

INTRODUCTION

The engine block, which is the supporting structure for the entire engine, is made from one of the following:

- Gray cast iron
- Cast aluminum
- Die-cast aluminum alloy

All other engine parts are mounted on or in the block. This large casting supports the crankshaft and camshaft (on OHV engines) and holds all the parts in alignment. Blocks are often of the monoblock design, which means that the cylinder, water jacket, main bearing supports (saddles), and oil passages are all cast as one structure for strength and quietness.

Large-diameter holes in the block casting form the cylinders to guide the pistons. The cylinder holes are called bores because they are made by a machining process called boring. Combustion pressure loads are carried from the head to the crankshaft bearings through the block structure. The block has webs, walls, and drilled passages to contain the coolant and lubricating oil and to keep them separated from each other. Fig 1.

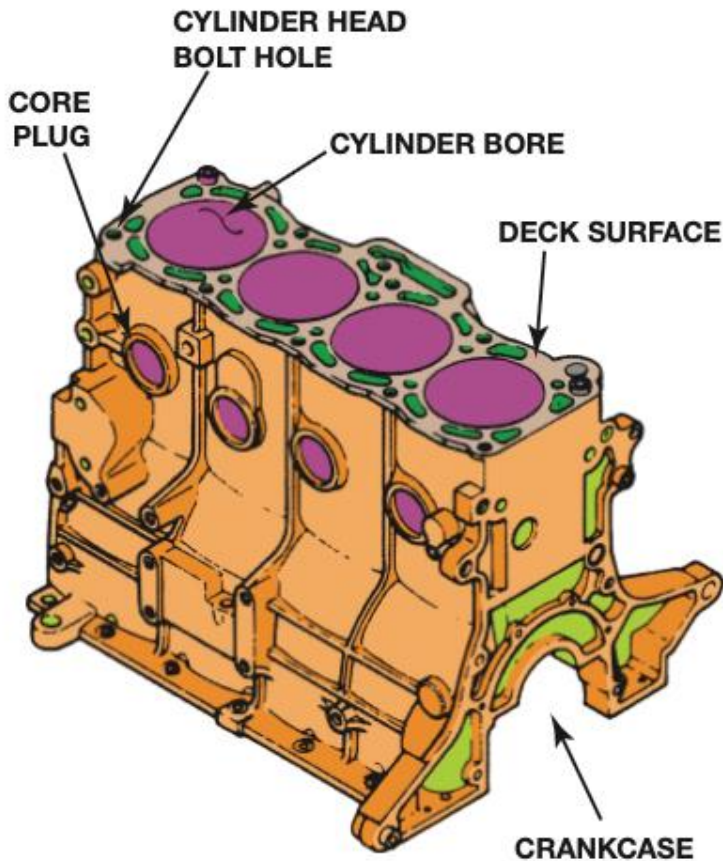


Figure 1. Engine block.

Mounting pads or lugs on the block transfer the engine torque reaction to the vehicle frame through attached engine mounts. A large mounting surface at the rear of the engine block is used for fastening a bell housing or transmission.

The cylinder head(s) and other components attach to the block. The joints between the components are sealed using gaskets or sealants. Gaskets or sealants are used in the joints to take up differences that are created by machining irregularities and that result from different pressures and temperatures.

Engine designers have used foundry techniques to make engines lightweight by making the cast-iron block walls and bulkheads only as heavy as necessary to support their required loads. Aluminum is used for some cylinder blocks and is nonmagnetic and lightweight.

Aluminum block engines usually require cast-iron cylinder walls for proper wear and longevity. Most cast-aluminum blocks have cast-iron cylinder sleeves (liners). The cast-iron cylinder sleeves are either cast into the aluminum block during manufacturing or pressed into the aluminum block. Fig 2.

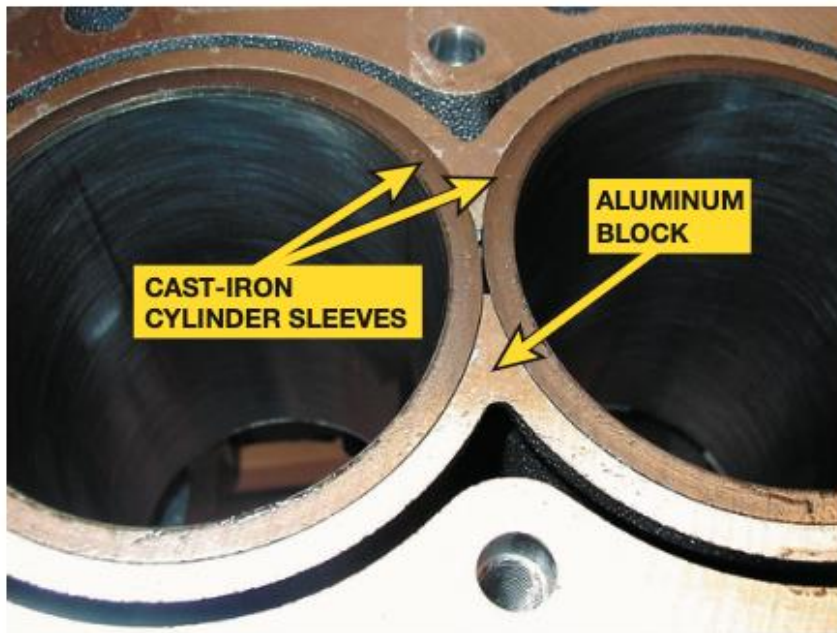


Figure 2. Cast iron sleeves in an aluminum block.

Cylinders are surrounded by cooling passages. These coolant passages around the cylinders are often called the cooling jacket. The engine block also has oil holes that carry lubricating oil to the required locations. During manufacture, all oil holes, called the oil gallery, are drilled from outside the block. After oil holes are drilled, the unneeded open ends may be capped by pipe plugs, steel balls, or cup-type soft plugs, often called oil gallery plugs. Figs 3 and 4.

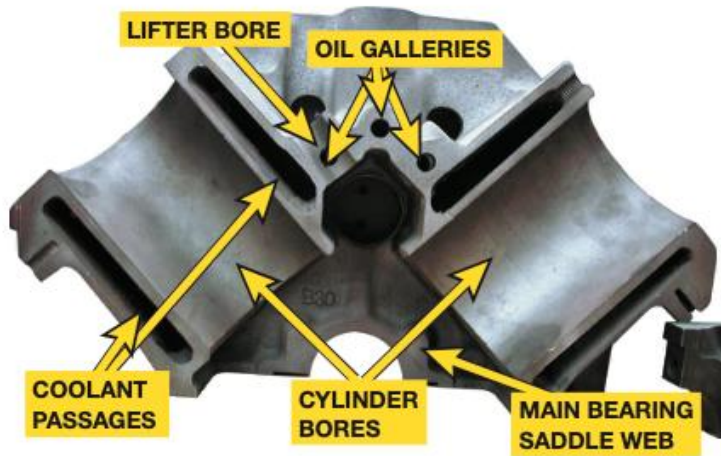


Figure 3. Coolant passages and oil galleries.

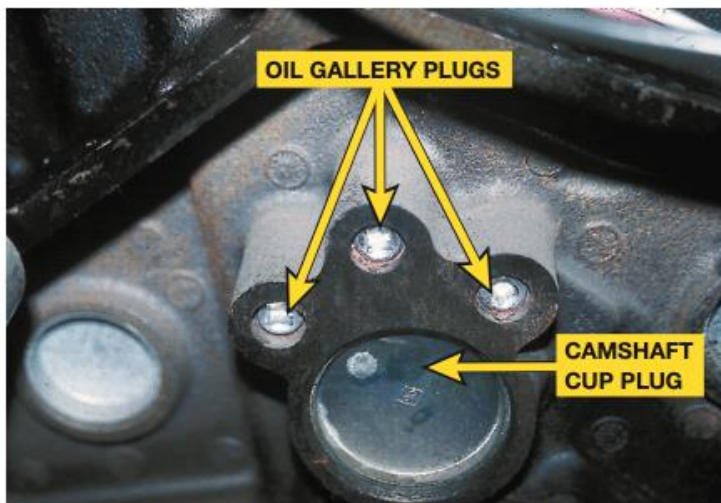


Figure 4. Engine block plugs.

The main bearing caps are cast or manufactured from sintered or billeted materials, separately from the block. Standard production engines usually use two bolts to hold the main bearing cap in place. Heavy-duty and high-performance engines often use additional main bearing support bolts. Fig 5.

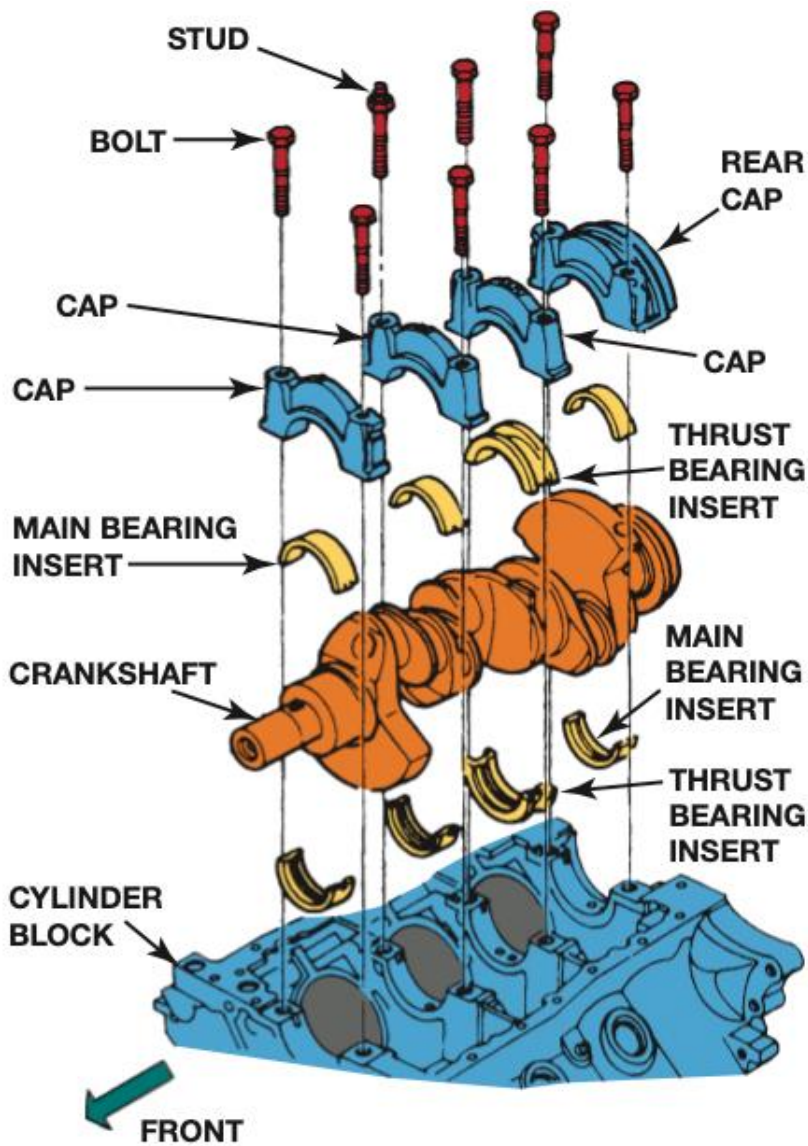


Figure 5. Main bearings and caps.

ASE TEST TOPICS

1. Remove and disassemble engine block; identify and mark the location and orientation of parts; clean and prepare components for inspection; determine needed action.

Whenever any - engine-related work is being performed, always print out the specified procedure as published in service information to avoid doing any harm to the vehicle or the engine.

Rear-wheel drive vehicle. There are two ways to remove the engine. The method to be used must be determined before the engine is removed from the vehicle.

1. The engine can be lifted out of the chassis with the transmission/transaxle attached.
2. The transmission/transaxle can be separated from the engine and left in the chassis.

- Under the vehicle, remove the driveshaft and disconnect the exhaust pipes. Also unbolt the engine mounts. The transmission controls and wiring need to be disconnected at the connectors, and clutch linkages disconnected and labeled.
- An engine lift hoist chain or cable is attached and snugged to take most of the weight. This leaves the engine loose on the mounts. For the best results, use the factory-installed lifting hooks that are attached to the engine.
- The front of the engine must come almost straight up as the transmission slides from under the floor pan.
- The engine and transmission are hoisted free of the automobile, swung clear, and lowered on an open floor area. Fig 6.

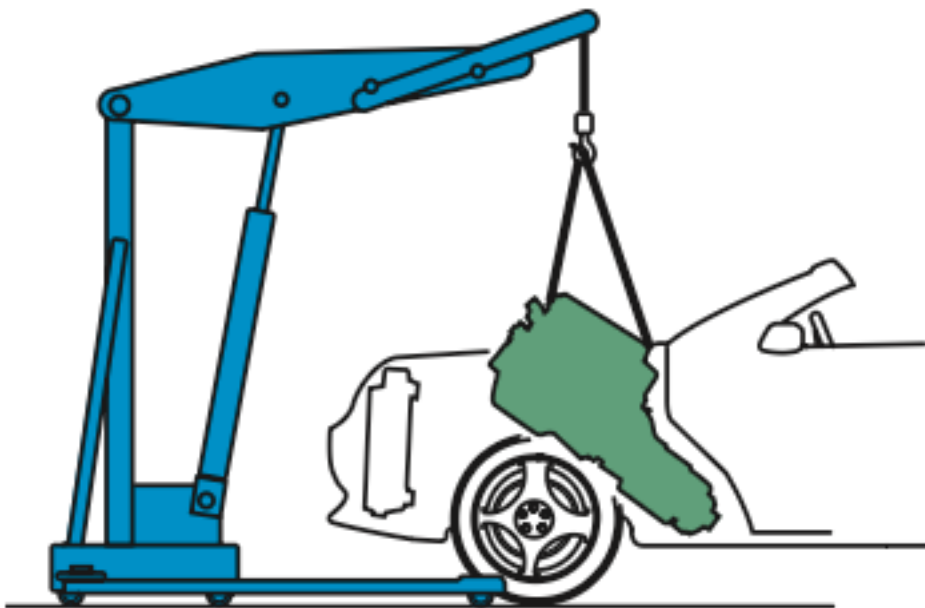


Figure 6. Removing the engine.

Front-wheel-drive vehicle. Check service information for the exact procedure to follow to remove the engine from a front-wheel-drive vehicle. Depending on the vehicle, the engine could be removed from the top or lowered and removed from underneath. On many front-wheel-drive - vehicles the engine, transmission, and entire front cradle is removed as an assembly, then disassembled. Fig 7.

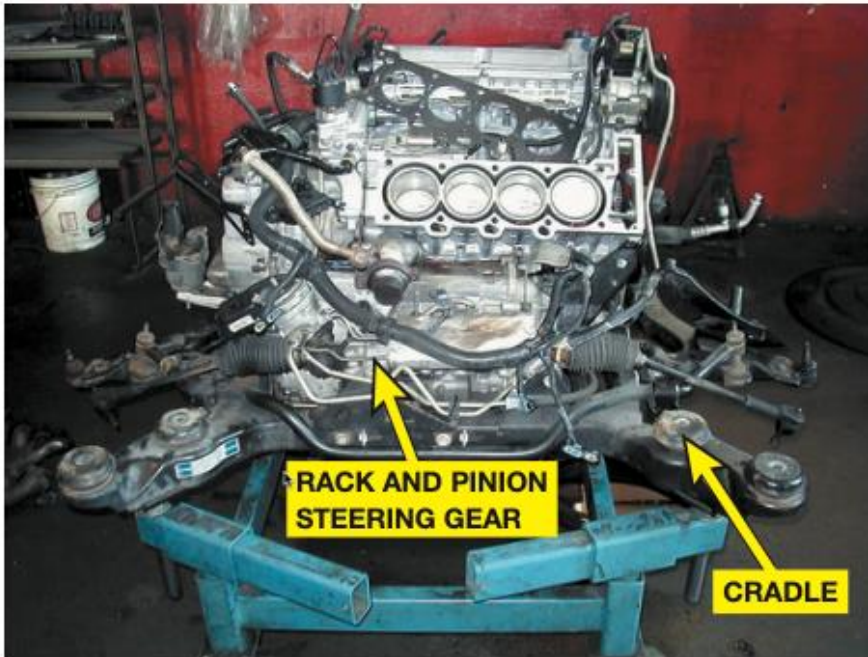


Figure 7. The complete front-wheel-drive assembly lowered onto a special rack.

Cam-in-block engine head removal

- Remove the rocker arm covers Examine the rocker arms, valve springs, and valve tips for obvious defects. Remove the rocker arms and pushrods and, if they are to be reused, place them in a location so that the rockers and the pushrods can be installed back to their original location.
- Remove or disconnect the intake and exhaust manifolds.
- Remove the cylinder head bolts (also called cap screws) following the reverse of the installation procedure. Loosening the fasteners at the ends of the cylinder head first, then working toward the center, helps reduce the chance of warpage to the cylinder head. Be sure to notice and mark the head bolt locations, as they are often different lengths, depending on their location in the head. Carefully lift the head from the block deck.

Overhead cam engine head removal

Disassembling an overhead camshaft engine differs from a cam-in-block (OHV) engine. This is necessary due to the timing chain/belt that drives the camshaft(s). Some steps that are different are:

- Remove the crankshaft harmonic balancer pulley that will allow access to the timing chain or belt cover.
- Remove the timing belt/chain cover(s) and then the timing belt(s) or chain(s).
- With most overhead camshaft engines, the camshaft(s) must be removed before removing the cylinder head due to location of the head bolts.
- Remove the cylinder head by removing the cylinder head bolts in the opposite order of assembly.

Disassembly of the short block

- Mount the engine on an engine stand and remove the oil pan. Turn the engine upside down for access to the connecting rod fasteners.
- The connecting rod caps should be marked (numbered) so that they can be reassembled in exactly the same position. If the connecting rods are not marked from the factory, they should be marked using an electric pencil or permanent marker.
- Before the pistons can be removed from the block, the ridge at the top of the cylinder must be removed. After removing the fasteners, fit the rod bolts with protectors to keep the bolt threads from damaging the crankshaft journals, and then carefully remove the piston and rod assemblies.
- The next step after the water pump has been removed is to remove the crankshaft vibration damper (also called a harmonic balancer). The damper should be removed only with a threaded puller. With the damper assembly off, the timing cover can be removed. Remove the timing components from the cam and crankshaft sprockets. Fig 8.



Figure 8. Removing the vibration damper.

- The camshaft and balance shafts, if equipped, can be removed at this time, or they can be removed after the crankshaft is out.
- The main bearing caps should be checked for position markings before they are removed. They have been machined in place and will not fit perfectly in any other location. After marking, they can be removed so the crankshaft can be removed.

After the pistons and crankshaft have been removed, remove all cups and plugs and carefully inspect the block for faults that could affect whether the engine can be rebuilt. Further detailed inspection should be completed after the components have been cleaned.

2. Visually inspect engine block for cracks, corrosion, condition of passages, and condition of core and gallery plug hole(s), inspect surfaces for warpage, finish, and condition.

After the parts have been thoroughly cleaned, they should be reexamined for defects. A magnifying glass is helpful in finding defects. Cracks in engine blocks, cylinder heads, crankshafts, and other engine components are sometimes difficult to find during a normal visual inspection, which is why most engine builders use a crack detection procedure on critical engine parts. Magnetic flux testing is the method most often used on steel and iron components. Fig 9.

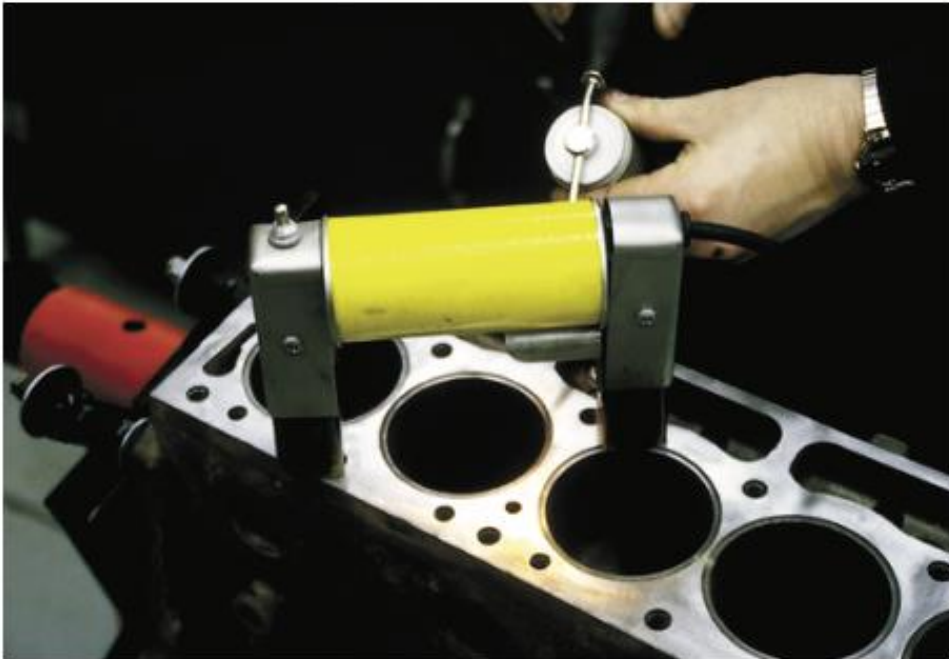


Figure 9. Crack detection using a strong magnetic field and fine iron powder.

The flatness of the block deck should be checked. The flatness of the block deck is checked using a straightedge and a feeler gauge. To be sure that the top of the block is flat, check the block in six locations as shown.

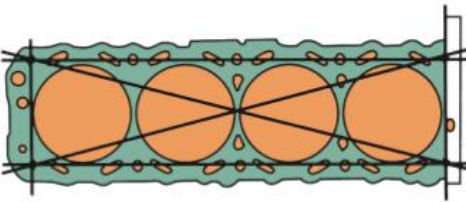
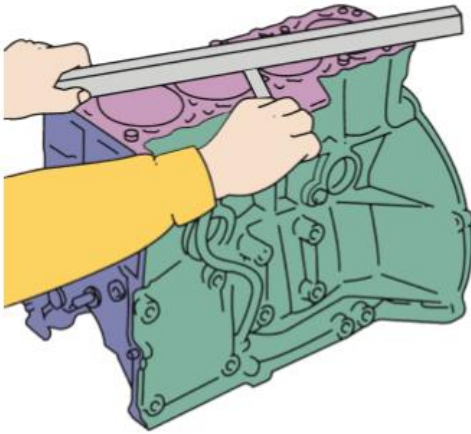


Figure 10. Checking the block deck..

3. Inspect, clean, replace, and/or reinstall fasteners; torque fasteners; inspect and repair damaged threads.

All threads in the block should be thoroughly cleaned. Many experts recommend using a thread chaser, because a tap could cut and remove metal. A chaser will restore the threads without removing metal. Check that all liquid has been removed from the bolt holes in the block. If liquid is in the bottom of a blind hole, the block can be cracked when the bolt is installed. Fig 11.

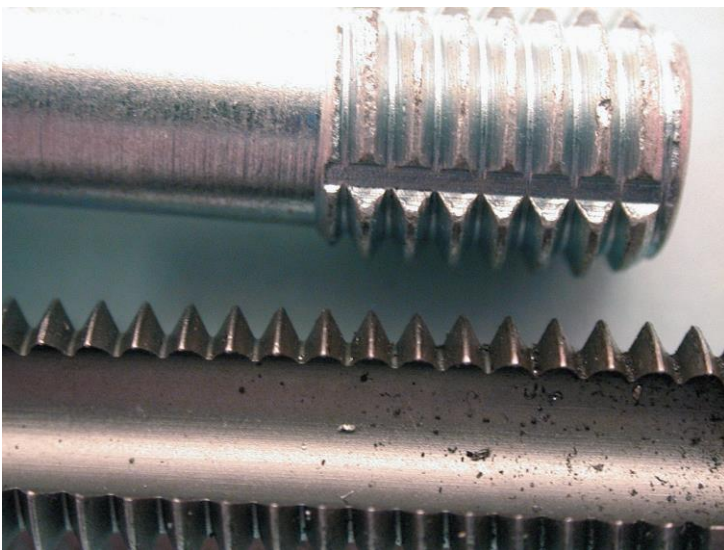


Figure 11. Use a thread chaser (top) to clean threaded holes.

Thread repair inserts are used to replace the original threaded hole when it has become damaged beyond use. The original threaded hole is enlarged and tapped for threads, and a threaded insert is installed to restore the threads to the original size. Fig 12.

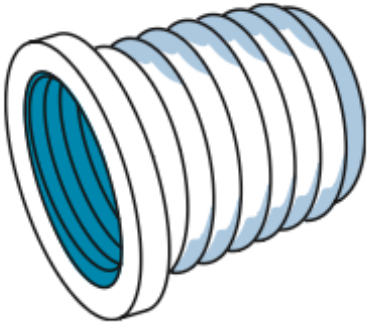


Figure 12. A thread repair insert.

4. Inspect piston oil cooling nozzle/jets for damage, proper alignment, and restrictions.

Some engines, usually diesel engines, are equipped with oil squirters that spray or stream oil toward the underneath side of the piston head to cool the piston. These should be checked for clogging. Fig 13.

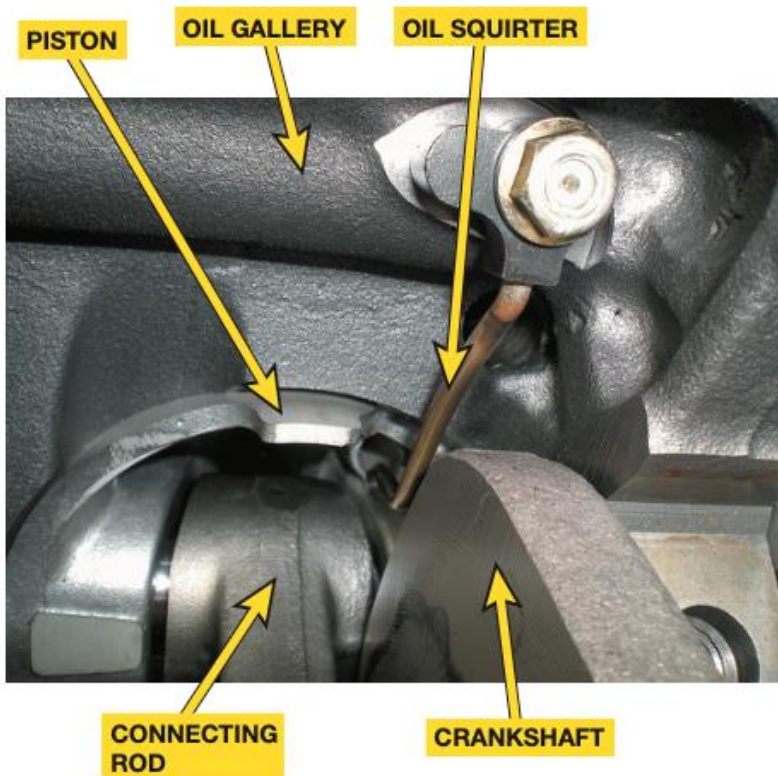


Figure 13. Piston cooling nozzle.

5. Replace core and gallery plugs.

Core holes left in the external block wall are machined and sealed with soft core plugs or expansion plugs (also called freeze plugs or Welsh plugs). A cup plug is installed about 0.02 to 0.05 inch (0.5 to 1.3 mm) below the surface of the block, using sealant to prevent leaks. Fig 14.

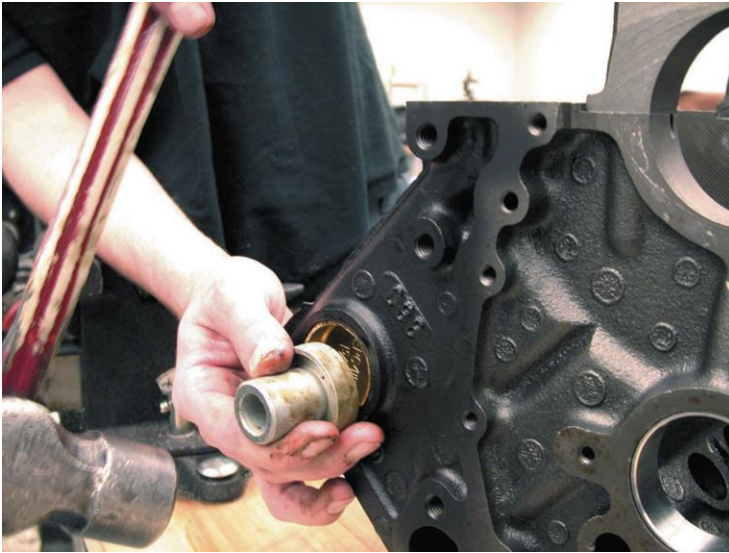


Figure 14. Installing a core plug.

6. Clean and inspect cylinder walls; measure cylinder bore; determine needed action.

Cylinders should be measured across the engine (perpendicular to the crankshaft), where the greatest wear occurs. In other words, measure the bores at 90 degrees to the piston pin. Most wear will be found just below the ridge, and the least amount of wear will occur below the lowest ring travel. The cylinder should be checked for out-of-round and taper. Fig 15.

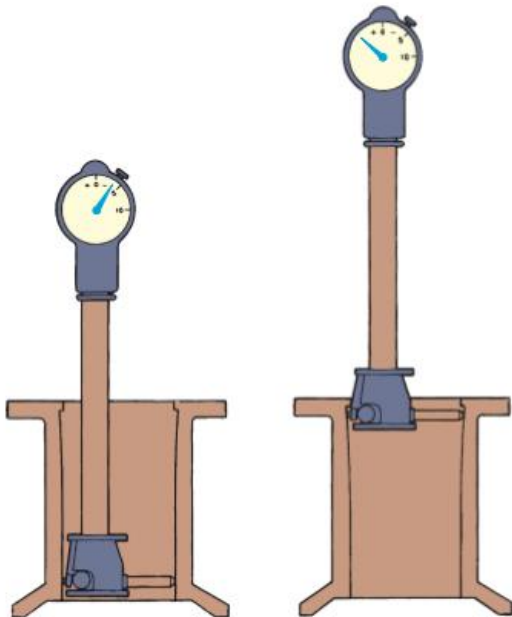


Figure 15. Measuring the cylinder using a dial bore gauge.

7. Inspect crankshaft for endplay, journal damage, keyway damage, visual surface cracks, and condition of thrust flange and sealing surface; check oil passage condition; measure journal wear; check crankshaft reluctor ring/tone wheel (where applicable).

Crankshafts should be carefully measured to determine the following:

- Size of main and rod bearing journals compared to factory specifications Fig 16.
- Each journal checked for out-of-round condition
- Each journal checked for taper



Figure 16. Measuring a crankshaft main journal.

8. Inspect main bearing wear patterns; inspect and measure main bearing bore and cap alignment; mark caps for location and orientation.

The main bearing journals of a straight crankshaft are in alignment. If the main bearing housing bores in the block are not in alignment, the crankshaft will bend as it rotates. This condition increases rotational friction of the crankshaft and will lead to premature bearing failure or a broken crankshaft.

A precision ground straightedge and a feeler gauge are used to determine the amount of warpage. The amount of variation along the entire length of the block should not exceed 0.0015 inch (0.038 mm). Fig 17.

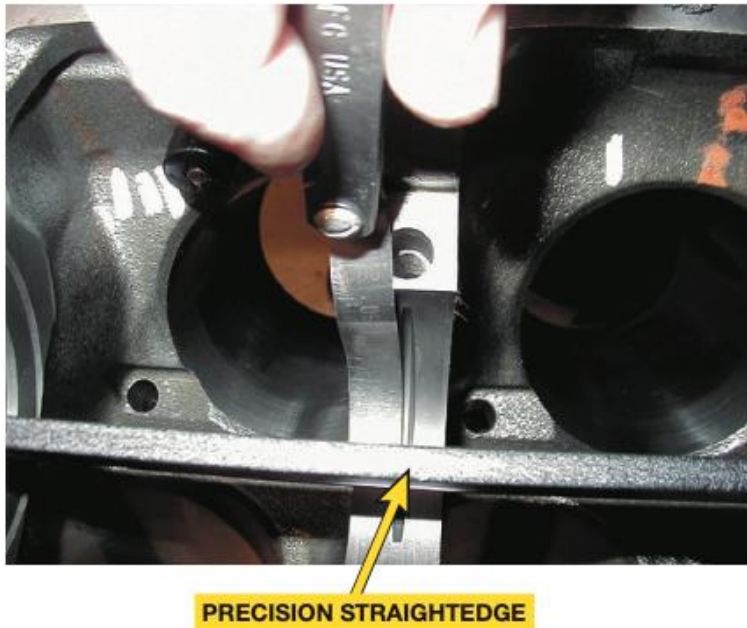


Figure 17. Checking main bearing bore alignment.

9. Install main bearings and crankshaft; check bearing clearances and endplay.

These are the steps to follow when installing the main bearings and checking main bearing clearances.

- Each of the main bearing caps will only fit one location and the caps must be positioned correctly.
- The correct-size bearings should be placed in the block and cap, making sure that the bearing tang locks into its slot.
- The upper main bearing has an oil feed hole. The lower bearing does not have an oil hole.
- Lower the crankshaft squarely so that it does not damage the thrust bearing. Carefully rest the clean crankshaft in the block on the upper main bearings.
- After making sure that there is no oil on the crank journal of the bearing, place a strip of Plastigage® (gauging plastic) on each main bearing journal. Install the main bearing caps and tighten the bolts to specifications.
- Remove each cap and check the width of the Plastigage® with the markings on the gauge envelope, as shown in Fig 18.
- The width of the plastic strip indicates the oil clearance.



Figure 18. The width of the plastic strip indicates the clearance.

The main bearing caps and crankshaft should be removed after checking for proper bearing clearance. The surface of the bearings should be given a thin coating of oil or assembly lubricant to provide initial lubrication for engine start-up. Install the crankshaft using the following steps.

STEP 1 The crankshaft should be carefully placed in the bearings to avoid damage to the thrust bearing surfaces.

STEP 2 The bearing caps are installed with their identification numbers correctly positioned. The caps were originally machined in place, so they can only fit correctly in their original position.

STEP 3 The main bearing cap bolts are tightened finger tight, and the crankshaft is rotated. It should rotate freely. If not, stop and recheck everything.

STEP 4 Tighten the main bearing caps to the specified assembly torque, and in the specified sequence.

STEP 5 Using a dial indicator, check the crankshaft endplay. Fig.19.

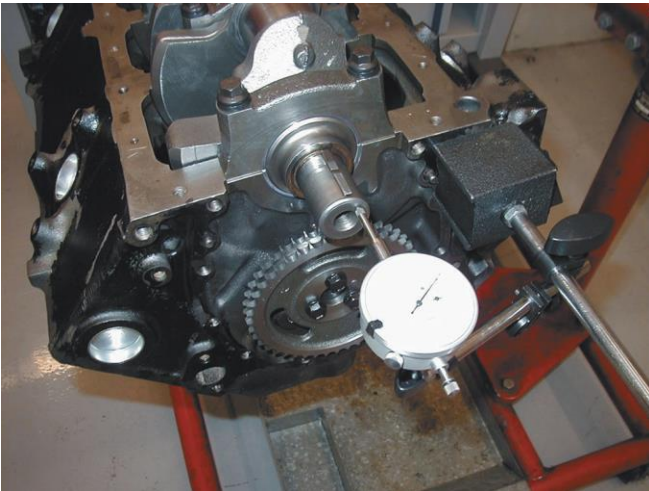


Figure 19. Measuring crankshaft end play

10. Inspect camshaft drive gear train components (includes gear(s), chain(s), tensioner(s), guide(s) and belt systems); repair or replace as needed.

The crankshaft drives the camshaft with one of the following:

- Timing gears
- Sprockets and chains
- Sprockets and timing belts

Timing chains often have tensioners (dampers) pressing on the unloaded side of the chain. The tensioner is held against the chain by either a spring or hydraulic oil pressure. Fig 20.

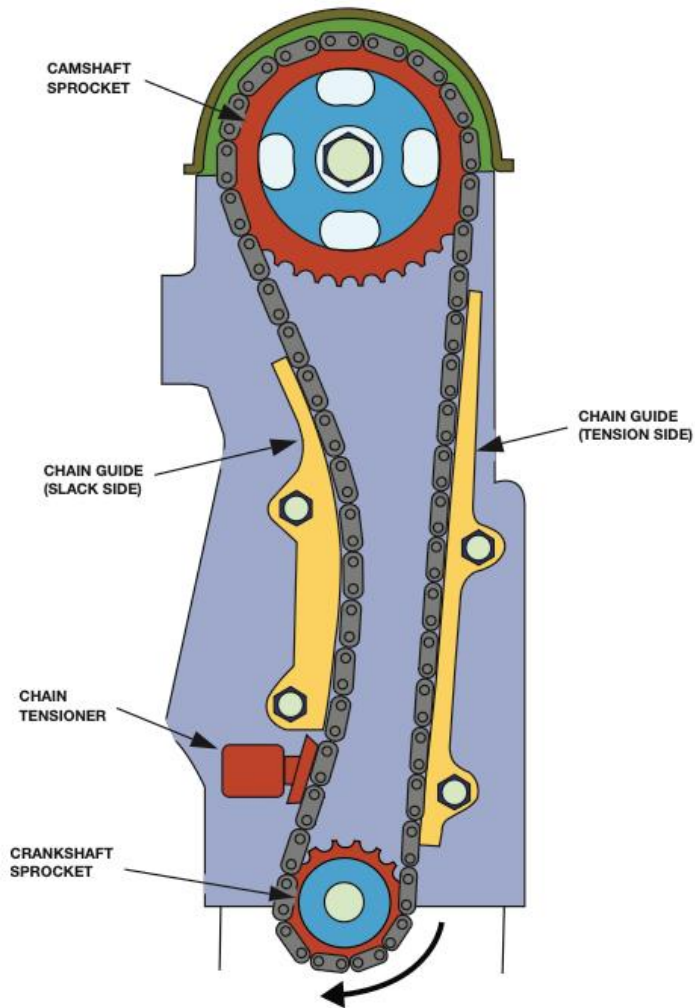


Figure 20. Timing chain, guides, and tensioner.

Many overhead camshaft engines use a timing belt rather than a chain. Cam drive belts are made from rubber and reinforced with fabric. Fig 21.

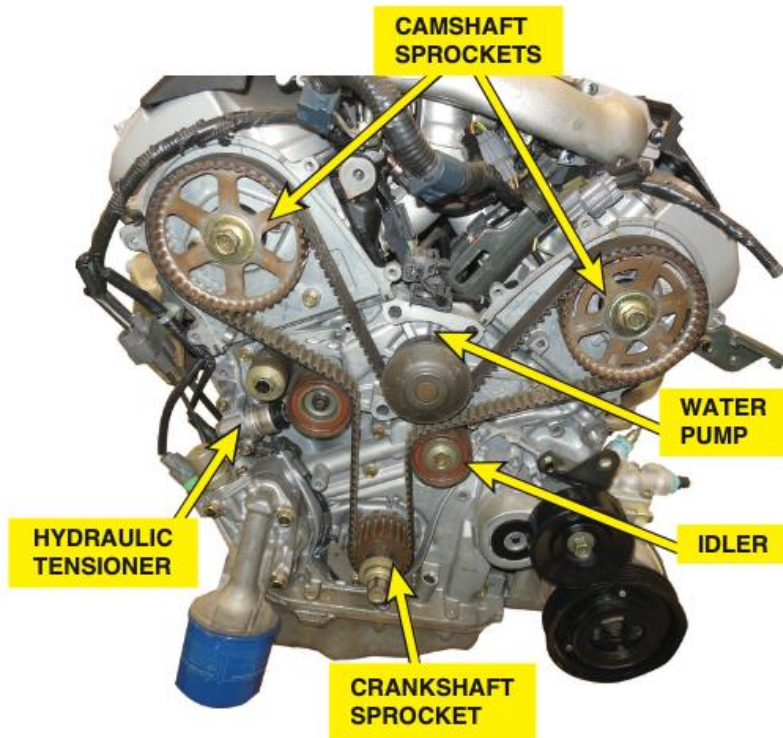


Figure 21. Timing Belt and related components.

Unless the engine is freewheeling, the piston can hit the valves if the belt breaks. A freewheeling engine is one that causes no internal damage if the camshaft drive belt breaks when the engine is running. An interference engine, however, causes some of the valves that are open to hit the pistons, causing major engine damage.

11. Inspect camshaft journals and lobes; measure camshaft lift; determine needed repairs.

The bearing journals of the camshaft(s) can be measured using a micrometer and compared with factory specifications for taper. Camshaft journals should be measured in three locations, 120 degrees apart, to check for out-of-round. The cam lift can also be measured with a micrometer and compared with factory specifications. Fig 22 and 23.

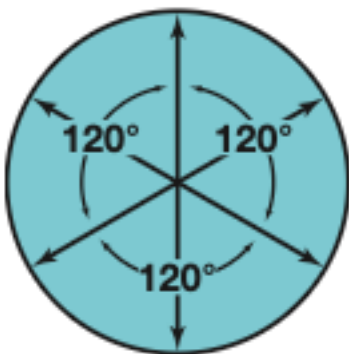


Figure 22. Measuring cam journals.

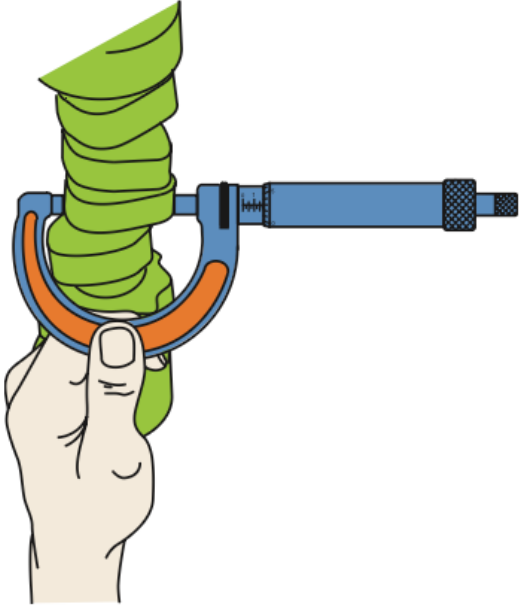


Figure 23. Measuring lobe wear.

12. Inspect camshaft bore for wear, damage, out-of-round, and alignment; determine needed repairs.

A telescopic gauge is used with a micrometer to measure the inside diameter cam bearings. The bearings is measured by inserting a telescopic gauge into the bore and rotating the handle lock to allow the arms of the gauge to contact the inside of the bearing. Tighten the handle lock and remove the gauge. Use a micrometer to measure the telescopic gauge. Fig 24.

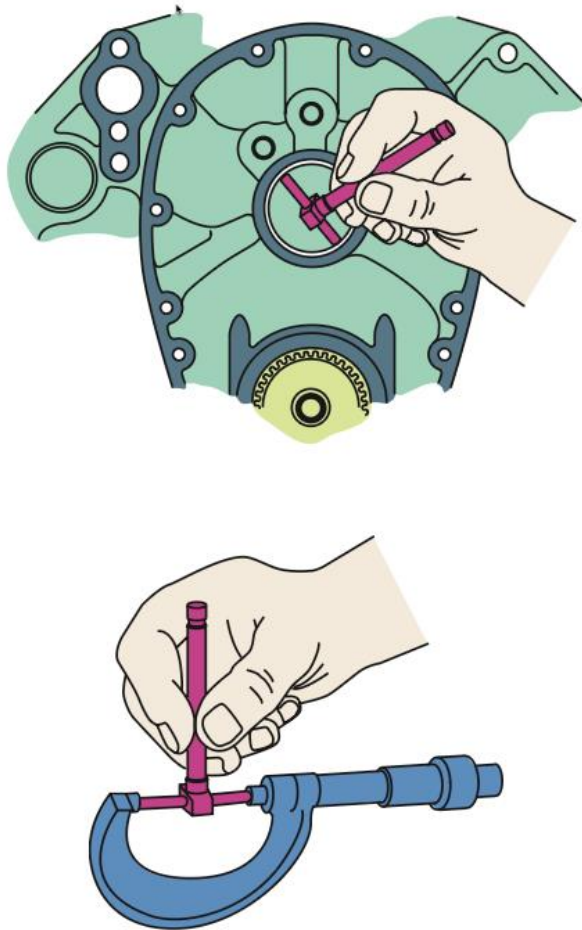


Figure 24. Measuring camshaft bore.

13. Inspect auxiliary (balance, intermediate, idler, counterbalance, or silencer) shaft(s), drive(s)/gear(s), chain(s), belt(s), and support bearings for damage and wear; time balance shaft to crankshaft.

Some engines use balance shafts to dampen normal engine vibrations. Dampening is reducing the vibration to an acceptable level.

One type of balance shaft system is designed to counterbalance vibrations on a four-stroke, 4-cylinder engine. Two shafts are used, and they turn at twice the engine speed. In most applications, both shafts rotate in the same direction and are driven by a chain or gear off the crankshaft. Counterweights on the balance shafts are positioned to oppose the natural rolling action of the engine, as well as the secondary vibrations caused by the piston and rod movements. Since the late 1980s, both Ford and General Motors added a balance shaft to many of their V-6 engines. Fig 25.

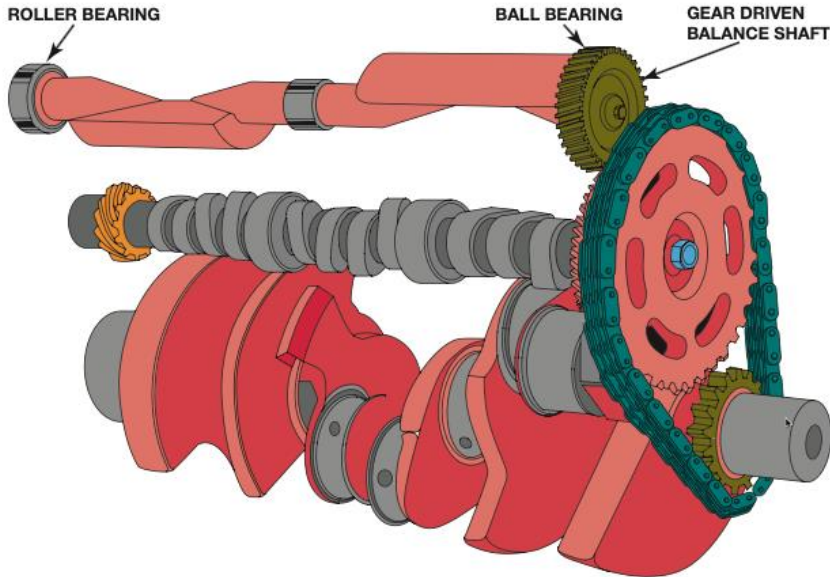


Figure 25. A balance shaft on a V-6 engine must be timed to the crankshaft.

14. Inspect, measure, service, or replace pistons and piston/wrist pins; identify piston and bearing wear patterns.

All engine power is developed by burning fuel mixed with air in the combustion chamber. Heat from the combustion causes the burned gas to increase in pressure. The force of this pressure is converted into useful work through the piston, connecting rod, and crankshaft. The piston is attached to the connecting rod with a piston pin, also called a wrist pin. Fig. 26.

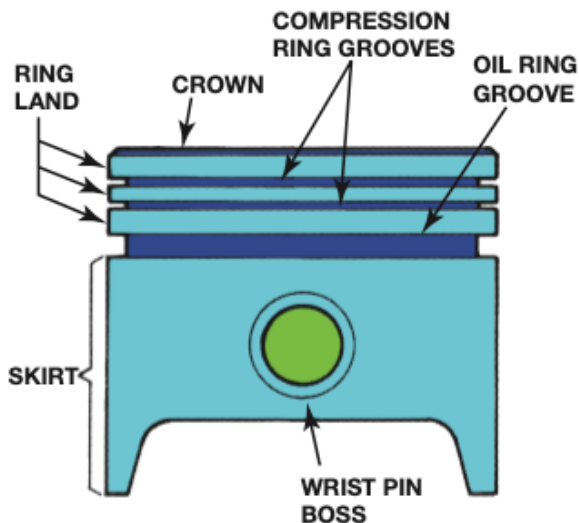


Figure 26. Parts of a piston.

15. Inspect connecting rods and bearings for damage, bore condition, and pin fit; mark caps for location and orientation.

The connecting rod transfers the force and reciprocating motion of the piston to the crankshaft. The small end of the connecting rod reciprocates with the piston. The large end connects to the crankpin. The big end of the connecting rod must be a perfect circle. Once a rod and cap are initially machined, they must remain a “matched set,” due to the precise machining required to obtain a perfect circle. Fig 27.

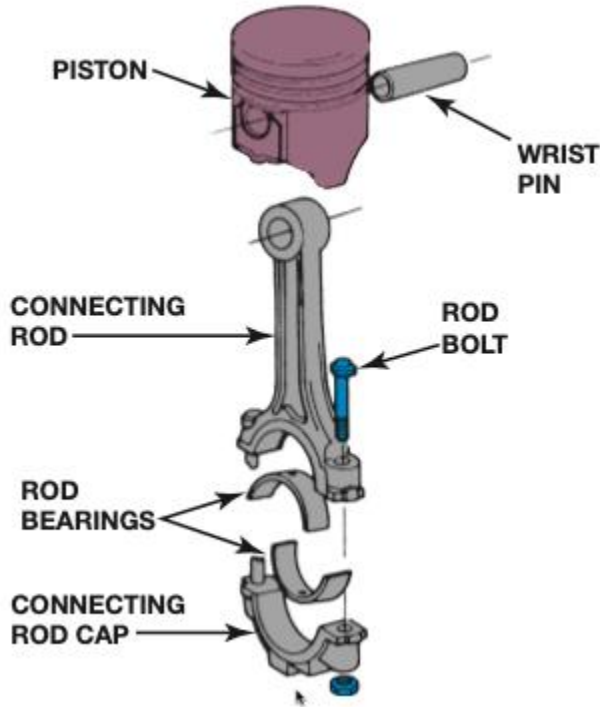


Figure 27. Connecting rod and related components.

16. Inspect, measure, adjust, install, and/or replace piston rings; assemble piston and connecting rod; install piston/rod assembly; check bearing clearance and side play; install connecting rod bearings.

As the piston goes rapidly up and down in the cylinder, it tosses the rings to the top and to the bottom of the ring grooves. The pounding of each ring in its groove gradually increases the piston ring side clearance. The side clearance in the groove should be checked with a feeler gauge. Fig. 28.



Figure 28. Checking piston ring side clearance.

After the block and cylinder bores have been reconditioned, invert the piston and push each ring into the lower quarter of the cylinder; then measure the ring gap. The usual ring gap should be approximately 0.004 inch for each inch of bore diameter. Fig. 29.

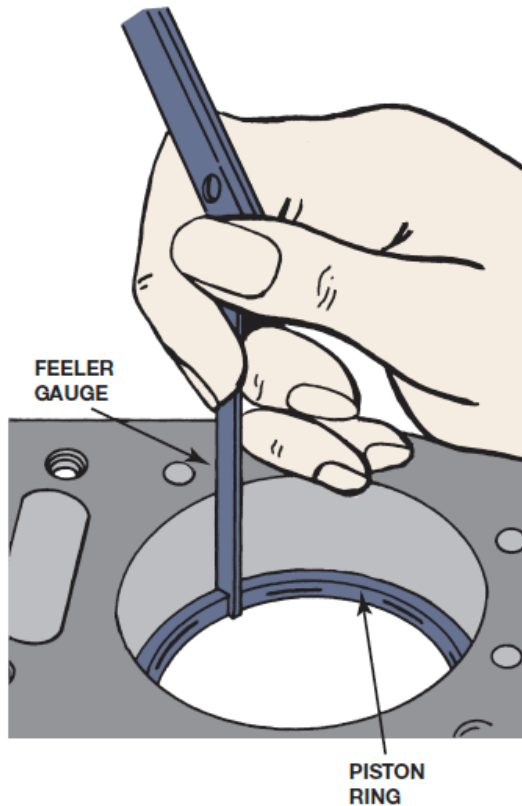


Figure 29. Measuring ring end gap.

To assemble the piston and rod, the piston pin is put in one side of the piston. The small end of the connecting rod should be checked for proper size. The small end of the connecting rod is heated before the pin is installed.

This causes the rod eye to expand so that the pin can be pushed into place with little force. The pin must be rapidly pushed into the correct center position. Fig.30.

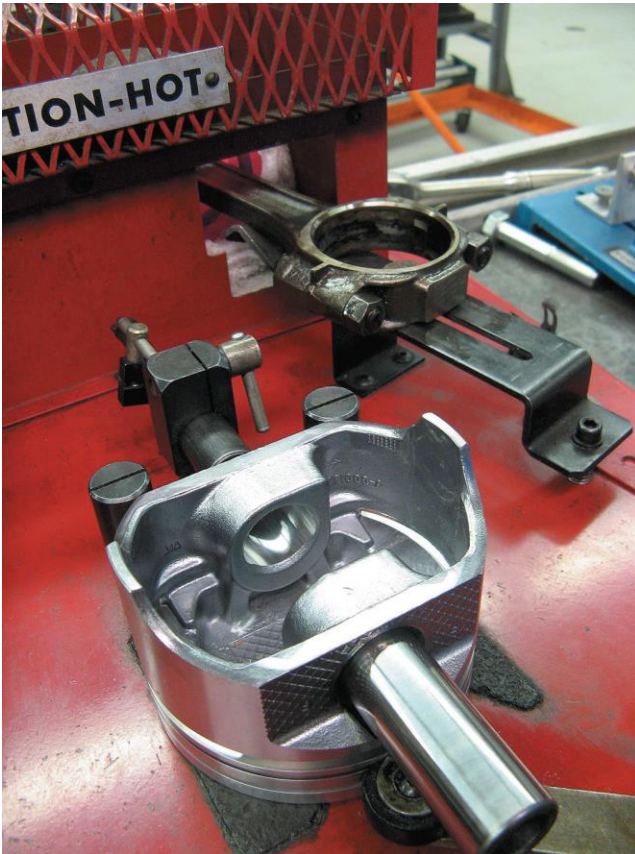


Figure 30. The piston pin is pushed into the heated small end of the connecting rod.

To install the piston/rod assembly follow these simplified steps. Each engine will have some differences.

- Using a squirt-type oil can, squirt oil over the rings and the skirt of the piston.
- The piston ring compressor is then put on the piston to hold the rings in their grooves.
- Rotate the crankshaft so the crankshaft journal is at the bottom (BDC) to help prevent the rod from touching the crankshaft when the piston is installed.
- Remove the bearing cap from the rod and install the bearings.
- Install protectors over the rod bolts. This helps prevent damage to the crankshaft journal when the piston/rod assembly is installed.
- The upper rod bearing should be in the rod and the piston should be turned so that the notch on the piston head is facing the front of the engine.
- The piston and rod assembly is placed in the cylinder through the block deck. The ring compressor must be kept tightly against the block deck as the piston is pushed into the cylinder
- The piston is pushed into the cylinder until the rod bearing is fully seated on the journal. Fig. 31.



Figure 31. Installing the piston.

After installing and torquing the rod caps, the connecting rods should be checked to ensure that they have the correct side clearance. Fig. 32.

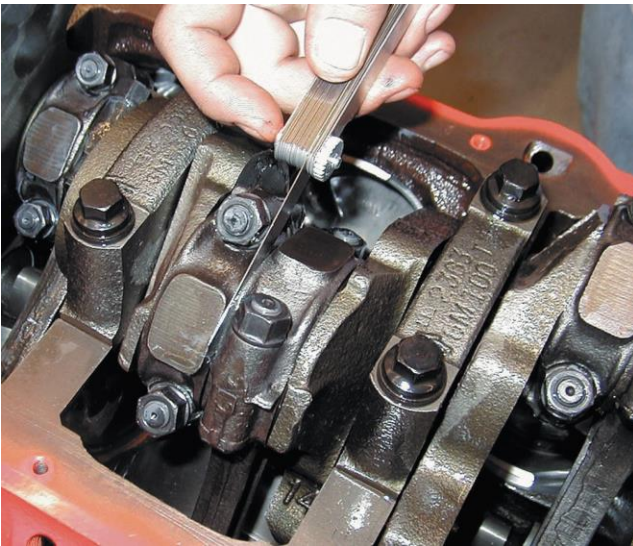


Figure 32. Checking side clearance.

17. Inspect, reinstall, or replace crankshaft vibration damper/harmonic balancer.

Vibration dampers are seated in place by one of three methods.

- The damper hub of some engines is pulled into place using the hub attaching bolt.
- The second method uses a special installation tool that screws into the attaching bolt hole to pull the hub into place. The tool is removed, and the attaching bolt is installed and torqued.

- The last method is used on engines that have no attaching bolt. These hubs depend on a press-fit to hold the hub on the crankshaft. The hub is seated using a special tube-type driver. Check service information for the exact procedure and tool to use.

18. Inspect crankshaft flange and flywheel mating surfaces; inspect and replace crankshaft pilot bearing/bushing (if applicable); inspect flywheel/flexplate and flywheel ring gear for cracks and wear (includes dual-mass flywheel); measure flywheel runout.

The engine end of a transmission input (clutch) shaft is supported by a pilot bearing that is pressed into the end of the crankshaft. Fig. 33.

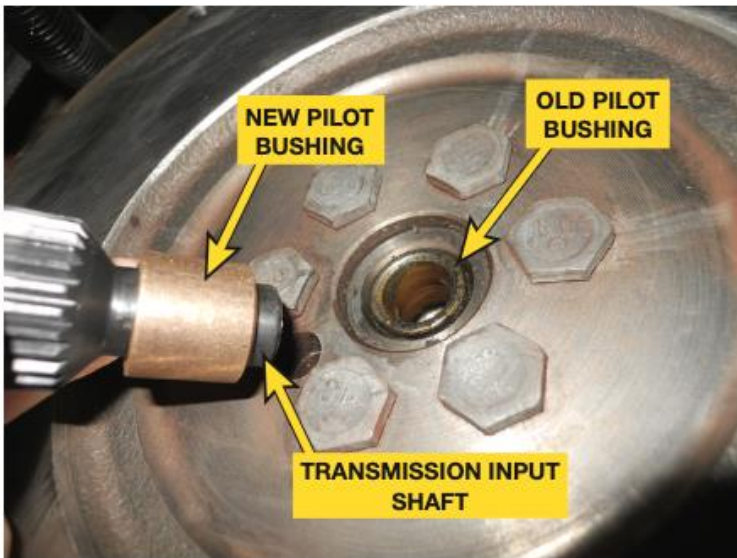


Figure 33. Pilot bushing.

The friction surface of the flywheel should be checked for grooves, nicks, or heat damage (discoloration or cracks caused by excessive heat). Any of these indicates that the flywheel needs to be resurfaced or replaced.

If there is a vibration concern or an odd wear pattern at the hub of the disc or pressure plate release levers, the flywheel should be checked for excessive runout. Face or axial runout is checked by positioning a dial indicator with the indicating stylus at the outer edge of the flywheel face. Fig. 34.

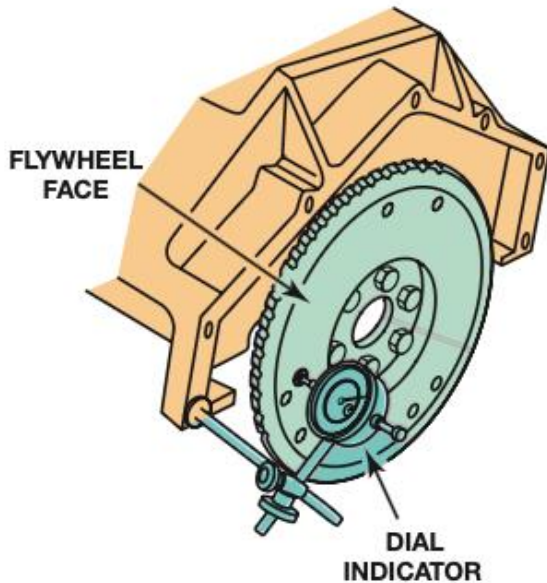


Figure 34. Checking flywheel runout.

Some vehicles, especially high-performance vehicles and vehicles equipped with diesel engines use a dual-mass flywheel. The purpose of a dual-mass flywheel is to dampen engine vibrations and keep them from being transmitted to the passenger compartment through the transmission and shift linkage.

If the dual-mass flywheel fails, the symptom is the same as a slipping clutch. The torque-limiting friction material connecting the primary and secondary flywheels can fail. This failure requires the replacement of the flywheel assembly.

19. Inspect and replace pans and covers.

20. Assemble the engine using gaskets, seals, formed-in-place (tube-applied) sealants, and thread sealers according to manufacturer's specifications.

Cover gaskets are used to seal valve covers, oil pans, timing chain, and other covers. The gasket must be impermeable to the fluids it is designed to seal in or out. The gasket must conform to the shape of the surface, and it must be resilient, or elastic, to maintain the sealing force as it is compressed.

Molded, oil-resistant synthetic rubber is being used in more applications to seal covers.

Rubber-coated metal (RCM) gaskets use a metal core to give strength to the gasket. The metal is coated with a layer on both sides with silicone rubber and molded in sealing beads.

Formed in place gaskets (FIPG) are commonly used because they can be applied at the engine plant using a robot. When FIPG are being replaced during an engine repair or overhaul, check service information for the exact gasket material to use. Fig. 35.



Figure 35. A front engine cover sealed with a formed in place gasket.

21. Inspect in-block camshaft variable valve timing (VVT) components; repair or replace as needed.

Variable valve timing (VVT) involves the use of electric and hydraulic actuators that are used to change the timing of the camshaft(s) in relation to the crankshaft. Variable valve timing, also called variable cam timing (VCT), allows the valves to be operated at different points in the combustion cycle to improve performance.

The vane phaser system used on OHC engines uses a camshaft position (CMP) sensor on each camshaft. Each camshaft has its own actuator and its own oil control valve (OCV). The vane phaser uses a rotor with four vanes, which is connected to the end of the camshaft. Oil pressure is controlled on both sides of the vanes of the rotor. The OCV varies the balance of pressure on either side of the vanes and thereby controls the position of the camshaft. A return spring is used under the reluctor of the phaser to help return it to the home position. Fig 36.

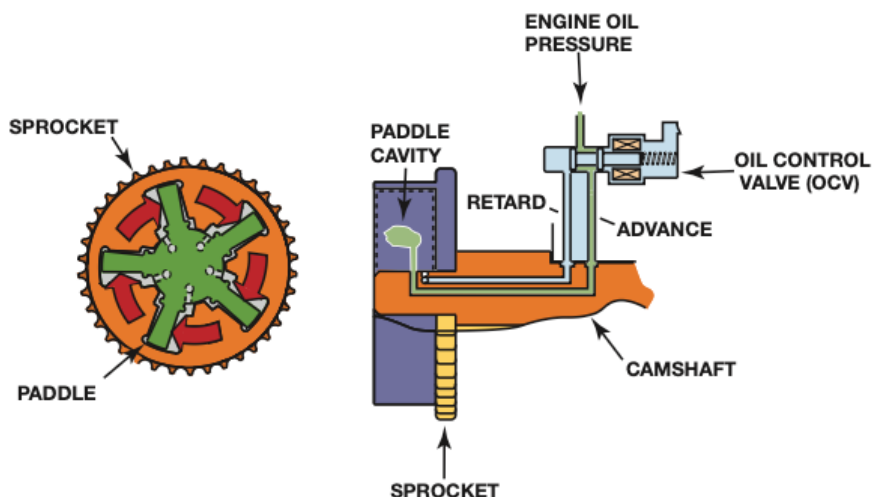


Figure 36. Variable valve timing vane-type phaser.

22. Inspect cylinder deactivation system.

Some engines are designed to be operated on four of eight or three of six cylinders during low-load conditions to improve fuel economy. The PCM monitors engine speed, coolant temperature, throttle position, and load. It then determines when to deactivate cylinders.

the key to this process is the use of two-stage hydraulic valve lifters. In normal operation, the inner and outer lifter sleeves are held together by a pin and operate as an assembly. When the computer determines that the cylinder can be deactivated, oil pressure is delivered to a passage, which depresses the pin and allows the outer portion of the lifter to follow the contour of the cam while the inner portion remains stationary, keeping the valve closed. Fig. 37.

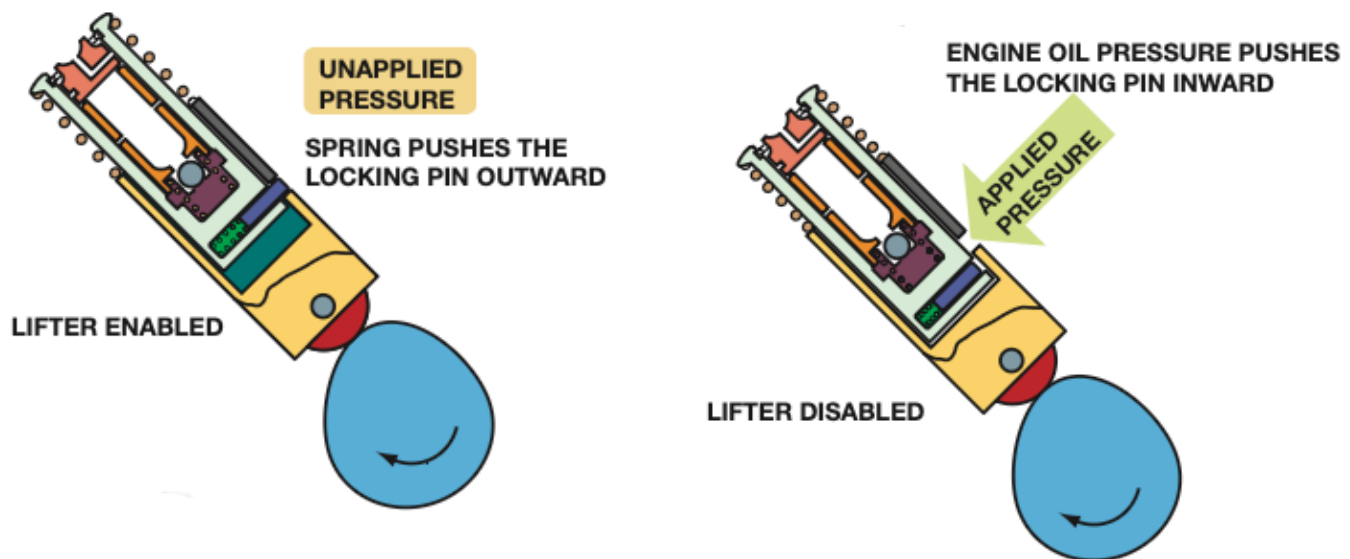


Figure 37. The lifter can be locked or unlocked.

When cylinders are deactivated, the fuel injectors are turned off, but the spark plugs continue to fire. Keeping the spark plugs firing helps to prevent the spark plugs from cooling, which could lead to fouling.

23. Assemble and install/reinstall engine; prime lubrication system as needed.

When starting to assemble the engine, be sure to have all of the instructions from all of the parts used.

- Read. Read all instructions that are included with all new parts and gaskets. Often very important information or suggested specifications are included and may be at the end.
- Understand. Be sure to fully understand everything that is stated in the instructions. If unsure as to what is meant, ask a knowledgeable technician or call the company to be sure that all procedures are clearly understood.
- Follow. Be sure to follow all of the instructions. Do not pick the easy procedures and skip others.

Refer to previous topics in this Study Guide for engine reassembly procedures. Refer to Study Guide A1B for information concerning cylinder head service and installation.

Final engine assembly points.

- Manifolds
 - The intake manifold gasket for a V-type engine may be a one-piece gasket or it may have several pieces. Inline engines usually have a one-piece intake manifold gasket. Only some exhaust manifolds use gaskets. The exhaust manifold operates at very high temperatures, so there is usually some expansion and contraction movement in the manifold-to-head joint. Fig. 38.

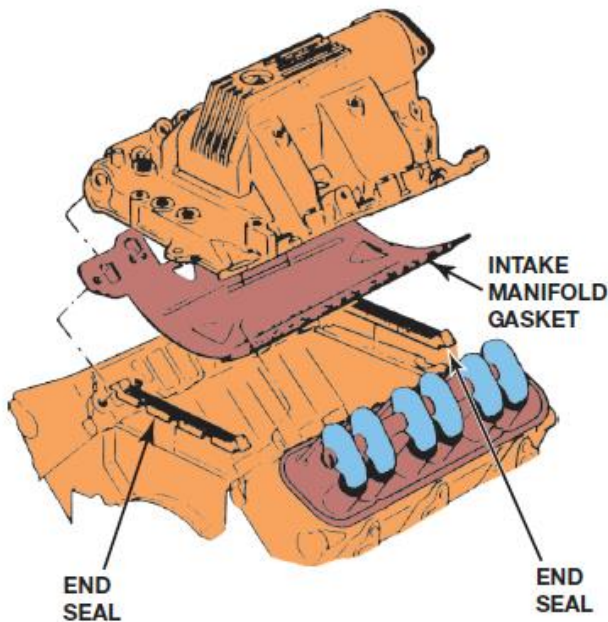


Figure 38. Intake manifold and gaskets.

- Timing cover
 - The timing cover with seal and gasket installed are placed over the timing gears and/ or chain and sprockets. Fig. 39.

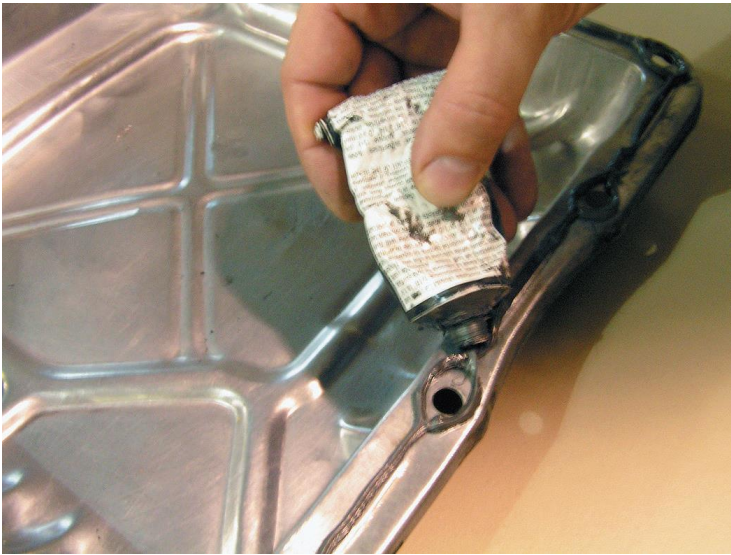


Figure 39. Preparing the timing cover for installation.

- Oil pump
 - When an engine is rebuilt, the oil pump should be replaced with a new pump and oil pickup screen. Most vehicle manufacturers recommend that the oil pump and screen be replaced rather than cleaned.
- Oil pan
 - The oil pan should be checked and straightened as necessary. Fig. 40



Figure 40. Straightening an oil pan.

- Water pump
 - A reconditioned, rebuilt, or new water pump should be used. A new thermostat should be installed being careful to check that the wax pellet side of the thermostat faces toward the engine.

Prefabricating the engine

With oil in the engine, oil pressure should be established before the engine is started. Engines that do not drive the oil pump with a distributor will require the use of a pressurized pre-lubing tool. The pre-lube tool is connected to the oil pressure sending unit hole to send oil throughout the engine oil galleries. This ensures that oil is delivered to all parts of the engine before the engine is started. Fig. 41.



Figure 41. The engine should be pre-lubed until oil is seen.

Engine installation must be thoroughly checked to ensure that it is in proper condition to give the customer dependable operation for a long time. Using a checklist guarantees that all accessories are correctly reinstalled on the engine.

Installation, rear-wheel drive. The engine must be tipped as it was during removal to let the transmission go into the engine compartment first. The transmission is worked under the floor pan as the engine is lowered into the engine compartment. The front engine mounts are aligned, and the rear cross-member and rear engine mount are installed. The engine mount bolts are installed, and the nuts are torqued. Then the hoist is removed.

Installation, front-wheel drive. Many engines for front-wheel-drive vehicles are installed from underneath the vehicle. Often the entire drivetrain package is placed back in the vehicle while it is attached to the cradle. The vehicle is positioned on a hoist and is lowered onto the engine cradle assembly to install. Always check the recommended procedure for the vehicle being serviced.

The following items should be connected to the engine assembly.

- Throttle and cruise control linkages or cables (if equipped).
- Exhaust system to the exhaust manifolds.
- If any of the steering linkage was previously disconnected, it can be reattached while work is being done under the vehicle.

- After the engine is in place, the front engine accessories can all be installed, if they were not installed before the engine was put in the chassis.
- The air-conditioning compressor is reattached to the engine, with care being taken to avoid damaging the air-conditioning hoses and lines.
- Connect all wiring to the starter and alternator as required.
- Connect the instrument and computer sensor wires, including fuel system and throttle control connectors.
- Double-check the condition and routing of all wiring, being certain that wires have not been pinched or broken, before installing a fully charged battery.
- Attach the positive cable first and then the ground cable.