

Automotive Engines Theory and Servicing

Ninth Edition

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Chapter 34 Engine Assembly and Dynamometer Testing

ALWAYS LEARNING

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OBJECTIVES (1 OF 2)

34.1 Explain short block preparation and cylinder head preparation.

34.2 Discuss trial assembly and final short block assembly.

34.3 Describe camshaft installation and piston/rod installation.

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OBJECTIVES (2 OF 2)

34.4 Explain the cylinder head installation procedure.

34.5 Discuss torque-to-yield head bolts.

34.6 Explain valve train assembly and final assembly of an engine.

34.7 Explain dynamometer testing.

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DETAILS, DETAILS, DETAILS

- Read
- Understand
- Follow

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FIGURE 34-1 A Ford 1.0 liter 3-cylinder engine is different than many small engines and may require detailed service information to be sure that all of the steps are taken for proper assembly.



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SHORT BLOCK PREPARATION

- Items to Check
- Surface Finish
- Checking Surfaces Before Assembly
- Preparing the Block For Studs
- Preparing Threaded Holes

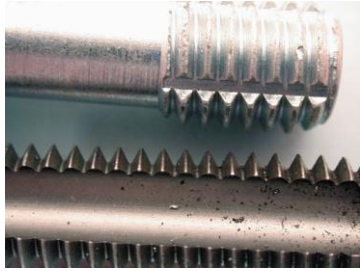


FIGURE 34-2 Deburring all sharp edges is an important step to achieve proper engine assembly.

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FIGURE 34-6 A thread chaser (top) is the preferred tool to clean threaded holes because it cleans without removing metal compared to a tap (bottom).



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CYLINDER HEAD PREPARATION (1 OF 2)

- Check the following details on the cylinder head(s).
 - The surface finish of the fire deck is as specified for the head gasket type to be used.
 - All valves should be checked for leakage by pouring mineral spirits into the intake and exhaust ports and look for leakage past the valves.

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CYLINDER HEAD PREPARATION (2 OF 2)

- All valve springs should be checked for even spring pressure and installed height.
- Check for proper pushrod length.
- If replacement rocker arms are used, be sure that the geometry and total lift will be okay.

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TRIAL ASSEMBLY

- Short Block
- Valve Train
- Check the Angle Between Heads



FIGURE 34-8 A trial assembly showed that some grinding of the block will be needed to provide clearance for the counterweight of the crankshaft. Also, notice that the engine has been equipped with studs for the four-bolt

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FINAL SHORT BLOCK ASSEMBLY (1 OF 2)

- Block Preparation
- Installing Cups and Plugs
- Cam Bearings
- Measuring Main Bearing Clearance
- Correcting Bearing Clearance
- Lip Seal Installation

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FINAL SHORT BLOCK ASSEMBLY (2 OF 2)

- Rope Seal Installation
- Crankshaft Installation
- Thrust Bearing Clearance
- Main Bearing Tightening Procedure
- Crankshaft Rotating Torque

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FIGURE 34-26 Installing a camshaft is easier if the engine is vertical so gravity can help, and this method reduces the possibility of damaging the cam bearings.



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INSTALLING THE CAMSHAFT

- Prelubrication
- Camshaft Precautions
 - New valve lifters
 - Reuse camshaft if possible
 - Never use:
 - A hydraulic lifter camshaft with solid lifters
 - OR hydraulic lifters with a solid lifter camshaft.

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FIGURE 34-27 A commercial additive designed to protect a flat-bottom lifter camshaft used in older vehicles when using newer oils that do not have enough ZDDP to protect the camshaft and lifters.



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PISTON/ROD INSTALLATION

- Checking Piston Rings
- Piston Markings
- Connecting Rod Bearing Clearance
- Piston Installation
- Connecting Rod Side Clearance

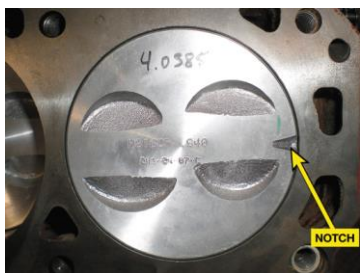


FIGURE 34-28 A feeler gauge is used to check piston ring gap.

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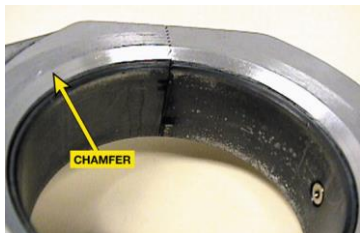
FIGURE 34-29 The notch on a piston should always face toward the front of the engine.



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FIGURE 34-30 On V-type engines that use paired rod journals, the side of the rod with the large chamfer should face toward the crank throw (outward).



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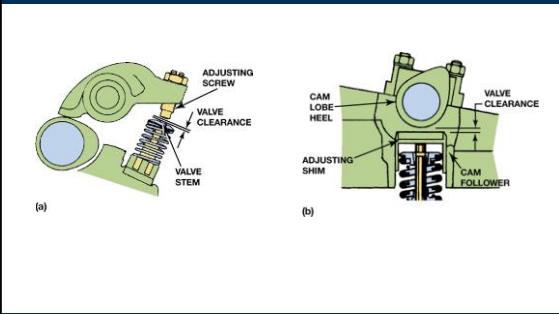
CYLINDER HEAD INSTALLATION

- Installing the Camshaft For OHC Engines
- Head Bolt Torque Sequence
- Clamping Force
- Fastener Consideration
- Thread Lubricant

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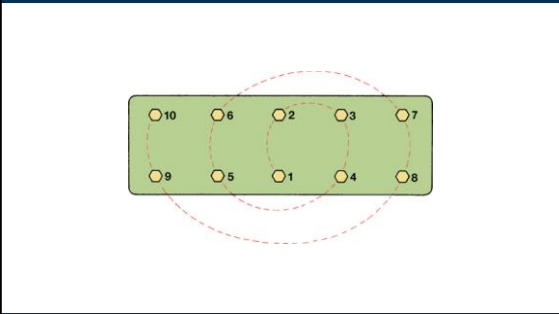
FIGURE 34-39 Valve clearance allows the metal parts to expand and maintain proper operation, both when the engine is cold and at normal operating temperature. (a) Adjustment is achieved by turning the adjusting screw. (b) Adjustment is achieved by changing the thickness of the adjusting shim.



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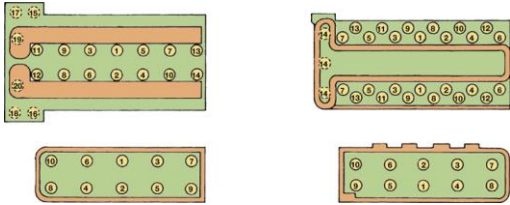
FIGURE 34-41 Typical cylinder head tightening sequence.



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FIGURE 34-42 Examples of cylinder head bolt torquing sequences.



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TORQUE-TO-YIELD HEAD BOLTS

- Definition and Terminology
- Bolt Construction
- Torque-to-yield Procedure
- Torque Angle Method

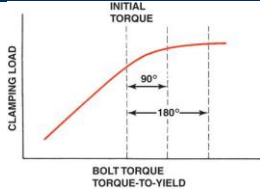


FIGURE 34-44 Due to variations in clamping force with turning force (torque) of head bolts, some engines are specifying the torque-to-yield procedure. The first step is to torque the bolts by an even amount called the initial torque. Final clamping load is achieved by turning the bolt a specified number of degrees. Bolt stretch provides the proper clamping force.

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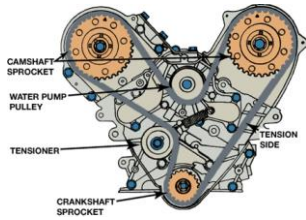
VALVE TRAIN ASSEMBLY

- Timing Drives for OHC Engines
- Hydraulic Valve Lifter Installation
- Bleeding Hydraulic Lifters
- Timing Chains and Gears Installation
- OHV Engine Lifter And Pushrod Installation
- Hydraulic Lifter Adjustment
- Solid Lifter Adjustment

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FIGURE 34-48 Both camshafts have to be timed on this engine and the timing belt also drives the water pump.



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FINAL ASSEMBLY (1 OF 2)

- Manifold Installation
- Timing Cover Installation
- Vibration Damper Installation
- Oil Pump Installation
- Oil Pan Installation

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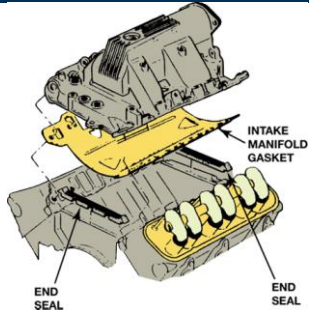
FINAL ASSEMBLY (2 OF 2)

- Water Pump Installation
- Engine Painting
- Prelubricating the Engine
- Setting Ignition Timing

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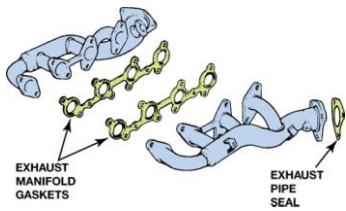
FIGURE 34-54 This intake manifold gasket includes end seals and a full shield cover for the valley to keep hot engine oil from heating the intake manifold.



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FIGURE 34-55 An exhaust manifold gasket is used on some engines. It seals the exhaust manifold to the cylinder head.



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FIGURE 34-62 Heat tabs can be purchased from engine supply companies.



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DYNAMOMETER TESTING

- Purposes
- Types of Dynamometers
- Terminology
- Measured Values
- Calculated Numbers
- Standards
- Final Notes

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FIGURE 34-64 A chassis dynamometer is used to measure torque at the drive wheels. There is a power loss through the drive train so the measured values are about 20% less than when measuring engine output at the flywheel using an engine dynamometer.



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1 Clean the main bearing journal and then place a strip of Plastigage material across the entire width of the journal.



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2 Carefully install the main bearing cap with the bearing installed.



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3 Torque main bearing cap bolts to factory specifications.



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4 Carefully remove the bearing cap and, using the package that contained the Plastigage strips, measure the width of the compressed material. The gauge is calibrated in thousandths of the inch. Repeat for each main bearing.



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5 To measure rod bearing oil clearance, start by removing the rod cap.



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6 Clean the rod bearing journal and then place a strip of Plastigage across the entire width of the journal.



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7 Torque the rod bearing cap nuts to factory specifications.



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8 Remove the rod cap and measure the oil clearance using the markings on the Plastigage package. The wider the compressed gauge material, the narrower the bearing oil clearance. Repeat for all rod bearings.



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SUMMARY (1 OF 3)

- The technician should read, understand, and follow all instructions that came with the parts and gaskets to ensure proper assembly.
- Assembling the short block includes preparing the block and installing the crankshaft and the piston/rod assemblies.
- A trial assembly should be performed before the final assembly.

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SUMMARY (2 OF 3)

- Cylinder head assembly includes checking valve spring tension as well as proper rocker arm and pushrod measurements.
- A trial assembly should be performed before the final assembly.
- All bearing oil clearances should be checked using a micrometer and telescoping gauges or Plastigage.

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SUMMARY (3 OF 3)

- Piston ring end gap should be checked before the pistons are installed.
- Cylinder head bolts should be properly tightened and in the specified sequence.
- Testing an engine on a dynamometer allows the engine to be tested before being installed in a vehicle.

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