2000-01 ENGINES

3.4L V6 - Aztek & FWD Van

ENGINE IDENTIFICATION

Engine is identified by eighth character of Vehicle Identification Number (VIN). VIN is visible through windshield on left side of instrument panel. VIN is also located on Safety Compliance Certification Label attached to left door lock pillar.

Engine may also be identified by engine identification (ID) number stamped on left side of cylinder block, on engine-to-transaxle mating flange. Engine ID number, LA1, identifies 3.4L SFI engine.

VIN ENGINE CODE

Engine	Code
3.4L SFI	E

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

Engine has hydraulic valve lifters. Valve adjustment is not required.

TROUBLE SHOOTING

NOTE: To trouble shoot engine mechanical components, see appropriate table in TROUBLE SHOOTING article in GENERAL INFORMATION.

REMOVAL & INSTALLATION

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 COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

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

FUEL PRESSURE RELEASE

Disconnect negative battery cable. Loosen fuel filler cap. Install Fuel Pressure Gauge (J-34730-1A) to fuel pressure test head. Wrap shop towel around pressure connection when installing fuel pressure gauge to absorb

fuel leakage. Place gauge bleed hose in container. Open bleed valve to relieve fuel pressure.

COOLING SYSTEM BLEEDING

1. Open air bleed screw located on thermostat housing (there may be a second bleed screw on water pump). Slowly fill cooling system through radiator neck to base of radiator neck. Wait 2 minutes. Recheck fluid level. Add coolant to restore level to base of radiator neck.
2. Install radiator cap. Close air bleed screws. Start engine and allow fan to cycle on and off 3 times. Check fluid level.

ENGINE

Removal

CAUTION: Always replace accelerator control cable with NEW cable whenever engine is removed. This damage can result in loss of control of vehicle.

CAUTION: Position cruise control cable aside to avoid damage. If cable is damaged, it must be replaced. Damage can result in loss of control of vehicle.

1. Disconnect battery cables. Remove throttle body and air inlet duct. Disconnect cruise control cable, and position aside. Remove accelerator control cable. Drain cooling system. Disconnect radiator hoses and heater hoses from engine. Remove engine mount struts.
2. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect fuel lines at quick disconnects. Disconnect necessary electrical connectors and vacuum lines from engine. Disconnect brake booster hose.
3. Disconnect transmission shift control cable and A/C lines. Raise and support vehicle. Drain engine oil. Disconnect wiring harness grounds. Disconnect exhaust/converter pipe from right exhaust manifold. On AWD Aztek, remove rear drive shaft. Remove front wheels.
4. Remove lower radiator baffle. Remove inner fender splash shields. Remove stabilizer shaft links from lower control arms. Remove tie rod ends from steering knuckles. Remove lower ball joints from knuckles. Drain transaxle fluid.
5. Remove transaxle cooler lines and bracket from transaxle. Remove drive axles from transaxle. See appropriate FWD AXLE SHAFTS article in DRIVE AXLES. Wire drive axles to steering knuckles.

CAUTION: Failure to disconnect intermediate shaft from rack and pinion steering gear stub shaft can result in damage to steering gear and/or intermediate shaft. This damage can result in loss of control of vehicle.

6. Remove pinch bolt/screw at intermediate shaft. Remove intermediate shaft from steering gear. Support engine/transaxle/frame with transaxle table. Remove frame-to-body bolts. Raise vehicle, to separate engine/transaxle/frame from vehicle. Remove starter. Remove flywheel-to-torque converter bolts. Install engine hoist. Remove engine-to-transaxle bolts. Remove engine.

Installation

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

CAUTION: When installing intermediate shaft, ensure shaft is seated prior to pinch bolt installation.

UPPER INTAKE MANIFOLD

Removal

1. Disconnect negative battery cable. Drain cooling system. Remove air cleaner ducts.
2. Remove accelerator and cruise control cables with bracket from throttle body. Remove front spark plug wires. Disconnect harness connectors, vacuum hoses and coolant hoses from throttle body. Remove ignition coil bracket with coils and canister purge solenoid.
3. Remove Manifold Absolute Pressure (MAP) sensor. Disconnect and remove emission control vacuum harness. See **Fig. 1**. Remove EGR valve and generator front and side brackets. Remove upper intake manifold retaining bolts. Remove upper intake manifold. See **Fig. 2**.

Installation

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

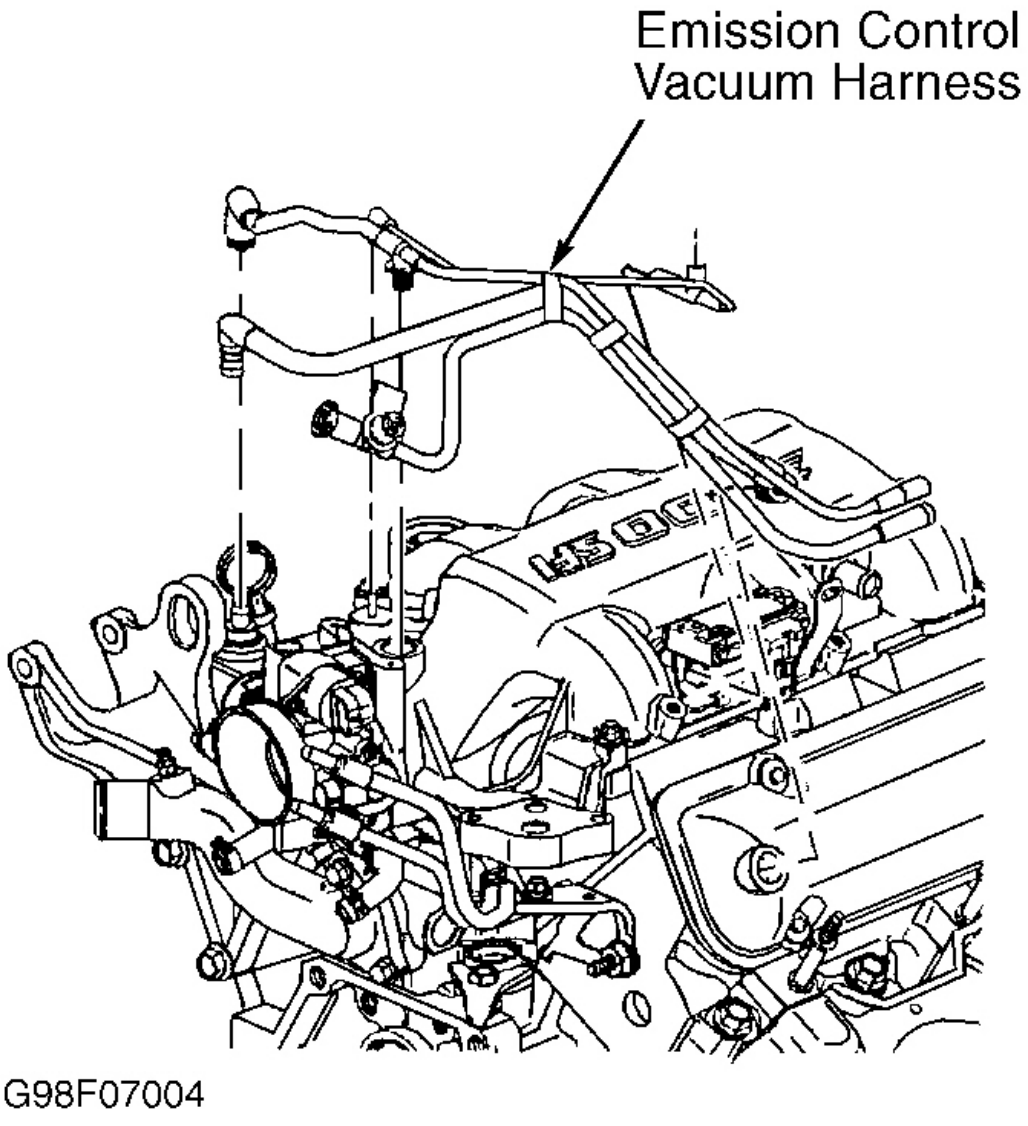


Fig. 1: Emission Control Vacuum Harness
Courtesy of GENERAL MOTORS CORP.

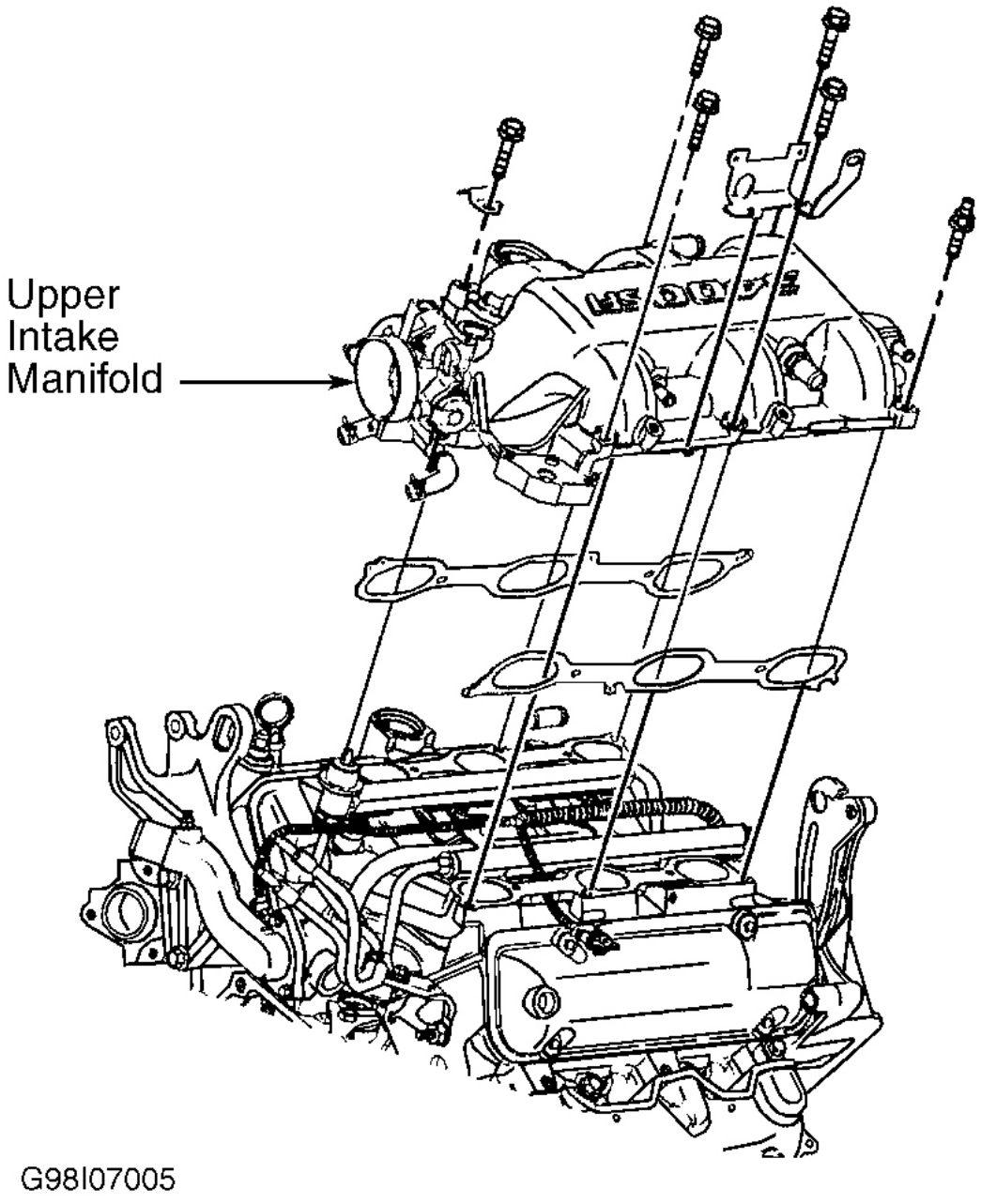


Fig. 2: Upper Intake Manifold Assembly
Courtesy of GENERAL MOTORS CORP.

LOWER INTAKE MANIFOLD

Removal

1. Disconnect negative battery cable. Remove upper intake manifold. See **UPPER INTAKE MANIFOLD**. Remove valve covers. See **VALVE COVERS**. Disconnect harness connectors from intake manifold components. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect fuel lines from rail. Remove fuel rail.
2. Unbolt power steering pump from front cover, and position aside. Disconnect upper radiator hose, heater hoses and thermostat by-pass hose from lower intake manifold. Remove lower intake manifold retaining bolts. Remove lower intake manifold. Loosen rocker arms and remove push rods to remove lower intake manifold gaskets.

Installation

NOTE: When replacing lower intake manifold gasket, a revised intake manifold gasket has been introduced by manufacturer. This new design gasket helps resolve issues related to intake manifold oil/coolant leaks. The gasket requires a revised torque specification and procedure in addition to the use of NEW revised intake manifold bolts. Please review TSB ENGINE OIL OR COOLANT LEAK (INSTALL NEW INTAKE MANIFOLD GASKET) for complete information.

NOTE: All gasket-mating surfaces need to be free of oil, and foreign material.

1. Clean all gasket mating surfaces. Install lower intake manifold gaskets. With the gaskets in place, apply a 0.31-0.39" (8-10 mm) drop of GM® RTV sealer (12346286 US; 10953472 Canada) or equivalent to the 4 corners of the intake manifold-to-block joint. Connect the drops at both ends on the ridge where the front and rear of lower intake manifold contacts the block with a bead of RTV sealer that is 0.31-0.39" (8-10 mm) wide and 0.12-0.20" (3.0-5.0 mm) thick.
2. Install push rods into original position and tighten rocker arms to specification. See **TORQUE SPECIFICATIONS**. Install lower intake manifold. Apply Sealant (12345282) to bolt threads.
3. Hand tighten vertical bolts. Hand tighten diagonal bolts. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. See **Fig. 3**. To complete installation, reverse removal procedure.

NOTE: An oil leak may result if vertical bolts are not tightened before diagonal bolts.

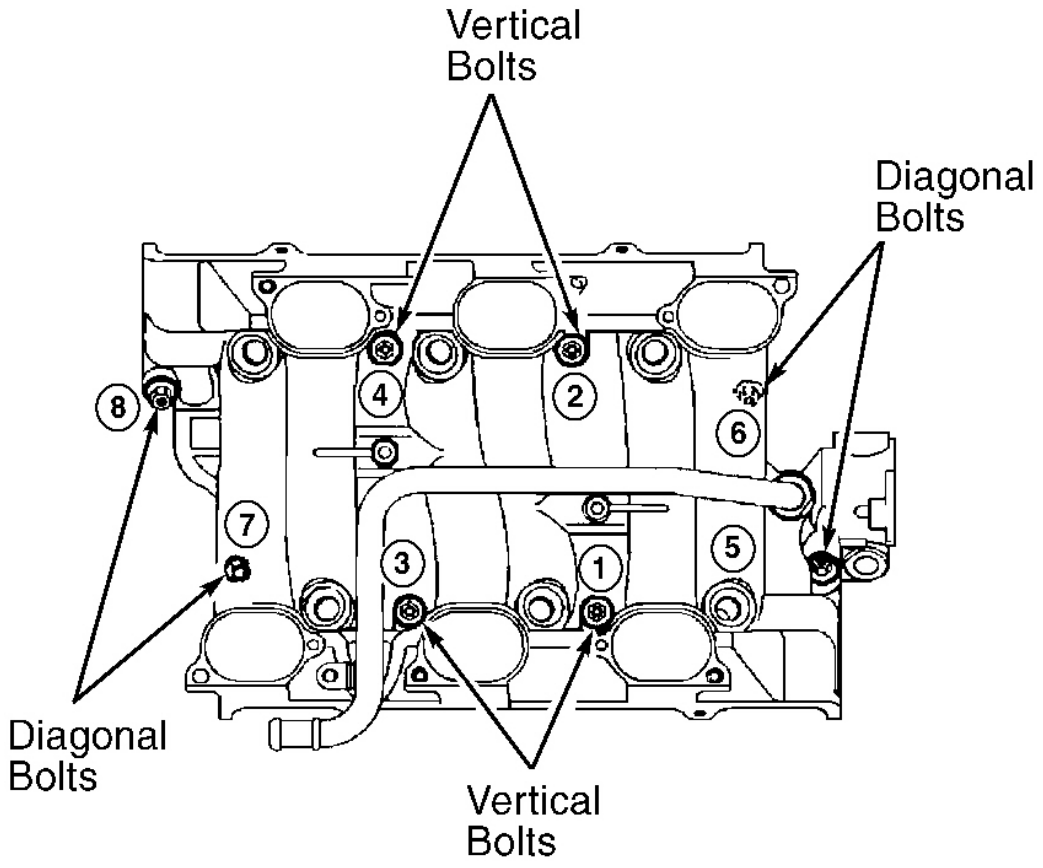


Fig. 3: Lower Intake Manifold Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

EXHAUST MANIFOLDS

Removal (Left)

1. Disconnect negative battery cable. Remove air cleaner duct. Drain cooling system. Remove left (front) engine mount strut bracket. Disconnect upper radiator hose from engine. Remove A/T vacuum modulator pipe (if equipped).
2. Remove thermostat by-pass pipe. Remove crossover pipe heat shield. Remove crossover pipe bolts at left exhaust manifold. Remove left (front) exhaust manifold heat shield. Remove exhaust manifold retaining nuts. Remove exhaust manifold and gasket.

Removal (Right)

1. Disconnect negative battery cable. Remove engine. See **ENGINE**.
2. Remove heat shields. Remove RH side spark plugs. Remove exhaust manifold and gaskets.

Installation

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

VALVE COVERS

Removal (Left)

Disconnect negative battery cable. Remove front spark plug wires. Remove A/T vacuum modulator pipe (if equipped). Remove right engine strut at engine. Remove PCV valve. Remove valve cover retaining bolts. Remove valve cover and gasket.

Removal (Right)

Disconnect negative battery cable. Remove accessory drive belt. Remove generator braces. Remove generator and bracket. Remove rear spark plug wires. Remove ignition coil bracket, with coils and canister purge solenoid attached. Remove vacuum hose from air duct at right valve cover. Remove valve cover retaining bolts. Remove valve cover and gasket.

Installation

Apply RTV Sealer (12345739) where cylinder head and intake manifold meet. See **Fig. 4**. Install valve cover and gasket. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.

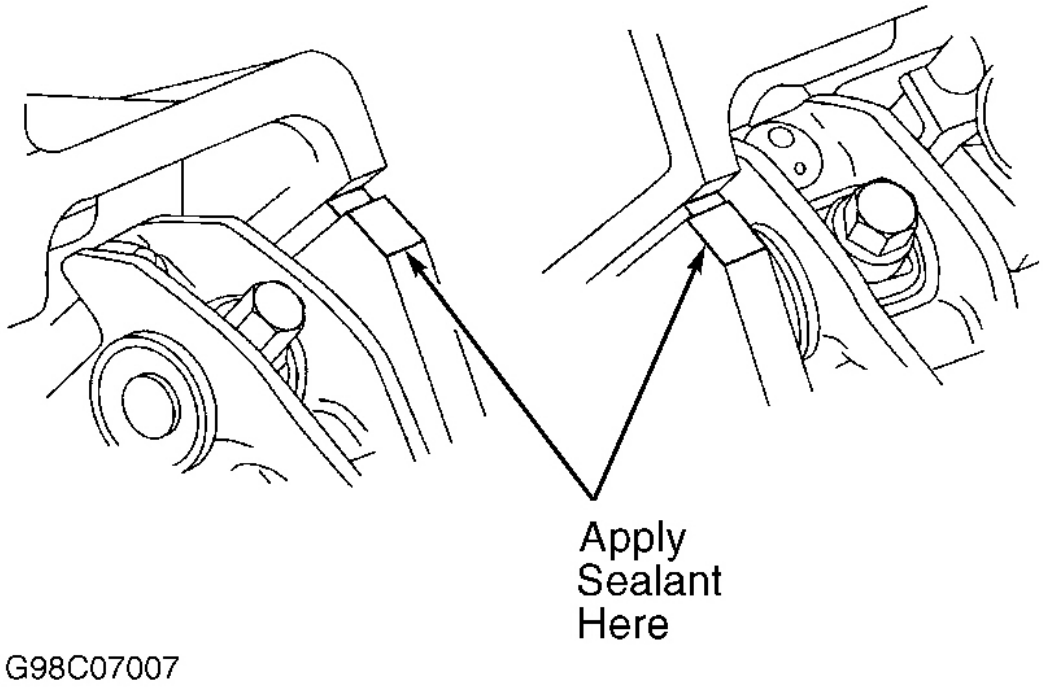


Fig. 4: RTV Application To Seal Valve Covers
Courtesy of GENERAL MOTORS CORP.

CYLINDER HEAD

NOTE: Place valve train parts in a rack to ensure installation in same location from which they were removed. Intake push rod are 5.68" (144.18 mm) long, and exhaust push rods are 6.0" (152.51 mm) long. If only removing rocker arms and push rods, DO NOT remove lower intake manifold.

Removal

1. Disconnect negative battery cable. Raise and support vehicle. Drain cooling system. Drain engine oil. Lower vehicle. Remove upper intake manifold. See **UPPER INTAKE MANIFOLD**. Remove lower intake manifold. See **LOWER INTAKE MANIFOLD**.
2. Mark position of rocker arms and push rods. Remove rocker arm bolts. Remove rocker arms and push rods. Remove exhaust crossover pipe. Remove right engine mount strut bracket. Remove oil level indicator tube. Remove spark plug wires.
3. Remove spark plugs. Remove exhaust manifold. See **EXHAUST MANIFOLDS**. Remove cylinder head retaining bolts in reverse order. See **Fig. 5**. Remove cylinder head and gasket.

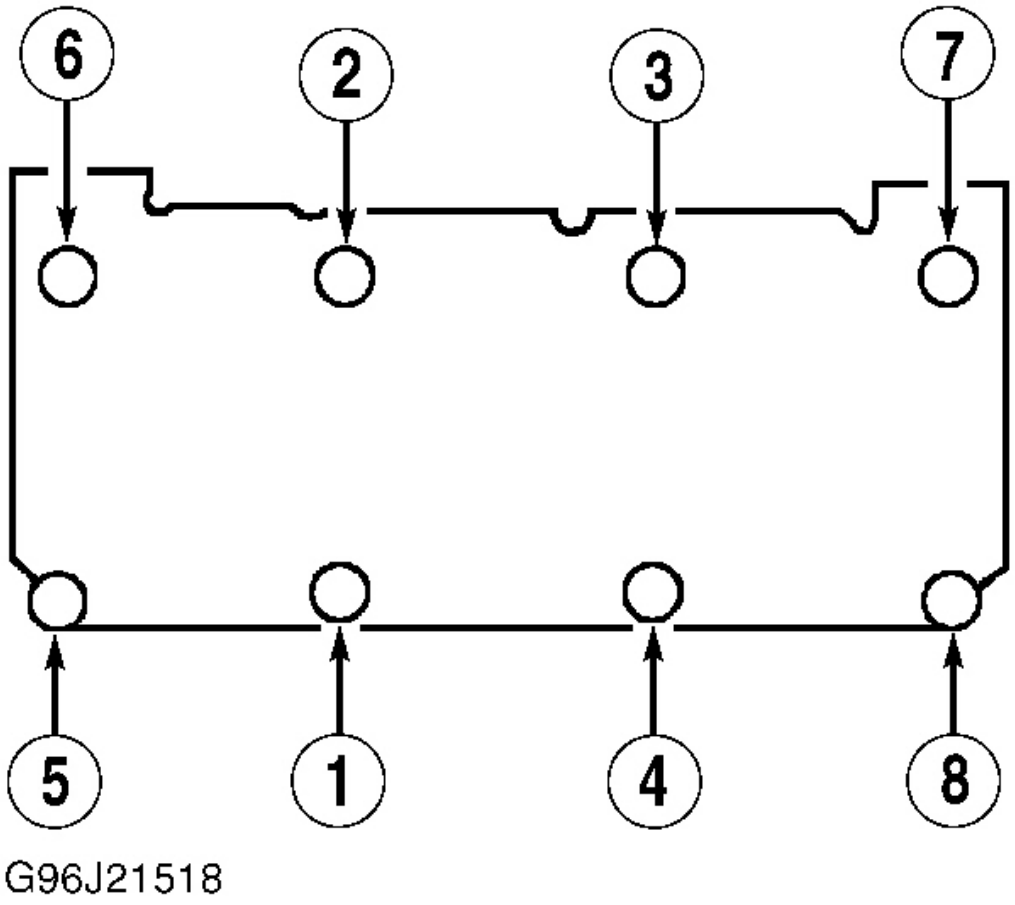


Fig. 5: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

Inspection

If warpage of cylinder head gasket surface exceeds .005" (.127 mm), machine surface. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. DO NOT remove more than .010" (.25 mm) of material from original surface.

Installation

1. Clean cylinder head bolt threads and cylinder block holes. Install new head gasket, make sure THIS SIDE UP marking faces up.
2. Install cylinder head. Install head bolts and tighten in sequence to specification. See **Fig. 5**. See **TORQUE SPECIFICATIONS**. To install remaining components, reverse removal procedure.

CRANKSHAFT FRONT SEAL

Removal

Disconnect negative battery cable. Remove accessory drive belt. Raise and support vehicle. Remove right front wheel. Remove right inner fender splash shield. Remove crankshaft damper bolt and washer. Using Crankshaft Damper Puller (J-24420-B), remove damper. Using a seal puller, carefully pry out seal.

Installation

Coat seal with oil to make installation easier. Using Front Cover Aligner & Oil Seal Installer (J-35468), install crankshaft front seal. Clean damper key and keyway. Apply RTV Sealant (12345739) onto key and keyway. Install damper using Crankshaft Damper Installer (J-29113). Install damper bolt and tighten to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.

FRONT COVER

Removal

1. Disconnect negative battery cable. Drain cooling system. Drain engine oil. Remove front crankshaft damper. Remove accessory drive belt tensioner. Unbolt power steering pump, and position aside with hoses attached.
2. Remove thermostat by-pass pipe. Disconnect lower radiator hose from water pump. Remove water pump pulley. Remove upper and lower crankshaft position sensor wiring harness brackets from front cover. Remove front cover retaining bolts. Remove front cover and gasket. See **Fig. 6**.

Installation

To install, reverse removal procedures. Apply Sealer (12346004) to both sides of lower edges of front cover gasket where it contacts oil pan gasket.

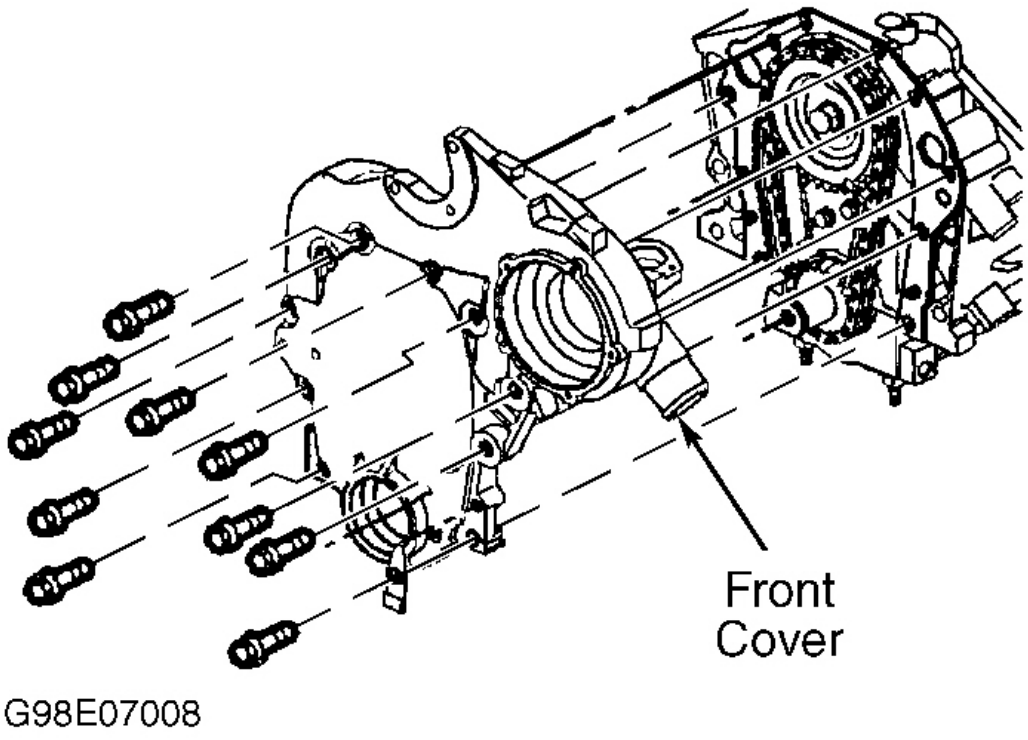


Fig. 6: Front Cover Assembly
Courtesy of GENERAL MOTORS CORP.

TIMING CHAIN

Removal

1. Disconnect negative battery cable. Drain cooling system. Drain engine oil. Remove front cover. See **FRONT COVER**. Rotate crankshaft until timing marks on crankshaft sprocket and camshaft sprocket are aligned on timing chain damper. See **Fig. 7**.
2. Remove camshaft sprocket bolt. Remove camshaft sprocket and timing chain. Using Crankshaft Sprocket Puller (J5825-A), remove crankshaft sprocket. Remove timing chain damper bolts and remove damper.

Installation

1. Using Crankshaft Sprocket Installer (J-38612), install crankshaft sprocket. Install timing chain damper. Tighten damper bolts to specification. See **TORQUE SPECIFICATIONS**.
2. Align crankshaft timing mark to timing mark on bottom of chain damper. Hold camshaft sprocket with chain hanging down, and install chain to crankshaft gear. Align timing mark on camshaft gear with timing mark on top of chain damper. See **Fig. 7**.

3. Install camshaft sprocket bolt. Lubricate chain with engine oil. Install timing chain front cover with NEW gasket. Tighten cover bolts to specification. See **TORQUE SPECIFICATIONS**. To install remaining components, reverse removal procedure.

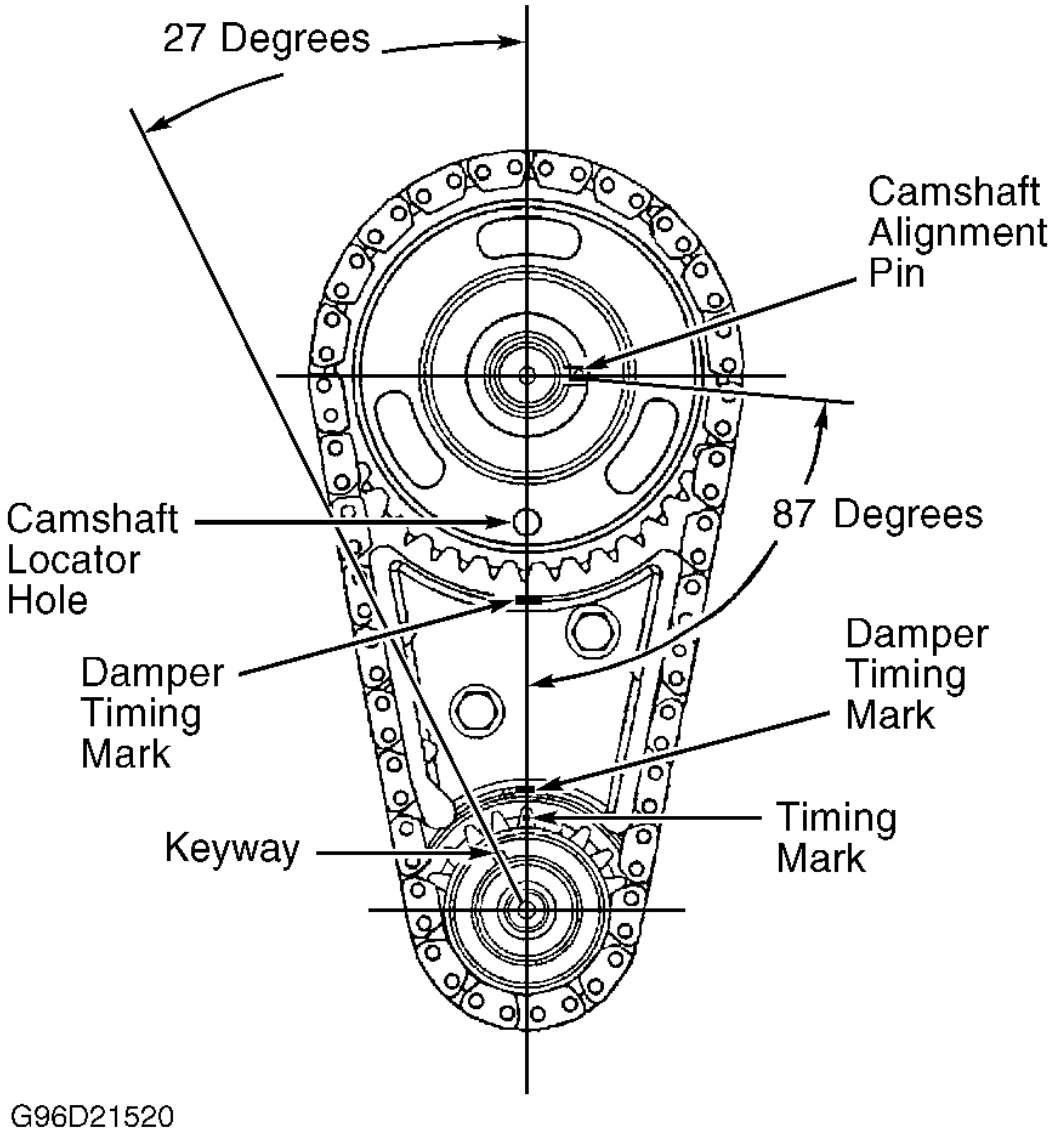


Fig. 7: Aligning Timing Marks
Courtesy of GENERAL MOTORS CORP.

ROCKER ARM & VALVE LASH ADJUSTER

NOTE: Place valve train parts in a rack to ensure installation in same location from

which they were removed. Intake push rods are 5.68" (144.18 mm) long, and exhaust push rods are 6.0" (152.51 mm) long. If only removing rocker arms and push rods, DO NOT remove lower intake manifold.

Removal

Remove upper intake manifold. See **UPPER INTAKE MANIFOLD**. Remove lower intake manifold. See **LOWER INTAKE MANIFOLD**. Mark position of rocker arms and push rods. Remove rocker arms and push rods. Remove guide bolts and guide. Remove valve lifters.

Installation

If installing new lifter, coat bottom of lifter with Lifter Prelube (1052365). Install lifter in original bore. To complete installation, reverse removal procedure. Ensure push rods are installed correctly.

CAMSHAFT

NOTE: To remove camshaft, engine must be removed from vehicle.

Removal

Remove engine. See **ENGINE**. Remove upper intake manifold. See **UPPER INTAKE MANIFOLD**. Remove lower intake manifold. See **LOWER INTAKE MANIFOLD**. Remove push rods and valve lifters, noting location for installation reference. See **ROCKER ARM & VALVE LASH ADJUSTER**. Remove front cover. See **FRONT COVER**. Remove timing chain and camshaft sprocket. See **TIMING CHAIN**. Remove oil pump drive clamp. Remove oil pump drive assembly. See **Fig. 8**. Remove camshaft thrust plate screws and thrust plate. Carefully rotate and pull camshaft out of bearing bore.

Inspection

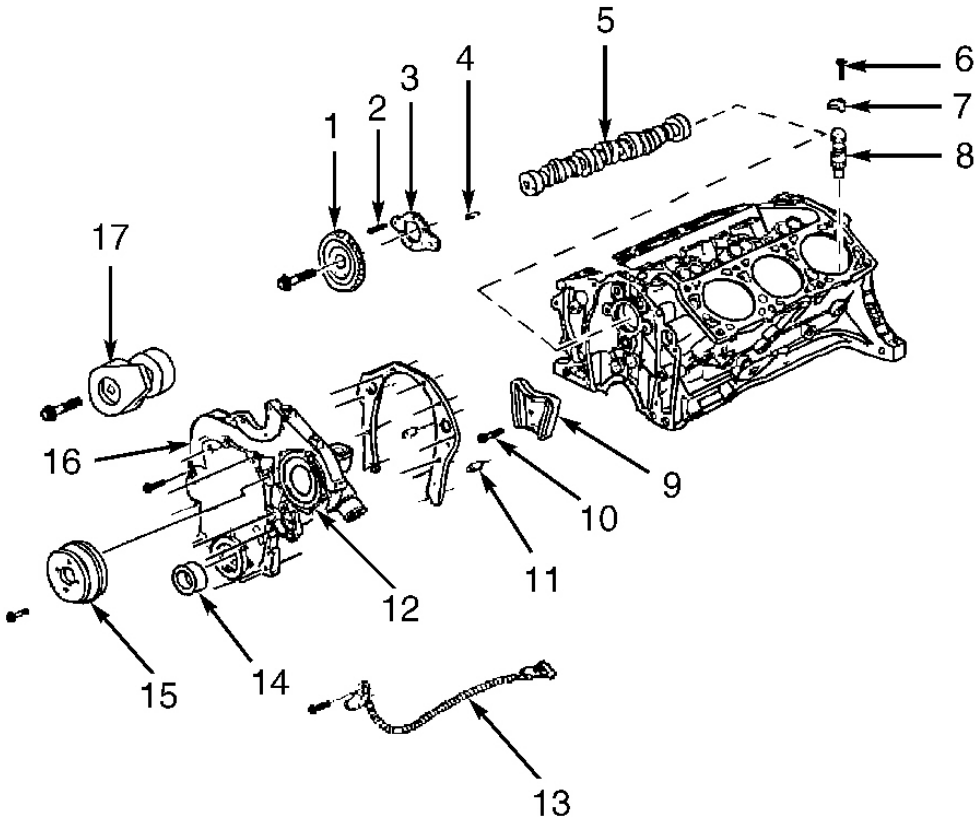
If journal runout, lobe lift or oil clearance is not within specification, replace camshaft. See **CAMSHAFT** table under ENGINE SPECIFICATIONS. If necessary, remove camshaft bearings using Remover/Installer (J-33049).

CAUTION: If camshaft bearings were removed, ensure oil holes are aligned during installation. Front and rear camshaft bearings have a different outside diameter than inner bearings. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS. If replacing camshaft, coat lobes with Prelube (1052365) prior to installation.

Installation

1. Lubricate camshaft bearings, camshaft lobes and thrust plate with Lubricant (1052365). Lubricate camshaft journals with engine oil. Carefully rotate and install camshaft into bearing bore.
2. Install camshaft thrust plate. To install remaining components, reverse removal procedure. Ensure timing marks are aligned. See **Fig. 7**. Install valve lifters and push rods in original locations. If camshaft was

replaced, add Engine Oil Supplement (1052367) to engine oil. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.



1. Camshaft Sprocket
2. Camshaft Thrust Plate Screw
3. Camshaft Thrust Plate
4. Camshaft Sprocket Alignment Pin
5. Camshaft
6. Oil Pump Drive Clamp Bolt
7. Oil Pump Drive Clamp
8. Oil Pump Drive Assembly
9. Timing Chain Dampener
10. Timing Chain Dampener Bolt
11. Engine Front Cover Alignment Pin
12. Water Pump
13. Crankshaft Position Sensor
14. Crankshaft Front Oil Seal
15. Water Pump Pulley
16. Engine Front Cover
17. Drive Belt Tensioner

G98A07011

Fig. 8: Front Cover & Camshaft Assembly
Courtesy of GENERAL MOTORS CORP.

CRANKSHAFT REAR OIL SEAL

Removal

Remove transaxle and flywheel/flexplate. See appropriate TRANSMISSION REMOVAL & INSTALLATION article in TRANSMISSION SERVICING for A/T, or appropriate article in CLUTCHES for M/T. Using appropriate seal removing procedure, remove rear crankshaft oil seal.

Installation

1. Coat inner and outer seal surfaces with engine oil. Install seal on mandrel of Seal Installer (J-34686) until dust lip bottoms against tool collar. Align seal installer dowel pin with crankshaft. Install seal installer on crankshaft. See **Fig. 9**.
2. Turn seal installer handle until seal is installed. Remove seal installer. To complete installation, reverse removal procedure. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.

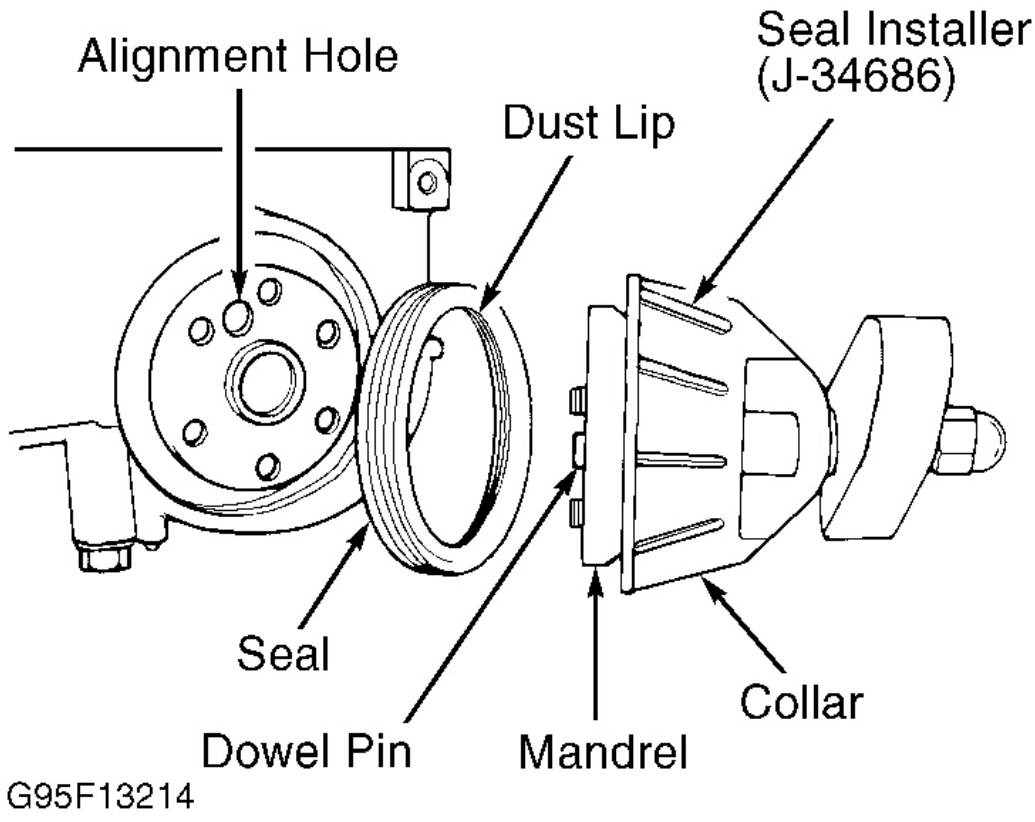


Fig. 9: Installing Rear Crankshaft Seal
Courtesy of GENERAL MOTORS CORP.

THERMOSTAT

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the procedure. DO NOT use paints, lubricants or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Removal & Installation

1. Remove the air cleaner and duct assembly. See **Fig. 10**. Drain the coolant until the coolant level is below the thermostat. See **COOLING SYSTEM BLEEDING**.
2. Remove the crossover exhaust pipe. See **Fig. 11**. Remove the radiator hose from the thermostat housing.
3. Remove the thermostat housing bolts and clean any sealer from the bolt threads. See **Fig. 12**. Remove the thermostat housing and gasket.
4. Remove the thermostat. Inspect and clean the mating surfaces.
5. Install the thermostat housing and gasket. Install RTV sealer (GM P/N 1052366) to the thermostat housing bolt threads. Install the thermostat housing bolts. See **TORQUE SPECIFICATIONS**.
6. To complete installation, reverse removal procedure. Fill the cooling system. Inspect the cooling system for leaks. Repair as necessary.

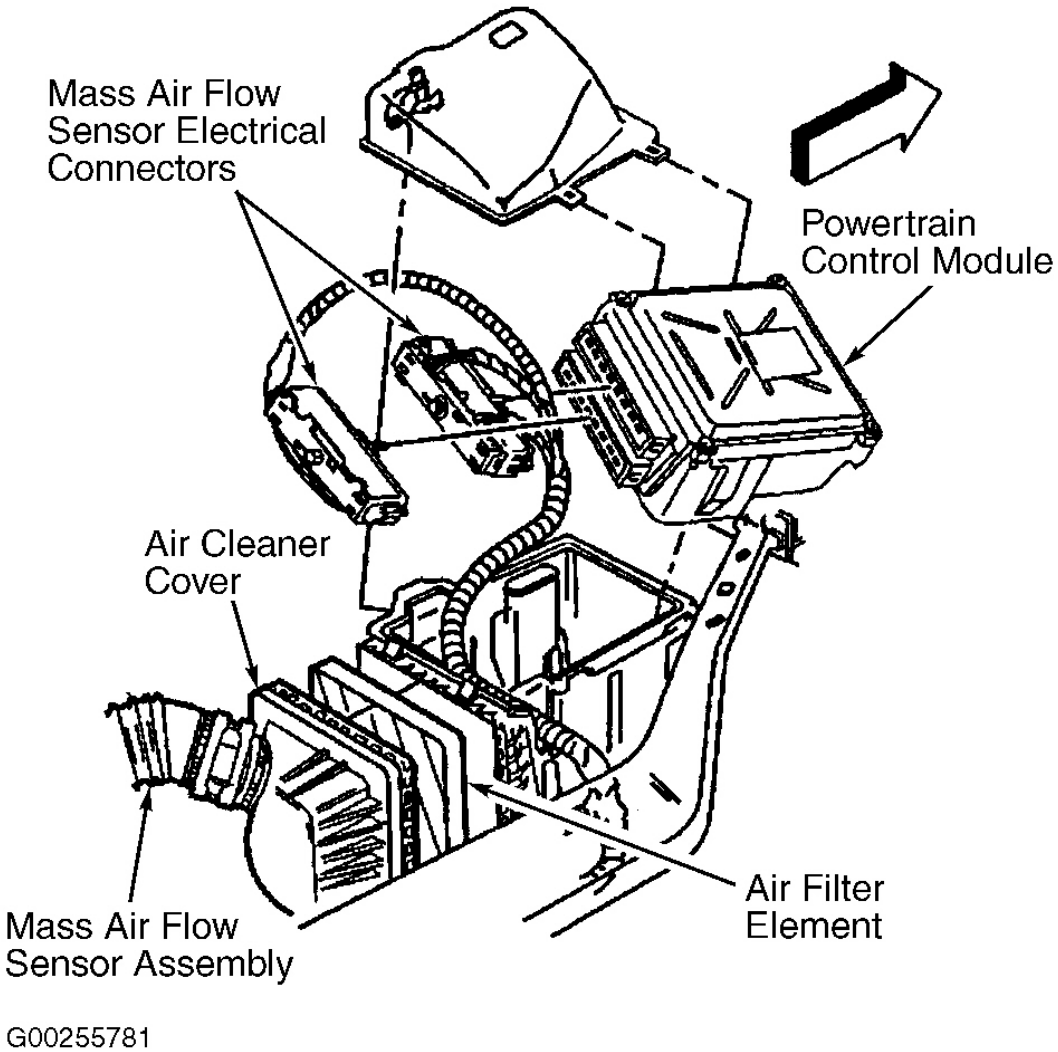


Fig. 10: Removing/Installing Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

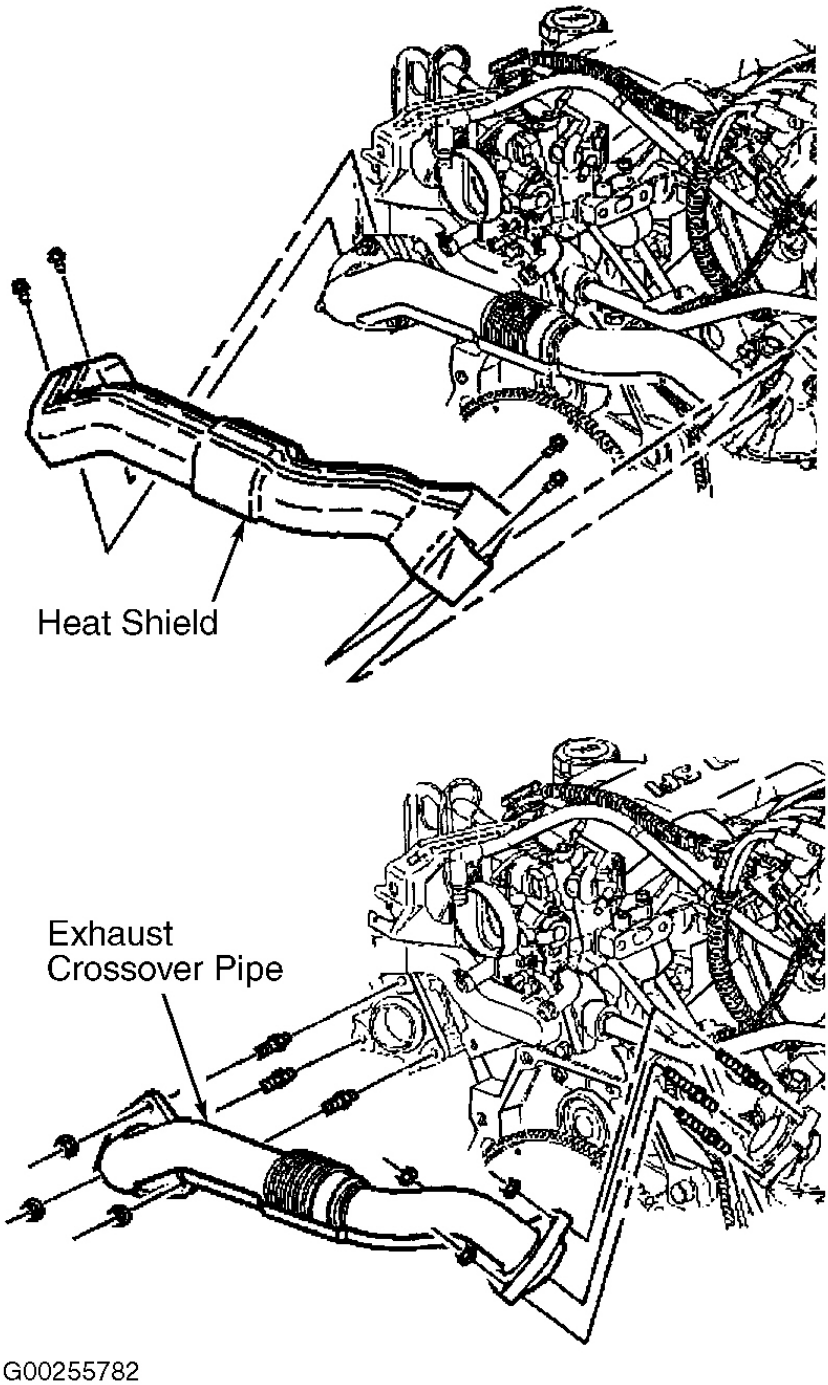


Fig. 11: Removing/Installing Exhaust Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

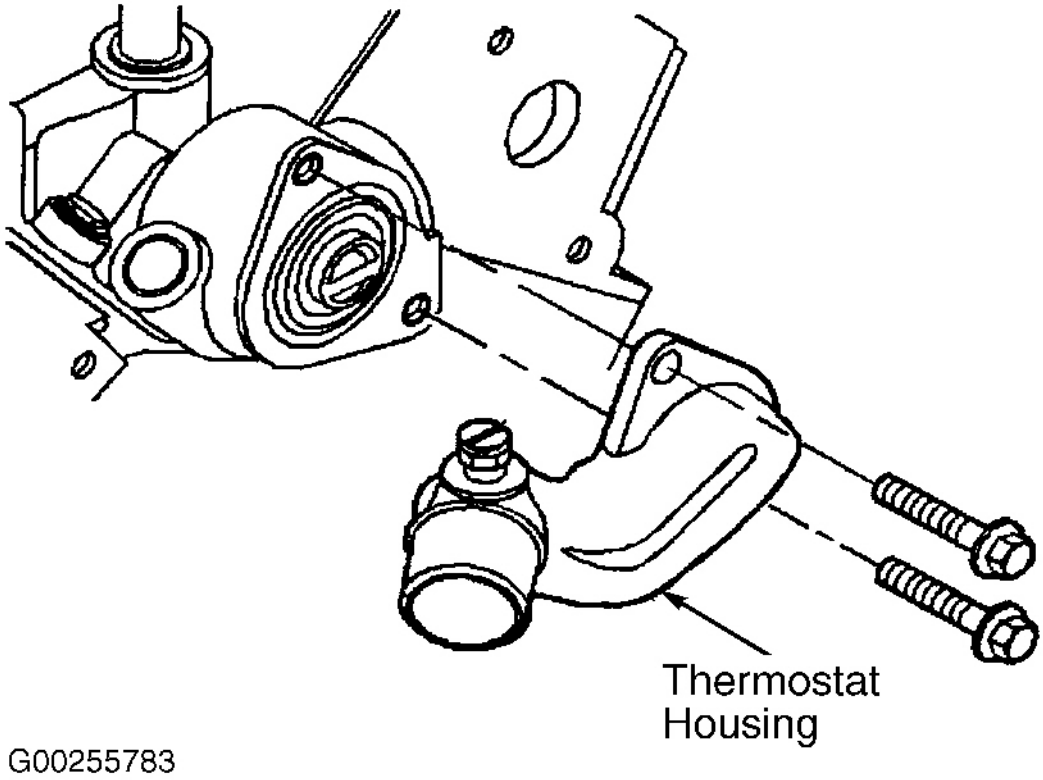


Fig. 12: Removing/Installing Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

WATER PUMP

Removal

Disconnect negative battery cable. Drain cooling system. Loosen water pump pulley bolts. Remove accessory drive belt. Remove water pump pulley. Note locator tab near 12 o'clock position at top of water pump housing for installation reference. Remove water pump retaining bolts. Remove water pump and gasket.

Installation

Install water pump with NEW gasket, ensuring locator tab at top of water pump housing is positioned vertically. To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

OIL PAN

Removal

1. Disconnect negative battery cable. Remove motor mount struts. Install Engine Support Fixture & Adapters (J-28467-6A, J-28467-7A, J-28467-8A, J-28467-34 and J-28467-500).
2. Raise and support vehicle. Remove A/C compressor retaining bolts, and position aside with hoses attached. Remove 3-way catalytic converter pipe from right (rear) exhaust manifold. Drain engine oil. Disconnect oil level sensor harness connector. Remove starter. Remove transaxle brace from oil pan. Remove lower engine and transaxle motor mount nuts.
3. Using support fixture, raise engine to gain access for oil pan removal. Remove engine mount and bracket from oil pan. Remove left (front) and right (rear) oil pan side bolts. Remove oil pan-to-block retaining bolts. Remove oil pan and gasket. See **Fig. 13**.

Installation

Apply a small amount of Sealant (1234579) on either side of rear main bearing cap, where seal surface on cap meets cylinder block. See **Fig. 14**. Install gasket and oil pan. To complete installation, reverse removal procedure. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**. Fill crankcase with oil.

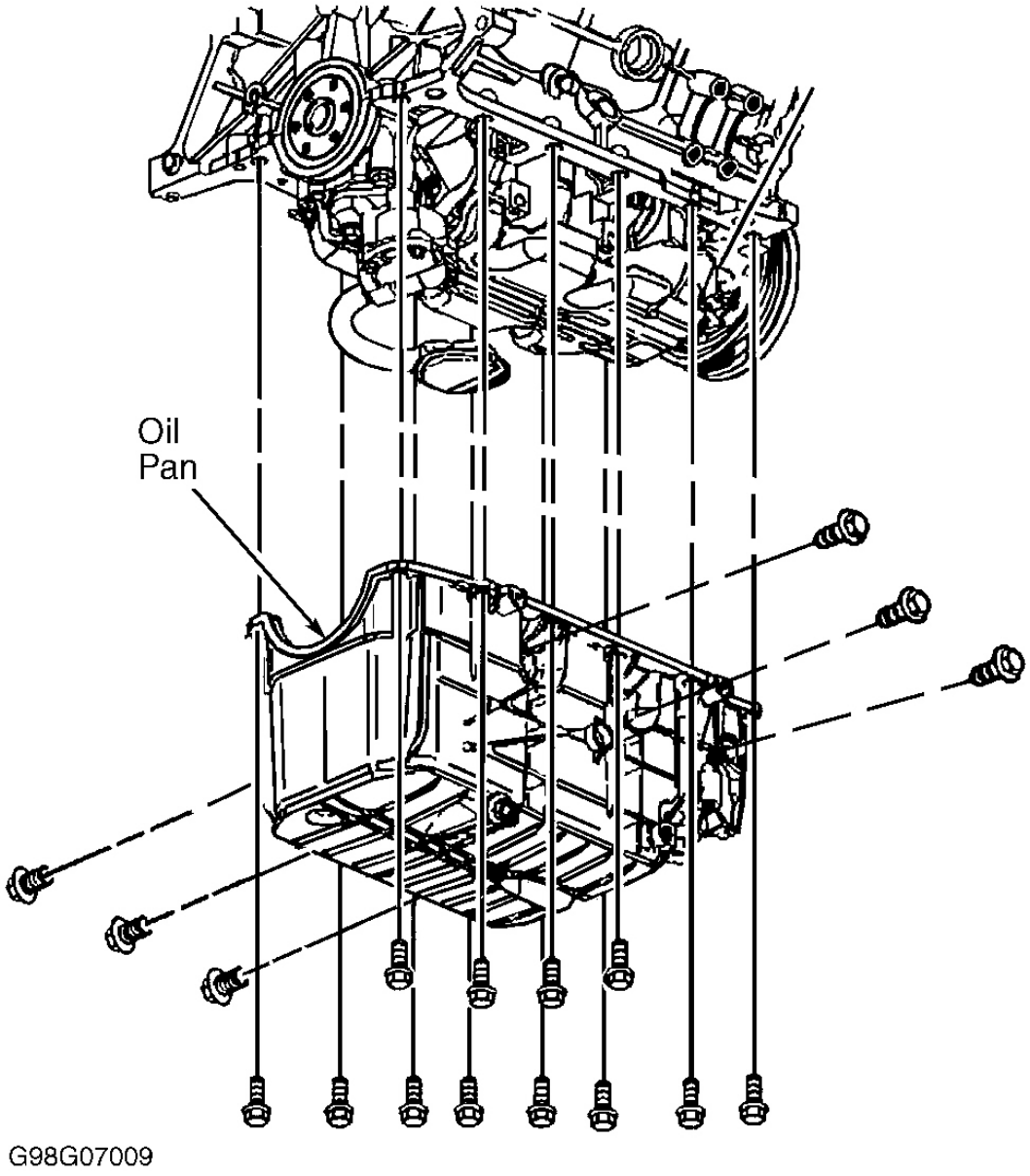


Fig. 13: Oil Pan Mounting
Courtesy of GENERAL MOTORS CORP.

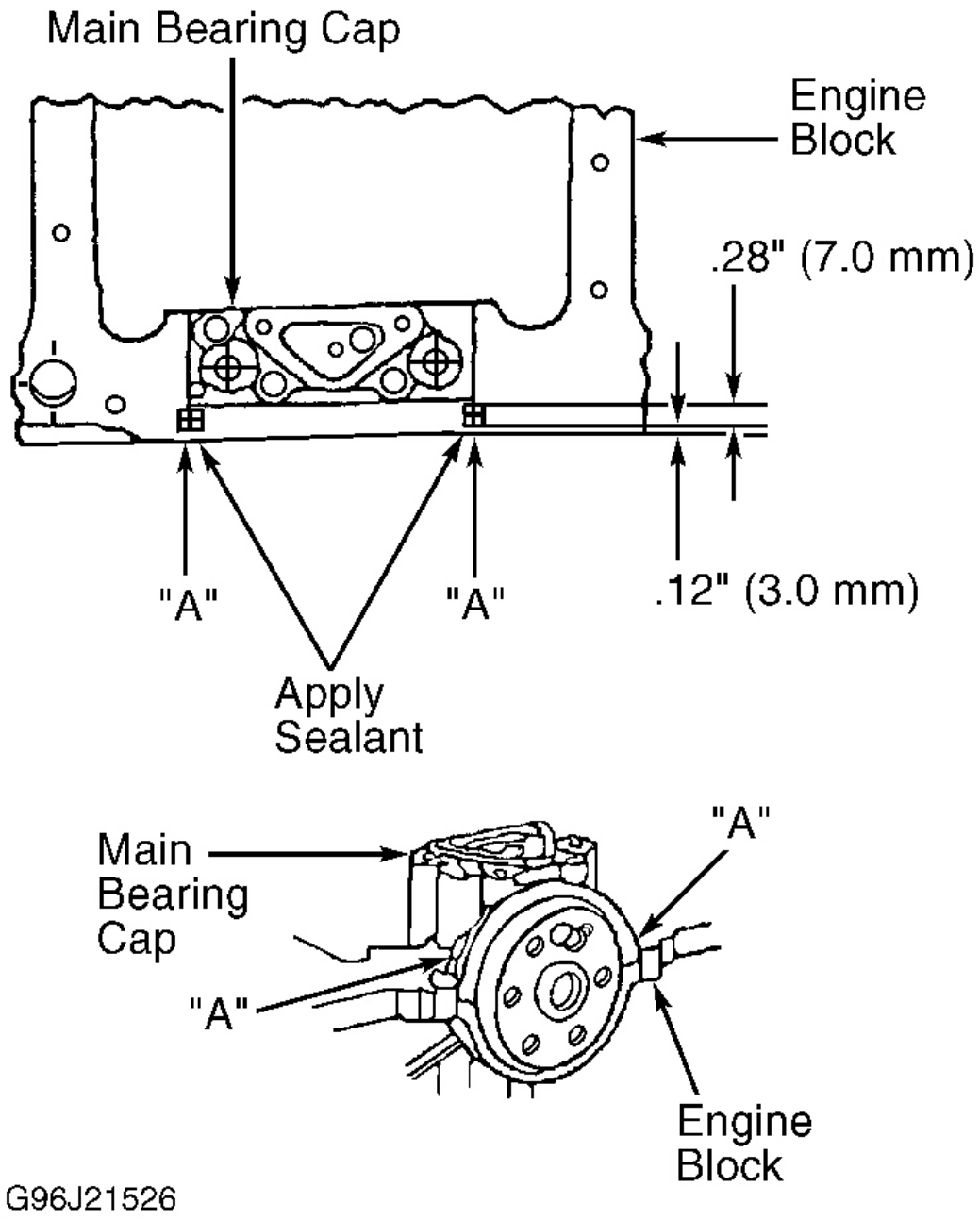


Fig. 14: Oil Pan Sealing
Courtesy of GENERAL MOTORS CORP.

OVERHAUL

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

CYLINDER HEAD

Cylinder Head

1. Clean head gasket mating surface. Clean carbon from combustion chambers. DO NOT damage surfaces. Check cylinder head for cracks, burrs, nicks and warpage.
2. Check cylinder head warpage. Resurface cylinder head if warpage exceeds specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. DO NOT machine more than .010" (.25 mm) from original cylinder head surface.

Valve Springs

1. Measure valve spring installed height from surface of cylinder head spring pad to underside of spring retainer. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS. If installed height is not within specification, a spacer can be installed between cylinder head and valve spring to obtain correct height.
2. Inspect valve spring free length and pressure. Replace valve spring if free length and pressure are not within specification.

CAUTION: Do not install valve spring spacers unless necessary. Using more spacers than required can result in spring breakage or worn camshaft lobes.

Valve Stem Oil Seals

When installing new valve stem seals, ensure oil seal bottoms on valve guide. Oversized valve stem seals must be installed when oversize valves are used.

Valve Guides

1. Valve guides must be reamed for an oversize valve if valve stem-to-guide oil clearance exceeds specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Valves are available with oversize stems.
2. If oversize valves or oversize valve stem oil seals are not available, valve guide may be reamed to use a service bushing. Always use reamers in proper sequence (smallest first).

NOTE: Always grind valve seat after valve guide has been reamed or service bushing has been installed.

Valve Seat

Ensure valve seat angle, seat width and seat runout are within specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Valve seats must be ground when valve guide is reamed or replaced. Seat

replacement information is not available from manufacturer.

Valves

1. Ensure head diameter, valve face runout, stem diameter and valve margin are within specification. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS.
2. Oversize valves are available. When servicing valve stem tip, DO NOT remove more than .010" (.25) from end of valve stem.

Valve Seat Correction Angles

Grind valve seat to a true 46-degree angle. If seat width is too wide after grinding, use a 20-degree stone to lower seat, or a 70-degree stone to raise seat. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

Mark piston in relation to cylinder bore and rod for reassembly. Ensure arrow on top of piston faces front of engine upon reassembly. Replace rod if bend or twist exceeds specification. See **CONNECTING RODS** table under ENGINE SPECIFICATIONS.

Fitting Pistons

Measure piston diameter with pin removed. Measure diameter at 90-degree angle to pin on pin center line. If piston clearance is not within specification, machine cylinder bore and install oversize piston(s) as necessary. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.

Piston Rings

Ensure ring end gap and side clearance are within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.

Installing Piston Rings

Install piston rings with identification mark toward top of piston and ring gaps properly spaced. See **Fig. 15**.

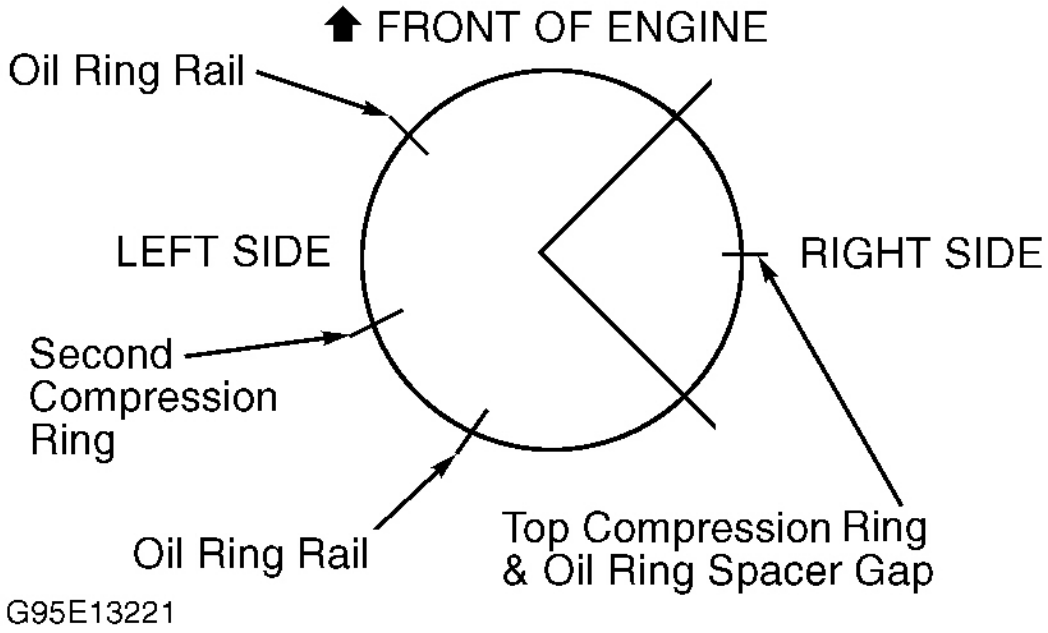


Fig. 15: Positioning Piston Ring Gaps
Courtesy of GENERAL MOTORS CORP.

Rod Bearings

Ensure rod side clearance is .0007-.0024" (.018-.061 mm). If connecting rod bearing oil clearance is not within correct specification, machine crankshaft and replace bearings. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS.

Crankshaft & Main Bearings

Measure crankshaft main bearing for proper oil clearance, out-of-round and taper. If any measurements are not within specification, machine crankshaft and replace bearings. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS.

Crankshaft Flange Runout

1. With engine removed and crankshaft installed, or with crankshaft mounted on "V" blocks, measure crankshaft flange runout. Mount dial indicator, and place dial indicator stem on crankshaft flange. Adjust dial indicator to zero.
2. Mark reference point on crankshaft flange. Ensure crankshaft is thrust forward so end float will not affect readings. Turn crankshaft 360 degrees.
3. Observe and record readings. Reading should not vary more than .0016" (.041 mm). If readings exceed specification, replace crankshaft.

Thrust Bearing

1. With main bearing cap bolts installed and loosely tightened, pry crankshaft rearward to align bearing caps, then push forward to align rear face of thrust main bearing. Tighten main bearing cap bolts to specification. See **TORQUE SPECIFICATIONS**.
2. Measure crankshaft end play. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS.

Cylinder Block

Measure block for flatness with a straightedge and feeler gauge across cylinder bores. If deck surface warpage exceeds specification, machine surface. DO NOT remove more than .010" (.25 mm) of material from original deck surface. If more is removed, block must be replaced.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Oil delivery system supplies oil to crankshaft journals first. See **Fig. 16**. Oil from main bearings is then supplied to connecting rod bearings through intersecting passages in crankshaft. Passages in crankshaft main bearings supply oil to camshaft bearings through vertical drilled holes. Oil passages from camshaft journals supply oil to hydraulic lifters. Lifters pump oil through push rods to rocker arms. Oil drains back and is directed by cast dams in crankcase casting to supply camshaft lobes. Cam chain drive is lubricated by indirect oil splash.

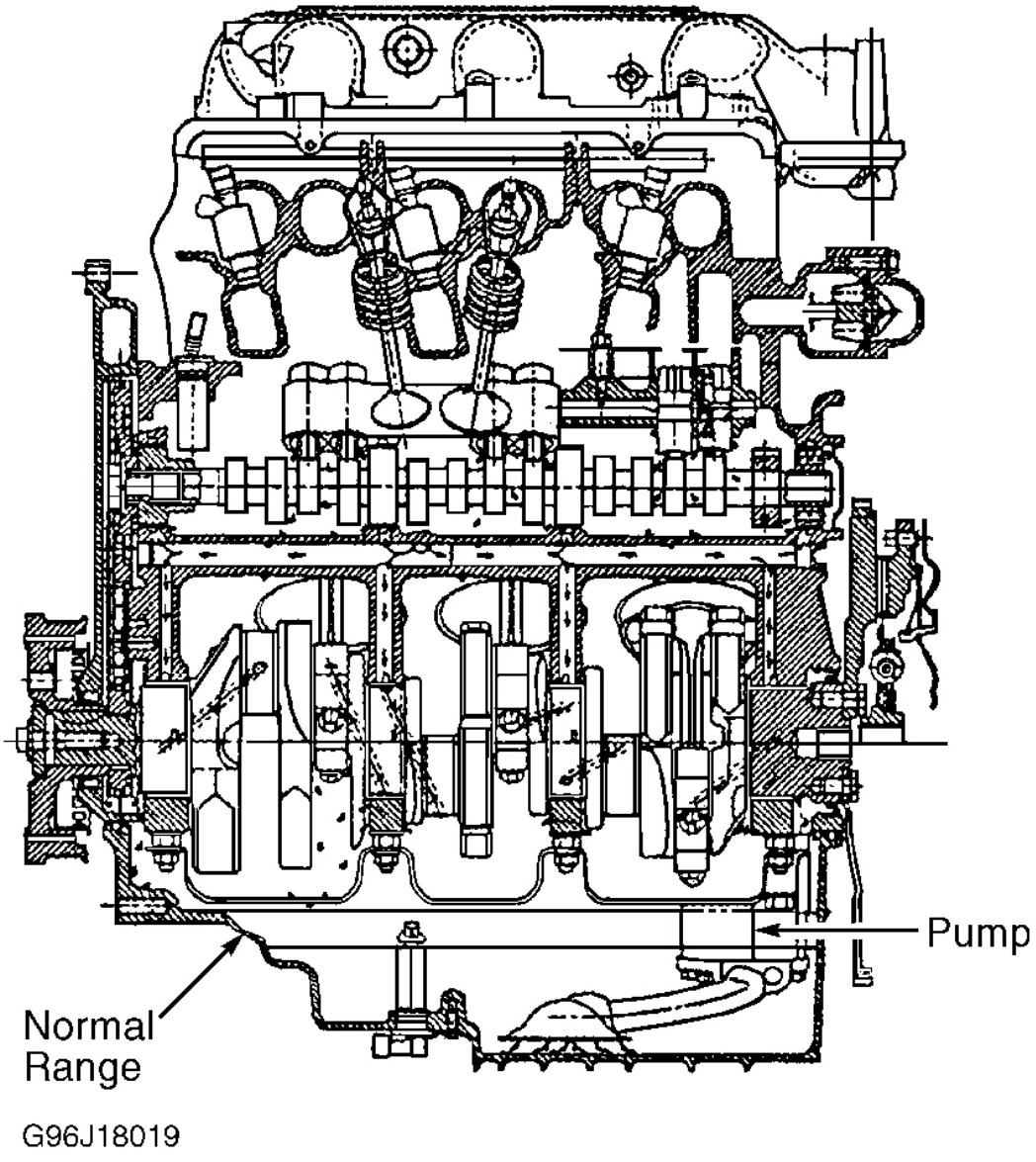


Fig. 16: Engine Oiling System
Courtesy of GENERAL MOTORS CORP.

Crankcase Capacity

Engine oil capacity is 4.0 qts. (3.8L). More oil will be needed when changing oil filter.

Oil Pressure

Normal oil pressure is 50-65 psi (3.5-4.5 kg/cm^2) at 1200 RPM (at normal operating temperature).

OIL PUMP

Removal & Disassembly

1. Remove oil pan. See **OIL PAN** under REMOVAL & INSTALLATION. Remove oil pump mounting bolts. Remove oil pump and drive shaft extension.
2. To disassemble, remove pump cover. DO NOT remove pick-up tube from cover unless loose or broken. If pick-up tube is loose, bent or has been removed, replace pick-up tube and pump cover.

WARNING: Pressure regulator valve spring is under pressure. Remove retaining pin carefully in order to avoid possible injury.

3. Remove gears from pump body. Remove cotter pin securing spring and pressure regulator valve. Remove valve and spring.

Inspection

1. Inspect components for damage. Using straightedge and feeler gauge, measure gear end clearance. Measure housing pocket depth and diameter. Measure gear diameter and length (thickness). Measure side clearance between gear tooth and housing.
2. Measure gear lash clearance between gear teeth. Check clearance between pressure regulator valve and bore. Replace components or entire assembly if not within specification. See **OIL PUMP SPECIFICATIONS** table.

OIL PUMP SPECIFICATIONS

Application	In. (mm)
Diameter	1.503-1.505 (38.18-38.23)
End Clearance	.002-.005 (.040-.125)
Gear Diameter	1.498-1.500 (38.05-38.10)
Housing Pocket Depth	1.202-1.204 (30.52-30.58)
Lash Clearance	.0037-.0077 (.094-.195)
Length (Thickness)	1.199-1.200 (30.45-30.48)
Pressure Relief Valve-To-Bore Clearance	.0015-.0035 (.038-.089)
Side Clearance	.001-.003 (.038-.088)

NOTE: Use only original equipment gaskets for oil pump service, as gasket thickness is critical.

Reassembly & Installation

1. Coat all components with engine oil. To reassemble, reverse disassembly procedure using NEW pump cover gasket. If installing new pick-up tube, apply Sealant (1050026) to pick-up tube. Install pick-up tube

into pump cover using Suction Pipe Installer (J-21882) and plastic hammer.

2. To install, reverse removal procedure. Ensure pump extension shaft is fully engaged. Tighten oil pump bolt to specification. See **TORQUE SPECIFICATIONS**.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Camshaft Sprocket Bolt	103 (140)
Connecting Rod Cap Nut	
Step 1	15 (20)
Step 2	Additional 75 Degrees
Crankshaft Balancer Bolt	76 (103)
Cylinder Head Bolt (1) (2)	
Step 1	(2)
Step 2	(2)
Engine Mount Bracket-To-Oil Pan	43 (58)
Engine Mount Nut	32 (43)
Engine Mount Strut Bracket	
Right	37 (50)
Left	52 (71)
Radiator	21 (28)
Exhaust Crossover Pipe Nut	18 (24)
Exhaust Manifold Bolt	12 (16)
Flexplate/Flywheel Bolt (3)	52 (71)
Front Timing Case Cover Bolt	
Large Diameter	
Long	41 (56)
Short	35 (47)
Small Diameter	21 (28)
Ignition Coil Bracket	18 (24)
Intake Manifold Bolts	
Lower	
Step 1	(5)
Step 2	(5)
Step 3	(5)
Upper	18 (24)
Main Bearing Cap Bolt	
Step 1	37 (50)
Step 2	Additional 77 Degrees

Oil Cooler Fitting	37 (50)
Oil Pan-To-Block	
Bottom Bolt	18 (24)
Side Bolt	37 (50)
Oil Pump Mounting Bolt	30 (41)
Rocker Arm Bolt	
Step 1	14 (19)
Step 2	Additional 30 Degrees
Serpentine Drive Belt Tensioner Bolt	37 (50)
Spark Plugs	15 (20)
Thermostat Housing Bolts	18 (25)
Throttle Body Bolt	18 (24)
Timing Chain Damper Bolt	15 (20)
Water Pump Pulley Bolt	18 (24)
	INCH Lbs. (N.m)
Camshaft Thrust Plate Bolt	89 (10)
Thermostat By-Pass Pipe-To-Front Cover Bolt	106 (12)
Valve Cover Bolt (6)	89 (10)
Valve Lifter Guide Bolt	89 (10)
Water Pump-To-Front Cover Bolt	89 (10)

(1) Apply Sealant (1052080) to cylinder head bolts.

(2) Refer to TSB **REVISED CYLINDER HEAD BOLT TORQUE SPECIFICATION AND TIGHTENING SEQUENCE** . Tighten cylinder head bolts in sequence. See **Fig. 5**.

(3) Apply Thread Locker (12345382) to flexplate/flywheel bolts.

(4) This information has been revised due to GM® Administrative Message #VSS20030024, dated 3/4/2003.

(5) See **TSB** For Revised Lower Intake Torque**Fig. 3**.

(6) Finger tighten first.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	**Specification**
Displacement	209 Cu. In. (3.4L)
Bore	3.62" (92.0 mm)
Stroke	3.31" (84.1 mm)
Compression Ratio	9.5:1
Fuel System	SFI

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft End Play	.0024-.0083 (.061-.211)
Main Bearings	
Journal Diameter	2.6473-2.6483 (67.241-67.267)
Journal Out-Of-Round	.0002 (.005)
Journal Runout	.0016 (.041)
Journal Taper	.0002 (.005)
Oil Clearance	
Except Thrust Bearing	.0008-.0025 (.020-.064)
Thrust Bearing	.0012-.0030 (.030-.076)
Connecting Rod Bearings	
Journal Diameter	1.9987-1.9994 (50.767-50.785)
Journal Out-Of-Round	.0002 (.005)
Journal Taper	.0002 (.005)
Oil Clearance	.0007-.0024 (.018-.061)

CONNECTING RODS

Application	In. (mm)
Bore Diameter	
Pin Bore	(1)
Crankpin Bore	2.124-2.125 (53.95-53.98)
Maximum Bend (2)	.007 (.18)
Maximum Twist (3)	.0015 (.038)
Side Play	.0015 (.038)

(1) Information not available from manufacturer.

(2) Per 3" (76.2 mm) of rod length.

(3) Per 1" (25.4 mm) of rod length.

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	.0013-.0030 (.033-.076)
Diameter	3.6209-3.6216 (91.971-91.989)
Pin Bore	.9057-.9060 (23.005-23.012)
Pins	
Diameter	.9052-.9054 (22.992-22.997)
Piston Fit	.0004-.0008 (.010-.020)

Rod Fit	Press Fit
Rings	
No. 1	
End Gap	.006-.014 (.15-.36)
Side Clearance	.0016-.0030 (.041-.076)
No. 2	
End Gap	.019-.029 (.48-.74)
Side Clearance	.0016-.0035 (.041-.089)
No. 3 (Oil)	
End Gap	.010-.030 (.25-.76)
Side Clearance (Max.)	.008 (.20)

CYLINDER BLOCK

Application	**In. (mm)**
Camshaft Bearing Bore	
Front & Rear	2.0090-2.0110 (51.029-51.079)
No. 2 & 3	1.9990-2.0010 (50.775-50.825)
Crankshaft Main Bearing Bore	2.8407-2.8412 (72.155-72.168)
Cylinder Bore	
Diameter	3.6228-3.6235 (92.019-92.037)
Maximum Taper	.0004 (.010)
Maximum Out-Of-Round	.0003 (.008)
Maximum Deck Warpage (1)	N/A

(1) Information is not available from manufacturer. DO NOT machine more than .010" (.25 mm) from original surface.

VALVES & VALVE SPRINGS

Application	**Specification**
Valves	
Face Angle	45°
Margin	
Exhaust	.0106" (.269 mm)
Intake	.0083" (.211 mm)
Valve Springs	
Free Length	1.91" (48.5 mm)
Installed Height	1.701" (43.21 mm)
	Lbs. @ In. (kg @ mm)
Pressure	

Valve Closed	72 @ 1.70 (32.7 @ 43.2)
Valve Open	230 @ 1.26 (104.3 @ 32.0)

CYLINDER HEAD

Application	Specification
Valve Seats	
Intake Valve	
Seat Angle	46°
Seat Width	.061-.071" (1.55-1.80 mm)
Maximum Seat Runout	.0014" (.036 mm)
Exhaust Valve	
Seat Angle	46°
Seat Width	.067-.079" (1.70-2.01 mm)
Maximum Seat Runout	.0014" (.036 mm)
Valve Guides	
Valve Guide Oil Clearance	.001-.003" (.03-.08 mm)

CAMSHAFT

Application	In. (mm)
Camshaft Bearing Inside Diameter	1.8710-1.8720 (47.523-47.549)
Journal Diameter	1.868-1.869 (47.45-47.48)
Journal Runout	.001 (.03)
Lobe Lift	
Intake	.273 (6.93)
Exhaust	.273 (6.93)
Oil Clearance	.001-.004 (.025-.101)