

ENGINE

Engine Mechanical - 6.2L (LT1) - Description and Operation - Corvette

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM DESCRIPTION

A closed crankcase ventilation system is used in order to provide a more complete scavenging of the crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases and then passed through a crankcase ventilation valve into the intake manifold.

The primary control is through the crankcase ventilation valve which meters the flow at a rate depending on manifold vacuum. To maintain idle quality, the crankcase ventilation valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

Filtered fresh air is routed from up-stream of the throttle blade to the front of the right and left rocker arm covers via formed rubber hoses. To reduce the potential of oil pullover into the throttle bore area due to back flow of the ventilation system, the fittings in the rocker arm covers are shielded from the rocker arms. From there fresh air and gases are routed through the crankcase and up to the front of the Valve Lifter Oil Manifold where the positive crankcase ventilation (PCV) valve is located. Gases are then routed through a hose to the intake manifold.

CRANKCASE VENTILATION SYSTEM DESCRIPTION (WITH Z52 OPTION)

A closed crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. Filtered air from the air induction system duct is supplied to the crankcase, mixed with blow-by vapors and passes through a crankcase ventilation metering device before entering the intake manifold. The primary component in the positive crankcase ventilation (PCV) system is the PCV flow metering device (valve). Vacuum changes within the intake manifold result in flow variations of the blow-by vapors. If abnormal operating conditions occur, the design of the PCV system permits excessive amounts of blow-by vapors to back flow through the crankcase vent tube and into the engine induction system to be consumed during normal combustion. This engine ventilation system design minimizes oil consumption and significantly reduces the potential for oil ingestion during vehicle limit handling maneuvers.

LT1 Dry Sump Engine (with Z52 Option)

The LT1 Dry Sump engine utilizes an integral positive crankcase ventilation (PCV) system which is located in the valve lifter oil manifold assembly beneath the intake manifold. The valve lifter oil manifold assembly contains composite oil separating baffles and PCV plumbing. Filtered fresh air is routed from upstream of the throttle plate to the engine oil tank where it mixes with crankcase gasses and is passed to both engine rocker arm covers. The rocker arm covers' design shields rocker arm oil spray, thereby reducing the potential for oil being drawn back into the tank during backflow of the ventilation system. Blow-by vapors are routed from the valve lifter oil manifold assembly through an

integrated PCV valve, then through a formed nylon hose before entering the intake manifold behind the throttle body.

ENGINE COMPONENT DESCRIPTION

The 6.2 Liter V8 LT1 Engine

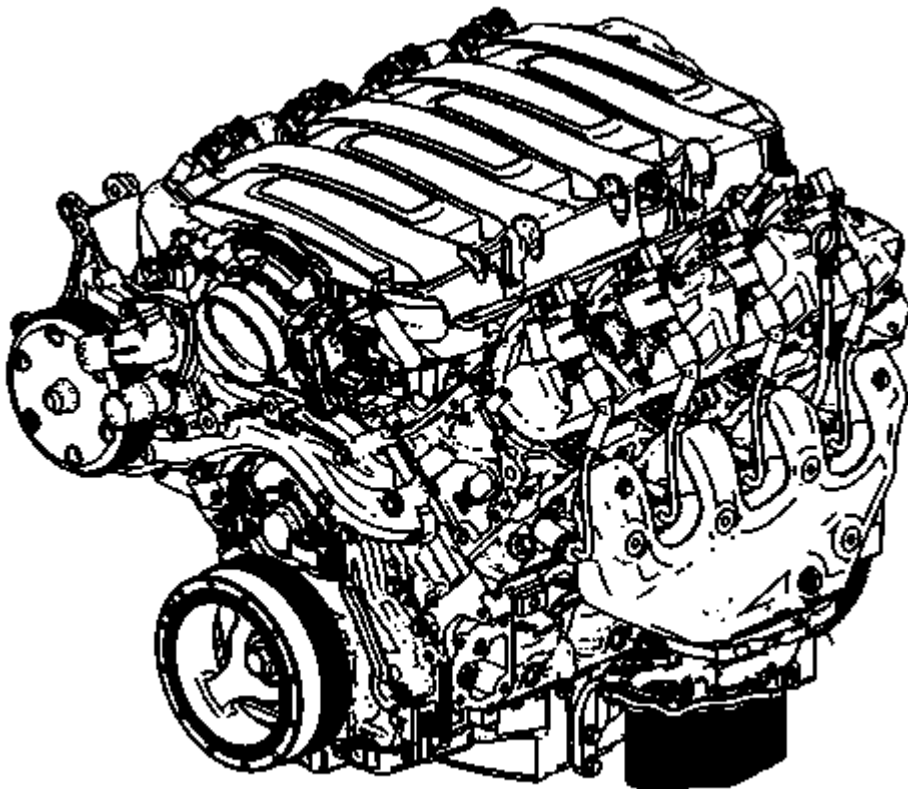


Fig. 1: 6.2 Liter V8 LT1 Engine
Courtesy of GENERAL MOTORS COMPANY

Camshaft and Drive System

A billet steel 1-piece camshaft is supported by 5 bearings pressed into the engine block. The camshaft has a tri-lobe forward of the rear journal for actuating the direct injection fuel pump. The CMP actuator is mounted to the front of the camshaft and retained by the CMP solenoid valve. The CMP actuator is driven by the crankshaft sprocket through the camshaft timing chain. The CMP sensor wheel is incorporated into the front face of the CMP actuator with the CMP sensor and CMP actuator magnet mounted in the engine front cover. A timing chain tensioner is mounted to the front of the engine block above the crankshaft sprocket. The externally splined crankshaft sprocket is positioned to the crankshaft by a key and keyway. The crankshaft sprocket external splines drive the oil pump drive gear. A retaining plate mounted to the front of the engine block maintains camshaft location. Refer to **Camshaft Position Actuator and Solenoid Valve Description**.

Crankshaft

The crankshaft is made of hardened forged steel. The crankshaft is supported by 5 crankshaft bearings. The bearings are retained by crankshaft bearing caps which are machined with the engine block for proper alignment and clearance. The crankshaft journals are undercut and rolled. The center main journal is the thrust journal. A CKP reluctor ring is press-fit mounted at the rear of the crankshaft. The reluctor ring is not serviceable separately.

Cylinder Heads

The cylinder heads are cast aluminum and have pressed in place powdered metal valve guides and valve seats. The valve rocker arm covers are retained to the cylinder head by 10 perimeter mounted rocker arm cover bolts. Cylinder heads are a high-flow design with offset intake valve rocker arms.

Engine Block

The engine block is a cam-in-block deep skirt 90 degree V-configuration with 5 crankshaft bearing caps. The engine block is cast aluminum. The 5 crankshaft bearing caps each have 4 vertical M10 and 2 horizontal M8 mounting bolts. The camshaft is supported by 5 camshaft bearings pressed into the block. The left bank of cylinders are number 1-3-5-7 (#1 is front left) and the right bank of cylinders are 2-4-6-8 (#2 is front right) viewed from the flywheel end of the engine. The engine firing order is 1-8-7-2-6-5-4-3.

Exhaust Manifolds

The exhaust manifolds are a 1-piece cast iron design. The exhaust manifolds direct exhaust gasses from the combustion chambers to the exhaust system. Each manifold also has an externally mounted heat shield that is retained by bolts.

Intake Manifold

The intake manifold is a 1-piece composite design that incorporates brass threaded inserts for mounting the throttle body and wire harness studs. Each side of the intake manifold is sealed to the cylinder head by 8 silicone push in place gaskets. The electronically actuated throttle body bolts to the front of the intake manifold. The throttle body is sealed by a 1-piece push in place silicone gasket. The intake manifold covers the direct injected fuel rail assembly, fuel pipes and fuel pump. The manifold absolute pressure (MAP) sensor is installed and retained to the top left of the intake manifold midway back under the left engine cover. The evaporative (EVAP) emission canister purge solenoid valve is mounted right front of the intake aft of the throttle body assembly

Fuel System

The fuel system consists of 8 separate direct injection fuel injectors, two high pressure fuel rails, a high pressure cross-over fuel pipe (connects the two fuel rails), a high pressure fuel feed pipe (connects the cross-over pipe to the high pressure fuel pump), a high pressure fuel pump and a low pressure fuel feed pipe. The injectors are each seated into their individual bores in the cylinder heads with two combustion seals to provide sealing. The high pressure fuel pump mounts to the rear of the Valve Lifter Oil Manifold in the engine valley. Motion is transmitted to the pump from a tri-lobe on the

rear of the camshaft through a hydraulic roller lifter.

Oil Pan

The structural rear-sump oil pan is cast aluminum. Incorporated into the design is the oil filter mounting boss, drain plug opening, baffle, oil deflector, oil pump screen and oil level sensor (wet sump system only). The oil filter bypass valve is in the oil filter assembly. An external oil cooler assembly is mounted directly to the left side of the oil pan. The oil pan is sealed to the oil pump with a silicone push in place gasket and to the engine block with RTV sealant. Dowels are pressed into the pan for aid in alignment to the engine block during assembly.

Piston and Connecting Rod Assembly

The pistons are cast aluminum. The pistons use 2 compression rings and 1 oil control ring assembly. The piston is a low friction, lightweight design with a recessed top and barrel shaped skirt. The piston pins are chromium steel and are a full-floating design. The connecting rods are powdered metal. The connecting rods are fractured at the connecting rod journal and then machined for the proper clearance. All applications use a piston with a graphite coated skirt. The piston and pin are to be serviced as an assembly.

Valve Rocker Arm Cover Assemblies

The valve rocker arm covers are cast aluminum and use a pre-molded silicon gasket for sealing. Mounted to each rocker cover are the coil assemblies. Incorporated into the left and right valve rocker arm covers are the positive crankcase ventilation (PCV) fresh air passages. Incorporated into the left cover is the oil fill tube (wet sump system only).

Valve Train

Motion is transmitted from the camshaft through the hydraulic roller valve lifters and tubular pushrods to the roller type rocker arms. The nylon valve lifter guides position and retain the valve lifters. The valve rocker arms are mounted on individual pedestals or pivot supports that are incorporated into the cylinder heads. Each rocker arm is retained by a bolt. Valve lash is net build. Cylinders 1, 4, 6 and 7 are active fuel management. Refer to **Cylinder Deactivation (Active Fuel Management) System Description**.

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) SYSTEM DESCRIPTION

System Operation

General Motors Active Fuel Management engine control system has the ability, under certain light load driving conditions, to provide maximum fuel economy by deactivating 4 of the engines 8 cylinders. The engine will normally operate on 8 cylinders in V8 mode during starting, idling and medium or heavy throttle conditions. When commanded ON, the engine control module (ECM) will direct the active fuel management system and deactivate cylinders 1 and 7 on the left bank and cylinders 4 and 6 on the right bank, forcing V4 mode. Refer to **Lubrication Description**, **Lubrication Description (with Z52 Option)** and **Cylinder Deactivation (Active Fuel Management) System Description**.

Valve Lifter Oil Manifold Assembly

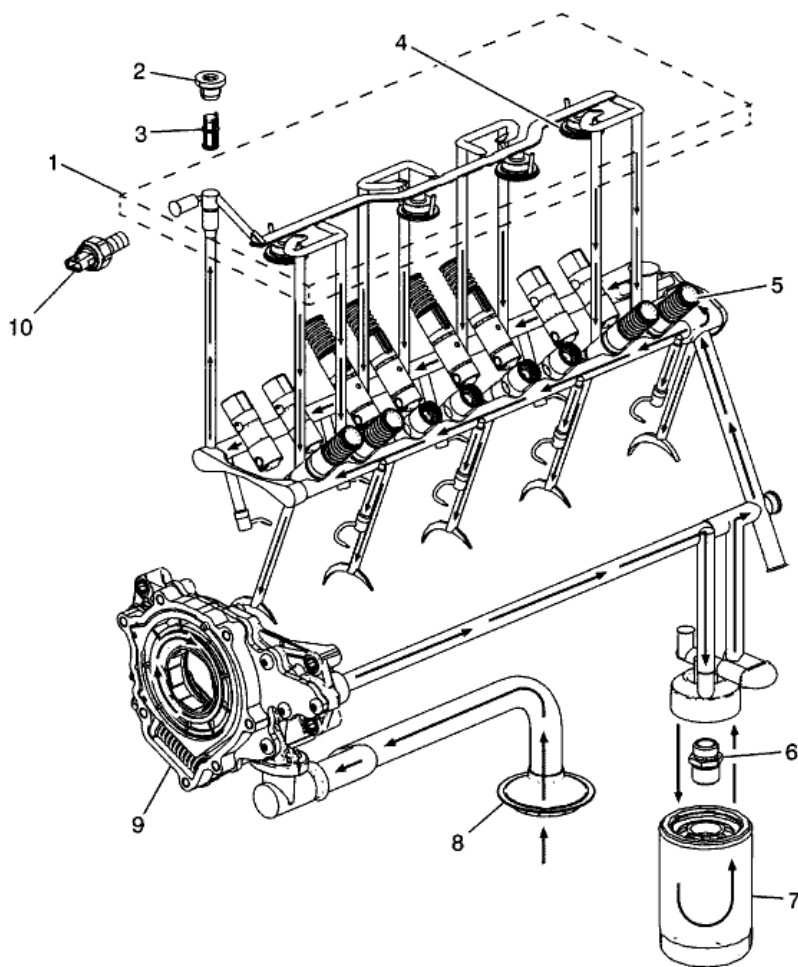


Fig. 2: Valve Lifter Oil Manifold Assembly
Courtesy of GENERAL MOTORS COMPANY

The valve lifter oil manifold assembly (1) is bolted to the top of the engine block beneath the intake manifold assembly. The oil manifold consists of 4 electrically operated and normally-closed solenoids (4). Each solenoid directs the flow of pressurized engine oil to the active fuel management intake and exhaust valve lifters (5).

When enabling conditions are met for active fuel management operation, the ECM will ground each solenoid control circuit in firing order sequence, allowing current to flow through the solenoid windings. With the windings energized, the solenoid valves open and direct pressurized engine oil through the valve lifter oil manifold into 8 vertical passages in the engine block lifter valley. The 8 vertical passages, 2 per AFM cylinder, direct pressurized oil to the valve lifter bores of the cylinders to be deactivated. When vehicle operating conditions require a return to V8 mode, the ECM will turn OFF the ground circuit for the solenoids, allowing the solenoid valves to close. When the solenoid valves are closed, remaining oil pressure is exhausted through the bleed passages of the valve lifter oil manifold into the engine block lifter valley. The housing of the oil manifold incorporates a vent

To help control contamination within the active fuel management hydraulic system, a small replaceable oil filter (3) is located in the valve lifter oil manifold oil inlet passage. The oil pressure sensor (10) monitors engine oil pressure and provides information to the ECM.

Active Fuel Management Valve Lifters

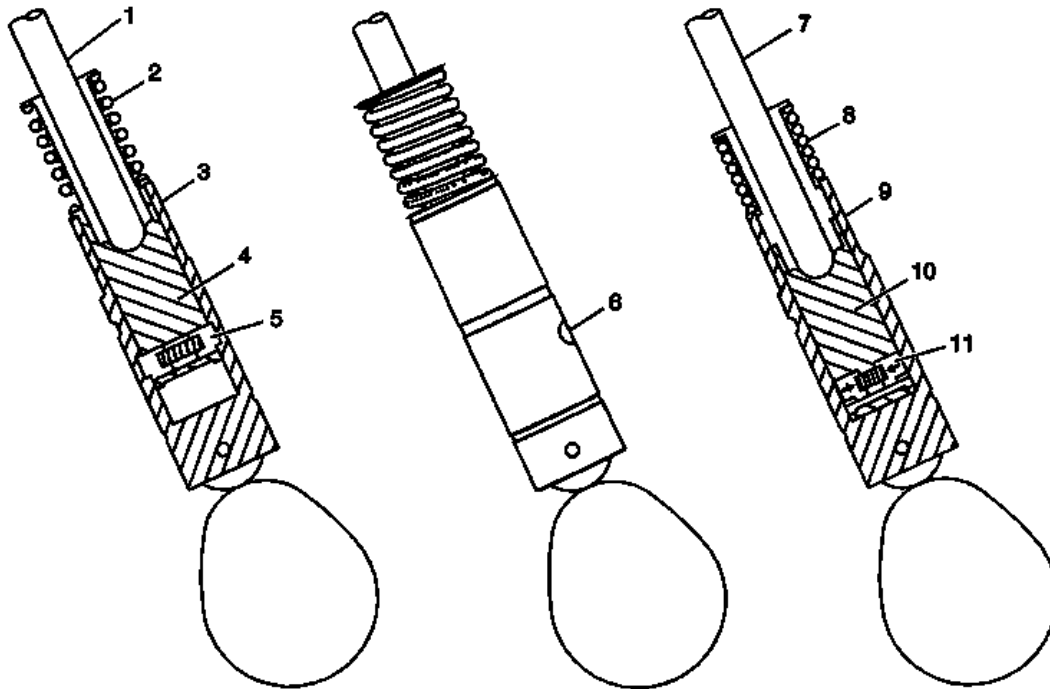


Fig. 3: Displacement On Demand Valve Lifters
Courtesy of GENERAL MOTORS COMPANY

When operating in V8 mode, the active fuel management valve lifters function similar to the non-active fuel management valve lifters. The active fuel management oil manifold solenoids are in the closed position, with no pressurized oil directed to the valve lifters. The pushrod (1) travels upward and downward to actuate the rocker arm and valve. The spring loaded locking pins (5) of the lifter are extended outward and mechanically lock the pin housing (4) to the outer body of the valve lifter (3).

When the active fuel management system is commanded ON, the ECM will direct the solenoids of the oil manifold to open and direct pressurized oil to the valve lifters. Oil travels through the valve lifter oil manifold and engine block oil galleries and enters the inlet port (6) of the valve lifter.

When operating in V4 mode, pressurized oil forces the locking pins (11) inward. The pushrod (7) remains in a constant position and does not travel upward and downward. The outer body of the lifter (9) moves upward and downward independently from the pin housing (10). The valve lifter spring (8) retains tension on the valve train components to eliminate valve train noise.

When the active fuel management system is commanded OFF, the ECM directs the solenoids of the oil manifold to close, stopping the flow of pressurized oil to the valve lifters. The oil pressure within the

outer body.

Engine Block

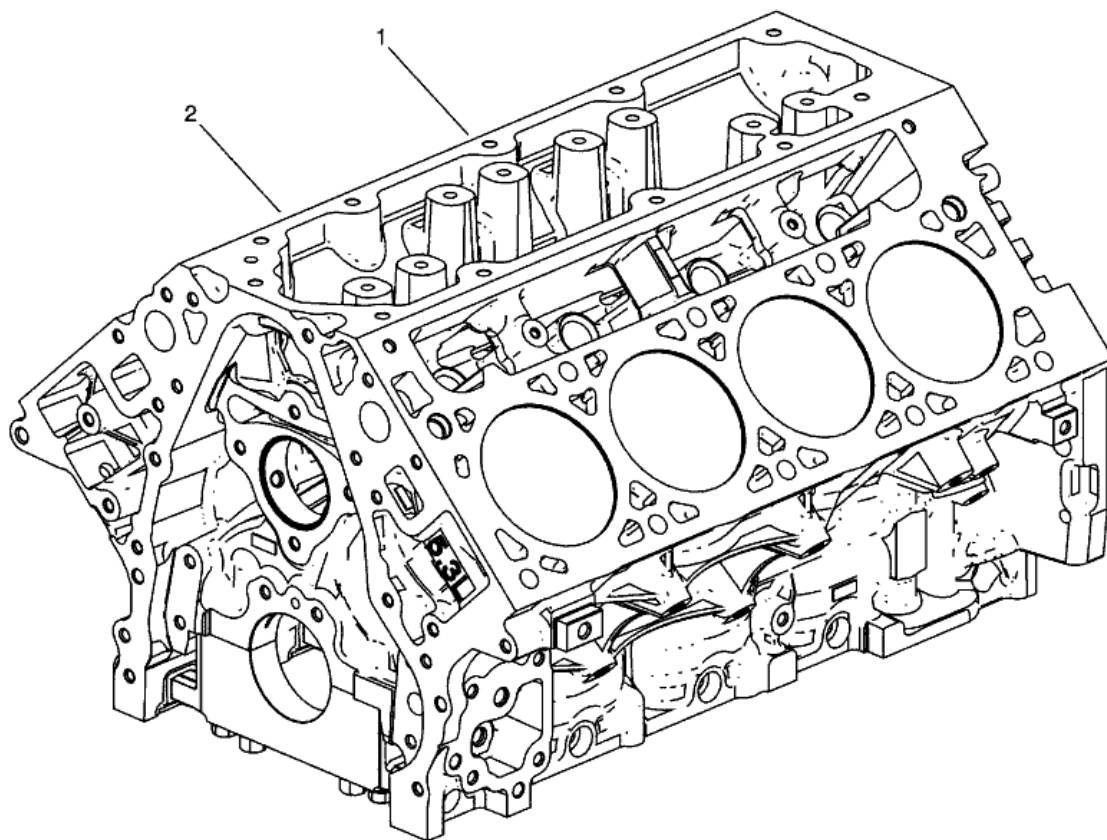


Fig. 4: Engine Block

Courtesy of **GENERAL MOTORS COMPANY**

The active fuel management engine block incorporates additional features to support active fuel management system operation. Engine oil pressure is routed to the valve lifter oil manifold assembly from an oil gallery (2) in the front of the cylinder block. Cylinders 1, 4, 6 and 7 each have 2 vertical, cast-in-block oil passages (1). The vertical oil passages permit oil flow from the manifold assembly to the valve lifter bores.

Engine Control Module (ECM)

Refer to **Cylinder Deactivation (Active Fuel Management) System Description** .

CAMSHAFT POSITION ACTUATOR AND SOLENOID VALVE DESCRIPTION

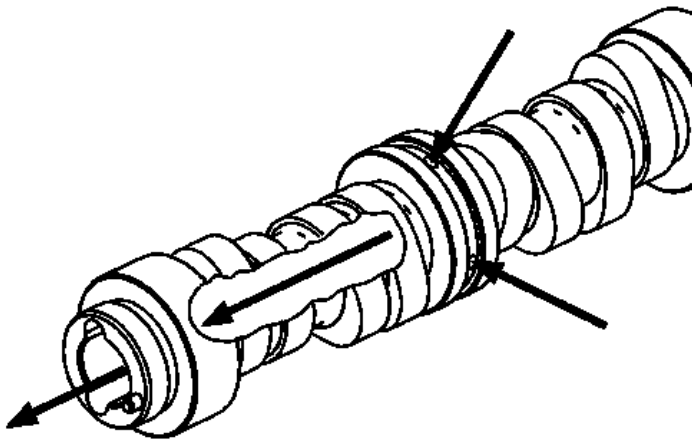


Fig. 5: Camshaft Lubrication Path
 Courtesy of GENERAL MOTORS COMPANY

The camshaft is designed to provide a lubrication path for pressurized engine oil to flow to the camshaft position (CMP) actuator. Pressurized engine oil enters the camshaft at bearing journal location number 2. Oil travels through the camshaft, out the front and into the CMP actuator solenoid valve.

CMP Actuator Solenoid Valve

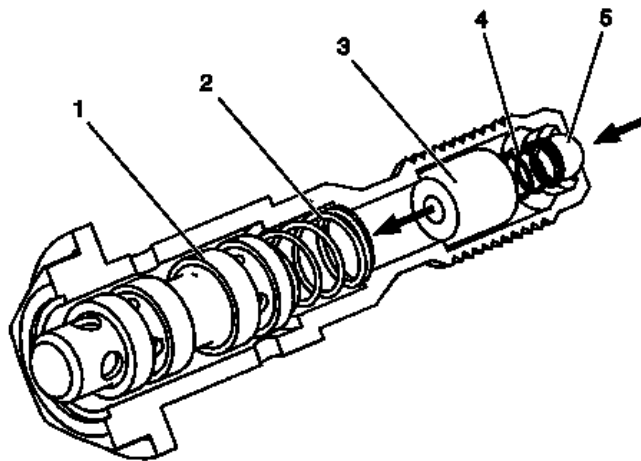


Fig. 6: CMP Actuator Solenoid Valve Components
 Courtesy of GENERAL MOTORS COMPANY

The CMP actuator solenoid valve consists of a housing, spool valve (1), spool return spring (2), oil filter (3), inlet check ball return spring (4) and inlet check ball (5). Pressurized engine oil enters the valve and travels through the filter to the spool. Spool position is controlled by the CMP magnet and engine control module (ECM). When the spool is moved to the proper position, oil flow is directed through the valve and into the CMP actuator assembly. The CMP solenoid valve is a torque-to-yield design and should be replaced each time it is removed.

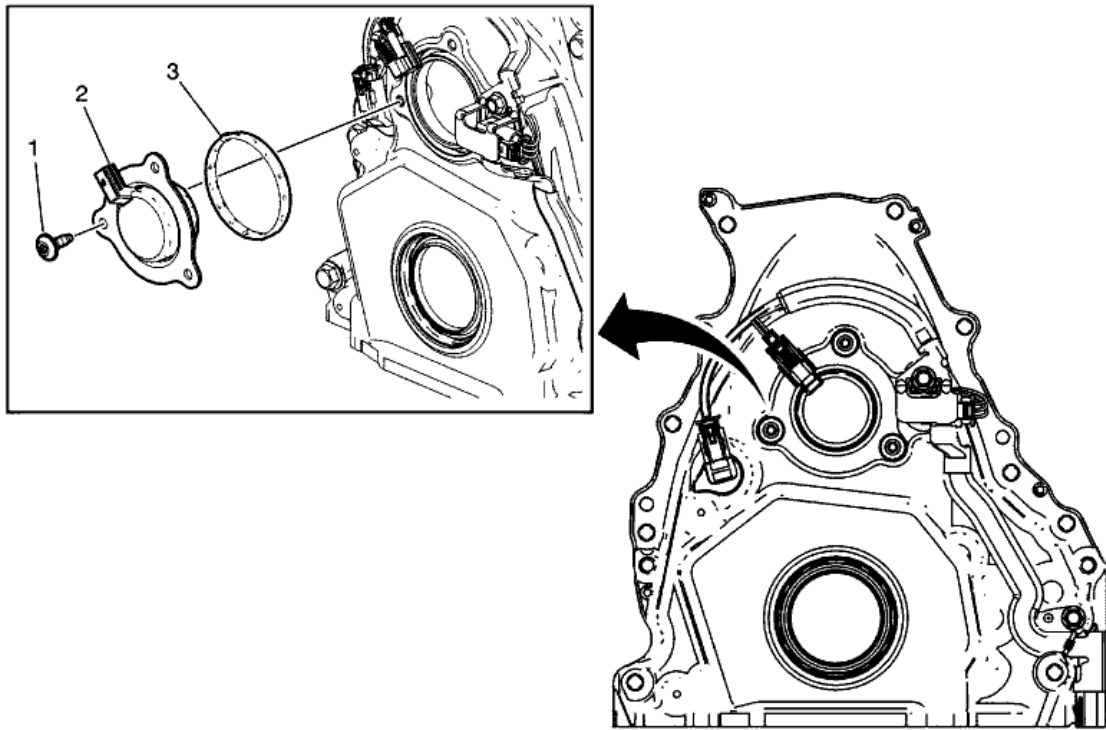


Fig. 7: CMP Actuator Magnet
 Courtesy of GENERAL MOTORS COMPANY

The CMP actuator magnet (2) is located in the engine front cover and is sealed by a press in place gasket (3). The CMP actuator magnet is controlled by a 12-volt 150 Hz pulse width 0-100 percent duty cycle signal from the ECM. When energized, the solenoid uses electromagnetic force on the magnet pintle to position the spool valve of the CMP solenoid valve.

CMP Actuator

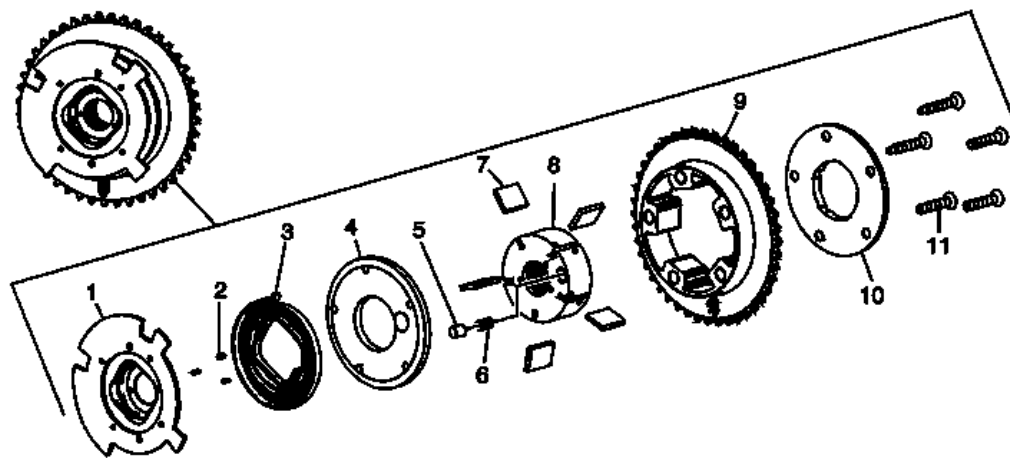


Fig. 8: View Of CMP Actuator Components
 Courtesy of GENERAL MOTORS COMPANY

The CMP actuator is a vane type design that hydraulically changes angle or timing of the camshaft relative to crankshaft position. The CMP actuator allows earlier or later intake and exhaust valve opening during the 4-stroke engine cycle. The CMP actuator cannot vary the duration of valve opening or valve lift. The CMP actuator is to be serviced as an assembly. For system operation, refer to **Camshaft Actuator System Description** .

The CMP actuator consists of the CMP reluctor wheel (1), wheel retaining pins (2), return spring (3), front cover (4), park position pin (5), park position pin spring (6), vanes and vane springs (7), rotor (8), housing with chain sprocket (9), sealing cover/thrust plate (10) and bolts (11).

CMP System Operation

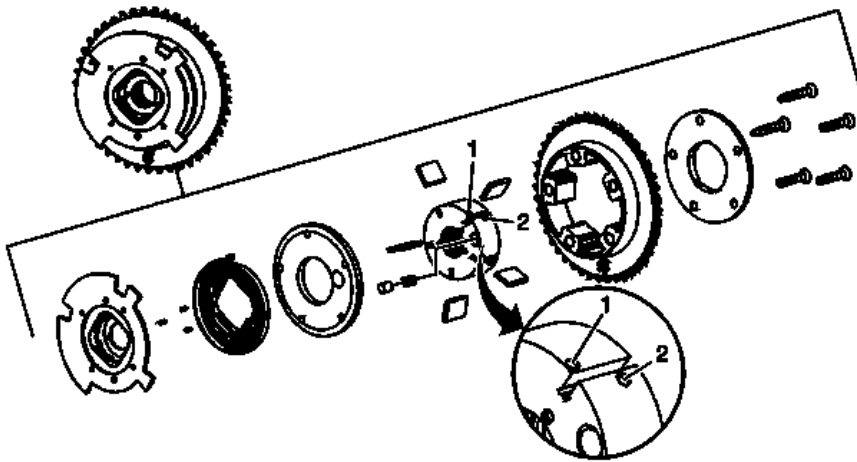


Fig. 9: CMP Actuator
Courtesy of GENERAL MOTORS COMPANY

A CMP actuator dynamically changes valve timing events relative to piston timing by controlling camshaft position. This is sometimes referred to as variable valve timing or camshaft phasing. Variable valve timing or camshaft phasing does not change duration or lift.

- By advancing camshaft timing, an improvement in low end torque can be achieved.
- By retarding camshaft timing slightly, an improvement in high end power can be achieved.
- By retarding camshaft timing significantly, an improvement in light load fuel economy can be achieved.

There are 5 cavities divided by vanes within the CMP actuator.

- When oil is directed to the advance cavities (1), the camshaft timing is advanced.
- When oil is directed to the retard cavities (2), the camshaft timing is retarded.
- When oil is directed to both cavities, the camshaft is held stationary.

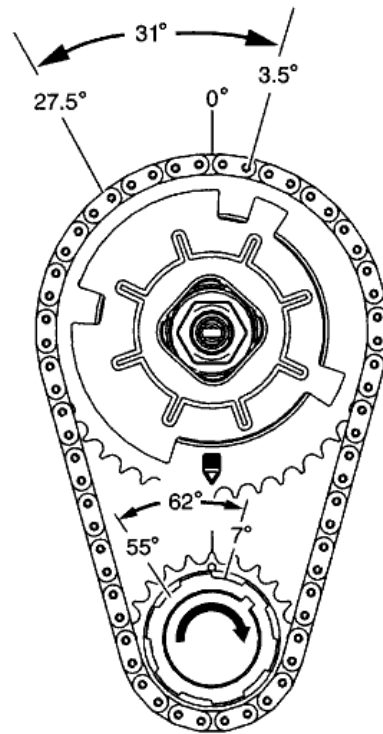


Fig. 10: Degree Range Of Authority At Crankshaft
Courtesy of GENERAL MOTORS COMPANY

The CMP actuator has a 62 degree range of authority at the crankshaft (31 degrees at the camshaft). With the engine not running and no engine oil pressure to the CMP actuator, the high tension spring positions camshaft timing at the 7 degree advanced park position at the crankshaft (3.5 degrees at the camshaft). During normal engine operation and based on performance requirements, the ECM may adjust camshaft timing, as required, within a range from 7 degrees advanced at the crankshaft (3.5 degrees at the camshaft) to 55 degrees retard at the crankshaft (27.5 degrees at the camshaft).

CMP System Lubrication Flow and Actuator Operation

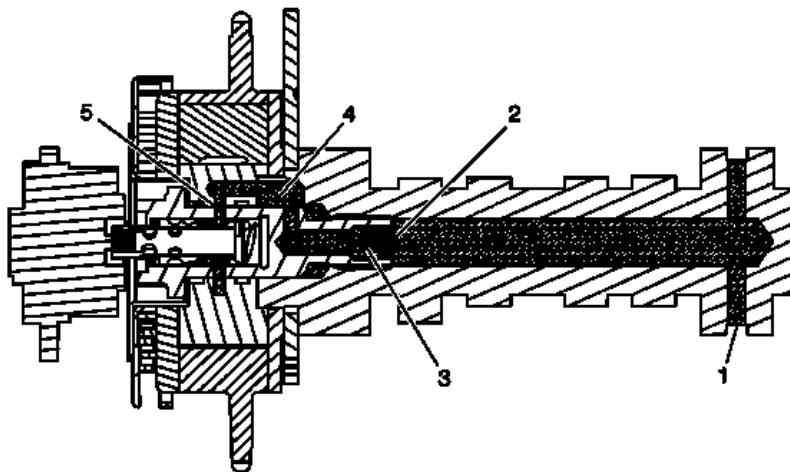


Fig. 11: Cutaway View Of Actuator

Courtesy of **GENERAL MOTORS COMPANY**

1. Oil enters the camshaft at the second main bearing journal (1).
2. Oil travels through the camshaft into the CMP actuator valve check ball (2) and filter (3).
3. Oil exits the valve and travels through the internal passages of the camshaft (4).
4. Oil exits the camshaft and enters the actuator oil entry ports.
5. Oil travels through the actuator and is directed back into the valve (5).
6. Valve spool position directs oil to the advance or retard passages of the actuator.

The valve may also, under certain conditions, be positioned in a neutral position with alternating low, balanced oil flow between the advance and retard passages of the actuator.

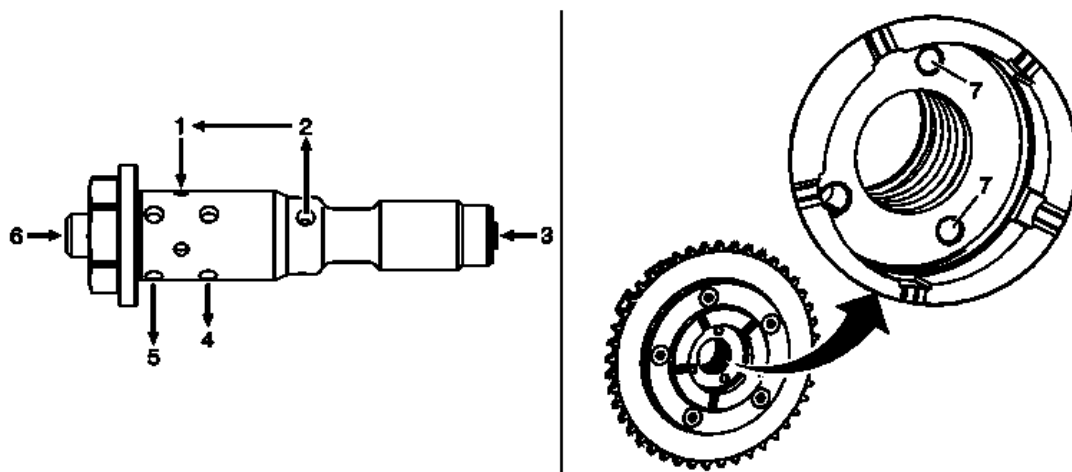


Fig. 12: Identifying Actuator Passages
Courtesy of **GENERAL MOTORS COMPANY**

1. Oil flows from the camshaft into the valve inlet (3) through the internal check ball and filter.
2. Oil exits the valve (2) and travels within the internal passages of the camshaft into the entry ports (7) of the actuator.
3. The center oil groove of the actuator is pressurized and oil reenters the valve (1).
4. Valve spool position directs oil out of the valve advance (5) or retard (4) ports to the actuator.

The valve may also, under certain conditions, be positioned in a neutral position with alternating low, balanced oil flow between the advance and retard passages of the actuator.

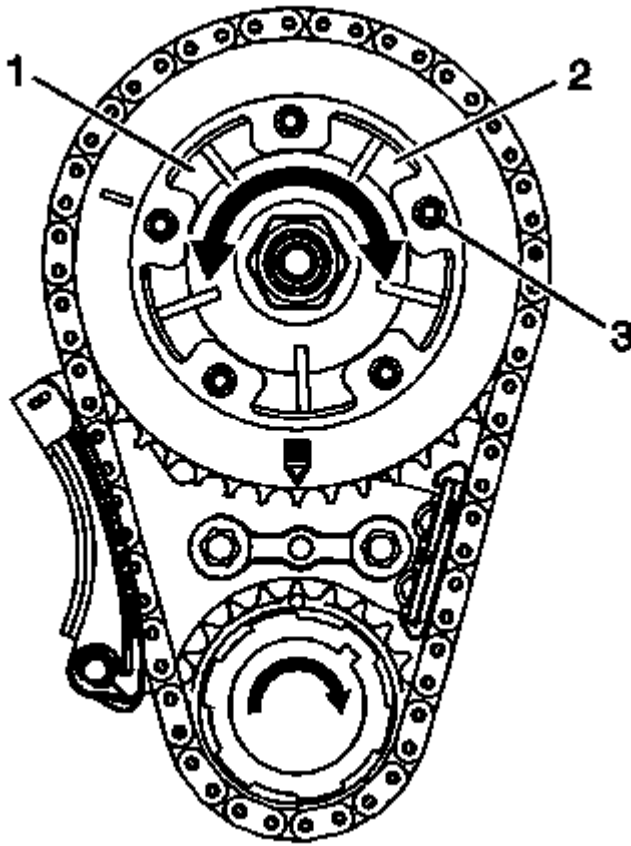


Fig. 13: View Of Advance And Retard Cavities
Courtesy of GENERAL MOTORS COMPANY

1. Pressurized oil enters the retard cavities (2) of the actuator and moves the park pin (3) from the locked position.
2. As pressure increases within the retard cavities (2), the rotor and camshaft rotate counter clockwise retarding valve timing.
3. As the duty cycle decreases, the spool is repositioned and oil is sent to the advance cavities (1), rotating the rotor and camshaft clockwise, advancing valve timing.
 - With a 0 percent duty cycle signal to the magnet, the spool is positioned in the fully extended position and there is full flow to the advance cavities of the actuator. As duty cycle increases to near 50 percent, flow to the advance cavities is decreased.
 - With a 50 percent duty cycle, the spool is positioned neutral, with no flow to either the advance and retard cavities.
 - With a 51-100 percent duty cycle, the spool is positioned to provide oil flow to retard cavities. As the duty cycle increases, the flow to retard cavities increases.
 - With a 100 percent duty cycle, there is full flow to the retard cavities of the actuator.
 - The above duty cycle percentage values are only a guideline, as the actual duty cycle values may vary based on engine oil temperature, solenoid magnet coil temperature, magnet coil resistance and other specifics.

CMP Actuator Park Position Verification

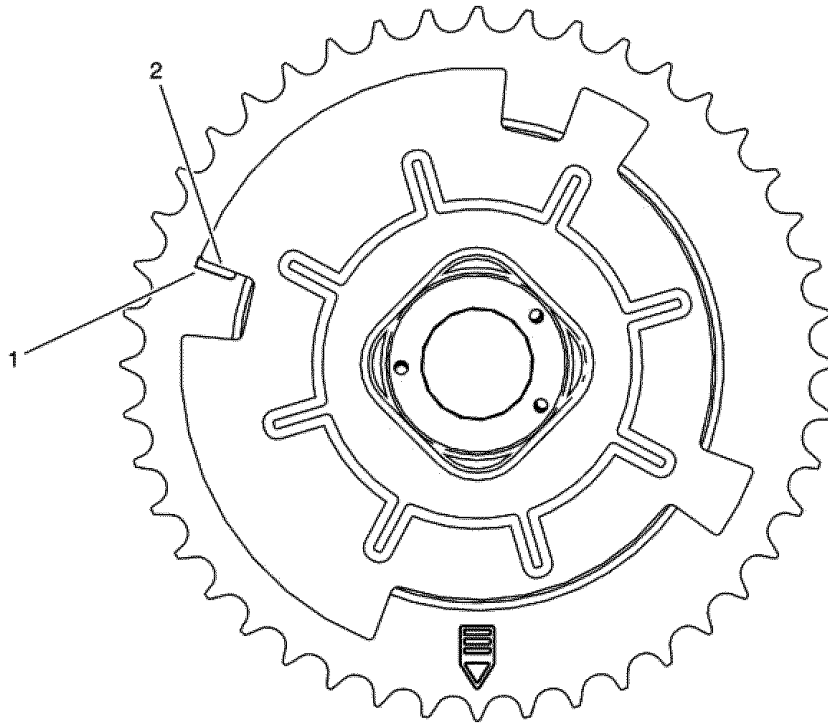


Fig. 14: CMP Actuator Park Position
Courtesy of GENERAL MOTORS COMPANY

The CMP actuator can be visually inspected to determine if the tension spring has returned the reluctor wheel and rotor to the park position.

With the reluctor wheel returned to the proper parked position, the edge of the notched area of the wheel (2) aligns with the marking (1) on the camshaft sprocket.

CMP Actuator Handling Safety

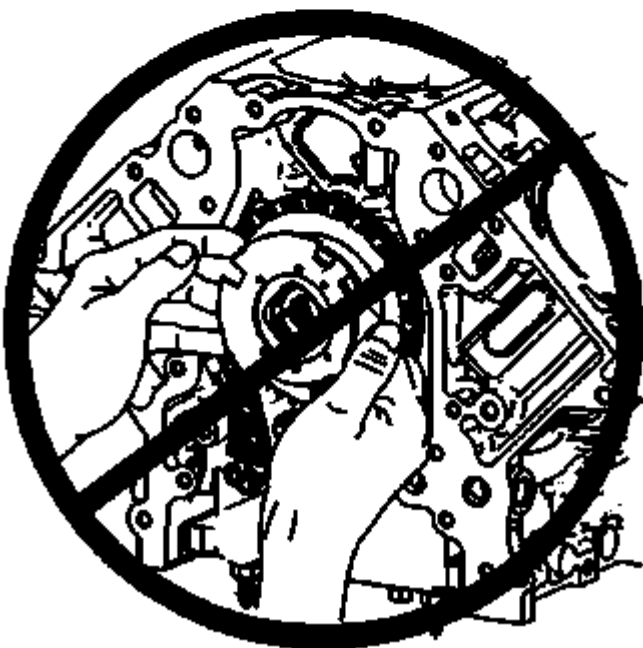
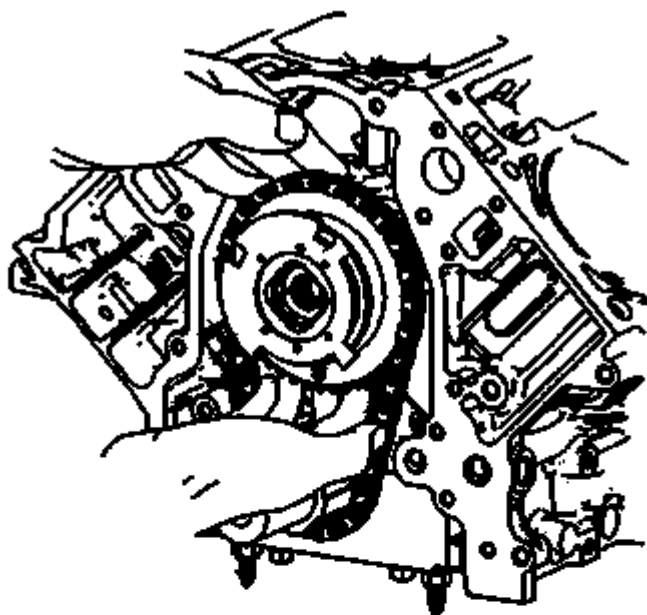


Fig. 15: View Of Proper CMP Actuator Removal
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Camshaft Position Actuator Removal and Installation Warning .

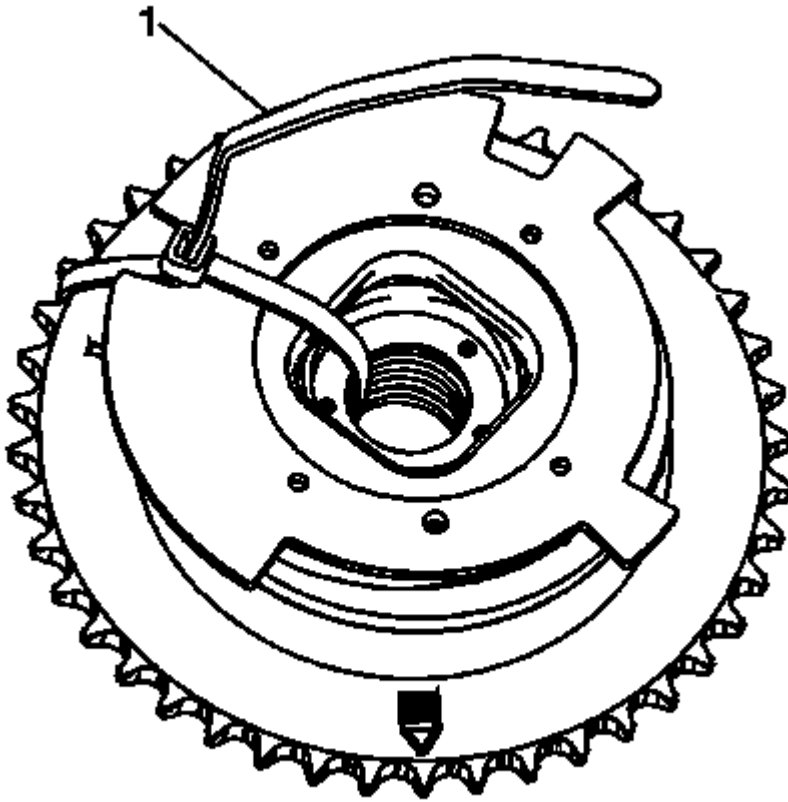


Fig. 16: View Of Tie Strap Through Center Of Actuator
Courtesy of GENERAL MOTORS COMPANY

Install tie wrap (1) to retain the reluctor wheel to the sprocket. The reluctor wheel is mounted to the actuator body with 3 roll pins.

NEW PRODUCT INFORMATION

The purpose of New Product Information is to highlight or indicate, important product changes from the previous model year.

Changes may include 1 or more of the following items:

- Torque values and/or fastener tightening strategies
- Changed engine specifications
- New sealants and/or adhesives
- Disassembly and assembly procedure revisions
- Engine mechanical diagnostic procedure revisions
- New special tools required
- A component comparison from the previous year

Changed Engine Specifications

A variety of specifications have been revised based on the new design of the LT1 engine. Refer to **Engine Mechanical Specifications** .

Torque Values and/or Fastener Tightening Strategies

- All fasteners and threaded holes on the LT1 engine utilize metric threads.
- Cylinder head, connecting rod, crankshaft balancer, camshaft sprocket and main bearing cap bolts still apply a torque and angle tightening strategy.
- Certain fasteners should not be used again. Bolts, studs or other fasteners that must be replaced, will be called out in the specific service procedure.

New Sealants and/or Adhesives

Sealers and adhesives, as required, are identified within the specific service procedures. Refer to **Adhesives, Fluids, Lubricants and Sealers** .

Disassembly and Assembly Procedure Revisions

A variety of procedures have been revised based on the new design LT1 engine.

Engine Mechanical Diagnostic Procedure Revisions

Diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **Diagnostic Starting Point - Vehicle** .

New Special Tools Required

A variety of new special tools are required for the new design LT1 engine. Refer to **Special Tools** .

A Component Comparison from the Previous Year

The 6.2L LS3 VIN W Gen 4 engine is replaced by the 6.2L LT1 VIN 7 Gen 5 engine. Refer to **Engine Component Description**.

LUBRICATION DESCRIPTION

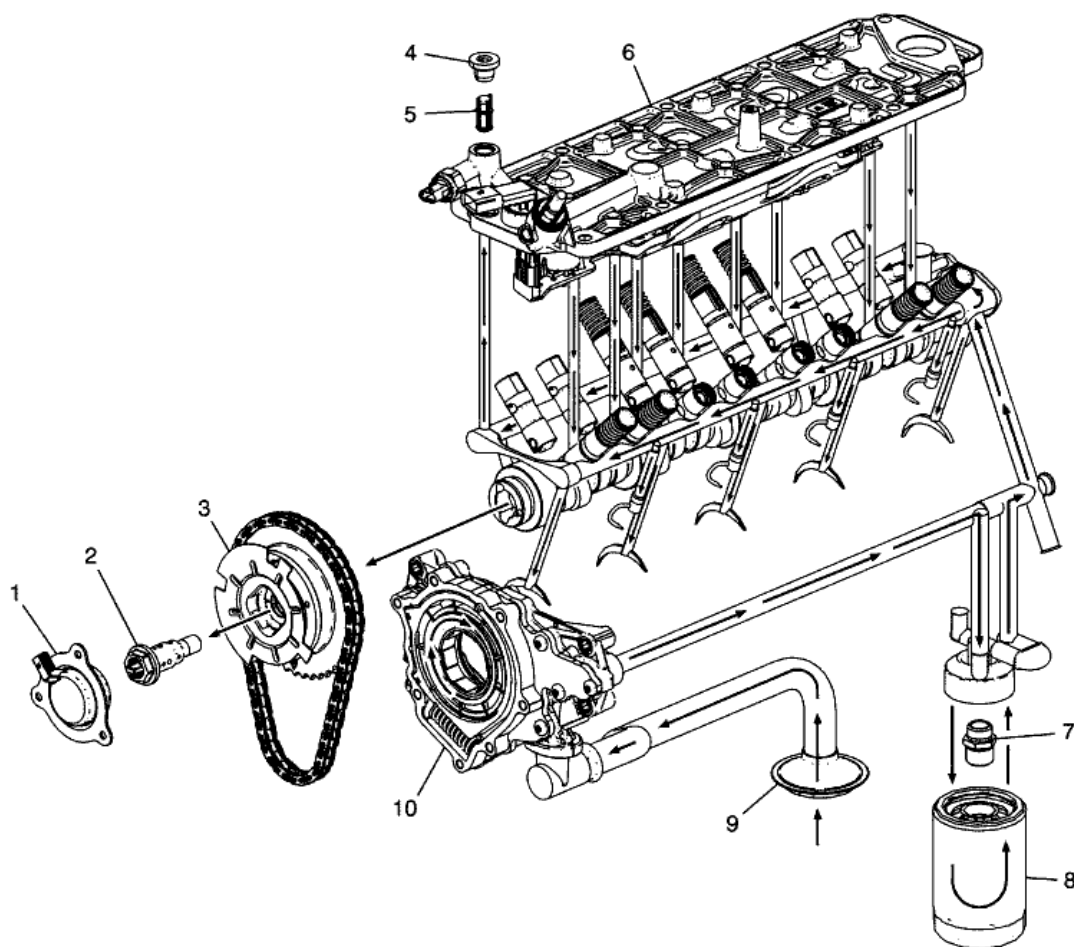


Fig. 17: Two-Stage Vane-Type Oil Pump Assembly, Valve Lifter Oil Manifold Assembly And Cmp Magnet
Courtesy of GENERAL MOTORS COMPANY

Engine lubrication is supplied by a variable displacement two-stage vane-type oil pump assembly (10). An oil control solenoid valve, controlled by the engine control module (ECM), mounted to the oil pump provides two stage functionality. The oil pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump rotor and vanes rotate and draw oil from the oil pan sump through a pick-up screen and pipe (9). The oil is pressurized as it passes through the pump and is sent through the engine block lower oil gallery.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter (8) where harmful contaminants are removed. A bypass valve is incorporated into the oil filter, which permits oil flow in the event the filter becomes restricted.

Oil is then directed from the filter to the upper main oil galleries and the valve lifter oil manifold assembly (6). Oil from the left upper oil gallery is directed to the crankshaft and camshaft bearings. Oil that has entered both the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil

at the top front of the engine.

An oil passage at camshaft bearing location 2 permits oil flow into the center of the camshaft. Oil enters the camshaft exiting at the front and into the camshaft position (CMP) actuator solenoid valve (2). The CMP valve spool position is controlled by the engine control module (ECM) and CMP magnet (1). When commanded by the ECM, the CMP magnet repositions the CMP actuator solenoid valve spool directing pressurized oil into the CMP actuator to control valve timing. Refer to [Camshaft Position Actuator and Solenoid Valve Description](#).

With active fuel management activated, the ECM commands the 4 solenoids to open, directing oil through the engine block oil galleries to the intake and exhaust valve lifters for cylinders 1, 4, 6 and 7.

LUBRICATION DESCRIPTION (WITH Z52 OPTION)

Engine Lubrication Flow

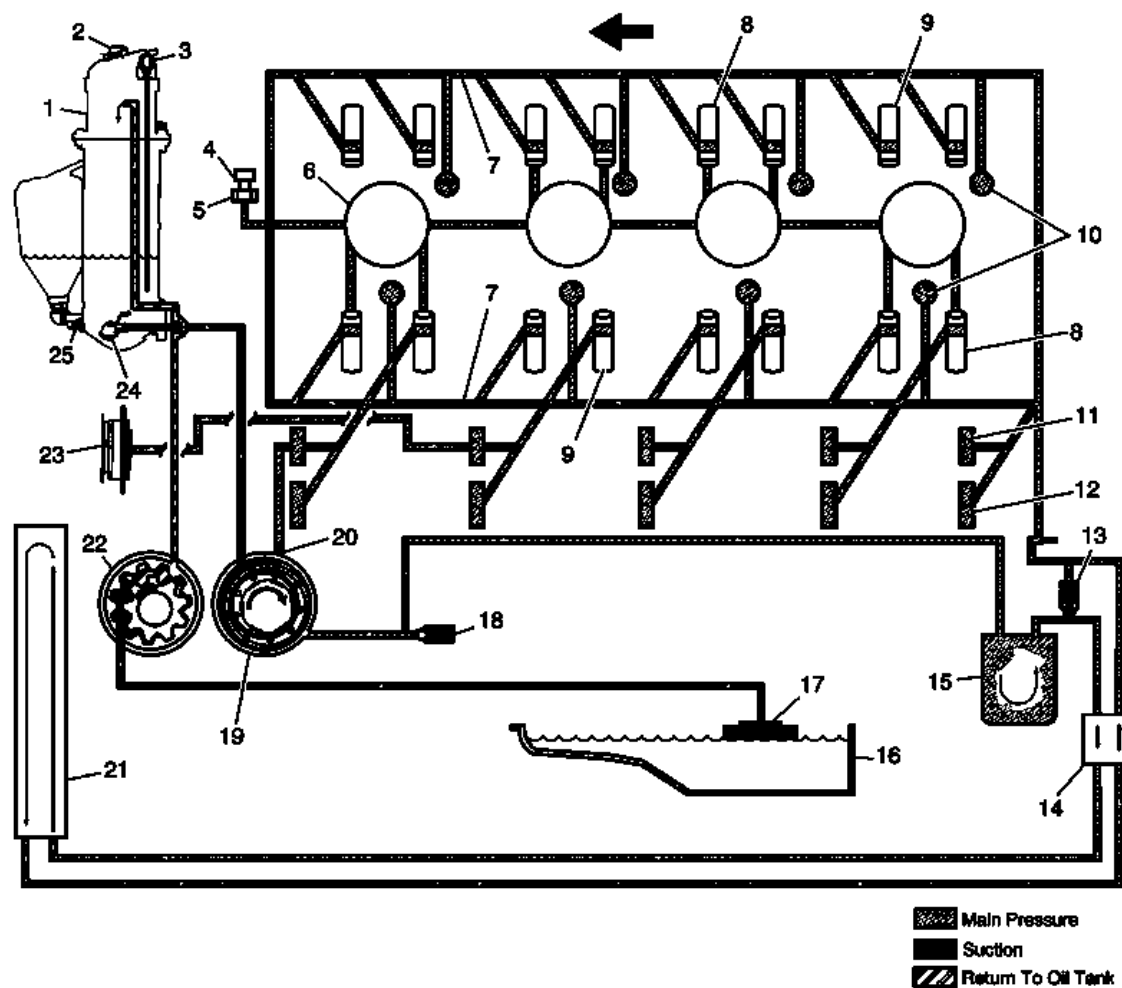


Fig. 18: Engine Lubrication Flow
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Oil Tank
2	Oil Fill Cap
3	Oil Level Indicator
4	Oil Pressure Sensor
5	Valve Lifter Oil Filter
6	AFM Solenoid
7	Upper Main Oil Galleries
8	AFM Valve Lifters
9	Valve Lifters
10	Piston Oil Nozzle
11	Camshaft Bearings
12	Crankshaft Bearings
13	Bypass Valve - Oil Cooler
14	Engine Oil Cooler
15	Oil Filter
16	Oil Pan Sump
17	Oil Pump Screen
18	Pressure Relief Valve - Oil Pump
19	Oil Pump - Primary
20	Oil Pump - 1st Stage Pressure Cavity
21	Oil Cooler
22	Oil Pump - Secondary
23	CMP Actuator
24	Oil Tank Screen
25	Oil Temperature Sensor

Engine lubrication is supplied by a two-stage oil pump assembly. The oil pump assembly consists of a primary vane-type variable displacement pump and a secondary gerotor-style pump. The primary pump contains a pressure relief valve that protects the oil pan mounted oil filter from over pressurization during cold engine start up. If system pressure exceeds 600 kPa (87 psi), the pressure relief valve will open and exhaust oil back into the oil pan. The front or forward gear set is the secondary pump (22). The rear or rearward housing contains the primary pump (19). Refer to Oil Pump Assembly in **Disassembled Views (6.2L LT1)** , **Disassembled Views (6.2L LT1 with Z52 Option)** . The pump assembly is mounted at the front of the engine and driven directly by the crankshaft sprocket. The vanes of the primary pump (19) rotate clockwise and draw oil from the engine oil tank (1) through the oil tank screen (24). The oil is pressurized as it passes through the primary pump and is sent through the engine block lower oil gallery.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter (15) where harmful contaminants are removed. A bypass valve is incorporated into the oil filter, which permits oil flow in the event the filter becomes restricted.

Oil exits the oil filter and is then directed to the external oil cooler (14). The external oil cooler consists of an oil pan mounted core, coolant lines and a reservoir in the vehicle radiator. A bypass valve (13) is incorporated into the oil cooler assembly in the event oil flow within the cooler is restricted. Oil returns from the oil cooler and is directed to the upper main oil galleries (7) and Valve Lifter Oil Manifold Assembly.

Oil from the left upper oil gallery is directed to the crankshaft bearings (12), valve lifter bores for cylinders 1, 3, 5 and 7, camshaft bearings (11) and piston oil nozzles (10) for cylinders 1, 3, 5 and 7. Oil from the right upper oil gallery is directed to the valve lifters bores for cylinders 2, 4, 6 and 8 and piston oil nozzles (10) for cylinders 2, 4, 6 and 8. The piston oil nozzle assemblies are designed to provide oil to the bottom side of the piston for cooling purposes. The piston oil nozzles have an internal check ball that is held in the normally closed position by the spring until system oil pressure exceeds 300 kPa (43.5 psi).

An oil passage at camshaft bearing location 1 permits oil flow to the upper rear of the primary oil pump (19). Oil is pumped through this passage and provides hydraulic pressure to the first stage oil pressure cavity (20) in the primary oil pump (19). Hydraulic pressure in the first stage pressure cavity regulates engine oil pressure and can help reduce the load on the engine during normal operating conditions.

An oil passage at camshaft bearing location 2 permits oil flow into the center of the camshaft. Oil enters the camshaft exiting at the front and into the camshaft position (CMP) actuator solenoid valve (23). The CMP valve spool position is controlled by the engine control module (ECM) and CMP magnet. When commanded by the ECM, the CMP magnet repositions the CMP actuator solenoid valve spool directing pressurized oil into the CMP actuator to control valve timing.

Oil from the right upper gallery is also pumped up to the Valve Lifter Oil Manifold Assembly. A Valve Lifter Oil Filter (5) and Oil Pressure Sensor (4) are located on the right front side of the Valve Lifter Oil Manifold Assembly. With active fuel management activated or ON, the ECM commands the 4 manifold solenoids (6) to open, directing oil through the manifold and to the 4 active fuel management intake and exhaust valve lifters (8), for cylinders 1, 4, 6 and 7.

Oil exits the valve lifters and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returns to the oil pan (16), where the secondary pump (22) draws oil through a oil pump screen (17). The secondary pump (22) returns oil to the engine oil tank (1). Incorporated within the engine oil tank assembly are the oil level indicator (3), oil fill cap (2), oil temperature sensor (25), positive crankcase ventilation (PCV) fresh air port and an oil pump screen (24).

CLEANLINESS AND CARE

- Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice, even if not specifically stated.
- When any internal engine parts are serviced, care and cleanliness is important.
- When components are removed for service, they should be marked, organized or retained in a specific order for assembly. Refer to **Separating Parts**.

same mating surface as when removed.

- An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in millimeters or thousandths of an inch. These surfaces should be covered or protected to avoid component damage.
- A liberal coating of clean engine oil should be applied to friction areas during assembly.
- Proper lubrication will protect and lubricate friction surfaces during initial operation.

SEPARATING PARTS

- IMPORTANT:**
- **Many internal engine components will develop specific wear patterns on their friction surfaces.**
 - **When disassembling the engine, internal components MUST be separated, marked or organized in a way to ensure installation to their original location and position.**

Separate, mark or organize the following components:

- Piston and the piston pin
- Piston to the specific cylinder bore
- Piston rings to the piston
- Connecting rod location and orientation to the crankshaft journal
- Connecting rod to the bearing cap

A paint stick or etching/engraving type tool are recommended. Stamping the connecting rod or cap near the bearing bore may affect component geometry.

- Crankshaft main and connecting rod bearings
- Camshaft and valve lifters
- Valve lifters, lifter guides, pushrods and rocker arm assemblies
- Valve to the valve guide
- Valve spring to the cylinder head location
- Engine block main bearing cap location and direction
- Oil pump drive and driven gears

REPLACING ENGINE GASKETS

Special Tools

J 28410 Gasket Remover

For equivalent regional tools, refer to **Special Tools** .

Gasket Use and Applying Sealants

- Do not use any gasket again unless specified.
- Gaskets that can be used again will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called out in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Remove all gasket and sealing material from the part using the **J 28410** remover or equivalent.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper or power tools to clean the gasket surfaces.
 - These methods of cleaning can cause damage to the component sealing surfaces.
 - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
 - This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

CAUTION: Refer to Sealant Caution .

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Tighten bolts to specifications. Do not overtighten.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALANT

Pipe Joint Compound

NOTE: Three types of sealer are commonly used in engines. These are room temperature vulcanizing (RTV) sealer, anaerobic gasket eliminator sealer and pipe joint compound. The correct sealer and amount must be used in the proper

location to prevent oil leaks. DO NOT interchange the 3 types of sealers. Use only the specific sealer or the equivalent as recommended in the service procedure.

- Pipe joint compound is a pliable sealer that does not completely harden. This type of sealer is used where 2 non-rigid parts, such as the oil pan and the engine block, are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include the exhaust manifold, head gasket or other surfaces where gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.

To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

CAUTION: Refer to Sealant Caution .

- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes.
- Apply a continuous bead of pipe joint compound to one sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to specifications. Do not overtighten.

RTV Sealer

- RTV sealant hardens when exposed to air. This type of sealer is used where 2 non-rigid parts, such as the intake manifold and the engine block, are assembled together.
- Do not use RTV sealant in areas where extreme temperatures are expected. These areas include the exhaust manifold, head gasket or other surfaces where a gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.

To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

CAUTION: Refer to Sealant Caution .

- Apply RTV sealant to a clean surface. Use a bead size as specified in the procedure. Run the bead to the inside of any bolt holes.
- Assemble components while the RTV sealant is still wet, within 3 minutes. Do not wait for the RTV sealant to skin over.
- Tighten bolts to specifications. Do not overtighten.

Anaerobic Sealer

- Anaerobic gasket eliminator hardens in the absence of air. This type of sealer is used where 2 rigid parts, such as castings, are assembled together. When two rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.
- Follow all safety recommendations and directions that are on the container.

To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

- Apply a continuous bead of gasket eliminator to 1 flange. Surfaces to be sealed must be clean and dry.

CAUTION: Refer to Sealant Caution .

- Spread the sealer evenly with your finger to get a uniform coating on the sealing surface.

NOTE: Anaerobic sealed joints that are partially torqued and allowed to cure more than 5 minutes may result in incorrect shimming and sealing of the joint.

- Tighten bolts to specifications. Do not overtighten.
- After properly tightening the fasteners, remove the excess sealer from the outside of the joint.

TOOLS AND EQUIPMENT

Special tools are listed and illustrated throughout this section, with a complete listing at the end of the section. These tools or their equivalents, are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools also minimize possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. Torque wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

To properly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves
- A clean, well lit, work area
- A suitable parts cleaning tank
- A compressed air supply
- Trays or storage containers to keep parts and fasteners organized
- An adequate set of hand tools
- Approved engine repair stand
- An approved engine lifting device that will adequately support the weight of the components