

# OVERHAUL

**NOTE:** For overhaul procedures not listed, see ENGINE OVERHAUL PROCEDURES article in **GENERAL INFORMATION**.

## CYLINDER HEAD

### Cylinder Head

1. Check cylinder head for cracks and warpage at cylinder head gasket surface. Replace cylinder head if warpage exceeds specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. DO NOT resurface cylinder head.
2. Measure cylinder head height from top of valve cover gasket surface on cylinder head to cylinder head gasket surface. Replace cylinder head if cylinder head height is not within specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.
3. If removing intake manifold covers from cylinder head, remove bolts and intake manifold cover. Intake manifold cover is located on side of cylinder head. DO NOT bend intake manifold cover, as RTV sealant retains cover on cylinder head. To install, apply RTV sealant on sealing surfaces of intake manifold cover. Install intake manifold cover. Tighten bolts to specification. See TORQUE SPECIFICATIONS.
4. Remove injector control pressure sensor and "O" ring from cylinder head if necessary. Injector control pressure sensor is located on driver side cylinder head. Before installing injector control pressure sensor, apply Threadlock® sealant on threads of injector control pressure sensor. Install injector control pressure sensor using NEW "O" ring. Tighten injector control pressure sensor to specification. See TORQUE SPECIFICATIONS.
5. If necessary to replace fuel injector sleeve in cylinder head, see FUEL INJECTORS under REMOVAL & INSTALLATION.

### Valve Springs

1. Check valve spring free length, out-of-square and pressure. Replace valve spring if not within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.
2. Measure valve spring installed height from bottom of spring seat in cylinder head to bottom of surface of spring retainer. Ensure valve spring installed height is within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.

### Valve Stem Oil Seals

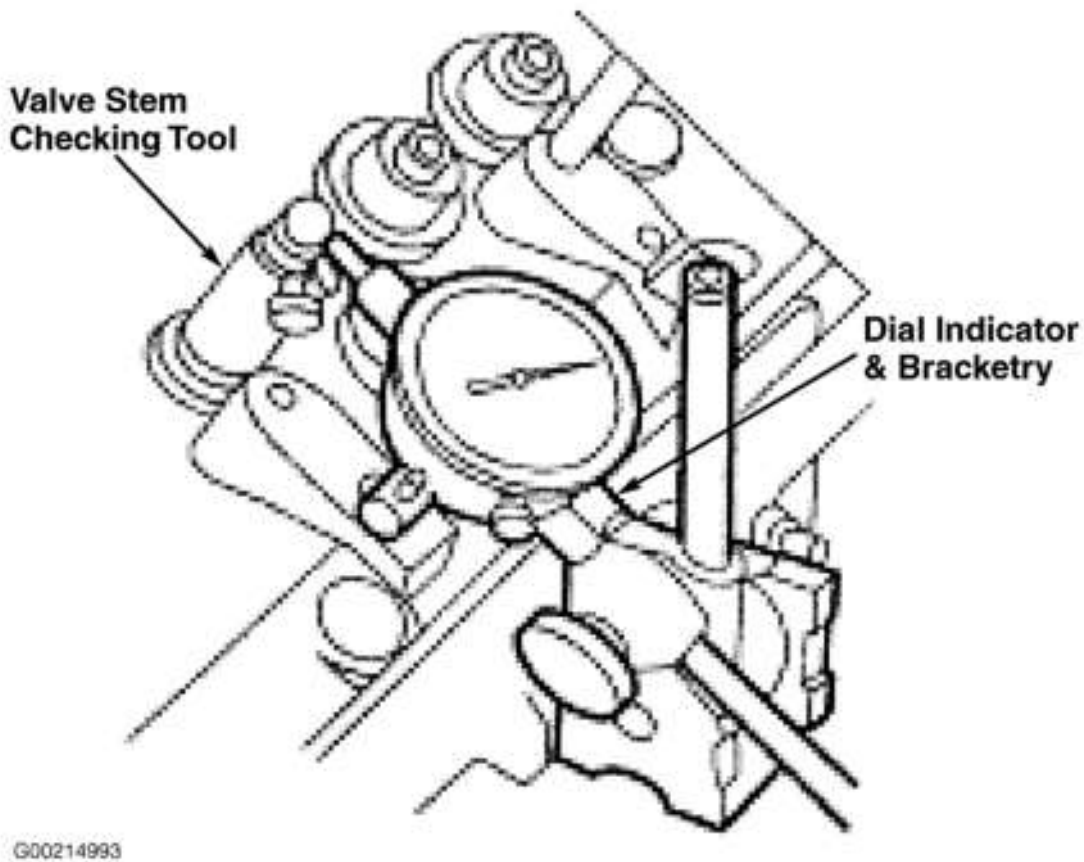
Valve stem seals are used on intake and exhaust valves. No special installation procedure is required for valve stem oil seals.

### Valve Guides

**NOTE:** Valve stem diameter must be within specifications before checking valve stem to valve guide clearance. If necessary, use a magnetic base.

1. Using the Dial Indicator with Brackets (100-002, TOOL-4201-C) and Valve Stem Checking Tool (303-004, TOOL-6505-E), check valve stem-to-valve guide oil clearance. Install a valve stem checking tool on the valve stem and install a dial indicator with brackets. See Fig. 132.

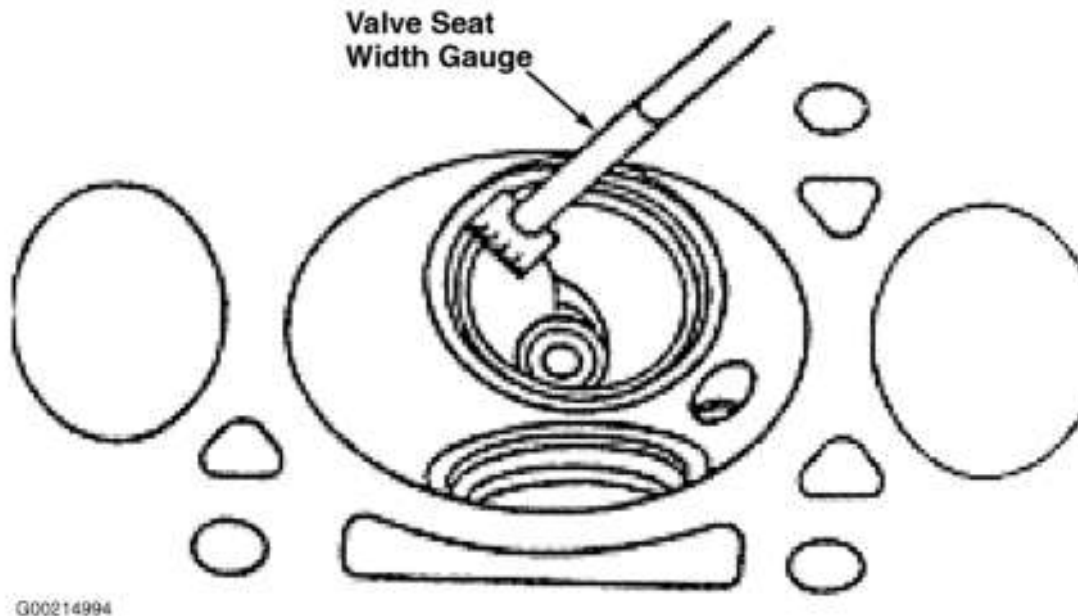
2. Lower the valve until the valve stem checking tool contacts the upper surface of the valve guide. Move the valve stem checking tool toward the indicator and zero the indicator. Move the valve stem checking tool away from the indicator and note the reading. The reading will be **DOUBLE** the valve stem-to-valve guide clearance.
3. Valves with oversize stems will need to be installed if out of specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.



**Fig. 132: Measuring Valve Stem-To-Valve Guide Oil Clearance**  
Courtesy of FORD MOTOR CO.

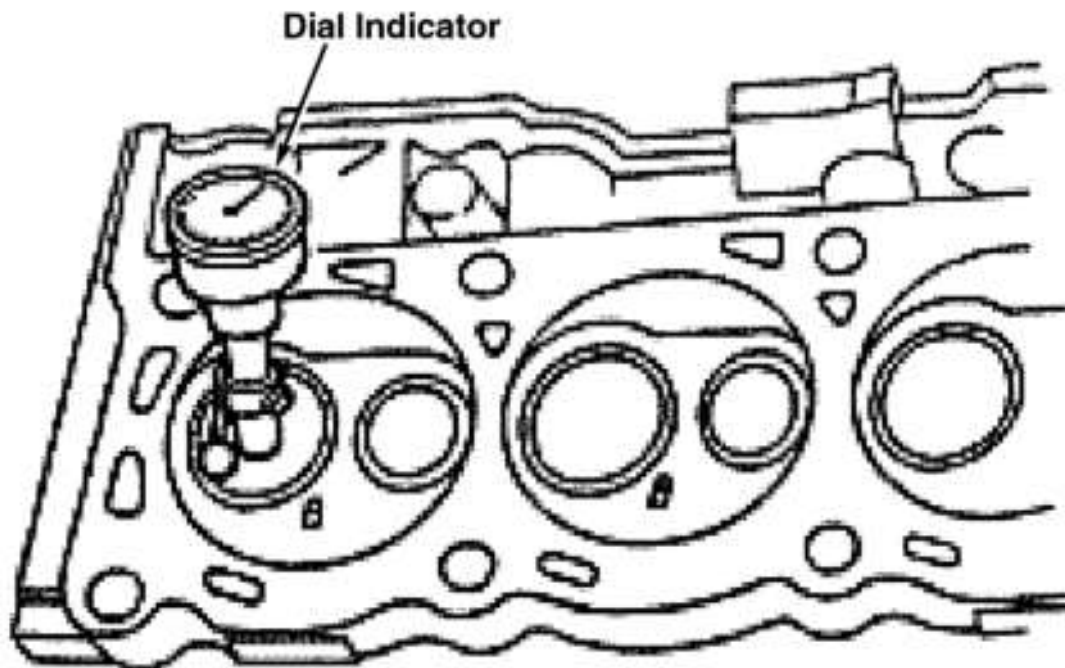
### **Valve Seat**

Check valve seat width and runout. See **Fig. 133** and **Fig. 134** . Grind valve seat if not within specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Ensure valve spring installed height is correct after grinding valve seats. See **VALVE SPRINGS**.



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**Fig. 133: Measuring Valve Seat Width**  
Courtesy of FORD MOTOR CO.



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**Fig. 134: Measuring Valve Seat Runout**  
Courtesy of FORD MOTOR CO.

## Valves

1. Ensure valve stem diameter and valve margin are within specification. See **VALVES & VALVE**

**SPRINGS** table under ENGINE SPECIFICATIONS.

**CAUTION: DO NOT grind more than .010" (.25 mm) from tip of valve stem when resurfacing tip of valve stem.**

2. Resurface tip of valve stem if necessary. DO NOT grind more than .010" (.25 mm) from tip of valve stem. Once valves are re-ground, install valve in cylinder head.
3. Using dial indicator, measure valve head recession by measuring distance from deck surface on cylinder head to valve head. Valve head recession should be within specification. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS.

## **VALVE TRAIN**

### **Rocker Arm Assembly**

For disassembly and reassembly of rocker arm assembly, see **ROCKER ARM ASSEMBLY & PUSH ROD** under REMOVAL & INSTALLATION.

### **Valve Lifters**

1. Ensure roller rotates smoothly and without excessive play. Measure valve lifter outside diameter and valve lifter bore diameter in cylinder block to determine oil clearance. Replace valve lifter if oil clearance is not within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.
2. If necessary to disassemble valve lifter, remove retainer and components from valve lifter body. See **Fig. 116**. Inspect all components for damage. Ensure plunger moves freely in plunger body. Replace valve lifter if plunger fails to move freely in plunger body or if any components are damaged. Valve lifter must be replaced as an assembly.

## **CYLINDER BLOCK ASSEMBLY**

### **Piston & Rod Assembly**

1. Ensure connecting rod and connecting rod cap are marked with corresponding cylinder number before removing. If removing piston from connecting rod, remove snap rings from piston. Tap piston pin from piston.
2. Ensure crankpin bore diameter, out-of-round and taper are within specification. See **CONNECTING ROD** table under ENGINE SPECIFICATIONS. Replace connecting rod if not within specification. Check connecting rod center-to-center length, bend and twist. Replace connecting rod if not within specification. See **CONNECTING ROD** table under ENGINE SPECIFICATIONS.
3. Measure piston pin bushing bore diameter on connecting rod. Bushing may be replaced if diameter exceeds specification. See **CONNECTING ROD** table under ENGINE SPECIFICATIONS. The piston pins are a floating type piston pin and should not require a press to remove or install them. Install NEW bushing and ream to obtain correct inside diameter. See **CONNECTING ROD** table under ENGINE SPECIFICATIONS.
4. For measuring piston diameter, see **FITTING PISTONS**.

### **Fitting Pistons**

1. Measure piston diameter 1.68" (42.7 mm) below lower land of oil ring at 90 degree angle to piston

pin. Replace piston if piston diameter is not within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.

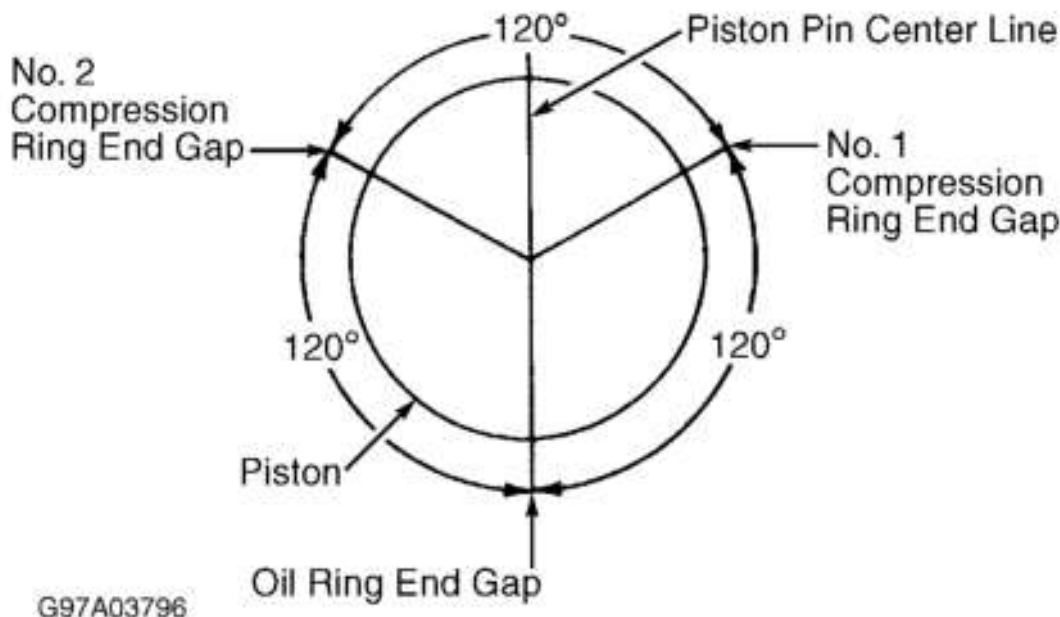
2. Measure cylinder bore diameter at top, middle and bottom of cylinder bore parallel with crankshaft and at a 90 degree angle to crankshaft. Ensure cylinder bore diameter, out-of-round and taper are within specification. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS.
3. Ensure piston clearance is within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS. If piston clearance is not within specification, hone or bore cylinders on cylinder block for oversize pistons. Pistons are available in .010" (.25 mm), .020" (.51 mm) and .030" (.76 mm) oversize.

### Piston Rings

1. Ring end gap should be measured with piston ring positioned in cylinder bore at area where no piston ring wear exists. Ensure ring end gap is within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.
2. To check side clearance on No. 1 and 2 (upper) compression rings, use feeler gauge to measure clearance between piston ring and piston. Ensure side clearance is within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.

**NOTE:** No. 1 (upper) compression ring contains one identification mark and No. 2 (lower) compression rings contains 2 identification marks. Ensure compression rings are installed in correct location with identification mark toward top of piston.

3. Install piston rings on piston, with identification mark on piston ring toward top of piston. Ensure piston ring end gaps are properly positioned. See **Fig. 135**.



**Fig. 135: Positioning Piston Rings**  
Courtesy of FORD MOTOR CO.

**CAUTION: If rod bearing failure exists, oil cooler must be replaced and turbocharger must be checked. For replacement of oil cooler, see OIL COOLER ASSEMBLY under REMOVAL & INSTALLATION.**

### **Rod Bearings**

1. Ensure connecting rod and connecting rod cap are marked with corresponding cylinder number before removing.
2. Use Plastigage to check rod bearing clearance. Apply light coat of engine oil to connecting rod bolt threads before tightening nuts to specification. See TORQUE SPECIFICATIONS.
3. Ensure oil clearance and side play are within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS and CONNECTING RODS tables under ENGINE SPECIFICATIONS.

**CAUTION: If main bearing failure exists, oil cooler must be replaced and turbocharger must be checked. For replacement of oil cooler, see OIL COOLER ASSEMBLY under REMOVAL & INSTALLATION.**

### **Crankshaft & Main Bearings**

1. Ensure main bearing caps are marked or location and direction of installation before removing from cylinder block. Ensure connecting rod journals, crankshaft main bearing journal diameter, taper and out-of-round are within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.
2. Apply light coat of engine oil to main bearing cap bolt threads before tightening bolt to specification. See TORQUE SPECIFICATIONS. Ensure oil clearance and end play are within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.

### **Thrust Bearing**

Thrust bearing is located on No. 5 (rear) main bearing. Replace thrust bearing if crankshaft end play is not within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.

### **Cylinder Block**

1. Check cylinder block deck surface for warpage at cylinder head gasket surface. Resurface cylinder block if warpage exceeds specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS. DO NOT remove more than .010" (.25 mm) of material from cylinder block if resurfacing cylinder block.
2. Measure cylinder bore diameter at top, middle and bottom of cylinder bore parallel with crankshaft and at a 90 degree angle to crankshaft. Ensure cylinder bore diameter, out-of-round and taper are within specification. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.

**CAUTION: Ensure piston cooling oil jets are removed before honing or boring cylinder bores to prevent damage to cooling jet.**

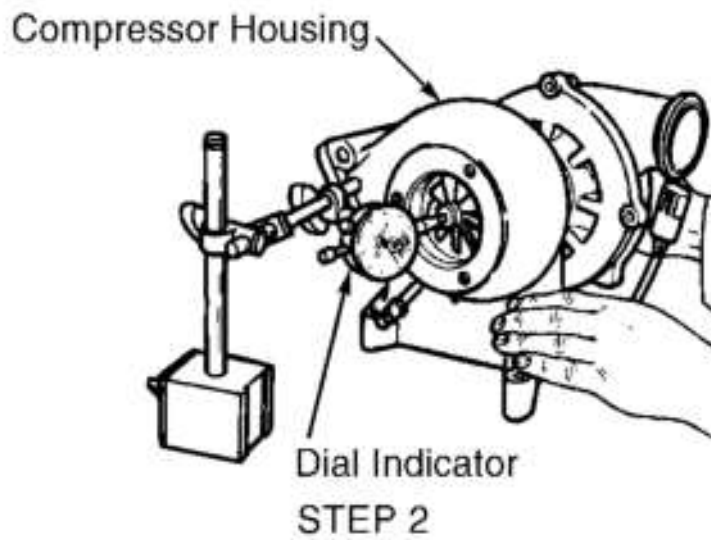
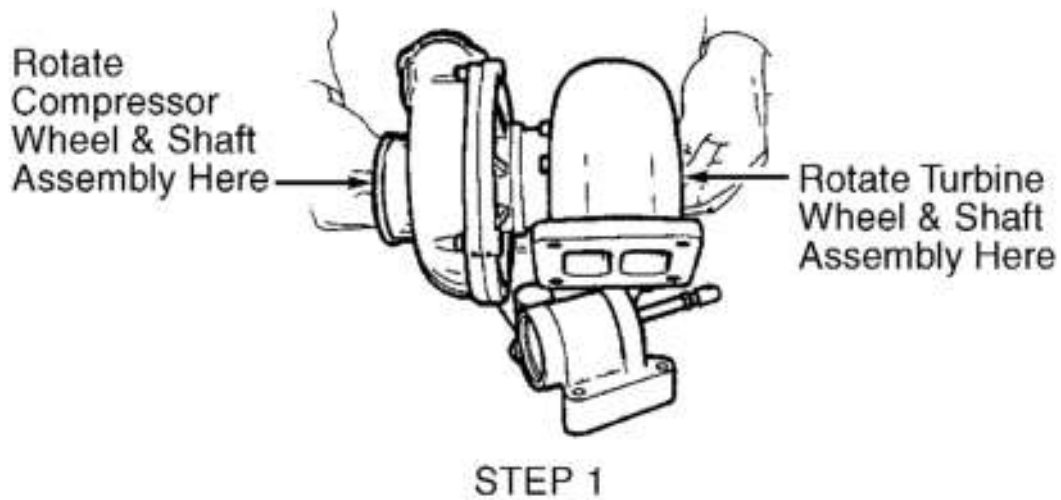
3. If cylinder bore diameter, out-of-round or taper exceeds specification, hone or bore cylinders on

cylinder block for oversize pistons. Pistons are available in .010" (.25 mm), .020" (.51 mm) and .030" (.76 mm) oversize.

## **TURBOCHARGER**

### **Preliminary Inspection**

1. Disconnect air intake tube and exhaust pipe from turbocharger. Rotate turbine wheel, shaft assembly and compressor wheel inside turbocharger. Shaft assembly should rotate smoothly. Perform STEP 1 in illustration. See **Fig. 136**.
2. Push compressor wheel and shaft assembly as far in one direction as possible while rotating shaft assembly. Ensure compressor wheel does not contact compressor housing while rotating shaft assembly. Push turbine wheel and shaft assembly as far in one direction as possible while rotating shaft assembly. Ensure turbine wheel does not contact turbine housing while rotating shaft assembly.
3. If compressor wheel or turbine wheel does not contact housing while rotating shaft assembly, bearings in turbocharger are okay. Go to next step. If compressor wheel or turbine wheel contacts housing while rotating shaft assembly, bearings in turbocharger are defective. Replace turbocharger.
4. Install dial indicator so stem on dial indicator contacts end of shaft assembly at compressor wheel. Perform STEP 2 in illustration. See **Fig. 136**. Push shaft assembly as far in one direction as possible and zero dial indicator. Push shaft assembly as far in opposite direction and note shaft end play. Replace turbocharger if shaft end play is not .0008-.0040" (.020-.10 mm).



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**Fig. 136: Checking Turbocharger**  
Courtesy of FORD MOTOR CO.