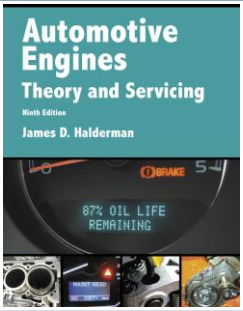
Automotive Engines Theory and Servicing
Ninth Edition



Chapter 16
Lubrication System Operation and Diagnosis

OBJECTIVES (1 OF 2)

16.1 Explain the purpose of the lubrication system, and state the lubrication principles.

16.2 Discuss engine lubrication systems.

16.3 Describe the purpose and function of oil pumps.

OBJECTIVES (2 OF 2)

16.4 Discuss the purpose and function of oil passages.

16.5 Discuss oil pans, oil coolers, and the dry sump system.

LUBRICATION PRINCIPLES (1 OF 2)

- Lubrication between two moving surfaces results from an oil film that separates the surfaces and supports the load.

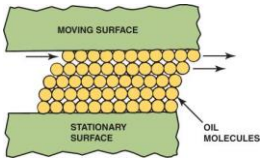


FIGURE 16–1 Oil molecules cling to metal surfaces but easily slide against each other.

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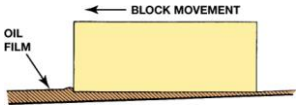
FIGURE 16–2 Wedge-shaped oil film developed below a moving block.



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LUBRICATION PRINCIPLES (1 OF 2)

- This wedging action is called hydrodynamic lubrication, and depends on the force applied to the rate of speed between the objects and the thickness of the oil.

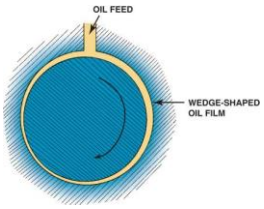

FIGURE 16–3 Wedge-shaped oil film curved around a bearing journal.

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ENGINE LUBRICATION SYSTEMS

- Purpose and Function
- Normal Oil Pressure
- Oil Temperature

FIGURE 16–4 The dash oil pressure gauge may be a good indicator of engine oil pressure. If there is any concern about the oil pressure, always use a mechanical gauge to be sure.

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OIL PUMPS (1 OF 2)

- Purpose and Function
- Parts and Operation
- Types of Oil Pumps
  - External gear type
  - Internal/external gear type
  - Rotor type
  - Gerotor type

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FIGURE 16–5 An oil pump driven by the camshaft.

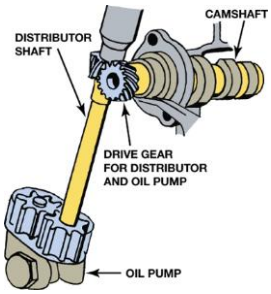

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FIGURE 16–6 In an external gear-type oil pump, the oil flows through the pump around the outside of each gear. This is an example of a positive displacement pump, wherein everything entering the pump must leave the pump.

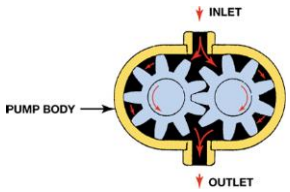

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FIGURE 16–7 A typical internal/external oil pump mounted in the front cover of the engine that is driven by the crankshaft.

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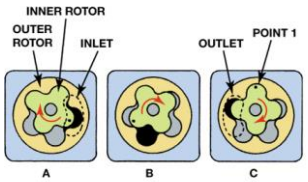
FIGURE 16–8 The operation of a rotor-type oil pump.



A. OIL IS PICKED UP IN LOBE OF OUTER ROTOR.
B. OIL IS MOVED IN LOBE OF OUTER ROTOR TO OUTLET.
C. OIL IS FORCED OUT OF OUTLET BECAUSE THE INNER AND OUTER ROTORS MESH TOO TIGHTLY AT POINT 1 AND THE OIL CANNOT PASS THROUGH.

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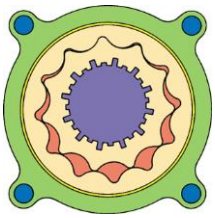
FIGURE 16–9 Gerotor-type oil pump driven by the crankshaft.



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OIL PUMPS (2 OF 2)

- Oil Pressure Regulation
- Factors Affecting Oil Pressure
  - Leaks
  - Oil pump capacity
  - Viscosity of the engine oil
- Oil Pump Checks
  - Visual inspection
  - Measurements

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FIGURE 16–10 Oil pressure relief valves are spring loaded. The stronger the spring tension, the higher the oil pressure.

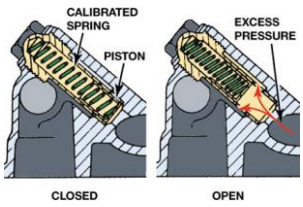

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FIGURE 16–11 A typical engine design that uses both pressure and splash lubrication. Oil travels under pressure through the galleries (passages) to reach the top of the engine. Other parts are lubricated as the oil flows back down into the oil pan or is splashed onto parts.

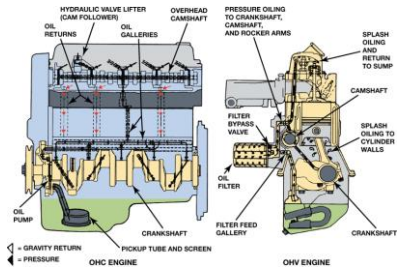

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FIGURE 16–12 (a) A visual inspection indicated that this pump cover was worn. (b) An embedded particle of something was found on one of the gears, making this pump worthless except for scrap metal.


(a)


(b)

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OIL PASSAGES

- Oil from the oil pump first flows through the oil filter then goes through a drilled hole that intersects with a drilled main oil gallery, or longitudinal header.
  - This is a long hole drilled from the front of the block to the back.
    - Inline engines use one oil gallery.
    - V-type engines may use two or three galleries.

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FIGURE 16–14 An intermediate shaft drives the oil pump on this overhead camshaft engine. Note the main gallery and other drilled passages in the block and cylinder head.

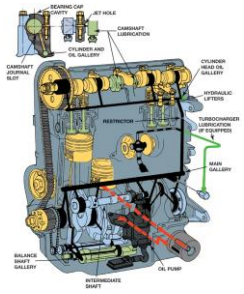

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FIGURE 16–15 Oil is sent to the rocker arms on this Chevrolet V-8 engine through the hollow pushrods. The oil returns to the oil pan through the oil drainback holes in the cylinder head.

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OIL PANS

- The oil pan is where engine oil is used for lubricating the engine.
  - Another name for the oil pan is a sump.

FIGURE 16–16 A typical oil pan with a built-in windage tray used to keep oil from being churned up by the rotating crankshaft.

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DRY SUMP SYSTEM

- Construction and Operation
- Advantages
- Disadvantages

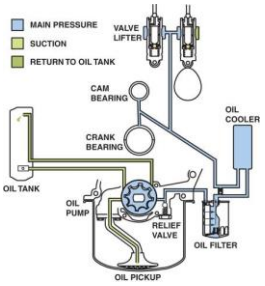

FIGURE 16–17 A dry sump system as used in a Chevrolet Corvette.

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OIL COOLERS

- Coolant flows through the oil cooler to help warm the oil when the engine is cold and cool the oil when the engine is hot.
- Oil temperature should be:
  - Above 212°F (100°C) to boil off any accumulated moisture
  - Below 280°F to 300°F (138°C to 148°C)

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FIGURE 16–18 Oil is cooled by the flow of coolant through the oil filter adaptor.

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SUMMARY

- Viscosity is the oil's thickness or resistance to flow.
- Normal engine oil pump pressure ranges from 10 to 60 PSI (200 to 400 kPa) or 10 PSI for every 1000 engine RPM.
- Hydrodynamic oil pressure around engine bearings is usually over 1,000 PSI (6,900 kPa).
- The oil pump is driven directly by the crankshaft or by a gear or shaft from the camshaft.

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