SECTION 4

LUBRICATION SYSTEM

CONTENTS

LUBRICATION SYSTEM

6V AND 8V ENGINES

Figure 1 schematically illustrates the flow of oil through a typical 6V or 8V–92 engine lubrication system including the various components such as the oil pump, full–flow oil filter, oil cooler, pressure regulator and bypass valve.

The oil pump is placed in the crankshaft front cover and consists of a pair of spur gears, one large and one small, which mesh together and ride in a cavity inside the crankshaft cover. The large gear is concentric with and splined to a pump drive hub on the front end of the crankshaft. The pump idler gear is much smaller and runs on a bushing and hardened steel shaft pressed into the crankshaft cover.

The oil is drawn by suction from the oil pan through the intake screen and pipe to the oil pump where it is pressurized. The oil then passes from the pump into a short gallery in the cylinder block to the oil cooler adaptor plate. At the same time, oil from the pump is directed to a spring–loaded pressure relief valve mounted on the cylinder block. This valve discharges excess oil directly to the oil sump when the pump pressure exceeds 105 psi (724 kPa).

From the oil cooler adaptor plate, the oil passes into the full–flow filter, through the oil cooler and then back into the cylinder block where a short vertical oil gallery and a short diagonal oil gallery carry the oil to the main longitudinal oil gallery through the middle of the block. Valves are also provided to bypass the oil filter and oil cooler should either one become plugged.

Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of the oil temperature, by means of a pressure regulator valve located at the end of a vertical oil gallery connected to the main oil gallery. This vertical gallery is located at the front of the cylinder block on the side opposite the cooler (Fig. 1). When the oil pressure at the valve exceeds 50 psi (345 kPa), the regulator valve opens, discharging oil back into the sump.

From the main oil gallery, the pressurized oil flows through drilled passages to each main bearing then passes to an adjacent pair of connecting rods by means of grooves in the unloaded halves of the main and connecting rod bearings and drilled passages in the crankshaft. The rifle drilled connecting rods carry oil from the rod bearings to the piston pin bushing.

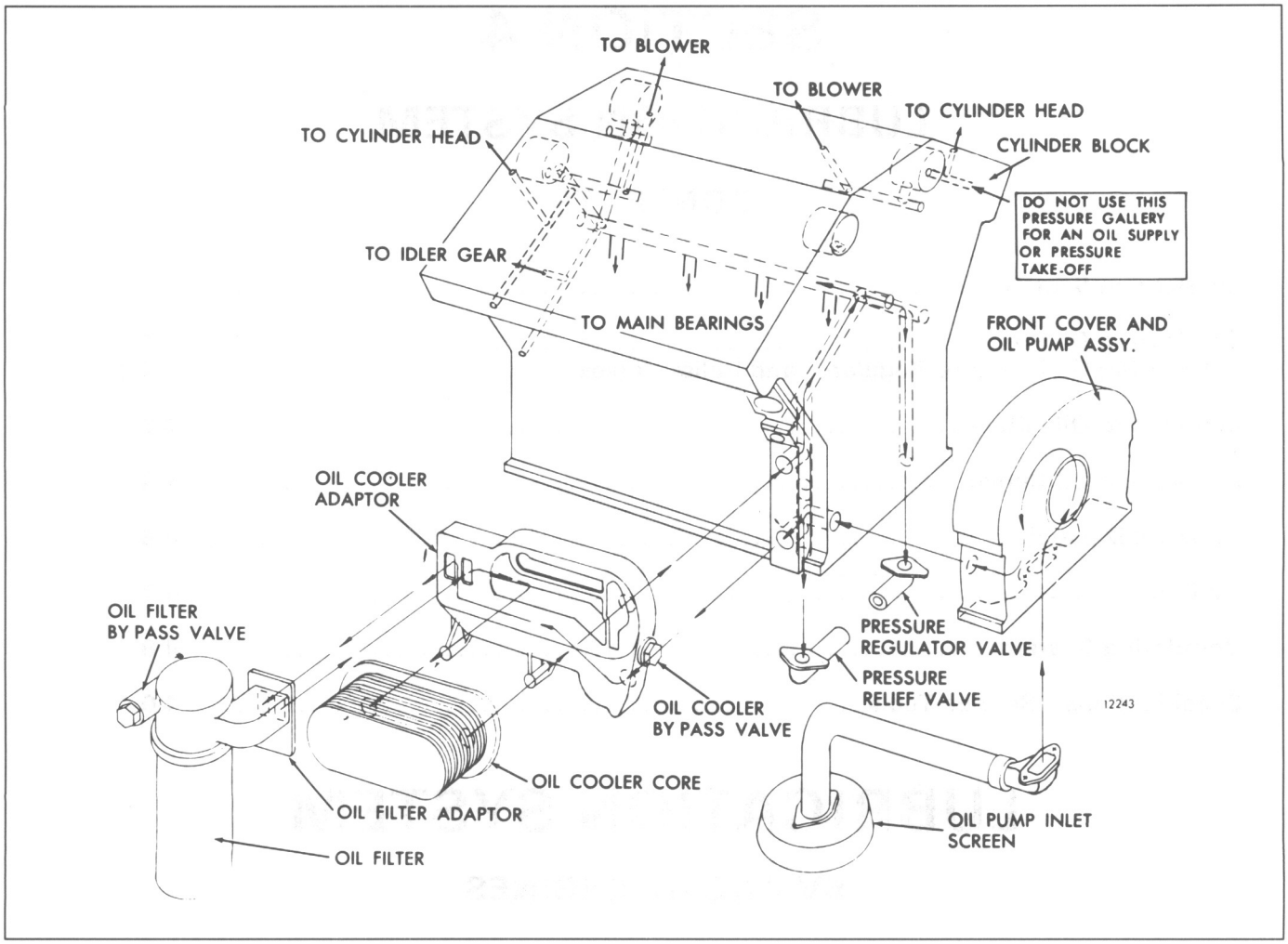


Fig. 1 – Schematic Diagram of Typical 6V and 8V Lubrication Systems

At the rear of the block, two diagonally drilled oil passages, which intersect the main oil gallery, carry oil to the two rear camshaft end bearings. Oil is then conducted through the rifle drilled camshaft to the intermediate and front end bearings. Oil from the camshaft intermediate bearings is directed against the camshaft lobes and cam rollers which run in an oil bath. This oil from the intermediate bearings provides lubrication of the cam lobes immediately after starting the engine when the oil is cold and before camshaft bearing oil flow and oil drainage from the cylinder head have had time to build up.

The diagonally drilled oil passage on the right side at the rear of the block intersects with a vertical passage to carry oil to the right bank cylinder head. A short gallery also intersects with this diagonal passage to lubricate the idler gear bearing. Another gallery intersecting the diagonal passage from the camshaft at the front of the block supplies oil to the left bank cylinder head.

NOTICE: Do not use the oil gallery on the upper front left bank of the cylinder block (Fig. 1) for an oil supply or pressure take–off. This gallery intersects the cylinder head oil supply gallery. If used, it will reduce oil pressure to the rocker arm assemblies.

Drilled passages, intersecting longitudinal galleries which parallel the camshafts, lead to the blower and supply oil for the blower drive gears and bearings.

Oil from the right–bank camshaft front end bearing lubricates the water pump drive gear and bearings and the front camshaft gear.

The gear train is lubricated by the overflow of oil from the camshaft pocket spilling into the gear train compartment and by splash from the oil pan. A certain amount of oil also

spills into the gear train compartment from both camshaft rear end bearings, the blower drive gear bearing and the idler gear bearing. The blower drive gear bearing is lubricated through an external pipe from the blower rear end plate to the blower drive support.

The valve and injector operating mechanism is lubricated from a longitudinal oil passage, on the camshaft side of each cylinder head, which connects to the main oil gallery in the cylinder block. Oil from this passage enters the drilled rocker arm shafts through the lower end of the rocker shaft bolts and rocker shaft brackets. Excess oil from the rocker arms lubricates the exhaust valves and cam followers.

Lubrication System Maintenance

Use the proper viscosity grade and type of *heavy duty* oil as outlined in Section 13.3. Change the oil and replace the oil filter elements at the periods recommended by the oil supplier (based on his analysis of the drained engine oil) to ensure trouble–free lubrication and longer engine life. For fuel leak detection refer to Section 2.0.

The oil level should never be allowed to drop below the *low* mark on the dipstick. Overfilling the crankcase may contribute to abnormal oil consumption, high oil temperature, and also result in oil leaking past the crankshaft rear oil seal.

To obtain the true oil level, the engine should be stopped and sufficient time (approximately twenty minutes) allowed for the oil to drain back from the various parts of the engine. If more oil is required, add only enough to bring the level to the *full* mark on the dipstick.

Cleaning Lubrication System

Thorough flushing of the lubrication system is required at times. Should the engine lubrication system become contaminated by an ethylene glycol base antifreeze solution or other soluble material, refer to Section 5 for the recommended cleaning procedures.

Detection Of Lube Oil Leaks

Detroit Diesel uses red dye to detect lube oil system leaks during engine test. Customers receiving new engines may notice some residual dye remaining in their lube oil systems. This dye should be quickly dispersed after the first few hours of engine operation.

12 AND 16V ENGINES

Figure 2 schematically illustrates the flow of oil through a typical 16V–92 engine lubrication system.

NOTICE: Do not use the oil gallery on the upper bank at the front of each cylinder block (Fig. 2) for an oil supply or pressure take–off. This oil gallery intersects the cylinder head oil supply gallery. If used, it will reduce pressure to the rocker arm assemblies.

The lubricating oil is circulated by a gear–type pressure pump mounted on the number seven and eight bearing caps (12V engine) or number nine and ten main bearing caps (16V engine) and gear–driven from the rear end of the crankshaft. On some engines, the oil pump is mounted at the front on the number one and two main bearing caps and gear–driven by an oil pump drive gear bolted to the front crankshaft gear.

An oil pressure relief valve mounted on the junction block bypasses excess oil directly into the oil sump when the pressure on the outlet side of the pump exceeds approximately 120 psi (827 kPa).

Since bypass valves are provided in the oil coolers and the oil filters, the oil will bypass the coolers or filters if they become plugged.

Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of the oil temperature, by two pressure regulator valves located at the end of the vertical oil galleries (Fig. 2). When the oil pressure at the regulator valves exceeds 50 psi (345 kPa), the valves open, discharging excess oil back into the oil sump.

Detection Of Lube Oil Leaks

Detroit Diesel uses red dye to detect lube oil system leaks during engine test. Customers receiving new engines may notice some residual dye remaining in their lube oil systems. This dye should be quickly dispersed after the first few hours of engine operation.

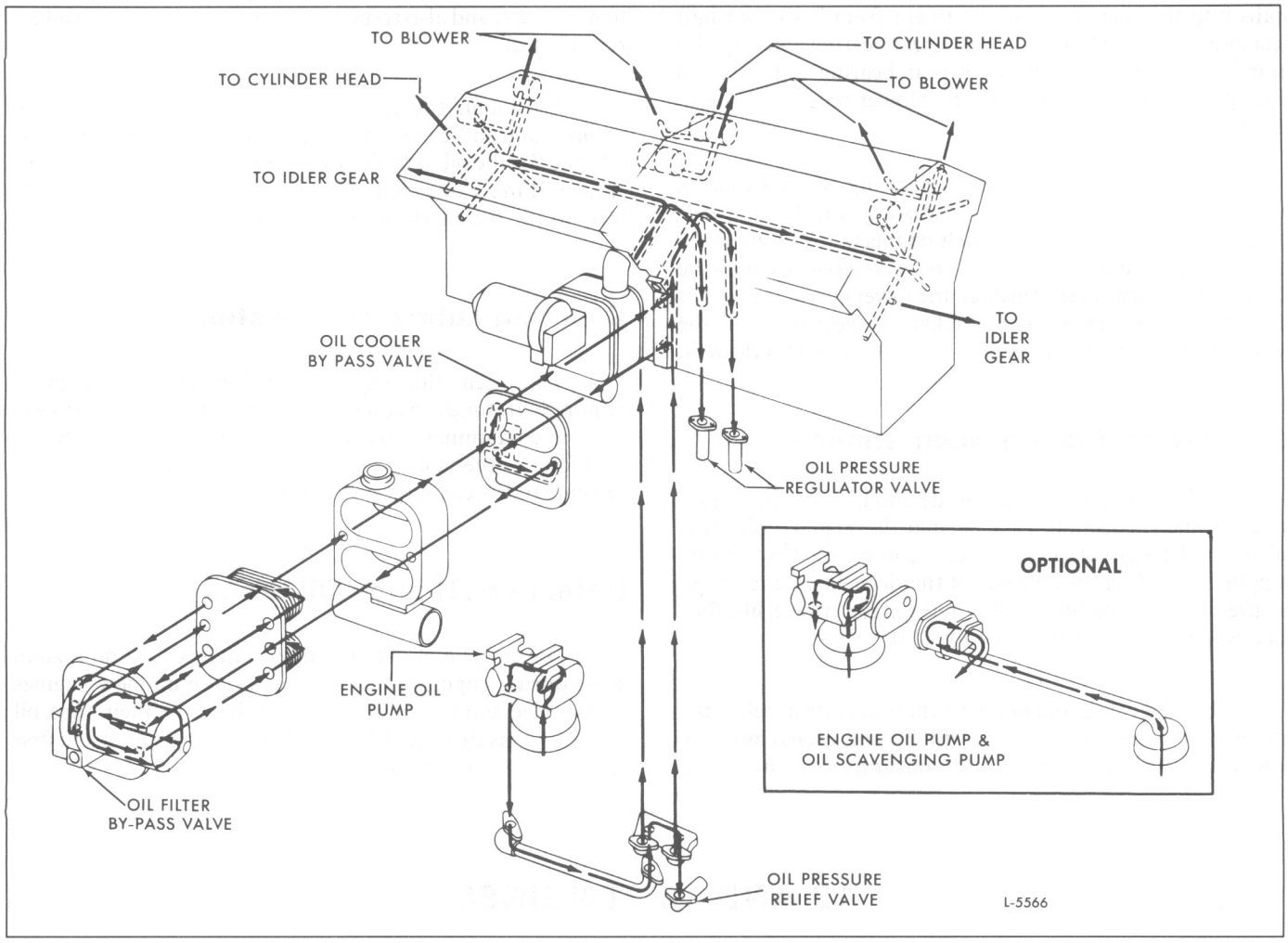


Fig. 2 – Schematic Diagram of Typical 16V Lubrication System

LUBRICATING OIL PUMP (6V-92 and 8V-92 Engines)

PUMP MOUNTED IN FRONT COVER

The gear type lubricating oil pump is mounted in the crankshaft front cover, which also functions as the oil pump body (Fig. 1). The pump consists of two spur gears which mesh and rotate in a cavity inside the crankshaft cover. The pump drive gear is concentric with and splined to a pump drive hub on the front end of the crankshaft. The pump driven gear and bushing assembly rotates on a hardened steel shaft. One end of the driven gear shaft is pressed into the crankshaft front cover and the other end is supported in the oil pump gear retaining plate.

To standardize and provide more oil pressure at lower engine speeds, the 8V–92 oil pump is now used on 6V–92 engines (effective with 6VF–51331). The 6V–92 and 8V–92 oil pumps are interchangeable and only the 8V–92 pump will be serviced. However, the component parts of the 6V–92 oil pump will continue to be serviced.

Operation

As the gears revolve, a vacuum is created on the inlet side of the pump and oil is drawn from the oil pan through the intake screen and pipe assembly into a passage, in the crankshaft front cover, which leads to the inlet port in the pump. The oil then enters the cavities between the gears and the crankshaft front cover, and is then forced out under pressure through the discharge port into a short gallery in the cylinder block which leads to the oil filter, block main oil gallery. At the same time, the oil is directed through a short vertical gallery to the pressure relief valve which opens at approximately 105 psi (724 kPa) to return excess oil to the oil pan.

Remove Oil Pump

1. Drain the oil and remove the oil pan.
2. Remove the oil pan gasket and clean all traces of the gasket from both the oil pan and the cylinder block.
3. Remove the bolts and lock washers which secure the oil inlet pipe and screen support to the crankshaft front cover and to the main bearing cap. Then, remove the oil inlet pipe and screen support as an assembly.
4. Remove the crankshaft front cover from the engine as outlined in Section 1.3.5.
5. Remove the oil pump drive hub and key from the crankshaft.

Disassemble Oil Pump

1. Remove the self–locking bolts that secure the oil pump gear retaining plate to the crankshaft front cover. Then, remove the retaining plate.
2. Remove the oil pump drive and driven gears from the crankshaft front cover.

Inspection

Clean all of the parts with fuel oil and dry them with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

Examine the oil pump gear cavity in the crankshaft front cover. Replace the cover if the surfaces are worn or scored excessively. If necessary, replace the crankshaft front oil seal, as outlined in Section 1.3.2.

Replace the driven gear shaft if it is worn or scored excessively. When a new shaft is pressed in place, the shoulder on the shaft must be flush to .020" below the finished face of the crankshaft front cover.

The clearance between the driven gear bushing and the shaft is .001" to .0025" when new parts are used, or a maximum of .0035" with used parts.

Inspect the teeth on the oil pump gears and the pump drive hub. Also, examine the bushing in the driven gear for wear. The bushing is not serviced separately. Therefore, if the bushing is worn, it will be necessary to replace both the drive and driven gears as they are only serviced as a set. The use of excessively worn gears will result in low oil pressure which may cause serious damage throughout the engine.

Inspect the inner face of the oil pump gear retaining plate. Replace the retaining plate if it is scored or worn.

Remove the screen and cover from the oil inlet pipe assembly. Then, clean the parts with fuel oil and dry them with compressed air. Reassemble the screen, cover and oil intake pipe.

Whenever the oil pump is removed for service, remove and inspect the oil pressure regulator and oil pressure relief valves as outlined in Section 4.1.1.

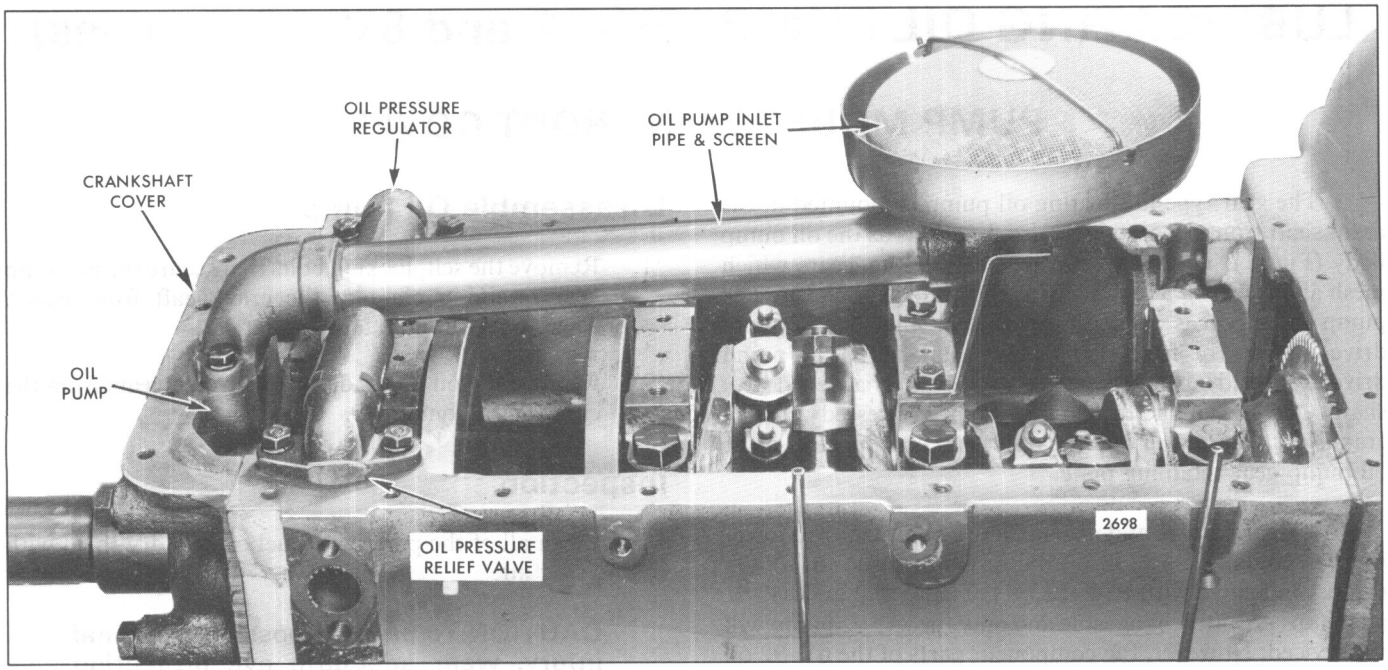


Fig. 1 – Typical Lubricating Oil Pump Mounting (6V–92 or 8V–92 Engine)

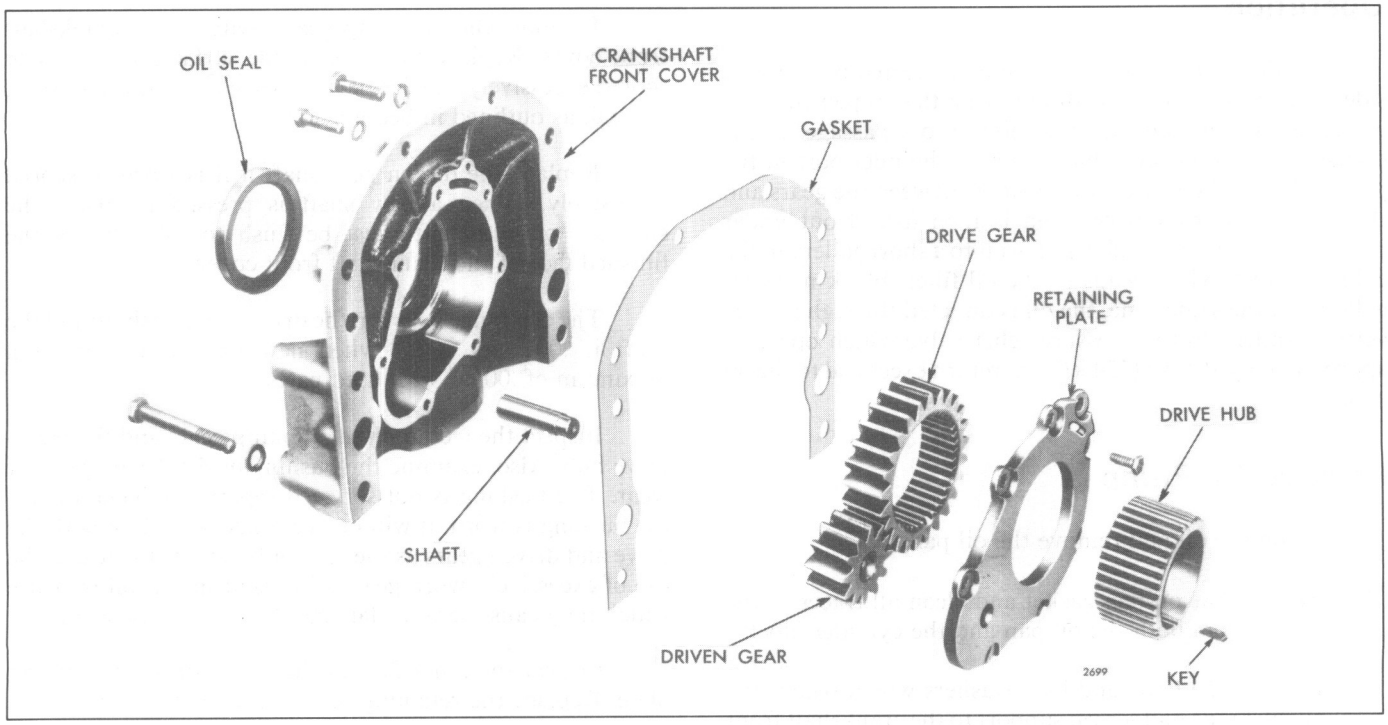


Fig. 2 – Lubricating Oil Pump Details and Relative Locations of Parts (6V–92 or 8V–92 Engine)

Assemble Oil Pump

Refer to Fig. 2 and assemble the oil pump as follows:

1. Lubricate the oil pump gears and the driven gear shaft with engine oil. Then, install the gears in the crankshaft front cover.
2. Install the gear retaining plate and secure it to the crankshaft front cover with eight 5/16"–18 x 3/4" self–locking bolts. Tighten the bolts to 13–17 lb–ft (18–23 N•m) torque.

   NOTICE: Self–locking bolts must be used due to the close clearance between the oil pump and the crankshaft.
3. Install the key in the crankshaft and slide the oil pump drive hub in place.

Install Oil Pump

1. Install the crankshaft front cover on the engine as outlined in Section 1.3.5.
2. Refer to Fig. 1 and install the oil inlet pipe and screen assembly. Use a new gasket between the oil inlet pipe and the crankshaft front cover.
3. Install the oil pan, using the new gasket. Starting with the center bolt on each side and working toward each end of the oil pan, tighten the 3/8"–16 bolts to 10–20 lb–ft (14–27 N•m) torque.
4. Fill the oil pan, to the proper level on the dipstick, with the lubricating oil recommended in the *Lubrication Specifications* in Section 13.3.

PUMP MOUNTED ON MAIN BEARING CAPS

The gear–type scavenging oil pump used on the 6V–92 and 8V–92 engines is mounted on the No. 1 and 2 main bearing caps and is driven by an oil pump drive gear mounted on the crankshaft (Fig. 3).

An opening is provided on the oil pump body for mounting an oil pump inlet pipe and screen assembly. A scavenging oil pump inlet pipe and screen is mounted on the oil pump scavenging body and is supported with brackets to a main bearing cap.

Oil is drawn by suction from the oil pan through the oil pump inlet screen and pipe into the oil pump where it is pressurized.

Remove Oil Pump

1. Remove the drain plug from the oil pan and drain the oil.

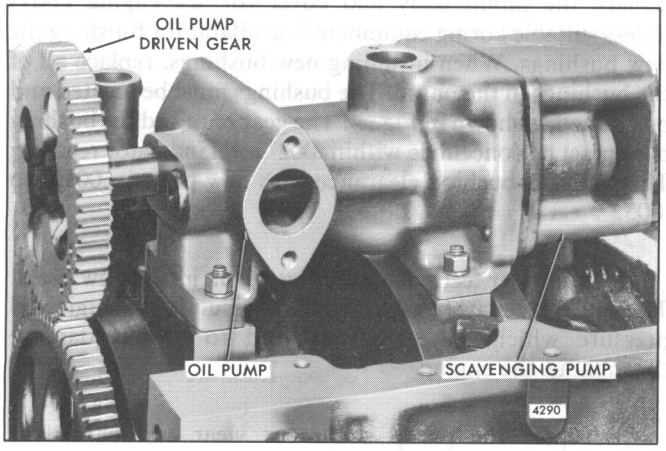


Fig. 3 – Oil Pump Mounting (6V–92 and 8V–92 Engine)

2. Remove the oil pan bolts and remove the oil pan. Clean all traces of the gasket from both the oil pan and the cylinder block.
3. Remove the two mounting bolts and lock washers and remove the oil pressure regulator valve from the cylinder block.
4. Remove the four bolts and lock washers which attach the oil pressure relief valve to the oil pump body and cylinder block.
5. Remove the two self–locking bolts and lift the screen off the inlet pipe. Remove the two bolts and remove the oil pump inlet pipe.
6. Remove the bolts and lock washers which attach the support brackets to the oil pump scavenging inlet pipe and to the main bearing cap.
7. Remove the two bolts and lock washers which attach the oil pump scavenging inlet pipe and baffle plate to the scavenging pump body. Remove the scavenging inlet pipe and baffle plate.
8. Remove the nuts and lock washers which attach the oil pump to the main bearing caps. Then, remove the oil pump assembly.

   NOTICE: Shims are used between the oil pump mounting feet and the main bearing caps. Whenever the original pump is reinstalled, the same shims or an equal number of new (identical) shims must be placed under both the front and rear mounting feet and the number then adjusted to obtain the proper clearance between the gears.

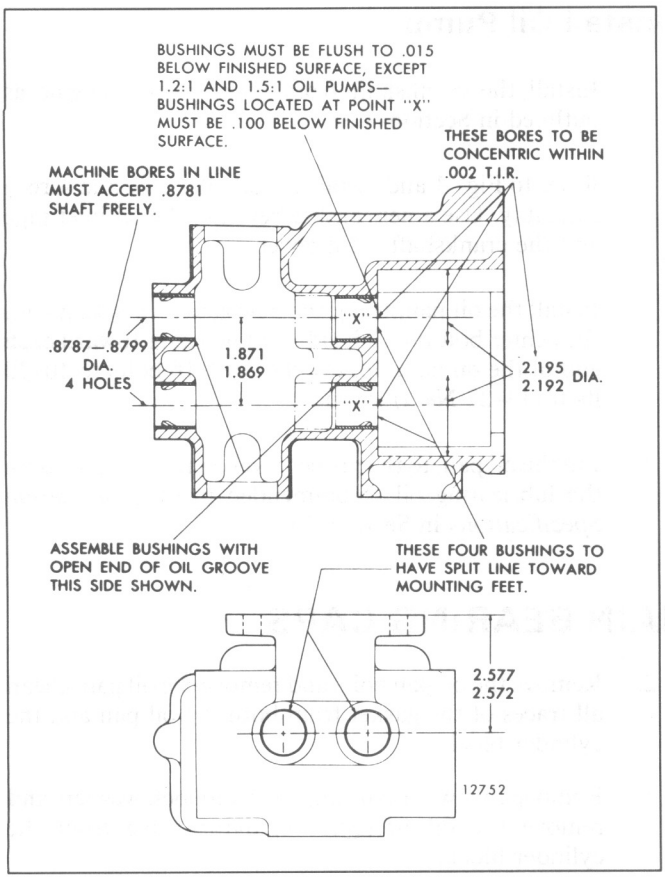


Fig. 4 – Diameter and Location of Bushing in Oil Pump (6V–92 and 8V–92 Engine)

Disassemble Oil Pump

Observe carefully the position of all parts including the oil pump inlet pipe and the scavenging oil pump inlet pipe during disassembly to facilitate reassembly of the oil pump.

1. Remove the four self–locking bolts which attach the scavenging pump body to the oil pump body. Then, remove the scavenging pump body.

2. Remove the scavenging pump drive and driven gears from the oil pump drive and driven shafts.

3. Remove the Woodruff key from the drive shaft and slide the spacer off the end of the shafts.

4. Withdraw the driven shaft and driven gear as an assembly from the oil pump body.

5. Remove the bolt and special washer securing the oil pump driven gear to the drive shaft and remove the gear.

6. Withdraw the drive shaft and gear as an assembly from the oil pump body.

7. Press the oil pump drive shaft out of the oil pump gear. Remove the Woodruff key from the shaft.

8. Press the driven shaft out of the driven gear in the same manner as in Step 7 above. Remove the Woodruff key from the shaft.

9. Remove the cover and gasket from the oil pump body.

Inspection

Wash all of the parts in clean fuel oil and dry them with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

The greatest amount of wear in the oil pump is imposed on the internal drive and driven gears. This wear may be kept to a minimum by keeping the lubricating oil clean and acid–free. If dirt and sludge are allowed to accumulate in the lubricating system, pronounced gear wear may occur in a comparatively short period of time. Proper servicing of oil filters will increase the life of the gears.

Examine the internal gear cavity of the pump body and scavenger pump, if used, for wear or scoring. Also, inspect the pump cover, or spacer between the pump and the scavenger pump bodies, for wear. Replace the parts, if necessary.

Inspect the bushings in the pump body and cover (or scavenging body). If the bushings are worn excessively, replace the pump body and cover (or scavenging body) unless suitable boring equipment is available for finishing the new bushings. When installing new bushings, replace all of the bushings in the pump. The bushings must be located and positioned as shown in Fig. 4. The gear bore and the bushing bore must be concentric within .002" total indicator reading. The shaft–to–bushing clearance with new parts is .0015" to .0032".

If the gear teeth are scored or worn, install new gears. The use of excessively worn gears will result in low engine oil pressure which, in turn, may lead to serious damage throughout the engine.

Inspect the pump shafts for wear and check the keyways. Replace the shafts, if necessary.

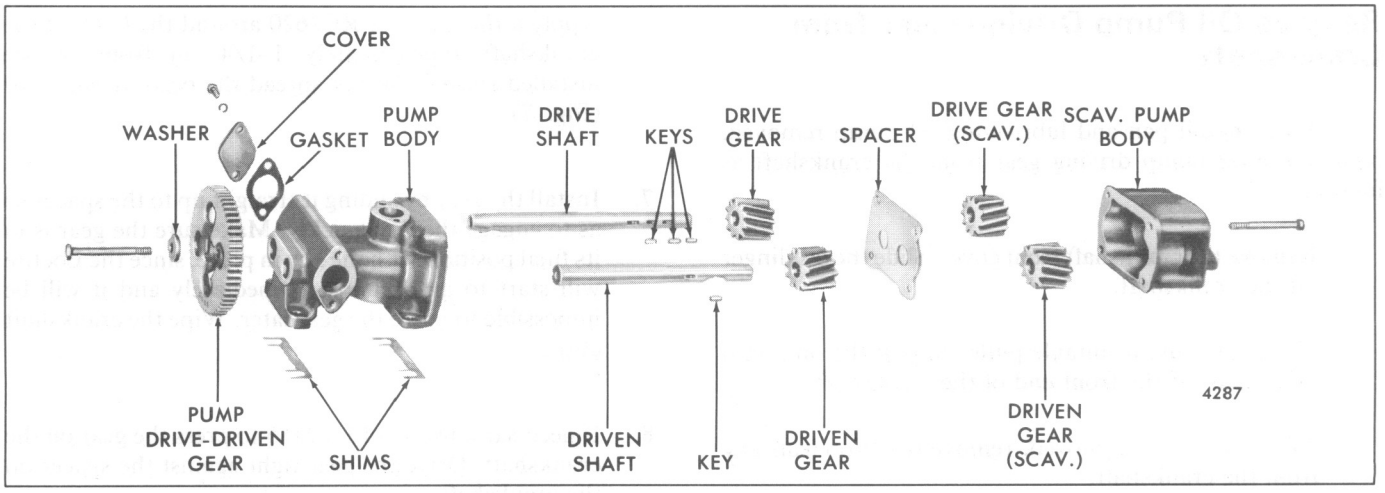


Fig. 5 – Lubricating Oil Pump Details and Relative Location of Parts (6V–92 and 8V–92 Engine)

Remove the oil inlet screen from the oil inlet pipe and clean both the screen and pipe with fuel oil and dry them with compressed air.

Inspect the external pump drive–driven gear for wear and replace it, if necessary.

Inspection of the pressure relief valve and oil pressure regulator are covered in Section 4.1.1.

Assemble Oil Pump

Refer to Fig. 5 and assemble the oil pump as follows:

1. Insert the Woodruff key in the keyway of the oil pump drive shaft and apply a light coat of engine oil on the shaft.

2. Press the drive shaft into the oil pump drive gear. Position the gear 7.570" from the end of the drive shaft (Fig. 6). Use tool J 22397.

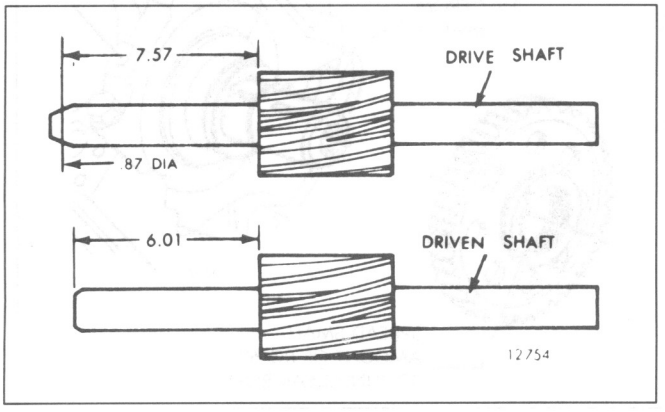


Fig. 6 – Location of Oil Pump Gear on Shaft

3. Insert the Woodruff key in the keyway of the driven shaft. Apply a light coat of engine oil on the shaft. Press the shaft in the driven gear. Position the gear 6.010" from the end of the shaft (Fgi. 6). Use tool J 22398.

4. Install the drive shaft and gear as an assembly in the oil pump body.

5. Install the oil pump driven gear on the drive shaft. Place the special washer on the bolt with the crown side toward the head of the bolt and tighten the bolt to 60–65 lb–ft (81–85 N•m) torque.

6. Install the driven shaft and gear as an assembly in the pump body.

7. Slide the spacer on the shafts. Insert the two remaining Woodruff keys in the drive shaft. Slide the scavenging pump gears on the shafts.

NOTICE: The scavenging pump drive and driven gears must be in the same relative position as the oil pump drive and driven gears.

8. Secure the scavenging pump body to the oil pump body with four self–locking bolts.

9. Place a new gasket on the oil pump body side cover and fasten it to the pump body with two bolts and lock washers.

NOTICE: The oil pump gears must turn freely after assembly. Any bind in the pump must be eliminated before it is installed on the engine.

Remove Oil Pump Driving Gear from Crankshaft

With the oil pan and lubricating oil pump removed, remove the oil pump driving gear from the crankshaft as follows:

1. Remove the crankshaft front cover. Slide the oil slinger off the crankshaft.
2. If required, use a suitable puller to pull the oil pump drive gear off the front end of the crankshaft.
3. After the gear is removed, remove the Woodruff key from the crankshaft.
4. Slide the oil pump drive gear spacer off the end of the crankshaft.

Install Oil Pump Driving Gear on Crankshaft

Whenever a 6V–92 or 8V–92 engine crankshaft–mounted oil pump drive gear requires replacement, Loctite RC/620 retaining compound (or equivalent) *must* be used to ensure proper gear retention. Use the following procedure:

1. Measure the crankshaft diameter and gear bore. Both parts must be within the specifications shown. Replace, if necessary.

   C/S dia. – 2.498/2.500 inch

   Gear Bore – 2.5005/2.5010 inch

2. Clean the crankshaft, spacer, gear and key with a chlorinated solvent such as that used with a dye penetrant kit. Make sure the parts are dry before proceeding.
3. Install the spacer and key, but do not apply primer or retaining compound to either part.
4. Apply Loctite Primer "T" to the crankshaft and the gear bore. Allow to dry a minimum of 5 minutes before beginning Step 5. Follow the manufacturer's instructions on the container.
5. Shake well before using and apply a small amount of Loctite RC/620 to the gear bore (Fig. 7). Spread the compound to make sure the entire bore is covered. Remove excess compound from the chamfer area of the gear, but do not wipe dry.
6. Apply a *thin bead* of RC/620 around the O.D. of the crankshaft approximately 1–1/4" in front of the installed spacer. Do not spread the bead or wipe dry (Fig. 7).
7. Install the gear by sliding it straight up to the spacer so as to engage the key quickly. Make sure the gear is in its final position with the key in place, since the Loctite will start to grab almost immediately and it will be impossible to move the gear later. Wipe the crankshaft clean.
8. If necessary, use Tool J 22285 to press the gear on the crankshaft. Drive the gear tight against the spacer on the crankshaft.
9. Install the oil slinger with the dished side away from the gear.
10. Install the engine front cover as outlined in Section 1.3.5.
11. Allow the Loctite to cure for four hours minimum before starting the engine.

NOTICE: Chemicals such as Loctite RC/620 have a shelf life of one year which should not be exceeded. Check with a Loctite supplier for product use beyond its recommended life.

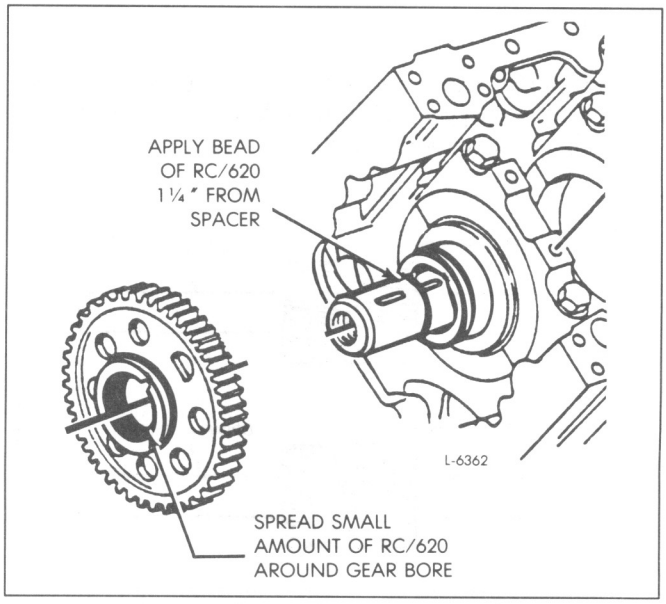


Fig. 7 – Location of Loctite RC/620

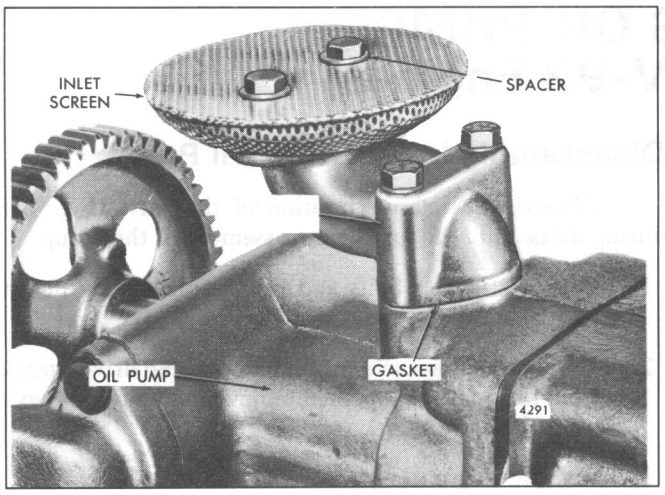


Fig. 8 – Inlet Pipe and Screen Mounting

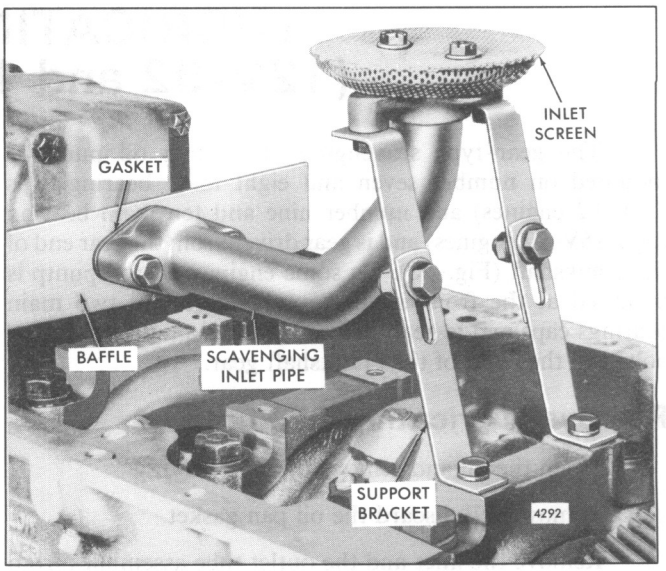


Fig. 9 – Scavenging Inlet Pipe and Screen Mounting

Install Oil Pump

1. Position the oil pump over the studs on the No. 1 and 2 main bearing caps so that the gear teeth mesh with the crankshaft oil pump drive gear teeth.

2. Fasten the oil pump to the main bearing caps with four nuts and lock washers.

   NOTICE: Place the same number of shims between the oil pump feet and the main bearing caps as were removed. Removing or installing shims controls the gear tooth adjustment. The addition or removal of one set of .005" shims will change the gear tooth clearance by .0035".

3. With the engine in the running position, check the tooth clearance between the oil pump gear and the crankshaft gear. Use a feeler gage or a suitable indicator. The clearance should be .006" to .012".

4. Use two new gaskets and position the oil pressure relief valve on the cylinder block and against the oil pump body. Secure the oil pressure relief valve with four bolts and lock washers.

5. Use a new gasket and position the oil pump inlet pipe on the oil pump body. Secure the inlet pipe with two bolts and lock washers. Place the screen on the inlet pipe and fasten it with two self–locking bolts and two spacers (Fig. 8).

6. Place a new gasket between the scavenging pump body and baffle plate and between the baffle plate and the scavenging oil pump inlet pipe. Secure the pipe and baffle with two bolts and lock washers to the scavenging pump body (Fig. 9).

7. Attach the two support brackets to the scavenging inlet pipe. Secure the brackets to the main bearing cap with bolts and lock washers.

8. Place the screen on the scavenging inlet pipe and fasten it with two self–locking bolts and two plain washers.

9. Recheck all of the bolts for tightness to ensure there will be no leaks in the oil pump and pipe connections.

10. Use a new gasket and secure the oil pump pressure regulator valve to the cylinder block with two bolts and lock washers.

11. Place a new gasket on the oil pan and install the pan on the cylinder block. Start all of the oil pan bolts before tightening them. Tighten the bolts snugly but not excessively, starting with the center bolts and working toward each end of the oil pan. Excessive tightening of the bolts will crush the oil pan gasket unnecessarily.

12. Fill the oil pan to the proper level with the oil recommended in the *Lubrication Specifications* in Section 13.3.

LUBRICATING OIL PUMP (12V–92 and 16V–92 Engines)

The gear–type scavenging lubricating oil pump is mounted on number seven and eight main bearing caps (12V–92 engines) and number nine and ten main bearing caps (16V–92 engines) and is gear driven from the rear end of the crankshaft (Fig. 10). On some engines, the oil pump is mounted at the front on the number one and two main bearings caps and is gear–driven by an oil pump drive gear bolted to the front of the crankshaft gear.

Remove Lubricating Oil Pump

1. Drain the oil and remove the oil pan(s).
2. Remove and discard the oil pan gasket.
3. Remove the inlet and the outlet tube assemblies from the oil pump and the scavenging pump (Fig. 10).
4. Remove the nuts and lock washers which attach the oil pump to the main bearing caps, then remove the oil pump.

NOTICE: On some engines, shims are used between the oil pump mounting feet and the main bearing caps. Whenever the original pump is reinstalled, the same shims or an equal number of new (identical) shims must be placed under both the front and rear mounting feet and the number then adjusted to obtain the proper clearance between the pump drive and driven gears.

Disassemble Lubricating Oil Pump

Observe the relative position of the parts (Fig. 14) during disassembly to facilitate reassembly of the pump:

1. Remove the five bolts and lift the scavenging pump body from the pump body.
2. Withdraw the scavenging pump drive and driven gears from the pump shafts, then remove the Woodruff keys from the drive shaft.
3. Remove the spacer.
4. Withdraw the driven shaft and gear as an assembly from the pump body.
5. Attach puller J 24420–A to the pump driven gear. Place a couple of washers or a nut between the end of the pump shaft and the puller screw to protect the end of the pump shaft. Then remove the gear by turning the puller screw clockwise (Fig. 11).
6. Remove the key from the shaft.
7. Withdraw the drive shaft and gear as an assembly from the pump body.
8. Press the oil pump drive shaft out of the oil pump gear (Fig. 12).
9. Remove the key from the shaft.

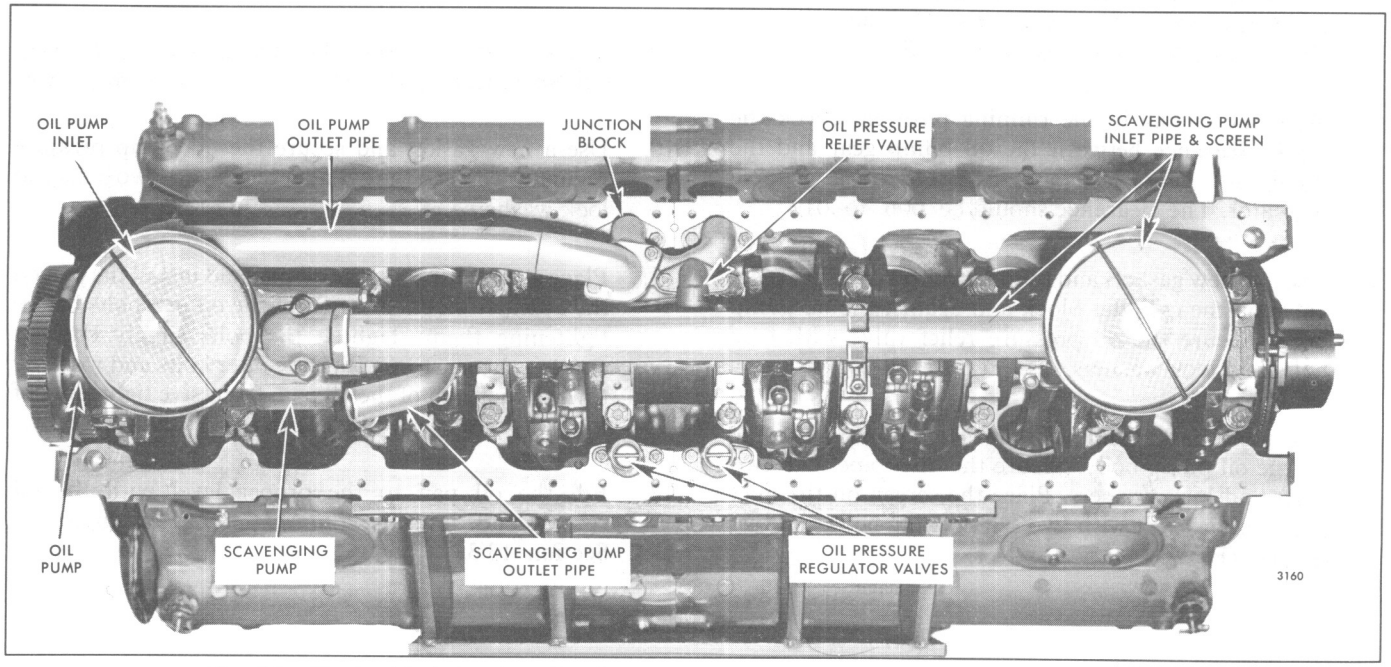


Fig. 10 – Typical Lubricating Oil Pump Rear Mounted (12V–92 and 16V–92 Engines)

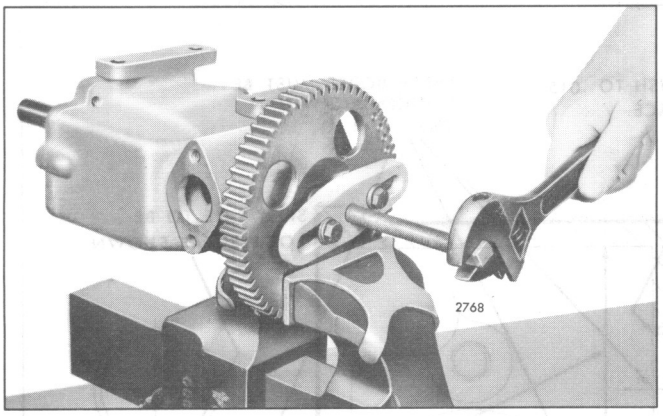


Fig. 11 – Removing Oil Pump Drive–Driven Gear

Inspection

Wash all of the parts in clean fuel oil and dry them with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

The greatest amount of wear in the oil pump is imposed on the internal drive and driven gears. This wear may be kept to a minimum by keeping the lubricating oil clean and acid–free. If dirt and sludge are allowed to accumulate in the lubricating system, pronounced gear wear may occur in a comparatively short period of time. Proper servicing of oil filters will increase the life of the gears.

Examine the internal gear cavity of the pump body and scavenger pump for wear or scoring. Also, inspect the spacer between the pump and the scavenger pump bodies for wear. Replace the parts, if necessary.

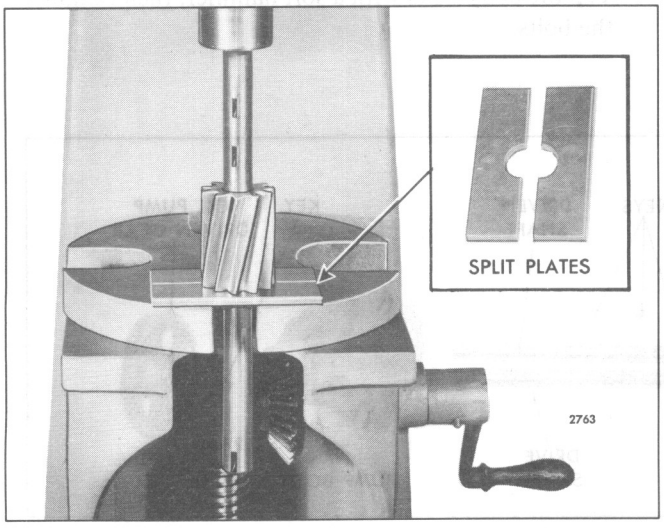


Fig. 12 – Pressing Oil Pump Gear From Shaft

Inspect the bushings in the pump body and scavenging body. If the bushings are worn excessively, replace the pump body and scavenging body unless suitable boring equipment is available for finishing the new bushings. When installing new bushings, replace all of the bushings in the pump. The bushings must be located and positioned as shown in Fig. 13. The gear bore and the bushing bore must be concentric within .002" total indicator reading. The shaft–to–bushing clearance with new parts is .0015" to .0032".

If the gear teeth are scored or worn, install new gears. The use of excessively worn gears will result in low engine oil pressure which, in turn, may lead to serious damage throughout the engine.

Inspect the pump shafts for wear and check the keyways. Replace the shafts, if necessary.

Remove the oil inlet screen from the oil inlet pipe and clean both the screen and pipe with fuel oil and dry them with compressed air.

Inspect the external pump drive–driven gear for wear and replace it, if necessary.

Inspection of the pressure relief valve and oil pressure regulator are covered in Section 4.1.1.

Assemble Lubricating Oil Pump

1. Install the oil pump gear key in the oil pump drive shaft.
2. Lubricate the drive shaft, then press the oil pump drive gear on the shaft with tool J 9380 (Fig. 15). Tool J 9380 will position the gear 5.50" from the end of the shaft as well as prevent the shaft from bending during gear installation.
3. Lubricate the driven shaft and press the oil pump driven gear on the shaft. Use tool J 9381 to position the gear 4.68" from the end of the shaft.
4. Install the drive shaft and gear assembly in the pump body in its original position.
5. Install the key in the driven gear end of the drive shaft.
6. Press the driven gear on the drive shaft until the clearance between the gear hub and the pump body is .010" (Fig. 16).
7. Install the driven shaft and gear assembly in the pump body.

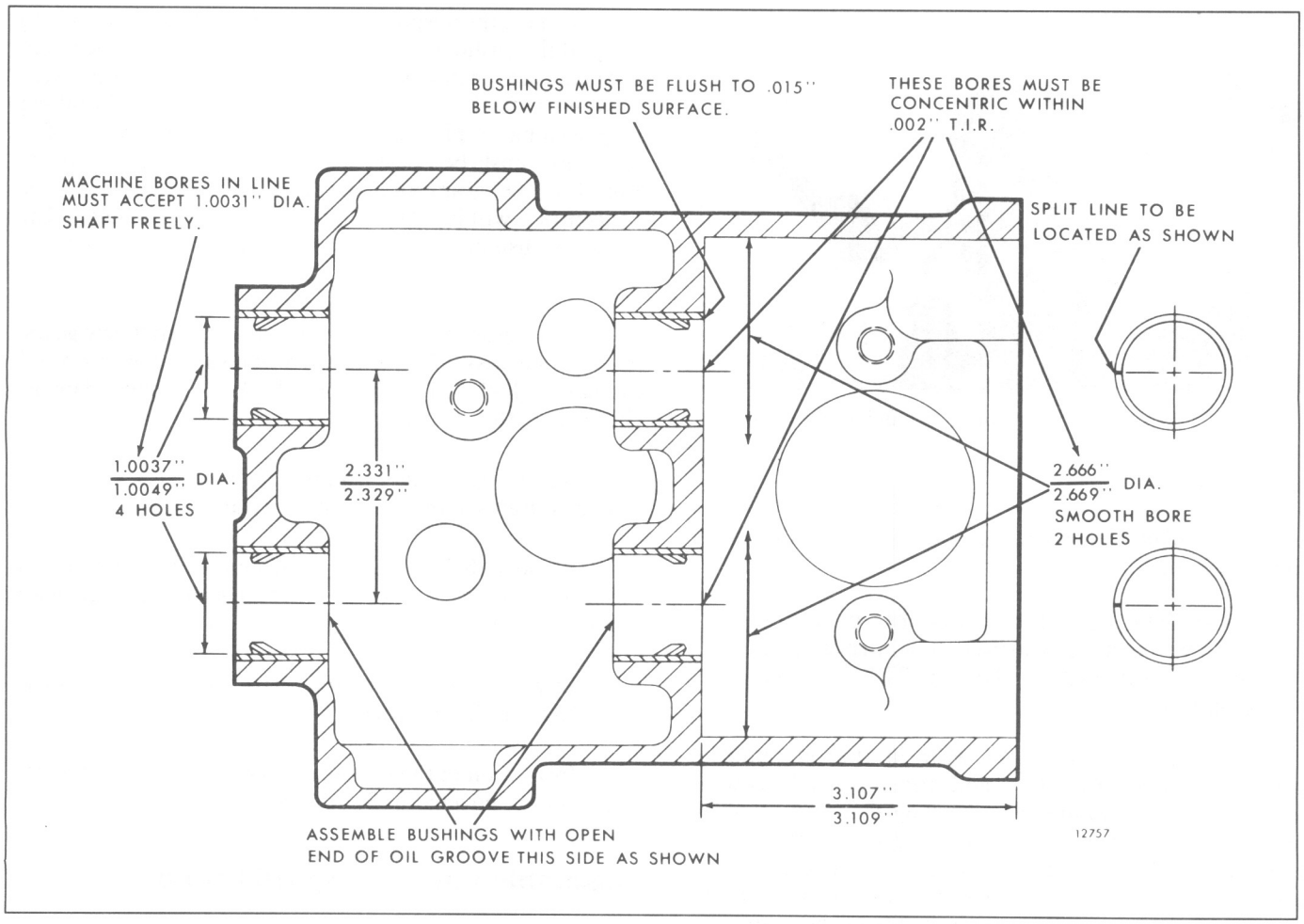


Fig. 13 – Diameter and Location of Bushing in Oil Pump (12V–92 and 16V–92 Engines)

8. Slide the spacer on the shafts. Install the keys in the drive shaft, then slide the scavenging pump gears on the shafts. The right–hand and left–hand scavenging pump gears must be in the same relative position as the oil pump gears (Fig. 14).

   Secure the scavenging pump body to the oil pump body with five bolts and lock washers.

9. Rotate the oil pump driven gear by hand to make certain the gears and the shafts rotate freely. If necessary, loosen the scavenging pump body bolts. Tap the body bolts with a soft hammer, then retighten the bolts.

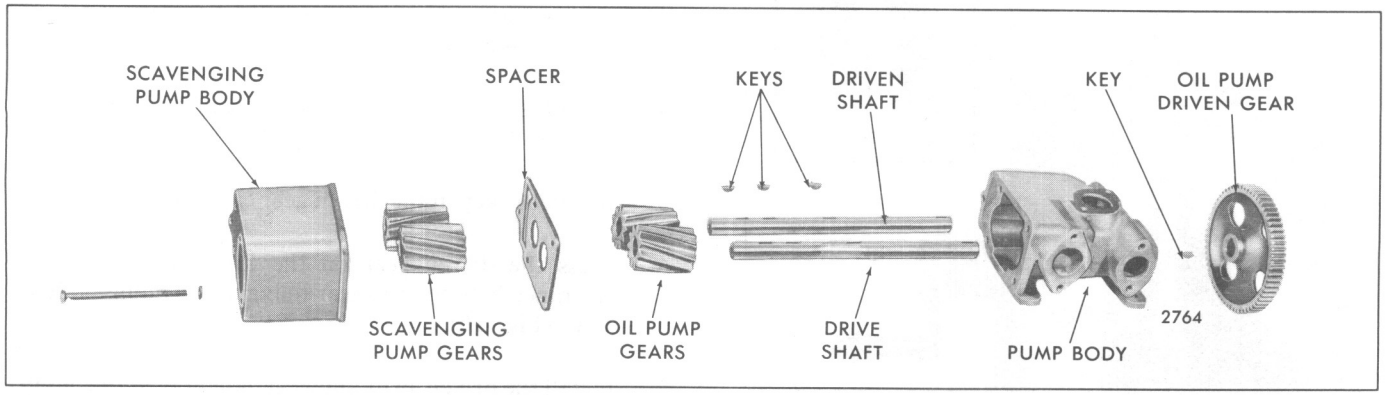


Fig. 14 – Lubricating Oil Pump Details and Relative Location of Parts (12V–92 and 16V–92 Engines)

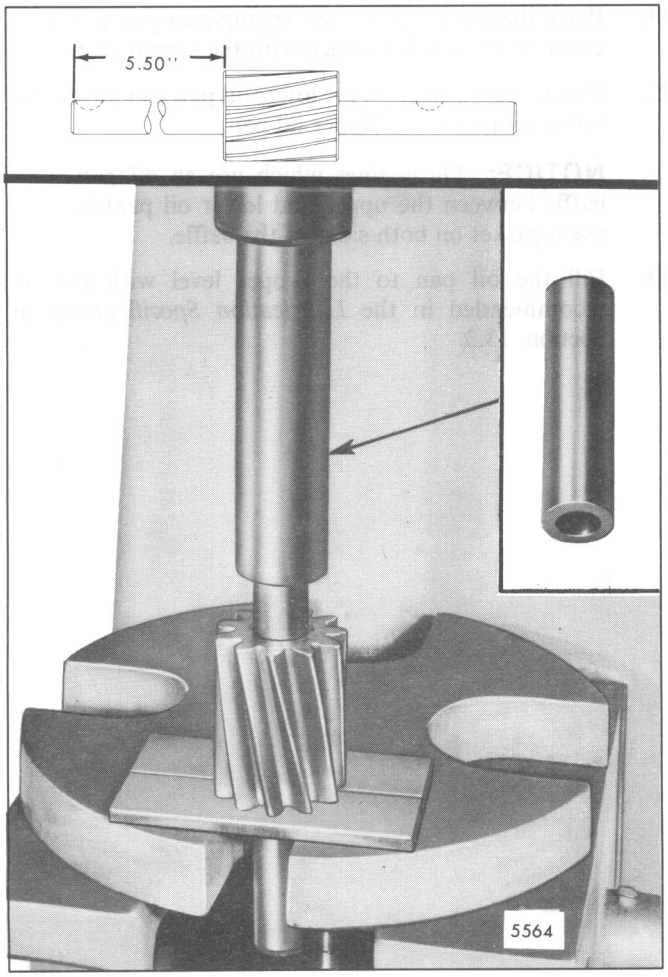


Fig. 15 – Installing Oil Pump Gear on Shaft using Tool J 9380

Remove Oil Pump Drive Gear

Since the oil pump drive gear is bolted to the rear crankshaft timing gear, oil pump drive gear removal, inspection and installation, is covered in Section 1.7.5.

Install Lubricating Oil Pump

1. Position the rear mounted oil pump on the number seven and eight main bearing caps (12V–92 engines) and number nine and ten main bearing caps (16V–92 engines) so that the oil pump drive gear teeth mesh with the oil pump driven gear teeth. Secure the oil pump to the bearing caps with four nuts and lock washers (Fig. 10).

2. Check the backlash (clearance) between the oil pump drive and driven gears with a feeler gage or a suitable dial indicator. The backlash should be .006" to .012".

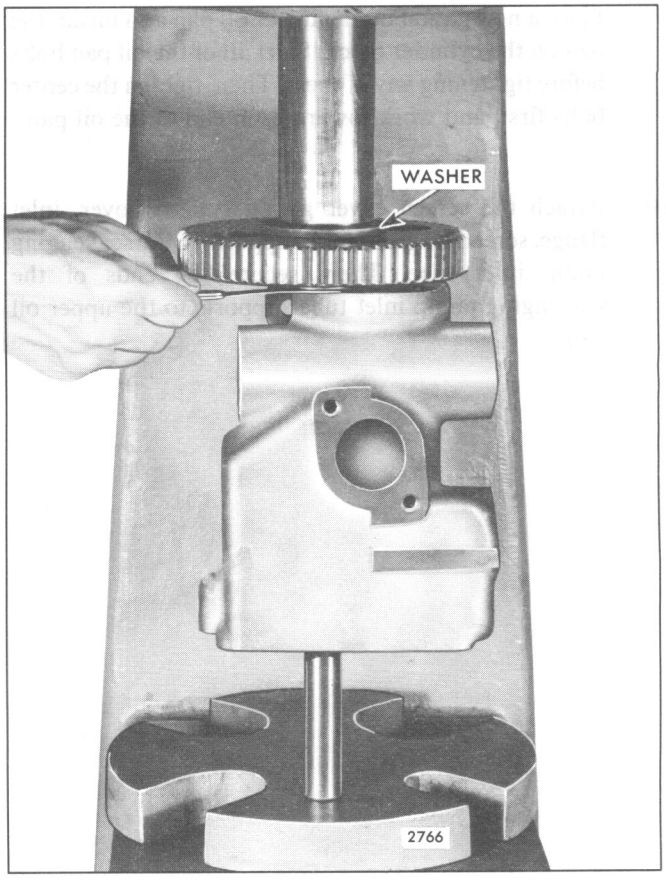


Fig. 16 – Installing Oil Pump Drive–Driven Gear on Shaft

Install shims between the oil pump mounting feet and the main bearing caps, as required, to obtain the proper backlash. Install or remove the same number of shims, under both mounting feet, to keep the pump level. The addition or removal of each .005" shim will change the gear backlash .0035".

3. Install the junction block if it was removed (Fig. 10). When installing the junction block, use new junction block–to–cylinder block gaskets to prevent oil leaks.

4. Install the oil pump inlet and outlet pipes. Use a new inlet pipe–to–oil pump gasket. Also, use a new gasket at each end of the oil pump outlet tube.

5. Install the oil pump screen cover gasket, screen cover, inlet pipe flange and screen stop on the oil pump inlet pipe. Next, place the screen in the screen cover and lock it in place with the screen retainer.

6. Install the scavenging pump inlet and outlet pipes. Use a new inlet pipe–to–scavenging pump gasket and a new outlet pipe–to–scavenging pump gasket.

7. Install the scavenging pump inlet pipe support.

8. Refer to Section 4.1.1 for the oil pressure regulator and oil pressure relief valve coverage.

9. Place a new gasket on the upper oil pan and install the pan on the cylinder block. Start all of the oil pan bolts before tightening any of them. Then, tighten the center bolts first, and work toward each end of the oil pan.

10. Attach the screen cover gasket, screen cover, inlet flange, screen stop and tube supports to the scavenging pump inlet tube. Then, secure the ends of the scavenging pump inlet tube supports to the upper oil pan.

11. Place the screen in the scavenging pump inlet screen cover, then lock it in place with the screen retainer.

12. Place a new gasket on the lower oil pan and attach the lower oil pan to the upper oil pan.

    NOTICE: On engines which use an oil pan baffle between the upper and lower oil pan(s), use a gasket on both sides of the baffle.

13. Fill the oil pan to the proper level with the oil recommended in the *Lubrication Specifications* in Section 13.3.

LUBRICATING OIL PRESSURE REGULATOR AND RELIEF VALVES

OIL PRESSURE REGULATOR VALVE (6V and 8V Engines)

Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of the oil temperature, by an oil pressure regulator valve. The valve is installed at the end of the vertical oil gallery near the front of the cylinder block on the side opposite the oil cooler (Fig. 1).

The oil pressure regulator consists of a valve body, a hollow piston–type valve, a spring, a spring seat and a pin to retain the valve assembly within the valve body (Fig. 2).

Current regulator valve assemblies (identified by a blue paint mark on the casting seam) include a flat washer between the valve and the valve spring. The washer raises valve operating pressure by 5 psi (34.5 kPa). Because of the increased lubrication that results from the higher operating pressure, DDC recommends modifying the former valve assembly when the oil pan is removed for engine repair or service. Modify the valve by installing one (1) .406" x .812" x .065" flat washer between the valve and the spring.

The valve is held on its seat by the spring, which is compressed by the pin in back of the spring seat. The entire assembly is bolted to the lower flange of the cylinder block and sealed against leaks by a gasket between the block and the valve body. When conditions are such that the oil pressure at the valve exceeds 50 psi (345 kPa), the valve is forced from its seat and oil from the engine gallery is bypassed to the engine oil pan. Thus stabilized lubricating oil pressure is maintained at all times.

Under normal conditions, the oil pressure regulator should require very little attention. If sludge accumulates in the lubrication system, the valve may not work freely, thereby remaining open or failing to open at the normal operating pressure.

Whenever the lubricating oil pump is removed for inspection, remove the regulator valve and spring and thoroughly clean and inspect them.

Remove Oil Pressure Regulator

1. Remove the two regulator–to–cylinder block attaching bolts and lock washers.
2. Tap the regulator body lightly to loosen it from the gasket and the cylinder block. Remove the regulator and the gasket.

Disassemble Oil Pressure Regulator

1. Clamp the regulator assembly in the soft jaws of a bench vise and remove the spring seat retaining pin from the regulator body.
2. Remove the spring seat, spring and valve from regulator body.

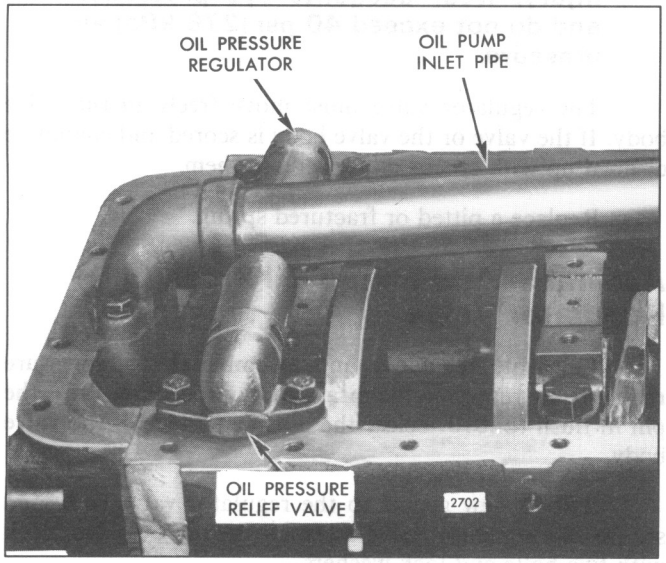


Fig. 1 – Oil Pressure Regulator Valve and Relief Valve Mounting (6V or 8V Engine Oil Pump in Front Cover)

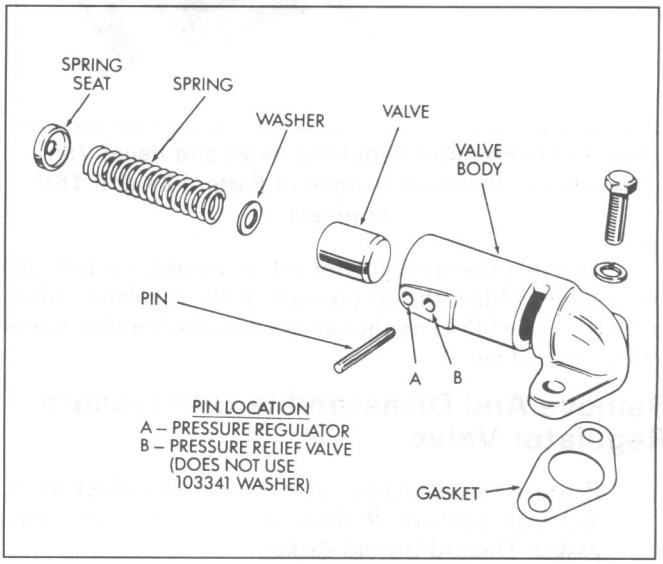


Fig. 2 – Oil Pressure Regulator Valve and Relief Valve and Relative Location of Parts

Inspection

Clean all of the regulator components in fuel oil and dry them with compressed air. Then inspect them for wear or damage.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

The regulator valve must move freely in the valve body. If the valve or the valve body is scored and cannot be cleaned up with crocus cloth, replace them.

Replace a pitted or fractured spring.

Assemble Oil Pressure Regulator

After the parts have been cleaned and inspected, refer to Fig. 2 and assemble the regulator as follows:

1. Apply clean engine oil to the outer face of the valve and slide it into the regulator body, closed end first.
2. Insert the spring in the valve and install the spring seat. While compressing the spring, install the retaining pin behind the spring seat. Press the pin flush to .010" below the surface of the valve body.

NOTICE: The valve body used on the 6V and 8V engines (with an oil pump in the front cover) has two retaining pin holes (Fig. 2). Install the pin in the outermost hole for the regulator valve. The inner hole is used when the valve is assembled as an oil pump relief valve assembly. It is important that the retaining pin be positioned correctly so the proper valve opening pressure will be obtained.

Install Oil Pressure Regulator

1. Remove all traces of old gasket material from the regulator body and the cylinder block.
2. Affix a new gasket to a cast iron regulator body and secure the regulator assembly to the cylinder block with two bolts and lock washers. When installing a regulator assembly with an aluminum housing, use 3/8" plain washers on the bolts and be sure the washers are against the aluminum housing.

OIL PRESSURE REGULATOR VALVE (12V and 16V Engines)

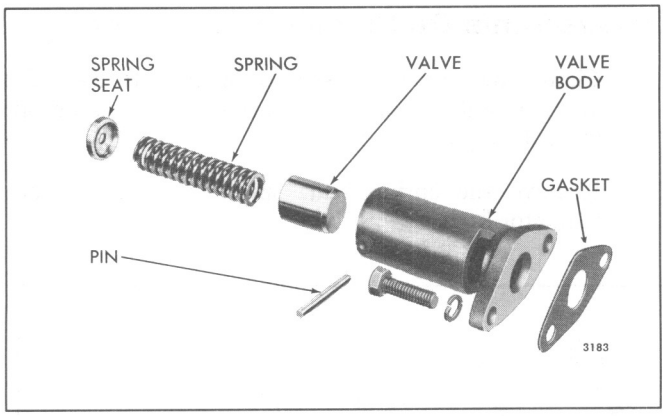


Fig. 3 – Oil Pressure Regulator Valve and Relief Valve Details and Relative Location of Parts (12V and 16V Engines)

Two oil pressure regulator valves are used on 12V and 16V engines. When the oil pressure at the regulator valves exceeds 50 psi (345 kPa), the valves open, discharging excess oil into the oil pan.

Remove And Disassemble Oil Pressure Regulator Valve

1. Remove the regulator valve–to–cylinder block bolts and lock washers. Remove the regulator valve and gasket. Discard the old gasket.
2. Drive the spring seat retaining pin out of the valve body.
3. Remove the spring seat, spring and valve from the valve body (Fig. 3).

Inspection

Clean all of the regulator components with fuel oil and dry them with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

The regulator valve must move freely in the valve body. If the valve or the valve body is scored and cannot be cleaned up with crocus cloth, replace them.

Replace a pitted or fractured spring.

Assemble And Install Oil Pressure Regulator Valve

Lubricate the valve and assemble the oil pressure regulator by reversing the disassembly procedure. Press the pin in flush to .010" below the outside surface of the valve body.

Affix a new gasket to the regulator valve body and secure the regulator valve assembly to the cylinder block with two bolts and lock washers.

Install the second valve as outlined below.

OIL PRESSURE RELIEF VALVE (6V AND 8V ENGINES)

Oil leaving the pump under pressure passes into the pressure relief valve body. The spring–loaded valve opens when the pressure exceeds approximately 105 psi (724 kPa) and directs the excess oil to the oil pan. The pressure relief valve is located at the lower end of the vertical oil gallery near the front of the cylinder block on the oil cooler side (Fig. 1).

The pressure relief valve consists of a valve body, a hollow piston–type valve, a spring, spring seat and a pin to retain the valve assembly within the valve body.

The relief valve assembly used on the 6V and 8V engines is composed of the same parts as the regulator valve assembly (Fig. 2). However, the retaining pin is located in the inner pin hole in the valve body to provide the necessary tension on the spring.

To provide sufficient clearance between the relief valve housing and the stabilizer bolts, on engines equipped with a main bearing cap mounted lubricating oil pump, a new relief valve is now being used. To eliminate the possibility of cracking the valve housing at assembly, the casting was thickened and the corner of the valve housing at the stabilizer bolt location was removed. The former and new relief valves are not separately interchangeable and only the new relief valve will be serviced.

NOTICE: Be sure and use the correct main bearing cap bolt and washer at the stabilizer positions to obtain minimum clearance.

Service operations for the pressure relief valve are similar to those of the regulator valve.

The spring in the 6V and 8V relief valve assemblies is the same as used in the oil pressure regulator assemblies.

Replace the springs when they are pitted or fractured.

OIL PRESSURE RELIEF VALVE (12V AND 16V ENGINES)

The oil pressure relief valve, mounted on the junction block, bypasses excess oil directly into the oil sump when the oil pressure in the cylinder block main oil galleries exceeds approximately 120 psi or 827 kPa (Fig. 3, Section 4.1).

The valve, spring, spring seat and the pin used in the oil pressure relief valve are identical to the parts used in the oil pressure regulator valve (Fig. 3). Therefore, the removal, disassembly, inspection, assembly and installation procedures given for the oil pressure regulator valve also apply to the relief valve.

LUBRICATING OIL FILTERS

The V–92 engines are equipped with a full–flow type lubricating oil filter. A bypass type oil filter may be used in addition to the full–flow type filter when additional filtration is desired.

Full–Flow Oil Filter

The full–flow type lubricating oil filter is installed ahead of the oil cooler in the lubrication system. The 6V and 8V engines are equipped with a single filter (Fig. 1). The 12V and 16V engines use either two single or two dual oil filters. The filters may be mounted directly to the oil cooler adaptor or remotely mounted on the oil cooler cover and connected by flexible hoses to a filter junction which is attached to the oil cooler adaptor (Fig. 2). Certain units may be equipped with an oil cooler cover which also functions as an oil filter adaptor.

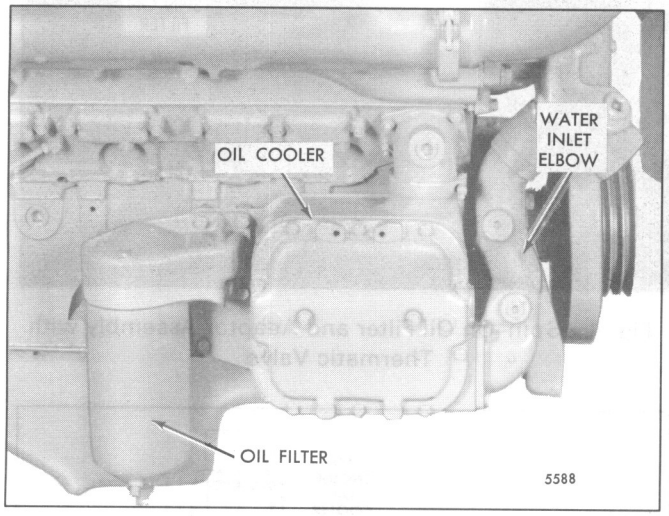


Fig. 1 – Typical Full–Flow Oil Filter Mounting (6V or 8V Engine)

The filter assembly consists of a replaceable element enclosed within a shell which is mounted on an adaptor or base. When the filter shell is in place, the element is restrained from movement by a coil spring.

All of the oil supplied to the engine by the oil pump passes through the filter before reaching the various moving parts of the engine. The oil is forced by pump pressure through a passage in the filter adaptor or base to the space surrounding the filter element. Impurities are filtered out as the oil is forced through the element to a central passage surrounding the center stud and out through another passage in the filter adaptor or base and then to the oil cooler.

A valve, which opens at approximately 18–21 psi (124–145 kPa), is located in the filter adaptor or base and will bypass the oil directly to the oil cooler should the filter become clogged.

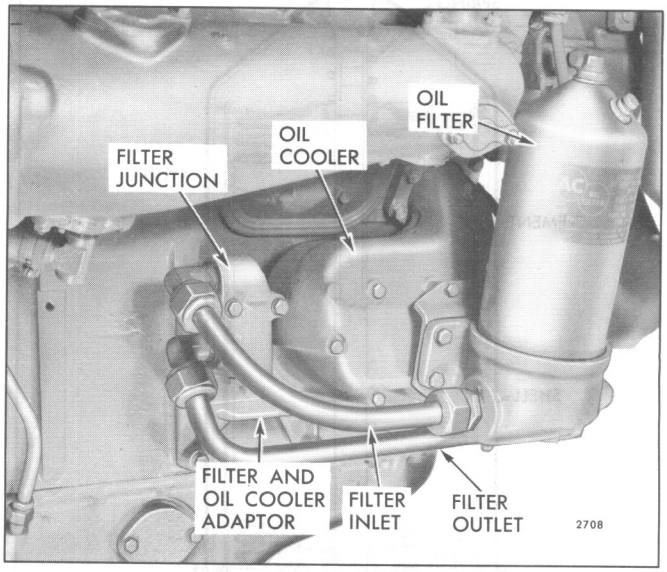


Fig. 2 – Typical Full–Flow Remote Mounted Oil Filter

Conversion adaptor kits (K–4 for the 6V–92 and the K–5 for the 8V–92) for spin–on, full–flow lube oil filters are now available as field replacement items.

NOTICE: Spin–on filters should not replace filter assemblies on transmissions.

The spin–on lubricating oil filter (throwaway type) and mounting adaptor are now being installed on certain engines. The spin–on filter requires a new mounting adaptor which in some cases is part of the oil cooler cover.

Bypass Oil Filter

When additional filtration is desired, an oil filter of the bypass type may also be installed on the engine (Fig. 3). However, the size of the orifice on the discharge side of the filter must not exceed .101" (6V and 8V engines) or .125" (12V and 16V engines) to control the oil flow rate and to provide sufficient oil pressure when the engine is running at idle speed.

When the engine is running, a portion of the lubricating oil is bled off the oil gallery and passed through the bypass filter. Eventually all of the oil passes through the filter, filtering out fine foreign particles that may be present.

The bypass filter assembly consists of a replaceable element contained in a shell mounted on a combination base and mounting bracket. When the shell is in place, the filter element is restrained from movement by a coil spring at the top. A hollow center stud serves as the outlet passage from the filter as well as securing the shell in place.

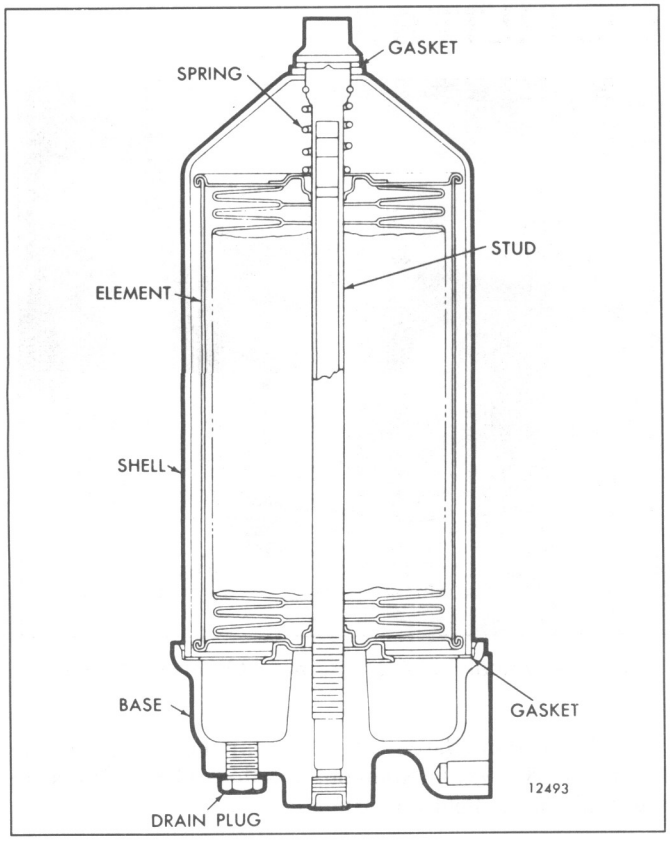


Fig. 3 – Typical Bypass Type Oil Filter

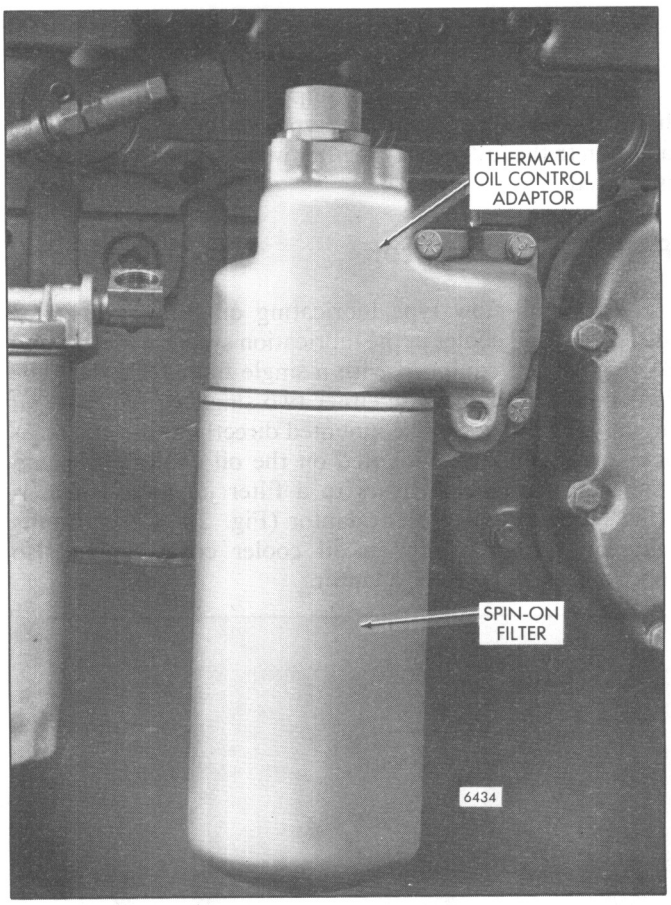


Fig. 4 – Spin–On Oil Filter and Adaptor Assembly with Thermatic Valve

Thermatic Oil Control Valve

A spin–on lube oil filter adaptor assembly with a temperature–sensitive thermatic oil control valve (Fig. 4) is available as an option on certain Series 92 industrial engines. This valve was formerly used on certified automotive models, but was discontinued effective with 1988 production build engines. A service kit is available from DDC distributors to completely replace the thermatic valve when no longer required.

The thermatic valve is installed in the top of the oil filter adaptor assembly where it operates like a thermostat to control the flow of lube oil through the engine and oil cooler. The valve operates in the following manner (Fig. 5).

At lube oil temperatures below 215°F (102°C) the valve stays in the bypass mode. Filtered engine oil bypasses the oil cooler and flows directly to the main oil gallery. With no oil passing through the oil cooler, engine oil warms up rapidly. When oil temperature is between 215°F–230°F (102°C–110°C) the thermatic valve is partially open. The valve senses oil temperature and modulates oil both through and around the oil cooler. At oil temperatures above 230°F (110°C) the valve is fully open and all the oil flows through the oil cooler.

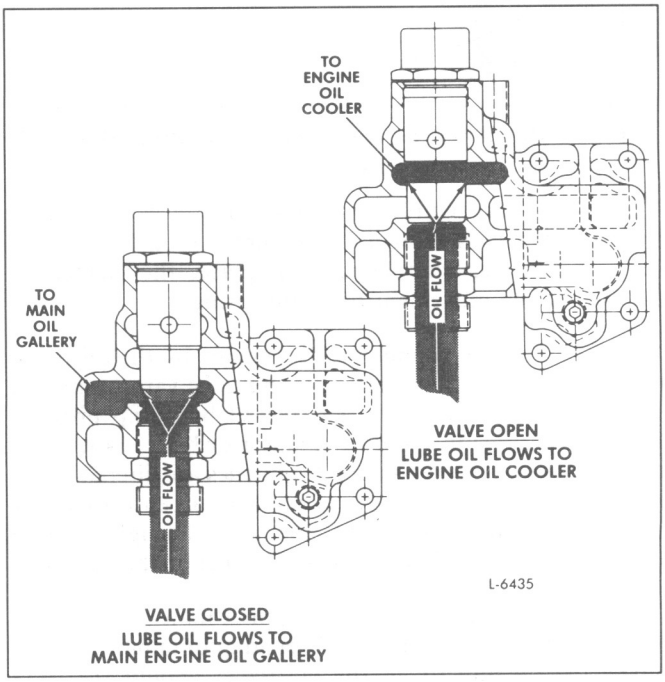


Fig. 5 – Thermatic Valve Operation

Use of the thermatic valve allows the engine lube oil to reach its normal range quickly, reducing the amount of time during which the engine operates on heavier cold engine oil. During light load engine operation, the valve keeps the oil within the proper temperature range for optimum lubrication. By maintaining the oil temperature within the 215°F–230°F (102°C–110°C) range, friction and pumping losses are minimized, resulting in more efficient engine operation. The thermatic oil control valve assembly also incorporates a relief valve which permits oil to bypass the oil cooler if the cooler should become plugged.

Oil Filter Maintenance

With the use of detergent lubricating oils, the color of the lubricant has lost value as an indicator of oil cleanliness or proper filter action. Due to the ability of the detergent compounds to hold minute carbon particles in suspension, heavy duty oils will always appear dark colored on the oil level dipstick.

Heavy sludge deposits found on the filter elements at the time of an oil change must be taken as an indication that the detergency of the oil has been exhausted. When this occurs, the oil drain interval should be shortened. The removal of abrasive dust, metal particles and carbon must be ensured by replacement of the oil filter elements at the time the engine oil is changed.

Selection of a reliable oil supplier, strict observation of his oil change period recommendations and proper filter maintenance will ensure trouble–free lubrication and longer engine life.

• An optional AC service filter is available which has a synthetic (fiberglass), rather than an organic (cellulose) filtering medium. The filter is available in spin–on or canister style and is otherwise identical to the current production filter. The new filter traps particles as small as 12 microns (at 98% efficiency per AC test procedures), compared to 45 microns for the production filter. Because of its increased filtering capability, DDC recommends using it on new, rebuilt, or newly overhauled engines being placed in service.

NOTICE: The new service filter will improve oil filtration on a properly maintained and operated engine. It will not prevent wear or malfunctions caused by poor maintenance or improper engine operation.

Replace Oil Filter Element

Replace the element in either the full–flow or bypass type oil filter assembly (Figs. 3 and 6) as follows:

1. Remove the drain plug from the filter shell or the filter adaptor or base and drain the oil.
2. Back out the center stud and withdraw the shell, element and stud as an assembly. Discard the element and the shell gasket.
3. Remove the center stud and gasket. Retain the gasket unless it is damaged and oil leaks occurred.
4. Remove the nut on the full–flow filter center stud.
5. Remove and discard the element retainer seal (Fig. 6). Install a new seal.
6. Clean the filter shell and the adaptor or base.
7. Install the center stud gasket and slide the stud (with the spring, washer, seal and retainer installed on the full–flow filter stud) through the filter shell.
8. Install a new shell gasket in the filter adaptor or base.

   NOTICE: Before installing the filter shell gasket, be sure all of the old gasket material is removed from the filter shell and the adaptor or base. Also make sure the gasket surfaces of the shell and the adaptor or base have no nicks, burrs or other damage.
9. Position the new filter element carefully over the center stud and within the shell. Then, place the shell, element and stud assembly in position on the filter adaptor or base and tighten the stud to 50–60 lb–ft (68–81 N•m) torque.

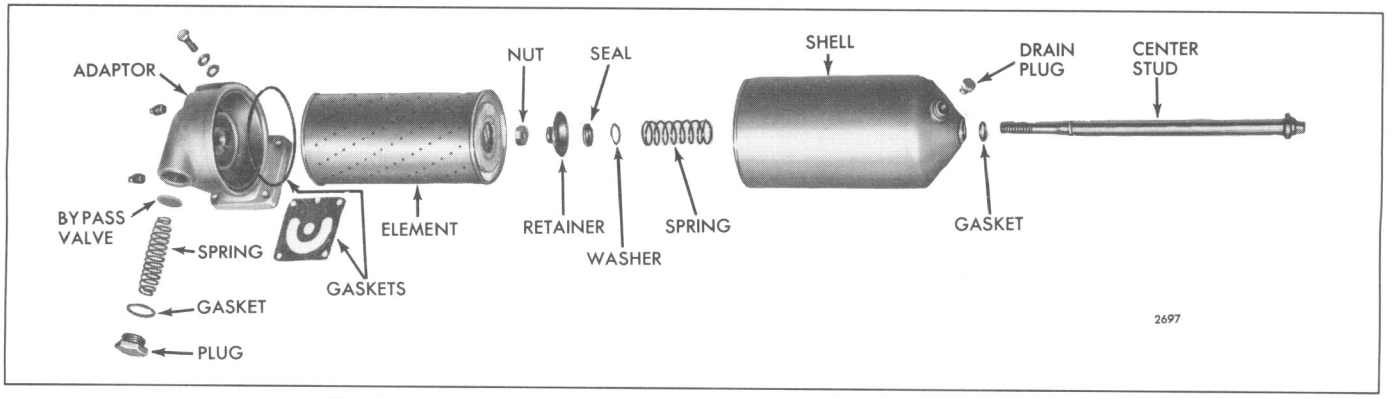


Fig. 6 – Full Flow Oil Filter Details and Relative Location of Parts

10. Install the drain plug.
11. Start and run the engine for a short period and check for oil leaks. After any oil leaks have been corrected and the engine has been stopped long enough (approximately twenty (20) minutes) for the oil from various parts of the engine to drain back to the crankcase, add sufficient oil to bring it to the proper level on the dipstick.

Replace Spin–On Filter

1. Remove the oil filter using strap wrench tool J 29917 which must be used with a 1/2" drive socket wrench and extension.
2. Discard the used oil filter.
3. Clean the filter adaptor with a clean, lint–free cloth.
4. Lightly coat the oil filter gasket (seal) with clean engine oil. When installing an oil filter on a DDEC engine, fill 2/3 full with clean engine oil before installing. This will insure full lubrication of bearing surfaces when the engine is started and prevent logging a faulty low oil pressure code (45).
5. Start the new filter on the adaptor and *tighten by hand* until the gasket touches the mounting adaptor head. Tighten an additional two–thirds turn.

NOTICE: Mechanical tightening will distort or crack the filter adaptor.

6. Start and run the engine for a short period and check for oil leaks. After any oil leaks have been corrected and the engine has been stopped long enough for oil from the various parts of the engine to drain back to the crankcase (approximately twenty (20) minutes), add sufficient oil to raise the oil level to the proper mark on the dipstick.

Remove And Install Bypass Valve

1. Remove the plug and gasket or the screw and retainer and withdraw the spring and bypass valve.
2. Wash all of the parts in clean fuel oil and dry them with compressed air.
3. Inspect the parts for wear. If necessary, install new parts.
4. Using a new gasket, reassemble and install the bypass valve. Tighten the 1 1/4"–16 bypass valve plug to 95–105 lb–ft (129–143 N•m) or the 1 1/2"–16 plug to 110–130 lb–ft (150–177 N•m) torque.

LUBRICATING OIL COOLER (Plate–Type)

In order to perform its functions satisfactorily, the lubricating oil must be kept within the proper temperature limits. If the oil is too cold, it will not flow freely. If the oil is too hot, it cannot support the bearing loads, it cannot carry away enough heat, and it may result in too great an oil flow. As a consequence, oil pressure may drop below acceptable limits and oil consumption may become excessive.

In performing its lubricating and cooling functions, the oil absorbs a considerable amount of heat and this heat must be dissipated by an oil cooler.

Each engine is provided with an oil cooler mounted on the right–hand side of the cylinder block at the lower front corner (Figs. 1 and 2) as viewed from the flywheel end of the engine. Two engine oil coolers are used on the 12 and 16V engines and are centrally located on the side of the cylinder block.

The 6 and 8V naturally aspirated engines usually are equipped with an 18 or 24 plate oil cooler (three plates per cylinder). Most current 6V turbocharged engines are equipped with an 18 plate oil cooler (three plates per cylinder). Former and certain 6V and the 8V turbocharged engines are equipped with a 24 plate oil cooler (four plates per cylinder).

To improve sealing between the oil cooler housing adaptor, gasket and plate on certain vehicle engines, additional bolt holes and 5/16"–18 bolts have been added (Fig. 3). Only the new adaptor, plate and gasket will be available for service. To use the former adaptor plate with the new gasket and adaptor, drill two additional holes as indicated in Fig. 3.

A new, one–piece cast oil cooler adaptor which elminates the need for a separate cover plate and gasket is being used on 6V and 8V–92 engines. The new adaptor also eliminates the potential for external oil leakage between the gasket surfaces of the former adaptor and oil cooler adaptor plate (Fig. 4). The new adaptor is completely interchangeable with the former adaptor and only the new will be serviced. The gasket and plate used with the former adaptor will be retained for service.

Oil from the lubricating oil pump flows through a passage in the oil cooler adaptor to the oil filter, then through the oil cooler, and finally through the outlet passage in the cooler adaptor which leads to the cylinder block oil galleries. The engine coolant is pumped through the oil cooler and completely surrounds the oil cooler core.

To ensure continuing engine lubrication should the oil cooler become plugged, a bypass valve is installed in the oil cooler adaptor (Fig. 5).

Remove Oil Cooler Assembly

1. Drain the cooling system by opening the drain cock at the bottom of the oil cooler housing or water inlet elbow.

2. Remove any accessories or equipment necessary, such as the full flow oil filter, to provide access to the oil cooler.

3. Loosen the clamps and slide the hose down on the water inlet elbow.

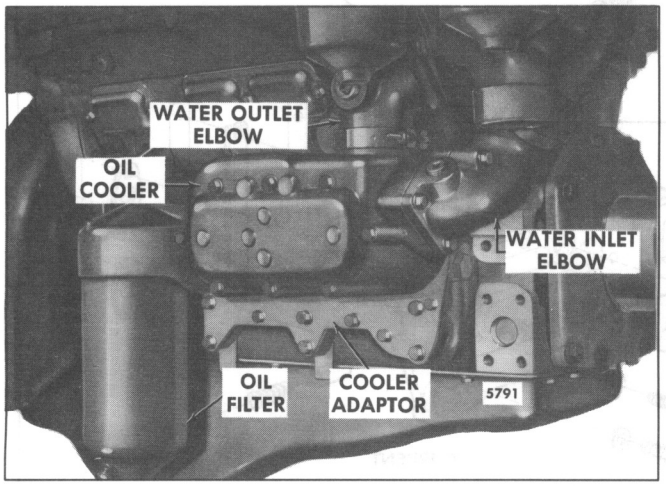


Fig. 1 – Typical Oil Cooler Mounting (6V or 8V Engine)

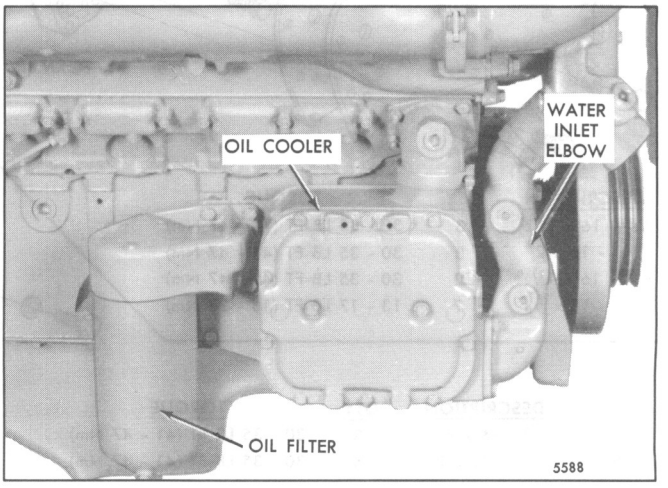


Fig. 2 – Typical Oil Cooler Mounting (Turbocharged Engine)

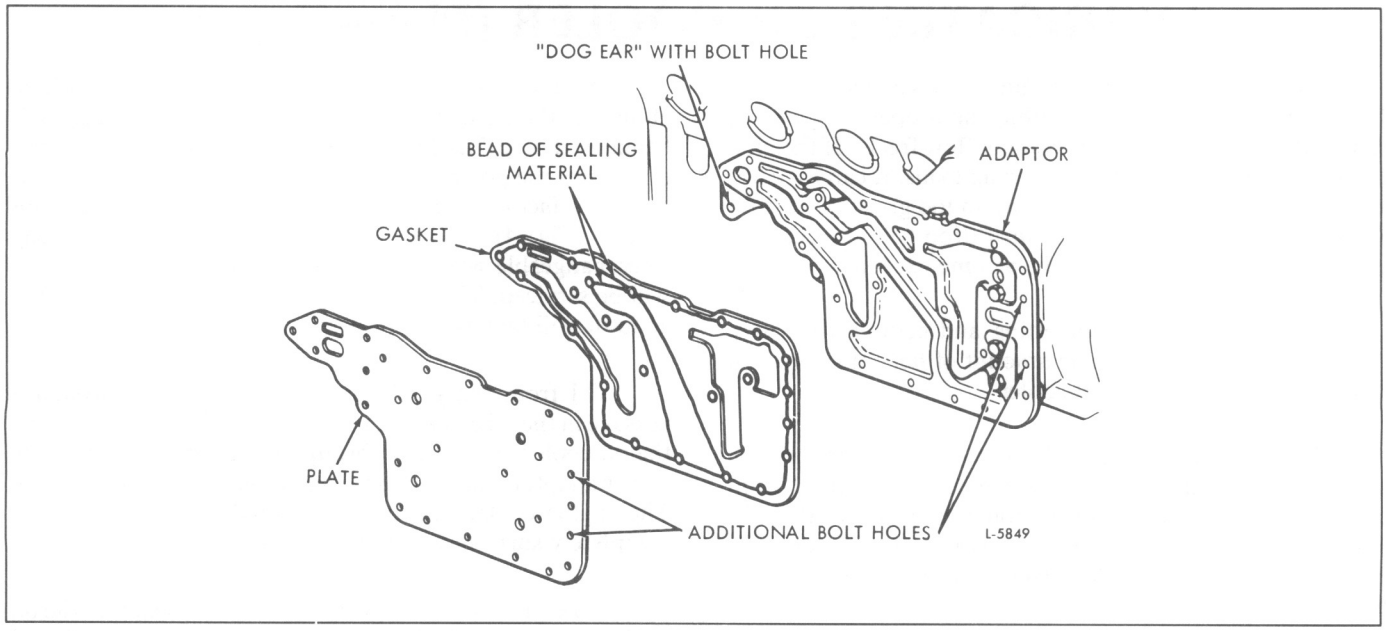


Fig. 3 – Oil Cooler Adaptor (Certain Vehicle Engine)

4. Remove the bolts and lock washers which retain the water inlet elbow to the oil cooler housing. Then remove the elbow and gasket.

5. If a water outlet elbow is used, loosen the seal clamp. Remove the bolts, nuts and lock washers and withdraw the water outlet flange and seal, or water outlet elbow, seal and gasket.

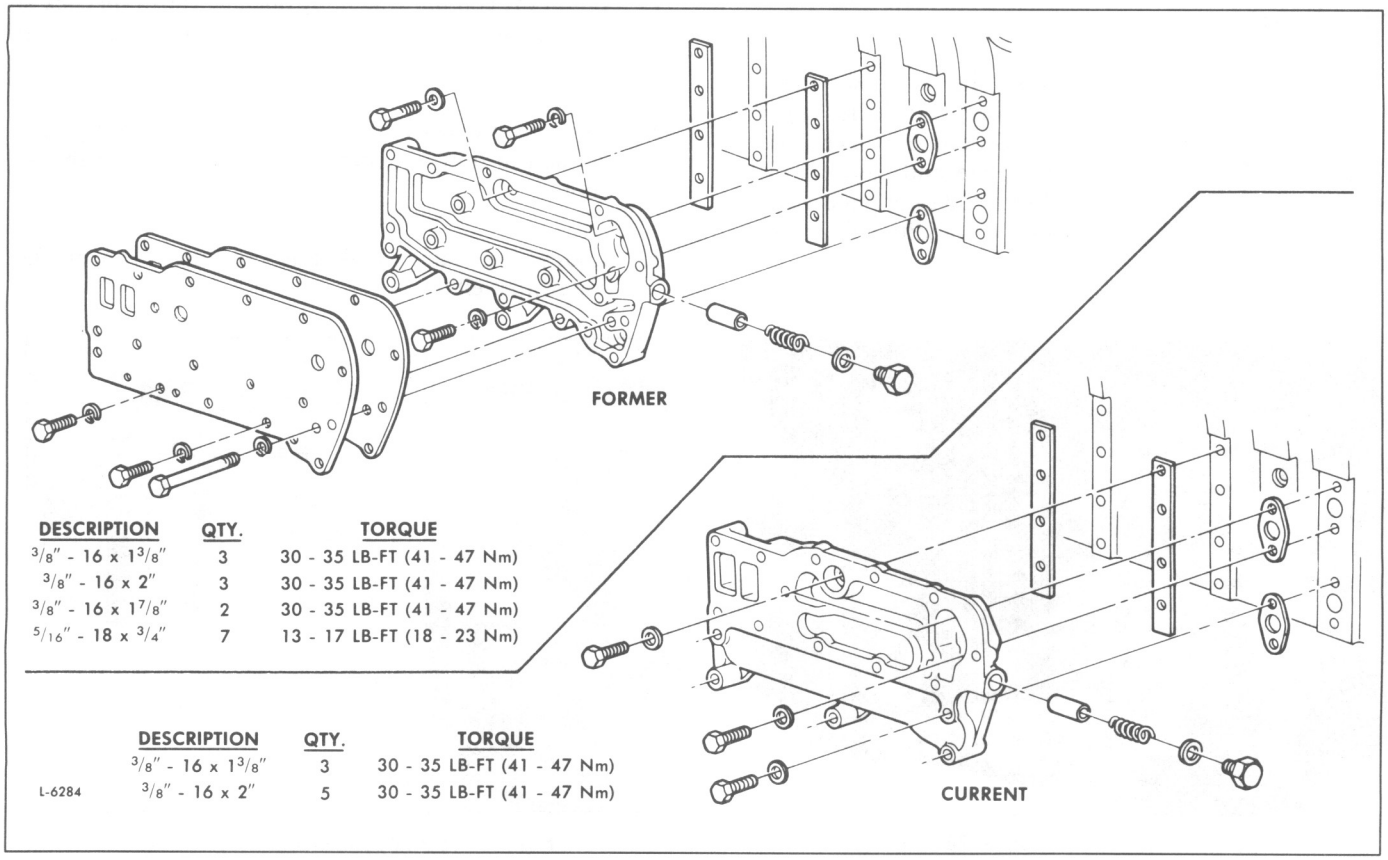


Fig. 4 – Former and Current Oil Cooler Configuration

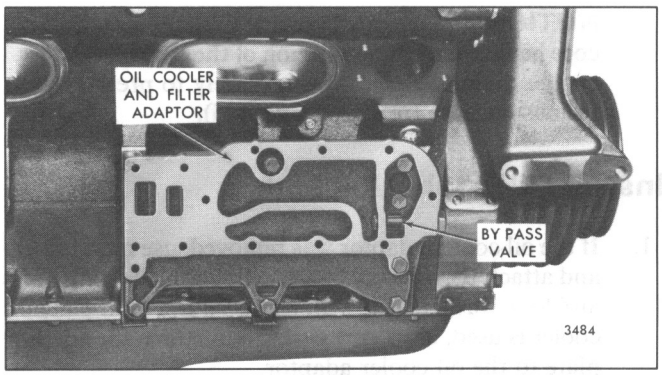


Fig. 5 – Oil Cooler Adaptor and Bypass Valve Mounting

6. Remove the bolts and lock washers and withdraw the oil cooler housing and oil cooler core as an assembly, using care to avoid dropping the oil cooler core.

   If the engine is equipped with a twin plate oil cooler (Fig. 9), remove the two outer bolts at the top of the oil cooler cover and install two studs (approximately 8–1/2" long and with a 5/16"–18 thread at one end) to support the housing, oil cooler core and cover. Then remove the remaining bolts, lock washers and two copper washers. The cover, oil cooler core, housing and gaskets may then be removed.

7. If the oil cooler adaptor is to be removed, first remove the oil filter. Then remove the bolts and lock washers which attach the adaptor to the cylinder block and withdraw the adaptor and gaskets.

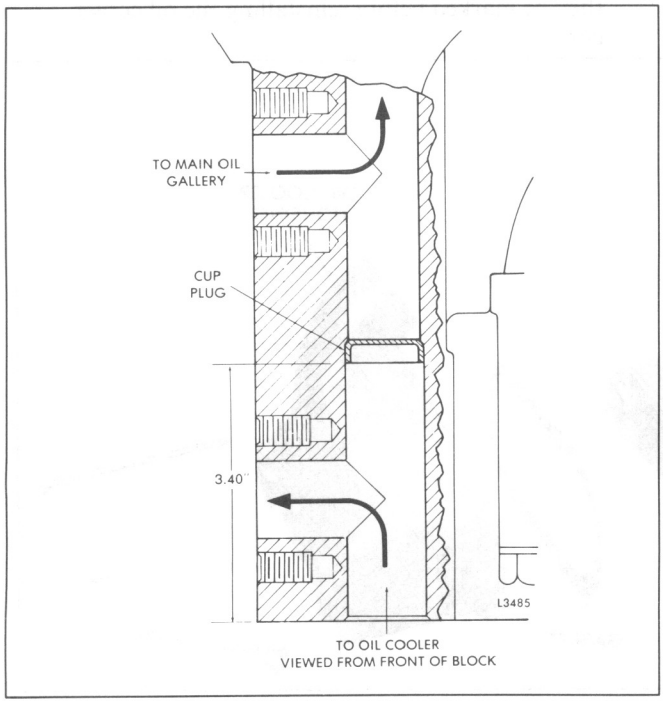


Fig. 6 – Location of Cylinder Block Oil Gallery Cup Plug

To remove the oil cooler adaptor used with the twin plate cooler, the adaptor plate must be removed first.

8. Clean all traces of gasket material from the cylinder block and the oil cooler components.

9. Inspect the vertical oil passage in the cylinder block for the presence of the cup plug which directs the flow of oil through the oil cooler (Fig. 6). Absence of this plug will result in high oil temperature or low oil pressure (resulting from high oil temperature).

Clean Oil Cooler Core

1. Clean the oil passages in the oil cooler core by circulating a solution of 1,1,1–tricholoroethane through the passages with a force pump.

   CAUTION: Perform this operation in the open or in a well ventilated room. Avoid breathing the fumes or direct contact of the chemicals with your skin.

Clean the oil cooler core before the sludge hardens. If the oil passages are badly clogged, circulate an alkaline cleaning solution through the oil cooler core and flush it thoroughly with clean, hot water.

NOTICE: Do not attempt to clean an oil cooler core when an engine failure occurs in which metal particles from worn or broken parts are released into the lubricating oil. In this instance, replace the oil cooler core.

2. After cleaning the oil passages, clean the water side of the oil cooler core by immersing it in a solution made as follows: add 1/2 pound of oxalic acid to each 2–1/2 gallons of a solution composed of 1/3 muriatic acid and 2/3 water. The cleaning action is evident by the bubbling and foaming. Carefully observe the process

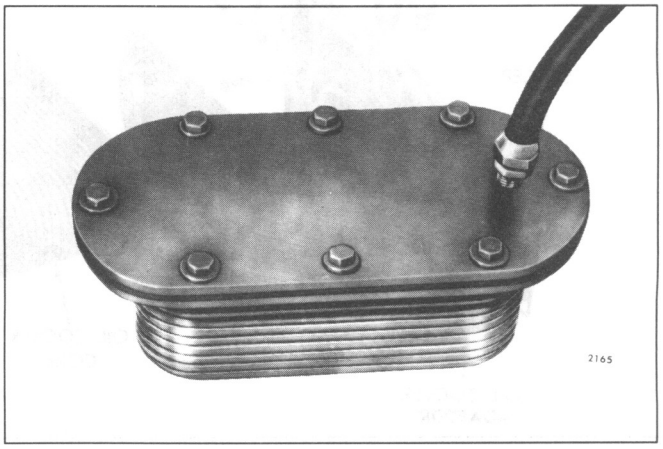


Fig. 7 – Oil Cooler Core Prepared for Pressure Check

and remove the oil cooler core from the solution when the bubbling stops (this usually takes from 30 to 60 seconds). Then thoroughly flush the oil cooler core with clean, hot water. After cleaning, dip the oil cooler core in light oil.

CAUTION: Protect your eyes and avoid breathing the fumes or direct contact of the acid with your skin.

Pressure Check Oil Cooler Core

1. Make a suitable plate and attach it to the flanged side of the oil cooler core. Use a gasket made from rubber to ensure a tight seal. Drill and tap the plate to permit an air hose fitting to be attached at the inlet side of the oil cooler core (Fig. 7).

2. Attach an air hose and apply approximately 75–150 psi (517–1 034 kPa) air pressure. Then submerge the oil cooler core and plate assembly in a tank of water heated to 180°F (82°C). Any leaks will be indicated by air bubbles in the water.

CAUTION: When making this pressure test be sure that personnel are adequately protected against any stream of pressurized water from a leak or rupture of a fitting, hose or the oil cooler core.

3. After the pressure check is completed, remove the plate and air hose and dry the oil cooler core with compressed air. Replace the oil cooler core if leaks were indicated.

NOTICE: In cases where a leaking oil cooler core has caused contamination of the engine, the engine must be flushed immediately to prevent serious damage (refer to Section 5).

Install Oil Cooler Assembly

1. If the oil cooler adaptor was removed, use new gaskets and attach the adaptor to the cylinder block with bolts and lock washers (Figs. 4, 8 and 9). If a twin plate oil cooler is used, use a new gasket and attach the adaptor plate to the oil cooler adaptor.

NOTICE: The current adaptor–to–block bolts with hardened washers will continue to be used. These bolts are pre–coated with a lock and seal compoud and may be reused if Loctite No. 242 (J 26558–242) or equivalent, is applied to the block bolt holes before bolt installation.

2. Affix new gaskets to the inner and outer faces of the flange and insert the oil cooler core in the oil cooler housing.

NOTICE: The inlet and outlet openings in the oil cooler core are marked "IN" and "OUT". Make sure the oil cooler core is reinstalled in its original position, otherwise the oil flow will be reversed and could result in foreign particles that may not have been removed to be loosened and circulated through the engine. If the openings are unidentified, it is suggested that they be marked before reinstalling the oil cooler core.

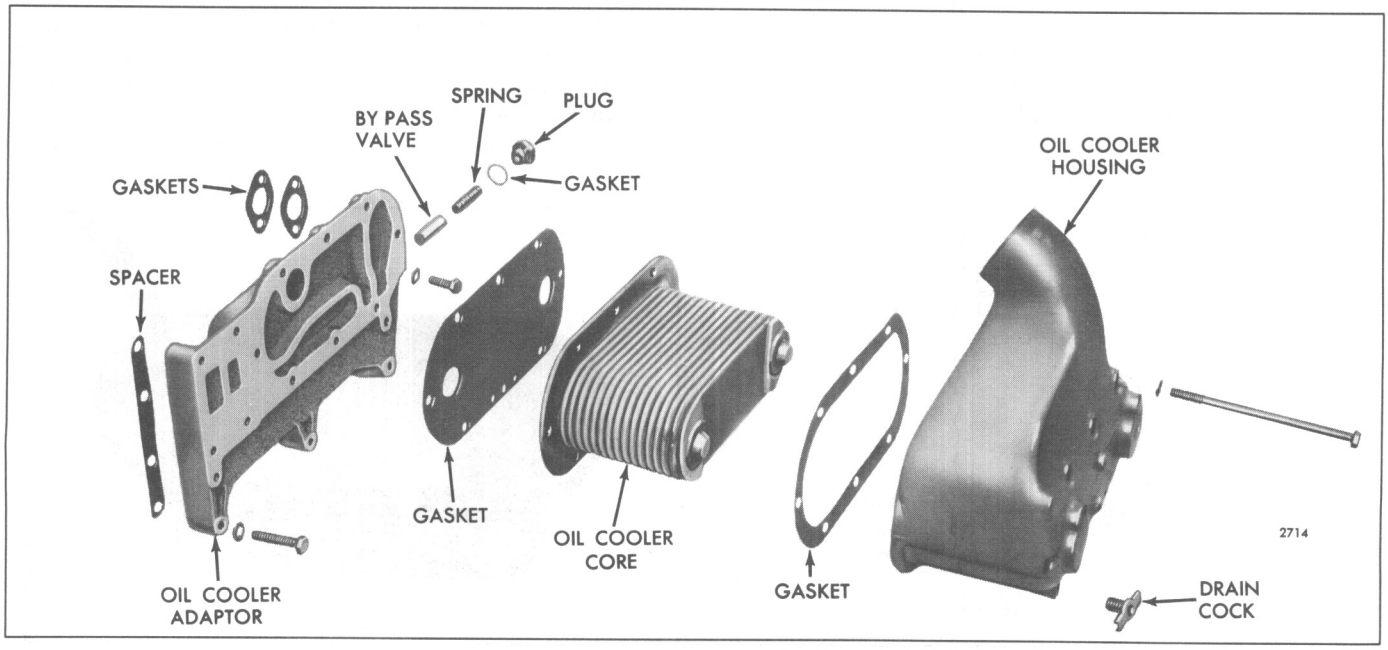


Fig. 8 – Oil Cooler Details and Relative Location of Parts

3. Place the housing and oil cooler core against the adaptor and secure them with bolts and lock washers.

If a twin plate oil cooler is used, install two guide studs. Then, using new gaskets, slide the housing, oil cooler core and cover over the dowels in the order illustrated in Fig. 9 and secure them in place with bolts, lock washers and new copper washers. Remove the studs and install the remaining two bolts and lock washers.

NOTICE: A tab is provided on current cover gaskets to ensure the gasket is installed correctly.

4. Install the water outlet flange and seal, or water outlet elbow, seal and gasket. Secure the flange or elbow to the cylinder block with bolts, nuts and lock washers. If an elbow is used, tighten the seal clamp.

5. Affix a new gasket to the oil cooler housing at the water inlet opening and secure the water inlet elbow to the housing with bolts and lock washers.

6. Slide the water inlet elbow hose in position and tighten the clamps.

7. Install any accessories which were removed to provide access to the oil cooler.

8. Close the drain cock in the oil cooler housing and fill the cooling system to the proper level.

9. Add sufficient oil to the crankcase to bring the oil level to the proper level on the dipstick.

10. Start and run the engine for a short period and check for oil and water leaks. After any leaks have been corrected and the engine has been stopped long enough (approximately twenty minutes) for the oil from various parts of the engine to drain back to the crankcase, bring the oil level up to the proper level on the dipstick.

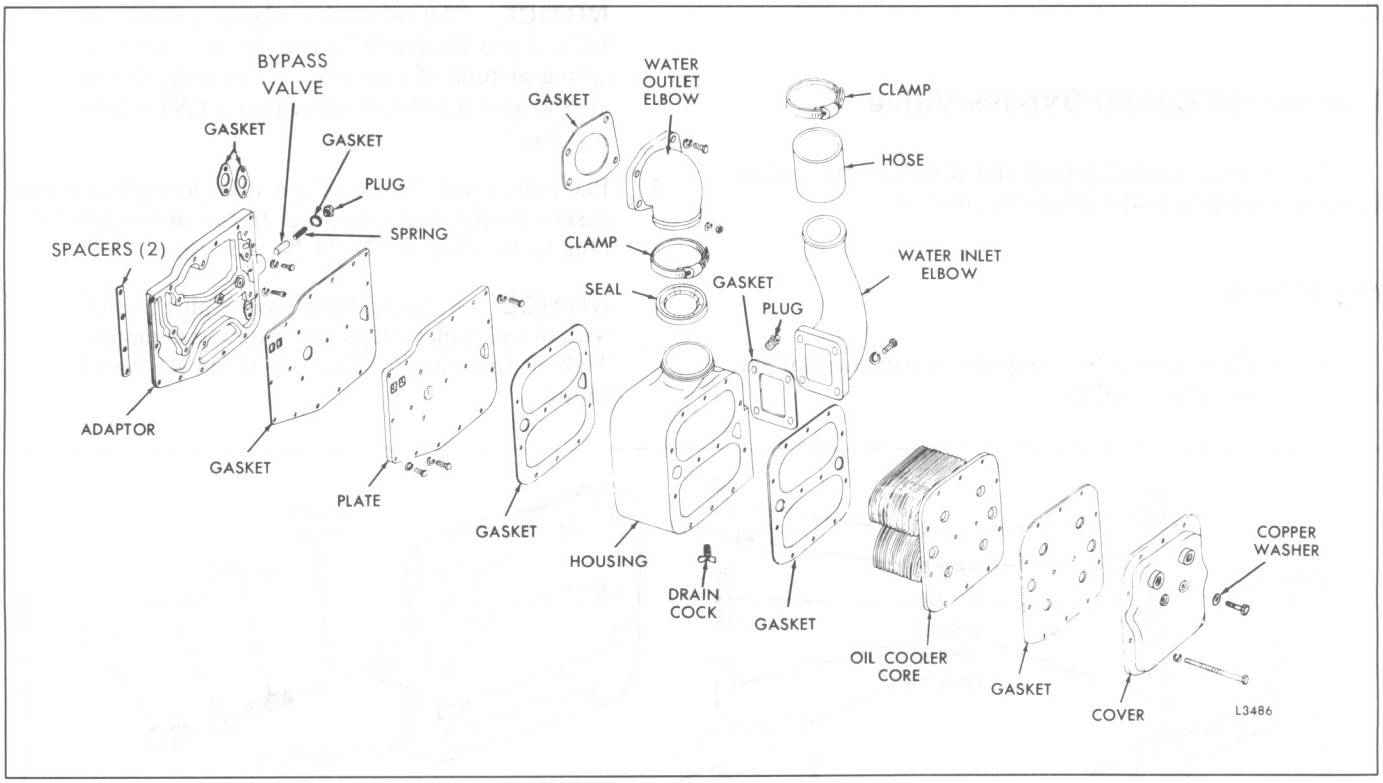


Fig. 9 – Twin Plate Oil Cooler Details and Relative Location of Parts

LUBRICATING OIL COOLER BYPASS VALVE

To ensure engine lubrication should the oil cooler become plugged, a bypass valve is installed in the inlet passage of the oil cooler adaptor (Fig. 5). The valve opens and allows the oil to bypass the oil cooler when the pressure at the inlet side exceeds the pressure at the outlet side by 40 psi (276 kPa).

The bypass valve assembly, which consists of a valve, spring, retaining plug and gasket, should be removed, cleaned and reassembled whenever the oil cooler core is cleaned or replaced. However, the bypass valve can be disassembled without removing the oil cooler on most models.

A new bypass valve spring has been released to provide increased oil circulation through the lube oil coolers. The new valve spring (2.56" long, orange paint identification) replaces the former spring (2" long, no paint identification) in the engine models that use the adaptors shown in Figs. 3 and 10.

Remove Oil Cooler Bypass Valve

Remove the retaining plug and withdraw the gasket, spring and valve from the oil cooler adaptor.

Inspection

Clean the bypass valve components with fuel oil and dry them with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

Inspect the valve and spring for wear and replace them if necessary. The bypass valve spring has a free length of approximately 2–1/64". Use spring tester J 29196 to check the spring load. When a force of 12 pounds or less will compress the spring to 1.793", replace the spring.

Install Oil Cooler Bypass Valve

Refer to Figs. 8, 9 and 10 – Install the bypass valve, as follows:

1. Apply clean engine oil to the outside surface of the valve and place it in the oil cooler adaptor valve cavity, closed end first.

   NOTICE: The oil cooler adaptors shown in Figs. 3 and 10 should be updated with the new spring at time of overhaul. This spring should also be replaced at each subsequent major engine overhaul.

2. Place the spring inside of the valve and place a new gasket on the retaining plug. Install and tighten the plug to 30–40 lb–ft (41–54 N•m) torque.

   NOTICE: A *slotted* bypass valve plug is used with the oil cooler adaptor plug on some engines. Tighten this plug to 25–30 lb–ft (34–41 N•m) torque.

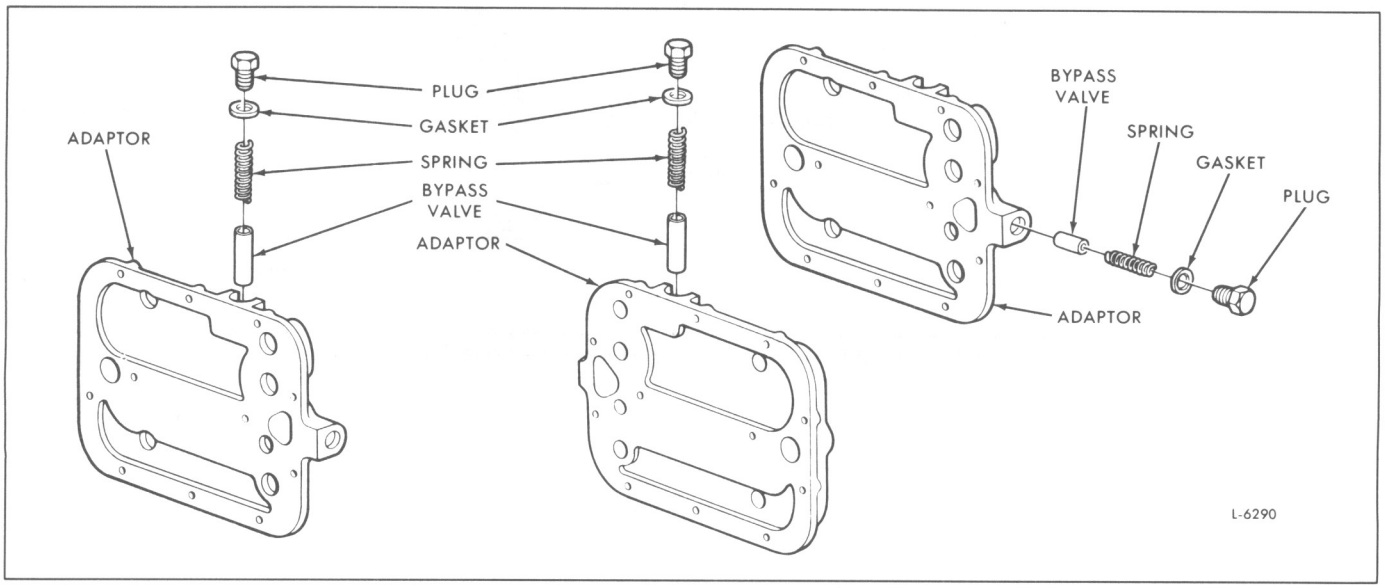


Fig. 10 – Oil Cooler Adaptors with Bypass Valve Assembly Components

LUBRICATING OIL COOLER (Tube–Type)

Certain engines are equipped with a tube–type oil cooler mounted on the side of the engine. Torqmatic converter units use a single basic oil cooler which consists of two sections; one section for the engine oil and the other section for the converter oil (Fig. 11). The Hydraulic Retarder units use a dual oil cooler of which one section cools the engine oil and three sections are used to cool the brake oil (Fig. 12).

A serviceable tube type oil cooler with removable tube bundles is now being used on certain 8V engines. The tube type oil cooler consists of a shell, two tube bundles, four seal rings and a front and rear cover (Fig. 14).

NOTICE: An improved fluoroelastomer seal ring is now being used in the single and dual tube type oil coolers. The improved seal ring is used at four locations on the oil cooler and should be used at overhaul, or whenever the oil cooler is serviced. Only the improved seal ring is serviced.

The coolant from the engine water pump flows through a passage in the oil cooler front cover, passes through the tubes of each section of the oil cooler, back to the outlet passage in the front cover, and finally to the water jackets in the cylinder block (Fig. 13).

The engine oil from the lubricating oil pump enters a passage in the oil cooler front cover, passes through the remote mounted oil filter, then around the tubes in the engine section of the oil cooler, back through the outlet passage in the front cover, and then to the oil galleries in the cylinder block (Fig. 13).

A bypass valve (Fig. 11) is provided which will permit the engine oil to flow directly through the oil cooler should the oil filter become clogged.

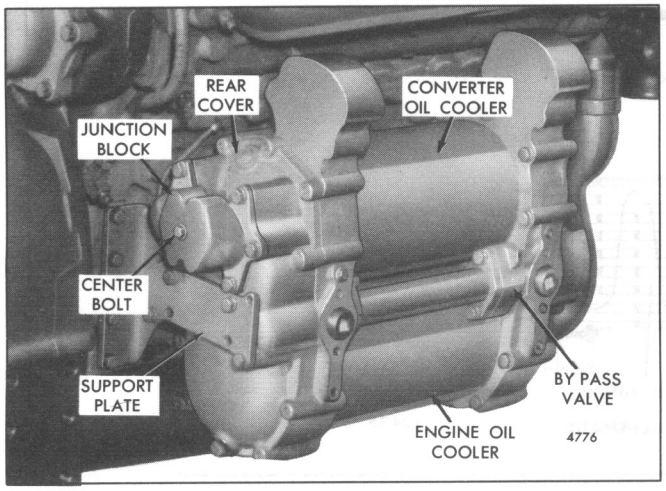


Fig. 11 – Single Tube–Type Oil Cooler Mounting

Oil from the Torqmatic converter or Hydraulic Retarder flows through a flexible hose connected to an oil passage in the oil cooler front end–casting, through the converter or retarder oil cooler sections and out through an oil passage in the oil cooler rear end–casting to a flexible hose which carries the cool oil back to the converter or Hydraulic Retarder (Fig. 13).

Remove Oil Cooler

1. Open the drain cock at the bottom of the rear oil cooler cover and drain the cooling system.

2. Disconnect the oil filter lines and the torque converter oil lines at the cooler. Also remove any accessories necessary to provide access to the oil cooler.

3. Loosen the clamps and slide the hose down on the water inlet elbow. Then remove the bolts and lock washers which attach the elbow to the oil cooler front cover and withdraw the elbow and gasket.

4. Loosen the clamp on the water outlet flange seal. Then remove the bolts, nuts and washers which attach the flange to the cylinder block. Remove the flange, gasket, seal and clamp.

5. Remove the bolts and lock washers which attach the oil cooler to the cylinder block and the oil cooler support bracket. Remove the oil cooler and the gaskets.

6. Drain the oil from the oil cooler.

7. Clean the exterior surfaces of the oil cooler with fuel oil.

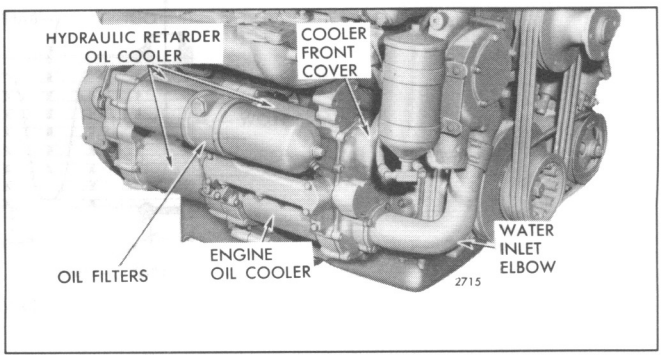
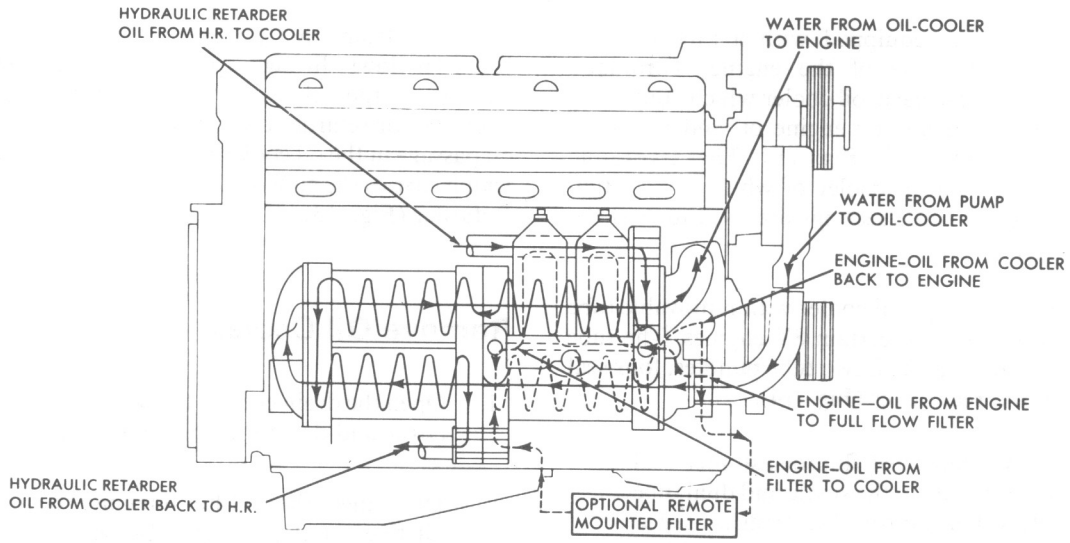
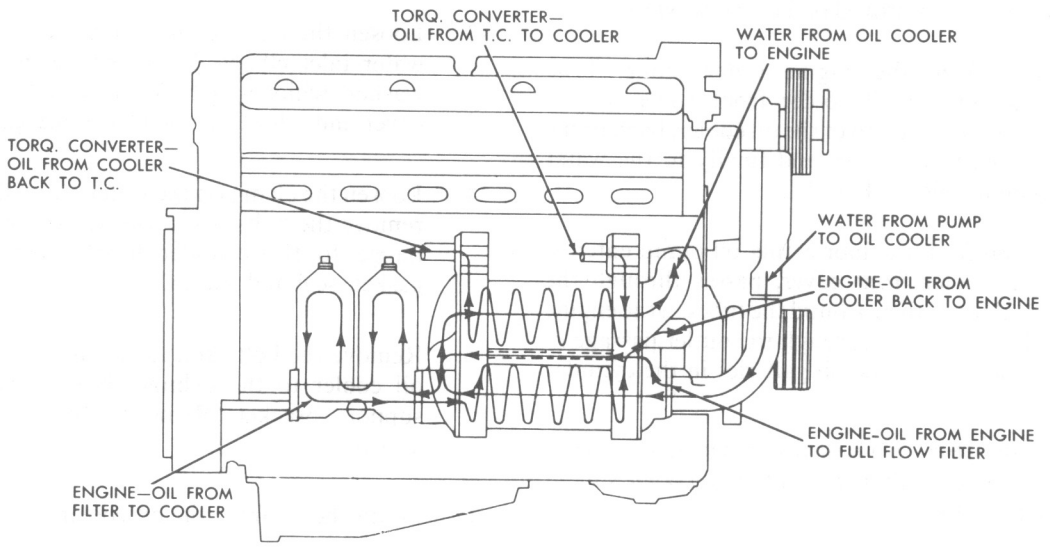


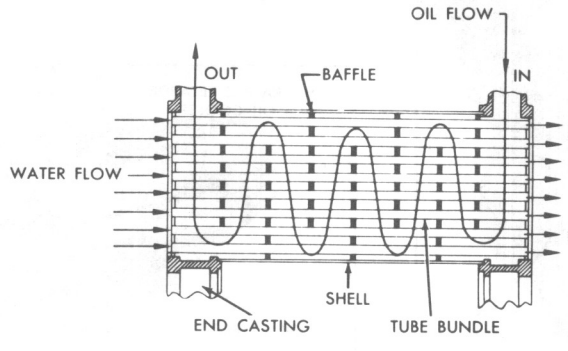
Fig. 12 – Dual Tube–Type Oil Cooler Mounting



HYDRAULIC RETARDER SYSTEM



TORQUE CONVERTER SYSTEM



EXCHANGER—SCHEMATIC 12435

Fig. 13 – Tube–Type Oil Cooler Flow Diagrams

Remove Tube Type Bundles (Current Engines)

The tube bundles are a snug fit in the shell and easily removed. Puller holes are located in the ends of the tube bundles for help in removal. The tube bundles are serviced separately.

NOTICE: The oil cooler tube bundles must be reinstalled in their respective positions (Fig. 14). If necessary, match mark them before removing the tube bundles from the shell.

Clean Oil Cooler

1. Clean the engine oil portion of the oil cooler as follows:

   NOTICE: Do not attempt to clean an oil cooler core when an engine failure occurs in which metal particles from worn or broken parts are released into the lubricating oil. In this instance, replace the oil cooler core.

   a. Replace the oil bypass tube and the oil bypass valve assembly with a long tube connected between the front and rear end castings of the oil cooler.

   b. Seal the oil outlet (to filter) and oil inlet (from filter) openings in the front and rear oil cooler covers with steel plates and gaskets.

   c. Attach a steel plate, which is fitted with an air hose connection, to the oil outlet (to engine) in the front cover.

   d. Attach an air hose, which is connected to an air supply capable to maintaining approximately 100 psi (689 kPa) pressure during the process of expelling the solvent. Then stand the oil cooler on end so the baffles inside the cooler shell will be in a horizontal position.

   e. Fill the oil cooler with a cleaning solvent and apply air pressure to expel the solvent and sludge.

   CAUTION: This operation should be performed in the open or in a well ventilated room when toxic chemicals are used. Also, since the solvent and sludge will be expelled with considerable force, it is suggested that the oil cooler be lowered upright in a barrel to prevent injury to personnel and to keep the spray of sludge contained within a small area.

   f. Refill the oil cooler with clean solvent and attach the air hose fitting to the inlet side of the cooler.

      Apply air pressure to expel the solvent. Repeat the flushing operation in alternate directions until the solvent comes out clean twice from each direction.

   g. Remove the tube which replaced the oil bypass tube and valve assembly.

2. Clean the torque converter oil portion of the oil cooler by circulating a cleaning solvent through the oil passages.

3. Clean the water side of the oil cooler by circulating a solvent such as Oakite through the tubes. Then remove the end covers and run a brush through the tubes. After the brushing is completed, rinse the tubes with clean, hot water.

   NOTICE: Precautions must be taken so the cleaning agents do not corrode the tubes. If an acid solution is used, the residue must be neutralized.

Inspect Oil Bypass Valve

Remove the spring retainer screw and withdraw the retainer, spring and valve from the valve housing. Use spring tester J 22738–02 to check the valve spring load. Replace the spring if a load of less than 6–1/2 pounds will compress it to a length of 13/16". Examine the spring retainer. If the retainer is bent, install a new valve assembly.

Assemble Removeable Tube Type Bundles

For ease in assembling, each tube bundle is marked with an "O" and the cooler shell is marked with an "O" (Fig. 14). The "O"s must line up to ensure proper location of the baffles in the shell. The tube bundles can be installed either end first.

To avoid cutting the seal rings and leaking seal rings it is important that each tube bundle be installed in the shell as follows:

1. Place the shell in a vertical position on the floor.

2. Install the bottom seal ring in the seal ring groove and coat it with lubricating oil.

   NOTICE: The seal ring groove must be free of burrs and foreign material.

3. Prior to inserting the tube bundle, inspect both ends of the element at the lead in chamfer for nicks, dents or burrs.

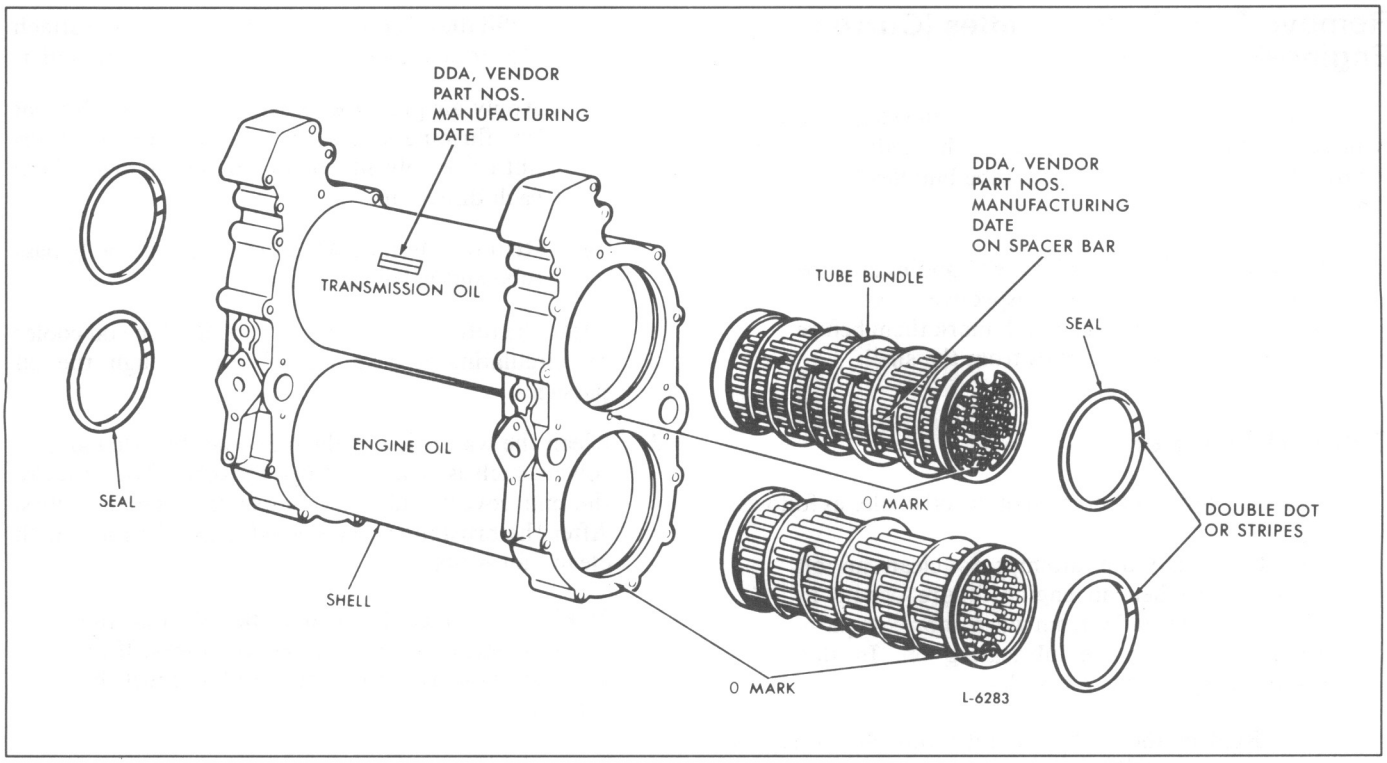


Fig. 14 – Tube–Type Oil Cooler (Removable Bundles) and Relative Location of Parts

NOTICE: Be sure the correct bundle is used in its proper location prior to installation using the bundle part number identification on the spacer bar for reference only.

4. Insert the tube bundle into the shell and carefully press the bundle just pass the upper seal ring groove.

NOTICE: Do not directly hammer on the tubes in the bundles as solder breakage or tube damage could occur.

5. Install the upper seal ring in the seal ring groove and coat with lubricating oil.

6. Invert the tube and shell assembly and press the tube bundle in the opposite direction.

7. The tube bundle should now be flush with the shell at both ends.

The above procedure applies whenever the oil cooler is assembled, even if the tube bundle has slipped out during shipment.

The new front and rear covers have a 3/8" tang on the top and bottom surface to retain the tube bundles in their proper position.

The former and current tube type oil cooler assemblies are completely interchangeable on an engine. Only the current oil cooler assemblies and their component parts will be serviced.

NOTICE: When rebuilding a tube type oil cooler, it is important to note that the current design oil cooler cannot be used with a former design oil cooler in a twin oil cooler application. If one half of a former twin oil cooler application needs replacing, it will be necessary to replace both halves of the oil cooler.

Assemble Oil Cooler

1. Place the bypass valve and spring in the valve housing. Then install the spring retainer.

2. Install a new seal ring in each oil bypass tube flange and slide one flange over each end of the tube. Attach a new gasket to each flange.

3. Install two 3/8"–16 x 5" bolts, with lock washers, through the flange and gasket at one end of the tube. Place the bypass valve assembly and a new gasket over the ends of the bolts.

4. Place the oil bypass valve and tube assembly in position and thread the bolts into the front end casting of the oil cooler. Then install two 3/8"–16 x 3–1/2" bolts and lock washers in the flange at the other end of the tube. Tighten all four bolts to 30–35 lb–ft (41–47 N•m) torque.

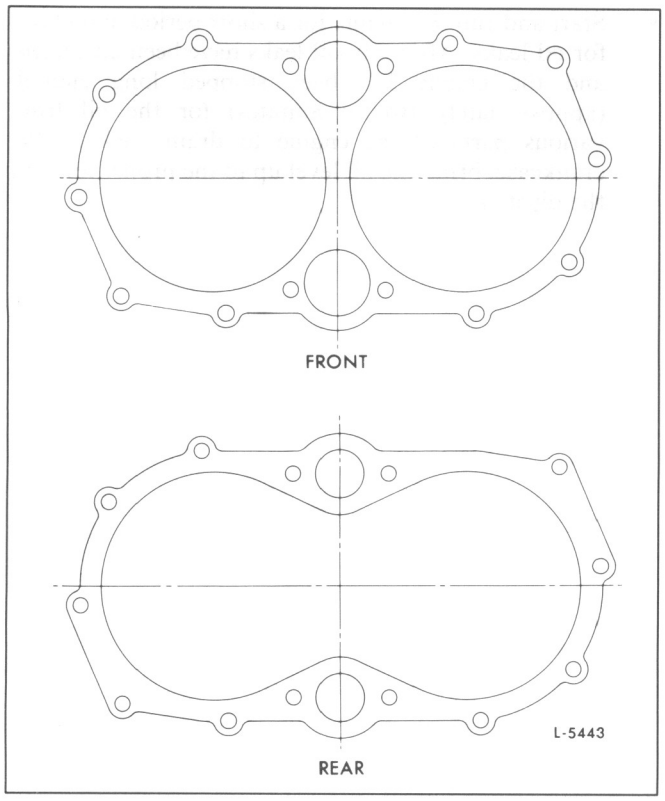


Fig. 15 – Cover Gaskets for Dual Tube Type Oil Cooler

5. Install the oil hole covers and gaskets used on the opposite side of the oil cooler, if they were previously removed.

6. Use a new front gasket (Fig. 15) and attach the front cover to the oil cooler with ten 3/8"–16 x 3" bolts and lock washers. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque.

7. Use a new rear gasket (Fig. 15) and attach the rear cover to the oil cooler with ten 3/8"–16 x 3" bolt and lock washers. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque.

8. On the single tube type oil cooler (Fig. 11), use a new gasket and attach the junction block to the oil cooler rear cover with six 3/8"–16 x 1" bolts and lock washers. Also install the 3/8"–16 x 2" center bolt and lock washer. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque.

9. On a dual tube type oil cooler (Fig. 16), assemble the two rear cooler cover support plates, the upper retainer plate and the necessary .062" shims with three 3/8"–16 x 1–5/8" bolts. Then assemble the lower retainer plate and necessary .062" shims using a new gasket between the oil cooler cover and support plate with five 3/8"–16 x 1–1/8" bolts and lock washers. Also include the center bolt and lockwasher. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque.

Install Oil Cooler

1. Attach new gaskets to the mounting pads on the oil cooler front cover and place the oil cooler in position against the cylinder block. Secure the front end of the oil cooler to the cylinder block with four 3/8"–16 x 2–1/4" bolts and lock washers. Then secure the rear end of the oil cooler to the support bracket with four 3/8"–16 x 1" bolts and lock washers. Tighten all of the oil cooler mounting bolts to 30–35 lb–ft (41–47 N•m) torque.

2. Place the water outlet flange seal and clamp in position. Then use a new gasket and install the flange. Use new copper washers with the two bolts. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque and the nuts to 35–39 lb–ft (47–53 N•m) torque.

3. Use a new gasket and attach the water inlet elbow to the oil cooler front cover with four 3/8"–16 x 1–1/8" bolts and lock washers. Tighten the bolts to 30–35 lb–ft (41–47 N•m) torque. Then slide the water inlet elbow hose in place and tighten the clamps.

4. Connect the oil filter and torque converter oil lines to the oil cooler.

5. Install any accessories that were removed to provide access to the oil cooler.

6. Install any pipe plugs that were removed.

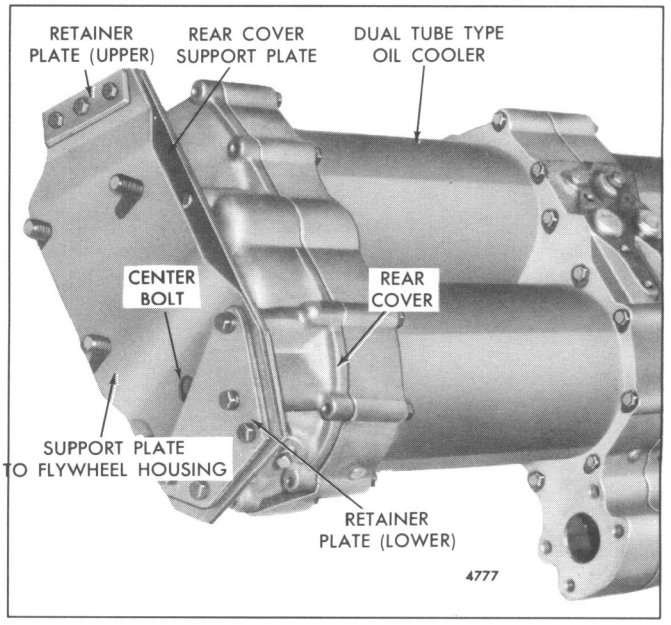


Fig. 16 – Dual Tube Type Oil Cooler

7. Close the drain cock in the oil cooler rear cover and fill the cooling system to the proper level.

8. Add sufficient oil to the crankcase to bring the oil level to the proper level on the dipstick.

9. Start and run the engine for a short period and check for oil leaks. After any oil leaks have been corrected, and the engine has been stopped long enough (approximately twenty minutes) for the oil from various parts of the engine to drain back to the crankcase, bring the oil level up to the proper level on the dipstick.

OIL LEVEL DIPSTICK

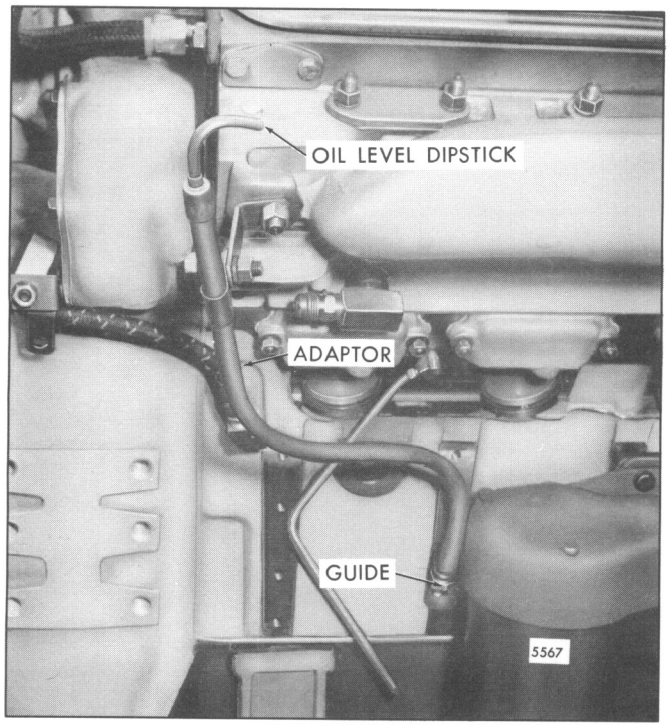


Fig. 1 – Typical Dipstick Mounting

A steel ribbon type oil level dipstick is used to check the quantity of oil in the engine oil pan. The dipstick is located in the side of the cylinder block or the oil pan (Fig. 1). The current engines include a 3/4" long rubber oil seal inside the cap of the dipstick. This prevents the escape of vapors carrying oil from the dipstick tube.

Maintain the oil level between the full and low marks on the dipstick and never allow it to drop below the low mark. No advantage is gained by having the oil level above the full mark. Overfilling will cause the oil to be churned by the crankshaft throws causing foaming or aereation of the oil. Operation below the low mark will expose the pump pick–up causing aereation and/or loss of pressure.

Check the oil level after the engine has been stopped for a minimum of twenty minutes to permit oil in the various parts of the engine to drain back into the oil pan.

Dipsticks are normally marked for use only when the equipment the engine powers is on a level surface. Improper oil levels can result if the oil level is checked with the equipment on a grade.

Fill the crankcase with oil as follows:

1. Fill the oil pan to the full mark on the dipstick.
2. Start and run the engine for approximately ten minutes.
3. Stop the engine and wait a minimum of twenty minutes. Then add the required amount of oil to reach the full mark on the dipstick.

   NOTICE: Each engine oil filter will require approximately two additional quarts (1.9 litres) of oil.

Marine Engines

Dipsticks in marine engines are located and marked to provide the proper oil level at any angle within the recommended maximum installation angle applicable to the specific boat.

In a properly filled crankcase, the oil level must be below the crankshaft rear oil seal when the boat is at rest.

Coach Engines

Running level dipsticks are available on certain inclined 6V–92 coach engines. These dipsticks permit accurate reading of the oil level with the engine at idle (running level) or at rest (static level). Running level dipsticks are identified by "6V–92 FLX" or "6V–92 RTS" on the end of their handle.

OIL PAN

The V–92 engines may be equipped with a stamped steel, cast iron or aluminum oil pan. Either a one–piece oil pan (Fig. 1) or an upper and lower pan bolted together may be used. Certain 16V engines are equipped with an upper oil pan and two lower pans. Depending upon the model application, oil pans may be provided to permit an engine inclination of up to 45°.

Some oil pans are provided with an oil level dipstick adaptor and oil filler adaptor mounting holes.

A sectional oil pan gasket, consisting of two side sections and two end sections, incorporate all the necessary bolt holes.

Remove And Install Oil Pan

1. Remove the drain plug and drain the oil.

2. Remove the bolt and washer assemblies and detach the oil pan, being careful not to damage the oil pump piping and inlet screen.

   NOTICE: The stamped metal oil pans used on some marine engines have a thin protective coating to shield the metal against the action of a salt water atmosphere. Therefore, do not rest, slide or rock the engine on its oil pan. If the surface of the oil pan is scratched, electrolysis will take place and damage to the oil pan will result. Also exercise care when performing engine repairs, to avoid scratching the outer surfaces of the oil pan.

3. Clean all of the old gasket material from the cylinder block and the oil pan. Clean the oil pan with fuel oil and dry it thoroughly with compressed air.

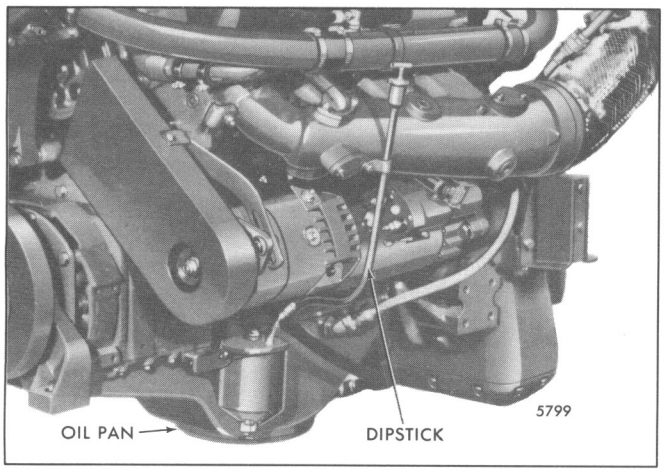


Fig. 1 – Typical One–Piece Oil Pan

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

4. Inspect a cast oil pan for porosity or cracks, a stamped oil pan for dents or other damage which may necessitate repair or replacement. Check for misaligned flanges or raised surfaces surrounding the bolt holes by placing the pan on a surface plate or other large flat surface.

5. When installing the oil pan on a 6 or 8V engine, use a new gasket(s) and, starting with the center bolt on each side and working alternately toward each end of the pan, tighten the bolts to 10–20 lb–ft (14–27 N•m) torque. *Do not overtighten the bolts.* Once the bolts are tightened to the specified torque, do not retighten them as it could be detrimental to the current type oil pan gasket. If a leak should develop at the oil pan, check if the lock washer is compressed. If not, the bolt may be tightened. However, if the lock washer is compressed and leaking occurs, remove the oil pan and determine the cause of the leakage.

   NOTICE: Current oil pan bolts (stamped metal pans) are coated with a locking material. To re–activate the locking ability of the bolts, apply a drop or two of Loctite J 26558–242, or equivalent, to the threads of the bolts at re–assembly.

6. When installing the upper oil pan on a 16V engine, use a new gasket(s) and place the oil pan in position against the cylinder block and flywheel housing. Install all of the 3/8"–16 oil pan attaching bolts and lock washers finger tight only. Then install the two 3/4"–10 oil pan to flywheel housing bolts and lock washers to draw the oil pan tight against the flywheel housing. Next, tighten the 3/8"–16 oil pan bolts to draw the oil pan tight against the cylinder block. Now tighten the 3/4"–10 bolts to 240–250 lb–ft (325–339 N•m) torque and the 3/8"–16 oil pan bolts to 10–20 lb–ft (14–27 N•m) torque. When tightening the oil pan bolts, tighten the center bolts first working alternately towards each end of the oil pan. Then install the lower oil pans and tighten the attaching bolts.

7. Install and tighten the drain plug to 25–35 lb–ft (34–47 N•m) torque.

8. Fill the oil pan with new oil (refer to Sections 4.6 and 13.3) to the full mark on the dipstick. Then start and run the engine for a short period to check for oil leaks.

9. Stop the engine and, after approximately twenty minutes, check the oil level. Add oil, if necessary.

VENTILATING SYSTEM

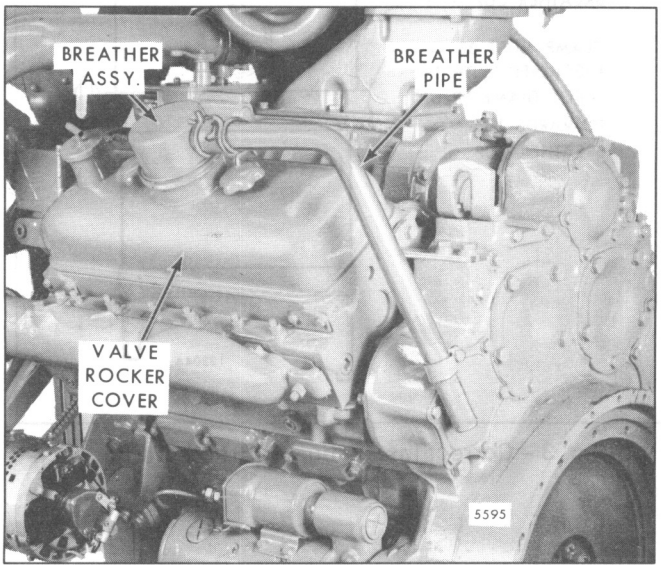


Fig. 1 – Typical Mounting of Breather Assembly on Valve Rocker Cover

Harmful vapors which may be formed within the engine are removed from the crankcase, gear train and valve compartment by a continuous pressurized ventilating system.

Breathing is through two openings in the rear main bearing bulkhead of the crankcase and one large hole in the cylinder block rear end plate. They connect to a central chamber (separated from chambers on each side which carry oil draining back from the cylinder heads) that leads to an exit at the top of the cylinder block.

The external tube(s) connects the cylinder block exit hole at the rear of the cylinder head(s).

The current left bank cylinder head to cylinder block breather system used on 6V–92 engines is now being used in 8V–92 engines effective with 8VF–017875 (Fig. 2). An elbow is bolted to the side of the cylinder head and a tube pressed in the opening at the top rear end of the cylinder block (Fig. 2). They are joined with a rubber hose and clamps. The former breather system continues for the right bank cylinder head to cylinder block breather system, and will continue to be used on both banks for certain engine applications, because of clearance considerations.

Effective with engine serial number 6VF–105223, the right–bank rocker cover breather and associated harware have been removed from 6V–92TA, TTA automotive and 6V–92TA upright coach engines. Removal of the right–bank rocker cover breather affects 6V–92TA, TTA automotive and 6V–92 upright coach engines *only*. Failure to use a rocker cover breather on the left–bank head can result in excessively high engine crankcase pressure. Excessive pressure can, in turn, cause crankshaft oil seal leakage and/or loss of oil through the dipstick tube.

The rocker cover(s) provides a large cross–sectional air flow area at maximum height for efficient breathing and oil separation. A breather assembly(s) is mounted at the openings in the rocker cover(s).

To index the breather assembly exhaust outlet on the current aluminum die cast valve rocker covers, no disassembly is required. Insert a 1–1/8" outer diameter pipe or wood dowel into the exhaust outlet, apply pressure and rotate the outlet to the desired location.

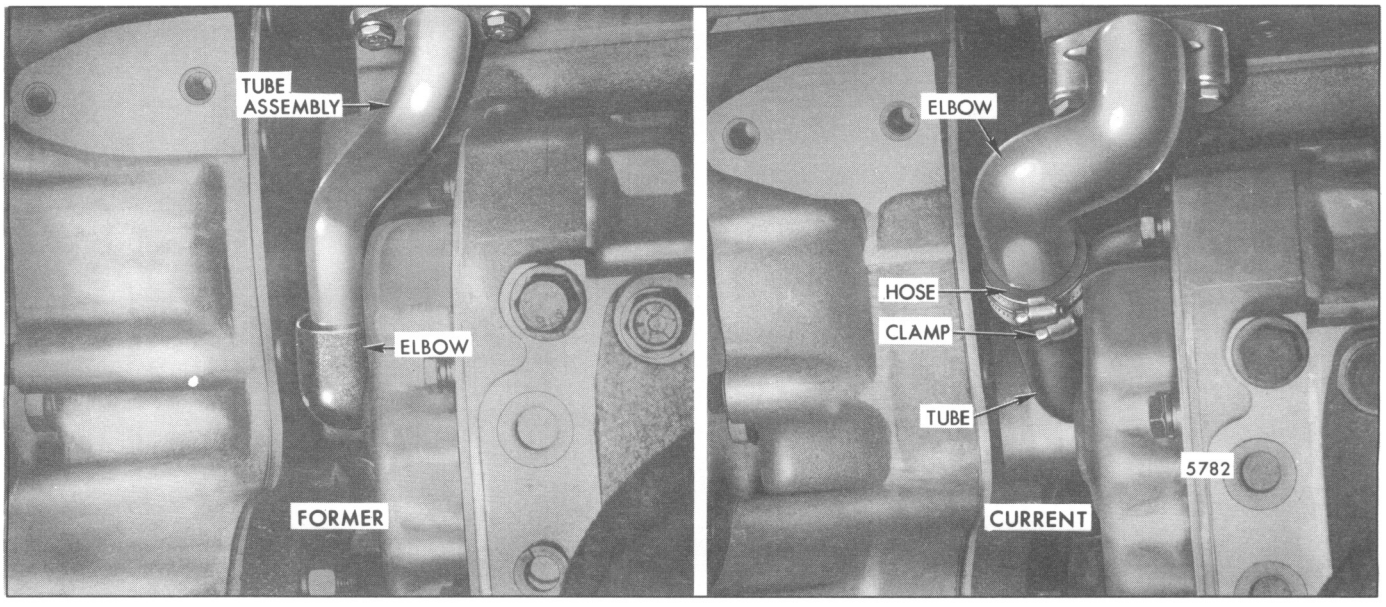


Fig. 2 – Cylinder Block to Cylinder Head Breather Systems for 6V–92 and 8V–92 Engines

Service

The element in the breather assembly mounted on the valve rocker cover should be cleaned if excessive crankcase pressure occurs (Fig. 1). Also, clean the breather pipe.

NOTICE: Dirt can collect around the breather clamp. Clean out the dirt thoroughly before disassembling the breather.

Wash the element in fuel oil and dry it with compressed air.

CAUTION:To prevent possible personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

When reassembling the breather on the rocker cover, *be sure the clamp is installed with the large (open) diameter facing up* as illustrated in Fig. 3. If the clamp is improperly installed, it could eventually loosen.

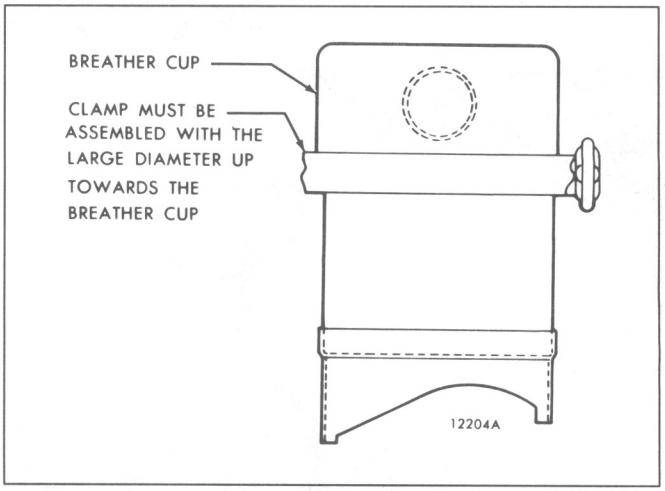


Fig. 3 – Correct Installation of Breather Clamp

SPECIFICATIONS - SERVICE TOOLS

SPECIFICATIONS

STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

THREAD SIZE	260M BOLTS TORQUE (lb-ft)	Nom	THREAD SIZE	280M OR BETTER TORQUE (lb-ft)	Nom
1/4–20	5–7	7–9	1/4–20	7–9	10–12
1/4–28	6–8	8–11	1/4–28	8–10	11–14
5/16–18	10–13	14–18	5/16–18	13–17	18–23
5/16–24	11–14	15–19	5/16–24	15–19	20–26
3/8–16	23–26	31–35	3/8–16	30–35	41–47
3/8–24	26–29	35–40	3/8–24	35–39	47–53
7/16–14	35–38	47–51	7/16–14	46–50	62–68
7/16–20	43–46	58–62	7/16–20	57–61	77–83
1/2–13	53–56	72–76	1/2–13	71–75	96–102
1/2–20	62–70	84–95	1/2–20	83–93	113–126
9/16–12	68–75	92–102	9/16–12	90–100	122–136
9/16–18	80–88	109–119	9/16–18	107–117	146–159
5/8–11	103–110	140–149	5/8–11	137–147	186–200
5/8–18	126–134	171–181	5/8–18	168–178	228–242
3/4–10	180–188	244–254	3/4–10	240–250	325–339
3/4–16	218–225	295–305	3/4–16	290–300	393–407
7/8–9	308–315	417–427	7/8–9	410–420	556–569
7/8–14	356–364	483–494	7/8–14	475–485	644–657
1–8	435–443	590–600	1–8	580–590	786–800
1–14	514–521	697–705	1–14	685–695	928–942

Grade identification markings are normally stamped on the heads of the bolts. To aid identification of the various bolts used in Detroit Diesel engines, refer to the following chart.

Grade Identification Marking on Bolt Head		GM Number	SAE Grade Designation	Nominal Size Diameter (inch)	Tensile Strength Min. (psi)
None		GM 255-M	1	No. 6 thru 1 1/2	60,000
None		GM 260-M	2	No. 6 thru 3/4 over 3/4 to 1 1/2	74,000 60,000
	Bolts and Screws	GM 280-M	5	No. 6 thru 1 over 1 to 1 1/2	120,000 105,000
	Hex Head Sems Only	GM 275-M	5.1	No. 6 thru 3/8	120,000
	Bolts and Screws	GM 290-M	7	1/4 thru 1 1/2	133,000
	Bolts and Screws	GM 300-M	8	1/4 thru 1 1/2	150,000
	Bolts and Screws	GM 455-M	None	No. 6 thru 1 1/2	55,000

BOLT IDENTIFICATION CHART

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

APPLICATION	THREAD SIZE	TORQUE (lb–ft)	TORQUE N•m
Oil pan bolts	5/15–18	10–12	14–16
Oil pan bolts	3/8–16	10–20	14–27
Lubricating oil filter center stud	5/8–18	50–60	68–81
Oil pan drain plug (nylon washer)	18mm	25–35	34–47

SERVICE TOOLS

TOOL NAME	TOOL NO.
Bar type gear puller	J–24420
Oil pump drive and driven gear installer (16V)	J–9382
Oil pump drive gear installer (16V)	J–9380
Oil pump drive shaft gear installer (6V and 8V)	J–22397
Oil pump driven gear installer (16V)	J–9381
Oil pump driven shaft gear installer (6V and 8V)	J–22398
Oil Pump driving gear installer (6V and 8V)	J–22285
Spring tester 0–125 lbs.	J–29196
Strap wrench (spin–on filter)	J–24783

