

5. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

Installation

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear. **When replacing standard bearings with new bearings, fit bearings to minimum specified clearance.** If the desired clearance cannot be obtained with a standard bearing, try one half of a 0.001 or 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance. Be certain that bearings and that the bearing bore in the block or cap are clean. Foreign material under a bearing insert can cause bearing failure.
2. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 can be inserted in the oil hole in the crankshaft. With Tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
3. Install the cap bearing.
4. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
5. If the rear main bearing is replaced, replace the oil seal in the rear main bearing cap as described under Crankshaft Rear Oil Seal in Part 21-01.
6. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Torque the cap bolts to specifications. Repeat the procedure for the remaining bearings that require replacement.
7. If the thrust bearing cap (No. 5 main bearing) has been removed, install it as follows:

Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 26). Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specification.

8. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and

rotating the pump shaft until oil emerges from the outlet opening. Then install the oil pump and the inlet tube, following instructions under Oil Pan Installation.

9. Clean the gasket surfaces of the block and oil pan. Be sure to clean the seal grooves of the block and oil pan. The oil pan has a two-piece gasket. Coat the block side of the gasket with an oil resistant sealer. Position the oil pan gasket on the block, then install the oil pan and related parts following instructions under Oil Pan Installation. Install the oil level dipstick.
10. Fill the crankcase to the proper level with the recommended engine oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARINGS

Removal

1. Follow steps 1 and 2 under Main Bearing Replacement.
2. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean crankshaft journal. When replacing standard bearings with new bearings, fit the bearing to minimum specified clearance.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitted in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After bearing has been fitted, clean and apply light coat of engine oil SE to journal and bearings. Install connecting rod cap. Be sure connecting rod bolt heads are properly seated in connecting rod. Torque nuts to specifications.
7. Repeat the procedure for the remaining connecting rods that require new bearings.

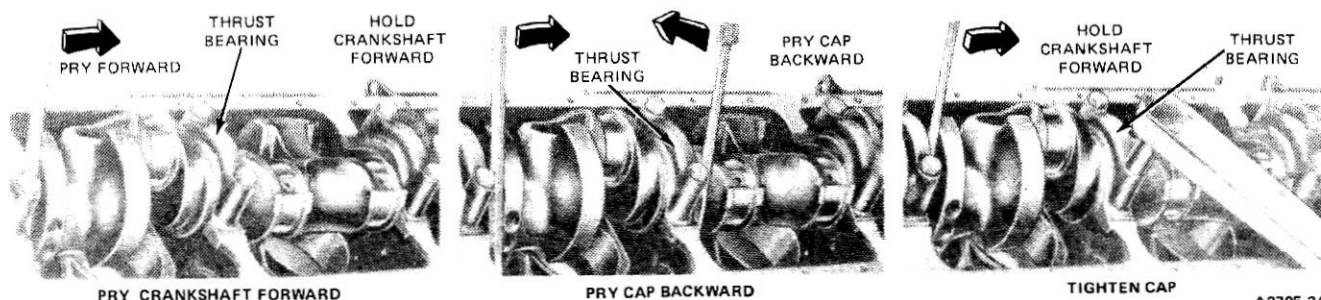


FIG. 26 Typical Thrust Bearing Alignment

8. Install the oil pump assembly and oil pan following the procedure under Main Bearings.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase.
2. Refer to Cylinder Head Removal and remove the cylinder head and related parts.
3. Remove the oil pan and related parts. Remove the oil pump inlet tube and the oil pump.
4. Turn the crankshaft until the piston to be removed is at the bottom of the stroke, then place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
5. Make sure all the connecting rod caps are marked so that they can be installed in the original positions. Remove the connecting rod cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. Avoid damage to the crankpin or the cylinder wall when removing the piston and rod.

Installation

1. Clean the oil pump inlet tube screen, and the oil pan and block gasket surfaces.
2. Oil the piston rings, pistons and cylinder walls with light engine oil.
3. Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 6, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is transferred from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder.
4. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 27). Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 28). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the notch in the dome of the piston toward the front of the engine (Fig. 30).**
5. Check the clearance of each bearing, following the procedure under Connecting Rod Bearings.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of the stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap. Torque the nuts to specifications.

8. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal (Fig. 29).
9. Prime the oil pump by filling the inlet opening with the oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump and the oil pump inlet tube. Install the oil pan and related parts.

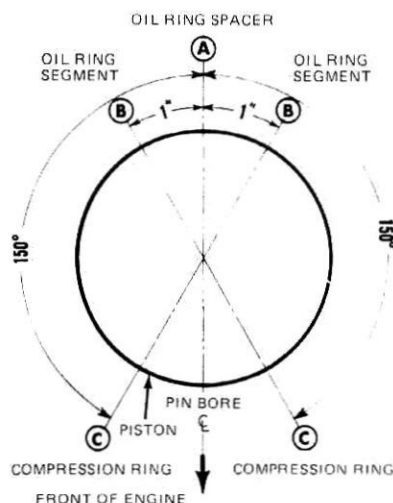


FIG. 27 Piston Ring Gap Spacing

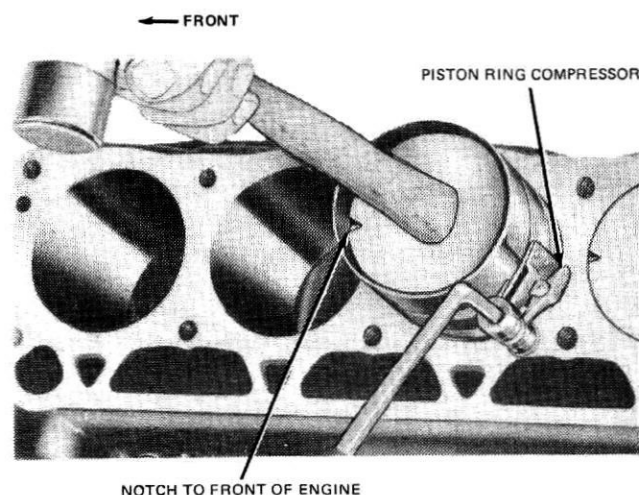


FIG. 28 Piston Installation

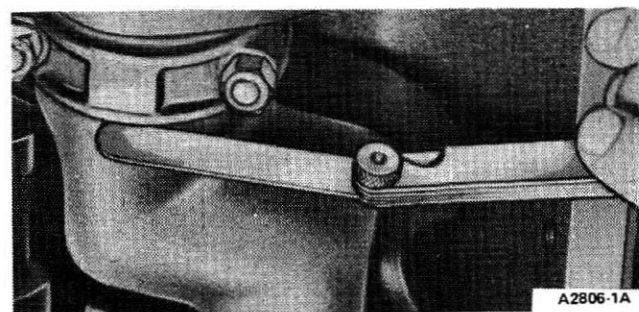


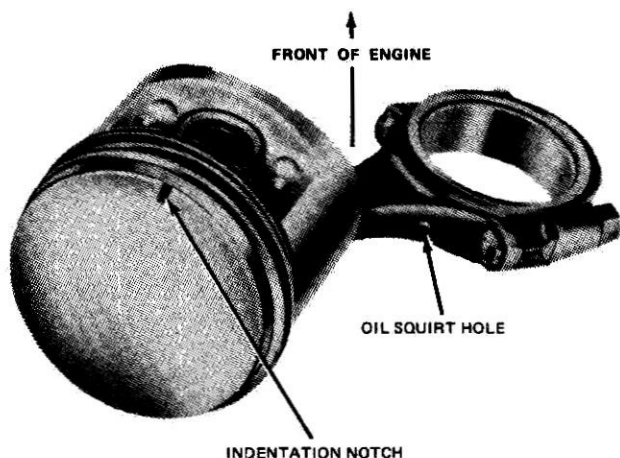
FIG. 29 Typical Connecting Rod Side Clearance

10. Install the cylinder head by following the instructions under Cylinder Head Installation.
11. Fill the crankcase with proper grade of oil.
12. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil, coolant, fuel and vacuum leaks.
13. Check and adjust the ignition timing, engine idle speed and the fuel mixture.
14. Install the air cleaner assembly.

CRANKSHAFT

Removal

The crankshaft and related parts are shown in Fig. 31.



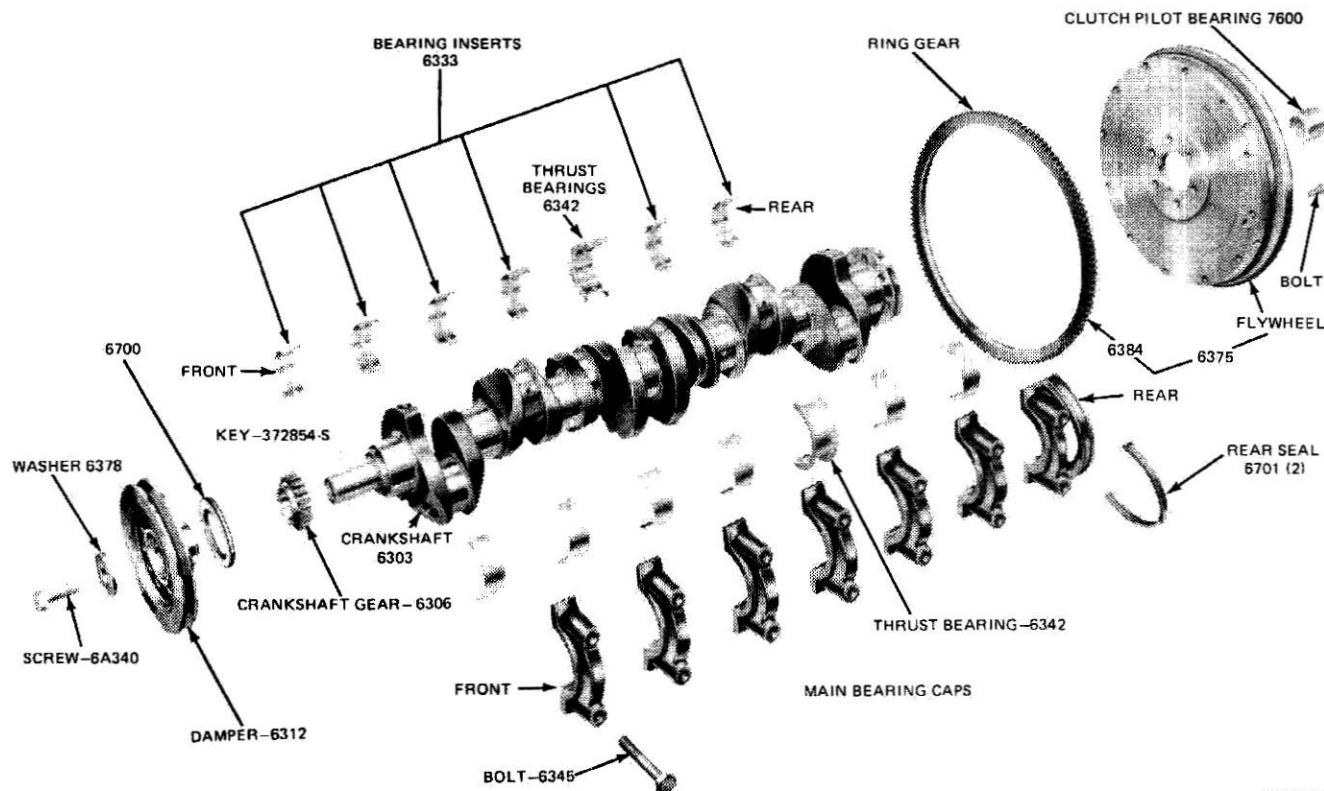
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FIG. 30 Typical Piston and Connecting Rod Assembly

1. With engine removed from vehicle and placed on a work stand, remove the oil level dipstick.
2. Remove the accessory drive pulley (if so equipped). Remove the crankshaft damper attaching bolt and washer. Remove the crankshaft vibration damper using Tool T58P-6316-B.
3. Remove the cylinder front cover and air conditioning idler pulley assembly (if so equipped). Remove the cover gasket.
4. Check the timing chain deflection as detailed in Part 21-01; then remove the timing chain and sprockets as detailed under Cylinder Front Cover and Timing Chain Removal.
5. Invert the engine on the work stand. Remove the flywheel. Remove the oil pan and gasket. Remove the oil pump.
6. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations. Turn the crankshaft until the connecting rod from which the cap is being removed is down. Remove the connecting rod cap. Push the connecting rod and piston assembly up in the cylinder. Repeat for the remaining caps.
7. Remove the main bearing caps.
8. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap.



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FIG. 31 Crankshaft and Related Parts

2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. Clean the rear journal oil seal grooves. Install a new rear journal oil seal in the block and rear main bearing cap.
5. Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface. **Do not apply sealer to the area forward of the oil slinger groove.**
6. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
7. Place the upper main bearing inserts in position in the bores with the tang fitting the slot provided.
8. Install the lower main bearing inserts in the bearing caps.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**
10. Check the clearance of each main bearing. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No. 5 bearing). **Be sure that the main bearing caps are installed in the original locations. Torque the bearing cap bolts to specifications.**
12. Align thrust bearing as described under Main Bearings.
13. Check crankshaft end plays as detailed in Part 21-01.
14. If the end play exceeds specifications, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks or dirt. If the thrust faces are not damaged or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure described under Main Bearings. Check the end play which should be within specifications.
15. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under Connecting Rod Bearings.
16. If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings.
17. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
18. Install the connecting rod cap. Torque the nuts to specifications.
19. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each connecting rod crankshaft journal.
20. Turn the engine on the work stand so that the front end is up. Install the timing chain and sprockets, cylinder front cover and crankshaft pulley or damper, as detailed under Cylinder Front Cover and Timing Chain Installation.
21. Clean the oil pan, oil pump, and oil pump screen.
22. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump following steps 1, 2 and 3 under Oil Pump Installation. Install the oil pan following steps 2 thru 5 under Oil Pan Installation.
23. Position the flywheel on the crankshaft. Apply oil-resistant sealer to the flywheel attaching bolts. Install and torque the bolts to specifications.
On a flywheel for a manual-shift transmission, locate the clutch disc and install the pressure plate.
24. Turn the engine on the work stand so that the engine is in the normal position. Install the oil level dipstick. Install the accessory drive pulley (if so equipped). Install and adjust the drive belt and accessory belts to specifications.
25. Remove the engine from the work stand and install it in the vehicle, following engine installation instructions.

CAMSHAFT BEARING

The camshaft bearings are available pre-finished to size and require no reaming for standard and 0.015 inch undersize journal diameters.

Removal

1. Remove the engine following the procedures under Engine Removal and Installation. Place the engine on a work stand and remove the flywheel and the camshaft. Remove the rear bearing bore plug.
2. Remove the camshaft bearings with the tool shown in Fig. 32.
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 32. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the