terminal	Continuity
1 (RED)	12 (GRN)	Yes
2 (PNK)	3 (PNK)	Yes
3 (BRN/BLK)	8 (BLU/RED) (1)	Yes
4 (RED/YEL)	11 (YEL/GRN)	Yes

(1) - Also, check for continuity between switch and body ground.

POWER MIRROR MOTOR

NOTE: For power mirror motor circuit testing, see POWER MIRROR MOTOR under COMPONENT TESTS.

POWER MIRROR SWITCH CIRCUIT

ES300

1) Disconnect power mirror switch harness connector. Check for continuity between power mirror switch connector terminal No. 8 (White/Black wire) and ground. See WIRING DIAGRAMS. If continuity exists, go to next step. If continuity does not exist, repair wiring harness as necessary.

2) Measure voltage between power mirror switch connector terminal No. 4 (Pink/Blue wire) and ground. With ignition off, voltage should not exist. With ignition on, battery voltage should exist. If voltage is not as specified, repair wiring harness as necessary. If

voltage is as specified, check power mirror switch. See POWER MIRROR SWITCH under COMPONENT TESTS.

GS300 & GS400

For power mirror switch circuit testing, see BODY CONTROL SYSTEMS - GS300 & GS400 article.

LS400

For power mirror switch circuit testing, see POWER TILT STEERING COLUMN SYSTEMS - LS400 article.

LX470

For power mirror switch circuit testing, see REMOTE CONTROL MIRROR ECU CIRCUIT.

RX300

1) Disconnect power mirror switch harness connector. Check for continuity between power mirror switch connector terminal No. 10 (White/Black wire) and ground. See WIRING DIAGRAMS. If continuity exists, go to next step. If continuity does not exist, repair wiring harness as necessary.

2) Measure voltage between power mirror switch connector terminal No. 9 (Pink wire) and ground. With ignition off, voltage should not exist. With ignition on, battery voltage should exist. If voltage is not as specified, repair wiring harness as necessary. If voltage is as specified, check power mirror switch. See POWER MIRROR SWITCH under COMPONENT TESTS.

SC300 & SC400 (Without Memory)

1) Disconnect power mirror switch harness connector. Check for continuity between power mirror switch connector terminal No. 8 (White/Black wire) and ground. See WIRING DIAGRAMS. If continuity exists, go to next step. If continuity does not exist, repair wiring harness as necessary.

2) Measure voltage between power mirror switch connector terminal No. 12 (Gray wire) and ground. With ignition off, voltage should not exist. With ignition on, battery voltage should exist. If voltage is not as specified, repair wiring harness as necessary. If voltage is as specified, check power mirror switch. See POWER MIRROR SWITCH under COMPONENT TESTS.

SC300 & SC400 (With Memory)

For power mirror switch circuit testing, see REMOTE CONTROL MIRROR ECU CIRCUIT.

REMOTE CONTROL MIRROR ECU CIRCUIT

LX470, SC300 & SC400 (With Memory)

Disconnect remote control mirror ECU harness connectors. Using an ohmmeter, check for continuity between specified remote control mirror ECU connector terminals (harness side) within specified conditions. See REMOTE CONTROL MIRROR ECU CIRCUIT CONTINUITY (LX470) or REMOTE CONTROL MIRROR ECU CIRCUIT CONTINUITY (SC300 & SC400) table. See Fig. 1 or 2. If continuity does not exist, repair wiring harness as necessary. If continuity exists, check remote control mirror ECU. See REMOTE CONTROL MIRROR ECU PIN VOLTAGES under COMPONENT TESTS.

REMOTE CONTROL MIRROR ECU CIRCUIT CONTINUITY (LX470)

Condition	Terminals
All Conditions	7 & 19; 10 & 11; 10 & 12; 14 & Ground; 22 & 23; 23 & 24

Left Switch	
Up	6 & 17
Down	6 & 16
Left	4 & 17
Right	4 & 16
Right Switch	
Up	5 & 17
Down	5 & 16
Left	3 & 17
Right	3 & 16

REMOTE CONTROL MIRROR ECU CIRCUIT CONTINUITY (SC300 & SC400)

Condition	Terminals
All Conditions	A1 & A2; A1 & A3; A8 & A10; A9 & A10; A11 & Ground; A12 & A13; A16 & (1)
Left Switch	
Up	B3 & B6
Down	B1 & B6
Left	B3 & B5
Right	B1 & B5
Right Switch	
Up	B2 & B3
Down	B1 & B2
Left	B3 & B4
Right	B1 & B4

(1) - Continuity should exist between terminal A16 of remote control mirror ECU and terminal No. 1 of tilt and telescoping ECU connector T9, and between terminal A16 of remote control mirror ECU and terminal No. 18 of tilt and telescoping ECU connector T10. See Fig. 3.

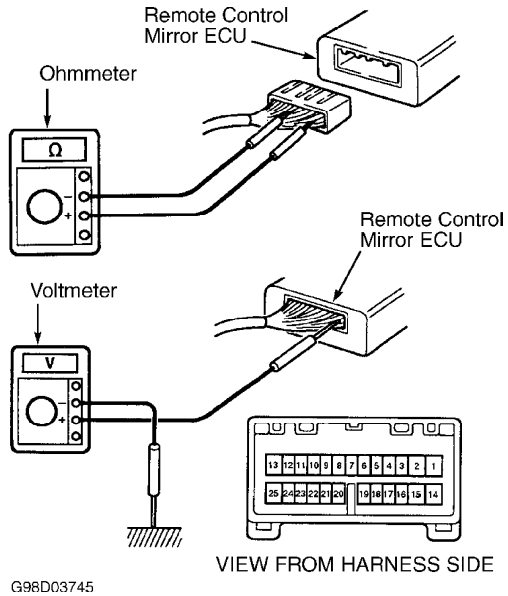


Fig. 1: Testing Remote Control Mirror ECU & Circuits (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

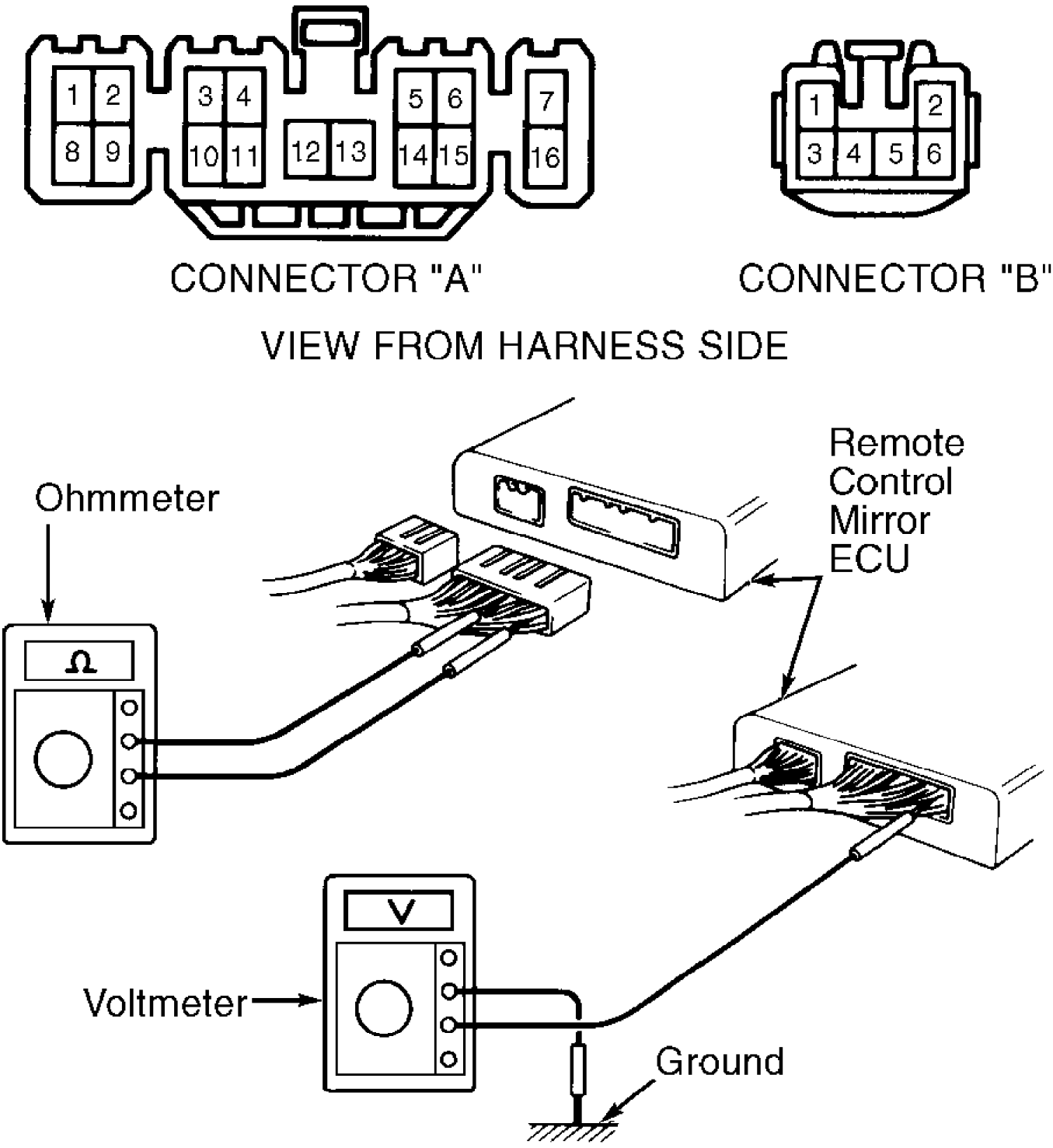
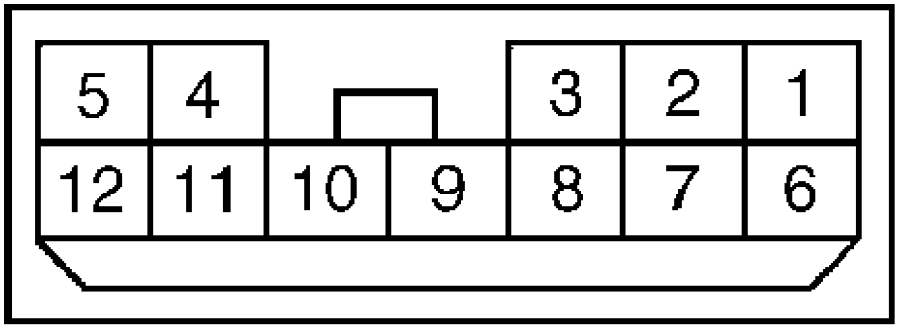
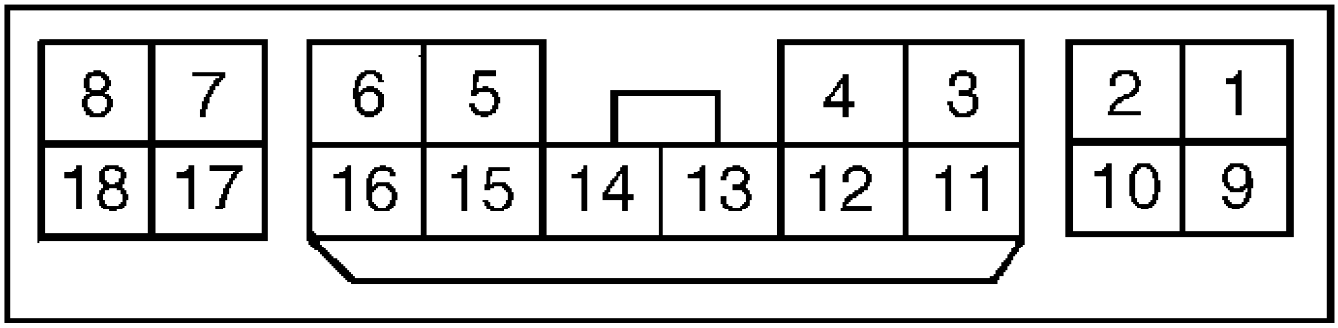


Fig. 2: Testing Remote Control Mirror ECU & Circuits (SC300 & SC400 With Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



CONNECTOR TERMINAL T9



CONNECTOR TERMINAL T10

VIEW FROM TERMINAL SIDE

98E10615

Fig. 3: Identifying Tilt & Telescoping ECU Connectors & Terminals (SC300 & SC400 With Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REAR VIEW MIRROR ELECTRO CHROMIC CIRCUIT

GS300, GS400, LS400, LX470, RX300, SC300 & SC400

1) Remove rear view mirror. Check for continuity between rear view mirror switch connector terminal No. 4 and ground. See WIRING DIAGRAMS. If continuity exists, go to next step. If continuity does not exist, repair wiring harness as necessary.

2) Measure voltage between rear view mirror switch connector terminal No. 1 and ground. With ignition switch in LOCK or ACC position, voltage should not exist. With ignition switch in ON position, battery voltage should exist. If voltage is not as specified, repair wiring harness as necessary. If voltage is as specified, check rear view mirror electro chromic. See REAR VIEW MIRROR ELECTRO CHROMIC under COMPONENT TESTS.

COMPONENT TESTS

DRIVING POSITION MEMORY & RETURN SWITCH (WITH MEMORY)

GS300, GS400, LS400, LX470, SC300 & SC400

Remove driving position memory and return switch. Check for continuity between specified driving position memory and return switch terminals (component side) with switch in specified position. See appropriate DRIVING POSITION MEMORY & RETURN SWITCH CONTINUITY table. See Fig. 4 or 5. If continuity is not as specified, replace driving position memory and return switch.

DRIVING POSITION MEMORY & RETURN SWITCH CONTINUITY (GS300 & GS400)

Terminals	Switch Position	Continuity
1 & 7	Set Switch On	Yes
1 & 3	Return Switch No. 1 On	Yes
1 & 5	Return Switch No. 2 On	Yes

DRIVING POSITION MEMORY & RETURN SWITCH CONTINUITY (LS400)

Terminals	Switch Position	Continuity
3 & 4	Set Switch On	Yes
3 & 7	Return Switch No. 1 On	Yes
3 & 6	Return Switch No. 2 On	Yes

DRIVING POSITION MEMORY & RETURN SWITCH CONTINUITY (LX470, SC300 & SC400)

Terminals	Switch Position	Continuity
3 & 4	Set Switch On	Yes
3 & 2	Return Switch No. 1 On	Yes
3 & 1	Return Switch No. 2 On	Yes

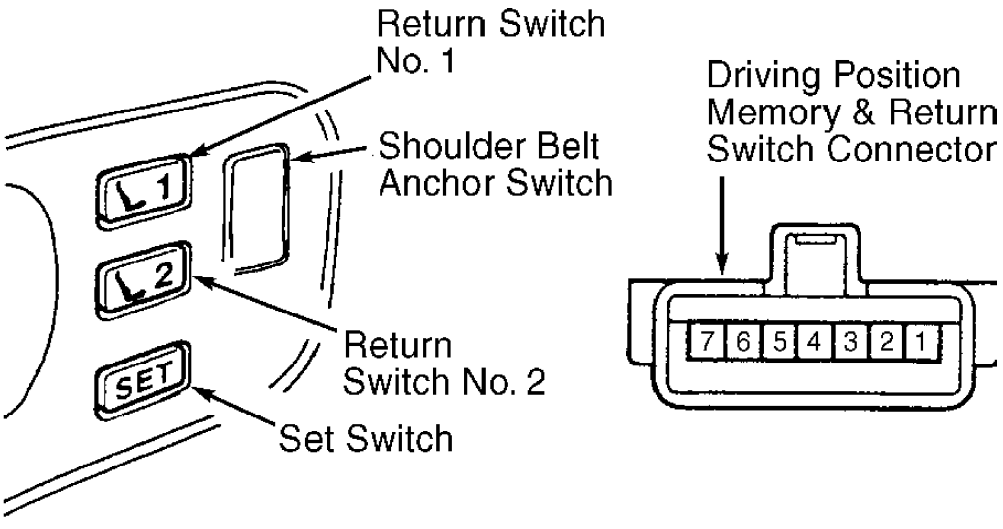


Fig. 4: Driving Position Memory & Return Switch Terminals (LS400 Shown; GS300 & GS400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

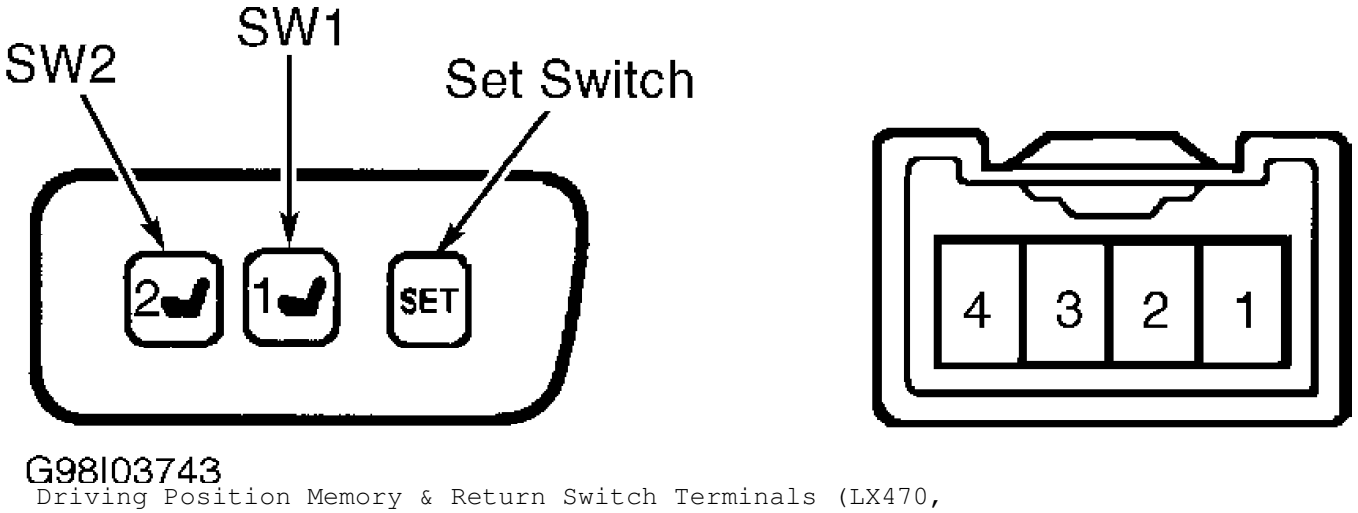


Fig. 5: Driving Position Memory & Return Switch Terminals (LX470, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POWER MIRROR MOTOR

Disconnect power mirror motor harness connector. Apply battery voltage and ground between specified terminals of power mirror motor harness connector (reverse polarity to move/operate motor in opposite direction). See appropriate POWER MIRROR MOTOR TEST table. See Figs. 6-13. If motor does not operate as specified, replace power mirror motor.

POWER MIRROR MOTOR TEST (ES300)

Mirror Direction	Terminals
Left/Right	2 & 3
Up/Down	1 & 2

POWER MIRROR MOTOR TEST (GS300 & GS400)

Mirror Direction	Terminals
With Memory	
Left/Right	1 & 2
Up/Down	2 & 6
Without Memory	
Left/Right	4 & 5
Up/Down	5 & 6

POWER MIRROR MOTOR TEST (LS400)

Mirror Direction	Terminals
With Memory	
Left/Right	11 & 12
Up/Down	10 & 11
Without Memory	
Left/Right	5 & 6
Up/Down	4 & 5

POWER MIRROR MOTOR TEST (LX470)

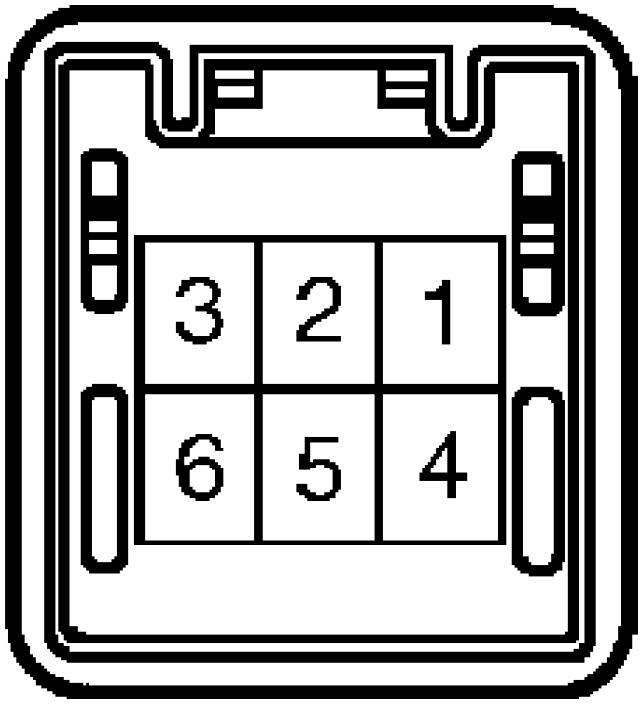
Mirror Direction	Terminals
Left/Right	7 & 8
Up/Down	6 & 7

POWER MIRROR MOTOR TEST (RX300)

Mirror Direction	Terminals
Left/Right	4 & 5
Up/Down	5 & 6

POWER MIRROR MOTOR TEST (SC300 & SC400)

Mirror Direction	Terminals
With Memory	
Left/Right	12 & 13
Up/Down	3 & 13
Without Memory	
Left/Right	1 & 2
Up/Down	2 & 3



G97J06879

Fig. 6: Power Mirror Motor Connector Terminals (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

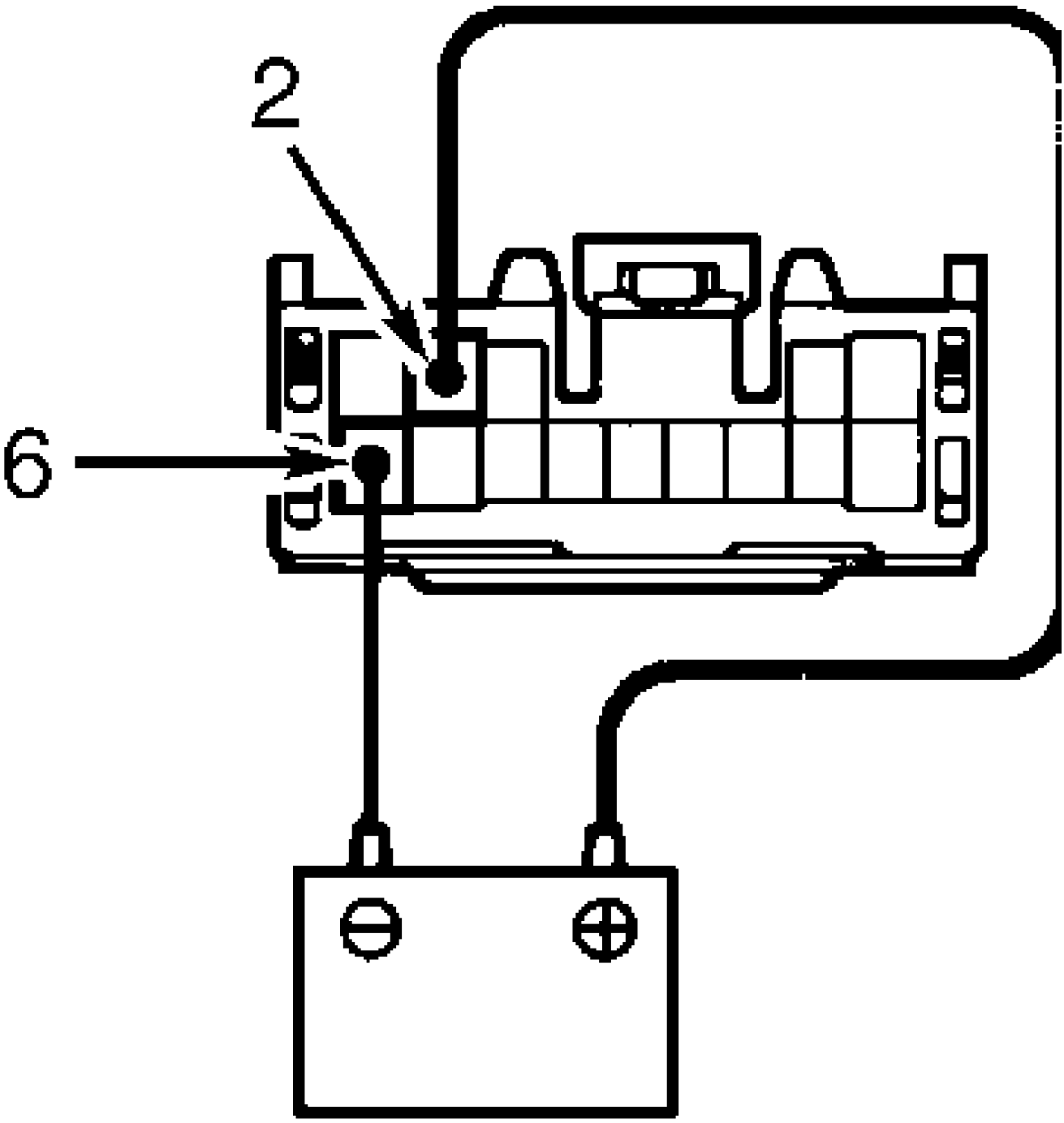


Fig. 7: Power Mirror Motor Connector Terminals (GS300 & GS400 With Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

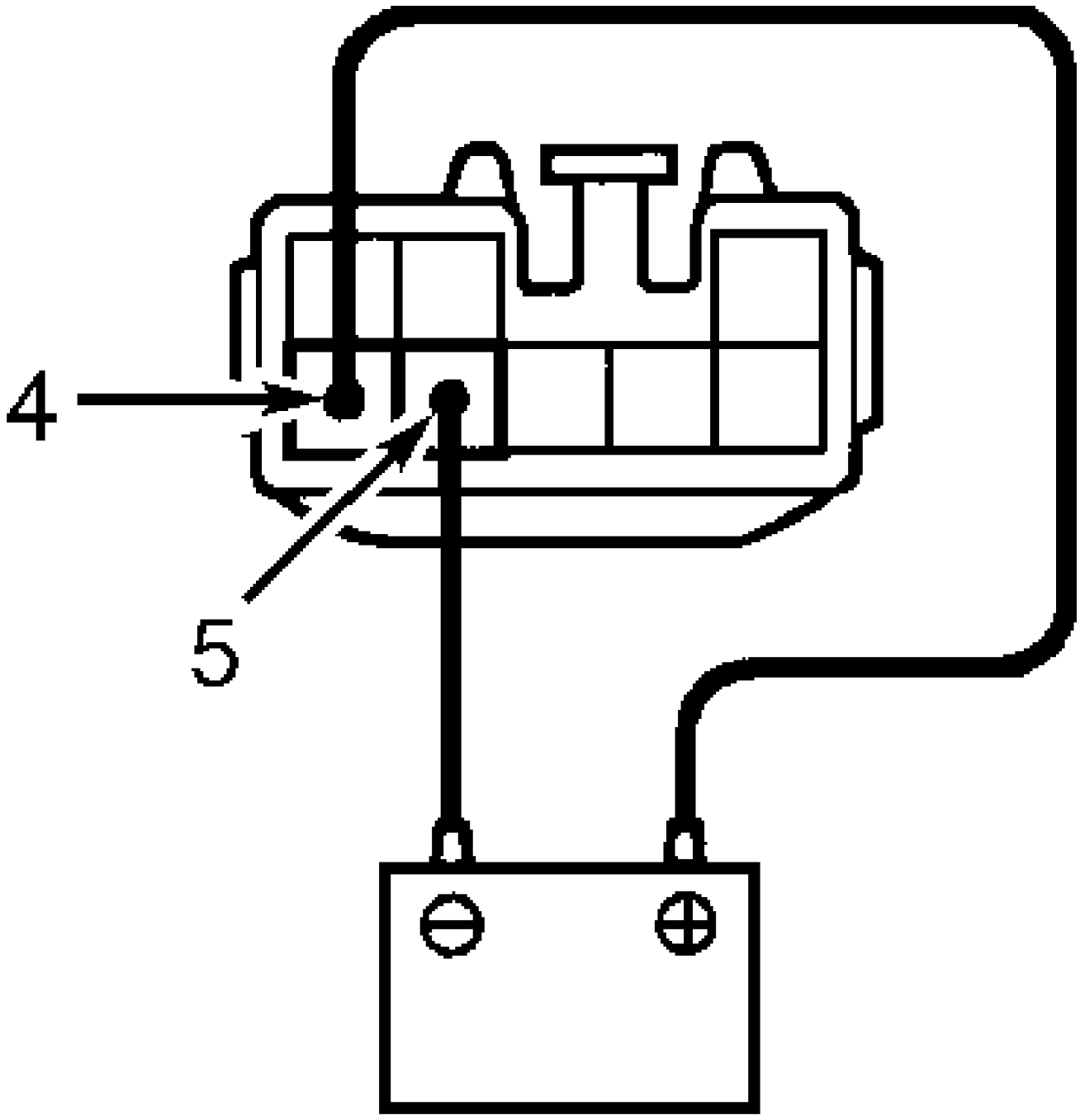


Fig. 8: Power Mirror Motor Connector Terminals (GS300 & GS400 Without Memory & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

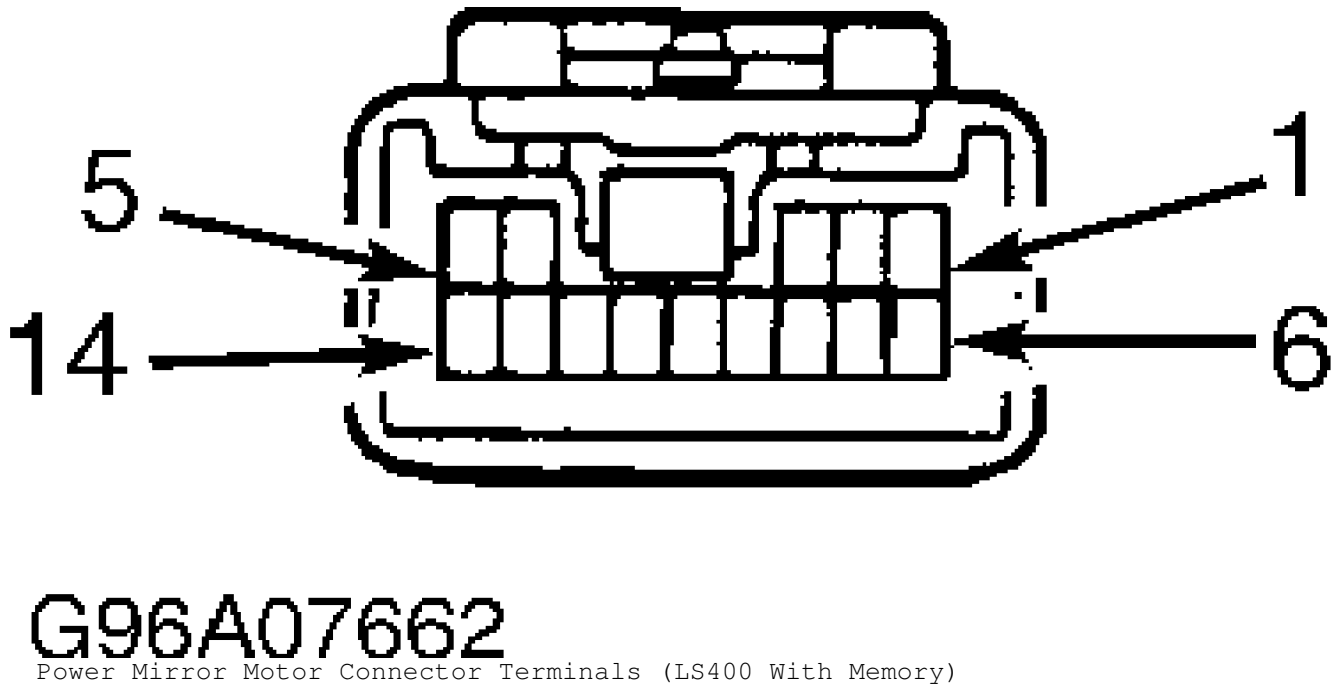


Fig. 9: Power Mirror Motor Connector Terminals (LS400 With Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

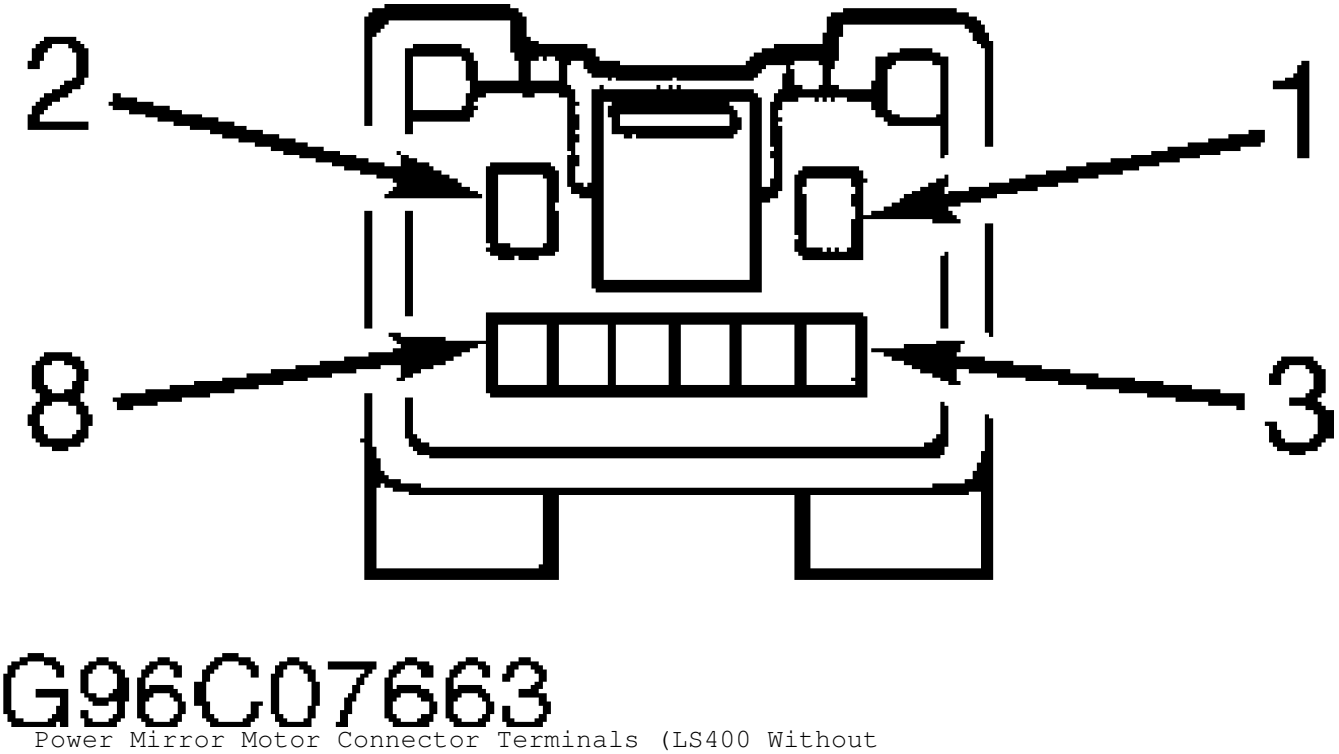
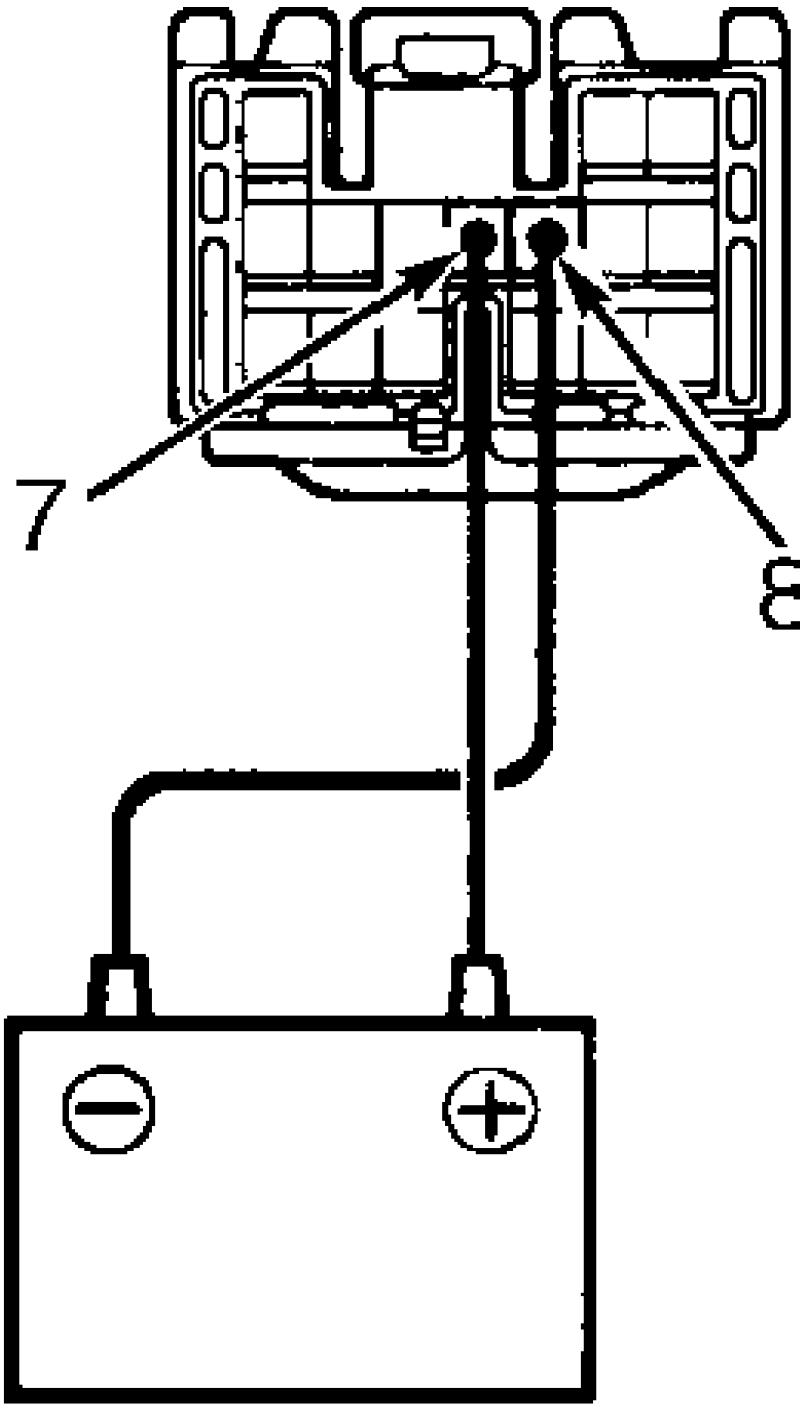


Fig. 10: Power Mirror Motor Connector Terminals (LS400 Without Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G99A50153

Fig. 11: Power Mirror Motor Connector Terminals (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

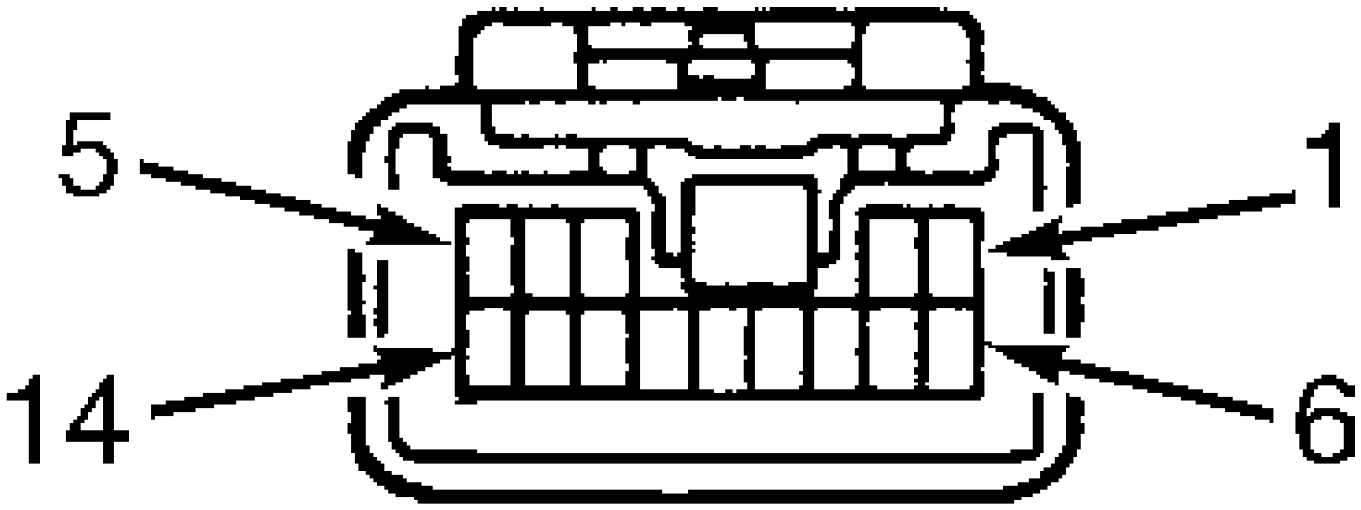


Fig. 12: Power Mirror Motor Connector Terminals (SC300 & SC400 With Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Fig. 13: Power Mirror Motor Connector Terminals (SC300 & SC400 Without Memory)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POWER MIRROR POSITION SENSOR (WITH MEMORY)

GS300 & GS400

1) Disconnect power mirror motor harness connector. Connect three 1.5-volt dry cell batteries together in series. See Fig. 14. Connect dry cell battery positive lead to terminal No. 8 and negative lead to terminal No. 11. Connect positive lead of voltmeter to terminal No. 9 and negative lead to terminal No. 11.

2) While watching voltmeter, apply battery voltage and ground

to terminals No. 2 and 6, reversing polarity as necessary to move mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-1.8 volts to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly. If voltage is as specified, go to next step.

3) Disconnect 4 leads of voltmeter and battery voltage from power mirror motor connector terminals (leave dry cell assembly connected). Connect positive lead of voltmeter to terminal No. 10 and negative lead to terminal No. 11.

4) Apply battery voltage and ground between terminals No. 1 and 2, reversing polarity as necessary to move mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-1.8 volts to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly.

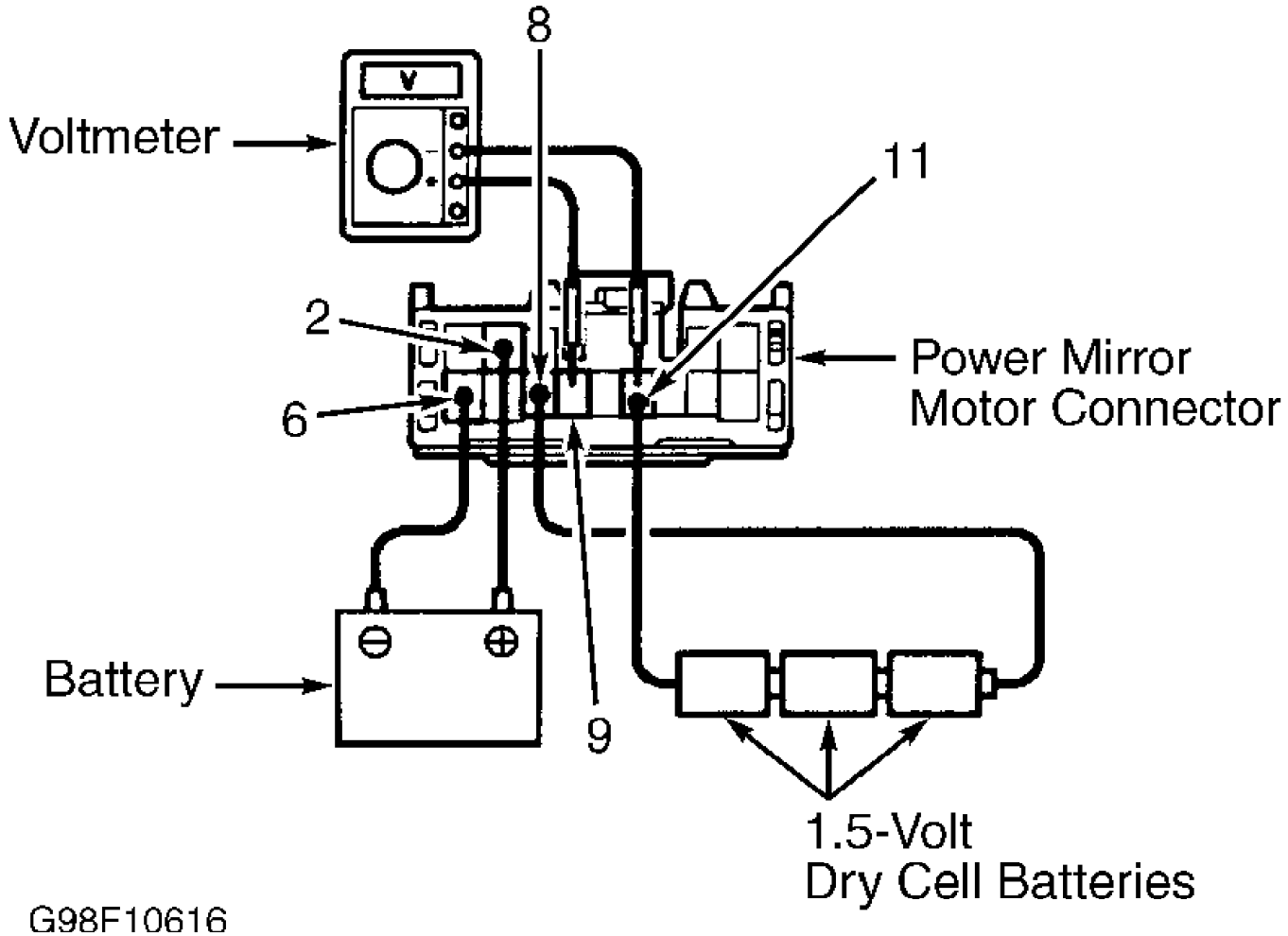


Fig. 14: Testing Power Mirror Position Sensor (GS300 & GS400) Courtesy of Toyota Motor Sales, U.S.A., Inc.

LS400

1) Disconnect power mirror motor harness connector. Connect three 1.5-volt dry cell batteries together in series. See Fig. 15. Connect dry cell battery positive lead to terminal No. 7 and negative lead to terminal No. 6. Connect positive lead of voltmeter to terminal No. 13 and negative lead to terminal No. 6.

2) While watching voltmeter, apply battery voltage and ground to terminals No. 10 and 11, reversing polarity as necessary to move

mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-.9 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly. If voltage is as specified, go to next step.

3) Disconnect 4 leads of voltmeter and battery voltage from power mirror motor connector terminals (leave dry cell assembly connected). Connect positive lead of voltmeter to terminal No. 14 and negative lead to terminal No. 6.

4) Apply battery voltage and ground between terminals No. 11 and 12, reversing polarity as necessary to move mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-.9 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly.

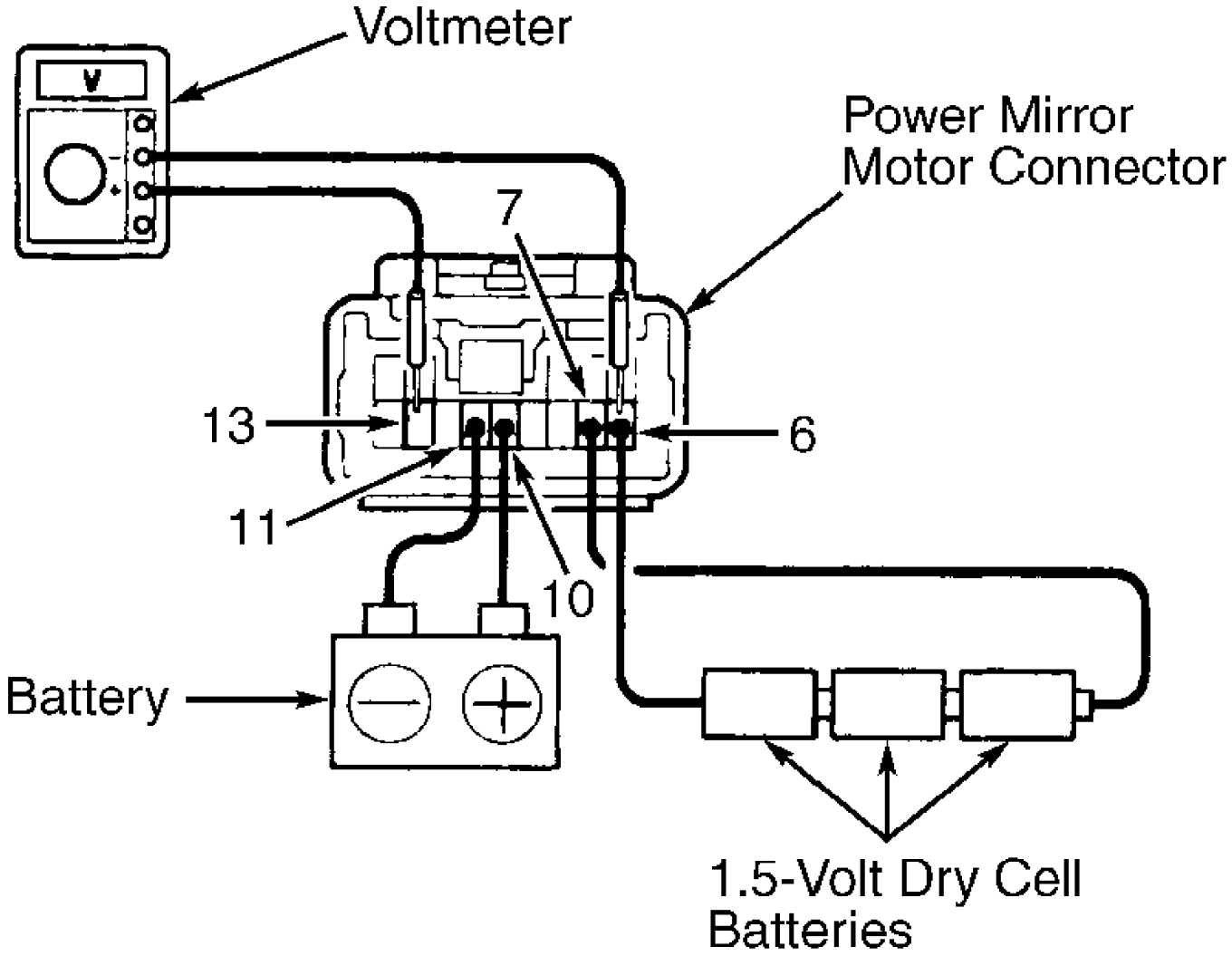


Fig. 15: Testing Power Mirror Position Sensor (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

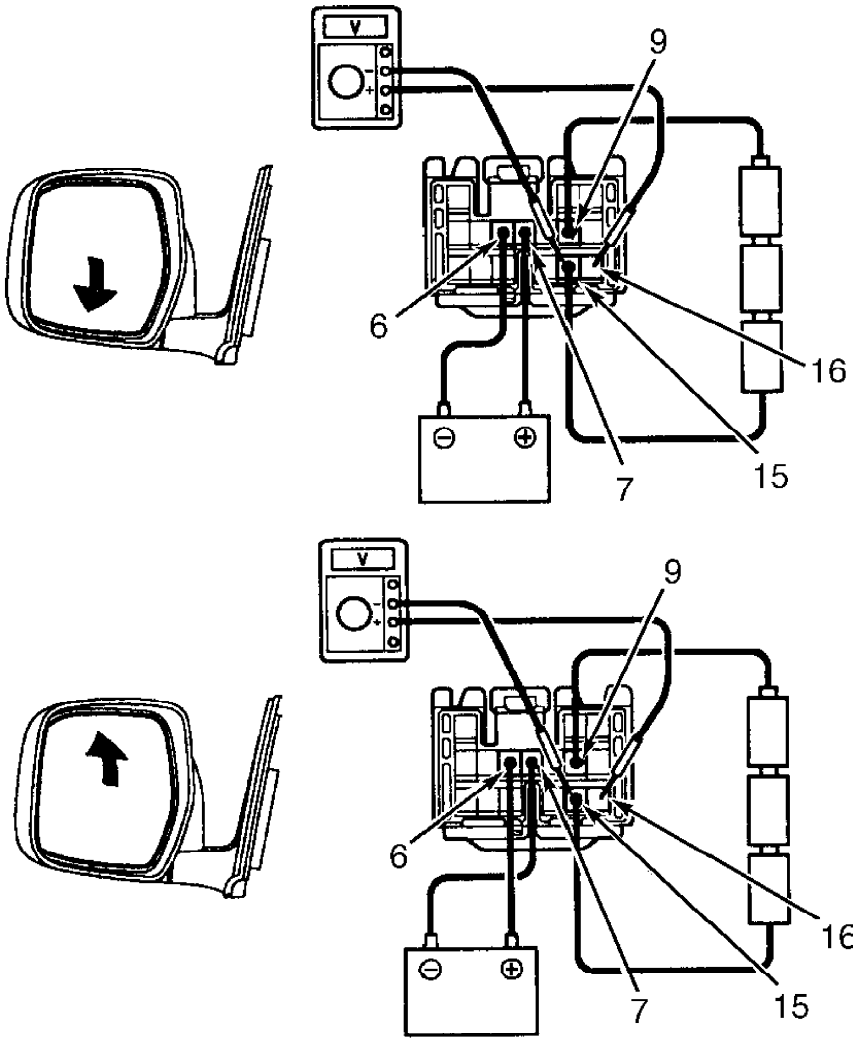
LX470

1) Disconnect power mirror motor harness connector. Connect three 1.5-volt dry cell batteries together in series. See Fig. 16. Connect dry cell battery positive lead to terminal No. 9 and negative lead to terminal No. 15. Connect positive lead of voltmeter to terminal No. 16 and negative lead to terminal No. 15.

2) While watching voltmeter, apply battery voltage and ground between terminals No. 7 and 6, reversing polarity as necessary to move mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-1.8 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly. If voltage is as specified, go to next step.

3) Disconnect 4 leads of voltmeter and battery voltage from power mirror motor connector terminals (leave dry cell assembly connected). Connect positive lead of voltmeter to terminal No. 10 and negative lead to terminal No. 15.

4) Apply battery voltage and ground between terminals No. 6 and 7, reversing polarity as necessary to move motor in both directions. As mirror moves, voltage should gradually and smoothly change from 0-1.8 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly.



G98G03742

Fig. 16: Testing Power Mirror Position Sensor (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SC300 & SC400

1) Disconnect power mirror motor harness connector. Connect

three 1.5-volt dry cell batteries together in series. See Fig. 17. Connect dry cell battery positive lead to terminal No. 11 and negative lead to terminal No. 8. Connect positive lead of voltmeter to terminal No. 10 and negative lead to terminal No. 8.

2) While watching voltmeter, apply battery voltage and ground between terminals No. 3 and 13, reversing polarity as necessary to move mirror in both directions. As mirror moves, voltage should gradually and smoothly change from 0-.9 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly. If voltage is as specified, go to next step.

3) Disconnect 4 leads of voltmeter and battery voltage from power mirror motor connector terminals (leave dry cell assembly connected). Connect positive lead of voltmeter to terminal No. 9 and negative lead to terminal No. 8.

4) Apply battery voltage and ground between terminals No. 12 and 13, reversing polarity as necessary to move motor in both directions. As mirror moves, voltage should gradually and smoothly change from 0-.9 volt to 2.8-5.0 volts. If voltage is not as specified, replace power mirror motor assembly.

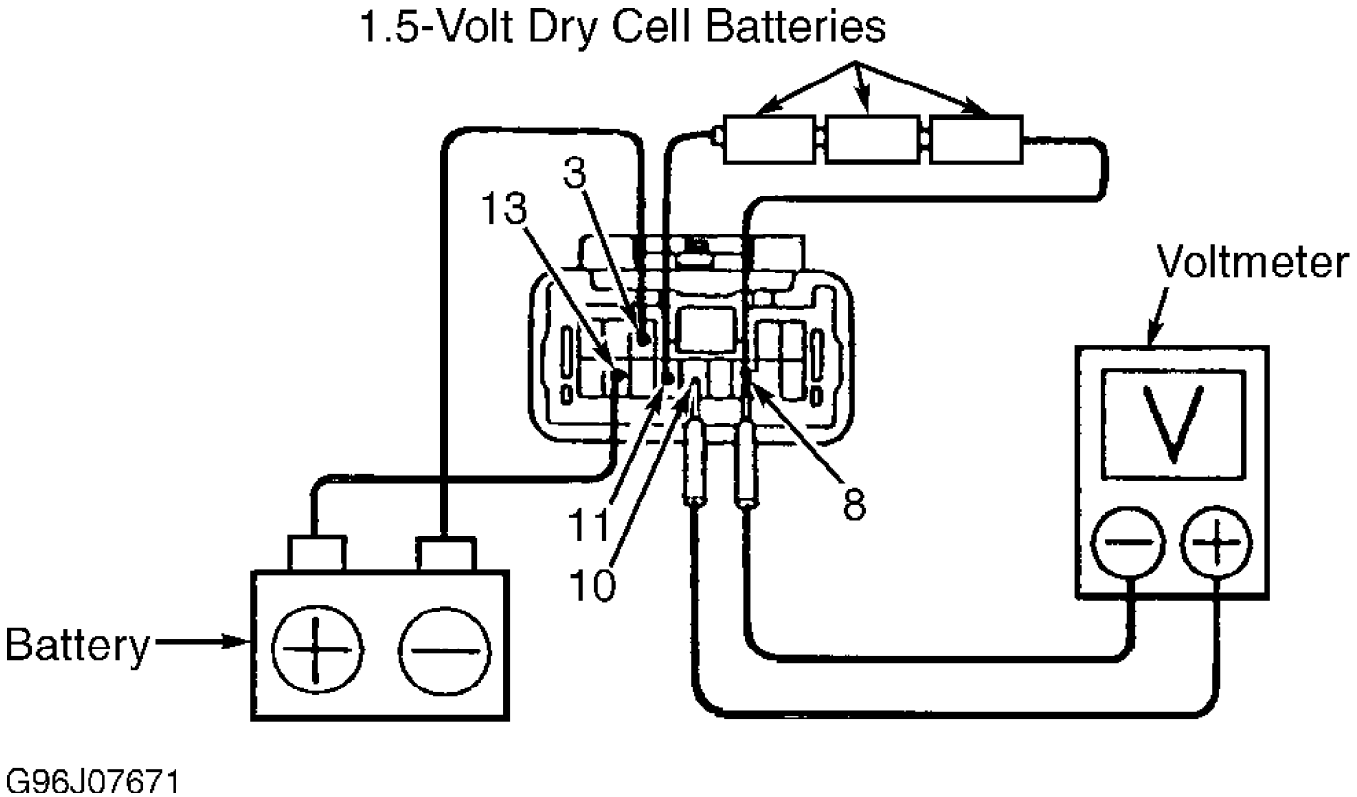


Fig. 17: Testing Power Mirror Position Sensor (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POWER MIRROR SWITCH

Remove power mirror switch. Check resistance or continuity between specified power mirror switch terminals (component side) with switch in specified position. See appropriate POWER MIRROR SWITCH RESISTANCE or POWER MIRROR SWITCH CONTINUITY table. See Figs. 18-21. If resistance or continuity is not as specified, replace power mirror switch.

POWER MIRROR SWITCH CONTINUITY (ES300)

Switch Position	Terminals
Left Switch	
Off (Neutral)	(1)
Up	3 & 4; 7 & 8
Down	3 & 8; 4 & 7
Left	4 & 9; 7 & 8
Right	4 & 7; 8 & 9
Right Switch	
Off (Neutral)	(1)
Up	1, 7 & 8; 2 & 4
Down	1, 2 & 8; 4 & 7
Left	1, 7 & 8; 4 & 10
Right	1, 8 & 10; 4 & 7

(1) - Continuity should not exist between any terminals.

POWER MIRROR SWITCH RESISTANCE (GS300, GS400 & LS400)

Switch Position	Terminals	Resistance (Ohms)
Left & Right Select Switch		
Left	8 & 9	100
Right	8 & 9	0
Left & Right Switch		
Up	7 & 9	About 100
Right	7 & 9	250
Down	7 & 9	470
Left	7 & 9	800

POWER MIRROR SWITCH CONTINUITY (LX470)

Switch Position	Terminals
Left Switch	
Off (Neutral)	(1)
Up	1, 7 & 8; 3 & 4
Down	1, 3 & 8; 4 & 7
Left	1, 7 & 8; 4 & 9
Right	1, 8 & 9; 4 & 7
Right Switch	
Off (Neutral)	(1)
Up	2 & 4; 7 & 8
Down	2 & 8; 4 & 7
Left	4 & 10; 7 & 8
Right	4 & 7; 8 & 10
Retract Switch	
Return	2 & 6; 3 & 5
Retract	2 & 3; 5 & 6

(1) - Continuity should not exist between any terminals.

POWER MIRROR SWITCH CONTINUITY (RX300)

Switch Position	Terminals
Left Switch	
Off (Neutral)	(1)
Up	1 & 9; 6 & 10

Down	1 & 10; 6 & 9
Left	5 & 9; 6 & 10
Right	5 & 10; 6 & 9
Right Switch	
Off (Neutral)	(1)
Up	6 & 10; 7 & 9
Down	6 & 9; 7 & 10
Left	6 & 10; 8 & 9
Right	6 & 9; 8 & 10

(1) - Continuity should not exist between any terminals.

POWER MIRROR SWITCH CONTINUITY (SC300 & SC400)

Switch Position	Terminals
Left/Right Select Switch	
Off (Neutral)	(1)
Left & Right	2 & 9; 3 & 10
Left Switch	
Off (Neutral)	(1)
Up	3 & 12; 8 & 11
Down	3 & 8; 11 & 12
Left	2 & 12; 8 & 11
Right	2 & 8; 11 & 12
Right Switch	
Off (Neutral)	(1)
Up	8 & 11; 10 & 12
Down	8 & 10; 11 & 12
Left	8 & 11; 9 & 12
Right	8 & 9; 11 & 12

(1) - Continuity should not exist between any terminals.

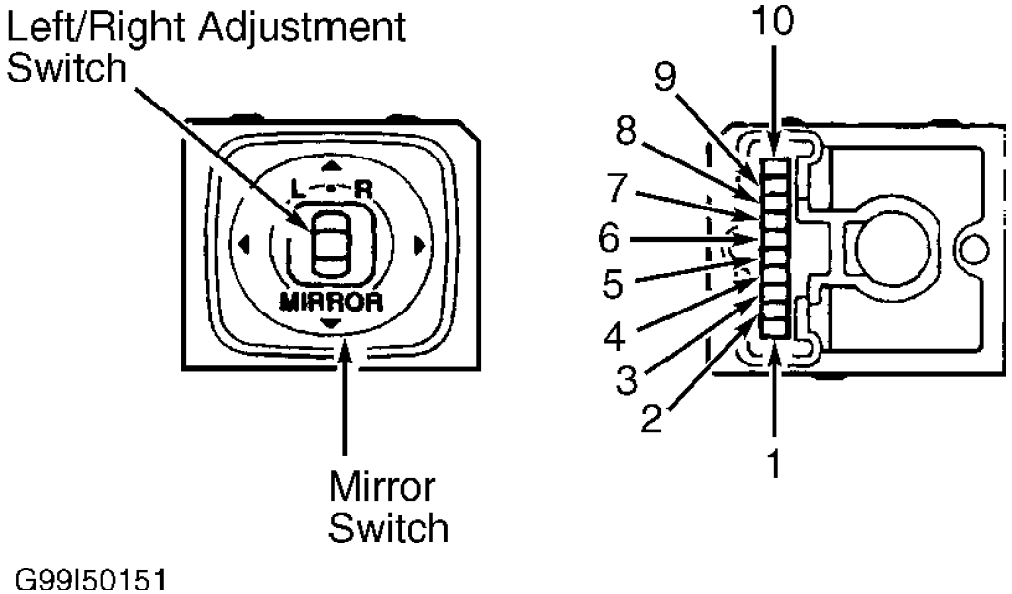
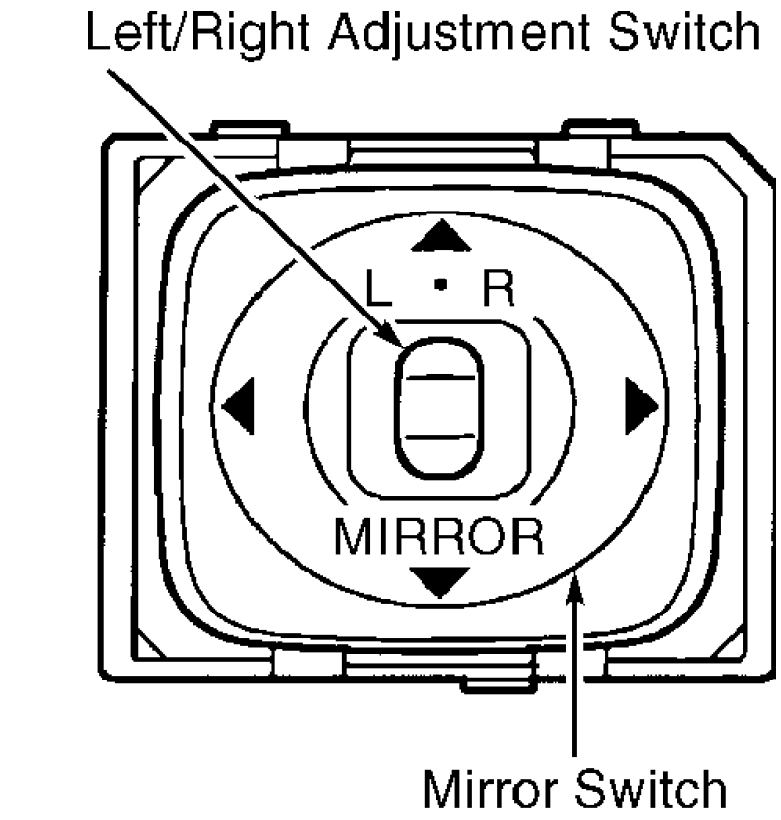
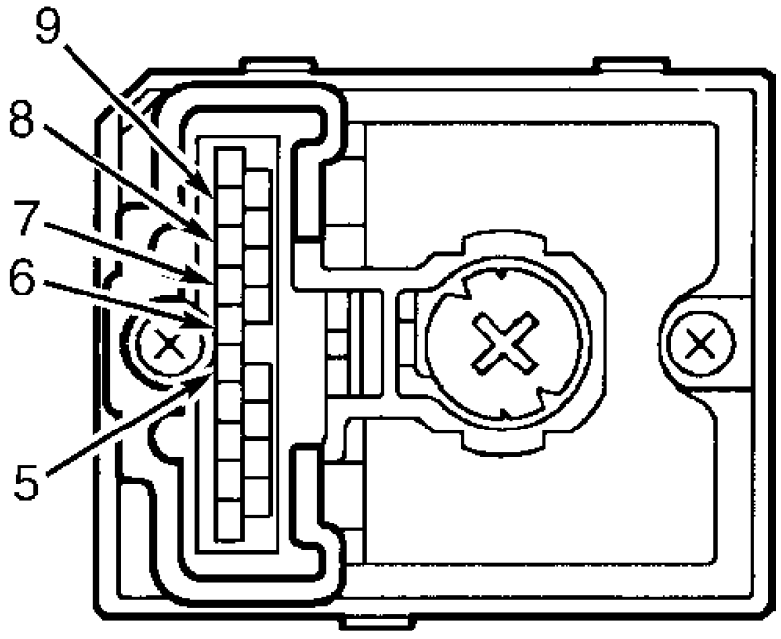


Fig. 18: Power Mirror Switch & Connector (ES300 & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.





G98B10612

Fig. 19: Power Mirror Switch & Connector (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

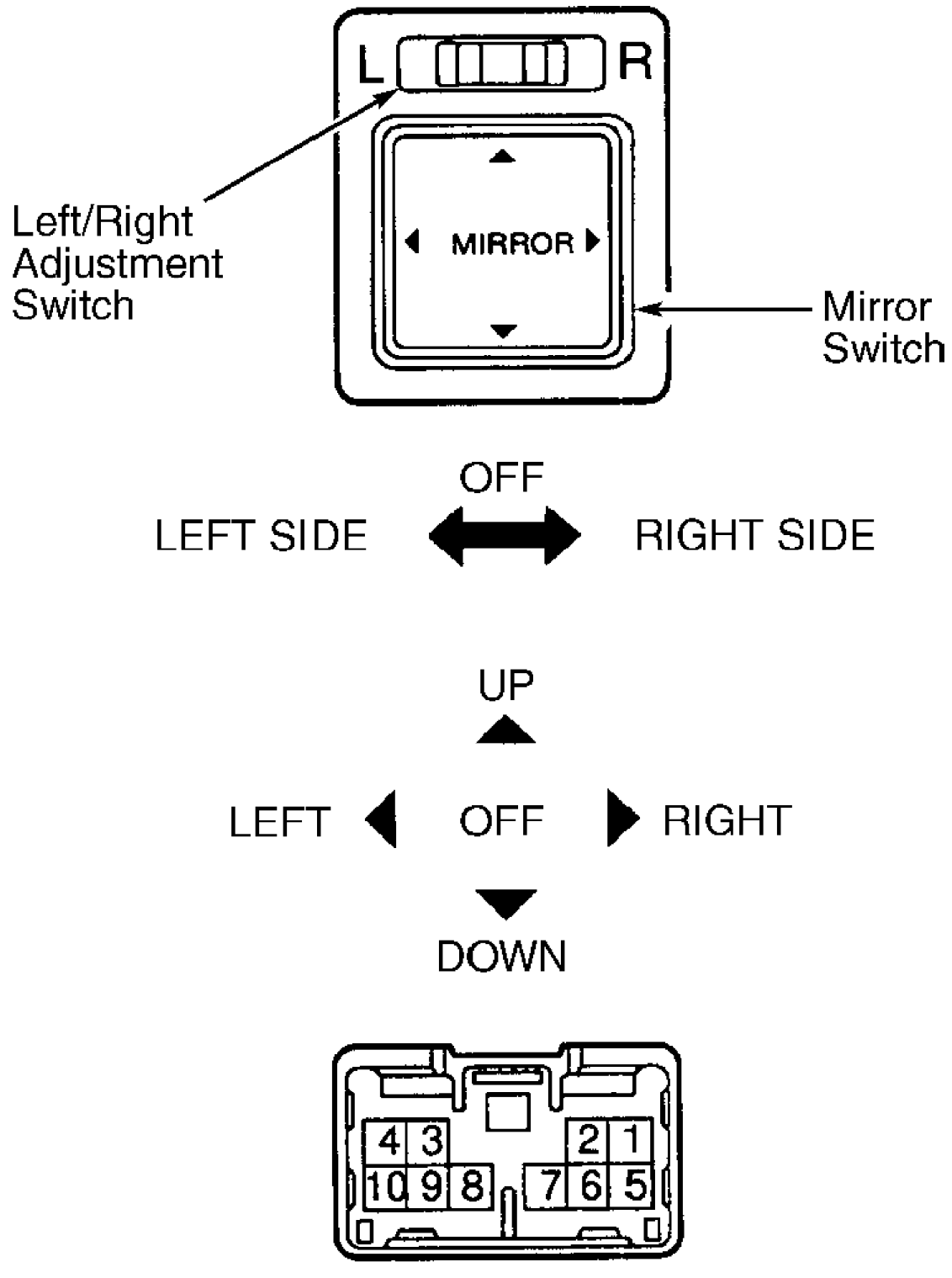


Fig. 20: Power Mirror Switch & Connector (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G93G01677

Fig. 21: Power Mirror Switch & Connector (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOTE CONTROL MIRROR ECU PIN VOLTAGES

LX470, SC300 & SC400 (With Memory)

Turn ignition on. Using a voltmeter, measure voltage by backprobing between the following remote control mirror ECU connector terminals and ground within specified conditions. See REMOTE CONTROL MIRROR ECU PIN VOLTAGES (LX470) or REMOTE CONTROL MIRROR ECU PIN VOLTAGES (SC300 & SC400) table. See Fig. 1 or 2. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, replace remote control mirror ECU.

REMOTE CONTROL MIRROR ECU PIN VOLTAGES (LX470)

Terminal	Condition	Voltage
1	All Conditions	Battery
2	Ignition Off	Zero
2	Ignition On	Battery
3	All Conditions	About 5.0
4	All Conditions	About 5.0
5	All Conditions	About 5.0
6	All Conditions	About 5.0
7	Either Mirror, Except Off	About 5.0
8	Left Mirror, Down	(1) 2.8-5.0
8	Left Mirror, Up	(1) 0.0-0.9
9	Left Mirror, Left	(1) 2.8-5.0
9	Left Mirror, Right	(1) 0.0-0.9
10	Left Mirror, Left Or Down	Battery
11	Left Mirror, Right	Battery
12	Left Mirror, Up	Battery
20	Right Mirror, Down	(1) 2.8-5.0
20	Right Mirror, Up	(1) 0.0-0.9
21	Right Mirror, Left	(1) 0.0-0.9
21	Right Mirror, Right	(1) 2.8-5.0
22	Right Mirror, Right Or Down	Battery
23	Right Mirror, Left	Battery
24	Right Mirror, Up	Battery

(1) - As mirror moves, voltage should gradually change.

REMOTE CONTROL MIRROR ECU PIN VOLTAGES (SC300 & SC400)

Terminal	Condition	Voltage
A1	Right Mirror, Left	Battery
A2	Right Mirror, Up	Battery
A3	Right Mirror, Right Or Down	Battery
A4	All Conditions	Battery
A5	Right Mirror, Left	(1) 0.0-0.9
A5	Right Mirror, Right	(1) 2.8-5.0
A6	Right Mirror, Down	(1) 2.8-5.0
A6	Right Mirror, Up	(1) 0.0-0.9
A7	Ignition Off	Zero
A7	Ignition On	Battery
A8	Left Mirror, Right	Battery
A9	Left Mirror, Up	Battery
A10	Left Mirror, Left Or Down	Battery
A13	Either Mirror, Except Off	About 5.0
A14	Left Mirror, Left	(1) 2.8-5.0
A14	Left Mirror, Right	(1) 0.0-0.9
A15	Left Mirror, Down	(1) 2.8-5.0
A15	Left Mirror, Up	(1) 0.0-0.9
B2	All Conditions	About 5.0
B4	All Conditions	About 5.0
B5	All Conditions	About 5.0
B6	All Conditions	About 5.0

(1) - As mirror moves, voltage should gradually change.

OUTER MIRROR ELECTRO CHROMIC

GS300 & GS400 (With Memory)

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 5 and battery negative lead to terminal No. 4 at mirror connector. See Fig. 7. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

GS300 & GS400 (Without Memory) & RX300

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 2 and battery negative lead to terminal No. 1 at mirror connector. See Fig. 8. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

LS400 (With Memory)

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 4 and battery negative lead to terminal No. 3 at mirror connector. See Fig. 9. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

LS400 (Without Memory)

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 2 and battery negative lead to terminal No. 1 at mirror connector. See Fig. 10. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

LX470

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 2 and

battery negative lead to terminal No. 3 at mirror connector. See Fig. 11. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

SC300 & SC400 (With Memory)

Disconnect outer mirror connector. Using jumper wires, connect 1.5 volt dry cell battery positive lead to terminal No. 1 and battery negative lead to terminal No. 2 at mirror connector. See Fig. 12. Mirror face should change from bright to dark. Replace mirror assembly as necessary.

REAR VIEW MIRROR ELECTRO CHROMIC

GS300, GS400, LS400, LX470, RX300, SC300 & SC400

Remove rear view mirror. Using jumper wires, apply positive battery lead to terminal No. 1 and negative battery lead to terminal No. 4 at rear view mirror harness connector. See Fig. 22. Connect positive lead of voltmeter to terminal No. 2 and negative lead to terminal No. 3. Press mirror switch. Observe voltmeter and shine an electric light on face of mirror. Battery voltage should be present and face should change from bright to dark. Replace rear view mirror as necessary.

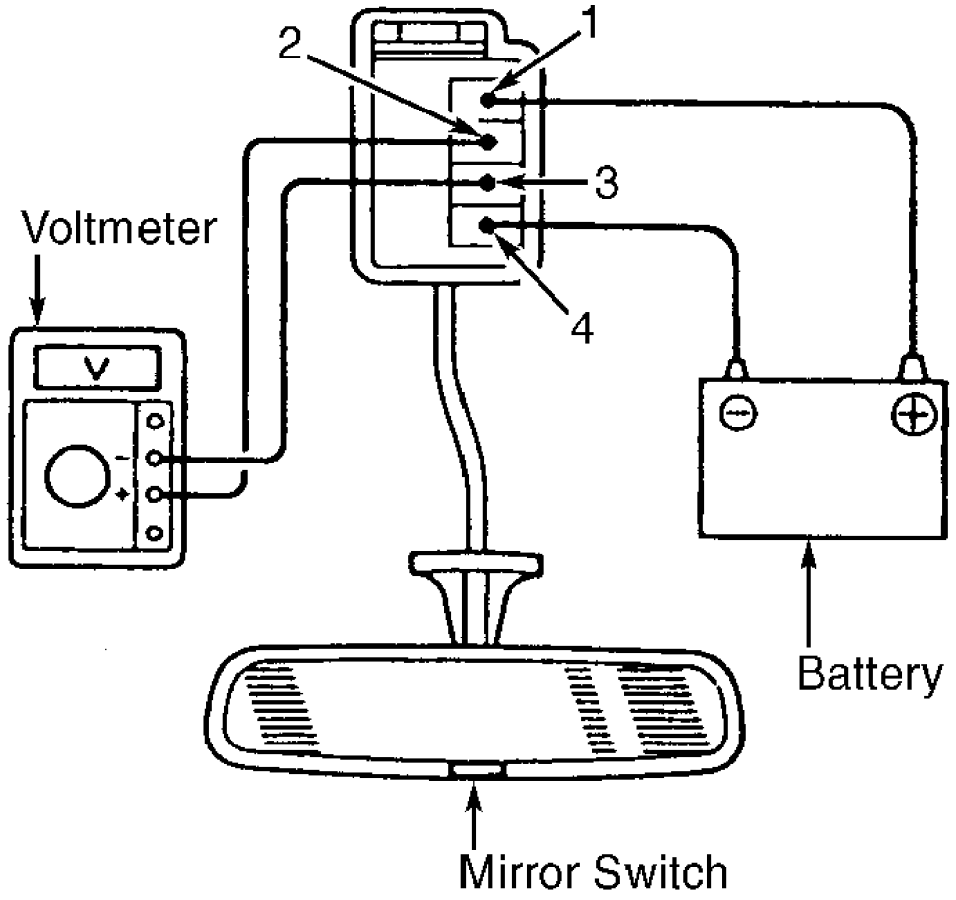


Fig. 22: Testing Rear View Mirror Electro Chromic (GS300, GS400, LS400, LX470, RX300, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

CAUTION: To prevent damage, pry out decorative trim pieces with a plastic tool or a screwdriver with a taped tip.

POWER MIRROR ASSEMBLY

NOTE: To remove mirror glass from power mirror assembly, see POWER MIRROR GLASS.

Removal & Installation (ES300, GS300, GS400 & LS400)

1) Disconnect negative battery cable. Pry cover away from upper speaker. Remove screws and inner door handle bezel. Pry up front edge of switch base plate, and pull plate forward to remove.

2) Remove screws or clips securing door trim panel. Pry door trim panel away from door to release retaining clips. Pull door trim panel upward to disengage from door. Remove courtesy light (if equipped). Remove door window frame trim/garnish. Remove upper speaker. Remove 3 bolts and disconnect power mirror assembly electrical connector. Remove power mirror assembly. To install, reverse removal procedure.

Removal & Installation (LX470 & RX300)

Disconnect negative battery cable. Remove lower frame bracket garnish. Remove 3 bolts and disconnect power mirror assembly electrical connector. Remove power mirror assembly. To install, reverse removal procedure.

Removal & Installation (SC300 & SC400)

Disconnect negative battery cable. Pry cover away from upper speaker. Remove 3 bolts and disconnect power mirror assembly electrical connector. Remove power mirror assembly. To install, reverse removal procedure.

POWER MIRROR SWITCH

Removal & Installation (ES300, GS300, GS400, LS400 & LX470)

Remove lower trim panel from below left side of instrument panel. Remove screws, and then lower hood release and/or parking brake release lever out of way. Remove screws under power mirror switch (as necessary). Using a screwdriver, carefully pry switch out from lower trim panel. Disconnect electrical connectors. To install, reverse removal procedure.

RX300

Remove lower cluster finish panel from left side of instrument panel. Disconnect electrical connectors. Using a screwdriver, carefully pry switch out from finish panel. To install, reverse removal procedure.

Removal & Installation (SC300 & SC400)

Using a screwdriver, carefully pry front end and middle of switch panel out from driver’s door armrest. See Fig. 23. Pull switch panel forward to remove and disconnect electrical connectors. To install, reverse removal procedure.

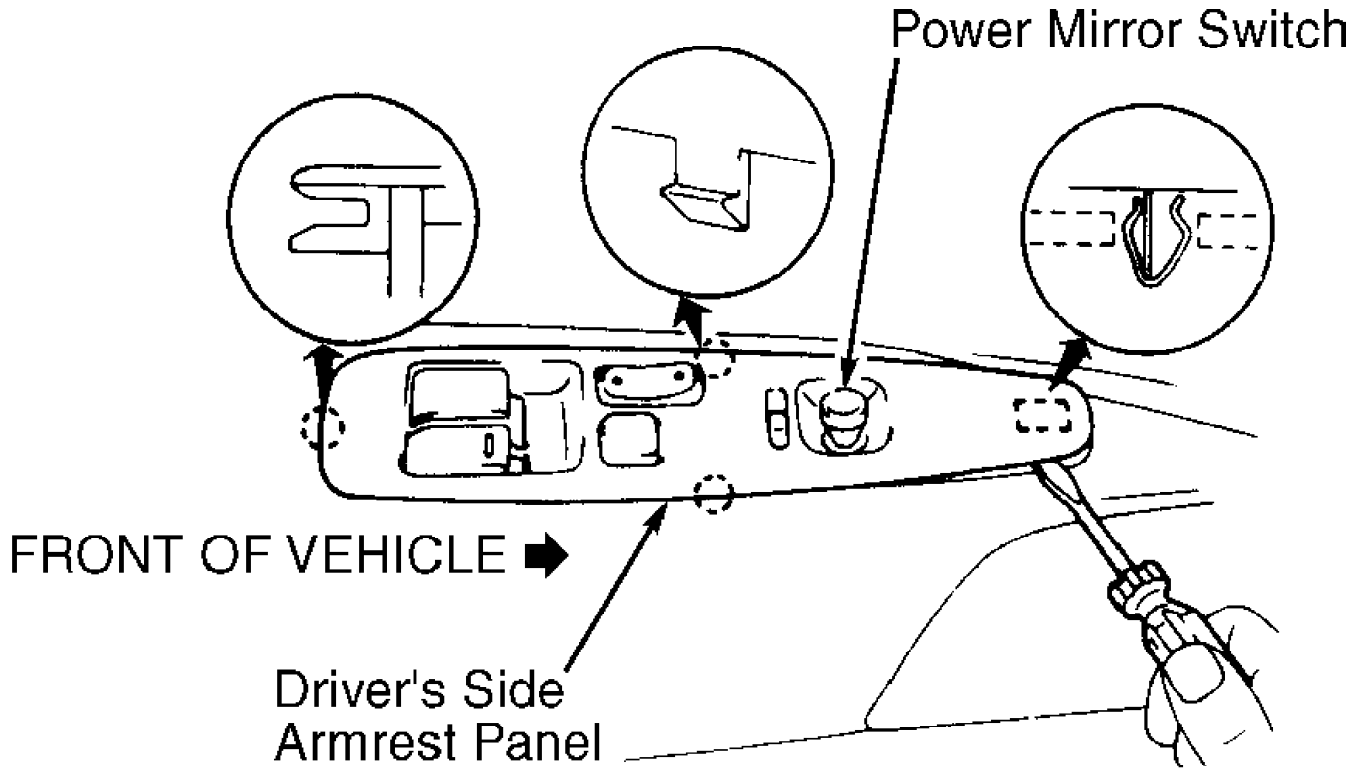


Fig. 23: Removing Power Mirror Switch (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POWER MIRROR GLASS

WARNING: To prevent fire, ensure mirror defogger switch is turned off and element has cooled before sliding shop towel behind mirror.

Removal & Installation

Disconnect negative battery cable. Slide a shop towel between mirror glass and housing. Use shop towel to pull out bottom of mirror (2 clips at bottom of mirror glass secure mirror to motor assembly). Pull bottom of mirror upward until tabs at top of mirror disengage from motor assembly. On heated mirrors, disconnect heater electrical connector. To install, reverse removal procedure.

REMOTE CONTROL MIRROR ECU

Removal & Installation (LX470)

Remove door trim panel. Remove ECU screws, disconnect electrical connectors and remove remote control mirror ECU. To install, reverse removal procedure.

Removal & Installation (SC300 & SC400)

Remove cover from under left side of instrument panel. Remove ECU screws, disconnect electrical connectors and remove remote control mirror ECU. To install, reverse removal procedure.

REAR VIEW MIRROR

Removal & Installation (GS300, GS400, LS400, LX470, RX300, SC300 & SC400)

Remove center visor panel. Remove mirror screws, disconnect electrical connector and remove rear view mirror. To install, reverse removal procedure.

WIRING DIAGRAMS

NOTE: For vehicles equipped with power memory mirrors, see appropriate wiring diagram in POWER SEATS - WITH MEMORY article.

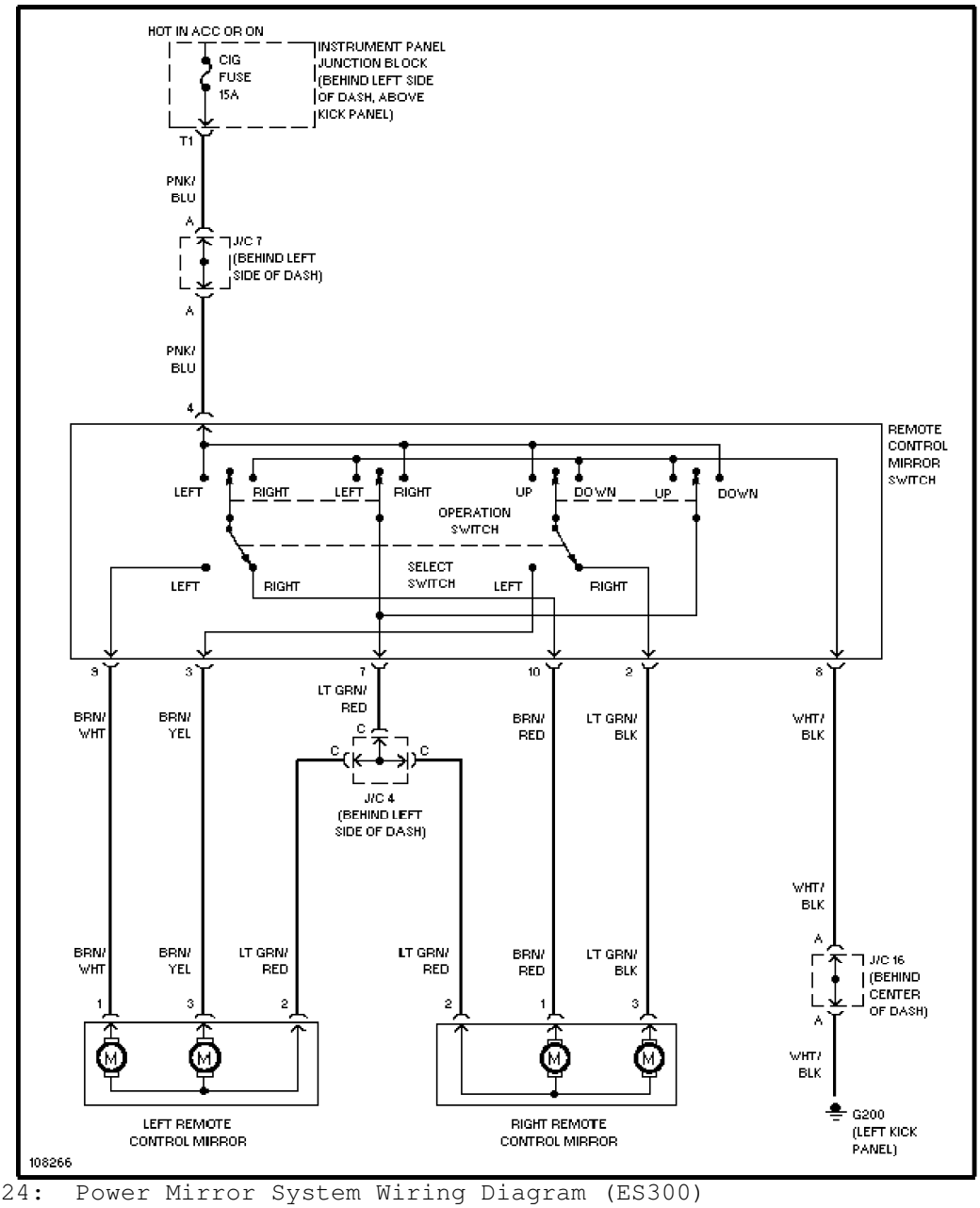


Fig. 24: Power Mirror System Wiring Diagram (ES300)

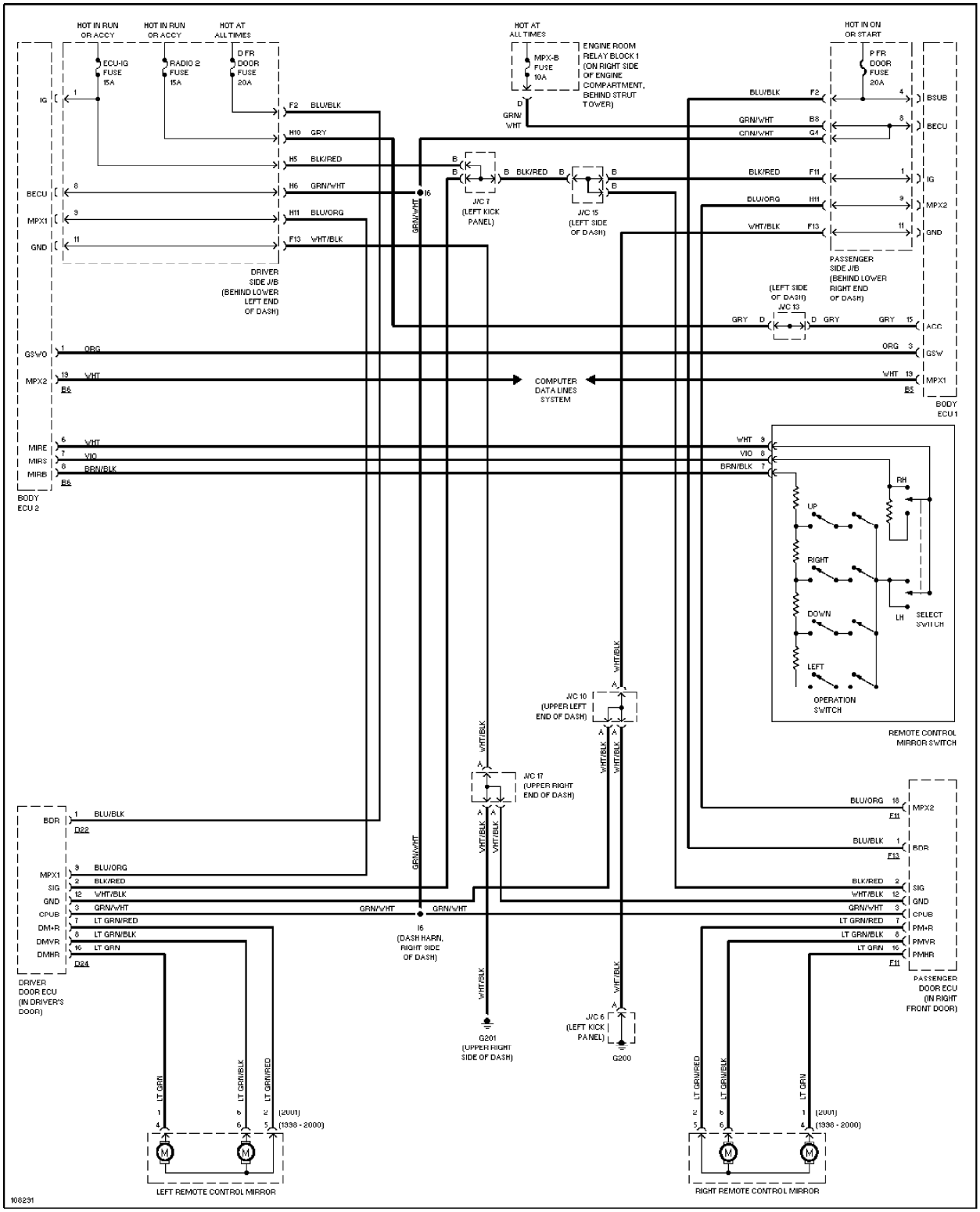


Fig. 25: Power Mirror System Wiring Diagram (GS300)

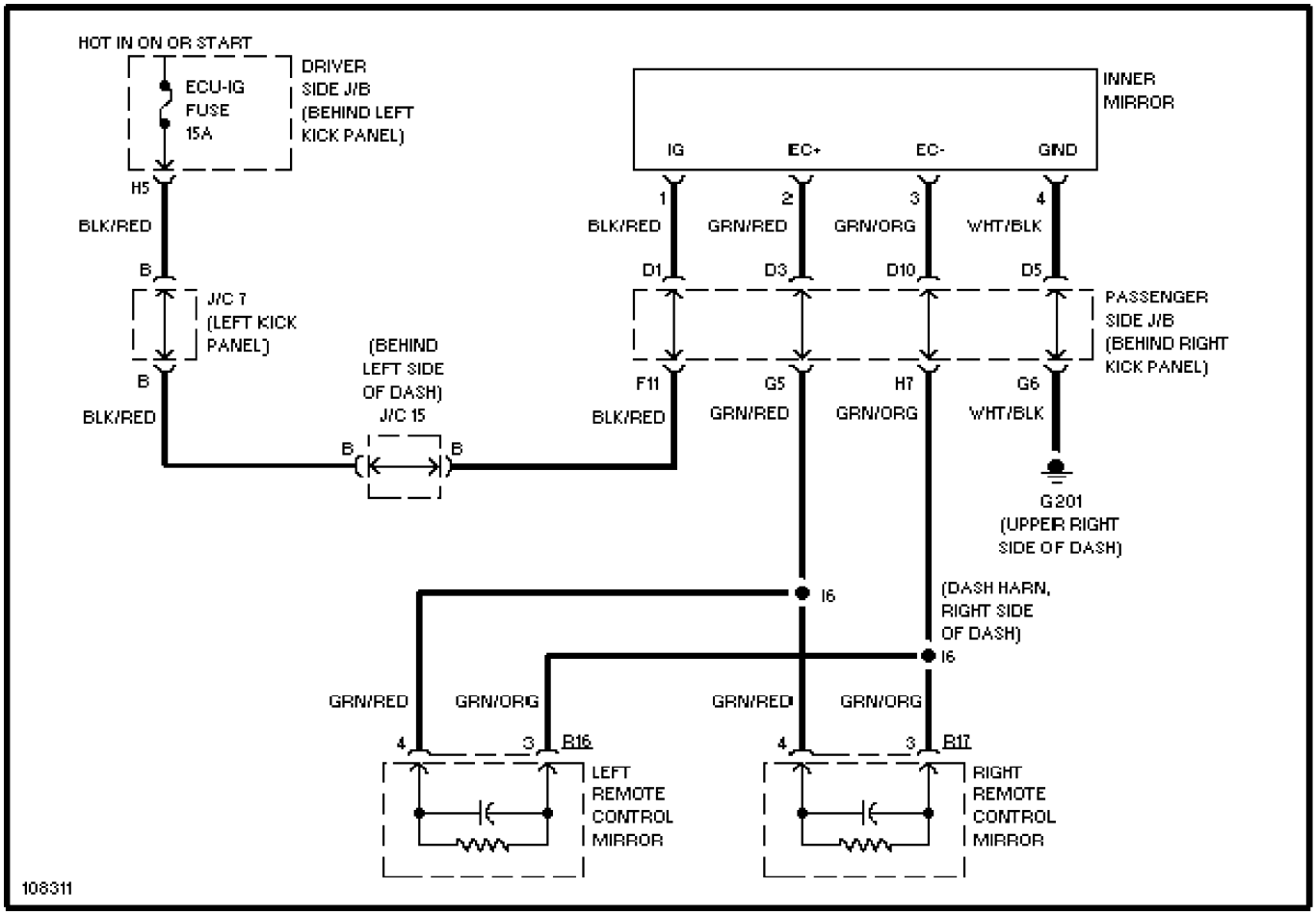


Fig. 26: Power Mirror System Wiring Diagram (GS300 & GS400 - Automatic Day/Night Mirrors)

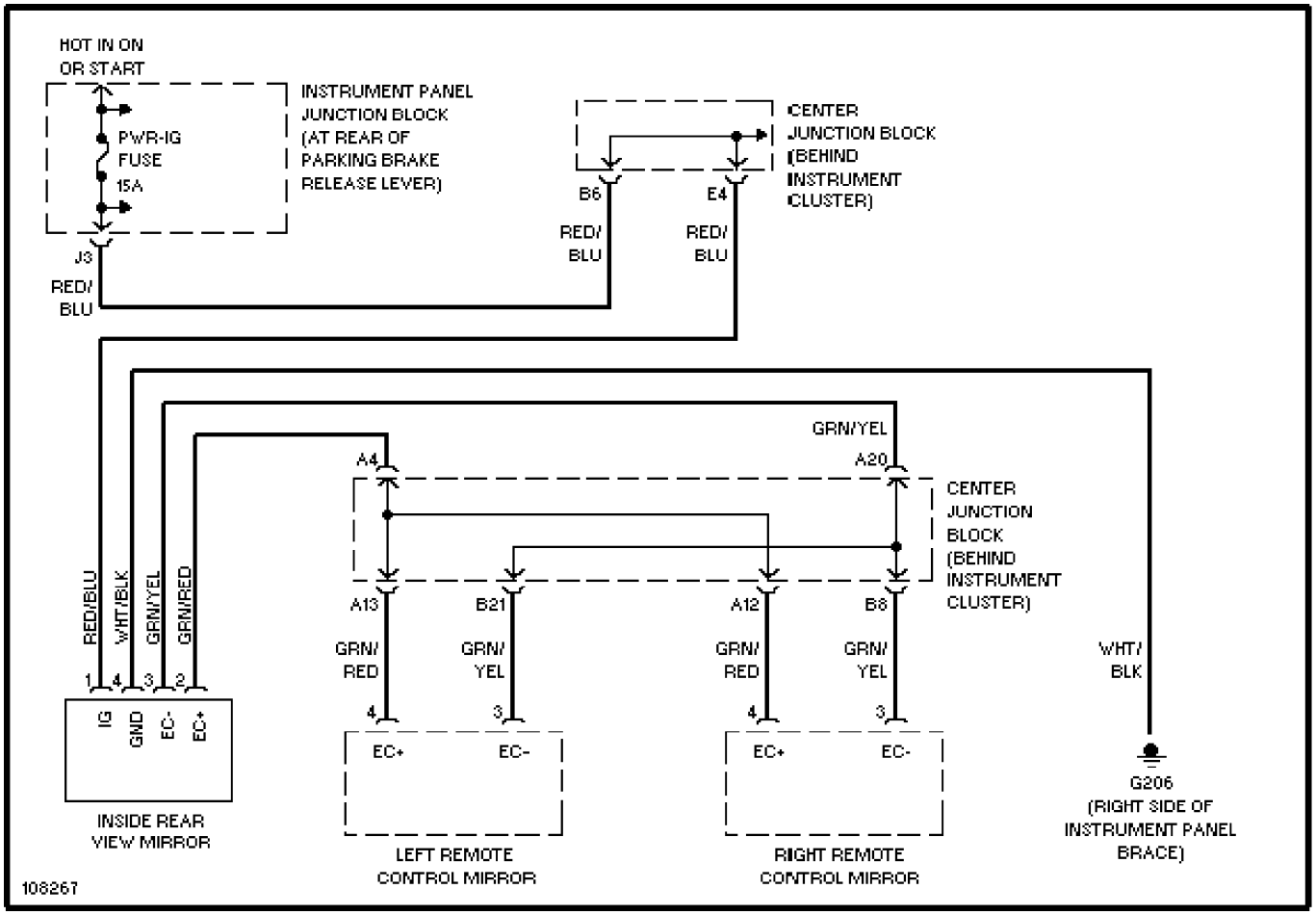


Fig. 27: Power Mirror System Wiring Diagram (LS400 - Automatic Day/Night Mirrors)

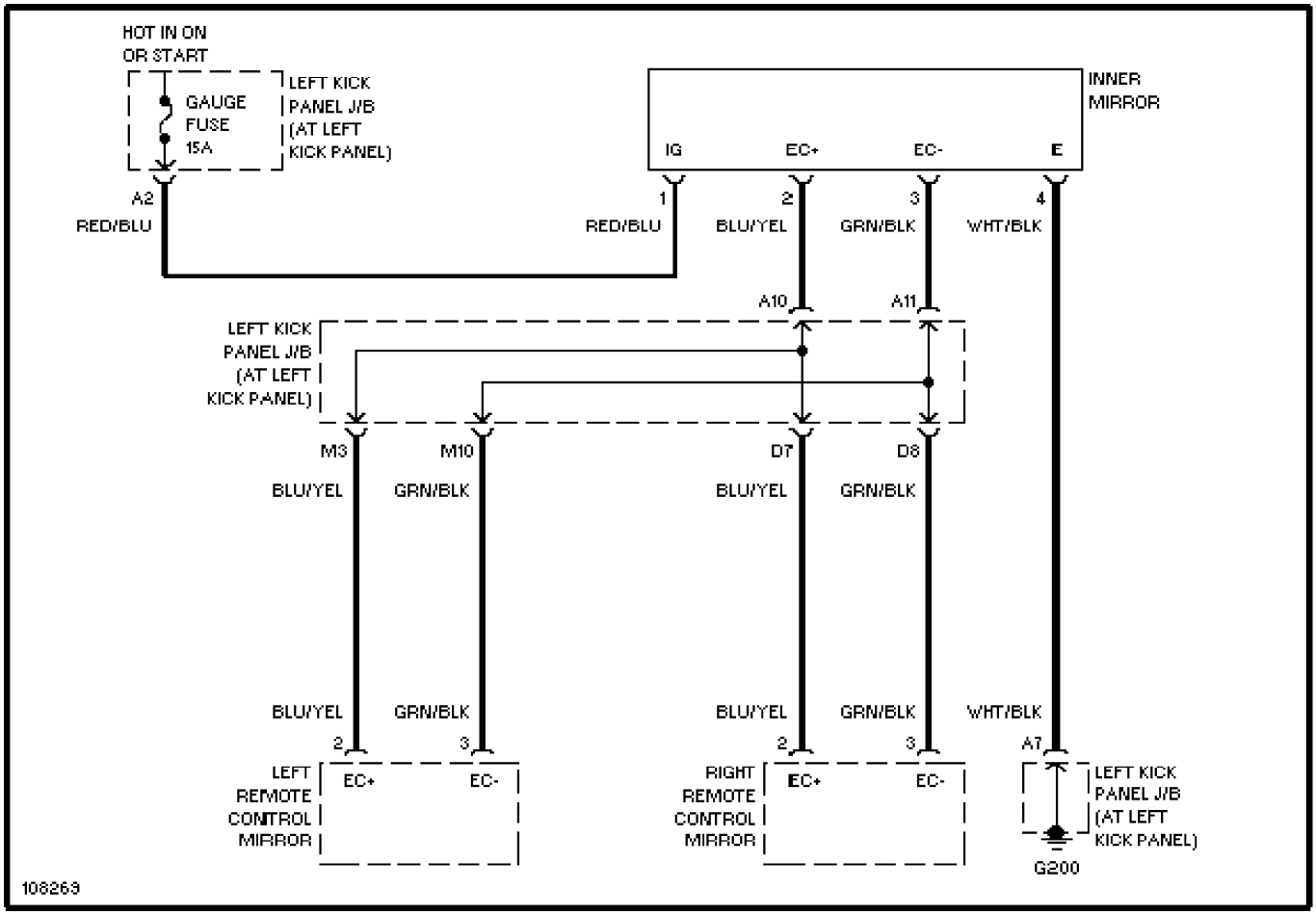


Fig. 28: Power Mirror System Wiring Diagram (LX470 - Automatic Day/Night Mirrors)

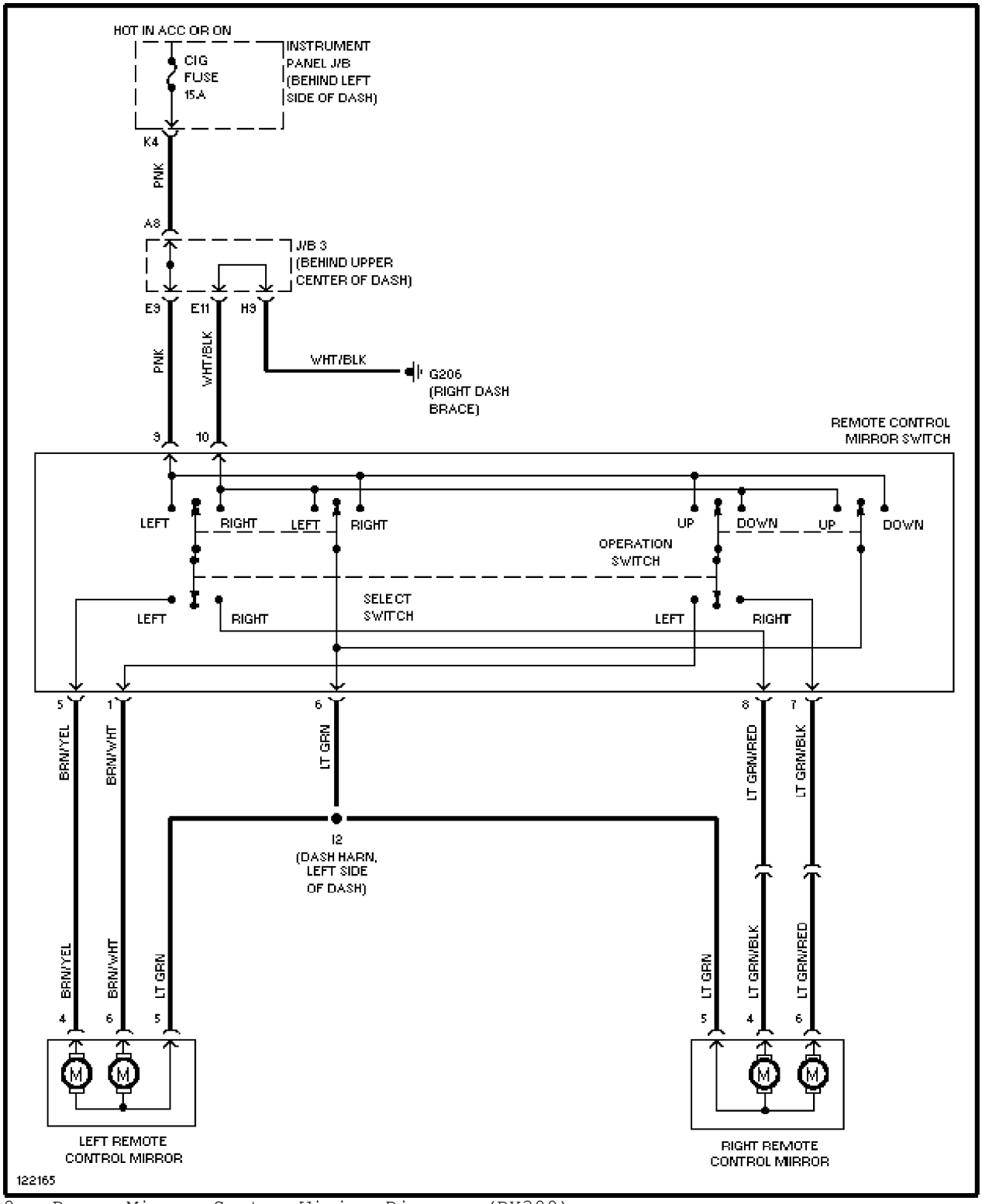


Fig. 29: Power Mirror System Wiring Diagram (RX300)

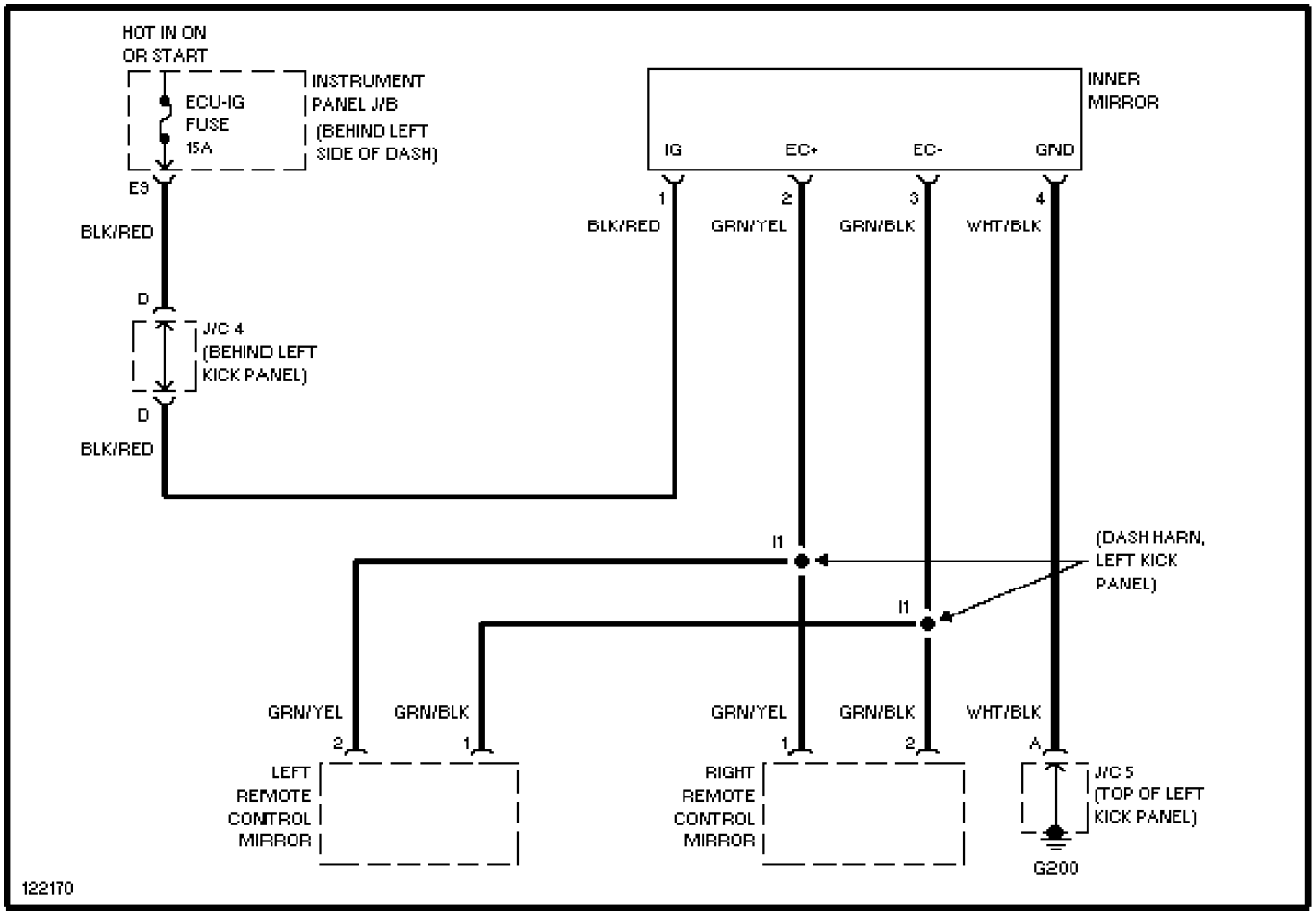


Fig. 30: Power Mirror System Wiring Diagram (RX300 - Automatic Day/Night Mirrors)

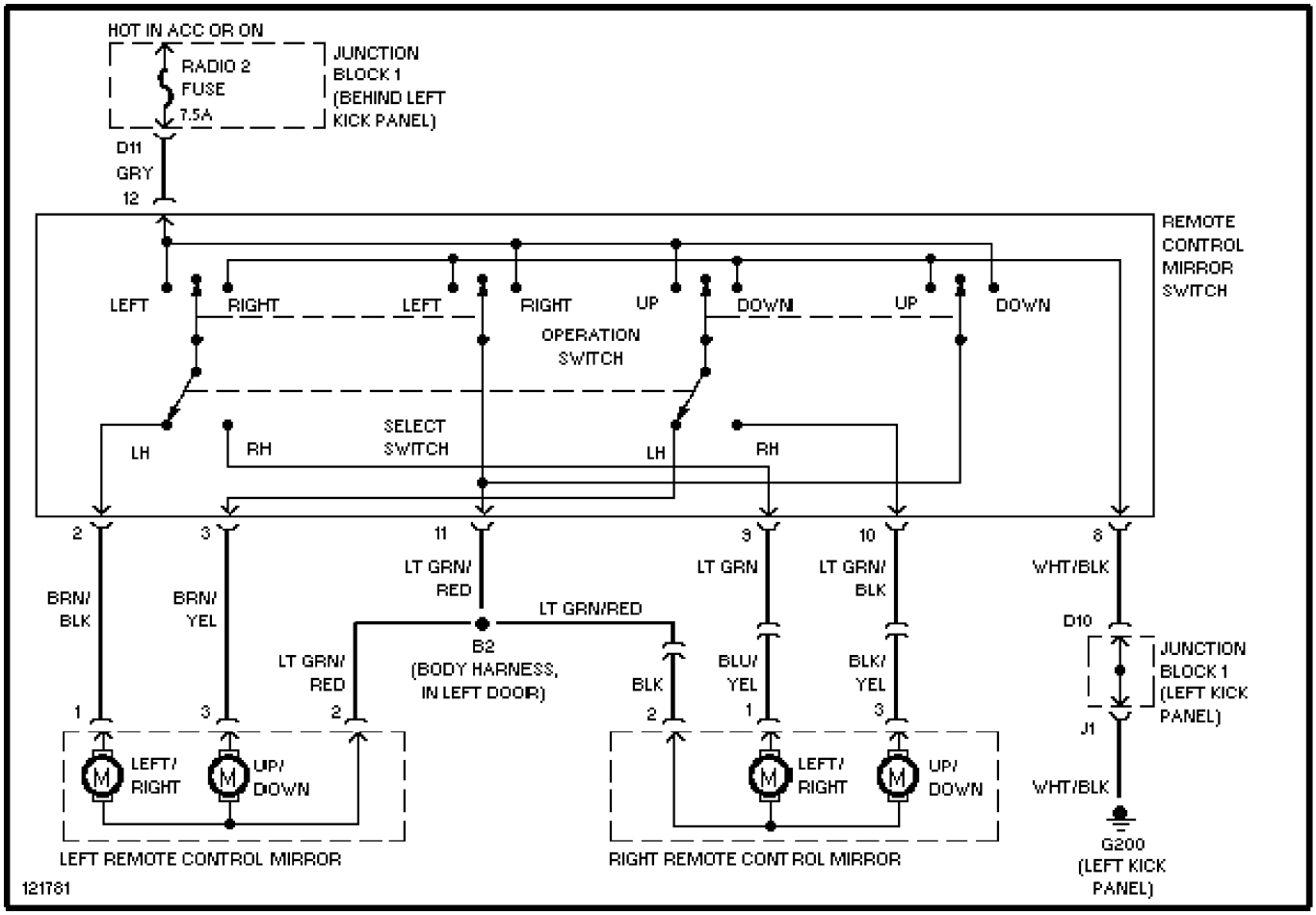


Fig. 31: Power Mirror System Wiring Diagram (SC300 & SC400)

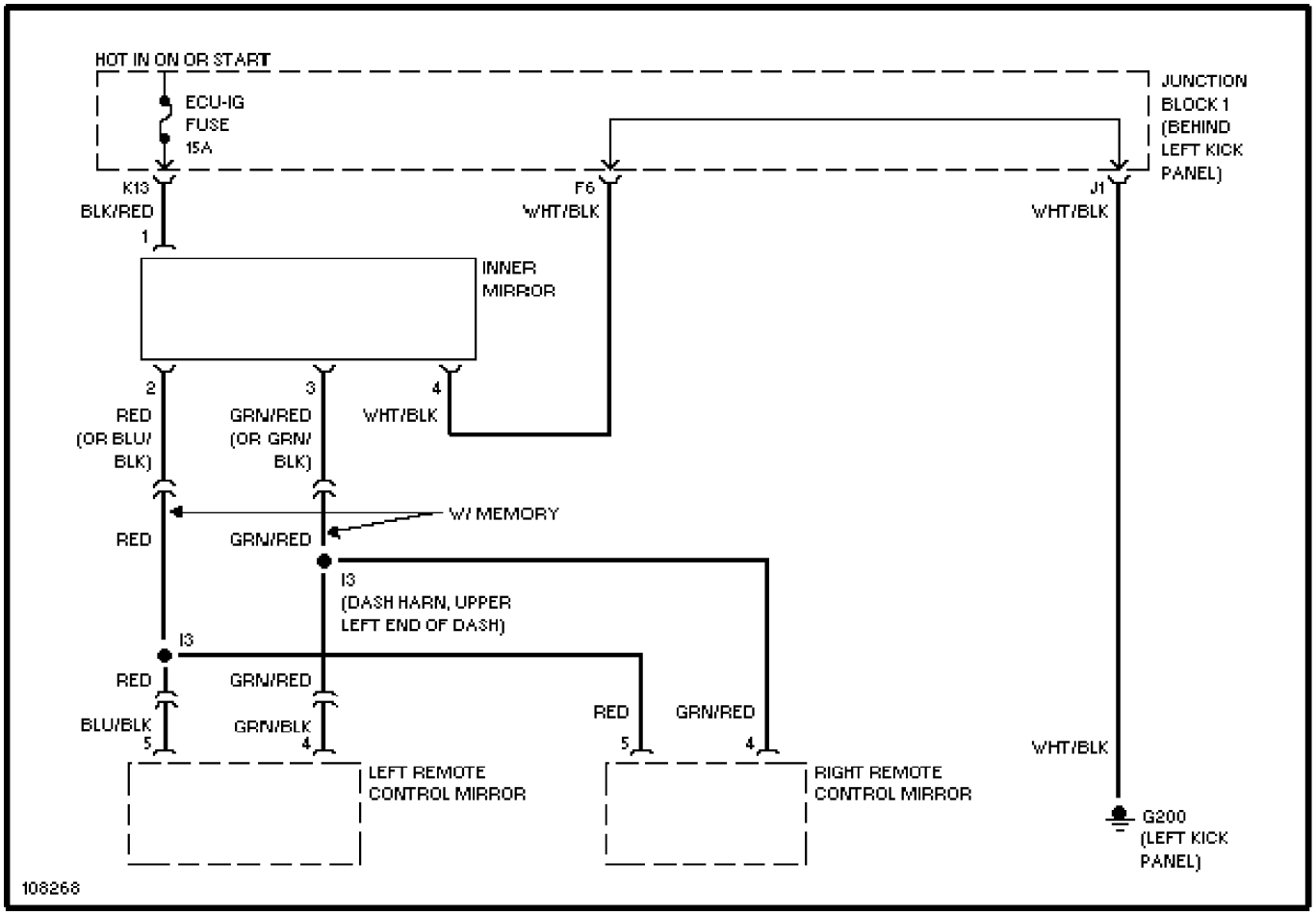


Fig. 32: Power Mirror System Wiring Diagram (SC300 & SC400 - Automatic Day/Night Mirrors)

MULTIPLEX CONTROL SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Multiplex Control Systems
LEXUS

RX300

DESCRIPTION & OPERATION

The multiplex control system consists of a body Electronic Control Unit (ECU) connected to a communication bus. Communication bus includes driver's door ECU, passenger's front door ECU, left rear door ECU, right rear door ECU, power seat ECU (with memory), sun roof control ECU (if equipped), combination meter ECU, instrument control panel, and Engine Control Module (ECM). See Fig. 1. Bus is connected to body ECU. The multiplex control system is also equipped with a self-diagnostic function. Some electrical systems are directly connected to the body ECU, while some electrical loads and switches are connected to the appropriate system ECU.

Vehicle body electrical systems are controlled by serial communication in which each ECU is linked together by a single communication line. Once signals are received from door lock control switch or door courtesy light switch, each ECU determines the condition of the switches and doors. Each ECU converts the signal to digital signals, and then outputs the signals to other ECUs. The body ECU receives these digital signals, and then determines the conditions of the switches and doors to use various controls to operate a specific system or motor. However, if there are no changes in input signals because doors are still closed or switches are not used within 30 seconds, the body ECU interrupts the communication to save battery power. After interruption, any changes in input signals will cause communication to resume.

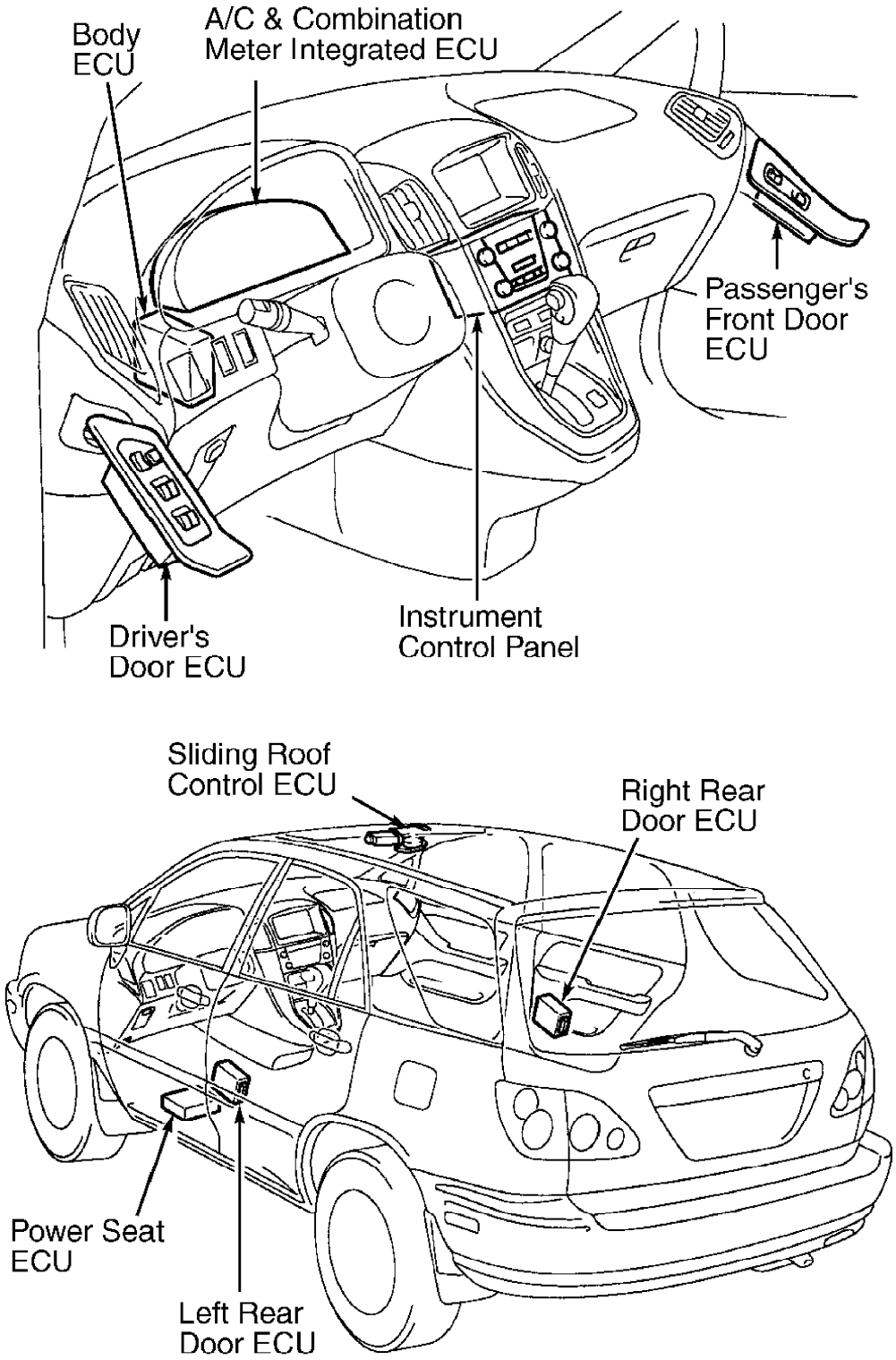


Fig. 1: Locating Multiplex Control System Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SELF-DIAGNOSTICS

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

When diagnosing multiplex control system, perform BODY CONTROL ECU and OPEN DOOR INDICATOR LIGHT inspection procedures first to ensure DTCs can be retrieved. See PRELIMINARY INSPECTION.

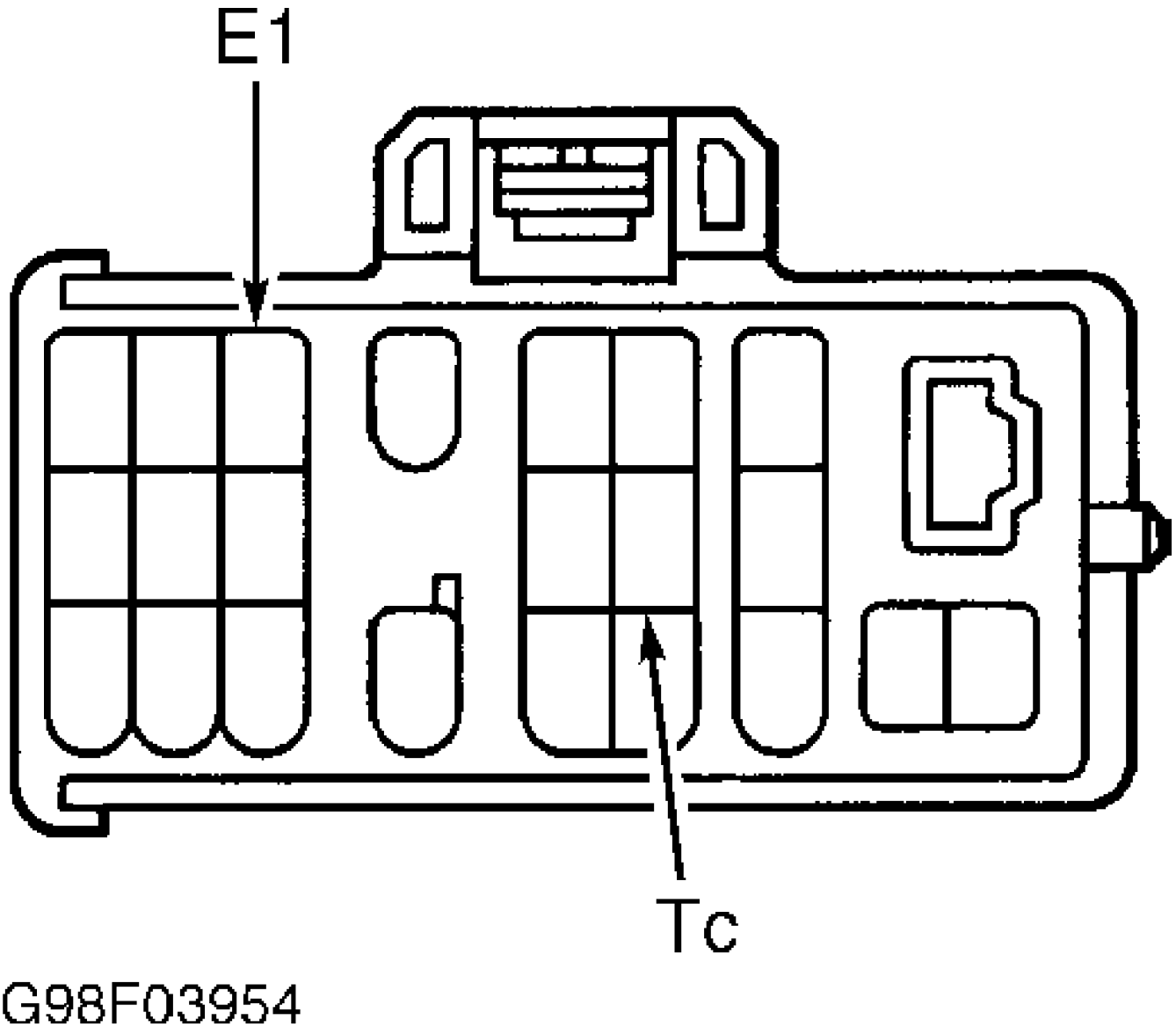


Fig. 2: Identifying Data Link Connector 1 (DLC1) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

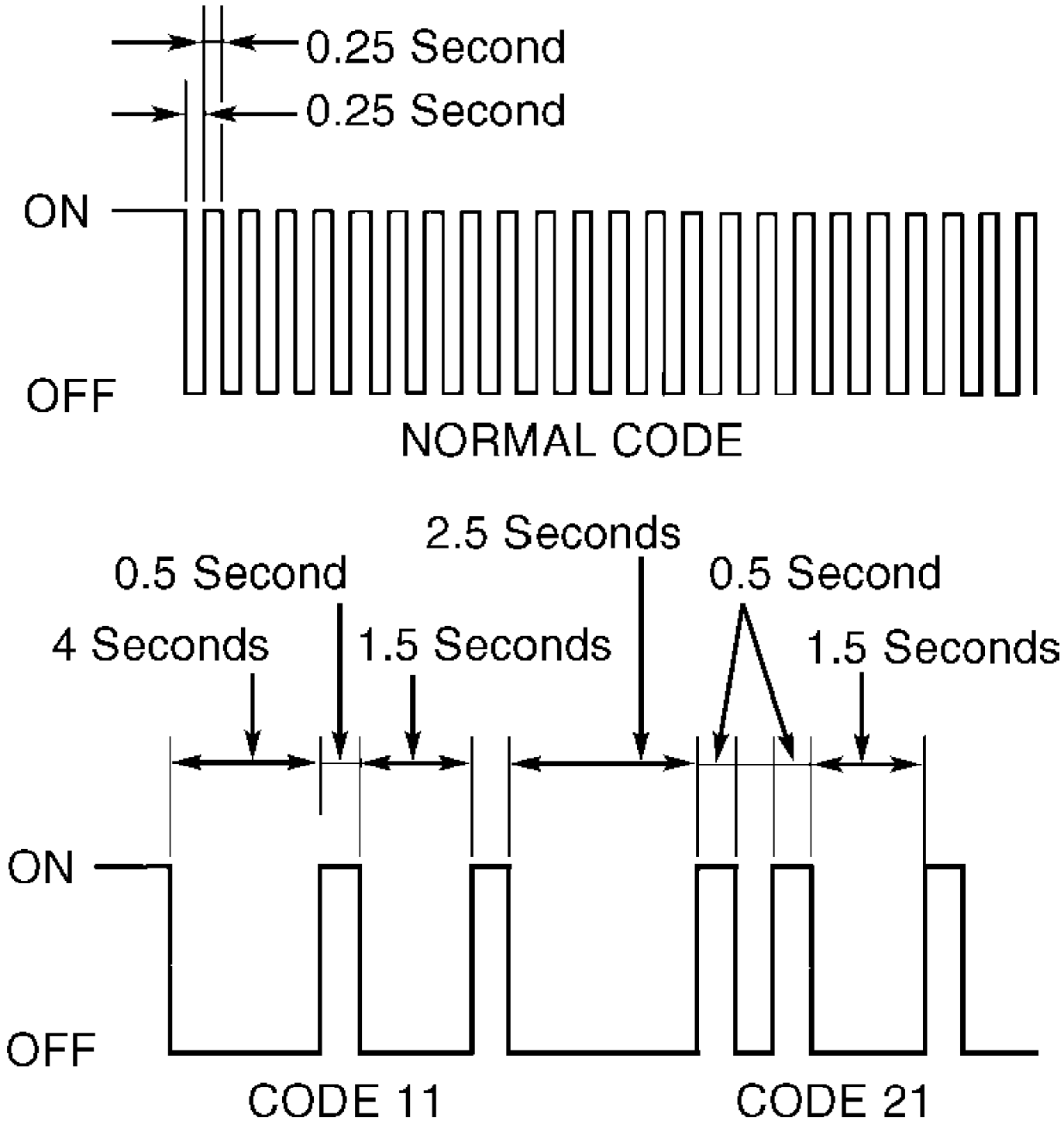


Fig. 3: Reading Open Door Indicator Light DTCs
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PRELIMINARY INSPECTION

Body Control ECU

Check body ECU operation. See BODY CONTROL SYSTEMS - RX300 article. Replace body ECU as necessary. If body control ECU is operating properly, check open door indicator light. See OPEN DOOR INDICATOR LIGHT.

Open Door Indicator Light

Open and close driver or passenger door while observing open door indicator light operation on instrument cluster. If indicator illuminates when doors are open and goes out when doors are closed, indicator light is operating properly and DTCs can be retrieved. See RETRIEVING DIAGNOSTIC TROUBLE CODES. If indicator light does not illuminate when doors are opened, repair open door indicator light. See INSTRUMENT PANELS - RX300 article.

MULTIPLEX DIAGNOSTIC TROUBLE CODE (DTC) DEFINITIONS

OBD-II DTC/2-Digit DTC	Description
B1211/11	No Communication Between Driver's Door ECU & Body ECU
B1212/12	No Communication Between Passenger's Front Door ECU & Body ECU
B1214/14	Door System Bus Communication Circuit Is Shorted To Battery Voltage
B1215/15	Door System Bus Communication Circuit Is Shorted To Ground
B1216/16	No Communication Between Right Rear Door ECU & Body ECU
B1217/17	No Communication Between Left Rear Door ECU & Body ECU
B1221/21	(1) Power Window Master Switch Circuit
B1222/22	(1) Driver's Door Lock Control Switch Circuit
B1223/23	(1) Passenger's Front Window Switch Circuit
B1224/24	(1) Passenger's Door Lock Control Switch Circuit
B1225/25	(1) Right Rear Window Switch Circuit
B1226/26	(1) Left Rear Window Switch Circuit
B1231/31	Driver's Jam Protection Limit Switch Circuit
B1232/32	Driver's Jam Protection Pulse Switch Circuit
B1233/33	Passenger's Front Jam Protection Limit Switch Circuit
B1234/34	Passenger's Front Jam Protection Pulse Switch Circuit
B1235/35	Right Rear Jam Protection Limit Switch Circuit
B1236/36	Right Rear Jam Protection Pulse Switch Circuit
B1237/37	Left Rear Jam Protection Limit Switch Circuit
B1238/38	Left Rear Jam Protection Pulse Switch Circuit
B1241/41	Body ECU Switch Circuit Diagnosis
B1242/42	Wireless Door Lock Tuner Circuit Malfunction
B1244/44	Light Sensor Circuit Malfunction
B1256/56	Instrument Control Panel Circuit Diagnosis
B1261/61	No Communication Between ECM & Body ECU
B1272/72	No Communication Between Power Seat ECU (W/Memory) & Body ECU
B1273/73	No Communication Between Sun Roof Control ECU & Body ECU
B1275/75	No Communication Between Accessory Bus Buffer & Body ECU
B1276/76	No Communication Between Combination Meter ECU & Body ECU
B1277/77	No Communication Between Instrument Control Panel & Body ECU

(1) - DTC is not a malfunction. DTC displays switch function. If DTC is not displayed when switch is operated, failure in switch contact exists. If DTC is displayed when switch is not operated,

switch is stuck.

RETRIEVING DIAGNOSTIC TROUBLE CODES

Open Door Indicator Light Method

Multiplex self-diagnostic system open door indicator light DTCs are retrieved through Data Link Connector 1 (DLC1). DLC1 is located in left rear side of engine compartment. Connect a jumper wire between DLC1 terminals E1 and Tc. See Fig. 2. Turn ignition on. DTCs are displayed as flashes of open door indicator light located on instrument cluster. Open door indicator light DTCs are displayed as 2-digit numbers. Observe indicator light, paying careful attention to length of pauses, in order to read DTCs correctly. See Fig. 3. See MULTIPLEX DIAGNOSTIC TROUBLE CODE (DTC) DEFINITIONS table. If DTC(s) is present, perform test(s) in order given. Go to appropriate DTC under DIAGNOSTIC TESTS. After checking for DTCs, disconnect jumper wire and turn ignition off.

Scan Tool Method

Multiplex self-diagnostic system OBD-II DTCs are retrieved through Data Link Connector 3 (DLC3). DLC3 is located under left side of instrument panel. Connect scan tool to DLC3. Turn ignition on. Follow LEXUS or OBD-II scan tool instructions to retrieve DTCs. See MULTIPLEX DIAGNOSTIC TROUBLE CODE (DTC) DEFINITIONS table. If DTC(s) is present, perform test(s) in order given. Go to appropriate DTC under DIAGNOSTIC TESTS.

CLEARING DIAGNOSTIC TROUBLE CODES

NOTE: DTCs will be cleared from memory when DTC is normally retrieved.

DIAGNOSTIC TESTS

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

DTC B1211/11: NO COMMUNICATION BETWEEN DRIVER'S DOOR ECU & BODY ECU

1) Verify driver's door power window AUTO up operates properly. If driver's door power window AUTO up operation is normal, go to next step. If driver's door power window AUTO up operation is not normal, replace driver's door ECU.

2) Disconnect 22-pin combination meter ECU connector. See Fig. 4. Disconnect 25-pin driver's door ECU connector. Disconnect 25-pin left rear door ECU connector. See Fig. 5. Check for continuity in Yellow/Red wire between combination meter ECU connector terminal MPX- and driver's door ECU connector terminal MPX1. Also, check for continuity in Purple wire between driver's door ECU connector terminal MPX2 and left rear door ECU connector terminal MPX1. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace driver's door ECU.

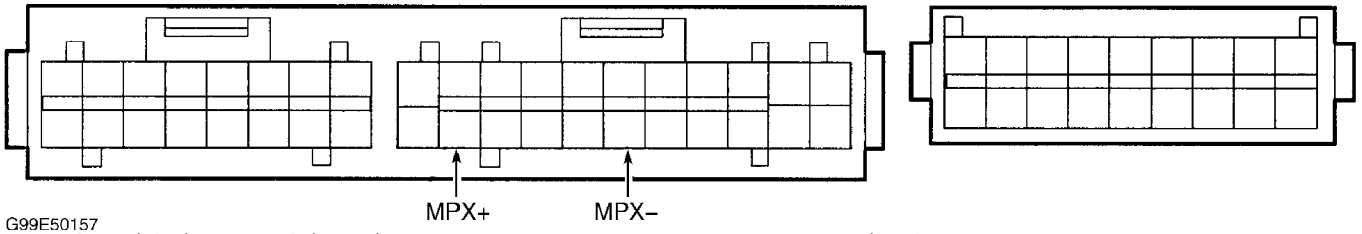
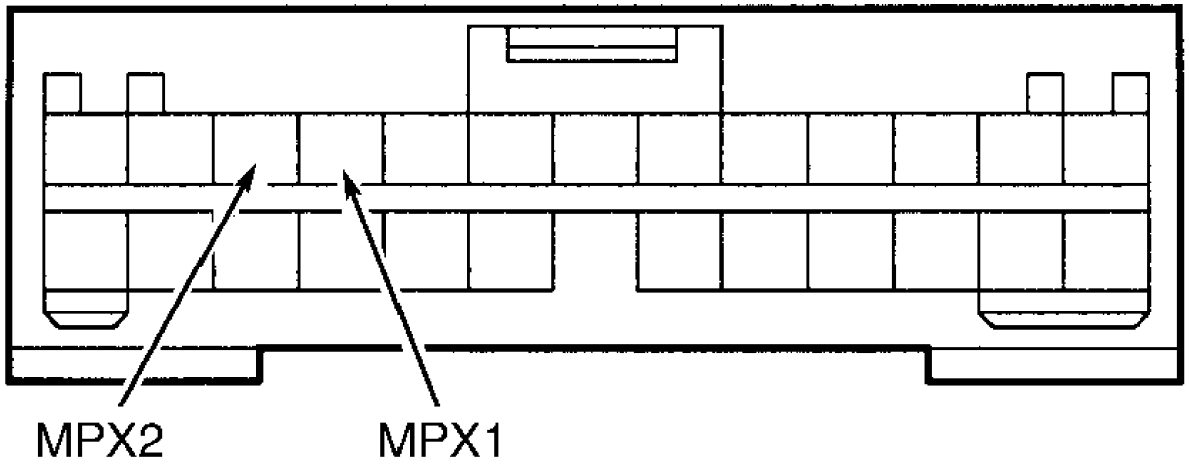


Fig. 4: Identifying Combination Meter ECU Connectors & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



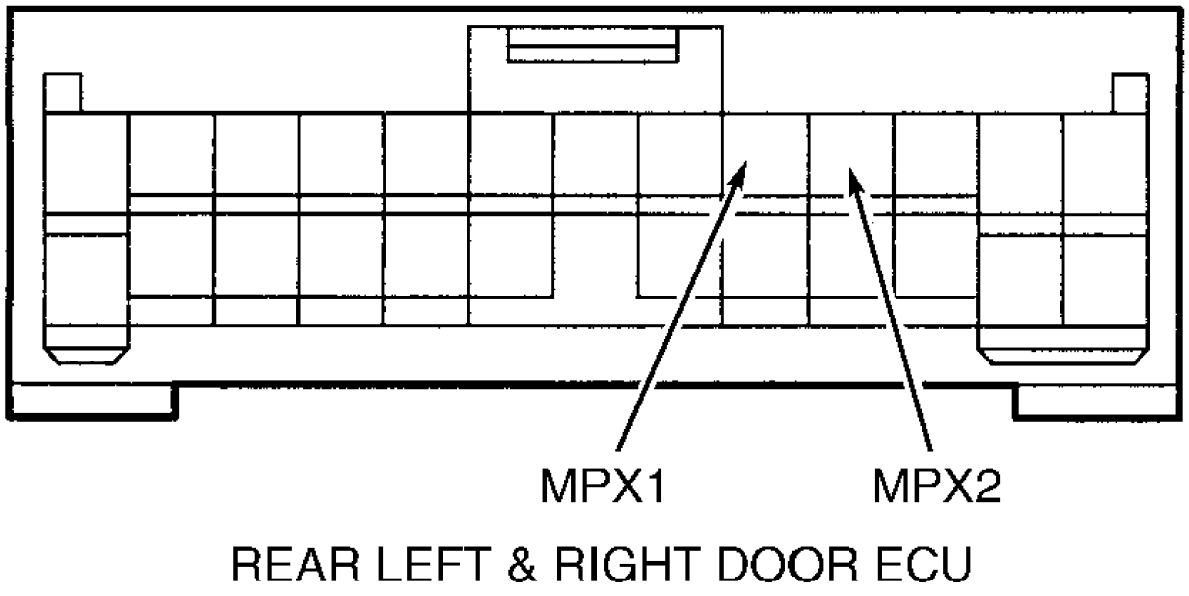


Fig. 5: Identifying Front & Rear Door ECU Connectors & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1212/12: NO COMMUNICATION BETWEEN PASSENGER'S FRONT DOOR ECU & BODY ECU

1) Verify passenger's front door power window AUTO up operates properly. If passenger's front door power window AUTO up operation is normal, go to next step. If passenger's front door power window AUTO up operation is not normal, replace passenger's front door ECU.

2) Disconnect 22-pin Engine Control Module (ECM) connector. See Fig. 6. Disconnect 25-pin passenger's front door ECU connector. Disconnect 25-pin right rear door ECU connector. See Fig. 5. Check for continuity in Yellow wire between ECM connector terminal MPX1 and passenger's front door ECU connector terminal MPX2. Also, check for continuity in Yellow/Red wire between passenger's front door ECU connector terminal MPX1 and right rear door ECU connector terminal MPX2. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace passenger's front door ECU.

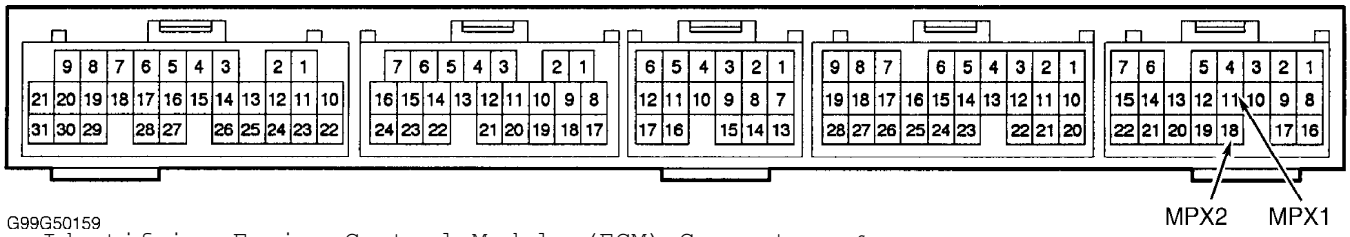


Fig. 6: Identifying Engine Control Module (ECM) Connectors & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1214/14 & DTC B1215/15: DOOR SYSTEM BUS COMMUNICATION CIRCUIT SHORT

NOTE: DTC B1214/14 is set for short to battery and DTC B1215/15 is set for short to ground.

1) Disconnect 22-pin Engine Control Module (ECM) connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace tilt and telescopic ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

2) Reconnect 22-pin ECM connector. If vehicle is not equipped with sun roof, go to next step. If vehicle is equipped with sun roof, disconnect 10-pin sun roof control ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace sun roof control ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

3) Reconnect sun roof control ECU connector. Disconnect 25-pin passenger's front door ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace passenger's front door ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

4) Reconnect passenger's front door ECU connector. Disconnect 25-pin right rear door ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace right rear door ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

5) Reconnect right rear door ECU connector. Disconnect 25-pin left rear door ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace left rear door ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

6) Reconnect left rear door ECU connector. Disconnect 22-pin power seat (with memory) ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace power seat (with memory) ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

7) Reconnect power seat (with memory) ECU connector. Disconnect 25-pin driver's door ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace driver's door ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

8) Reconnect driver's door ECU connector. Disconnect 22-pin combination meter ECU connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace left rear door ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

9) Reconnect combination meter ECU connector. Disconnect 13-pin instrument control panel connector. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, replace power seat (with memory) ECU. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

10) Disconnect 21-pin body ECU connector. Leave instrument control panel connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Black/Orange wire between body ECU and instrument control panel. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

11) Reconnect body ECU connector. Disconnect 22-pin combination meter ECU connector. Leave instrument control panel connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Yellow/Black wire between instrument control panel and combination meter ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

12) Reconnect instrument control panel connector. Disconnect 25-pin driver's door ECU connector. Leave combination meter ECU connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Yellow/Red wire between combination meter ECU and driver's door ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

13) Reconnect combination meter ECU connector. Disconnect 25-pin left rear door ECU connector. Leave driver's door ECU connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Violet wire between driver's door ECU and left rear door ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

14) Reconnect driver's door ECU connector. Disconnect 25-pin right rear door ECU connector. Leave left rear door ECU connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace White wire between left rear door ECU and right rear door ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

15) Reconnect left rear door ECU connector. Disconnect 25-pin passenger's front door ECU connector. Leave right rear door ECU connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Yellow/Red wire between right rear door ECU and passenger's front door ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

16) Reconnect right rear door ECU connector. Disconnect 22-pin ECM connector. Leave passenger's front door ECU connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace Yellow wire between passenger's front door ECU and ECM. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, go to next step.

17) Reconnect passenger's front door ECU connector. Disconnect 17-pin body ECU connector. Leave ECM connector disconnected. Retrieve DTCs. If DTC B1214/14 or DTC B1215/15 is not displayed, repair or replace White/Red wire between ECM and body ECU. See WIRING DIAGRAMS. If DTC B1214/14 or DTC B1215/15 is displayed, replace body ECU.

DTC B1216/16: NO COMMUNICATION BETWEEN RIGHT REAR DOOR ECU & BODY ECU

1) Verify right rear door power window AUTO up operates properly. If right rear door power window AUTO up operation is normal, go to next step. If right rear door power window AUTO up operation is not normal, replace right rear door ECU.

2) Disconnect 25-pin passenger's front door ECU connector. Disconnect 25-pin right rear door ECU connector. Disconnect 25-pin left rear door ECU connector. See Fig. 5. Check for continuity in Yellow/Red wire between passenger's front door ECU connector terminal MPX1 and right rear door ECU connector terminal MPX2. Also, check for continuity in White wire between right rear door ECU connector terminal MPX1 and left rear ECU connector terminal MPX2. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace right rear door ECU.

DTC B1217/17: NO COMMUNICATION BETWEEN LEFT REAR DOOR ECU & BODY ECU

1) Verify left rear door power window AUTO up operates properly. If left rear door power window AUTO up operation is normal, go to next step. If left rear door power window AUTO up operation is not normal, replace left rear door ECU.

2) Disconnect 25-pin driver's door ECU connector. Disconnect 25-pin left rear door ECU connector. Disconnect 25-pin right rear door ECU connector. See Fig. 5. Check for continuity in Violet wire between driver's door ECU connector terminal MPX2 and left rear door ECU connector terminal MPX1. Also, check for continuity in White wire between left rear door ECU connector terminal MPX2 and right rear ECU connector terminal MPX1. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace left rear door ECU.

DTC B1221/21: POWER WINDOW MASTER SWITCH CIRCUIT

Check power window master switch. Power window master switch is part of driver's door ECU. To check driver's door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

DTC B1222/22: DRIVER'S DOOR LOCK CONTROL SWITCH CIRCUIT

Check driver's door lock control switch. Driver's door lock control switch is part of driver's door ECU. To check driver's door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article. Check driver door key lock and unlock switch. See COMPONENT TESTS in BODY CONTROL SYSTEMS - RX300 article. If driver door key lock and unlock switch is okay, check driver door key lock and unlock switch circuit. See CIRCUIT TESTS in BODY CONTROL SYSTEMS - RX300 article.

DTC B1223/23: PASSENGER'S FRONT WINDOW SWITCH CIRCUIT

Check passenger's front window switch. Passenger's front window switch is part of passenger's front door ECU. To check passenger's front door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

DTC B1224/24: PASSENGER'S DOOR LOCK CONTROL SWITCH CIRCUIT

Check passenger's door lock control switch. Passenger's door

lock control switch is part of passenger's front door ECU. To check passenger's front door ECU, go to appropriate wiring diagram in POWER DOOR LOCKS, TRUNK LID & FUEL DOOR RELEASE article.

B1225/25: RIGHT REAR WINDOW SWITCH CIRCUIT

Check right rear window switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If right rear window switch is okay, check right rear window switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1226/26: LEFT REAR WINDOW SWITCH CIRCUIT

Check left rear window switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If left rear window switch is okay, check left rear window switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1231/31: DRIVER'S JAM PROTECTION LIMIT SWITCH CIRCUIT

Check driver's jam protection limit switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If driver's jam protection limit switch is okay, check driver's jam protection limit switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1232/32: DRIVER'S JAM PROTECTION PULSE SWITCH CIRCUIT

Check driver's jam protection pulse switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If driver's jam protection pulse switch is okay, check driver's jam protection pulse switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1233/33: PASSENGER'S FRONT JAM PROTECTION LIMIT SWITCH CIRCUIT

Check passenger's front jam protection limit switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If passenger's front jam protection limit switch is okay, check passenger's front jam protection limit switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1234/34: PASSENGER'S FRONT JAM PROTECTION PULSE SWITCH CIRCUIT

Check passenger's front jam protection pulse switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If passenger's front jam protection pulse switch is okay, check passenger's front jam protection pulse switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1235/35: RIGHT REAR JAM PROTECTION LIMIT SWITCH CIRCUIT

Check right rear jam protection limit switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If right rear jam protection limit switch is okay, check right rear jam protection limit switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1236/36: RIGHT REAR JAM PROTECTION PULSE SWITCH CIRCUIT

Check right rear jam protection pulse switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If right rear jam protection pulse switch is okay, check right rear jam protection pulse switch

circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1237/37: LEFT REAR JAM PROTECTION LIMIT SWITCH CIRCUIT

Check left rear jam protection limit switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If left rear jam protection limit switch is okay, check left rear jam protection limit switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1238/38: LEFT REAR JAM PROTECTION PULSE SWITCH CIRCUIT

Check left rear jam protection pulse switch. See COMPONENT TESTS in POWER WINDOWS - RX300 article. If left rear jam protection pulse switch is okay, check left rear jam protection pulse switch circuit. See CIRCUIT TESTS in POWER WINDOWS - RX300 article.

DTC B1241/41: BODY ECU SWITCH CIRCUIT DIAGNOSIS

Check driver's seat belt buckle switch. See COMPONENT TESTS in BODY CONTROL SYSTEMS - RX300 article. If driver's seat belt buckle switch is okay, check driver's seat belt buckle switch circuit. See CIRCUIT TESTS in BODY CONTROL SYSTEMS - RX300 article. Check light control switch (combination switch). See COMPONENT TESTS in STEERING COLUMN SWITCHES article. If light control switch (combination switch) is okay, check light control switch (combination switch) circuit. See CIRCUIT TESTS in STEERING COLUMN SWITCHES article. Check stoplight switch. See COMPONENT TESTS in BODY CONTROL SYSTEMS - RX300 article. If stoplight switch is okay, check stoplight switch circuit. See CIRCUIT TESTS in BODY CONTROL SYSTEMS - RX300 article.

DTC B1242/42: WIRELESS DOOR LOCK TUNER CIRCUIT

1) Disconnect 19-pin body ECU connector B6. See Fig. 7. Disconnect 7-pin wireless door lock ECU connector. Wireless door lock ECU is located in left side of rear compartment. Check for continuity in Blue wire between body ECU connector terminal RDA and body ground. If continuity does not exist, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists, go to next step.

2) Reconnect body ECU connector B6. Retrieve DTCs. If DTC 1242/42 is not displayed, replace wireless door lock ECU. If DTC 1242/42 is displayed, replace body ECU.

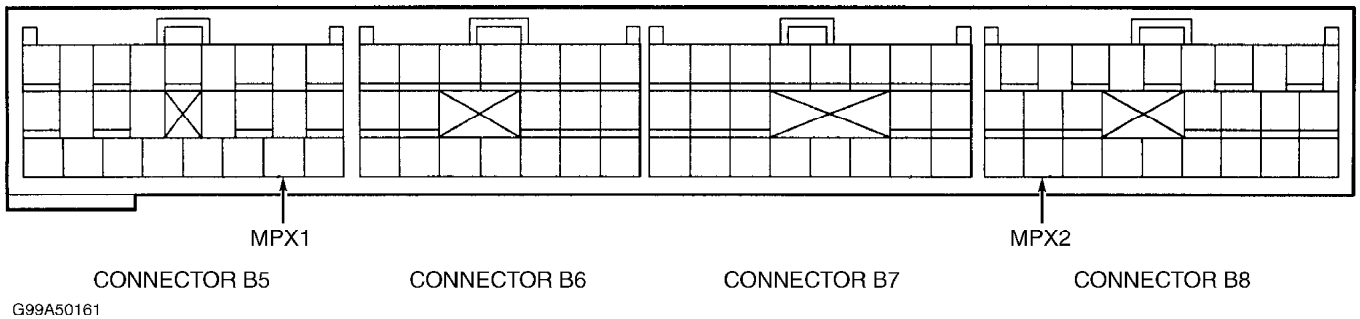


Fig. 7: Identifying Body ECU Connectors & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1244/44: LIGHT SENSOR CIRCUIT MALFUNCTION

NOTE: LEXUS scan tool must be used for this test.

1) Connect scan tool to DLC3. DLC3 connector is located under left side of instrument panel. Turn ignition on. Using scan tool, check light sensor output frequency. If frequency is 47-1200 Hz, go to next step. If frequency is not 47-1200 Hz, replace light sensor.

2) Check circuits for faults between light sensor and body ECU. Light sensor is located under left side of instrument panel. See WIRING DIAGRAMS. Repair or replace wiring harness or connectors as necessary. If circuits are okay, replace body ECU.

DTC B1256/56: INSTRUMENT CONTROL PANEL CIRCUIT DIAGNOSIS

Check the following switches:

* Multifunction switch.
* Power switch.
* Sound mode switch.
* Clock switch.
* CD switch.
* TAPE switch.
* FM 1/2 switch.
* AM switch.
* INFO switch.
* BRIGHTNESS switch.
* TUNE SEEK TRAC switch.
* EJECT switch.
* MUTE switch.
* MODE switch.
* A/C switch.
* R/F switch.
* REAR defogger switch.
* FRONT defogger switch.
* OFF switch.
* AUTO switch.

Repair or replace as necessary. If switches are okay, check switch circuits. See WIRING DIAGRAMS. Repair or replace as necessary.

DTC B1261/61: NO COMMUNICATION BETWEEN ECM & BODY ECU

1) Verify engine starts normally. If engine does not start normally, a problem may exist in ECM. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE. If engine starts normally, go to next step.

2) Disconnect 17-pin body ECU connector B5. See Fig. 7. Disconnect 22-pin ECM connector. See Fig. 6. Disconnect 25-pin passenger's front door ECU connector. See Fig. 5. Check for continuity in White/Red wire between body ECU connector terminal MPX1 and ECM connector terminal MPX2. Also, check for continuity in Yellow wire between ECM connector terminal MPX1 and passenger's front door ECU connector terminal MPX2. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace ECM.

DTC B1272/72: NO COMMUNICATION BETWEEN POWER SEAT ECU (W/MEMORY) & BODY ECU

1) Verify power seat operates properly. If power seat operation is normal, go to next step. If power seat operation is not normal, replace power seat ECU.

2) Disconnect 25-pin right rear door ECU connector. Disconnect 25-pin left rear door ECU connector. See Fig. 5. Disconnect 22-pin power seat ECU connector. See Fig. 8. Check for continuity in

White wire between right rear door ECU connector terminal MPX1 and power seat ECU connector terminal MPX1. Also, check for continuity in White wire between left rear door ECU connector terminal MPX2 and power seat ECU connector terminal MPX1. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace power seat ECU.

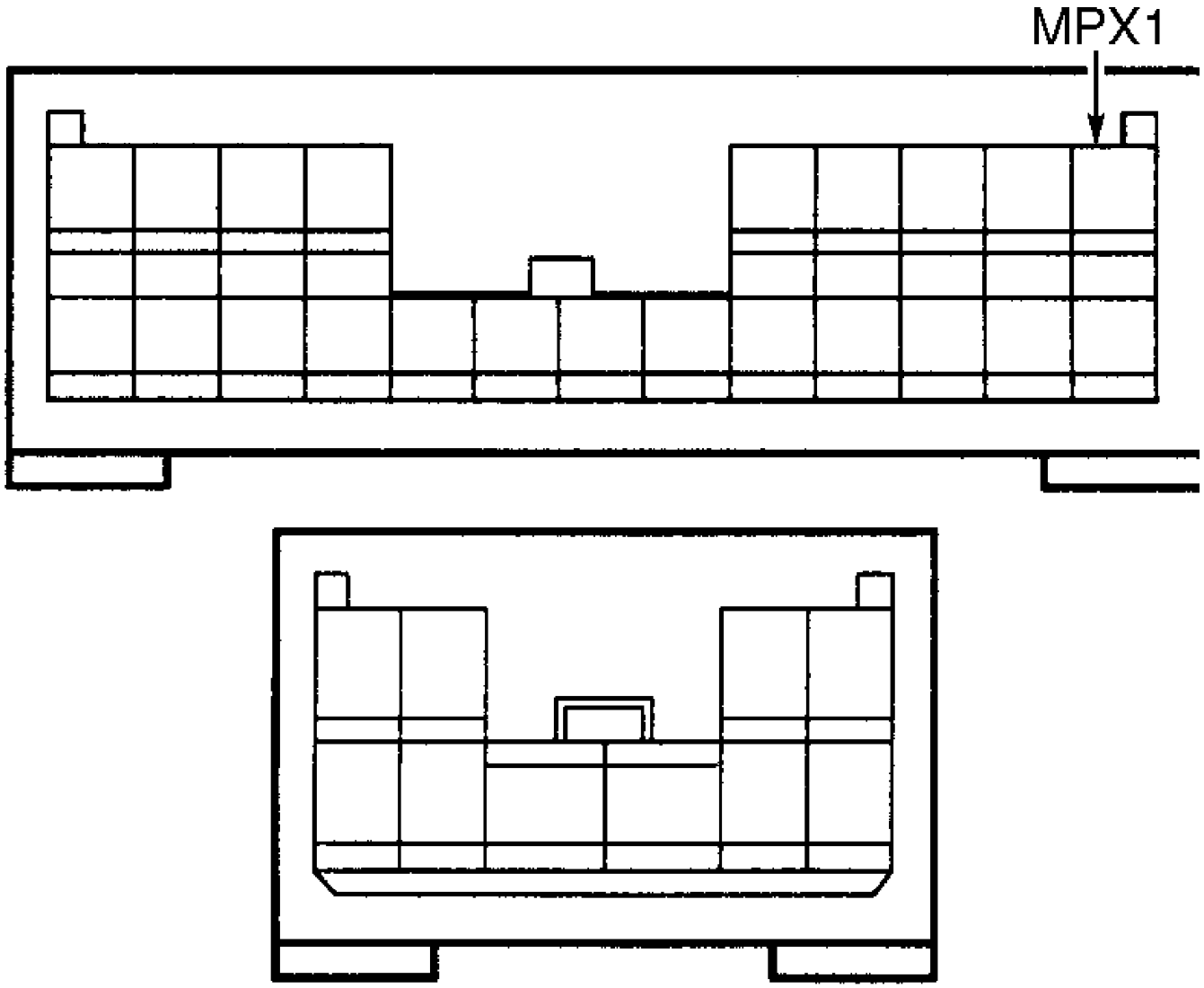


Fig. 8: Identifying Power Seat (W/Memory) ECU Connectors & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1273/73: NO COMMUNICATION BETWEEN SUN ROOF CONTROL ECU & BODY ECU

1) Verify sliding sun roof operates properly. If sliding sun roof operation is normal, go to next step. If sliding sun roof operation is not normal, replace sun roof control ECU.

2) Disconnect 10-pin sun roof control ECU connector. See Fig. 9. Disconnect 17-pin body ECU connector B5. See Fig. 7. Check for continuity in White/Red wire between sun roof control ECU connector

terminal MPX1 and body ECU connector terminal MPX1. If continuity does not exist, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists, replace sun roof control ECU.

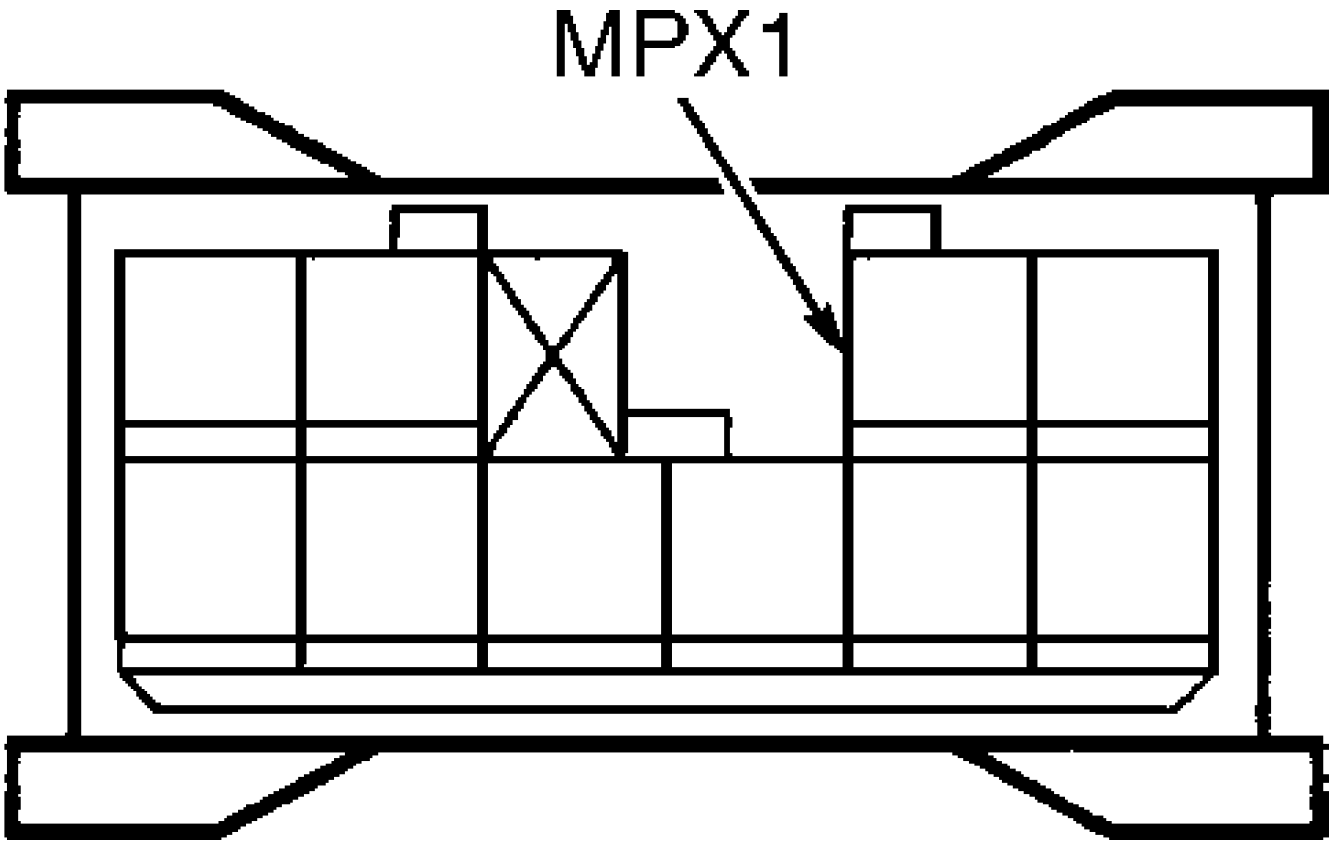


Fig. 9: Identifying Sun Roof Control ECU Connector & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1275/75: NO COMMUNICATION BETWEEN ACCESSORY BUS & BODY ECU

NOTE: Testing information is not available from manufacturer for DTC B1275/75.

DTC B1276/76: NO COMMUNICATION BETWEEN COMBINATION METER ECU & BODY ECU

Disconnect 13-pin instrument control panel connector. See Fig. 10. Disconnect 22-pin combination meter ECU connector. See Fig. 4 . Disconnect 25-pin driver's door ECU connector. See Fig. 5. Check for continuity in Yellow/Black wire between instrument control panel connector terminal MPX- and combination meter ECU connector terminal MPX+. Also, check for continuity in Yellow/Red wire between combination meter ECU connector terminal MPX- and driver's door ECU connector terminal MPX1. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace combination meter ECU.

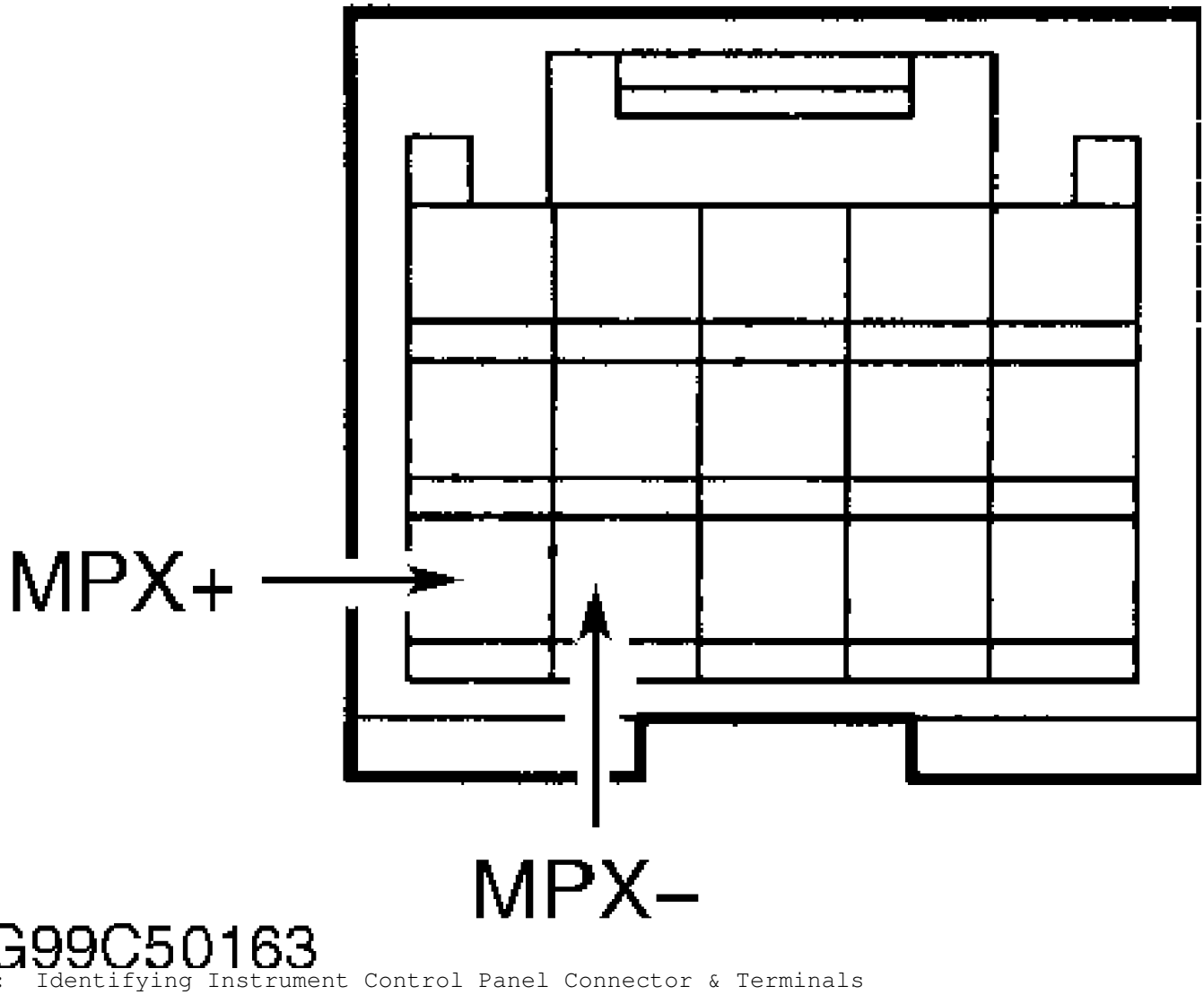


Fig. 10: Identifying Instrument Control Panel Connector & Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC B1277/77: NO COMMUNICATION BETWEEN INSTRUMENT CONTROL PANEL & BODY ECU

Disconnect 21-pin body ECU connector B8. See Fig. 7. Disconnect 13-pin instrument control panel connector. See Fig. 10. Disconnect 22-pin combination meter ECU connector. See Fig. 4. Check for continuity in Black/Orange wire between body ECU connector terminal MPX2 and instrument control panel connector terminal MPX+. Also, check for continuity in Yellow/Black wire between instrument control panel connector terminal MPX- and combination meter ECU connector terminal MPX+. If continuity does not exist in all measurements, repair or replace wiring harness or connectors. See WIRING DIAGRAMS. If continuity exists in all measurements, replace instrument control panel.

WIRING DIAGRAMS

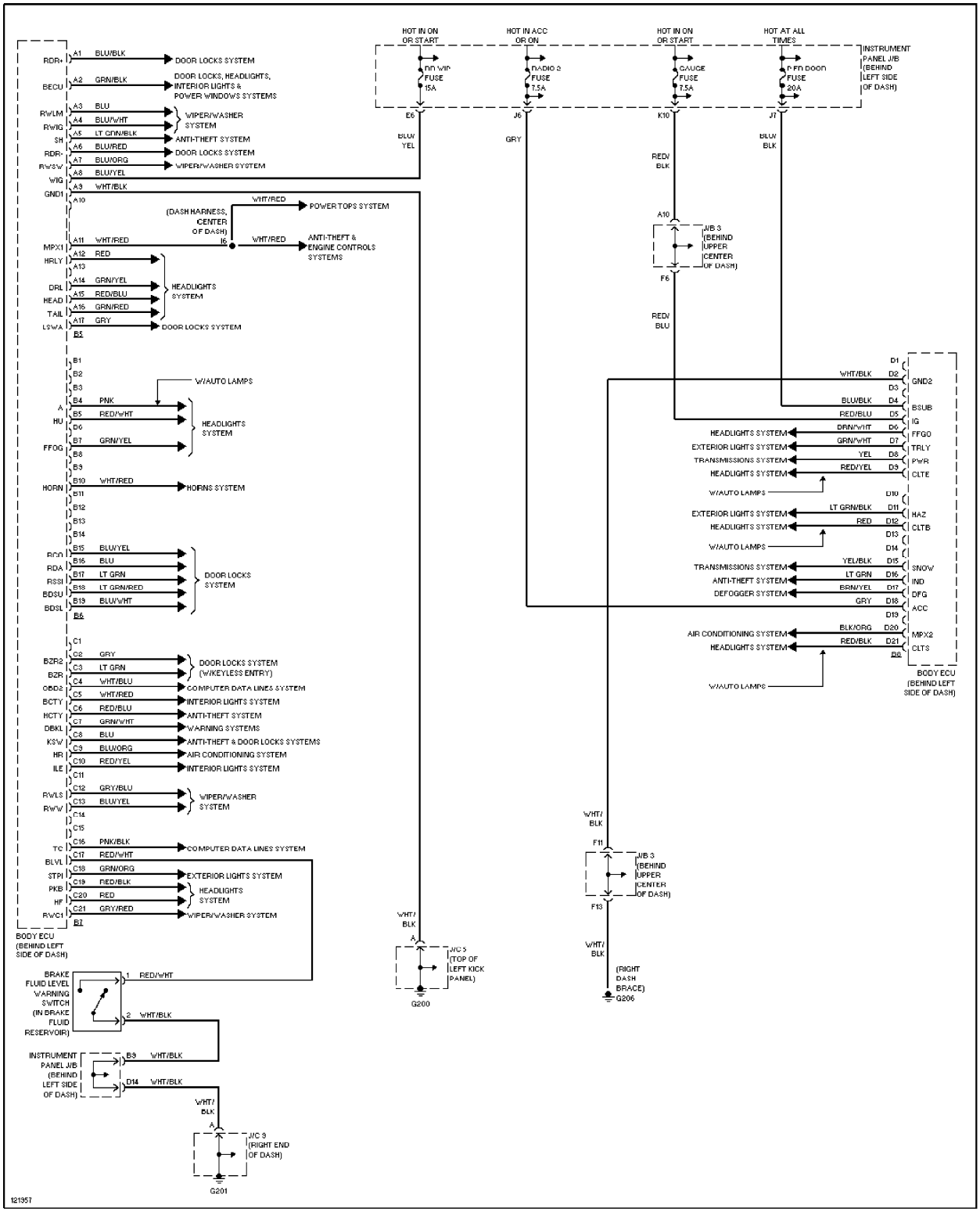


Fig. 11: Multiplex Control System Wiring Diagram (RX300)

PARASITIC LOAD EXPLANATION & TEST PROCEDURES

1999 Lexus RX 300

GENERAL INFORMATION
Parasitic Load Explanation & Test Procedures

* PLEASE READ THIS FIRST *

This article is provided for general information only. Not all procedures apply to all makes and models.

GENERAL INFORMATION

The term Parasitic Load refers to electrical devices that continue to use or draw current after the ignition switch is turned to OFF position. This small amount of continuous battery draw is expressed in milliamps (mA). On Ford Motor Co. and General Motors vehicles produced after 1980, a typical Parasitic Load should be no more than 50 milliamps (0.050 amps).

Vehicles produced since 1980 have memory devices that draw current with ignition off for as long as 20 minutes before shutting down the Parasitic Drain. When Parasitic Load exceeds normal specifications, the vehicle may exhibit dead battery and no-start condition.

Follow test procedure for checking Parasitic Loads to completion. A brief overview of a suggested test procedure is included along with some typical Parasitic Load specifications. Refer to the GENERAL MOTORS PARASITIC LOAD TABLE chart.

TESTING FOR PARASITIC LOAD

INTRODUCTION

CAUTION: Always turn ignition off when connecting or disconnecting battery cables, battery chargers or jumper cables. DO NOT turn test switch to OFF position (which causes current to run through ammeter or vehicle electrical system).

NOTE: Memory functions of various accessories must be reset after the battery is reconnected.

The battery circuit must be opened to connect test switch (shunt) and ammeter into the circuit. When a battery cable is removed, timer circuits within the vehicle computer are interrupted and immediately begin to discharge. If in doubt about the condition of the ammeter fuse, test it with an ohmmeter prior to beginning test. An open fuse will show the same reading (00.00) as no parasitic drain. Begin test sequence with the meter installed and on the 10-amp scale. Select lower scale to read parasitic draw.

TEST PROCEDURE USING TEST SWITCH

1) Turn ignition off. Remove negative battery terminal cable. Install Disconnect Tool (J-38758) test switch male end to negative battery cable. Turn test switch knob to OFF position (current through meter). Install negative battery cable to the female end of test switch.

2) Turn test switch knob to ON position (current through switch). Road test vehicle with vehicle accessories on (radio, air conditioner, etc.). After road test, turn ignition switch to LOCKED position and remove key. Connect ammeter terminals to test switch

terminals. See Fig. 1. Select 10-amp scale.

3) Turn off all electrical accessories. Turn off interior lights, underhood lamp, trunk light, illuminated entry, etc. To avoid damaging ammeter or obtaining a false meter reading, all accessories must be off before turning test switch knob to OFF position.

4) Turn test switch knob to OFF position to allow current to flow through ammeter. If meter reads wrong polarity, turn test switch to ON position and reverse leads. Turn test switch to OFF position. Observe current reading. If reading is less than 2 amps, turn test switch to ON position to keep electrical circuits powered-up.

5) Select low amp scale. Switch lead to the correct meter position. Turn test switch to OFF position and compare results to normal current draw. See the GENERAL MOTORS PARASITIC LOAD TABLE. If current draw is unusually high for the vehicle's overall electrical system, remove system fuses one at a time until current draw returns to normal.

6) Turn test switch to ON position each time door is opened or fuse is removed. Turn switch to OFF position to read current draw value through meter. When the cause of excessive current drain has been located and repaired, remove test switch and reconnect negative battery cable to the negative battery terminal.

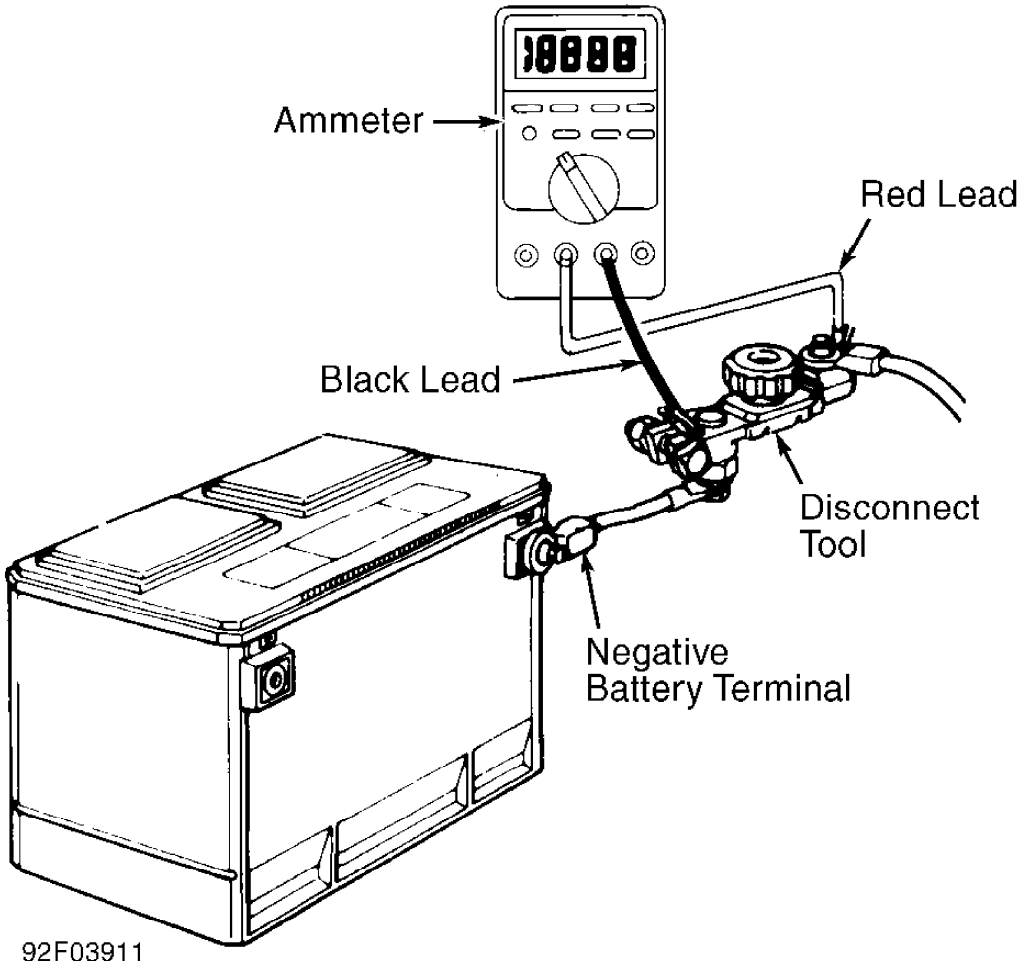


Fig. 1: Connecting Kent-Moore Disconnect Tool (J-38758)
Courtesy of General Motors Corp.

GENERAL MOTORS PARASITIC LOAD TABLE (MILLIAMPS)

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Anti-Theft System	0.4	1.0	...
Auto Door Lock	1.0	1.0	...
Body Control Module	3.6	12.4	20
Central Processing System	1.6	2.7	20
Electronic Control Module	5.6	10.0	...
Electronic Level Control	2.0	3.3	20
Heated Windshield Module	0.3	0.4	...
HVAC Power Module	1.0	1.0	...
Illuminated Entry	1.0	1.0	1
Light Control Module	0.5	1.0	...
Oil Level Module	0.1	0.1	...
Multi-Function Chime	1.0	1.0	...
Pass Key Decoder Module	0.75	1.0	...
Power Control Module	5.0	7.0	...
Retained Accessory Power	3.8	3.8	...
Radio	7.0	8.0	15
Twilight Sentinel Module	1.0	1.0	...
Voltage Regulator	1.4	2.0	...

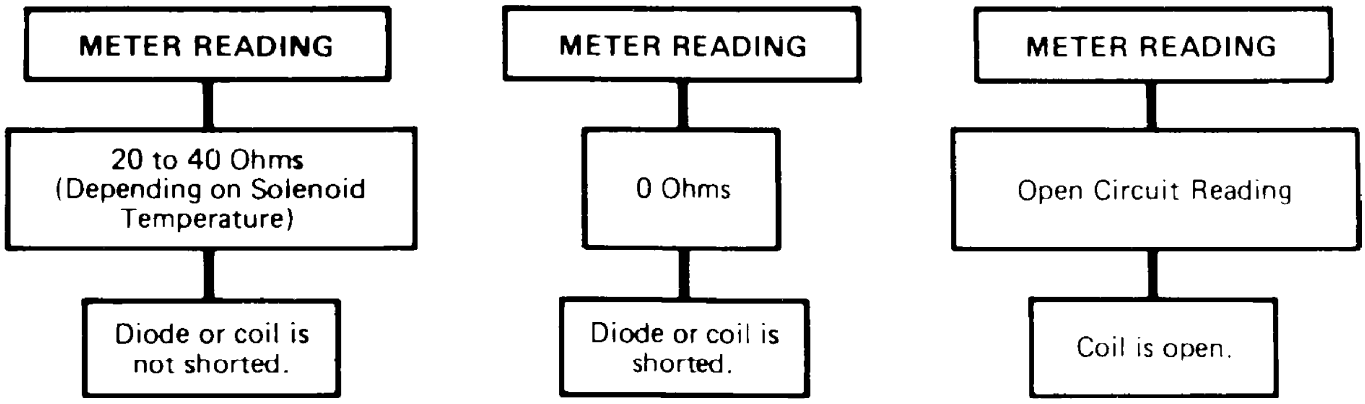
INTERMITTENT PARASITIC LOAD PROBLEMS

Intermittent parasitic lad can occur because of a memory device that does not power down with ignition off. With an intermittent parasitic load, battery draw can be greater than 1.0 amp. To find and intermittent problem requires that an ammeter and Disconnect Tool (J-38758) test switch be connected and left in the circuit. See Fig. 1. Road test vehicle. After road test, turn ignition off and remove key.

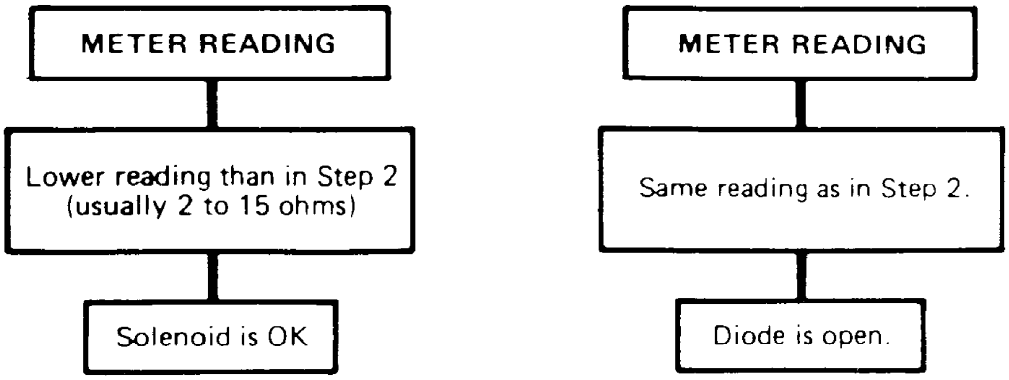
Monitor the milliamps scale for 15-20 minutes after ignition is turned off. This allows monitoring memory devices to determine if they time out and stop drawing memory current. The test switch is needed to protect ammeter when the vehicles is started.

DIODE CHECK & SOLENOID TEST (GENERAL MOTORS)

Step 1) Select the X1 SCALE and zero the needle.
Step 2) Attach the POSITIVE SOLENOID LEAD (Red lead) to the POSITIVE METER LEAD and the NEGATIVE SOLENOID LEAD (Black lead) to the NEGATIVE METER LEAD.



Step 3) Reverse the solenoid lead attachments.



92H03912
Fig. 2: Diode Check & Solenoid Test (General Motors)
Courtesy of General Motors Corp.

QUAD DRIVER TEST (GENERAL MOTORS)

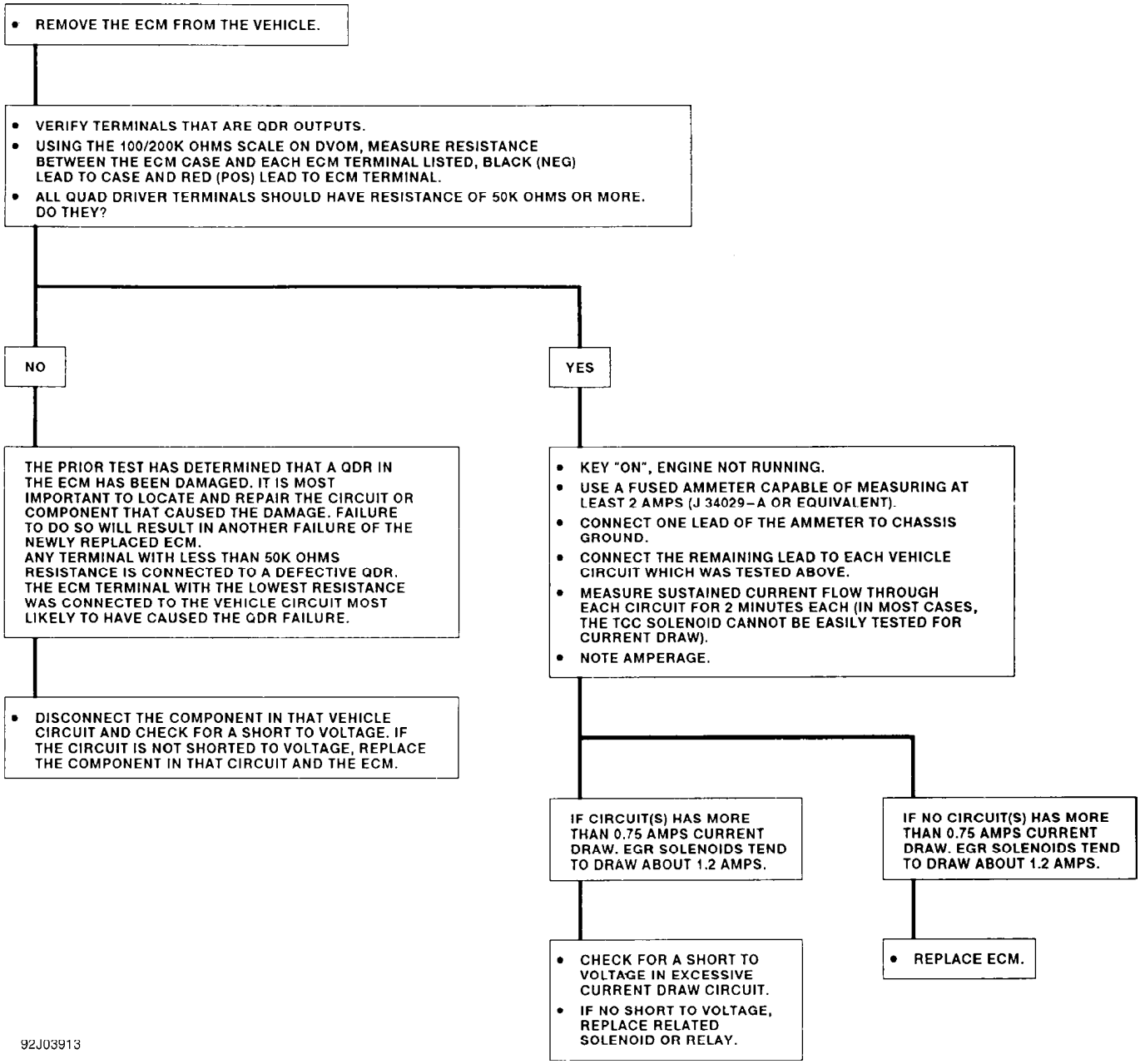


Fig. 3: Quad Driver Test (General Motors)
Courtesy of General Motors Corp.

PASSIVE RESTRAINT SYSTEM INSPECTION

1999 Lexus RX 300

GENERAL INFORMATION
Air Bag/SRS Component Inspection & Replacement Tables

Asian Imports

INTRODUCTION

When a vehicle equipped with passive restraint system has been involved in a collision, certain systems and components must be inspected and or replaced regardless of whether or not the air bag has deployed. Follow the manufacturer's guidelines provided in this article.

WARNING: Accidental air bag deployment is possible. Personal injury may result. Avoid area near steering wheel and instrument panel even if air bags have deployed. Dual-stage air bag modules may be present that could contain an undeployed stage. When disposing of a deployed dual-stage air bag, always treat it as a "live" module. See appropriate AIR BAG RESTRAINT SYSTEM articles in the ACCESSORIES/SAFETY EQUIPMENT section.

ACURA (1988-01)

AIR BAG APPLICATION

APPLICATION - ACURA

Make/Model	Year	Location	Table
Integra	1994-01	D/P	ACURA-1
Legend	1991-95	D/P	ACURA-1
	1988-90	DS	ACURA-1
MDX	2001	DS, PS2	ACURA-1
NSX	1993-01	D/P	ACURA-1
	1991-92	DS	ACURA-1
SLX	1996-99	D/P	ACURA-2
Vigor	1993-94	D/P	ACURA-1
	1992	DS	ACURA-1
2.2CL	1997	D/P	ACURA-1
2.3CL	1998-99	D/P	ACURA-1
2.5TL	1995-98	D/P	ACURA-1
3.0CL	1997-99	D/P	ACURA-1
3.2CL	2001	DS, PS2, SI	ACURA-1
3.2TL	2002	D/P2, SI	ACURA-1
	2000-01	DS, PS2, SI	ACURA-1
	1996-99	D/P	ACURA-1
3.5RL	1999-02	DS, PS2, SI	ACURA-1
	1996-98	D/P	ACURA-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

ACURA-1

Action	Component or System
Replace After Deployment	* Air bag modules * Side air bag modules (if equipped-on side deployed) * SRS control unit * Side impact sensors (if equipped-on side deployed) * Seat belt pretensioners (if equipped) * Seat belts (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Cable reel * Dash or impact sensors (if equipped) * Seat belt anchor points * SRS control unit * SRS wiring harnesses * OPDS sensor (2)
Comments	If any components are damaged, they must be replaced. DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness. After vehicle is repaired, ensure AIR BAG warning light is functioning properly.
(1) - Replace seat belts if the air bags were deployed and-or they were being worn at time of collision (check for damage at seat belt anchor points). (2) - Occupant Position Detection System.	

ACURA-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * SRS control unit * Seat belts (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Instrument panel braces * Instrument panel steering column reinforcement plate * Knee bolster & mounting points * Seat belt anchor points * Cable reel * Steering column * Wiring harness
Comments	If any components are damaged, they must be replaced. DO NOT attempt wiring harness repairs. Replace harness.
(1) - Replace seat belts if the air bags were deployed and-or they were being worn at time of collision (check for damage at seat belt anchor points).	

DAEWOO (1999-01)

AIR BAG APPLICATION

APPLICATION - DAEWOO

Make/Model	Year	Location	Table
Lanos	1999-01	D/P	DAEWOO-1
Leganza	1999-01	D/P	DAEWOO-1
Nubira	1999-01	D/P	DAEWOO-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

DAEWOO-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag wiring harness (1) * Clockspring (1) * Seat belt pretensioners (if equipped) * Sensing-diagnostic module
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Instrument panel braces * Knee bolsters & mounting points * Satellite sensors (if equipped) * Seat belts & mounting points * Steering column * Wiring harness
Comments	DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness.
(1) - Replace on all models except 2001 Leganza. On 2001 Leganza, inspect and replace if damaged.	

HONDA (1991-01)

AIR BAG APPLICATION

APPLICATION - HONDA

Make/Model	Year	Location	Table
Accord	2001	D/P2, SI	HONDA-1
	2000	DS, PS2, SI	HONDA-1
	1993-99	D/P	HONDA-1
	1991-92	DS	HONDA-1
Civic	2001	D/P2, SI	HONDA-1

	1994-00	D/P		HONDA-1
	1992-93	DS		HONDA-1
Civic del Sol	1994-98	D/P		HONDA-1
	1993	DS		HONDA-1
CR-V	1997-01	DP		HONDA-1
Insight	2000-01	D/P		HONDA-1
Odyssey	1995-01	D/P		HONDA-1
Passport	1996-01	D/P		HONDA-2
	1995 1/2	D/P		HONDA-2
Prelude	1994-00	D/P		HONDA-1
Prelude Ex. SI 4WS	1992-93	DS		HONDA-1
Prelude SI 4WS	1992-93	D/P		HONDA-1
S-2000	2000-01	D/P		HONDA-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

HONDA-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Side air bag modules (if equipped-on side deployed) * SRS control unit * Side impact sensors (if equipped-on side deployed * Seat belt pretensioners (if equipped) * Seat belts (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Cable reel * Dash sensors (1991-94) * Seat belt anchor points * SRS control unit * SRS wiring harnesses * OPDS sensor (2)
Comments	If any components are damaged, they must be replaced. DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness. After vehicle is repaired, ensure AIR BAG warning light is functioning properly.
(1) - Replace seat belts if the air bags were deployed and-or they were being worn at time of collision (check for damage at seat belt anchor points). (2) - Occupant Position Detection System.	

HONDA-2

Action	Component or System
Replace After	* Air bag module(s)

Deployment	* SRS control unit * Seat belts (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Instrument panel braces * Instrument panel steering column reinforcement plate * Knee bolster & mounting points * Passenger-side air bag door * Seat belt anchor points * Cable reel * Steering wheel & column * Wiring harnesses
Comments	If any components are damaged, they must be replaced. DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness.

(1) - Replace seat belts if the air bags were deployed and-or they were being worn at time of collision (check for damage at seat belt anchor points).

HYUNDAI (1994-01)

AIR BAG APPLICATION

APPLICATION - HYUNDAI

Make/Model	Year	Location	Table
Accent	2001	D/P, SI	HYUNDAI-1
	1995-00	D/P	HYUNDAI-1
Elantra	2001	D/P, SI	HYUNDAI-1
	1996-00	D/P	HYUNDAI-1
	1994-95	DS	HYUNDAI-1
Sonata	1999-01	D/P, SI	HYUNDAI-1
	1995-98	D/P	HYUNDAI-1
Santa Fe	2001	D/P, SI	HYUNDAI-1
Tiburon	1997-01	D/P	HYUNDAI-1
XG300	2001	D/P, SI	HYUNDAI-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

HYUNDAI-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control module with machine screws * Clockspring (1) * Seat belt pretensioners (if equipped)

Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Clockspring * Seat belts & mounting points * Steering column * Steering wheel * Wiring harnesses * Satellite sensors (if equipped) * Passenger presence detection system (if equipped)
Comments	If any components are damaged, they must be replaced. DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness.

(1) - 1994 Elantra only.

INFINITI (1990-01)

AIR BAG APPLICATION

APPLICATION - INFINITI

Make/Model	Year	Location	Table
G20	1999-01	D/P, SI	INFINITI-1
	1993-96	D/P	INFINITI-2
I30	2001	D/P2, SI	INFINITI-1
	1998-00	D/P, SI	INFINITI-1
	1997	D/P	INFINITI-1
	1996	D/P	INFINITI-2
J30	1997	D/P	INFINITI-1
	1994-96	D/P	INFINITI-2
	1993	D/P	INFINITI-3
M30	1990-92	DS	INFINITI-3
Q45	1998-01	D/P, SI	INFINITI-1
	1997	D/P	INFINITI-1
	1994-96	D/P	INFINITI-2
	1990-93	DS	INFINITI-3
QX4	2000-01	D/P, SI	INFINITI-1
	1997-99	D/P	INFINITI-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

INFINITI-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Crash zone sensor-front sensor (if equipped) * Side air bag module (1) (2) * Satellite sensor (1) (2)

	* Seat belt pretensioners (3) * Seat back assembly (4)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * Crash zone sensor-front sensor (if equipped) * Side air bag module * Satellite sensor * Center pillar inner (1) * Instrument panel * Seat (1) * Seat belt pretensioners (2) * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	Inspect all SIR components for dents, deformities or rust. After vehicle is repaired, check AIR BAG warning light to ensure system is functioning properly. DO NOT repair, splice or modify any SRS harness. Replace damaged section of harness.

(1) - On side of impact, including inspection of seat slides and adjusters.
(2) - Except 1997-99 QX4.
(3) - Except 1996-98 I30 and 1997-99 QX4.
(4) - 1999-01 G20 and Q45, if side air bag deployed. 2000-01 QX4, if side air bag deployed.

INFINITI-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Instrument panel * Seat belt pretensioners
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * Instrument panel * Seat belt pretensioners * All sensors * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	Inspect all SIR components for dents, deformities or rust. After vehicle is repaired, check AIR BAG warning light to ensure system is functioning properly. DO NOT repair, splice or modify any SRS harness. Replace damaged section of harness.

(1) - Except I30.
(2) - Except 1996 I30, 1995-96 J30 and Q45.

INFINITI-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Sensors in affected collision area
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * All sensors * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	Inspect all SIR components for dents, deformities or rust. After vehicle is repaired, check AIR BAG warning light to ensure system is functioning properly. DO NOT repair, splice or modify any SRS harness. Replace damaged section of harness.

ISUZU (1990-01)

AIR BAG APPLICATION

APPLICATION - ISUZU

Make/Model	Year	Location	Table
Amigo	1999-00	D/P	ISUZU-2
Hombre	1996-00	D/P	ISUZU-1
Impulse	1990-92	DS	ISUZU-4
Oasis	1996-98	D/P	ISUZU-5
Rodeo	1996-01	D/P	ISUZU-2
	1995 1/2	D/P	ISUZU-2
Rodeo Sport	2001	D/P	ISUZU-2
Stylus	1991-93	DS	ISUZU-4
Trooper	1996-01	D/P	ISUZU-2
	1995	D/P	ISUZU-3
VehiCROSS	1999-01	D/P	ISUZU-2

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

ISUZU-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Sensors in area of accident damage
Inspect & If	* Instrument panel braces

Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Instrument panel steering column reinforcement plate * Knee bolster * Seat belts & mounting points * Sensors in area of accident damage * SRS coil assembly * Steering column
Comments	Any sensor that the Diagnostic Energy Reserve Module (DERM) indicates as bad must be replaced. If any components are damaged or bent, they must be replaced. SRS wiring can be repaired following manufacturer's instructions.

ISUZU-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Sensing & Diagnostic Module (SDM)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Instrument panel braces * Instrument panel steering column reinforcement plate * Knee bolster & mounting points * Seat belts & mounting points * SRS coil assembly * Passenger-side air bag door * Steering column * Wiring harnesses
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace harness.

ISUZU-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * All sensors
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* SRS coil assembly * Instrument panel steering column reinforcement plate * Instrument panel braces * Knee bolsters * Seat belts & mounting points * Sensors in area of accident damage * Steering column
Comments	If any components are damaged or bent, they must be replaced.

ISUZU-4

Action	Component or System
Replace After Deployment	* Air bag module * All sensors

Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Arming sensor * Coil assembly * Diagnostic Energy Module (DERM) * Forward sensor * Instrument panel steering column reinforcement plate * Knee pad * Passenger compartment sensor * Steering column * Wiring harness & brackets * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced.

ISUZU-5

Action	Component or System
Replace After Deployment	* Air bag module(s) * Seat belt pretensioners (if equipped) * SRS control unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Cable reel * Dash sensors (1991-94) * Seat belts & mounting points * SRS control unit * SRS wiring harnesses
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring repairs. If SRS wiring or harness connectors are faulty, replace faulty wiring harness. After vehicle is repaired, ensure AIR BAG warning light is functioning properly.

KIA (1995-01)

AIR BAG APPLICATION

APPLICATION - KIA

Make/Model	Year	Location	Table
Rio	2001	D/P	KIA-1
Sephia	1996-00	D/P	KIA-1
	1995 1/2	D/P	KIA-1
Sportage	1996-99	D/P, KI	KIA-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

Action	Component or System
Replace After Deployment	* Air bag module(s) * Impact bracket (1) * Seat belt pretensioners (2)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag diagnosis control unit * Clockspring * Impact sensors & sensor mountings (3) * Steering column * Steering wheel * Instrument panel * Wiring harness * Seat belts & mounting points * Impact bracket (1)
Comments	After repairs are completed, ensure AIR BAG warning light is functioning properly.

(1) - 1998-99 Sportage. Impact bracket located between front bumper and frame mounted energy absorber. Failure to replace could allow air bags to deploy at less than 8 MPH.
(2) - If equipped.
(3) - 1995 1/2 Sephia only.

LEXUS (1990-01)

AIR BAG APPLICATION

APPLICATION - LEXUS

Make/Model	Year	Location	Table
ES250	1990-91	DS	LEXUS-6
ES300	1998-01	D/P, SI	LEXUS-3
	1997	D/P	LEXUS-1
	1994-96	D/P	LEXUS-4
	1992-93	DS	LEXUS-5
GS300	2001	D/P, SI, HI	LEXUS-7
	1998-00	D/P, SI	LEXUS-3
	1993-97	D/P	LEXUS-4
GS430	2001	D/P, SI, HI	LEXUS-7
GS400	1998-00	D/P, SI	LEXUS-3
IS300	2001	D/P, SI	LEXUS-3
LS400	1997-00	D/P, SI	LEXUS-3
	1995-96	D/P	LEXUS-1
	1993-94	D/P	LEXUS-4
	1990-92	DS	LEXUS-6
LS430	2001	DS, PS2, SI, HI	LEXUS-7
LX450	1996-97	D/P	LEXUS-1
LX470	1998-01	D/P	LEXUS-2
RX300	1999-01	D/P, SI	LEXUS-3
SC300	1996-00	D/P	LEXUS-1
	1993-95	D/P	LEXUS-4
	1992	DS	LEXUS-5
SC400	1996-00	D/P	LEXUS-1
	1993-95	D/P	LEXUS-4
	1992	DS	LEXUS-5

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

LEXUS-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor assembly (control unit) * Front seat belt pretensioners
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor assembly * Front seat belt pretensioners * Glove box door (1) * Instrument panel * Instrument panel reinforcement * Spiral cable * Steering wheel * Wiring harnesses & connectors * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced.
(1) - 1997 ES300, 1996 LS400 and 1996-09 LX450 only.	

LEXUS-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor assembly (control unit) * Front air bag sensors (1) * Front seat belt pretensioners
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor assembly * Front air bag sensors * Front seat belt pretensioners * Instrument panel * Instrument panel reinforcement * Spiral cable * Steering wheel * Wiring harnesses & connectors * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.
(1) - Replace both front sensors.	

LEXUS-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor assembly (control unit) * Front air bag sensors (if equipped) (1) * Front seat belt pretensioners (2) * Side air bag module (if deployed) (3) * Side air bag sensor assembly (If side air bag module deployed)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor assembly * Front air bag sensors (if equipped) * Front seat belt pretensioners * Seat belts & mounting points * Side air bag modules * Side air bag sensor assembly * Glove box door (4) * Instrument panel * Instrument panel reinforcement * Spiral cable * Steering wheel * Wiring harnesses & connectors
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

(1) - Replace both front sensors.
(2) - Except 1997 LS400.
(3) - On 1999 ES300, replace seat back assembly.
(4) - 1997 LS400 only.

LEXUS-4

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor assembly (control unit) * Front air bag sensors * Front seat belt pretensioners (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Center air bag sensor assembly * Front air bag sensors * Front seat belt pretensioners (1) * Glove box door (2) * Instrument panel * Instrument panel reinforcement * Spiral cable * Steering wheel * Wiring harnesses & connectors * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer’s instructions.

(1) - 1993-95 GS300 and 1993-94 LS400.
(2) - Except 1994-95 SC300 and SC400.

LEXUS-5

Action	Component or System
Replace After Deployment	* Air bag module * Air bag sensor assembly (control unit) * Front air bag sensors
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module * Center air bag sensor assembly * Front air bag sensors * Spiral cable * Steering wheel * Wiring harnesses & connectors * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer’s instructions.

LEXUS-6

Action	Component or System
Replace After Deployment	* Air bag module * Front air bag sensors
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module * Front air bag sensors * Center air bag sensor assembly * Spiral cable * Steering wheel * Wiring harnesses & connectors * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer’s instructions.

LEXUS-7

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (replace both sensors) * Seat air bag modules (1) * Head air bag modules (1) * Head-side air bag sensor (2) * Seat belt pretensioners (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors * Instrument panel & reinforcement

Deploy)	* Seat belts & mounting points * Seat belt pretensioners * Seat back cover & frame * Head-side air bag sensors * Spiral cable * Steering wheel * Wiring harnesses & connectors
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.
(1) - If deployed. (2) - If side air bag module has deployed.	

MAZDA (1990-01)

AIR BAG APPLICATION

APPLICATION - MAZDA

Make/Model	Year	Location	Table
Miata	1999-01	D/P	MAZDA-3
	1995-97	D/P	MAZDA-1
	1994	D/P	MAZDA-2
	1990-93	DS	MAZDA-2
Millenia	2001	D/P, SI	MAZDA-4
	1999-00	D/P	MAZDA-3
	1995-98	D/P	MAZDA-1
MPV	2000-01	D/P, SI	MAZDA-4
	1996-98	D/P	MAZDA-1
	1995	DS	MAZDA-1
	1993-94	DS	MAZDA-2
MX-3	1994-95	D/P	MAZDA-2
MX-6	1995-98	D/P	MAZDA-1
	1994	D/P	MAZDA-2
	1993	DS	MAZDA-2
Pickup	1999-01	D/P	MAZDA-3
	1997-98	D/P	MAZDA-2
	1995-96	DS	MAZDA-2
Protege	2000	D/P, SI	MAZDA-4
	1999	D/P	MAZDA-3
	1995-98	D/P	MAZDA-1
RX7	1994-95	D/P	MAZDA-2
	1990-93	DS	MAZDA-2
Tribute	2001	D/P, SI	MAZDA-4
626	2000-01	D/P, SI	MAZDA-4
	1999	D/P	MAZDA-3
	1995-98	D/P	MAZDA-1
	1994	D/P	MAZDA-2
	1993	DS	MAZDA-2
929	1992-95	D/P	MAZDA-2

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

MAZDA-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Clockspring * Impact sensors & sensors mountings * Steering column * Steering wheel * Wiring harness * Seat belts & mounting points
Comments	DO NOT attempt wiring harness repairs. Replace entire wiring harness. Impact sensors must always be installed with arrow on sensor facing front of vehicle.

MAZDA-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag diagnosis control unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Clockspring * Impact sensors & sensors mountings * Steering column * Steering wheel * Wiring harness * Seat belts & mounting points
Comments	DO NOT attempt wiring harness repairs. Replace entire wiring harness. Impact sensors must always be installed with arrow on sensor facing front of vehicle.

MAZDA-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag diagnosis control unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Clockspring * Front impact sensor (1) * Steering column * Steering wheel * Wiring harness * Seat belts & mounting points
Comments	DO NOT attempt wiring harness repairs. Replace entire wiring harness.
(1) - 2001 Miata only.	

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag diagnosis control unit * Side air bag sensor * Seat back frame, pad & trim
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Clockspring * Steering column * Steering wheel * Wiring harness * Seat belts & mounting points * Seat back & frame
Comments	DO NOT attempt wiring harness repairs. Replace entire wiring harness.

MITSUBISHI (1990-01)

AIR BAG APPLICATION

APPLICATION - MITSUBISHI

Make/Model	Year	Location	Table
Diamante	1999-01	D/P	MITSUBISHI-6
	1997-98	D/P	MITSUBISHI-2
	1994-96	D/P	MITSUBISHI-3
	1992-93	DS	MITSUBISHI-3
Eclipse	2000-01	D/P, SI	MITSUBISHI-1
	1996-99	D/P	MITSUBISHI-2
	1995	D/P	MITSUBISHI-4
Expo	1994-95	DS	MITSUBISHI-2
Galant	1999-01	D/P, SI	MITSUBISHI-1
	1997-98	D/P	MITSUBISHI-2
	1994-96	D/P	MITSUBISHI-3
Mirage	2000-01	D/P	MITSUBISHI-6
	1997-99	D/P	MITSUBISHI-2
	1995-96	D/P	MITSUBISHI-5
	1994	DS	MITSUBISHI-5
Montero	2001	D/P, SI	MITSUBISHI-3
	1996-00	D/P	MITSUBISHI-3
	1994-95	DS	MITSUBISHI-3
Montero Sport	1997-01	D/P	MITSUBISHI-3
Sigma	1990	DS	MITSUBISHI-4
3000GT	1997-99	D/P	MITSUBISHI-2
	1994-96	D/P	MITSUBISHI-3
	1991-93	DS	MITSUBISHI-3

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

MITSUBISHI-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * SRS control unit * Side impact sensors (if side air bags deployed) * Front seat back assembly (if side air bags deployed) * Seat belt pretensioner(s) (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * SRS control unit * Side impact sensors * Clockspring * Steering column & intermediate joint * Steering wheel * Front seat back assembly * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.
(1) - 2001 Galant only.	

MITSUBISHI-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * SRS control unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * SRS control unit * Clockspring * Steering column & intermediate joint * Steering wheel * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.

MITSUBISHI-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Front impact sensors * SRS control unit * Side impact sensors (1) * Front seat back assembly (2) * Seat belt pretensioners (3)
Inspect & If Damaged Replace Component (Even If	* Air bag module(s) * SRS control unit * Front & side impact sensors (if equipped)

Air Bag Did Not Deploy)	* Front seat back assembly * Clockspring * Steering column & intermediate joint * Steering wheel * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.

(1) - 2001 Montero only.
(2) - If side air bags deployed.
(3) - 2001 Montero Sport only.

MITSUBISHI-4

Action	Component or System
Replace After Deployment	* Air bag module(s) * Clockspring * Front impact sensors * Steering column & intermediate joint * Steering wheel
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * SRS control unit * Clockspring * Front impact sensors * Steering column * Steering wheel * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.

MITSUBISHI-5

Action	Component or System
Replace After Deployment	* Air bag module(s) * SRS control unit
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * SRS control unit * Clockspring * Steering column * Steering wheel * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.

MITSUBISHI-6

Action	Component or System
Replace After Deployment	* Air bag module(s) * SRS control unit

	* Seat belt pretensioner(s)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * SRS control unit * Clockspring * Steering column & intermediate joint * Steering wheel * Seat belts & mounting points * Wiring harness
Comments	If any components are damaged or bent, they must be replaced.

NISSAN (1989-01)

AIR BAG APPLICATION

APPLICATION - NISSAN

Make/Model	Year	Location	Table
Altima	2000-01	D/P, SI	NISSAN-2
	1998-99	D/P	NISSAN-3
	1995-97	D/P	NISSAN-4
	1994	D/P	NISSAN-6
	1993	DS	NISSAN-6
Frontier	1998-01	D/P	NISSAN-1
Maxima	2001	D/P2, SI	NISSAN-2
	1998-00	D/P, SI	NISSAN-2
	1997	D/P	NISSAN-3
	1995-96	D/P	NISSAN-4
	1994	D/P	NISSAN-5
	1992-93	DS	NISSAN-6
NX Coupe	1991-93	DS	NISSAN-6
Pathfinder	1999-01	D/P, SI	NISSAN-2
	1996-98	D/P	NISSAN-5
Pickup	1996-97	DS	NISSAN-5
Pulsar NX	1989-90	DS	NISSAN-6
Quest	1997-01	D/P	NISSAN-3
	1996	D/P	NISSAN-4
	1994-95	D/P	NISSAN-6
Sentra	2000-01	D/P, SI	NISSAN-2
	1997-99	D/P	NISSAN-3
	1995-96	D/P	NISSAN-4
	1994	DS	NISSAN-5
	1993	DS	NISSAN-6
Xterra	2000-01	D/P	NISSAN-1
200SX	1997-98	D/P	NISSAN-3
	1995-96	D/P	NISSAN-4
240SX	1997-98	D/P	NISSAN-3
	1995-96	D/P	NISSAN-4
300ZX	1994-96	D/P	NISSAN-4
	1991-93	DS	NISSAN-6

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

NISSAN-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Seat belt pretensioners (if equipped)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * Crash zone sensor (1) * Instrument panel * Passenger deactivation switch * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.
(1) - 2000 Frontier 4WD only.	

NISSAN-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Crash zone sensor (1) * Side air bag module (2) (3) * Satellite sensor (1) * Seat belt pretensioners (if equipped)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit diagnosis * Crash zone sensor (1) * Side air bag module (2) * Satellite sensor (2) * Seat belt pretensioners * Seat belts & mounting points * Center pillar inner (2) * Instrument panel * Seat and-or seat back (2) (3) * Spiral cable * Steering wheel * Wiring harnesses
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.
(1) - If equipped. (2) - On the side of impact. (3) - On Altima, Pathfinder and Sentra, replace all parts of seat back (including seat back frame). On 2000 Maxima, inspect and replace damaged seat components (including seat	

adjuster and slides) using new bolts. On 2001 Maxima, replace all parts of seat back, including frame.

NISSAN-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Seat belt pretensioners (if equipped)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * Instrument panel * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.

NISSAN-4

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * All sensors (1) * Instrument panel * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.
(1) - 300ZX only.	

NISSAN-5

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * All sensors * Crash zone sensor * Instrument panel * Spiral cable * Steering wheel * Wiring harnesses

	* Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.

(1) - Except Pathfinder and Pickup.
(2) - 4WD Pickup only.
(3) - Pathfinder only.

NISSAN-6

Action	Component or System
Replace After Deployment	* Air bag module(s) * Control unit, diagnosis * Sensors in affected collision area
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Control unit, diagnosis * All sensors * Spiral cable * Steering wheel * Wiring harnesses * Seat belts & mounting points
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.

SUBARU (1992-01)

AIR BAG APPLICATION

APPLICATION - SUBARU

Make/Model	Year	Location	Table
Forester	2001-02	D/P, SI	SUBARU-1
	1998-00	D/P	SUBARU-1
Impreza	1994-00	D/P	SUBARU-1
	1993	DS	SUBARU-1
Legacy	2000-01	D/P, SI	SUBARU-1
	1995-99	D/P	SUBARU-1
	1992-94	DS	SUBARU-1
Outback	2000-01	D/P, SI	SUBARU-1
SVX	1994-97	D/P	SUBARU-1
	1992-93	DS	SUBARU-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

SUBARU-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag control module * Front impact sensors (1) * Side air bag sensors (1) (2) * Front seat assembly (if side air bag is deployed) (1) * Steering shaft (3) * Seat belt pretensioners (3)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag control module * Combination switch & clockspring * Front impact sensors * Steering column assembly * Steering wheel * Wiring harness * Seat belts & mounting points * Side air bag sensors (1)
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring repairs.
(1) - If equipped. (2) - On side of deployment. (3) - 2001 Legacy and outback only.	

SUZUKI (1995-01)

AIR BAG APPLICATION

APPLICATION - SUZUKI

Make/Model	Year	Location	Table
Esteem	1995-01	D/P	SUZUKI-1
Sidekick	1996-98	D/P	SUZUKI-1
Swift	1995-01	D/P	SUZUKI-1
Vitara & Grand Vitara	1999-01	D/P	SUZUKI-1
XL7	2001	D/P	SUZUKI-1
X90	1996-98	D/P	SUZUKI-1

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

SUZUKI-1

Action	Component or System
Replace After	* Air bag module(s)

Deployment	* Sensing & Diagnostic Module (SDM)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag warning light * Combination switch assembly * Contact coil * Forward discriminating sensor (1) * Instrument panel reinforcement * Knee bolsters * Seat belts & mounting points * SDM bracket * Steering column bracket * Steering column & shaft joints * Steering wheel * Wiring harness * Air bag module(s) * Sensing & Diagnostic Module (SDM)
Comments	If any components are damaged or bent, they must be replaced. DO NOT attempt SRS wiring harness repairs.

(1) - Swift only.

TOYOTA (1990-01)

AIR BAG APPLICATION

APPLICATION - TOYOTA

Make/Model	Year	Location	Table
Avalon	1998-01	D/P, SI	TOYOTA-1
	1996-97	D/P	TOYOTA-3
	1995	D/P	TOYOTA-4
Camry	1998-01	D/P, SI	TOYOTA-1
	1997	D/P	TOYOTA-3
	1996	D/P	TOYOTA-5
	1994-95	D/P	TOYOTA-6
	1992-93	DS	TOYOTA-9
Celica	2000-01	D/P, SI	TOYOTA-1
	1998-99	D/P	TOYOTA-2
	1996-97	D/P	TOYOTA-5
	1994-95	D/P	TOYOTA-7
	1990-93	DS	TOYOTA-10
Corolla	1998-01	D/P, SI	TOYOTA-1
	1996-97	D/P	TOYOTA-3
	1994-95	D/P	TOYOTA-6
	1993	DS	TOYOTA-9
Echo	2001	D/P, SI	TOYOTA-1
	2000	D/P	TOYOTA-1
Land Cruiser	1998-01	D/P	TOYOTA-2
	1995-97	D/P	TOYOTA-4
Highlander	2001	D/P	TOYOTA-1
MR2	2000-01	D/P, SI	TOYOTA-12
	1994-95	D/P	TOYOTA-6
	1991-93	DS	TOYOTA-10
Paseo	1996-97	D/P	TOYOTA-3
	1993-95	DS	TOYOTA-9
Previa	1996-97	D/P	TOYOTA-3
	1994-95	D/P	TOYOTA-6
	1992-93	DS	TOYOTA-9

Prius	2001	D/P, SI	TOYOTA-1
RAV4	1998-01	D/P	TOYOTA-11
	1996-97	D/P	TOYOTA-3
Sequoia	2001	D/P, SI, HI	TOYOTA-13
Sienna	2001	D/P, SI	TOYOTA-1
	1998-00	D/P	TOYOTA-11
Solara	1999-01	D/P, SI	TOYOTA-1
Supra	1997-98	D/P	TOYOTA-4
	1993-96	D/P	TOYOTA-5
	1990-92	DS	TOYOTA-10
Tacoma	1998-01	D/P	TOYOTA-12
	1997	D/P	TOYOTA-4
	1995-96	DS	TOYOTA-9
Tercel	1998	D/P	TOYOTA-2
	1996-97	D/P	TOYOTA-3
	1995	D/P	TOYOTA-8
	1993-94	DS	TOYOTA-9
Tundra	2000-01	D/P	TOYOTA-12
T100	1994-98	DS	TOYOTA-9
4Runner	1999-01	D/P	TOYOTA-1
	1996-98	D/P	TOYOTA-4

D/P - Driver's & Passenger's Side.
D/P2 - Driver's & Passenger's Side (Dual-Stage).
DS - Driver's Side.
HI - Head Impact.
KI - Knee Impact.
SI - Side Impact.
PS2 - Passenger's Side (Dual-Stage).

INSPECTION PROCEDURES

TOYOTA-1

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (replace both sensors if equipped) * Seat belt pretensioner (1) * Seat air bag modules (if equipped) (2) (3) * Side air bag sensor (if equipped) (4) * Door side air bag sensor (if equipped) (4)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Door side air bag sensors (if equipped) * Front air bag sensors (if equipped) * Glove box or glove box door * Instrument panel & reinforcement * Seat belts & mounting points * Seat belt pretensioners * Seat back cover & frame * Side air bag sensors (if equipped) * Spiral cable * Steering wheel * Wiring harness & connectors
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

(1) - If front air bags are deployed, replace all seat belt pretensioners. (2) - On side of impact. (3) - On Prius, replace air bag module and seat back as an assembly. (4) - If seat air bag module is deployed.	

TOYOTA-2

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (if equipped) (1) * Seat belt pretensioner (2)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (if equipped) * Seat belt pretensioners * Seat belts & mounting points * Instrument panel * Instrument panel reinforcement * Glove box & glove box door (3) * Spiral cable * Steering wheel * Wiring harness & connectors
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.
(1) - Replace both front sensors. (2) - If air bags are deployed, replace all seat belt pretensioners. (3) - Except 1998 Tercel.	

TOYOTA-3

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Spiral cable * Steering wheel * Instrument panel * Instrument panel reinforcement * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

TOYOTA-4

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Instrument panel * Instrument panel reinforcement * Glove box & glove box door * Steering wheel * Spiral cable * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

TOYOTA-5

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors * Instrument panel * Instrument panel reinforcement * Steering wheel * Spiral cable * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer’s instructions.
(1) - Replace both front sensors.	

TOYOTA-6

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors * Instrument panel * Instrument panel reinforcement * Glove box & glove box door * Steering wheel * Spiral cable * Wiring harness & connectors

	* Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer's instructions.
(1) - Replace both front sensors.	

TOYOTA-7

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors * Instrument panel * Center console bracket support * Steering wheel * Spiral cable * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer's instructions.
(1) - Replace both front sensors.	

TOYOTA-8

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Instrument panel * Center console bracket support * Steering wheel * Spiral cable * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

TOYOTA-9

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit)

	* Front air bag sensors (if equipped) (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module * Air bag sensor (control unit) * Front air bag sensors (if equipped) * Steering wheel * Spiral cable * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer's instructions.
(1) - Replace both front sensors. (2) - On Tacoma, DO NOT attempt wiring harness repairs. Replace entire wiring harness.	

TOYOTA-10

Action	Component or System
Replace After Deployment	* Air bag module(s) * Front air bag sensors (if equipped) (1)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module * Front air bag sensors * Steering wheel * Spiral cable * Air bag sensor (control unit) (2) * Wiring harness & connectors * Seat belts & mounting points
Comments	If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer's instructions.
(1) - Replace both front sensors. (2) - Replace if bracket or case is deformed, vinyl seal is broken, connector is damaged, or if sensor has been dropped.	

TOYOTA-11

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (1) * Seat belt pretensioner (2)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors * Seat belt pretensioners * Seat belts & mounting points * Instrument panel * Instrument panel reinforcement * Glove box & glove box door * Spiral cable

	* Steering wheel * Wiring harness & connectors
Comments	(3) If components are in any way damaged or bent, they must be replaced. Wiring for front air bag sensors can be repaired following manufacturer's instructions.

(1) - Repair both front sensors.
(2) - If air bags are deployed, replace all seat belt pretensioners.
(3) - On Sienna, DO NOT attempt wiring harness repairs. Replace entire wiring harness.

TOYOTA-12

Action	Component or System
Replace After Deployment	* Driver-side air bag module * Passenger-side air bag module (1) * Air bag sensor (control unit) * Front air bag sensors (if equipped) (2) * Seat belt pretensioner (if equipped) (3)
Inspect & If Damaged Replace Component (Even If Air Bag Did Not Deploy)	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (if equipped) * Seat belt pretensioners * Seat belts & mounting points * Instrument panel * Instrument panel reinforcement * Glove box & glove box door * Spiral cable * Steering wheel * Wiring harness & connectors
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

(1) - If passenger-side air bag module cut-off switch is OFF when impact occurs, replace switch. If switch is ON when impact occurs, and air bag deployed, check switch.
(2) - Replace both front sensors.
(3) - If air bags are deployed, replace all seat belt pretensioners.

TOYOTA-13

Action	Component or System
Replace After Deployment	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors (replace both sensors) * Seat air bag modules (1) * Head air bag modules (1) * Head-side air bag sensor (2) * Seat belt pretensioner (3)
Inspect & If Damaged Replace Component (Even If	* Air bag module(s) * Air bag sensor (control unit) * Front air bag sensors

Air Bag Did Not Deploy)	* Instrument panel & reinforcement * Seat belts & mounting points * Seat belt pretensioners * Seat back cover & frame * Head-side air bag sensors * Spiral cable * Steering wheel * Wiring harness & connectors
Comments	If components are in any way damaged or bent, they must be replaced. DO NOT attempt wiring harness repairs. Replace entire wiring harness.

(1) - If deployed.
(2) - If side or head air bag modules are deployed.
(3) - If front air bags are deployed, replace all seat belt pretensioners.

POWER WINDOWS

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Power Windows
LEXUS

RX300

DESCRIPTION & OPERATION

POWER WINDOW SYSTEM

Automatic Operation

To partially lower driver's window, press button slightly and hold until window is at desired level. To fully lower window without having to hold button down, press button down firmly and release. Automatic operation is controlled by driver door ECU.

Key Off Operation

The windows can be operated for about 45 seconds after ignition is turned off, or until either front door has been opened. This function is referred to as "key off".

Door Key Cylinder Operation

The windows can be operated using key in driver's door key cylinder. To close windows, insert key in driver's door key cylinder, turn key counterclockwise and hold. To open windows, turn key clockwise and hold.

Transmitter (Remote Operation)

Pressing unlock button of multi-remote transmitter (key fob) for 1.5 seconds or more will lower all windows. Window lowering is stopped when unlock button is released.

Catching Prevention (Jam Function)

In the event an object is caught in area of window travel during upward movement, power window motor will reverse direction as a safety measure. If point of window resistance is such that window opening is greater than 7.874" (200 mm), window will automatically lower 1.969" (50 mm) and stop. If point of resistance is such that window opening is 7.874" (200 mm) or less, window will automatically lower until opening is 7.874" (200 mm) and stop.

POWER WINDOW SWITCHES

Master Switch

All windows can be controlled from master switch on driver's door panel. One of the individual switches on master switch controls driver's window. All other individual switches control passenger's windows. Master switch is integral with driver door ECU.

Passenger's Switch

Individual window switches are located on door panel of each passenger door. Front passenger's switch is integral with passenger door ECU. Rear passenger switches are separate from passenger door ECUs.

Window Lock Switch

When button for window lock switch (located in master switch assembly) is depressed, passenger windows cannot be operated from master switch or passenger's switches. Only driver's window can be

operated.

COMPONENT LOCATIONS

Body Control ECU
Behind left side of instrument panel.

Door Courtesy Switch
In each door pillar.

Door ECU (Equipped With 4)
Inside each door.

Door Key Lock/Unlock Switch
Integral with front door key cylinders.

D RR DOOR Fuse (20-Amp)
In instrument panel junction block.

ECU-B Fuse (7.5-Amp)
In engine compartment junction block.

Engine Compartment Junction Block
Left side of engine compartment.

FL DOOR Fuse (20-Amp)
In engine compartment junction block.

GAUGE Fuse (7.5-Amp)
In instrument panel junction block.

Instrument Panel Junction Block
Below left side of instrument panel.

P FR DOOR Fuse (20-Amp)
In instrument panel junction block.

P RR DOOR Fuse (20-Amp)
In instrument panel junction block.

ADJUSTMENTS

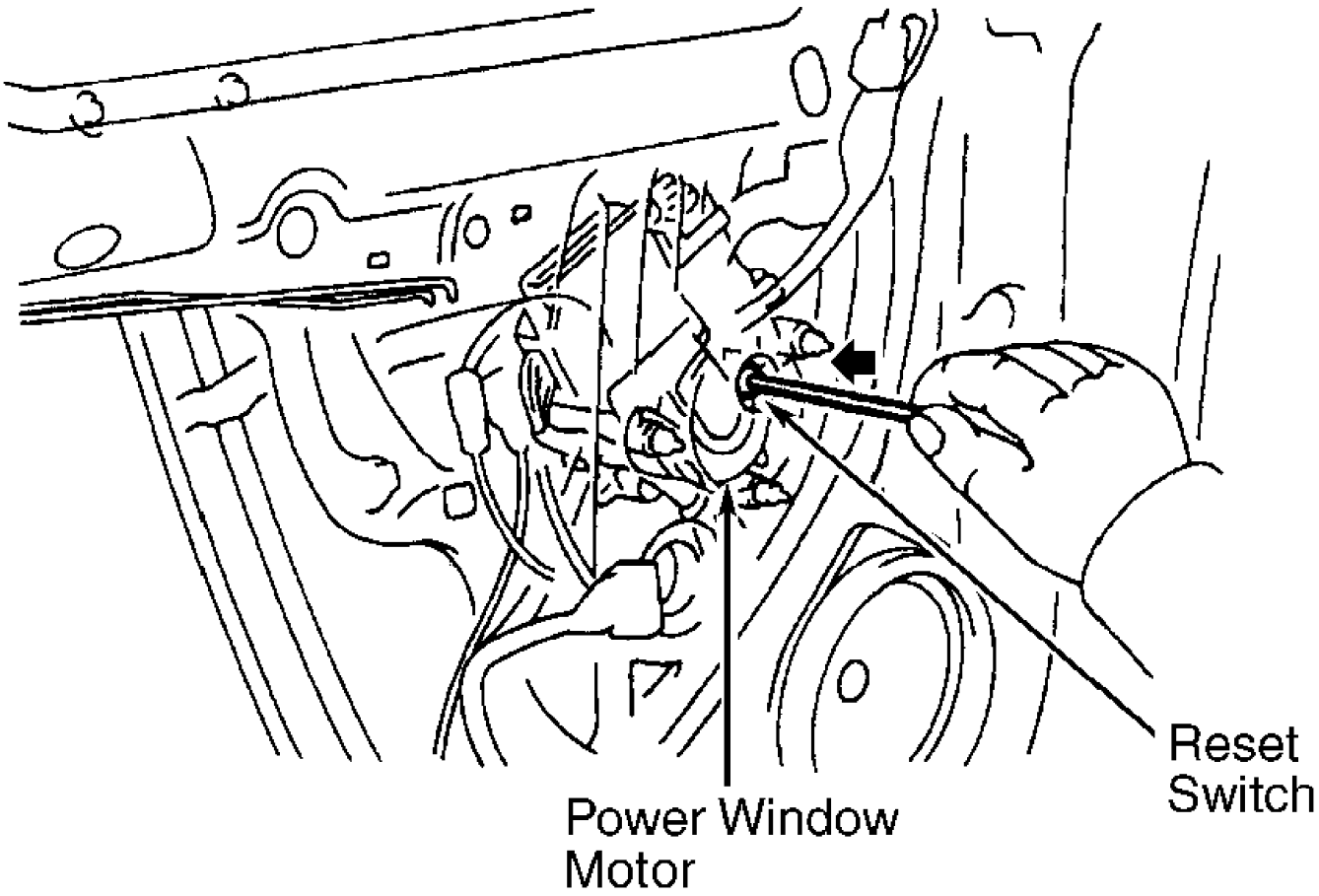
* PLEASE READ THIS FIRST *

NOTE: The following adjustments set limit switch to OFF position at window glass TDC and resets window motor jam function. Perform these adjustments when window motor has been replaced or removed from window regulator assembly.

JAM FUNCTION RESET

1) Remove door panel. Reconnect window switch. Turn ignition on. Using window switch manual UP mode, close window fully. Using a wire .079" (2 mm) in diameter with a flat end, press reset switch on power window motor. See Fig. 1.

2) Using window switch manual DOWN mode, open window fully. Remove wire from reset switch. Using window switch manual UP mode, close window fully. Verify proper window operation using window switch AUTO function.



G99C51500

Fig. 1: Adjusting Limit Switch (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POWER WINDOW MOTOR LIMIT SWITCH

With window motor removed from regulator assembly, connect motor to vehicle harness. rotate motor 6-10 turns or 4-5 seconds in upward window direction. This sets limit switch to OFF position (TDC of window glass).

TROUBLE SHOOTING

Perform a visual inspection, checking for open fuses, disconnected or damaged wire harnesses and components. Repair or replace items as necessary and recheck operation. If no problems are found, diagnose by symptom. See SYMPTOM TESTS.

SYMPTOM TESTS

* PLEASE READ THIS FIRST *

NOTE: To diagnose symptoms not listed, check system circuits and components which may be related to symptom. See CIRCUIT TESTS and COMPONENT TESTS.

The following items are available for symptom testing:

* Power window moves down during up operation.
* Down operation (jam function) inoperative when foreign object restricts window travel.

DURING POWER WINDOW UP OPERATION, WINDOW MOVES DOWN

1) Check window for binding during up operation. If cause is improper window installation or faulty weather strip, repair or replace as necessary. After repairs, go to next step. If cause cannot be identified, go to next step.
2) Adjust limit switch. See POWER WINDOW MOTOR LIMIT SWITCH under ADJUSTMENTS. Recheck window operation. If operation is not okay, go to next step.
3) Adjust window glass installation. Recheck window operation. If operation is not okay, go to next step.
4) Remove power window motor/regulator assembly. Leave electrical connectors connected. Using master switch, operate window motor/regulator. If window motor/regulator operates without binding, go to next step. If operation is not as specified, repair or replace as necessary.
5) Replace door ECU with a known-good door ECU from another door. Reinstall window motor/regulator assembly and reset limit switch. See POWER WINDOW MOTOR LIMIT SWITCH under ADJUSTMENTS. Recheck system. If operation is normal, replace door ECU. If operation is not normal, replace power window motor.

DOWN OPERATION INOPERATIVE

NOTE: This test diagnoses inoperative down operation (jam function) when foreign object restricts window up operation.

1) Ensure AUTO UP ("one-touch") operation is okay with ignition on. Restrict window movement as window is operated upward. Window should switch to downward operation. If point of resistance is such that window opening is greater than 7.874" (200 mm), window will automatically lower 1.969" (50 mm) and stop. If point of resistance is such that window opening is 7.874" (200 mm) or less, window will automatically lower until opening is 7.874" (200 mm) and stop. If operation is as specified, system is okay at this time. If operation is not as specified, go to next step.
2) Reset window motor jam function. See JAM FUNCTION RESET under ADJUSTMENTS. Recheck window operation. If operation is not okay, replace master switch.

CIRCUIT TESTS

JAM PROTECTION LIMIT SWITCH CIRCUIT

1) Using scan tool in DATA LIST mode, check jam protection limit switch. If results are okay, circuit is okay at this time. If results are not okay, go to next step.
2) Check jam protection limit switch. See JAM PROTECTION LIMIT SWITCH under COMPONENT TESTS. Repair as necessary. If switch is okay, go to next step.
3) Check wire harness and connectors between jam protection limit switch and appropriate door ECU. See WIRING DIAGRAMS. Repair as necessary. If wire harness and connectors are okay, circuit is okay at this time.

JAM PROTECTION PULSE SWITCH CIRCUIT

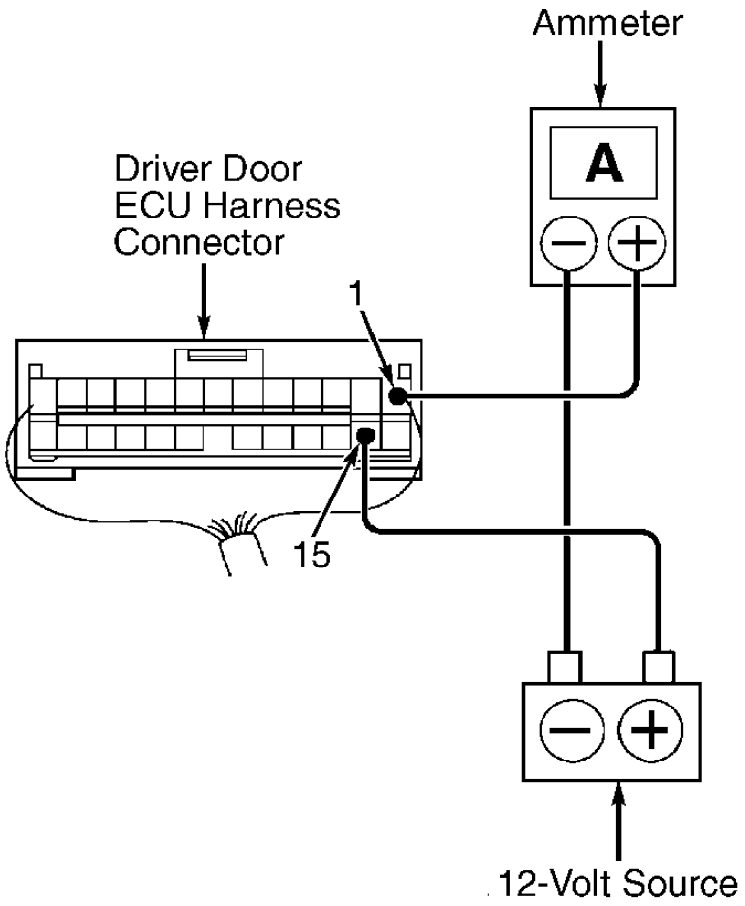
1) Check jam protection pulse switch. See JAM PROTECTION PULSE SWITCH under COMPONENT TESTS. Replace window motor as necessary. If jam protection pulse switch is okay, go to next step.

2) Check wire harness and connectors between jam protection pulse switch and appropriate door ECU. See WIRING DIAGRAMS. Repair as necessary. If wire harness and connectors are okay, circuit is okay at this time.

ONE-TOUCH SYSTEM CIRCUIT

1) Disconnect driver door ECU harness connector. Using an ammeter, connect positive lead to terminal No. 1 of harness connector, and negative lead to negative terminal of battery. See Fig. 2. Using a jumper wire, connect battery positive to terminal No. 15 at harness connector.

2) As window travels downward, amperage should be about 7 amps. Ensure amperage increases to 14.5 amps or greater when window reaches end of travel. With voltage still applied, amperage should decrease to less than one amp within 4-90 seconds as thermistor inside window motor opens. If operation is not as specified, replace window motor.



G99A51508

Fig. 2: Testing One-Touch System Circuit
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REAR WINDOW SWITCH CIRCUIT

1) Using scan tool, check for body control ECU DTCs. If DTCs B1225 or B1226 are present, rear window switch, door lock control switch or related wire harness is faulty. Repair as necessary. If DTCs are not present, go to next step.

2) Check window switch. See WINDOW SWITCH under COMPONENT TESTS. Repair as necessary. If window switch is okay, go to next step.

3) Check wire harness and connectors between appropriate window switch and rear door ECU. See WIRING DIAGRAMS. Repair as necessary. If harness and connectors are okay, go to next step.

4) Check wire harness and connectors between appropriate rear window switch and master switch. See WIRING DIAGRAMS. Repair as necessary. If harness and connectors are okay, circuit is okay at this time.

WINDOW MOTOR CIRCUIT

1) Using scan tool in ACTIVE TEST mode, operate windows. If windows operate, circuits are okay at this time. If window(s) do not operate, go to next step.

2) Check appropriate window motor. See WINDOW MOTOR under COMPONENT TESTS. Replace if necessary. If window motors are okay, go to next step.

3) Check wire harness and connectors between appropriate window motor and door ECU. See WIRING DIAGRAMS. Repair as necessary. If wire harness and connectors are okay, circuits are okay at this time.

COMPONENT TESTS

JAM PROTECTION LIMIT SWITCH

Driver & Front Passenger Windows

1) Disconnect window motor harness connector. Connect ohmmeter between terminals No. 4 and 5 of motor connector. See Fig. 3. Using jumper wires, connect battery positive to terminal No. 1 and battery negative to terminal No. 2. Continuity should be present as window travels upward. Ensure continuity is not present when window is in fully closed position.

2) Reverse polarity of voltage to motor. Continuity should be present as window travels downward. Ensure continuity is not present when window is in fully open position. If continuity is not as specified, replace window motor.

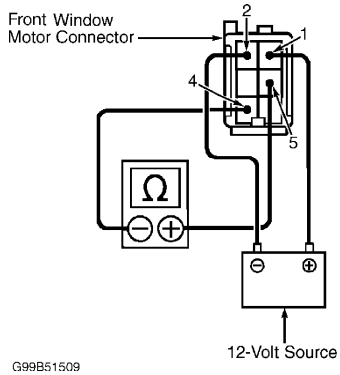


Fig. 3: Testing Jam Protection Limit Switch (Driver & Front Passenger Windows)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear Passenger Windows

1) Disconnect window motor harness connector. Connect ohmmeter between terminals No. 2 and 6 of motor connector. See Fig. 4. Using jumper wires, connect battery positive to terminal No. 3 and battery negative to terminal No. 1. Continuity should be present as window travels upward. Ensure continuity is not present when window is in fully closed position.

2) Reverse polarity of voltage to motor. Continuity should be present as window travels downward. Ensure continuity is not present when window is in fully open position. If continuity is not as specified, replace window motor.

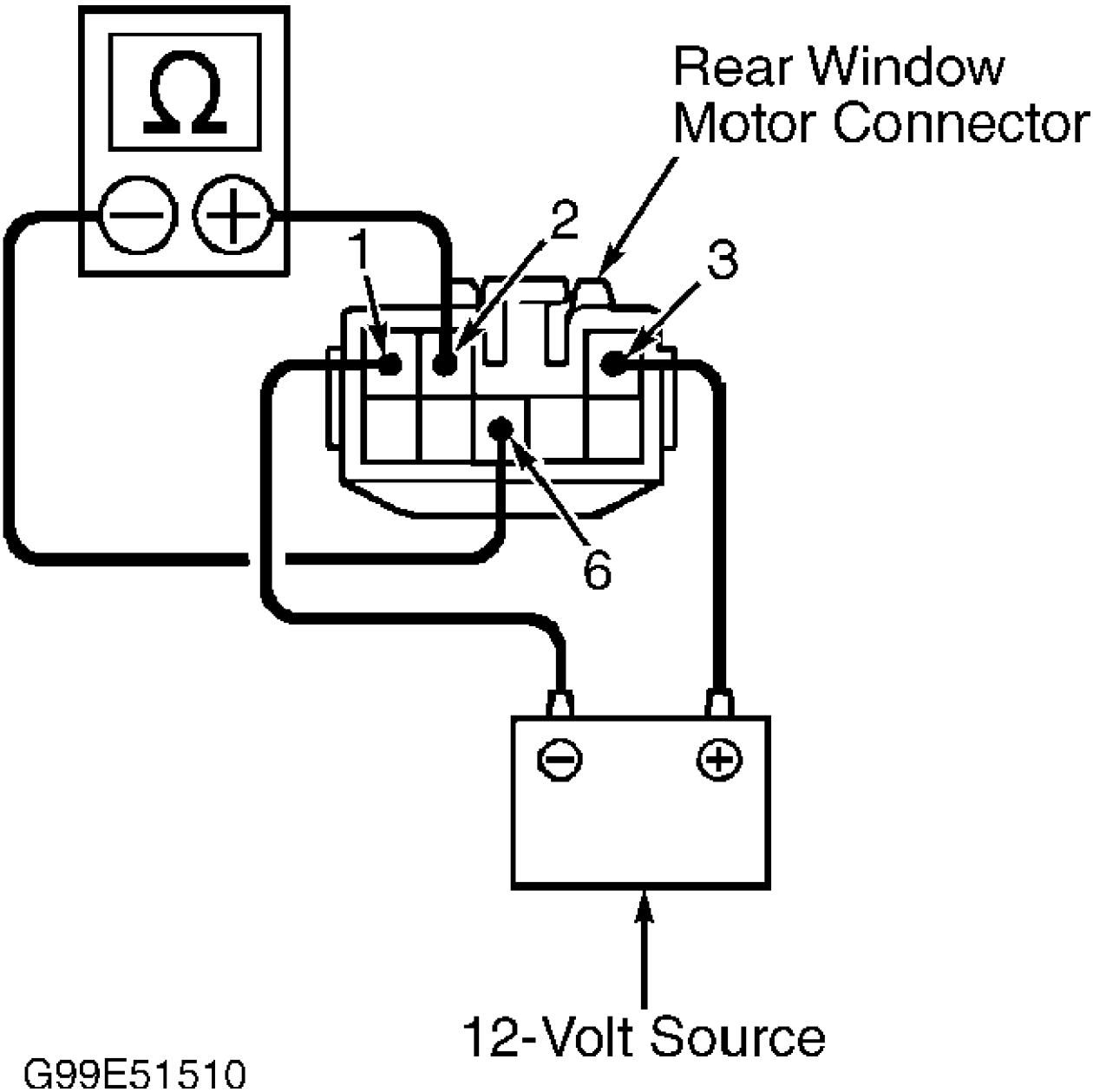


Fig. 4: Testing Jam Protection Limit Switch (Rear Passenger Windows) Courtesy of Toyota Motor Sales, U.S.A., Inc.

JAM PROTECTION PULSE SWITCH

Driver & Front Passenger Windows

1) Disconnect window motor harness connector. Connect DVOM set to measure frequency between terminals No. 4 and 6 of motor connector. See Fig. 5. Using jumper wires, connect battery positive to terminal No. 1 and battery negative to terminal No. 2. Ensure a pulse is generated as window motor operates.

2) Reverse polarity of voltage to motor. Ensure a pulse is generated as window motor operates in opposite direction. If operation is not as specified, replace window motor.

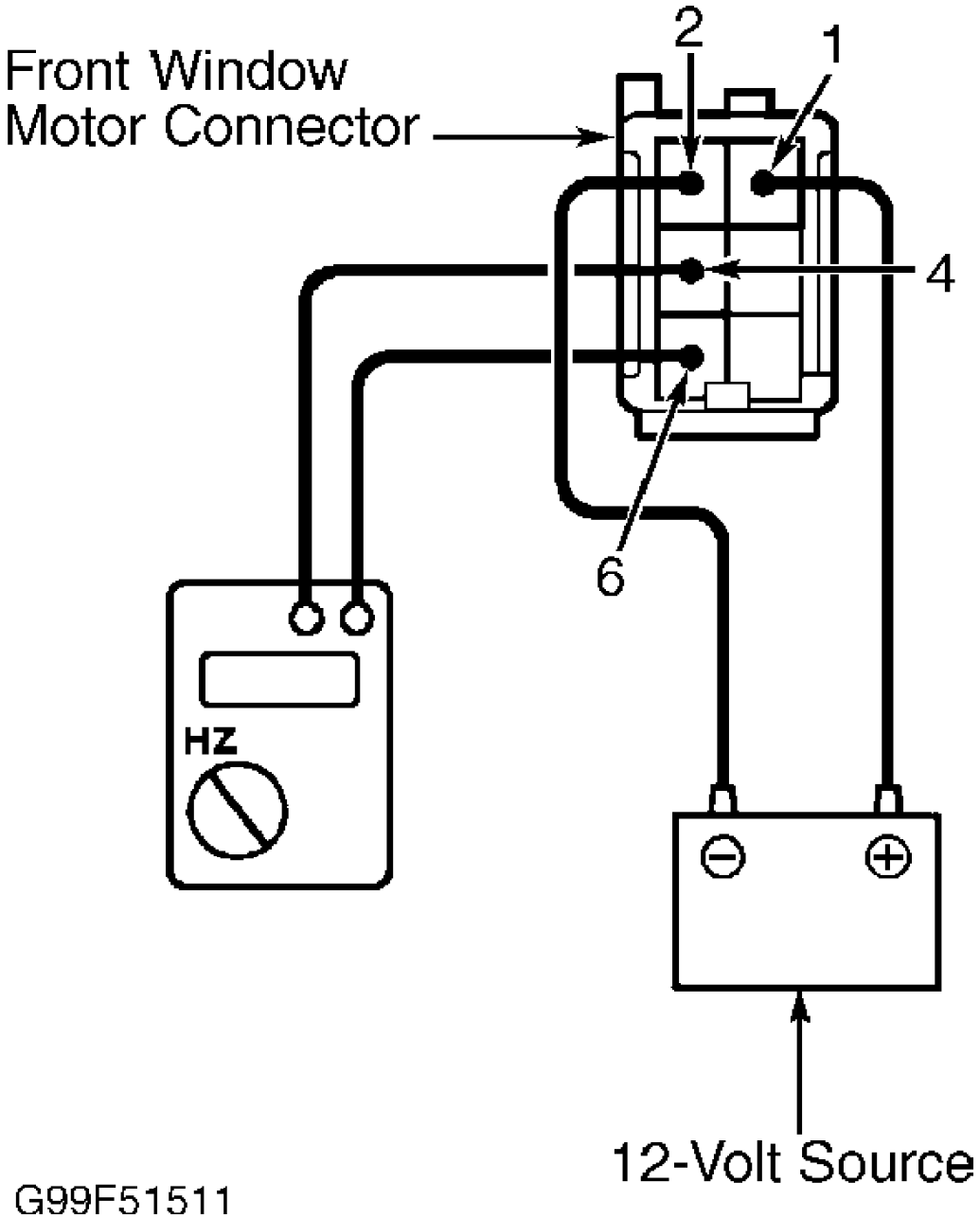


Fig. 5: Testing Jam Protection Pulse Switch (Driver & Front Passenger Windows)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear Passenger Windows

1) Disconnect window motor harness connector. Connect DVOM set to measure frequency between terminals No. 3 and 5 of motor connector. See Fig. 6. Using jumper wires, connect battery positive to terminal No. 1 and battery negative to terminal No. 2. Ensure a pulse is generated as window motor operates.

2) Reverse polarity of voltage to motor. Ensure a pulse is generated as window motor operates in opposite direction. If operation is not as specified, replace window motor.

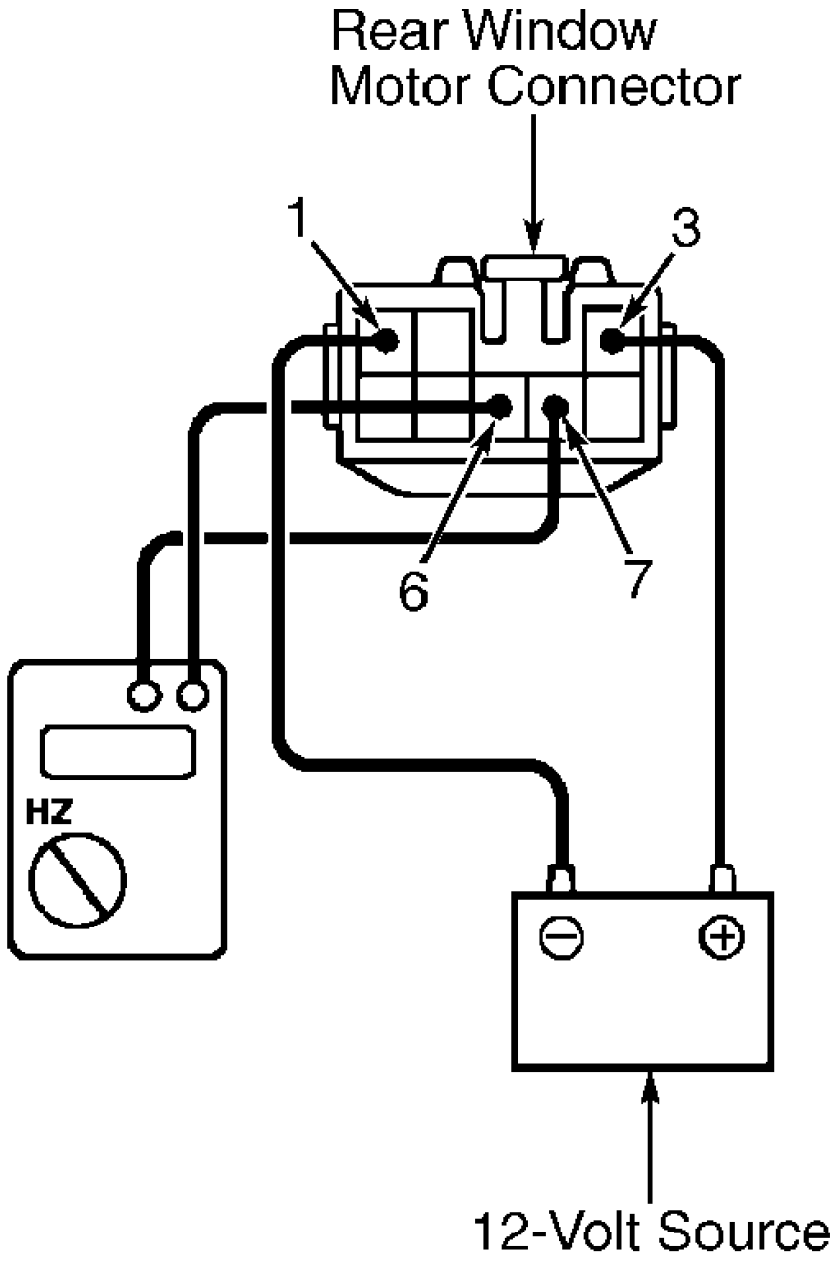


Fig. 6: Testing Jam Protection Pulse Switch (Rear Passenger Windows) Courtesy of Toyota Motor Sales, U.S.A., Inc.

WINDOW MOTOR

Driver & Front Passenger Windows

1) Disconnect window motor harness connector. Apply battery voltage and ground between motor connector terminals No. 1 (Red wire) and No. 2 (Green wire). Motor should operate. To reverse motor direction, reverse polarity of voltage to motor.

2) Using an ammeter in series with 12-volt source and window motor, monitor amperage as window reaches end of its travel. Continue to apply voltage. In 4-90 seconds, thermistor inside window motor should open and amperage should decrease to less than one amp.

3) Wait 60 seconds, and then reverse polarity of voltage to motor. Window should travel in opposite direction. With voltage still applied at end of window travel, amperage should decrease to less than one amp within 4-90 seconds. If operation is not as specified, replace window motor.

Rear Passenger Windows

1) Disconnect window motor harness connector. Apply battery voltage and ground between motor connector terminals No. 1 (Green wire) and No. 3 (Red wire). Motor should operate. To reverse motor direction, reverse polarity of voltage to motor. Replace motor if it does not operate as specified.

2) Using an ammeter in series with 12-volt source and window motor, monitor amperage as window reaches end of its travel. Continue to apply voltage. In 4-90 seconds, thermistor inside window motor should open and amperage should be less than one amp.

3) Wait 60 seconds, and then reverse polarity of voltage to motor. Window should travel in opposite direction. With voltage still applied at end of window travel, amperage should decrease to less than one amp within 4-90 seconds. Replace motor if it does not operate as specified.

WINDOW SWITCH

Remove window switch. Using DVOM, check for continuity between terminals of window switch. See Fig. 7. Ensure continuity is as specified between appropriate terminals in indicated switch positions. See WINDOW SWITCH CONTINUITY SPECIFICATIONS table. If continuity is not as specified, replace window switch.

WINDOW SWITCH CONTINUITY SPECIFICATIONS

Switch Position	Test Between Terminals	Continuity
UP (Auto)	3 & 4; 3 & 6	Yes
UP (Manual)	3 & 6	Yes
OFF (Neutral)	Any	No
DOWN (Manual)	5 & 6	Yes
DOWN (Auto)	4 & 6; 5 & 6	Yes

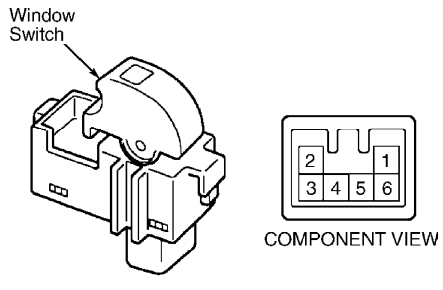


Fig. 7: Identifying Window Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WINDOW SWITCH ILLUMINATION

Remove window switch. Apply battery positive to switch terminal No. 3, and battery negative to switch terminal No. 2. See Fig. 7. Switch should illuminate. If operation is not as specified, replace window switch.

REMOVAL & INSTALLATION

WINDOW MOTOR & REGULATOR ASSEMBLY

CAUTION: To keep from scratching door trim components, put tape on tip of screwdriver before prying components from door.

Removal & Installation (Front)

1) Disconnect negative battery cable. Remove bezel from inner door handle by removing screw. Gently pry window switch panel from door and disconnect electrical connector. Remove courtesy light. Remove clips and screws from door trim and remove door trim.

2) Disconnect 2 cables and remove inside door handle assembly. Remove speaker. Remove service hole cover. Remove door belt molding from top edge of door. Using screwdriver, pry out lower frame bracket garnish.

3) If necessary, remove outside rear view mirror. Position window glass to access window securing bolts through service holes. Remove 2 bolts and window glass.

4) Remove window glass runs. Disconnect window regulator/motor harness connector. Remove window regulator through service hole. To install, reverse removal procedure.

Removal & Installation (Rear)

1) Disconnect negative battery cable. Remove bezel from inner door handle by removing screw. Gently pry window switch from door and disconnect electrical connector. Remove clips and screws from door trim and remove door trim.

2) Remove rear door ECU. Remove speaker. Disconnect 2 cables and remove inside door handle assembly. Remove service hole cover. Remove door weatherstrip. Position window glass to access window securing bolts through service holes.

3) Remove window glass securing bolts. Position window glass toward front of vehicle. Remove screw and 2 bolts and remove window division bar by rotating 90 degrees and pulling upward. Remove quarter window glass and rear window glass.

4) Disconnect window regulator/motor harness connector. Remove window regulator through service hole. To install, reverse removal procedure.

WIRING DIAGRAMS

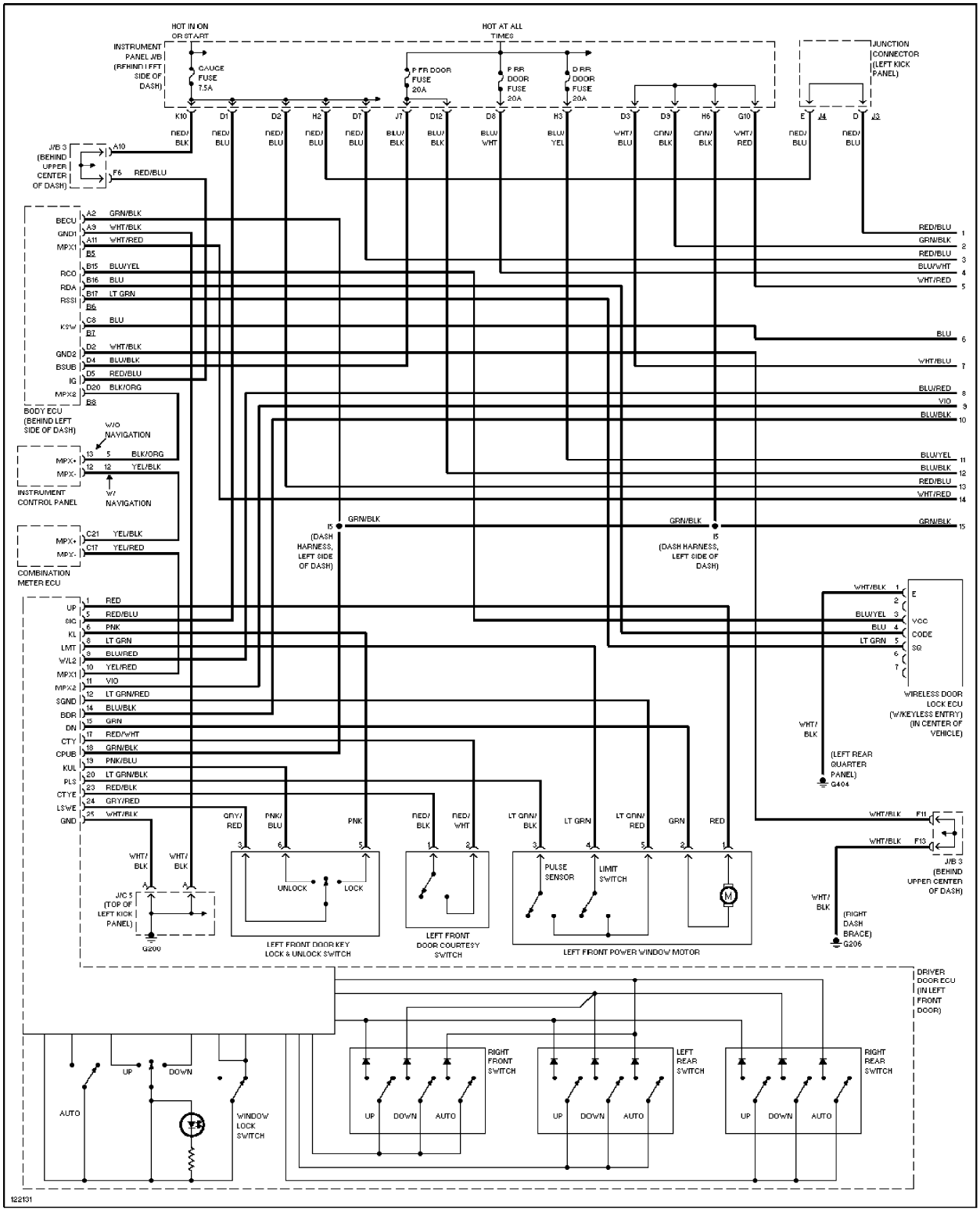


Fig. 8: Power Window System Wiring Diagram (RX300 - 1 Of 3)

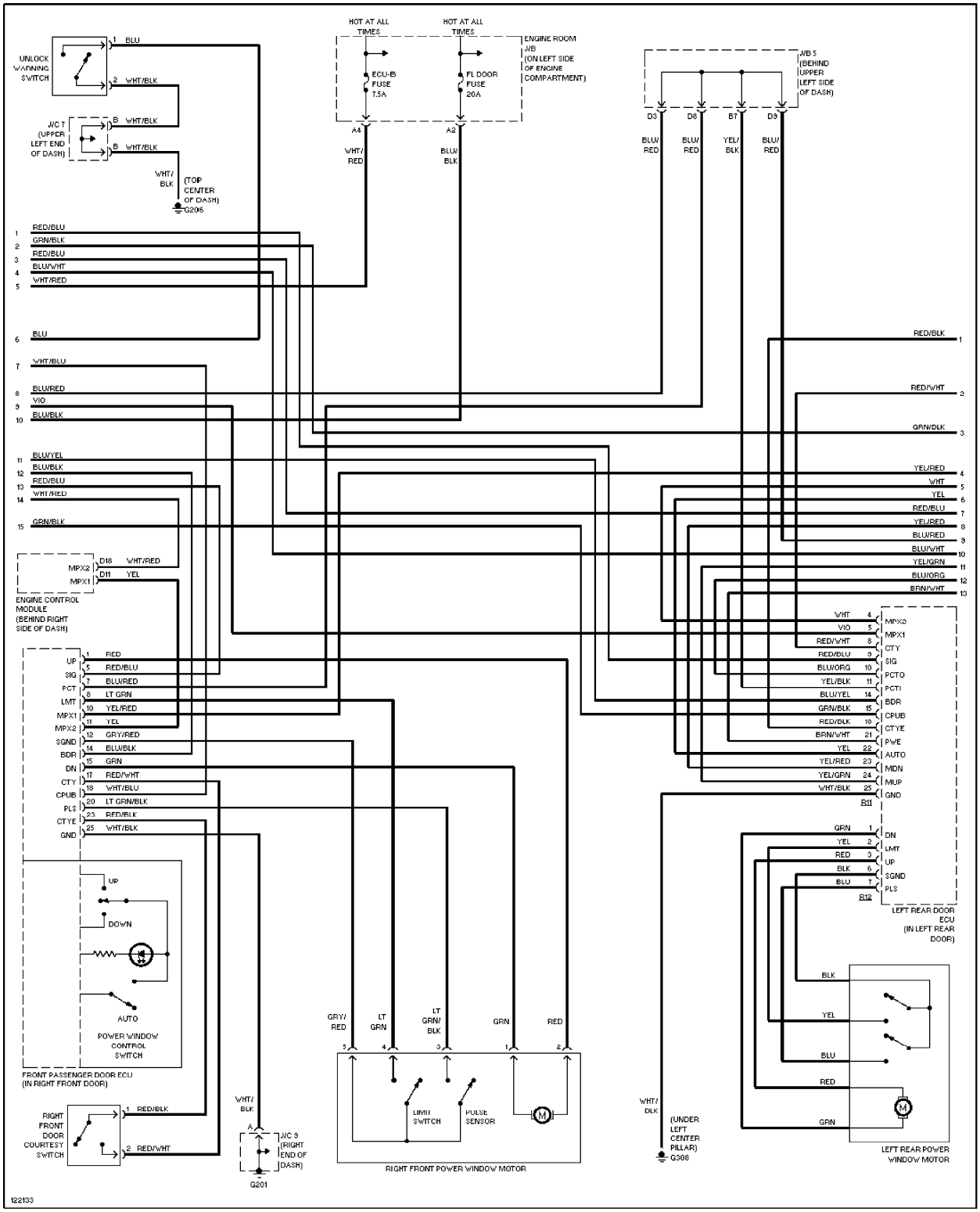


Fig. 9: Power Window System Wiring Diagram (RX300 - 2 Of 3)

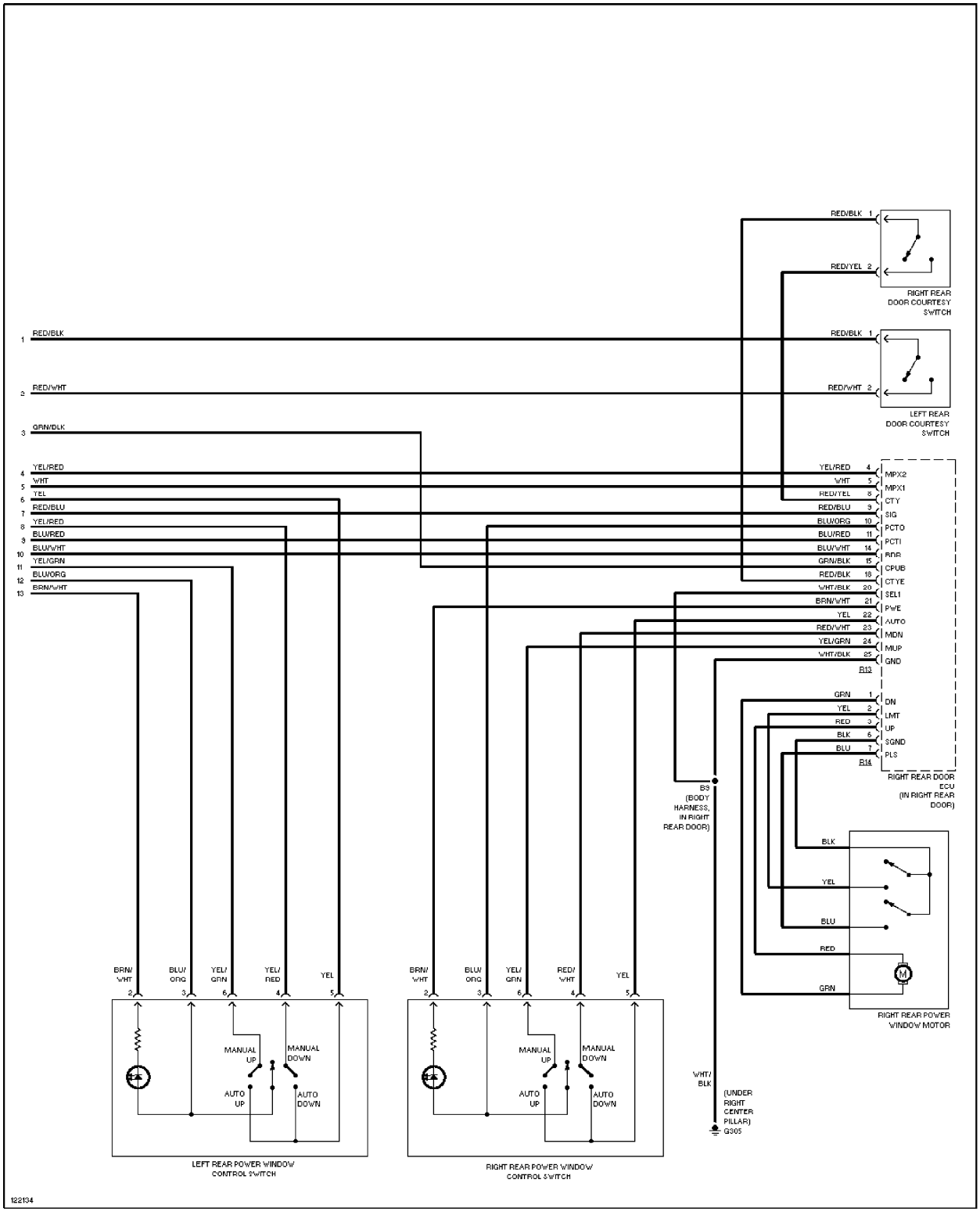


Fig. 10: Power Window System Wiring Diagram (RX300 - 3 Of 3)

SEATS - POWER WITHOUT MEMORY

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Power Seats - Without Memory
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

DESCRIPTION & OPERATION

Seat cushion moves 6 ways (front up and down, rear up and down, and slide forward and backward). Seat back reclines forward and backward. All vehicles except ES300 are equipped with an adjustable lumbar support. LS400 also includes a power headrest. Seat switch controls power and ground to seat motors. A circuit breaker in power seat motor protects circuit.

TROUBLE SHOOTING

BOTH SEATS DO NOT OPERATE, DEFOGGER DOES NOT OPERATE

Check POWER fuse (30-amp) on all models, DOOR fuse (30-amp) on SC300, D/SEAT and P/SEAT fuses (30-amp) on GS300 and GS400, SEAT FR fuse (30-amp) on LS400. Check wiring harness between fuse panel and seat.

DRIVER'S SEAT DOES NOT OPERATE, PASSENGER'S SEAT OKAY

Check driver's seat switch and wiring harness for inoperative seat.

PASSENGER'S SEAT DOES NOT OPERATE, DRIVER'S SEAT OKAY

Check passenger's seat switch and wiring harness.

SEAT DOES NOT OPERATE IN ONE DIRECTION

Check power seat switch. Check appropriate motor. Check wiring between motor and seat switch.

HEADREST DOES NOT OPERATE

LS400
Check headrest switch, wiring harness and lumbar support motor.

LUMBAR SEAT DOES NOT OPERATE

GS300, GS400, LS400, SC300 & SC400
Check lumbar switch, wiring harness and lumbar support motor.

COMPONENT TESTS

POWER SEAT MOTOR TEST

NOTE: On LS400, circuit breaker should reset within 90 seconds.

1) Disconnect power seat motor connector. Apply battery voltage and ground across power seat motor connector terminals. Reverse polarity to move seat in opposite direction. If power seat motor does not operate, replace power seat motor.

2) If power seat motor operates, move seat fully in one direction until it stops. With seat stopped, keep battery voltage applied to terminals until circuit breaker is heard opening (within 60 seconds). If circuit breaker does not open, replace power seat motor.

3) If circuit breaker opens, reverse polarity and wait until seat moves in opposite direction. If seat moves in opposite direction (within 60 seconds), power seat motor is okay. If seat does not move in opposite direction (within 60 seconds), replace power seat motor.

POWER SEAT SWITCH TEST

Disconnect switch connector. Check continuity between specified terminals of switch connector. See appropriate POWER SEAT SWITCH TEST table. See Figs. 1-5. Replace switch if there is no continuity.

POWER SEAT SWITCH TEST (ES300 & LX470)

Switch Position	(1) Terminals
Driver's Seat	
Slide	
Forward	4 & 7; 8 & 11
Off	4 & 7; 4 & 8
Backward	4 & 11; 7 & 8
Front Up/Down	
Up	7 & 9; 10 & 11
Off	7 & 9; 7 & 11
Down	7 & 10; 9 & 11
Rear Up/Down	
Up	2 & 11; 3 & 7
Off	2 & 3; 2 & 7
Down	2 & 7; 3 & 11
Recline	
Forward	1 & 11; 5 & 7
Off	1 & 5; 1 & 7
Backward	1 & 7; 5 & 11
Passenger's Seat	
Slide	
Forward	4 & 7; 8 & 11
Off	4 & 7; 4 & 8
Backward	4 & 11; 7 & 8
Front Up/Down	
Up	7 & 10; 9 & 11
Off	7 & 9; 7 & 10
Down	7 & 9; 10 & 11
Rear Up/Down	
Up	2 & 7; 3 & 11
Off	2 & 3; 2 & 7
Down	2 & 11; 3 & 7
Recline	
Forward	1 & 11; 5 & 7

Off	1 & 5; 1 & 7
Backward	1 & 7; 5 & 11

(1) - See Fig. 1.

POWER SEAT SWITCH TEST (GS300, GS400 & RX300)

Switch Position	(1) Terminals
Driver's Seat	
Slide	
Forward	1 & 9; 4 & 6
Off	4 & 6; 4 & 9
Backward	1 & 6; 4 & 9
Front Up/Down	
Up	1 & 10; 4 & 5
Off	4 & 5; 4 & 10
Down	1 & 5; 4 & 10
Rear Up/Down	
Up	1 & 7; 4 & 8
Off	4 & 7, 4 & 8
Down	1 & 8; 4 & 7
Recline	
Forward	1 & 3; 2 & 4
Off	2 & 4; 3 & 4
Backward	1 & 2; 3 & 4
Lumbar (2)	
Forward	1 & 4; 2 & 3
Off	1 & 3; 2 & 3
Release	1 & 3; 2 & 4
Passenger's Seat	
Slide	
Forward	1 & 9; 4 & 6
Off	4 & 6; 4 & 9
Backward	1 & 6; 4 & 9
Front Up/Down	
Up	1 & 5; 4 & 10
Off	4 & 5; 4 & 10
Down	1 & 10; 4 & 5
Rear Up/Down	
Up	1 & 8; 4 & 7
Off	4 & 7, 4 & 8
Down	1 & 7; 4 & 8
Recline	
Forward	1 & 3; 2 & 4
Off	2 & 4, 3 & 4
Backward	1 & 2; 3 & 4
Lumbar (2)	
Forward	1 & 4; 2 & 3
Off	1, 2 & 3
Release	1 & 3; 2 & 4

(1) - See Fig. 2.
(2) - Check between lumbar switch terminals. See Fig. 5.

POWER SEAT SWITCH TEST (LS400)

Switch Position	(1) Terminals
Slide	
Forward	11 & 14; 12 & 13

Off	11 & 13; 12 & 13
Backward	11 & 13; 12 & 14
Front Up/Down	
Up	9 & 14; 10 & 13
Off	9 & 13; 10 & 13
Down	9 & 13; 10 & 14
Rear Up/Down	
Up	5 & 14; 6 & 13
Off	5 & 13; 6 & 13
Down	5 & 13; 6 & 14
Recline	
Forward	4 & 14; 3 & 13
Off	4 & 13; 3 & 13
Backward	4 & 13; 3 & 14
Headrest	
Up	14 & 15; 13 & 16
Off	13 & 15; 13 & 16
Down	5 & 13; 6 & 14
Lumbar (2)	
Driver's Seat	
Forward	1 & 4; 2 & 3
Off	1 & 3; 2 & 3
Release	1 & 3; 2 & 4
Passenger's Seat	
Forward	1 & 4; 2 & 3
Off	2 & 3; 2 & 4
Release	1 & 3; 2 & 4

(1) - See Fig. 3.
(2) - Check between lumbar switch terminals. See Fig. 5.

POWER SEAT SWITCH TEST (SC300 & SC400)

Switch Position	(1) Terminals
Driver's & Passenger's Seat	
Slide	
Forward	1 & 7; 2 & 12
Off	1 & 12; 2 & 12
Backward	1 & 12; 2 & 7
Front Up/Down	
Up	4 & 6; 5 & 7
Off	4 & 5; 4 & 6
Down	4 & 5; 6 & 7
Rear Up/Down	
Up	3 & 8; 7 & 9
Off	3 & 8; 3 & 9
Down	3 & 9; 7 & 8
Recline	
Forward	3 & 12; 4 & 7
Off	3 & 12; 4 & 12
Backward	3 & 7; 4 & 12
Lumbar	
Forward	7 & 11; 10 & 12
Off	10 & 12; 11 & 12
Release	7 & 10; 11 & 12

(1) - See Fig. 4.

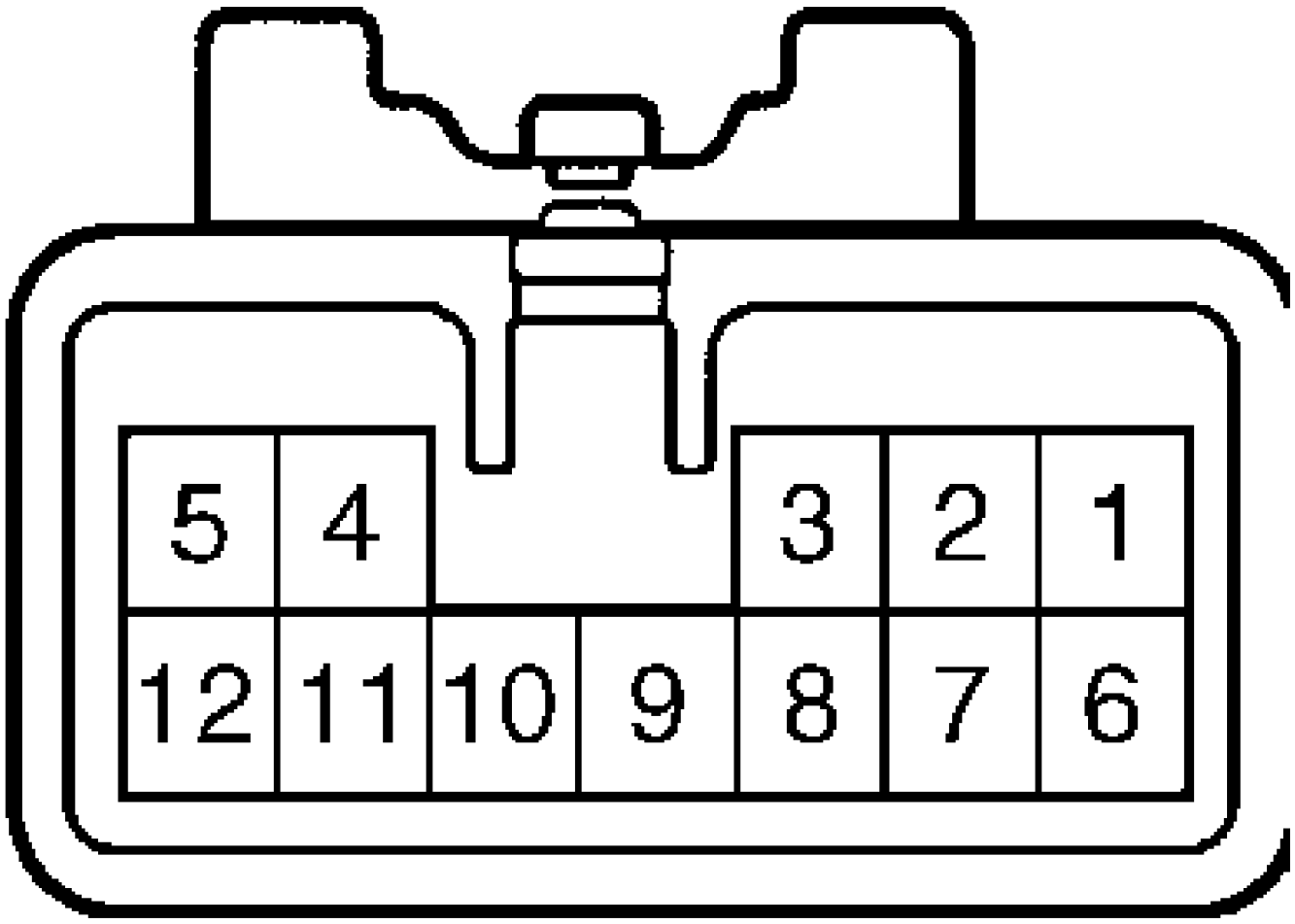


Fig. 1: Identifying Seat Switch Connector Terminals (ES300 & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

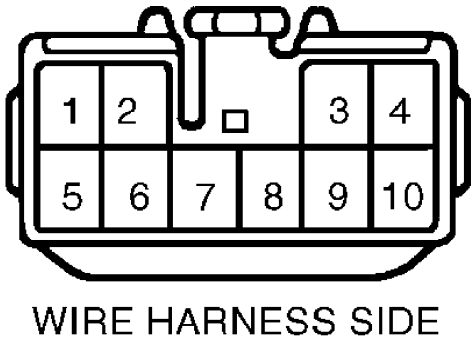


Fig. 2: Identifying Seat Switch Connector Terminals (GS300, GS400 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

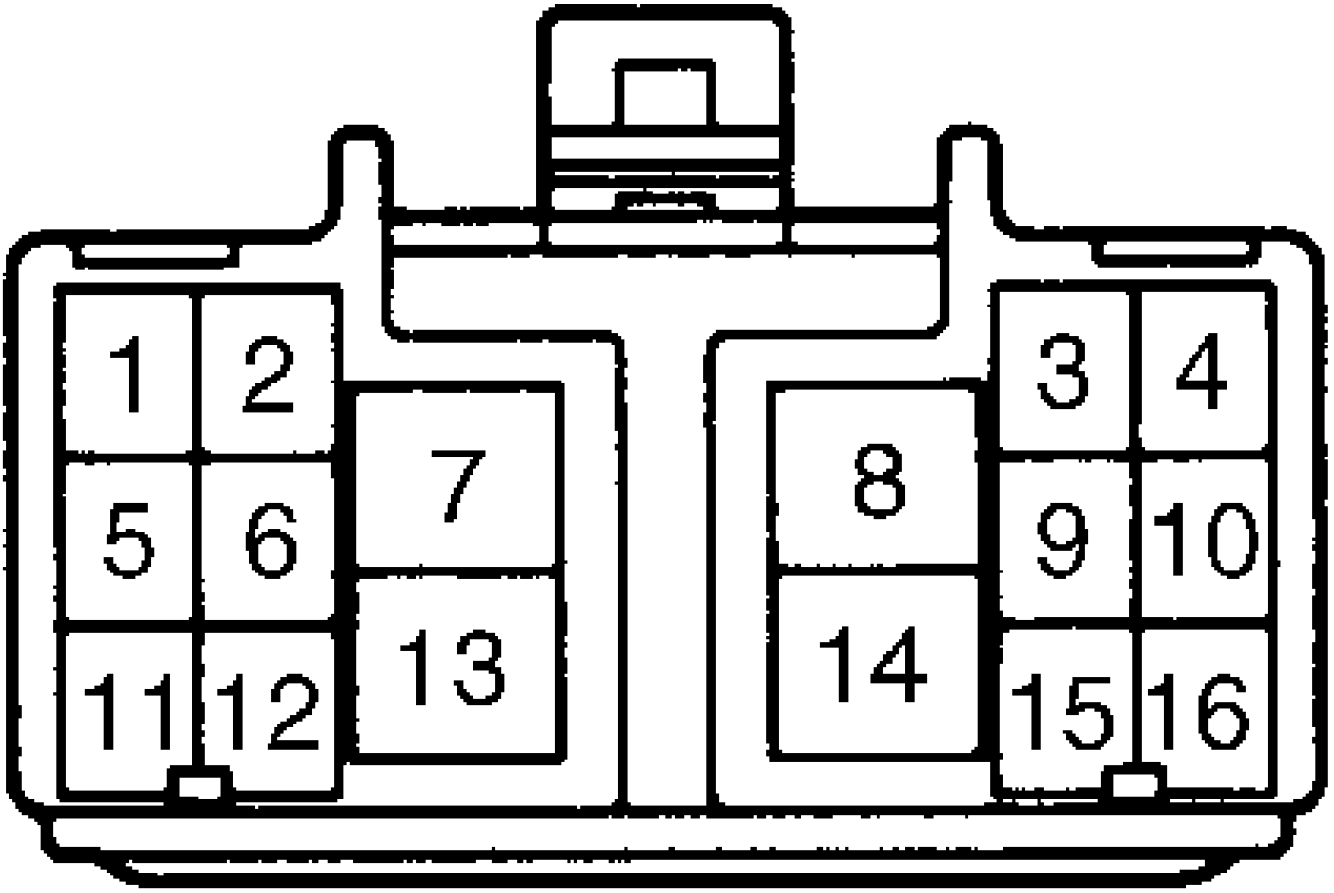


Fig. 3: Identifying Seat Switch Connector Terminals (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

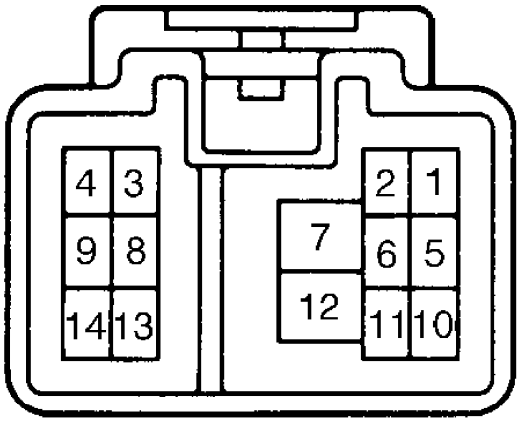


Fig. 4: Identifying Seat Switch Connector Terminals (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

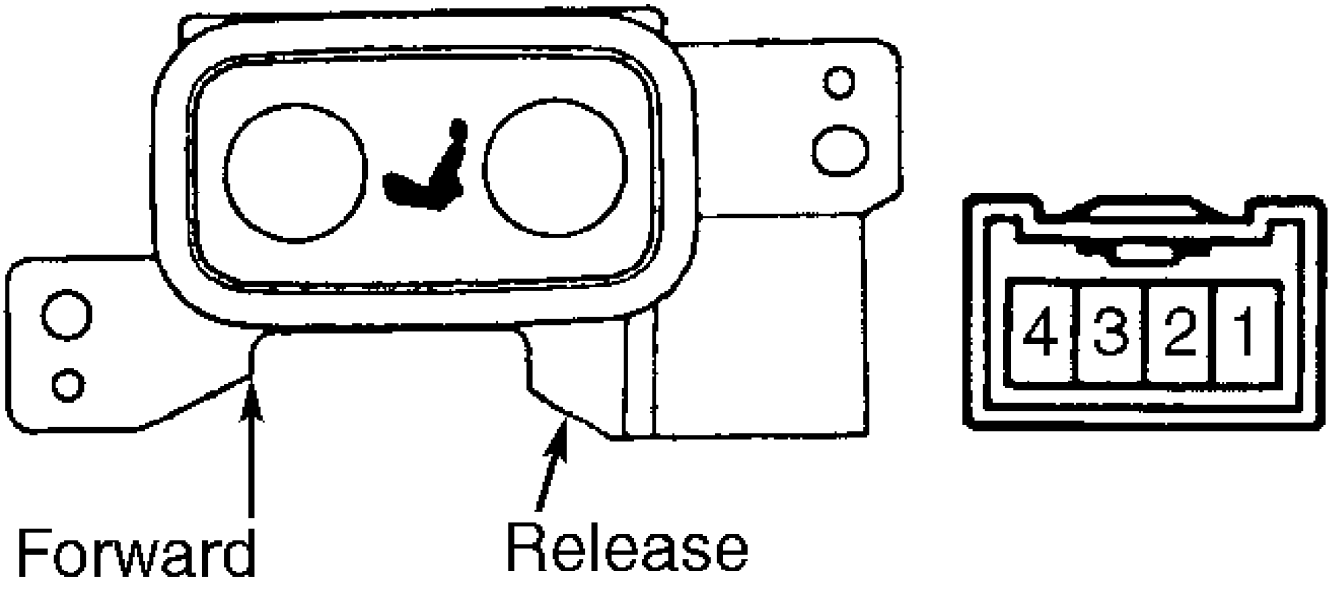


Fig. 5: Identifying Lumbar Support Switch Wiring Harness Connector Terminals (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

POWER SEAT

Removal & Installation

On GS300 and GS400, remove seat belt retractor and seat belt shoulder anchor. On all models, remove seat track covers. Remove seat track bolts. Disconnect seat harness connectors. To disassemble/assemble seat, see exploded view. See Figs. 6 and 7. To install, reverse removal procedure.

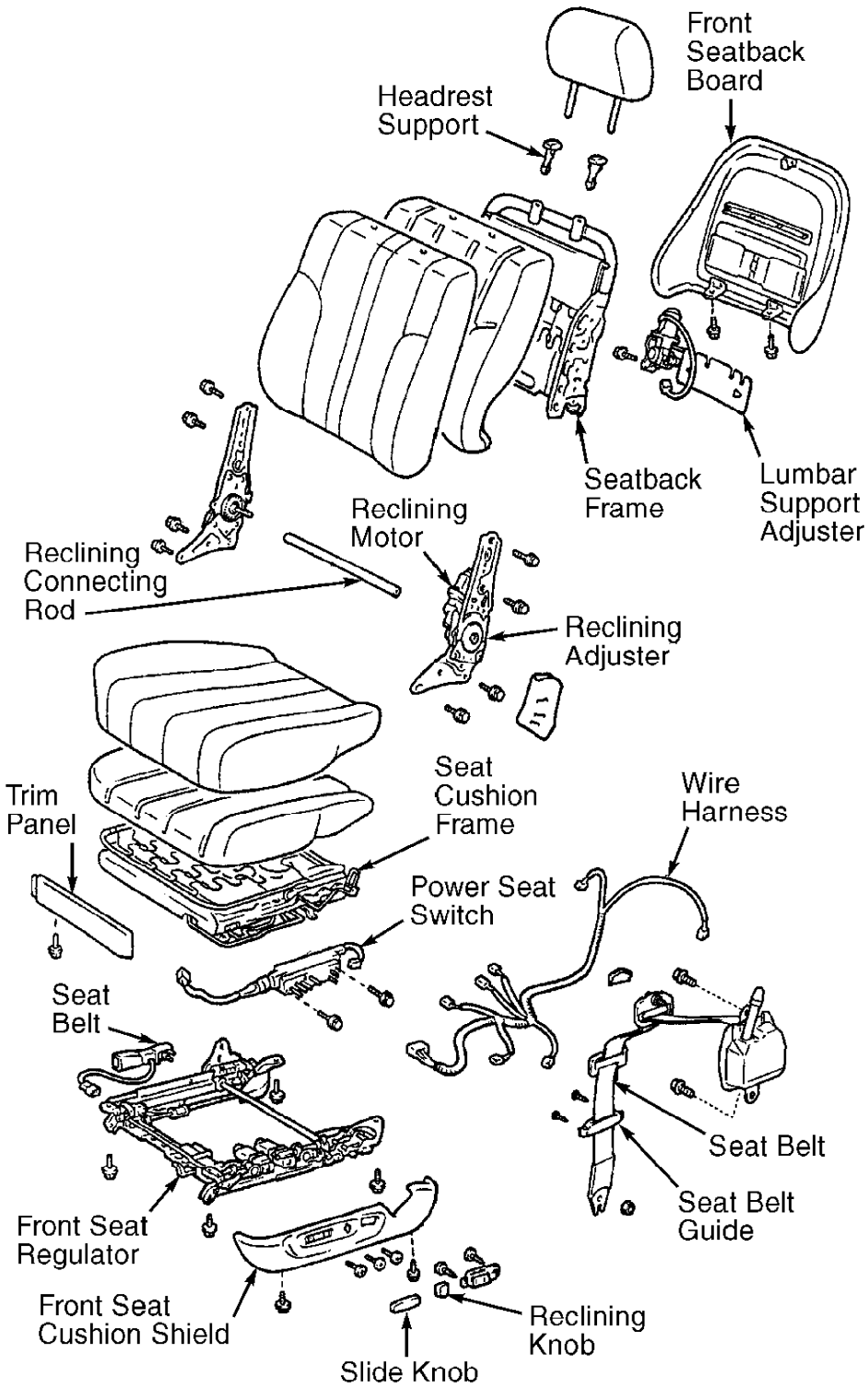


Fig. 6: Exploded View Of Power Seat (GS300 Shown; Others Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

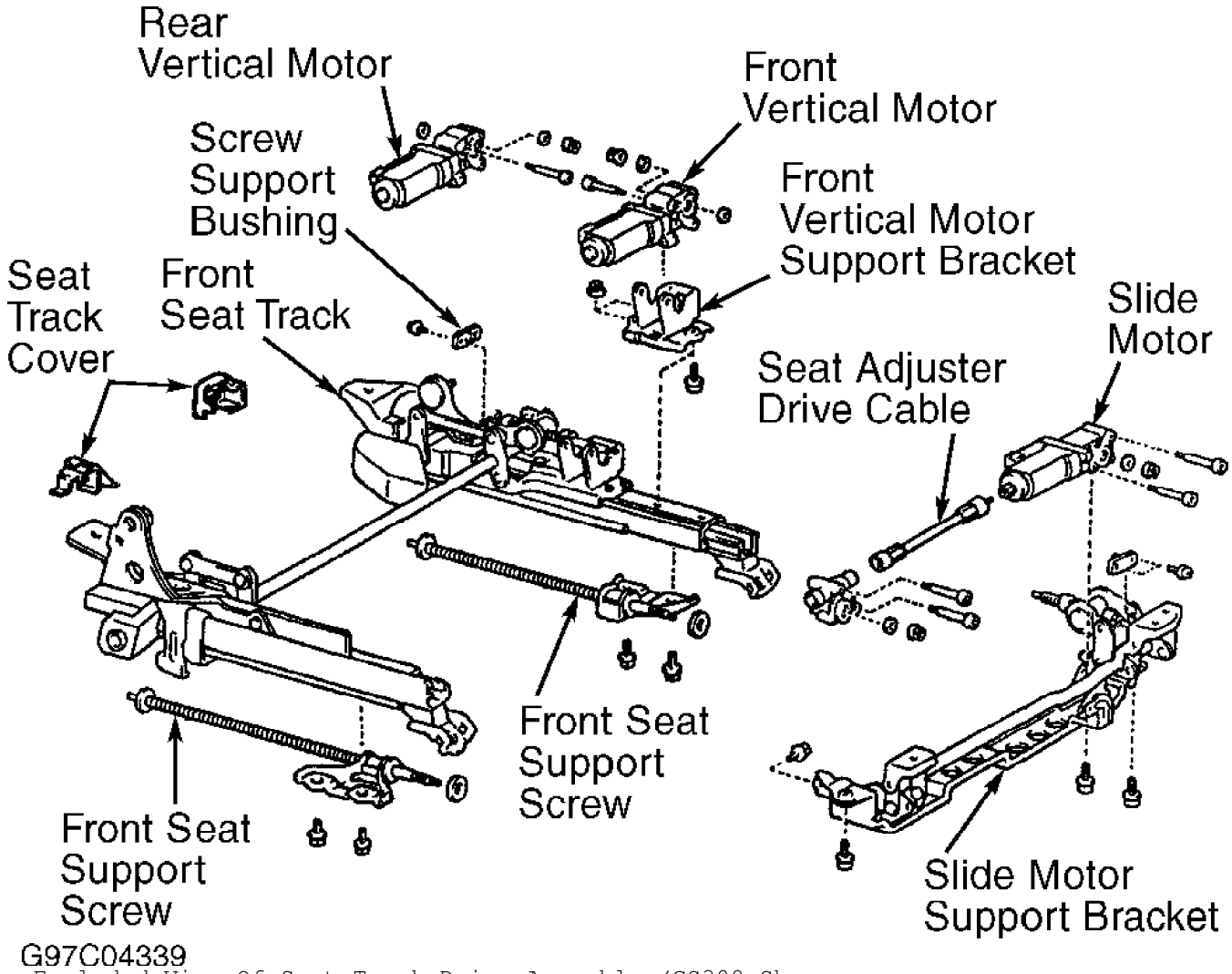


Fig. 7: Exploded View Of Seat Track Drive Assembly (GS300 Shown; Others Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WIRING DIAGRAMS

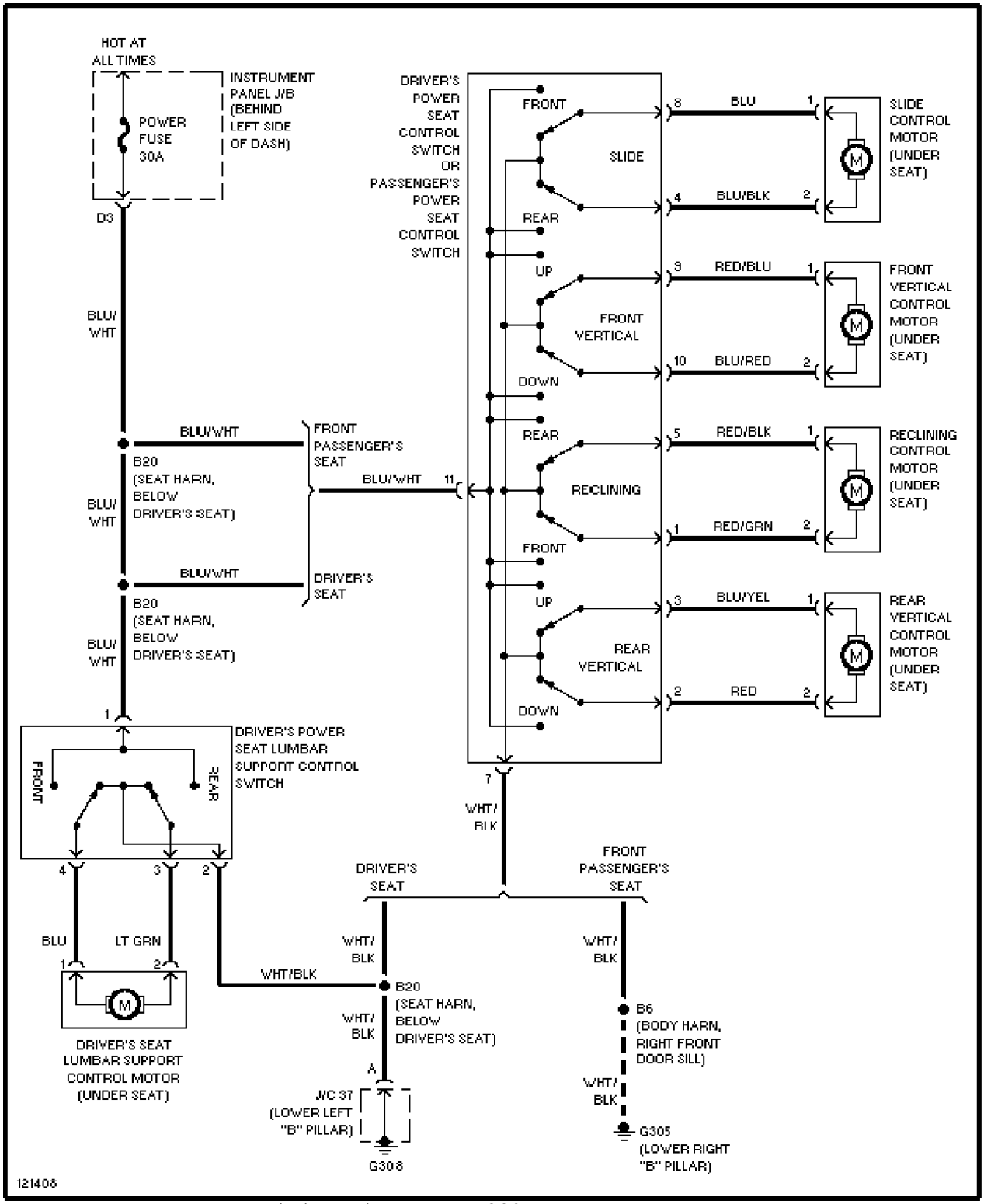


Fig. 8: Power Seat System Wiring Diagram (ES300)

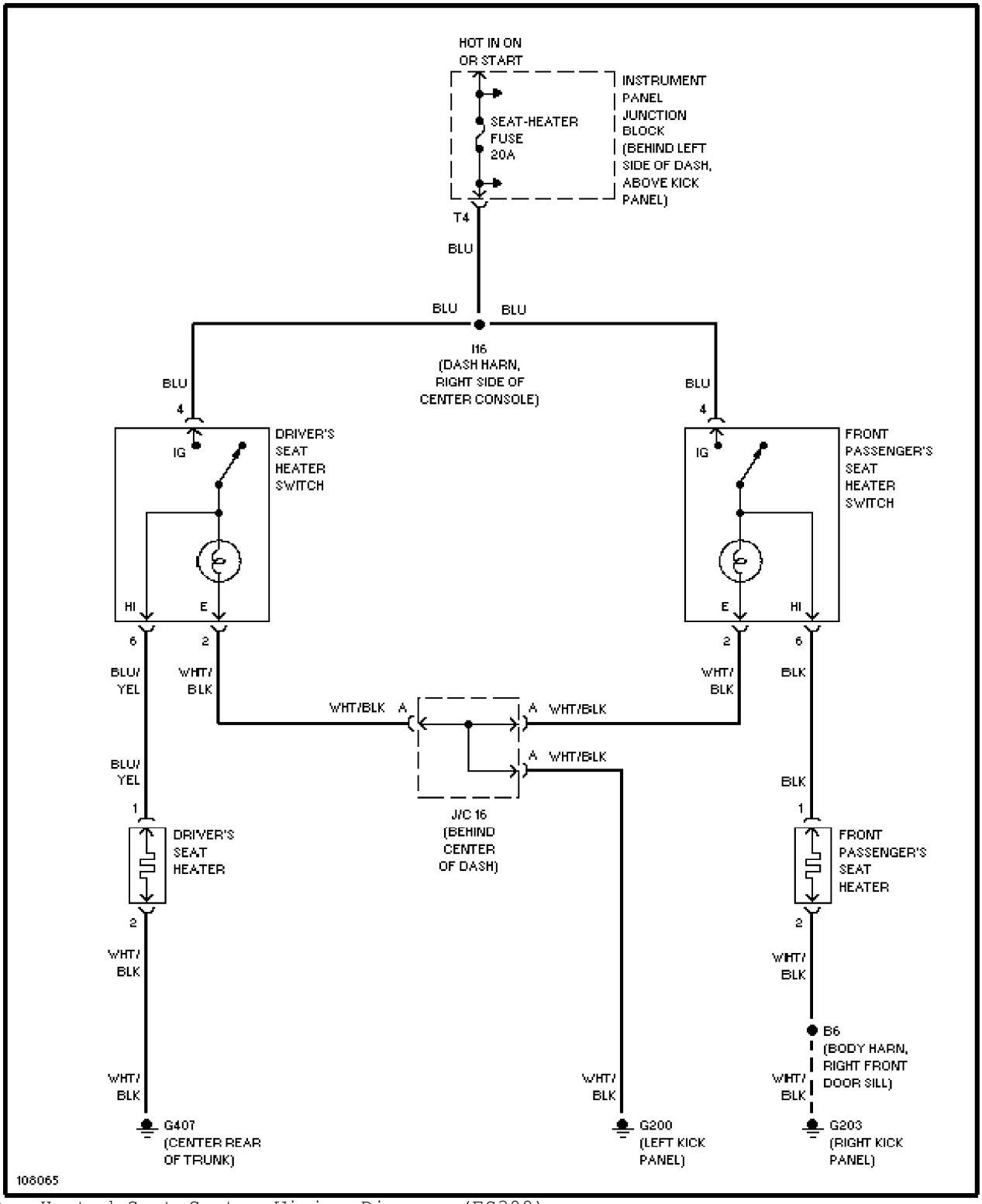


Fig. 9: Heated Seat System Wiring Diagram (ES300)

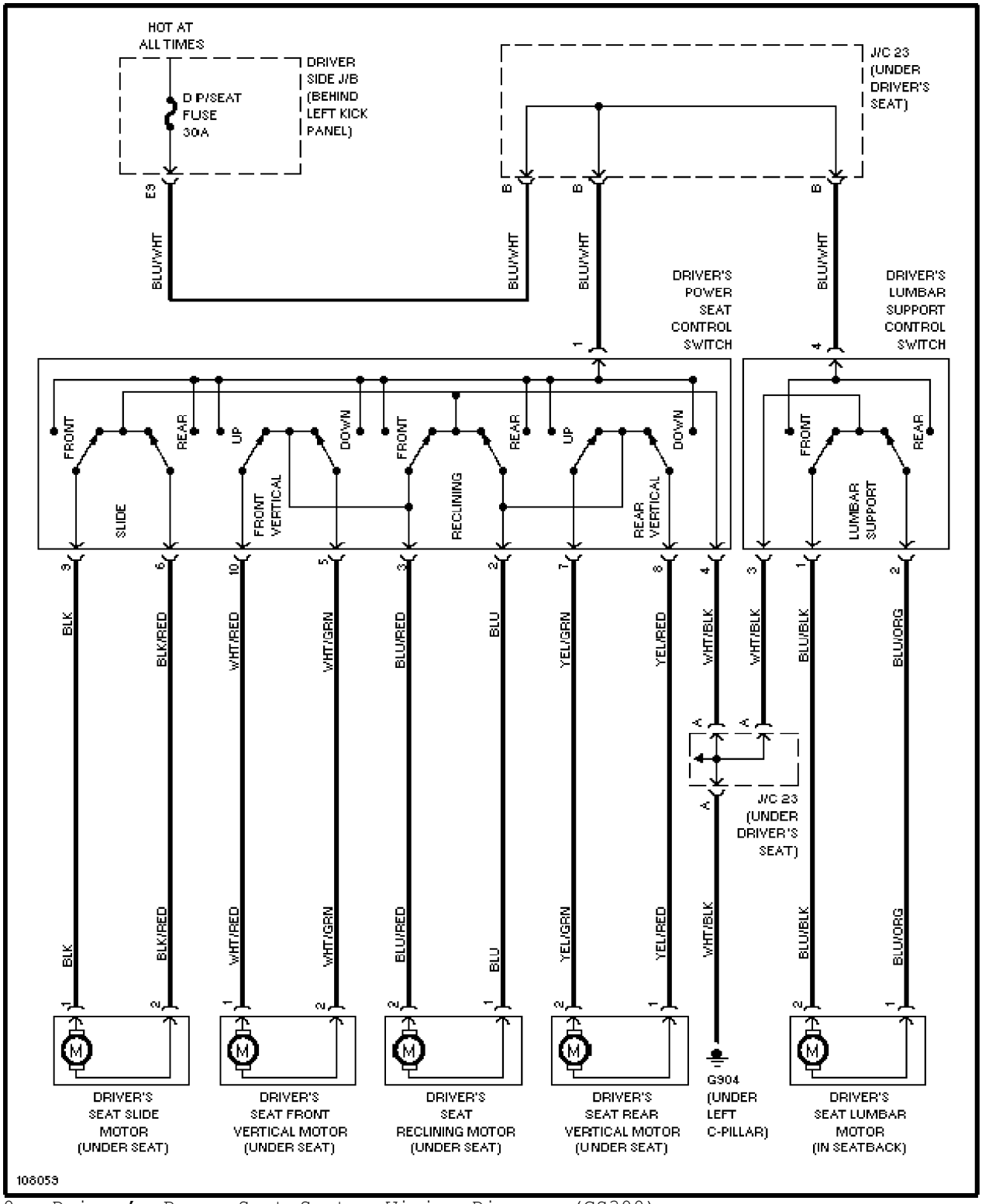


Fig. 10: Driver’s Power Seat System Wiring Diagram (GS300)

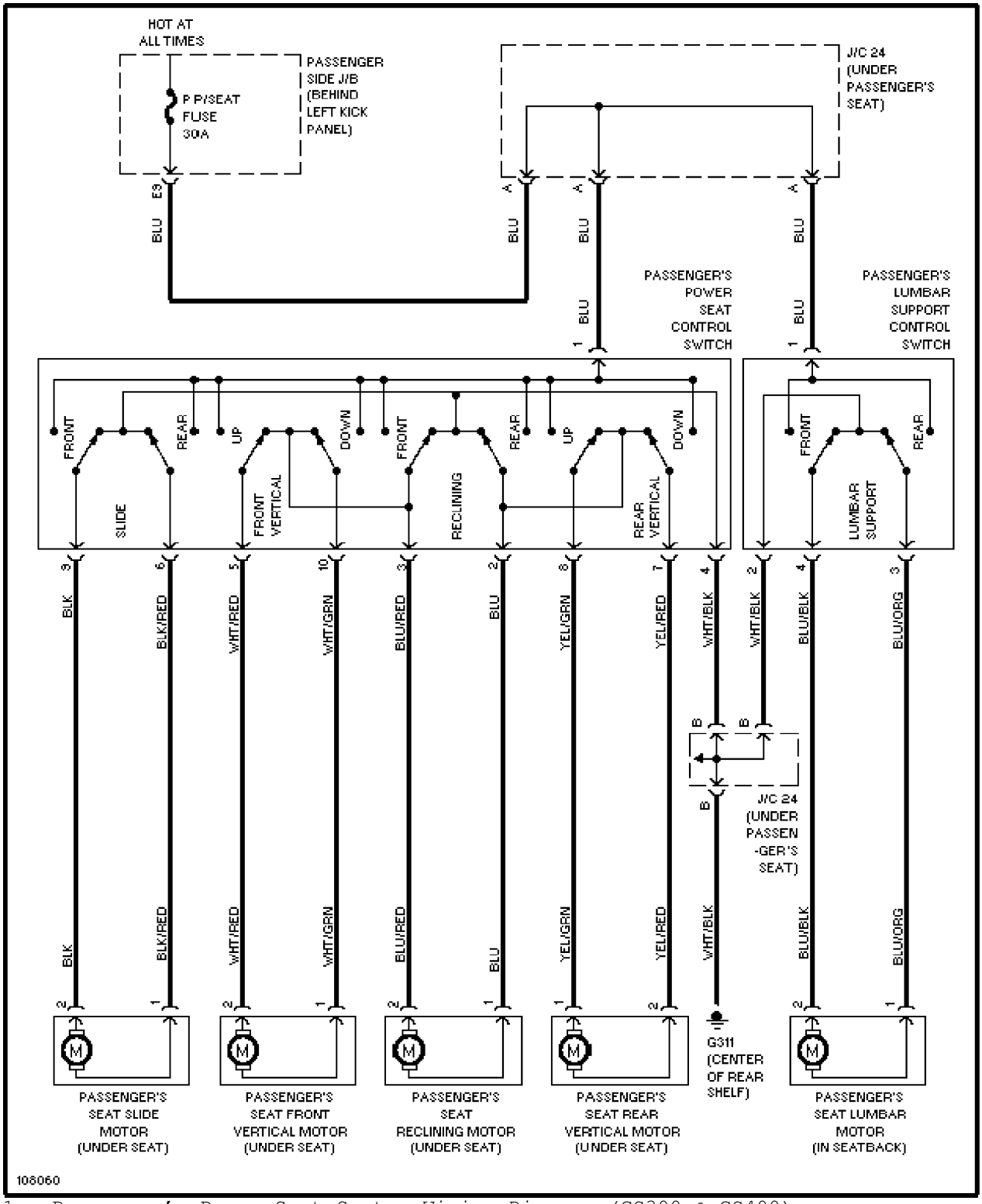


Fig. 11: Passenger’s Power Seat System Wiring Diagram (GS300 & GS400)

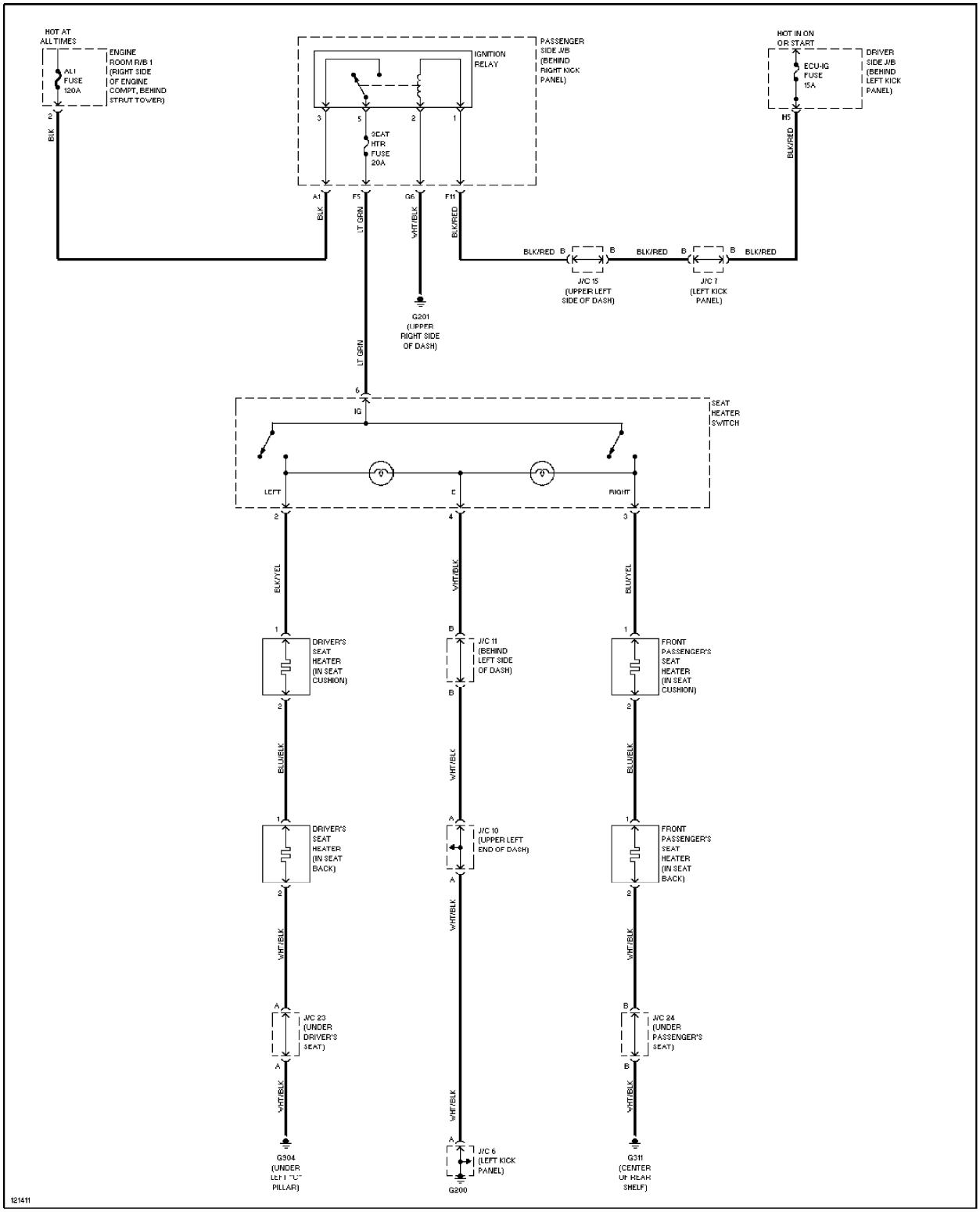


Fig. 12: Heated Seat System Wiring Diagram (GS300 & GS400)

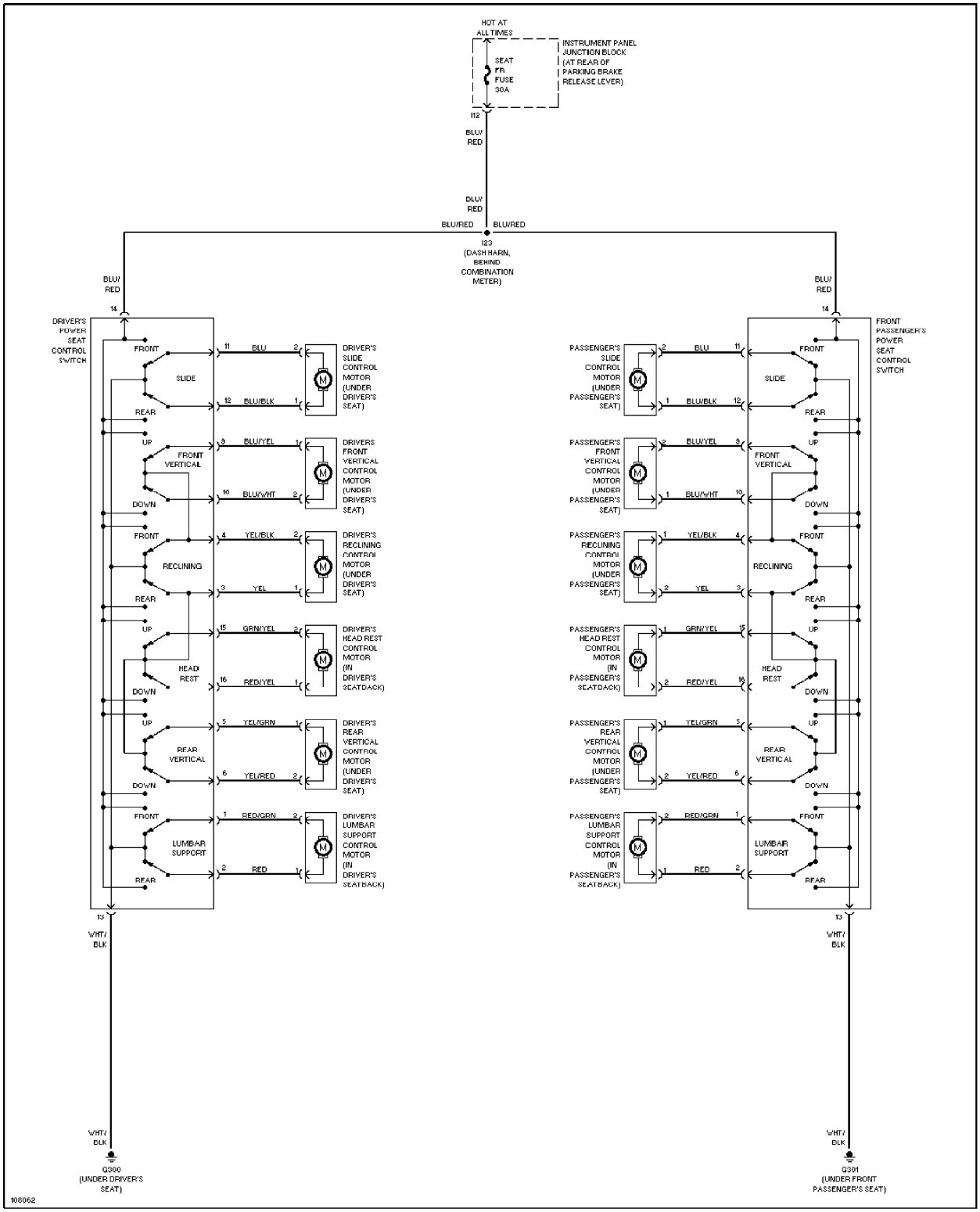


Fig. 13: Power Seat System Wiring Diagram (LS400)

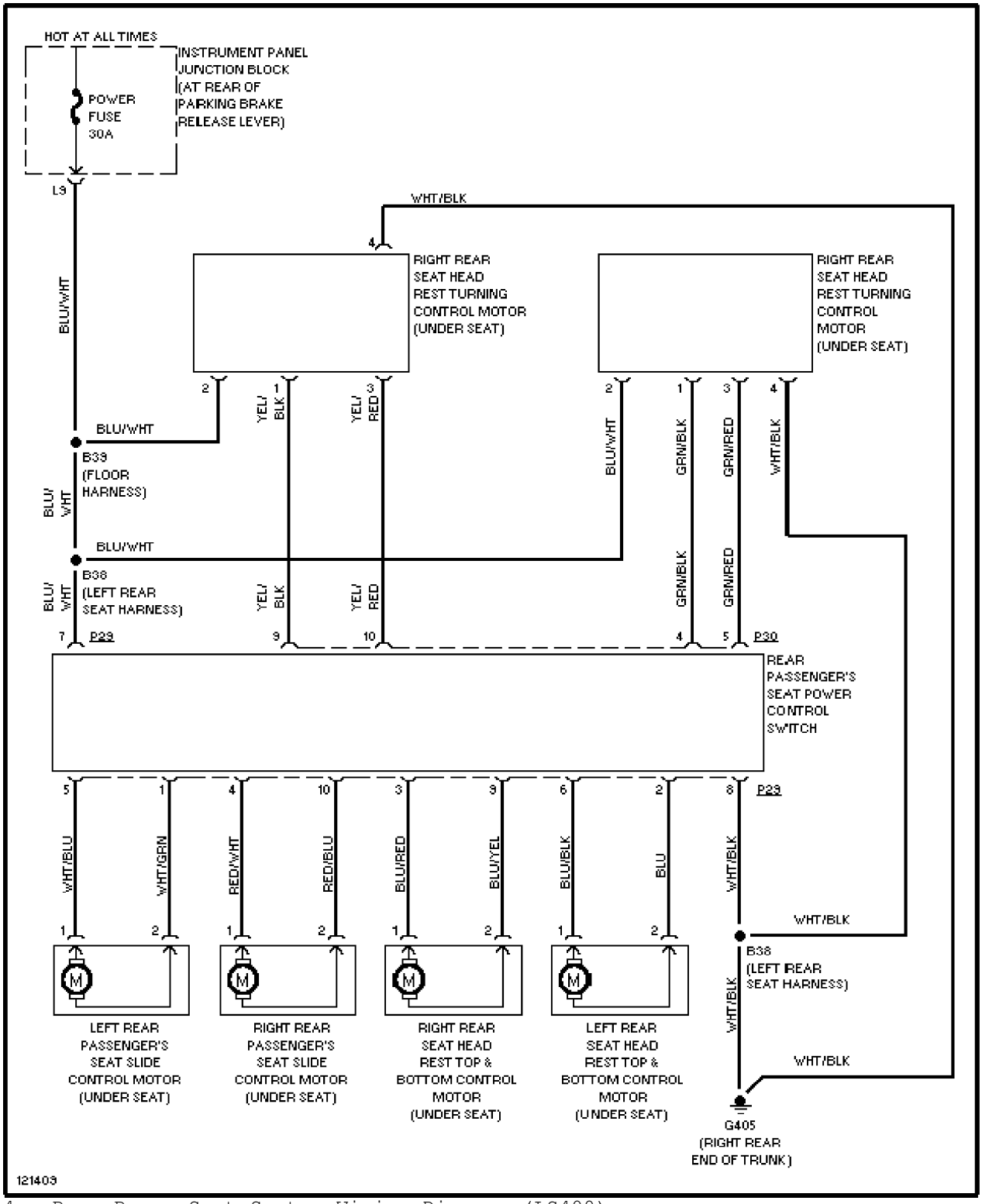


Fig. 14: Rear Power Seat System Wiring Diagram (LS400)

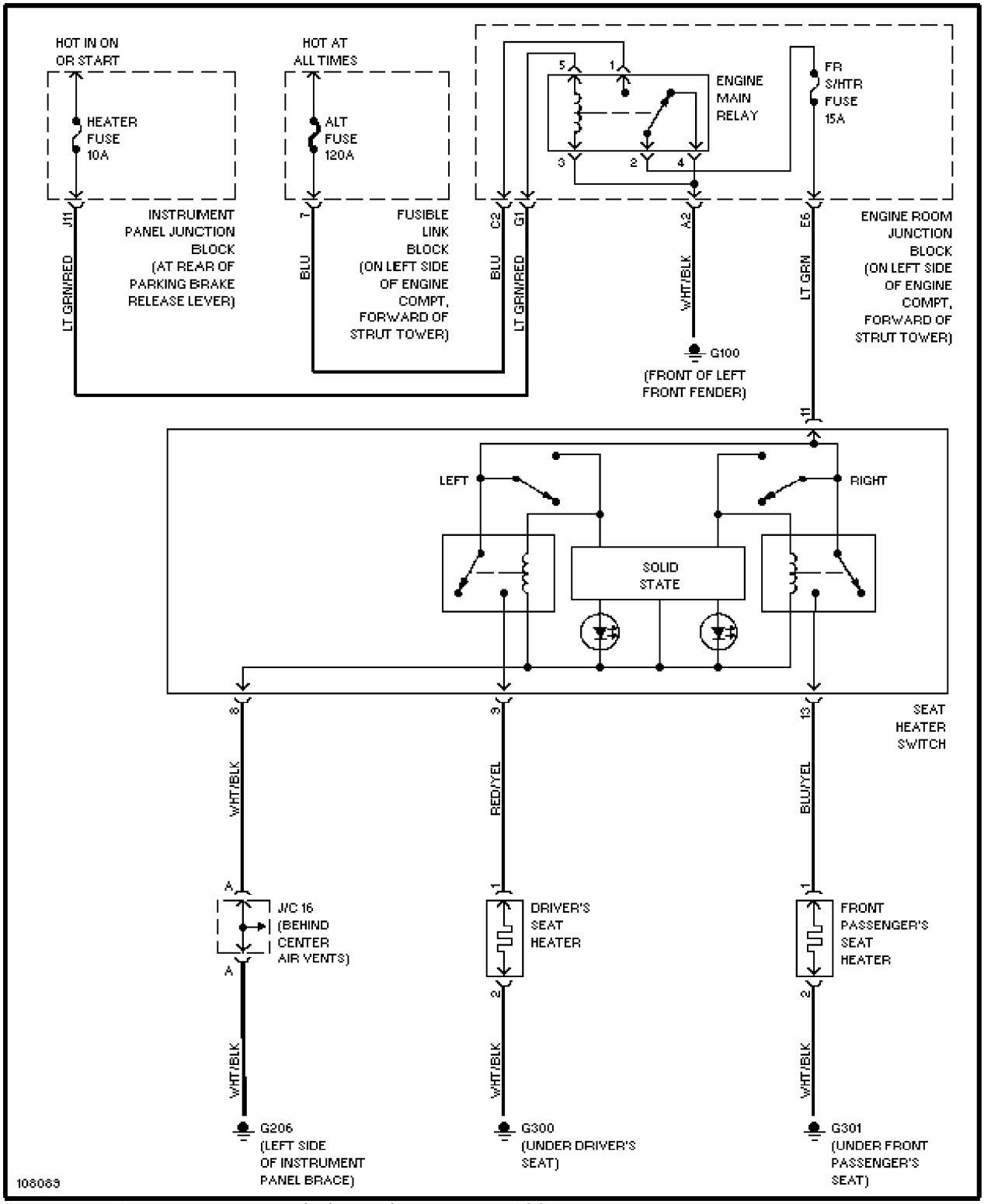


Fig. 15: Heated Seat System Wiring Diagram (LS400)

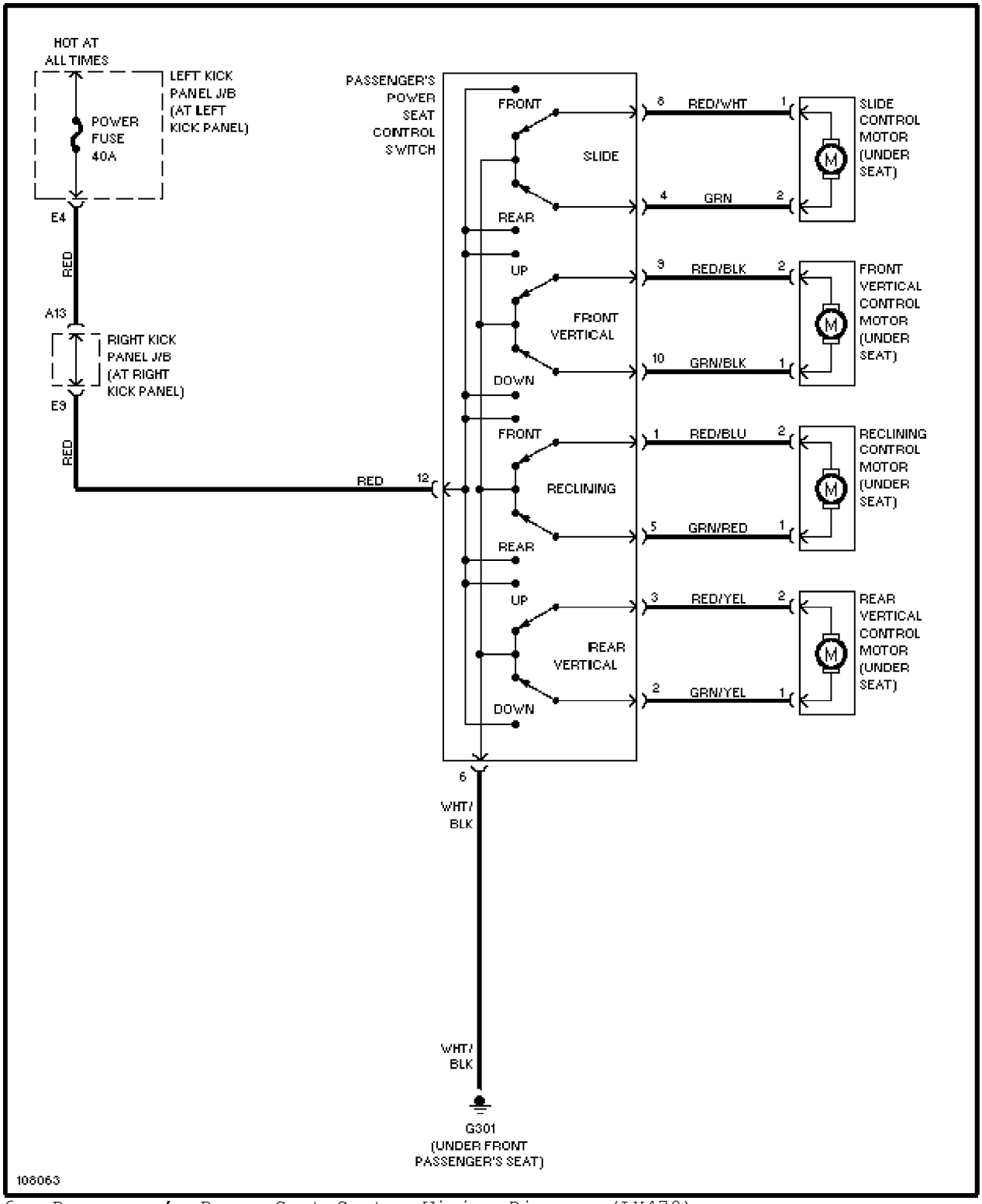


Fig. 16: Passenger's Power Seat System Wiring Diagram (LX470)

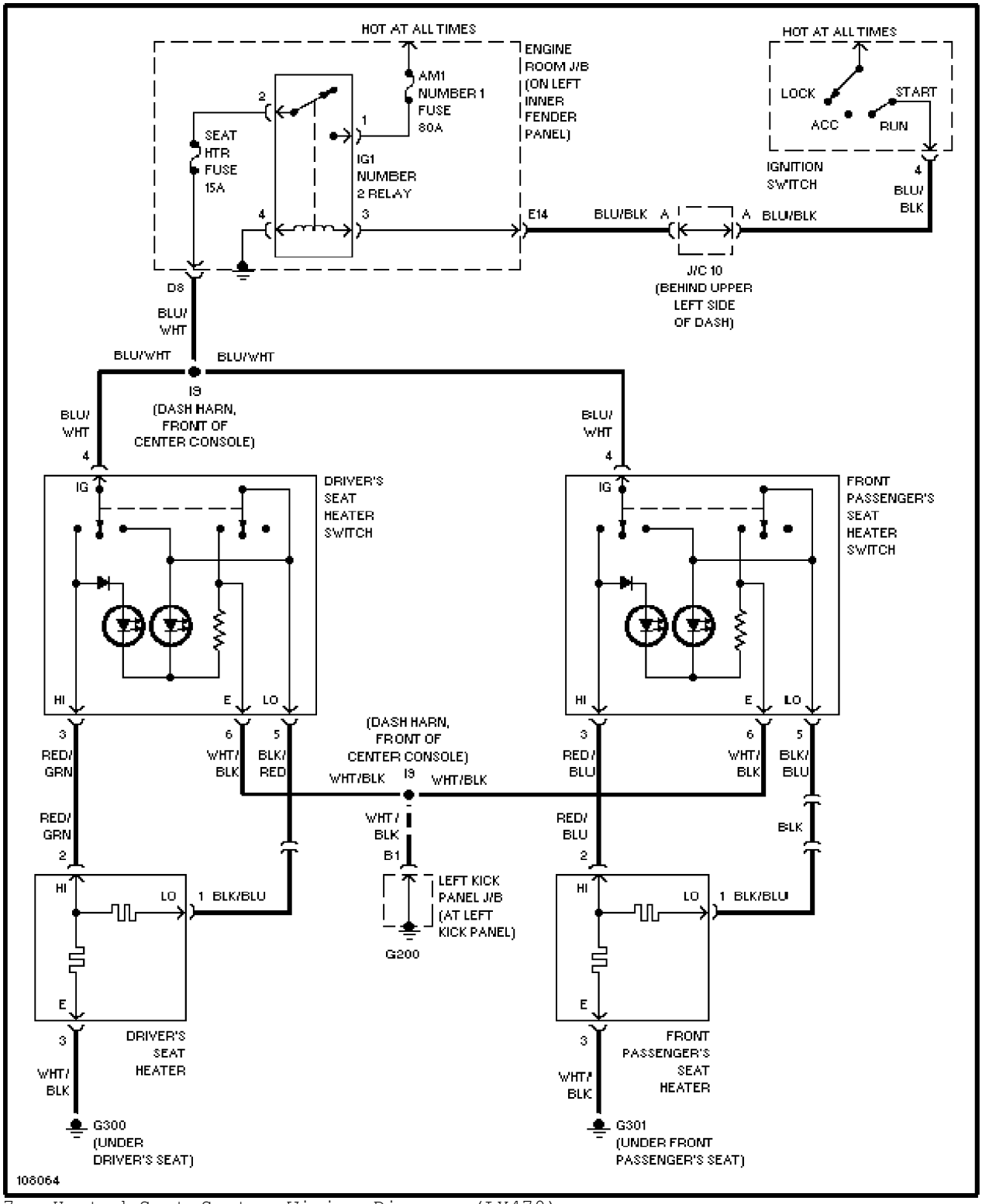


Fig. 17: Heated Seat System Wiring Diagram (LX470)

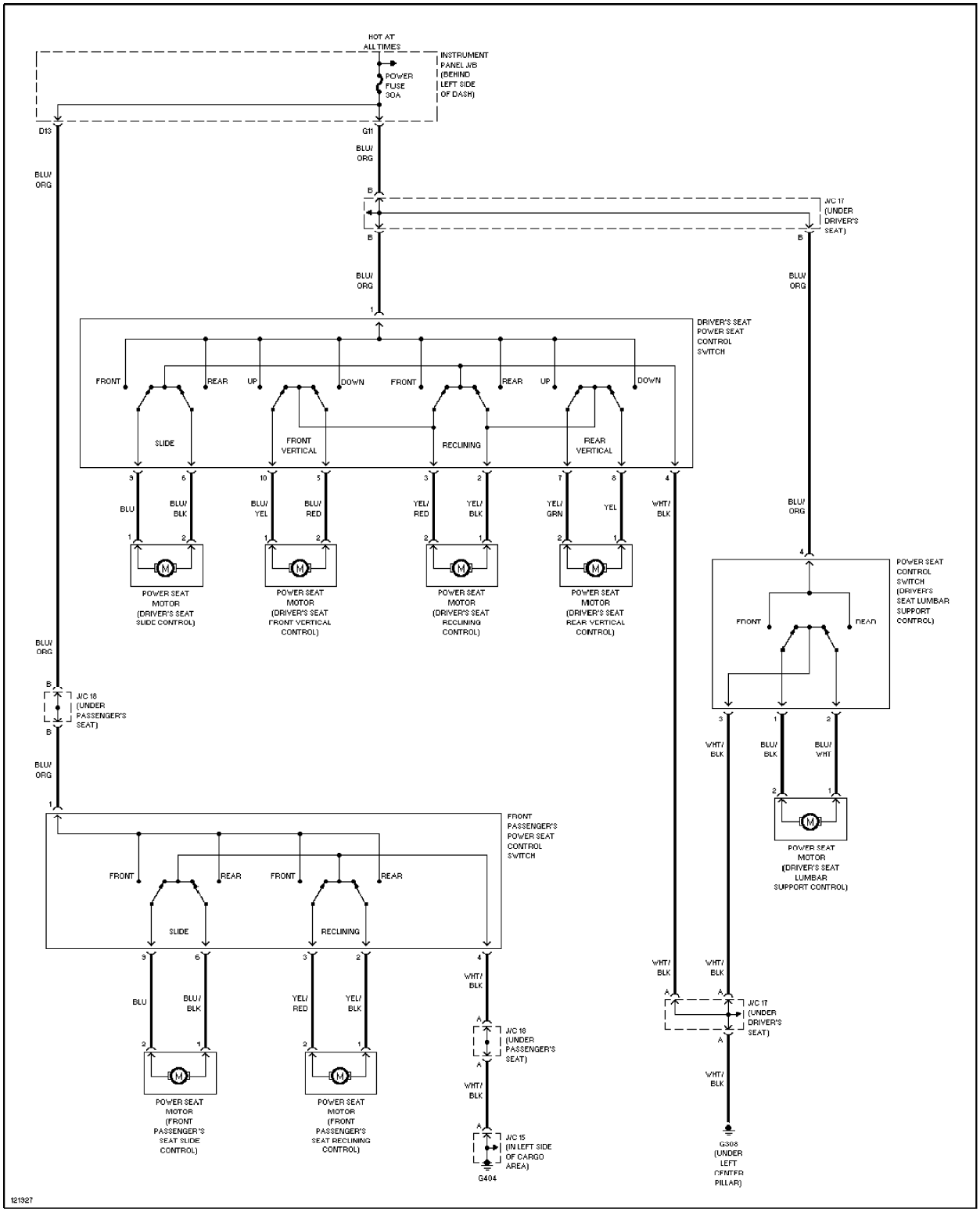


Fig. 18: Power Seat System Wiring Diagram (RX300)

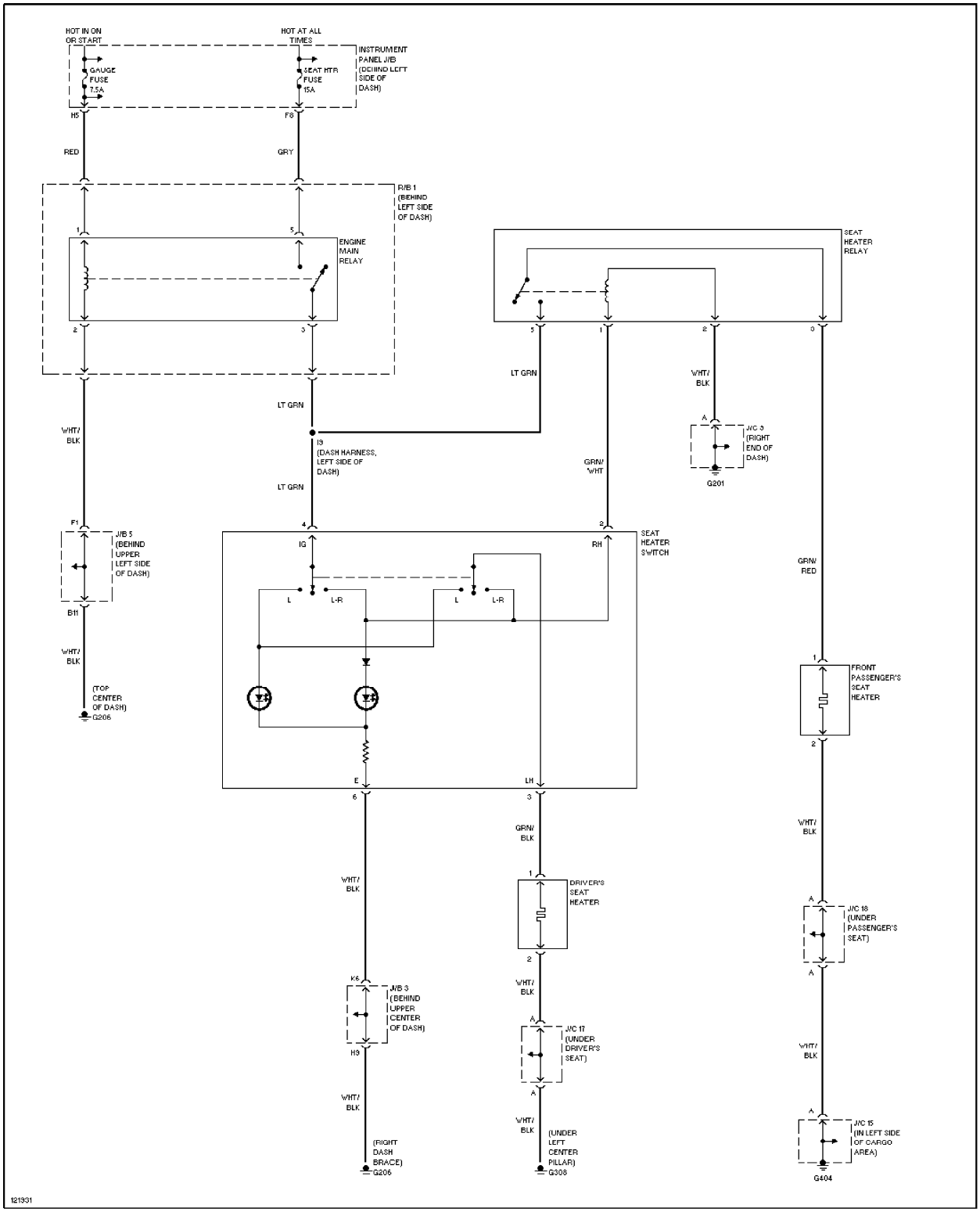


Fig. 19: Heated Seat System Wiring Diagram (RX300)

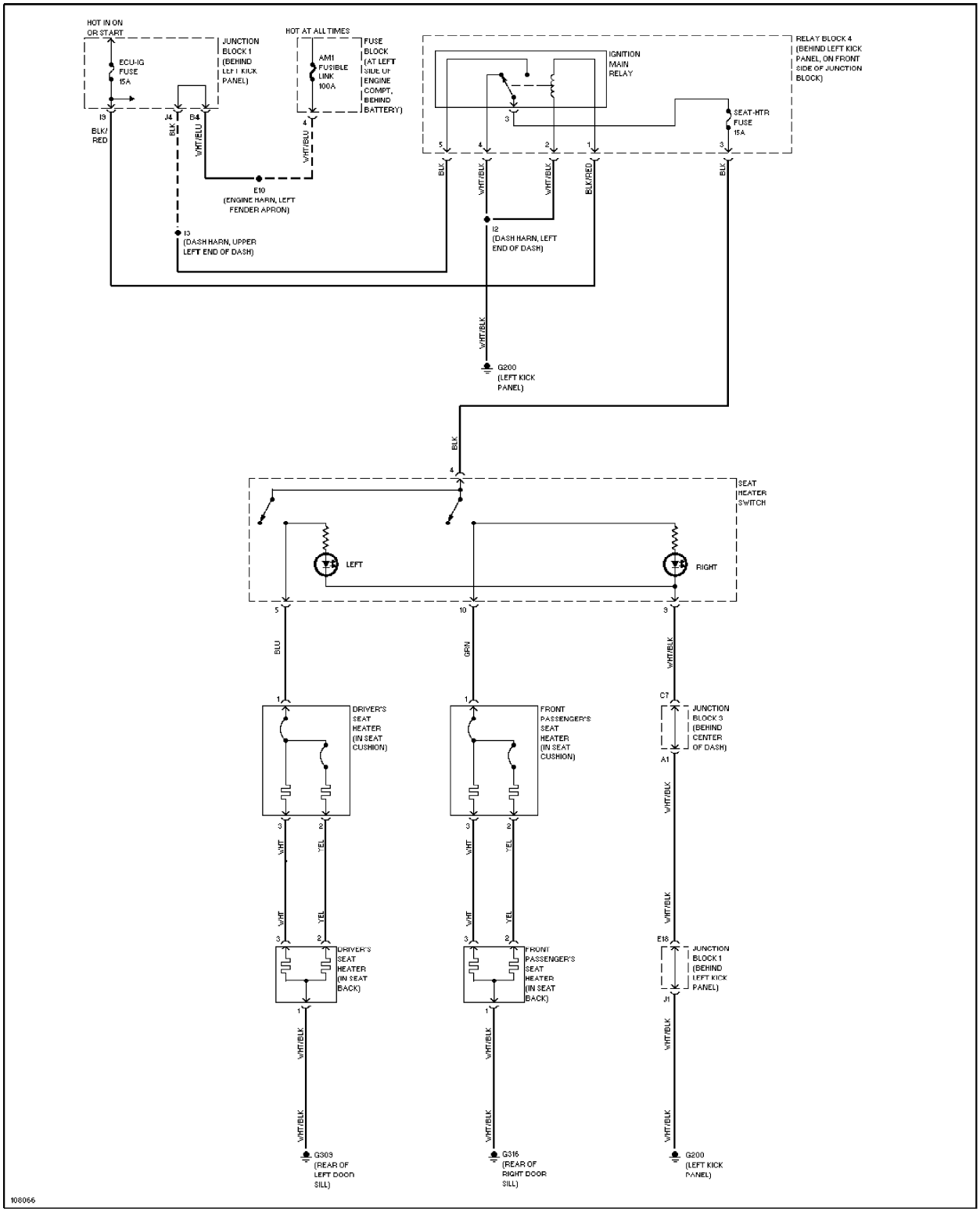


Fig. 20: Heated Seat System Wiring Diagram (SC300 & SC400)

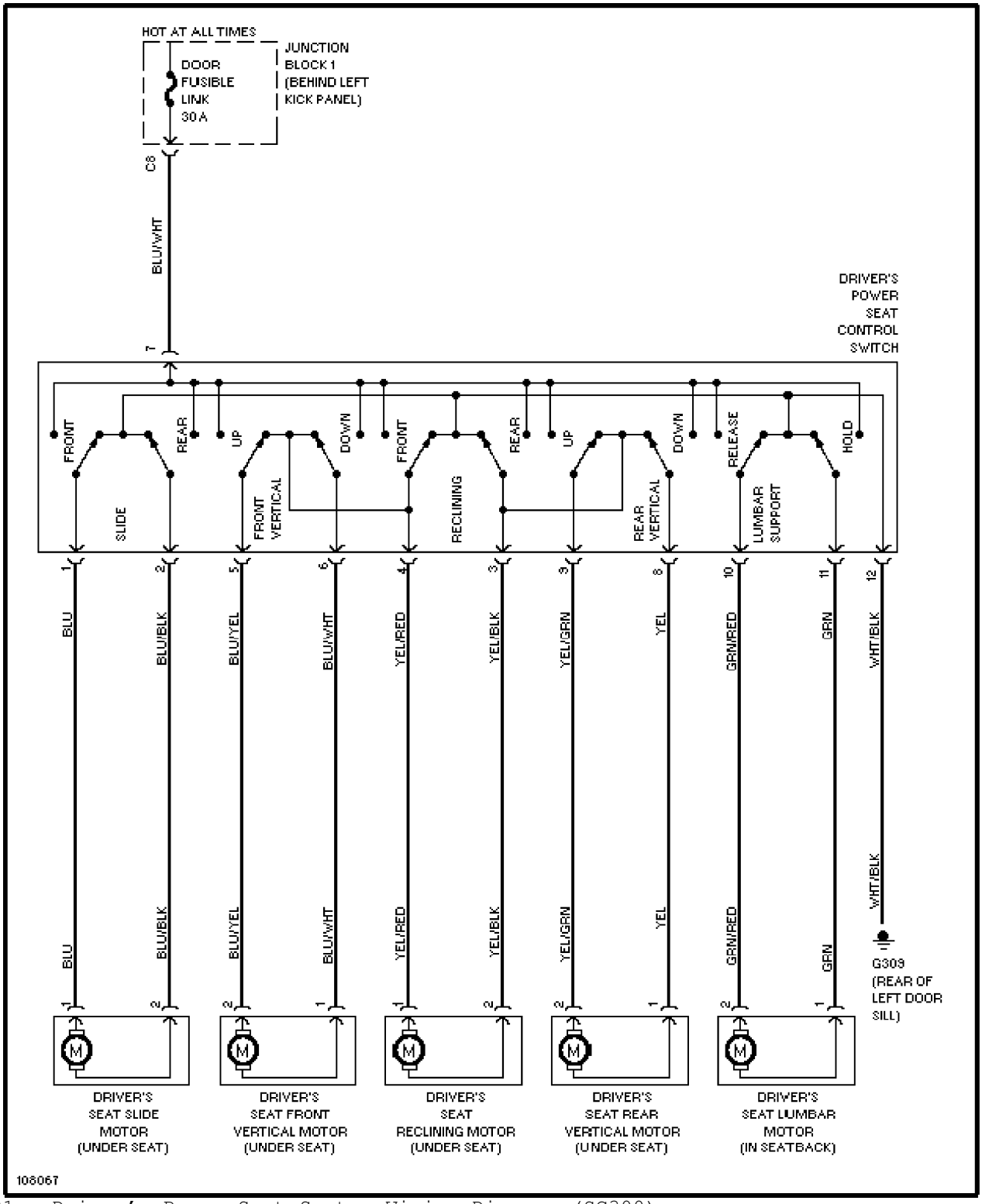


Fig. 21: Driver’s Power Seat System Wiring Diagram (SC300)

SHIFT INTERLOCK SYSTEM

1999 Lexus RX 300

1999 AUTOMATIC TRANSMISSIONS
Toyota & Lexus Shift Lock System

Chevrolet; Prizm
Lexus; ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400
Toyota; Avalon, Camry, Camry Solara, Celica, Corolla, Land Cruiser, Rav4, Sienna, Tacoma, 4Runner

DESCRIPTION

Transmission/transaxle is equipped with a electronically controlled shift lock and key lock system. See Fig. 1. Shift lock system prevents shift lever from being moved from Park unless brake pedal is depressed. In case of a malfunction, shift lever can be released by depressing shift lock override button, located near shift lever. Key lock system prevents ignition key from being moved from ACC to LOCK position on ignition switch unless shift lever is in Park.

System consists of brakelight switch, key interlock solenoid, shift lock control switch, shift lock control Electronic Control Unit (ECU), shift lock solenoid and shift lock release button. All models may not be equipped with all components. See Fig. 1.

NOTE: Sienna is equipped with cable operated shift lock system. See CABLE OPERATED SHIFT LOCK SYSTEM CHECK and ADJUSTMENTS.

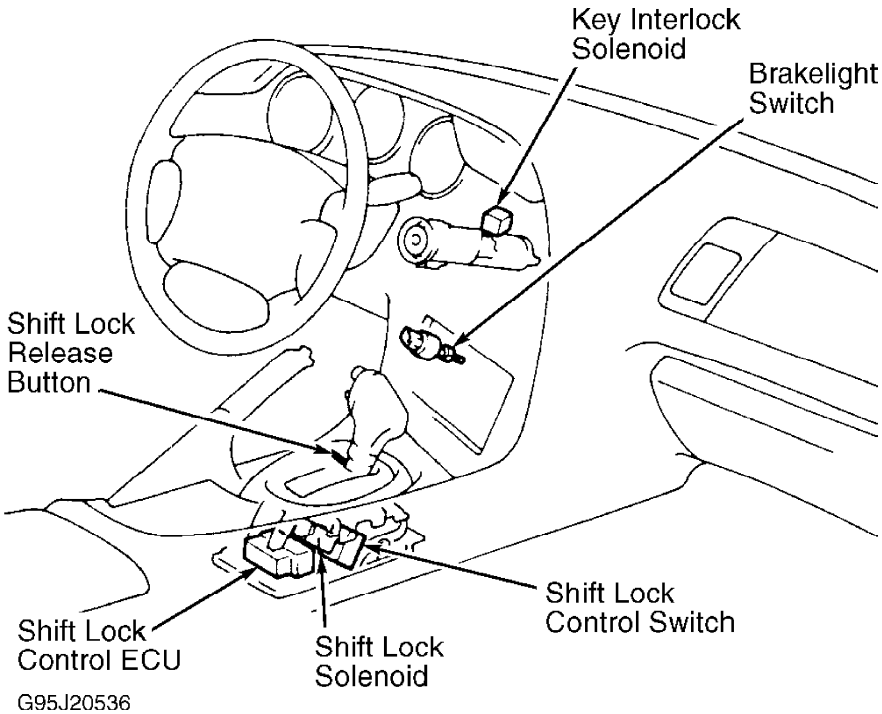


Fig. 1: Shift & Key Lock System Component Locations (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

OPERATION

SHIFT LOCK SYSTEM

With ignition on, when brake pedal is depressed, an input signal is sent from brakelight switch to ECU. With shift lever in Park, an input signal from shift control switch is input to ECU, indicating shift lever is in Park. ECU then operates shift lock solenoid, so shift lever can be moved from Park.

KEY LOCK SYSTEM

With ignition in ON or ACC position and shift lever in Park, shift lock control switch opens and voltage from ECU to key interlock solenoid is turned off. When key interlock solenoid is turned off, ignition key can be turned from ACC to LOCK position on ignition switch.

COMPONENT TESTS

* PLEASE READ THIS FIRST *

NOTE: If ignition is left in ACC or ON position with shift lever in any gear range except Park for about one hour, ECU then operates to release lock mechanism.

ELECTRONIC CONTROL UNIT (ECU)

Access ECU. See Fig. 1. ECU is under center console, in front or back of shifter. Turn ignition on. Backprobing ECU harness connector with DVOM, check voltage between designated terminals. Voltage should be as specified. See appropriate SHIFT LOCK SYSTEM PIN VOLTAGES table. For circuit identification, see appropriate wiring diagram in WIRING DIAGRAMS.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (AVALON, CAMRY, CAMRY SOLARA, COROLLA, ES300, PRIZM & RX300)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	0
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	7.5-11.5
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6-9
Shift Lock Solenoid		
SLS+ - GND	Ignition Switch In ACC, Shifter In "P" Position	0
SLS+ - GND	Depress Brake Pedal	8-13.5
SLS+ - GND	Ignition Switch In ACC, Shifter Not In "P" Position	0

Application & Terminals	Description	Voltage
Shift Lock Control Switch		
P1 - P	Ignition Switch ON, Shifter In "P" Position, Depress Brake Pedal	0
P1 - P	Ignition Switch In ON, Shifter Not In "P" Position	9-13.5
P2 - P	Ignition Switch In ACC, Shifter In "P" Position	9-13.5

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (CELICA, LAND CRUISER, LX470 & TACOMA)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	0
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	10-14
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6-9
Shift Lock Solenoid		
SLS+ - SLS-	Ignition Switch In ACC, Shifter In "P" Position	0
SLS+ - SLS-	Depress Brake Pedal	8-13.5
SLS+ - SLS-	Depress Brake Pedal, (After 20 Seconds)	5.5-9.5
SLS+ - SLS-	Ignition Switch In ACC, Shifter Not In "P" Position	0
Shift Lock Control Switch		
P1 - P	Ignition Switch In ON Position, Shifter In "P" Position, Depress Brake Pedal	0
P1 - P	Ignition Switch In ON, Shifter Not In "P" Position	9-13.5
P2 - P	Ignition Switch In ACC, Shifter In "P" Position	9-13.5
P2 - P	Ignition Switch In ACC, Shifter Not In "P" Position	0

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (GS300 & GS400)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
ACC - GND	Ignition Switch In ON Position	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	0
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6-9
SLS+ - GND	Ignition Switch In ON, Shifter In "P" Position	0
SLS+ - GND	Ignition Switch In ON, Depress Brake Pedal	3-6
SLS+ - GND	Ignition Switch In ON, Release Brake Pedal	0
SLS+ - GND	Ignition Switch In ACC, Shifter Not In "P" Position	3-6
P1 - GND	Shifter In "P" Position	0
P1 - GND	Shifter Not In "P" Position	10-14

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (LS400)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	1.5 Or Less
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	8.5-10.5
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	7-8.5
Shift Lock Solenoid		
SLS+ - SLS-	Ignition Switch In ACC, Shifter In "P" Position	0
SLS+ - SLS-	Depress Brake Pedal	8.8-12.5
SLS+ - SLS-	Depress Brake Pedal, (After 20 Seconds)	6.5-9.2
SLS+ - SLS-	Ignition Switch In ACC, Shifter Not In "P" Position	0
Shift Lock Control Switch		
P1 - P	Ignition Switch In ON Position, Shifter In "P" Position, Depress	

	Brake Pedal	0
P1 - P	Ignition Switch In ON, Shifter Not In "P" Position	10-14
P2 - P	Ignition Switch In ACC, Shifter In "P" Position	10-14
P2 - P	Ignition Switch In ACC, Shifter Not In "P" Position	0

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (RAV4)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	0
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	8-13.5
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6-8.5
Shift Lock Solenoid		
SLS+ - GND	Ignition Switch In ACC, Shifter In "P" Position	0
SLS+ - GND	Depress Brake Pedal	8-14
SLS+ - GND	Ignition Switch In ACC, Shifter Not In "P" Position	0
Shift Lock Control Switch		
P1 - P	Ignition Switch In ON Position, Shifter In "P" Position, Depress Brake Pedal	0
P1 - P	Ignition Switch In ON, Shifter Not In "P" Position	10-14
P2 - P	Ignition Switch In ACC, Shifter In "P" Position	10-14

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (SC300 & SC400)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC	

	Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	1.5 Or Less
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	8.5-10.5
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6.5-8.5
Shift Lock Solenoid		
SLS+ - SLS-	Ignition Switch In ACC, Shifter In "P" Position	0
SLS+ - SLS-	Depress Brake Pedal	8.0-12.5
SLS+ - SLS-	Depress Brake Pedal, (After 20 Seconds)	6.5-9.2
SLS+ - SLS-	Ignition Switch In ACC, Shifter Not In "P" Position	0
Shift Lock Control Switch		
P1 - P	Ignition Switch In ON Position, Shifter In "P" Position, Depress Brake Pedal	0
P1 - P	Ignition Switch In ON, Shifter Not In "P" Position	10-14
P2 - P	Ignition Switch In ACC, Shifter In "P" Position	10-14
P2 - P	Ignition Switch In ACC, Shifter Not In "P" Position	0

(1) - Voltage measurement after one second.

NOTE: Ground (GND) terminal is also referred to as "E" terminal.

SHIFT LOCK SYSTEM PIN VOLTAGES (4RUNNER)

Application & Terminals	Description	Voltage
ECU		
ACC - GND	Ignition Switch In ACC Position	10-14
IG - GND	Ignition Switch In ON Position	10-14
STP - GND	Depress Brake Pedal	10-14
KLS - GND	Ignition Switch In ACC, Shifter In "P" Position	0
KLS - GND	Ignition Switch In ACC, Shifter Not In "P" Position	7.5-11
KLS - GND	(1) Ignition Switch In ACC, Shifter Not In "P" Position	6-9.5
Shift Lock Solenoid		
SLS+ - SLS-	Ignition Switch In ACC,	

		Shifter In "P" Position	0
SLS+ - SLS-		Depress Brake Pedal	8-13.5
SLS+ - SLS-		Depress Brake Pedal (After 20 Seconds)	6-8.5
SLS+ - SLS-		Ignition Switch In ACC, Shifter Not In "P" Position	0
Shift Lock Control Switch			
P1 - P		Ignition Switch In ON Position, Shifter In "P" Position, Depress Brake Pedal	0
P1 - P		Ignition Switch In ON, Shifter Not In "P" Position	9-13.5
P2 - P		Ignition Switch In ACC, Shifter In "P" Position	9-13.5
P2 - P		Ignition Switch In ACC, Shifter Not In "P" Position	0

(1) - Voltage measurement after one second.

SHIFT LOCK SOLENOID

1) Disconnect electrical connector from shift lock solenoid. Using ohmmeter, measure resistance between shift lock solenoid terminals. See WIRING DIAGRAMS.

2) Replace shift lock solenoid if resistance is not within specification. See SHIFT LOCK SOLENOID RESISTANCE SPECIFICATIONS table. Apply battery voltage between shift lock solenoid terminals. Replace shift lock solenoid if operating sound cannot be heard.

SHIFT LOCK SOLENOID RESISTANCE SPECIFICATIONS

Application	Ohms
Avalon, Camry, Camry Solara & Tacoma (A43D)	30-35
Celica, Corolla, GS300, GS400, Prizm & 4Runner	21-27
ES300 & RX300	29-36
Land Cruiser, LS400, LX470, SC300, SC400 & Tacoma (A-340E/F)	20-28
RAV4	26-33

KEY INTERLOCK SOLENOID

1) Disconnect electrical connector from key interlock solenoid. Using ohmmeter, measure resistance between key interlock solenoid terminals. See WIRING DIAGRAMS.

2) Replace key interlock solenoid if resistance is not 12-17 ohms. Apply battery voltage between of key interlock solenoid terminals. Replace key interlock solenoid if operating sound cannot be heard.

SHIFT LOCK CONTROL SWITCH

Disconnect electrical connector from shift lock control switch. Using ohmmeter, check continuity between specified terminals in relation to shift lever. See WIRING DIAGRAMS. See SHIFT LOCK CONTROL SWITCH CONTINUITY table. Replace switch if continuity is not as specified.

NOTE: Continuity must be checked in accordance with position of release button on shift lever and shift lever position.

SHIFT LOCK CONTROL SWITCH CONTINUITY

Shift Lever Position & Condition	Terminals
Any Other Gear Except Park	P & P2
Park & Release Button Not Pushed	P & P1
Park & Release Button Is Pushed	P & P1 Or P & P2

CABLE OPERATED SHIFT LOCK SYSTEM CHECK

Sienna

Ensure shift lock cable does not interfere with wiring harness. Ensure ignition switch turns to LOCK position when shift lever is in "P" position. Ensure brake pedal returns fully. Ensure shift lock is released when brake pedal is depressed with ignition switch at ACC, ON or START position.

ADJUSTMENTS

PARKING LOCK CABLE

Sienna

Place shift lever in "P" position. Turn ignition switch to LOCK position. Loosen 2 bolts and ensure pedal button touches pedal plate cushion. Tighten 2 bolts to 97 INCH lbs. (11 N.m).

WIRING DIAGRAMS

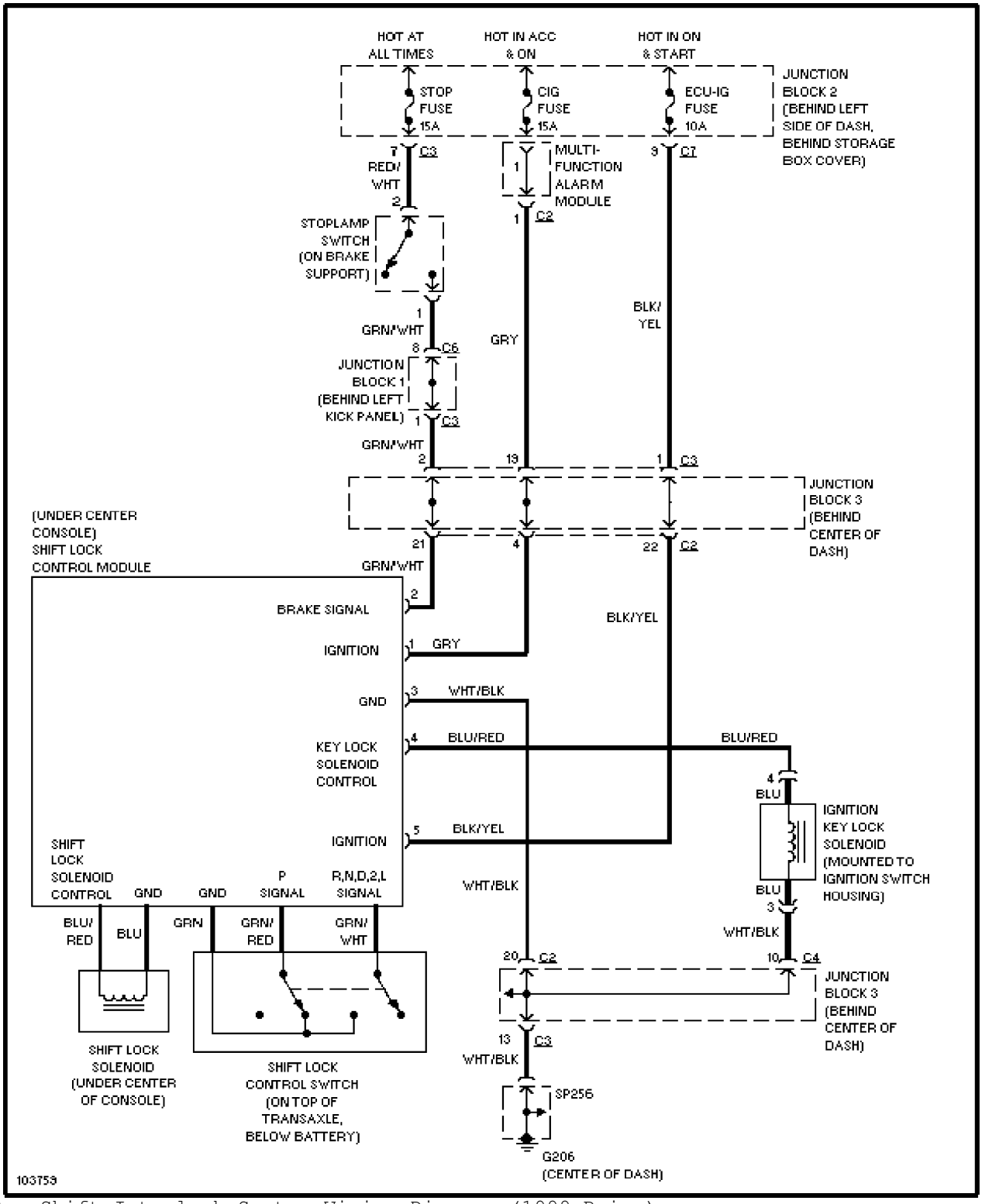


Fig. 2: Shift Interlock System Wiring Diagram (1999 Prizm)

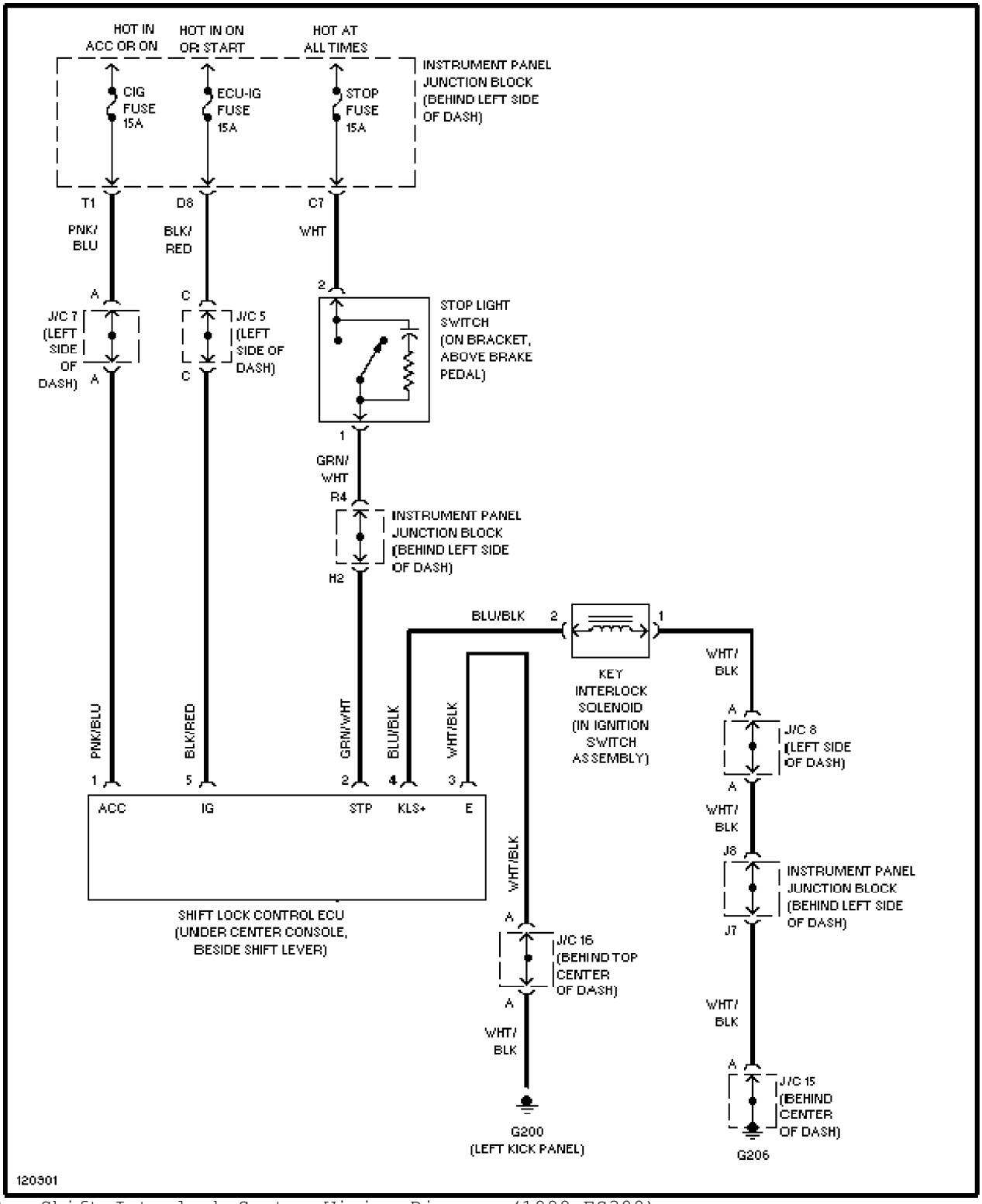


Fig. 3: Shift Interlock System Wiring Diagram (1999 ES300)

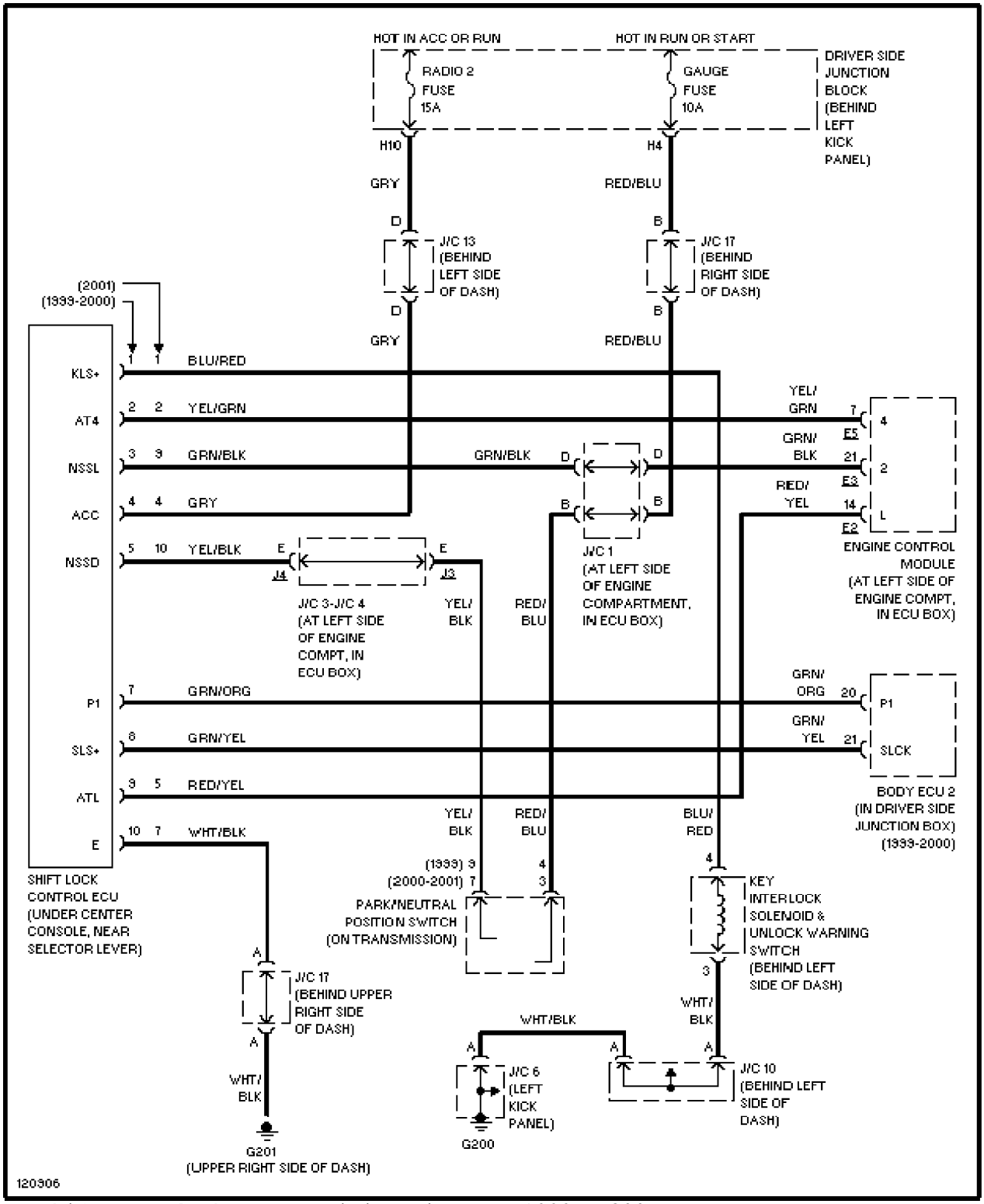


Fig. 4: Shift Interlock System Wiring Diagram (1999 GS300)

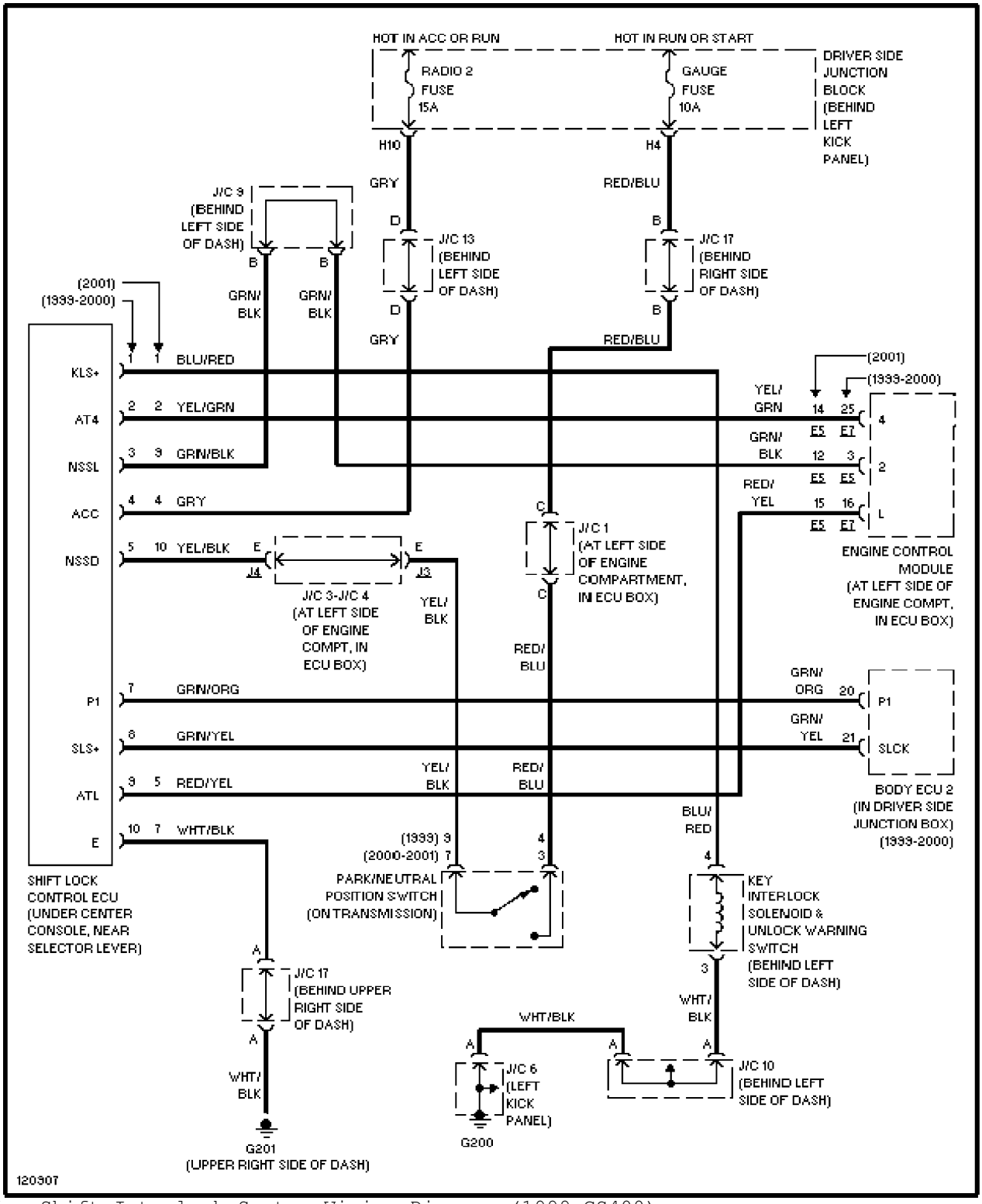


Fig. 5: Shift Interlock System Wiring Diagram (1999 GS400)

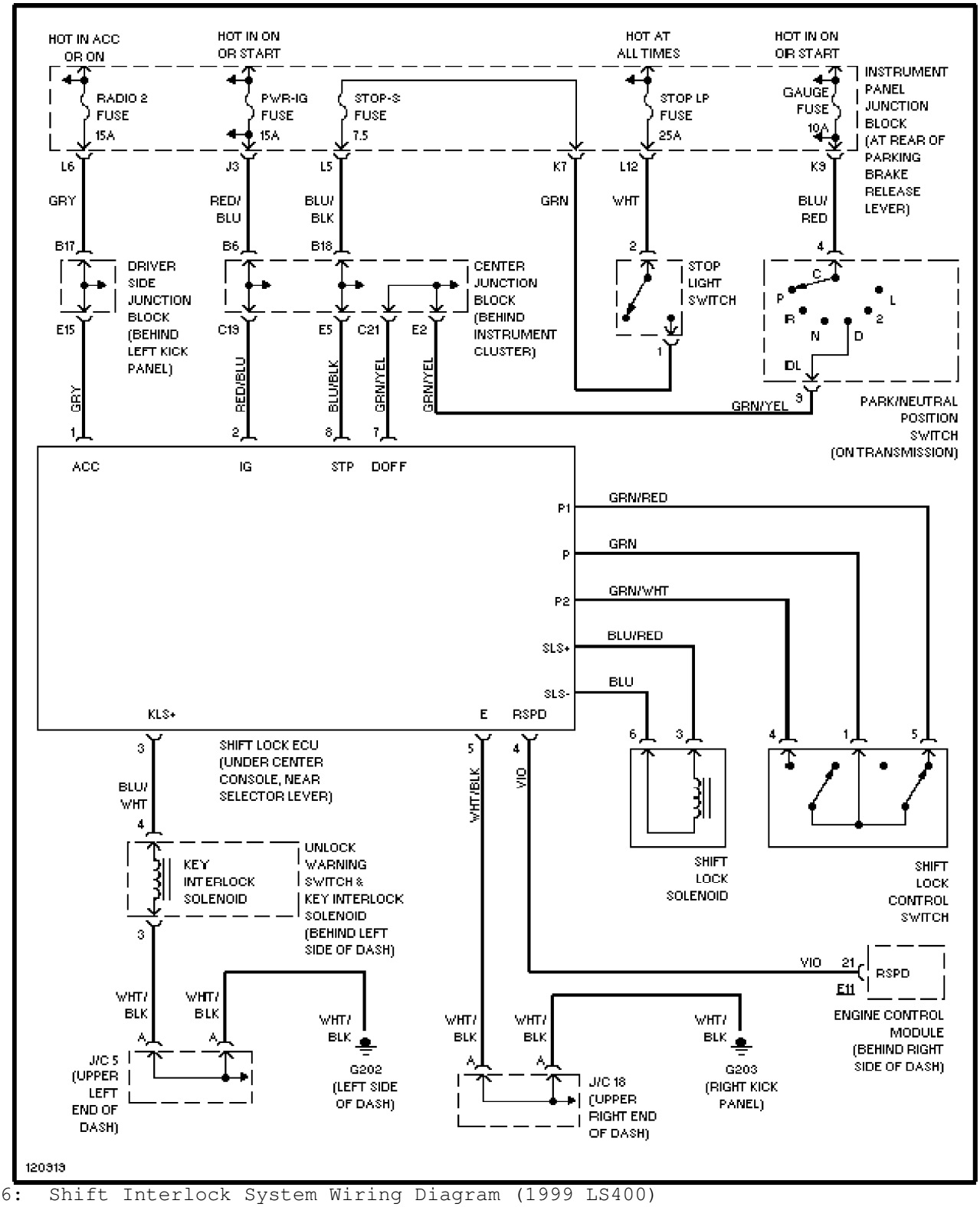


Fig. 6: Shift Interlock System Wiring Diagram (1999 LS400)

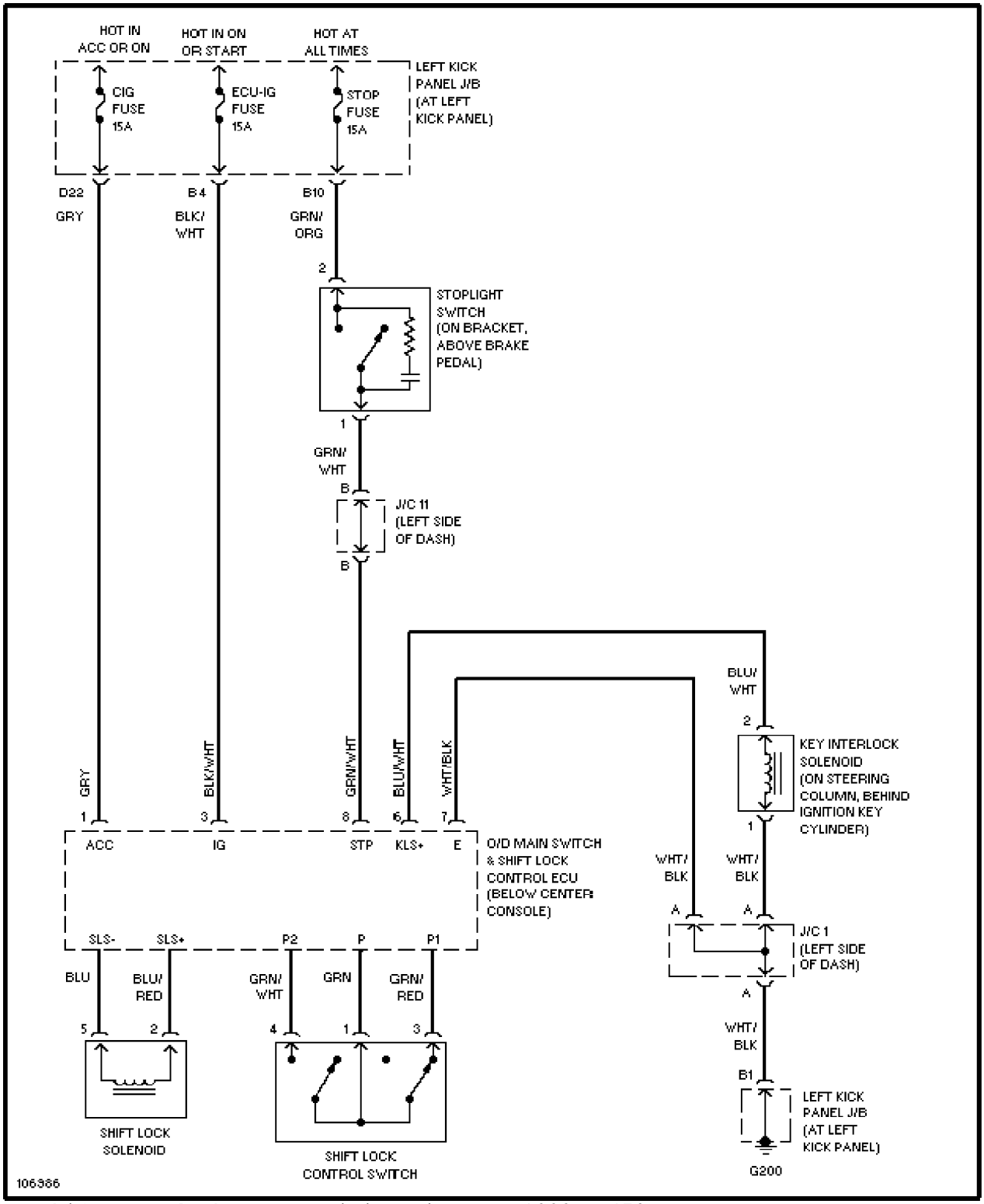


Fig. 7: Shift Interlock System Wiring Diagram (1999 LX470)

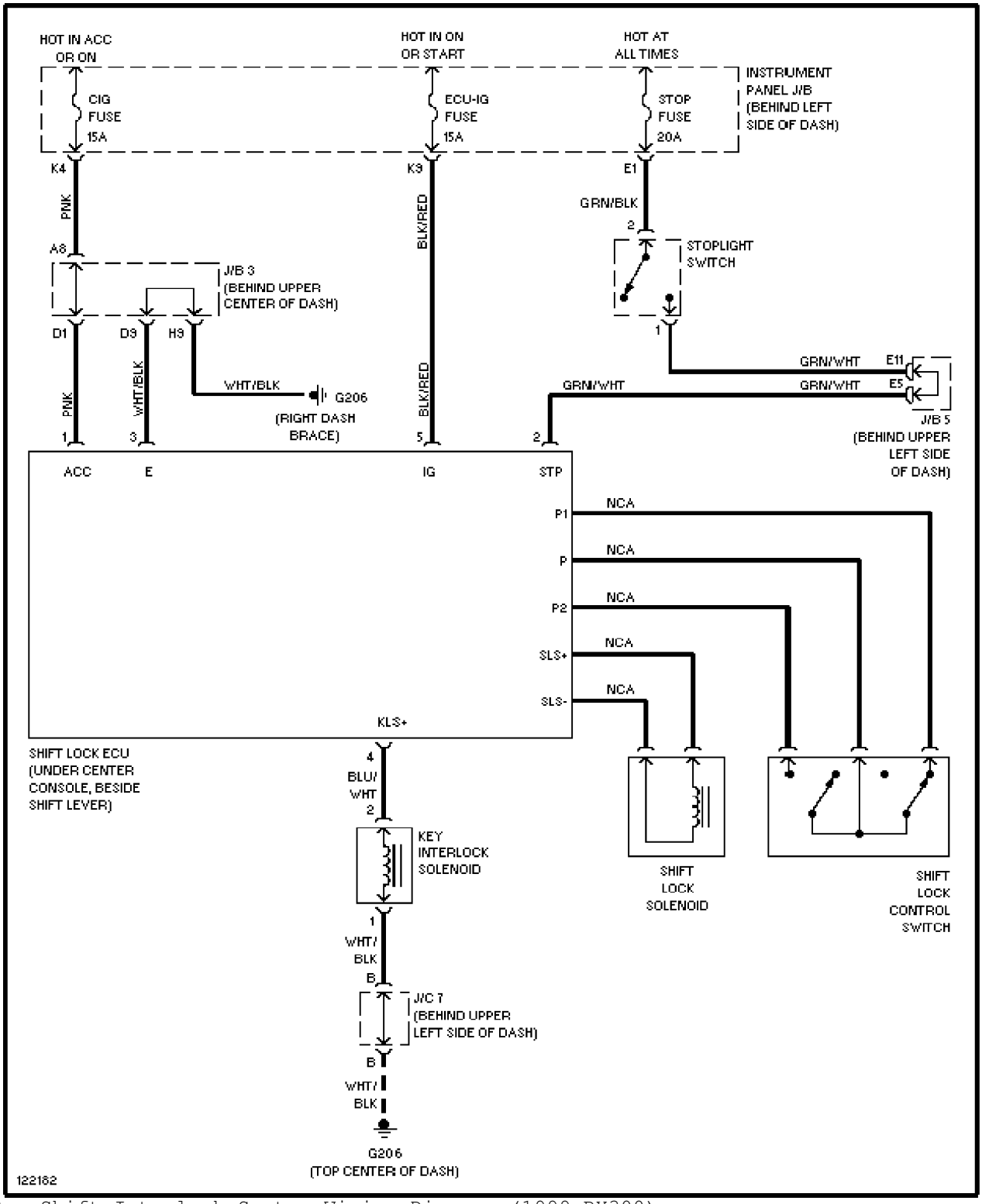


Fig. 8: Shift Interlock System Wiring Diagram (1999 RX300)

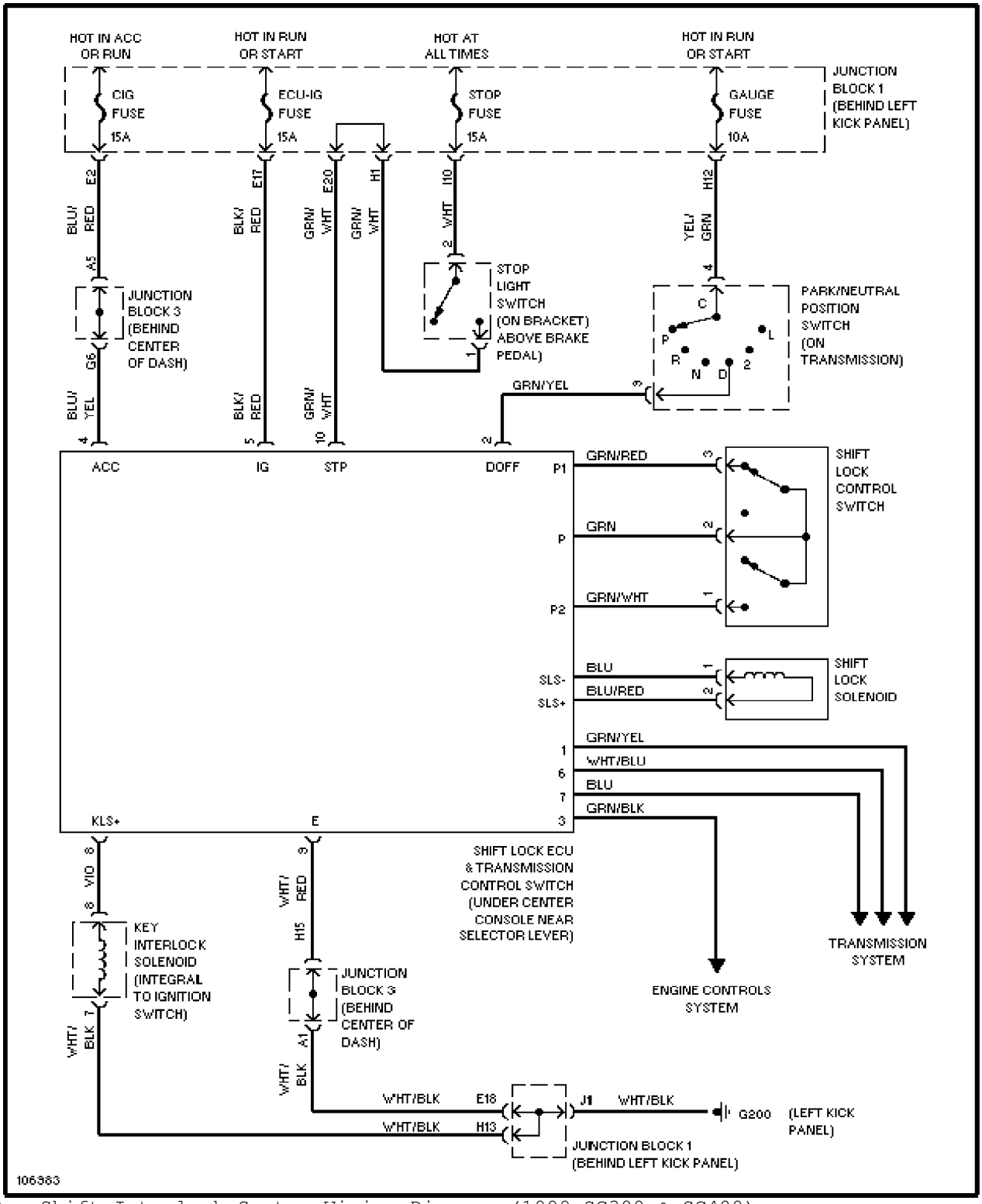


Fig. 9: Shift Interlock System Wiring Diagram (1999 SC300 & SC400)

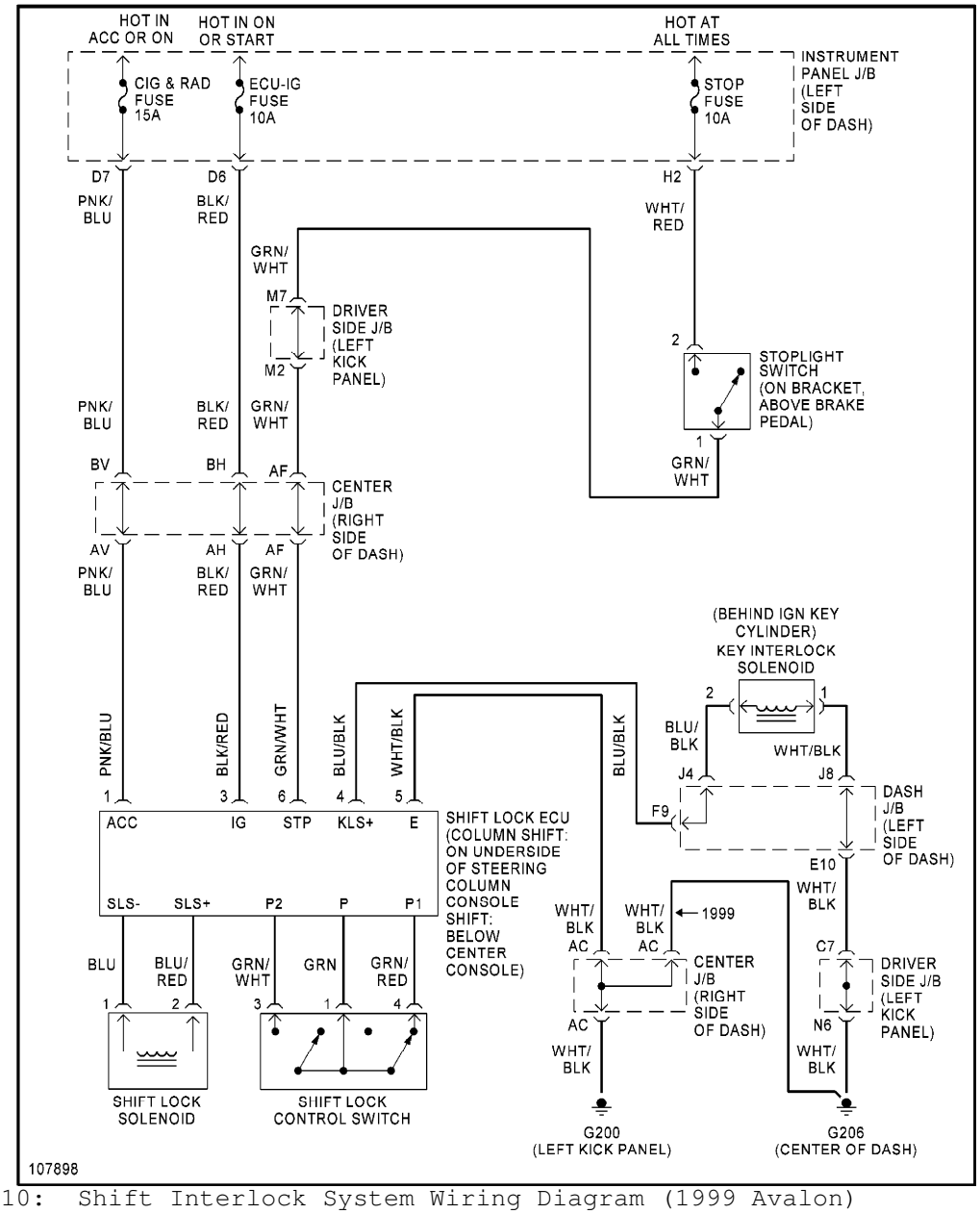


Fig. 10: Shift Interlock System Wiring Diagram (1999 Avalon)

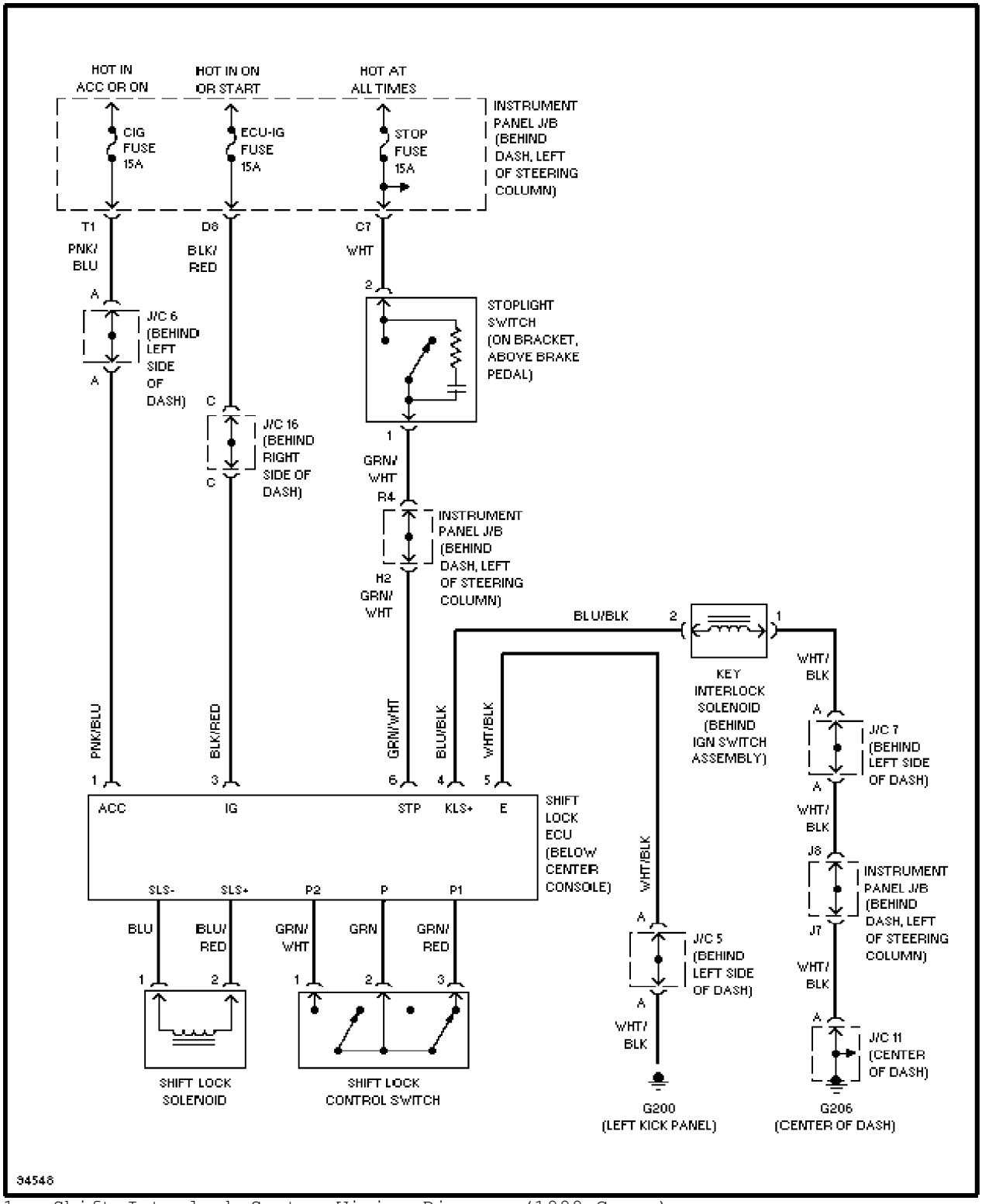


Fig. 11: Shift Interlock System Wiring Diagram (1999 Camry)

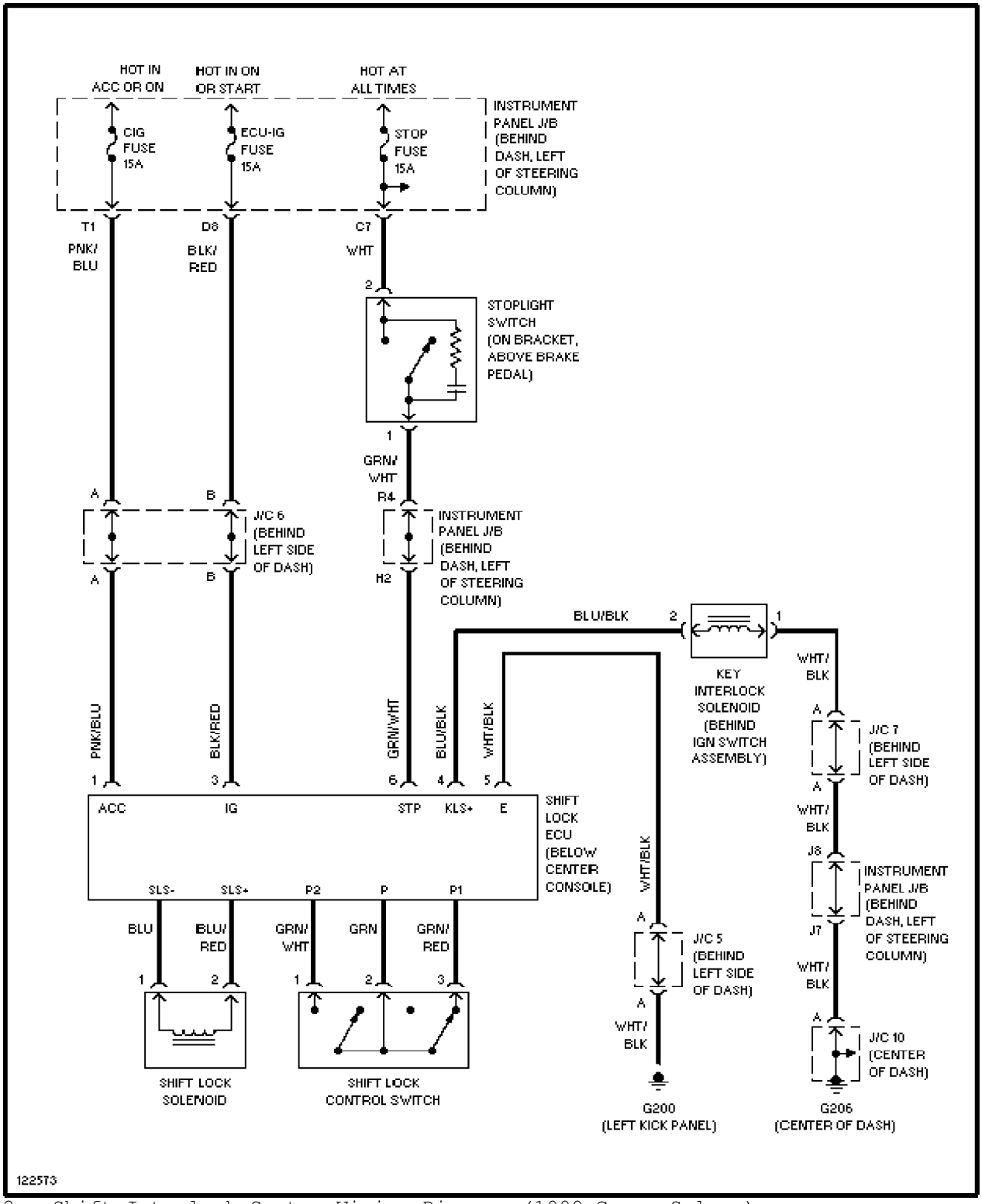


Fig. 12: Shift Interlock System Wiring Diagram (1999 Camry Solara)

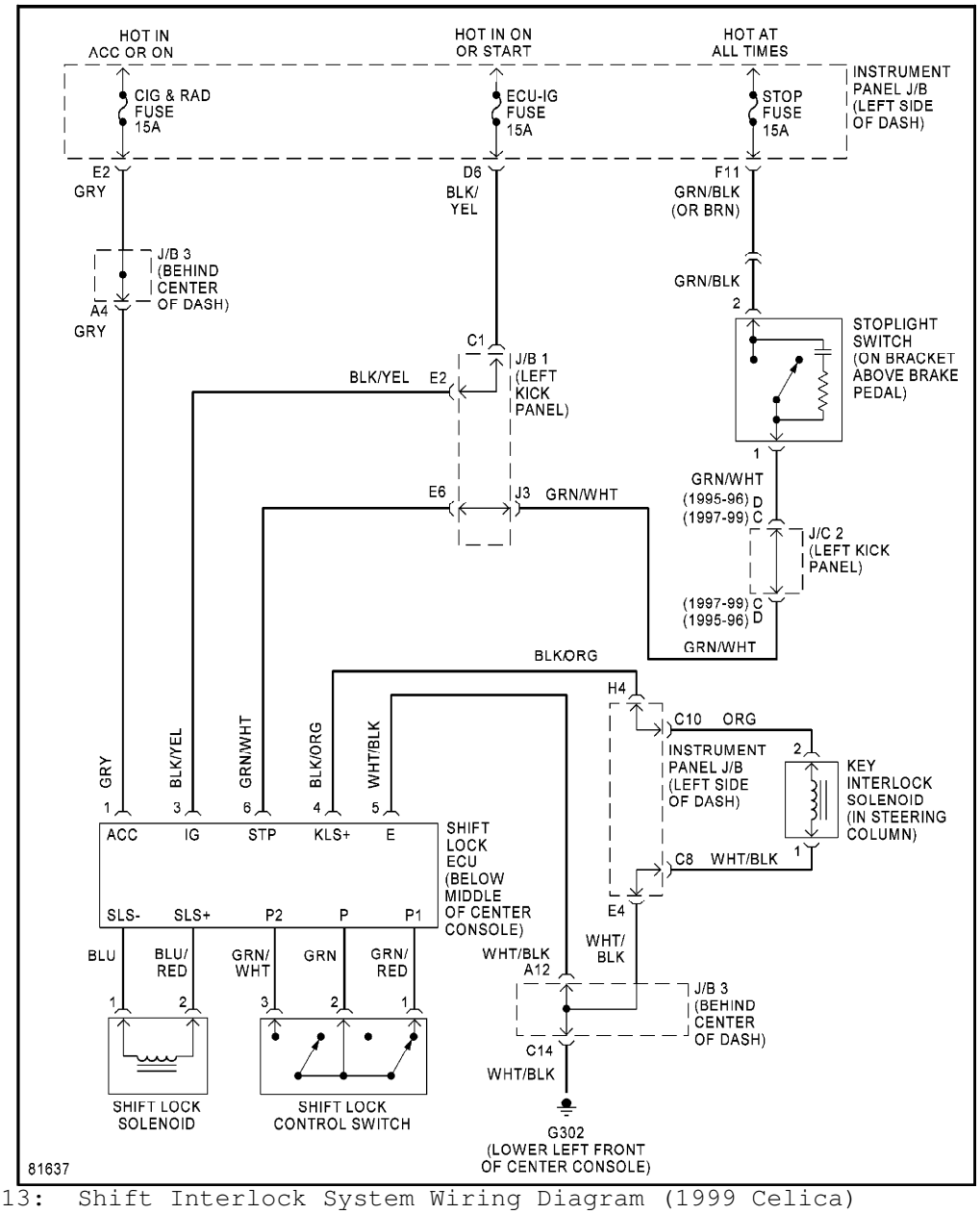


Fig. 13: Shift Interlock System Wiring Diagram (1999 Celica)

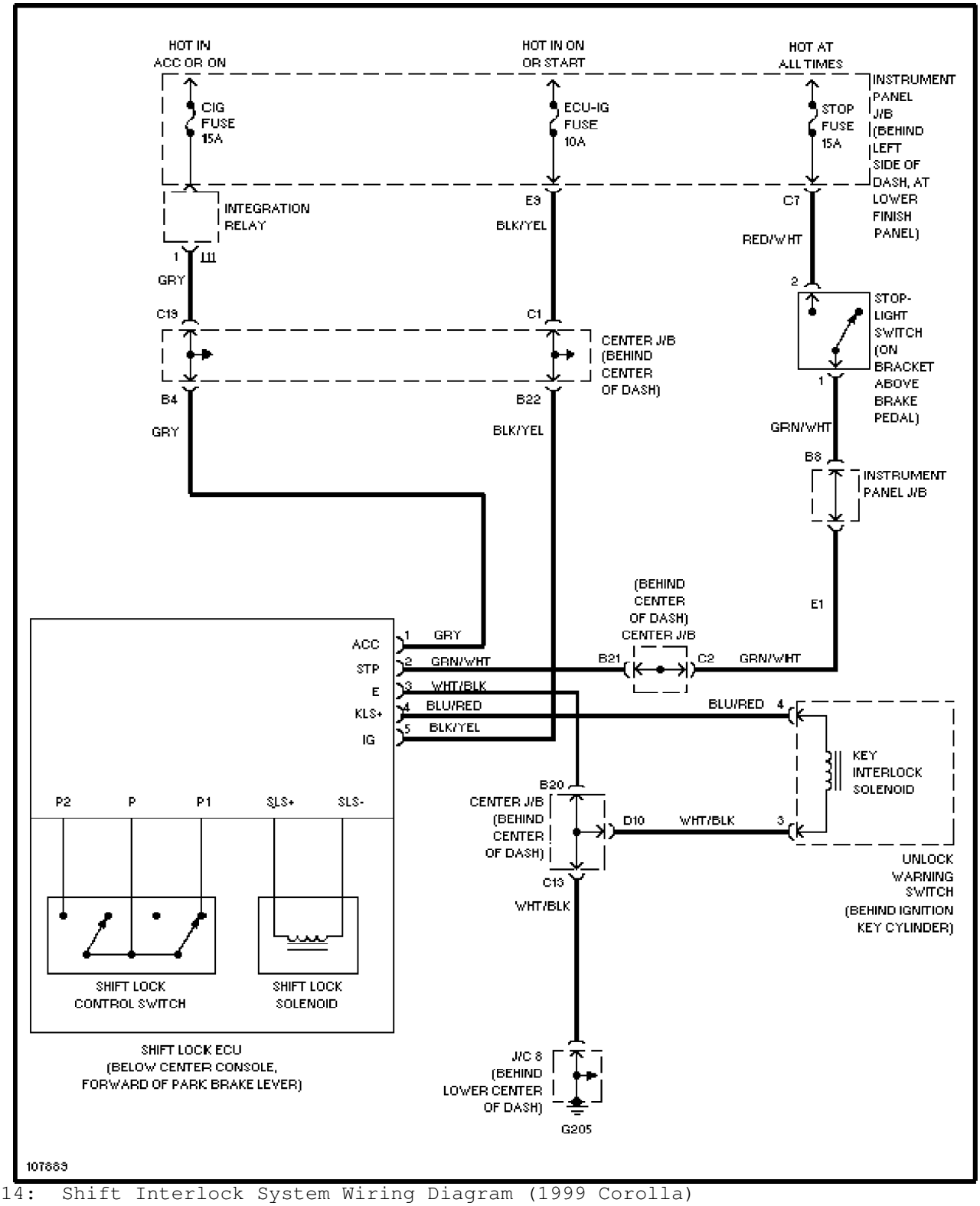


Fig. 14: Shift Interlock System Wiring Diagram (1999 Corolla)

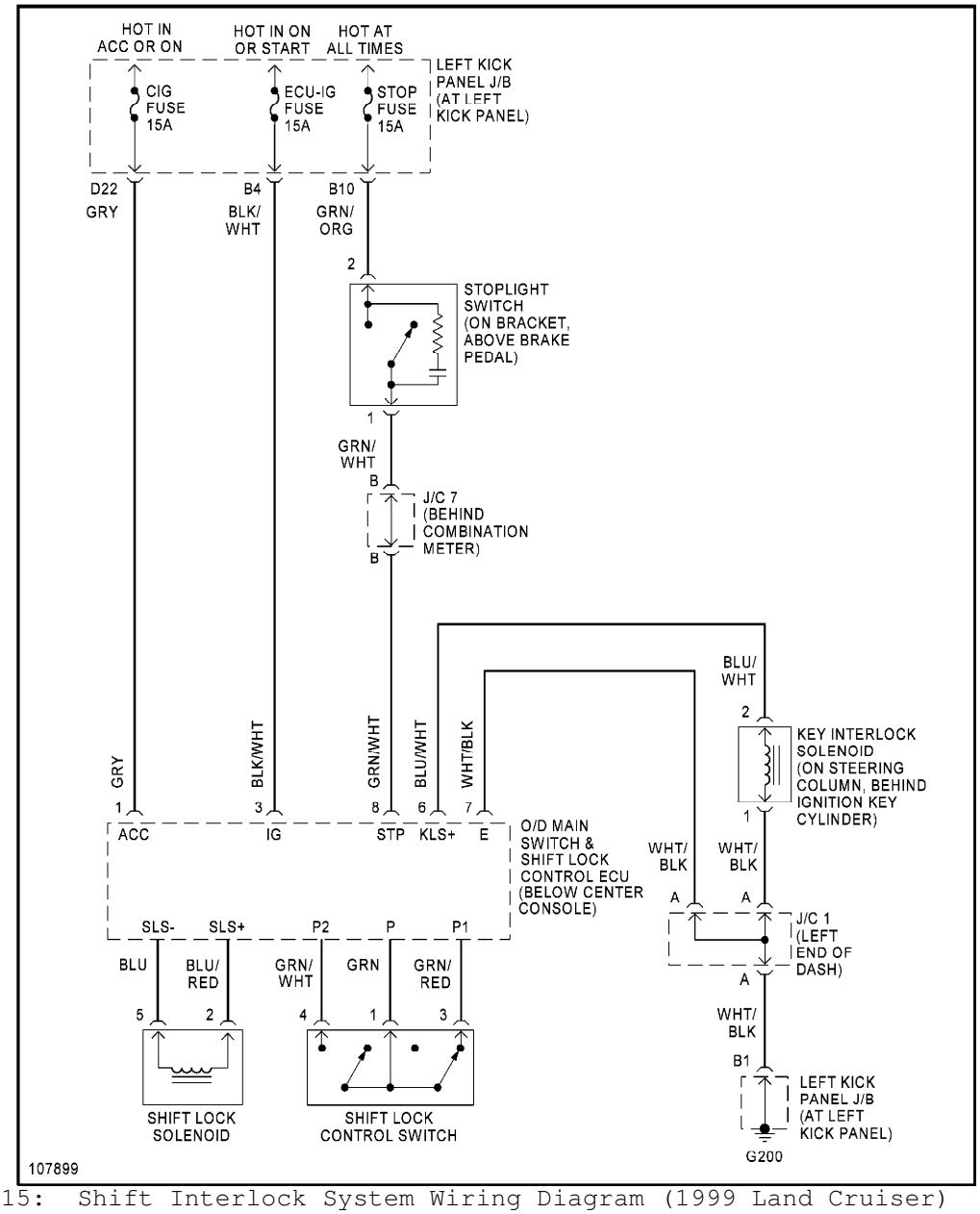


Fig. 15: Shift Interlock System Wiring Diagram (1999 Land Cruiser)

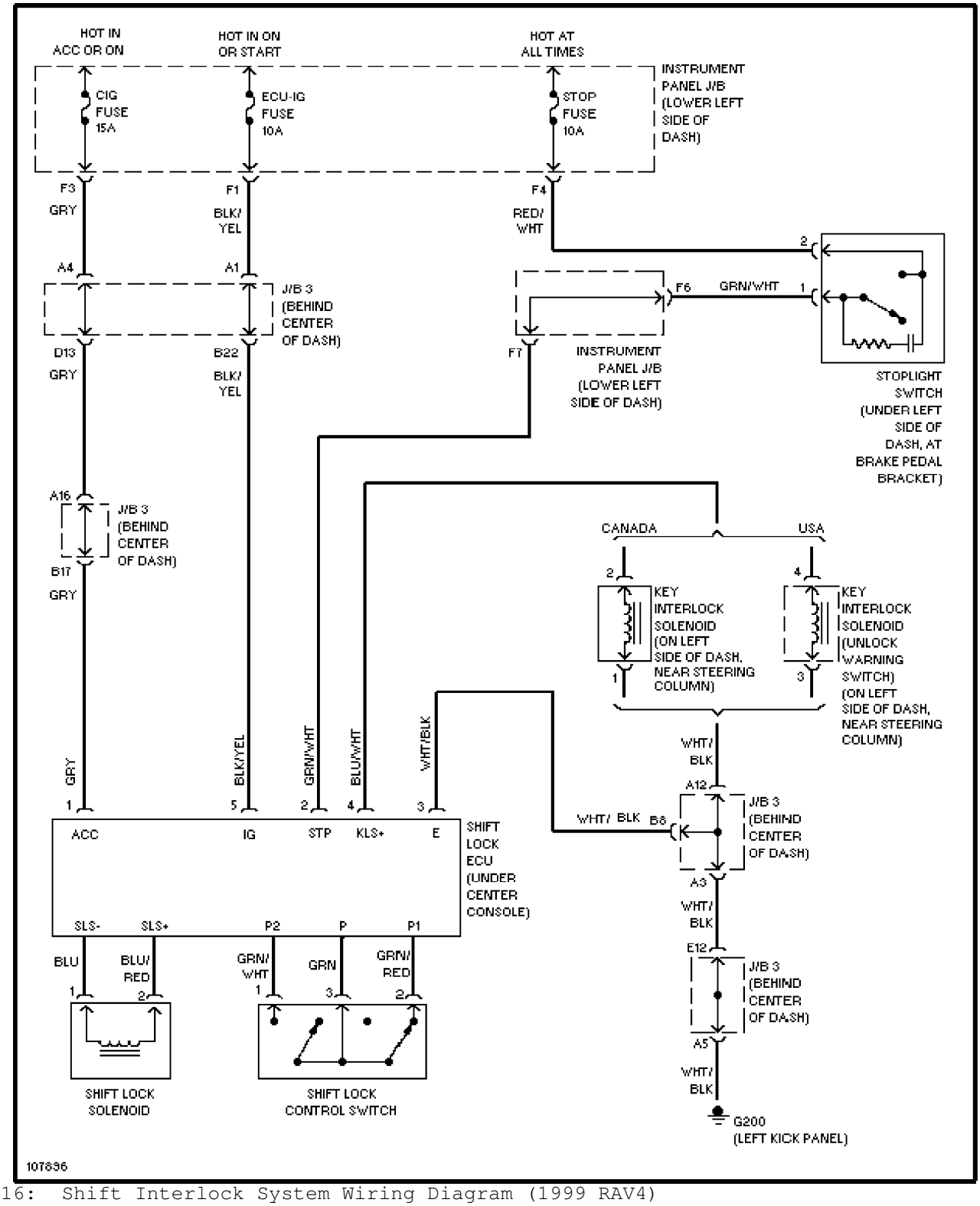


Fig. 16: Shift Interlock System Wiring Diagram (1999 RAV4)

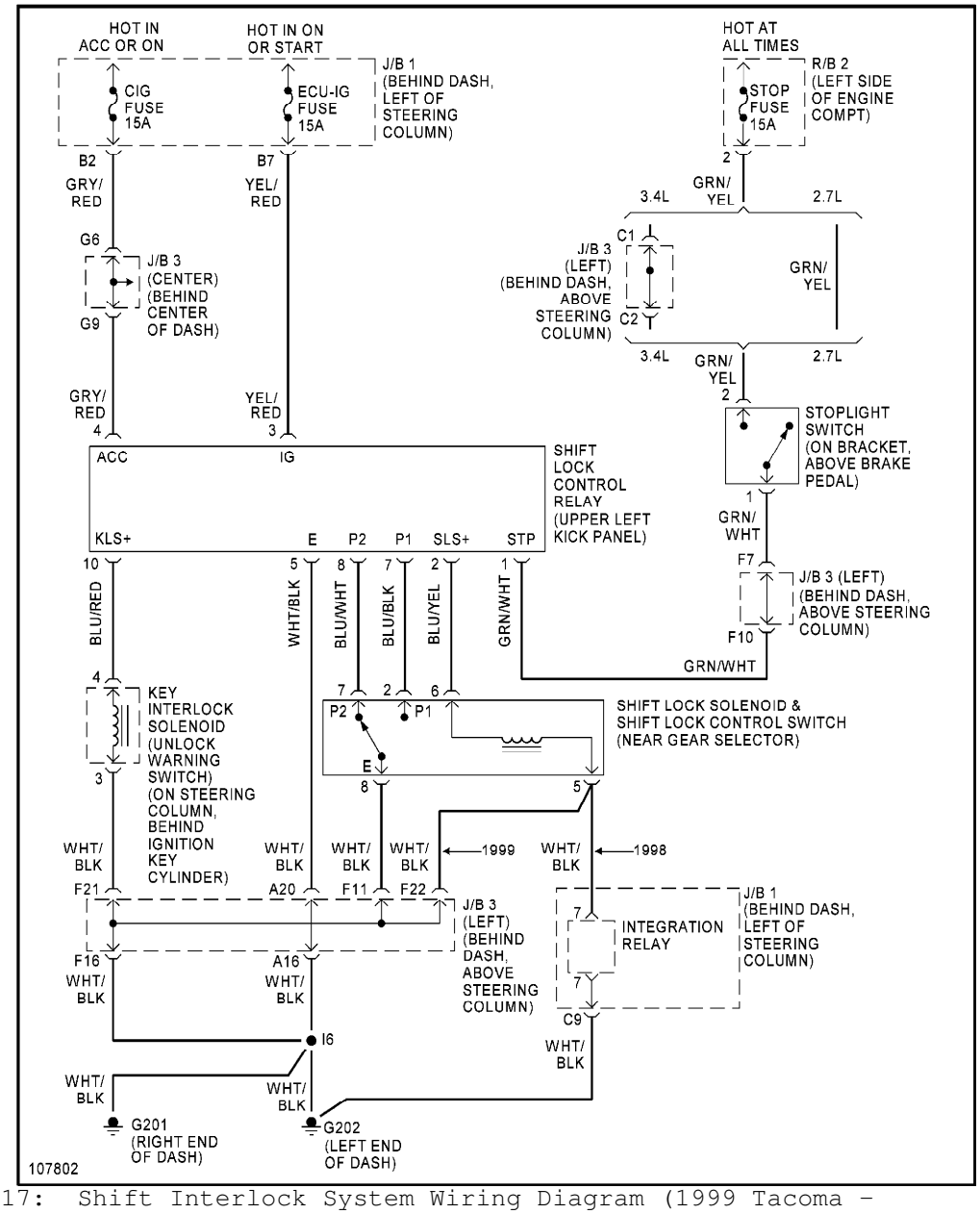


Fig. 17: Shift Interlock System Wiring Diagram (1999 Tacoma - With Column Shift)

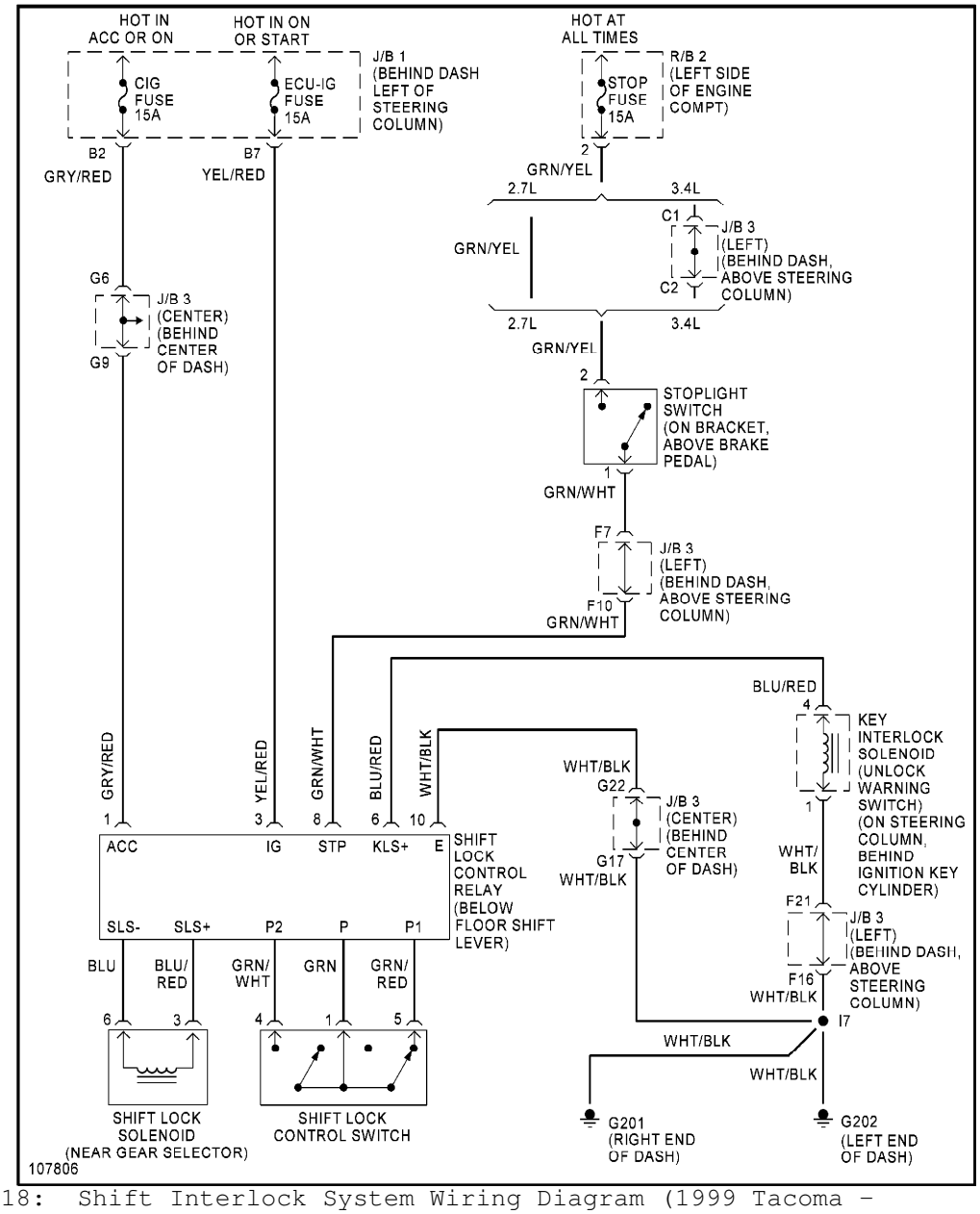


Fig. 18: Shift Interlock System Wiring Diagram (1999 Tacoma - With Floor Shift)

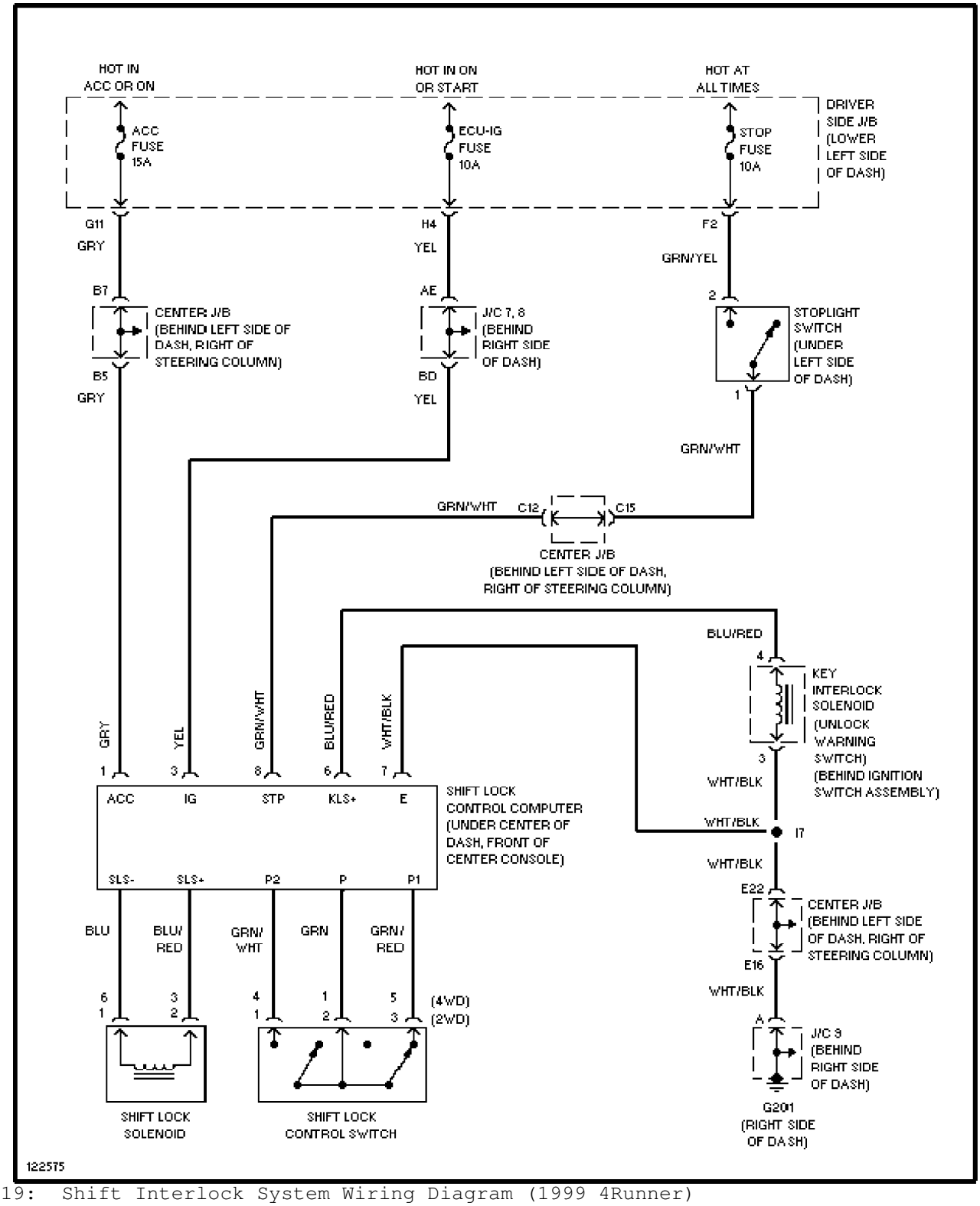


Fig. 19: Shift Interlock System Wiring Diagram (1999 4Runner)

STARTER

1999 Lexus RX 300

1999 STARTING & CHARGING SYSTEMS
Starters
LEXUS

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION & OPERATION

STARTER

Nippondenso gear reduction starter motor uses an overrunning clutch. A brush holder in the end cover retains 4 brushes and springs. See Fig. 8, 9 or 10.

STARTER CONTROL CIRCUIT

SC300 & SC400
With ignition switch in START position, current flows to Park/Neutral Position (PNP) switch. PNP switch prevents the starter from operating if the transmission is in gear. Current flows through the starter relay coil and is grounded at theft deterrent and door lock control ECU. This energizes the starter relay, allowing battery power to the starter solenoid. The starter solenoid engages, allowing current to flow through starter motor field coils.

Except SC300 & SC400
With ignition switch in START position, current flows to Park/Neutral Position (PNP) switch. PNP switch prevents the starter from operating if the transmission is in gear. Current flows through the starter relay coil to ground. This energizes the starter relay, allowing battery power to the starter solenoid. The starter solenoid engages, allowing current to flow through starter motor field coils.

COMPONENT LOCATIONS

COMPONENT LOCATIONS (ES300 & RX300)

Engine Control Module (ECM)
Under right side of instrument panel, near glove box.

Park/Neutral Position (PNP) Switch
On side of transmission.

Starter Relay
Left of battery, in fuse/relay block.

Starter Solenoid
On starter.

COMPONENT LOCATIONS (GS300 & GS400)

Engine Control Module (ECM)
Forward of left front strut tower.

Park/Neutral Position (PNP) Switch
On side of transmission.

Starter Relay

Behind right front strut tower, in fuse/relay block.

Starter Solenoid
On starter.

COMPONENT LOCATIONS (LS400)

Engine Control Module (ECM)
Under right side of instrument panel, near glove box.

Park/Neutral Position (PNP) Switch
On side of transmission.

Starter Relay
Forward of left front strut tower, in fuse/relay block.

Starter Solenoid
On starter.

COMPONENT LOCATIONS (SC300 & SC400)

Engine Control Module (ECM)
Under right side of instrument panel, below glove box.

Park/Neutral Position (PNP) Switch
On side of transmission.

Starter Relay
Forward of left front strut tower, in fuse/relay block.

Starter Solenoid
On starter.

Theft Deterrent/Door Lock Control ECU
Behind left side of instrument panel.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

ON-VEHICLE TESTING

PARK/NEUTRAL POSITION (PNP) SWITCH TEST

Disconnect Park/Neutral Position (PNP) switch connector. See COMPONENT LOCATIONS. Check for continuity between specified terminals of PNP switch. See PARK/NEUTRAL POSITION (PNP) SWITCH CONTINUITY SPECIFICATIONS table. See Fig. 1. If continuity is not as specified, replace PNP switch.

PARK/NEUTRAL POSITION (PNP) SWITCH CONTINUITY SPECIFICATIONS

Application & Gearshift Position	Between Terminals
ES300 & RX300	
P	2 & 7; 5 & 6
R	2 & 8
N	2 & 9; 5 & 6
D	2 & 10
2	2 & 3

L	2 & 4
GS300 & GS400	
P	4 & 7; 5 & 6
R	4 & 8
N	4 & 10; 5 & 6
D, 4 (Or M)	4 & 9
3	2 & 4
2, L	2 & 3
LS400	
P	4 & 7; 5 & 6
R	4 & 8
N	4 & 10; 5 & 6
D, 4	4 & 9
3	2 & 4
2, L	3 & 4
SC300 & SC400	
P	4 & 7; 5 & 6
R	4 & 8
N	4 & 10; 5 & 6
D, 3	4 & 9
2	2 & 4
L	3 & 4

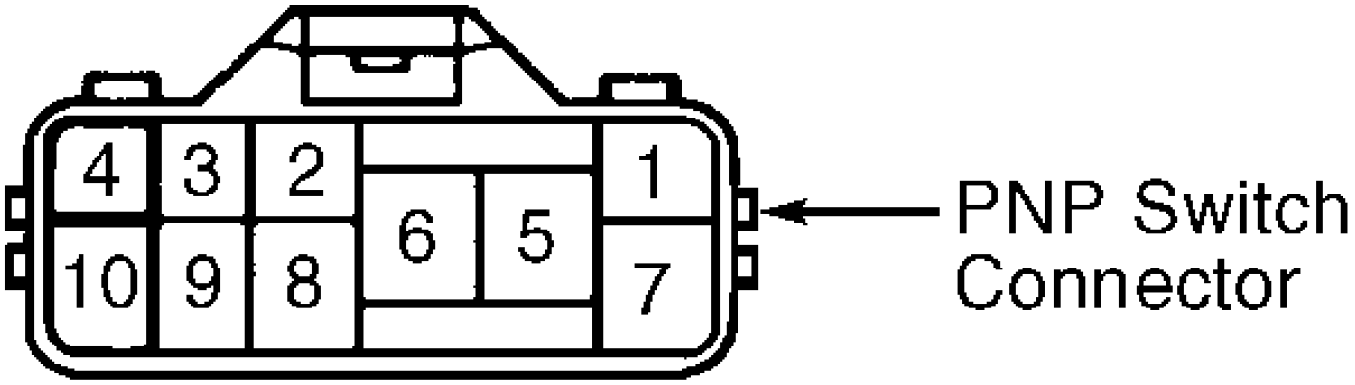
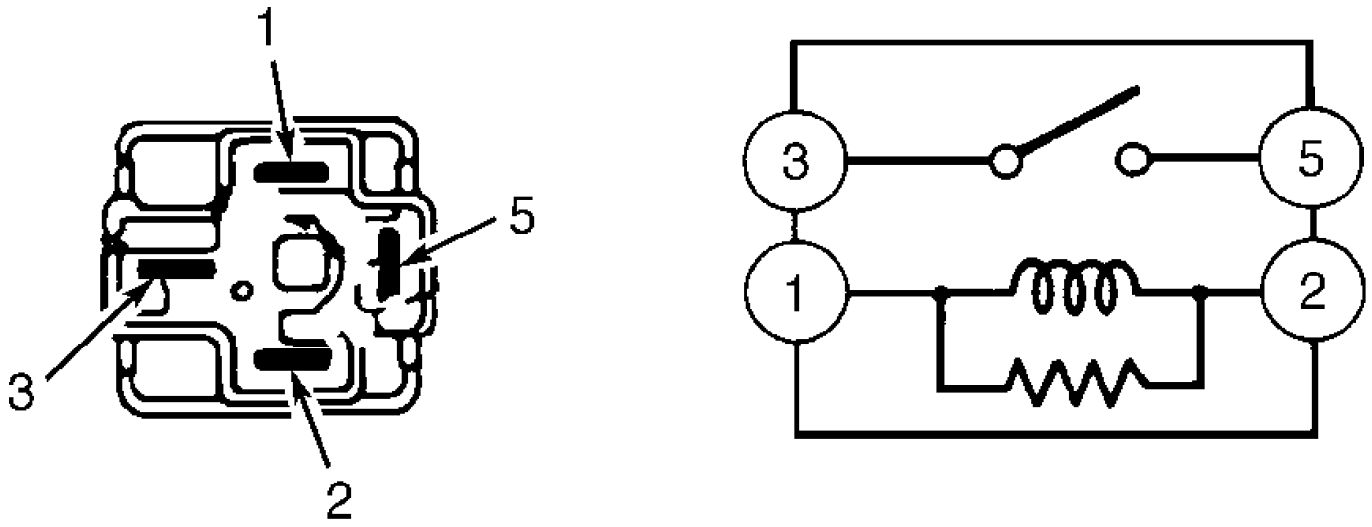


Fig. 1: Identifying PNP Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

STARTER RELAY TEST

Remove starter relay. See COMPONENT LOCATIONS. Check for continuity between starter relay terminals No. 1 and 2. See Fig. 2. Continuity should exist. If continuity does not exist, replace relay. Check for continuity between starter relay terminals No. 3 and 5. Continuity should not exist. If continuity exists, replace relay. Apply battery voltage across starter relay terminals No. 1 and 2. Check for continuity between starter relay terminals No. 3 and 5. Continuity should exist. If continuity does not exist, replace relay.



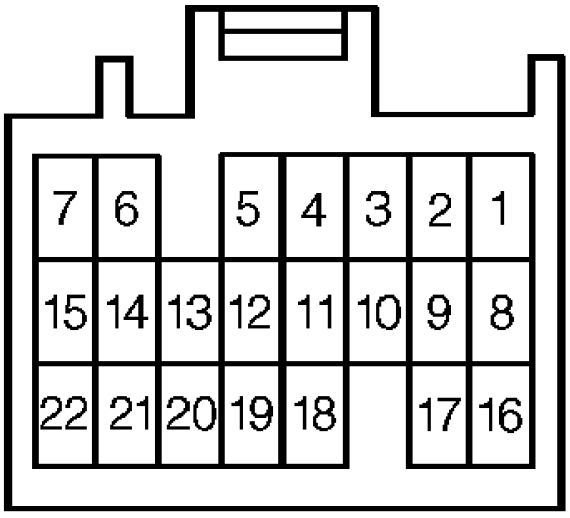
G94I46126

Fig. 2: Identifying Starter Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

STARTER SIGNAL CIRCUIT TEST

ES300

Remove glove box and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 22-pin connector E7 terminal No. 7 (Gray wire). See Fig. 3. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.



G99C08059

Fig. 3: Identifying ECM Connector Terminals (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300

Remove ECM hood and cover, and locate ECM. See COMPONENT

LOCATIONS. Using DVOM, backprobe ECM 28-pin connector E5 terminal No. 2 (Black wire). See Fig. 4. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

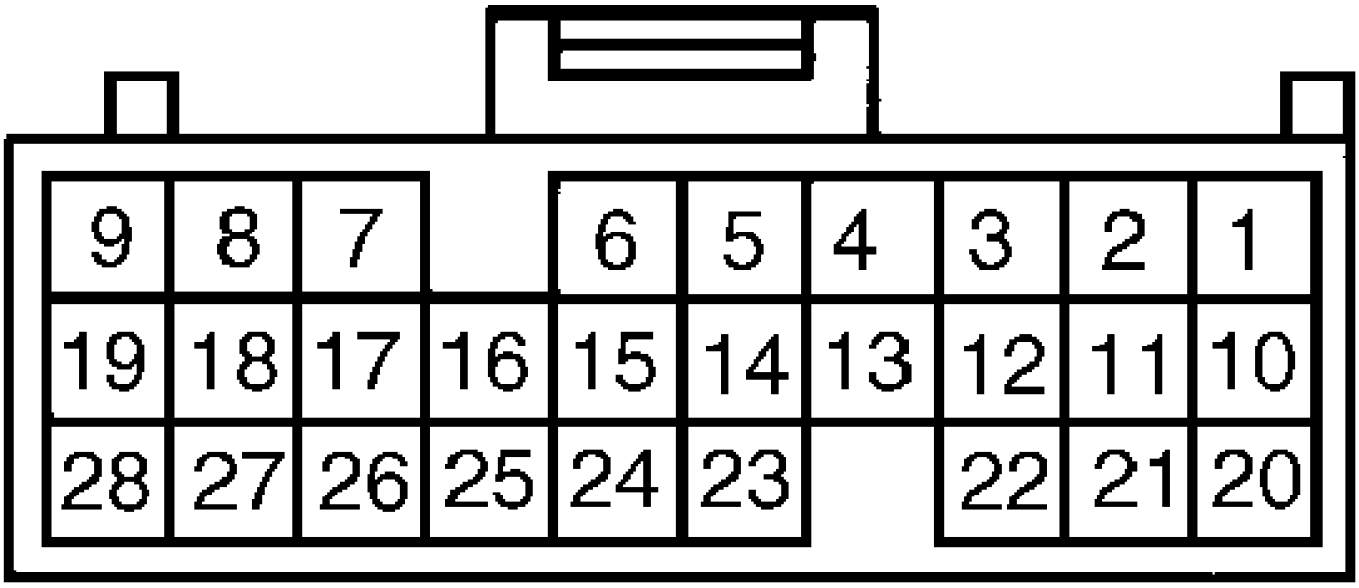


Fig. 4: Identifying ECM Connector Terminals (GS300, GS400, LS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS400

Remove ECM hood and cover, and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 28-pin connector E5 terminal No. 17 (Black wire). See Fig. 4. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

LS400

Remove instrument panel under cover, and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 28-pin connector E11 terminal No. 17 (Black wire). See Fig. 4. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

RX300

Remove glove box and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 22-pin connector E11 terminal No. 7 (Gray wire). See Fig. 3. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

SC300

Remove instrument panel under cover, and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 28-pin connector E18 terminal No. 2 (Green/Red wire). See Fig. 4. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

SC400

Remove instrument panel under cover, and locate ECM. See COMPONENT LOCATIONS. Using DVOM, backprobe ECM 28-pin connector E18 terminal No. 17 (Green/Red wire). See Fig. 4. Check for voltage with ignition in START position. If voltage is 6 volts or more, ECM is okay. If voltage is less than 6 volts, check for open in wiring harness or connectors between ECM and starter relay. Repair as necessary. If wiring harness and connectors are okay, replace ECM.

BENCH TESTING

* PLEASE READ THIS FIRST *

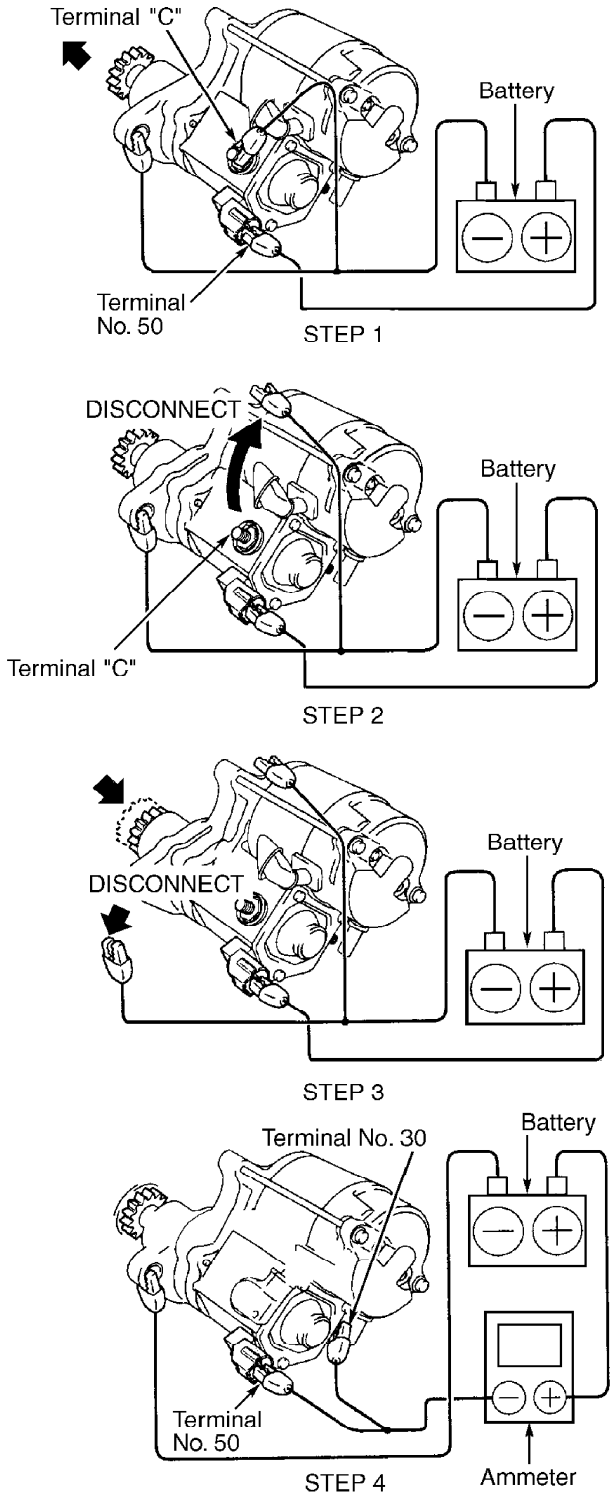
CAUTION: DO NOT operate starter for more than 3-5 seconds.

SOLENOID TEST

1) Disconnect starter field coil lead from terminal "C". Connect battery to starter solenoid. See Fig. 5 or 6. Perform STEP 1. Clutch pinion gear should move outward. If clutch pinion gear does not move outward, replace starter solenoid. If clutch pinion gear moves outward, go to next step.

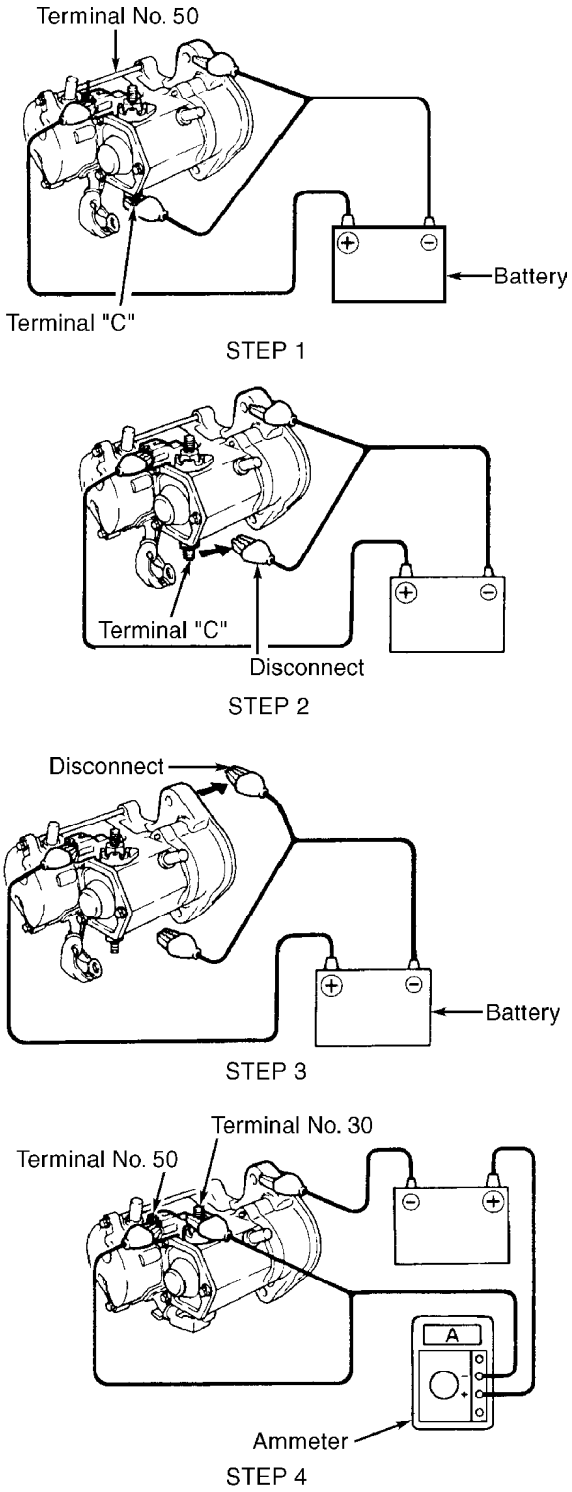
2) Leave battery connected. Disconnect jumper lead from terminal "C". Perform STEP 2. Clutch pinion gear should remain in outward position. If clutch pinion gear does not remain in outward position, replace starter solenoid. If clutch pinion gear remains in outward position, go to next step.

3) Disconnect jumper lead from starter housing. Perform STEP 3. Clutch pinion gear should move inward. If clutch pinion gear does not move inward, replace starter solenoid. If clutch pinion gear moves inward, starter solenoid is okay.



G99G08061

Fig. 5: Bench Testing Starter (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G93A82131

Fig. 6: Bench Testing Starter (GS300, GS400, LS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NO-LOAD TEST

CAUTION: DO NOT operate starter for more than 3-5 seconds.

Connect battery and ammeter to starter. See Fig. 5 or 6. Perform STEP 4. Starter armature should rotate smoothly and steadily with pinion gear moving out. Amperage draw should be within specification. See NO-LOAD TEST SPECIFICATIONS table.

NO-LOAD TEST SPECIFICATIONS

Application	Maximum Amps	Volts
ES300, GS300, RX300 & SC300	90	11.5
GS400, LS400 & SC400	100	11.5

ARMATURE TEST

1) Using ohmmeter, check for continuity between all segments of commutator. If continuity does not exist, replace armature. Using ohmmeter, check for continuity between commutator and armature coil core. If continuity exists, replace armature.

2) Inspect commutator for dirty or burnt surfaces. Repair as necessary using No. 400 sandpaper or a lathe. Place commutator on "V" blocks. Using a dial gauge, measure circle runout. See appropriate STARTER SPECIFICATIONS table under STARTER SPECIFICATIONS. Repair as necessary using a lathe.

3) Using a vernier caliper, measure commutator diameter. See appropriate STARTER SPECIFICATIONS table under STARTER SPECIFICATIONS. If commutator diameter is less than minimum specification, replace armature.

4) Ensure commutator mica undercut depth is clean and free of foreign materials. Smooth out edge. Measure commutator mica undercut depth. See appropriate STARTER SPECIFICATIONS table under STARTER SPECIFICATIONS. If undercut depth is less than minimum specification, correct depth by using a hacksaw blade to remove mica from between segments.

BRUSHES

1) Using a vernier caliper, measure brush length. See STARTER SPECIFICATIONS table under STARTER SPECIFICATIONS. If brush length is less than minimum specification, replace brush holder and field frame.

2) Using a pull scale, note brush spring tension the instant the brush spring separates from brush. See STARTER SPECIFICATIONS table under STARTER SPECIFICATIONS. If brush spring tension is less than minimum specification, replace brush springs.

FIELD COIL TEST

Using ohmmeter, check for continuity between starter solenoid lead and field coil brush lead. If continuity does not exist, replace field frame. Using ohmmeter, check for continuity between field coil end and field frame. If continuity exists, repair or replace field frame.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

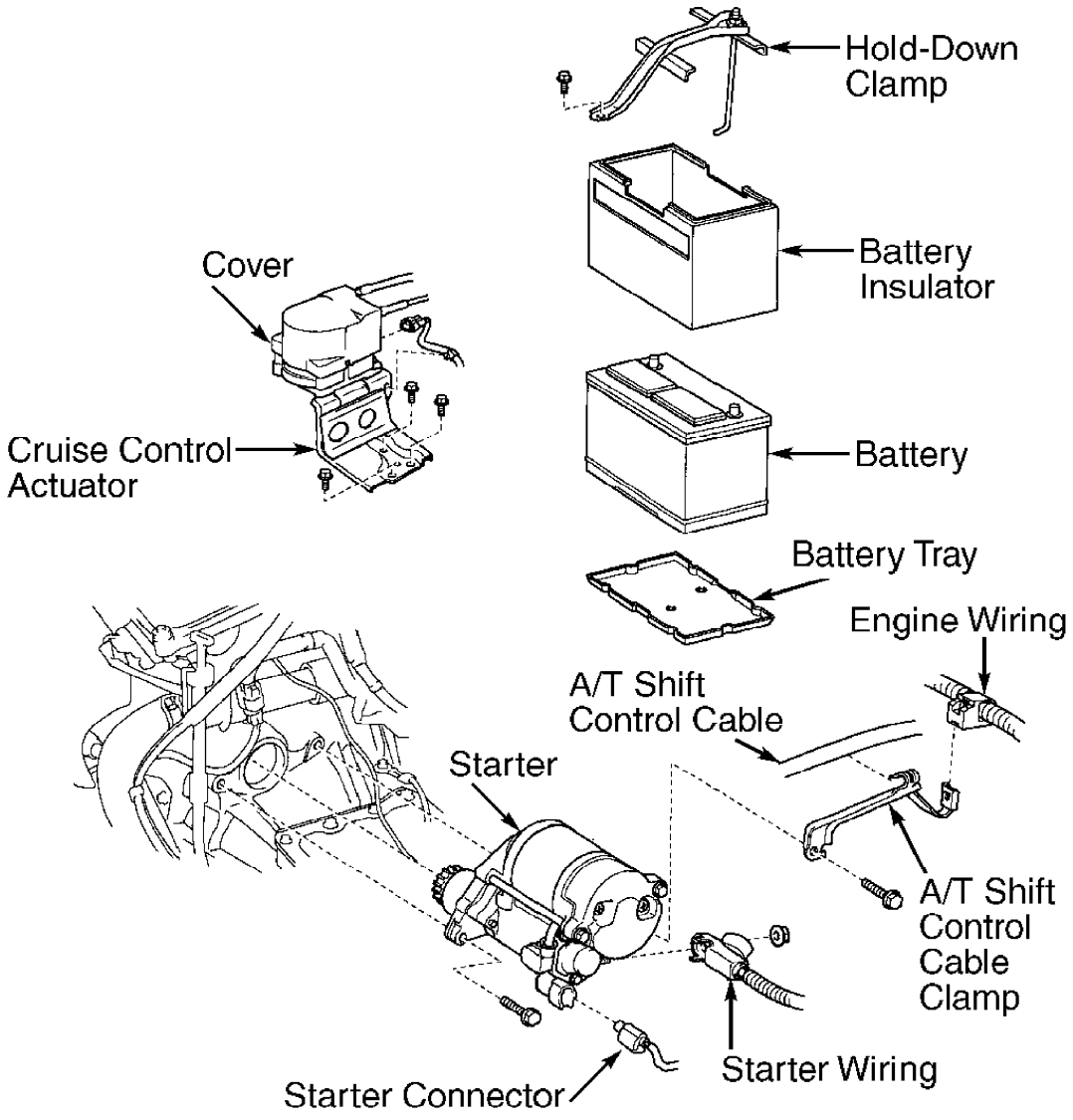
WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article in ACCESSORIES & EQUIPMENT. DO NOT apply electrical power to any

component on steering column without first deactivating air bag system. Air bag may deploy.

STARTER

Removal & Installation (ES300)

Disconnect battery cables. Remove battery and battery tray. See Fig. 7. Remove cruise control actuator. Disconnect A/T shift control cable and engine wiring. Remove starter wiring nut and disconnect starter wiring. Disconnect starter connector. Remove starter bolts, A/T shift control cable clamp, and starter. To install, reverse removal procedure. Tighten starter bolts to specification. See TORQUE SPECIFICATIONS.



G99I08062

Fig. 7: Removing & Installing Starter (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (GS300 & SC300)

Disconnect negative battery cable. Remove starter wiring nut

and disconnect starter wiring. Disconnect starter connector. Remove starter bolts and remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See TORQUE SPECIFICATIONS.

NOTE: On GS400, LS400 and SC400, starter is located under lower intake manifold, at rear of engine.

Removal (GS400, LS400 & SC400)

1) Disconnect negative battery cable. Remove engine undercover. Drain cooling system. Remove "V" bank cover. Remove intake air connector pipe. Disconnect accelerator cable and all electrical connectors from throttle body. Remove 2 bolts and 2 nuts, and disconnect throttle body from intake manifolds. Remove throttle body gasket.

2) Disconnect fuel inlet hose from fuel main tube. Remove all brackets and components, and disconnect all electrical connectors, hoses, and tubes necessary for removal of intake manifold assembly. Disconnect fuel injector wiring harness connectors.

3) Remove engine wiring clamps from brackets. Remove bolts, and engine wiring harness protectors from upper intake manifold, by-pass joints, right delivery pipe, and cylinder head. Remove 6 bolts, and 4 nuts attaching intake manifold to cylinder heads. Remove intake manifold assembly and gaskets.

4) Disconnect heater hoses from coolant by-pass pipe and remove by-pass pipe. Remove rear coolant by-pass joints and gaskets. Remove starter wiring nut and disconnect starter wiring. Disconnect starter connector. Remove 2 starter bolts and starter.

Installation

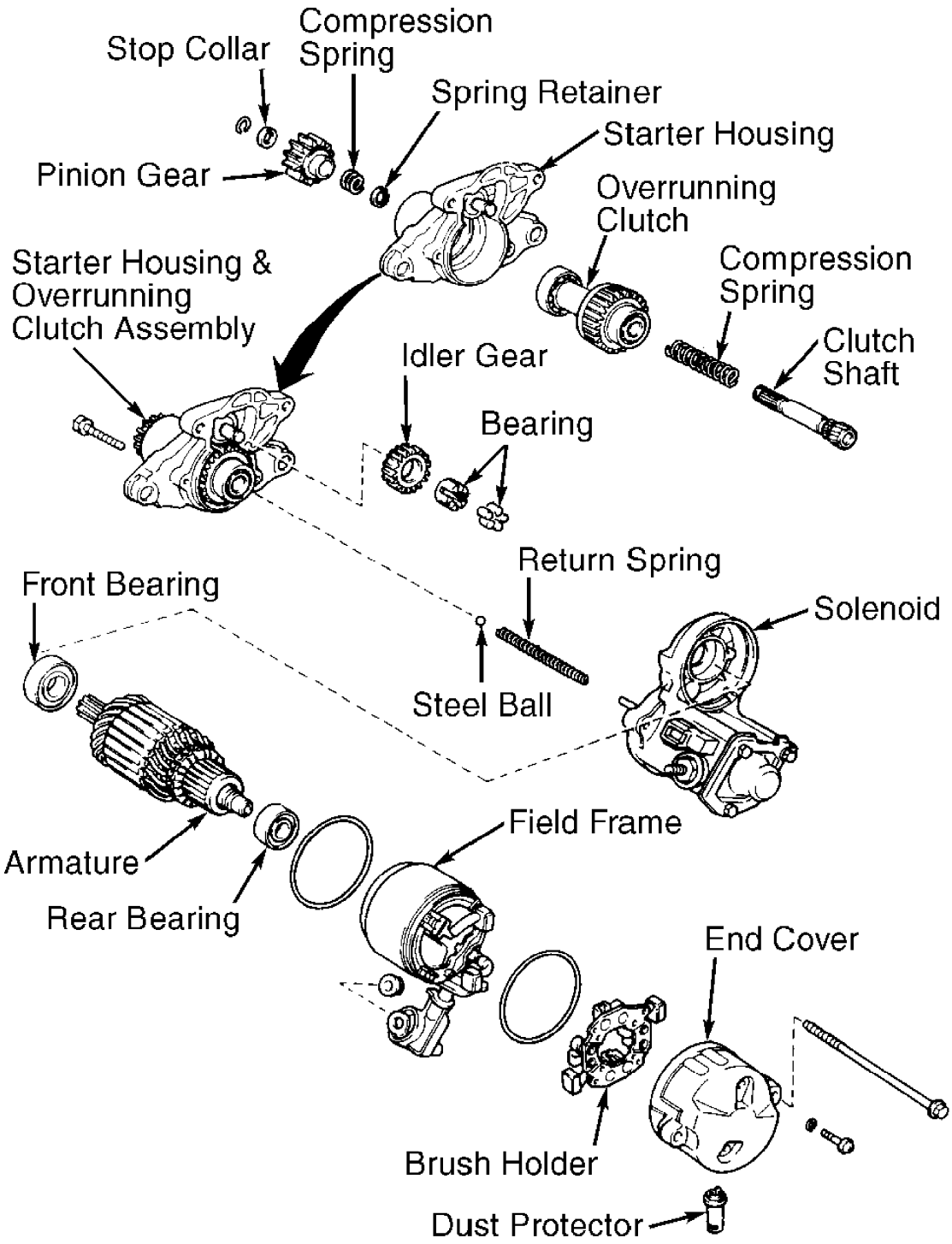
To install, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Ensure White mark on intake manifold gasket faces upward. Fill cooling system. Start engine and check for coolant, vacuum, and fuel leaks.

Removal & Installation (RX300)

Disconnect battery cables. Remove battery and battery tray. Disconnect MAF meter connector, wire clamp, and EVAP hose from air cleaner cap. Remove air cleaner cap and air filter. Remove 3 bolts and air cleaner case. Remove starter wiring nut and disconnect starter wiring. Disconnect starter connector. Remove starter bolts and starter. To install, reverse removal procedure. Tighten starter bolts and air cleaner case bolts to specification. See TORQUE SPECIFICATIONS.

OVERHAUL

NOTE: Use illustration for overhaul procedure. See Fig. 8, 9 or 10.



G94B46129

Fig. 8: Exploded View Of Starter Assembly (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

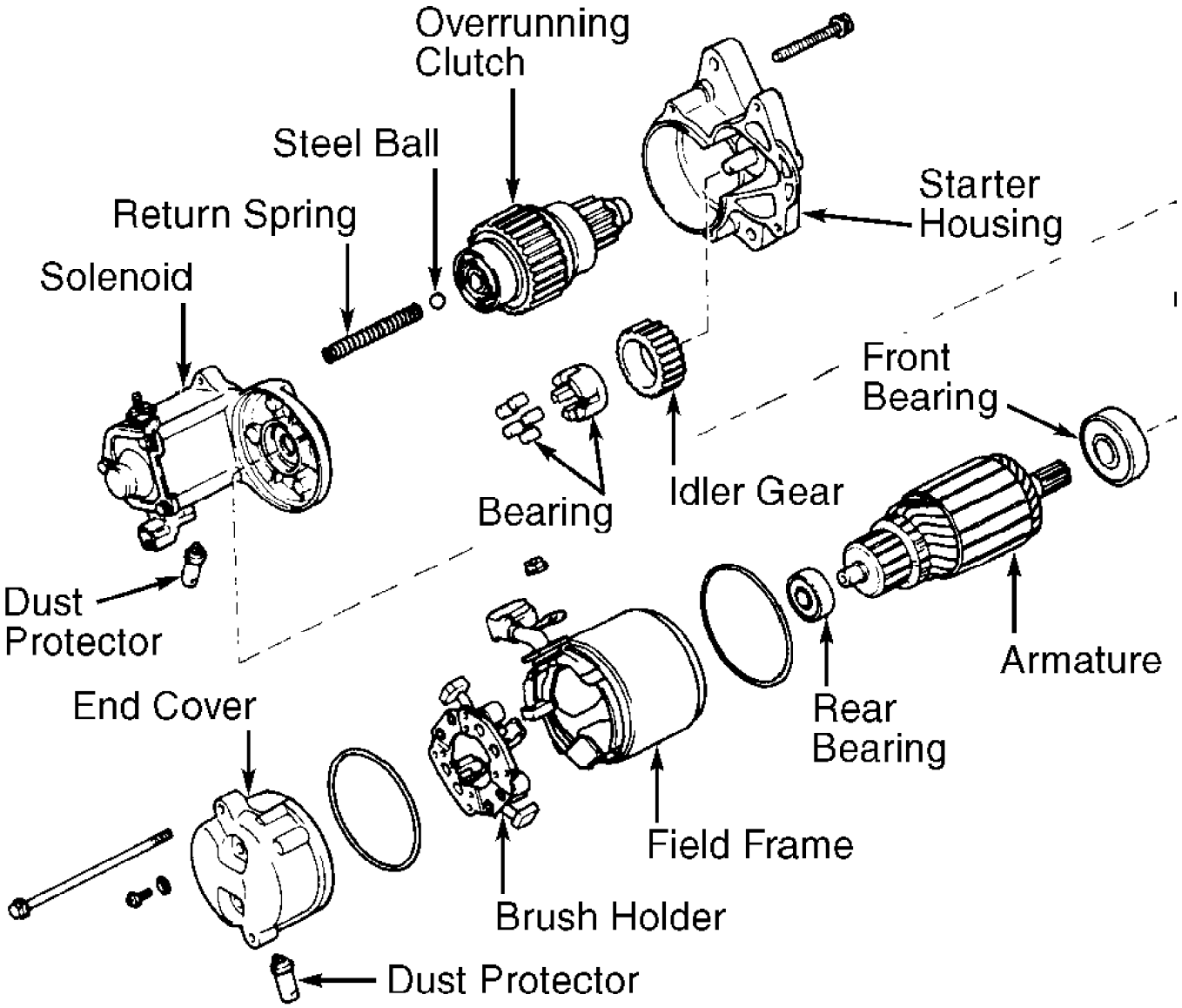
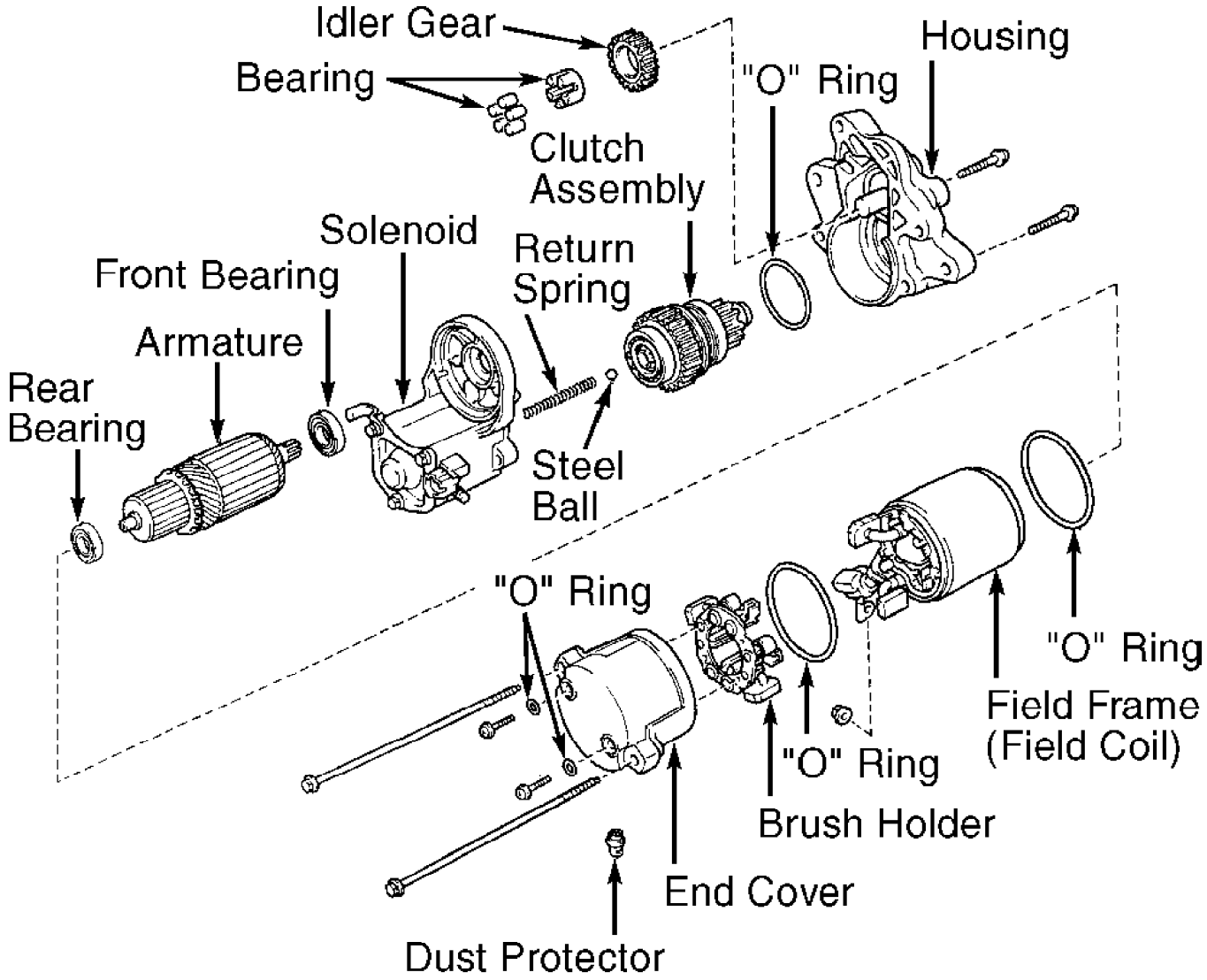


Fig. 9: Exploded View Of Starter Assembly (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G96B07035

Fig. 10: Exploded View Of Starter Assembly (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

STARTER SPECIFICATIONS

STARTER SPECIFICATIONS (ES300, GS300, RX300 & SC300)

Application	Specification
Brush Length	
Standard	.61" (15.5 mm)
Minimum	.39" (10.0 mm)
Brush Spring Tension	3.9-5.3 Lbs. (1.8-2.4 kg)
Commutator Diameter	
Standard	1.18" (30.0 mm)
Minimum	1.14" (29.0 mm)
Commutator Mica Undercut (Minimum) (1)	.008" (.20 mm)
Commutator Runout (Maximum)	.002" (.05 mm)

(1) - Depth of groove between each segment of commutator.

STARTER SPECIFICATIONS (GS400, LS400 & SC400)

Application	Specification
Brush Length	
Standard	.59" (15.0 mm)
Minimum	.35" (9.0 mm)
Brush Spring Tension	4.8-6.2 Lbs. (2.2-2.8 kg)
Commutator Diameter	
Standard	1.38" (35.0 mm)
Minimum	1.34" (34.0 mm)
Commutator Mica Undercut (Minimum) (1)	.008" (.20 mm)
Commutator Runout (Maximum)	.002" (.05 mm)

(1) - Depth of groove between each segment of commutator.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (ES300, GS300, RX300 & SC300)

Application	Ft. Lbs. (N.m)
Starter Bolt	27 (37)
Terminal Nut	13 (18)
	INCH Lbs. (N.m)
Air Cleaner Case Bolt (RX300)	44 (5.0)
End Cover Bolt	22 (2.5)

TORQUE SPECIFICATIONS (GS400, LS400 & SC400)

Application	Ft. Lbs. (N.m)
Coolant By-Pass Pipe Bolt	13 (18)
Fuel Inlet-To-Fuel Main Tube	22 (30)
Intake Manifold Bolt/Nut	13 (18)
Rear Coolant By-Pass Joint Nut	13 (18)
Starter Bolt	
GS400	27 (37)
LS400 & SC400	29 (39)
Terminal Nut	13 (18)
Throttle Body Bolt/Nut	13 (18)
	INCH Lbs. (N.m)
End Cover Bolt	32 (3.6)

WIRING DIAGRAMS

NOTE: For LX470 information, see WIRING DIAGRAMS in STARTERS article in TOYOTA.

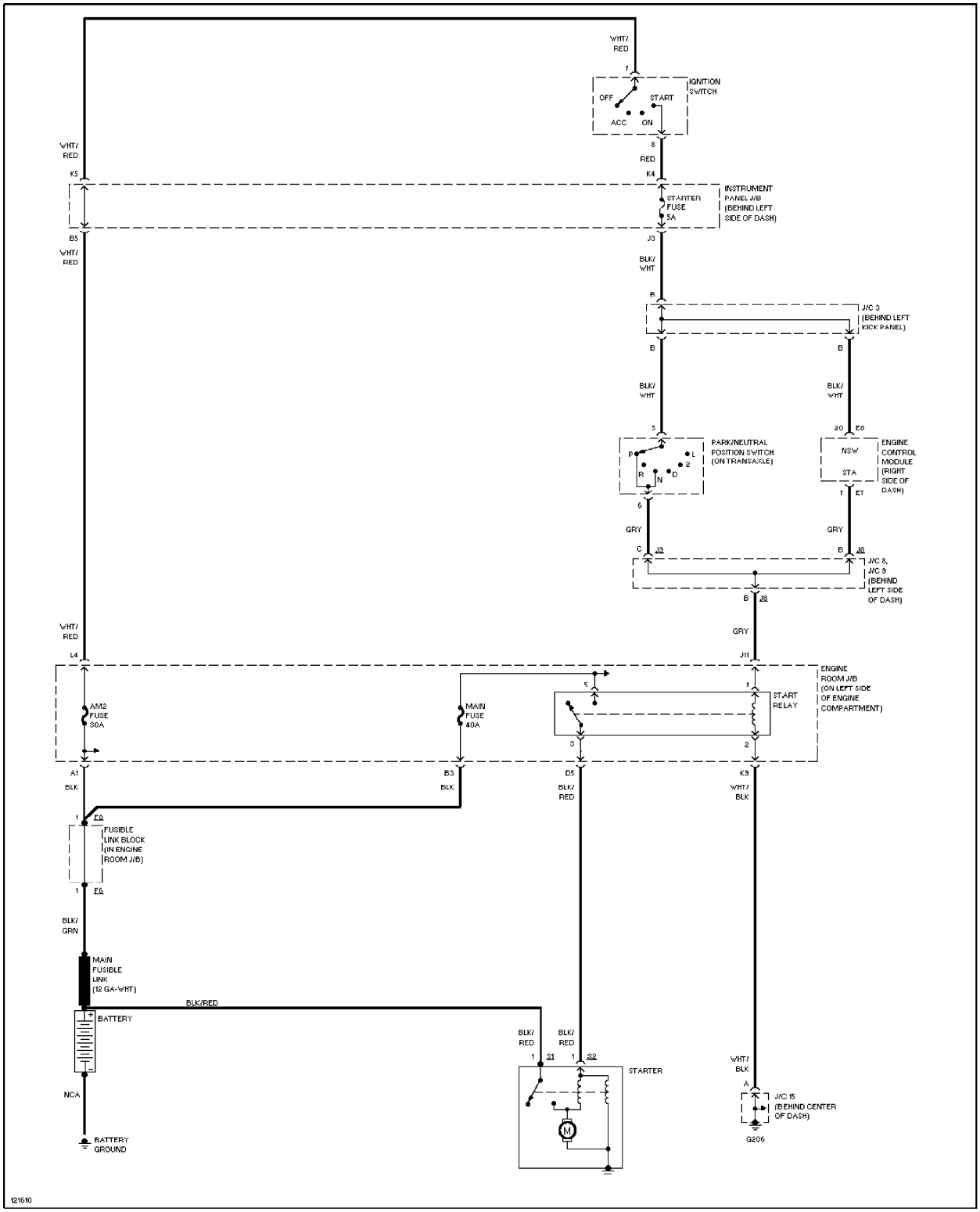


Fig. 11: Starting System Wiring Diagram (ES300)

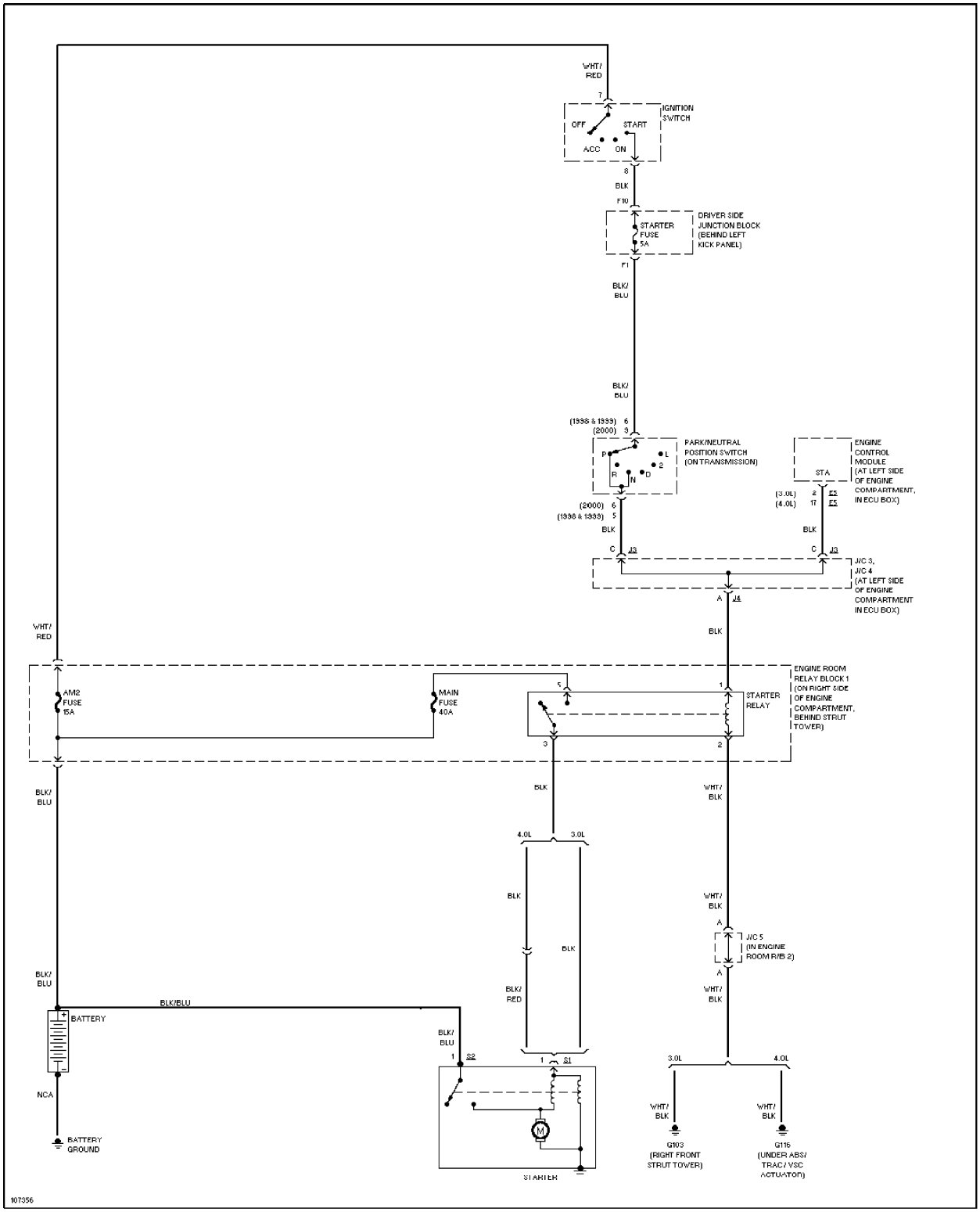


Fig. 12: Starting System Wiring Diagram (GS300 & GS400)

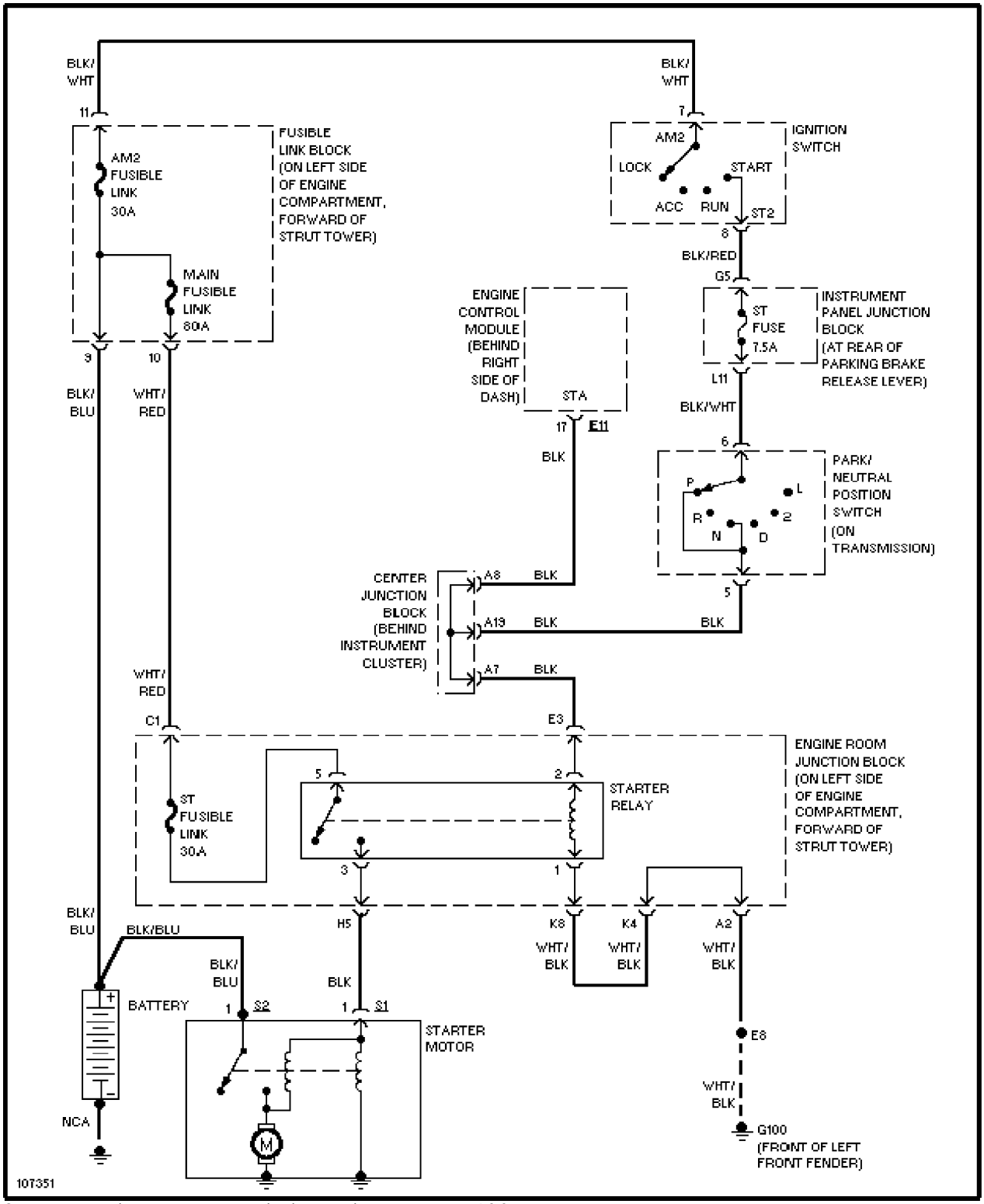


Fig. 13: Starting System Wiring Diagram (LS400)

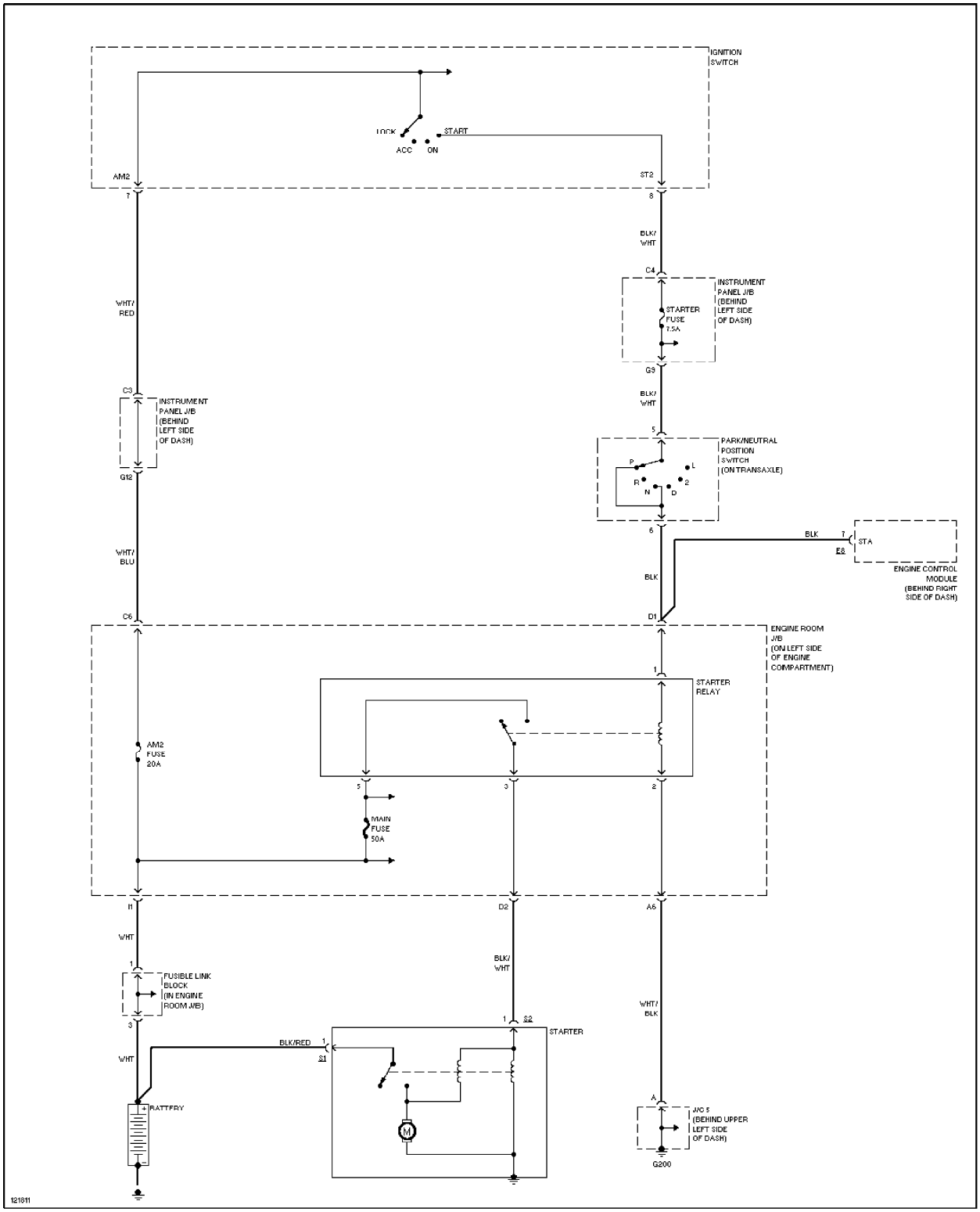


Fig. 14: Starting System Wiring Diagram (RX300)

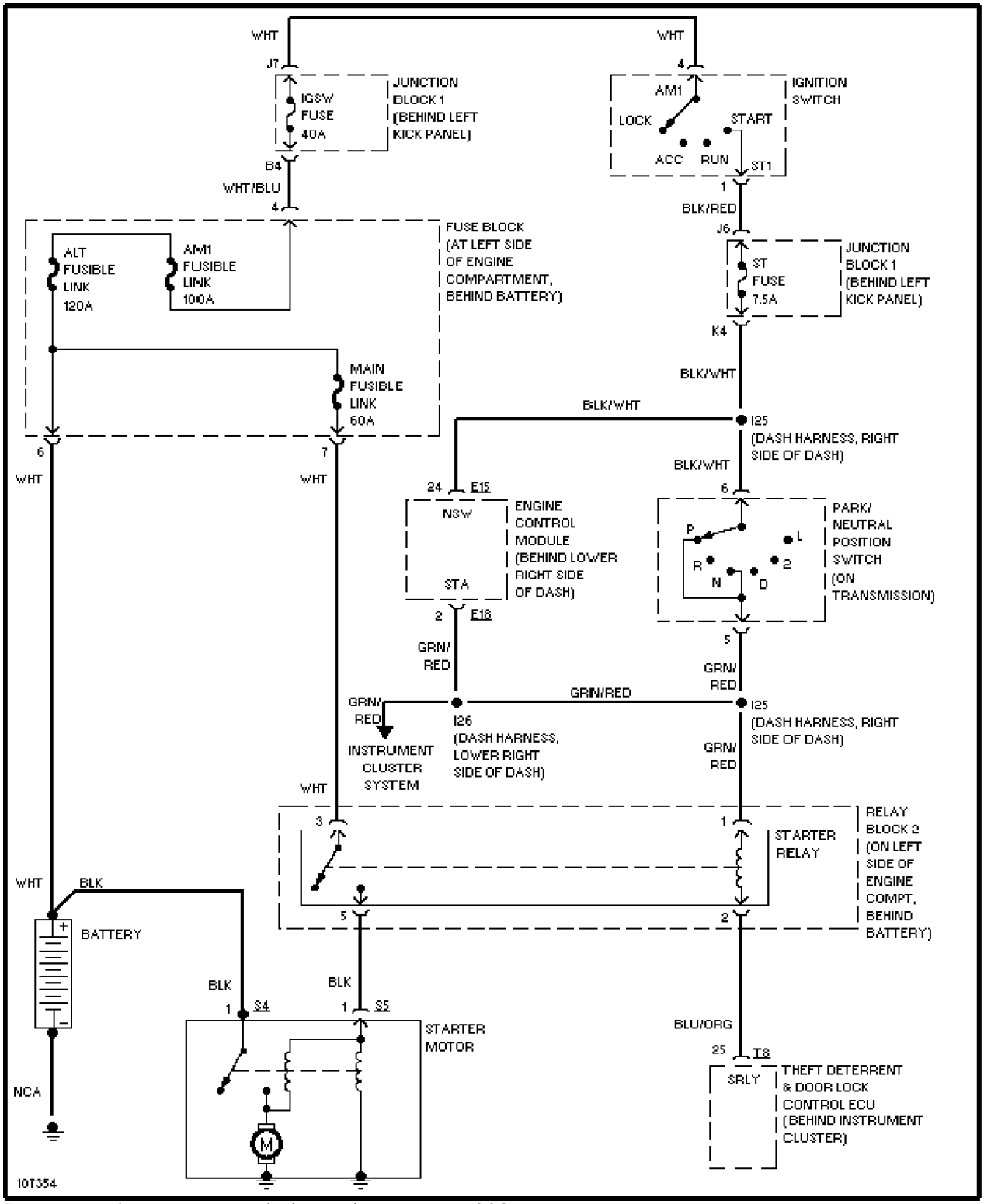


Fig. 15: Starting System Wiring Diagram (SC300)

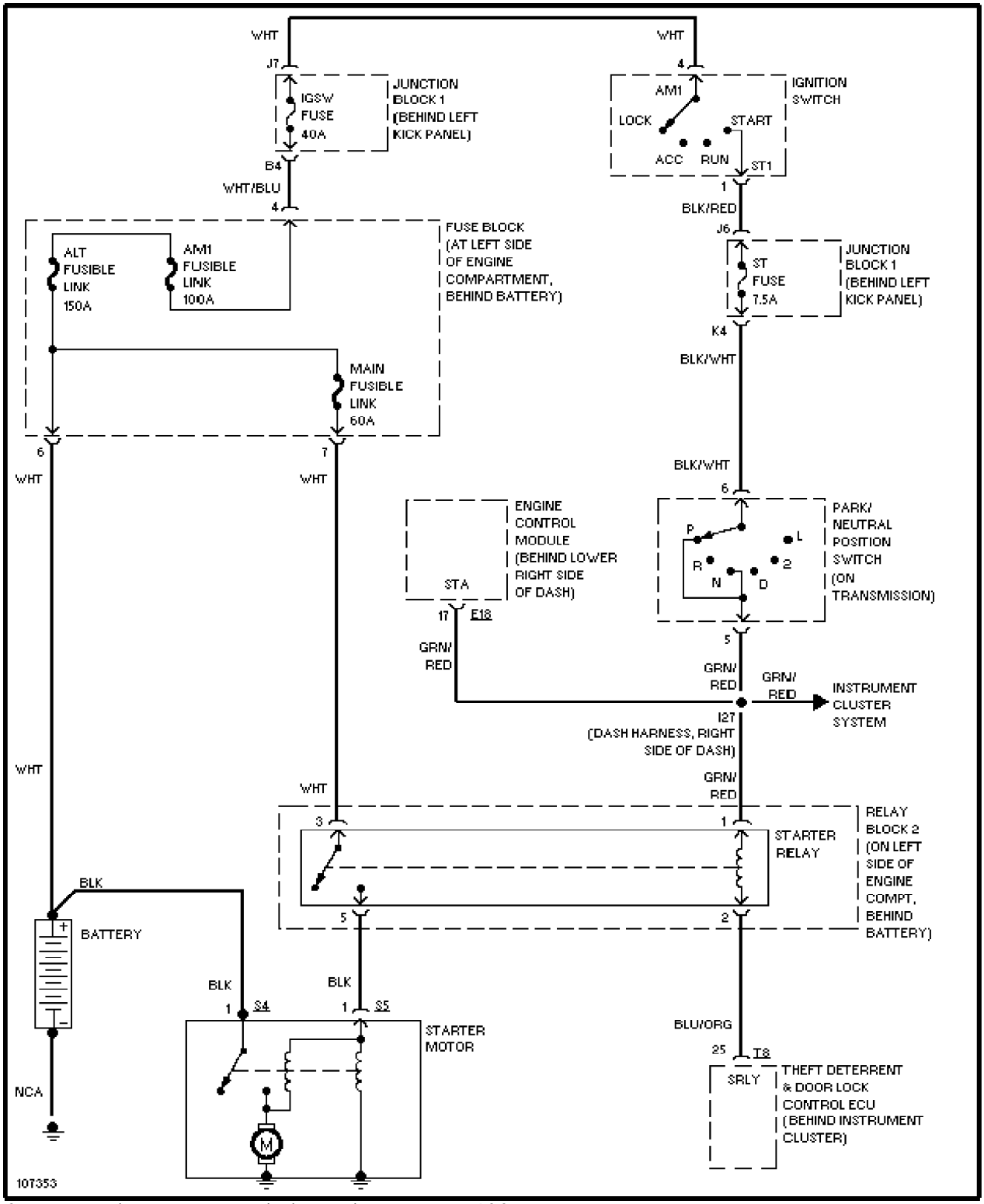


Fig. 16: Starting System Wiring Diagram (SC400)

STEERING COLUMN SWITCHES

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Steering Column Switches
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

DESCRIPTION

Headlight/taillight and turn signal switches (left side of column) and wiper/washer switch (right side of column) are part of the combination switch. Combination switch also includes headlight dimmer and foglight switches (left side of column on headlight switch). Cruise control switch and tilt/telescopic steering column switch are not part of combination switch.

CIRCUIT TESTS

CRUISE CONTROL SWITCH CIRCUIT

For cruise control switch circuit testing procedure, see appropriate CRUISE CONTROL SYSTEMS article.

IGNITION SWITCH CIRCUIT

Turn ignition on. Using DVOM, measure voltage by backprobing rear of ignition switch connector between the following terminals and ground with ignition switch in specified position. See appropriate IGNITION SWITCH CIRCUIT VOLTAGE table. See Fig. 1 or 2. If battery voltage is not present at each terminal, repair wiring harness or replace components as necessary. If battery voltage is present at each terminal, check ignition switch. See IGNITION SWITCH under COMPONENT TESTS.

IGNITION SWITCH CIRCUIT VOLTAGE (ES300 & LS400)

Terminal	Switch Position
1 & Ground	START
2 & Ground	Any Position
3 & Ground	ACC Or ON
4 & Ground	ON
6 & Ground	ON
7 & Ground	Any Position
8 & Ground	START

IGNITION SWITCH CIRCUIT VOLTAGE (GS300, GS400, LX470 & RX300)

Terminal	Switch Position

2 & Ground	Any Position
3 & Ground	ACC Or ON
4 & Ground	ON
6 & Ground	ON Or START
7 & Ground	Any Position
8 & Ground	START

IGNITION SWITCH CIRCUIT VOLTAGE (SC300 & SC400)

Terminal	Switch Position
2 & Ground	ON
3 & Ground	ACC Or ON
4 & Ground	Any Position
5 & Ground	START
6 & Ground	ON
11 & Ground	Any Position

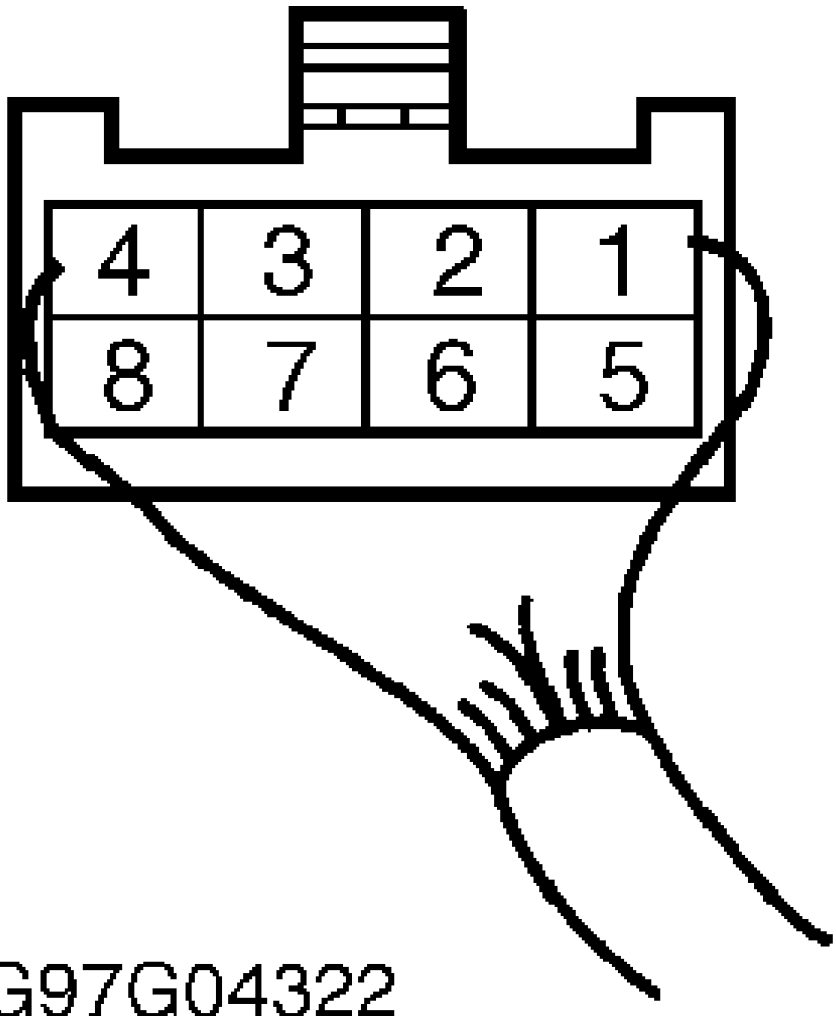
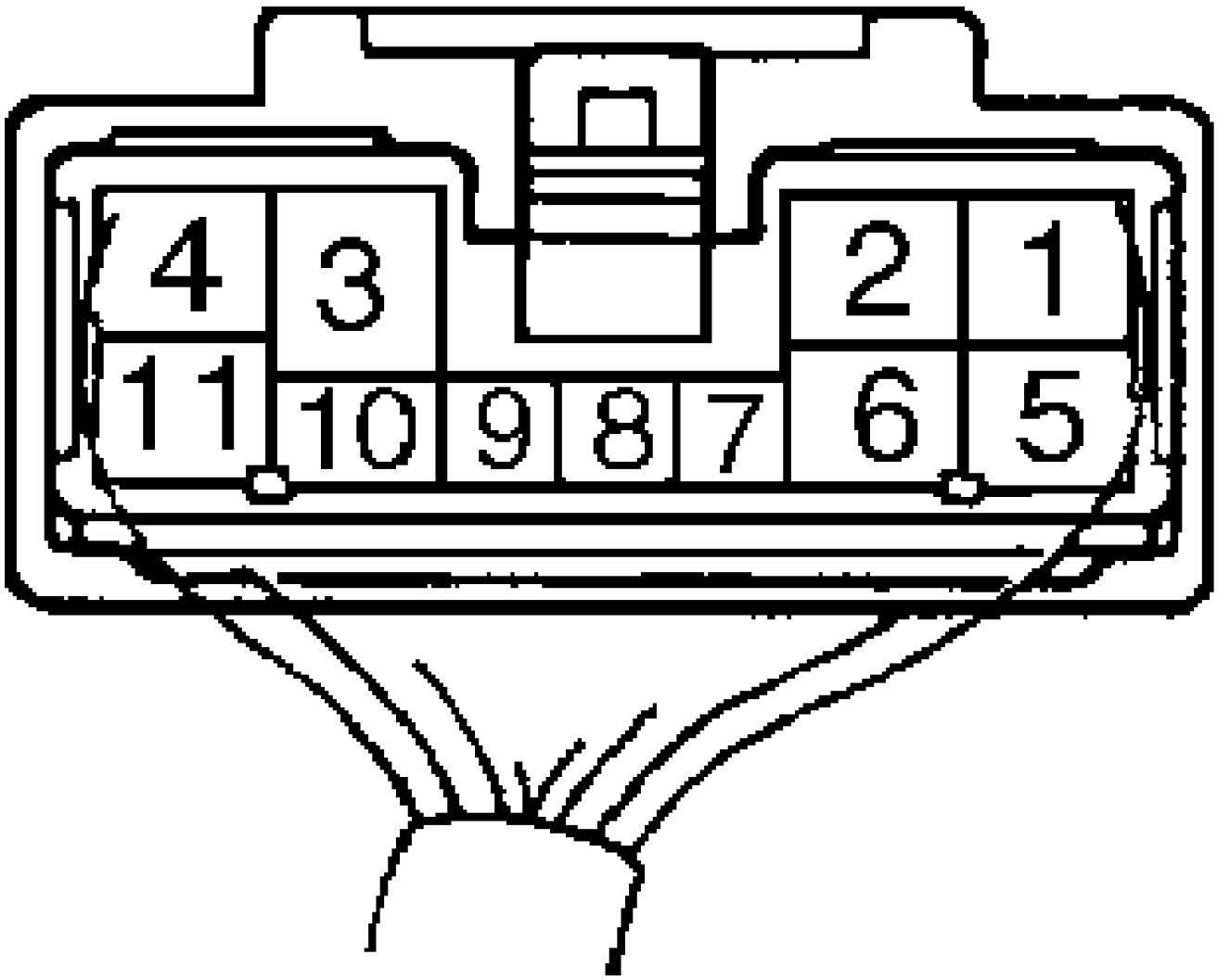


Fig. 1: Identifying Ignition Switch Connector Terminals (ES300, GS300, GS400, LS400, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G99A50138

Fig. 2: Identifying Ignition Switch/Key Unlock Warning Switch Connector Terminals (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

KEY UNLOCK WARNING SWITCH CIRCUIT

ES300, GS300, GS400, LS400, LX470 & RX300

Turn ignition off. Using DVOM, check continuity by backprobing rear of key unlock warning switch connector between specified terminals and ground with ignition key as specified. See KEY UNLOCK WARNING SWITCH CIRCUIT CONTINUITY (ES300, GS300, GS400, LS400, LX470 & RX300) table. See Fig. 3 or 4. If continuity is not as specified, repair wiring harness or replace components as necessary. If continuity is as specified, check key unlock warning switch. See KEY UNLOCK WARNING SWITCH under COMPONENT TESTS.

KEY UNLOCK WARNING SWITCH CIRCUIT CONTINUITY (ES300, GS300, GS400, LS400, LX470 & RX300)

Terminal	Condition	Continuity
1 & Ground	All Conditions	Yes
2 & Ground	Ignition Key Removed	No
2 & Ground	Ignition Key Set	Yes

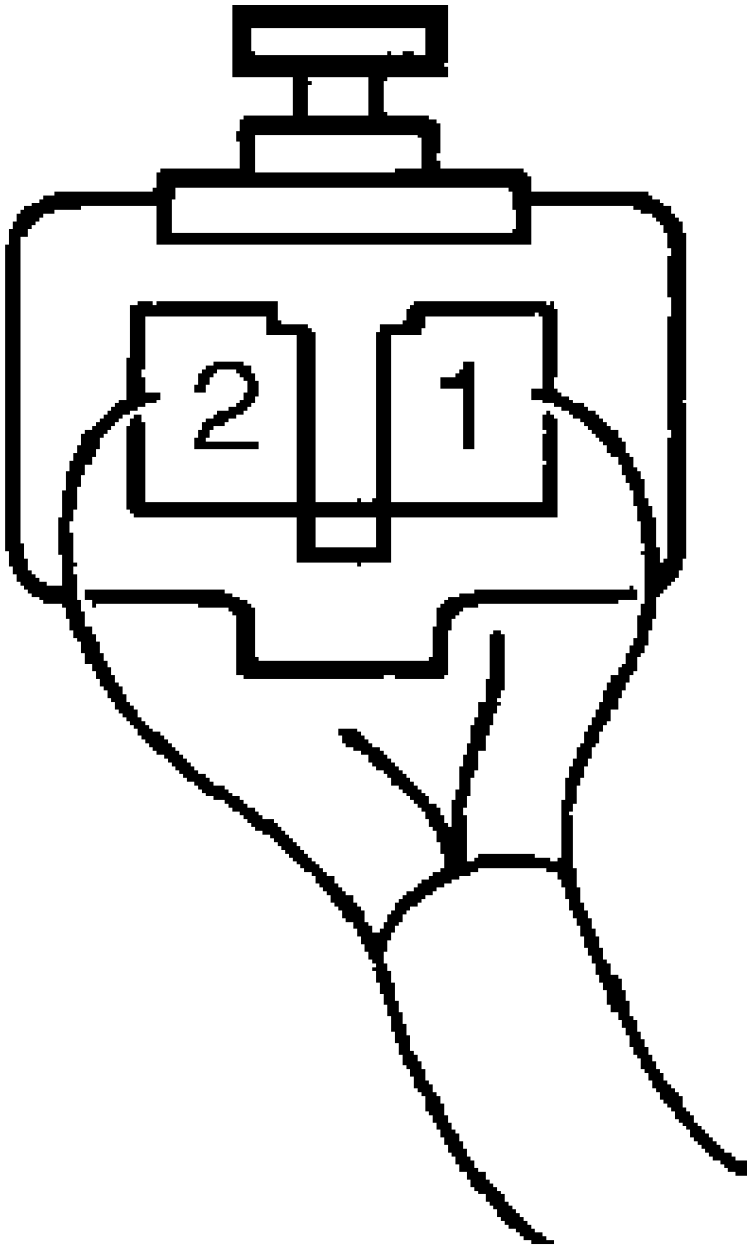


Fig. 3: Identifying Key Unlock Warning Switch Connector Terminals (ES300, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

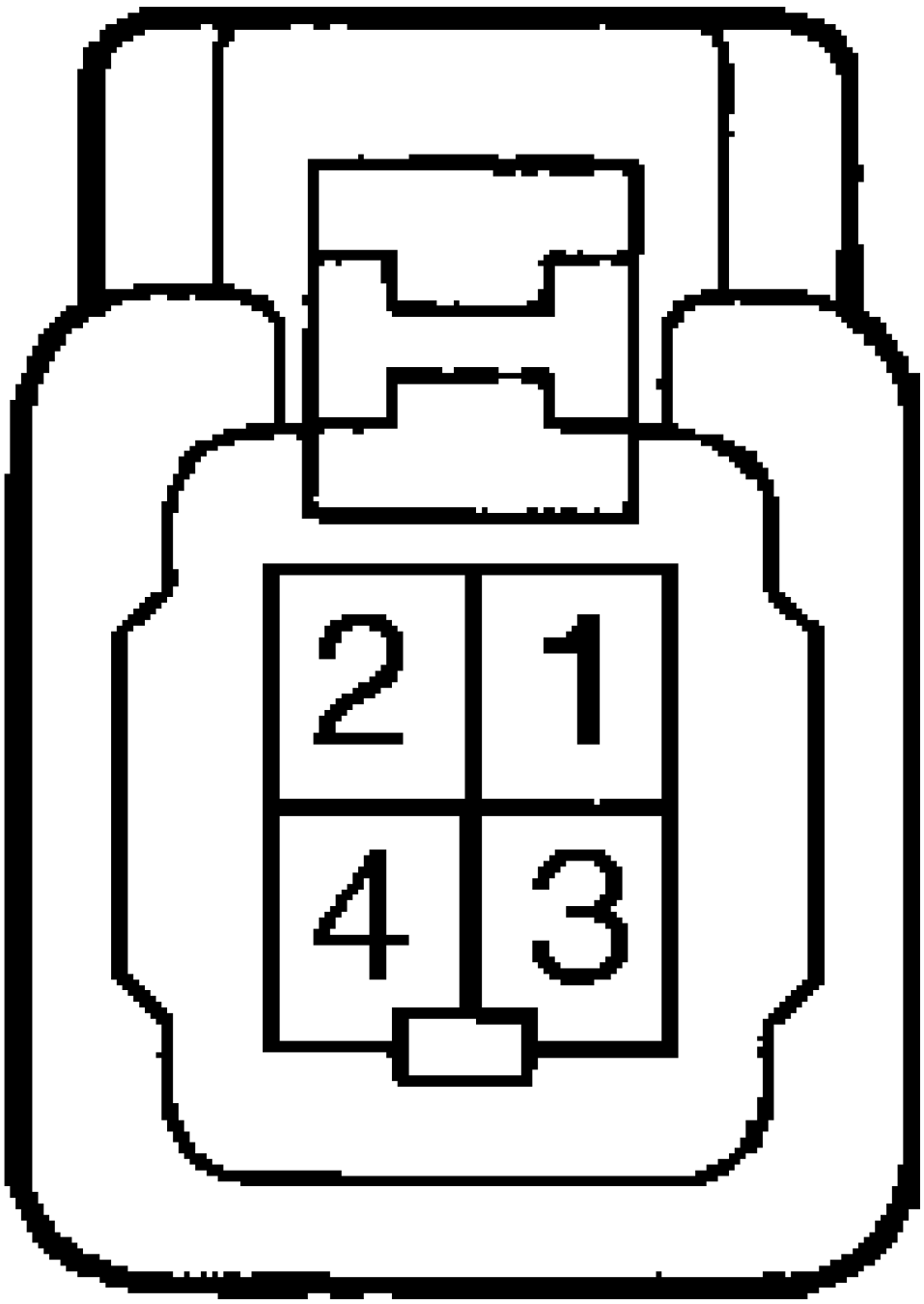


Fig. 4: Identifying Key Unlock Warning Switch Connector Terminals (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SC300 & SC400

Turn ignition off. Using DVOM, check continuity by backprobing rear of ignition switch/key unlock warning switch connector between specified terminals and ground with ignition key as specified. See KEY UNLOCK WARNING SWITCH CIRCUIT CONTINUITY (SC300 & SC400) table. See Fig. 2. If continuity is not as specified, repair wiring harness or replace components as necessary. If continuity is as specified, check key unlock warning switch. See KEY UNLOCK WARNING SWITCH under COMPONENT TESTS.

KEY UNLOCK WARNING SWITCH CIRCUIT CONTINUITY (SC300 & SC400)

Terminal	Condition	Continuity
9 & Ground	All Conditions	Yes
10 & Ground	Ignition Key Removed	No
10 & Ground	Ignition Key Set	Yes

LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT

ES300, LX470 & RX300

1) Turn ignition off. Disconnect 17-pin combination switch connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 16 (White/Black wire) and ground. If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch and ground connection. Retest system operation.

2) Using an ohmmeter, check continuity between connector (harness side) terminals No. 10 (Red/Blue wire on ES300 and LX470; Light Green wire on RX300) and No. 17 (Red/Blue wire on ES300 and LX470; Light Green wire on RX300). If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch. Retest system operation.

3) Reconnect 17-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with light control/dimmer/foglight switch in specified position. See appropriate LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE table. See Fig. 5. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check light control/dimmer/foglight switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (ES300 & RX300)

Terminal	Switch Position	Voltage
7 & Ground	Low Beam	Zero
7 & Ground	High Beam Or Flash	Battery
8 & Ground	Low Beam Or High Beam	Zero
8 & Ground	Flash	Battery
10 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
10 & Ground	HEAD, High Beam Or Flash & Fog Light Switch ON	Battery
11 & Ground	OFF Or TAIL	Zero
11 & Ground	HEAD	Battery
12 & Ground	OFF, TAIL Or HEAD	Zero
12 & Ground	AUTO	Battery
13 & Ground	OFF Or TAIL	Zero
13 & Ground	HEAD	Battery
14 & Ground	OFF	Zero
14 & Ground	TAIL Or HEAD	Battery

17 & Ground	High Beam Or Flash	Zero
17 & Ground	Low Beam	Battery

LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (LX470)

Terminal	Switch Position	Voltage
8 & Ground	Flash	Zero
8 & Ground	Low Beam Or High Beam	Battery
10 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
10 & Ground	HEAD, High Beam Or Flash & Fog Light Switch ON	Battery
11 & Ground	OFF Or TAIL	Zero
11 & Ground	HEAD	Battery
13 & Ground	HEAD	Zero
13 & Ground	OFF Or TAIL	Battery
13 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
13 & Ground	HEAD, High Beam Or Flash, & Fog Light Switch ON	Battery
14 & Ground	OFF	Battery
14 & Ground	TAIL Or HEAD	Zero

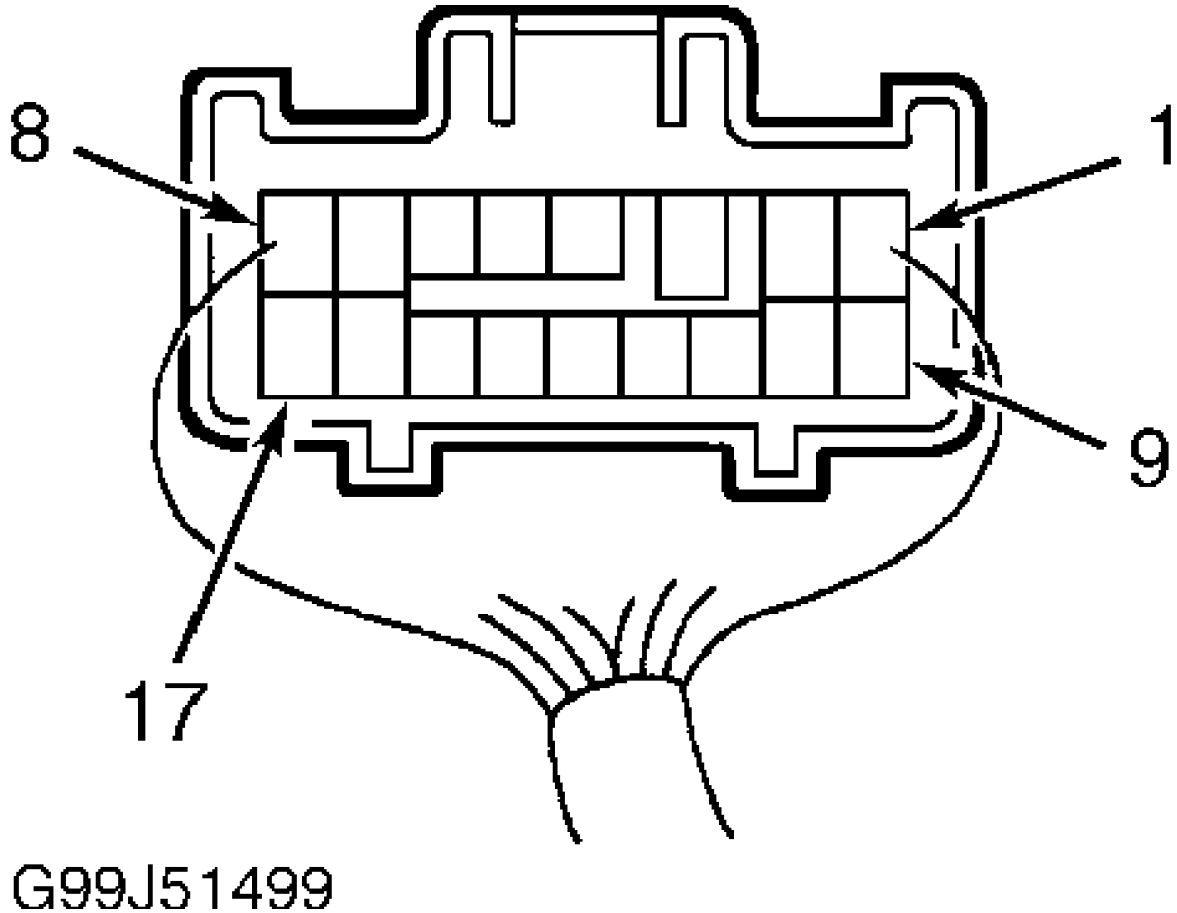


Fig. 5: Identifying Combination Switch Connector Terminals (ES300, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

1) Turn ignition off. Disconnect 18-pin combination switch connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 16 (White/Black wire) and ground. Also, check continuity between connector (harness side) terminal No. 17 (White/Black wire) and ground. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between combination switch and ground connection. Retest system operation.

2) Using an ohmmeter, check continuity between connector (harness side) terminals No. 11 (Green/Black wire) and No. 18 (Green/Black wire). If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch. Retest system operation.

3) Reconnect 18-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with light control/dimmer/foglight switch in specified position. See LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (GS300 & GS400) table. See Fig. 6. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check light control/dimmer/foglight switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (GS300 & GS400)

Terminal	Switch Position	Voltage
8 & Ground	Flash Or HEAD & High Beam	Zero
8 & Ground	HEAD & Low Beam	Battery
9 & Ground	HEAD	Battery
11 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
11 & Ground	HEAD, High Beam Or Flash & Fog Light Switch ON	Battery
12 & Ground	OFF Or TAIL	Zero
12 & Ground	HEAD	Battery
13 & Ground	OFF, TAIL Or HEAD	Zero
13 & Ground	AUTO	Battery
14 & Ground	OFF Or TAIL	Zero
14 & Ground	HEAD	Battery
15 & Ground	OFF	Zero
15 & Ground	TAIL Or HEAD	Battery
18 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
18 & Ground	HEAD, High Beam Or Flash, & Fog Light Switch ON	Battery

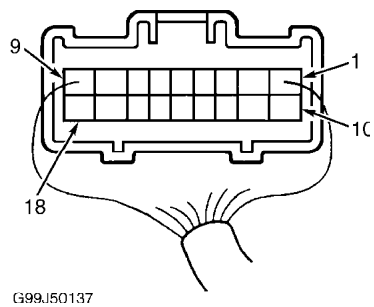


Fig. 6: Identifying Combination Switch Connector Terminals (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LS400

1) Turn ignition off. Disconnect 18-pin combination switch connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 16 (White/Black wire) and ground. Also, check continuity between connector (harness side) terminal No. 17 (White/Black wire) and ground. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between combination switch and ground connection. Retest system operation.

2) Using an ohmmeter, check continuity between connector (harness side) terminals No. 11 (Blue wire) and No. 18 (Blue wire). If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch. Retest system operation.

NOTE: Light control switch is controlled by the body control Electronic Control Unit (ECU). For circuit testing procedure, see BODY CONTROL SYSTEMS - LS400 article. Proceed with step 2) for dimmer/foglight switch circuit testing.

3) Turn ignition off. Reconnect 18-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with dimmer/foglight switch in specified position. See DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (LS400) table. See Fig. 6. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check dimmer/foglight switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (LS400)

Terminal	Switch Position	Voltage
8 & Ground	HEAD & Low Beam	Zero
8 & Ground	Flash Or HEAD & High Beam	Battery
9 & Ground	Any Position	Battery
11 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
11 & Ground	HEAD, High Beam Or Flash & Fog Light Switch ON	Battery
12 & Ground	OFF Or TAIL	Zero
12 & Ground	HEAD	Battery
18 & Ground	HEAD & High Beam Or Flash	Zero
18 & Ground	HEAD & Low Beam	Battery

SC300 & SC400

1) Turn ignition off. Disconnect 14-pin combination switch connector "A" and 18-pin combination switch connector "B". Using an ohmmeter, check continuity between connector "B" (harness side) terminal No. 4 (White/Black wire) and ground. Also, check continuity between connector "B" (harness side) terminal No. 18 (White/Black wire) and ground. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between combination switch and ground connection. Retest system operation.

2) Using an ohmmeter, check continuity between connector "A" (harness side) terminal No. 10 (Green/White wire) and connector "B" (harness side) terminal No. 1 (Green/White wire). If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch. Retest system operation.

3) Turn ignition off. Reconnect 14-pin and 18-pin combination switch connectors. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following

terminals and ground with light control/dimmer/foglight switch in specified position. See LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (SC300 & SC400) table. See Fig. 7. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check combination switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

LIGHT CONTROL/DIMMER/FOGLIGHT SWITCH CIRCUIT VOLTAGE (SC300 & SC400)

Terminals	Switch Position	Voltage
A10 & Ground	HEAD, Low Beam & Fog Light Switch ON	Zero
A10 & Ground	HEAD, High Beam Or Flash & Fog Light Switch ON	Battery
A11 & Ground	OFF Or TAIL	Zero
A11 & Ground	HEAD	Battery
B7 & Ground	Any Position Except Flash	Battery
B9 & Ground	OFF Or TAIL	Zero
B9 & Ground	HEAD	Battery

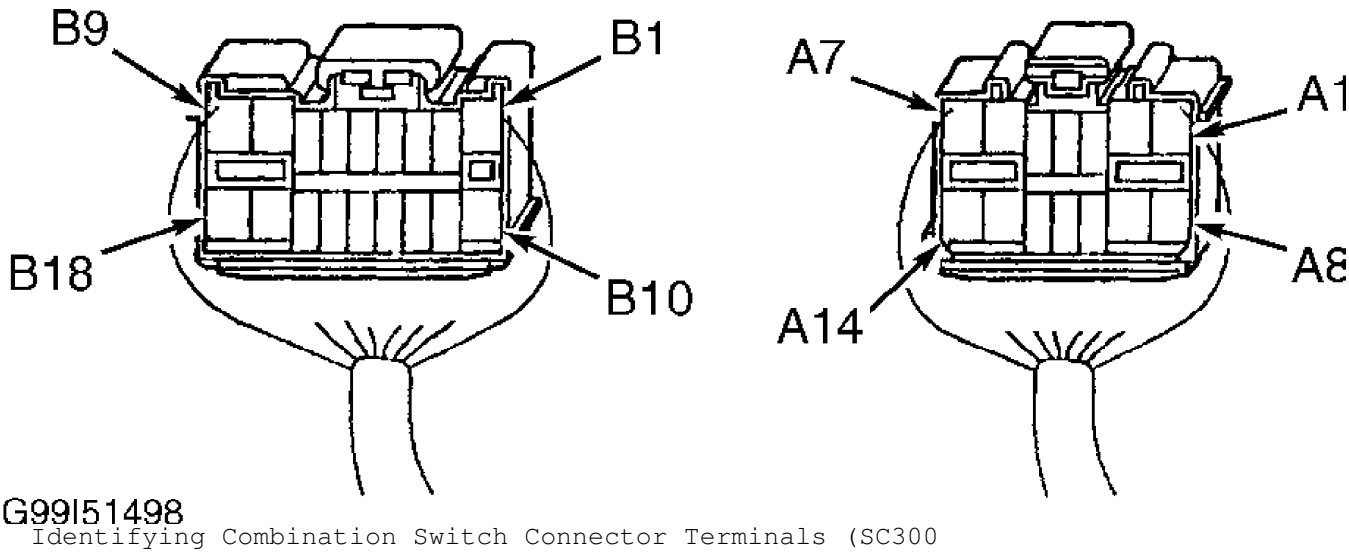


Fig. 7: Identifying Combination Switch Connector Terminals (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TILT/TELESCOPIC STEERING COLUMN SWITCH CIRCUIT

For tilt/telescopic steering column switch circuit testing procedure, see appropriate POWER TILT STEERING COLUMN SYSTEMS article.

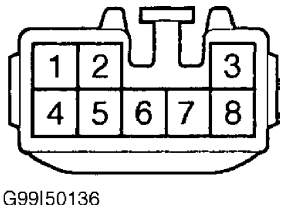


Fig. 8: Identifying Turn Signal Flasher Connector Terminals (GS300, GS400, LS400, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TURN SIGNAL FLASHER CIRCUIT

ES300, SC300 & SC400

1) Turn ignition off. Remove turn signal flasher. Using an ohmmeter, check continuity between connector (harness side) terminal No. 3 (White/Black wire) and ground. Also, check continuity between connector (harness side) terminal No. 2 (Green/Red wire on ES300; White/Red wire on SC300 and SC400) and ground with hazard warning switch on and ignition on. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between turn signal flasher, hazard warning switch and ground connection. Retest system operation.

2) Turn ignition on. Using a voltmeter, measure voltage between connector (harness side) terminal No. 1 (Green/White wire on ES300; Red/Black wire on SC300 and SC400) and ground with hazard warning switch on and ignition on. If battery voltage is present, check turn signal flasher. See TURN SIGNAL FLASHER under COMPONENT TESTS. If battery voltage is not present, repair wire harness between turn signal flasher and hazard warning switch. Retest system operation.

GS300, GS400, LS400, LX470 & RX300

1) Turn ignition off. Disconnect 8-pin turn signal flasher connector. Turn ignition on. Using a voltmeter, measure voltage between specified terminals of connector (harness side) and ground with ignition switch in specified position. See TURN SIGNAL FLASHER CIRCUIT VOLTAGE table. See Fig. 8. If voltages are as specified, go to next step. If voltages are not as specified, repair wiring harness or replace components as necessary. Retest system operation.

TURN SIGNAL FLASHER CIRCUIT VOLTAGE

Terminal	Switch Position	Voltage
1 & Ground	LOCK Or ACC	Zero
1 & Ground	ON	Battery
4 & Ground	Any Position	Battery

2) Turn ignition off. Using an ohmmeter, check continuity between specified terminals of connector (harness side) and ground with specified switches in specified positions. See TURN SIGNAL FLASHER CIRCUIT CONTINUITY table. See Fig. 8. If continuity is as specified, replace turn signal flasher. Retest system operation. If continuity is not as specified, repair wiring harness or replace components as necessary. Retest system operation.

TURN SIGNAL FLASHER CIRCUIT CONTINUITY

Terminal	Switch Position	Continuity
2 & Ground	Any Position	Yes
3 & Ground	Any Position	Yes
5 & Ground	Turn Signal Switch In Right Or Off	No
5 & Ground	Turn Signal Switch In Left	Yes
6 & Ground	Turn Signal Switch In Left Or Off	No
6 & Ground	Turn Signal Switch In Right	Yes
7 & Ground	Any Position	Yes
8 & Ground	Hazard Warning Switch Off	No
8 & Ground	Hazard Warning Switch On	Yes

TURN SIGNAL SWITCH CIRCUIT

NOTE: Turn signals are grounded through turn signal lights.

ES300

1) Turn ignition off. Disconnect 17-pin combination switch connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 1 (Green/Black wire) and ground. Also, check continuity between connector (harness side) terminal No. 3 (Green/Yellow wire) and ground. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between combination switch and turn signal lights. Retest system operation.

2) Reconnect 17-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with turn signal switch in specified position. See TURN SIGNAL SWITCH CIRCUIT VOLTAGE (ES300) table. See Fig. 5. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check turn signal switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

TURN SIGNAL SWITCH CIRCUIT VOLTAGE (ES300)

Terminals	Switch Position	Voltage
2 & Ground	Ignition On & Turn Signal Switch In Neutral Position	Zero
2 & Ground	Hazard Warning Switch On	Battery
2 & Ground	Ignition On & Turn Signal Switch In Right Or Left Position	Battery

GS300, GS400 & LS400

1) Turn ignition off. Disconnect 18-pin combination switch connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 2 (White/Black wire) and ground. If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch and ground connection. Retest system operation.

2) Reconnect 18-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with turn signal switch in specified position. See TURN SIGNAL SWITCH CIRCUIT VOLTAGE (GS300, GS400 & LS400) table. See Fig. 6. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check turn signal switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

TURN SIGNAL SWITCH CIRCUIT VOLTAGE (GS300, GS400 & LS400)

Terminals	Switch Position	Voltage
1 & Ground	Ignition On & Turn Signal Switch In Left Position	Battery
2 & Ground	Ignition On & Turn Signal Switch In Neutral Position	Zero
3 & Ground	Ignition On & Turn Signal Switch In Right Position	Battery

LX470 & RX300

1) Turn ignition off. Disconnect 17-pin combination switch

connector. Using an ohmmeter, check continuity between connector (harness side) terminal No. 2 (White/Black wire) and ground. If continuity exists, go to next step. If continuity does not exist, repair wire harness between combination switch and ground connection. Retest system operation.

2) Reconnect 17-pin combination switch connector. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with turn signal switch in specified position. See TURN SIGNAL SWITCH CIRCUIT VOLTAGE (LX470 & RX300) table. See Fig. 5. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check turn signal switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

TURN SIGNAL SWITCH CIRCUIT VOLTAGE (LX470 & RX300)

Terminals	Switch Position	Voltage
1 & Ground	Ignition On & Turn Signal Switch In Left Position	Battery
2 & Ground	Ignition On & Turn Signal Switch In Neutral Position	Zero
3 & Ground	Ignition On & Turn Signal Switch In Right Position	Battery

NOTE: Turn signals are grounded through turn signal lights.

SC300 & SC400

1) Turn ignition off. Disconnect 14-pin combination switch connector "A" and 18-pin combination switch connector "B". Using an ohmmeter, check continuity between connector "A" (harness side) terminal No. 7 (Green/Yellow wire) and ground. Also, check continuity between connector "A" (harness side) terminal No. 14 (Green/Black wire) and ground with hazard switch in ON position. If continuity exists at both terminals, go to next step. If continuity does not exist at either terminal, repair wire harness between combination switch and turn signal lights. Retest system operation.

2) Turn ignition off. Reconnect 14-pin and 18-pin combination switch connectors. Turn ignition on. Using DVOM, measure voltage by backprobing rear of combination switch connector between the following terminals and ground with turn signal switch in specified position. See TURN SIGNAL SWITCH CIRCUIT VOLTAGE (SC300 & SC400) table. See Fig. 7. If voltages are not as specified, repair wiring harness or replace components as necessary. If voltages are as specified, check turn signal switch. See COMBINATION SWITCH under COMPONENT TESTS. Replace combination switch as necessary. Retest system operation.

TURN SIGNAL SWITCH CIRCUIT VOLTAGE (SC300 & SC400)

Terminals	Switch Position	Voltage
B10 & Ground	Ignition On & Turn Signal Switch In Neutral Position	Zero
B10 & Ground	Hazard Warning Switch On	Battery
B10 & Ground	Ignition On & Turn Signal Switch In Right Or Left Position	Battery

WIPER/WASHER SWITCH CIRCUIT

For wiper/washer switch circuit testing procedure, see

appropriate WIPER/WASHER SYSTEMS article.

COMPONENT TESTS

COMBINATION SWITCH

Remove steering column covers. Disconnect electrical connectors from combination switch. Using an ohmmeter, check for continuity between specified terminals of combination switch with specified switch in specified position. See appropriate COMBINATION SWITCH CONTINUITY table. See Fig. 9, 10 or 11. If continuity does not exist, replace combination switch.

COMBINATION SWITCH CONTINUITY (ES300, LX470 & RX300)

Switch Position	Terminals
Light Control (Headlight/Taillight) Switch	
Off	(1)
Tail	14 & 16
Head	13, 14 & 16
Auto	12 & 16
Dimmer Switch	
Flash-To-Pass	7, 8 & 16
Low Beam	16 & 17
Foglight Switch	
Off	(1)
On	10 & 11
High Beam	7 & 16
Turn Signal Switch	
Left	1 & 2
Neutral	(1)
Right	2 & 3

(1) - Continuity should not exist between any terminals.

COMBINATION SWITCH CONTINUITY (GS300, GS400 & LS400)

Switch Position	Terminals
Light Control (Headlight/Taillight) Switch	
Off	(1)
Tail	15 & 16
Head	14, 15 & 16
Auto	13 & 16
Dimmer Switch	
Flash-To-Pass	8, 9 & 17
Low Beam	17 & 18
High Beam	8 & 17
Foglight Switch	
Off	(1)
On	11 & 12
Turn Signal Switch	
Left	1 & 2
Neutral	(1)
Right	2 & 3

(1) - Continuity should not exist between any terminals.

COMBINATION SWITCH CONTINUITY (SC300 & SC400)

Switch Position	Terminals
Light Control (Headlight/Taillight) Switch	
Off	(1)
Tail	B3 & B4
Head	B3, B4 & B13
Auto	B4 & B12
Dimmer Switch	
Flash-To-Pass	B7, B9 & B18
Low Beam	B1 & B18
High Beam	B9 & B18
Foglight Switch	
Off	(1)
On	A10 & A11
Turn Signal Switch	
Left	A14 & B10
Neutral	(1)
Right	A7 & B10

(1) - Continuity should not exist between any terminals.

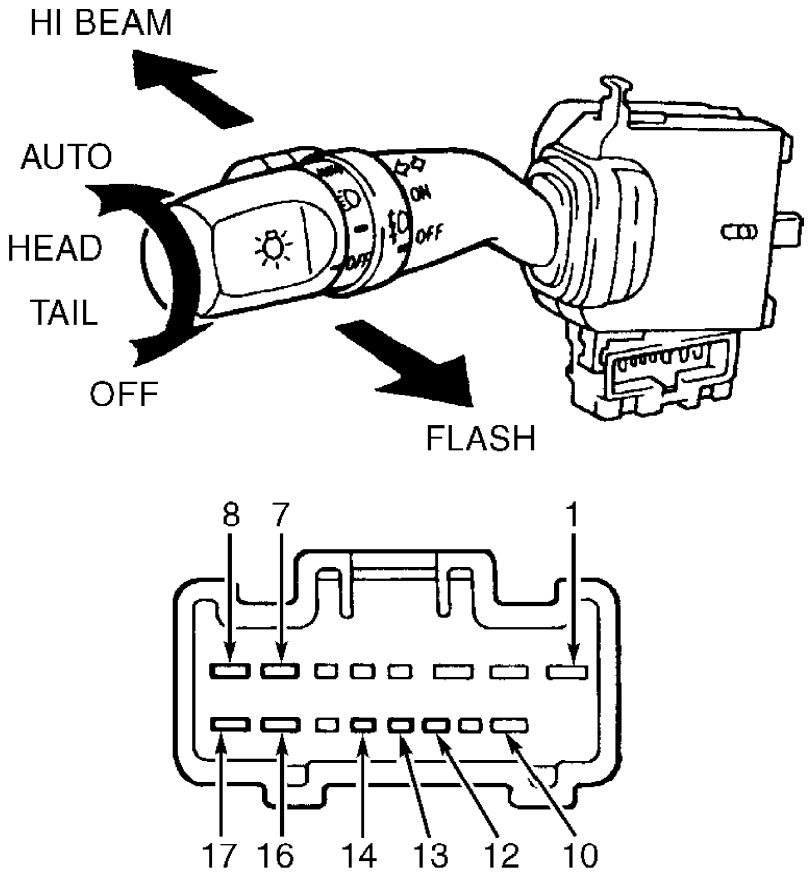
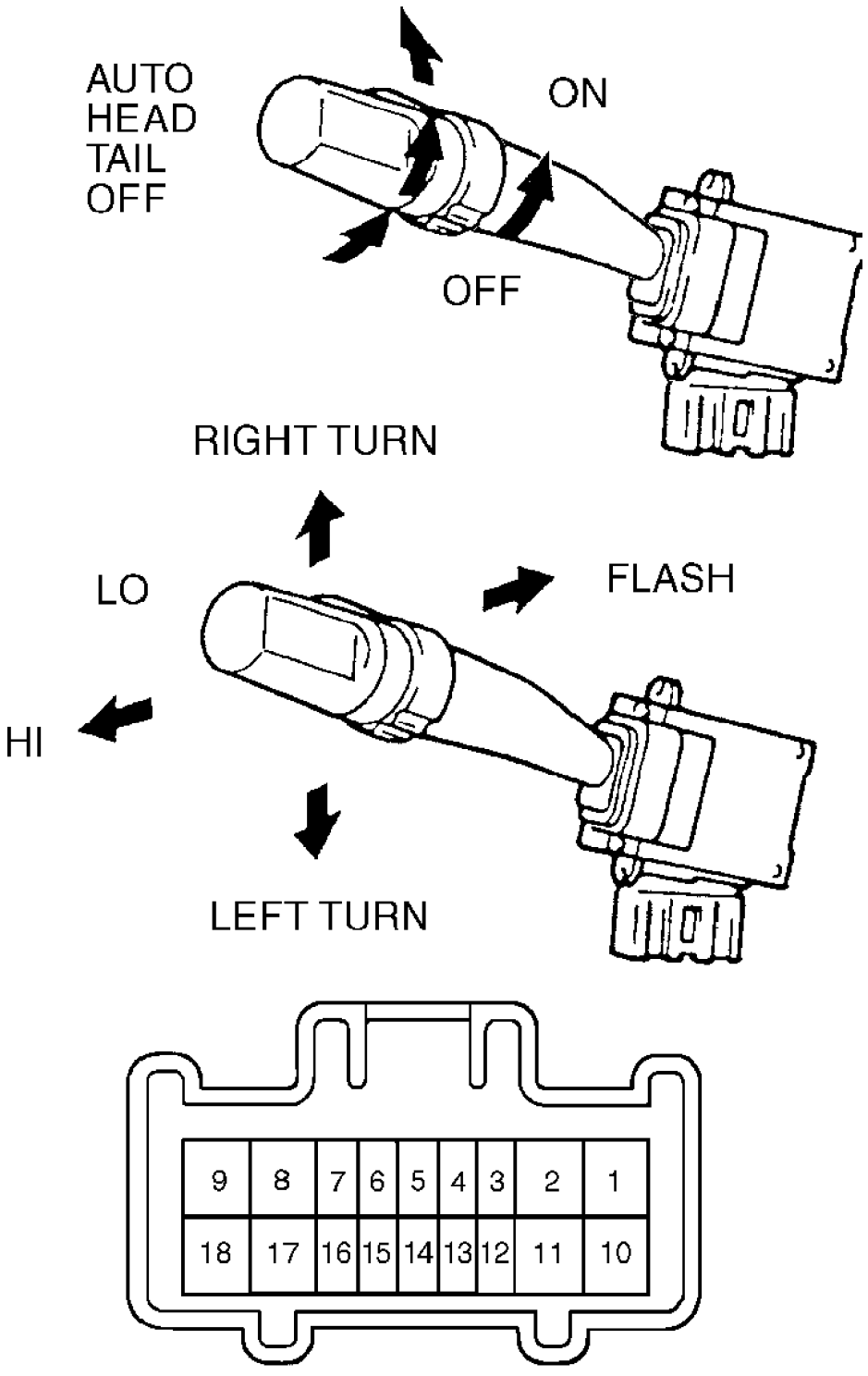


Fig. 9: Testing Combination Switch (ES300, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G96J07647

Fig. 10: Testing Combination Switch (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

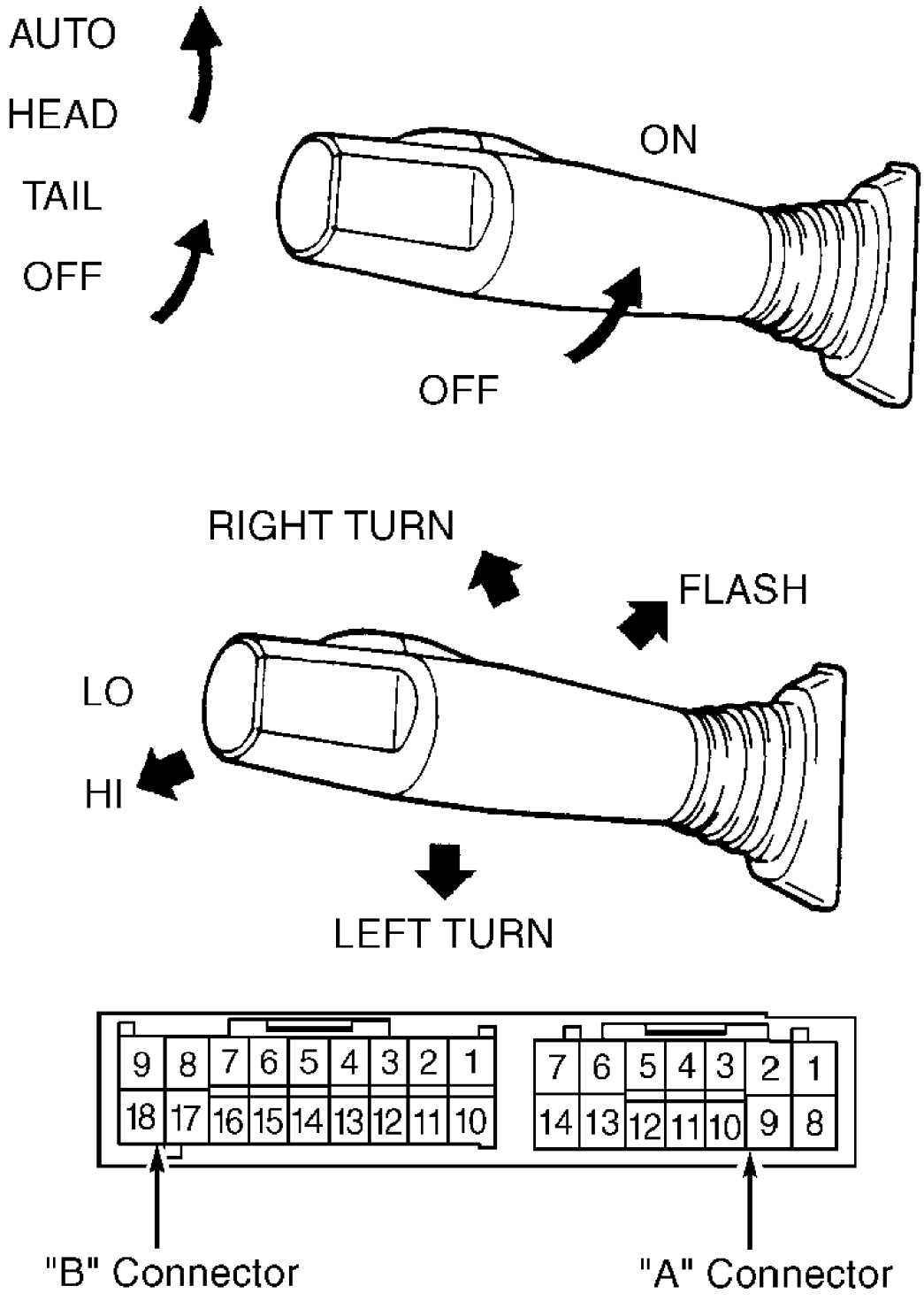


Fig. 11: Testing Combination Switch Terminals (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRUISE CONTROL SWITCH

For cruise control switch testing procedure, see appropriate CRUISE CONTROL SYSTEMS article.

HORN SWITCH

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

1) Disconnect negative battery cable. Remove covers from sides of steering wheel. Loosen Torx screws securing horn pad/air bag module to steering wheel. Lift horn pad/air bag module from steering wheel and place on top of steering column (leave connector attached). Disconnect 6-pin connector from combination switch. See Fig. 12.

2) Connect ohmmeter between chassis ground and terminal No. 6 of 6-pin connector (backprobe terminal). Continuity should not exist. Press horn contact plate against steering wheel spoke. Continuity should exist with horn pressed. If continuity is not as specified, replace steering wheel or harness as necessary.

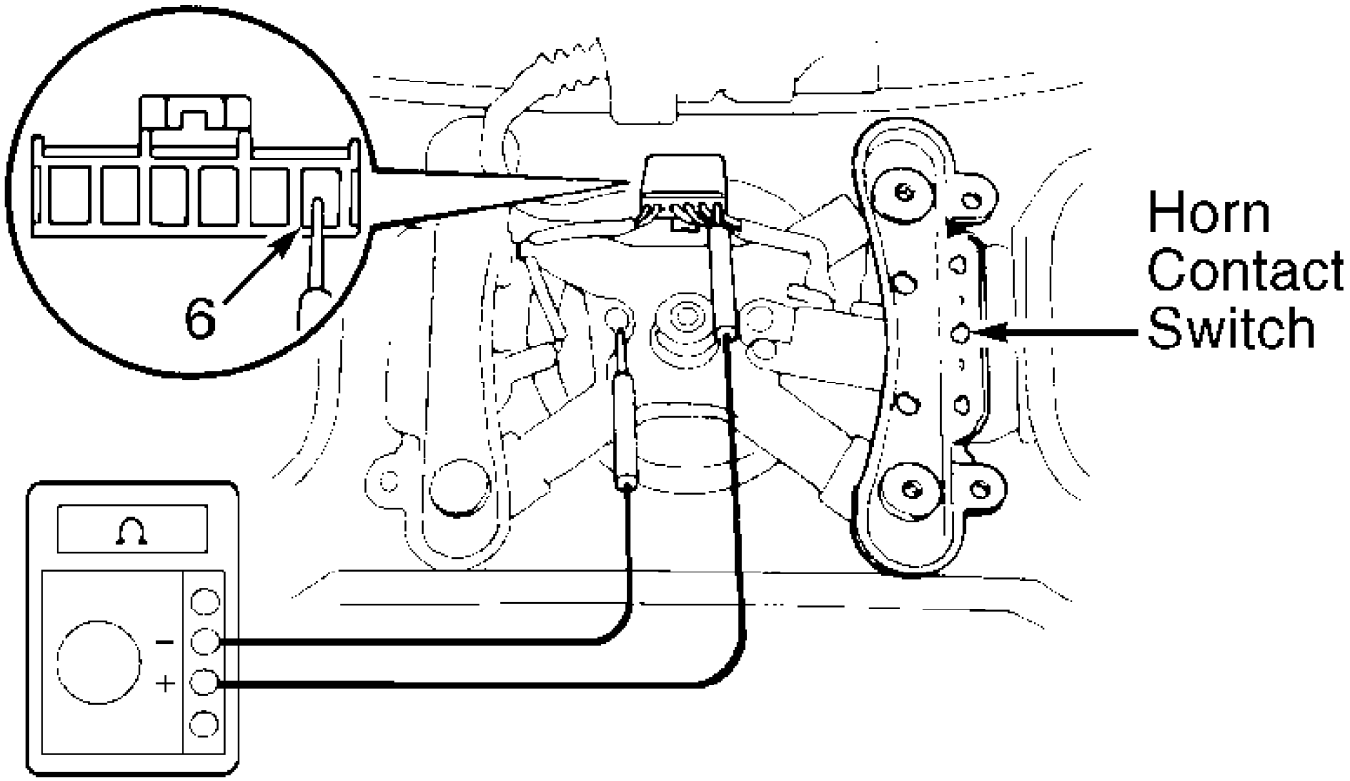


Fig. 12: Testing Horn Switch
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IGNITION SWITCH

Remove ignition switch. Using an ohmmeter, check for continuity between the following ignition switch terminals with switch in specified position. See appropriate IGNITION SWITCH CONTINUITY table. See Fig. 13 or 14. If continuity does not exist, replace

ignition switch.

IGNITION SWITCH CONTINUITY (ES300, GS300, GS400, LS400, LX470 & RX300)

Switch Position	Terminals
LOCK	(1)
ACC	2 & 3
ON	2, 3 & 4; 6 & 7
START	1, 2 & 4; 6, 7 & 8

(1) - Continuity should not exist between any terminals.

IGNITION SWITCH CONTINUITY (SC300 & SC400)

Switch Position	Terminals
LOCK	(1)
ACC	3 & 4
ON	2, 3 & 4; 6 & 11
START	1, 2 & 4; 5, 6 & 11

(1) - Continuity should not exist between any terminals.

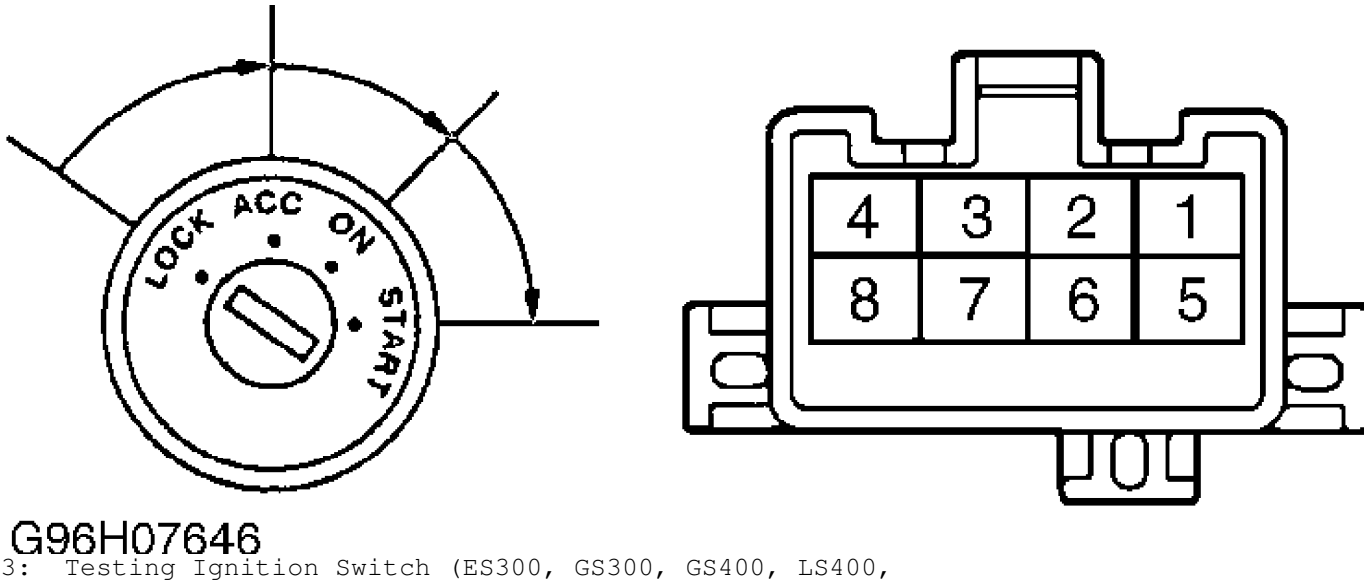


Fig. 13: Testing Ignition Switch (ES300, GS300, GS400, LS400, LX470 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

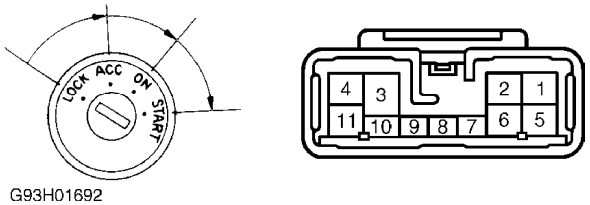


Fig. 14: Testing Ignition Switch (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

KEY UNLOCK WARNING SWITCH

ES300, GS300, GS400, LS400, LX470 & RX300

Key unlock warning switch is mounted on ignition switch. Remove ignition switch. Insert ignition key into ignition key cylinder. Using an ohmmeter, check continuity between key unlock warning switch terminals No. 1 and 2. Continuity should exist. If continuity does not exist, replace key unlock warning switch.

SC300 & SC400

Key unlock warning switch is mounted on ignition switch. Remove ignition switch. Insert ignition key into ignition key cylinder. Using an ohmmeter, check continuity between ignition switch/key unlock warning switch terminals No. 9 and 10. See Fig. 14. Continuity should exist. If continuity does not exist, replace key unlock warning switch.

RELAYS

Pre-Test Information

Locate and remove relay. See appropriate RELAY LOCATIONS table. Identify relay type and perform appropriate relay testing procedure. See RELAY IDENTIFICATION table. If relay does not test as specified, replace relay.

Foglight Relay

Behind left kick panel.

Headlight Control Relay

In junction block, in left side of engine compartment, near strut tower.

Horn Relay

In junction block, in left side of engine compartment, near strut tower.

Integration Relay

In junction block, behind left side of instrument panel.

Taillight Control Relay

In junction block, behind left side of instrument panel.

Turn Signal Flasher Relay

Behind left kick panel.

Foglight Relay

In junction block, behind left kick panel.

Headlight Control Relay

In junction block, in right rear of engine compartment, behind strut tower.

Headlight Dimmer Relay

In junction block, in left side of engine compartment, forward of strut tower.

Horn Relay

In junction block, in left rear of engine compartment, behind strut tower.

Taillight Control Relay

In junction block, behind left kick panel.

Turn Signal Flasher Relay

Behind left kick panel.

Foglight Relay
In junction block, behind left side of instrument panel.

Headlight Control Relay
In junction block, in left side of engine compartment, near strut tower.

Headlight Dimmer Relay
In junction block, in left side of engine compartment, near strut tower.

Horn Relay
In junction block, in left side of engine compartment, near strut tower.

Taillight Control Relay
In junction block, behind left side of instrument panel.

Turn Signal Flasher Relay
Behind left kick panel.

Foglight Relay
In junction block, behind left kick panel.

Headlight Control Relay
In junction block, in left side of engine compartment, near strut tower.

Headlight Dimmer Relay
In junction block, in left side of engine compartment, near strut tower.

Horn Relay
In junction block, in left side of engine compartment, near strut tower.

Taillight Control Relay
In junction block, behind left kick panel.

Turn Signal Flasher Relay
Behind left side of instrument panel.

Foglight Relay
In junction block, behind left side of instrument panel.

Headlight Control Relay
In junction block, in left side of engine compartment, near strut tower.

Horn Relay
In junction block, in left side of engine compartment, near strut tower.

Taillight Control Relay
In junction block, behind left side of instrument panel.

Turn Signal Flasher Relay
Behind left side of instrument panel.

Foglight Relay
In junction block, behind left kick panel.

Headlight Control Relay
In junction block, in left side of engine compartment, near strut tower.

Horn Relay
Behind left kick panel.

Integration Relay
In junction block, behind left kick panel.

Taillight Control Relay
In junction block, behind left kick panel.

Turn Signal Flasher Relay
In junction block, behind left kick panel.

RELAY IDENTIFICATION

Application	(1) Relay Type
Foglight Relay	
ES300, GS300, GS400, LX470 & RX300	A
LS400, SC300 & SC400	B
Headlight Control Relay	C
Headlight Dimmer Relay	
GS300, GS400 & LS400	D
LX470	C
Horn Relay	
ES300, GS300, GS400, LX470 & RX300	A
LS400, SC300 & SC400	E
Integration Relay	
ES300, SC300 & SC400	(2)
Taillight Control Relay	
ES300, GS300, GS400, LX470 & RX300	A
LS400, SC300 & SC400	B
Turn Signal Flasher Relay	
ES300, SC300 & SC400	F

(1) - See Figs. 15-20.
(2) - For testing procedure, see AUTOMATIC HEADLIGHTS article.

Testing Relay Type "A" & "B"
Continuity should exist between relay terminals No. 1 and 2. Continuity should not exist between terminals No. 3 and 5. Apply battery voltage and ground between terminals No. 1 and 2. Continuity should exist between terminals No. 3 and 5.

Testing Relay Type "C"
Continuity should exist between relay terminals No. 1 and 2. Continuity should not exist between terminals No. 3 and 4. Apply battery voltage and ground between terminals No. 1 and 2. Continuity should exist between terminals No. 3 and 4.

Testing Relay Type "D"
Continuity should exist between relay terminals No. 1 and 4, and between terminals No. 2 and 4. Apply battery voltage and ground between terminals No. 2 and 4. Continuity should exist between terminals No. 3 and 4.

Testing Relay Type "E"
Continuity should exist between relay terminals No. 1 and 2. Continuity should not exist between terminals No. 2 and 3. Apply

battery voltage and ground between terminals No. 1 and 2. Battery voltage should exist between terminals No. 2 and 3.

Testing Relay Type "F" (Turn Signal Flasher Relay)

Connect battery positive lead to turn signal flasher relay terminal No. 2 and negative battery lead to terminal No. 3. Connect 2 turn signal light bulbs (21-watt) in parallel to terminals No. 1 and 3. See Fig. 20. Light bulbs should flash about 60-120 times per minute. If bulbs do not flash as specified, replace turn signal flasher relay.

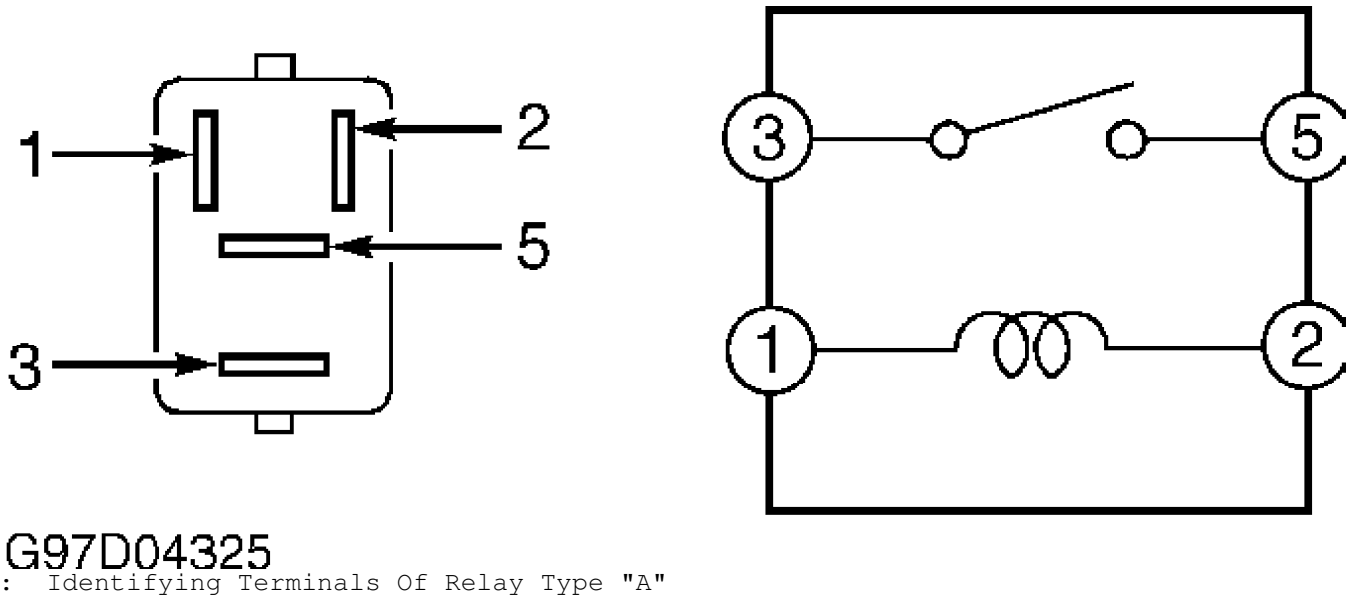


Fig. 15: Identifying Terminals Of Relay Type "A"
Courtesy of Toyota Motor Sales, U.S.A., Inc.

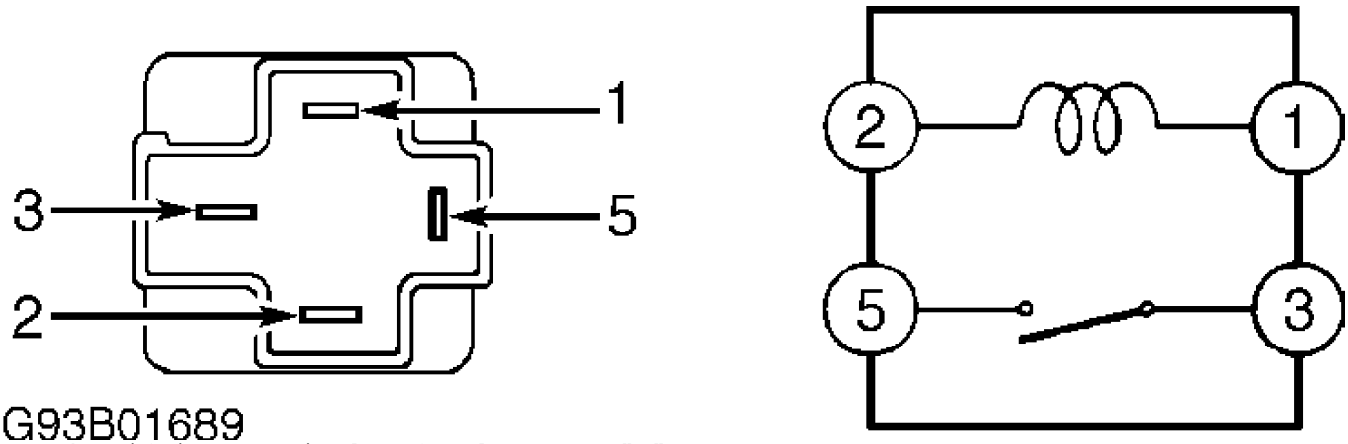


Fig. 16: Identifying Terminals Of Relay Type "B"
Courtesy of Toyota Motor Sales, U.S.A., Inc.

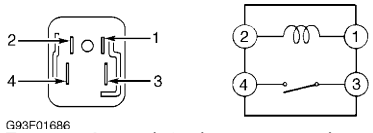


Fig. 17: Identifying Terminals Of Relay Type "C"
Courtesy of Toyota Motor Sales, U.S.A., Inc.

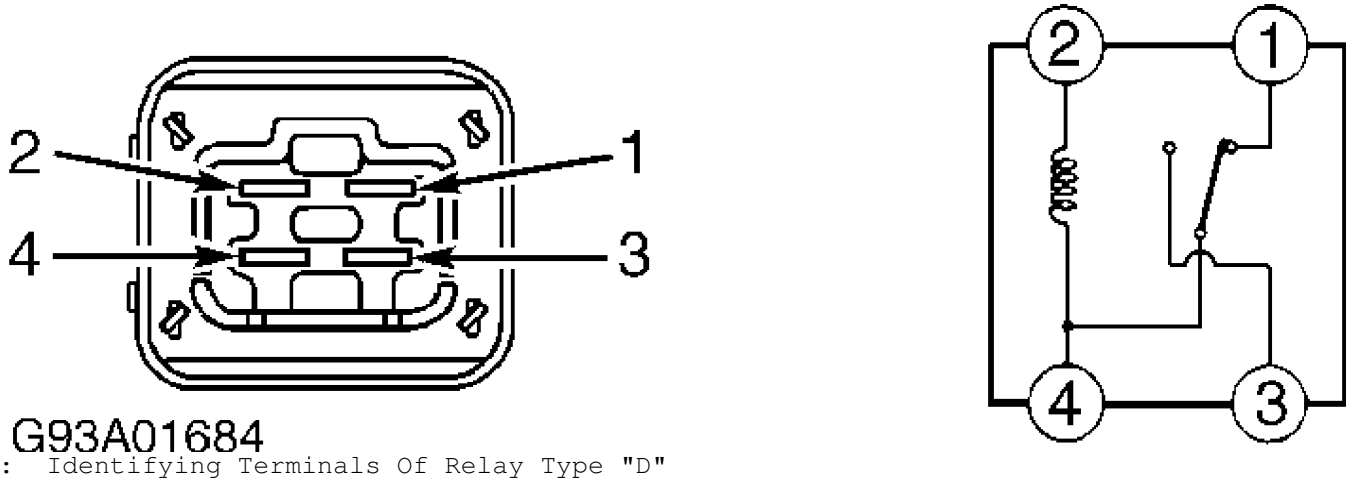


Fig. 18: Identifying Terminals Of Relay Type "D"
Courtesy of Toyota Motor Sales, U.S.A., Inc.

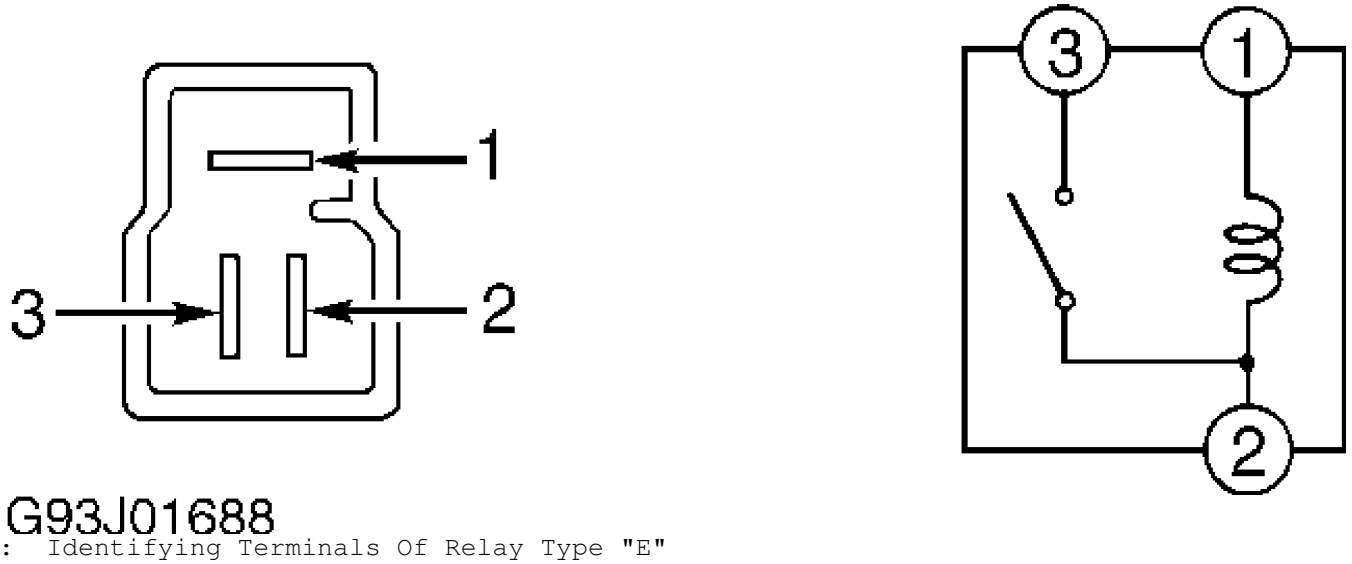


Fig. 19: Identifying Terminals Of Relay Type "E"
Courtesy of Toyota Motor Sales, U.S.A., Inc.

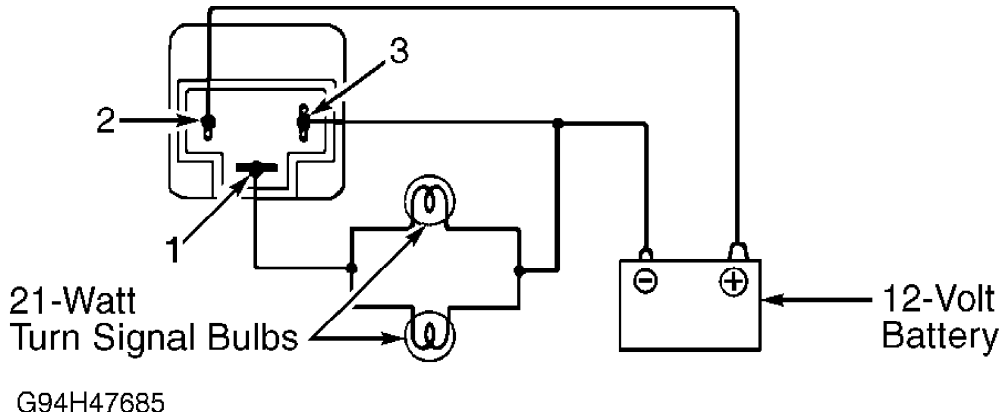


Fig. 20: Testing Relay Type "F" (Turn Signal Flasher Relay)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

For tilt/telescopic steering column switch testing procedure, see appropriate POWER TILT STEERING COLUMN SYSTEMS article.

TURN SIGNAL FLASHER

ES300, SC300 & SC400
For turn signal flasher testing procedure, see RELAYS.

GS300, GS400, LS400, LX470 & RX300
For turn signal flasher testing procedure, see TURN SIGNAL FLASHER CIRCUIT under CIRCUIT TESTS.

WIPER/WASHER SWITCH

For wiper/washer switch testing procedure, see appropriate WIPER/WASHER SYSTEMS article.

REMOVAL & INSTALLATION

* PLEASE READ THIS FIRST *

WARNING: Deactivate air bag system before performing any service operation. See AIR BAG RESTRAINT SYSTEMS article. DO NOT apply electrical power to any component on steering column without first deactivating air bag system. Air bag may deploy.

AIR BAG MODULE & STEERING WHEEL

Removal & Installation
1) Ensure front wheels are in a straight-ahead position. Turn ignition switch to LOCK position. Disconnect and shield negative battery cable. Wait at least 90 seconds. Remove 2 steering wheel screw covers. Loosen steering wheel pad screws until groove along screw circumference catches on screw case. See Fig. 21.
2) Lift steering wheel pad (air bag module) from steering wheel, and disconnect air bag (squib) electrical connector. See Fig. 22. Place steering wheel pad on a flat surface, with pad cover facing upward. Reference mark steering wheel in relation to steering shaft. Remove steering wheel using steering wheel puller.
3) To install, reverse removal procedure. Ensure steering wheel-to-steering shaft reference mark is aligned. Tighten steering wheel nut and steering wheel pad Torx screws to specification. See TORQUE SPECIFICATIONS.

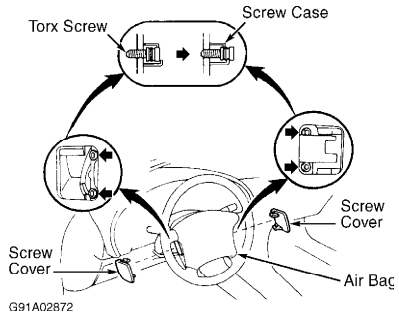


Fig. 21: Removing Steering Wheel Pad
Courtesy of Toyota Motor Sales, U.S.A., Inc.

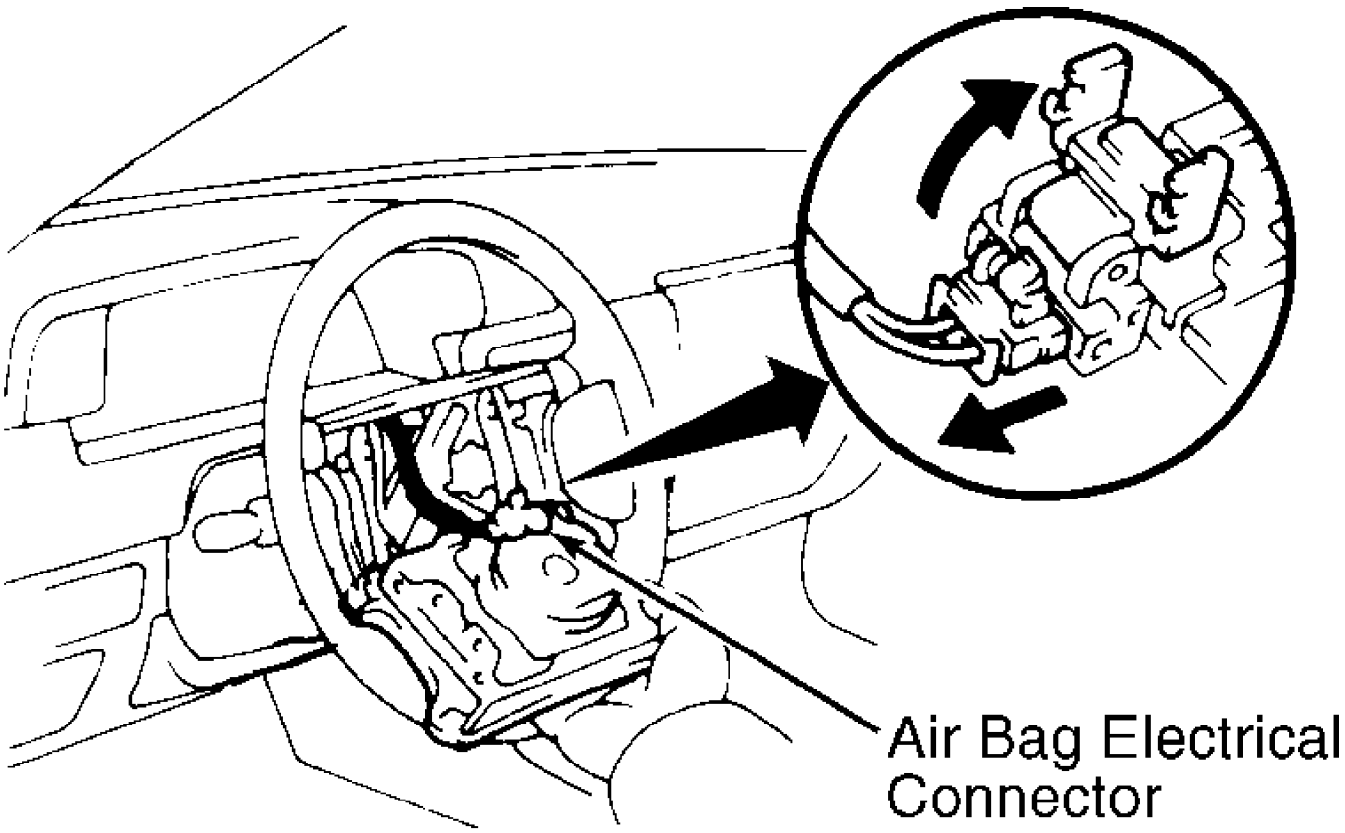


Fig. 22: Disconnecting Air Bag Electrical Connector
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMBINATION SWITCH

NOTE: Spiral cable is an integral part of combination switch.

Removal

Ensure front wheels are in straight-ahead position. Remove air bag module and steering wheel. See AIR BAG MODULE & STEERING WHEEL. Remove instrument trim panels as necessary to access steering column covers. Remove steering column covers. Disconnect electrical connectors from combination switch. Remove screws and combination switch.

WARNING: During installation, if spiral cable mating mark is not properly aligned, steering wheel may not turn completely, or flat cable inside spiral cable may be severed, disabling SRS.

Installation

Ensure front wheels are in straight-ahead position. Install combination switch. Turn spiral cable counterclockwise until it stops. Turn spiral cable clockwise about 3 turns until colored mating mark is aligned. See Fig. 23. To complete installation, reverse removal procedure.

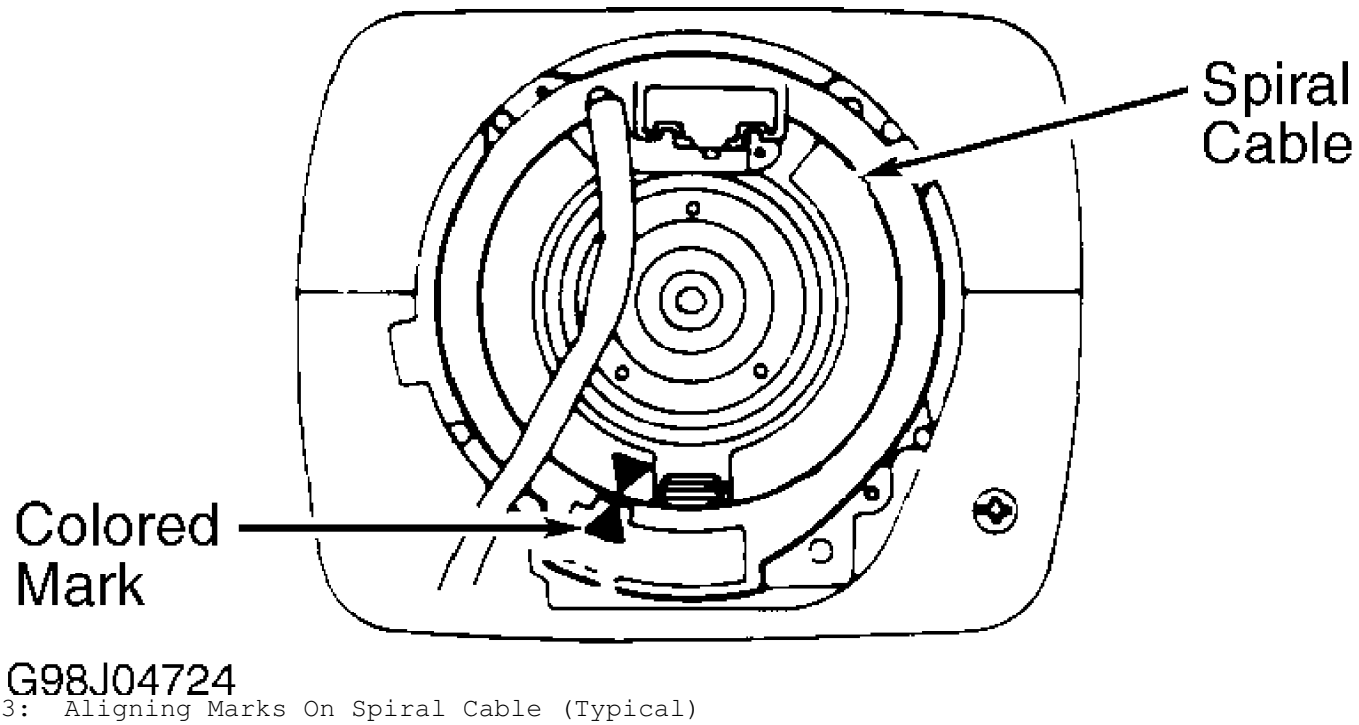


Fig. 23: Aligning Marks On Spiral Cable (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Steering Wheel Nut	26 (35)
	INCH Lbs. (N.m)
Steering Wheel Pad Torx Screw	
ES300 & RX300	63 (7.1)
GS300, GS400, LS400 & LX470	78 (8.8)
SC300 & SC400	80 (9.0)

WIRING DIAGRAMS

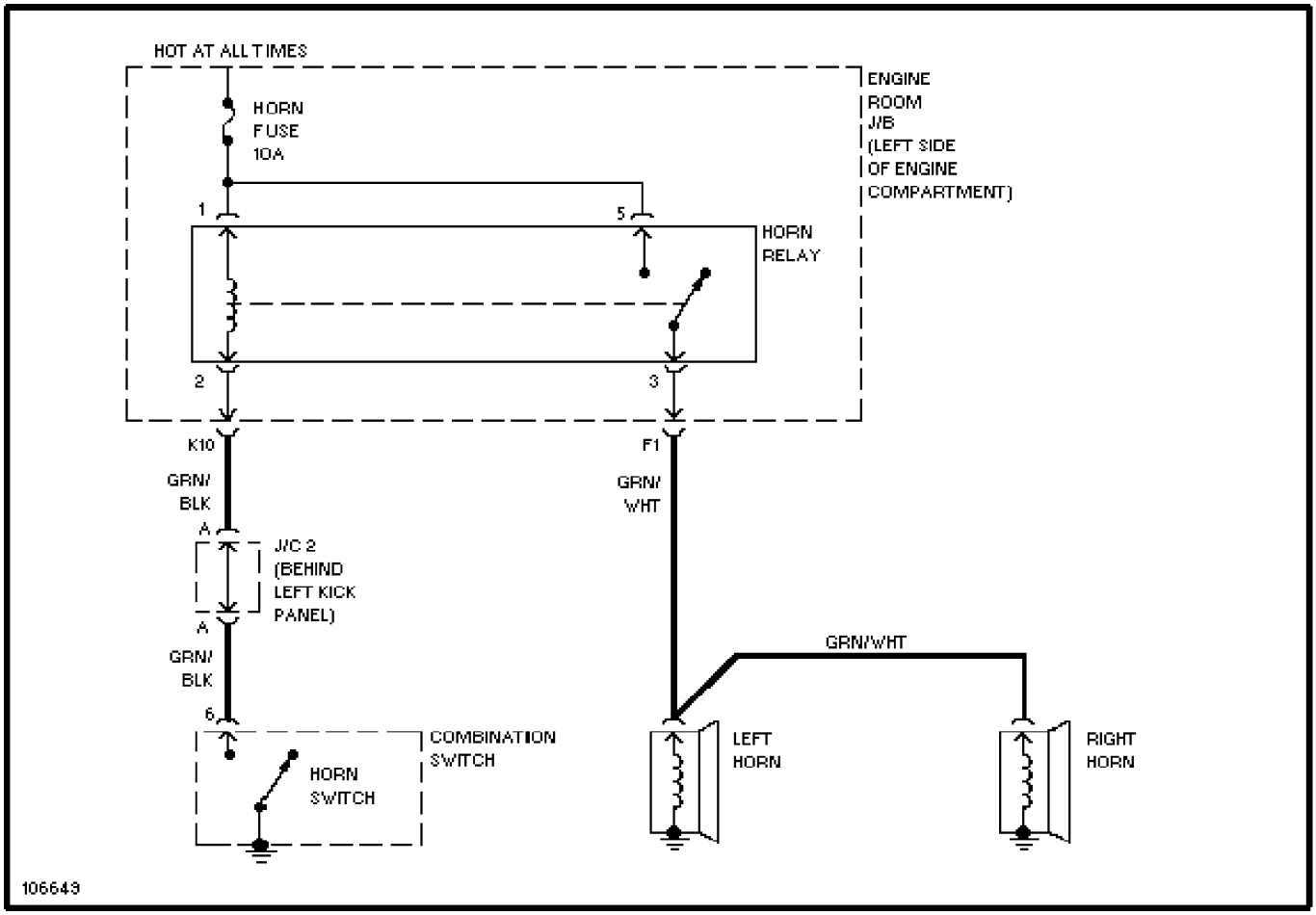


Fig. 24: Horn System Wiring Diagram (ES300)

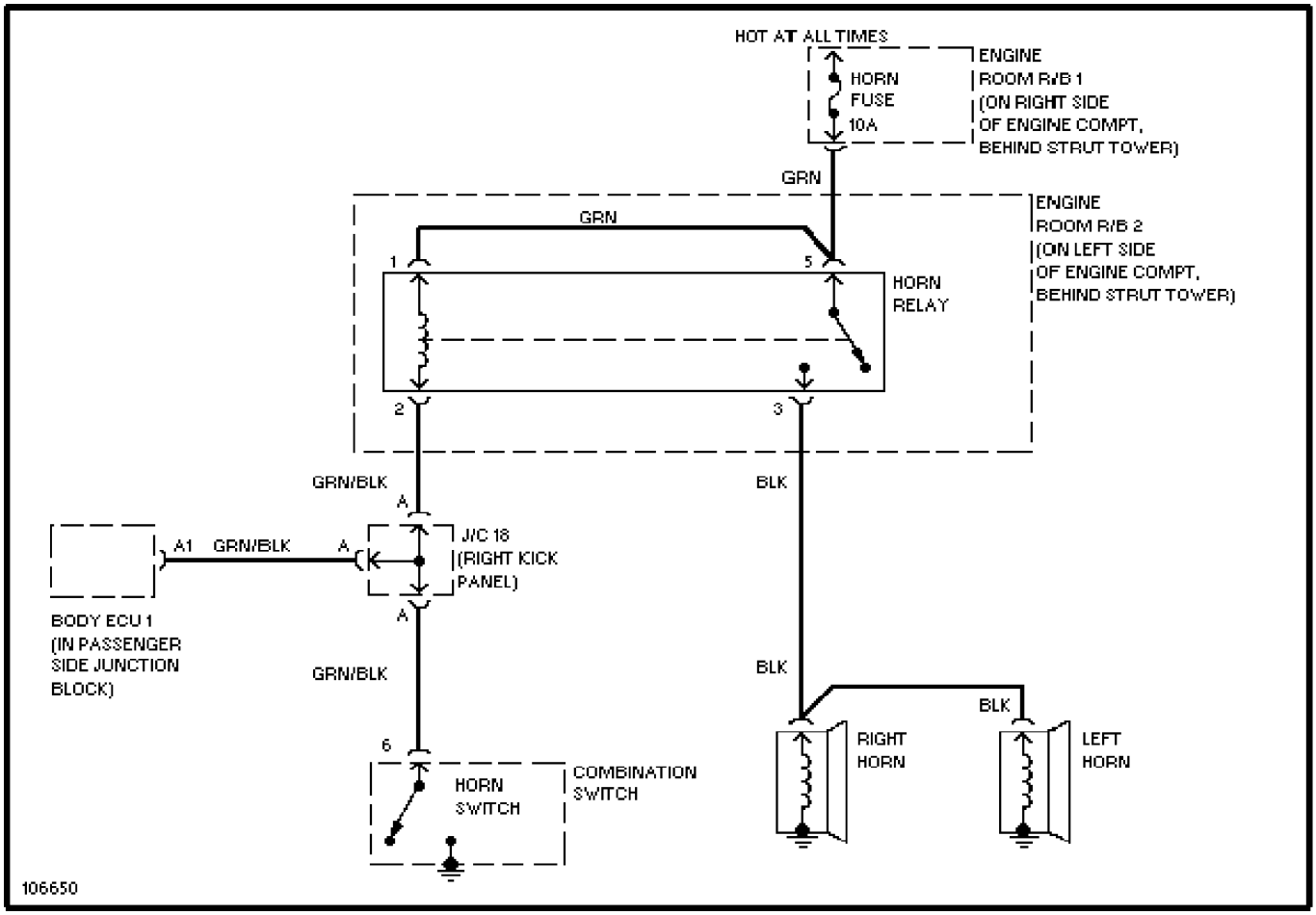


Fig. 25: Horn System Wiring Diagram (GS300 & GS400)

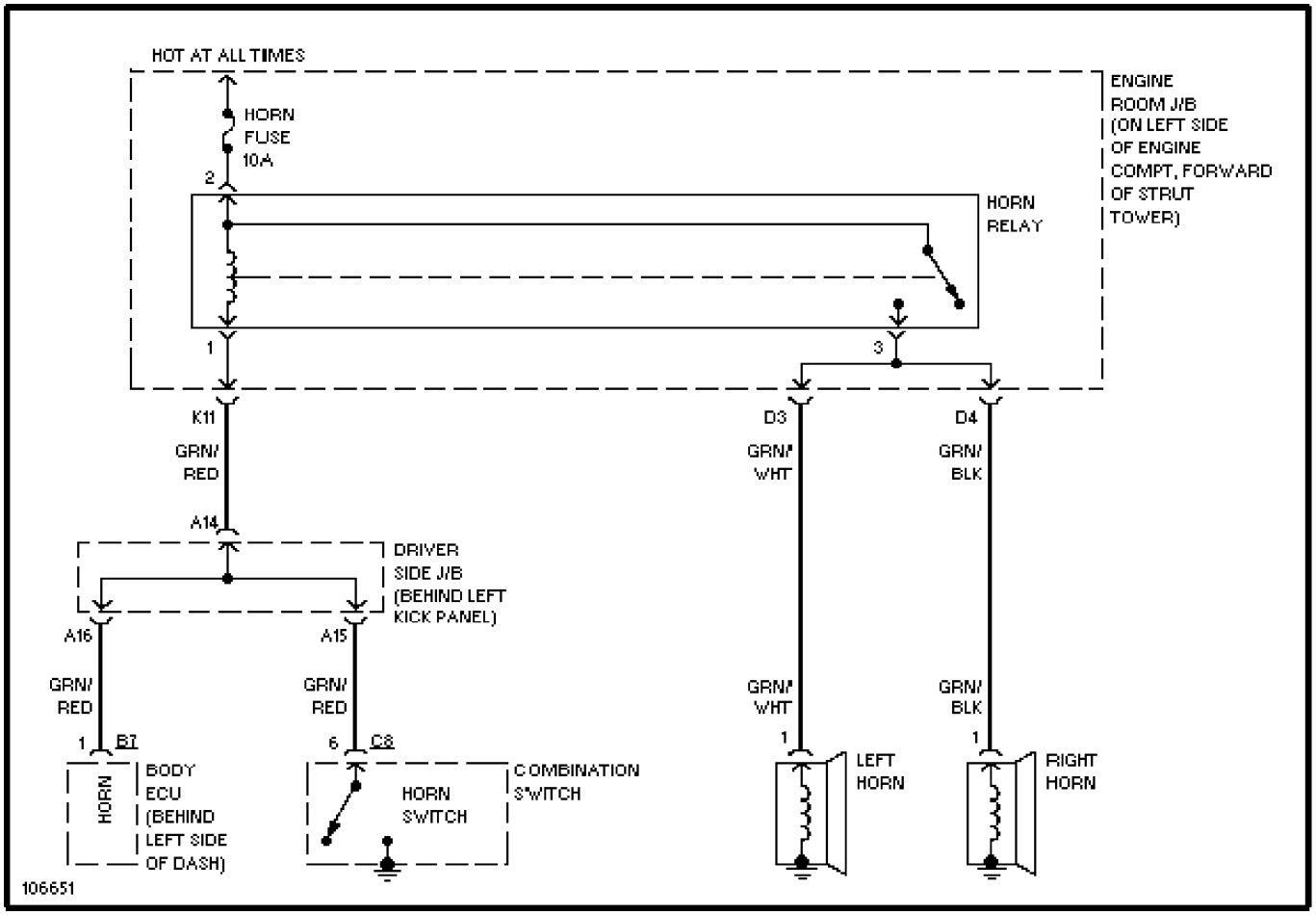


Fig. 26: Horn System Wiring Diagram (LS400)

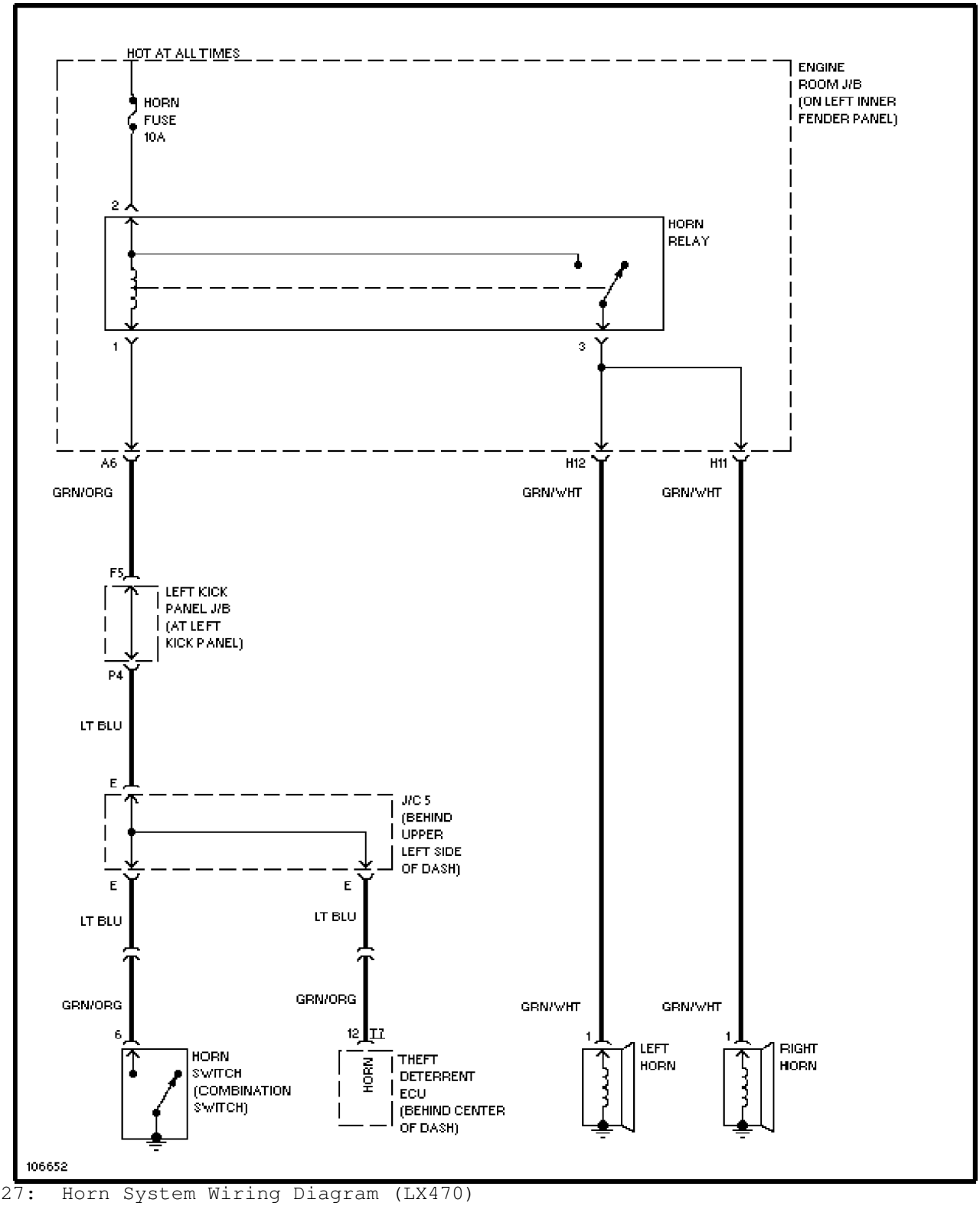


Fig. 27: Horn System Wiring Diagram (LX470)

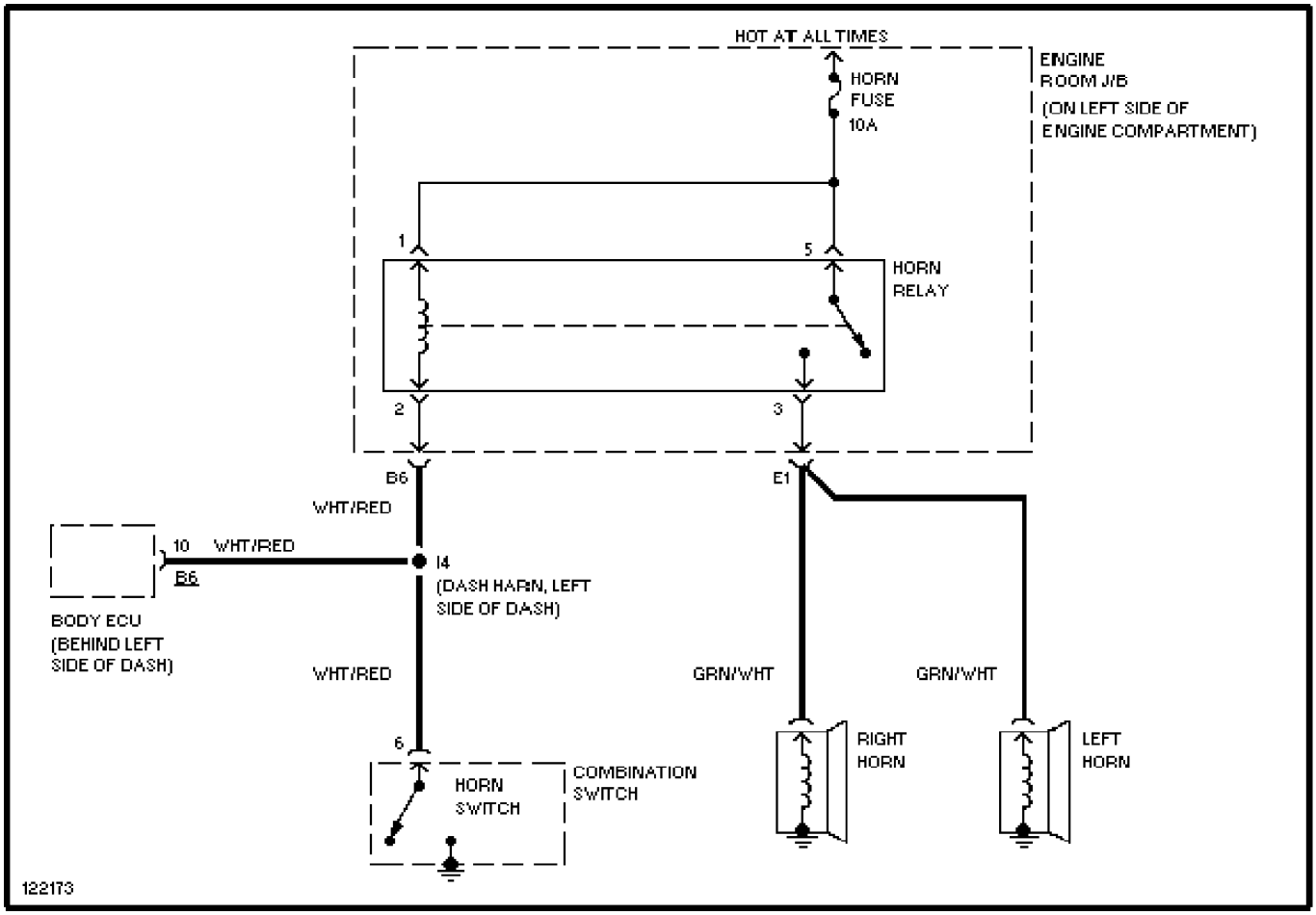


Fig. 28: Horn System Wiring Diagram (RX300)

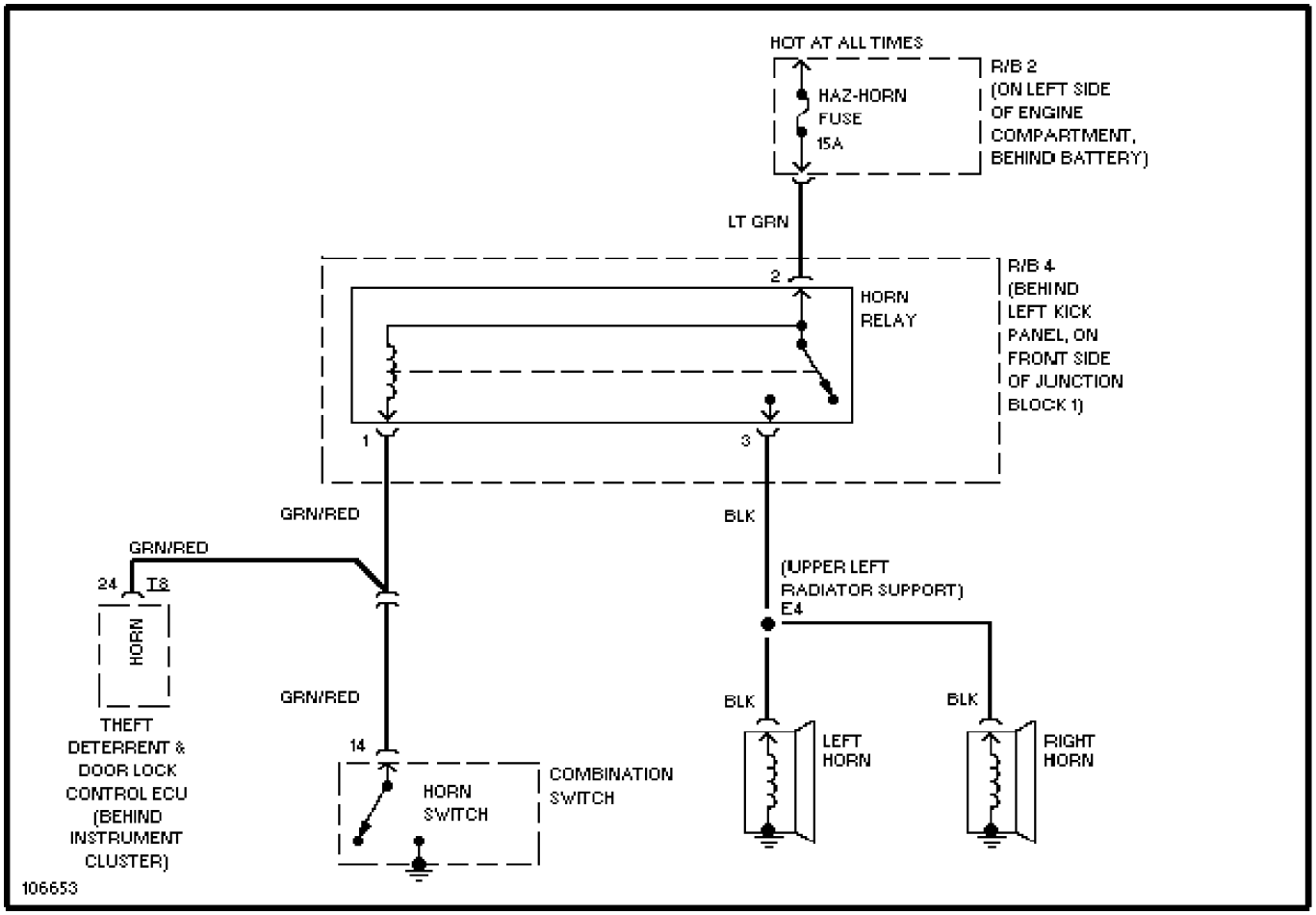


Fig. 29: Horn System Wiring Diagram (SC300 & SC400)

STEERING SYSTEM - POWER

1999 Lexus RX 300

1999-2000 STEERING
Lexus Power Rack & Pinion

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION & OPERATION

Power steering system consists of a belt-driven pump, variable-assist steering gear and connecting hydraulic lines. All models are equipped with an air control valve which increases idle speed when heavy load exists on power steering pump. Some models are equipped with Progressive Power Steering. For wiring diagrams, see ELECTRONIC POWER STEERING article.

LUBRICATION

CAPACITY

POWER STEERING FLUID CAPACITY

Application	Qts. (L)
ES300	2.3 (2.2)
GS300 & RX300	1.2 (1.1)
GS400, LS400, SC300 & SC400	1.1 (1.0)

FLUID TYPE

Use Dexron-II or III ATF type fluid.

FLUID LEVEL CHECK

Check fluid level with engine idling at 1000 RPM or less. MIN/MAX marks are divided into HOT and COLD ranges depending on fluid temperature. Fluid level should be within HOT or COLD range marks depending on fluid temperature. DO NOT overfill.

HYDRAULIC SYSTEM BLEEDING

1) Fill reservoir. Note fluid level carefully. Raise and support front of vehicle. With engine off, rotate steering wheel from lock to lock several times. Lower vehicle.
2) Start engine. With engine idling, rotate steering wheel to full lock position, either left or right, and hold in position for 2-3 seconds. Then rotate steering wheel to opposite full lock position and hold it there for 2-3 seconds. Repeat several times. Stop engine. Check for foaming or emulsification. Check fluid level. Repeat procedure if necessary.

ADJUSTMENTS

POWER STEERING PUMP BELT

On ES300 and RX300 models, measure drive belt tension, using Belt Tension Gauge (95506-00020). Adjust belt to obtain 150-185 lbs. (68-84 kg) tension for new belt, or 95-135 lbs. (43-61 kg) tension for

any belt that has run longer than 5 minutes. All other vehicles are equipped with an automatic belt tensioner, and do not require adjustment.

CABLE REEL

NOTE: Cable reel may also be known as spiral cable or clockspring.

1) Ensure front wheels are in straight-ahead position. Remove steering wheel and horn pad. See STEERING WHEEL & HORN PAD under REMOVAL & INSTALLATION in STEERING COLUMNS article.
2) Rotate cable reel counterclockwise by hand until it becomes hard to turn. Rotate cable reel clockwise 2 1/2-3 turns. Mating marks should align. Reference mark should be visible through inspection hole. Install steering wheel, ensuring mating marks are aligned.

SYSTEM TESTS

HYDRAULIC SYSTEM PRESSURE TEST

1) On ES300 models, disconnect pressure line joint between power steering pump and steering gear. On all other models, disconnect pressure line at power steering gear. On all models, connect gauge side of pressure gauge to pressure line from power steering pump. Connect valve side of pressure gauge to pressure line fitting on steering gear.
2) Bleed system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION. Warm power steering fluid to at least 176°F (80°C). With engine at idle, close pressure gauge valve and observe gauge reading. DO NOT keep valve closed longer than 10 seconds, and DO NOT turn steering wheel. If pressure is less than specified in POWER STEERING PUMP PRESSURE table, repair or replace power steering pump.

POWER STEERING PUMP PRESSURE

Model	psi (kg/cm²)
ES300 & RX300	1138 (80)
GS300 & GS400	1209 (85)
LS400	1209 (85)
SC300 & SC400	1067 (75)

3) With engine idling, open valve fully. Measure and record pressure at 1000 RPM and 3000 RPM. Difference in measurements should be less than 71 psi (5 kg/cm²). If difference is greater than 71 psi (5 kg/cm²), repair or replace flow control valve.
4) With gauge valve fully open and engine idling, rotate steering wheel to full lock position and observe gauge reading. Steering gear is leaking internally if pressure is less than specified in POWER STEERING PUMP PRESSURE table. Repair or replace as required. Disconnect pressure gauge and reconnect pressure line to steering gear. Check fluid level and bleed system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION.

STEERING WHEEL TURNING FORCE

NOTE: Tire type, inflation pressure, and contact surface will affect turning effort, and must be considered while making diagnosis.

1) Center steering wheel. Remove steering wheel horn pad. See STEERING WHEEL & HORN PAD under REMOVAL & INSTALLATION in STEERING COLUMNS article. With engine at idle, attach torque wrench to steering wheel nut. See Fig. 1. Measure turning effort in both directions. Maximum steering effort should not exceed specification. See STEERING WHEEL TURNING FORCE table.

2) If steering effort is excessive, repair system as necessary. Unplug pressure control valve harness connector. Measure turning effort again. If steering effort is excessive, repair system as necessary. See ELECTRONIC POWER STEERING article.

STEERING WHEEL TURNING FORCE

Application	INCH Lbs. (N.m)
Solenoid Connected	
ES300 & RX300	52 (5.9)
GS300 & GS400	61 (6.9)
LS400	61 (6.9)
SC300 & SC400	48 (5.4)
Solenoid Disconnected	
All Models	(1)

(1) - Turning force is 26 ft. lbs. (35 N.m).

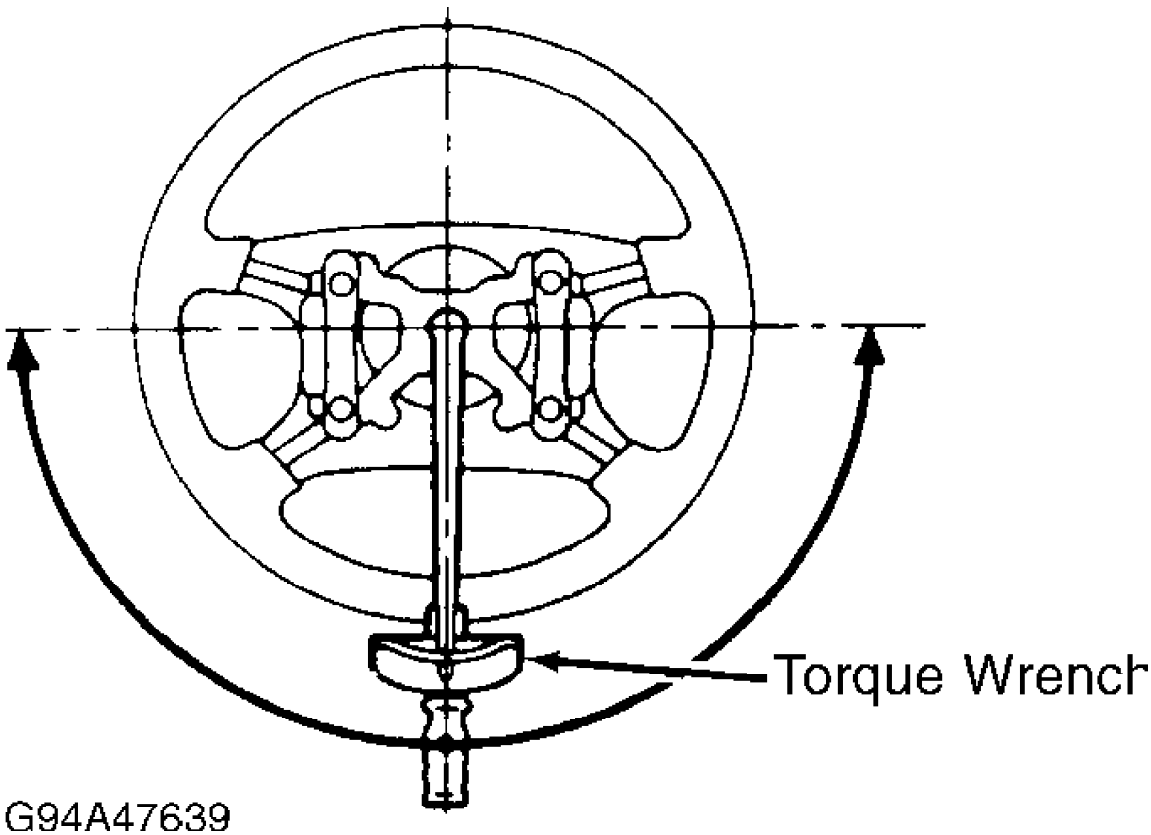


Fig. 1: Measuring Steering Wheel Turning Force
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

POWER STEERING PUMP

Removal & Installation (ES300 & RX300)

On ES300 models, remove right front fender apron seal. On ES300 and RX300 models, remove oil pressure switch. Remove clamps and disconnect pressure line and return hose. Remove drive belt. Loosen mounting bolt, remove adjusting bolt and remove power steering pump. To install, reverse removal procedure. Fill and bleed system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION.

NOTE: Upper mounting bolt cannot be removed.

Removal & Installation (GS300, SC300)

Remove engine under cover. Rotate drive belt tensioner clockwise to release belt tension. Disengage belt from power steering pump pulley. Remove clamps and disconnect pressure line and return hose. Remove mounting bolts and remove pump. To install, reverse removal procedure. Fill and bleed system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION.

Removal & Installation (GS400, LS400 & SC400)

1) On all models, remove engine undercover and air cleaner assembly. On LS400 models, remove battery clamp cover and brake actuator assembly. On all models except GS300, rotate drive belt tensioner counterclockwise (clockwise on GS300) to relieve belt tension. Disengage drive belt from power steering pump.

2) Note hose mounting orientation and disconnect pressure line, return hose and 2 vacuum hoses. Remove pump. To install, reverse removal procedure. Use NEW gaskets and "O" rings when installing pressure line fitting. Fill and bleed system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION.

POWER RACK & PINION

NOTE: Before removing power rack and pinion, secure steering wheel in centered position. Remove steering wheel pad and steering wheel. If steering wheel moves during removal or installation procedure, air bag cable reel must be recentered. See CABLE REEL under ADJUSTMENTS.

Removal

On all models, disconnect tie-rod ends. Disconnect steering column intermediate shaft assembly. Remove clamps and disconnect pressure and return lines. Remove mounting bolts and nuts and remove steering gear assembly from left side of vehicle. On SC300 and SC400 models, disconnect PPS solenoid connector. On ES300 models, remove 4 bolts and disconnect stabilizer bar (but do not remove bar) and remove fuel line protector. Remove 2 mounting bolts and nuts and remove gear assembly from left side of vehicle.

Installation

1) On all models, install steering gear assembly from left side of vehicle. Install mounting grommets and brackets and tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Connect pressure and return lines and tighten line clamps. Connect tie-rod ends. On SC300 and SC400 models, connect PPS solenoid. On ES300 models, install fuel line protector. Connect stabilizer bar and tighten bolts to specification.

2) Ensure steering wheel is positioned straight ahead. Connect steering column intermediate shaft assembly. Install center spiral cable and steering wheel. Ensure steering wheel and spiral cable are centered. Install steering wheel pad. Fill and bleed power

steering system. See HYDRAULIC SYSTEM BLEEDING under LUBRICATION. Check steering wheel alignment. Check front-end alignment and adjust toe-in. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

OVERHAUL

POWER STEERING PUMP

Disassembly (ES300 & RX300)

1) Clamp pump in vise. Remove pulley. See Fig. 2. Remove front and rear brackets. Remove suction port fitting and "O" ring. Remove pressure port fitting, "O" ring, flow control valve and spring.

2) Remove rear housing and "O" rings. Remove wave washer, side plate, gasket, cam ring, 10 vane plates and vane rotor. Remove snap ring from pump shaft, and using plastic mallet, tap out pump shaft. Remove 2 straight pins from front housing.

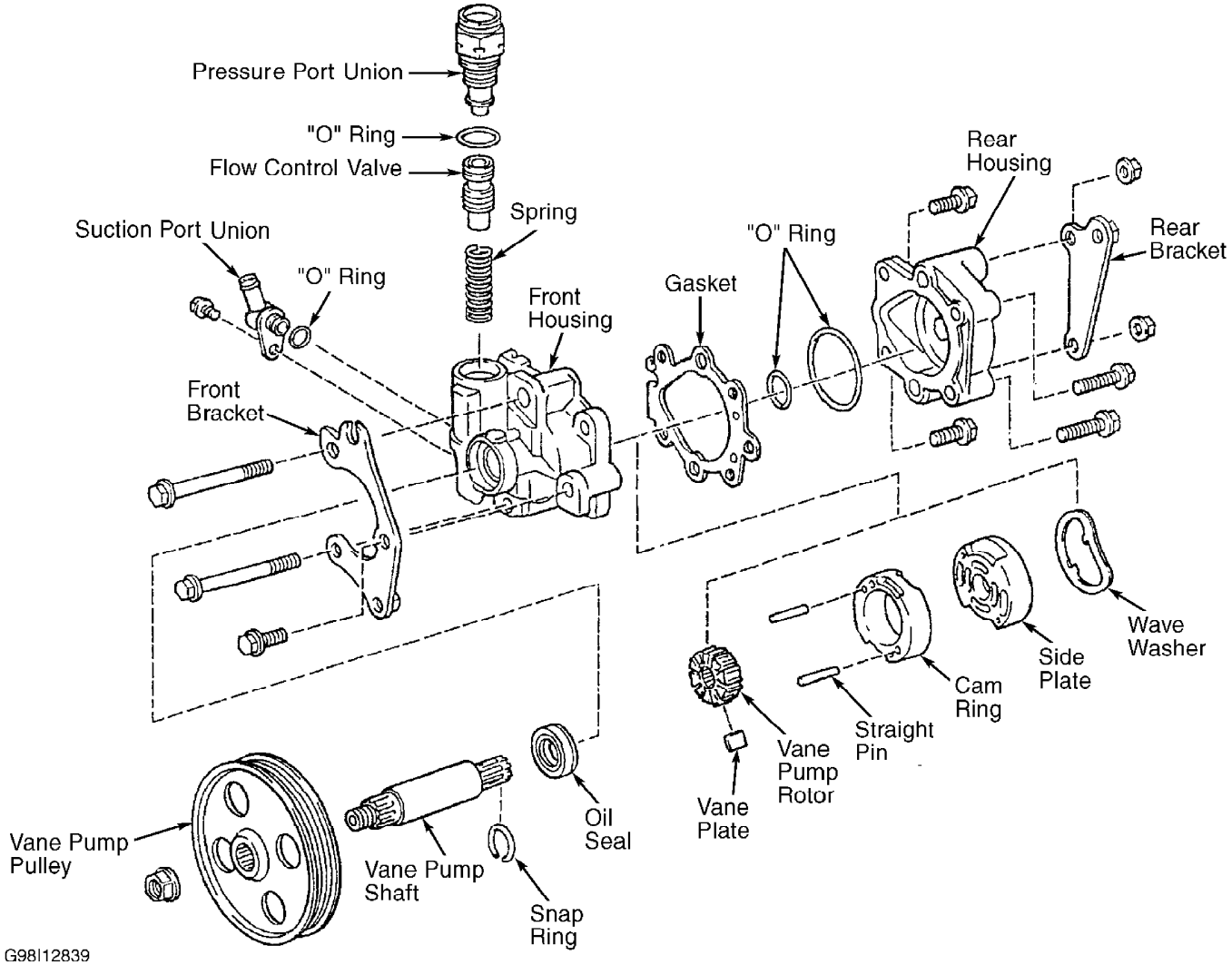


Fig. 2: Exploded View Of Power Steering Pump (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) Lubricate all moving parts with PS fluid. Install pump

shaft into housing. Using plastic mallet, tap 2 NEW straight pins into front housing. Install cam ring onto pump shaft, aligning holes on cam ring with 2 straight pins in front housing, and with mark on cam ring facing outward. Install vane rotor with the inscribed mark facing outward and install NEW snap ring. Install the 10 vane plates with the rounded end facing outward. Install side plate with NEW gasket, aligning holes on side plate with 2 straight pins. Install wave washer so that its' tabs fit into slots in side plate. Coat 2 NEW "O" rings with PS fluid and install rear housing.

2) Install flow control valve, spring, and pressure port fitting with NEW "O" ring. Install suction port fitting with NEW "O" ring. Install front and rear brackets and pump pulley.

3) Measure rotating torque. Rotating torque should not exceed 2.4 INCH lbs. (0.3 N.m). Pump should rotate freely with no abnormal noise.

Disassembly (GS300 & SC300)

1) Clamp pump body in vise. Using Shaft Holder (09960-10010) to prevent rotation, remove pulley. Remove oil reservoir. On GS300 models, remove solenoid valve and "O" ring. On SC300 models, remove pressure port and "O" ring. On all models, remove flow control valve and spring. See Figs. 3 or 4. Remove rear housing.

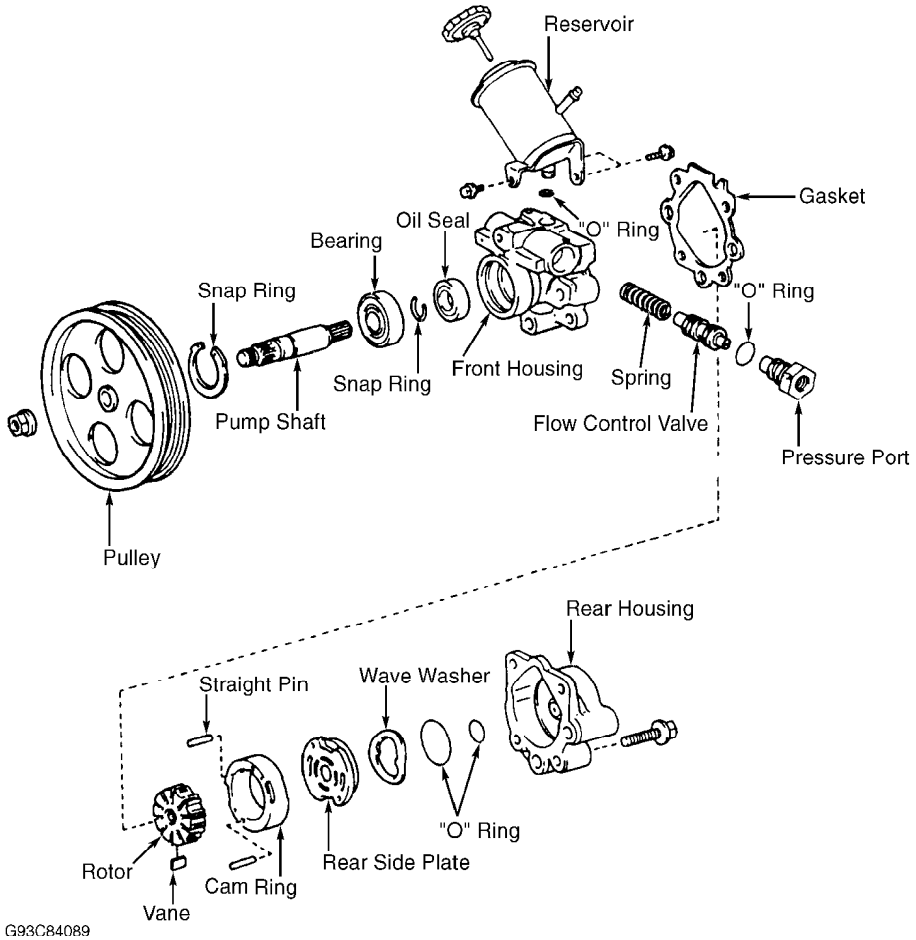


Fig. 3: Exploded View Of Power Steering Pump (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

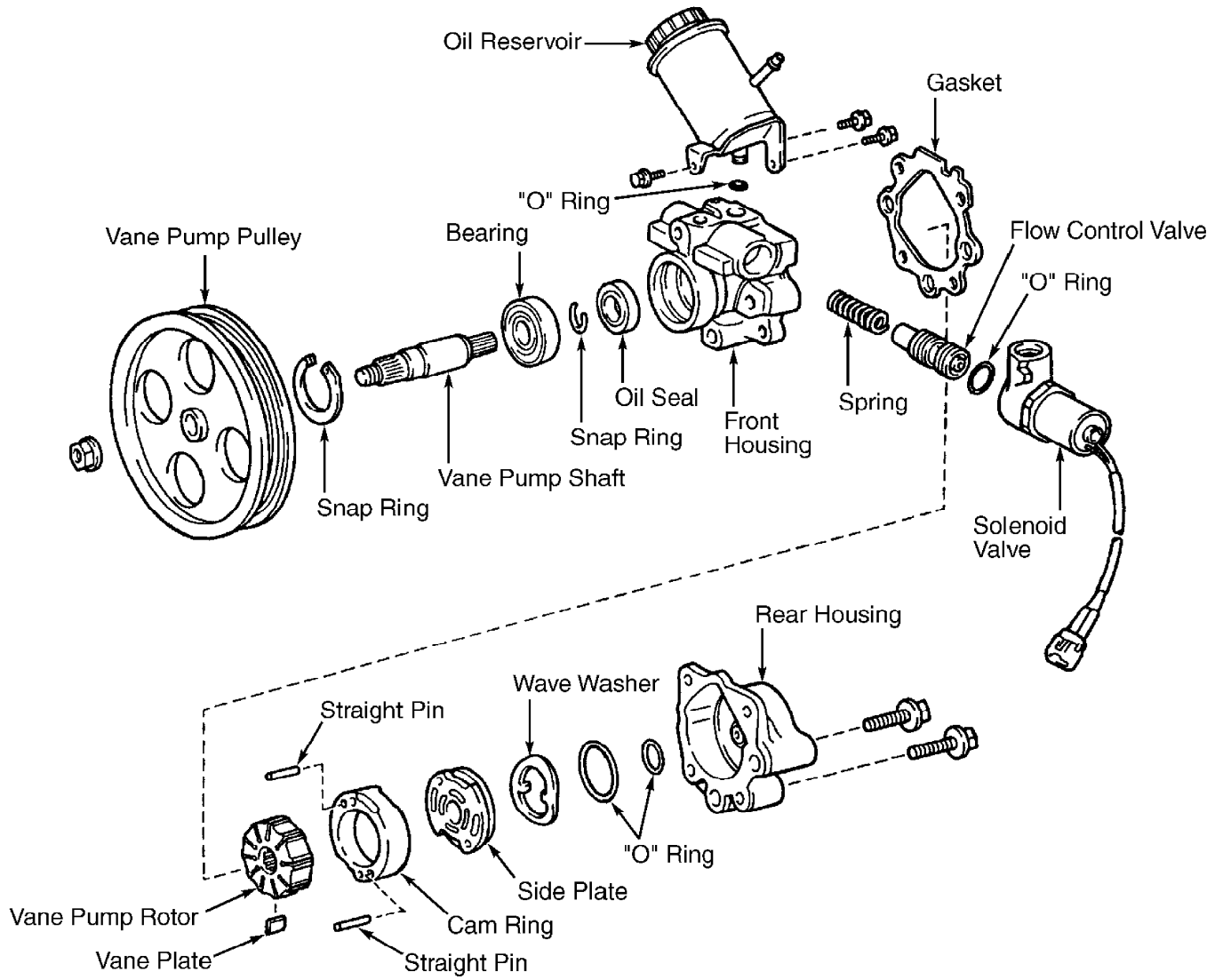


Fig. 4: Exploded View Of Power Steering Pump (GS300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Remove wave washer, side plate, cam ring, vane rotor and 10 vane plates. Use plastic mallet and tap out side plate and wave washer from rear housing. Remove 2 straight pins from front housing. Remove gasket and snap ring from front housing and press out vane pump shaft with bearing. Press bearing from shaft if replacing. See Fig. 3.

Reassembly

1) Lubricate all moving parts with power steering fluid. Using Bearing Driver (09608-04031), press pump shaft and bearing into housing and install NEW snap ring. Using plastic mallet, tap 2 NEW straight pins into place in front housing. Align holes of cam ring with straight pins and install cam ring with mark facing outward. Install vane rotor with mark facing outward and install 10 vane plates with rounded end facing outward. Install NEW gasket on front cover and install side plate aligning holes of plate with straight pins.

2) Install wave washer so that its tabs fit into the slots in side plate. Install rear housing, coating NEW "O" rings with PS fluid. Install flow control valve and spring. On GS300 models, install

solenoid valve and "O" ring. On SC300 models, install pressure port and "O" ring. On all models, install oil reservoir and pump pulley. Measure rotating torque. Rotating torque should not exceed 2.2 INCH lbs. (0.25 N.m). Pump should rotate freely with no abnormal noise.

Disassembly (GS400, LS400 & SC400)

1) Mount pump in vise. Remove pump pulley. See Figs. 5, 6 or 7. On LS400 and GS400 models, remove air control valve. On GS400 models, remove solenoid valve. On SC400 models, remove pressure port fitting. On all models, remove flow control valve, spring and "O" ring. Remove snap ring and spring seat from front housing. Screw .24" x .039" bolt into seat and pull out seat. Remove "O" ring from seat.

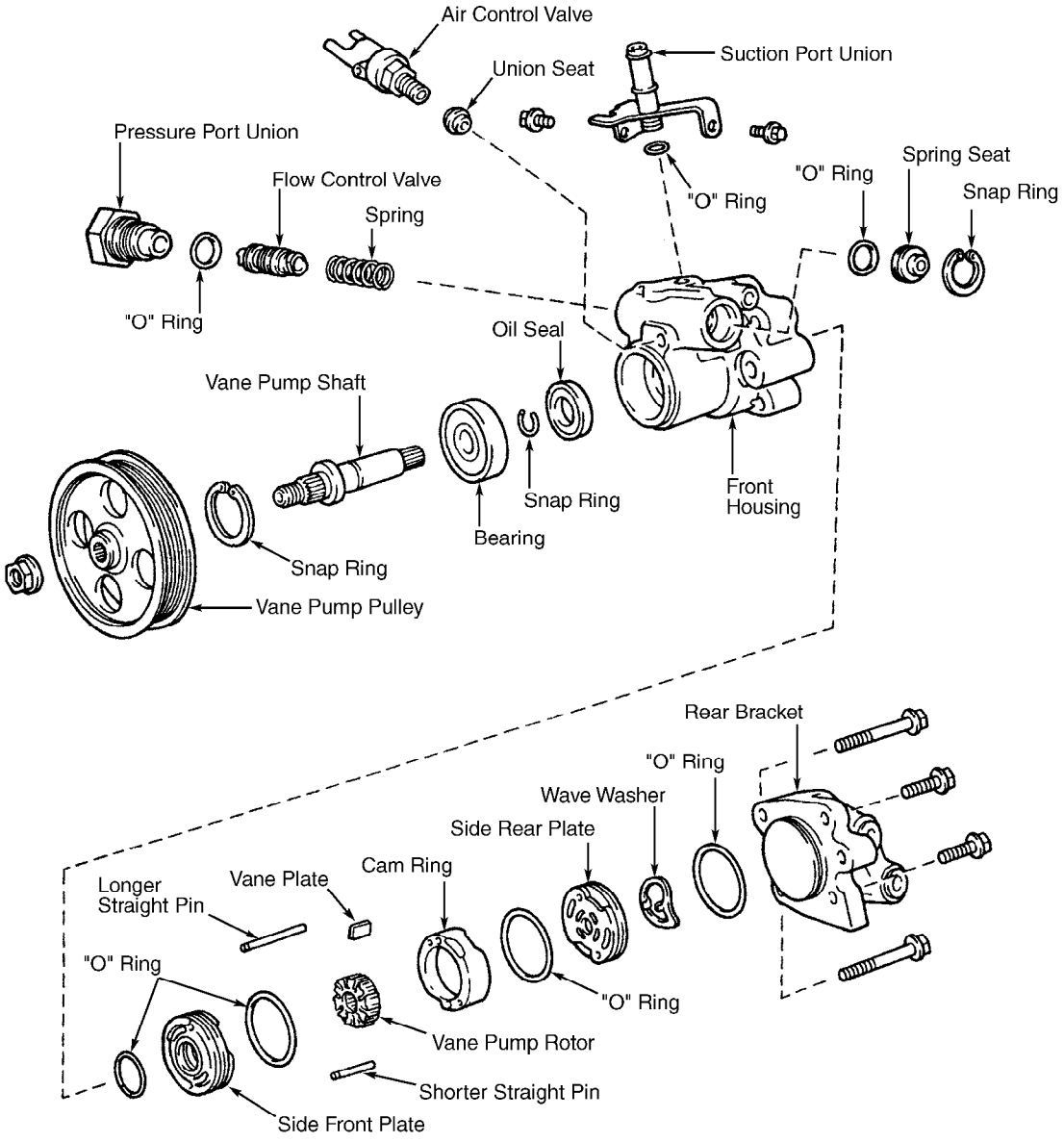


Fig. 5: Exploded View Of Power Steering Pump (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

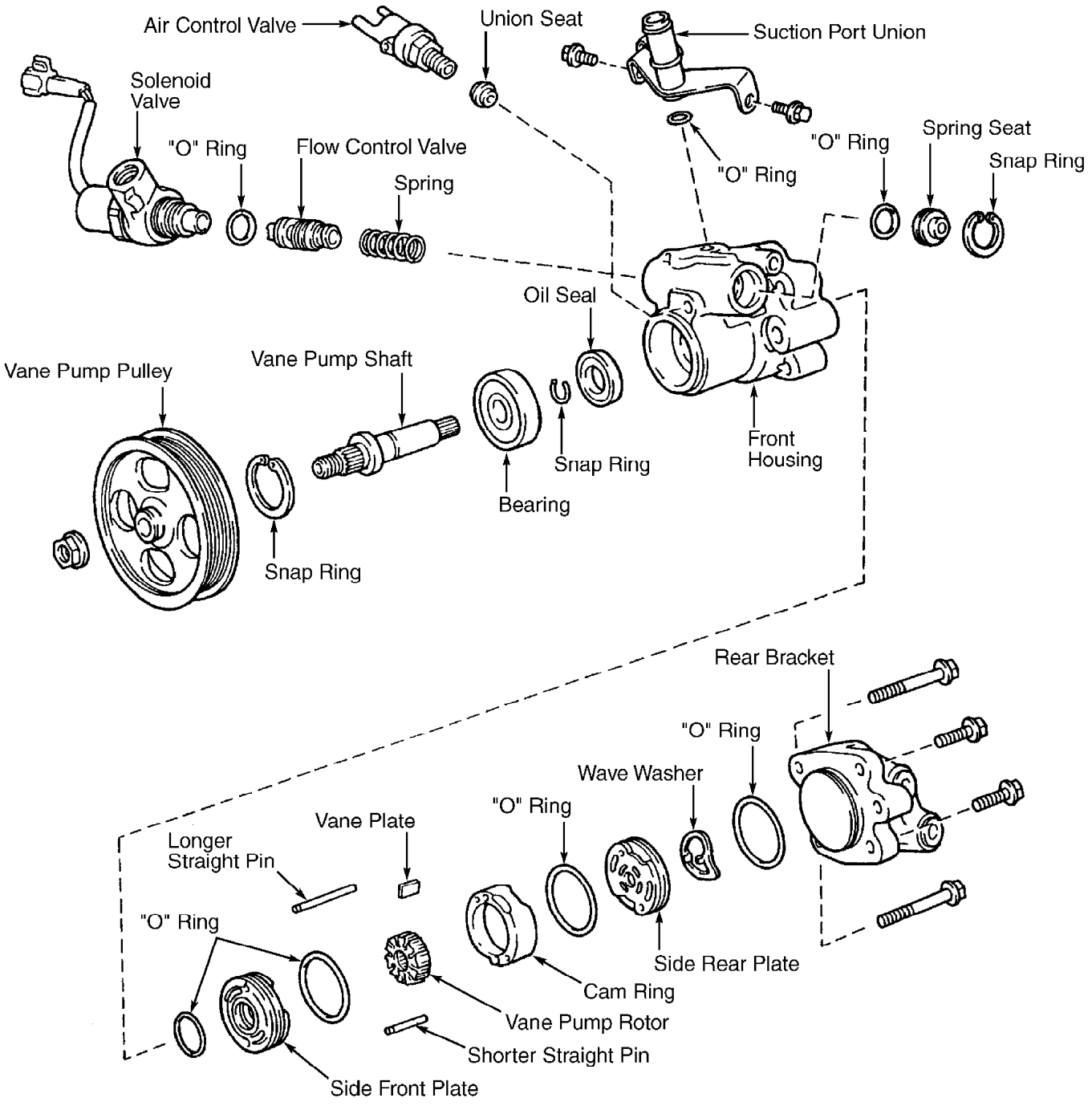


Fig. 6: Exploded View Of Power Steering Pump (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

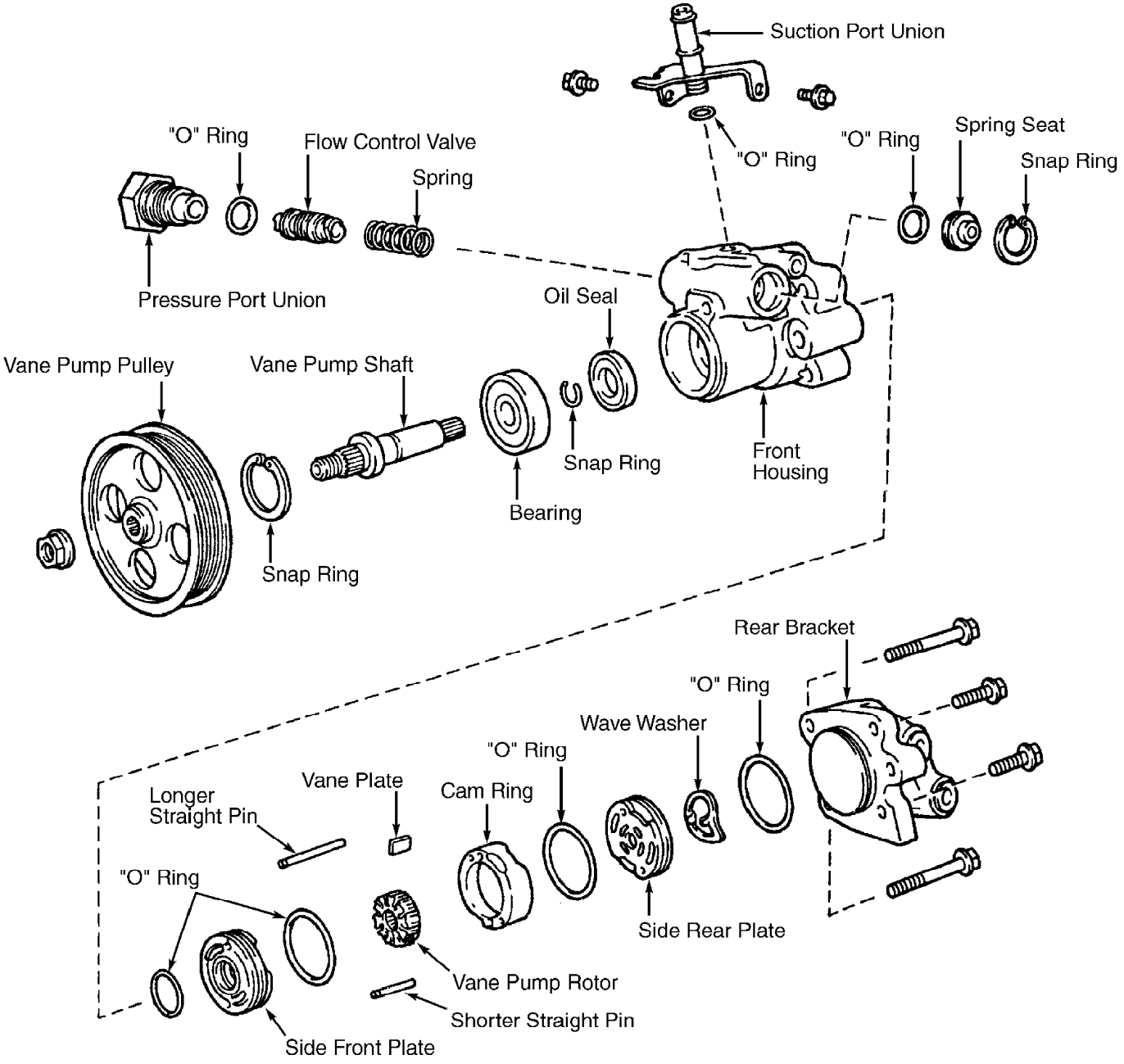


Fig. 7: Exploded View Of Power Steering Pump (SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Remove pump shaft snap ring from front housing. Temporarily install nut and flat washer to pump shaft. With Puller (09911-00011) and Slide Hammer (09912-00010) remove pump shaft and bearing. Remove rear bracket retaining bolts, rear bracket and "O" ring. Remove wave washer.

3) Using an extension bar, press out front side plate, cam ring, rotor, vane plates, and rear side plate as an assembly. Separate assembly components, and remove "O" rings. Remove the shorter pin from front side plate and the longer pin from front housing.

Reassembly

1) Lubricate all moving parts with power steering fluid. Press shaft and bearing assembly into front housing and install NEW snap ring. DO NOT damage pump shaft oil seal.

2) Install a NEW longer straight pin into front housing. Install NEW "O" rings onto front and rear side plates. Install a NEW shorter straight pin into side front plate. Align wide hole in side front plate with longer pin and the inscribed mark on side front plate facing outward. Press side front plate into front housing using a press and Adaptor (09238-47012).

3) Align wide hole in cam ring with long pin and install cam ring with mark on ring facing outward. Install vane rotor with inscribed mark facing outward. Install 10 vane plates with rounded edges facing outward.

4) Align wide hole in side rear plate with longer straight pin. Press side rear plate into front housing. Install wave washer so tangs fit into slots in side rear plate. Install NEW "O" ring onto rear bracket and install bracket. Tighten retaining bolts to specification. See TORQUE SPECIFICATIONS.

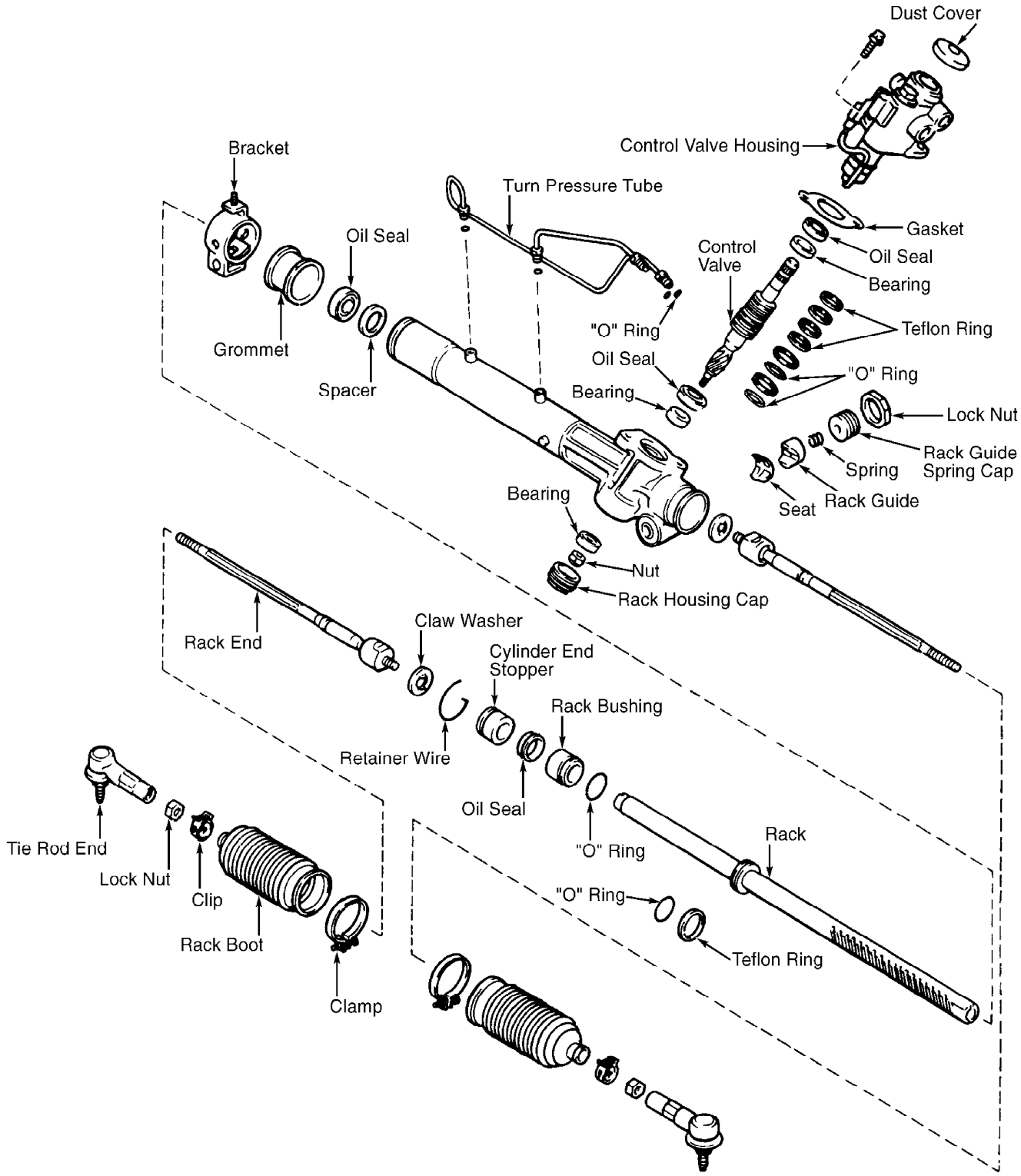
5) Install NEW "O" ring on spring seat and install spring seat with bolt hole facing outward. Install NEW snap ring. Install flow control valve, spring and "O" ring. On LS400 and GS400 models, install air control valve. Install suction port fitting. On GS400 models, install solenoid valve. On SC400 models, install pressure port fitting. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

6) Install pump pulley and tighten to specification. Measure pump rotating torque. Rotating torque should not exceed 2.2 INCH lbs. (.25 N.m). Pump should rotate freely with no abnormal noise.

POWER RACK & PINION

Disassembly (ES300 & RX300)

1) Using Rack Housing Stand (09612-00012), clamp rack and pinion assembly in vise. Remove 2 turn pressure tubes. See Fig. 8. Mark outer tie-rod ends for reassembly reference and remove tie-rod ends. Remove rack boots and clamps. Using a hammer and screwdriver, unstake rack end claw washers. Use care not to damage rack.



G93E01742

Fig. 8: Exploded View Of Rack & Pinion (ES300 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Using a 24 mm end wrench to hold rack steady, and Spanner

Wrench (09922-10010), remove rack end claw washers and rack ends (inner tie-rod ends) from rack housing. Discard claw washers. Using Spanner Wrench (09922-10010), remove rack guide spring cap lock nut. Remove rack guide spring cap, rack guide spring, and rack guide sub-assembly from rack housing.

3) Remove rack housing cap. Using Socket Wrench (09616-00010) to prevent control valve shaft from rotating, remove self-locking nut and dust cover. Mark valve housing and rack housing for reassembly reference and remove the 2 bolts. Separate control valve housing from rack housing and press out control valve assembly with oil seal from rack housing.

4) Mark mounting brackets and rack housing for reassembly reference. Remove brackets and grommets. With screwdriver pry clamp off of bracket and remove grommet from bracket. Using Wrench (09631-10021), rotate stopper clockwise until retainer wire is visible through service hole. Rotate stopper counterclockwise and remove retainer wire. Using a brass punch and hammer, tap rack out of housing with bushing. Remove oil seal and bushing.

Reassembly

1) Lubricate all parts with power steering fluid. Using Oil Seal Driver (09950-60010), install NEW oil seal in rack housing. Coat with oil and install Rack Guide (09631-33010) onto rack. Install rack into rack housing. Remove rack guide. Repeat procedure to install seal and rack on opposite end of rack housing. DO NOT tilt or damage seal.

2) Coat NEW "O" rings with oil and install to rack housing bushings. Install bushings into rack housing.

3) Align installation hole for wire of stopper with slot in rack housing. Install NEW wire into stopper. Using Socket Wrench (09631-10021), rotate stopper clockwise until end of stopper retainer wire disappears. Connect Steering Rack Oil Seal Tester (09631-12071) to pressure line fittings. Apply 16 in. Hg vacuum to rack assembly. If vacuum does not hold for 30 seconds, check installation of oil seals.

4) Install rack housing grommets into brackets. Align reference marks on rack housing brackets and rack housing, place brackets in vise and tighten vise to fasten clamps. Coat Teflon rings with PS fluid and install control valve assembly into valve housing. Using Seal Driver (09612-22011), press NEW seal into control valve housing. Place NEW gasket on rack housing. Align reference marks on valve housing and rack housing and install control valve assembly. Install self-locking nut and dust cover.

5) Apply Loctite Sealant to rack housing cap. Install rack housing cap and tighten to 43 ft. lbs. (58 N.m). Stake housing cap in 2 places. Install rack guide sub-assembly, rack guide spring and rack guide spring cap. Using torque wrench and Socket (09631-10021), tighten spring cap to 18 ft. lbs. (24 N.m). Loosen spring cap 12 degrees counterclockwise. Using an INCH-lb. torque wrench and Socket (09616-00010), rotate control valve shaft left and right 1 to 2 times. Loosen spring cap until spring is not compressed.

6) With INCH-lb. torque wrench attached to control valve shaft, tighten rack guide spring cap until control valve shaft rotating torque is 7-12 INCH lbs. (.8-1.4 N.m). Apply sealant to 2 or 3 threads rack guide spring cap lock nut. While holding spring cap from turning, tighten spring cap lock nut to 37 ft. lbs. (50 N.m). Recheck control valve turning torque, and readjust if necessary.

7) Install rack ends and NEW claw washers. Align claw washer tangs with steering rack grooves. Using a 24 mm end wrench to hold steering rack steady, and Spanner Wrench (09922-10010), tighten rack ends to 45 ft. lbs. (61 N.m). Using a brass punch and hammer, stake claw washers. DO NOT damage rack. Install rack boots, clamps and clips. Install outer tie-rod ends and lock nuts, aligning reference marks. After adjusting toe-in, tighten lock nuts to specification. Install 2 turn pressure tubes with NEW "O" rings.

Disassembly (GS300, GS400, LS400, SC300 & SC400)

1) Using Rack Housing Stand (09612-00012), clamp rack and pinion assembly in vise. Remove pressure tubes. See Figs. 9 and 10. Mark outer tie-rod ends and rack ends for reassembly reference. Remove outer tie-rod ends and lock nuts. Remove rack boots, clamps and clips. Using appropriate spanner wrench, remove rack ends (inner tie-rod ends) and claw washers. Remove damper support bracket (if equipped). Remove rack guide spring lock nut, rack guide spring cap, spring, guide, and seat.

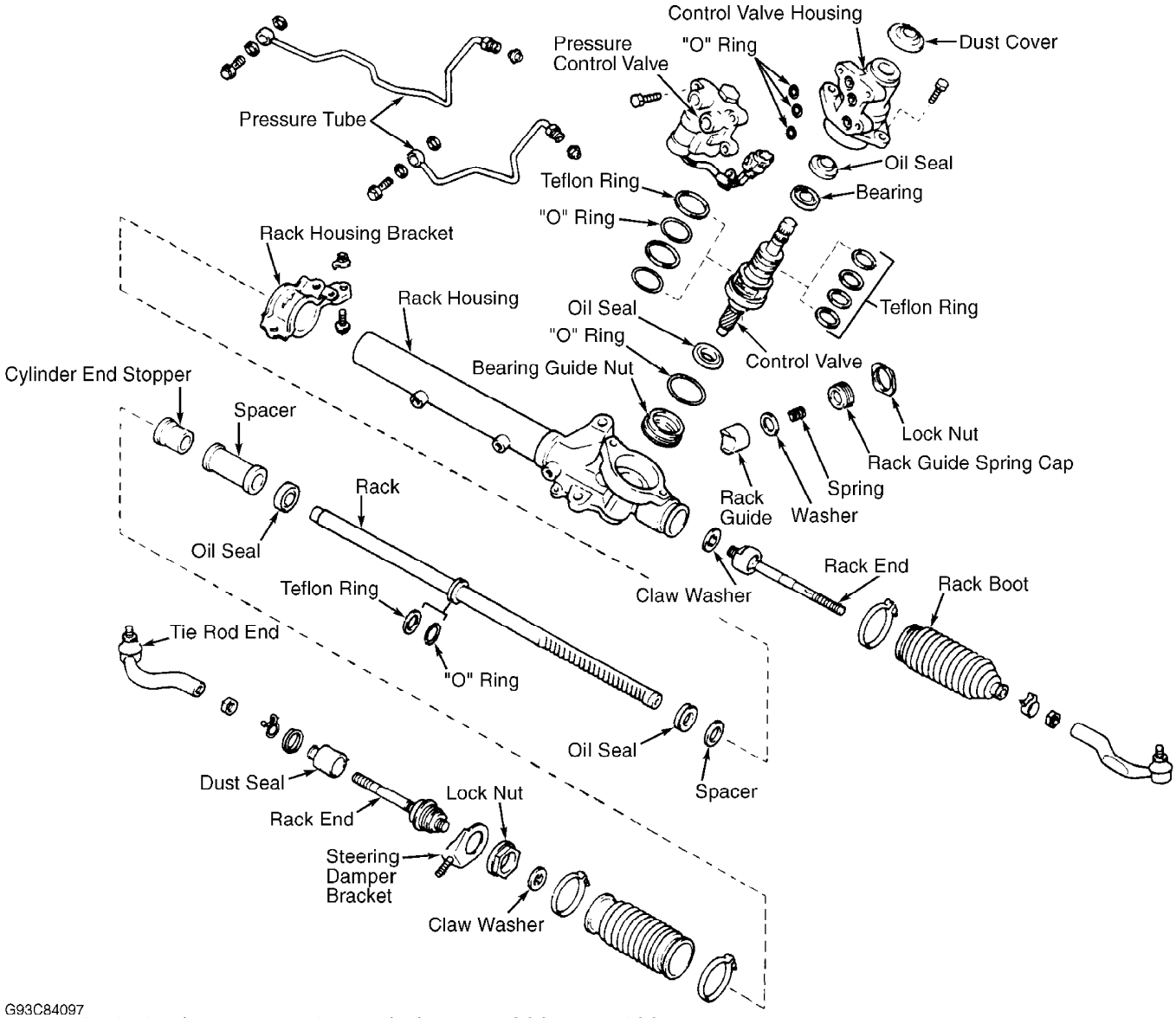
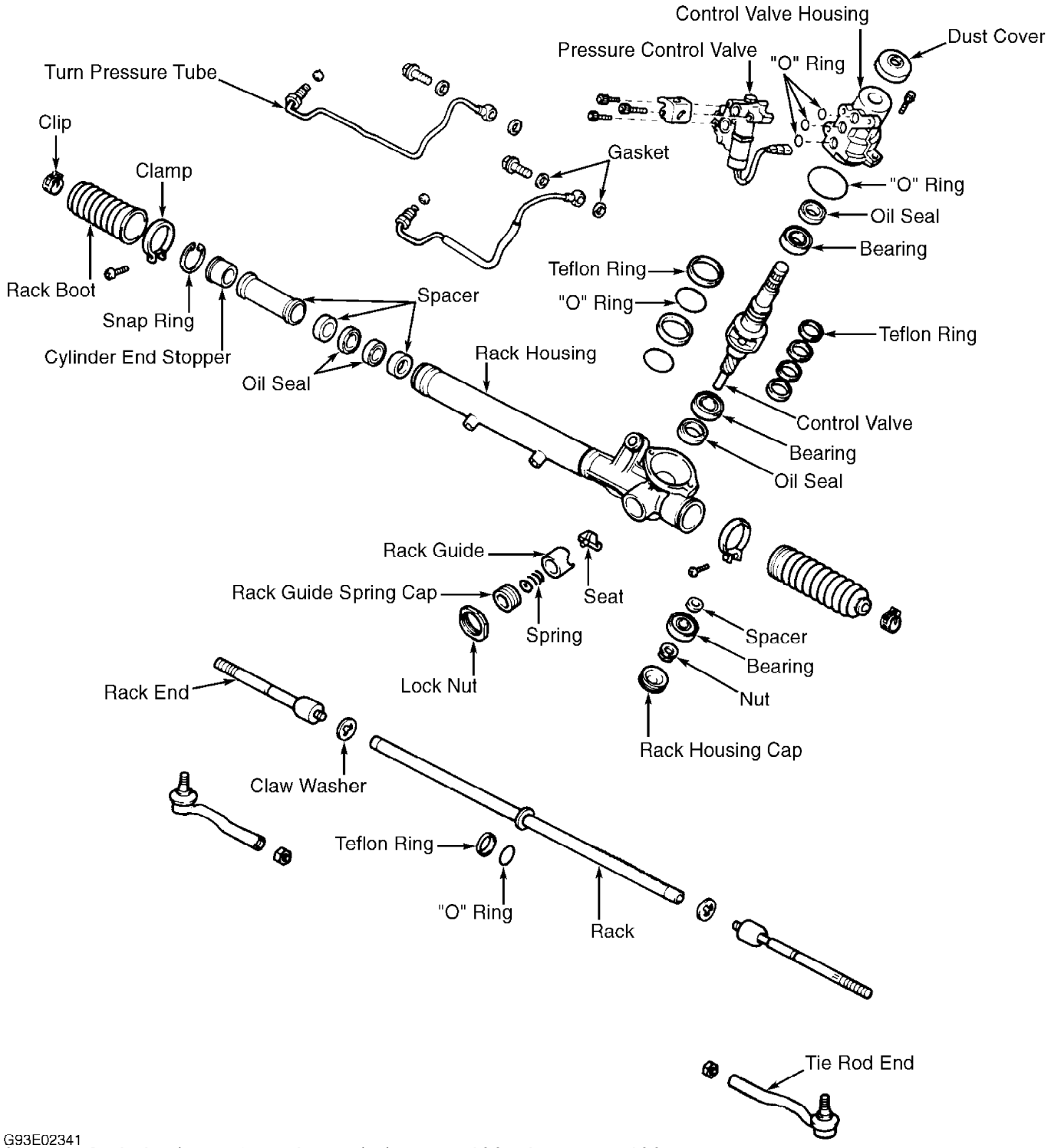


Fig. 9: Exploded View Of Rack & Pinion (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G93E02341

Fig. 10: Exploded View Of Rack & Pinion (SC400 Shown; LS400 & SC300 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Remove rack housing cap. Using Worm Bearing Adjuster (09631-22060 for GS300 models or 09616-00010 for all other models), remove lock nut, dust cover, and control valve. Remove lower bearing

and spacer. Remove snap ring, cylinder end stopper, spacers, and oil seal. Using Bearing Driver (09612-10061), press out rack until end stopper touches press bed. Using brass punch, tap rack and end stopper from housing. Remove spacers and oil seal.

Reassembly

1) Lubricate parts with power steering fluid. Using Oil Seal Drivers (09951-60010 or 09952-06010), install oil seal. Coat Rack Guide (09631-20102), with PS fluid and insert onto rack. DO NOT damage seal.

2) Wrap end of rack with vinyl tape and slide rack into rack housing. Remove rack guide. Using Seal Driver (09950-06010), install oil seal in opposite end of rack housing. Using Seal Driver (09950-06010), drive in spacer and cylinder end stopper. Install NEW snap ring.

3) Connect Steering Rack Oil Seal Tester (09631-22030 for GS300 models, or 09631-12071 for all other models), to pressure tube fittings. Apply 16 in. Hg vacuum to rack assembly. If vacuum does not hold for 30 seconds, check installation of oil seals.

4) Install control valve and control valve housing. Install lower bearing and spacer. Apply Loctite Sealant to 2 or 3 threads of rack housing cap. Install lock nut and rack housing cap. Install rack guide seat, rack guide, and rack guide spring.

5) Apply sealant to 2 or 3 threads of spring cap. Tighten spring cap to 18 ft. lbs. (24 N.m). Loosen spring cap 12 degrees counterclockwise. Rotate control valve shaft right and left 1 or 2 times. Loosen spring cap until spring is not compressed.

6) Attach INCH-lb. torque wrench to control valve shaft. Tighten rack guide spring cap until control valve rotating torque is as specified in RACK PRELOAD table.

RACK PRELOAD

Application	INCH Lbs. (N.m)
SC300 & SC400	6.9-14.8 (.8-1.7)
GS300 & GS400	4.1-14.9 (.5-1.7)
ES300 & RX300	6.9-12.2 (.8-1.4)
LS400	7.8-10.4 (.9-1.2)

7) Apply sealant to 2 or 3 threads on rack guide spring cap lock nut. Tighten lock nut to 41 ft. lbs. (55 N.m). Recheck control valve turning torque, and readjust if necessary. To complete assembly, reverse disassembly procedure.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Control Valve Self-Locking Nut	29 (39)
Pressure Control Valve Bolt	13 (18)
Pressure Line-To-Pressure Tube Joint (1)	27 (37)
Pressure Port Fitting	
Except SC300 & GS300	51 (69)
SC300 & GS300	61 (83)
Pressure Tube-To-Control Valve Housing Fitting Bolt	
ES300 & RX300	18 (24)
GS300, LS400, SC300 & SC400	36 (49)
Pressure Tube-To-Pump Fitting Bolt	36 (49)

Pump Mounting Bolt	
Except SC300 & GS300	29 (39)
SC300 & GS300	17 (23)
Pump Mounting Nut	32 (43)
Pump Pulley Nut	32 (43)
Rack & Pinion Assembly Mounting Bracket Bolts & Nuts	
ES300 & RX300	133 (180)
GS300	48 (65)
LS400, SC300 & SC400	56 (76)
Rack End-To-Rack (1)	
ES300 & RX300	45 (61)
GS300	56 (76)
LS400, SC300 & SC400	57 (77)
Rack Guide Spring Cap	18 (24)
Rack Guide Spring Cap Lock Nut (1)	37 (50)
Rack Housing Cap	
LS400	51 (69)
ES300 & RX300	43 (58)
Steering Column Lower Universal Joint Bolt	26 (35)
Tie Rod End Lock Nut	
ES300 & RX300	55 (75)
LS400, GS300, SC300 & SC400	41 (56)
Tie Rod-To-Steering Knuckle Nut	
ES300 & RX300	36 (49)
GS300	64 (87)
LS400	44 (60)
SC300 & SC400	48 (65)

	INCH Lbs. (N.m)
Pump Housing End Retaining Bolt	115 (13)
Reservoir-To-Pump Mounting Bolts (GS300 & LS400)	115 (13)
Suction Port Union Retaining Bolt (LS400)	115 (13)

(1) - Measured using a torque wrench with a fulcrum length of 13.4" (340 mm).

* STEERING UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Steering, Suspension, Wheel Alignment, Wheels and Tires
January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

CONTENTS

Motorist Assurance Program (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)
OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

Steering and Suspension

AIR RIDE SUSPENSION
AIR RIDE SUSPENSION - AIR SHOCKS AND AIR STRUTS
AIR RIDE SUSPENSION - AIR SPRING VALVES
AIR RIDE SUSPENSION - AIR SPRINGS
AIR RIDE SUSPENSION - COMPRESSORS
AIR RIDE SUSPENSION - HEIGHT SENSORS
AIR RIDE SUSPENSION - MODULES
AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)
AIR RIDE SUSPENSION - SWITCHES (ON/OFF)
AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)
AIR RIDE SUSPENSION - TUBING
AIR RIDE SUSPENSION - WARNING LAMPS
AIR RIDE SUSPENSION - WIRING HARNESSES
BALL JOINTS
BUSHINGS
CENTER LINKS
CONTROL ARM SHAFTS
CONTROL ARMS
DRAG LINKS
ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS
IDLER ARMS
KING PINS
PITMAN ARMS
POWER STEERING HOSES
POWER STEERING (HYDRAULIC) PUMPS
RADIUS ARMS
RELAY RODS
SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES
SPINDLES
SPRINGS - COIL, LEAF AND TORSION BAR
STEEL POWER STEERING LINES
STEERING ARMS
STEERING DAMPERS
STEERING GEARS (EXCEPT RACK AND PINION)
STEERING GEARS - RACK AND PINION
STEERING KNUCKLES
STRIKE OUT BUMPERS
STRUT RODS
STRUT UPPER BEARING PLATE ASSEMBLIES
SWAY BAR LINKS
SWAY BARS
TIE ROD ENDS (INNER AND OUTER)
TRACK BARS
TRAILING ARMS

WHEEL BEARINGS, RACES AND SEALS

Wheel Alignment

WHEEL ALIGNMENT

Wheels and Tires

TIRES
VALVE STEMS
WHEEL ATTACHMENT HARDWARE
WHEELS (RIMS)

MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above, standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve

states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested." In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and the conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a

customer's vehicle has one of these conditions, the procedure may be only to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 – To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 – To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 – Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

STEERING AND SUSPENSION

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

Steering and suspension are complex systems made up of a

variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

CAUTION: DO NOT use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

AIR RIDE SUSPENSION

NOTE: Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

AIR RIDE SUSPENSION - AIR SHOCKS AND AIR STRUTS

NOTE: This section covers the air spring portion of the air shock or strut. For damping portion of shock or strut conditions and procedures, refer to the SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES section.

AIR RIDE SUSPENSION - AIR SHOCK AND AIR STRUT INSPECTION

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement.

AIR RIDE SUSPENSION - AIR SPRING VALVES

AIR RIDE SUSPENSION - AIR SPRING VALVE INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware		

threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Blocked	A	..	Require repair or replacement.
Connector bent	A	..	Require repair or replacement.
Connector broken	A	.....	Require replacement.
Connector loose	A	..	Require repair or replacement.
Inoperative	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Restricted	A	..	Require repair or replacement.

AIR RIDE SUSPENSION - AIR SPRINGS

AIR RIDE SUSPENSION - AIR SPRING INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require replacement of broken part.
Attaching hardware incorrect	A	.....	Require replacement of incorrect part.
Attaching hardware loose	A	...	Require repair or replacement of loose part.
Attaching hardware missing	C	..	Require replacement of missing part
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Collar cracked	A	.....	Require replacement.
End cap cracked	A	.....	Require replacement.
Inner fabric of bag damaged	A	.....	Require replacement.
Leaking	A	..	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	.....	Suggest replacement.
Piston cracked	A	.....	Require replacement.

AIR RIDE SUSPENSION - COMPRESSORS

AIR RIDE SUSPENSION - COMPRESSOR INSPECTION

Condition	Code		Procedure
Attaching hardware bent .	B	...	Require repair or replacement of bent part.
Attaching hardware broken	A	...	Require replacement of broken part.

Condition	Code	Procedure
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Does not build pressure	A	(1) Further inspection required.
Excessive run time	B	(2) Further inspection required.
Inoperative	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

(1) - If failure to build pressure is traced to the compressor, require replacement.
(2) - If excessive run time is traced to the compressor, require replacement.

AIR RIDE SUSPENSION - HEIGHT SENSORS

AIR RIDE SUSPENSION - HEIGHT SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Dust boot missing	2	(1) Suggest replacement.
Dust boot split	2	(1) Suggest replacement.
Dust boot torn	2	(1) Suggest replacement.
Housing cracked	A	Require replacement.
Lead routing incorrect	B	Require rerouting according to

			vehicle manufacturer's specifications.
Loose	B	...	Require adjustment to vehicle manufacturer's specifications.
Missing	C	.....	Require replacement.
Output signal incorrect	A	..	Require repair or replacement.
Wire lead damaged	A	..	Require repair or replacement.

(1) - This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.

AIR RIDE SUSPENSION - MODULES

AIR RIDE SUSPENSION - MODULE INSPECTION

Condition	Code		Procedure
Attaching hardware loose	A	...	Require repair or replacement of loose part.
Attaching hardware missing	C	..	Require replacement of missing part.
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Housing cracked	2	..	Suggest repair or replacement.
Inoperative	A	.....	Require replacement.
Missing	C	.....	Require replacement.

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

AIR RIDE SUSPENSION - RELAY (COMPRESSOR) INSPECTION

Condition	Code		Procedure
Housing cracked	2	.....	(1) Suggest replacement.
Intermittent	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Output signal incorrect	A	.....	Require replacement.

(1) - If moisture enters the relay, it can reduce life expectancy or impair function.

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

AIR RIDE SUSPENSION - SWITCH (ON/OFF) INSPECTION

Condition	Code		Procedure
Broken	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Output signal incorrect	A	.....	Require replacement.

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

AIR RIDE SUSPENSION - TORSION SPRING (COUNTER BALANCING) INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - TUBING

AIR RIDE SUSPENSION - TUBING INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Blocked	A	Require repair or replacement.
Fitting incorrect	B	Require replacement.
Leaking	A	Require repair or replacement.
Line type incorrect	B	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Routed incorrectly	B	Require routing correction.

AIR RIDE SUSPENSION - WARNING LAMPS

AIR RIDE SUSPENSION - WARNING LAMP INSPECTION

Condition	Code	Procedure
Bulb burned out	A	Require replacement.
Warning light does		

not come on during bulb check	..	. Further inspection required to determine cause.
Warning light flashes ...	..	. Further inspection required to determine cause.
Warning light is intermittent	..	. Further inspection required to determine cause.
Warning light stays on after initial bulb check	..	. Further inspection required to determine cause.

AIR RIDE SUSPENSION - WIRING HARNESSES

AIR RIDE SUSPENSION – WIRING HARNESS INSPECTION

Condition	Code	Procedure
Connector bent	A ..	Require repair or replacement.
Connector broken	A ..	Require repair or replacement.
Connector loose	A ..	Require repair or replacement.
Damaged (cut, burned, or chafed)	A ..	Require repair or replacement.
Excessive resistance	B ..	Require repair or replacement.
Fuse blown	A	Require replacement.
Fusible link blown	A	Require replacement.
Open	A ..	Require repair or replacement.
Poor ground	A ..	Require repair or replacement.
Routed incorrectly	B ..	Require rerouting according to vehicle manufacturer's specifications.
Shorted	A ..	Require repair or replacement.
Terminal bent	A ..	Require repair or replacement.
Terminal broken	A ..	Require repair or replacement.
Terminal corroded	A ..	Require repair or replacement.
Terminal loose	A ..	Require repair or replacement.

BALL JOINTS

Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice.

NOTE: The term "perceptible movement," defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the "perceptible movement" standard. Before requiring or suggesting any parts be replaced based on "perceptible movement," consult your repair manual to determine if OEM specifications exist.

You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.

BALL JOINT INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace ball joint.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace ball joint.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace ball joint.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace ball joint.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace ball joint.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace ball joint.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace ball joint.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Greaseable ball joint will not take grease	2	(5) Suggest replacement of grease fitting.
Nut on ball joint loose	A	(6) Require repair or replacement.
Pre-load adjustment incorrect	B	Require repair or replacement.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.

Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(5) - If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

BUSHINGS

BUSHING INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace bushing.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace bushing.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace bushing.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace bushing.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace bushing.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace bushing.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace bushing.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace bushing.
Binding	A	Require repair or replacement.

Deteriorated, affecting performance	A	Require repair or replacement.
Distorted, affecting performance	A	Require repair or replacement.
Leaking (fluid-filled type)	A	Require replacement.
Missing	C	Require replacement.
Noisy	2	(1) Further inspection required.
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement.
Seized	A	Require replacement.
Shifted (out of position)	B	Require repair or replacement.
Split	A	Require replacement.
Surface cracking (weather-checked)	..	No service suggested or required.

(1) - If noise isolated to bushing, suggest repair or replacement.

CAUTION: Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.

CENTER LINKS

CENTER LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace center link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace center link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace center link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace center link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace center link.
Bent	B	Require replacement.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.

Condition	Code	Procedure
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(3) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Looseness (perceptible horizontal movement)	1	(5) Suggest replacement.
Looseness that is excessive	B	(5)(6) Require replacement.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Stud loose in taper hole	A	(7) Require repair or replacement.
Taper hole elongated	A	(8) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for damaged taper hole.
(8) - Check for damaged stud.

CONTROL ARM SHAFTS

CONTROL ARM SHAFT INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shaft.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shaft.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shaft.

Condition	Code	Procedure
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shaft.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shaft.
Bent	B	Require replacement.
Shaft bushing surface undersized (worn)	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

CONTROL ARMS

CONTROL ARM INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace control arm.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace control arm.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace control arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace control arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace control arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace control arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace control arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace control arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.

Ball joint hole oversized (loose interference or press fit)	B	(1) Further inspection required.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.

DRAG LINKS

DRAG LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace drag link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace drag link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace drag link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace drag link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace drag link.
Bent	B	Require replacement.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(5) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Looseness (perceptible horizontal movement)	1	(6) Suggest replacement.
Looseness that is		

excessive	B	(6)(7) Require replacement.
Seized	A	Require replacement.
Stud bent	B	(8) Require replacement.
Stud broken	A	(8) Require replacement.
Stud loose in taper hole	A	(8) Require repair or replacement.
Taper hole elongated	A	(9) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(8) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - Missing grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(7) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(8) - Check for damaged taper hole.
(9) - Check for damaged stud.

ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS

NOTE: This section covers the electronic damping control portion of the electronic shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES section.

ELECTRONIC RIDE CONTROL SHOCK AND STRUT INSPECTION

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Electronic valve control inoperative	2	(1) Suggest replacement.
Terminal bent	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	Require repair or replacement.
Terminal loose	A	Require repair or replacement.

(1) - It is acceptable to replace with a non-electronically controlled unit, where available.

IDLER ARMS

IDLER ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace idler arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace idler arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace idler arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace idler arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace idler arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace idler arm.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(5) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Greaseable joint will not take grease	2	(1) Suggest replacement of grease fitting.
Looseness at frame bracket end	B	(6)(7) Require repair or replacement.
Looseness at link end (perceptible horizontal movement)	1	(8) Suggest replacement.
Looseness at link end that is excessive	B	(8)(9) Require replacement.
Mounted out of position (center link not parallel)	B	Require repositioning.
Nut on stud loose	A	(10) Require repair or replacement.

Seized	A		Require replacement.
Stud bent	B	(11)	Require replacement.
Stud broken	A	(11)	Require replacement.
Taper hole elongated	A	(12)	Require replacement.
Threads damaged	A		Require repair or replacement.
Threads stripped (threads missing)	A	(11)	Require replacement.
Wear exceeds manufacturer's specifications	B		Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - Missing grease seal will allow contaminants to enter joint and will accelerate wear.
(6) - If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.
(7) - Looseness is defined as movement that creates excessive toe change.
(8) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(9) - Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity.
(10) - Check for bent stud or damaged taper hole.
(11) - Check for damaged taper hole.
(12) - Check for damaged stud.

KING PINS

You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.

KING PIN INSPECTION

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement.
Bearing balls worn	A	Require replacement.
Bearing races pitted	A	Require replacement.
Bearing races worn	A	Require replacement.
Bearing rollers pitted	A	Require replacement.
Bearing rollers worn	A	Require replacement.
Bearing seal bent	2	Suggest replacement of seal or bearing.
Bearing seal missing	2	Suggest replacement of seal or bearing.
Bearing seal torn	2	Suggest replacement of seal or bearing.
Binding	A	Require repair or replacement

		of affected parts.
End caps missing	C	. Require replacement of missing part, if available; otherwise, replace king pin.
End play exceeds specifications	B	..... Require repair.
Grease fitting broken ...	A	.. Require replacement of grease fitting.
Grease fitting missing ..	C	.. Require replacement of grease fitting.
Grease fitting won't seal	A	.. Require replacement of grease fitting.
Locating pins missing ...	C	. Require replacement of missing part, if available; otherwise, replace king pin.
Looseness exceeds manufacturer's specifications	B	.... Require replacement of worn parts.
Seized	A	..... Require replacement.
Threads damaged	A	. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Will not take grease	2	..... (1) Suggest replacement of grease fitting.

(1) - If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.

PITMAN ARMS

PITMAN ARM INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace pitman arm.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace pitman arm.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace pitman arm.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace pitman arm.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace pitman arm.
Bent	B	..... Require replacement.
Binding	A	..... (1) Further inspection required.

Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(3) Suggest replacement of seal.
Grease seal torn	2	(4) Suggest replacement of seal.
Looseness (perceptible horizontal movement)	1	(5) Suggest replacement.
Looseness that is excessive	B	(5)(6) Require replacement.
Nut on stud loose	A	(7) Require repair or replacement.
Seized	A	Require replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Stud bent	B	(8) Require replacement.
Stud broken	A	(8) Require replacement.
Stud loose in taper hole	A	(8) Require repair or replacement.
Taper hole elongated	A	(9) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(8) Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for bent stud of damaged taper hole.
(8) - Check for damaged taper hole.
(9) - Check for damaged stud.

POWER STEERING HOSES

POWER STEERING HOSE INSPECTION

Condition	Code	Procedure
Blistered	B	Require replacement.
Blocked	A	Require repair or replacement.
Fitting threads damaged	A	Require repair or replacement.

Fitting threads stripped (threads missing)	A	Require replacement.
Inner fabric (webbing) cut	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Outer covering is cracked to the extent that the inner fabric of hose is visible	B	Require replacement.
Restricted	A	Require repair or replacement.

POWER STEERING (HYDRAULIC) PUMPS

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

POWER STEERING (HYDRAULIC) PUMP INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Belt alignment incorrect	B	(1) Further inspection required.
Belt cracked	1	Suggest replacement.
Belt frayed	1	Suggest replacement.
Belt missing	C	Require replacement.
Belt noisy	2	(2) Further inspection required.
Belt plies separated	A	Require replacement.
Belt tension out of specification	B	Require adjustment or replacement.
Belt worn beyond adjustment range	B	Require replacement.
Belt worn so it contacts bottom of pulley	A	Require replacement.
Binding	A	Require repair or replacement.
Fluid at or beyond service interval	3	Suggest fluid change.

Fluid contaminated	B	(3) Require flushing and refilling of the system.
Fluid level incorrect	B	Require adjustment of fluid level.
Inadequate assist	A	(4) Further inspection required.
Leaking	A	Require repair or replacement.
Noise	2	(5) Further inspection required.
Pulley bent	A	Require repair or replacement of pulley.
Pulley missing	C	Require replacement of pulley.
Remote reservoir leaking	A	Require replacement of reservoir,
Reservoir cap broken	A	Require replacement of cap.
Reservoir cap missing	C	Require replacement of cap.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.
(3) - Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(4) - If pump is source of inadequate assist, require repair or replacement.
(5) - If noise is isolated to pump, suggest repair or replacement.

RADIUS ARMS

RADIUS ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped		

(threads missing)	A	..... Require replacement.

RELAY RODS

RELAY ROD INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace relay rod.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace relay rod.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace relay rod.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace relay rod.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace relay rod.
Bent	B	..... Require replacement.
Binding	A	..... (1) Further inspection required.
Grease boot cracked	2	..... (2) Suggest replacement.
Grease boot missing	2	..... (3) Suggest replacement.
Grease boot torn	2	..... (4) Suggest replacement.
Grease fitting broken ...	A	..... Require replacement grease fitting.
Grease fitting missing ..	C	... Require replacement of grease fitting.
Grease fitting won't seal	A	... Require replacement of grease fitting.
Grease seal missing	2	..... (3) Suggest replacement.
Grease seal torn	2	..... (4) Suggest replacement.
Looseness (perceptible horizontal movement) ...	1	..... (5) Suggest replacement.
Looseness that is excessive	B	..... (5)(6) Require replacement.
Seized	A	..... Require replacement.
Stud bent	B	..... (7) Require replacement.
Stud loose in taper hole	A	..... (7) Require repair or replacement.
Taper hole elongated	A	..... (8) Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... (7) Require replacement.
Wear exceeds manufacturer's specifications	B	..... Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for damaged taper hole.
(8) - Check for damaged stud.

SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for improved performance and preventive maintenance.

* Part is close to the end of its useful life
* To extend tire life
* To balance ride and handling
* To improve stopping distance

When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

Under no circumstances should a technician bend struts or strut housings.

A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details.

NOTE: If vehicle is equipped with original equipment coil over shocks, apply the conditions for coil springs from the SPRINGS - COIL, LEAF AND TORSION BAR section of the STEERING AND SUSPENSION guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacing the shocks with standard shocks for any spring-related condition.

SHOCK ABSORBER, STRUT CARTRIDGE AND STRUT ASSEMBLY INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace shock or strut.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shock or strut.

Attaching hardware corroded, affecting structural integrity ...	A .	Require replacement of corroded part, if available; otherwise, replace shock or strut.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace shock or strut.
Attaching hardware loose	A ...	Require repair or replacement of loose part, if available; otherwise, replace shock or strut.
Attaching hardware missing	C ..	Require replacement of missing part, if available; otherwise, replace shock or strut.
Attaching hardware threads damaged	A ...	Require repair or replacement of part with damaged threads, if available; otherwise, replace shock or strut.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shock or strut.
Binding	A	Require replacement.
Body dented	A	(1) Further inspection required.
Body punctured	A	Require replacement.
Brake hose bracket bent	B ..	Require repair or replacement.
Brake hose bracket missing	C	Require replacement.
Brake hose bracket threads damaged	A ..	Require repair or replacement.
Brake hose bracket threads stripped (threads missing)	C	Require replacement.
Compression bumper missing	C	Require replacement of compression bumper.
Compression bumper split	1	Suggest replacement of compression bumper.
Damping (none)	A	Require replacement.
Dust boot (bellows) split	2	(2) Suggest replacement of boot.
Dust boot (bellows) missing	2	(2) Suggest replacement of boot.
Dust boot (bellows) torn	2	(2) Suggest replacement of boot.
Dust shield broken	2	(2) Suggest replacement.
Dust shield missing	2	(2) Suggest replacement.
Gland nut (strut housing cap) is not removable		

using appropriate tool	A	..	(3) Require replacement of nut and/or housing.
Gland nut (strut housing cap) threads damaged	A	...	Require repair or replacement of nut.
Gland nut (strut housing cap) threads stripped (threads missing)	A	.....	Require replacement of nut.
Housing dented	A	.....	(1) Further inspection required.
Housing punctured	A	.....	Require replacement.
Jounce bumper missing	C	...	Require replacement of jounce bumper.
Jounce bumper split	1	...	Suggest replacement of jounce bumper.
Leaking oil, enough for fluid to be running down the body	A	.....	(4) Require replacement.
Noise	2	.....	(5) Further inspection required.
Piston rod bent	A	.....	Require replacement.
Piston rod broken	A	.....	Require replacement.
Piston rod has surface defect	2	.....	Suggest replacement.
Piston rod threads damaged	A	..	Require repair or replacement.
Piston rod threads stripped (threads missing)	A	.....	Require replacement.
Seized	A	.....	Require replacement.
Shock missing	C	.....	Require replacement.
Strut housing bent	A	.....	Require replacement.
Strut housing cap (gland nut) is not removable using appropriate tool	A	.....	(3) Require replacement of nut and/or housing.
Strut housing cap (gland nut) threads damaged	A	...	Require repair or replacement of nut.
Strut housing cap (gland nut) threads stripped (threads missing)	A	.....	Require replacement of nut.
Strut housing severely corroded, affecting structural integrity	A	.....	Require replacement.
Strut housing threads damaged	A	..	Require repair or replacement.
Strut housing threads stripped (threads missing)	A	.....	Require replacement.
Tire cupping	A	.....	(6) Further inspection required.

(1) – Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.
(2) – This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) – Only required if replacing cartridge.
(4) – CAUTION: If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.

(5) - If noise is isolated to shock or strut, suggest replacement.
(6) - Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.

SPINDLES

SPINDLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Race seat area undersized	B	Require replacement.
Scored	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

SPRINGS - COIL, LEAF AND TORSION BAR

When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling.

When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height.

Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.

SPRING (COIL, LEAF AND TORSION BAR) INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware		

corroded, affecting structural integrity	A	..	Require replacement of corroded part.
Attaching hardware incorrect	A	.....	Require replacement of incorrect part.
Attaching hardware loose	A	....	Require repair or replacement of loose part.
Attaching hardware missing	C	...	Require replacement of missing part.
Attaching hardware threads damaged	A	....	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	.....	Require replacement.
Coil clash	..	..	(1) Require ride height check.
Coil spring insulator deteriorated	2	.....	Suggest replacement of insulator.
Coil spring insulator missing	2	.....	Suggest replacement of insulator.
Coil spring insulator split	2	.....	Suggest replacement of insulator.
Coil spring plastic coating deteriorated - rust present	A	.....	(2) Refer to manufacturer's service requirements.
Composite spring damaged	..	.....	(3) Further inspection required.
Cracked (all springs except composite leaf and secondary leave(s) on multi-leaf springs)	A	.....	Require replacement.
Installed incorrectly	B	.....	Require repair.
Leaf spring insulators missing	2	.....	Suggest replacement of insulators.
Secondary leaf on multi-leaf spring broken	1	....	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	1	....	Suggest repair or replacement
Torsion bar adjuster bent	A	.....	(4) Require repair or replacement of adjuster.
Torsion bar adjuster seized	A	....	(4) Require repair or replacement of adjuster.
Torsion bar adjuster threads damaged	A	....	(4) Require repair or replacement of part with damaged threads.
Torsion bar adjuster threads stripped			

(threads missing)	A	.....	Require replacement of part with stripped threads.
Vehicle suspension height not within OEM specifications	B	.....	Require adjustment or replacement.

(1) - If vehicle is within manufacturer's height specifications, no service is suggested or required.
(2) - Some manufacturers require replacement under these conditions.
(3) - Check vehicle ride height. If ride height is OK, no service is suggested or required.
(4) - Only required if ride height needs to be adjusted.

STEEL POWER STEERING LINES

CAUTION: When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM design specifications.

STEEL POWER STEERING LINE INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	... Require repair or replacement of bent part.
Attaching hardware broken	A	... Require replacement of broken part.
Attaching hardware loose	A	... Require repair or replacement of loose part.
Attaching hardware missing	C	.. Require replacement of missing part.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads.
Blocked	A	.. Require repair or replacement.
Fitting incorrect (such as compression fitting)	B	..... Require replacement.
Flare type incorrect	B	..... Required replacement.
Leaking	A	..... Require tightening or replacement.
Line type incorrect	B	..... Require replacement.
Restricted	A	..... Require replacement.
Routed incorrectly	B	..... Require routing correction.
Rust-pitted	1	..... Suggest replacement.
Rust pitted, affecting structural integrity ..	A	..... Require replacement.

STEERING ARMS

STEERING ARM INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Taper hole elongated	A	(1) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Check for damaged stud.

STEERING DAMPERS

The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed instead of repairing or replacing.

STEERING DAMPER INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace steering damper.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace steering damper.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace steering damper.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace steering

			damper.
Attaching hardware loose	A	...	Require repair or replacement of loose part, if available; otherwise, replace steering damper.
Attaching hardware missing	C	..	Require replacement of missing part, if available; otherwise, replace steering damper.
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads, if available; otherwise, replace steering damper.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads, if available; otherwise, replace steering damper.
Binding	A	.....	Require replacement.
Damper body dented	A	.....	(1) Further inspection required.
Damper body punctured	A	.....	Require replacement.
Damping (none)	A	.....	Require replacement.
Dust boot (bellows) missing	2	.....	(2) Suggest replacement of boot.
Dust boot (bellows) split	2	.....	(2) Suggest replacement of boot.
Dust shield broken	2	.....	(2) Suggest replacement.
Dust shield missing	2	.....	(2) Suggest replacement.
Leaking oil, enough for fluid to be running down the body	A	.....	Require replacement.
Loose	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Noise	2	.....	(3) Further inspection required.
Piston rod bent	A	.....	Require replacement.
Piston rod broken	A	.....	Require replacement.
Piston rod has surface defect	2	.....	Suggest replacement.
Piston rod threads stripped (threads missing)	A	.....	Require replacement.
Piston rod threads damaged	A	..	Require repair or replacement.
Seized	A	.....	Require replacement.

(1) - Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.
(2) - This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) - If noise is isolated to damper, suggest replacement.

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEAR (EXCEPT RACK AND PINION) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Binding	A	Require repair or replacement
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	(1) Require flushing and refilling of the system.
Gasket leaking	A	Require repair or replacement of gasket.
Housing leaking	A	Require replacement.
Hydraulic fittings leaking	A	Require repair or replacement of fittings.
Inadequate power assist	A	(2) Further inspection required. See note below.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement of seal and/or mating part.
Splines damaged	A	Require repair or replacement of splines.
Splines stripped	A	Require replacement of splines.
Steering coupler shield cracked	2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.
U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

(1) - Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(2) - If steering gear is source of inadequate assist, require repair or replacement.

STEERING GEARS - RACK AND PINION

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS - RACK AND PINION INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Balance tube blocked	A	Require repair or replacement of balance tube.
Balance tube missing	C	Require replacement of balance tube.
Balance tube restricted	A	Require repair or replacement of balance tube.
Bellows boot clamp missing	C	Require replacement of clamp.
Bellows boot cracked (not through)	2	Suggest replacement of bellows boot.
Bellows boot missing	C	Require replacement of bellows boot.
Bellows boot not sealing	A	Require repair or replacement of bellows boot.
Bellows boot torn	A	Require replacement of bellows boot.
Bellows boot twisted		

(from toe adjustment)	B	Require repair.
Fitting leaking	A	Require repair or replacement.
Fitting missing	A	Require replacement of fitting.
Fitting threads damaged	A	Require repair or replacement of part with damaged threads.
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	(1) Require flushing and refilling of the system.
Gasket leaking	A	Require repair or replacement.
Hard steering on cold start-up	1	(2) Suggest repair or replacement.
Housing cracked, affecting structural integrity	B	Require replacement.
Housing leaking	A	Require replacement.
Inadequate power assist	A	(3) Further inspection required.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Steel line blocked	A	Require repair or replacement of line.
Steel line leaking	A	Require repair or replacement of line.
Steel line missing	C	Require replacement of line.
Steel line restricted	A	Require repair or replacement of line.
Steering coupler shield cracked	2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Steering coupler shield torn	2	Suggest replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.
U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

(1) - Determine and correct source of contamination. Follow OE

specifications for fluid type.
(2) - Indicates internal wear.
(3) - If steering gear is source of inadequate assist, require repair or replacement.

STEERING KNUCKLES

STEERING KNUCKLE INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Pinch bolt incorrect	B	Require replacement with bolt that meets OE design.
Pinch bolt loose	B	Require repair.
Pinch bolt missing	B	Require replacement.
Pinch bolt tabs deformed (pinched together), .032" or more before clamping	B	(1) Require replacement.
Taper hole elongated	A	(2) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Steering knuckle deformation can cause pinch bolt breakage.
(2) - Check for damaged stud.

STRIKE OUT BUMPERS

STRIKE OUT BUMPER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of

		broken part.
Attaching hardware corroded, affecting structural integrity ...	A	..... Require replacement of corroded part.
Attaching hardware loose	A	... Require repair or replacement of loose part.
Attaching hardware missing	C	..... Require replacement of missing part.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads.
Missing	C	..... Require replacement.
Split	1	..... Suggest replacement.

STRUT RODS

STRUT ROD INSPECTION

Condition	Code	Procedure
Adjusting nut seized	A	..... (1) Require repair or replacement.
Attaching hardware bent	B	... Require repair or replacement of bent part, if available; otherwise, replace strut rod.
Attaching hardware broken	A	... Require replacement of broken part, if available; otherwise, replace strut rod.
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace strut rod.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace strut rod.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace strut rod.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace strut rod.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace strut rod.
Attaching (mating) hole oversized	A	... Require repair or replacement

		of frame.
Attaching point on frame corroded, affecting structural integrity ...	A	..... Require repair of frame.
Bent	A	..... Require replacement.
Mating (attaching) hole oversized	A	... Require repair or replacement of frame.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

(1) - Only required if an alignment is being performed.

STRUT UPPER BEARING PLATE ASSEMBLIES

NOTE: When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.

STRUT UPPER BEARING PLATE ASSEMBLY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require replacement of broken part, if available; otherwise, replace bearing plate assembly.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace bearing plate assembly.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace bearing plate assembly.
Bearing axial or radial movement exceeds vehicle manufacturer's specifications	B	..... Require replacement of bearing.
Bearing binding	A	..... Require replacement of bearing.
Bearing missing	C	..... Require replacement of bearing.
Bearing seized	A	..... Require replacement of bearing.
Bent	B	..... Require replacement.
Holes distorted	A	..... Require replacement.

Missing	C	Require replacement.
Severely corroded, affecting structural integrity	A	Require replacement.

SWAY BAR LINKS

SWAY BAR LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace link.
Ball and socket has looseness (perceptible vertical movement)	1	(1) Suggest replacement.
Ball and socket has looseness that is excessive	B	(1)(2) Require replacement.
Bent	B	Require replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	2	(3) Suggest replacement.
Grease boot missing	2	(4) Suggest replacement.
Grease boot torn	2	(5) Suggest replacement.
Missing	C	Require replacement.
Nut on stud loose	A	(6) Require repair.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.

(1) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

(2) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural

integrity.
(3) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

SWAY BARS

SWAY BAR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace sway bar.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace sway bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace sway bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace sway bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace sway bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace sway bar.
Bent	B	Require replacement.
Broken	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

TIE ROD ENDS (INNER AND OUTER)

TIE ROD END (INNER AND OUTER) INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace tie rod end.
Attaching hardware		

loose	A	Require repair or replacement of loose part, if available; otherwise, replace tie rod end.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace tie rod end.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace tie rod end.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace tie rod end.
Adjusting sleeve bent	B	Require replacement of sleeve or tie rod end.
Adjusting sleeve clamps out of position	B	Require repair.
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve or tie rod end.
Adjusting sleeve missing	C	Require replacement of sleeve or tie rod end.
Adjusting sleeve seized	A	(1) Require repair or replacement.
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve or tie rod end.
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve or tie rod end.
Binding	A	(2) Further inspection required.
Grease boot cracked	2	(3) Suggest replacement.
Grease boot missing	2	(4) Suggest replacement.
Grease boot torn	2	(5) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(4) Suggest replacement of seal.
Grease seal torn	2	(5) Suggest replacement of seal.
Greaseable tie rod end won't take grease	2	(6) Suggest replacement of grease fitting.
Looseness (perceptible horizontal movement)	1	(7) Suggest replacement.
Looseness exceeds manufacturer's specifications	B	Require replacement.

Looseness that is excessive	B	(7)(8) Require replacement.
Nut on stud loose	A	(9) Require repair or replacement of nut.
Seized	A	Require replacement
Stud bent	B	(10) Require replacement.
Stud broken	A	(10) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(10) Require replacement.

(1) - Only required if toe needs to be adjusted.
(2) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(3) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(6) - If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.
(7) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(8) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) - Check for bent stud or damaged taper hole.
(10) - Check for damaged taper hole.

TRACK BARS

TRACK BAR INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace track bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace track bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace track bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace track bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace track bar.

Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	2	(1) Suggest replacement.
Grease boot missing	2	(2) Suggest replacement.
Grease boot torn	2	(3) Suggest replacement.
Holes distorted	A	Require replacement.
Looseness (perceptible horizontal movement)	1	(4) Suggest replacement.
Looseness that is excessive	B	(4)(5) Require replacement.
Nut on stud loose	A	(6) Require repair or replacement of nut.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(2) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(5) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

TRAILING ARMS

TRAILING ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace trailing arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace trailing arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace trailing arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise,

		replace trailing arm.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace trailing arm.
Bent	B	..... Require replacement.
Bushing hole oversized ..	B	..... Require replacement.
Corroded, affecting structural integrity ...	A	..... Require replacement.
Holes distorted	A	..... Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

WHEEL BEARINGS, RACES AND SEALS

NOTE: When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

WHEEL BEARING, RACE AND SEAL INSPECTION

Condition	Code	Procedure
Rear axle seal on rear-wheel drive leaking	A	..... Require replacement of seal and inspection of axle, bearing, housing, and vent tube.
Seal bent	1	..... Suggest replacement.
Seal leaking	A	. Require replacement of seal and inspection of bearings.
Seal missing	C	..... Require replacement.
Seal torn	A	..... Require replacement.
Wheel bearing assembly feels rough when rotated	A	.. Require replacement of bearing assembly.
Wheel bearing balls are pitted	A	.. Require replacement of bearing assembly.
Wheel bearing balls are worn	A	.. Require replacement of bearing assembly.
Wheel bearing end-play exceeds vehicle manufacturer's specifications	B	.. Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	A	..... Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	A	.. Require replacement of bearing

			assembly.
Wheel bearing races are worn	A	..	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	A	..	Require replacement of bearing assembly.
Wheel bearing rollers are worn	A	..	Require replacement of bearing assembly.

WHEEL ALIGNMENT

WHEEL ALIGNMENT

Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to OEM specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment.

Failure to replace or correct suggested parts or service may prevent a proper alignment.

Before performing an alignment check, inspect and verify the following:

* Tire pressure and size
* Vehicle loading
* Ride height
* Steering and suspension parts

If the inspection reveals that all the above are within published specifications, a wheel alignment check and an alignment, if needed, may be performed.

CAUTION: Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer, for example, Ford forged twin "I" beam axles. All measurements and specifications must be noted on the inspection report.

WHEEL ALIGNMENT INSPECTION

Condition	Code	Procedure
Dog tracking, shown to be caused by faulty alignment	2	..... Suggest repair.
Lead, shown to be caused by faulty alignment	A	..... Require alignment.
Part has been changed, affecting alignment	A	..... Require alignment check.
Pull, shown to be caused by faulty alignment	A	..... Require alignment.
Steering wheel off-center	2	..... Suggest alignment.
Tire wear, shown to be caused by		

faulty alignment	A	.....	Require alignment.
Wander, shown to be caused by faulty alignment	A	.....	Require alignment.

WHEELS AND TIRES

TIRES

These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

WARNING: High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death.

WARNING: Only specially trained persons should dismount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death.

WARNING: Consult the vehicle owner’s manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. DO NOT exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association

WARNING: When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. DO NOT mix different speed rating designations on the same axle.

WARNING: DO NOT mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule.

WARNING: DO NOT mix size or type (all season, performance, mud and snow) of tires on the same axle.

TIRE INSPECTION

Condition	Code	Procedure
Air pressure incorrect ..	B	..... Require repair
Bead broken	A	..... Require replacement.
Bead leaking, caused by tire	A	.. Require repair or replacement.
Bead wire/cord exposed ..	A	..... Require replacement.
Cord or belt material exposed	A	..... Require replacement.
Cord ply separations	A	..... Require replacement.

Directional/asymmetrical tires mounted incorrectly	B	.....	Require remounting and/or repositioning.
Irregular tread wear, affecting performance	2	.....	(1) Suggest replacement.
Load ratings less than OEM specifications	B	.....	Require replacement.
Mixed tread types (all season, performance, mud and snow) on same axle	A	.....	Require replacement.
Number of punctures exceeds manufacturer's limit	B	.....	Require replacement.
Out of balance	B	.	Require rebalance of tire/wheel assembly.
Ply separation	A	.....	Require replacement.
Pull or lead, caused by tire	A	..	Require repair or replacement.
Radial and bias or bias-belted ply tires on same axle	B	..	Require repair or replacement.
Radials are on the front and not on the rear	B	.....	(2) Require repair or replacement.
Run flat damage	A	.....	Require replacement.
Shoulder cut	A	.....	Require replacement.
Shoulder puncture	A	.....	Require replacement.
Shoulder with plug	A	.....	Require replacement.
Sidewall bulge	A	.....	Require replacement.
Sidewall cut	A	.....	Require replacement.
Sidewall indentation	..	.....	No service required or suggested.
Sidewall puncture	A	.....	Require replacement.
Sidewall with plug	A	.....	Require replacement.
Speed rating designations different on same axle	2	..	Suggest repair or replacement.
Tire and wheel assembly has excessive run-out	B	.....	(3) Require repair or replacement of appropriate part.
Tires with more than 1/4" diameter difference on a four-wheel drive vehicle	B	.....	Require replacement.
Tread area puncture larger in diameter than manufacturer's specifications	B	.....	Require replacement.
Tread missing pieces (chunking), exposing cord	A	.....	Require replacement.
Tread missing pieces (chunking), not exposing cord	1	.....	Suggest replacement.
Tread separations	A	.....	Require replacement.
Tube in tubeless tire	3	....	(4) Suggest removal of tube.
Weather-checking	..	.....	No service required or suggested.
Worn to tread wear			

indicators ..... B ..... Require replacement.

(1) - Determine and correct cause of irregular tire wear.
(2) - If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.
(3) - Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.
(4) - Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and/or wheel listed in these guidelines.

VALVE STEMS

VALVE STEM INSPECTION

Condition	Code	Procedure
Bent	1	Suggest replacement.
Broken	A	Require replacement.
Cut, but not leaking	1	Suggest replacement.
Deteriorated (cracking, dry rot)	1	Suggest replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped	A	Require replacement.
Valve cap missing	C	Require replacement of cap.
Weather-checking	1	Suggest replacement.
Won't take air	A	Require repair or replacement.

WHEEL ATTACHMENT HARDWARE

For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHMENT HARDWARE INSPECTION

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	(1) Require replacement.
Loose	B	Require repair or replacement of affected component.
Lug nut installed backward	B	Require repair or replacement.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut rounded	A	(2) Require replacement of nut.
Lug nut seized	A	(2) Require replacement of nut.

Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.
Threads stripped	A	Require replacement of component with stripped threads.

(1) - Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) - Only required if removing wheel.

WHEELS (RIMS)

WARNING: Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

WHEEL (RIM) INSPECTION

Condition	Code	Procedure
Bead leaking, caused by wheel	A	(1) Require repair or replacement.
Bent hub mounting surface	A	Require replacement.
Bent rim, causing vibration	2	(1) Suggest replacement.
Broken	A	Require replacement.
Cast wheel porous, causing a leak	A	Require repair or replacement.
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement.
Corrosion, affecting structural integrity	A	Require replacement.
Corrosion build-up on wheel mounting surface	A	Require repair.
Cracked	A	Require replacement.
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning.
Load capacity less than OEM specifications	B	Require replacement.
Offset mismatched on same axle	B	Require replacement.
Rivets leaking	A	Require replacement.
Run-out beyond OEM specs	B	Require replacement.
Stud holes elongated	A	(2) Require replacement.
Welded or brazed repair	2	Suggest replacement.

Welds leaking	A		Require replacement.
Wheel centering (pilot) hole incorrect	B		Require replacement.

(1) - CAUTION: DO NOT attempt to correct a bent rim.
(2) - Inspect wheel attaching hardware for damage.

SUSPENSION - FRONT

1999 Lexus RX 300

1999-2000 SUSPENSION
Lexus Front

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION

NOTE: Some ES300, LS400 and LX470 models use air suspension. Basic mechanical procedures are covered in this article. For wiring diagrams, see ELECTRONIC article.

ES300 and RX300 suspension combines MacPherson struts with "L" shape lower arms. GS300 and LS400 suspension includes lower arms, struts, shock absorbers, and coil springs (pneumatic cylinders on LS400 with air suspension). All models include stabilizer bars. SC300 and SC400 suspension includes coil springs and struts.

ADJUSTMENTS & INSPECTION

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

BALL JOINT CHECKING

Lower Ball Joint Play (GS300, GS400 & LS400)
Raise and support vehicle and remove wheel assembly. Using a dial indicator with a magnetic base, place the base on the strut bar and position the spindle of the dial indicator parallel to the knuckle arm. Measure play of lower ball joint when axle is pushed up. Maximum play should be 0.012" (.30 mm) for LS400, or .035" (.90 mm) for GS3300 and GS400. If not to specification, replace ball joint.

Lower & Upper Ball Joint Rotational Check
Remove lower ball joint. On SC300 and SC400 models, lower control arm must be removed. See LOWER CONTROL ARM & BALL JOINT under REMOVAL & INSTALLATION. Clamp ball joint in vise. Move stud back and forth 5 times through its entire range. Install nut. Using INCH-lb. torque wrench, rotate stud at rate of 2-4 seconds per turn. Measure rotating torque on fifth turn. See LOWER BALL JOINT ROTATIONAL CHECK table.

LOWER BALL JOINT ROTATIONAL CHECK

Model	INCH Lbs. (N.m)
ES300 & RX300	8.7-30 (1-3.5)
GS300 & GS400	.9-26 (.1-3.0)
LS400	9-30 (1-2.5)
SC300 & SC400	9-31 (1.0-3.5)

HUB BEARING & AXLE HUB

NOTE: On vehicles equipped with air suspension, ensure ignition switch is in OFF position BEFORE raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to

vehicle.

All Models

1) Raise and support vehicle. Remove wheels and tires. Remove caliper retaining bolts. Remove caliper from steering knuckle. Suspend caliper with wire. Reference mark disc and hub for reassembly. Remove brake disc. Measure axle bearing axial play with dial indicator. Maximum bearing play should be .002" (.05 mm). If bearing play exceeds specification replace bearing. See HUB BEARING under REMOVAL & INSTALLATION.

2) Measure axle hub runout. Hub runout should not exceed .002" (.05 mm). If axle play is excessive, replace axle bearing. If hub runout is excessive, replace hub. See HUB & KNUCKLE ASSEMBLY under REMOVAL & INSTALLATION.

REMOVAL & INSTALLATION

COIL SPRING

See SHOCK ABSORBER ASSEMBLY.

HUB & KNUCKLE ASSEMBLY

NOTE: If hub bearing replacement is necessary, see HUB BEARING under REMOVAL & INSTALLATION.

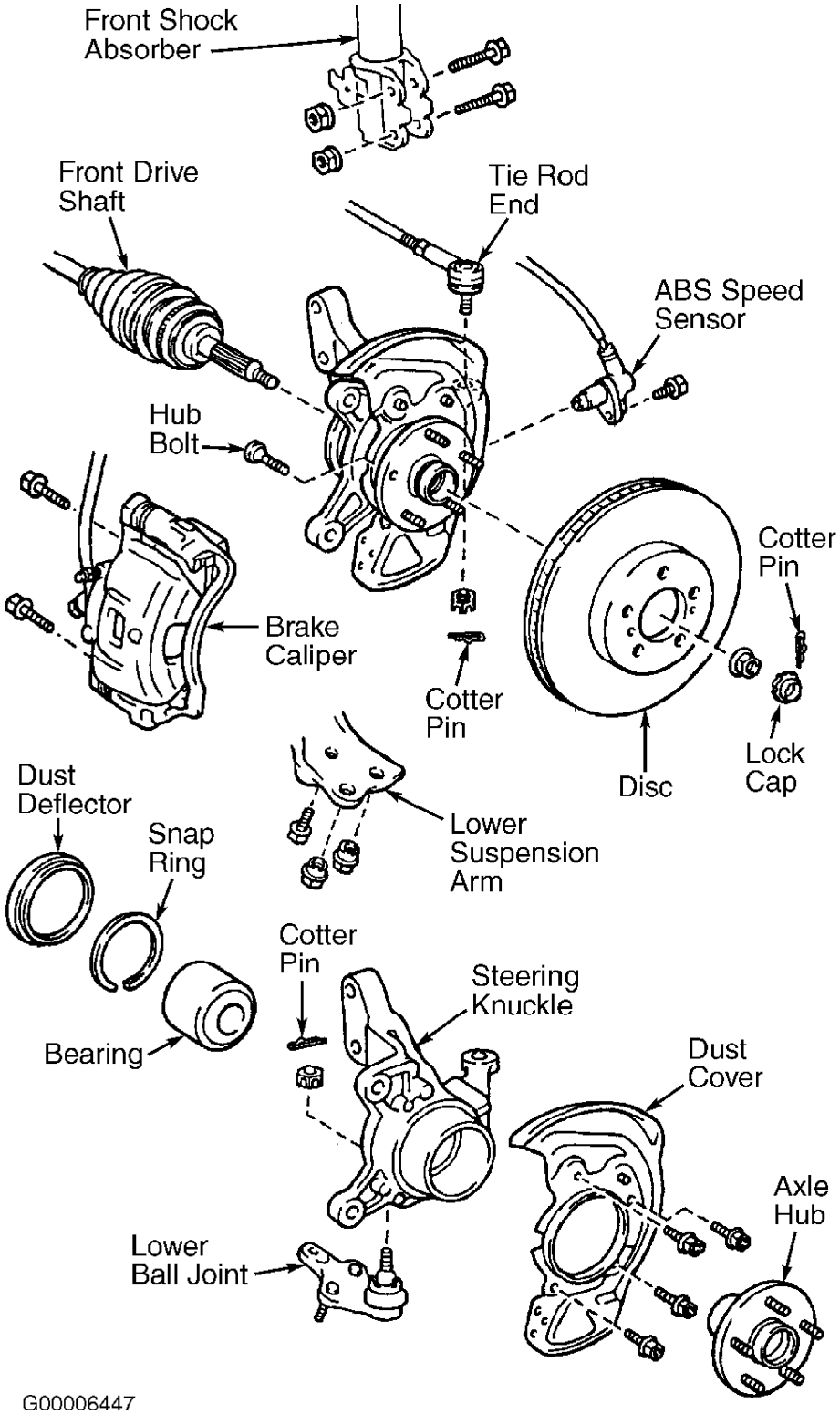
CAUTION: On vehicles equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

Removal (ES300 & RX300)

1) Raise and support vehicle. Remove front wheels. Have an assistant apply brakes, if necessary, and remove axle nut. Remove 2 bolts, caliper and disc. Support caliper securely. DO NOT allow caliper to hang from brake hose. See Fig. 1.

2) Remove ABS wheel speed sensor and wiring harness from steering knuckle. Loosen 2 strut-to-knuckle bolts, but DO NOT remove. Remove cotter pin and nut from the tie rod end. Using Puller (09610-20012), disconnect tie rod end from steering knuckle.

3) Disconnect lower ball joint from lower arm. Remove 2 nuts and bolt. Remove strut-to-knuckle bolts. Remove steering knuckle and hub as an assembly.



G00006447

Fig. 1: Exploded View Of Hub & Knuckle Assembly (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300 & GS400)

1) Raise and support vehicle. Remove front wheel. Reference

mark brake disc and axle hub for reassembly. Remove brake caliper and disc assembly. See Fig. 2.

2) Remove ABS wheel speed sensor and bolt. Remove upper side of clip and nut. Using Puller (09610-20012), remove steering knuckle from upper suspension arm. Remove 2 bolts and steering knuckle from lower ball joint.

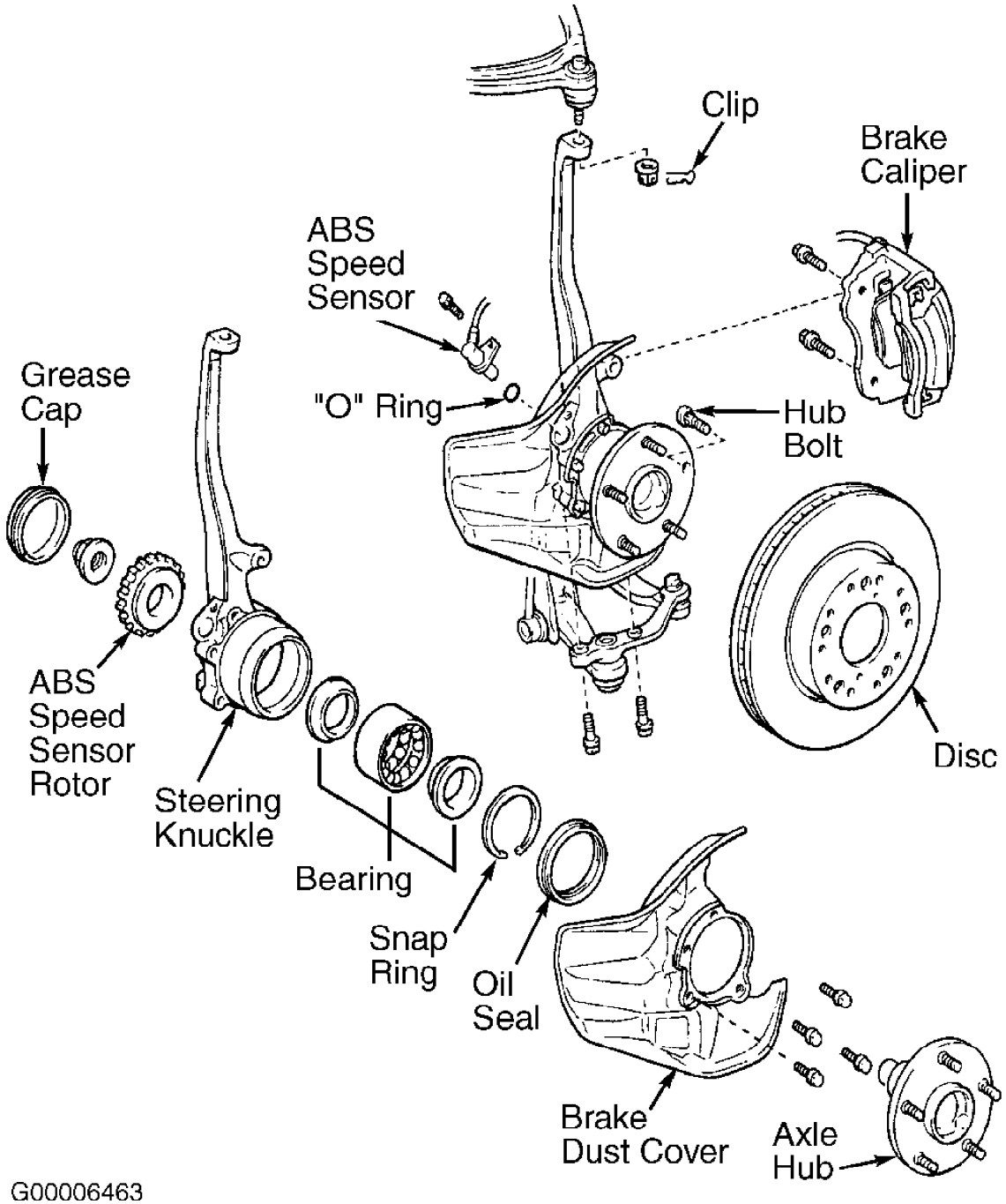


Fig. 2: Exploded View Of Hub & Knuckle Assembly (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LS400)

1) Raise and support vehicle. Remove wheel. Reference mark

brake disc and axle hub for reassembly. Remove 2 bolts and brake caliper. Support brake caliper securely. Remove 2 screws and disc. Remove 2 bolts, ABS wheel speed sensor and wiring harness from steering knuckle. See Fig. 3.

2) Remove 2 attaching bolts and disconnect steering knuckle from lower ball joint. Remove clip and nut. Using Puller (09610-20012), disconnect steering knuckle, and remove from upper ball joint.

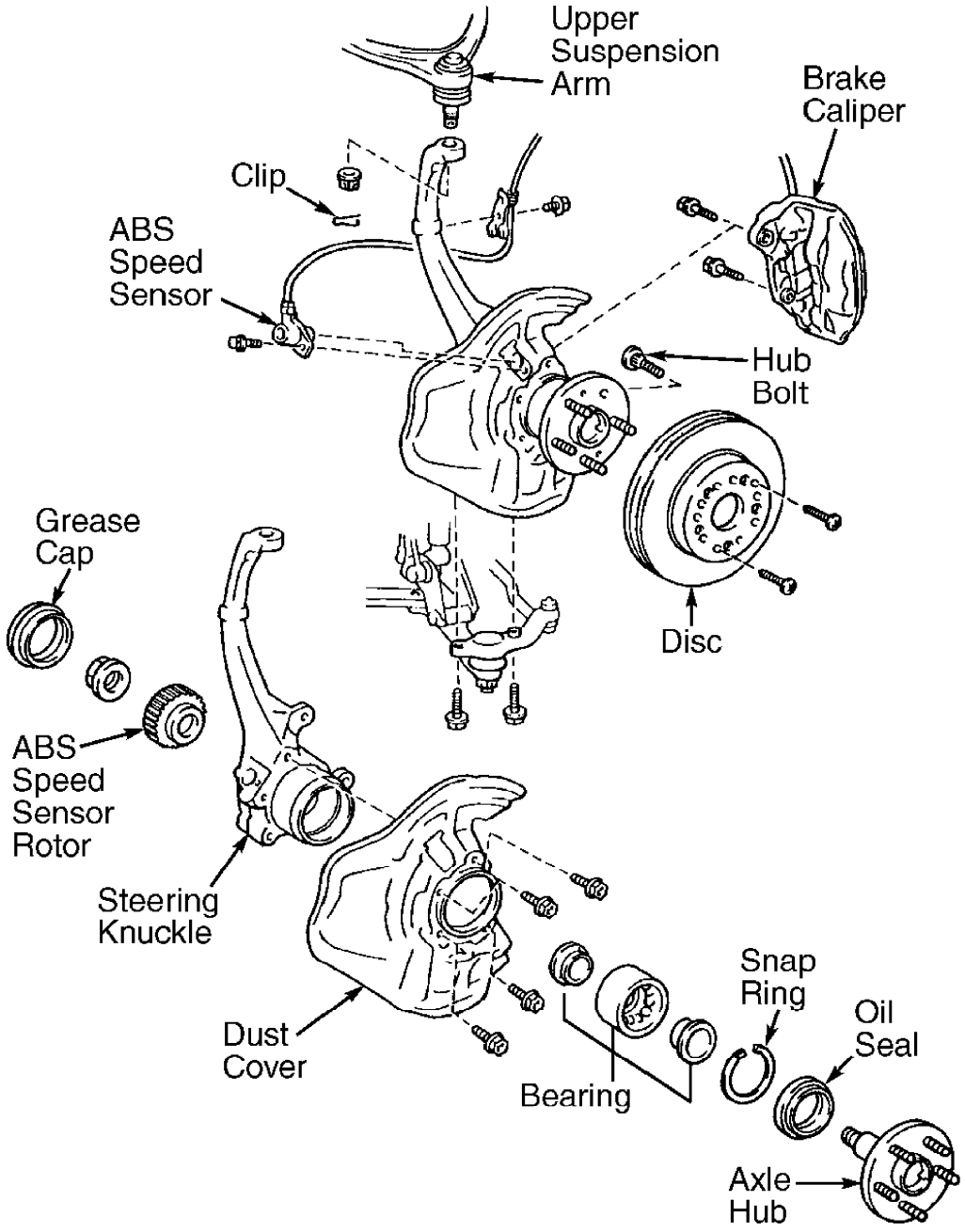


Fig. 3: Exploded View Of Hub & Knuckle Assembly (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (SC300 & SC400)

1) Raise and support vehicle. Remove front wheel. Remove

caliper assembly. Reference mark disc and hub for reassembly. Remove 2 screws and brake disc.

2) Remove cotter pin and nut. See Fig. 4. Using Puller (09628-10011), disconnect tie rod end from steering knuckle. Remove ABS speed sensor.

3) Remove cotter pin and lock nut from upper ball joint. Remove retaing clip and lock nut from lower ball joint. Using Puller (09628-62011), remove steering knuckle from upper and lower suspension arms.

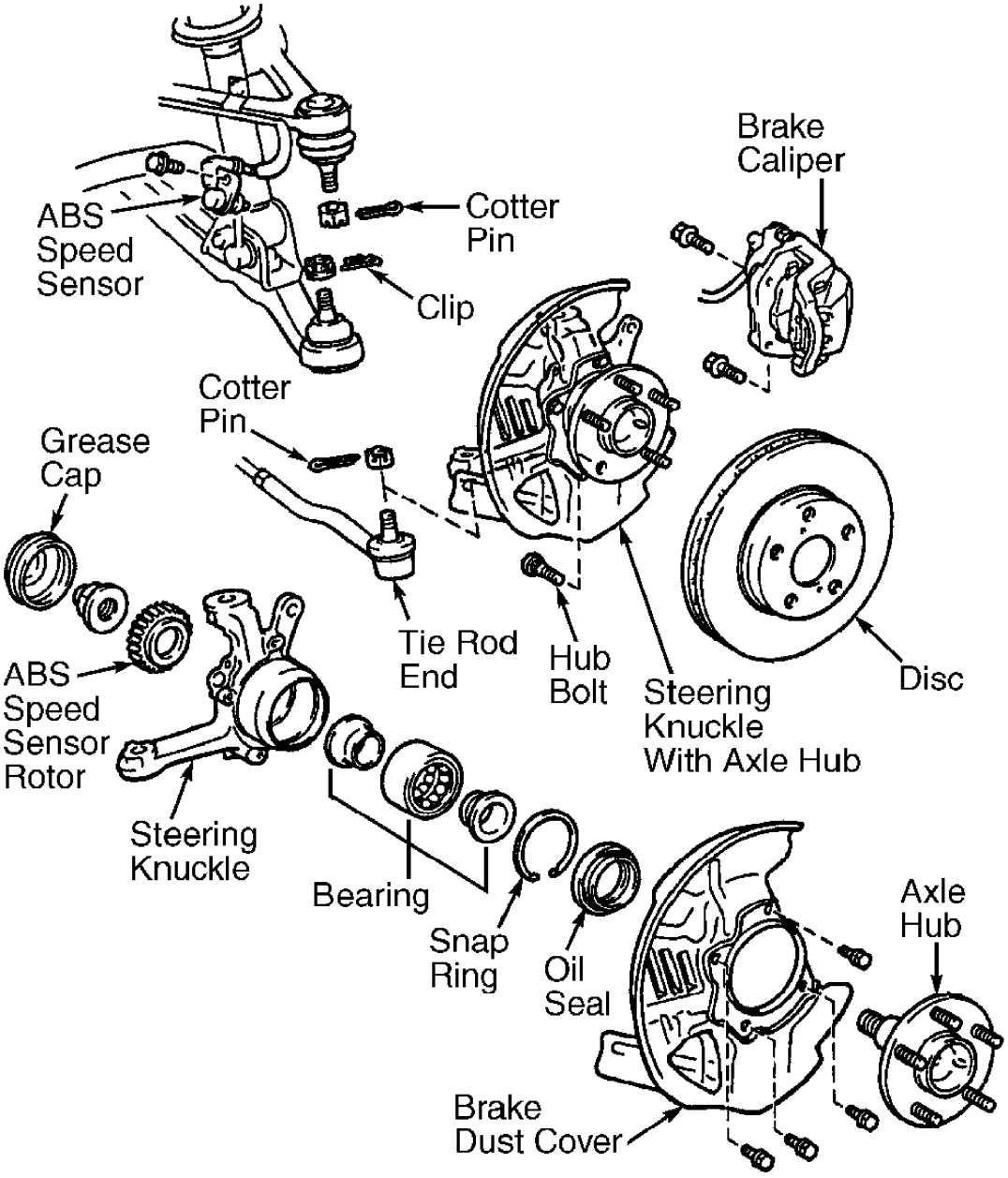


Fig. 4: Exploded View Of Hub & Knuckle Assembly (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation (All Models)

To install steering knuckle, reverse removal procedure.

Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS. Adjust front end alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

LOWER CONTROL ARM & BALL JOINT

CAUTION: On vehicles equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

Removal (ES300 & RX300)

Raise and support vehicle. Remove front wheel. Disconnect lower suspension arm from lower ball joint. Remove 2 bolts on front side of lower suspension arm. Remove bolt and nut on rear side of lower suspension arm. Remove lower suspension arm. Remove lower suspension arm bushing stopper from lower suspension arm shaft.

Installation

To install, reverse removal procedure. See TORQUE SPECIFICATIONS. Adjust wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal (GS300 & GS400)

1) Raise and support vehicle. Remove front wheel. Remove engine undercovers. Remove brake caliper and disc assembly, and suspend with wire.

2) Remove clip and nut. Using Puller (09610-20012), disconnect tie rod end from steering knuckle. Remove nut, and disconnect height control sensor link from shock absorber bracket.

3) Remove stabilizer bar and links. Disconnect tie rod end from steering knuckle. Remove bolt and nut. Disconnect stabilizer bar link from stabilizer bar. Remove nut and stabilizer bar link.

4) Disconnect shock absorber from shock absorber bracket. Loosen lower control arm mounting bolts. Remove cotter pin and nut from lower ball joint. Using Puller (09628-62011), disconnect lower ball joint.

5) Loosen or remove steering rack assembly as necessary. See POWER RACK & PINION article in STEERING. Remove nut, 2 bolts and strut bar bracket.

6) Reference mark camber adjusting cam and suspension crossmember for reassembly reference. Remove bolt, nut, washer and lower suspension arm assembly.

7) Remove bolt and shock absorber bracket from No. 1 suspension arm. Remove 2 bolts, and separate No. 1 and No. 2 lower suspension arms.

Installation

To install, reverse removal procedure. Align camber adjuster cam reference marks. Ensure suspension is stabilized in ride height position before tightening inner control arm pivot bolts. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS. Adjust wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal (LS400)

1) Raise and support vehicle. Remove front wheel. Remove brake caliper and disc assembly. Remove ABS wheel speed sensor and wiring harness. DO NOT disconnect pad wear indicator connector.

2) Remove clip and nut from tie rod end. Using Puller (09610-20012), disconnect tie rod end from steering knuckle. Remove cotter pin and nut from lower ball joint.

3) Using Puller (09628-62011), remove lower ball joint from

lower suspension arm. Remove clip and nut. Using puller, disconnect steering knuckle from upper ball joint. Remove steering knuckle with lower ball joint. See HUB & KNUCKLE ASSEMBLY. Remove strut as an assembly. See SHOCK ABSORBER ASSEMBLY. On models with coil spring suspension, remove front shock absorber. On models with air suspension, remove pneumatic cylinder.

4) Remove front shock absorber lower bracket. Remove 2 nuts, and disconnect strut bar from lower suspension arm. Remove 2 nuts and suspension member brace. Reference mark camber adjuster cam for reassembly reference. Remove nut, adjusting cam and lower arm.

Installation

To install, reverse removal procedure. Align camber adjuster cam reference marks. See TORQUE SPECIFICATIONS. Adjust wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal (SC300 & SC400)

1) Raise and support vehicle. Remove front wheel. Remove engine under cover. Remove brake caliper and attaching bolts from steering knuckle.

2) Disconnect stabilizer bar link from lower control arm. Remove clip and nut. Using Puller (09628-62011), disconnect steering knuckle from lower suspension arm.

3) Remove nut, washer and bolt, and disconnect lower suspension arm from shock absorber. Remove nut, 2 bolts and front lower suspension arm bracket stay.

4) Reference mark front and rear adjuster cams and body for reassembly. Remove adjuster cam nuts, cams, plates, stopper and lower suspension arm. Remove shock absorber bracket from lower suspension arm.

Installation

To install, reverse removal procedure. Align adjuster cam reference marks. Tighten fasteners to specifications. See TORQUE SPECIFICATIONS. Adjust wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

STABILIZER BAR

CAUTION: On vehicles equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

Removal (ES300 & RX300)

Raise and support vehicle. Remove front wheels. Remove stabilizer bar links. Remove left and right stabilizer bar bracket attaching bolts, brackets and bushings. Remove stabilizer bar from the left side of vehicle. DO NOT damage pressure lines.

Removal (GS300, GS400, SC300 & SC400)

Raise and support vehicle. Remove front wheels. Remove engine under cover. Remove stabilizer links. Remove 4 mounting bolts, and stabilizer bar with brackets and bushings.

Removal (LS400)

1) Raise and support vehicle. Remove steering knuckle with axle hub. See HUB & KNUCKLE ASSEMBLY.

2) On models with coil spring suspension, remove shock absorber and coil spring. On models with air suspension, remove pneumatic cylinder.

3) Remove left and right stabilizer bar links. Remove shock absorber lower bracket. Remove strut bar.

4) Remove stabilizer bar brackets and bushings. To remove stabilizer bar, remove 4 strut bar bracket bolts. Pull out strut bar bracket from stabilizer bar. Remove stabilizer bar from remaining strut bar bracket.

Inspection (All Models)

Clamp stabilizer link in vise. Move ball joint stud back and forth 5 times through its entire range. Install nut. Using INCH-lb. torque wrench, rotate stud at rate of 2-4 seconds per turn. Measure rotating torque on fifth turn. Rotating torque should be .40-8.7 INCH lbs. (.05-1.0 N.m).

Installation (All Models)

To install, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

SHOCK ABSORBER ASSEMBLY

CAUTION: On vehicles equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

Removal (ES300 & RX300)

1) Raise and support vehicle. Remove front wheel. Remove flexible brake hose, ABS speed sensor wire harness, and clamp from shock absorber. Disconnect stabilizer bar link from shock absorber.

2) Disconnect shock absorber from steering knuckle. Remove 2 nuts and bolts on lower side of shock absorber. Remove shock absorber from steering knuckle.

3) On models without electronic modulated suspension, remove shock absorber with coil spring. Remove 3 nuts and suspension support No. 2. See Fig. 5.

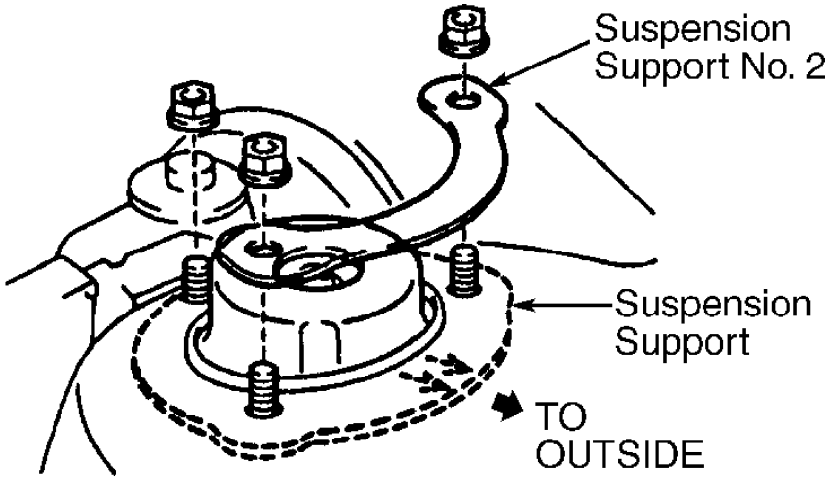


Fig. 5: Removing Shock Absorber Components (ES300 & RX300 Without Electronic Modulated Suspension)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

4) On models with electronic modulated suspension, disconnect

shock absorber control actuator sub-wire harness connector. See Fig. 6 . Remove 3 nuts and shock absorber cap. Slide grommet up wire harness. Remove clip and disconnect shock absorber control actuator connector. Using socket wrench, loosen nut in middle of suspension support (DO NOT remove nut at this time). See Fig. 6. Carefully, remove 3 nuts holding coil spring/strut unit to chassis and remove.

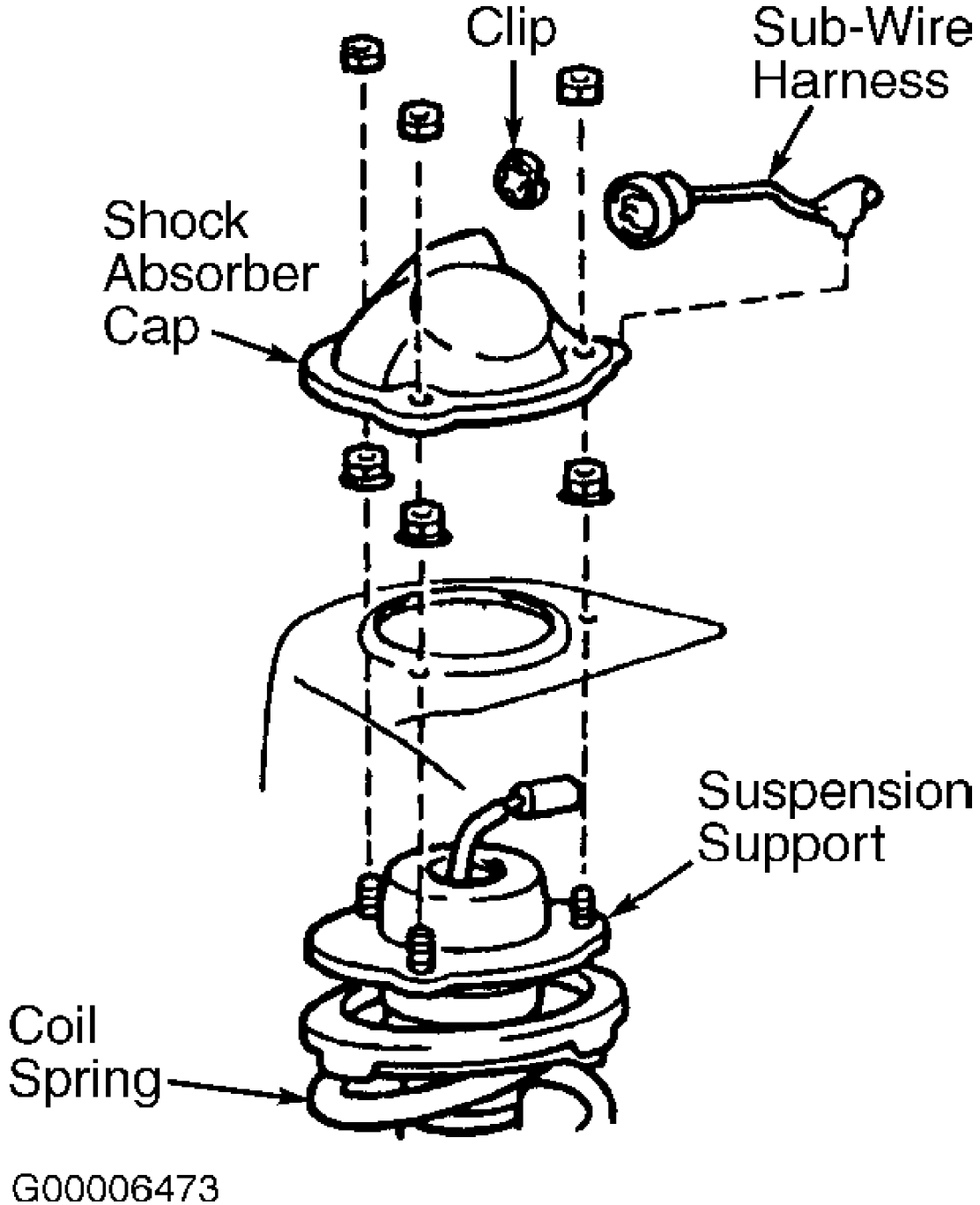


Fig. 6: Removing Shock Absorber Components (ES300 With Electronic Modulated Suspension)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300 & GS400)

1) Raise and support vehicle. Remove front wheel. Remove brake caliper from steering knuckle. Disconnect ABS speed sensor and wiring harness from steering knuckle. Remove bolts, ABS speed sensor and harness.
2) Using Ball Joint Puller (0960-20012), disconnect upper suspension arm from steering knuckle. Remove nut and bolt. Disconnect stabilizer bar from stabilizer bar link.
3) To remove shock absorber, remove bolt and nut. Disconnect shock absorber from shock absorber bracket. Loosen piston rod lock nut. Remove 3 nuts, shock absorber and suspension support No. 1 from body.

Removal (LS400)
1) Raise and support vehicle. Remove front wheel. Remove nut and disconnect sensor link.
2) Remove clip and nut. Using Puller (09610-20012), disconnect steering knuckle from upper ball joint. DO NOT allow steering knuckle weight to hang from brakeline.
3) Disconnect shock absorber from shock absorber lower bracket. Remove plug from suspension support. Loosen suspension support center nut. DO NOT remove nut. Remove 3 nuts and shock absorber with coil spring.

Removal (SC300 & SC400)
1) Raise and support vehicle. Remove front wheel. Remove and suspend caliper. Remove fender splash shield. If left strut is to be removed, remove windshield washer reservoir. Remove bolt and disconnect ABS speed sensor and wiring harness clamp from steering knuckle.
2) Disconnect upper suspension arm, and support safely. Disconnect shock absorber from lower suspension arm. Remove plug from support. Loosen lock nut in middle of suspension support. DO NOT remove nut. Remove 3 nuts, spring support assembly and shock absorber from body.

Inspection (All Models)
Inspect shock absorber. Compress and extend shock absorber rod. Ensure there is no abnormal resistance or unusual operation sounds. Replace shock absorber if necessary.

Installation (All Models)
To install, reverse removal procedure. After installation, check ABS speed sensor signal and front wheel alignment. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment.

UPPER CONTROL ARM & BALL JOINT

CAUTION: On LS400 models equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

Removal (GS300, GS400 & LS400)
1) Raise and support vehicle. Remove shock absorber assembly from vehicle. See SHOCK ABSORBER ASSEMBLY. Remove 2 bolts and upper suspension arm.
2) On LS400 models with coil suspension, remove front shock absorber assembly. On LS400 models with air suspension, remove front pneumatic cylinder.
3) On all models, remove bolt, and disconnect ABS wheel speed sensor wiring harness from upper suspension arm. Remove bolts and

upper suspension arm.

Removal (SC300 & SC400)

1) Raise and support vehicle. Remove front wheel. Remove and suspend caliper. Remove fender splash shield. If left control arm is to be removed, remove windshield washer reservoir. Remove ABS speed sensor and wiring harness from steering knuckle.

2) Remove cotter pin and nut. Using Puller (09628-62011), disconnect upper suspension arm from knuckle. Remove nut, 2 washers and bolt. Remove upper suspension arm.

Installation (All Models)

To install, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

HUB BEARING

Remove hub and knuckle assembly from vehicle. See HUB & KNUCKLE ASSEMBLY. Remove oil seal and bearing retainer snap ring from steering knuckle. Use a puller to remove hub bearing from steering knuckle. Use a press to install new bearing. Reverse removal procedures to complete installation.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATION (ES300 & RX300)

Application	Ft. Lbs. (N.m)
Axle Shaft Nut	217 (294)
Ball Joint-To-Lower Arm Nut	94 (127)
Ball Joint-To-Steering Knuckle	91 (123)
Caliper Bolt	79 (107)
Center Strut Nut	
Without Electronic Suspension	36 (49)
With Electronic Suspension	26 (36)
Lower Arm Pivot Bolt	152 (206)
Shock Absorber Cap Nut	9 (14)
Stabilizer Bar Bushing Retainer Bolt	14 (19)
Stabilizer Bar Link Nut	29 (39)
Steering Gear Mounting Bolt	134 (181)
Steering Knuckle-To-Strut Bolt	156 (211)
Upper Strut Mounting Nut	59 (80)
Tie Rod End Lock Nuts	54 (74)
Tie Rod End-To-Steering Knuckle Nut	36 (49)
Wheel Lug Nut	76 (103)
	INCH Lbs. (N.m)
ABS Wheel Speed Sensor Bolt	69 (7.8)
Dust Cover	74 (8.3)

TORQUE SPECIFICATION (GS300 & GS400)

Application	Ft. Lbs. (N.m)
Caliper Retaining Bolt	87 (118)
Camber Adjuster Cam Nut	36 (49)
Caster Adjuster Cam Nut	173 (235)
Center Strut Piston Nut	20 (27)

Hub Nut	147 (199)
Lower Ball Joint-To-Control Arm Nut	119 (162)
Lower Ball Joint-To-Knuckle Bolt	83 (113)
Lower Strut Mounting Bolt/Nut	116 (157)
Stabilizer Bar Bracket Bolt	41 (55)
Stabilizer Bar Link-To-Control Arm Nut	83 (113)
Stablilizer Bar-To-Link Bolt/Nut	21 (28)
Strut Bracket-To-Lower Control Arm Bolt	43 (58)
Strut Retaining Nuts	41 (56)
Tie Rod End-To-Knuckle Nut	48 (65)
Upper Ball Joint Nut	64 (87)
Upper Control Arm Retaining Bolts	39 (53)
Wheel Lug Nut	76 (103)
	INCH Lbs. (N.m)
ABS Wheel Speed Sensor Bolt	69 (7.8)

TORQUE SPECIFICATIONS (LS400)

Application	Ft. Lbs. (N.m)
Axle Hub Nut	147 (199)
Caliper Retaining Bolt	87 (118)
Camber Adjuster Cam Nut	185 (251)
Center Strut Piston Nut	20 (28)
Lower Ball Joint Mounting Bolt	113 (83)
Lower Strut-To-Steering Knuckle Bolt	106 (143)
Stabilizer Bar Bracket Bolts	21 (28)
Stabilizer Link Nut	70 (95)
Steering Knuckle Bolt	48 (65)
Strut Bar (Front Nut)	134 (181)
Strut Bar-To-Lower Suspension Retaining Bolts/Nuts	134 (181)
Strut Bar-To-Lower Arm Nuts	121 (164)
Strut Bracket	
Inner Bolt-To-Lower Arm Bolt	43 (59)
Outer Bolt-To-Lower Arm Bolt	83 (113)
Strut Retaining Nuts	43 (59)
Tie Rod End-To-Knuckle Nut	43 (59)
Upper Ball Joint Nut	48 (65)
Upper Control Arm Retaining Bolts	83 (113)
Wheel Lug Nut	76 (103)
	INCH Lbs. (N.m)
ABS Wheel Speed Sensor Bolt	69 (7.8)

TORQUE SPECIFICATIONS (SC300 & SC400)

Application	Ft. Lbs. (N.m)
Axle Hub Lock Nut	147 (199)
Caliper Mounting Bolt	87 (118)
Camber Adjuster Cam Bolt	166 (226)
Stabilizer Bar Bracket Bolt	13 (18)
Stabilizer Link Nut	54 (74)
Steering Knuckle-To-Lower Arm Bolt	92 (125)
Steering Knuckle-To-Upper Arm Bolt	76 (103)
Strut-To-Lower Arm Bolt	105 (143)
Suspension Support Plate-To-Body Nut	26 (35)
Tie Rod End-To-Knuckle Nut	48 (65)

Upper Arm Pivot Bolt	121 (164)
Wheel Lug Nut	76 (103)
	INCH Lbs. (N.m)
ABS Wheel Speed Sensor Bolt	69 (7.8)

SUSPENSION - REAR

1999 Lexus RX 300

1999-2000 SUSPENSION
Lexus Rear

ES300, GS300, GS400, LS400, RX300, SC300, SC400

DESCRIPTION & OPERATION

ES300 consists of parallel lower suspension arms, strut rods, coil-over shock absorbers and stabilizer bar. GS300, GS400, LS400, SC300 and SC400 suspension consists of upper arms, unequal length lower suspension arms, strut rods, coil-over shock absorbers and stabilizer bar.

ADJUSTMENTS & INSPECTION

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

WHEEL BEARING

CAUTION: On vehicles equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

1) Raise and support vehicle. Place one hand on dust shield near axle bearing carrier. Rotate rear wheel by hand. If rotation is smooth and free, wheel bearing is okay.
2) Remove brake caliper, and suspend it using wire. Match mark axle hub and disc for reassembly reference. Remove brake disc from hub. Measure bearing axial play with dial indicator. Maximum axial play is .002" (.05 mm). Replace hub or bearing if play is excessive.
3) Measure hub runout. Maximum hub runout is .002" (.05 mm). If bearing play is excessive, replace hub or bearing. If hub runout is excessive, replace hub. See REAR HUB & BEARING ASSEMBLY (RWD MODELS) under REMOVAL & INSTALLATION.

REMOVAL & INSTALLATION

COIL SPRING

NOTE: See STRUT ASSEMBLY.

REAR AXLE CARRIER

Removal & Installation (ES300)
1) Raise and support vehicle. Remove rear wheels. Remove brake caliper and disc assembly. Suspend it using wire. Place match marks on hub and disc for reassembly reference. Measure bearing axial play. See WHEEL BEARING.
2) Remove rear axle hub. Remove "O" ring. Remove ABS speed sensor. Remove fasteners and disconnect strut rod from rear axle carrier. Remove lower shock mounting. Remove No. 2 lower suspension arm. Remove rear axle carrier.

3) To install, reverse removal procedure. After installation, check ABS speed sensor signal and rear wheel alignment. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (GS300 & GS400)

1) Place matching marks on adjusting cam and lower suspension arm. Disconnect No. 1 and No. 2 lower suspension arms from axle hub. Place matching marks on drive shaft and side gear shaft with paint (DO NOT use punch) for installation reference.

2) Using a 10 mm hexagon wrench, remove 6 hexagon bolts and 2 washers while depressing brake pedal. Using a brass bar and hammer, lightly tap end of drive shaft. Disengage axle hub. Remove drive shaft. Remove parking brake shoes. Disconnect parking brake cable. Using Puller (09628-62011), remove upper arm from axle carrier. Remove axle carrier.

3) To install, reverse removal procedure. After installation, check ABS speed sensor signal and rear wheel alignment. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (LS400)

1) Raise and support vehicle. Remove rear wheels. On models with air suspension, place match marks on link and bracket. Disconnect height control sensor link. On all models, remove and suspend brake caliper. Mark disc and hub for installation reference. Measure bearing axial play. See WHEEL BEARING.

2) Remove rear suspension member brace. Place matching marks on drive shaft and side gear shaft with paint (DO NOT use punch) for installation reference. Remove 6 bolts and 2 tab washers from CV joint. Lightly tap end of drive shaft, disengage axle hub, and remove drive shaft.

3) Remove parking brake shoe and cable. Remove ABS wheel speed sensor. Remove strut rod and lower suspension arms. See LOWER SUSPENSION ARM. Loosen bolt on lower side of shock absorber. DO NOT remove bolt.

4) Remove 2 upper control arm nuts. Remove lower bolt on shock absorber. Remove 2 upper suspension arm bolts and axle carrier with upper suspension arm.

5) To install, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal & Installation (RX300 2WD)

1) Remove rear wheels. Remove flexible hose from shock absorber bracket. Measure bearing axial play. See WHEEL BEARING.

2) Remove ABS speed sensor and "O" ring. Remove rear axle hub. Remove "O" ring. Support backing plate securely. Loosen and remove bolts and nut. Disconnect strut rod from rear axle carrier.

3) Remove 2 nuts and bolts on lower side of shock absorber. Remove nut, washer, bolt, and disconnect No. 1 and No. 2 lower suspension arms. Remove rear axle carrier.

4) To install reverse removal procedure. After installation, check ABS sensor signal and rear wheel alignment. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (RX300 4WD)

1) Remove rear wheels. Measure bearing axial play. See WHEEL BEARING.

2) Remove cotter pin and lock cap. Apply brakes and remove nut. Remove 2 bolts, brake caliper and disc. Support brake caliper securely. Remove ABS speed sensor from axle carrier.

3) Disassemble parking brake assembly. Remove 2 bolts and disconnect parking brake cable from backing plate. Loosen 2 bolts on

lower side of shock absorber. DO NOT remove nuts and bolts. Remove strut rod rear bolt and nut. Disconnect strut rod from axle carrier.

4) Remove No. 1 lower suspension arm set bolt and nut from axle carrier. Disconnect No. 1 lower suspension from axle carrier. Remove No. 2 set bolt and nut. Disconnect No. 2 lower suspension arm from axle carrier. Remove axle carrier with hub.

5) To install reverse removal procedure. After installation, check ABS sensor signal and rear wheel alignment. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (SC300 & SC400)

1) Raise and support vehicle. Remove rear wheels. Measure bearing axial play. See WHEEL BEARING.

2) Remove cotter pin and lock cap. Apply brakes and remove nut. Remove disc and caliper. Remove 2 bolts and rear suspension member brace. Place matching marks on drive shaft and side gear shaft with paint (DO NOT use punch) for installation reference.

3) Depress brake pedal and remove 6 bolts and tab washers from CV joint. Lightly tap end of drive shaft, disengage axle hub, and remove drive shaft.

4) Remove parking brake shoe. Remove ABS speed sensor. Remove 2 parking brake cable and backing plate bolts.

5) Slide backing plate to outside, and disconnect parking brake cable. Disconnect strut rod and lower suspension arms. Using puller, disconnect ball joint and remove axle carrier from upper suspension arm.

6) To install reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

REAR HUB & BEARING ASSEMBLY (RWD MODELS)

Inspection (All Models)

1) On LS400 models equipped with air suspension, turn ignition switch to OFF position. On all models, raise and support vehicle. Remove rear wheel. Remove brake caliper, and support it using wire. Paint match marks on disc brake rotor and axle hub and remove brake rotor.

2) Position a dial indicator near center of axle hub and measure backlash in bearing shaft direction. If backlash is greater than .002" (.05 mm) replace bearing.

3) Position a dial indicator on axle hub face near outside of hub bolt and measure axle hub deviation. If axle hub deviation is greater than .0028" (.071 mm), replace axle hub.

Removal (GS300, GS400, SC300 & SC400)

1) Remove axle shafts. See appropriate AXLE SHAFTS article. Remove brake caliper, and support it using wire.

2) Paint mating marks on brake rotor and axle hub. DO NOT use punch marks. Remove brake rotor. Remove parking brake shoes. Remove ABS speed sensor. Remove 4 outer hub bolts. Remove inner hub bolt.

3) Slide hub and backing plate outward and disconnect parking brake. Remove strut rod. Disconnect parking brake cable and exhaust support brackets. Paint match marks on adjusting cam and rear suspension crossmember. Using Puller (09628-10011), remove No. 1 lower suspension arm. See Fig. 1.

4) Using Puller (09610-20012), remove No. 2 lower suspension arm. See Fig. 2. Using Puller (09628-62011), disconnect upper arm from axle carrier. See Fig. 3. Remove hub assembly.

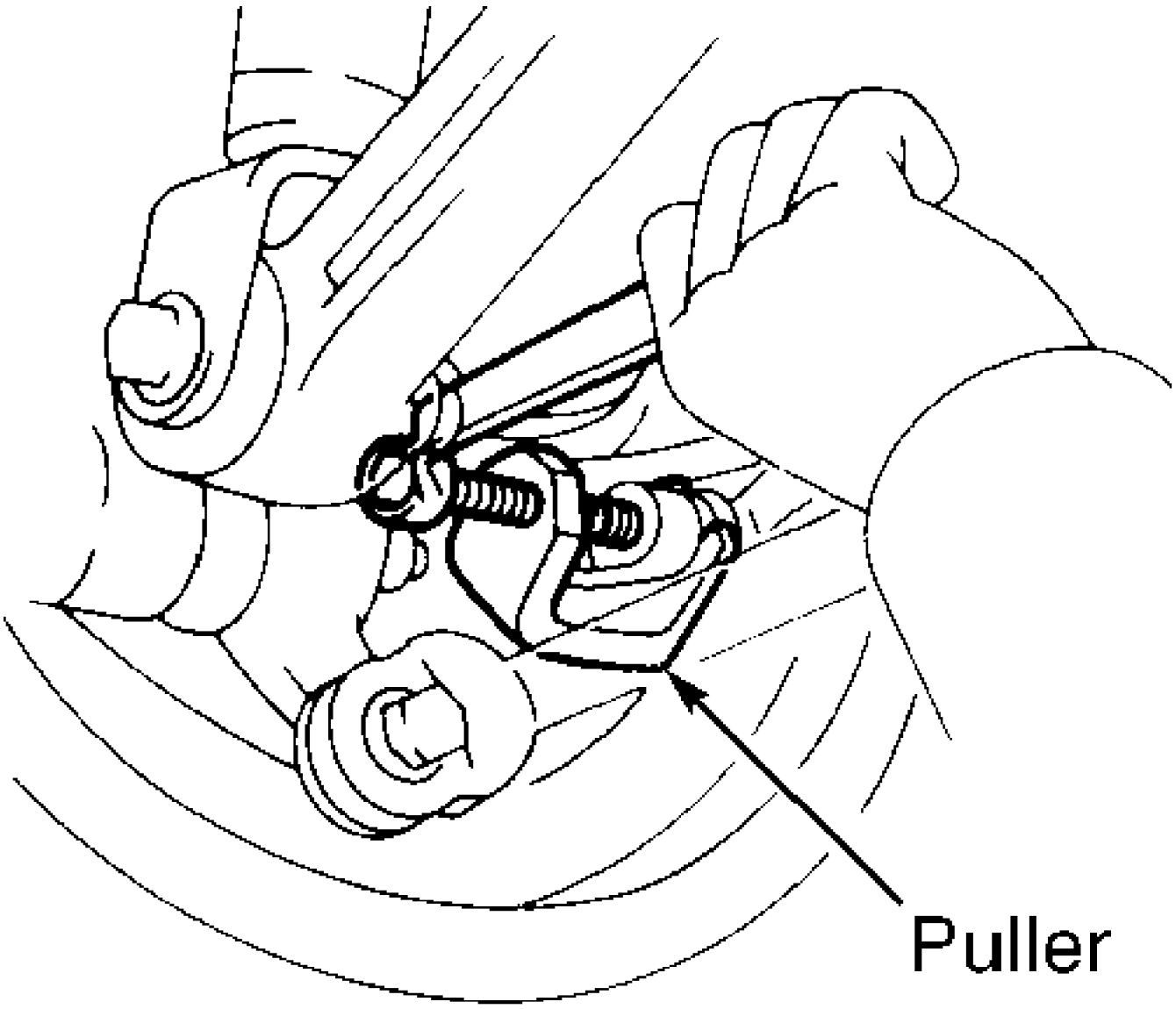


Fig. 1: Removing No. 1 Lower Suspension Arm (GS300, GS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

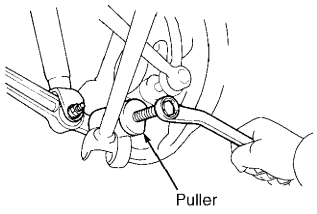


Fig. 2: Removing No. 2 Lower Suspension Arm (GS300, GS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

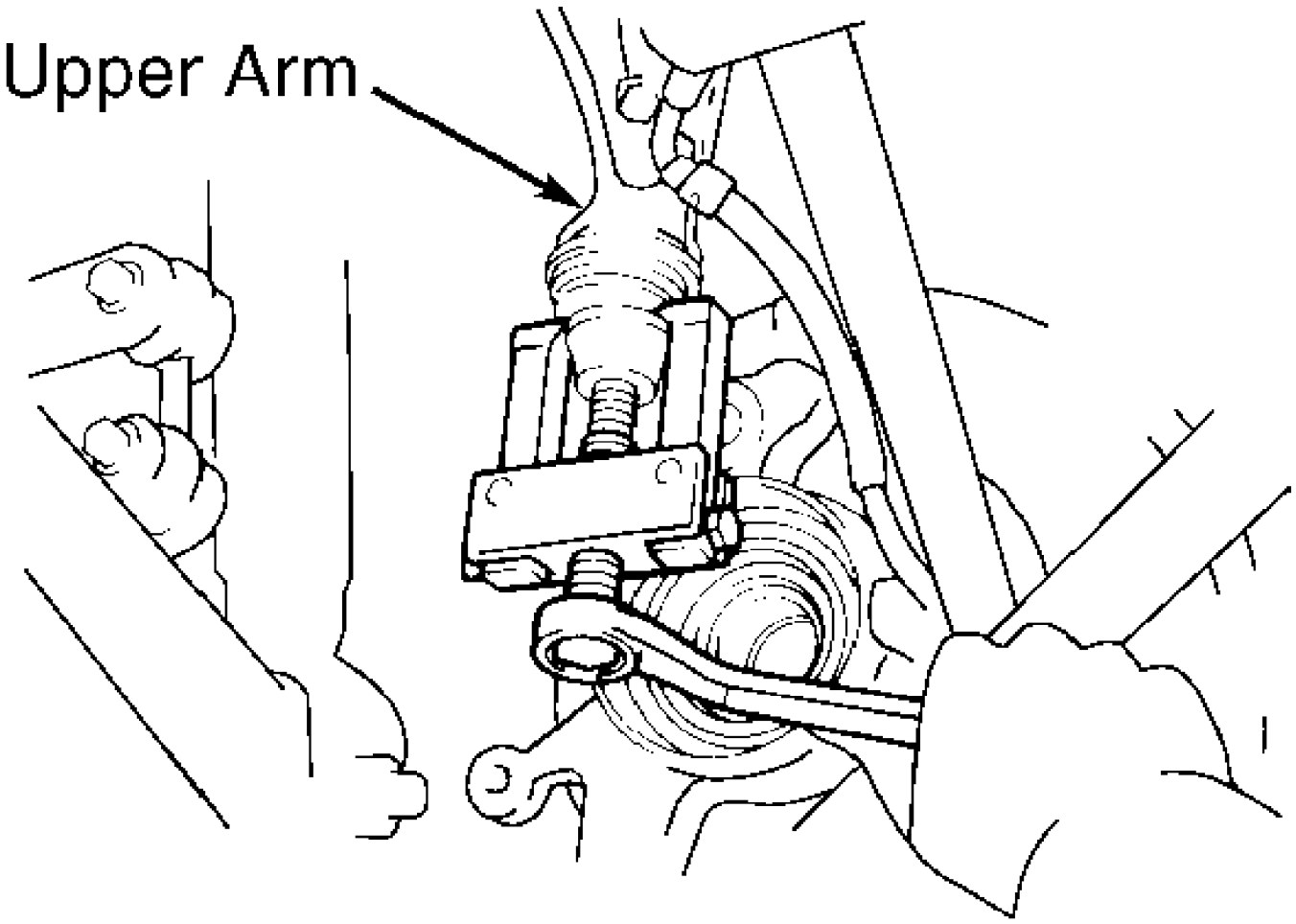


Fig. 3: Removing Upper Arm From Axle Carrier (GS300, GS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly

1) Using a screwdriver, remove dust shield from hub assembly. See Fig. 4. Secure hub assembly in vise. Using Rear Axle Shaft Puller (09520-00031) and slide hammer, remove axle hub. Remove backing plate. Using Seal Puller (09308-00010) and slide hammer, remove inner oil seal. See Fig. 9.

2) Using puller, remove inner race. Remove outer oil seal. Remove bearing snap ring. Temporarily install inner race from axle hub inside bearing assembly. Press bearing from hub assembly.

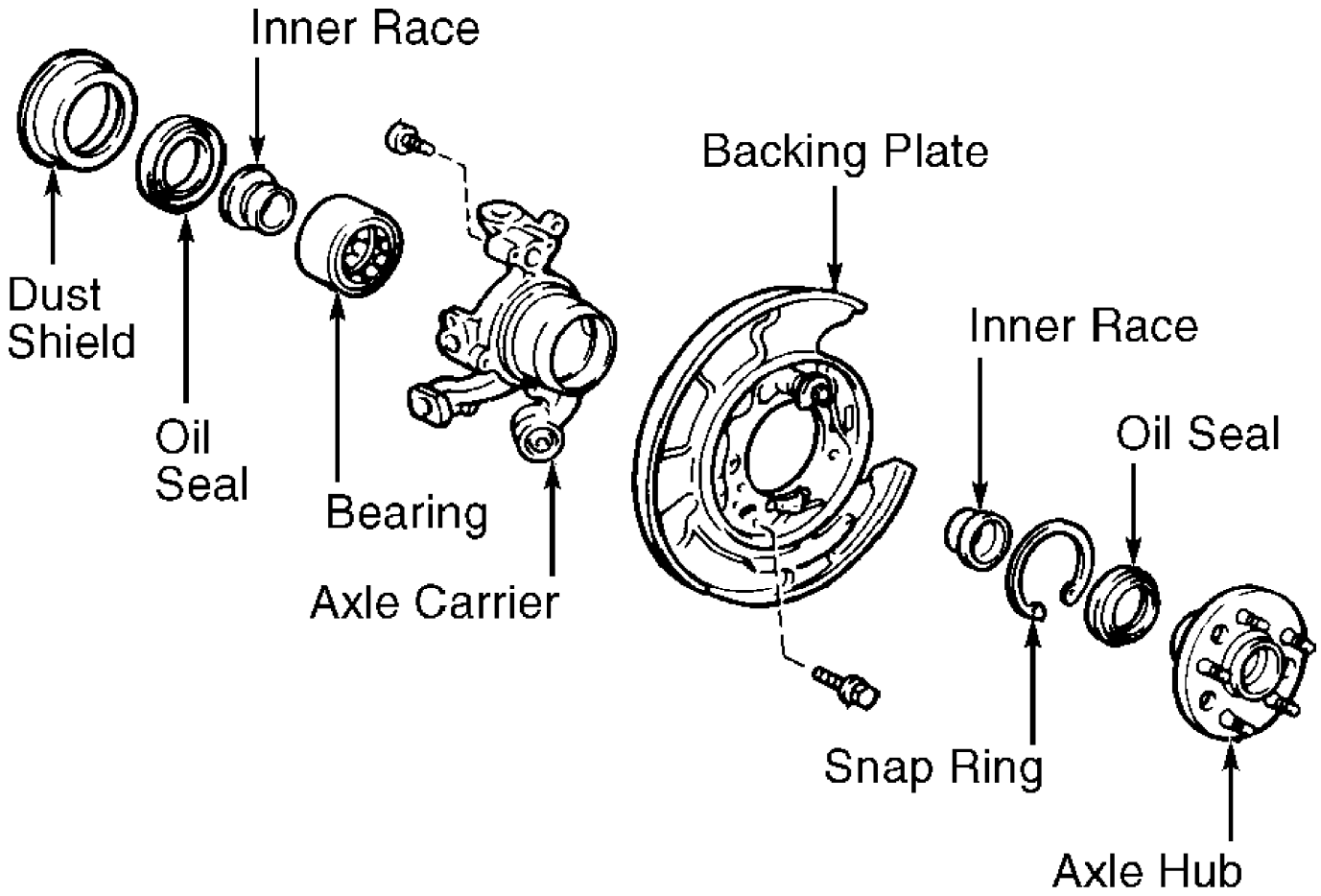


Fig. 4: Exploded View Of Hub Assembly (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) Using Bearing Replacer (09309-36010) and Seal Installer (09608-32010), press bearing into hub assembly. See Fig. 10. Install bearing snap ring. Install snap ring and outer seal.

2) Temporarily install backing plate onto hub assembly. Install inner bearing race. Press axle hub into hub assembly. Using seal installer, install inner oil seal and dust shield.

Installation

To complete installation, reverse removal procedure. Before tightening suspension bolts to specification, lower vehicle. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check rear wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal (LS400)

1) If vehicle is equipped with air suspension, ensure ignition switch is turned to OFF position. Remove axle shafts. See appropriate AXLE SHAFTS article. Remove brake caliper, and support it using wire.

2) Paint mating marks on brake rotor and axle hub. DO NOT use punch marks. Remove brake rotor. Remove speed sensor. Remove parking brake assembly.

3) Remove strut rod-to-hub assembly nut and bolt. See Fig. 5. Use paint to apply mating marks to No. 1 lower suspension arm adjusting cam and body. See Fig. 6.

4) Remove No. 1 lower suspension arm adjusting cam. Remove bolt attaching No. 1 lower suspension arm to hub assembly. Using a press, remove No. 1 lower suspension arm from hub assembly.

5) Disconnect stabilizer bar link (height control sensor link on vehicles with air suspension) from No. 2 lower suspension arm. See Fig. 7. Use paint to apply mating marks to No. 2 lower suspension arm adjusting cam and body. Remove No. 2 lower suspension arm adjusting cam. See Fig. 8.

6) Loosen, but DO NOT remove, shock absorber lower mounting bolt. Remove 2 upper suspension arm mounting bolts. Remove lower shock absorber mounting bolt. Remove hub assembly with upper suspension arm.

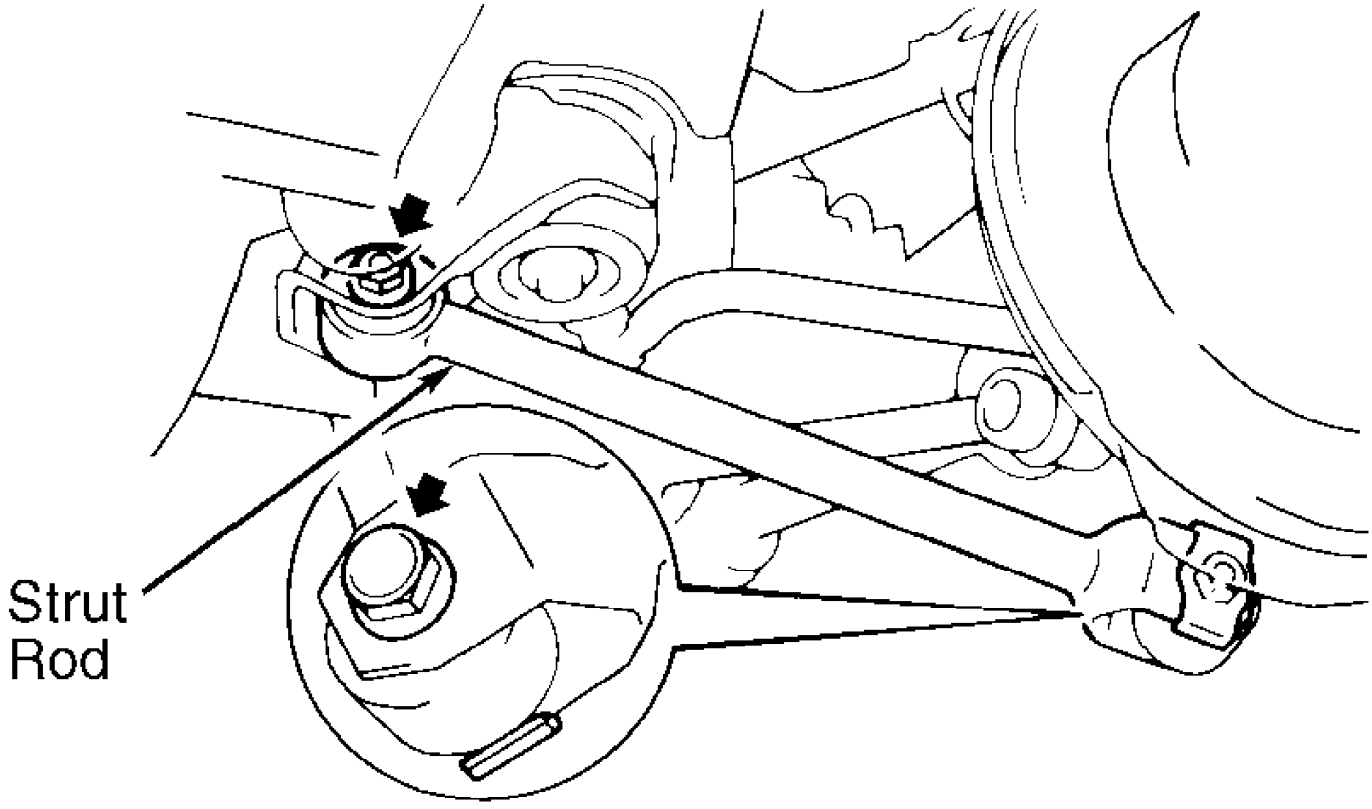


Fig. 5: Removing Strut Rod (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

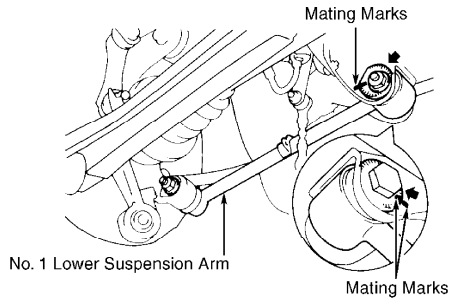


Fig. 6: Removing No. 1 Lower Suspension Arm (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

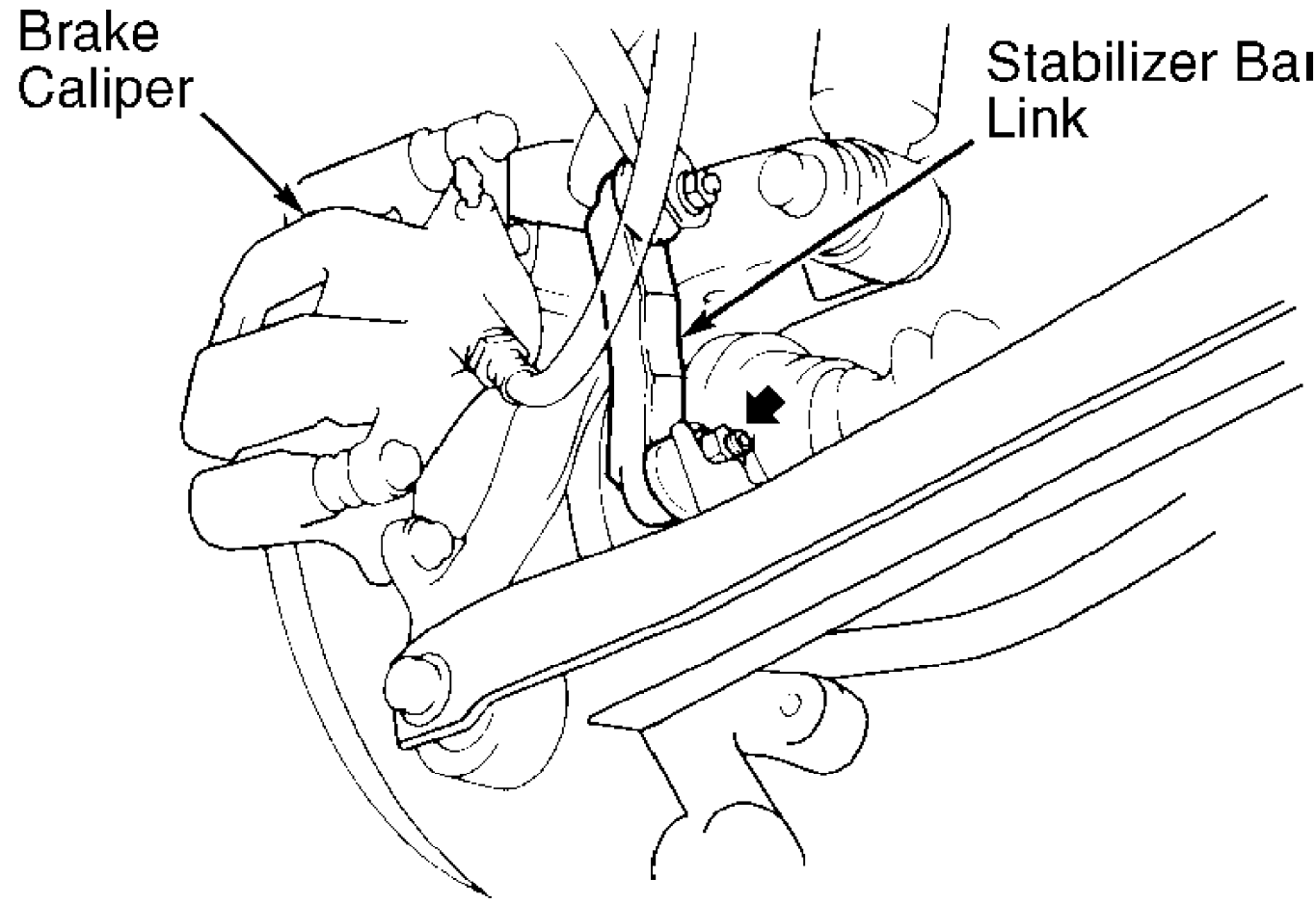


Fig. 7: Removing Stabilizer Bar Link (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

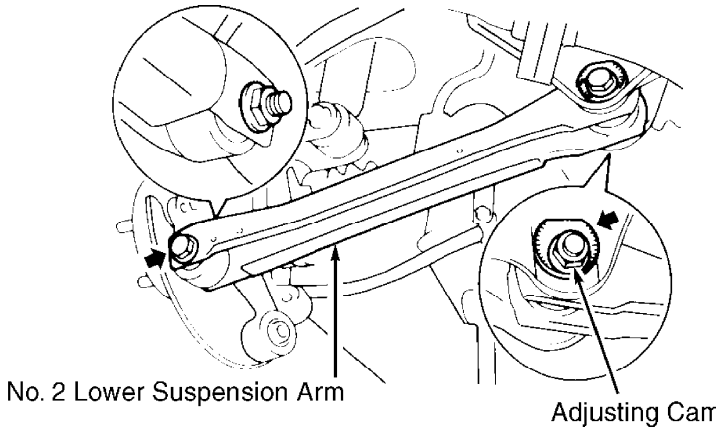


Fig. 8: Removing No. 2 Lower Suspension Arm (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly
1) Install 2 nuts and bolt into hub assembly. Secure hub

assembly in a soft-jawed vise. Loosen nut attaching upper suspension arm to hub assembly to end of threads on bolt.

2) Using a hammer, tap end of nut to loosen bolt from hub assembly. Remove upper suspension arm from hub assembly. Using a screwdriver, remove dust shield from hub assembly.

3) Using a slide hammer, remove inner oil seal. See Fig. 9. Remove 2 bolts and nuts from backing plate. Press axle hub from hub assembly. Remove backing plate.

4) Press inner race from axle hub. Using a slide hammer, remove outer oil seal. Remove bearing snap ring. Temporarily install inner race from axle hub inside bearing assembly. Press bearing from hub assembly.

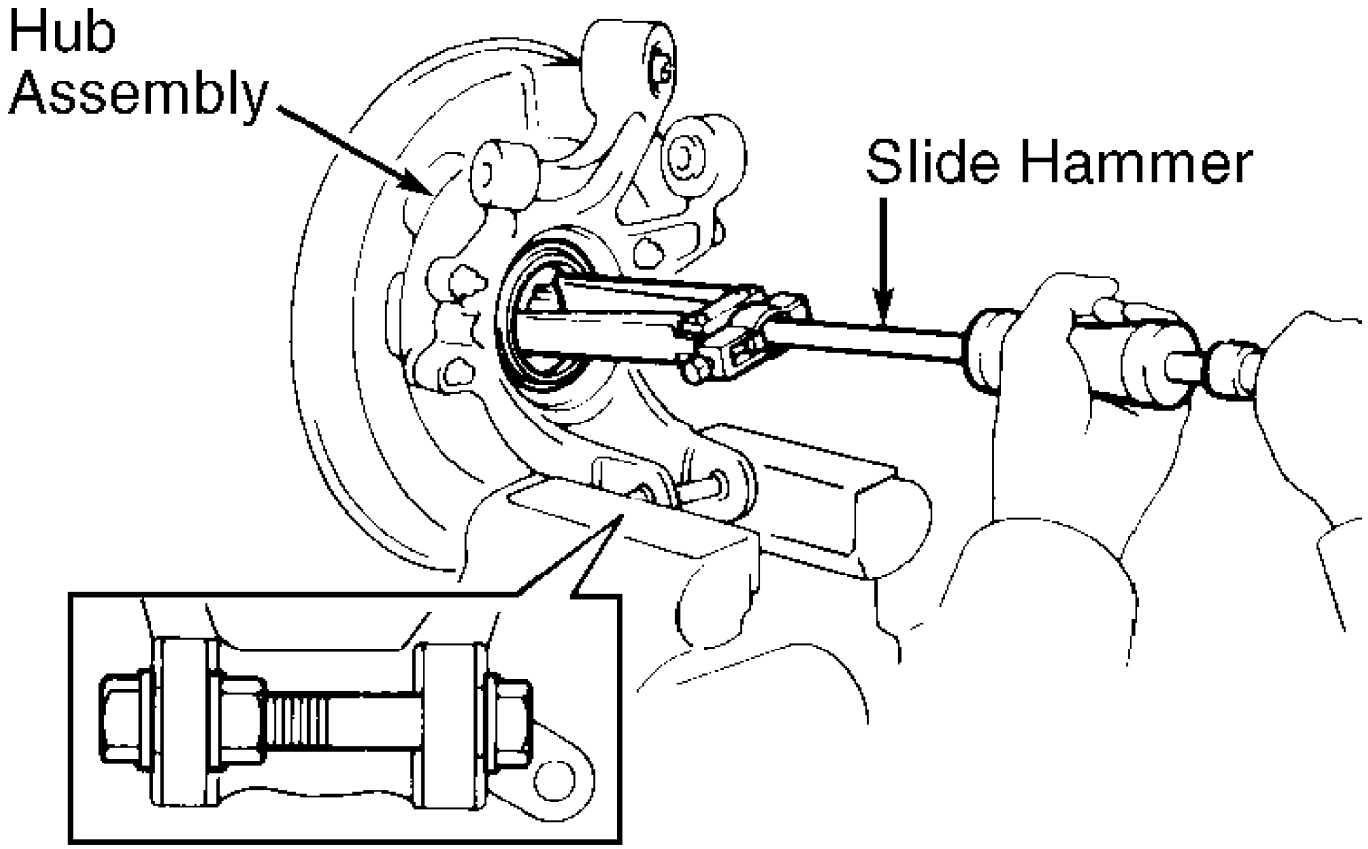


Fig. 9: Removing Inner Oil Seal
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) Place bearing replacer on inboard side of hub assembly. See Fig. 10. Press bearing into hub assembly. Install bearing snap ring. Install backing plate onto hub assembly.

2) Install inner bearing race. Install outer bearing race. Install outer oil seal. Press axle hub into hub assembly. Install inner oil seal.

3) Align hole in dust shield with hole in hub assembly. Install dust shield. Secure hub assembly in a soft-jawed vise. Install upper suspension arm to hub assembly. Install a NEW upper suspension nut.

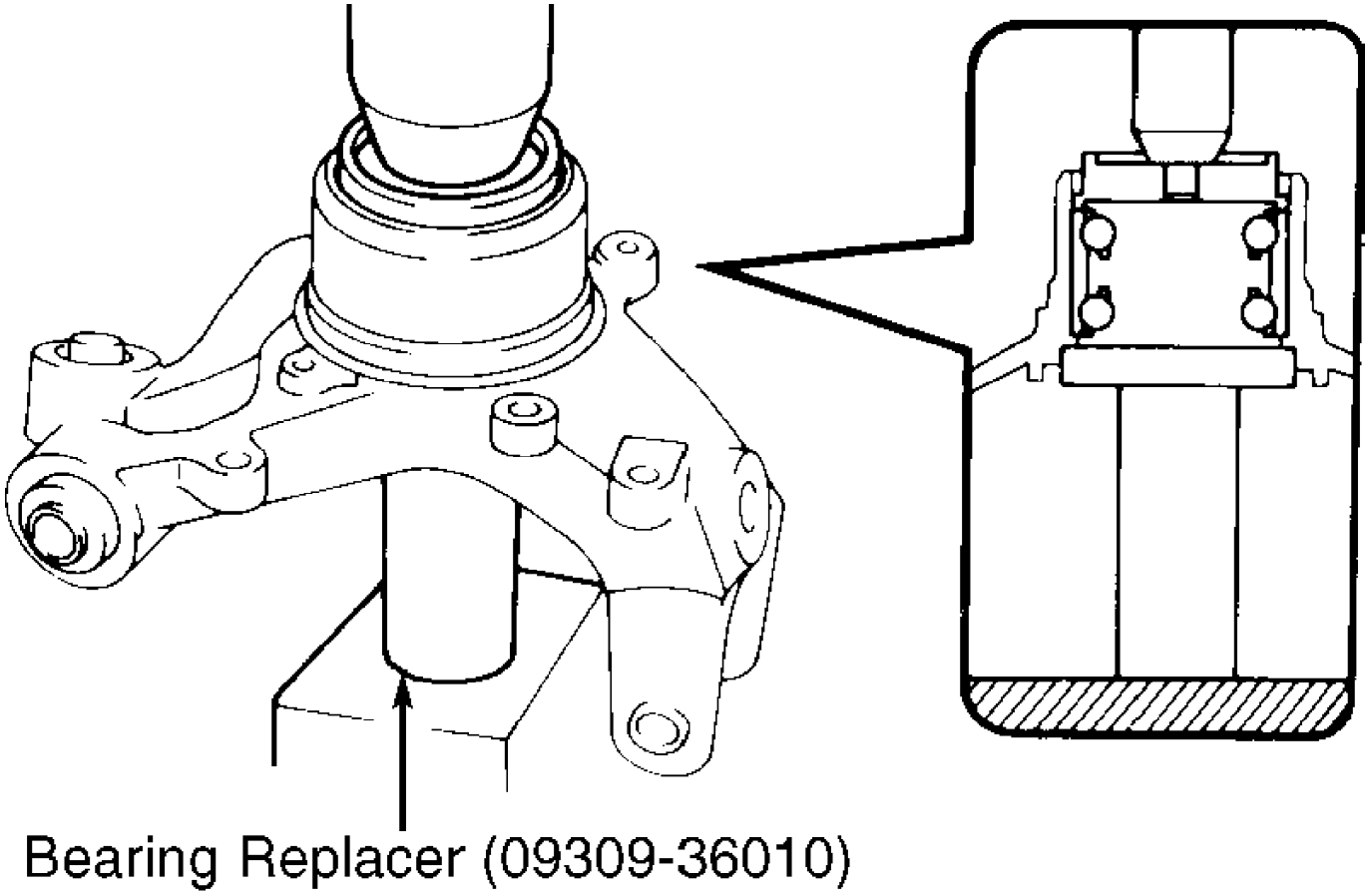


Fig. 10: Installing Hub Bearing
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

To complete installation, reverse removal procedure. Before tightening suspension bolts to specification, lower vehicle, and turn ignition switch to ON position. Bounce vehicle up and down several times to stabilize suspension. Turn ignition switch to OFF position and raise vehicle. Tighten suspension nuts and bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

LOWER SUSPENSION ARM

Removal (ES300)

1) Raise and support vehicle. Remove rear wheels. Remove exhaust center pipe. Disconnect parking brake cable. Remove attaching bolts and nuts. Remove strut rod. See Fig. 11.

2) Remove 3 nuts and washers. Remove No. 2 lower suspension arm. Remove "LH" and "RH" stabilizer brackets.

3) Support suspension member with jack. Remove 4 nuts, 2 bolts and suspension member lower stoppers. Remove lower suspension member. Remove No. 1 lower suspension arm with 2 bolts and washer.

Installation

To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See

SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

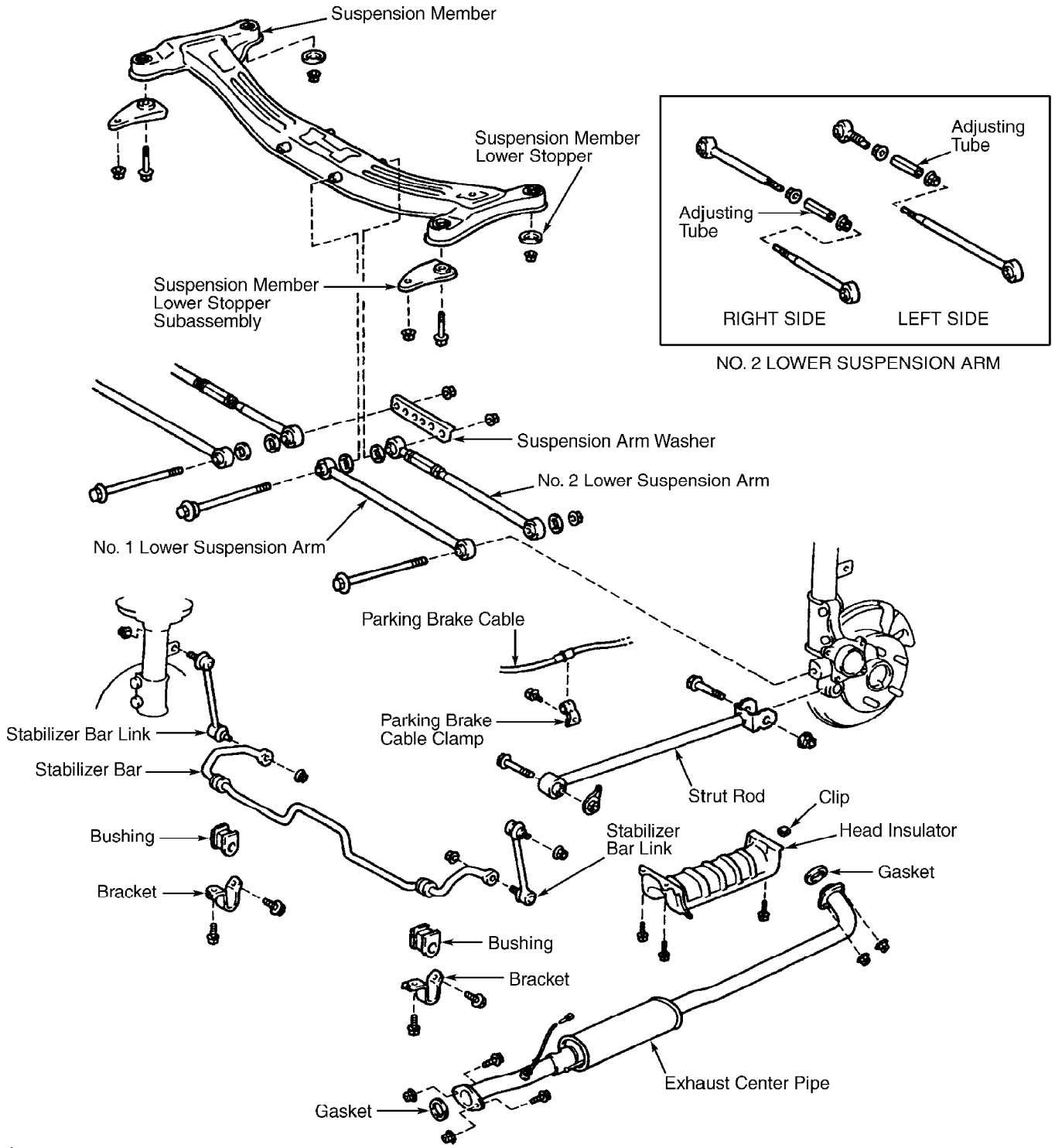


Fig. 11: Exploded View Of Rear Suspension (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300 & GS400)
1) Raise and support vehicle. Remove wheels. Remove fender

apron seal. Remove 2 bolts, nuts and No. 1 lower suspension arm.

2) On models with Halogen type headlight, remove bolt, nut and disconnect stabilizer bar link from No. 2 suspension arm. On models with HID type headlight, remove bolt and nut and disconnect stabilizer bar link and height control link from No. 2 suspension arm. On all models, remove bolt, nut and disconnect shock absorber from No. 2 suspension arm. See Fig. 12.

3) Place reference marks on adjuster cam and No. 2 lower suspension arm. Remove nut, adjusting cam No. 2 and adjusting cam No. 1. Remove bolt, nut, washer and No. 2 lower suspension arm.

Installation

To install, reverse removal procedure. Align reference marks made during removal. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

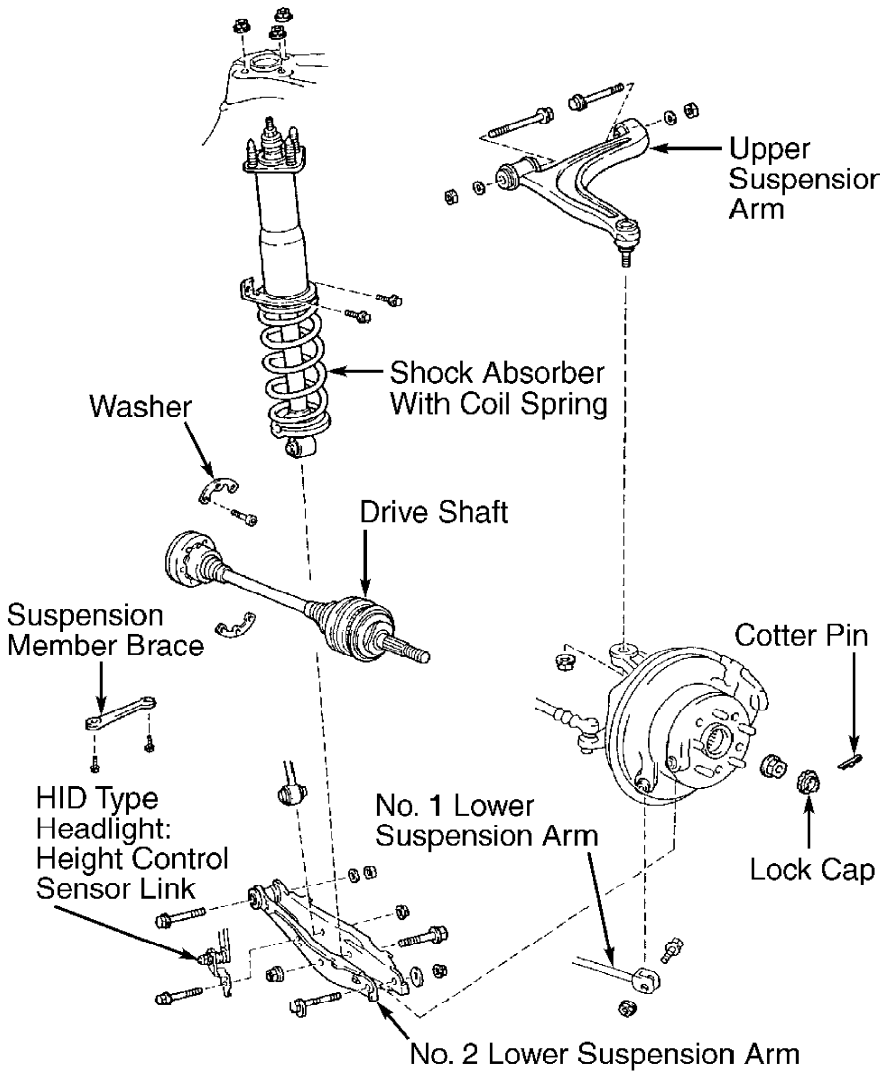


Fig. 12: Exploded View Of Rear Suspension (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LS400)

CAUTION: On LS400 models equipped with air suspension, ensure ignition switch is in OFF position before raising vehicle. If ignition is on when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle.

1) Raise and support vehicle. Remove rear wheels. Disconnect strut rod from rear axle carrier.
2) On air suspension models, place match marks on the height control sensor link bracket and link. Remove nut, and disconnect link from No. 1 lower suspension arm. See Fig. 13.
3) On all models, place reference marks on adjusting cam and body. Remove bolt and adjusting cam. Remove nut on axle carrier side of No. 1 lower suspension arm. Use puller to disconnect ball joint and remove No. 1 lower arm.
4) Remove stabilizer bar link from No. 2 lower arm. Place match marks on adjusting cam and body. Remove nut and adjusting cam. Remove No. 2 lower suspension arm.

Installation

To install, reverse removal procedure. Align reference marks made during removal. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

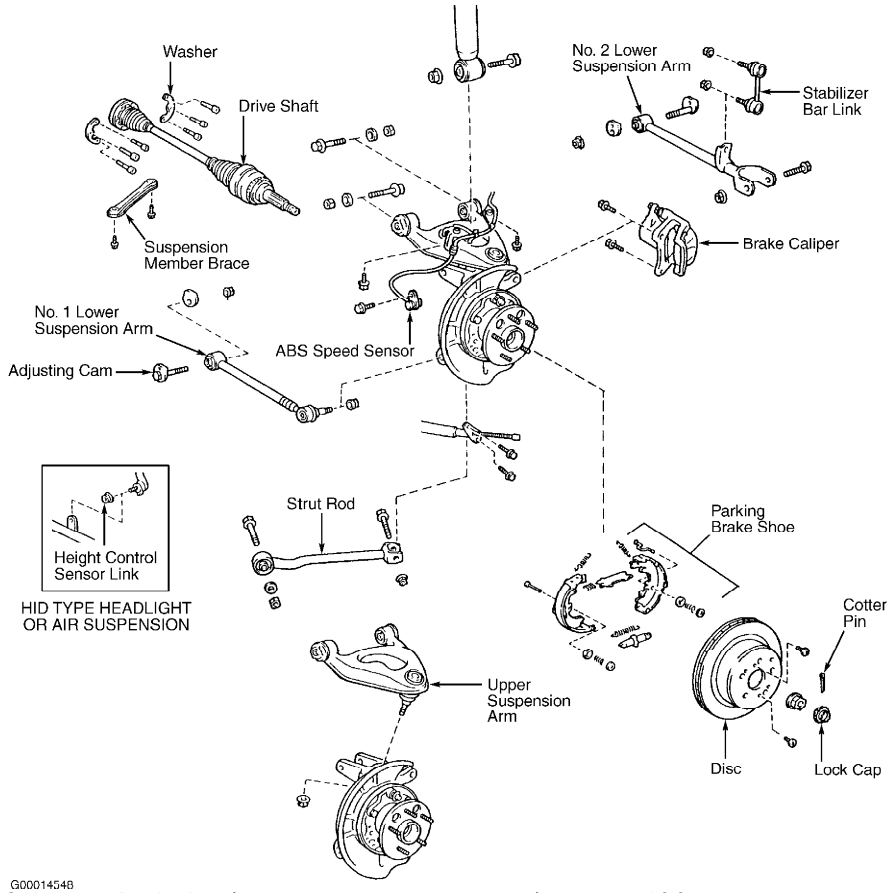


Fig. 13: Exploded View Of Rear Suspension (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (SC300 & SC400)

1) Raise and support vehicle. Remove rear wheels. Remove

brake caliper and support with wire. Disconnect center exhaust pipe with tailpipe and support the pipe assembly firmly. Remove attaching bolts, nuts and strut rod from rear axle carrier.

2) Disconnect parking brake cable. Using Puller (09628-10011), disconnect lower control arm from axle carrier. Mark adjuster cam and body for reassembly reference. Remove nut, washer and No. 2 adjusting cam and plate. Remove lower suspension arm.

3) Remove nut, washer and bolt. Disconnect shock absorber. Remove nut, and disconnect stabilizer bar link from No. 2 lower suspension arm.

4) Use puller to disconnect ball joint and No. 2 lower arm from axle carrier. Mark adjusting cam and body for reassembly reference. Remove nut, washer, No. 2 adjusting cam, plate and No. 2 lower arm.

Installation

To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

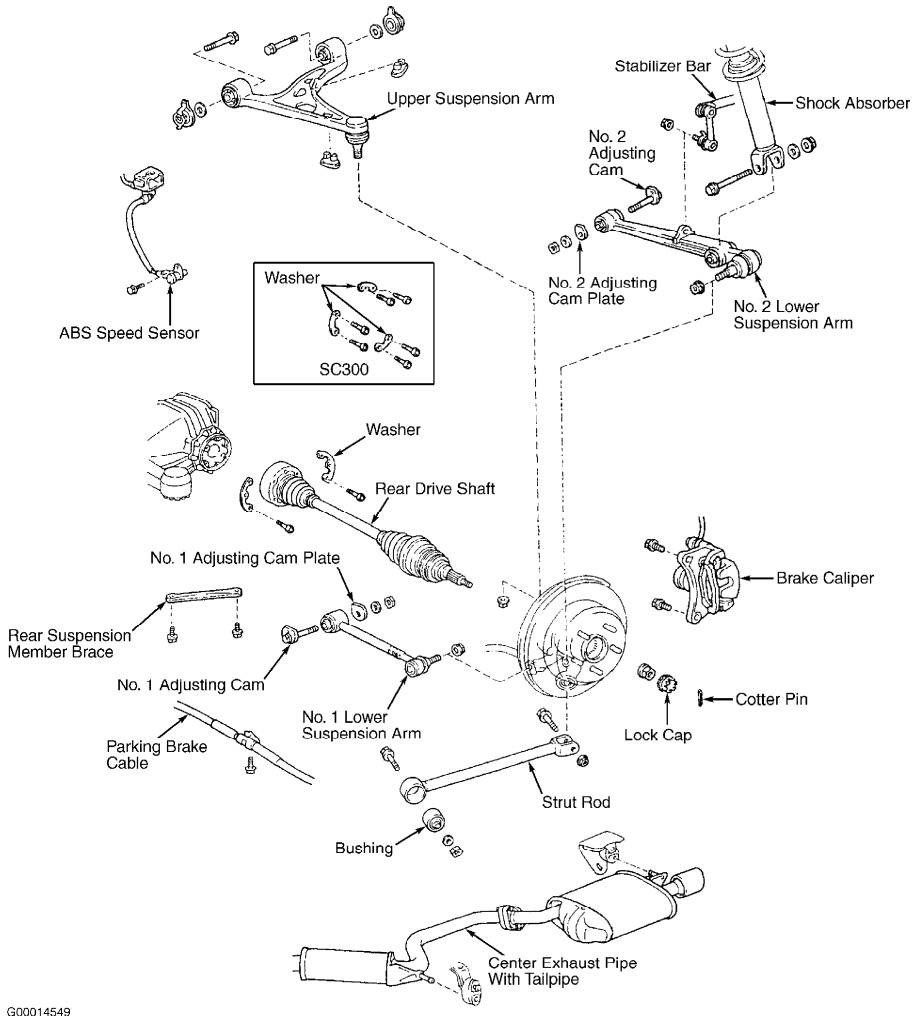


Fig. 14: Exploded View Of Rear Suspension (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (RX300)

1) Remove rear wheels. Remove exhaust center pipe and

tailpipe. Disconnect parking brake cable bracket. Remove 2 bolts, nuts and strut rod.

2) Place match marks on toe-adjusting cam and suspension member. Remove bolt, nut and toe-adjusting cam. Disconnect No. 2 lower suspension arm from rear suspension member. See .

3) On 2WD models, remove nut, washer and No. 2 lower suspension arm. Remove bolt and nut. Disconnect No. 1 lower suspension arm from rear axle carrier.

4) On 4WD models, remove bolt, nut and No. 2 lower suspension arm. Remove No. 1 lower suspension arm bolts and nuts. Disconnect No. 1 lower suspension arm from rear axle carrier.

5) On all models, loosen No. 1 lower arm rear suspension member side set bolt. DO NOT remove bolt. Support rear suspension member with jack. Remove 4 nuts, 2 bolts and 2 retainers from rear suspension member. Lower jack, and remove bolt, nut and No. 1 suspension arm.

Installation

To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

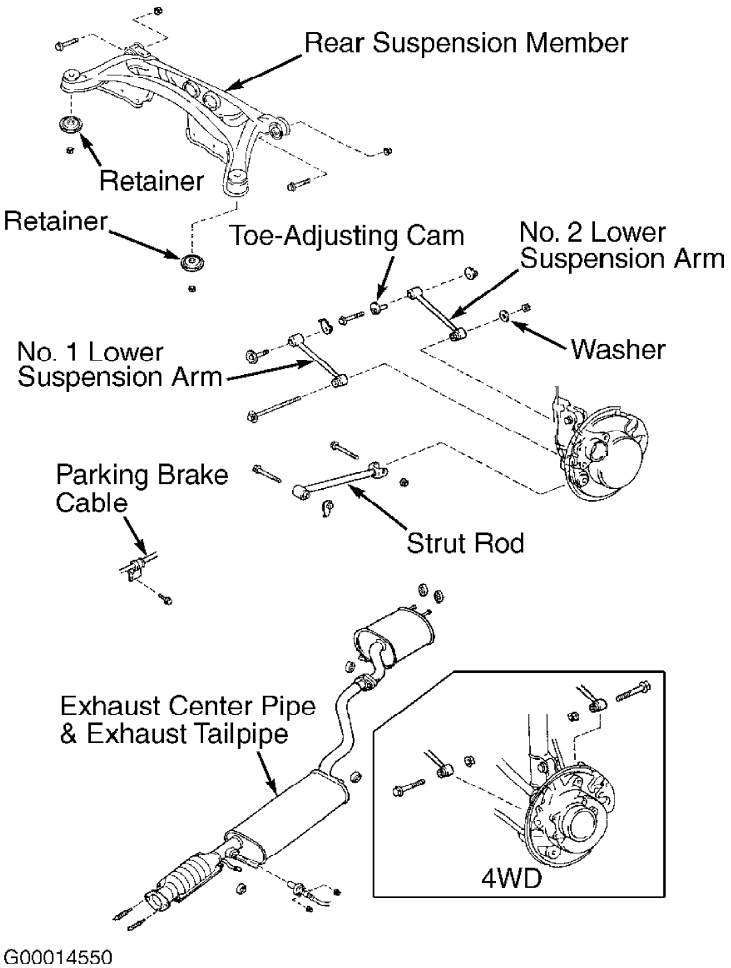


Fig. 15: Exploded View Of Rear Suspension (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LOWER SUSPENSION ARM BUSHINGS

Removal & Installation

Remove lower suspension arm. See LOWER SUSPENSION ARM. Using press tools, remove bushing. Press new bushing into arm. To complete installation, reverse removal procedure.

UPPER SUSPENSION ARM

Removal & Installation (GS400 & GS300)

1) Raise and support vehicle. Remove drive shaft. See REAR AXLE CARRIER. Remove shock absorber. See REMOVAL & INSTALLATION.

2) Using Puller (09628-62011), disconnect upper suspension arm from axle carrier. Remove 2 bolts, nuts, washers and upper suspension arm. See Fig. 12.

3) To install, reverse removal procedure. Check ABS speed signal and rear wheel alignment. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (LS400)

Raise and support vehicle. Remove rear axle hub with upper suspension arm. See REAR HUB & BEARING ASSEMBLY (RWD MODELS). Install bolt and 2 nuts into axle carrier, and secure it in a vise. Loosen nut to position. Using hammer, tap nut, and remove upper suspension arm. To install, reverse removal procedure. Check ABS speed sensor signal and rear wheel alignment. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (SC400 & SC300)

1) Raise and support vehicle. Remove rear wheels. Remove drive shaft. See REAR AXLE CARRIER. Remove 2 bolts and brake caliper from rear axle hub. Support brake caliper securely.

2) Remove ABS wire harness clamp. Disconnect center exhaust pipe with tailpipe. Using Puller (09628-62011), disconnect upper suspension arm from axle carrier. Remove 2 bolts, nuts, washers and upper suspension arm.

3) To install, reverse removal procedure. Check rear wheel alignment. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

STABILIZER BAR

Removal & Installation (ES300 & RX300)

Raise and support vehicle. Remove rear wheels. Disconnect exhaust pipe (if necessary). Remove left and right stabilizer bar links. Remove left and right stabilizer bar No. 2 brackets and bushings. Remove stabilizer bar. To install, reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

STRUT ASSEMBLY

Removal & Installation (ES300)

1) Remove rear side seat back, package tray trim, high-mount brake light, seat belt hole cover. Remove rear seat belt. Raise and support vehicle. Remove rear wheels. Disconnect brake hose and ABS speed senor wiring harness clamp from shock absorber.

2) Disconnect stabilizer bar link from shock absorber. Loosen 2 nuts on lower side of shock absorber. Support rear axle carrier using jack. On models without electronic modulated suspension, loosen center nut, and remove 3 attaching nuts. Lower the rear axle carrier, and remove 2 attaching bolts. Remove shock absorber and coil spring assembly from vehicle.

3) On models with electronic modulated suspension, remove

clamp and clip from shock absorber. Disconnect absorber control actuator connector. Using Spanner/Socket (09817-33190), loosen center nut. DO NOT remove nut. Remove 3 attaching nuts. Lower rear axle carrier, and remove 2 bolts. Remove shock absorber and coil spring assembly from vehicle.

4) To complete installation, reverse removal procedure. Install rear wheels. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal & Installation (GS300 & GS400)

1) Raise and support vehicle. Remove luggage compartment front trim panel. Remove rear wheels. Remove suspension arm No. 2. Loosen center nut of suspension support. Remove 3 nuts, 2 bolts and shock absorber with coil spring.

2) To complete installation, reverse removal procedure. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal & Installation (LS400)

1) Raise and support vehicle. Remove rear wheels. Remove rear seat cushion and rear seat back. Remove package tray trim. Remove rear drive shaft. See REAR AXLE CARRIER. Disconnect stabilizer link from stabilizer bar. Remove brake caliper.

2) Remove ABS speed sensor. On models with HID type headlight, place match marks on height control sensor link and bracket. Remove nut, and disconnect height control sensor link from No. 1 lower suspension arm.

3) On all models, loosen bolt and remove nut on lower side of shock absorber. Support rear axle carrier with a jack. Remove 3 nuts and shock absorber cap. Loosen suspension support center nut. Remove 3 nuts. Lower rear axle carrier, and remove bolt on lower side of shock absorber. Remove shock absorber and coil spring.

4) To install, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

Removal & Installation (RX300)

1) Raise and support vehicle. Remove deck side cover. Remove rear wheels. Remove bolt and ABS speed sensor wire harness clamp from shock absorber. Remove flexible hose from shock absorber bracket. Remove nut, and disconnect stabilizer bar link from shock absorber.

2) Loosen 2 bolts on lower side of shock absorber. DO NOT remove bolts. Support rear axle with a jack. Remove cap from suspension support. Loosen center nut. DO NOT remove nut. Remove 3 nuts of suspension support. Lower rear axle carrier. Remove 2 nuts and bolts on lower side of shock absorber. Remove shock absorber with coil spring.

3) To install, reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (SC300 & SC400)

1) Raise and support vehicle. Remove rear wheels. Remove brake caliper, and suspend using wire. Remove nut, and disconnect stabilizer bar link from No. 2 lower control arm. Remove nut, washer and bolt at lower end of shock absorber. Loosen, center nut. DO NOT remove nut. Remove 3 retaining nuts, spring support reinforcement and shock absorber with coil spring.

2) Inspect shock absorber. Compress and extend shock absorber rod. Ensure there is no abnormal resistance or unusual operation sounds. If there is abnormality, replace shock absorber.

3) To complete installation, reverse removal procedure.

Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Check wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

WHEEL BEARING

See REAR HUB & BEARING ASSEMBLY (RWD MODELS).

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (ES300)

Application	Ft. Lbs. (N.m)
Axle Carrier Nuts	
Nut "A" (New)	188 (255)
Nut "A" (Reused)	145 (196)
Nut "B"	134 (181)
Brake Caliper Bolt	34 (47)
Lower Suspension Arm Bolts	134 (181)
Shock Absorber Nuts	
New	188 (255)
Used	145 (196)
Stabilizer Bushing Retainer Bolt	14 (19)
Stabilizer Link Nut	29 (39)
Strut Rod-To-Body Nut	83 (113)
Strut Rod-To-Carrier Bolt	83 (113)
Strut-To-Carrier Bolt	
New	188 (255)
Used	145 (196)
Suspension Member Lower Stopper Nuts & Bolt	
Nut "A"	38 (51)
Nut "B"	28 (38)
Bolt	38 (51)
Upper Suspension Support-To-Bracket Bolt	29 (39)
Upper Suspension Support-To-Piston Bolt	
Without Electronic Suspension	36 (49)
With Electronic Suspension	26 (36)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
ABS Sensor Bolt	69 (7.8)
Parking Brake Cable-To-Axle	48 (5.4)

TORQUE SPECIFICATIONS (GS300 & GS400)

Application	Ft. Lbs. (N.m)
Brake Caliper Frame-To-Axle Carrier Bolt	77 (104)
No. 1 Lower Arm-To-Body Bolt	55 (75)
No. 1 Lower Arm-To-Rear Axle Carrier Nut	55 (75)
No. 2 Lower Arm-To-Body Bolt (Camber)	81 (110)
No. 2 Lower Suspension Arm	81 (110)
Rear Drive Shaft Bolts	61 (83)
Stabilizer Bar Brackets	13 (18)
Stabilizer Bar Link Nut	48 (65)
Strut Rod-To-Body Bolt/Nut	47 (64)
Suspension Support Center Nut	20 (27)
Upper Ball Joint-To-Axle Carrier Nut	80 (108)
Upper Suspension Arm-To-Body Bolt	65 (88)

Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
ABS Sensor Bolt	69 (7.8)
Parking Brake Cable-To-Axle	69 (7.8)

TORQUE SPECIFICATIONS (LS400)

Application	Ft. Lbs. (N.m)
Backing Plate Bolts/Nuts	43 (59)
Brake Caliper-To-Axle Carrier Bolt	77 (104)
No. 1 Lower Arm-To-Body Bolt (Camber)	57 (78)
No. 1 Lower Arm-To-Rear Axle Carrier Bolt	43 (59)
No. 2 Lower Arm-To-Body Bolt (Camber)	57 (78)
No. 2 Lower Arm-To-Rear Axle Carrier Bolt	60 (81)
Rear Drive Shaft Bolts	58 (79)
Stabilizer Bar Bushing Bracket Bolt	13 (18)
Stabilizer Bar Link Nut	48 (65)
Strut Rod-To-Body Bolt	57 (78)
Strut Rod-To-Rear Axle Carrier Bolt	136 (184)
Strut-To-Axle Carrier Bolt	101 (137)
Suspension Support Center Nut	20 (27)
Suspension Support-To-Body Bolt	47 (64)
Upper Ball Joint-To-Axle Carrier Nut	80 (108)
Upper Suspension Arm-To-Body Bolt	121 (164)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
ABS Sensor Bolt	69 (7.8)
Height Control Sensor Link Nut	48 (5)

TORQUE SPECIFICATIONS (RX300)

Application	Ft. lbs. (N.m)
Axle Hub Bolts	59 (80)
Backing Plate Nuts	53 (72)
Brake Caliper & Disc Bolts	34 (47)
Drive Shaft Lock Nut	159 (216)
Drive Shaft-To-Differential Side Gear Shaft Nuts	51 (69)
Flexible Hose	21 (29)
No. 1 Suspension Arm Set Bolt/Nut	130 (177)
No. 1 Upper Suspension Arm-To-Axle Carrier	130 (177)
No. 2 Suspension Arm Set Bolt/Nut	130 (177)
No. 2 Suspension Arm-To- Suspension Member	83 (113)
Stabilizer Bar Link Nut	29 (39)
Strut Rod Bolt/Nut	91 (123)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
ABS Sensor Bolt	71 (8)
Parking Brake Cable Bolts	71 (8)
Parking Brake Cable Bracket	44 (5)

TORQUE SPECIFICATIONS (SC300 & SC400)

Application	Ft. Lbs. (N.m)
Backing Plate Set Bolts	19 (26)
Brake Caliper-To-Axle Carrier Bolt	77 (104)
No. 1 Lower Arm-To-Bracket Bolt	43 (59)
No. 1 Lower Arm-To-Carrier Bolt (Camber)	136 (184)
No. 2 Lower Arm-To-Bracket Bolt	110 (150)
No. 2 Lower Arm-To-Carrier Bolt (Camber)	134 (184)
Rear Axle Carrier Nut	80 (109)
Rear Drive Shaft Bolts	58 (79)
Stabilizer Bushing Retainer Bolt	21 (28)
Stabilizer Link Nut	54 (74)
Strut Center Nut	20 (27)
Strut-To-Body Nuts	18 (25)
Strut-To-Carrier Bolt	101 (137)
Suspension Center Nut	20 (27)
Upper Arm-To-Bracket Bolt	121 (164)
Upper Suspension Arm Nut	80 (108)
Wheel Lug Nuts	76 (103)
	INCH Lbs. (N.m)
ABS Sensor Bolt	69 (7.8)
Parking Brake Cable-To-Axle	69 (7.8)

* SUSPENSION UNIFORM INSPECTION GUIDELINES *

1999 Lexus RX 300

GENERAL INFORMATION
Steering, Suspension, Wheel Alignment, Wheels and Tires
January 2000 Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

CONTENTS

Motorist Assurance Program (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)
OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

Steering and Suspension

AIR RIDE SUSPENSION
AIR RIDE SUSPENSION - AIR SHOCKS AND AIR STRUTS
AIR RIDE SUSPENSION - AIR SPRING VALVES
AIR RIDE SUSPENSION - AIR SPRINGS
AIR RIDE SUSPENSION - COMPRESSORS
AIR RIDE SUSPENSION - HEIGHT SENSORS
AIR RIDE SUSPENSION - MODULES
AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)
AIR RIDE SUSPENSION - SWITCHES (ON/OFF)
AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)
AIR RIDE SUSPENSION - TUBING
AIR RIDE SUSPENSION - WARNING LAMPS
AIR RIDE SUSPENSION - WIRING HARNESSES
BALL JOINTS
BUSHINGS
CENTER LINKS
CONTROL ARM SHAFTS
CONTROL ARMS
DRAG LINKS
ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS
IDLER ARMS
KING PINS
PITMAN ARMS
POWER STEERING HOSES
POWER STEERING (HYDRAULIC) PUMPS
RADIUS ARMS
RELAY RODS
SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES
SPINDLES
SPRINGS - COIL, LEAF AND TORSION BAR
STEEL POWER STEERING LINES
STEERING ARMS
STEERING DAMPERS
STEERING GEARS (EXCEPT RACK AND PINION)
STEERING GEARS - RACK AND PINION
STEERING KNUCKLES
STRIKE OUT BUMPERS
STRUT RODS
STRUT UPPER BEARING PLATE ASSEMBLIES
SWAY BAR LINKS
SWAY BARS
TIE ROD ENDS (INNER AND OUTER)
TRACK BARS
TRAILING ARMS

WHEEL BEARINGS, RACES AND SEALS

Wheel Alignment

WHEEL ALIGNMENT

Wheels and Tires

TIRES
VALVE STEMS
WHEEL ATTACHMENT HARDWARE
WHEELS (RIMS)

MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM (MAP)

Automotive industry professionals and interested readers: The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from auto repair companies and independents, parts and equipment manufacturers and suppliers, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We encourage motorists to take greater responsibility for their vehicles-through proper, manufacturer-recommended, maintenance, and endorse participating service and repair shops (including franchisees and dealers) who adopt (1) the MAP Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require an inspection of the vehicle's (problem) system and that the results be communicated to the customer according to industry standards. Since the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical Systems.

Further, revisions to all of these inspection communication standards are re-published periodically. In addition to the above, standards for Drive Train and Transmissions were promulgated and published in 1998. Participating shops utilize these Uniform Inspection & Communication Standards (UI&CS) as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association governing body, and the program adjusted as needed.

To assure recourse for auto repair customers if they are not satisfied with a repair transaction, the Motorist Assurance Program offers mediation and arbitration through the BBB and other similar non-profit organizations. MAP conducted pilot programs in twelve

states before announcing the program nationally in October 1998. During the pilots, participating repair shops demonstrated their adherence to the Pledge and Standards and agreed to follow the UI&CS in communicating the results of their inspection to their customers. Complaints and "come-backs" dropped significantly.

To put some "teeth" in the program, an accreditation requirement for shops was initiated. The requirements are stringent, and a self-policing technique has been incorporated which includes the "mystery shopping" of outlets. By year-end 1999, over 4,000 auto repair facilities had been accredited by the Motorist Assurance Program.

We welcome you to join us as we continue our outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

1444 I Street, NW - Suite 700
Washington, DC 20005
Phone (202) 712-9042 - Fax (202) 216-9646
E-mail map@bostromdc.org

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-line, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested." In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and the conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience, or the vehicle manufacturer's recommended service interval and must be documented.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a

customer's vehicle has one of these conditions, the procedure may be only to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition.

When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement

A – Part no longer performs intended purpose
B – Part does not meet a design specification (regardless of performance)
C – Part is missing

NOTE: When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

Reasons to Suggest Repair or Replacement

1 – Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)
2 – To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)
3 – To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
4 – Technician's recommendation based on substantial and informed experience

NOTE: Suggested services are always optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

STEERING AND SUSPENSION

SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

Steering and suspension are complex systems made up of a

variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

CAUTION: DO NOT use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

AIR RIDE SUSPENSION

NOTE: Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

AIR RIDE SUSPENSION - AIR SHOCKS AND AIR STRUTS

NOTE: This section covers the air spring portion of the air shock or strut. For damping portion of shock or strut conditions and procedures, refer to the SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES section.

AIR RIDE SUSPENSION - AIR SHOCK AND AIR STRUT INSPECTION

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement.

AIR RIDE SUSPENSION - AIR SPRING VALVES

AIR RIDE SUSPENSION - AIR SPRING VALVE INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware		

threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Blocked	A	..	Require repair or replacement.
Connector bent	A	..	Require repair or replacement.
Connector broken	A	.....	Require replacement.
Connector loose	A	..	Require repair or replacement.
Inoperative	A	..	Require repair or replacement.
Leaking	A	..	Require repair or replacement.
Restricted	A	..	Require repair or replacement.

AIR RIDE SUSPENSION - AIR SPRINGS

AIR RIDE SUSPENSION - AIR SPRING INSPECTION

Condition	Code		Procedure
Attaching hardware broken	A	...	Require replacement of broken part.
Attaching hardware incorrect	A	.....	Require replacement of incorrect part.
Attaching hardware loose	A	...	Require repair or replacement of loose part.
Attaching hardware missing	C	..	Require replacement of missing part
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Collar cracked	A	.....	Require replacement.
End cap cracked	A	.....	Require replacement.
Inner fabric of bag damaged	A	.....	Require replacement.
Leaking	A	..	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	.....	Suggest replacement.
Piston cracked	A	.....	Require replacement.

AIR RIDE SUSPENSION - COMPRESSORS

AIR RIDE SUSPENSION - COMPRESSOR INSPECTION

Condition	Code		Procedure
Attaching hardware bent .	B	...	Require repair or replacement of bent part.
Attaching hardware broken	A	...	Require replacement of broken part.

Condition	Code	Procedure
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Does not build pressure	A	(1) Further inspection required.
Excessive run time	B	(2) Further inspection required.
Inoperative	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

(1) - If failure to build pressure is traced to the compressor, require replacement.
(2) - If excessive run time is traced to the compressor, require replacement.

AIR RIDE SUSPENSION - HEIGHT SENSORS

AIR RIDE SUSPENSION - HEIGHT SENSOR INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Dust boot missing	2	(1) Suggest replacement.
Dust boot split	2	(1) Suggest replacement.
Dust boot torn	2	(1) Suggest replacement.
Housing cracked	A	Require replacement.
Lead routing incorrect	B	Require rerouting according to

			vehicle manufacturer's specifications.
Loose	B	...	Require adjustment to vehicle manufacturer's specifications.
Missing	C	.....	Require replacement.
Output signal incorrect	A	..	Require repair or replacement.
Wire lead damaged	A	..	Require repair or replacement.

(1) - This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.

AIR RIDE SUSPENSION - MODULES

AIR RIDE SUSPENSION - MODULE INSPECTION

Condition	Code		Procedure
Attaching hardware loose	A	...	Require repair or replacement of loose part.
Attaching hardware missing	C	..	Require replacement of missing part.
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Housing cracked	2	..	Suggest repair or replacement.
Inoperative	A	.....	Require replacement.
Missing	C	.....	Require replacement.

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

AIR RIDE SUSPENSION - RELAY (COMPRESSOR) INSPECTION

Condition	Code		Procedure
Housing cracked	2	.....	(1) Suggest replacement.
Intermittent	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Output signal incorrect	A	.....	Require replacement.

(1) - If moisture enters the relay, it can reduce life expectancy or impair function.

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

AIR RIDE SUSPENSION - SWITCH (ON/OFF) INSPECTION

Condition	Code		Procedure
Broken	A	.....	Require replacement.
Missing	C	.....	Require replacement.
Output signal incorrect	A	.....	Require replacement.

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

AIR RIDE SUSPENSION - TORSION SPRING (COUNTER BALANCING) INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - TUBING

AIR RIDE SUSPENSION - TUBING INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Blocked	A	Require repair or replacement.
Fitting incorrect	B	Require replacement.
Leaking	A	Require repair or replacement.
Line type incorrect	B	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Routed incorrectly	B	Require routing correction.

AIR RIDE SUSPENSION - WARNING LAMPS

AIR RIDE SUSPENSION - WARNING LAMP INSPECTION

Condition	Code	Procedure
Bulb burned out	A	Require replacement.
Warning light does		

not come on during bulb check	..	. Further inspection required to determine cause.
Warning light flashes ...	..	. Further inspection required to determine cause.
Warning light is intermittent	..	. Further inspection required to determine cause.
Warning light stays on after initial bulb check	..	. Further inspection required to determine cause.

AIR RIDE SUSPENSION - WIRING HARNESSES

AIR RIDE SUSPENSION – WIRING HARNESS INSPECTION

Condition	Code	Procedure
Connector bent	A ..	Require repair or replacement.
Connector broken	A ..	Require repair or replacement.
Connector loose	A ..	Require repair or replacement.
Damaged (cut, burned, or chafed)	A ..	Require repair or replacement.
Excessive resistance	B ..	Require repair or replacement.
Fuse blown	A	Require replacement.
Fusible link blown	A	Require replacement.
Open	A ..	Require repair or replacement.
Poor ground	A ..	Require repair or replacement.
Routed incorrectly	B ..	Require rerouting according to vehicle manufacturer's specifications.
Shorted	A ..	Require repair or replacement.
Terminal bent	A ..	Require repair or replacement.
Terminal broken	A ..	Require repair or replacement.
Terminal corroded	A ..	Require repair or replacement.
Terminal loose	A ..	Require repair or replacement.

BALL JOINTS

Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice.

NOTE: The term "perceptible movement," defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the "perceptible movement" standard. Before requiring or suggesting any parts be replaced based on "perceptible movement," consult your repair manual to determine if OEM specifications exist.

You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.

BALL JOINT INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace ball joint.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace ball joint.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace ball joint.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace ball joint.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace ball joint.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace ball joint.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace ball joint.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Greaseable ball joint will not take grease	2	(5) Suggest replacement of grease fitting.
Nut on ball joint loose	A	(6) Require repair or replacement.
Pre-load adjustment incorrect	B	Require repair or replacement.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.

Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(5) - If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

BUSHINGS

BUSHING INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace bushing.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace bushing.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace bushing.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace bushing.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace bushing.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace bushing.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace bushing.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace bushing.
Binding	A	Require repair or replacement.

Deteriorated, affecting performance	A	Require repair or replacement.
Distorted, affecting performance	A	Require repair or replacement.
Leaking (fluid-filled type)	A	Require replacement.
Missing	C	Require replacement.
Noisy	2	(1) Further inspection required.
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement.
Seized	A	Require replacement.
Shifted (out of position)	B	Require repair or replacement.
Split	A	Require replacement.
Surface cracking (weather-checked)	..	No service suggested or required.

(1) - If noise isolated to bushing, suggest repair or replacement.

CAUTION: Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.

CENTER LINKS

CENTER LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace center link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace center link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace center link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace center link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace center link.
Bent	B	Require replacement.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.

Condition	Code	Procedure
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(3) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Looseness (perceptible horizontal movement)	1	(5) Suggest replacement.
Looseness that is excessive	B	(5)(6) Require replacement.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Stud loose in taper hole	A	(7) Require repair or replacement.
Taper hole elongated	A	(8) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for damaged taper hole.
(8) - Check for damaged stud.

CONTROL ARM SHAFTS

CONTROL ARM SHAFT INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shaft.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shaft.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shaft.

Condition	Code	Procedure
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shaft.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shaft.
Bent	B	Require replacement.
Shaft bushing surface undersized (worn)	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

CONTROL ARMS

CONTROL ARM INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace control arm.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace control arm.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace control arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace control arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace control arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace control arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace control arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace control arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.

Ball joint hole oversized (loose interference or press fit)	B	(1) Further inspection required.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.

DRAG LINKS

DRAG LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace drag link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace drag link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace drag link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace drag link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace drag link.
Bent	B	Require replacement.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(5) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Looseness (perceptible horizontal movement)	1	(6) Suggest replacement.
Looseness that is		

excessive	B	(6)(7) Require replacement.
Seized	A	Require replacement.
Stud bent	B	(8) Require replacement.
Stud broken	A	(8) Require replacement.
Stud loose in taper hole	A	(8) Require repair or replacement.
Taper hole elongated	A	(9) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(8) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - Missing grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(7) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(8) - Check for damaged taper hole.
(9) - Check for damaged stud.

ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS

NOTE: This section covers the electronic damping control portion of the electronic shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES section.

ELECTRONIC RIDE CONTROL SHOCK AND STRUT INSPECTION

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Electronic valve control inoperative	2	(1) Suggest replacement.
Terminal bent	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	Require repair or replacement.
Terminal loose	A	Require repair or replacement.

(1) - It is acceptable to replace with a non-electronically controlled unit, where available.

IDLER ARMS

IDLER ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace idler arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace idler arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace idler arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace idler arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace idler arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace idler arm.
Binding	A	(1) Further inspection required.
Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(5) Suggest replacement.
Grease seal torn	2	(4) Suggest replacement.
Greaseable joint will not take grease	2	(1) Suggest replacement of grease fitting.
Looseness at frame bracket end	B	(6)(7) Require repair or replacement.
Looseness at link end (perceptible horizontal movement)	1	(8) Suggest replacement.
Looseness at link end that is excessive	B	(8)(9) Require replacement.
Mounted out of position (center link not parallel)	B	Require repositioning.
Nut on stud loose	A	(10) Require repair or replacement.

Seized	A		Require replacement.
Stud bent	B	(11)	Require replacement.
Stud broken	A	(11)	Require replacement.
Taper hole elongated	A	(12)	Require replacement.
Threads damaged	A		Require repair or replacement.
Threads stripped (threads missing)	A	(11)	Require replacement.
Wear exceeds manufacturer's specifications	B		Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - Missing grease seal will allow contaminants to enter joint and will accelerate wear.
(6) - If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.
(7) - Looseness is defined as movement that creates excessive toe change.
(8) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(9) - Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity.
(10) - Check for bent stud or damaged taper hole.
(11) - Check for damaged taper hole.
(12) - Check for damaged stud.

KING PINS

You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.

KING PIN INSPECTION

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement.
Bearing balls worn	A	Require replacement.
Bearing races pitted	A	Require replacement.
Bearing races worn	A	Require replacement.
Bearing rollers pitted	A	Require replacement.
Bearing rollers worn	A	Require replacement.
Bearing seal bent	2	Suggest replacement of seal or bearing.
Bearing seal missing	2	Suggest replacement of seal or bearing.
Bearing seal torn	2	Suggest replacement of seal or bearing.
Binding	A	Require repair or replacement

		of affected parts.
End caps missing	C	. Require replacement of missing part, if available; otherwise, replace king pin.
End play exceeds specifications	B	..... Require repair.
Grease fitting broken ...	A	.. Require replacement of grease fitting.
Grease fitting missing ..	C	.. Require replacement of grease fitting.
Grease fitting won't seal	A	.. Require replacement of grease fitting.
Locating pins missing ...	C	. Require replacement of missing part, if available; otherwise, replace king pin.
Looseness exceeds manufacturer's specifications	B	.... Require replacement of worn parts.
Seized	A	..... Require replacement.
Threads damaged	A	. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.
Will not take grease	2	..... (1) Suggest replacement of grease fitting.

(1) - If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.

PITMAN ARMS

PITMAN ARM INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace pitman arm.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace pitman arm.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace pitman arm.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace pitman arm.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace pitman arm.
Bent	B	..... Require replacement.
Binding	A	..... (1) Further inspection required.

Grease boot cracked	2	(2) Suggest replacement.
Grease boot missing	2	(3) Suggest replacement.
Grease boot torn	2	(4) Suggest replacement.
Grease fitting broken	A	Require replacement grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(3) Suggest replacement of seal.
Grease seal torn	2	(4) Suggest replacement of seal.
Looseness (perceptible horizontal movement)	1	(5) Suggest replacement.
Looseness that is excessive	B	(5)(6) Require replacement.
Nut on stud loose	A	(7) Require repair or replacement.
Seized	A	Require replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Stud bent	B	(8) Require replacement.
Stud broken	A	(8) Require replacement.
Stud loose in taper hole	A	(8) Require repair or replacement.
Taper hole elongated	A	(9) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(8) Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for bent stud of damaged taper hole.
(8) - Check for damaged taper hole.
(9) - Check for damaged stud.

POWER STEERING HOSES

POWER STEERING HOSE INSPECTION

Condition	Code	Procedure
Blistered	B	Require replacement.
Blocked	A	Require repair or replacement.
Fitting threads damaged	A	Require repair or replacement.

Fitting threads stripped (threads missing)	A	Require replacement.
Inner fabric (webbing) cut	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Outer covering is cracked to the extent that the inner fabric of hose is visible	B	Require replacement.
Restricted	A	Require repair or replacement.

POWER STEERING (HYDRAULIC) PUMPS

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

POWER STEERING (HYDRAULIC) PUMP INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Belt alignment incorrect	B	(1) Further inspection required.
Belt cracked	1	Suggest replacement.
Belt frayed	1	Suggest replacement.
Belt missing	C	Require replacement.
Belt noisy	2	(2) Further inspection required.
Belt plies separated	A	Require replacement.
Belt tension out of specification	B	Require adjustment or replacement.
Belt worn beyond adjustment range	B	Require replacement.
Belt worn so it contacts bottom of pulley	A	Require replacement.
Binding	A	Require repair or replacement.
Fluid at or beyond service interval	3	Suggest fluid change.

Fluid contaminated	B	(3) Require flushing and refilling of the system.
Fluid level incorrect	B	Require adjustment of fluid level.
Inadequate assist	A	(4) Further inspection required.
Leaking	A	Require repair or replacement.
Noise	2	(5) Further inspection required.
Pulley bent	A	Require repair or replacement of pulley.
Pulley missing	C	Require replacement of pulley.
Remote reservoir leaking	A	Require replacement of reservoir,
Reservoir cap broken	A	Require replacement of cap.
Reservoir cap missing	C	Require replacement of cap.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Determine cause of incorrect alignment and require repair.
(2) - Determine cause of noise and suggest repair.
(3) - Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(4) - If pump is source of inadequate assist, require repair or replacement.
(5) - If noise is isolated to pump, suggest repair or replacement.

RADIUS ARMS

RADIUS ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped		

(threads missing)	A	..... Require replacement.

RELAY RODS

RELAY ROD INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace relay rod.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace relay rod.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace relay rod.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace relay rod.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace relay rod.
Bent	B	..... Require replacement.
Binding	A	..... (1) Further inspection required.
Grease boot cracked	2	..... (2) Suggest replacement.
Grease boot missing	2	..... (3) Suggest replacement.
Grease boot torn	2	..... (4) Suggest replacement.
Grease fitting broken ...	A	..... Require replacement grease fitting.
Grease fitting missing ..	C	... Require replacement of grease fitting.
Grease fitting won't seal	A	... Require replacement of grease fitting.
Grease seal missing	2	..... (3) Suggest replacement.
Grease seal torn	2	..... (4) Suggest replacement.
Looseness (perceptible horizontal movement) ...	1	..... (5) Suggest replacement.
Looseness that is excessive	B	..... (5)(6) Require replacement.
Seized	A	..... Require replacement.
Stud bent	B	..... (7) Require replacement.
Stud loose in taper hole	A	..... (7) Require repair or replacement.
Taper hole elongated	A	..... (8) Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... (7) Require replacement.
Wear exceeds manufacturer's specifications	B	..... Require replacement.

(1) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

(6) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(7) - Check for damaged taper hole.
(8) - Check for damaged stud.

SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for improved performance and preventive maintenance.

* Part is close to the end of its useful life
* To extend tire life
* To balance ride and handling
* To improve stopping distance

When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

Under no circumstances should a technician bend struts or strut housings.

A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details.

NOTE: If vehicle is equipped with original equipment coil over shocks, apply the conditions for coil springs from the SPRINGS - COIL, LEAF AND TORSION BAR section of the STEERING AND SUSPENSION guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacing the shocks with standard shocks for any spring-related condition.

SHOCK ABSORBER, STRUT CARTRIDGE AND STRUT ASSEMBLY INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace shock or strut.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shock or strut.

Attaching hardware corroded, affecting structural integrity ...	A .	Require replacement of corroded part, if available; otherwise, replace shock or strut.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace shock or strut.
Attaching hardware loose	A ...	Require repair or replacement of loose part, if available; otherwise, replace shock or strut.
Attaching hardware missing	C ..	Require replacement of missing part, if available; otherwise, replace shock or strut.
Attaching hardware threads damaged	A ...	Require repair or replacement of part with damaged threads, if available; otherwise, replace shock or strut.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shock or strut.
Binding	A	Require replacement.
Body dented	A	(1) Further inspection required.
Body punctured	A	Require replacement.
Brake hose bracket bent	B ..	Require repair or replacement.
Brake hose bracket missing	C	Require replacement.
Brake hose bracket threads damaged	A ..	Require repair or replacement.
Brake hose bracket threads stripped (threads missing)	C	Require replacement.
Compression bumper missing	C	Require replacement of compression bumper.
Compression bumper split	1	Suggest replacement of compression bumper.
Damping (none)	A	Require replacement.
Dust boot (bellows) split	2	(2) Suggest replacement of boot.
Dust boot (bellows) missing	2	(2) Suggest replacement of boot.
Dust boot (bellows) torn	2	(2) Suggest replacement of boot.
Dust shield broken	2	(2) Suggest replacement.
Dust shield missing	2	(2) Suggest replacement.
Gland nut (strut housing cap) is not removable		

using appropriate tool	A	..	(3) Require replacement of nut and/or housing.
Gland nut (strut housing cap) threads damaged	A	...	Require repair or replacement of nut.
Gland nut (strut housing cap) threads stripped (threads missing)	A	.....	Require replacement of nut.
Housing dented	A	.....	(1) Further inspection required.
Housing punctured	A	.....	Require replacement.
Jounce bumper missing	C	...	Require replacement of jounce bumper.
Jounce bumper split	1	...	Suggest replacement of jounce bumper.
Leaking oil, enough for fluid to be running down the body	A	.....	(4) Require replacement.
Noise	2	.....	(5) Further inspection required.
Piston rod bent	A	.....	Require replacement.
Piston rod broken	A	.....	Require replacement.
Piston rod has surface defect	2	.....	Suggest replacement.
Piston rod threads damaged	A	..	Require repair or replacement.
Piston rod threads stripped (threads missing)	A	.....	Require replacement.
Seized	A	.....	Require replacement.
Shock missing	C	.....	Require replacement.
Strut housing bent	A	.....	Require replacement.
Strut housing cap (gland nut) is not removable using appropriate tool	A	.....	(3) Require replacement of nut and/or housing.
Strut housing cap (gland nut) threads damaged	A	...	Require repair or replacement of nut.
Strut housing cap (gland nut) threads stripped (threads missing)	A	.....	Require replacement of nut.
Strut housing severely corroded, affecting structural integrity	A	.....	Require replacement.
Strut housing threads damaged	A	..	Require repair or replacement.
Strut housing threads stripped (threads missing)	A	.....	Require replacement.
Tire cupping	A	.....	(6) Further inspection required.

(1) – Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.
(2) – This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) – Only required if replacing cartridge.
(4) – CAUTION: If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.

(5) - If noise is isolated to shock or strut, suggest replacement.
(6) - Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.

SPINDLES

SPINDLE INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Race seat area undersized	B	Require replacement.
Scored	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

SPRINGS - COIL, LEAF AND TORSION BAR

When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling.

When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height.

Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.

SPRING (COIL, LEAF AND TORSION BAR) INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware		

corroded, affecting structural integrity	A	..	Require replacement of corroded part.
Attaching hardware incorrect	A	.....	Require replacement of incorrect part.
Attaching hardware loose	A	....	Require repair or replacement of loose part.
Attaching hardware missing	C	...	Require replacement of missing part.
Attaching hardware threads damaged	A	....	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads.
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	.....	Require replacement.
Coil clash	..	..	(1) Require ride height check.
Coil spring insulator deteriorated	2	.....	Suggest replacement of insulator.
Coil spring insulator missing	2	.....	Suggest replacement of insulator.
Coil spring insulator split	2	.....	Suggest replacement of insulator.
Coil spring plastic coating deteriorated - rust present	A	.....	(2) Refer to manufacturer's service requirements.
Composite spring damaged	..	.....	(3) Further inspection required.
Cracked (all springs except composite leaf and secondary leave(s) on multi-leaf springs)	A	.....	Require replacement.
Installed incorrectly	B	.....	Require repair.
Leaf spring insulators missing	2	.....	Suggest replacement of insulators.
Secondary leaf on multi-leaf spring broken	1	....	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	1	....	Suggest repair or replacement
Torsion bar adjuster bent	A	.....	(4) Require repair or replacement of adjuster.
Torsion bar adjuster seized	A	....	(4) Require repair or replacement of adjuster.
Torsion bar adjuster threads damaged	A	....	(4) Require repair or replacement of part with damaged threads.
Torsion bar adjuster threads stripped			

(threads missing)	A	.....	Require replacement of part with stripped threads.
Vehicle suspension height not within OEM specifications	B	.....	Require adjustment or replacement.

(1) - If vehicle is within manufacturer's height specifications, no service is suggested or required.
(2) - Some manufacturers require replacement under these conditions.
(3) - Check vehicle ride height. If ride height is OK, no service is suggested or required.
(4) - Only required if ride height needs to be adjusted.

STEEL POWER STEERING LINES

CAUTION: When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM design specifications.

STEEL POWER STEERING LINE INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	... Require repair or replacement of bent part.
Attaching hardware broken	A	... Require replacement of broken part.
Attaching hardware loose	A	... Require repair or replacement of loose part.
Attaching hardware missing	C	.. Require replacement of missing part.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads.
Blocked	A	.. Require repair or replacement.
Fitting incorrect (such as compression fitting)	B	..... Require replacement.
Flare type incorrect	B	..... Required replacement.
Leaking	A	..... Require tightening or replacement.
Line type incorrect	B	..... Require replacement.
Restricted	A	..... Require replacement.
Routed incorrectly	B	..... Require routing correction.
Rust-pitted	1	..... Suggest replacement.
Rust pitted, affecting structural integrity ..	A	..... Require replacement.

STEERING ARMS

STEERING ARM INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Taper hole elongated	A	(1) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

(1) - Check for damaged stud.

STEERING DAMPERS

The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed instead of repairing or replacing.

STEERING DAMPER INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace steering damper.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace steering damper.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace steering damper.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace steering

			damper.
Attaching hardware loose	A	...	Require repair or replacement of loose part, if available; otherwise, replace steering damper.
Attaching hardware missing	C	..	Require replacement of missing part, if available; otherwise, replace steering damper.
Attaching hardware threads damaged	A	...	Require repair or replacement of part with damaged threads, if available; otherwise, replace steering damper.
Attaching hardware threads stripped (threads missing)	A	.....	Require replacement of part with stripped threads, if available; otherwise, replace steering damper.
Binding	A	.....	Require replacement.
Damper body dented	A	.....	(1) Further inspection required.
Damper body punctured	A	.....	Require replacement.
Damping (none)	A	.....	Require replacement.
Dust boot (bellows) missing	2	.....	(2) Suggest replacement of boot.
Dust boot (bellows) split	2	.....	(2) Suggest replacement of boot.
Dust shield broken	2	.....	(2) Suggest replacement.
Dust shield missing	2	.....	(2) Suggest replacement.
Leaking oil, enough for fluid to be running down the body	A	.....	Require replacement.
Loose	A	..	Require repair or replacement.
Missing	C	.....	Require replacement.
Noise	2	.....	(3) Further inspection required.
Piston rod bent	A	.....	Require replacement.
Piston rod broken	A	.....	Require replacement.
Piston rod has surface defect	2	.....	Suggest replacement.
Piston rod threads stripped (threads missing)	A	.....	Require replacement.
Piston rod threads damaged	A	..	Require repair or replacement.
Seized	A	.....	Require replacement.

(1) - Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.
(2) - This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) - If noise is isolated to damper, suggest replacement.

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEAR (EXCEPT RACK AND PINION) INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Binding	A	Require repair or replacement
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	(1) Require flushing and refilling of the system.
Gasket leaking	A	Require repair or replacement of gasket.
Housing leaking	A	Require replacement.
Hydraulic fittings leaking	A	Require repair or replacement of fittings.
Inadequate power assist	A	(2) Further inspection required. See note below.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement of seal and/or mating part.
Splines damaged	A	Require repair or replacement of splines.
Splines stripped	A	Require replacement of splines.
Steering coupler shield cracked	2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.
U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

(1) - Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(2) - If steering gear is source of inadequate assist, require repair or replacement.

STEERING GEARS - RACK AND PINION

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS - RACK AND PINION INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Balance tube blocked	A	Require repair or replacement of balance tube.
Balance tube missing	C	Require replacement of balance tube.
Balance tube restricted	A	Require repair or replacement of balance tube.
Bellows boot clamp missing	C	Require replacement of clamp.
Bellows boot cracked (not through)	2	Suggest replacement of bellows boot.
Bellows boot missing	C	Require replacement of bellows boot.
Bellows boot not sealing	A	Require repair or replacement of bellows boot.
Bellows boot torn	A	Require replacement of bellows boot.
Bellows boot twisted		

(from toe adjustment)	B	Require repair.
Fitting leaking	A	Require repair or replacement.
Fitting missing	A	Require replacement of fitting.
Fitting threads damaged	A	Require repair or replacement of part with damaged threads.
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	(1) Require flushing and refilling of the system.
Gasket leaking	A	Require repair or replacement.
Hard steering on cold start-up	1	(2) Suggest repair or replacement.
Housing cracked, affecting structural integrity	B	Require replacement.
Housing leaking	A	Require replacement.
Inadequate power assist	A	(3) Further inspection required.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Steel line blocked	A	Require repair or replacement of line.
Steel line leaking	A	Require repair or replacement of line.
Steel line missing	C	Require replacement of line.
Steel line restricted	A	Require repair or replacement of line.
Steering coupler shield cracked	2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Steering coupler shield torn	2	Suggest replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.
U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

(1) - Determine and correct source of contamination. Follow OE

specifications for fluid type.
(2) - Indicates internal wear.
(3) - If steering gear is source of inadequate assist, require repair or replacement.

STEERING KNUCKLES

STEERING KNUCKLE INSPECTION

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Pinch bolt incorrect	B	Require replacement with bolt that meets OE design.
Pinch bolt loose	B	Require repair.
Pinch bolt missing	B	Require replacement.
Pinch bolt tabs deformed (pinched together), .032" or more before clamping	B	(1) Require replacement.
Taper hole elongated	A	(2) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

(1) - Steering knuckle deformation can cause pinch bolt breakage.
(2) - Check for damaged stud.

STRIKE OUT BUMPERS

STRIKE OUT BUMPER INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of

		broken part.
Attaching hardware corroded, affecting structural integrity ...	A	..... Require replacement of corroded part.
Attaching hardware loose	A	... Require repair or replacement of loose part.
Attaching hardware missing	C	..... Require replacement of missing part.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads.
Missing	C	..... Require replacement.
Split	1	..... Suggest replacement.

STRUT RODS

STRUT ROD INSPECTION

Condition	Code	Procedure
Adjusting nut seized	A	..... (1) Require repair or replacement.
Attaching hardware bent	B	... Require repair or replacement of bent part, if available; otherwise, replace strut rod.
Attaching hardware broken	A	... Require replacement of broken part, if available; otherwise, replace strut rod.
Attaching hardware incorrect	A	..... Require replacement of incorrect part, if available; otherwise, replace strut rod.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace strut rod.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace strut rod.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace strut rod.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace strut rod.
Attaching (mating) hole oversized	A	... Require repair or replacement

		of frame.
Attaching point on frame corroded, affecting structural integrity ...	A	..... Require repair of frame.
Bent	A	..... Require replacement.
Mating (attaching) hole oversized	A	... Require repair or replacement of frame.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

(1) - Only required if an alignment is being performed.

STRUT UPPER BEARING PLATE ASSEMBLIES

NOTE: When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.

STRUT UPPER BEARING PLATE ASSEMBLY INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	... Require replacement of broken part, if available; otherwise, replace bearing plate assembly.
Attaching hardware loose	A	... Require repair or replacement of loose part, if available; otherwise, replace bearing plate assembly.
Attaching hardware missing	C	.. Require replacement of missing part, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads damaged	A	... Require repair or replacement of part with damaged threads, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace bearing plate assembly.
Bearing axial or radial movement exceeds vehicle manufacturer's specifications	B	..... Require replacement of bearing.
Bearing binding	A	..... Require replacement of bearing.
Bearing missing	C	..... Require replacement of bearing.
Bearing seized	A	..... Require replacement of bearing.
Bent	B	..... Require replacement.
Holes distorted	A	..... Require replacement.

Missing	C	Require replacement.
Severely corroded, affecting structural integrity	A	Require replacement.

SWAY BAR LINKS

SWAY BAR LINK INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace link.
Ball and socket has looseness (perceptible vertical movement)	1	(1) Suggest replacement.
Ball and socket has looseness that is excessive	B	(1)(2) Require replacement.
Bent	B	Require replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	2	(3) Suggest replacement.
Grease boot missing	2	(4) Suggest replacement.
Grease boot torn	2	(5) Suggest replacement.
Missing	C	Require replacement.
Nut on stud loose	A	(6) Require repair.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.

(1) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

(2) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural

integrity.
(3) - Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) - Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) - Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

SWAY BARS

SWAY BAR INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace sway bar.
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace sway bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace sway bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace sway bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace sway bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace sway bar.
Bent	B	Require replacement.
Broken	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

TIE ROD ENDS (INNER AND OUTER)

TIE ROD END (INNER AND OUTER) INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace tie rod end.
Attaching hardware		

loose	A	Require repair or replacement of loose part, if available; otherwise, replace tie rod end.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace tie rod end.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace tie rod end.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace tie rod end.
Adjusting sleeve bent	B	Require replacement of sleeve or tie rod end.
Adjusting sleeve clamps out of position	B	Require repair.
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve or tie rod end.
Adjusting sleeve missing	C	Require replacement of sleeve or tie rod end.
Adjusting sleeve seized	A	(1) Require repair or replacement.
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve or tie rod end.
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve or tie rod end.
Binding	A	(2) Further inspection required.
Grease boot cracked	2	(3) Suggest replacement.
Grease boot missing	2	(4) Suggest replacement.
Grease boot torn	2	(5) Suggest replacement.
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	2	(4) Suggest replacement of seal.
Grease seal torn	2	(5) Suggest replacement of seal.
Greaseable tie rod end won't take grease	2	(6) Suggest replacement of grease fitting.
Looseness (perceptible horizontal movement)	1	(7) Suggest replacement.
Looseness exceeds manufacturer's specifications	B	Require replacement.

Looseness that is excessive	B	(7)(8) Require replacement.
Nut on stud loose	A	(9) Require repair or replacement of nut.
Seized	A	Require replacement
Stud bent	B	(10) Require replacement.
Stud broken	A	(10) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(10) Require replacement.

(1) - Only required if toe needs to be adjusted.
(2) - If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(3) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(5) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(6) - If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.
(7) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(8) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) - Check for bent stud or damaged taper hole.
(10) - Check for damaged taper hole.

TRACK BARS

TRACK BAR INSPECTION

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace track bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace track bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace track bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace track bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace track bar.

Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	2	(1) Suggest replacement.
Grease boot missing	2	(2) Suggest replacement.
Grease boot torn	2	(3) Suggest replacement.
Holes distorted	A	Require replacement.
Looseness (perceptible horizontal movement)	1	(4) Suggest replacement.
Looseness that is excessive	B	(4)(5) Require replacement.
Nut on stud loose	A	(6) Require repair or replacement of nut.
Seized	A	Require replacement.
Stud bent	B	(7) Require replacement.
Stud broken	A	(7) Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	(7) Require replacement.
Wear exceeds manufacturer's specifications	B	Require replacement.

(1) - Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(2) - Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(3) - Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(4) - If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.
(5) - Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(6) - Check for bent stud or damaged taper hole.
(7) - Check for damaged taper hole.

TRAILING ARMS

TRAILING ARM INSPECTION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace trailing arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace trailing arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace trailing arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise,

		replace trailing arm.
Attaching hardware threads stripped (threads missing)	A	..... Require replacement of part with stripped threads, if available; otherwise, replace trailing arm.
Bent	B	..... Require replacement.
Bushing hole oversized ..	B	..... Require replacement.
Corroded, affecting structural integrity ...	A	..... Require replacement.
Holes distorted	A	..... Require replacement.
Threads damaged	A	.. Require repair or replacement.
Threads stripped (threads missing)	A	..... Require replacement.

WHEEL BEARINGS, RACES AND SEALS

NOTE: When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

WHEEL BEARING, RACE AND SEAL INSPECTION

Condition	Code	Procedure
Rear axle seal on rear-wheel drive leaking	A	..... Require replacement of seal and inspection of axle, bearing, housing, and vent tube.
Seal bent	1	..... Suggest replacement.
Seal leaking	A	. Require replacement of seal and inspection of bearings.
Seal missing	C	..... Require replacement.
Seal torn	A	..... Require replacement.
Wheel bearing assembly feels rough when rotated	A	.. Require replacement of bearing assembly.
Wheel bearing balls are pitted	A	.. Require replacement of bearing assembly.
Wheel bearing balls are worn	A	.. Require replacement of bearing assembly.
Wheel bearing end-play exceeds vehicle manufacturer's specifications	B	.. Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	A	..... Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	A	.. Require replacement of bearing

			assembly.
Wheel bearing races are worn	A	..	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	A	..	Require replacement of bearing assembly.
Wheel bearing rollers are worn	A	..	Require replacement of bearing assembly.

WHEEL ALIGNMENT

WHEEL ALIGNMENT

Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to OEM specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment.

Failure to replace or correct suggested parts or service may prevent a proper alignment.

Before performing an alignment check, inspect and verify the following:

* Tire pressure and size
* Vehicle loading
* Ride height
* Steering and suspension parts

If the inspection reveals that all the above are within published specifications, a wheel alignment check and an alignment, if needed, may be performed.

CAUTION: Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer, for example, Ford forged twin "I" beam axles. All measurements and specifications must be noted on the inspection report.

WHEEL ALIGNMENT INSPECTION

Condition	Code	Procedure
Dog tracking, shown to be caused by faulty alignment	2	..... Suggest repair.
Lead, shown to be caused by faulty alignment	A	..... Require alignment.
Part has been changed, affecting alignment	A	..... Require alignment check.
Pull, shown to be caused by faulty alignment	A	..... Require alignment.
Steering wheel off-center	2	..... Suggest alignment.
Tire wear, shown to be caused by		

faulty alignment	A	.....	Require alignment.
Wander, shown to be caused by faulty alignment	A	.....	Require alignment.

WHEELS AND TIRES

TIRES

These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

WARNING: High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death.

WARNING: Only specially trained persons should dismount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death.

WARNING: Consult the vehicle owner’s manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. DO NOT exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association

WARNING: When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. DO NOT mix different speed rating designations on the same axle.

WARNING: DO NOT mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule.

WARNING: DO NOT mix size or type (all season, performance, mud and snow) of tires on the same axle.

TIRE INSPECTION

Condition	Code	Procedure
Air pressure incorrect ..	B	..... Require repair
Bead broken	A	..... Require replacement.
Bead leaking, caused by tire	A	.. Require repair or replacement.
Bead wire/cord exposed ..	A	..... Require replacement.
Cord or belt material exposed	A	..... Require replacement.
Cord ply separations	A	..... Require replacement.

Directional/asymmetrical tires mounted incorrectly	B	.....	Require remounting and/or repositioning.
Irregular tread wear, affecting performance	2	.....	(1) Suggest replacement.
Load ratings less than OEM specifications	B	.....	Require replacement.
Mixed tread types (all season, performance, mud and snow) on same axle	A	.....	Require replacement.
Number of punctures exceeds manufacturer's limit	B	.....	Require replacement.
Out of balance	B	.	Require rebalance of tire/wheel assembly.
Ply separation	A	.....	Require replacement.
Pull or lead, caused by tire	A	..	Require repair or replacement.
Radial and bias or bias-belted ply tires on same axle	B	..	Require repair or replacement.
Radials are on the front and not on the rear	B	.....	(2) Require repair or replacement.
Run flat damage	A	.....	Require replacement.
Shoulder cut	A	.....	Require replacement.
Shoulder puncture	A	.....	Require replacement.
Shoulder with plug	A	.....	Require replacement.
Sidewall bulge	A	.....	Require replacement.
Sidewall cut	A	.....	Require replacement.
Sidewall indentation	..	.....	No service required or suggested.
Sidewall puncture	A	.....	Require replacement.
Sidewall with plug	A	.....	Require replacement.
Speed rating designations different on same axle	2	..	Suggest repair or replacement.
Tire and wheel assembly has excessive run-out	B	.....	(3) Require repair or replacement of appropriate part.
Tires with more than 1/4" diameter difference on a four-wheel drive vehicle	B	.....	Require replacement.
Tread area puncture larger in diameter than manufacturer's specifications	B	.....	Require replacement.
Tread missing pieces (chunking), exposing cord	A	.....	Require replacement.
Tread missing pieces (chunking), not exposing cord	1	.....	Suggest replacement.
Tread separations	A	.....	Require replacement.
Tube in tubeless tire	3	....	(4) Suggest removal of tube.
Weather-checking	..	.....	No service required or suggested.
Worn to tread wear			

indicators ..... B ..... Require replacement.

(1) - Determine and correct cause of irregular tire wear.
(2) - If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.
(3) - Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.
(4) - Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and/or wheel listed in these guidelines.

VALVE STEMS

VALVE STEM INSPECTION

Condition	Code	Procedure
Bent	1	Suggest replacement.
Broken	A	Require replacement.
Cut, but not leaking	1	Suggest replacement.
Deteriorated (cracking, dry rot)	1	Suggest replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped	A	Require replacement.
Valve cap missing	C	Require replacement of cap.
Weather-checking	1	Suggest replacement.
Won't take air	A	Require repair or replacement.

WHEEL ATTACHMENT HARDWARE

For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHMENT HARDWARE INSPECTION

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	(1) Require replacement.
Loose	B	Require repair or replacement of affected component.
Lug nut installed backward	B	Require repair or replacement.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut rounded	A	(2) Require replacement of nut.
Lug nut seized	A	(2) Require replacement of nut.

Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.
Threads stripped	A	Require replacement of component with stripped threads.

(1) - Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) - Only required if removing wheel.

WHEELS (RIMS)

WARNING: Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

WHEEL (RIM) INSPECTION

Condition	Code	Procedure
Bead leaking, caused by wheel	A	(1) Require repair or replacement.
Bent hub mounting surface	A	Require replacement.
Bent rim, causing vibration	2	(1) Suggest replacement.
Broken	A	Require replacement.
Cast wheel porous, causing a leak	A	Require repair or replacement.
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement.
Corrosion, affecting structural integrity	A	Require replacement.
Corrosion build-up on wheel mounting surface	A	Require repair.
Cracked	A	Require replacement.
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning.
Load capacity less than OEM specifications	B	Require replacement.
Offset mismatched on same axle	B	Require replacement.
Rivets leaking	A	Require replacement.
Run-out beyond OEM specs	B	Require replacement.
Stud holes elongated	A	(2) Require replacement.
Welded or brazed repair	2	Suggest replacement.

Welds leaking	A		Require replacement.
Wheel centering (pilot) hole incorrect	B		Require replacement.

(1) - CAUTION: DO NOT attempt to correct a bent rim.
(2) - Inspect wheel attaching hardware for damage.

* SYMPTOM CHECK LIST *

1999 Lexus RX 300

SYMPTOM CHECK LIST WORKSHEETS

* PLEASE READ THIS FIRST *

NOTE: This article is intended for general information purposes only. It does not apply specifically to one make or model.

PURPOSE

Why Use the Symptom Check List Worksheets?

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

* Reduce "No Trouble Found" problems
* Increase customer involvement
* Customer perceive that "they really care and listen"
* Save time during peak write-up periods
* Reduce recontacting customers for additional information
* Improve night drop information
* Insure all the right questions are asked at write-up

Making the Worksheets a Part of Your Normal Routine

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

* HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
* Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
* Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
* Make sure it is attached to the hard copy when it goes to the technician.
* Place a copy with the final repair papers and review it with the customer at delivery.
* Put a new worksheet in the glovebox of all departing customers.
* Require that you personally see a copy of all worksheets filled out for shop comebacks.
* Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

SYMPTOM CHECK LIST WORKSHEETS

CONDENSED VERSION - ALL ON ONE PAGE

NOTE: Have the service adviser fill out this form with the customer whenever possible.

DRIVEABILITY WORKSHEET

(To Be Filled Out By Vehicle Owner)

Name: _____ **Date:** _____ **Make:** _____

Model: _____ **Year:** _____ **Engine:** _____ **Mileage:** _____

FAULT CHARACTERISTICS – SYMPTOMS – DESCRIPTION OF PROBLEM (Please Check All That Apply In All Categories)

Starting Problems	☐ Will Not Crank ☐ Cranks, But Won't Start ☐ Starts, But Takes A Long Time
Engine Quits/ Running Problems	**Quits:** ☐ Right After Starting ☐ When Put Into Gear ☐ Right After Vehicle Comes To A Stop ☐ During Steady Speed Driving ☐ While Idling ☐ During Acceleration ☐ When Parking
Poor Idling Conditions	**Idle Speed:** ☐ Is Too Slow At All Times ☐ Is Too Slow With A/C On ☐ Is Too Fast ☐ Is Rough Or Uneven ☐ Fluctuates Up and Down
Poor Running Conditions	☐ Runs Rough ☐ Lacks Power ☐ Hesitates Or Stumbles On Acceleration ☐ Bucks and Jerks ☐ Engine Knocks, Pings, Rattles ☐ Backfires ☐ Poor Fuel Economy ☐ Misfires or Cuts Out ☐ Surges and/or Chuggles ☐ Dieseling or Run-On ☐ Engine Light Always On ☐ Engine Light On Sometimes ☐ Fuel, Gas, or Sulfur Smell
Auto. Transmission Problems	☐ Improper Shifting (early/late) ☐ Changes Gear Randomly On Its Own ☐ Vehicle Does Not Move When In Gear
Poor Handling	☐ Pulls To One Side ☐ Hard Steering ☐ Vehicle Shakes and/or Vibrates While Moving
Noise Problems	**Explain:**
Odor Problems	**Explain:**
Problem Frequency	☐ Always ☐ Often ☐ Occasionally
Usually Occurs	☐ Morning ☐ Afternoon ☐ Anytime
Engine Temp.	☐ Cold ☐ Warm ☐ Hot
Vehicle Speed	☐ Low ☐ Cruising ☐ High
Driving Conditions During Occurrence	☐ Short – Less Than 2 Miles ☐ 2-10 Miles ☐ Long – More Than 10 Miles ☐ Stop & Go ☐ While Turning ☐ While Braking ☐ At Gear Engagement ☐ With A/C Operating ☐ With Headlights On ☐ During Acceleration ☐ During Deceleration ☐ Mostly Downhill ☐ Mostly Uphill ☐ Mostly Level ☐ Mostly Curvy ☐ Rough Road
Driving Habits	☐ Drive Hard Before Engine Is Warmed ☐ Allow Engine To Warm ☐ Mostly City Driving ☐ Highway ☐ Park Vehicle Inside ☐ Outside **Drive Per Day:** ☐ Less Than 10 Miles ☐ 10-50 ☐ More Than 50 **Fuel Octane:** ☐ 87 ☐ 89 ☐ 91 ☐ More Than 91 **Brand:** _____ ☐ Gasohol ☐ Propane Conversion
Outside Weather	☐ Cold ☐ Warm ☐ Hot ☐ Wet/Rainy ☐ Fog ☐ Snow/Hail ☐ Dust/Dirt ☐ Dry ☐ Humid

Fig. 1: Entire Vehicle – Symptom Check List For Customer

FULL VERSION - ALL ON FOUR PAGES

NOTE: Have the service adviser fill out these forms with the

customer whenever possible.

Dear Valued Customer:
Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO.:**

DIAGNOSTIC WORKSHEET

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/"Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Pings, detonates
- ☐ Suphur, rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

EXPLAIN: _____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)

- ☐ Always ☐ Few seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ___ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0 degrees F ☐ Cold - 0 to 32 degrees F
- ☐ Cool - 32 to 60 degrees F ☐ Warm - 60 to 80 degrees F
- ☐ Hot - Above 80 degrees F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/Ice ☐ Wet roads ☐ Other (explain below)

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising steady at _____ MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between _____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?** _____

- ☐ Regular UL ☐ Mid range UL ☐ Premium Unleaded
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Rev/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

50G15061

Fig. 2: Symptom Check List - Page 1

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

- ☐ Knocks
- ☐ Hard metal
- ☐ Light metal
- ☐ Roars
- ☐ Ticking
- ☐ Whine
- ☐ Squeaks
- ☐ Rattles
- ☐ Scraping
- ☐ Other _____

HOW OFTEN DOES IT OCCUR?

- ☐ Continuous
- ☐ Often
- ☐ Intermittent
- ☐ Just started
- ☐ Since new

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Speed
- ☐ RPM
- ☐ Only moving
- ☐ On turns
- ☐ Braking
- ☐ Hard throttle
- ☐ Light throttle
- ☐ Decelerate
- ☐ Steady speed
- ☐ Idle in gear
- ☐ Idle out of gear
- ☐ Hot days
- ☐ Cold days
- ☐ Humid or rainy
- ☐ Temperature _____
- ☐ Heavy bumps
- ☐ Light bumps
- ☐ Smooth pavement

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:

VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15062

Fig. 3: Symptom Check List - Page 2

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner ☐ Heater ☐ Defroster ☐ Vent ☐ Bi-Level ☐ Fan/blower
☐ Max A/C ☐ Automatic Temperature Control ☐ Mix/blend ☐ Economy ☐ All

SYMPTOM

☐ Does not work ☐ Blows wrong temperature air ☐ No air comes out of vents ☐ Rapid cycling
☐ Noisy (explain) ☐ Broken ☐ Odor ☐ Air comes from wrong outlets ☐ Blows fuse
☐ Leaks ☐ Insufficient heat or cool ☐ Other (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Intermittent ☐ Right after startup
☐ When change controls only ☐ Other (explain below) ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

_____

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
WHEN DOES IT OCCUR? ☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____

_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15063

Fig. 4: Symptom Check List - Page 3

WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into____ gear
☐ Noisy when in _____ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): _____
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____
☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

EXPLAIN: _____

COMMENTS:

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15064
Fig. 5: Symptom Check List - Page 4

INDIVIDUAL SYSTEM-BASED CHECK LISTS

NOTE: Have the service adviser fill out these forms with the customer whenever possible.

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Ping, detonates
- ☐ Sulphur/rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into next gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

EXPLAIN: _____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)

- ☐ Always ☐ Few Seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ____ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0°F ☐ Cold - 0 to 32°F
- ☐ Cool - 32 to 60°F ☐ Warm - 60 to 80°F
- ☐ Hot - above 80°F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/Ice ☐ Wet roads
- ☐ Other (explain): _____

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising - steady at MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between ____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?**

- ☐ Regular UL ☐ Midrange UL ☐ Premium UL
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Reverse/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15054

Fig. 6: Engine Driveability & Automatic Transmission

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50C15059

Fig. 7: Brakes, Steering, & Suspension

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

- ☐ Air conditioner
- ☐ Heater
- ☐ Defroster
- ☐ Vent
- ☐ Bi-Level
- ☐ Fan/blower
- ☐ Max A/C
- ☐ Automatic Temperature Control
- ☐ Mix/blend
- ☐ Economy
- ☐ All

SYMPTOM

- ☐ Does not work
- ☐ Blows wrong temperature air
- ☐ No air comes out of vents
- ☐ Rapid cycling
- ☐ Noisy (explain)
- ☐ Broken
- ☐ Odor
- ☐ Air comes from wrong outlets
- ☐ Blows fuse
- ☐ Leaks
- ☐ Insufficient heat or cool
- ☐ Other (explain below)

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Hot
- ☐ Cold
- ☐ Intermittent
- ☐ Right after startup
- ☐ When change controls only
- ☐ Other (explain below)
- ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50A15057

Fig. 8: Air Conditioning, Heater & Ventilation

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50B15058
Fig. 9: Electrical, Radio & Tape/CD Player

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into_____ gear
☐ Noisy when in _____ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): _____
_____
_____
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____
_____
_____
☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

EXPLAIN: _____
_____
_____
_____
_____
_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15056

Fig. 10: Manual Transmission & Clutch

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

☐ Knocks	☐ Hard metal	☐ Light metal	☐ Roars	☐ Ticking	☐ Whine
☐ Squeaks	☐ Rattles	☐ Scraping	☐ Other _____		

HOW OFTEN DOES IT OCCUR?

☐ Continuous ☐ Often ☐ Intermittent ☐ Just started ☐ Since new

WHEN DOES IT OCCUR?

☐ All the time	☐ Speed	☐ RPM	☐ Only moving	☐ On turns	☐ Braking
☐ Hard throttle	☐ Light throttle	☐ Decelerate	☐ Steady speed	☐ Idle in gear	☐ Idle out of gear
☐ Hot days	☐ Cold days	☐ Humid or rainy	☐ Temperature _____		
☐ Heavy bumps	☐ Light bumps	☐ Smooth pavement			

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50F15060

Fig. 11: Squeak, Rattle, & Noise Conditions

WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level	☐ Any time it rains	☐ While driving in the rain	☐ Car wash only
☐ Back lower than front (facing uphill)		☐ Front lower than back (facing downhill)	

Location of Leak (where water appears):

☐ LF Door	☐ RF Door	☐ LR Door	☐ RR Door	☐ Windshield	☐ Rear window
☐ LF window	☐ RF window	☐ LR window	☐ RR window	☐ Side door	☐ Sunroof/T-Top
☐ Under instrument panel			☐ Rear door/rear hatch		

WINDNOISE:
Location:

☐ LF Door	☐ RF Door	☐ LR Door	☐ RR Door	☐ Windshield	☐ Rear window
☐ LF window	☐ RF window	☐ LR window	☐ RR window	☐ Side door	☐ Sunroof/T-Top
☐ Under instrument panel			☐ Rear door/rear hatch		

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15055

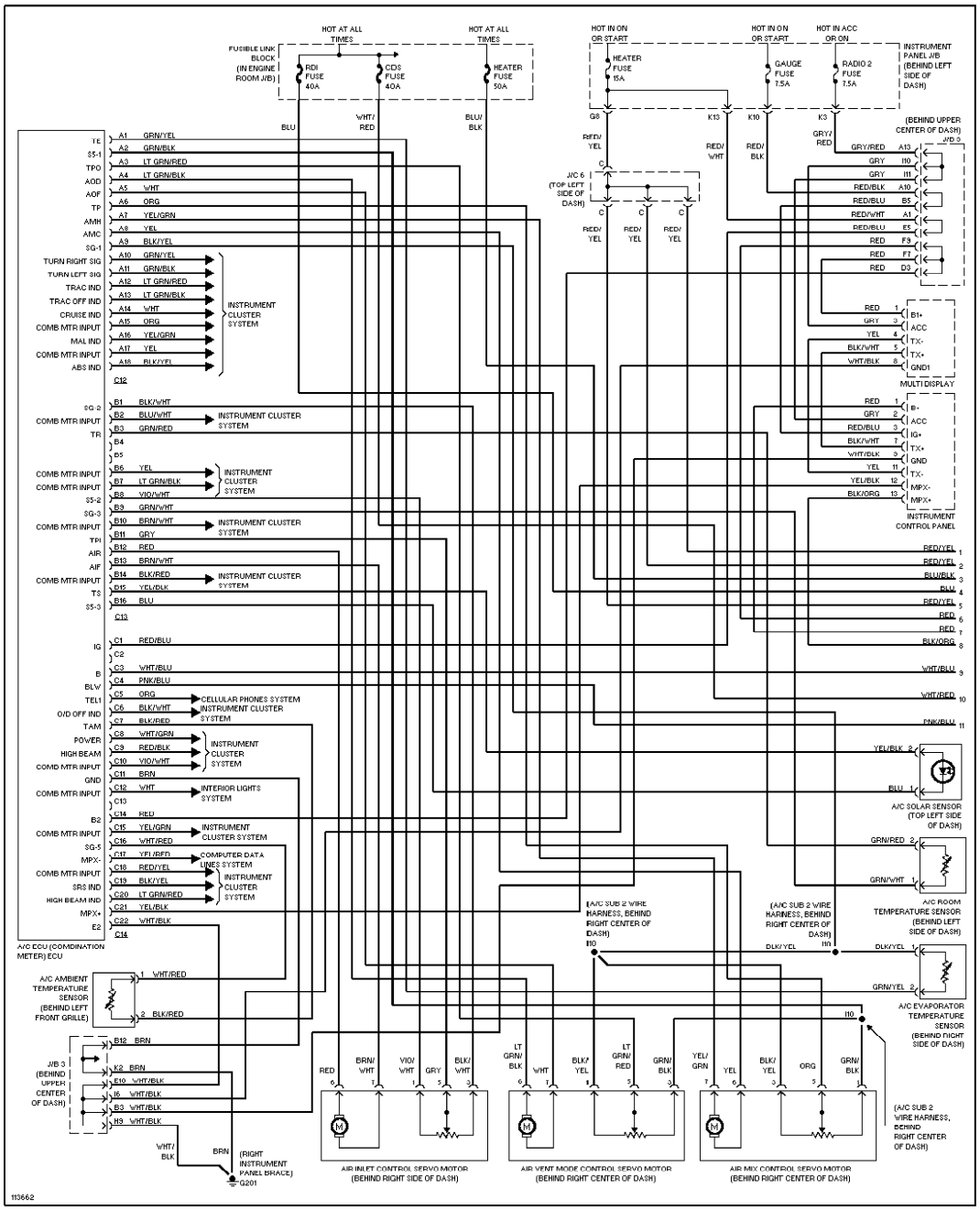
Fig. 12: Water Leak & Wind Noise

SYSTEM WIRING DIAGRAMS

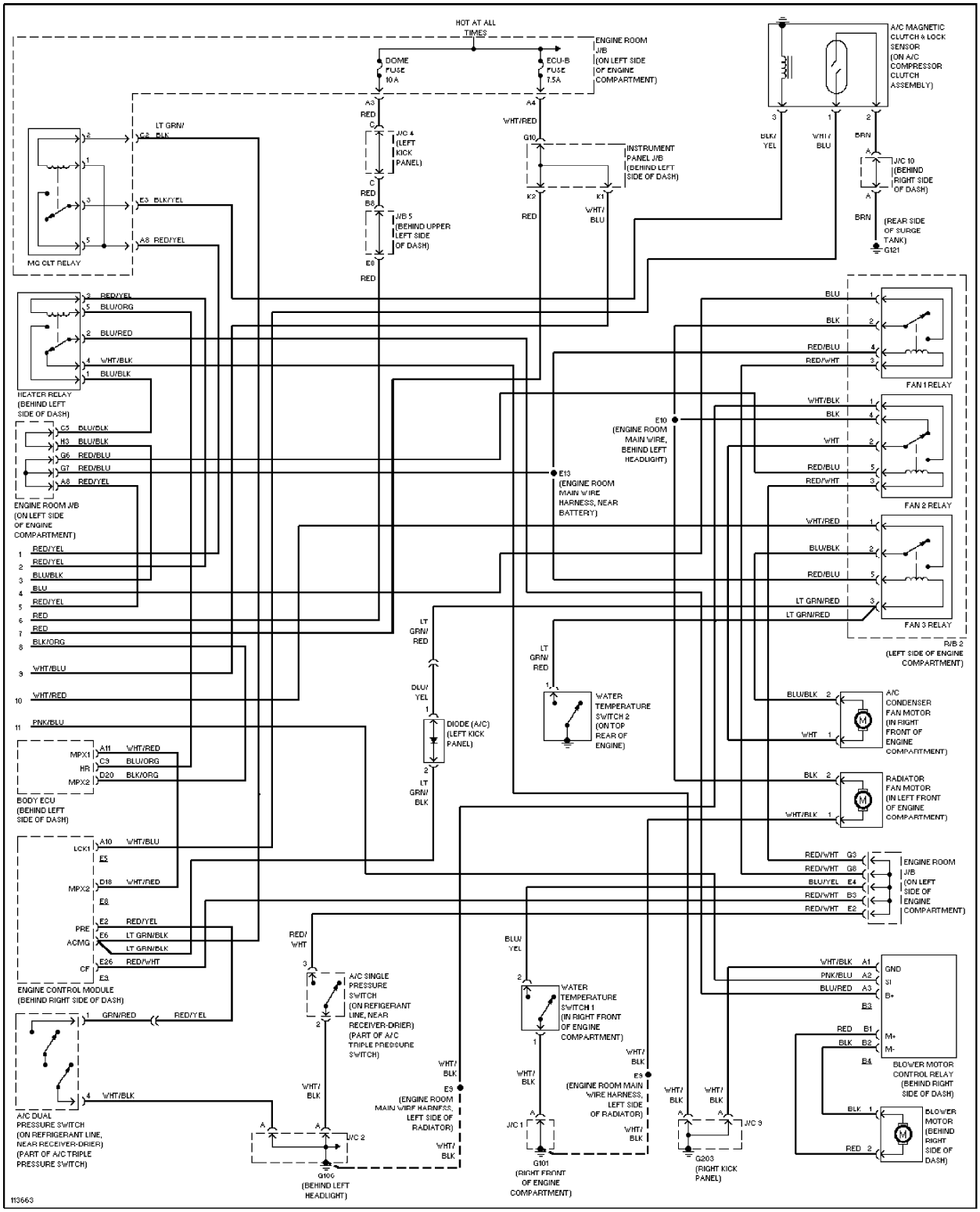
1999 Lexus RX 300

1999 System Wiring Diagrams
Lexus - RX 300

AIR CONDITIONING

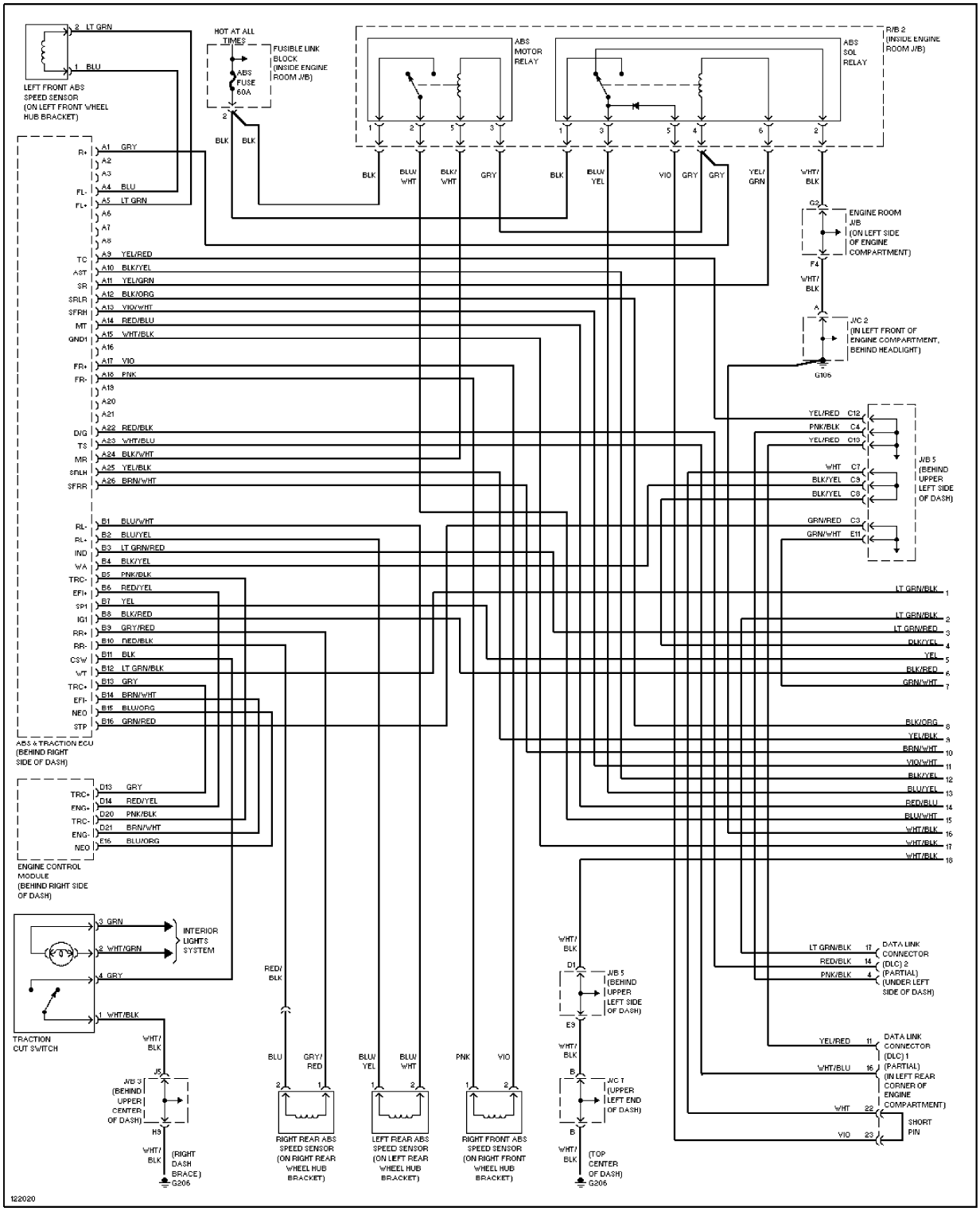


Automatic A/C Circuit (1 of 2)

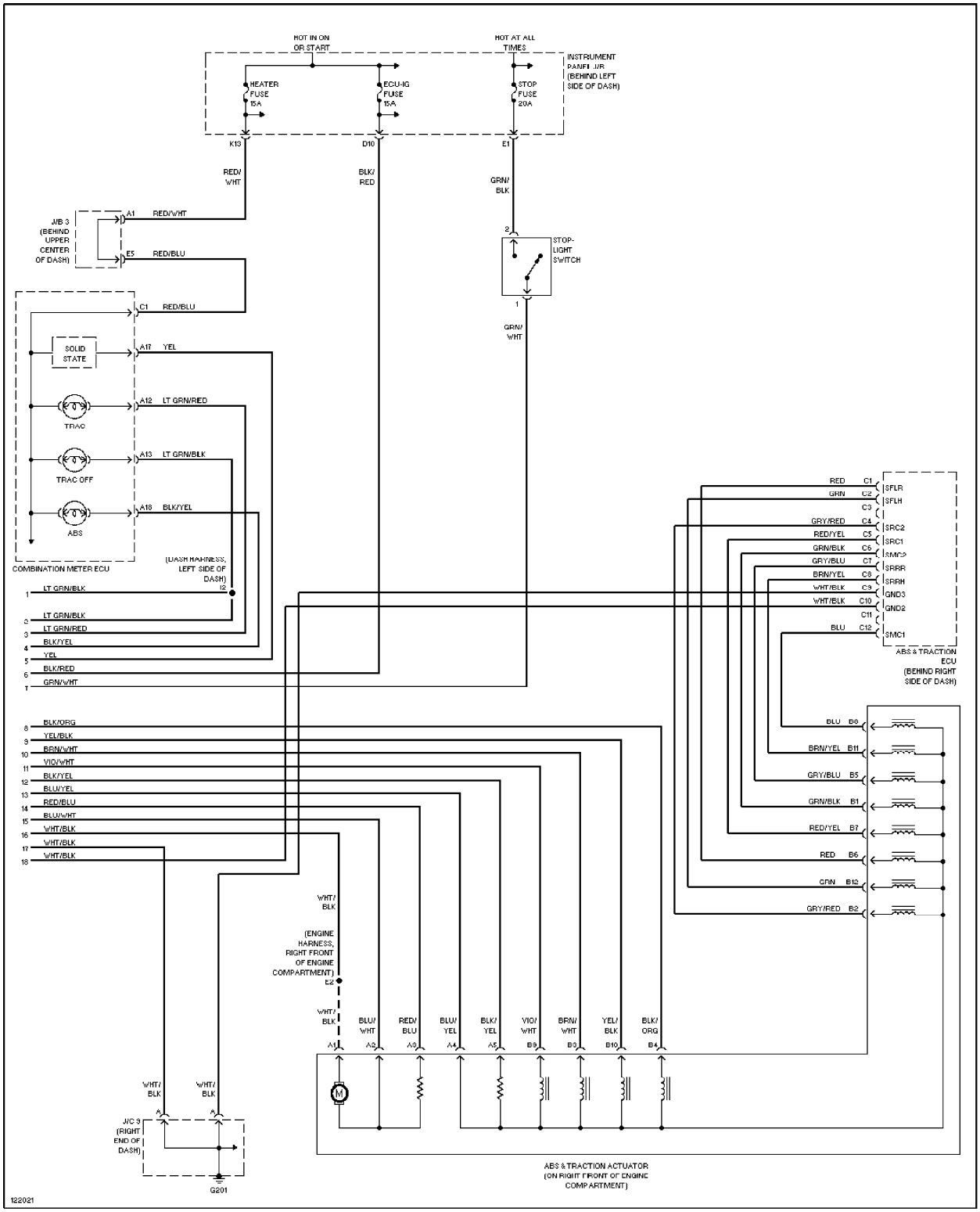


Automatic A/C Circuit (2 of 2)

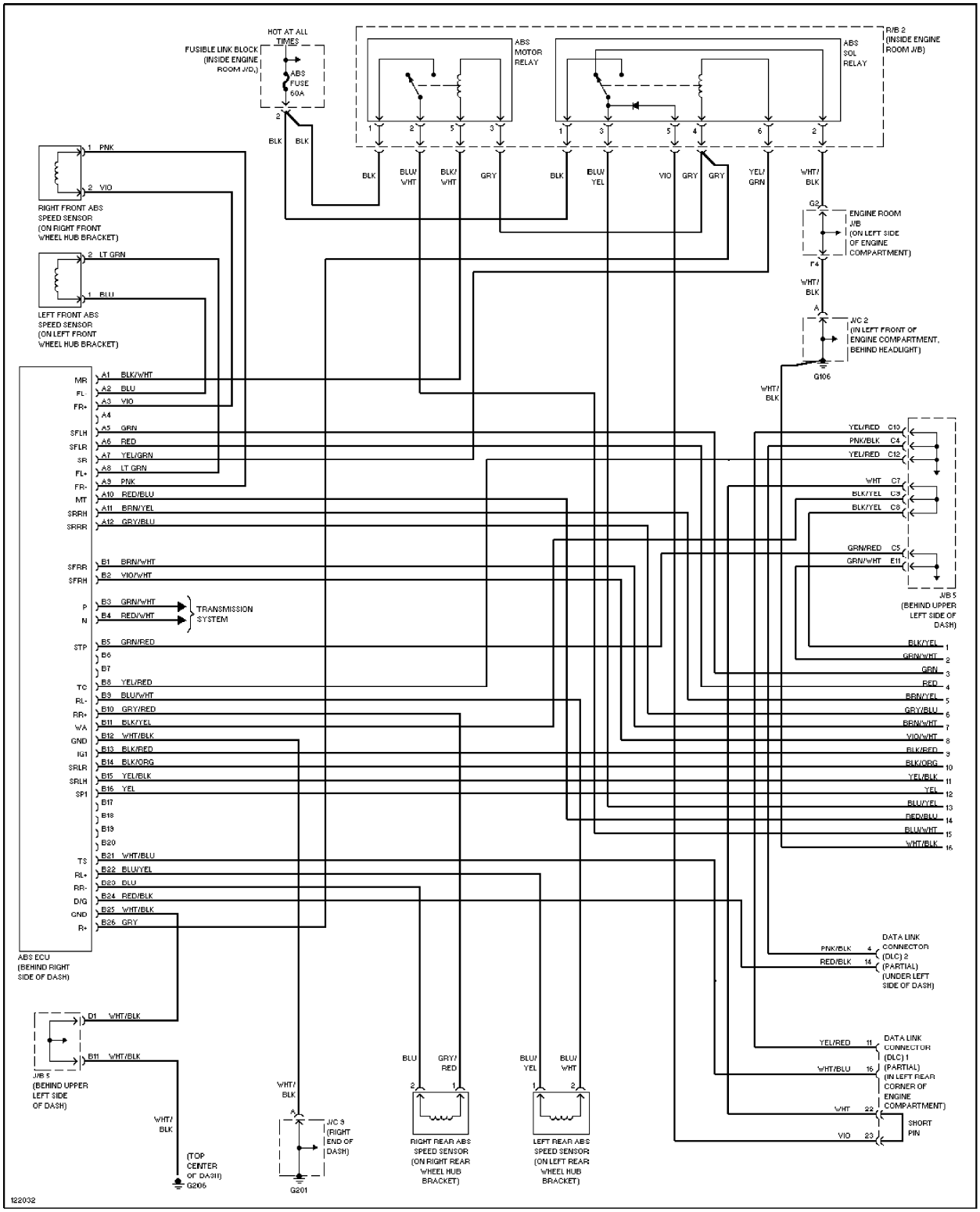
ANTI-LOCK BRAKES



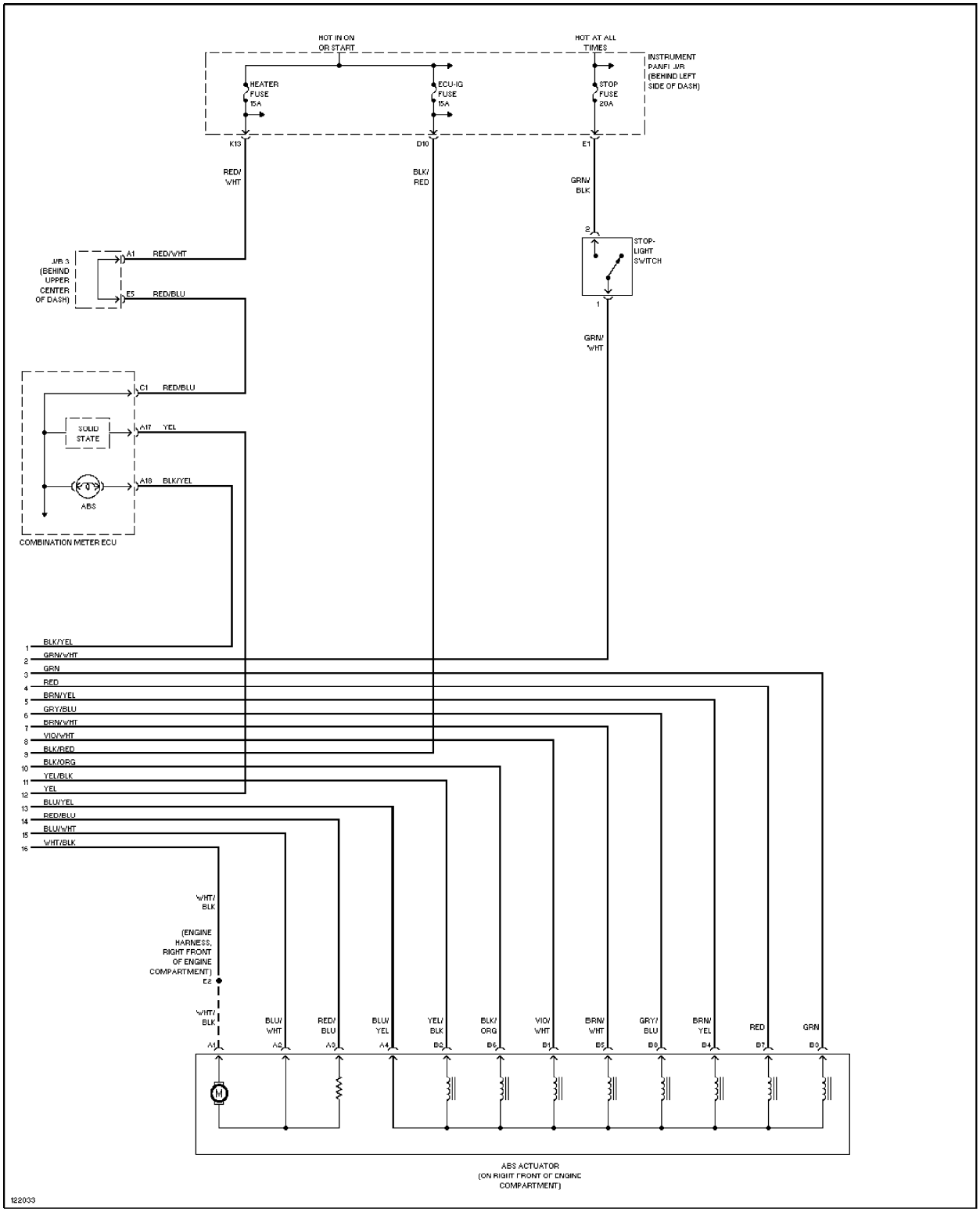
Anti-lock Brake Circuits, W/ Traction Control (1 of 2)



Anti-lock Brake Circuits, W/ Traction Control (2 of 2)

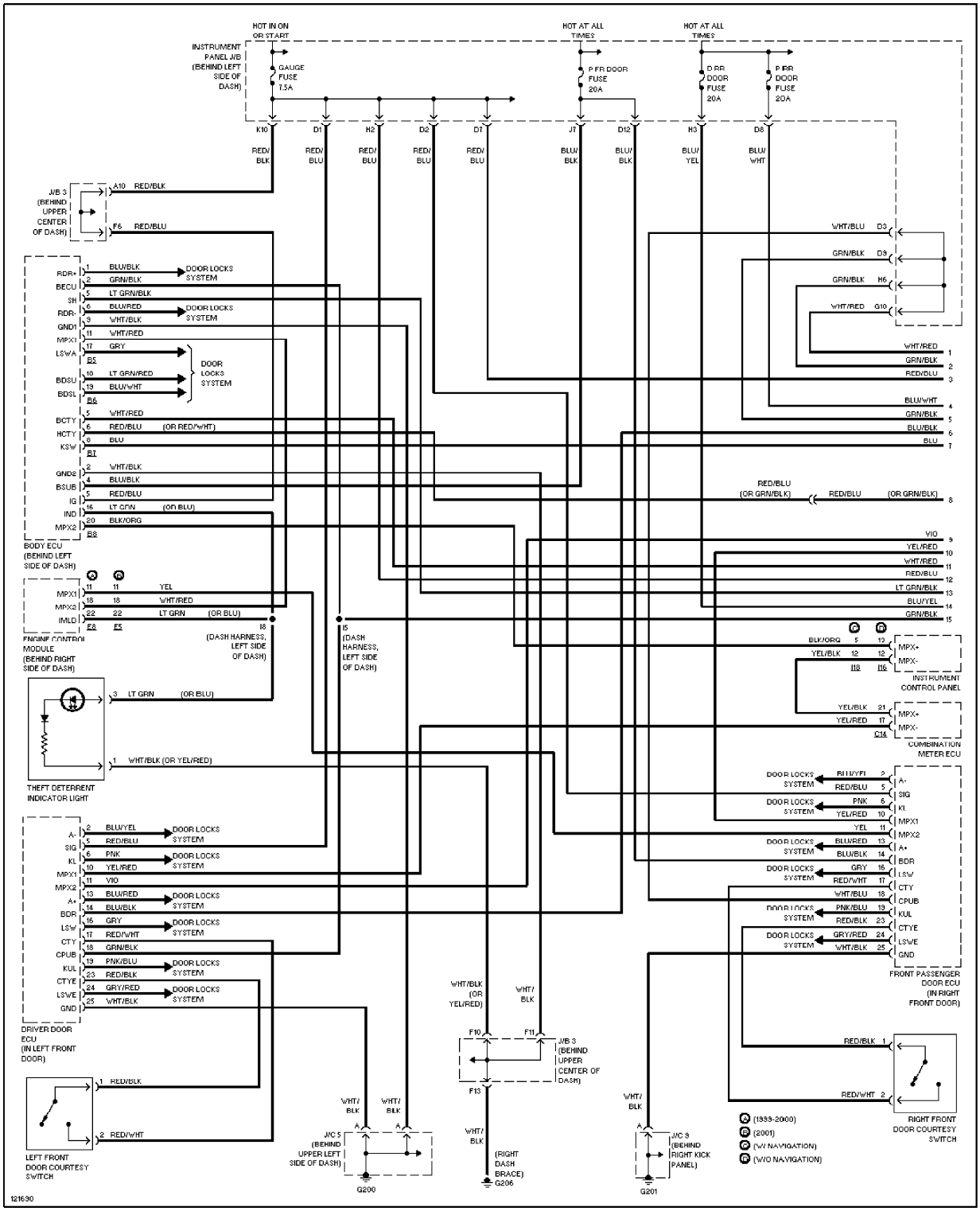


Anti-lock Brake Circuits, W/O Traction Control (1 of 2)

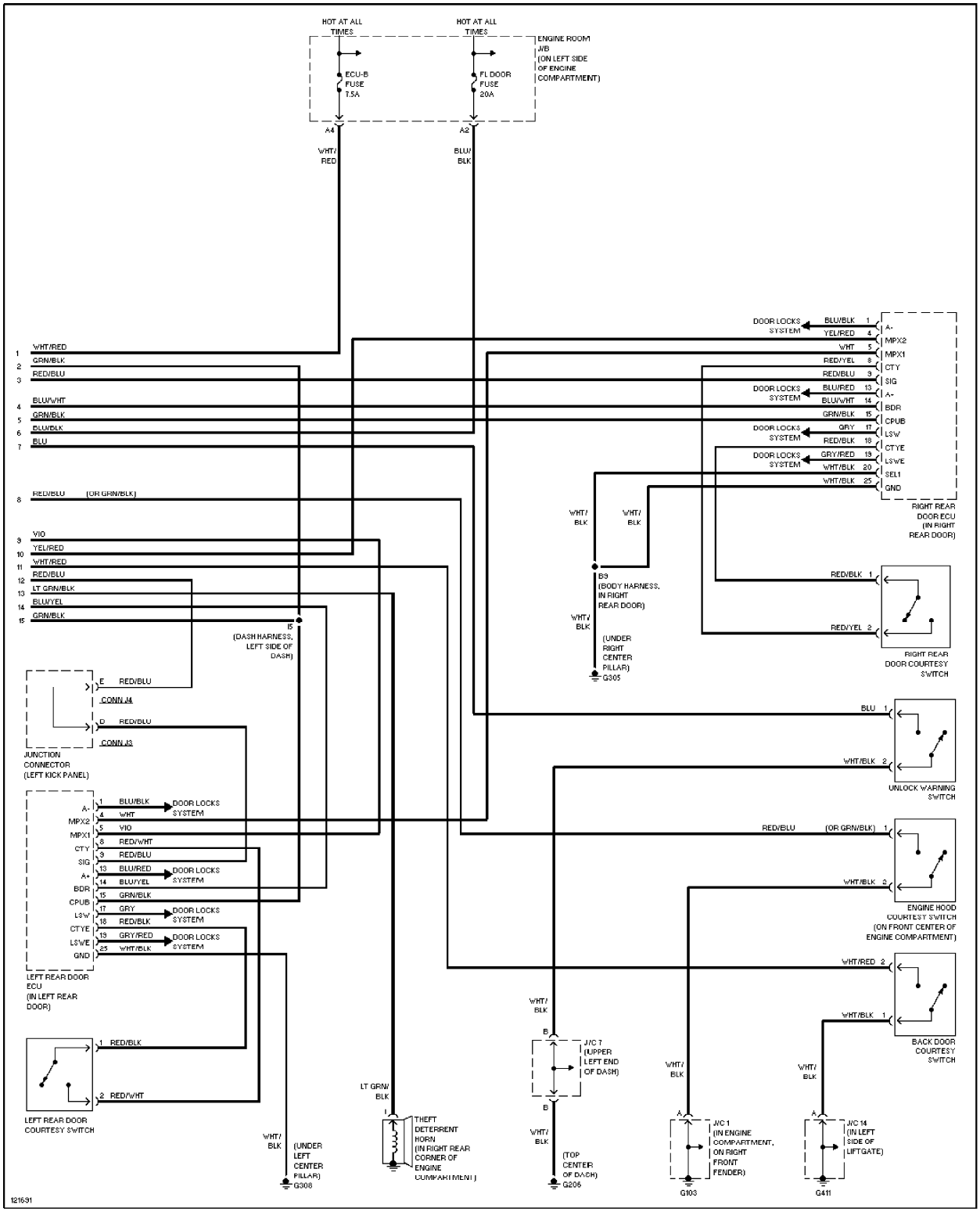


Anti-lock Brake Circuits, W/O Traction Control (2 of 2)

ANTI-THEFT

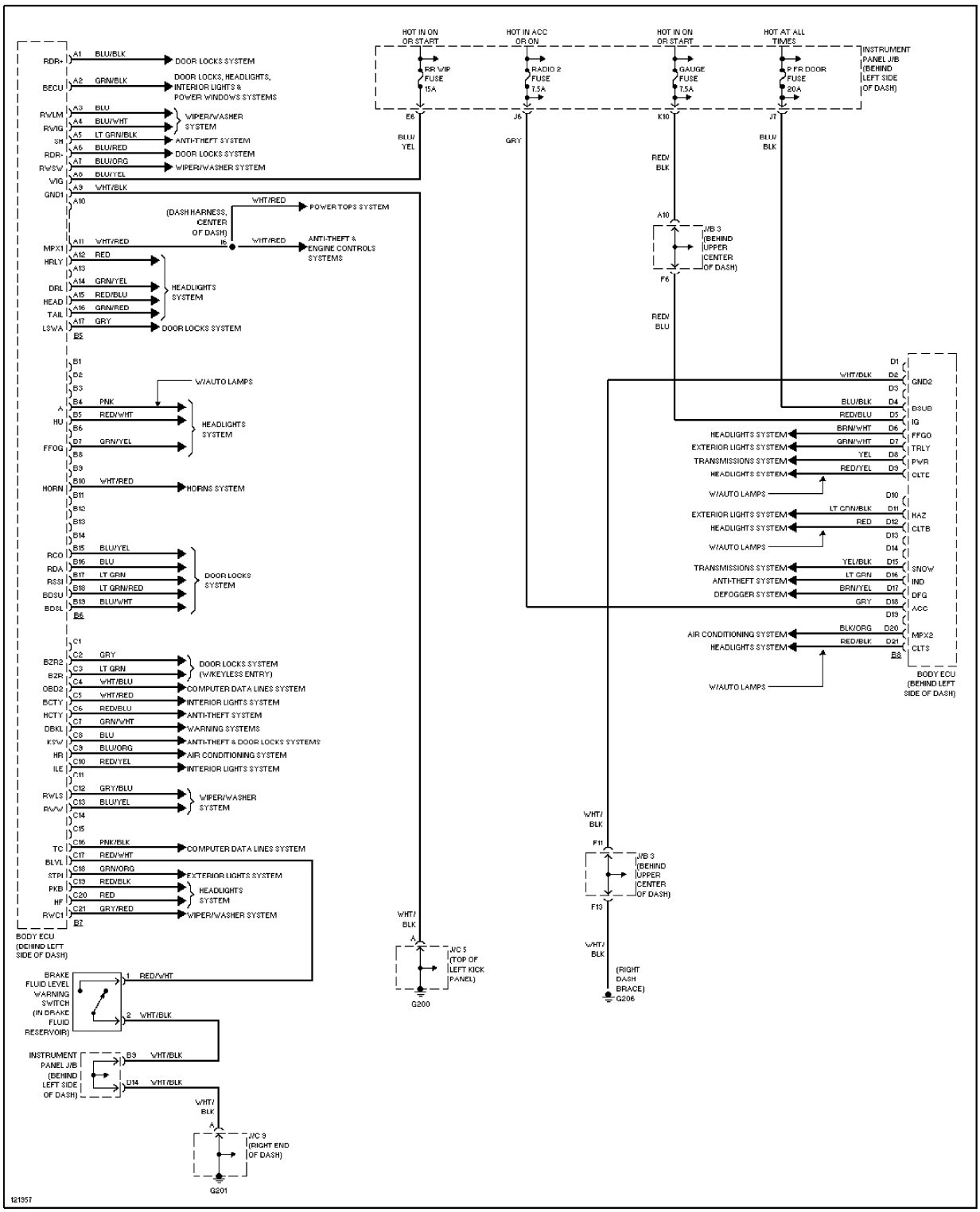


Anti-theft Circuit (1 of 2)



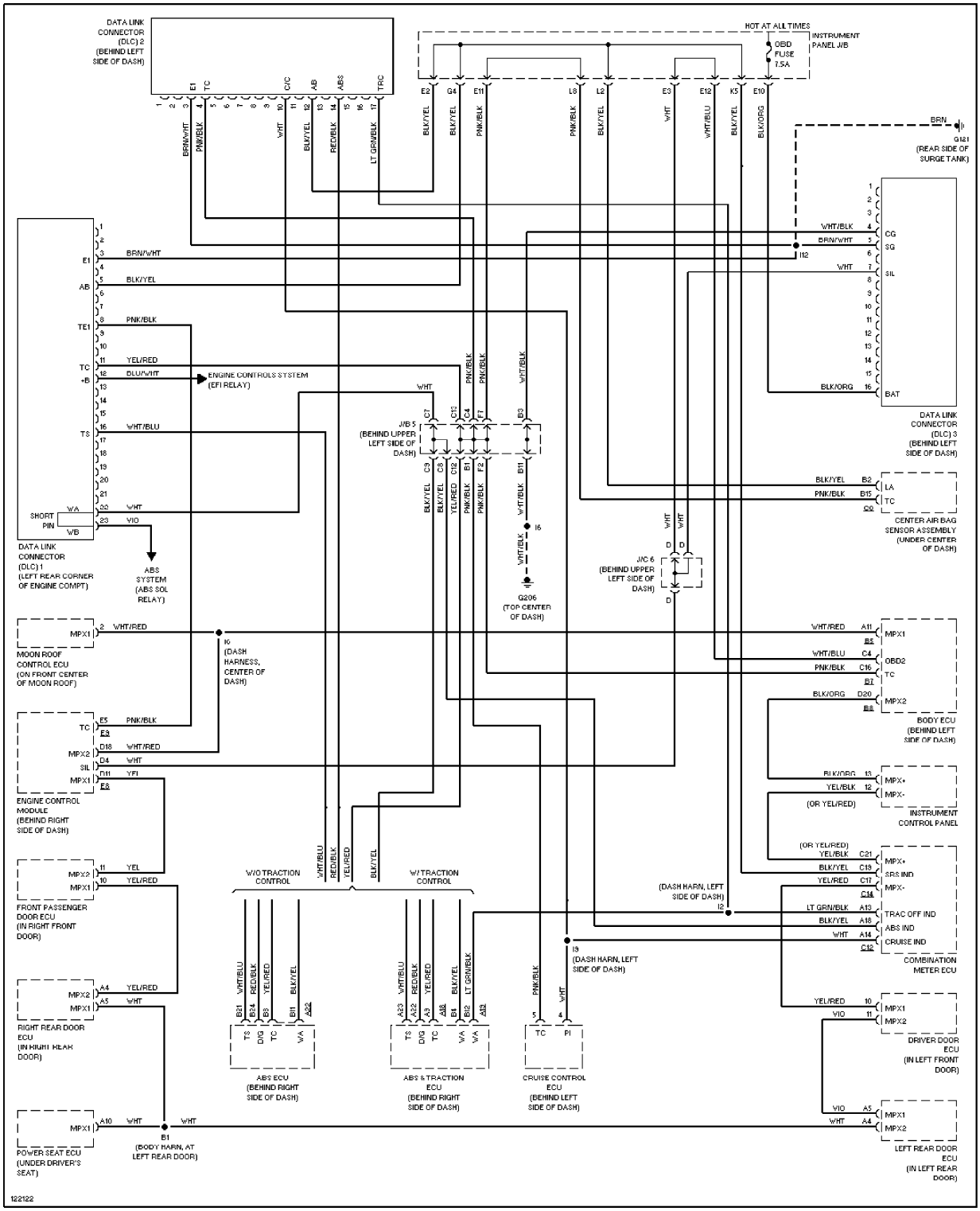
Anti-theft Circuit (2 of 2)

BODY COMPUTER



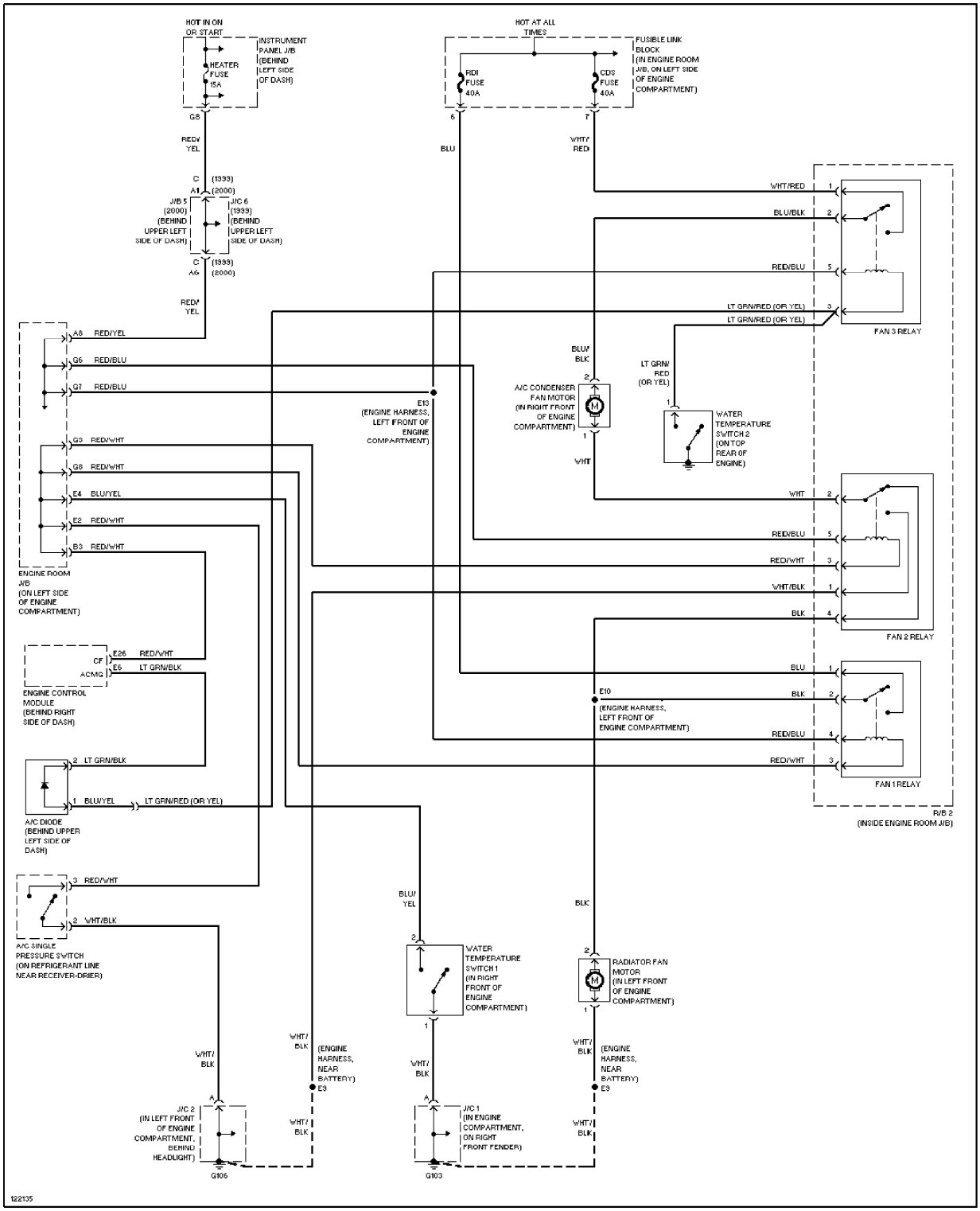
Body Computer Circuits

COMPUTER DATA LINES



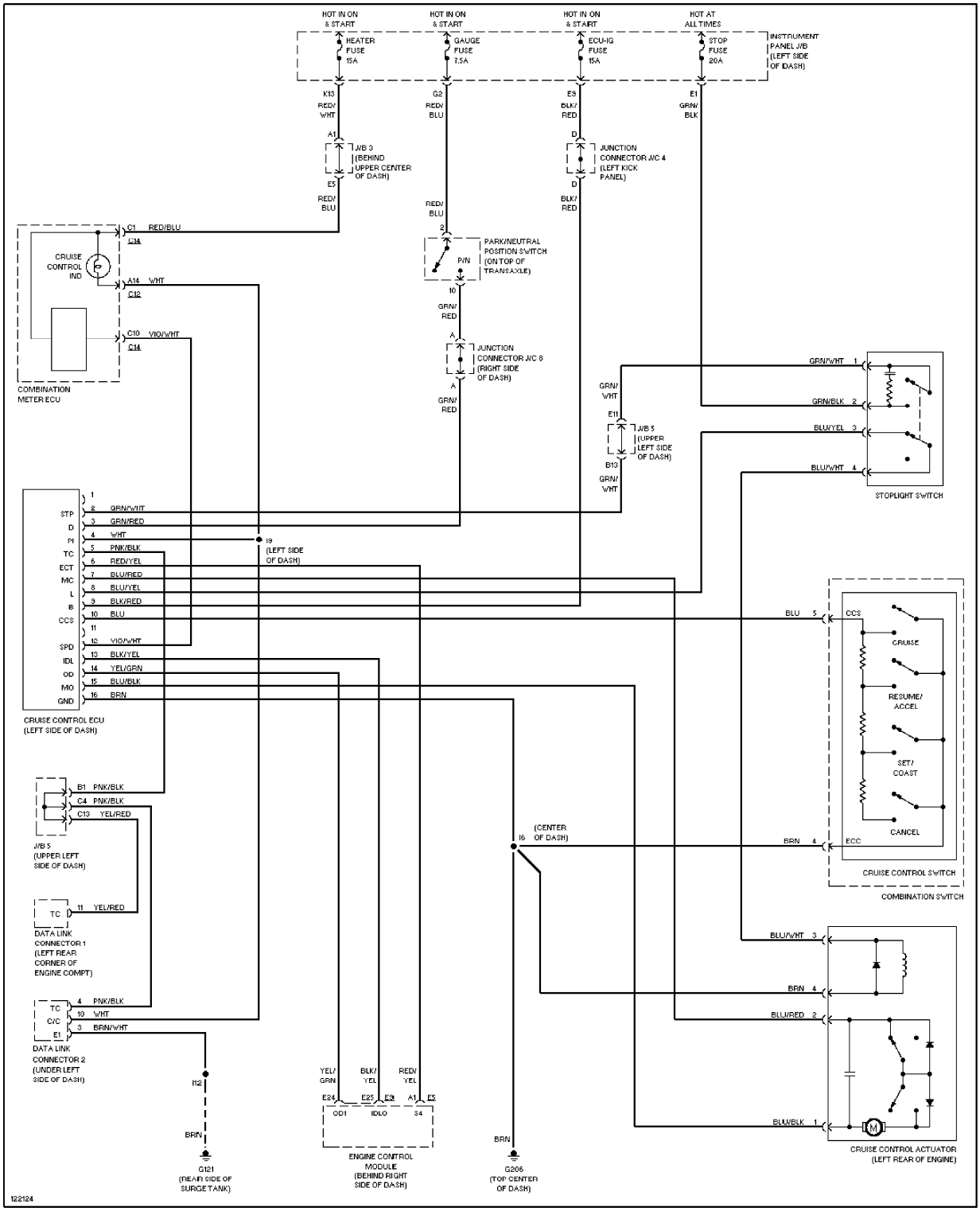
Computer Data Lines

COOLING FAN



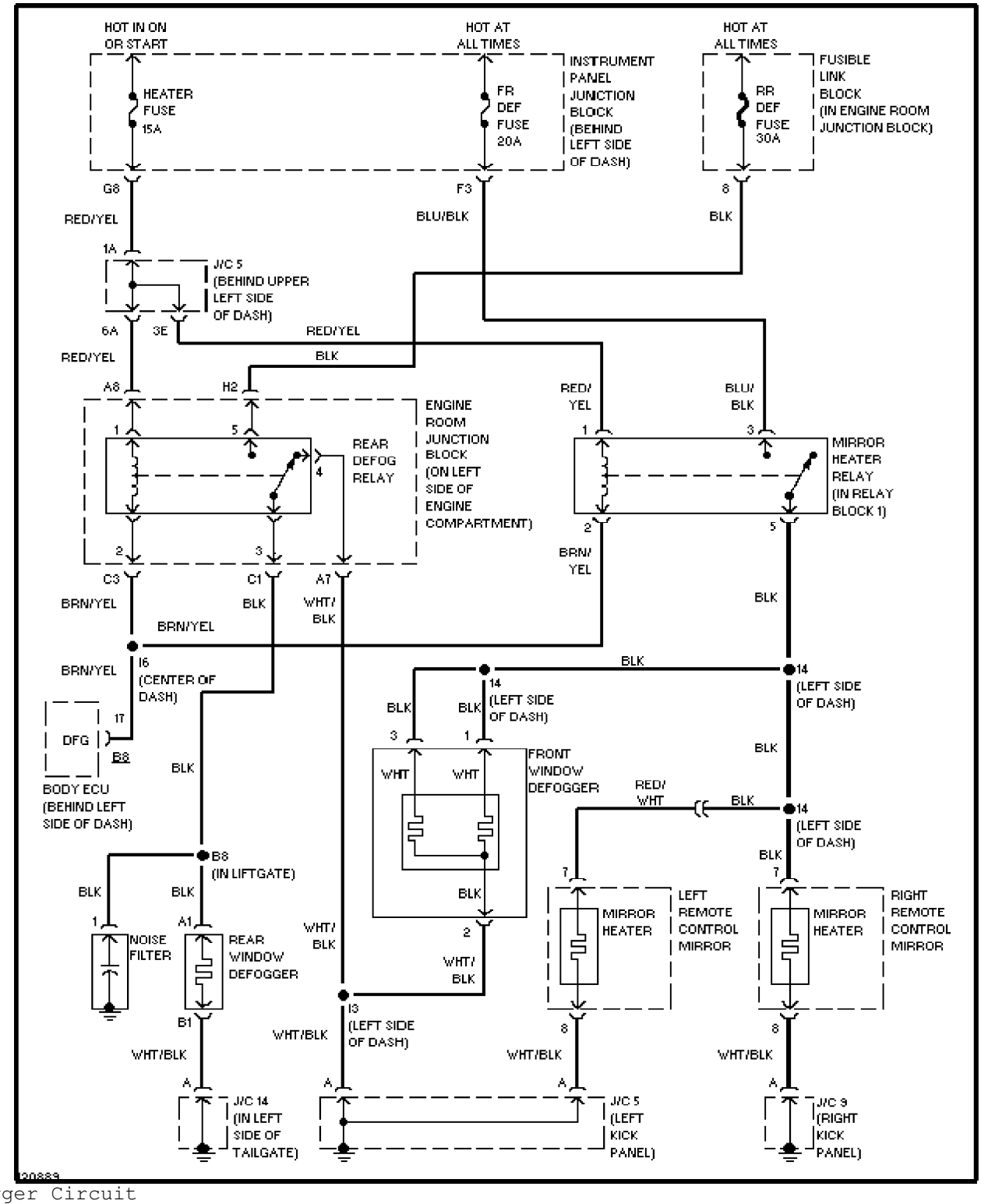
Cooling Fan Circuit

CRUISE CONTROL



Cruise Control Circuit

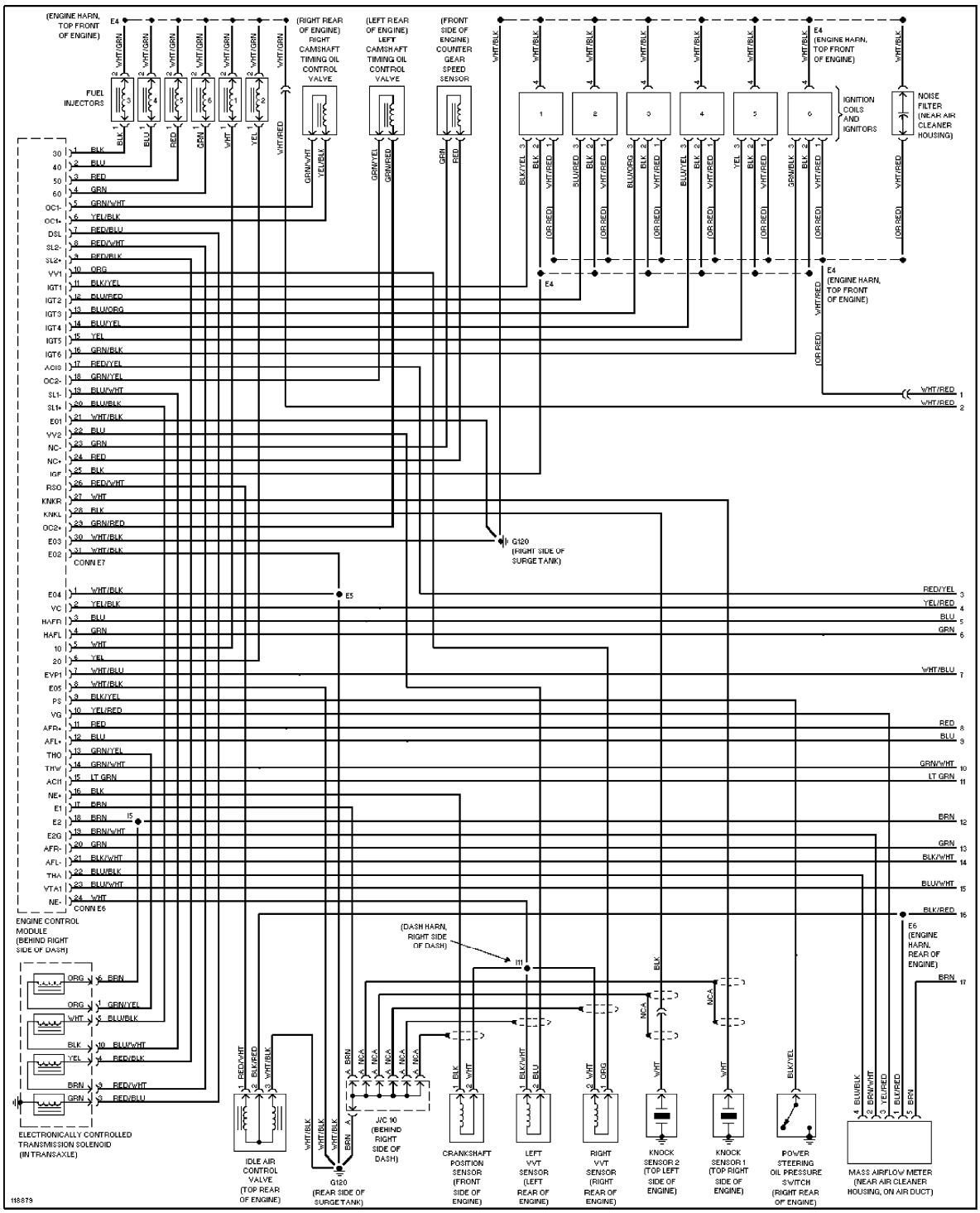
DEFOGGERS



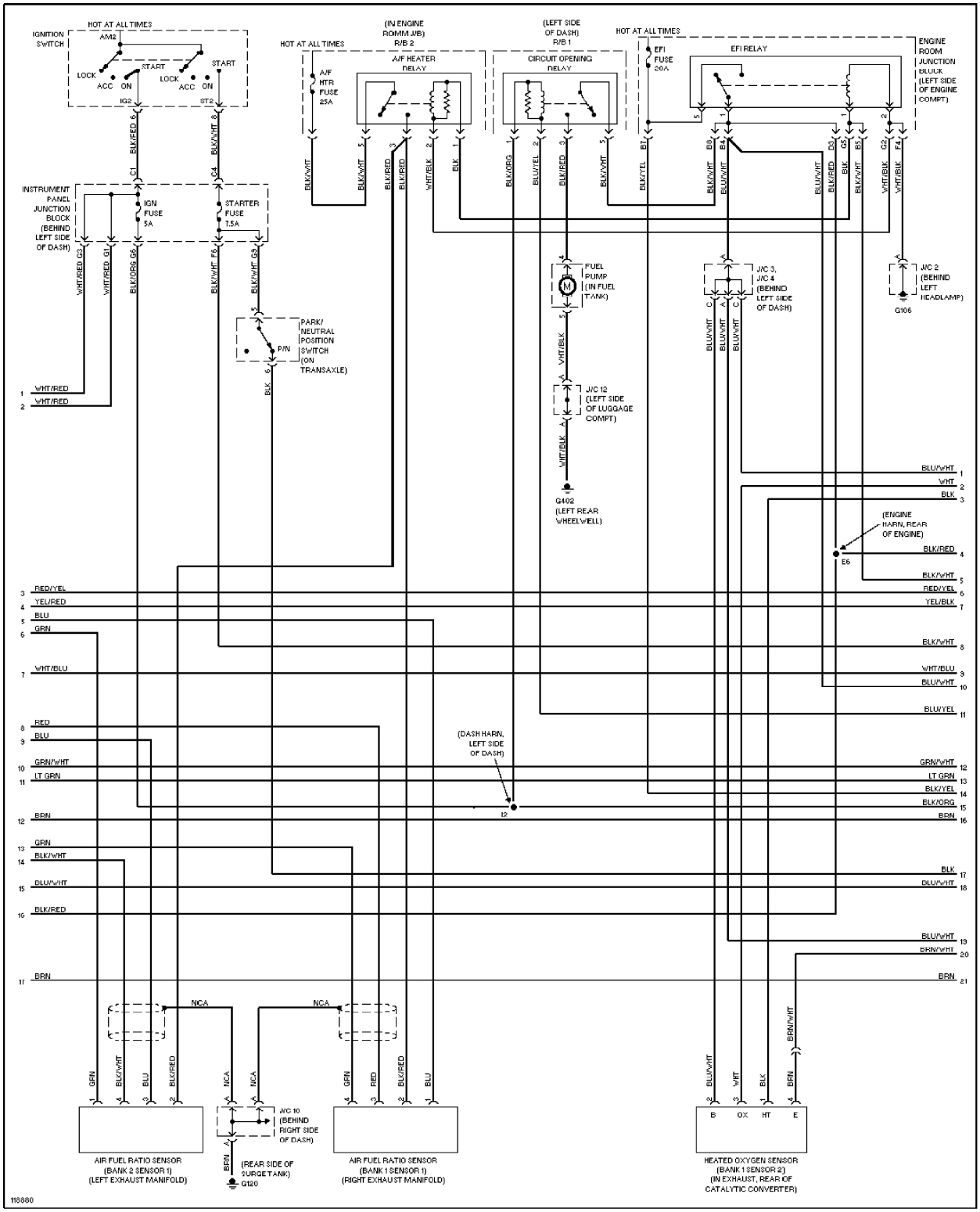
Defogger Circuit

ENGINE PERFORMANCE

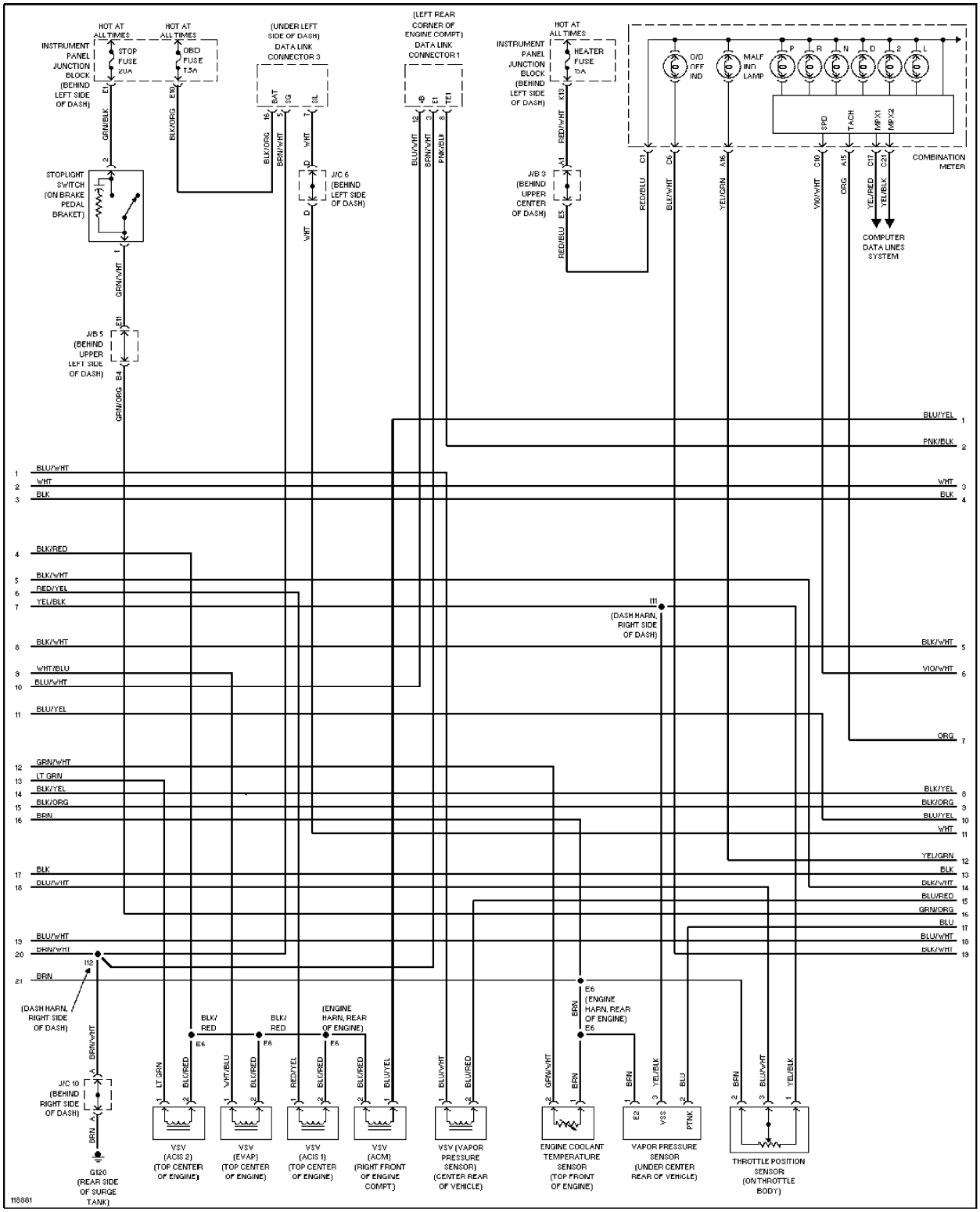
3.0L



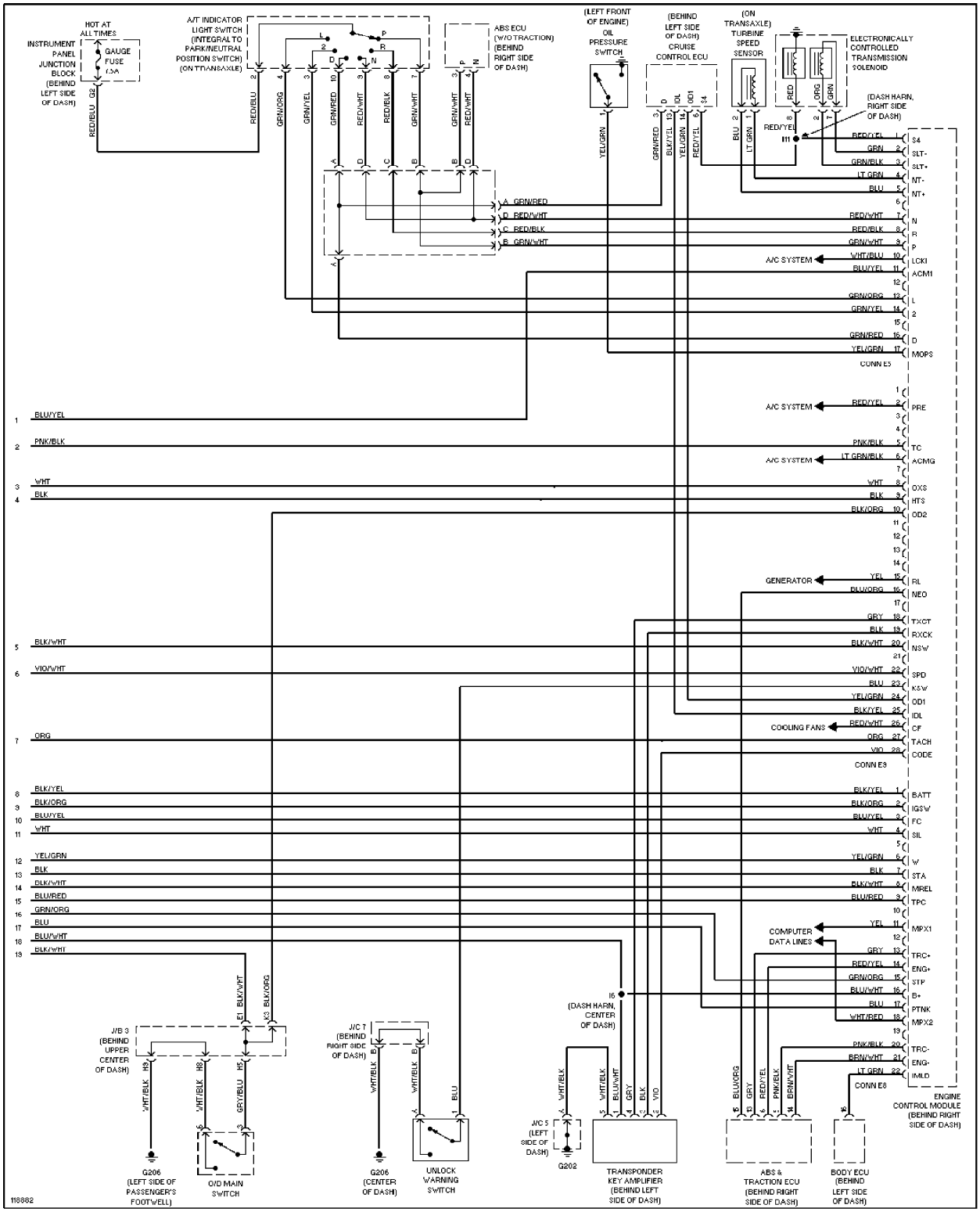
3.0L, Engine Performance Circuits (1 of 4)



3.0L, Engine Performance Circuits (2 of 4)

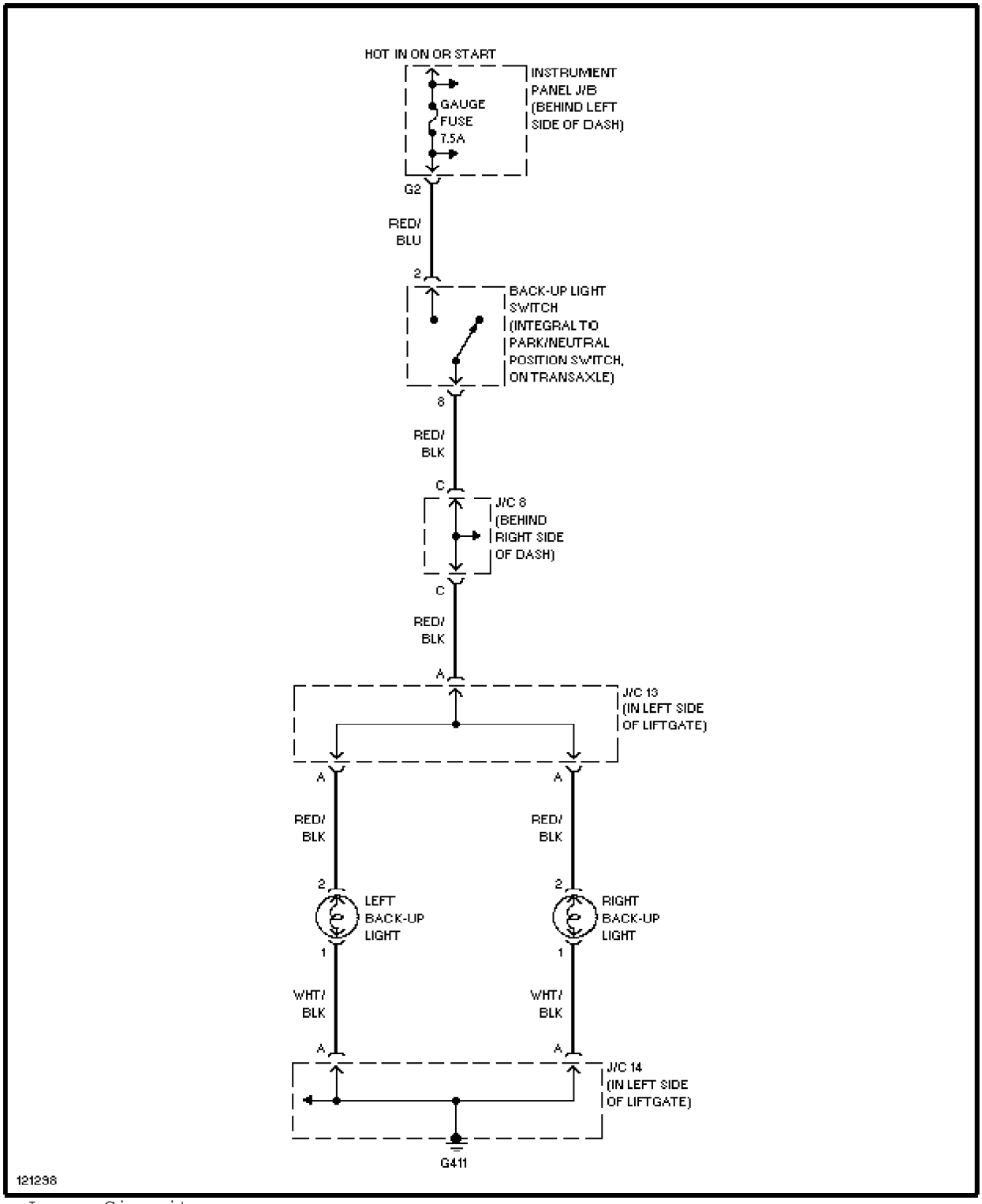


3.0L, Engine Performance Circuits (3 of 4)

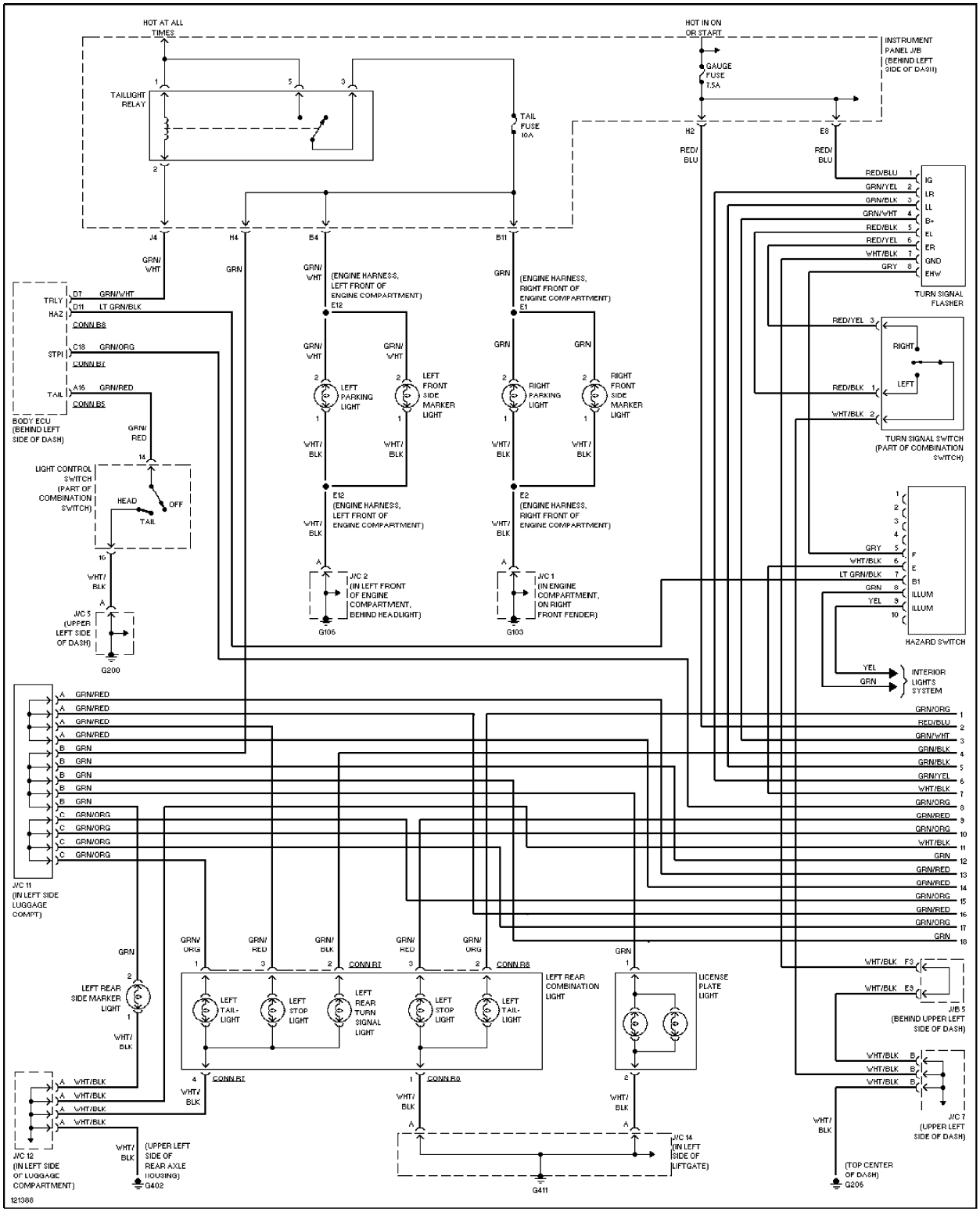


3.0L, Engine Performance Circuits (4 of 4)

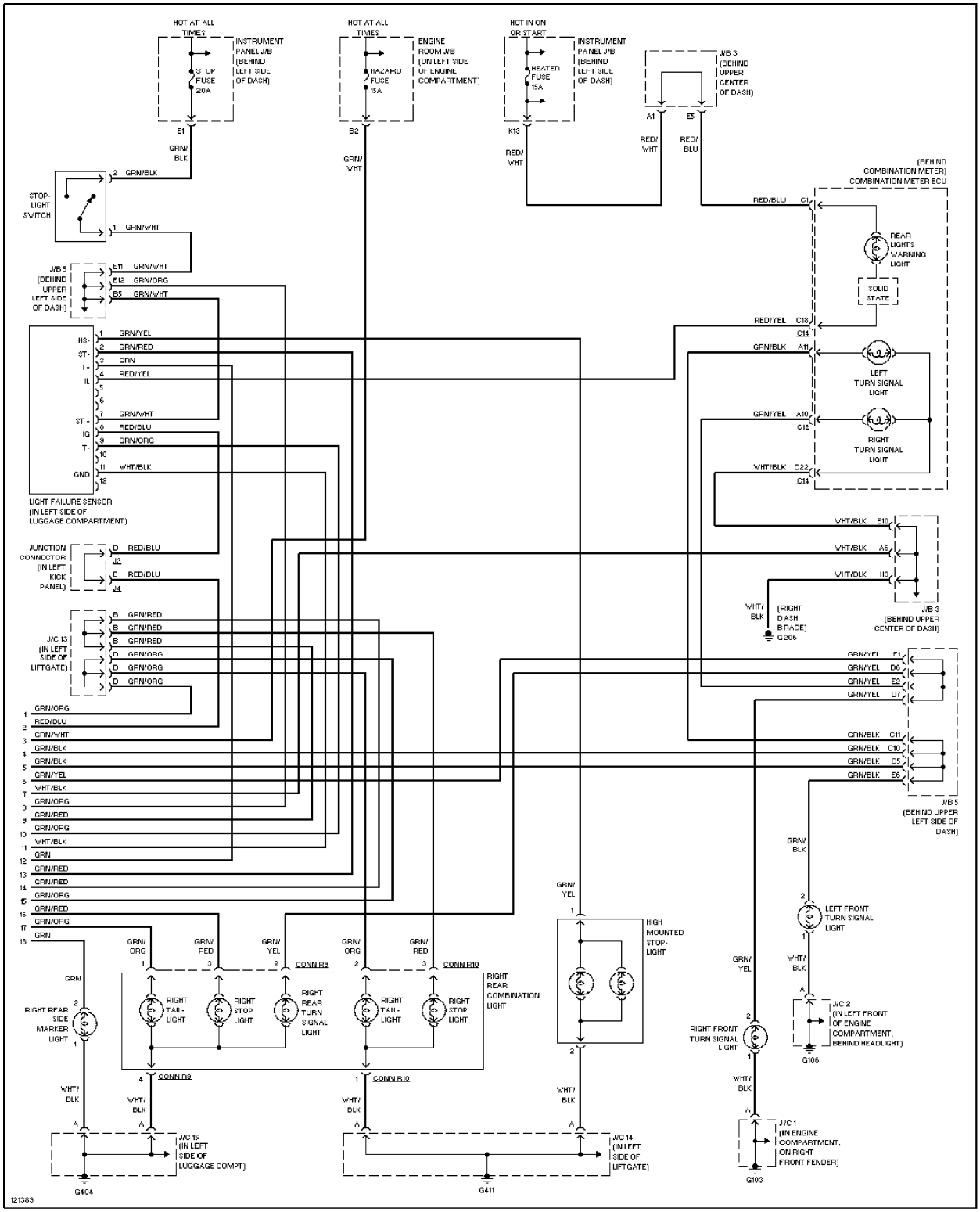
EXTERIOR LIGHTS



Back-up Lamps Circuit

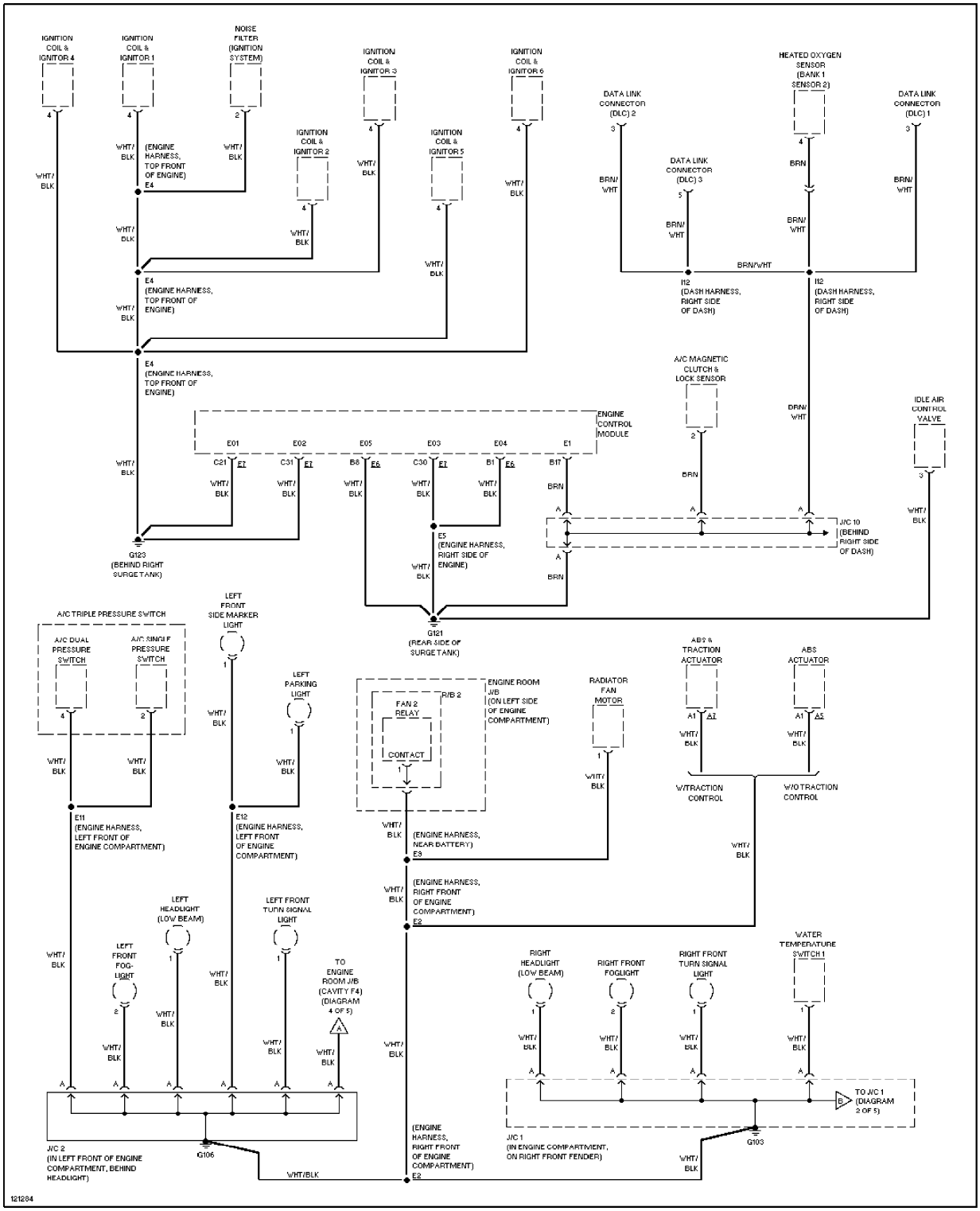


Exterior Lamps Circuit (1 of 2)

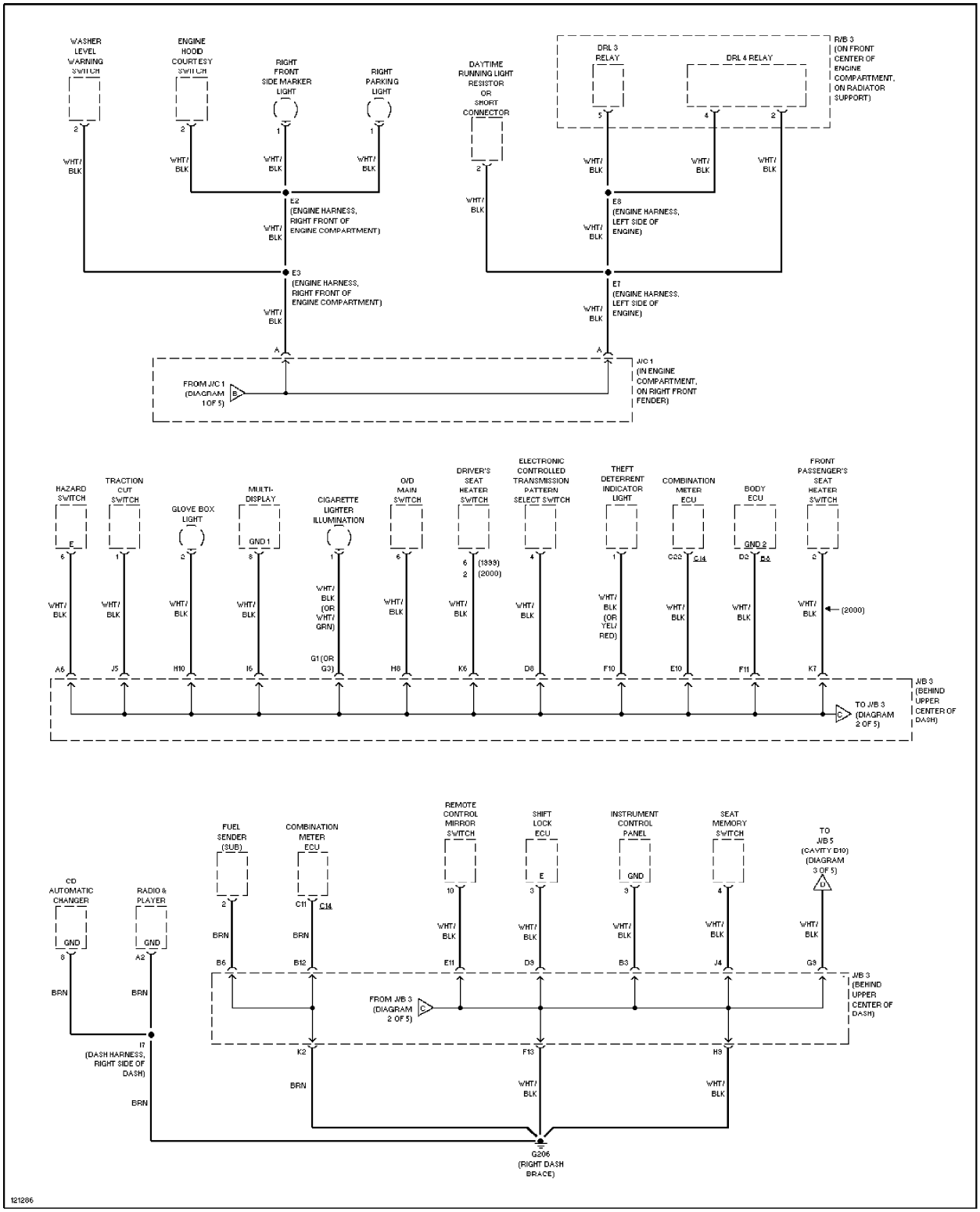


Exterior Lamps Circuit (2 of 2)

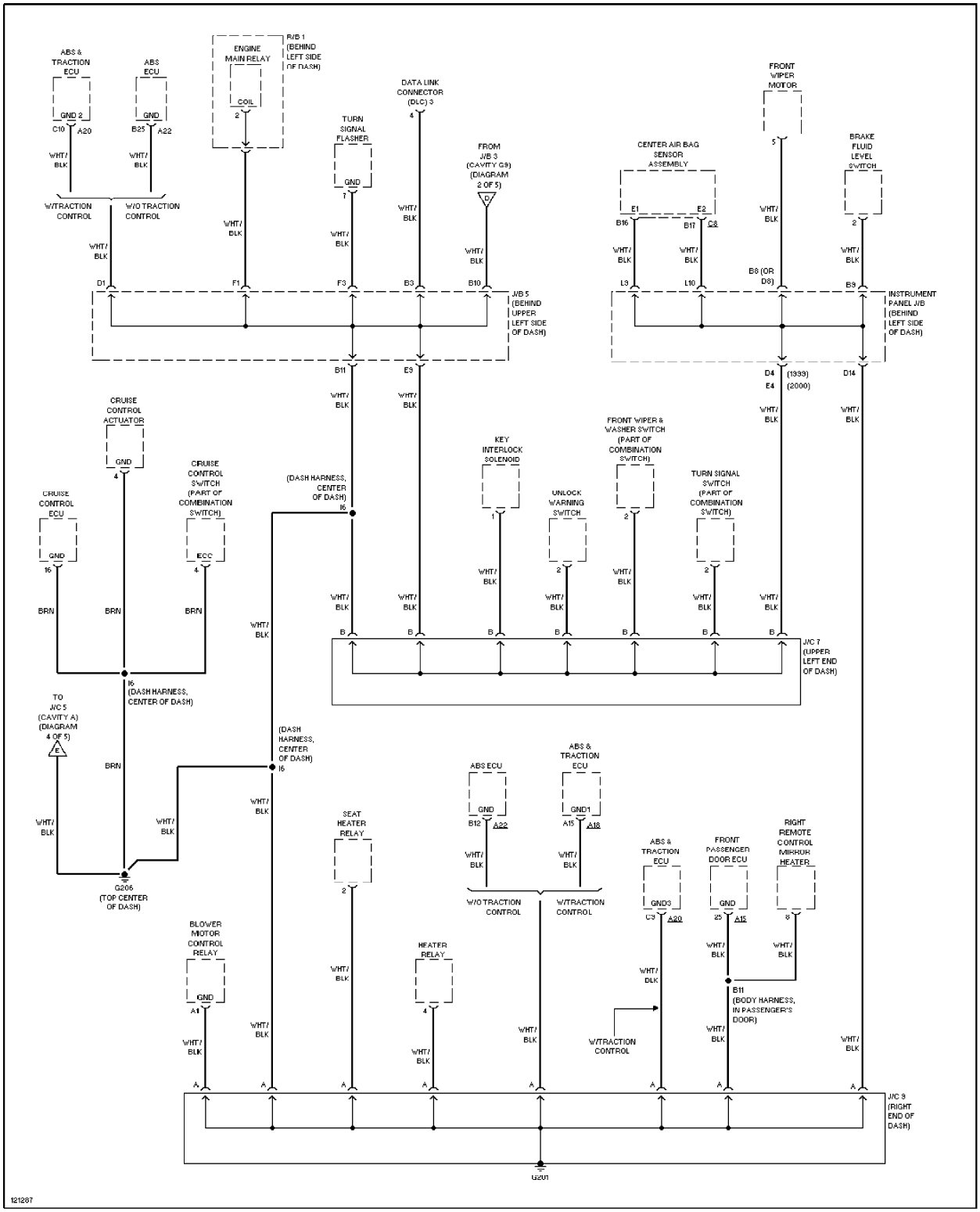
GROUND DISTRIBUTION



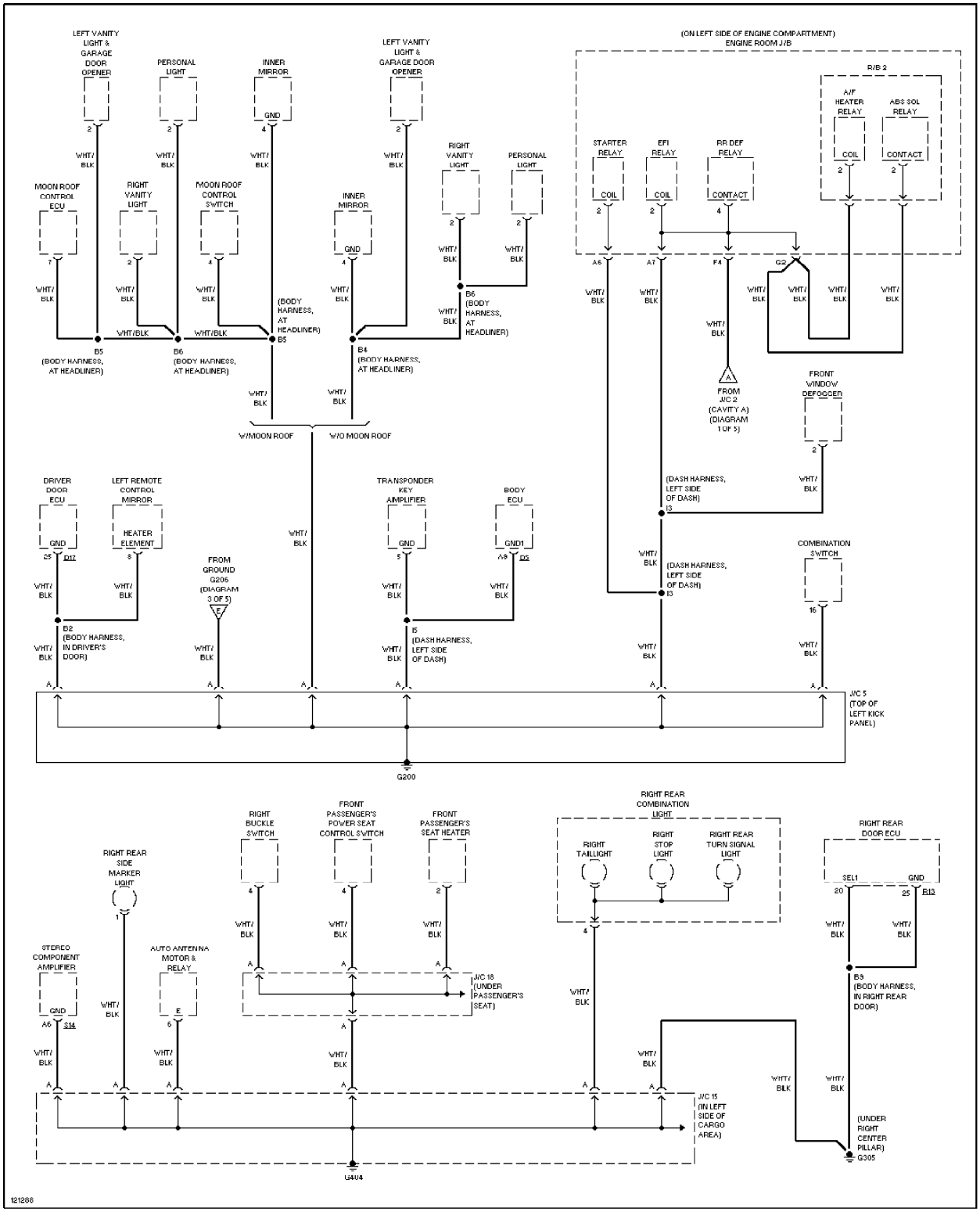
Ground Distribution Circuit (1 of 5)



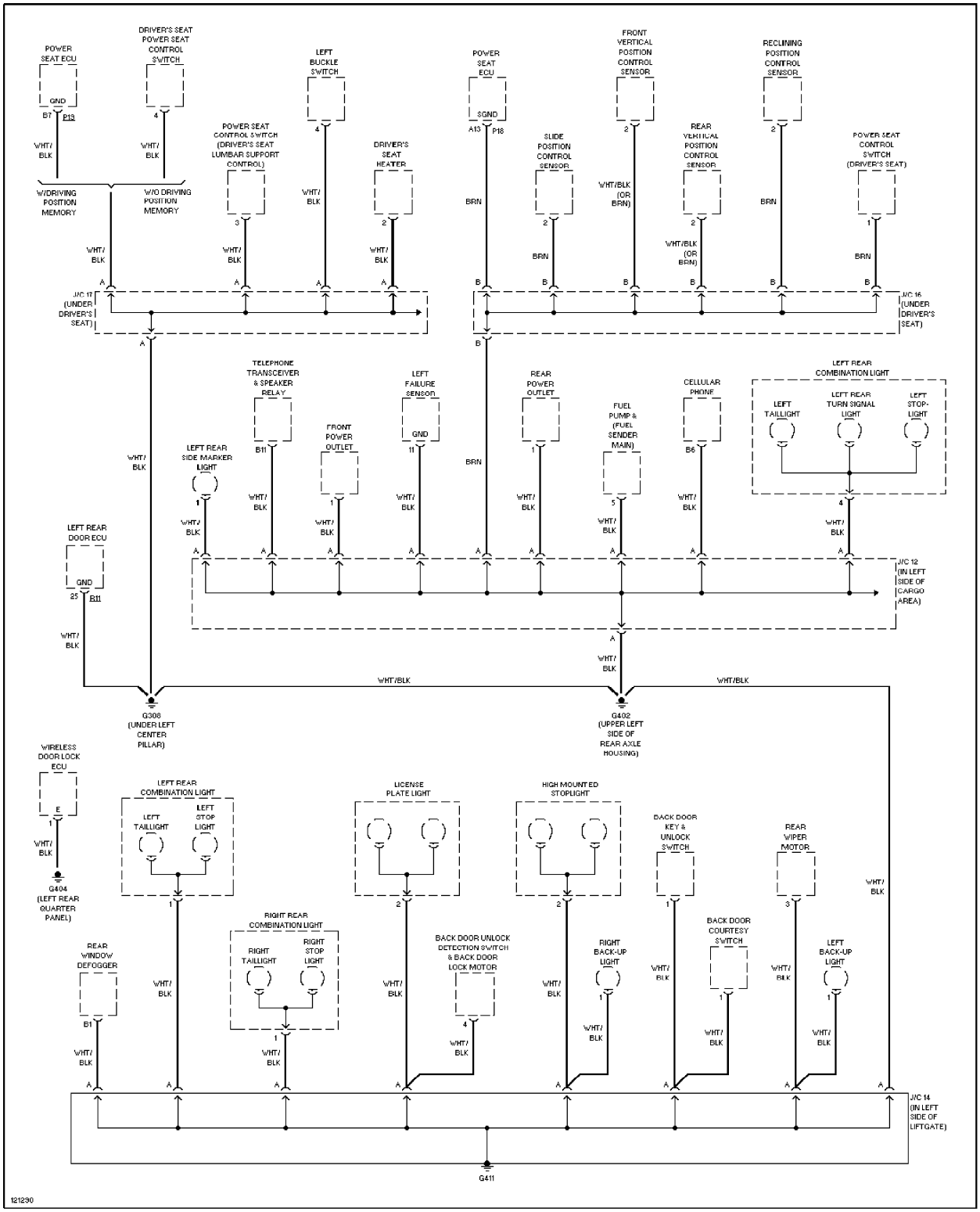
Ground Distribution Circuit (2 of 5)



Ground Distribution Circuit (3 of 5)

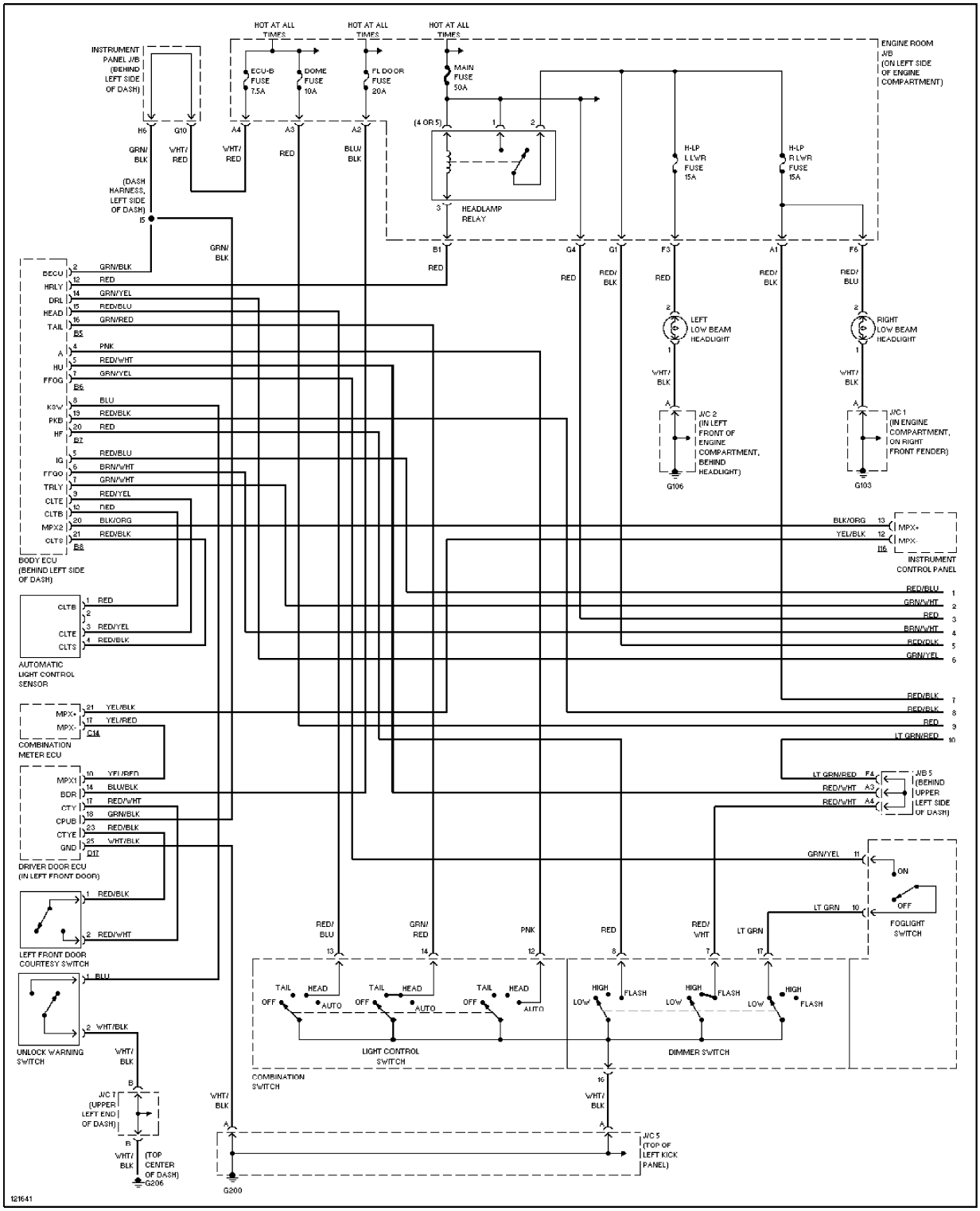


Ground Distribution Circuit (4 of 5)

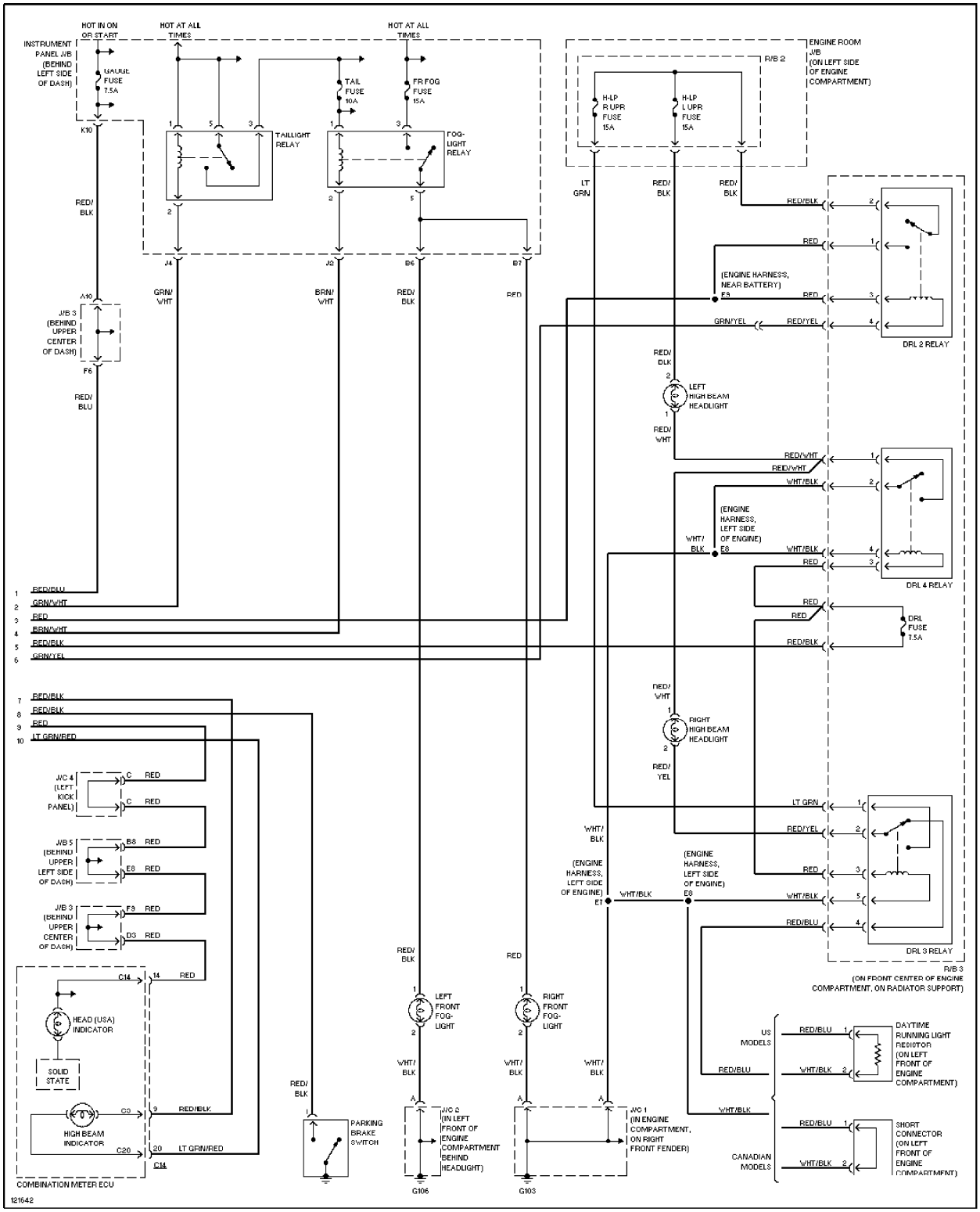


Ground Distribution Circuit (5 of 5)

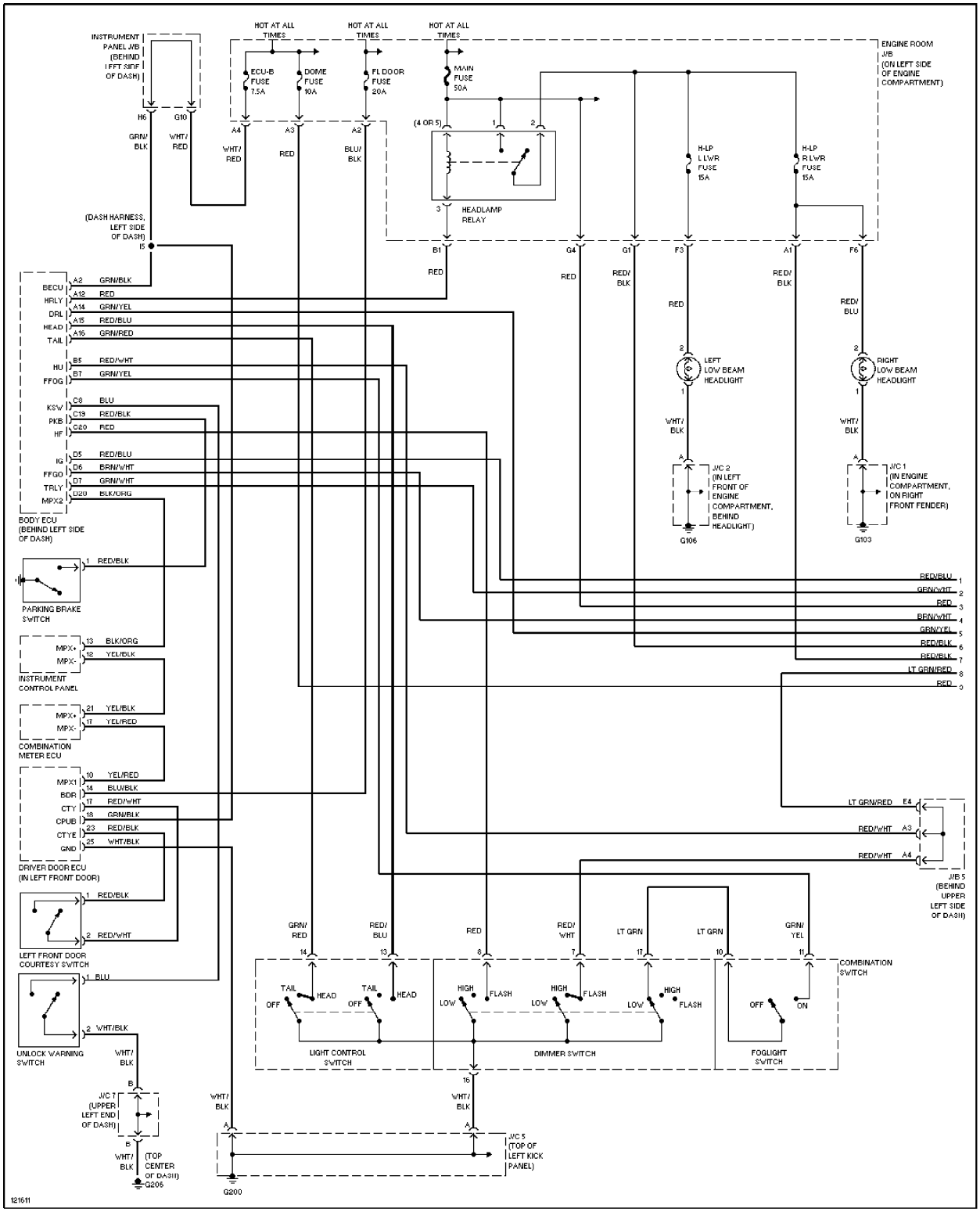
HEADLIGHTS



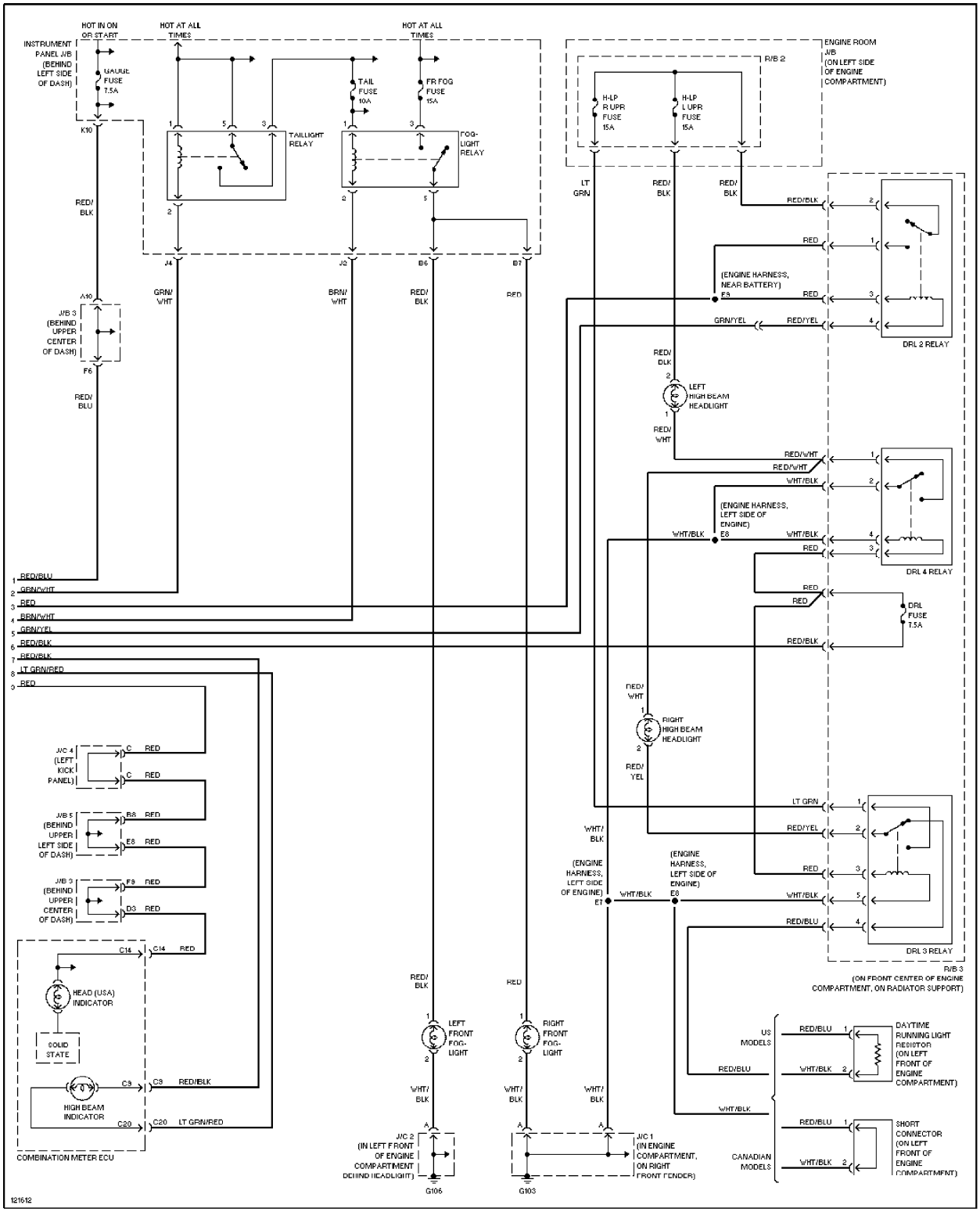
Headlight Circuit, W/ Autolamps (1 of 2)



Headlight Circuit, W/ Autolamps (2 of 2)

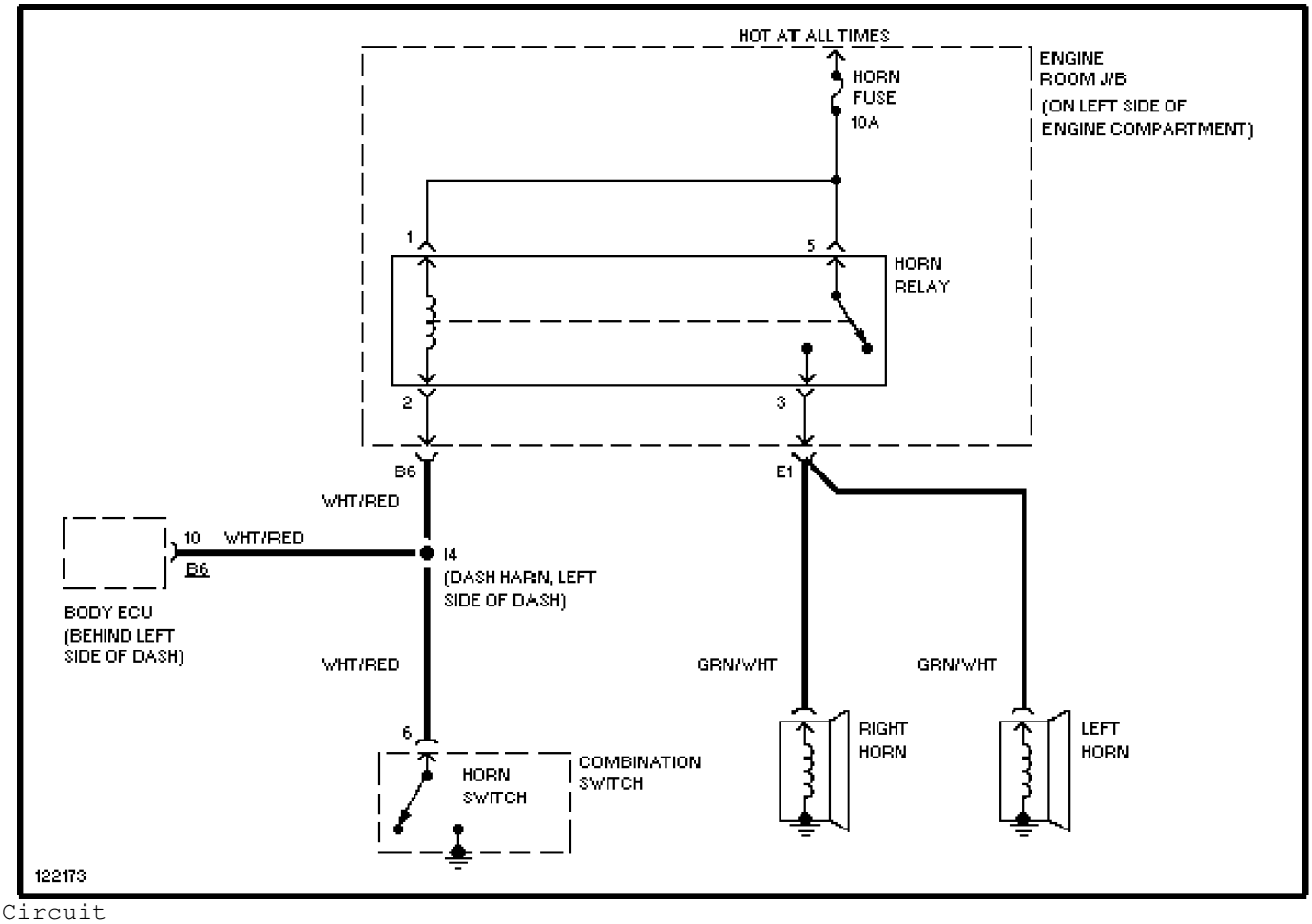


Headlight Circuit, W/O Autolamps (1 of 2)



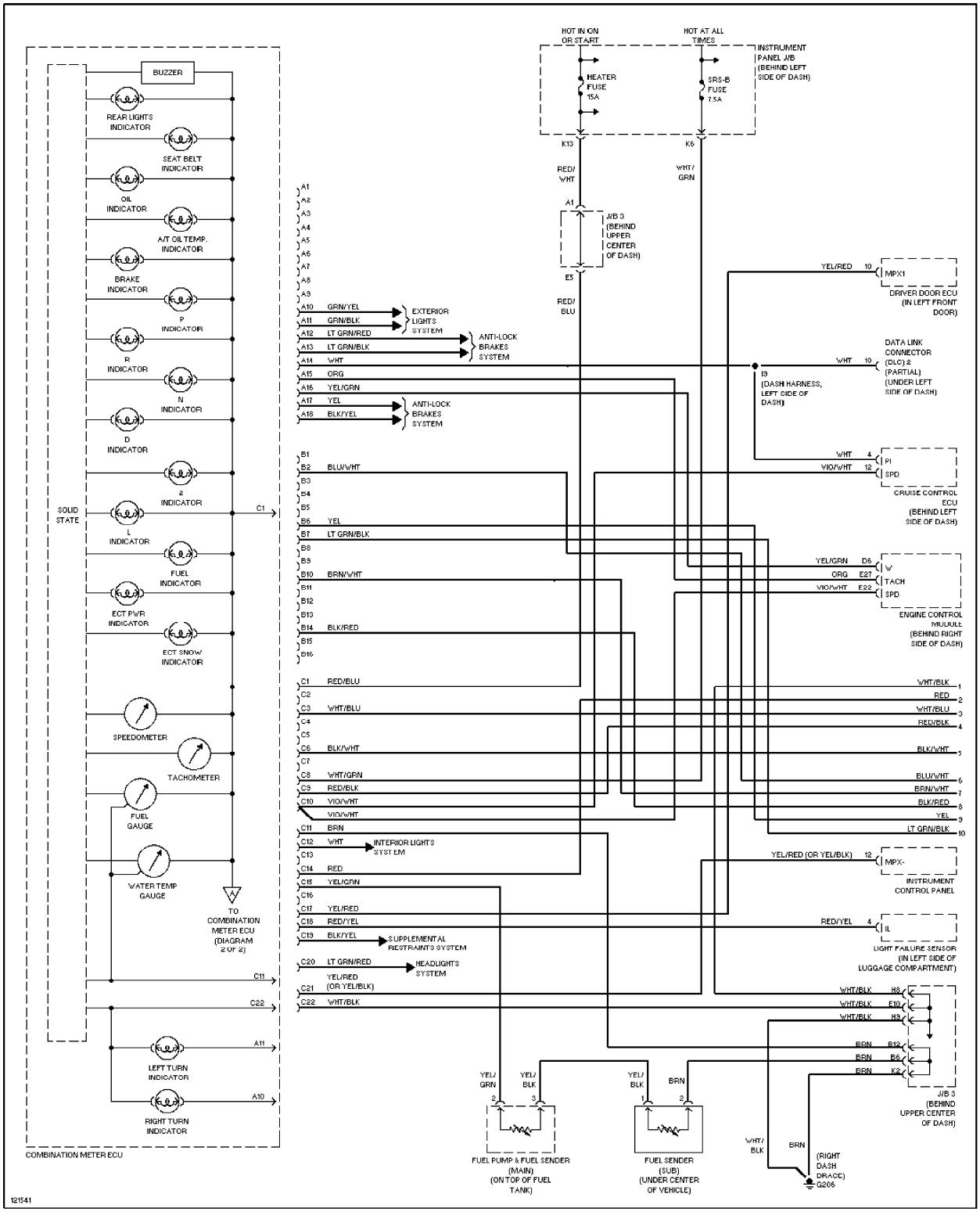
Headlight Circuit, W/O Autolamps (2 of 2)

HORN

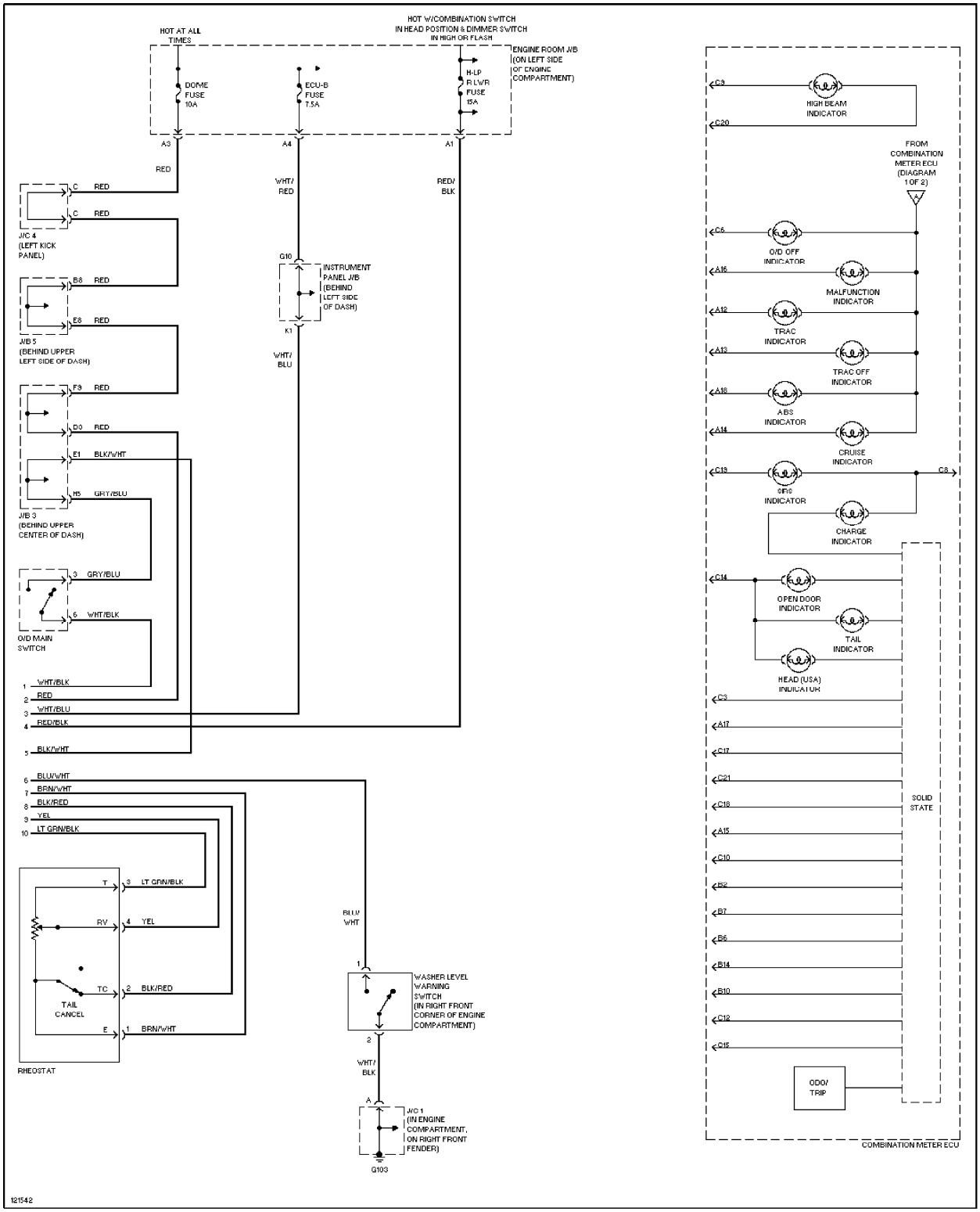


Horn Circuit

INSTRUMENT CLUSTER

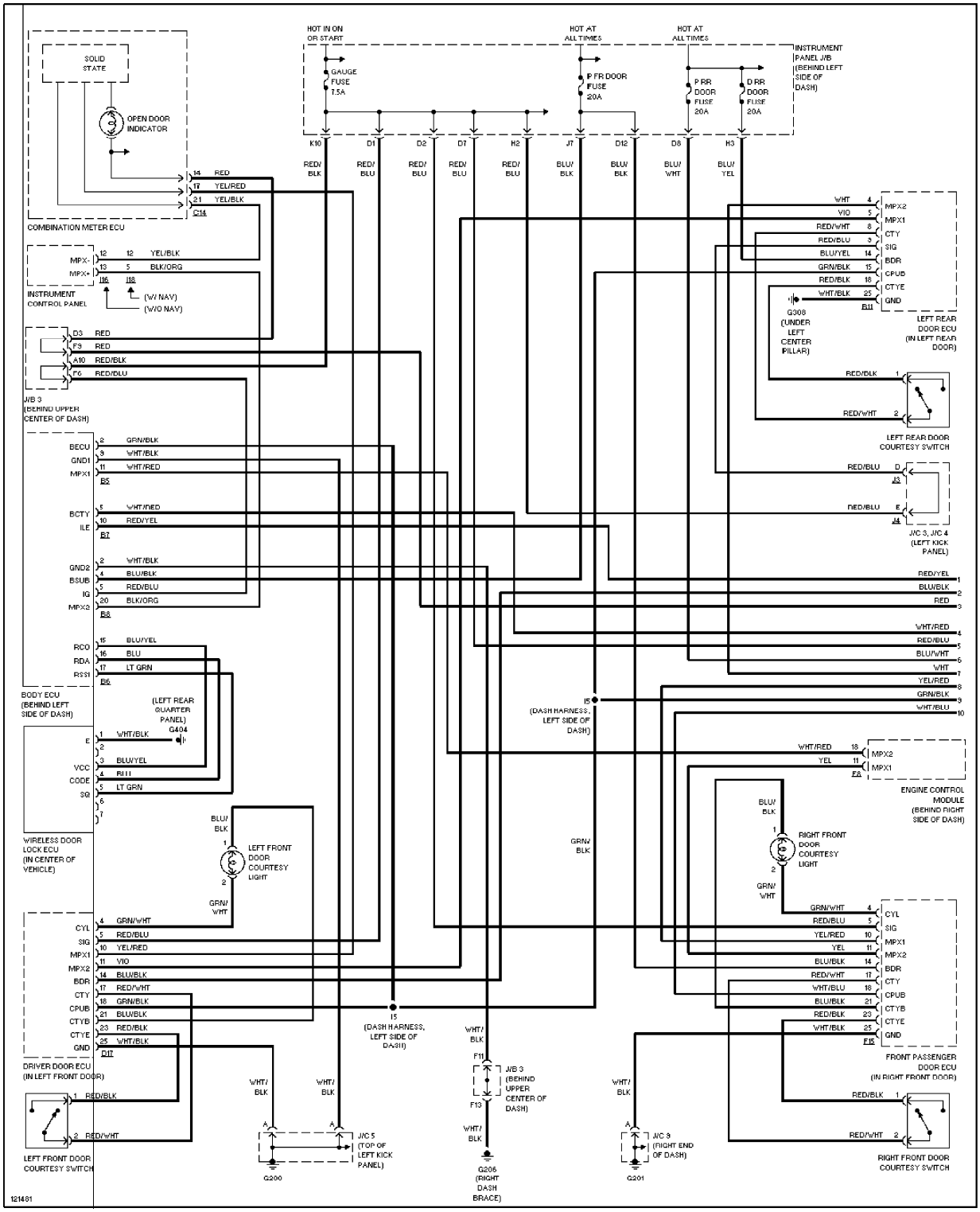


Instrument Cluster Circuit (1 of 2)

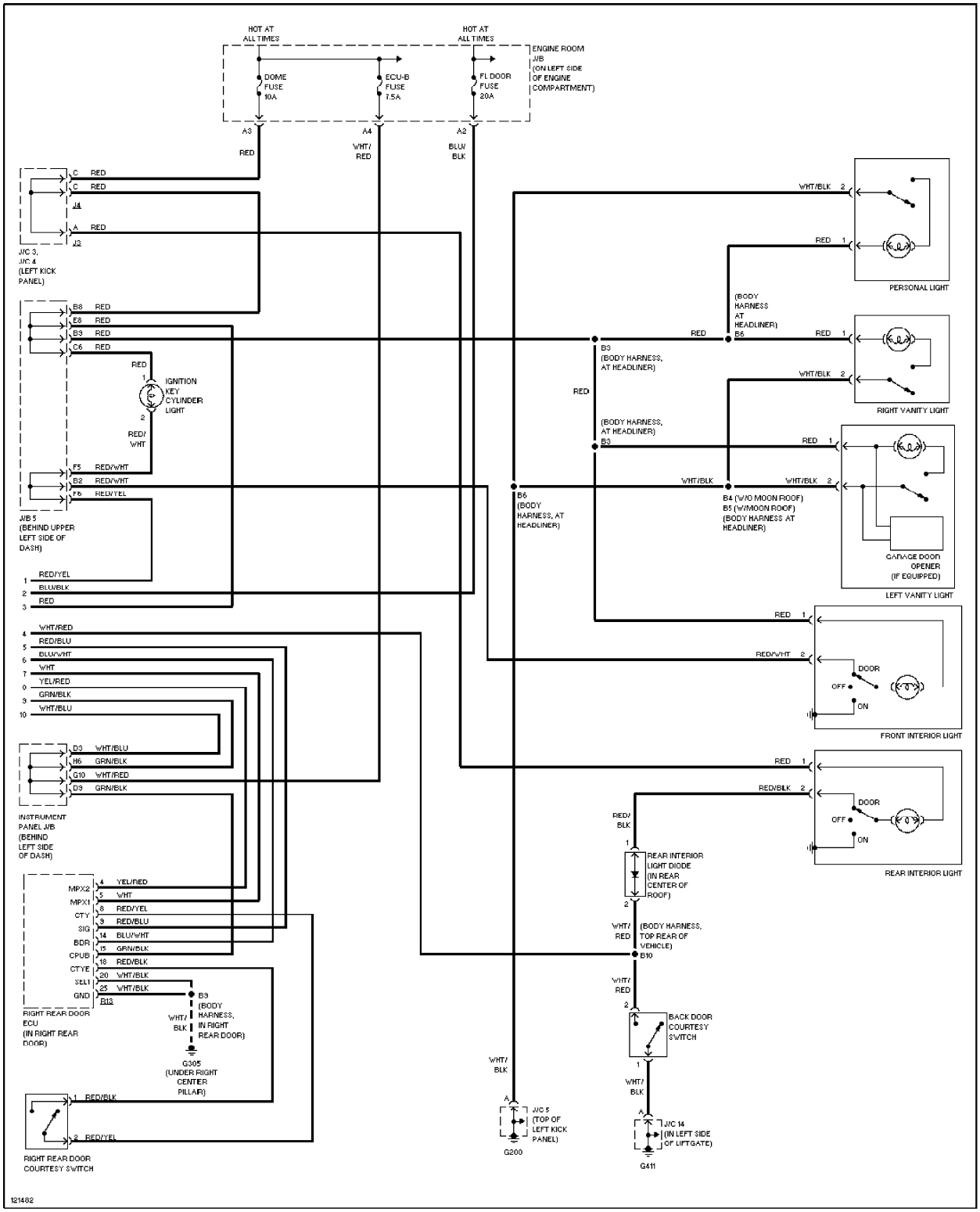


Instrument Cluster Circuit (2 of 2)

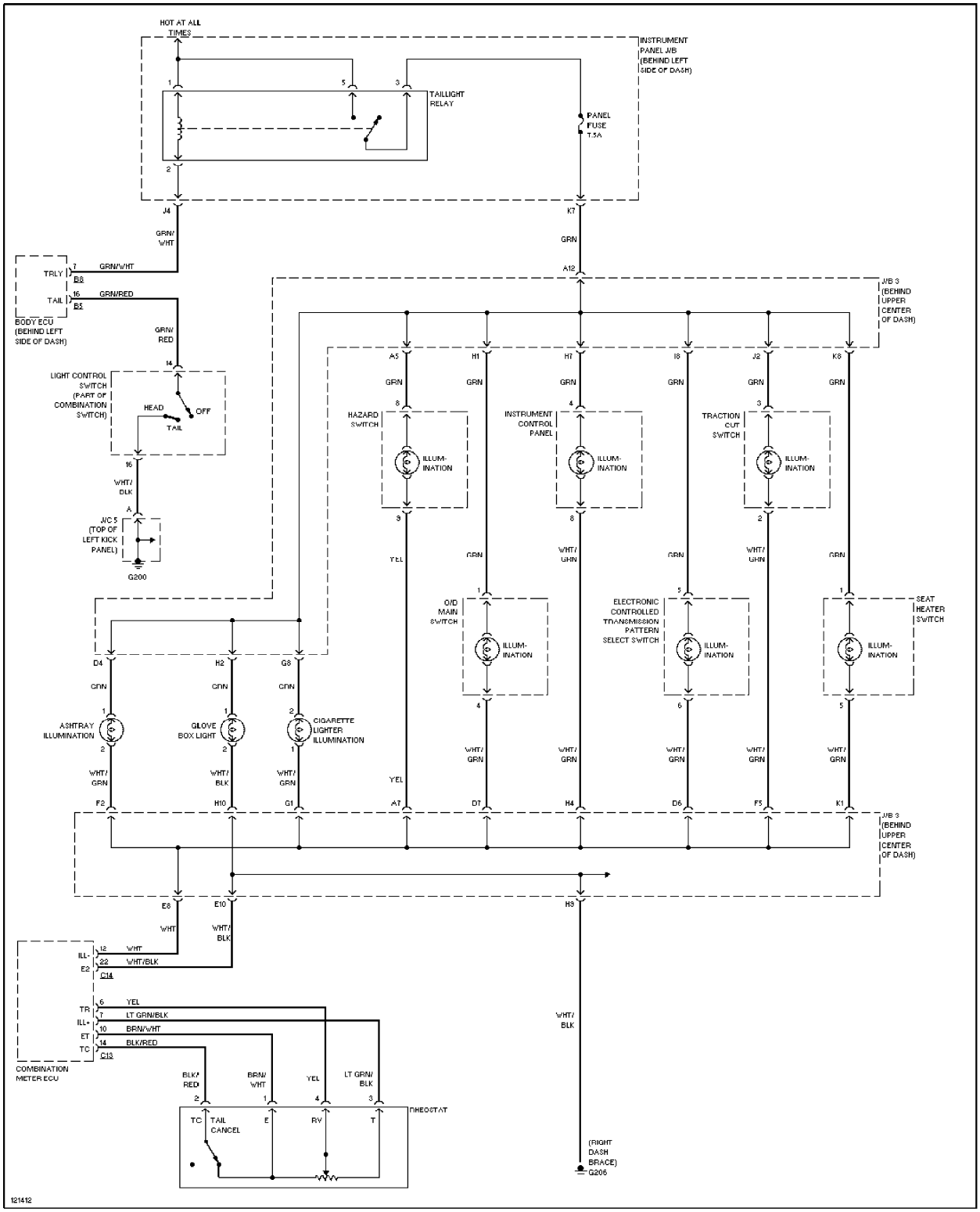
INTERIOR LIGHTS



Courtesy Lamps Circuit (1 of 2)

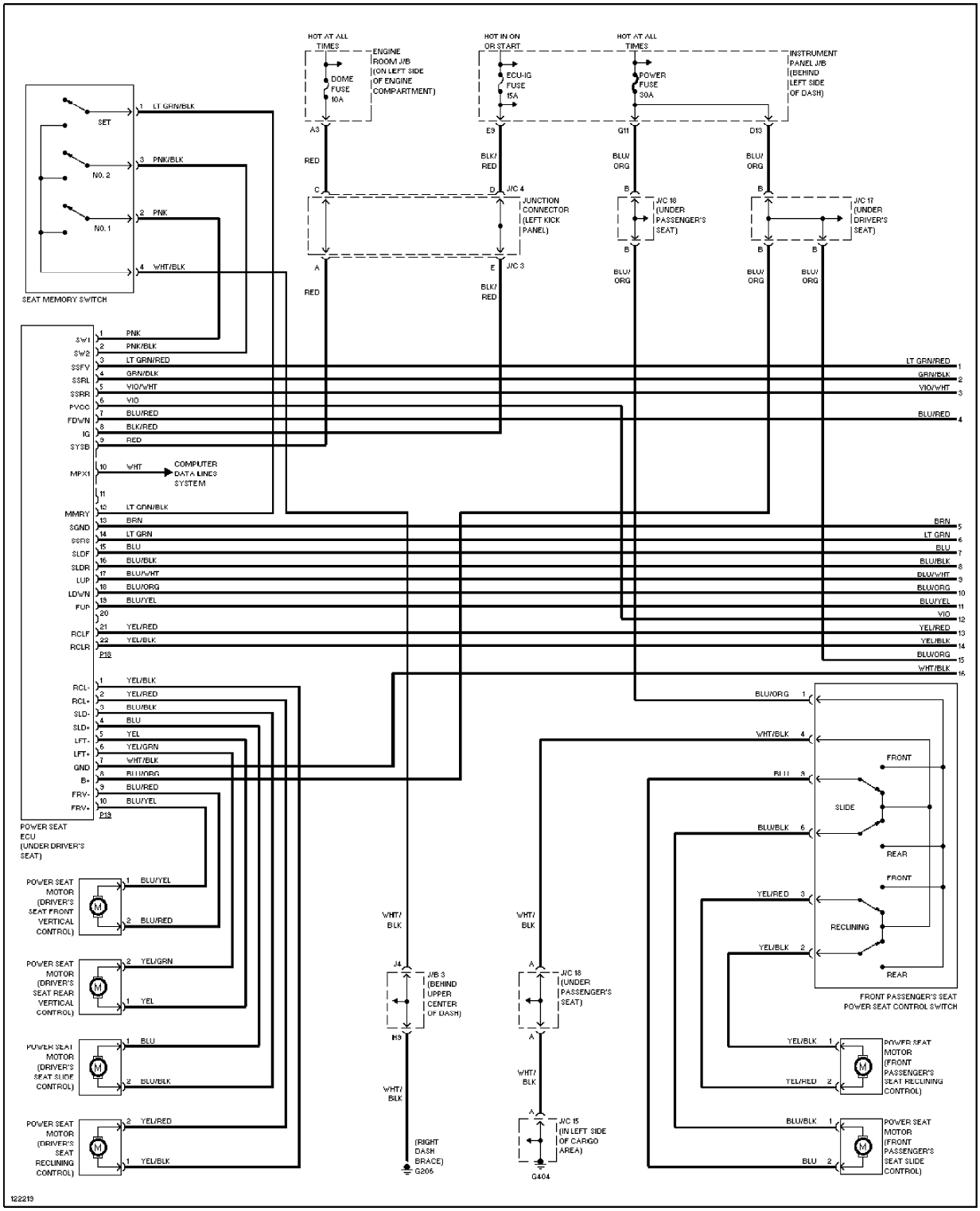


Courtesy Lamps Circuit (2 of 2)

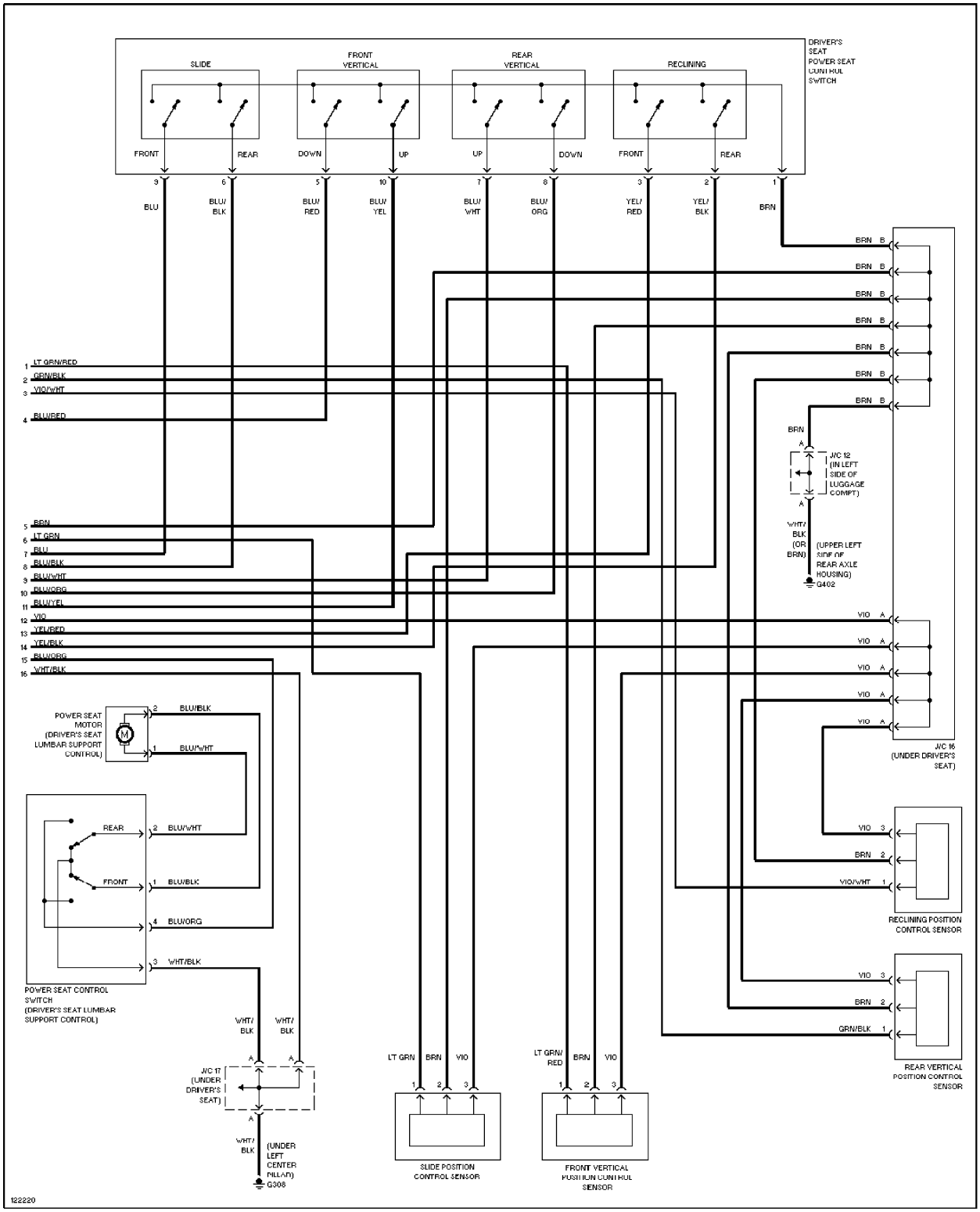


Instrument Illumination Circuit

MEMORY SYSTEMS

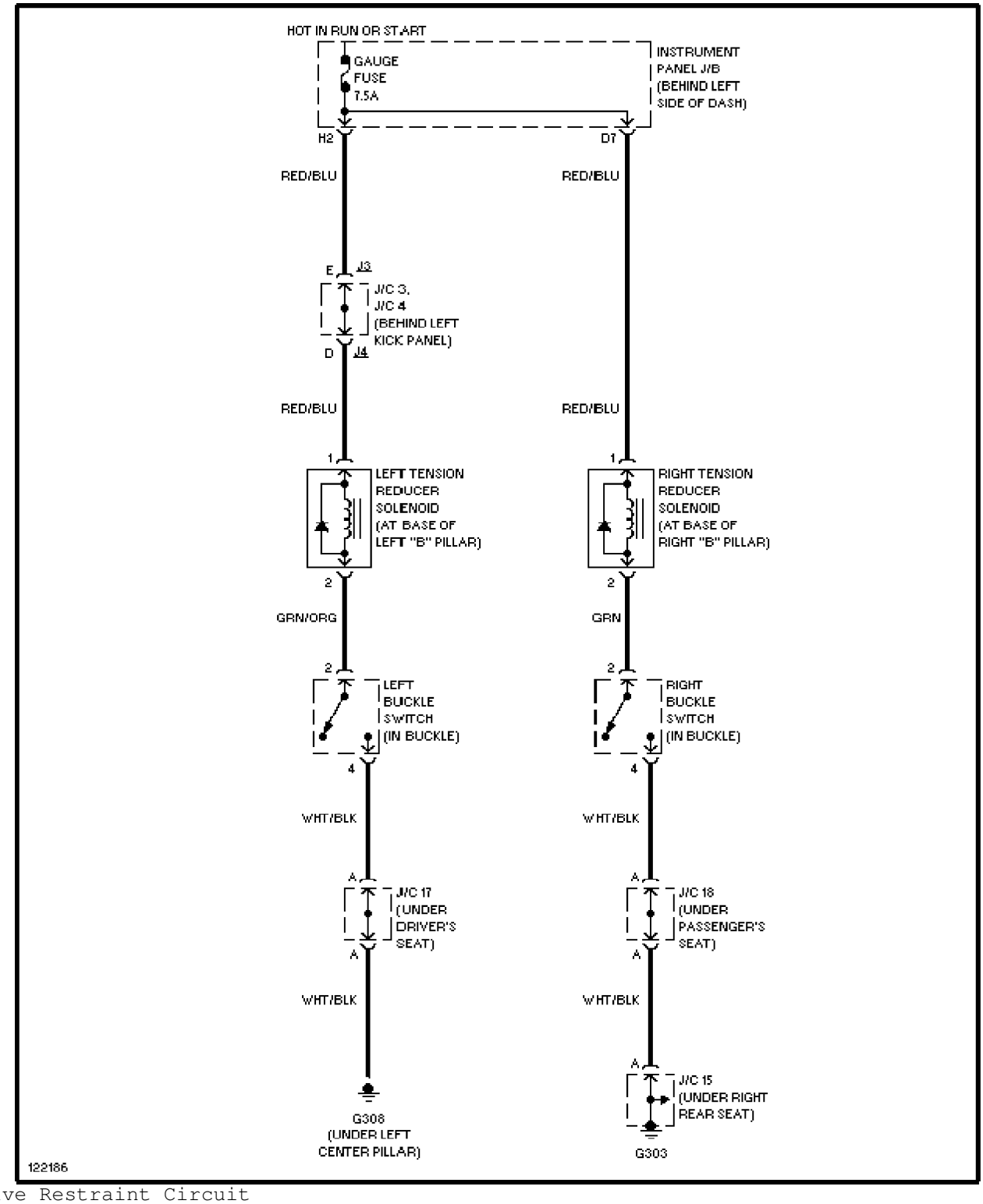


Memory Seat Circuit (1 of 2)



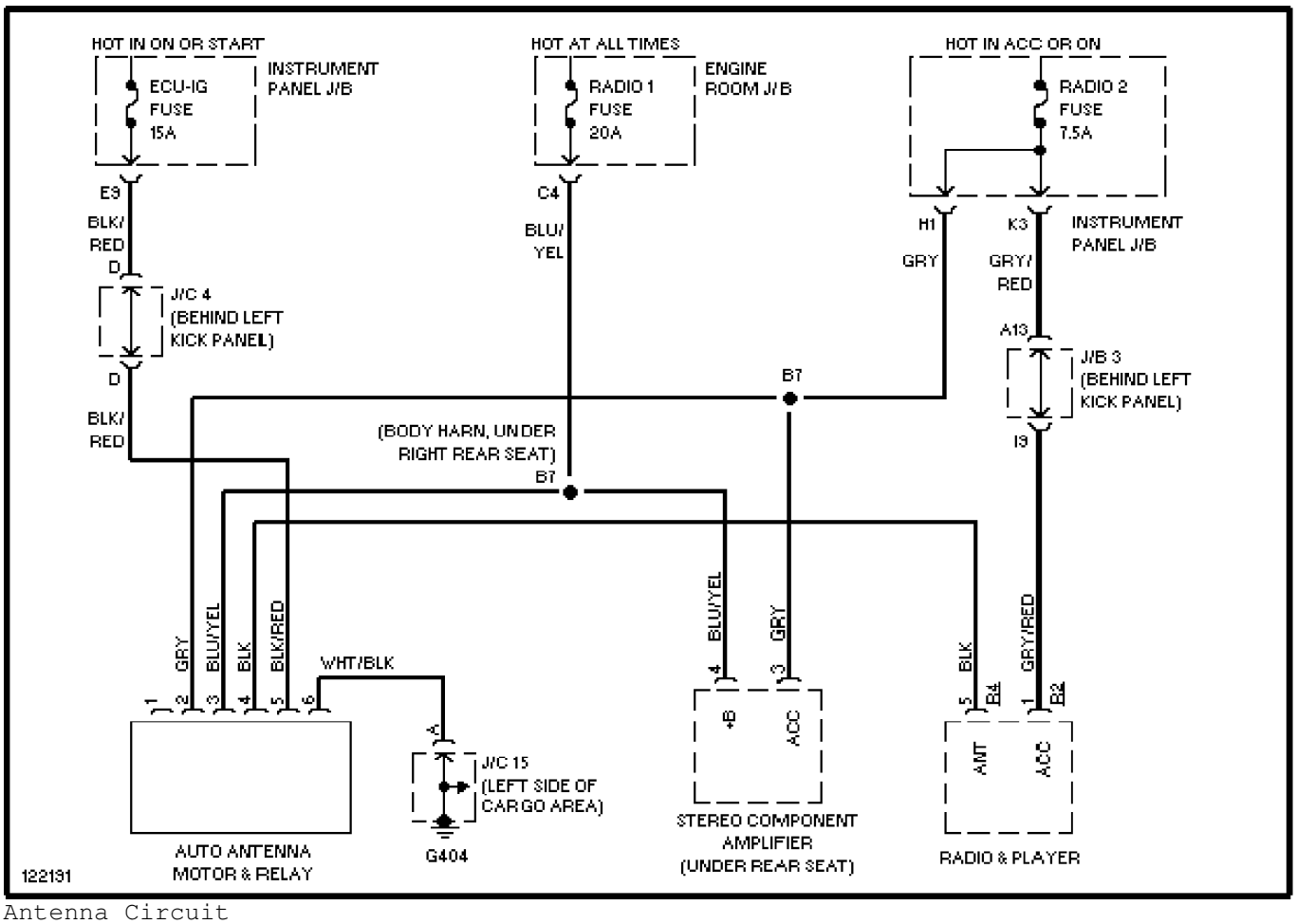
Memory Seat Circuit (2 of 2)

PASSIVE RESTRAINTS



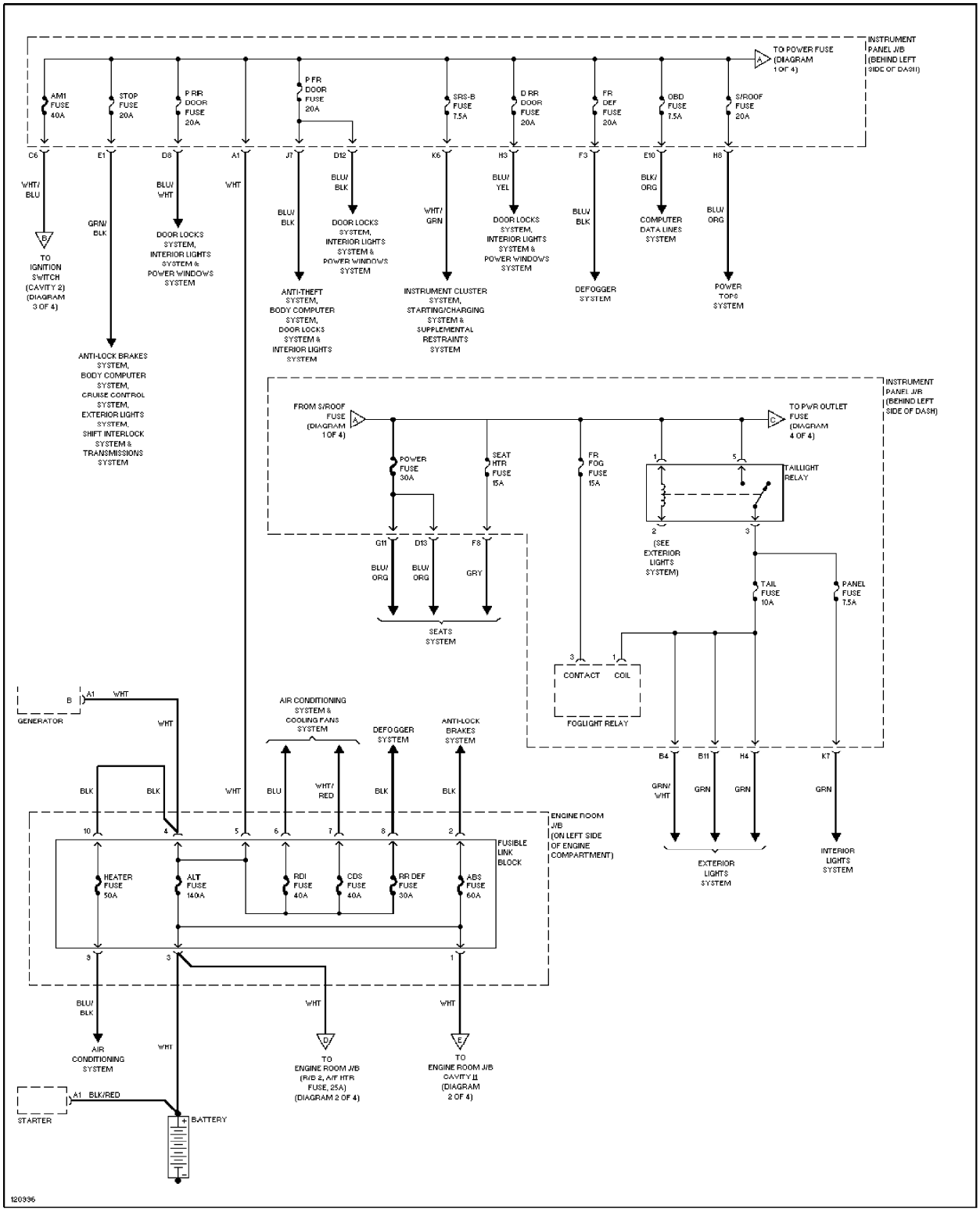
Passive Restraint Circuit

POWER ANTENNA

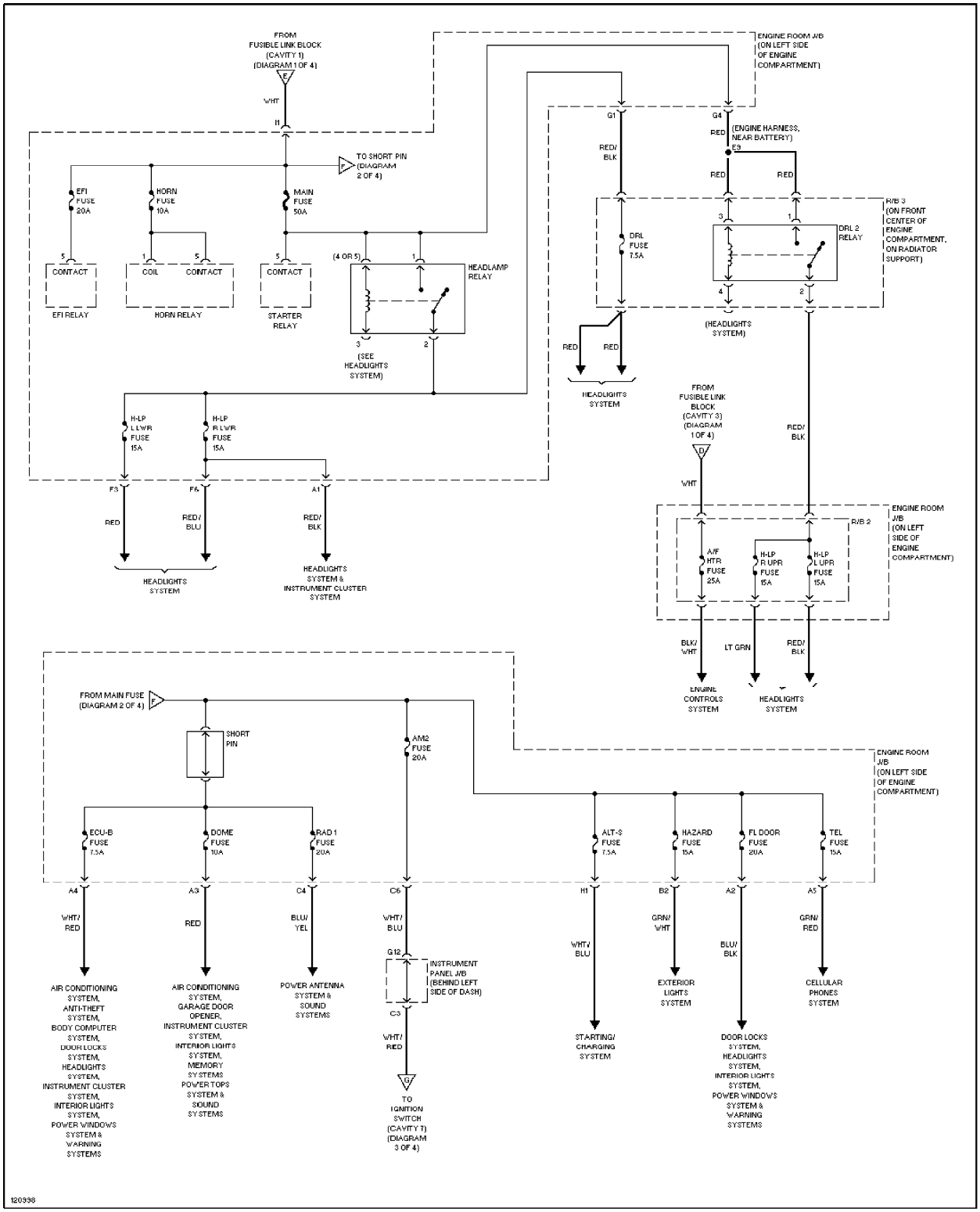


Power Antenna Circuit

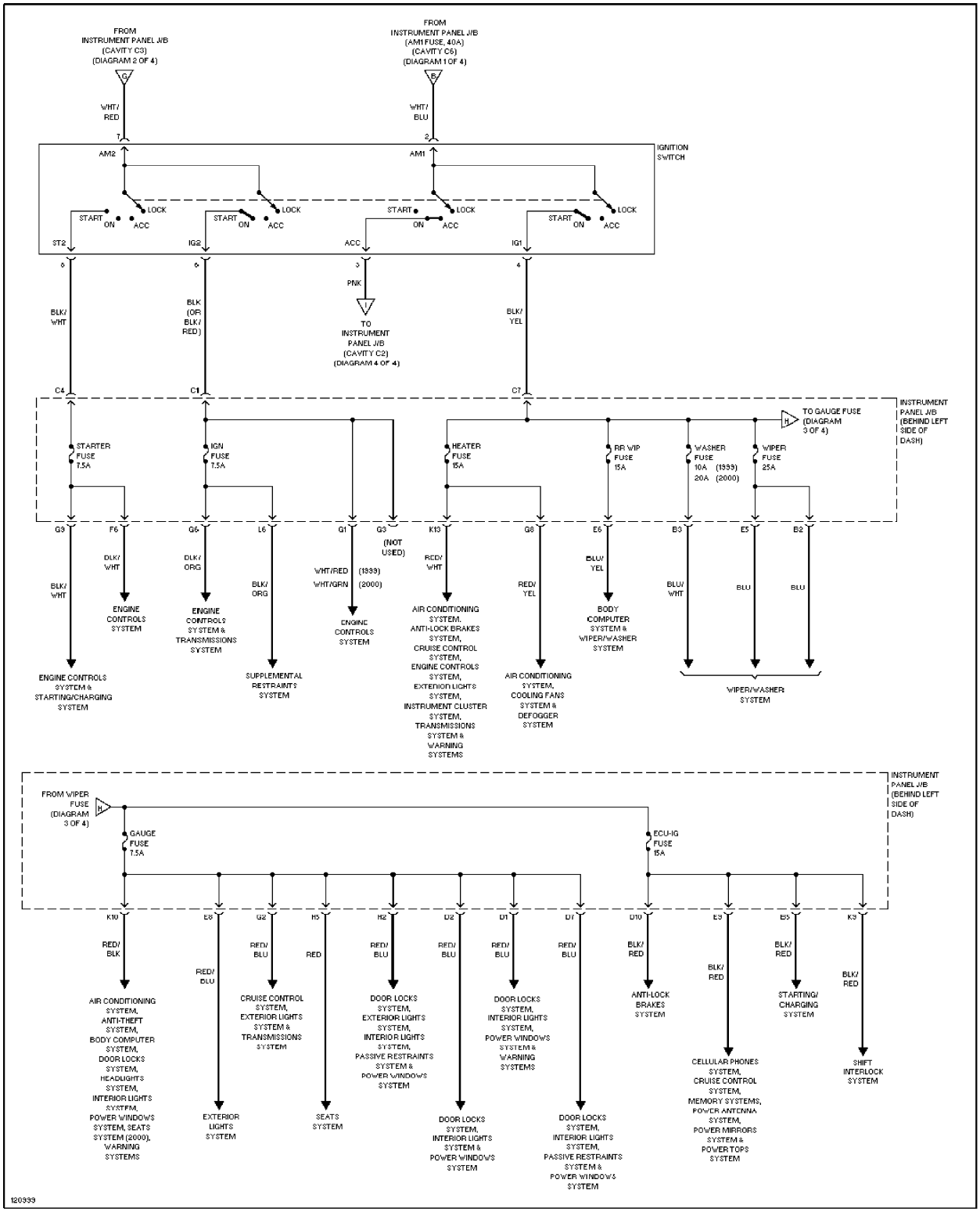
POWER DISTRIBUTION



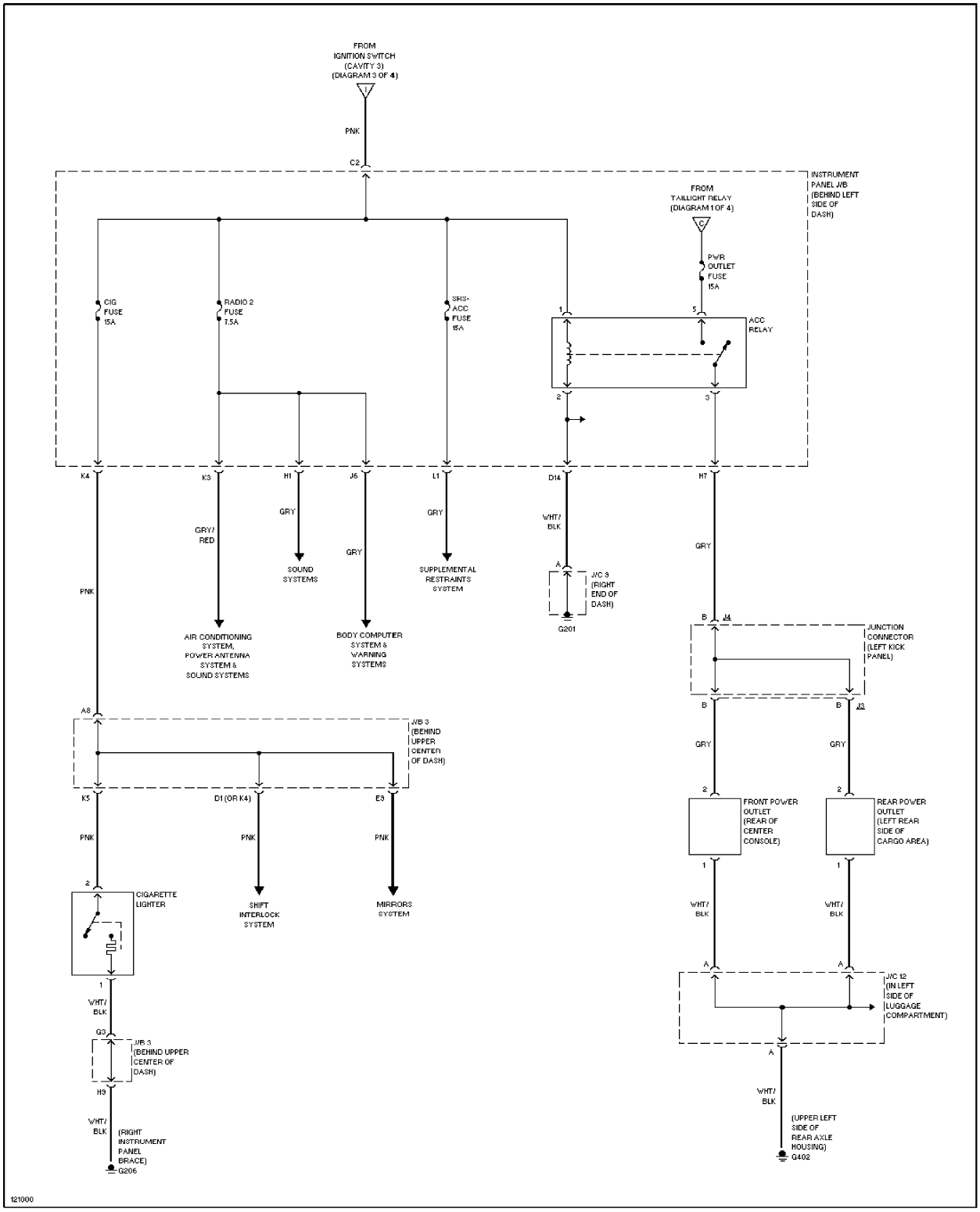
Power Distribution Circuit (1 of 4)



Power Distribution Circuit (2 of 4)

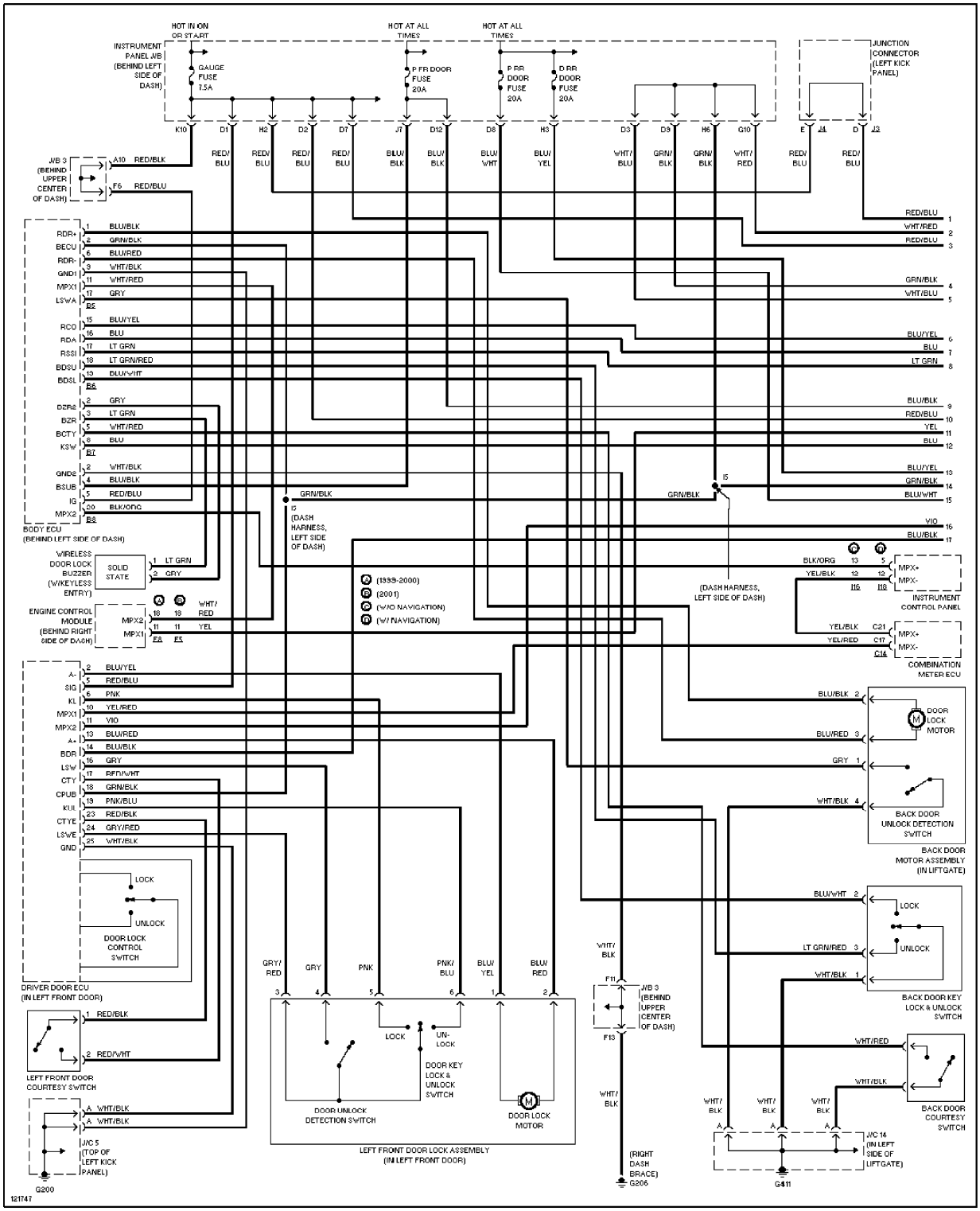


Power Distribution Circuit (3 of 4)

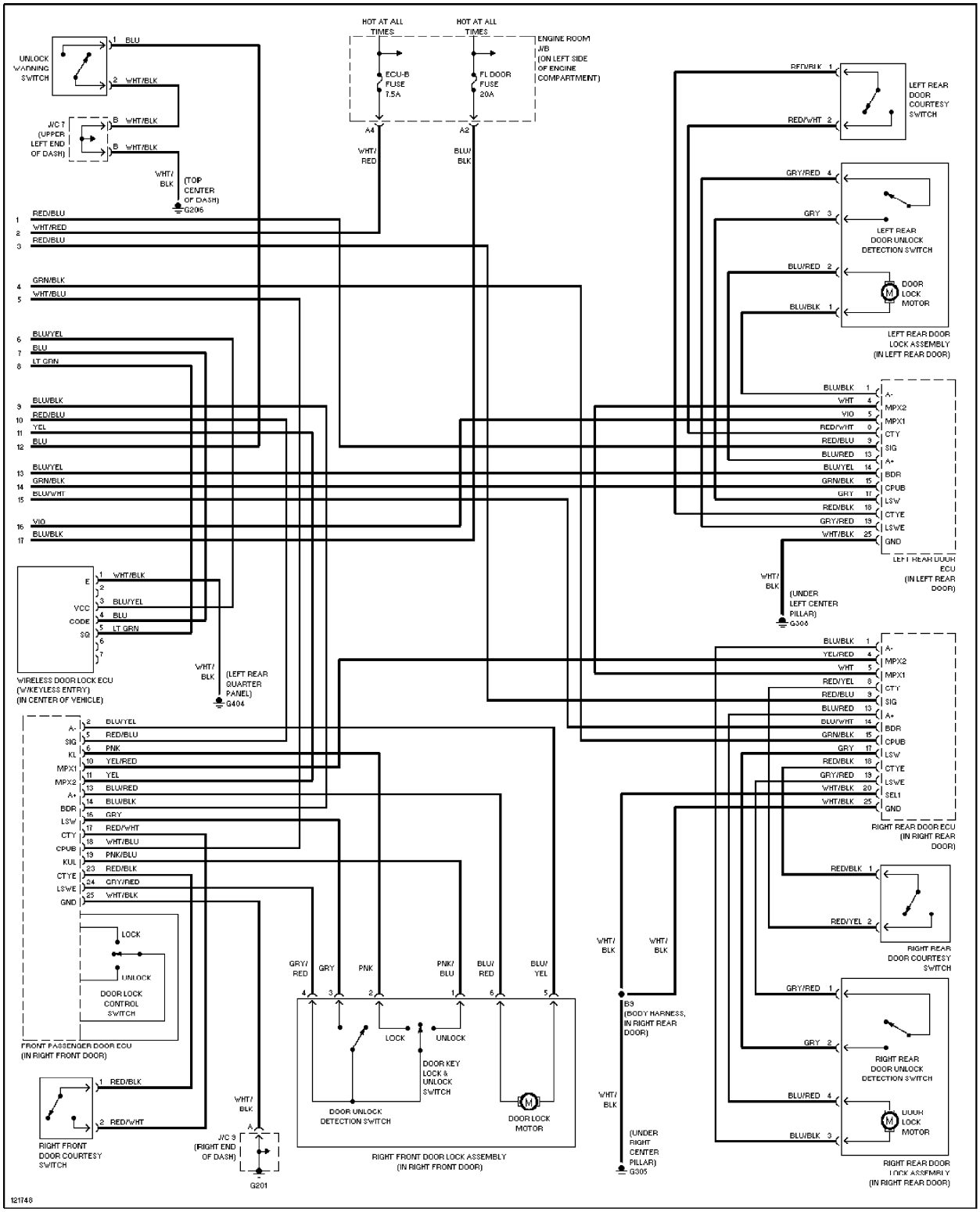


Power Distribution Circuit (4 of 4)

POWER DOOR LOCKS

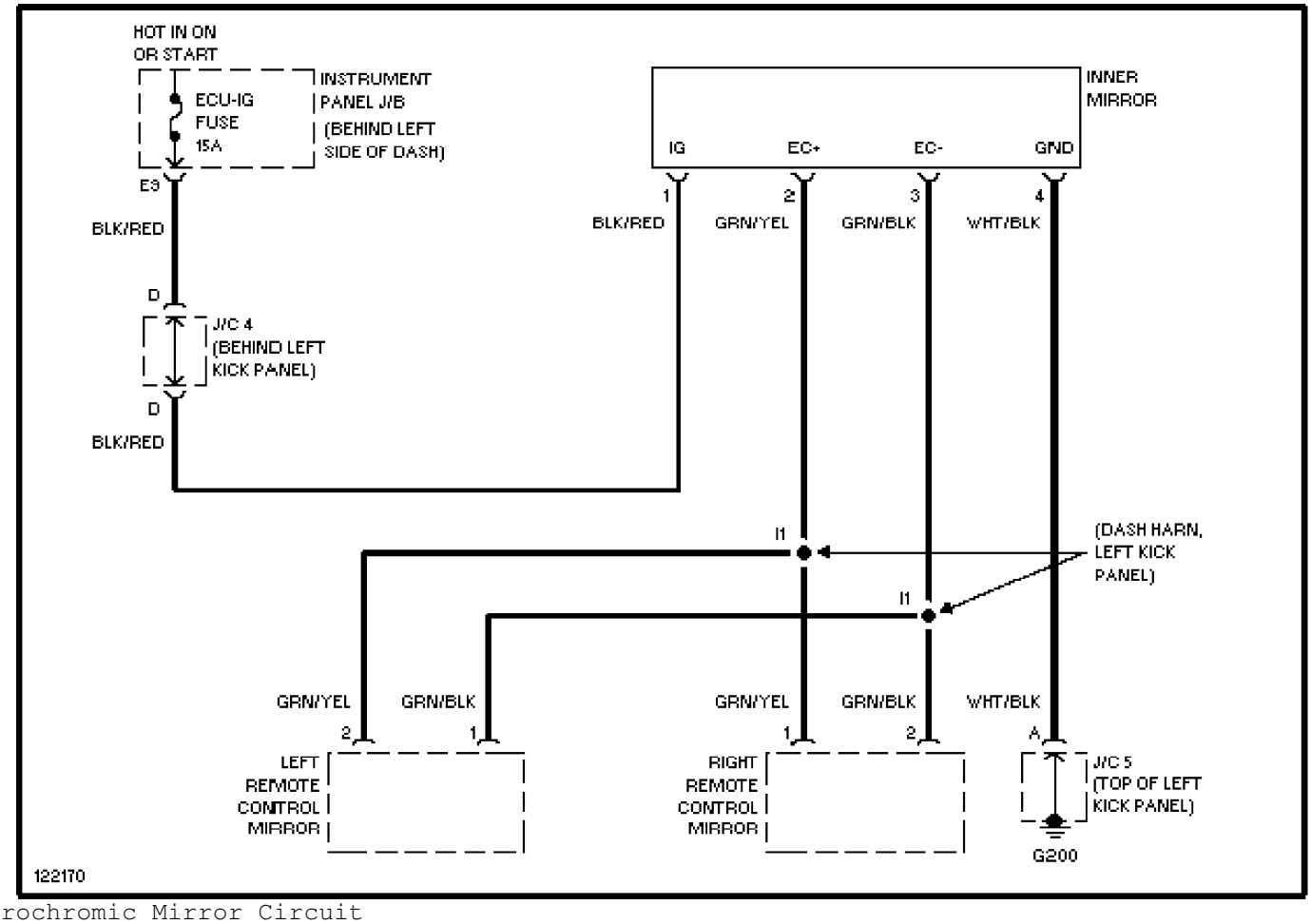


Power Door Lock Circuit (1 of 2)

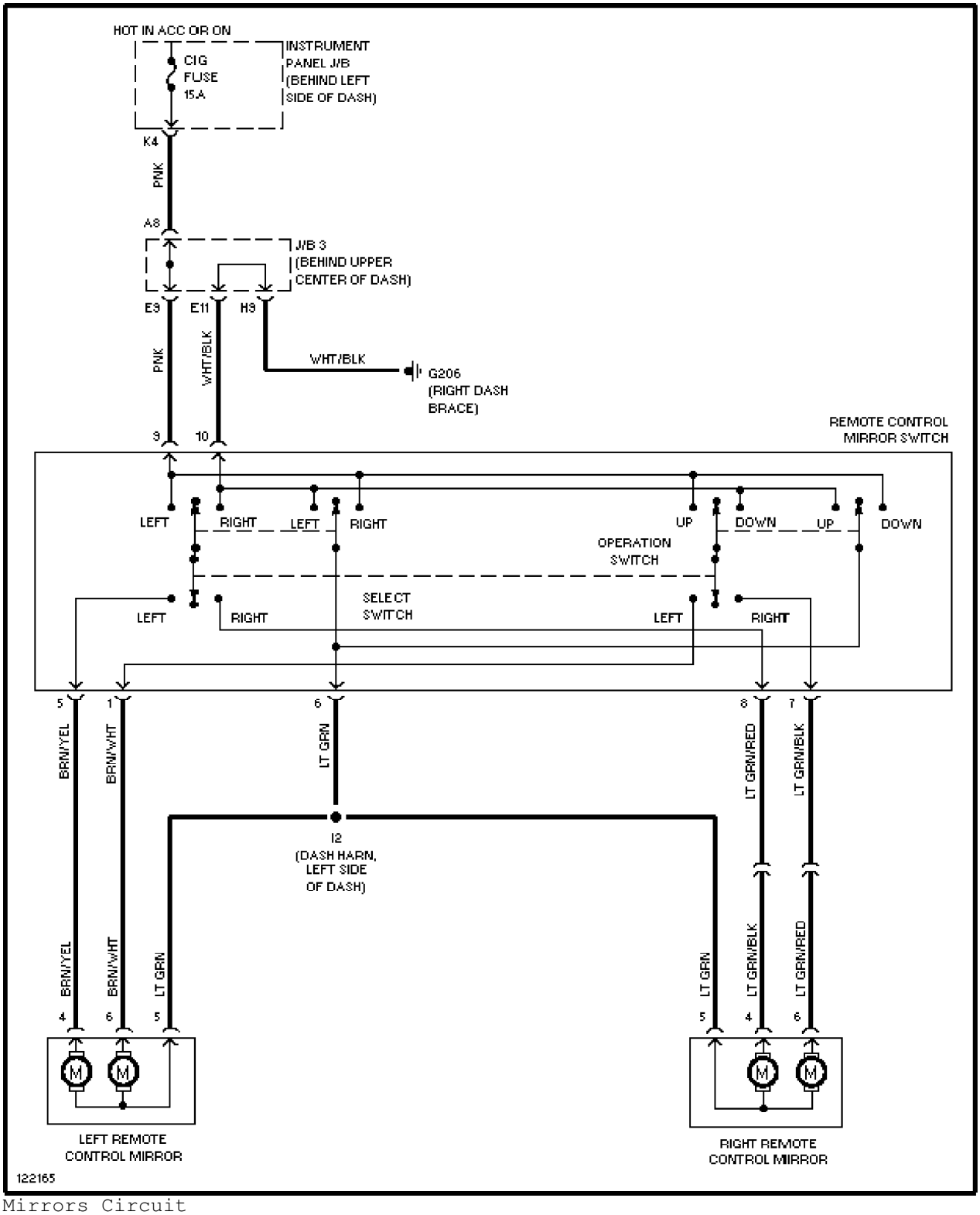


Power Door Lock Circuit (2 of 2)

POWER MIRRORS

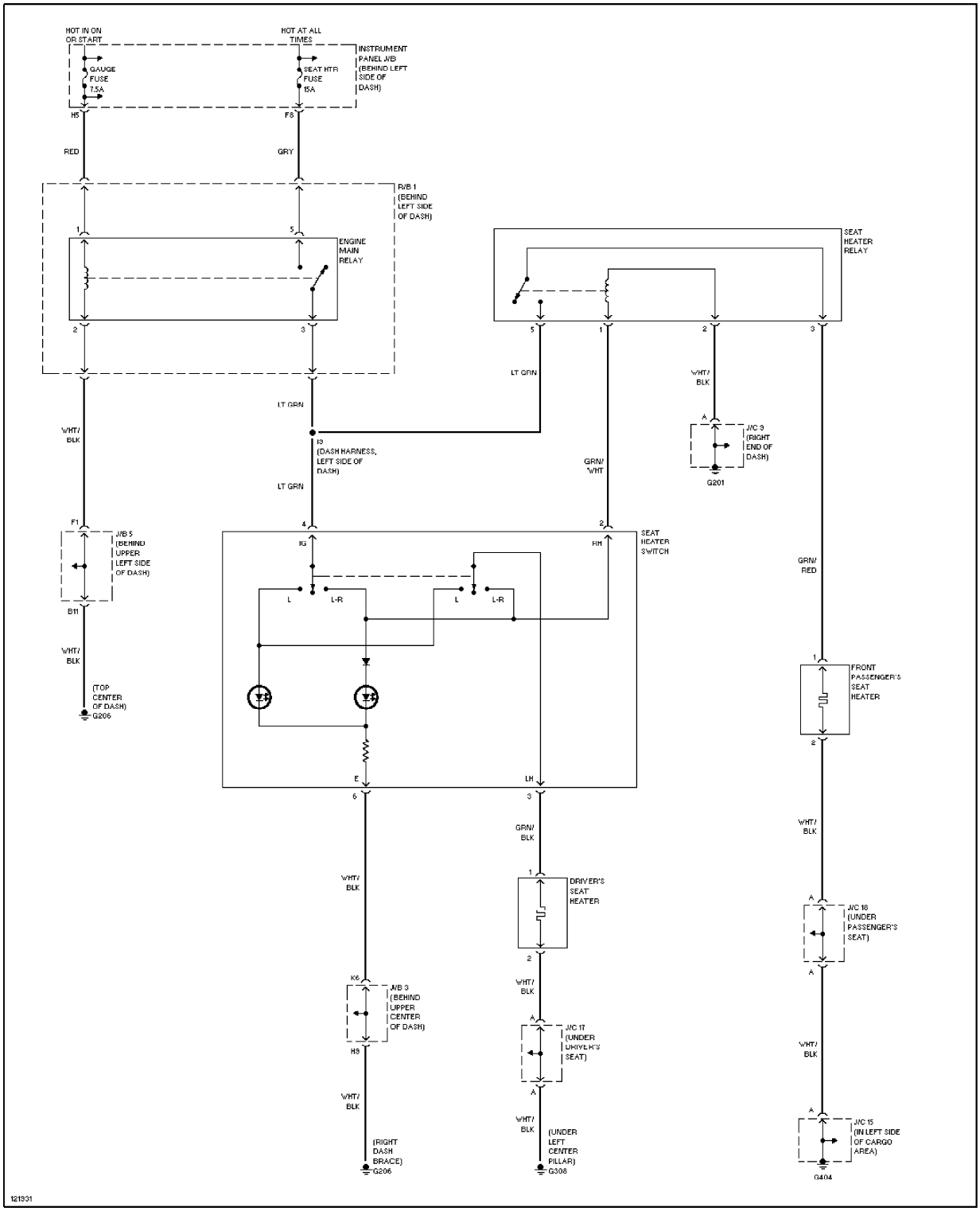


Electrochromic Mirror Circuit

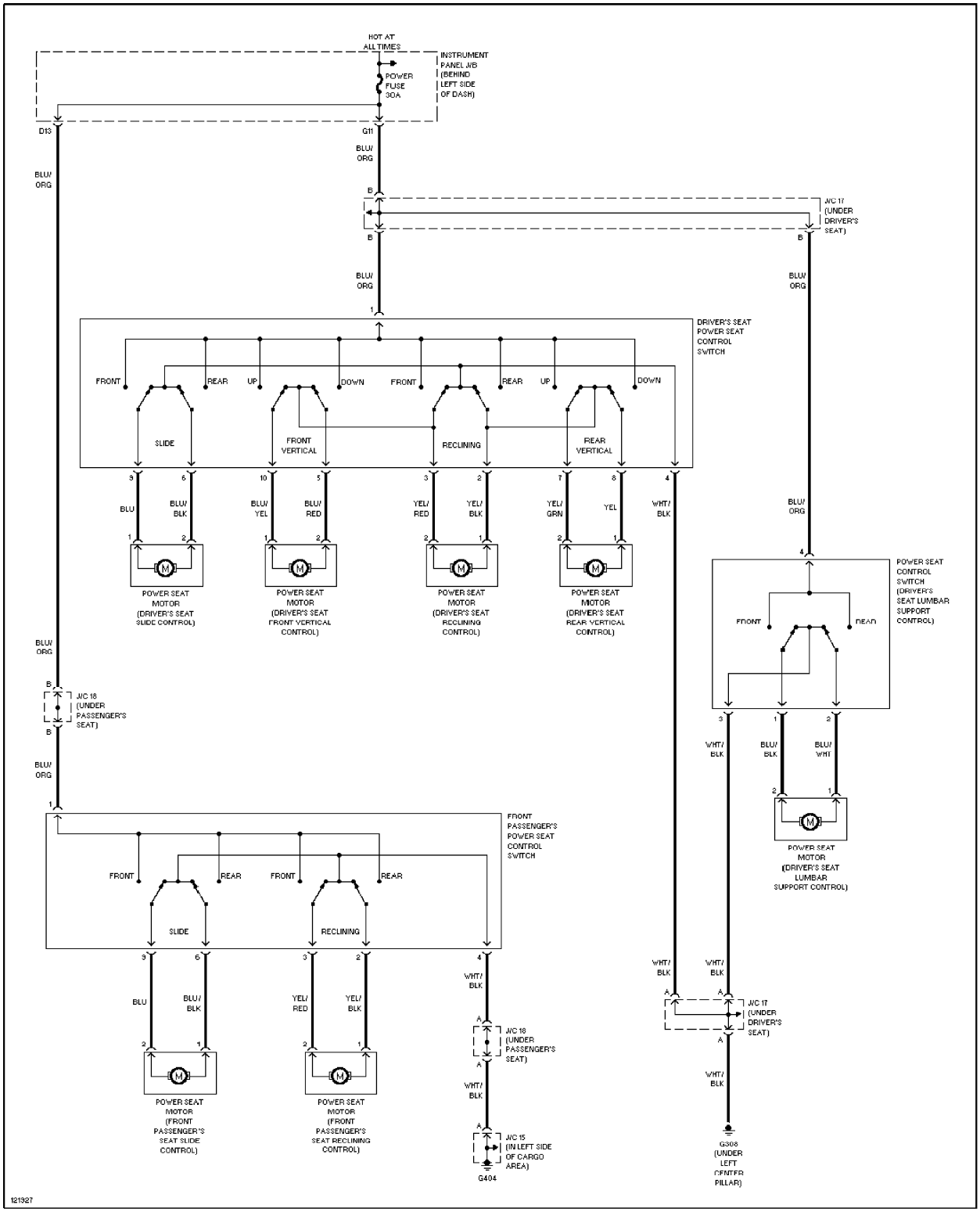


Power Mirrors Circuit

POWER SEATS

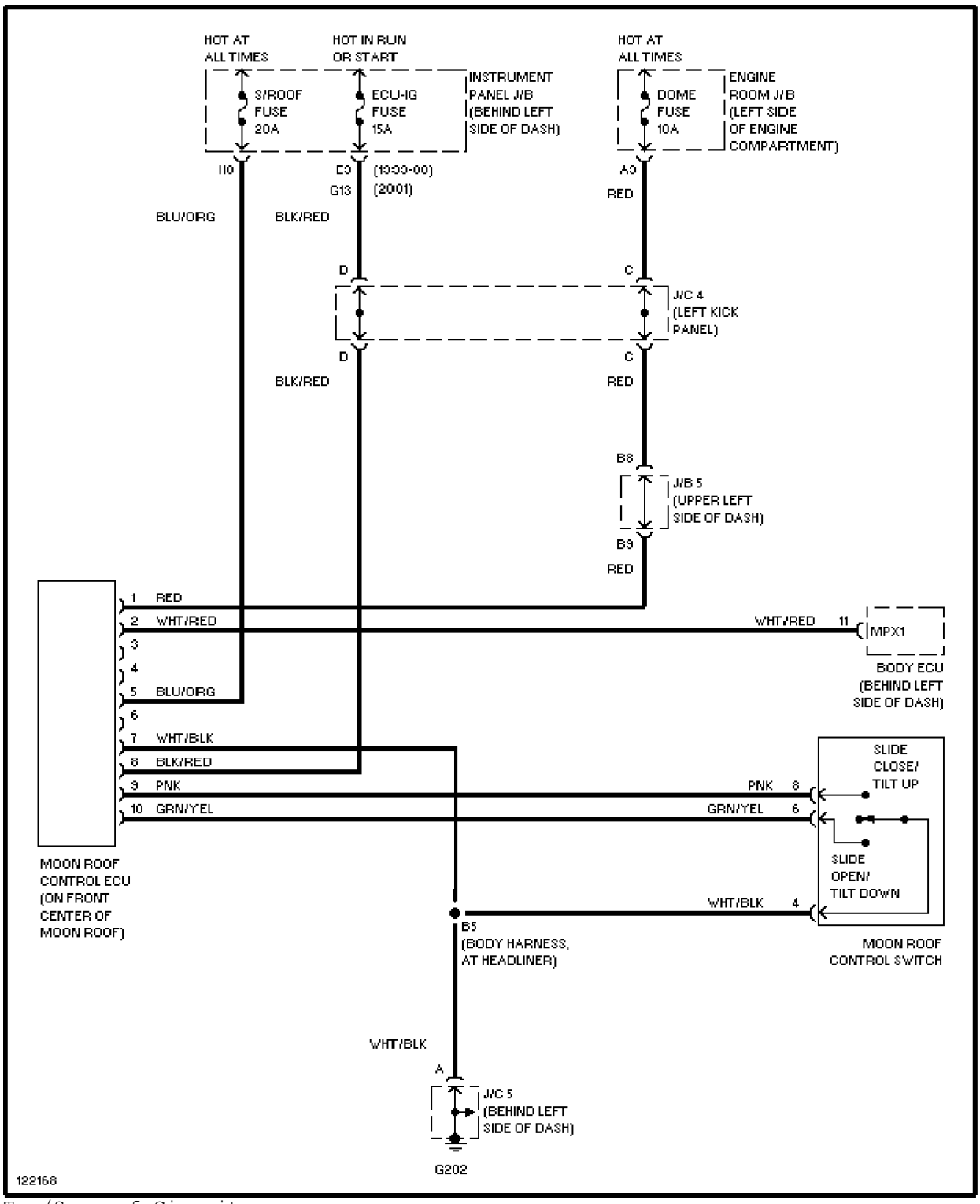


Heated Seats Circuit



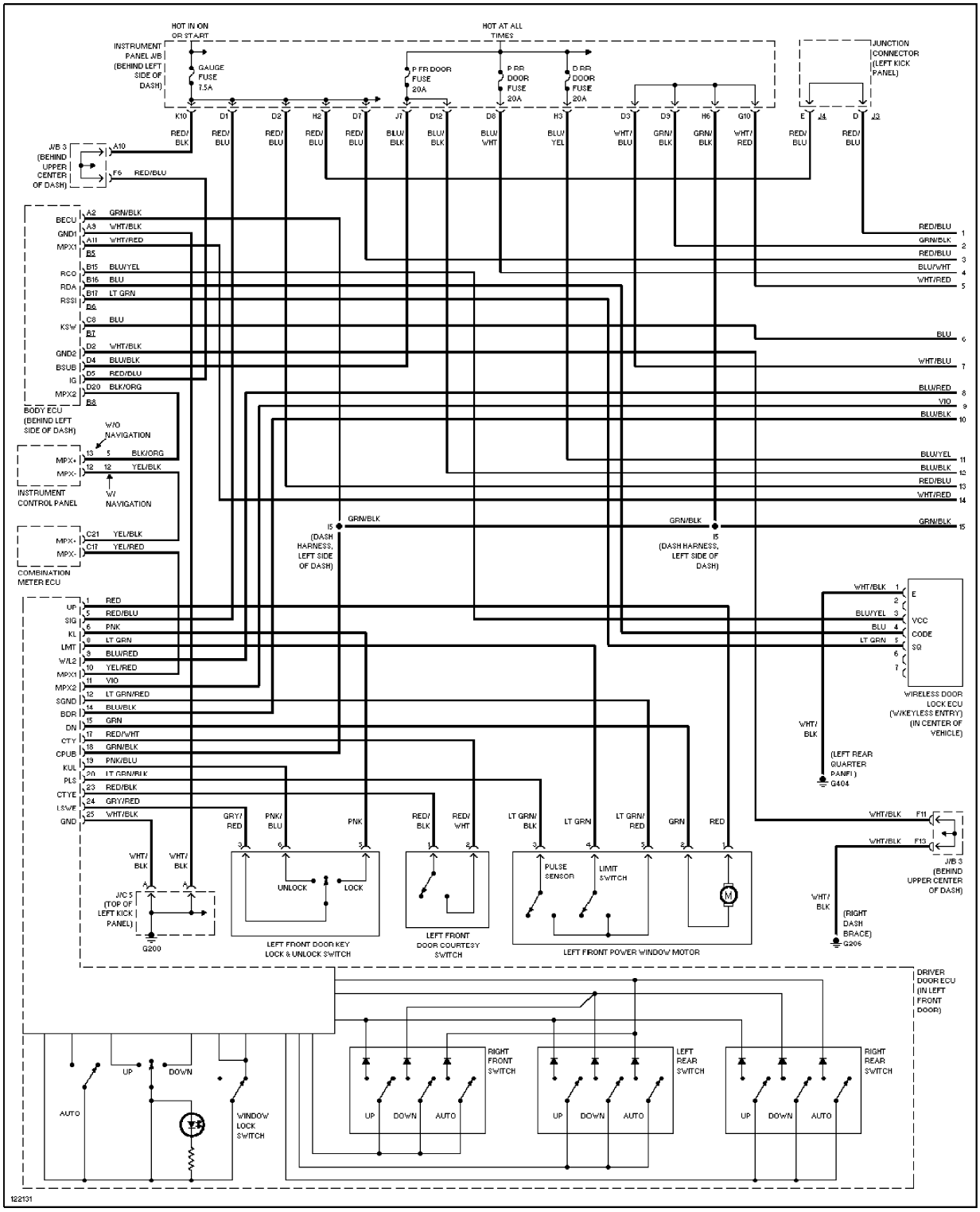
Power Seats Circuit

POWER TOP/SUNROOF

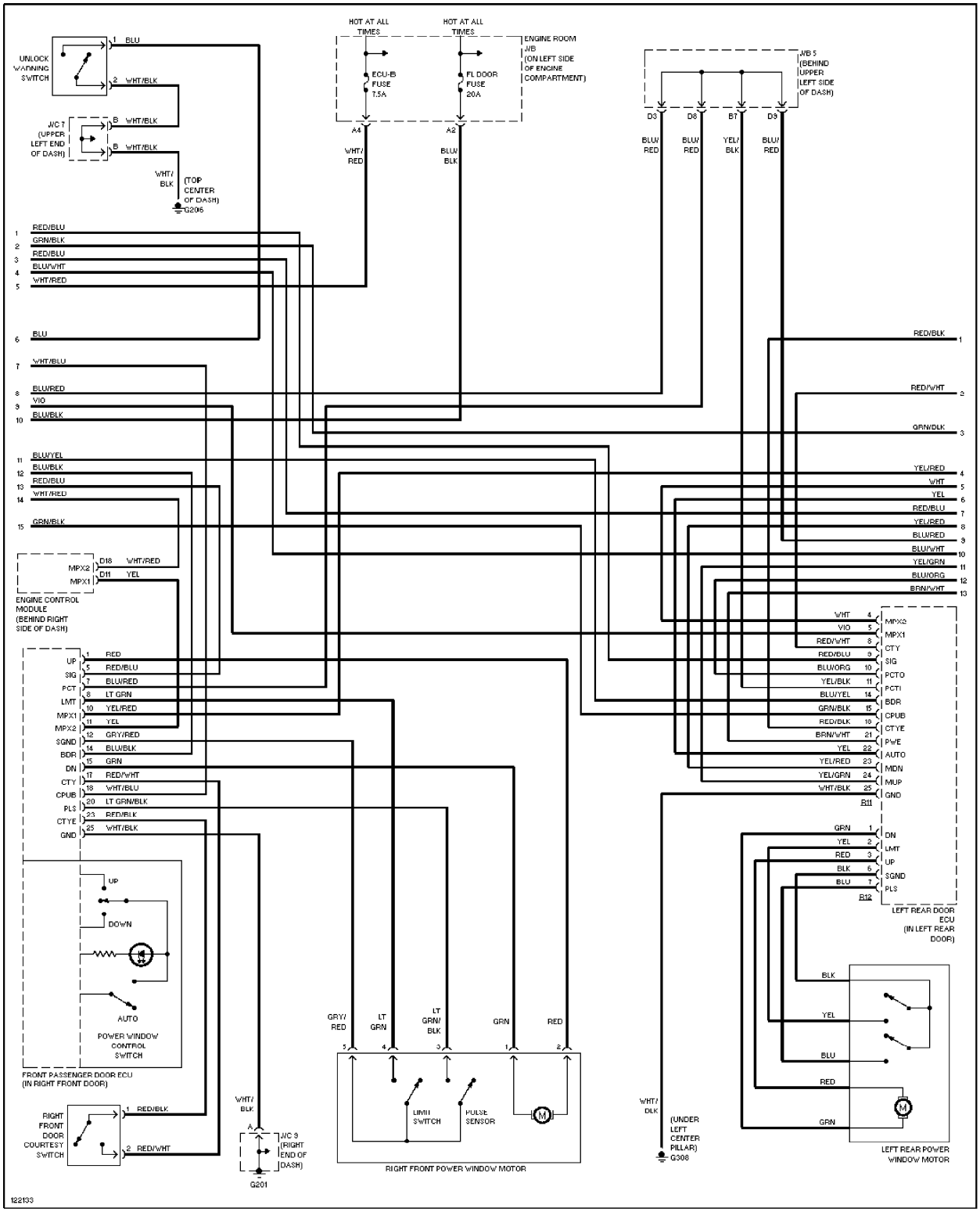


Power Top/Sunroof Circuits

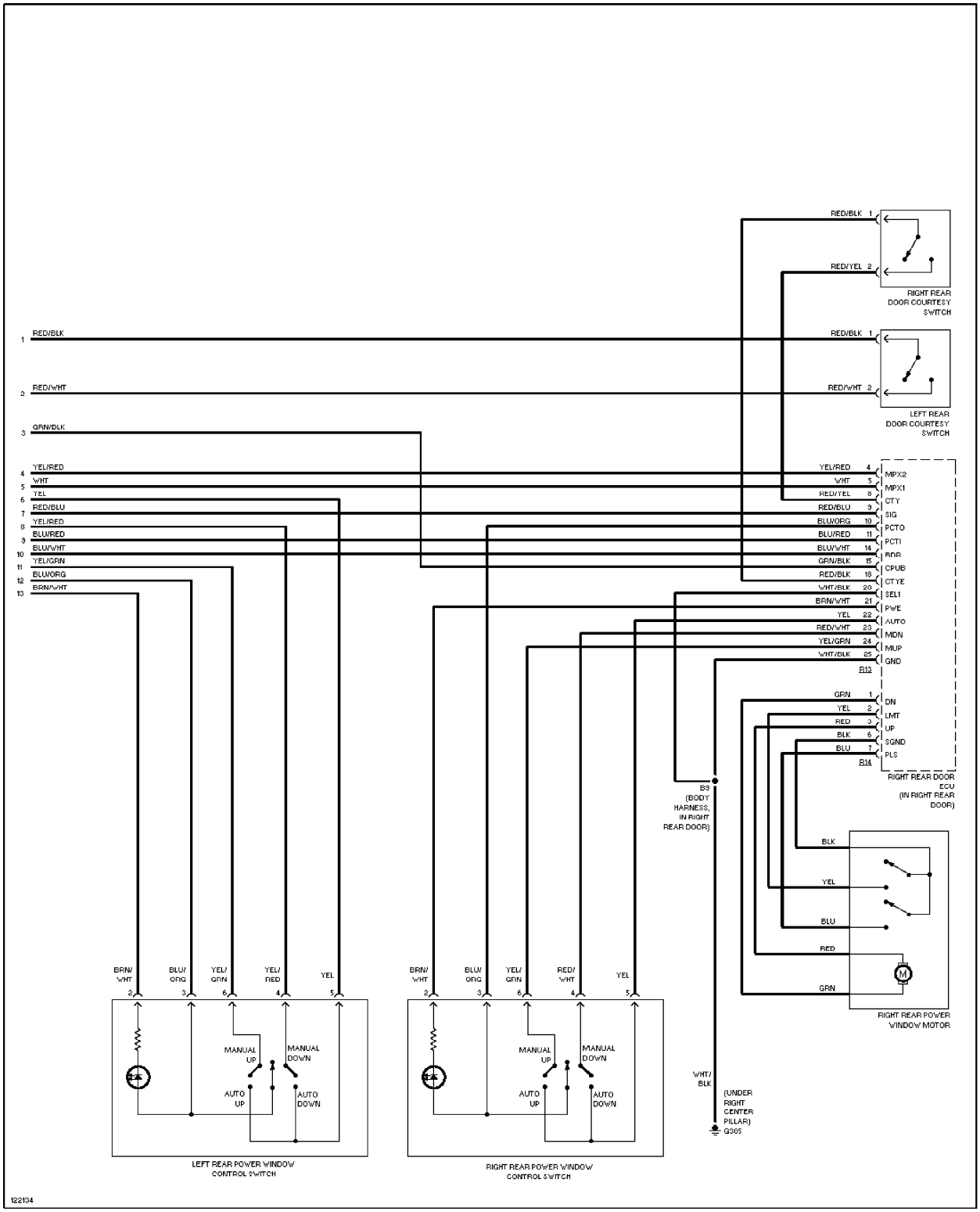
POWER WINDOWS



Power Window Circuit (1 of 3)

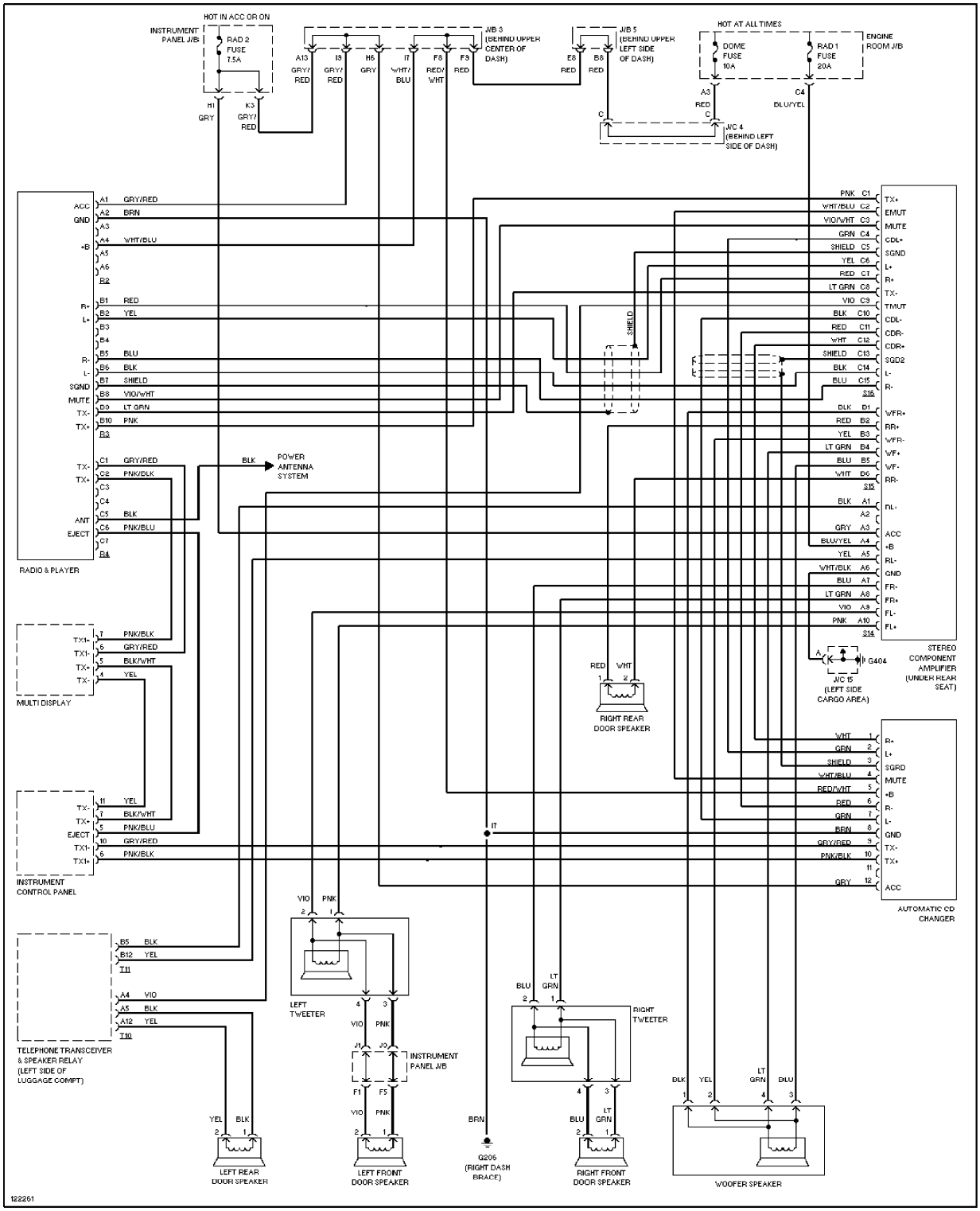


Power Window Circuit (2 of 3)



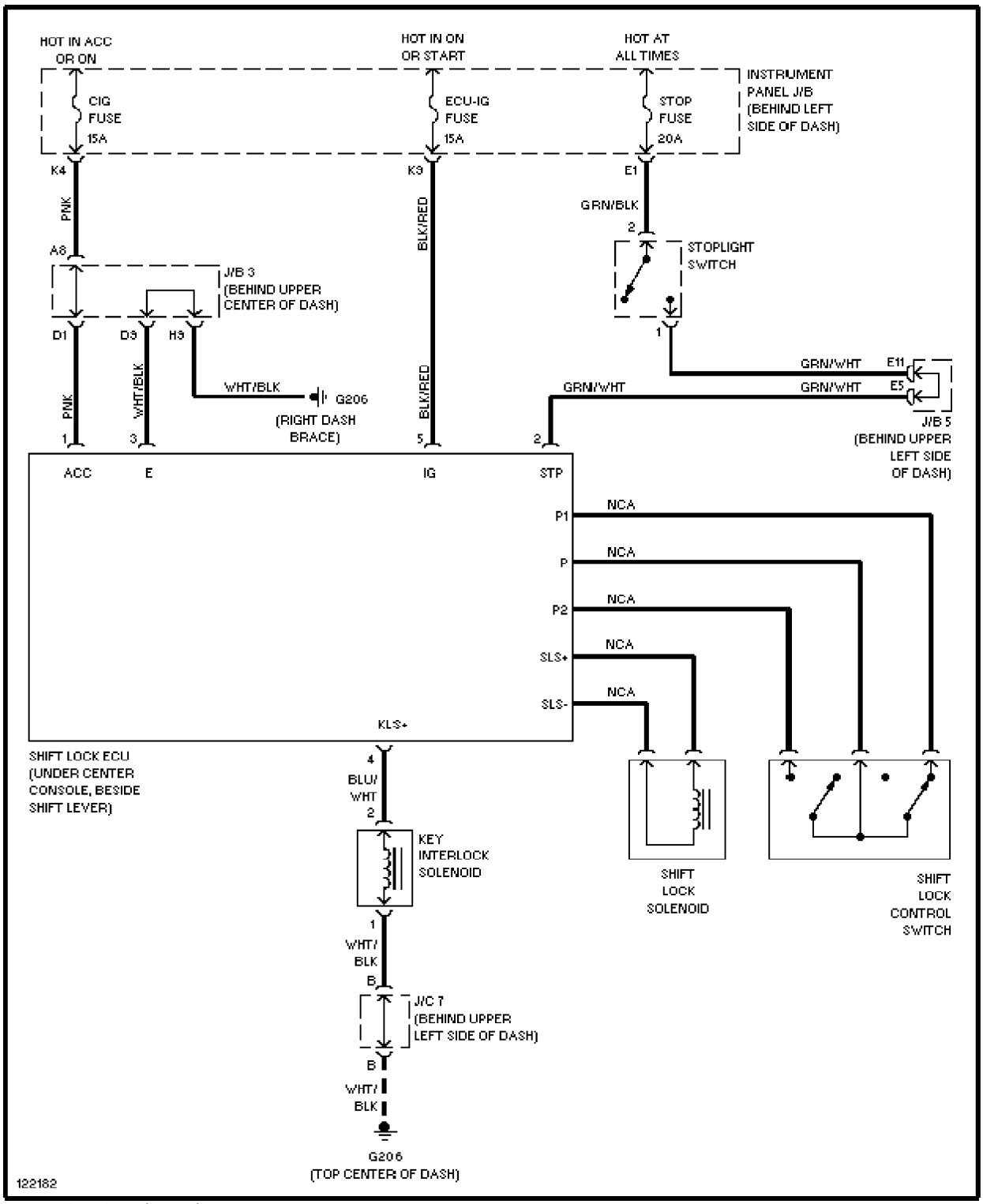
Power Window Circuit (3 of 3)

RADIO



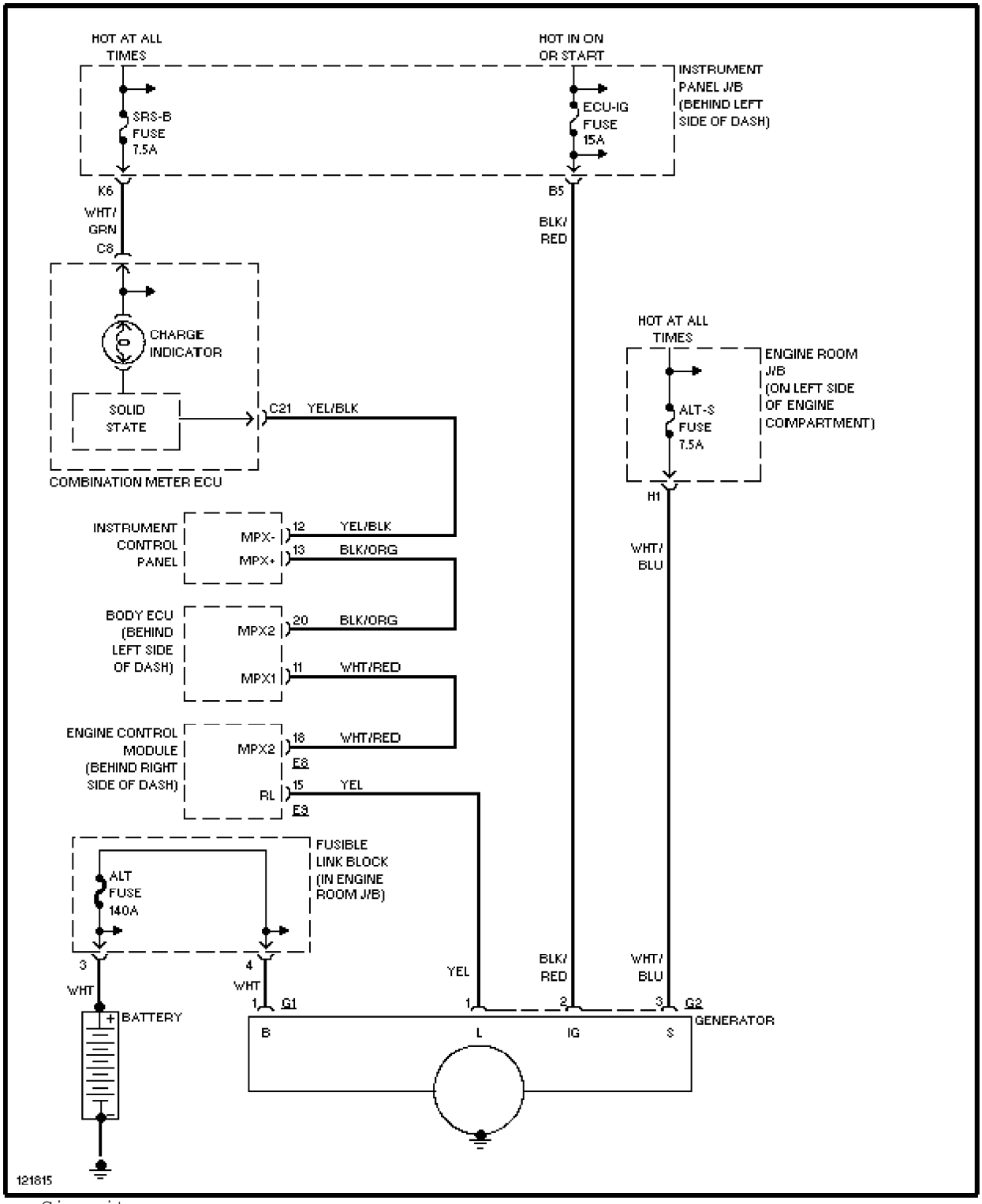
Radio Circuits

SHIFT INTERLOCKS

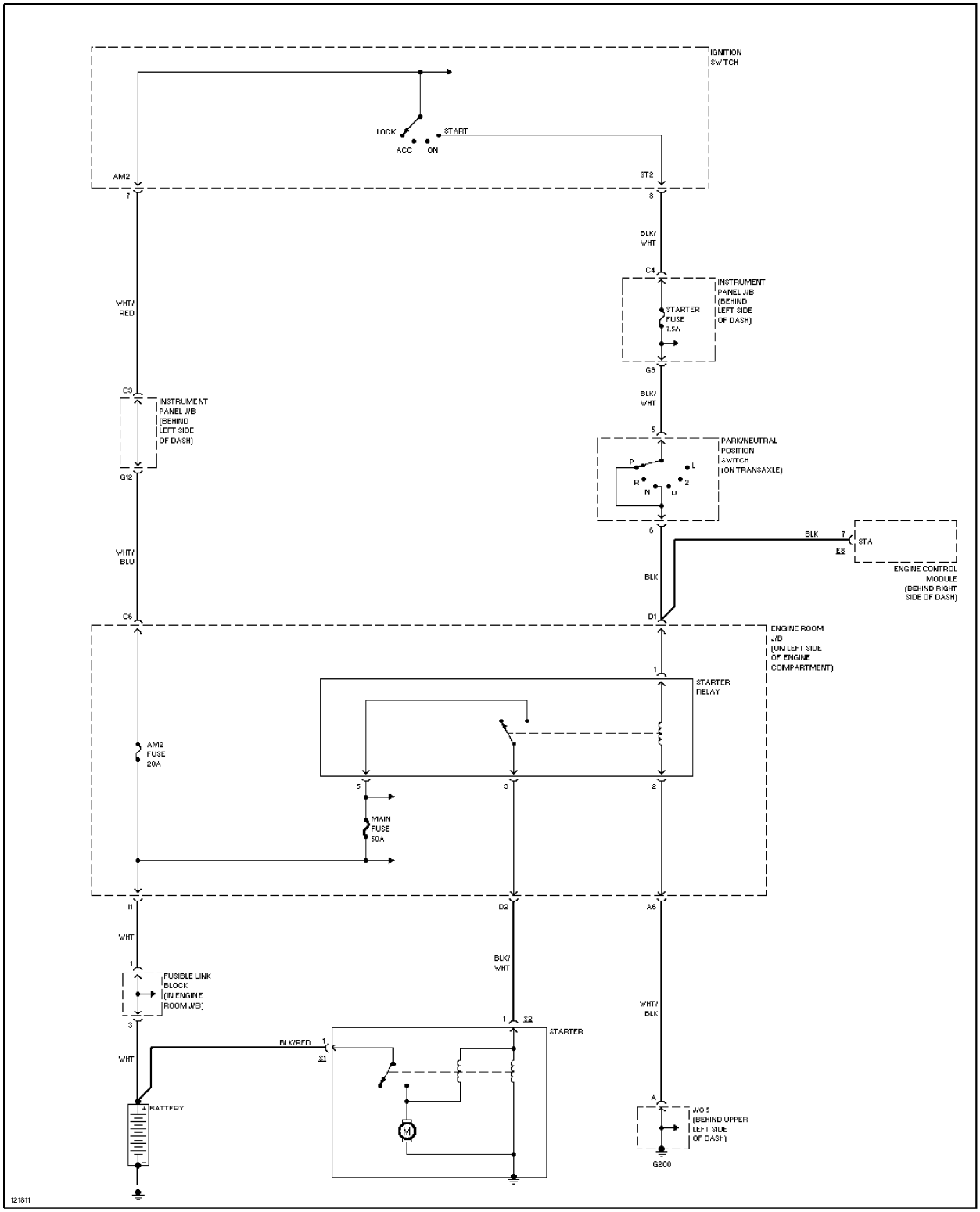


Shift Interlock Circuit

STARTING/CHARGING

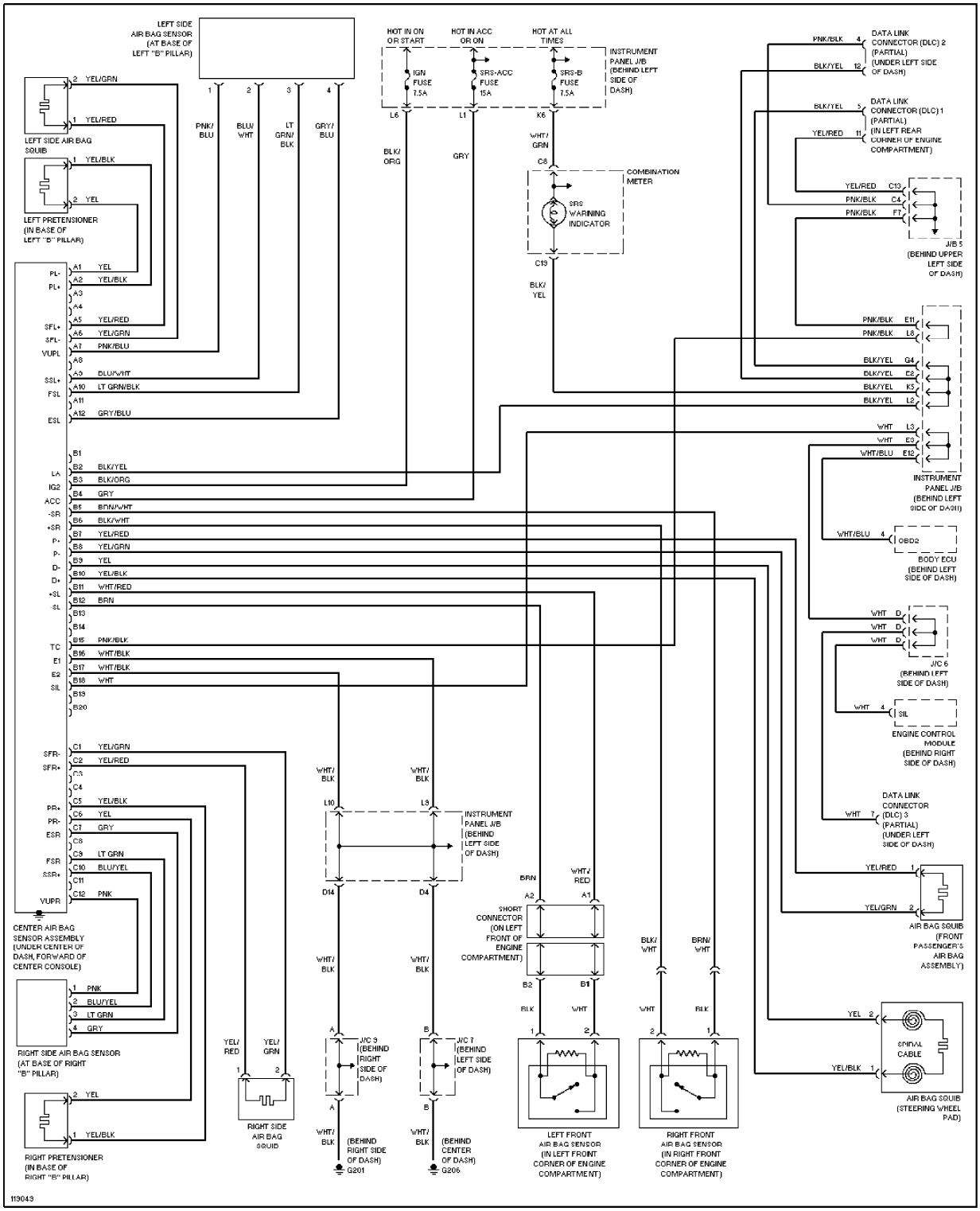


Charging Circuit



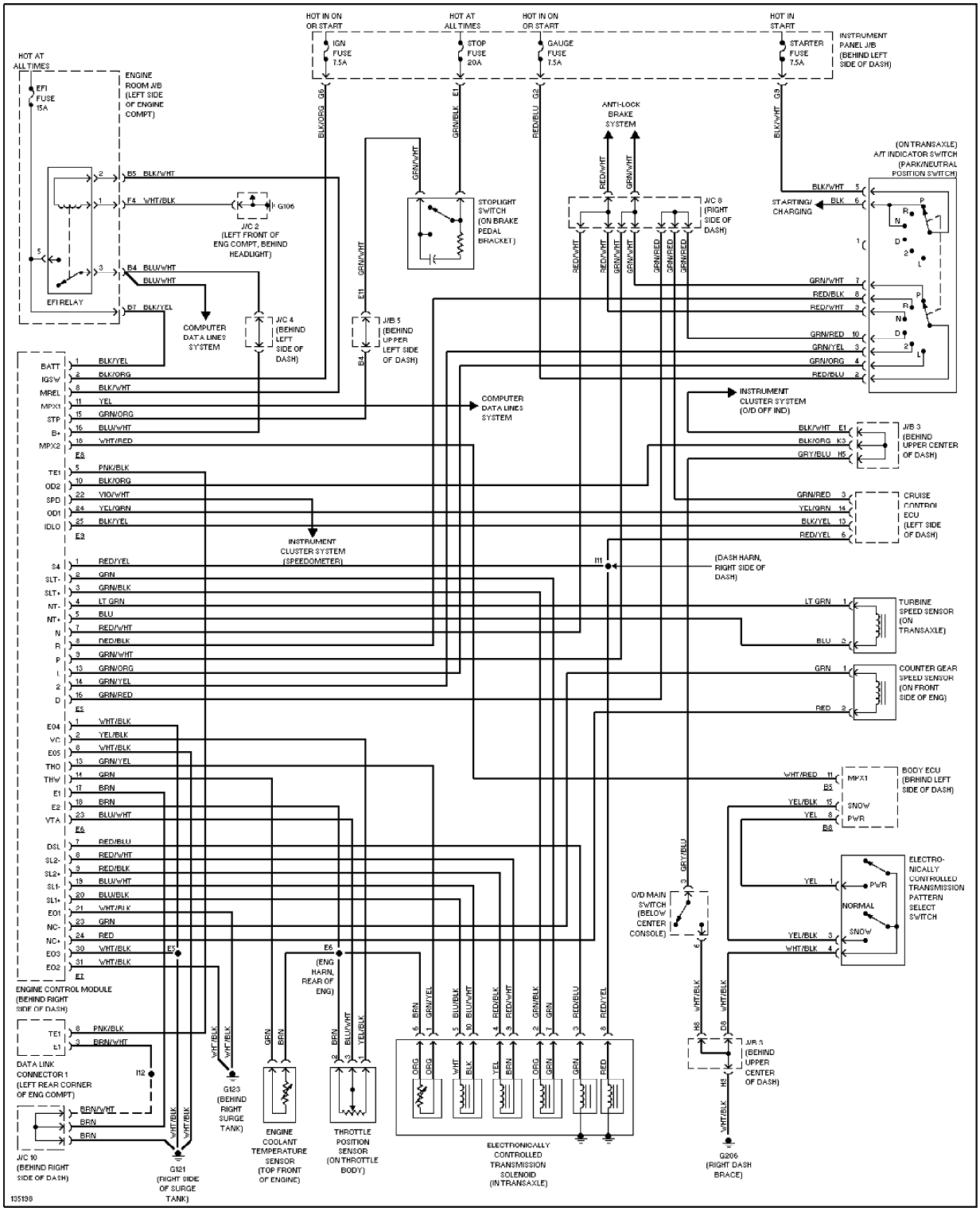
Starting Circuit

SUPPLEMENTAL RESTRAINTS



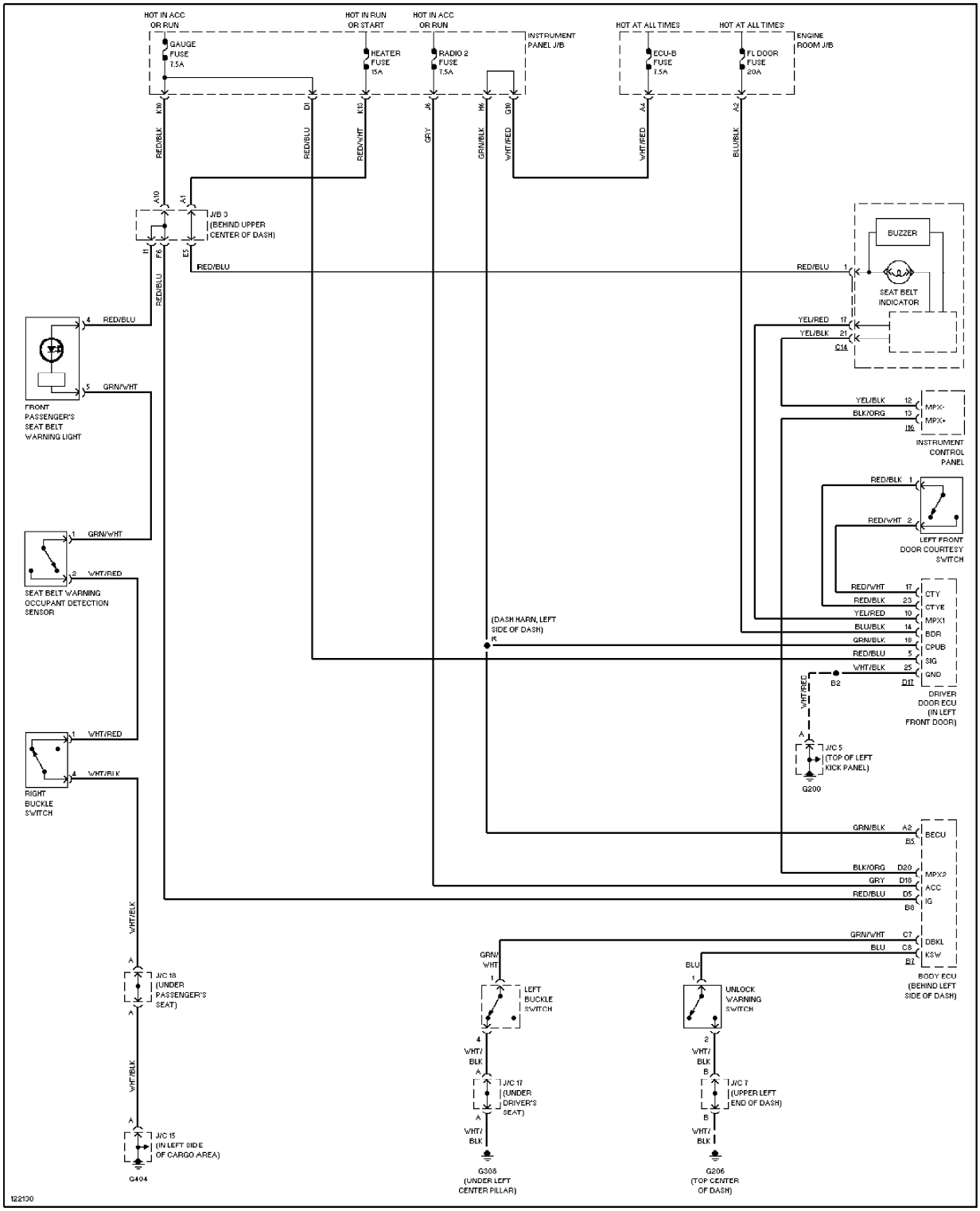
Supplemental Restraint Circuit

TRANSMISSION



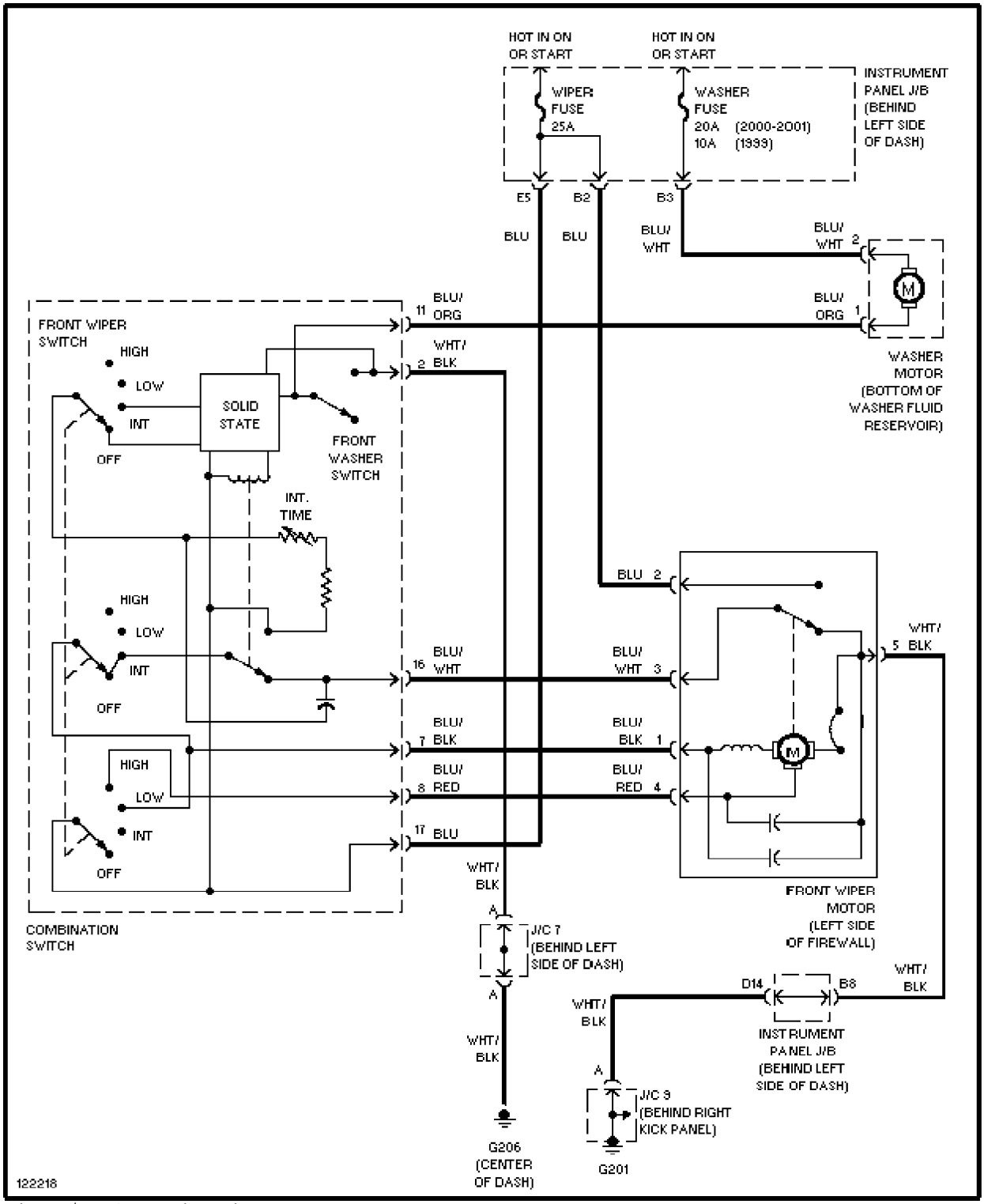
A/T Circuit

WARNING SYSTEMS

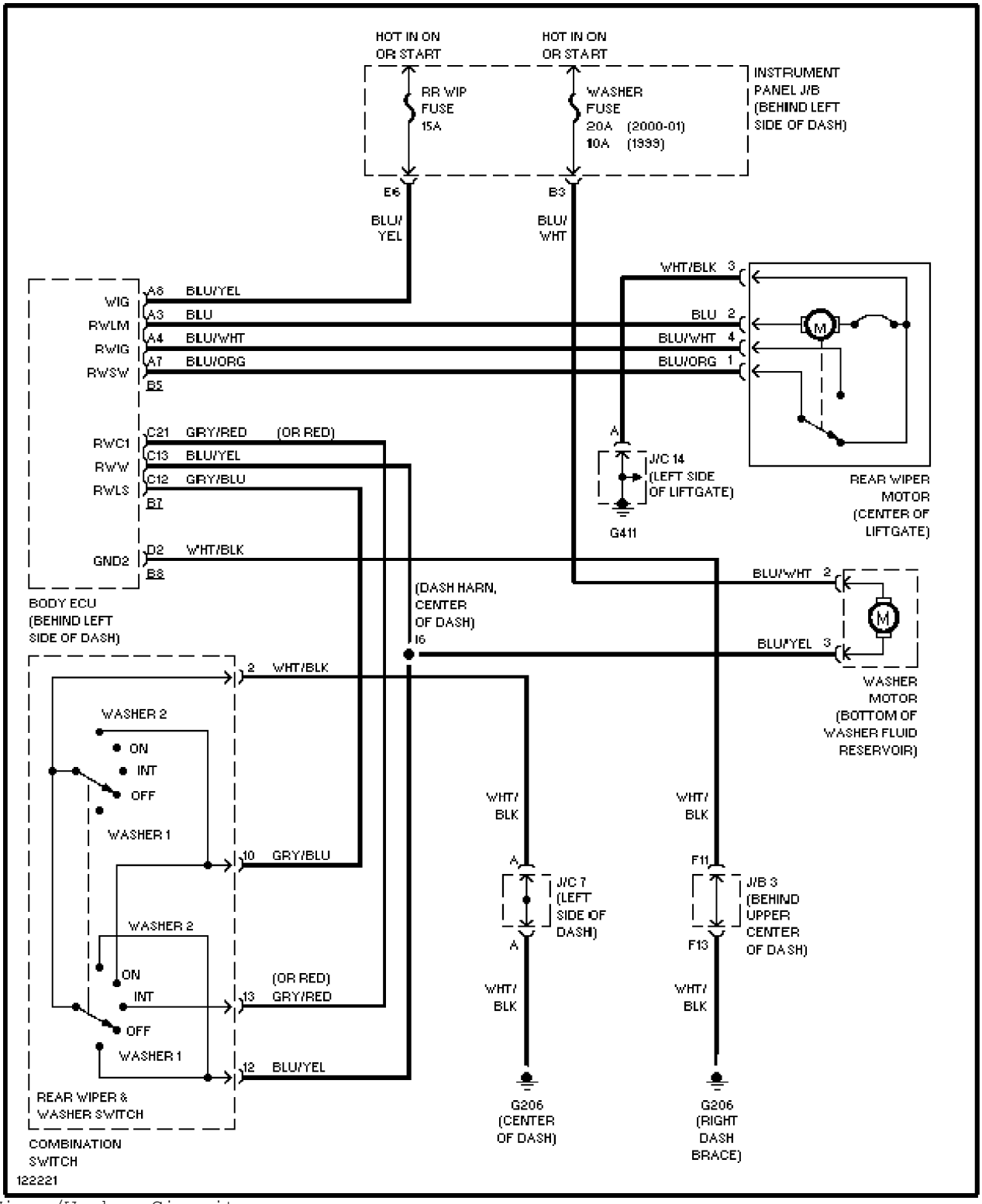


Warning System Circuits

WIPER/WASHER



Front Wiper/Washer Circuit



Rear Wiper/Washer Circuit

TRANSFER CASE OVERHAUL - MCU14

1999 Lexus RX 300

1999-2001 TRANSFER CASES
Lexus MCU14 Overhaul

APPLICATION

TRANSFER CASE APPLICATIONS

Application	Transfer Case Model
RX300	
Automatic Transaxle U140F	MCU14

DESCRIPTION

All-Wheel Drive (AWD) transfer case is a full-time unit. Transfer case can be removed from transaxle and serviced separately once transaxle is removed from vehicle.

ON-VEHICLE SERVICE

OIL SEAL REPLACEMENT

Removal

Remove oil filler plug. Remove oil drain plug, and drain transfer case oil. Remove drive shaft. Using appropriate puller, remove oil seal.

Installation

Coat seal with gear oil and install into extension housing using appropriate oil seal installer. Install drive shaft. Install drain plug and tighten to specification. See TORQUE SPECIFICATIONS. Fill transfer case with .95 qt. (.9L) of SAE 90W GL-5 or equivalent gear oil. Install filler plug and tighten to specification.

REMOVAL & INSTALLATION

NOTE: Separate removal and installation procedure for transfer unit is not provided by manufacturer.

TRANSFER CASE DISASSEMBLY & REASSEMBLY

Disassembly

1) Remove differential side gear intermediate shaft No. 2. Remove case cover. See Fig. 1. Remove oil deflector from case cover. Remove extension housing. Check and record starting torque of driven pinion using Driven Pinion Nut Socket (09326-20011). See Fig. 2. Starting torque should be 7.8-11.2 INCH lbs. (.9-1.3 N.m).

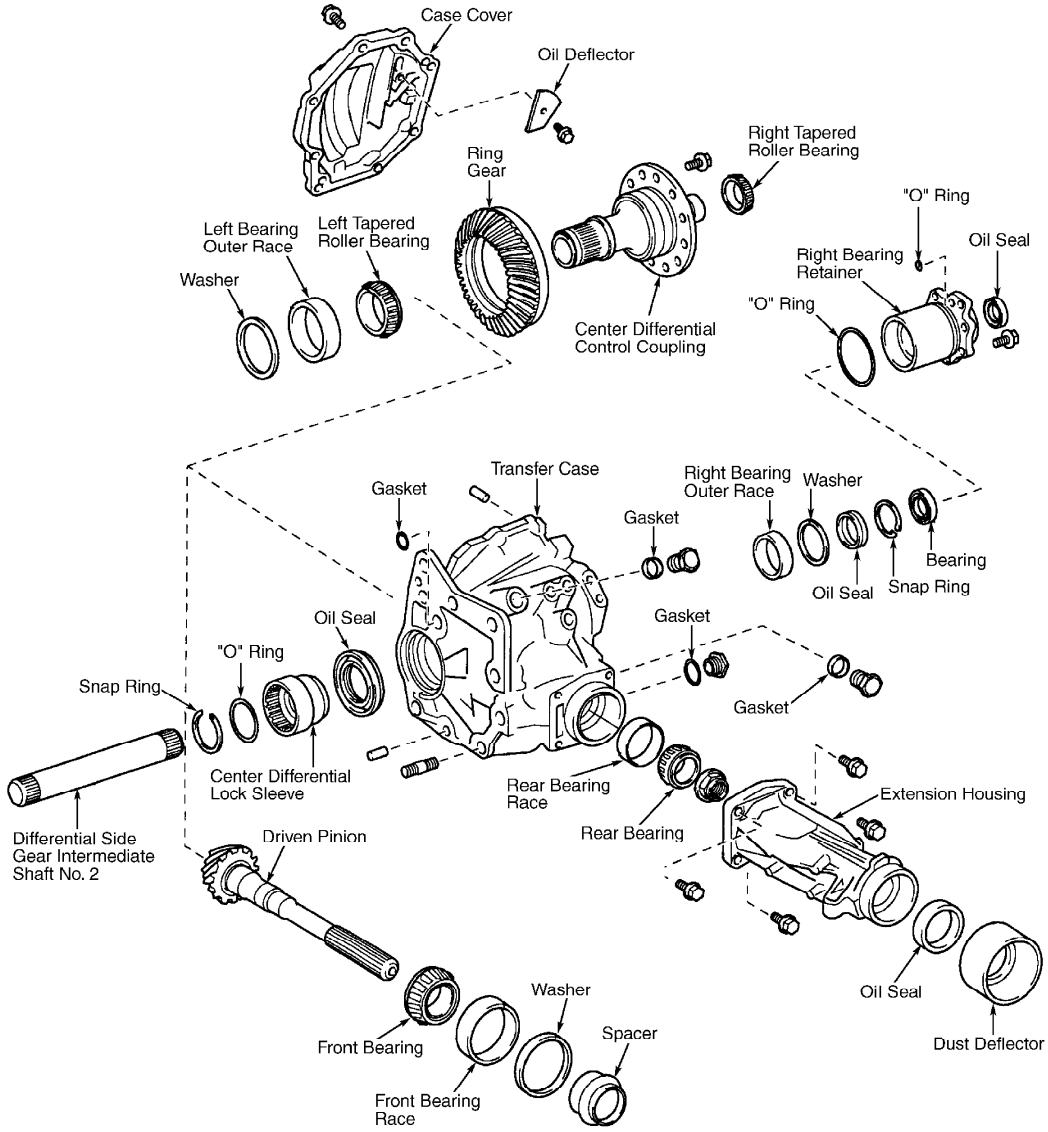
2) Check and record ring gear backlash. Mount dial indicator on transfer case. See Fig. 3. Backlash should be .004-.006" (.10-.15 mm). Remove center differential lock sleeve snap ring. Remove center differential lock sleeve using slide hammer with 2-jaw attachment. Remove "O" ring from center differential lock sleeve.

3) Remove bearing retainer from right side of transfer case. Remove internal components from bearing retainer. See Fig. 1. Remove

center differential control coupling from transfer case. Using appropriate puller, remove bearing from center differential control coupling (as necessary). Place center differential control coupling on "V" blocks and measure ring gear runout. Runout should not exceed .004" (.10 mm).

4) Place matching marks for reassembly reference on ring gear and center differential control coupling. Remove ring gear bolts in crisscross pattern. Using plastic faced hammer, remove ring gear. Place center differential control coupling on "V" blocks and measure ring gear mounting face runout. Runout should not exceed .004" (.10 mm).

5) Using hammer and chisel, unstake driven pinion lock nut. Remove lock nut. Press out driven pinion, rear bearing race and spacer. Remove remaining bearings and races (as needed).



G00026623

Fig. 1: Exploded View Of MCU15 Transfer Case
Courtesy of Nissan Motor Co., U.S.A.

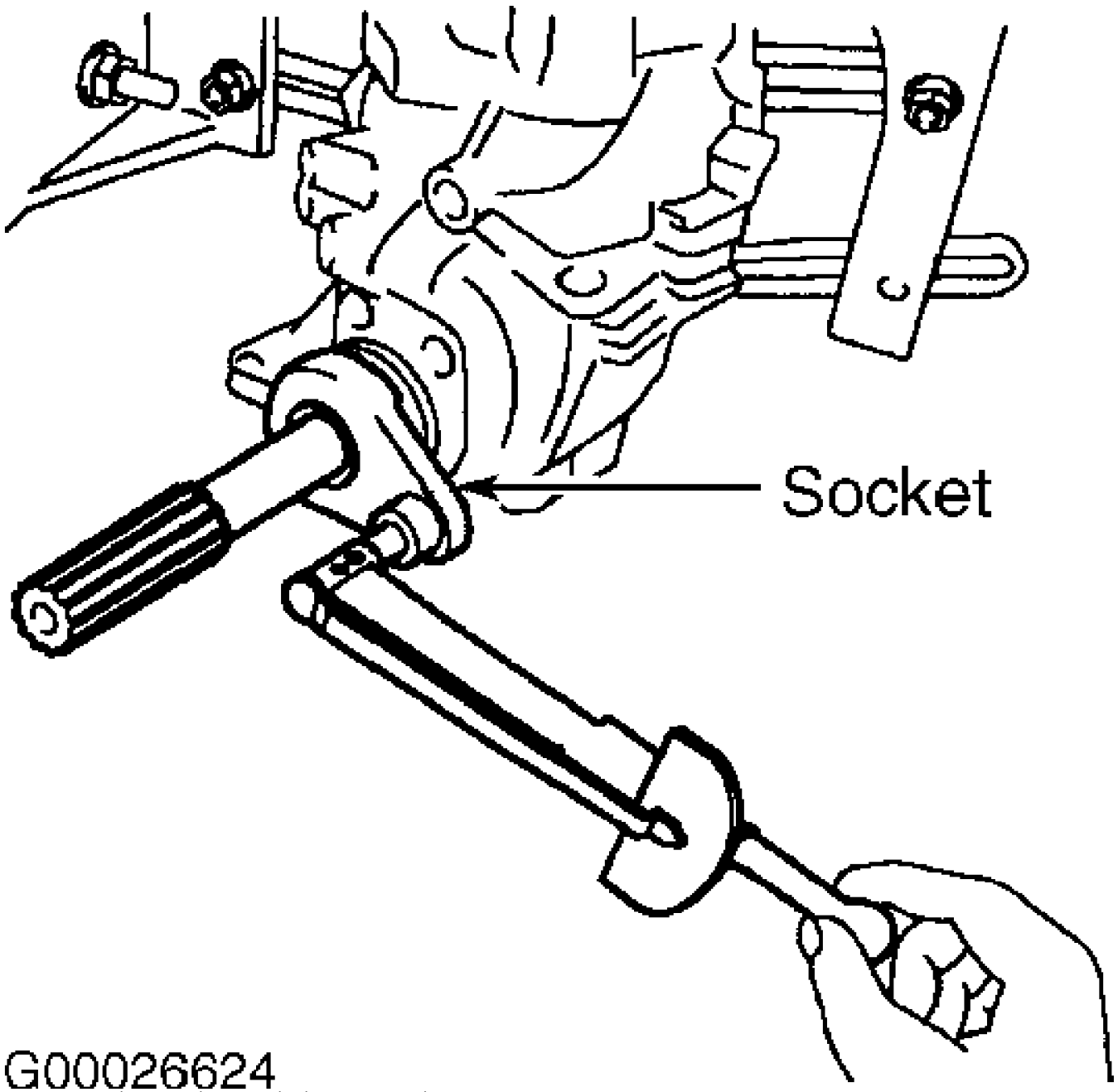
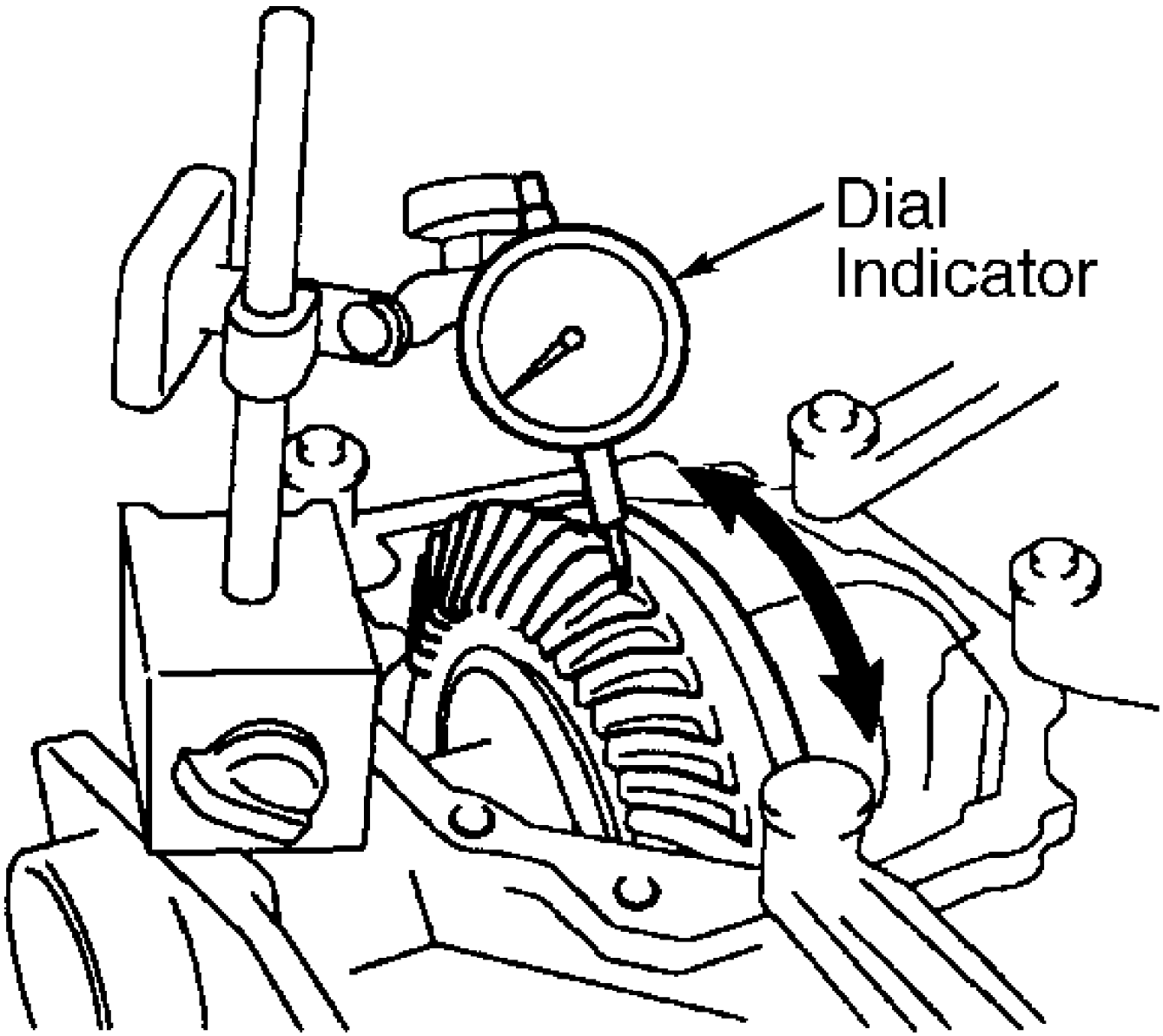


Fig. 2: Measuring Driven Pinion Starting Torque
Courtesy of Nissan Motor Co., U.S.A.



G00026622

Fig. 3: Measuring Ring Gear Backlash
Courtesy of Nissan Motor Co., U.S.A.

Reassembly

1) Install appropriate bearing races in transfer case (as needed). Use original washers. Install driven pinion in transfer case. Install NEW spacer and rear bearing inner race to driven pinion. Install lock nut and tighten to 218 ft. lbs. (295 N.m).

NOTE: If tightening torque for driven pinion lock nut is greater than specification and starting torque is less than specification, loosen lock nut and lubricate nut threads. Tighten lock nut and recheck starting torque.

2) Check starting torque of driven pinion using Driven Pinion Nut Socket (09326-20011). See Fig. 2. Starting torque should be 7.8-11.2 INCH lbs. (.9-1.3 N.m) for used bearings and 8.7-13.0 INCH lbs. (1.0-1.5 N.m) for new bearings. If starting torque is less than specification, tighten lock nut 5-10° and recheck. If starting torque is greater than specification, replace spacer.

3) Heat ring gear in boiling water for 10 minutes. Once water has evaporated, place ring gear in original location on center differential control coupling. Tighten bolts in crisscross pattern to specification. See TORQUE SPECIFICATIONS.

4) Install center differential control coupling in transfer case. Install original washer and bearing race in bearing retainer. See Fig. 1. Install original washer. Install bearing retainer. Tighten bolts in crisscross pattern to specification.

5) Check ring gear backlash. See Fig. 3. Backlash should be .004-.006" (.10-.15 mm). If backlash is not within specification, replace washer on ring gear side of transfer case. Washer thicknesses available are .082" (2.07 mm) to .118" (3.00 mm) in .001" (.03 mm) increments.

6) Coat ring gear teeth with appropriate marking compound. Rotate gear until clear contact pattern is obtained. Check pattern for proper contact. See GEAR TOOTH CONTACT PATTERNS article in APPLICATIONS & IDENTIFICATION. If proper contact pattern is not present, replace washer behind driven pinion front bearing inner race. Washer thicknesses available are .047" (1.20 mm) to .065" (1.65 mm) in .0004" (.01 mm) increments.

7) After proper ring gear tooth contact pattern is achieved, check driven pinion total rotating torque. Driven pinion total rotating torque should be an increase of 1.7-2.6 INCH lbs. (.2-.3 N.m) over starting torque for new bearings or an increase of .9-2.6 INCH lbs. (.1-.3 N.m) over starting torque for used bearings. If total rotating torque is not within specification, change washer in bearing retainer. Washer thicknesses available are .058" (1.47 mm) to .102" (2.58 mm) in .001" (.03 mm) increments.

8) Remove bearing retainer from transfer case. Remove bearing race and washer from bearing retainer. Install side gear shaft holder bearing in bearing retainer. Install snap ring and oil seal. Install washer and bearing race. Install "O" rings to bearing retainer. Install bearing retainer. Tighten bolts in crisscross pattern to specification.

9) Recheck driven pinion total rotating torque. Install remaining oil seals. Install "O" ring in center differential lock sleeve. Drive lock sleeve into position. Install snap ring. Stake driven pinion lock nut. Install extension housing. Install oil deflector on case cover. Apply sealant on case cover and install cover on transfer case. Tighten bolts in crisscross pattern to specification. Install differential side gear intermediate shaft No. 2.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Bearing Retainer Bolt	21 (28)
Case Cover Bolt	14 (20)
Drain & Fill Plugs	36 (49)
Driven Pinion Lock Nut	218 (295)
Extension Housing Bolt	19 (26)
Ring Gear Bolt	57 (78)

TRANSMISSION REMOVAL & INSTALLATION - A/T

1999 Lexus RX 300

1999-2000 AUTOMATIC TRANSMISSION REMOVAL
Lexus

APPLICATION

AUTOMATIC TRANSAXLE/TRANSMISSION APPLICATIONS

Application	Trans. Model
ES300	U-140E
GS300	A-650E
GS400	A-650E
LS400	A-650E
LX470	A-343F
RX300	U-140E & U-140F
SC300	A-340E
SC400	A-650E

REMOVAL & INSTALLATION

CAUTION: To prevent accidental air bag deployment, wait at least 90 seconds after disconnecting negative battery cable before servicing vehicle.

TRANSAXLE

Removal & Installation (ES300)

1) Remove hood. Using a 5-mm hexagon wrench, remove cap nuts at "V" bank cover located on top of engine. Turn "V" bank cover fastener counterclockwise. Remove fastener and cover.

2) Remove battery. Remove air cleaner. On models with cruise control, disconnect actuator connector and remove actuator with bracket. On all models, disconnect 2 speed sensor connectors. Remove 2 wiring harness mounting bolts. Remove ground terminal mounting bolt. Remove shift control cable clamp.

3) Disconnect electrical connector at starter. Remove 2 starter mounting bolts. Remove nut and disconnect terminal from starter. Remove starter. Remove 2 engine mounting absorber bracket bolts. Remove 5 transaxle-to-engine upper side mounting bolts. Disconnect ground cable.

4) Remove exhaust manifold bracket mounting bolts. Raise and support vehicle. Remove front wheels. Drain ATF from transaxle. Remove 10 screws for front side of fender liners and 2 screws for rear side of fender liners. Remove fender liners and engine undercover. Remove 5 bolts and center engine undercover.

5) Remove axle shafts. See appropriate article in DRIVE AXLES. Disconnect left and right stabilizer bar links. Remove 2 bolts and front exhaust pipe support stay. Remove 4 nuts from exhaust manifold. Remove 2 bolts and springs. Remove 3 gaskets.

6) Remove 2 nuts, bolts, front exhaust pipe support bracket and hole cover. Disconnect park/neutral position switch connector. Disconnect solenoid connector. Remove nut and disconnect shift control cable from lever. Remove clip and disconnect shift control cable from bracket.

7) Remove 3 front side engine mounting bolts. Loosen 2 clamps and disconnect 2 hoses at oil cooler. Remove 2 bolts and disconnect steering return pipe. Remove 2 grommets and nuts at left side transaxle mount. Remove 2 grommets and 4 nuts at rear engine mount.

Remove 4 front stabilizer bar bracket mounting bolts. Remove 2 steering gear mounting bolts. Support steering gear using rope or wire.

8) Remove torque converter bolts. Install engine sling and attach hoist to engine. Support front frame assembly and transaxle with appropriate jacks. Remove 6 bolts and 4 nuts from front frame and remove front frame assembly.

9) Remove bolt, nut and exhaust manifold plate. Remove 3 remaining engine-to-transaxle lower bolts. Separate transaxle from engine. Lower transaxle from vehicle. Remove torque converter.

10) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transaxle case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. Install Green torque converter bolt first, and then install remaining bolts.

11) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Replace 4 exhaust manifold nuts and 3 gaskets. When installing "V" bank cover fastener, remove fastener after installation, reposition as necessary, then position and push in. Refill all fluids to proper levels. Adjust shift control cable and park/neutral position switch, if necessary. Check front wheel alignment and road test vehicle.

Removal & Installation (RX300 With U-140E Transaxle)

1) Remove hood. Remove hood-to-cowl top seal. Remove left and right cowl top ventilator louvers. Remove left and right wiper arm and blade assemblies. Remove wiper motor and link assembly. Remove outer front cowl top panel assembly.

2) Remove air cleaner and battery. Disconnect 2 speed sensor connectors. Remove 4 wiring harness mounting bolts. Separate wiring harness from wiring harness clamp. Disconnect electrical connector from starter. Remove 2 starter bolts. Remove nut and disconnect terminal. Remove starter. Remove 2 bolts, nuts and exhaust manifold bracket.

3) Remove No. 2 front exhaust pipe at manifold, and front exhaust pipe. Remove 5 transaxle upper side mounting bolts. Raise and support vehicle. Remove front wheels. Remove engine undercover. Remove axle shafts. See appropriate article in DRIVE AXLES. Remove exhaust manifold bracket mounting bolt. Disconnect left and right stabilizer bar links.

4) Support steering gear using rope or wire. Remove 2 steering gear mounting bolts. Disconnect park/neutral position switch connector. Disconnect solenoid connector. Remove nut and disconnect shift control cable from lever. Remove clip and disconnect shift control cable from bracket.

5) Remove 2 bolts and disconnect power steering hose from frame. Remove 2 grommets and nuts at left side transaxle mount. Remove 2 grommets and 4 nuts at rear engine mount. Remove 2 engine mounting absorber bolts. Remove 3 front side engine mount bolts. Loosen 2 clamps and disconnect 2 oil cooler hoses.

6) Remove 2 bolts and access cover to torque converter bolts. Remove torque converter bolts. Install engine sling and attach hoist to engine. Support transaxle with appropriate jack. Remove 8 bolts from front frame. Remove left and right rear lower braces. Remove front frame assembly.

7) Remove 3 remaining engine-to-transaxle lower bolts. Separate transaxle from engine. Lower transaxle from vehicle. Remove torque converter.

8) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transaxle case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than

specified, reposition torque converter until fully seated. Install Green torque converter bolt first, and then install remaining bolts.

9) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Refill all fluids to proper levels. Adjust shift control cable and park/neutral position switch, if necessary. Check front wheel alignment and road test vehicle.

Removal & Installation (RX300 With U-140F Transaxle)

1) Transaxle and engine must be removed as an assembly. For engine removal, see appropriate article in ENGINES. Once engine and transaxle have been removed, disconnect electrical connector at starter. Remove 2 bolts and starter.

2) Remove bolt, nut and stay for left and right side exhaust manifold. Remove 5 bolts and right side stiffener plate. Remove 2 bolts and access cover to torque converter bolts. Remove torque converter bolts. Remove 3 engine-to-transaxle lower bolts.

3) Remove bolt and disconnect ground cable from transaxle. Disconnect park/neutral position switch, solenoid and 2 speed sensor connectors. Disconnect wiring harness from clamp. Remove 5 transaxle upper side mounting bolts. Disconnect ground cable. Remove transaxle from engine.

4) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transaxle case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. Install Black colored torque converter bolt first, and then install remaining bolts.

5) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Refill all fluids to proper levels. Adjust shift control cable and park/neutral position switch, if necessary. Check front wheel alignment and road test vehicle.

TRANSMISSION

Removal & Installation (GS300 & SC300)

1) Disconnect negative battery cable. Remove dipstick and oil filler tube. Remove air cleaner, mass airflow meter and intake air connector pipe assembly. Remove 8 nuts, 2 gaskets and exhaust manifold with catalytic converter from engine. Raise and support vehicle.

2) Remove engine undercover. On GS300, remove oxygen sensor. Remove 2 bolts and front floor center brace, located in front of transmission oil pan. On all models, remove 3 bolts, nuts and 2 gaskets from exhaust pipes. Remove 2 bolts and exhaust pipe support bracket. Remove 4 bolts and 2 gaskets at tail pipes.

3) Remove front and center exhaust pipes. On GS300, remove 10 bolts and 2 heat insulators. On SC300, remove 4 nuts and heat insulator. Remove 2 bolts and rear center floor crossmember brace located at rear of transmission oil pan. On all models, place reference marks on drive shaft flange(s) for installation reference. Unbolt and remove drive shaft with center support bearing. Plug transmission at tail shaft to prevent ATF leakage (if necessary).

4) Disconnect shift control rod from shift lever. Loosen 2 oil cooler pipe union nuts at transmission. Disconnect 3 clamp set bolts. Disconnect and remove oil cooler pipes. Remove hole cover to gain access to torque converter bolts. Remove torque converter bolts. Using appropriate transmission jack, support transmission.

5) Remove engine rear mounting bolts. Tilt rear of transmission down. Ensure radiator fan does not come in contact with fan shroud. Disconnect vehicle speed sensor connector. Disconnect O/D direct clutch speed sensor connector. Disconnect solenoid connector.

Disconnect park/neutral position switch connector. Unbolt all wiring harness clamp bolts.

6) Disconnect electrical connections at starter. Remove 2 starter bolts and starter. Remove transmission-to-engine mounting bolts and ground cable (if equipped). Move transmission rearward, and lower from vehicle.

7) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transmission case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. On GS300, install Black torque converter bolt first, and then install remaining bolts.

8) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Install NEW "O" ring on oil filler tube. Install NEW exhaust manifold gaskets, exhaust gaskets and exhaust pipe nuts. Refill all fluids to proper levels. Road test vehicle.

Removal & Installation (GS400 & LS400)

1) Disconnect negative battery cable. Remove dipstick. Raise and support vehicle. Remove engine undercover. On LS400, remove front suspension protector. On GS400, remove 2 bolts and front floor center brace located in front of transmission oil pan. On all models, disconnect oxygen sensors. Remove both front catalytic converters from exhaust pipes.

2) Remove 2 bolts and support bracket. On GS400, remove 4 bolts and 2 gaskets at tail pipes. On LS400, remove pipe clamp, set bolt and gasket. Remove front exhaust pipe. On all models, remove catalytic converters from exhaust manifolds. On LS400 models, remove heat insulator and engine rear mounting member bracket plate. On GS400, remove 2 nuts, 3 bolts and 2 heat insulators.

3) On LS400, remove oil filler tube. Remove second heat insulator. Remove center floor crossmember brace. On all models, place reference marks on drive shaft flanges for installation reference. Unbolt and remove drive shaft with center support bearing.

4) Disconnect shift control rod from shift lever. Loosen 2 oil cooler pipe union nuts at transmission. Disconnect 3 clamp set bolts. Disconnect and remove oil cooler pipes.

5) Remove 2 bolts and access cover to torque converter bolts. Remove torque converter bolts. Using appropriate transmission jack, support transmission.

6) Remove engine rear mounting bolts. Tilt rear of transmission down. Ensure radiator fan does not come in contact with fan shroud. Disconnect vehicle speed sensor connector. Disconnect O/D direct clutch speed sensor connector. Disconnect solenoid connector. Disconnect park/neutral position switch connector. Unbolt all wiring harness clamp bolts. Remove transmission-to-engine mounting bolts. Move transmission rearward, and lower from vehicle.

7) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transmission case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. Install Black torque converter bolt first, and then install remaining bolts.

8) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Install NEW "O" ring on oil filler tube. Install NEW exhaust gaskets and catalytic converter nuts. Refill all fluids to proper levels. Road test vehicle.

Removal & Installation (LX470)

1) Remove battery and tray. Remove air cleaner vent hose.

Remove drive belt. Remove fan and fluid coupling assembly. Remove fan shroud. Remove radiator. Remove dipstick. Remove oil filler tube upper side mounting bolt. Disconnect 2 bleeder hoses. Remove transfer case shift lever knob. Remove upper console panel.

2) Remove 4 bolts and transfer case shift lever boot. Remove No. 1 and 2 engine undercovers. Remove left and right exhaust pipes. Place reference marks on drive shaft flanges for installation reference. Remove front and rear drive shafts.

3) Remove bolt and oil filler tube. Remove "O" ring from oil filler tube. Remove nut and plate washer. Remove transmission control rod. Remove clip, plate washer and collar, and disconnect transfer case shift lever rod assembly.

4) Disconnect transmission speed sensor and solenoid connectors. Disconnect transmission fluid temperature sensor connector. Disconnect park/neutral position switch connector. Disconnect center differential lock indicator switch connector. Disconnect motor actuator connector. Disconnect "L4" position switch connector. Disconnect neutral position switch connector. Disconnect 5 clamps.

5) Remove bolts and access cover to torque converter bolts. Remove torque converter bolts. Loosen 2 oil cooler pipe union nuts at transmission. Remove oil cooler pipe clamp mounting bolt. Remove 2 oil cooler pipe union nuts.

6) Support transmission with jack. Remove 8 bolts and 2 nuts, then remove crossmember. Lower rear of transmission and remove transmission wire clamp bolt. Remove 10 transmission-to-engine bolts. Remove transmission.

7) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transmission case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. Install Green colored torque converter bolt first, and then install remaining bolts.

8) To complete installation, reverse removal procedures. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Install NEW "O" ring on oil filler tube. Check and refill all fluid levels as necessary. Road test vehicle.

Removal & Installation (SC400)

1) Remove dipstick. Remove oil filler tube. Raise and support vehicle. Place reference marks on drive shaft flanges for installation reference. Remove drive shaft with center support bearing. Note location of any adjusting washers at center support bearing (if equipped).

2) Remove engine undercover. Remove shift control rod from shift lever. Remove 4 bolts and remove exhaust pipe support bracket. Remove 6 nuts and remove catalytic converters from exhaust manifolds. Remove front wheels. Remove left and right stabilizer bar link nuts from front stabilizer bar.

3) Remove left and right strut assembly bolts from lower suspension arms. Remove 2 cotter pins and nuts from lower ball joints. Using appropriate puller, remove left and right lower suspension arms from lower ball joints. Remove 2 nuts, 4 bolts and 2 lower suspension arm bracket stays.

4) Place reference marks on 2 front wheel alignment adjustment cams and vehicle body for installation reference. Remove 2 nuts, adjustment cams and plate stoppers. Remove 4 bolts and nuts to suspension member. Remove left and right upper front crossmember extensions and suspension member set plates. Remove 6 bolts and suspension member with lower suspension arm.

5) Remove bolts and access cover to torque converter bolts. Remove torque converter bolts. Loosen 2 oil cooler pipe union nuts at

transmission. Remove oil cooler pipe clamp mounting bolts. Remove 2 oil cooler pipe union nuts. Support transmission with appropriate jack.

6) Remove engine rear mounting bolts. Tilt rear of transmission down. Ensure radiator fan does not come in contact with fan shroud. Disconnect vehicle speed sensor connector. Disconnect O/D direct clutch speed sensor connector. Disconnect solenoid connector. Disconnect park/neutral position switch connector. Unbolt all wiring harness clamp bolts. Remove transmission-to-engine mounting bolts. Move transmission rearward, and lower from vehicle.

7) Before installation, measure torque converter mounting depth. See Fig. 1. Measure distance between torque converter mounting surface and transmission case front surface. See TORQUE CONVERTER MOUNTING DEPTH table. If distance is less than specified, reposition torque converter until fully seated. Install Black colored torque converter bolt first, and then install remaining bolts.

8) To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS . Install NEW "O" ring on oil filler tube. Install NEW exhaust gaskets and catalytic converter nuts.

9) Prior to tightening suspension nuts and bolts, lower vehicle and bounce several times to allow suspension to settle. Check wheel alignment. Install lower suspension arm bracket stays after aligning vehicle. Refill all fluids to proper levels. Road test vehicle.

TORQUE CONVERTER MOUNTING DEPTH (1)

Application	In. (mm)
ES300 & RX300	.502 (12.75)
GS300 & SC300	.004 (0.10)
GS400, LS400, LX470 & SC400	.673 (17.10)

(1) - Use illustration for measurement procedure. See Fig. 1.

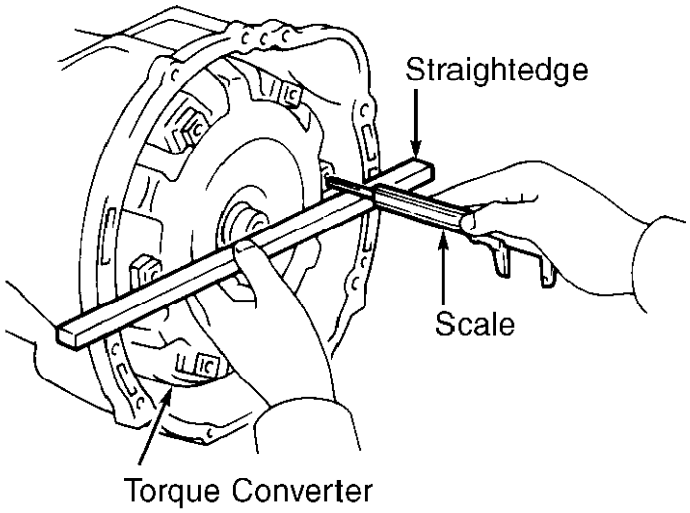


Fig. 1: Measuring Torque Converter Mounting Depth (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (ES300)

Application	Ft. Lbs. (N.m)
Engine Mounting Absorber Bracket Bolt	35 (48)
Engine-To-Transaxle Lower Bolt (3)	
Bolt @ 9 O'clock Position	48 (35)
2 Lower Bolts	27 (37)
Exhaust Manifold Bracket Bolt	15 (20)
Exhaust Manifold Nut	46 (62)
Exhaust Pipe Bolt With Springs	32 (43)
Flywheel-To-Crankshaft Bolt	61 (83)
Flywheel-To-Torque Converter Bolt	30 (41)
Front Exhaust Pipe Support Bracket Nut	15 (20)
Front Exhaust Pipe Support Stay Bolt	24 (33)
Front Frame	
12-mm Bolt	24 (32)
19-mm Bolt	134 (181)
Nut	27 (37)
Front Side Engine Mounting Bolt	59 (80)
Front Side Transaxle Mount Bolt	59 (80)
Hole Cover Bolt	15 (20)
Left Side Transaxle Mount Nut	59 (80)
Rear Engine Mount Bolt/Nut	49 (66)
Stabilizer Bar Bracket Mounting Bolt	14 (19)
Starter Bolt	29 (39)
Steering Gear Bolt	134 (181)
Transaxle-To-Engine Upper Side Mounting Bolt	49 (66)
Wheel Lug Nut	76 (103)

TORQUE SPECIFICATIONS (GS300, GS400, LS400 & SC300)

Application	Ft. Lbs. (N.m)
Access Cover Bolt	13 (18)
Catalytic Converter Nut	
At Exhaust Pipe	32 (43)
At Manifold	46 (62)
Drive Shaft Center Support Bearing Bolt	27 (37)
Drive Shaft-To-Differential Nut	58 (79)
Drive Shaft-To-Transmission Nut	58 (79)
Engine Rear Support Mounting Bolt	20 (27)
Exhaust Manifold-To-Engine Nut	29 (39)
Exhaust Pipe-To-Exhaust Manifold Nut	32 (43)
Exhaust Pipe Support Bracket Bolt	32 (43)
Flywheel-To-Crankshaft Bolt	61 (83)
Flywheel-To-Torque Converter Bolt	35 (48)
Oil Cooler Pipe Union Nut	32 (44)
Oxygen Sensor	32 (44)
Rear Center Floor Crossmember Brace Bolt	9 (13)
Shift Control Rod Nut	9 (13)
Starter Bolt	27 (37)
Tailpipe Nut	32 (43)
Transmission-To-Engine Bolt	
14-mm Head	27 (37)
17-mm Head	53 (72)

TORQUE SPECIFICATIONS (LX470)

Application	Ft. Lbs. (N.m)

Access Cover Bolt	13 (18)
Crossmember	
Bolt	37 (50)
Nut	55 (74)
Drive Plate Bolt	
1st Step	36 (49)
2nd Step	Tighten An Additional 90 Degrees
Drive Shaft Flange Bolt/Nut	
Front	59 (80)
Rear	78 (106)
Exhaust Pipe Flange Nut	46 (62)
Oil Cooler Pipe Union Nut	51 (69)
Radiator Bolt	13 (18)
Torque Converter Bolt	35 (48)
Transmission-To-Engine Bolt	53 (72)

TORQUE SPECIFICATIONS (RX300 WITH U-140E TRANSAXLE)

Application	Ft. Lbs. (N.m)
Engine Mounting Absorber Bracket Bolt	35 (48)
Engine-To-Transaxle Lower Bolt (3)	
Bolt @ 9 O'clock Position	48 (35)
2 Lower Bolts	27 (37)
Exhaust Manifold Bracket Bolt	25 (34)
Front Exhaust Pipe Assembly Bolt	41 (56)
Flywheel-To-Crankshaft Bolt	61 (83)
Flywheel-To-Torque Converter Bolt	30 (41)
Front Exhaust Pipe Support Bracket Bolt	15 (20)
Front Frame	
12-mm Bolt	24 (32)
19-mm Bolt	134 (181)
Nut	27 (37)
Front Side Engine Mounting Bolt	59 (80)
Left Side Transaxle Mount Nut	59 (80)
No. 2 Exhaust Pipe At Manifold Bolt	41 (56)
Rear Engine Mount Bolt/Nut	49 (66)
Starter Bolt	29 (39)
Steering Gear Bolt	134 (181)
Transaxle-To-Engine Upper Side Mounting Bolt	49 (66)
Wheel Lug Nut	76 (103)

TORQUE SPECIFICATIONS (RX300 WITH U-140F TRANSAXLE)

Application	Ft. Lbs. (N.m)
Engine-To-Transaxle Lower Bolts (3)	
Bolt @ 9 O'clock Position	48 (35)
2 Lower Bolts	27 (37)
Flywheel-To-Crankshaft Bolt	61 (83)
Flywheel-To-Torque Converter Bolt	30 (41)
Ground Cable Bolt	49 (66)
Starter Bolt	29 (39)
Transaxle-To-Engine Upper Side Mounting Bolt	49 (66)
Wheel Lug Nut	76 (103)

TORQUE SPECIFICATIONS (SC400)

Application	Ft. Lbs. (N.m)

Access Cover Bolt	13 (18)
Adjustment Cam Nut	166 (226)
Catalytic Converter Nut	
@ Exhaust Pipe	32 (43)
@ Manifold	46 (62)
Drive Shaft Center Support Bearing Bolt	36 (49)
Drive Shaft-To-Differential Nut	58 (79)
Drive Shaft-To-Transmission Nut	58 (79)
Engine Rear Mounting Bolt	18 (25)
Exhaust Pipe Support Bracket Bolt	32 (43)
Flywheel-To-Crankshaft Bolt	61 (83)
Flywheel-To-Torque Converter Bolt	35 (48)
Lower Ball Joint Nut	92 (125)
Lower Suspension Arm Bracket Stay	
Bolt	32 (43)
Nut	44 (59)
Oil Cooler Pipe Union Nut	32 (44)
Shift Control Rod Nut	9 (13)
Stabilizer Bar Link Nut	55 (74)
Strut Assembly Bolt	105 (143)
Suspension Member Bolts (6)	148 (200)
Suspension Member Set Plate	
Bolt	22 (29)
Nut	25 (33)
Transmission-To-Engine Bolt	
14-mm Head	27 (37)
17-mm Head	53 (72)
Wheel Lug Nut	76 (103)

TRANSMISSION SERVICING - A/T

1999 Lexus RX 300

1999-2000 AUTOMATIC TRANSMISSION SERVICING
Lexus

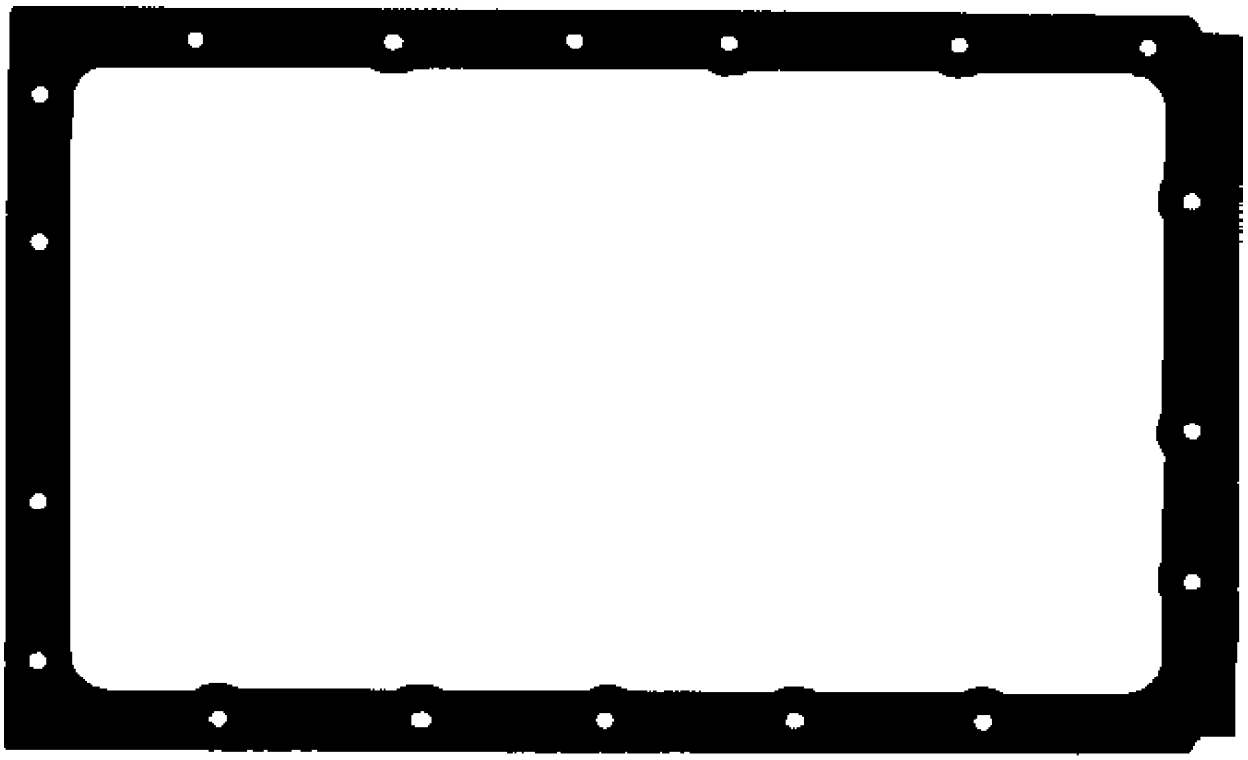
APPLICATION

AUTOMATIC TRANSAXLE/TRANSMISSION APPLICATIONS

Application	Trans. Model
ES300	U-140E
GS300	A-650E
GS400	A-650E
LS400	A-650E
LX470	A-343F
RX300	U-140E & U-140F
SC300	A-340E
SC400	A-650E

IDENTIFICATION

OIL PAN GASKET



G99D03712

Fig. 1: Identifying Oil Pan Gasket (A-340E, A-343F & A-650)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

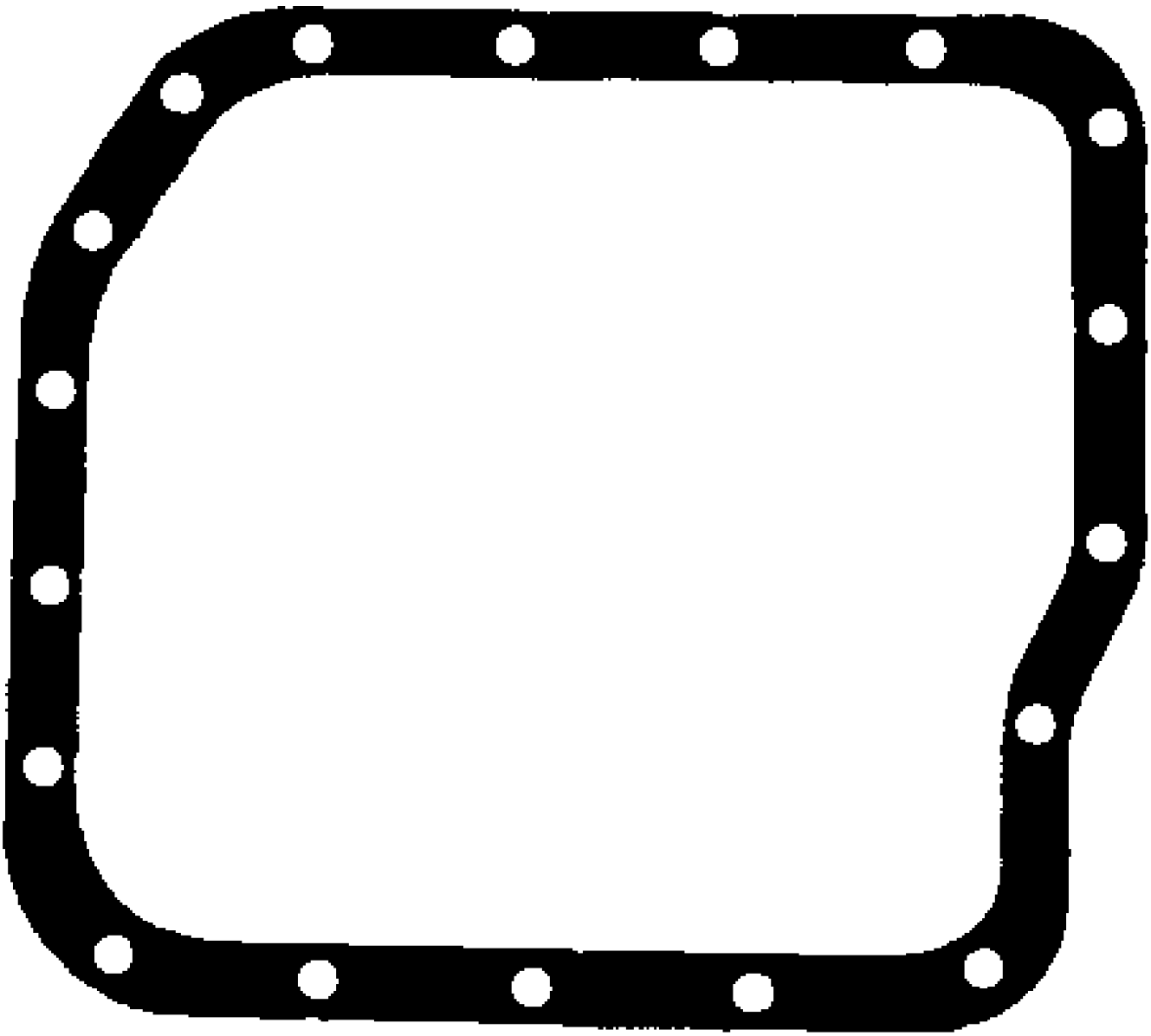


Fig. 2: Identifying Oil Pan Gasket (U-140E & U-140F)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LUBRICATION

SERVICE INTERVALS

Under normal driving conditions, inspect transmission fluid every 15,000 miles or 24 months, whichever comes first. Under severe driving conditions, replace fluid every 15,000 miles or 24 months.

CHECKING FLUID LEVEL

Transaxle & Transmission

1) Check transmission fluid with engine and transmission at 158-176°F (70-80°C). Park vehicle on a level surface and set parking brake.

2) With engine idling and parking brake engaged, move shift lever from Park to Low and return to Park. Remove and clean dipstick. Insert dipstick fully into oil filler tube. Remove dipstick and verify fluid level is in HOT range on dipstick. Add fluid as necessary.

RECOMMENDED FLUID

LX470 models use type D-II or Dexron-III ATF. All other models use Lexus/Toyota Type T-IV ATF. On U-140F, transfer case uses SAE 90, APL GL-5 fluid. Fluid capacity is 1.0 qt. (.9 L).

FLUID CAPACITIES

TRANSAXLE/TRANSMISSION FLUID CAPACITIES (1)

Application	Refill - Qts. (L)	Dry-Fill - Qts. (L)
ES300	3.7 (3.5)	8.7 (8.2)
GS300, GS400 & LS400	2.0 (1.9)	8.9 (8.4)
LX470	2.0 (1.9)	12.4 (11.7)
RX300		
U-140E	3.7 (3.5)	8.7 (8.2)
U-140F	4.3 (4.1)	9.7 (9.2)
SC300	2.0 (1.9)	8.1 (7.7)
SC400	2.0 (1.9)	8.9 (8.4)

(1) - Approximate capacity is listed.

DRAINING & REFILLING

WARNING: On LS400 equipped with air suspension, ensure ignition switch is turned to OFF position before raising vehicle. If ignition switch is in ON position when vehicle is raised, vehicle automatic height adjustment will operate, resulting in possible damage to vehicle or personal injury. Air suspension HI indicator light will blink if a system malfunction exists.

Transmission

1) Remove drain plug to drain fluid. If transmission oil filter is to be changed, remove oil pan. Remove oil filter and gasket.

2) Clean transmission oil pan and replace pan gasket. Install oil filter and gasket. Reinstall transmission oil pan. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Install drain plug. With engine off, add new fluid through oil filler tube.

3) Start engine and shift gear selector into all positions. Shift gear selector back into Park. Check fluid level. Add fluid to bring level up to COOL mark on dipstick.

4) Recheck fluid level when engine and transmission reaches operating temperature of 158-176°F (70-80°C). Add fluid up to HOT mark on dipstick.

ADJUSTMENTS

CONTROL SHAFT LEVER

Loosen nut on control rod. See Fig. 3. Push control rod fully rearward. Return transmission control shaft 2 notches to Neutral position. Place gear selector lever in Neutral. Hold selector lever

lightly toward Reverse position, and tighten control rod nut to 115 INCH lbs. (13 N.m). Start engine and ensure adjustment is correct.

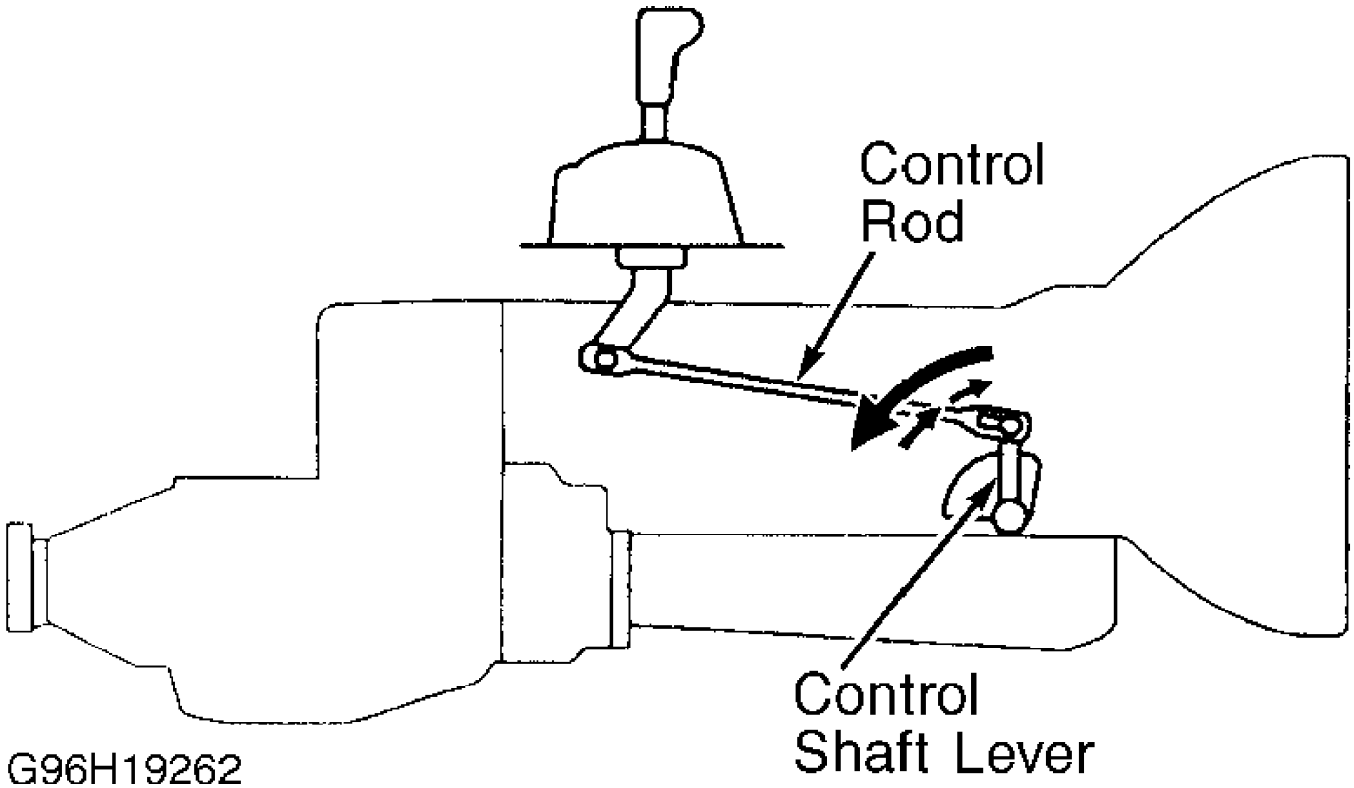


Fig. 3: Adjusting Control Shaft Lever
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARK/NEUTRAL POSITION SWITCH

If vehicle starts in positions other than Neutral and Park, adjust PNP switch. Loosen PNP switch bolt and set shift lever in "N" position. Align groove and neutral base line on PNP switch. See Fig. 4 . Hold switch in position and tighten bolt to 48 INCH lbs. (5.4 N.m) on ES300, RX300 and SC300, or 115 INCH lbs. (13 N.m) on all other models.

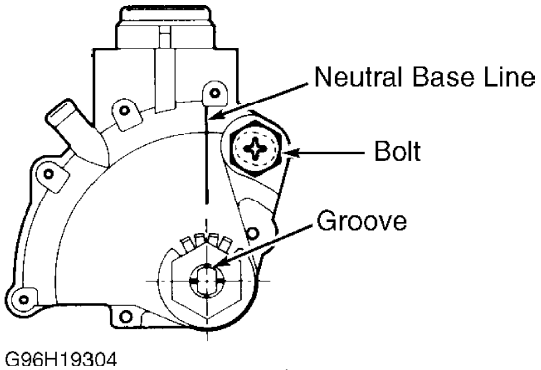


Fig. 4: Adjusting Park/Neutral Position Switch
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SHIFT CONTROL CABLE

Loosen swivel nut on transmission shift lever linkage under vehicle. Rotate shift lever on transmission fully to rear. Return lever 2 notches to Neutral position. Set in-car gear selector to "N" position. With gear selector in "N" position, lightly hold lever toward "R" position, and tighten swivel nut on transmission shift lever.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Drain Plug	
ES300 & RX300	36 (49)
Except ES300 & RX300	15 (20)
	INCH Lbs. (N.m)
Filter Bolt	
ES300 & RX300	97 (11)
Except ES300 & RX300	89 (10)
Oil Pan Bolt	
ES300 & RX300	69 (7.8)
Except ES300 & RX300	65 (7.4)

TROUBLE SHOOTING - BASIC PROCEDURES

1999 Lexus RX 300

GENERAL TROUBLE SHOOTING

*** PLEASE READ THIS FIRST ***

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	Dead battery	Check battery cells, alternator belt tension and alternator output
	Loose or corroded battery connections	Check all charging system connections
	Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
	Loose alternator wiring connections	Check all charging system connections
	Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
	Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article
	Defective regulator	See Regulator Check in

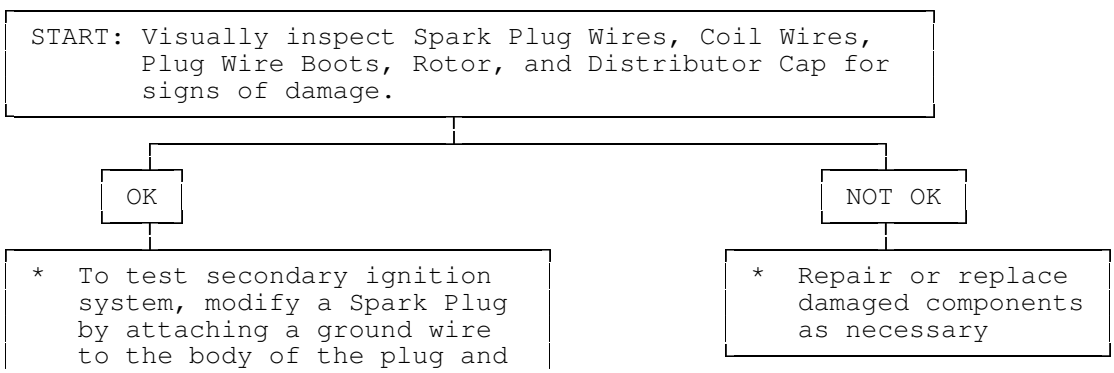
		ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	Blown fuse	See WIRING DIAGRAMS
	Defective alternator	See Testing in ALTERNATOR article
	Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
	Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
	Defective regulator	See Regulator Check in ALTERNATOR article
	Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
	Defective wiring	Check all wires and wire connections
	Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
	Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	Loose drive pulley	Tighten drive pulley attaching nut
	Loose mounting bolts	Tighten all alternator mounting bolts
	Worn or dirty bearings	See Bearing Replacement ALTERNATOR article

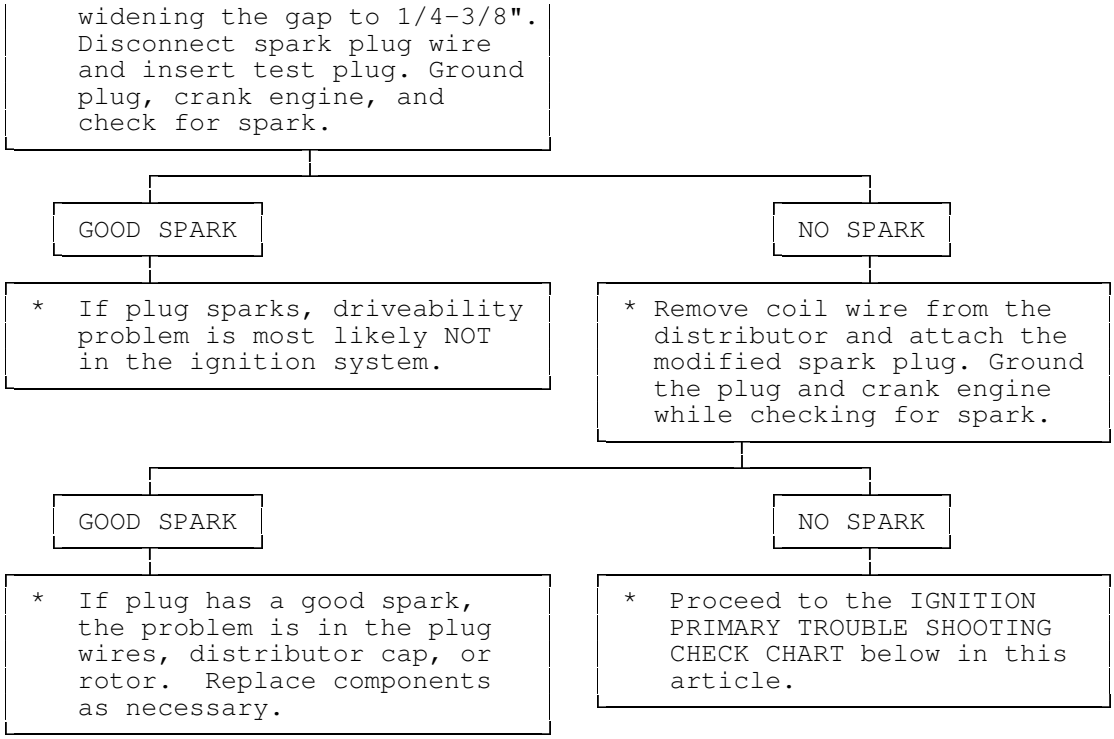
	Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
	Loose or corroded battery connections	Check all charging system connections
	Loose alternator connections	Check all charging system connections
	Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
	Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	Defective battery	Check alternator output and repair as necessary
	Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
	Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

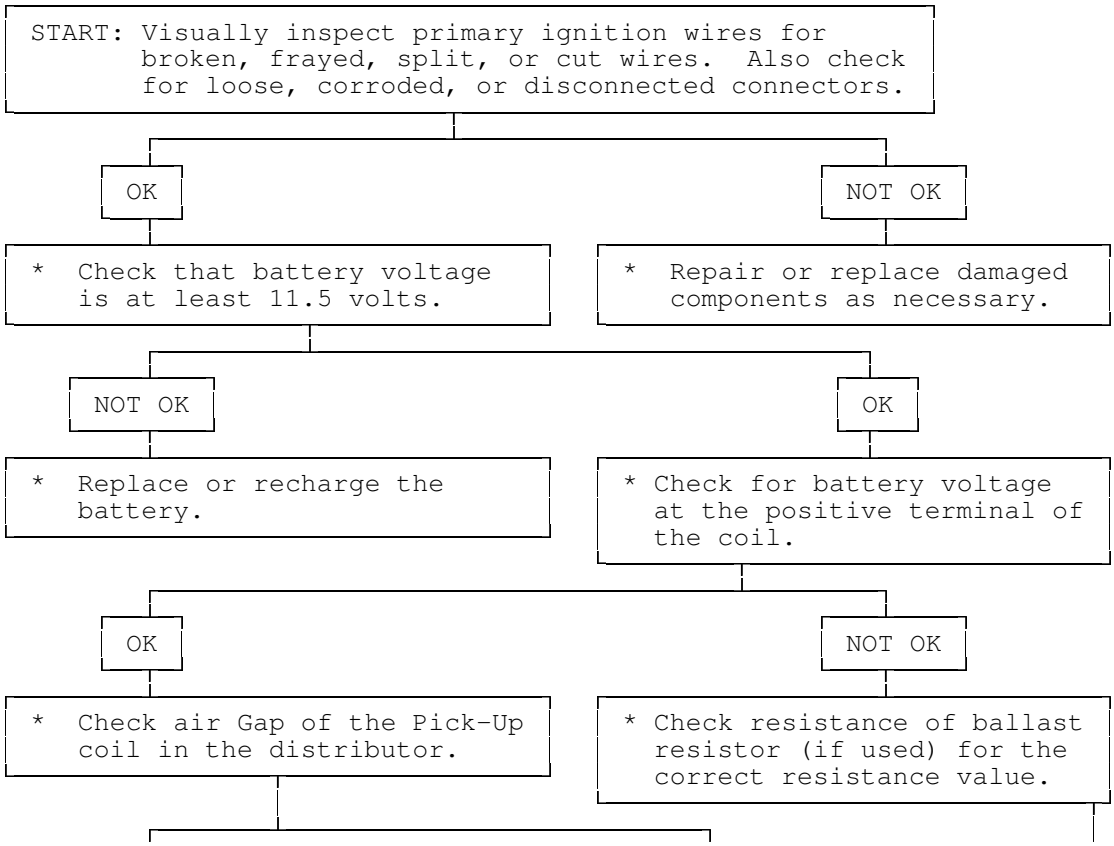
NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

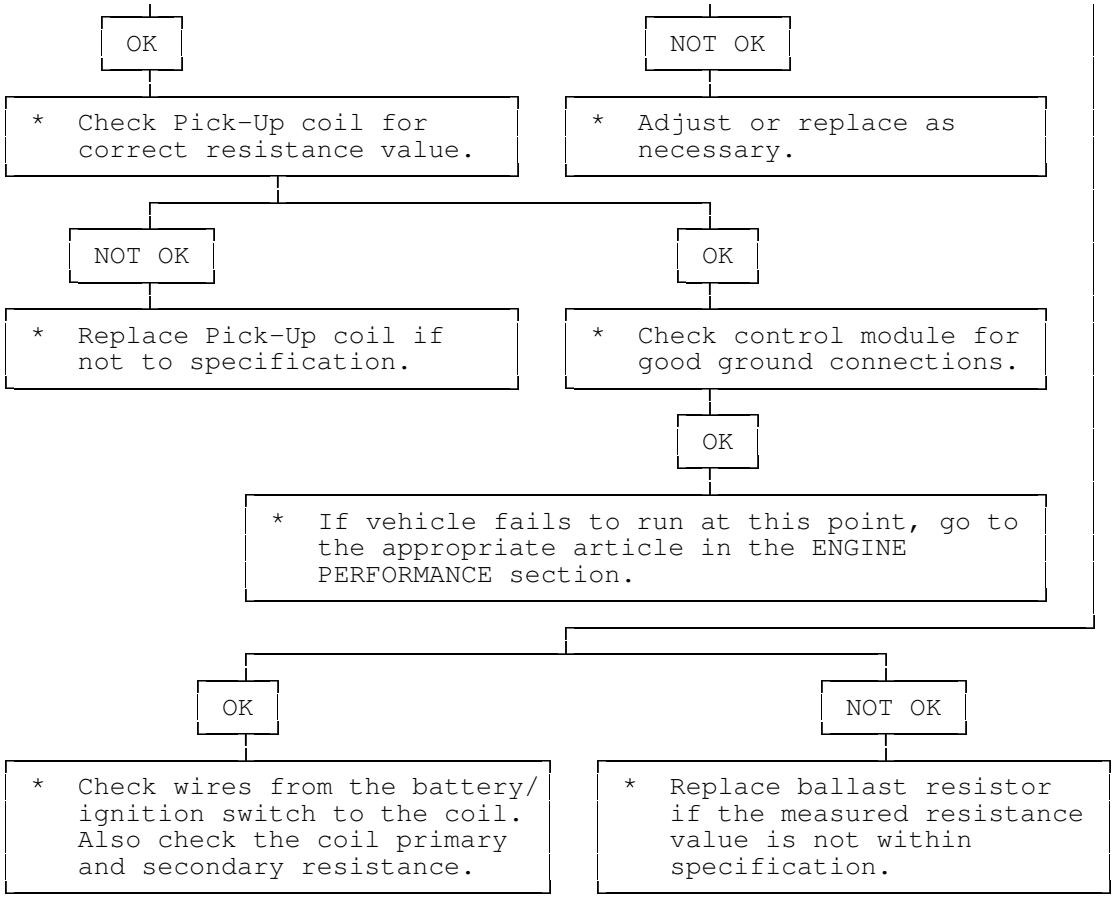
Ignition Secondary Trouble Shooting Chart





Ignition Primary Trouble Shooting Chart





STARTER TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
	Ignition switch faulty or misadjusted	Adjust or replace ignition switch
	Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
	Starter relay or starter defective	See Testing in STARTER article

	Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	Weak battery or dead cell	Charge or replace battery as necessary
	Loose or corroded battery connections	Check that battery connections are clean and tight
	Internal ground in starter windings	See Testing in STARTER article
	Grounded starter fields	See Testing in STARTERS
	Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	Starter clutch slipping	See STARTER article
	Broken clutch housing	See STARTER article
	Pinion shaft rusted or dry	See STARTER article
	Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
	Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	Faulty overrunning clutch	See STARTER article
	Broken clutch housing	See STARTER article
	Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
	Armature shaft sheared or reduction gear teeth stripped	See STARTER article
	Weak battery	Charge or replace battery as necessary
	Faulty solenoid	See On-Vehicle Tests in STARTER article
	Poor grounds	Check all ground connections for tight and clean connections
	Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	Battery weak or defective	Charge or replace battery as necessary

	Engine overheated	See ENGINE COOLING SYSTEM article
	Engine oil too heavy	Check that proper viscosity oil is used
	Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
	Current draw too low or too high	See Bench Tests in STARTER article
	Bent armature, loose pole shoes screws or worn bearings	See STARTER article
	Burned solenoid contacts	Replace solenoid
	Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	Engine timing too far advanced	See Ignition Timing in TUNE-UP article
	Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
	Broken starter clutch	See STARTER article
	Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
	Weak drive assembly thrust spring	See STARTER article
	Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	Defective point assembly	See Testing in STARTER article
	Poor point assembly ground	See Testing in STARTER article
	Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	Dead battery	Charge or replace battery as necessary
	Faulty wiring	Check all wiring and connections leading to relay
	Neutral safety switch faulty	Replace neutral safety switch
	Starter relay faulty	Replace starter relay

Starter Drive Will Not Disengage	Starter motor loose on mountings	Tighten starter attach bolts
	Worn drive end bushing	See STARTER article
	Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
	Drive yolk return spring broken or missing	Replace return spring
	Faulty ignition switch	Replace ignition switch
	Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
	Starter clutch not disengaging	Replace starter clutch
	Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	Faulty solenoid switch, switch connections or	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
	Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	Weak battery	Charge or replace battery as necessary
	Solenoid contacts corroded	Clean contacts or replace solenoid
	Faulty wiring	Check all wiring leading to solenoid
	Broken connections inside switch cover	Repair connections or replace solenoid
	Open hold-in wire	Replace solenoid
Low Current Draw	Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine	Distance too small between starter pinion and flywheel	

Fires With Key released. Engine Fires and Cranks Normally	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

WARNING: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	• Compressor clutch circuit open. • Compressor clutch coil inoperative. • Poor clutch ground connection. • Fan belts loose. • Thermostatic switch inoperative. • Thermostatic switch not adjusted. • Ambient temperature switch open. • Superheat fuse blown.
Excessive Noise or Vibration	• Missing or loose mounting bolts. • Bad idler pulley bearings. • Fan belts not tightened correctly. • Compressor clutch contacting body. • Excessive system pressure. • Compressor oil level low. • Damaged clutch bearings. • Damaged reed valves. • Damaged compressor.
Insufficient or No Cooling; Compressor Working	• Expansion valve inoperative. • Heater control valve stuck open. • Low system pressure. • Blocked condenser fins. • Blocked evaporator fins. • Vacuum system leak. • Vacuum motors inoperative. • Control cables improperly adjusted. • Restricted air inlet. • Mode doors binding. • Blower motor inoperative. • Temperature above system capacity.

HEATER SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to

problem symptoms. For model-specific Trouble Shooting, refer to DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	• Low Coolant Level • Incorrect thermostat. • Restricted coolant flow through heater core. • Heater hoses plugged. • Misadjusted control cable. • Sticking heater control valve. • Vacuum hose leaking. • Vacuum hose blocked. • Vacuum motors inoperative. • Blocked air inlet. • Inoperative heater blower motor. • Oil residue on heater core fins. • Dirt on heater core fins.
Too Much Heat	• Improperly adjusted cables. • Sticking heater control valve. • No vacuum to heater control valve. • Temperature door stuck open.
Air Flow Changes During Acceleration	• Vacuum system leak. • Bad check valve or reservoir.
Air From Defroster At All Times	• Vacuum system leak. • Improperly adjusted control cables. • Inoperative vacuum motor.
Blower Does Not Operate Correctly	• Blown fuse. • Blower motor windings open. • Resistors burned out. • Motor ground connection loose. • Wiring harness connections loose. • Blower motor switch inoperative. • Blower relay inoperative. • Fan binding or foreign object in housing. • Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	Incorrect tire pressure	Inflate tires to proper pressure
	Front end out of alignment	See WHEEL ALIGNMENT
	Mismatched tires	Check tires sizes
	Restricted brake lines or hoses	Check hose routing
	Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
	Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
	Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
	Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	Front linings worn out	Replace linings
	Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
	Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	Excessive lateral runout	Check rotor runout
	Parallelism not to specifications	Reface or replace rotor
	Wheel bearings not adjusted	See SUSPENSION
	Rear drums out-of-round	Reface or replace drums
	Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
	Partial system failure	Check fluid and pipes
	Worn disc pad or lining	Replace pad or lining
	Caliper piston stuck or	

	sluggish	See DISC BRAKES or BRAKE SYSTEM
	Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
	Brake fade due to incorrect pads for linings	Replace pads or linings
	Linings or pads glazed	Replace pads or linings
	Worn drums	Reface or replace drums
Excessive Pedal Travel	Partial brake system failure	Check fluid and pipes
	Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
	Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
	Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
	Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
	Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
	Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
	Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
	Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
	Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
	Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
	Restricted brake lines or hoses	Check line routing
	Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM

	Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
	Incorrect installation of inboard disc pad	Remove and replace correctly
	Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
	Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM
	Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
	Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
	Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
	Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

COOLING SYSTEM TROUBLE SHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION
Overheating	Coolant Leak	Fill/Pressure Test System
	A/C Condenser Fins Clogged	Remove/Clean Condenser
	Radiator Fins Clogged	Remove/Clean Radiator
	Thermostat Stuck Closed	Replace Thermostat
	Clogged Cooling System Passages	Clean/Flush Cooling System

	Water Pump Malfunction	Replace Water Pump
	Fan Clutch Malfunction	Replace Fan Clutch
	Retarded Ignition Timing	Reset Ignition Timing
	Cooling Fan Malfunction	Test Cooling Fan/ Circuit
	Cooling Fan Motor Malfunction	Test Fan Motor
	Cooling Fan Relay Malfunction	Test Fan Relay
	Faulty Radiator Cap	Replace Radiator Cap
	Broken/Slipping Fan Belt	Replace Fan Belt
	Restricted Exhaust	Repair Exhaust System
Corrosion	Impurities In Coolant	Clean/Flush System
Coolant Leakage	Damaged hose	Replace Hose
	Leaky Water Pump	Replace Water Pump
	Damaged Radiator Seam	Replace/Repair Radiator
	Leaky Thermostat Cover	Replace Thermostat Cover
	Cylinder Head Problem	Check Head/Head Gasket
	Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative		
	Loose and/or Defective Radiator Cap	Replace Radiator Cap
	Overflow Tube Clogged and/or Leaking	Repair Tube
	Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow		
	Collapsed Heater Hose	Replace Heater Hose
	Plugged Heater Core	Clean/Replace Heater Core
	Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available

in the section(s) you are accessing.

BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
	Blown head gasket	Replace head gasket, See ENGINES
	Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Overheated engine	Check cooling system, See COOLING
	Blocked crankcase vent valve	Remove restriction
	Leaking EGR valve	Repair leak and/or replace valve
	Faulty fuel pump	Replace fuel pump
Engine Has Low Power	Leaking fuel pump	Repair leak and/or replace fuel pump
	Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
	Sticking valves or weak valve springs	Check valve train components, See ENGINES
	Incorrect valve timing	Reset valve timing, See ENGINES
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Blown head gasket	Replace head gasket. See ENGINES.
	Clutch slipping	Adjust pedal and/or replace components, See ENGINES
	Engine overheating	Check cooling system, See COOLING
	Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
	Auto. Trans. fluid level too low	Add fluid as necessary
	Improper vacuum diverter valve operation	Replace vacuum diverter valve
	Vacuum leaks	Inspect vacuum system and repair as required
	Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	Low fuel pump volume	Replace fuel pump
	Leaking valves or worn	Replace valves and/or springs, See ENGINES
	Incorrect valve timing	Reset valve timing,See ENGINES
	Intake manifold restricted	Remove restriction
	Worn distributor shaft	Replace distributor
Faulty Acceleration	Improper fuel pump stroke	Remove pump and reset pump stroke

	Incorrect ignition timing	Reset ignition timing, See TUNE-UP
	Leaking valves	Replace valves, See ENGINES
	Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	Improper ignition timing	Reset ignition timing, See TUNE-UP
	Faulty accelerator pump discharge	Replace accelerator pump
	Improper choke operation	Check choke and adjust as required
	Defective EGR valve	Replace EGR valve
	Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
	Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	Vacuum leak	Inspect and repair vacuum system
	Faulty vacuum diverter valve	Replace vacuum diverter valve
	Faulty choke operation	Check choke and adjust as required
	Exhaust system leak	repair exhaust system leak
Engine Detonation	Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
	Faulty ignition system	Check ignition timing, See TUNE-UP
	Spark plugs loose or faulty	Retighten or replace plugs
	Fuel delivery system clogged	Inspect lines, pump and filter for clog
	EGR valve inoperative	Replace EGR valve
	PCV system inoperative	Inspect and/or replace hoses or valve
	Vacuum leaks	Check vacuum system and repair leaks
	Excessive combustion chamber deposits	Remove built-up deposits
	Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
	Oil pan gasket broken or pan bent	Straighten pan and replace gasket
	Timing chain cover gasket broken	Replace timing chain cover gasket
	Rear main oil seal worn	Replace rear main oil seal
	Oil pan drain plug not seated properly	Remove and reinstall drain plug
	Camshaft bearing drain hole blocked	Remove restriction
	Oil pressure sending switch leaking	Remove and reinstall sending switch

Excessive Oil Consumption	Worn valve stems or guides	Replace stems or guides, See ENGINES
	Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
	Plugged oil drain back holes	Remove restrictions
	Improper PCV valve operation	Replace PCV valve
	Engine oil level too high	Remove excess oil
	Engine oil too thin	Replace thicker oil
	Valve stem oil deflectors damaged	Replace oil deflectors
	Incorrect piston rings	Replace piston rings, See ENGINES
	Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
	Insufficient piston ring tension	Replace rings, See ENGINES
	Piston ring grooves or oil return slots clogged	Replace piston rings, See ENGINES
	Piston rings sticking in grooves	Replace piston rings, See ENGINES
	Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
	Compression rings installed upside down	Replace compression rings correctly, See ENGINES
	Worn or scored cylinder walls	Rebore cylinders or replace block
	Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
	Intake gasket dowels too long	Replace intake gasket dowels
	Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	Low oil level	Add oil to proper level
	Oil pressure sender or gauge broken	Replace sender or gauge
	Oil pump malfunction	Remove and overhaul oil pump, See ENGINES
	Oil pressure relief valve sticking	Remove and reinstall valve
	Oil pump passages blocked	Overhaul oil pump, See ENGINES
	Oil pickup screen or tube blocked	remove restriction
	Loose oil inlet tube	Tighten oil inlet tube
	Loose camshaft bearings	Replace camshaft bearings, See ENGINES
	Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	Low engine oil level	Add oil to proper level
	Engine oil too thin	Remove and replace with thicker oil
	Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
	Oil pickup tube or screen blocked	Remove restrictions
	Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See

		ENGINES
High Oil Pressure	Improper grade of oil	Replace with proper oil
	Oil pressure relief valve stuck closed	Eliminate binding
	Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	Inadequate oil supply	Check oil delivery to main bearings
	Excessive main bearing clearance	Replace main bearings, See ENGINES
	Excessive crankshaft end play	Replace crankshaft, See ENGINES
	Loose flywheel or torque converter	Tighten attaching bolts
	Loose or damaged vibration damper	Tighten or replace vibration damper
	Crankshaft journals out-of-round	Re-grind crankshaft journals
	Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
	Crankshaft rod journal out-of-round	Re-grind crankshaft journal
	Misaligned connecting rod or cap	Remove rod or cap and realign
	Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
	Bore tapered or out-of-round	Rebore block
	Piston ring broken	Replace piston rings, See ENGINES
	Piston pin loose or seized	Replace piston pin, See ENGINES
	Connecting rods misaligned	Realign connecting rods
	Ring side clearance too loose or tight	Replace with larger or smaller rings
	Carbon build-up on piston	Remove carbon
Noisy Valve Train	Worn or bent push rods	Replace push rods, See ENGINES
	Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
	Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
	Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
	Valve lifter face worn	Replace valve lifters, See ENGINES
	Broken or cocked valve springs	replace or reposition springs
	Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
	Valve bent	Replace valve, See ENGINES
	Loose rocker arms	Retighten rocker arms, See ENGINES
	Excessive valve seat run-out	Reface valve seats, See ENGINES

	Missing valve lock	Install new valve lock
	Excessively worn camshaft lobes	Replace camshaft, See ENGINES
	Plugged valve lifter oil holes	Eliminate restriction or replace lifter
	Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
	Rocker arm nut installed upside down	Remove and reinstall correctly
	Valve lifter incorrect for engine	Remove and replace valve lifters
	Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	Improper valve lash	Re-adjust valve lash, See ENGINES
	Worn or dirty valve lifters	Clean and/or replace lifters
	Worn valve guides	Replace valve guides, See ENGINES
	Excessive valve seat or face run-out	Reface seats or valve face
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
	Bent push rods	Replace push rods, See ENGINES
	Broken valve springs	Replace valve springs, See ENGINES
Burned,Sticking or Broken Valves	Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES
	Improper lifter clearance	Re-adjust clearance or replace lifters
	Worn guides or improper guide clearance	Replace valve guides, See ENGINES
	Out-of-round valve seats or improper seat width	Re-grind valve seats
	Gum deposits on valve stems, seats or guides	Remove deposits
	Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	Undersize pistons	Replace with larger pistons, See ENGINES
	Wrong piston rings	Replace with correct rings, See ENGINES
	Out-of-round cylinder bore	Re-bore cylinder bore
	Improper connecting rod alignment	Remove and realign connecting rods
	Excessively worn ring grooves	Replace pistons, See ENGINES
	Improperly assembled piston pins	Re-assemble pin-to -piston, See ENGINES
	Insufficient ring gap clearance	Install new rings, See ENGINES
	Engine overheating	Check cooling system
	Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
	Exhaust manifold	Replace exhaust

	cracked or broken	manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Choke not closing	Check choke operation, see FUEL SYSTEMS
	Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
	Fast idle RPM too low	Reset RPM to specif-ication, see TUNE-UP
	Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
	Vacuum leak	Inspect vacuum system for leaks
	Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
	Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	Choke vacuum kick setting incorrect	Reset vacuum kick setting,see FUEL SYSTEMS
	Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
	Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up,Then Idles, Slowly With Black Smoke	Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
	Fast idle cam index	Reset fast idle cam

	incorrect	index, see FUEL SYSTEMS
	Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
	Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
	Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	Defective choke control switch	Replace choke control switch
	Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
	Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
	Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
	Secondary throttles not closed	Inspect lockout adjustment,see FUEL SYSTEMS
Sag or Stall After Warmup	Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
	Defective accelerator pump	Replace pump, see FUEL SYSTEMS
	Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	Vacuum leak	Inspect vacuum lines
	Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
	Float level setting too low	Reset float level, see,FUEL SYSTEMS
	Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
	Carburetor idle or transfer system plugged	Inspect system and remove restriction
	Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	Defective accelerator pump	Replace pump, see FUEL SYSTEMS
	Metering rod carrier sticking or binding	Remove restriction
	Large vacuum leak	Inspect vacuum system and repair leak
	Float level setting too low	Reset float level, see FUEL SYSTEMS
	Defective fuel pump, lines or filter	Inspect pump, lines and filter
	Air door setting incorrect	Adjust air door setting, see FUEL

DIESEL ENGINE TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	Bad battery connections or dead batteries	Check connections and/or replace

		batteries
	Bad starter connections or bad starter	Check connections and/or replace batteries
Engine Cranks Slowly, Won't Start	Bad battery connections or dead batteries	Check connections and/or replace batteries
	Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS
	Glow plug control not functioning	Check controller, see FUEL SYSTEMS
	Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
	No fuel to injection pump	Check fuel delivery system
	Fuel filter blocked	Replace fuel filter
	Fuel tank filter blocked	Replace fuel tank filter
	Fuel pump not operating	Check pump operation and/or replace pump
	Fuel return system blocked	Inspect system and remove restriction
	No voltage to fuel solenoid	Check solenoid and connections
	Incorrect or contaminated fuel	Replace fuel
	Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
	Low compression	Check valves, pistons, rings, see ENGINES
	Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
	Fast idle solenoid malfunctioning	Check solenoid and connections
	Fuel return system blocked	Check system and remove restrictions
	Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	No fuel to injection pump	Check fuel delivery system
	Incorrect or contaminated fuel	Replace fuel
	Low compression	Check valves, piston, rings, see ENGINES
	Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
	Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/ Idles Rough W/out Smoke or Noise	Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
	Injection line fuel leaks	Check lines and connections
	Fuel return system blocked	Check lines and connections

	Air in fuel system	Bleed air from system
	Incorrect or contaminated fuel	Replace fuel
	Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	Engine not fully broken in	Put more miles on engine
	Air in system	Bleed air from system
	Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	Blocked fuel filter	Replace fuel filter
	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
	Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
	External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	Loose or broken fuel line	Check lines and connections
	Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
	Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	Restricted air intake	Remove restriction
	EGR valve malfunction	Replace EGR valve
	Blocked or damaged exhaust system	Remove restriction and/or replace components
	Blocked fuel tank filter	Replace filter
	Restricted fuel filter	Remove restriction and/or replace filter
	Block vent in gas cap	Remove restriction and/or replace cap
	Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
	Blocked fuel return system	Remove restriction
	Incorrect or contaminated fuel	Replace fuel
	Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
	Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	Basic timing incorrect	Reset timing, see FUEL SYSTEMS
	EGR valve malfunction	Replace EGR valve
	Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS

	Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	Cooling system leaks	Check cooling system and repair leaks
	Belt slipping or damaged	Check tension and/or replace belt
	Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
	Head gasket leaking	Replace head gasket
Oil Light on at Idle	Low oil pump pressure	Check oil pump operation, see ENGINES
	Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed
	VACUUM PUMP DIAGNOSIS	
Excessive Noise	Loose pump-to-drive assembly screws	Tighten screws
	Loose tube on pump assembly	Tighten tube
	Valves not functioning properly	Replace valves
Oil Leakage	Loose end plug	Tighten end plug
	Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Cranks Normally)	Cold start valve inoperative	Test valve and circuit
	Poor connection;vacuum or wiring	Check vacuum and electrical connections
	Contaminated fuel	Test fuel for water or alcohol
	Defective fuel pump relay or circuit	Test relay and wiring
	Battery too low	Charge and test battery

	Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
	No distributor reference pulses	Repair ignition system as necessary
	Open coolant temperature sensor circuit	Test sensor and wiring
	Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
	Defective ECM	Replace ECM
	Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
	Defective Idle Air Control (IAC) valve	Test valve operation and circuit
	Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
	EGR valve open	Test EGR valve and control circuit
	Poor Oxygen sensor signal	Test for shorted or circuit
	Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	Low fuel pump volume	Faulty pump or restricted fuel lines or filters
	Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
	Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
	Open coolant temperature sensor circuit	Test sensor and wiring
	Faulty ignition operation	Check wires for cracks or poor connections, test secondary voltage with oscilloscope
	Contaminated fuel	Test fuel for water

		or alcohol
	Intermittent ECM ground	Test ECM ground connection for resistance
	Restricted air cleaner	Replace air cleaner
	Restricted exhaust system	Test for exhaust manifold back pressure
	Poor MAF sensor signal	Check leakage between sensor and manifold
	Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	Poor Knock sensor signal	Test for shorted or open sensor or circuit
	Poor Baro sensor signal	Test for shorted or open sensor or circuit
	Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
	Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

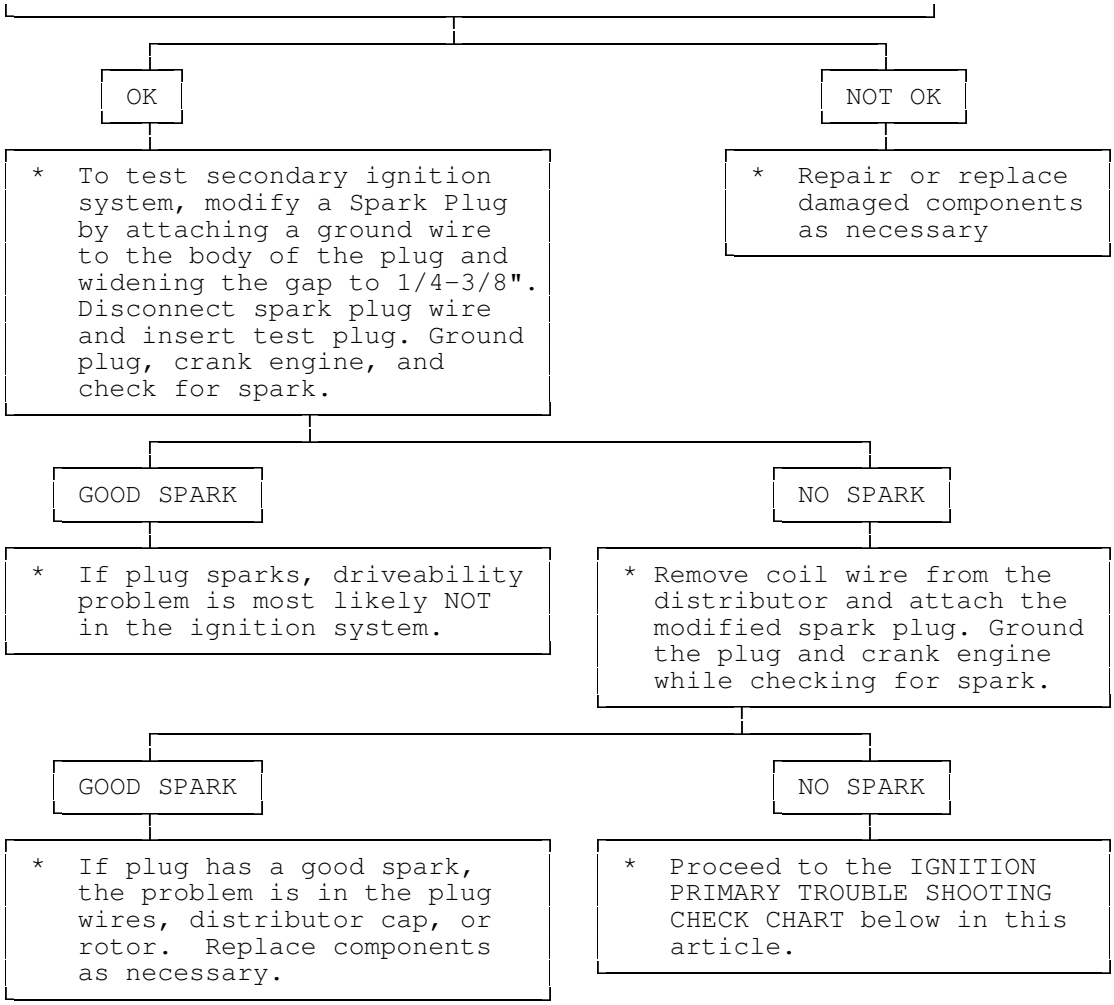
NOTE: For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

IGNITION SYSTEM TROUBLE SHOOTING

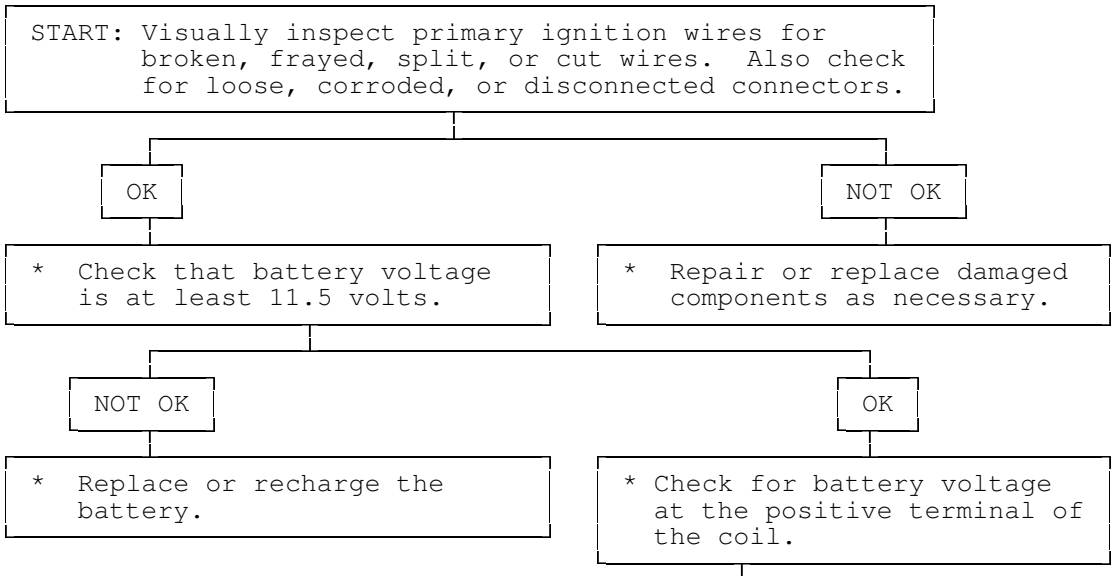
NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

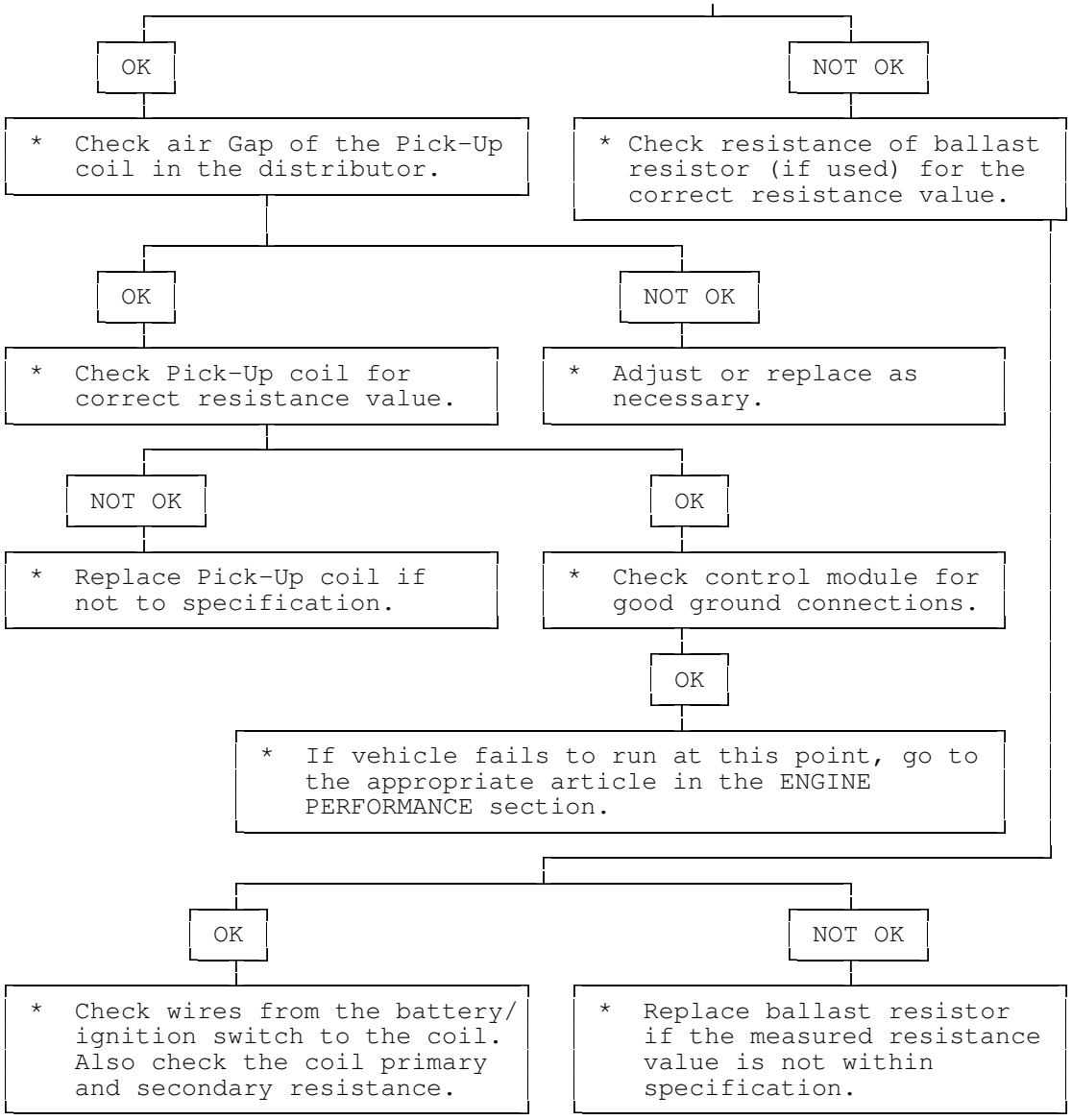
Ignition Secondary Trouble Shooting Chart

START: Visually inspect Spark Plug Wires, Coil Wires, Plug Wire Boots, Rotor, and Distributor Cap for signs of damage.



Ignition Primary Trouble Shooting Chart





STARTER TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter

	Ignition switch faulty or misadjusted	Adjust or replace ignition switch
	Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
	Starter relay or starter defective	See Testing in STARTER article
	Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	Weak battery or dead cell	Charge or replace battery as necessary
	Loose or corroded battery connections	Check that battery connections are clean and tight
	Internal ground in starter windings	See Testing in STARTER article
	Grounded starter fields	See Testing in STARTERS
	Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	Starter clutch slipping	See STARTER article
	Broken clutch housing	See STARTER article
	Pinion shaft rusted or dry	See STARTER article
	Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
	Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	Faulty overrunning clutch	See STARTER article
	Broken clutch housing	See STARTER article
	Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
	Armature shaft sheared or reduction gear teeth stripped	See STARTER article
	Weak battery	Charge or replace battery as necessary
	Faulty solenoid	See On-Vehicle Tests in STARTER article
	Poor grounds	Check all ground

		connections for tight and clean connections
	Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	Battery weak or defective	Charge or replace battery as necessary
	Engine overheated	See ENGINE COOLING SYSTEM article
	Engine oil too heavy	Check that proper viscosity oil is used
	Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
	Current draw too low or too high	See Bench Tests in STARTER article
	Bent armature, loose pole shoes screws or worn bearings	See STARTER article
	Burned solenoid contacts	Replace solenoid
	Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	Engine timing too far advanced	See Ignition Timing in TUNE-UP article
	Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
	Broken starter clutch	See STARTER article
	Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
	Weak drive assembly thrust spring	See STARTER article
	Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	Defective point assembly	See Testing in STARTER article
	Poor point assembly ground	See Testing in STARTER article
	Defective pull-in coil	Replace starter solenoid
Starter Relay	Dead battery	Charge or replace

Does Not Close		battery as necessary
	Faulty wiring	Check all wiring and connections leading to relay
	Neutral safety switch faulty	Replace neutral safety switch
	Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	Starter motor loose on mountings	Tighten starter attach bolts
	Worn drive end bushing	See STARTER article
	Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
	Drive yolk return spring broken or missing	Replace return spring
	Faulty ignition switch	Replace ignition switch
	Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
	Starter clutch not disengaging	Replace starter clutch
	Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	Faulty solenoid switch, switch connections or	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
	Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	Weak battery	Charge or replace battery as necessary
	Solenoid contacts corroded	Clean contacts or replace solenoid
	Faulty wiring	Check all wiring leading to solenoid
	Broken connections inside switch cover	Repair connections or replace solenoid
	Open hold-in wire	Replace solenoid
Low Current Draw	Worn brushes or weak	Replace brushes or brush springs as necessary

High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	Distance too small between starter pinion and flywheel Flywheel runout contributes to the intermittent nature	

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION	POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	Light Tan or Gray deposits	No Action
	Electrode not burned or fouled	No Action
	Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
	Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
	Clogged air filter	Clean and/or replace air filter
	Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
	Faulty ignition wires	Replace ignition wiring
	Prolonged operation at idle	Shut engine off during long idle
	Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	Worn rings and pistons	Install new rings and pistons

	Excessive cylinder wear	Rebore or replace block
	Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	Engine overheating	Check cooling system
	Wrong type of fuel	Replace with correct fuel
	Loose spark plugs	Retighten spark plugs
	Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	Incorrect type of fuel	Replace with correct fuel
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Burned valves	Replace valves
	Engine Overheating	Check cooling system
	Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	Severe detonation	Check for over-advanced timing or combustion
	Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	Additives in unleaded fuel	Try different fuel brand
Water In Combus-tion Chamber	Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Open circuit between distributor and bulkhead connector	Repair circuit
	Open circuit between bulkhead connector and	Repair circuit

	ignition switch	
	Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	Fuel lines leaking or clogged	Tighten fitting, remove restriction
	Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
	Centrifugal advance malfunction	Repair distributor advance
	Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
	Defective pick-up coil	Replace pick-up coil
	Defective ignition coil	Replace ignition coil
	Defective vacuum unit	Replace vacuum unit
	Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION	POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
	Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
	High resistance in coil wire	Replace coil wire
	Corrosion in coil tower terminal	Clean and/or replace coil
	Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
	Breaks in coil wire causing arcing	Replace coil wire
	Cracked coil tower causing arcing	Replace coil
	Low coil output	Replace coil
	Low engine compression	Determine cause and

		repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
	EGR valve stuck open	Clean and/or replace valve
	High resistance in spark plug wires	Replace spark plug wires
	Cracked or broken spark plug insulator	Replace spark plugs
	Intake vacuum leak	Repair leak
	Defective spark plugs	Replace spark plugs
	Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
	Breaks in plug wires causing arcing	Replace plug wires
	Cracked coil tower causing arcing	Replace coil
	Low compression	Determine cause and repair
	Defective spark plugs	Replace spark plugs
	Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	Cracked distributor cap terminals	Replace distributor cap
	Shorted spark plug wire	Determine cause and repair
	Mechanical problem in engine	Determine cause and repair
	Defective spark plugs	Replace spark plugs
	Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING TABLE

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Starting	Binding carburetor linkage	Eliminate binding
	Binding choke linkage	Eliminate binding
	Binding choke piston	Eliminate binding
	Restricted choke vacuum	Check vacuum lines for blockage

	Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
	Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
	Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
	Defective coil	Replace coil
	Improper spark plug gap	Regap spark plugs
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Defective spark plugs	Replace spark plugs
	Fuel lines clogged	Clean fuel lines
	EGR system malfunction	Check and repair EGR system
	PCV system malfunction	Repair PCV system
	Vacuum leaks	Check and repair vacuum system
	Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
	Restricted airflow	Remove restriction
	Vacuum advance malfunction	Check distributor operation
Dieseling	Binding carburetor linkage	Eliminate binding
	Binding throttle linkage	Eliminate blinding
	Binding choke linkage or fast idle cam	Eliminate binding
	Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
	Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE

	Engine cold and choke too lean	Adjust choke and allow engine to warm-up
	Defective spark plugs	Replace spark plugs
	Defective coil	Replace coil
Faulty Low Speed Operation	Clogged idle transfer slots	Clean idle transfer slots, see FUEL
	Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
	Clogged air cleaner	Replace air filter
	Defective spark plugs	Replace spark plugs
	Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
	Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Defective distributor centrifugal advance	Replace advance mechanism
	Defective distributor vacuum advance	Replace advance unit
	Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
	Faulty choke operation	Check choke and repair as required
	Clogged vacuum passages	Remove restrictions
	Improper size or clogged main jet	Check jet size and clean, see FUEL
	Restricted air cleaner	Check filter and replace as necessary
	Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	Defective spark plugs	Replace spark plugs
	Defective spark plug wires	Replace spark plug wires
	Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
	Cracked or broken vacuum hoses	Replace vacuum hoses

	Vacuum leaks	Repair vacuum leaks
	Fuel lines clogged	Remove restriction
Hesitation	Cracked or broken vacuum hoses	Replace vacuum hoses
	Vacuum leaks	Repair Vacuum leaks
	Binding carburetor linkage	Eliminate binding
	Binding throttle linkage	Eliminate binding
	Binding choke linkage or fast idle cam	Eliminate binding
	Improper float setting	Readjust float setting, see FUEL
	Cracked or broken ignition wires	Replace ignition wires
Rough idle, Missing or Stalling	Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
	Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
	Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
	Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
	Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
	Moisture in ignition components	Dry components
	Loose or broken ignition wires	Replace ignition wires
	Damaged distributor cap or or rotor	Replace distributor cap or rotor
	Faulty ignition coil	Replace ignition coil
	Fuel filter clogged or worn	Replace fuel filter
	Damaged idle mixture screw	Replace idle mixture screw, see FUEL
	Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
	Improper EGR valve operation	Replace EGR valve
	Faulty PCV valve air flow	Replace PCV valve
	Choke binding or improper choke setting	Reset choke or eliminate binding

	Vacuum leak	Repair vacuum leak
	Improper float bowl fuel level	Reset float adjustment, see FUEL
	Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
	Clogged or worn air cleaner filter	Replace air filter
	Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
	Exhaust manifold heat valve inoperative	Replace heat valve
	Improper distributor spark advance	Check distributor operation
	Leaking valves or valve components	Check and repair valvetrain
	Improper carburetor mounting	Remove and remount carburetor
	Excessive play in distributor shaft	Replace distributor
	Loose or corroded wiring connections	Repair or replace as required
Engine Surges	Improper PCV valve airflow	Replace PCV valve
	Vacuum leaks	Repair vacuum leaks
	Clogged air bleeds	Remove restriction
	EGR valve malfunction	Replace EGR valve
	Restricted air cleaner filter	Replace air filter
	Cracked or broken vacuum hoses	Replace vacuum hoses
	Cracked or broken ignition wires	Replace ignition wires
	Vacuum advance malfunction	Check unit and replace as necessary
	Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
	Carburetor setting too lean	Readjust mixture

		setting, see ENGINE PERFORMANCE
	Vacuum leak	Eliminate vacuum leak
	EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	Cracked or broken vacuum hoses	Replace vacuum hoses
	Vacuum leaks	Repair vacuum leaks
	Defective ignition wires	Replace wires
	Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
	Defective vacuum advance	Replace vacuum advance
	Defective spark plugs	Replace spark plugs
	Binding carburetor power piston	Eliminate binding
	Dirt in carburetor jets	Clean and/or replace jets
	Incorrect float adjustment	Readjust float setting, see FUEL
	Defective power valve	Replace power valve, see ENGINE PERFORMANCE
	Incorrect idle speed	Readjust idle speed
Engine Stalls	Improper float level	Readjust float level
	Leaking needle valve and seat	Replace needle valve and seat
	Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION

Excessive Noise	Loose pump-to-drive assembly screws	Tighten screws
	Loose tube on pump assembly	Tighten tube
	Valves not functioning properly	Replace valves
Oil Leakage	Loose end plug	Tighten end plug
	Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	.Low gear oil level, .Loose bell housing bolts, .Worn bearings or gears
Clunk On Deceleration (FWD Only)	.Loose engine mounts, .Worn inboard CV joints, .Worn differential pinion shaft, .Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	.Clutch Out Of Adjustment, .Shift linkage damaged or out of adjustment, .Gears or synchronizers damaged, .Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	.Worn rear outputshaft bearing
Gear Rattle	.Worn bearings, .Wrong gear oil, .Low gear oil, .Worn gears
Steady Ticking At Idle (Increases With RPM)	.Broken tooth on gear
Gear Clash When Shifting Forward Gears	.Worn or broken synchronizers
Loud Whine In Reverse	.Normal condition (1)

Noise When Stepping On Clutch	.Bad release bearing, .Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	.Faulty release bearing, .Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	.Worn clutch fork, .Worn or broken front bearing retainer
Transmission Shifts Hard	.Clutch not releasing, .Shift mechanism binding, .Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	.Bent shift fork, .Worn detent balls
Locked Into Gear, Cannot Shift	.Clutch adjustment, .Worn detent balls
Transmission Jumps Out Of Gear	.Pilot bearing worn, .Bent shift fork, .Worn gear teeth or face .Excessive gear train end play .Worn synchronizers .Missing detent ball spring .Shift mechanism worn or out of adjustment .Engine or transmission mount bolts loose or out of adjustment .Transmission not aligned
Shift Lever Rattle	.Worn shift lever or detents .Worn shift forks .Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	.Worn engine or transmission mounts
(1) - Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	Incorrect clutch adjustment	Adjust clutch
	Oil, grease or glaze on facings	Disassemble and clean or replace
	Loose "U" joint flange	See DRIVE AXLES article
	Worn input shaft spline	Replace input shaft
	Binding pressure plate	Replace pressure plate
	Binding release lever	See CLUTCH article
	Binding clutch disc hub	Replace clutch disc
	Unequal pressure plate contact	Replace worn/misaligned components
	Loose/bent clutch disc	Replace clutch disc
	Incorrect transmission alignment	Realign transmission
	Worn pressure plate, disc or flywheel	Replace damaged components
	Broken or weak pressure springs	Replace pressure plate
	Sticking clutch pedal	Lubricate clutch pedal & linkage
	Incorrect clutch disc facing	Replace clutch disc
	Engine loose in chassis	Tighten all mounting bolts
Failure to Release	Oil or grease on clutch facings	Clean or replace clutch clutch disc
	Incorrect release lever or pedal adjustment	See CLUTCH article
	Worn or broken clutch facings	Replace clutch disc
	Bent clutch disc or pressure plate	Replace damaged components
	Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
	Binding pilot bearing	Replace pilot bearing
	Sticking release bearing sleeve	Replace release bearing and/or sleeve
	Binding clutch cable	See CLUTCH article

	Defective clutch master	Replace master cylinder
	Defective clutch slave	Replace slave cylinder
	Air in hydraulic system	Bleed hydraulic system
Rattling	Weak or broken release lever spring	Replace spring and check alignment
	Damaged pressure plate	Replace pressure plate
	Broken clutch return spring	Replace return spring
	Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
	Worn clutch release bearing	Replace release bearing
	Dry or worn pilot bearing	Lubricate or replace pilot bearing
	Unequal release lever contact	Align or replace release lever
	Incorrect pedal free play	Adjust free play
	Warped or damaged clutch disc	Replace damaged components
Slipping	Pressure springs worn or	Release pressure plate
	Oily, greasy or worn facings	Clean or replace clutch disc
	Incorrect clutch alignment	Realign clutch assembly
	Warped clutch disc or pressure plate	Replace damaged components
	Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	Worn or damaged release	Replace release bearing
	Dry or worn pilot or release bearing	Lubricate or replace assembly
	Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
	Worn input shaft bearing	Replace bearing and seal
	Incorrect transmission alignment	Realign transmission
	Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	Sticking release bearing sleeve	Replace release bearing and/or sleeve

	Dry or binding clutch pedal hub	Lubricate and align components
	Floor mat interference with pedal	Lay mat flat in proper area
	Dry or binding ball/fork pivots	Lubricate and align components
	Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	Faulty interlock switch	Replace interlock switch
	Self-adjuster ratchet noise	Lubricate or replace self-adjuster
	Speed control interlock switch	Lubricate or replace interlock switch
Clutch Pedal Sticks Down	Binding clutch cable	See CLUTCH article
	Springs weak in pressure plate	Replace pressure plate
	Binding in clutch linkage	Lubricate and free linkage
Noisy	Dry release bearing	Lubricate or replace release bearing
	Dry or worn pilot bearing	Lubricate or replace bearing
	Worn input shaft bearing	Replace bearing
Transmission Click	Weak springs in pressure plate	Replace pressure plate
	Release fork loose on ball stud	Replace release fork and/or ball stud
	Oil on clutch disc damper	Replace clutch disc
	Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1) Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.

2) On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.

3) Measure the length of the chalk mark, which is the total

axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

* Vibrations of various unbalanced rotating parts of the vehicle.
* Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.
* Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing. For definitions of listed noises or sounds, see DRIVE AXLE - NOISE DIAGNOSIS under POWERTRAIN.

DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION

Knocking or Clunking		
	Differential Side Gear Clearance	Check Clearance
	Worn Pinion Shaft	Replace Pinion Shaft
	Axle Shaft End Play	Check End Play
	Missing Gear Teeth	Check Differential/ Replace Gear
	Wrong Axle Backlash	Check Backlash
	Misaligned Driveline	Realign Driveline
Clinking During Engagement		
	Side Gear Clearance	Check Clearance
	Ring and Pinion Backlash	Check Backlash
	Worn/Loose Pinion Shaft	Replace Shaft/Bearing
	Bad "U" Joint	Replace "U" Joint
	Sticking Slip Yoke	Lube Slip Yoke
	Broken Rear Axle Mount	Replace Mount
	Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns		
	Differential Side Gear Clearance	Check Clearance
	Wrong Turn On Plates (1)	Replace Clutch Plates
	Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds		
	Faulty Wheel Bearing	Replace Wheel Bearing
	Faulty "U" Joint	Replace "U" Joint
	Faulty Drive Shaft	Balance Drive Shaft
	Faulty Companion Flange	Replace Flange
	Faulty Slip Yoke Flange	Replace Flange

(1) - Limited slip differential only.

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to

problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	Rack and pinion mounting bracket loose	Tighten all mounting bolts
	Lack of/or incorrect lubricant	Correct as necessary
	Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
	Loose or worn steering linkage	See STEERING LINKAGE article
	Loose or worn steering gear shift	See MANUAL STEERING GEAR article
	Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
	Steering gear housing bolts loose	Tighten all mounting bolts
	Steering gear adjustment too loose	See MANUAL STEERING GEAR article
	Steering arms loose on	Tighten and check

	knuckles	steering linkage
	Rack and pinion mounting loose	Tighten all mounting bolts
	Rack and pinion out of adjustment	See adjustment in STEERING article
	Tie rod end loose	Tighten and check steering linkage
	Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	Lack of lubricant in ball joint or linkage	Lubricate and service systems
	Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
	Improper front end alignment	See WHEEL ALIGNMENT article
	Improper tire pressure	Inflate to proper pressure
	Tie rod binding	Inflate to proper pressure
	Shaft seal rubbing shaft	See STEERING COLUMN article
Excessive Vertical Motion	Improper tire pressure	Inflate to proper pressure
	Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
	Worn or faulty shock absorbers	Check and replace if necessary
	Loose tie rod ends or steering	Tighten or replace if necessary
	Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	Improper tire pressure	Inflate to proper pressure
	Front tires are different sizes	Rotate or replace if necessary
	Wheel bearings not adjusted properly	See FRONT SUSPENSION article
	Bent or broken suspension components	See FRONT SUSPENSION article
	Improper wheel alignment	See WHEEL ALIGNMENT article

	Brakes dragging	See BRAKES article
Instability	Low or uneven tire pressure	Inflate to proper pressure
	Loose or worn wheel bearings	See FRONT SUSPENSION article
	Loose or worn idler arm bushing	See FRONT SUSPENSION article
	Loose or worn strut bushings	See FRONT SUSPENSION article
	Incorrect front wheel alignment	See WHEEL ALIGNMENT article
	Steering gear not centered	See MANUAL STEERING GEARS article
	Springs or shock	Check and replace if necessary
	Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	Pressure hoses touching engine parts	Adjust to proper clearance
	Loose Pitman shaft	Adjust or replace if necessary
	Tie rods ends or Pitman arm loose	Tighten and check system
	Rack and pinion mounts loose	Tighten all mounting bolts
	Free play in worm and	See POWER STEERING GEAR article
	Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
	Free play in pot coupling	See STEERING COLUMN article

	Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
	Scored pressure plates	See POWER STEERING GEAR article
	Scored thrust plates or rotor	See POWER STEERING GEAR article
	Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	Vanes not installed	See POWER STEERING PUMP article
	Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	Air in fluid	See POWER STEERING PUMP article
	Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	Pump shaft bearing scored	Replace bearing and fluid
	Air in fluid or fluid level low	See POWER STEERING PUMP article
	Hose or column grounded	Check and replace if necessary
	Cover "O" ring missing or damaged	See POWER STEERING PUMP article
	Valve cover baffle missing or damaged	See POWER STEERING PUMP article
	Interference of components in pump	See POWER STEERING PUMP article
	Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	Noisy pump	See POWER STEERING PUMP article

	Free play in steering shaft bearing	See STEERING COLUMN article
	Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	Pump slippers too long	See POWER STEERING PUMP article
	Broken slipper springs	See POWER STEERING PUMP article
	Excessive wear or nicked rotors	See POWER STEERING PUMP article
	Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
	Flange rubbing steering gear adjuster	See STEERING COLUMN article
	Tight or frozen steering shaft bearing	See STEERING COLUMN article
	Steering gear out of adjustment	See POWER STEERING GEAR article
	Sticking or plugged spool valve	See POWER STEERING PUMP article
	Improper front end alignment	See WHEEL ALIGNMENT article
	Wheel bearings worn or loose	See FRONT SUSPENSION article
	Ties rods or ball joints binding	Check and replace if necessary
	Intermediate shaft joints binding	See STEERING COLUMN article
	Kinked pressure hoses	Correct or replace if necessary
	Loose housing head spanner nut	See POWER STEERING GEAR article
	Damaged valve lever	See POWER STEERING GEAR article
	Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
	Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
	Reaction ring sticking in cylinder	See POWER STEERING GEAR article

	Reaction ring sticking in housing head	See POWER STEERING GEAR article
	Steering pump internal leakage	See POWER STEERING PUMP article
	Steering gear-to-column misalignment	See STEERING COLUMN article
	Lack of lubrication in linkage	Service front suspension
	Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning	High internal pump leakage	See POWER STEERING PUMP article
Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	Power steering pump belt slipping	Adjust or replace if necessary
	Low fluid level	Check and fill to proper level
	Engine idle speed to low	Adjust to correct setting
	Air in pump fluid system	See POWER STEERING PUMP article
	Pump output low	See POWER STEERING PUMP article
	Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	Low fluid level	Check and fill to proper level
	Loose fan belt	Adjust or replace if necessary
	Insufficient pump pressure	See POWER STEERING PUMP article
	Sticky flow control valve	See POWER STEERING PUMP article
	Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	Air in pump fluid system	See POWER STEERING PUMP article
	Worn poppet valve in steering gear	See POWER STEERING PUMP article
	Excessive over center lash	See POWER STEERING GEAR article
	Thrust bearing out of adjustment	See POWER STEERING GEAR article

	Free play in pot coupling	See POWER STEERING PUMP article
	Steering gear coupling loose on shaft	See POWER STEERING PUMP article
	Steering disc mounting bolts loose	Tighten or replace if necessary
	Coupling loose on worm shaft	Tighten or replace if necessary
	Improper sector shaft adjustment	See POWER STEERING GEAR article
	Excessive worm piston side play	See POWER STEERING GEAR article
	Damaged valve lever	See POWER STEERING GEAR article
	Universal joint loose	Tighten or replace if necessary
	Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	Sticking flow control valve	See POWER STEERING PUMP article
	Insufficient pump pressure output	See POWER STEERING PUMP article
	Excessive internal pump leakage	See POWER STEERING PUMP article
	Excessive internal gear leakage	See POWER STEERING PUMP article
	Flange rubs against gear adjust plug	See STEERING COLUMN article
	Loose pump belt	Adjust or replace if necessary
	Low fluid level	Check and add proper amount of fluid
	Engine idle too low	Adjust to correct setting
	Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
	Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
	Cylinder head "O" ring damaged	See POWER STEERING PUMP article

No Power, Right Turns	Column pot coupling bottomed	See STEERING COLUMN article
	Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
	Right turn reaction seal damaged	See POWER STEERING GEAR article
	Internal leakage through piston end plug	See POWER STEERING GEAR article
	Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	Front end alignment incorrect	See WHEEL ALIGNMENT article
	Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	Flow control valve stuck or inoperative	See POWER STEERING PUMP article
	Pressure plate not flat against cam ring	See POWER STEERING PUMP article
	Extreme wear of cam ring	Replace and check adjustments
	Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
	Vanes not installed properly	See POWER STEERING PUMP article
	Vanes sticking in rotor slots	See POWER STEERING PUMP article
	Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Noise in Steering	Coupling pulled apart	See STEERING COLUMNS article

	Column not correctly aligned	See STEERING COLUMNS article
	Broken lower joint	Replace joint
	Horn contact ring not	See STEERING COLUMN article
	Bearing not lubricated	See STEERING COLUMN article
	Shaft snap ring not properly seated	Reseat or replace snap ring
	Plastic spherical joint not lubricated	See STEERING COLUMN article
	Shroud or housing loose	Tighten holding screws
	Lock plate retaining ring not seated	See STEERING COLUMN article
	Loose sight shield	Tighten holding screws
High Steering Shaft Effort	Column assembly misaligned	See STEERING COLUMN article
	Improperly installed dust shield	Adjust or replace
	Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	Column is out of alignment	See STEERING COLUMN article
	Improperly installed dust shield	Adjust or replace
	Seals or bearings not lubricated	See STEERING COLUMNS article
	Mounting bracket screws too long	Replace with new shorter screws
	Burrs on shift tube	Remove burrs or replace tube
	Lower bowl bearing assembled wrong	See STEERING COLUMN article
	Shift tube bent or broken	Replace as necessary
	Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	Sheared shift tube joint	Replace as necessary
	Sheared lower shaft lever	Replace as necessary
	Improper shift lever adjustment	See STEERING COLUMN article

	Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	Instrument panel bracket bolts loose	Tighten bolts and check bracket
	Broken weld nut on jacket	See STEERING COLUMN article
	Instrument bracket capsule sheared	See STEERING COLUMN article
	Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Front End Noise	Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
	Worn shocks or shock mountings	Replace struts or strut mountings
	Worn struts or strut mountings	Replace struts or strut mountings
	Loose or worn lower control arm	See SUSPENSION
	Loose steering gear-to-frame bolts	See STEERING
	Worn control arm bushings	See SUSPENSION
	Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	Tires or wheels out of balance	Check tire balance
	Incorrect wheel alignment	See WHEEL ALIGNMENT
	Drive shaft unbalanced	Check drive shaft balance

	Loose or worn wheel bearings	See WHEEL ALIGNMENT
	Loose or worn tie rod ends	See SUSPENSION
	Worn upper ball joints	See Ball Joint Checking in SUSPENSION
	Worn shock absorbers	Replace shock absorbers
	Worn strut bushings	Replace strut bushings
Car Pulls to One Side	Mismatched or uneven tires	Check tire condition
	Broken or sagging springs	See SUSPENSION
	Loose or worn strut bushings	See SUSPENSION
	Improper wheel alignment	See WHEEL ALIGNMENT
	Improper rear axle alignment	Check rear axle alignment
	Power steering gear unbalanced	See STEERING
	Front brakes dragging	See BRAKES
Abnormal Tire Wear	Unbalanced tires	Check tire balance & rotation
	Sagging or broken springs	See SUSPENSION
	Incorrect front end alignment	See WHEEL ALIGNMENT
	Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	Toe-In incorrect	See WHEEL ALIGNMENT
	Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	Bent or broken springs	See SUSPENSION
	Leaking or worn shock absorbers	Replace shock absorbers
	Frame misalignment	Check frame for damage
Spring Noises	Loose "U" Bolts	See SUSPENSION
	Loose or worn bushings	See SUSPENSION
	Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	Loose shock mountings	Check & tighten mountings
	Worn bushings	Replace bushings

	Air in system	Bleed air from system
	Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	Loose stabilizer bar	See SUSPENSION
	Faulty shocks or mountings	Replace shocks or mountings
	Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	Loose "U" bolts	See SUSPENSION
	Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	Improper tire inflation	Check tire pressure
	Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
	Suspension components worn	See SUSPENSION section
	Steering system components worn	See STEERING section
	Improper standing height	See WHEEL ALIGNMENT
	Uneven or sagging springs	See SUSPENSION section
	Bent wheel	See WHEEL ALIGNMENT
	Improper torsion bar adjustment	See SUSPENSION section
	Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
	Worn or defective shock	Replace shock absorbers
	Tires out of balance	Check tire balance
Pulls to One Side	Improper tire inflation	Check tire pressure
	Brake dragging	See BRAKE section

	Mismatched tires	See WHEEL ALIGNMENT
	Broken or sagging spring	See SUSPENSION section
	Broken torsion bar	See SUSPENSION section
	Power steering valve not centered	See STEERING section
	Front alignment out of tolerance	See WHEEL ALIGNMENT section
	Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
	Uneven sway bar links	See SUSPENSION section
	Frame bent	Check for frame damage
	Steering system bushing worn	See STEERING section
Hard Steering	Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
	Ball joint tight or seized	See SUSPENSION section
	Steering linkage too tight	See STEERING LINKAGE in STEERING section
	Power steering fluid low	Add proper amount of fluid
	Power steering drive belt loose	See STEERING section
	Power steering pump defective	See STEERING section
	Steering gear out of adjustment	See STEERING section
	Incorrect wheel alignment	See WHEEL ALIGNMENT
	Damaged steering gear	See STEERING section
	Damaged suspension	See SUSPENSION section
	Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	Strut rod or control arm bushing worn	See SUSPENSION section
	Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
	Improper tire inflation	Check tire pressure
	Stabilizer bar missing or defective	See SUSPENSION section

	Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
	Broken spring	See SUSPENSION section
	Defective shock absorbers	Replace shock absorbers
	Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	Tire out of balance/round	Check tire balance
	Excessive wheel runout	See WHEEL ALIGNMENT
	Insufficient or improper caster	See WHEEL ALIGNMENT section
	Worn suspension or steering components	See SUSPENSION section
	Defective shock absorbers	Replace shock absorber
	Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
	Power steering reaction Bracket loose	See STEERING section
	Steering gear box (rack) mounting loose	See STEERING section
	Steering gear adjustment loose	See STEERING section
	Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	Lower control arm bent	See SUSPENSION section
	Frame bent	Check frame for damage
Camber Not Adjustable	Control arm bent	See SUSPENSION section
	Frame bent	Check frame for damage
	Hub & bearing not seated properly	See SUSPENSION section

WAVEFORMS - INJECTOR PATTERN TUTORIAL

1999 Lexus RX 300

GENERAL INFORMATION
Waveforms - Injector Pattern Tutorial

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models.

PURPOSE OF THIS ARTICLE

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

* How a DVOM and noid light fall short of a lab scope.
* The two types of injector driver circuits, voltage controlled & current controlled.
* The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
* The two different pattern types you can use to diagnose with, voltage & current.
* All the valuable details injector patterns can reveal.

SCOPE OF THIS ARTICLE

This is NOT a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

IS A LAB SCOPE NECESSARY?

INTRODUCTION

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

OVERVIEW OF NOID LIGHT

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

* If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
* If an injector driver is weak or a minor voltage drop is present.

Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

* A dimly flashing light when it should be normal.
* A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

* Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
* Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/amperage circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understanding

the types of injector circuits that your noid lights are designed for. There are three. They are:

* Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
* Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
* Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) and an external injector resistor.

NOTE: Some noid lights can meet both the second and third categories simultaneously.

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

OVERVIEW OF DVOM

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

Checking Injector Resistance

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase an tool that checks injector coil windings under

full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around $240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

Checking Available Voltage At the Injector

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

* They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
* A few unusual conditions can cause inaccurate readings.
* Varying engine speeds can result in inaccurate readings.

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse

but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.

While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE.

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15° dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages everything together it does not miss anything (though this is also a

severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

* Injector mS on-time specification.
* Engine RPM when specification is valid.
* How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360° of crankshaft rotation, a bank-fire that injects every 720°, or an SFI that injects every 720°. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1) Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.

2) Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360° bank-fired, meaning an injector fires each and every crankshaft revolution.

3) Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use.

Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second.

Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.

4) Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period.

One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4° dwell.

Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O2 gets pushed into the exhaust and passes the O2 sensor. The O2 sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM

3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE (1)

Dwell Meter (2)	Duty Cycle Meter
1°	1%
15°	25%
30°	50%
45°	75%
60°	100%

(1) - These are just some examples for your understanding. It is okay to fill in the gaps.
(2) - Dwell meter on the six-cylinder scale.

THE TWO TYPES OF INJECTOR DRIVERS

OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. 1.

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening

times by increasing injector pulse width accordingly.

NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.

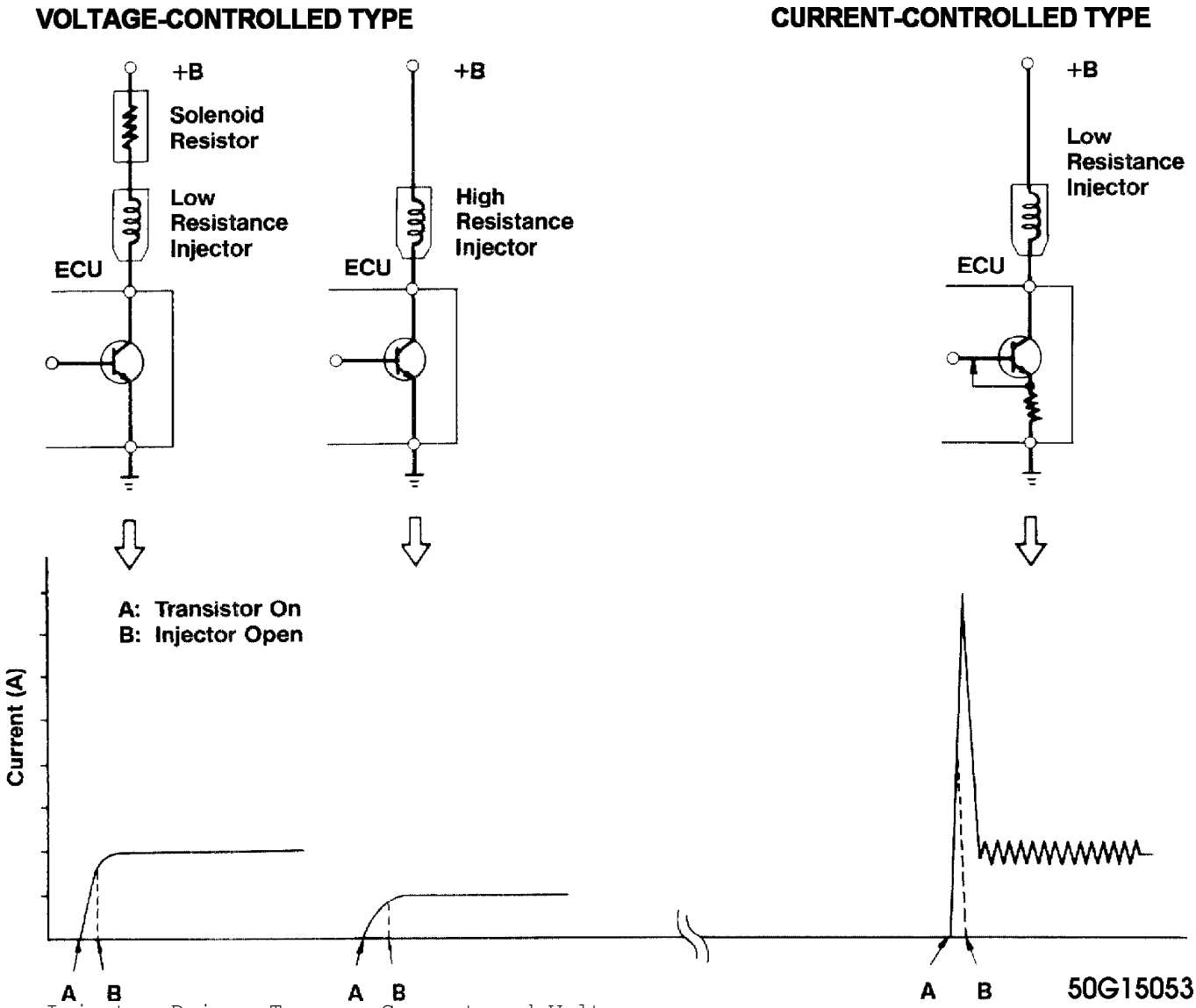


Fig. 1: Injector Driver Types - Current and Voltage

CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this

as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of Fig. 1 for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.

THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the latter are the 1970’s Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

INTERPRETING INJECTOR WAVEFORMS

INTERPRETING A VOLTAGE CONTROLLED PATTERN

NOTE: Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.

NOTE: This example is based on a constant power/switched ground circuit.

* See Fig. 2 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you

will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is

the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

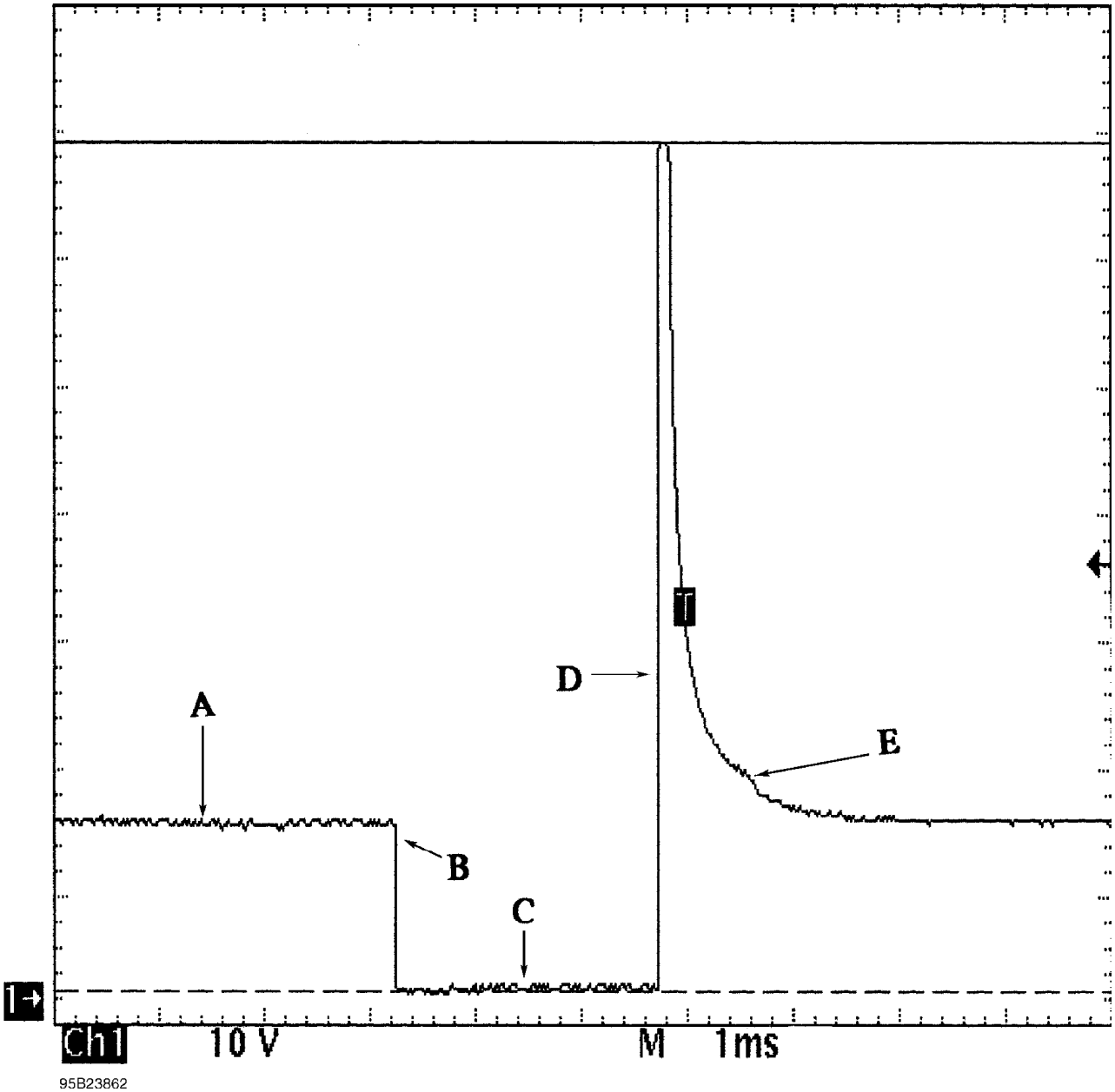


Fig. 2: Identifying Voltage Controlled Type Injector Pattern

INTERPRETING A CURRENT CONTROLLED PATTERN

NOTE: Current controlled drivers are also known as "Peak and Hold"

drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.

NOTE: This example is based on a constant power/switched ground circuit.

* See Fig. 3 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from

a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

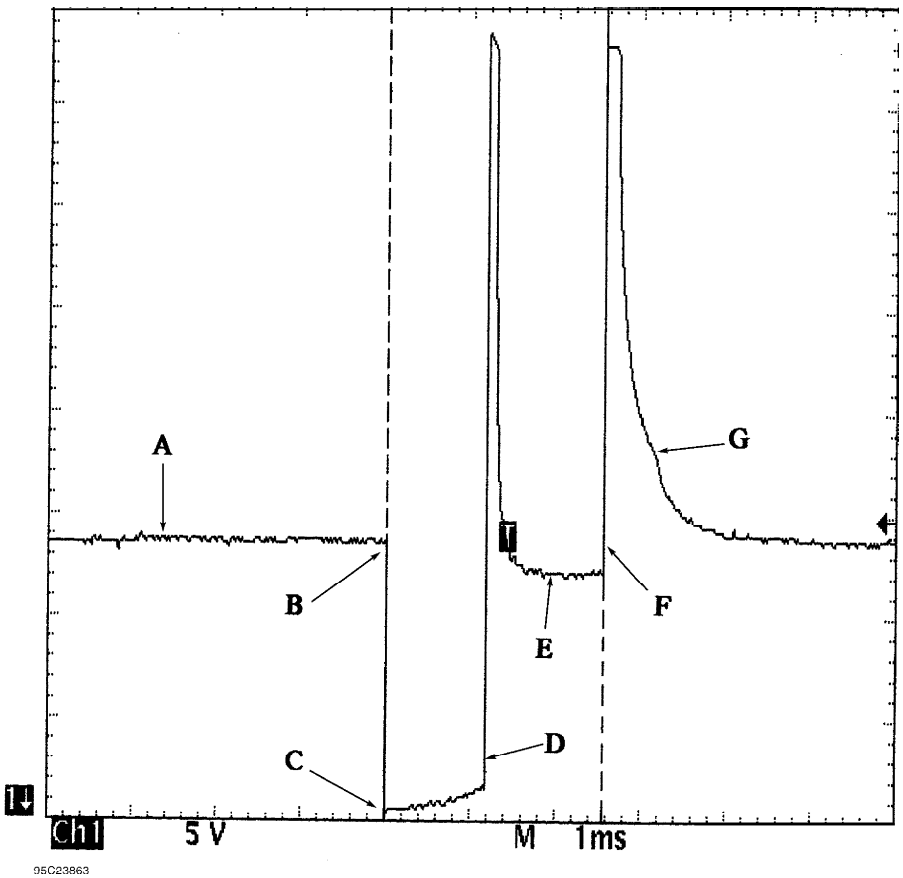


Fig. 3: Identifying Current Controlled Type Injector Pattern

CURRENT WAVEFORM SAMPLES

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. 4 indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See Fig. 4.

Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in Fig. 5 indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in Fig. 6. Notice that it limits current flow to 750 milliamps.

The waveform shown in Fig. 7 illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.

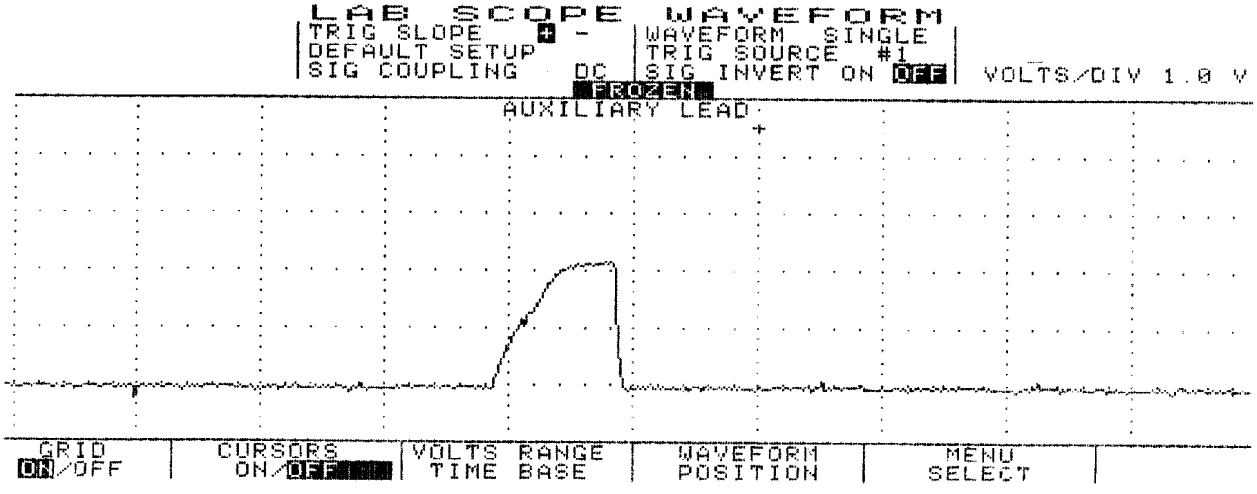


Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern

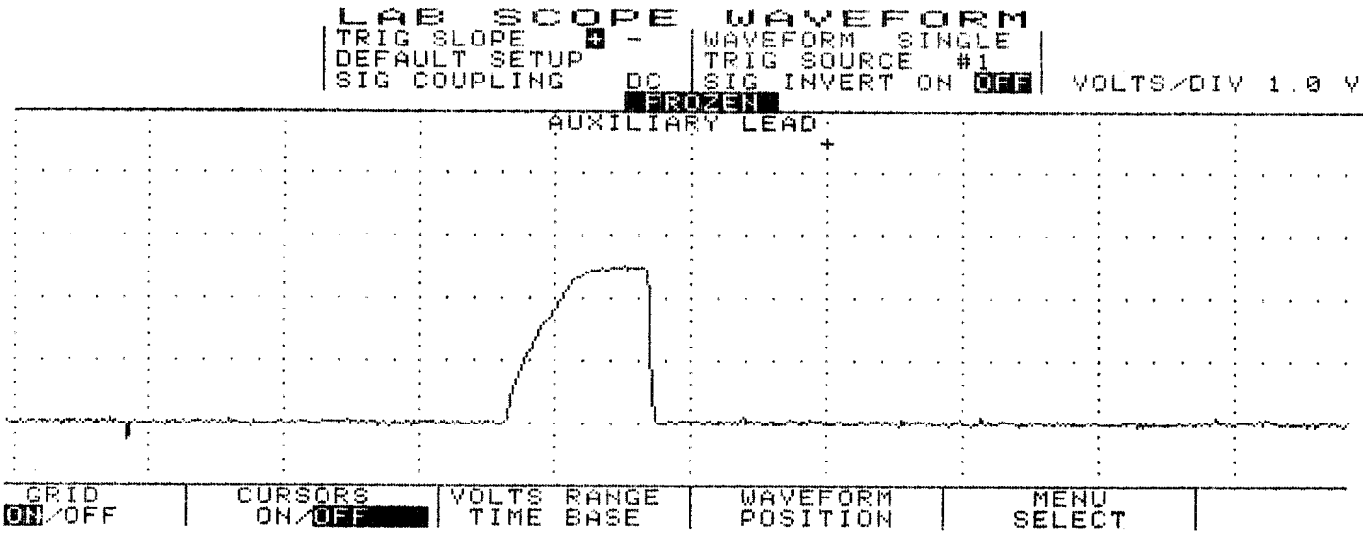


Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern

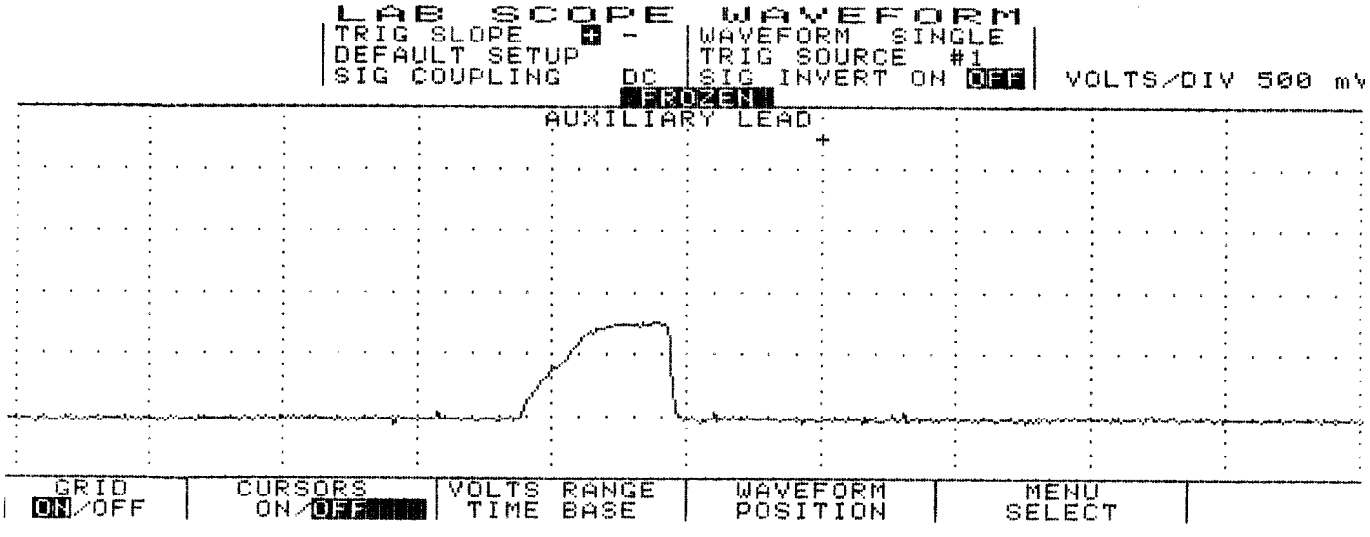


Fig. 6: Single Injector w/Normal Current Flow - Current Pattern

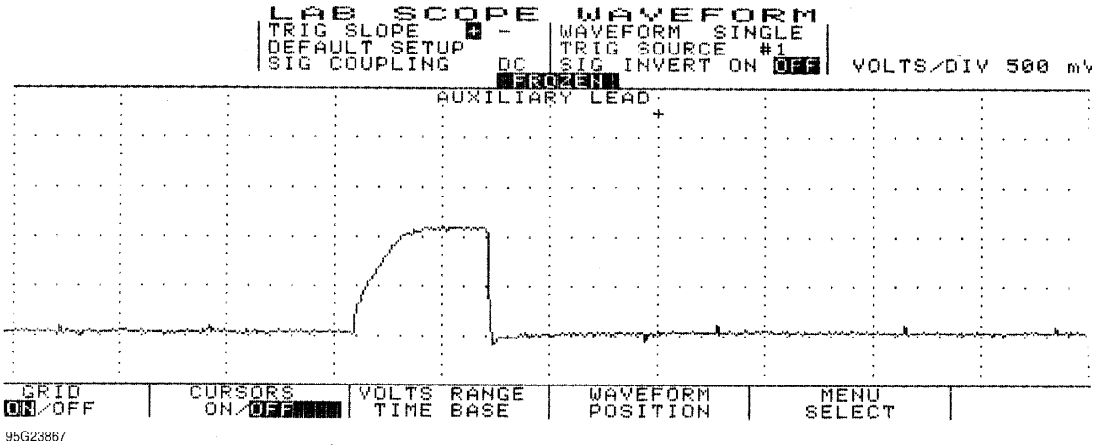


Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

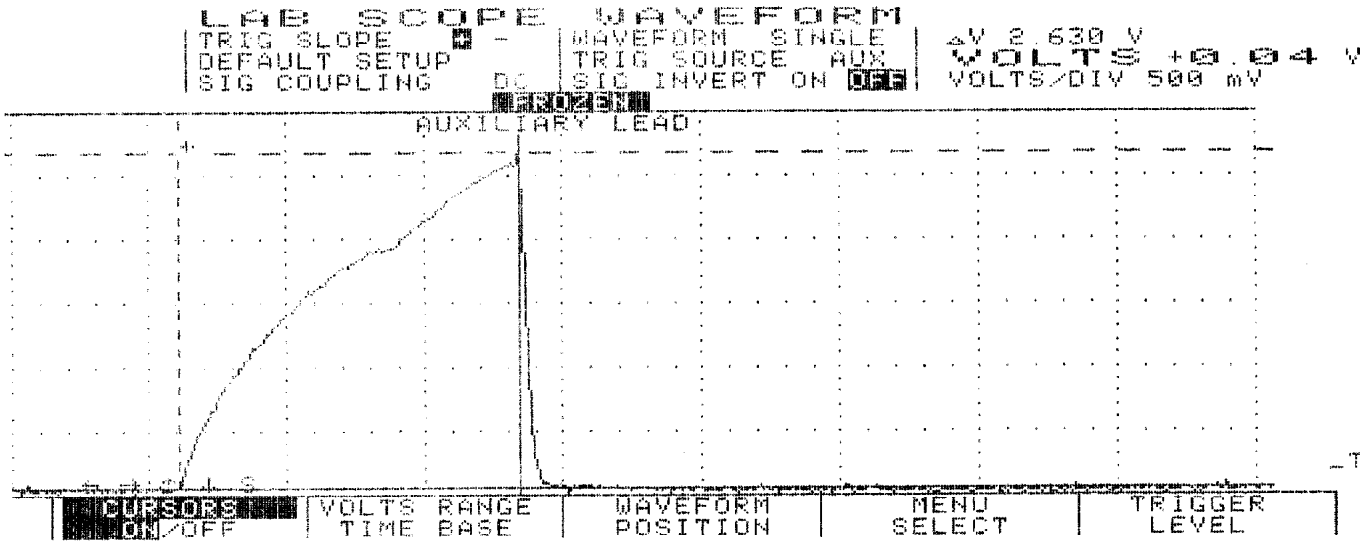
This time we will look at a GM 3.1L V6 VIN [T]. Fig. 8 shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in EXAMPLE #1 above, other factors knock this value down to roughly the 2.6 amp neighborhood.

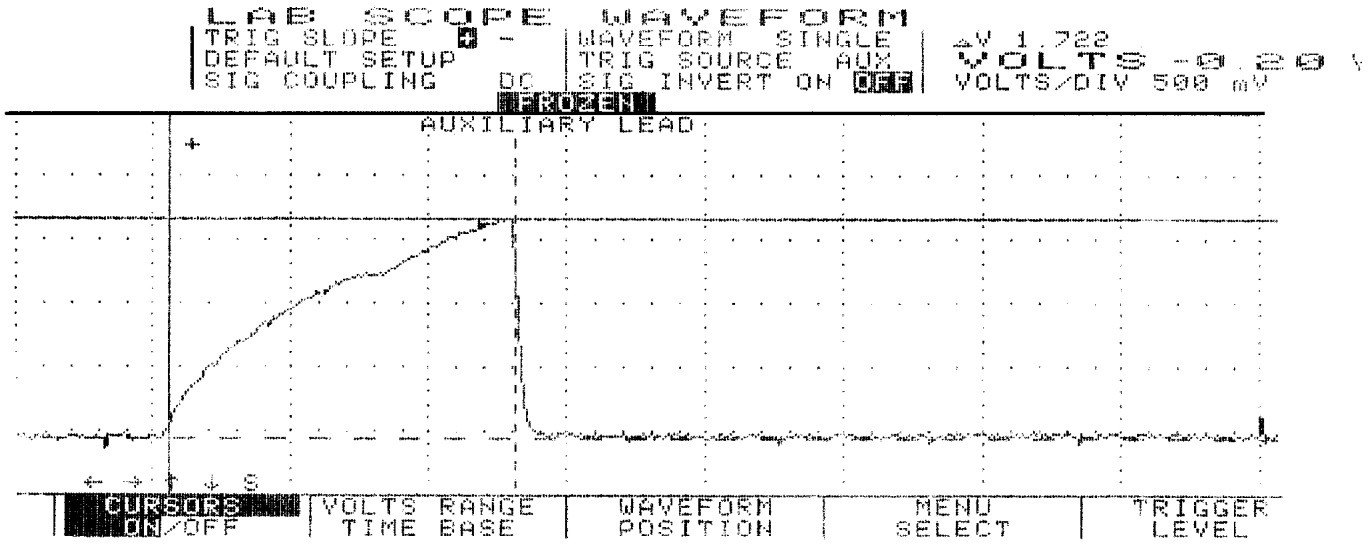
Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See Fig. 9. Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. 8). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.



95E23873

Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern



95F23874

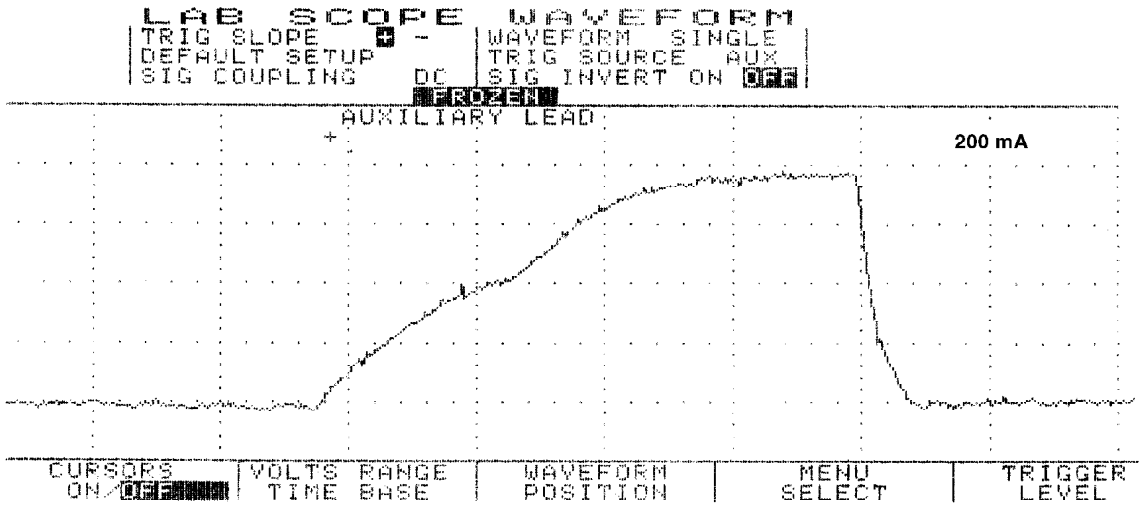
Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

Example #3 is of a Ford 5.0L V8 SEFI. Fig. 10 shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

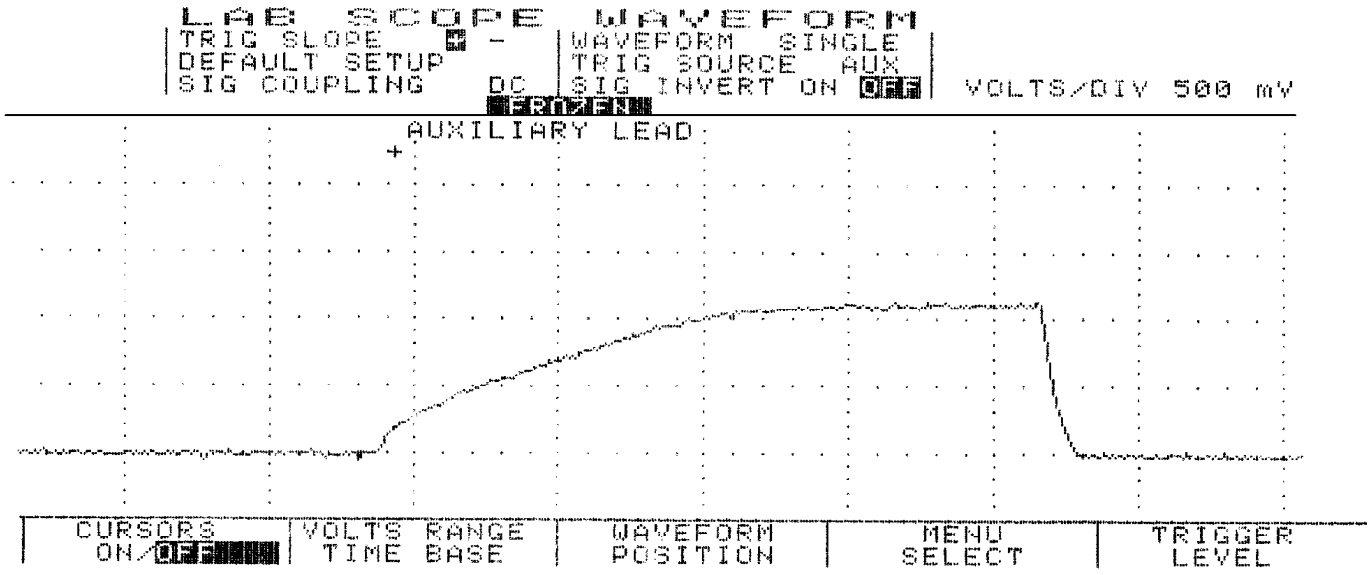
The next waveform pattern in Fig. 11 shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.



95G23875

Fig. 10: Single Injector w/Normal Current Flow - Current Pattern



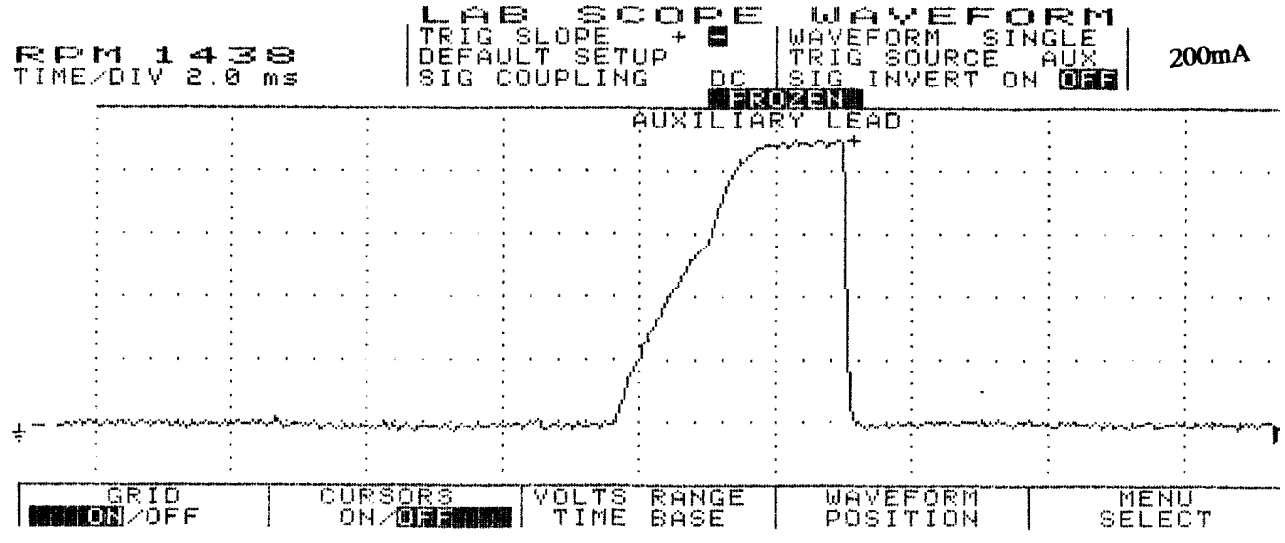
95H23876

Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

Example #4 is of a Ford 4.6L SEFI VIN [W]. See Fig. 12 for the known-good waveform pattern. This Ford system is different from the one above in EXAMPLE #3 as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.



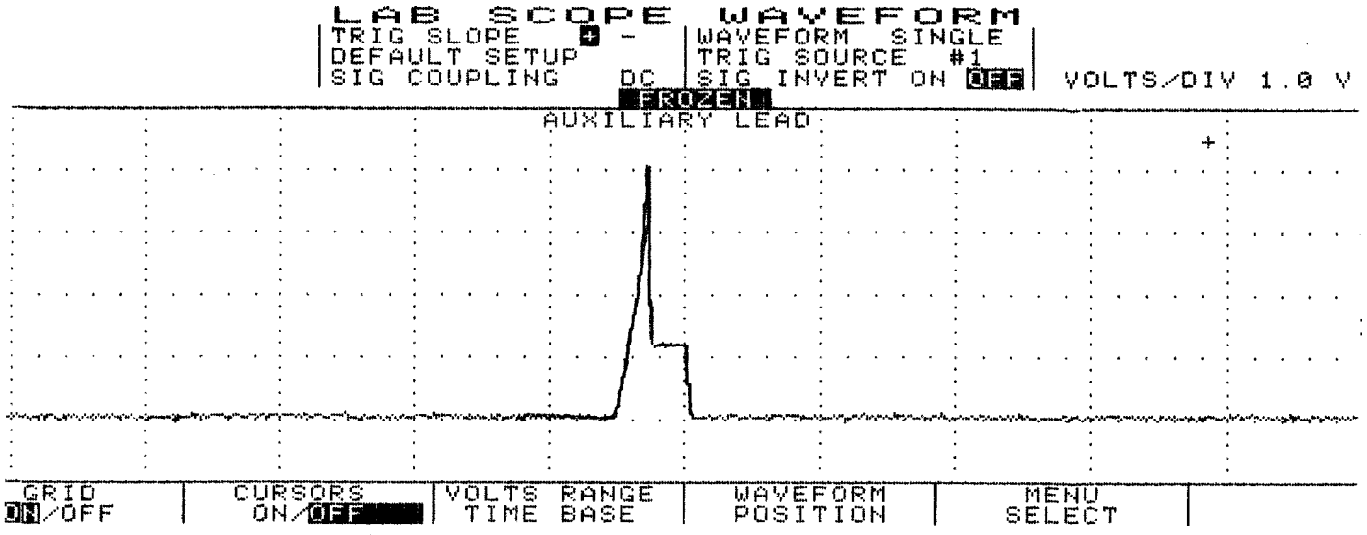
95D23872

Fig. 12: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

The known-good waveform in Fig. 13 is from a Chrysler 3.0L V6

PFI VIN [3]. It is a perfect example of the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.

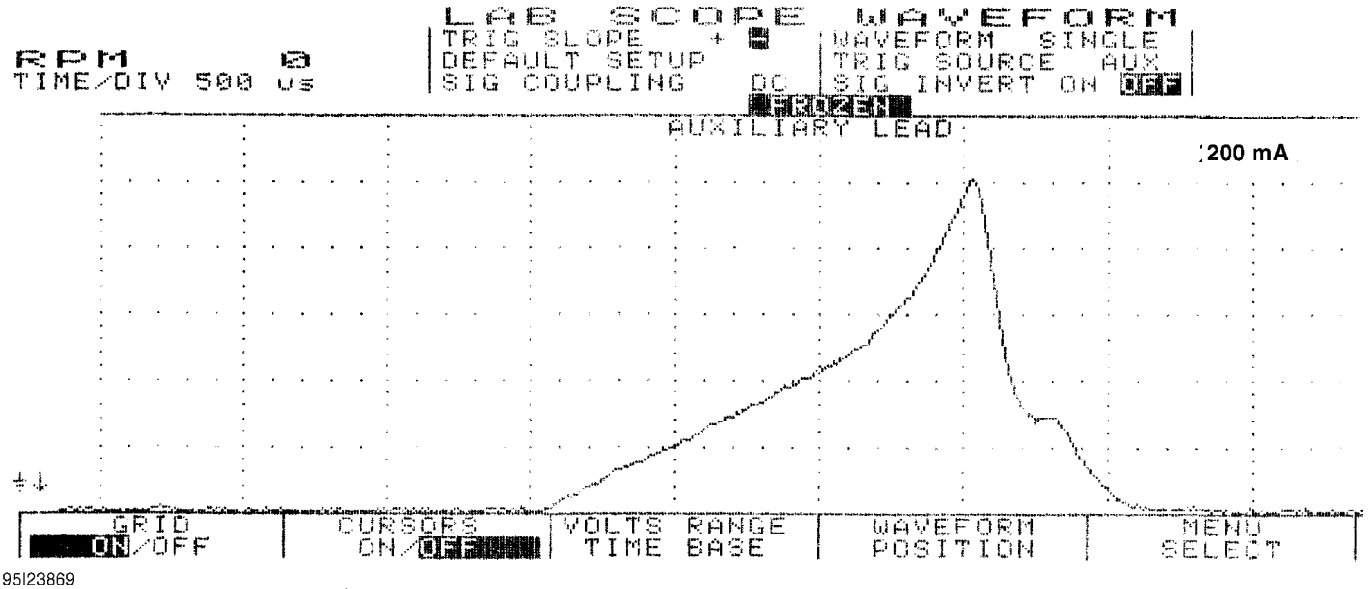


95H23868

Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See Fig. 14. The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.



95I23869

Fig. 14: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

The known-good current controlled type waveform in Fig. 15 is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

The next waveform is from the same type of engine, except

that it shows a faulty injector. See Fig. 16. Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.

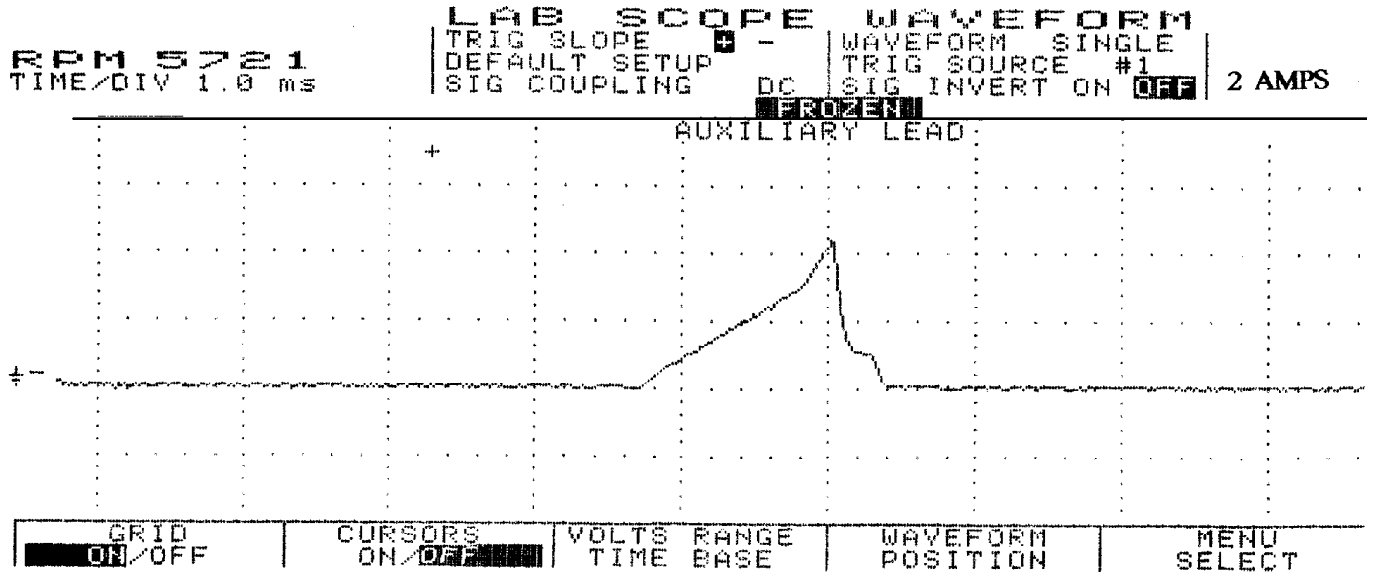


Fig. 15: Single Injector w/Normal Current Flow - Current Pattern

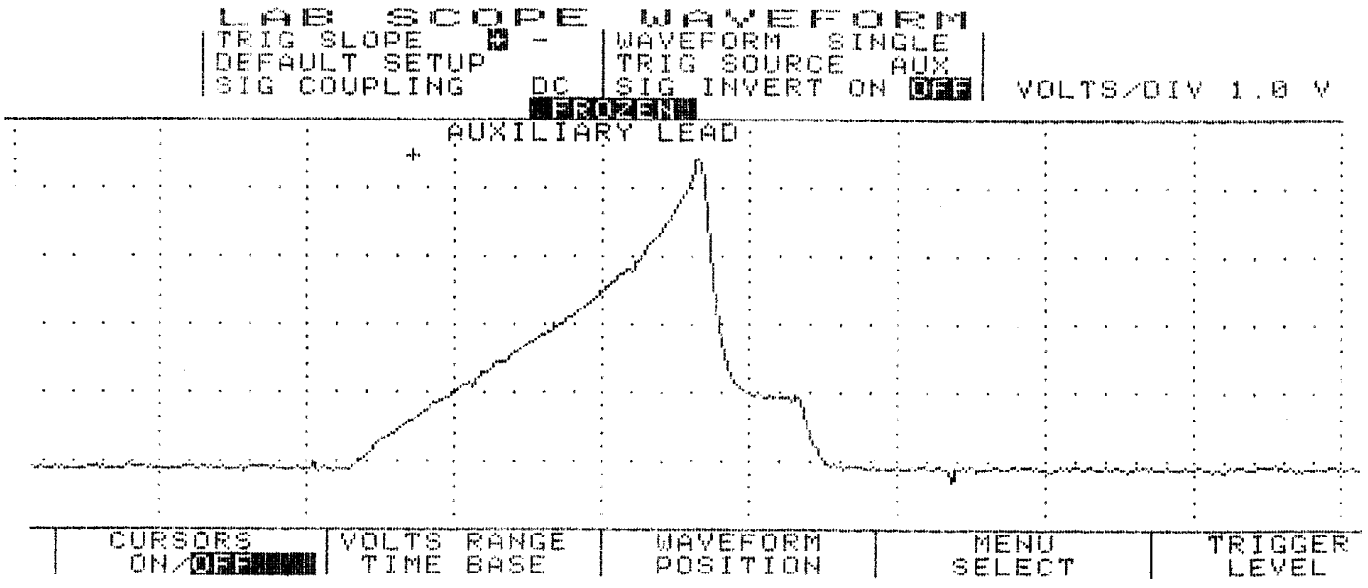
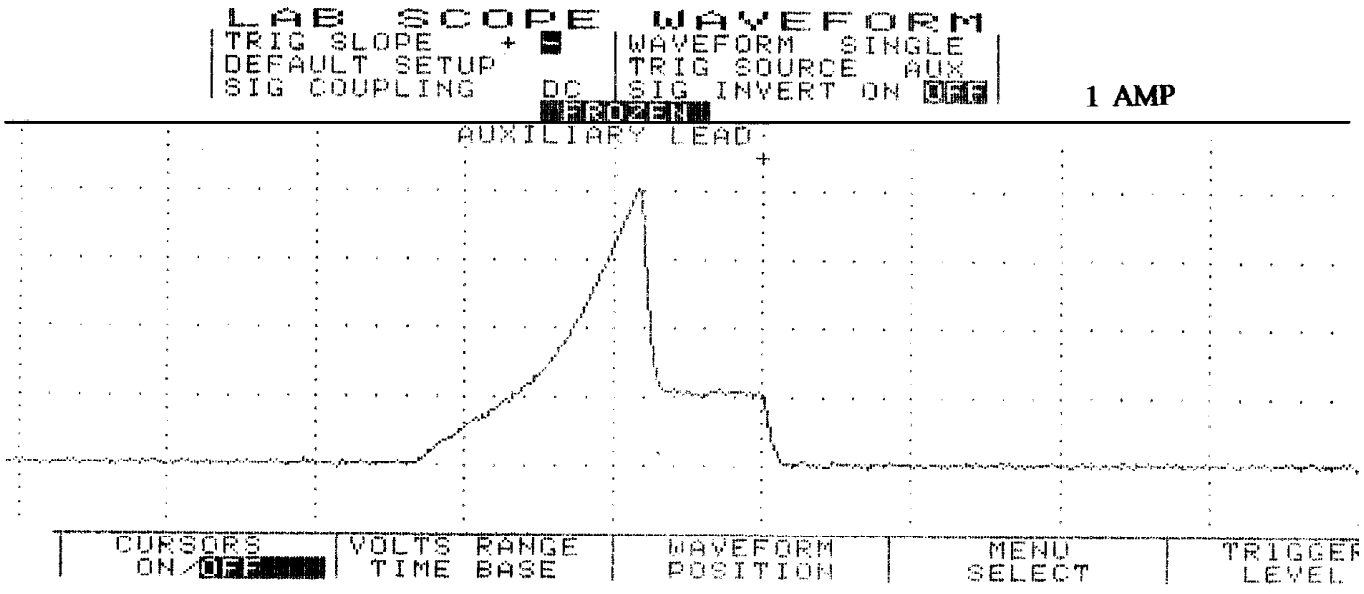


Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See Fig. 17 for waveform.



95B23870

Fig. 17: Single Injector w/Normal Current Flow - Current Pattern

VOLTAGE WAVEFORM SAMPLES

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. 18 illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. 19, was taken during hot idle, closed loop, and no load.

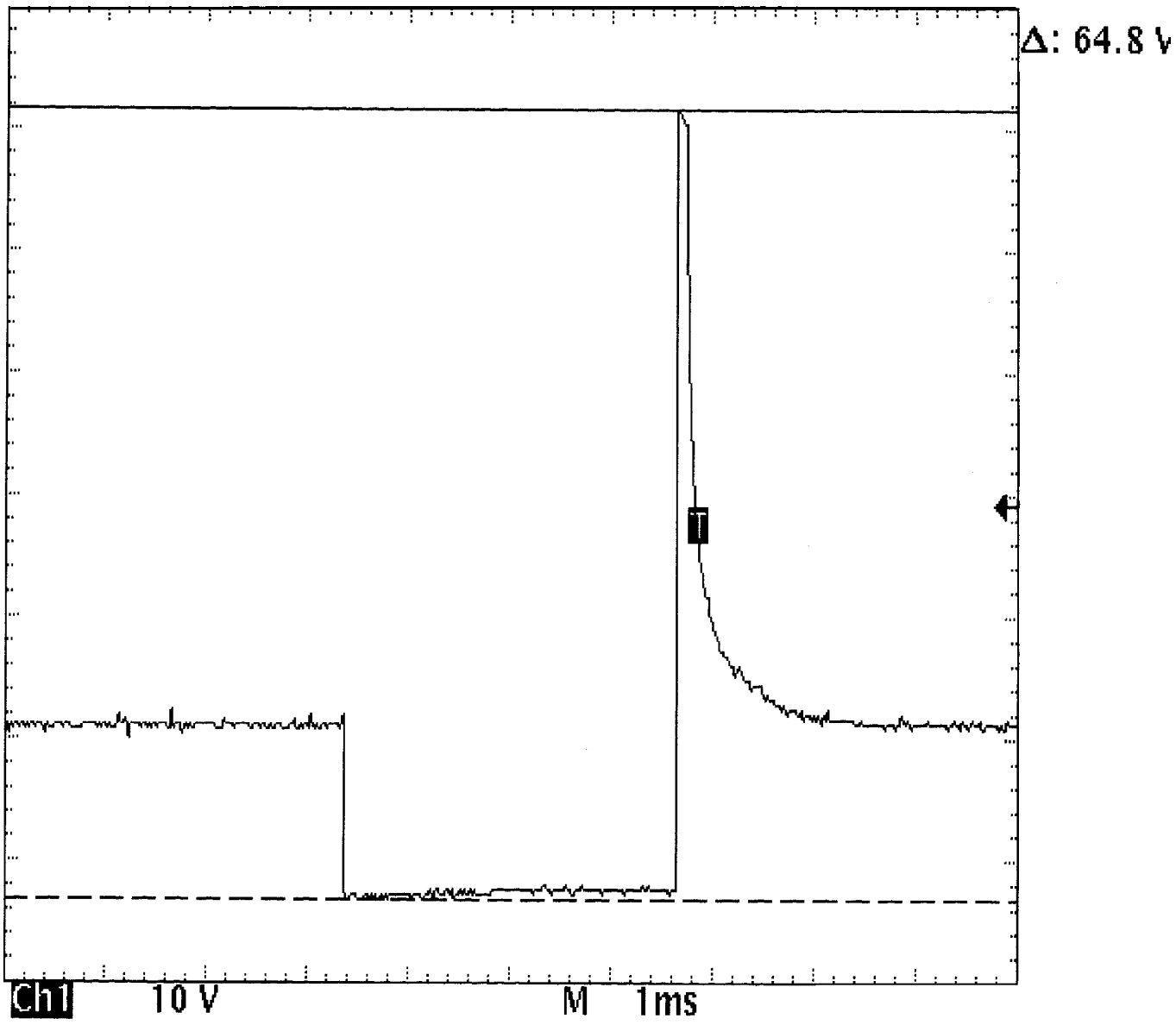


Fig. 18: Injector Bank - Known Good - Voltage Pattern

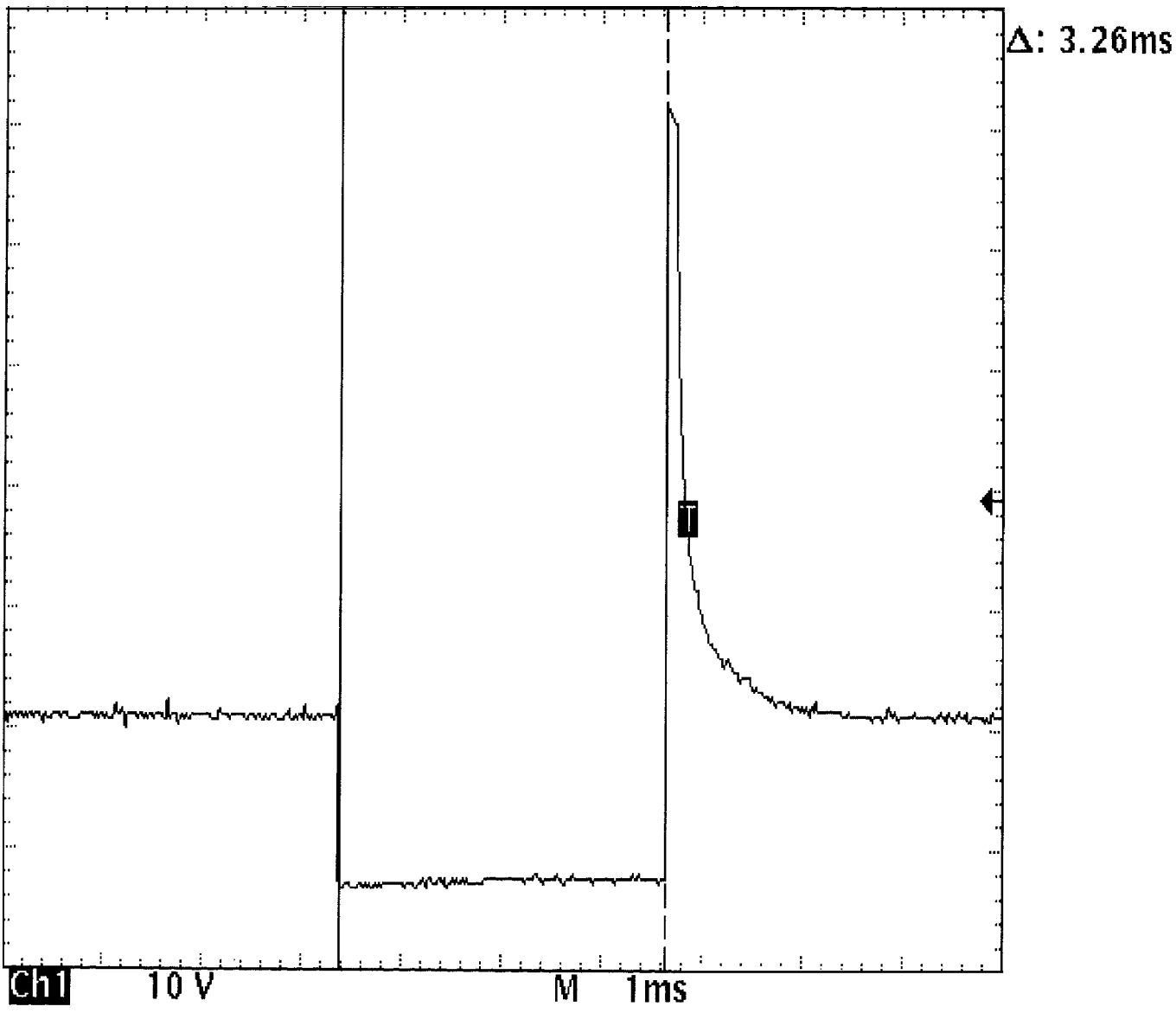
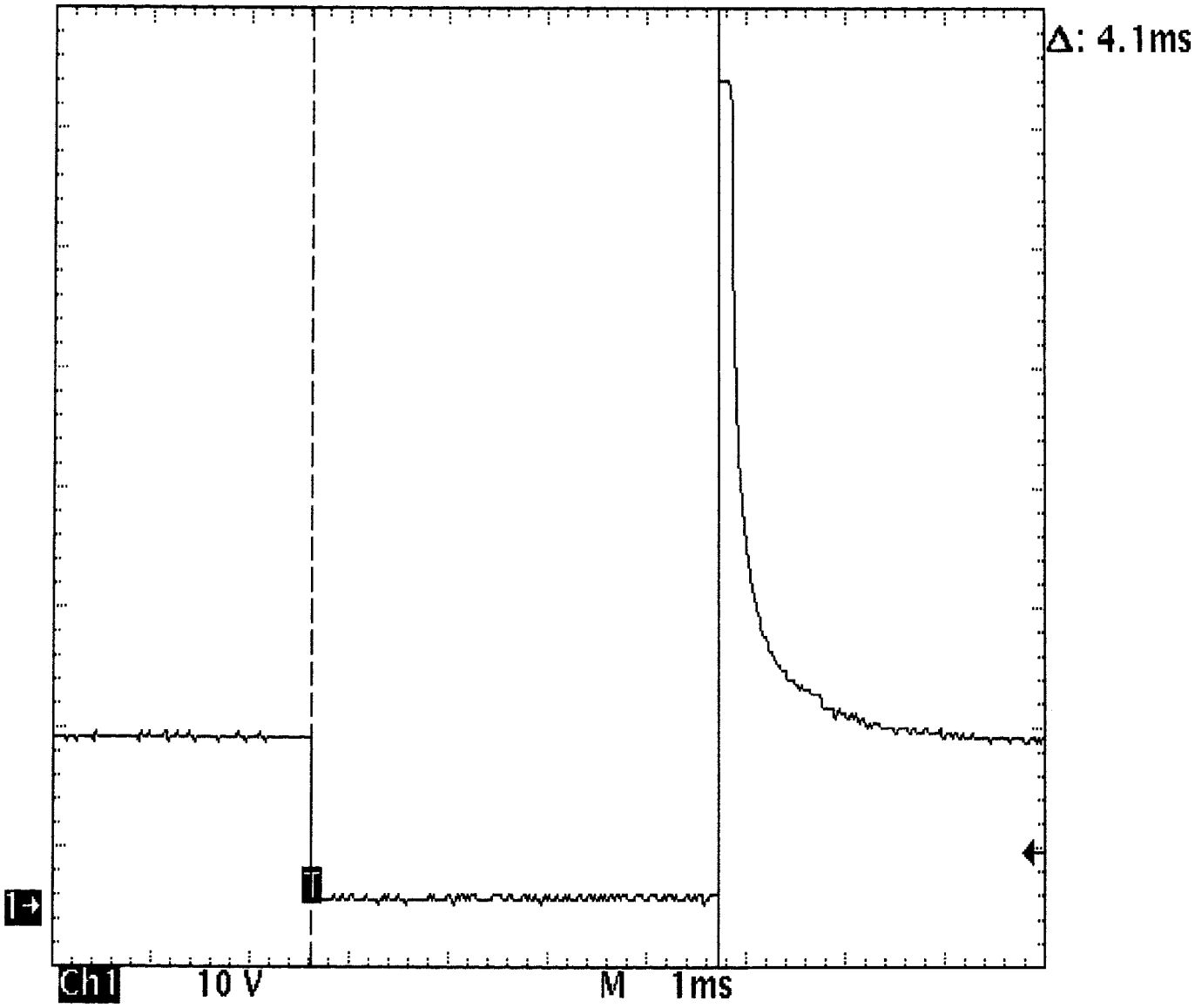


Fig. 19: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

The known-good waveform pattern in Fig. 20 is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.



95I23851

Fig. 20: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

This known-good waveform pattern, Fig. 21, is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.

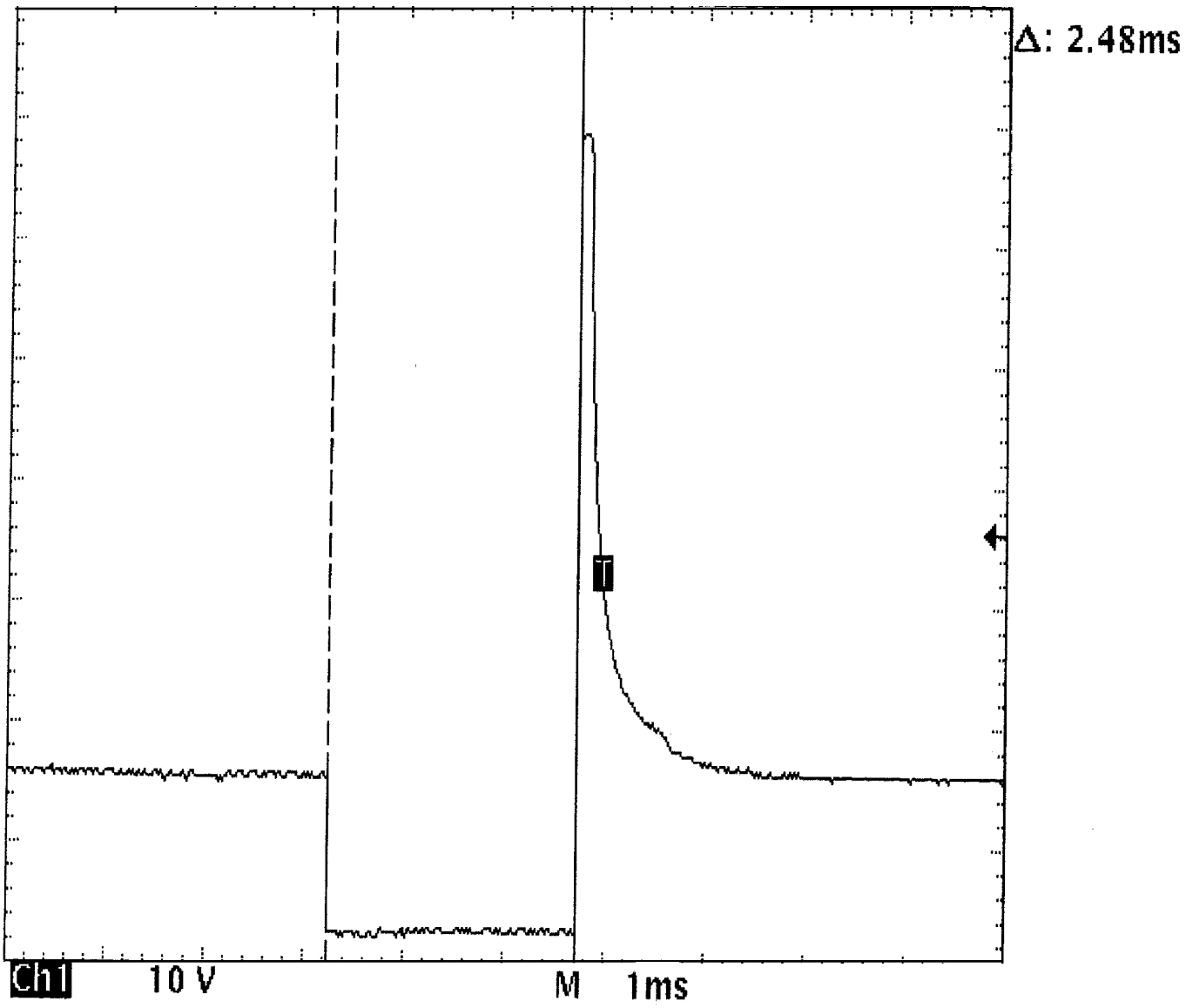
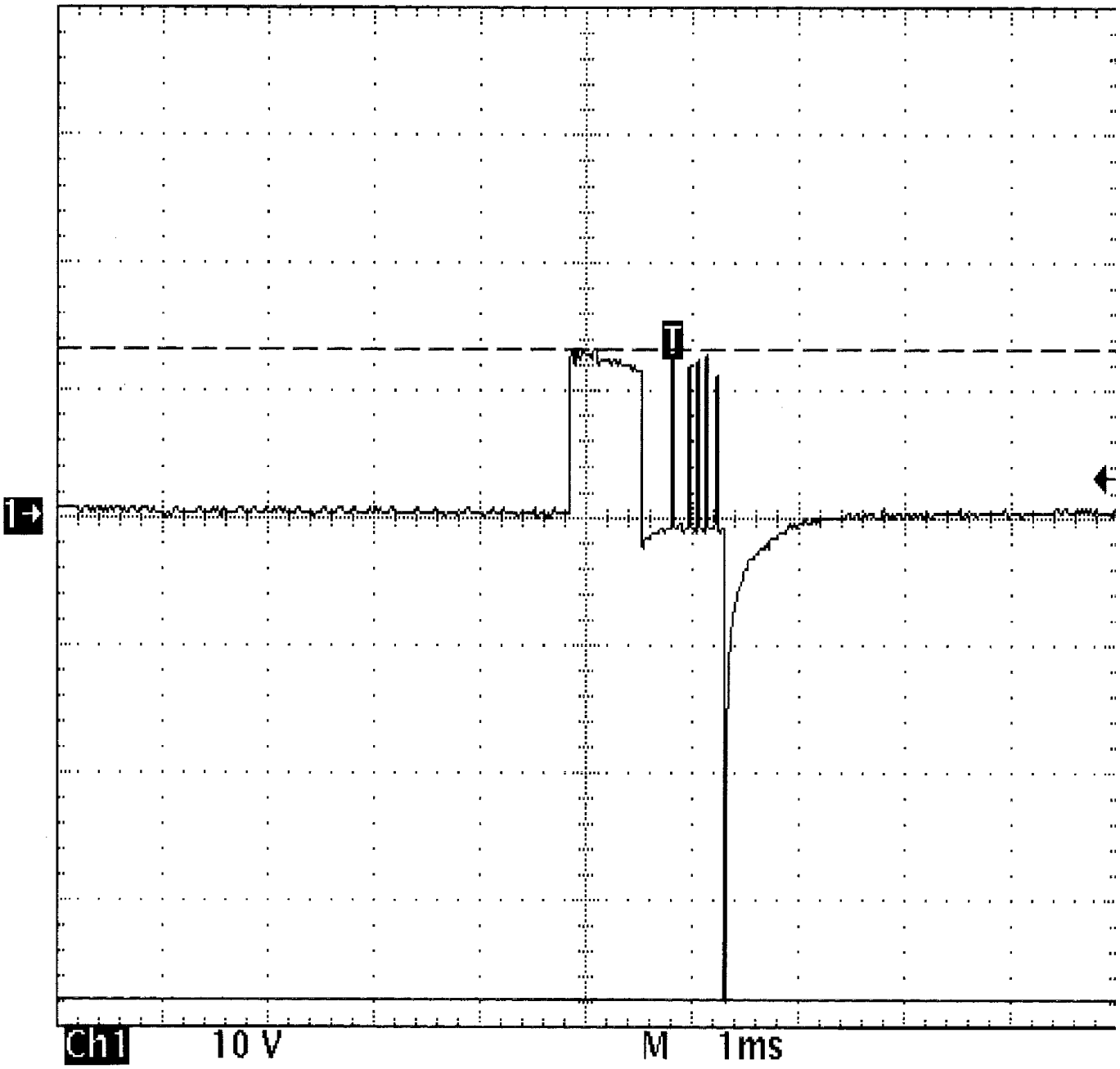


Fig. 21: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See Fig. 22 for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.



95J23860
Fig. 22: Single Injector - Known Good - Voltage Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a Chrysler 3.0L V6 VIN [3]. The first waveform, Fig. 23, is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. 24, was taken during hot idle, closed loop, and no load.

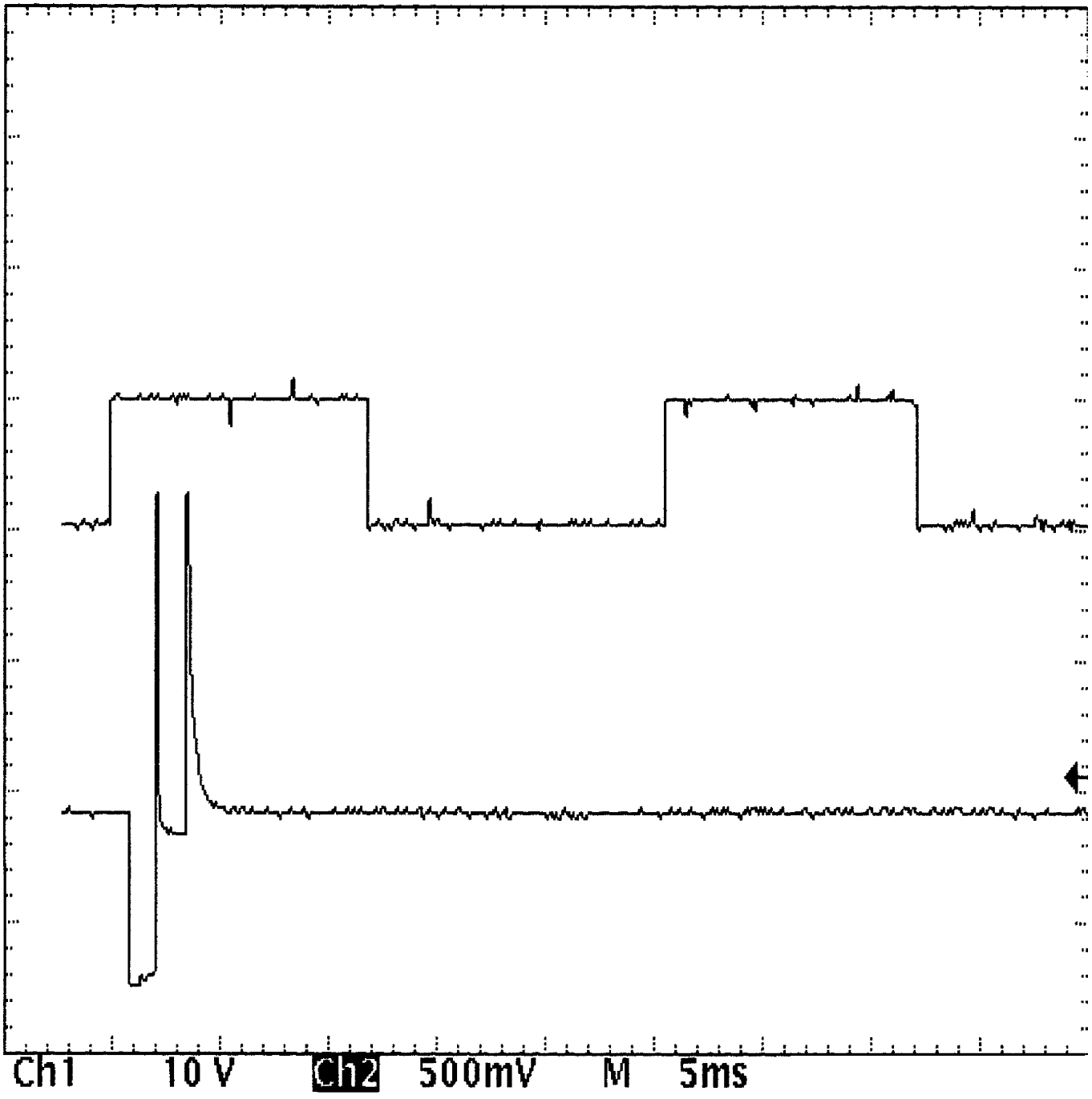
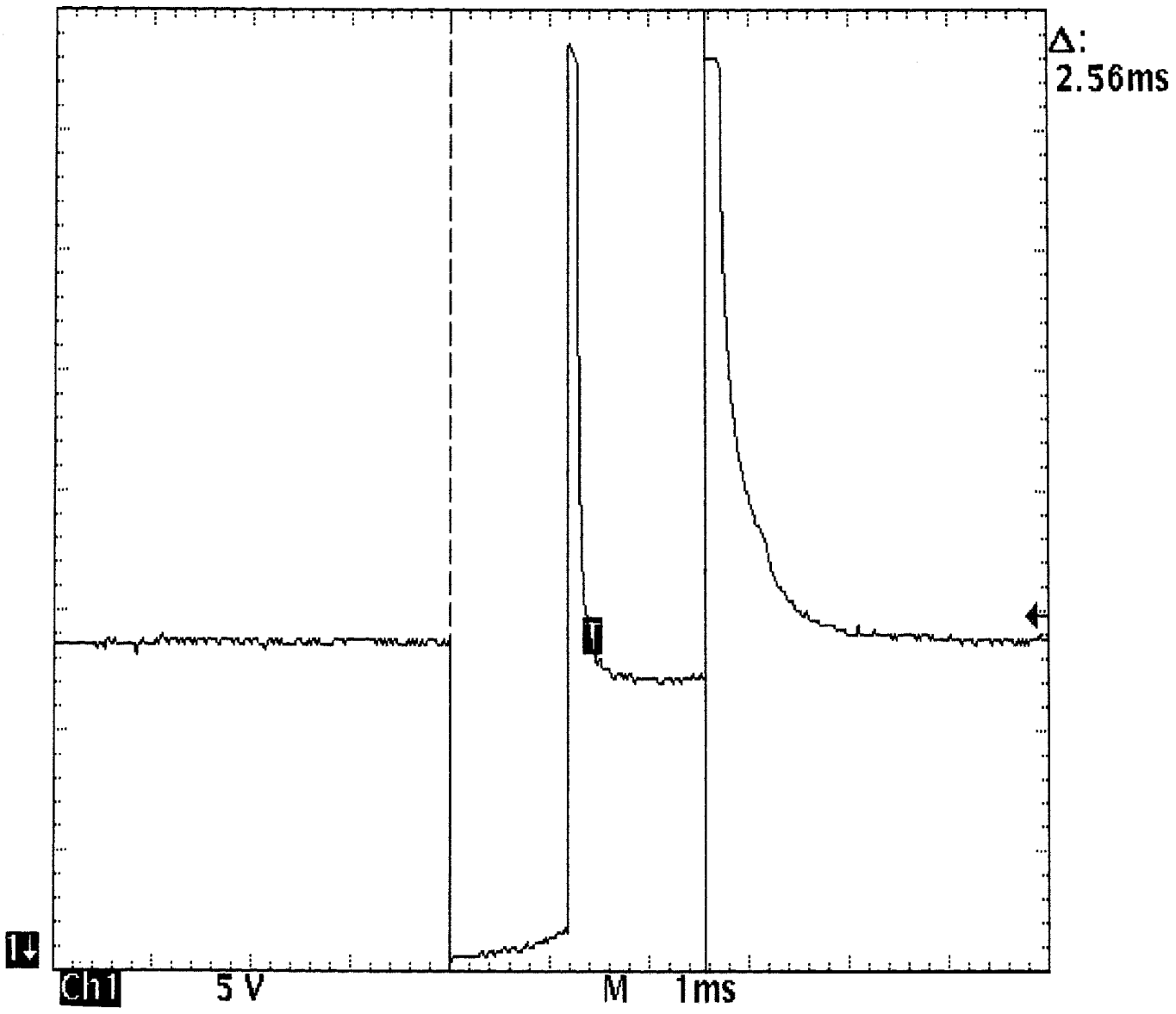


Fig. 23: Injector Bank - Known Good - Voltage Pattern



95B23854
Fig. 24: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See Fig. 25.

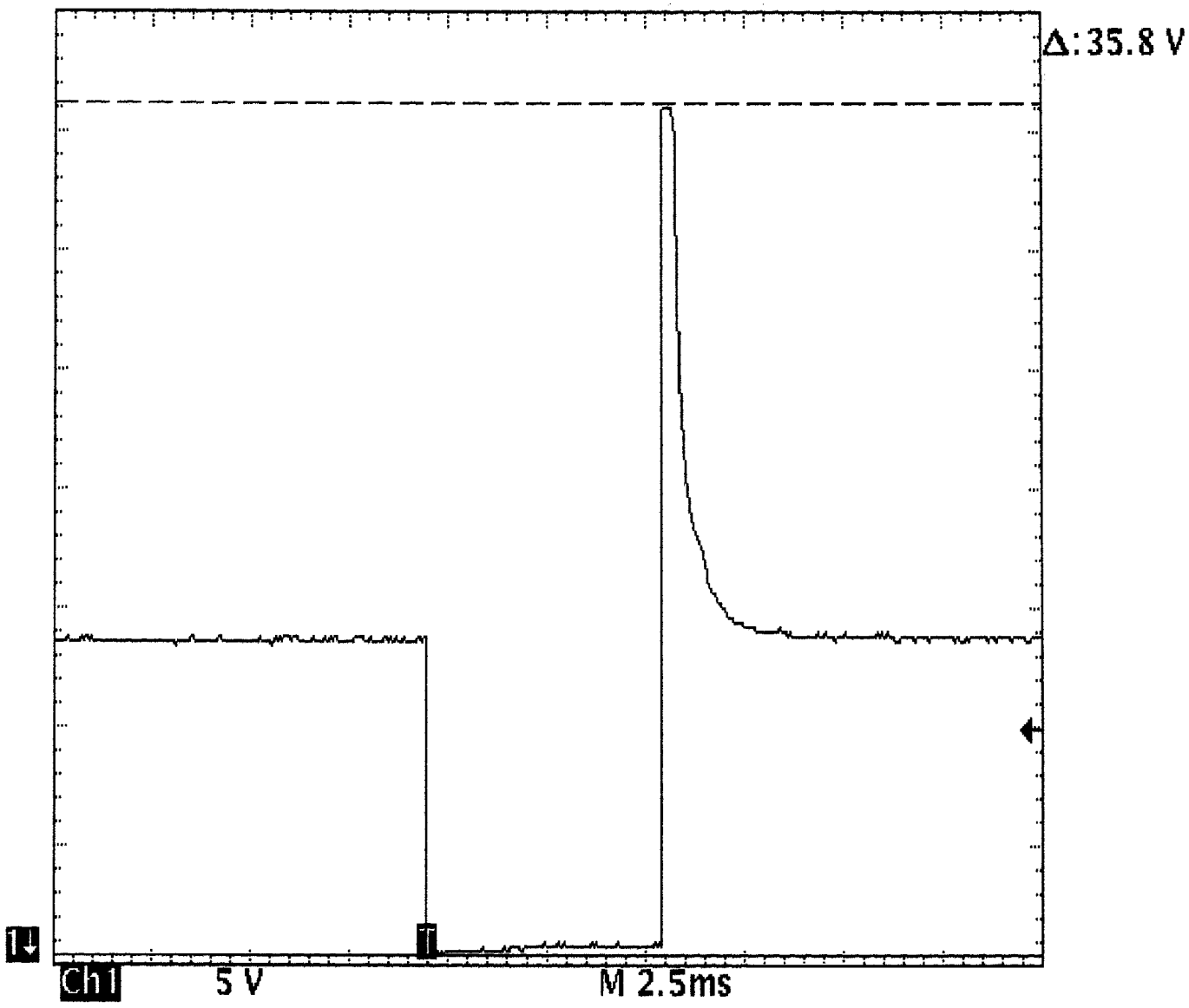


Fig. 25: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See Fig. 26.

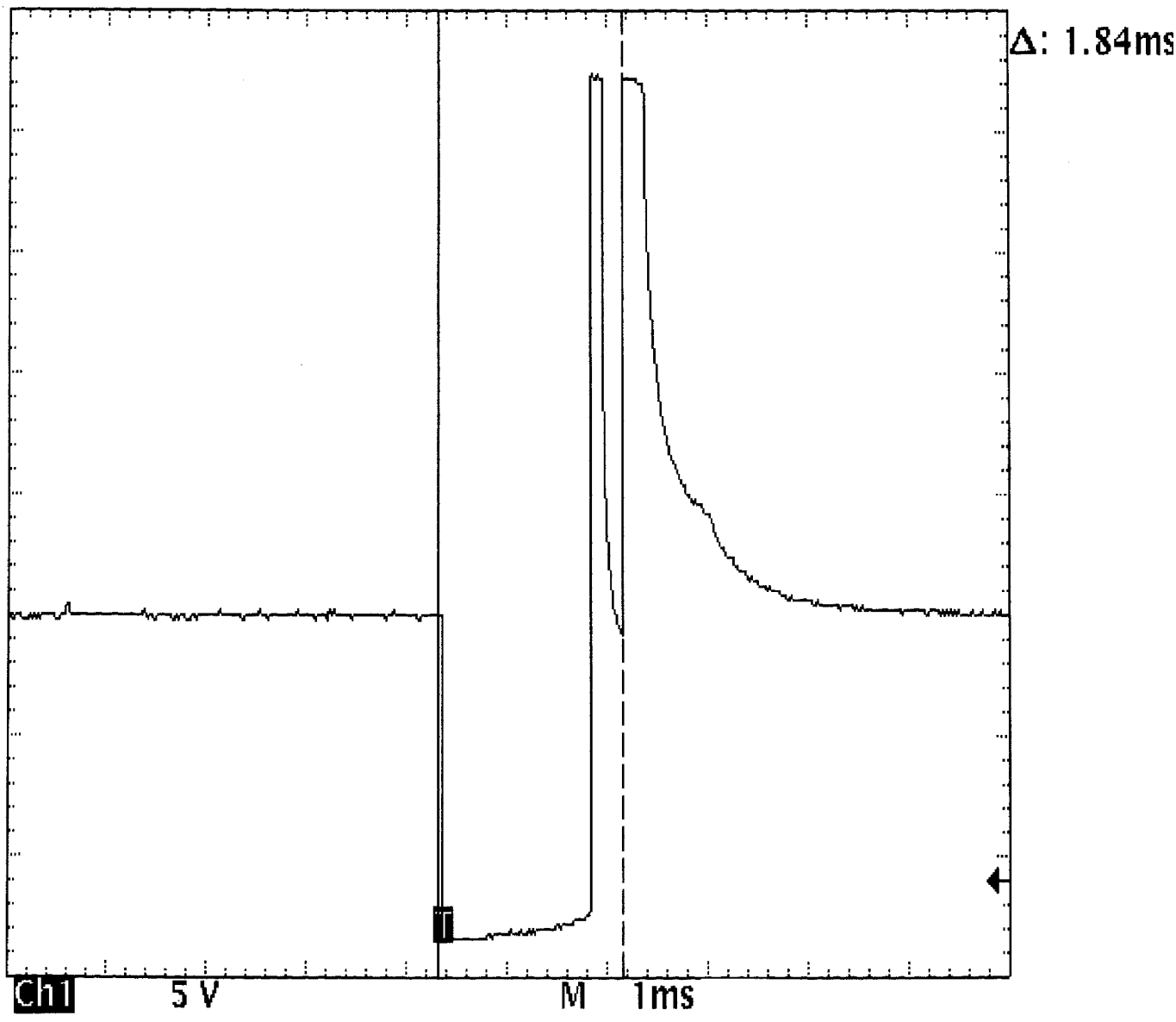
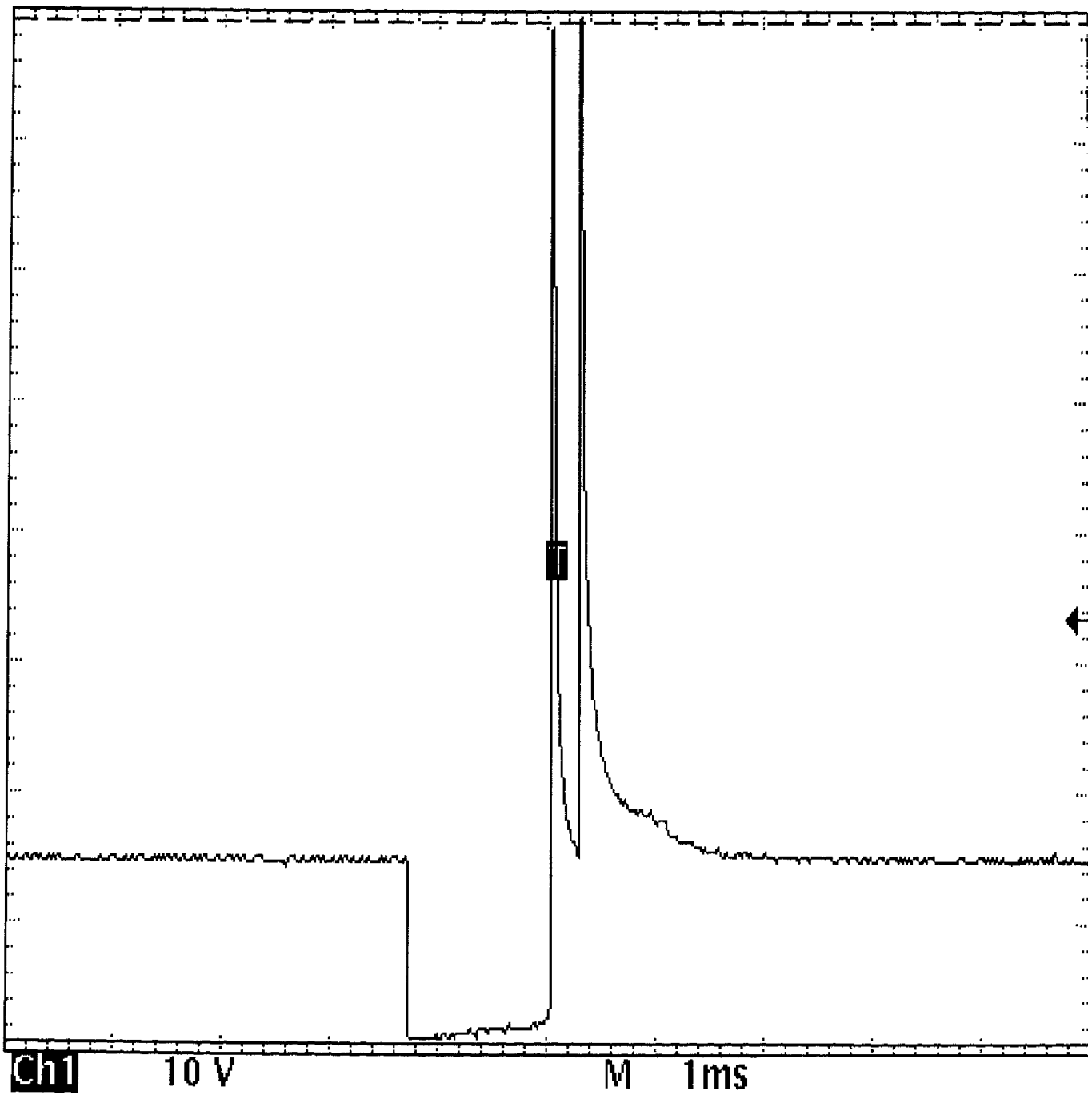


Fig. 26: Single Injector - Known Good - Voltage Pattern

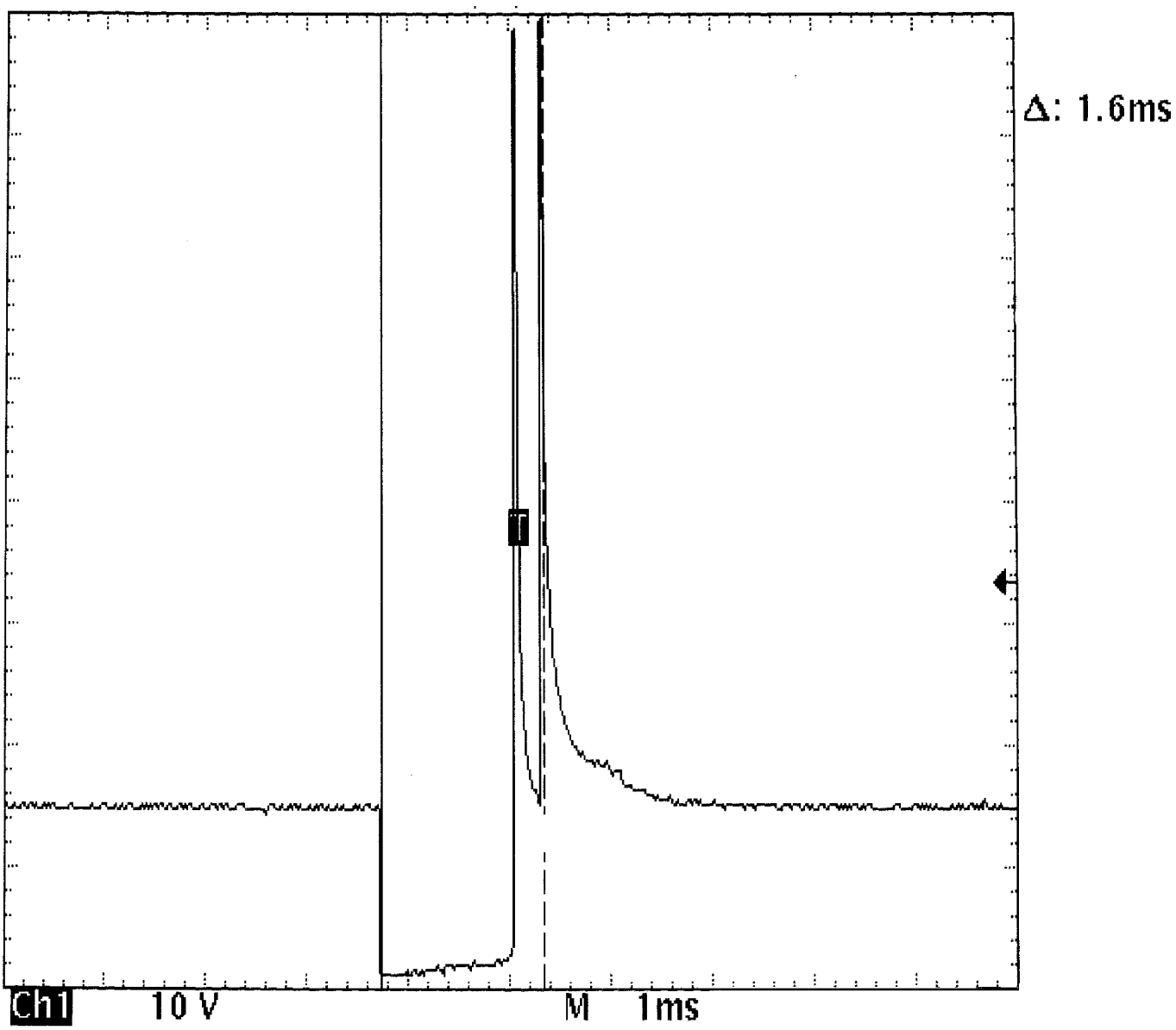
EXAMPLE #8 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. 27 illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. 28, was taken during hot idle, closed loop, and no load.



95D23849

Fig. 27: Single Injector - Known Good - Voltage Pattern



95H23850

Fig. 28: Single Injector - Known Good - Voltage Pattern

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

1999 Lexus RX 300

1999-2000 WHEEL ALIGNMENT
Lexus Specifications & Procedures

ES300, GS300, GS400, LS400, RX300, SC300, SC400

* PLEASE READ THIS FIRST *

NOTE: Prior to performing wheel alignment, perform preliminary visual and mechanical inspection of wheels, tires, and suspension components. See PRE-ALIGNMENT INSTRUCTIONS in WHEEL ALIGNMENT THEORY & OPERATION article in GENERAL INFORMATION.

RIDING HEIGHT ADJUSTMENT

* PLEASE READ THIS FIRST *

NOTE: On LS400 equipped with air suspension, ensure height control switch is in NORM position before adjusting height. Ensure all systems are functional before adjusting riding height or aligning wheels.

ALL MODELS (EXCEPT LS400 WITH AIR SUSPENSION)

1) Before adjusting wheel alignment, measure riding height. Measure riding height with vehicle on level surface and tires properly inflated. Bounce vehicle several times to allow suspension to settle. See Figs. 1 or 2.

2) Visually inspect vehicle for abnormal height difference from front to rear and from side to side. Remove heavy items from passenger and luggage compartments.

3) Measure riding height. See RIDING HEIGHT SPECIFICATIONS table. If riding height is not within specification, inspect suspension components. Repair or replace as necessary.

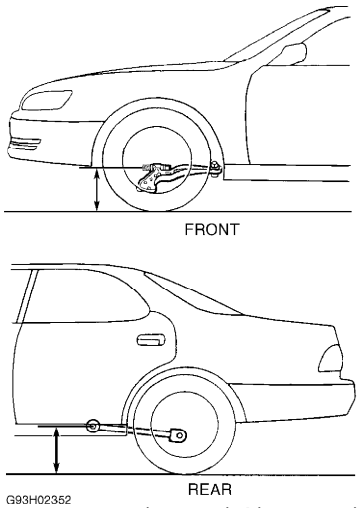


Fig. 1: Measuring Riding Height (ES300 Shown; RX300 Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

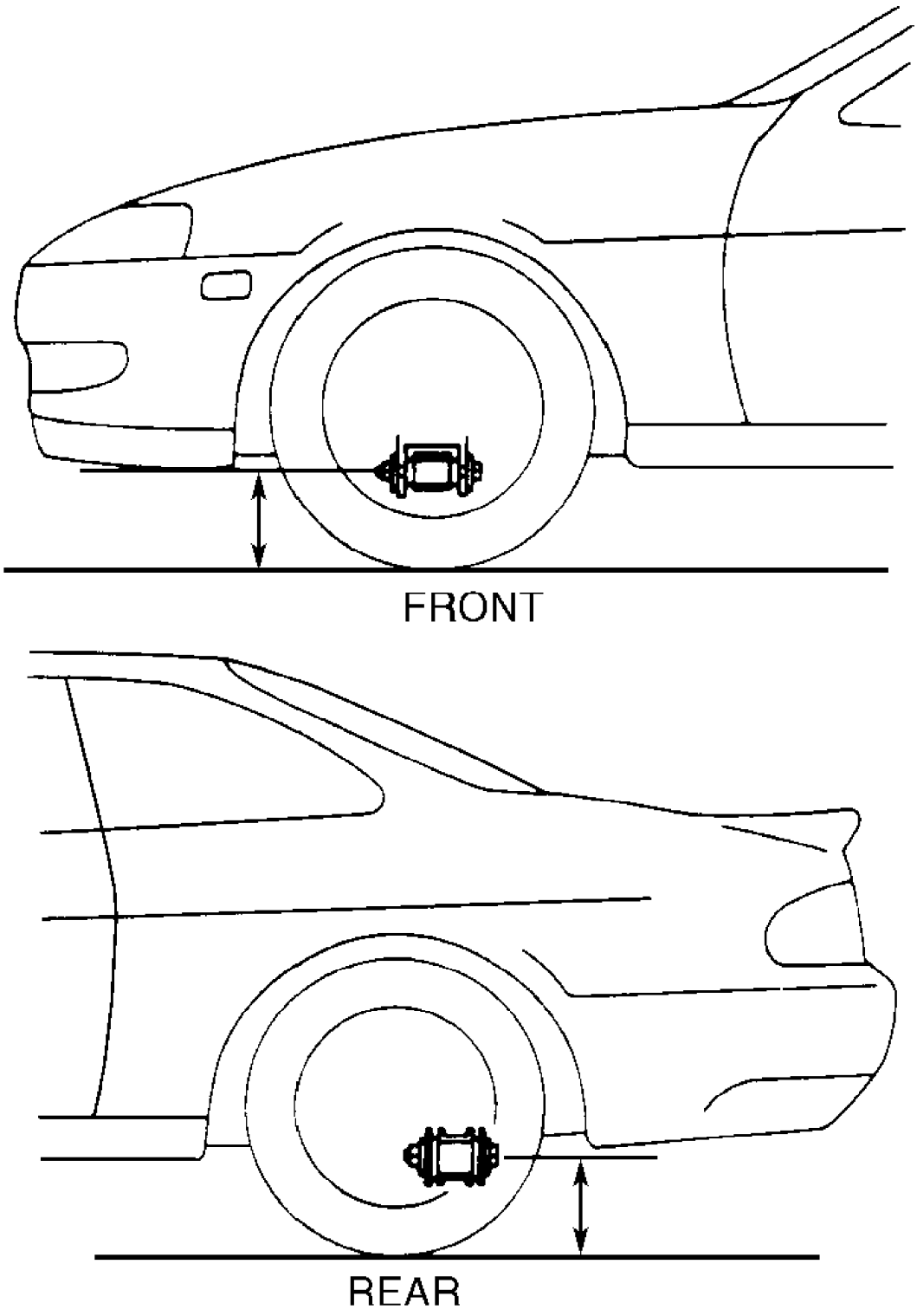


Fig. 2: Measuring Riding Height (GS300, GS400, LS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

RIDING HEIGHT SPECIFICATIONS

Application	In. (mm)
ES300	
Front	8.4 (213)
Rear	10.2 (259)
GS300 & GS400	
Tire Size P215/60R16	
Front	9.6 (244)
Rear	8.9 (226)
Tire Size 225/55R16	
Front	9.5 (241)
Rear	8.7 (221)
Tire Size 235/45ZR17	
Front	9.4 (239)
Rear	8.6 (218)
LS400	
With Air Suspension	
Front	9.4-10.2 (239-259)
Rear	8.3-9.1 (212-232)
Without Air Suspension	
Front	10.4 (264)
Rear	9.6 (243)
RX300	
Front	
2WD	10.24 (260)
4WD	10.20 (259)
Rear	12.44 (316)
SC300	
Front	7.5 (190)
Rear	9.7 (246)
SC400	
Front	7.5 (190)
Rear	9.7 (246)

LS400 WITH AIR SUSPENSION

1) Set height control switch to NORM position. Bounce vehicle up and down several times to stabilize suspension. Push vehicle forward and backward to settle tires.

2) Block wheels. Place transmission in Neutral. Release parking brake. Start engine. Set height control switch to HIGH position. After one minute, with vehicle height in raised position, set height control switch back to NORM position. Wait 50 seconds and repeat this step again.

3) Measure vehicle riding height. See Fig. 2. See RIDING HEIGHT SPECIFICATIONS table. If riding height is not as specified, adjust vehicle riding height by rotating height control sensor link.

4) To adjust height control sensor link, loosen 2 lock nuts on height control sensor link. Rotate height control sensor link bolt to adjust length. Length limit adjustment for front height control sensor link is .039" (10 mm). See Fig. 3.

NOTE: Rotating height control sensor link bolt one complete turn changes vehicle height about .20" (5 mm).

5) After adjustment, temporarily tighten lock nuts. Measure vehicle riding height. Readjust if necessary. Tighten lock nuts to specification. See TORQUE SPECIFICATIONS. Ensure ball joint and bracket are parallel when tightening lock nuts. See Fig. 3.

6) To adjust rear height, loosen nut on rear height control sensor arm. See Fig. 3. Moving link arm approximately .04" (1.0 mm)

changes vehicle ride height by .08" (2.0 mm). After adjustment, temporarily tighten lock nut. Measure vehicle riding height. Readjust if necessary. Tighten lock nut to specification. See TORQUE SPECIFICATIONS

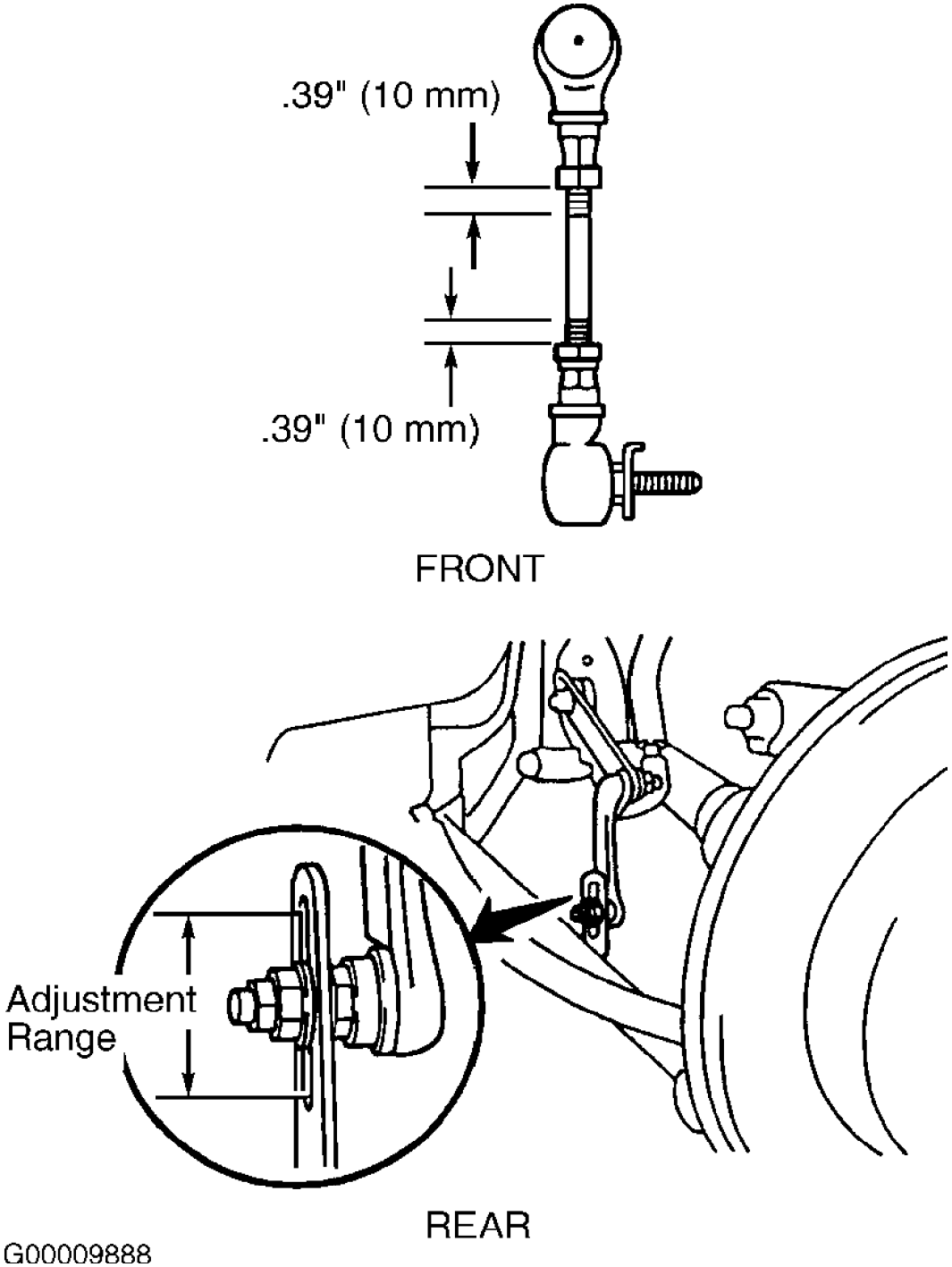


Fig. 3: Adjusting Front & Rear Riding Height Control Sensor Link (LS400 With Air Suspension)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

JACKING & HOISTING

* PLEASE READ THIS FIRST *

WARNING: On LS400 with air suspension, air suspension system needs to be disabled before jacking or hoisting, or suspension could be damaged. See DISABLING AIR SUSPENSION SYSTEM (LS400).

DISABLING AIR SUSPENSION SYSTEM (LS400)

Turn ignition off when jacking or hoisting vehicle. If it is necessary to have ignition on (engine running) when jacking or hoisting vehicle, connect a jumper wire between Data Link Connector No. 2 (DLC2) terminals E1 and Td. See Figs. 4 and 5. Turn ignition switch ON and raise vehicle.

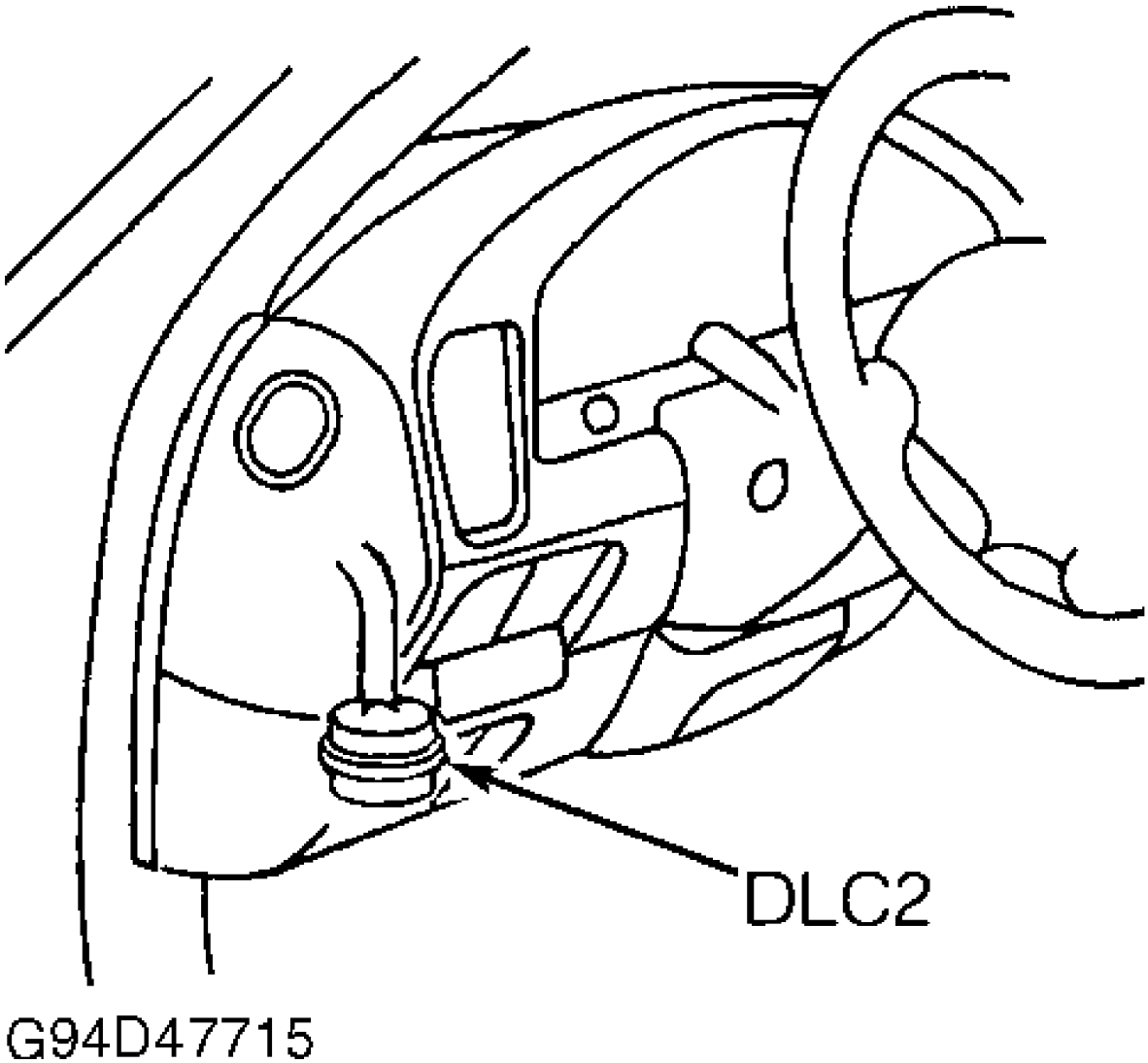


Fig. 4: Locating Data Link Connector (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

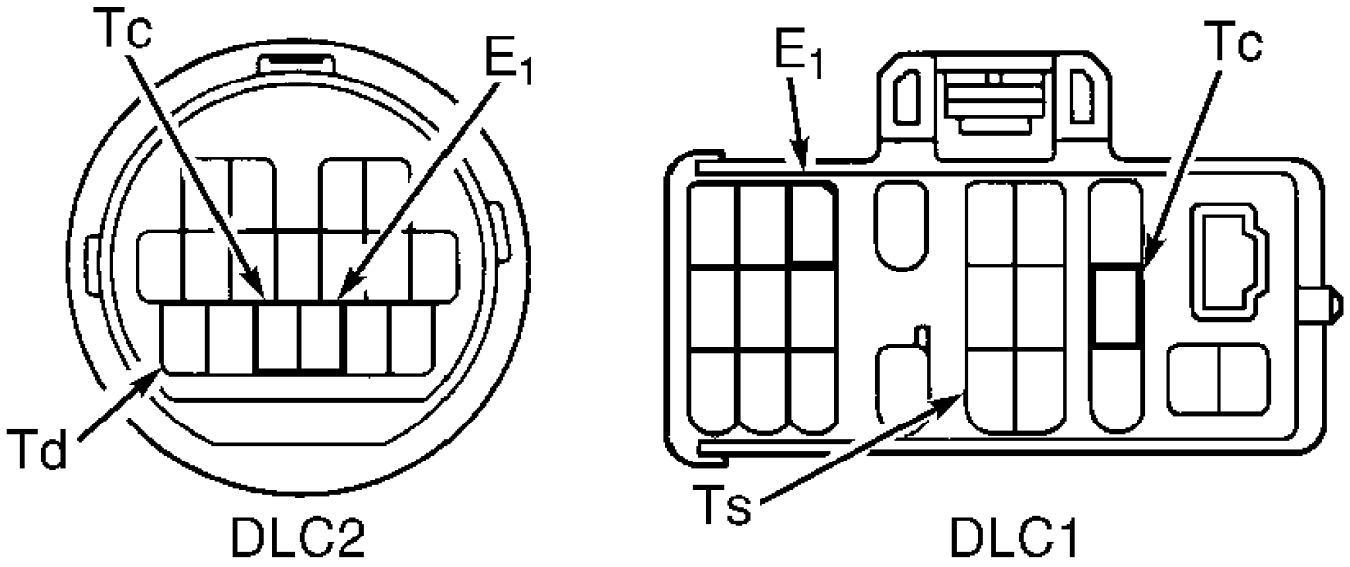


Fig. 5: Identifying Data Link Connector No. 2 (DLC2) Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FLOOR JACK

Place floor jack on vehicle support points shown. See Figs. 6 , 7, 8 or 9.

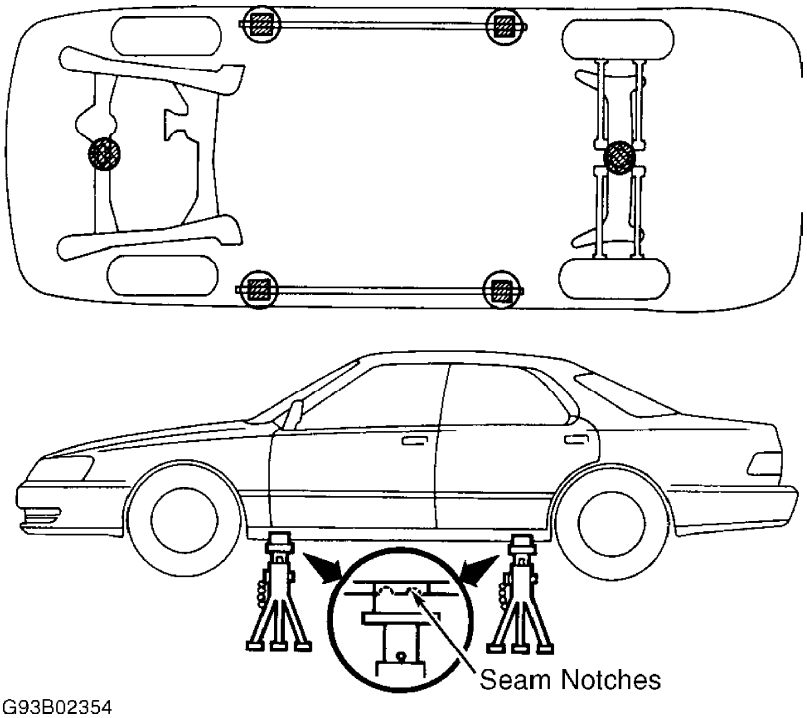


Fig. 6: Jacking & Hoisting Support Points (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

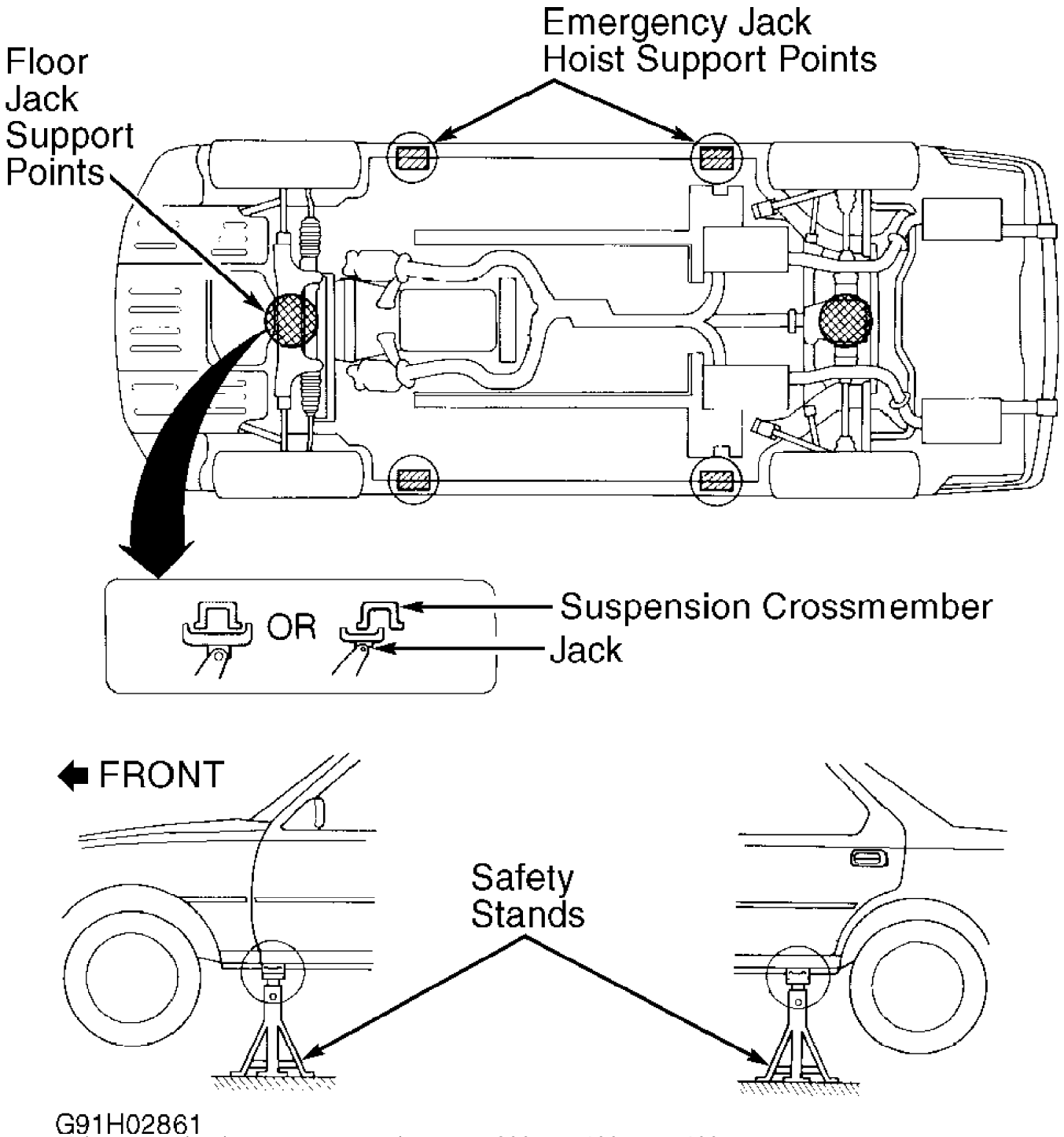


Fig. 7: Jacking & Hoisting Support Points (GS300, GS400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

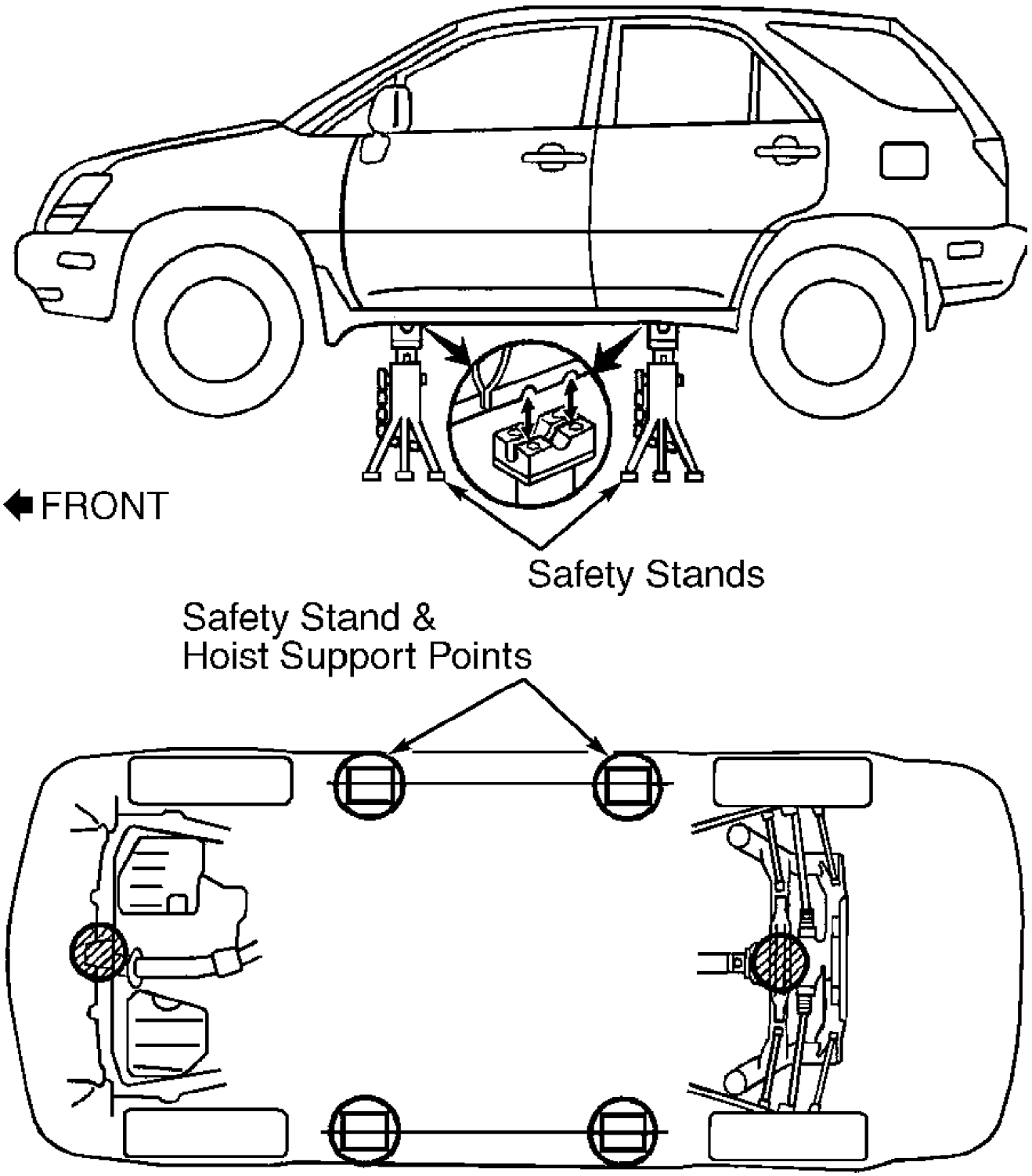


Fig. 8: Jacking & Hoisting Support Points (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

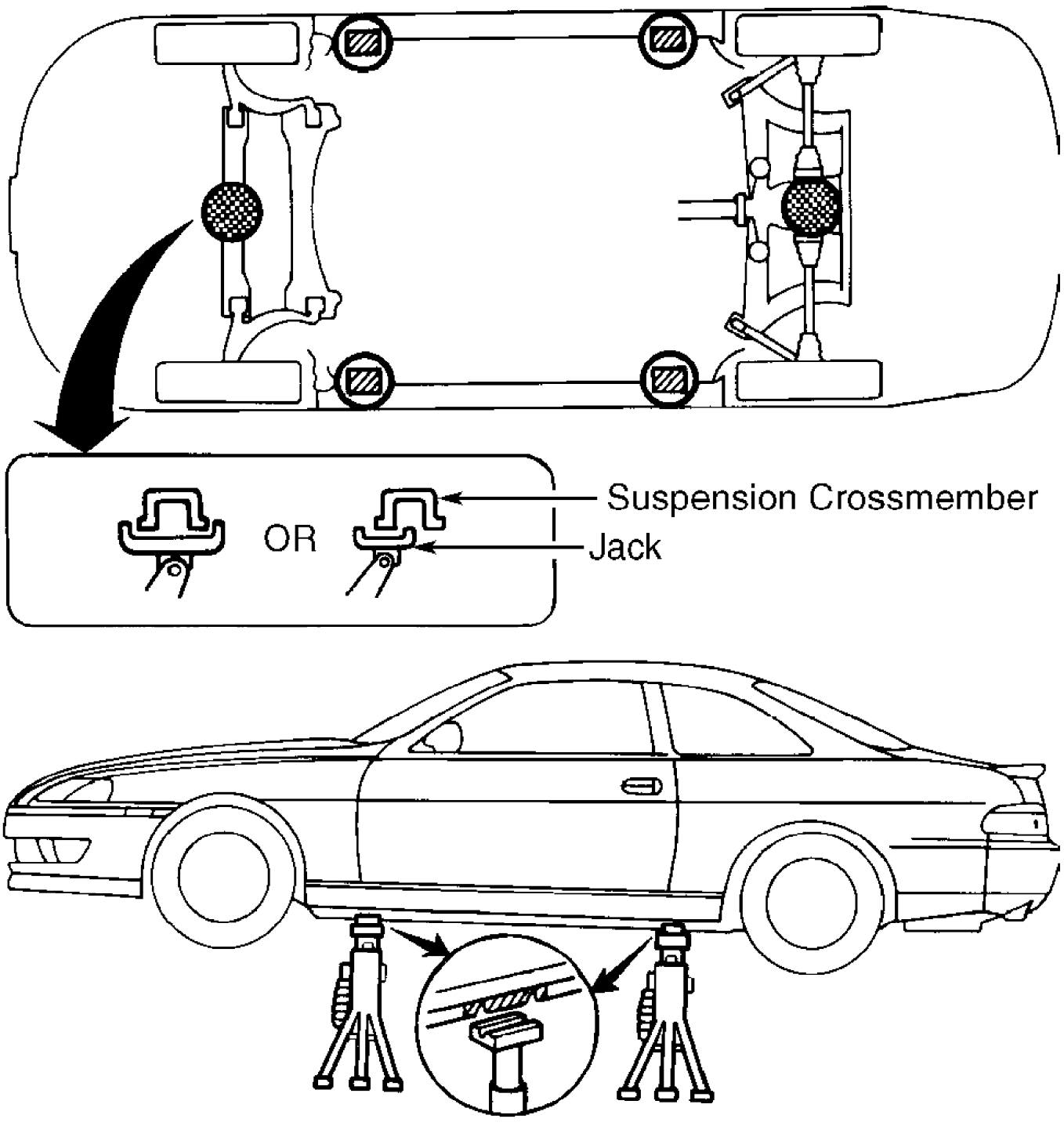


Fig. 9: Jacking & Hoisting Support Points (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

EMERGENCY JACKING

Place manufacturer-supplied jack under reinforced support points of sill, between front and rear wheels. Safety stands may also be placed at these points. See Figs. 6-9.

HOIST

Place lift blocks under reinforced support points of sill, between front and rear wheels. See Figs. 6-9.

WHEEL ALIGNMENT PROCEDURES

CAMBER ADJUSTMENT

Front Suspension (ES300 & RX300)

1) Inspect tires for wear and proper inflation. Inspect front wheel bearings for looseness. Measure tire runout. Tire runout should not exceed .04" (1.0 mm).

2) Inspect front suspension components for looseness. Ensure front shock absorbers operate properly. Measure vehicle riding height. See RIDING HEIGHT ADJUSTMENT.

3) Remove front wheels. Remove speed sensor clamp. Remove 2 lower shock absorber nuts while leaving bolts in place. Coat threads of nuts with engine oil. Temporarily install lower shock absorber nuts. Adjust camber by pushing or pulling lower side of shock absorber in direction camber adjustment is required. See Fig. 10. See WHEEL ALIGNMENT SPECIFICATIONS. Tighten lower shock absorber nuts to specification. See TORQUE SPECIFICATIONS.

4) If camber is still not within specifications, replace camber adjusting bolts. See Fig. 11. Estimate how much additional camber adjustment will be required and select the proper camber adjusting bolt and exchange selected adjusting bolts for original bolts until camber is within specifications. Adjusting value for set bolts is 6′-30′ (.1 degree -.5 degree).

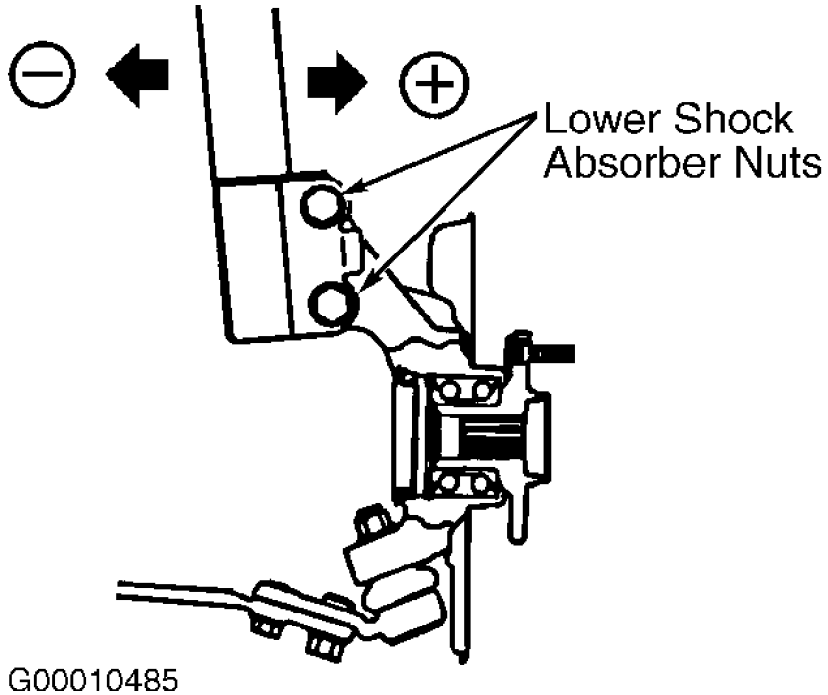


Fig. 10: Adjusting Camber (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Bolt / Adjusting Value	Set Bolt		Adjusting Bolt					
	90105–17001		90105–17003		90105–17004		90105–17005	
			1 Dot		2 Dots		3 Dots	
	1	2	1	2	1	2	1	2
15'	●			●				
30'	●					●		
45'	●							●
1°00'			●					●
1°15'					●			●
1°30'							●	●

G00010486

Fig. 11: Selecting Camber Adjusting Bolts (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Front Suspension (GS300, GS400, SC300 & SC400)

NOTE: On SC300 and SC400, front wheel camber and caster are adjusted together.

Measure and record camber and caster. See WHEEL ALIGNMENT SPECIFICATIONS. If adjustment is necessary, remove engine undercover. Remove nut, 2 bolts and front lower suspension arm bracket stay. Loosen adjuster cam bolts. Rotate adjuster cams as necessary. See Fig. 12. Tighten adjuster cam bolts to specification. See TORQUE SPECIFICATIONS.

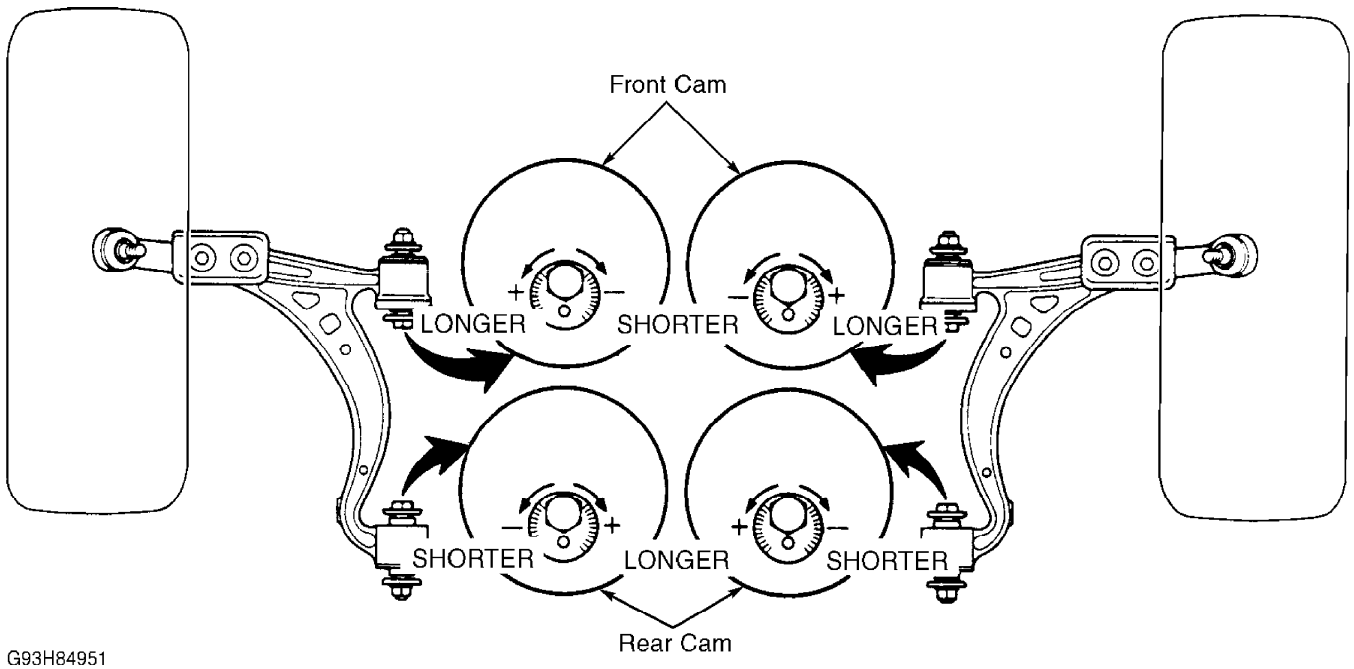


Fig. 12: Identifying Camber & Caster Cams (SC300 & SC400 Shown; GS300 & GS400 Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Front Suspension (LS400)

1) Inspect tires for wear and proper inflation. Inspect front wheel bearings for looseness. Measure wheel runout. Wheel runout should not exceed .06" (1.4 mm).

2) Inspect front suspension components for looseness. Ensure front shock absorbers operate properly. Measure vehicle riding height. See RIDING HEIGHT ADJUSTMENT.

3) Measure camber of each front wheel. See WHEEL ALIGNMENT SPECIFICATIONS. If camber is not within specification, loosen camber adjusting cam nuts. Remove suspension crossmember brace for access if necessary. Turn camber adjusting cam to obtain proper camber adjustment. Tighten adjusting cam nuts to specification. See TORQUE SPECIFICATIONS. Reinstall suspension crossmember brace.

Rear Suspension (ES300 & RX300)

Inspect tires for wear and proper inflation. Measure camber of both rear wheels. See WHEEL ALIGNMENT SPECIFICATIONS. If camber is not within specification, inspect rear suspension components. Replace any components that are worn or damaged. Rear camber is not adjustable.

Rear Suspension (GS300 & GS400)

NOTE: On GS300 and GS400, rear wheel camber and toe-in are adjusted together.

1) Inspect tires for wear and proper inflation. Ensure lengths of No. 1 and 2 lower suspension arms are equal by rotating adjuster cams (if necessary). See Fig. 13.

2) Measure camber of each rear wheel. See WHEEL ALIGNMENT SPECIFICATIONS. If camber and/or toe-in are not within specification, loosen adjuster cam bolts. Adjust by rotating adjuster cams. Tighten adjuster cam bolts to specification after adjustment. See TORQUE SPECIFICATIONS.

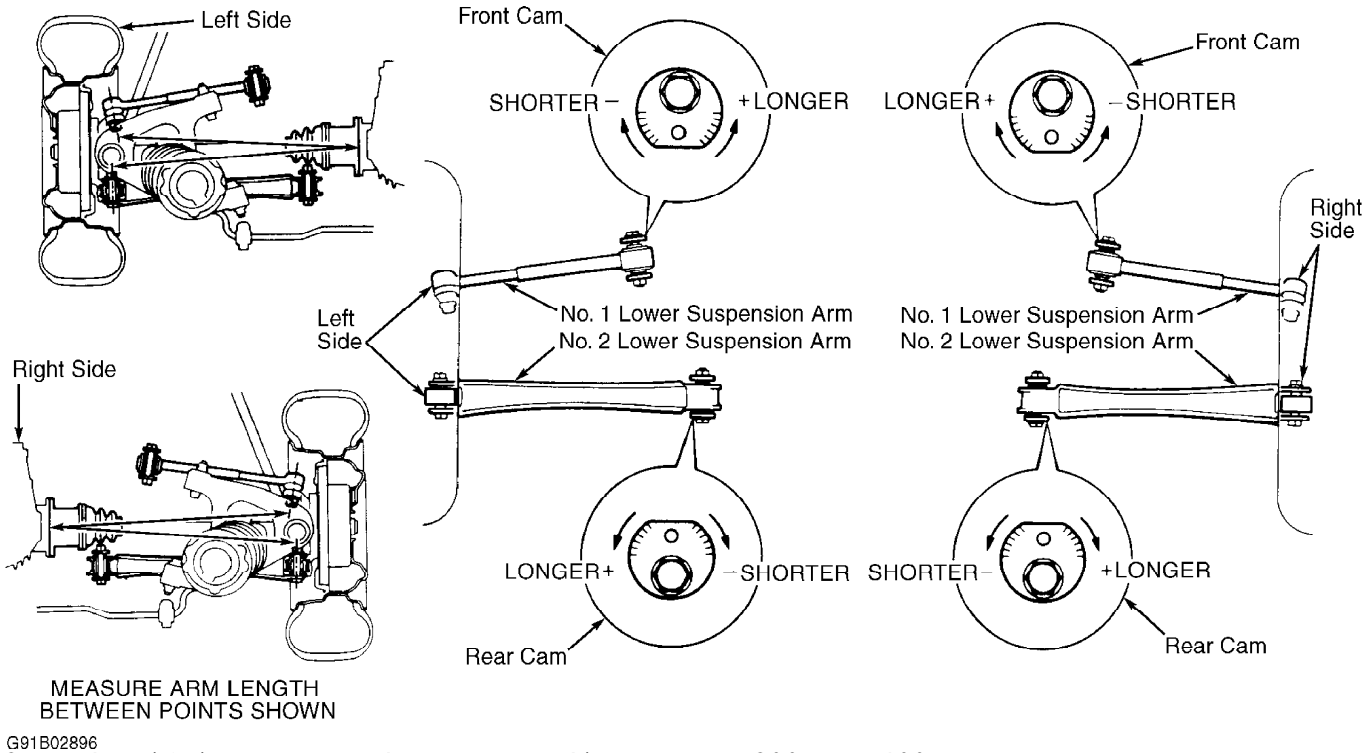


Fig. 13: Identifying Rear Camber & Toe Adjusters (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear Suspension (SC300, SC400 & LS400)

NOTE: On SC300, SC400 and LS400, rear wheel camber and toe-in are adjusted together.

Measure and record camber and toe-in. See WHEEL ALIGNMENT SPECIFICATIONS. Ensure lengths of No. 1 and 2 lower suspension arms are equal by rotating adjuster cams (if necessary). See Fig. 14. If camber adjustment is still necessary, loosen adjuster cam nuts. Rotate adjuster cams as necessary. Tighten adjuster cam nuts to specification. See TORQUE SPECIFICATIONS.

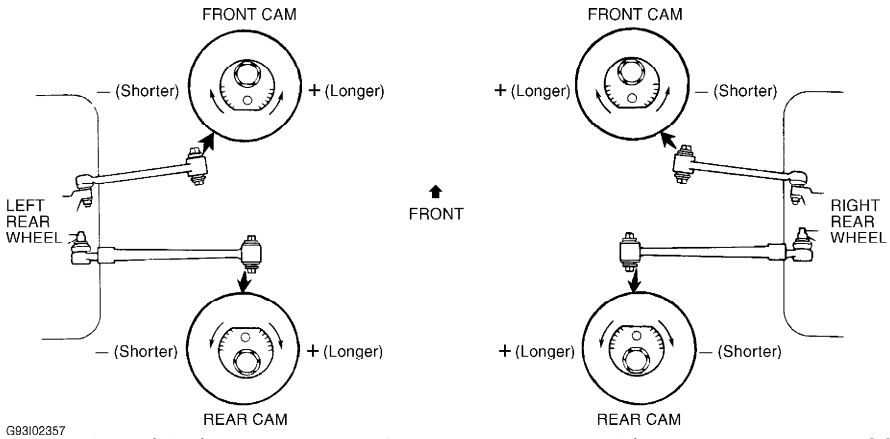


Fig. 14: Identifying Rear Camber & Toe-In Adjuster Cams (SC300, SC400 & LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CASTER ADJUSTMENT

Front Suspension (ES300, GS300, GS400 & RX300)

1) Ensure riding height, camber, and steering axis inclination are correct. See RIDING HEIGHT ADJUSTMENT. Also see CAMBER ADJUSTMENT and STEERING AXIS INCLINATION under WHEEL ALIGNMENT PROCEDURES.

2) Measure caster of each front wheel. See WHEEL ALIGNMENT SPECIFICATIONS. If caster is not within specification, inspect related front suspension components. Replace any components that are worn or damaged. Front caster is not adjustable.

Front Suspension (LS400)

1) Ensure riding height, camber, and steering axis inclination are correct. See RIDING HEIGHT ADJUSTMENT. Also see CAMBER ADJUSTMENT and STEERING AXIS INCLINATION under WHEEL ALIGNMENT PROCEDURES.

2) Measure caster of each front wheel. See WHEEL ALIGNMENT SPECIFICATIONS. If caster is not within specification, loosen caster adjusting cam nut. Turn caster adjusting cam to obtain correct caster reading. Tighten caster adjusting cam nut to specification. See TORQUE SPECIFICATIONS.

Front Suspension (SC300 & SC400)

Caster is adjusted together with camber. See CAMBER ADJUSTMENT under WHEEL ALIGNMENT PROCEDURES.

STEERING AXIS INCLINATION

Front Suspension

Ensure riding height, caster and camber are correct. See RIDING HEIGHT ADJUSTMENT. Also see CASTER ADJUSTMENT and CAMBER ADJUSTMENT under WHEEL ALIGNMENT PROCEDURES. If riding height, caster and camber are correct and steering axis inclination is still not as specified, recheck front knuckle for bend or damage and inspect front wheel bearings for looseness.

TOE-IN ADJUSTMENT

Front Suspension (All Models)

1) Ensure riding height, camber, steering axis inclination, and caster are correct. See RIDING HEIGHT ADJUSTMENT. Also see the following under WHEEL ALIGNMENT PROCEDURES:

* CAMBER ADJUSTMENT
* STEERING AXIS INCLINATION
* CASTER ADJUSTMENT

Ensure front wheels are in straight-ahead position.

2) Bounce both ends of vehicle several times to settle suspension. Measure toe-in. See WHEEL ALIGNMENT SPECIFICATIONS. If necessary, adjust toe-in by changing length of tie rods. Length of tie rods must be equal within .04" (1.0 mm) after adjustment on LS400 models, within .06" (1.5 mm) after adjustment on all other models.

Rear Suspension (ES300)

1) Ensure rear camber is correct. See CAMBER ADJUSTMENT under WHEEL ALIGNMENT PROCEDURES. Bounce both ends of vehicle several times to settle suspension. Adjust lengths of adjuster tubes so both are equal within .04" (1.0 mm). See Fig. 15.

2) Measure toe-in. See WHEEL ALIGNMENT SPECIFICATIONS. If

necessary, adjust length of each adjuster tube equally to adjust toe-in.

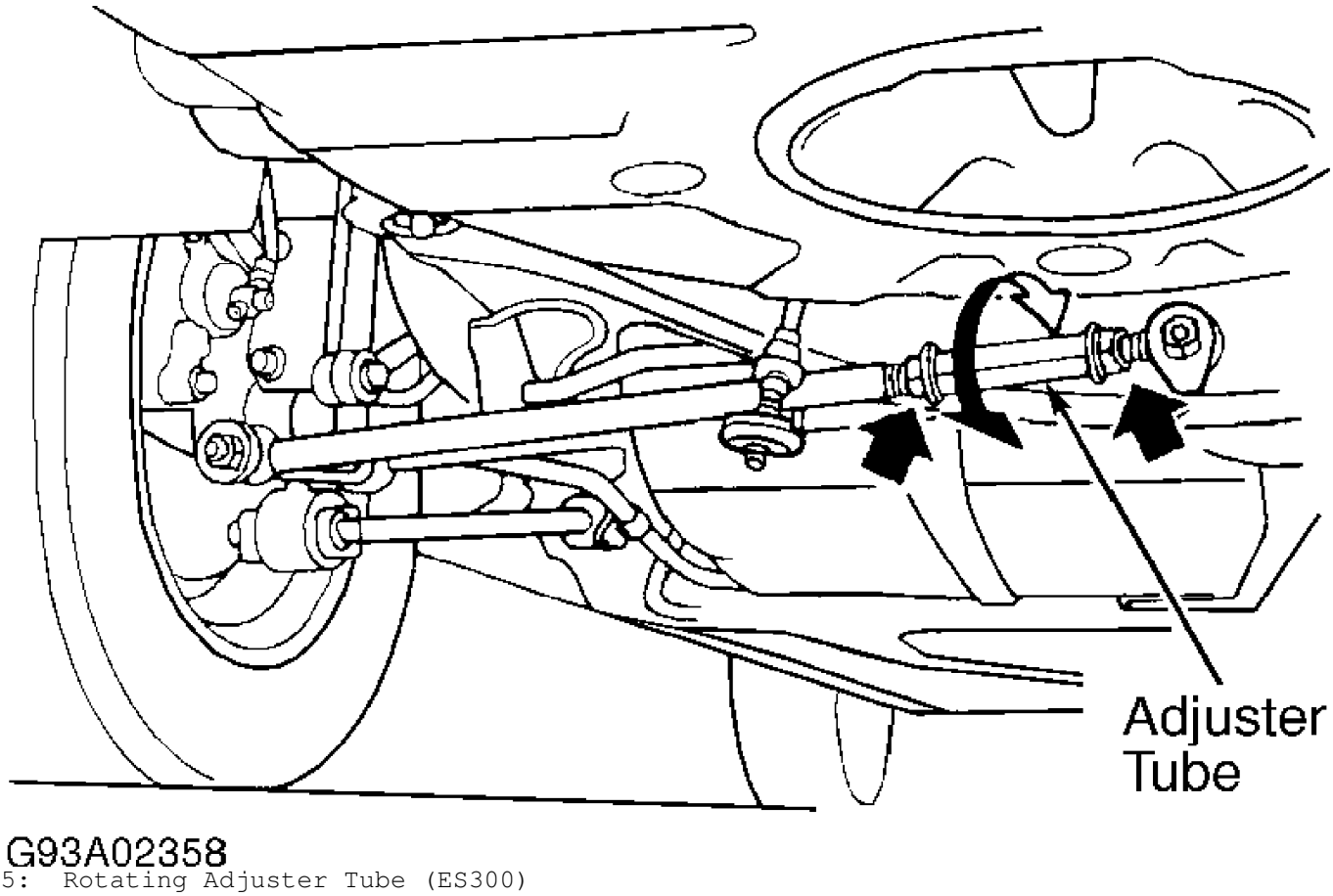


Fig. 15: Rotating Adjuster Tube (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear Suspension (GS300, GS400, LS400, RX300, SC300 & SC400)

Toe-in is adjusted together with camber. See CAMBER ADJUSTMENT under WHEEL ALIGNMENT PROCEDURES.

TOE-OUT ON TURNS

1) Ensure steering wheel is in straight-ahead position. Raise front of vehicle. Place turning radius gauges beneath front wheels. Lower front of vehicle.

2) Rotate steering wheel fully right and left, observing turning radius on both wheels. See WHEEL ALIGNMENT SPECIFICATIONS. If toe-out on turns is not within specification, inspect related front suspension components. Replace any components that are worn or damaged.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
ES300	
Lower Shock Absorber Nuts	156 (211)

Rear Adjuster Tube Lock Nut	41 (56)
Tie Rod End Lock Nuts	54 (74)
GS300 & GS400	
Front Camber Adjuster Cam Bolt	127 (172)
Rear Suspension Arm No. 1 & 2 Adjuster Cams	59 (81)
Tie Rod Lock End Nuts	41 (56)
LS400	
Front Camber Adjuster Cam Bolt	185 (251)
Rear Suspension Arm No. 1 & 2 Adjuster Cams	42 (57)
Tie Rod Lock End Nuts	41 (56)
RX300	
Lower Shock Absorber Nuts	156 (211)
Tie Rod End Lock Nuts	54 (74)
SC300 & SC400	
Front & Rear Cam Adjuster Bolt	167 (226)
Tie Rod End Lock Nuts	41 (56)
	INCH Lbs. (N.m)
LS400	
Height Control Sensor Link Lock Nuts	43 (4.9)

WHEEL ALIGNMENT SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS (ES300)

Application	Preferred	Range
Camber (1)		
Front	-.62	-1.37 To .13
Rear	-.75	-1.55 To -.05
Caster (1)	2.3	1.55 To 3.05
Steering Axis Inclination (1)	13.07	13.82 To 12.32
Toe-In (2)		
Front	0 (0)	-.08 To .08 (-2.0 To 2.0)
Rear	.16 (4.0)	.08 To .24 (2.0 To 6.0)
Toe-In (1)		
Front	0	-.20 To .20
Rear	.40	.20 To .60
Toe-Out On Turns (1)		
Inner	35.66	
Outer	31.40	

(1) - Measurement in degrees.
(2) - Measurement in inches (mm).

WHEEL ALIGNMENT SPECIFICATIONS (GS300 & GS400)

Application	Preferred	Range
GS300 & GS400		
Camber (1)		
Front	-.27	-.77 To .23
Rear	-.78	-1.28 To .28
Caster (1)	7.55	7.05 To 8.05
Steering Axis Inclination (1)	8.87	9.37 To 8.37
Toe-In (2)		

Front	.06 (1.5)	.02 To .14 (-.50 To 3.50)	
Rear	.06 (1.5)	.02 To .14 (-.50 To 3.50)	
Toe-In (1)			
Front	.15	-.05 To .35	
Rear	.13	-.07 To .33	
Toe-Out On Turns (1)			
Inner	38.85		
Outer	32.08		

(1) - Measurement in degrees.
(2) - Measurement in inches (mm).

WHEEL ALIGNMENT SPECIFICATIONS (LS400)

Application	Preferred	Range
With Air Suspension		
Camber (1)		
Front	.1	-.67 To .83
Rear	-1.42	-2.17 To -.67
Caster (1)	7.42	6.67 To 8.17
Steering Axis Inclination (1)	8.67	9.41 To 7.91
Toe-In (2)		
Front	.04 (1.0)	-.04 To .12 (-1.0 To 3.0)
Rear	.12 (3.0)	.04 To .20 (1.0 To 5.0)
Toe-In (1)		
Front	.10	-.10 To .30
Rear	.30	.10 To .50
Toe-Out On Turns (1)		
Inner	42	
Outer	34	
Without Air Suspension		
Camber (1)		
Front	.33	-.42 To 1.08
Rear	-.83	-1.58 To -.08
Caster (1)	7	.6.25 To 7.75
Steering Axis Inclination (1)	8.42	9.17 To 7.67
Toe-In (2)		
Front	.12 (3.0)	.04 To .16 (1.0 To 4.0)
Rear	.08 (2.0)	0 To .16 (0 To 4.0)
Toe-In (1)		
Front	.30	.20 To .40
Rear	.10	0 To .40
Toe-Out On Turns (1)		
Inner	42	
Outer	34.33	

(1) - Measurement in degrees.
(2) - Measurement in inches (mm).

WHEEL ALIGNMENT SPECIFICATIONS (RX300)

Application	Preferred	Range
Camber (1)		
Front	-.33	-1.08 To .42

Rear			
2WD	-.50	.....	-1.25 To .25
4WD	-.58	.....	-1.33 To .33
Caster (1)	2.08	.....	2.83 To 1.33
Steering Axis Inclination (1)	12.17	.....	12.92 To 11.42
Toe-In (1)			
Front	.10	.....	-.10 To .30
Rear			
2WD	.20	.....	0 To .40
4WD	.30	.....	.10 To .50
Toe-Out On Turns (1)			
Inner	31.05	.....	29.55 To 32.55
Outer	27.83	.....	

(1) - Measurement in degrees.

WHEEL ALIGNMENT SPECIFICATIONS (SC300 & SC400)

Application	Preferred		Range
Camber (1)			
Front	.03	.....	-.72 To .78
Rear	-1.08	.....	-1.83 To -.33
Caster (1)	3.02	.....	2.27 To 3.77
Steering Axis Inclination (1)	9.03	.....	9.78 To 8.28
Toe-In (2)			
Front	.04 (1.0)	.....	-.04 To .12 (-1.0 To 3.0)
Rear	.2 (5.0)	.....	.08 To .24 (2.0 To 6.0)
Toe-In (1)			
Front	.10	.....	-.10 To .30
Rear	.50	.....	.20 To .60
Toe-Out On Turns (1)			
Inner	37.07	.....	
Outer	32.38	.....	

(1) - Measurement in degrees.
(2) - Measurement in inches (mm).

WHEEL ALIGNMENT THEORY/OPERATION

1999 Lexus RX 300

GENERAL INFORMATION
Wheel Alignment Theory & Operation

All Models

ADJUSTMENTS

* PLEASE READ THIS FIRST *

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models.

PRE-ALIGNMENT INSTRUCTIONS

GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

* Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
* Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See Fig. 1.

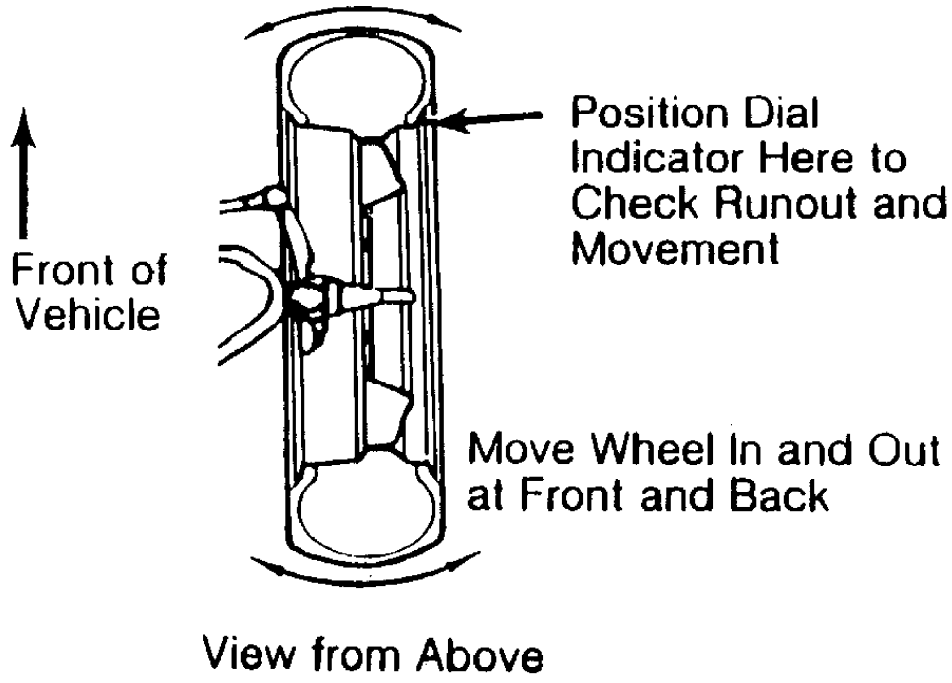


Fig. 1: Checking Steering Linkage

* Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm

vehicle is at normal riding height.

* Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See Fig. 2.
* Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

CAUTION: DO NOT attempt to correct alignment by straightening parts. Damaged parts must be replaced.

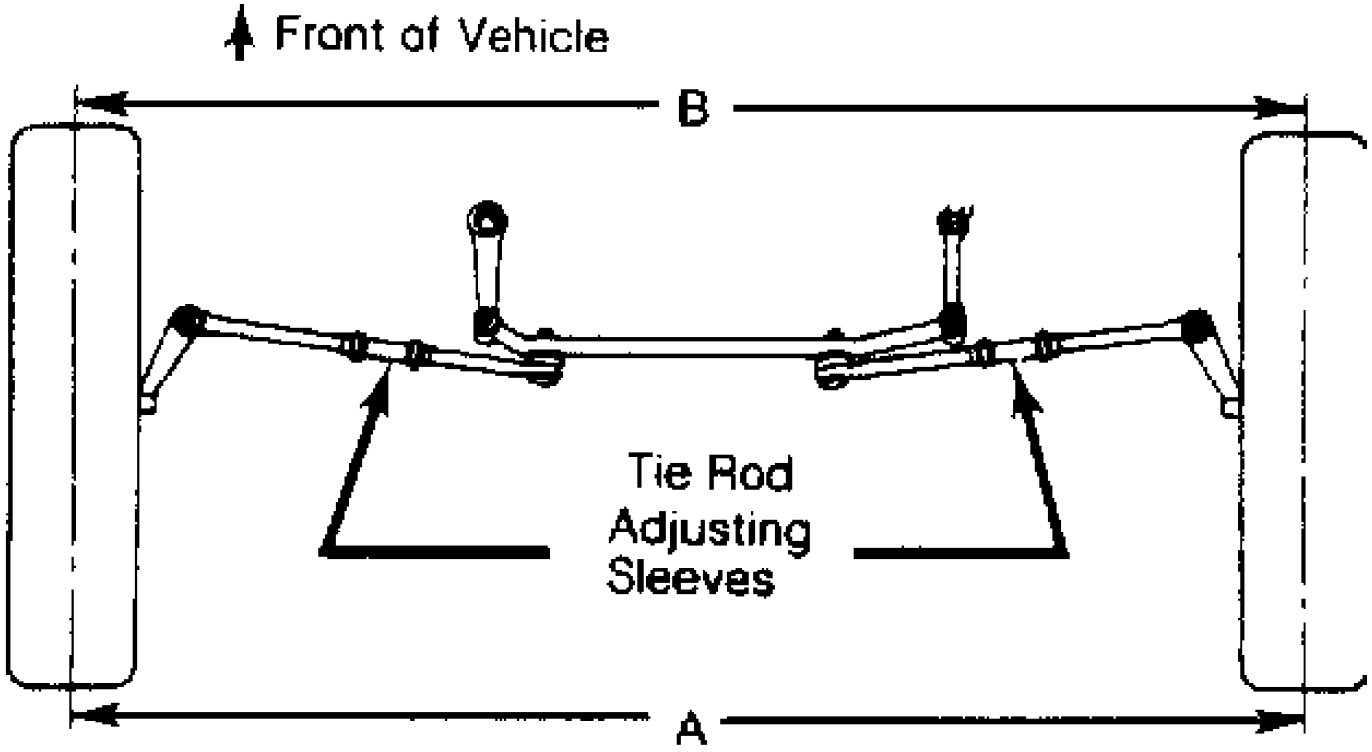


Fig. 2: Adjusting Tie Rod Sleeves (Top View)

CAMBER

1) Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See Fig. 3.

2) When wheels tilts outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.

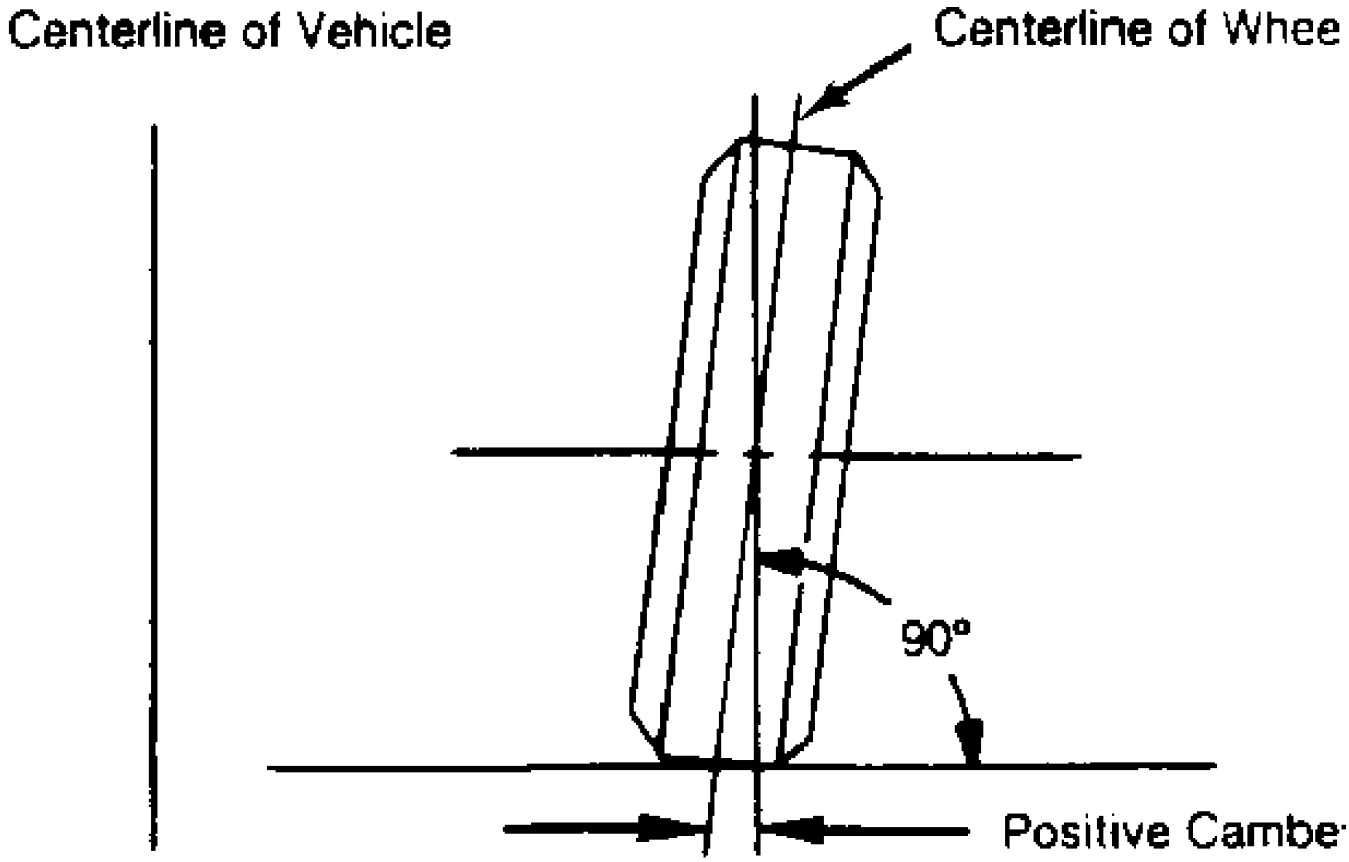


Fig. 3: Determining Camber Angle

CASTER

1) Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See Fig. 4.

2) When axis is tilted backward from vertical, caster is positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.

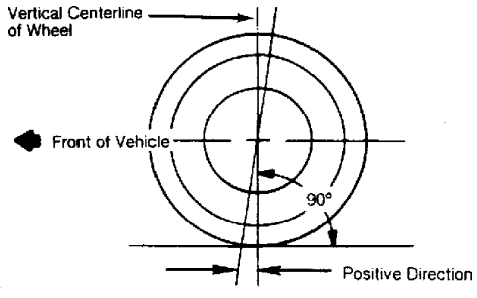


Fig. 4: Determining Caster Angle

TOE-IN ADJUSTMENT

Toe-in is the width measured at the rear of the tires

subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See Figs. 2 and 5.

2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.

3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.

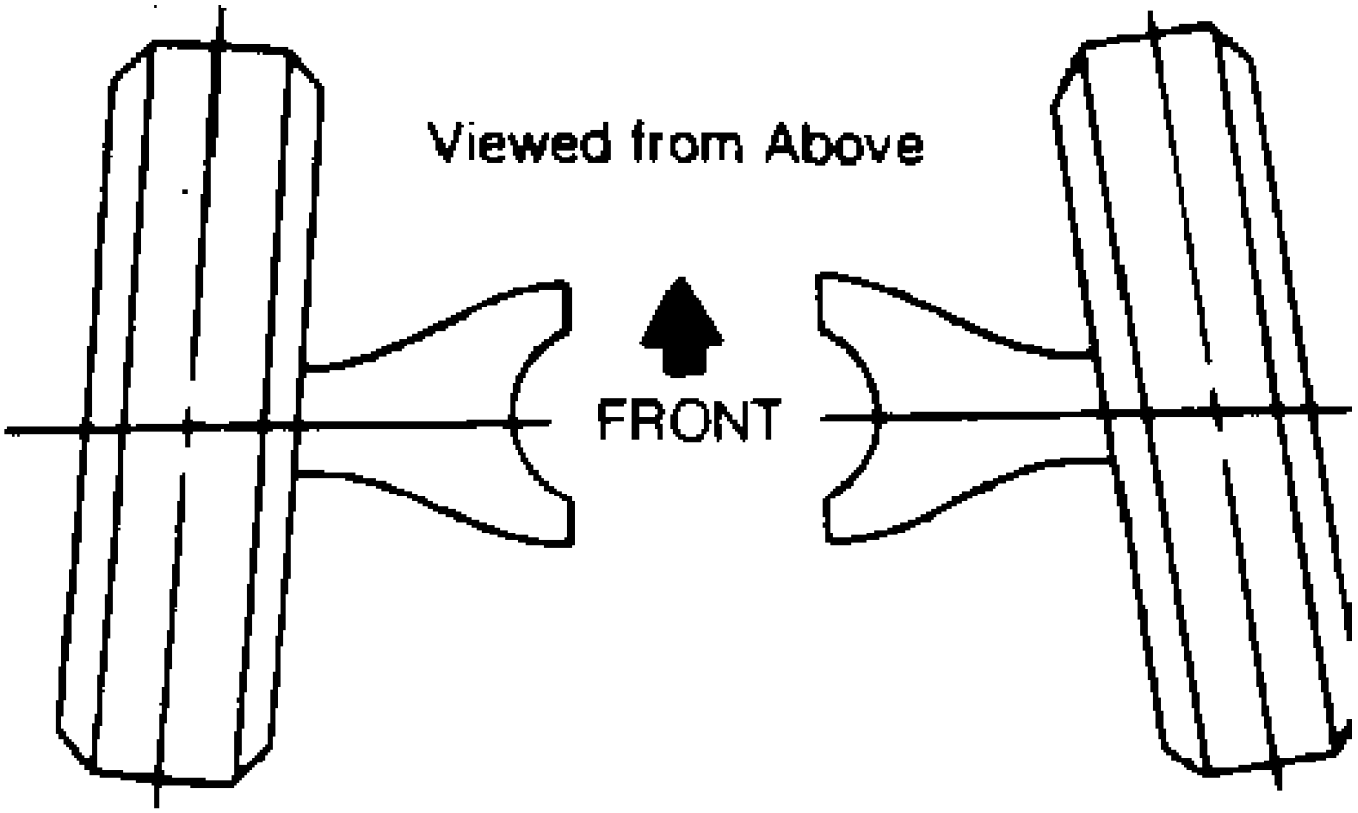


Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)

TOE-OUT ON TURNS

1) Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and toe-in properly adjusted, check toe-out with weight of vehicle on wheels.

2) Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

STEERING AXIS INCLINATION

1) Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See Fig. 6.

2) If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.

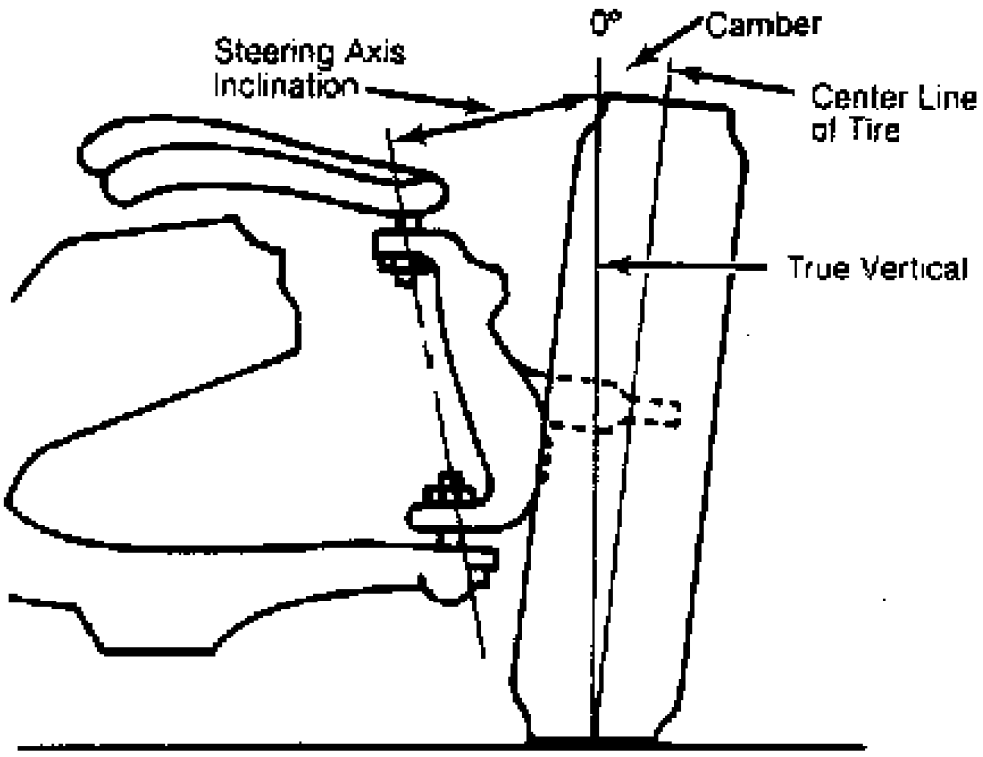


Fig. 6: Checking Steering Axis Inclination

WIPER/WASHER SYSTEM

1999 Lexus RX 300

1999 ACCESSORIES & EQUIPMENT
Wiper/Washer Systems
LEXUS

RX300

DESCRIPTION & OPERATION

FRONT WIPER/WASHER

Wipers use a 2-speed motor containing a parking switch. Wiper relay controls power to the front wiper motor. Wiper relay is integrated with wiper/washer switch. Wiper/washer switch has 3 positions; LO, HI and INT. Intermittent operation is adjusted by rheostat on wiper/washer switch. Washers are activated by pulling wiper/washer switch handle.

REAR WIPER/WASHER

Wipers use a 2-speed motor containing a parking switch. Rear wiper/washer system is controlled by the body control Electronic Control Unit (ECU). Wiper/washer switch has 2 positions; LO and INT. Washers are activated by turning rear wiper/washer switch handle.

COMPONENT LOCATIONS

Front Wiper Motor
On left side of firewall.

Rear Wiper Motor
On center of back door.

RR WIP Fuse
In junction block, behind left side of instrument panel.

WASHER Fuse
In junction block, behind left side of instrument panel.

Washer Motor
Front right corner of engine compartment.

WIPER Fuse
In junction block, behind left side of instrument panel.

Wiper Relay
Part of wiper/washer switch.

Wiper/Washer Switch
Part of combination switch.

ADJUSTMENTS

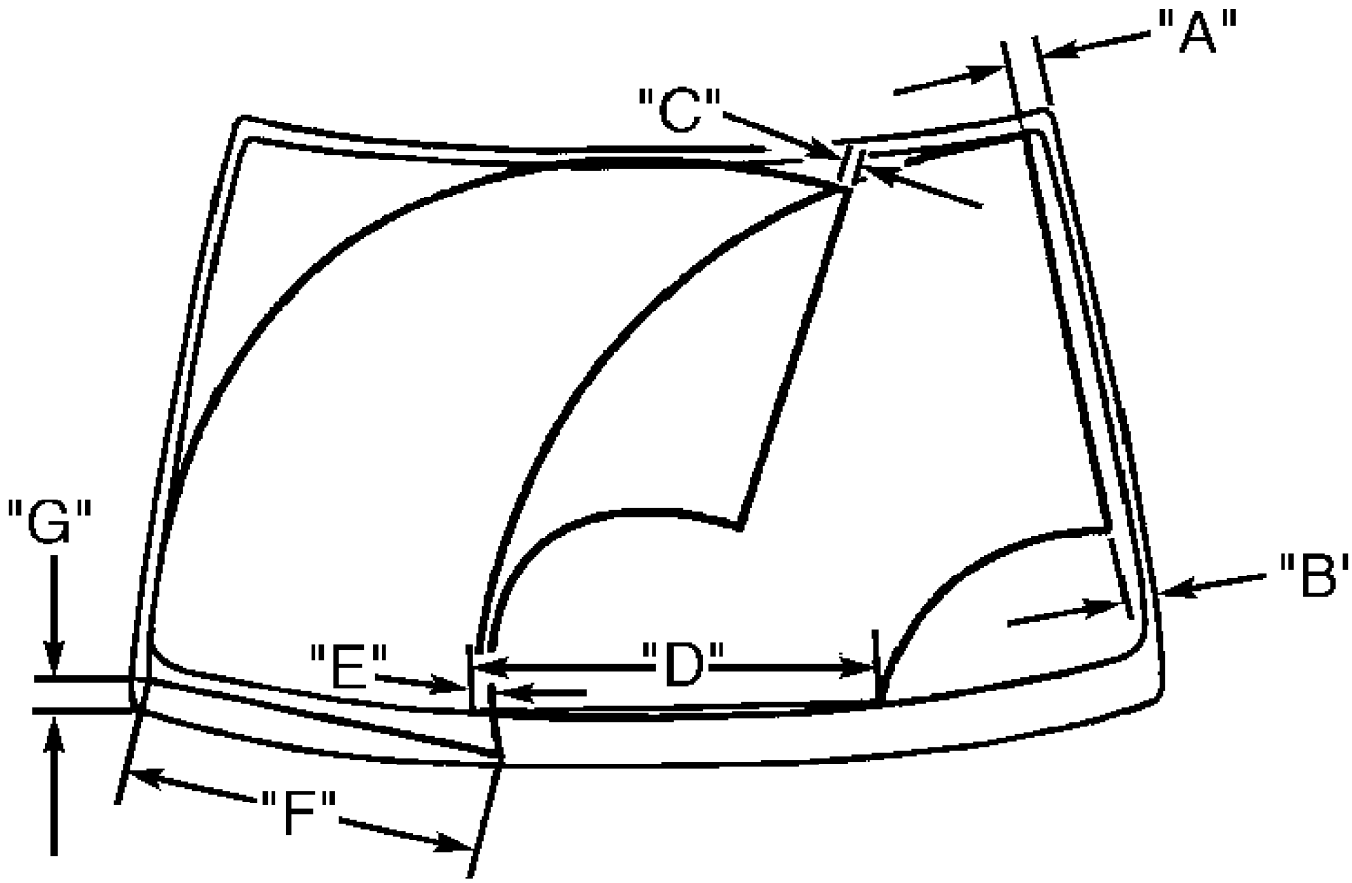
WIPER ARMS

Front Wiper
Turn wiper/washer switch on, and then off. Ensure wiper linkage stops in park position. Loosen front wiper arm nuts. Position

front wiper arms so distances are as specified. See FRONT WIPER ARM POSITION SPECIFICATIONS table. See Fig. 1. Tighten front wiper arm nuts to 18 ft. lbs. (24 N.m).

FRONT WIPER ARM POSITION SPECIFICATIONS

Position	In. (mm)
"A"	1.71 (43.5)
"B"	1.91 (48.5)
"C"	0.61 (15.5)
"D"	23.62 (600)
"E"	1.70 (43.1)
"F"	20.67 (525)
"G"	1.81 (46.0)



G99D50131

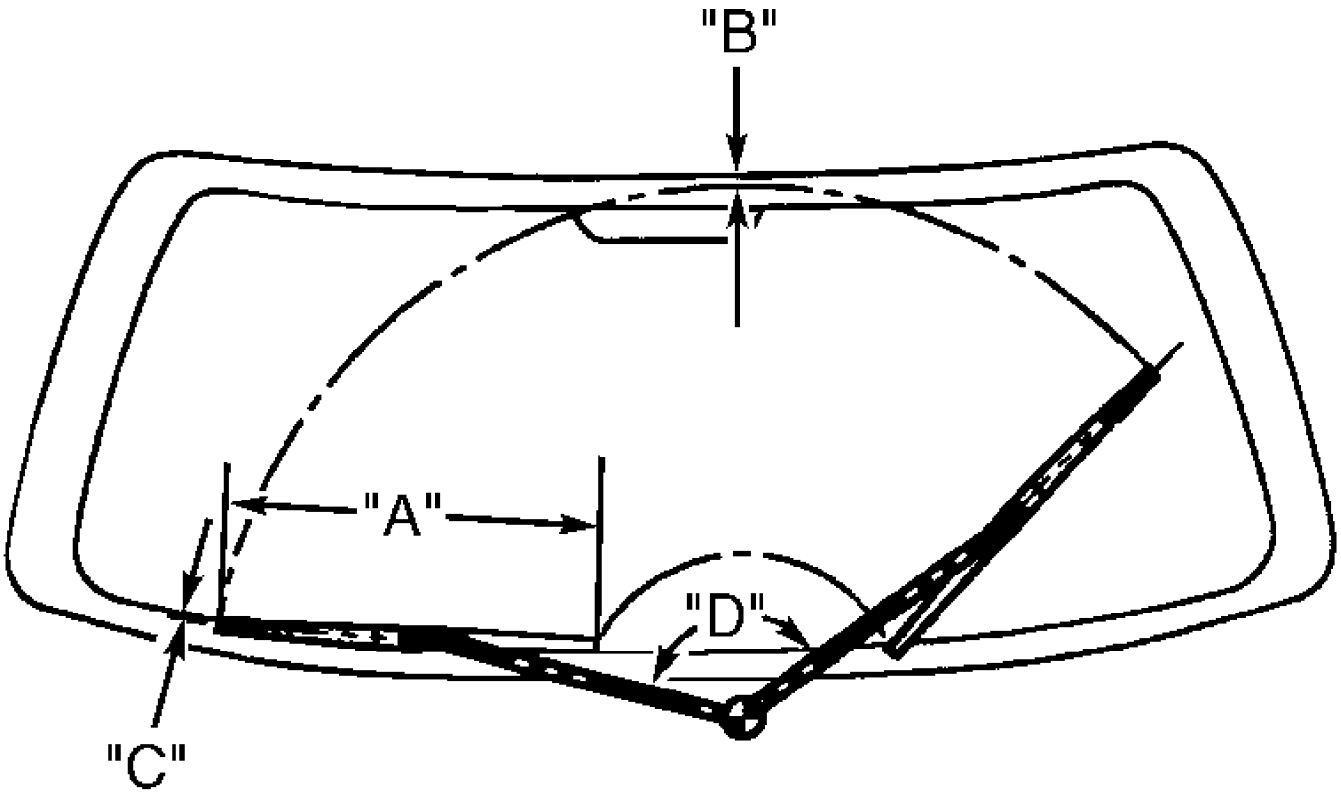
Fig. 1: Adjusting Front Wiper Arms
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear Wiper

Turn wiper/washer switch on, and then off. Ensure wiper linkage stops in park position. Loosen rear wiper arm nut. Position rear wiper arm so distances are as specified. See REAR WIPER ARM POSITION SPECIFICATIONS table. See Fig. 2. Tighten rear wiper arm nut to 49 INCH lbs. (5.5 N.m).

REAR WIPER ARM POSITION SPECIFICATIONS

Position	Specification
"A"	15.75" (400 mm)
"B"	0.26" (06.5 mm)
"C"	0" (0 mm)
"D"	130 Degrees



G99E50132

Fig. 2: Adjusting Rear Wiper Arm
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TROUBLE SHOOTING

Perform a visual inspection, checking for open fuses, disconnected or damaged wire harnesses and components. Repair or replace as necessary, and retest system operation. If no problems are found, diagnose system by symptom. See SYMPTOM DIAGNOSIS table.

SYMPTOM DIAGNOSIS

Problem	Inspect
Wipers & Washers Do Not Operate	WIPER Fuse; RR WIP Fuse; (1) Wiper/Washer Switch; (1) Wiper Motor; (2) Body Control ECU;

	(3) Wiring Harness
Wipers Do Not Operate In LO, HI Or MIST ...	(1) Wiper/Washer Switch;
	(1) Wiper Motor;
	(2) Body Control ECU;
	(3) Wiring Harness
Wipers Do Not Operate In INT	(1) Wiper/Washer Switch;
	(1) Wiper Motor;
	(2) Body Control ECU;
	(3) Wiring Harness
Washer Motor Does Not Operate	WASHER Fuse;
	(1) Wiper/Washer Switch;
	(1) Washer Motor;
	(3) Wiring Harness
Wipers Do Not Operate When Washer Switch Is On ...	(1) Washer Motor;
	(2) Body Control ECU;
	(3) Wiring Harness
Washer Fluid Does Not Operate	Washer Hose & Nozzle
With Wiper Switch In HI Position,	
Wiper Blade Contacts Body	(1)(4) Wiper Motor;
	(2) Body Control ECU;
	(3)(4) Wiring Harness
With Wiper Switch In OFF Position,	
Wiper Blade Does Not Retract Or	
Position Is Incorrect	(1)(4) Wiper Motor;
	(2) Body Control ECU;
	(3)(4) Wiring Harness

(1) - Perform appropriate circuit test under CIRCUIT TESTS. If more than one circuit test is listed, perform tests in order listed.
(2) - Perform BODY CONTROL ECU PIN VOLTAGE TESTS under COMPONENT TESTS in BODY CONTROL SYSTEMS - RX300 article.
(3) - Check wiring harness for opens or shorts. See WIRING DIAGRAMS. Repair or replace as necessary, and retest system operation.
(4) - Check wiper arm adjustment. See WIPER ARMS under ADJUSTMENTS.

CIRCUIT TESTS

* PLEASE READ THIS FIRST *

NOTE: Perform circuit tests in order listed in SYMPTOM DIAGNOSIS table under TROUBLE SHOOTING.

WASHER MOTOR CIRCUIT

NOTE: Front and rear wipers use the same washer motor. When testing washer motor, use front wiper switch to actuate motor.

1) Disconnect 3-pin washer motor connector. Turn ignition on. Using a voltmeter, measure voltage between terminal No. 2 (Blue/White wire) and ground. See WIRING DIAGRAMS. If battery voltage is present, go to next step. If battery voltage is not present, check wire harness, connectors and 10-amp WASHER fuse located in instrument panel junction block, behind left side of instrument panel. Repair or replace as necessary. Retest system operation.

2) Turn ignition off. Using an ohmmeter, check continuity between terminal No. 1 (Blue/Orange wire) and ground with washer switch on (pushed in). If continuity exists, check washer motor. See WASHER MOTOR under COMPONENT TESTS. Replace washer motor as necessary. Retest system operation. If continuity does not exist, repair wire harness between washer motor and wiper/washer switch. Retest system operation.

WIPER MOTOR CIRCUIT

Front

1) Disconnect 5-pin wiper motor connector. Turn ignition on. Using a voltmeter, measure voltage between terminal No. 2 (Blue wire) and ground. See WIRING DIAGRAMS. If battery voltage is present, go to next step. If battery voltage is not present, check wire harness, connectors and 25-amp WIPER fuse located in instrument panel junction block, behind left side of instrument panel. Repair or replace as necessary. Retest system operation.

2) Using a voltmeter, measure voltage between specified terminals and ground with wiper/washer switch in specified position. See WIPER MOTOR CIRCUIT VOLTAGE table. See WIRING DIAGRAMS. If battery voltage is as specified, go to next step. If battery voltage is not as specified, check wire harness, connectors and 25-amp WIPER fuse located in instrument panel junction block, behind left side of instrument panel. Repair or replace as necessary. Retest system operation.

WIPER MOTOR CIRCUIT VOLTAGE

Terminal	Switch Position	(1) Voltage
4 & Ground	OFF Or INT, LO	Zero
4 & Ground	HI	Battery
1 & Ground	OFF Or INT, HI	Zero
1 & Ground	LOW	Battery

(1) - With ignition switch in ON position.

3) Turn ignition off. Using an ohmmeter, check continuity between terminal No. 5 (White/Black wire) and ground. If continuity exists, check wiper motor. See WIPER MOTOR under COMPONENT TESTS. Replace wiper motor as necessary. Retest system operation. If continuity does not exist, repair wire harness between wiper motor and ground connection. Retest system operation.

Rear

Rear wiper motor circuit testing information is not available from manufacturer. To check rear wiper motor, go to WIPER MOTOR under COMPONENT TESTS.

WIPER/WASHER SWITCH CIRCUIT

1) Disconnect 18-pin combination (wiper/washer) switch connector. Turn ignition on. Using a voltmeter, measure voltage between terminal No. 17 (Blue wire) and ground. See WIRING DIAGRAMS. If battery voltage is present, go to next step. If battery voltage is not present, check wire harness, connectors and 25-amp WIPER fuse located in instrument panel junction block, behind left side of instrument panel. Repair or replace as necessary. Retest system operation.

2) Turn ignition off. Using an ohmmeter, check continuity between terminal No. 2 (White/Black wire) and ground. If continuity exists, check wiper/washer switch. See WIPER/WASHER SWITCH under COMPONENT TESTS. Replace combination (wiper/washer) switch as necessary. Retest system operation. If continuity does not exist, repair wire harness between combination (wiper/washer) switch and ground connection. Retest system operation.

COMPONENT TESTS

WASHER MOTOR

NOTE: DO NOT operate washer motor for more than 20 seconds.

NOTE: Terminals No. 2 and 1 operate front washer. Terminals No. 2 and 3 operate rear washer.

1) Disconnect 3-pin washer motor connector. Connect battery positive lead to washer motor terminal No. 2 (Blue/White wire) and battery negative lead to terminal No. 1 (Blue/Orange wire). See Fig. 3 . Washer motor should operate. If washer motor operates, go to next step. If motor does not operate, replace washer motor.

2) Connect battery positive lead to washer motor terminal No. 2 (Blue/White wire) and battery negative lead to terminal No. 3 (Blue/Yellow wire). Washer motor should operate. If motor does not operate, replace washer motor.

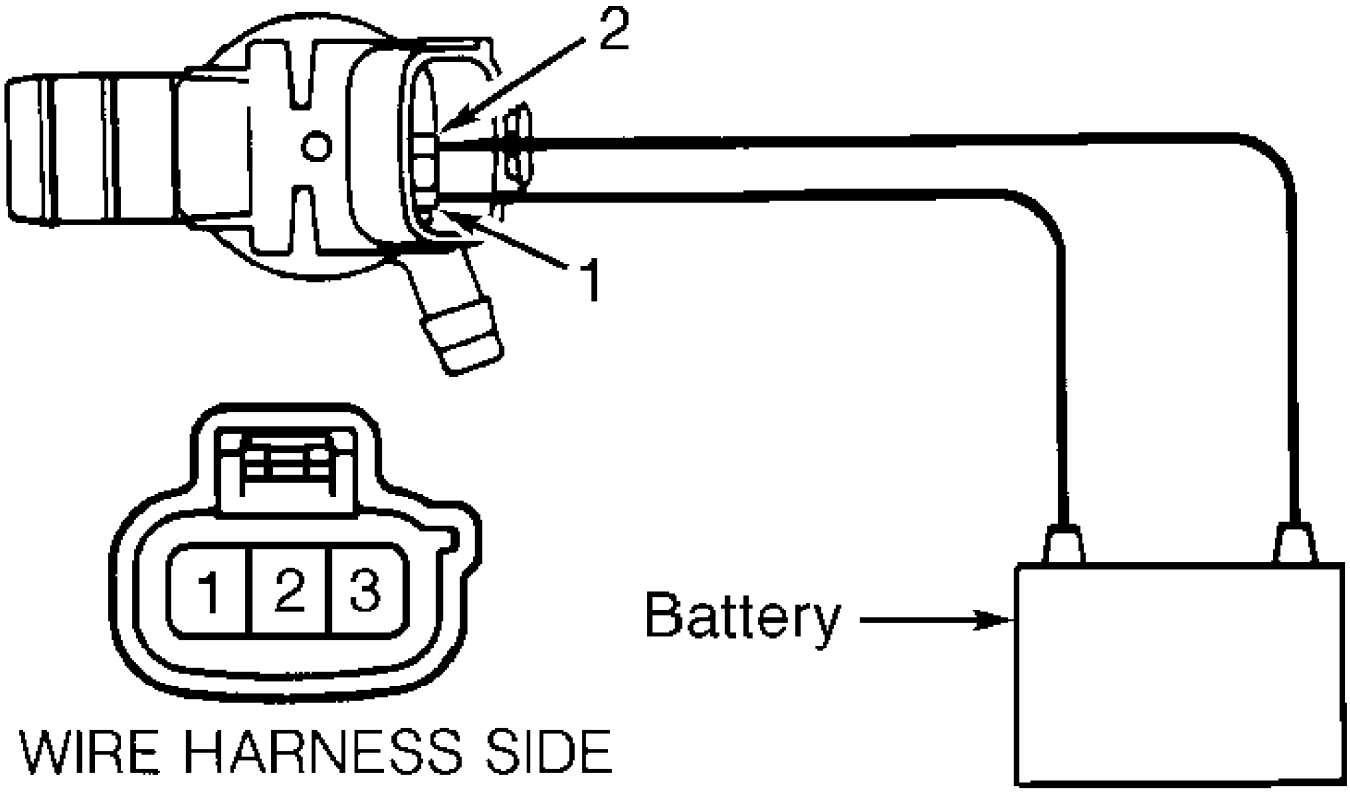


Fig. 3: Testing Washer Motor
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WIPER MOTOR

Front

1) Disconnect 5-pin wiper motor connector. Connect battery positive lead to wiper motor terminal No. 1 (Blue/Black wire) and negative battery lead to terminal No. 5 (White/Black wire). See Fig. 4 . If wiper motor operates at low speed, go to next step. If wiper motor does not operate at low speed, replace wiper motor.

2) Connect battery positive lead to wiper motor terminal No. 4 (Blue/Red wire) and negative battery lead to terminal No. 5 (White/Black wire). See Fig. 4. If wiper motor operates at high speed, go to next step. If wiper motor does not operate at high speed, replace wiper motor.

3) Operate motor at low speed and stop motor anywhere except in park position by disconnecting battery positive lead from wiper motor terminal No. 1 (Blue/Black wire). Leave battery negative lead connected to wiper motor terminal No. 5 (White/Black wire). Connect a jumper wire between wiper motor terminals No. 1 (Blue/Black wire) and No. 3 (Blue/White wire). Connect battery positive lead to terminal No. 2 (Blue wire). Wiper motor should momentarily operate, and then stop in park position. If wiper motor does not operate as specified, replace wiper motor.

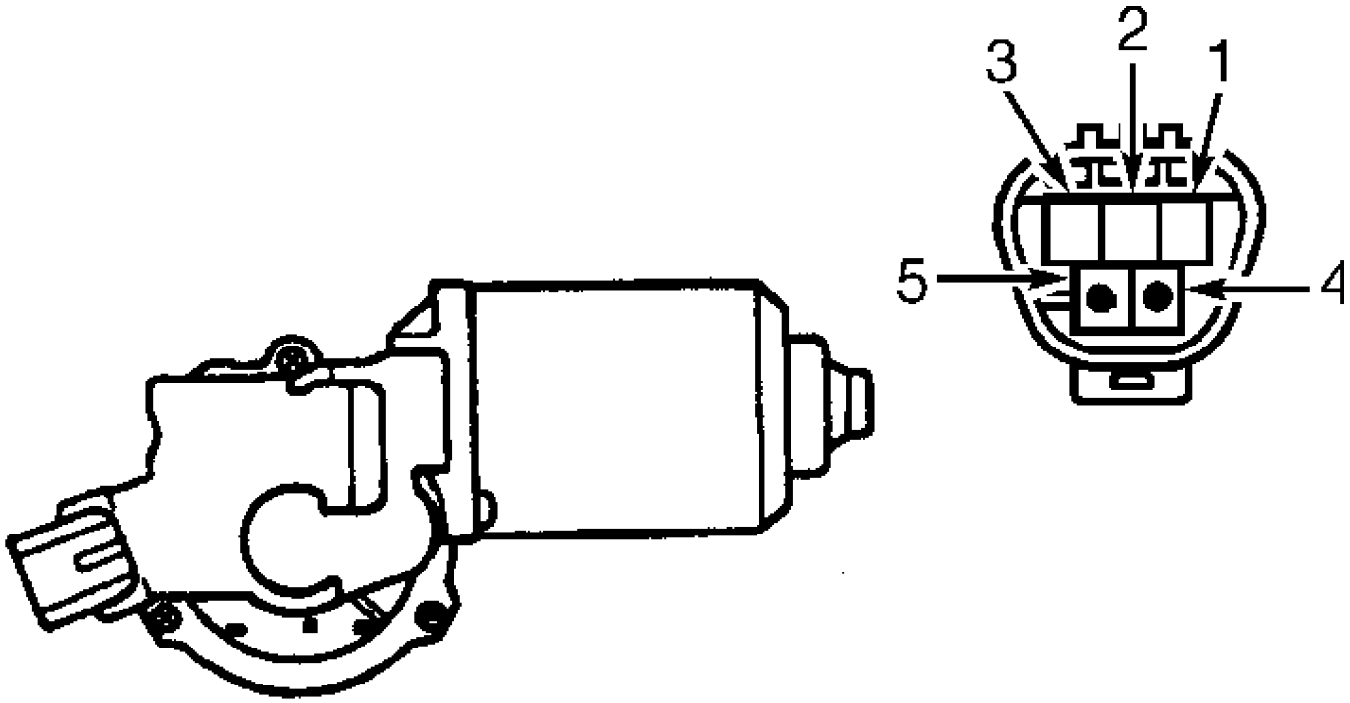
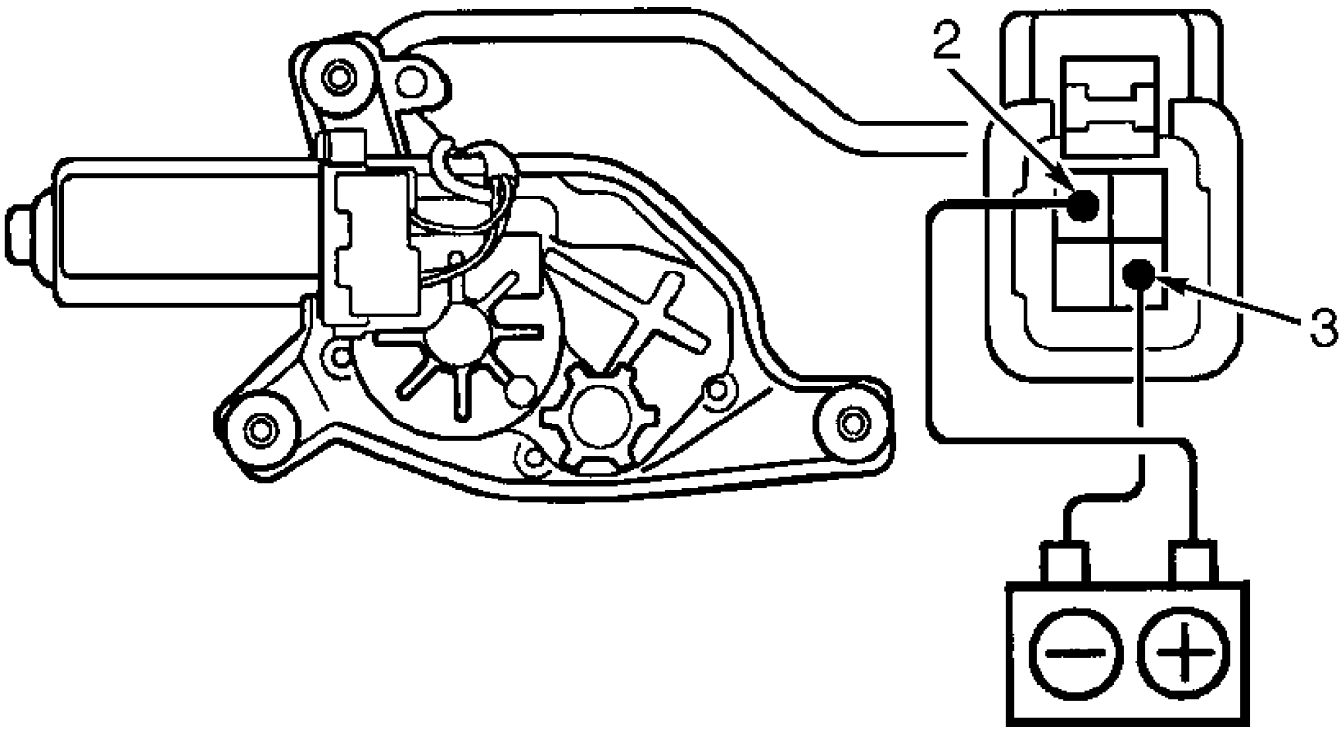


Fig. 4: Identifying Front Wiper Motor Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Rear

Disconnect 4-pin wiper motor connector. Connect battery positive lead to washer motor terminal No. 2 (Blue wire) and battery negative lead to terminal No. 3 (White/Black wire). See Fig. 5. Wiper motor should operate. If motor does not operate, replace wiper motor.



G99F50133

Fig. 5: Identifying Rear Wiper Motor Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WIPER/WASHER SWITCH

Continuity Test

Disconnect 18-pin combination (wiper/washer) switch connector. Check for continuity between specified wiper/washer switch terminals with switch in specified position. See FRONT WIPER/WASHER SWITCH CONTINUITY or REAR WIPER/WASHER SWITCH CONTINUITY table. See Fig. 6. If continuity is not as specified, replace combination (wiper/washer) switch.

FRONT WIPER/WASHER SWITCH CONTINUITY

Switch Position	Continuity Between Terminals
Wiper Off	7 & 16
Wiper Intermittent	7 & 16
Wiper Low	7 & 17
Wiper High	8 & 17
Washer	
Off	(1)
On	2 & 11

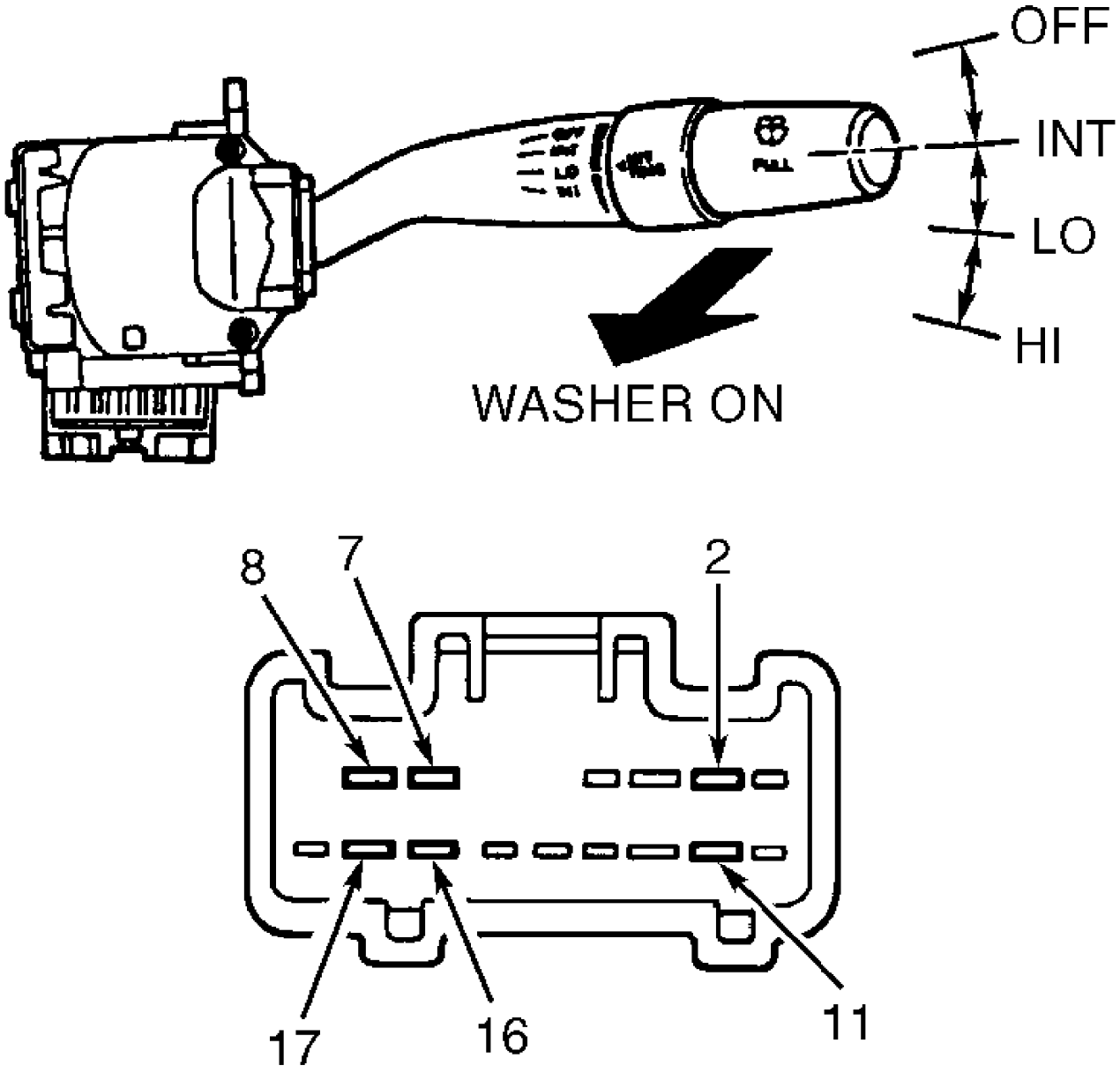
(1) - No continuity between terminals No. 2 and 11.

REAR WIPER/WASHER SWITCH CONTINUITY

Switch Position	Continuity Between Terminals

Wiper Off	(1)
Wiper Intermittent	2 & 13
Wiper On	2 & 10
Washer	
1	2 & 12
2	2, 10 & 12

(1) - No continuity.



G98J03946

Fig. 6: Identifying Combination (Wiper/Washer) Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Intermittent Feature Test (Front)
1) Disconnect 18-pin combination (wiper/washer) switch

connector. Move wiper/washer switch lever to INT position. Turn interval knob to FAST position. Connect battery positive lead to terminal No. 16 (Blue/White wire) and negative battery lead to terminal No. 2 (White/Black wire). See Fig. 6. Connect voltmeter positive lead to terminal No. 7 (Blue/Black wire) and voltmeter negative lead to terminal No. 2 (White/Black wire). If battery voltage is present, go to next step. If battery voltage is not present, replace combination (wiper/washer) switch.

2) Leave battery and voltmeter connected. Using a jumper wire, after connecting terminal No. 16 (Blue/White wire) to terminal No. 17 (Blue wire), connect jumper wire to terminal No. 2 (White/Black wire). With interval knob in fast position, voltage should rise from zero volts to battery voltage after about 1-3 seconds. With interval knob in slow position, voltage should rise from zero volts to battery voltage in about 10-15 seconds. If voltage is not as specified, replace combination (wiper/washer) switch.

Intermittent Feature Test (Rear)

Rear wiper intermittent feature testing information is not available from manufacturer.

Washer Linked Operation Test (Front)

Disconnect 18-pin combination (wiper/washer) switch connector. Connect battery positive lead to terminal No. 16 (Blue/White wire) and negative battery lead to terminal No. 2 (White/Black wire). See Fig. 6. Connect voltmeter positive lead to terminal No. 7 (Blue/Black wire) and voltmeter negative lead to terminal No. 2 (White/Black wire). Push in washer switch. Battery voltage should be present in less than one second after switch is pushed in (switch on), and remain present for about 3 seconds after switch is released (switch off). If voltage is not as specified, replace combination (wiper/washer) switch.

Washer Linked Operation Test (Rear)

Rear washer linked operation testing information is not available from manufacturer.

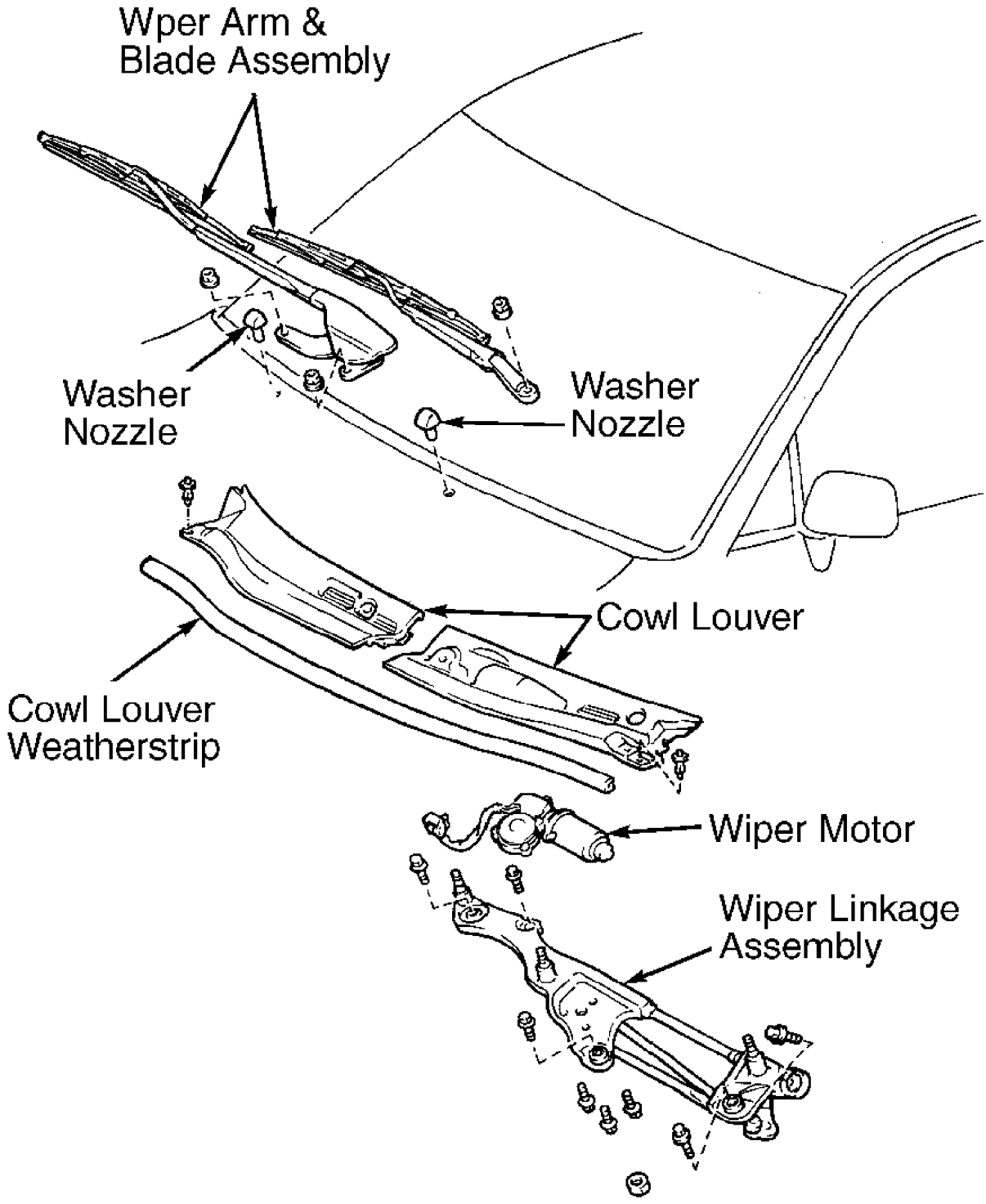
REMOVAL & INSTALLATION

FRONT WIPER MOTOR & LINKAGE ASSEMBLY

Removal & Installation

1) Note wiper arm and blade position. Remove wiper arm and blade assemblies. Remove cowl louver weatherstrip. See Fig. 7. Raise front side of cowl louver, and remove cowl louver.

2) Remove 5 bolts, and disconnect wiper motor connector. Raise front side of wiper motor and linkage assembly. Remove wiper motor and linkage assembly. To install, reverse removal procedure. Ensure wiper arms are installed in correct position. Adjust wiper arms as necessary. See WIPER ARMS under ADJUSTMENTS.



G99G50134

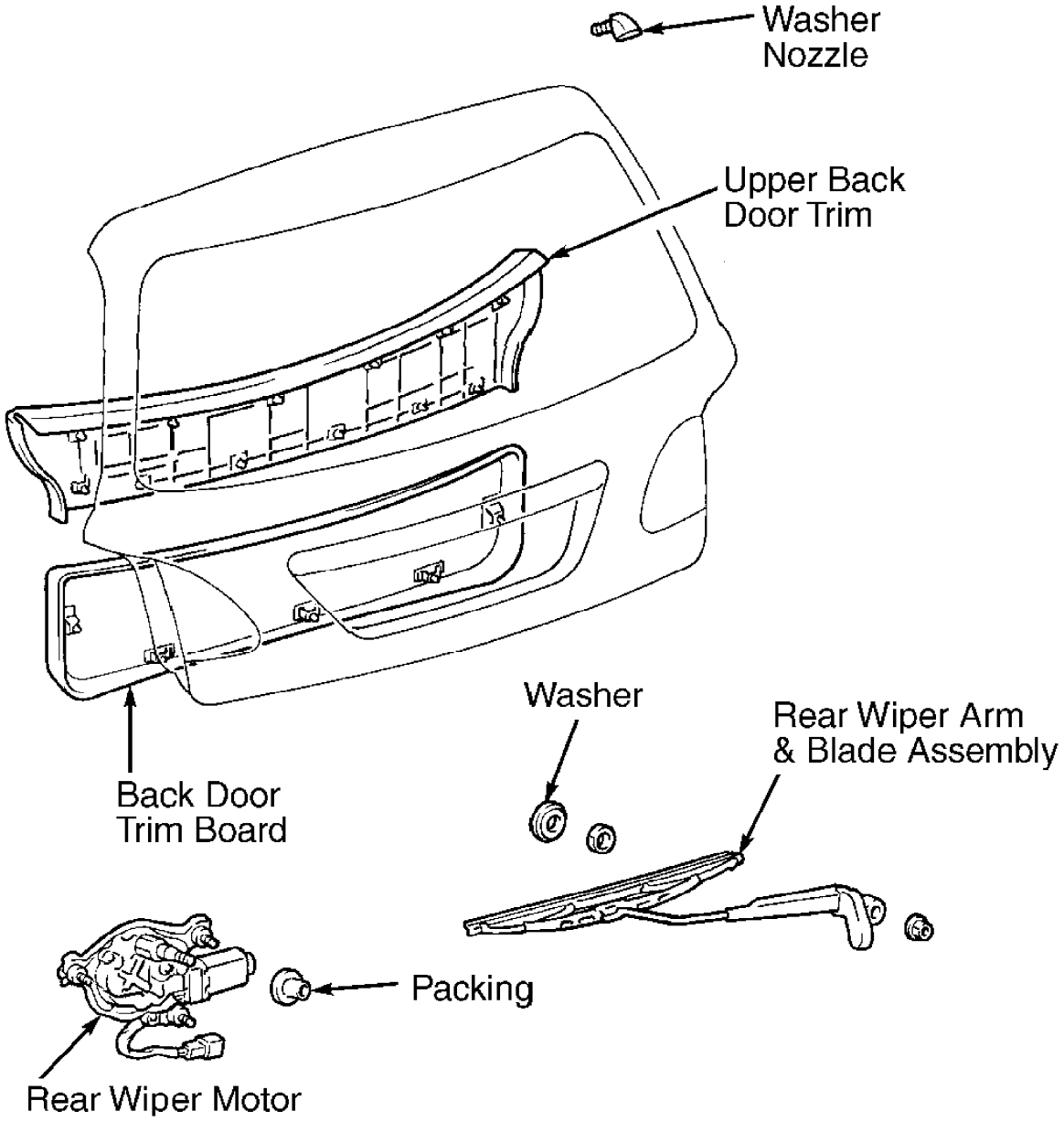
Fig. 7: Exploded View Of Front Wiper Motor & Linkage Assembly
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REAR WIPER MOTOR

Removal & Installation

1) Using a screwdriver, carefully pry off upper back door trim, and then back door trim board. See Fig. 8. Note wiper arm and blade position. Remove wiper arm and blade assembly.

2) Remove nut and washer on outer side of back door panel. Remove 3 bolts, and disconnect wiper motor connector. Remove wiper motor. Remove packing from wiper motor. To install, reverse removal procedure. Ensure wiper arm is installed in correct position. Adjust wiper arm as necessary. See WIPER ARMS under ADJUSTMENTS.



G99H50135

Fig. 8: Removing Rear Wiper Motor
Courtesy of Toyota Motor Sales, U.S.A., Inc.

WIPER/WASHER SWITCH

NOTE: Wiper/washer switch is part of combination switch. See COMBINATION SWITCH under REMOVAL & INSTALLATION in STEERING COLUMN SWITCHES article.

WIRING DIAGRAMS

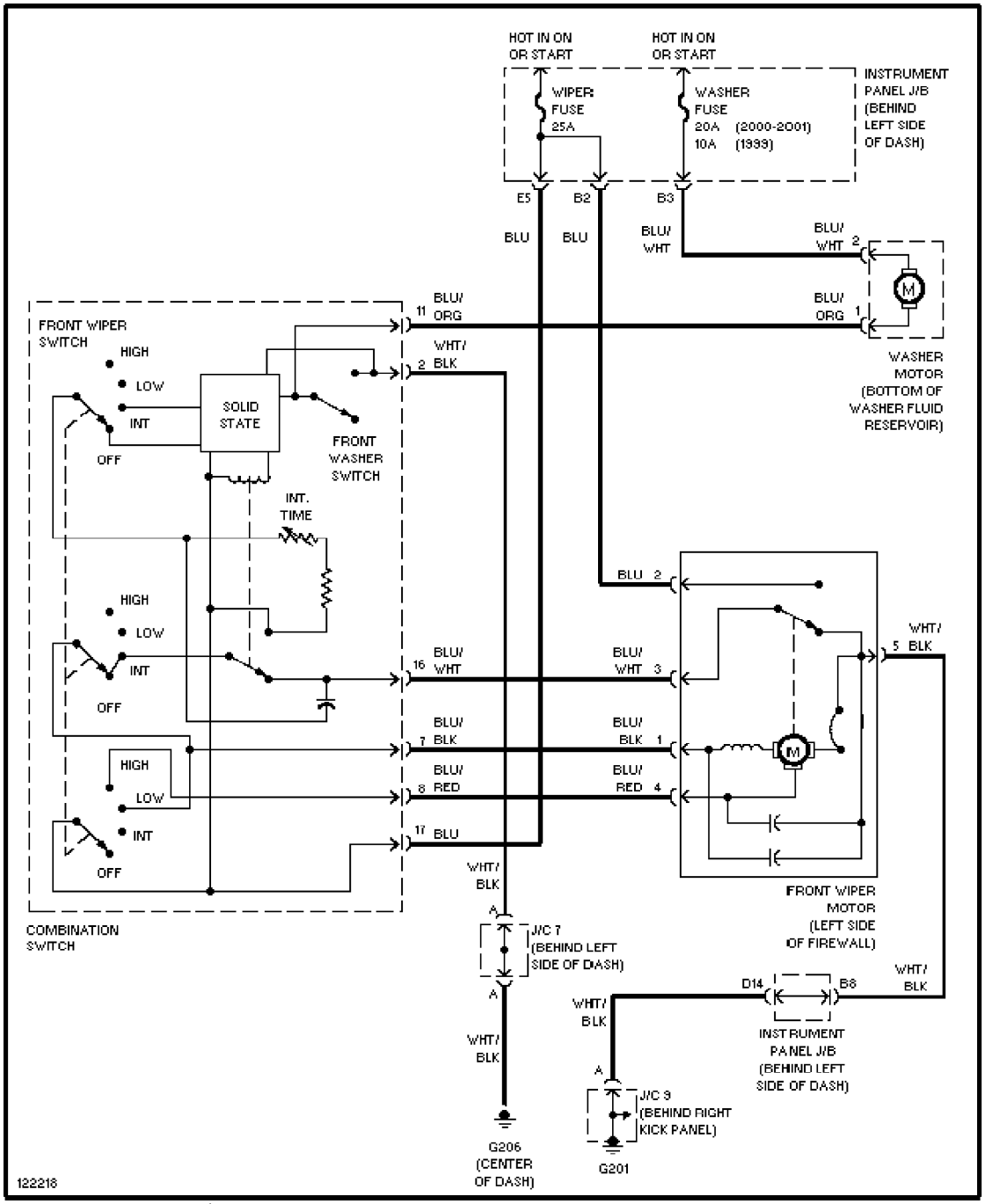


Fig. 9: Front Wiper/Washer System Wiring Diagram (RX300)

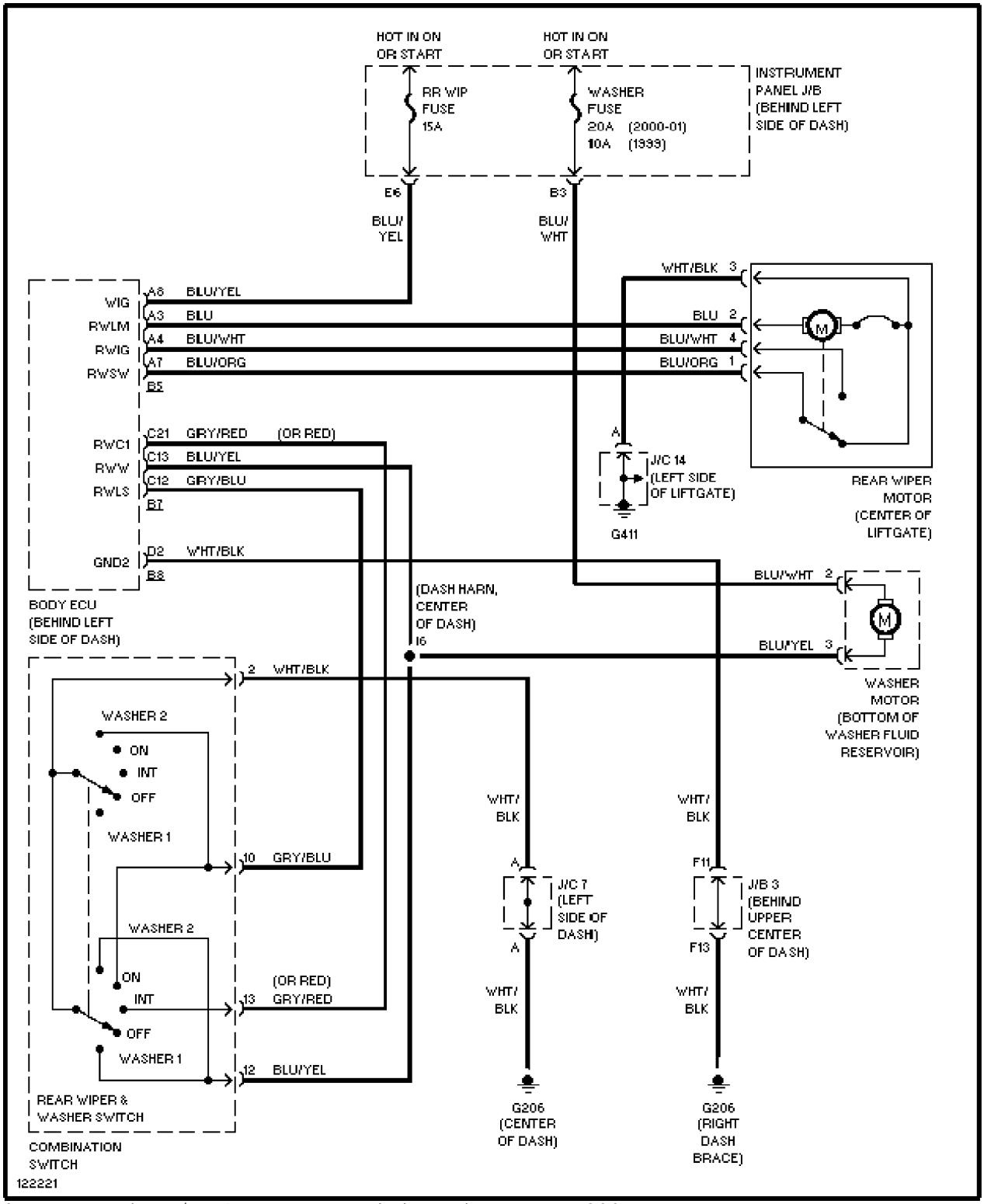


Fig. 10: Rear Wiper/Washer System Wiring Diagram (RX300)

A - ENGINE/VIN ID

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Lexus Introduction
LEXUS

MODEL IDENTIFICATION

MODEL COVERAGE

MODEL	ENGINE	ENGINE ID (1)	FUEL SYSTEM (2)	IGNITION SYSTEM
ES300	3.0L V6 (1MZ-FE)	F	SFI	(3) DIS
GS300	3.0L 6-Cyl. (2JZ-GE)	D	SFI	(3) DIS
GS400	4.0L V8 (1UZ-FE)	H	SFI	(3) DIS
LS400	4.0L V8 (1UZ-FE)	H	SFI	(3) DIS
LX470	4.7L V8 (2UZ-FE)	T	SFI	(3) DIS
RX300	3.0L V6 (1MZ-FE)	F	SFI	(3) DIS
SC300	3.0L 6-Cyl. (2JZ-GE)	D	SFI	(3) DIS
SC400	4.0L V8 (1UZ-FE)	H	SFI	(3) DIS

(1) - Engine may be identified by Vehicle Identification Number (VIN). Vin is located on VIN plate on left side of instrument panel. See Figs. 2-4. Engine serial number is stamped on cylinder block. See Figs. 5-8.
(2) - Fuel injection system is a Sequential Multiport Fuel Injection (SFI) system.
(3) - Application uses a Distributorless Ignition System (DIS).

VIN DEFINITION

J T 8 B D 6 8 S 1 X 0 0 4 8 0 3 8
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰

① Indicates Nature Of Origin.
② Indicates Manufacturer.
③ Indicates Vehicle Type.
④ Indicates Model.
⑤ **Indicates Engine Code.**
⑥ Indicates Transmission.
⑦⑧ Indicates Body Type, Series & Restraint System.
⑨ Indicates Check Digit.
⑩ **Indicates Model Year.**
⑪ Indicates Assembly Plant.
⑫⑬⑭⑮⑯⑰ Indicates Plant Sequence Number.

99I50400
Fig. 1: VIN Definition

MODEL YEAR VIN CODE APPLICATIONS

MODEL YEAR VIN CODE APPLICATION

VIN Code	Model Year
V	1997
W	1998
X	1999

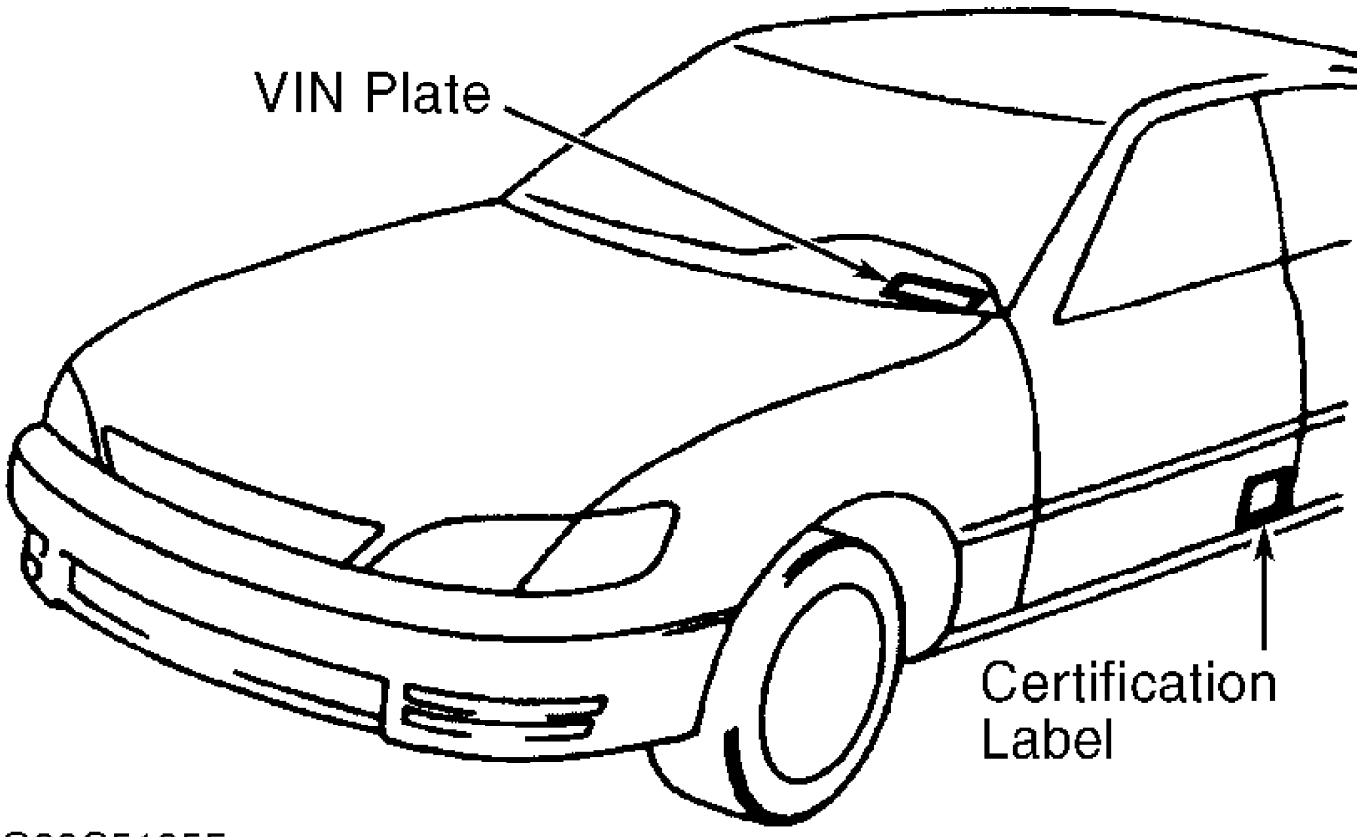


Fig. 2: Locating Typical Vehicle Identification Number (VIN) Plate & Certification Label (ES300, GS300, GS400, LS400, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

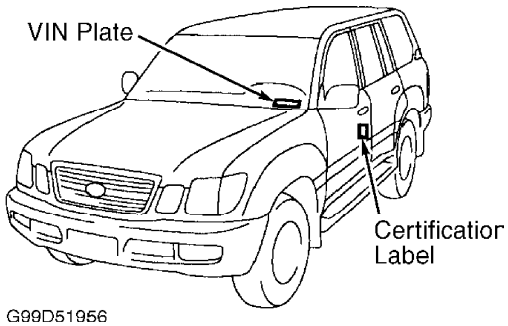


Fig. 3: Locating Vehicle Identification Number (VIN) Plate & Certification Label (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

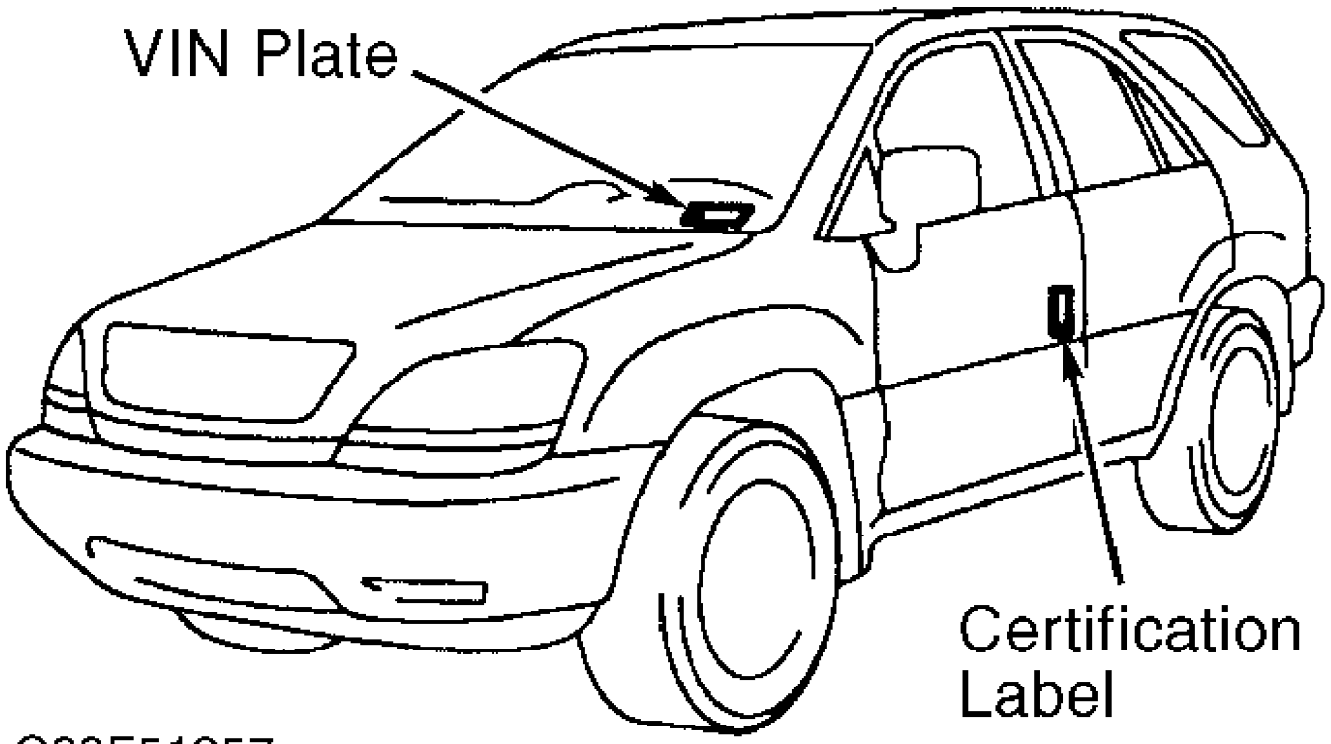


Fig. 4: Locating Vehicle Identification Number (VIN) Plate & Certification Label (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE SERIAL NUMBER LOCATION

Engine serial number is located on cylinder block. See Figs. 5-8.

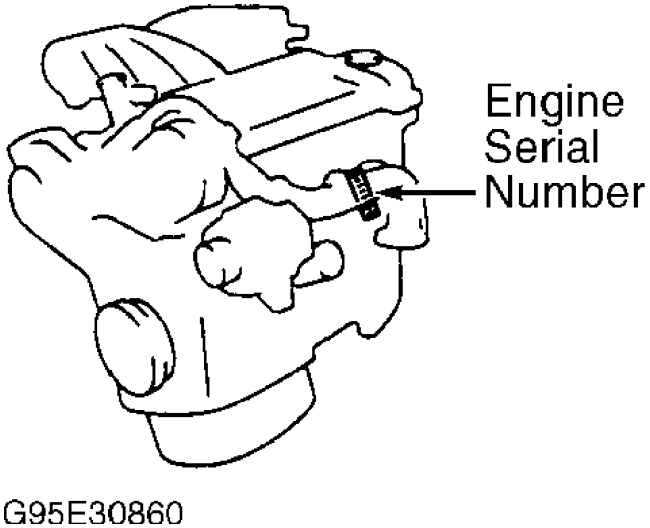


Fig. 5: Locating Engine Serial Number (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

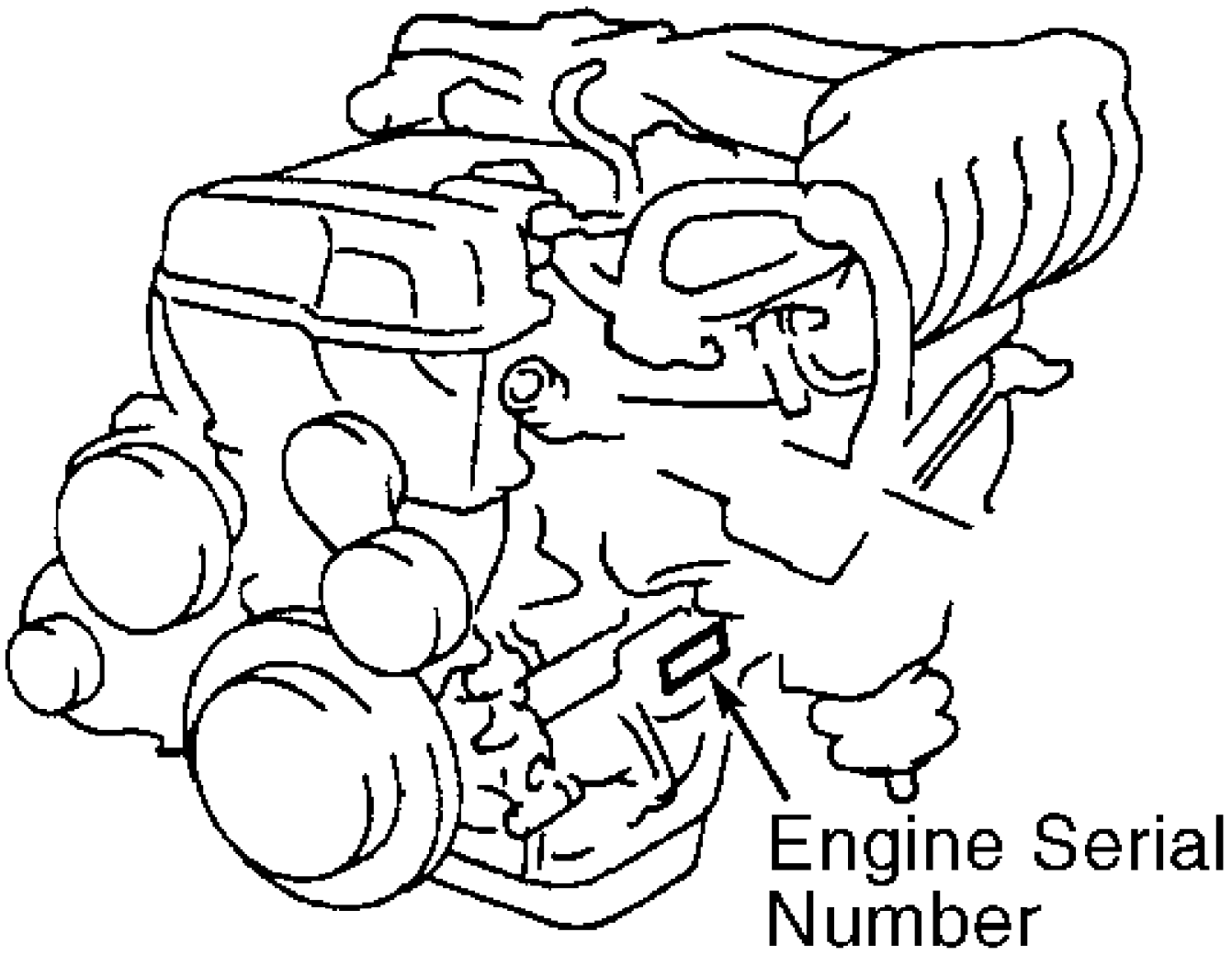


Fig. 6: Locating Engine Serial Number (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

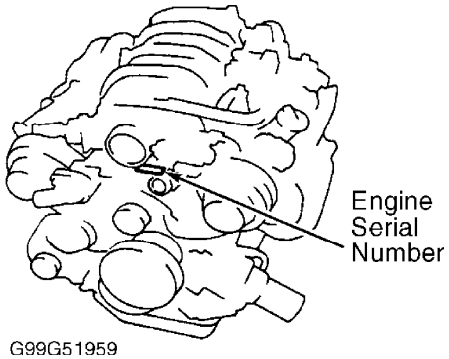


Fig. 7: Locating Engine Serial Number (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

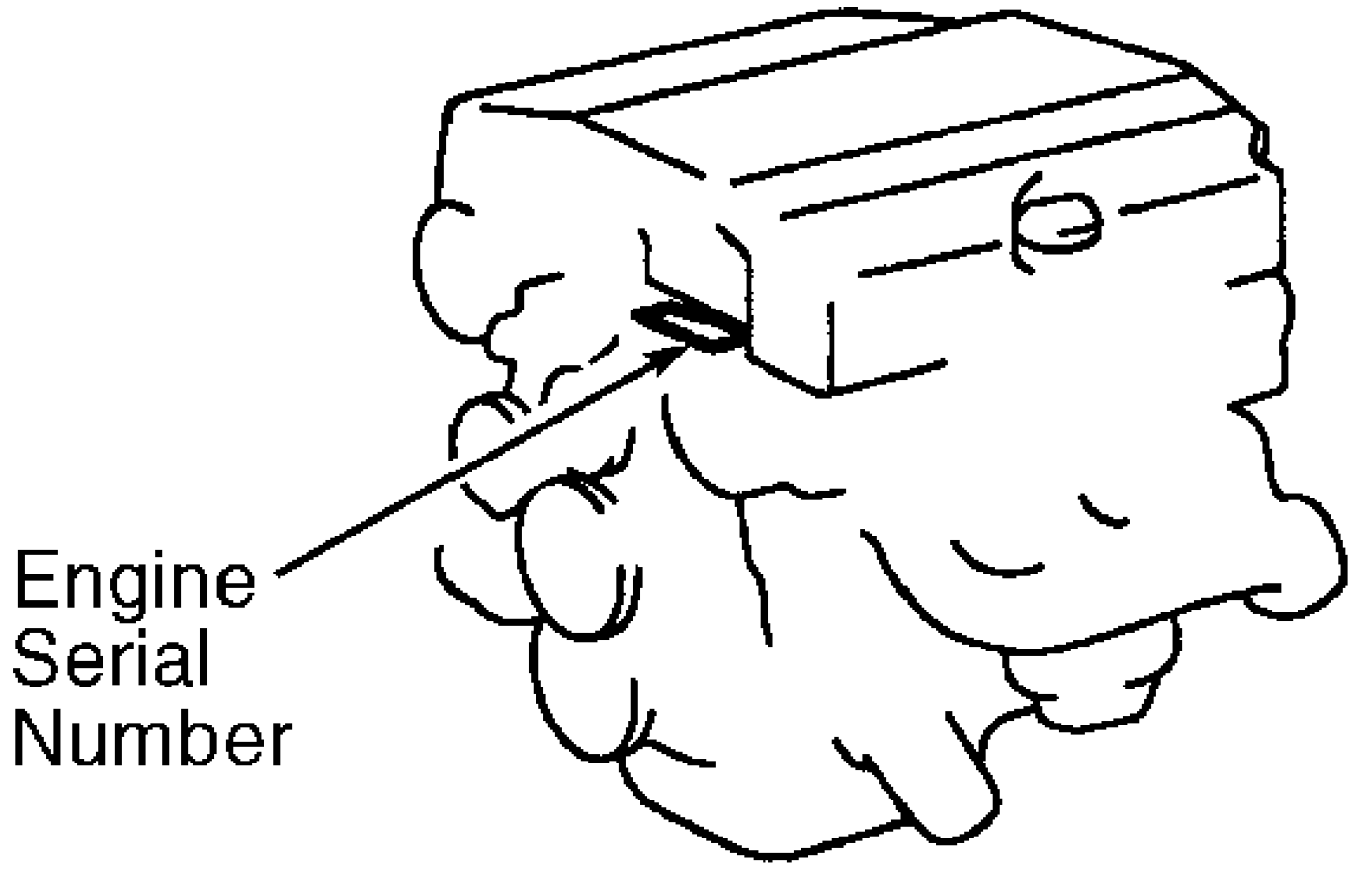


Fig. 8: Locating Engine Serial Number (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

B - EMISSION APPLICATION

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Emission Applications
LEXUS

EMISSION APPLICATIONS

EMISSION APPLICATIONS

Engine & Fuel System	Major Control Systems/Devices	Components/Other Related Devices
ES300 3.0L V6 SFI	PCV, EVAP, (1) TWC, (2) WU-TWC, FR, SPK, (3) AFS, (4) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, ORVR-COV, ORVR-OCKV, SPK-CC
GS300 3.0L 6-Cyl. SFI	PCV, EVAP, (6) TWC, FR, SPK, (7) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, ORVR-COV, ORVR-OCKV, SPK-CC
GS400 4.0L V8 SFI	PCV, EVAP, (8) TWC, FR, SPK, (9) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, ORVR-COV, ORVR-OCKV, SPK-CC
LS400 4.0L V8 SFI	PCV, EVAP, (8) TWC, FR, SPK, (9) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VCAT, EVAP-VPS, (5) EVAP-VPSVSV, SPK-CC
LX470 4.7L V8 SFI	PCV, EVAP, (10) TWC, FR, SPK, (11) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, SPK-CC
RX300 3.0L V6 SFI	PCV, EVAP, (12) TWC, FR, SPK, (3) AFS, (4) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, ORVR-COV, ORVR-OCKV, SPK-CC
SC300 3.0L 6-Cyl. SFI	PCV, EVAP, (6) TWC, FR, SPK, (7) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, SPK-CC
SC400 4.0L V8 SFI	PCV, EVAP, (8) TWC, FR, SPK, (9) HO2S, CEC, MIL	(5) EVAP-VSV, EVAP-VC, EVAP-VPS, (5) EVAP-VPSVSV, SPK-CC

(1) - One on exhaust pipe.
(2) - One on each bank below exhaust manifold.
(3) - One heated sensor on each exhaust manifold.
(4) - One on exhaust pipe, behind catalytic converter.

(5) - Controlled by ECM.
(6) - Two required. One on each exhaust manifold.
(7) - Four required. One on each side of catalytic converter.
(8) - Two required. One located between each exhaust pipe and each exhaust manifold.
(9) - Four required. One on each exhaust manifold and one on each exhaust pipe behind catalytic converter.
(10) - Two required. One on each exhaust pipe below exhaust manifold.
(11) - Four required. One on each exhaust manifold and one on each exhaust pipe, behind catalytic converter.
(12) - One on each bank below exhaust manifold and one on exhaust pipe.

ABBREVIATIONS

ABBREVIATION DEFINITIONS

Abbreviation	Definition
AFS	Air/Fuel Ratio Sensor
CEC	Computerized Engine Controls
EVAP	Fuel Evaporative System
EVAP-VC	EVAP Vapor Canister
EVAP-VCAT	EVAP Vapor Canister Air Tank
EVAP-VPS	EVAP Vapor Pressure Sensor
EVAP-VPSVSV	EVAP Vapor Pressure Sensor Vacuum Switching Valve
EVAP-VSV	EVAP Vacuum Switching Valve
FR	Fill Pipe Restrictor
HO2S	Heated Oxygen Sensor
MIL	Malfunction Indicator Light
ORVR-COV	Onboard Refueling Vapor Recovery Cut-Off Valve
ORVR-OCKV	Onboard Refueling Vapor Recovery Overfill Check Valve
PCV	Positive Crankcase Ventilation
SFI	Sequential Multiport Fuel Injection
SPK	Spark Controls
SPK-CC	SPK Computer Controlled
TWC	Three-Way Catalytic Converter
WU-TWC	Warm-Up Three-Way Catalytic Converter

C - SPECIFICATIONS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Service & Adjustment Specifications
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

Use this article to quickly find specifications related to servicing and on-vehicle adjustments. This is a quick-reference article to use when you are familiar with an adjustment procedure and only need a specification.

CAPACITIES

ES300 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.0 Qts. (4.7L)
Cooling System (Includes Heater)	9.7 Qts. (9.2L)
Automatic Transaxle (Toyota Type T-IV ATF)	
Drain & Refill	3.7 Qts. (3.5L)
Dry Fill	8.7 Qts. (8.3L)
Power Steering Fluid (Dexron-III)	.8 Qts. (.8L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

GS300 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.7 Qts. (5.4L)
Cooling System (Includes Heater)	8.1 Qts. (7.7L)
Automatic Transmission (Toyota Type T-IV ATF)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Fill	8.9 Qts. (8.4L)
Differential (SAE 80W-90/API GL-5)	1.4 Qts. (1.3L)
Power Steering Fluid (Dexron-III)	1.1 Qts. (1.0L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

GS400 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.8 Qts. (5.5L)
Cooling System (Includes Heater)	9.8 Qts. (9.3L)
Automatic Transmission (Toyota Type T-IV ATF)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Fill	8.9 Qts. (8.4L)
Differential (SAE 80W-90/API GL-5)	1.4 Qts. (1.3L)
Power Steering Fluid (Dexron-III)	1.1 Qts. (1.0L)

(1) - Approximate quantity is listed.

(2) - Use an API SJ energy conserving engine oil.

LS400 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.9 Qts. (5.6L)
Cooling System (Includes Heater)	11.6 Qts. (11.0L)
Automatic Transmission (Toyota Type T-IV ATF)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Fill	8.9 Qts. (8.4L)
Differential (SAE 80W-90/API GL-5)	1.4 Qts. (1.3L)
Power Steering Fluid (Dexron-III)	1.1 Qts. (1.0L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

LX470 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	7.2 Qts. (6.8L)
Cooling System (Includes Heater)	
With Front Heater Only	15.6 Qts. (14.8L)
With Front & Rear Heater	16.2 Qts. (15.3L)
Automatic Transmission (Dexron-III)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Refill	12.4 Qts. (11.7L)
Differential	
Front Axle (SAE 80W-90/API GL-5)	1.8 Qts. (1.7L)
Rear Axle	
With Limited Slip Differential (LSD) (Hypoid Gear Oil LSD SAE 80W-90/API GL-5)	3.5 Qts. (3.3L)
With Rear Differential Lock (SAE 80W-90/API GL-5)	3.4 Qts. (3.2L)
Without Rear Differential Lock (SAE 80W-90/API GL-5)	3.5 Qts. (3.3L)
Power Steering Fluid (Dexron-III)	.85 Qt. (.80L)
Transfer Case (SAE 75W-90/API GL-5)	1.4 Qts. (1.3L)
Active Height Control (AHC) Suspension Fluid (AHC Suspension Fluid Part No. 08886-01805)	(3)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.
(3) - Information is not available from manufacturer.

RX300 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.0 Qts. (4.7L)
Cooling System (Includes Heater)	9.5 Qts. (9.0L)
Automatic Transaxle (Toyota Type T-IV ATF)	
2WD	
Drain & Refill	3.7 Qts. (3.5L)
Dry Refill	8.7 Qts. (8.3L)
4WD	
Drain & Refill	4.3 Qts. (4.1L)

Dry Refill	9.7 Qts. (9.2L)
Differential	
4WD (SAE 80W-90/API GL-5)	1.0 Qts. (.9L)
Power Steering Fluid (Dexron-III)	1.2 Qt. (1.1L)
Transfer Case	
4WD (SAE 80W-90/API GL-5)	1.0 Qts. (.9L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

SC300 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.5 Qts. (5.2L)
Cooling System (Includes Heater)	8.9 Qts. (8.4L)
Automatic Transmission (Toyota Type T-IV ATF)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Fill	8.1 Qts. (7.7L)
Differential (SAE 80W-90/API GL-5)	1.4 Qts. (1.3L)
Power Steering Fluid (Dexron-III)	1.1 Qts. (1.0L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

SC400 FLUID CAPACITIES

Application	(1) Quantity
Crankcase (Includes Filter) (2)	5.0 Qts. (4.7L)
Cooling System (Includes Heater)	11.5 Qts. (10.9L)
Automatic Transmission (T-IV ATF)	
Drain & Refill	2.0 Qts. (1.9L)
Dry Fill	8.9 Qts. (8.4L)
Differential (SAE 80W-90/API GL-5)	1.4 Qts. (1.3L)
Power Steering Fluid (Dexron-III)	1.1 Qts. (1.0L)

(1) - Approximate quantity is listed.
(2) - Use an API SJ energy conserving engine oil.

QUICK-SERVICE

SERVICE INTERVALS & SPECIFICATIONS

REPLACEMENT INTERVALS (ES300, GS300, GS400, LS400, SC300 & SC400)

Component	Months	Miles
A/C Filter		
GS300, GS400 & LS400	12	15,000
Air Filter	24	30,000
Brake Fluid	24	30,000
Camshaft Timing Belt	72	90,000
Coolant	24	30,000
Engine Oil & Filter (1)		
Normal Service	6	7500
Severe Service	4	5000
Spark Plugs		
GS300 & SC300	48	60,000

ES300, GS400, LS400 & SC400	72	90,000
Automatic Transaxle/Transmission Fluid (1)(2)		
Normal Service	(3)	(3)
Severe Service	12	15,000
Differential Fluid (1)		
Normal Service	(3)	(3)
Severe Service	12	15,000

(1) - Different interval is required for normal service and severe service. Severe service is described as using cartop carrier, trailer towing, operating for short trips of less than 5 miles in freezing temperatures, extensive idling or low speed driving for long distances, or operating in rough, muddy or dusty conditions.
(2) - On models with transaxle, if transaxle has separate differential fluid reservoir on the transaxle, change differential fluid when changing transaxle fluid.
(3) - Service interval is not available from manufacturer.

REPLACEMENT INTERVALS (LX470 & RX300)

Component	Months	Miles
A/C Filter		
LX470	12	15,000
RX300	24	30,000
Air Filter	24	30,000
Brake Fluid	24	30,000
Camshaft Timing Belt	72	90,000
Coolant	24	30,000
Engine Oil & Filter (1)		
Normal Service	6	7500
Severe Service	4	5000
Spark Plugs	72	90,000
Automatic Transaxle/Transmission Fluid (1)		
Normal Service	(3)	(3)
Severe Service	12	15,000
Transfer Case (1)		
Normal Service	(3)	(3)
Severe Service	24	30,000
Differential Fluid (1)		
LX470		
With Limited Slip Differential		
Normal Service	24	30,000
Severe Service	12	15,000
Without Limited Slip Differential		
Normal Service	(3)	(3)
Severe Service	12	15,000
RX300		
With Limited Slip Differential		
Normal Service	48	60,000
Severe Service	12	15,000
Without Limited Slip Differential		
Normal Service	(2)	(2)
Severe Service	12	15,000
Repack Front Wheel Bearings		
LX470	24	30,000
Active Height Control (AHC) Suspension Fluid		
LX470	48	60,000

(1) - Different interval is required for normal service and severe service. Severe service is described as using cartop carrier, trailer towing, operating for short trips of less than 5 miles in freezing temperatures, extensive idling or low speed driving for long distances, or operating in rough, muddy or dusty conditions.
(2) - Service interval is not available from manufacturer.

VALVE CLEARANCE ADJUSTMENT INTERVALS

Application	Months	Miles
All Models (1)	48	60,000

(1) - Manufacturer recommends listening for valve noise from excessive valve clearance. Adjust valve clearance if valve noise exists.

BELT ADJUSTMENT Tension In Lbs. (kg) Using Burroughs Tension Gauge

Application	New Belt	(1) Used Belt
ES300		
A/C	139-191 (63-87)	99-121 (44-55)
Generator	170-180 (77-82)	95-135 (43-61)
Power Steering	150-185 (68-84)	95-135 (43-61)
GS300, GS400, LS400 & LX470	(2)	(2)
RX300		
A/C	139-191 (63-87)	66-110 (30-50)
Generator	170-180 (77-82)	70-110 (32-50)
Power Steering	150-185 (68-84)	95-135 (43-61)
SC300 & SC400	(2)	(2)

(1) - Used belt is a belt in operation at least 5 minutes.
(2) - Automatic belt tensioner is used. Adjustment is not required. Belt must be replaced if arrow mark on automatic belt tensioner is not within area "A". See Figs. 1-3.

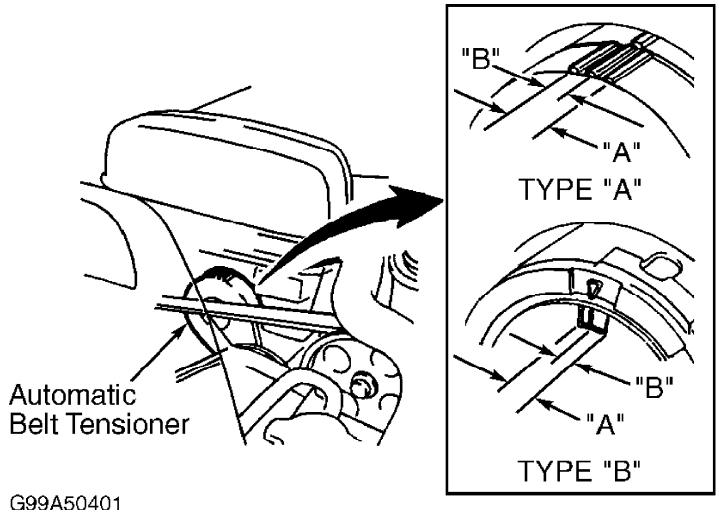


Fig. 1: Locating Arrow Mark On Automatic Belt Tensioner (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

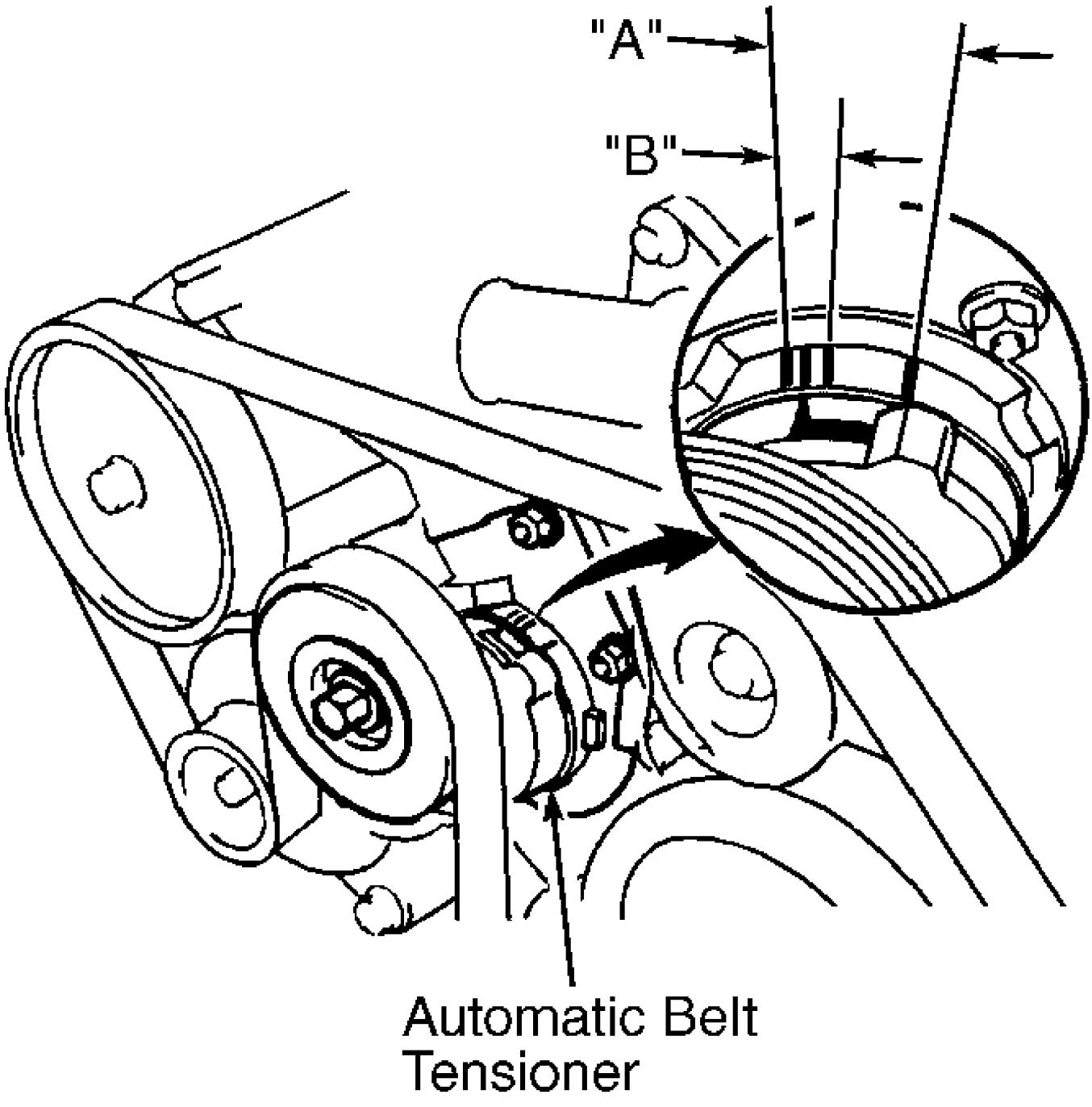


Fig. 2: Locating Arrow Mark On Automatic Belt Tensioner (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

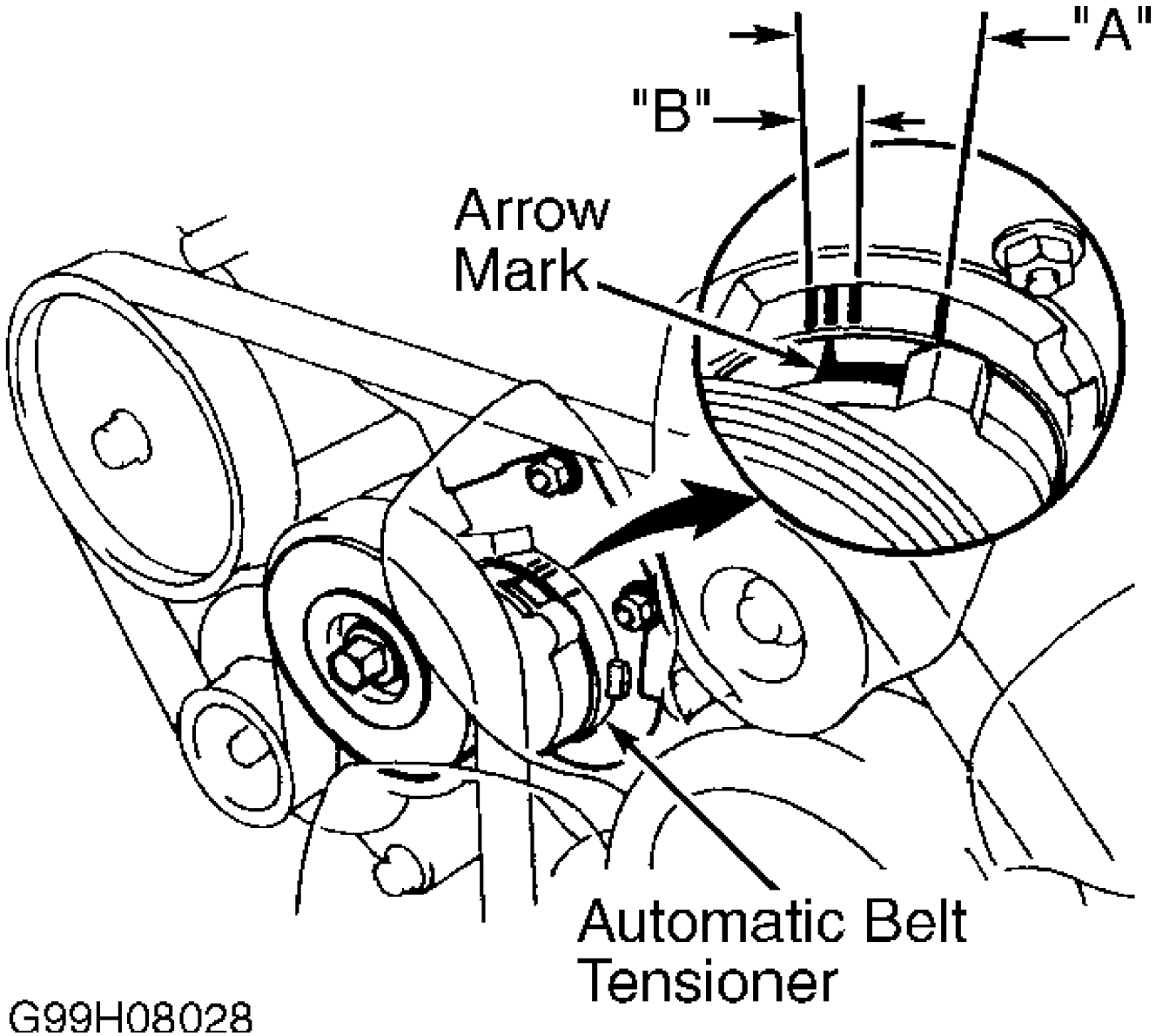


Fig. 3: Locating Arrow Mark On Automatic Belt Tensioner (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

MECHANICAL CHECKS

ENGINE COMPRESSION

Check engine compression with engine at cranking speed with battery fully charged, engine at normal operating temperature, all spark plugs removed and throttle wide open.

COMPRESSION SPECIFICATIONS

Application	Specification
Compression Ratio	
ES300, GS300, GS400, LS400, RX300, SC300 & SC400	10.5:1
LX470	9.6:1

Normal Compression Pressure	
ES300	218 psi (15.3 kg/cm²)
GS300 & SC300	192 psi (13.5 kg/cm²)
GS400, LS400 & SC400	178 psi (12.5 kg/cm²)
LX470	192 psi (13.5 kg/cm²)
RX300	218 psi (15.3 kg/cm²)
Minimum Compression Pressure	
ES300	145 psi (10.1 kg/cm²)
GS300 & SC300	156 psi (11.0 kg/cm²)
GS400, LS400, LX470 & SC400	142 psi (10.0 kg/cm²)
RX300	145 psi (10.1 kg/cm²)
Maximum Variation Between Cylinders	
All Models	14 psi (1.0 kg/cm²)

VALVE CLEARANCE

VALVE CLEARANCE SPECIFICATIONS (1)

Application	In. (mm)
Intake	.006-.010 (.15-.25)
Exhaust	.010-.014 (.25-.35)

(1) - Adjust valve clearance with engine cold.

IGNITION SYSTEM

IGNITION COIL

IGNITION COIL RESISTANCE (OHMS)

Application	Primary	Secondary
ES300	(1)	(1)
GS300 & SC300		
Cold (2)	.33-.52	8,500-14,700
Hot (3)	.42-.61	10,800-17,200
GS400, LS400, LX470, RX300 & SC400	(1)	(1)

(1) - Ignition coil resistance is not available from manufacturer.
(2) - Cold is with temperature of 14-122°F (-10-50°C).
(3) - Hot is with temperature of 122-212°F (51-100°C).

CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR RESISTANCE

Application	Ohms
All Models	
Cold (1)	835-1400
Hot (2)	1060-1645

(1) - Cold is with temperature of 14-122°F (-10-50°C).
(2) - Hot is with temperature of 122-212°F (50-100°C).

CRANKSHAFT POSITION SENSOR

CRANKSHAFT POSITION SENSOR RESISTANCE

Application	Ohms
All Models	
Cold (1)	1630-2740
Hot (2)	2065-3225

(1) - Cold is with temperature of 14-122°F (-10-50°C).
(2) - Hot is with temperature of 122-212°F (50-100°C).

HIGH TENSION WIRE RESISTANCE

HIGH TENSION WIRE RESISTANCE

Application	Maximum Ohms
ES300, GS400, LS400, LX470, RX300 & SC400	(1)
GS300 & SC300	25,000 Per Wire

(1) - Distributorless Ignition System (DIS) is used with ignition coil mounted on the spark plug. No high tension wires are used.

SPARK PLUGS

SPARK PLUG TYPE

Application	NGK No.	Denso No.
ES300, GS400, LS400, LX470, RX300 & SC400	IFR6A11	SK20R11
GS300 & SC300	BKR5EKPB11	PK16TR11

SPARK PLUG SPECIFICATIONS

Application	Gap In. (mm)	Torque Ft. Lbs. (N.m)
All Models	.043 (1.10)	13 (18)

FIRING ORDER

FIRING ORDER

Application	Firing Order
ES300 & RX300 (1)	(2) 1-2-3-4-5-6
GS300 & SC300 (3)	(4)
GS400, LS400, LX470 & SC400 (1)	(5) 1-8-4-3-6-5-7-2

(1) - System uses a Distributorless Ignition System (DIS) with ignition coil for each cylinder.
(2) - Cylinder No. 1 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3 and 5 are on right side of engine. Cylinders No. 2, 4 and 6 are on left side of engine.
(3) - System uses a Distributorless Ignition System (DIS) with 3 ignition coils. Cylinders No. 1 and 6 use same ignition coil.

Cylinders No. 2 and 5 use same ignition coil. Cylinders No. 3 and 4 use same ignition coil. Cylinder No. 1 is located at timing belt end of engine and cylinder No. 6 is located at flywheel end of engine.
(4) - Firing order is not available from manufacturer.
(5) - Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3, 5 and 7 are on left side of engine. Cylinders No. 2, 4, 6 and 8 on right side of engine.

IGNITION TIMING

IGNITION TIMING (Degrees BTDC @ Idle) (1)

Application	(2) Base Timing	(3) ECM Controlled Timing
ES300 & RX300	8-12	10-25
GS300 & SC300	8-12	6-16
GS400, LS400 & SC400	8-12	(4)
LX470	5-15	(4)

(1) - Check with engine at normal operating temperature, transmission/transaxle in Neutral, parking brake applied, and A/C and all accessories off.
(2) - With Jumper Wire (SST 09843-18020) installed between data link connector No. 1 terminals TE1 and E1 on ES300 and RX300 models, or terminals TC and E1 on all other models.
(3) - With jumper wire removed from data link connector No. 1.
(4) - Information is not available from manufacturer.

FUEL SYSTEM

FUEL PUMP

FUEL PUMP PERFORMANCE

Application	(1) Pressure psi (kg/cm²)
ES300, GS300, GS400, LS400, RX300, SC300 & SC400	44-50 (3.1-3.5)
LX470	38-44 (2.7-3.1)

(1) - Check fuel pressure with engine off and using scan tool connected to data link connector No. 3 with ignition on to activate fuel pump or by connecting battery voltage to terminals on electric fuel pump.

REGULATED FUEL PRESSURE

Application	At Idle W/Vacuum psi (kg/cm²)	At Idle W/O Vacuum psi (kg/cm²)
LX470	28-34 (2.0-2.4)	38-44 (2.7-3.1)
All Other Models	(1)	(1)

(1) - Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm²) with engine idling. Fuel pressure regulator is not vacuum controlled, as fuel pressure regulator is mounted on electric fuel pump in the fuel tank.

FUEL PUMP RESISTANCE

Application	Ohms @ 68°F (20°C)
All Models	.2-3.0

FUEL INJECTOR RESISTANCE

FUEL INJECTOR RESISTANCE

Application	Ohms @ 68°F (20°C)
All Models	13.4-14.2

IDLE SPEED

IDLE SPEED SPECIFICATIONS (1)

Application	Idle RPM
ES300, GS300, LX470, RX300 & SC300	650-750
GS400, LS400 & SC400	700-800

(1) - Check with engine at normal operating temperature, transaxle/transmission in Neutral, parking brake applied, air cleaner and all vacuum and air induction hoses installed, electronic fuel injection system wiring connectors properly installed, ignition timing properly set, and A/C and all accessories off.

THROTTLE OPENER

THROTTLE OPENER SPECIFICATIONS (1)

Application	RPM
ES300	1100-1700
RX300	(2)

(1) - Check with throttle opener vacuum hose disconnected and plugged, engine idling and at normal operating temperature.
(2) - Information is not available from manufacturer.

FUEL CUT

FUEL CUT SPECIFICATIONS (1)

Application	Fuel Return RPM
ES300	1200
GS300	1000
GS400 & LS400	1400
LX470	1000
RX300	1200
SC300	1000
SC400	1400

(1) - Check with engine at normal operating temperature and A/C off.

THROTTLE POSITION (TP) SENSOR

TP SENSOR RESISTANCE SPECIFICATIONS

Application	Terminals	Ohms @ 68°F (20°C)
ES300 & RX300 (1)		
Throttle Fully Closed	VTA & E2	200-6300
Throttle Fully Open	VTA & E2	2000-10,200
	VC & E2	2500-5900
GS300 & SC300	VC & E2	(2) 1200-3200
GS400, LS400, LX470 & SC400	VC & E2	(2) 1250-2350

(1) - Apply vacuum to throttle opener before checking TP sensor. Check resistance between specified terminals with throttle fully closed and throttle fully open.
(2) - Resistance at 68°F (20°C).

D - ADJUSTMENTS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
On-Vehicle Adjustments
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

ENGINE MECHANICAL

Before performing any on-vehicle adjustments to fuel or ignition systems, ensure engine mechanical condition is okay.

VALVE CLEARANCE

NOTE: Check and adjust valves with engine cold.

ES300

1) Remove passenger's side front fender apron for access to crankshaft pulley. Drain cooling system. Remove intake manifold cover. See Fig. 1.

2) Air intake chamber must be removed for removal of valve covers. Remove air cleaner cap assembly and air filter. Disconnect necessary electrical connections, control cables, PCV hose, coolant hoses, ground cables and vacuum hoses for removal of air intake chamber. See Fig. 1. Remove data link connector from end of air intake chamber.

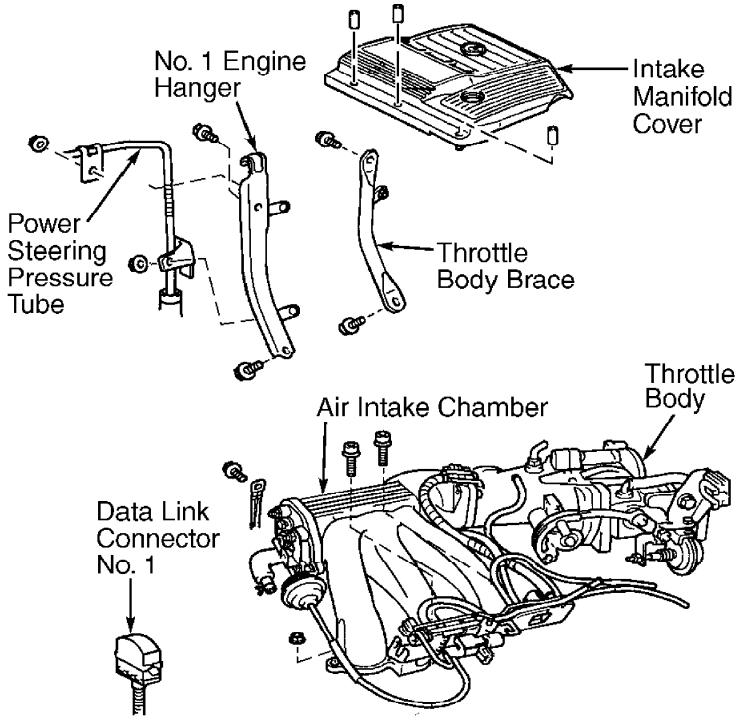


Fig. 1: Exploded View Of Typical Air Intake Chamber & Components (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Remove nuts and disconnect power steering pressure tube

from No. 1 engine hanger. See Fig. 1. Remove bolts, No. 1 engine hanger and throttle body brace. See Fig. 1.

4) Remove bolts/nuts, air intake chamber and gasket. Disconnect electrical connectors at ignition coils. Remove bolts and ignition coils. Disconnect upper radiator hose from coolant outlet at front of engine, between cylinder heads.

5) Disconnect electrical connectors for removal of wiring assemblies located above valve covers. Remove bolts/nuts and wiring assemblies. Remove bolts, valve covers and gaskets.

6) Rotate crankshaft pulley clockwise (viewed from front of engine) so crankshaft pulley timing mark (groove) aligns with "0" mark on timing belt cover and cylinder No. 1 is at TDC on compression stroke. Cylinder No. 1 is front cylinder on right side of engine when viewed from flywheel end of engine. See Fig. 2.

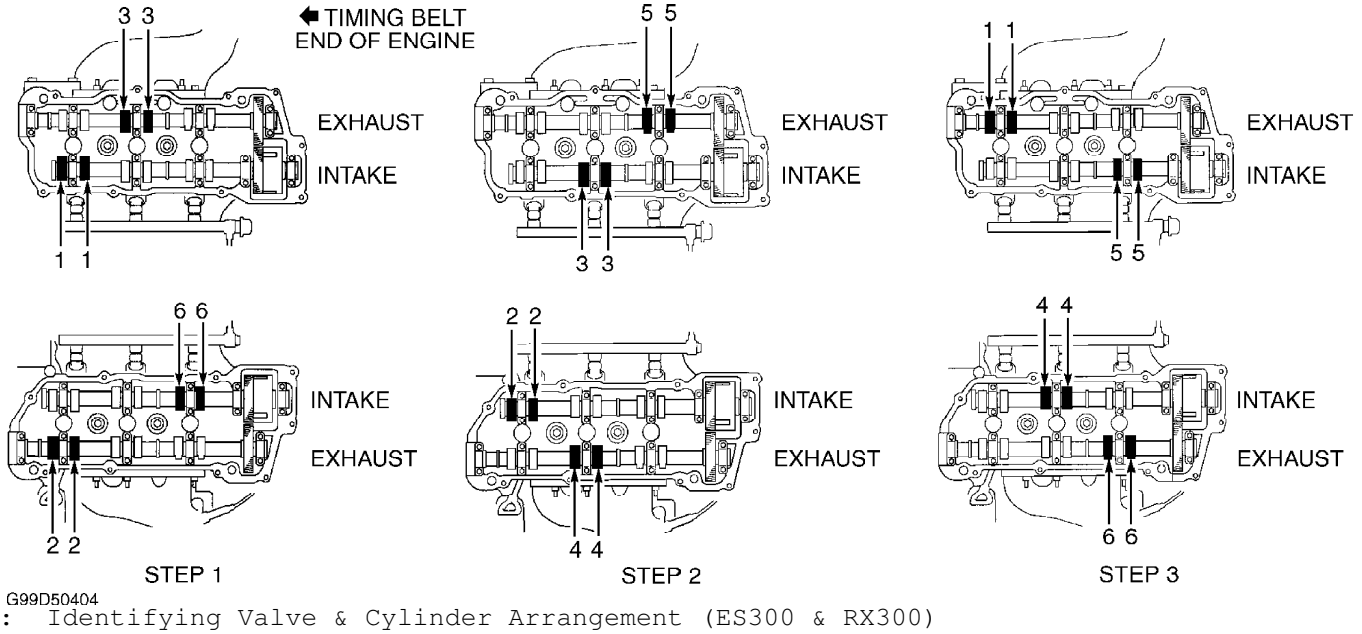


Fig. 2: Identifying Valve & Cylinder Arrangement (ES300 & RX300) Courtesy of Toyota Motor Sales, U.S.A., Inc.

7) Ensure cylinder No. 1 intake and exhaust valve lifters are loose. If valve lifters are not as described, rotate crankshaft clockwise one full revolution (360 degrees) and realign crankshaft pulley timing mark (groove) with "0" mark on timing belt cover.

8) Using feeler gauge, measure valve clearance between valve lifter and camshaft on intake valves on cylinders No. 1 and 6, and exhaust valves on cylinders No. 2 and 3. Perform STEP 1. See Fig. 2. Record valve clearance.

9) Rotate crankshaft pulley clockwise an additional 240 degrees (2/3 revolution). Measure valve clearance of intake valves on cylinders No. 2 and 3, and exhaust valves on cylinders No. 4 and 5. Perform STEP 2. See Fig. 2. Record valve clearance.

10) Rotate crankshaft pulley clockwise an additional 240 degrees (2/3 revolution). Measure valve clearance of intake valves on cylinders No. 4 and 5, and exhaust valves on cylinders No. 1 and 6. Perform STEP 3. See Fig. 2. Record valve clearance.

11) Ensure valve clearance is within specification. See VALVE CLEARANCE SPECIFICATIONS (ES300) table.

VALVE CLEARANCE SPECIFICATIONS (ES300)

Application	(1) In. (mm)

Intake	.006-.010 (.15-.25)
Exhaust	.010-.014 (.25-.35)

(1) - Adjust valve clearance with engine cold.

12) If valve clearance adjustment is required, rotate crankshaft pulley so camshaft lobe on valve to be adjusted is facing upward, away from valve lifter. Rotate valve lifter so notch area on valve lifter is at 90-degree angle to camshaft. This will place notch area perpendicular to camshaft.

13) Valve Clearance Adjuster (SST 09248-55040) is used to remove adjusting shim. Using SST "A" of valve clearance adjuster, press valve lifter downward. See Fig. 3. Install SST "B" between camshaft and valve lifter with side marked with "7" or "9" in the proper location, depending on cylinder application. See Fig. 3. Side marked with "7" should be used on front valves on cylinders No. 1 and 2 only. Side marked with "9" should be used on all except front valves on cylinders No. 1 and 2. Remove SST "A".

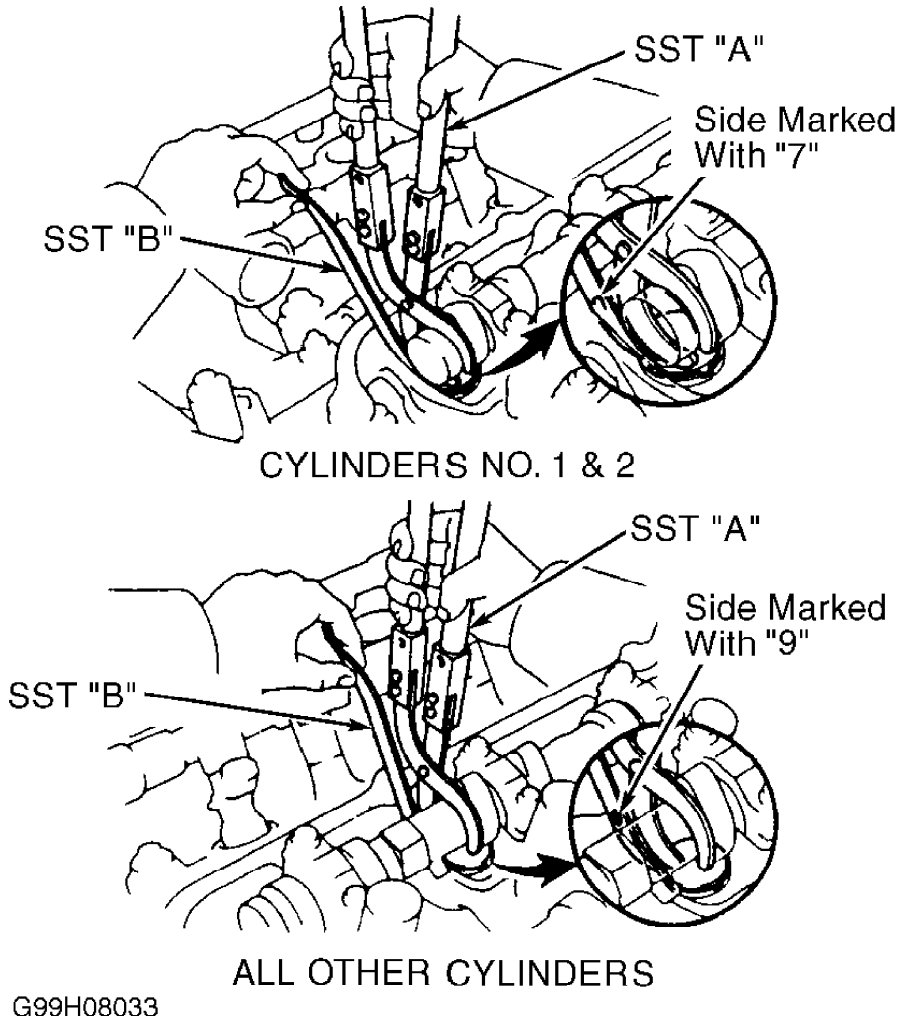


Fig. 3: Removing & Installing Valve Clearance Adjusting Shim (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

14) Using small screwdriver and magnet, remove adjusting

shim. Using micrometer, measure and record thickness of removed adjusting shim. Using measured clearance and adjusting shim thickness, determine correct thickness of adjusting shim to be used. See Figs. 5 and 6.

15) Install replacement adjusting shim with imprinted numbers on adjusting shim facing downward, toward valve lifter. Using SST "A", press downward on valve lifter and remove SST "B". Recheck valve clearance.

16) If spark plug tube gasket in valve cover requires replacement, bend gasket retaining tab upward. Pry spark plug tube gasket from valve cover. Use care not to scratch valve cover sealing surface.

17) Using hammer and proper sized bushing driver, tap spark plug tube gasket into valve cover until spark plug tube gasket is even with valve cover surface. Bend retaining tab downward. Coat spark plug tube gasket sealing area with grease.

18) Before installing valve covers and gaskets, apply sealant at specified areas on cylinder head. See Fig. 4. Install gasket and valve cover. Install and tighten valve cover bolts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure using NEW gaskets. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

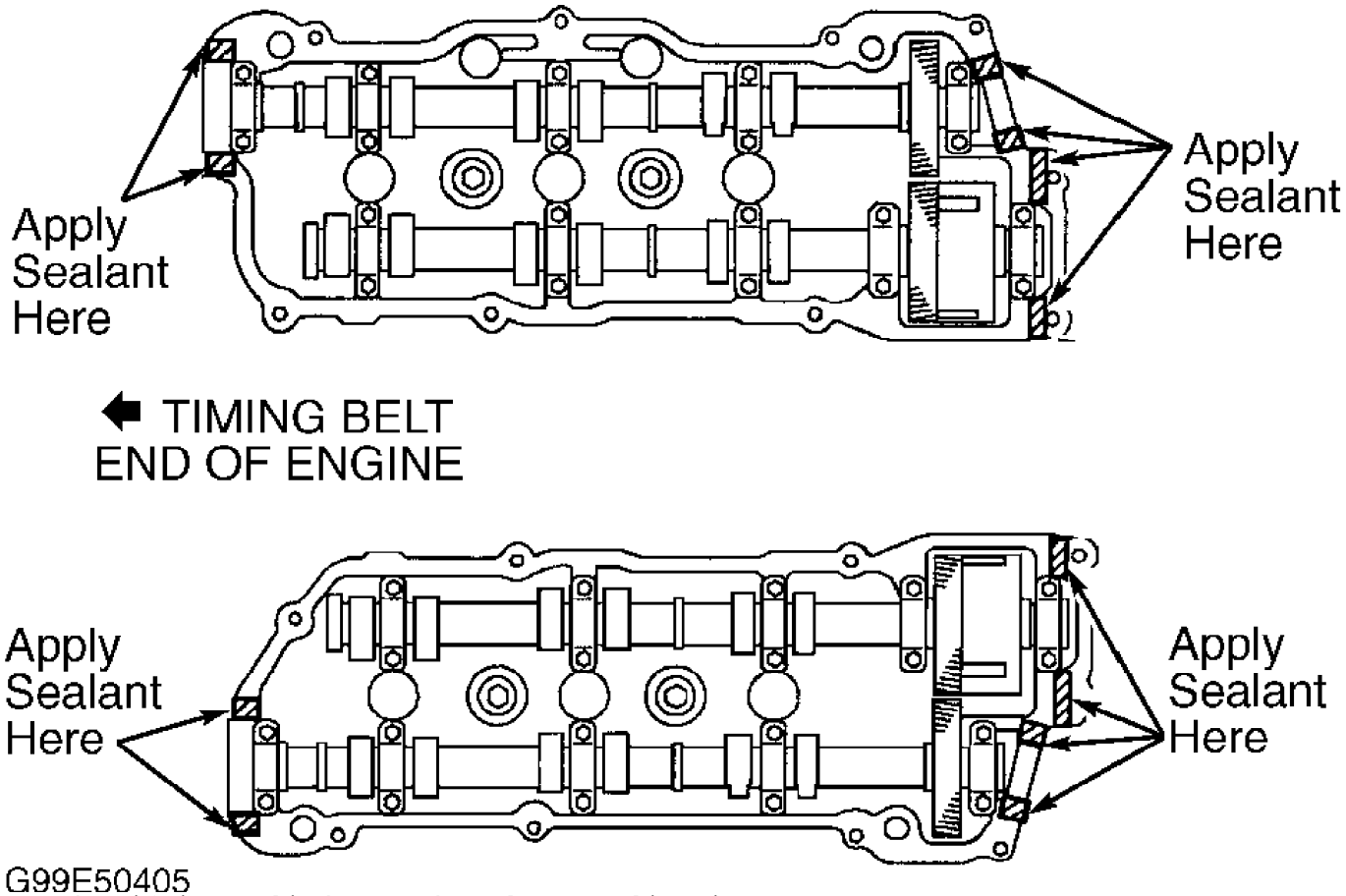


Fig. 4: Identifying Cylinder Head Sealant Application Areas (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

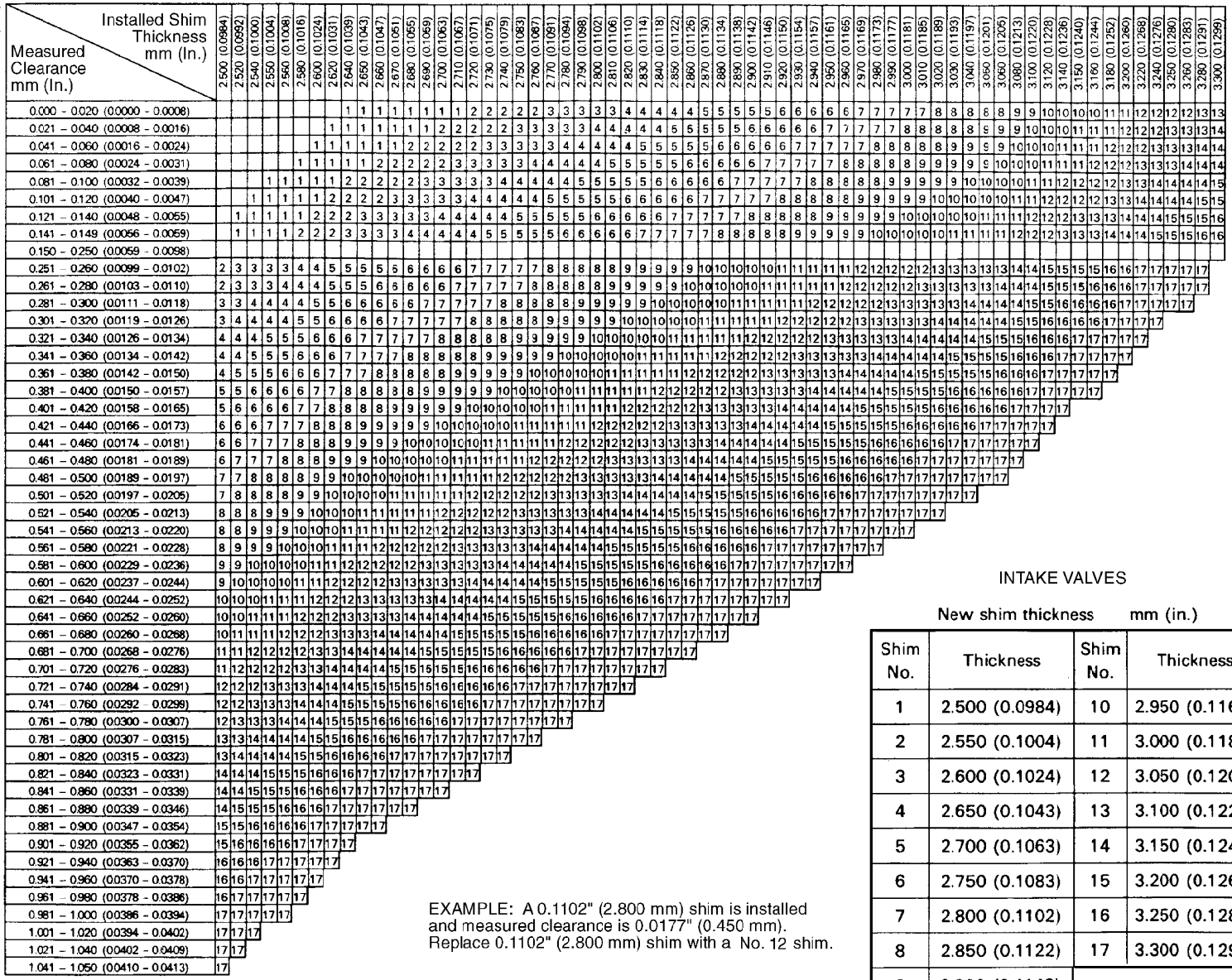


Fig. 5: Intake Valve Adjusting Shim Selection Chart (ES300, GS300, RX300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

EXAMPLE: A 0.1102" (2.800 mm) shim is installed and measured clearance is 0.0177" (0.450 mm). Replace 0.1102" (2.800 mm) shim with a No. 12 shim.

INTAKE VALVES

New shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness
1	2.500 (0.0984)	10	2.950 (0.1161)
2	2.550 (0.1004)	11	3.000 (0.1181)
3	2.600 (0.1024)	12	3.050 (0.1201)
4	2.650 (0.1043)	13	3.100 (0.1220)
5	2.700 (0.1063)	14	3.150 (0.1240)
6	2.750 (0.1083)	15	3.200 (0.1260)
7	2.800 (0.1102)	16	3.250 (0.1280)
8	2.850 (0.1122)	17	3.300 (0.1299)
9	2.900 (0.1142)		

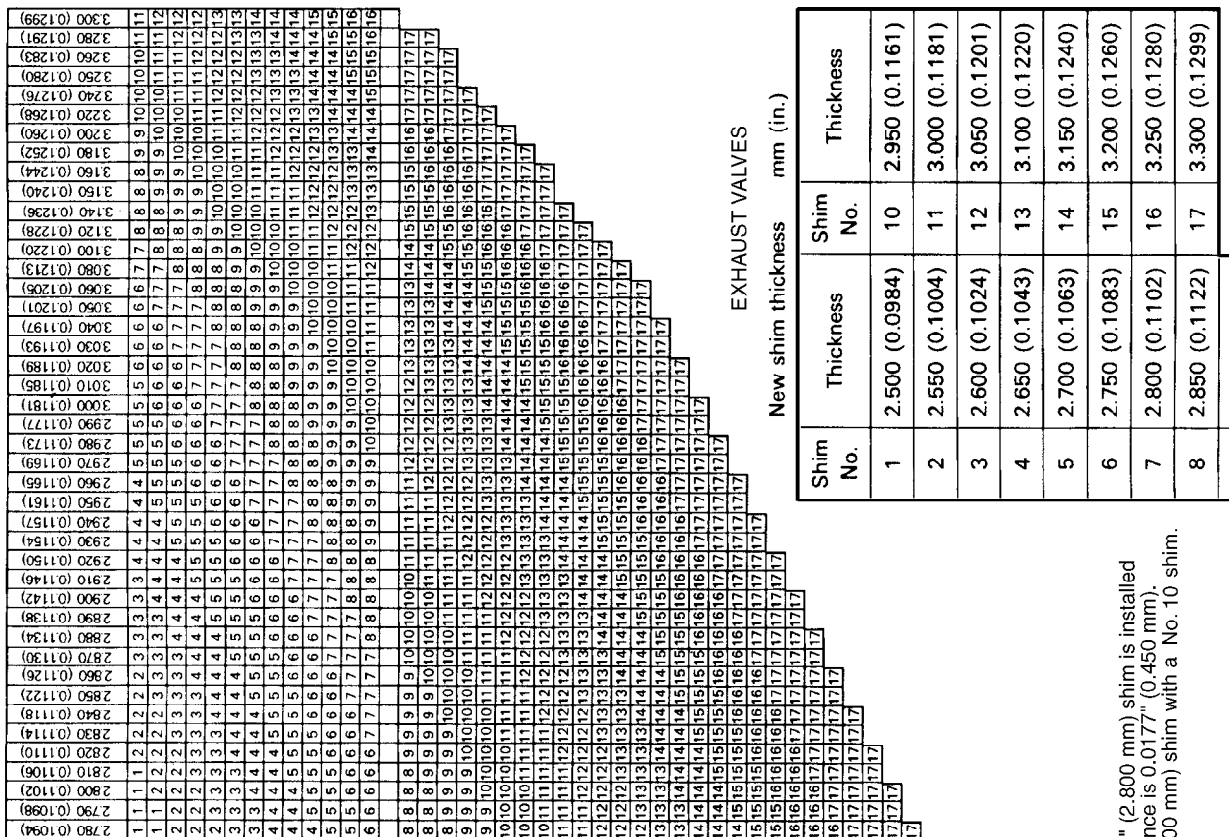


Fig. 6: Exhaust Valve Adjusting Shim Selection Chart (ES300, GS300, RX300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300 & SC300

1) Drain cooling system. Remove air intake pipe for access to intake air connector with throttle body. See Fig. 7. Disconnect necessary electrical connectors, control cables, hoses and engine wire clamps for removal of intake air connector with throttle body.

2) Note location of throttle body bracket. See Fig. 7. Remove throttle body bracket-to-cylinder head nuts. Remove intake air connector-to-air intake chamber bolts/nuts. Remove air intake connector with throttle body and gasket from air intake chamber.

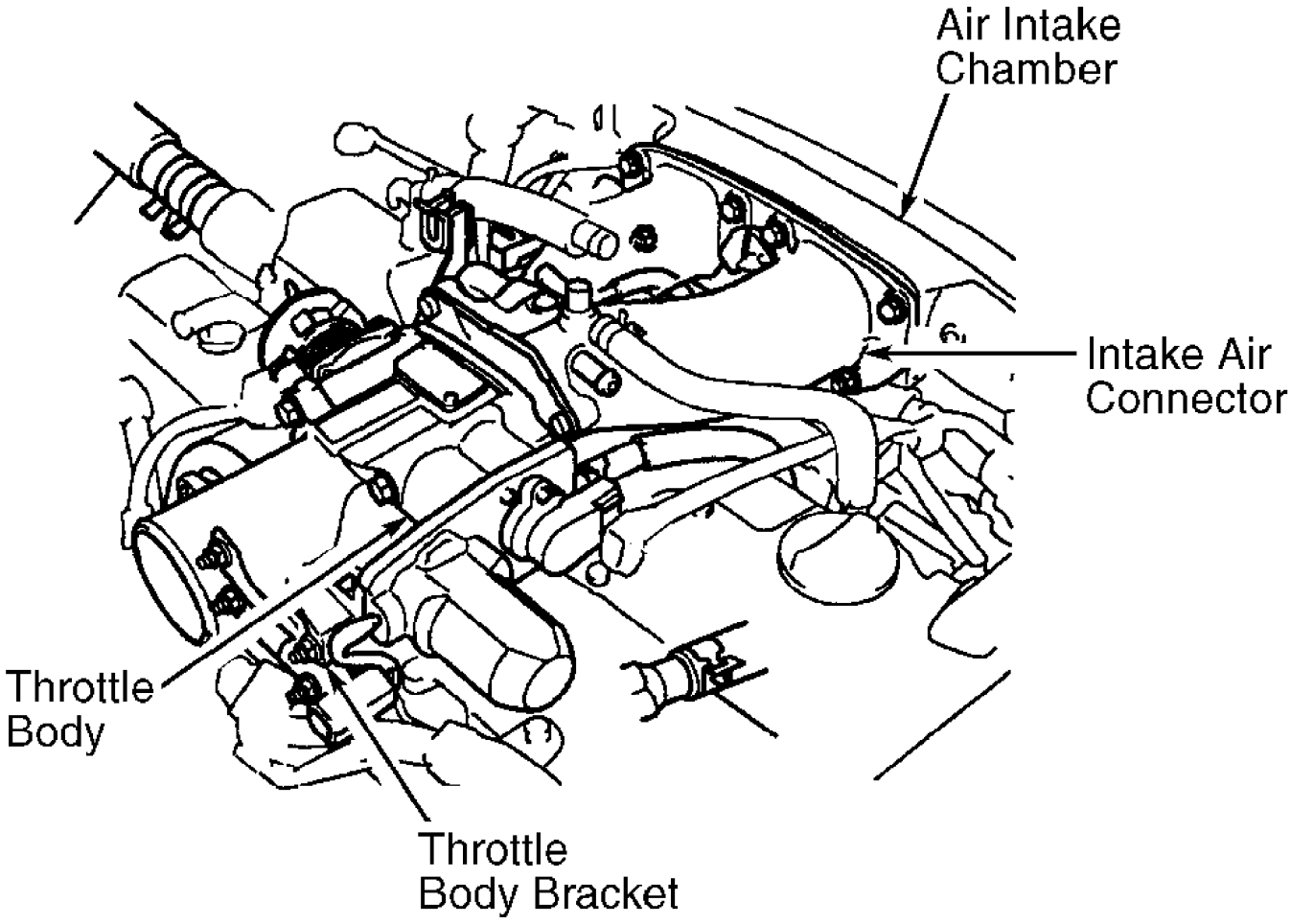


Fig. 7: Locating Intake Air Connector & Throttle Body Bracket (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Remove oil filler cap. Remove bolts and upper timing belt cover with gasket. Upper timing belt cover is located above timing belt. Disconnect electrical connectors from ignition coils, located above the spark plugs, in between the valve covers. Remove bolts and ignition coils with spark plug wires. Remove spark plugs.

4) Disconnect engine wiring harness for access to valve covers. Remove bolts/nuts, valve covers and gaskets.

5) Rotate crankshaft pulley clockwise so crankshaft pulley timing mark (groove) aligns with "0" mark on timing belt cover and cylinder No. 1 (front cylinder) is at TDC on compression stroke. Ensure timing marks on camshaft sprockets are aligned with timing marks on timing belt cover. See Fig. 8. If timing marks are not

aligned, rotate crankshaft pulley clockwise one full revolution (360 degrees) and realign crankshaft pulley timing mark (groove) with "0" mark on timing belt cover.

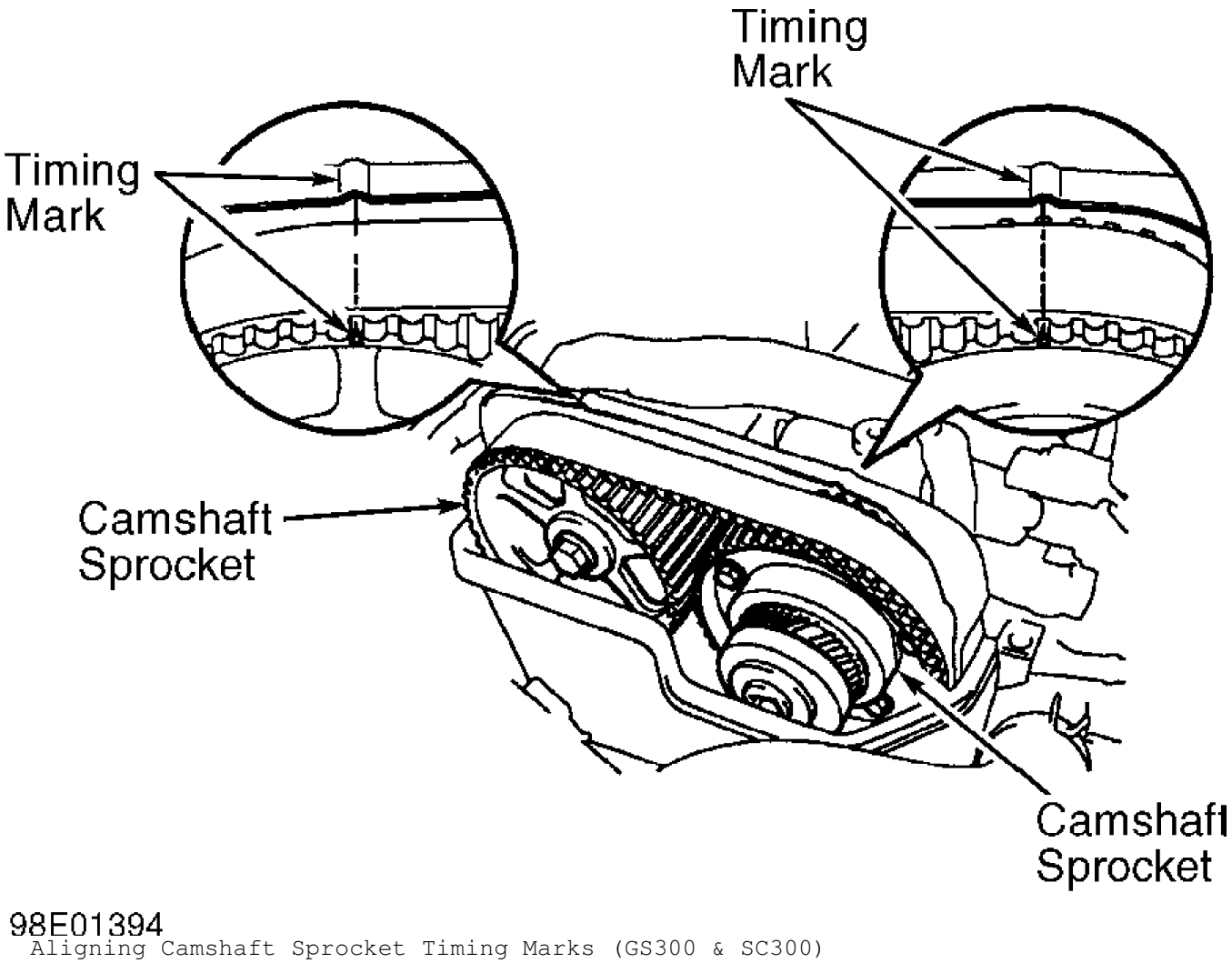


Fig. 8: Aligning Camshaft Sprocket Timing Marks (GS300 & SC300) Courtesy of Toyota Motor Sales, U.S.A., Inc.

6) Using feeler gauge, measure and record valve clearance of intake valves on cylinders No. 1, 2 and 4, and exhaust valves on cylinders No. 1, 3 and 5. Perform STEP 1. See Fig. 9.

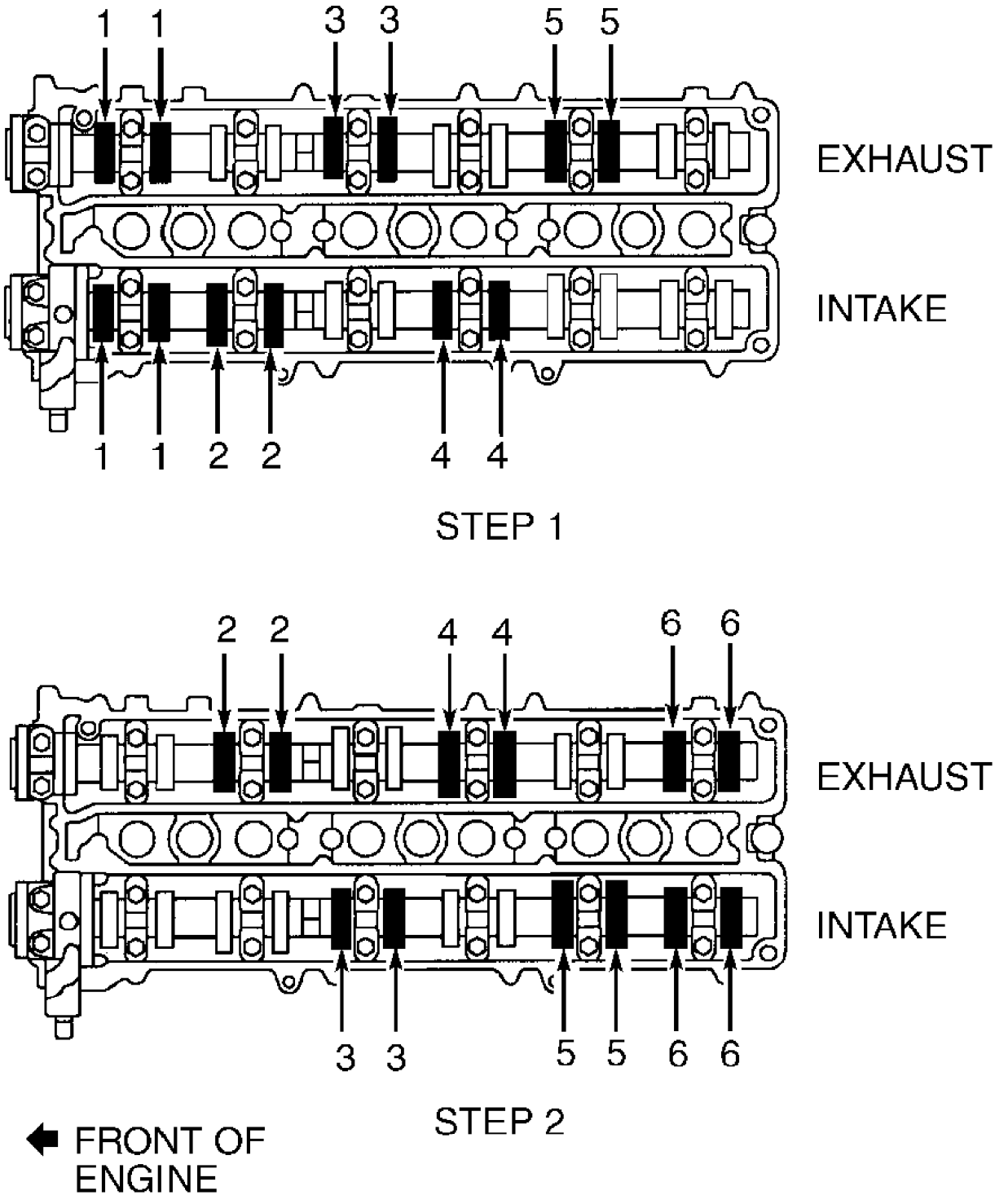


Fig. 9: Identifying Cylinder Numbers & Valve Arrangement (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

7) Rotate crankshaft pulley clockwise one full revolution

(360 degrees) and realign crankshaft pulley timing mark (groove) with "0" mark on timing belt cover. Using feeler gauge, measure and record valve clearance of intake valves on cylinders No. 3, 5 and 6, and exhaust valves on cylinders No. 2, 4 and 6. Perform STEP 2. See Fig. 9 .

8) Ensure valve clearance is within specification. See VALVE CLEARANCE SPECIFICATIONS (GS300 & SC300) table.

VALVE CLEARANCE SPECIFICATIONS (GS300 & SC300)

Application	(1) In. (mm)
Intake	.006-.010 (.15-.25)
Exhaust	.010-.014 (.25-.35)

(1) - Adjust valve clearance with engine cold.

9) If valve clearance adjustment is required, rotate crankshaft pulley so camshaft lobe is facing upward on valve to be adjusted. Rotate valve lifter so notch area on valve lifter is at 90-degree angle to camshaft. This will place notch area perpendicular to camshaft.

10) Valve Clearance Adjuster (SST 09248-55040) is used for adjusting valve clearance. Press valve lifter downward using SST "A" of valve clearance adjuster. See Fig. 10. Install SST "B" between camshaft and valve lifter with side marked with No. 7 or No. 9 at designated position. See Fig. 10. Remove SST "A".

NOTE: When adjusting valve clearance on intake valve on cylinder No. 1, it may be necessary to remove No. 2 camshaft bearing cap so SST "B" may be installed between camshaft and valve lifter.

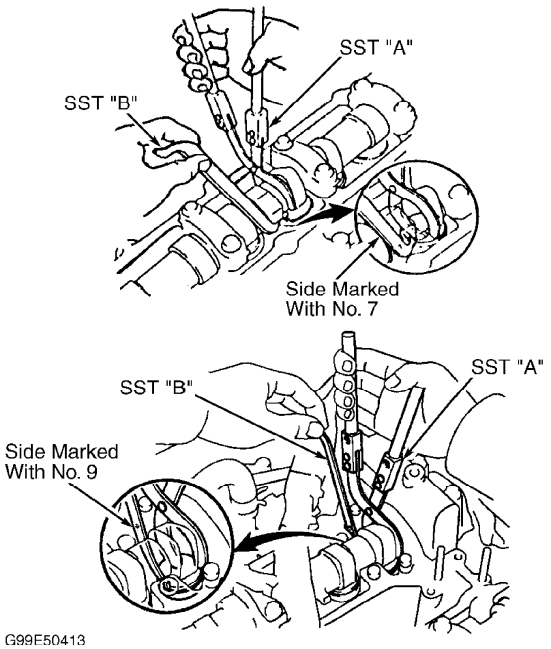


Fig. 10: Removing & Installing Valve Clearance Adjusting Shim (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

11) Using small screwdriver and magnet, remove adjusting

shim. Using micrometer, measure thickness of removed adjusting shim. Using measured clearance and adjusting shim thickness, determine correct thickness of adjusting shim to be used. See Figs. 5 and 6.

12) Install proper adjusting shim with imprinted numbers on adjusting shim facing downward, toward valve lifter. Using SST "A", press downward on valve lifter and remove SST "B". Recheck valve clearance.

13) Install No. 2 camshaft bearing cap if removed. Tighten camshaft bearing cap bolts to specification. See TORQUE SPECIFICATIONS.

14) To install remaining components, reverse removal procedure using NEW gasket for air intake connector. Before installing valve covers and gaskets, apply sealant at specified areas on cylinder head. See.Fig. 11. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

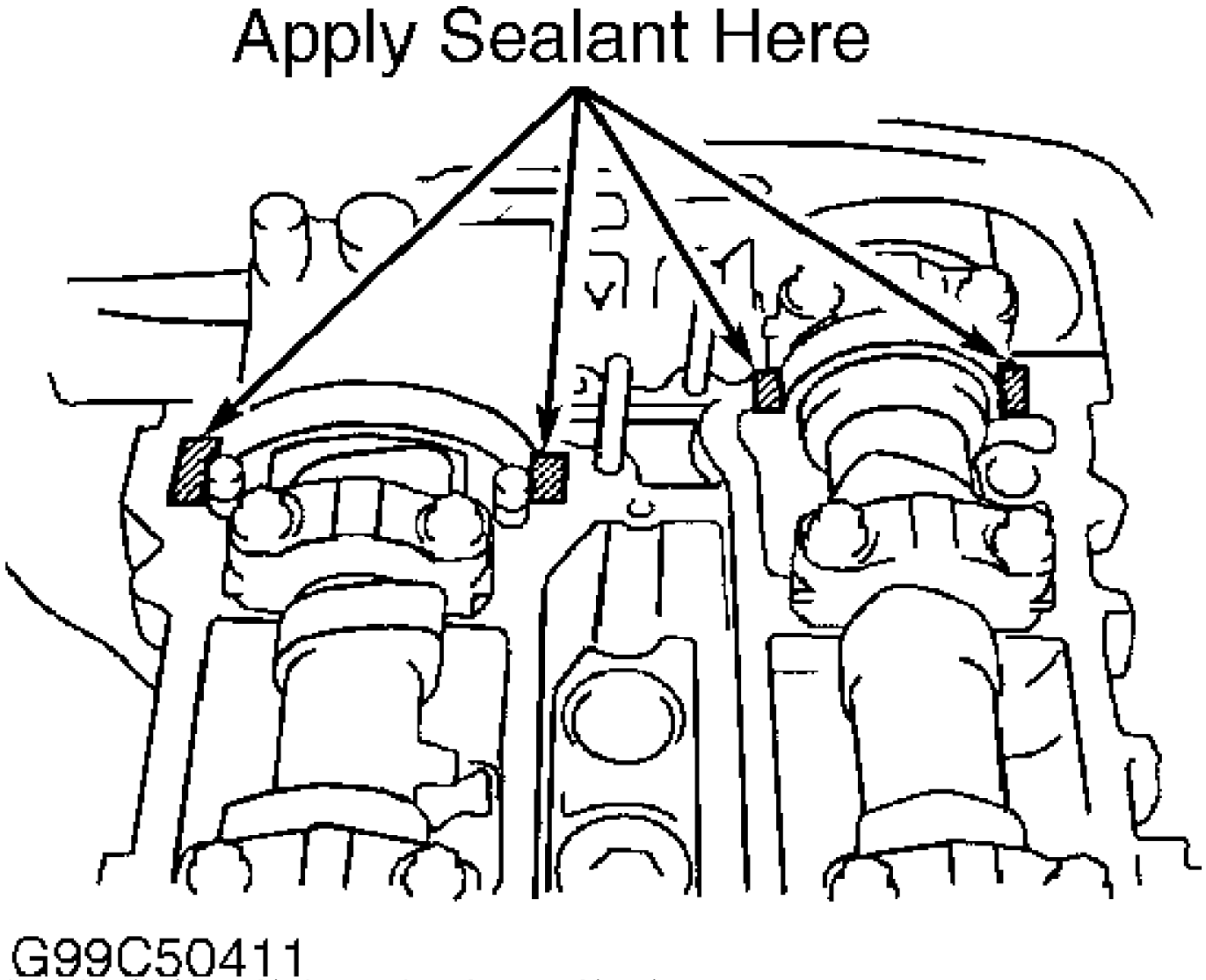


Fig. 11: Identifying Cylinder Head Sealant Application Areas (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS400, LS400, LX470 & SC400

1) Remove intake manifold cover located on top of engine,

above intake manifold. Drain cooling system if any coolant hoses must be disconnected for access to valve covers. Remove air cleaner assembly (if necessary) and all necessary air intake hoses for access to valve covers.

2) On LS400, LX470 and SC400, remove bolts/nuts and upper timing belt cover from front of each cylinder head at each camshaft. On all models, disconnect electrical connector at each ignition coil. Remove bolts and ignition coils from valve covers.

3) Remove engine and transmission oil dipsticks (if necessary) for access to valve covers. Disconnect necessary hoses, hose brackets and engine wiring brackets for access to valve covers. Remove bolts, seal washers, valve covers and gaskets.

4) Rotate crankshaft pulley clockwise (viewed from front of engine) so crankshaft pulley timing mark (groove) aligns with "0" mark on lower timing belt cover and cylinder No. 1 is at TDC on compression stroke. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. See Fig. 12.

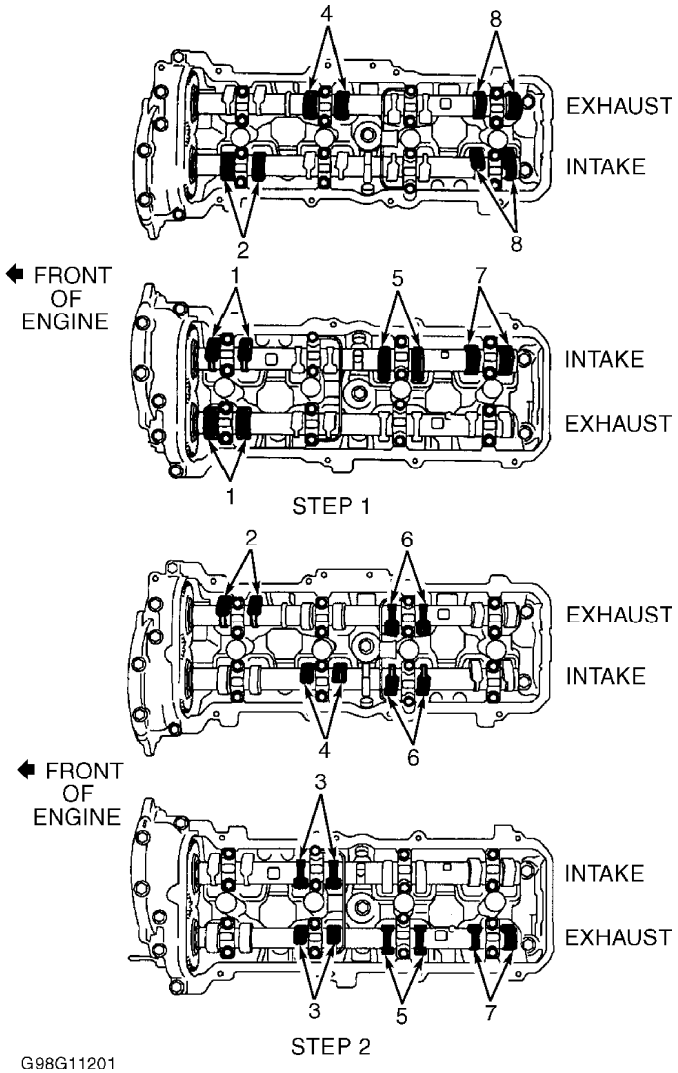


Fig. 12: Identifying Cylinder Numbers & Valve Arrangement (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

5) On GS400, ensure timing marks on back of camshaft

sprockets are aligned. See Fig. 13. On LS400, LX470 and SC400, ensure timing marks on camshaft sprockets are aligned with timing marks on timing belt rear plate. See Figs. 14 and 15. On all models, if timing marks are not aligned, rotate crankshaft clockwise one full revolution (360 degrees) and realign crankshaft pulley timing mark (groove) with "0" mark on timing belt cover.

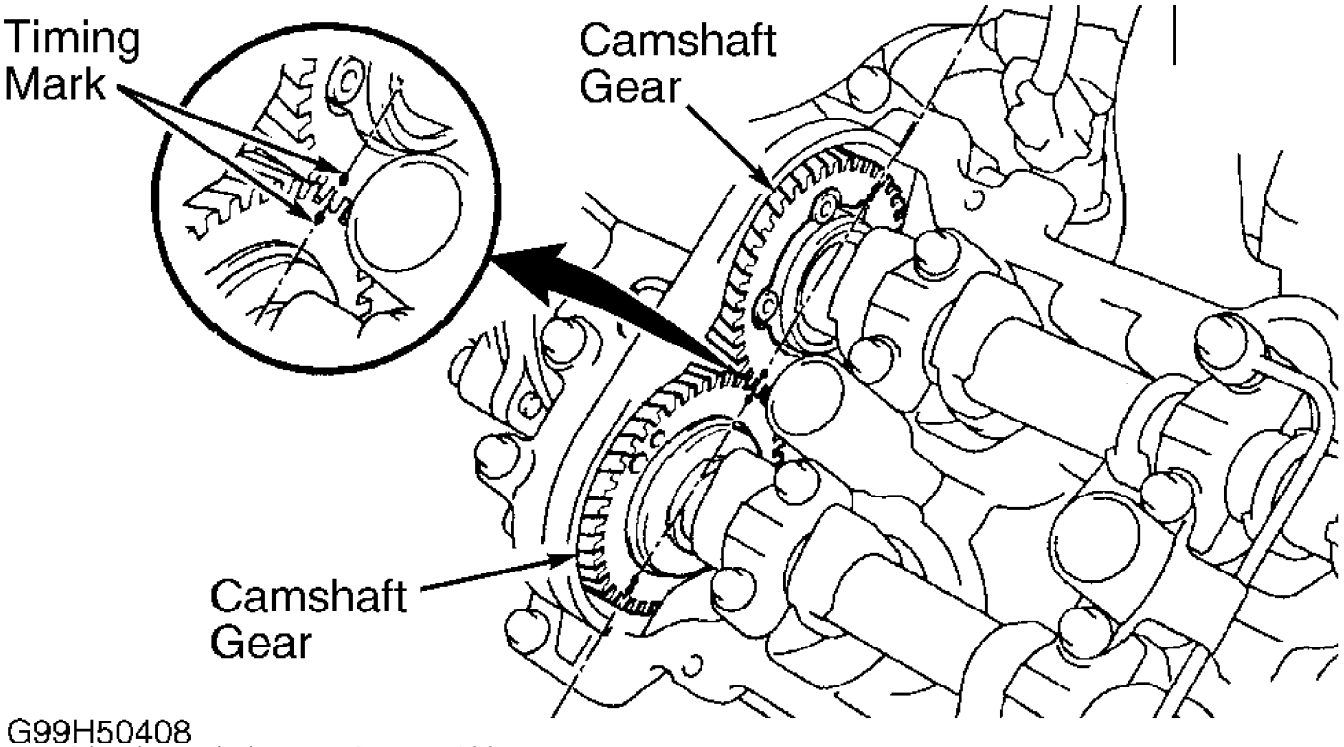


Fig. 13: Aligning Timing Marks (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

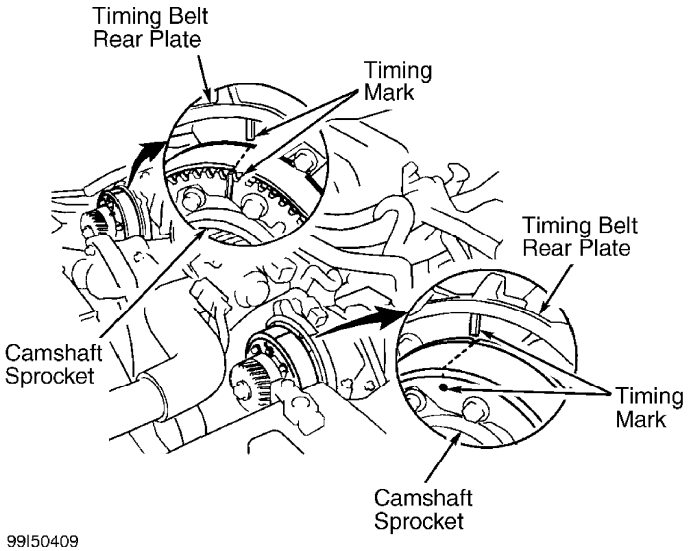


Fig. 14: Aligning Timing Marks (LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

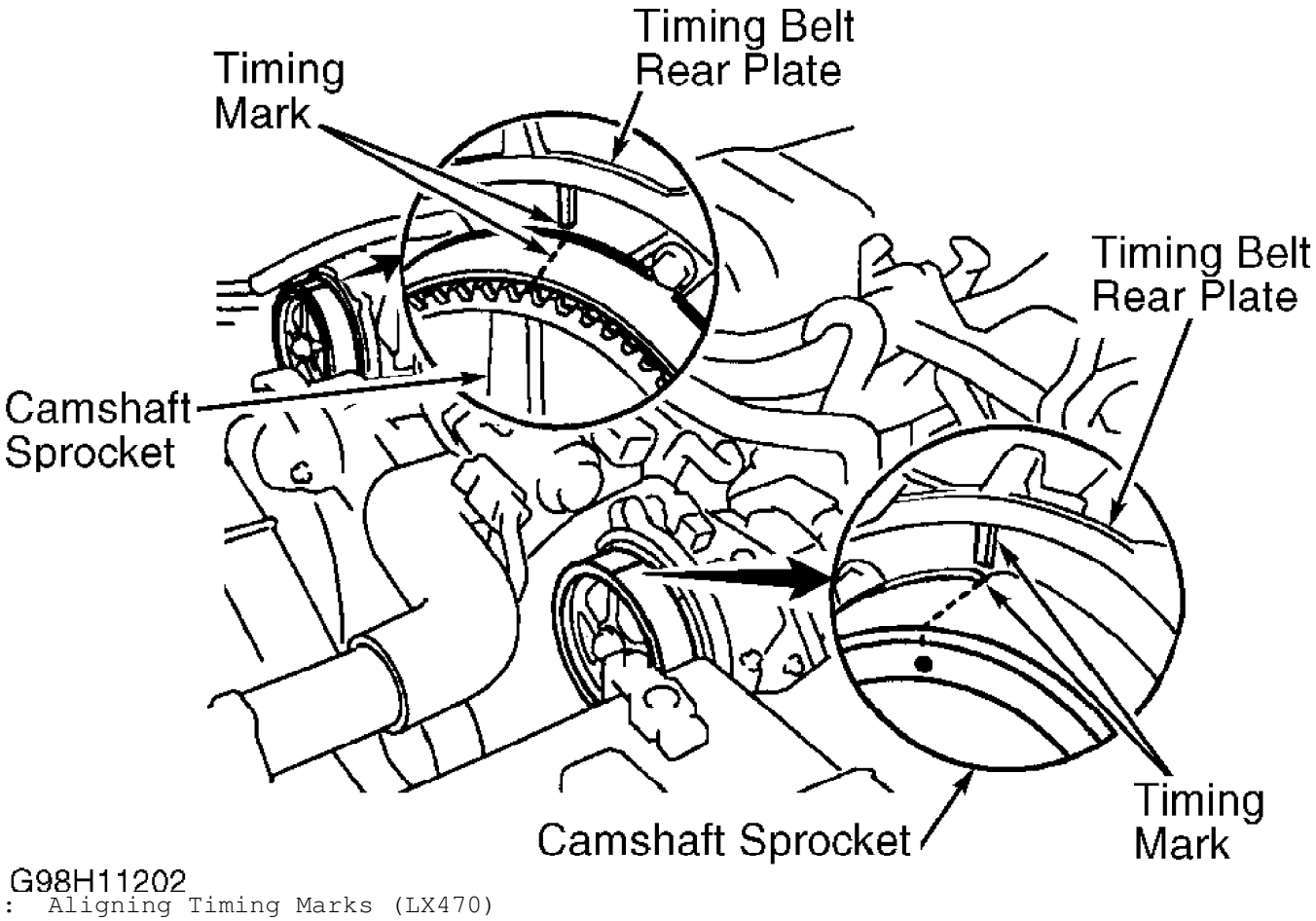


Fig. 15: Aligning Timing Marks (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

6) Using feeler gauge, measure valve clearance between valve lifter and camshaft on intake valves on cylinders No. 1, 2, 5, 7 and 8, and exhaust valves on cylinders No. 1, 4 and 8. Perform STEP 1. See Fig. 12. Record valve clearance.

7) Rotate crankshaft pulley clockwise one full revolution (360 degrees). Using feeler gauge, measure valve clearance between valve lifter and camshaft on intake valves on cylinders No. 3, 4 and 6, and exhaust valves on cylinders No. 2, 3, 5, 6 and 7. Perform STEP 2. See Fig. 12. Record valve clearance.

8) Ensure valve clearance is within specification. See VALVE CLEARANCE SPECIFICATIONS (GS400, LS400, LX470 & SC400) table.

VALVE CLEARANCE SPECIFICATIONS (GS400, LS400, LX470 & SC400)

Application	(1) In. (mm)
Intake	.006-.010 (.15-.25)
Exhaust	.010-.014 (.25-.35)

(1) - Adjust valve clearance with engine cold.

9) If valve clearance adjustment is required, adjusting shim between valve lifter and valve stem must be changed. To remove valve lifter, remove timing belt and camshafts. See appropriate article in ENGINES in appropriate MITCHELL\R manual.

10) Remove valve lifter and adjusting shim from valve. Using micrometer, measure thickness of adjusting shim removed. Using measured clearance and adjusting shim thickness, determine correct thickness of adjusting shim to be used. See Figs. 16 and 17. Install adjusting shim, valve lifter, camshafts and timing belt. Recheck valve clearance.

11) If spark plug tube gasket in valve cover requires replacement, bend gasket retaining tab upward. Pry spark plug tube gasket from valve cover. Use care not to scratch valve cover sealing surface.

12) Using hammer and proper sized bushing driver, tap spark plug tube gasket into valve cover until spark plug tube gasket is even with valve cover surface. Bend retaining tab downward. Coat spark plug tube gasket sealing area with grease.

13) Before installing valve covers and gaskets, apply sealant at specified areas on cylinder head. See Fig. 18. Install gasket, valve cover, seal washers and valve cover bolts. Install and tighten valve cover bolts to specification in several steps. See TORQUE SPECIFICATIONS.

14) To install remaining components, reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system if drained.

Fig. 16: Intake Valve Adjusting Shim Selection Chart (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

G98LI1204

Measured clearance mm (in.) \ Installed shim thickness mm (in.)	2.000 (0.0787)	2.020 (0.0795)	2.040 (0.0803)	2.060 (0.0811)	2.080 (0.0819)	2.100 (0.0827)	2.120 (0.0835)	2.140 (0.0843)	2.160 (0.0850)	2.180 (0.0858)	2.200 (0.0866)	2.210 (0.0870)	2.220 (0.0874)	2.230 (0.0878)	2.240 (0.0882)	2.250 (0.0886)	2.260 (0.0890)	2.270 (0.0894)	2.280 (0.0898)	2.290 (0.0902)	2.300 (0.0906)	2.310 (0.0909)	2.320 (0.0913)	2.330 (0.0917)	2.340 (0.0921)	2.350 (0.0925)	2.360 (0.0929)	2.370 (0.0933)	2.380 (0.0937)	2.390 (0.0941)	2.400 (0.0945)	2.410 (0.0949)	2.420 (0.0953)	2.430 (0.0957)	2.440 (0.0961)	2.450 (0.0965)	2.460 (0.0969)	2.470 (0.0972)	2.480 (0.0976)	2.490 (0.0980)	2.500 (0.0984)	2.510 (0.0988)	2.520 (0.0992)	2.530 (0.0996)	2.540 (0.1000)	2.550 (0.1004)	2.560 (0.1008)	2.570 (0.1012)	2.580 (0.1016)	2.590 (0.1020)	2.600 (0.1024)	2.620 (0.1031)	2.640 (0.1039)	2.660 (0.1047)	2.680 (0.1055)	2.700 (0.1063)	2.720 (0.1071)	2.740 (0.1079)	2.760 (0.1087)	2.780 (0.1094)	2.800 (0.1102)
0.000–0.030 (0.0000–0.0012)							00	00	00	00	02	02	04	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	44	46	48	50	52	54	56	58	60	62
0.031–0.050 (0.0012–0.0020)						00	00	00	00	02	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58	60	62	64
0.051–0.070 (0.0020–0.0028)					00	00	00	00	00	02	04	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	46	46	48	50	52	54	56	58	60	62	64	66
0.071–0.090 (0.0028–0.0035)				00	00	00	00	00	02	04	06	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62	64	66	68
0.091–0.110 (0.0036–0.0043)			00	00	00	00	00	02	04	06	08	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	54	56	58	60	62	64	66	68	70
0.111–0.130 (0.0044–0.0051)			00	00	00	00	02	04	06	08	10	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	56	58	60	62	64	66	68	70	72
0.131–0.149 (0.0052–0.0059)			00	00	00	02	04	06	08	10	12	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	58	60	62	64	66	68	70	72	74
0.150–0.250 (0.0059–0.0098)						

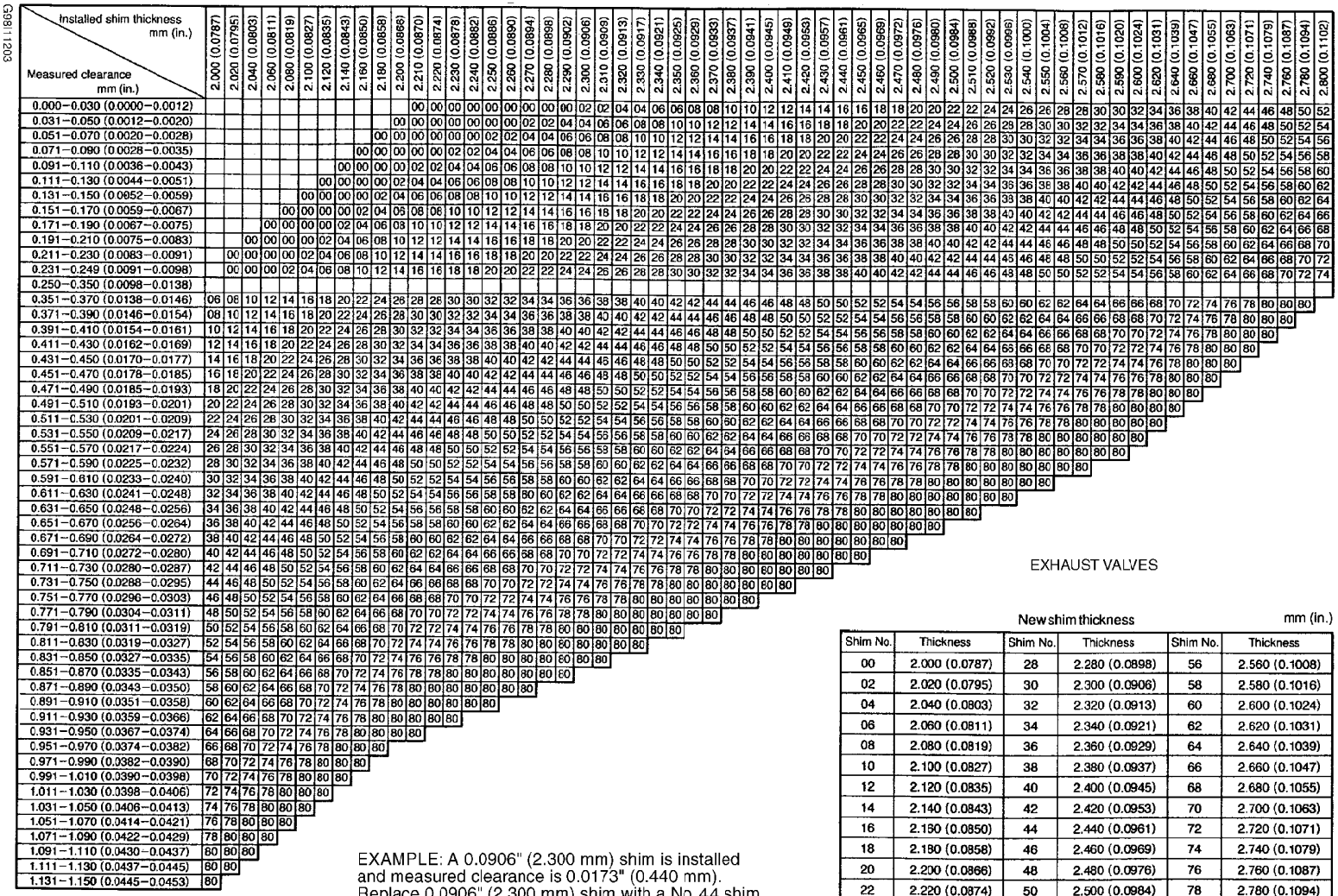


Fig. 17: Exhaust Valve Adjusting Shim Selection Chart (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

EXAMPLE: A 0.0906" (2.300 mm) shim is installed and measured clearance is 0.0173" (0.440 mm). Replace 0.0906" (2.300 mm) shim with a No. 44 shim.

EXHAUST VALVES

New shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 (0.0787)	28	2.280 (0.0898)	56	2.560 (0.1008)
02	2.020 (0.0795)	30	2.300 (0.0906)	58	2.580 (0.1016)
04	2.040 (0.0803)	32	2.320 (0.0913)	60	2.600 (0.1024)
06	2.060 (0.0811)	34	2.340 (0.0921)	62	2.620 (0.1031)
08	2.080 (0.0819)	36	2.360 (0.0929)	64	2.640 (0.1039)
10	2.100 (0.0827)	38	2.380 (0.0937)	66	2.660 (0.1047)
12	2.120 (0.0835)	40	2.400 (0.0945)	68	2.680 (0.1055)
14	2.140 (0.0843)	42	2.420 (0.0953)	70	2.700 (0.1063)
16	2.160 (0.0850)	44	2.440 (0.0961)	72	2.720 (0.1071)
18	2.180 (0.0858)	46	2.460 (0.0969)	74	2.740 (0.1079)
20	2.200 (0.0866)	48	2.480 (0.0976)	76	2.760 (0.1087)
22	2.220 (0.0874)	50	2.500 (0.0984)	78	2.780 (0.1094)
24	2.240 (0.0882)	52	2.520 (0.0992)	80	2.800 (0.1102)
26	2.260 (0.0890)	54	2.540 (0.1000)		

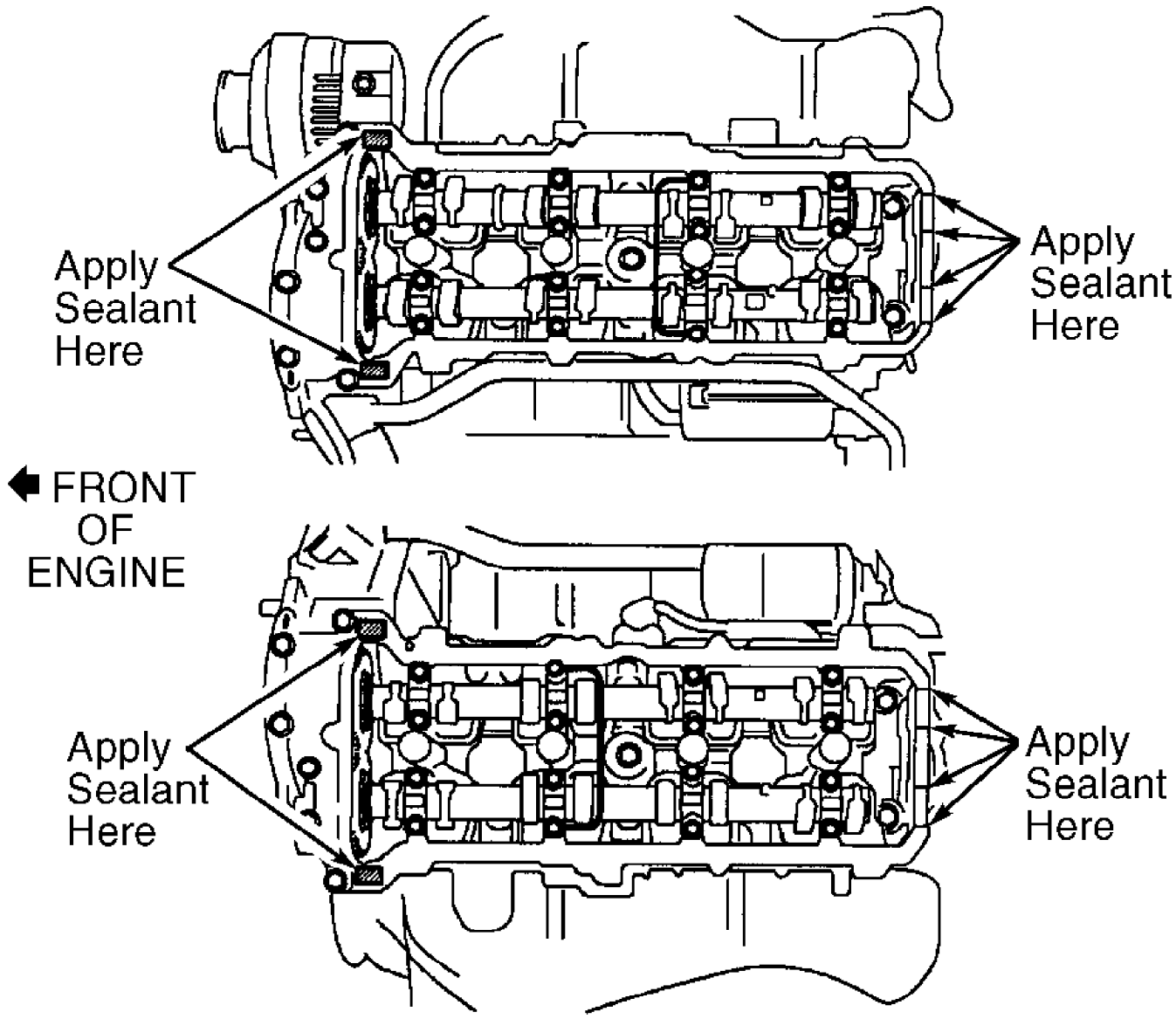


Fig. 18: Identifying Valve Cover Sealant Application Areas (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

RX300

1) Outer cowl top panel must be removed. See Fig. 19. Remove windshield wiper arm nuts and windshield wiper arms assemblies. Place protective tape along bottom of windshield to protect windshield. Remove cowl top seal.

2) Remove driver's side and passenger's side ventilation louvers. See Fig. 19. Disconnect electrical connector for wiper motor. Remove bolts and wiper motor with wiper link assembly. Remove bolts and outer cowl top panel.

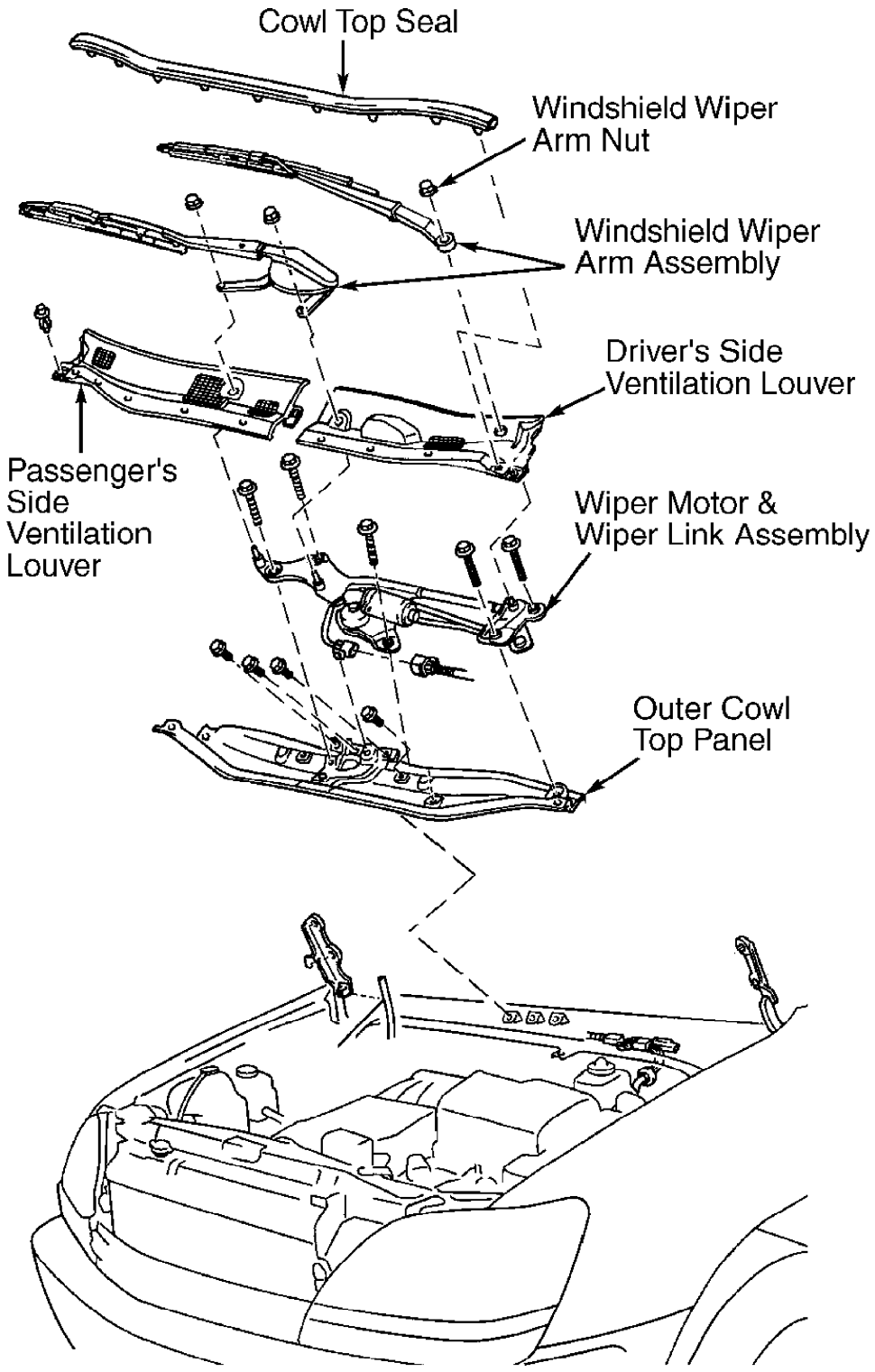


Fig. 19: Locating Outer Cowl Top Panel & Components (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Remove suspension upper brace. Suspension upper brace fits between strut towers and is bolted to top of each strut tower.

4) Remove passenger's side front fender apron for access to crankshaft pulley. Drain cooling system. Remove intake manifold cover. See Fig. 1.

5) Air intake chamber must be removed for removal of valve covers. Remove air cleaner cap assembly and air filter. Disconnect necessary electrical connections, control cables, PCV hose, coolant hoses, ground cables and vacuum hoses for removal of air intake chamber. See Fig. 1.

6) Remove nuts and disconnect power steering pressure tube from No. 1 engine hanger. See Fig. 1. Remove bolts, No. 1 engine hanger and throttle body brace. See Fig. 1.

7) Remove bolts/nuts, air intake chamber and gasket. Disconnect electrical connectors at ignition coils. Remove bolts and ignition coils. Disconnect upper radiator hose from coolant outlet at front of engine, between cylinder heads.

8) Disconnect electrical connectors for removal of wiring assemblies located above valve covers. Remove bolts/nuts and wiring assemblies. Remove bolts, valve covers and gaskets.

9) Rotate crankshaft pulley clockwise (viewed from front of engine) so crankshaft pulley timing mark (groove) aligns with "0" mark on timing belt cover and cylinder No. 1 is at TDC on compression stroke. Cylinder No. 1 is front cylinder on right side of engine when viewed from flywheel end of engine. See Fig. 2.

10) Ensure cylinder No. 1 intake and exhaust valve lifters are loose. If valve lifters are not as described, rotate crankshaft clockwise one full revolution (360 degrees) and realign crankshaft pulley timing mark (groove) with "0" mark on timing belt cover.

11) Using feeler gauge, measure valve clearance between valve lifter and camshaft on intake valves on cylinders No. 1 and 6, and exhaust valves on cylinders No. 2 and 3. Perform STEP 1. See Fig. 2. Record valve clearance.

12) Rotate crankshaft pulley clockwise an additional 240 degrees (2/3 revolution). Measure valve clearance of intake valves on cylinders No. 2 and 3, and exhaust valves on cylinders No. 4 and 5. Perform STEP 2. See Fig. 2. Record valve clearance.

13) Rotate crankshaft pulley clockwise an additional 240 degrees (2/3 revolution). Measure valve clearance of intake valves on cylinders No. 4 and 5, and exhaust valves on cylinders No. 1 and 6. Perform STEP 3. See Fig. 2. Record valve clearance.

14) Ensure valve clearance is within specification. See VALVE CLEARANCE SPECIFICATIONS (RX300) table.

VALVE CLEARANCE SPECIFICATIONS (RX300)

Application	(1) In. (mm)
Intake	.006-.010 (.15-.25)
Exhaust	.010-.014 (.25-.35)

(1) - Adjust valve clearance with engine cold.

15) If valve clearance adjustment is required, rotate crankshaft pulley so camshaft lobe on valve to be adjusted is facing upward, away from valve lifter. Rotate valve lifter so notch area on valve lifter is at 90-degree angle to camshaft. This will place notch area perpendicular to camshaft.

16) Valve Clearance Adjuster (SST 09248-55040) is used to remove adjusting shim. Using SST "A" of valve clearance adjuster, press valve lifter downward. See Fig. 3. Install SST "B" between camshaft and valve lifter with side marked with "7" or "9" in the proper location, depending on cylinder application. See Fig. 3. Side marked with "7" should be used on front valves on cylinders No. 1 and

2 only. Side marked with "9" should be used on all except front valves on cylinders No. 1 and 2. Remove SST "A".

17) Using small screwdriver and magnet, remove adjusting shim. Using micrometer, measure and record thickness of removed adjusting shim. Using measured clearance and adjusting shim thickness, determine correct thickness of adjusting shim to be used. See Figs. 5 and 6.

18) Install replacement adjusting shim with imprinted numbers on adjusting shim facing downward, toward valve lifter. Using SST "A", press downward on valve lifter and remove SST "B". Recheck valve clearance.

19) If spark plug tube gasket in valve cover requires replacement, bend gasket retaining tab upward. Pry spark plug tube gasket from valve cover. Use care not to scratch valve cover sealing surface.

20) Using hammer and proper sized bushing driver, tap spark plug tube gasket into valve cover until spark plug tube gasket is even with valve cover surface. Bend retaining tab downward. Coat spark plug tube gasket sealing area with grease.

21) Before installing valve covers and gaskets, apply sealant at specified areas on cylinder head. See Fig. 4. Install gasket and valve cover. Install and tighten valve cover bolts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure using NEW gaskets. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

IGNITION TIMING

ES300

1) Remove intake manifold cover. See Fig. 1. Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 20. Scan tool is used to read engine RPM.

2) Connect timing light lead to Black/Red at ignition coil electrical connector on top of front valve cover at cylinder No. 4. See Fig. 21. Cylinder No. 4 is second cylinder on left side when viewed from flywheel end of engine. See Fig. 2.

3) Apply parking brake. Place transaxle in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and allow engine to idle. Ensure idle speed is 650-750 RPM.

4) Install Jumper Wire (SST 09843-18020) between terminals TE1 and E1 on data link connector No. 1. See Fig. 22. Data link connector No. 1 is located on end of air intake chamber at passenger's side of engine compartment.

5) Timing marks are located on timing belt cover, near crankshaft pulley. Ensure base timing is 8-12 degrees BTDC at idle with transaxle in Neutral, and with A/C and all accessories off.

6) Remove jumper wire from data link connector No. 1. Ensure ECM controlled timing is 10-25 degrees BTDC. Shut engine off. Remove timing light and scan tool. Reinstall intake manifold cover.

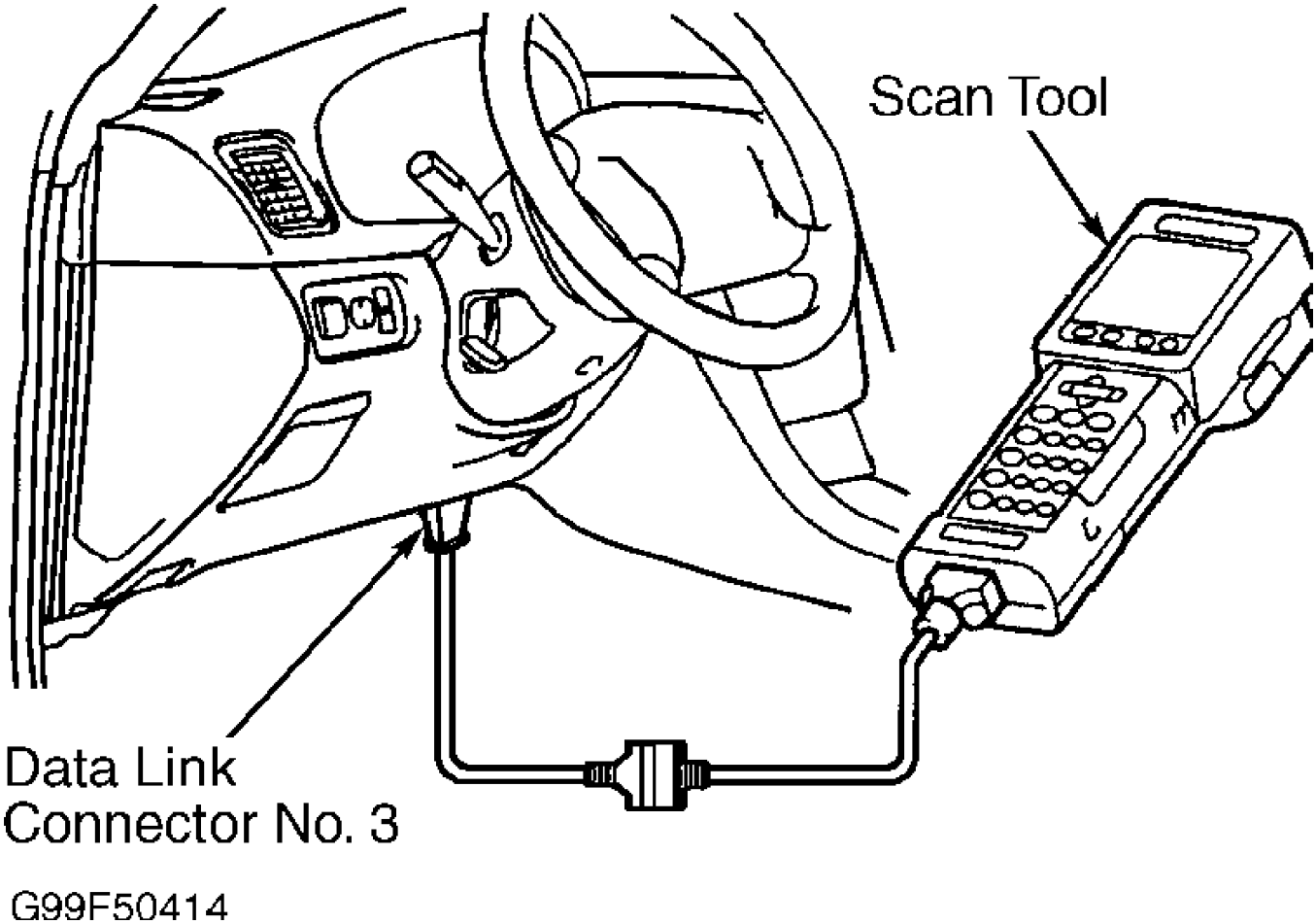


Fig. 20: Connecting Scan Tool To Data Link Connector No. 3 (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

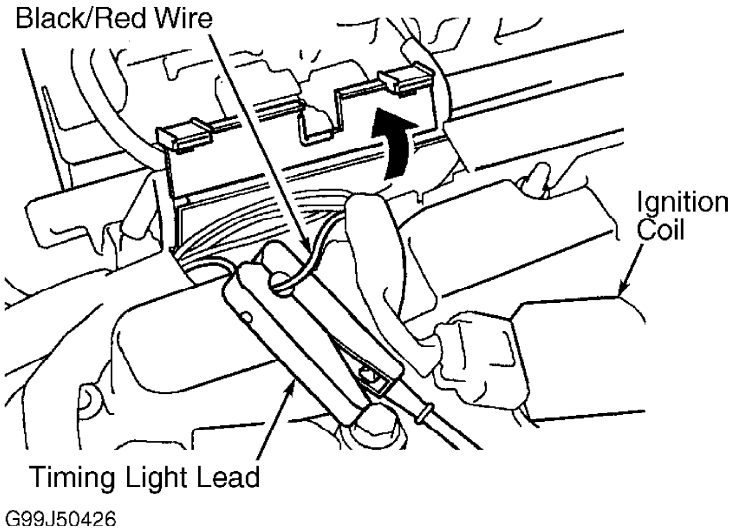


Fig. 21: Connecting Timing Light (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

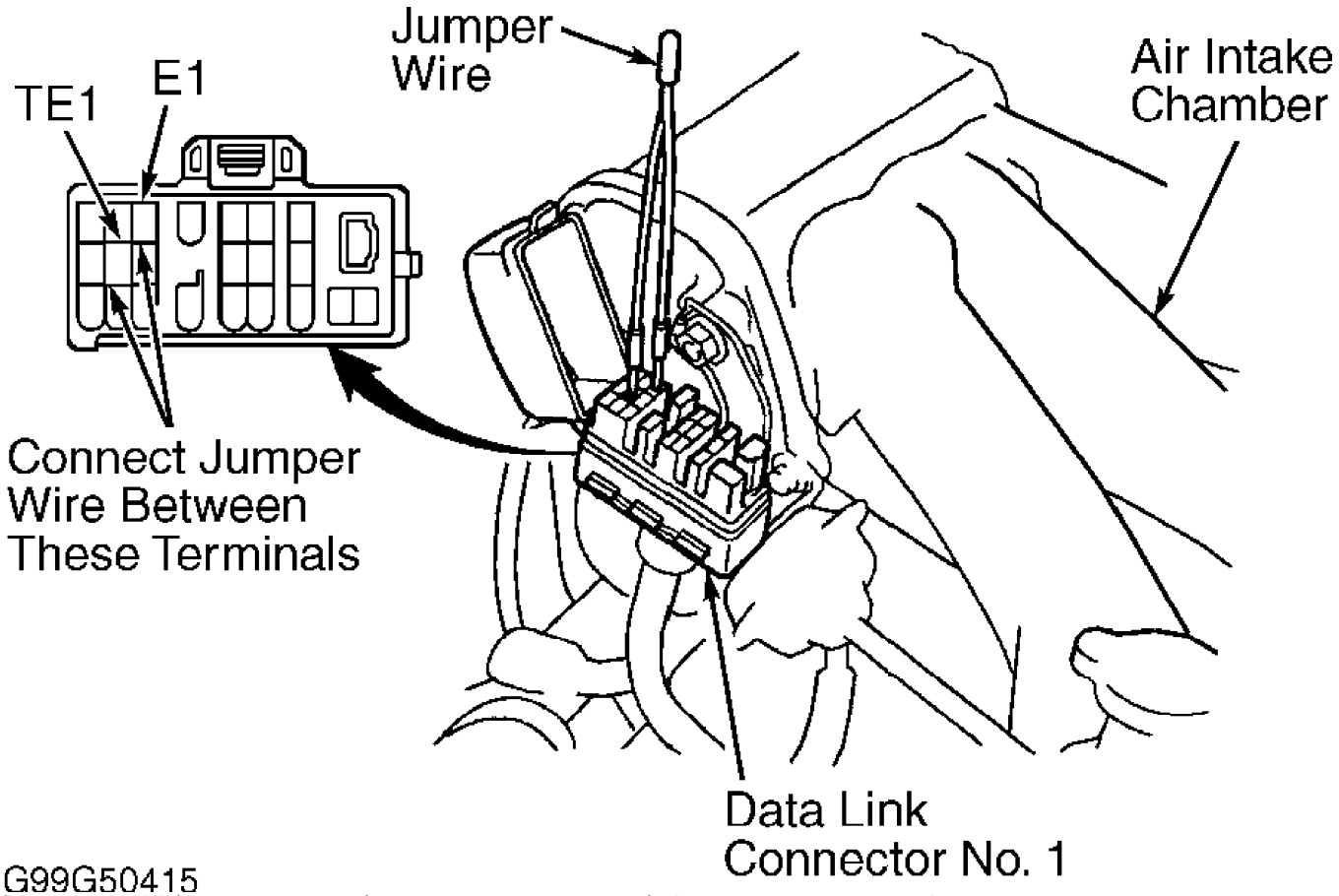


Fig. 22: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300 & SC300

1) Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 23. Scan tool is used to read engine RPM.

2) Connect timing light lead to White wire at ignitor. See Figs. 24 and 25. Ignitor is located on top of driver's side strut tower.

3) Apply parking brake. Place transmission in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and allow engine to idle. Ensure idle speed is 650-750 RPM.

4) Install Jumper Wire (SST 09843-18020) between terminals TC and E1 on data link connector No. 1. On GS300, data link connector No. 1 is located near driver's side strut tower. See Fig. 26. On SC300, data link connector No. 1 is located on end of air intake chamber. See Fig. 27.

5) On all models, timing marks are located on timing belt cover, near crankshaft pulley. Ensure base timing is 8-12 degrees BTDC at idle with transmission in Neutral, and with A/C and all accessories off.

6) Remove jumper wire from data link connector No. 1. Ensure ECM controlled timing is 6-16 degrees BTDC. Shut engine off. Remove timing light and scan tool.

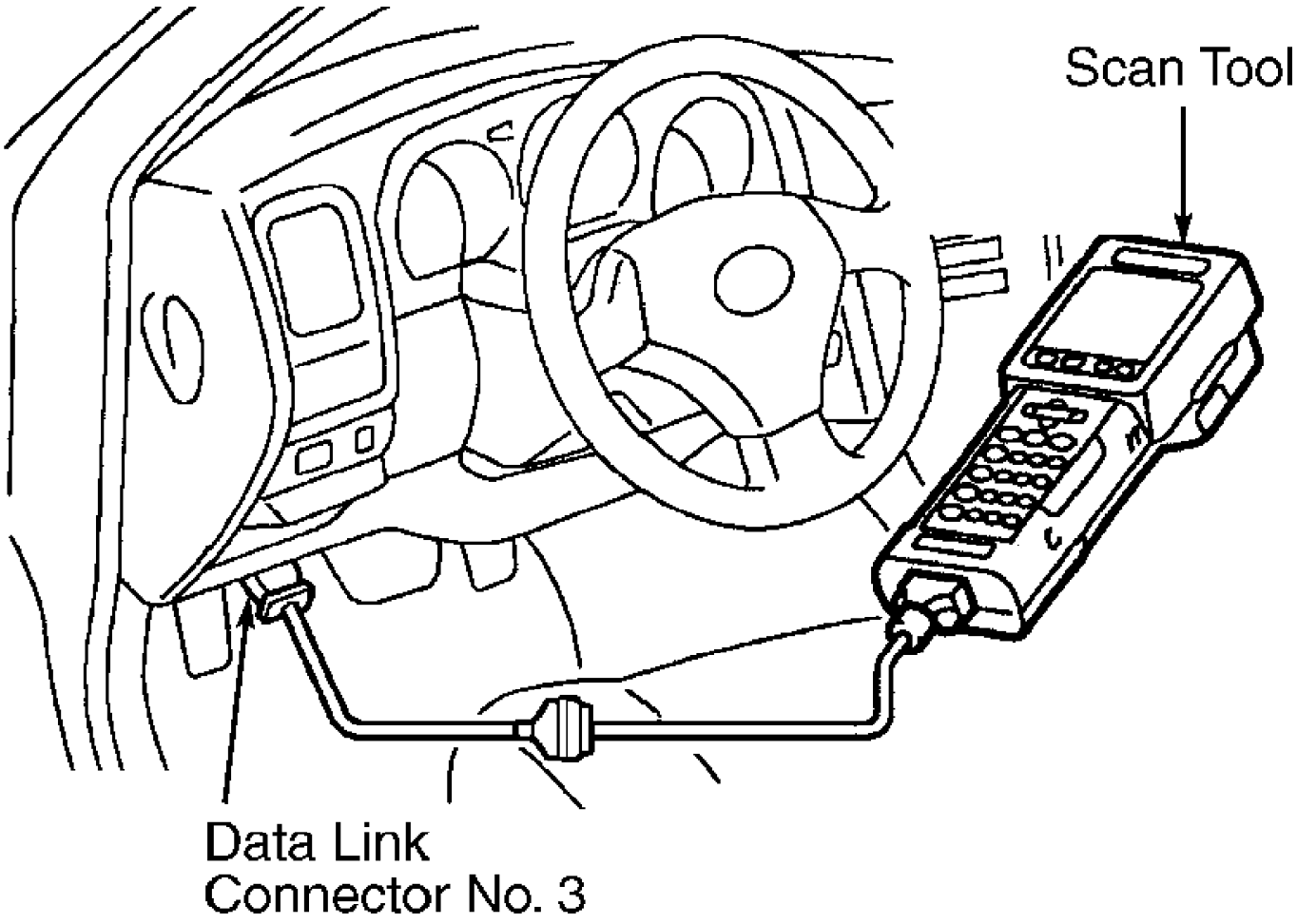


Fig. 23: Connecting Scan Tool To Typical Data Link Connector No. 3 (GS300, GS400, LS400, LX470, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

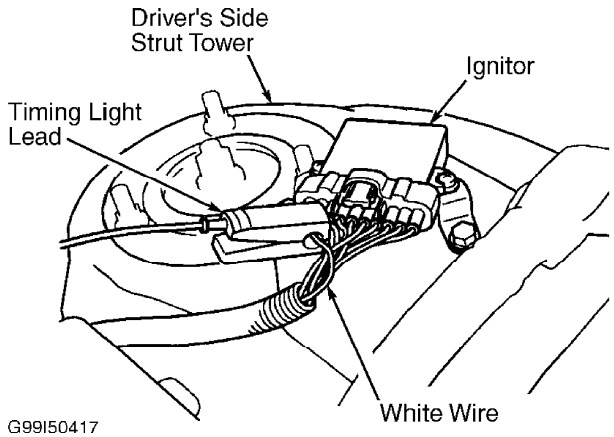


Fig. 24: Connecting Timing Light At Ignitor (GS300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

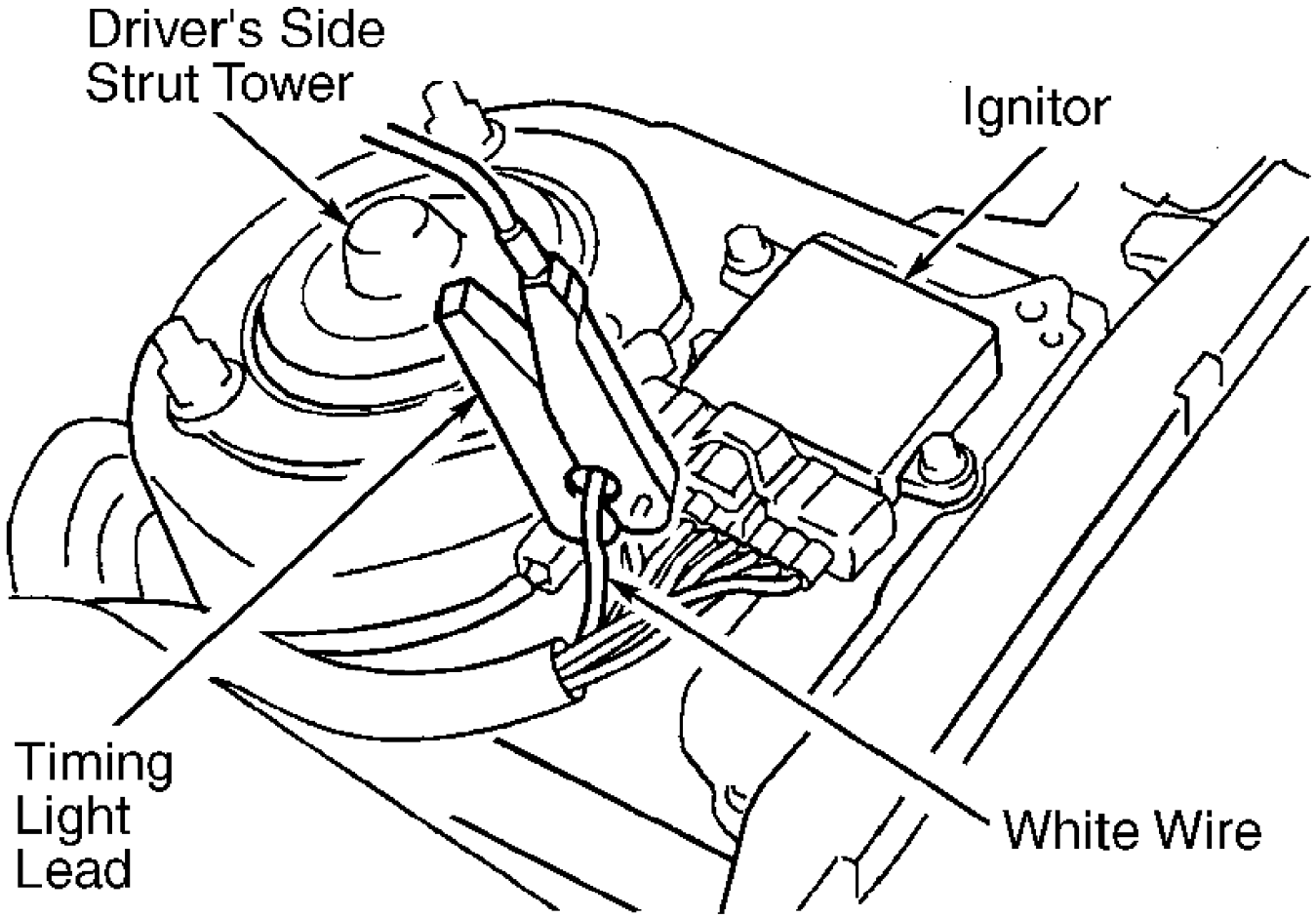


Fig. 25: Connecting Timing Light At Ignitor (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

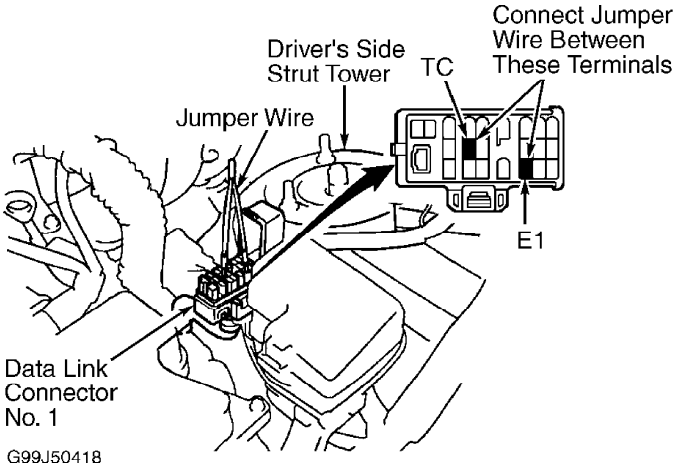


Fig. 26: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (GS300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

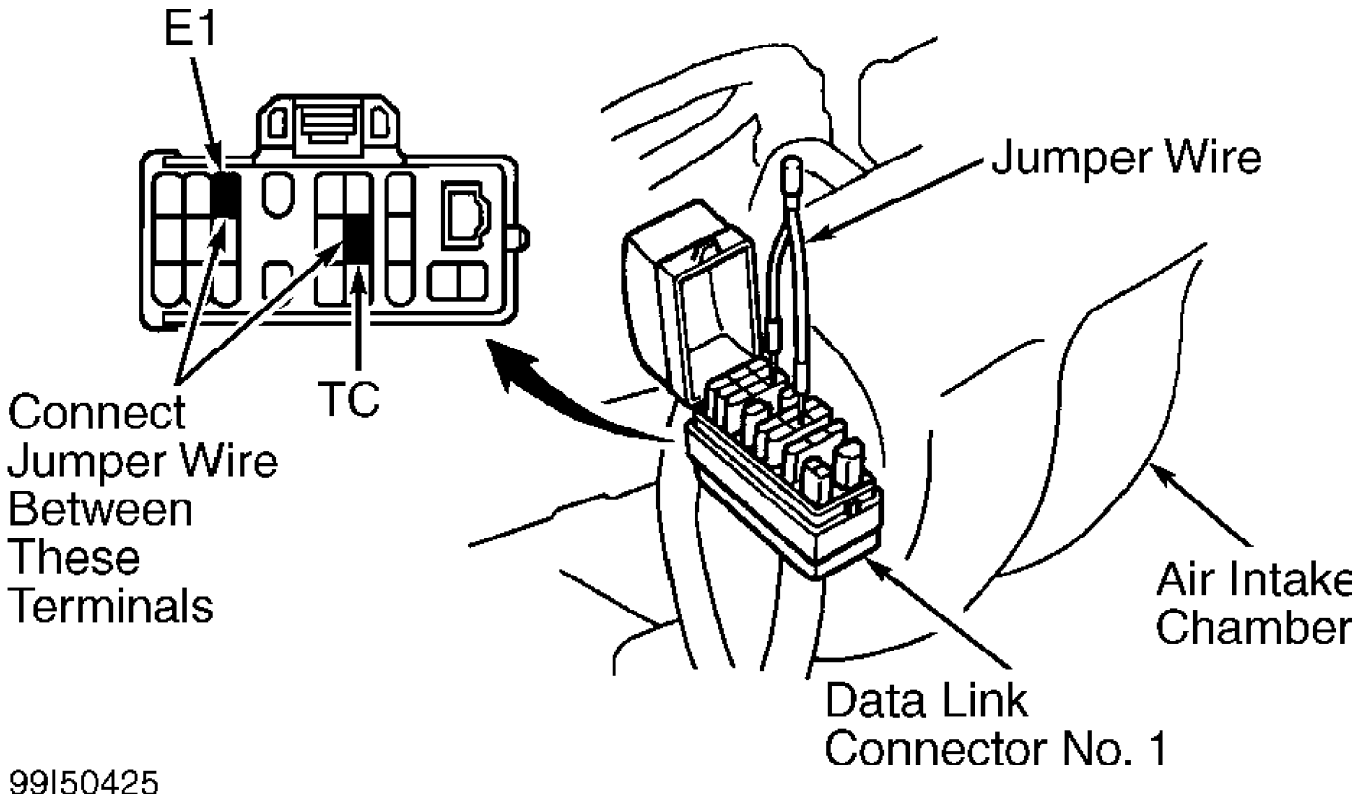


Fig. 27: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS400

1) Remove intake manifold cover located on top of engine, above intake manifold. Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 23. Scan tool is used to read engine RPM.

2) Connect timing light lead to Yellow wire at ignition coil electrical connector on top of driver's side valve cover at cylinder No. 1. See Fig. 28. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. See Fig. 12.

3) Install Jumper Wire (SST 09843-18020) between terminals TC and E1 on data link connector No. 1. See Fig. 29. Data link connector is located near driver's side strut tower.

4) Apply parking brake. Place transmission in Neutral. Start engine and allow engine to idle.

5) Timing marks are located on timing belt cover, near crankshaft pulley. Ensure base timing is 8-12 degrees BTDC at idle with transmission in Neutral, and with A/C and all accessories off. Shut engine off. Remove jumper wire, timing light and scan tool. Reinstall intake manifold cover.

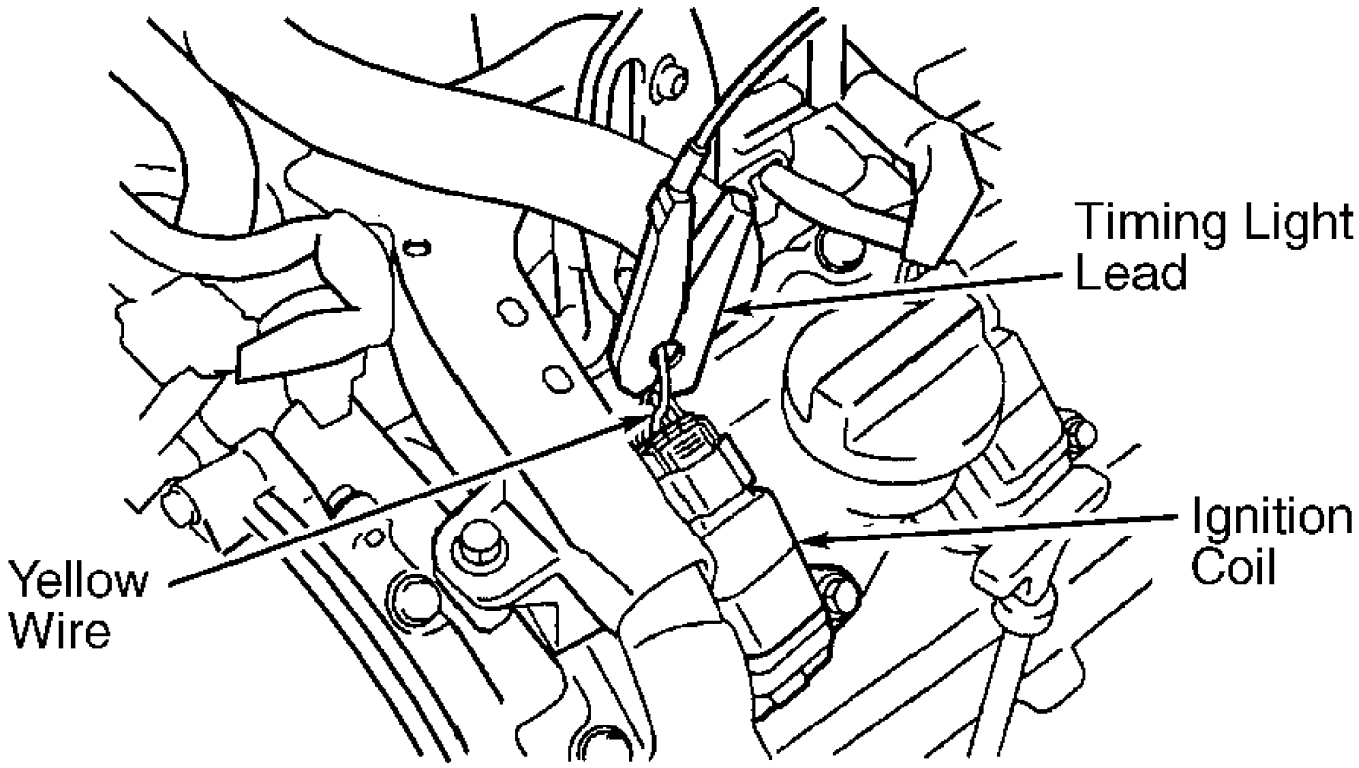


Fig. 28: Connecting Timing Light At Ignition Coil (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

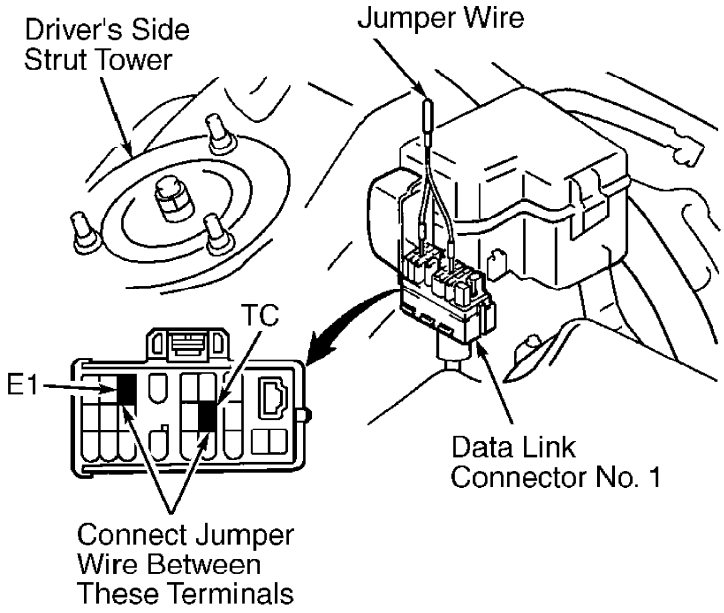


Fig. 29: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

1) Remove air cleaner inlet (if equipped) for access to intake manifold cover. Air cleaner inlet is located on top of the radiator. Remove intake manifold cover located on top of engine, above intake manifold. Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 23. Scan tool is used to read engine RPM.

2) Connect timing light lead to Yellow wire at ignition coil electrical connector on top of driver's side valve cover at cylinder No. 1. See Fig. 30. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. See Fig. 12.

3) Apply parking brake. Place transmission in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and allow engine to idle. Ensure idle speed is 700-800 RPM.

4) Install Jumper Wire (SST 09843-18020) between terminals TC and E1 on data link connector No. 1. See Fig. 31. Data link connector is located at near center of intake manifold and driver's side valve cover.

5) Timing marks are located on timing belt cover, near crankshaft pulley. Ensure base timing is 8-12 degrees BTDC at idle with transmission in Neutral, and with A/C and all accessories off. Shut engine off. Remove jumper wire, timing light and scan tool. Reinstall intake manifold cover and air cleaner inlet.

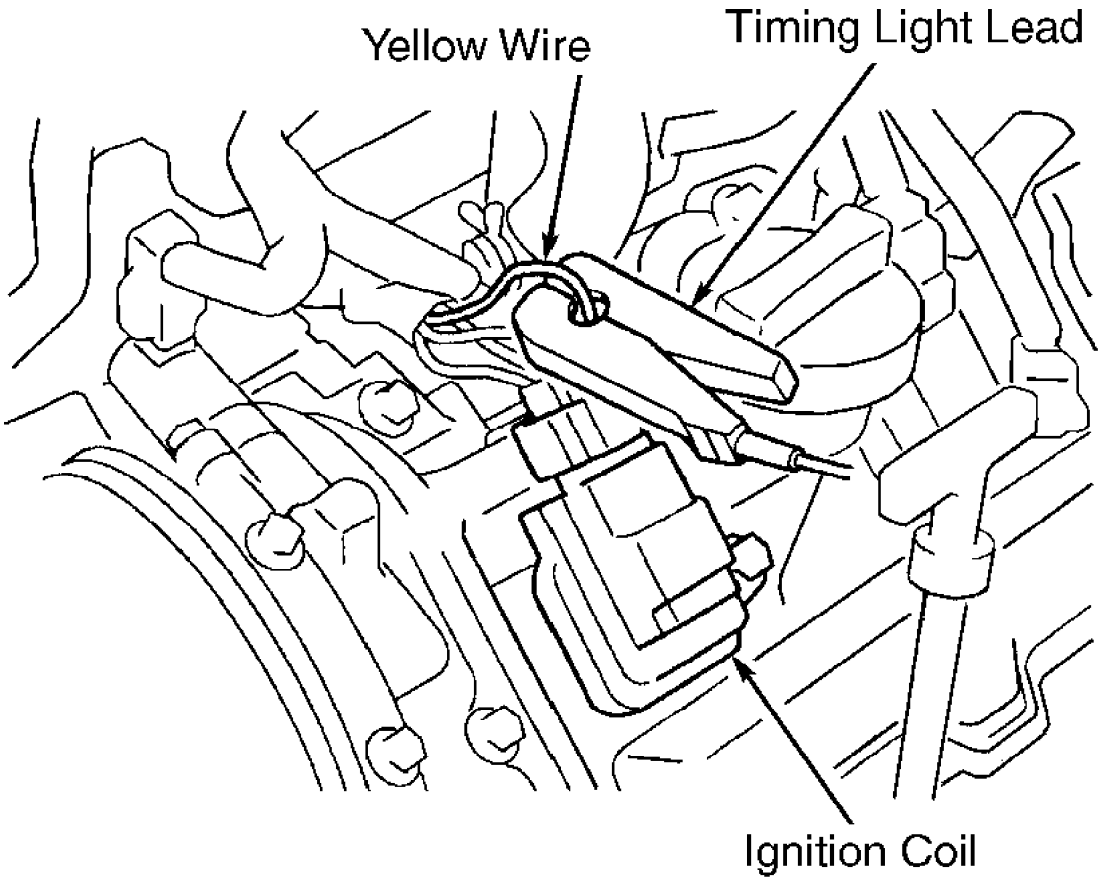
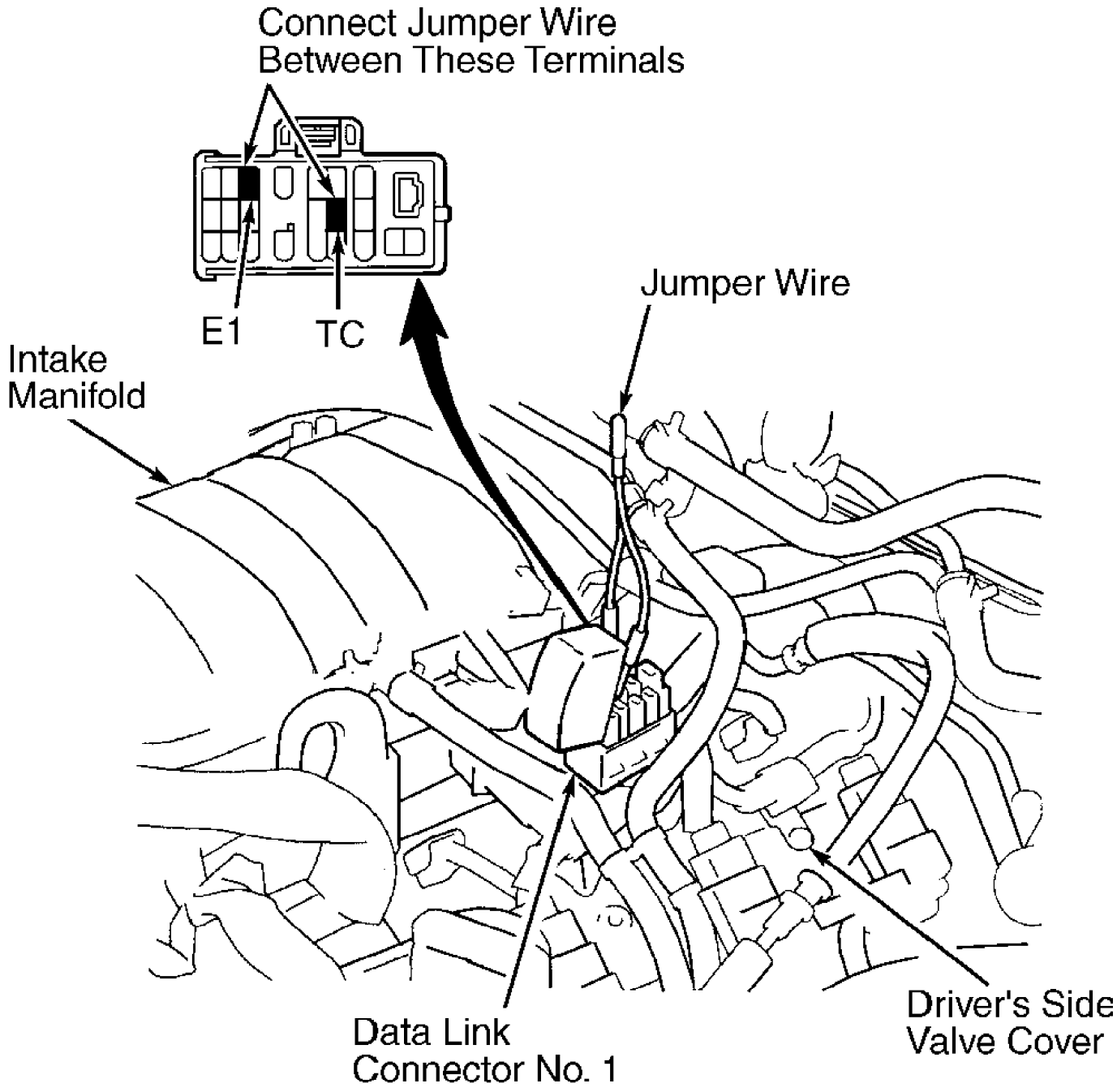


Fig. 30: Connecting Timing Light At Ignition Coil (LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



99E50421

Fig. 31: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LX470

1) Start engine and warm engine to normal operating temperature. Shut engine off. Remove intake manifold cover located on top of engine, above intake manifold.
2) Connect scan tool to data link connector No. 3. See

Fig. 23. Scan tool is used to read engine RPM.

3) Connect timing light lead to wire at ignition coil electrical connector on top of driver's side valve cover at cylinder No. 1. See Fig. 32. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. See Fig. 12.

4) Apply parking brake. Place transmission in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and then allow engine to idle. Ensure idle speed is 650-750 RPM.

5) Install Jumper Wire (SST 09843-18020) between terminals TC and E1 on data link connector No. 1. See Fig. 33. Data link connector No. 1 is located on passenger's side front fender, behind air cleaner.

6) Timing marks are located on timing belt cover, near crankshaft pulley. Ensure base ignition timing is 5-15 degrees BTDC at idle with transmission in Neutral. Shut engine off. Remove jumper wire, timing light and scan tool. Reinstall intake manifold cover.

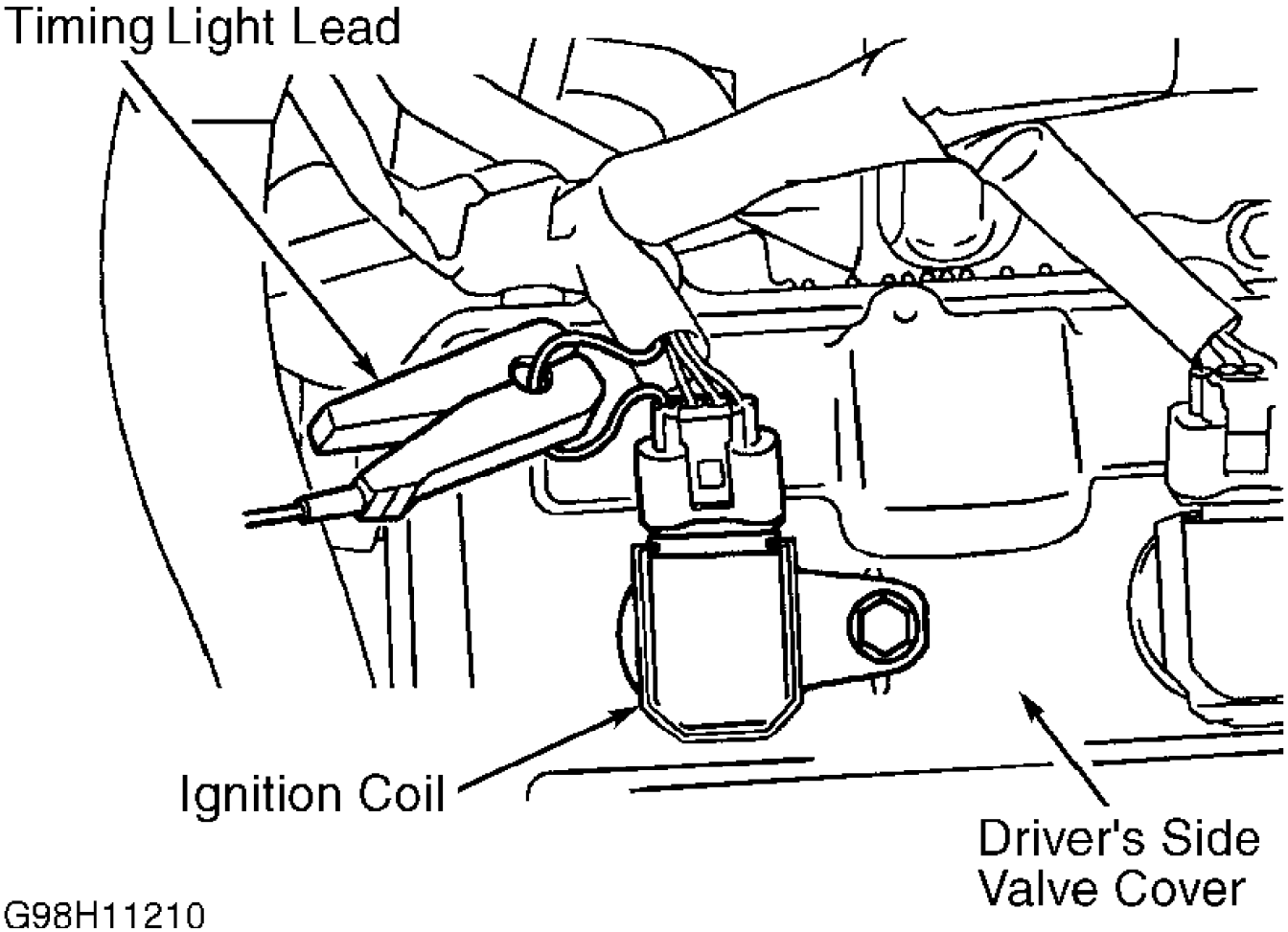


Fig. 32: Connecting Timing Light At Ignition Coil (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

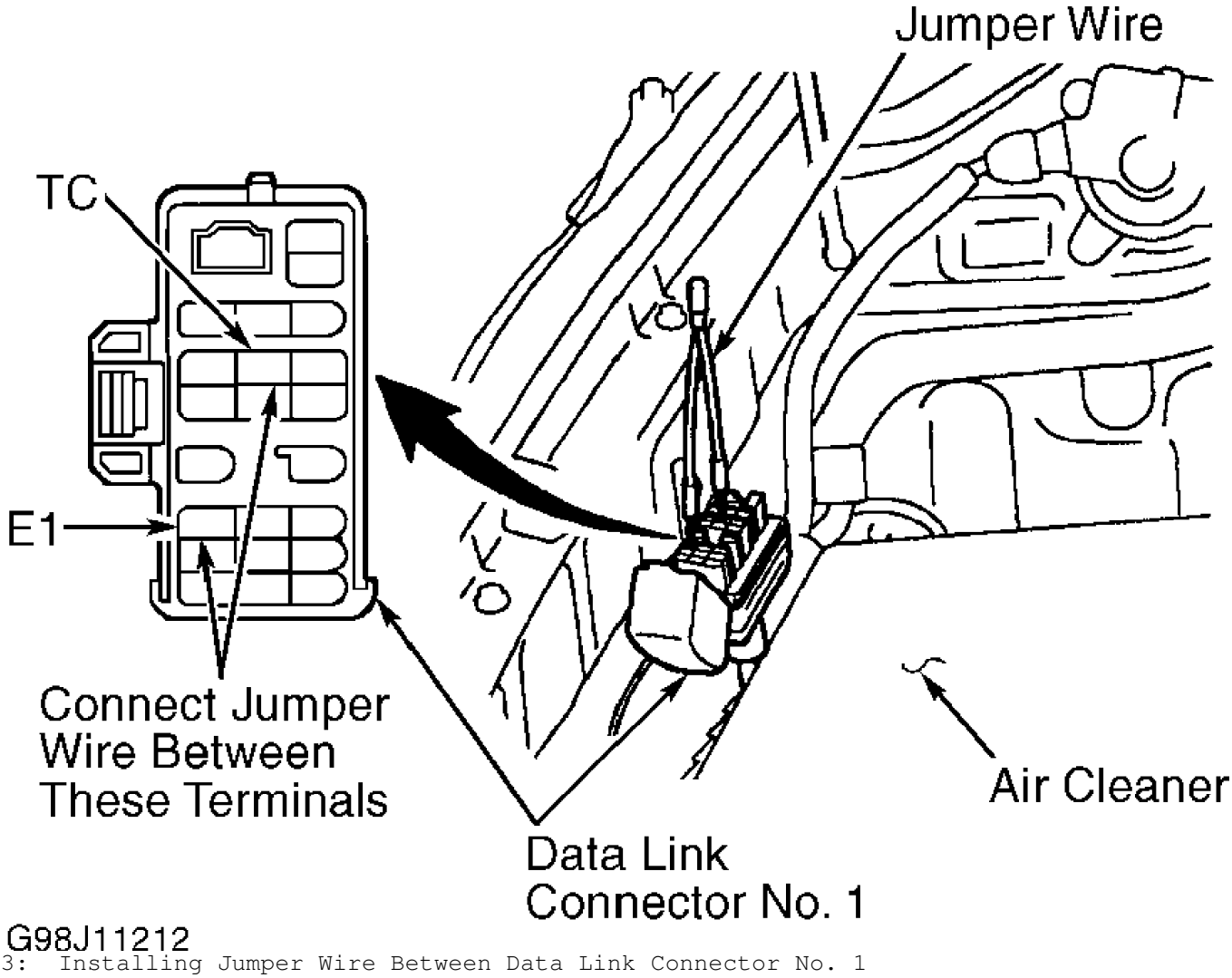


Fig. 33: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

RX300

1) Remove intake manifold cover. See Fig. 1. Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 34. Scan tool is used to read engine RPM.

2) Connect timing light lead to lead wire located near ignition on top of front valve cover. See Fig. 35.

3) Apply parking brake. Place transaxle in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and then allow engine to idle. Ensure idle speed is 650-750 RPM.

4) Install Jumper Wire (SST 09843-18020) between terminals TEI and E1 on data link connector No. 1. See Fig. 36. Data link connector No. 1 is located just in front of driver's side strut tower.

5) Timing marks are located on timing belt cover, near crankshaft pulley. Ensure base ignition timing is 8-12 degrees BTDC at idle with transaxle in Neutral, and with A/C and all accessories off. Remove jumper wire from data link connector No. 1. Ensure ECM controlled timing is 10-25 degrees BTDC. Shut engine off. Remove timing light and scan tool. Reinstall intake manifold cover.

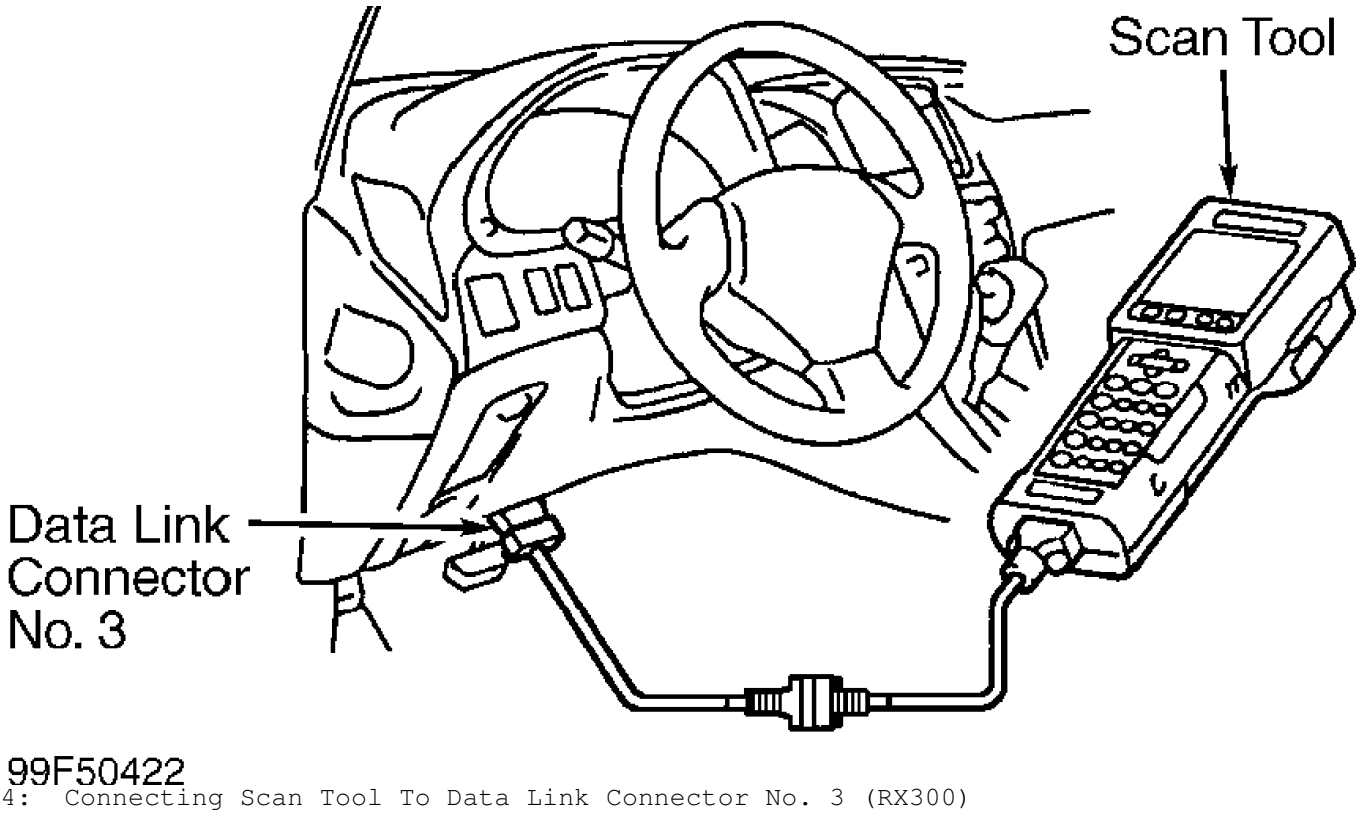


Fig. 34: Connecting Scan Tool To Data Link Connector No. 3 (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

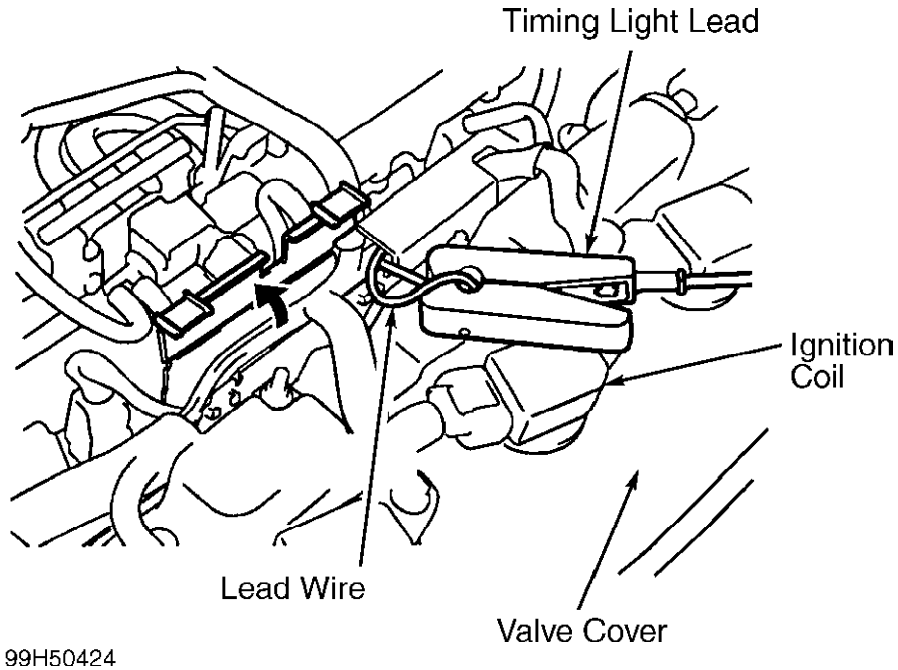


Fig. 35: Connecting Timing Light At Ignition Coil (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

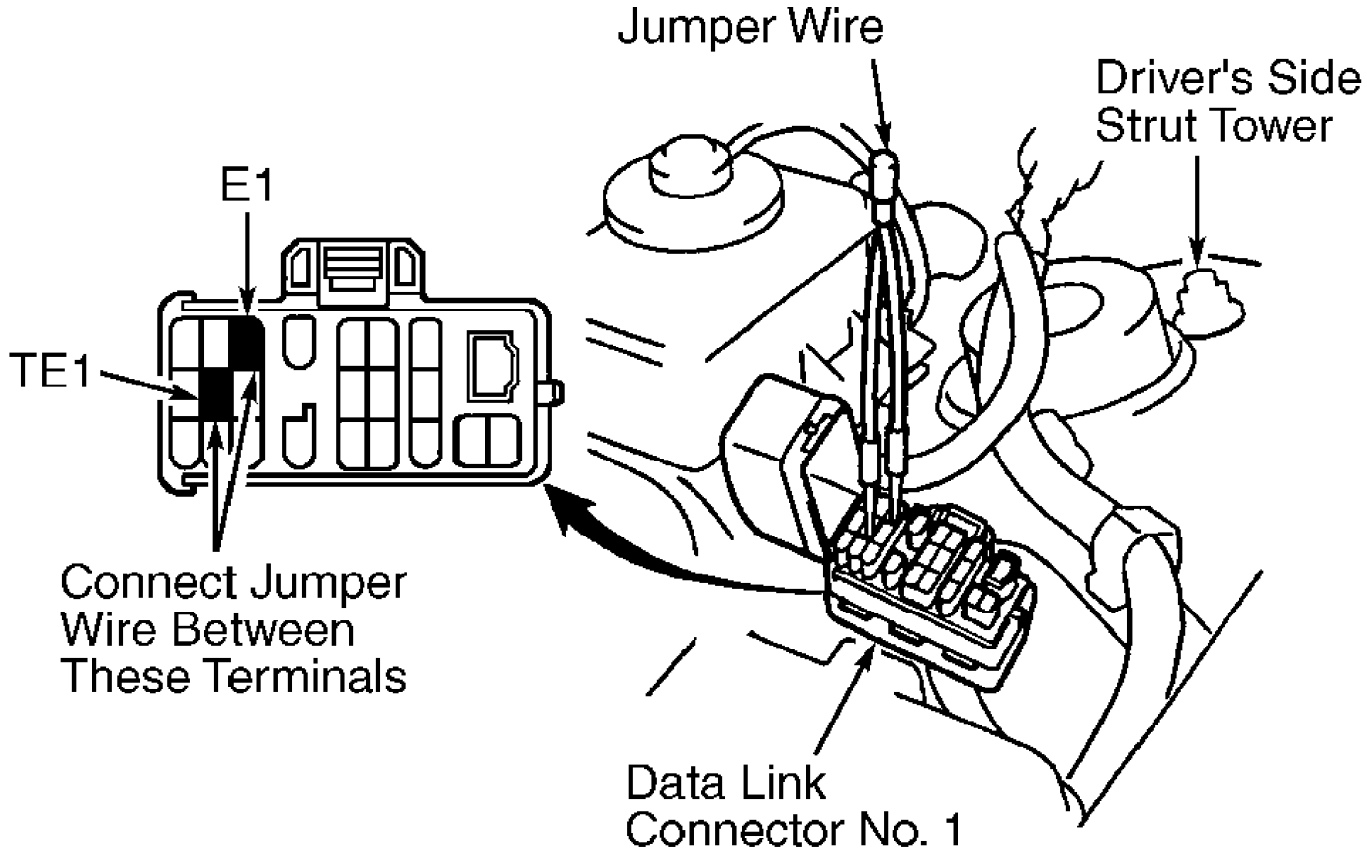


Fig. 36: Installing Jumper Wire Between Data Link Connector No. 1 Terminals (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IDLE SPEED & MIXTURE

NOTE: Mixture adjustment is not possible on any model.

IDLE SPEED

NOTE: Idle speed is controlled by Engine Control Module (ECM) and is not adjustable. Check idle speed with air cleaner installed, all air induction system hoses and vacuum lines connected, electronic fuel injection system wiring connectors properly installed, transmission/transaxle in Neutral, ignition timing properly set, A/C and all accessories off, and engine at normal operating temperature.

NOTE: Check idle speed with air cleaner installed, all air induction system hoses and vacuum lines connected, electronic fuel injection system wiring connectors properly installed, transmission/transaxle in Neutral, ignition timing properly set, A/C and all accessories off, and engine at normal operating temperature.

ES300 & RX300

1) Start engine and warm engine to normal operating temperature. Shut engine off.
2) Connect scan tool to data link connector No. 3. See

Figs. 20 and 34. Scan tool is used to read engine RPM. Apply parking brake.

3) Place transaxle in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and then allow engine to idle. Ensure idle speed is 650-750 RPM.

4) If idle speed is not within specification, check Idle Air Control (IAC) valve, wiring, Engine Control Module (ECM) and air intake system. See IDLE AIR CONTROL (IAC) SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. Shut engine off. Remove scan tool.

GS300, GS400, LS400, LX470, SC300 & SC400

1) Start engine and warm engine to normal operating temperature. Shut engine off. Connect scan tool to data link connector No. 3. See Fig. 23. Scan tool is used to read engine RPM.

2) Apply parking brake. Place transmission in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and then allow engine to idle. Ensure idle speed is within specification. See IDLE SPEED SPECIFICATIONS table.

IDLE SPEED SPECIFICATIONS

Application	Idle RPM
GS300, LX470 & SC300	650-750
GS400, LS400 & SC400	700-800

3) If idle speed is not within specification, check air intake system for leaks. If air intake system is okay, check throttle body. See THROTTLE BODY under THROTTLE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article. Shut engine off. Remove scan tool.

THROTTLE BODY LEVER ADJUSTMENT

NOTE: Throttle body lever adjustment may also be referred to as throttle body balance adjustment.

ES300 & RX300

NOTE: Throttle body lever adjustment must be performed if throttle body or idle air control valve is replaced, or if throttle body or idle air control valve is removed and reinstalled. Perform preliminary inspection to determine if throttle body lever adjustment must be performed. Throttle stop screws and throttle opener are preset. DO NOT alter throttle stop screw or throttle opener adjustment.

1) Preliminary Inspection - Using vacuum pump, apply 15.7 Hg in. of vacuum to throttle opener. Perform STEP 1. See Fig. 37. Ensure clearance exists at tip throttle opener and no clearance exists between throttle stop screws and throttle levers. Perform STEP 1. See Fig. 37.

2) Note location of No. 1 and 2 throttle bodies on No. 1 intake air control valve. Perform STEP 2. See Fig. 37. With 15.7 Hg in. of vacuum still applied to throttle opener, check that about .0051" (.130 mm) clearance exists between close side adjusting screw and throttle lever on No. 1 throttle body, and about .0087" (.220 mm) clearance exists between open side adjusting screw and throttle lever on No. 1 throttle body. Perform STEP 3. See Fig. 37.

3) Release vacuum and disconnect vacuum pump. Fully open throttle lever on No. 2 throttle body and measure clearance between close side adjusting screw and throttle lever on No. 1 throttle body.

Perform STEP 4. See Fig. 37. Clearance between close side adjusting screw and throttle lever on No. 1 throttle body should be .0098-.0177" (.250-.450 mm). If all clearances are as specified, throttle body lever adjustment is not required. If any clearance is not as specified, throttle body lever adjustment procedure must be performed. Proceed to adjustment procedure.

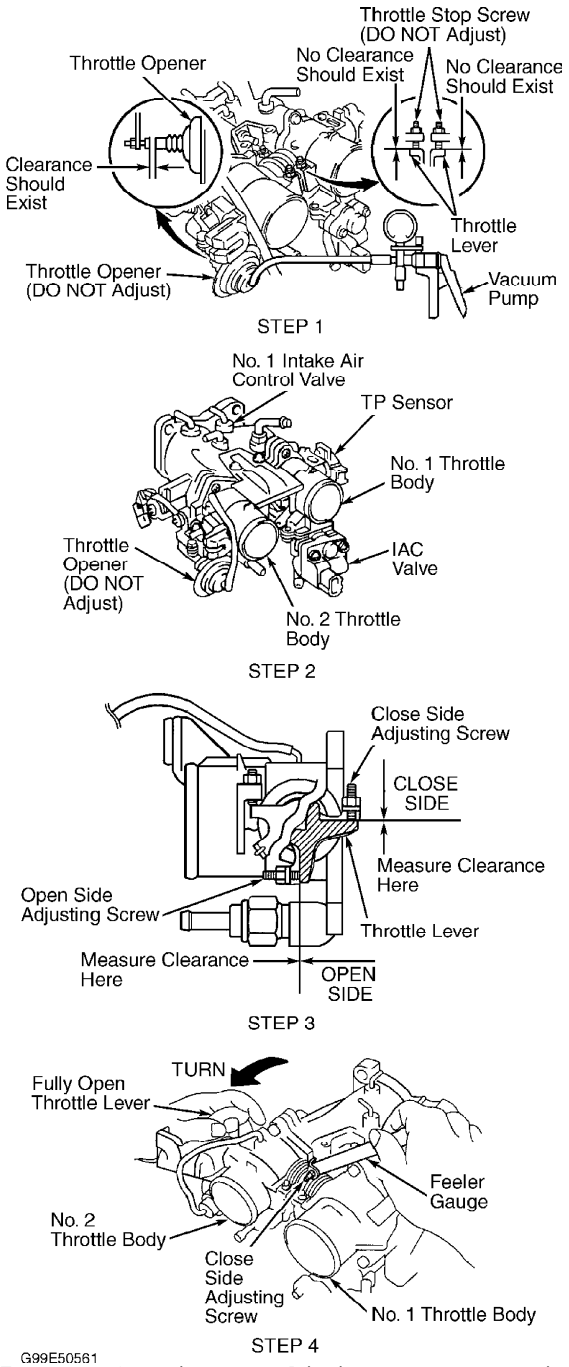


Fig. 37: Performing Preliminary Inspection For Throttle Body Lever Adjustment (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

1) Adjustment Procedure - Ensure preliminary inspection

procedure is performed before performing adjustment procedure. Using vacuum pump, apply 15.7 Hg in. of vacuum to throttle opener.

2) To adjust open side adjusting screw, loosen lock nut on open side adjusting screw. See Fig. 38. Loosen open side adjusting screw to provide clearance between open side adjusting screw and throttle lever on No. 1 throttle body. Tighten open side adjusting screw until it just contacts throttle lever on No. 1 throttle body. DO NOT rotate open side adjusting screw after it just contacts throttle lever or throttle lever on No. 1 throttle body will not contact throttle stop screw and improper adjustment will exist. Loosen open side adjusting screw 1/4 turn and tighten lock nut.

3) To adjust close side adjusting screw, loosen lock nut on close side adjusting screw. See Fig. 38. Loosen close side adjusting screw to provide clearance between close side adjusting screw and throttle lever on No. 1 throttle body. Tighten close side adjusting screw until it just contacts throttle lever on No. 1 throttle body. DO NOT rotate close side adjusting screw after it just contacts throttle lever or throttle lever on No. 2 throttle body will not contact throttle stop screw and improper adjustment will exist. Loosen close side adjusting screw 1/2-3/4 turn and tighten lock nut.

4) After open and close side adjusting screws are adjusted, perform preliminary inspection procedure again to ensure proper throttle body lever adjustment.

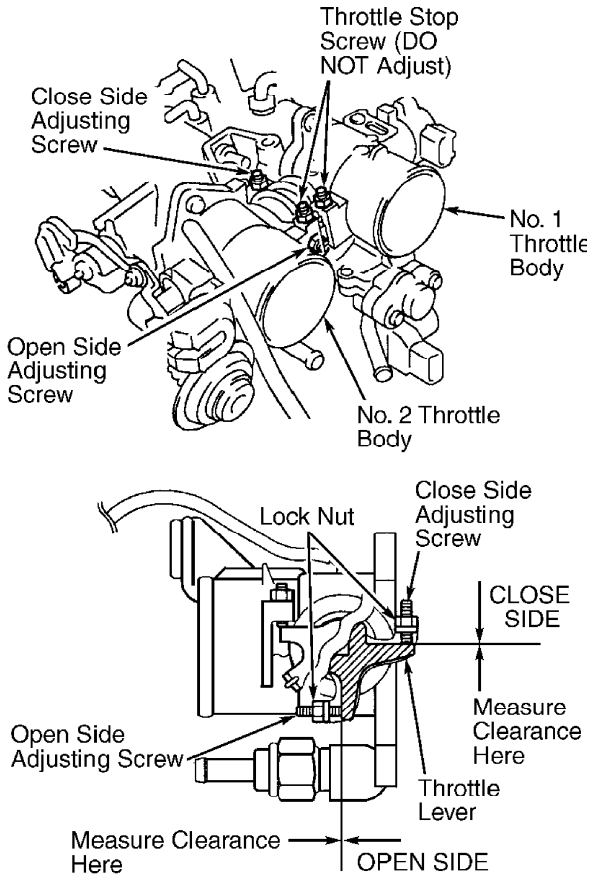


Fig. 38: Performing Throttle Body Lever Adjustment (ES300 & RX300) Courtesy of Toyota Motor Sales, U.S.A., Inc.

THROTTLE POSITION SENSOR

ES300 & RX300

1) Manufacturer does not list procedure for Throttle Position (TP) sensor adjustment. Only information available is for checking resistance of TP sensor.
2) Disconnect electrical connector from TP sensor. Note electrical terminals on TP sensor. See Fig. 39. Apply vacuum to throttle opener.
3) Using ohmmeter, check resistance between specified terminals in relation to throttle position. See THROTTLE POSITION SENSOR RESISTANCE (ES300 & RX300) table. Replace components as necessary if resistance is not within specification.

THROTTLE POSITION SENSOR RESISTANCE (ES300 & RX300) (1)

Application	Throttle Position	Terminals	Ohms
ES300 & RX300	Fully Closed	VTA & E2	200-6300
	Fully Open	VTA & E2	2000-10,200
		VC & E2	2500-5900

(1) - Apply vacuum to throttle opener before checking TP sensor.

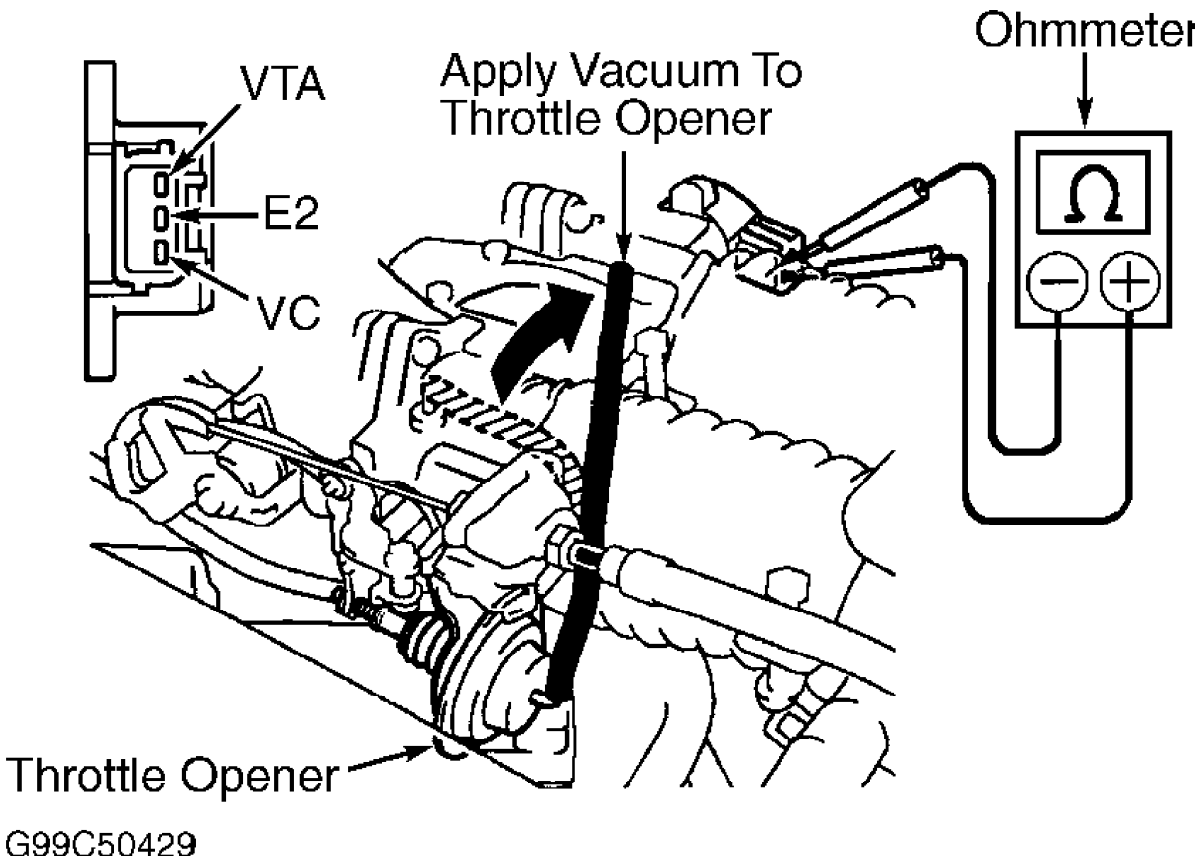


Fig. 39: Identifying Throttle Position (TP) Sensor Terminals (ES300 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300, GS400, LS400, LX470, SC300 & SC400

NOTE: Manufacturer does not list procedure for Throttle Position (TP) sensor adjustment on the vehicle. Only information available is for checking resistance of TP sensor. Manufacturer lists adjustment procedure only when replacing TP sensor. Proper adjustment must be performed when installing TP sensor on throttle body. See THROTTLE BODY under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

1) Disconnect electrical connector from TP sensor. Note electrical terminals on TP sensor. See Figs. 40 and 41.
2) Using ohmmeter, check resistance between terminals VC and E2 on TP sensor. See Figs. 40 and 41. Replace TP sensor if resistance is not within specification. See THROTTLE POSITION SENSOR RESISTANCE (GS300, GS400, LS400, LX470, SC300 & SC400) table.

THROTTLE POSITION SENSOR RESISTANCE (GS300, GS400, LS400, LX470, SC300 & SC400)

Application	Terminals	Ohms @ 68°F (20°C)
GS300 & SC300	VC & E2	(1) 1200-3200
GS400, LS400, LX470 & SC400	VC & E2	(1) 1250-2350

(1) - Resistance at 68°F (20°C).

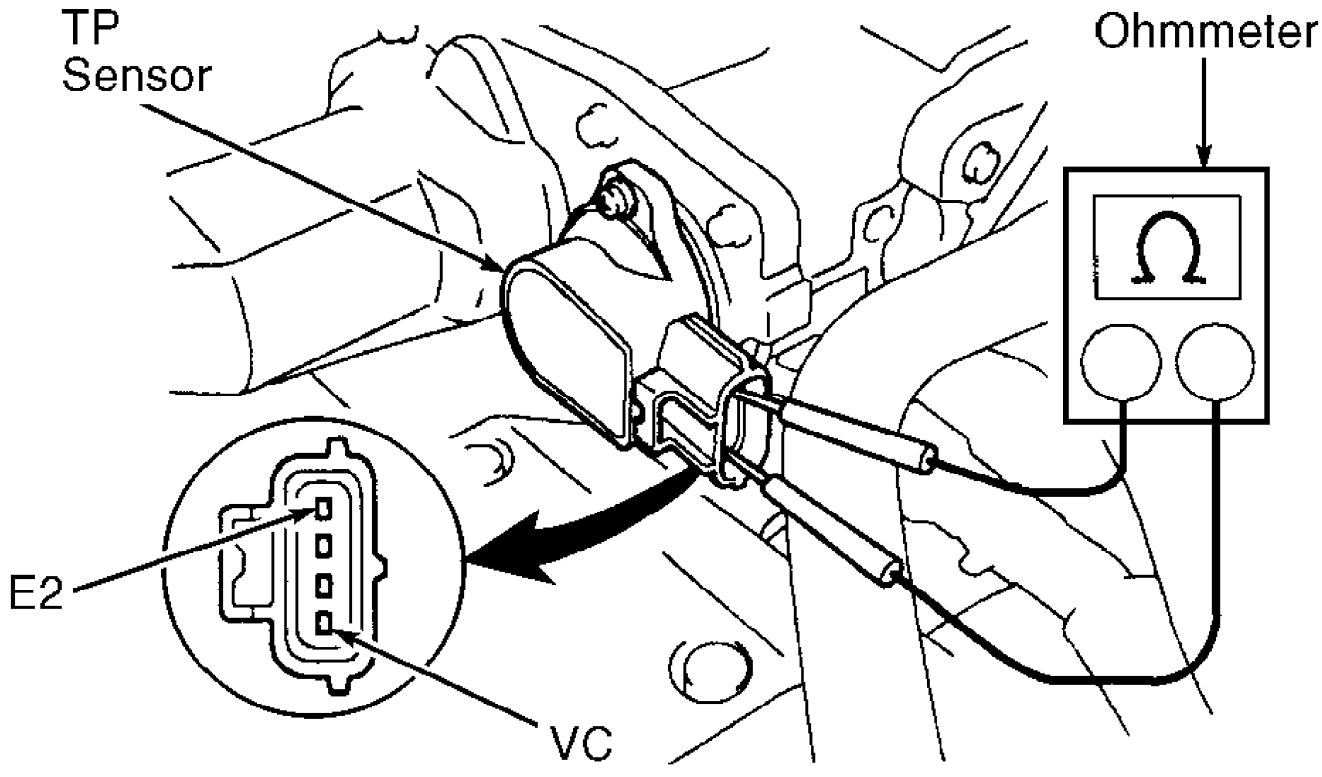


Fig. 40: Identifying Throttle Position (TP) Sensor Terminals (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

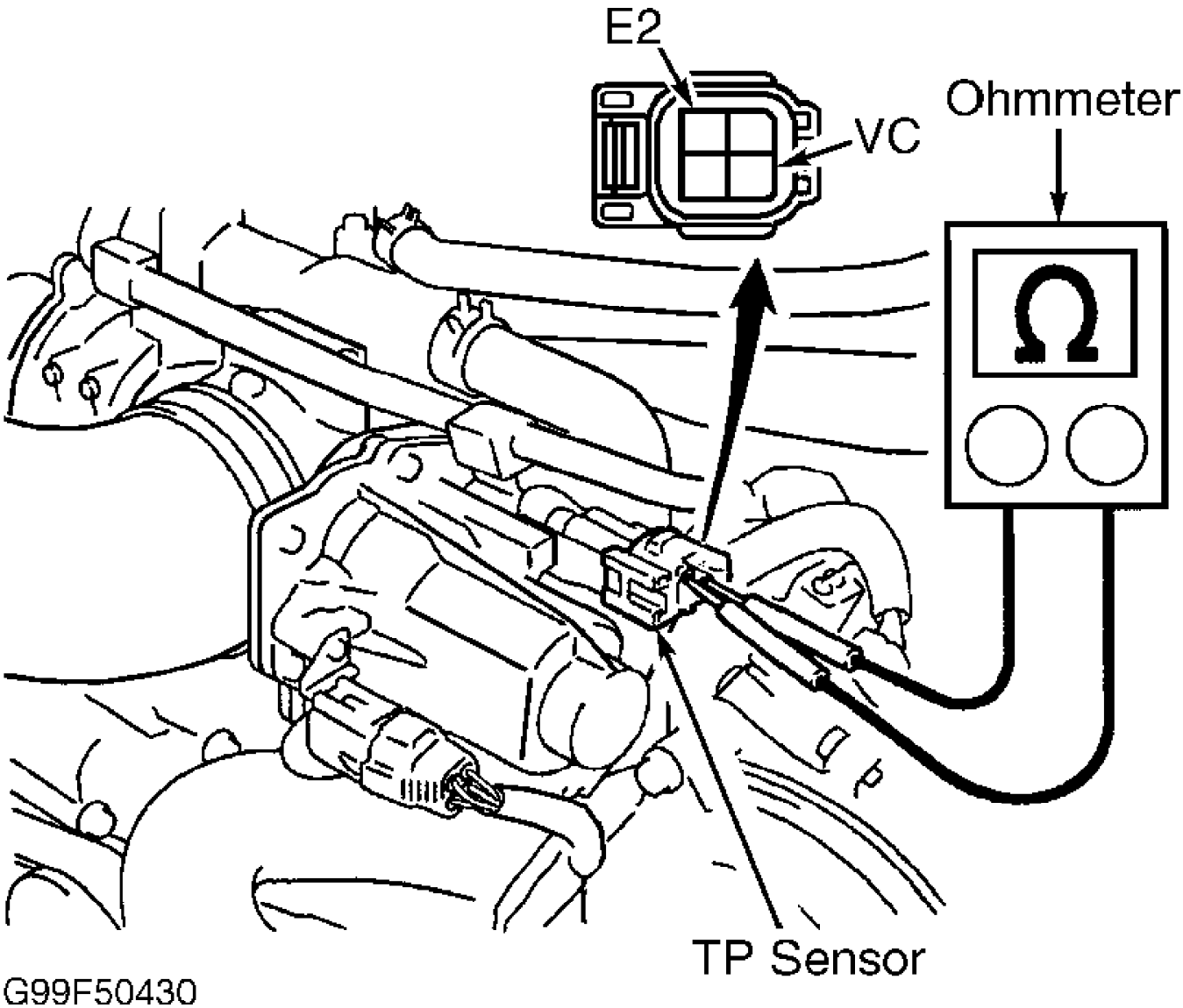


Fig. 41: Identifying Typical Throttle Position (TP) Sensor Terminals (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

THROTTLE OPENER

ES300

1) Start engine and warm engine to normal operating temperature. Shut engine off.

2) Connect scan tool to data link connector No. 3. See Fig. 20. Scan tool is used to read engine RPM. Apply parking brake.

3) Place transaxle in Neutral. Start engine and maintain engine at 2500 RPM for 90 seconds and then allow engine to idle. Ensure idle speed is 650-750 RPM.

4) Shut engine off. Disconnect and plug vacuum hose at throttle opener near throttle body. See Fig. 42. Start engine and note engine speed. Engine speed should be 1100-1700 RPM.

5) If engine speed is not within specification, replace

throttle body. Shut engine off. Reinstall vacuum hose on throttle opener. Start engine and ensure engine returns to proper idle speed.

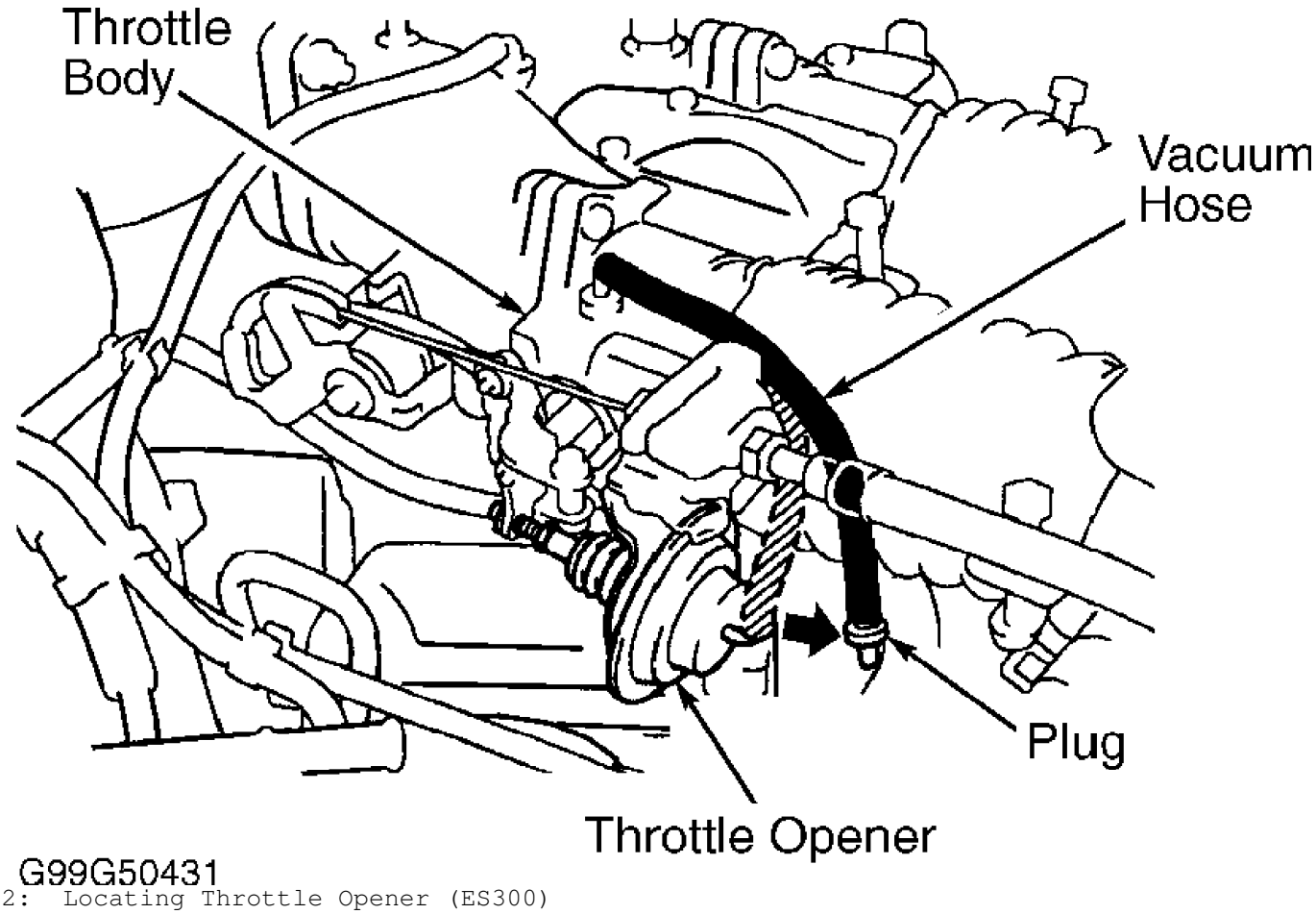


Fig. 42: Locating Throttle Opener (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

RX300

NOTE: Testing information is not available from manufacturer.

MISCELLANEOUS CONTROLS

PARK/NEUTRAL POSITION (PNP) SWITCH

For adjustment of PNP switch, see PARK/NEUTRAL POSITION (PNP) SWITCH under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (ES300)

Application	Ft. Lbs. (N.m)
Air Intake Chamber Bolt/Nut	32 (43)
No.1 Engine Hanger Bolt	29 (39)
Spark Plug	13 (18)

Throttle Body Brace Bolt	15 (20)
	INCH Lbs. (N.m)
Ignition Coil Bolt	71 (8.0)
Valve Cover Bolt	71 (8.0)

TORQUE SPECIFICATIONS (GS300 & SC300)

Application	Ft. Lbs. (N.m)
Camshaft Bearing Cap Bolt	15 (20)
Intake Air Connector-To-Air Intake Chamber Bolt/Nut	21 (29)
Spark Plug	13 (18)
Throttle Body Bracket-To-Cylinder Head Nut	15 (20)
	INCH Lbs. (N.m)
Ignition Coil Bolt	71 (8.0)
Upper Timing Belt Cover Bolt	71 (8.0)
Valve Cover Bolt/Nut	75 (8.5)

TORQUE SPECIFICATIONS (GS400, LS400, LX470 & SC400)

Application	Ft. Lbs. (N.m)
Spark Plug	13 (18)
Throttle Body Bolt/Nut	13 (18)
	INCH Lbs. (N.m)
Ignition Coil Bolt	66 (7.5)
Upper Timing Belt Cover Bolt/Nut	66 (7.5)
Valve Cover Bolt	53 (6.0)

TORQUE SPECIFICATIONS (RX300)

Application	Ft. Lbs. (N.m)
Air Intake Chamber Bolt/Nut	32 (43)
No.1 Engine Hanger Bolt	29 (39)
Spark Plug	13 (18)
Suspension Upper Brace Bolt	59 (80)
Throttle Body Brace Bolt	15 (20)
Windshield Wiper Arm Nut	18 (24)
	INCH Lbs. (N.m)
Ignition Coil Bolt	71 (8.0)
Valve Cover Bolt	71 (8.0)

E - THEORY/OPERATION

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Theory & Operation
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

AIR INDUCTION SYSTEM

ACOUSTIC CONTROL INDUCTION SYSTEM (ACIS)

NOTE: All models except LX470 have ACIS.

ES300 & RX300

ACIS is a variable induction system that improves low speed engine performance by increasing the length of the intake runners in the air intake chamber. In accordance with engine speed and throttle opening angle, the ACIS controls the intake manifold length in 3 stages by opening and closing the 2 Intake Air Control Valves (IACVs) that are located on the end of the air intake chamber and downstream of the throttle valves. See Fig. 1.

With engine under a heavy load and vehicle speed low, the Engine Control Module (ECM) turns on both ACIS Vacuum Switching Valves (VSVs) resulting in vacuum being supplied to both IACV actuators. This results in both IACVs closing, enabling the intake air chamber, throttle bodies, and air cleaner hose to function as an intake manifold. With engine under a heavy load and vehicle speed in the mid-range, the ECM turns on the ACIS VSV on the intake air chamber side and turns off the ACIS VSV downstream of the throttle valves. As a result the IACV in the air intake chamber closes and the IACV downstream of the throttle valves opens enabling the intake air chamber to function as the intake manifold. With engine under a light load and vehicle speed high, the ECM turns off both ACIS VSVs. This allows both IACVs to open enabling the intake air chamber to function as a normal intake air chamber.

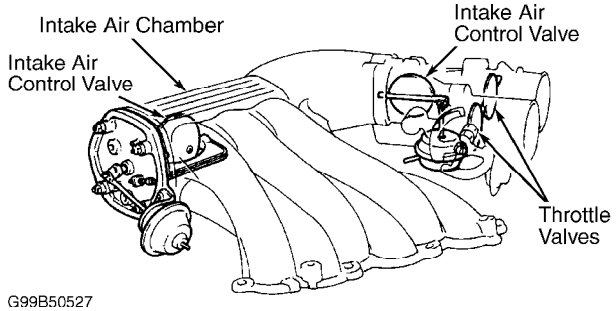


Fig. 1: Locating Intake Air Control Valves (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300, GS400, LS400, SC300 & SC400

ACIS is a variable induction system that improves low speed

engine performance by increasing the length of the intake runners in the air intake chamber. Engine Control Module (ECM) uses various input signals for determining intake air control valve system operation.

The ECM controls ground circuit for ACIS Vacuum Switching Valve (VSV). The VSV controls vacuum supply from vacuum tank to the ACIS actuator. ACIS actuator opens and closes an intake air control valve, which increases the length of the intake runners. For Intake Air Control Valve (IACV) location, see AIR INDUCTION SYSTEMS in appropriate SYSTEM & COMPONENT TESTING article.

ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS)

GS300, GS400, LS400, LX470, SC300 & SC400

The ETCS consists of throttle body, accelerator pedal position sensor, Throttle Position (TP) sensor, throttle control motor, magnetic clutch and Engine Control Module (ECM). ETCS uses the ECM to calculate throttle valve opening in the throttle body in relation to driving conditions. ETCS controls idle speed control system and cruise control system operation. Accelerator pedal position sensor is mounted on the throttle body and is integrated with throttle lever which attaches to the throttle cable. See Fig. 2. Accelerator pedal position sensor converts amount of accelerator pedal effort into 2 different types of output signals and delivers input signals to the ECM. The TP sensor delivers input signals to ECM to indicate throttle valve opening.

The ECM uses these input signals to operate the throttle control motor to obtain proper operating speeds in relation to accelerator pedal effort and engine speed to obtain proper idle speed and provide cruise control operation. Throttle control motor operation is also synchronized to the traction control system. The throttle control motor is mounted on side of throttle body and operates the throttle valve on the throttle body by the use of a magnetic clutch.

In the event of a ETCS malfunction, Malfunction Indicator Light (MIL) on instrument panel will be illuminated and Diagnostic Trouble Code (DTC) will be stored in the ECM. If malfunction exists, magnetic clutch will be disengaged, allowing spring pressure to close the throttle valve. When magnetic clutch is disengaged, throttle control motor will not operate the throttle valve. If ETCS is shut off, accelerator pedal may be used to operate throttle valve for vehicle operation in limp mode by using limp mode lever on the throttle body to operate the throttle valve. See Fig. 2.

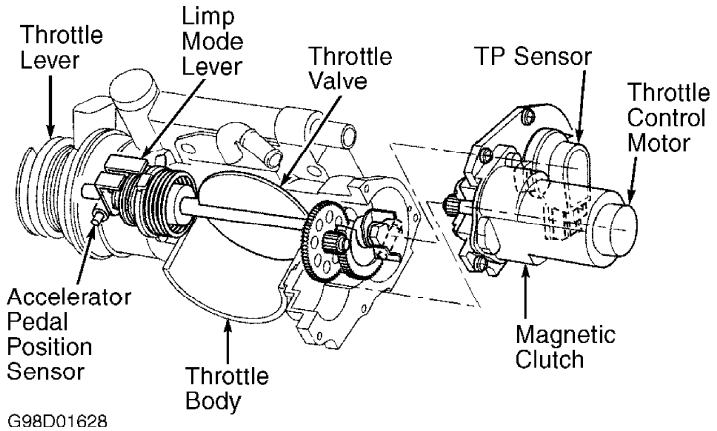


Fig. 2: Locating ETCS Components On Throttle Body
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE CONTROL MODULE (ECM)

ECM monitors and controls vehicle emissions, fuel system, ignition system and other various systems by using input signals from various input devices. ECM processes input signals from input devices and delivers output signals to various components for controlling system operation to achieve optimum engine performance for all operating conditions. See INPUT DEVICES and OUTPUT SIGNALS. ECM contains a fail-safe function which is used in case of sensor or switch failure. Fail-safe function uses preprogrammed values to provide a limp-in mode for minimal driveability. If a failure exists, ECM will inform the driver by turning on Malfunction Indicator Light (MIL) on the instrument panel. MIL may also be referred to as CHECK ENGINE light.

ECM contains a self-diagnostic system which may store a Diagnostic Trouble Code (DTC) if an electronic control system failure exists. DTC may be retrieved from ECM for system diagnosis using a scan tool. See SELF-DIAGNOSTIC SYSTEM. For ECM location, see Figs. 3-10.

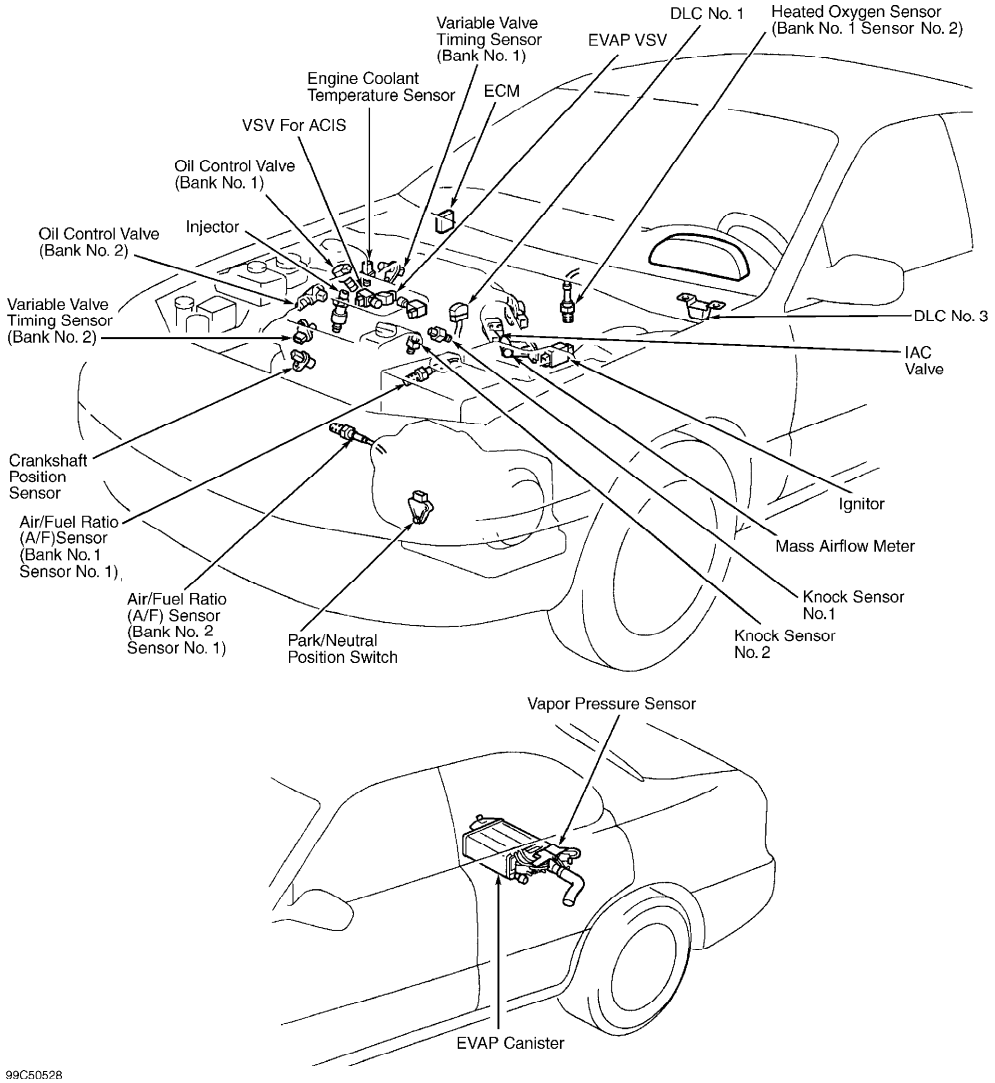


Fig. 3: Locating Computerized Engine Control Components (ES300) Courtesy of Toyota Motor Sales, U.S.A., Inc.

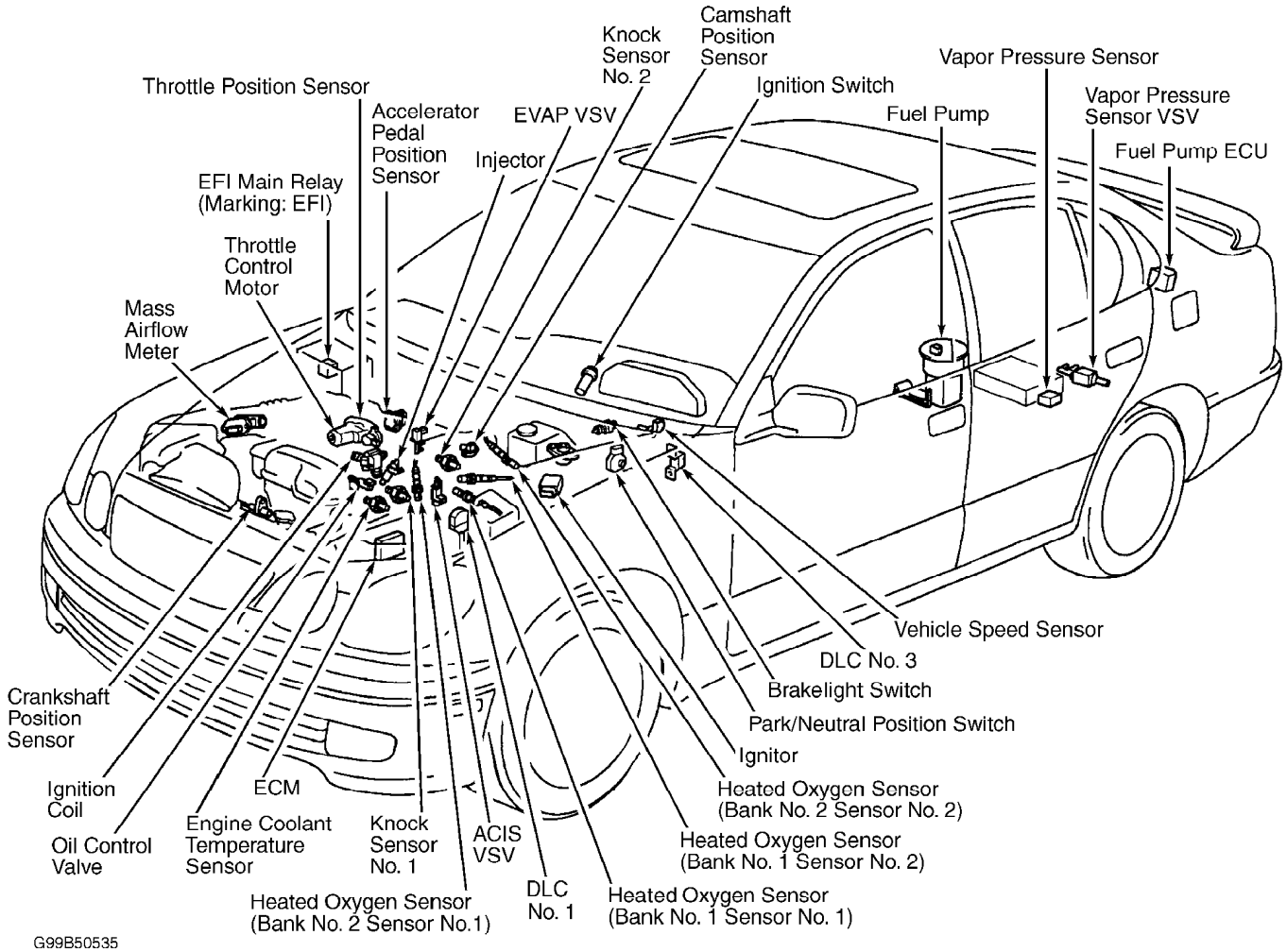


Fig. 4: Locating Computerized Engine Control Components (GS300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

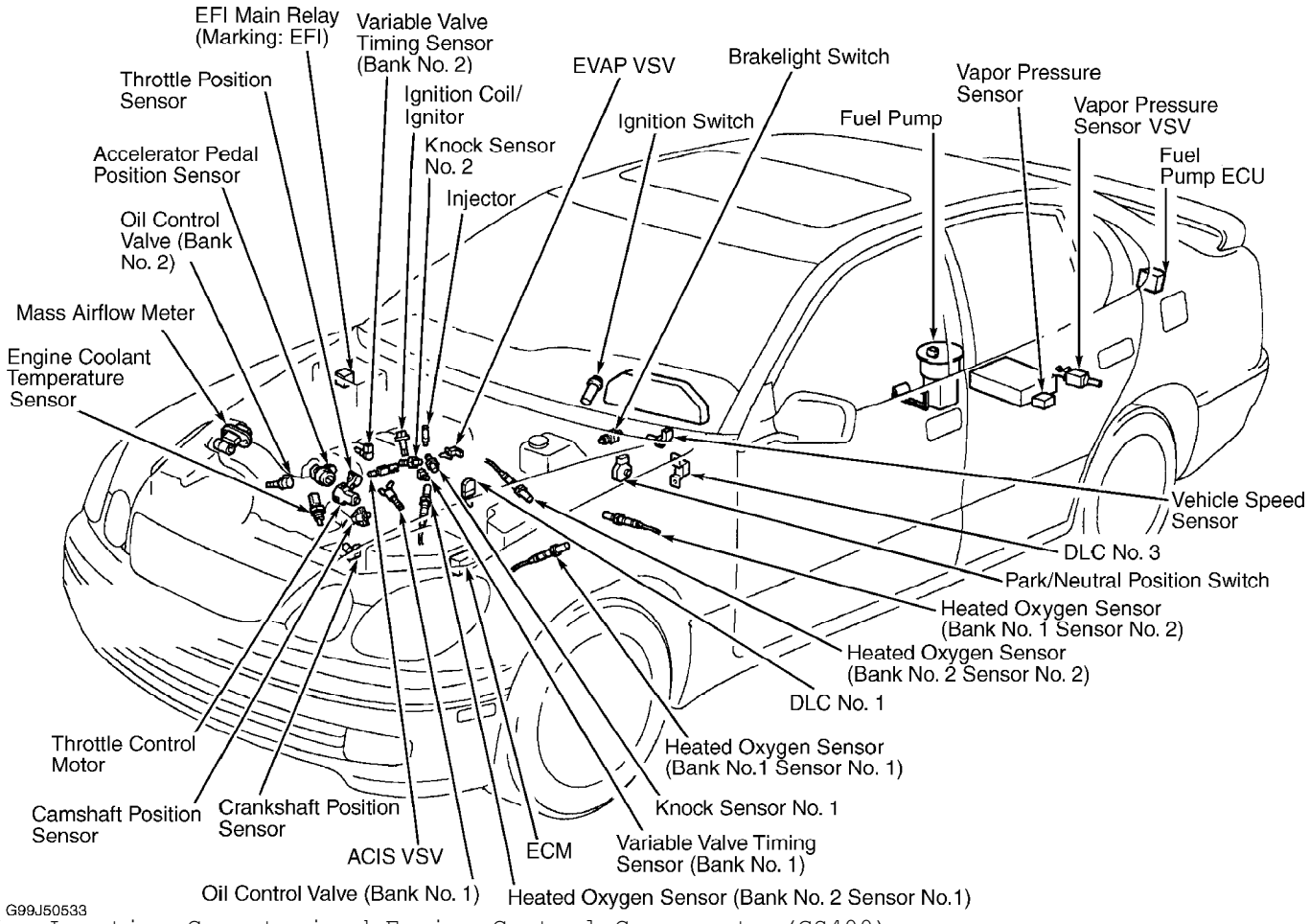


Fig. 5: Locating Computerized Engine Control Components (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

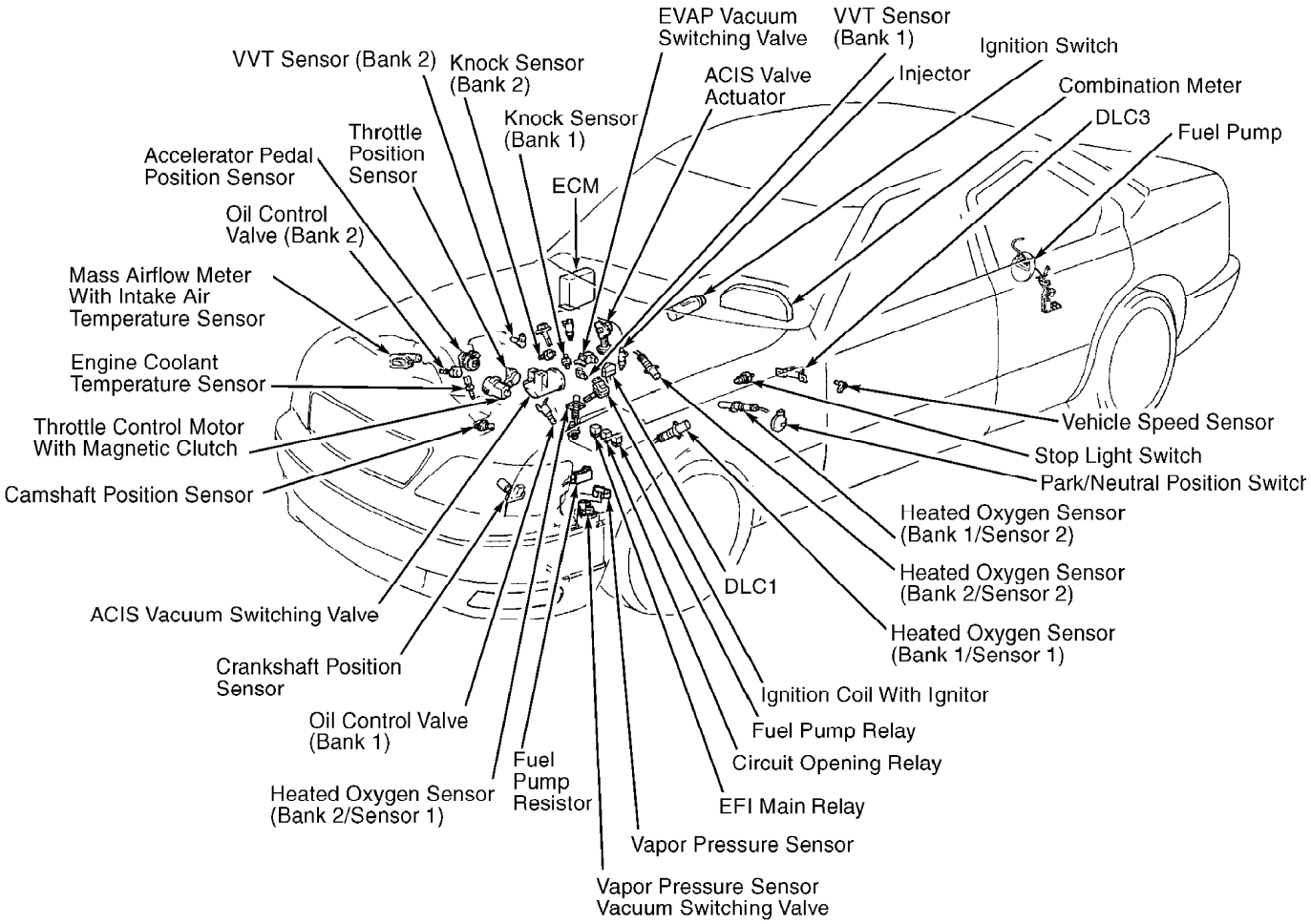


Fig. 6: Locating Computerized Engine Control Components (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

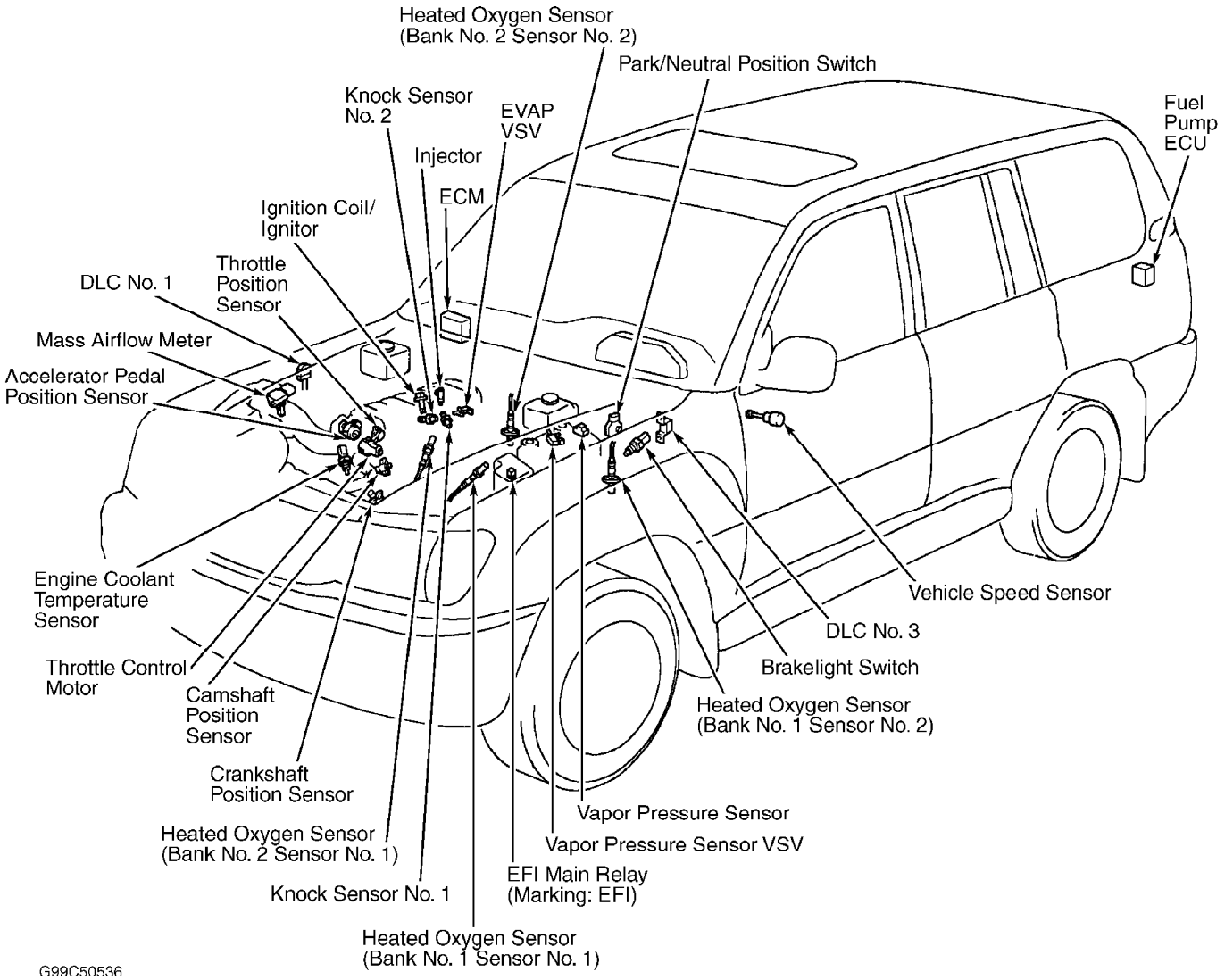


Fig. 7: Locating Computerized Engine Control Components (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

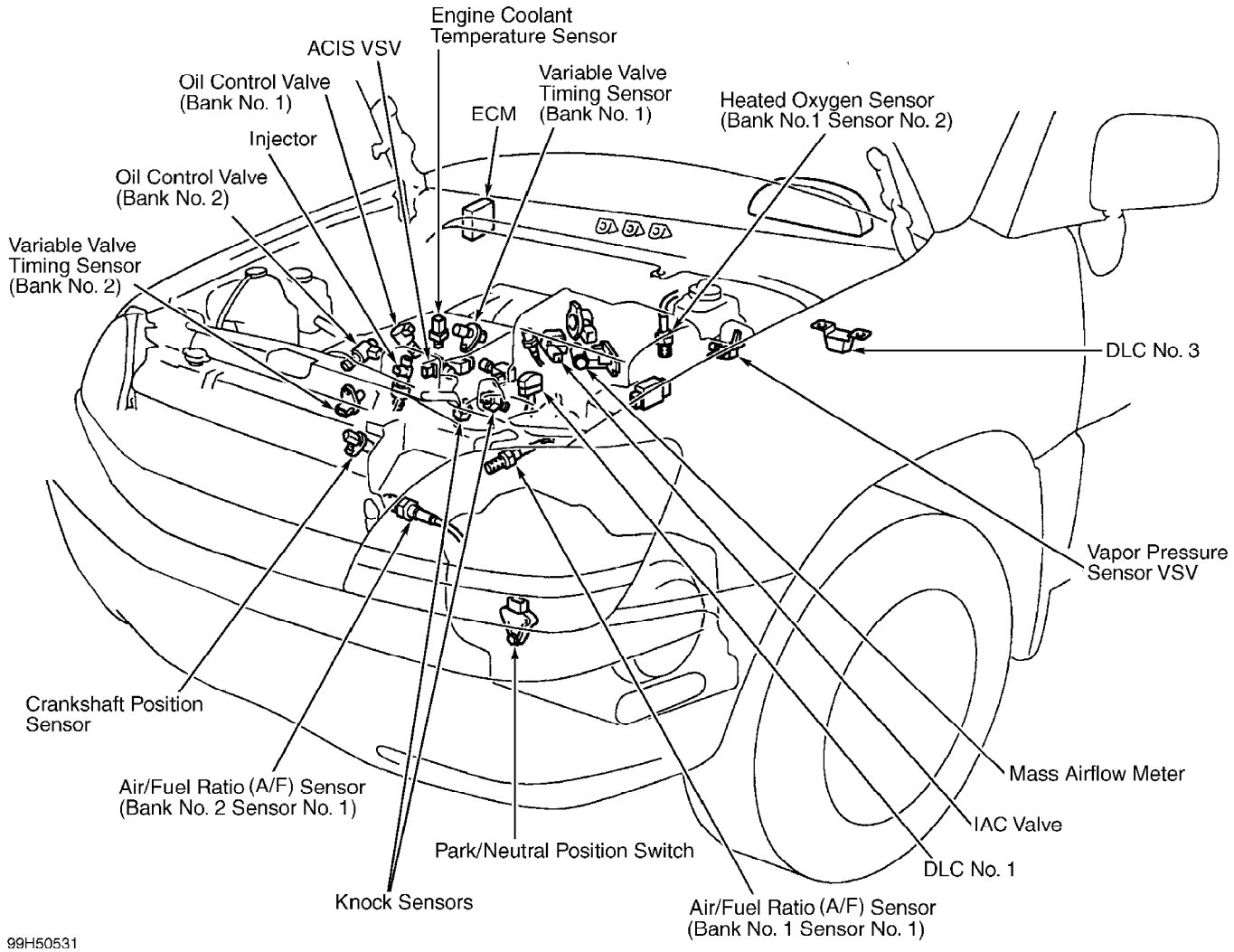


Fig. 8: Locating Computerized Engine Control Components (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

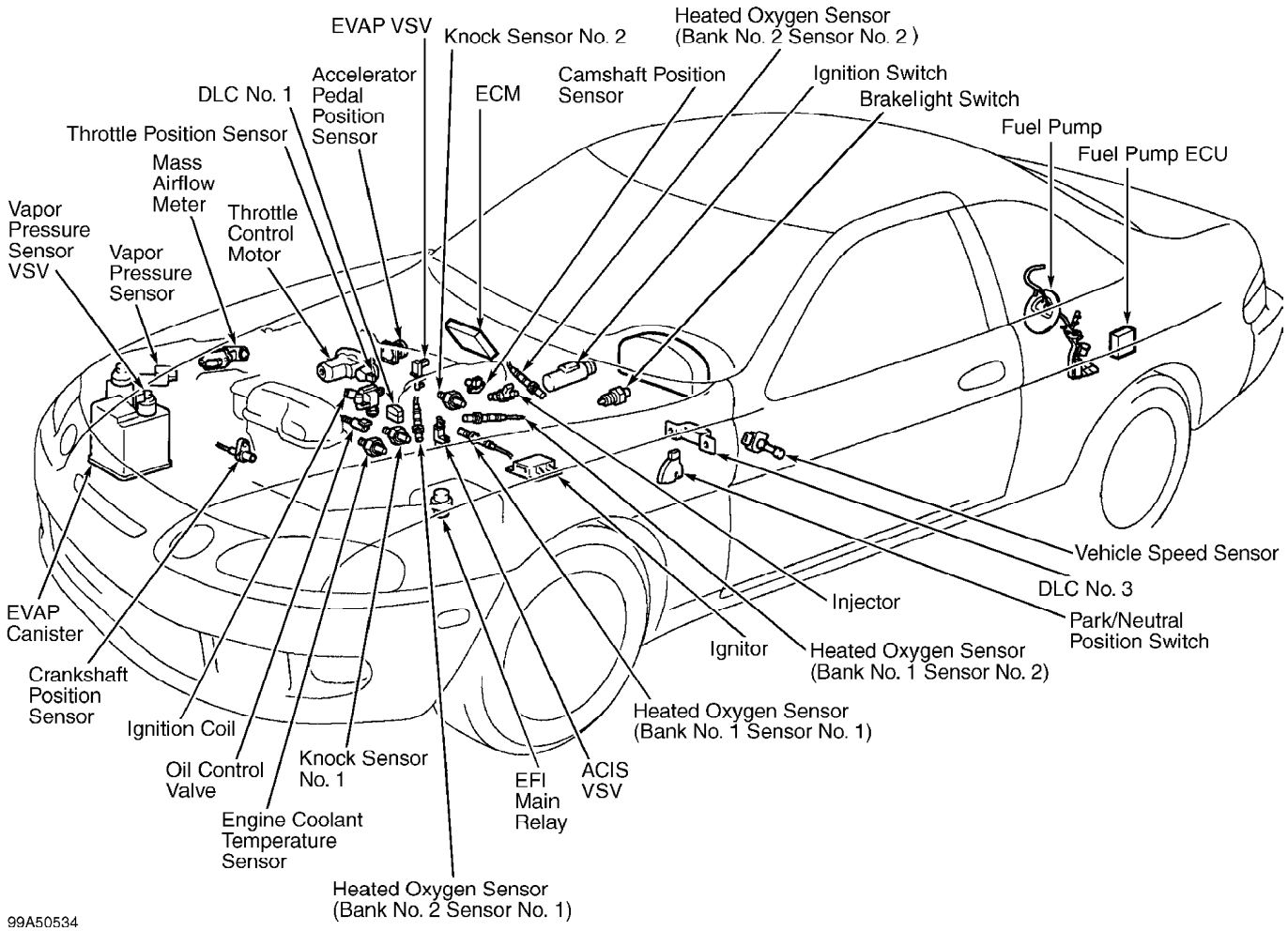


Fig. 9: Locating Computerized Engine Control Components (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

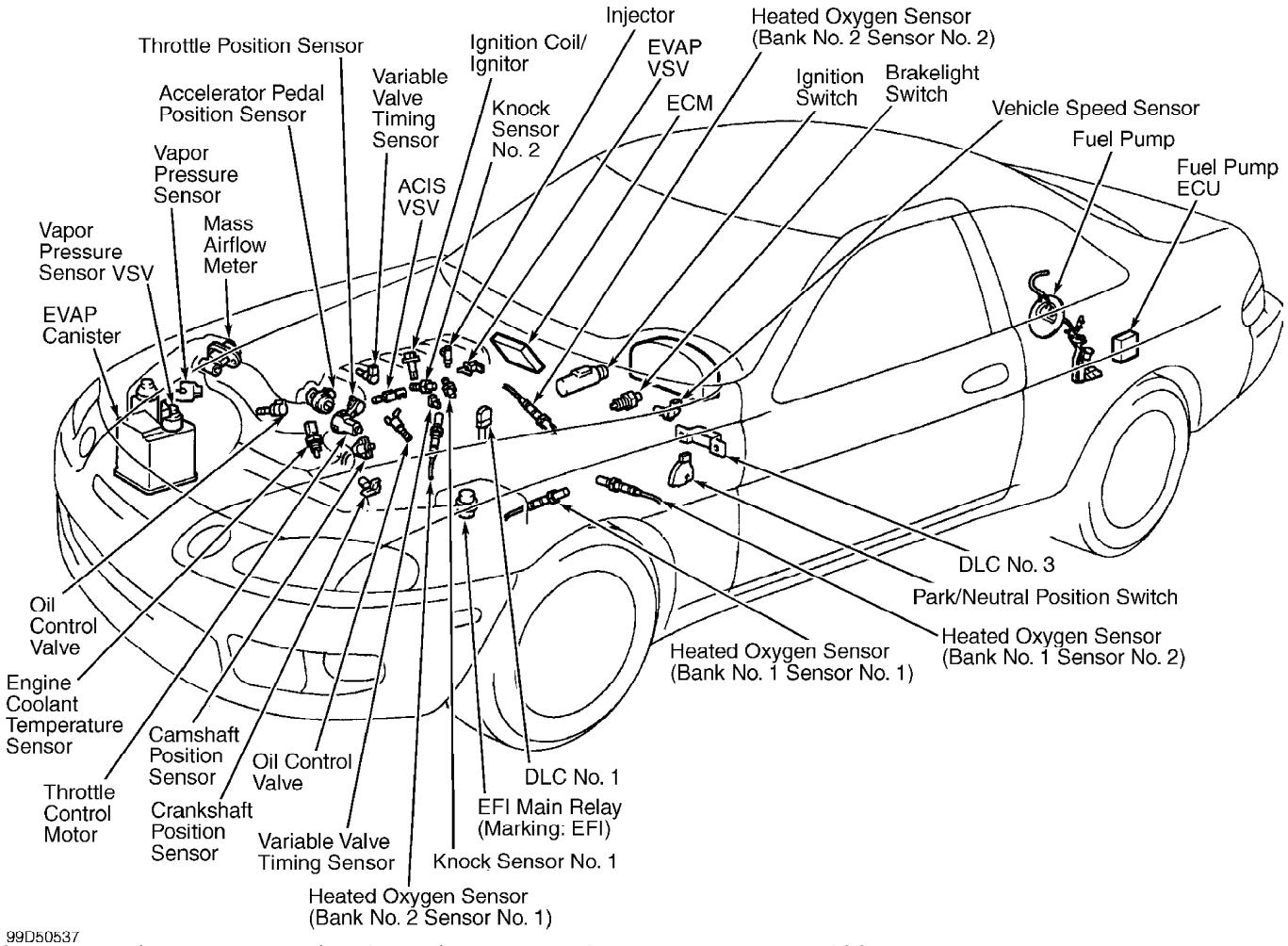


Fig. 10: Locating Computerized Engine Control Components (SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE IMMOBILIZER SYSTEM

Engine immobilizer system is a theft deterrent system that disables engine from starting by not allowing fuel injector operation and ignition system operation unless ignition key identification code matches identification code stored in the Engine Control Module (ECM). Engine immobilizer system consists of ignition key with transponder chip, transponder key coil, transponder key amplifier and ECM.

Transponder chip is incorporated into the ignition key. When ignition key is inserted into the ignition lock cylinder, the ECM instructs transponder key coil on ignition lock cylinder to supply an electromagnetic energy that enables transponder chip to transmit an ignition key identification code signal.

Transponder key amplifier then amplifies the ignition key identification code signal and delivers ignition key identification code signal to the ECM. The ECM compares received ignition key identification code signal to identification code stored in the ECM. If ignition key identification code and identification code in the ECM match, ECM will allow fuel injector operation and ignition system operation. If ignition key identification codes and identification code in the ECM do not match, ECM will not allow fuel injector operation and ignition system operation. For additional information on system operation and testing, see appropriate ENGINE IMMOBILIZER

SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.

VARIABLE VALVE TIMING (VVT) SYSTEM

NOTE: All models except LX470 have variable valve timing.

ES300 & RX300

The VVT system controls intake camshaft valve timing to provide improved torque, improved fuel economy and reduce exhaust emissions. VVT system consists of 2 oil control valves, 2 VVT controllers, crankshaft position sensor, oil pump, Engine Control Module (ECM) and associated wiring. See Fig. 11.

The exhaust camshaft is driven by the timing belt and the intake camshaft is driven by a gear on the end of the exhaust camshaft. The intake camshaft drive gear is integrated with the VVT controller to vary intake camshaft valve timing. The VVT controller consists of a housing driven from the exhaust camshaft and a vane that is attached to the intake camshaft. See Fig. 12. Oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT controller resulting in a change in valve timing.

NOTE: Variable valve timing controller may also be referred to as variable valve timing actuator. Oil control valve may also be referred to as camshaft timing oil control valve.

The oil control valve is an electrically controlled valve that receives oil pressure from the oil pump. See Fig. 13. The ECM uses input signals for engine speed, intake air volume, throttle position and engine coolant temperature to determine the operation of the oil control valve. ECM also uses input signals from VVT sensors and crankshaft position sensor for determining the actual intake camshaft valve timing. The ECM operates the oil control valve by controlling position of spool valve in the oil control valve. Positioning of spool valve determines which side of the piston the oil pressure will be applied on. By applying oil pressure on the piston, the piston will move inward or outward, causing the intake camshaft valve timing to change.

During light load, intake camshaft valve timing is retarded to provide stable engine operation. During medium load, intake camshaft valve timing is advanced to provide increased fuel economy and improved emission control. During heavy load in low to medium speed range, intake camshaft valve timing is advanced to provide increased torque. During heavy load in high speed range, intake camshaft valve timing is retarded to provide improved high speed range operation.

If a problem exists in the VVT system, a Diagnostic Trouble Code (DTC) may be stored in the ECM. DTC may be retrieved from ECM for system diagnosis using a scan tool. See SELF-DIAGNOSTICS - INTRODUCTION article.

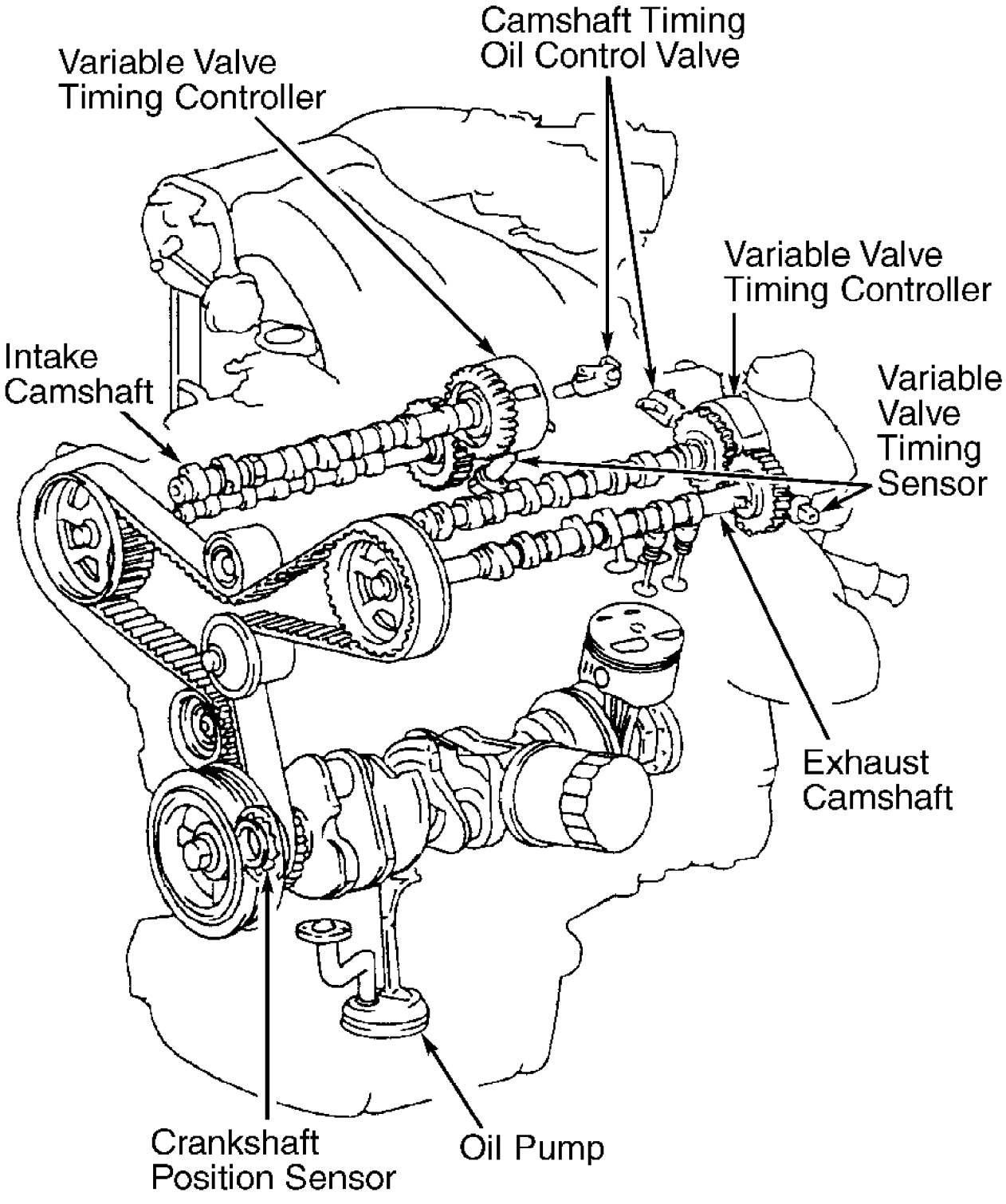


Fig. 11: Identifying Variable Valve Timing System Components (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

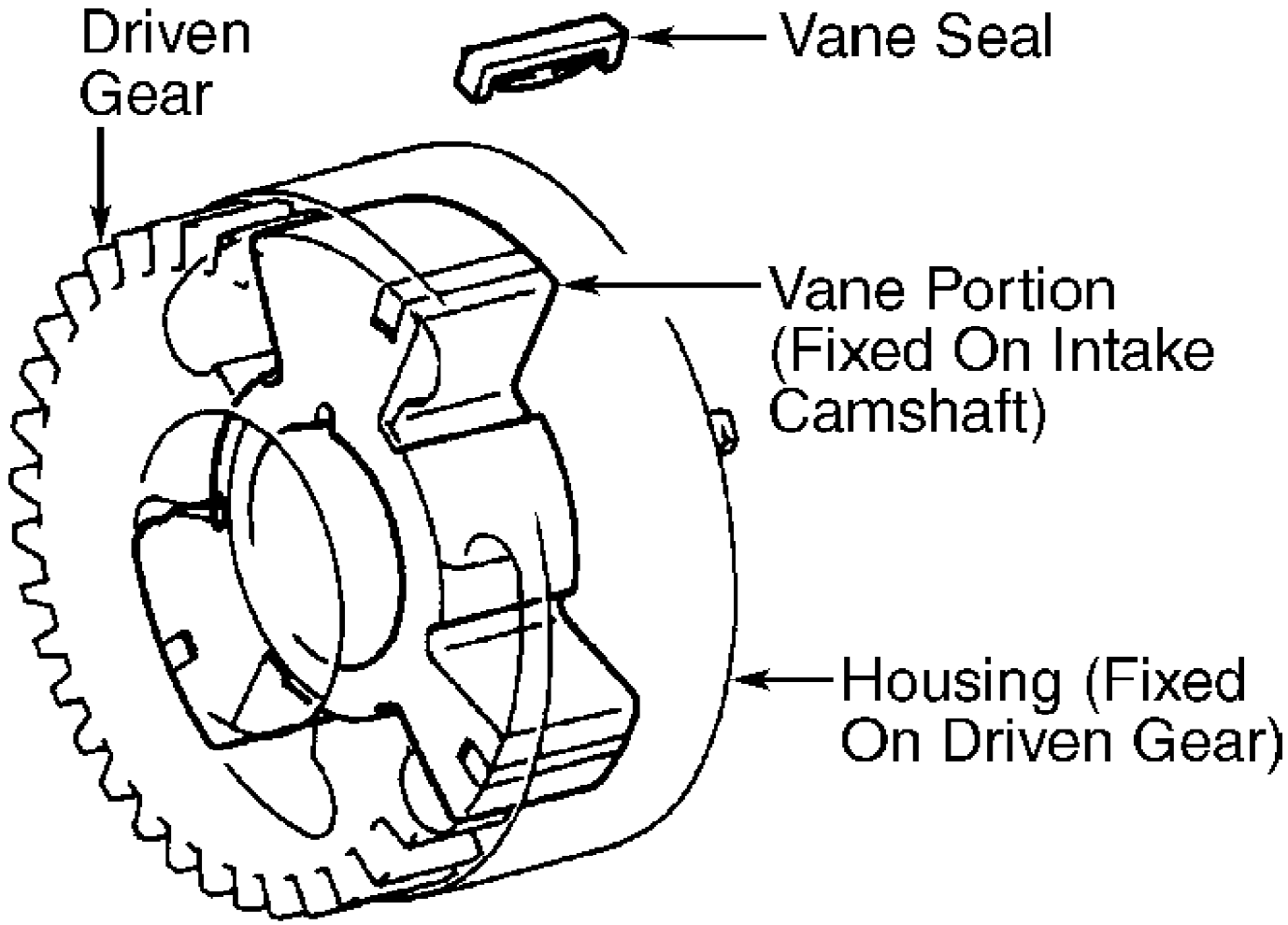


Fig. 12: Identifying Variable Valve Timing Controller Components (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

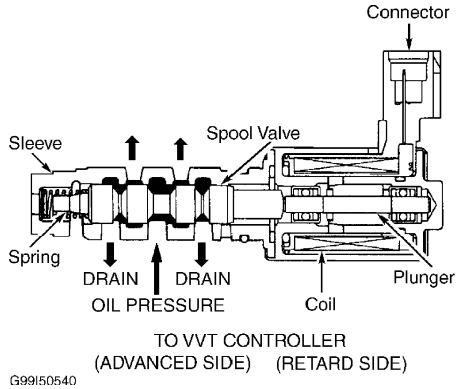


Fig. 13: Cross-Sectional View Of Oil Control Valve
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300 & SC300

The VVT system controls intake camshaft valve timing to

provide improved torque, improved fuel economy and reduce exhaust emissions. VVT system consists of a oil control valve, intake camshaft timing sprocket, crankshaft position sensor, camshaft position sensor, oil pump, Engine Control Module (ECM) and associated wiring. See Fig. 14.

Intake camshaft timing sprocket consists of an outer gear that is driven by the timing belt, inner gear that attaches to intake camshaft and a piston that moves between inner and outer gears. When the piston moves, the helical splines on the piston causes the inner and outer gear positions to change, resulting in a change in valve timing.

NOTE: Intake camshaft timing sprocket may also be referred to as intake camshaft timing pulley. Oil control valve may also be referred to as camshaft timing oil control valve.

Piston movement is determined by the oil control valve. The oil control valve is an electrically controlled valve that receives oil pressure from the oil pump. See Fig. 13. The ECM uses input signals for engine speed, intake air volume, throttle position and engine coolant temperature to determine the operation of the oil control valve. ECM also uses input signals from camshaft position sensor and crankshaft position sensor for determining the actual intake camshaft valve timing. The ECM operates the oil control valve by controlling position of spool valve in the oil control valve. Positioning of spool valve determines which side of the piston the oil pressure will be applied on. By applying oil pressure on the piston, the piston will move inward or outward, causing the intake camshaft valve timing to change.

When the engine is started or shut off, the oil control valve is positioned so intake camshaft valve timing is retarded. When engine is idling or during light load, intake camshaft valve timing is retarded to provide stable engine operation. During medium load, intake camshaft valve timing is advanced. During heavy load in low to medium speed range, intake camshaft valve timing is advanced to provide increased torque. During heavy load in high speed range, intake camshaft valve timing is retarded to provide improved high speed range operation. During cold temperature operation, intake camshaft valve timing is retarded to provide stable idle and increased fuel economy due to the lower fast idle speed.

If a problem exists in the VVT system, a Diagnostic Trouble Code (DTC) may be stored in the ECM. DTC may be retrieved from ECM for system diagnosis using a scan tool. See SELF-DIAGNOSTICS - INTRODUCTION article.

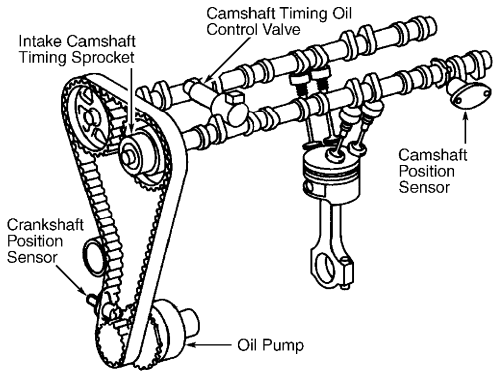


Fig. 14: Identifying Variable Valve Timing System Components (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS400, LS400 & SC400

The VVT system controls intake camshaft valve timing to provide improved torque, improved fuel economy and reduce exhaust emissions. VVT system consists of 2 oil control valves, 2 VVT controllers, crankshaft position sensor, 2 VVT sensors, oil pump and Engine Control Module (ECM). See Fig. 15.

VVT controller consists of an outer gear that is driven by the timing belt, inner gear that attaches to intake camshaft and a piston that moves between inner and outer gears. When the piston moves, the helical splines on the piston causes the inner and outer gear positions to change, resulting in a change in valve timing.

NOTE: Variable valve timing controller may also be referred to as intake camshaft timing sprocket. Oil control valve may also be referred to as camshaft timing oil control valve.

Piston movement is determined by the oil control valve. The oil control valve is an electrically controlled valve that receives oil pressure from the oil pump. See Fig. 13. The ECM uses input signals for engine speed, intake air volume, throttle position and engine coolant temperature to determine the operation of the oil control valve. ECM also uses input signals from VVT sensors and crankshaft position sensor for determining the actual intake camshaft valve timing. The ECM operates the oil control valve by controlling position of spool valve in the oil control valve. Positioning of spool valve determines which side of the piston the oil pressure will be applied on. By applying oil pressure on the piston, the piston will move inward or outward, causing the intake camshaft valve timing to change.

When the engine is started or shut off, the oil control valve is positioned so intake camshaft valve timing is retarded. When engine is idling or during low light, intake camshaft valve timing is retarded to provide stable engine operation. During medium load, intake camshaft valve timing is advanced. During heavy load in low to medium speed range, intake camshaft valve timing is advanced to provide increased torque. During heavy load in high speed range, intake camshaft valve timing is retarded to provide improved high speed range operation. During cold temperature operation, intake camshaft valve timing is retarded to provide stable idle and increased fuel economy due to the lower fast idle speed.

If a problem exists in the VVT system, a Diagnostic Trouble Code (DTC) may be stored in the ECM. DTC may be retrieved from ECM for system diagnosis using a scan tool. See SELF-DIAGNOSTICS - INTRODUCTION article.

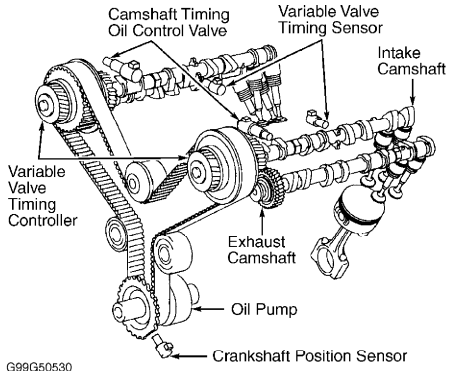


Fig. 15: Identifying Variable Valve Timing System Components (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage signals monitored by the Engine Control Module (ECM). The second category covers OUTPUT SIGNALS, which are components controlled by the ECM.

INPUT DEVICES

Vehicles are equipped with different combinations of input devices. Not all devices are used on all models. To determine the input device usage on a specific model, see appropriate wiring diagram in WIRING DIAGRAMS article.

Accelerator Pedal Position Sensor (GS300, GS400, LS400, LX470, SC300 & SC400)

Accelerator pedal position sensor is used with the ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) for controlling of the throttle operation. See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM for additional information.

NOTE: Air/Fuel (A/F) ratio sensor may also be referred to as air/fuel sensor.

Air/Fuel (A/F) Ratio Sensor (ES300 & RX300)

The heated A/F sensor monitors exhaust gas oxygen content and delivers an input signal to Engine Control Module (ECM). The ECM uses the input signal to control air/fuel ratio.

A/C Switch

When A/C is turned on, input signal is delivered to Engine Control Module (ECM). The ECM uses input signal to control engine idle speed during A/C operation.

Battery Signal

Battery voltage is always present at BATT terminal of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B terminal on ECM.

Brakelight Signal

Brakelight switch delivers an input signal to STP terminal of Engine Control Module (ECM) to indicate when brakes are applied. Input signal is mainly used for controlling fuel cut-off engine speed. Brakelight switch may also be referred to as stoplight switch.

NOTE: On ES300 and RX300, Camshaft Position (CMP) sensor is also referred to as a Variable Valve Timing (VVT) sensor. See VARIABLE VALVE TIMING SENSOR (ES300, GS400, LS400, RX300 & SC400).

Camshaft Position Sensors

The camshaft sensor contains a pick-up coil. A signal plate has one tooth on its outer circumference and is mounted on the camshaft. As the camshaft rotates, a protrusion on the signal plate passes near the pick-up coil. This induces AC voltage in the pick-up coil. The ECM senses this voltage signal and interprets it as camshaft position.

The ECM uses input signal for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system, heated oxygen sensor system and intake air control valve system. See CAMSHAFT POSITION SENSOR LOCATION table.

CAMSHAFT POSITION SENSOR LOCATION

Application	Location
GS300 & SC300	Left Rear Intake Side Of Cylinder Head
GS400, LS400, LX470 & SC400	Mounted To Front Of Left Upper (No. 3) Timing Belt Cover

Crankshaft Sensor

Crankshaft sensor contains a pick-up coil and is located at front of crankshaft, near crankshaft pulley. A signal plate (rotor) is mounted on the crankshaft pulley. As the crankshaft rotates, protrusions on the signal plate pass near the pick-up coil. This induces AC voltage in the pick-up coil. The ECM senses this voltage signal and uses it to determine engine speed and crankshaft position.

The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system, heated oxygen sensor system and intake air control valve system.

Engine Coolant Temperature (ECT) Sensor

ECT sensor contains a built-in thermistor in which resistance varies according to engine coolant temperature. ECT sensor delivers an input signal to THW terminal of Engine Control Module (ECM). ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system, engine idle speed control system, heated oxygen sensor system and operation of electronically controlled transaxles/transmissions. For ECT sensor location, see ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article.

Heated Oxygen Sensor (HO2S)

HO2S monitors exhaust gas oxygen content and generates a voltage signal that the ECM uses to determine fuel injection duration. HO2S is heated by an electric heater element.

Intake Air Temperature (IAT) Sensor

IAT sensor is part of mass airflow sensor. Intake air temperature sensor measures incoming intake air temperature and delivers an input signal to THA terminal of Engine Control Module (ECM). ECM uses input signal for controlling fuel injection duration to improve driveability during cold engine operation.

Knock Sensor

A piezoelectric ceramic element is incorporated within each knock sensor. If engine knocking occurs because of detonation, the piezoelectric element vibrates, generating voltage. Based on this voltage signal, Engine Control Module (ECM) retards ignition timing. All models are equipped with 2 knock sensors. For knock sensor location, see REMOVAL, OVERHAUL & INSTALLATION article.

Ignitor (GS300 & SC300)

Ignitor has a Black 10-pin connector and is located in engine compartment, on top of left strut tower. Primary circuit is turned off when Engine Control Module (ECM) delivers a signal to ignitor on the IGT wire, causing ignition coil to fire spark plug. After delivering a command to turn off primary circuit on IGT wire, the ECM monitors ignition confirmation signal on the IGF circuit to ensure primary switching has occurred. If IGF signal is not input to ECM, the ECM will stop fuel injection as a fail safe function.

Mass Airflow (MAF) Sensor

Airflow meter measures intake airflow volume. Engine Control Module (ECM) accomplishes this by applying a reference voltage to a

hot wire in the MAF sensor. As intake air flows across the hot wire, the resistance value changes, causing the reference voltage to change. ECM uses voltage signal to control fuel injection duration and ignition timing. MAF sensor also contains an intake air temperature sensor which is used to measure intake air temperature. See INTAKE AIR TEMPERATURE SENSOR.

Park/Neutral Position (PNP) Switch

PNP switch controls voltage signals to Engine Control Module (ECM) to indicate transaxle/transmission gear position. PNP switch is located on side of transaxle/transmission.

Throttle Position (TP) Sensor

Throttle Position (TP) sensor is located on side of throttle body. The TP sensor delivers an input signal indicating throttle valve opening angle to Engine Control Module (ECM). Voltage signal to ECM increases as throttle opening increases. With throttle fully closed, ECM should receive a voltage signal of about .7 volt. With throttle wide open, voltage signal should be about 2.7-5.2 volts. The ECM uses this input signal for adjusting air/fuel mixture, power increase correction and fuel cut-off operation.

Vapor Pressure Sensor

The Engine Control Module (ECM) monitors fuel tank pressure to determine if a leak or an abnormality exists in the EVAP system. A vapor pressure sensor Vacuum Switching Valve (VSV) is located in the vapor line to the EVAP canister. The ECM will operate the VSV, allowing vapor pressure sensor to monitor the fuel tank pressure and EVAP system. EVAP delivers an input signal to ECM to indicate fuel tank pressure.

NOTE: GS300 and SC300 models are equipped with variable valve timing but use the camshaft position sensor instead of Variable Valve Timing (VVT) sensors to determine camshaft position. See CAMSHAFT POSITION SENSOR. On ES300 and RX300, VVT sensor may also be referred to as camshaft position sensor.

Variable Valve Timing Sensor (ES300, GS400, LS400, RX300 & SC400)

The Variable Valve Timing (VVT) sensor consists of a signal plate and pick-up coil. The signal plate has one tooth and is mounted on each intake camshaft. When camshafts rotate, protrusion on the signal plate and the air gap on the pick-up coil changes causing fluctuations in the magnetic field and generates an electromotive force in the pick-up coil. The VVT sensor provides a feedback signal to ECM in order to control intake valve timing. See VARIABLE VALVE TIMING SENSOR LOCATION table.

VARIABLE VALVE TIMING SENSOR LOCATION

Application	Location
ES300 & RX300	Mounted On Outer Corner Of Each Cylinder Head, Just Below Valve Cover (Oil Filler Cap End)
GS400, LS400 & SC400	Top Of Engine, Mounted On Intake Side Of Each Cylinder Head

Vehicle Speed Sensor (GS300, LS400, LX470, SC300 & SC400)

Vehicle speed sensor is mounted near rear of transaxle/transmission. Vehicle speed sensor outputs a 4-pulse input signal for every revolution of the drive gear in

transaxle/transmission to the instrument cluster where input signal is converted to a rectangular waveform and then sent to Engine Control Module (ECM). ECM determines vehicle speed by using input signal and may use input signal for controlling fuel injection system and electronically controlled automatic transaxle/transmission (if equipped).

Vehicle Speed Sensor (ES300, GS400 & RX300)

Wheel speed sensors on each wheel deliver an input signal to Anti-Lock Brake System (ABS) Electronic Control Unit (ECU). ABS ECU converts input signals from wheel speed sensors to a 4-pulse input signal to the instrument cluster. Instrument cluster then converts 4-pulse input signal to a rectangular waveform and then sends input signal to Engine Control Module (ECM). ECM determines vehicle speed by using input signal. ECM uses input signal for controlling fuel injection system and electronic control of automatic transmission/transaxle.

OUTPUT SIGNALS

NOTE: Vehicles are equipped with different combinations of computer-controlled components. Not all components listed below are used on every vehicle. For theory and operation of each output component, refer to system indicated after component.

ACIS Vacuum Switching Valve (VSV)

See ACOUSTIC CONTROL INDUCTION SYSTEM (ACIS) under AIR INDUCTION SYSTEM.

A/F Heater Relay

See FUEL DELIVERY under FUEL SYSTEM.

Circuit Opening Relay

See FUEL DELIVERY under FUEL SYSTEM.

EFI Main Relay

See FUEL DELIVERY under FUEL SYSTEM.

Electronically Controlled Transmission/Transaxle

See TRANSMISSION/TRANSAXLE under MISCELLANEOUS CONTROLS.

Electronic Spark Advance System

See DISTRIBUTORLESS IGNITION SYSTEM under IGNITION SYSTEM.

EVAP Canister Vacuum Switching Valve

See EVAPORATIVE EMISSION (EVAP) SYSTEM under EMISSION SYSTEMS.

Fuel Injectors

See FUEL CONTROL under FUEL SYSTEM.

Fuel Pump

See FUEL DELIVERY under FUEL SYSTEM.

Fuel Pump Electronic Control Unit

See FUEL DELIVERY under FUEL SYSTEM.

Idle Speed Control System

See IDLE SPEED under FUEL SYSTEM.

Intake Air Control Valve

See ACOUSTIC CONTROL INDUCTION SYSTEM (ACIS) under AIR

INDUCTION SYSTEM.

Malfunction Indicator Light
See SELF-DIAGNOSTIC SYSTEM.

Self-Diagnostics
See SELF-DIAGNOSTIC SYSTEM.

Throttle Control Motor
See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Air/Fuel (A/F) Heater Relay (ES300 & RX300)
A/F HTR relay may also be referred to as A/F heater relay. A/F HTR relay is located in fuse/relay box in left side of engine compartment. Constant battery voltage is supplied from battery, through A/F HTR fuse to one side of A/F HTR relay. When A/F HTR relay is energized by MREL terminal of Engine Control Module (ECM), A/F HTR relay provides battery voltage to +B terminal at A/F ratio sensor.

Circuit Opening Relay (ES300 & RX300)
On RX300, circuit opening relay may be located in fuse/relay box on left side of engine compartment or relay box under left side of instrument panel. On ES300, circuit opening relay is located in fuse/relay box on left side of engine compartment. On all models, relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation.

Circuit Opening Relay (LS400)
Circuit opening relay is located in fuse/relay box in left side of engine compartment. Circuit opening relay controls fuel pump circuit by supplying voltage to fuel pump relay. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When ignition is turned on, voltage is supplied through IGN fuse to other side of circuit opening relay. When proper input signals are delivered to Engine Control Module (ECM), circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump relay which supplies voltage to fuel pump for fuel pump operation.

EFI Main Relay (ES300 & RX300)
The EFI fuse supplies constant battery voltage to EFI main relay. Relay is located in fuse/relay box in left side of engine compartment. When EFI main relay is energized, the EFI main relay provides battery voltage to circuit opening relay, data link connector and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of ECM.

EFI Main Relay (GS300, GS400, SC300 & SC400)
EFI main relay may also be referred to as EFI relay. On GS300 and GS400, relay is located in fuse/relay box in right side of engine compartment. On SC300 and SC400, relay is located in fuse/relay box in left side of engine compartment. On all models, EFI fuse supplies constant battery voltage to one side of EFI main relay. When EFI main

relay is energized by MREL terminal of Engine Control Module (ECM), EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components.

EFI Main Relay (LS400)

EFI main relay may also be referred to as EFI relay. Relay is located in fuse/relay box in left side of engine compartment. EFI fuse No. 1 supplies constant battery voltage to one side of EFI main relay. EFI main relay is energized by MREL terminal of Engine Control Module (ECM). When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay, EFI fuse No. 2 and to data link connector No. 1 and various other electrical components. EFI main relay also provides battery voltage to +B and +B1 terminals of ECM.

EFI Main Relay (LX470)

EFI main relay may also be referred to as EFI relay or ECD relay. Relay is located in fuse/relay box in left side of engine compartment. EFI fuse supplies constant battery voltage to one side of EFI main relay. EFI fuse may also be referred to as ECD fuse. When EFI main relay is energized by MREL terminal of Engine Control Module (ECM), EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components.

Fuel Pump (ES300 & RX300)

Electric fuel pump is mounted in the fuel tank. Fuel pump operates at one specified speed.

Fuel Pump & Fuel Pump Electronic Control Unit (GS300 & GS400)

Fuel pump operating speed (low, medium or high) is controlled by the operating condition of the engine such as: starting, idling, light load or heavy load. The Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump Electronic Control Unit (ECU) in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed. Fuel pump is located in fuel tank. Fuel pump ECU is located behind trim panel in upper left corner of luggage compartment.

Fuel Pump, Fuel Pump Electronic Control Unit & Fuel Pump Switch (LX470)

Fuel pump operating speed (low, medium or high) is controlled by the operating condition of the engine such as: starting, idling, light load or heavy load. The Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump Electronic Control Unit (ECU) in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed. Fuel pump is located in fuel tank. Fuel pump ECU is located behind inner panel, just behind driver’s side rear wheelwell. It may be necessary to remove rear seat back and seat cushion to access ECU.

Fuel pump switch is in the circuit between FPC terminal on ECM and FPC terminal on fuel pump ECU. Fuel pump switch may also be referred to as fuel pump inertia switch or fuel pump control switch. If vehicle is involved in a collision, fuel pump switch will shut off fuel pump by opening this circuit, and not allowing any input signal to be delivered from ECM to fuel pump ECU. Fuel pump switch is located on driver’s side, under front carpet, next to front console box. See Fig. 16. Fuel pump switch contains a reset switch which has an OFF and ON position. See Fig. 16. Continuity will exist between electrical terminals on fuel pump switch with reset switch in ON position, and no

continuity in OFF position. Reset switch must be in ON position for fuel pump operation.

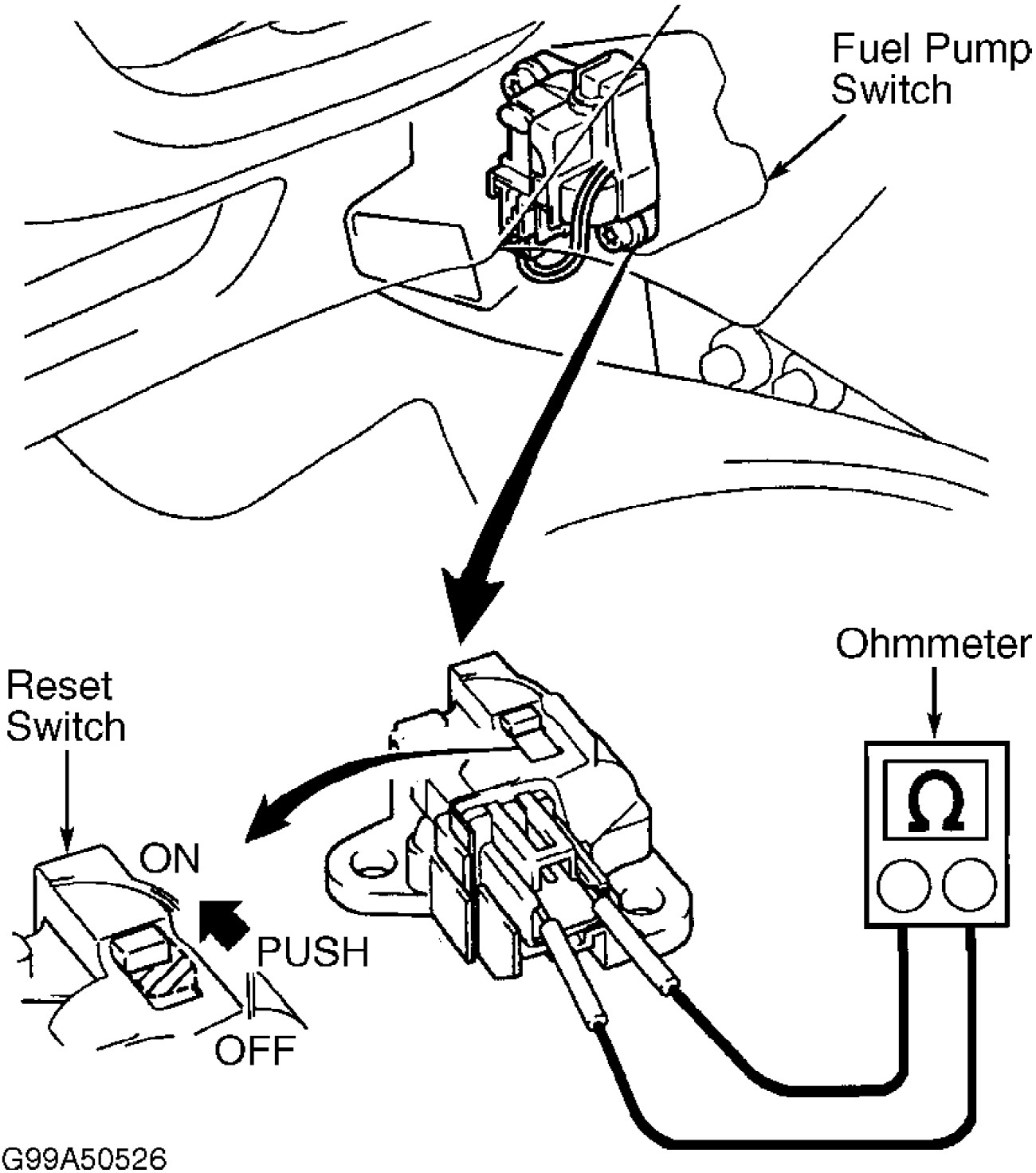


Fig. 16: Locating Fuel Pump Switch & Identifying Reset Switch Positions (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pump & Fuel Pump Electronic Control Unit (SC300 & SC400)

Fuel pump operating speed (low or high) is controlled by the operating condition of the engine such as: starting, idling, light load or heavy load. The Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump Electronic Control Unit (ECU) in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed. Fuel pump is located in fuel tank. Fuel pump ECU is located behind trim panel on inside of left rear quarter panel. It may be necessary to remove rear seat back and seat cushion to access ECU.

Fuel Pump, Fuel Pump Relay & Fuel Pump Resistor (LS400)

Fuel pump operating speed is controlled by operating condition of the engine such as: starting, idling, light load or heavy load. When engine is cranking and start signal is received at Engine Control Module (ECM), the ECM energizes circuit opening relay and voltage is applied to both sides of fuel pump relay. Fuel pump relay contacts are closed to one side and voltage is applied directly to fuel pump in which fuel pump operates at high speed. After engine starts during idling or light loads, fuel pump relay is energized by FPR terminal of ECM and contacts in fuel pump relay close to other side of relay. Voltage is then supplied to fuel pump by going from fuel pump relay through fuel pump resistor. Fuel pump now operates at low speed. Fuel pump is mounted in the fuel tank. Fuel pump relay is located in fuse/relay box at driver's side front corner of engine compartment, near battery. Fuel pump resistor is located at driver's side front corner of engine compartment, near end of fuse/relay box.

Fuel Pressure Regulator (Except LX470)

Fuel system is a returnless fuel system with fuel pressure regulator mounted on the fuel pump in the fuel tank. Fuel pressure regulator maintains constant fuel pressure to the fuel injectors.

Fuel Pressure Regulator (LX470)

Mounted on fuel rail, vacuum-operated fuel pressure regulator maintains constant fuel pressure to fuel injectors. As throttle is depressed and manifold vacuum decreases, fuel pressure regulator increases fuel pressure to maintain a constant fuel flow to fuel injectors.

Fuel Pressure Pulsation Damper (GS300 & SC300)

Fuel pressure pulsation damper lessens the effects of fuel pressure surges that occur when the injectors open. Damper is located in fuel inlet line near intake manifold.

FUEL CONTROL

Fuel-Cut System

During deceleration from high engine speed with throttle valve completely closed, the ECM stops fuel injection to improve fuel economy and lower exhaust emissions. When engine speed falls to less than a predetermined RPM or throttle valve is opened, fuel injection is resumed. Fuel cut-off and fuel injection resumption speeds are high when coolant temperature is low.

Fuel Injectors

Fuel injectors are electrically operated solenoids which deliver fuel to individual cylinders. Engine Control Module (ECM) controls fuel injector duration based on various input signals to determine air/fuel mixture. Fuel injector is energized when the ECM grounds the injector's circuit.

IDLE SPEED

Idle Speed Control System (ES300 & RX300)

Engine Control Module (ECM) is programmed with engine idle speed values. Idle speed control system provides a stable idle speed when engine is cold or idle speed decreases due to electrical load etc. ECM uses various input signals to maintain proper idle speed by controlling Idle Air Control (IAC) valve. IAC valve is located under No. 1 throttle body.

Throttle Opener (ES300 & RX300)

Throttle opener, mounted on No. 2 throttle body is vacuum controlled and allows engine to return to specified RPM after throttle is released.

Throttle Control Motor (GS300, GS400, LS400, LX470, SC300 & SC400)

Throttle control motor is used with the Electronic Throttle Control System (ETCS) for controlling the throttle operation and idle speed. See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM for additional information.

IGNITION SYSTEM

DISTRIBUTORLESS IGNITION SYSTEM

NOTE: The distributorless ignition system may be referred to as Electronic Spark Advance (ESA) system.

ES300 & RX300

Distributorless Ignition System (DIS) uses Engine Control Module (ECM) for determining ignition timing (spark advance). ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signals.

Two Variable Valve Timing (VVT) sensors and a crankshaft position sensor deliver input signals to ECM. VVT sensors may also be referred to as camshaft position sensors. ECM detects standard crankshaft position based on VVT sensor input signals and actual crankshaft position, and engine speed by crankshaft position sensor input signals. One VVT sensor is mounted in outer corner of each cylinder head, just below valve cover (oil filler cap end). Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. For knock sensor location, see REMOVAL, OVERHAUL & INSTALLATION article.

The ECM uses 6 ignition primary control signals to the ignitors for the ignition coils. The DIS uses 6 ignition coils with internal ignitors, one ignition coil for each cylinder. Cylinder No. 1 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3 and 5 are on right side of engine. Cylinders No. 2, 4 and 6 are on left side of engine.

ECM monitors IGF circuit at ignitor to ensure ignition coils have fired.

GS300 & SC300

The Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft

position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located on left rear intake side of cylinder head. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. For knock sensor location, see REMOVAL, OVERHAUL & INSTALLATION article.

The ECM uses 3 ignition primary control signals to the ignitor for the ignition coils. The DIS uses 3 ignition coils to fire 2 cylinders simultaneously using the same ignition coil. Cylinder No. 1 is front cylinder at front of engine. Cylinder No. 6 is the rear cylinder at flywheel end of engine. One ignition coil is mounted on top of spark plug on cylinders No. 2, 4 and 6. Spark plug wires are routed from ignition coils on top of spark plugs to the spark plugs on the remaining cylinders. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.

GS400, LS400, LX470 & SC400

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signals.

Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is mounted to front of left upper (No. 3) timing belt cover. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. For knock sensor location, see REMOVAL, OVERHAUL & INSTALLATION article.

The ECM uses 8 ignition primary control signals to the ignitors for the ignition coils. The DIS uses 8 ignition coils with internal ignitors, one ignition coil for each cylinder. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3, 5 and 7 are on left side of engine. Cylinders No. 2, 4, 6 and 8 are on right side of engine.

The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired. The ECM stops fuel injection as a fail-safe function if IGF signal if ECM does not receive the IGF signal.

EMISSION SYSTEMS

EVAPORATIVE EMISSION (EVAP) SYSTEM

The EVAP system prevents fuel tank gasoline vapors from escaping into the atmosphere. Fuel tank gasoline vapors are routed through EVAP canister into intake manifold for combustion in the cylinders.

The Engine Control Module (ECM) monitors fuel tank pressure to determine if a leak or an abnormality exists in the EVAP system. A vapor pressure sensor Vacuum Switching Valve (VSV) is located in vapor line to the EVAP canister. The ECM will operate the vapor pressure VSV, allowing vapor pressure sensor to monitor the fuel tank pressure and EVAP system. Vapor pressure sensor delivers an input signal to ECM to indicate fuel tank pressure. If a leak or an abnormality exists in the EVAP system, a diagnostic trouble code will be stored in the ECM.

An EVAP Vacuum Switching Valve (VSV) is used to control EVAP system. The ECM operates EVAP VSV which controls the vacuum flow for EVAP operation. For EVAP system testing and component locations, see EMISSION SYSTEMS & SUB-SYSTEMS in appropriate SYSTEM & COMPONENT TESTING article.

ON-BOARD REFILLING VAPOR RECOVERY (ORVR) SYSTEM

ES300, GS300, GS400 & RX300

ORVR system is used to recover fuel vapors into EVAP canister that are generated during refueling. ORVR system consists of fuel inlet pipe, overfill check valve and EVAP canister. See Fig. 17.

When fuel tank cap is removed, atmospheric pressure is applied to port "A" on overfill check valve. See Fig. 18. Overfill check valve may also be referred to as ORVR-OCKV or fill check valve. When fuel flows into fuel inlet pipe and fuel tank, the pressure in fuel tank increases. Increased pressure in fuel tank causes valve "B" on overfill valve to open, allowing fuel vapors to flow into EVAP canister. When fuel tank is full, valve "C" closes, shutting off vapor flow to EVAP canister.

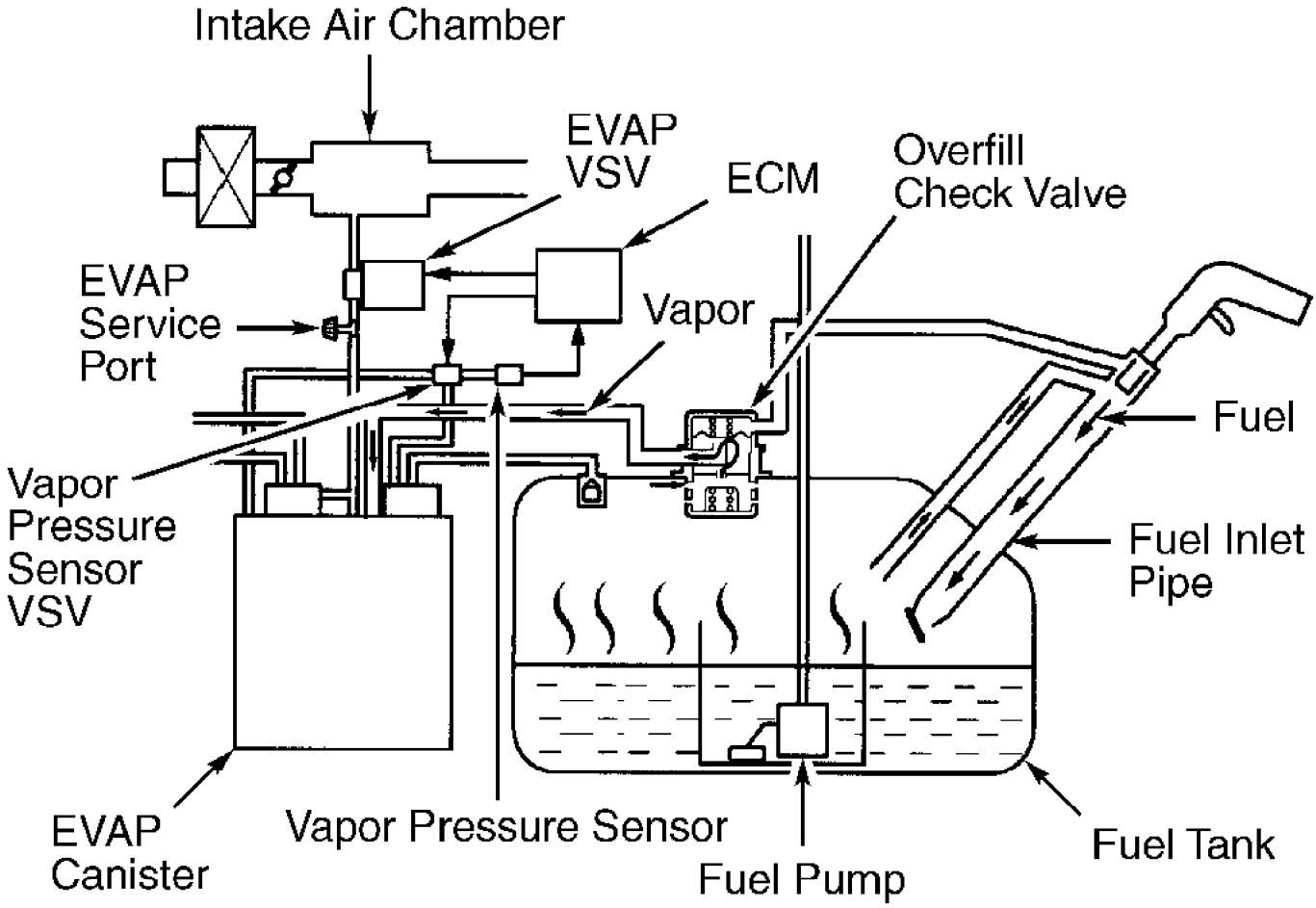


Fig. 17: Identifying Typical ORVR System Components (ES300, GS300, GS400 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

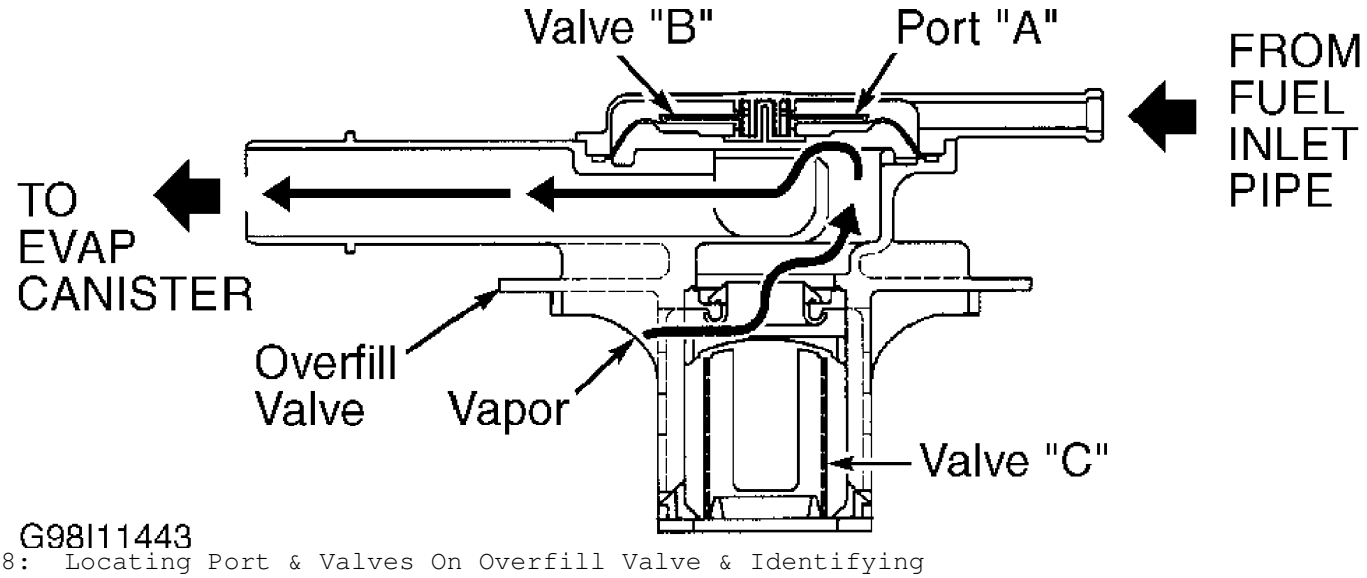


Fig. 18: Locating Port & Valves On Overfill Valve & Identifying Vapor Flow (ES300, GS300, GS400 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

Positive Crankcase Ventilation (PCV) system prevents crankcase vapors from escaping into the atmosphere. Crankcase vapors are routed from crankcase through a vacuum-controlled PCV valve and then delivered back into the cylinders. PCV system provides primary control of crankcase blow-by vapors, according to manifold vacuum. When manifold vacuum is high (at idle), PCV restricts vapor flow to maintain a smooth idle condition.

SELF-DIAGNOSTIC SYSTEM

MALFUNCTION INDICATOR LIGHT (MIL)

Engine Control Module (ECM) is equipped with self-diagnostic system. By analyzing various input signals, ECM detects system malfunctions related to various operating parameters. When malfunction occurs, ECM will inform the driver by turning on Malfunction Indicator Light (MIL) on the instrument panel. If self-diagnostic system detects a fault, it stores a trouble code in the ECM memory, and grounds the MIL circuit, which causes the MIL to come on. For more information, see SELF-DIAGNOSTICS - INTRODUCTION article.

Diagnostic Trouble Codes (DTC) may be set by malfunction of various engine sensors, switches or circuits. DTC is stored in ECM memory. When DTC is stored, MIL on instrument panel will come on. DTC can be retrieved for system diagnosis. For additional information on self-diagnostic system, see SELF-DIAGNOSTICS - INTRODUCTION article.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if they malfunction.

TRANSMISSION/TRANSAXLE

NOTE: Only electronically controlled transmissions/transaxles are

covered. Some models have transmissions and transaxles that are not electronically controlled.

Electronically Controlled Transmission/Transaxle

Engine Control Module (ECM) uses input signals for controlling transmission/transaxle operation.

F - BASIC TESTING

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Basic Diagnostic Procedures
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

NOTE: Vehicles are equipped with an engine immobilizer system. Engine immobilizer system is a theft deterrent system which disables the engine from starting by not allowing ignition system operation and fuel injector operation unless ignition key identification code matches identification code stored in Engine Control Module (ECM). For additional information on system operation and testing, see appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.

INTRODUCTION

The following diagnostic steps will help prevent overlooking a simple problem. This is also where to begin diagnosis for a no-start condition. The first step in diagnosing any driveability problem is verifying the customer's complaint with a test drive under the conditions the problem reportedly occurred.

Before entering self-diagnostics, perform a careful and complete visual inspection. Most engine control problems result from mechanical breakdowns, poor electrical connections or damaged/misrouted vacuum hoses. Before condemning the computerized system, perform each test listed in this article.

NOTE: Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure.

PRELIMINARY INSPECTION & ADJUSTMENTS

VISUAL INSPECTION

Visually inspect all electrical wiring, looking for chafed, stretched, cut or pinched wiring. Ensure electrical connectors fit tightly and are not corroded. Ensure vacuum hoses are properly routed and are not pinched or cut. See VACUUM DIAGRAMS article to verify routing and connections (if necessary). Inspect air induction system for possible vacuum leaks.

MECHANICAL INSPECTION

Compression

Warm engine to normal operating temperature before checking the compression. Ensure battery is fully charged. Remove ignition coils and spark plugs. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Check engine mechanical condition with a compression gauge, vacuum gauge, or engine analyzer with throttle fully open. See engine analyzer manual for specific instructions. See COMPRESSION SPECIFICATIONS. Install and tighten spark plugs to 13 ft. lbs. (18 N.m).

COMPRESSION SPECIFICATIONS

Application	Specification
Normal Compression Pressure	
ES300	218 psi (15.3 kg/cm²)
GS300 & SC300	192 psi (13.5 kg/cm²)
GS400, LS400 & SC400	178 psi (12.5 kg/cm²)
LX470	192 psi (13.5 kg/cm²)
RX300	218 psi (15.3 kg/cm²)
Minimum Compression Pressure	
ES300	145 psi (10.1 kg/cm²)
GS300 & SC300	156 psi (11.0 kg/cm²)
GS400, LS400, LX470 & SC400	142 psi (10.0 kg/cm²)
RX300	145 psi (10.1 kg/cm²)
Maximum Variation Between Cylinders	
All Models	14 psi (1.0 kg/cm²)

FUEL SYSTEM

Basic diagnosis of fuel system should begin by checking fuel pump operation and fuel pressure.

WARNING: ALWAYS release fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

FUEL PUMP OPERATION

NOTE: Electric fuel pump is located in the fuel tank. Electric fuel pump operation may be checked by using scan tool or by applying battery voltage to electric fuel pump with electric fuel pump installed in the fuel tank.

Checking Fuel Pump Operation Using Scan Tool (ES300 & RX300)

1) Connect scan tool to data link connector No. 3. See Figs. 1 and 2. Turn ignition on. DO NOT start engine.

2) Turn scan tool on. Select ACTIVE TEST mode on scan tool. Using scan tool manufacturer's instructions, activate fuel pump. On ES300, listen for fuel pump operating sound and feel for fuel pressure in fuel inlet line at fuel filter. On RX300, listen for fuel pump operating sound and feel for fuel pressure in fuel inlet line that goes from rear of fuel rail to the fuel inlet pipe. On all models, turn ignition off. Remove scan tool. If fuel pump operates, check fuel pressure. See FUEL PRESSURE.

3) If fuel pump does not operate, EFI main relay or circuit opening relay may be defective. For relay application and explanation of relay operation, see FUEL PUMP CONTROL CIRCUIT. For testing of EFI main relay or circuit opening relay, see appropriate SYSTEM & COMPONENT TESTING article.

4) If relays are okay, check for defective fuses, fusible links or wiring. See appropriate wiring diagram in WIRING DIAGRAMS article. If fuses, fusible links and wiring are okay, check for defective fuel pump. See CHECKING FUEL PUMP OPERATION BY APPLYING BATTERY VOLTAGE TO FUEL PUMP. If fuel pump operates, check fuel pump control circuit. See FUEL DELIVERY under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article.

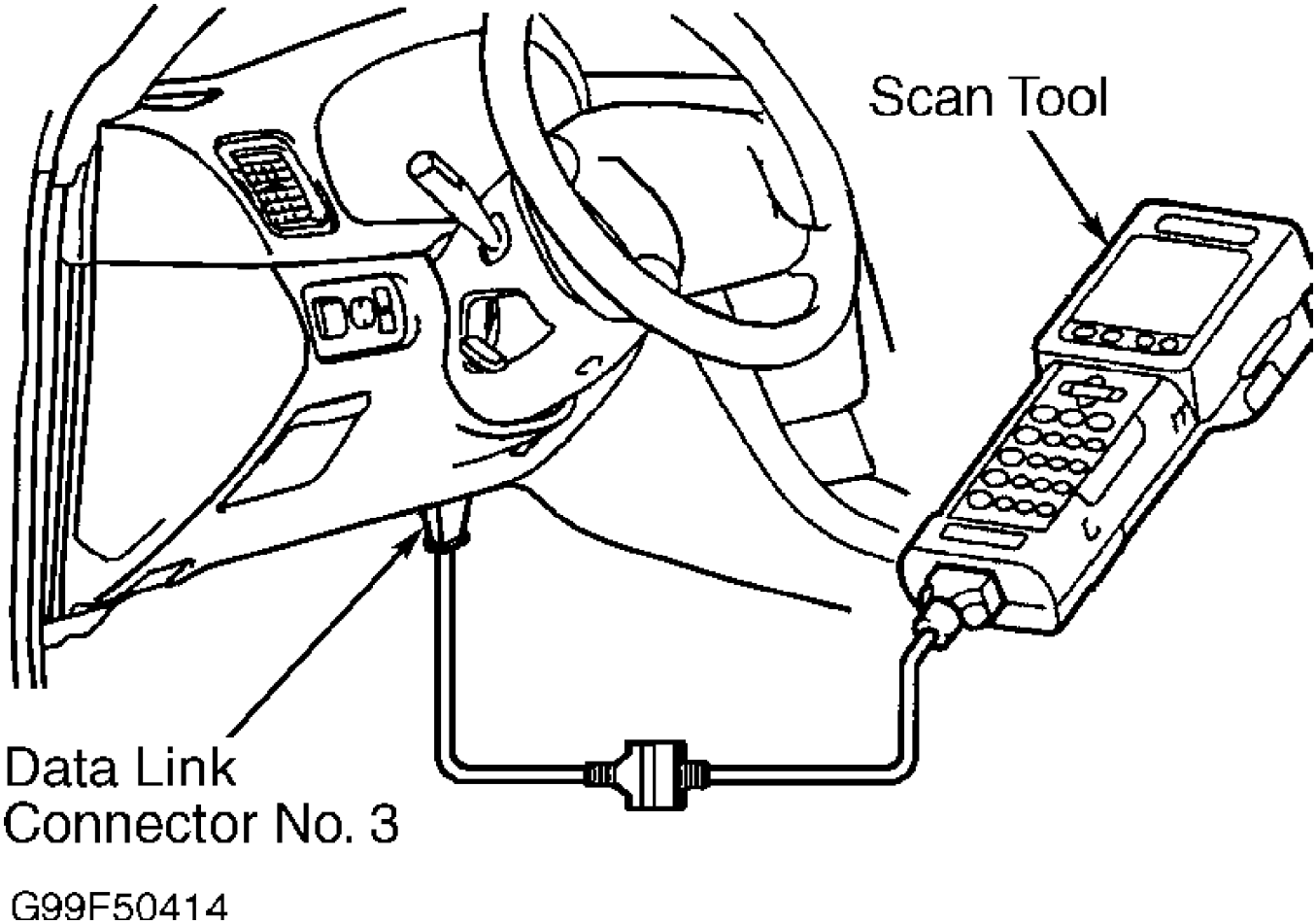


Fig. 1: Connecting Scan Tool To Data Link Connector No. 3 (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

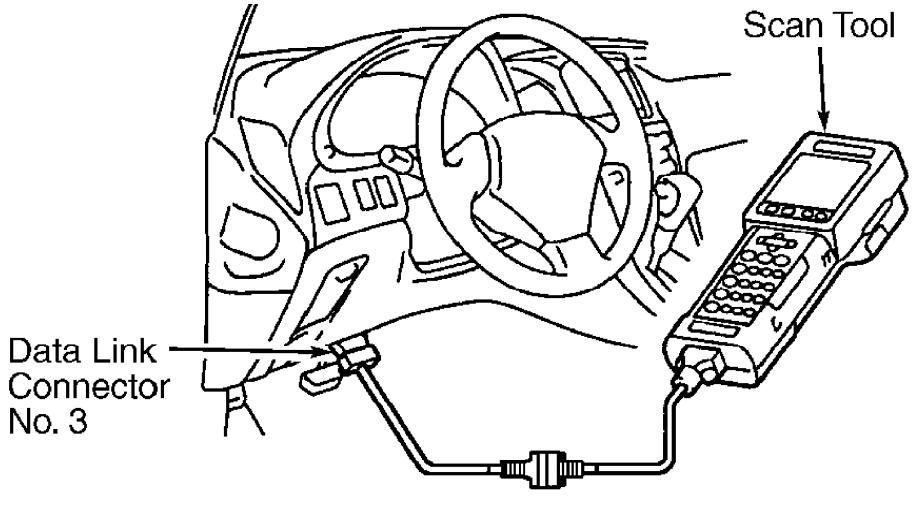


Fig. 2: Connecting Scan Tool To Data Link Connector No. 3 (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Checking Fuel Pump Operation Using Scan Tool (GS300, GS400, SC300 & SC400)

1) Connect scan tool to data link connector No. 3. See Fig. 3 . Turn ignition on. DO NOT start engine.

2) Turn scan tool on. Select ACTIVE TEST mode on scan tool. Using scan tool manufacturer's instructions, activate fuel pump. On GS300 and SC300, listen for fuel pump operating sound and check that screw at center of fuel pressure pulsation damper moves upward due to the fuel pressure. See Fig. 4. Fuel pulsation damper is located at firewall end of fuel rail. On GS400 and SC400, listen for fuel pump operating sound and feel for fuel pressure in fuel inlet hose to rear of the fuel rails.

3) On all models, turn ignition off. Remove scan tool. If fuel pump operates, check fuel pressure. See FUEL PRESSURE. If fuel pump does not operate, EFI main relay or fuel pump Electronic Control Unit (ECU) may be defective. For explanation of EFI main relay and fuel pump ECU operation, see FUEL PUMP CONTROL CIRCUIT. For testing of EFI main relay, see appropriate SYSTEM & COMPONENT TESTING article.

4) If EFI main relay is okay, check for defective fuses, fusible links or wiring. See appropriate wiring diagram in WIRING DIAGRAMS article. If fuses, fusible links and wiring are okay, check for defective fuel pump. See CHECKING FUEL PUMP OPERATION BY APPLYING BATTERY VOLTAGE TO FUEL PUMP. If fuel pump operates, check fuel pump control circuit. See FUEL DELIVERY under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article.

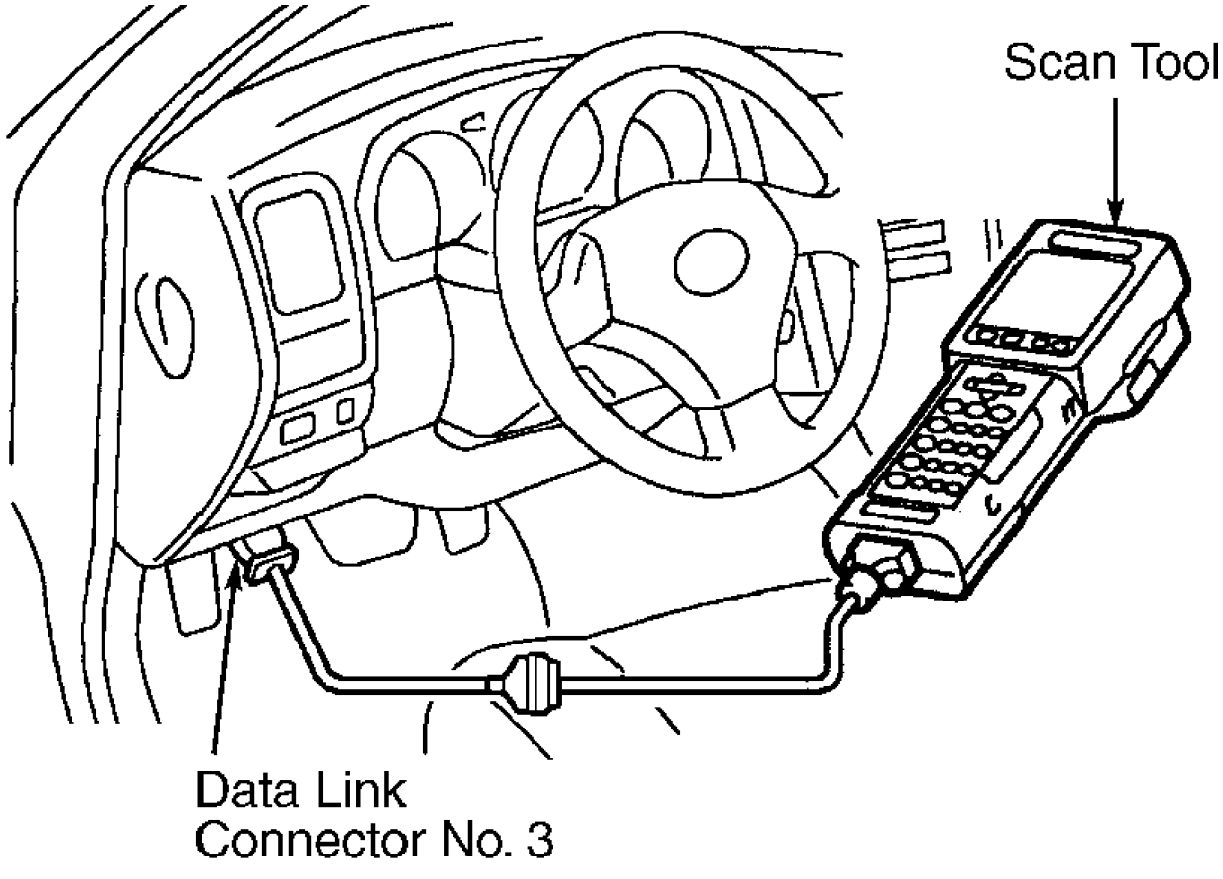


Fig. 3: Connecting Scan Tool To Typical Data Link Connector No. 3 (GS300, GS400, LS400, LX470, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

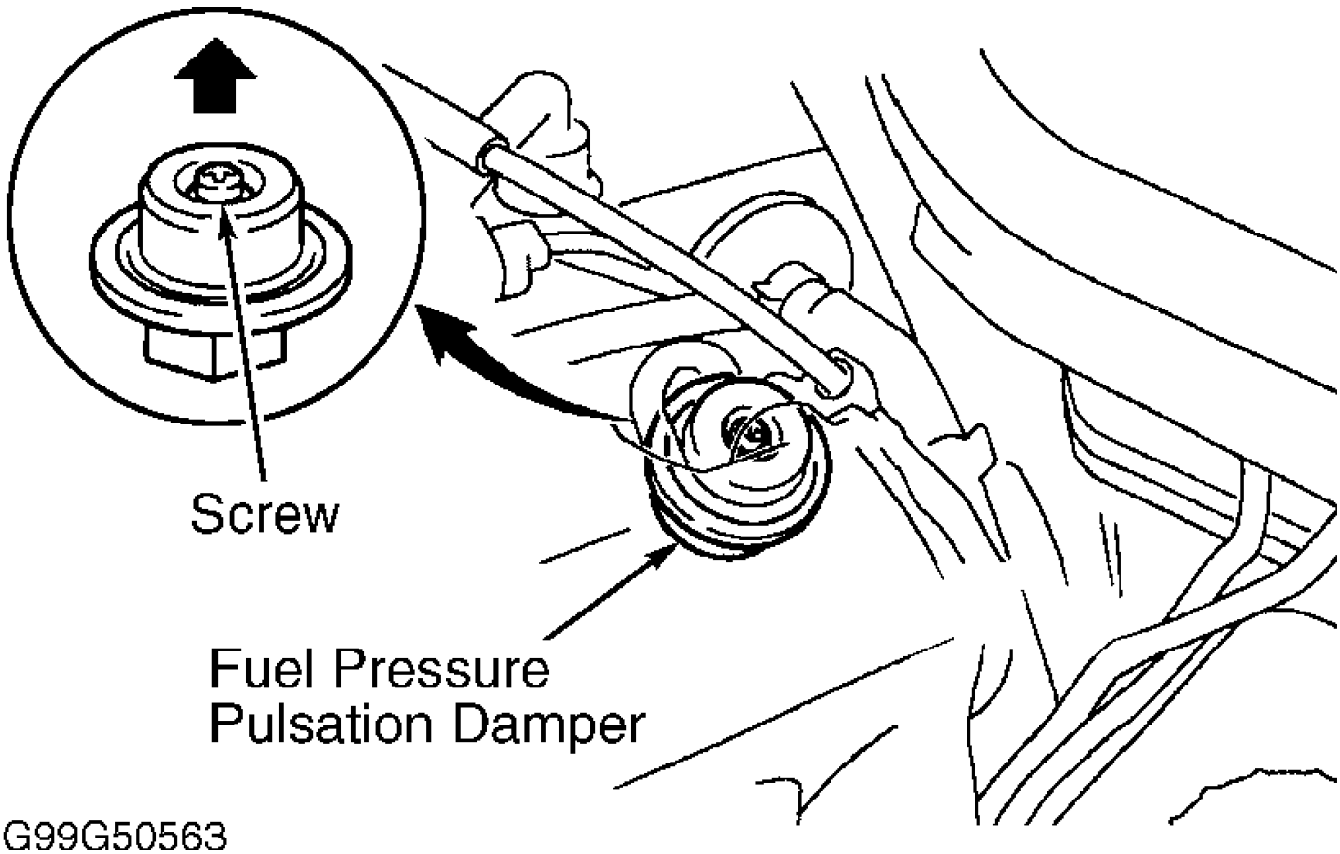


Fig. 4: Locating Typical Fuel Pressure Pulsation Damper & Screw (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Checking Fuel Pump Operation Using Scan Tool (LS400)

1) Connect scan tool to data link connector No. 3. See Fig. 3 . Turn ignition on. DO NOT start engine.

2) Turn scan tool on. Select ACTIVE TEST mode on scan tool. Using scan tool manufacturer's instructions, activate fuel pump. Listen for fuel pump operating sound and feel for fuel pressure in fuel inlet line to rear of the fuel rails.

3) Turn ignition off. Remove scan tool. If fuel pump operates, check fuel pressure. See FUEL PRESSURE. If fuel pump does not operate, EFI main relay, circuit opening relay, fuel pump relay or fuel pump resistor may be defective. For explanation of relays and fuel pump resistor operation, see FUEL PUMP CONTROL CIRCUIT. For testing of relays and fuel pump resistor, see appropriate SYSTEM & COMPONENT TESTING article.

4) If EFI main relay, circuit opening relay, fuel pump relay or fuel pump resistor are okay, check for defective fuses, fusible links or wiring. See appropriate wiring diagram in WIRING DIAGRAMS article. If fuses, fusible links and wiring are okay, check for defective fuel pump. See CHECKING FUEL PUMP OPERATION BY APPLYING BATTERY VOLTAGE TO FUEL PUMP. If problem exists in fuel pump relay or control circuit, Diagnostic Trouble Code (DTC) P1200 may be stored in Engine Control Module (ECM). See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs.

Checking Fuel Pump Operation Using Scan Tool (LX470)

1) Connect scan tool to data link connector No. 3. See Fig. 3 . Turn ignition on. DO NOT start engine.

2) Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump. Remove intake manifold cover located on top of engine, above intake manifold. Intake manifold cover must be removed for access to fuel pressure pulsation damper located at firewall end of driver's side fuel rail. See Fig. 5.

3) Listen for operating sound at fuel pump and check that screw at center of fuel pressure pulsation damper moves upward due to the fuel pressure. See Fig. 5. If fuel pump operates, check fuel pressure. See FUEL PRESSURE.

4) If fuel pump does not operate, EFI main relay, fuel pump Electronic Control Unit (ECU) or fuel pump switch may be defective, or fuel pump switch may need to be reset. For explanation of EFI main relay, fuel pump ECU and fuel pump switch operation, or resetting of fuel pump switch, see FUEL PUMP CONTROL CIRCUIT. For testing of EFI main relay or fuel pump switch, see appropriate SYSTEM & COMPONENT TESTING article.

5) If EFI main relay and fuel pump switch are okay, check for defective fuses or wiring. See appropriate wiring diagram in WIRING DIAGRAMS article. If fuses and wiring are okay, check for defective fuel pump. See CHECKING FUEL PUMP OPERATION BY APPLYING BATTERY VOLTAGE TO FUEL PUMP. If problem exists in fuel pump ECU or control circuit, Diagnostic Trouble Code (DTC) P1200 may be stored in Engine Control Module (ECM). See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs.

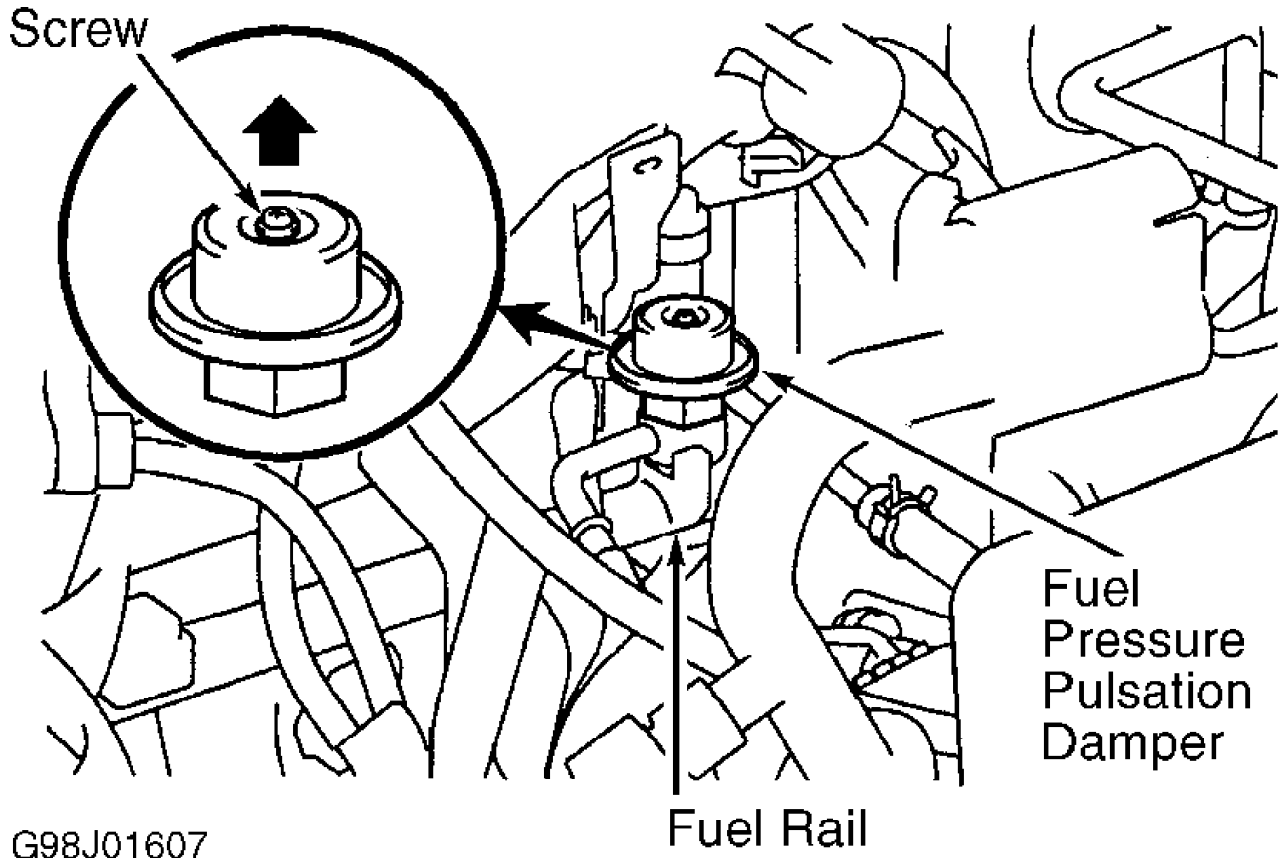


Fig. 5: Locating Fuel Pressure Pulsation Damper & Screw (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Checking Fuel Pump Operation By Applying Battery Voltage To Fuel Pump

1) On ES300, GS300 and GS400, remove rear seat cushion. Remove cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit and is located on top of fuel tank, near fuel pump. Go to step 5).

2) On LS400, SC300 and SC400, remove trunk floor mat. Remove trunk trim cover from behind rear seat in the trunk for access to the fuel tank. Disconnect 2-pin electrical connector for fuel pump. Electrical connector for fuel pump is located near the rear speaker and fuel pump is located on front of fuel tank, behind rear seat. See Figs. 8 and 11. Go to step 5).

3) On LX470, remove second seats, rear door scuff plates, step plates, second seat lock covers, rear carpet and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit and is located on top of fuel tank, near fuel pump. Go to step 5).

4) On RX300, remove driver's side rear seat. Remove carpet and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit and is located on top of fuel tank, near fuel pump. Go to next step.

CAUTION: When applying battery voltage to fuel pump, DO NOT apply battery voltage for more than 10 seconds, or fuel pump may be damaged.

5) On all models, connect battery voltage to specified terminals on fuel pump to activate fuel pump. See Figs. 6-11. DO NOT apply battery voltage to fuel pump for more than 10 seconds.

6) Listen for fuel pump operating sound. Disconnect battery voltage from fuel pump. If fuel pump operates, check fuel pressure after reinstalling components. See FUEL PRESSURE.

7) If fuel pump fails to operate, replace fuel pump and/or lead wire to fuel pump (if equipped). See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pump will not operate while trying to start engine, see appropriate CHECKING FUEL PUMP OPERATION USING SCAN TOOL under FUEL PUMP OPERATION for additional testing information.

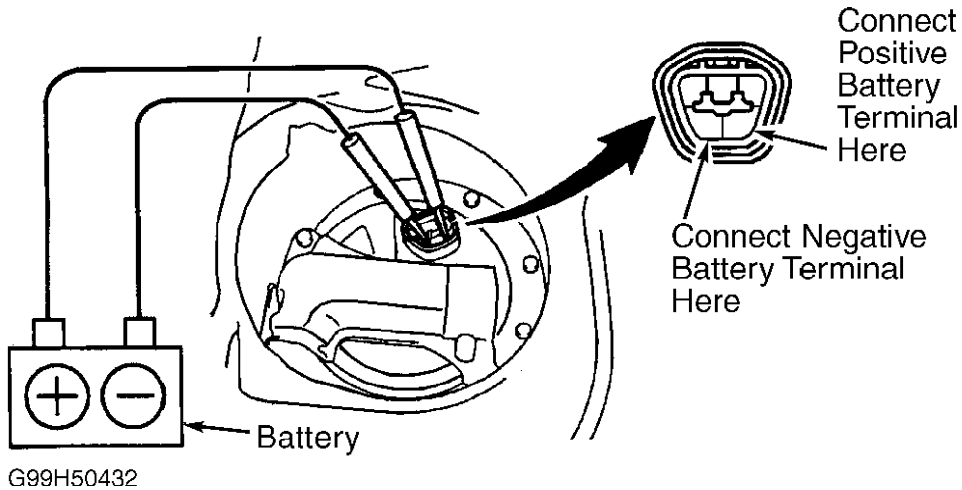


Fig. 6: Checking Fuel Pump Operation (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

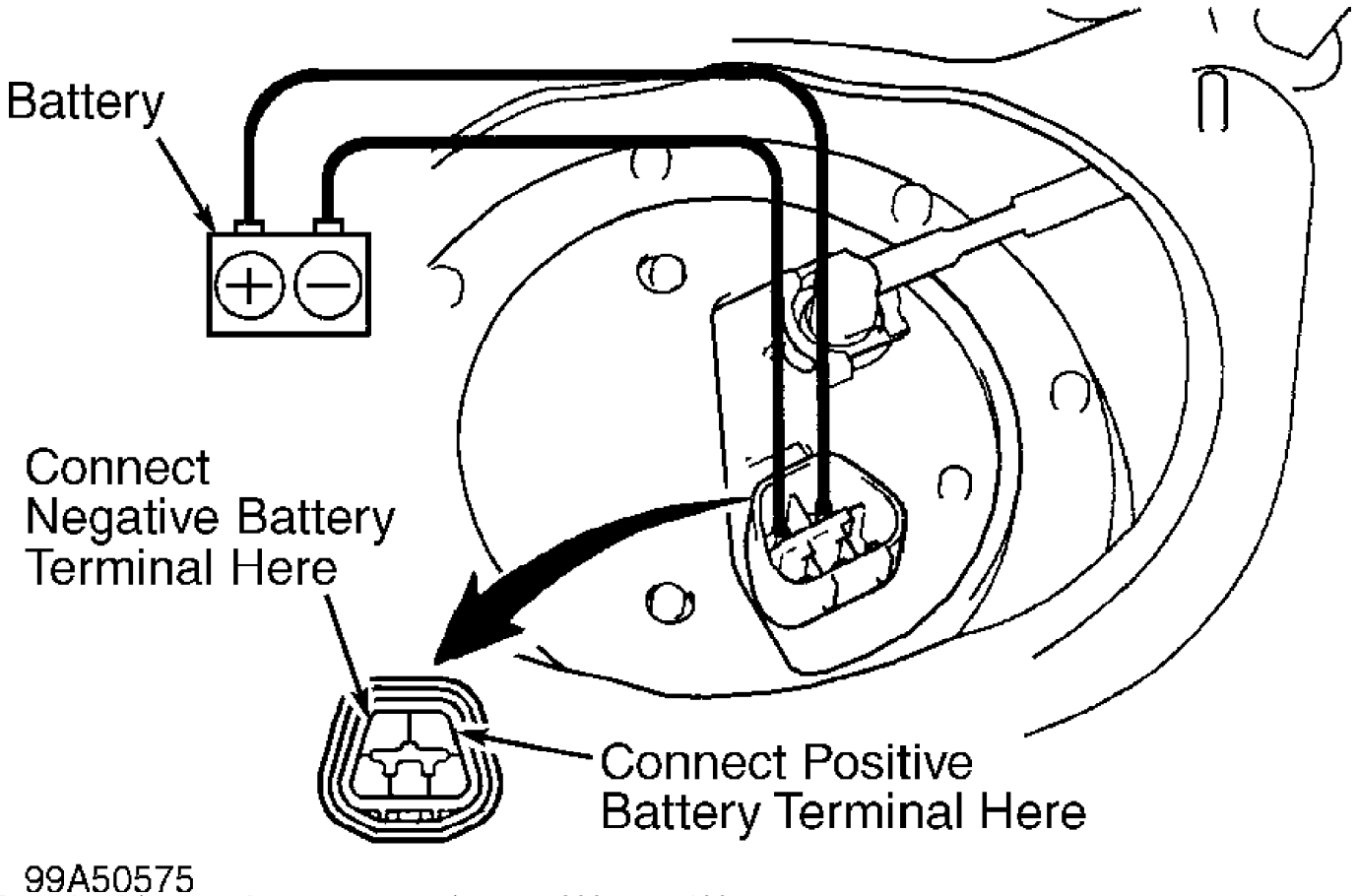


Fig. 7: Checking Fuel Pump Operation (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

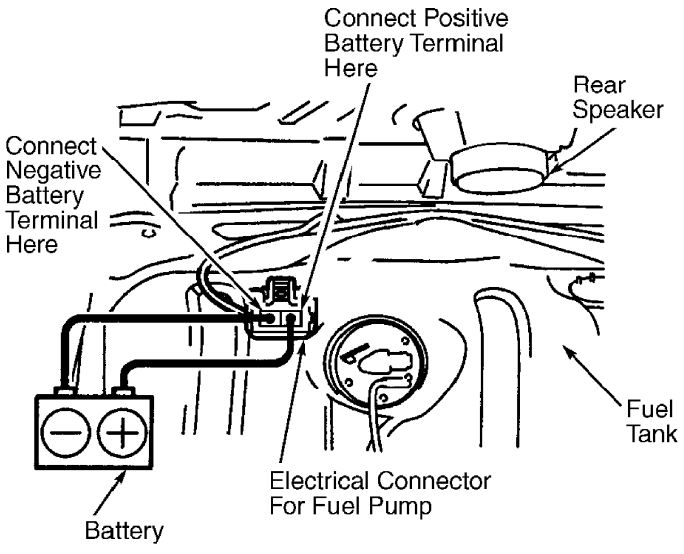


Fig. 8: Locating Electrical Connector For Fuel Pump & Checking Fuel Pump Operation (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

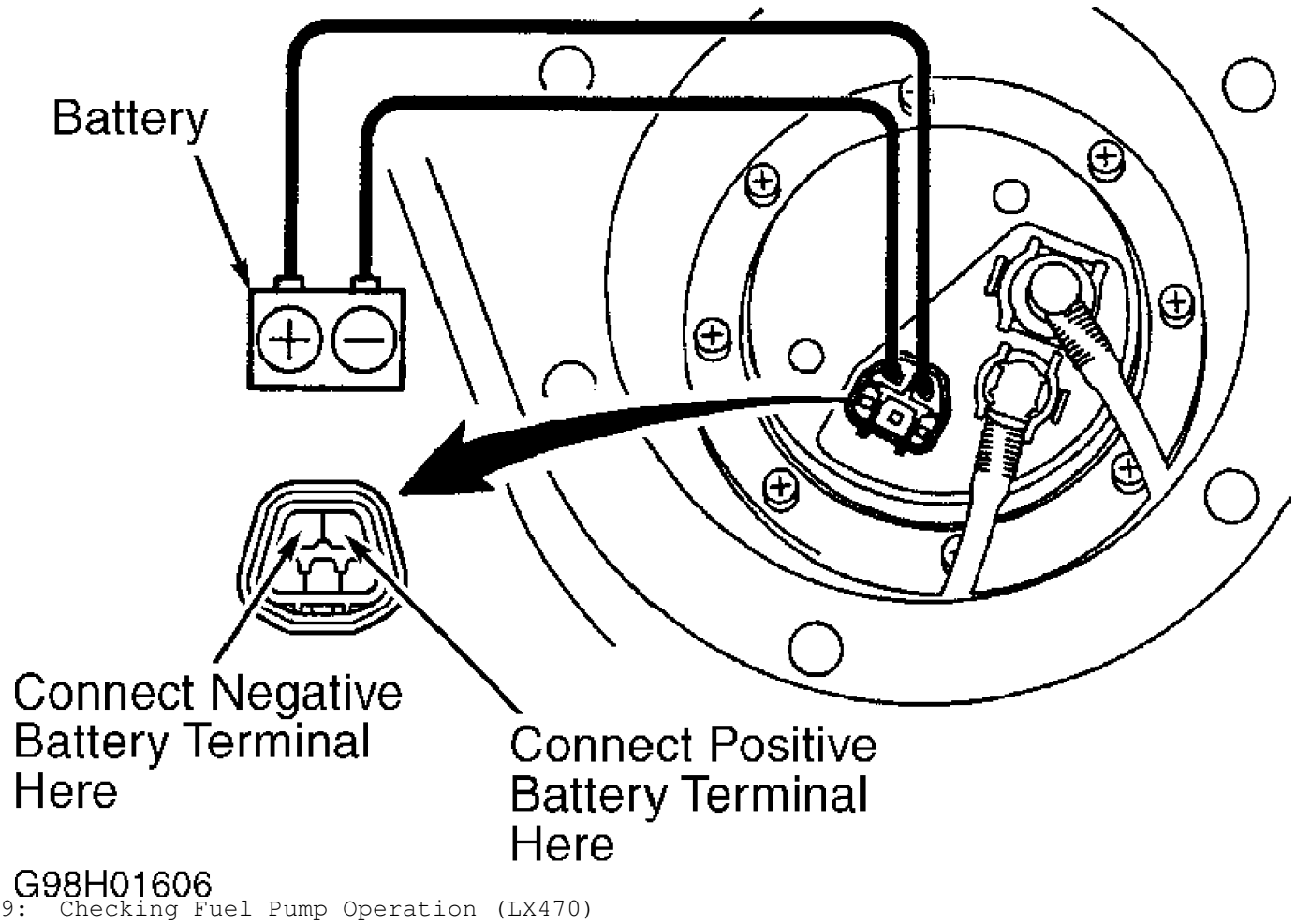


Fig. 9: Checking Fuel Pump Operation (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

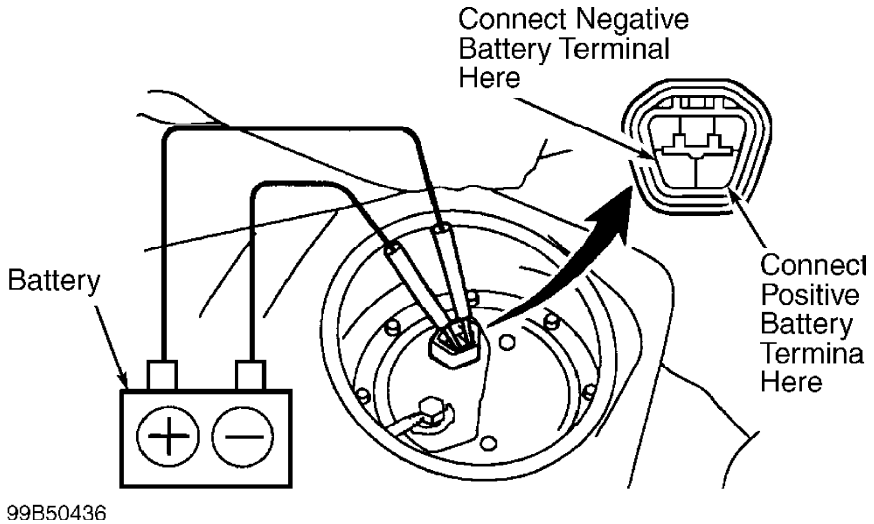


Fig. 10: Checking Fuel Pump Operation (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

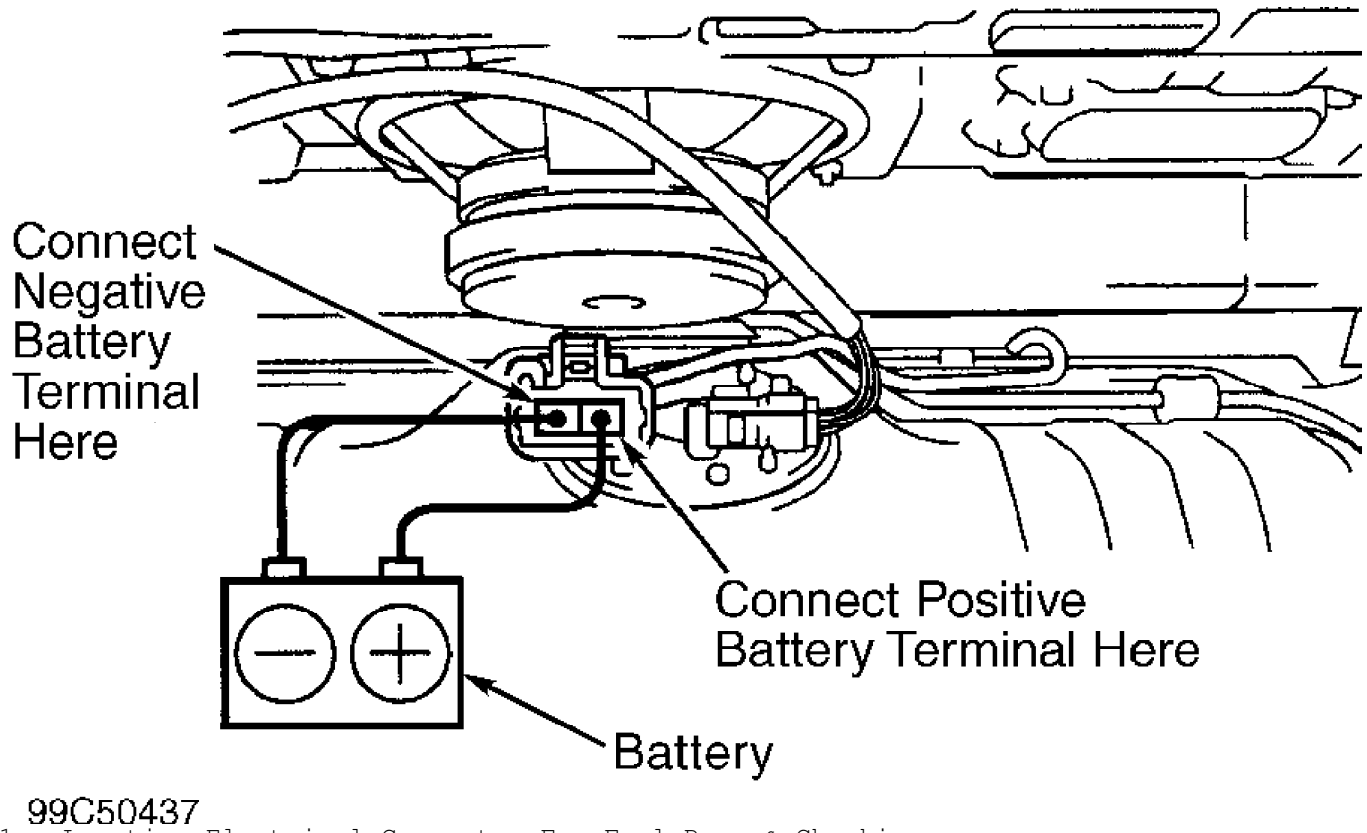


Fig. 11: Locating Electrical Connector For Fuel Pump & Checking Fuel Pump Operation (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL PRESSURE RELEASE

1) On ES300, GS300 & GS400, remove rear seat cushion and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit. Go to step 5).

2) On LS400, SC300 and SC400, remove trunk floor mat. Remove trunk trim cover from behind rear seat in the trunk for access to the fuel tank. Disconnect 2-pin electrical connector for fuel pump. Electrical connector for fuel pump is located near the rear speaker and fuel pump is located on front of fuel tank, behind rear seat. See Figs. 8 and 11. Go to step 5).

3) On LX470, disconnect electrical connector for fuel pump. See Fig. 12. This is electrical connector for fuel pump and fuel gauge sending unit. Go to step 5).

4) On RX300, remove driver's side rear seat. Remove carpet and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit and is located on top of fuel tank, near fuel pump. Go to next step.

5) On all models, start engine and allow engine to idle until engine stalls. Turn ignition off. Reinstall electrical connector for fuel pump and any removed components.

6) Disconnect negative battery cable. Place suitable container under fuel line connection. Cover fuel line connection with shop towel. Slowly loosen fuel line connection, allowing any fuel pressure to be released. Once fuel pressure is released, fuel system

components may be serviced.

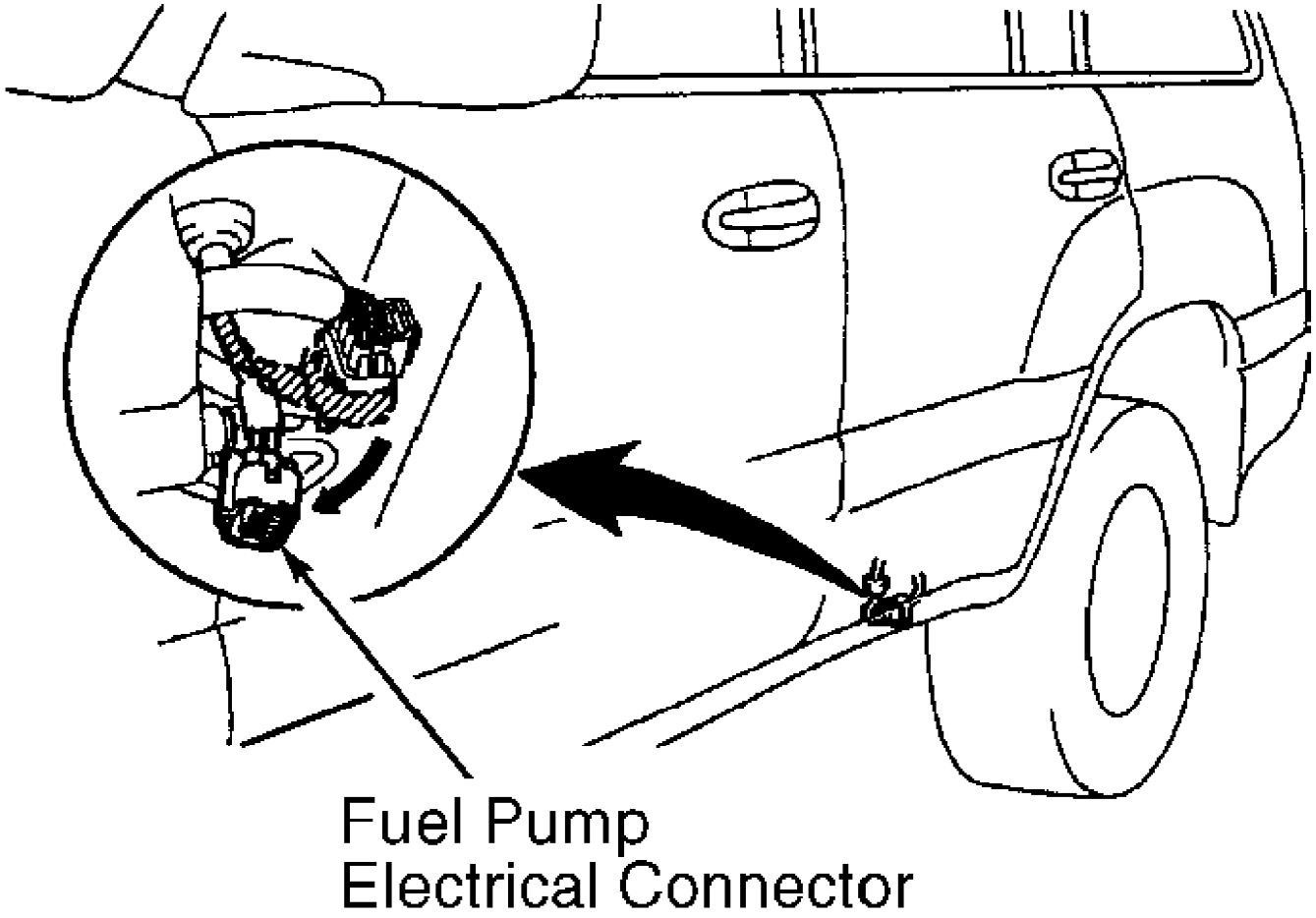


Fig. 12: Locating Fuel Pump Electrical Connector (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL PRESSURE

ES300

1) Ensure battery is fully charged. Release fuel pressure. See FUEL PRESSURE RELEASE. Disconnect negative battery cable.

2) Purchase a No. 1 fuel pipe Part No. (23801-20060) from parts department. No. 1 fuel pipe is fuel pipe that attaches to top of fuel filter. Remove fuel pipe connector from end of NEW No. 1 fuel pipe. See Fig. 13.

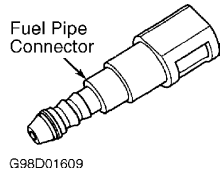


Fig. 13: Identifying Fuel Pipe Connector (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Remove fuel pipe clamp from No. 1 fuel pipe at fuel filter. Perform STEP 1. See Fig. 14. Ensure area around No. 1 fuel

pipe and fuel filter is clean.

CAUTION: Use care when disconnecting No. 1 fuel pipe from fuel filter, as some residual fuel pressure may still exist in the fuel system.

4) Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel filter. Perform STEP 2. See Fig. 14.

5) Install Adapter (SST 09268-41250), hose and fuel pressure gauge from Fuel Pressure Gauge Set (SST 09268-45012) with fuel pipe connector between No. 1 fuel pipe and fuel filter. See Fig. 15. Ensure hose, No. 1 fuel pipe and fuel pipe connector are properly connected.

6) Install negative battery cable. Connect scan tool to data link connector No. 3. See Fig. 1. Turn ignition on. DO NOT start engine.

7) Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump and note fuel pressure. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

NOTE: Fuel pump may also be activated by connecting battery voltage to specified terminals on fuel pump. See Fig. 6.

8) If fuel pressure is within specification, go to next step. If fuel pressure exceeds specification, replace fuel pressure regulator mounted on fuel pump in the fuel tank. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, check for leaking fuel hoses or connections, restricted fuel filter, defective fuel pump or defective fuel pressure regulator.

9) Remove scan tool from data link connector No. 3. Start engine and note fuel pressure with engine idling. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2). Shut engine off and note fuel pressure. Fuel pressure should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes. If fuel pressure is within specification and holds as specified, go to next step. If fuel pressure is not within specification or does not hold as specified, check for defective fuel pump, fuel injector or fuel pressure regulator.

10) Release fuel pressure. Disconnect negative battery cable. Remove adapter, hose, fuel pressure gauge and fuel pipe connector.

CAUTION: DO NOT reuse old retainer when installing No. 1 fuel pipe on fuel filter. Always use a NEW retainer.

11) Apply light coat of engine oil on tip of pipe on fuel filter to allow for ease of disconnect fitting and No. 1 fuel pipe installation. Using NEW retainer, install No. 1 fuel pipe on fuel filter until "click" sound is heard. DO NOT reuse old retainer. Pull on No. 1 fuel pipe to ensure fuel pipe is properly locked on fuel filter.

12) Reinstall fuel pipe clamp until "click" sound is heard. Pull upward on fuel pipe clamp to ensure fuel pipe clamp is securely locked on fuel filter. Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

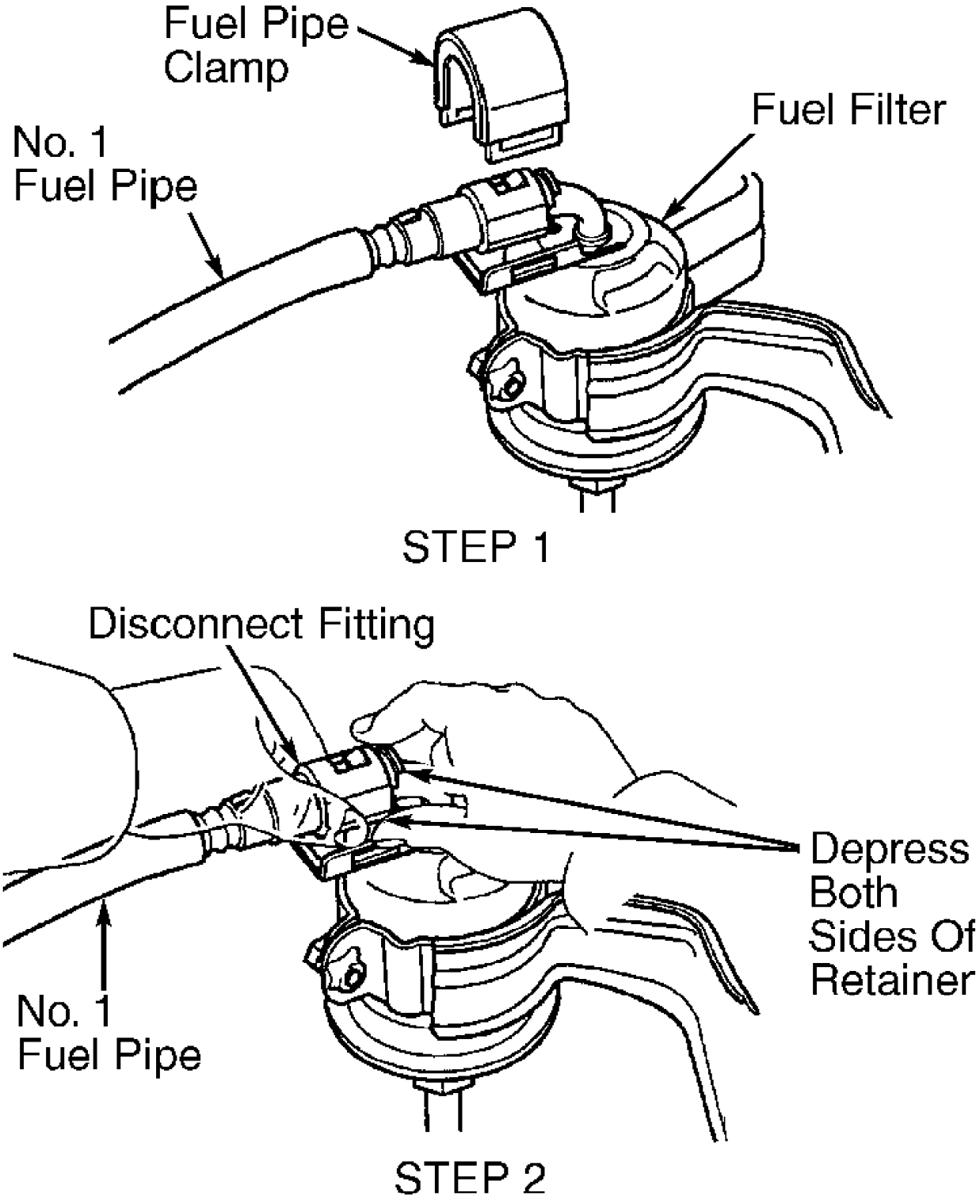


Fig. 14: Disconnecting No. 1 Fuel Pipe From Fuel Filter (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

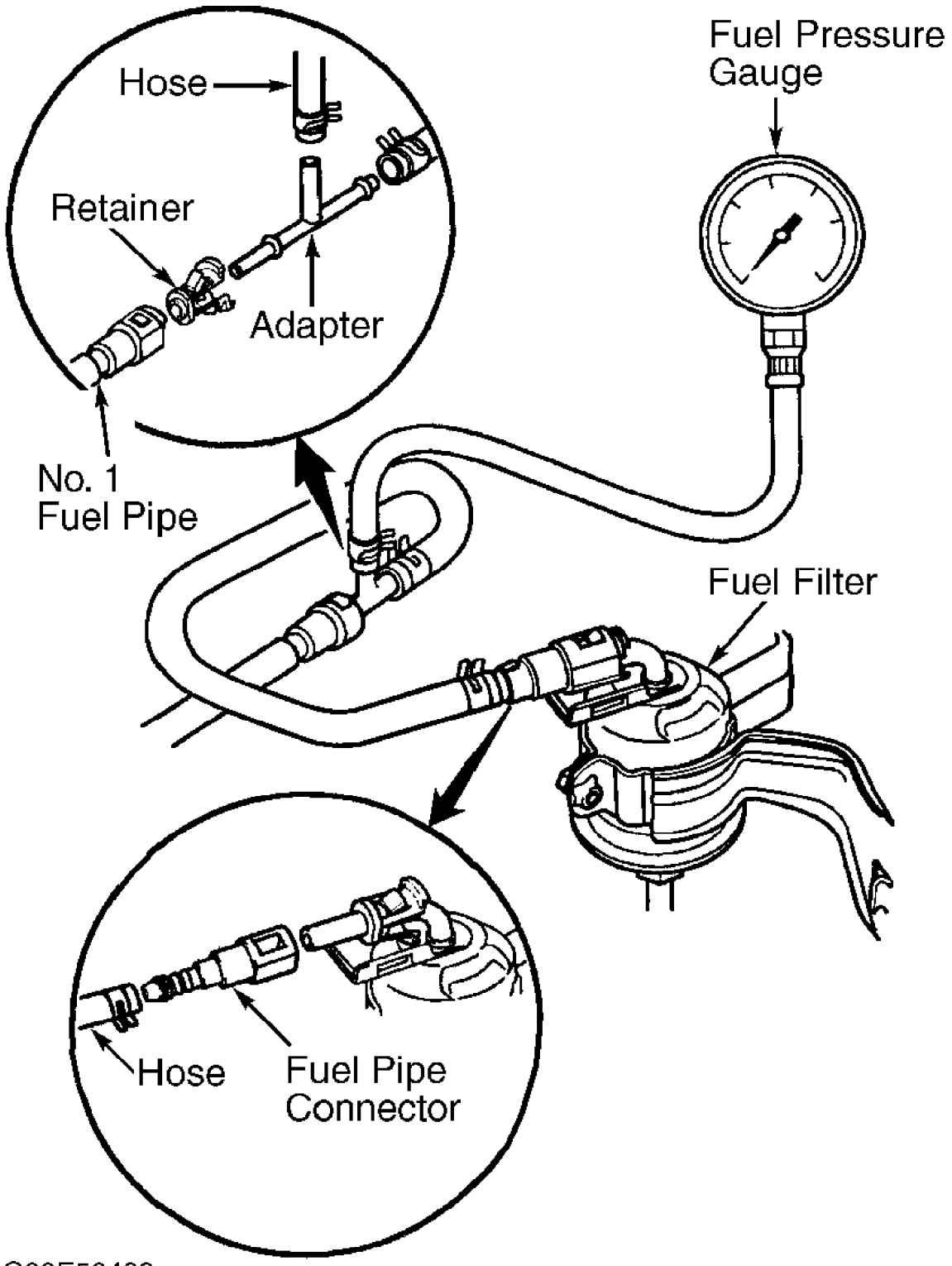


Fig. 15: Installing Fuel Pressure Gauge (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300 & SC300
1) Ensure battery is fully charged. Release fuel pressure.

See FUEL PRESSURE RELEASE. Disconnect negative battery cable.

2) Note location of fuel inlet hose on fuel pipe support. See Fig. 16. Remove union bolt with gaskets, and disconnect fuel inlet hose from fuel pipe support.

3) Using Adapter (SST 09268-41190), Union (SST 90405-06167) and fuel pressure gauge from Fuel Pressure Gauge Set (SST 09268-45014) with gaskets, install fuel pressure gauge and fuel inlet hose. See Fig. 16. Tighten adapter to 21 ft. lbs. (29 N.m). Install negative battery cable.

4) Connect scan tool to data link connector No. 3. See Fig. 3 . Turn ignition on. DO NOT start engine. Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump and note fuel pressure. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

NOTE: Fuel pump may also be activated by connecting battery voltage to specified terminals on fuel pump. See Figs. 7 and 11.

5) If fuel pressure is within specification, go to next step. If fuel pressure exceeds specification, replace fuel pressure regulator mounted on fuel pump in the fuel tank. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, check for leaking fuel hoses or connections, restricted fuel filter, defective fuel pump or fuel pressure regulator.

6) Remove scan tool from data link connector No. 3. Start engine and note fuel pressure with engine idling. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

7) Shut engine off and note fuel pressure. Fuel pressure should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes. If fuel pressure holds as specified, go to next step. If fuel pressure does not hold as specified, check for defective fuel pump, fuel injector or fuel pressure regulator.

8) Release fuel pressure. Disconnect negative battery cable. Remove adapter, union and fuel pressure gauge. Reinstall fuel inlet hose on fuel pipe support using NEW gasket. Tighten union bolt to 21 ft. lbs. (29 N.m). Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

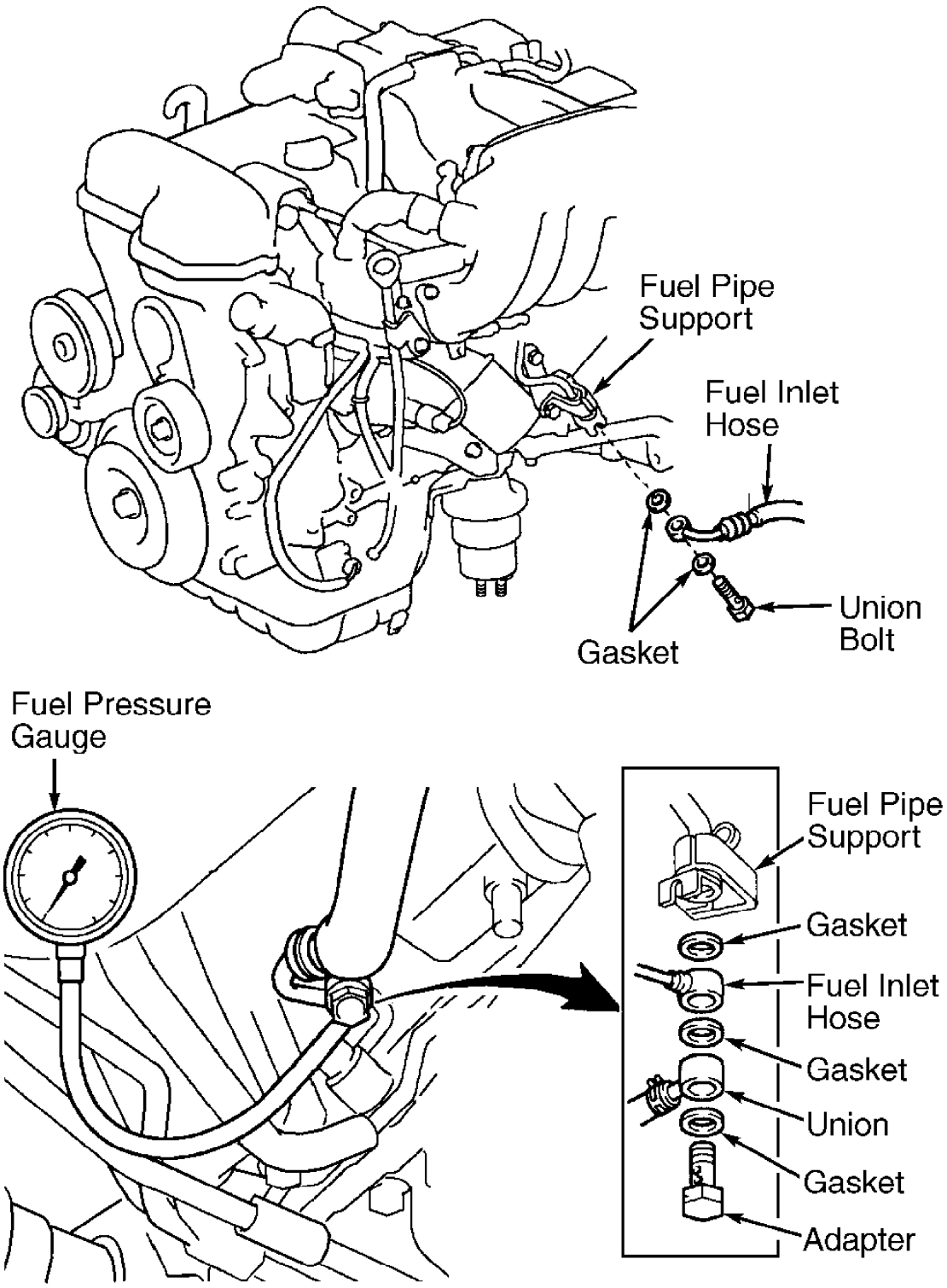


Fig. 16: Locating Typical Fuel Inlet Hose & Installing Fuel Pressure Gauge (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS400, LS400 & SC400

1) Ensure battery is fully charged. Release fuel pressure. See FUEL PRESSURE RELEASE. Disconnect negative battery cable.

2) Remove intake manifold cover located on top of engine, above intake manifold. Intake manifold cover must be removed for access to fuel pressure pulsation dampers. Fuel pressure pulsation dampers are located at firewall end of each fuel rail. See Fig. 17. Remove necessary components for access to fuel pressure pulsation damper on passenger's side fuel rail.

3) Remove fuel pressure pulsation damper with gaskets from rear of passenger's side fuel rail. Using Adapter (SST 09268-41190), Union (SST 90405-06167) and fuel pressure gauge from Fuel Pressure Gauge Set (SST 09268-45014) with gaskets, install fuel pressure gauge and rear fuel pipe on rear of passenger's side fuel rail. See Fig. 17. Tighten adapter to 29 ft. lbs. (39 N.m). Install negative battery cable.

4) Connect scan tool to data link connector No. 3. See Fig. 3 . Turn ignition on. DO NOT start engine. Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump and note fuel pressure. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

NOTE: Fuel pump may also be activated by connecting battery voltage to specified terminals on fuel pump. See Figs. 7, 8 and 11.

5) If fuel pressure is within specification, go to next step. If fuel pressure exceeds specification, replace fuel pressure regulator mounted on fuel pump in the fuel tank. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, check for leaking fuel hoses or connections, restricted fuel filter, defective fuel pump or fuel pressure regulator.

6) Remove scan tool from data link connector No. 3. Start engine and note fuel pressure with engine idling. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

7) Shut engine off and note fuel pressure. Fuel pressure should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes. If fuel pressure holds as specified, go to next step. If fuel pressure does not hold as specified, check for defective fuel pump, fuel injector or fuel pressure regulator.

8) Release fuel pressure. Disconnect negative battery cable. Remove adapter, union and fuel pressure gauge. Using NEW gaskets, install rear fuel pipe and fuel pressure pulsation damper on passenger's side fuel rail. Tighten fuel pressure pulsation damper to 29 ft. lbs. (39 N.m). Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

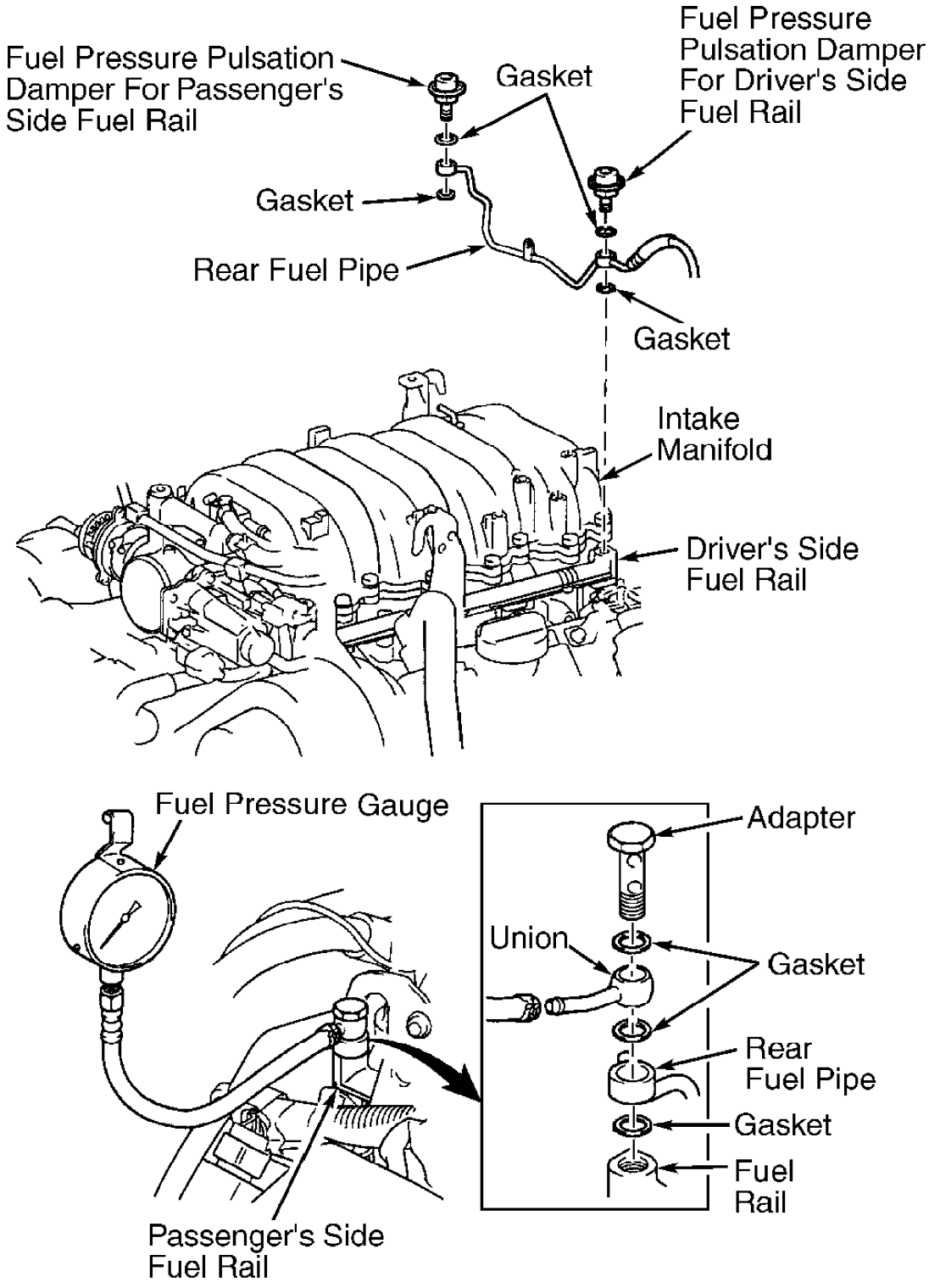


Fig. 17: Locating Fuel Pressure Pulsation Dampers, Rear Fuel Pipe & Installing Fuel Pressure Gauge (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

1) Ensure battery is fully charged. Release fuel pressure. See FUEL PRESSURE RELEASE. Disconnect negative battery cable.

2) Remove intake manifold cover located on top of engine, above intake manifold. Intake manifold cover must be removed for access front fuel pipe at front of driver's side fuel rail. See Fig. 18.

3) Remove union bolt with gaskets, and disconnect front fuel pipe from front of driver's side fuel rail. It may be necessary to remove retaining bolt at center of front fuel pipe when disconnecting front fuel pipe from driver's side fuel rail.

4) Install Union (SST 90405-06167), Adapter (SST 09268-41190) and fuel pressure gauge from Fuel Pressure Gauge Set (SST 09268-45014) with front fuel pipe on driver's side fuel rail. See Fig. 19. Tighten adapter to 29 ft. lbs. (39 N.m).

5) Install negative battery cable. Connect scan tool to data link connector No. 3. See Fig. 3. Turn ignition on. DO NOT start engine.

6) Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump and note fuel pressure. Fuel pressure should be 38-44 psi (2.7-3.1 kg/cm^2).

NOTE: Fuel pump may also be activated by connecting battery voltage to specified terminals on fuel pump. See Fig. 9.

7) If fuel pressure is within specification, go to next step. If fuel pressure exceeds specification, replace fuel pressure regulator mounted near center of passenger's side fuel rail. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, check for leaking fuel hoses or connections, restricted fuel filter, defective fuel pump or defective fuel pressure regulator.

8) Remove scan tool from data link connector No. 3. Start engine. Disconnect and plug vacuum hose at fuel pressure regulator mounted near center of passenger's side fuel rail. Note fuel pressure with engine idling. Fuel pressure should be should be 38-44 psi (2.7-3.1 kg/cm^2).

9) Reinstall vacuum hose on fuel pressure regulator. Note fuel pressure with engine idling. Fuel pressure should be 28-34 psi (2.0-2.4 kg/cm^2). If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, check for defective vacuum hose or fuel pressure regulator.

10) Shut engine off and note fuel pressure. Fuel pressure should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes. If fuel pressure holds as specified, go to next step. If fuel pressure does not hold as specified, check for defective fuel pump, fuel injector or fuel pressure regulator.

11) Release fuel pressure. Disconnect negative battery cable. Remove union, adapter and fuel pressure gauge from driver's side fuel rail. Using NEW gaskets, install front fuel pipe on driver's side fuel rail. Tighten union bolt to 29 ft. lbs. (39 N.m) and retaining bolt for front fuel pipe (if loosened) to 66 INCH lbs. (7.5 N.m).

12) Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump. Install intake manifold cover.

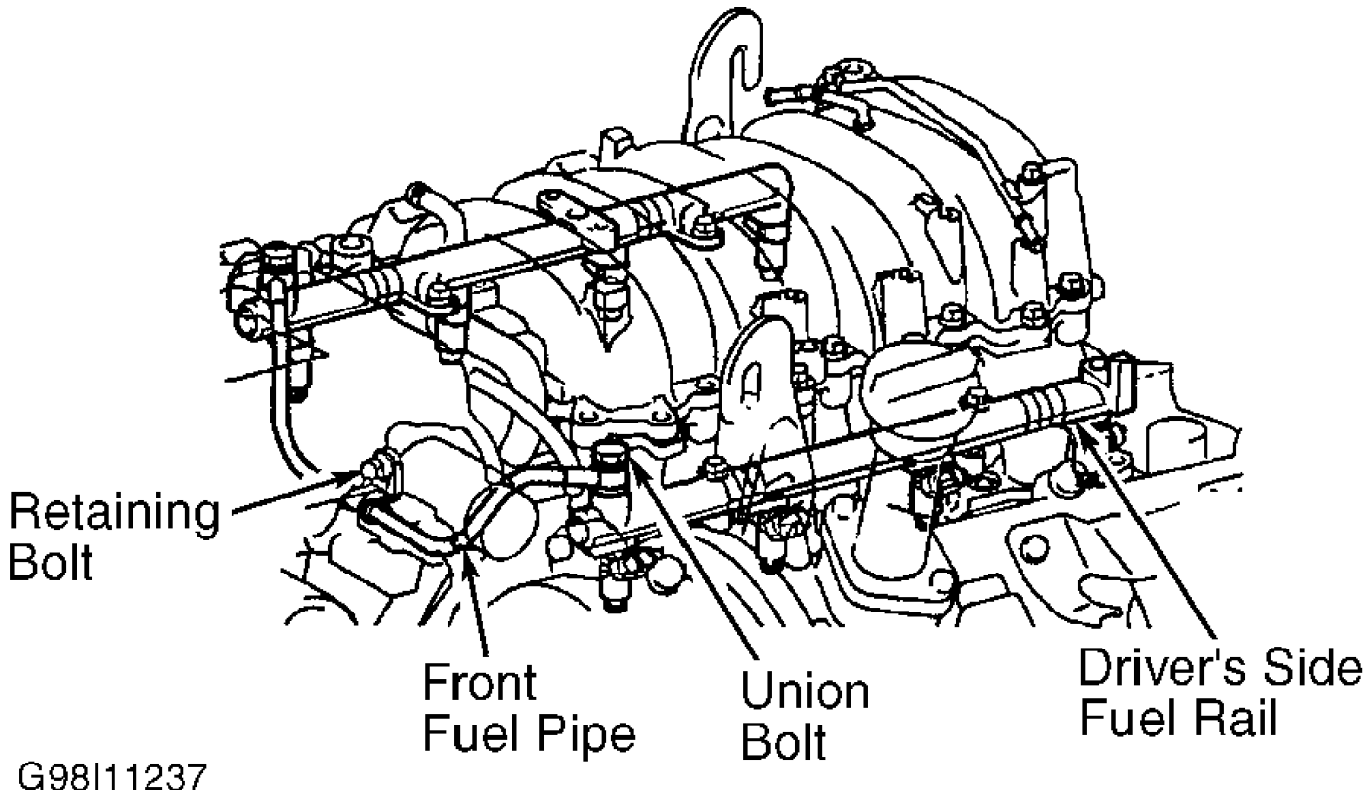


Fig. 18: Locating Front Fuel Pipe & Driver's Side Fuel Rail (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

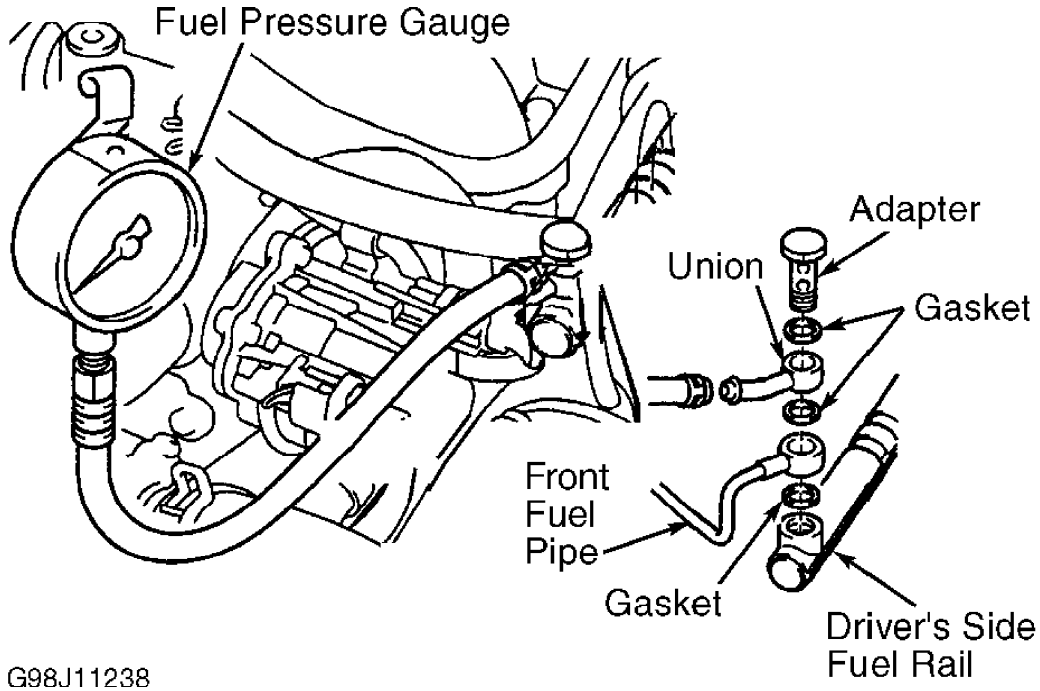


Fig. 19: Installing Fuel Pressure Gauge (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

RX300
1) Ensure battery is fully charged. Release fuel pressure.

See FUEL PRESSURE RELEASE. Disconnect negative battery cable.

2) Purchase a No. 1 fuel pipe Part No. (23801-20040) from parts department. No. 1 fuel pipe is fuel pipe that fits between fuel rails and fuel inlet pipe. See Fig. 20. Remove fuel pipe connector from end of NEW No. 1 fuel pipe. See Fig. 13.

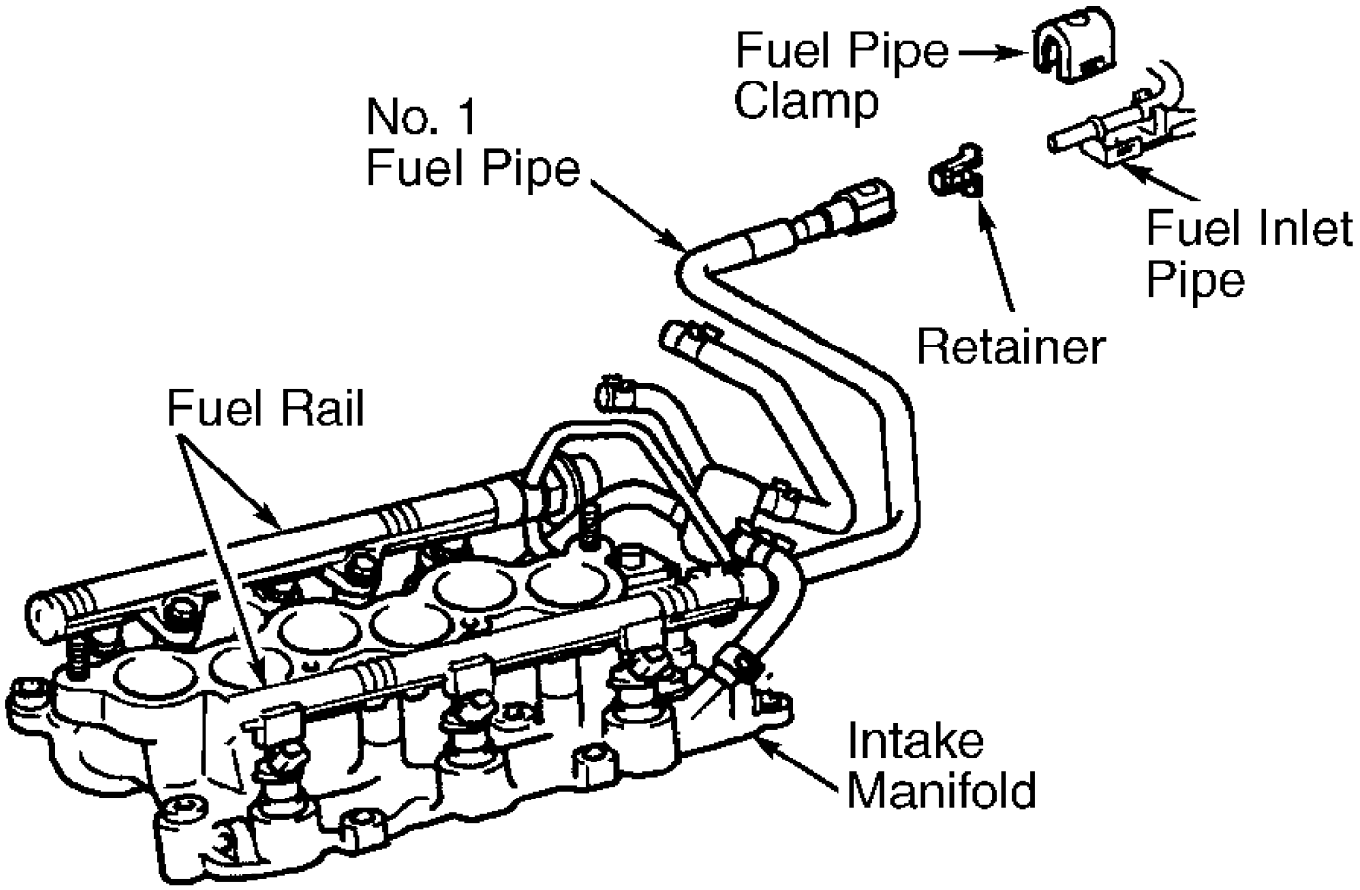


Fig. 20: Locating No. 1 Fuel Pipe, Fuel Pipe Clamp & Fuel Inlet Pipe (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Remove fuel pipe clamp from No. 1 fuel pipe at fuel inlet pipe. See Fig. 20. Ensure area around No. 1 fuel pipe and fuel inlet pipe is clean.

CAUTION: Use care when disconnecting No. 1 fuel pipe from fuel inlet pipe, as some residual fuel pressure may still exist in the fuel system.

4) Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel inlet pipe. See Fig. 21.

5) Install Adapter (SST 09268-41250), hose and fuel pressure gauge from Fuel Pressure Gauge Set (SST 09268-45012) with fuel pipe connector between No. 1 fuel pipe and fuel inlet pipe. See Fig. 22. Ensure hose, No. 1 fuel pipe and fuel pipe connector are properly connected.

6) Install negative battery cable. Connect scan tool to data link connector No. 3. See Fig. 2. Turn ignition on. DO NOT start engine.

7) Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate fuel pump and note fuel pressure. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2).

NOTE: Fuel pump may also be activated by connecting battery voltage to specified terminals on fuel pump. See Fig. 10.

8) If fuel pressure is within specification, go to next step. If fuel pressure exceeds specification, replace fuel pressure regulator mounted on fuel pump in the fuel tank. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, check for leaking fuel hoses or connections, restricted fuel filter, defective fuel pump or defective fuel pressure regulator.

9) Remove scan tool from data link connector No. 3. Start engine and note fuel pressure with engine idling. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2). Shut engine off and note fuel pressure. Fuel pressure should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes. If fuel pressure is within specification and holds as specified, go to next step. If fuel pressure is not within specification or does not hold as specified, check for defective fuel pump, fuel injector or fuel pressure regulator.

10) Release fuel pressure. Disconnect negative battery cable. Remove adapter, hose, fuel pressure gauge and fuel pipe connector.

11) Install No. 1 fuel pipe on fuel inlet pipe. Pull on No. 1 fuel pipe to ensure fuel pipe is properly locked on fuel inlet pipe. Reinstall fuel pipe clamp until "click" sound is heard. Pull upward on fuel pipe clamp to ensure fuel pipe clamp is securely locked on fuel inlet pipe. Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

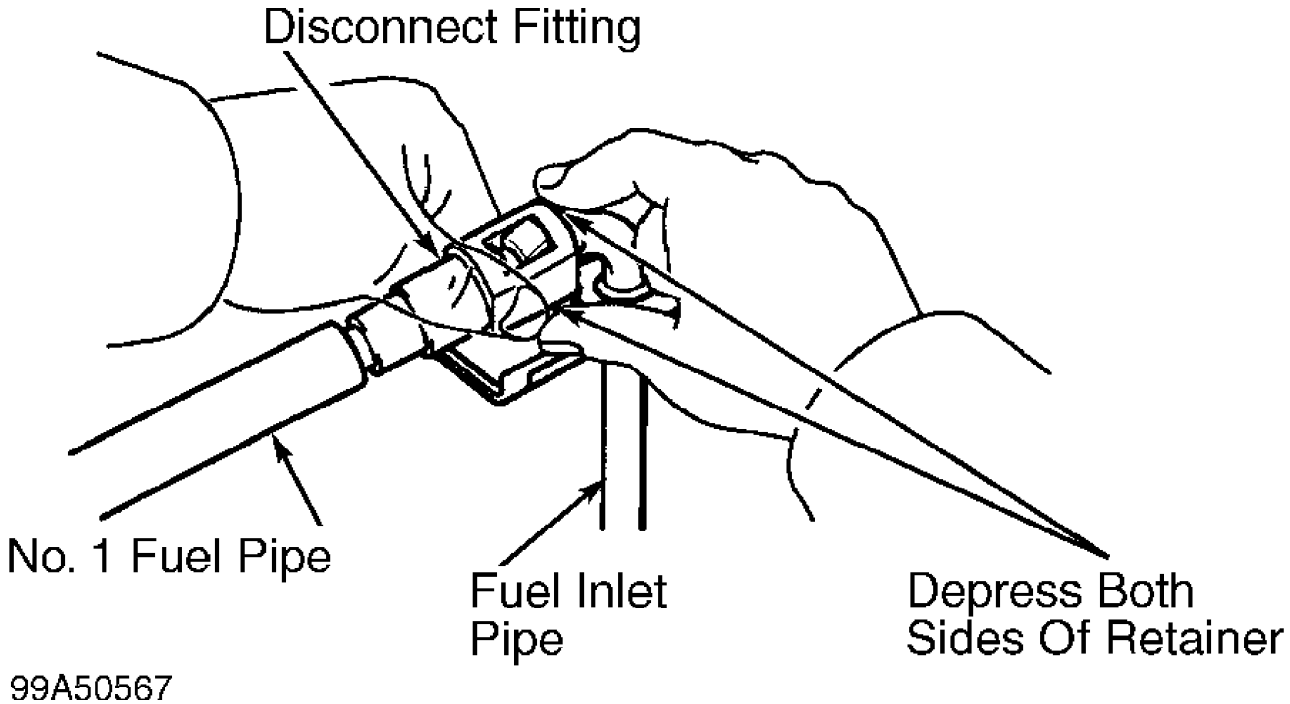


Fig. 21: Disconnecting No. 1 Fuel Pipe From Fuel Inlet Pipe (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

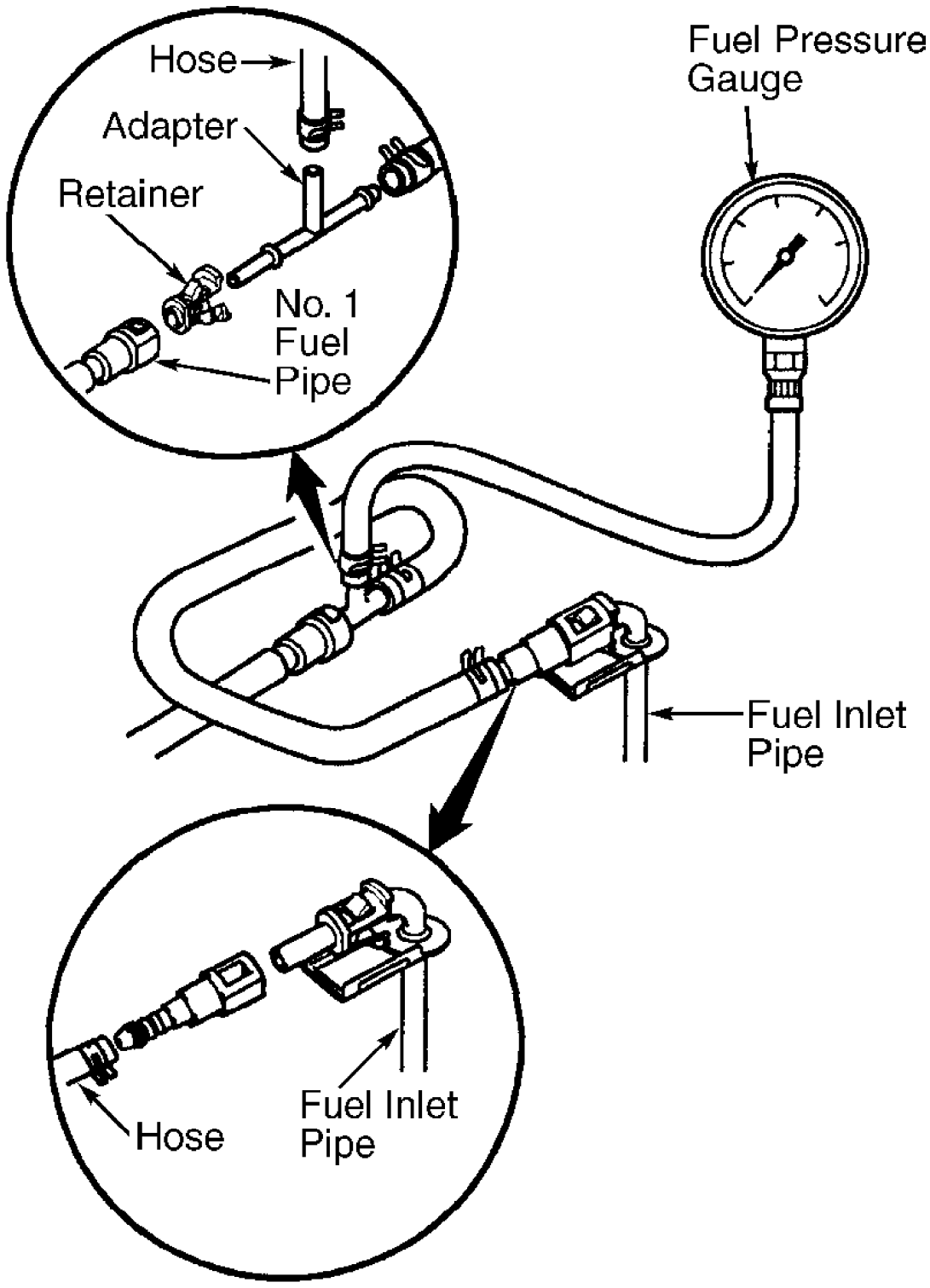


Fig. 22: Installing Fuel Pressure Gauge (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL PUMP CONTROL CIRCUIT

NOTE: For information on testing relays and fuel system components, see appropriate SYSTEM & COMPONENT TESTING article. For complete wiring circuit of electrical components on a specific model, see appropriate wiring diagram in WIRING DIAGRAMS article.

Circuit Opening Relay (ES300 & RX300)

Circuit opening relay controls fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When ignition is turned on, voltage is supplied through IGN fuse to other side of circuit opening relay. When proper input signals are delivered to Engine Control Module (ECM), circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. On ES300, circuit opening relay is located in fuse/relay box at driver's side front corner of engine compartment, just in front of strut tower. On RX300, circuit opening relay may be located in fuse/relay box at driver's side front corner of engine compartment, near battery, or in relay box behind driver's side of instrument panel, just above the kick panel.

Circuit Opening Relay (LS400)

Circuit opening relay controls fuel pump circuit by supplying voltage to fuel pump relay. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When ignition is turned on, voltage is supplied through IGN fuse to other side of circuit opening relay. When proper input signals are delivered to Engine Control Module (ECM), circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump resistor and fuel pump relay which supplies voltage to fuel pump for fuel pump operation. Circuit opening relay is located in fuse/relay box at driver's side of engine compartment, just in front of strut tower. For operation of fuel pump relay and fuel pump resistor, see FUEL PUMP RELAY & FUEL PUMP RESISTOR (LS400).

EFI Main Relay (ES300 & RX300)

EFI main relay may also be referred to as EFI relay. EFI fuse supplies constant battery voltage to one side of EFI main relay. EFI main relay is energized by MREL terminal of Engine Control Module (ECM). When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. EFI main relay also provides battery voltage to +B terminal of ECM. EFI main relay is located in fuse/relay box at driver's side front corner of engine compartment, near battery.

EFI Main Relay (GS300 & GS400)

EFI main relay may also be referred to as EFI relay. EFI fuse supplies constant battery voltage to one side of EFI main relay. When EFI main relay is energized by MREL terminal of Engine Control Module (ECM), EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components. EFI main relay also provides battery voltage to +B and +B1 terminals of ECM. For operation of fuel pump ECU, see FUEL PUMP ELECTRONIC CONTROL UNIT (ECU) - (GS300 & GS400). EFI main relay is located in fuse/relay box at passenger's side rear corner of engine compartment, near rear of strut tower and battery.

EFI Main Relay (LS400)

EFI main relay may also be referred to as EFI relay. EFI fuse No. 1 supplies constant battery voltage to one side of EFI main relay. EFI main relay is energized by MREL terminal of Engine Control Module

(ECM). When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay, through EFI fuse No. 2 and to data link connector No. 1 and various other electrical components. EFI main relay also provides battery voltage to +B and +B1 terminals of ECM. EFI main relay is located in fuse/relay box at driver's side of engine compartment, just in front of strut tower.

EFI Main Relay (LX470)

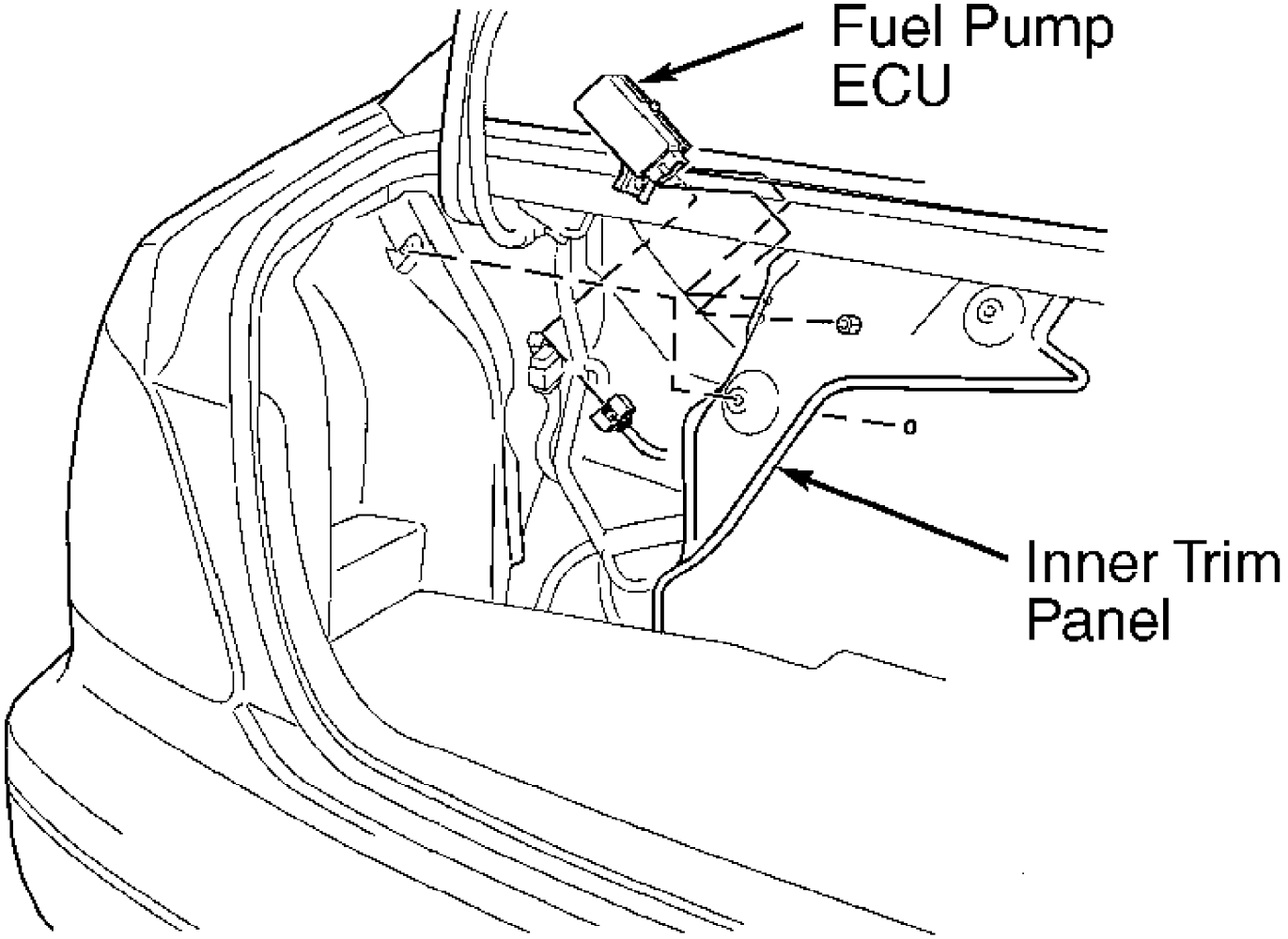
EFI main relay may also be referred to as EFI relay or ECD relay. EFI fuse supplies constant battery voltage to one side of EFI main relay. EFI fuse may also be referred to as ECD fuse. When EFI main relay is energized by MREL terminal of Engine Control Module (ECM), EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components. EFI main relay also provides battery voltage to +B and +B1 terminals of ECM. For operation of fuel pump ECU and fuel pump switch, see FUEL PUMP ELECTRONIC CONTROL UNIT (ECU) & FUEL PUMP SWITCH (LX470). EFI main relay is located in fuse/relay box at driver's side front corner of engine compartment, near battery.

EFI Main Relay (SC300 & SC400)

EFI main relay may also be referred to as EFI relay. EFI fuse supplies constant battery voltage to one side of EFI main relay. When EFI main relay is energized by MREL terminal of Engine Control Module (ECM), EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components. EFI main relay also provides battery voltage to B and B2 terminals of ECM on SC300 or +B and +B1 terminals of ECM on SC400 of ECM. On all models, for operation of fuel pump ECU, see FUEL PUMP ELECTRONIC CONTROL UNIT (ECU) - (SC300 & SC400). EFI main relay is located in fuse/relay box at driver's side front corner of engine compartment, near battery.

Fuel Pump Electronic Control Unit (ECU) - (GS300 & GS400)

Fuel pump operating speed is controlled by operating condition of the engine such as: starting, idling, light load or heavy load. Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with engine operating condition. Fuel pump ECU uses this input signal to determine how much voltage should be delivered to fuel pump for varying fuel pump operating speed. When engine starts or is under heavy load with engine at high speed, ECM delivers about 3.8-volt input signal to fuel pump ECU. Fuel pump ECU then provides battery voltage to fuel pump so fuel pump operates at high speed. When engine is under heavy load with engine at low speed, ECM delivers about 2.5-volt input signal to fuel pump ECU. Fuel pump ECU then provides about 10 volts to fuel pump so fuel pump operates at medium speed. When engine is idling or under light load, ECM delivers about 1.3-volt input signal to fuel pump ECU. Fuel pump ECU then provides about 8.5 volts to the fuel pump so fuel pump operates at low speed. Fuel pump ECU is located behind inner trim panel at driver's side rear corner of the trunk. See Fig. 23.



99C50569

Fig. 23: Locating Fuel Pump ECU (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pump Electronic Control Unit (ECU) - (SC300 & SC400)

Fuel pump operating speed is controlled by operating condition of the engine such as: starting, idling, light load or heavy load. Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with engine operating condition. Fuel pump ECU uses this input signal to determine how much voltage should be delivered to fuel pump for varying fuel pump operating speed. When engine starts, ECM delivers about 5.0-volt input signal to fuel pump ECU. Fuel pump ECU then provides battery voltage to fuel pump so fuel pump operates at high speed. After engine starts, during idling or light loads, ECM delivers about 2.5-volt input signal to fuel pump ECU. Fuel pump ECU then provides about 9 volts to fuel pump so fuel pump operates at low speed. If engine is under heavy load, ECM delivers input signal to fuel pump ECU and fuel pump ECU then operates fuel pump at high speed. Fuel pump ECU is located behind inner trim panel on driver's side of vehicle, behind driver's side door pillar. See Fig. 24.

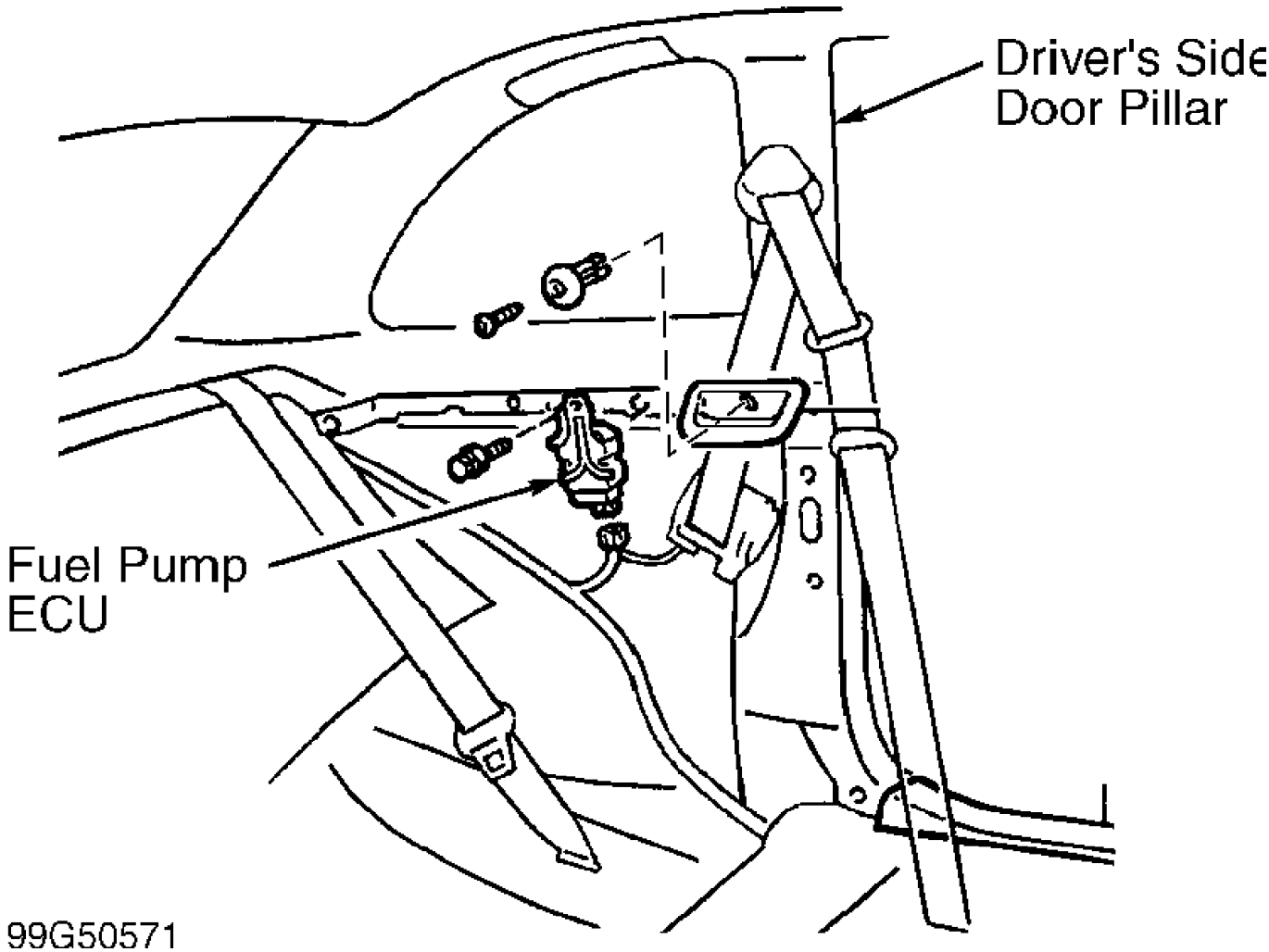


Fig. 24: Locating Fuel Pump ECU (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pump Electronic Control Unit (ECU) & Fuel Pump Switch (LX470)

Fuel pump operating speed is controlled by operating condition of the engine such as: starting, idling, light load or heavy load. Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with engine operating condition. Fuel pump ECU uses this input signal to determine how much voltage should be delivered to fuel pump for varying fuel pump operating speed. When engine starts or is under heavy load with engine at high speed, ECM delivers about 3.8-volt input signal to fuel pump ECU. Fuel pump ECU then provides battery voltage to fuel pump so fuel pump operates at high speed. When engine is under heavy load with engine at low speed, ECM delivers about 2.5-volt input signal to fuel pump ECU. Fuel pump ECU then provides about 10 volts to fuel pump so fuel pump operates at medium speed. When engine is idling or under light load, ECM delivers about 1.3-volt input signal to fuel pump ECU. Fuel pump ECU then provides about 8.5 volts to the fuel pump so fuel pump operates at low speed. If a problem exists in fuel pump ECU or control circuit, Diagnostic Trouble Code (DTC) P1200 may be stored in ECM. See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs. Fuel pump ECU is located behind inner panel, just behind driver’s side rear

wheelwell. See Fig. 25.

Fuel pump switch is in the circuit between FPC terminal on ECU and FPC terminal on fuel pump ECU. Fuel pump switch may also be referred to as fuel pump inertia switch or fuel pump control switch. If vehicle is involved in a collision, fuel pump switch will shut off the fuel pump by opening this circuit, and not allowing any input signal to be delivered from ECM to fuel pump ECU. Fuel pump switch is located on driver's side of instrument panel. See Fig. 26. Fuel pump switch contains a reset switch which has an OFF and ON position. See Fig. 26. Continuity will exist between electrical terminals on fuel pump switch with reset switch in the ON position, and no continuity in the OFF position. Reset switch must be in ON position for fuel pump operation.

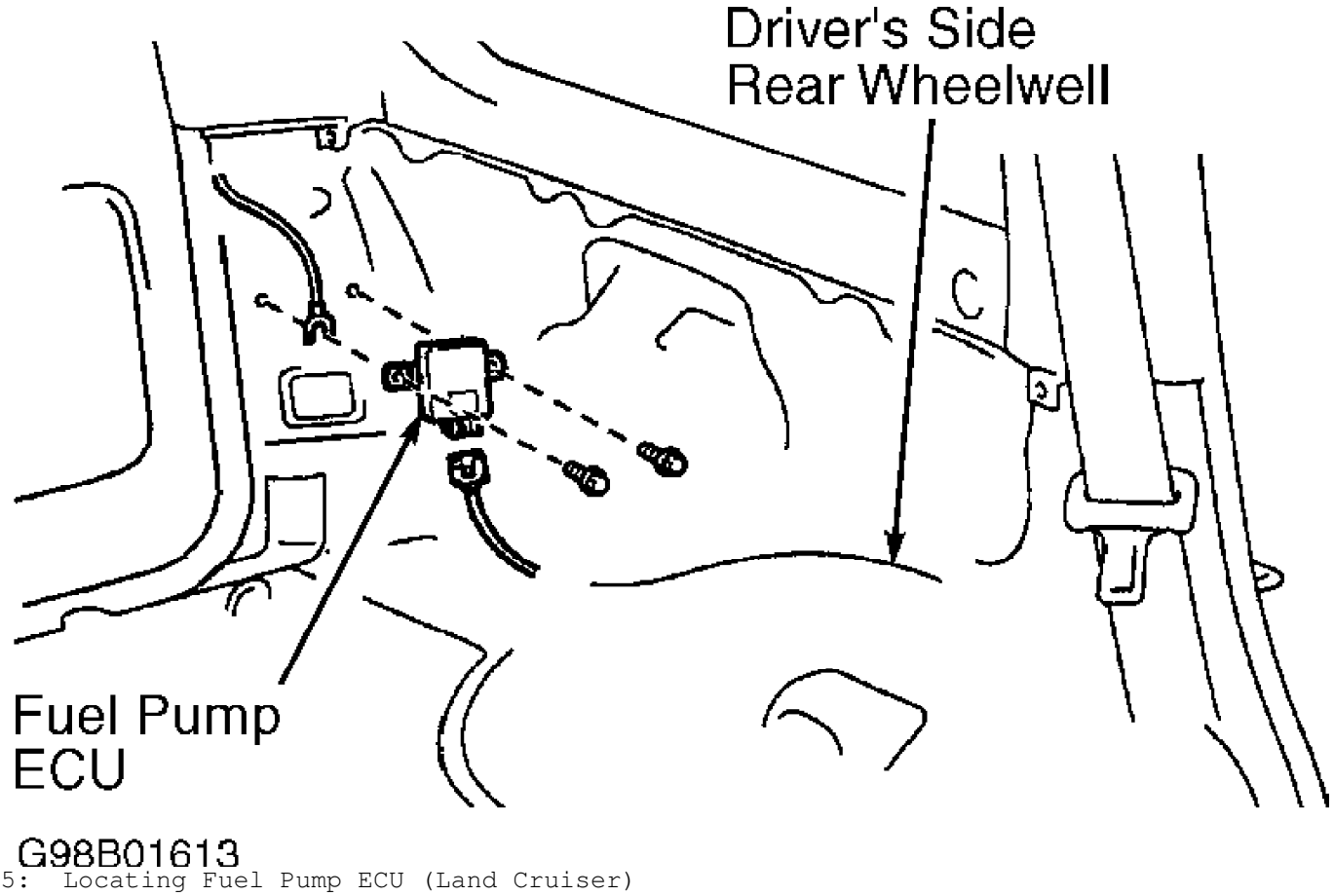
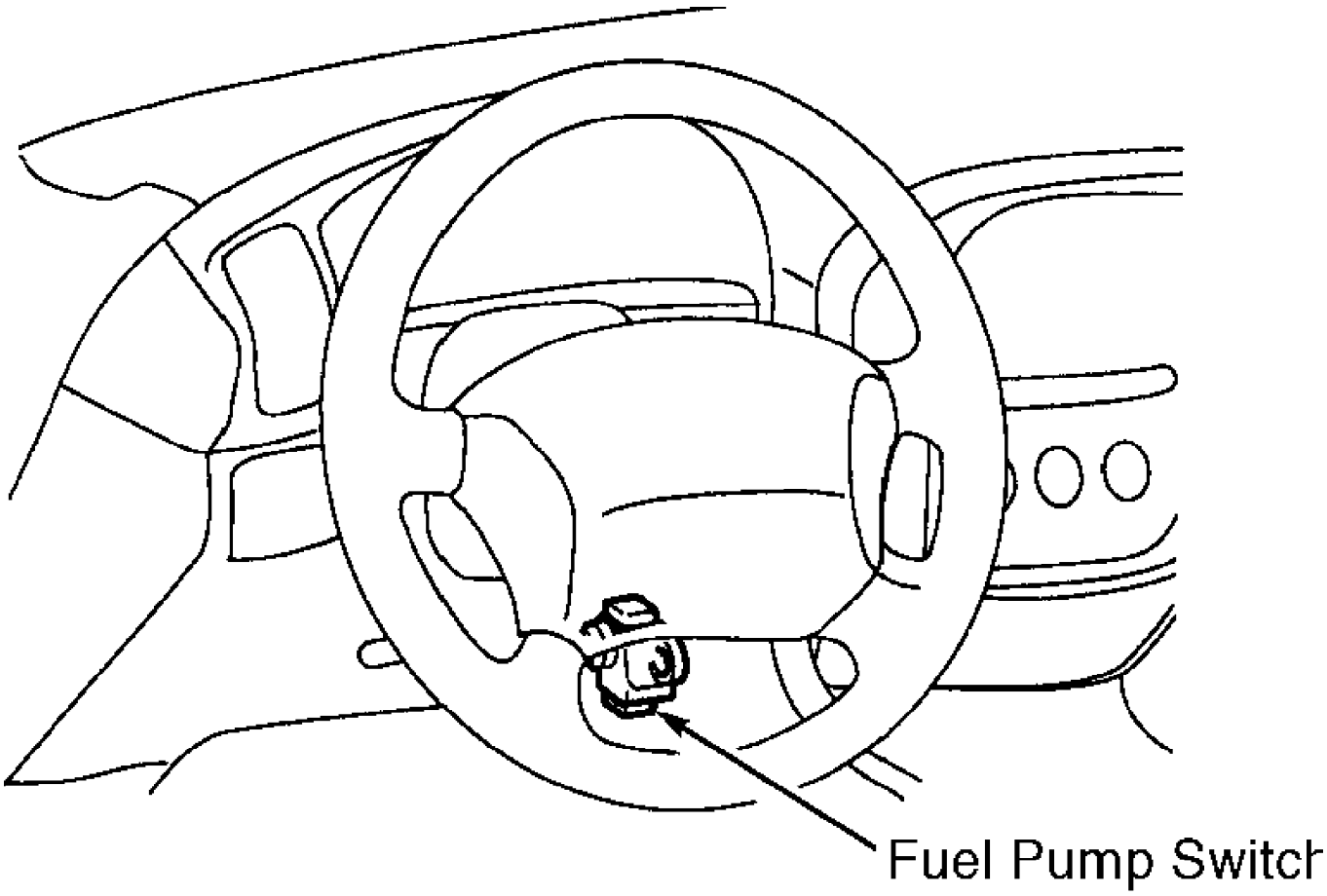


Fig. 25: Locating Fuel Pump ECU (Land Cruiser)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



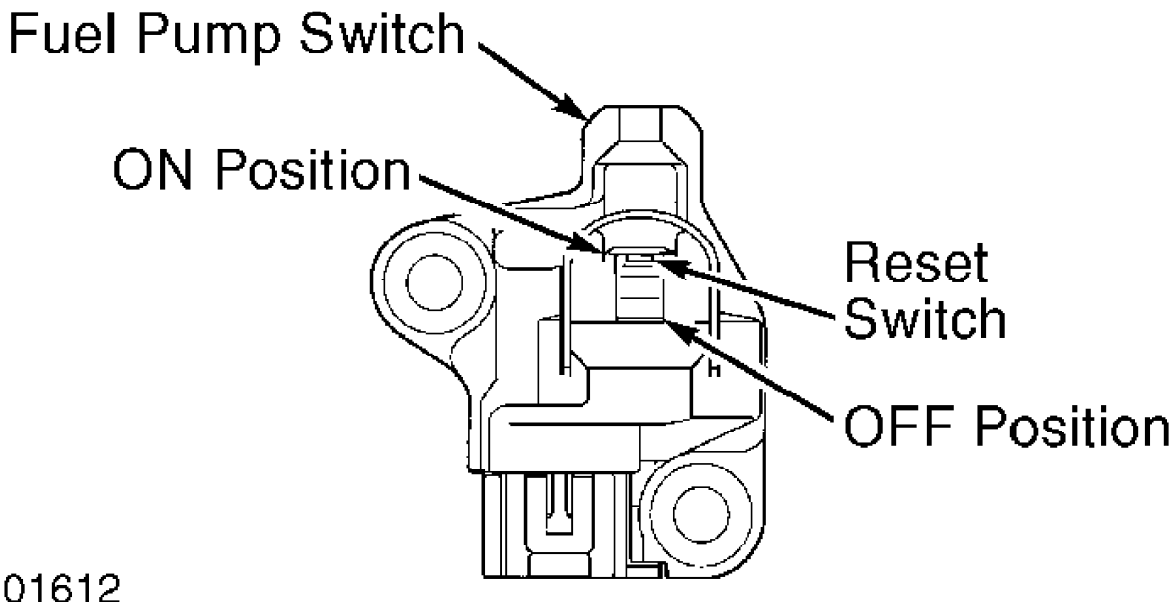
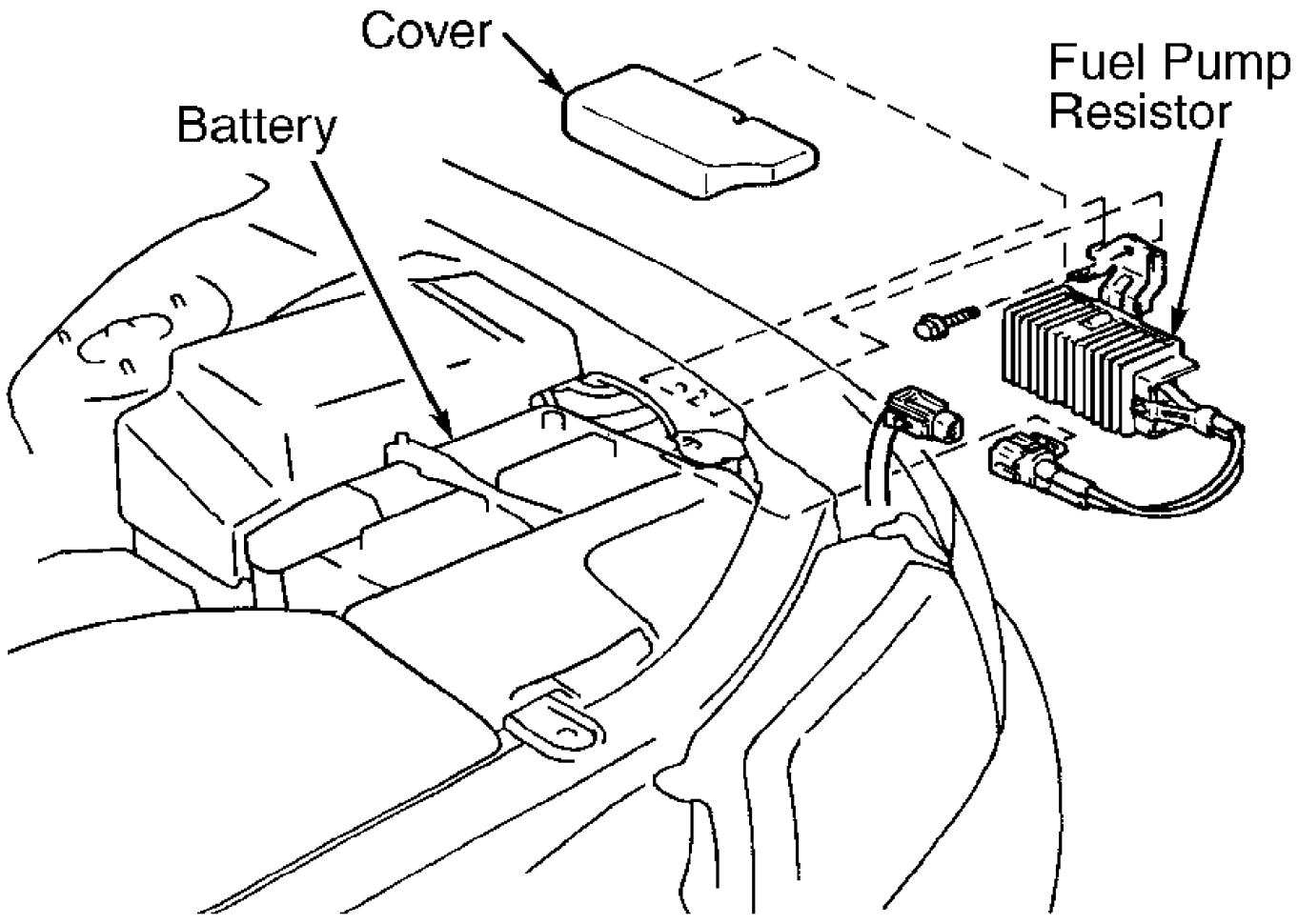


Fig. 26: Locating Fuel Pump Switch & Identifying Reset Switch Positions (Land Cruiser)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pump Relay & Fuel Pump Resistor (LS400)

Fuel pump operating speed is controlled by operating condition of the engine such as: starting, idling, light load or heavy load. When engine is cranking and start signal is received at Engine Control Module (ECM), ECM energizes circuit opening relay and voltage is applied to both sides of fuel pump relay. Fuel pump relay contacts are closed and voltage is applied directly to fuel pump in which fuel pump operates at high speed. After engine starts during idling or light loads, fuel pump relay is energized by FPR terminal of ECM and contacts in fuel pump relay open. Voltage is then supplied to fuel pump by going from circuit opening relay and through fuel pump resistor. Fuel pump now operates at low speed. If a problem exists in fuel pump relay or control circuit, Diagnostic Trouble Code (DTC) P1200 may be stored in ECM. See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs. Fuel pump relay is located in fuse/relay box at driver's side of engine compartment, just in front of strut tower. Fuel pump resistor is located below cover at driver's side front corner of engine compartment, near battery. See Fig. 27.



99F50570

Fig. 27: Locating Fuel Pump Resistor (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IGNITION CHECKS

SPARK TEST

ES300, GS400, LS400, LX470, RX300 & SC400

1) Remove ignition coils. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

2) Reinstall electrical connectors on ignition coils. Remove spark plugs. Install spark plug on each ignition coil. Ground spark plugs against cylinder block. Disconnect electrical connectors at fuel injectors.

CAUTION: DO NOT crank engine for longer than 5 seconds when checking for spark.

3) Crank engine and check for spark. If spark does not exist, check electrical connection at ignition coil. If electrical connection is okay, go to next step. If electrical connection is defective, repair as necessary and recheck for spark.

4) Install different ignition coil on spark plug and recheck for spark. If spark still does not exist, go to next step. If spark now exists with different ignition coil, replace original ignition coil.

5) Turn ignition on. Using voltmeter, check for battery voltage at ignition coil positive terminal. See appropriate wiring diagram in WIRING DIAGRAMS article. If battery voltage exists, go to next step. If battery voltage does not exist, check wiring between ignition switch and ignition coil.

NOTE: On ES300 and RX300, 2 camshaft position sensors are used and may also be referred to as Variable Valve Timing (VVT) sensor. Both camshaft position sensors should be checked when checking camshaft position sensors resistance.

6) On all models, check resistance of camshaft position sensor(s). See CAMSHAFT POSITION SENSOR RESISTANCE. If camshaft position sensor resistance is within specification, go to next step. If camshaft position sensor resistance is not within specification, replace camshaft position sensor. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

7) Check resistance of crankshaft position sensor. See CRANKSHAFT POSITION SENSOR RESISTANCE. If crankshaft position sensor resistance is within specification, go to next step. If crankshaft position sensor resistance is not within specification, replace crankshaft position sensor. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

8) Check ignition IGT signal from Engine Control Module (ECM) to ignition coil. If ignition IGT signal from ECM is defective, Diagnostic Trouble Code (DTC) P1300, P1305, P1310, P1315, P1320, P1325, P1330 or P1340 will be set in ECM memory to indicate a specified ignitor circuit malfunction. See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs. DTCs P1330 or P1340 apply only to GS400, LS400, LX470 and SC400.

9) If ignition IGT signal is okay, substitute another ignition coil and recheck system operation. If ignition IGT signal is defective, check wiring between ECM and ignition coil. See ECM LOCATION table. If wiring is defective, repair wiring as necessary and recheck system operation. If wiring is okay, substitute another ECM and recheck system operation. Reinstall components. Install and tighten spark plugs to 13 ft. lbs. (18 N.m).

ECM LOCATION

Model	(1) Location

ES300	Behind Glove Box
GS400	Driver's Side Front Corner Of Engine Compartment
LS400, LX470 & RX300	Behind Glove Box
SC400	Under Passenger's Side Front Carpet Below Instrument Panel

(1) - For illustration of ECM location, see THEORY & OPERATION article.

GS300 & SC300

1) Remove ignition coils. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Reconnect electrical connectors on ignition coils.

2) Remove spark plugs. Install spark plug on each ignition coil and spark plug wire. Ground spark plugs against cylinder block.

CAUTION: To prevent gasoline from being injected, DO NOT crank engine for longer than 5 seconds when checking for spark.

3) Crank engine and check for spark. If spark exists at spark plug on ignition coil, but not at spark plug on spark plug wire, go to next step. If spark does not exist at any spark plug, check ignition coil and ignitor electrical connections. Ignitor is located in engine compartment, on top of driver's side strut tower. If electrical connections are okay, go to step 5). If electrical connections are defective, repair as necessary and recheck for spark.

4) Using ohmmeter, check resistance of spark plug wire. Replace spark plug wire if resistance exceeds 25,000 ohms per wire.

5) Turn ignition on. Using voltmeter, check for battery voltage at positive terminal on ignitor and ignition coil. See appropriate wiring diagram in WIRING DIAGRAMS article. If battery voltage exists, go to next step. If battery voltage does not exist, check wiring between ignition switch, ignition coil and ignitor. See appropriate wiring diagram in WIRING DIAGRAMS article.

6) Check ignition coil resistance. See IGNITION COIL RESISTANCE. If ignition coil resistance is within specification, go to next step. If ignition coil resistance is not within specification, replace ignition coil.

7) Check resistance of camshaft position sensor. See CAMSHAFT POSITION SENSOR RESISTANCE. If camshaft position sensor resistance is within specification, go to next step. If camshaft position sensor resistance is not within specification, replace camshaft position sensor. See ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

8) Check resistance of crankshaft position sensor. See CRANKSHAFT POSITION SENSOR RESISTANCE. If crankshaft position sensor resistance is within specification, go to next step. If crankshaft position sensor resistance is not within specification, replace crankshaft position sensor. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

9) Check ignition IGT signal from Engine Control Module (ECM) to ignitor. If ignition IGT signal from ECM is defective, Diagnostic Trouble Code (DTC) P1300 will be set in the ECM memory to indicate an ignitor circuit malfunction. See SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article for retrieving of DTCs.

10) If ignition IGT signal is okay, substitute another ignitor and recheck system operation. If ignition IGT signal is defective, check wiring between ECM and ignitor. On GS300, ECM is located at driver's side front corner of engine compartment. On SC300, ECM is located under passenger's side front carpet below instrument panel. On all models, if wiring is defective, repair wiring as

necessary and recheck system operation. If wiring is okay, substitute another ECM and recheck system operation. Reinstall components. Install and tighten spark plugs to 13 ft. lbs. (18 N.m).

CAMSHAFT POSITION SENSOR RESISTANCE

1) Disconnect electrical connector at camshaft position sensor. See CAMSHAFT POSITION SENSOR LOCATION table. See Figs. 28-30.

CAMSHAFT POSITION SENSOR LOCATION

Application	Ohms
ES300 & RX300	(1) Two Sensors Are Used, One At Each Flywheel End Of Cylinder Head, Just Below Valve Cover
GS300 & SC300	Just Above Intake Manifold At Rear Corner Of Cylinder Head
GS400, LS400, LX470 & SC400	Behind Driver's Side Upper Timing Belt Cover, Near Camshaft Sprocket With Electrical Connector Near Front Of Upper Timing Belt Cover

(1) - Camshaft position sensors may also be referred to as Variable Valve Timing (VVT) sensors.

2) Using ohmmeter, check resistance between electrical terminals on camshaft position sensor. See Figs. 28-30. Ensure camshaft position sensor resistance is within specification. See CAMSHAFT POSITION SENSOR RESISTANCE table. Replace camshaft position sensor if resistance is not within specification. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

CAMSHAFT POSITION SENSOR RESISTANCE

Application	Ohms
All Models	
Cold (1)	835-1400
Hot (2)	1060-1645

(1) - Cold is with temperature of 14-122°F (-10-50°C).
(2) - Hot is with temperature of 122-212°F (50-100°C).

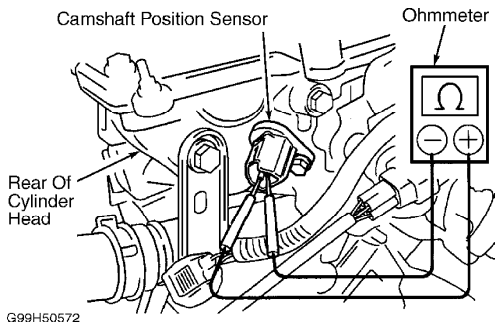


Fig. 28: Locating & Checking Typical Camshaft Position Sensor (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

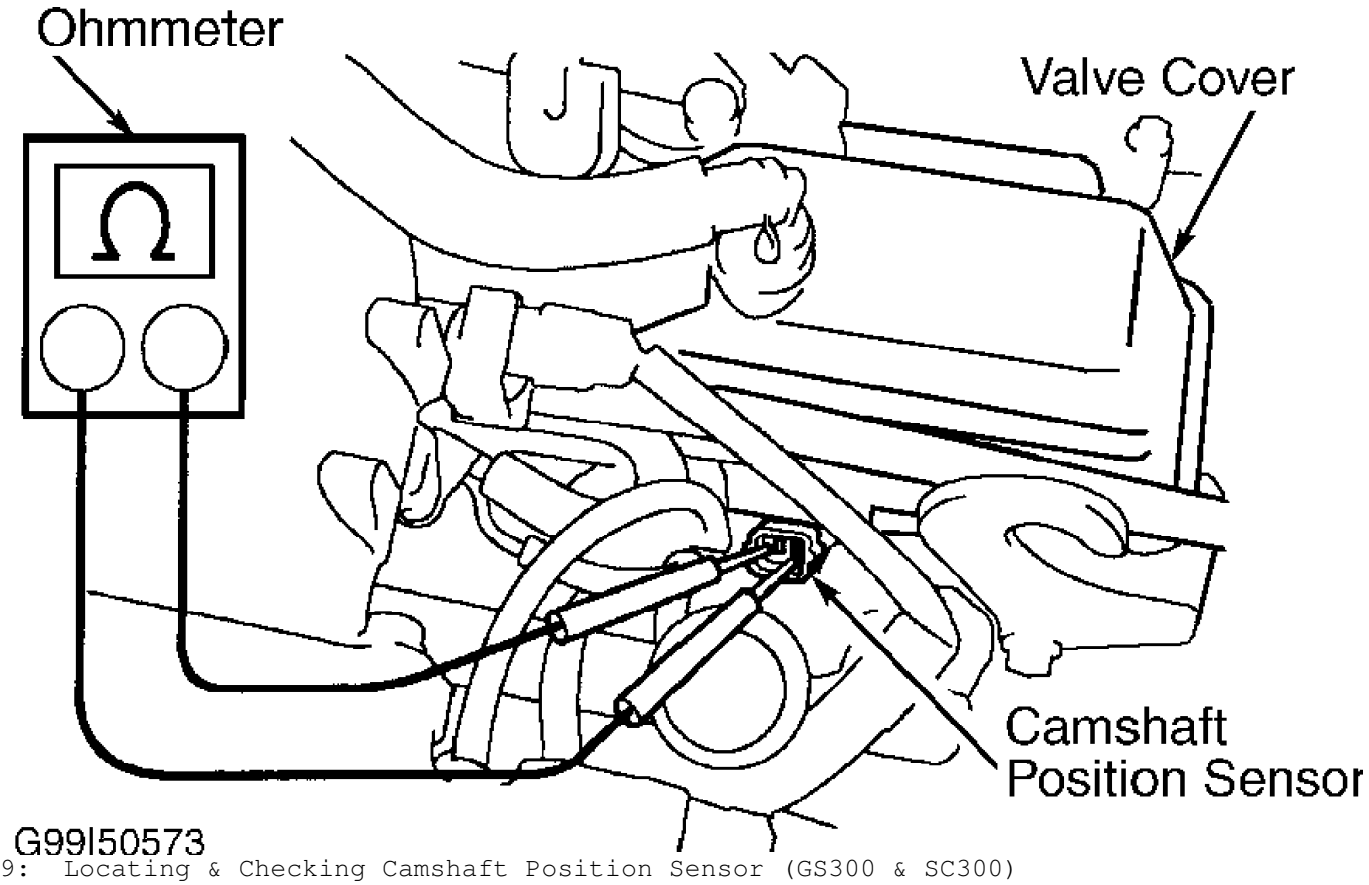


Fig. 29: Locating & Checking Camshaft Position Sensor (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

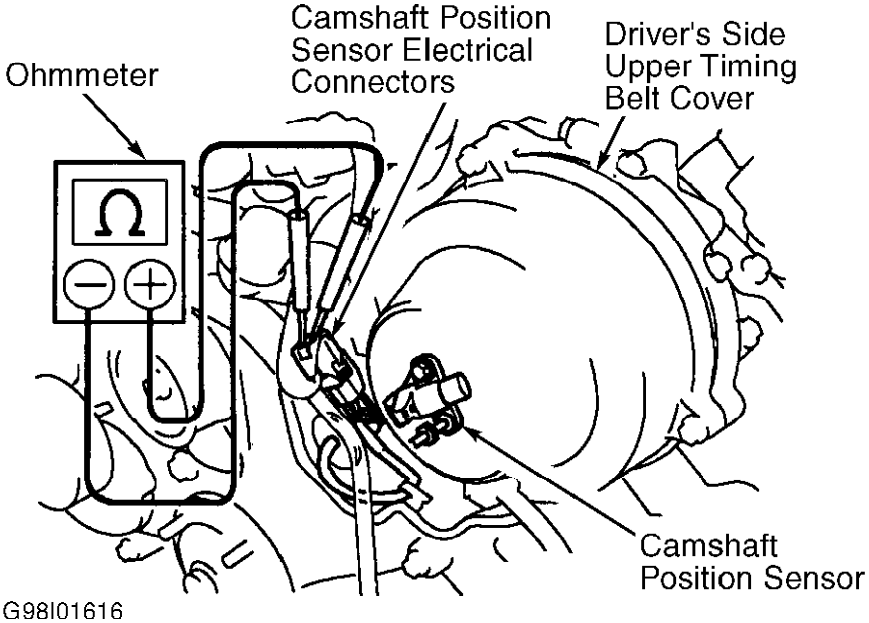


Fig. 30: Locating & Checking Camshaft Position Sensor (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRANKSHAFT POSITION SENSOR RESISTANCE

ES300, GS400, LX470 & RX300

1) Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. See Figs. 31 and 32.

2) Manufacturer lists inspection procedure with crankshaft position sensor removed before checking the resistance. On ES300 and RX300, remove passenger's side fender apron for access to crankshaft position sensor. On GS400 and LX470, remove lower engine cover for access to crankshaft position sensor.

3) On all models, disconnect electrical connector at crankshaft position sensor. Remove bolt and crankshaft position sensor. Using ohmmeter, check resistance between electrical terminals on crankshaft position sensor. Replace crankshaft position sensor if resistance is not within specification. See CRANKSHAFT POSITION SENSOR RESISTANCE table.

4) Reinstall crankshaft position sensor. On ES300 and RX300, install and tighten crankshaft position sensor bolt to 71 INCH lbs. (8.0 N.m). On GS400 and LX470, install and tighten crankshaft position sensor bolt to 58 INCH lbs. (6.6 N.m). On all models, reinstall electrical connector on crankshaft position sensor.

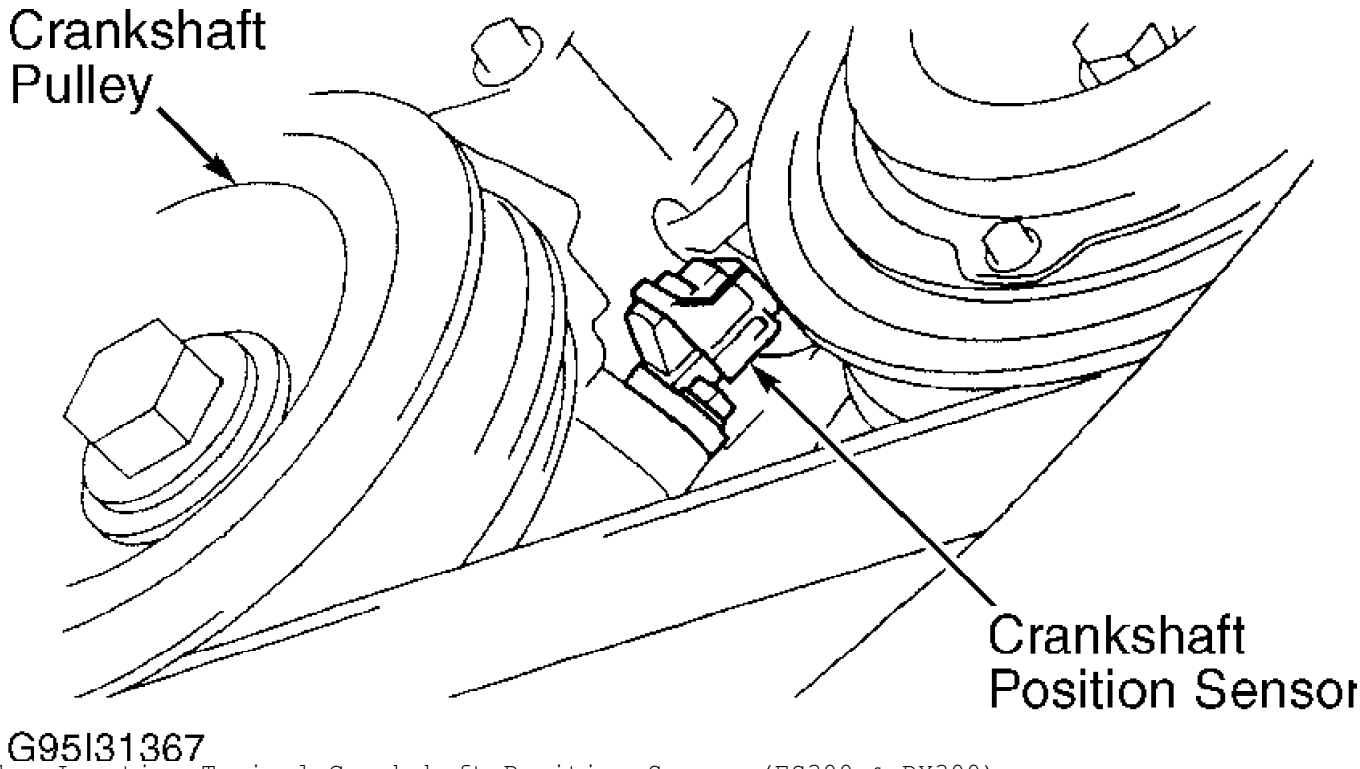


Fig. 31: Locating Typical Crankshaft Position Sensor (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

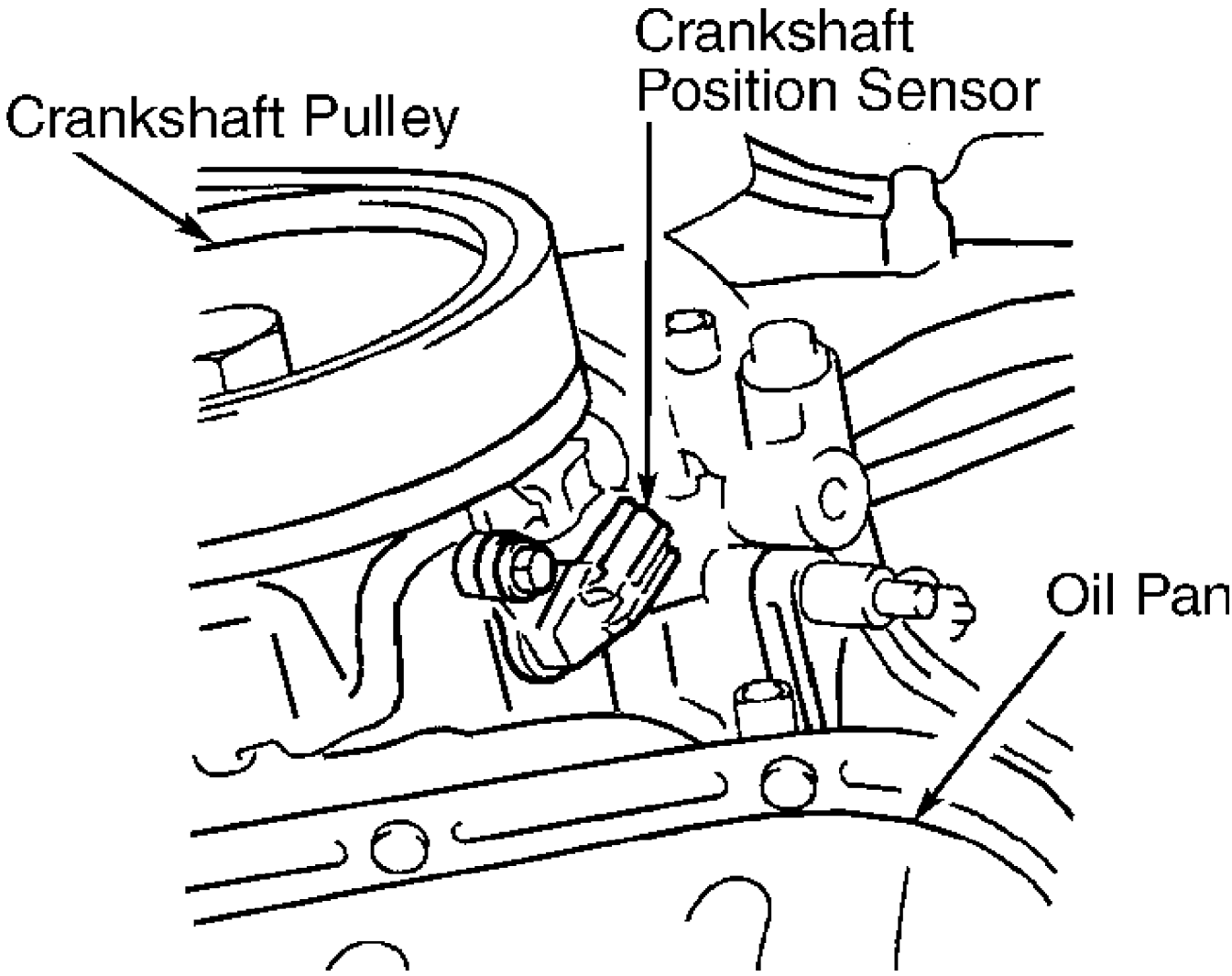


Fig. 32: Locating Typical Crankshaft Position Sensor (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

GS300 & SC300

1) Crankshaft position sensor is located near crankshaft pulley, just above oil pan on passenger's side of engine with electrical connector located near water pump. Disconnect crankshaft position sensor electrical connector. See Fig. 33. Remove bolt from electrical connector retaining bracket. See Fig. 33.

2) Using ohmmeter, check resistance between electrical terminals on crankshaft position sensor electrical connector. Ensure crankshaft position sensor resistance is within specification. See CRANKSHAFT POSITION SENSOR RESISTANCE table. Replace crankshaft position sensor if resistance is not within specification. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Reinstall electrical connector.

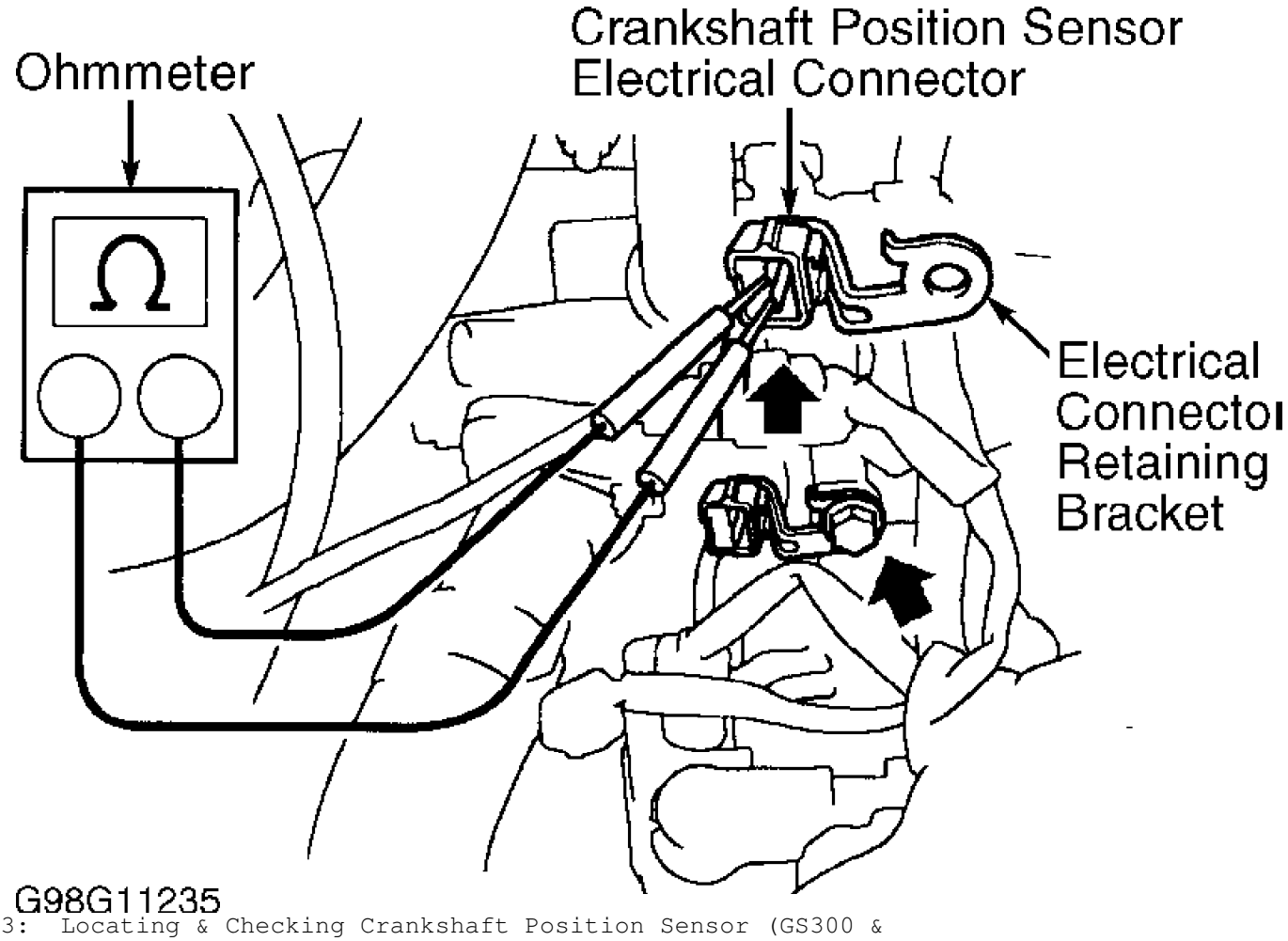


Fig. 33: Locating & Checking Crankshaft Position Sensor (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

LS400 & SC400

1) On LS400, remove lower engine cover and oil pan protector for access to crankshaft position sensor. On SC400, remove lower engine cover for access to crankshaft position sensor. On all models, crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. See Fig. 32. Disconnect electrical connector at crankshaft position sensor.

2) Using ohmmeter, check resistance between electrical terminals on crankshaft position sensor. Ensure crankshaft position sensor resistance is within specification. See CRANKSHAFT POSITION SENSOR RESISTANCE table. Replace crankshaft position sensor if resistance is not within specification. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Reinstall electrical connector.

CRANKSHAFT POSITION SENSOR RESISTANCE

Application	Ohms
All Models	
Cold (1)	1630-2740
Hot (2)	2065-3225

(1) - Cold is with temperature of 14-122°F (-10-50°C).
(2) - Hot is with temperature of 122-212°F (50-100°C).

IGNITION COIL RESISTANCE

ES300, GS400, LS400, LX470, RX300 & SC400
Ignition coil resistance is not available from manufacturer.

GS300 & SC300
1) Remove ignition coil. See IGNITION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.
2) Using ohmmeter, check ignition coil primary resistance between positive (+) and negative (-) electrical terminals on ignition coil. See Fig. 34. Replace ignition coil if ignition coil primary resistance is not within specification. See IGNITION COIL RESISTANCE table.
3) Using ohmmeter, check ignition coil secondary resistance between electrical terminal and spark plug terminal on ignition coil. See Fig. 35. Replace ignition coil if ignition coil secondary resistance is not within specification. See IGNITION COIL RESISTANCE (OHMS) table. Reinstall ignition coil.

IGNITION COIL RESISTANCE (OHMS)

Application	Primary	Secondary
GS300 & SC300		
Cold (1)	.33-.52	8500-14,700
Hot (2)	.42-.61	10,800-17,200

(1) - Cold is with temperature of 14-122°F (-10-50°C).
(2) - Hot is with temperature of 122-212°F (51-100°C).

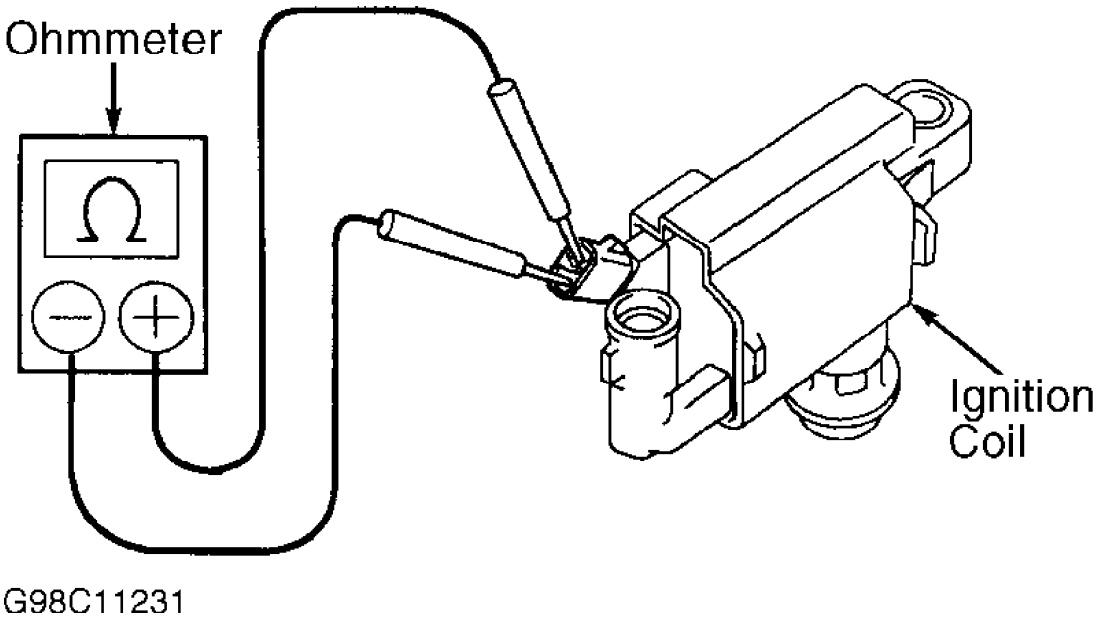


Fig. 34: Checking Ignition Coil Primary Resistance (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

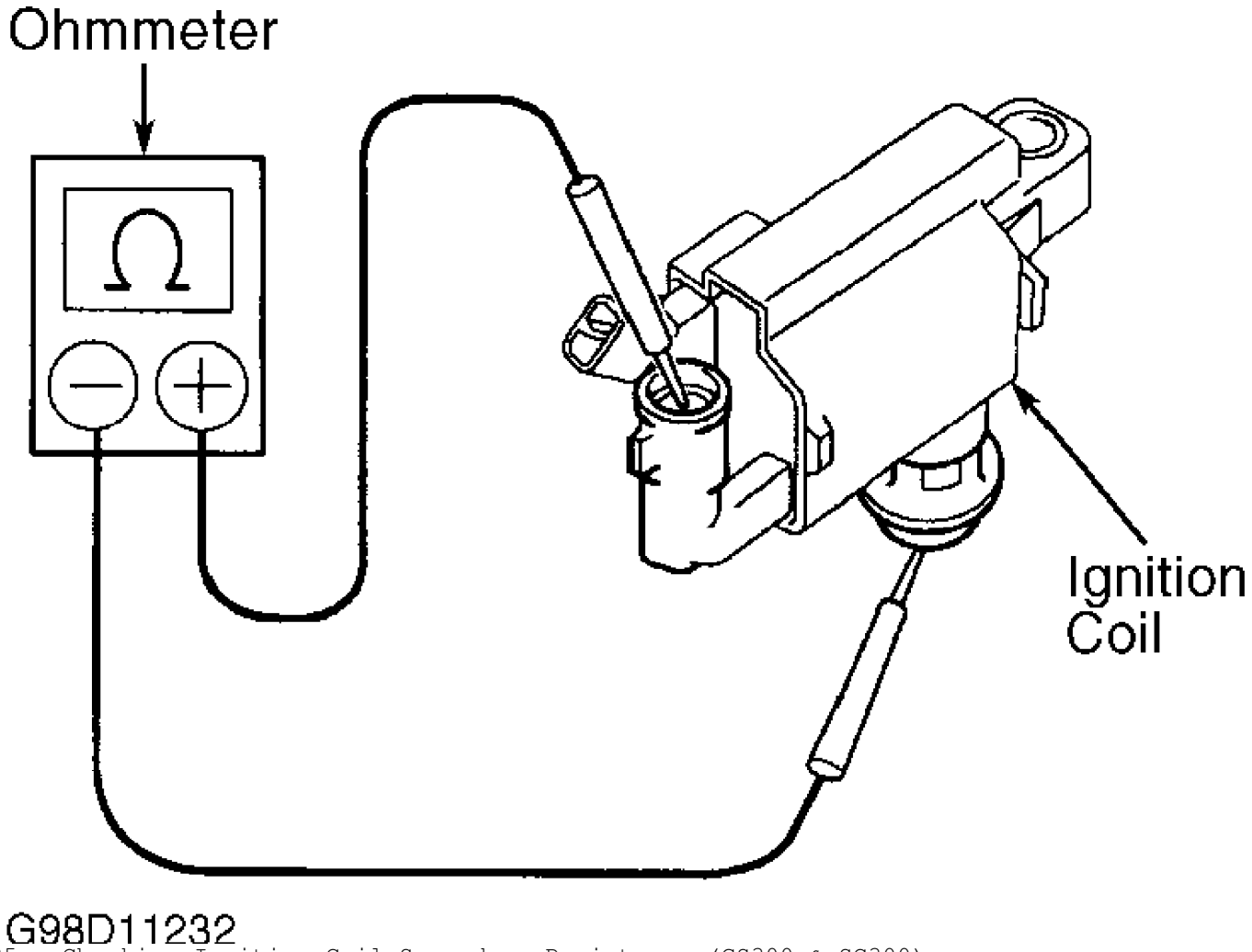


Fig. 35: Checking Ignition Coil Secondary Resistance (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IDLE SPEED & IGNITION TIMING

Ensure idle speed and ignition timing are set to specification. For adjustment procedures, see ON-VEHICLE ADJUSTMENTS article.

SUMMARY

If no faults were found while performing BASIC DIAGNOSTIC PROCEDURES, proceed to appropriate SELF-DIAGNOSTICS article. If no hard diagnostic trouble codes are found in self-diagnostics, proceed to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.) or intermittent diagnostic procedures.

G - TESTS W/CODES - INTRODUCTION

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Self-Diagnostics - Introduction
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

If no faults were found while performing BASIC DIAGNOSTIC PROCEDURES, proceed with self-diagnostics. If no Diagnostic Trouble Codes (DTCs) are present after entering self-diagnostics, proceed to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.).

SYSTEM OVERVIEW

The ECM monitors engine operation and contains a self-diagnostic system which stores Diagnostic Trouble Codes (DTCs) and complies to On-Board Diagnostics Generation-II (OBD-II) standards. The goal of OBD-II regulation is to provide vehicle with an on-board diagnostic system which is capable of continuously monitoring the efficiency of emission control system, and to improve diagnosis and repair when system failures occur.

The Federal Test Procedure (FTP) sets maximum allowable emission standards. A Malfunction Indicator Light (MIL) must illuminate if a system or component either fails or deteriorates to a point where the vehicle emissions could rise above 1 1/2 times FTP standards.

If malfunction does not reoccur in 3 ignition cycles, the MIL goes off, but DTCs remain recorded in ECM memory. DTCs may only be retrieved using an On-Board Diagnostic (OBD-II) scan tool that complies with SAE standard J-1978 or Lexus scan tool connected to Data Link Connector (DLC) No. 3. The scan tool also provides freeze-frame data and can be used to clear codes.

DETECTION LOGIC

Two-Trip Detection Logic

Two-trip detection logic is used to prevent erroneous malfunction detection. When a malfunction initially occurs, Diagnostic Trouble Code (DTC) will be temporarily stored in ECM memory, but MIL on instrument panel will not illuminate.

The second time that a malfunction is detected, MIL on instrument panel will illuminate, provided ignition is turned off and then back on after first malfunction was detected. This is referred to as the 2-Trip Detection Logic and only applies to specified DTCs.

DTCs P0300-P0308 Detection Logic

On DTCs P0300-P0308, MIL is set in 2 stages. If the ECM detects misfiring, strong enough to cause catalytic converter overheating, for any 200 revolutions of the engine, MIL will blink, but will not stay illuminated. If the ECM detects misfiring, strong enough to cause deterioration of catalytic converter, during 2 consecutive drive cycles, for any 1000 revolutions of the engine, MIL will illuminate.

NOTE: When road testing vehicle in CHECK mode (Lexus scan tool only), the Two Trip Detection Logic will not function. Also, MIL will illuminate first time a malfunction is detected.

DATA LINK CONNECTOR

OBD-II regulations (SAE J-1850) standardizes Data Link Connector (DLC) configurations. On all models, DLC No. 3 connector is located under left side of instrument panel. See appropriate illustration in appropriate SELF-DIAGNOSTICS article.

FREEZE-FRAME DATA

The ECM records engine operating condition when a misfire, fuel trim (mixture) malfunction or other malfunction (fuel system, calculated load, coolant temperature, fuel trim (mixture), engine speed, vehicle speed, etc.) exists. If more than one fault is detected, only data from the first malfunction is recorded. Recorded data is useful for determining conditions in which the malfunction occurs.

ECM LOCATION

NOTE: For location of other computerized engine control components, see appropriate illustration in THEORY & OPERATION article.

ES300, LS400, LX470 & RX300
Behind glove box.

GS300 & GS400
Left front of engine compartment.

SC300 & SC400
Under front of carpet on passenger side of vehicle.

SELF-DIAGNOSTIC SYSTEM

MALFUNCTION INDICATOR LIGHT (MIL) INSPECTION

NOTE: The CHECK engine light located on instrument cluster is known as Malfunction Indicator Light (MIL). Inspect MIL to ensure it is operational and will come on if a Diagnostic Trouble Code (DTC) is set.

1) Turn ignition on with engine off. MIL should come on and remain on. If MIL does not come on, check bulb circuit on instrument cluster and wiring circuit between MIL and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. See ECM LOCATION.
2) Start engine and ensure MIL goes off. If MIL remains on with engine running, a malfunction is detected. Proceed to RETRIEVING DIAGNOSTIC TROUBLE CODES.

TESTING PROCEDURE

To ensure correct diagnosis and repair, testing should be done in the following sequence:

* Record Customer Complaint - Ensure all customer complaints or observations are recorded. Test drive vehicle with customer when necessary for malfunction verification.
* Retrieve Diagnostic Trouble Codes - Connect appropriate OBD-II scan tool. Retrieve codes and record any freeze-frame data. See RETRIEVING DIAGNOSTIC TROUBLE CODES.
* Clear Trouble Codes - Clear codes using scan tool. See

CLEARING DIAGNOSTIC TROUBLE CODES.

* Perform Visual Inspection - Inspect all connectors of suspect circuit or component. Ensure all connections are clean and tight.
* Confirm Symptoms & Trouble Codes - Perform road test. Determine if original symptoms are still present. Retrieve codes.
* Diagnose & Repair Diagnostic Trouble Codes - Perform diagnosis and repair procedures as needed. See appropriate SELF-DIAGNOSTICS article. If no codes are present, proceed to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.).
* Verification Procedure - After repairs have been completed, clear all diagnostic trouble codes. See CLEARING DIAGNOSTIC TROUBLE CODES. Perform road test. Ensure no codes are present and all symptoms and/or complaints have been repaired.

RETRIEVING DIAGNOSTIC TROUBLE CODES

NOTE: Diagnostic Trouble Codes (DTCs) may be retrieved using Lexus scan tool or On-Board Diagnostic (OBD-II) scan tool that complies with SAE standard J-1978. Lexus scan tool or OBD-II scan tool may be operated in NORMAL mode when retrieving trouble codes. Only Lexus scan tool may be used in CHECK mode when retrieving DTCs.

NORMAL mode is used to retrieve DTCs from Engine Control Module (ECM). CHECK mode is used to check for DTCs when operating vehicle to simulate conditions in which DTC was set. CHECK mode contains a higher sensing ability to detect malfunctions. CHECK mode helps determine malfunctions caused by poor electrical connections, which are difficult to determine using NORMAL mode.

NOTE: If using Lexus scan tool, when ignition is turned from ON to ACC or OFF position or scan tool is switched from NORMAL mode to CHECK mode, all DTCs and freeze-frame data will be erased. DO NOT switch modes until all DTCs and freeze-frame data are recorded.

NORMAL Mode Code Retrieval

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. DLC No. 3 is located under left side of instrument panel. Turn ignition on with engine off. Turn scan tool on. Using scan tool manufacturer's instructions, check for DTCs and freeze-frame data.

2) If scan tool displays UNABLE TO CONNECT TO VEHICLE, DLC No. 3 must be checked. See DLC NO. 3 INSPECTION under SCAN TOOL PROBLEMS. If scan tool does not display UNABLE TO CONNECT TO VEHICLE, go to next step.

3) Record any DTCs and freeze-frame data displayed for system diagnosis. If driveability problem exists and no DTCs are present, go to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom.

4) If any DTCs are present, perform appropriate diagnostic test in appropriate SELF-DIAGNOSTICS article. See appropriate DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION table. For more information on freeze-frame data, see FREEZE-FRAME DATA under INTRODUCTION. For information on 2-trip detection logic codes, see TWO-TRIP DETECTION LOGIC under INTRODUCTION.

5) After repairs for DTC have been completed, DTCs must be cleared from ECM memory. See CLEARING DIAGNOSTIC TROUBLE CODES.

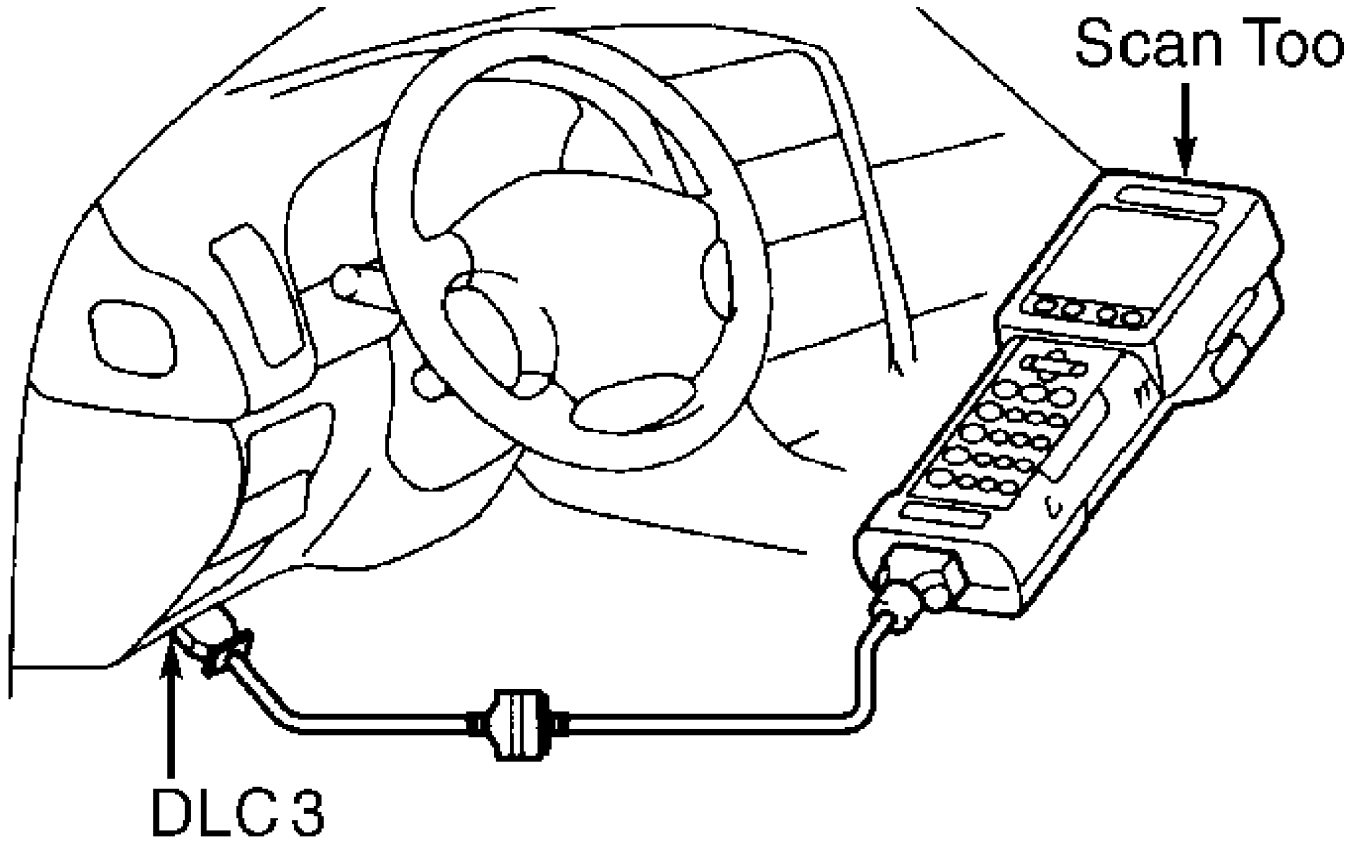


Fig. 1: Connecting Scan Tool To DLC No. 3 (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CHECK Mode Code Retrieval (Lexus Scan Tool Only)

1) Ensure vehicle battery is fully charged (at least 11 volts). Apply parking brake. Shift transmission/transaxle into Neutral (M/T) or Park (A/T). Turn A/C and all accessories off. Ensure throttle is in idle position.

2) Turn ignition off. Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. DLC No. 3 connector is located under left side of instrument panel. Turn ignition on with engine off. Turn scan tool on.

3) Switch scan tool from NORMAL mode to CHECK mode. CHECK mode is operational if MIL on instrument cluster flashes. Start engine. Ensure MIL goes off. Try to simulate conditions of driveability complaint described by customer.

NOTE: If ignition is turned from ON to ACC or OFF position, all DTCs and freeze-frame data will be erased. DO NOT switch modes until all DTCs and freeze-frame data are recorded.

4) Record any DTCs and freeze-frame data displayed for system diagnosis. If driveability problem exists and no codes are present, go to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom.

5) If any DTCs are present, perform appropriate circuit test. See appropriate DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION table. For more information on freeze-frame data, see FREEZE-FRAME DATA under INTRODUCTION. For information on 2-trip detection logic codes, see TWO-TRIP DETECTION LOGIC under INTRODUCTION.

6) After repairs for DTC have been completed, DTC must be cleared from ECM memory. See CLEARING DIAGNOSTIC TROUBLE CODES.

CLEARING DIAGNOSTIC TROUBLE CODES

1) After performing repairs, clear ECM memory of all stored Diagnostic Trouble Codes (DTCs) and freeze-frame data. DTCs and freeze-frame data may be cleared by using scan tool and scan tool manufacturer's instructions.

NOTE: If using Lexus Scan Tool, DTCs and freeze-frame data may be cleared by switching from CHECK mode to NORMAL mode or from NORMAL mode to CHECK mode.

2) DTCs and freeze-frame data may also be cleared by removing EFI fuse and ECTS fusee (if equipped with electronic throttle control system) from fuse/relay box located in engine compartment. DTCs and freeze-frame data may also be cleared by disconnecting negative battery cable. However, other memory functions (clock, radio, alarm, seats, etc.) will be cancelled and must be reset.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - ES300

DTC (1)	Description
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow (MAF) Sensor Circuit
P0101	Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110	Intake Air Temperature (IAT) Sensor Circuit
P0115	Engine Coolant Temperature (ECT) Sensor Circuit
P0116	Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120	Throttle Position (TP) Sensor Circuit Malfunction
P0121	Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150	Heated Oxygen Sensor Fault (Except Calif. Emissions)
P0141	Heated Oxygen Sensor Heater Circuit
P0171 Or P0172	System Too Lean/Rich
P0300	Random Cylinder Misfire Detected
P0301-P0306	Cylinders No. 1-6 Misfire Detected
P0325 Or P0330	Knock Sensor
P0335 Or P1335	Crankshaft Position (CKP) Sensor Circuit
P0340	Variable Valve Timing (VVT) Sensor Circuit
P0420	Catalyst System Efficiency Below Threshold
P0440	Evap System Malfunction
P0441	Incorrect Evap Purge Flow
P0446	Evap Vent Control Fault
P0450	Evap Pressure Sensor Malfunction
P0451	Evap Pressure Sensor Range/Performance Fault
P0500	Vehicle Speed Sensor (VSS) Malfunction
P0505	Idle Control System Malfunction
P0710 (3)	Transmission Fluid Temperature Sensor Fault
P0750 (3)	Shift Solenoid Valve No. 1 Fault
P0753 (3)	Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3)	Shift Solenoid Valve No. 2 Fault
P0758 (3)	Shift Solenoid Valve No. 2 Electrical Fault
P0765 (3)	Shift Solenoid Valve No. 4 Fault

P0768 (3) ..... Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3) ..... Lock-Up Solenoid Fault
P0773 (3) ..... Lock-Up Solenoid Circuit Electrical Fault
P1130 Or P1150 ..... Air/Fuel Sensor Circuit Range/Performance Fault
P1133 Or P1153 ..... Air/Fuel Sensor Circuit Response Malfunction
P1135 Or P1155 ..... Air/Fuel Sensor Heater Circuit Malfunction
P1300, P1305, P1310,
P1315, P1320 Or P1325 ..... Ignitor Circuit Malfunction
P1345 Or P1350 ..... Variable Valve Timing (VVT) Circuit Malfunction
P1346 Or P1351 ..... Variable Valve Timing (VVT) Circuit Range/Performance Fault
P1349 Or P1354 ..... Variable Valve Timing (VVT) System Malfunction
P1520 ..... Stoplight Switch Signal Malfunction
P1600 ..... ECM Batt Malfunction
P1656 Or P1663 ..... Oil Control Valve (OCV) Malfunction
P1725 (3) ..... Input Turbine Speed Sensor Circuit Fault
P1730 (3) ..... Counter Gear Speed Sensor Circuit Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - ES300 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - GS300

DTC (1) Description

B2795 (2) ..... Unmatched Key Code
B2796 (2) ..... No Communication In Immobilizer System
B2797 (2) ..... Communication Malfunction No. 1
B2798 (2) ..... Communication Malfunction No. 2
P0100 ..... Mass Airflow (MAF) Sensor Circuit
P0101 ..... Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110 ..... Intake Air Temperature (IAT) Sensor Circuit
P0115 ..... Engine Coolant Temperature (ECT) Sensor Circuit
P0116 ..... Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120 ..... Throttle Position (TP) Sensor Circuit Malfunction
P0121 ..... Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125 ..... Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150 ..... Heated Oxygen Sensor Circuit Malfunction
P0133 Or P0153 ..... Heated Oxygen Sensor Circuit Slow Response
P0135 Or P0155 ..... Heated Oxygen Sensor Heater Circuit
P0136 Or P0156 ..... Heated Oxygen Sensor Circuit Malfunction
P0141 Or P0161 ..... Heated Oxygen Sensor Heater Circuit
P0171 Or P0172 ..... System Too Lean/Rich
P0300 ..... Random Cylinder Misfire Detected
P0301-P0306 ..... Cylinders No. 1-6 Misfire Detected
P0325 Or P0330 ..... Knock Sensor Circuit Malfunction
P0335 Or P1335 ..... Crankshaft Position (CKP) Sensor
P0340 ..... Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430 ..... Catalyst System
P0440 ..... Evap System Malfunction

P0441 ..... Incorrect Evap Purge Flow
P0446 ..... Evap Vent Control Fault
P0450 ..... Evap Pressure Sensor Malfunction
P0451 ..... Evap Pressure Sensor Range/Performance Fault
P0500 ..... Vehicle Speed Sensor (VSS) Malfunction
P0505 ..... Idle Control System Malfunction
P0710 (3) ..... Transmission Fluid Temperature Sensor Fault
P0715 (3) ..... Turbine Speed Sensor Fault
P0750 (3) ..... Shift Solenoid Valve No. 1 Fault
P0753 (3) ..... Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3) ..... Shift Solenoid Valve No. 2 Fault
P0758 (3) ..... Shift Solenoid Valve No. 2 Electrical Fault
P0760 (3) ..... Shift Solenoid Valve No. 3 Fault
P0763 (3) ..... Shift Solenoid Valve No. 3 Electrical Fault
P0768 (3) ..... Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3) ..... Lock-Up Solenoid Fault
P1120 ..... Accelerator Position Sensor Circuit Malfunction
P1121 ..... Accelerator Position Sensor Circuit Malfunction
P1125 ..... Throttle Control Motor Circuit Malfunction
P1126 ..... Electromagnetic Clutch Circuit Malfunction
P1127 ..... Electronic Throttle Control System (ETCS) Actuator Power Source Circuit Malfunction
P1128 ..... Throttle Control Motor Lock Malfunction
P1129 ..... Electronic Throttle Control System (ETCS) Malfunction
P1300 ..... Ignitor Circuit Malfunction
P1346 .. Variable Valve Timing (VVT) Circuit Range/Performance Fault
P1349 ..... Variable Valve Timing (VVT) System Malfunction
P1520 ..... Stoplight Switch Signal Malfunction
P1600 ..... ECM Batt Malfunction
P1633 ..... Electronic Throttle Control System (ETCS) Circuit ECM Malfunction
P1645 ..... Body ECU Malfunction
P1656 ..... Oil Control Valve (OCV) Circuit Malfunction
P1755 (3) ..... Shift Solenoid Valve SLU Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1765 (3) ..... Shift Solenoid Valve SLN Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - GS300 & GS400 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - GS400

DTC (1) Description

B2795 (2) ..... Unmatched Key Code
B2796 (2) ..... No Communication In Immobilizer System
B2797 (2) ..... Communication Malfunction No. 1
B2798 (2) ..... Communication Malfunction No. 2
P0100 ..... Mass Airflow (MAF) Sensor Circuit
P0101 .... Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110 ..... Intake Air Temperature (IAT) Sensor Circuit
P0115 ..... Engine Coolant Temperature (ECT) Sensor Circuit
P0116 ..... Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault

P0120 ..... Throttle Position (TP) Sensor Circuit Malfunction
P0121 ..... Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125 ..... Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150 ..... Heated Oxygen Sensor Circuit Malfunction
P0133 Or P0153 ..... Heated Oxygen Sensor Circuit Slow Response
P0135 Or P0155 ..... Heated Oxygen Sensor Heater Circuit
P0136 Or P0156 ..... Heated Oxygen Sensor Circuit Malfunction
P0141 Or P0161 ..... Heated Oxygen Sensor Heater Circuit
P0171 Or P0172 ..... System Too Lean/Rich
P0300 ..... Random Cylinder Misfire Detected
P0301-P0308 ..... Cylinders No. 1-8 Misfire Detected
P0325 Or P0330 ..... Knock Sensor Circuit Malfunction
P0335 Or P1335 ..... Crankshaft Position (CKP) Sensor
P0340 ..... Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430 ..... Catalyst System Efficiency Below Threshold
P0440 ..... Evap System Malfunction
P0441 ..... Incorrect Evap Purge Flow
P0446 ..... Evap Vent Control Fault
P0450 ..... Evap Pressure Sensor Fault
P0451 ..... Evap Pressure Sensor Range/Performance Malfunction
P0500 ..... Vehicle Speed Sensor (VSS) Malfunction
P0505 ..... Idle Control System Malfunction
P0710 (3) ..... Transmission Fluid Temperature Sensor Fault
P0715 (3) ..... Turbine Speed Sensor Fault
P0750 (3) ..... Shift Solenoid Valve No. 1 Fault
P0753 (3) ..... Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3) ..... Shift Solenoid Valve No. 2 Fault
P0758 (3) ..... Shift Solenoid Valve No. 2 Electrical Fault
P0760 (3) ..... Shift Solenoid Valve No. 3 Fault
P0763 (3) ..... Shift Solenoid Valve No. 3 Electrical Fault
P0768 (3) ..... Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3) ..... Lock-Up Solenoid Fault
P1120 ..... Accelerator Position Sensor Circuit Malfunction
P1121 ..... Accelerator Pedal Position Sensor Circuit Malfunction
P1125 ..... Throttle Control Motor Circuit Malfunction
P1126 ..... Electromagnetic Clutch Circuit Malfunction
P1127 ..... Electronic Throttle Control System (ETCS) Actuator Power Source Circuit Malfunction
P1128 ..... Throttle Control Motor Lock Malfunction
P1129 ..... Electronic Throttle Control System (ETCS) Malfunction
P1300, P1305, P1310, P1315, P1320, P1325, P1330 Or P1340 ..... Ignitor Circuit Malfunction
P1345 Or P1350 ..... Variable Valve Timing (VVT) Sensor Circuit Malfunction
P1346 Or P1351 ..... Variable Valve Timing (VVT)
P1349 Or P1354 ..... Variable Valve Timing (VVT)
P1520 ..... Stoplight Switch Signal Malfunction
P1566 (4) ..... Cruise Control Main Switch Circuit Fault
P1600 ..... ECM Batt Malfunction
P1633 ..... Electronic Throttle Control System (ETCS) Circuit ECM Malfunction
P1645 ..... Body ECU Malfunction
P1656 Or P1663 ..... Oil Control Valve (OCV)
P1755 (3) ..... Shift Solenoid Valve SLU Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1765 (3) ..... Shift Solenoid Valve SLN Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.

(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - GS300 & GS400 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.
(4) - This DTC applies to cruise control system. See appropriate CRUISE CONTROL SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - LS400

DTC (1)	Description
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow (MAF) Sensor Circuit
P0101	Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110	Intake Air Temperature (IAT) Sensor Circuit Malfunction
P0115	Engine Coolant Temperature (ECT) Sensor Circuit Malfunction
P0116	Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120	Throttle Position (TP) Sensor Circuit Malfunction
P0121	Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150	Heated Oxygen Sensor Circuit Malfunction
P0133 Or P0153	Heated Oxygen Sensor Circuit Slow Response
P0135 Or P0155	Heated Oxygen Sensor Heater Circuit
P0136 Or P0156	Heated Oxygen Sensor Circuit Malfunction
P0141 Or P0161	Heated Oxygen Sensor Heater Circuit
P0171 Or P0172	System Too Lean/Rich
P0300	Random Cylinder Misfire Detected
P0301-P0308	Cylinders No. 1-8 Misfire Detected
P0325 Or P0330	Knock Sensor Circuit Malfunction
P0335 Or P1335	Crankshaft Position (CKP) Sensor
P0340	Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430	Catalyst System Efficiency Below Threshold
P0440	Evap System Malfunction
P0441	Incorrect Evap Purge Flow
P0446	Evap Vent Control Fault
P0450	Evap Pressure Sensor Malfunction
P0451	Evap Pressure Sensor Range/Performance Fault
P0500	Vehicle Speed Sensor (VSS) Malfunction
P0505	Idle Control System Malfunction
P0710 (3)	Transmission Fluid Temperature Sensor Fault
P0715 (3)	Turbine Speed Sensor Fault
P0750 (3)	Shift Solenoid Valve No. 1 Fault
P0753 (3)	Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3)	Shift Solenoid Valve No. 2 Fault
P0758 (3)	Shift Solenoid Valve No. 2 Electrical Fault
P0760 (3)	Shift Solenoid Valve No. 3 Fault
P0763 (3)	Shift Solenoid Valve No. 3 Electrical Fault
P0768 (3)	Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3)	Lock-Up Solenoid Fault
P1120	Accelerator Position Sensor Circuit Malfunction
P1121	Accelerator Pedal Position Sensor Circuit Malfunction
P1125	Throttle Control Motor Circuit Malfunction

P1126 ..... Electromagnetic Clutch Circuit Malfunction
P1127 ..... Electronic Throttle Control System (ETCS) Actuator Power Source Circuit Malfunction
P1128 ..... Throttle Control Motor Lock Malfunction
P1129 ..... Electronic Throttle Control System (ETCS) Malfunction
P1200 ..... Fuel Pump Relay Circuit
P1300, P1305, P1310, P1315, P1320, P1325, P1330 Or P1340 ..... Ignitor Circuit Malfunction
P1345 Or P1350 ..... Variable Valve Timing (VVT) Sensor Circuit Malfunction
P1346 Or P1351 ..... Variable Valve Timing (VVT)
P1349 Or P1354 ..... Variable Valve Timing (VVT)
P1520 ..... Stoplight Switch Signal Malfunction
P1566 (4) ..... Cruise Control Main Switch Circuit Fault
P1600 ..... ECM Batt Malfunction
P1633 ..... Electronic Throttle Control System (ETCS) Circuit ECM Malfunction
P1645 ..... Body ECU Malfunction
P1656 Or P1663 ..... Oil Control Valve (OCV)
P1755 (3) ..... Shift Solenoid Valve SLU Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1765 (3) ..... Shift Solenoid Valve SLN Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - LS400 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.
(4) - This DTC applies to cruise control system. See appropriate CRUISE CONTROL SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (LX470)

DTC (1)	Description
B2785 (2)	Ignition Switch On Malfunction
B2786 (2)	Ignition Switch Off Malfunction
B2791 (2)	Key Unlock Warning Switch Off Malfunction
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow (MAF) Meter Circuit
P0101	Mass Airflow (MAF) Meter Circuit Range/Performance
P0110	Intake Air Temperature (IAT) Sensor Circuit
P0115	Engine Coolant Temperature (ECT) Sensor Circuit
P0116	Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance
P0120	Throttle Position (TP) Sensor Circuit
P0121	Throttle Position (TP) Sensor Circuit Range/Performance
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130	Heated Oxygen Sensor No. 1 Circuit
P0133	Heated Oxygen Sensor No. 1 Circuit Slow Response
P0135	Heated Oxygen Sensor No. 1 Heater Circuit
P0136	Heated Oxygen Sensor No. 2 Circuit

P0141 ..... Heated Oxygen Sensor No. 2 Heater Circuit
P0150 ..... Heated Oxygen Sensor No. 1 Circuit
P0153 ..... Heated Oxygen Sensor No. 1 Circuit Slow Response
P0155 ..... Heated Oxygen Sensor No. 1 Heater Circuit
P0156 ..... Heated Oxygen Sensor No. 2 Circuit
P0161 ..... Heated Oxygen Sensor No. 2 Heater Circuit
P0171 Or P0172 ..... System Too Lean/Rich
P0300 ..... Random Misfire Detected
P0301-P0308 ..... Cylinders No. 1-8 Misfire Detected
P0325 Or P0330 ..... Knock Sensor No. 1 Or 2 Circuit
P0335 ..... Crankshaft Position (CKP) Sensor Circuit
P0340 ..... Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430 ..... Catalyst System Efficiency Below Threshold
P0440 ..... Evaporative Emission Control System
P0441 ..... Incorrect EVAP Purge Flow
P0446 ..... EVAP Vent Control Circuit
P0450 ..... EVAP Pressure Sensor Circuit
P0451 ..... EVAP Pressure Sensor Range/Performance
P0500 ..... Vehicle Speed Sensor Circuit
P0505 ..... Idle Air Control (IAC) System Circuit
P0710 (3) ..... Transmission Fluid Temperature Sensor Malfunction
P0715 (3) ..... Turbine Speed Sensor Malfunction
P0750 (3) ..... Shift Solenoid Valve No. 1 Malfunction
P0753 (3) ..... Shift Solenoid Valve No. 1 Electrical Malfunction
P0755 (3) ..... Shift Solenoid Valve No. 2 Malfunction
P0758 (3) ..... Shift Solenoid Valve No. 2 Electrical Malfunction
P0770 (3) ..... Lock-Up Solenoid Malfunction
P0773 (3) ..... Lock-Up Solenoid Circuit Electrical Malfunction
P1120 ..... Accelerator Pedal Position (APP) Sensor Circuit
P1121 ..... Accelerator Pedal Position (APP) Sensor Circuit Range/Performance
P1125 ..... Throttle Control Motor Circuit
P1126 ..... Magnetic Clutch Circuit
P1127 ..... Electronic Throttle Control System Actuator Power Source Circuit
P1128 ..... Throttle Control Motor Lock Circuit
P1129 ..... Electronic Throttle Control System Circuit
P1200 ..... Fuel Pump Relay/ECU Circuit
P1300 ..... Ignitor No. 1 Circuit
P1305 ..... Ignitor No. 2 Circuit
P1310 ..... Ignitor No. 3 Circuit
P1315 ..... Ignitor No. 4 Circuit
P1320 ..... Ignitor No. 5 Circuit
P1325 ..... Ignitor No. 6 Circuit
P1330 ..... Ignitor No. 7 Circuit
P1335 ..... Crankshaft Position (CKP) Sensor Circuit
P1340 ..... Ignitor (No. 8) Circuit
P1520 ..... Stoplight Switch Signal Circuit (A/T Only)
P1600 ..... ECM BATT Circuit
P1633 ..... ECM Malfunction (Electronic Throttle Control System Circuit)
P1700 (3) ..... Vehicle Speed Sensor No. 2 Malfunction
P1760 (3) ..... Shift Solenoid Valve SLT Malfunction
P1780 ..... Park/Neutral Position (PNP) Switch Circuit

(1) - Some codes are two-trip detection logic code(s). For more information, see TWO-TRIP DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - LX470 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to models with electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in

appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - RX300

DTC (1)	Description
B2785 (2)	Ignition Switch On Fault
B2786 (2)	Ignition Switch Off Fault
B2791 (2)	Key Unlock Warning Switch OFF Fault
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow (MAF) Sensor Circuit
P0101	Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110	Intake Air Temperature (IAT) Sensor Circuit
P0115	Engine Coolant Temperature (ECT) Sensor Circuit
P0116	Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120	Throttle Position (TP) Sensor Circuit Malfunction
P0121	Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0136	Heated Oxygen Sensor Circuit Fault
P0141	Heated Oxygen Sensor Heater Circuit Fault
P0171 Or P0172	System Too Lean/Rich
P0300	Random Cylinder Misfire Detected
P0301-P0306	Cylinders No. 1-6 Misfire Detected
P0325 Or P0330	Knock Sensor Circuit Fault
P0335 Or P1335	Crankshaft Position (CKP) Sensor Circuit
P0340	Variable Valve Timing (VVT) Sensor Circuit
P0420	Catalyst System Efficiency Below Threshold
P0440	Evap System Malfunction
P0441	Incorrect Evap Purge Flow
P0446	Evap Vent Control Fault
P0450	Evap Pressure Sensor Malfunction
P0451	Evap Pressure Sensor Range/Performance Fault
P0500	Vehicle Speed Sensor (VSS) Malfunction
P0505	Idle Control System Malfunction
P0710 (3)	Transmission Fluid Temperature Sensor Fault
P0750 (3)	Shift Solenoid Valve No. 1 Fault
P0753 (3)	Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3)	Shift Solenoid Valve No. 2 Fault
P0758 (3)	Shift Solenoid Valve No. 2 Electrical Fault
P0765 (3)	Shift Solenoid Valve No. 4 Fault
P0768 (3)	Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3)	Lock-Up Solenoid Fault
P0773 (3)	Lock-Up Solenoid Circuit Electrical Fault
P1130 Or P1150	Air/Fuel Sensor Circuit Range/Performance Fault
P1133 Or P1153	Air/Fuel Sensor Circuit Response Malfunction
P1135 Or P1155	Air/Fuel Sensor Heater Circuit Malfunction
P1300, P1305, P1310, P1315, P1320 Or P1325	Ignitor Circuit Malfunction
P1345 Or P1350	Variable Valve Timing (VVT) Circuit Malfunction
P1346 Or P1351	Variable Valve Timing (VVT) Circuit Range/Performance Fault
P1349 Or P1354	Variable Valve Timing (VVT) System Malfunction
P1520	Stoplight Switch Signal Malfunction
P1600	ECM Batt Malfunction
P1645	Body ECU Malfunction
P1656 Or P1663	Oil Control Valve (OCV) Malfunction

P1725 (3) ..... Input Turbine Speed Sensor Circuit Fault
P1730 (3) ..... Counter Gear Speed Sensor Circuit Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - RX300 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - SC300

DTC (1)	Description
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow (MAF) Sensor Circuit
P0101	Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110	Intake Air Temperature (IAT) Sensor Circuit
P0115	Engine Coolant Temperature (ECT) Sensor Circuit
P0116	Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120	Throttle Position (TP) Sensor Circuit Malfunction
P0121	Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150	Heated Oxygen Sensor Circuit Malfunction
P0133 Or P0153	Heated Oxygen Sensor Circuit Slow Response
P0135 Or P0155	Heated Oxygen Sensor Heater Circuit
P0136 Or P0156	Heated Oxygen Sensor Circuit Malfunction
P0141 Or P0161	Heated Oxygen Sensor Heater Circuit
P0171 Or P0172	System Too Lean/Rich
P0300	Random Cylinder Misfire Detected
P0301-P0306	Cylinders No. 1-6 Misfire Detected
P0325 Or P0330	Knock Sensor Circuit Malfunction
P0335 Or P1335	Crankshaft Position (CKP) Sensor
P0340	Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430	Catalyst System
P0440	Evap System Malfunction
P0441	Incorrect Evap Purge Flow
P0446	Evap Vent Control Fault
P0450	Evap Pressure Sensor Fault
P0451	Evap Pressure Sensor Range/Performance Malfunction
P0500	Vehicle Speed Sensor (VSS) Malfunction
P0505	Idle Control System Malfunction
P0710 (3)	Transmission Fluid Temperature Sensor Fault
P0715 (3)	Turbine Speed Sensor Fault
P0750 (3)	Shift Solenoid Valve No. 1 Fault
P0753 (3)	Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3)	Shift Solenoid Valve No. 2 Fault
P0758 (3)	Shift Solenoid Valve No. 2 Electrical Fault
P0770 (3)	Lock-Up Solenoid Fault
P1120	Accelerator Position Sensor Circuit Malfunction
P1121	Accelerator Position Sensor Circuit Malfunction

P1125 ..... Throttle Control Motor Circuit Malfunction
P1126 ..... Electromagnetic Clutch Circuit Malfunction
P1127 ..... Electronic Throttle Control System (ETCS) Actuator Power Source Circuit Malfunction
P1128 ..... Throttle Control Motor Lock Malfunction
P1129 ..... Electronic Throttle Control System (ETCS) Malfunction
P1300 ..... Ignitor Circuit Malfunction
P1346 .. Variable Valve Timing (VVT) Circuit Range/Performance Fault
P1349 ..... Variable Valve Timing (VVT) System Malfunction
P1520 ..... Stoplight Switch Signal Malfunction
P1600 ..... ECM Batt Malfunction
P1633 ..... Electronic Throttle Control System (ETCS) Circuit ECM Malfunction
P1656 ..... Oil Control Valve (OCV) Circuit Malfunction
P1755 (3) ..... Shift Solenoid Valve SLU Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1765 (3) ..... Shift Solenoid Valve SLN Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - SC300 & SC400 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION - SC400

DTC (1) Description

B2795 (2) ..... Unmatched Key Code
B2796 (2) ..... No Communication In Immobilizer System
B2797 (2) ..... Communication Fault No. 1
B2798 (2) ..... Communication Fault No. 2
P0100 ..... Mass Airflow (MAF) Sensor Circuit
P0101 .... Mass Airflow (MAF) Sensor Circuit Range/Performance Fault
P0110 ..... Intake Air Temperature (IAT) Sensor Circuit
P0115 ..... Engine Coolant Temperature (ECT) Sensor Circuit
P0116 ..... Engine Coolant Temperature (ECT) Sensor Circuit Range/Performance Fault
P0120 ..... Throttle Position (TP) Sensor Circuit Malfunction
P0121 ..... Throttle Position (TP) Sensor Circuit Range/Performance Fault
P0125 ..... Insufficient Coolant Temperature For Closed Loop Fuel Control
P0130 Or P0150 ..... Heated Oxygen Sensor Circuit Malfunction
P0133 Or P0153 ..... Heated Oxygen Sensor Circuit Slow Response
P0135 Or P0155 ..... Heated Oxygen Sensor Heater Circuit
P0136 Or P0156 ..... Heated Oxygen Sensor Circuit Malfunction
P0141 Or P0161 ..... Heated Oxygen Sensor Heater Circuit
P0171 Or P0172 ..... System Too Lean/Rich
P0300 ..... Random Cylinder Misfire Detected
P0301-P0308 ..... Cylinders No. 1-8 Misfire Detected
P0325 Or P0330 ..... Knock Sensor Circuit Malfunction
P0335 Or P1335 ..... Crankshaft Position (CKP) Sensor
P0340 ..... Camshaft Position (CMP) Sensor Circuit
P0420 Or P0430 ..... Catalyst System Efficiency Below Threshold
P0440 ..... Evap System Malfunction
P0441 ..... Incorrect Evap Purge Flow

P0446 ..... Evap Vent Control Fault
P0450 ..... Evap Pressure Sensor Fault
P0451 ..... Evap Pressure Sensor Range/Performance Fault
P0500 ..... Vehicle Speed Sensor (VSS) Malfunction
P0505 ..... Idle Control System Malfunction
P0710 (3) ..... Transmission Fluid Temperature Sensor Fault
P0715 (3) ..... Turbine Speed Sensor Fault
P0750 (3) ..... Shift Solenoid Valve No. 1 Fault
P0753 (3) ..... Shift Solenoid Valve No. 1 Electrical Fault
P0755 (3) ..... Shift Solenoid Valve No. 2 Fault
P0758 (3) ..... Shift Solenoid Valve No. 2 Electrical Fault
P0760 (3) ..... Shift Solenoid Valve No. 3 Fault
P0763 (3) ..... Shift Solenoid Valve No. 3 Electrical Fault
P0768 (3) ..... Shift Solenoid Valve No. 4 Electrical Fault
P0770 (3) ..... Lock-Up Solenoid Fault
P1120 ..... Accelerator Position Sensor Circuit Malfunction
P1121 ..... Accelerator Pedal Position Sensor Circuit Malfunction
P1125 ..... Throttle Control Motor Circuit Malfunction
P1126 ..... Electromagnetic Clutch Circuit Malfunction
P1127 ..... Electronic Throttle Control System (ETCS) Actuator Power Source Circuit Malfunction
P1128 ..... Throttle Control Motor Lock Malfunction
P1129 ..... Electronic Throttle Control System (ETCS) Malfunction
P1300, P1305, P1310, P1315, P1320, P1325, P1330 Or P1340 ..... Ignitor Circuit Malfunction
P1345 Or P1350 ..... Variable Valve Timing (VVT) Sensor Circuit Malfunction
P1346 Or P1351 ..... Variable Valve Timing (VVT)
P1349 Or P1354 ..... Variable Valve Timing (VVT)
P1520 ..... Stoplight Switch Signal Malfunction
P1566 (4) ..... Cruise Control Main Switch Circuit Fault
P1600 ..... ECM Batt Malfunction
P1633 ..... Electronic Throttle Control System (ETCS) Circuit ECM Malfunction
P1656 Or P1663 ..... Oil Control Valve (OCV)
P1755 (3) ..... Shift Solenoid Valve SLU Fault
P1760 (3) ..... Shift Solenoid Valve SLT Fault
P1765 (3) ..... Shift Solenoid Valve SLN Fault
P1780 ..... Park/Neutral Position Switch Malfunction

(1) - Some codes are two-trip detection logic code(s). For more information, see DETECTION LOGIC under INTRODUCTION.
(2) - MIL will not illuminate. For testing procedures, see ENGINE IMMOBILIZER SYSTEMS - SC300 & SC400 article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
(3) - These codes only apply to electronically controlled transmissions. For testing procedures, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.
(4) - This DTC applies to cruise control system. See appropriate CRUISE CONTROL SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.

TROUBLE CODE TEST DRIVE CONFIRMATION

1) On certain Diagnostic Trouble Codes (DTCs), once DTC has been cleared from ECM memory, a DTC test drive confirmation test can be performed to verify repairs made and that DTC does not reset. The test drive confirmation test will duplicate the conditions required to set specified DTCs.

2) Test drive confirmation test lists the procedure to be

performed to check that DTC does not reset. Test drive confirmation tests apply only to specific DTCs. Test drive confirmation test will be included with proper DTC diagnostic test in appropriate SELF-DIAGNOSTICS article.

SCAN TOOL PROBLEMS

DLC NO. 3 INSPECTION

1) If scan tool displays UNABLE TO CONNECT TO VEHICLE when scan tool is connected, try scan tool on another vehicle. If scan tool operates on another vehicle, go to next step. If scan tool does not operate on another vehicle, problem is probably with scan tool.

2) Check DLC No. 3 for loose or damaged terminals. Ensure DLC No. 3 terminals are in correct position in connector. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If connector and terminals are okay, go to next step.

3) Check voltage and resistance between ground and specified terminal on DLC No. 3. See DLC NO. 3 VOLTAGE & RESISTANCE SPECIFICATIONS table. See Fig. 2. If voltage and resistance readings are not as specified, check wiring circuit. See appropriate wiring diagram in WIRING DIAGRAMS article.

DLC NO. 3 VOLTAGE & RESISTANCE SPECIFICATIONS

Terminal No. (Application)	Specification
4 (Chassis Ground)	One Ohm Or Less
5 (Signal)	One Ohm Or Less
7 (BUS+ Line)	(1)
16 (Battery Voltage)	9-14 Volts

(1) - Terminal No. 7 of DLC No. 3 provides a pulse generation during the information transmission from the Engine Control Module (ECM).

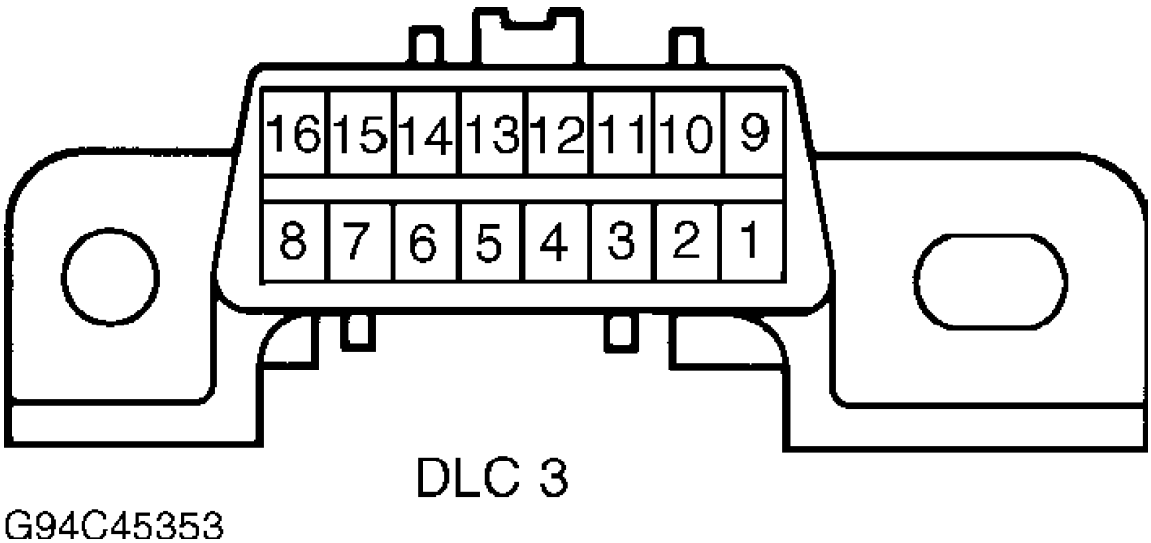


Fig. 2: Identifying DLC No. 3 Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SUMMARY

If no diagnostic trouble codes are present, driveability symptoms exist or intermittents exist, proceed to TROUBLE SHOOTING - NO CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.) or intermittent procedures.

G - TESTS W/CODES - TESTS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Self-Diagnostics - RX300
LEXUS

DIAGNOSTIC TESTS

NOTE: Before performing any diagnostic test, refer to SELF -DIAGNOSTICS - INTRODUCTION article for diagnostic system functions and system diagnostic procedures. For component locations, see appropriate illustration in THEORY & OPERATION article.

DTC P0100: MASS AIRFLOW (MAF) SENSOR CIRCUIT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

MAF sensor uses a platinum hot wire maintained at a constant temperature. Airflow past sensor affects temperature and current flow through sensor. If DTC P0100 is set, ECM will operate in fail-safe mode, keeping ignition timing and injection volume constant. DTC P0100 is set when ECM detects a open or short circuit with engine speed at 4000 RPM or less for more than 3 seconds. Possible causes are:

* Open or short in MAF circuit.
* Faulty MAF sensor.
* Faulty ECM.

Diagnostic Aids

After confirming DTC P0100, use scan tool to access CURRENT DATA to confirm mass airflow ratio. If ratio is 0.0 gm/sec., VG circuit may be open or shorted or power source circuit may be open. If ratio is 271.0 gm/sec. or more, E2G circuit may be open. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Turn ignition on. Turn on scan tool. Start engine and allow it to idle. Monitor MAF rate. If scan tool reading is 0.0 gm/sec., go to next step. If reading is 271.0 gm/sec. or more once engine is at normal operating temperature, go to step 5).

2) Disconnect MAF sensor connector. Turn ignition on. Using voltmeter, measure voltage between ground and terminal No. 1 (Black/Red wire) at MAF sensor wiring harness connector. If voltage is 9-14 volts, go to next step. If voltage is not 9-14 volts, check for open in Black/Red wire between MAF sensor connector and EFI relay. EFI relay is located in junction block at left side of engine compartment. If circuit is okay, check EFI relay. See appropriate SYSTEM & COMPONENT TESTING article.

3) Access ECM behind glove box. Start engine. Backprobing ECM connector, measure voltage between ground and terminal No. 10 (Yellow/Red wire) at ECM E6 connector. See Fig. 2. If voltage is 1.1-

1.5 volts, replace ECM and retest system.

4) If voltage is not 1.1-1.5 volts, locate and repair open or short circuit in Yellow/Red wire between MAF sensor and ECM E10 connector. If Pink wire is okay, replace MAF sensor and retest system.

5) Access ECM behind glove box. Turn ignition off. Backprobing ECM E6 connector, check for continuity between ground and terminal No. 19 (Brown/White wire) at ECM E6 connector. See Fig. 2. If continuity does not exist, replace ECM and retest system. If continuity exists, go to next step.

6) Check for an open in Brown/White wire between MAF sensor and ECM E6 connector. Repair as necessary. If circuit is okay, replace MAF sensor.

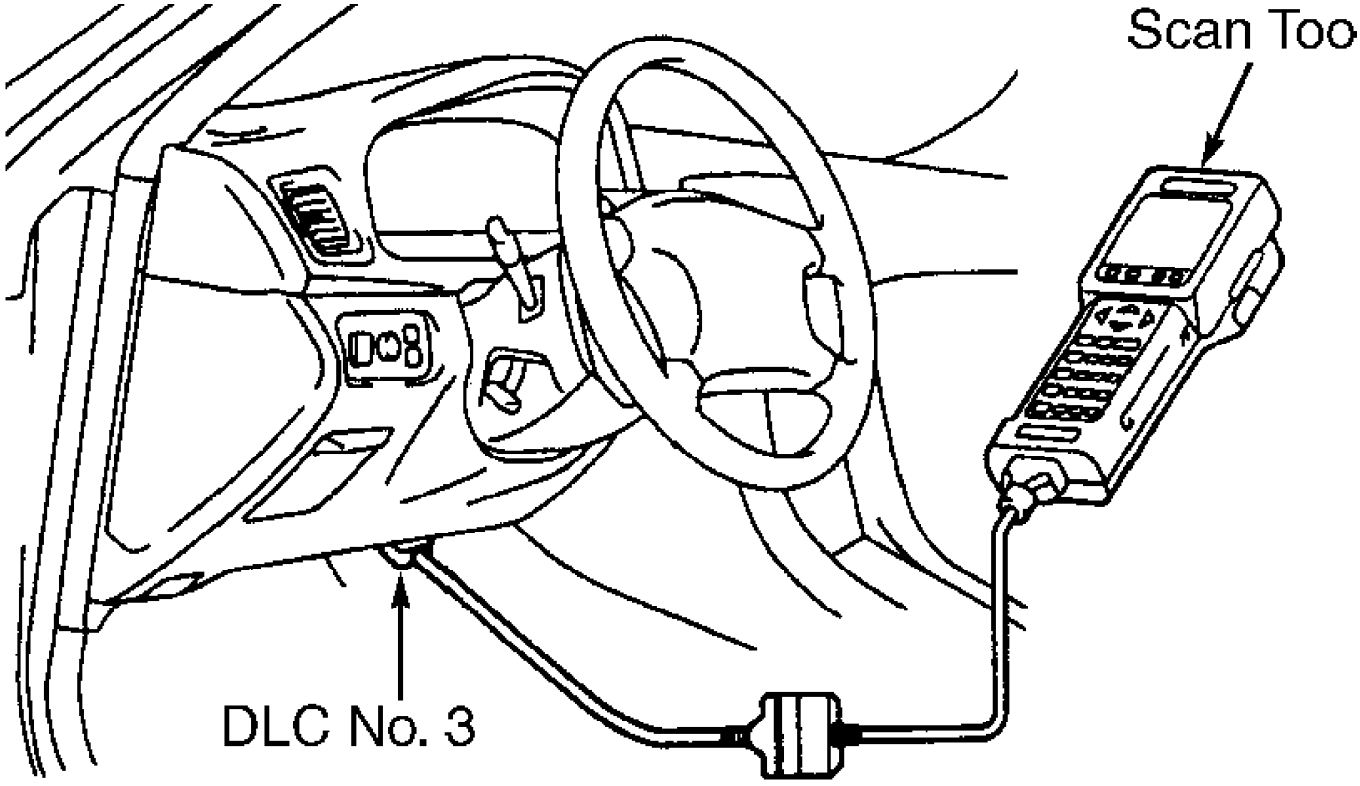


Fig. 1: Connecting Scan Tool To DLC No. 3
Courtesy of Toyota Motor Sales, U.S.A., Inc.

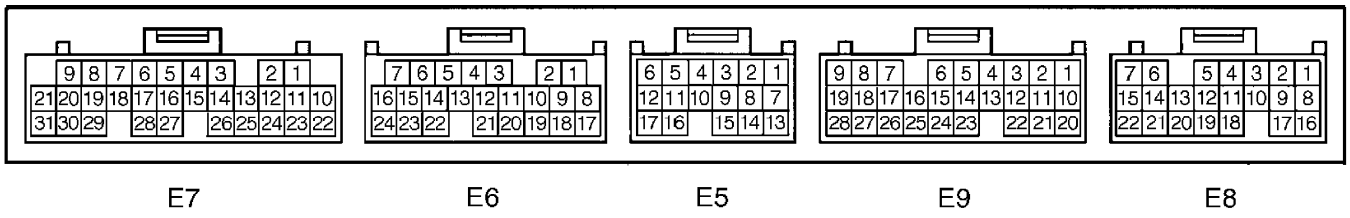


Fig. 2: Identifying Electronic Control Module (ECM) Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC P0101: MASS AIRFLOW (MAF) SENSOR CIRCUIT

RANGE/PERFORMANCE FAULT

Circuit Description

MAF sensor uses a platinum hot wire maintained at a constant temperature. Airflow past sensor affects temperature and current flow through sensor. If DTC P0101 is set, ECM will operate in fail-safe mode, keeping ignition timing and injection volume constant. DTC P0101 is set when throttle valve is fully closed, MAF sensor output is more than 2.2 volts, and Engine Coolant Temperature (ECT) sensor indicates more than 158°F (70°C) for 10 seconds or more at engine speed of 900 RPM or less.

DTC P0101 will also set when Throttle Position (TP) sensor output is .63 volt or more, and MAF sensor output is less than 1.06 volts for 10 seconds or more at engine speed or 1500 or more. Possible cause is:

* Faulty MAF sensor.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

Retrieve trouble codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article. If only DTC P0101 is displayed, replace MAF sensor and retest system. If other codes are displayed, diagnose and repair those codes first and retest system.

DTC P0110: INTAKE AIR TEMPERATURE (IAT) SENSOR CIRCUIT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

The IAT sensor is a thermistor built into the MAF sensor to monitor temperature of air flowing through MAF sensor. Based on IAT sensor signal, ECM increases fuel injection volume to improve driveability during cold engine operation. If DTC P0110 is set, ECM will operate in fail-safe mode, in which intake air temperature is assumed to be 68°F (20°C). DTC P0110 is set when ECM detects an open or short in IAT sensor circuit. Possible causes are:

* Open or short in IAT sensor circuit.
* Faulty IAT sensor.
* Faulty ECM.

NOTE: If DTCs P0110, P0115 and P0120 are output together, inspect ECM terminal E2 (ground) circuit for an open. Repair as necessary. See appropriate wiring diagram in WIRING DIAGRAMS article.

Diagnostic Aids

After confirming DTC P0110, use scan tool to access CURRENT DATA to confirm air intake temperature. If temperature displayed on scan tool is -40°F (-40°C), IAT sensor circuit may be open. If temperature displayed on scan tool is 284°F (140°C) or more, IAT sensor circuit may be shorted. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Turn ignition on. Turn scan tool on. Using scan tool, monitor IAT sensor temperature. If temperature displayed is same as actual intake air temperature, check IAT sensor and ECM connections. Problem is intermittent. If temperature displayed is 284°F (140°C) or more, go to step 4). If temperature displayed is -40°F (-40°C), go to next step.

2) Turn ignition off. Disconnect MAF sensor connector. Connect a fused jumper wire between terminals No. 4 (Blue/Black wire) and No. 5 (Brown wire) at MAF sensor harness connector. Turn ignition on. Using scan tool, monitor IAT sensor temperature. If temperature displayed is 284°F (140°C) or more, ensure MAF connector is okay. If connector is okay, replace MAF sensor and retest system. If temperature displayed is less than 284°F (140°C), go to next step.

3) Turn ignition off. Remove fused jumper wire. Access ECM behind glove box. Backprobing, connect a fused jumper wire between terminals No. 18 (Brown wire) and No. 22 (Blue/Black wire) at ECM E6 connector. See Fig. 2. If temperature displayed on scan tool is 284°F (140°C) or more, check and repair open in Blue/Black wire between MAF harness connector and ECM E6 connector. If temperature displayed on scan tool is not 284°F (140°C) or more, replace ECM and retest system.

4) Turn ignition off. Disconnect MAF sensor connector. Turn ignition on. If temperature displayed on scan tool is -40°F (-40°C), replace MAF sensor and retest system. If temperature displayed is not -40°F (-40°C), turn ignition off and go to next step.

5) Access ECM behind glove box. Disconnect ECM E6 connector. Turn ignition on. If temperature displayed is -40°F (-40°C), locate and repair short circuit in wiring harness between MAF sensor and ECM. See Fig. 2. If temperature displayed by scan tool is not -40°F (-40°C), replace ECM and retest system.

DTC P0115: ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

The ECT sensor is a thermistor that monitors coolant temperature. If DTC P0115 is set, ECM will operate in a fail-safe mode, in which engine coolant is assumed to be 176°F (80°C). DTC P0115 is set when ECM detects a open or short in ECT sensor circuit. Possible causes are:

* Open or short in ECT sensor circuit.
* Faulty ECT sensor.
* Faulty ECM.

NOTE: If DTCs P0110, P0115 and P0120 are output together, inspect ECM terminal E2 (ground) circuit for an open. Repair as necessary. See appropriate wiring diagram in WIRING DIAGRAMS article.

Diagnostic Aids

After confirming DTC P0115, use scan tool to access CURRENT DATA to confirm engine coolant temperature. If temperature displayed on scan tool is -40°F (-40°C), ECT sensor circuit may be open. If

temperature displayed on scan tool is 284°F (140°C) or more, ECT sensor circuit may be shorted. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Turn ignition on. Turn scan tool on. Using scan tool, monitor ECT sensor temperature. If temperature displayed is same as actual coolant temperature, check component and ECM connections. Problem is intermittent If temperature displayed is 284°F (140°C), go to step 4). If temperature displayed is -40°F (-40°C), go to next step.

2) Turn ignition off. Disconnect ECT sensor harness connector. Connect a fused jumper wire between terminals No. 2 (Green/White wire) and No. 1 (Brown wire) at ECT sensor harness connector. Turn ignition on. Using scan tool, monitor ECT sensor temperature. If temperature displayed is 284°F (140°C) or more, ensure ECT connector is okay. If connector is okay, replace ECT sensor and retest system. If temperature displayed is less than 284°F (140°C), go to next step.

3) Turn ignition off. Remove fused jumper wire. Access ECM behind glove box. Backprobing, connect a fused jumper wire between terminals No. 14 (Green/White wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. If temperature displayed on scan tool is 284°F (140°C) or more, check and repair open in Green/White wire between ECT sensor harness connector and ECM E6 connector. If temperature displayed on scan tool is not 284°F (140°C) or more, replace ECM and retest system.

4) Turn ignition off. Disconnect ECT sensor harness connector. Turn ignition on. If temperature displayed on scan tool is -40°F (-40°C), replace ECT sensor and retest system. If temperature displayed is not -40°F (-40°C), turn ignition off and go to next step.

5) Access ECM behind glove box. Disconnect ECM E6 connector. Turn ignition on. If temperature displayed is -40°F (-40°C), locate and repair short circuit in wiring harness between ECT sensor and ECM E6 connector. See Fig. 2. If temperature displayed by scan tool is not -40°F (-40°C), replace ECM and retest system.

DTC P0116: ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT RANGE/PERFORMANCE FAULT

Circuit Description

The ECT sensor is a thermistor that monitors coolant temperature. If DTC P0116 is set, ECM will operate in a fail-safe mode, in which engine coolant is assumed to be 176°F (80°C). DTC P0116 is set when after engine has been running for 20 minutes ECM detects a temperature of less than 19.4°F (-7°C) on THW circuit, and actual engine coolant temperature is 95°F (35°C). DTC P0116 is also set when after engine has been running for 5 minutes ECM detects a temperature of less than 50°F (10°C), or detects a temperature equal to or greater than 19.4°F (-7°C) on THW circuit, and actual engine coolant temperature is 95°F (35°C). DTC P0116 is set when after engine has been running for 2 minutes ECM detects a temperature of more than or equal to 50°F (10°C) on THW circuit, and actual engine coolant temperature is 95°F (35°C). Possible causes are:

* Faulty ECT sensor.
* Faulty cooling system.

NOTE: If DTCs P0115 and P0116 are output together, diagnose DTC P0115 first. Inspect engine coolant temperature circuit for an open. Repair as necessary. See appropriate wiring diagram in WIRING DIAGRAMS article.

Diagnostic Aids

After confirming DTC P0116, use scan tool to access CURRENT DATA to confirm engine coolant temperature. If temperature displayed on scan tool is -40°F (-40°C), ECT sensor circuit may be open. If temperature displayed on scan tool is 284°F (140°C) or more, ECT sensor circuit may be shorted. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

Retrieve trouble codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article. If other codes are displayed, diagnose and repair those codes first and retest system. If only DTC P0116 is displayed, check cooling system thermostat. Replace thermostat as necessary and retest system. If thermostat is okay, replace ECT sensor and retest system.

DTC P0120: THROTTLE POSITION (TP) SENSOR CIRCUIT MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

The TP sensor is a variable resistor that monitors throttle opening. TP sensor is mounted in throttle body. The ECM determines vehicle driving condition and adjusts air/fuel mixture accordingly. DTC P0120 is set when ECM consistently detects less than .1 volt on VTA circuit. DTC P0120 is also set if ECM consistently detects 4.9 volts or more on VTA circuit. Possible causes are:

* Open or short in TP sensor circuit.
* Faulty TP sensor.
* Faulty ECM.

NOTE: If DTCs P0110, P0115 and P0120 are output together, inspect ECM terminal E2 (ground) circuit for an open. Repair as necessary. See appropriate wiring diagram in WIRING DIAGRAMS article.

Diagnostic Aids

After confirming DTC P0120, use scan tool to access CURRENT DATA to confirm throttle valve opening percentage with throttle open and closed. If percentage displayed on scan tool is always zero percent, VC circuit may be open or VTA circuit may be shorted. If percentage displayed on scan tool is always 75 percent, E2 circuit may be open. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Turn ignition on. Turn scan tool on. Using scan tool, monitor throttle valve opening percentage. Opening percentage should be approximately 10 percent with fully closed throttle. Depress accelerator pedal to floor (WOT). Opening percentage should be approximately 75 percent. If percentages are within specification, check all connections. Problem may be intermittent. If percentages are not within specification, go to next step.

2) Disconnect TP sensor harness connector. Turn ignition on. Using voltmeter, measure voltage between ground and Yellow/Black wire at TP sensor harness connector. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, go to step 5).

3) Turn ignition off. Using ohmmeter, measure resistance between terminals No. 1 (Yellow/Black wire) and No. 2 (Brown wire) at TP sensor component connector. Resistance should be 2500-5900 ohms. Measure resistance between terminals No. 2 (Brown wire) and No. 3 (Blue/White wire). Resistance should be 200-6300 ohms with throttle fully closed, and 2000-10,200 ohms with throttle fully open. If any readings are not within specification, replace TP sensor. If all readings are within specification, go to next step.

4) Connect TP sensor harness connector. Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 23 (Blue/White wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. Voltage should be .3-1.0 volt with throttle fully closed, and 2.7-5.2 volts with throttle fully open (WOT). If voltages are as specified, replace ECM and retest system. If voltages are not as specified, locate and repair open or short in Blue wire between TP sensor and ECM E10 connector.

5) Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 2 (Yellow/Black wire) and No. 18 (Brown wire) at ECM E6 connector. If voltage is 4.5-5.5 volts, locate and repair open in Yellow/Black wire between TP sensor and ECM E6 connector. If voltage is not 4.5-5.5 volts, replace ECM and retest system.

DTC P0121: THROTTLE POSITION (TP) SENSOR CIRCUIT RANGE/PERFORMANCE FAULT

Circuit Description

The TP sensor is a variable resistor that monitors throttle opening. TP sensor is mounted in throttle body. The ECM determines vehicle driving condition and adjusts air/fuel mixture accordingly. DTC is set when after vehicle speed has exceeded 19 MPH and output value of TP sensor was out of range with vehicle speeds of 0-19 MPH. Possible cause is:

* Faulty Throttle Position (TP) sensor.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

Retrieve trouble codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article. If only DTC P0121 is displayed, replace TP sensor and retest system. If other codes are displayed, diagnose and repair those codes first and retest system.

DTC P0125: INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. A/F sensor refers to sensor No. 1 in exhaust manifold.

Circuit Description

Air/Fuel (A/F) sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to control air/fuel ratio. A/F sensor includes a heater. DTC is set when A/F sensor output does not change with engine speed at 1500 RPM or more, vehicle speed 25-62 MPH and throttle valve not fully closed for at least 2 minutes. Possible causes are:

* Open or short in A/F sensor circuit.
* Faulty A/F sensor (bank No. 1 or 2 sensor No. 1).
* Faulty ECM.

Diagnostic Aids

After confirming DTC P0125, use scan tool to access CURRENT DATA to confirm voltage output of heated oxygen sensors (bank No. 1 and 2 sensor No. 1). ECM controls voltage of AF+ and AF- terminals at ECM to a fixed voltage (3.3 volts at AF+ terminal; 3.0 volts at AF- terminal). It is impossible to confirm A/F sensor output voltage without using a scan tool. OBD-II scan tools will display one fifth A/F sensor output voltage as Lexus scan tool will. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

During fuel enrichment, output voltage of A/F sensors maybe less than 0.56 volt (2.8 volts on Lexus scan tool). During fuel cut, output voltage of A/F sensors maybe more than 0.76 volt (3.8 volts on Lexus scan tool). If output voltage of A/F sensor remains at 0.66 volt (3.3 volts on Lexus scan tool) during all conditions, A/F sensor circuit may be open. If output voltage of A/F sensor remains at 0.76 volt (3.8 volts on Lexus scan tool) or more during all conditions, A/F sensor circuit may be shorted. If output voltage of A/F sensor remains at 0.56 volt (2.8 volts on Lexus scan tool) or less during all conditions, A/F sensor circuit may be shorted.

Diagnosis & Repair

1) If other DTCs are displayed, diagnose and repair those DTCs first and retest system. If only DTC P0125 is displayed, go to next step.

2) Check for open or short in wiring between ECM and suspect A/F sensor. See appropriate wiring diagram in WIRING DIAGRAMS article. If problem exists, repair wiring as necessary. If problem does not exist, go to next step.

3) Disconnect suspect A/F sensor harness connector. One A/F sensor is located in each exhaust manifold. Measure resistance between terminal B+ (Black wire) and HT (Black/White wire on bank No. 1 or Black/Red wire on bank No. 2) at A/F sensor connector (component side). Measure resistance at both A/F sensors. Resistance should be . 8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistances are not as specified, replace appropriate A/F sensor. If resistances are as specified, go to next step.

4) Connect scan tool to Data Link Connector (DLC) No. 3. Start engine and raise engine speed to 2500 RPM for approximately 90 seconds. Using scan tool, monitor each A/F sensor output voltage. See AIR/FUEL RATIO SENSOR SPECIFICATIONS table. If voltage is as specified, go to next step. If voltage is not as specified, go to step 5).

AIR/FUEL RATIO SENSOR SPECIFICATIONS

Application	(1) Voltage

Using OBD-II Scan Tool	
Engine Idling	0.66
Engine Racing	0.76 Or More
Driving Vehicle (2)	0.56 Or Less
Using Lexus Scan Tool	
Engine Idling	3.3
Engine Racing	3.8 Or More
Driving Vehicle (2)	2.8 Or Less

(1) - Voltage should not remain at specification given.
(2) - Drive vehicle at 25 MPH or more with engine speed at 1500 RPM or more while opening and closing throttle valve.

5) Perform test drive confirmation then go to next step. See TEST DRIVE CONFIRMATION under DTC P1130 OR P1150: HEATED OXYGEN SENSOR FAULT.

6) Clear and recheck for DTCs. If DTC P0125 is displayed again, replace ECM. If DTC P0125 is not displayed again, go to next step.

7) Vehicle either ran out of fuel or problem is intermittent. Check component and ECM connections.

DTC P0136: HEATED OXYGEN SENSOR CIRCUIT FAULT

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Heated oxygen sensor No. 2 refers to sensor furthest away from engine block.

Circuit Description

Heated oxygen sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to determine fuel injection system operation. Heated oxygen sensors include a heater. DTC is set when bank No. 1, sensor No. 2 voltage remains at .4 volt or more, or .6 volt or less during vehicle operation (31 MPH or more), once engine is at normal operating temperature. Possible cause is:

* Faulty heated oxygen sensor No. 2.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) If any other DTCs are displayed, diagnose and repair those DTCs first. If only DTC P0136 is displayed, go to next step.

2) Check for open or short in wiring between ECM and heated oxygen sensor No. 2. See appropriate wiring diagram in WIRING DIAGRAMS article. If problem exists, repair wiring as necessary. If problem does not exist, go to next step.

3) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Start and warm engine to normal operating temperature. Monitor heated oxygen sensor No. 2 output voltage. Snap accelerate engine to about 4000 RPM 3 times. Voltage should fluctuate from less than .4 volt to .6 volt or more. If voltage is as specified, problem is intermittent. Check component and ECM connections. If voltage is not as specified, replace heated oxygen sensor No. 2.

DTC P0141: HEATED OXYGEN SENSOR HEATER CIRCUIT FAULT

CAUTION: If ECM replacement is instructed in following testing, always

ensure ECM harness connectors and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. Heated oxygen sensor No. 1 refers to sensor closest to engine block. Heated oxygen sensor No. 2 refers to sensor furthest away from engine block.

Circuit Description

Heated oxygen sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to determine fuel injection system operation. Heated oxygen sensors include a heater. DTC is set when heated oxygen sensor heater current draw exceeds 2 amps or heated oxygen sensor heater current draw is .25 amp or less when heater operates. Possible causes are:

* Open or short in heated oxygen sensor circuit.
* Faulty heated oxygen sensor No. 2 heater.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Access ECM behind glove box. Turn ignition on. Using DVOM, backprobe between ground and terminal No. 9 (Black wire) at ECM harness connector E9. See Fig. 2. Voltage should be 9-14 volts. If voltage is as specified, replace ECM. If voltage is not as specified, go to next step.

2) Turn ignition off. Disconnect heated oxygen sensor No. 2 harness connector. Connector is located underneath driver's seat, near center console. It may be necessary to remove driver's seat to access connector. Measure resistance between terminals HT (Pink/Black wire) and B+ (Black/Yellow wire) at heated oxygen sensor No. 2 connector. Resistance should be 11-16 ohms at 68°F (20°C). If resistance is not as specified, replace heated oxygen sensor No. 2. If resistance is as specified, go to next step.

3) Repair wiring between ECM and heated oxygen sensor No. 2 or between heated oxygen sensor No. 2 and EFI main relay. See appropriate wiring diagram in WIRING DIAGRAMS article.

DTC P0171 OR P0172: SYSTEM TOO LEAN/RICH

NOTE: Bank No. 1 refers to bank that includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. Sensor No. 1 refers to sensor closest to engine block.

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Fuel trim refers to feedback compensation value compared

against basic injection time. Fuel trim includes short-term and long-term fuel trim. If total of short term fuel trim value and long term value is within 25 percent, system is functioning properly. DTC P0171 is set when fuel trim is rich beyond a certain value. Possible causes are:

* Exhaust system leak.
* Air intake hose loose.
* Fuel line pressure.
* Injector blockage.
* Faulty Mass Airflow (MAF) sensor.
* Faulty Engine Coolant Temperature (ECT) sensor.
* Faulty A/F sensor.

DTC P0172 is set when fuel trim is lean beyond a certain value. Possible causes are:

* Exhaust system leak.
* Fuel line pressure.
* Injector blockage or leak.
* Faulty Mass Airflow (MAF) sensor.
* Faulty Engine Coolant Temperature (ECT) sensor.
* Faulty A/F sensor.

Diagnostic Aids

Short-term and long-term fuel trim value should be within plus or minus 35 percent of each other at 176°F (80°C). ECM controls voltage of AF+ and AF- terminals at ECM to a fixed voltage (3.3 volts at AF+ terminal; 3.0 volts at AF- terminal). It is impossible to confirm A/F sensor output voltage without using a scan tool. OBD-II scan tools will display one fifth A/F sensor output voltage as Lexus scan tool will. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

During fuel enrichment, output voltage of A/F sensors maybe less than 0.56 volt (2.8 volts on Lexus scan tool). During fuel cut, output voltage of A/F sensors maybe more than 0.76 volt (3.8 volts on Lexus scan tool). If output voltage of A/F sensor remains at 0.66 volt (3.3 volts on Lexus scan tool) during all conditions, A/F sensor circuit may be open. If output voltage of A/F sensor remains at 0.76 volt (3.8 volts on Lexus scan tool) or more during all conditions, A/F sensor circuit may be shorted. If output voltage of A/F sensor remains at 0.56 volt (2.8 volts on Lexus scan tool) or less during all conditions, A/F sensor circuit may be shorted.

Diagnosis & Repair

1) Ensure oil dipstick, oil filler cap, PCV system and all other air induction system components are intact and operating properly. If problem exists, repair as necessary. If problem does not exist, go to next step.

2) Check fuel injectors. See FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. If problem exists, repair as necessary. If problem does not exist, go to next step.

3) Check Mass Airflow (MAF) meter and Engine Coolant Temperature (ECT) sensor. See ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article. If problem exists, replace appropriate sensor(s). If problem does not exist, go to next step.

4) Check spark and ignition system. See IGNITION CHECKS in BASIC DIAGNOSTIC PROCEDURES article. If problem exists, repair as necessary. If problem does not exist, go to next step.

5) Check fuel pressure. See FUEL SYSTEM in BASIC DIAGNOSTIC PROCEDURES article. If fuel pressure is not within specification, repair as necessary. If fuel pressure is within specification, go to next step.

6) Check exhaust system for leaks. If problem exists, repair as necessary. If problem does not exist, go to next step.

7) Connect scan tool to Data Link Connector (DLC) No. 3. Start engine and raise engine speed to 2500 RPM for approximately 90 seconds. Using scan tool, monitor each A/F sensor output voltage. See AIR/FUEL RATIO SENSOR SPECIFICATIONS table. If voltage is not as specified, go to next step. If voltage is as specified, go to step 9).

AIR/FUEL RATIO SENSOR SPECIFICATIONS

Application	(1) Voltage
Using OBD-II Scan Tool	
Engine Idling	0.66
Engine Racing	0.76 Or More
Driving Vehicle (2)	0.56 Or Less
Using Lexus Scan Tool	
Engine Idling	3.3
Engine Racing	3.8 Or More
Driving Vehicle (2)	2.8 Or Less

(1) - Voltage should not remain at specification given.
(2) - Drive vehicle at 25 MPH or more with engine speed at 1500 RPM or more while opening and closing throttle valve.

8) Check for open or short in wiring between ECM and A/F sensor. See appropriate wiring diagram in WIRING DIAGRAMS article. If problem exists, repair wiring as necessary. If problem does not exist, replace A/F sensors.

9) Perform test drive confirmation then go to next step. See TEST DRIVE CONFIRMATION under DTC P1130 OR P1150: AIR/FUEL SENSOR CIRCUIT RANGE/PERFORMANCE FAULT.

10) Clear and recheck for DTCs. If DTCs P0171 and/or P0172 are displayed again, replace ECM. If neither DTC P0171 and P0172 are displayed again, go to next step.

11) Vehicle either ran out of fuel or problem is intermittent. Check component and ECM connections.

DTC P0300: RANDOM CYLINDER MISFIRE DETECTED

Circuit Description

ECM uses signals provided by crankshaft and camshaft position sensors. If engine speed rate has changed enough to equal a preset number, a misfire is detected and MIL is illuminated. If misfire rate is high enough, and driving conditions will cause catalytic converter damage or overheating, MIL blinks when a misfire is occurring. DTC is set when misfiring of random cylinders is detected during any particular 200 or 1000 revolutions. Possible causes are:

* Faulty ignition system.
* Faulty fuel injector(s).
* Improper fuel pressure.
* Faulty engine compression.
* Improper valve clearance.
* Improper valve timing.
* Faulty Mass Airflow (MAF) meter.
* Faulty Engine Coolant Temperature (ECT) sensor.
* Open or short in wiring.
* Poor connector contact at ECM.
* Faulty ECM.

Diagnostic Aids

When 2 or more codes for misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates misfires were detected and recorded at different times. If misfire cannot be reproduced, reason may be because of driving with lack of fuel, improper fuel, fouled spark plug, etc. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Test Drive Confirmation

1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Record any DTCs and freeze frame data. Switch scan tool to CHECK mode (Lexus scan tool only). Drive vehicle several times with engine speed, load and its surrounding range shown with ENGINE SPD, CALC LOAD in freeze frame data or MISFIRE RPM and MISFIRE LOAD in scan tool data list.

2) Drive vehicle at specified engine speeds. See DRIVING PATTERN table. Turn ignition off after symptom is simulated the first time, then repeat test drive again (OBD-II scan tool only). If a misfire is detected, a DTC will set and misfire will be indicated in freeze frame data. Turn ignition off and wait a minimum of 5 seconds.

DRIVING PATTERN

RPM	(1) Minutes
Idling	3 1/2
1000	3
2000	1 1/2
3000	1

(1) - Minimum specification given.

Diagnosis & Repair

1) Check vacuum hoses for leaks, blockage and proper routing. Also, check wiring and connectors for damage or poor connections. If problem exists, repair as necessary and perform TEST DRIVE CONFIRMATION. If problem does not exist, go to next step.

2) Check spark and ignition system. See IGNITION CHECKS in BASIC DIAGNOSTIC PROCEDURES article. If problem exists, repair as necessary. If problem does not exist, go to next step.

3) Access ECM behind glove box. Turn ignition on. Using DVOM, backprobe ECM connector and measure voltage between ground and fuel injector terminals at specified ECM connector. See IDENTIFYING FUEL INJECTOR TERMINALS table. See Fig. 2. If voltage is 9-14 volts at each terminal, go to step 5). If voltage is not 9-14 volts at each terminal, go to next step.

IDENTIFYING FUEL INJECTOR TERMINALS

Fuel Injector No.	Terminal	Wire Color
1	5 (1)	White
2	6 (1)	Yellow
3	1 (2)	Black
4	2 (2)	Blue
5	3 (2)	Red
6	4 (2)	Green

(1) - Terminal is located in ECM harness connector E6. See Fig. 2.
(2) - Terminal is located in ECM harness connector E7. See Fig. 2.

4) Disconnect fuel injector harness connector at misfiring cylinder. Measure resistance between fuel injector terminals (component side). Resistance should be 13.4-14.2 ohms at 68°F (20°C). If resistance is as specified, repair open or short in power circuit to fuel injector or in wiring harness between ECM and fuel injector. See appropriate wiring diagram in WIRING DIAGRAMS article. If resistance is not as specified, replace fuel injector.

5) Check fuel pressure. See FUEL SYSTEM in BASIC DIAGNOSTIC PROCEDURES article. If fuel pressure is not within specification, repair as necessary. If fuel pressure is within specification, go to next step.

6) Check fuel injectors. See FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. If problem exists, repair as necessary. If problem does not exist, go to next step.

7) Check Mass Airflow (MAF) meter and Engine Coolant Temperature (ECT) sensor. See ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article. If problem exists, replace appropriate sensor(s). If problem does not exist, go to next step.

8) Check engine compression. See BASIC DIAGNOSTIC PROCEDURES article. If engine compression is okay, check valve clearance. See ON-VEHICLE ADJUSTMENTS article. If valve clearance is okay, it may be necessary to check valve timing. See appropriate article in ENGINES in appropriate MITCHELL\R manual.

DTC P0301-P0306: CYLINDERS NO. 1-6 MISFIRE DETECTED

NOTE: When 2 or more codes for a misfiring cylinder are recorded repeatedly, but DTC P0300 is not recorded, it indicates that misfires were detected and stored into ECM memory at different times.

Circuit Description

ECM uses signals provided by crankshaft and camshaft position sensors. If engine speed rate has changed enough to equal a preset number, a misfire is detected and MIL is illuminated. If misfire rate is high enough, and driving conditions will cause catalytic converter damage or overheating, MIL blinks when a misfire is occurring. DTC is set during any particular 200 revolutions of engine, misfiring is detected which can cause catalytic converter overheating and/or damage or during any particular 1000 revolutions of engine, misfiring is detected which can cause a deterioration in emission levels. Possible causes are:

* Faulty ignition system.
* Faulty injector(s).
* Incorrect fuel pressure.
* Low engine compression.
* Incorrect valve clearance.
* Incorrect valve timing.
* Faulty Mass Airflow (MAF) sensor.
* Faulty Engine Coolant Temperature (ECT) sensor.
* Open or short in secondary ignition wire.
* Loose connector.
* Faulty ECM.

Diagnostic Aids

When 2 or more codes for misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates misfires were detected and recorded at different times. If misfire cannot be reproduced, reason may be because of driving with lack of fuel, improper fuel, fouled spark plug, etc. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

For diagnosis and repair procedure, see DTC P0300: RANDOM CYLINDER MISFIRE DETECTED.

DTC P0325 OR P0330: KNOCK SENSOR CIRCUIT FAULT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Knock sensors are located on either side of cylinder block underneath lower intake manifold assembly. Sensor generates voltage when engine block vibrates due to knocking. ECM retards timing based on this voltage signal. DTC P0325 and P0330 are set when there is no knock sensor signal to ECM with engine speed of 2000-5600 RPM. DTC P0325 is for knock sensor No. 1 on right bank. DTC P0330 is for knock sensor No. 2 on left bank. Possible causes are:

* Open or short in knock sensor circuit.
* Knock sensor (loose).
* Faulty ECM.

Diagnostic Aids

Normal mode vibration frequency of knock sensor is 7.1 kHz. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

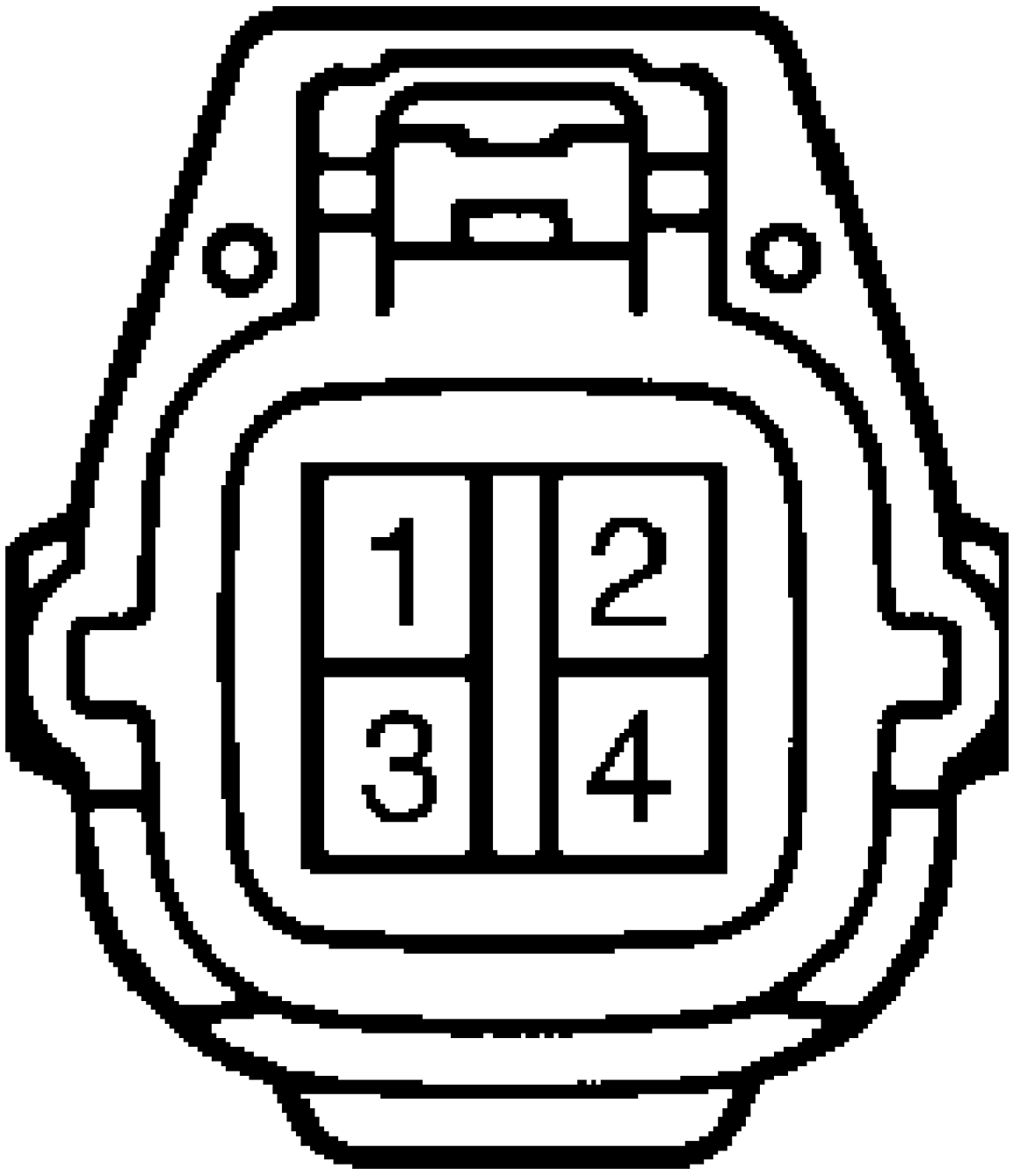
1) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 3. Disconnect EA1 connector. EA1 connector is a wire-to-wire connector located in engine compartment, near idle air control valve. Connector is a Dark Gray 4-pin connector.

2) Connect a fused jumper wire between terminal No. 1 of male connector to terminal No. 2 of female connector. Connect another fused jumper wire between terminal No. 2 of male connector to terminal No. 1 of female connector. See Fig. 3. Turn ignition on. Turn scan tool on. Clear trouble codes. See CLEARING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article. Start and warm engine to normal operating temperature.

3) Snap accelerate engine 3 times to 4000 RPM. Retrieve trouble codes. See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in SELF-DIAGNOSTICS - INTRODUCTION article. If same code is repeated as before, go to next step. If code has changed, go to step 5).

4) Check for open or short circuit(s) between EA1 connector and ECM harness connector. Repair as necessary. If circuits are okay, replace ECM and retest system.

5) Check for open or short circuit(s) between EA1 connector and suspect knock sensor. If DTC P0325 has changed to DTC P0330, check knock sensor circuit on right bank. If DTC P0330 changed to DTC P0325, check knock sensor circuit on left bank. Repair as necessary. If harness is okay, replace knock sensor.



95D31222

Fig. 3: Identifying EA1 Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC P0335 OR P1335: CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

The CKP sensor is a pick-up coil mounted next to crankshaft pulley. A 34-tooth signal plate is mounted to crankshaft. DTC P0335 is set if no cranking signal is received by ECM from CKP sensor. DTC P0335 is also set if no signal is received by ECM from CKP sensor with engine speed of 600 RPM or more. DTC P1335 is set if no engine running signal is received by ECM from CKP sensor with engine speed of 1000 RPM or more. Possible causes are:

* Open or short in CKP sensor circuit.
* Faulty CKP sensor.
* Faulty starter.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Disconnect CKP sensor harness connector. Using ohmmeter, measure resistance between sensor connector terminals. Resistance should be 1630-2740 ohms at 14-122°F (-10-50°C) or 2065-3225 ohms at 122-212°F (50-100°C). Replace sensor as necessary. If sensor is okay, go to next step.

2) Check for open or short circuit in wiring harness between ECM and CKP sensor. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring harness is okay, remove and inspect sensor. Also, inspect signal plate. Replace as necessary. If both components are okay, replace ECM and retest system.

DTC P0340: VARIABLE VALVE TIMING (VVT) SENSOR CIRCUIT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Variable Valve Timing (VVT) sensor is also known as Camshaft Position (CMP) sensor.

Circuit Description

Vehicle is equipped with 2 VVT sensors. Each VVT sensor consists of a magnet, iron core and pick-up coil. One VVT sensor is mounted in outer corner of each cylinder head, just below valve cover (oil filler cap end). A 3-tooth signal plate is mounted to outer camshaft. DTC P0340 is set when no cranking signal is received by ECM from sensor. DTC P0340 is also set when no signal is received by ECM from sensor with engine speed of 600 RPM or more. Possible causes are:

* Open or short in VVT sensor circuit.
* Faulty VVT sensor.
* Faulty starter.

* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Disconnect VVT sensor harness connector. Using ohmmeter, measure resistance between sensor connector terminals. Resistance should be 835-1400 ohms at 14-122°F (-10-50°C) or 1060-1645 ohms at 122-212°F (50-100°C). Check resistance at each VVT sensor.

2) Replace sensor(s) as necessary. If sensor(s) is okay, check for open or short circuit in wiring harness between ECM and VVT sensor. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring harness is okay, remove and inspect sensor(s). Also, inspect signal plate. Replace as necessary. If both components are okay, replace ECM and retest system.

DTC P0420: CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. Air/Fuel (A/F) sensor refers to sensor closest to engine block. Heated oxygen sensor No. 2 refers to sensor furthest away from engine block.

Circuit Description

ECM compares waveform of Air/Fuel (A/F) sensor (located before catalytic converter) with waveform of heated oxygen sensor No. 2 (located after converter) to determine if converter performance has deteriorated. If both waveforms change at similar rate, catalyst performance has deteriorated. DTC is set when A/F sensor and heated oxygen sensor No. 2 waveforms have same amplitude after vehicle is driven for 5 minutes at 20-50 MPH. Possible causes are:

* Faulty catalytic converter.
* Open or short in heated oxygen sensor No. 2.
* Faulty heated oxygen sensor No. 2.
* Open or short in A/F sensor circuit.
* Faulty A/F sensor.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) If other DTCs are displayed, diagnose and repair those DTCs first and retest system. If only DTC P0420 is displayed, go to next step.

2) Check exhaust system for leaks. If problem exists, repair as necessary. If problem does not exist, go to next step.

3) Disconnect suspect A/F sensor harness connector. One A/F sensor is located in each exhaust manifold. Measure resistance between terminal B+ (Black wire) and HT (Black/White wire on bank No. 1 or Black/Red wire on bank No. 2) at A/F sensor connector (component side). Measure resistance at both A/F sensors. Resistance should be . 8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistances are not as specified, replace appropriate A/F sensor. If resistances are as specified, go to next step.

4) Check heated oxygen sensor No. 2 circuits. See DTC P0136: HEATED OXYGEN SENSOR CIRCUIT. If problem exists, repair as necessary. If problem does not exist, replace catalytic converter.

DTC P0440: EVAP SYSTEM MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Vapor pressure sensor and Vacuum Switching Valve (VSV) for vapor pressure sensor are used to detect faults in EVAP system. DTC P0440 is set if EVAP system leak is detected or vapor pressure sensor malfunctions (detection of atmospheric pressure in fuel tank, after vehicle has been driven for 20 minutes). Possible causes are:

* Faulty vapor pressure sensor.
* Fuel tank cap installed incorrectly.
* Fuel tank cap defective.
* Damaged, disconnected or blocked vacuum hose.
* Fuel tank damaged.
* Charcoal canister damaged.
* Hose between fuel tank and charcoal canister damaged.

NOTE: If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, perform appropriate diagnostic test first before performing DTC P0440 test.

Diagnostic Aids

Ask customer if fuel cap has been left off or not completely tightened recently. This may cause DTC to be set. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Check with vehicle driver if fuel tank cap was found loose at any time. If fuel tank cap was loose, it probably was cause of DTC P0440 to set. If fuel tank cap was not loose, check for cracks, deformations or loose connections in the following:

* Fuel tank.
* Charcoal canister.
* Fuel tank filler pipe.
* Hose and tubes around fuel tank and charcoal canister.

Repair as necessary. If components are okay, go to next step.

2) Check if fuel tank cap is an original manufacturer’s cap. If fuel tank cap is an original manufacturer’s cap, go to next step. If fuel tank cap is not an original manufacturer cap, replace cap with a manufacturer’s cap.

3) Check if fuel tank cap is installed properly. Reinstall fuel cap as necessary. If fuel cap is installed properly, go to next step.

4) Check for damaged fuel tank cap and gasket. Replace fuel cap as necessary. If fuel tank cap and gasket are okay, go to next step.

5) Remove fuel tank cap. Visually inspect fuel tank filler neck for damage. Replace filler neck as necessary. If filler neck is okay, go to next step.

6) Check vacuum hoses between vapor pressure sensor and vapor pressure sensor and VSV for vapor pressure sensor, and between vapor pressure sensor and charcoal canister. Check hoses for correct

installation, looseness and damage. Repair as necessary. If vacuum hoses are okay, go to next step.

7) Check hose and tube between fuel tank and charcoal canister for correct installation and damage. Repair as necessary. If hose and tube are okay, go to next step.

8) Visually inspect charcoal canister for cracks or damage. Replace canister as necessary. If canister is okay, go to next step.

9) Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 2 (Yellow/Black wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, replace ECM and retest system.

10) Backprobing ECM harness connector, measure voltage between terminal No. 17 (Blue wire) at ECM E8 connector and terminal No. 18 (Brown wire) at ECM E6 connector. Disconnect vacuum supply hose from vapor pressure sensor. Sensor has 2 vacuum ports and is mounted on charcoal canister underneath rear of vehicle. Connect a vacuum pump to sensor. If voltage is 2.9-3.7 volts without vacuum applied, and .5 volt or less with 1.2-19.7 in. Hg (4-66 kPa) applied, go to step 12). If voltage is not as specified, go to next step.

11) Check for an open or short in wiring harness between vapor pressure sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace vapor pressure sensor.

12) Disconnect fuel tank-to-charcoal canister vacuum hose from charcoal canister. Ensure fuel tank cap is installed properly. Using compressed air, apply .71 psi (.05 kg/cm^2) to fuel tank. If tank does not hold pressure for a minimum of one minute, replace fuel tank or fuel tank over fill valve as necessary. If tank holds pressure, no fault is indicated at this time. Probable cause of DTC P0440 to set was an incorrectly installed fuel tank cap.

DTC P0441: INCORRECT EVAP PURGE FLOW DTC P0446: EVAP VENT CONTROL FAULT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Vapor pressure sensor and Vacuum Switching Valve (VSV) for vapor pressure sensor are used to detect faults in EVAP system.

DTC P0441 or P0446 are set if EVAP system leak is detected by ECM or if there is a malfunction in EVAP VSV, vapor pressure sensor VSV, or in vapor pressure sensor. DTC P0441 is also set if pressure in charcoal canister does not drop during purge control, or during purge cut-off, pressure in charcoal canister is low.

DTC P0446 is also set if when vapor pressure sensor is off, ECM does not sense continuity between vapor pressure sensor and charcoal canister. DTC P0446 is also set if when vapor pressure sensor is on, ECM does not sense continuity between vapor pressure sensor and fuel tank. DTC P0446 is also set if after purge cut off is on, pressure in charcoal canister is maintained at atmospheric pressure. Possible causes are:

* Open or short in vapor pressure sensor VSV circuit.
* Open or short in EVAP VSV circuit.
* Open or short circuit in vapor pressure sensor circuit.
* Faulty VSV for EVAP system.

* Faulty vapor pressure sensor VSV.
* Faulty vapor pressure sensor.
* Disconnected, cracked, damaged or blocked vacuum hose.
* Faulty charcoal canister.

NOTE: If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, perform appropriate circuit test first before performing DTC P0440 test.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair (Using Lexus Scan Tool)

1) Check EVAP VSV, vapor pressure sensor VSV and vapor pressure sensor wiring harness connectors for damaged pins, corrosion and loose wires. Repair as necessary. If connectors are okay, go to next step. For component locations, see appropriate illustration in THEORY & OPERATION article.

2) Check all EVAP related vacuum hoses for damage, blockage, looseness and correct routing. Repair as necessary. If vacuum hoses are okay, go to next step. For proper vacuum hose routing, see appropriate illustration in VACUUM DIAGRAMS article.

3) Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 2 (Yellow/Black wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, replace ECM and retest system.

4) Backprobing ECM harness connector, measure voltage between terminal No. 17 (Blue wire) at ECM E8 connector and terminal No. 18 (Brown wire) at ECM E6 connector. Disconnect vacuum hose from vapor pressure sensor. Sensor has 2 vacuum ports and is located on charcoal canister underneath rear of vehicle. Connect a vacuum pump to sensor. Voltage should be 2.9-3.7 volts without vacuum applied, and .5 volt or less with 1.2-19.7 in. Hg (4-66 kPa) applied. If voltage is as specified, go to step 6). If voltage is not as specified, go to next step.

5) Check for an open or short in wiring harness between vapor pressure sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace vapor pressure sensor.

6) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Using scan tool, select ACTIVE TEST mode. Disconnect EVAP VSV vacuum hose from charcoal canister. Start engine. Connect a vacuum gauge to disconnected vacuum hose. Using scan tool, activate EVAP VSV. When EVAP VSV is activated, vacuum should be present. When EVAP VSV is not activated, no vacuum should be present. If vacuum is as specified, go to step 10). If vacuum is not as specified, go to next step.

7) Check for correct routing, looseness, damage and blockage in vacuum hoses between intake manifold and EVAP VSV, and between EVAP VSV and charcoal canister. Repair as necessary. If hoses are okay, go to next step.

8) Check EVAP VSV. See appropriate SYSTEM & COMPONENT TESTING article. If EVAP VSV is not okay, replace EVAP VSV and charcoal canister. Also clean vacuum hoses between throttle body and EVAP VSV, and EVAP VSV and charcoal canister. If EVAP VSV is okay, go to next step.

9) Check for an open or short in wiring harness between EFI main relay, EVAP VSV and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest system.

10) Disconnect vapor pressure sensor VSV. Sensor VSV has 3 vacuum ports and is located on charcoal canister underneath rear of

vehicle. Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Turn ignition on. Select ACTIVE TEST mode on scan tool. Using scan tool, turn vapor pressure sensor VSV on. Apply compressed air to port "E" of vapor pressure sensor VSV. Air should flow from port "F". See Fig. 4. Using scan tool, turn vapor pressure sensor VSV off. Air should flow from port "G". If valve operates correctly, go to step 13). If valve does not operate correctly, go to next step.

11) Check vapor pressure sensor VSV. See appropriate SYSTEM & COMPONENT TESTING article. If vapor pressure sensor VSV is not okay, replace vapor pressure sensor VSV and charcoal canister. Also clean vacuum hoses between charcoal canister and vapor pressure sensor VSV, and vapor pressure sensor VSV and vapor pressure sensor. If vapor pressure sensor VSV is okay, go to next step.

12) Check for an open or short in wiring harness between EFI main relay, vapor pressure sensor VSV and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest system.

13) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Select ACTIVE TEST mode on scan tool. Ensure vapor pressure sensor VSV is disconnected. Start engine. Using scan tool, activate EVAP VSV. Backprobing ECM harness connector, measure voltage between terminal No. 17 (Pink wire) at ECM E7 connector and terminal No. 18 (Brown wire) at ECM E10 connector. See Fig. 2. Voltage should be 2 volts or less. If voltage is as specified, go to step 15). If voltage is not as specified, go to next step.

14) Check vacuum hose between charcoal canister and vapor pressure sensor VSV, and vacuum hose between vapor pressure sensor and vapor pressure sensor VSV. If problem exists, repair vacuum hoses as necessary. If problem does not exist, go to next step.

15) Remove fuel tank cap. Ensure vapor pressure sensor VSV connector is disconnected. Select ACTIVE TEST mode on scan tool. Start engine. Using scan tool, switch EVAP VSV on for 5 seconds. Backprobing ECM harness connector, measure voltage between terminals No. 17 (Pink wire) at ECM E7 connector and No. 18 (Brown wire) at ECM E10 connector 5 seconds after switching EVAP VSV from on to off. If voltage is 2.5 volts or less, go to next step. If voltage is more than 2.5 volts, replace charcoal canister.

16) Charcoal canister or fuel tank overfill check valve maybe be defective. Check fuel evaporation system. See FUEL EVAPORATION SYSTEM under EMISSION SYSTEMS & SUB-SYSTEMS in appropriate SYSTEM & COMPONENT TESTING article. Repair as necessary. If no problem is indicated, replace ECM.

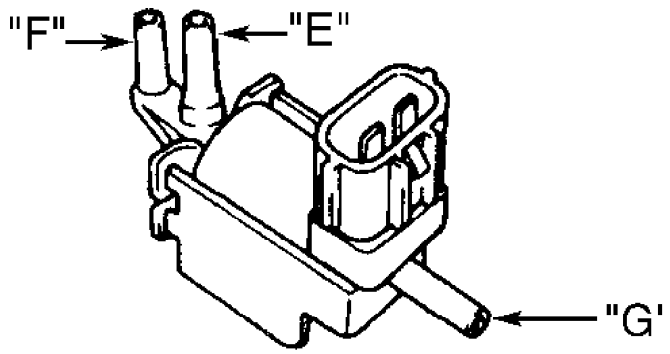


Fig. 4: Identifying Vapor Pressure Sensor VSV Vacuum Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Diagnosis & Repair (Using OBD-II Scan Tool)

1) Check EVAP VSV, vapor pressure sensor VSV and vapor

pressure sensor wiring harness connectors for damaged pins, corrosion and loose wires. Repair as necessary. If connectors are okay, go to next step. For component locations, see THEORY & OPERATION article.

2) Check all EVAP related vacuum hoses for blockage, damage, looseness and correct routing. Repair as necessary. If vacuum hoses are okay, go to next step. For proper vacuum hose routing, see VACUUM DIAGRAMS article.

3) Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 2 (Yellow/Black wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, replace ECM and retest system.

4) Backprobing ECM harness connector, measure voltage between terminal No. 17 (Blue wire) at ECM E8 connector and No. 18 (Brown wire) at ECM E6 connector. Disconnect vacuum hose from vapor pressure sensor. Sensor has 2 vacuum ports and is mounted on charcoal canister underneath rear of vehicle. Connect a vacuum pump to sensor. If voltage is 2.9-3.7 volts without vacuum applied, and .5 volt with 1.2-19.7 in. Hg (4-66 kPa) applied, go to step 6). If voltage is not as specified, go to next step.

5) Check for an open or short in wiring harness between vapor pressure sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace vapor pressure sensor.

6) Disconnect EVAP VSV vacuum hoses. For EVAP VSV location, see THEORY & OPERATION article. Turn ignition on. Access ECM harness connectors behind glove box. Backprobing, connect a fused jumper wire between ground and terminal No. 7 (White/Blue Green wire) at ECM E6 connector. See Fig. 2.

7) Apply compressed air to EVAP VSV port "E". See Fig. 5. Air should flow from port "F". Remove fused jumper wire. Air should not flow from port "F". If EVAP VSV functions as specified, go to step 10). If EVAP VSV does not function as specified, go to next step.

8) Check EVAP VSV operation. See appropriate SYSTEM & COMPONENT TESTING article. If EVAP VSV is not okay, replace EVAP VSV and charcoal canister as necessary. Also clean vacuum hose between throttle body and EVAP VSV, and EVAP VSV and charcoal canister. If VSV is okay, go to next step.

9) Check for an open or short in wiring harness between EFI main relay, EVAP VSV and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest system.

10) Disconnect vapor pressure sensor VSV vacuum hoses. VSV has 3 vacuum ports and is mounted on top of EVAP charcoal canister underneath rear of vehicle. Access ECM harness connectors behind glove box. Turn ignition on. Backprobing, connect a fused jumper wire between ground and terminal No. 9 (Blue/Red wire) at ECM E8 connector. See Fig. 2. Apply compressed air to VSV port "E". See Fig. 4.

11) Air should flow from port "F". Disconnect fused jumper wire. Air should flow from port "G". If VSV does not function as specified, go to next step. If VSV functions as specified, charcoal canister or fuel tank overfill valve may be defective. Check fuel evaporation system. See appropriate SYSTEM & COMPONENT TESTING article. Repair as necessary.

12) Check vapor pressure sensor VSV. See appropriate SYSTEM & COMPONENT TESTING article. If VSV is okay, go to next step. If vapor pressure sensor VSV is not okay, replace vapor pressure sensor VSV and charcoal canister as necessary. Also clean vacuum hose between charcoal canister and vapor pressure sensor VSV, and vapor pressure sensor VSV and vapor pressure sensor.

13) Check for an open or short in wiring harness between EFI main relay, vapor pressure sensor VSV and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is

okay, replace ECM and retest system.

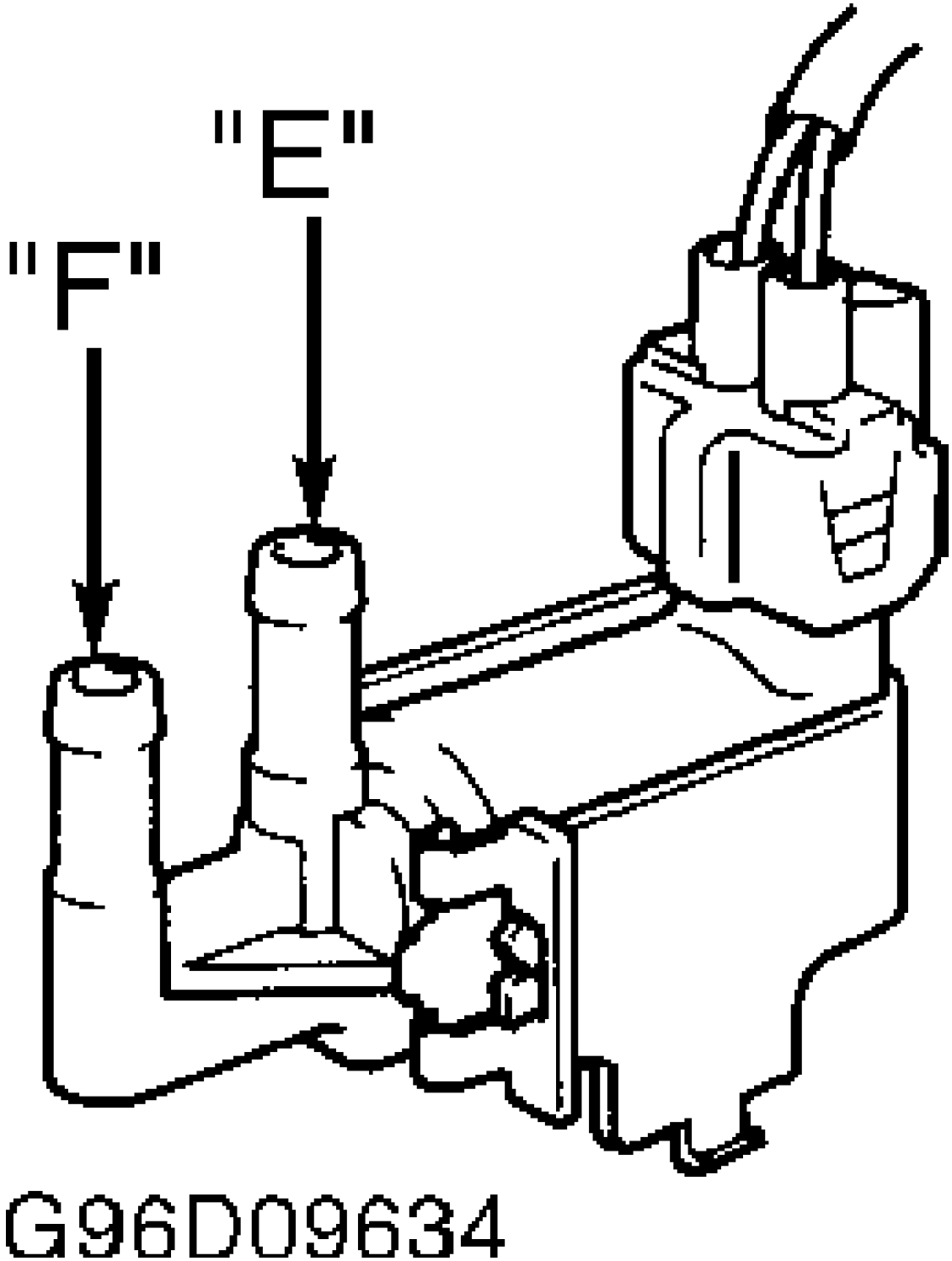


Fig. 5: Identifying EVAP VSV Vacuum Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DTC P0450: EVAP PRESSURE SENSOR MALFUNCTION DTC P0451: EVAP PRESSURE SENSOR RANGE/PERFORMANCE FAULT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Vapor pressure sensor and Vacuum Switching Valve (VSV) for vapor pressure sensor are used to detect faults in EVAP system.

DTC P0450 is set if 10 seconds after engine starts, vapor pressure sensor reading is less than -1.0 in. Hg (-3.5 kPa), or equal to or greater than .4 in. Hg (1.5 kPa) for 7 seconds or more. DTC P0451 is set if vapor pressure sensor output changes while vehicle is standing at idle and vapor pressure sensor VSV is on. Possible causes are:

* Short or open in vapor pressure sensor circuit.
* Faulty vapor pressure sensor.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Access ECM harness connectors behind glove box. Turn ignition on. Backprobing ECM harness connector, measure voltage between terminals No. 2 (Yellow/Black wire) and No. 18 (Brown wire) at ECM E6 connector. See Fig. 2. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, replace ECM and retest system.

2) Backprobing ECM harness connector, measure voltage between terminal No. 17 (Blue wire) at ECM E8 connector and terminal No. 18 (Brown wire) at ECM E6 connector. Disconnect vacuum hose from vapor pressure sensor. Sensor has 2 vacuum ports and is mounted on charcoal canister underneath rear of vehicle. Connect a vacuum pump to sensor. If voltage is 2.9-3.7 volts without vacuum applied, and .5 volt with 1.2-19.7 in. Hg (4-66 kPa) vacuum applied, replace ECM and retest system. If voltage is not as specified, go to next step.

3) Check for an open or short in wiring harness between vapor pressure sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace vapor pressure sensor. Retest system.

DTC P0500: VEHICLE SPEED SENSOR (VSS) MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Anti-Lock Brake System (ABS) Vehicle Speed Sensor (VSS) detects wheel speed and sends signals to ABS ECU. The ABS ECU converts signals into a 4-pulse signal and outputs signal to instrument cluster. Instrument cluster converts signal to a more precise waveform and outputs signal to ECM. ECM determines vehicle speed based on frequency of these pulse signals. DTC is set when ECM does not detect

any VSS signal while vehicle is in motion. Possible causes are:

* Faulty vehicle speed sensor.
* Open or short in VSS circuit.
* Faulty instrument cluster.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Test drive vehicle and check operation of speedometer. If speedometer is not operating correctly, repair speedometer as necessary. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual. If speedometer is operating correctly, go to next step.

2) Access ECM behind glove box. Turn ignition off. Disconnect ECM E9 connector. See Fig. 2. Using voltmeter, check for continuity between ground and terminal No. 22 (Violet/White wire) at ECM E9 harness connector. If continuity does not exist, go to next step. If continuity exists, locate and repair short to ground in Violet/White wire between ECM E8 connector and instrument cluster.

3) Turn ignition on. Measure voltage between ground and terminal No. 22 (Violet/White wire) at ECM E8 harness connector. If voltage is 9-14 volts, go to next step. If voltage is not 9-14 volts, locate and repair open in Violet/White wire between junction connector J17, located behind center of instrument panel and ECM.

4) Check for open in Violet/White wire between junction block J17 and instrument cluster. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair wiring as necessary and retest system. If wiring is okay, replace ECM and retest system.

DTC P0505: IDLE CONTROL SYSTEM MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Idle Air Control (IAC) valve is a rotary solenoid type and is located in front of air intake chamber. Intake air by-passing the throttle valve is directed to IAC valve through a passage. This allows air volume by-passing the throttle valve to be regulated. DTC P0505 is set if idle speed continues to vary greatly from target speed. Possible causes are:

* IAC valve stuck or closed.
* Open or short in IAC valve circuit.
* Open or short in A/C signal circuit.
* Faulty air intake hose.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) If using Lexus scan tool, go to next step. If using OBD-II scan tool, go to step 3).

2) Warm engine to operating temperature. Turn accessories and A/C off. Place transmission in Neutral. Connect Lexus scan tool to DLC No. 3 and select ACTIVE TEST MODE. See Fig. 1. Using Lexus scan tool, turn TE1 on and off. Record engine speed 5 seconds before and after TE1 is turned on and off. If engine speed changes more than 100 RPM, go to step 7). If engine speed does not change more than 100 RPM, go to step 4).

3) Warm engine to operating temperature. Turn accessories and A/C off. Place transmission in Neutral. Connect OBD-II scan tool to DLC No. 3. Connect Jumper Wire (09843-18020) between DLC No. 1 connector terminals No. 8 (Purple/Black wire) and No. 3 (Brown/White wire). DLC No. 1 is located near left rear corner of engine compartment. Connect and disconnect Jumper Wire (09843-18020) several times. Record engine speed 5 seconds before and after Jumper Wire (09843-18020) is connected and disconnected. If engine speed changes more than 100 RPM, go to step 7). If engine speed does not change more than 100 RPM, go to next step.

4) Access ECM behind glove box. Turn ignition off. Disconnect ECM E7 connector. See Fig. 2. Turn ignition on. Using voltmeter, measure voltage between ground and terminal No. 26 (Red/White wire) at ECM E7 connector. If voltage is 9-14 volts, go to step 6). If voltage is not 9-14 volts, go to next step.

5) Check IAC valve. See IDLE CONTROL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. Replace IAC valve as necessary. If IAC valve is okay, check for open or short circuit in connectors or wiring harness between engine compartment junction block and IAC valve, or between IAC valve and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair wiring as necessary.

6) Check IAC valve operation. See IDLE CONTROL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. Replace IAC valve as necessary. If IAC valve is okay, check IAC valve and passages for carbon build-up and blockage. Repair as necessary. If no build-up or blockage exists, replace ECM.

7) Ensure oil dipstick, oil filler cap, PCV system and all other air induction system components are intact and operating properly. If problem exists, repair as necessary. If problem does not exist, an open or short in A/C switch signal circuit may exist. Check A/C amplifier. See appropriate article in appropriate MITCHELL\R AIR CONDITIONING & HEATING SERVICE & REPAIR manual. Repair as necessary.

DTC P1130 OR P1150: AIR/FUEL SENSOR CIRCUIT RANGE/PERFORMANCE FAULT

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM connectors and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1.

Circuit Description

Air/Fuel (A/F) sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to control air/fuel ratio. A/F sensor includes a heater. DTC P1130 is for bank No. 1 A/F sensor. DTC P1150 is for bank No. 2 A/F sensor. DTC is set when A/F sensor voltage output remains the same with engine running after engine is warmed to normal operating temperature. Possible causes are:

* Open or short in A/F sensor circuit.
* Faulty A/F sensor.
* Faulty ECM.

Diagnostic Aids

After confirming DTC P1130 and/or P1150, use scan tool to access CURRENT DATA to confirm voltage output of heated oxygen sensors (bank No. 1 and 2 sensor No. 1). ECM controls voltage of AF+ and AF- terminals at ECM to a fixed voltage (3.3 volts at AF+ terminal; 3.0 volts at AF- terminal). It is impossible to confirm A/F sensor output voltage without using a scan tool. OBD-II scan tools will display one fifth A/F sensor output voltage as Lexus scan tool will. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

During fuel enrichment, output voltage of A/F sensors maybe less than 0.56 volt (2.8 volts on Lexus scan tool). During fuel cut, output voltage of A/F sensors maybe more than 0.76 volt (3.8 volts on Lexus scan tool). If output voltage of A/F sensor remains at 0.66 volt (3.3 volts on Lexus scan tool) during all conditions, A/F sensor circuit may be open. If output voltage of A/F sensor remains at 0.76 volt (3.8 volts on Lexus scan tool) or more during all conditions, A/F sensor circuit may be shorted. If output voltage of A/F sensor remains at 0.56 volt (2.8 volts on Lexus scan tool) or less during all conditions, A/F sensor circuit may be shorted.

Test Drive Confirmation

1) If using OBD-II scan tool, go to step 3). If using Lexus scan tool, connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Switch scan tool to CHECK mode and go to next step.

2) Start and warm engine to normal operating temperature with all accessories off. Drive vehicle at 38-75 MPH and engine speed at 1600-3200 RPM for 3-5 minutes. Stop vehicle and allow to idle for one minute. If malfunction exists, MIL will illuminate.

3) Start and warm engine to normal operating temperature. Drive vehicle at 38-75 MPH and engine speed at 1600-3200 RPM for 3-5 minutes. Stop vehicle and allow to idle for one minute. Turn ignition off. Repeat driving and idle part of test. If malfunction exists, MIL will illuminate.

Diagnosis & Repair

1) If other DTCs are displayed, diagnose and repair those DTCs first and retest system. If only DTC P1130 and/or P1150 is displayed, go to next step.

2) Connect scan tool to Data Link Connector (DLC) No. 3. Start engine and raise engine speed to 2500 RPM for approximately 90 seconds. Using scan tool, monitor each A/F sensor output voltage. See AIR/FUEL RATIO SENSOR SPECIFICATIONS table. If voltage is as specified, go to next step. If voltage is not as specified, go to step 8).

AIR/FUEL RATIO SENSOR SPECIFICATIONS

Application	(1) Voltage
Using OBD-II Scan Tool	
Engine Idling	0.66
Engine Racing	0.76 Or More
Driving Vehicle (2)	0.56 Or Less
Using Lexus Scan Tool	
Engine Idling	3.3
Engine Racing	3.8 Or More
Driving Vehicle (2)	2.8 Or Less

(1) - Voltage should not remain at specification given.
(2) - Drive vehicle at 25 MPH or more with engine speed at 1500 RPM or more while opening and closing throttle valve.

---

3) Check for open or short in wiring between ECM and suspect A/F sensor. See appropriate wiring diagram in WIRING DIAGRAMS article. If problem exists, repair wiring as necessary. If problem does not exist, go to next step.

4) Disconnect suspect A/F sensor harness connector. One A/F sensor is located in each exhaust manifold. Measure resistance between terminal B+ (Black/Red wire) and HT (Blue wire on bank No. 1 or Green wire on bank No. 2) at A/F sensor connector (component side). Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistances are not as specified, replace appropriate A/F sensor. If resistances are as specified, go to next step.

5) Ensure oil dipstick, oil filler cap, PCV system and all other air induction system components are intact and operating properly. If problem exists, repair as necessary. If problem does not exist, go to next step.

6) Check fuel pressure. See FUEL SYSTEM in BASIC DIAGNOSTIC PROCEDURES article. If fuel pressure is not within specification, repair as necessary. If fuel pressure is within specification, go to next step.

7) Check fuel injectors. See FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. If problem exists, repair as necessary. If problem does not exist, replace defective A/F sensor.

8) Perform test drive confirmation then go to next step. See TEST DRIVE CONFIRMATION.

9) Clear and recheck for DTCs. If DTC P1130 and/or P1150 is displayed again, replace ECM. If DTC P1130 and P1150 are not displayed again, go to next step.

10) Vehicle either ran out of fuel or problem is intermittent. Check component and ECM connections.

DTC P1133 OR P1153: AIR/FUEL SENSOR CIRCUIT RESPONSE MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM connectors and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1.

NOTE: For component location, see appropriate illustration in THEORY & OPERATION article.

Circuit Description

Air/Fuel (A/F) sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to control air/fuel ratio. A/F sensor includes a heater. DTC is set when A/F sensor output does not change with engine speed at 1400 RPM or more with vehicle speed at more than 38 MPH. DTC P1133 is for bank No. 1 A/F sensor. DTC P1153 is for bank No. 2 A/F sensor. Possible cause is:

* Faulty A/F sensor.

Diagnostic Aids

After confirming DTC P1133 and/or P1153, use scan tool to access CURRENT DATA to confirm voltage output of heated oxygen sensors (bank No. 1 and 2 sensor No. 1). ECM controls voltage of AF+ and AF- terminals at ECM to a fixed voltage (3.3 volts at AF+ terminal; 3.0 volts at AF- terminal). It is impossible to confirm A/F sensor output voltage without using a scan tool. OBD-II scan tools will display one fifth A/F sensor output voltage as Lexus scan tool will. Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

During fuel enrichment, output voltage of A/F sensors maybe less than 0.56 volt (2.8 volts on Lexus scan tool). During fuel cut, output voltage of A/F sensors maybe more than 0.76 volt (3.8 volts on Lexus scan tool). If output voltage of A/F sensor remains at 0.66 volt (3.3 volts on Lexus scan tool) during all conditions, A/F sensor circuit may be open. If output voltage of A/F sensor remains at 0.76 volt (3.8 volts on Lexus scan tool) or more during all conditions, A/F sensor circuit may be shorted. If output voltage of A/F sensor remains at 0.56 volt (2.8 volts on Lexus scan tool) or less during all conditions, A/F sensor circuit may be shorted.

Test Drive Confirmation

1) If using OBD-II scan tool, go to step 3). If using Lexus scan tool, connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 1. Switch scan tool to CHECK mode and go to next step.

2) Start and warm engine to normal operating temperature with all accessories off. Drive vehicle at 38-75 MPH and engine speed at 1600-3200 RPM for 3-5 minutes. Stop vehicle and allow to idle for one minute. If malfunction exists, MIL will illuminate.

3) Start and warm engine to normal operating temperature. Drive vehicle at 38-75 MPH and engine speed at 1600-3200 RPM for 3-5 minutes. Stop vehicle and allow to idle for one minute. Turn ignition off. Repeat driving and idle part of test. If malfunction exists, MIL will illuminate.

Diagnosis & Repair

1) If other DTCs are displayed, diagnose and repair those DTCs first and retest system. If only DTC P1133 and/or P1153 is displayed, go to next step.

2) Disconnect suspect A/F sensor harness connector. One A/F sensor is located in each exhaust manifold. Measure resistance between terminal B+ (Black/Red wire) and HT (Blue wire on bank No. 1 or Green wire on bank No. 2) at A/F sensor connector (component side). Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistances are not as specified, replace appropriate A/F sensor. If resistances are as specified, go to next step.

3) Perform test drive confirmation then go to next step. See TEST DRIVE CONFIRMATION.

4) Clear and recheck for DTCs. If DTC P1133 and/or P1153 is displayed again, replace ECM. If DTC neither P1133 and P1153 are displayed again, go to next step.

5) Vehicle either ran out of fuel or problem is intermittent. Check component and ECM connections.

DTC P1135 OR P1155: AIR/FUEL SENSOR HEATER CIRCUIT MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM connectors and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For

programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1.

Circuit Description

Air/Fuel (A/F) sensor monitors exhaust gas oxygen content and delivers an input signal to ECM. ECM uses input signal to control air/fuel ratio. A/F sensor includes a heater. DTC P1135 is for bank No. 1 A/F sensor. DTC P1155 is for bank No. 2 A/F sensor. DTC is set when A/F sensor heater output is more than 8 amps or when heater output is less than .25 amps. Possible causes are:

* Open or short in A/F sensor circuit.
* Faulty A/F sensor heater.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Access ECM behind glove box. Turn ignition on. Using DVOM, backprobe at ECM harness connector and measure voltage between ground and terminals No. 3 (Blue wire) and No. 4 (Green wire) at ECM harness connector E6. See Fig. 2. If both voltages are 9-14 volts, replace ECM. If either voltage is not 9-14 volts, go to next step.

2) Disconnect suspect A/F sensor harness connector. One A/F sensor is located in each exhaust manifold. Measure resistance between terminal B+ (Black/Red wire) and HT (Black/White wire on bank No. 1 or Black/Red wire on bank No. 2) at A/F sensor connector (component side). Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistances are not as specified, replace appropriate A/F sensor. If resistances are as specified, go to next step.

3) Check for open or short in wiring between EFI main relay, A/F sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary.

DTC P1300, P1305, P1310, P1315, P1320 OR P1325: IGNITOR CIRCUIT MALFUNCTION

Circuit Description

This system is equipped with a Direct Ignition System (DIS), with a coil/ignitor devoted to each cylinder. Primary circuit is turned off when ECM delivers a signal to ignitor on the IGT wire, causing ignition coil to fire spark plug. After delivering a command to turn off primary circuit on IGT wire, the ECM monitors ignition confirmation signal on the IGF circuit to ensure primary switching has occurred. If IGF signal is not input to ECM, the ECM will stop fuel injection as a fail-safe function. DTC will set if there is no IGF signal to ECM with engine running. DTC 1300 is for cylinder No. 1. DTC 1305 is for cylinder No. 2. DTC 1310 is for cylinder No. 3. DTC 1315 is for cylinder No. 4. DTC 1320 is for cylinder No. 5. DTC 1325 is for cylinder No. 6. Possible causes are:

* Open or short in IGF or IGT circuit.
* Faulty ignition coil/ignitor.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records

engine conditions when malfunction is detected.

Diagnosis & Repair

1) Check for spark at misfiring cylinder. See IGNITION CHECKS in BASIC DIAGNOSTIC PROCEDURES article. If spark is present, go to next step. If spark is not present, go to step 4).

2) Check for open or short in IGF and IGT circuits between ECM E7 connector and suspect ignition coil/ignitor. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If circuits are okay, go to next step.

3) Disconnect Black 4-pin connector at suspect ignition coil/ignitor. Turn ignition on. Backprobing, measure voltage between ground and terminal No. 25 (Black wire) at ECM E7 connector. See Fig. 2. If voltage is 4.5-5.5 volts, replace suspect ignition coil/ignitor. If voltage is not 4.5-5.5 volts, replace ECM and retest.

4) Check for open or short in suspect IGT circuit between ECM E7 connector and suspect ignition coil/ignitor. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If circuit is okay, go to next step.

5) Backprobing, measure voltage between ground and suspect IGT circuit terminal at ECM E7 connector while cranking engine. See IDENTIFYING IGT CIRCUIT ECM E7 CONNECTOR TERMINALS table. If voltage is .1-4.5 volts, go to next step. If voltage is not .1-4.5 volts, replace ECM and retest.

IDENTIFYING IGT CIRCUIT ECM E7 CONNECTOR TERMINALS

Terminal	Wire Color
11	Black/Yellow
12	Blue/Red
13	Blue/Orange
14	Blue/Yellow
15	Yellow
16	Green/Black

6) Disconnect all ignition coil/ignitor connectors. Backprobing, measure voltage between ground and each IGT circuit terminal of ECM E7 connector while cranking engine. See IDENTIFYING IGT CIRCUIT ECM E7 CONNECTOR TERMINALS table. If voltage is .1-4.5 volts, go to next step. If voltage is not .1-4.5 volts, replace ECM and retest.

7) Ensure suspect ignition coil/ignitor connector is disconnected. Measure voltage between ground and suspect coil/ignitor harness connector terminal No. 1 (White/Red wire on early production models or Red wire on late production models). Turn ignition switch to ON, then to START position. If voltage is not 9-14 volts, go to next step. If voltage is 9-14 volts, check open in Brown wire between suspect ignition coil/ignitor connector terminal No. 4 and ground. Repair as necessary.

8) Check for open or short in wire harness and connector between ignition switch and suspect ignition coil/ignitor. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If circuit is okay, go to next step.

9) Check EFI main relay. See appropriate SYSTEM & COMPONENT TESTING article. EFI main relay is located in underhood engine compartment at left side of engine. Replace as necessary. If EFI main relay is okay, replace suspect ignition coil/ignitor.

DTC P1345 OR P1350: VARIABLE VALVE TIMING (VVT) CIRCUIT MALFUNCTION

NOTE: Variable Valve Timing (VVT) sensor is also known as camshaft position sensor.

Circuit Description

The Variable Valve Timing (VVT) sensor consists of a signal plate and pick-up coil. The signal plate has one tooth and is mounted on each intake camshaft. The VVT sensor provides feedback to ECM in order to control intake valve timing. DTC P1345 or P1350 is set when ECM does not sense VVT sensor signal during cranking for 4 or more seconds. DTC P1345 or P1350 is also set if ECM does not sense VVT sensor signal with engine speed at 600 RPM or more for 5 or more seconds. DTC P1345 or P1350 is also set if ECM senses VVT sensor signal 5 times while crankshaft rotates 2 times. DTC P1345 is for bank No. 1 (left cylinder head). DTC P1350 is for bank No. 2 (right cylinder head). Possible causes are:

* Open or short in VVT sensor circuit.
* Faulty VVT sensor.
* ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Disconnect suspect VVT sensor connector. Measure resistance between VVT sensor harness connector terminals. Resistance should be 835-1400 ohms at 14-122°F (-10-50°C), or 1060-1645 ohms at 122-212°F (50-100°C). Replace VVT sensor as necessary. If resistance is as specified, go to next step.

2) Check for open or short circuit in wiring harness between ECM connector and appropriate VVT sensor. Repair as necessary. If wiring harness is okay, inspect VVT sensor installation. Tighten sensor as necessary. If VVT sensor is installed properly, replace ECM and retest.

DTC P1346 OR P1351: VARIABLE VALVE TIMING (VVT) CIRCUIT RANGE/PERFORMANCE FAULT

NOTE: Variable Valve Timing (VVT) sensor is also known as camshaft position sensor.

Circuit Description

The Variable Valve Timing (VVT) sensor consists of a signal plate and pick-up coil. The signal plate has one tooth and is mounted on each intake camshaft. The VVT sensor provides feedback to ECM in order to control intake valve timing. DTC P1346 is set when ECM detects a deviation in crankshaft position sensor and VVT sensor for bank No. 1 (left cylinder head). DTC P1351 is set when ECM detects a deviation in crankshaft position sensor and VVT sensor for bank No. 2 (right cylinder head). Possible causes are:

* Mechanical system malfunction (timing belt stretched or timing belt teeth jumped).
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

Check valve timing. Check for loose, stretched or jumped

Copyrig

appropriate MITCHELL\R manual. Repair as necessary. If valve timing and timing belt are okay, replace ECM.

DTC P1349 OR P1354: VARIABLE VALVE TIMING (VVT) SYSTEM

MALFUNCTION

NOTE: Variable Valve Timing (VVT) sensor is also known as camshaft position sensor.

Circuit Description

The Variable Valve Timing (VVT) system controls intake valve timing in response to driving conditions. Electronic Control Module (ECM) controls Oil Control Valve (OCV) to ensure correct valve timing. A OCV is located in each cylinder head at flywheel end of engine. Oil pressure controlled by the OCV is supplied to the VVT controller. VVT controller then changes relative position between camshaft and crankshaft. VVT controller is located on the front of each intake camshaft. DTC P1349 is set if ECM detects valve timing does not change (fixed timing) for bank No. 1 (left cylinder head). DTC P1354 is set if ECM detects valve timing does not change for bank No. 2 (right cylinder head). Possible causes are:

* Incorrect valve timing.
* Faulty oil control valve.
* Faulty VVT controller assembly.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair (Using Lexus Scan Tool)

1) Check valve timing. See appropriate article in ENGINES in appropriate MITCHELL\R manual. Repair as necessary. If valve timing is okay, go to next step.

2) Using scan tool, select ACTIVE TEST mode. Select VVT. Note idle speed when OCV is activated by scan tool. If idle speed is normal with OCV off and engine idles rough or stalls when OCV is on, VVT is functioning properly at this time. DTC may have been set because of a foreign object that was temporarily caught in the engine oil system but after a short time system returned to normal. If idle speed does not function as specified, go to next step.

3) With engine idling, check voltage to OCV. If checking OCV for bank No. 1 (left cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 29 (Green/Red wire) and No. 18 (Green/Yellow wire). If checking OCV for bank No. 2 (right cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 5 (Green/White wire) and No. 6 (Yellow/Black wire). On all applications, ensure oscilloscope pattern is as shown. See Fig. 6. As engine speed is increased, waveform frequency ("A") should lengthen. If waveform pattern is as shown, go to next step. If waveform pattern is not as shown, replace ECM.

4) Remove timing belt cover and timing belt. See appropriate article in ENGINES in appropriate MITCHELL\R manual. Remove OCV. Place a shop towel under OCV cylinder head opening. Rotate VVT pulley from left to right about 30 degrees 2-3 times. Oil should drain from OCV cylinder head opening. If oil does not drain from opening, replace VVT pulley/gear assembly and go to next step. If oil drains from opening, go to next step.

5) With OCV removed, connect a jumper wire between positive battery terminal and terminal No. 1 at OCV. See Fig. 7. Connect another jumper wire between negative battery terminal and terminal No. 2 at OCV and note OCV plunger operation. With battery voltage applied,

plunger on end of OCV should extend. Disconnect a jumper wire. Without battery voltage applied, plunger should retract. If OCV operates as specified, go to next step. If OCV does not operate as specified, replace OCV and go to next step.

6) Check for blockage in OCV. Check oil check valve and oil pipe located under OCV. Repair as necessary and retest. If components are okay, go to next step.

7) Clear DTCs. Start engine and allow it to idle. Turn ignition off. Turn ignition on and check for DTCs. If DTC P1349 or P1354 is not present, no problem is indicated at this time. DTC may have been set because of a foreign object that was temporarily caught in the engine oil system but after a short time system returned to normal. If DTC P1349 or P1354 is present, replace ECM and retest.

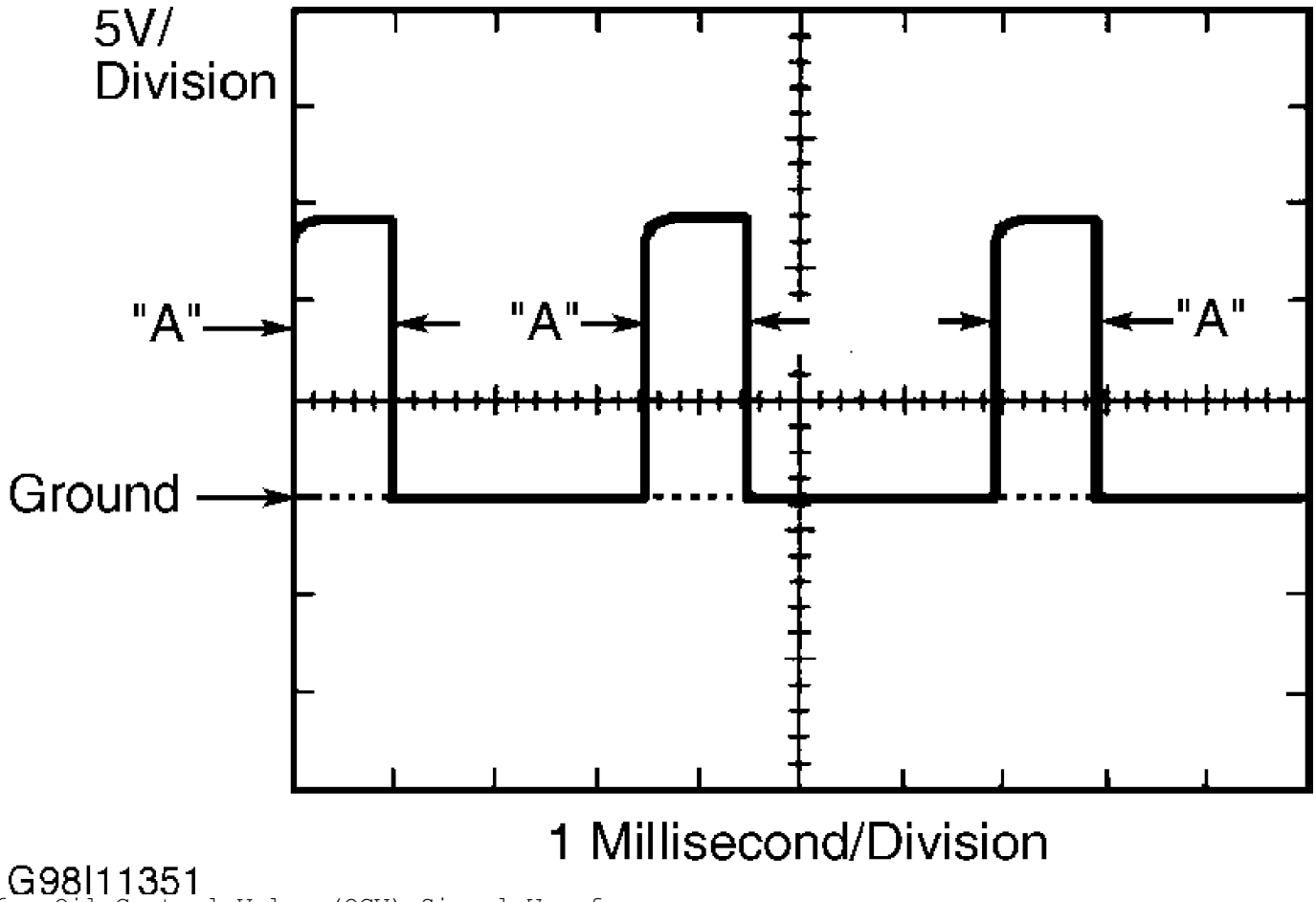


Fig. 6: Oil Control Valve (OCV) Signal Waveform
Courtesy of Toyota Motor Sales, U.S.A., Inc.

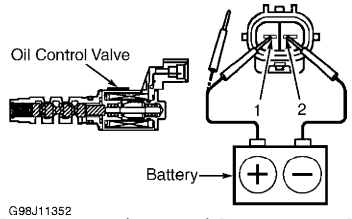


Fig. 7: Testing Oil Control Valve (OCV)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Diagnosis & Repair (Using OBD-II Scan Tool)

1) Check valve timing. See appropriate article in ENGINES in appropriate MITCHELL\R manual. Repair as necessary. If valve timing is okay, go to next step.

2) Start engine and allow it to idle. Disconnect suspect Oil Control Valve (OCV) and note idle speed. OCV is located in each cylinder head at flywheel end of engine. Engine idle speed should not change. Using jumper wires, apply battery voltage to OCV. Engine should idle rough or stall. If OCV operates as specified, go to next step. If OCV does no operate as specified, go to step 4).

3) With engine idling, check voltage to OCV. If checking OCV for bank No. 1 (left cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 29 (Green/Red wire) and No. 18 (Green/Yellow wire). If checking OCV for bank No. 2 (right cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 5 (Green/White wire) and No. 6 (Yellow/Black wire). On all applications, ensure oscilloscope waveform pattern is as shown. See Fig. 6. As engine speed is increased, waveform frequency ("A") should lengthen. If waveform pattern is not as shown, replace ECM. If waveform pattern is as shown, no problem is indicated at this time. DTC may have been set because of a foreign object that was temporarily caught in the engine oil system but after a short time system returned to normal.

4) Remove timing belt cover and timing belt. See appropriate article in ENGINES in appropriate MITCHELL\R manual. Remove OCV. Place a shop towel under OCV cylinder head opening. Rotate VVT pulley from left to right about 30 degrees 2-3 times. Oil should drain from OCV cylinder head opening. If oil does not drain from opening, replace VVT pulley/gear assembly and go to next step. If oil drains from head opening, go to next step.

5) With OCV removed, connect a jumper wire between positive battery terminal and terminal No. 1 at OCV. See Fig. 7. Connect another jumper wire between negative battery terminal and terminal No. 2 at OCV. With battery voltage applied, plunger on end of OCV should extend. Disconnect jumper wires. Without battery voltage applied, plunger should retract. If OCV operates as specified, go to next step. If OCV does not operate as specified, replace OCV and go to next step.

6) Check for blockage in OCV. Check oil check valve and oil pipe located under OCV. Repair as necessary and retest. If components are okay, go to next step.

7) Clear DTCs. Start engine and allow it to idle. Turn ignition off. Turn ignition on and check for DTCs. If DTC P1349 or P1354 is not present, no problem is indicated at this time. DTC may have been set because of a foreign object that was temporarily caught in the engine oil system but after a short time system returned to normal. If DTC P1349 or P1354 is present, replace ECM and retest.

DTC P1520: STOPLIGHT SWITCH SIGNAL MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

The stoplight signal is used to detect when brakes have been applied. ECM uses this signal to control fuel cut-off engine speed. DTC P1520 is set if stoplight switch does not turn off when vehicle is being driven. Possible causes are:

* Short in stoplight switch signal circuit.
* Faulty stoplight switch.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Check stoplights. If stoplights do not function properly, repair as necessary and retest system. See appropriate wiring diagram in EXTERIOR LIGHTS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual. If stoplights function properly, go to next step.

2) Access ECM behind glove box. Turn ignition on. Backprobing ECM E8 connector, measure voltage between ground and terminal No. 15 (Green/Orange wire) at ECM E8 connector. See Fig. 2. With brake pedal depressed, voltage should be 7.5-14.0 volts. With brake pedal released, voltage should be less than 1.5 volts. If voltage is not as specified, go to next step. If voltage is as specified, problem is intermittent.

3) Check wiring harness between ECM E7 connector and stoplight switch. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary and retest system. If wiring harness is okay, replace ECM. Retest system.

DTC P1600: ECM BATT MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Battery voltage is supplied to BATT terminal at ECM at all times. This circuit is used by diagnostic trouble code memory and air/fuel ratio adaptive control value memory. DTC P1600 is set if there is an open in back-up power source circuit. Possible causes are:

* Open in back-up power source circuit.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) Access ECM behind glove box. Locate ECM E8 connector. See Fig. 2. Backprobing ECM connector, measure voltage between ground and terminal No. 16 (Blue/White wire) at ECM E8 connector. If voltage is not 9-14 volts, go to next step. If voltage is 9-14 volts, replace ECM and retest system.

2) Remove and inspect EFI fuse (20-amp) from junction block, located in left side of engine compartment. If fuse is blown, check cause of blown fuse and repair as necessary. If fuse is okay, check and repair wiring harness or connector between battery, EFI fuse and ECM.

DTC P1645: BODY ECU MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always

ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

ECM receives operating condition (on/off) of A/C system from A/C ECU and also receives electrical load information from the body ECU. ECM uses this information to control engine (idle up, etc.). DTC will set if there is no communication to body ECU or A/C ECU from 5 seconds or more. Possible causes are:

* Faulty body ECU.
* Faulty A/C ECU.
* Communication network fault.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

If DTC P1645 is set, diagnose multiplex communication system. See appropriate MULTIPLEX CONTROL SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual. Repair as necessary.

DTC P1656 OR P1663: OIL CONTROL VALVE (OCV) MALFUNCTION

NOTE: Variable Valve Timing (VVT) sensor is also known as camshaft position sensor.

Circuit Description

The Variable Valve Timing (VVT) system controls intake valve timing in response to driving conditions. Electronic Control Module (ECM) controls Oil Control Valve (OCV) to ensure correct valve timing. An OCV is located in each cylinder head at flywheel end of engine. Oil pressure controlled by the OCV is supplied to the VVT controller. VVT controller then changes relative position between camshaft and crankshaft. VVT controller is located on the front of each intake camshaft. DTC P1656 or P1663 is set if ECM detects an open or short in OCV circuit. DTC P1656 is for bank No. 1 (left cylinder head) OCV circuit. DTC P1663 is for bank No. 2 (right cylinder head) OCV circuit. Possible causes are:

* Open or short in OCV circuit.
* Faulty OCV.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair (Using Lexus Scan Tool)

1) Using scan tool, select ACTIVE TEST mode. Select VVT. Note idle speed when OCV is activated by scan tool. If idle speed is normal with OCV off and engine idles rough or stalls when OCV is on, VVT is functioning properly at this time. Fault is intermittent. DTC may have been set because of a foreign object that was temporarily caught in the engine oil system but after a short time system returned to normal. If idle speed does not function as specified, go to next step.

2) Start engine and allow it to idle. Disconnect suspect Oil Control Valve (OCV) and note idle speed. OCV is located in each

cylinder head at flywheel end of engine. Engine idle speed should not change. Using jumper wires, apply battery voltage to OCV. Engine should idle rough or stall. If OCV operates as specified, go to next step. If OCV does not operate as specified, replace OCV.

3) With engine idling, check voltage to OCV. If checking OCV for bank No. 1 (left cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 29 (Green/Red wire) and No. 18 (Green/Yellow wire). If checking OCV for bank No. 2 (right cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 5 (Green/White wire) and No. 6 (Yellow/Black wire). On all applications, ensure oscilloscope pattern is as shown. See Fig. 6. As engine speed is increased, waveform frequency ("A") should lengthen. If waveform pattern is as shown, go to next step. If waveform pattern is not as shown, replace ECM.

4) Check for an open or short circuit in wiring harness between suspect OCV and ECM. Repair wiring harness as necessary. If wiring harness is okay, fault is intermittent.

Diagnosis & Repair (Using OBD-II Scan Tool)

1) Start engine and allow it to idle. Disconnect suspect Oil Control Valve (OCV) and note idle speed. OCV is located in each cylinder head at flywheel end of engine. Engine idle speed should not change. Using jumper wires, apply battery voltage to OCV. Engine should idle rough or stall. If OCV operates as specified, go to next step. If OCV does not operate as specified, replace OCV.

2) With engine idling, check voltage to OCV. If checking OCV for bank No. 1 (left cylinder head), backprobing, connect oscilloscope between ECM E7 connector terminals No. 29 (Green/Red wire) and No. 18 (Green/Yellow wire). If checking OCV for bank No. 2 (right cylinder head), backprobing, connect oscilloscope between ECM E11 connector terminals No. 5 (Green/White wire) and No. 6 (Yellow/Black wire). On all applications, ensure oscilloscope pattern is as shown. See Fig. 6. As engine speed is increased, waveform frequency ("A") should lengthen. If waveform pattern is as shown, go to next step. If waveform pattern is not as shown, replace ECM.

3) Check for an open or short circuit in wiring harness between suspect OCV and ECM. Repair wiring harness as necessary. If wiring harness is okay, fault is intermittent.

DTC P1780: PARK/NEUTRAL POSITION SWITCH MALFUNCTION

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

Park/neutral position switch is on whenever shift lever is in "N" or "P" position. With switch on, ECM terminal NSW is grounded via starter relay (zero voltage at terminal NSW). With shift lever in "D", "2", "L" or "R" position, switch is off (battery voltage at terminal NSW).

DTC P1780 is set when 2 or more switches are on simultaneously for "N", "2", "L"or "R"position. DTC P1780 is also set if park/neutral position switch is on while driving vehicle for 30 seconds or more at 44 MPH or more. DTC P1780 is also set if park/neutral position switch is on while driving vehicle for 30 seconds or more with engine speed at 1500-2500 RPM. Possible causes are:

* Short in Park/Neutral Position (PNP) switch circuit.
* Faulty PNP switch.
* Faulty ECM.

Diagnostic Aids

Using scan tool, read freeze frame data. Freeze frame records engine conditions when malfunction is detected.

Diagnosis & Repair

1) If using Lexus scan tool, go to next step. If not using Lexus scan tool, go to step 3).

2) Connect Lexus scan tool to DLC No. 3. See Fig. 1. Turn ignition on. Turn scan tool on. Using scan tool, read transaxle shift positions while shifting transaxle shift lever through all gear positions. If scan tool display does not indicate correct shifter positions, go to next step. If scan tool display indicates correct shifter positions, Park/Neutral Position (PNP) switch is functioning properly. Problem is internal transaxle. Identify symptom and repair as necessary. See appropriate article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

3) Access ECM behind glove box. Turn ignition on. Backprobing, measure voltage between ground and ECM E9 connector NSW circuit terminal No. 20 (Black/White wire). Also measure voltage between ground and ECM E5 connector "R" circuit terminal No. 8 (Red/Black wire), "2" circuit terminal No. 14 (Green/Yellow wire) and "L" circuit terminal No. 13 (Green/Orange wire). See Fig. 2. Shift lever through all gear positions. See Fig. 8. If voltage is not as specified, go to next step. If voltage is as specified, PNP switch is functioning properly. Problem is internal transaxle. Identify symptom and repair as necessary. See appropriate article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

4) Check PNP switch. See ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article. Replace PNP switch as necessary. If PNP switch is okay, check short circuit in wiring harness between battery and PNP switch. Also check wiring harness between ECM and PNP switch. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary and retest system. If wiring harness is okay, replace ECM and retest system.

Position	NSW–Body ground	R–Body ground	2–Body ground	L–Body ground
P,N	0 V	0 V	0 V	0 V
R	9 ~ 14 V*	9 ~ 14 V*	0 V	0 V
D	9 ~ 14 V	0 V	0 V	0 V
2	9 ~ 14 V	0 V	9 ~ 14 V	0 V
L	9 ~ 14 V	0 V	0 V	9 ~ 14 V

*The voltage will drop slightly due to lighting up of the back-up light.

G98C11348

Fig. 8: Testing Park/Neutral Position Switch Circuits
Courtesy of Toyota Motor Sales, U.S.A., Inc.

H - TESTS W/O CODES

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Trouble Shooting - No Codes
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

Before diagnosing symptoms or intermittent faults, perform steps in BASIC DIAGNOSTIC PROCEDURES article and SELF-DIAGNOSTICS article. Use this article to diagnose driveability problems existing when a Diagnostic Trouble Code (DTC) is not present.

NOTE: Some driveability problems may have been corrected by manufacturer with a revised computer control unit. Check with manufacturer for latest computer application.

Symptom checks can direct the technician to malfunctioning component(s) for further diagnosis. A symptom should lead to a specific component, system test or adjustment.

Use intermittent test procedures to locate driveability problems that DO NOT occur when the vehicle is being tested. These test procedures should also be used if a soft (intermittent) trouble code was present, but no problem was found during self-diagnostic testing.

NOTE: For specific testing procedures, see appropriate SYSTEM & COMPONENT TESTING article. For specifications, see ON-VEHICLE ADJUSTMENTS or SERVICE & ADJUSTMENT SPECIFICATIONS article.

SYMPTOMS

SYMPTOM DIAGNOSIS

When a Diagnostic Trouble Code (DTC) cannot be confirmed or problem cannot be confirmed in BASIC DIAGNOSTIC PROCEDURES, find basic symptom. For example, vehicle engine will not start. Appropriate heading matching vehicle symptom is DOES NOT START. Listed under DOES NOT START are more specific conditions. Find specific condition which best describes vehicle malfunction. Perform checks in order given. DO NOT skip steps.

NOTE: Even if a DTC is not set, this article may refer you to a test procedure for a specific DTC in SELF-DIAGNOSTICS article.

This article includes trouble shooting for the following symptoms:

* Does Not Start
* Difficult To Start
* Poor Idling
* Poor Driveability
* Engine Stall

DOES NOT START

Engine Does Not Crank:

* Check battery and battery cables.
* Check starter.
* Check starter relay. See appropriate SYSTEM & COMPONENT TESTING article.

No Initial Combustion:

* Check engine immobilizer system. See appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
* Check ECM power source circuit with ignition on. See ECM POWER SOURCE CIRCUIT (IGNITION KEYED) under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF -DIAGNOSTICS - LX470 article.
* Check Electronic Control Module (ECM) connector for loose, damaged or corroded terminals and repair as necessary. If connector is okay, check ECM ground circuits. See appropriate wiring diagram in POWER DISTRIBUTION article in WIRING DIAGRAMS in appropriate MITCHELL\R manual. Repair as necessary. If ground circuits are okay, replace ECM with a known-good ECM and retest.

No Complete Combustion:

* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF -DIAGNOSTICS - LX470 article.

DIFFICULT TO START

Difficult To Start, Cranks Normal:

* Check starter signal circuit. See STARTER SIGNAL CIRCUIT under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF -DIAGNOSTICS - LX470 article.
* Check engine compression. See BASIC DIAGNOSTIC PROCEDURES article.

Difficult To Start When Cold:

* Check starter signal circuit. See STARTER SIGNAL CIRCUIT under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF -DIAGNOSTICS - LX470 article.

Difficult To Start When Hot:

* Check starter signal circuit. See STARTER SIGNAL CIRCUIT under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

POOR IDLING

High Idle Speed:

* Check A/C compressor signal circuit. See appropriate AUTOMATIC A/C-HEATER SYSTEMS article in appropriate MITCHELL\R AIR CONDITIONING & HEATING SERVICE & REPAIR manual.
* Check ECM power source circuit with ignition on. See ECM POWER SOURCE CIRCUIT (IGNITION KEYED) under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.

Low Idle Speed:

* Check A/C compressor signal circuit. See appropriate AUTOMATIC A/C-HEATER SYSTEMS article in appropriate MITCHELL\R AIR CONDITIONING & HEATING SERVICE & REPAIR manual.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

Rough Idle:

* Check engine compression. See BASIC DIAGNOSTIC PROCEDURES article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

Surging:

* Check ECM power source circuit with ignition on. See ECM POWER SOURCE CIRCUIT (IGNITION KEYED) under COMPUTERIZED ENGINE CONTROLS in appropriate SYSTEM & COMPONENT TESTING article.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

POOR DRIVEABILITY

Hesitation/Poor Acceleration:

* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in

appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

* Check for faulty automatic transmission (electronics). See appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

Surging:

* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

ENGINE STALL

Engine Stall After Start:

* Check engine immobilizer system. See appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual.
* Check fuel pump control circuit. On all models except LX470, see FUEL PUMP CONTROL CIRCUIT under FUEL SYSTEM in appropriate SYSTEM & COMPONENT TESTING article. On LX470, perform DTC P1200: FUEL PUMP RELAY/ECU CIRCUIT test in SELF-DIAGNOSTICS - LX470 article.

Engine Stall During A/C Operation:

* Check A/C compressor signal circuit. See appropriate AUTOMATIC A/C-HEATER SYSTEMS article in appropriate MITCHELL\R AIR CONDITIONING & HEATING SERVICE & REPAIR manual.
* Check Electronic Control Module (ECM) connector for loose, damaged or corroded terminals and repair as necessary. If connector is okay, check ECM ground circuits. See appropriate wiring diagram in POWER DISTRIBUTION article in WIRING DIAGRAMS in appropriate MITCHELL\R manual. Repair as necessary. If ground circuits are okay, replace ECM with a known-good ECM and retest.

Unable To Refuel Or Difficult To Refuel:

* Check fuel Evaporation (EVAP) system. See FUEL EVAP SYSTEM TEST under EMISSION SYSTEMS & SUB-SYSTEMS in appropriate SYSTEM & COMPONENT TESTING article.

INTERMITTENTS

INTERMITTENT PROBLEM DIAGNOSIS

Intermittent fault testing requires duplicating circuit or component failure to identify the problem. These procedures may lead to computer setting a fault code which may help in diagnosis.

If problem vehicle does not produce fault codes, monitor voltage or resistance values using a DVOM while attempting to reproduce conditions causing intermittent fault. A status change on DVOM indicates a fault has been located.

Use a DVOM to pinpoint faults. When monitoring voltage, ensure ignition switch is in ON position or engine is running. Ensure

ignition switch is in OFF position or negative battery cable is disconnected when monitoring circuit resistance. Status changes on DVOM during test procedures indicate area of fault.

TEST PROCEDURES

Intermittent Simulation

To reproduce the conditions creating an intermittent fault, use the following methods:

* Lightly vibrate component. See VIBRATION METHOD.
* Heat component. See HEATING METHOD.
* Wiggle or bend wiring harness. See VIBRATION METHOD.
* Spray component with water. See WATER SPRINKLING METHOD.
* Remove vacuum from component.
* Apply vacuum to component.

Monitor circuit/component voltage or resistance while simulating intermittent. If engine is running, monitor for Diagnostic Trouble Codes (DTCs). Use test results to identify a faulty component or circuit.

VIBRATION METHOD

Wiring Harness Testing

Using DVOM, monitor suspected circuit or component. Lightly shake wiring harness while noting fluctuation in DVOM reading. Inspect component connector harness for stretched areas. Inspect wiring harness at area where it goes through the body.

Component, Relay & Sensor Testing

Using DVOM, monitor suspected circuit or component. Lightly vibrate suspected component, relay or sensor while noting fluctuation in DVOM reading.

Electrical Connector Testing

Using DVOM, monitor suspected circuit or component. Lightly shake electrical connector while noting fluctuation in DVOM reading. Visually inspect electrical connector for damage.

HEATING METHOD

Component Testing

Heat the suspected component with a hair dryer while checking for a malfunction to exist. DO NOT apply heat directly to the components in the Engine Control Module (ECM). DO NOT heat any component to more than 140°F (60°C).

WATER SPRINKLING METHOD

CAUTION: Ensure vehicle does not have any water leaks before using water sprinkling method. If water leak exists, use care when applying water that no water is sprayed directly on any electronic components.

Spray outside of vehicle and front of radiator with water while checking for a malfunction to exist. DO NOT spray water directly into engine compartment. The temperature and humidity may be changed by spraying water onto the front of the radiator. DO NOT directly spray electronic components with water.

I - SYSTEM/COMPONENT TESTS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
System & Component Testing - ES300 & RX300
LEXUS

INTRODUCTION

Before testing separate components or systems, perform procedures in BASIC DIAGNOSTIC PROCEDURES article. Since many computer-controlled and monitored components set a trouble code if they malfunction, also perform procedures in SELF-DIAGNOSTICS - INTRODUCTION article.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

AIR INDUCTION SYSTEMS

ACOUSTIC CONTROL INDUCTION SYSTEM (ACIS)

NOTE: All models are equipped with 2 Intake Air Control Valves (IACVs) and 2 ACIS Vacuum Switching Valves (VSVs). No. 1 IACV is located between the air intake chamber and No. 1 and 2 throttle bodies. No 2 IACV is located on front of air intake chamber. IACV VSVs are part of the emission control valve set and is located near air intake chamber.

Intake Air Control Valve

1) Locate ACIS Idle Air Control Valve (IACV) to be tested. No. 1 IACV is located between the air intake chamber and No. 1 and 2 throttle bodies. See Fig. 1. No 2 IACV is located on front of air intake chamber. See Fig. 2. Install a 3-way vacuum "T" fitting in vacuum hose between IACV actuator and ACIS Vacuum Switch Valve (VSV). Connect a vacuum gauge to vacuum "T" fitting. Start engine. With engine idling, ensure vacuum is not present. See Fig. 1 or 2.

2) Snap accelerator to Wide Open Throttle (WOT). Ensure vacuum reading momentarily reads about 7.9 in. Hg and IACV actuator rod moves. If vacuum is not as specified or actuator valve rod fails to move, go to next step.

3) Remove IACV. See AIR INDUCTION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Apply about 7.9 in. Hg to IACV actuator. If IACV actuator rod does not move, replace IACV actuator. If IACV actuator rod moves, check to see if diaphragm holds vacuum for at least one minute. If diaphragm does not hold vacuum, replace actuator. If diaphragm holds vacuum, check ACIS vacuum tank. See ACIS VACUUM TANK.

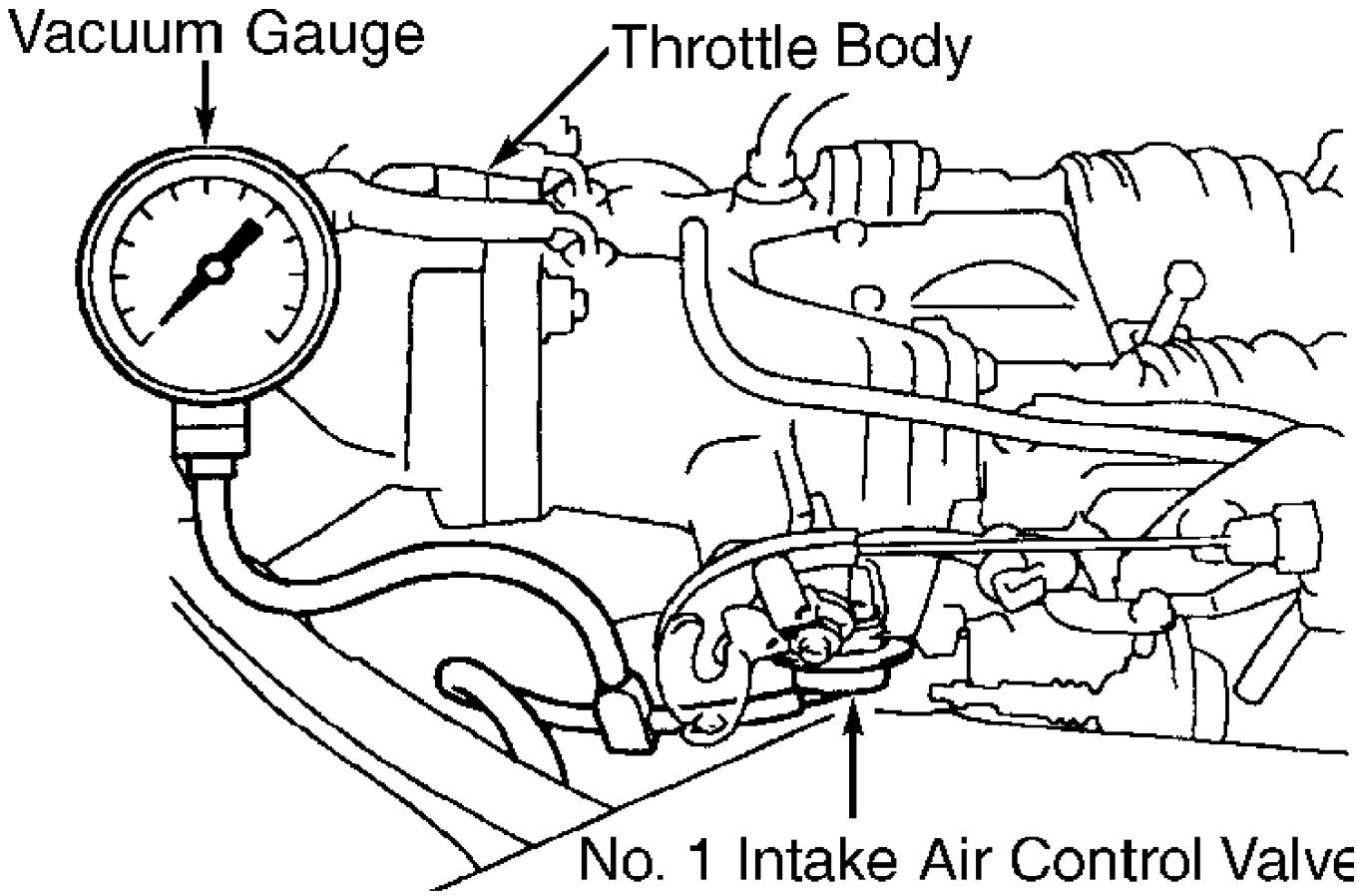


Fig. 1: Testing No. 1 Intake Air Control Valve (IACV) Operation
Courtesy of Toyota Motor Sales, U.S.A., Inc.

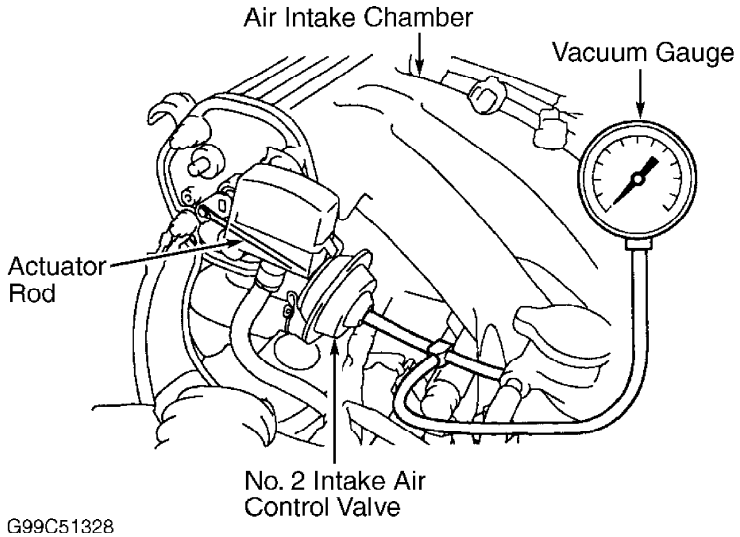


Fig. 2: Testing No. 2 Intake Air Control Valve (IACV) Operation
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ACIS Vacuum Tank

1) Disconnect vacuum hoses from vacuum tank. Vacuum tank is

located at left side of engine compartment, under battery tray. Apply air pressure to port "B" on vacuum tank. Ensure air flows from port "A". Perform STEP 1. See Fig. 3. Apply air pressure to port "A". Ensure air does not flow from port "B". Perform STEP 2. See Fig. 3. Go to next step.

2) Plug port "B" on vacuum tank. Using vacuum pump, apply 7.9 in. Hg of vacuum to port "A". Perform STEP 3. See Fig. 3. Ensure vacuum reading will hold for at least one minute. Replace vacuum tank if defective and recheck system operation. If vacuum tank is okay, reconnect vacuum hoses. Check ACIS vacuum switching valve. See ACIS VACUUM SWITCHING VALVE.

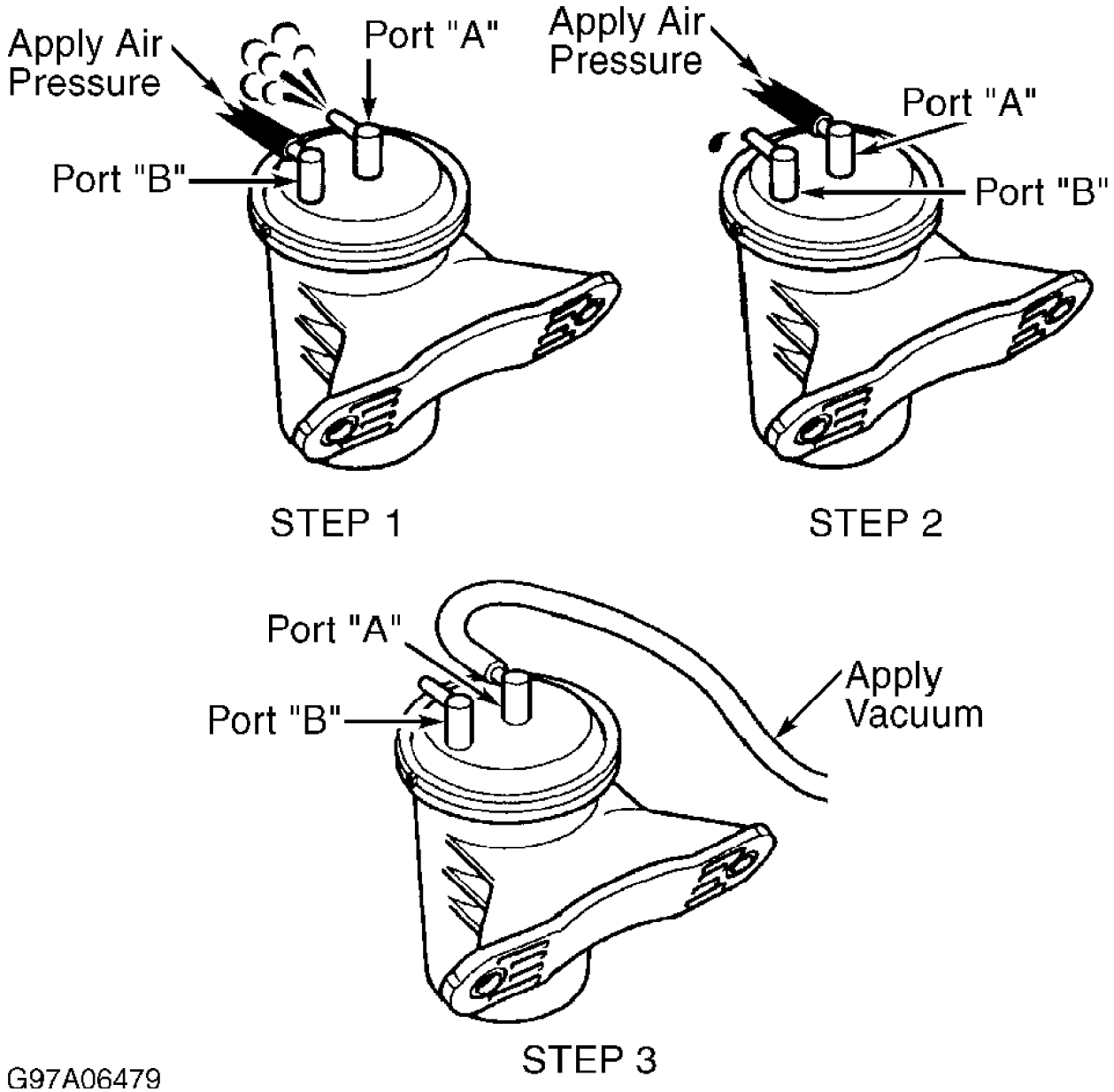


Fig. 3: Testing Vacuum Tank
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ACIS Vacuum Switching Valve

1) Remove engine cover and wire harness cover. Remove

emission control valve set. See Fig. 4. Disconnect vacuum hoses and electrical connector from ACIS Vacuum Switching Valve (VSV).

2) Remove VSV if necessary. Measure resistance between VSV terminals. If resistance is not 33-39 ohms at 68°F (20°C), replace ACIS VSV. If resistance is 33-39 ohms at 68°F (20°C), check for continuity between VSV case and each terminal at VSV connector (this checks for an internal short). If continuity does not exist, go to next step. If continuity exists, replace VSV.

3) Apply compressed air to VSV port "E". See Fig. 5. Air should flow out of filter, but not out of port "F". Using jumper wires, apply 9-14 volts and ground to VSV terminals. Apply compressed air to VSV port "E". Air should flow out of port "F", but not out of filter. If ACIS VSV does not function as specified, replace ACIS VSV.

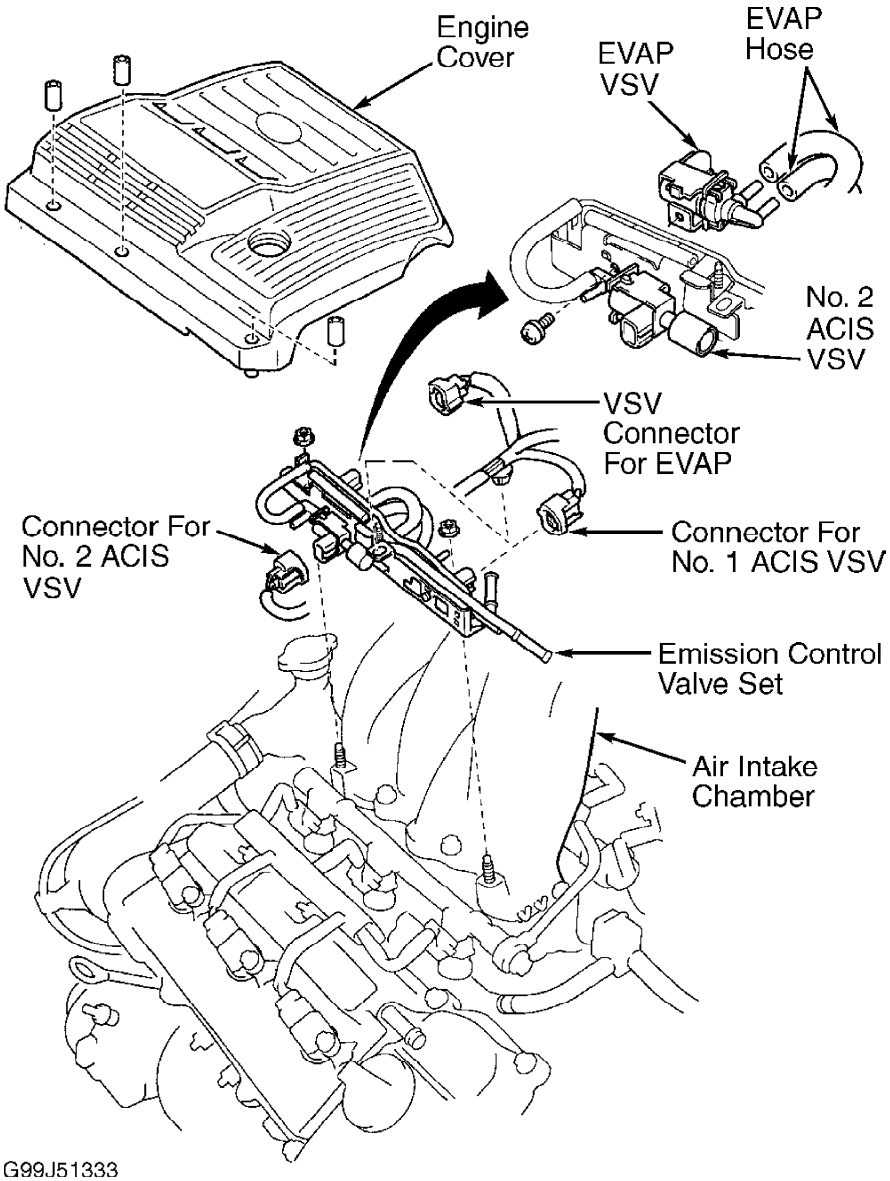


Fig. 4: Locating Vacuum Switching Valves
Courtesy of Toyota Motor Sales, U.S.A., Inc.

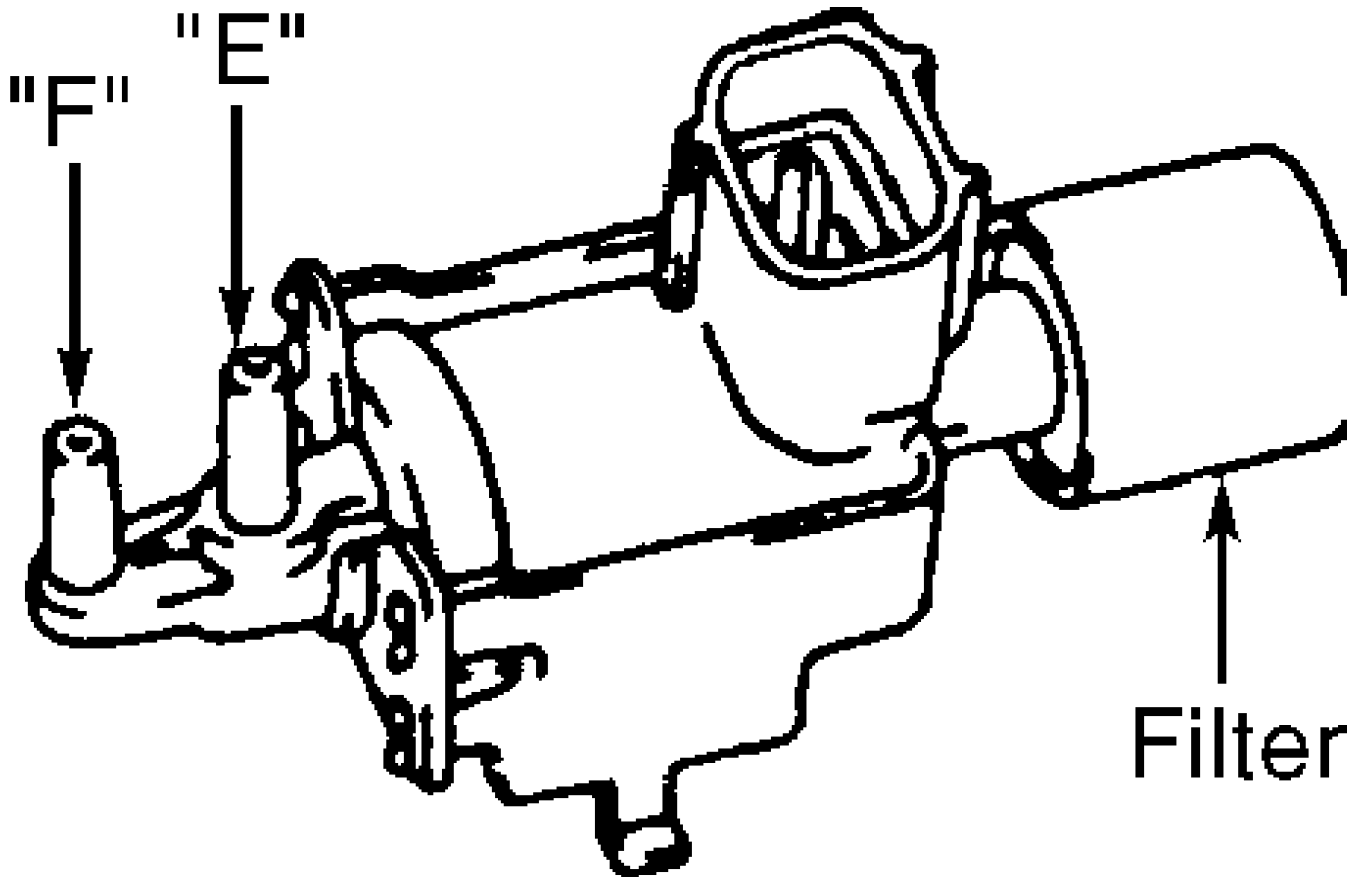


Fig. 5: Identifying ACIS Vacuum Switching Valve (VSV) Vacuum Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

COMPUTERIZED ENGINE CONTROLS

ECM BACK-UP POWER CIRCUIT (BATTERY)

If circuit or components are faulty, a Diagnostic Trouble Code (DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

ECM POWER SOURCE CIRCUIT (IGNITION KEYED)

CAUTION: If ECM replacement is instructed during any test procedures, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

When ignition switch is turned on, 9-14 volts is applied to the terminal IGSW at ECM main relay control circuit, sending a signal to terminal M-REL at ECM switching EFI main relay on. When ignition is turned off, ECM will keep EFI main relay on for 2 seconds or less in

order to reset Idle Air Control (IAC) valve.

ES300

1) Access ECM behind glove box. Turn ignition on. Backprobing connector, connect DVOM negative lead to terminal No. 17 (Brown wire) at ECM E10 connector and positive lead to terminal No. 16 (Black/Yellow wire) at ECM E7 connector. See Fig. 6. If 9-14 volts is present, ECM power circuit is okay. Diagnose by symptom. See TROUBLE SHOOTING - NO CODES article. If 9-14 volts is not present, go to next step.

2) Check for an open circuit in Brown wire between ground and terminal 17 at ECM E10 connector. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, go to next step.

3) Measure voltage between chassis ground and terminal No. 2 (Black/Red wire) at ECM E7 connector. If 9-14 volts is present, go to step 5). If 9-14 volts is not present, check IGN fuse in instrument panel junction box under left side of instrument panel.

4) If fuse is blown, repair cause of blown fuse. If fuse is okay, check ignition switch. See STEERING COLUMN SWITCHES article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual. Replace ignition switch as necessary and retest. If ignition switch is okay, repair open circuit between battery and ignition switch, or between ignition switch and ECM.

5) Turn ignition on. Measure voltage between chassis ground and terminal 8 (Black/White wire) at ECM E7 connector. If 9-14 volts is not present, replace ECM. If 9-14 volts is present, check EFI fuse located in engine compartment fuse/relay box at left front of engine compartment. If fuse is okay, go to next step. If EFI fuse is blown, repair cause of blown fuse.

6) Check EFI main relay located in engine compartment fuse/relay box at left front of engine compartment. See RELAYS under RELAYS & SOLENOIDS. If EFI main relay is okay, check circuit between chassis ground and terminal No. 8 at ECM E7 connector. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If circuit is okay, repair circuit between battery and EFI fuse.

RX300

1) Access ECM behind glove box. Turn ignition on. Backprobing connector, connect DVOM negative lead to terminal No. 17 (Brown wire) at ECM E6 connector and positive lead to terminal No. 16 (Blue/White wire) at ECM E8 connector. See Fig. 7. If 9-14 volts is present, ECM power circuit is okay. Diagnose by symptom. See TROUBLE SHOOTING - NO CODES article. If 9-14 volts is not present, go to next step.

2) Check for an open circuit in Brown wire between ground and terminal 17 at ECM E6 connector. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, go to next step.

3) Measure voltage between chassis ground and terminal No. 2 (Black/Orange wire) at ECM E8 connector. If 9-14 volts is present, go to step 5). If 9-14 volts is not present, check IGN fuse in instrument panel junction box under left side of instrument panel.

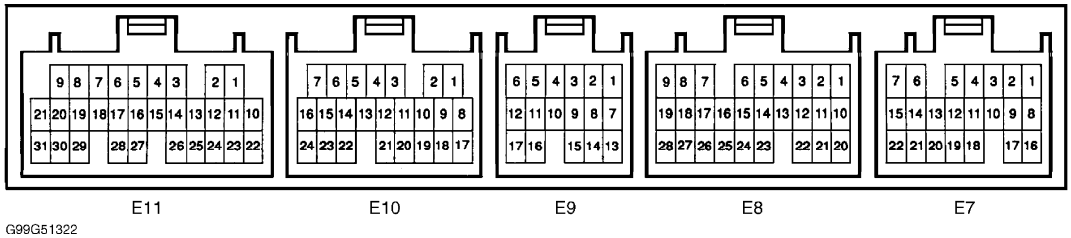
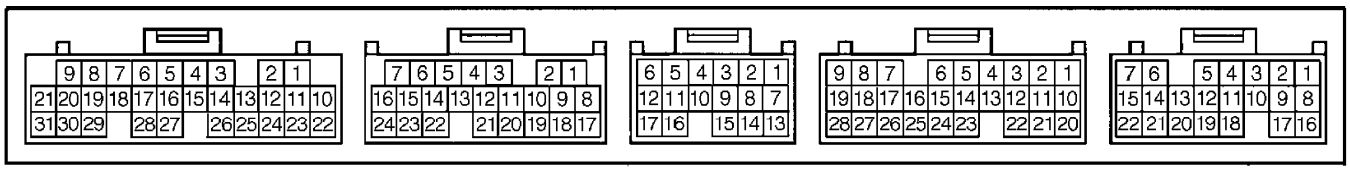


Fig. 6: Identifying Electronic Control Module (ECM) Connector Terminals (ES300)

Courtesy of Toyota Motor Sales, U.S.A., Inc.



G99F51321

Fig. 7: Identifying Electronic Control Module (ECM) Connector Terminals (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

4) If fuse is blown, repair cause of blown fuse. If fuse is okay, check ignition switch. See STEERING COLUMN SWITCHES article in ACCESSORIES & EQUIPMENT in appropriate MITCHELL\R manual. Replace ignition switch as necessary and retest. If ignition switch is okay, repair open circuit between battery and ignition switch, or between ignition switch and ECM.

5) Turn ignition on. Measure voltage between chassis ground and terminal 8 (Black/White wire) at ECM E8 connector. If 9-14 volts is not present, replace ECM. If 9-14 volts is present, check EFI fuse located in engine compartment fuse/relay box at left front of engine compartment. If fuse is okay, go to next step. If EFI fuse is blown, repair cause of blown fuse.

6) Check EFI main relay located in engine compartment fuse/relay box at left front of engine compartment. See RELAYS under RELAYS & SOLENOIDS. If EFI main relay is okay, check circuit between chassis ground and terminal No. 8 at ECM E8 connector. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If circuit is okay, repair circuit between battery and EFI fuse.

STARTER SIGNAL CIRCUIT

CAUTION: If ECM replacement is instructed during any test procedures, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Circuit Description

When engine is being cranked, intake air flow is slow, so fuel vaporization is poor. A rich mixture is necessary to achieve good startability. While engine is being cranked, 9-14 volts is supplied to ECM terminal STA. Starter signal is mainly used to increase fuel injection pulse for starting injection control and after-start injection control.

NOTE: The following test assumes starter cranks normally with ignition in START position. If starter does not crank normally, check and repair starter circuit before continuing with this test.

Diagnosis & Repair (Using Lexus Scan Tool)

1) Connect Lexus scan tool to Data Link Connector (DLC) No. 3. See Fig. 8. Turn scan tool on. Turn ignition on. Using scan tool, read STA signal with ignition on and then while cranking starter.

2) With ignition on, STA signal should be off. With ignition switch in START position, STA signal should be on. If STA signal is

not as specified, go to next step. If STA signal is as specified, no problem is indicated at this time. Diagnose by symptom. See TROUBLE SHOOTING - NO CODES article.

3) Check for open in wiring harness between ECM and starter relay. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest.

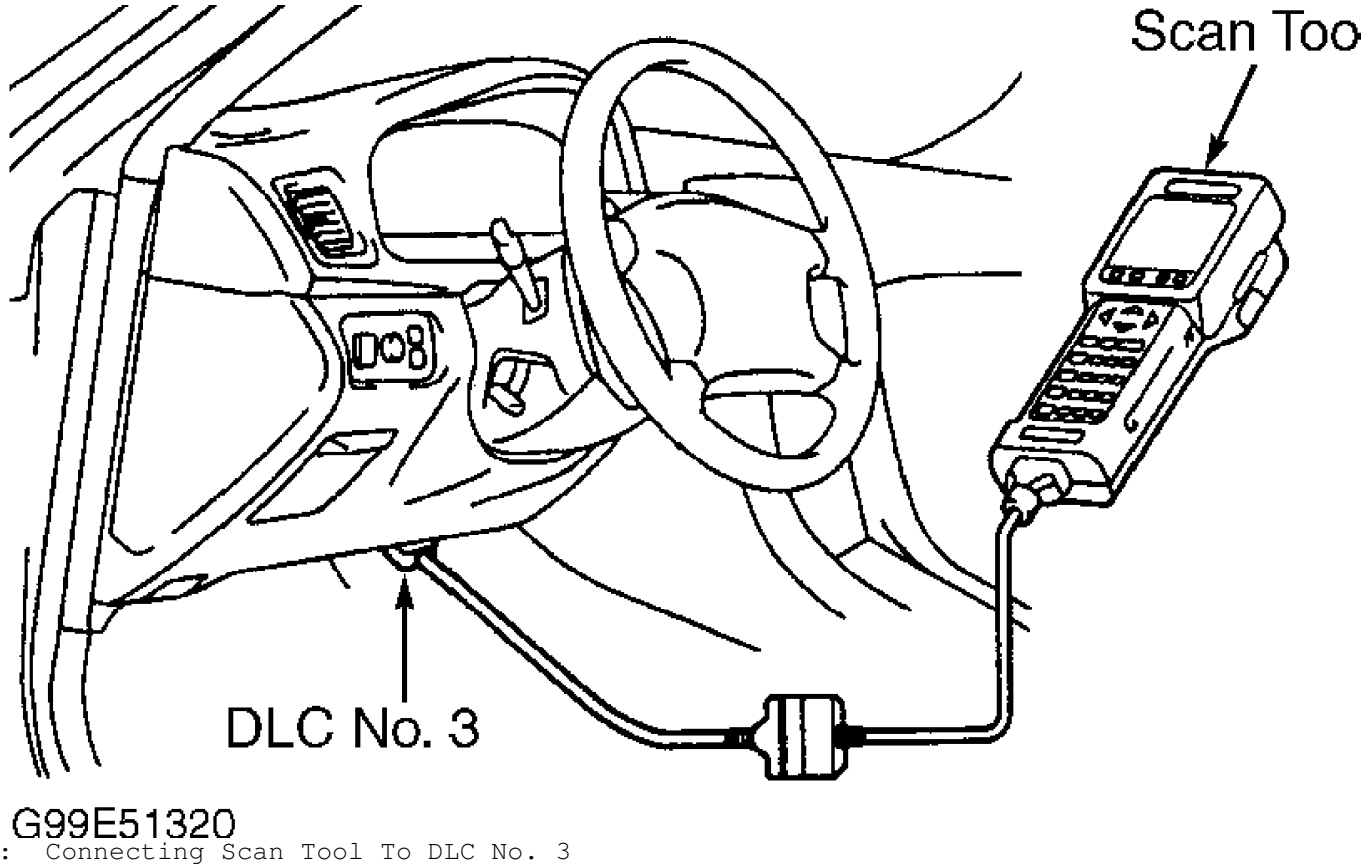


Fig. 8: Connecting Scan Tool To DLC No. 3
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Diagnosis & Repair (Using OBD-II Scan Tool) - ES300

1) Access ECM harness connectors behind glove box. Backprobing ECM harness connector, measure voltage between ground and terminal No. 7 (Gray wire) STA at ECM E7 connector. See Fig. 6.

2) Turn ignition switch to START position. With starter being cranked, voltage should be 6 volts or more. If voltage is not as specified, go to next step. If voltage is as specified, no problem is indicated at this time. Diagnose by symptom. See TROUBLE SHOOTING - NO CODES article.

3) Check for open in wiring harness between ECM and starter relay. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest.

Diagnosis & Repair (Using OBD-II Scan Tool) - RX300

1) Access ECM harness connectors behind glove box. Backprobing ECM harness connector, measure voltage between ground and terminal No. 7 (Black wire) STA at ECM E8 connector.Fig. 7.

2) Turn ignition switch to START position. With starter being cranked, voltage should be 6 volts or more. If voltage is not as specified, go to next step. If voltage is as specified, no problem is indicated at this time. Diagnose by symptom. See TROUBLE SHOOTING - NO CODES article.

3) Check for open in wiring harness between ECM and starter relay. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest.

ENGINE SENSORS & SWITCHES

AIR/FUEL RATIO (A/F) SENSOR HEATER RESISTANCE

NOTE: Bank No. 1 refers to bank which includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. A/F sensor refers to sensor No. 1 in exhaust manifold/pipe in front of catalytic converter.

Disconnect A/F sensor connector to be tested. Measure resistance between terminals B+ and HT of A/F sensor connector. See Fig. 9. Resistance should be .8-1.4 ohms at 68°F (20°C) or 1.8-3.2 ohms at 1472°F (800°C). Replace A/F sensor if resistance is not as specified.

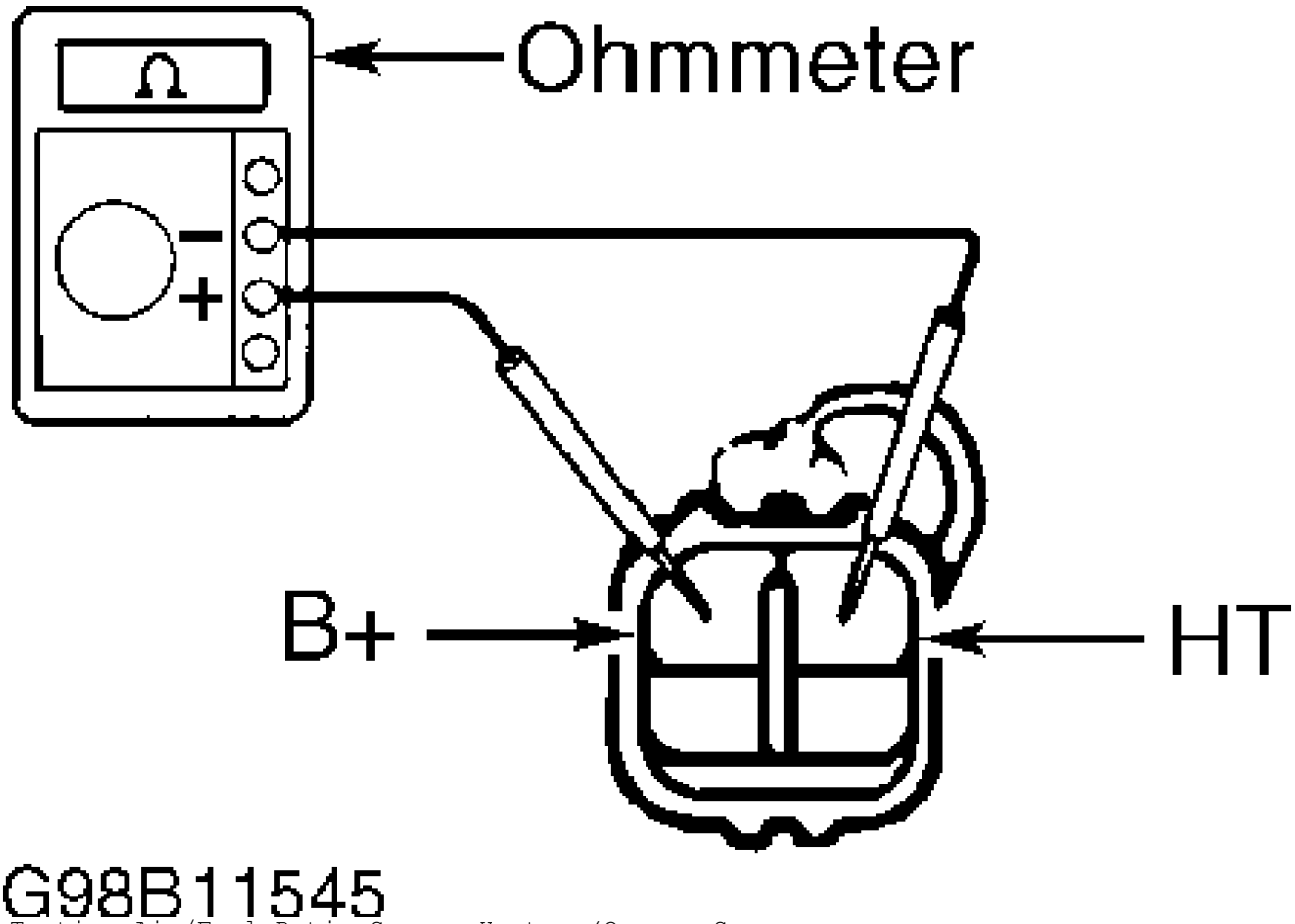


Fig. 9: Testing Air/Fuel Ratio Sensor Heater (Oxygen Sensor Heater Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CAMSHAFT POSITION SENSOR

Camshaft Position (CMP) sensor is also referred to as Variable Valve Timing (VVT) sensor. For VVT sensor testing, see

VARIABLE VALVE TIMING SENSOR.

CRANKSHAFT POSITION SENSOR

The Crankshaft Position Sensor (CKP) sensor is a pick-up coil and is mounted next to crankshaft pulley. Turn ignition off. Disconnect CKP sensor connector. Measure resistance between CKP sensor terminals. Replace CKP sensor if resistance is not as specified. See CRANKSHAFT POSITION SENSOR RESISTANCE table.

CRANKSHAFT POSITION SENSOR RESISTANCE

Temperature °F (°C)	Ohms
14-122 (-10-50)	1630-2740
123-212 (51-100)	2065-3225

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

1) Ensure ignition is off. Note location of ECT sensor. See ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOCATION table. Remove ECT sensor.

2) Place probe end of ECT sensor and thermometer in container of water. Attach ohmmeter between ECT sensor terminals. Heat water and note that resistance is within specification in relation to temperature. See Fig. 10. Replace ECT sensor if resistance is not within specification.

3) Using NEW gasket, install ECT sensor. Tighten ECT sensor to 15 ft. lbs. (20 N.m). Fill cooling system.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOCATION

Model	Location
ES300	On Coolant Housing In Front Of Intake Manifold, At Timing Belt End Of Engine & Contains Dark Gray 2-Pin Electrical Connector With Green/Black & Red Wires
RX300	On Coolant Housing In Front Of Intake Manifold, At Timing Belt End Of Engine & Contains Dark Gray 2-Pin Electrical Connector With Green/White & Brown Wires

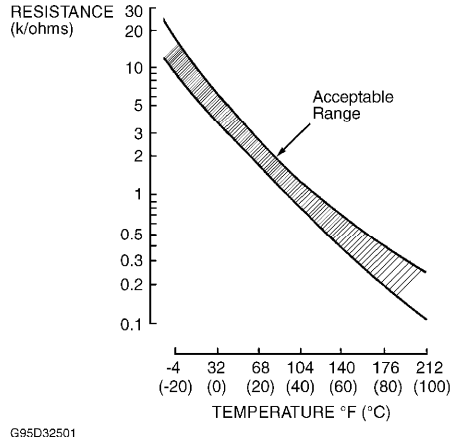


Fig. 10: Testing Engine Coolant Temperature (ECT) Sensor
Courtesy of Toyota Motor Sales, U.S.A., Inc.

HEATED OXYGEN SENSOR HEATER RESISTANCE

NOTE: Bank No. 1 refers to bank that includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. Sensor No. 1 refers to sensor closest to engine block. Sensor No. 2 refers to sensor furthest away from engine block.

On ES300, bank No. 1 sensor No. 2 connector is located under driver's seat carpet, next to center counsel. Remove drivers's seat to access connector. On RX300, bank No. 1 sensor No. 2 connector is located under passenger's seat. Remove passenger's seat to access connector. On all models, disconnect oxygen sensor connector. Measure resistance between terminals B+ and HT at oxygen sensor connector. See Fig. 9. Replace oxygen sensor if resistance is not 11.0-16.0 ohms.

HEATED OXYGEN SENSOR OPERATION

If circuit or component is faulty, a Diagnostic Trouble Code (DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

INTAKE AIR TEMPERATURE (IAT) SENSOR

IAT Sensor Resistance

On all models, IAT sensor is part of Mass Airflow (MAF) sensor. Turn ignition off. Disconnect MAF sensor connector. Measure resistance between MAF sensor terminals THA and E2. See Fig. 11. Replace MAF sensor if resistance is not as specified. See INTAKE AIR TEMPERATURE (IAT) SENSOR RESISTANCE table.

INTAKE AIR TEMPERATURE (IAT) SENSOR RESISTANCE

Ambient Temperature °F (°C)	Ohms
-4 (-20)	13,600-18,400
68 (20)	2210-2690
140 (60)	493-667

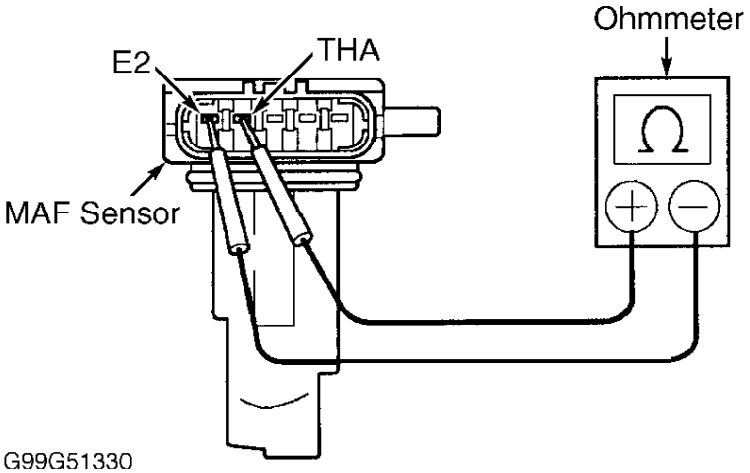


Fig. 11: Measuring IAT Sensor Resistance At MAF Sensor (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

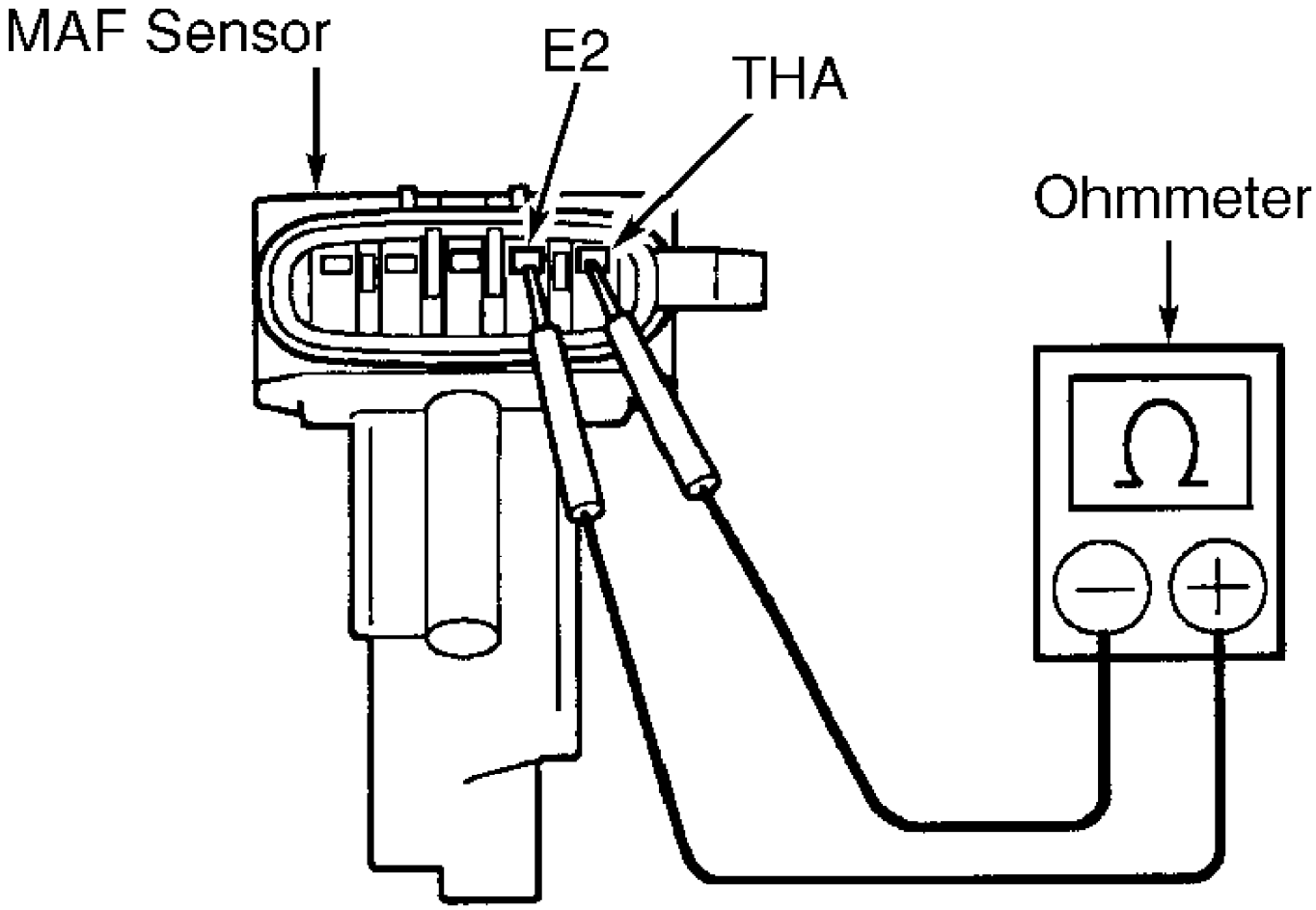


Fig. 12: Measuring IAT Sensor Resistance At MAF Sensor (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

KNOCK SENSOR

Remove knock sensor. See KNOCK SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article. Check for continuity between knock sensor terminal and knock sensor body (hex portion). If continuity does not exist, knock sensor is okay. If continuity exists, replace knock sensor.

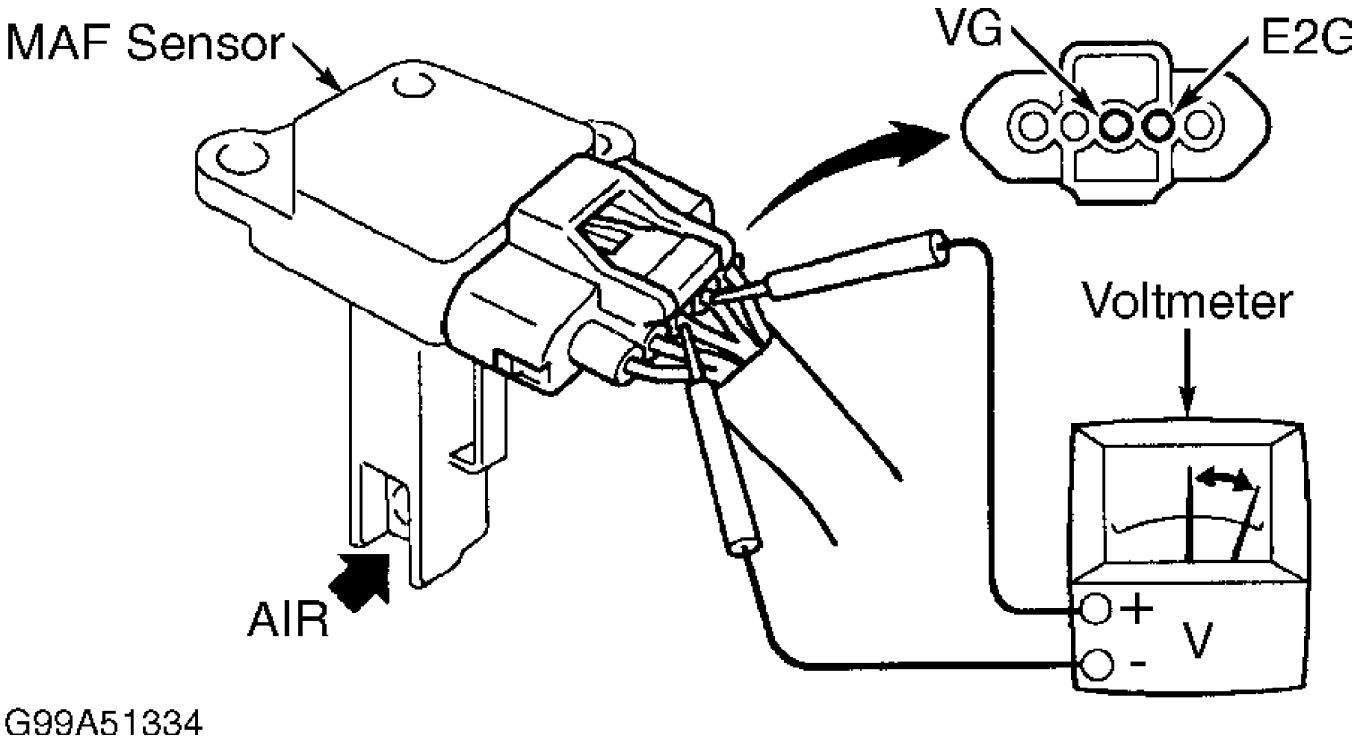
MASS AIRFLOW (MAF) SENSOR

MAF Sensor Resistance

Disconnect MAF sensor connector. Measure resistance between MAF sensor terminals THA and E2 at MAF sensor. See Fig. 11 or 12. Resistance should be as specified. See INTAKE AIR TEMPERATURE (IAT) SENSOR RESISTANCE table. If resistance is not as specified, replace MAF sensor.

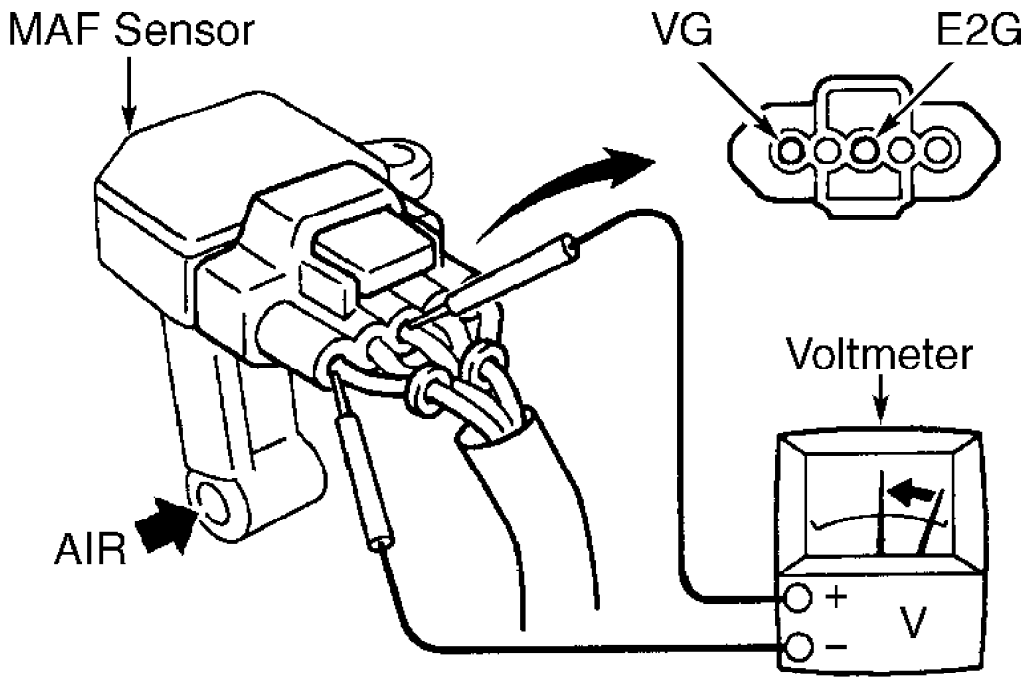
MAF Sensor Voltage

Leave MAF sensor connector attached. Turn ignition on. Backprobing, connect voltmeter positive lead to terminal VG and negative lead to terminal E2G at MAF sensor connector. See Fig. 13 or 14. Apply compressed air to MAF sensor. If voltage does not fluctuate while applying compressed air to MAF sensor, replace MAF sensor.



G99A51334

Fig. 13: Testing Mass Airflow (MAF) Sensor (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



99B51335

Fig. 14: Testing Mass Airflow (MAF) Sensor (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARK/NEUTRAL POSITION (PNP) SWITCH

1) If PNP switch is out of adjustment, voltage signals may not be correctly applied to ECM, causing a Diagnostic Trouble Code (DTC) to set. Before assuming PNP switch is faulty, adjust PNP switch. See PARK/NEUTRAL POSITION (PNP) SWITCH under MISCELLANEOUS CONTROLS in ON-VEHICLE ADJUSTMENTS article.

2) After switch adjustment is completed, recheck for codes. If DTC does not reset, PNP switch is okay. If DTC resets, remove PNP switch. Check for continuity between specified terminals of PNP switch. See PNP SWITCH CONTINUITY table. See Fig. 15. If continuity is not as specified, replace PNP switch. If continuity is as specified, install and adjust PNP switch.

PNP SWITCH CONTINUITY

Application & Switch Position	Terminals
P	2 & 7; 5 & 6
R	2 & 8
N	2 & 9; 5 & 6
D	2 & 10
2	2 & 3
L	2 & 4

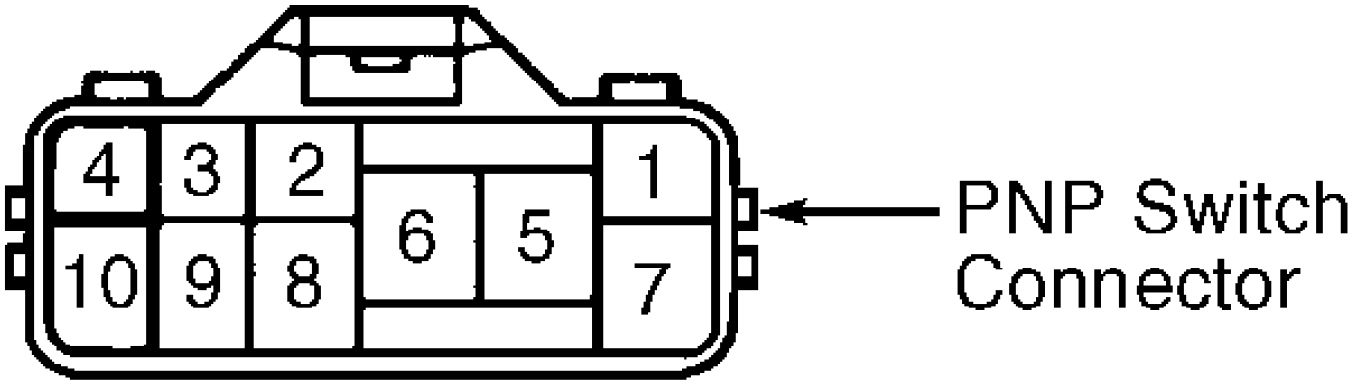


Fig. 15: Identifying PNP Switch Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

PARK/NEUTRAL POSITION (PNP) SWITCH CIRCUIT

If circuit or component is faulty, a Diagnostic Trouble Code (DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

THROTTLE POSITION (TP) SENSOR

1) Turn ignition off. Ensure throttle linkage moves smoothly. Ensure throttle lever is adjusted properly. See THROTTLE BODY LEVER ADJUSTMENT in ON-VEHICLE ADJUSTMENTS article. Disconnect electrical connector from Throttle Position (TP) sensor on throttle body. Disconnect vacuum hose from throttle body. See Fig. 16. Connect a vacuum pump to disconnected vacuum hose and apply vacuum.

2) Using ohmmeter, check resistance between specified terminals in relation to throttle position. With throttle fully closed, resistance between terminals VTA and E2 should be 200-6300 ohms. See Fig. 16. With throttle fully open, resistance between

terminals VAT and E2 should be 2000-10,200 ohms. Resistance between terminals VC and E2 should be 2500-5900 ohms. If resistance is not as specified, replace TP sensor.

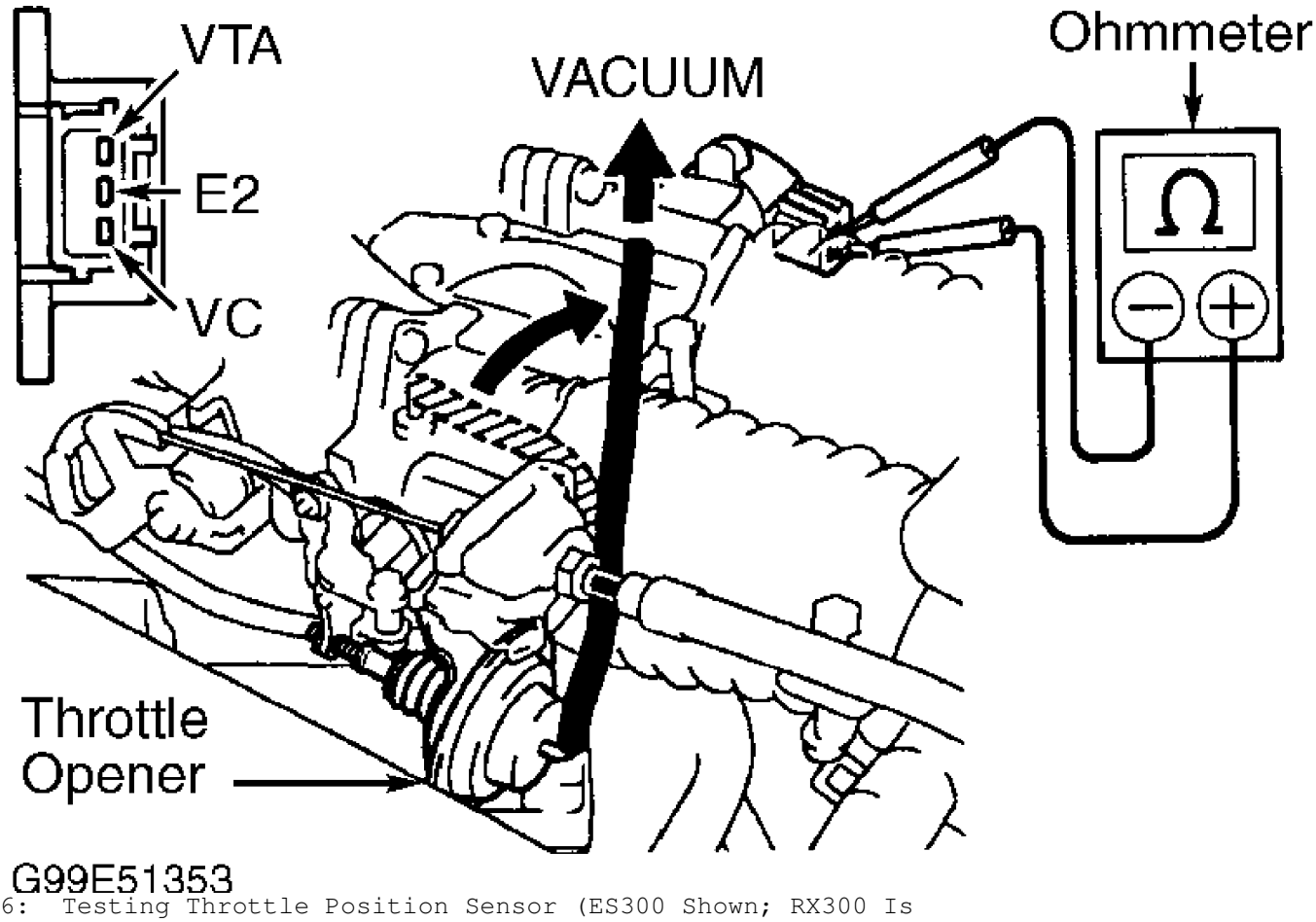


Fig. 16: Testing Throttle Position Sensor (ES300 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

VAPOR PRESSURE SENSOR

For vapor pressure sensor testing, see VAPOR PRESSURE SENSOR CIRCUIT (ALL MODELS) under FUEL EVAPORATION SYSTEM.

VARIABLE VALVE TIMING SENSOR

NOTE: Variable Valve Timing (VVT) sensor may also be referred to as a Camshaft Position (CMP) sensor.

One Variable Valve Timing (VVT) sensor is mounted in outer corner of each cylinder head, just below valve cover (oil filler cap end). Remove engine cover. Disconnect VVT sensor 2-pin connector. Measure resistance between VVT sensor terminals. Resistance should be 835-1400 ohms at 14-122°F (-10-50°C), or 1060-1645 ohms at 123-212°F (51-100°C). Replace VVT sensor if resistance is not as specified.

VEHICLE SPEED SENSOR (VSS)

If a VSS circuit fault is present, a Diagnostic Trouble Code

(DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

RELAYS & SOLENOIDS

RELAYS

NOTE: For cooling fan relay testing, see appropriate article in ENGINE COOLING in appropriate MITCHELL\R manual.

Air/Fuel (A/F) HTR Relay, Circuit Opening Relay, EFI Main Relay Or Starter Relay

1) Remove relay to be tested. On RX300, circuit opening relay may be located in fuse/relay box on left side of engine compartment or relay box under left side of instrument panel. On ES300, circuit opening relay is located in fuse/relay box on left side of engine compartment. On all models, A/F HTR relay, EFI main relay and starter relay are located in the main fuse/relay box on left side of engine compartment.

2) Check for continuity between relay terminals No. 1 and 2. See Fig. 17 or 18. Continuity should exist. Check for continuity between relay terminals No. 3 and 5. Continuity should not exist.

3) Using jumper wires, apply battery voltage across relay terminals No. 1 and 2. Check for continuity between relay terminals No. 3 and 5 with relay energized. Continuity should exist. If continuity is not as specified, replace relay.

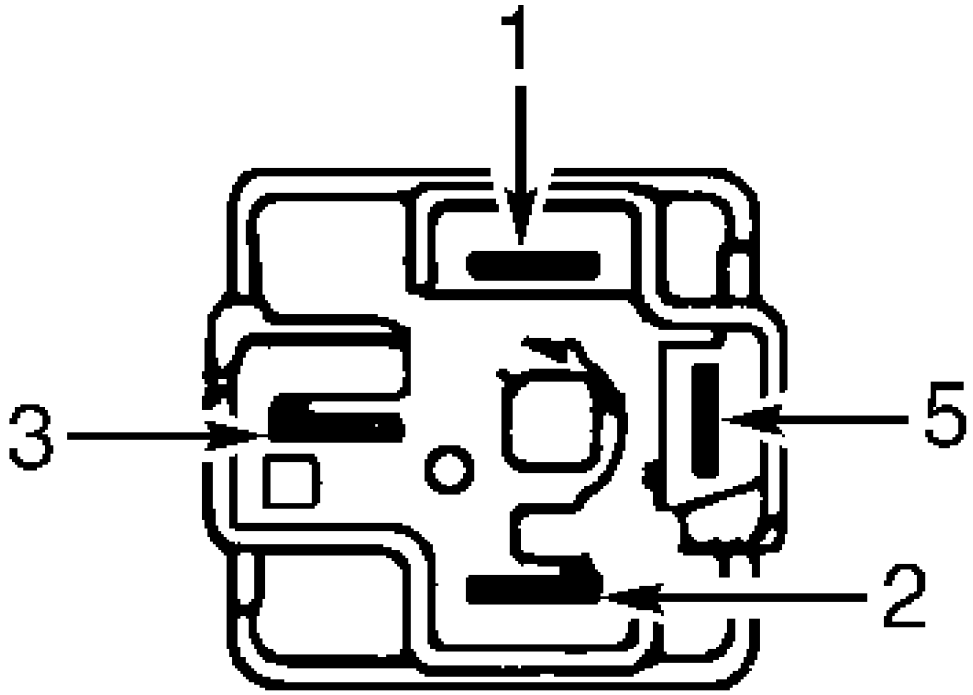
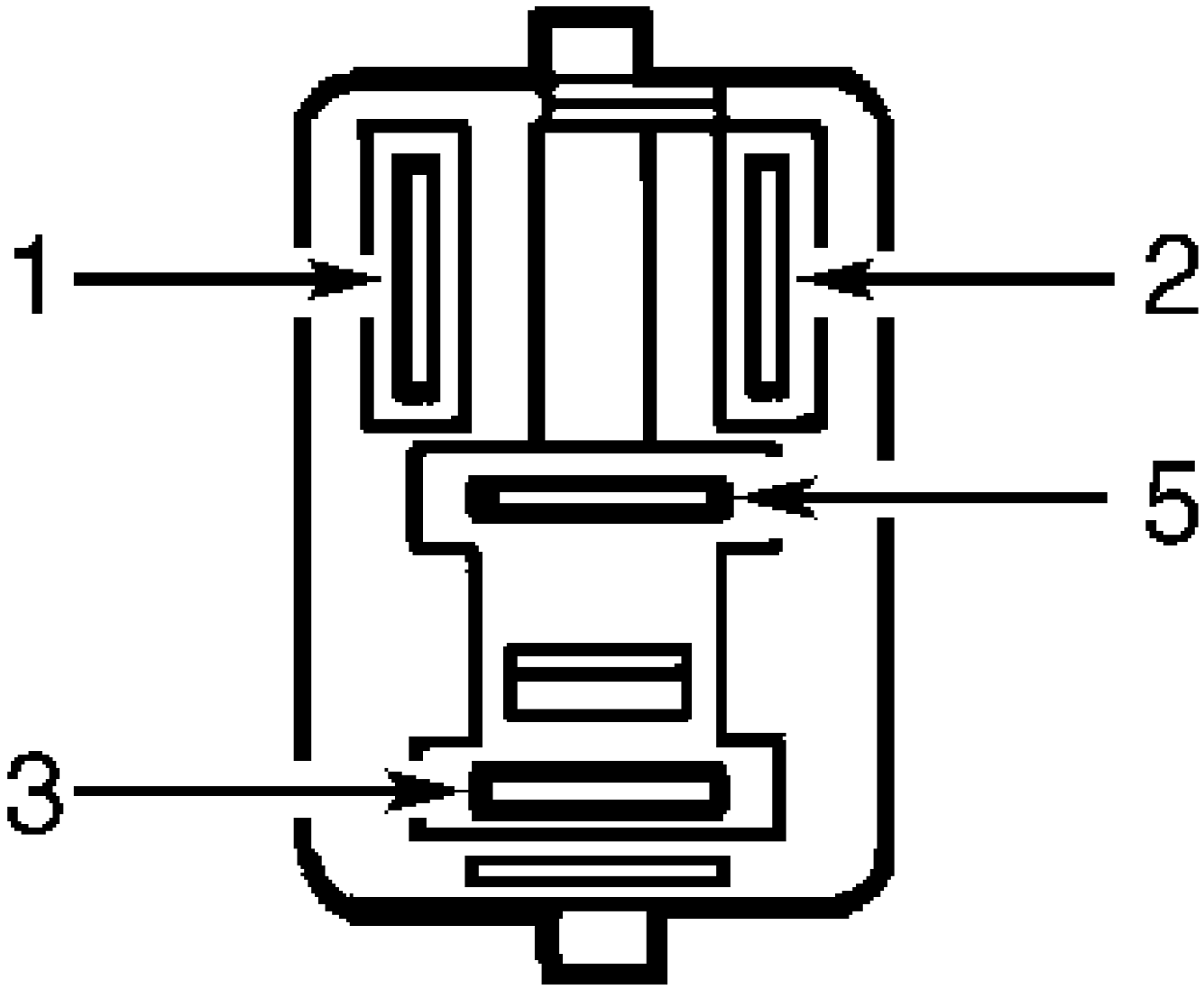


Fig. 17: Identifying Starter Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.



G97A06177

Fig. 18: Identifying A/F HTR Relay, Circuit Opening Relay & EFI Main Relay Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

SOLENOIDS

ACIS Vacuum Switching Valve
See ACOUSTIC CONTROL INDUCTION SYSTEM (ACIS) under AIR INDUCTION SYSTEMS.

EVAP Vacuum Switching Valve
See EVAP VACUUM SWITCHING VALVE (ALL MODELS) under FUEL EVAPORATION SYSTEM.

Fuel Injectors
See FUEL CONTROL under FUEL SYSTEM.

Vapor Pressure Sensor Vacuum Switching Valve

See VAPOR PRESSURE SENSOR VACUUM SWITCHING VALVE (ALL MODELS) under FUEL EVAPORATION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Fuel Pump Operation (Using Lexus Scan Tool)

1) Connect Lexus scan tool to Data Link Connector (DLC) No. 3. See Fig. 8. Turn ignition on. Turn scan tool on. DO NOT start engine.

2) Select ACTIVE TEST mode on scan tool. Using Lexus scan tool manufacturer's instructions, activate electric fuel pump. Fuel pump is operating if fuel pump operating sound can be heard or pulsations can be felt in fuel line near fuel rail.

3) If fuel pump does not operate, check for faulty fusible link/fuses. See appropriate wiring diagram in WIRING DIAGRAMS article. Check for faulty EFI main relay in fuse/relay box at left front of engine compartment. Check for faulty fuel pump, ECM or poor wiring connections.

Fuel Pump Operation (Using Battery Voltage)

1) Remove rear seat cushion. Remove fuel pump access cover. Remove floor service hole cover. Disconnect 5-pin connector from fuel pump and sending unit assembly. Connect a fused jumper wire between fuel pump connector terminal No. 5 and ground. See Fig. 19.

2) Connect one end of second fused jumper wire to fuel pump connector terminal No. 4 first and then connect other end of fused jumper wire to battery voltage. Do not apply battery voltage to fuel pump for more than 10 seconds.

3) Fuel pump is operating if fuel pump operating sound can be heard or pulsations can be felt in fuel line near fuel rail. If fuel pump does not operate, replace fuel pump.

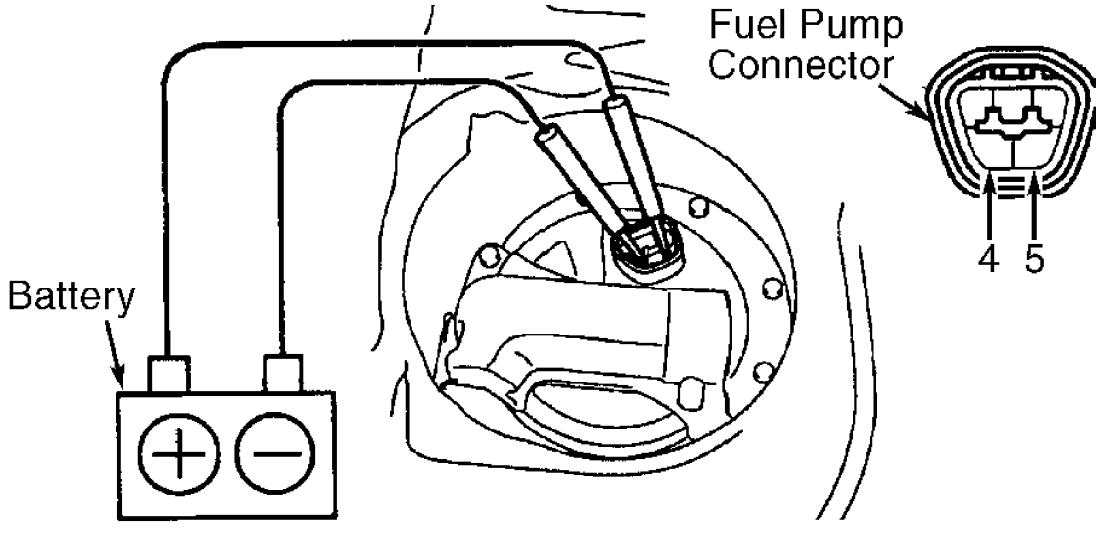


Fig. 19: Testing Fuel Pump
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pump Resistance

Remove rear seat cushion. Remove floor service hole cover.

Disconnect 5-pin connector from fuel pump and sending unit assembly. Measure resistance between 5-pin fuel pump and sending unit connector terminals No. 4 and 5. See Fig. 19. Replace fuel pump if resistance is not 0.2-3.0 ohms at 68°F (20°C).

CAUTION: If ECM replacement is instructed, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair as necessary and repeat testing to confirm ECM malfunction.

Fuel Pump Control Circuit

1) Check fuel pump operation. See FUEL PUMP OPERATION (USING LEXUS SCAN TOOL) or FUEL PUMP OPERATION (USING BATTERY VOLTAGE). If fuel pump does not operate, go to next step. If fuel pump operates, check starter signal circuit. See STARTER SIGNAL CIRCUIT under COMPUTERIZED ENGINE CONTROLS. Repair as necessary.

2) Check ECM power source circuit. See ECM POWER SOURCE CIRCUIT (IGNITION KEYED) under COMPUTERIZED ENGINE CONTROLS. Repair as necessary. If circuit is okay, go to next step.

3) Check circuit opening relay. See RELAYS under RELAYS & SOLENOIDS. Replace circuit opening relay as necessary. If relay is okay, access ECM connectors behind glove compartment. Turn ignition on. On ES300, backprobing connector, measure voltage between chassis ground and terminal No. 3 (Green/Red wire) at ECM E7 connector. See Fig. 6. On RX300, backprobing connector, measure voltage between chassis ground and terminal No. 3 (Blue/Yellow wire) at ECM E8 connector. See Fig. 7.

4) On all models, if battery voltage is not present, check for an open circuit in wiring harness between EFI main relay and circuit opening relay or between opening relay and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Replace as necessary. If battery voltage is present, go to next step.

5) Check fuel pump. See FUEL PUMP RESISTANCE. Replace fuel pump as necessary. If fuel pump is okay, check for an open circuit in wiring harness between circuit opening relay and fuel pump or between fuel pump and ground. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM and retest.

Fuel Pump Pressure

To check fuel pump pressure, see FUEL SYSTEM in BASIC DIAGNOSTIC PROCEDURES article.

Fuel Pressure Regulator

All models use a returnless fuel system and is not equipped with a fuel pressure regulator on fuel rail. Fuel pressure regulator is mounted to fuel pump assembly and is located in fuel tank. To check in tank fuel pressure regulator, perform FUEL PRESSURE test under FUEL SYSTEM in BASIC DIAGNOSTIC PROCEDURES article.

FUEL CONTROL

Fuel Injector Circuit

If circuit or component is faulty, a Diagnostic Trouble Code (DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

Fuel Injector Operation

Remove engine cover. Using a stethoscope, listen for clicking from each injector (or feel injector for vibration using a screwdriver) with engine running or cranking. If clicking is not heard, check for loose connection at fuel injector connector or fuel injector resistance. See FUEL INJECTOR RESISTANCE. If fuel injector is

okay, check for no voltage signal at suspect injector connector.

Fuel Injector Resistance

Remove engine cover. Turn ignition off. Disconnect appropriate injector connector. Measure resistance between injector terminals. Resistance should be about 13.4-14.2 ohms at 68°F (20°C). If resistance is not about 13.4-14.2 ohms at 68°F (20°C), replace injector.

Fuel Injector Volume (ES300)

1) Remove fuel injector. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Fuel injector is connected to fuel filter for checking fuel injector volume. Remove fuel pipe clamp from No. 1 fuel pipe at fuel filter. Perform STEP 1. See Fig. 20. Ensure area around No. 1 fuel pipe and fuel filter is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel filter. Perform STEP 2. See Fig. 20.

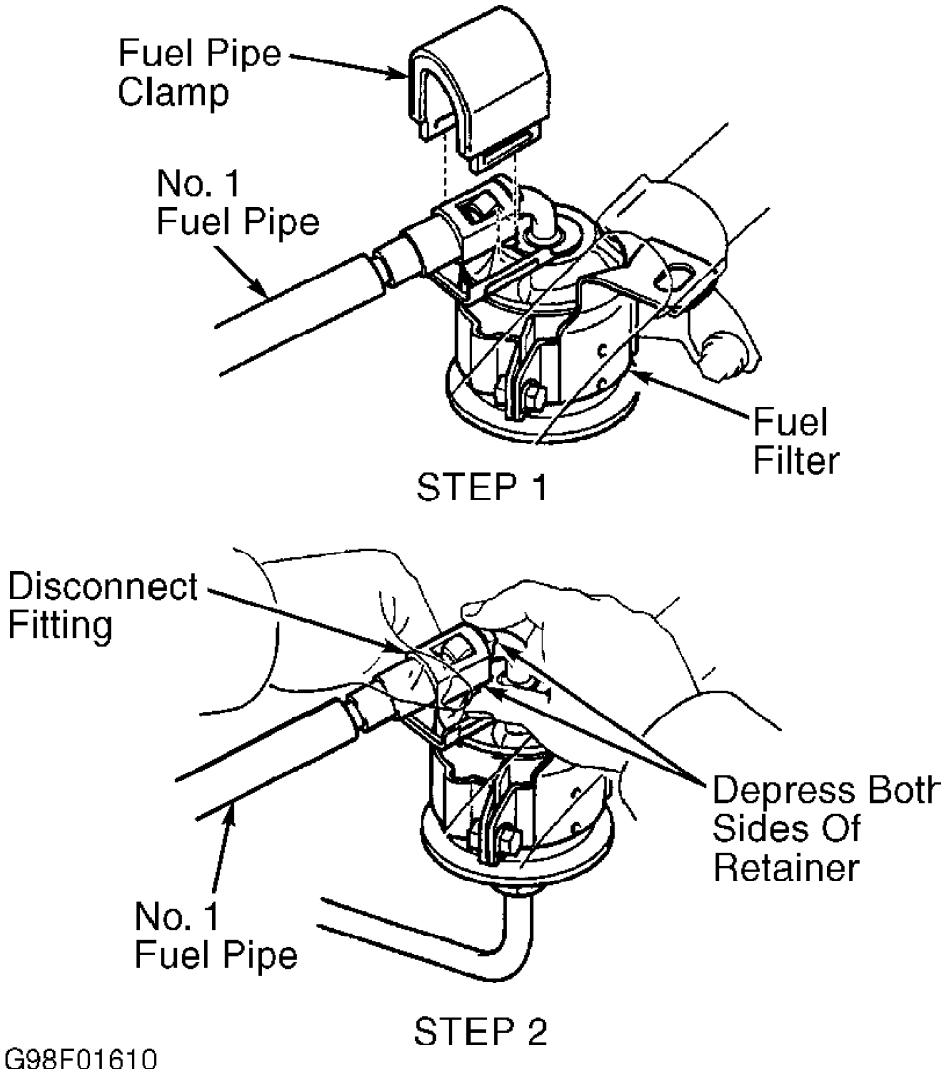


Fig. 20: Disconnecting No. 1 Fuel Pipe From Fuel Filter (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Purchase a NEW No. 1 fuel pipe Part No. (23801-20060) from parts department. No. 1 fuel pipe is the fuel pipe that attaches to

top of fuel filter. Remove fuel pipe connector from end of NEW No. 1 fuel pipe. See Fig. 21.

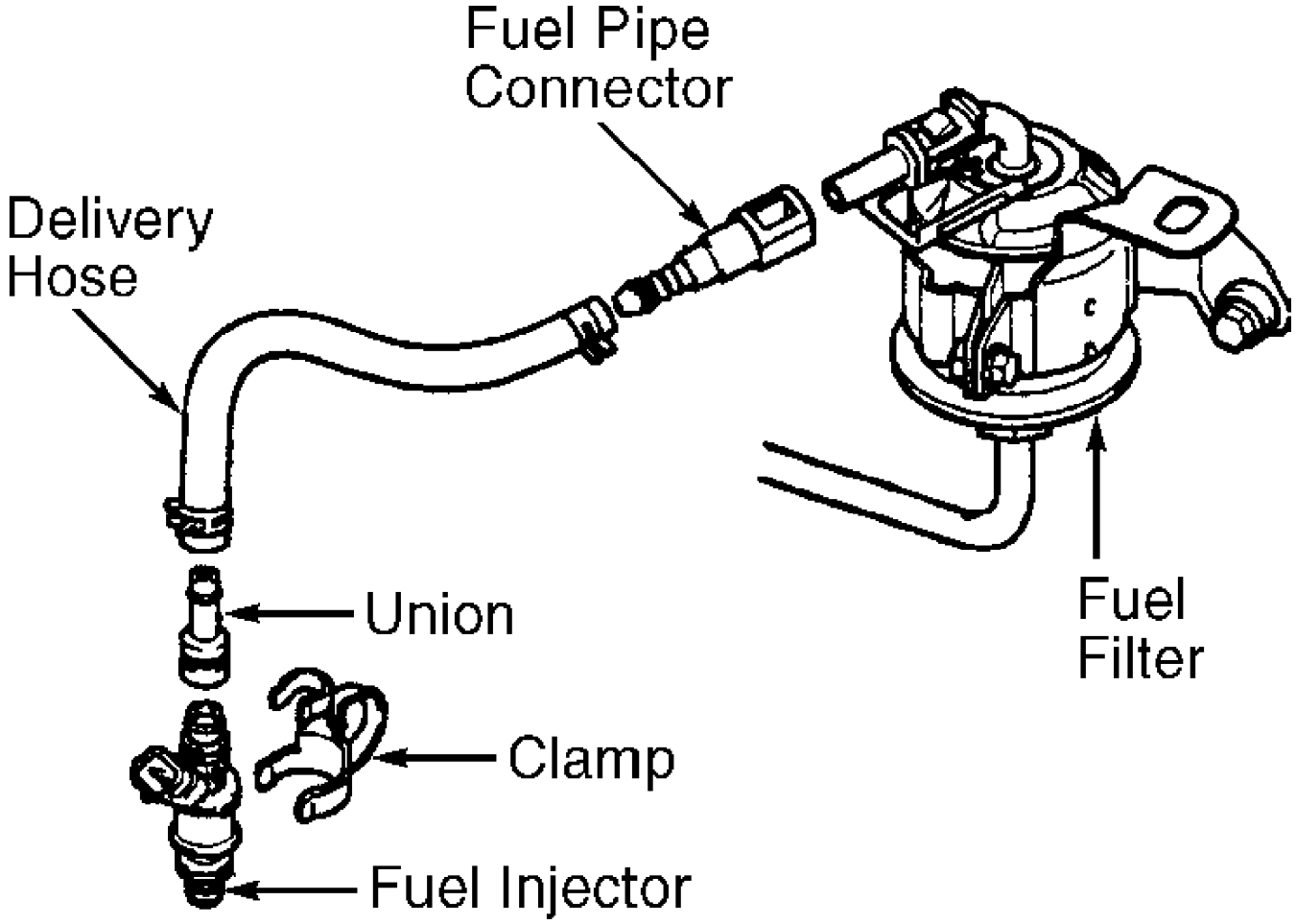


Fig. 21: Connecting Fuel Injector Test Equipment (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Install delivery hose from Fuel Injector Measuring Kit (SST 09268-41047) with fuel pipe connector on fuel filter. See Fig. 21 . Ensure delivery hose and fuel pipe connector are properly connected on fuel filter. Check that grommet and "O" ring are installed on top of fuel injector. Using clamp and union from fuel injector measuring kit, connect fuel injector to delivery hose. See Fig. 21.

4) Place fuel injector into a clean graduated container. Place vinyl tube on end of fuel injector to prevent fuel spillage. Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 8. Turn ignition on. Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer’s instructions, activate fuel pump.

NOTE: Fuel pump may also be operated to pressurize fuel system by applying battery voltage to fuel pump connector terminals. For operating of fuel pump, see FUEL PUMP OPERATION (USING BATTERY VOLTAGE) under FUEL DELIVERY.

5) Connect Fuel Injector Tester (09842-30070) to fuel

injector for 15 seconds. See Fig. 22. Measure fuel injector volume. Test each fuel injector 2-3 times. Replace fuel injector if fuel injector volume is not within specification. See FUEL INJECTOR VOLUME SPECIFICATIONS table. Ensure difference between fuel injector volume on all fuel injectors is within specification. See FUEL INJECTOR VOLUME SPECIFICATIONS table.

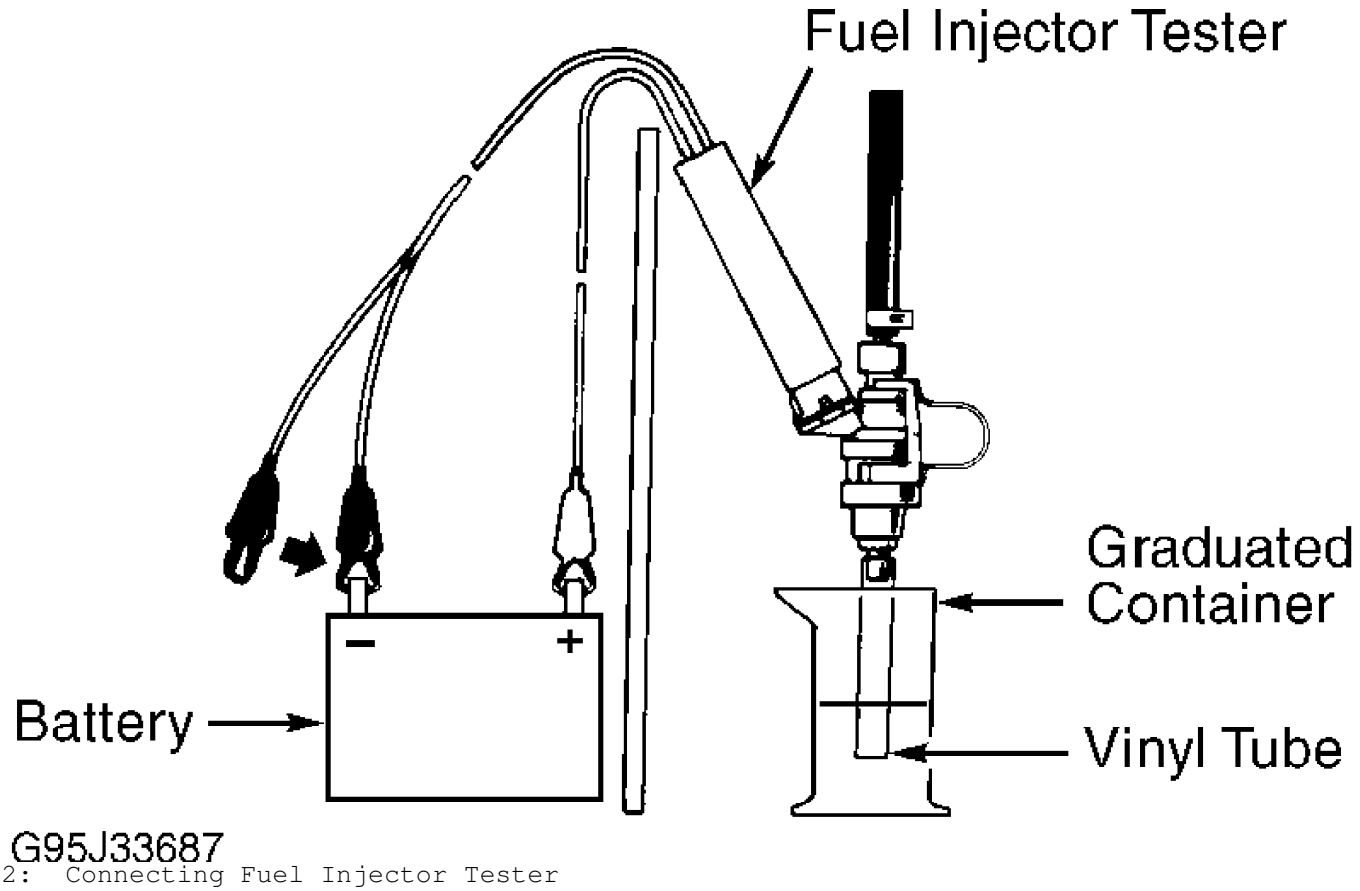


Fig. 22: Connecting Fuel Injector Tester
Courtesy of Toyota Motor Sales, U.S.A., Inc.

6) Disconnect fuel injector tester. Ensure fuel leakage from end of fuel injector does not exceed one drop within 12 minutes. Replace fuel injector if leakage exceeds specification. Disconnect negative battery cable. Remove test equipment. Apply light coat of engine oil on tip of pipe on fuel filter to allow for ease of disconnect fitting and No. 1 fuel pipe installation.

CAUTION: DO NOT reuse old retainer when installing No. 1 fuel pipe on fuel filter. Always use a NEW retainer.

7) Using NEW retainer, install No. 1 fuel pipe on fuel filter until "click" sound is head. DO NOT reuse old retainer. Pull on No. 1 fuel pipe to ensure fuel pipe connector is properly locked on fuel filter.

8) Reinstall fuel pipe clamp until "click" sound is head. Pull upward on fuel pipe clamp to ensure clamp is securely locked on fuel filter. Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

FUEL INJECTOR VOLUME SPECIFICATIONS

Application	(1) Cu. In. (cc)
Volume	3.7-4.5 (60-73)
Difference Between Injectors	0.8 (13)

(1) - Specification listed is for a 15 second period.

Fuel Injector Volume (RX300)

1) Remove fuel injector. See FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Fuel injector is connected to fuel inlet pipe for checking fuel injector volume. Remove fuel pipe clamp from No. 1 fuel pipe at fuel inlet pipe. Perform STEP 1. See Fig. 23. Ensure area around No. 1 fuel pipe and fuel inlet pipe is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel inlet pipe. Perform STEP 2. See Fig. 23.

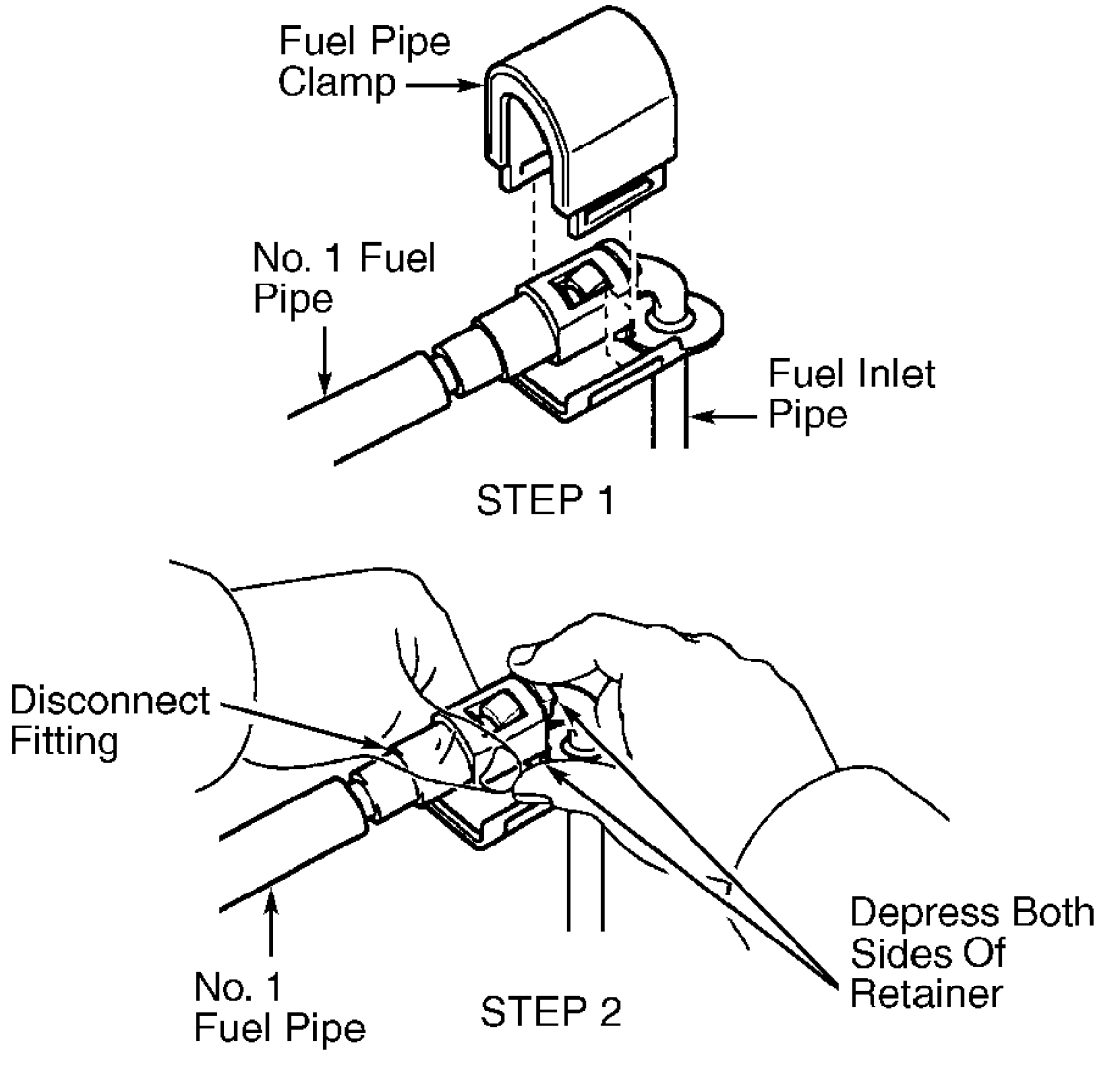


Fig. 23: Disconnecting No. 1 Fuel Pipe From Fuel Inlet Pipe (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

2) Purchase a NEW No. 1 fuel pipe Part No. (23801-20040) from parts department. Remove fuel pipe connector from end of NEW No. 1

fuel pipe. See Fig. 24.

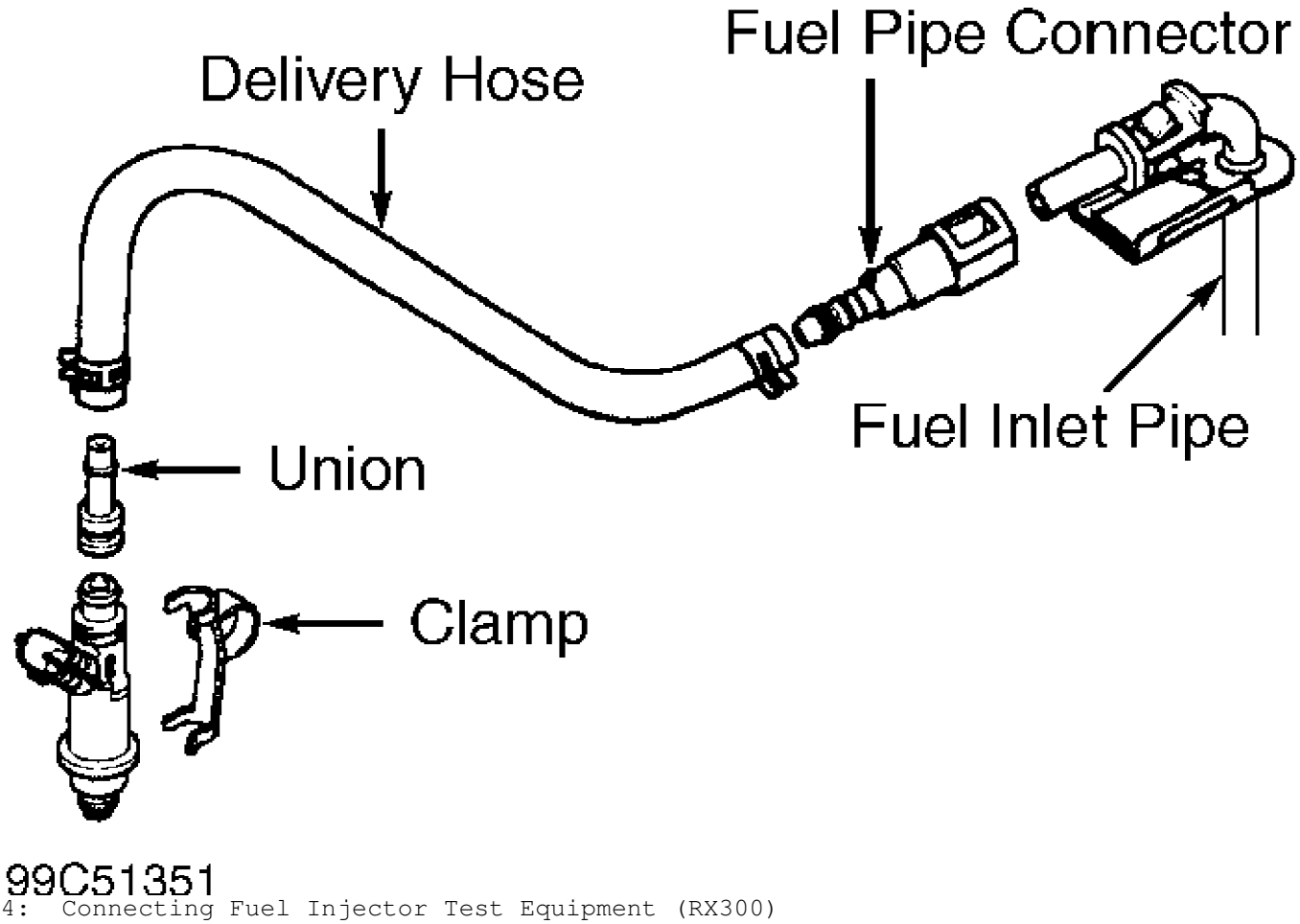


Fig. 24: Connecting Fuel Injector Test Equipment (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Install delivery hose from Fuel Injector Measuring Kit (SST 09268-41047) with fuel pipe connector on fuel inlet pipe. See Fig. 24. Ensure delivery hose and fuel pipe connector are properly connected on fuel inlet pipe. Check that grommet and "O" ring are installed on top of fuel injector. Using clamp and union from fuel injector measuring kit, connect fuel injector to delivery hose. See Fig. 24.

4) Place fuel injector into a clean graduated container. Place vinyl tube on end of fuel injector to prevent fuel spillage. Connect scan tool to data link connector No. 3. See Fig. 8. Turn ignition on. Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer’s instructions, activate fuel pump.

NOTE: Fuel pump may also be operated to pressurize fuel system by applying battery voltage to fuel pump connector terminals. For operating of fuel pump, see FUEL PUMP OPERATION (USING BATTERY VOLTAGE) under FUEL DELIVERY.

5) Connect Fuel Injector Tester (09842-30070) to fuel injector for 15 seconds. See Fig. 22. Measure fuel injector volume. Test each fuel injector 2-3 times. Replace fuel injector if fuel injector volume is not within specification. See FUEL INJECTOR VOLUME SPECIFICATIONS table. Ensure difference between fuel injector volume

on all fuel injectors is within specification. See FUEL INJECTOR VOLUME SPECIFICATIONS table.

6) Disconnect fuel injector tester. Ensure fuel leakage from end of fuel injector does not exceed one drop per minute. Replace fuel injector if leakage exceeds specification. Disconnect negative battery cable. Remove test equipment. Apply light coat of engine oil on tip of fuel inlet pipe to allow for ease of disconnect fitting and No. 1 fuel pipe installation.

CAUTION: DO NOT reuse old retainer when installing No. 1 fuel pipe on fuel inlet pipe. Always use a NEW retainer.

7) Using NEW retainer, install No. 1 fuel pipe on fuel filter until "click" sound is head. DO NOT reuse old retainer. Pull on No. 1 fuel pipe to ensure fuel pipe connector is properly locked on fuel inlet pipe.

8) Reinstall fuel pipe clamp until "click" sound is head. Pull upward on fuel pipe clamp to ensure clamp is securely locked on fuel inlet pipe. Install negative battery cable. Check for fuel leaks by using scan tool to energize fuel pump.

FUEL CUT SYSTEM OPERATION

Remove engine cover. Start and warm engine to operating temperature. Turn A/C off. Use a stethoscope to listen for injector operating noise (or feel for vibration with finger). Increase engine speed to at least 3500 RPM. Release throttle lever. When throttle lever is released, injectors should stop operating momentarily until engine speed decreases to 1200 RPM. Shut engine off. Remove scan tool.

IDLE AIR CONTROL (IAC) SYSTEM

SYSTEM OPERATION

1) Ensure engine is at normal operating temperature. Ensure idle speed is 650-750 RPM. Ensure transmission is in Neutral. Turn A/C off. Connect Fused Jumper Wire (09843-18020) between terminals TE1 and E1 of DLC No. 1 located at front of air intake chamber. See Fig. 25. DLC No. 1 is located right of intake air chamber.

2) Engine speed should increase to about 1000 RPM for about 5 seconds then return to idle (650-750 RPM). If engine speed is as specified, go to AIR ASSIST SYSTEM. If engine speed is not as specified, disconnect jumper wire from DLC No. 1. Check IAC valve operation. Replace IAC valve as necessary. If IAC valve is okay, check for open or short in IAC valve wiring. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair wiring as necessary. If wiring is okay, replace ECM.

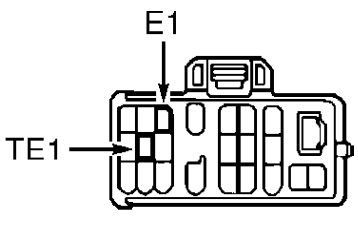


Fig. 25: Identifying Data link Connector (DLC) No. 1 Connector Terminals
Courtesy of Toyota Motor Sales, U.S.A., Inc.

AIR ASSIST SYSTEM

1) Ensure engine is at normal operating temperature. Ensure idle speed is 650-750 RPM. Ensure transmission is in Neutral. Turn A/C off. Connect Jumper Wire (09843-18020) between terminals TE1 and E1 of DLC No. 1. See Fig. 25.

2) Engine speed should increase to about 900-1300 RPM for about 10 seconds then return to idle (650-750 RPM). Turn ignition off. Disconnect air assist hose from air pipe. See Fig. 26. Plug hose end, and cap off hose pipe fitting.

3) Start engine. If engine idles at about 500 RPM or less (or if engine stalls), air assist system is okay. If engine speed does not operate as specified, check and repair vacuum leak.

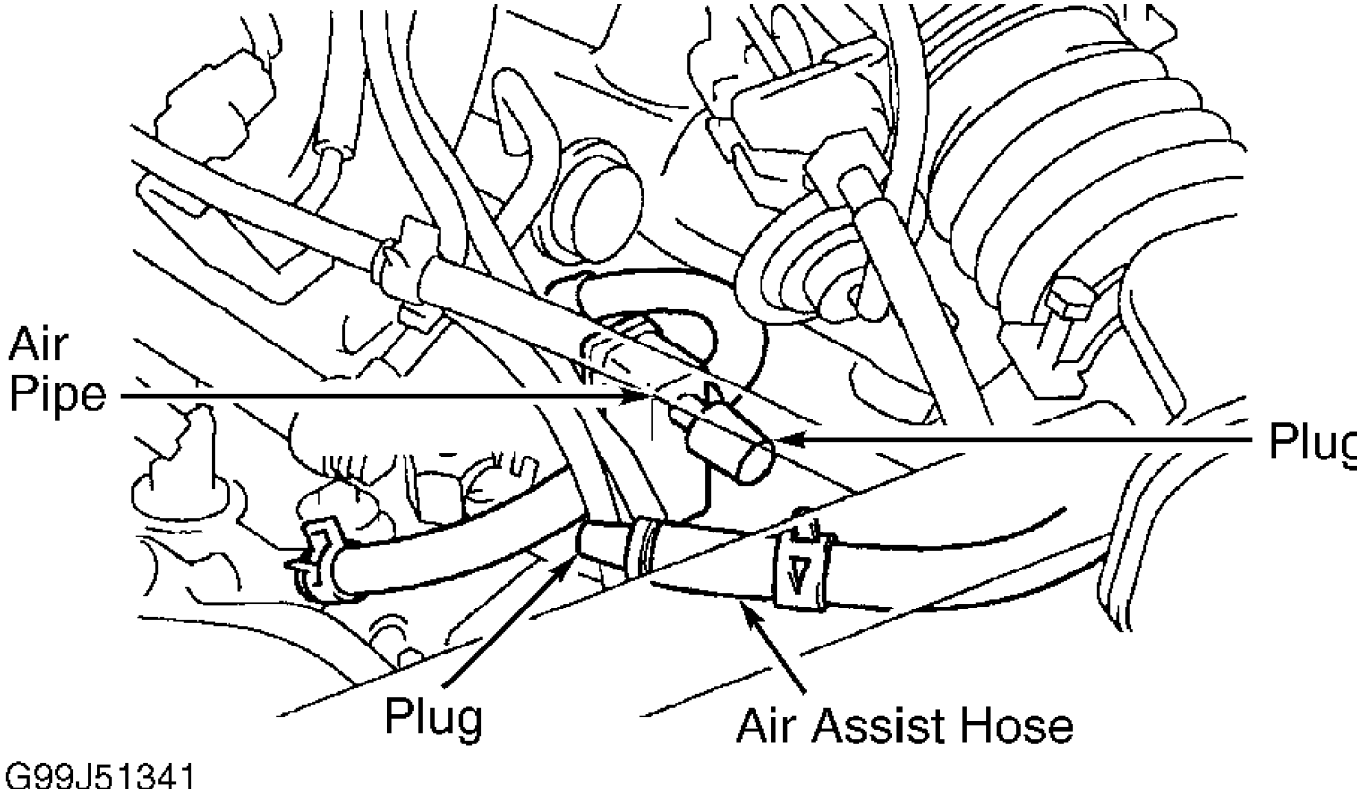


Fig. 26: Locating Air Assist Hose
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IAC VALVE OPERATION

Remove throttle body. See THROTTLE BODY in REMOVAL, OVERHAUL & INSTALLATION article. Remove IAC valve from throttle body. Check IAC valve position. IAC valve should be in half open position. See Fig. 27 . Connect IAC valve connector to IAC valve. Turn ignition on and observe IAC valve operation. IAC valve should move to fully closed, fully open and then to half open position within 5 seconds of turning ignition on. If IAC valve operation is not as specified, replace IAC valve and retest.

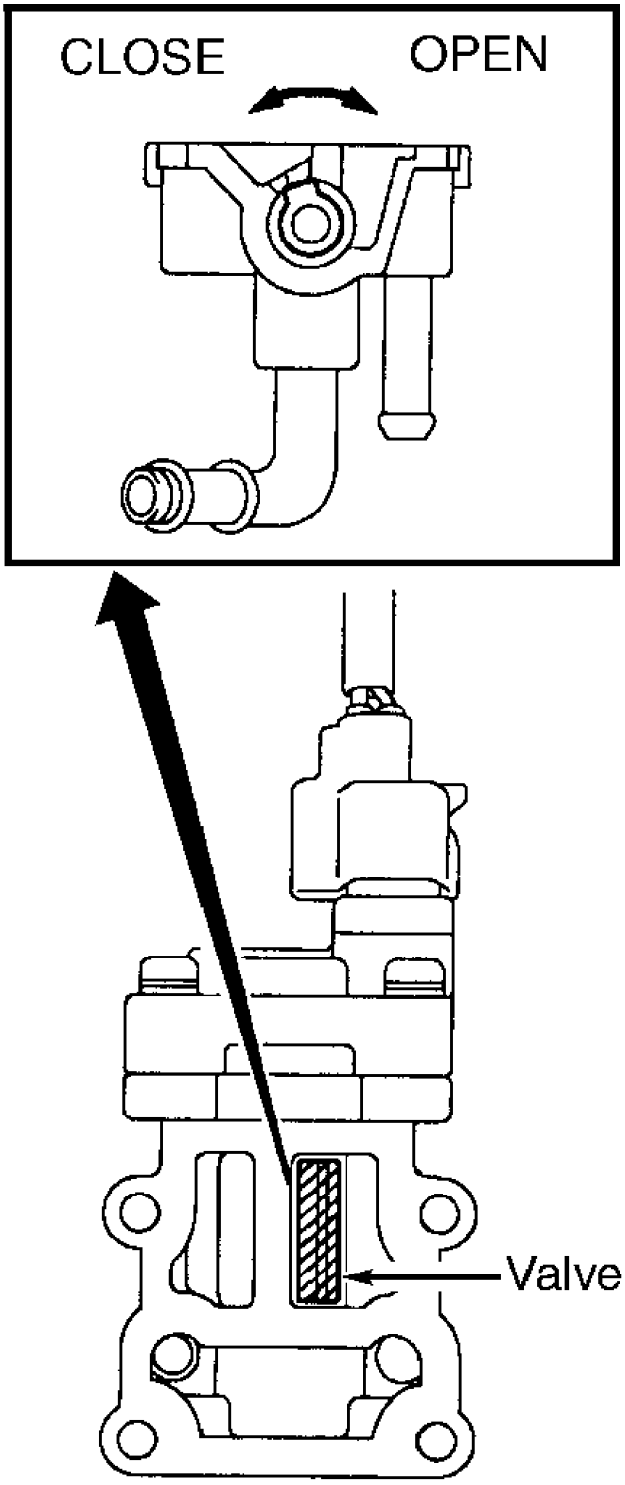


Fig. 27: Checking Idle Air Control (IAC) Valve Operation
Courtesy of Toyota Motor Sales, U.S.A., Inc.

IGNITION SYSTEM

NOTE: For basic ignition checks, see IGNITION CHECKS in BASIC DIAGNOSTIC PROCEDURES article.

EMISSION SYSTEMS & SUB-SYSTEMS

CAUTION: If ECM replacement is instructed in following testing, always ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

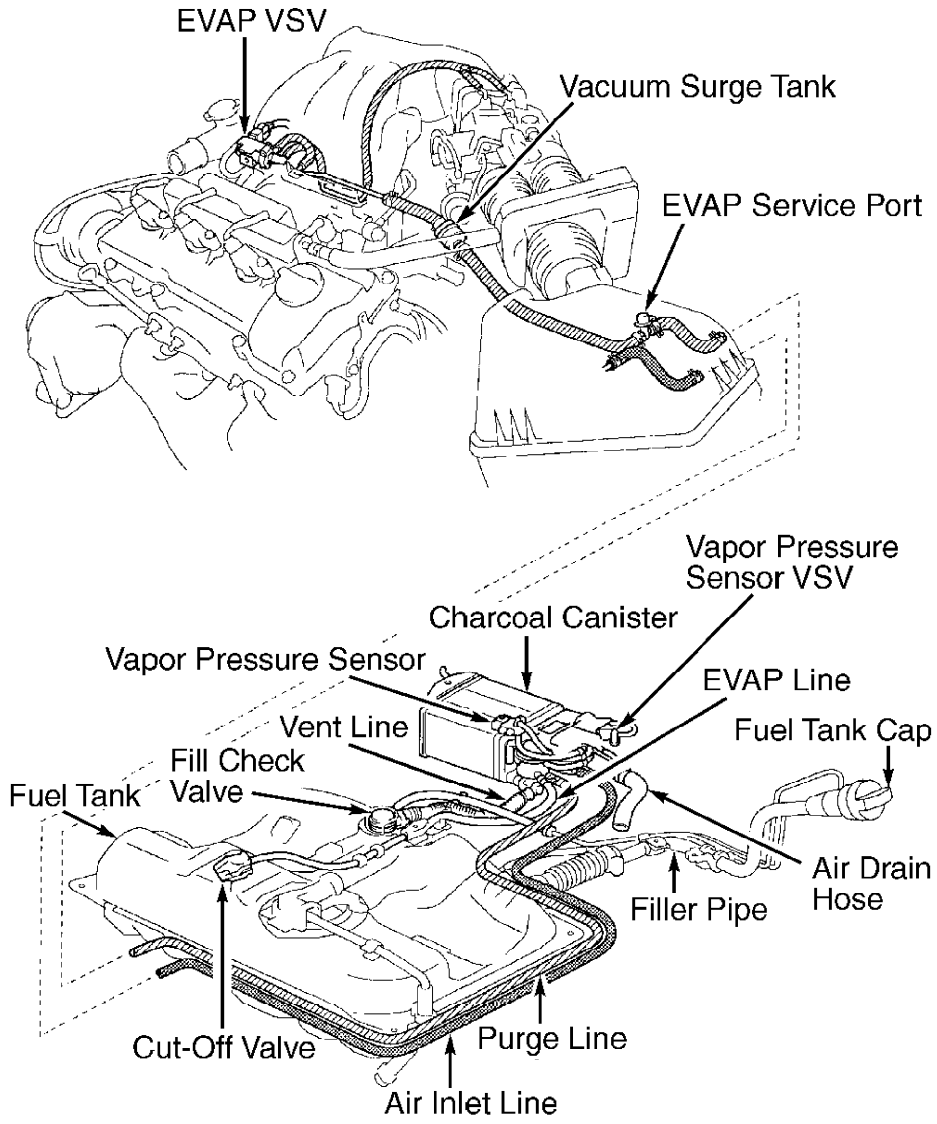


Fig. 28: Identifying Emission System Components (ES300 Shown; RX300 Late Release Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CAUTION: If ECM replacement is instructed in following testing, always

ensure ECM harness connector and ground circuit are okay. If either are suspect, repair and repeat testing to confirm ECM malfunction. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

FUEL EVAPORATION SYSTEM

NOTE: Fuel EVAP system may also referred to as On-Board Refilling Vapor Recorvery (ORVR) system.

NOTE: RX300 early release models (built prior to March of 1999) are not equipped with an EVAP service port to pressurize EVAP system. RX300 late release models (built after March of 1999) are equipped with a EVAP service port. For fuel EVAP system test on RX300 early release models, see FUEL EVAP SYSTEM TEST (RX300 EARLY RELEASE)

Fuel EVAP System Test (ES300 & RX300 Late Release)

1) Fuel EVAP system is also referred to as On-Board Refilling Vapor Recorvery (ORVR) system. Inspect all EVAP system lines and connections for sharp bends or damage. See Fig. 28. Fuel inlet pipe may also be referred to as fuel filler pipe. Inspect fuel inlet pipe for cracks, damage or fuel leakage. Inspect fuel tank cap for cracks or deformed gasket. Replace components if defective or damaged.

2) Start engine and warm engine to normal operating temperature. Shut engine off. Connect vacuum gauge from EVAP system test kit to EVAP service port. EVAP service port is located in engine compartment (under air filter housing), in the purge vacuum hose for EVAP system. See Fig. 28.

3) EVAP Vacuum Switching Valve (VSV) must be operated. If scan tool is available, go to next step. If scan tool is not available, go to step 5).

4) Connect scan tool to Data Link Connector (DLC) No. 3. See Fig. 8. Start engine. Turn scan tool on. Select ACTIVE TEST MODE on scan tool. Using scan tool manufacturer's instructions, activate EVAP VSV. Go to step 6).

5) Disconnect electrical connector at EVAP VSV. EVAP VSV is mounted on air intake chamber and contains a Blue 2-pin electrical connector. See Fig. 4. Using jumper wires, connect battery voltage and ground to EVAP VSV terminals. Start engine. Go to next step.

6) Check vacuum reading on vacuum gauge with engine idling. Vacuum should be .368-19.713 in. Hg for more than 5 seconds. If vacuum is within specification, go to next step. If vacuum reading is not within specification, check for loose or restricted vacuum hose to EVAP service port, or for malfunctioning EVAP VSV. To check EVAP VSV operation, see EVAP VACUUM SWITCHING VALVE (ALL MODELS).

7) Shut engine off. If using scan tool to operate EVAP VSV, stop operation of EVAP VSV. Remove scan tool. Go to next step. If connecting battery voltage to EVAP VSV to operate EVAP VSV, disconnect jumper wires and reconnect electrical connector on EVAP VSV. Go to next step.

8) Disconnect vacuum gauge from EVAP service port. Connect pressure gauge to EVAP service port. Locate charcoal canister under rear of vehicle near fuel tank. See Fig. 29. Install hose crimper on charcoal canister air drain hose.

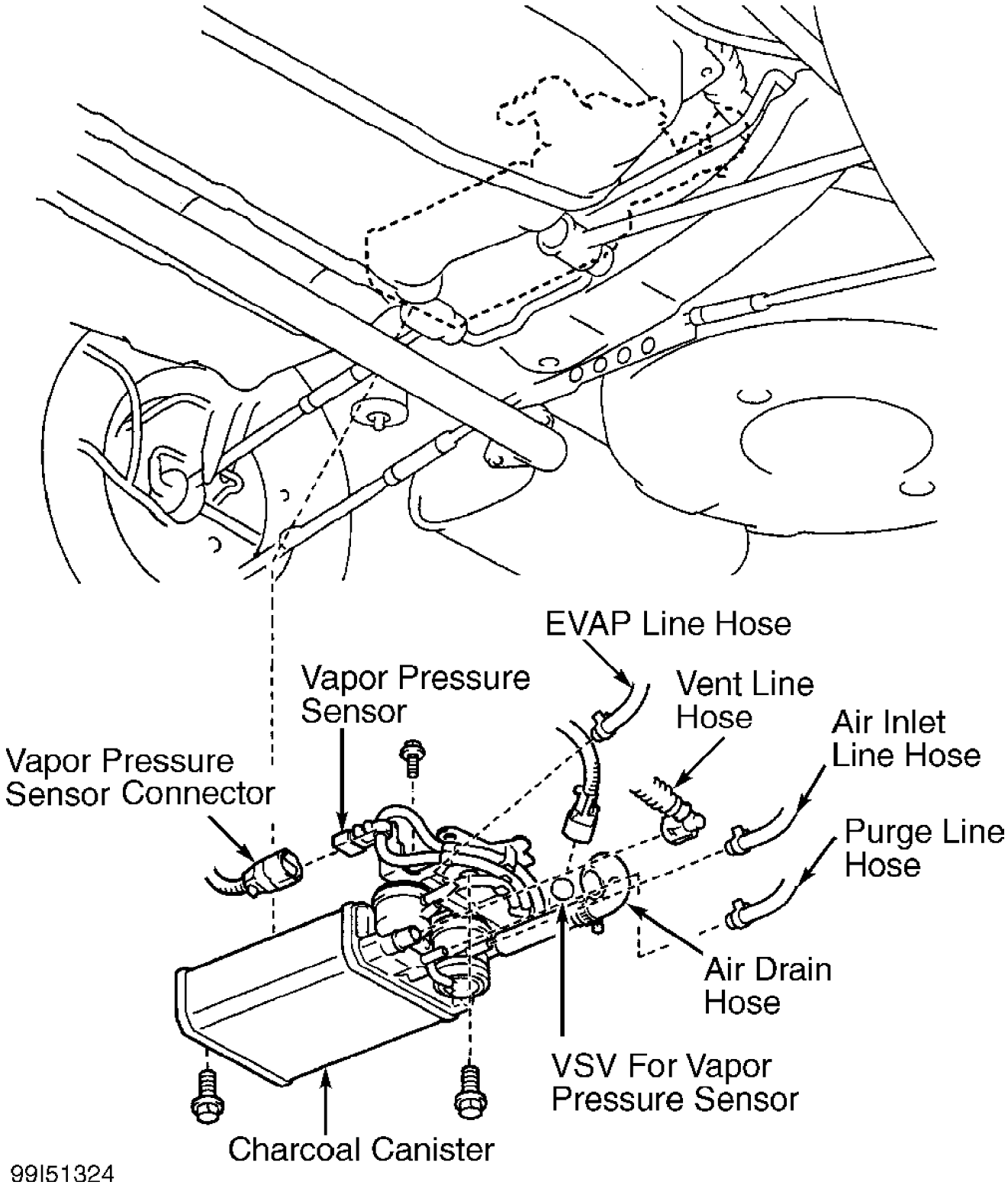


Fig. 29: Identifying Fuel Evaporation System Components (ES300 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

9) Apply 13.5-15.5 in. H2O of pressure to EVAP service port.

After 2 minutes of applying the pressure, the pressure should be 7.7-8.8 in. H2O. If pressure is within specification, remove hose crimper and go to next step. If pressure cannot be maintained, remove hose crimper and check for disconnected vacuum hose between EVAP VSV, charcoal canister and fuel tank. If vacuum hose is properly installed on EVAP VSV, charcoal canister and fuel tank, check for stuck open EVAP VSV. To check EVAP VSV operation, see EVAP VACUUM SWITCHING VALVE (ALL MODELS).

10) With pressure still applied at EVAP service port, remove fuel tank cap and note pressure reading. Pressure should decrease when fuel tank cap is removed. If pressure decreases when fuel tank cap is removed, remove pressure gauge and go to next step. If pressure does not decrease when fuel tank cap is removed, remove pressure gauge and check for restricted vacuum hose between EVAP service port, charcoal canister and fuel tank. Repair or replace vacuum hose as necessary.

11) To check airtightness of fuel tank and fuel inlet pipe, disconnect EVAP line hose from charcoal canister. See Fig. 29. Apply .58 psi (.040 kg/cm^2) air pressure to EVAP line hose so pressure inside the fuel tank is .58 psi (.040 kg/cm^2). Check that pressure inside fuel tank holds steady for one minute.

12) If pressure inside fuel tank holds steady for one minute, reinstall EVAP line hose on charcoal canister. Go to next step. If pressure inside fuel tank will not hold steady for one minute, check for leaking hoses or pipes at fuel tank and fuel inlet pipe, or for leaks at fuel tank or installed components on fuel tank. If no leaks exist, replace fuel tank and fuel inlet pipe. Reinstall EVAP line hose on charcoal canister. Go to next step.

NOTE: Overfill check valve may also be referred to as fill check valve. Cut-off valve may also be referred to as fuel cut-off valve.

13) To check overfill check valve and cut-off valve, disconnect purge line hose, air drain hose and EVAP line hose from charcoal canister. Install cap on air drain hose port. See Fig. 29.

14) Apply .58 psi (.040 kg/cm^2) air pressure to purge line hose fitting on charcoal canister. See Fig. 29. Ensure air flows from EVAP line hose when air pressure is applied to purge line hose fitting on charcoal canister. If fuel tank is full of fuel, air may not flow from EVAP line hose, as overfill check valve may be closed. Ensure fuel tank is not full of fuel when checking for airflow at EVAP line hose.

15) If air flows from EVAP line hose, go to next step. If air does not flow from EVAP line hose, check for restrictions in EVAP line hose and vent line hose. If any hose is restricted, replace hose and recheck operation. If hoses are not restricted, replace overfill check valve and cut-off valve located on top of fuel tank. See Fig. 29.

16) Reinstall purge line hose, air drain hose and EVAP line hose on charcoal canister. To check air inlet line, disconnect air inlet line hose from charcoal canister. See Fig. 29. Apply air pressure to air inlet line hose. Air should flow through air inlet line hose. If air flows through air inlet line hose, go to next step. If air does not flow through air inlet line hose, check for restricted air inlet line hose or air inlet line.

17) Disconnect necessary electrical connectors and components for removal of charcoal canister. Disconnect purge line hose, EVAP line hose and air inlet line hose from charcoal canister.

18) Push connector on vent line hose toward charcoal canister and pinch both sides of retainer on connector, and then disconnect vent line hose with connector from charcoal canister. See Fig. 30.

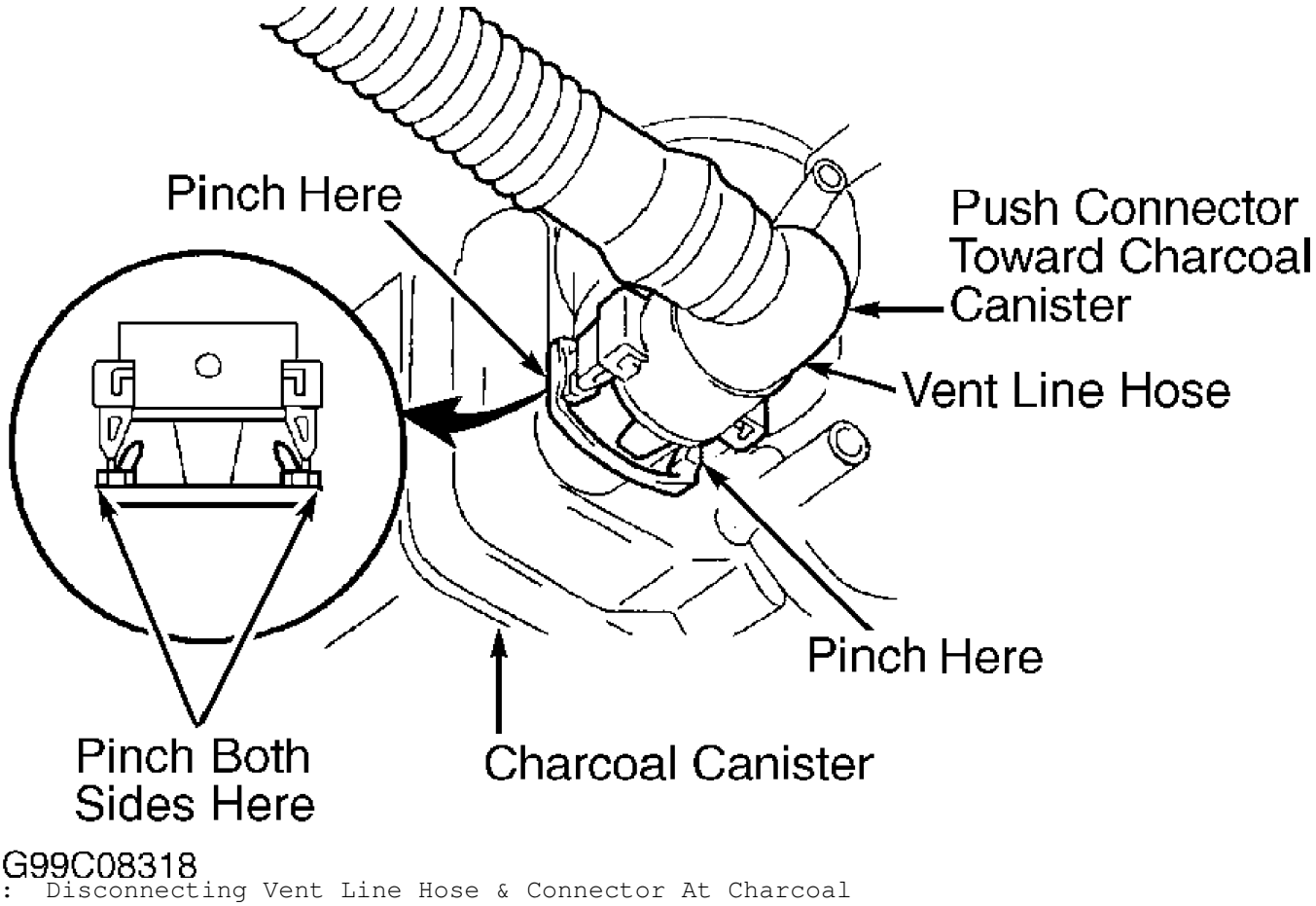


Fig. 30: Disconnecting Vent Line Hose & Connector At Charcoal Canister
Courtesy of Toyota Motor Sales, U.S.A., Inc.

19) Remove charcoal canister and vapor pressure sensor retaining bolts. Remove charcoal canister. Inspect charcoal canister for cracks or damage at all hose fittings. If charcoal canister is okay, go to next step. If charcoal canister is defective, replace charcoal canister.

20) To check charcoal canister, install cap on vent port on charcoal canister. See Fig. 31. Apply .26 psi (.018 kg/cm^2) air pressure to EVAP port while holding purge port closed. Ensure air flows freely from air drain port.

21) Apply .26 psi (.018 kg/cm^2) air pressure to EVAP port while holding air drain port and purge port closed. See Fig. 31. Ensure no air flows from air inlet port.

22) Using vacuum pump, apply 1.01 in. Hg of vacuum to purge port. See Fig. 31. Ensure vacuum does not decrease when air inlet port is closed, and that vacuum decreases when air inlet port is opened.

23) While holding air inlet port closed, use vacuum pump to apply 1.01 in. Hg of vacuum to EVAP port. See Fig. 31. Ensure air flows into purge port. Remove cap from vent port. Replace charcoal canister if defective.

24) Reinstall charcoal canister. If fuel EVAP system operates properly, it may be necessary to check operation of EVAP Vacuum Switching Valve (VSV), vapor pressure sensor and vapor pressure sensor Vacuum Switching Valve (VSV). See EVAP VACUUM SWITCHING VALVE (ALL MODELS), VAPOR PRESSURE SENSOR CIRCUIT (ALL MODELS) and VAPOR PRESSURE SENSOR VACUUM SWITCHING VALVE (ALL MODELS).

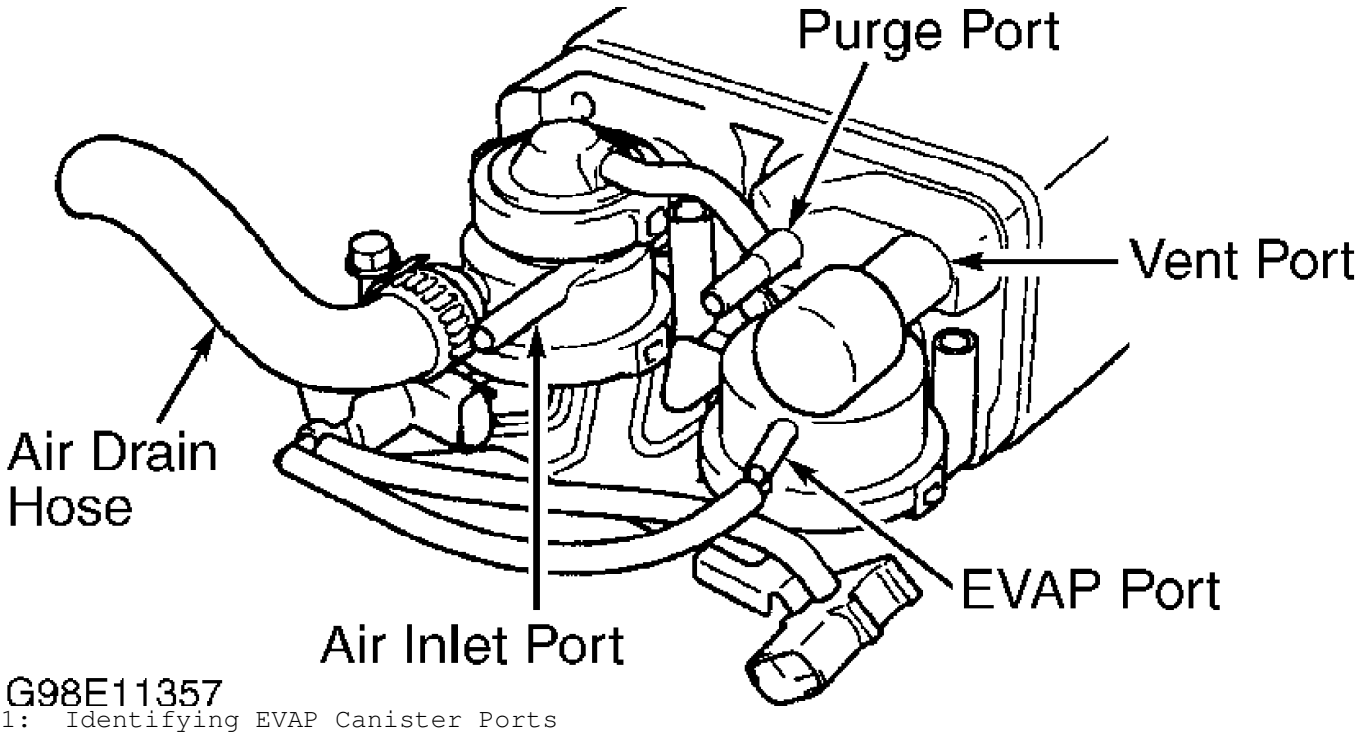


Fig. 31: Identifying EVAP Canister Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel EVAP System Test (RX300 Early Release)

1) Inspect all EVAP system lines and connections for sharp bends or damage. Fuel inlet pipe may also be referred to as fuel filler pipe. Inspect fuel inlet pipe for cracks, damage or fuel leakage. Inspect fuel tank cap for cracks or deformed gasket. Replace components if defective or damaged.

2) To check airtightness of fuel tank and fuel inlet pipe, disconnect EVAP line hose from charcoal canister. See Fig. 29. Apply .58 psi (.040 kg/cm^2) air pressure to EVAP line hose so pressure inside the fuel tank is .58 psi (.040 kg/cm^2). Check that pressure inside fuel tank holds steady for one minute.

3) If pressure inside fuel tank holds steady for one minute, reinstall EVAP line hose on charcoal canister. Go to next step. If pressure inside fuel will not hold steady for one minute, check for leaking hoses or pipes at fuel tank and fuel inlet pipe, or for leaks at fuel tank or installed components on fuel tank. If no leaks exist, replace fuel tank and fuel inlet pipe. Reinstall EVAP line hose on charcoal canister. Go to next step.

NOTE: Overfill check valve may also be referred to as fill check valve. Cut-off valve may also be referred to as fuel cut-off valve.

4) To check overfill check valve and cut-off valve, disconnect purge line hose and EVAP line hose from charcoal canister, and install cap on air drain hose. See Fig. 29.

5) Apply .58 psi (.040 kg/cm^2) air pressure to purge line hose fitting on charcoal canister. See Fig. 29. Ensure air flows from EVAP line hose when air pressure is applied to purge line hose fitting on charcoal canister. If fuel tank is full of fuel, air may not flow from EVAP line hose, as overfill check valve may be closed. Ensure fuel tank is not full of fuel when checking for airflow at EVAP line hose.

6) If air flows from EVAP line hose, go to next step. If air

does not flow from EVAP line hose, check for restrictions in EVAP line hose and vent line hose. If any hose is restricted, replace hose and recheck operation. If hoses are not restricted, replace overfill check valve and cut-off valve located on top of fuel tank. See Fig. 29.

7) Reinstall purge line hose and EVAP line hose on charcoal canister, To check air inlet line, disconnect air inlet line hose from charcoal canister. See Fig. 29. Apply air pressure to air inlet line hose. Air should flow through air inlet line hose. If air flows through air inlet line hose, go to next step. If air does not flow through air inlet line hose, check for restricted air inlet line hose or air inlet line.

8) Disconnect necessary electrical connectors and components for removal of charcoal canister. Disconnect purge line hose, EVAP line hose and air inlet line hose from charcoal canister. Push connector on vent line hose toward charcoal canister and pinch both sides of retainer on connector, and then disconnect vent line hose with connector from charcoal canister. See Fig. 30.

9) Remove charcoal canister and vapor pressure sensor retaining bolts. Remove charcoal canister. Inspect charcoal canister for cracks or damage at all hose fittings. If charcoal canister is okay, go to next step. If charcoal canister is defective, replace charcoal canister.

10) To check charcoal canister, install cap on vent port on charcoal canister. See Fig. 31. Apply .26 psi (.018 kg/cm^2) air pressure to EVAP port while holding purge port closed. Ensure air flows freely from air drain port.

11) Apply .26 psi (.018 kg/cm^2) air pressure to EVAP port while holding air drain port and purge port closed. See Fig. 31. Ensure no air flows from air inlet port.

12) Using vacuum pump, apply 1.01 in. Hg of vacuum to purge port. See Fig. 31. Ensure vacuum does not decrease when air inlet port is closed, and that vacuum decreases when air inlet port is opened.

13) While holding air inlet port closed, use vacuum pump to apply 1.01 in. Hg of vacuum to EVAP port. See Fig. 31. Ensure air flows into purge port. Remove cap from vent port. Replace charcoal canister if defective.

14) Reinstall charcoal canister. If fuel EVAP system operates properly, it may be necessary to check operation of EVAP Vacuum Switching Valve (VSV), vapor pressure sensor and vapor pressure sensor Vacuum Switching Valve (VSV). See EVAP VACUUM SWITCHING VALVE (ALL MODELS), VAPOR PRESSURE SENSOR CIRCUIT (ALL MODELS) and VAPOR PRESSURE SENSOR VACUUM SWITCHING VALVE (ALL MODELS).

Charcoal Canister (All Models)

For testing of charcoal canister, see appropriate FUEL EVAP SYSTEM TEST.

EVAP Vacuum Switching Valve (All Models)

1) Remove engine cover. Remove control valve set and wire harness cover. See Fig. 4. Disconnect electrical connector and vacuum hoses from EVAP Vacuum Switching Valve (VSV). Measure resistance between VSV terminals. If resistance is 27-33 ohms at 68°F (20°C), go to next step. If resistance is not as specified, replace VSV.

2) Check for continuity between VSV case and each terminal of VSV connector (this checks for an internal short). If continuity does not exist, go to next step. If continuity exists, replace VSV.

3) Apply compressed air to port "E". See Fig. 32. Air should not flow from port "F". If VSV function as specified, go to next step. If VSV does not function as specified, replace VSV.

4) Apply battery voltage across VSV terminals. Apply compressed air to port "E". If air flows out of port "F", VSV is functioning properly. If air does not flow out of port "F", replace VSV.

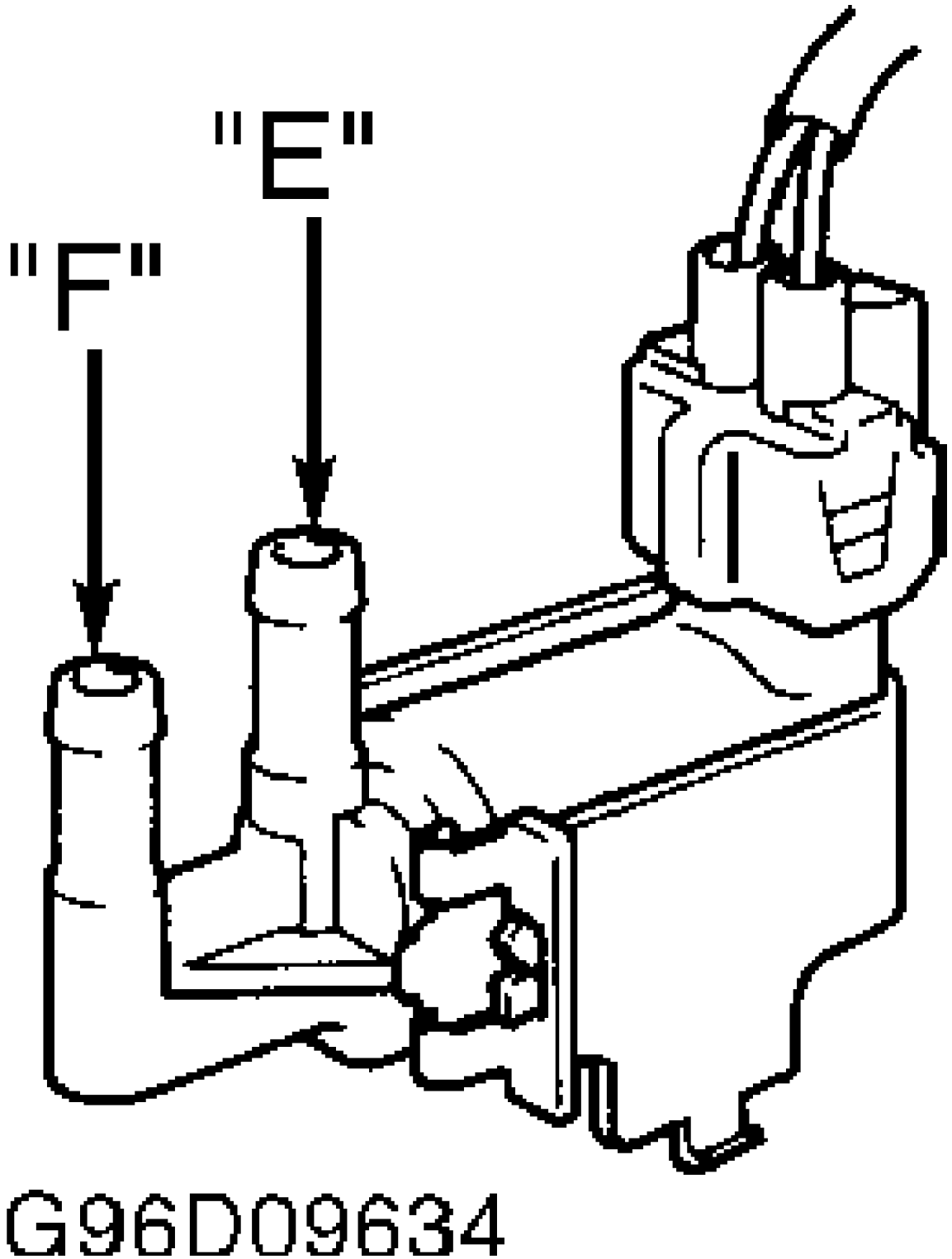


Fig. 32: Identifying EVAP VSV Vacuum Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: Vapor pressure sensor is available is 2 different configurations. Type "A" sensor has one vacuum port on each

side of sensor.

See Fig. 33. Type "B" sensor has 2 vacuum ports on the same side of sensor.

Vapor Pressure Sensor Circuit (All Models)

1) Disconnect vapor pressure sensor connector. Sensor has 2 vacuum ports and is mounted on top of EVAP charcoal canister underneath rear of vehicle. See Fig. 29. Turn ignition on. Measure voltage between terminals VC and E2 at vapor pressure sensor connector terminals. See Fig. 33. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, check wiring harness between sensor and ECM. See appropriate wiring diagram in WIRING DIAGRAMS article. Repair as necessary. If wiring is okay, replace ECM.

2) Turn ignition off. Reconnect vapor pressure sensor connector. Access ECM harness connectors behind glove box. Disconnect vapor pressure sensor vacuum hose. See Fig. 34. Turn ignition on.

3) On ES300, backprobing ECM harness connector, measure voltage between terminals No. 18 (Brown wire) at ECM E10 connector and No. 17 (Pink wire) at ECM E7 connector. See Fig. 6. On RX300, backprobing ECM harness connector, measure voltage between terminals No. 18 (Brown wire) at ECM E 6 connector and No. 17 (Blue wire) at ECM E8 connector. See Fig. 7. On all models, voltage reading should be as follows:

* 3.0-3.6 volts with no vacuum applied.
* 1.3-2.1 volts with .59 in. Hg (2.0 kPa) of vacuum applied.
* 4.2-4.8 volts with .22 psi (1.5 kPa) of pressure applied.

If voltage is not as specified, replace vapor pressure sensor.

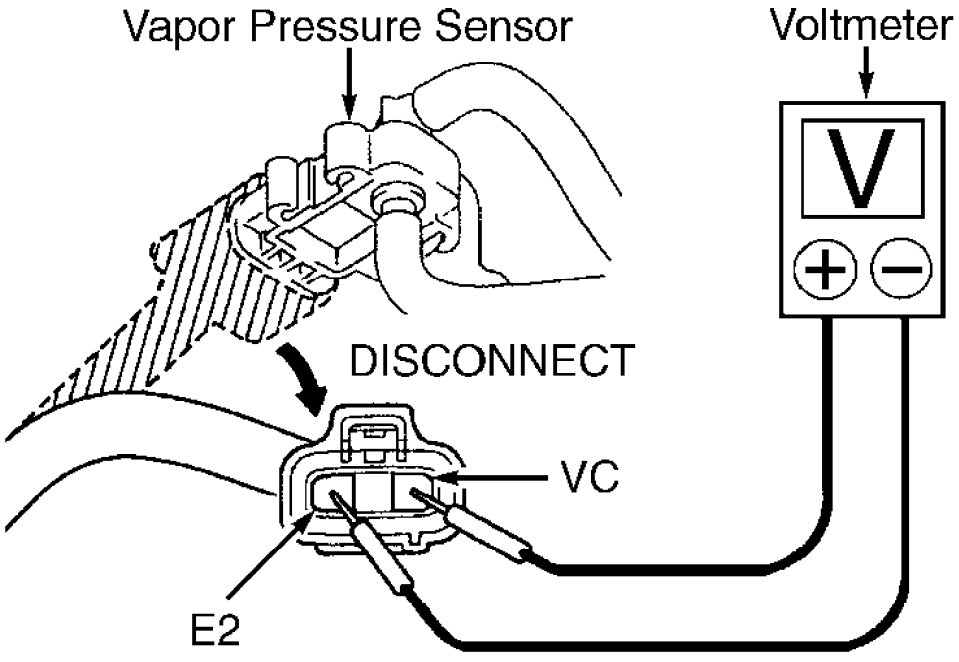
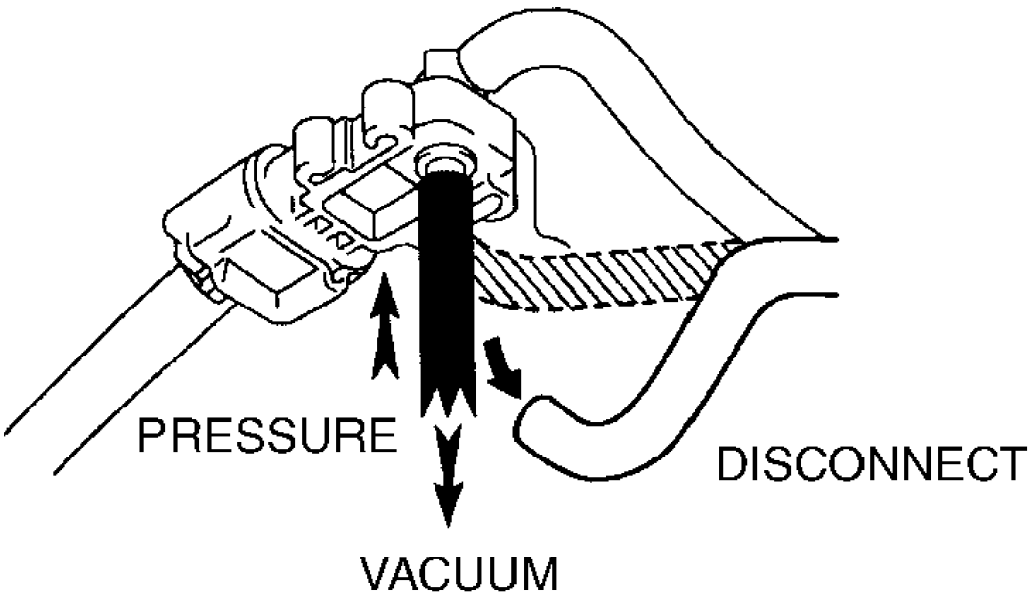
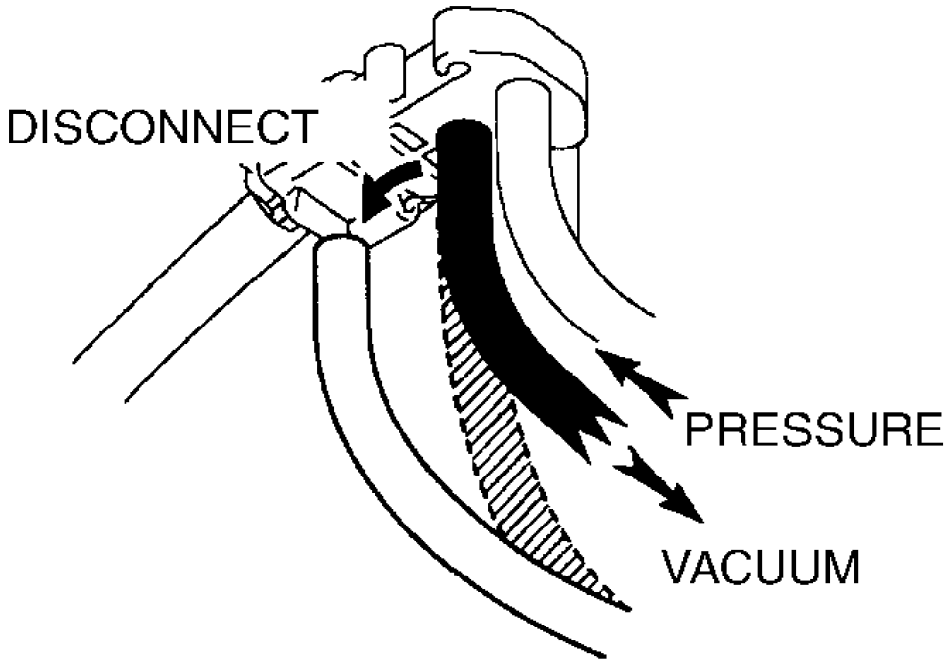


Fig. 33: Checking Voltage At Vapor Pressure Sensor
Courtesy of Toyota Motor Sales, U.S.A., Inc.



TYPE "A" VAPOR PRESSURE SENSOR



TYPE "B" VAPOR PRESSURE SENSOR

G99D51337

Fig. 34: Testing Vapor Pressure Sensor Operation
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Vapor Pressure Sensor Vacuum Switching Valve (All Models)

1) Remove vapor pressure sensor. Vacuum Switching Valve (VSV)

has 3 vacuum ports and is mounted on top of EVAP canister. See Fig. 29 . Measure resistance between vapor pressure sensor VSV terminals. If resistance is 33-39 ohms at 68°F (20°C), go to next step. If resistance is not 33-39 ohms, replace VSV.

2) Check for continuity between vapor pressure sensor VSV case and each terminal of VSV connector (this checks for an internal short). If continuity does not exist, go to next step. If continuity exists, replace vapor pressure sensor VSV.

3) Apply air pressure to VSV port "E". See Fig. 35. If air flows from port "G", go to next step. If air does not flow from port "G", replace VSV.

4) Using jumper wires, apply battery voltage and ground across VSV terminals. Apply compressed air to port "E". If air flows out of port "F", VSV is functioning properly. If air does not flow from port "F", replace VSV.

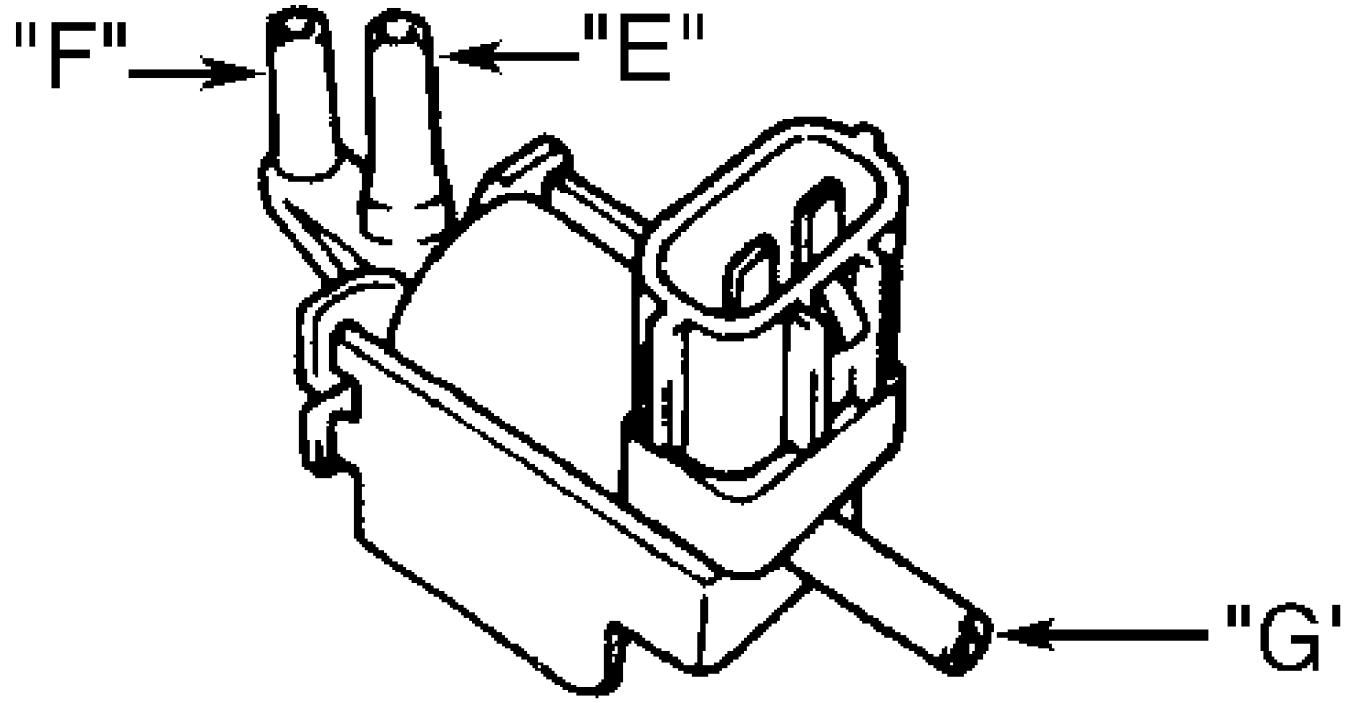


Fig. 35: Identifying Vapor Pressure Sensor VSV Ports
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POSITIVE CRANKCASE VENTILATION (PCV)

PCV Valve

Remove PCV valve from valve cover. Inspect PCV hoses, connections and gaskets for leaks and damage. Apply compressed air to cylinder head side of PCV valve. Air should pass freely through PCV valve. Apply compressed air to intake manifold side of PCV valve. Air should not pass freely through PCV valve. Clean or replace PCV valve if air does not flow as specified.

VARIABLE VALVE TIMING (VVT) SYSTEM

VARIABLE VALVE TIMING (VVT) SYSTEM OPERATION

If VVT system circuits or components are faulty, a Diagnostic Trouble Code (DTC) should set. Retrieve DTCs and perform appropriate diagnostic test. See SELF-DIAGNOSTICS - INTRODUCTION article.

CAMSHAFT TIMING OIL CONTROL VALVE

NOTE: Camshaft timing oil control valve is also referred to as oil control valve.

Resistance Check

Remove engine cover. Disconnect connector from Oil Control Valve (OCV) to be tested. Oil control valves are located at front top of each cylinder head. On ES300, left OCV has a 2-pin connector with Green/Yellow and Green/Red wires. Right OCV has a 2-pin connector with Green/White and Green wires. On RX300, left OCV has a 2-pin connector with Green/Yellow and Green/Red wires. Right OCV has a 2-pin connector with Green/White and Yellow/Black wires. On all models, measure resistance between OCV terminals. Resistance should be 6.9-7.9 ohms at 68°F (20°C). If resistance is not 6.9-7.9 ohms, replace OCV.

Oil Control Valve Operation

Remove Oil Control Valve (OCV) to be tested. Connect a fused jumper wire between battery voltage and terminal No. 1 at OCV. See Fig. 36. Connect another jumper wire between negative battery terminal and terminal No. 2 at OCV and note OCV plunger operation. With battery voltage applied, plunger on end of OCV should extend. Disconnect a jumper wire. Without battery voltage applied, plunger should retract. If OCV operation is not as specified, replace OCV.

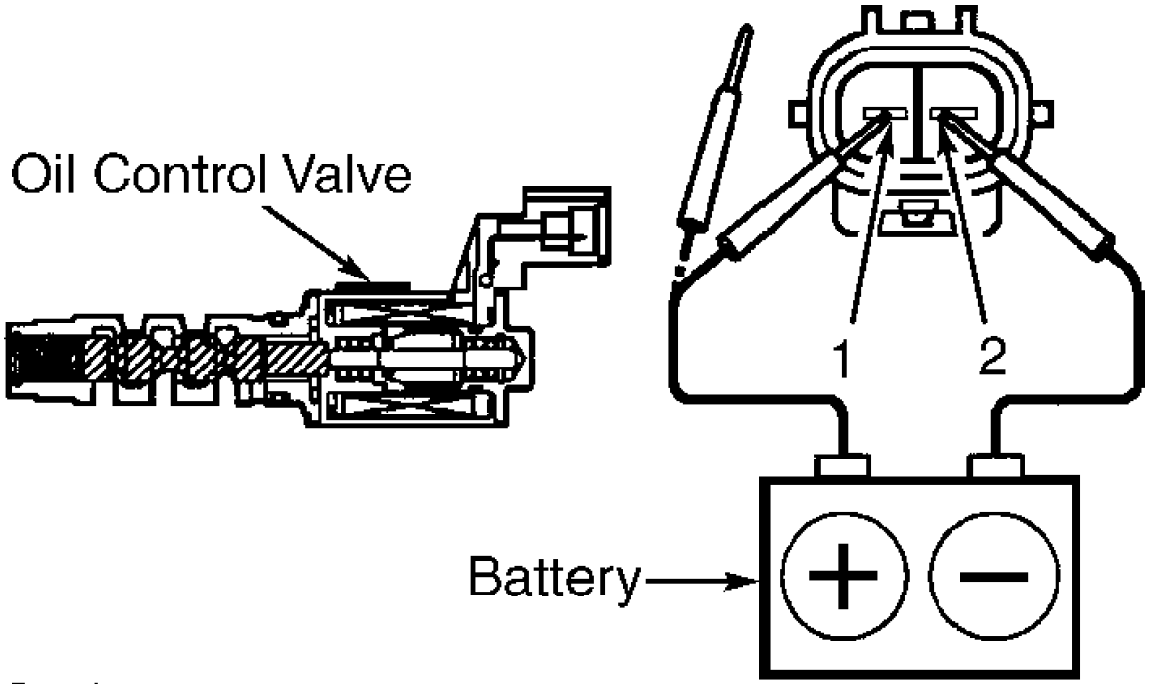


Fig. 36: Testing Camshaft Timing Oil Control Valve
Courtesy of Toyota Motor Sales, U.S.A., Inc.

VARIABLE VALVE TIMING (VVT) SENSOR

For VVT sensor testing, see VARIABLE VALVE TIMING SENSOR under ENGINE SENSORS & SWITCHES.

THROTTLE CONTROLS

THROTTLE OPENER

NOTE: Throttle opener testing for RX300 is not available from manufacturer.

ES300

1) Start engine and warm engine to normal operating temperature. Ensure idle speed is 650-750 RPM. Disconnect and plug vacuum hose at throttle opener near throttle body. See Fig. 37.

2) Start engine and note engine speed. Engine speed should be 1100-1700 RPM. If engine speed is not 1100-1700 RPM, replace throttle body. See THROTTLE BODY under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

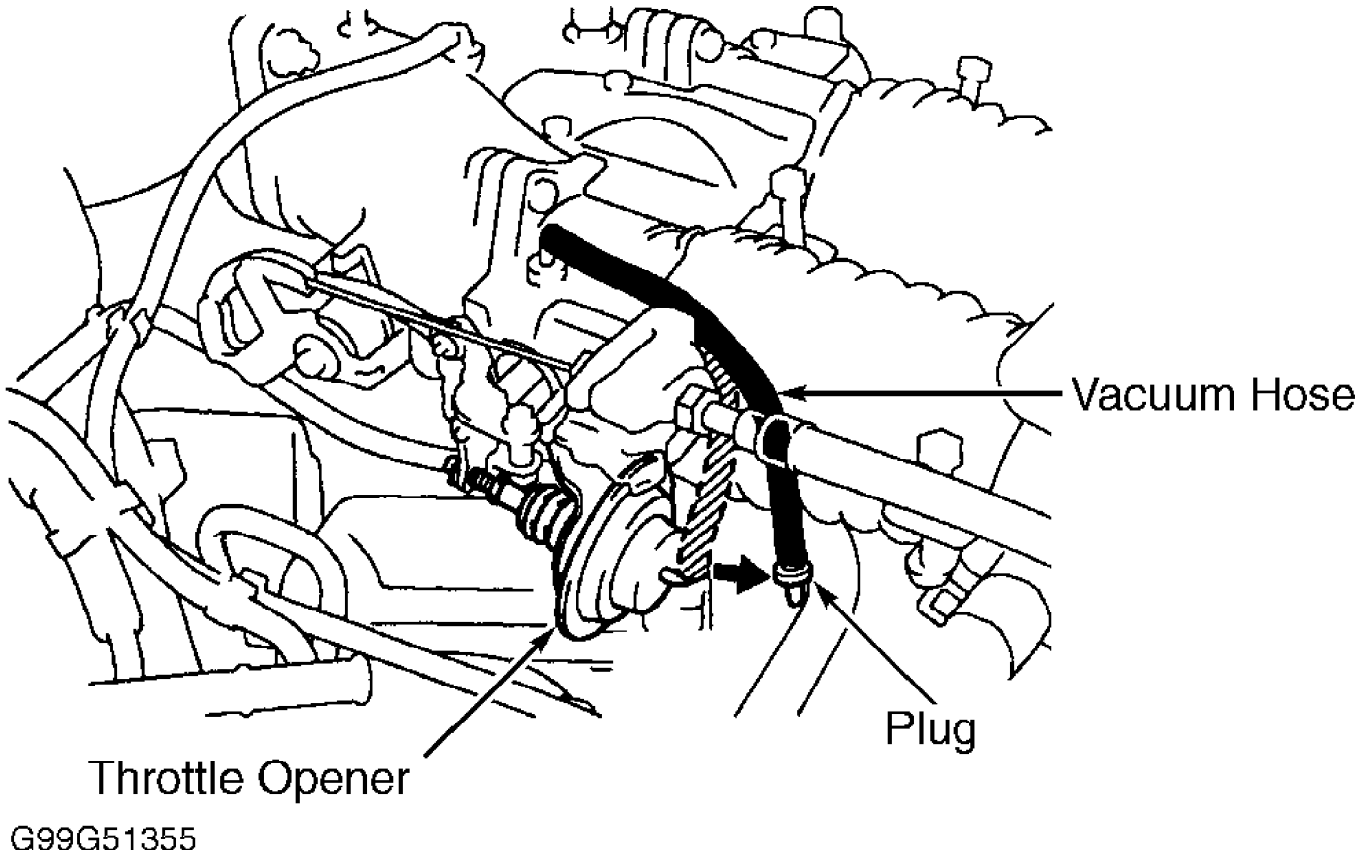


Fig. 37: Locating Throttle Opener (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

MISCELLANEOUS CONTROLS

NOTE: Although some of the controlled devices listed here are not technically engine performance components, they can affect driveability if they malfunction.

COOLING FAN SYSTEM

For electric cooling fan testing, see SPECIFICATIONS and ELECTRIC COOLING FANS articles in ENGINE COOLING in appropriate MITCHELL\R manual.

TRANSMISSION

For transmission diagnostic information, see appropriate ELECTRONIC CONTROLS article in AUTOMATIC TRANSMISSIONS in appropriate MITCHELL\R TRANSMISSION SERVICE & REPAIR manual.

J - PIN VOLTAGE CHARTS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Pin Voltage Charts
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

Pin voltage charts are used for diagnosing intermittent symptoms and faults that are unable to be resolved during self-diagnostics. Pin voltage tests ensure the Engine Control Module (ECM) is receiving and transmitting proper voltage and other signals. Before performing pin voltage tests, ensure engine mechanical condition has been thoroughly inspected and self-diagnostics has been attempted. Technical Service Bulletins (TSBs) may also be helpful in correcting a hard to diagnose problem.

NOTE: Unless stated otherwise in testing procedures, perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance. Voltage readings may vary slightly due to battery condition or charging rate. When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

ENGINE CONTROL MODULE LOCATION

For Engine Control Module (ECM) location, see ECM LOCATION table.

ECM LOCATION

Model	(1) Location
ES300	Behind Glove Box
GS300 & GS400	Driver's Side Front Corner Of Engine Compartment
LS400, LX470 & RX300	Behind Glove Box
SC300 & SC400	Under Passenger's Side Front Carpet Below Instrument Panel

(1) - For illustration of ECM location, see THEORY & OPERATION article.

NOTE: An engine immobilizer system is used on all models. If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

PIN VOLTAGE CHARTS

PIN VOLTAGE CHART INDEX

For appropriate pin voltage chart figure reference, see PIN VOLTAGE CHART INDEX table.

PIN VOLTAGE CHART INDEX

Model	See Figs
ES300	1-3
GS300	4 & 5
GS400	6-8
LS400	9-11
LX470	12-14
RX300	15 & 16
SC300	17 & 18
SC400	19-21

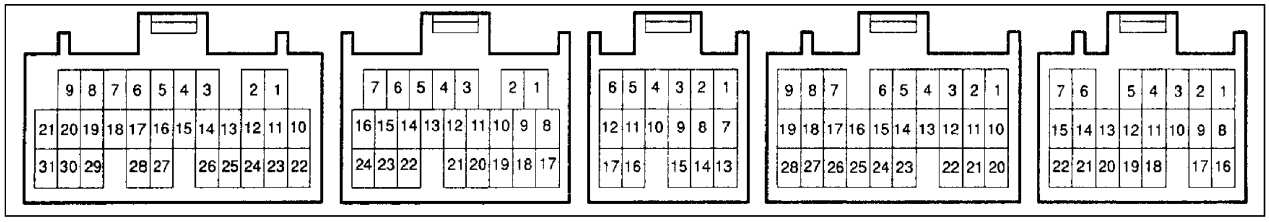
NOTE: When using pin voltage chart, it may be necessary to determine wire color by using wire color abbreviation. See WIRE COLOR ABBREVIATIONS table.

WIRE COLOR ABBREVIATIONS (1)

Wire Color Abbreviation	Wire Color
B	Black
BR	Brown
G	Green
GR	Gray
L	Blue
LG	Light Green
O	Orange
P	Pink
R	Red
SB	Sky Blue
V	Violet
W	White
Y	Yellow

(1) - Example: L-Y is a Blue wire with a Yellow tracer.

NOTE: For wiring circuit identification, see appropriate wiring diagram in WIRING DIAGRAMS article.



Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E7– 1) – E1 (E10 – 17)	B–Y ↔ BR	Always	9 ~ 14
+B (E7 – 16) – E1 (E10 – 17)	B–Y ↔ BR	IG switch ON	9 ~ 14
VC (E10 – 2) – E2 (E10–18)	Y ↔ BR	IG switch ON	4.5 ~ 5.5
VTA1 (E10–23) – E2 (E10–18)	L ↔ BR	IG switch ON Throttle valve fully closed	0.3 ~ 1.0
		IG switch ON Throttle valve fully open	3.2 ~ 4.9
VG (E10–10) – E2G (E10–19)	P ↔ R–B	Idling , A/C switch OFF	1.1 ~ 1.5
VV1 (E11–10) – NE– (E10–24)	O ↔ BR	Idling	Pulse generation
VV2 (E11–22) – NE– (E10–24)	L ↔ BR		
NE+ (E10–16) – NE– (E10–24)	B–R ↔ BR	Idling	Pulse generation
OC1+ (E11–6) – OC1– (E11–5)	G ↔ G–W	IG switch ON	Pulse generation
OC2+ (E11–29) – OC2– (E11–18)	G–R ↔ G–Y		
THA (E10 – 22) – E2 (E10 – 18)	L–Y ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E10 –14) – E2 (E10 – 18)	G–B ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E7 – 7) – E1 (E10 – 17)	GR ↔ BR	Cranking	6.0 or more
CODE (E8 – 28) – E1 (E10 – 17)	G–W ↔ BR	At time of inserting key	Pulse generation
IGSW (E7 – 2) – E1 (E10 – 17)	B–R ↔ BR	IG switch ON	9 ~ 14
TXCT (E8 – 18) – E1 (E10 – 17)	L–Y ↔ B–R	At time of inserting key	Pulse generation
IMLD (E7 – 22) – E1 (E10 – 17)	R–Y ↔ BR	In condition without key inserted	Pulse generation
MREL– (E7 – 8) – E1 (E10 – 17)	B–W ↔ BR	IG switch ON	9 ~ 14

99I51936

Fig. 1: Pin Voltage Chart (ES300 - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
#10 (E10 – 5) – E01 (E11 – 21)	L ↔ BR	Idling	Pulse generation
#20 (E10 – 6) – E01 (E11 – 21)	R ↔ BR	IG switch ON	9 ~ 14
		Idling	Pulse generation
#30 (E11 – 1) – E01 (E11 – 21)	Y ↔ BR	IG switch ON	9 ~ 14
		Idling	Pulse generation
#40 (E11 – 2) – E01 (E11 – 21)	W ↔ BR	IG switch ON	9 ~ 14
		Idling	Pulse generation
#50 (E11 – 3) – E01 (E11 – 21)	R–L ↔ BR	IG switch ON	9 ~ 14
		Idling	Pulse generation
#60 (E11 – 4) – E01 (E11 – 21)	G ↔ BR	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT1 (E11 – 11) – E1 (E10 – 17)	L – B ↔ BR	Idling	Pulse generation
IGT2 (E11 – 12) – E1 (E10 – 17)	L – W ↔ BR	Idling	Pulse generation
IGT3 (E11 – 13) – E1 (E10 – 17)	L – R ↔ BR	Idling	Pulse generation
IGF (E11 – 25) – E1 (E10 – 17)	W–R ↔ BR	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
NE+ (E10 – 16) – NE– (E10 –24)	B–R ↔ BR	Idling	Pulse generation
ELS (E8 – 4) – E1 (E10 – 17)	G–O ↔ BR	Taillight switch ON	7.5 ~ 14
		Taillight switch OFF	0 ~ 1.5
ELS2 (E8 – 13) – E1 (E10 – 17)	B–Y ↔ BR	Defogger switch ON	7.5 ~ 14
		Defogger switch OFF	0 ~ 1.5
ACIS (E11 – 17) – E01 (E11 – 21)	R–Y ↔ BR	IG switch ON	9 ~ 14
FC (E7 – 3) – E01 (E11 – 21)	G–R ↔ BR	IG switch ON	9 ~ 14
		Idling	0 ~ 3.0
EVP1 (E10 – 7) – E01 (E11 – 21)	LG ↔ BR	IG switch ON	9 ~ 14
RSO (E11 – 26) – E01 (E11 – 21)	R–W ↔ BR	IG switch ON Disconnect E7 of ECM connector	9 ~ 14
OXS (E8 – 8) – E1 (E10 – 17)	B ↔ BR	Maintain engine speed at 2,500 rpm for 2 min. after warming up	Pulse generation
HTS (E8 – 9) – E03 (E11 – 30)	P–B ↔ BR	Idling	Below 3.0
		IG switch ON	9 ~ 14

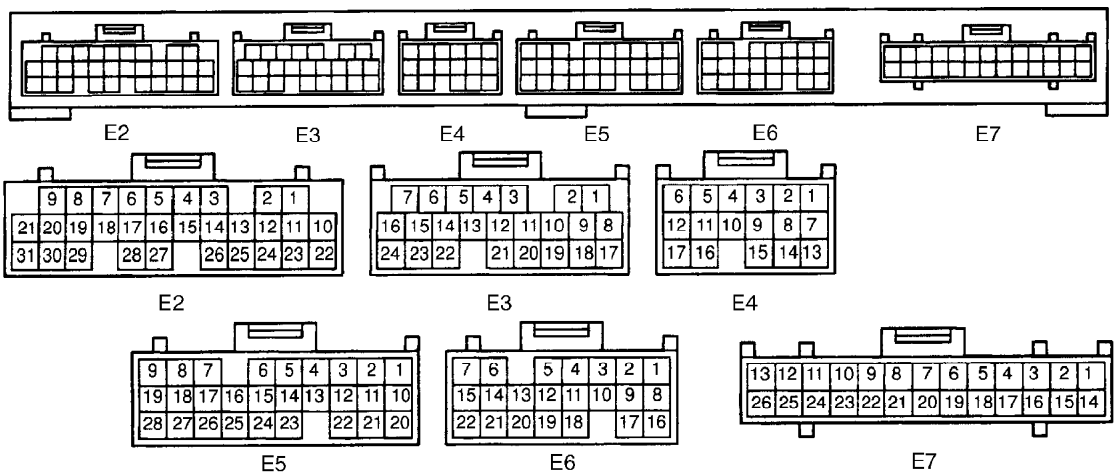
99J51937

Fig. 2: Pin Voltage Chart (ES300 - 2 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
KNKR (E11 – 27) – E1 (E10 – 17)	W ↔ BR	Idling	Pulse generation
KNKL (E11 – 28) – E1 (E10 – 17)	W ↔ BR	Idling	Pulse generation
NSW (E8 – 20) – E1 (E10 – 17)	B–W ↔ BR	IG switch ON Other shift position in "P" ,"N" position	9 ~ 14
		IG switch ON Shift position in "P" ,"N" position	0 ~ 3.0
SPD (E8 – 22) – E1 (E10 – 17)	V–W ↔ BR	IG switch ON Rotate driving wheel slowly	Pulse generation
TC (E8 – 5) – E1 (E10 – 17)	L–W ↔ BR	IG switch ON	9 ~ 14
W (E7 – 6) – E01 (E11 – 21)	G–R ↔ BR	IG switch ON	Below 3.0
PS (E10 – 9) – E1 (E10 – 17)	B–L ↔ BR	IG switch ON	9 ~ 14
ACT (E8 – 17) – E1 (E10 – 17)	LG–B ↔ BR	A/C switch OFF	Below 2.0
		A/C switch ON at idling	9 ~ 14
A/C (E8 – 7) – E1 (E10 – 17)	B–Y ↔ BR	A/C switch ON at idling	Below 2.0
		A/C switch OFF	9 ~ 14
CF (E8 – 26) – E1 (E10 – 17)	G–W ↔ BR	Electric cooling fan is operating on high speed	9 ~ 14
		Electric cooling fan is operating on low speed or OFF	0 ~ 2
TACH (E8 – 27) – E1 (E10–17)	B-O ↔ BR	Idling	Pulse generation
TPC (E7 – 9) – E01 (E11 – 21)	V ↔ BR	IG switch ON Disconnect vacuum hose from vapor pressure sensor	9 ~ 14
PTNK (E7 – 17) – E1 (E10 – 17)	P ↔ BR	IG switch ON	3.0 ~ 3.6
		IG switch ON Apply vacuum 2.0 kPa (15 mmHg, 0.6 in.Hg)	1.3 ~ 2.1
SIL (E7 – 4) – E1 (E10 – 17)	W ↔ BR	During transmission	Pulse generation
STP (E7 – 15) – E1 (E10 – 17)	G–W ↔ BR	IG switch ON Brake pedal depressed	7.5 ~ 14
		IG switch ON Brake pedal released	Below 1.5
AFR+ (E10 – 11) – E1 (E10 – 17)	G ↔ BR	IG switch ON	3.0 ~ 3.6
AFR– (E10 – 20) – E1 (E10 – 17)	R ↔ BR	IG switch ON	2.7 ~ 3.3
AFL+ (E10 – 12) – E1 (E10 – 17)	L ↔ BR	IG switch ON	3.0 ~ 3.6
AFL– (E10 – 21) – E1 (E10 – 17)	B–W ↔ BR	IG switch ON	2.7 ~ 3.3
HAFR (E10 – 3) – E04 (E10 – 1)	B-W↔ BR	Idling	Below 3.0
		IG switch ON	9 ~ 14
HAFL (E10 – 4) – E05 (E10 – 8)	B–R ↔ BR	Idling	Below 3.0
		IG switch ON	9 ~ 14
KSW (E8 – 23) – E1 (E10 – 17)	L–B ↔ BR	At time of inserting key	Below 1.5
		In condition without key inserted	4 ~ 5
RXCK (E8 – 19) – E1 (E10 – 17)	R–L ↔ BR	At time of inserting key	Pulse generation

99A51938

Fig. 3: Pin Voltage Chart (ES300 - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E6–1) – E1 (E3–17)	B–Y ↔ BR	Always	9 ~ 14
BM (E6–7) – E1 (E3–17)	V–Y ↔ BR		
IGSW (E6–9) – E1 (E3–17)	B –O ↔ BR	IG switch ON	9 ~ 14
+B (E6–16) – E1 (E3–17)	B–R ↔ BR		
B2 (E6–8) – E1 (E3–17)	B–R ↔ BR		
VC (E3–2) – E2 (E3–18)	L–Y ↔ BR	IG switch ON	4.5 ~ 5.5
VTA (E3–23) – E2 (E3–18)	Y–G ↔ BR	IG switch ON Accelerator pedal released	0.4 ~ 1.0
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VTA2 (E3–24) – E2 (E3–18)	Y–R ↔ BR	IG switch ON Accelerator pedal released	2.0 ~ 2.9
		IG switch ON Accelerator pedal depressed	4.6 ~ 5.1
VPA (E3–15) – E2 (E3–18)	L ↔ BR	IG switch ON Accelerator pedal released	0.3 ~ 0.9
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VPA2 (E3–16) – E2 (E3–18)	L–R ↔ BR	IG switch ON Accelerator pedal released	1.8 ~ 2.7
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
VG (E3–10) – EVG (E3–19)	R–L ↔ GR	Idling, P or N position, A/C switch OFF	1.1 ~ 1.5
THA (E3–22) – E2 (E3–18)	W–R ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E3–14) – E2 (E3–18)	B–R ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E5–2) – E1 (E3–17)	B ↔ BR	Shift lever position P or N position, ignition switch START	9 ~ 14
M+ (E2–8) – E1 (E3–17) M– (E2–7) – E1 (E3–17)	W ↔ BR B ↔ BR	Idling	Pulse generation
SIL (E6–11) – E1 (E3–17)	W ↔ BR	IG switch ON	9 ~ 14
SP2+ (E4–5) – SP2– (E4–11)	L–Y ↔ R–L	Vehicle is driving	Pulse generation

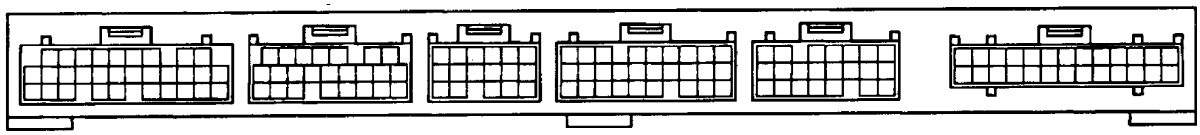
G99B51939

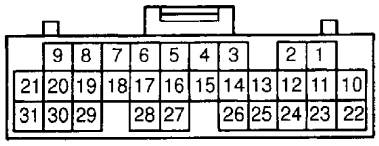
Fig. 4: Pin Voltage Chart (GS300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

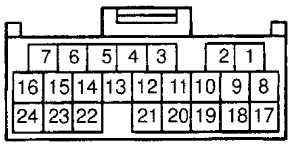
Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
#10 (E3-5) - E01 (E2-21) #20 (E3-6) - E01 (E2-21) #30 (E2-1) - E01 (E2-21) #40 (E2-2) - E01 (E2-21) #50 (E2-3) - E01 (E2-21) #60 (E2-4) - E01 (E2-21)	Y ↔ W-B B-W ↔ W-B L ↔ W-B R ↔ W-B W ↔ W-B R-L ↔ W-B	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT (E2-11) - E1 (E3-17) IGT2 (E2-12) - E1 (E3-17) IGT3 (E2-13) - E1 (E3-17)	B-Y ↔ BR B-L ↔ BR B-R ↔ BR	Idling	Pulse generation
IGF (E2-25) - E1 (E3-17)	B ↔ BR	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
G2 (E2-10) - NE- (E2-22)	Y ↔ L	Idling	Pulse generation
NE + (E2-23) - NE- (E2-22)	W ↔ L		
MREL (E6-10) - E1 (E3-17)	B-Y ↔ BR	IG switch ON	9 ~ 14
FPC (E6-5) - E1 (E3-17)	B-L ↔ BR	IG switch ON	Below 1.5
		Idling	Pulse generation
DI (E6-4) - E1 (E3-17)	B-R ↔ BR	Idling	7.0 or more
STP (E5-6) - E1 (E3-17)	G-W ↔ BR	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
PRG (E3-7) - E01 (E2-21)	B-Y ↔ W-B	IG switch ON	9 ~ 14
TPC (E7-13) - E01 (E2-21)	W-R ↔ W-B	IG switch ON	9 ~ 14
PTNK (E5-18) - E2 (E3-18)	L-Y ↔ BR	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 4.0 kPa (30 mmHg, 1.1 in.Hg)	Below 0.5
OX1A (E3-12) - E2 (E3-18) OX1B (E5-8) - E2 (E3-18) OX2A (E3-11) - E2 (E3-18) OX2B (E7-24) - E2 (E3-18)	B ↔ BR W ↔ BR W ↔ BR R ↔ BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HT1A (E3-4) - E01 (E2-21) HT1B (E7-26) - E01 (E2-21) HT2A (E3-3) - E01 (E2-21) HT2B (E7-25) - E01 (E2-21)	R ↔ W-B GR ↔ W-B Y ↔ W-B GR-B ↔ W-B	Idling	Below 3.0
		IG switch ON	9 ~ 14
KNK1 (E2-28) - E1 (E3-17)	B ↔ BR	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNK2 (E2-27) - E1 (E3-17)	GR ↔ BR		
TC (E5-5) - E1 (E3-17)	P-B ↔ BR	IG switch ON	9 ~ 14
W (E6-6) - E01 (E2-21)	GR-R ↔ W-B	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACMG (E5-13) - E01 (E2-21)	L-O ↔ W-B	A/C switch ON (at idling)	Below 3.0
		A/C switch OFF	9 ~ 14
OCV+ (E2-18) - OCV- (E2-17)	W-R ↔ R-W	IG switch ON	Pulse generation
ACIS (E2-5) - E01 (E2-21)	B-L ↔ W-B	IG switch ON	9 ~ 14
		Engine speed between 2,500 and 4,000 rpm	Below 3.0
CL+ (E2-20) - CL- (E2-19)	G-R ↔ Y-R	Idling	Pulse generation

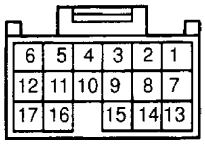
G99E51940

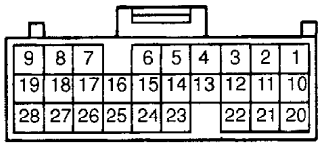
Fig. 5: Pin Voltage Chart (GS300 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

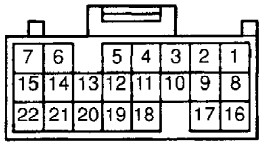


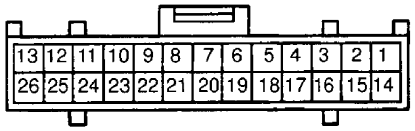












Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E6–1) – E1 (E3–17)	B–Y ↔ BR	Always	9 ~ 14
+BM (E6–7) – E1 (E3–17)	V–Y ↔ BR		
IGSW (E6–9) – E1 (E3–17)	B–O ↔ BR	IG switch ON	9 ~ 14
+B1 (E6–16) – E1 (E3–17)	B–R ↔ BR		
+B2 (E6–8) – E1 (E3–17)	B–R ↔ BR		
VC (E3–2) – E2 (E3–18)	L–Y ↔ BR	IG switch ON	4.5 ~ 5.5
VTA (E3–13) – E2 (E3–18)	R–B ↔ BR	IG switch ON Accelerator pedal released	0.4 ~ 1.0
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VTA2 (E3–20) – E2 (E3–18)	L–B ↔ BR	IG switch ON Accelerator pedal released	2.0 ~ 2.9
		IG switch ON Accelerator pedal depressed	4.6 ~ 5.1
VPA (E3–21) – E2 (E3–18)	L–W ↔ BR	IG switch ON Accelerator pedal released	0.3 ~ 0.9
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VPA2 (E3–9) – E2 (E3–18)	Y–B ↔ BR	IG switch ON Accelerator pedal released	1.8 ~ 2.7
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
VG (E3–10) – EVG (E3–19)	R–L ↔ GR	Idling, P or N position, A/C switch OFF	0.5 ~ 3.0
THA (E3–22) – E2 (E3–18)	W–R ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E3–14) – E2 (E3–18)	B–R ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E5–17) – E1 (E3–17)	B ↔ BR	Shift lever position P or N position, Ignition switch START	6.0 or more

99F51941

Fig. 6: Pin Voltage Chart (GS400 - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
#10 (E3–5) – E01 (E2–21) #20 (E3–6) – E01 (E2–21) #30 (E2–1) – E01 (E2–21) #40 (E2–2) – E01 (E2–21) #50 (E2–3) – E01 (E2–21) #60 (E2–4) – E01 (E2–21) #70 (E2–5) – E01 (E2–21) #80 (E2–6) – E01 (E2–21)	Y ↔ W–B B–R ↔ W–B L ↔ W–B R ↔ W–B W ↔ W–B R–L ↔ W–B G ↔ W–B B ↔ W–B	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT1 (E2–11) – E1 (E3–17) IGT2 (E2–12) – E1 (E3–17) IGT3 (E2–13) – E1 (E3–17) IGT4 (E2–14) – E1 (E3–17) IGT5 (E2–15) – E1 (E3–17) IGT6 (E2–16) – E1 (E3–17) IGT7 (E2–25) – E1 (E3–17) IGT8 (E2–26) – E1 (E3–17)	Y–B ↔ BR Y–G ↔ BR R–W ↔ BR B–R ↔ BR L–Y ↔ BR R–L ↔ BR Y–R ↔ BR L–W ↔ BR	Idling	Pulse generation
IGF1 (E2–27) – E1 (E3–17) IGF2 (E2–28) – E1 (E3–17)	G–B ↔ BR R ↔ BR	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
G2 (E2–10) – NE– (E2–22)	Y ↔ L	Idling	Pulse generation
NE+ (E2–23) – NE– (E2–22)	W ↔ L		
M–REL (E6–10) – E1 (E3–17)	B–Y ↔ BR	IG switch ON	9 ~ 14
DI (E6–4) – E1 (E3–17)	B–R ↔ BR	IG switch ON	0 ~ 3.0
FPC (E6–5) – E1 (E3–17)	B–L ↔ BR	IG switch ON	9 ~ 14
STP (E5–6) – E1 (E3–17)	G–W ↔ BR	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
PRG (E3–7) – E1 (E3–17)	B–Y ↔ BR	IG switch ON	9 ~ 14
TPC (E5–10) – E1 (E3–17)	W–R ↔ BR	IG switch ON	9 ~ 14
PTNK (E5–22) – E2 (E3–18)	L–Y ↔ BR	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	Below 0.5
OXL1 (E3–12) – E1 (E3–17) OXL2 (E5–18) – E1 (E3–17) OXR1 (E3–11) – E1 (E3–17) OXR2 (E5–27) – E1 (E3–17)	W ↔ BR W ↔ BR B ↔ BR R ↔ BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HTL (E3–4) – E1 (E3–17) HTL2 (E5–8) – E1 (E3–17) HTR (E3–3) – E1 (E3–17) HTR2 (E5–7) – E1 (E3–17)	Y–G ↔ BR GR ↔ BR R–Y ↔ BR GR–B ↔ BR	Idling	Below 3.0
		IG switch ON	9 ~ 14
KNKL (E2–18) – E1 (E3–17)	GR ↔ BR	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNKR (E2–17) – E1 (E3–17)	B ↔ BR		
TC (E5–5) – E1 (E3–17)	P–B ↔ BR	IG switch ON	9 ~ 14
W (E6–6) – E1 (E3–17)	GR–R ↔ BR	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACMG (E5–13) – E1 (E3–17)	L–O ↔ BR	A/C switch ON (at idling)	Below 3.0
		A/C switch OFF	9 ~ 14
ENG+ (F6–14) – ENG– (E6–21) TRC+ (E6–13) – TRC– (E6–20)	LG ↔ L P ↔ V	Idling	Pulse generation

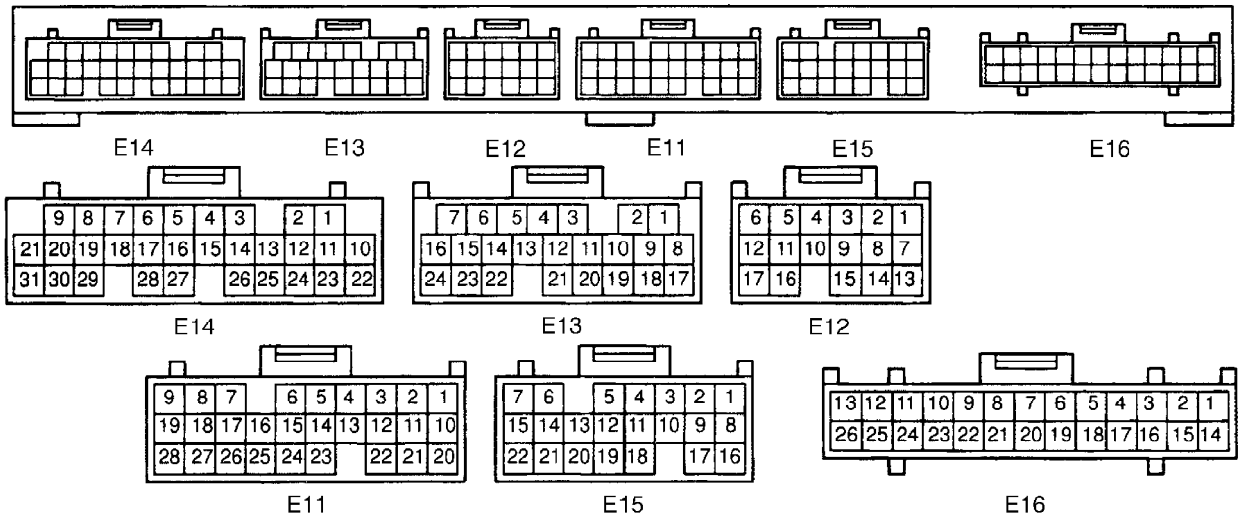
99G51942

Fig. 7: Pin Voltage Chart (GS400 - 2 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
VVL+ (E3–16) – VVL– (E3–24)	R ↔ G	Idling	Pulse generation
VVR+ (E3–15) – VVR– (E3–23)	Y ↔ L		
OCV+ (E2–20) – OCV– (E2–19)	W–R ↔ L–B	IG switch ON	Pulse generation
OCR+ (E5–19) – OCR– (E5–28)	W–G ↔ Y–R		
ACIS (E2–29) – E01 (E2–21)	B–L ↔ W–B	IG switch ON	9 – 14
		Engine speed between 2,500 rpm and 4,000 rpm	Below 3.0
CL+ (E4–12) – CL– (E3–8)	G–R ↔ Y–R	Idling	Pulse generation
M+ (E2–8) – E1 (E3–17) M– (E2–7) – E1 (E3–17)	G ↔ BR R ↔ BR	Idling	Pulse generation
SIL (E6–11) – E1 (E3–17)	W ↔ BR	During transmission	Pulse generation
SP2+ (E4–5) – SP2– (E4–11)	L–Y ↔ R–L	Vehicle is driving	Pulse generation

99H51943

Fig. 8: Pin Voltage Chart (GS400 - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E15–1) – E1 (E13–17)	B–Y ↔ W–B	Always	9 ~ 14
+BM (E15–7) – E1 (E13–17)	L–Y ↔ W–B		
IGSW (E15–9) – E1 (E13–17)	B–O ↔ W–B	IG switch ON	9 ~ 14
+B (E15–16) – E1 (E13–17)	W ↔ W–B		
+B1 (E15–8) – E1 (E13–17)	W ↔ W–B		
VC (E13–2) – E2 (E13–18)	B–R ↔ BR	IG switch ON	4.5 ~ 5.5
VTA (E13–13) – E2 (E13–18)	P–L ↔ BR	IG switch ON Accelerator pedal fully closed	0.4 ~ 1.0
		IG switch ON Accelerator pedal fully open	3.2 ~ 4.8
VTA2 (E13–20) – E2 (E13–18)	B–L ↔ BR	IG switch ON Accelerator pedal fully closed	2.0 ~ 2.9
		IG switch ON Accelerator pedal fully open	4.6 ~ 5.1
VPA (E13–21) – E2 (E13–18)	P ↔ BR	IG switch ON Accelerator pedal fully closed	0.3 ~ 0.9
		IG switch ON Accelerator pedal fully open	3.2 ~ 4.8
VPA2 (E13–9) – E2 (E13–18)	R–B ↔ BR	IG switch ON Accelerator pedal fully closed	1.8 ~ 2.7
		IG switch ON Accelerator pedal fully open	4.7 ~ 5.1
VG (E13–10) – EVG (E13–19)	L–Y ↔ G–W	Idling, P or N position, A/C switch OFF	0.5 ~ 3.0
THA (E13–22) – E2 (E13–18)	Y–B ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E13–14) – E2 (E13–18)	R–L ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E11–17) – E1 (E13–17)	B ↔ W–B	Shift lever position P or N position, Ignition switch START	6.0 or more

G99J51945

Fig. 9: Pin Voltage Chart (LS400 - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
#1 (E13–5) – E01 (E14–21) #2 (E13–6) – E01 (E14–21) #3 (E14–1) – E01 (E14–21) #4 (E14–2) – E01 (E14–21) #5 (E14–3) – E01 (E14–21) #6 (E14–4) – E01 (E14–21) #7 (E14–5) – E01 (E14–21) #8 (E14–6) – E01 (E14–21)	Y ↔ W–B B ↔ W–B L ↔ W–B R ↔ W–B G ↔ W–B R–L ↔ W–B W ↔ W–B B–W ↔ W–B	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT1 (E14–11) – E1 (E13–17) IGT2 (E14–12) – E1 (E13–17) IGT3 (E14–13) – E1 (E13–17) IGT4 (E14–14) – E1 (E13–17) IGT5 (E14–15) – E1 (E13–17) IGT6 (E14–16) – E1 (E13–17) IGT7 (E14–25) – E1 (E13–17) IGT8 (E14–26) – E1 (E13–17)	LG ↔ W–B B ↔ W–B L ↔ W–B R ↔ W–B G ↔ W–B R–L ↔ W–B Y–G ↔ W–B B–W ↔ W–B	Idling	Pulse generation
IGF1 (E14–27) – E1 (E13–17)	Y–B ↔ W–B	IG switch ON	4.5 ~ 5.5
IGF2 (E14–28) – E1 (E13–17)	Y ↔ W–B	Idling	Pulse generation
G2 (E14–10) – NE– (E14–22)	Y ↔ W	Idling	Pulse generation
NE+ (E14–23) – NE– (E14–22)	B ↔ W		
MREL (E15–10) – E1 (E13–17)	LG ↔ W–B	IG switch ON	9 ~ 14
FPR (E15–4) – E1 (E13–17)	G–R ↔ W–B	IG switch ON	0 ~ 3.0
FC (E15–5) – E1 (E13–17)	G–B ↔ W–B	IG switch ON	9 ~ 14
STP (E11–6) – E1 (E13–17)	L–B ↔ W–B	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
PRG (E13–7) – E1 (E13–17)	L–B ↔ W–B	IG switch ON	9 ~ 14
TPC (E11–10) – E1 (E13–17)	W–G ↔ W–B	IG switch ON	9 ~ 14
PTNK (E11–22) – E2 (E13–18)	B–L ↔ BR	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	Below 0.5
OXL1 (E13–12) – E1 (E13–17) OXL2 (E11–18) – E1 (E13–17) OXR1 (E13–11) – E1 (E13–17) OXR2 (E11–27) – E1 (E13–17)	B ↔ W–B G ↔ W–B W ↔ W–B Y ↔ W–B	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HTL (E13–4) – E1 (E13–17) HTL2 (E11–8) – E1 (E13–17)	R ↔ W–B R ↔ W–B	Idling	Below 3.0
HTR (E13–3) – E1 (E13–17) HTR2 (E11–7) – E1 (E13–17)	Y ↔ W–B V–W ↔ W–B	IG switch ON	9 ~ 14
KNKL (E14–18) – E1 (E13–17)	B ↔ W–B	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNKR (E14–17) – E1 (E13–17)	GR ↔ W–B		
TC (E11–5) – E1 (E13–17)	LG–B ↔ W–B	IG switch ON	9 ~ 14
W (E15–6) – E1 (E13–17)	Y–R ↔ W–B	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACMG (E11–13) – E1 (E13–17)	W ↔ W–B	A/C switch ON (at idling)	Below 3.0
		A/C switch OFF	9 ~ 14
ENG+ (E15–14) – ENG– (E15–21) TRC+ (E15–13) – TRC– (E15–20)	BR ↔ Y L ↔ P	Idling	Pulse generation

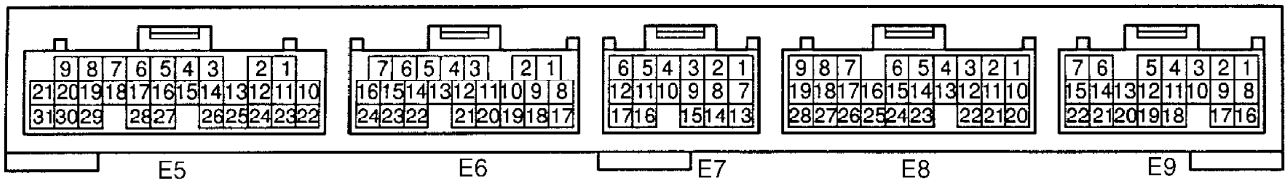
99A51946

Fig. 10: Pin Voltage Chart (LS400 - 2 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
VVL+ (E13–16) – VVL– (E13–24)	R ↔ G	Idling	Pulse generation
VVR+ (E13–15) – VVR– (E13–23)	Y ↔ L		
OCV+ (E14–20) – OCV– (E14–19)	L–W ↔ L–B	IG switch ON	Pulse generation
OCR+ (E11–19) – OCR– (E11–28)	L–W ↔ L		
ACIS (E14–29) – E01 (E14–21)	W–L ↔ W–B	IG switch ON	9 ~ 14
		Engine speed between 2,500 rpm and 4,000 rpm	Below 3.0
CL+ (E12–12) – CL– (E13–8)	L–R ↔ G–B	Idling	Pulse generation
M+ (E14–8) – E1 (E13–17) M– (E14–7) – E1 (E13–17)	Y ↔ W–B L ↔ W–B	Idling	Pulse generation
ST1– (E16–14) – E1 (E13–17)	B–Y ↔ W–B	IG switch ON, Brake pedal is depressed	Below 1.5
		IG switch ON, Brake pedal is released	7.5 ~ 14
SIL (E15–11) – E1 (E13–17)	L ↔ W–B	During transmission	Pulse generation
SP2+ (E12–5) – SP2– (E –11)	G ↔ R	Vehicle is driving	Pulse generation

G99B51947

Fig. 11: Pin Voltage Chart (LS400 - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E9–1) – E1 (E6–17)	B–R ↔ BR	Always	9 ~ 14
+BM (E9–7) – E1 (E6–17)	Y–B ↔ BR		
IGSW (E9–9) – E1 (E6–17)	B–R ↔ BR	IG switch ON	9 ~ 14
+B (E9–16) – E1 (E6–17)	B–Y ↔ BR		
+B1 (E9–8) – E1 (E6–17)	B–Y ↔ BR		
MREL (E9–10) – E1 (E6–17)	B–W ↔ BR	IG switch ON	9 ~ 14
VC (E6–2) – E2 (E6–18)	L–R ↔ BR–W	IG switch ON	4.5 ~ 5.5
VG (E6–10) – EVG (E6–19)	L–Y ↔ G–W	Idling, P or N position, A/C switch OFF	0.5 ~ 3.0
THA (E6–22) – E2 (E6–18)	Y–B ↔ BR–W	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E6–14) – E2 (E6–18)	G–B ↔ BR–W	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
VTA (E6–13) – E2 (E6–18)	R–Y ↔ BR–W	IG switch ON Accelerator pedal released	0.4 ~ 1.0
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VTA2 (E6–20) – E2 (E6–18)	Y–B ↔ BR–W	IG switch ON Accelerator pedal released	2.0 ~ 2.9
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
VPA (E6–21) – E2 (E6–18)	R ↔ BR–W	IG switch ON Accelerator pedal released	0.3 ~ 0.9
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VPA2 (E6–9) – E2 (E6–18)	R–B ↔ BR–W	IG switch ON Accelerator pedal released	1.8 ~ 2.7
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
OXL1 (E6–12) – E1 (E6–17) OXL2 (E8–18) – E1 (E6–17) OXR1 (E6–11) – E1 (E6–17) OXR2 (E8–27) – E1 (E6–17)	B ↔ BR B ↔ BR W ↔ BR W ↔ BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HTL (E6–4) – E1 (E6–17) HTL2 (E8–8) – E1 (E6–17)	R ↔ BR L ↔ BR	Idling	Below 3.0
HTR (E6–3) – E1 (E6–17) HTR2 (E8–7) – E1 (E6–17)	Y ↔ BR R–B ↔ BR	IG switch ON	9 ~ 14

98I11948

Fig. 12: Pin Voltage Chart (LX470 - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
#1 (E6–5) – E01 (E5–21) #2 (E6–6) – E01 (E5–21) #3 (E5–1) – E01 (E5–21) #4 (E5–2) – E01 (E5–21) #5 (E5–3) – E01 (E5–21) #6 (E5–4) – E01 (E5–21) #7 (E5–5) – E01 (E5–21) #8 (E5–6) – E01 (E5–21)	Y ↔ W–B B ↔ W–B L ↔ W–B R ↔ W–B G ↔ W–B R–L ↔ W–B W ↔ W–B B–W ↔ W–B	IG switch ON	9 – 14
		Idling	Pulse generation
KNKL (E5–18) – E1 (E6–17)	B ↔ BR	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNKR (E5–17) – E1 (E6–17)	W ↔ BR		
G2 (E5–10) – NE– (E5–22)	R ↔ G	Idling	Pulse generation
NE+ (E5–23) – NE– (E5–22)	L ↔ G		
PRG (E6–7) – E1 (E6–17)	L–B ↔ BR	IG switch ON	9 ~ 14
TPC (E8–10) – E1 (E6–17)	L ↔ BR	IG switch ON	9 – 14
PTNK (E8–22) – E2 (E6–18)	L–B ↔ BR–W	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 3.5 kPa (26 mmHg, 1.0 in. Hg)	Below 0.5
SPD (E8–15) – E1 (E6–17)	V ↔ BR	IG switch ON Rotate driving wheel slowly	Pulse generation
CL+ (E5–29) – CL– (E5–24)	G ↔ L	Idling	Pulse generation
M+ (E5–8) – E1 (E6–17) M– (E5–7) – E1 (E6–17)	R ↔ BR W ↔ BR	Idling	Pulse generation
DI (E9–4) – E1 (E6–17)	G–R ↔ BR	IG switch ON	9 ~ 14
FPC (E9–5) – E1 (E6–17)	G–W ↔ BR	IG switch ON	0 ~ 3.0
IGT1 (E5–11) – E1 (E6–17) IGT2 (E5–12) – E1 (E6–17) IGT3 (E5–13) – E1 (E6–17) IGT4 (E5–14) – E1 (E6–17) IGT5 (E5–15) – E1 (E6–17) IGT6 (E5–16) – E1 (E6–17) IGT7 (E5–25) – E1 (E6–17) IGT8 (E5–26) – E1 (E6–17)	B ↔ BR R ↔ BR L ↔ BR G ↔ BR Y ↔ BR B–Y ↔ BR B–L ↔ BR L–B ↔ BR	Idling	Pulse generation
IGF1 (E5–27) – E1 (E6–17) IGF2 (E5–28) – E1 (E6–17)	B–W ↔ BR B–R ↔ BR	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
STP (E8–6) – E1 (E6–17)	G–W ↔ BR	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
STA (E8–17) – E1 (E6–17)	B–R ↔ BR	Shift lever position P or N position, ignition switch START	6.0 or more
NSW (E8–20) – E1 (E6–17)	B–W ↔ BR	IG switch ON Other shift position in "P" ,"N" position	9 ~ 14
		IG switch ON Shift position in "P" ,"N" position	0 ~ 3.0
W (E9–6) – E1 (E6–17)	W ↔ BR	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACT (E8–13) – E1 (E6–17)	L–B ↔ BR	A/C switch OFF	Below 3.0
		A/C switch ON at idling	9 ~ 14
A/C (E8–25) – E1 (E6–17)	W–G ↔ BR	A/C switch ON at idling	Below 1.5
		A/C switch OFF	7.5 ~ 14

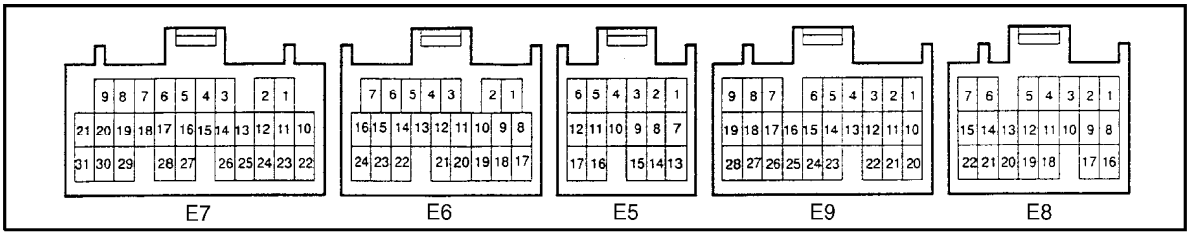
98J11949

Fig. 13: Pin Voltage Chart (LX470 - 2 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminals No.)	Wiring Color	Condition	STD Voltage (V)
ST1– (E9–19) – E1 (E6–17)	R–G ↔ BR	IG switch ON, Brake pedal is depressed	Below 1.5
		IG switch ON, Brake pedal is released	7.5 ~ 14
SIL (E9–11) – E1 (E6–17)	V–W ↔ BR	During transmission	Pulse generation
ELS (E8–12) – E1 (E6–17)	G–W↔ BR	Taillight switch ON, Defogger switch ON	7.5 ~ 14
		Taillight switch OFF, Defogger switch OFF	0 ~ 1.5
TACH (E8–16) – E1 (E6–17)	B ↔ BR	Idling	Pulse generation
KSW (E9–20) – E1 (E6–17)	R–B ↔ BR	At the time of inserting the key	Below 1.5
		In the condition without the key inserted	4 ~ 5
RXCK (E9–13) – E1 (E6–17)	V–G ↔ BR	At the time of inserting the key	Pulse generation
CODE (E9–12) – E1 (E6–17)	L–B ↔ BR	At the time of inserting the key	Pulse generation
TXCT (E9–14) – E1 (E6–17)	R–Y ↔ BR	At the time of inserting the key	Pulse

98D11950

Fig. 14: Pin Voltage Chart (LX470 - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E8–1) – E1 (E6–17)	B–Y ↔ BR	Always	9 – 14
+B (E8–16) – E1 (E6–17)	L–W ↔ BR	IG switch ON	9 – 14
VC (E6–2) – E2 (E6–18)	Y–B ↔ BR	IG switch ON	4.5 – 5.5
VTA1 (E6–23) – E2 (E6–18)	L–W ↔ BR	IG switch ON, Throttle valve fully closed	0. – 1.0
		IG switch ON, Throttle valve fully open	3.2 – 4.9
VG (E6–10) – E2G (E6–19)	Y–R ↔ BR–W	Idling, A/C switch OFF	1.1 – 1.5
VV1+ (E7–10) – NE– (E6–24)	O ↔ W	Idling	Pulse generation
VV2+ (E7–22) – NE– (E6–24)	L ↔ W		
NE+ (E6–16) – NE– (E6–24)	B ↔ W	Idling	Pulse generation
OC1+ (E7–6) – OC1– (E7–5)	Y–B ↔ G–W	IG switch ON	Pulse generation
OC2+ (E7–29) – OC2– (E7–18)	G–R ↔ G–Y		
THA (E6–22) – E2 (E6–18)	L–B ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 – 3.4
THW (E6–14) – E2 (E6–18)	G–W ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 – 1.0
STA (E8–7) – E1 (E6–17)	B ↔ BR	Cranking	6.0 or more
#10 (E6–5) – E01 (E7–21)	W ↔ W–B	IG switch ON	9 – 14
#20 (E6–6) – E01 (E7–21)	Y ↔ W–B		
#30 (E7–1) – E01 (E7–21)	B ↔ W–B		
#40 (E7–2) – E01 (E7–21)	L ↔ W–B		
#50 (E7–3) – E01 (E7–21)	R ↔ W–B	Idling	Pulse generation
#60 (E7–4) – E01 (E7–21)	G ↔ W–B		
IGT1 (E7–11) – E1 (E6–17)	B–Y ↔ BR	Idling	Pulse generation
IGT2 (E7–12) – E1 (E6–17)	L–R ↔ BR		
IGT3 (E7–13) – E1 (E6–17)	L–O ↔ BR		
IGT4 (E7–14) – E1 (E6–17)	L–Y ↔ BR		
IGT5 (E7–15) – E1 (E6–17)	Y ↔ BR		
IGT6 (E7–16) – E1 (E6–17)	G–B ↔ BR		
IGF (E7–25) – E1 (E6–17)	B ↔ BR	IG switch ON	4.5 – 5.5
		Idling	Pulse generation
ACIS (E7–17) – E01 (E7–21)	R–Y ↔ W–B	IG switch ON	9 – 14
FC (E8–3) – E01 (E7–21)	L–Y ↔ W–B	IG switch ON	9 – 14
		Idling	0 – 3.0
RSO (E7–26) – E01 (E7–21)	R–W ↔ W–B	IG switch ON, Disconnect E7 connector from ECM	9 – 14
OXS (E9–8) – E1 (E6–17)	W ↔ BR	Maintain engine speed at 2,500 rpm for 3 min. after warming up	Pulse generation

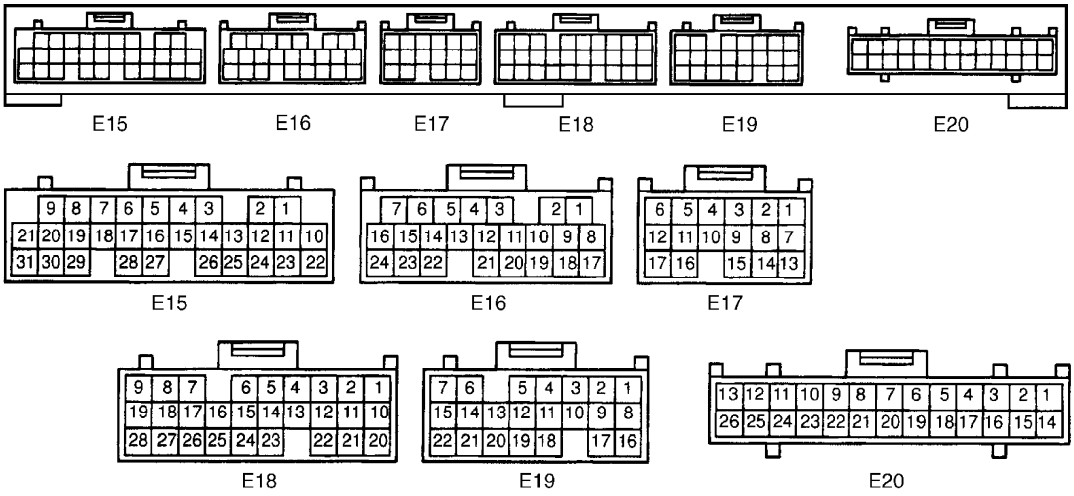
99C51948

Fig. 15: Pin Voltage Chart (RX300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
HTS (E9–9) – E03 (E7–30)	B ↔ W–B	Idling	Below 3.0
		IG switch ON	9 – 14
KNKR (E7–27) – E1 (E6–17)	W ↔ BR	Idling	Pulse generation
KNKL (E7–28) – E1 (E6–17)	B ↔ BR		
NSW (E9–20) –E1 (E6–17)	B–W ↔ BR	IG switch ON, Other shift position in P, N	9 – 14
		IG switch ON, shift position in P, N	0 – 3.0
SPD (E9–22) – E1 (E6–17)	V–W ↔ BR	IG switch ON, Rotate driving wheel slowly	0 – 5
TC (E9–5) – E1 (E6–17)	P–B ↔ BR	IG switch ON	9 – 14
W (E8–6) – E1 (E6–17)	Y–G ↔ BR	IG switch ON	Below 3.0
EVP1 (E6–7) – E01 (E7–21)	W–L ↔ W–B	IG switch ON	9 – 14
PS (E6–9) – E1 (E6–17)	B–Y ↔ BR	IG switch ON	9 –14
CF (E9–26) – E1 (E6–17)	R–W ↔ BR	Electric cooling fan is operating on high speed	9 – 14
		Electric cooling fan is operating on low speed or OFF	0 – 2
TACH (E9–27) – E1 (E6–17)	O ↔ BR	Idling	Pulse generation
PTNK (E8–17) – E1 (E6–17)	L ↔ BR	IG switch ON	3 0 – 3.6
		IG switch ON, Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	1.3 – 2.1
SIL (E8–4) – E1 (E6–17)	W ↔ BR	During transmission	Pulse generation
STP (E8–15) – E1 (E6–17)	G–O ↔ BR	IG switch ON, Brake pedal depressed	7.5 – 14
		IG switch ON, Brake pedal released	Below 1.5
AFR+ (E6–11) – E1 (E6–17)	R ↔ BR	IG switch ON	3.0 – 3.6
AFL+ (E8–12) – E1 (E6–17)	L ↔ BR		
AFR– (E6–20) – E1 (E6–17)	G ↔ BR	IG switch ON	2.7 – 3.3
AFL– (E6–21) – E1 (E6–17)	B–W ↔ BR		
HAFR (E6–3) – E04 (E6 -1)	L ↔W–B	Idling	Below 3.0
HAFL (E6–4) – E05 (E8-6)	G ↔W–B	IG switch ON	9 – 14
KSW (E9–23) – E1 (E6–17)	L ↔ BR	At time of inserting key	Below 1.5
		In condition without key inserted	4 – 5
RXCK (E9–19) – E1 (E6–17)	B ↔ BR	At time of inserting key	Pulse generation
CODE (E9–28) – E1 (E6–17)	V ↔ BR	At the time of inserting the key	Pulse generation
IGSW (E8–2) – E1 (E6–17)	B–O ↔ BR	IG switch ON	9 – 14
TXCT (E9–18) – E1 (E6–17)	GR ↔ BR	At time of inserting key	Pulse generation
IMLD (E8–22) – E1 (E6–17)	L–G ↔ BR	In condition without key inserted	Pulse generation
MREL (E8–8) – E1 (E6–17)	B–W ↔ BR	IG switch ON	9 – 14

99D51949

Fig. 16: Pin Voltage Chart (RX300 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E19–1) – E1 (E16–17)	B–W ↔ W–R	Always	9 ~ 14
BM (E19–7) – E1 (E16–17)	L–R ↔ W–R		
IGSW (E19–9) – E1 (E16–17)	B–O ↔ W–R	IG switch ON	9 ~ 14
B (E19–16) – E1 (E16–17)	B–R ↔ W–R		
B2 (E19–8) – E1 (E16–17)	B–R ↔ W–R		
VC (E16–2) – E2 (E16–18)	L–B ↔ BR	IG switch ON	4.5 ~ 5.5
VTA (E16–23) – E2 (E16–18)	Y ↔ BR	IG switch ON Accelerator pedal released	0.4 ~ 1.0
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VTA2 (E16–24) – E2 (E16–18)	R ↔ BR	IG switch ON Accelerator pedal released	2.0 ~ 2.9
		IG switch ON Accelerator pedal depressed	4.6 ~ 5.1
VPA (E16–15) – E2 (E16–18)	Y–B ↔ BR	IG switch ON Accelerator pedal released	0.3 ~ 0.9
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VPA2 (E16–16) – E2 (E16–18)	R–B ↔ BR	IG switch ON Accelerator pedal released	1.8 ~ 2.7
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
VG (E16–10) – EVG (E16–19)	L–W ↔ G–W	Idling, P or N position, A/C switch OFF	1.1 ~ 1.5
THA (E16–22) – E2 (E16–18)	Y–G ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E16–14) – E2 (E16–18)	LG ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E18–2) – E1 (E16–17)	G–R ↔ W–R	Shift lever position P or N position, Ignition switch START	9 ~ 14
M+ (E15–8) – E1 (E16–17) M– (E15–7) – E1 (E16–17)	B ↔ W–R W ↔ W–R	Idling	Pulse generation
SIL (E19–11) – E1 (E16–17)	B ↔ W–R	IG switch ON	9 ~ 14
SP2+ (E17–5) – SP2– (E17–11)	L–Y ↔ R–Y	Vehicle is driving	Pulse generation

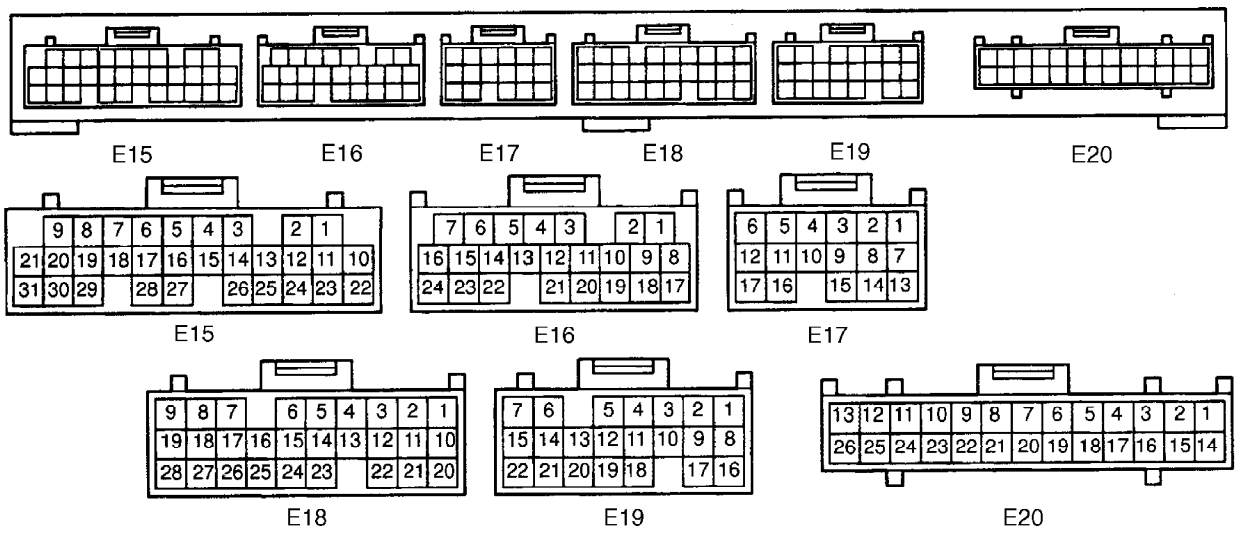
G99H51950

Fig. 17: Pin Voltage Chart (SC300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
#10 (E16–5) – E01 (E15–21) #20 (E16–6) – E01 (E15–21) #30 (E15–1) – E01 (E15–21) #40 (E15–2) – E01 (E15–21) #50 (E15–3) – E01 (E15–21) #60 (E15–4) – E01 (E15–21)	Y ↔ W–B W–L ↔ W–B BR ↔ W–B B–R ↔ W–B W ↔ W–B L–R ↔ W–B	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT (E15–11) – E1 (E16–17) IGT2 (E15–12) – E1 (E16–17) IGT3 (E15–13) – E1 (E16–17)	W–G ↔ W–R Y ↔ W–R G–W ↔ W–R	Idling	Pulse generation
IGF (E15–25) – E1 (E16–17)	R–Y ↔ W–R	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
G2 (E15–10) – NE– (E15–22)	L ↔ G	Idling	Pulse generation
NE + (E15–23) – NE– (E15–22)	R ↔ G		
MREL (E19–10) – E1 (E16–17)	B–Y ↔ W–R	IG switch ON	9 ~ 14
FPC (E19–5) – E1 (E16–17)	R–W ↔ W–R	IG switch ON	Below 1.5
		Idling	Pulse generation (0 and 4.5 - 5.5)
DI (E19–4) – E1 (E16–17)	P ↔ W–R	Idling	7.0 or more
STP (E18–6) – E1 (E16–17)	G–W ↔ W–R	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
PRG (E16–7) – E01 (E15–21)	G–B ↔ W–B	IG switch ON	9 ~ 14
TPC (E20–13) – E01 (E15–21)	W–L ↔ W–B	IG switch ON	9 ~ 14
PTNK (E18–18) – E2 (E16–18)	R ↔ BR	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	Below 0.5
OX1A (E16–12) – E2 (E16–18) OX1B (E18–8) – E2 (E16–18) OX2A (E16–11) – E2 (E16–18) OX2B (E20–24) – E2 (E16–18)	W ↔ BR W ↔ BR R–L ↔ BR G ↔ BR	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HT1A (E16–4) – E01 (E15–21) HT1B (E20–26) – E01 (E15–21) HT2A (E16–3) – E01 (E15–21) HT2B (E20–25) – E01 (E15–21)	L ↔ W–B BR ↔ W–B R–W ↔ W–B R–Y ↔ W–B	Idling	Below 3.0
		IG switch ON	9 ~ 14
KNK1 (E15–28) – E1 (E16–17)	W ↔ W–R	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNK2 (E15–27) – E1 (E16–17)	W ↔ W–R		
TC (E18–5) – E1 (E16–17)	Y ↔ W–R	IG switch ON	9 ~ 14
W (E19–6) – E01 (E15–21)	L–Y ↔ W–B	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACMG (E18–13) – E01 (E15–21)	W ↔ W–B	A/C switch ON (at idling)	Below 3.0
		A/C switch OFF	9 ~ 14
OCV+ (E15–18) – OCV– (E15–17)	W–R ↔ Y–B	IG switch ON	Pulse generation
ACIS (E15–5) – E01 (E15–21)	G–R ↔ W–B	IG switch ON	9 ~ 14
		Engine speed between 2,500 and 4,000 rpm	Below 3.0
CL+ (E15–20) – CL– (E15–19)	G–Y ↔ G–B	Idling	Pulse generation

99I51951

Fig. 18: Pin Voltage Chart (SC300 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
BATT (E19–1) – E1 (E16–17)	B–W ↔ W–R	Always	9 ~ 14
+BM (E19–7) – E1 (E16–17)	L–R ↔ W–R		
IGSW (E19–9) – E1 (E16–17)	B–O ↔ W–R	IG switch ON	9 ~ 14
+B (E19–16) – E1 (E16–17)	B–R ↔ W–R		
+B1 (E19–8) – E1 (E16–17)	B–R ↔ W–R		
VC (E16–2) – E2 (E16–18)	L–B ↔ BR	IG switch ON	4.5 ~ 5.5
VTA (E16–13) – E2 (E16–18)	Y ↔ BR	IG switch ON Accelerator pedal released	0.4 ~ 1.0
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VTA2 (E16–20) – E2 (E16–18)	R–Y ↔ BR	IG switch ON Accelerator pedal released	2.0 ~ 2.9
		IG switch ON Accelerator pedal depressed	4.6 ~ 5.1
VPA (E16–21) – E2 (E16–18)	Y–R ↔ BR	IG switch ON Accelerator pedal released	0.3 ~ 0.9
		IG switch ON Accelerator pedal depressed	3.2 ~ 4.8
VPA2 (E16–9) – E2 (E16–18)	R–L ↔ BR	IG switch ON Accelerator pedal released	1.8 ~ 2.7
		IG switch ON Accelerator pedal depressed	4.7 ~ 5.1
VG (E16–10) – EVG (E16–19)	L–W ↔ G–W	Idling, P or N position, A/C switch OFF	0.5 ~ 3.0
THA (E16–22) – E2 (E16–18)	Y–G ↔ BR	Idling, Intake air temp. 20°C (68°F)	0.5 ~ 3.4
THW (E16–14) – E2 (E16–18)	LG ↔ BR	Idling, Engine coolant temp. 80°C (176°F)	0.2 ~ 1.0
STA (E18–17) – E1 (E16–17)	G–R ↔ W–R	Shift lever position P or N position, Ignition switch START	6.0 or more

99J51952

Fig. 19: Pin Voltage Chart (SC400 - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
#1 (E16–5) – E01 (E15–21) #2 (E16–6) – E01 (E15–21) #3 (E15–1) – E01 (E15–21) #4 (E15–2) – E01 (E15–21) #5 (E15–3) – E01 (E15–21) #6 (E15–4) – E01 (E15–21) #7 (E15–5) – E01 (E15–21) #8 (E15–6) – E01 (E15–21)	Y ↔ W–B R ↔ W–B B ↔ W–B B–R ↔ W–B W–L ↔ W–B R–W ↔ W–B L–R ↔ W–B G ↔ W–B	IG switch ON	9 ~ 14
		Idling	Pulse generation
IGT1 (E15–11) – E1 (E16–17) IGT2 (E15–12) – E1 (E16–17) IGT3 (E15–13) – E1 (E16–17) IGT4 (E15–14) – E1 (E16–17) IGT5 (E15–15) – E1 (E16–17) IGT6 (E15–16) – E1 (E16–17) IGT7 (E15–25) – E1 (E16–17) IGT8 (E15–26) – E1 (E16–17)	R–W ↔ W–R W–R ↔ W–R Y–G ↔ W–R R–Y ↔ W–R P ↔ W–R G–R ↔ W–R LG ↔ W–R L–B ↔ W–R	Idling	Pulse generation
IGF1 (E15–27) – E1 (E16–17) IGF2 (E15–28) – E1 (E16–17)	G–B ↔ W–R L–R ↔ W–R	IG switch ON	4.5 ~ 5.5
		Idling	Pulse generation
G2 (E15–10) – NE– (E15–22)	L ↔ W	Idling	Pulse generation
NE (E15–23) – NE– (E15–22)	B ↔ W		
MREL (E19–10) – E1 (E16–17)	B–Y ↔ W–R	IG switch ON	9 ~ 14
DI (E19–4) – E1 (E16–17)	P ↔ W–R	IG switch ON	0 ~ 3.0
FPC (E19–5) – E1 (E16–17)	R–W ↔ W–R	IG switch ON	9 ~ 14
STP (E18–6) – E1 (E16–17)	G–W ↔ W–R	Brake pedal is depressed	7.5 ~ 14
		Brake pedal is released	Below 1.5
PRG (E16–7) – E1 (E16–17)	G–R ↔ W–R	IG switch ON	9 ~ 14
TPC (E18–10) – E1 (E16–17)	W–L ↔ W–R	IG switch ON	9 ~ 14
PTNK (E18–22) – E2 (E16–18)	R ↔ BR	Ignition switch ON	2.9 ~ 3.7
		Apply vacuum 4.0 kPa (30 mmHg, 1.2 in.Hg)	Below 0.5
OXL1 (E16–12) – E1 (E16–17) OXL2 (E18–18) – E1 (E16–17) OXR1 (E16–11) – E1 (E16–17) OXR2 (E18–27) – E1 (E16–17)	W ↔ W–R R–L ↔ W–R B ↔ W–R G ↔ W–R	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HTL (E16–4) – E1 (E16–17) HTL2 (E18–8) – E1 (E16–17)	L ↔ W–R BR–W ↔ W–R	Idling	Below 3.0
HTR (E16–3) – E1 (E16–17) HTR2 (E18–7) – E1 (E16–17)	R–W ↔ W–R R–Y ↔ W–R	IG switch ON	9 ~ 14
KNKL (E15–18) – E1 (E16–17)	W ↔ W–R	Maintain engine speed at 4,000 rpm after warming up	Pulse generation
KNKR (E15–17) – E1 (E16–17)	W ↔ W–R		
TC (E18–5) – E1 (E16–17)	Y ↔ W–R	IG switch ON	9 ~ 14
W (E19–6) – E1 (E16–17)	L–Y ↔ W–R	Idling	9 ~ 14
		IG switch ON	Below 3.0
ACMG (E18–13) – E1 (E16–17)	W ↔ W–R	A/C switch ON (at idling)	Below 3.0
		A/C switch OFF	9 ~ 14
ENG+ (E19–14) – ENG– (E19–21) TRC+ (E19–13) – TRC– (E19–20)	B ↔ W BR ↔ Y	Idling	Pulse generation

99A51953

Fig. 20: Pin Voltage Chart (SC400 - 2 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Symbols (Terminal No.)	Wiring Color	Condition	STD Voltage (V)
VVL+ (E16–16) – VVL– (E16–24)	R ↔ G	Idling	Pulse generation
VVR+ (E16–15) – VVR– (E16–23)	B–R ↔ BR		
OCV+ (E15–20) – OCV– (E15–19)	B–W ↔ R–B	IG switch ON	Pulse generation
OCR+ (E18–19) – OCR– (E18–28)	W–R ↔ G–Y		
ACIS (E15–29) – E01 (E15–21)	L–W ↔ W–B	IG switch ON	9 – 14
		Engine speed between 2,500 rpm and 4,000 rpm	Below 3.0
CL+ (E17–12) – CL– (E16–8)	L–B ↔ L–Y	Idling	Pulse generation
M+ (E15–8) – E1 (E16–17) M– (E15–7) – E1 (E16–17)	R ↔ W–R G ↔ W–R	Idling	Pulse generation
SIL (E19–11) – E1 (E16–17)	B ↔ W–R	During transmission	Pulse generation
SP2+ (E17–5) – SP2– (E17–11)	P ↔ V	Vehicle is driving	Pulse generation

99B51954

Fig. 21: Pin Voltage Chart (SC400 - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

K - SENSOR RANGE CHARTS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Sensor Operating Range Charts
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

Sensor operating range information can help determine if a sensor is out of calibration. An out-of-calibration sensor may not set a trouble code, but it can cause driveability problems.

NOTE: Unless stated otherwise in test procedure, perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance. If sensor connector has more than 2 terminals, see appropriate SYSTEM & COMPONENT TESTING article for terminal identification.

ACCELERATOR PEDAL POSITION SENSOR

GS300, GS400, LS400, LX470, SC300 & SC400
For accelerator pedal position sensor testing, see ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article.

AIR/FUEL RATIO SENSOR (EX300 & RX300)

NOTE: Air/Fuel Ratio (A/F) sensor may also be referred to as Air/Fuel (A/F) sensor.

AIR/FUEL RATIO SENSOR RESISTANCE

Temperature °F (°C)	Ohms
68 (20)	.8-1.4
1472 (800)	1.8-3.2

(1) - Measure resistance between terminals +B and HT of A/F sensor 4-pin connector. See Fig. 1.

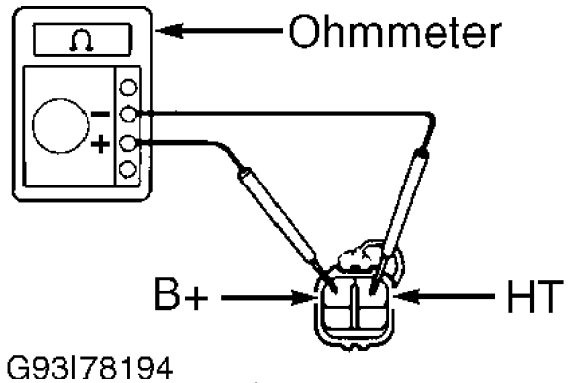


Fig. 1: Measuring Air/Fuel Ratio Sensor Heater Or Oxygen Sensor Heater Resistance
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR RESISTANCE

Temperature °F (°C)	(1) Ohms
14-122 (-10-50)	835-1400
123-212 (51-100)	1060-1645

(1) - Measure resistance between sensor terminals.

CRANKSHAFT POSITION SENSOR

CRANKSHAFT POSITION SENSOR RESISTANCE

Temperature °F (°C)	(1) Ohms
14-122 (-10-50)	1630-2740
123-212 (51-100)	2065-3225

(1) - Measure resistance between sensor terminals.

CAMSHAFT TIMING OIL CONTROL VALVE

ES300, GS300, GS400, LS400, RX300, SC300 & SC400
See CAMSHAFT TIMING OIL CONTROL VALVE RESISTANCE table.

CAMSHAFT TIMING OIL CONTROL VALVE RESISTANCE

Application	(1) Ohms @ 68°F (20°C)
ES300, GS400, LS400, RX300 & SC400	6.9-7.9
GS300 & SC300	5.5-12.0

(1) - Measure resistance between sensor terminals.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Using ohmmeter, check resistance between engine coolant temperature sensor terminals. Ensure resistance is within specification in relation to specified temperature. See Fig. 2.

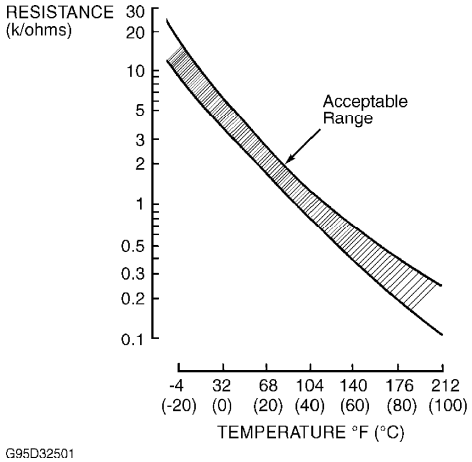


Fig. 2: Engine Coolant Temperature Sensor Resistance Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

INTAKE AIR TEMPERATURE SENSOR

Intake Air Temperature (IAT) sensor is part of mass airflow sensor. For IAT sensor testing, see ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article.

KNOCK SENSOR

KNOCK SENSOR (KS) CONTINUITY (1)

Measure Continuity Between	Continuity
Knock Sensor Terminal & Sensor Body	No

(1) - Replace sensor if continuity exists.

OXYGEN SENSOR HEATER

OXYGEN SENSOR HEATER RESISTANCE (1)

Temperature °F (°C)	Ohms
68 (20)	11-16

(1) - Measure resistance between terminals +B and HT of oxygen sensor 4-pin connector. See Fig. 1.

THROTTLE POSITION SENSOR

TP SENSOR RESISTANCE

Application & Throttle Plate Position	TP Sensor Terminals	Ohms @ 68°F (20°C)
ES300 & RX300 (1)		
Throttle Fully Closed	VTA & E2	200-6300
Throttle Fully Open	VTA & E2	2000-10,200
All Positions	VC & E2	2500-5900
GS300 & SC300	VC & E2	1200-3200
GS400, LS400, LX470 & SC400	VC & E2	1250-2350

(1) - Disconnect vacuum hose from throttle opener. Apply vacuum to throttle opener to allow throttle to fully seat.

VAPOR PRESSURE SENSOR

For vapor pressure sensor testing, see ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article.

VARIABLE VALVE TIMING (VVT) SENSOR

ES300, GS300, GS400, LS400, RX300, SC300 & SC400
See VARIABLE VALVE TIMING (VVT) SENSOR RESISTANCE table.

VARIABLE VALVE TIMING (VVT) SENSOR RESISTANCE

Temperature °F (°C)	(1) Ohms

14-122 (-10-50)	835-1400
123-212 (51-100)	1060-1645

(1) - Measure resistance between sensor terminals.

VEHICLE SPEED SENSOR

For vehicle speed sensor testing, see ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article.

L - WIRING DIAGRAMS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Wiring Diagrams
LEXUS

WIRING DIAGRAMS

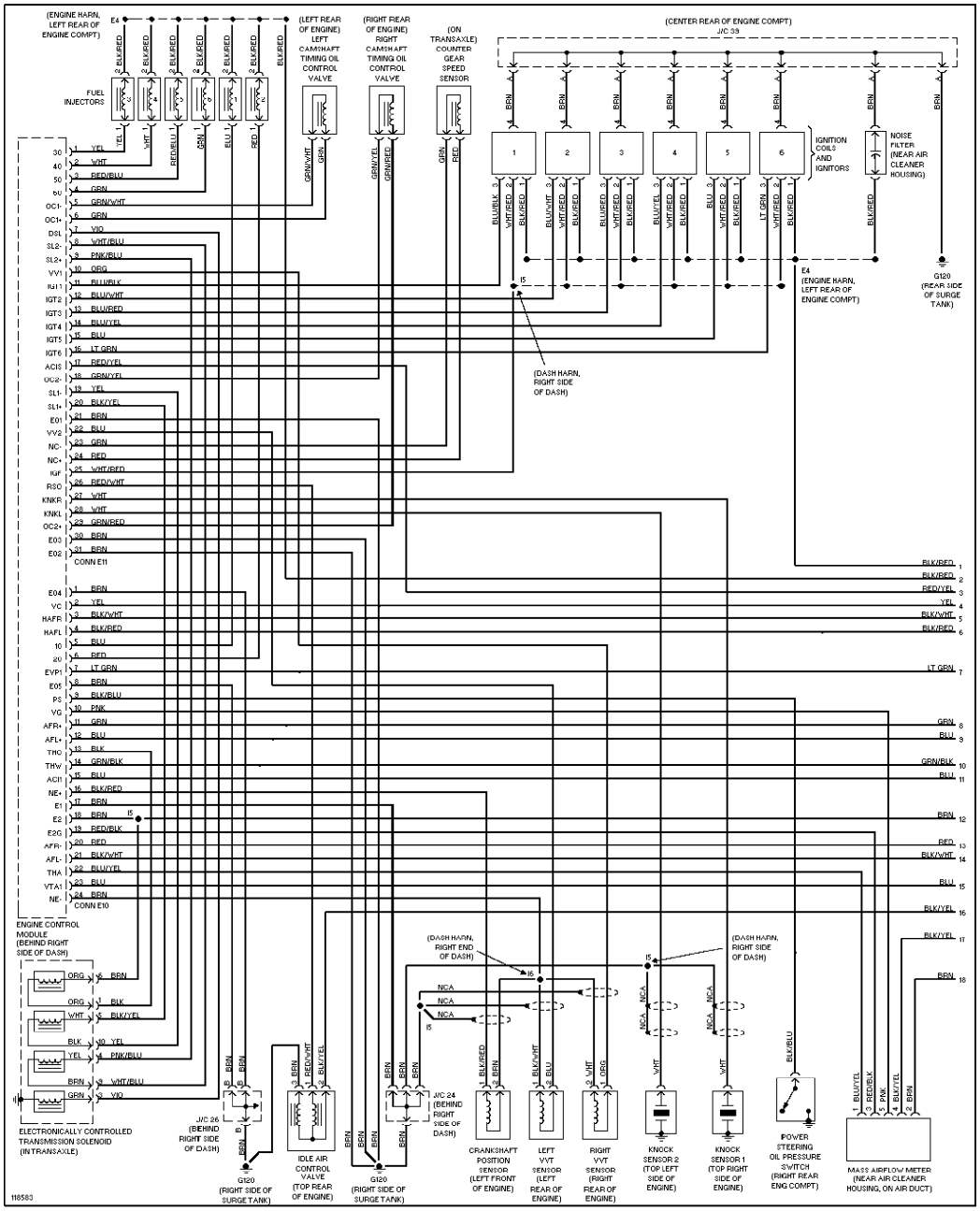


Fig. 1: Wiring Diagram (ES300 3.0L - 1 Of 4)

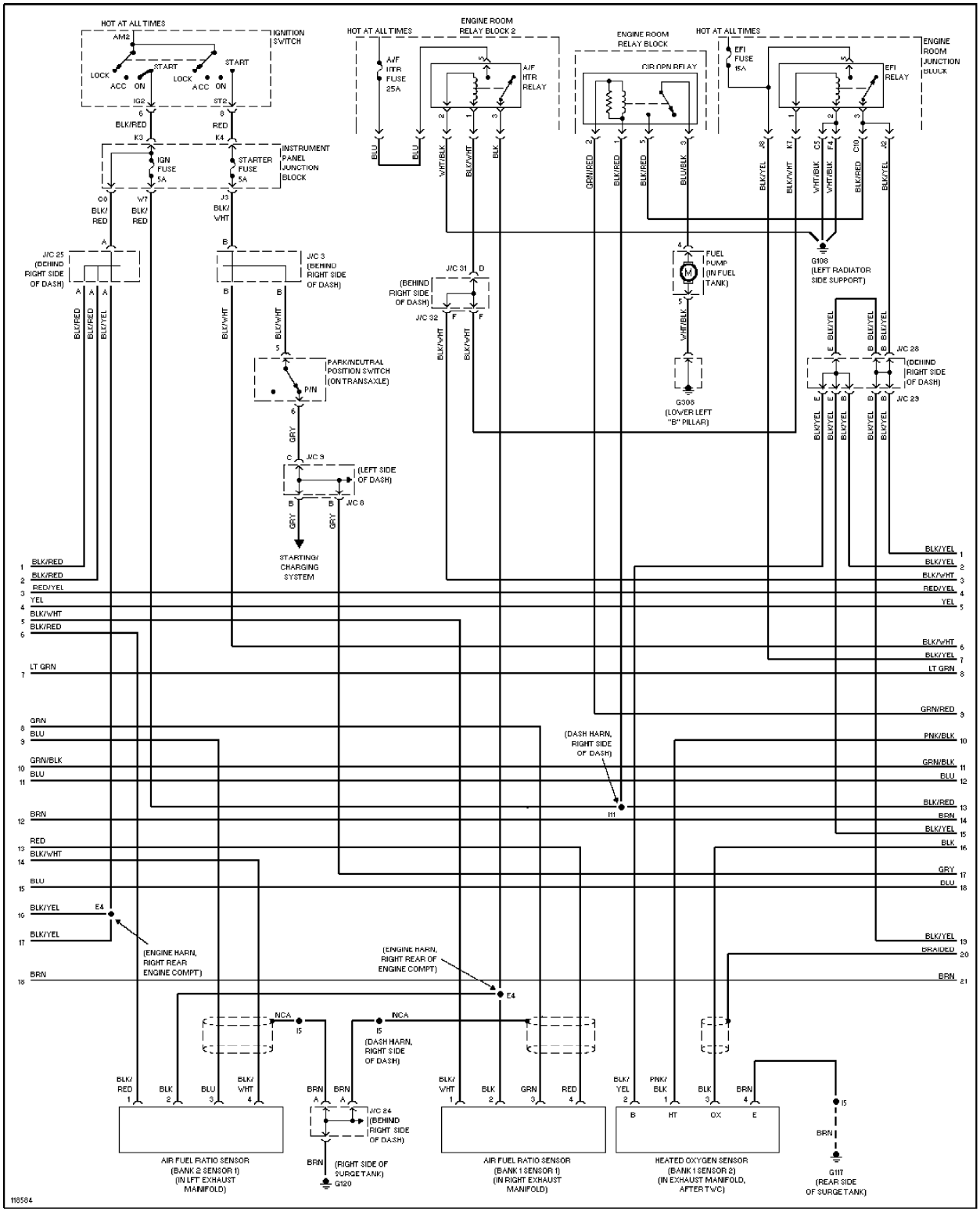


Fig. 2: Wiring Diagram (ES300 3.0L - 2 Of 4)

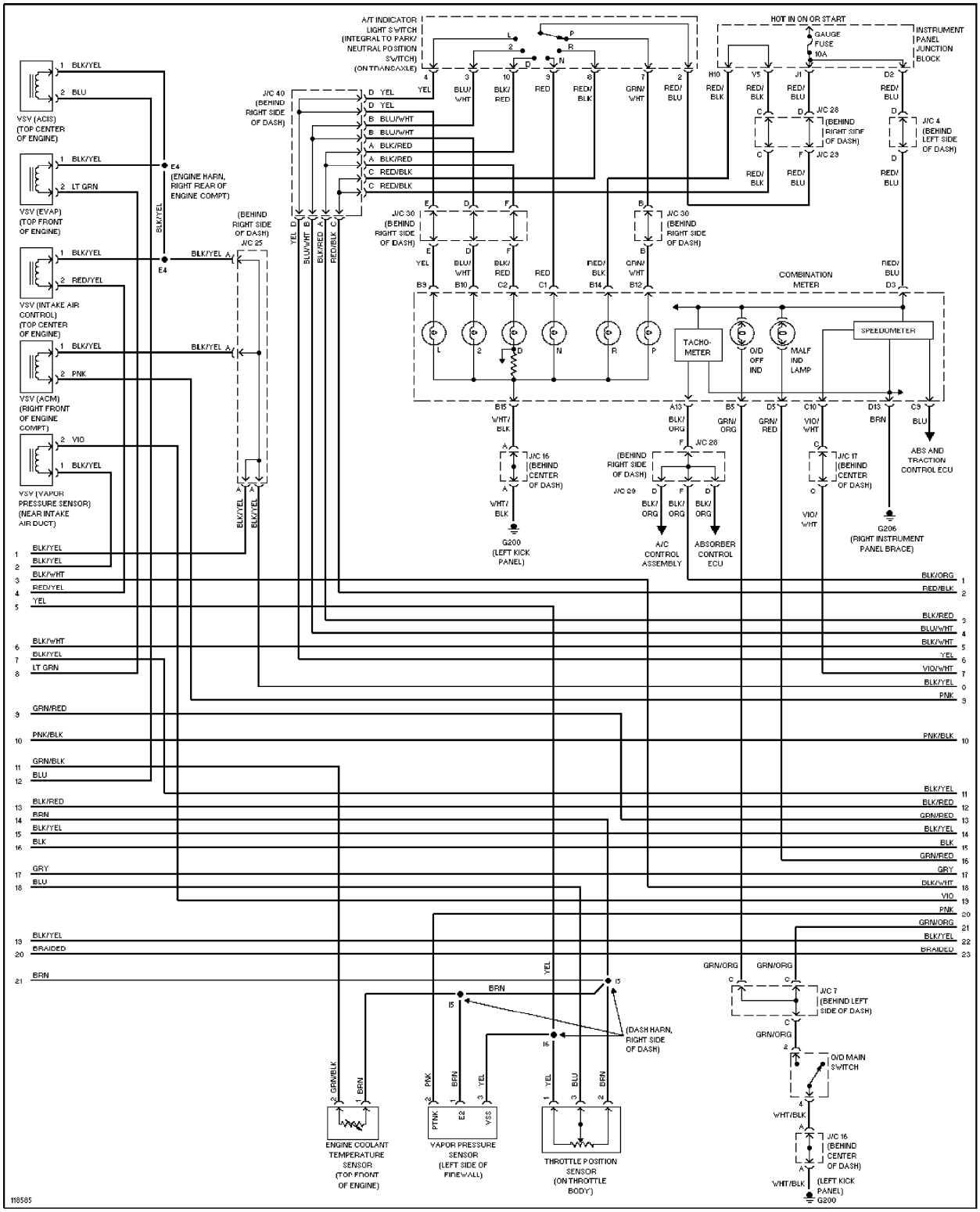


Fig. 3: Wiring Diagram (ES300 3.0L - 3 Of 4)

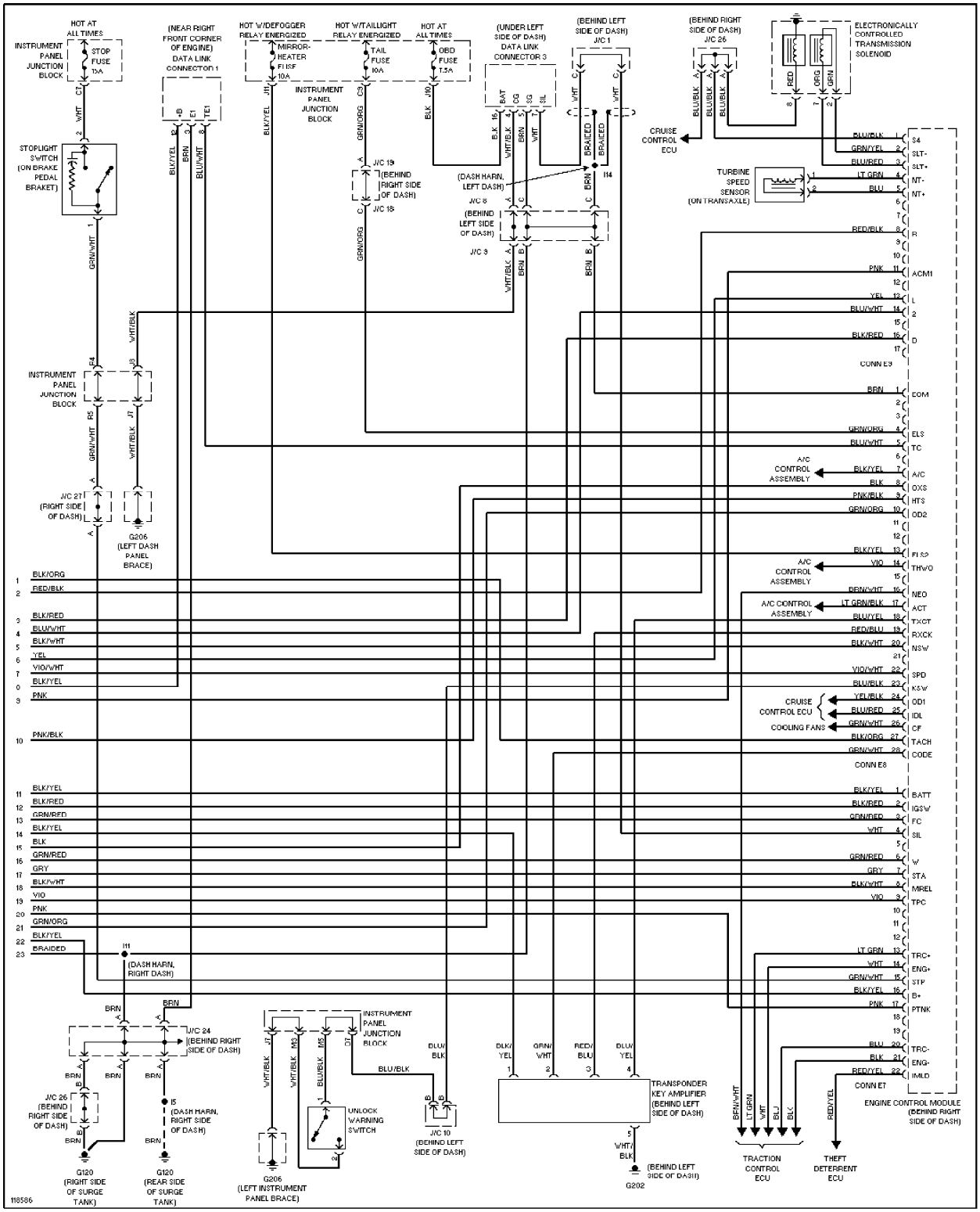


Fig. 4: Wiring Diagram (ES300 3.0L - 4 Of 4)

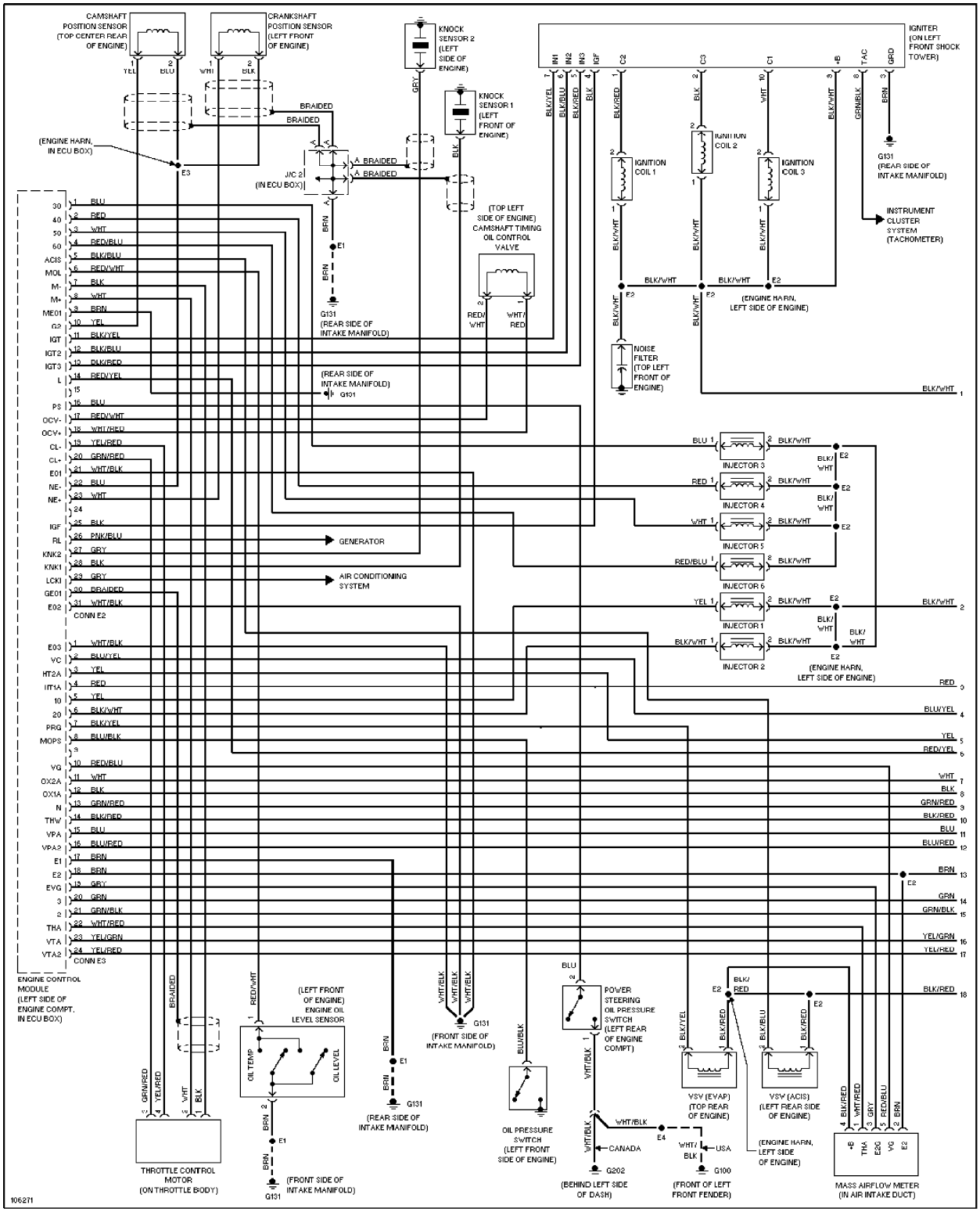


Fig. 5: Wiring Diagram (GS300 3.0L - 1 Of 4)

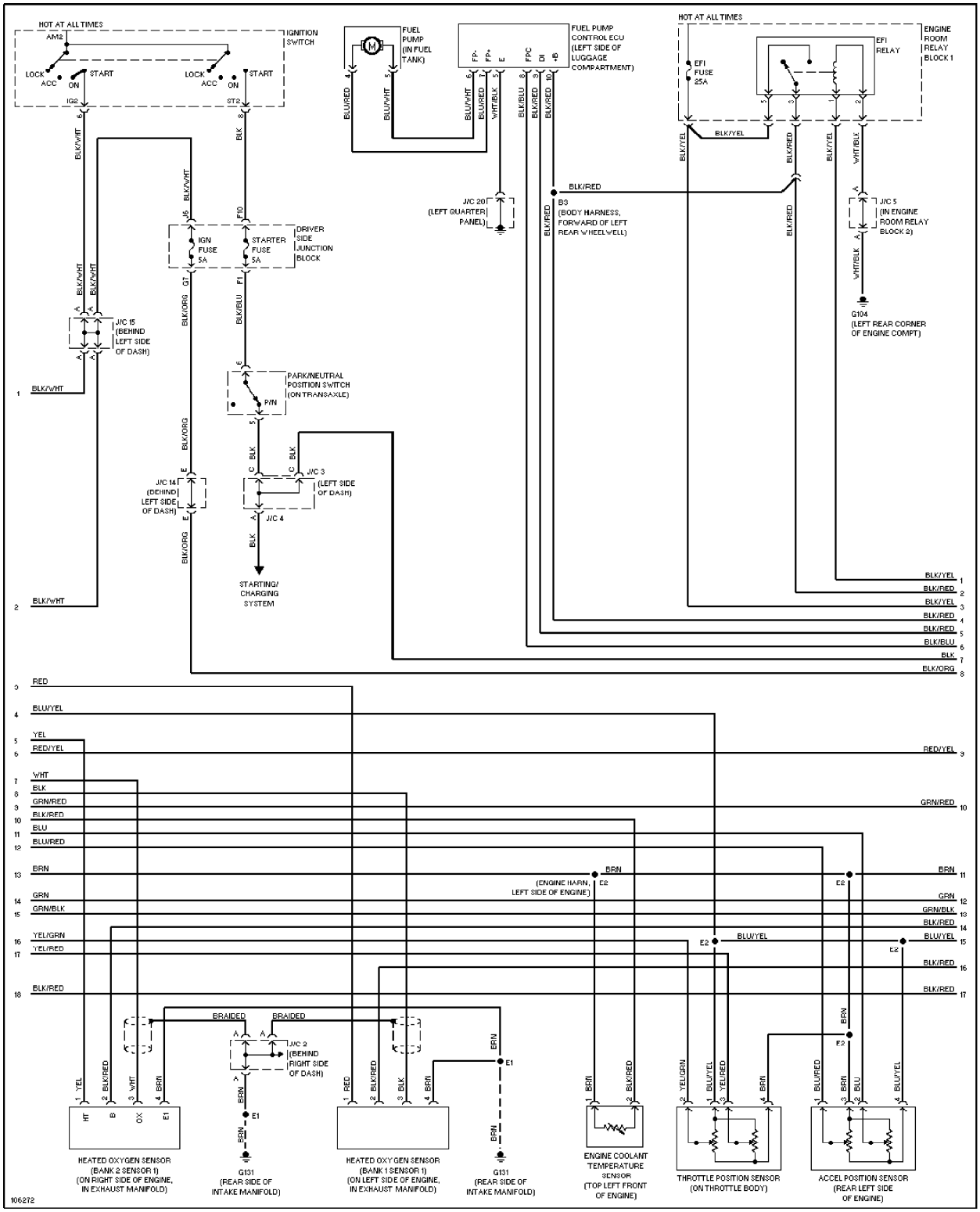


Fig. 6: Wiring Diagram (GS300 3.0L - 2 Of 4)

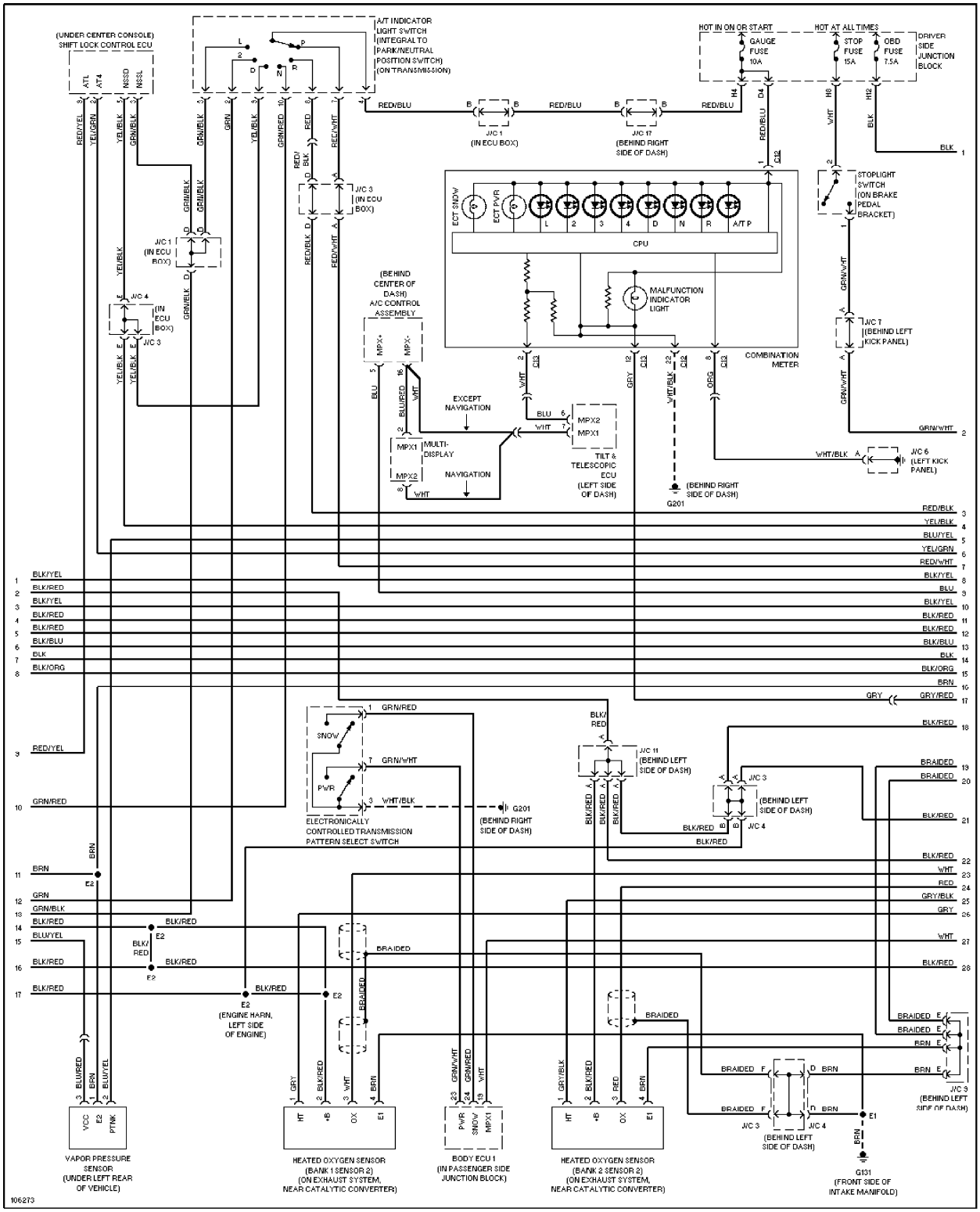


Fig. 7: Wiring Diagram (GS300 3.0L - 3 Of 4)

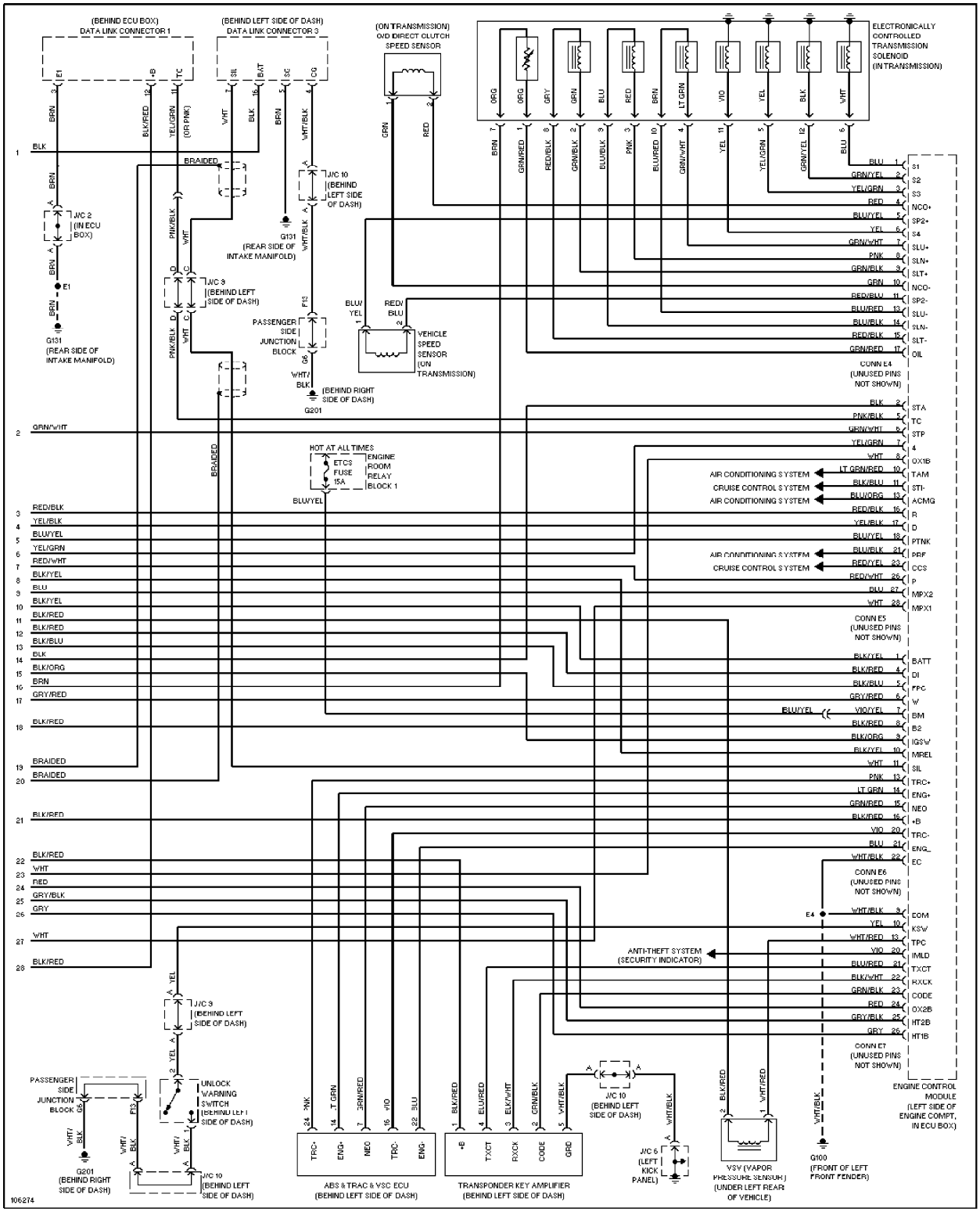


Fig. 8: Wiring Diagram (GS300 3.0L - 4 Of 4)

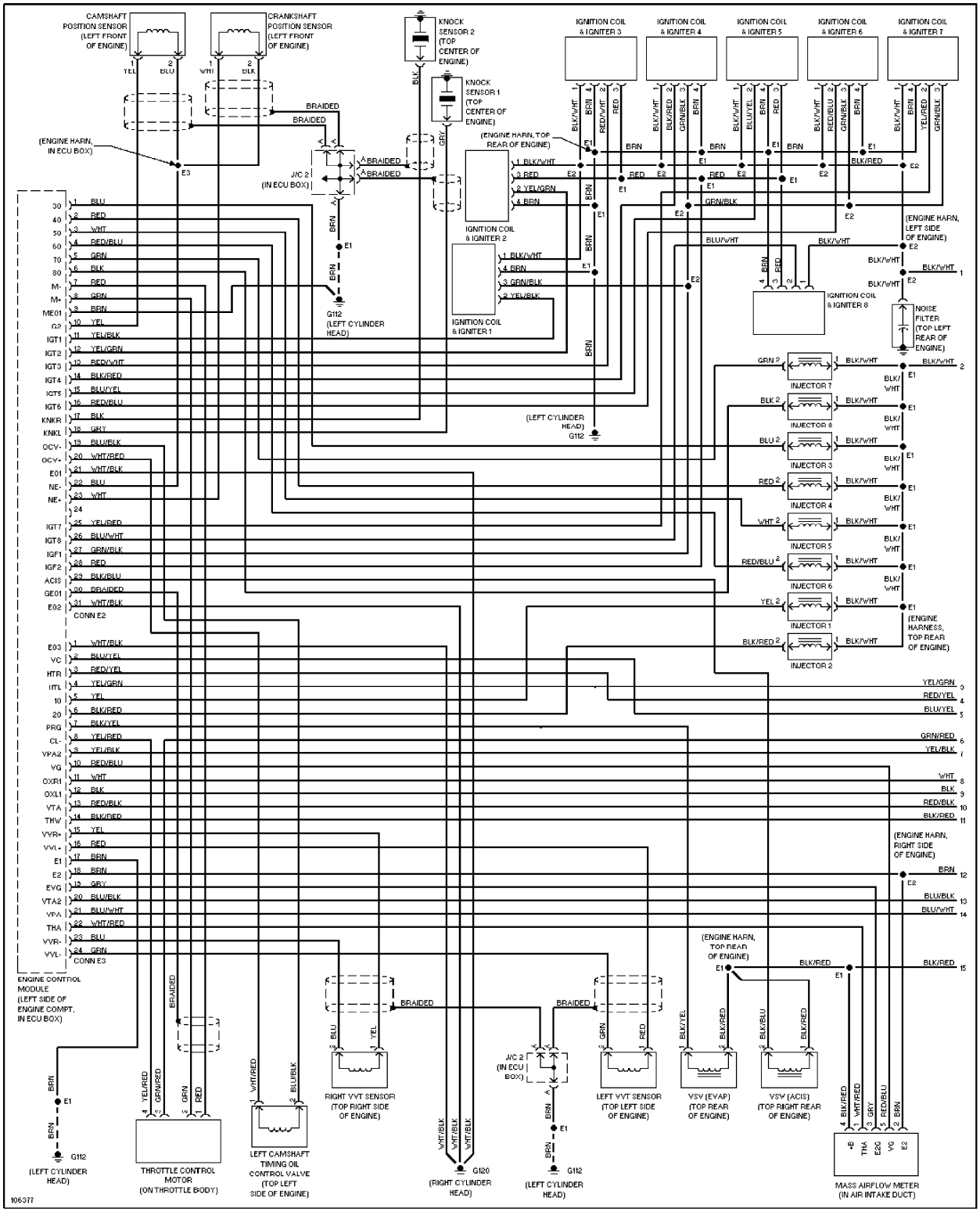


Fig. 9: Wiring Diagram (GS400 4.0L - 1 Of 4)

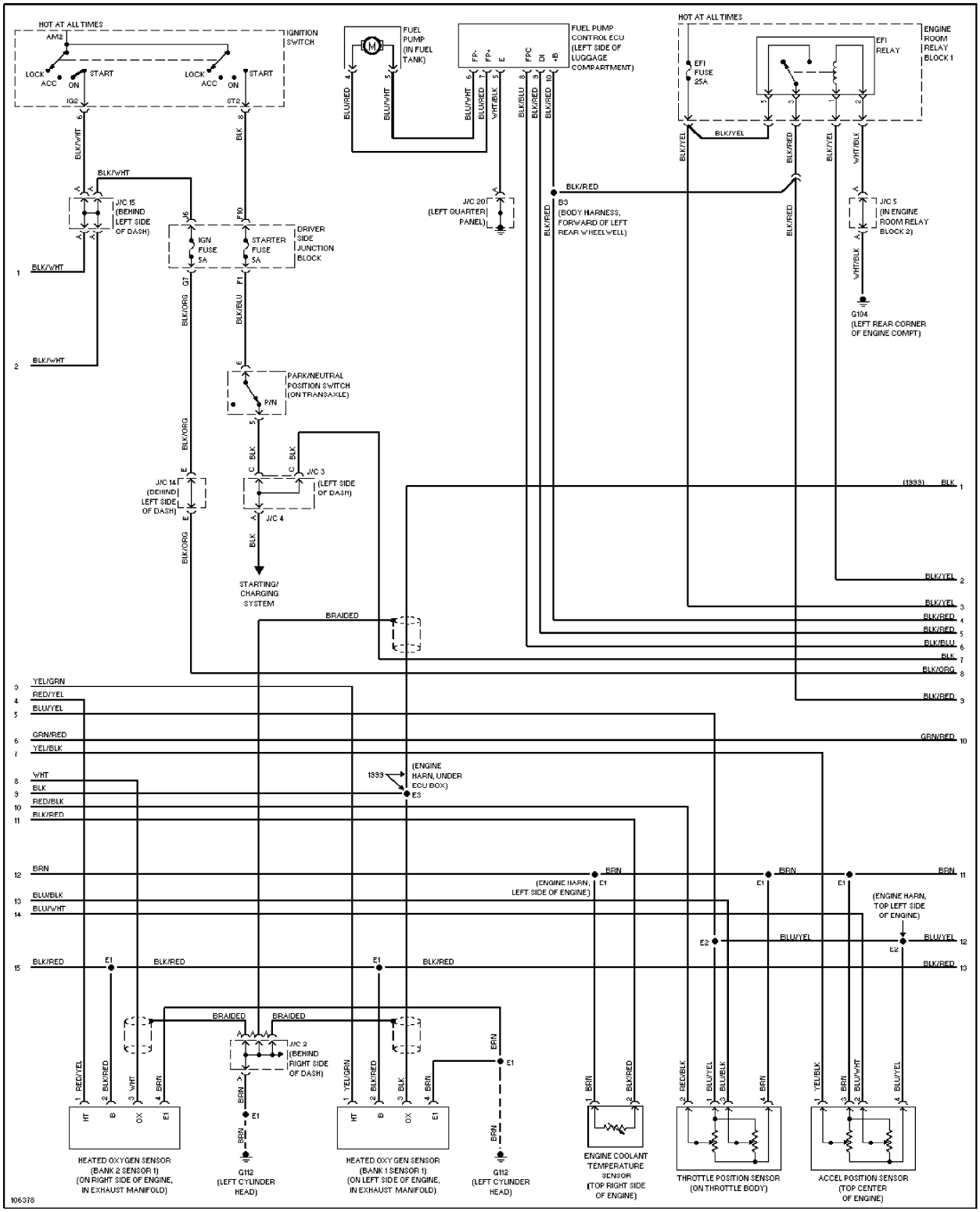


Fig. 10: Wiring Diagram (GS400 4.0L - 2 Of 4)

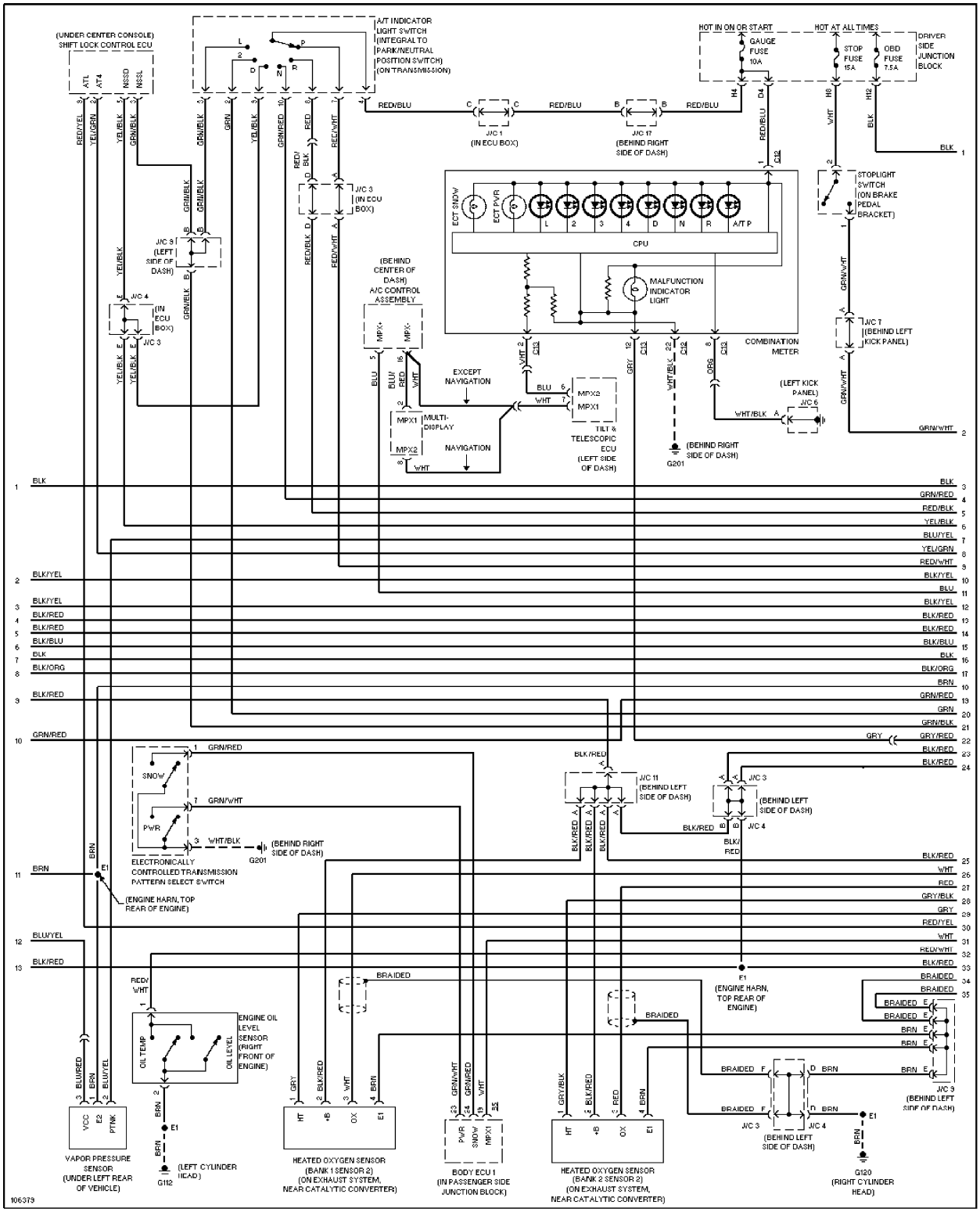


Fig. 11: Wiring Diagram (GS400 4.0L - 3 Of 4)

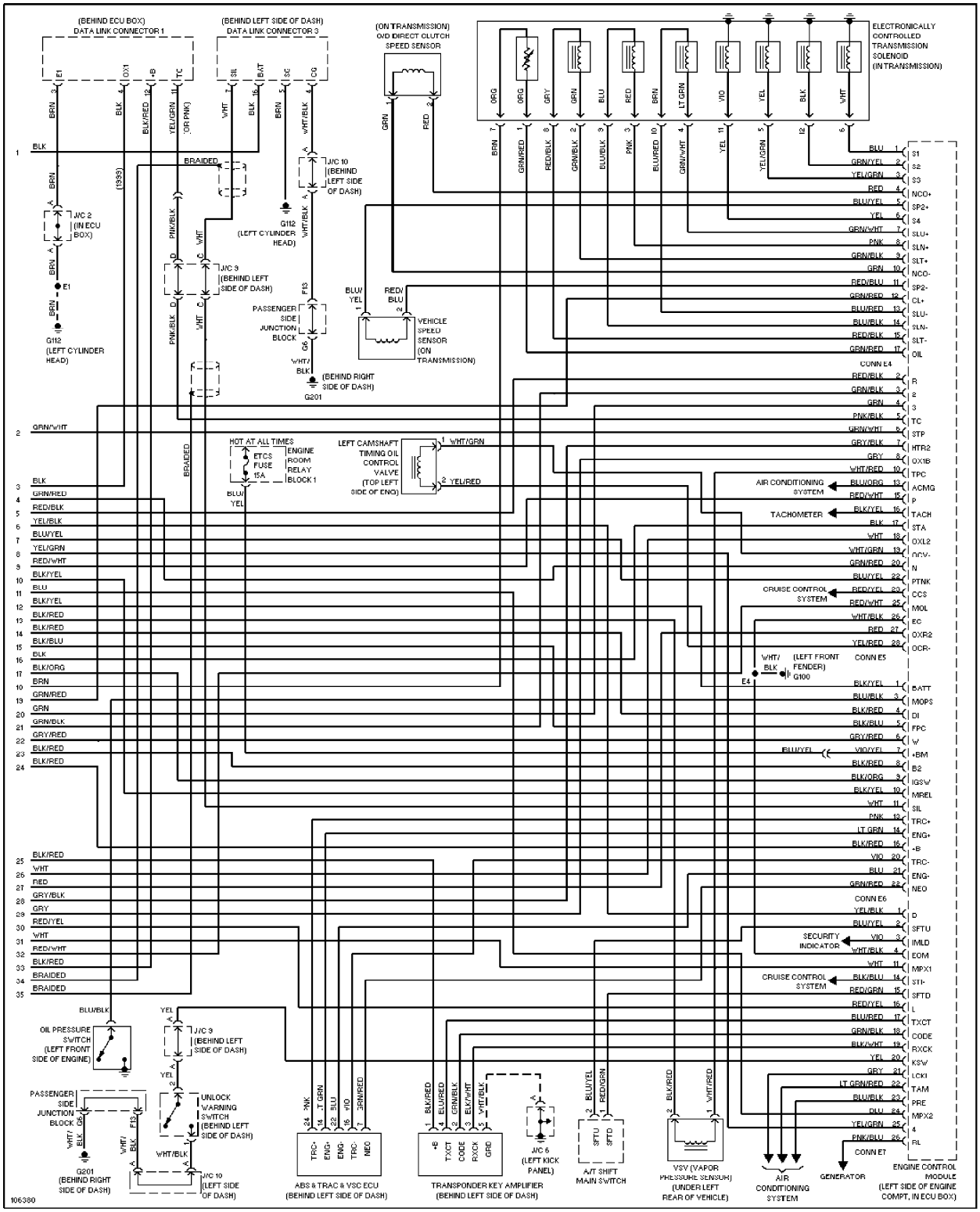


Fig. 12: Wiring Diagram (GS400 4.0L - 4 Of 4)

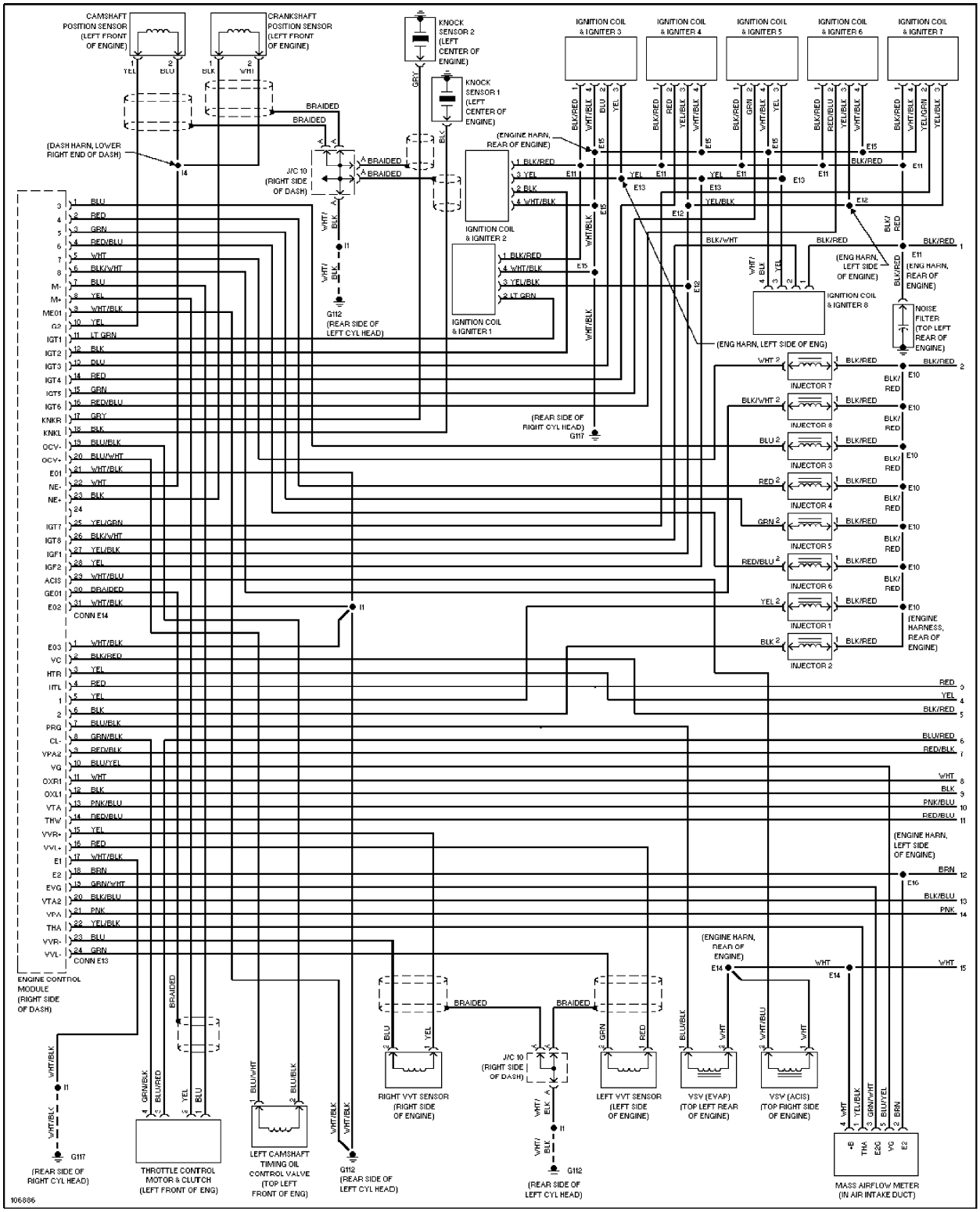


Fig. 13: Wiring Diagram (LS400 4.0L - 1 Of 4)

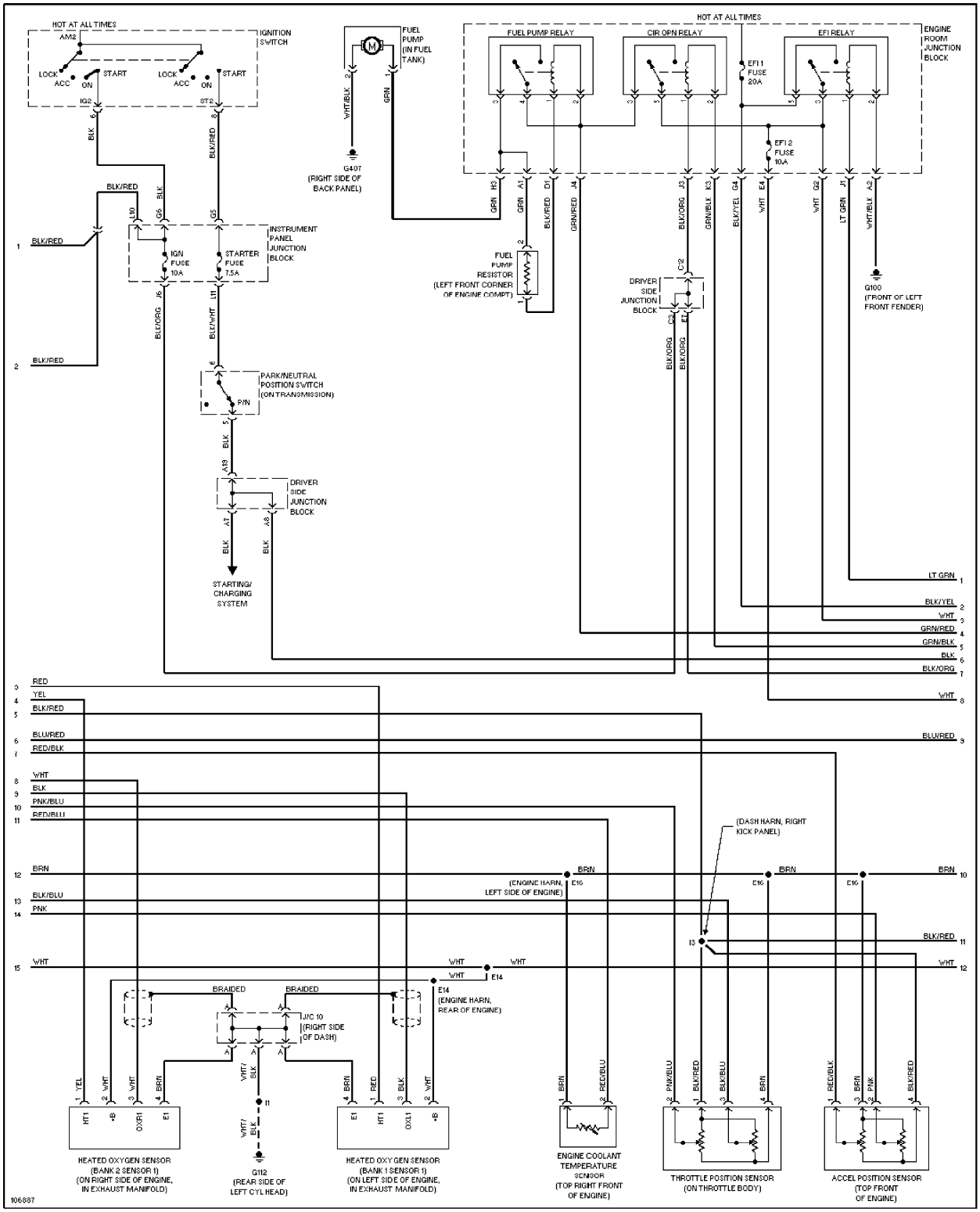


Fig. 14: Wiring Diagram (LS400 4.0L - 2 Of 4)

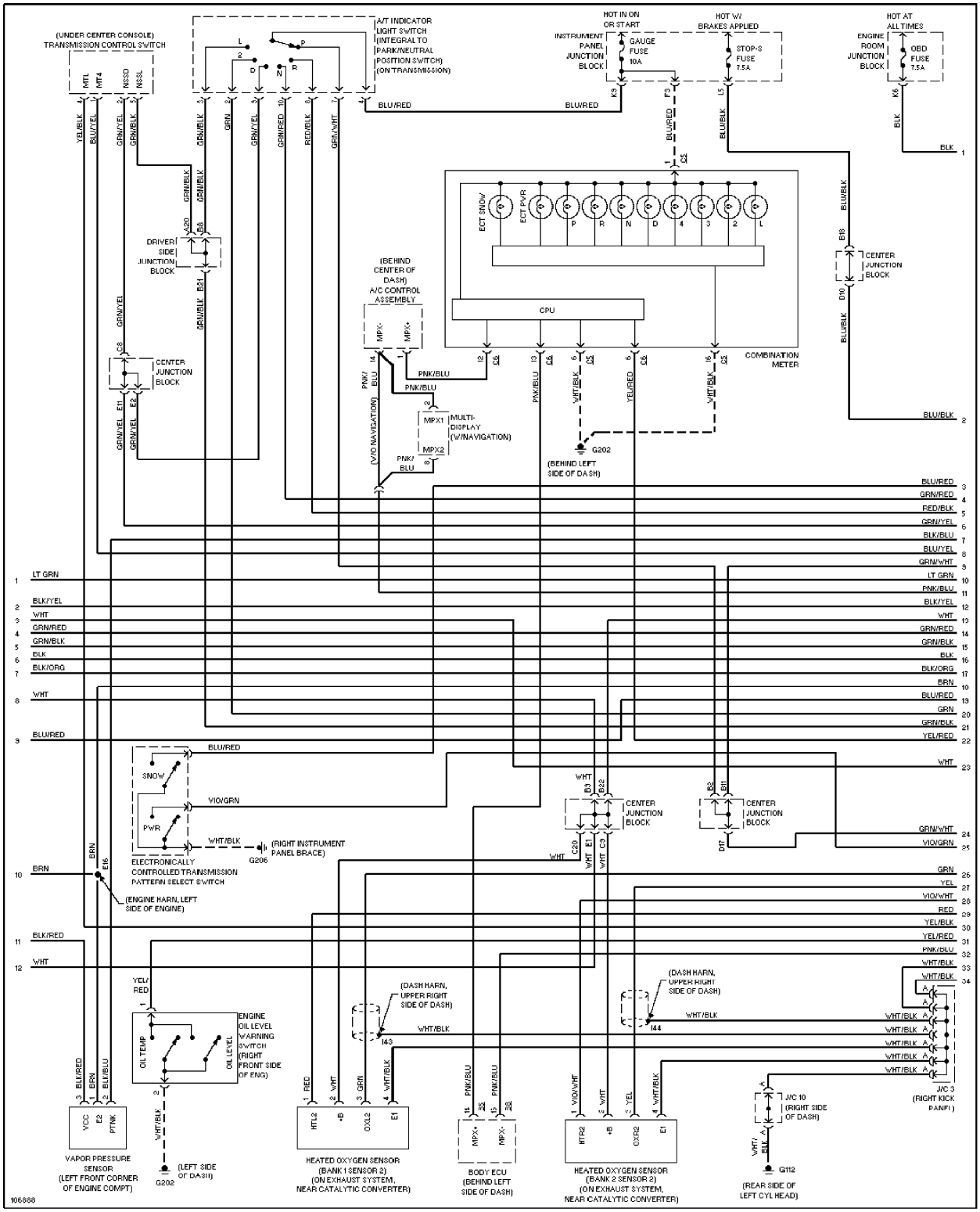


Fig. 15: Wiring Diagram (LS400 4.0L - 3 Of 4)

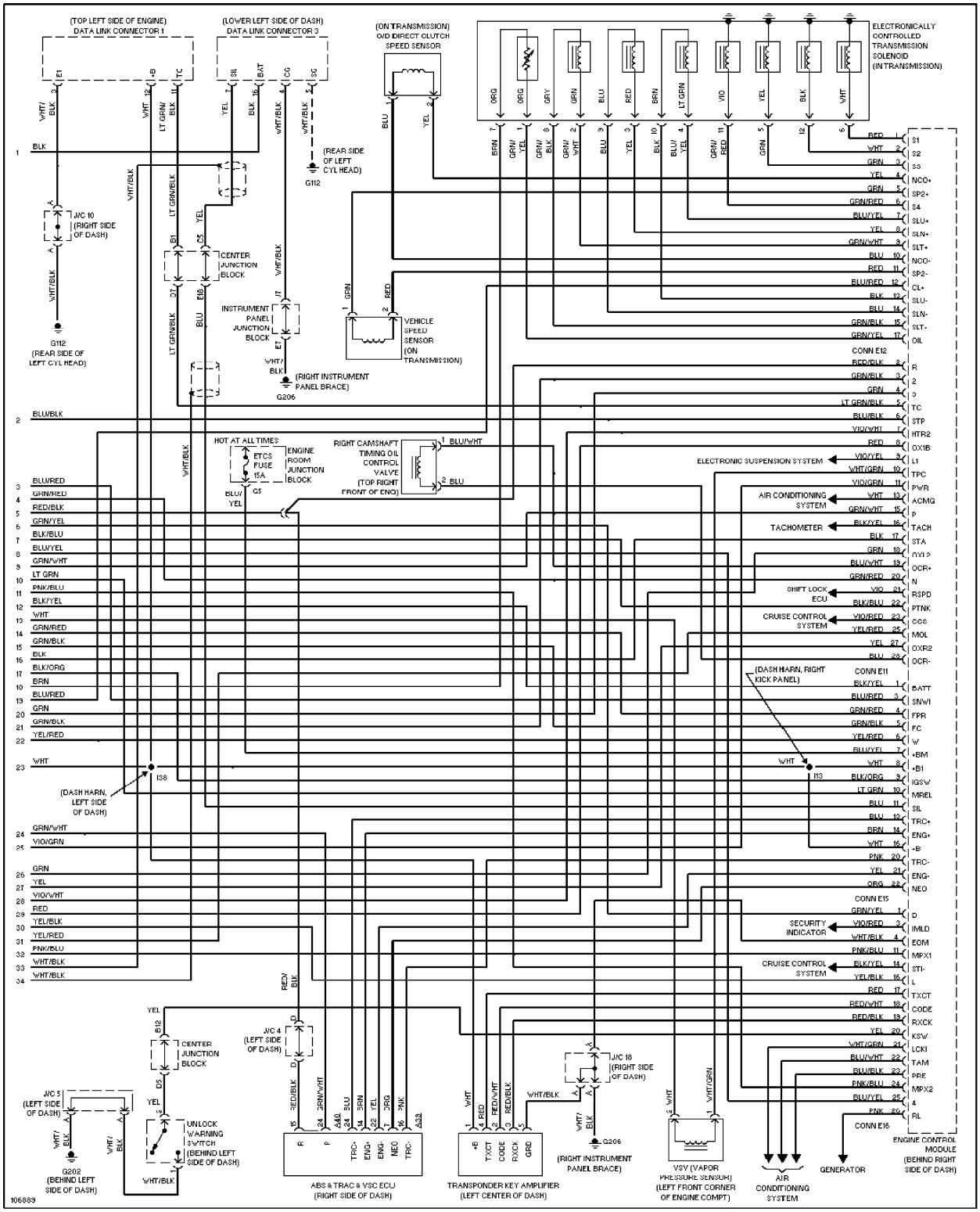


Fig. 16: Wiring Diagram (LS400 4.0L - 4 Of 4)

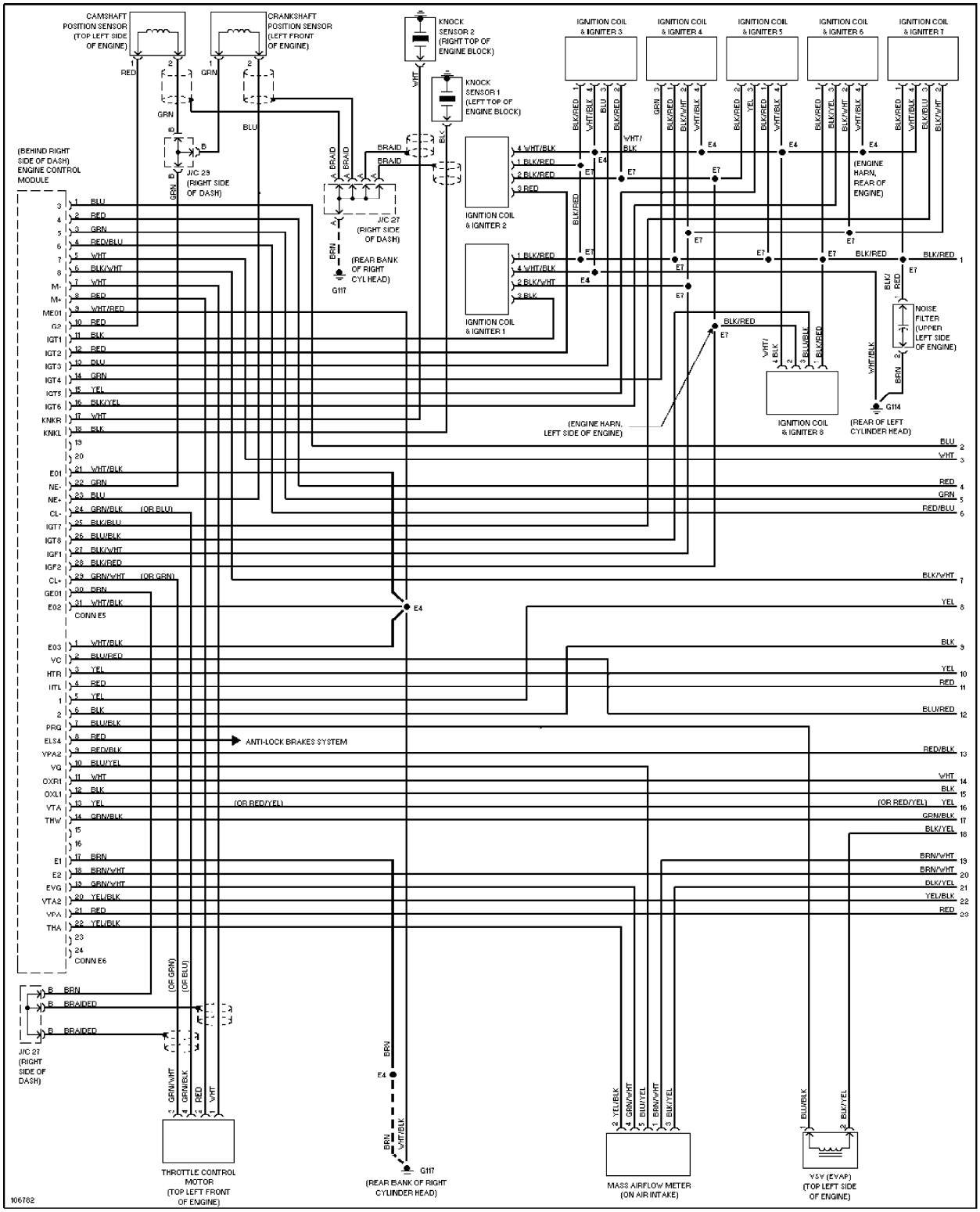


Fig. 17: Wiring Diagram (LX470 4.7L - 1 Of 4)

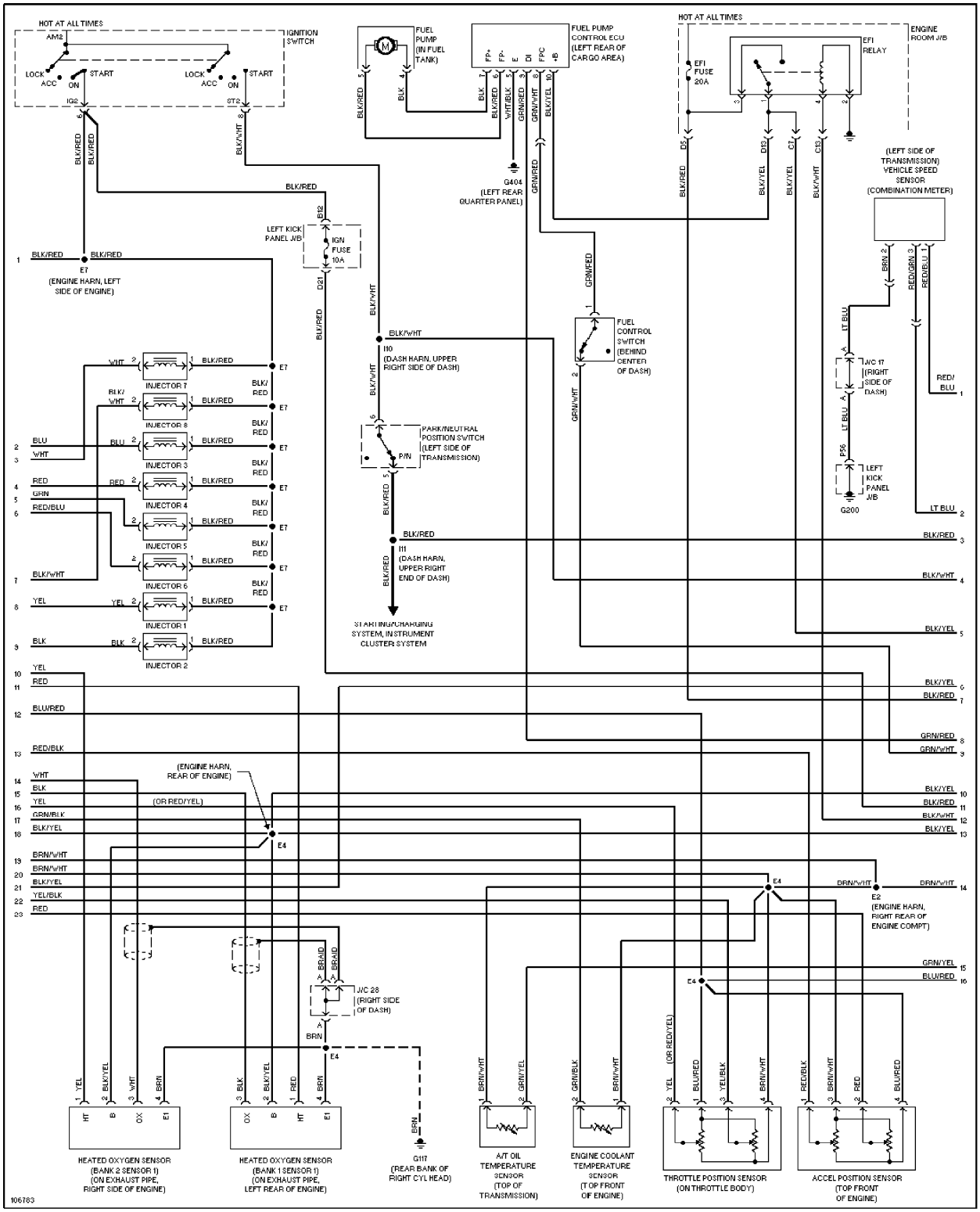


Fig. 18: Wiring Diagram (LX470 4.7L - 2 Of 4)

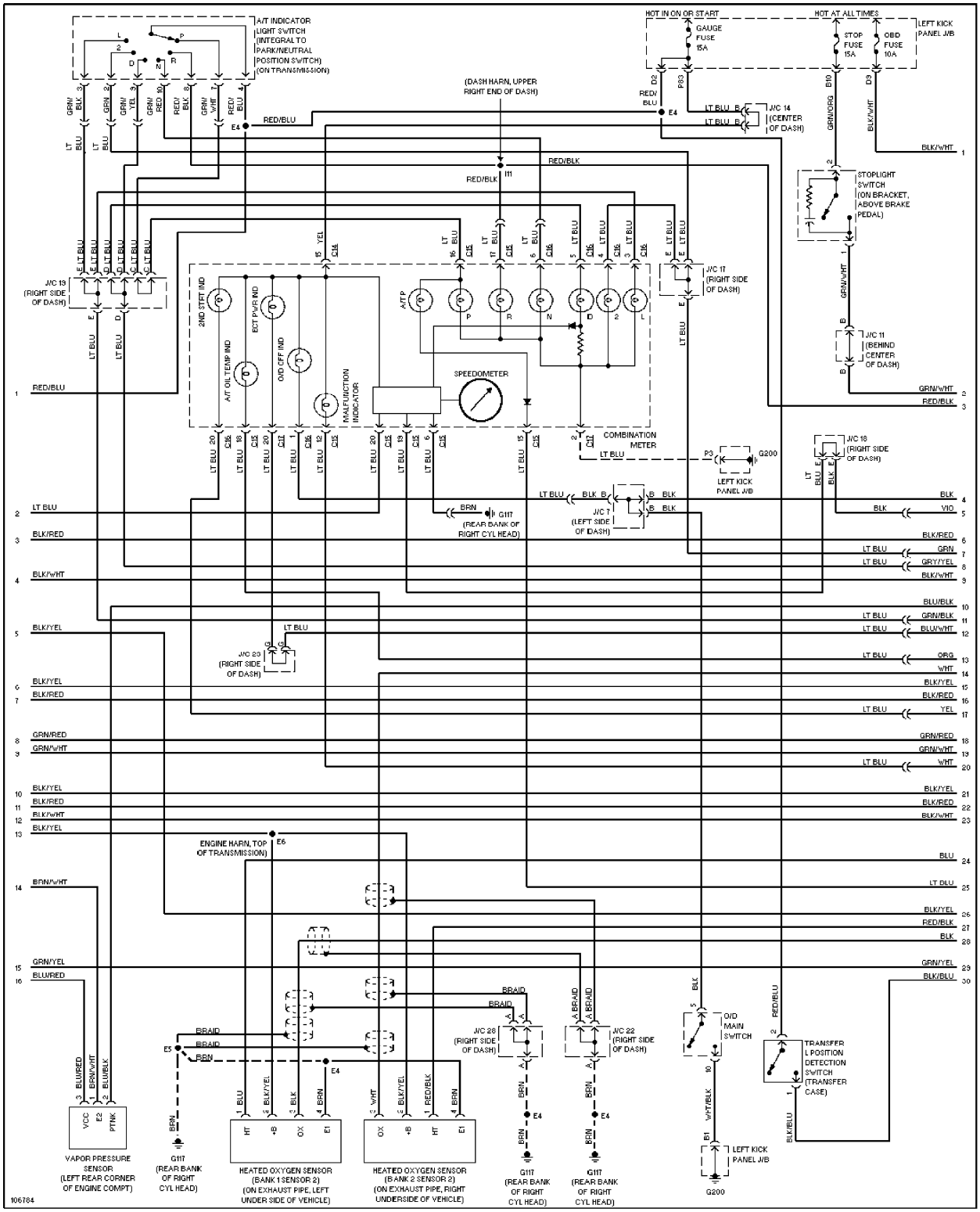


Fig. 19: Wiring Diagram (LX470 4.7L - 3 Of 4)

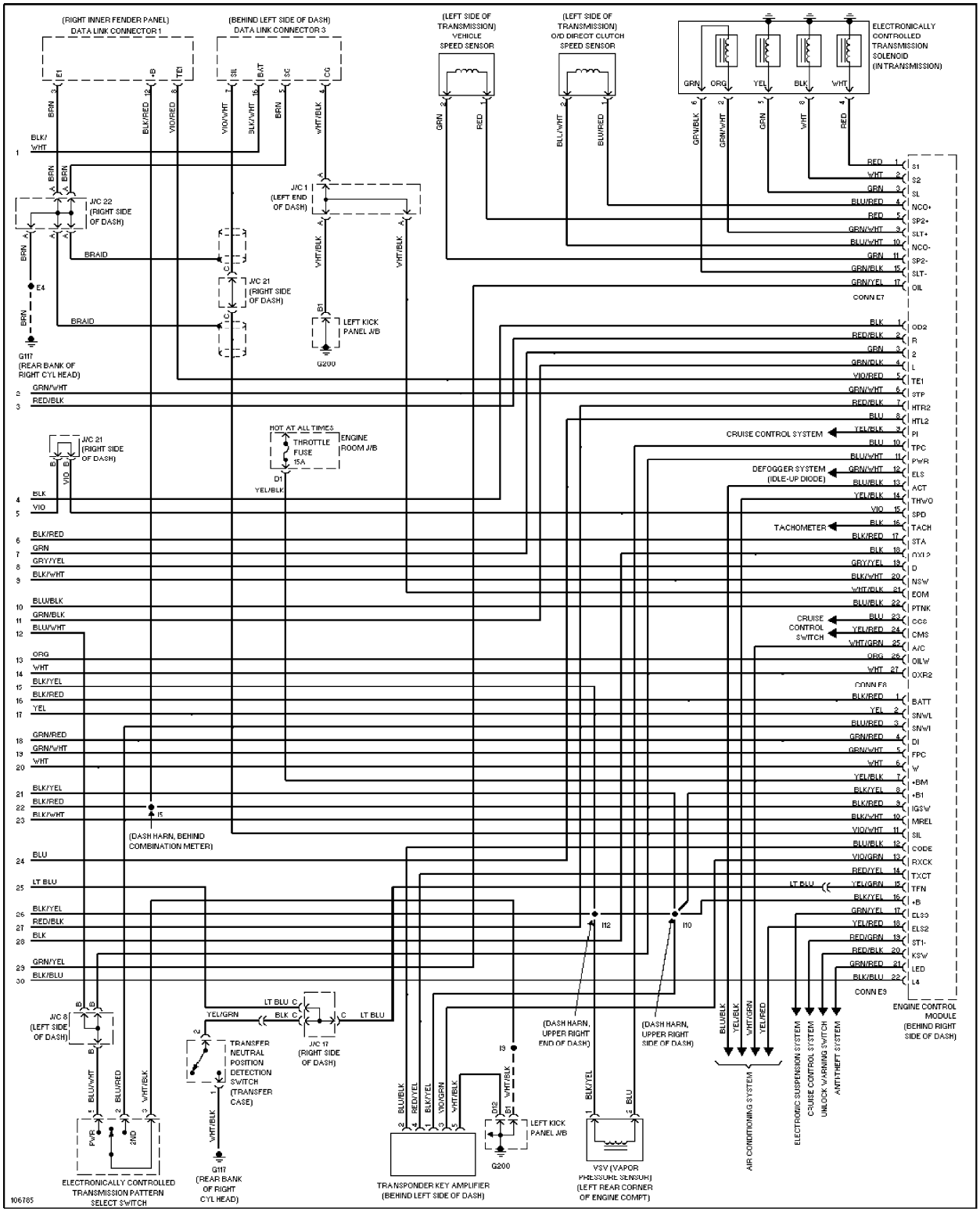


Fig. 20: Wiring Diagram (LX470 4.7L - 4 Of 4)

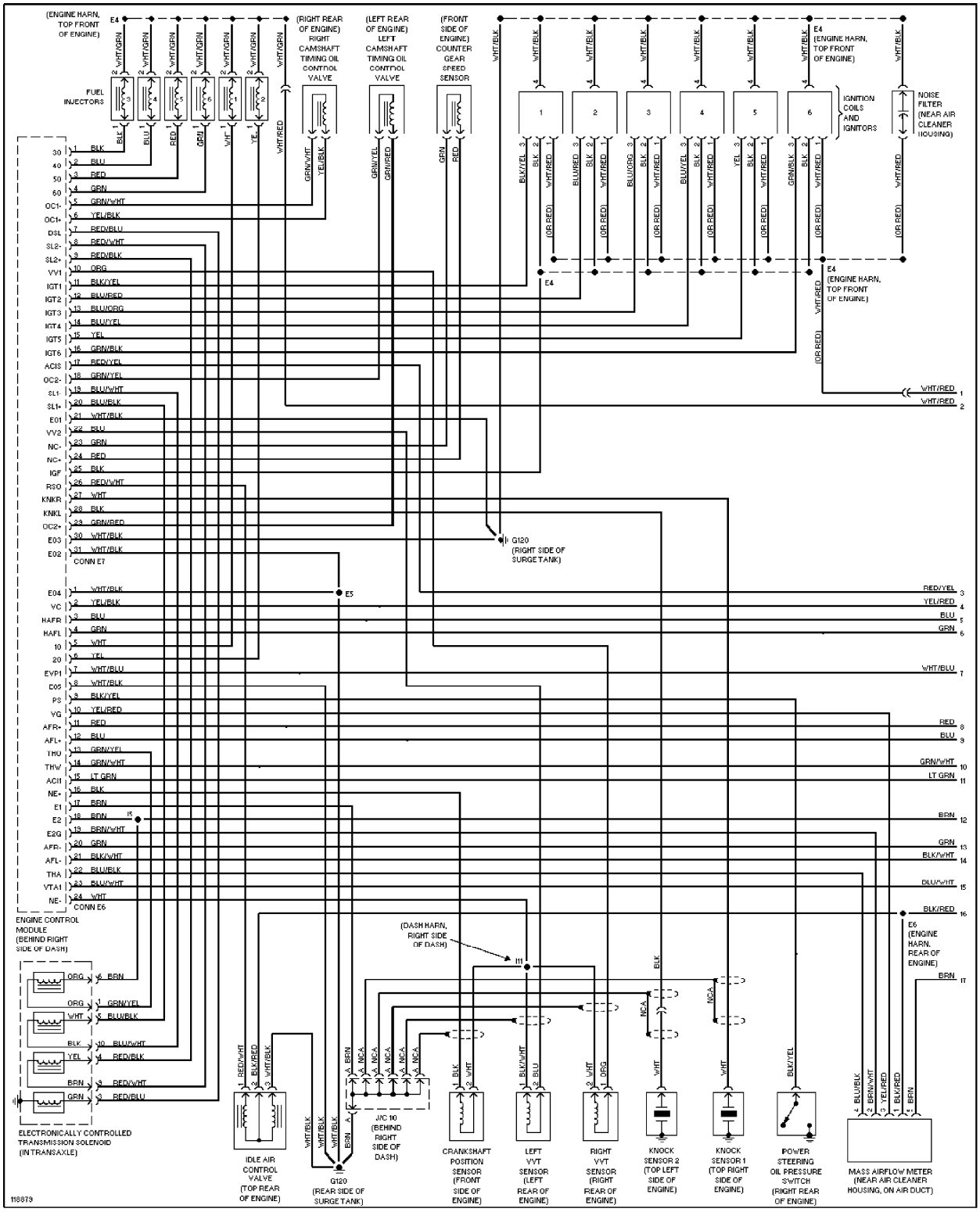


Fig. 21: Wiring Diagram (RX300 3.0L - 1 Of 4)

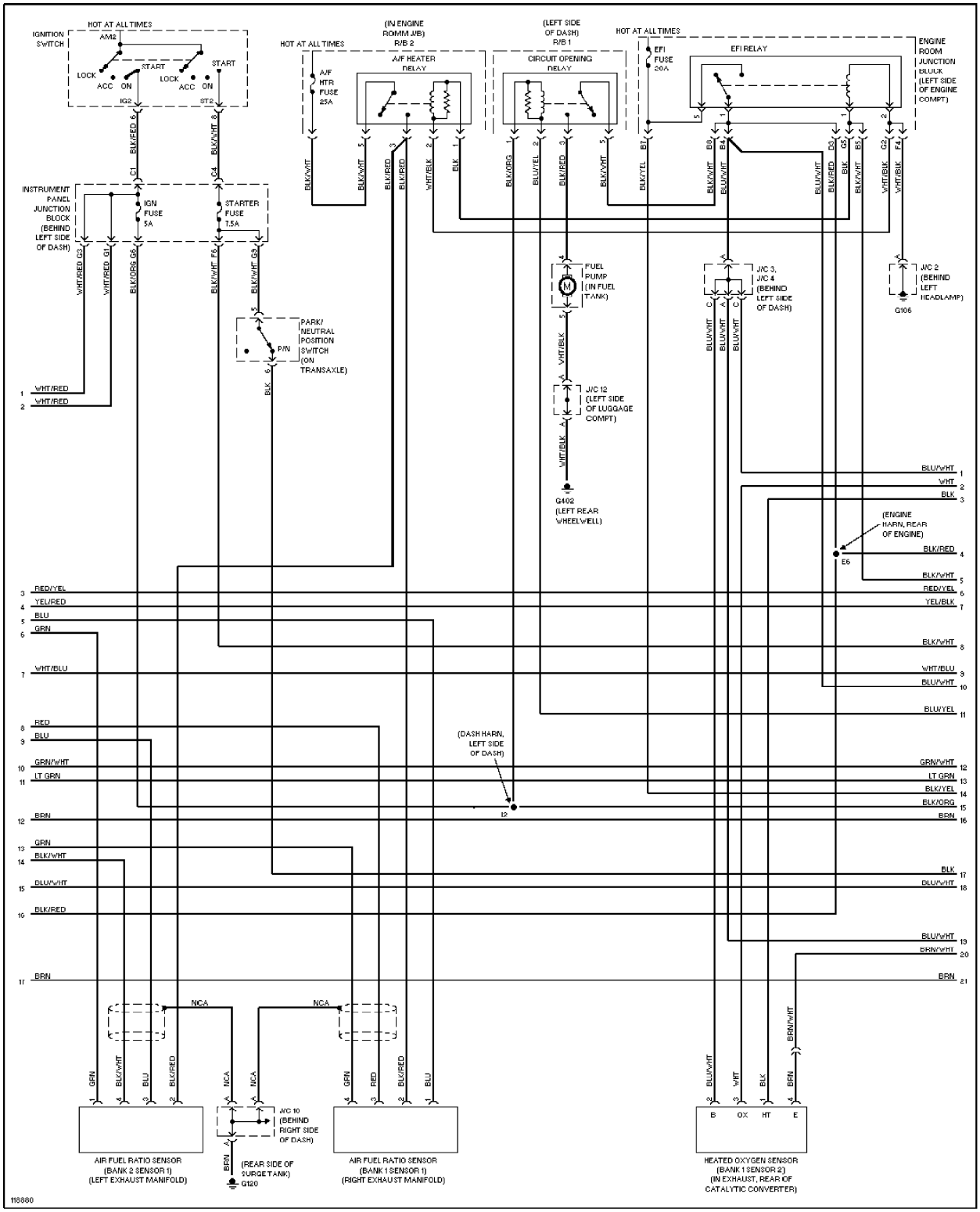


Fig. 22: Wiring Diagram (RX300 3.0L - 2 Of 4)

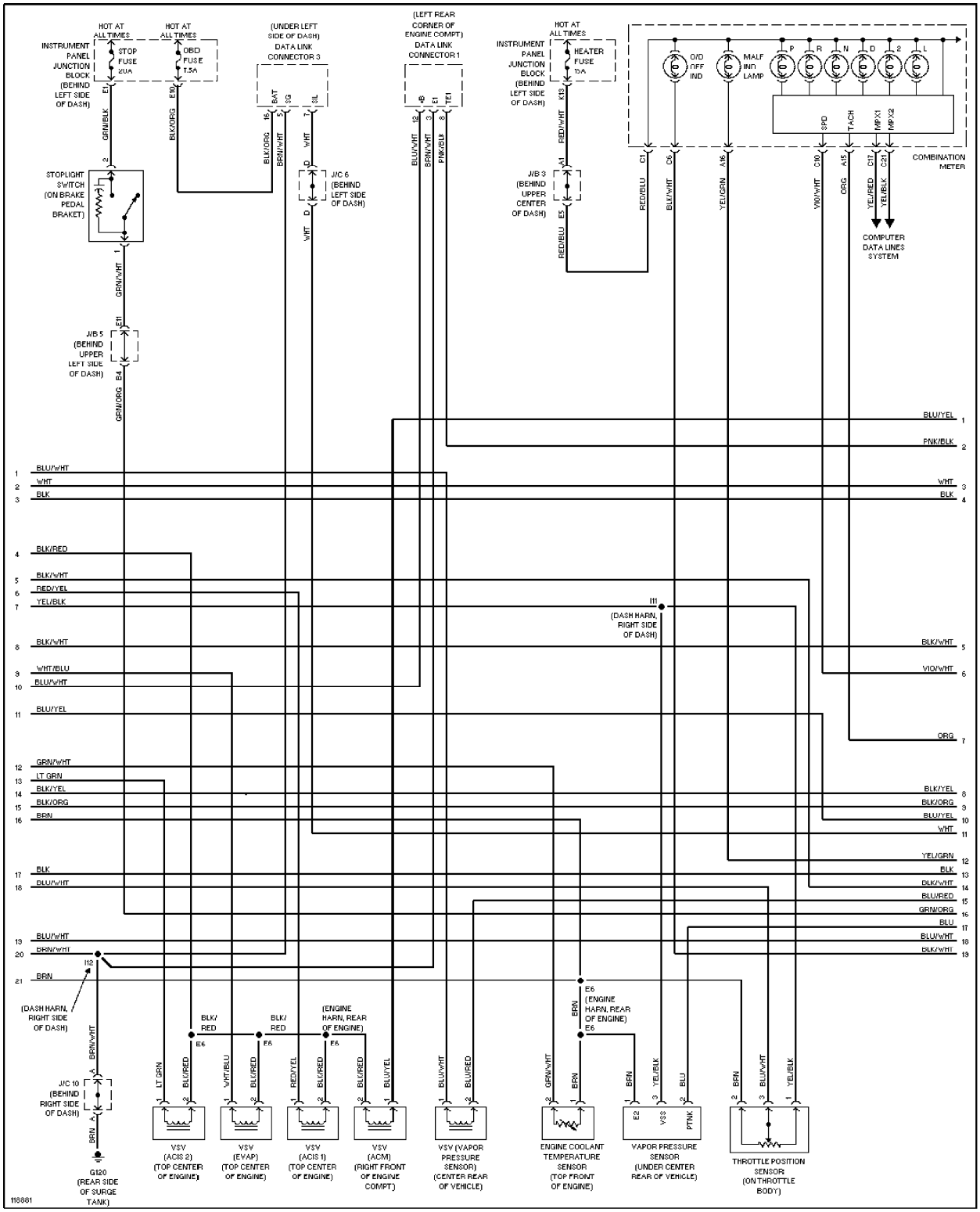


Fig. 23: Wiring Diagram (RX300 3.0L - 3 Of 4)

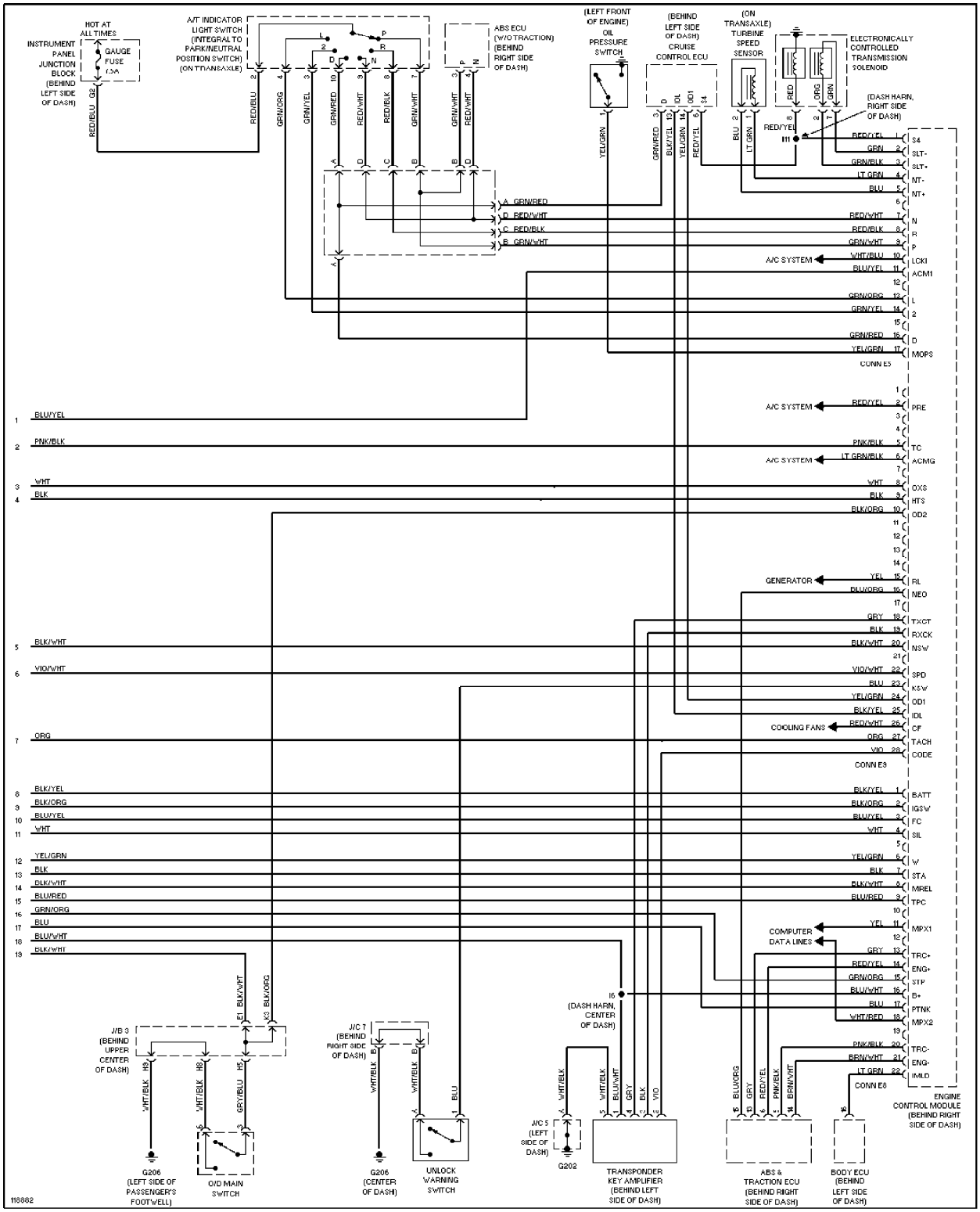


Fig. 24: Wiring Diagram (RX300 3.0L - 4 Of 4)

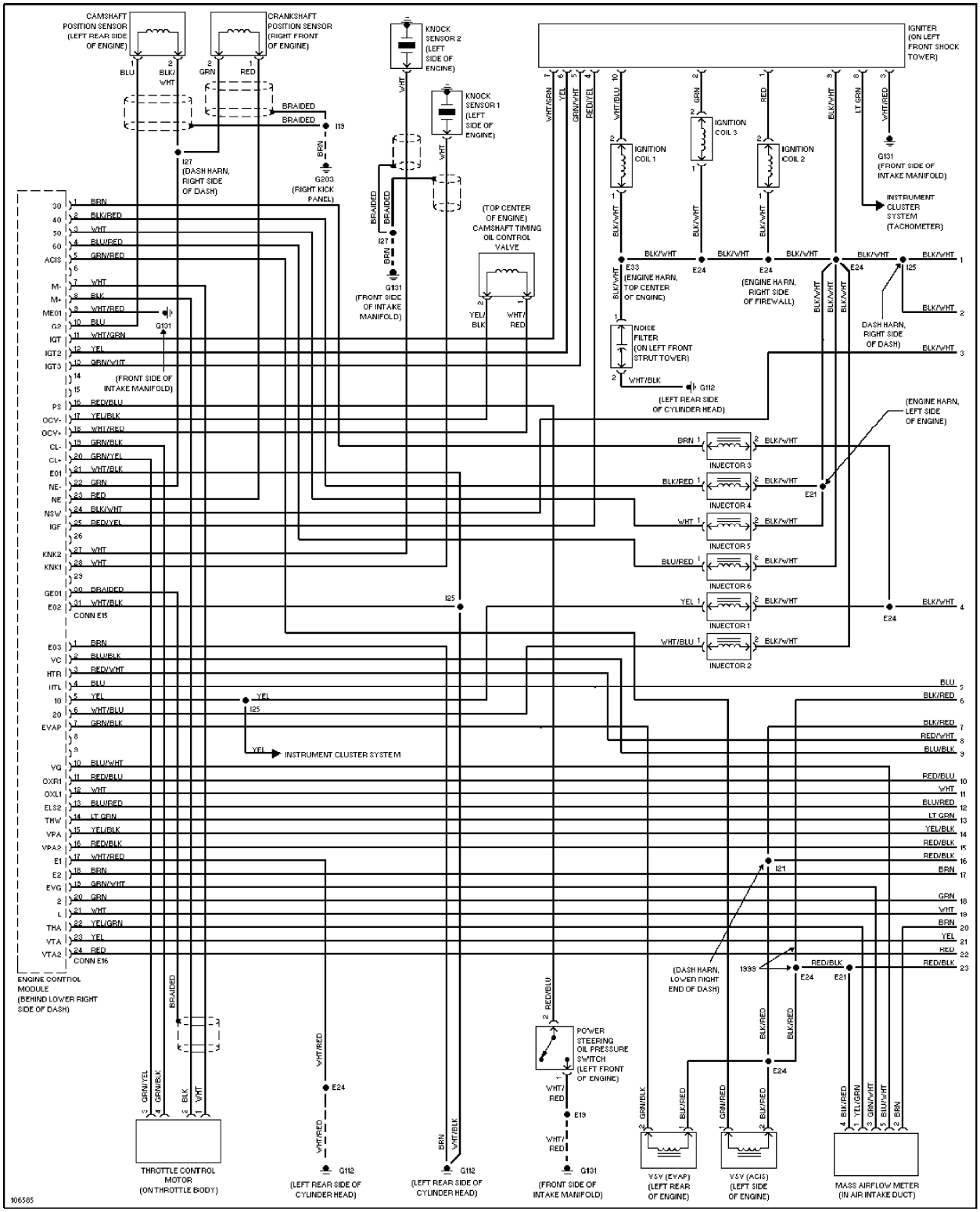


Fig. 25: Wiring Diagram (SC300 3.0L - 1 Of 4)

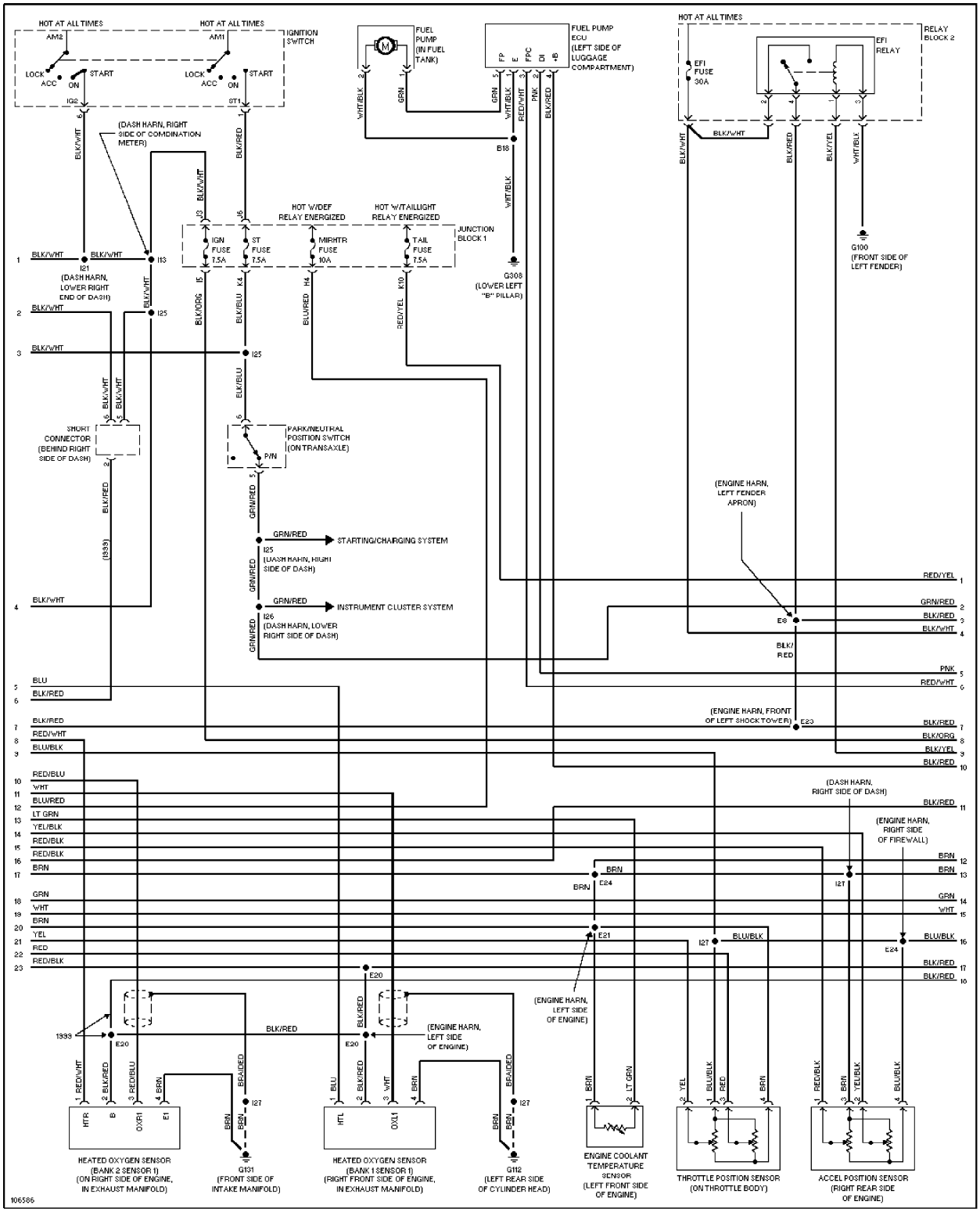


Fig. 26: Wiring Diagram (SC300 3.0L - 2 Of 4)

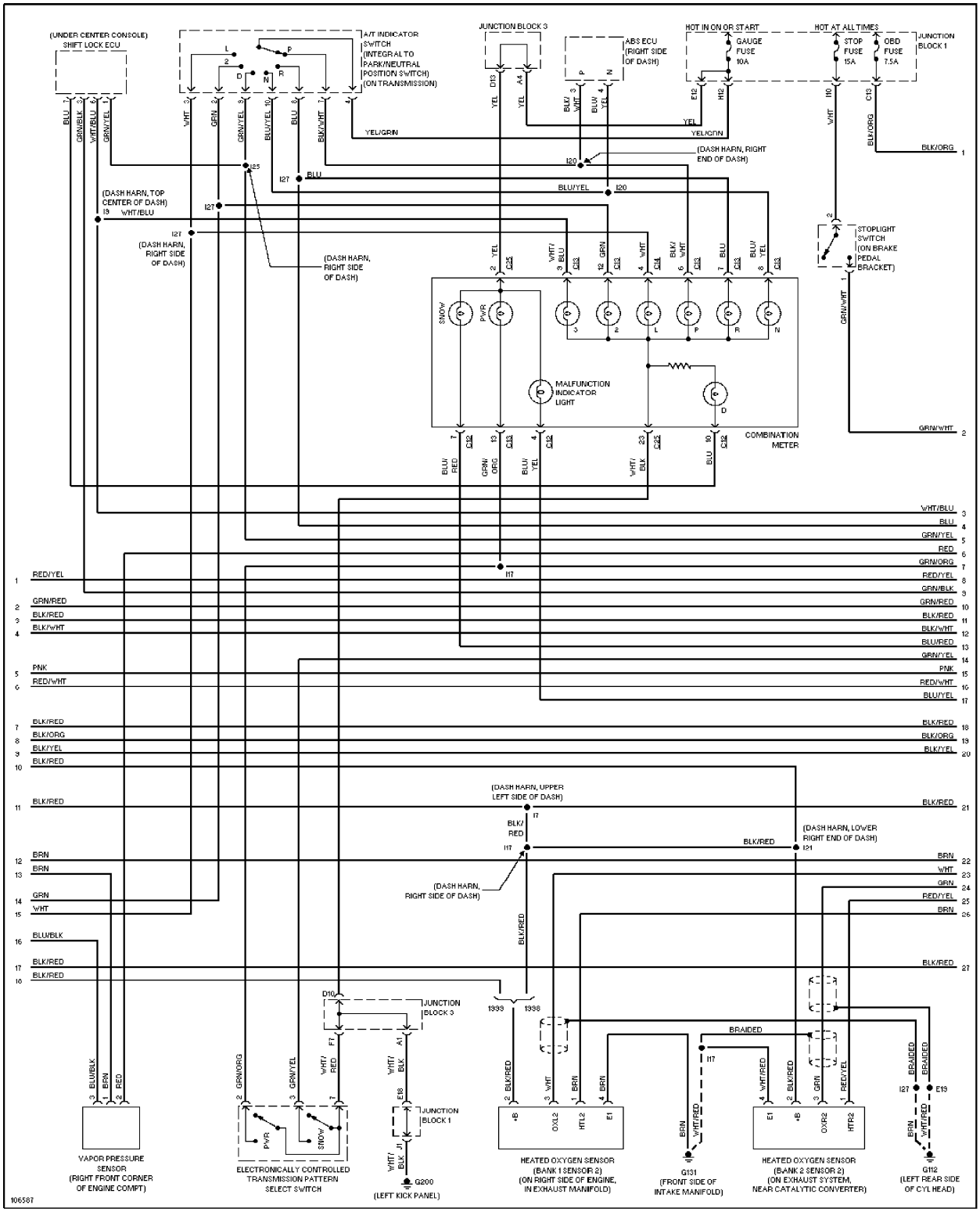


Fig. 27: Wiring Diagram (SC300 3.0L - 3 Of 4)

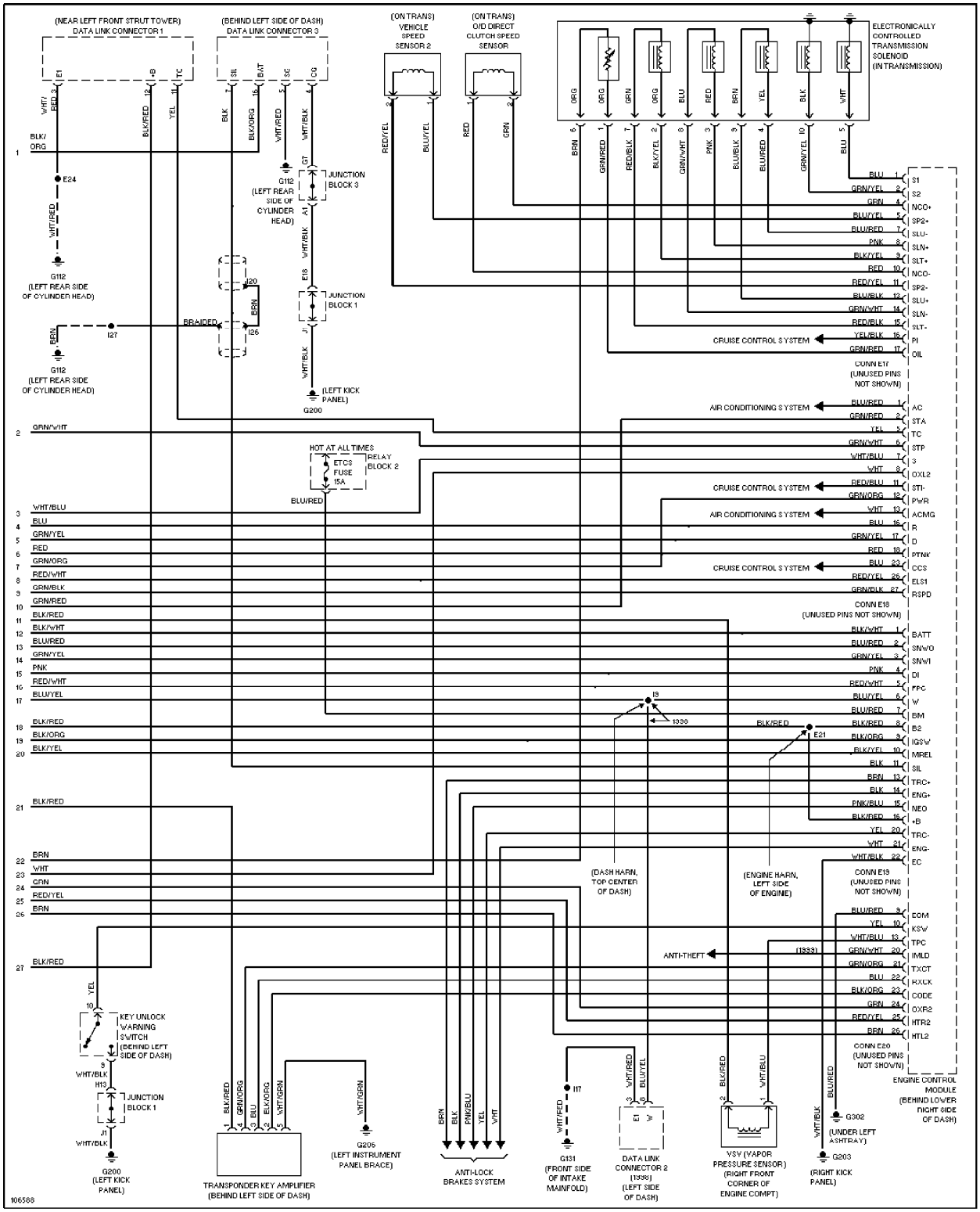


Fig. 28: Wiring Diagram (SC300 3.0L - 4 Of 4)

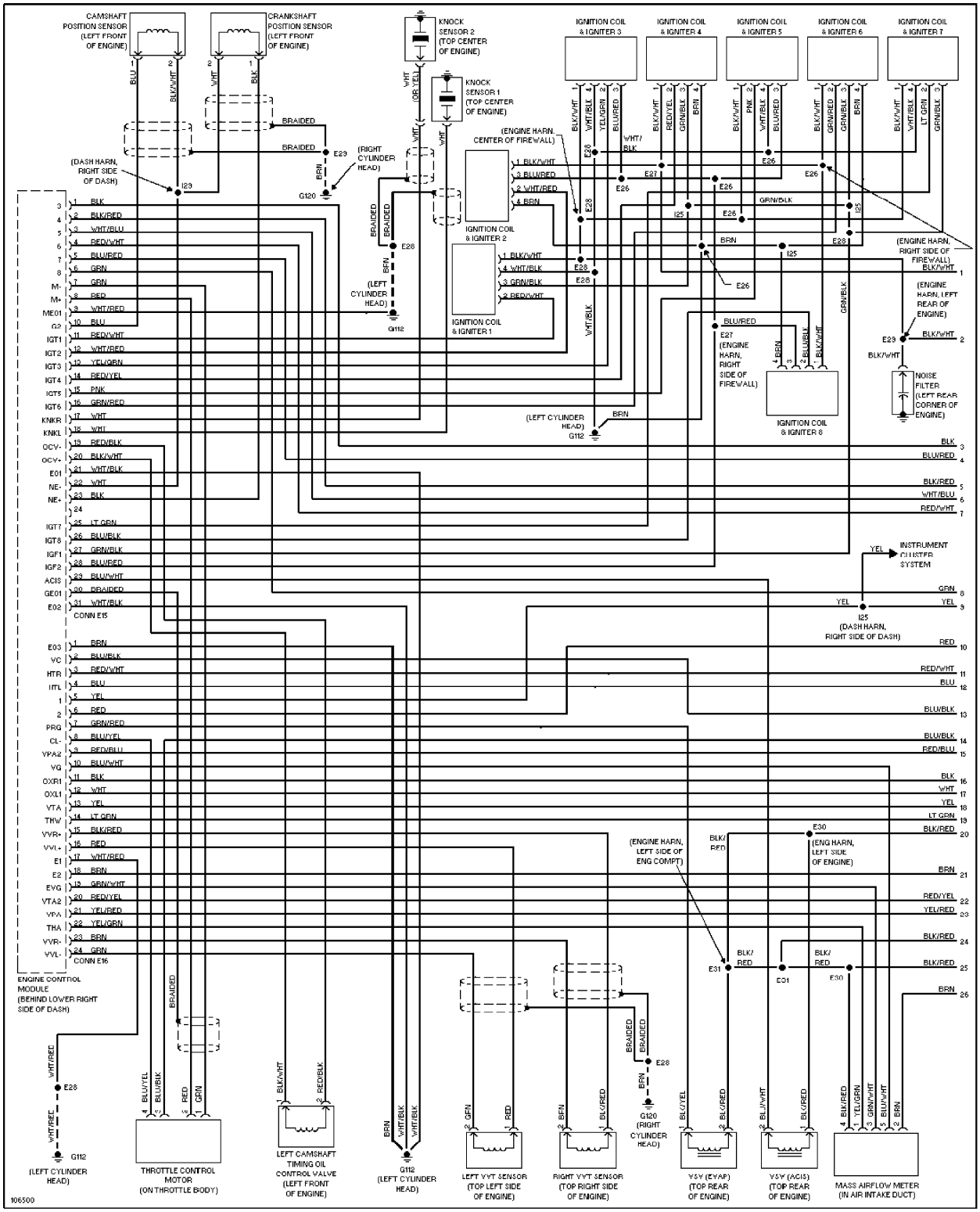


Fig. 29: Wiring Diagram (SC400 4.0L - 1 Of 4)

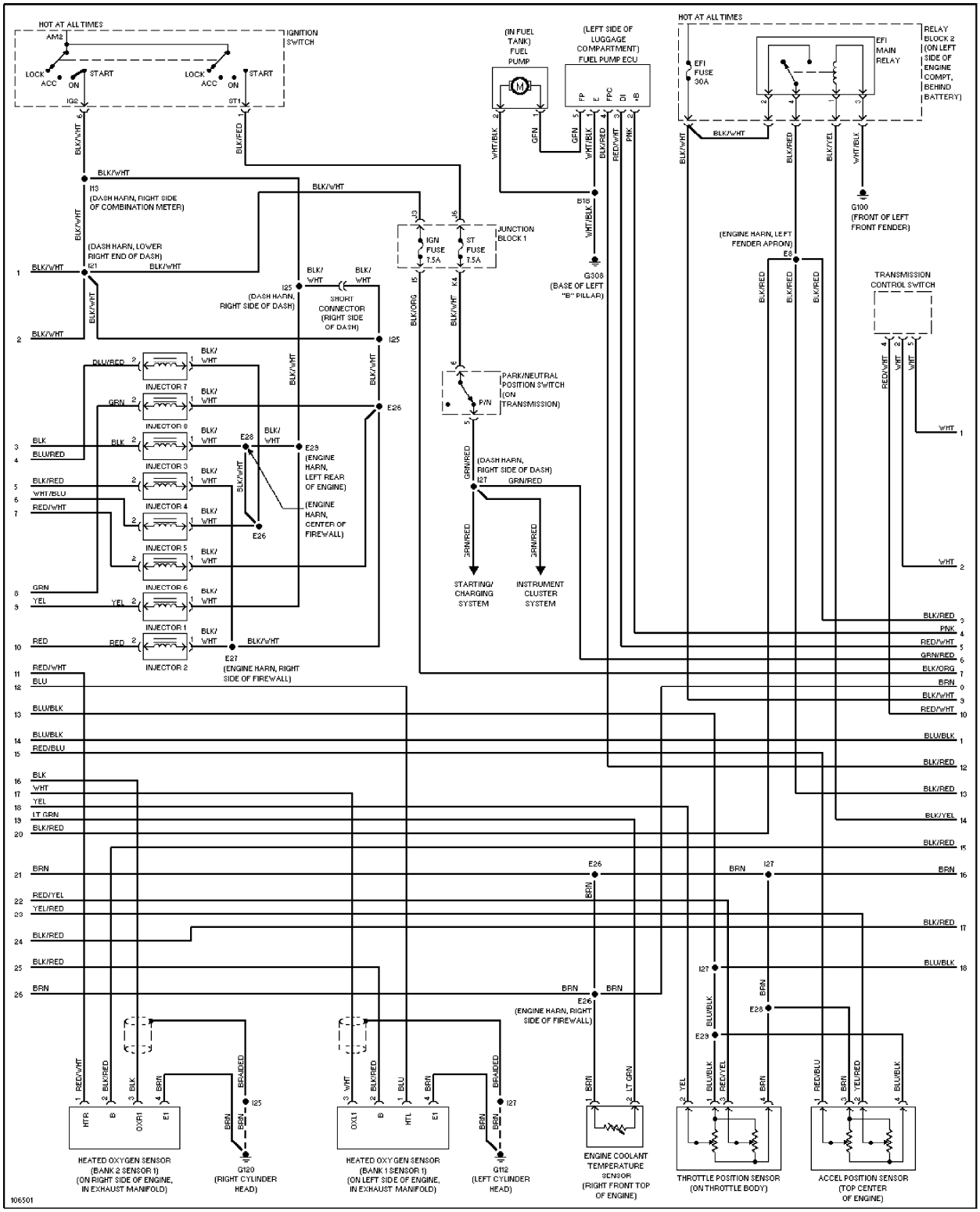


Fig. 30: Wiring Diagram (SC400 4.0L - 2 Of 4)

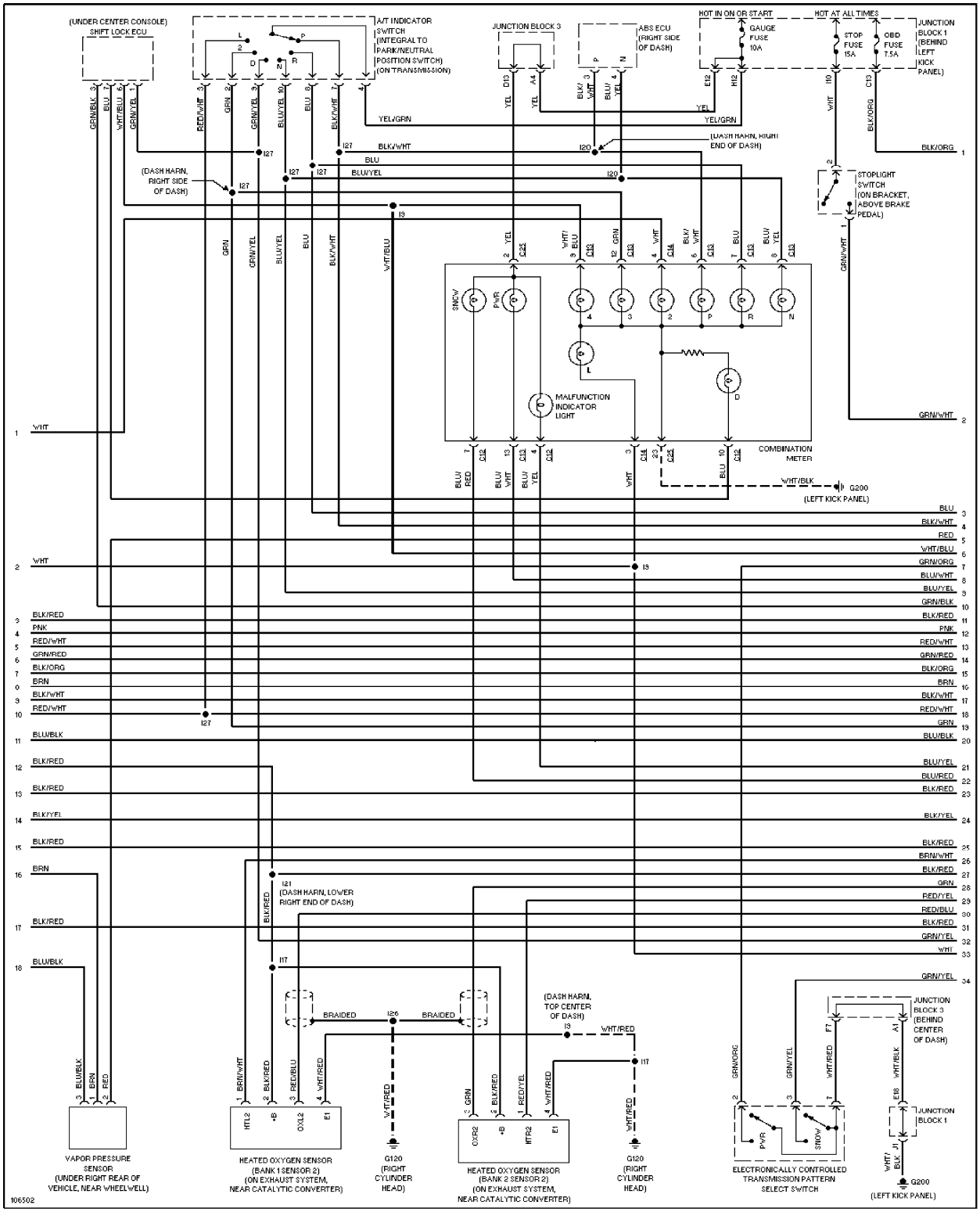


Fig. 31: Wiring Diagram (SC400 4.0L - 3 Of 4)

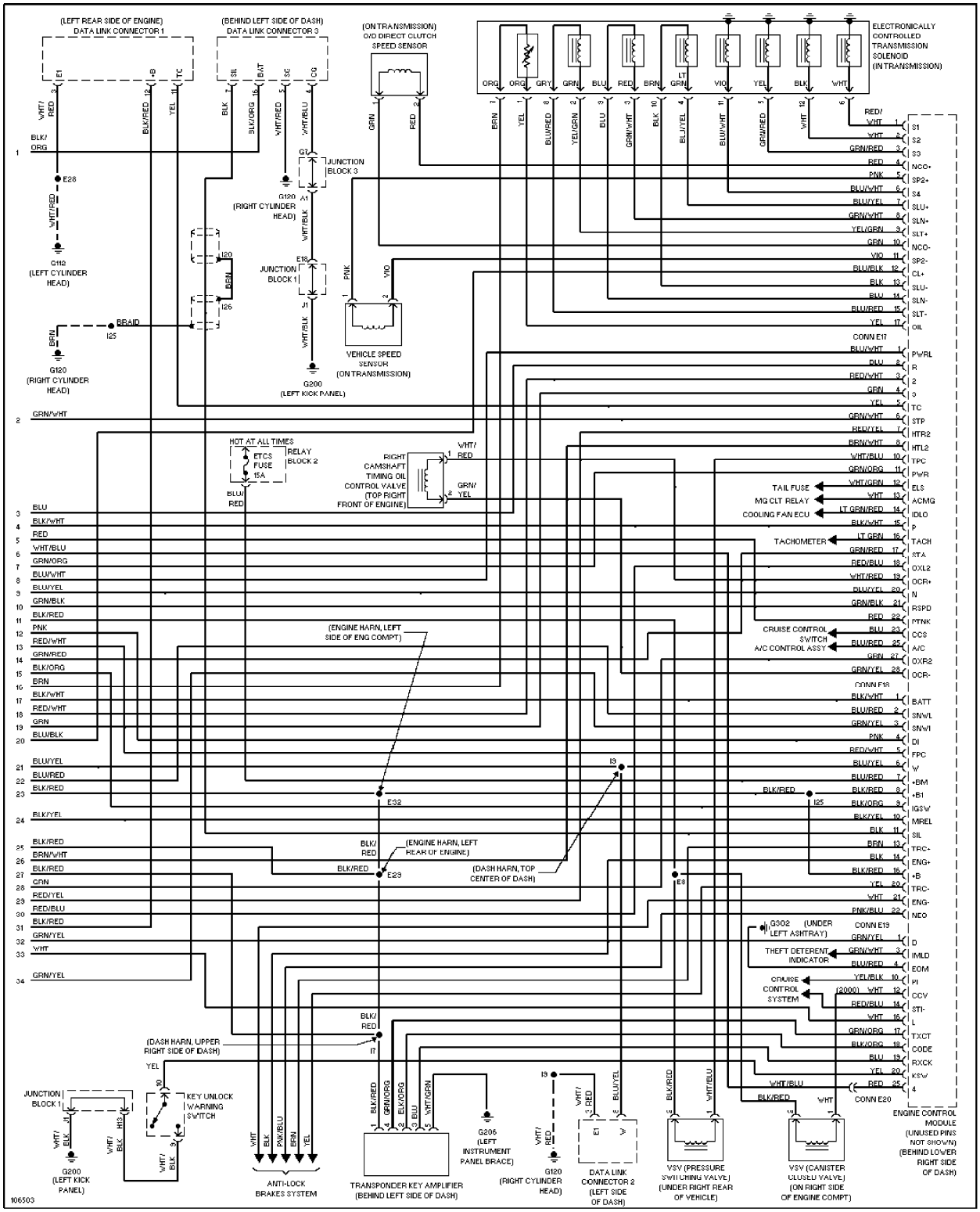


Fig. 32: Wiring Diagram (SC400 4.0L - 4 Of 4)

M - VACUUM DIAGRAMS

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Vacuum Diagrams
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

This article contains underhood views and vacuum diagrams of vacuum hose routing. Use these vacuum diagrams during the visual inspection in BASIC DIAGNOSTIC PROCEDURES article. This will assist in identifying improperly routed vacuum hoses which may cause driveability and/or computer-indicated malfunctions.

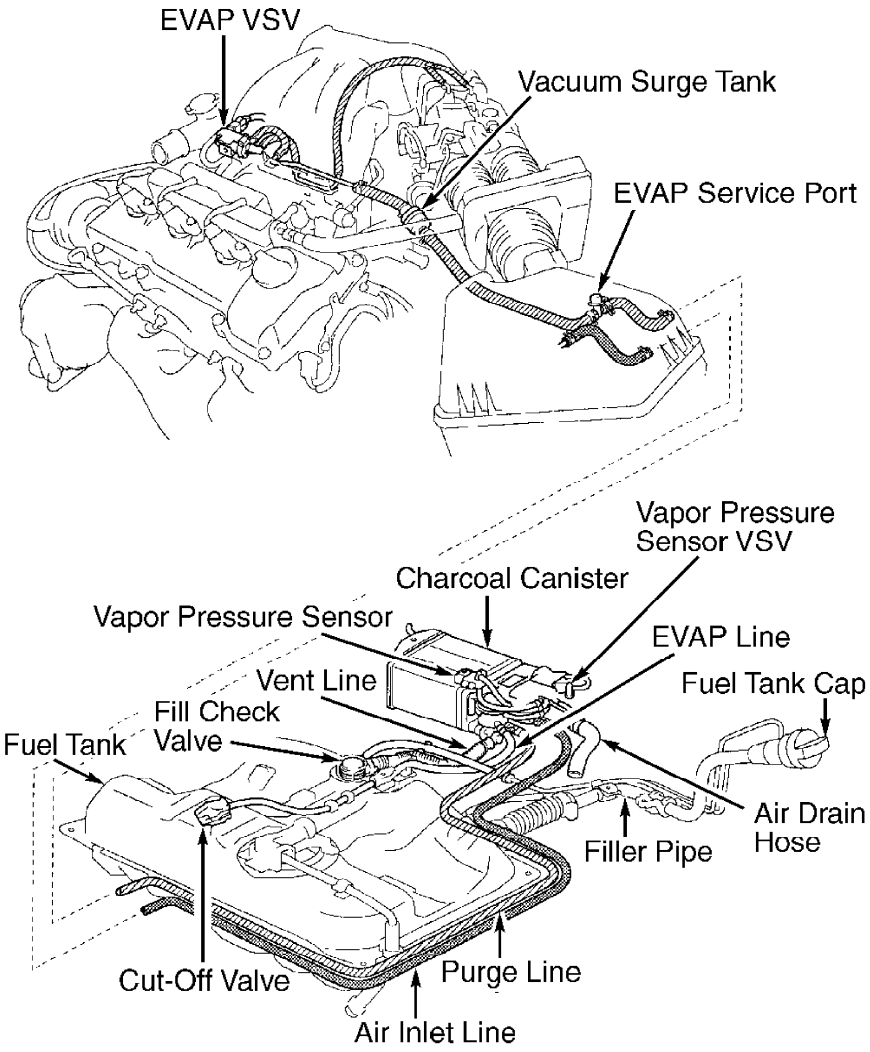


Fig. 1: Vacuum Diagram (ES300 Shown; RX300 Late Release Is Similar - 1 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

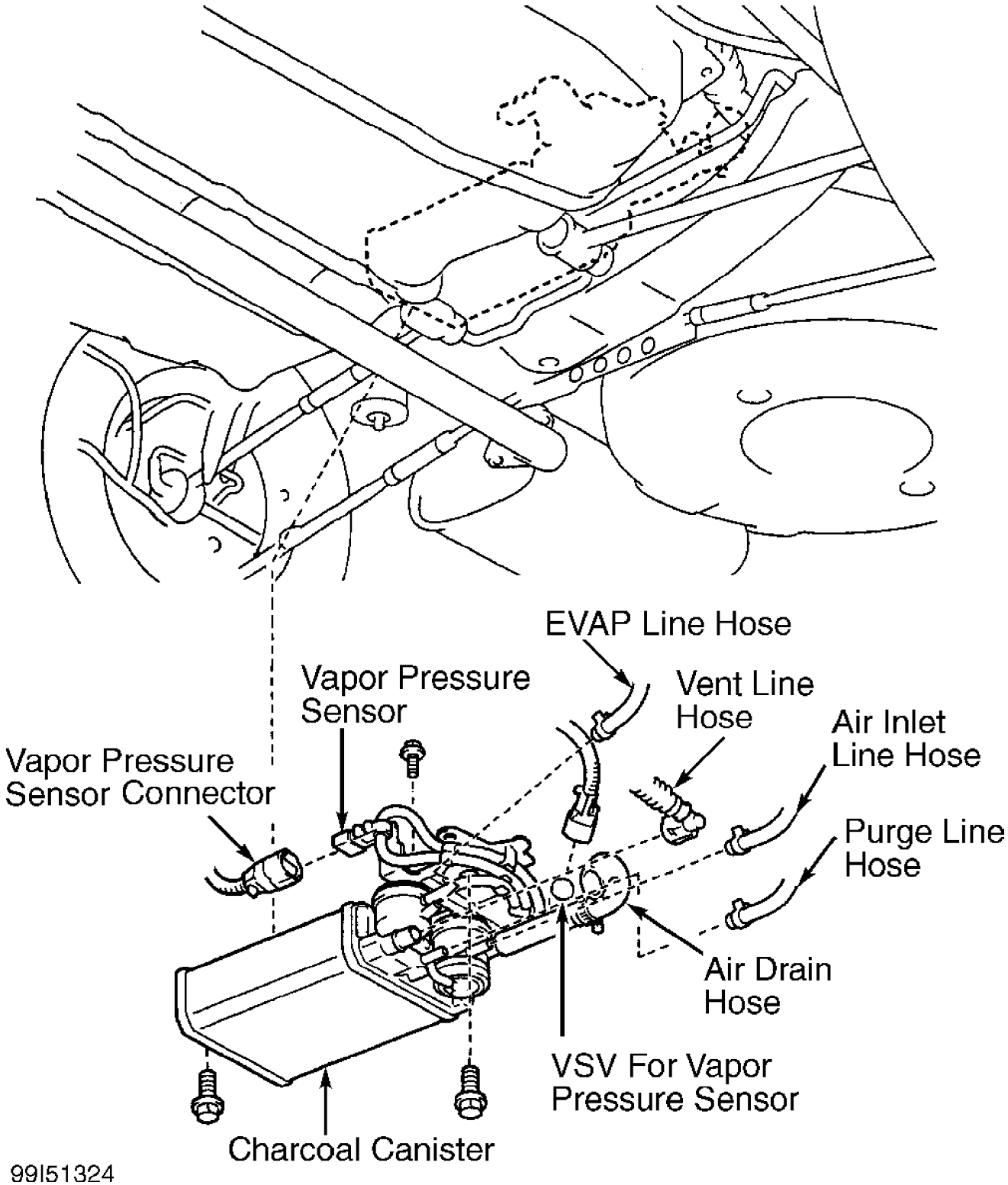


Fig. 2: Vacuum Diagram (ES300 Shown; RX300 Is Similar - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

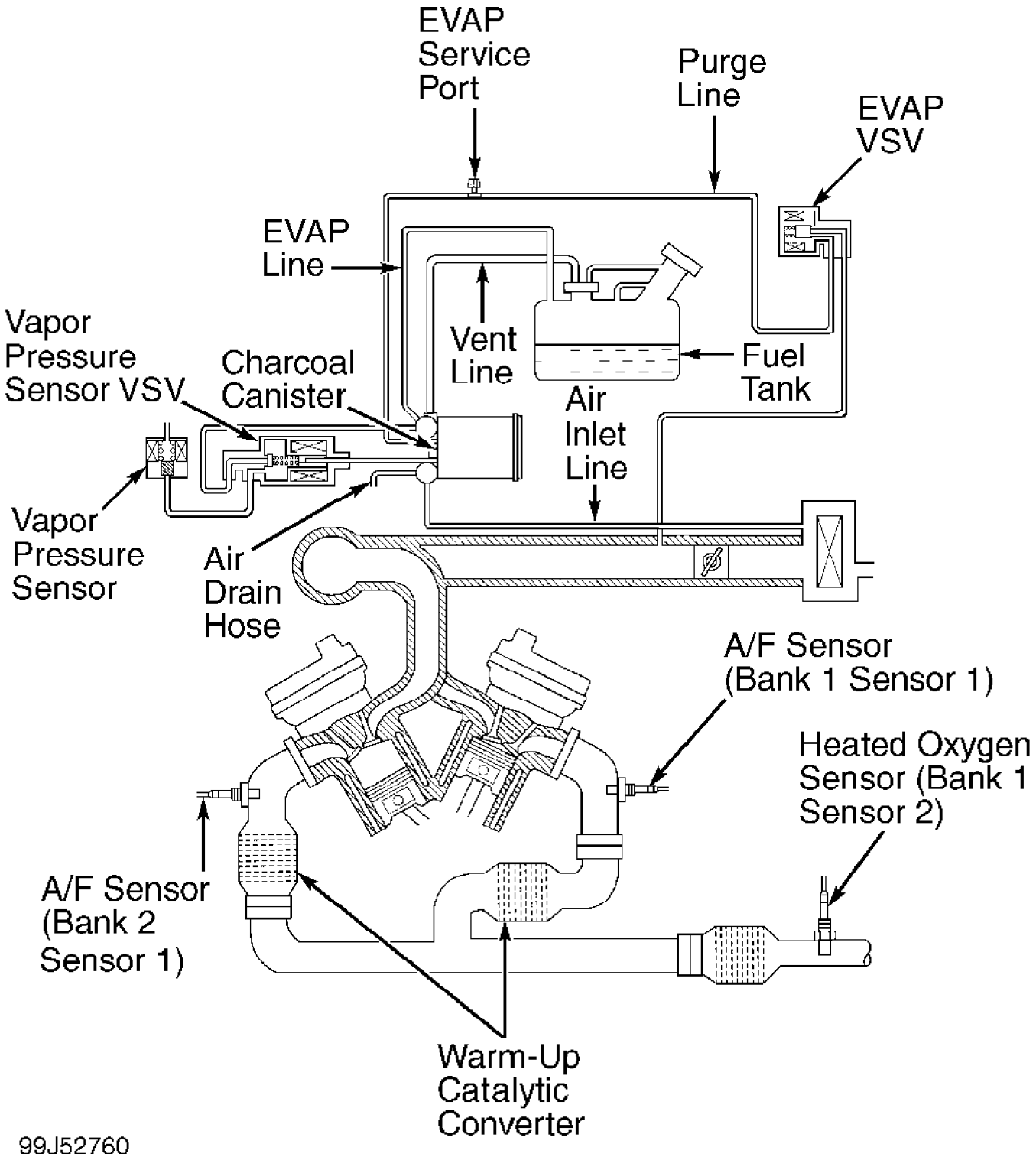


Fig. 3: Vacuum Diagram (ES300 Shown; RX300 Late Release Is Similar - 3 Of 3)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

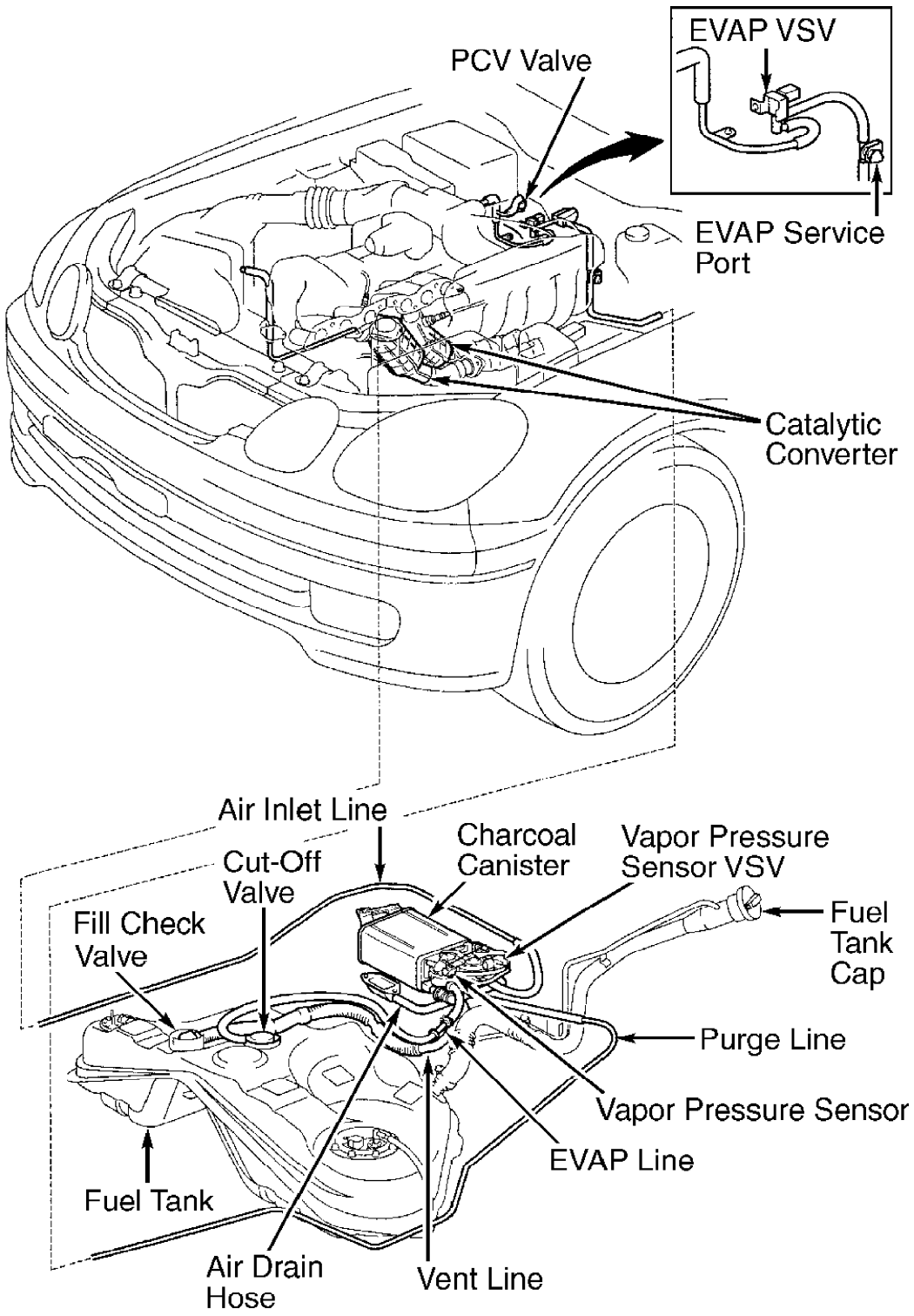


Fig. 4: Vacuum Diagram (GS300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

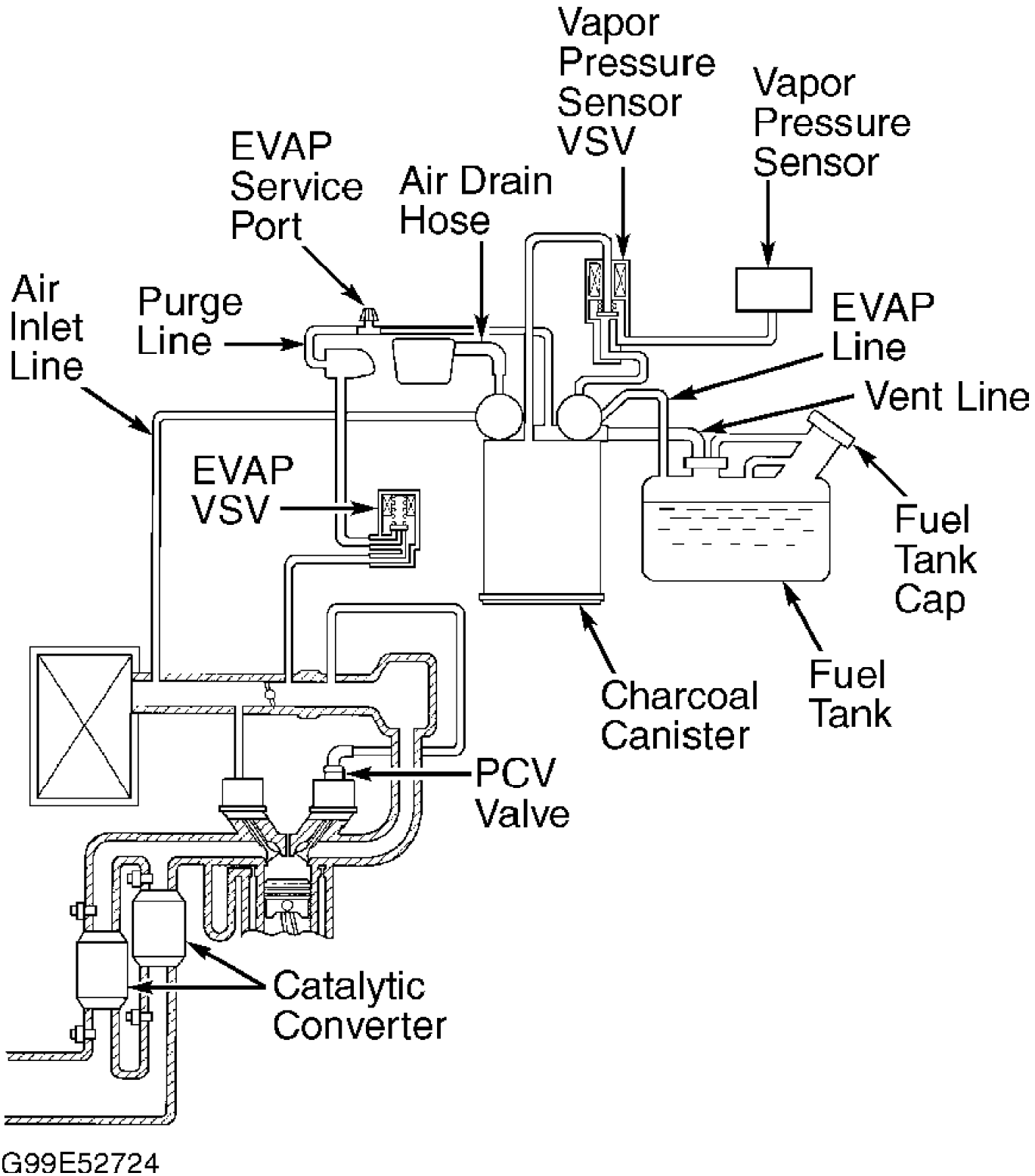


Fig. 5: Vacuum Diagram (GS300 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

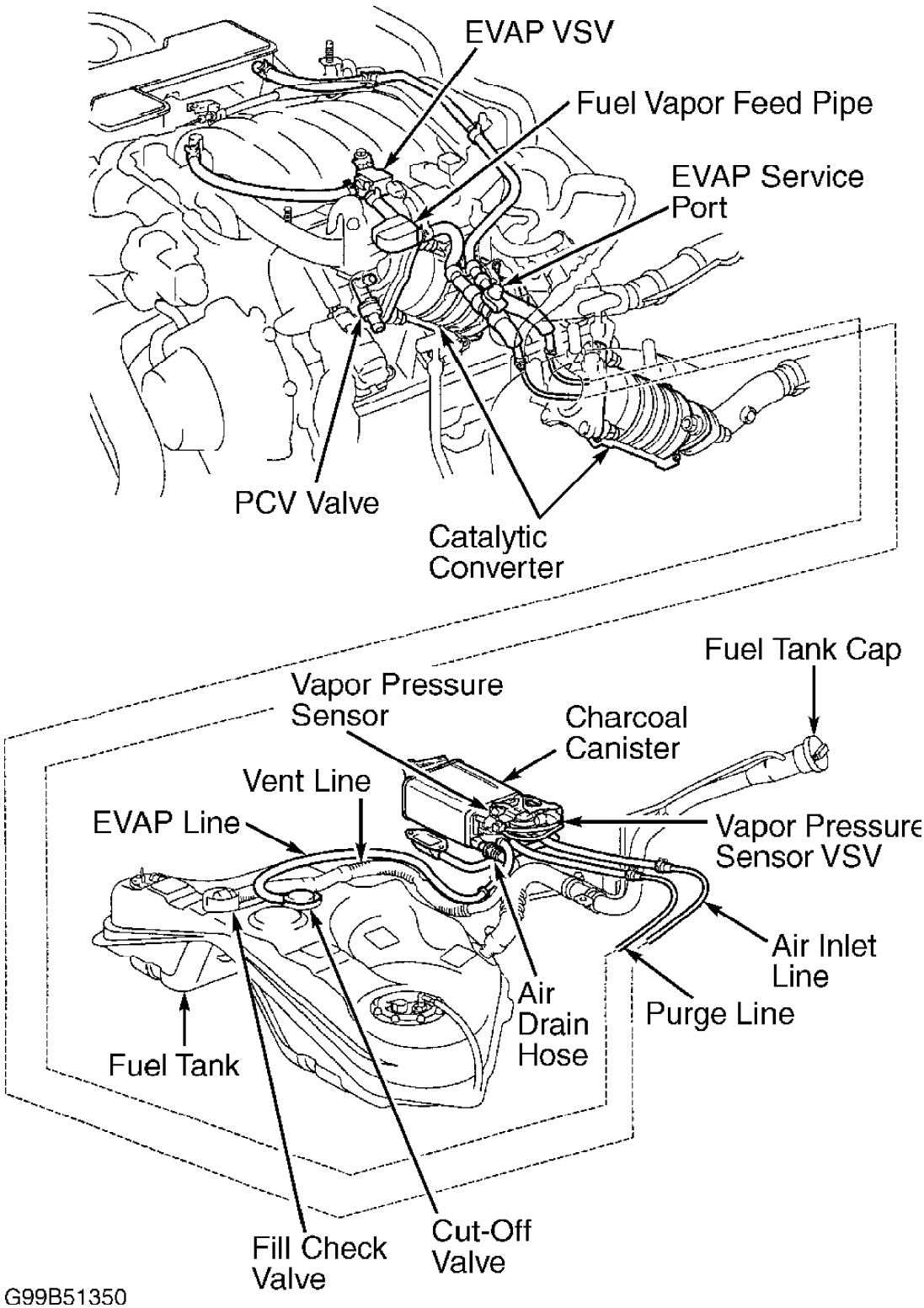


Fig. 6: Vacuum Diagram (GS400 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

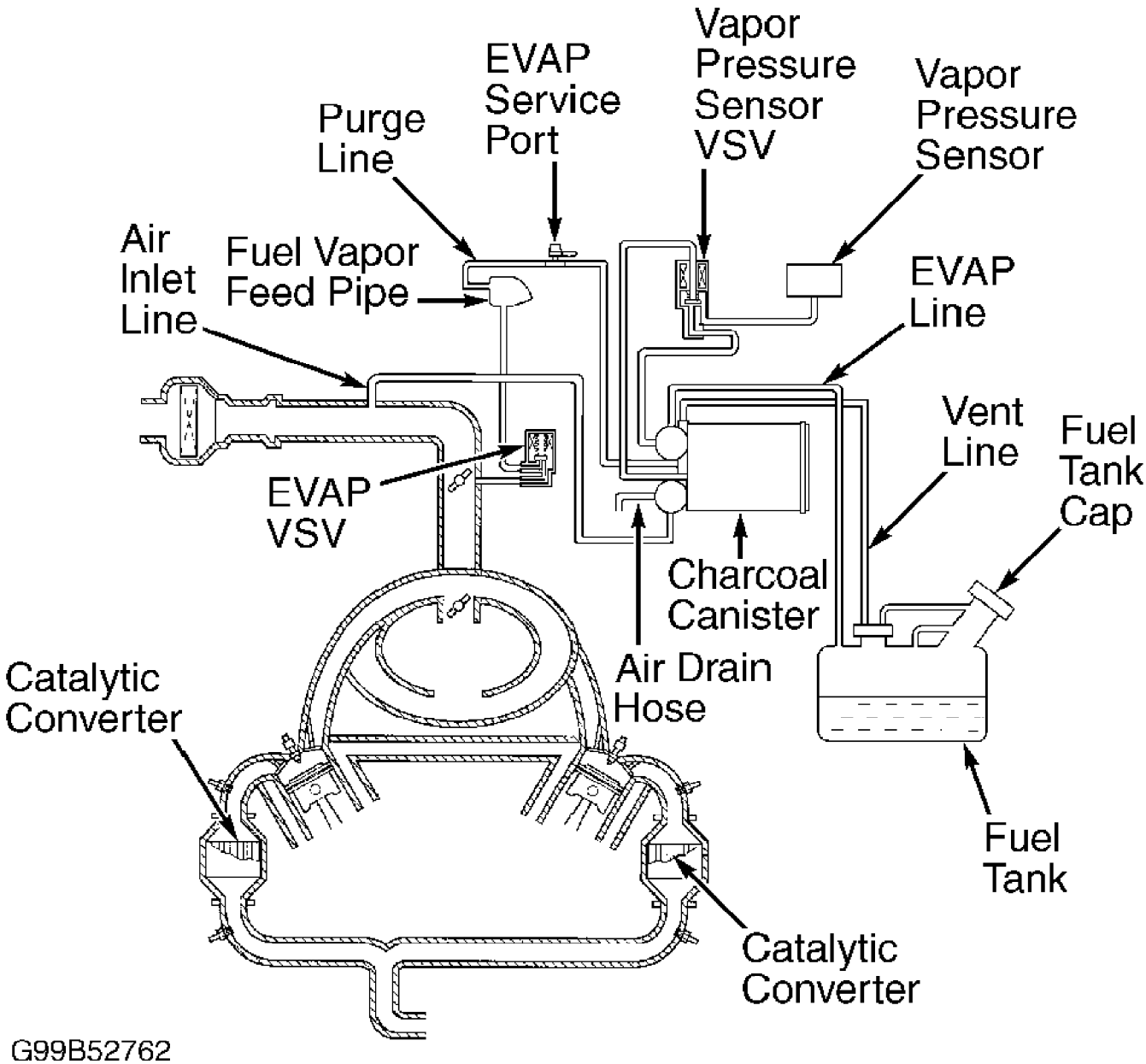


Fig. 7: Vacuum Diagram (GS400 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

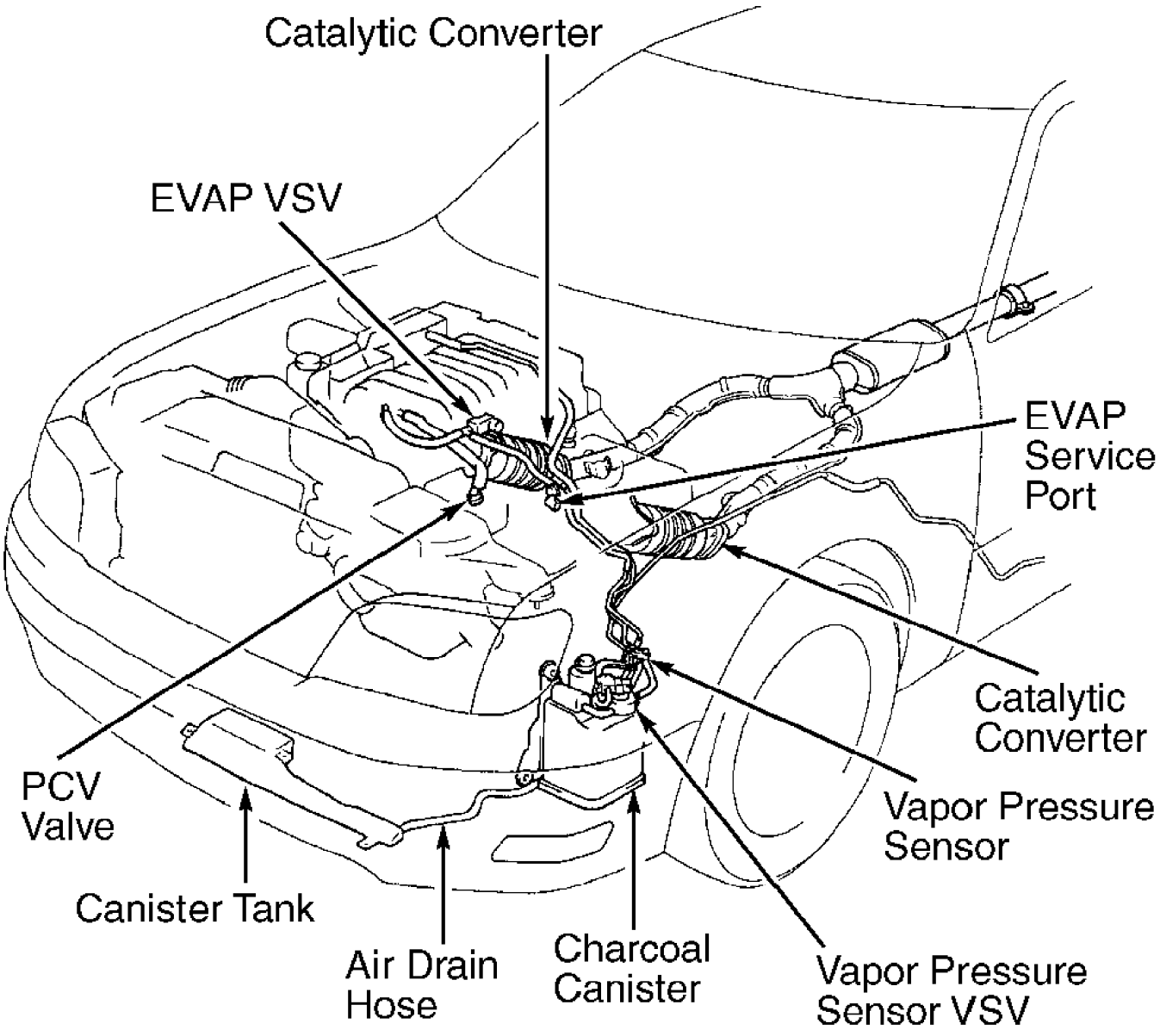


Fig. 8: Vacuum Diagram (LS400 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

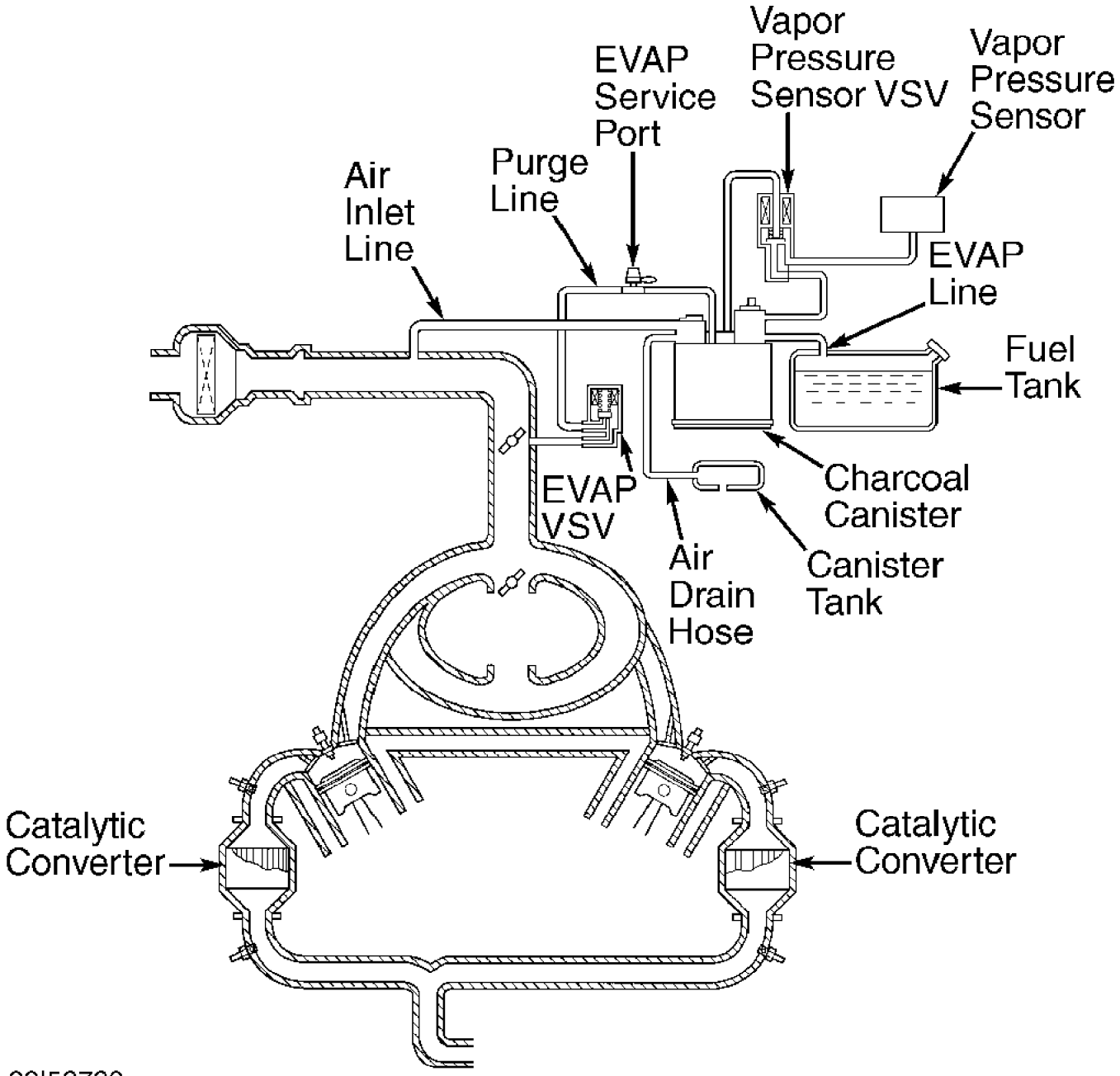


Fig. 9: Vacuum Diagram (LS400 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

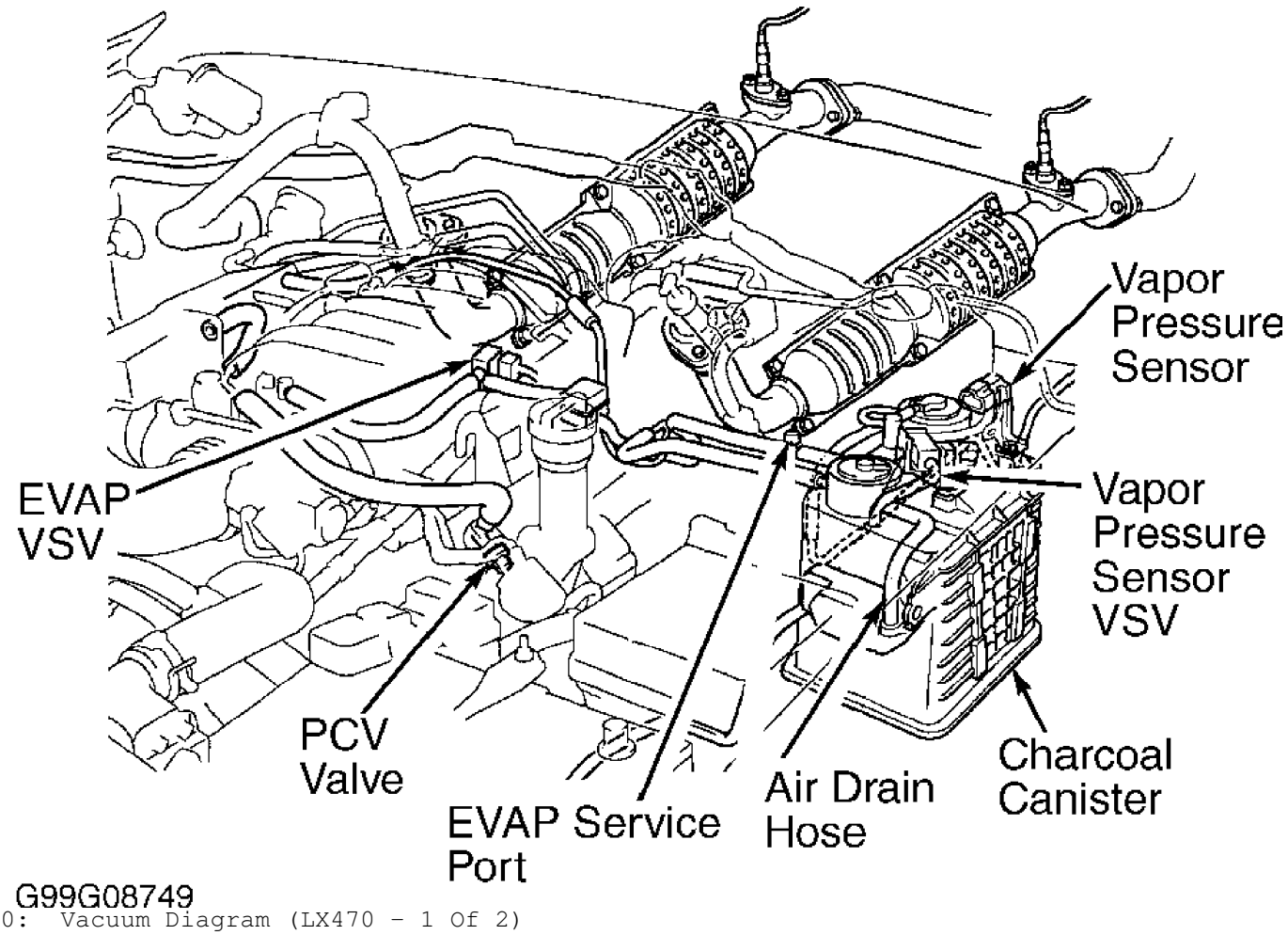


Fig. 10: Vacuum Diagram (LX470 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

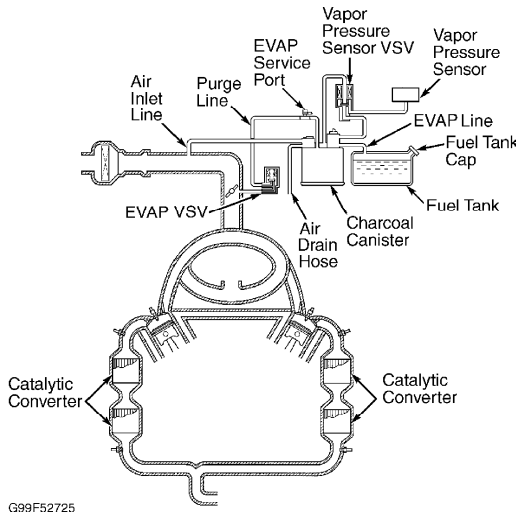


Fig. 11: Vacuum Diagram (LX470 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

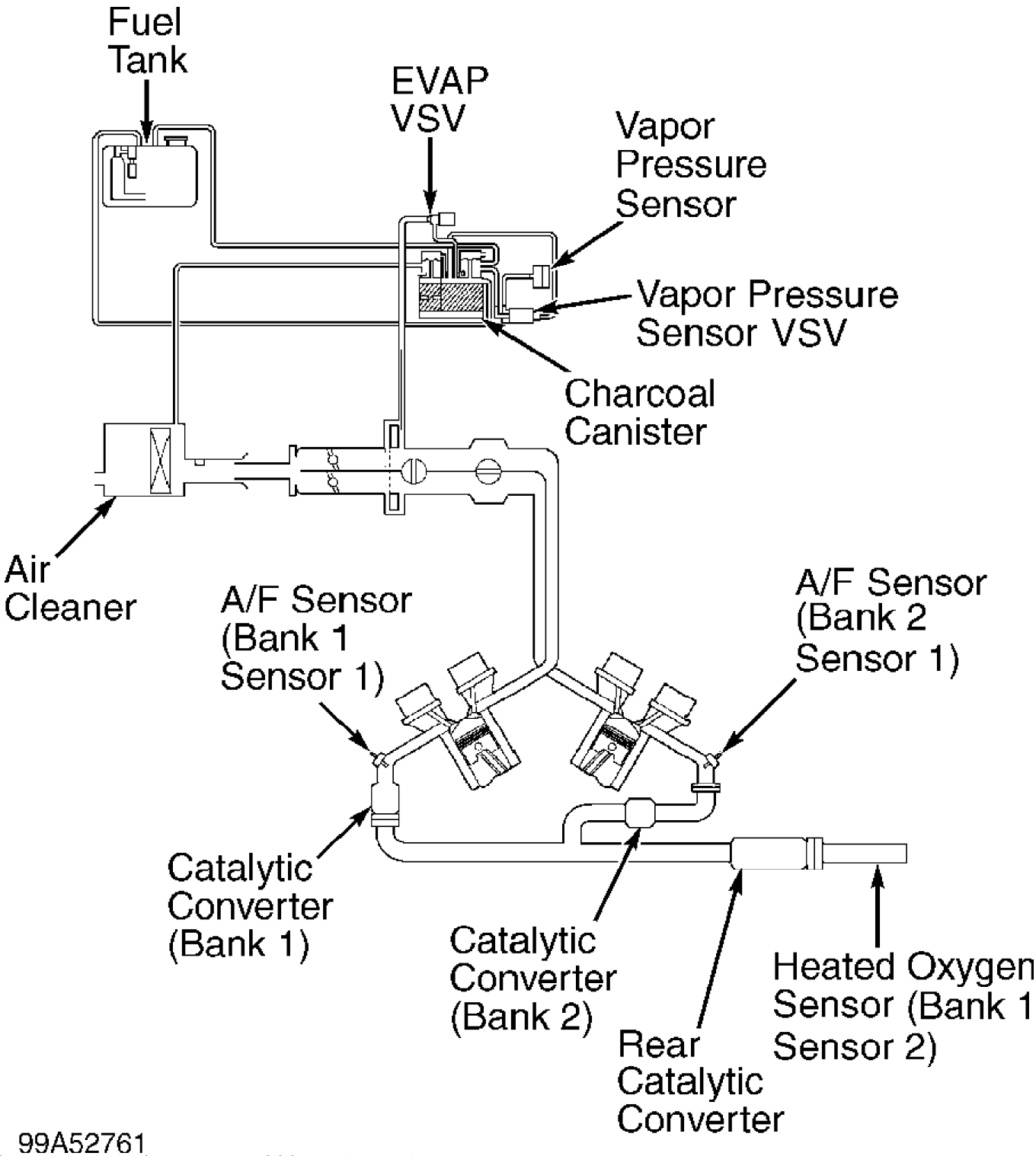


Fig. 12: Vacuum Diagram (RX300 Early Release)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

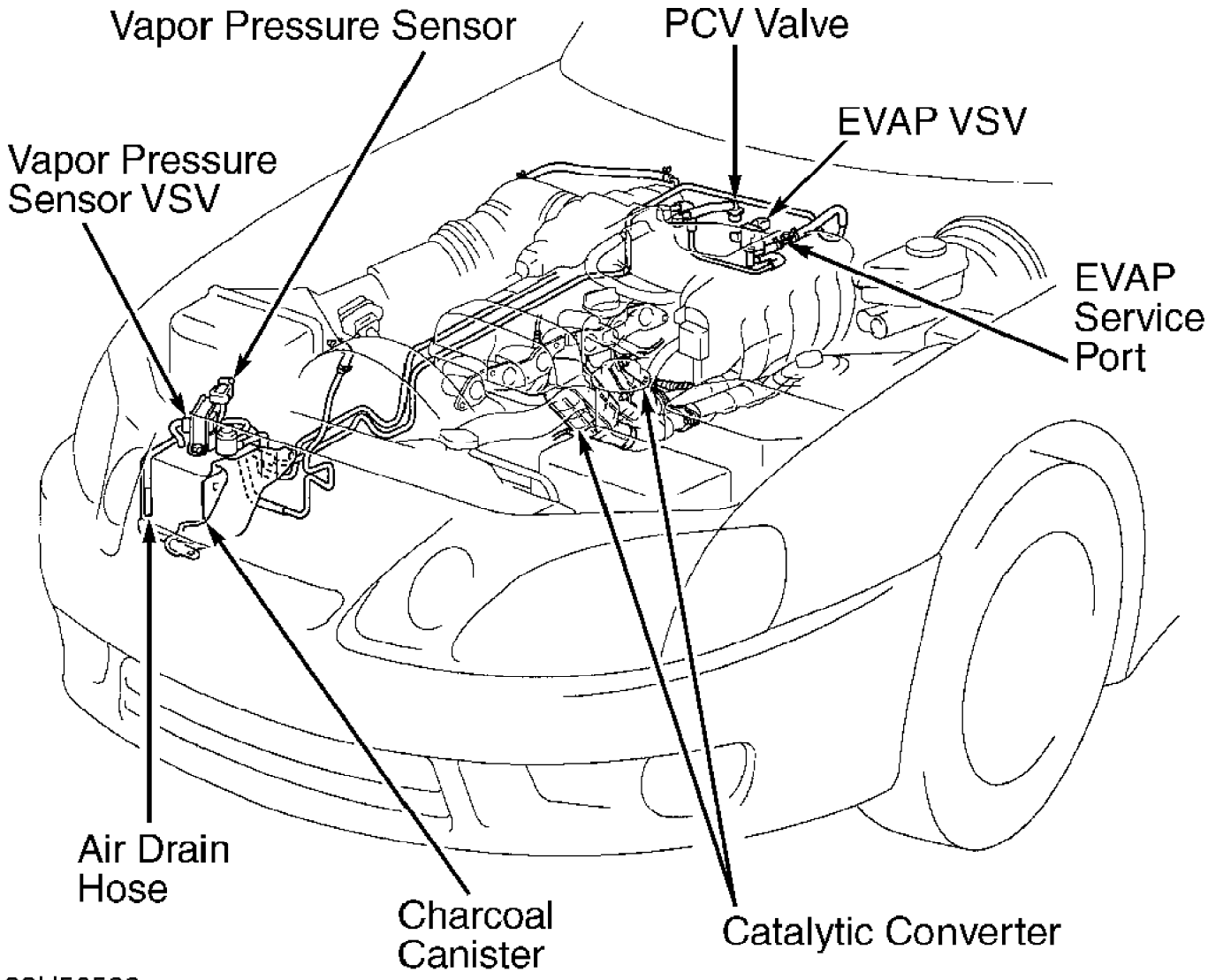


Fig. 13: Vacuum Diagram (SC300 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

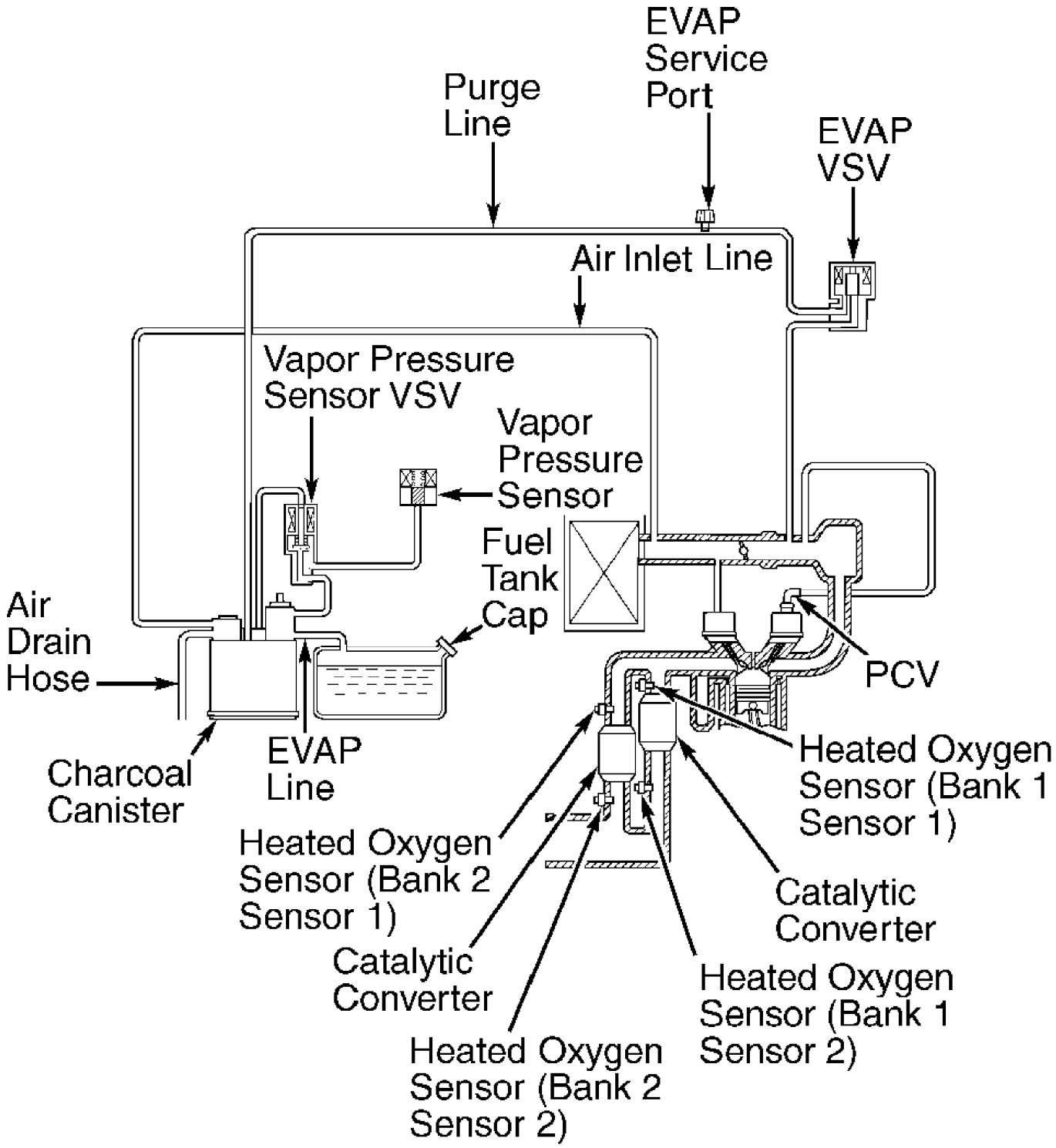


Fig. 14: Vacuum Diagram (SC300 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

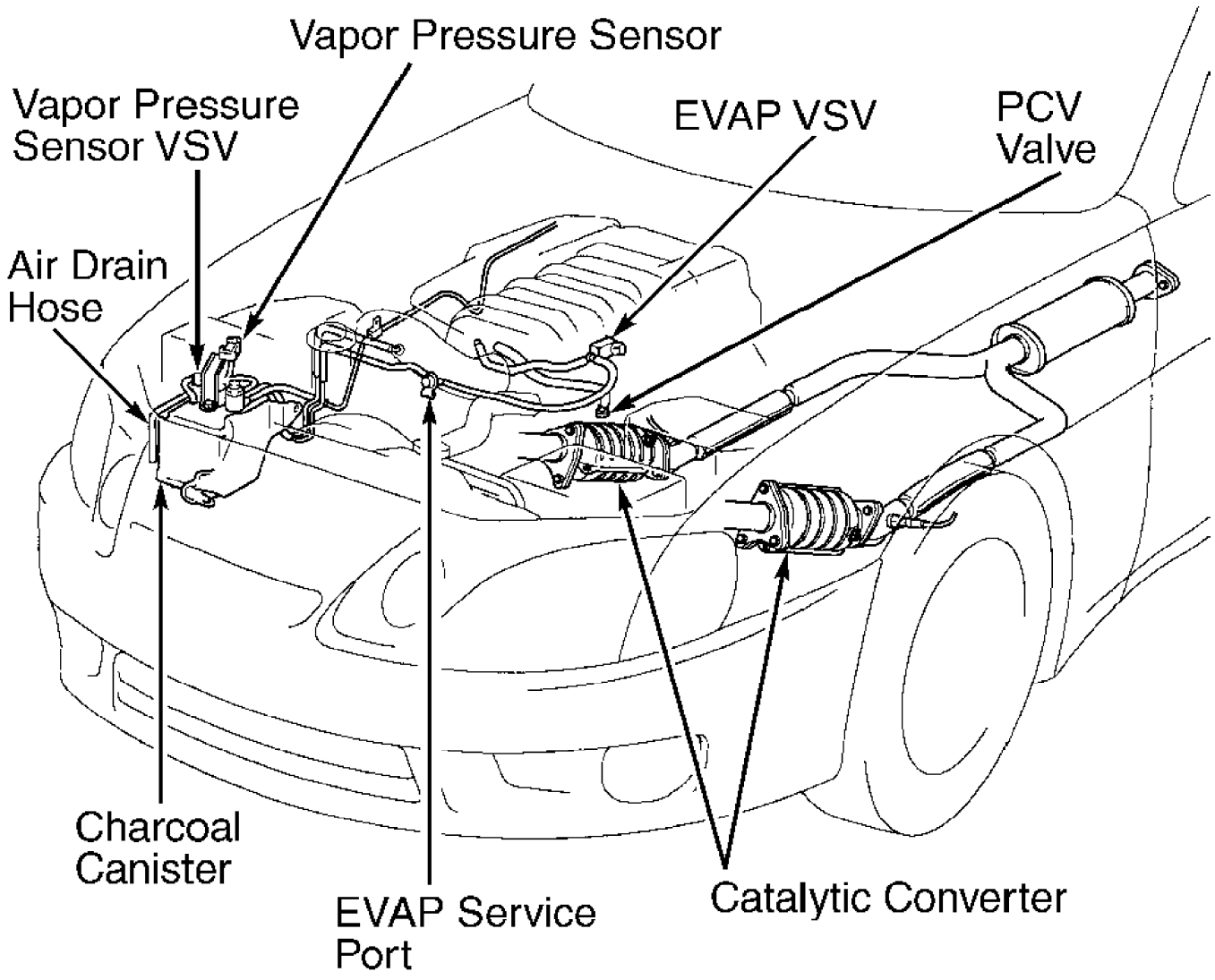


Fig. 15: Vacuum Diagram (SC400 - 1 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

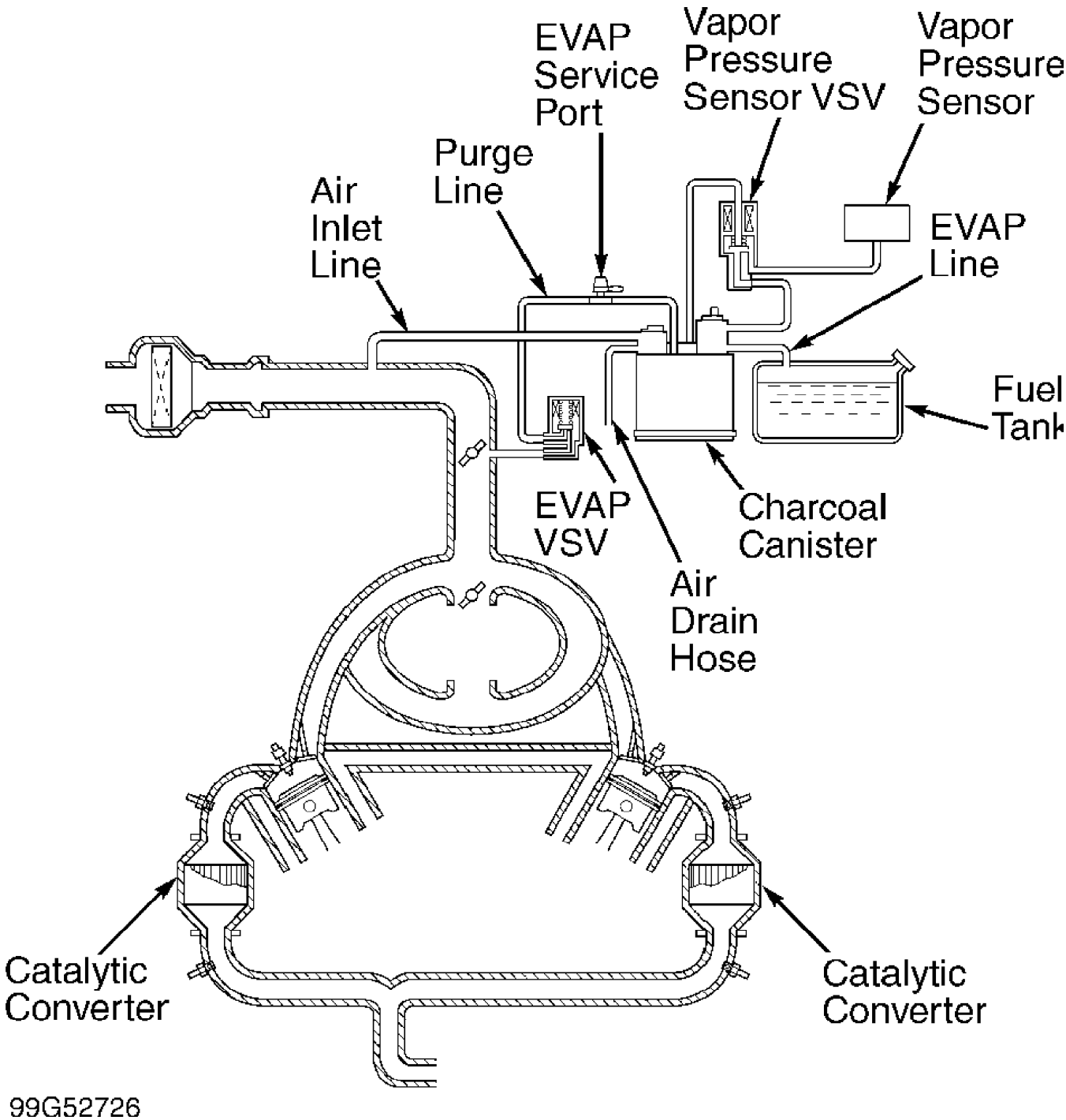


Fig. 16: Vacuum Diagram (SC400 - 2 Of 2)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

N - REMOVE/INSTALL/OVERHAUL

1999 Lexus RX 300

1999 ENGINE PERFORMANCE
Removal, Overhaul & Installation
LEXUS

ES300, GS300, GS400, LS400, LX470, RX300, SC300, SC400

INTRODUCTION

Removal, overhaul and installation procedures are covered in this article. If component removal and installation is primarily an unbolt and bolt-on procedure, only a torque specification may be furnished.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See appropriate COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

COMPUTERIZED ENGINE CONTROLS

ENGINE CONTROL MODULE (ECM)

CAUTION: If ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

Removal & Installation
Ensure ignition is off. Remove ECM. See ECM LOCATION table. To install, reverse removal procedure.

ECM LOCATION

Application	Location
ES300, LS400, LX470 & RX300	Behind Glove Box
GS300 & GS400	Left Front Of Engine Compartment
SC300 & SC400	Under Front Of Carpet On Passenger Side Of Vehicle

FUEL PUMP ELECTRONIC CONTROL UNIT (ECU)

Removal & Installation (GS300 & GS400)
Fuel pump ECU is located on left side of luggage compartment. See Fig. 1. Remove luggage compartment trim cover. Disconnect electrical connector at fuel pump ECU. Remove bolt and fuel pump ECU. To install, reverse removal procedure.

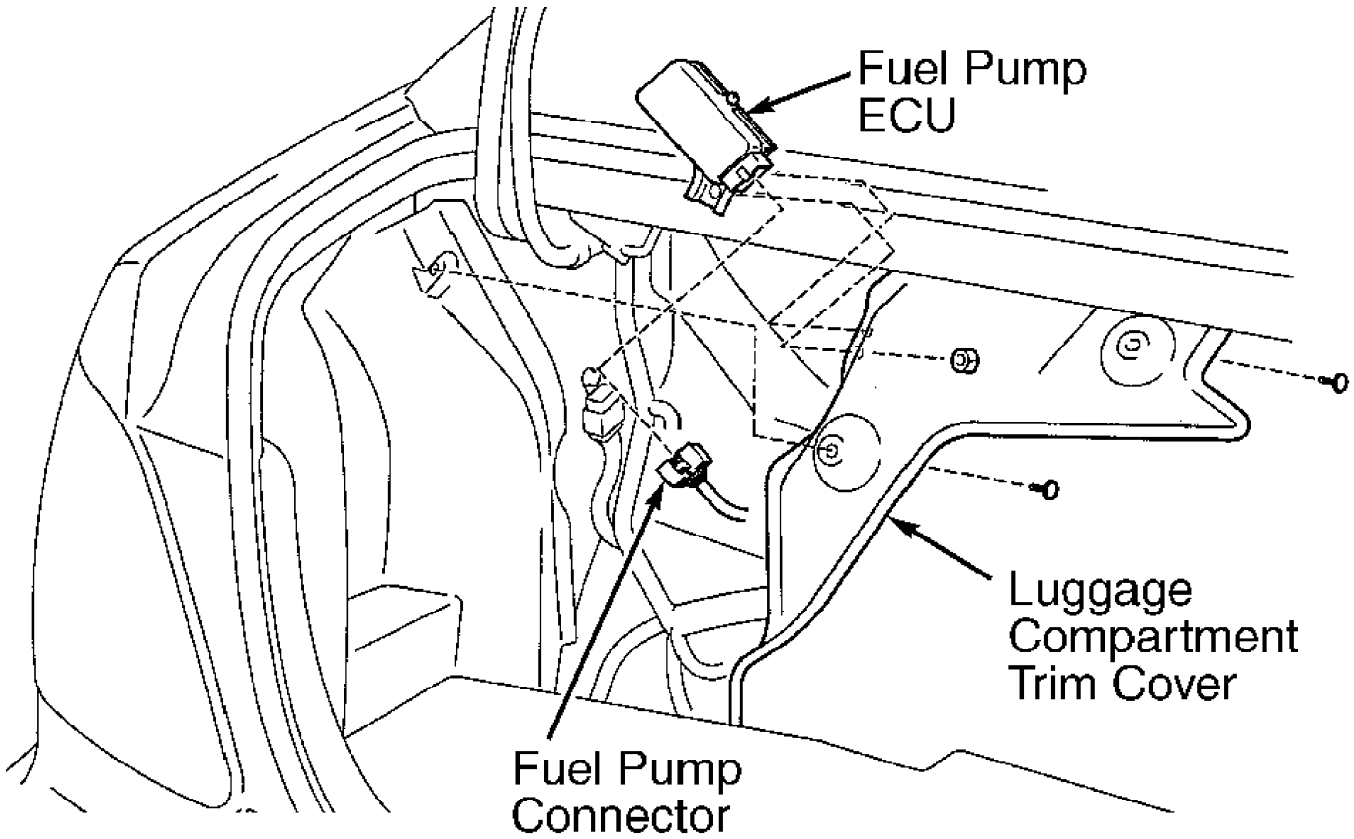


Fig. 1: Locating Fuel Pump ECU (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (LX470)

Fuel pump ECU is located behind inner panel, just behind driver's side rear wheelwell. See Fig. 2. Remove necessary scuff plates and inner panel for access to fuel pump ECU. Disconnect electrical connector at fuel pump ECU. Remove bolts and fuel pump ECU. To install, reverse removal procedure.

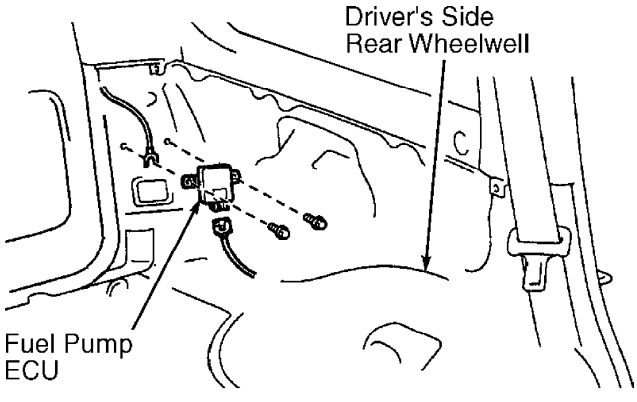


Fig. 2: Locating Fuel Pump ECU (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (SC300 & SC400)

Fuel pump ECU is located behind left rear quarter trim panel.

See Fig. 3. Remove rear seat back and seat cushion to access ECU. Remove scuff plate and left rear quarter trim panel. Disconnect electrical connector at fuel pump ECU. Remove bolt and fuel pump ECU. To install, reverse removal procedure.

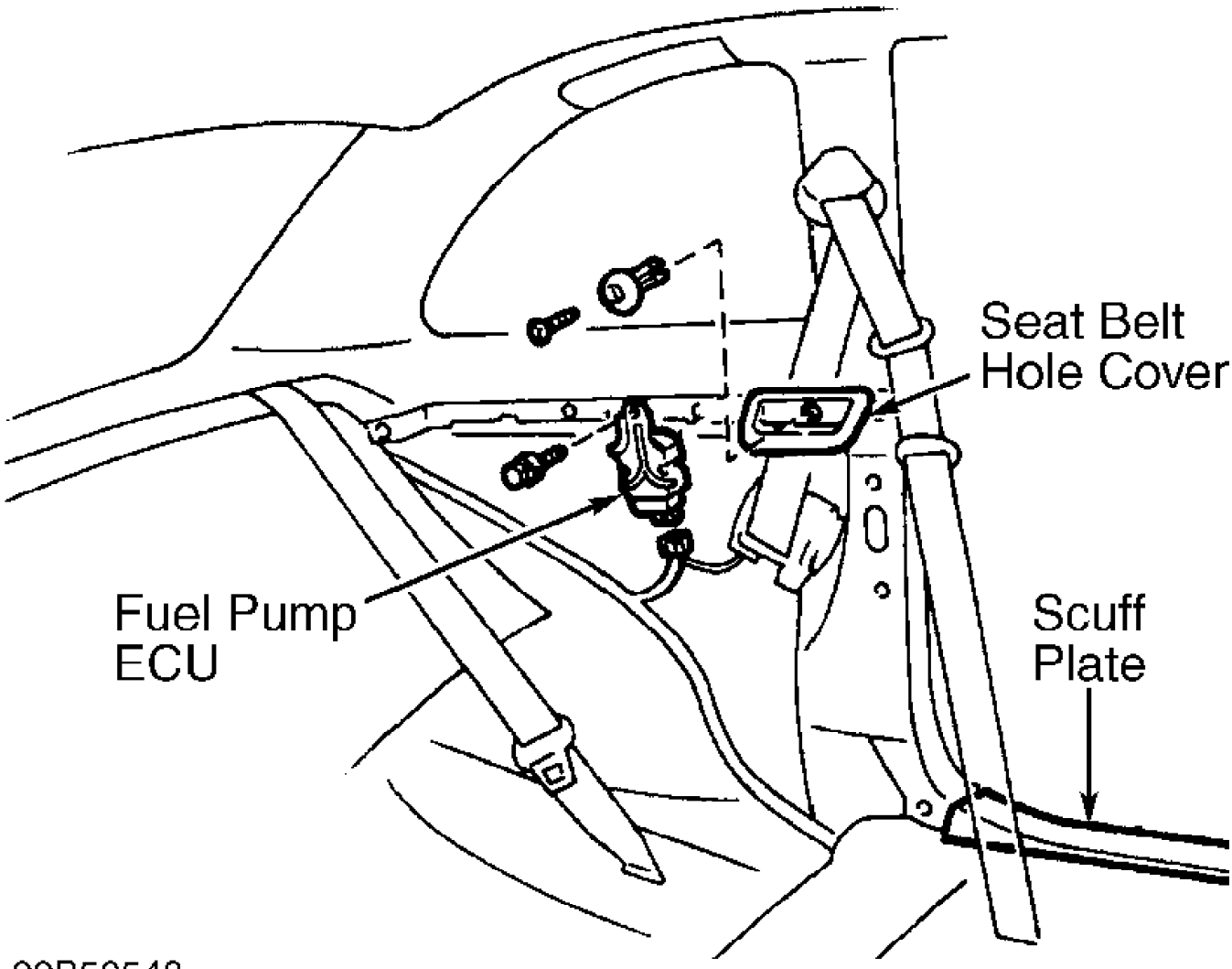


Fig. 3: Locating Fuel Pump ECU (SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE SENSORS & SWITCHES

ACCELERATOR PEDAL POSITION SENSOR

Removal & Installation (GS300, GS400, LS400, LX470, SC300 & SC400)

For accelerator pedal position sensor removal and installation procedures, see THROTTLE BODY under FUEL SYSTEM.

AIR/FUEL RATIO (A/F) SENSOR

NOTE: Air/Fuel Ratio (A/F) sensor may also be referred to as Air/Fuel (A/F) sensor.

Removal & Installation (ES300 & RX300)

Two heated A/F sensors are used. Heated A/F sensor on rear (firewall side) down pipe is referred to as bank No. 1, sensor No. 1. Heated A/F sensor on front (radiator side) exhaust manifold is referred to as bank No. 2, sensor No. 1. Disconnect A/F sensor connector. Remove A/F sensor from exhaust manifold or exhaust down pipe. To install, reverse removal procedure. Tighten A/F sensor to specification. See TORQUE SPECIFICATIONS.

CAMSHAFT POSITION SENSOR

Removal & Installation

On ES300 and RX300, Camshaft Position (CMP) sensor is also known as Variable Valve Timing (VVT) sensor. For VVT sensor removal and installation, see VARIABLE VALVE TIMING SENSOR under VARIABLE VALVE TIMING (VVT) SYSTEM. On all other models, see CAMSHAFT POSITION SENSOR under IGNITION SYSTEM.

CRANKSHAFT POSITION SENSOR

Removal & Installation

For crankshaft position sensor removal and installation procedures, see CRANKSHAFT POSITION SENSOR under IGNITION SYSTEM.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Removal & Installation (ES300, GS300, RX300 & SC300)

Drain cooling system. Disconnect ECT sensor connector. See ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOCATION table. Remove ECT sensor and gasket. To install, reverse removal procedure using NEW gasket. Tighten ECT sensor to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

Removal & Installation (GS400, LS400 & SC400)

1) Disconnect negative battery cable. Drain cooling system. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM. Remove ECT sensor.

2) To install, reverse removal procedure using NEW gasket. Tighten ECT sensor to specification. See TORQUE SPECIFICATIONS. Fill and bleed cooling system.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOCATION

Model	Location
ES300	On Coolant Housing In Front Of Intake Manifold, At Timing Belt End Of Engine & Contains Dark Gray 2-Pin Connector With Green/Black & Red Wires
GS300	Left Front Of Cylinder Head & Contains a Black 2-Pin Connector With Black/Red & Brown Wires
GS400	Near Throttle Body & Contains a Black 2-Pin Connector With Black/Red & Brown Wires
LS400	Near Throttle Body & Contains a Black 2-Pin Connector With Red/Blue & Brown Wires
LX470	Passenger's Side Of Coolant Pipe At Front Of Engine, In Front Of Intake Manifold & Contains a Gray 2-Pin Connector With Green/Black & Brown/White Wires
RX300	On Coolant Housing In Front Of Intake Manifold, At Timing Belt End Of Engine & Contains Dark Gray 2-Pin Connector With Green/White & Brown Wires
SC300	Left Front Of Cylinder Head & Contains a Green

	2-Pin Connector With Light Green & Brown Wires
SC400	Near Throttle Body & Contains a Green 2-Pin Connector With Light Green & Brown Wires

HEATED OXYGEN SENSOR

NOTE: Bank No. 1 refers to bank that includes cylinder No. 1. Bank No. 2 refers to bank without cylinder No. 1. Sensor No. 1 refers to sensor closest to engine block. Sensor No. 2 refers to sensor farthest away from engine block.

Removal & Installation (ES300 & RX300)

Heated oxygen sensor is located behind catalytic converter and is also referred to as bank No. 1, sensor No. 2. On ES300, remove driver's seat to access oxygen sensor connector. On RX300, remove passenger's seat to access oxygen sensor connector. On all models, disconnect oxygen sensor connector. Remove oxygen sensor. To install, reverse removal procedure. Tighten oxygen sensor to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (GS300)

1) Three heated oxygen sensors are used. One heated oxygen sensor is located in each exhaust manifold and one sensor is located behind catalytic converter. Connector for bank No. 2, sensor No. 2 is located under front passenger's seat carpet, near center console.

2) Disconnect electrical connector for heated oxygen sensor to be removed. Remove heated oxygen sensor. To install, reverse removal procedure. Tighten heated oxygen sensor to specification. See TORQUE SPECIFICATIONS.

Removal (GS400)

1) One sensor is located in each exhaust manifold and one sensor is located behind each catalytic converter. Connector for bank No. 1, sensor No. 2 is located under driver's seat carpet, near center console. Connector for bank No. 2, sensor No. 2 is located under front passsenger's seat carpet, near center console.

2) If removing bank No. 2, sensor No. 2, remove lower trim panel under glove box. Disconnect electrical connector for heated oxygen sensor to be removed. Remove heated oxygen sensor. To install, reverse removal procedure. Tighten heated oxygen sensor to specification. See TORQUE SPECIFICATIONS.

Removal (LS400) Bank No. 1 & 2, Sensor No. 2

1) One sensor is located in each exhaust manifold and one sensor is located behind each catalytic converter. Connector for bank No. 1, sensor No. 2 is located on driver side compartment, near front of center console. Connector for bank No. 2, sensor No. 2 is located on passsenger's side compartment, near front of center console.

2) If removing bank No. 1, sensor No. 2, remove driver's side scuff plate. See Fig. 4. Remove accelerator pedal. Remove rear air duct and heater air duct guide. Disconnect connector and remove oxygen sensor.

3) If removing bank No. 2, sensor No. 2, remove front passenger side scuff plate. See Fig. 5. Remove undercover trim panel from right side of instrument panel. Remove rear air duct and heater air duct guide. Disconnect connector and remove oxygen sensor.

Installation

To install, reverse removal procedure. Tighten heated oxygen sensor to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (SC300) Bank No. 2, Sensor No. 2

Remove shift lever knob, lever cover and upper rear console panel. See Fig. 6. Remove radio. Remove cup holder and upper console panel. Remove passenger side floor carpet. Disconnect oxygen sensor connector. Remove oxygen sensor. To install, reverse removal procedure. Tighten heated oxygen sensor to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (SC400) Bank No. 1 & 2, Sensor No. 2

For both oxygen sensors, remove shift lever knob, lever cover and upper rear console panel. See Fig. 7. Remove radio. Remove cup holder and upper console panel. For bank No. 1, sensor 2, remove passenger side floor carpet. For both oxygen sensors, disconnect oxygen sensor connector. Remove oxygen sensor. To install, reverse removal procedure. Tighten heated oxygen sensor to specification. See TORQUE SPECIFICATIONS.

KNOCK SENSOR

Removal (ES300)

1) Air intake chamber and intake manifold must be removed for access to knock sensors. Knock sensors are located on either side of cylinder block underneath intake manifold assembly. See Fig. 8. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Disconnect negative battery cable. Remove engine cover. Remove air cleaner hose and resonator. Drain cooling system.

2) Remove air cleaner housing assembly. Disconnect accelerator cable. Disconnect ground cables and ground strap from air intake chamber. See Fig. 8. Disconnect power steering hose from No. 1 engine hanger. Remove Data Link Connector (DLC) No. 1 from bracket on Intake Air Control (IAC) valve.

3) Remove PCV hose from PCV valve at right cylinder head. Remove brake booster vacuum hose from air intake chamber. Disconnect 2 water by-pass hoses from throttle body. Remove air assist hose from throttle body. Disconnect EVAP purge hose from pipe on emission control valve set. Remove 2 vacuum hoses from ACIS vacuum tank. Remove engine wiring harness clamp from emission control valve set. Remove No. 1 engine hanger and throttle body bracket.

4) Disconnect any remaining vacuum hoses and electrical connectors necessary to remove air intake chamber. See Fig. 8. Remove air intake chamber assembly and gasket. Disconnect fuel injector connectors. Remove fuel pipe clamp from No. 1 fuel pipe at fuel filter. Perform STEP 1. See Fig. 9.

5) Ensure area around No. 1 fuel pipe and fuel filter is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel filter. Perform STEP 2. See Fig. 9. Remove heater hose from intake manifold. Remove intake manifold bolts, nuts and washers. Remove intake manifold, fuel rails and injectors as an assembly. Disconnect Engine Coolant Temperature (ECT) sender gauge connector.

6) Disconnect ECT sensor connector. Disconnect ground strap near upper radiator hose. Remove upper radiator hose. Remove engine coolant reservoir hose. Disconnect water by-pass hose. Remove water outlet and gaskets. Disconnect knock sensor connectors. Remove knock sensors.

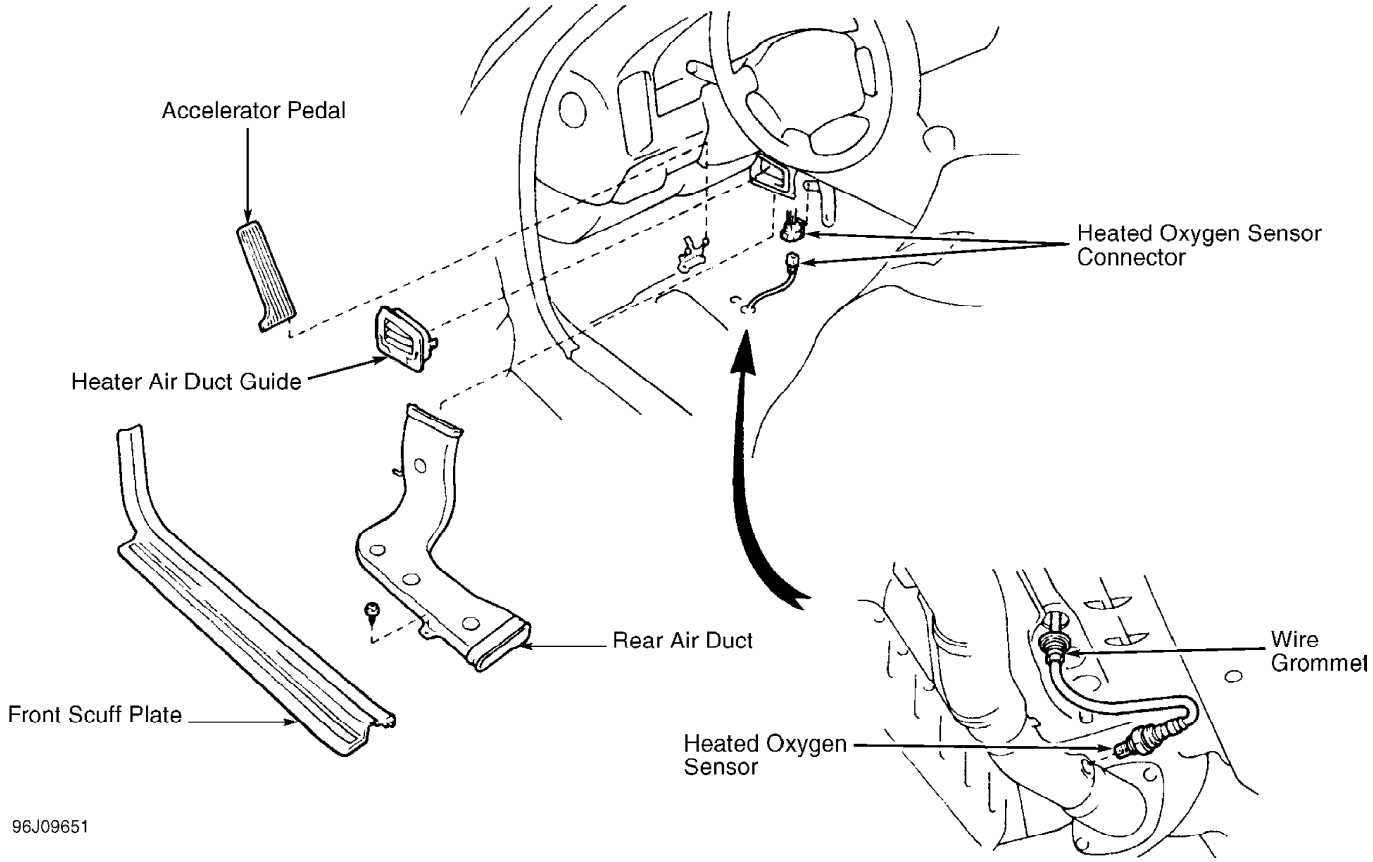


Fig. 4: Removing Bank No. 1, Sensor No. 2 (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

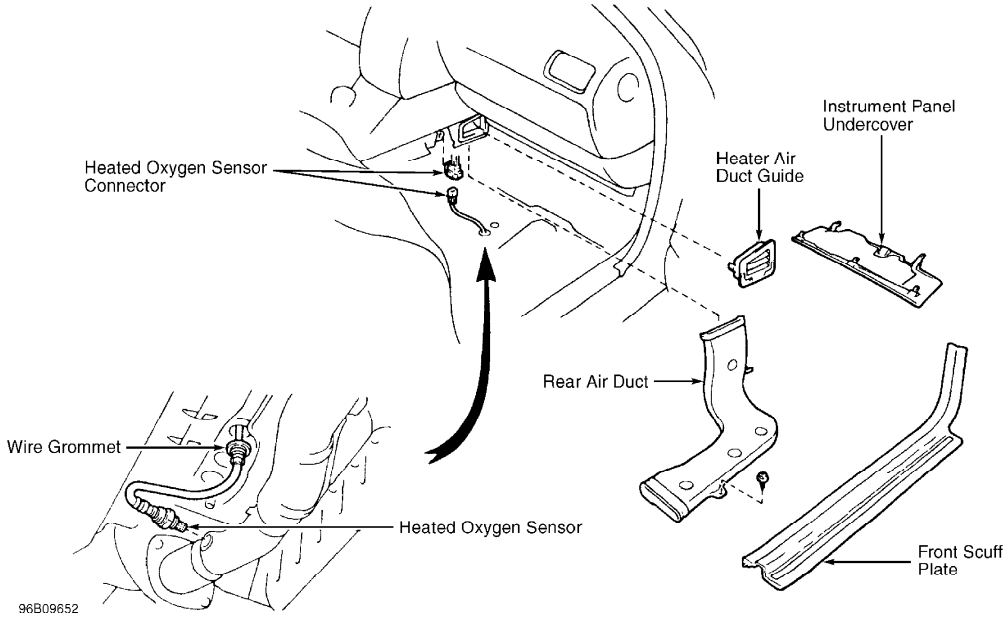


Fig. 5: Removing Bank No. 2, Sensor No. 2 (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

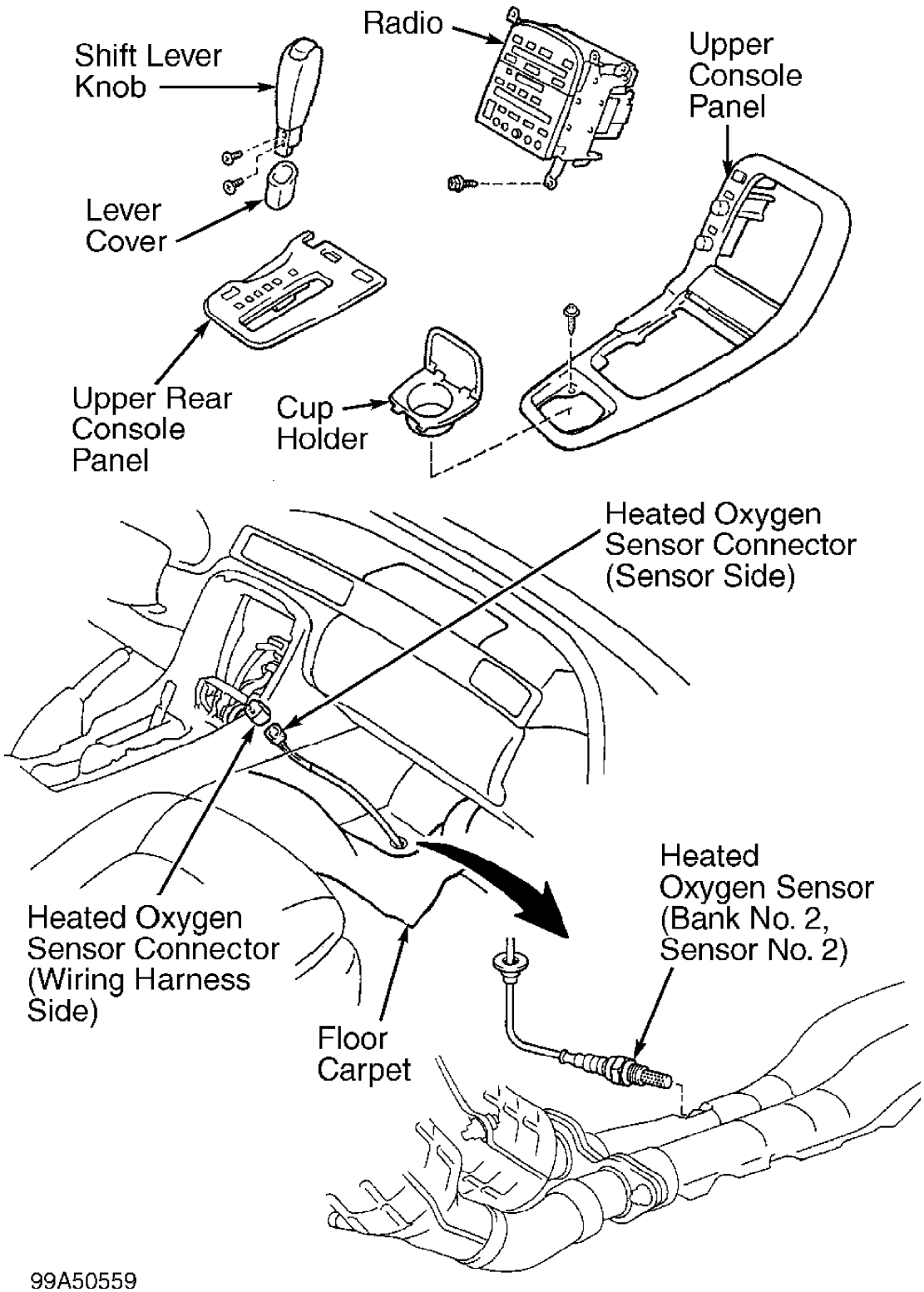


Fig. 6: Removing Bank No. 2, Sensor No. 2 (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

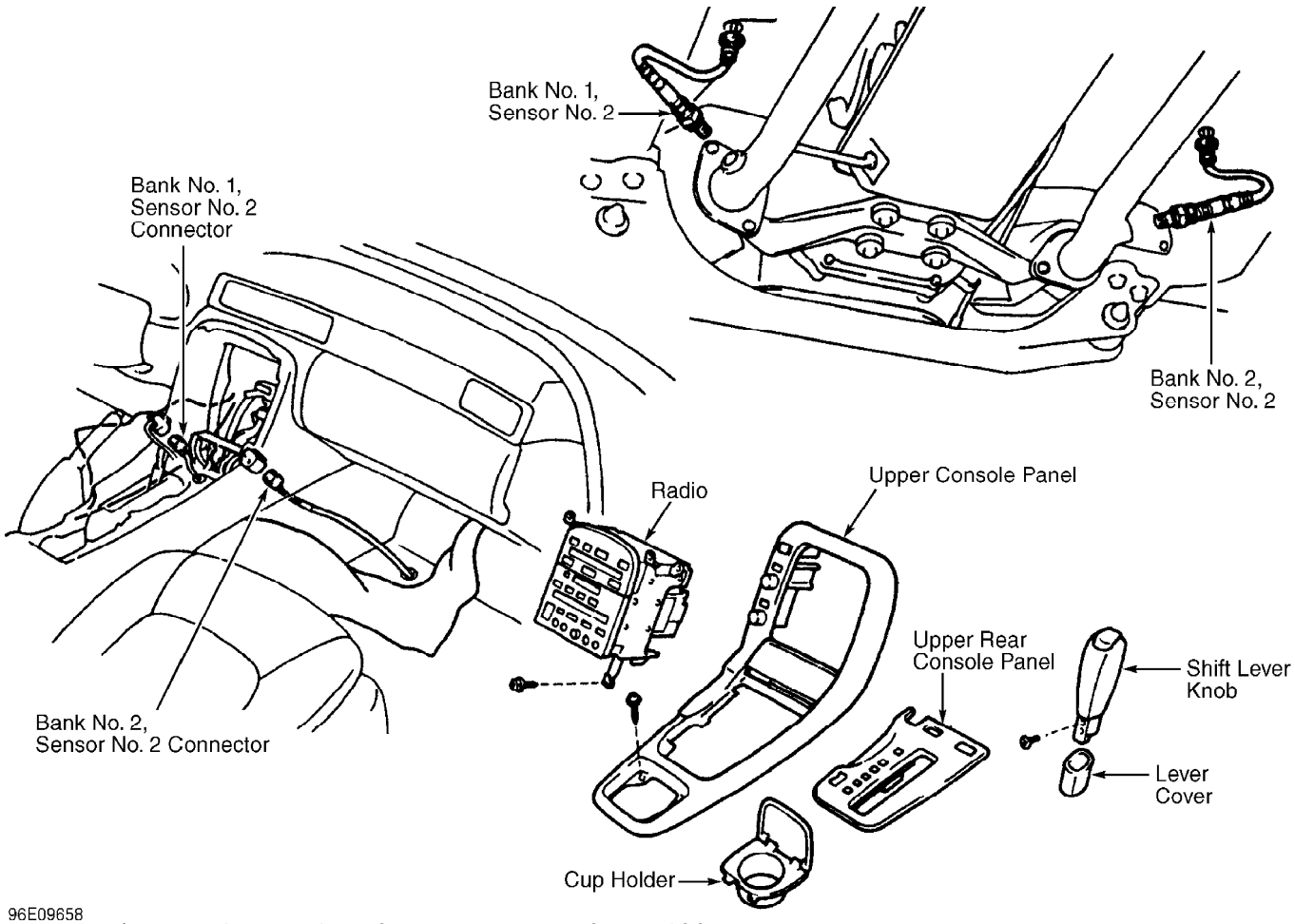


Fig. 7: Removing Bank No. 1 & 2, Sensor No. 2 (SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Installation

1) To install, reverse removal procedure. Install NEW intake chamber assembly gasket. Install NEW gaskets to water outlet. Ensure not to scratch seal surface of water outlet with stud bolt.

2) Tighten intake manifold assembly bolts and nuts in sequence and to specification in several passes. See Fig. 10. See TORQUE SPECIFICATIONS. After installing intake manifold assembly, retighten water outlet mounting bolts and nuts to specification. Fill and bleed cooling system.

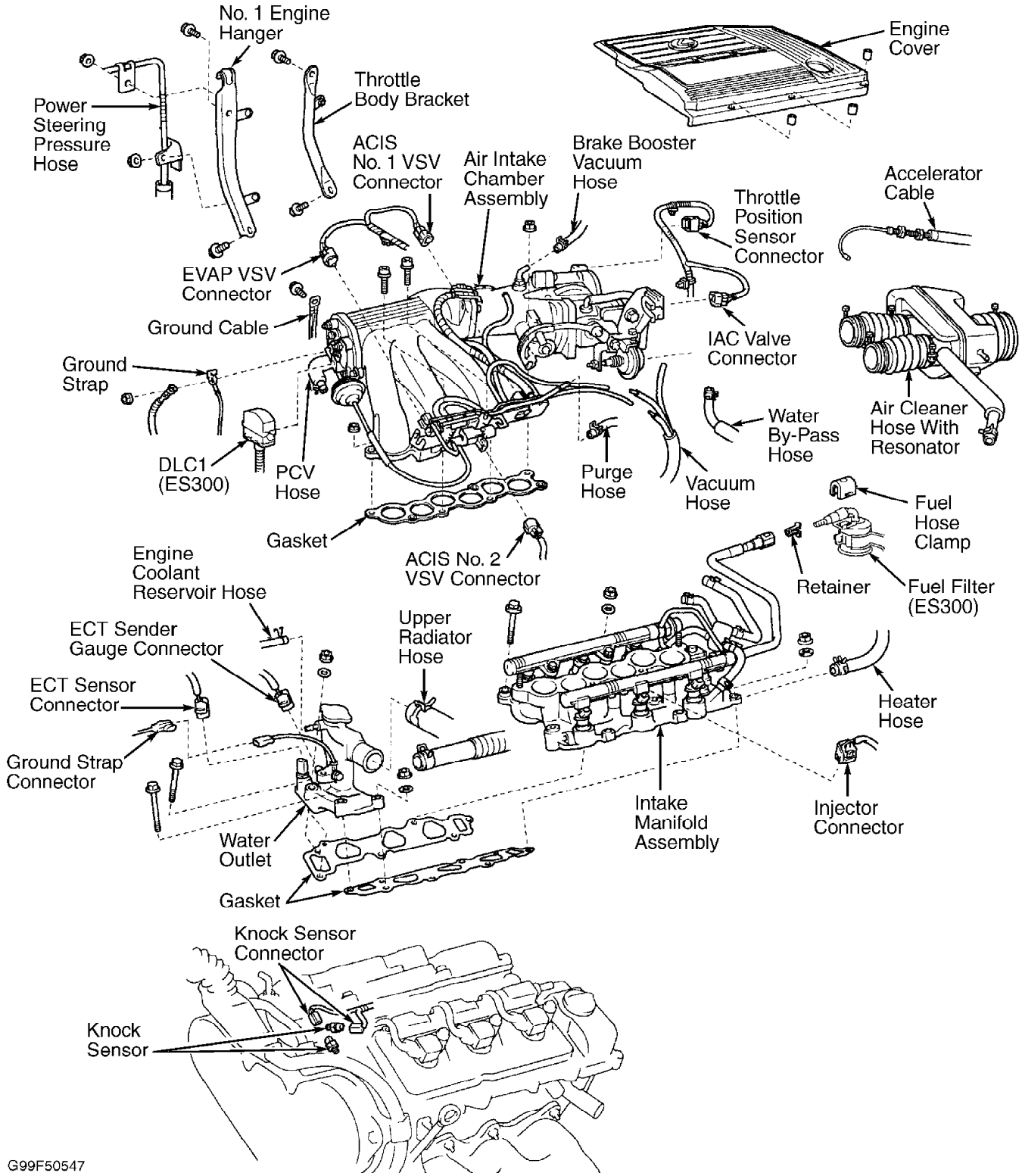


Fig. 8: Exploded View Of Intake Manifold & Air Intake Chamber Components (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

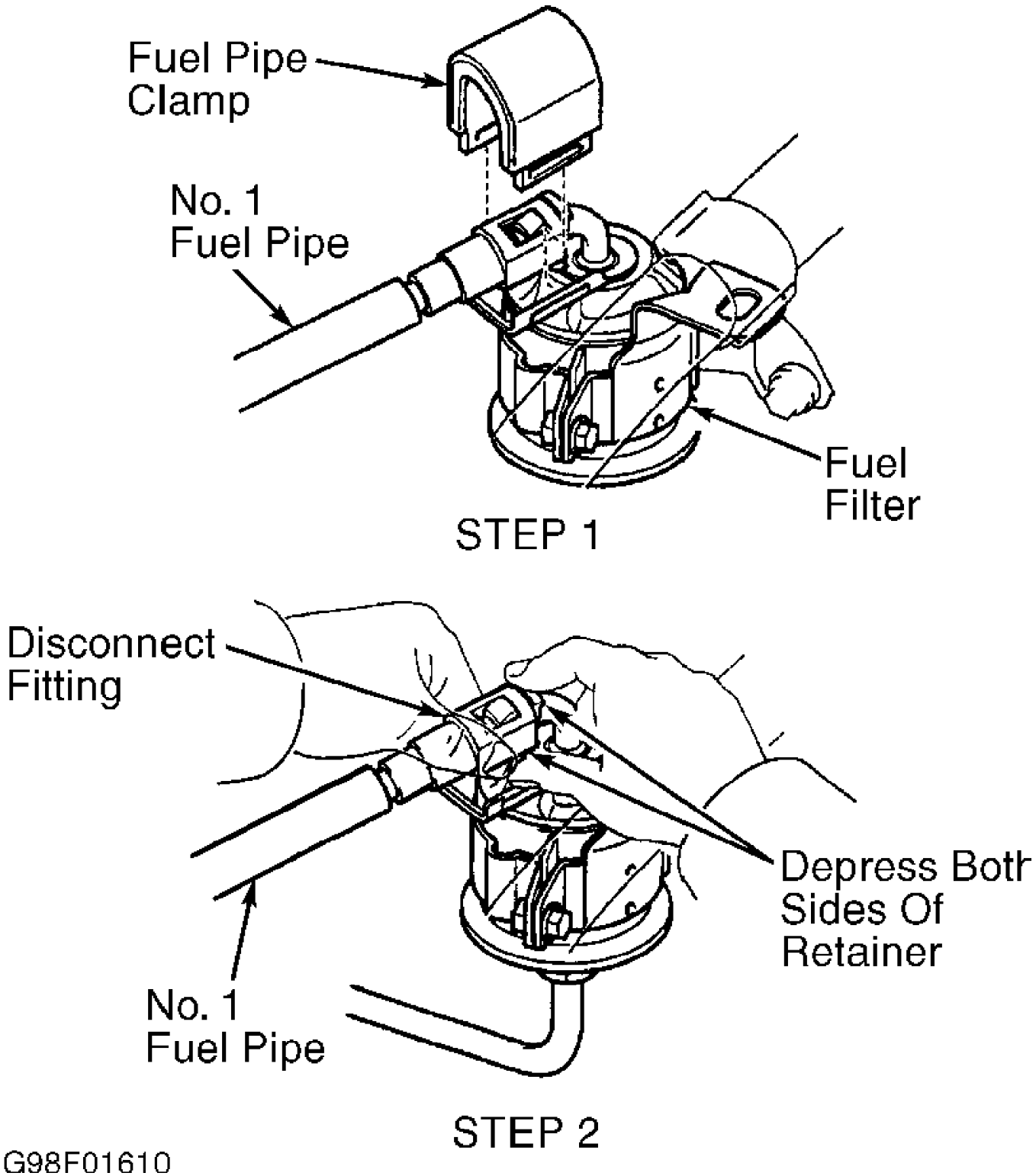


Fig. 9: Disconnecting No. 1 Fuel Pipe From Fuel Filter (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

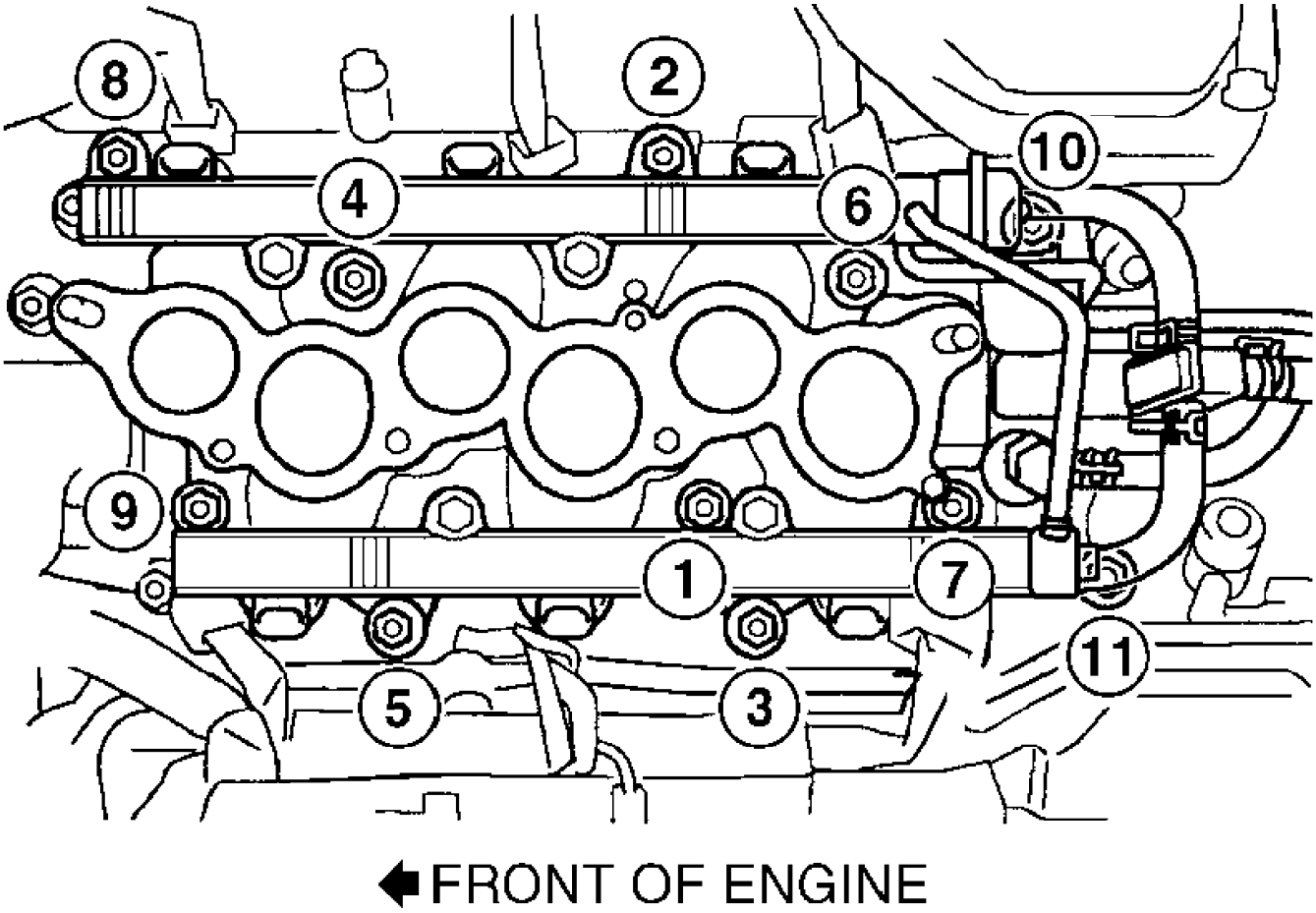


Fig. 10: Intake Manifold Tightening Sequence (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (GS300)

1) Knock sensors are located on front and rear left side of cylinder block. Disconnect negative battery cable. If removing front knock sensor, remove power steering pump rear stay bracket. If removing rear knock sensor, remove A/T oil dipstick and guide. Disconnect wiring at starter. Remove starter bolts and starter. On all sensors, disconnect knock sensor connector. Remove knock sensor.

2) To install, reverse removal procedure. Tighten knock sensor to specification. See TORQUE SPECIFICATIONS. When installing starter, tighten upper mounting bold along with clamp bracket to specification.

Removal (GS400)

1) Knock sensors are located under intake manifolds on cylinder block. To remove knock sensors, upper and lower intake manifolds must be removed. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Remove air cleaner assembly. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Disconnect fuel inlet hose. See Fig. 11. Disconnect EVAP vacuum switching valve connector. Remove PCV hose from upper intake manifold.

2) Disconnect EVAP vacuum switching valve vacuum hose. Remove EVAP air inlet hose from air tube. Remove No. 2 engine cover bracket

from engine hanger. See Fig. 11. Remove EVAP vacuum switching valve from upper intake manifold. Remove accelerator cable clamp from upper intake manifold. Remove No. 3 engine cover bracket from upper intake manifold.

3) Remove 4 bolts and left wiring harness protector from upper intake manifold and camshaft bearing cap. Disconnect wiring harness clamps from brackets on right fuel rail. Remove bolts and disconnect rear engine wiring harness protector from rear water by-pass joint and right cylinder head.

4) Disconnect ACIS vacuum switching valve connector. Disconnect upper intake manifold ground strap. Remove power steering hose from upper intake manifold. Remove ACIS connector bracket from upper intake manifold.

5) Remove accelerator cable bracket from upper intake manifold. Disconnect injector connectors. Remove bolts, nuts, upper intake manifold, lower intake manifold assembly and gaskets. Disconnect knock sensor connector(s) and remove knock sensor(s).

Installation

To install, reverse removal procedure. Install and tighten knock sensor to specification. See TORQUE SPECIFICATIONS. Position NEW intake manifold gaskets with White mark facing upward. Marks are painted on outer tabs of gasket. Install upper and lower intake manifold assembly and tighten bolts/nuts to specification.

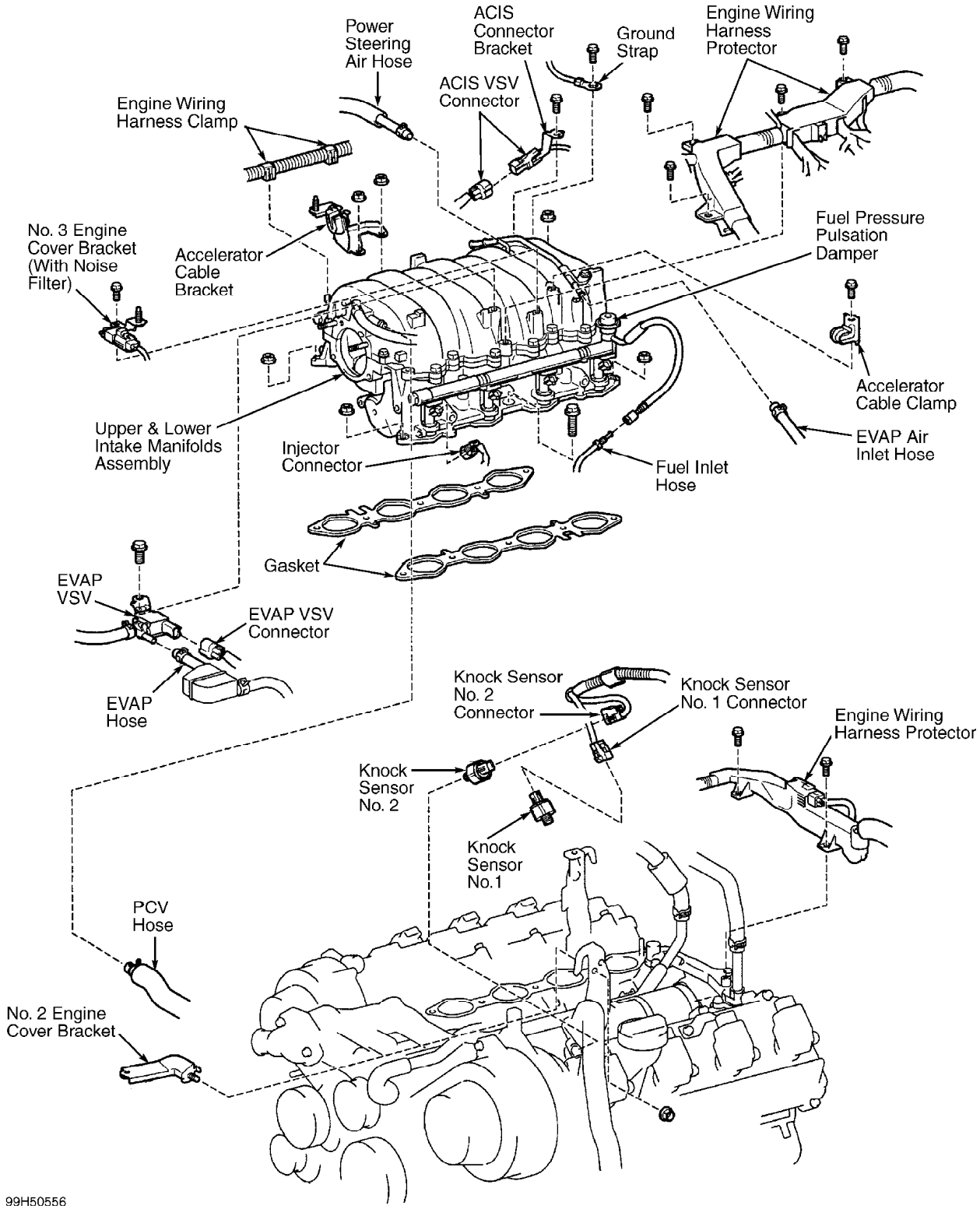


Fig. 11: Removing Knock Sensors (GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LS400)
1) Knock sensors are located under intake manifolds on

cylinder block. To remove knock sensors, upper and lower intake manifolds must be removed. Remove engine cover. Remove battery cover, air cleaner inlet and intake air connector. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM.

2) Disconnect fuel inlet hose. Remove throttle body from intake manifolds. See THROTTLE BODY under FUEL SYSTEM. Disconnect accelerator cable. Disconnect EVAP and ACIS vacuum switching valve connectors.

3) Disconnect fuel injector connectors. Disconnect noise filter connector. See Fig. 12. Disconnect brake booster vacuum hose from union on intake manifold. Disconnect PCV hose from PCV valve. Disconnect EVAP hose from EVAP pipe on intake manifold. Disconnect EVAP vacuum switching valve hose. Disconnect power steering air hose from intake manifold.

4) Remove EVAP pipe from intake manifold. Remove accelerator cable bracket. Disconnect ACIS vacuum switch valve connector from engine cover bracket. Remove engine cover brackets. Remove EVAP vacuum switching valve. Disconnect wiring harness clamps from wire clamp bracket on right fuel rail. Remove bolts and disconnect engine wiring harness protector from rear water by-pass joint and right cylinder head.

5) Remove bolts and disconnect engine wiring harness protector and wiring harness clamp bracket from intake manifold. Remove upper and lower intake manifolds as an assembly. Remove intake manifold gaskets. Disconnect knock sensor connectors. Remove knock sensors.

Installation

To install, reverse removal procedure. Install NEW intake manifold gaskets with White mark facing upward. Marks are painted on outer tabs of gasket. Tighten knock sensor to specification. See TORQUE SPECIFICATIONS.

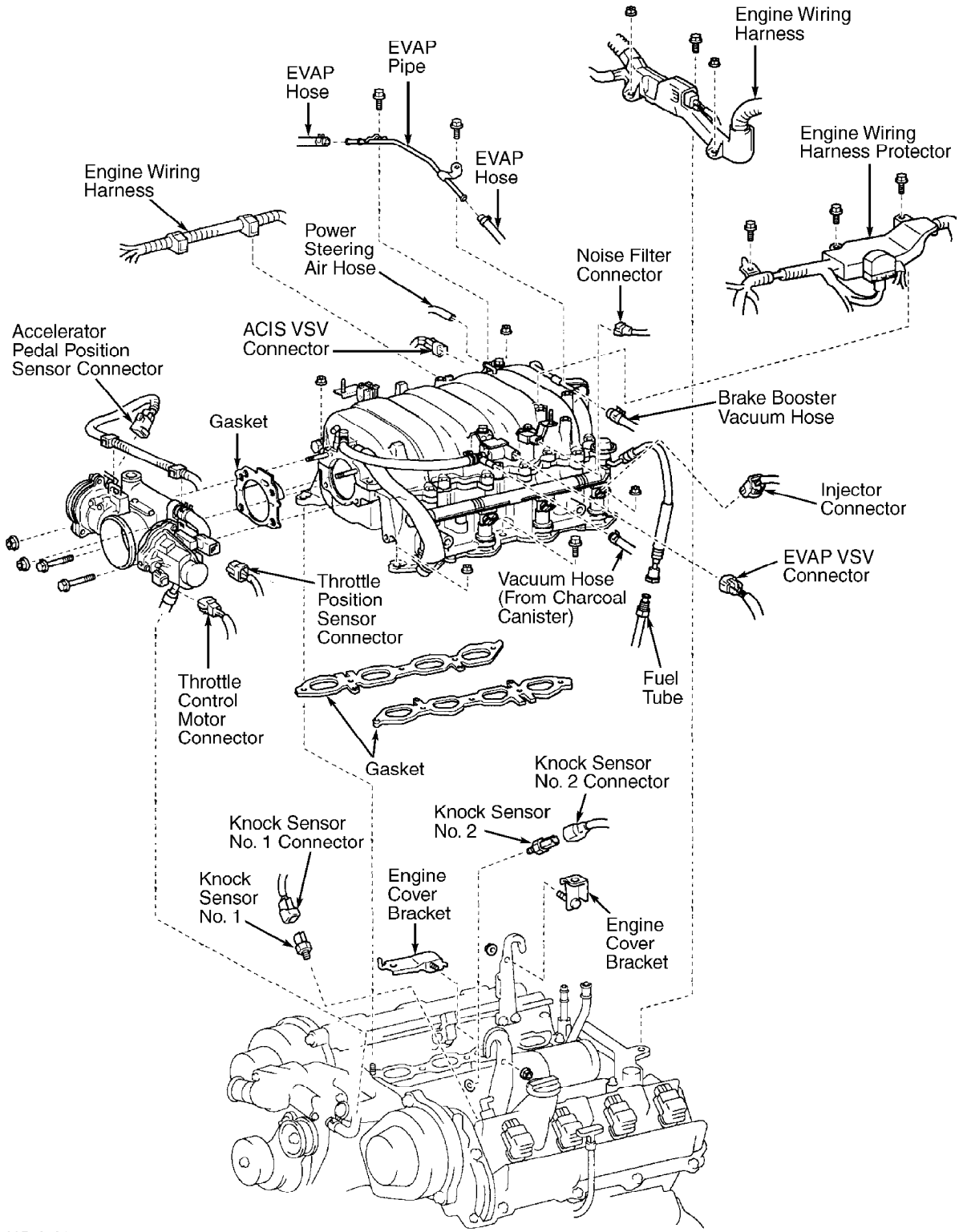


Fig. 12: Removing Knock Sensors (LS400 Shown; SC400 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LX470)
1) Intake manifold must be removed to access knock sensors.

Knock sensors are located on cylinder block under intake manifold. Intake manifold consists of an upper and lower intake manifold.

2) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Remove engine cover. Remove air intake hose with intake air connector located between throttle body and air cleaner assembly.

3) Remove throttle body from intake manifold. See THROTTLE BODY under FUEL SYSTEM. Depress both sides of retainer and pull fuel inlet hose with disconnect fitting from fuel filter. See Fig. 13.

4) Disconnect necessary electrical connectors, fuel return hose, vacuum hoses, PCV hose and wiring clamps for removal of intake manifold. Remove bolts and disconnect engine wiring harness protector from rear of water by-pass joint and right cylinder head. Disconnect ground straps at rear of cylinder heads.

5) Disconnect engine wiring harness protector from top of intake manifold. See Fig. 14. Remove EVAP pipe from rear of intake manifold. Remove engine cover brackets. Remove bolts/nuts that secure lower section of intake manifold to cylinder heads.

6) Remove intake manifold with fuel injectors and fuel rails as an assembly. Remove intake manifold gaskets. Disconnect electrical connectors at knock sensors. Using Socket (SST 09816-30010), remove knock sensor(s) from cylinder block.

Installation

1) To install, reverse removal procedure. Install and tighten knock sensor to specification. See TORQUE SPECIFICATIONS. Position NEW intake manifold gaskets with White mark facing upward. Install upper and lower intake manifold assembly and tighten bolts/nuts to specification.

2) Apply light coat of engine oil on tip of pipe on fuel filter to allow for ease of disconnect fitting and fuel inlet hose installation. Using NEW retainer, install fuel inlet hose on fuel filter until "click" sound is heard. DO NOT reuse old retainer. Pull on fuel inlet hose to ensure fuel inlet hose is properly locked on fuel filter.

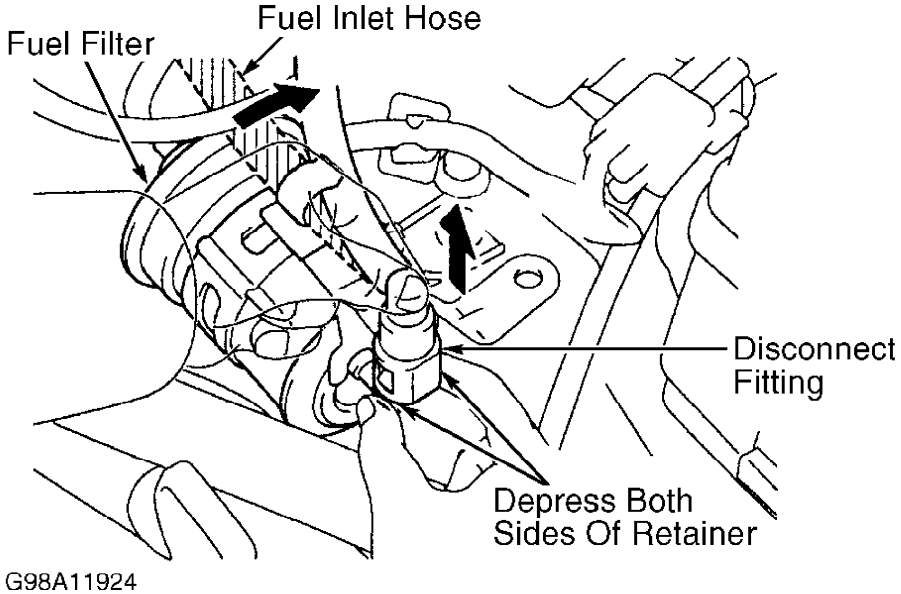


Fig. 13: Disconnecting Fuel Inlet Hose At Fuel Filter (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

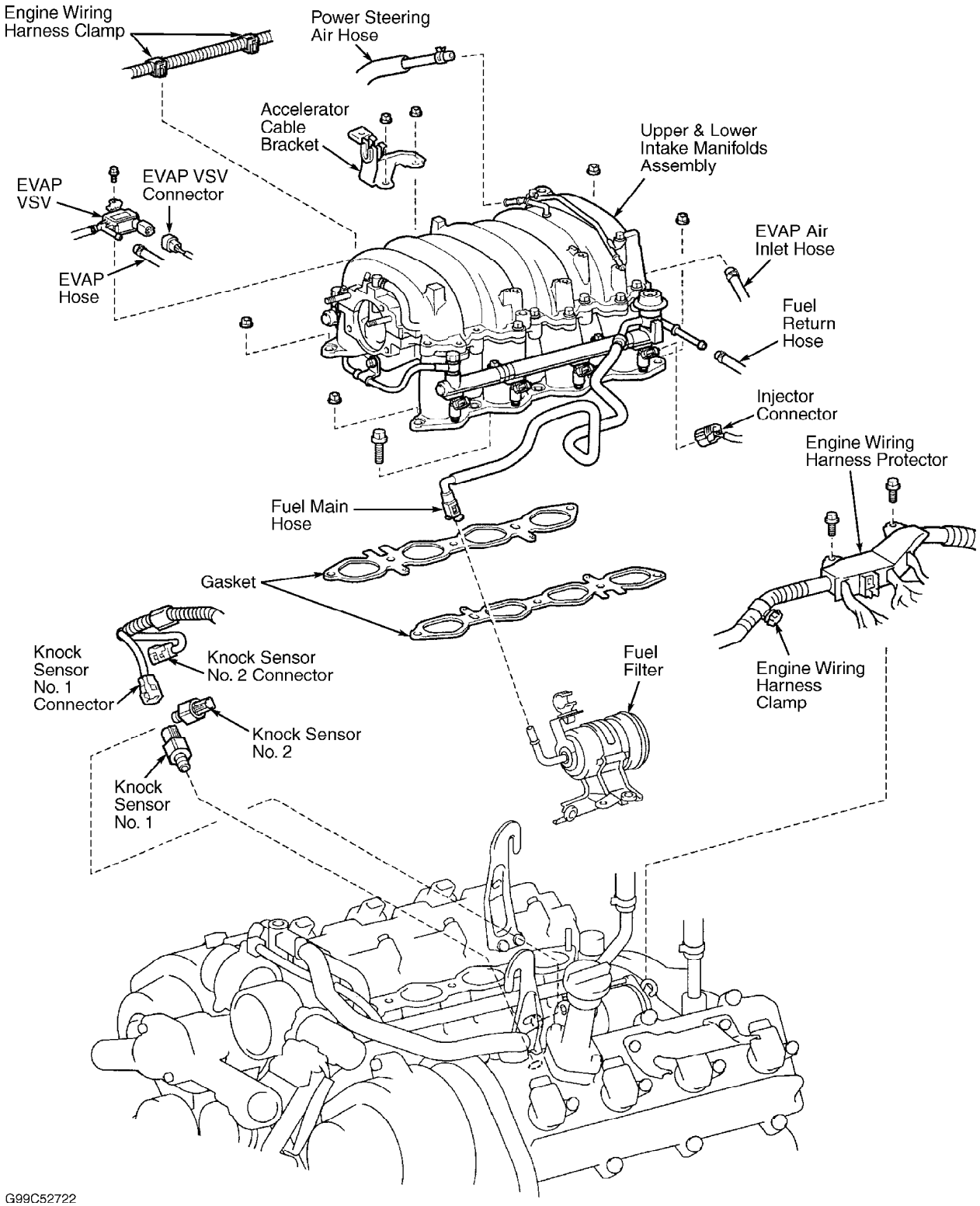


Fig. 14: Removing Knock Sensors (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (RX300)
1) Air intake chamber and intake manifold must be removed to

access knock sensors. Knock sensors are located on either side of cylinder block underneath intake manifold assembly. See Fig. 8. Remove windshield wiper arm nuts and windshield wiper arms.

2) Remove hood-to-cowl top seal. See Fig. 15. Remove clips, driver's side and passenger's side ventilator louvers. Disconnect electrical connector for windshield wiper motor. Remove wiper motor with wiper link. Remove bolts from cowl top panel and remove panel.

3) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Disconnect negative battery cable. Remove engine cover. Remove air cleaner hose and resonator. Drain cooling system.

4) Remove air cleaner housing assembly. Disconnect accelerator cable. Disconnect ground cables and ground strap from air intake chamber. See Fig. 8. Disconnect power steering hose from No. 1 engine hanger.

5) Remove PCV hose from PCV valve at right cylinder head. Remove brake booster vacuum hose from air intake chamber. Disconnect 2 water by-pass hoses from throttle body. Remove air assist hose from throttle body. Disconnect EVAP purge hose from pipe on emission control valve set. Remove 2 vacuum hoses from ACIS vacuum tank. Remove engine wire clamp from emission control valve set. Remove No. 1 engine hanger and throttle body bracket.

6) Disconnect any remaining vacuum hoses and electrical connectors necessary to remove air intake chamber. See Fig. 8. Remove air intake chamber assembly and gasket. Disconnect injector connectors. Remove fuel pipe clamp from No. 1 fuel pipe at fuel inlet pipe. Perform STEP 1. See Fig. 16.

7) Ensure area around No. 1 fuel pipe and fuel inlet pipe is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel inlet pipe. Perform STEP 2. See Fig. 16. Remove heater hose from intake manifold. Remove intake manifold bolts, nuts and washers. Remove intake manifold, fuel rails and injectors as an assembly. Disconnect Engine Coolant Temperature (ECT) sender gauge connector.

8) Disconnect ECT sensor connector. Disconnect ground strap near upper radiator hose. Remove upper radiator hose. Remove engine coolant reservoir hose. Disconnect water by-pass hose. Remove water outlet and gaskets. Disconnect knock sensor connectors. Remove knock sensors.

Installation

1) To install, reverse removal procedure. Install NEW intake chamber assembly gasket. Install NEW gaskets to water outlet. Ensure not to scratch seal surface of water outlet with stud bolt.

2) Tighten intake manifold assembly bolts and nuts in sequence and to specification in several passes. See Fig. 10. See TORQUE SPECIFICATIONS. After installing intake manifold assembly, retighten water outlet mounting bolts and nuts to specification. Fill and bleed cooling system.

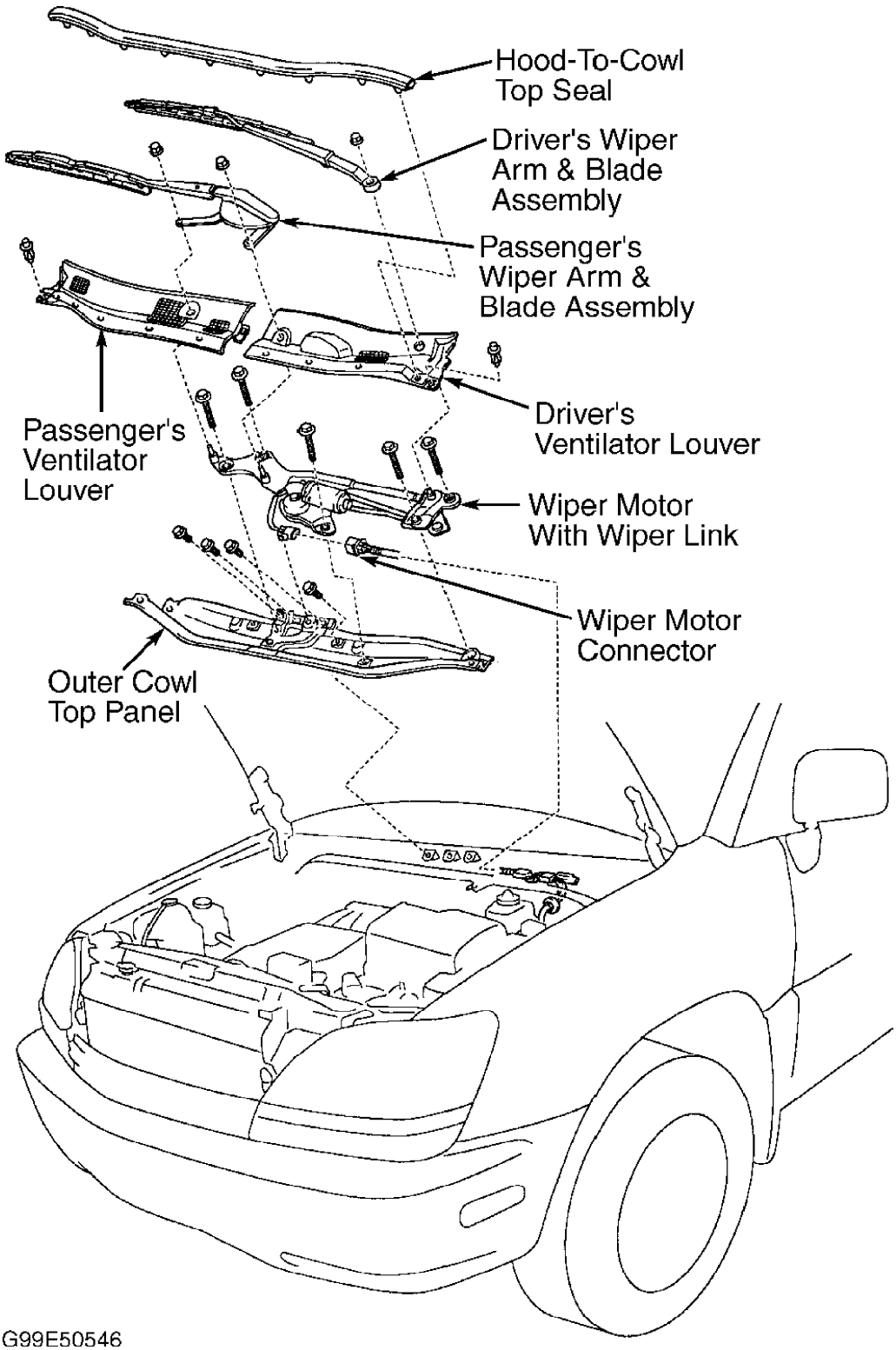


Fig. 15: Identifying Outer Cowl Top Panel & Components (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

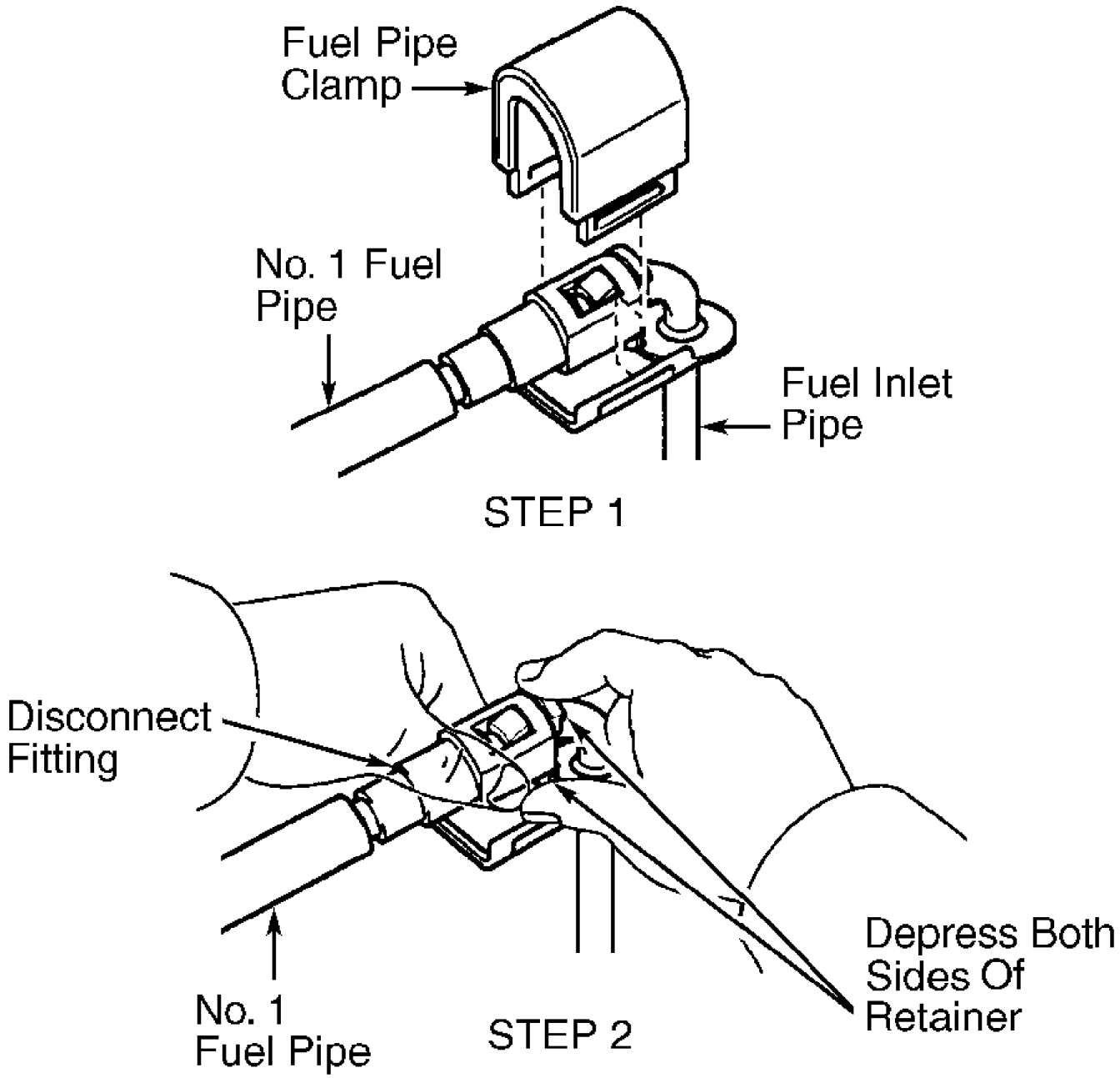


Fig. 16: Disconnecting No. 1 Fuel Pipe From Fuel Inlet Pipe (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (SC300)

Knock sensors are located on front and rear left side of cylinder block. Disconnect negative battery cable. Disconnect wiring at starter. Remove starter bolts and starter. Disconnect knock sensor connector. Remove knock sensor. To install, reverse removal procedure. Tighten knock sensor and starter bolts to specification. See TORQUE SPECIFICATIONS.

Removal (SC400)

1) Knock sensors are located under intake manifolds on

cylinder block. To remove knock sensors upper and lower intake manifolds must be removed. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM.

2) Disconnect EVAP and ACIS vacuum switching valve connectors. Disconnect fuel injector connectors. Disconnect noise filter and camshaft timing oil control valve connectors. Disconnect brake booster vacuum hose. Disconnect PCV hose from PCV valve.

3) Disconnect EVAP vacuum switching valve hose. Disconnect power steering air hose from intake manifold. See Fig. 12. Disconnect rear water by-pass joint heater hose. Disconnect water by-pass pipe heater hose. Disconnect vacuum hose from heater water valve vacuum switching valve.

4) Disconnect water by-pass hoses from throttle body. Disconnect wiring harness clamp from throttle body. Remove accelerator cable bracket. Remove engine cover brackets. Disconnect 2 wiring harness clamps from bracket on right fuel rail. Remove bolt and wiring harness clamp bracket from right front bearing cap.

5) Remove engine wiring harness protector from rear water by-pass joint and right cylinder head. Remove EVAP vacuum switching valve. Remove wiring harness clamp bracket from left valve cover. Remove engine wiring harness protector from intake manifold and left front bearing cap. Remove bolts, nuts, intake manifold assembly and gaskets. Disconnect knock sensor connectors. Remove knock sensors.

Installation

To install, reverse removal procedure. Install NEW intake manifold gaskets with White mark facing upward. Marks are painted on outer tabs of gasket. Tighten knock sensor to specification. See TORQUE SPECIFICATIONS.

PARK/NEUTRAL POSITION (PNP) SWITCH

Removal (ES300 & RX300)

1) The PNP switch is located on side of transaxle. Remove splash shield from underneath engine. Disconnect electrical connector at PNP switch. Remove nut from shift control cable and separate cable from shift control lever.

2) Remove nut, washer and shift control lever. Bend tab upward on lock plate, away from PNP switch retaining nut. Remove PNP switch retaining nut and lock plate. Remove PNP switch retaining bolts and PNP switch.

Installation

1) Using NEW lock plate, install PNP switch on transaxle. Install and tighten PNP switch retaining nut and PNP switch retaining bolts to specification. See TORQUE SPECIFICATIONS. Bend over tab on lock plate against PNP switching retaining nut.

2) Reinstall shift control lever, washer and nut on PNP switch and tighten nut to specification. See TORQUE SPECIFICATIONS. Reconnect shift cable on control lever. Check that engine starts only with shift lever in Park and Neutral. If PNP switch adjustment is required, go to next step.

3) Ensure parking brake is applied. Place shift lever in Neutral. Loosen PNP switch retaining bolts. Rotate PNP switch so neutral base line aligns with groove. See Fig. 17. Tighten PNP switch retaining bolts to specification. See TORQUE SPECIFICATIONS.

4) Reconnect PNP switch connector. Install engine splash shield. If PNP switch still does not function properly, test PNP switch. See ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article. Reinstall electrical connector.

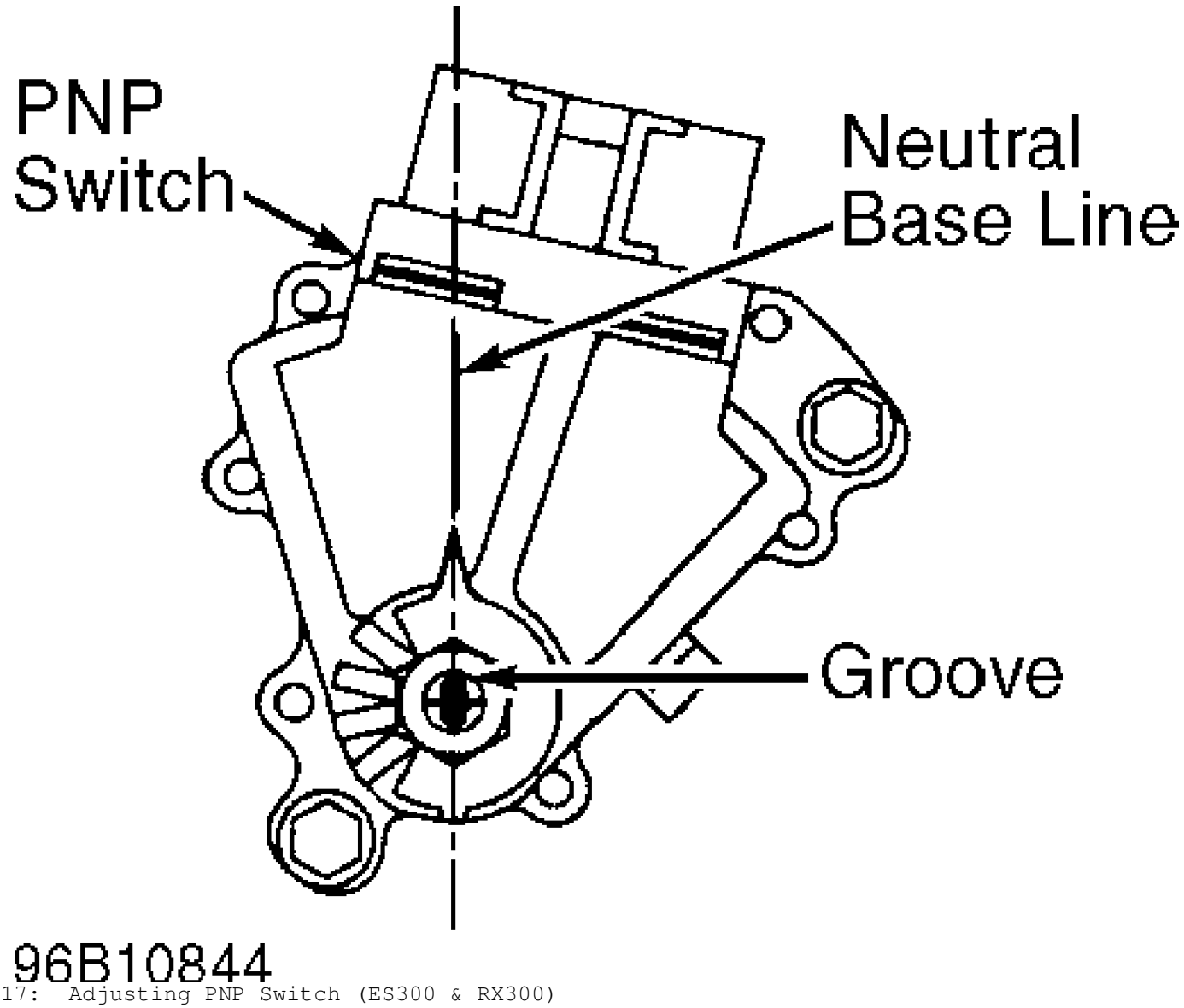


Fig. 17: Adjusting PNP Switch (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300, GS400, LS400, LX470, SC300 & SC400)

The PNP switch is located on side of transmission. Remove front exhaust pipe, if necessary. Disconnect Park/Neutral Position (PNP) switch connector. Remove control shaft lever. See Fig. 18. Pry off lock washer and remove nut. Remove bolt and PNP switch.

Installation

1) Install PNP switch on transmission. Install and tighten PNP switch retaining nut and bolt to specification. See TORQUE SPECIFICATIONS.

2) Reinstall control lever, washer and nut on PNP switch. Tighten control lever nut to specification. See TORQUE SPECIFICATIONS. Check that engine starts only with shift lever in Park and Neutral. If PNP switch adjustment is required, go to next step.

3) Ensure parking brake is applied. Place shift lever in Neutral. Loosen PNP switch retaining bolts. Rotate PNP switch so neutral base line aligns with groove. See Fig. 19. Tighten PNP switch

retaining bolt to specification. See TORQUE SPECIFICATIONS.

4) Reconnect PNP switch connector. If PNP switch still does not function properly, test PNP switch. See ENGINE SENSORS & SWITCHES in appropriate SYSTEM & COMPONENT TESTING article. Reinstall electrical connector.

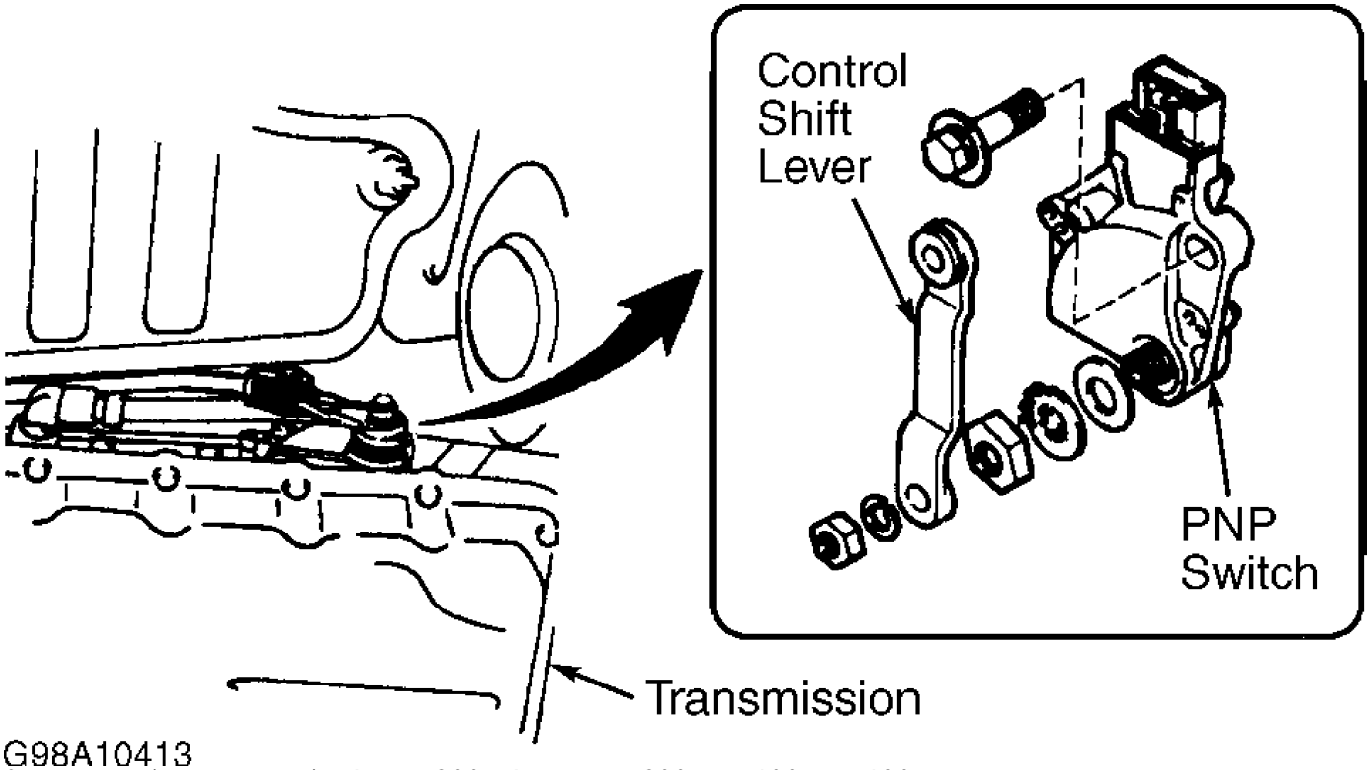


Fig. 18: Removing PNP Switch (SC300 Shown; GS300, GS400, LS400, LX470 & SC400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

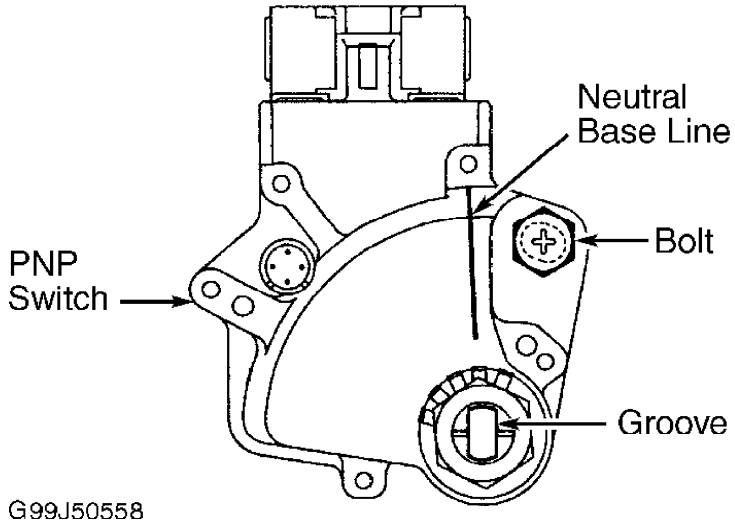


Fig. 19: Adjusting PNP Switch (GS300, GS400, LS400, LX470, SC300 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

THROTTLE POSITION (TP) SENSOR

Removal & Installation

For TP sensor removal and installation procedures, see THROTTLE BODY under FUEL SYSTEM.

VARIABLE VALVE TIMING SENSOR

Removal & Installation

GS300 and SC300 models are equipped with variable valve timing but use the camshaft position sensor instead of Variable Valve Timing (VVT) sensors to determine camshaft position. See CAMSHAFT POSITION SENSOR under IGNITION SYSTEM. On all other models, see VARIABLE VALVE TIMING SENSOR under VARIABLE VALVE TIMING (VVT) SYSTEM.

VEHICLE SPEED SENSOR

NOTE: On ES300, GS400 and RX300, Anti-Lock Brake System (ABS) wheel speed sensor detects wheel speed and sends signals to ABS ECU.

Removal (LX470)

1) Vehicle Speed Sensor (VSS) is located on transmission. See Fig. 20. Disconnect VSS connector.

2) Remove retaining bolt and VSS with "O" ring from transmission. If necessary to remove drive gear assembly from VSS, remove retaining clip from outside of VSS. Retaining clip is located just below "O" ring groove near end of VSS. Remove drive gear from VSS.

Installation

To install, reverse removal procedure using NEW "O" ring. Coat "O" ring with ATF before installing on VSS. Tighten retaining bolt to specification. See TORQUE SPECIFICATIONS.

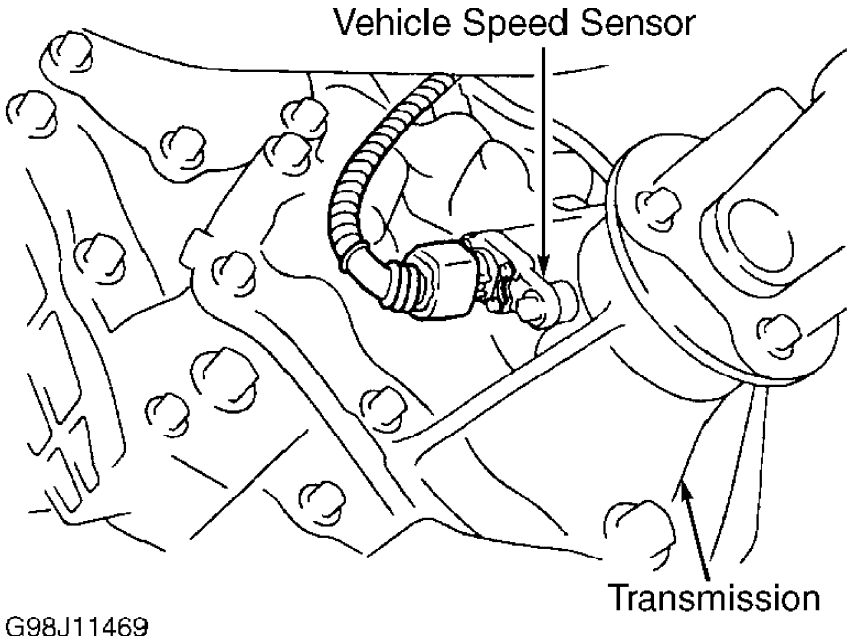


Fig. 20: Locating Vehicle Speed Sensor (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (SC300 & SC400)

Vehicle Speed Sensor (VSS) is located on transmission.

Disconnect VSS connector. Remove retaining bolt and VSS from transmission. Remove "O" ring from VSS. To install, reverse removal procedure using NEW "O" ring. Coat "O" ring with ATF before installing on VSS. Tighten VSS retaining bolt to specification. See TORQUE SPECIFICATIONS.

MOTORS

THROTTLE CONTROL MOTOR

Removal & Installation (GS300, GS400, LS400, LX470, SC300 & SC400)

For throttle control motor removal and installation procedures, see THROTTLE BODY under FUEL SYSTEM.

IGNITION SYSTEM

CAMSHAFT POSITION (CMP) SENSOR

NOTE: On ES300 and RX300, Camshaft Position (CMP) sensor is also known as Variable Valve Timing (VVT) sensor. For VVT sensor removal and installation, see VARIABLE VALVE TIMING SENSOR.

Removal (GS300)

1) Camshaft Position (CMP) sensor is located at left rear intake side of cylinder head. Drain engine coolant. Disconnect engine wiring harness clamp and bolt from engine oil dipstick guide. Remove engine oil dipstick guide along with dipstick. Remove "O" ring from dipstick guide.

2) Disconnect engine wiring harness clamp and bolt from A/T oil dipstick guide. See Fig. 21. Pull out A/T oil dipstick guide and dipstick from A/T oil dipstick tube. Remove "O" ring from dipstick guide.

3) Disconnect noise filter connector. See Fig. 21. Disconnect engine wiring harness clamp from bracket. Remove bolt, bracket and noise filter. Remove intake air connector-to-air intake chamber bolts and nuts.

4) Disconnect power steering air, No. 2 vacuum pipe, and ACIS actuator hoses. See Fig. 21. Disconnect accelerator cable. Remove bolt and accelerator cable clamp. Disconnect EVAP hose. Remove bolt and clamp. Remove air intake chamber and gaskets. Disconnect ACIS vacuum switching valve connector.

5) Remove nuts, vacuum control valve set and No. 2 vacuum pipe. Disconnect engine wiring harness clamp from No. 2 vacuum pipe clamp bracket. Remove upper (No. 3) timing belt cover. Disconnect air assist hose from intake manifold. Disconnect water by-pass hose from throttle body. Disconnect ground terminals from intake manifold. Disconnect throttle position sensor and injector connectors. Disconnect CMP sensor connector. Disconnect knock sensors and starter connectors.

6) Disconnect engine wiring harness clamp from intake manifold clamp bracket. Remove nuts and disconnect engine wiring harness protector from intake manifold. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Remove fuel pressure pulsation damper. See FUEL PRESSURE PULSATION DAMPER under FUEL SYSTEM.

7) Remove power steering pump rear stay. Disconnect starter wiring from manifold stay. Remove bolts and manifold stay. Remove bolts, nuts and intake manifold. Remove fuel rail assembly and gasket. Remove bolts and CMP sensor.

Installation

Install NEW engine oil dipstick guide "O" ring. Apply soapy water to "O" ring, before installation. Install NEW A/T oil dipstick guide "O" ring. To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS.

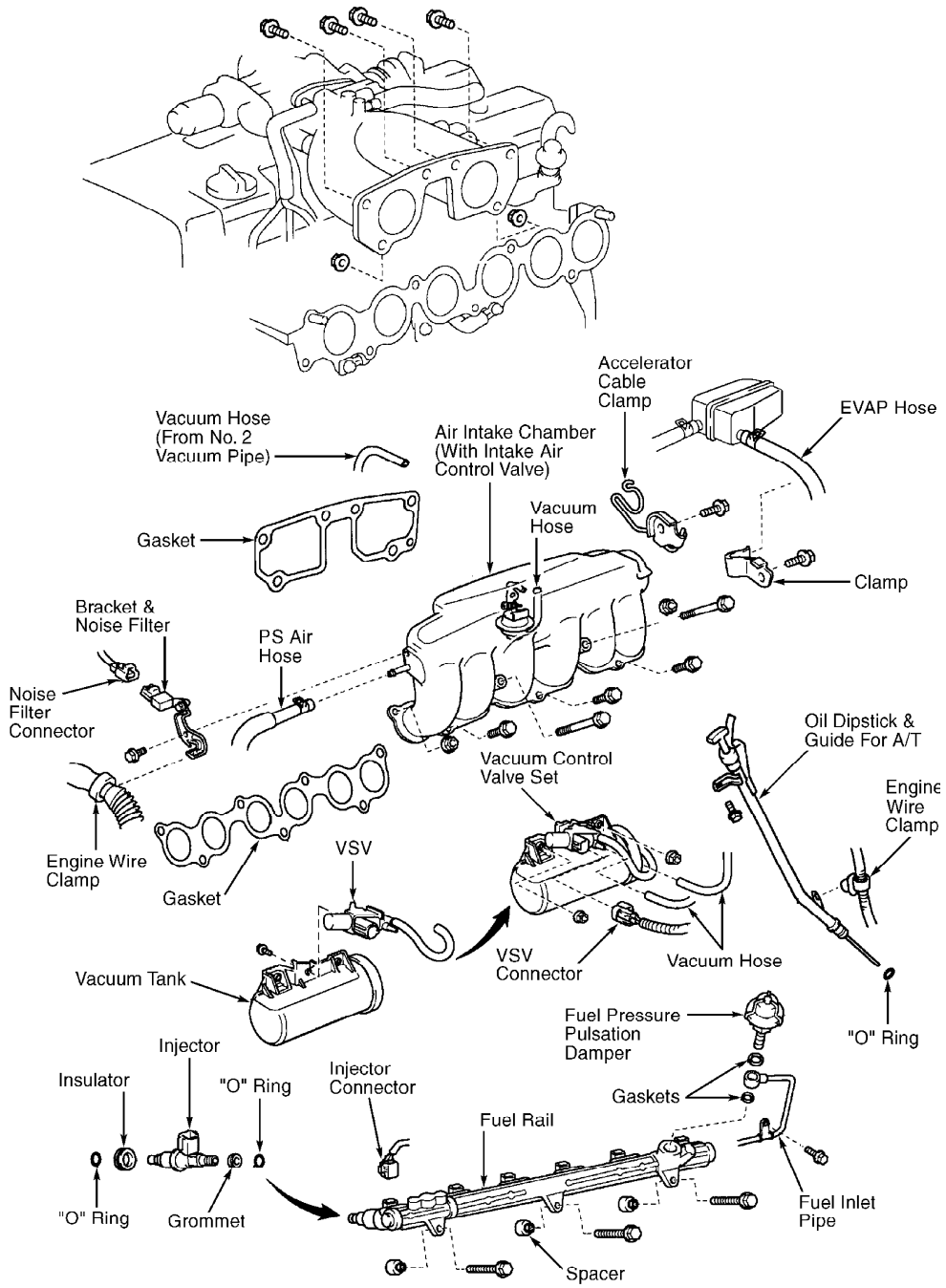


Fig. 21: Exploded View Of Air Intake Chamber & Fuel Rail Components (GS300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS400, LX470 & SC400)

1) Camshaft Position (CMP) sensor is mounted to front of left upper (No. 3) timing belt cover. Remove engine cover. Drain engine coolant. Disconnect upper radiator hose from front water by-pass connector. Disconnect engine wiring harness from wire clamps. Disconnect CMP connector. Disconnect CMP sensor wiring harness from wire clamp on left upper timing belt cover.

2) Remove wire grommet from left upper timing belt cover. Remove left upper timing belt cover nut and bolts. Disconnect wire clamp for CMP sensor from left upper timing belt cover. Remove connector holder from sensor connector. Remove left upper timing belt cover and gasket. Remove bolt, stud and CMP sensor.

Installation

To complete installation, reverse removal procedure. Refill cooling system and check for leaks. Check ignition timing. See ON-VEHICLE ADJUSTMENTS.

Removal (LS400)

1) Camshaft Position (CMP) sensor is mounted to front of left upper (No. 3) timing belt cover. Remove engine cover. Remove battery cover. Remove air cleaner inlet. Drain engine coolant. Disconnect upper radiator hose from front water by-pass connector. Disconnect engine wiring harness from wire clamps.

2) Disconnect CMP wiring harness from wire clamp on timing belt cover. Disconnect CMP connector from connector bracket. Disconnect CMP connector. Remove wire grommet from timing belt cover. Remove left upper timing belt cover and gasket. Remove bolt, stud and CMP sensor.

Installation

Refill cooling system and check for leaks. To complete installation reverse removal procedure. Check ignition timing. See ON-VEHICLE ADJUSTMENTS.

Removal (SC300)

1) Drain engine coolant. Remove bolt from oil dipstick guide. Remove engine oil dipstick guide along with dipstick. Remove "O" ring from dipstick guide. Remove bolt from A/T oil dipstick guide. Pull out A/T oil dipstick guide and dipstick from A/T oil dipstick tube. Remove "O" ring from dipstick guide.

2) Remove bolt, and disconnect engine wiring harness protector from air intake chamber. Disconnect brake booster vacuum hose from intake chamber. Remove intake air connector-to-air intake chamber bolts and nuts. Disconnect power steering air hose from air intake chamber. See Fig. 22.

3) Disconnect ACIS actuator vacuum hose. Disconnect No. 2 pipe vacuum hose. Disconnect Data Link Connector (DLC) No. 1 from air intake chamber. Remove bolts, nuts, air intake chamber and gaskets. Remove vacuum control valve set and No. 2 vacuum pipe. Remove upper (No. 3) timing belt cover. Disconnect air assist hose from intake manifold. Disconnect water by-pass hose from throttle body.

4) Disconnect ground straps from intake manifold. Disconnect throttle position sensor and fuel injector connectors. Disconnect CMP and knock sensor connectors. Disconnect starter connector. Disconnect oil level sensor and ACIS vacuum switching valve connectors.

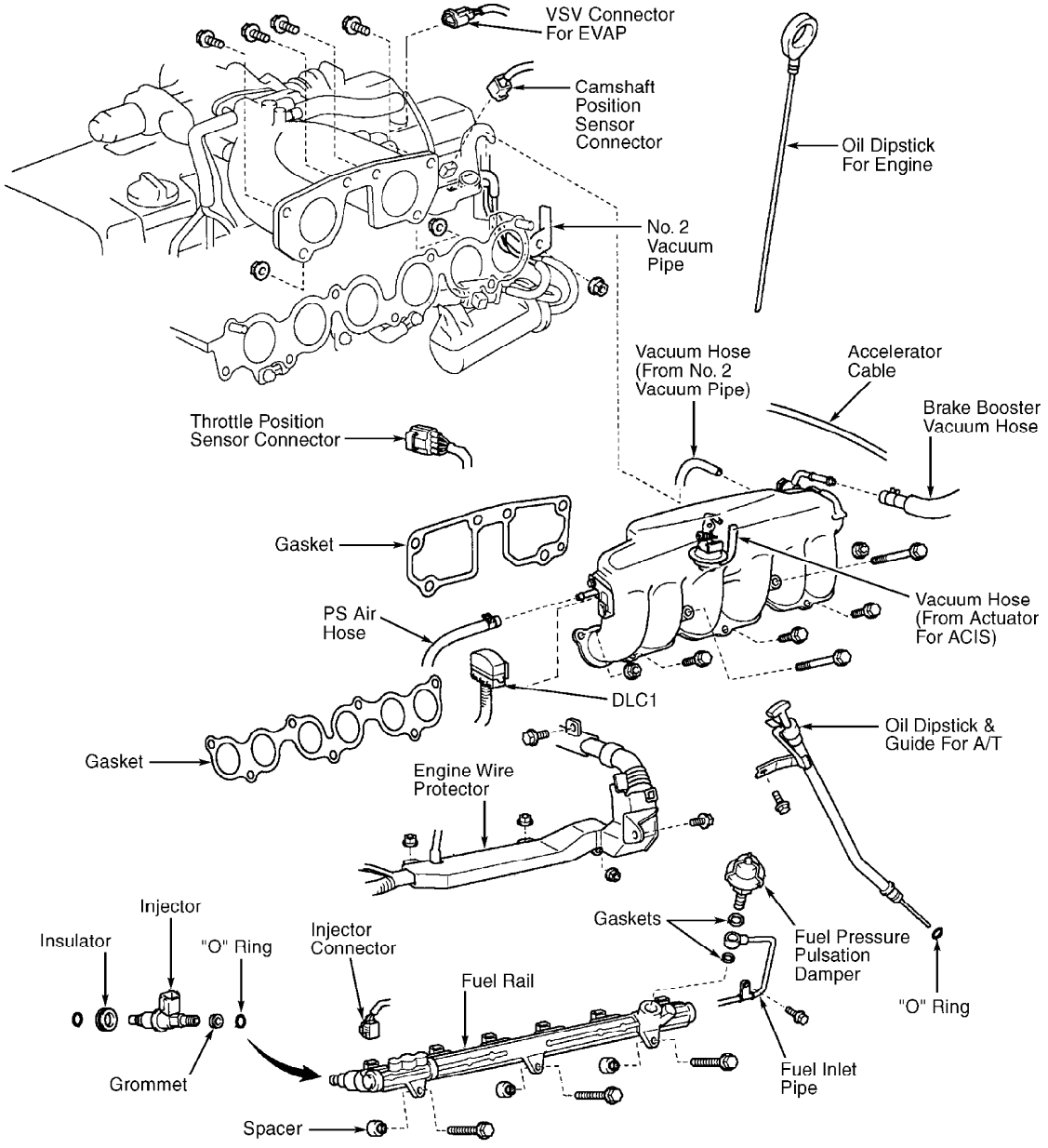
5) Disconnect engine wiring harness clamps from intake manifold. Remove nuts, and disconnect engine wiring harness protector from intake manifold. Remove fuel pulsation damper and upper gasket. Remove power steering pump rear stay. Disconnect starter wiring harness from intake manifold stay.

6) Remove bolts and intake manifold stay. Remove bolts, nuts and intake manifold. Remove fuel rail assembly and gasket. Remove bolts and CMP sensor.

Installation

1) Install NEW brake booster union and air intake chamber gaskets. Install NEW intake manifold gasket. Route water by-pass hose between No. 2 and 3 intake ports of manifold and fuel rail. Install NEW engine oil dipstick guide "O" ring.

2) Apply soapy water to "O" ring, before installation. Install NEW A/T oil dipstick guide "O" ring. To complete installation, reverse removal procedure. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS.



98H11558

Fig. 22: Exploded View Of Air Intake Chamber & Fuel Rail Components (SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRANKSHAFT POSITION (CKP) SENSOR

Removal (ES300 & RX300)

Crankshaft Position (CKP) sensor is located at front of crankshaft, near crankshaft pulley. Remove passenger's side inner fender apron for access to crankshaft pulley. Remove bolt and CKP sensor. Disconnect electrical connector at CKP sensor. To install, reverse removal procedure. Tighten bolt to specification. See TORQUE SPECIFICATIONS.

Removal (GS300 & SC300)

1) Crankshaft Position (CKP) sensor is located at front of crankshaft, near crankshaft pulley. Remove engine undercover. Using a wrench, loosen belt tension by rotating serpentine belt tensioner bolt clockwise and remove serpentine belt. See Fig. 23. Disconnect generator connector. Remove rubber cap and nut, and disconnect generator wire.

2) Disconnect engine wiring harness clamp from generator wire clip. Remove bolt and pipe clamp, and disconnect A/T oil cooler pipes from generator. Remove bolt, nut, pipe bracket and generator. Disconnect Crankshaft Position (CKP) sensor connector. Remove connector bracket-to-water pump bolt. Remove bolt and CKP sensor. Remove connector bracket and connector.

Installation

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

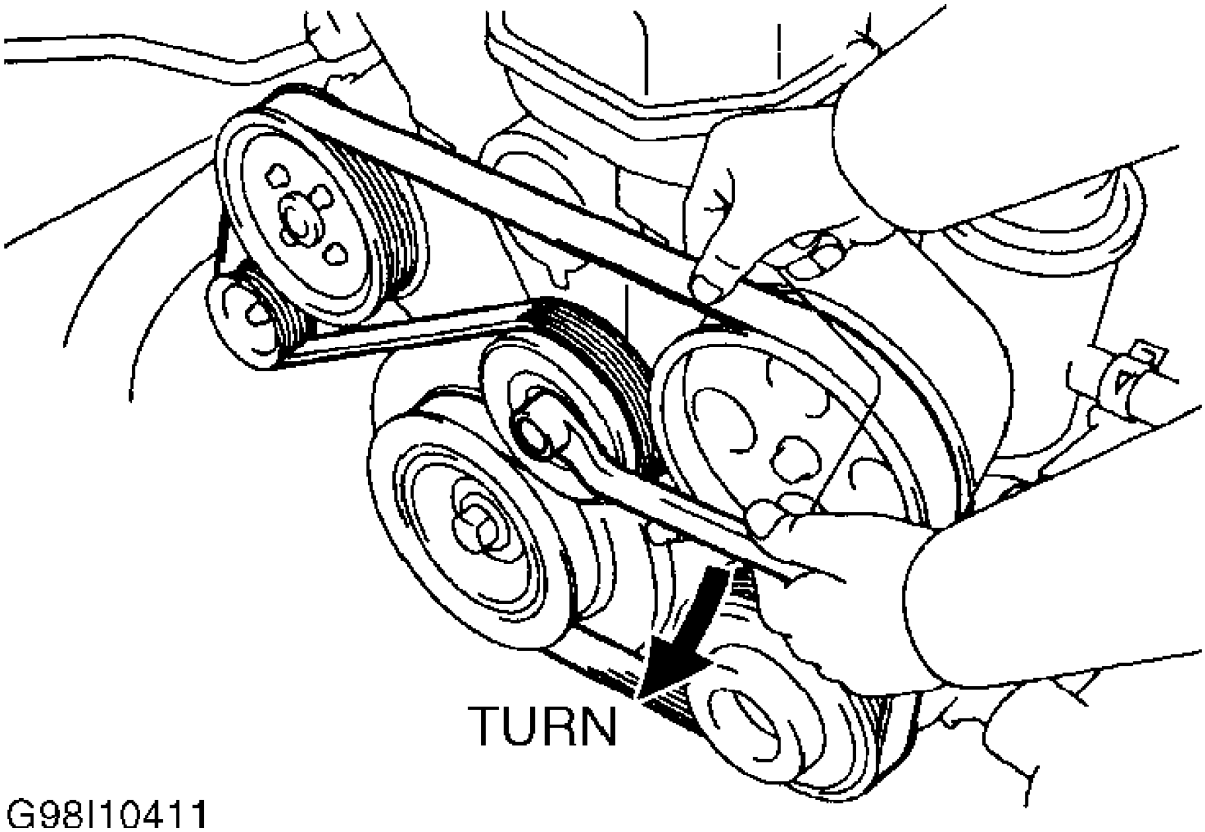


Fig. 23: Removing Serpentine Belt (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (GS400, LS400, LX470 & SC400)

Crankshaft Position (CKP) sensor is located at front of

crankshaft, near crankshaft pulley. Remove oil pan protector, if equipped. Remove engine undercover. Disconnect CKP sensor connector and remove sensor. To install reverse removal procedure. Tighten CKP sensor bolt to specification. See TORQUE SPECIFICATIONS.

IGNITION COILS

Removal & Installation (ES300 & RX300)

Distributorless Ignition System (DIS) uses 6 ignition coils with internal ignitors, one ignition coil/ignitor for each cylinder. Remove engine cover. Disconnect electrical connector at ignition coil/ignitor. Remove bolt and ignition coil/ignitor. To install, reverse removal procedure. Tighten ignition coil/ignitor bolt to specification. See TORQUE SPECIFICATIONS.

Removal (GS300 & SC300)

1) Remove intake air resonator. See Fig. 24. Remove upper (No. 3) timing belt cover. Disconnect accelerator cable. Disconnect throttle position sensor and throttle control motor connectors. Disconnect accelerator pedal position sensor connector. Remove wiring harness clamp from clamp bracket at throttle body.

2) Remove bolts, nut and throttle body. Remove nuts and throttle body bracket. Disconnect water by-pass hose from hose clamp on oil filter bracket. Slightly slide throttle body away from intake air connector. Remove bolts and throttle body gasket.

3) Disconnect ignition coil connectors. Remove bolts and disconnect engine wiring harness clamps. Remove bolts, ignition coils and wire set assembly. Disconnect coil wires.

Installation

To install, reverse removal procedure. Install coil wires and wire holders as illustrated. See Fig. 25. Tighten all bolts and nuts to specification. See TORQUE SPECIFICATIONS.

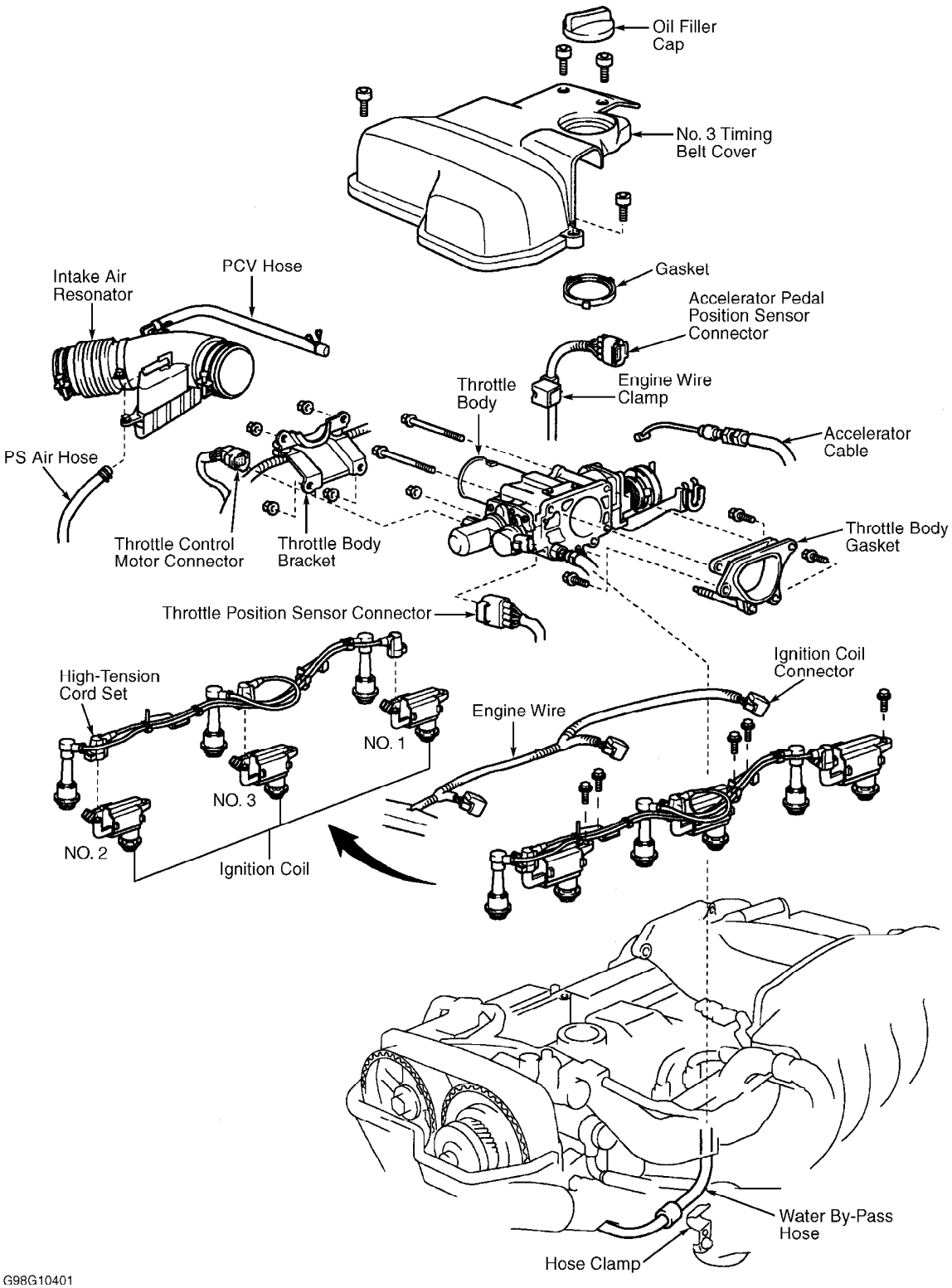


Fig. 24: Removing Ignition Coils (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

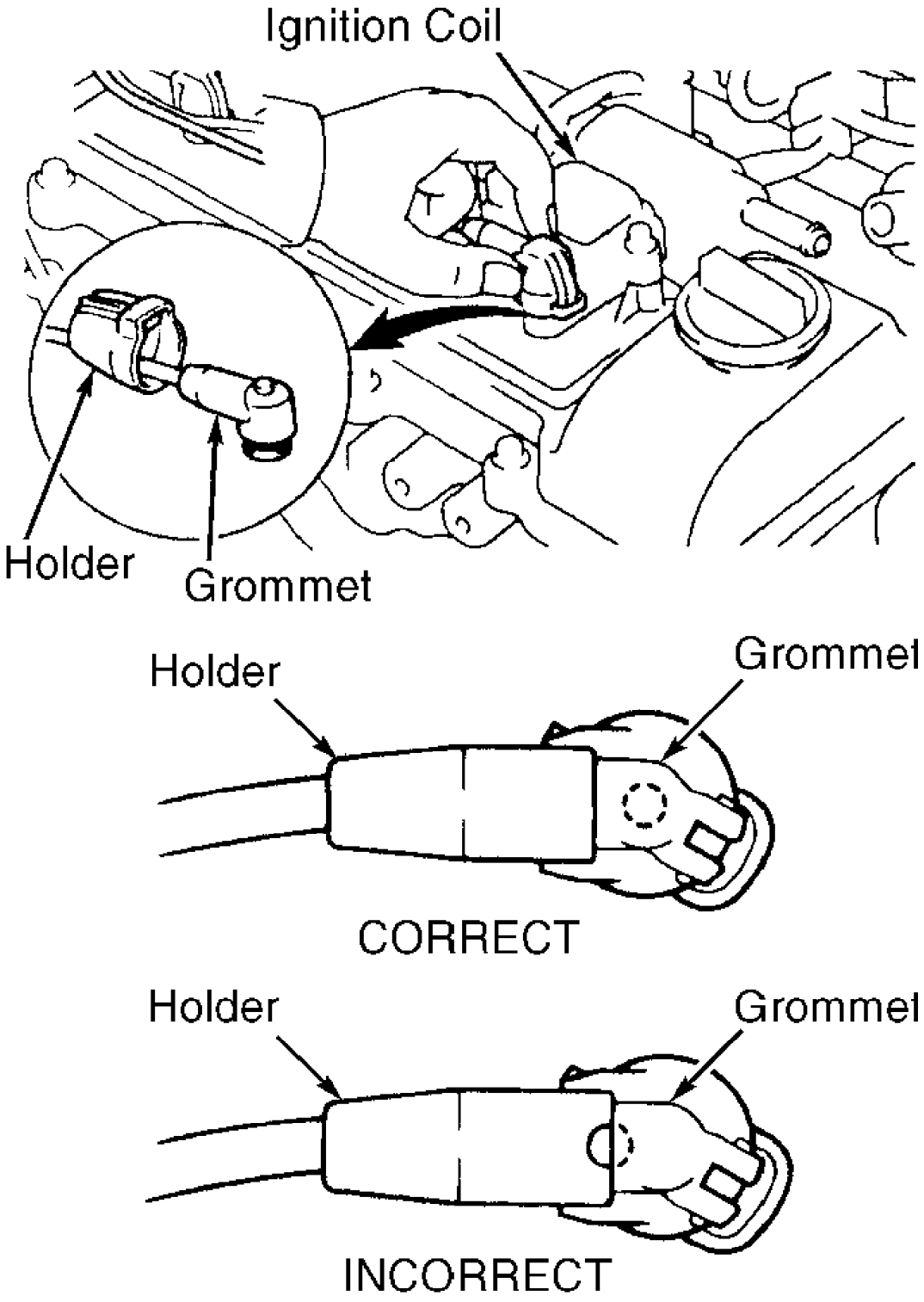


Fig. 25: Installing Coil Wire Holder (GS300 & SC300
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (LS400)
Distributorless Ignition System (DIS) uses 8 ignition coils

with internal ignitors, one ignition coil/ignitor for each cylinder. Remove engine cover and battery cover. Remove intake air connector located between throttle body and air cleaner assembly. Disconnect ignition coil/ignitor connector. Remove bolt and ignition coil/ignitor. To install, reverse removal procedure. Tighten ignition coil/ignitor bolt and nuts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (GS400, LX470 & SC400)

Distributorless Ignition System (DIS) uses 8 ignition coils with internal ignitors, one ignition coil/ignitor for each cylinder. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect electrical connector at ignition coil/ignitor. Remove bolt and ignition coil/ignitor. To install reverse removal procedure. Tighten ignition coil/ignitor bolt to specification. See TORQUE SPECIFICATIONS.

FUEL SYSTEM

WARNING: Always relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

FUEL SYSTEM PRESSURE RELEASE

1) On ES300, GS300 and GS400, remove rear seat cushion and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit. Go to step 5).

2) On LS400, SC300 and SC400, remove trunk floor mat. Remove trunk trim cover from behind rear seat in the trunk for access to the fuel tank. Disconnect 2-pin electrical connector for fuel pump. Electrical connector for fuel pump is located near the rear speaker and fuel pump is located on front of fuel tank, behind rear seat. Go to step 5).

3) On LX470, disconnect electrical connector for fuel pump. See Fig. 26. This is electrical connector for fuel pump and fuel gauge sending unit. Go to step 5).

4) On RX300, remove driver's side rear seat. Remove carpet and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector for fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit, and is located on top of fuel tank, near fuel pump. Go to next step.

5) On all models, start engine and allow engine to idle until engine stalls. Turn ignition off. Reinstall electrical connector for fuel pump and any removed components.

6) Disconnect negative battery cable. Place suitable container under fuel line connection. Cover fuel line connection with shop towel. Slowly loosen fuel line connection, allowing any fuel pressure to be released. Once fuel pressure is released, fuel system components may be serviced.

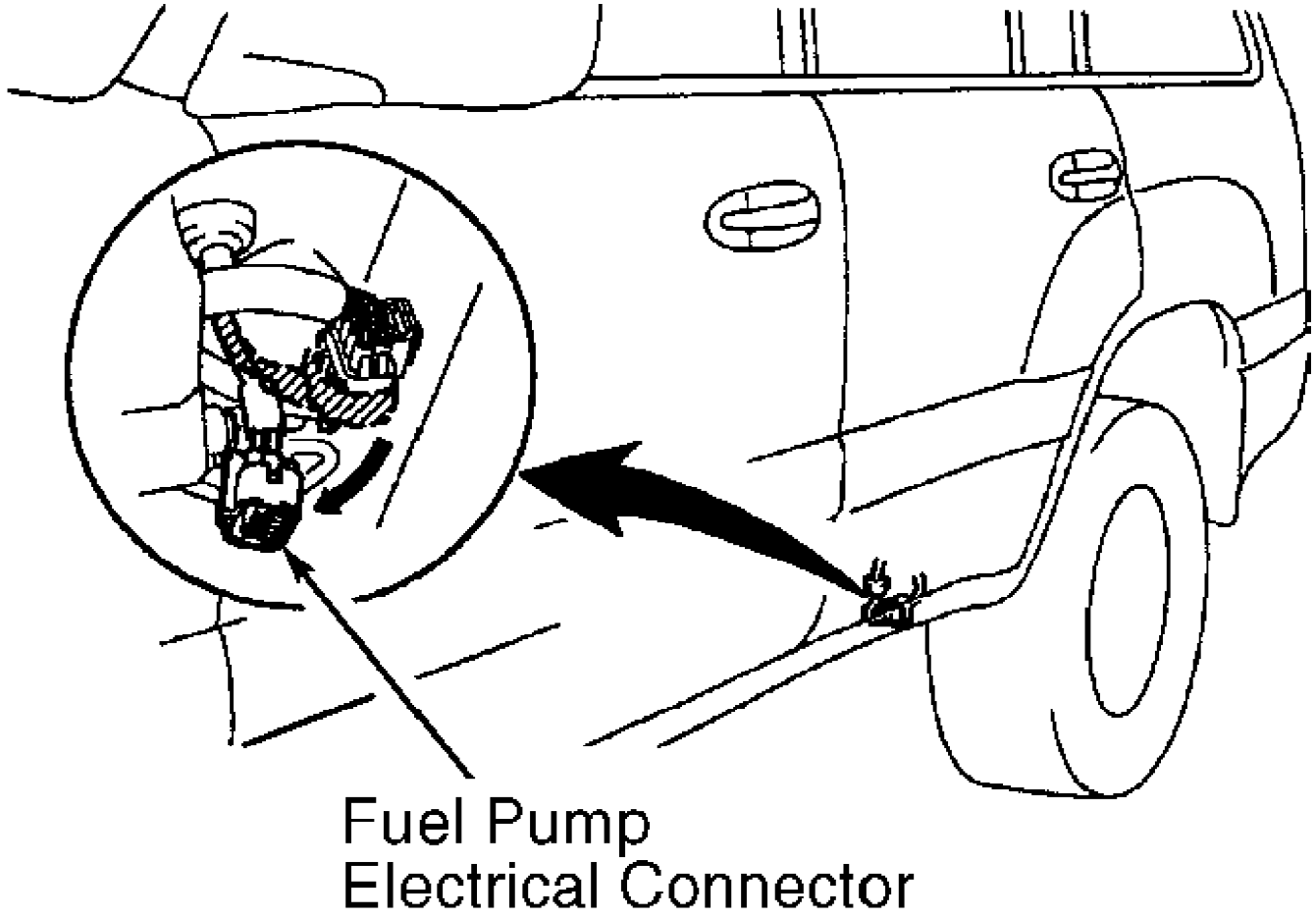


Fig. 26: Locating Fuel Pump Electrical Connector (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL LINE QUICK CONNECTOR

GS300, GS400 & LX470

1) Ensure fuel line connector is clean. Disconnect fuel line connector as illustrated. See Fig. 27. If connector and line are stuck, pinch retainer, push and pull connector to free. DO NOT use tools to disconnect connector. After disconnecting, ensure seal surface is clean. Cover connector with plastic, to prevent damage.

2) When removing retainer from fuel line, replace with new one. Apply small amount of engine oil to fuel line tip for easier installation. Push connector and retainer together until a click sound is heard. Ensure connection is secure by pulling on connector. Start engine and check for leaks.

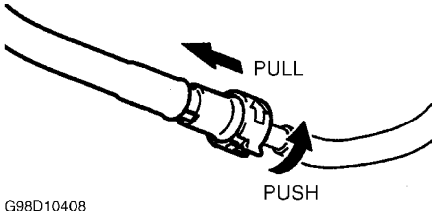


Fig. 27: Disconnecting Fuel Line Quick Connector (GS300, GS400 & LX470)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL PRESSURE PULSATION DAMPER

Removal (GS300 & SC300)

Release fuel system pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect EVAP vacuum switching valve connector. Disconnect EVAP hose from EVAP pipe. Disconnect vacuum hose from No. 2 vacuum pipe at air intake chamber. See Fig. 21 or 22. Remove No. 2 vacuum pipe-to-intake manifold nut. Place a towel under fuel rail. Remove fuel line-to-intake manifold bolt. Slowly loosen and remove pulsation damper and gaskets.

Installation

To install, reverse removal procedure. Install NEW pulsation damper gaskets, larger gasket on top of banjo fitting and smaller gasket on bottom. Using a torque wrench and Steering Rack Wrench (09617-24011), tighten pulsation damper to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

Removal (GS400)

1) Release fuel system pressure. See FUEL SYSTEM PRESSURE RELEASE. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect accelerator cable clamp from upper intake manifold. Remove EVAP vacuum switching valve from upper intake manifold. Remove PCV hose from upper intake manifold. Remove EVAP vacuum hose from EVAP vacuum switching valve. Remove air inlet hose from air tube.

2) Remove No. 2 engine cover bracket from No. 1 engine hanger. See Fig. 11. Remove EVAP vacuum switching valve from upper intake manifold. Remove accelerator cable clamp from upper intake manifold. Remove No. 3 engine cover bracket from upper intake manifold.

3) Remove bolts and disconnect engine wiring harness protector from upper intake manifold. See Fig. 28. Place a towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove fuel pressure pulsation damper(s) and gaskets.

Installation

Temporarily install fuel pressure pulsation damper(s), NEW pulsation damper gaskets and fuel line. Remove bolts and air tube. Disconnect engine wiring harness clamp from bracket. Disconnect No. 5 ignition coil connector and No. 7 injector connector. Using a torque wrench and Steering Rack Wrench (09617-24011), tighten fuel pressure pulsation dampers to specification. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Check for fuel leaks.

Removal (LS400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove engine cover. Remove battery cover and air cleaner inlet. Remove intake air connector located between throttle body and air cleaner assembly. Disconnect accelerator cable. Disconnect vacuum hoses from EVAP vacuum switching valve. Disconnect brake booster vacuum hose from intake manifold. See Fig. 28 . Disconnect PCV hose from PCV valve.

2) Disconnect EVAP vacuum switching valve connector. Disconnect noise filter connector. See Fig. 28. Remove bolts and disconnect engine wiring harness protector, wire clamp bracket and engine wiring harness from intake manifold. Place a shop towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove fuel pressure pulsation damper(s) and upper gaskets. Remove rear fuel line from fuel rails and lower pulsation damper gaskets.

Installation

To install, reverse removal procedure. Use NEW fuel pressure pulsation damper gaskets. Using a torque wrench and Steering Rack Wrench (09617-24011), tighten fuel pressure pulsation damper(s) to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

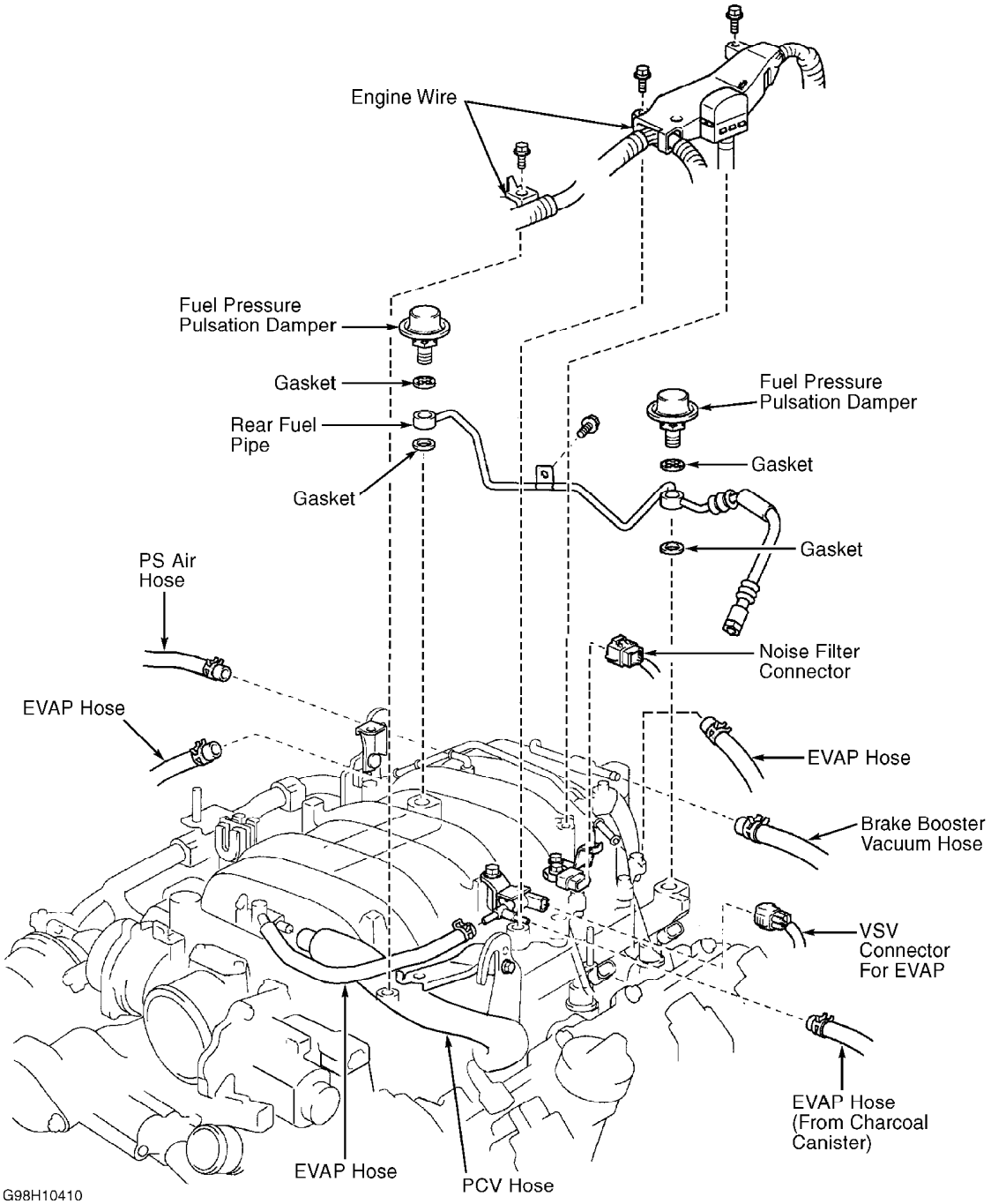


Fig. 28: Removing Fuel Pressure Pulsation Dampers & Gaskets (LS400 Shown; GS400 & SC400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (SC400)

1) Release fuel system pressure. See FUEL SYSTEM PRESSURE RELEASE. Remove engine cover. Disconnect accelerator cable clamp from upper intake manifold. Remove EVAP vacuum switching valve from upper intake manifold. Disconnect noise filter connector. See Fig. 28.

2) Remove engine cover brackets. Disconnect brake booster vacuum hose and PCV hose from intake manifold. Disconnect left cylinder head fuel injector connectors. Disconnect left cylinder head ignition coil/ignitor connectors. Disconnect left cylinder head camshaft timing oil control valve connector. Disconnect variable valve timing sensor No. 2 connector. See Fig. 41.

3) Disconnect camshaft position sensor connector. Disconnect engine wiring harness from wire clamp on left cylinder head valve cover and timing belt rear plate. Disconnect engine wiring harness from wire clamps on timing belt cover. Disconnect engine wiring harness protector and wire clamp bracket from intake manifold and left front bearing cap. Place a towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove fuel pressure pulsation damper(s) and gaskets.

Installation

To install, reverse removal procedure. Use NEW fuel pressure pulsation damper gaskets. Using a torque wrench and Steering Rack Wrench (09617-24011), tighten pulsation damper(s) to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

FUEL FILTER (IN-TANK)

NOTE: ES300 is equipped with an in-tank fuel filter and a fuel filter that is located in left rear of engine compartment. See Fig. 8 for engine compartment fuel filter. LX470 is not equipped with an in-tank fuel filter. Fuel filter is located in engine compartment. See Fig. 14.

Removal & Installation (GS300, GS400, LS400, RX300, SC300 & SC400)

Fuel filter is mounted to fuel pump assembly. Fuel pump is located in fuel tank. For in-tank fuel filter removal and installation procedures, see FUEL PUMP.

FUEL PRESSURE REGULATOR

NOTE: All models except LX470 use a returnless fuel system. Fuel pressure regulator is mounted to fuel pump assembly and is located in fuel tank. LX470 uses a fuel return system with fuel pressure regulator mounted on fuel rail.

Removal & Installation (ES300)

Remove fuel pump assembly from fuel tank. See FUEL PUMP. Remove screw and in-tank fuel filter. See Fig. 29. Remove "O" ring from in-tank fuel filter. Remove screw and fuel pressure regulator. Remove "O" ring from fuel pressure regulator. To install, reverse removal procedure. Apply a light coat of gasoline to NEW "O" ring. Check for fuel leaks.

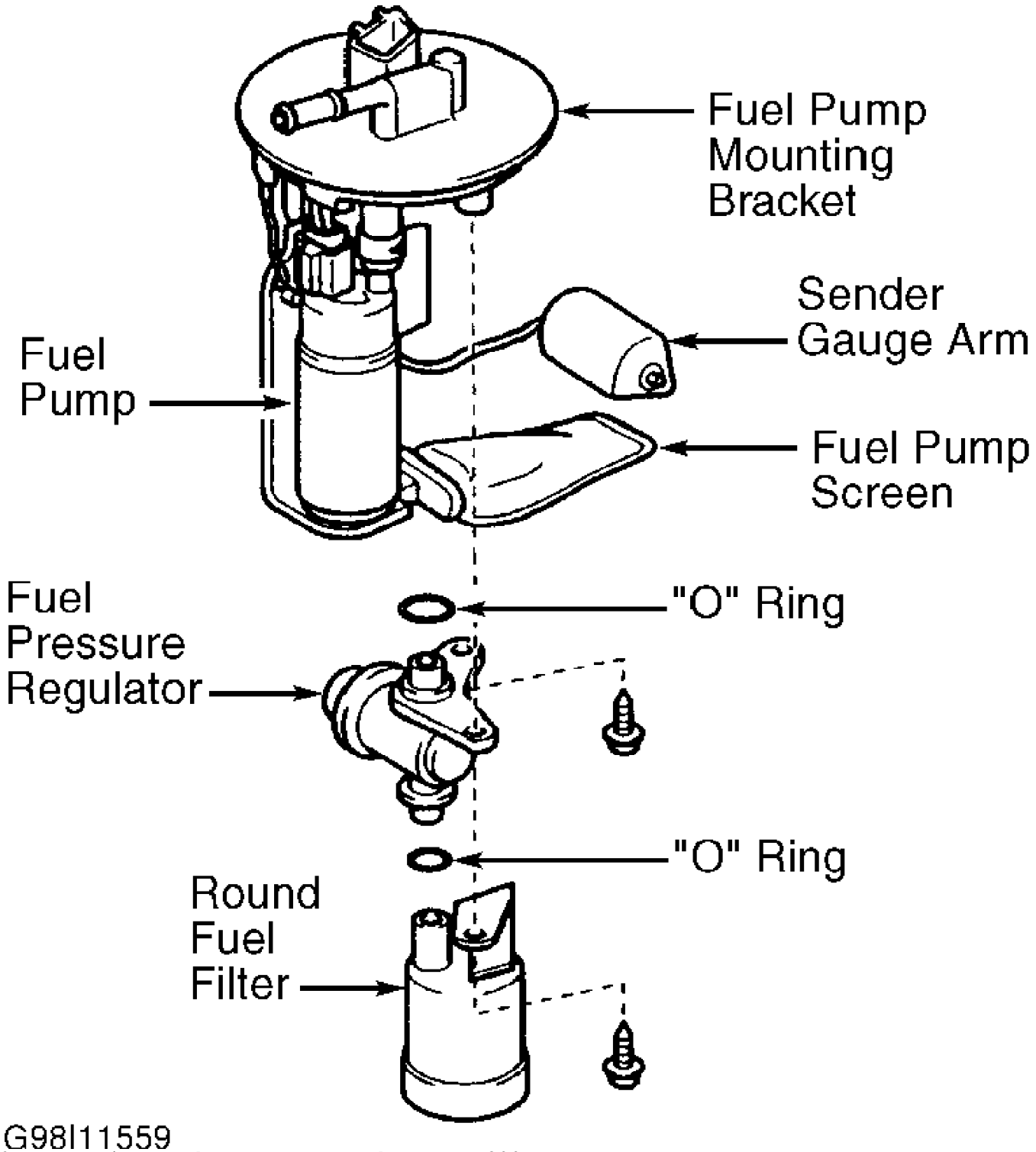


Fig. 29: Removing Fuel Pressure Regulator (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (GS300, GS400 & RX300)

For fuel pressure regulator removal and installation procedures, see FUEL PUMP.

Removal (LS400)

Remove fuel pump assembly from fuel tank. See FUEL PUMP. Remove screw, fuel filter and fuel pressure regulator. See Fig. 35. Remove "O" rings from fuel pressure regulator and fuel filter.

Installation

To install, reverse removal procedure. Apply a light coat of gasoline to NEW fuel pressure regulator "O" rings. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

Removal (LX470)

1) Fuel pressure regulator is bolted to center of passenger's side fuel rail. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE.

2) Remove engine cover. Place shop towel below fuel pressure regulator to absorb any gasoline. Disconnect vacuum hose and fuel return hose from fuel pressure regulator. Remove bolts and fuel pressure regulator with "O" ring. Remove "O" ring from fuel pressure regulator.

Installation

To install, reverse removal procedure using NEW "O" ring. Coat "O" ring with gasoline before installing fuel pressure regulator on fuel rail. Use twisting motion when installing fuel pressure regulator on fuel rail. Tighten fuel pressure regulator bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

Removal (SC300 & SC400)

Remove fuel pump assembly from fuel tank. See FUEL PUMP. Remove screw, and disconnect ground strap from fuel pump clamp. See Fig. 39. Remove fuel pump from pump bracket. Remove rubber cushion from fuel pump. Disconnect fuel pump together with fuel hose from fuel pressure regulator. Remove fuel pump. Remove screw, fuel filter and fuel pressure regulator. Remove "O" rings from fuel pressure regulator and fuel filter.

Installation

To install, reverse removal procedure. Apply a light coat of gasoline to NEW "O" rings. Ensure fuel pressure regulator and fuel filter rotate smoothly. If fuel pressure regulator and fuel filter do not rotate smoothly, remove and reinstall components. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

FUEL PUMP

Removal (ES300)

1) Remove rear seat cushion and back. Remove floor carpet. Remove floor service hole cover. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Disconnect fuel pump and sender gauge connector. See Fig. 30.

2) Remove fuel tank protector. Ensure area around disconnect fitting on fuel line at fuel pump is clean. Depress both sides of retainer and pull fuel line with disconnect fitting from outlet tube on fuel pump. See Fig. 31. Remove fuel tank vent tube set plate. Remove fuel pump assembly and gasket from fuel tank. Ensure fuel pump filter and sender gauge arm are not damaged or bent.

Disassembly & Reassembly

Disconnect fuel pump connector. Pull off lower side of fuel pump from pump bracket. See Fig. 30. Disconnect fuel hose from fuel pump. Remove fuel pump from fuel pump assembly bracket. Remove rubber cushion from fuel pump. Remove retaining clip and pull fuel pump

screen from fuel pump. To reassembly, reverse disassembly procedure. Install NEW fuel pump assembly gasket and fuel pump screen retaining clip.

Installation

To install, reverse removal procedure. Tighten fuel pump assembly-to-fuel tank mounting bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

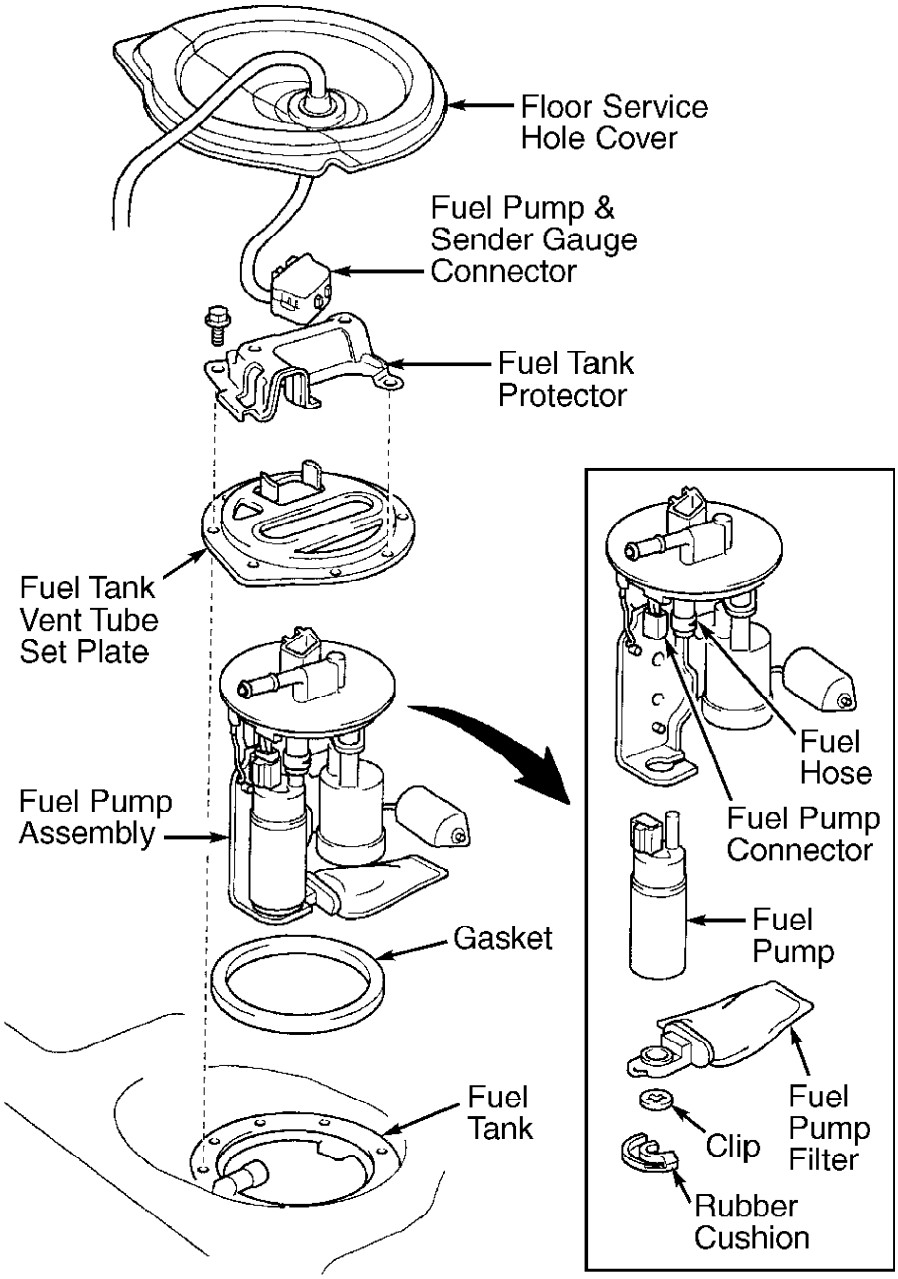


Fig. 30: Exploded View Of Fuel Pump Assembly (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

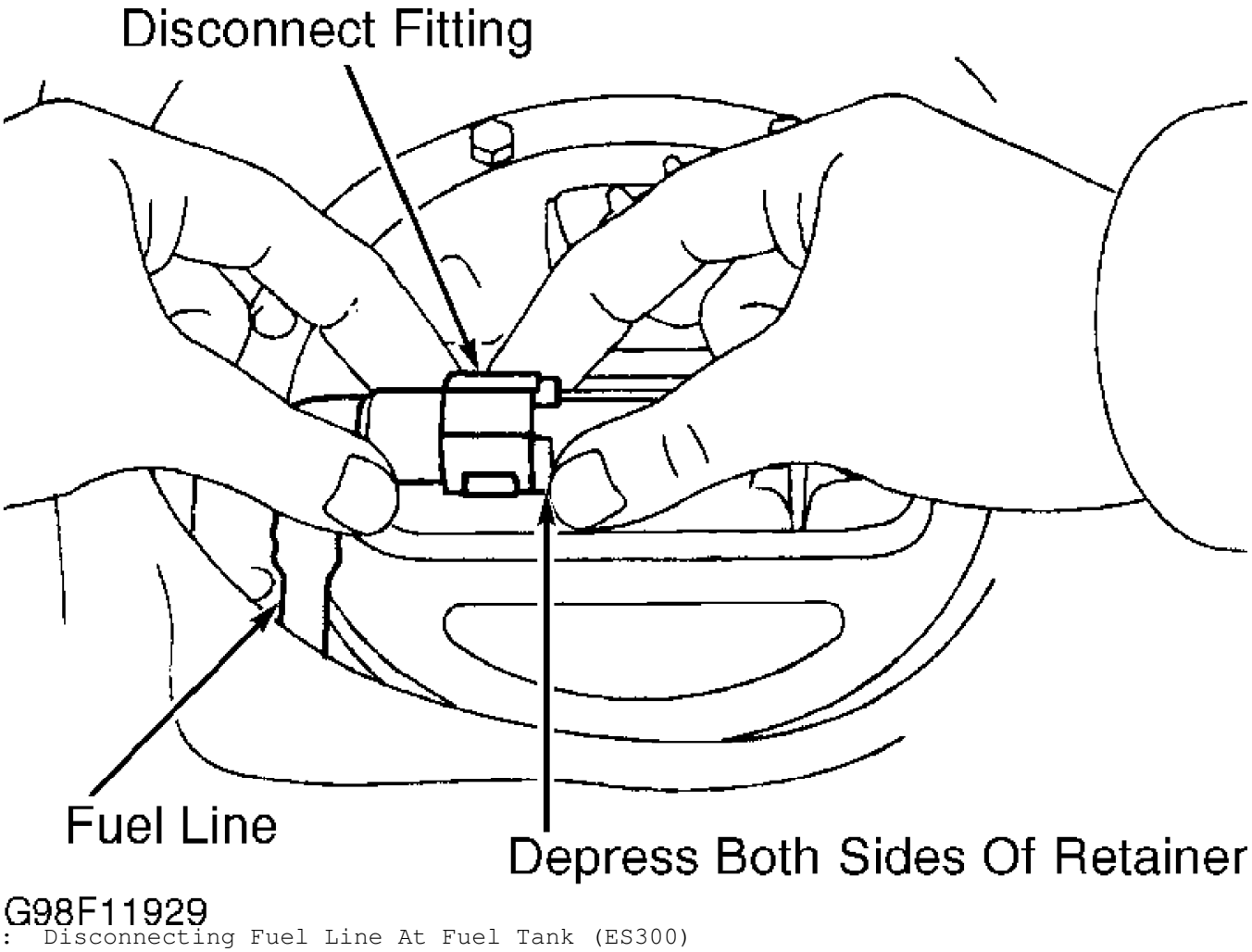


Fig. 31: Disconnecting Fuel Line At Fuel Tank (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300 & GS400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove rear seat cushion. Remove floor service hole cover. Disconnect fuel pump and sender gauge connector. Remove clip and disconnect fuel line at fuel tank. See Fig. 32.

2) Plug port at fuel suction plate with a clean rubber cap. See Fig. 32. Remove 8 bolts and fuel tank vent tube set plate. Lift up fuel pump and sender gauge assembly, and disconnect sub-suction hose from fuel return jet tube. See Fig. 33. Remove fuel pump assembly and gasket. Ensure that fuel pump filter and sender gauge arm are not damaged or bent.

Disassembly & Reassembly

1) Using 2 small screwdrivers, pry off No. 2 fuel suction support. See Fig. 34. Ensure not to damage suction supports. Remove suction support rubber cushion. Disconnect fuel return jet tube from clamp of No. 2 suction support. Pull out fuel pressure regulator from in tank fuel filter and remove fuel pressure regulator and fuel return jet tube assembly. Remove "O" ring from fuel pressure regulator.

2) Remove clip and remove fuel pump screen. Using 2 small screwdrivers, pry off No. 1 fuel suction support. Ensure not to damage suction support. Remove No. 2 fuel filter cushion. Disconnect fuel

pump connector.

3) Using a pulling motion, remove fuel filter and fuel pump assembly. See Fig. 34. Remove No. 1 fuel filter cushion. Remove "O" ring from fuel port of fuel suction plate. Using a pulling motion, remove fuel pump from fuel filter.

4) To reassemble, reverse disassembly procedure. Apply a light coat of gasoline to NEW "O" rings. Install NEW fuel pump assembly gasket and fuel pump screen retaining clip.

Installation

To install, reverse removal procedure. Tighten fuel tank vent tube set plate bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

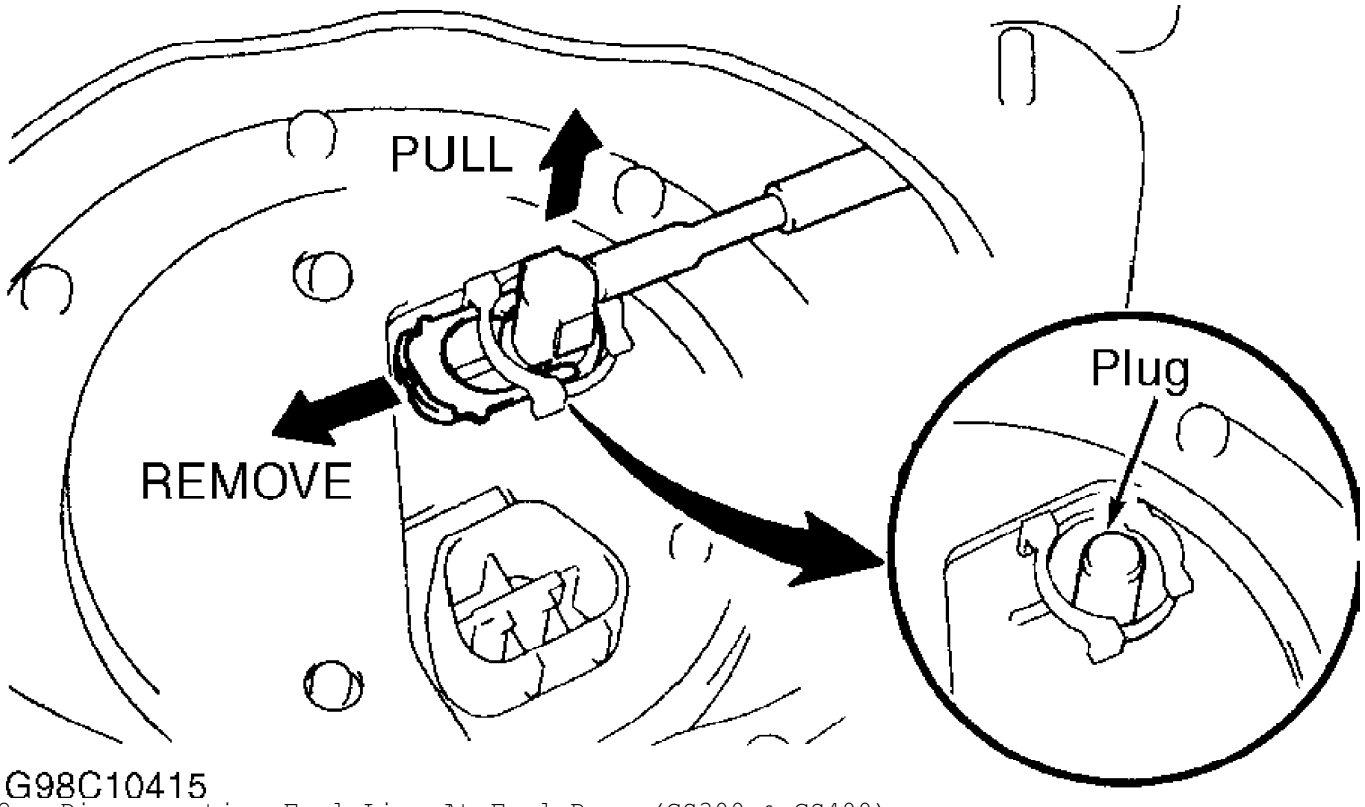


Fig. 32: Disconnecting Fuel Line At Fuel Pump (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

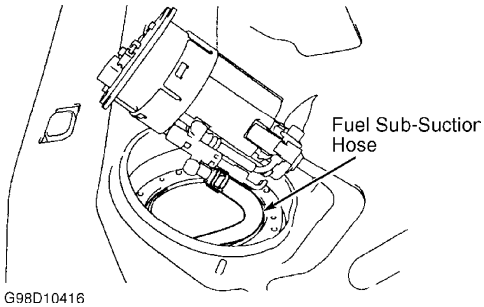


Fig. 33: Identifying Sub-Suction Hose (GS300 & GS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

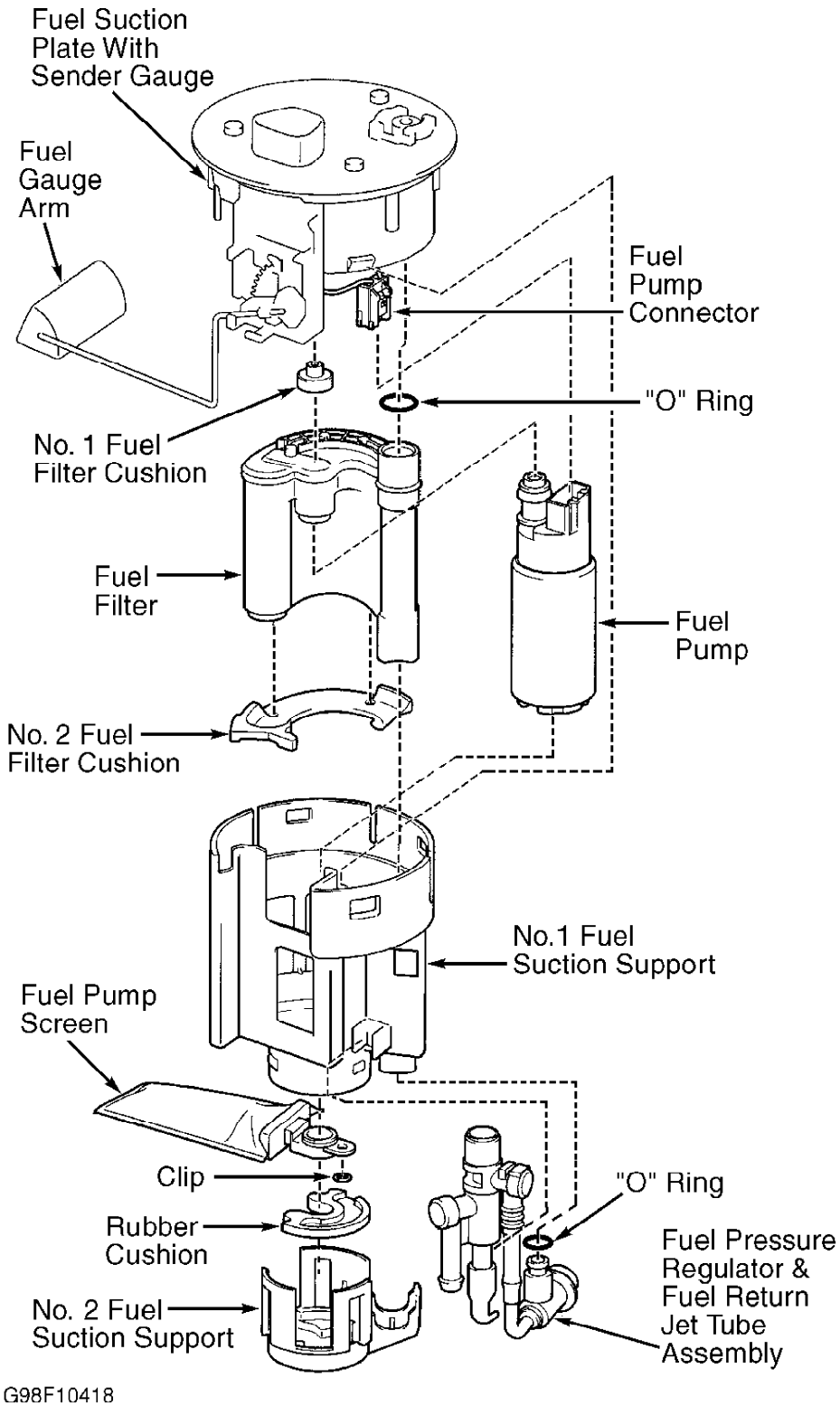


Fig. 34: Exploded View Of Fuel Pump Assembly (GS300 & GS400 Shown; RX300 Is Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LS400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove luggage compartment floor mat. Remove luggage compartment trim cover to expose fuel tank. Disconnect fuel pump connector. Remove rear seat cushion and seat back. Remove service hole cover.

2) Remove fuel pump set plate. See Fig. 35. Disconnect fuel pump bracket from fuel tank. Disconnect fuel hose from fuel pump bracket. Remove fuel pump and bracket assembly from fuel tank.

Disassembly & Reassembly

1) Remove nuts, spring washers, and wires from fuel pump. Remove screw and wire from fuel pump ground clamp. Pull out lower side of fuel pump from pump bracket. Disconnect fuel hose from fuel pump. Remove fuel pump from pump bracket. Remove rubber cushion from fuel pump.

2) Remove screw and fuel pump ground clamp from fuel pump. Remove clip and pull out fuel pump filter (screen). To reassemble, reverse disassembly procedure. Install NEW fuel pump filter (screen) retaining clip. Install NEW fuel pump set plate gasket.

Installation

To install, reverse removal procedure. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

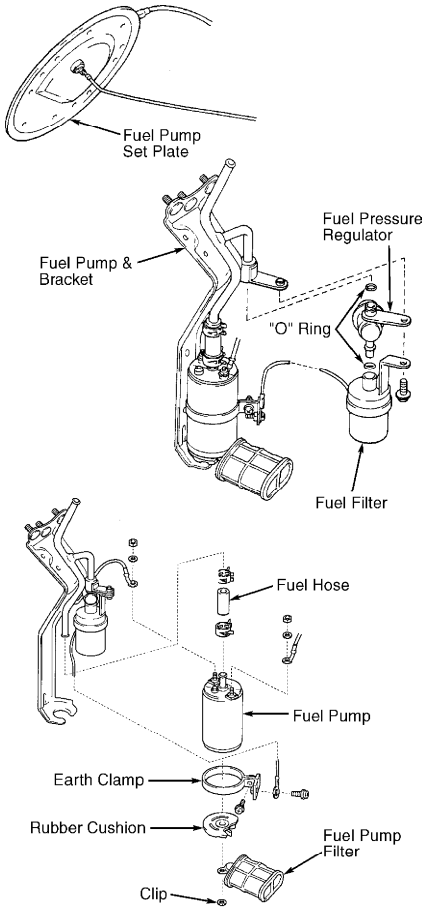


Fig. 35: Exploded View Of Fuel Pump (LS400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LX470)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE.

2) Remove rear seats, rear door scuff plates, step plates, rear seat lock covers, rear carpet and cover plate on floor panel for access to electrical connector for fuel pump. Disconnect electrical connector from top of fuel pump. This is electrical connector for fuel pump and fuel gauge sending unit.

3) Ensure area around fuel supply line and fuel return line on top of fuel pump is clean. Spread apart ends of retaining clips and pull retaining clips from fuel supply line and fuel return line on top of fuel pump. See Fig. 36.

4) Disconnect fuel supply line and fuel return line from top of fuel pump. It may be necessary to slightly rotate fuel supply line or fuel return line during removal to free line from fitting on fuel pump.

5) Remove fuel pump retaining plate-to-fuel tank bolts and fuel pump retaining plate. Remove fuel pump assembly and gasket from fuel tank. Use care not to damage fuel filter (screen) on bottom of fuel pump and fuel gauge sending unit when removing fuel pump.

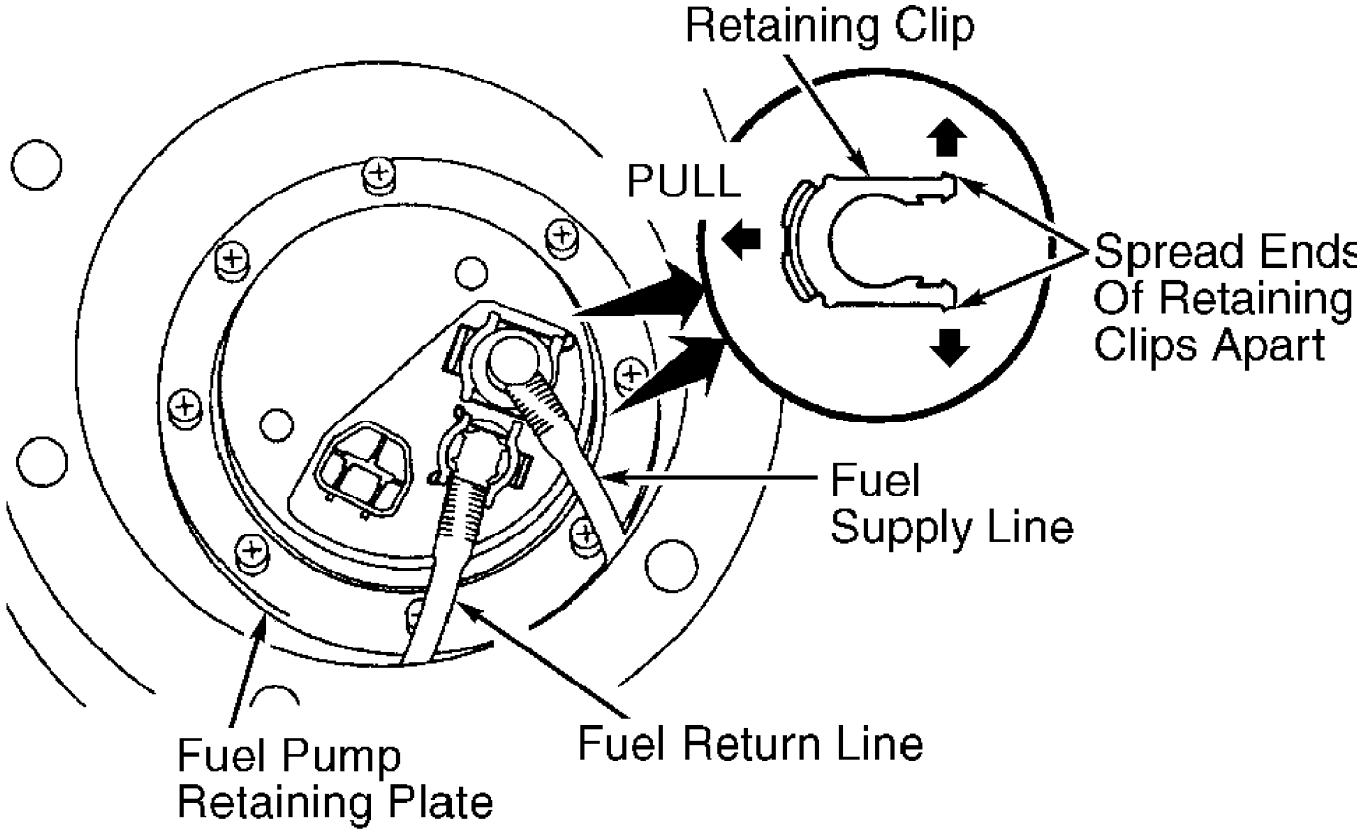


Fig. 36: Removing Retaining Clips From Fuel Lines & Locating Fuel Pump Retaining Plate (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly & Reassembly

1) Disconnect lead wire from top of fuel pump. See Fig. 37. Pull bottom of fuel pump from fuel pump mounting bracket. Disconnect fuel hose at top of fuel pump. Remove fuel pump with rubber cushion from fuel pump mounting bracket.

2) Remove rubber cushion from bottom of fuel pump. Using small screwdriver, remove retaining clip that holds fuel filter on bottom of fuel pump. Remove fuel filter from fuel pump. To reassemble, reverse disassembly procedure using NEW retaining clip on fuel filter.

Installation

1) Install fuel pump in fuel tank using a NEW gasket. Tighten fuel pump retaining plate-to-fuel tank bolts to specification. See TORQUE SPECIFICATIONS.

2) Ensure fuel supply and fuel return lines and connections on fuel pump are clean. Install fuel supply line and fuel return line on fuel pump. Install retaining clip on fuel supply line and fuel return line until "click" sound is heard. Lightly pull on retaining clips to ensure retaining clips are properly locked on the fuel pump. To install remaining components, reverse removal procedure. Check for fuel leaks.

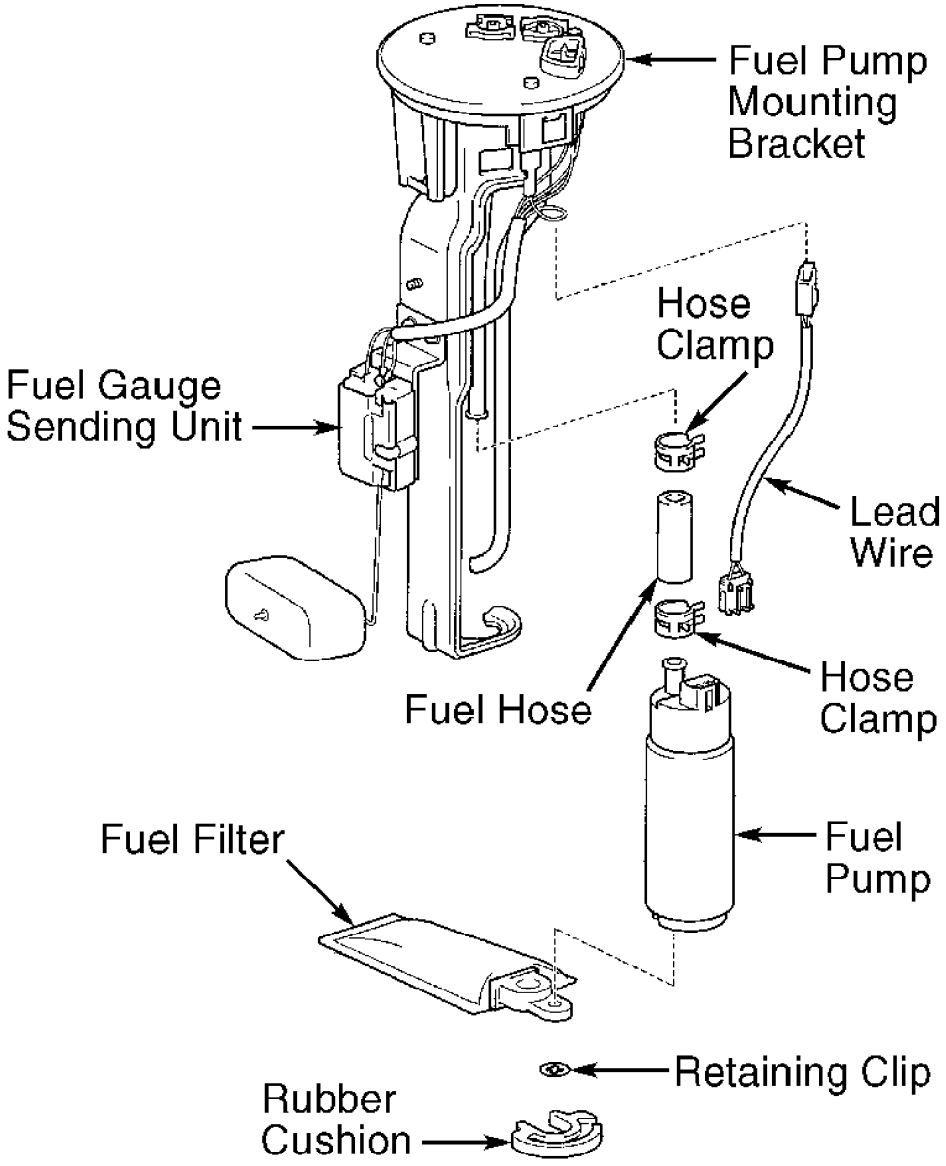


Fig. 37: Exploded View Of Fuel Pump & Components (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (RX300)

1) Remove driver's side rear seat. Remove carpet and floor

service hole cove on floor panel for access to electrical connector for fuel pump. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Disconnect fuel pump and sender gauge connector. See Fig. 34.

2) Ensure area around fuel line at fuel pump is clean. Disconnect fuel line from fuel pump. See Fig. 38. Remove fuel tank vent tube set plate. Remove fuel pump assembly and gasket from fuel tank. Ensure that fuel pump filter and sender gauge arm are not damaged or bent.

Disassembly & Reassembly

1) Using 2 small screwdrivers, pry off No. 2 fuel suction support. See Fig. 34. Ensure not to damage suction supports. Remove suction support rubber cushion. Disconnect fuel return jet tube from clamp of No. 2 suction support. Pull out fuel pressure regulator from in tank fuel filter and remove fuel pressure regulator and fuel return jet tube assembly. Remove "O" ring from fuel pressure regulator.

2) Remove clip and remove fuel pump screen. Using 2 small screwdrivers, pry off No. 1 fuel suction support. Ensure not to damage suction support. Remove No. 2 fuel filter cushion. Disconnect fuel pump connector.

3) Using a pulling motion, remove fuel filter and fuel pump assembly. See Fig. 34. Remove No. 1 fuel filter cushion. Remove "O" ring from fuel port of fuel suction plate. Using a pulling motion, remove fuel pump from fuel filter.

4) To reassemble, reverse disassembly procedure. Apply a light coat of gasoline to NEW "O" rings. Install NEW fuel pump assembly gasket and fuel pump screen retaining clip.

Installation

To install, reverse removal procedure. Tighten fuel tank vent tube set plate bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

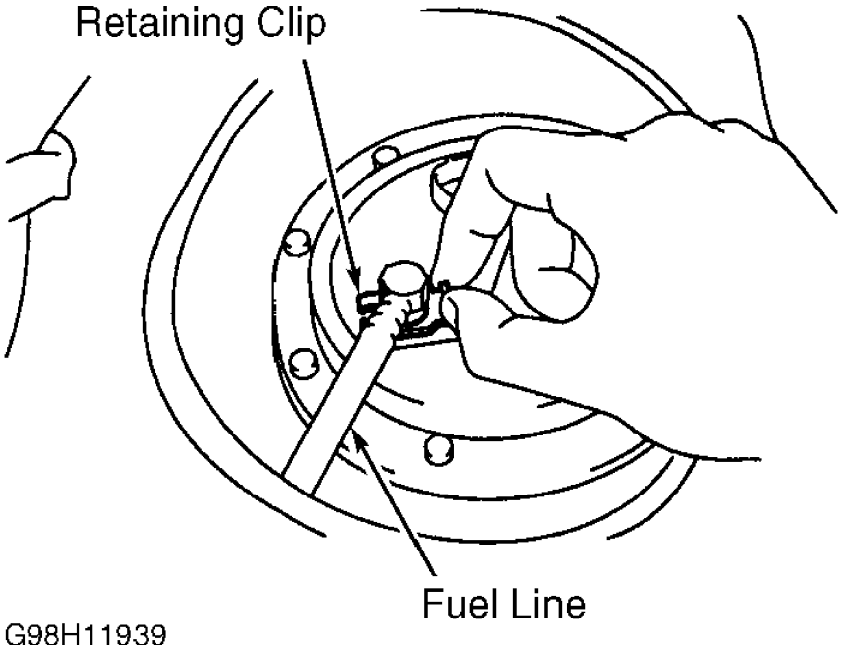


Fig. 38: Disconnecting Fuel Line At Fuel Tank (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (SC300 & SC400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE.

Disconnect negative battery cable. Remove luggage compartment floor mat. Remove luggage compartment trim cover to expose fuel tank. Remove fuel tank mounting bolts. Disconnect fuel pump connector. Remove rear seat cushion and back. Remove service hole cover.

2) Remove fuel pump set plate. Remove 3 nuts and disconnect fuel pump bracket from fuel tank. See Fig. 39. Disconnect fuel hose from fuel pump bracket. Remove fuel pump assembly. Remove fuel pump set plate gasket.

Disassembly & Reassembly

Disconnect electrical connector from fuel pump. Remove screw, and disconnect ground strap from fuel pump clamp. Remove fuel pump from fuel pump bracket. Remove rubber cushion from fuel pump. Disconnect fuel hose from fuel pump and remove fuel pump. Remove screw and fuel pump clamp. Remove clip and fuel pump screen. To reassemble, reverse disassembly procedure. Install NEW fuel pump screen retaining clip. Install NEW fuel pump set plate gasket.

Installation

To install, reverse removal procedure. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Check for fuel leaks.

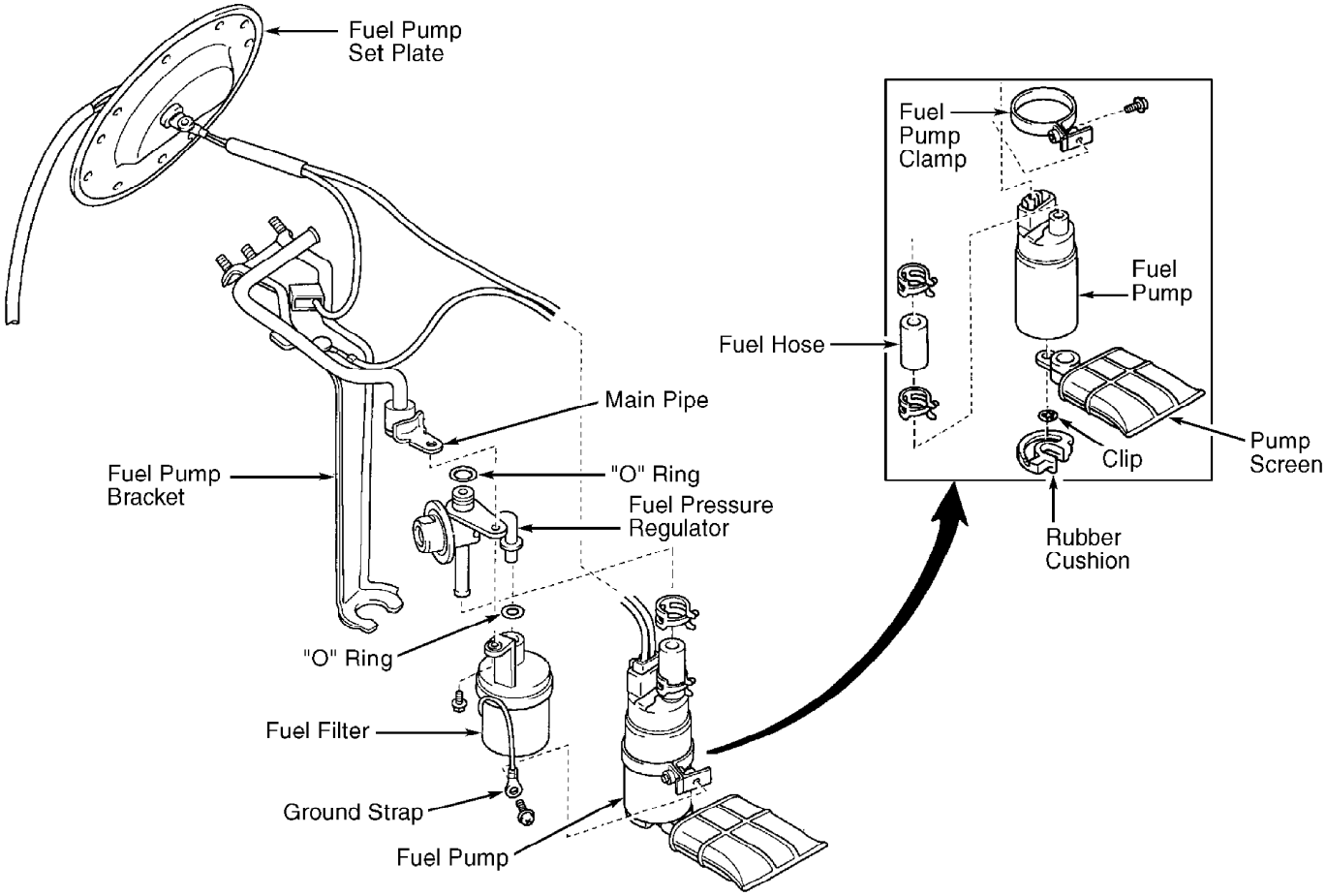


Fig. 39: Exploded View Of Fuel Pump Assembly (SC300 & SC400) Courtesy of Toyota Motor Sales, U.S.A., Inc.

FUEL RAILS & INJECTORS

Removal (ES300)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove air cleaner hose and resonator. Disconnect accelerator cable. Disconnect Throttle Position (TP) sensor connector. Disconnect Idle Air Control (IAC) valve connector.

2) Disconnect Acoustic Control Induction System (ACIS) vacuum switching valve connectors. Disconnect EVAP vacuum switching valve connector. Remove Data Link Connector (DLC) No. 1 from bracket on IAC valve. See Fig. 8. Disconnect power steering hose from No. 1 engine hanger.

3) Remove PCV hose from PCV valve at right cylinder head. Disconnect ground strap and cable from ACIS IAC valve. Disconnect ground cable from air intake chamber. Disconnect brake booster vacuum hose from air intake chamber. Disconnect 2 water by-pass hoses from throttle body.

4) Disconnect air assist hose from throttle body. Disconnect EVAP purge hose from pipe on emission control valve set. Remove 2 vacuum hoses from ACIS vacuum tank. Remove engine wiring harness clamp from emission control valve set. Remove air intake chamber assembly and gasket.

5) Disconnect fuel injector connectors. Disconnect air assist pipe from bracket at fuel line. Remove air assist hoses from intake manifold. Remove fuel pipe clamp from No. 1 fuel pipe at fuel filter. Perform STEP 1. See Fig. 9.

6) Ensure area around No. 1 fuel pipe and fuel filter is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel filter. Perform STEP 2. See Fig. 9. Remove fuel rail bolts. Remove fuel rails together with injectors and fuel line. Remove spacers from intake manifold. Remove injectors from fuel rails. Remove "O" rings and grommets from injectors.

Installation

1) Install NEW "O" rings, insulators and grommets on injectors. Apply a light coat of gasoline to fuel injector "O" rings and fuel rails injector openings. Using a twisting motion, push injectors onto fuel rail. Ensure injectors are fully seated. Ensure injector connectors are positioned outward.

2) Place 4 fuel rail spacers in position on intake manifold. Apply a light coat of gasoline to intake manifold injector ports. Assemble fuel rails, fuel lines and injectors in position on intake manifold. Temporarily install 4 injector rail bolts. Temporarily install fuel line-to-intake manifold bolt. Ensure fuel injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly. Replace "O" rings.

3) Ensure fuel injector connectors are positioned outward. Tighten fuel rail-to-intake manifold bolts to specification. See TORQUE SPECIFICATIONS. Tighten fuel line-to-intake manifold bolt. Align alignment marks (White paint) on fuel line. See Fig. 40. Install fuel line clamp to engine compartment fuel filter until a click is heard. Ensure fuel line clamp is installed securely.

4) Connect air assist hoses to intake manifold. Install air assist pipe. Connect injector connectors. Install NEW intake chamber assembly gasket. Install air cleaner hose with resonator. To complete installation, reverse removal procedure. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Turn ignition on. Start engine and check fuel system for leaks.

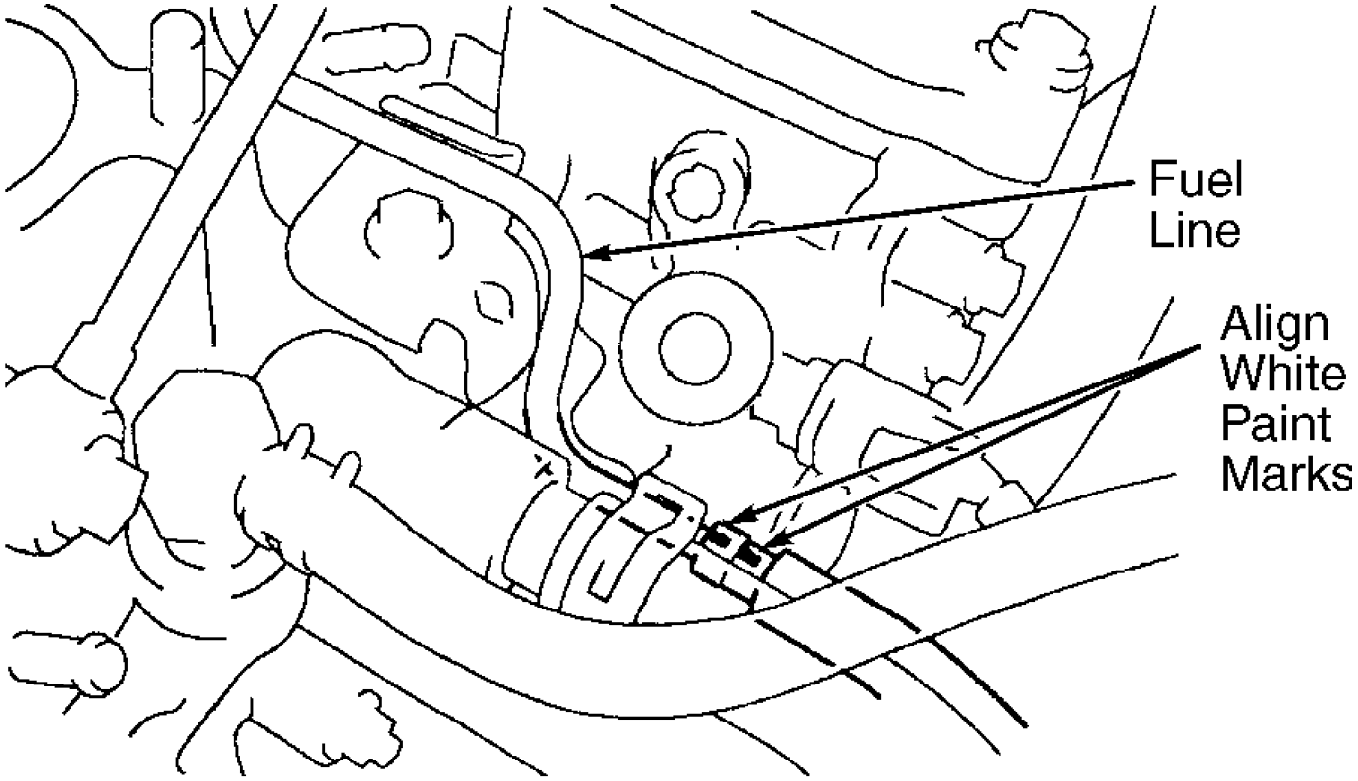


Fig. 40: Aligning Fuel Line White Paint Marks (ES300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Disconnect noise filter connector. Disconnect engine wiring harness clamp from bracket. Remove bolt, bracket and noise filter. Remove intake air connector-to-air intake chamber bolts and nuts.

2) Disconnect power steering air, No. 2 vacuum pipe, and ACIS actuator hoses. See Fig. 21. Disconnect accelerator cable. Remove bolt and accelerator cable clamp. Disconnect EVAP hose. Remove bolt and clamp. Remove air intake chamber and gaskets.

3) Remove No. 2 vacuum pipe-to-intake manifold nut. Remove fuel inlet pipe-to-intake manifold bolt. Remove fuel pressure pulsation damper and gaskets. See FUEL PRESSURE PULSATION DAMPER.

4) Disconnect injector connectors. Disconnect camshaft position sensor, throttle position sensor and EVAP vacuum switching valve connectors. Remove fuel rail bolts. Remove fuel rail and fuel injectors as an assembly. Remove injectors from fuel rail. Remove "O" rings, grommets and insulators from injector. Remove spacers from intake manifold.

Installation

1) Install NEW "O" rings, insulators and grommets on injectors. Apply a light coat of gasoline to fuel injector "O" rings. Apply a light coat of gasoline to fuel rail injector opening. Using a twisting motion, push injectors into fuel rail. Ensure injectors are fully seated in fuel rail. Ensure fuel injector connectors are positioned outward.

2) Install 3 spacers in position on intake manifold. Apply a light coat of gasoline to intake manifold injector ports. Place

injectors and fuel rail assembly onto intake manifold. Temporarily install fuel rail-to-intake manifold bolts.

3) Ensure injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly. Replace "O" rings. Position injector connectors upward. Connect injector connectors. Injector connectors for cylinders No. 1, 3 and 5 are Dark Gray, and for cylinders No. 2, 4 and 6 are Brown.

4) Tighten fuel rail mounting bolts to specification. See TORQUE SPECIFICATIONS. Install fuel pressure pulsation damper and gaskets. See FUEL PRESSURE PULSATION DAMPER. To complete installation, reverse removal procedure. Fill cooling system. Start engine and inspect for fuel and coolant leaks.

Removal (GS400)

1) Release fuel system pressure. See FUEL SYSTEM PRESSURE RELEASE. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect accelerator cable clamp from upper intake manifold. Remove EVAP vacuum switching valve from upper intake manifold. Remove PCV hose from upper intake manifold. Remove EVAP vacuum hose from EVAP vacuum switching valve. Remove air inlet hose from air tube.

2) Remove No. 2 engine cover bracket from No. 1 engine hanger. See Fig. 11. Remove EVAP vacuum switching valve from upper intake manifold. Remove accelerator cable clamp from upper intake manifold. Remove No. 3 engine cover bracket from upper intake manifold.

3) Remove bolts and disconnect engine wiring harness protector from upper intake manifold. See Fig. 28. Place a towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove fuel pressure pulsation dampers and gaskets.

4) Remove ACIS vacuum switching valve from upper intake manifold. Remove accelerator cable bracket. Disconnect fuel injector connectors. Remove fuel rail mounting nuts. See Fig. 41. Remove fuel rails, injectors and spacers. Remove No. 5, 6, 7 and 8 fuel injector connectors. Remove "O" rings, grommets and insulators from each injector.

Installation

1) Install NEW insulators and grommets on injectors. Apply a light coat of gasoline to NEW fuel injector "O" rings. Install "O" rings. Using a twisting motion, push injectors into fuel rail. Ensure injectors are fully seated in fuel rail. Ensure fuel injector connectors are positioned outward.

2) Install 4 spacers in position on intake manifold. Place injectors and fuel rail assembly onto intake manifold. Temporarily install fuel rail-to-intake manifold nuts.

3) Ensure injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly and may be pinched. Replace "O" rings. Position injector connectors outward. Tighten fuel rail mounting nuts to specification. See TORQUE SPECIFICATIONS.

4) Install fuel pressure pulsation dampers and gaskets. See FUEL PRESSURE PULSATION DAMPER. To complete installation, reverse removal procedure. Fill cooling system. Start engine and inspect for fuel and coolant leaks.

Removal (LS400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove engine cover. Remove battery cover and air cleaner inlet. Remove intake air connector located between throttle body and air cleaner assembly. Disconnect accelerator cable. Disconnect vacuum hoses from EVAP vacuum switching valve. Disconnect brake booster vacuum hose from intake manifold. See Fig. 28

. Disconnect PCV hose from PCV valve.

2) Disconnect EVAP vacuum switching valve connector. Disconnect noise filter connector. See Fig. 28. Remove bolts and disconnect engine wiring harness protector, wire clamp bracket and engine wiring harness from intake manifold. Place a shop towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove pulsation dampers and upper gaskets.

3) Remove rear fuel line from fuel rails and lower pulsation damper gaskets. Disconnect injector connectors. Disconnect engine wiring harness from fuel rail. Disconnect Variable Valve Timing (VVT) sensor connectors. See Fig. 41.

4) Remove EVAP vacuum switching valve. Remove accelerator cable bracket and engine cover brackets. Remove fuel rail mounting nuts. Remove fuel rails and injectors as an assembly. See Fig. 41. Remove spacers. Remove injectors from fuel rail. Remove "O" rings, grommets and insulators from each injectors.

Installation

1) Install NEW insulators and grommets on injectors. Apply a light coat of gasoline to NEW fuel injector "O" rings. Install "O" rings. Using a twisting motion, push injectors into fuel rail. Ensure injectors are fully seated in fuel rail. Ensure fuel injector connectors are positioned outward. Install 4 spacers in position on intake manifold.

2) Place injectors and fuel rail assembly onto intake manifold. Temporarily install fuel rail-to-intake manifold nuts. Ensure injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly and may be pinched. Replace "O" rings. Position injector connectors outward. Tighten fuel rail mounting nuts to specification. See TORQUE SPECIFICATIONS.

3) Connect injector connectors. Install fuel pressure pulsation dampers and gaskets. See FUEL PRESSURE PULSATION DAMPER. To complete installation, reverse removal procedure. Fill cooling system. Start engine and inspect for fuel and coolant leaks.

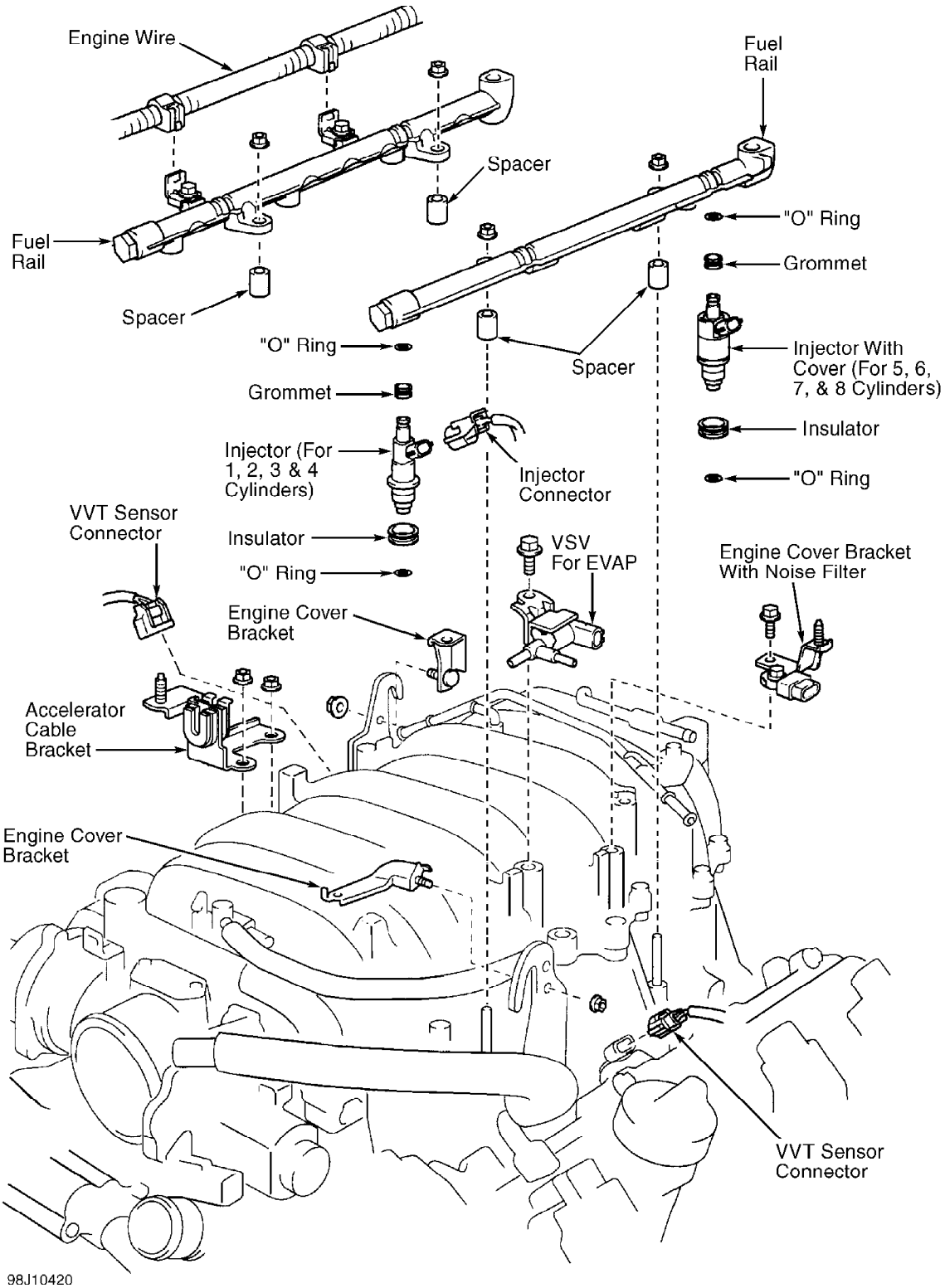


Fig. 41: Removing Fuel Rails (LS400 Shown; GS400 & SC400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LX470)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE.

Remove engine cover. Remove air intake hose with intake air connector located between throttle body and air cleaner assembly.

2) Remove fuel pressure pulsation damper with gaskets, and separate fuel supply hose from fuel rail. See Fig. 42.

3) Disconnect accelerator cable from accelerator cable clamp. Remove accelerator cable bracket and accelerator cable clamp. Remove engine cover brackets and EVAP Vacuum Switching Valve (VSV) from intake manifold. Disconnect PCV hose from PCV valve. Remove bolts and disconnect engine wiring harness protector from intake manifold.

4) Disconnect engine wiring harness clamp from engine hanger at front of intake manifold. Disconnect engine wiring harness clamps from brackets on passenger's side fuel rail. Remove fuel return pipe-to-fuel rail clamp bolt and separate clamp on fuel return pipe from rear of driver's side fuel rail.

5) Remove front fuel pipe clamp bolt from clamp at center of front fuel pipe. Remove front fuel pipe-to-fuel rail union bolt with gaskets, and remove front fuel pipe from front of both fuel rails. See Fig. 42. Note location of electrical connectors on fuel injectors for installation reference. Disconnect electrical connectors at fuel injectors.

6) Remove fuel rail-to-intake manifold nuts. Remove fuel rails and fuel injectors as an assembly from intake manifold. Note direction of spacer installation on intake manifold for installation reference. Remove spacers and insulators from intake manifold. Remove fuel injectors from fuel rail. Remove "O" ring and grommet from fuel injector.

Installation

1) Install NEW grommet on each fuel injector. Coat NEW "O" ring with gasoline and install "O" ring on each fuel injector. Use twisting motion when installing fuel injector on fuel rail. Position electrical connectors on fuel injectors toward outside of fuel rail. Ensure spacers and NEW insulators are installed on intake manifold.

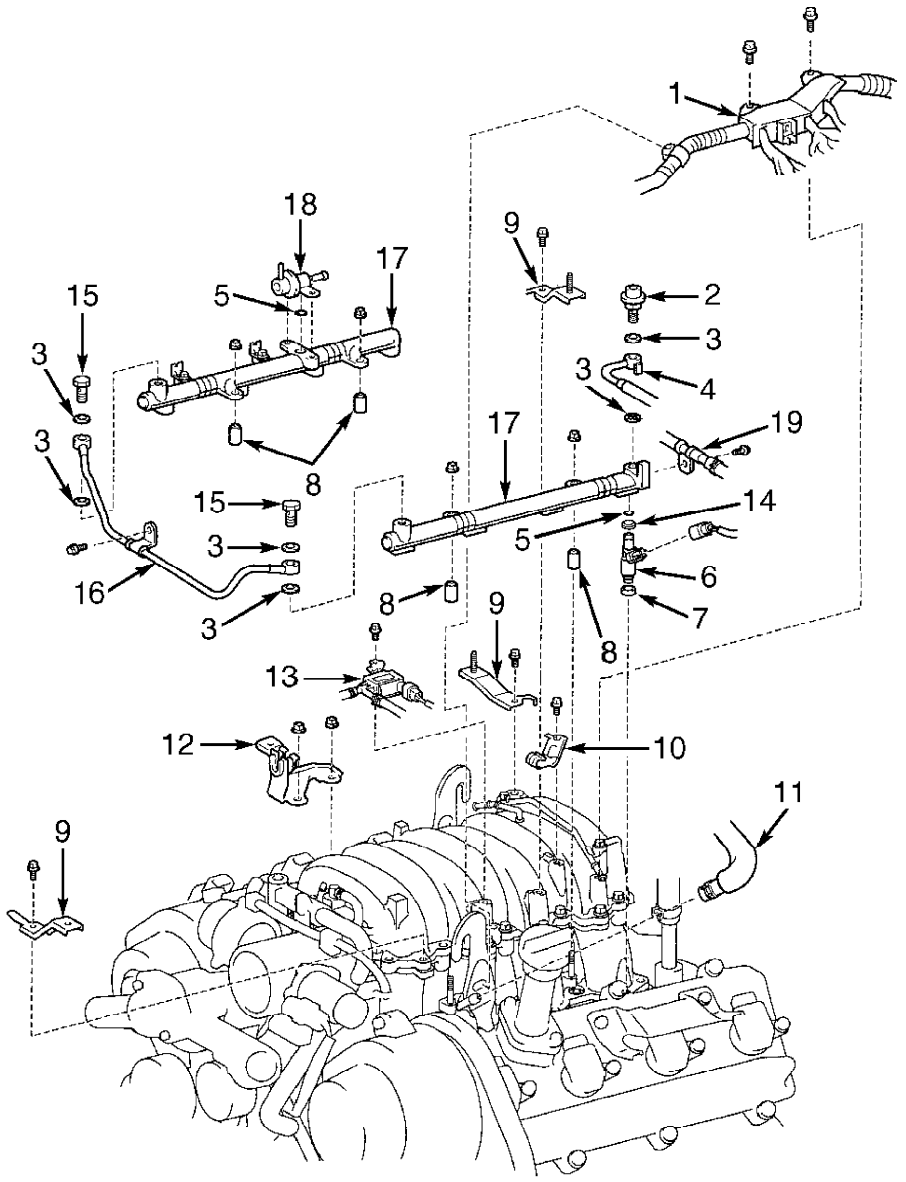
2) When installing fuel rails, install fuel rails with fuel injectors on intake manifold. Loosely install fuel rail-to-intake manifold nuts. Using NEW gaskets, install front fuel pipe and front fuel pipe-to-fuel rail union bolts on front of both fuel rails. Install front fuel pipe clamp bolt in clamp at center of front fuel pipe. Tighten front fuel pipe-to-fuel rail union bolts and front fuel pipe clamp bolt to specification. See TORQUE SPECIFICATIONS.

3) Install clamp and fuel return pipe-to-fuel rail clamp bolt on rear of driver's side fuel rail. Tighten fuel return pipe-to-fuel rail clamp bolt to specification. See TORQUE SPECIFICATIONS.

4) Ensure fuel injectors rotate smoothly. If fuel injectors fail to rotate smoothly, check for improper "O" ring installation. Ensure electrical connector on each fuel injector is facing toward outside of fuel rail.

5) Tighten fuel rail-to-intake manifold nuts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure. Use NEW gaskets when installing fuel pulsation damper.

6) Using a torque wrench and Steering Rack Wrench (09617-24011), tighten pulsation damper to specification. See TORQUE SPECIFICATIONS. Install negative battery cable. Operate fuel pump and check for fuel leaks.



1. Engine Wiring Harness Protector
2. Fuel Pulsation Damper
3. Gasket
4. Fuel Supply Hose
5. "O" Ring
6. Fuel Injector
7. Insulator
8. Spacer
9. Engine Cover Bracket
10. Accelerator Cable Clamp
11. PCV Hose
12. Accelerator Cable Bracket
13. EVAP VSV
14. Grommet
15. Front Fuel Pipe-To-Fuel Rail Union Bolt
16. Front Fuel Pipe
17. Fuel Rail
18. Fuel Pressure Regulator
19. Fuel Return Pipe

G99D52723

Fig. 42: Exploded View Of Fuel Rails & Components (LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (RX300)
1) Remove windshield wiper arm nuts and windshield wiper

arms. Remove hood-to-cowl top seal. See Fig. 15. Remove clips, driver's side and passenger's side ventilator louvers. Disconnect electrical connector for windshield wiper motor. Remove wiper motor with wiper link. Remove bolts from cowl top panel and remove panel.

2) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove engine cover. Remove air cleaner hose and resonator. Drain cooling system.

3) Remove air cleaner housing assembly. Disconnect accelerator cable. Disconnect ground cables and ground strap from air intake chamber. See Fig. 8. Disconnect power steering hose from No. 1 engine hanger.

4) Remove PCV hose from PCV valve at right cylinder head. Remove brake booster vacuum hose from air intake chamber. Disconnect 2 water by-pass hoses from throttle body. Remove air assist hose from throttle body. Disconnect EVAP purge hose from pipe on emission control valve set. Remove 2 vacuum hoses from ACIS vacuum tank. Remove engine wiring harness clamp from emission control valve set. Remove No. 1 engine hanger and throttle body bracket.

5) Disconnect any remaining vacuum hoses and electrical connectors necessary to remove air intake chamber. See Fig. 8. Remove air intake chamber assembly and gasket. Disconnect fuel injector connectors. Disconnect air assist pipe from bracket at fuel line. Remove air assist hoses from intake manifold.

6) Remove fuel pipe clamp from No. 1 fuel pipe at fuel inlet pipe. Perform STEP 1. See Fig. 16. Ensure area around No. 1 fuel pipe and fuel inlet pipe is clean. Depress both sides of retainer and pull No. 1 fuel pipe with disconnect fitting from fuel inlet pipe. Perform STEP 2. See Fig. 16.

7) Remove fuel rail bolts. Remove fuel rails together with injectors and fuel line. Remove spacers from intake manifold. Remove injectors from fuel rails. Remove "O" rings and grommets from injectors.

Installation

1) Install NEW "O" rings, insulators and grommets on injectors. Apply a light coat of gasoline to fuel injector "O" rings and fuel rails injector openings. Using a twisting motion, push injectors onto fuel rail. Ensure injectors are fully seated. Ensure injector connectors are positioned outward.

2) Place 4 fuel rail spacers in position on intake manifold. Apply a light coat of gasoline to intake manifold injector ports. Assemble fuel rails, fuel lines and injectors in position on intake manifold. Temporarily install 4 injector rail bolts. Temporarily install fuel line-to-intake manifold bolt. Ensure fuel injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly. Replace "O" rings.

3) Ensure injector connectors are positioned outward. Tighten fuel rail-to-intake manifold bolts to specification. See TORQUE SPECIFICATIONS. Tighten fuel line-to-intake manifold bolt. Align alignment marks (White paint) on fuel line. See Fig. 43. Install fuel line clamp to engine compartment fuel filter until a click is heard. Ensure fuel line clamp is installed securely.

4) Connect air assist hoses to intake manifold. Install air assist pipe. Connect injector connectors. Install NEW intake chamber assembly gasket. Install air cleaner hose with resonator. To complete installation, reverse removal procedure. Tighten all bolts to specification. See TORQUE SPECIFICATIONS. Turn ignition on. Start engine and check fuel system for leaks.

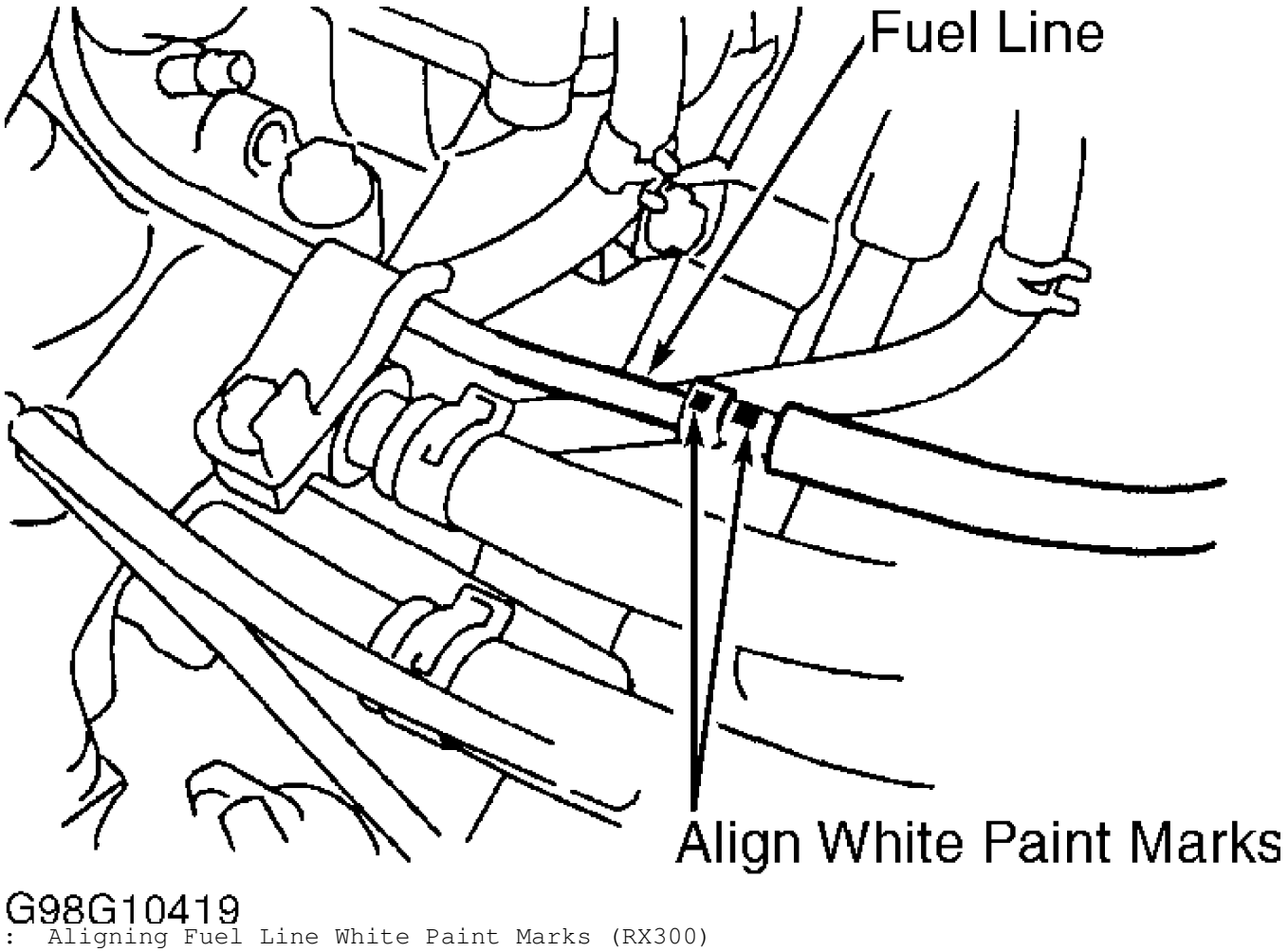


Fig. 43: Aligning Fuel Line White Paint Marks (RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (SC300)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove bolt from oil dipstick guide. Remove engine oil dipstick guide along with dipstick. Remove "O" ring from dipstick guide. Remove bolt from A/T oil dipstick guide. See Fig. 22. Pull out A/T oil dipstick guide and dipstick from A/T oil dipstick tube. Remove "O" ring from dipstick guide.

2) Remove bolt and disconnect engine wiring harness protector from air intake chamber. Disconnect brake booster vacuum hose from intake chamber. Remove brake booster union bolt, brake booster union and gaskets. Remove intake air connector-to-air intake chamber bolts and nuts.

3) Disconnect power steering air hose from air intake chamber. See Fig. 22. Remove vacuum hose from ACIS actuator. Remove vacuum hose from No. 2 vacuum pipe. Disconnect Data Link Connector (DLC) No. 1 from air intake chamber. Remove bolts, nuts, air intake chamber and gaskets. Remove bolt and accelerator cable clamp.

4) Place towel under fuel pipe. Remove fuel pressure pulsation damper and upper gasket. Remove fuel line-to-intake manifold bolt. Remove No. 2 vacuum pipe-to-intake manifold. Disconnect fuel line from fuel line support. Remove lower pulsation damper gasket.

5) Remove engine wiring harness protector-to-body bolt. Disconnect fuel injector connectors. Disconnect camshaft position sensor and throttle position sensor connectors. Disconnect EVAP and

ACIS vacuum switching valve connectors. Remove engine wiring harness protector from intake manifold.

6) Remove fuel rail with injectors. Remove injectors from fuel rail. Remove "O" rings, insulators and grommets from injectors. Remove spacers from intake manifold.

Installation

1) Install NEW brake booster union and intake chamber gaskets. Install NEW fuel pressure pulsation damper gasket. Install NEW "O" rings, insulators and grommets on injectors. Apply a light coat of gasoline to fuel injector "O" rings.

2) Apply a light coat of gasoline to fuel rail injector opening. Using a twisting motion, push injectors into fuel rail. Ensure injectors are fully seated in fuel rail. Ensure fuel injector connectors are positioned outward.

3) Install 3 spacers in position on intake manifold. Apply a light coat of gasoline to intake manifold injector ports. Place injectors and fuel rail assembly onto intake manifold. Temporarily install fuel rail-to-intake manifold bolts.

4) Ensure injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly. Replace "O" rings. Position injector connectors upward. Connect injector connectors. Injector connectors for cylinders No. 1, 3 and 5 are Dark Gray. Injector connectors for cylinders No. 2, 4 and 6 are Brown.

5) To complete installation, reverse removal procedure. Tighten fuel rail mounting bolts to specification. See TORQUE SPECIFICATIONS. Fill cooling system. Start engine and check for fuel and coolant leaks.

Removal (SC400)

1) Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE. Disconnect negative battery cable. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect accelerator cable. Remove EVAP vacuum switching valve. See Fig. 41.

2) Remove engine cover brackets. Disconnect brake booster vacuum hose and PCV hose from intake manifold. Disconnect fuel injector connectors. Disconnect left cylinder head ignition coil/ignitor connectors. Disconnect camshaft timing oil control valve connectors. Disconnect Variable Valve Timing (VVT) sensor connectors. See Fig. 41.

3) Disconnect camshaft position sensor connector. Disconnect engine wiring harness from wire clamp on left cylinder head valve cover and timing belt rear plate. Disconnect engine wiring harness from wire clamps on timing belt cover. Disconnect engine wiring harness protector and wire clamp bracket from intake manifold and left front bearing cap. Place a towel under fuel line. Slowly loosen fuel pressure pulsation damper. Remove fuel pressure pulsation dampers and gaskets.

4) Disconnect wiring harness clamps from wire clamp bracket on right fuel rail. Remove accelerator cable bracket. Remove fuel rail-to-intake manifold nuts. Remove fuel rails and injectors as an assembly. See Fig. 41. Remove injectors from fuel rail. Remove "O" rings, grommets and insulators from injectors.

Installation

1) Install NEW upper and lower fuel pressure pulsation damper gaskets. Install NEW "O" rings, insulators and grommets on injectors. Apply a light coat of gasoline to fuel injector "O" rings. Using a twisting motion, push injectors into fuel rail.

2) Ensure injectors are fully seated in fuel rail. Ensure fuel injector connectors are positioned outward. Install 4 spacers in position on intake manifold. Place injectors and fuel rail assembly

onto intake manifold. Temporarily install fuel rail-to-intake manifold nuts.

3) Ensure injectors rotate smoothly. If injectors do not rotate smoothly, "O" rings were installed incorrectly and may be pinched. Replace "O" rings. Position injector connectors outward. Tighten fuel rail-to-intake manifold nuts. Connect fuel injector connectors.

4) To complete installation, reverse removal procedure. Tighten fuel rail mounting nuts to specification. See TORQUE SPECIFICATIONS. Start engine and inspect for fuel leaks.

FUEL PUMP SWITCH

NOTE: Fuel pump switch may also be referred to as fuel pump inertia switch or fuel pump control switch.

Removal & Installation (LX470)

Fuel pump switch is located on driver's side, under front carpet, next to front console box and contains a reset switch. See Fig. 44. Remove carpet and disconnect electrical connector at fuel pump switch. Remove bolts and fuel pump switch. To install, reverse removal procedure. Ensure reset switch is in ON position for fuel pump operation.

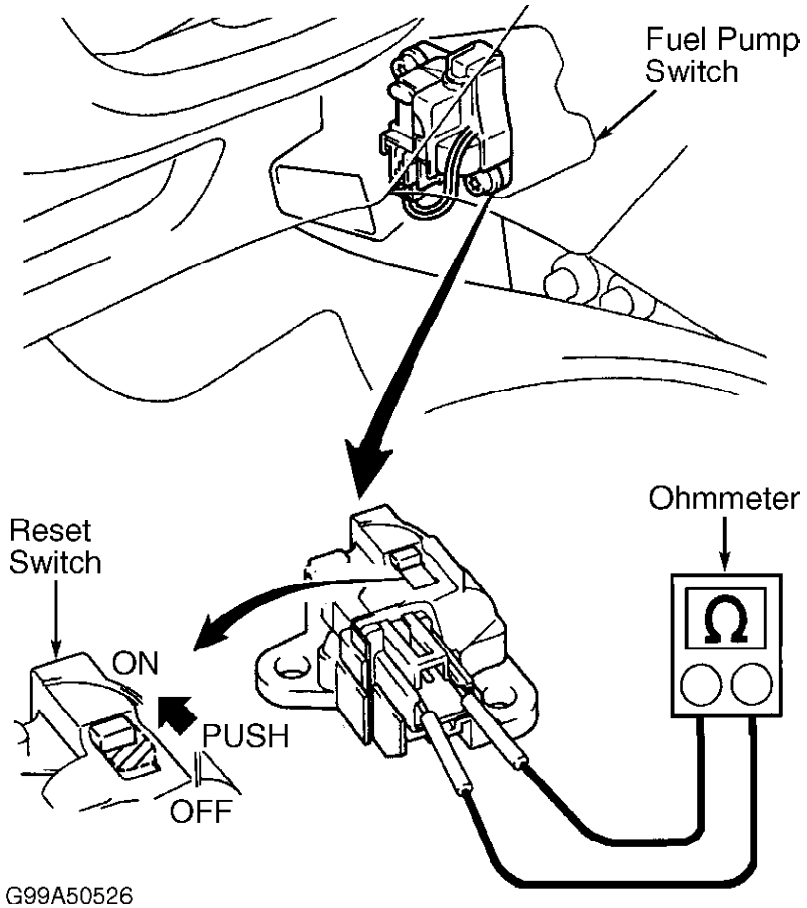


Fig. 44: Locating Fuel Pump Switch & Identifying Reset Switch Positions
Courtesy of Toyota Motor Sales, U.S.A., Inc.

THROTTLE BODY

NOTE: On ES300 and RX300, No. 1 throttle body, No. 2 throttle body and No. 1 air intake air control valve are removed as an assembly. See Fig. 45. No. 1 air intake air control valve may also be referred to as No. 3 throttle body.

Removal (ES300 & RX300)

Disconnect negative battery cable. Drain cooling system. Remove engine cover. Disconnect throttle cable from throttle linkage. Disconnect PCV hose. Remove air cleaner hoses with resonator. Disconnect Throttle Position (TP) sensor. Disconnect Idle Air Control (IAC) valve connector. Disconnect water by-pass hose from intake manifold and from water inlet housing. Disconnect air assist hose. Disconnect fuel vapor hose from emission control valve set. Disconnect vacuum hoses as necessary. Remove throttle body and gasket.

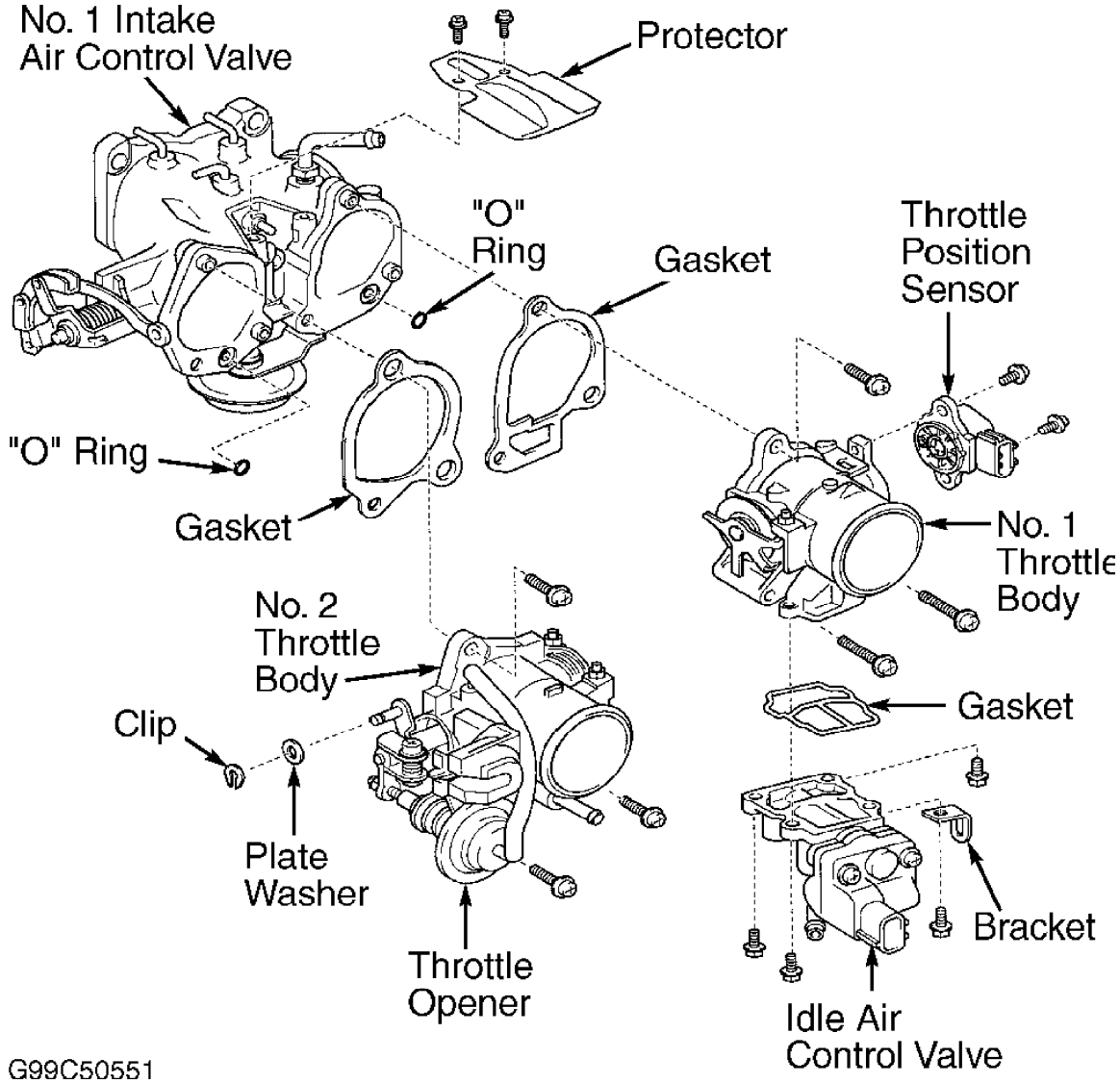


Fig. 45: Exploded View Of Throttle Body & Components (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly

1) If necessary to remove Throttle Position (TP) sensor,

remove TP sensor retaining screws and TP sensor from throttle body. See Fig. 45.

2) If necessary to remove Idle Air Control (IAC) valve, remove IAC valve retaining screws, bracket, IAC valve and gasket. If necessary to replace throttle bodies, remove protector, clip and plate washer. Disconnect accelerator link. Remove 6 throttle body retaining screws, No. 1 throttle body, No. 2 throttle body and 2 gaskets from No. 1 intake air control valve.

Reassembly

To install TP sensor, ensure throttle valve is fully closed. Place TP sensor on throttle body with TP sensor turned clockwise 30-60 degrees against the fully closed throttle valve. Turn sensor clockwise until TP sensor mounting holes line up with throttle body mounting holes. Install and tighten TP sensor retaining screws. To install IAC valve, use a NEW IAC valve gasket. Position IAC valve on throttle body. Install and tighten IAC valve screws.

Installation

Using compressed air, clean all passages. Clean throttle body gasket surfaces. Install NEW gaskets, "O" rings and throttle bodies. See Fig. 45. Tighten throttle body screws to specification. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Fill cooling system with proper mix of water and coolant.

Removal (GS300 & SC300)

1) Disconnect negative battery cable. Drain cooling system. Remove intake air resonator. Disconnect accelerator cable from throttle linkage. Disconnect throttle position sensor connector. Remove throttle control motor and accelerator pedal position sensor connectors. Remove engine wiring harness clamp from clamp bracket of throttle body.

2) Remove throttle body bolts and nuts. Slightly slide throttle body away from intake air connector. DO NOT handle throttle body by throttle motor. Disconnect water by-pass hoses from throttle body and remove throttle body.

Disassembly

1) If necessary to remove Throttle Position (TP) sensor, remove retaining screws and TP sensor from throttle body. See Fig. 46.

2) If necessary to remove throttle control motor, ensure Throttle Position (TP) sensor is removed from throttle body. Disconnect electrical connector for throttle control motor from wiring bracket. See Fig. 46. Remove retaining screws and cover to access throttle control motor. Remove retaining screws and throttle control motor from throttle body.

3) If necessary to remove accelerator pedal position sensor, using small screwdriver, bend tabs on washer plate away from retaining screws for accelerator pedal position sensor. See Fig. 46. Remove retaining screws, washer plate and accelerator pedal position sensor from throttle body.

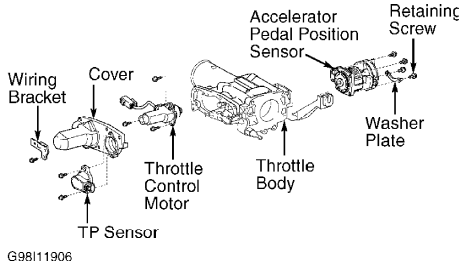


Fig. 46: Exploded View Of Throttle Body & Components (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) To install accelerator pedal position sensor, install accelerator pedal position sensor, washer plate and retaining screws on throttle body. Tighten retaining screws to specification in sequence. See Fig. 47. See TORQUE SPECIFICATIONS. Bend tabs on washer plate against retaining screws. See Fig. 47.

2) To check accelerator pedal position sensor operation after installation on throttle body, install electrical connector on accelerator pedal position sensor.

3) Connect scan tool to Data Link Connector (DLC) No. 3 located under left side of instrument panel. Turn ignition on. DO NOT depress accelerator pedal after ignition is turned on. Using scan tool, check that ACCEL POS#1 (VPA) voltage of the CURRENT DATA is .3-.9 volt. This is the standard accelerator pedal position sensor voltage. Turn ignition off. Disconnect electrical connector for accelerator pedal position sensor.

4) To install throttle control motor, ensure all gears on throttle control motor and throttle body are clean. Apply thin coat of grease on the entire surface of the gear teeth on the throttle body. Install throttle control motor on throttle body. Ensure holes on throttle control motor align with pins on throttle body.

5) Rotate throttle control motor clockwise and install retaining screw "A". See Fig. 48. Ensure throttle control motor is tight against the pins on throttle body. Install remaining retaining screws in throttle control motor. Tighten retaining screws to specification. See TORQUE SPECIFICATIONS.

6) Install cover and retaining screws. Ensure grommet on throttle control motor is not pinched. Tighten cover retaining screws to specification. See TORQUE SPECIFICATIONS. Reinstall electrical connector for throttle control motor on wiring bracket.

7) To install TP sensor, ensure throttle valve opening on throttle body is about 3.5 degrees. Install TP sensor on throttle body so it is at position No. 1 (30 degrees). See Fig. 49. Rotate TP sensor counterclockwise to position No. 2 until it contacts throttle valve. See Fig. 49. Install retaining screws.

8) To check TP sensor adjustment, reinstall electrical connector on TP sensor. Connect scan tool to Data Link Connector (DLC) No. 3 under left side of instrument panel. Turn ignition on.

NOTE: Ensure accelerator pedal is not depressed after turning ignition on when adjusting TP sensor.

9) Use scan tool to read throttle valve opening which is displayed as a percentage. Throttle valve opening may be read by accessing THROTTLE POS under CURRENT DATA on scan tool.

10) While reading throttle valve opening, rotate TP sensor counterclockwise (toward throttle control motor on throttle body) until throttle valve opening is 15.6 percent, as this is the center of the standard throttle valve opening of 14.4-16.8 percent. Tighten TP sensor retaining screws to specification. See TORQUE SPECIFICATIONS.

NOTE: When TP sensor retaining screws are tightened, this may cause the throttle valve opening to change. Ensure throttle valve opening remains at 15.6 percent after TP sensor retaining screws are tightened. Readjust TP sensor if necessary.

11) Using screwdriver, fully close throttle valve on throttle body. Use scan tool to read throttle valve opening by accessing THROTTLE POS under CURRENT DATA on scan tool. With throttle valve fully closed, throttle valve opening should be 10-14 percent.

12) If throttle valve opening is not within specification with throttle valve fully closed, repeat steps 9) through 11) until

correct throttle valve opening is obtained. Turn ignition off. Remove scan tool.

Installation

To install, reverse removal procedure using NEW gaskets. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. If using original hose clamps on water by-pass hoses, install hose clamps as illustrated. See Fig. 50. Fill cooling system.

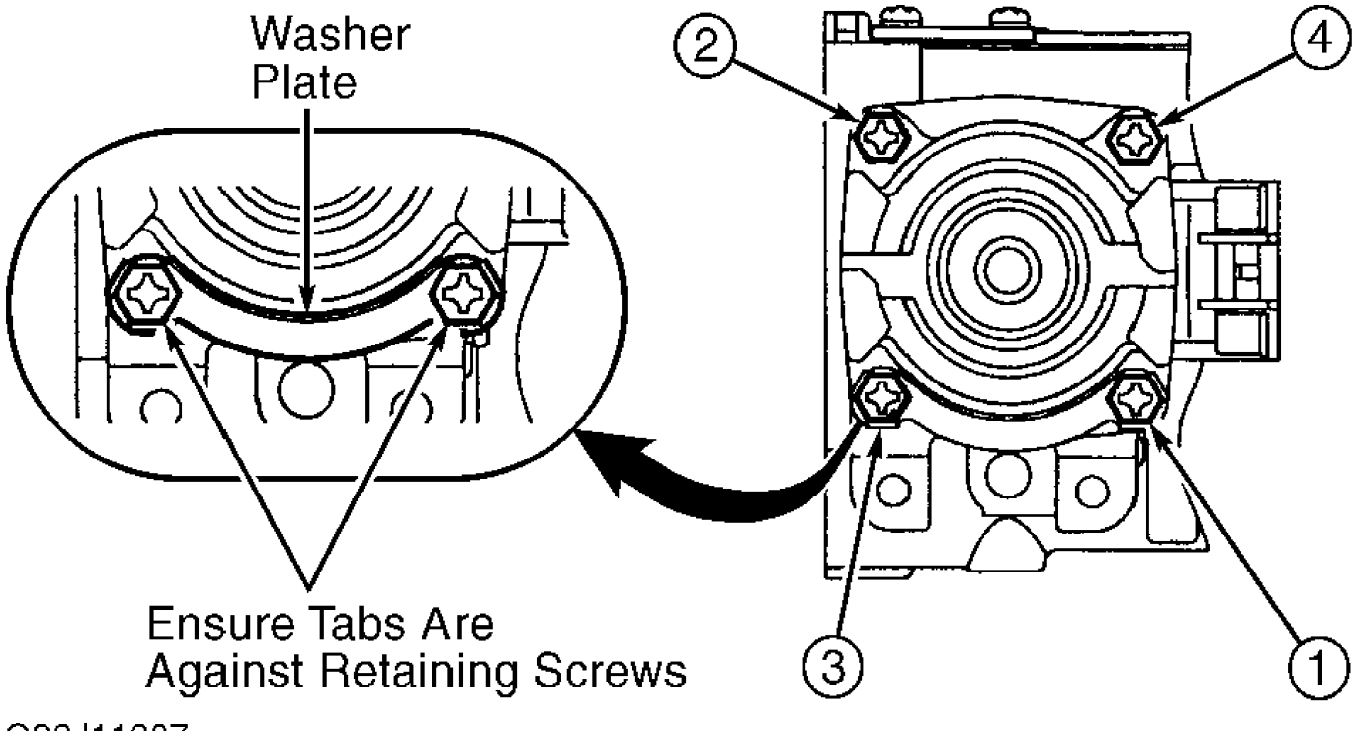


Fig. 47: Accelerator Position Sensor Retaining Screw Installation Sequence & Positioning Of Tabs On Washer Plate (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

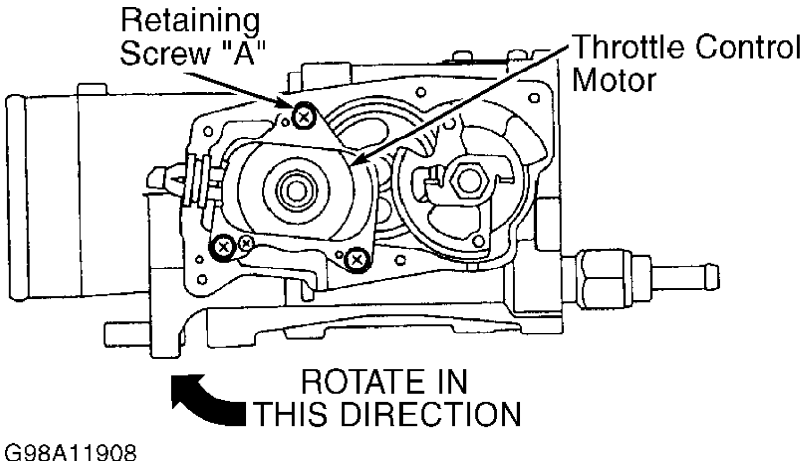


Fig. 48: Rotating Throttle Control Motor & Installing Retaining Screw "A" (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

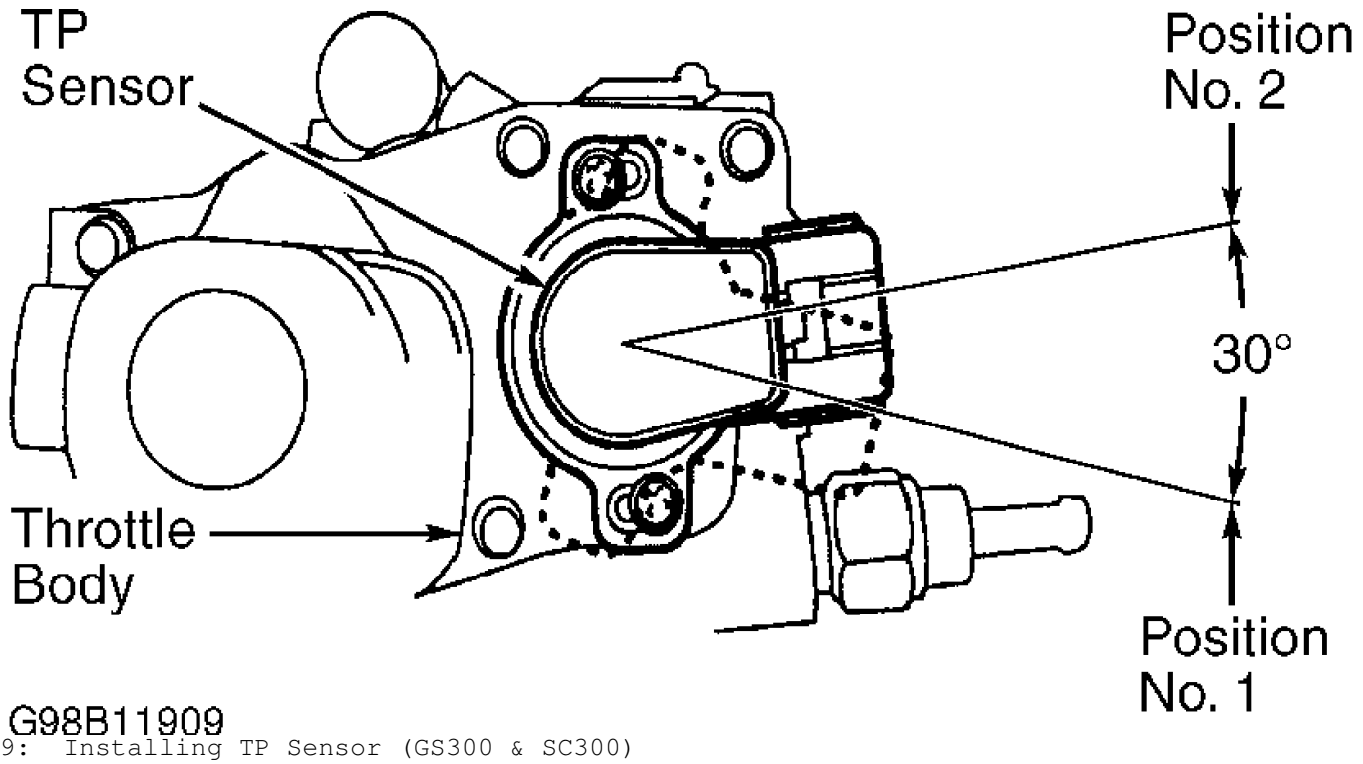


Fig. 49: Installing TP Sensor (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

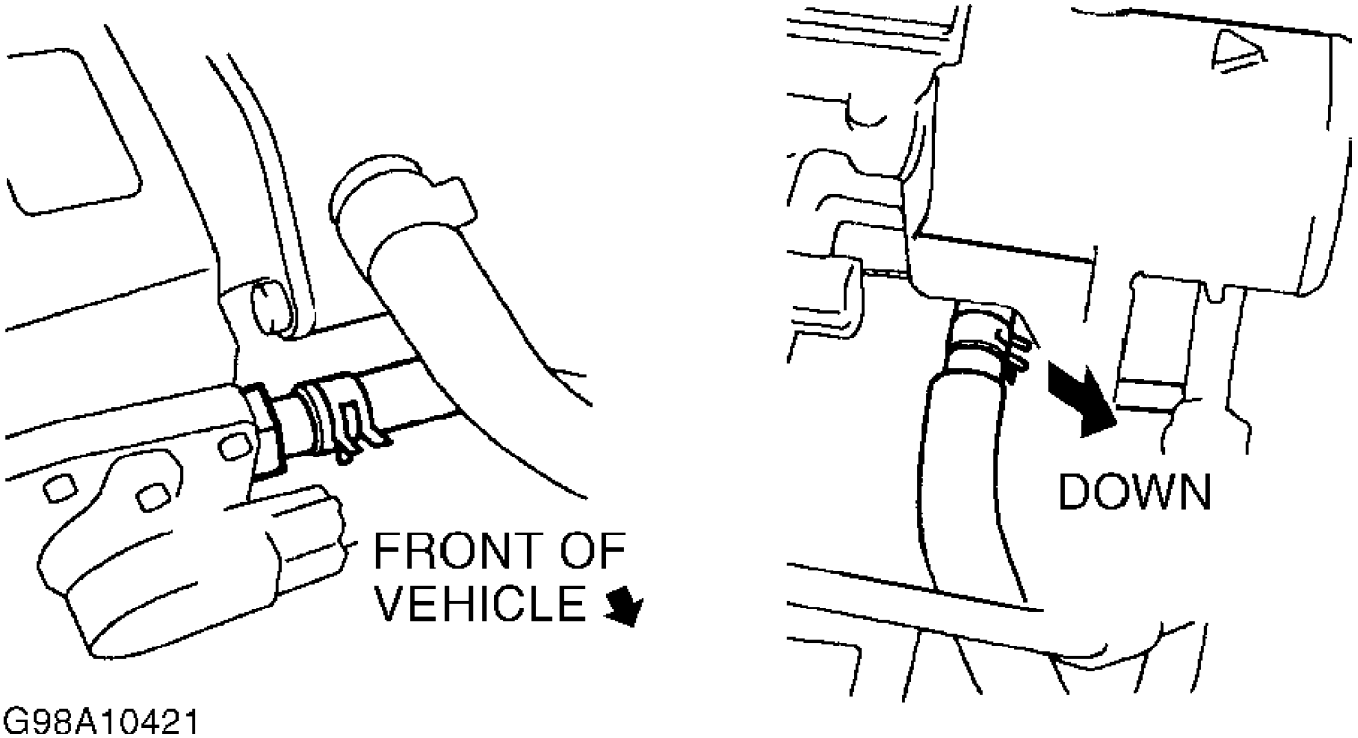


Fig. 50: Identifying Water By-Pass Hose Clamp Positions (GS300 & SC300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS400, LS400 & SC400)

1) Remove engine cover. Disconnect negative battery cable. Drain cooling system. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect accelerator cable from throttle body. Disconnect accelerator pedal position sensor connector. Disconnect throttle position sensor connector. Disconnect throttle control motor connector.

2) Disconnect throttle control motor wire from clamps on wire brackets. Disconnect water by-pass hoses from throttle body. Remove bolts/nuts and throttle body from intake manifold. Remove throttle body and gasket.

Disassembly

1) If necessary to remove Throttle Position (TP) sensor, remove TP sensor retaining screws and TP sensor from throttle body. See Fig. 51.

2) If necessary to remove throttle control motor, ensure TP sensor is removed from throttle body. Disconnect throttle control motor electrical connector from connector bracket. See Fig. 51.

3) Remove throttle control motor cover-to-throttle body retaining screws from outside of throttle control motor cover. Remove throttle control motor cover with throttle control motor from throttle body.

4) Remove throttle control motor-to-throttle control motor cover screws from inside of throttle control motor cover. Remove throttle control motor and wave washer from throttle control motor cover.

5) If necessary to remove accelerator pedal position sensor, remove retaining screws and accelerator pedal position sensor from throttle body. See Fig. 51.

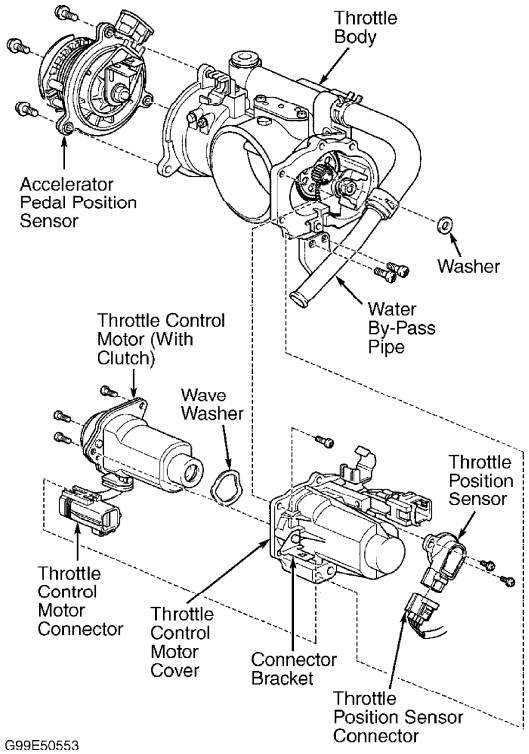


Fig. 51: Exploded View Of Throttle Body & Components (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly

1) To install accelerator pedal position sensor, ensure throttle valve opening on throttle body is about 4 degrees. Install accelerator pedal position sensor on throttle body so it is at position No. 1 (20 degrees). See Fig. 52.

2) Rotate accelerator pedal position sensor clockwise to position No. 2 until it contacts throttle valve. See Fig. 52. Install and tighten retaining screws to specification. See TORQUE SPECIFICATIONS.

3) To check accelerator pedal position sensor operation after installation on throttle body, install electrical connector on accelerator pedal position sensor. Connect scan tool to Data Link Connector (DLC) No. 3 under left side of instrument panel.

4) Turn ignition on. DO NOT depress accelerator pedal after ignition is turned on. Using scan tool, check that ACCEL POS#1 (VPA) voltage of the CURRENT DATA is .35-.85 volt. This is the standard accelerator pedal position sensor voltage. Turn ignition off. Disconnect electrical connector for accelerator pedal position sensor.

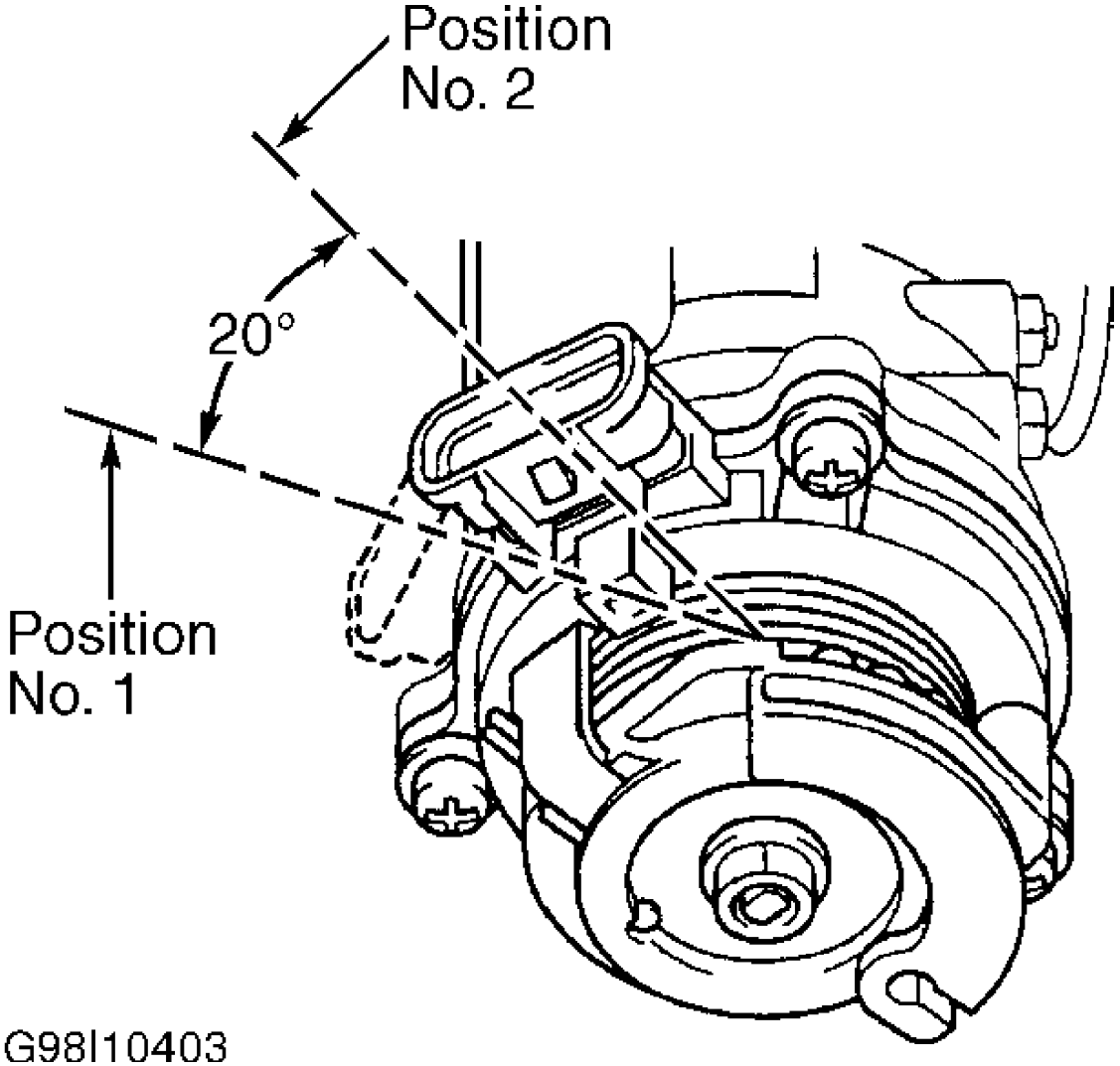


Fig. 52: Installing Accelerator Pedal Position Sensor GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CAUTION: When installing throttle control motor in throttle control

motor cover, ensure holes on throttle control motor align with pins on throttle control motor cover.

5) To install throttle control motor, install wave washer in throttle control motor cover. Install throttle control motor in throttle control motor cover so that holes on throttle control motor align with pins on throttle control motor cover. Ensure grommet around wire for throttle control motor engages throttle control motor cover. See Fig. 51.

6) Install and tighten throttle control motor-to-throttle control motor cover screws to specification. See TORQUE SPECIFICATIONS. Ensure all gears on throttle control motor and throttle body are clean. Apply thin coat of grease on entire surface of gear teeth on the throttle body.

CAUTION: Ensure washer is installed on gear on throttle body before installing throttle control motor. See Fig. 51.

7) Install washer on gear on throttle body. See Fig. 51. Install throttle control motor cover with throttle control motor on throttle body. Ensure holes on throttle control motor cover align with pins on throttle body.

8) Install and tighten throttle control motor cover-to-throttle body retaining screws to specification. See TORQUE SPECIFICATIONS. Reinstall throttle control motor electrical connector on connector bracket. Reinstall and adjust TP sensor.

9) To install TP sensor, ensure throttle valve opening on throttle body is about 4 degrees. Install TP sensor on throttle body so it is at position No. 1 (15 degrees). See Fig. 53. Rotate TP sensor counterclockwise to position No. 2 until it contacts throttle valve. See Fig. 53. Loosely install TP sensor retaining screws.

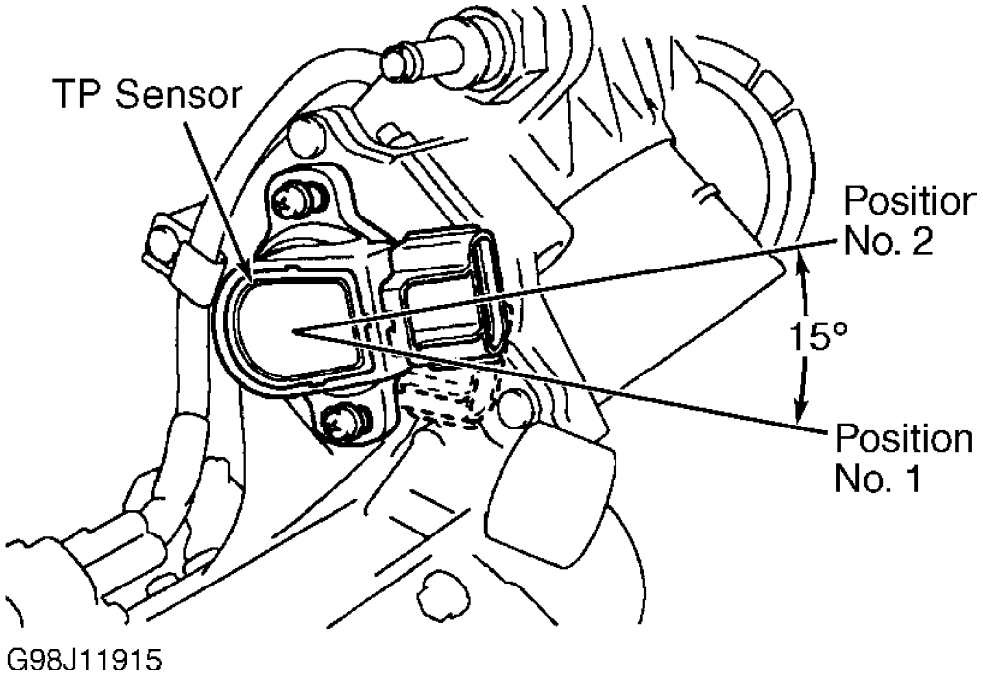


Fig. 53: Installing TP Sensor (GS400, LS400, LX470 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: Ensure electrical connector is not installed on accelerator pedal position sensor when checking TP sensor adjustment.

10) To check TP sensor adjustment after installation on throttle body, install electrical connector on TP sensor. Ensure electrical connector is NOT installed on accelerator pedal position sensor. Connect scan tool to data link connector No. 3 under left side of instrument panel. Turn ignition on.

NOTE: Ensure accelerator pedal is not depressed after turning ignition on when adjusting TP sensor.

11) Use scan tool to read throttle valve opening which is displayed as a percentage. Throttle valve opening may be read by accessing THROTTLE POS under CURRENT DATA on scan tool.

12) While reading throttle valve opening, rotate TP sensor clockwise and counterclockwise until throttle valve opening is 15.2 percent, as this is the center of the standard throttle valve opening of 14.4-16.0 percent. Tighten TP sensor retaining screws to specification. See TORQUE SPECIFICATIONS. When TP sensor retaining screws are tightened, this may cause the throttle valve opening to change. Ensure throttle valve opening remains at 15.2 percent after TP sensor retaining screws are tightened. Readjust TP sensor if necessary.

13) Ensure throttle valve on throttle body is fully closed. Use scan tool to read throttle valve opening by accessing THROTTLE POS under CURRENT DATA on scan tool. With throttle valve fully closed, throttle valve opening should be 10-14 percent.

14) If throttle valve opening is not within specification with throttle valve fully closed, repeat steps 11) through 13) until correct throttle valve opening is obtained. Turn ignition off. Remove scan tool. Disconnect electrical connector at TP sensor.

Installation

To install, reverse removal procedure using NEW throttle body gasket. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

IDLE AIR CONTROL (IAC) VALVE

ES300 & RX300

If IAC valve replacement is necessary, remove throttle body. See THROTTLE BODY.

AIR INDUCTION SYSTEM

INTAKE AIR CONTROL VALVE

NOTE: Intake Air Control (IAC) valve is used on Acoustic Control Induction System (ACIS).

Removal (ES300 & RX300)

Disconnect negative battery cable. Remove No. 1 Intake Air Control (IAC) valve. See THROTTLE BODY under FUEL SYSTEM. Disconnect vacuum hose from No. 2 IAC valve located on end of air intake chamber. See Fig. 54. On ES300, remove Data Link Connector (DLC) No. 1 and bracket. On all models, disconnect ground strap and ground cable from IAC valve. Remove remaining IAC valve retaining nuts. Remove IAC valve by prying between air intake chamber and IAC valve. Remove gasket.

Installation

To install, reverse removal procedure using NEW IAC valve gasket. Apply Seal Packing (08826-00080) at designated areas of IAC valve. See Fig. 55. Apply a light coat of engine oil at rubber area on

IAC valve before installing. Tighten nuts to specification. See TORQUE SPECIFICATIONS.

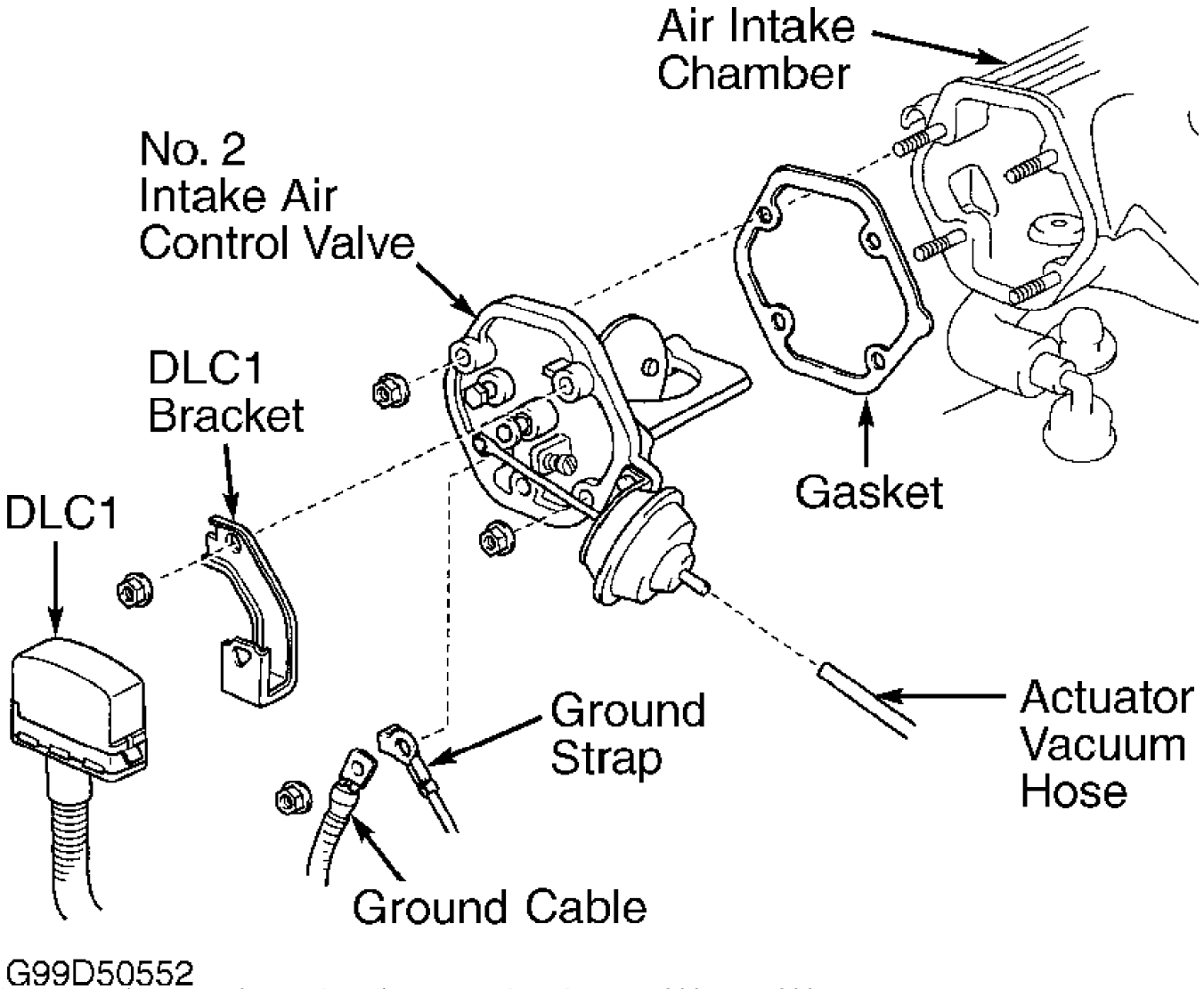


Fig. 54: Removing No. 2 Intake Air Control Valve (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

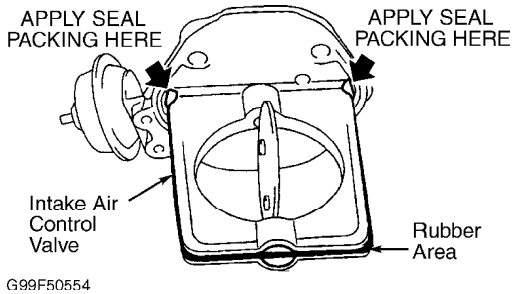


Fig. 55: Identifying Seal Packing Application Areas & Rubber Area On Intake Air Control Valve (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (GS300)

1) Intake Air Control (IAC) valve is mounted underneath middle of air intake chamber. See Fig. 21. Remove A/T oil dipstick and guide. Disconnect negative battery cable. Disconnect noise filter connector. See Fig. 21. Disconnect engine wire clamp from bracket. Remove bolt, bracket and noise filter. Remove bolts, nuts and intake air connector to air intake chamber.

2) Disconnect power steering air hose, vacuum hose from No. 2 vacuum pipe, and vacuum hose from Intake Air Control (IAC) valve actuator. See Fig. 21. Disconnect accelerator cable. Remove bolt and accelerator cable clamp. Disconnect EVAP hose, bolt and clamp. Remove air intake chamber and gaskets. Remove IAC valve from air intake chamber.

3) If servicing vacuum tank or ACIS vacuum switching valve, remove vacuum tank from intake manifold. Disconnect ACIS vacuum switching valve connector. Disconnect vacuum hoses from air intake chamber, vacuum tank and vacuum switching valve. Remove ACIS vacuum switching valve from vacuum tank.

Installation

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

Removal (GS400)

1) Intake Air Control (IAC) valve is bolted to underside of upper intake manifold. Remove air cleaner assembly. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM. Disconnect fuel inlet hose. See Fig. 11.

2) Disconnect EVAP vacuum switching valve connector. Remove PCV hose from upper intake manifold. Disconnect EVAP vacuum switching valve vacuum hose. Remove EVAP air inlet hose from air tube. Remove No. 2 engine cover bracket from engine hanger. See Fig. 11. Remove EVAP vacuum switching valve from upper intake manifold.

3) Remove accelerator cable clamp from upper intake manifold. Remove No. 3 engine cover bracket from upper intake manifold. Remove 4 bolts and left wiring harness protector from upper intake manifold and camshaft bearing cap. Disconnect wire clamps on right engine wire from brackets on right fuel rail. Remove bolts and disconnect rear engine wiring harness protector from rear water by-pass joint and right cylinder head.

4) Disconnect ACIS vacuum switching valve connector. Disconnect upper intake manifold ground strap. Remove power steering hose from upper intake manifold. Remove ACIS connector bracket from upper intake manifold. Remove accelerator cable bracket from upper intake manifold. Disconnect injector connectors. Remove upper intake manifold and lower intake manifold as an assembly. Remove intake manifold gaskets.

5) Disconnect vacuum hose from ACIS vacuum switching valve. Disconnect vacuum hose from vacuum tank. Remove nuts, vacuum tank and ACIS vacuum switching valve assembly from lower intake manifold. Remove vacuum hose, screw and ACIS vacuum switching valve from vacuum tank.

6) Remove vacuum hose, nuts, intake air control valve actuator and gasket from upper intake manifold. Separate upper and lower intake manifolds. Remove IAC valve from upper intake manifold. See Fig. 56.

Installation

1) To install, reverse removal procedure. Install NEW IAC valve actuator gasket. Slightly rotate actuator lever clockwise. See Fig. 57. Connect actuator and air control valve levers. Install IAC valve.

2) Install NEW intake manifold gaskets with White mark facing

upward. Marks are painted on outer tabs of gasket. Ensure longer intake manifold bolts are installed in proper location. See Fig. 58. Ensure to route IAC valve actuator vacuum hose under rear fuel line when reconnecting. Tighten all nuts/bolts to specification. See TORQUE SPECIFICATIONS.

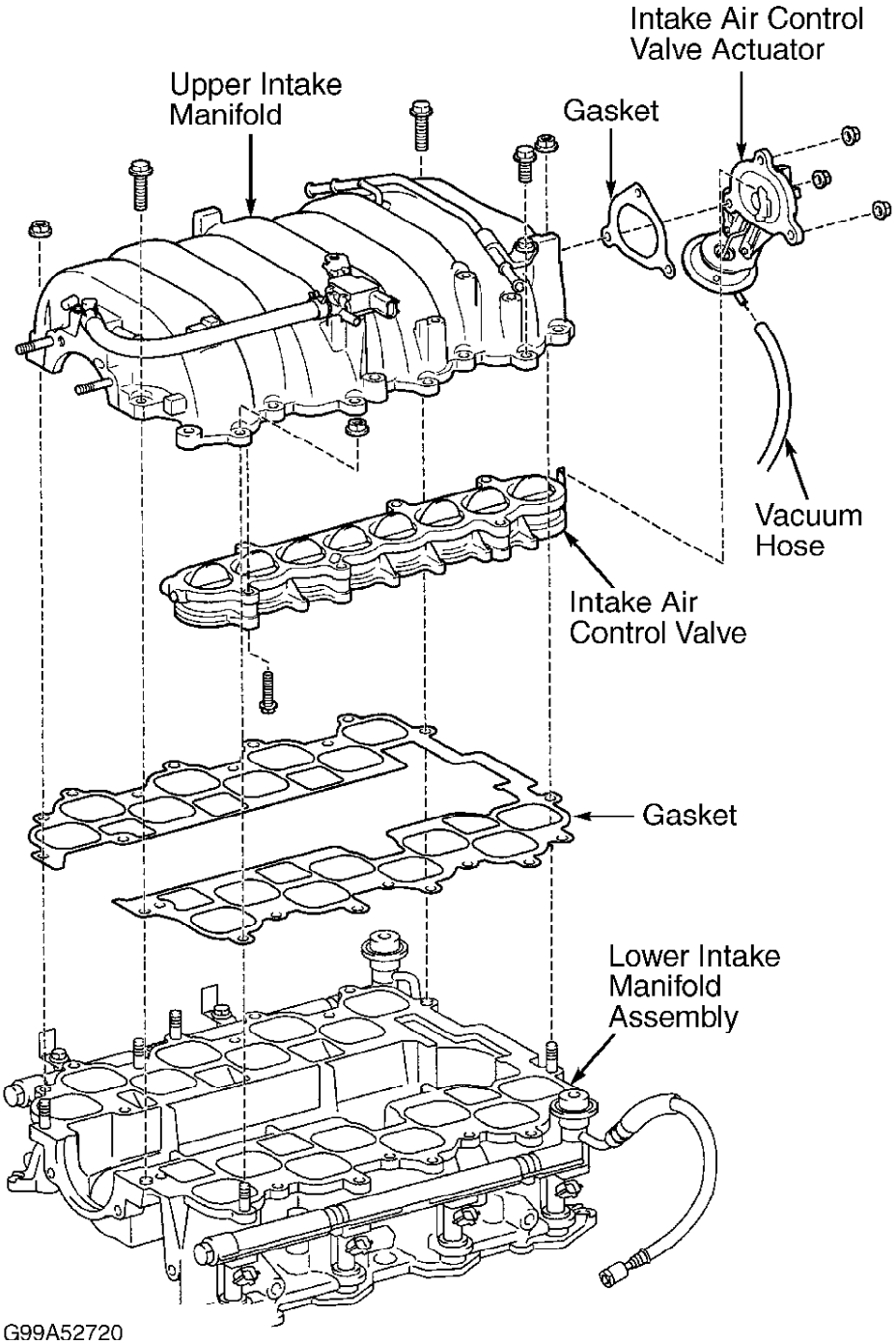


Fig. 56: Identifying Intake Air Control Valve (GS400 Shown; LS400 & SC400 Are Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

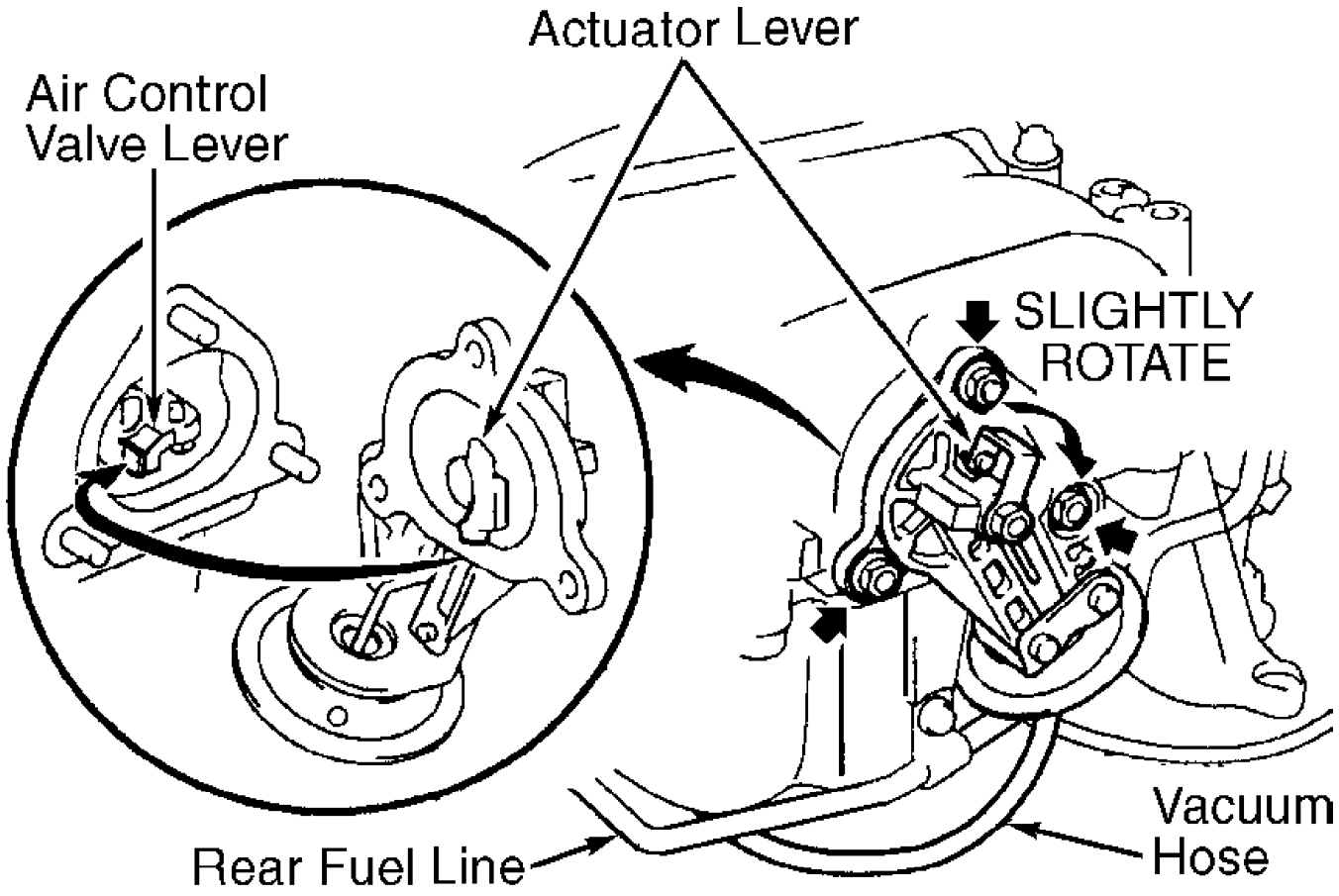


Fig. 57: Installing Air Control Valve Actuator Lever (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

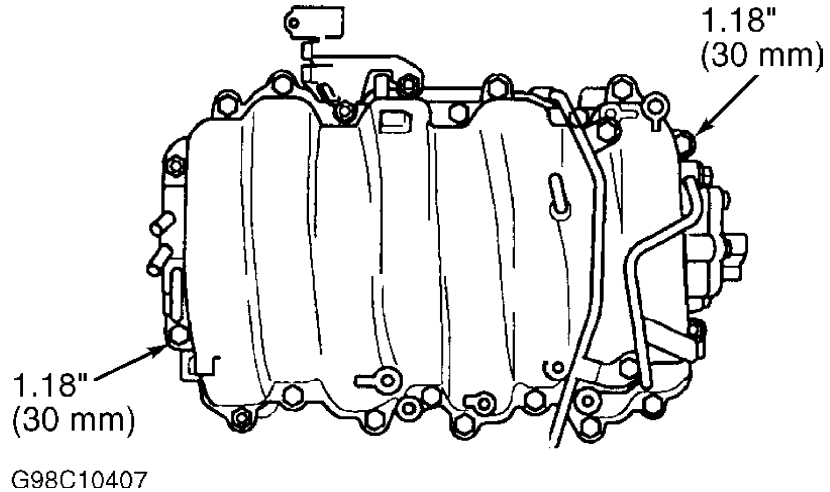


Fig. 58: Installing Intake Manifold Bolts (GS400, LS400 & SC400)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal (LS400)
1) Intake Air Control (IAC) valve is bolted to underside of

upper intake manifold. Remove engine cover. Remove battery cover, air cleaner inlet and intake air connector. Release fuel pressure. See FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM.

2) Disconnect fuel inlet hose. Remove throttle body from intake manifolds. See THROTTLE BODY under FUEL SYSTEM. Disconnect accelerator cable. Disconnect throttle position sensor connector. See Fig. 12. Disconnect accelerator pedal position sensor and throttle motor connectors.

3) Disconnect EVAP and ACIS vacuum switching valve connectors. Disconnect fuel injector connectors. Disconnect noise filter connector. Disconnect brake booster vacuum hose from union on intake manifold. Disconnect PCV hose from PCV valve. Disconnect EVAP hose from EVAP pipe. Disconnect EVAP vacuum switching valve hose. Disconnect power steering air hose from intake manifold.

4) Remove EVAP pipe from intake manifold. Remove accelerator cable bracket. Remove engine cover brackets. Remove EVAP vacuum switching valve. Disconnect wiring harness clamps from wire clamp bracket on right fuel rail.

5) Remove bolts and disconnect engine wiring harness protector from rear water by-pass joint and right cylinder head. Remove bolts and disconnect engine wiring harness protector and wire clamp bracket from intake manifold. Remove upper and lower intake manifolds as an assembly.

6) Disconnect vacuum hose from ACIS actuator. Remove bolts, and disconnect ACIS vacuum switching valve connector from upper intake manifold. Remove nuts, bolts, accelerator cable bracket and engine cover bracket. Separate upper and lower intake manifold, and remove gasket. Remove IAC valve from upper intake manifold. See Fig. 56.

Installation

1) To install, reverse removal procedure. Install NEW IAC valve actuator gasket. Slightly rotate actuator lever clockwise. See Fig. 57. Connect actuator and air control valve levers. Install IAC valve.

2) Install NEW intake manifold gaskets with White mark facing upward. Marks are painted on outer tabs of gasket. Ensure longer intake manifold bolts are installed in proper location. See Fig. 58. Ensure to route IAC valve actuator vacuum hose under rear fuel line when reconnecting. Tighten all nuts/bolts to specification. See TORQUE SPECIFICATIONS.

Removal (SC300)

1) Intake Air Control (IAC) valve is mounted underneath middle of air intake chamber. See Fig. 22. Remove engine oil dipstick. Remove bolt and A/T oil dipstick and guide. Remove A/T oil dipstick guide "O" ring. Remove bolt and disconnect engine wiring harness protector from air intake chamber. Disconnect brake booster vacuum hose from intake chamber. Remove union bolt, brake booster union and gaskets.

2) Remove intake air connector-to-air intake chamber bolts and nuts. Disconnect Power Steering (PS) hose and No. 2 vacuum pipe hose from air intake chamber. Disconnect Intake Air Control (IAC) valve (ACIS actuator) hose. See Fig. 22. Disconnect Data Link Connector (DLC) No. 1 from air intake chamber. Remove bolts, nuts, air intake chamber and gaskets. Remove IAC valve.

3) If servicing vacuum tank or ACIS vacuum switching valve, remove bolt and accelerator cable clamp. Disconnect ACIS vacuum switching valve connector. Disconnect vacuum hoses from vacuum tank and remove ACIS vacuum switching valve. Remove nuts and vacuum tank from intake manifold.

Installation

To install, reverse removal procedure. Install NEW A/T oil

dipstick and guide "O" ring. Install NEW brake booster union and air intake chamber gaskets. Tighten all bolts and nuts to specification. See TORQUE SPECIFICATIONS.

Removal (SC400)

1) Intake Air Control (IAC) valve is bolted to underside of upper intake manifold. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM.

2) Disconnect EVAP and ACIS vacuum switching valve connectors. Disconnect fuel injector connectors. Disconnect noise filter and camshaft timing oil control valve connectors. Disconnect brake booster vacuum hose. Disconnect PCV hose from PCV valve.

3) Disconnect EVAP vacuum switching valve hose. Disconnect power steering air hose from intake manifold. See Fig. 12. Disconnect rear water by-pass joint heater hose. Disconnect water by-pass pipe heater hose. Disconnect vacuum hose from heater water valve vacuum switching valve.

4) Disconnect water by-pass hoses from throttle body. Disconnect wire clamp from throttle body. Disconnect wire clamps from throttle body. Remove accelerator cable bracket. Remove engine cover brackets. Disconnect 2 wire clamps from wire clamp bracket on right fuel rail. Remove bolt and wire clamp bracket from right front bearing cap.

5) Remove bolts, and disconnect engine wiring harness protector from rear water by-pass joint and right cylinder head. Remove EVAP vacuum switching valve. Remove bolt and wire clamp bracket from left valve cover. Remove bolts, and disconnect engine wiring harness protector from intake manifold and left front bearing cap. Remove bolts, nuts, intake manifold assembly and gaskets.

6) Remove nuts, ACIS actuator and gasket. Disconnect vacuum hose from ACIS actuator. Remove bolt, and disconnect ACIS vacuum switching valve from upper intake manifold. Remove nuts, bolts, upper intake manifold and gasket. Remove bolts and IAC valve. See Fig. 56.

Installation

1) To install, reverse removal procedure. Install NEW IAC valve actuator gasket. Slightly rotate actuator lever clockwise. See Fig. 57. Connect actuator and air control valve levers. Install IAC valve.

2) Install NEW intake manifold gaskets with White mark facing upward. Marks are painted on outer tabs of gasket. Ensure longer intake manifold bolts are installed in proper location. See Fig. 58. Ensure to route IAC valve actuator vacuum hose under rear fuel line when reconnecting. Tighten all nuts/bolts to specification. See TORQUE SPECIFICATIONS.

INTAKE AIR CONTROL VALVE VACUUM SWITCHING VALVE

NOTE: Intake air control valve VSV may also be referred to as Acoustic Control Induction System (ACIS) vacuum switching valve.

Removal & Installation (ES300 & RX300)

Remove engine cover cover. Remove emission control valve set. See Fig. 59. Disconnect vacuum hoses and electrical connector from Vacuum Switching Valve (VSV). Remove VSV. To install, reverse removal procedure.

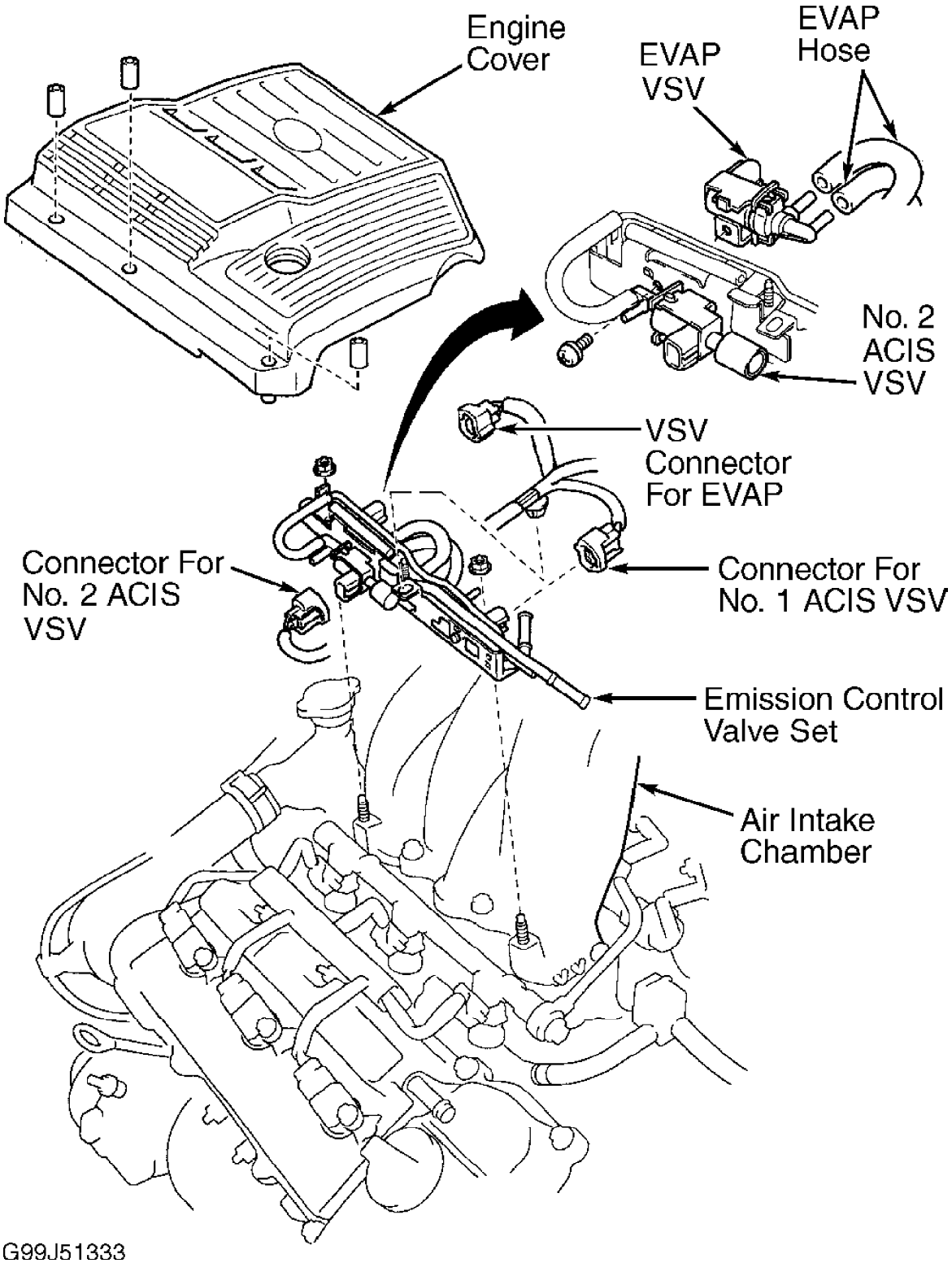


Fig. 59: Locating Vacuum Switching Valves (ES300 & RX300)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Removal & Installation (GS300, GS400, LS400, SC300 & SC400)
For removal and installation procedures, see INTAKE AIR

CONTROL VALVE.

EMISSION SYSTEMS

CHARCOAL CANISTER

NOTE: Charcoal canister is also referred to as EVAP canister.

Removal & Installation (GS300 & GS400)

Charcoal canister assembly is located next to fuel tank. Remove right rear axle shaft. See appropriate RWD AXLE SHAFT article in DRIVE AXLES in appropriate MITCHELL\R manual. Disconnect vapor pressure sensor connector. Disconnect vapor pressure sensor vacuum switching valve connector. Disconnect charcoal canister hoses. Remove nuts and charcoal canister assembly. To install, reverse removal procedure.

VARIABLE VALVE TIMING (VVT) SYSTEM

CAMSHAFT TIMING OIL CONTROL VALVE

Removal (GS300 & SC300)

Oil Control Valve (OCV) is located on left front of cylinder head and has a Black 2-pin connector. Turn ignition off. Remove upper timing belt cover (No. 3 cover). Disconnect OCV connector. Remove bolt, OCV and "O" ring.

Installation

Using a NEW "O" ring, install OCV. Tighten OCV retaining bolt and upper timing belt cover bolts to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (GS400, LS400 & SC400)

1) Each cylinder head has one OCV located in front inside corner of cylinder head. Remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly, if necessary. Remove throttle body. See THROTTLE BODY under FUEL SYSTEM. To remove left camshaft OCV, remove bolt and disconnect engine wiring harness protector from rear of valve cover. Disconnect OCV connector. Remove bolt and OCV. Remove "O" ring from OCV.

2) To remove right OCV, disconnect OCV connector. Remove bolt and OCV. Remove "O" ring from OCV. To install, reverse removal procedure. Install NEW "O" rings and gaskets. Tighten OCV bolt to specification. See TORQUE SPECIFICATIONS.

VARIABLE VALVE TIMING (VVT) INTAKE CAMSHAFT PULLEY

For removal and installation procedure of variable valve timing intake camshaft pulley, see appropriate article in ENGINES in appropriate MITCHELL\R manual.

VARIABLE VALVE TIMING (VVT) SENSOR

NOTE: GS300 and SC300 models are equipped with variable valve timing but use the camshaft position sensor instead of Variable Valve Timing (VVT) sensors to determine camshaft position. See CAMSHAFT POSITION SENSOR under IGNITION SYSTEM.

Removal & Installation (ES300 & RX300)

1) VVT sensor may also be referred to as camshaft position

sensor. One Variable Valve Timing (VVT) sensor is mounted in outer corner of each cylinder head, just below valve cover (oil filler cap end). Remove engine cover. Remove air cleaner hose and resonator from between air cleaner and air intake chamber. Disconnect VVT sensor 2-pin connector. Remove bolt, VVT sensor and "O" ring.

2) To install, reverse removal procedure. Use NEW "O" ring when installing VVT sensor. Tighten VVT sensor bolt to specification. See TORQUE SPECIFICATIONS.

Removal & Installation (GS400)

1) To remove left VVT sensor, remove engine cover. Remove No. 2 engine cover bracket. Disconnect hose from EVAP vacuum switching valve. Remove EVAP vacuum switching valve. Remove No. 3 engine cover bracket. Remove accelerator cable clamp. Disconnect PCV hose from front of upper intake manifold. Disconnect EVAP air inlet hose. Disconnect engine wire protector from upper intake manifold and valve cover. Disconnect VVT sensor connector. Disconnect No. 5 ignition coil/ignitor connector and No. 5 fuel injector connector. Remove bolt and pry out VVT sensor.

2) To remove right VVT sensor, remove engine cover. Remove intake air connector pipe located between throttle body and air cleaner assembly. Disconnect VVT sensor connector. Disconnect No. 4 ignition coil/ignitor coil connector and No. 4 fuel injector connector. Remove bolt and pry out VVT sensor. To install, reverse removal procedure. Tighten VVT sensor bolt to specification. See TORQUE SPECIFICATIONS.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (ES300 & RX300)

Application	Ft. Lbs. (N.m)
Air/Fuel Ratio Sensor	32 (43)
Air Intake Chamber Bolts	32 (43)
Engine Coolant Temperature Sensor	14 (19)
Fuel Line-To-Intake Manifold Bolt	14 (19)
Heated Oxygen Sensor	32 (43)
Intake Manifold Bolts/Nuts	(1) 11 (15)
Knock Sensor	29 (39)
No. 1 Engine Hanger Bolt	29 (39)
No. 1 Intake Air Control Valve Nuts	21 (29)
No. 2 Intake Air Control Valve Nuts	10 (16)
Shift Cable-To-Control Lever Nut	11 (15)
Spark Plug	13 (18)
Throttle Body Bracket Bolt	15 (20)
Water Outlet Bolts	11 (15)
Windshield Wiper Arm Nut (RX300)	18 (24)
	INCH Lbs. (N.m)
Crankshaft Position Sensor Bolt	69 (8.0)
Fuel Pump Protector (ES300)	35 (3.9)
Fuel Pump-To-Tank Bolts	35 (3.9)
Fuel Rail Mounting Bolts	89 (10.0)
Ignition Coil/Ignitor Bolt	69 (8.0)
Throttle Body Screws	61 (6.9)
Park/Neutral Position Switch Bolt	48 (5.4)
Variable Valve Timing Sensor (2)	69 (8.0)

(1) - Tighten in sequence. See Fig. 10.
(2) - Variable valve timing sensor is also known as camshaft position

sensor.

TORQUE SPECIFICATIONS (GS300, GS400, LS400, LX470, SC300 & SC400)

Application	Ft. Lbs. (N.m)
Air Intake Chamber Bolts/Nuts	
GS300 & SC300	21 (28)
Engine Coolant Temperature Sensor	14 (19)
Fuel Pressure Pulsation Damper	24 (33)
Fuel Rail Mounting Bolts	
GS300 & SC300	15 (20)
Fuel Rail Mounting Nuts	
GS400, LS400, LX470 & SC400	13 (18)
Fuel Tank Mounting Bolts	
SC300 & SC400	18 (25)
Fuel Tank Strap Bolts	
GS300, GS400 & LX470	29 (39)
Generator Mounting Bolt/Nut	
GS300 & SC300	30 (40)
Heated Oxygen Sensor	33 (45)
Intake Manifold Bolts/Nuts	
GS300 & SC300	(1) 21 (28)
Knock Sensor	33 (45)
Lower Intake Manifold Bolts	
GS400, LS400, LX470 & SC400	(1) 13 (18)
Park/Neutral Position Switch Bolt	(2) 10 (13)
Park/Neutral Position Switch Nut	10 (13)
Power Steering Pump Rear Stay (GS300)	29 (39)
Starter Bolts	
GS300 & SC300	27 (37)
Shift Lever Nut	10 (13)
Throttle Body Nuts	
GS300 & SC300	15 (20)
GS400, LS400, LX470 & SC400	13 (18)
Transmission Control Shaft Lever Nut	12 (16)
Upper-To-Lower Intake Manifold Bolts/Nuts	
GS400, LS400, LX470 & SC400	(1) 13 (18)
Vehicle Speed Sensor Bolt (LX470)	12 (16)
	INCH Lbs. (N.m)
Accelerator Position Sensor Screws	
GS300 & SC300	33 (3.7)
GS400, LS400, LX470 & SC400	48 (5.4)
Camshaft Position Sensor Bolt	
GS300 & SC300	80 (9.0)
GS400, LS400, LX470 & SC400	66 (7.5)
Camshaft Timing Oil Control Valve Bolt	
GS300 & SC300	71 (8.0)
GS400, LS400 & SC400	66 (7.5)
Crankshaft Position Sensor Bolt	
GS300 & SC300	80 (9.0)
GS400, LS400, LX470 & SC400	58 (6.5)
Fuel Pressure Regulator Bolts (LX470)	66 (7.5)
Fuel Tank Vent Tube Set Plate Bolts	
GS300, GS400, LX470 & SC300	31 (3.5)
LS400 & SC400	26 (3.0)
Ignition Coil Bolt	
GS300 & SC300	71 (8.0)
GS400, LS400, LX470 & SC400	66 (7.5)
Intake Air Control Valve Bolt	

GS400, LS400 & SC400	75 (8.5)
Throttle Control Motor Screws	
GS300 & SC300	33 (3.7)
GS400, LS400, LX470 & SC400	30 (3.4)
Throttle Control Motor Cover Screws	
GS300 & SC300	15 (1.7)
GS400, LS400, LX470 & SC400	30 (3.4)
Throttle Position Sensor Screws	15 (1.7)
Upper Timing Belt Cover Bolts	
GS300 & SC300	71 (8.0)
GS400, LS400, LX470 & SC400	66 (7.5)
Variable Valve Timing Sensor	
GS400, LS400 & SC400	58 (6.5)
Vehicle Speed Sensor Bolt	
SC300 & SC400	48 (5.4)

(1) - Uniformly tighten in several passes.
(2) - On SC300, tighten park/neutral position switch bolt to 48 INCH lbs. (5.4 N.m).