TC18, TC21, TC21D
CONTENTS

SECTION 1
ENGINE SYSTEMS

CONTENTS

GENERAL INFORMATION

DESCRIPTION AND OPERATION

This section describes the engine overhaul and repair procedures of the Models TC18, TC21, and TC21D tractors. Repair procedures are essentially the same for all models except as noted in the repair procedures.

The tractors are equipped with three-cylinder in-line engines. They are all four cycle, overhead valve, liquid cooled engines. The engines are identified by a code cast into the lower right side of the cylinder block, just behind the hydraulic pump. The identification numbers of the engines used is shown in the following chart.

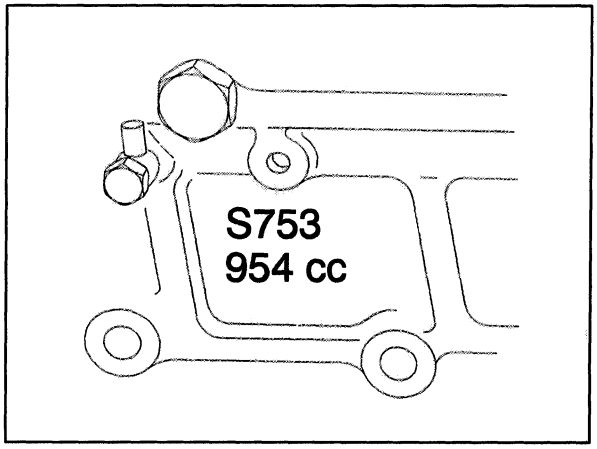

Figure 1-1

IDENTIFICATION CHART

ENGINE IDENTIFICATION	TRACTOR MODEL	HORSE-POWER
S753	TC18	18.5
S773	TC21 & TC21D	21.0

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

The cylinder head incorporates the valve assemblies, rocker arms, rocker shaft, push rods, lifters, and pre-combustion chambers. The air intake manifold is incorporated into the left hand side of the valve cover assembly. The exhaust manifold is bolted on the left-hand side of the cylinder head. The cylinder heads have integral valve guides. Standard size valves only are used. Figure 1-2 provides a cut-away front and side view of an engine.

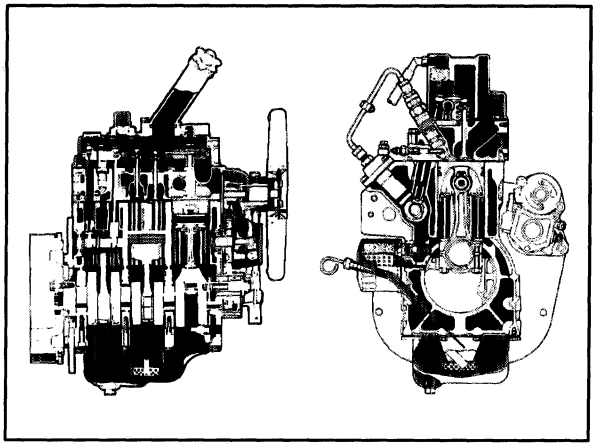

Figure 1-2

A pre-combustion chamber is located between the injector assembly and the combustion chamber of the cylinder and provides an area for initial ignition of the fuel for improved starting. A glow plug located in the head extends into the pre-combustion chamber and, when energized, pre-heats the fuel-air mixture for improved fuel ignition under cold weather conditions.

CYLINDER BLOCK ASSEMBLY

The cylinder block assembly contains the pistons, connecting rods, crankshaft, timing gears, and engine oil pump. The engine crankshaft is supported by four main bearings. The front main bearing is a full circle bearing positioned in a bore in the front of the block. The second, third, and fourth main bearings are split liners located in holders bolted to the block. The camshaft is supported by two ball bearings one located on each end of the block. The engines utilize a straight connecting rod and a three ring piston.

ENGINE OVERHAUL

ENGINE DISASSEMBLY

1. Open the radiator drain, 1, and drain and remove the radiator assembly. See "Radiator Removal" discussed later in this section, pg 1-55.

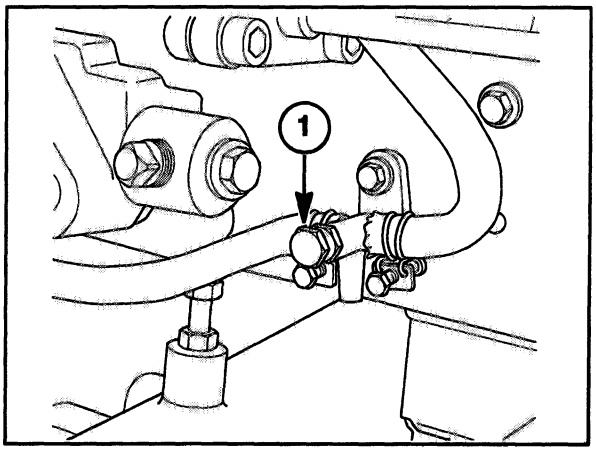

Figure 1-3

2. Disconnect the electrical connector, 1, for the head lamps.

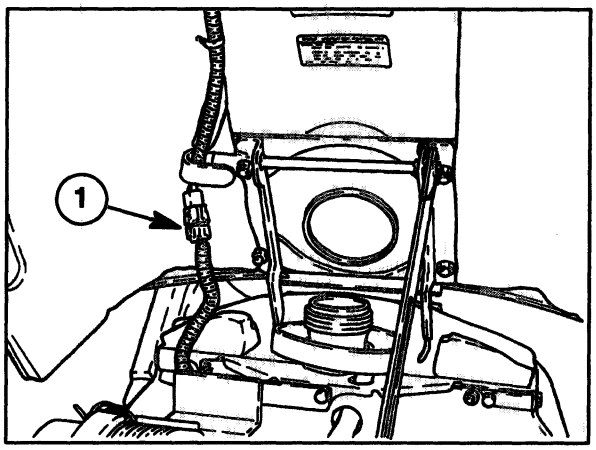

Figure 1-4

3. Remove the clip pin, 1, from the hood support, 2, and gradually lower the hood.

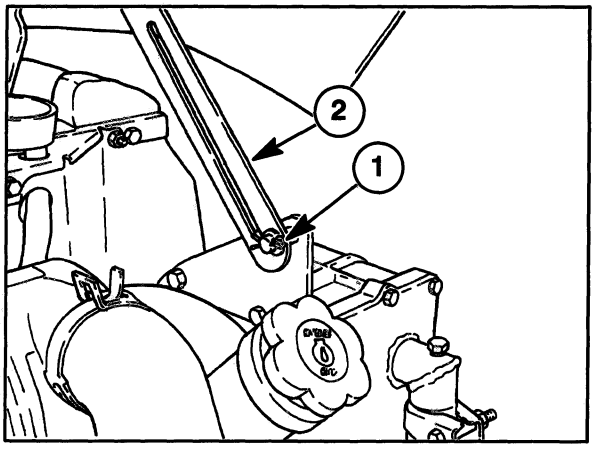

Figure 1-5

4. Pull the instrument panel out by hand and remove the clip pins, 1, from the hood hinge pins, 2. Then remove the hinge pins.
5. Raise the hood and remove from the tractor.

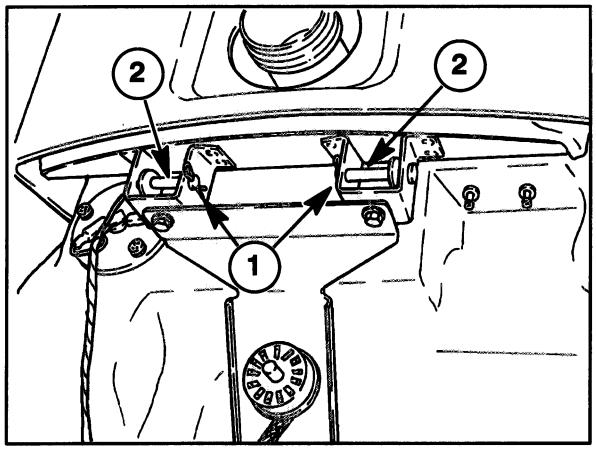

Figure 1-6

6. Remove the whole air cleaner assembly, 1, along with the air cleaner hoses.

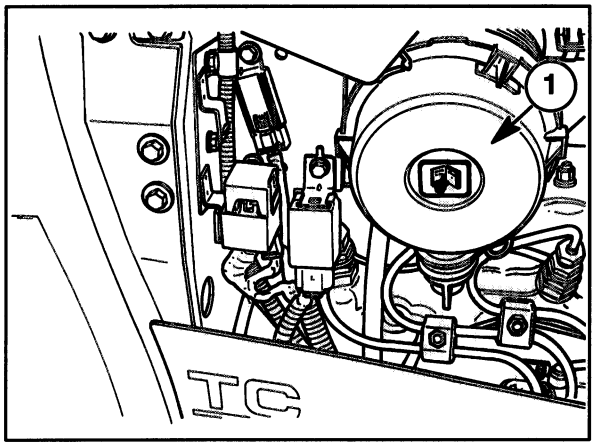

Figure 1-7

7. Remove the two capscrews, 1, and remove the air cleaner mounting bracket, 2.

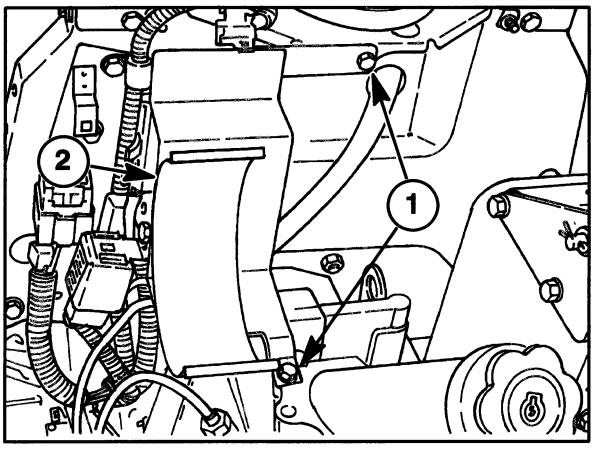

Figure 1-8

8. Remove the exhaust muffler and manifold assembly, 1.

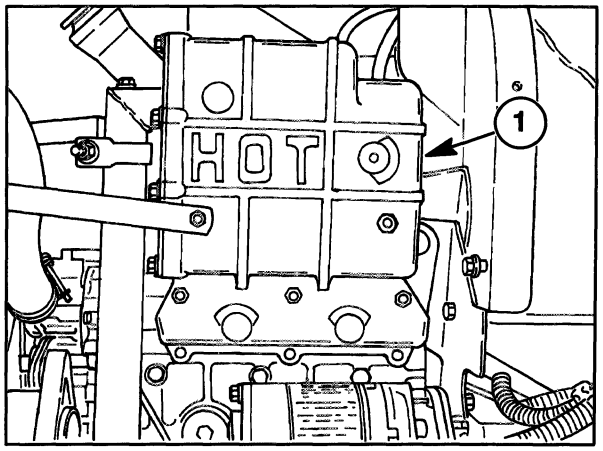

Figure 1-9

FUEL INJECTOR AND GLOW PLUG REMOVAL

1. Clean all dirt and oil from the injectors and surrounding areas.
2. Disconnect the fuel lines, 1, from the injectors and cap all openings.
3. Remove the three glow plugs, 2.
4. Disconnect the return line to the fuel tank from the number three injector.
5. Remove the injector assemblies, 3.

   NOTE: Be sure to remove the injector sealing washer from the injector bore, if not removed with the injector.

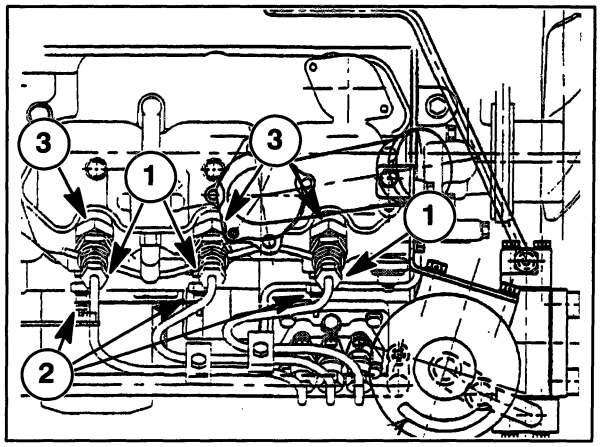

Figure 1-10

OIL PRESSURE SWITCH REMOVAL

1. Disconnect and remove the oil pressure switch, 1.

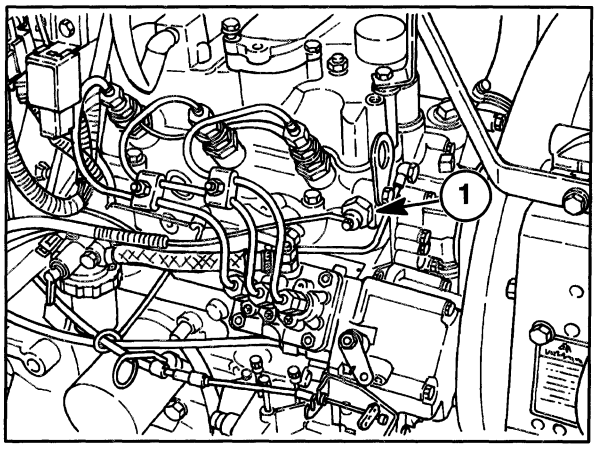

Figure 1-11

TEMPERATURE SENDING SWITCH AND ALTERNATOR REMOVAL

1. Remove the temperature sending switch, 1, from the front of the cylinder head.
2. Loosen the alternator mounting bolts, 2, and remove the V-belt, 3, from the drive pulley.
3. Disconnect the wires from the back of the alternator.
4. Remove the alternator mounting bolts and remove the alternator, 4.

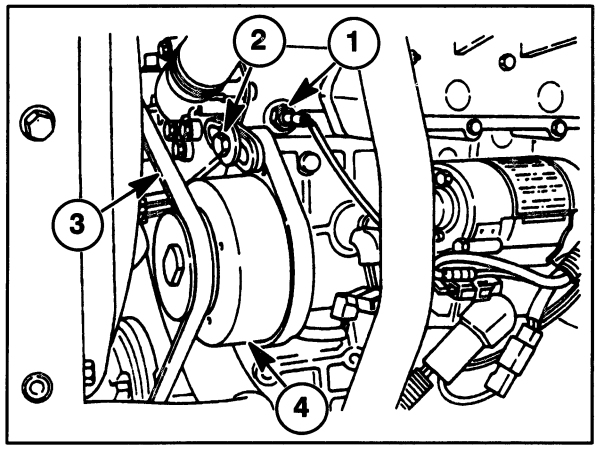

Figure 1-12

FAN, WATER PUMP, AND EXTERNAL OIL TUBE REMOVAL

1. Remove the fan and water pump assembly. See "Water Pump and Thermostat Removal" discussed later in this section, pg 1-57.
2. Remove the external oil transfer tube banjo bolts, 1, from the front of the cylinder head and the side of the cylinder block and remove the external oil transfer tube.

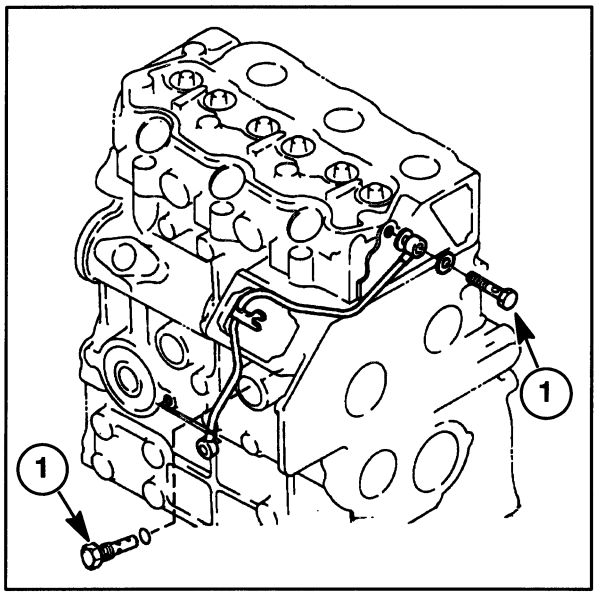

Figure 1-13

VALVE COVER REMOVAL

1. Remove the valve cover, 1, and gasket.

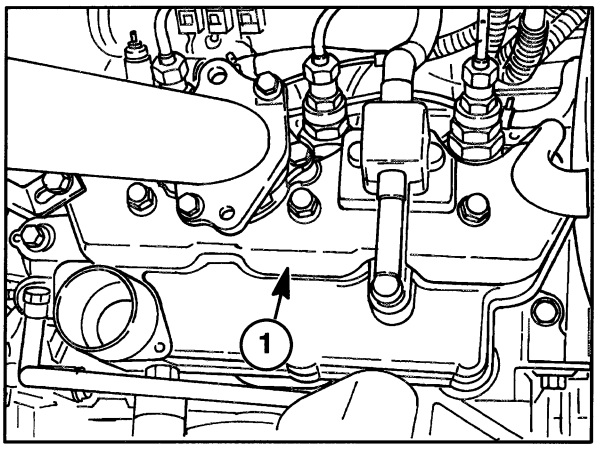

Figure 1-14

ROCKER SHAFT AND PUSH ROD REMOVAL

1. Remove the valve rocker arms, 1, shaft, 2, rocker arm supports, 3, and springs, 4, as an assembly
2. Remove the push rods, 5.

   NOTE: Be sure to keep the valve components in separately marked containers for re-assembly in their original position.

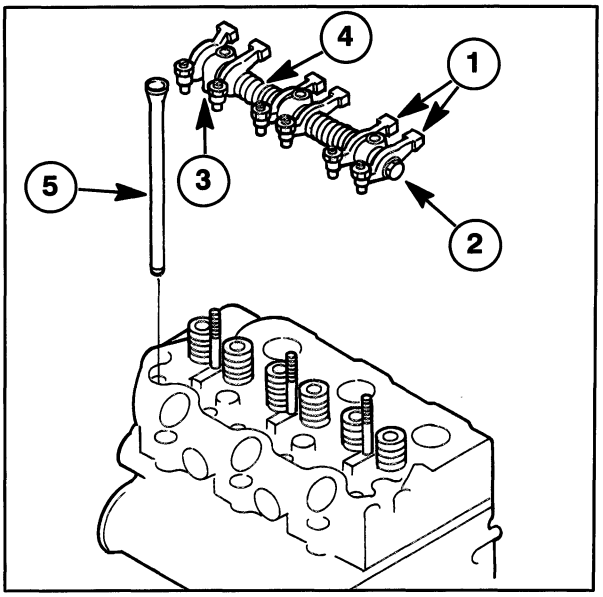

Figure 1-15

CYLINDER HEAD REMOVAL

1. To remove the cylinder head, remove the cylinder head bolts, 1, by alternately loosening a half turn at a time to prevent warping the head.

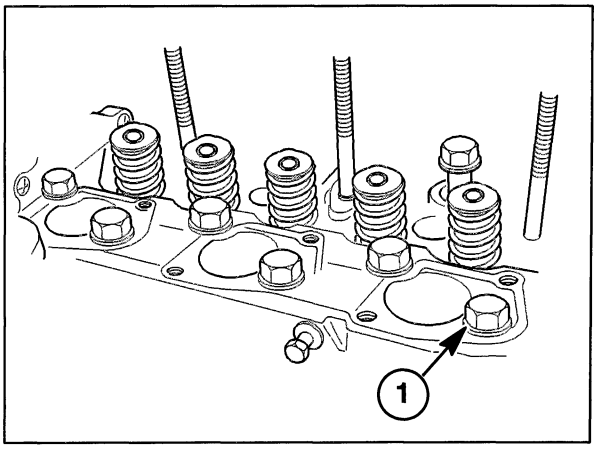

Figure 1-16

VALVE TAPPET REMOVAL

1. Remove the valve tappets, 1, from the machined bore in the cylinder block.

   NOTE: Be sure to keep the valve components in separately marked containers for re-assembly in their original position.

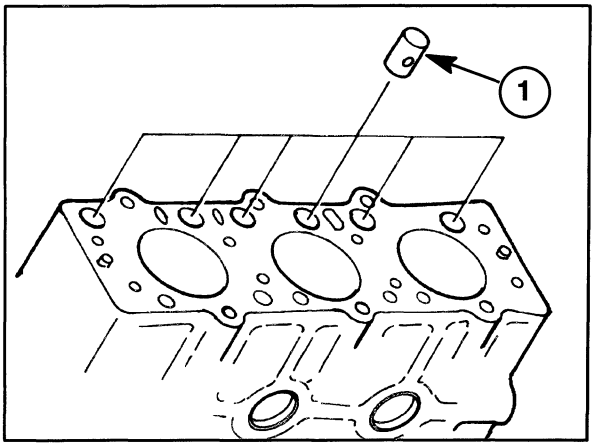

Figure 1-17

FUEL SHUT-OFF SOLENOID REMOVAL

1. Remove the wire connector, 1, and unscrew the fuel shut-off solenoid, 2.

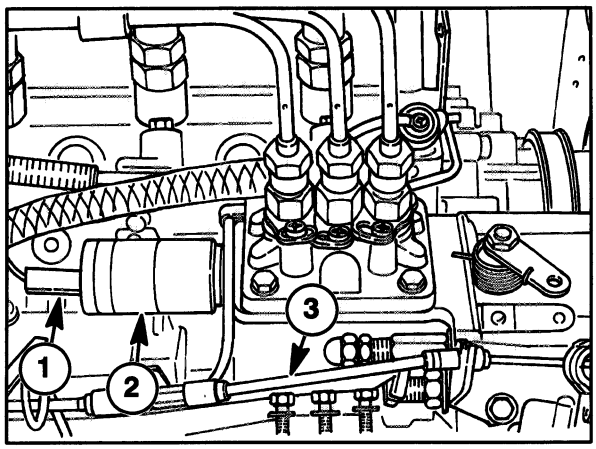

Figure 1-18

ENGINE TIMING GEAR COVER, TIMING GEARS, AND CAMSHAFT

1. Drain the engine crankcase oil into a suitable container.
2. Remove the nut, 1, and washer, 2, and remove the pulley, 3, from the crankshaft, 4.
3. Disconnect the throttle control cable from the governor lever, 3, Figure 1-18.

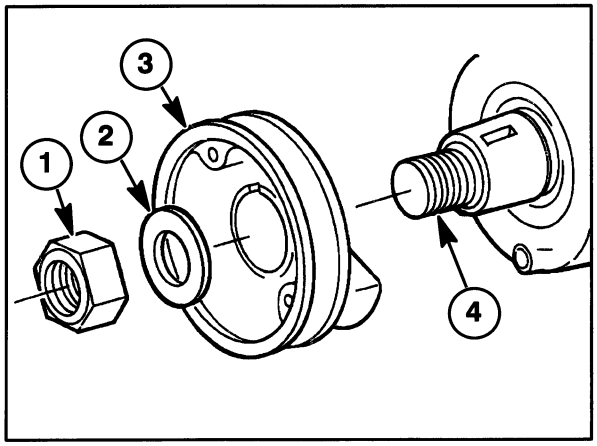

Figure 1-19

4. Remove the injection pump mounting bolts and raise the injection pump enough to remove the spring pin, 1, and separate the governor link from the control rack.

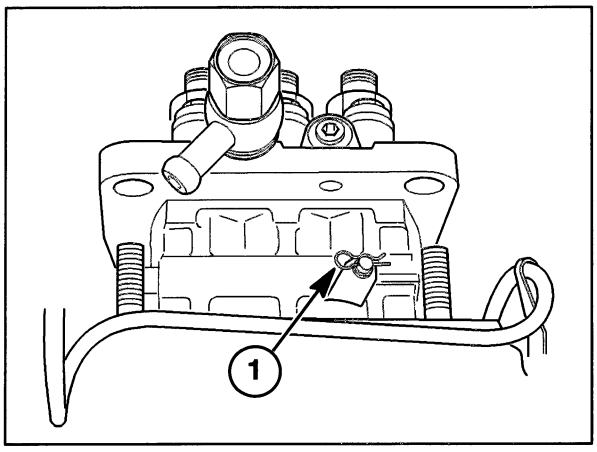

Figure 1-20

5. If equipped, remove the power steering pump reservoir tank dipstick-filler cap, 1. Remove the reservoir drain plug, 2, from the bottom of the reservoir, and drain the fluid out of the reservoir tank, 3, into a suitable container.
6. Loosen the hose clamp, 4, on the suction tube and disconnect the hose from the suction tube.
7. Remove the pressure tube, 5, from the engine side of the steering pump.
8. Remove the through bolts, 6, and remove the steering pump from the front cover. Cap and plug all lines and openings.

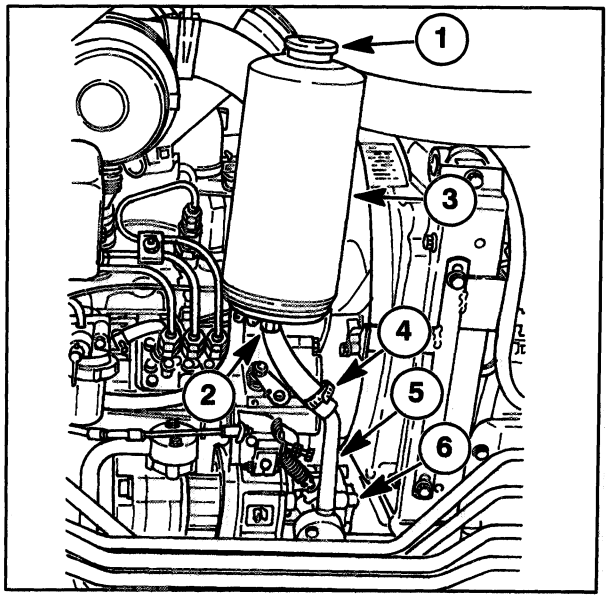

Figure 1-21

9. Remove the retaining bolts, 1, and lift the front cover, 2, and gasket, 3, off the locating dowels.

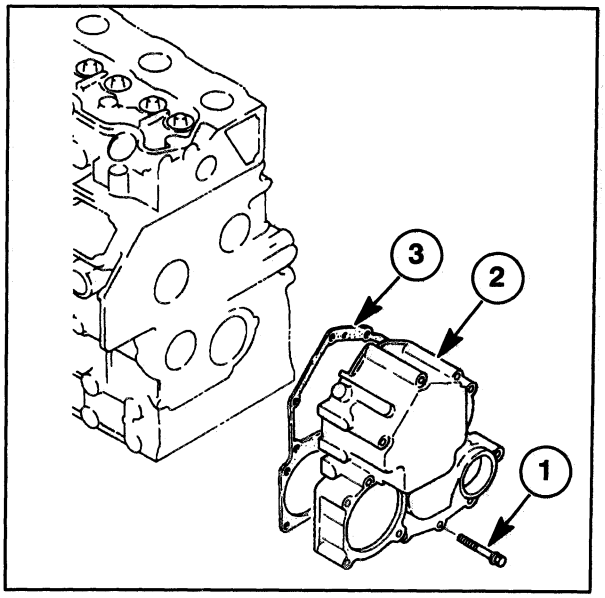

Figure 1-22

Timing Gears and Camshaft Removal

1. Remove the retaining ring, 1, and remove the idler gear and oil pump assembly, 2.

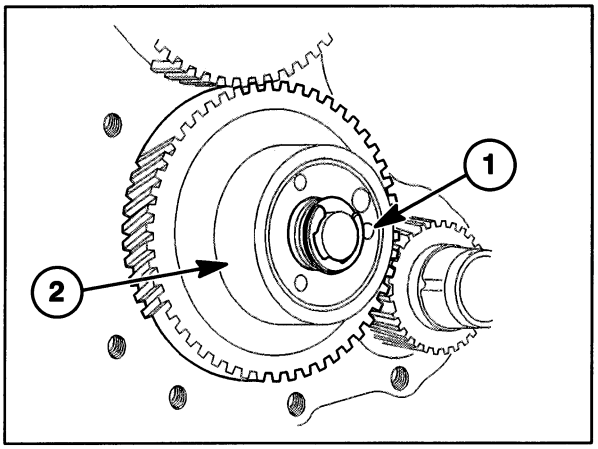

Figure 1-23

2. Remove the two bolts securing the keeper plate, 1. One bolt must be accessed using the access hole, 2, in the cam gear.
3. Slide the camshaft and gear out of the camshaft bore.

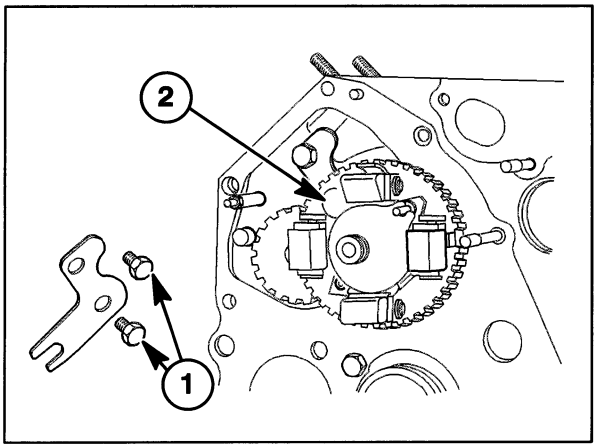

Figure 1-24

Oil Sump Removal

1. Remove the oil sump retainer bolts, 1.
2. Remove the oil sump and discard gasket.

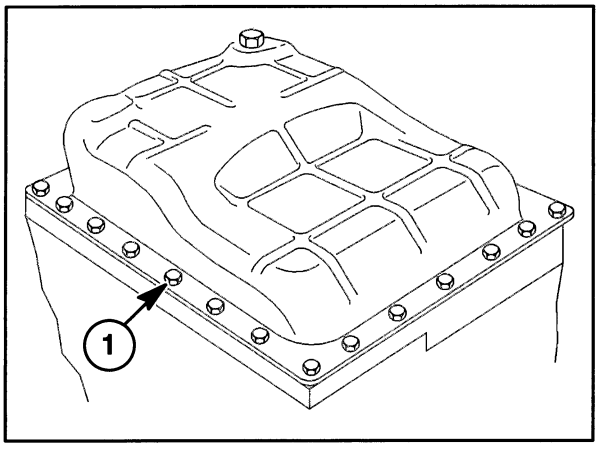

Figure 1-25

Oil Suction Pipe and Strainer Removal

1. Remove the two retaining bolts, 1.
2. Remove the oil strainer, 2, and rotate the oil suction pipe, 3, out of it's bore.

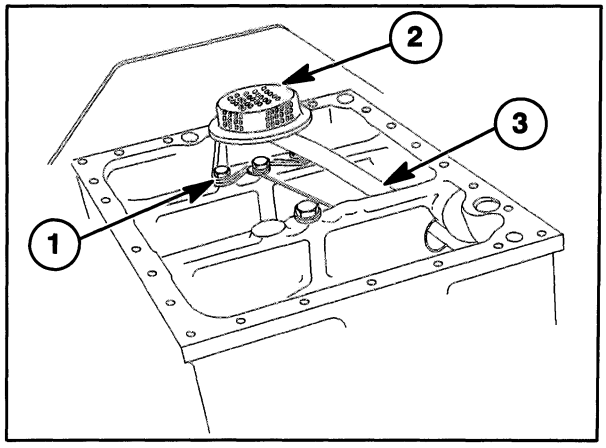

Figure 1-26

Connecting Rods, Bearings, and Piston Removal

1. Remove the bolts, 1, retaining the three connecting rod caps, 2.
2. Remove the connecting rod caps with lower half of the connecting rod bearing.

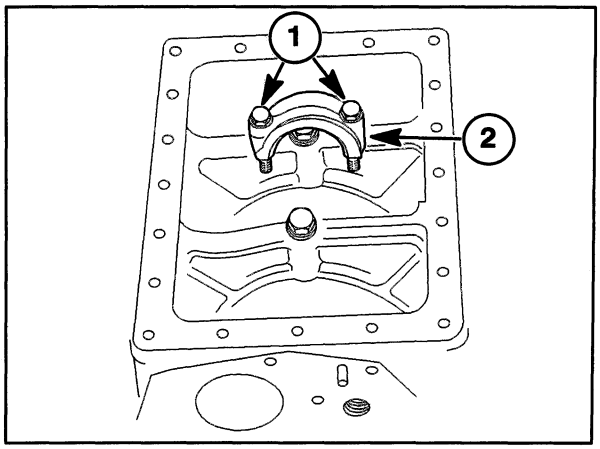

Figure 1-27

3. If necessary, remove any ridge from the top of the cylinder bores using a suitable ridge reamer.
4. Push the piston and connecting rod out of the cylinder block.
5. Replace the connecting rod caps to the piston assembly it was removed from. Keep together in cylinder sequence.

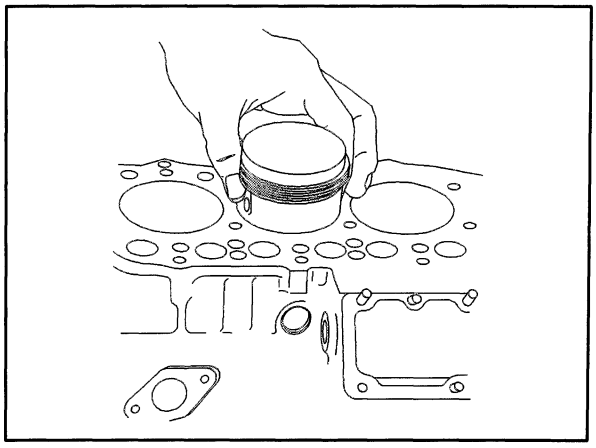

Figure 1-28

Flywheel Removal

1. Loosen the flywheel retaining bolts, 1.
2. Using a brass drift and hammer, tap the end of the crankshaft, 2, to loosen the flywheel, 3, from the shaft.
3. Remove the retaining bolts, lock washers, and flywheel from the crankshaft.

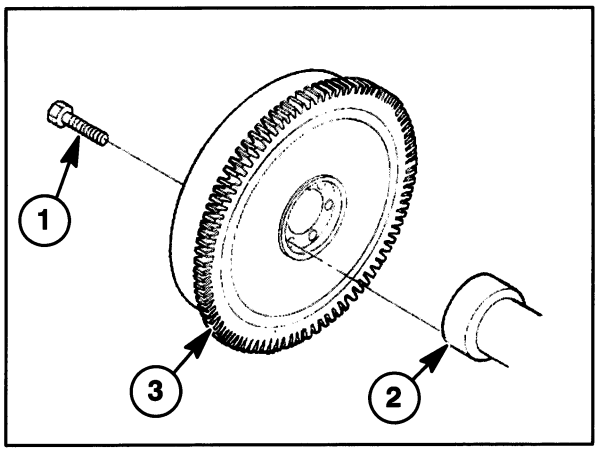

Figure 1-29

Backplate and Oil Seal Removal

1. Remove the backplate retaining bolts and remove the backplate.
2. Remove the rear oil seal, 1.

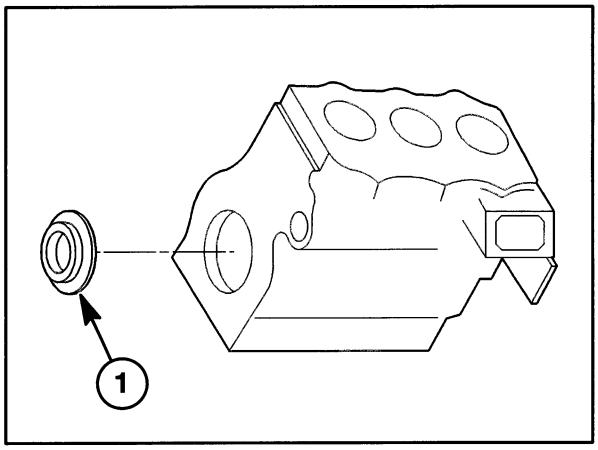

Figure 1-30

Crankshaft and Main Bearings Removal

1. Remove the crankshaft bearing holder retaining bolts, 1.
2. Slide the crankshaft and main bearing assembly through the rear of the engine.

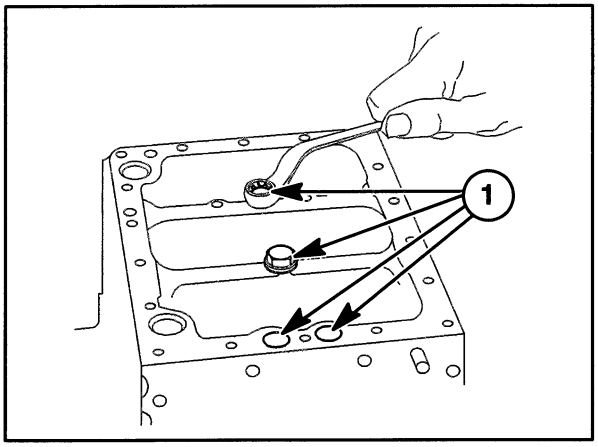

Figure 1-31

DISASSEMBLY, INSPECTION, AND ASSEMBLY OF COMPONENT ASSEMBLIES

CYLINDER HEAD DISASSEMBLY

1. Clean the cylinder head and remove any carbon deposits from around the heads.
2. Use a valve spring compressor and remove the valve spring retainer locks, 1, spring, 2, and spring retainer, 3, from each valve, 4.
3. Remove the valves and place the valve components together in separately marked containers for re-assembly in their original position.

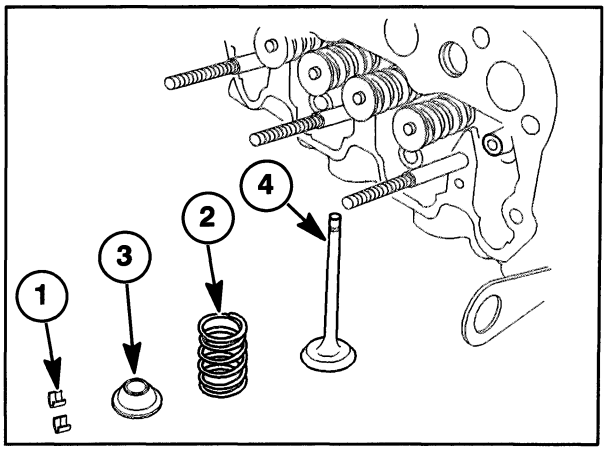

Figure 1-32

CYLINDER HEAD INSPECTION AND REPAIR

1. Clean all carbon deposits from the combustion chamber and valve ports using a wire brush and scraper.
2. Clean all dirt and residue from the gasket surface using care not to scratch or nick the machined surface.
3. Clean the cylinder head in solvent and air dry.
4. Inspect the head for cracks in the following areas:
   - Valve ports
   - Valve seats
   - Pre-chamber
5. Inspect the gasket surfaces for scratches or nicks, which could cause leakage.
6. Examine the core hole plugs for rust or signs of leakage. If a plug shows signs of damaging rust or leakage, replace all plugs in the head.
7. Using a straight edge, 1, and a feeler gauge, 2, check the cylinder head for warpage lengthwise, crosswise, and diagonally. Resurface or replace the head if the warpage is greater than 0.12 mm (0.005 in.).

   NOTE: If resurfacing requires removal of more than 0.50 mm (0.020 in.) material replace the head.
8. Inspect the pre-chamber for carbon deposits and looseness. Remove any carbon deposits found. If the pre-chamber is found to be loose, the cylinder head is warped and must be replaced.

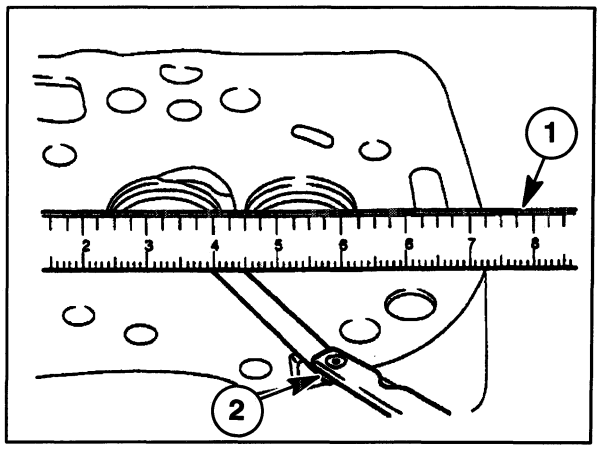

Figure 1-33

VALVE SEATS

Examine the valve seat and reface the seat if damaged. Valve seat grinding requires that the seat be ground to a specific width and positioned to contact the valve face at a specified point. A valve that extends too deep into the combustion chamber will result in valve burning, and if the valve is recessed too deep into the head it will cause a rapid build-up of carbon deposits.

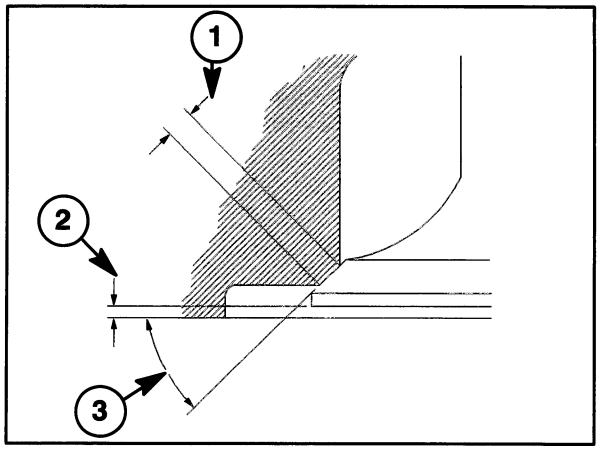

Figure 1-34

1. Correct Valve Seat Width - 1.7 - 2.1 mm (0.067 - 0.0826 in.) - Seat must strike center of valve face
2. Correct Valve Head Margin - 0.775 - 1.075 mm (0.0305 - 0.042 in.)
3. Angle of Valve Seat - 45°

1. Check the seat for surface defects. Use a 45° stone if necessary to reface. Grind away only enough material to provide a smooth even seat.
2. Check the seat width. If necessary, use a 15° stone to lower the seat contact point and a 75° stone to raise the seat contact point.

   NOTE: Refacing the seat should always be coordinated with refacing the valve to assure a compression tight fit.

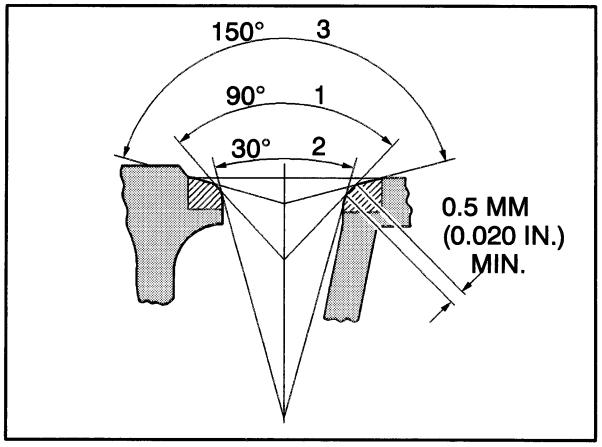

Figure 1-35

1. Seat angle - 45° Stone
2. Lower Seat Location - 15° Stone
3. Raise Seat Location - 75° Stone

VALVES

1. Clean all deposits from the valves using a soft wire brush. Inspect the condition of the valves. Discard valves that are badly burned, cracked, or bent.

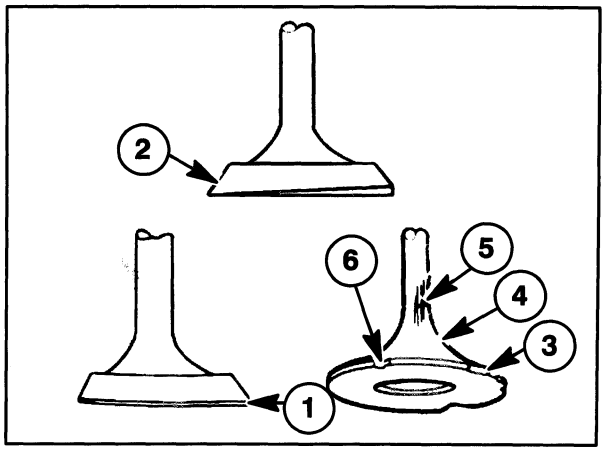

Figure 1-36

1. Margin too Thin - Min. 0.5 mm (0.002 in.)
2. Bent Valve
3. Pitting
4. Indented
5. Wear or Nicking
6. Burned

2. Using a micrometer, measure the valve stem at points "A", "B", and "C". Replace the valve if the stem diameter is less than the following dimensions:

Intake	Exhaust
6.89 mm (0.271 in.)	6.84 mm (0.269 in.)

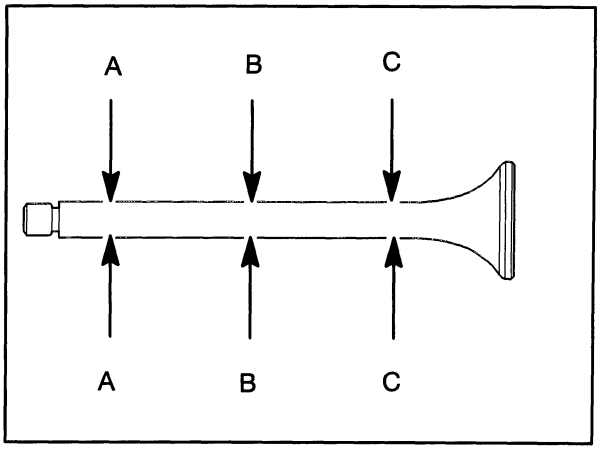

Figure 1-37

3. If inspection indicates that the valve may be reused, the valve should be ground.
4. After grinding the valve and seat, check to make sure the seat contacts the center of the valve face. Using Prussian Blue, lightly coat the valve seat, Place the valve in position and rotate the valve slightly while holding a slight pressure against the valve. If the blue is transferred to the center of the valve face, the contact is correct.

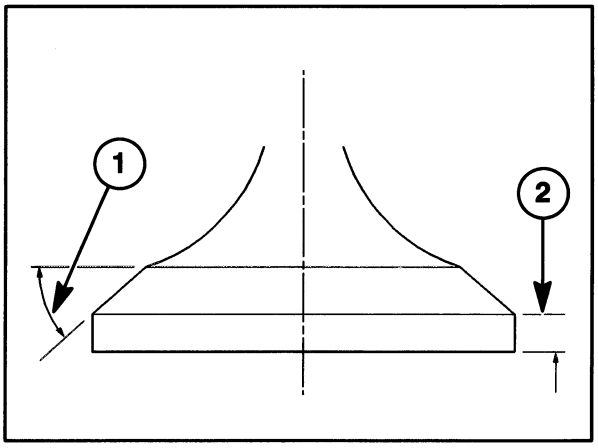

Figure 1-38

1. 45° Seat Angle
2. Correct Valve Margin

5. If Prussian Blue is not available, Mark the valve face or seat, 1, with a soft lead pencil. Rotate the valve slightly in the seat. The penciled lines will be broken at the seat contact area.

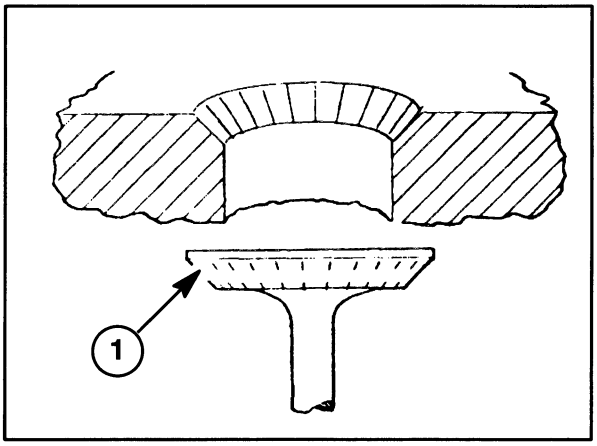

Figure 1-39

VALVE GUIDES

Thoroughly clean the valve guides before attempting to check internal wear.

1. Using a telescoping gauge and a micrometer, measure the valve guide bore at the top and bottom wear points, 1.

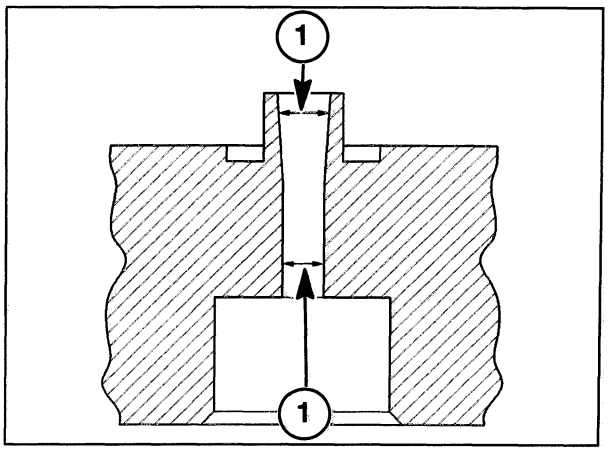

Figure 1-40

2. Determine the valve stem to valve guide clearance, 1, by subtracting the stem diameter from the valve guide diameter. Replace valves if the clearance, 1, is more than 0.2 mm (0.008 in.) intake valves, or 0.2 mm (0.0078 in.) exhaust valves.
3. Replace the cylinder head if excessive clearance is determined and the valves have met all specified measurement requirements. See "Specifications" discussed later in this section, pg 1-69.

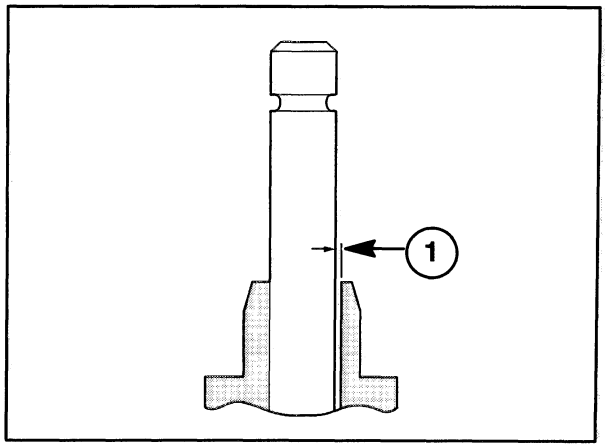

Figure 1-41

VALVE SPRINGS

1. Place the valve springs on a flat surface. Measure the free length of the spring and squareness. Replace springs that do not meet the following specifications.

Max. Out of Square	Min. Free Length
2.0 mm (0.079 in.)	33.5 mm (1.319 in.)

2. Place the springs in a suitable spring load tester and measure the spring load rating. Replace spring that do not meet the following specifications.

Standard	Maximum
8.1 kg (17.8 lbs) at 30.4 mm (1.20 in.)	7 kg (15.43 lbs) at 30.4 mm (1.20 in.)

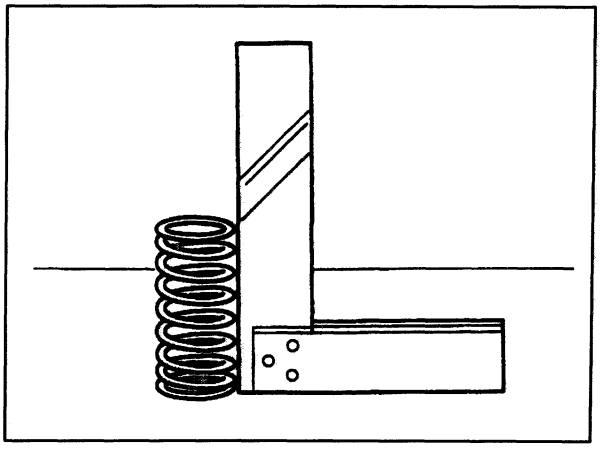

Figure 1-42

ROCKER ARMS

1. Examine the rocker arms and shafts for wear or damage. Check the adjusting screws for damaged threads or excessive wear. Check the valve stem contact area for pitting or excessive wear. Slight wear patterns may be removed using a fine grit oil stone.
2. Using an outside micrometer, measure the wear points, 1, on the rocker shaft. Replace the rocker shaft if the wear at any point is less than 11.57 mm (0.456 in.).

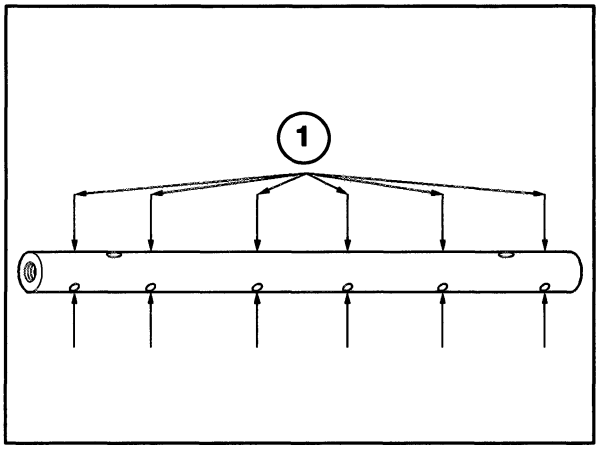

Figure 1-43

3. Using a telescoping gauge and micrometer, measure the inside diameter of the rocker arm. Replace rocker arms having a bore diameter exceeding 11.74 mm (0.462 in.).
4. Subtract the measurement taken from the rocker arms from the rocker arm shaft. The clearance should be within range 0.032 - 0.068 mm (0.00125 - 0.00267 in.). Replace the rocker arms and/or shaft if the measurement exceeds 0.2 mm (0.008 in.).

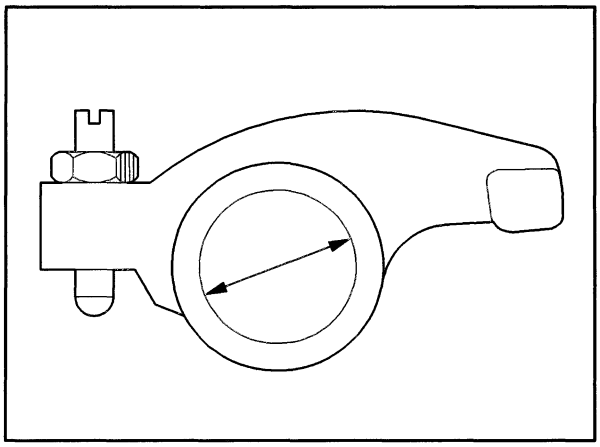

Figure 1-44

PUSH RODS

1. Check the push rods for straightness by rolling on a flat surface. Replace rods that are bent.
2. Inspect the ends of the push rods for excessive wear. If any push rod is worn, the corresponding lifter and rocker arm should also be inspected for excessive wear.

CYLINDER HEAD ASSEMBLY

1. Insert each valve in the guide from which it was removed and lightly lap the valve to be sure of an even seat around the valve face. Remove the valve and remove all traces of lapping compound.
2. Install new valve seals on the valve guides using a suitable driver.
3. Using a spring compressor, assemble the valves, 1, springs, 2, retainers, 3, and keepers, 4.

   NOTE: If removed, always install a new pre-combustion chamber. The pre-combustion chamber is a press fit in the cylinder head and should not be reused. On installation, be sure to position the locating tang correctly in the groove in the cylinder head.

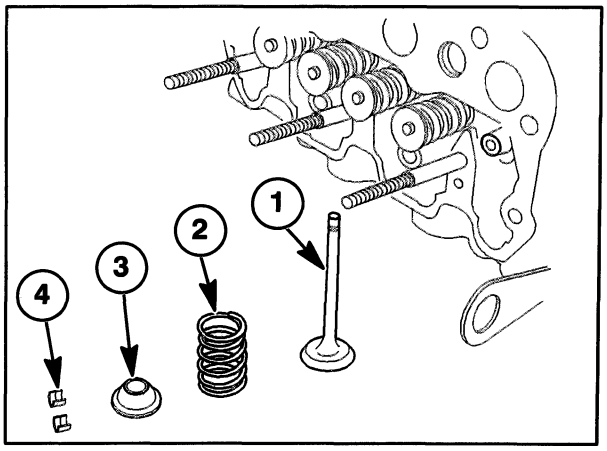

Figure 1-45

CYLINDER BLOCK

1. Inspect the cylinder block top face for cracks, damage, and warping in the same way as for the cylinder head. Replace the cylinder block if warp is greater than 0.12 mm (0.005 in.).
2. Visually inspect the cylinder bore. There should be no scoring, rust, or corrosion.
3. Using a telescoping gauge in line with the crankshaft, measure the inside diameter of the top bore, approximately 10 mm (0.394 in.) below the top of the cylinder block.
4. Repeat this measurement at right angles to the crankshaft at the same distance.
5. In line with the crankshaft at the bottom of the bore, measure approximately 81.89 mm (3.22 in.) from the top of the cylinder.
6. Repeat this measurement at right angles to the crankshaft at the same distance.

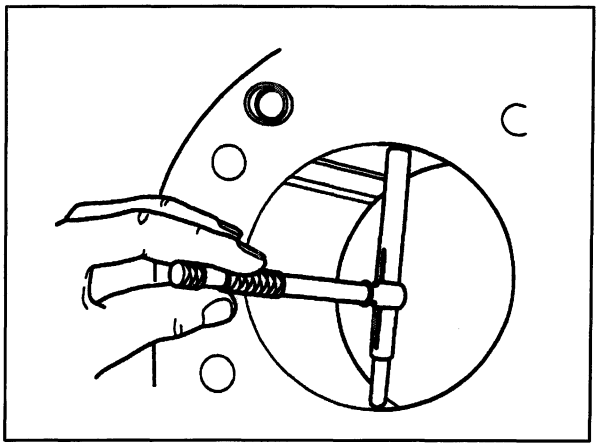

Figure 1-46

7. **Model TC18:**

   If the cylinder diameter is in the range of 75.0 - 75.019 mm (2.952 - 2.953 in.), bore the cylinder to 75.2 mm (2.960 in.) and install oversize pistons and rings.

   If the cylinder diameter is in the range of 75.5 - 75.519 mm (2.972 - 2.973 in.), bore the cylinder to 75.7 mm (2.9803 in.).

   NOTE: If the cylinder diameter exceeds 76.2 mm (3.0 in.) the cylinder block must be replaced.

8. **Model TC21 & TC21D:**

   If the cylinder diameter is in the range of 77.0 - 77.019 mm (3.031 - 3.032 in.), bore the cylinder to 77.2 mm (3.039 in.) and install oversize pistons and rings.

   If the cylinder diameter is in the range of 77.5 - 77.519 mm (3.051 - 3.052 in.), install oversize pistons and rings.

   NOTE: If the cylinder block exceeds 77.7 mm (3.059 in.) the cylinder block must be replaced.

   After re-bore it will be necessary to hone the cylinder to obtain a clearance of 0.0525 - 0.0865 mm (0.00207 - 0.00341 in.) between the piston and cylinder wall.

NOTE: The follow chart specifies oversize piston and bore diameters.

Tractor Model	Piston Oversize	Bore Diameter
TC18	0.5 mm (0.020 in.)	75.4325 - 75.4475 mm (2.9697 - 2.9703 in.)
	1.0 mm (0.040 in.)	75.9325 - 75.9475 mm (2.9894 - 2.990 in.)
TC21 & TC21D	0.5 mm (0.020 in.)	76.9325 - 76.9475 mm (3.029 - 3.0294 in.)
	1.0 mm (0.040 in.)	N/A

9. Determine the piston to bore clearance as follows:

   - Measure the diameter of the piston and the cylinder bore. Subtract the diameter of the piston from the diameter of the cylinder bore.
   - If the clearance is less than 0.0525 mm (0.021 in.) hone the cylinder to obtain the correct clearance (within 0.0525 - 0.0865 mm [0.0021 - 0.0034 in.]).

   If the clearance is greater than 0.25 mm (0.010 in.), check the cylinder bore and piston for excess wear. Replace the piston or bore the cylinder block as required.

PISTONS, PISTON RINGS, AND CONNECTING RODS DISASSEMBLY AND INSPECTION

Pistons

1. Using a suitable piston ring expander, 1, remove the piston rings from the pistons.

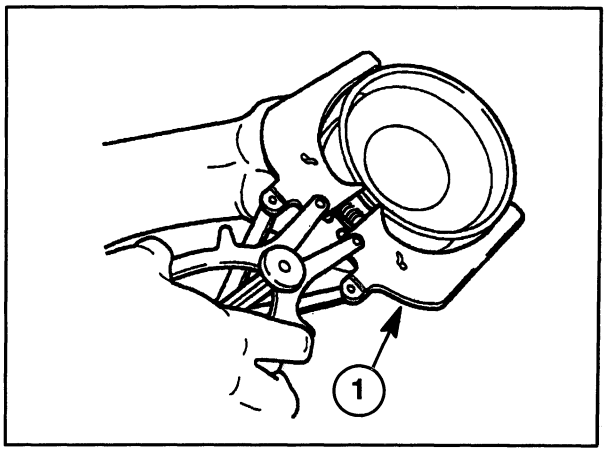

Figure 1-47

2. Remove the wrist pin retaining ring and drive the wrist pin, 1, out of the piston using pin remover tool no. FNH01585, 2.

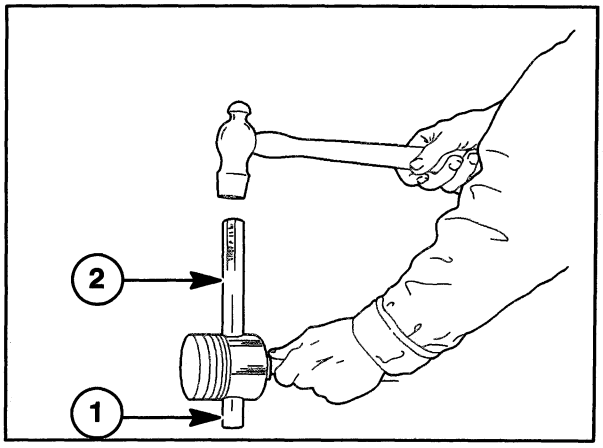

Figure 1-48

3. Wash the pistons and connecting rods in a suitable solvent and dry with a lint free cloth or compressed air.
4. Using a groove cleaner, 1, remove the carbon deposits from the ring grooves. Be careful to avoid cutting any metal from either the side or the bottom of the grooves.

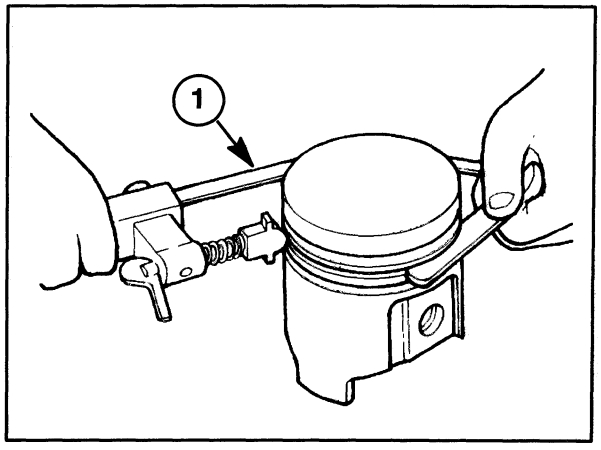

Figure 1-49

5. Inspect the piston ring lands for excessive wear. Use a new piston ring, 1, and a feeler gauge, 2, to check the ring side clearance. Replace pistons having a ring side clearance exceeding the following dimensions:

Compression Ring	Oil Control Ring
0.25 mm (0.010 in.)	0.15 mm (0.006 in.)

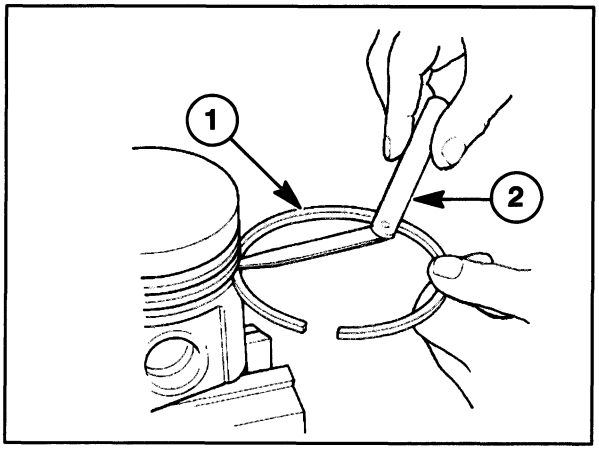

Figure 1-50

6. Using a micrometer, 1, check the piston diameter at 90° from the wrist pin bore. Replace pistons that are worn to less than the following piston diameter dimensions:

Tractor Model	Wear Limit
TC18	74.7 mm (2.941 in.)
TC21 & TC21D	76.7 mm (3.021 in.)

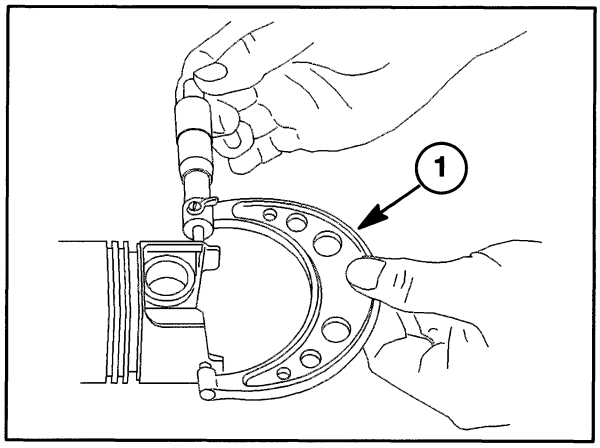

Figure 1-51

7. Using a telescoping gauge, 1, and a micrometer, 2, measure the piston wrist pin bore and the wrist pin diameter. Replace piston and/or wrist pins that are not within the following limits:

Wrist Pin Bore Maximum	21.016 mm (0.827 in.)
Wrist Pin Diameter Minimum	20.98 mm (0.826 in.)
Wrist Pin Clearance Maximum	0.02 mm (0.008 in.)

NOTE: In some instances the wrist pin diameter may be equal to or slightly larger than the wrist pin bore. This interference fit is normal.

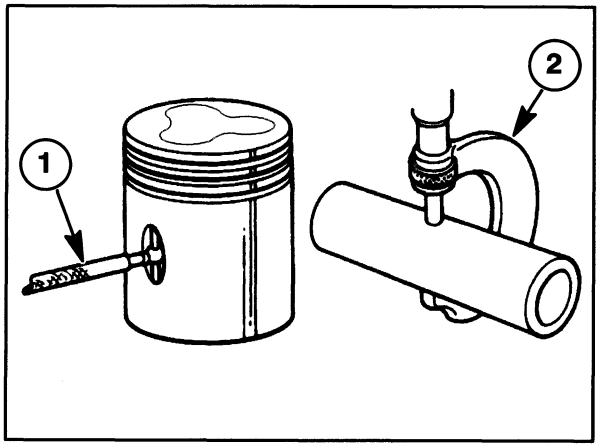

Figure 1-52

Piston Rings

1. Position the piston rings, 1, one at a time, in the cylinder to the lowest point of travel. Use an inverted piston to square the ring in the bore.
2. With a feeler gauge, 2, measure the ring gap.

   NOTE: The ring is shown at the top of its travel for clarity.

3. Replace rings with a gap clearance in excess of 1.0 mm (0.039 in.)
4. Enlarge the ring gap if less than 0.2 mm (0.008 in.).

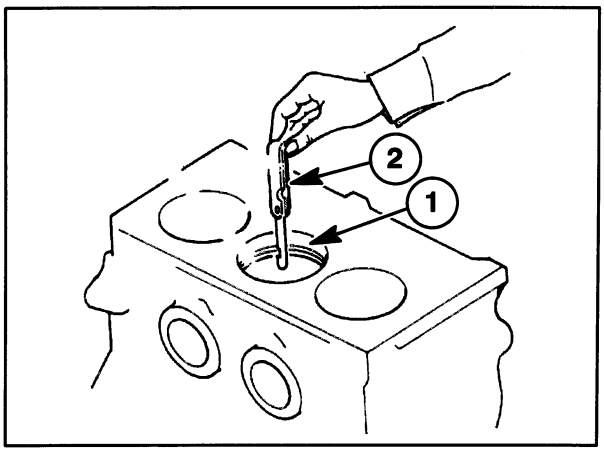

Figure 1-53

Connecting Rods

1. Check the connecting rods, 1, for damage and alignment. Place each rod in an alignment fixture, 2, to check for bent or twisted condition.
2. Straighten or replace rods that are bent or twisted more than the following dimensions:

Max Bend	Max Twist
1.5 mm (0.059 in.) per 100 mm (3.937 in.)	0.20 mm (0.008 in.) per 100 mm (3.937 in.)

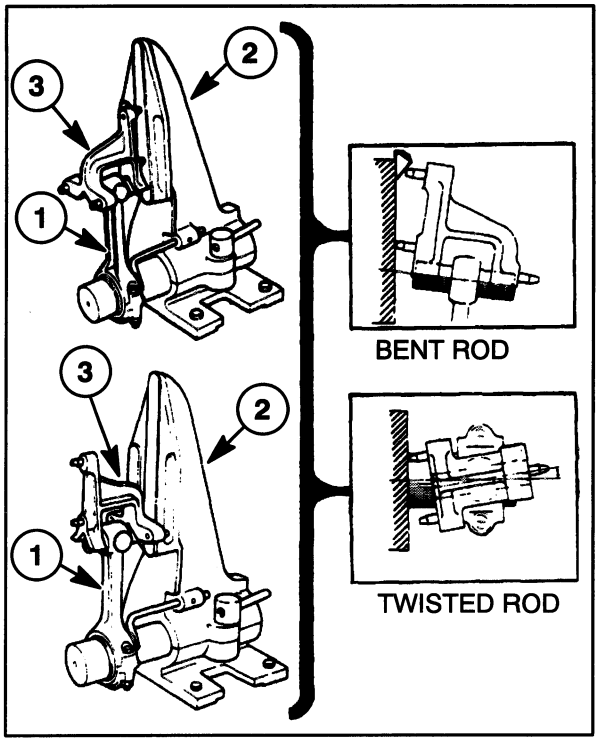

Figure 1-54

1. Connecting Rod
2. Alignment Fixture
3. Gauge

3. Using a telescoping gauge, 1, and a micrometer, 2, measure the inside diameter of the connecting rod wrist pin bushing, 3.
4. Replace bushings measuring more than 20.8 mm (0.819 in.).

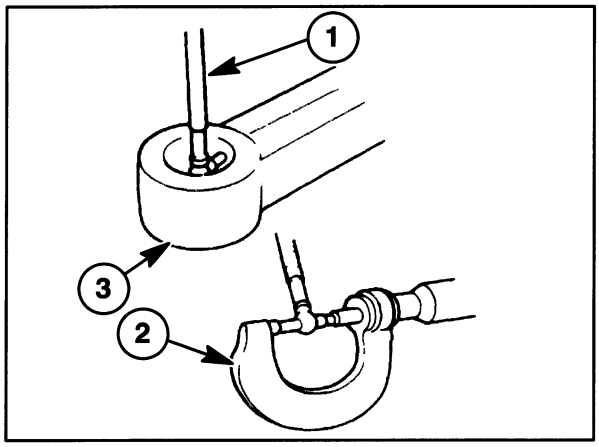

Figure 1-55

1. Telescoping gauge
2. Micrometer
3. Connecting Rod

5. Remove and install the connecting rod wrist pin bushings using a suitable driver, 1, and press, 2. Press a new bushing into the rod bore.

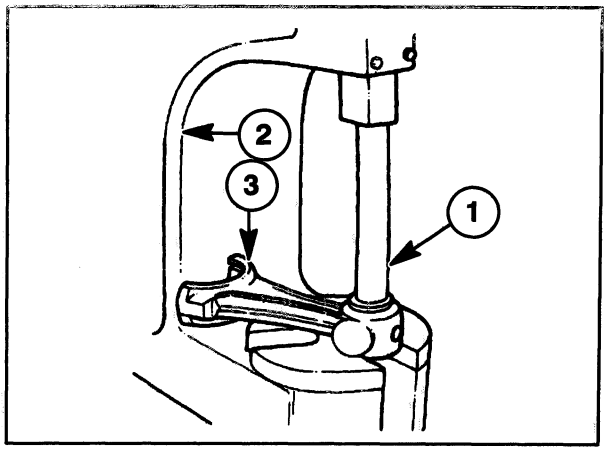

Figure 1-56

1. Bushing Driver
2. Press
3. Connecting Rod

6. When installing a new wrist pin bushing, use the hole in the rod and drill a lube hole in the new bushing.
7. Ream and hone the bushing to the following finish size:

Standard	Maximum
0.008 - 0.023 mm (0.0003 - 0.0009 in.)	0.08 mm (0.0031 in.)

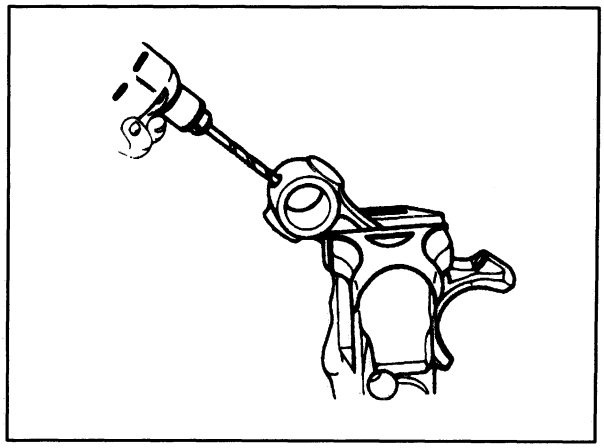

Figure 1-57

8. Install the connecting rod on the crankshaft, and torque the bolts to 29 - 34 N·m (22 - 25 ft lbs). Push the rod to one side and measure the clearance with a feeler gauge. If the play is more than 0.7 mm (0.028 in.) at, 1, replace the connecting rod.

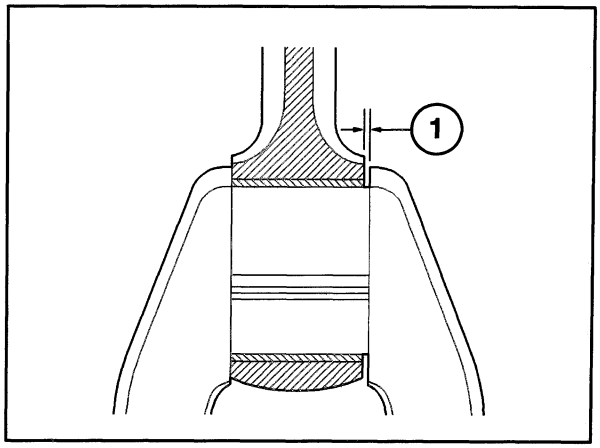

Figure 1-58

Connecting Rod Bearing Oil Clearance Check

1. Remove all foreign matter from the bearing and crankshaft.
2. Cut a piece of plastigauge, 1, to the same width as the bearing. Place the plastigauge on the crankshaft. Avoid the oil hole.
3. Install the rod cap and torque to 29 - 34 N·m (22 - 25 ft lbs).
4. Remove the rod cap and measure the width of the flattened plastigauge using the plastigauge scale, 2.
5. The width of the widest flattened plastigauge is the minimum clearance and the width of the narrowest plastigauge is the greatest clearance. Select the proper size bearing liners to obtain the correct clearance. See "Specifications" discussed later in this section, pg 1-69.

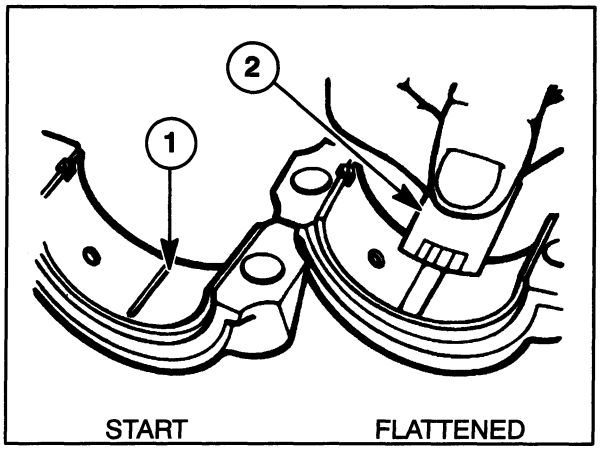

Figure 1-59

1. Plastigauge
2. Scale

PISTONS, RINGS, AND CONNECTING ROD ASSEMBLY

1. Assemble the pistons and connecting rods with the matching marks, 1, on the rods on the same side as the trade name "SHIBAURA", 2, embossed on the inside of the piston skirt. Install the piston pin, and retaining rings.

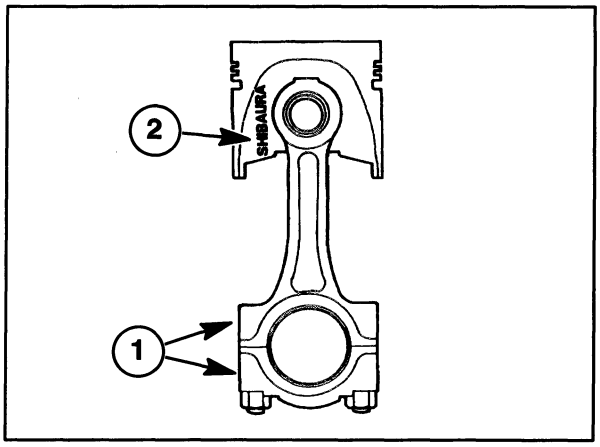

Figure 1-60

2. Using a suitable ring expander tool, install the piston rings positioning the ring gaps at approximately 120° from each other. Install the third (oil ring) first as follows:

   Put the expander ring, 1, in position in its groove.

   Fit the upper side rail, 2, on top of the expander. Insert the end of the side rail into the groove and hold it in position with the thumb. Slide the rail into position with the other thumb.

   Fit the lower side rail, 3, in a similar manner.

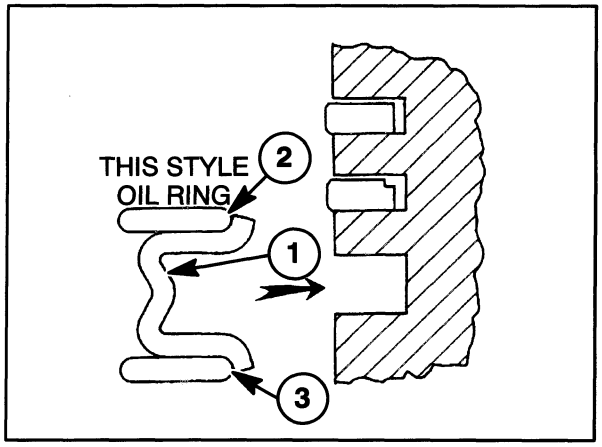

Figure 1-61

CRANKSHAFT

Main Bearing and Thrust Bearing Removal and Inspection

1. Remove the two retaining bolts, from the bearing holders, 1.
2. Remove the bearing holders, bearing liners, 2, and thrust bearings, 3.

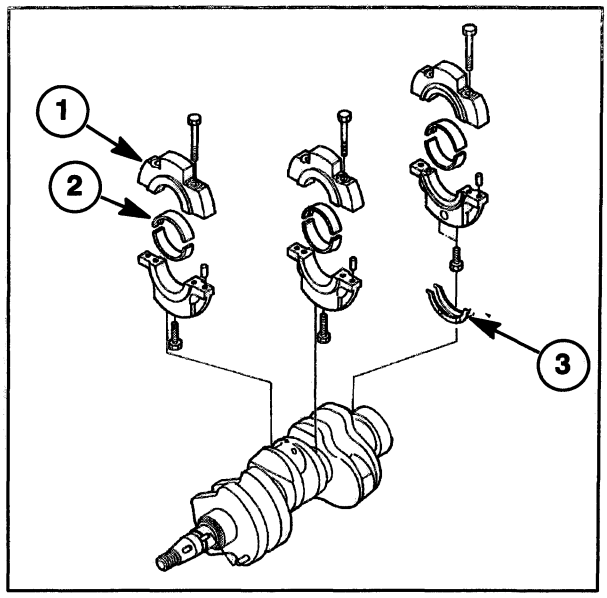

Figure 1-62

1. Holder
2. Main liner
3. Thrust Bearing

3. Position a piece of plastigauge, 1, across the full width of the bearing liner, 2, at approximately 1/4 inch off center, Figure 1-63.
4. Install the bearing holder and tighten the bolts to 19 - 24 N·m (14 - 18 ft lbs)

   NOTE: Do not permit the bearing holder to rotate, even the slightest amount.
5. Remove the bearing holder and measure the width of the flattened plastigauge with the plastigauge scale, 3. The width of the plastigauge at the widest point is the minimum clearance and the width of the plastigauge at the narrowest point is the maximum clearance. The difference between the two readings indicates the taper.
6. Replace the bearing liners, or grind the crankshaft journals to obtain the correct bearing clearance.

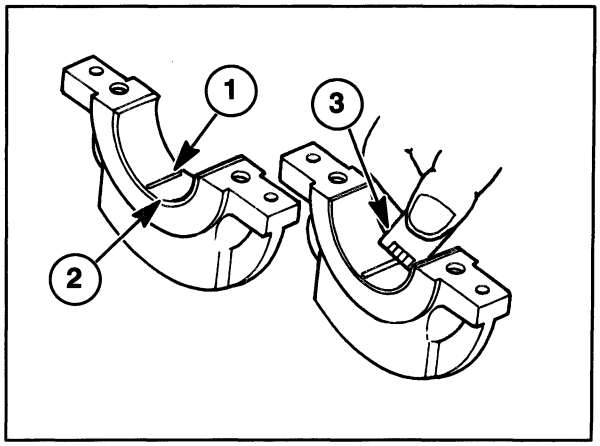

Figure 1-63

Standard Thickness	Allowable Limit
0.039 - 0.101 mm (0.0015 - 0.004 in.)	0.2 mm (0.0079 in.)

7. Check the thrust bearings for wear, poor contact, burning, or other defects. Using a micrometer measure the thrust bearing thickness. If the bearing is found to be defective or is not within the following tolerance, replace the bearing:

Standard Thickness	Allowable Limit
1.95 - 2.0 mm (0.077 - 0.079 in.)	1.8 mm (0.071 in.)

Crankshaft Inspection

1. Inspect the crankshaft gear teeth for wear or damage and replace if necessary.
2. Using a dial indicator, measure the crankshaft journals for size, run out, and taper.
3. The amount of taper in a journal is the difference in the measurement taken at points 1 and 2 on a journal.
4. The amount of run out in a journal is the difference in the measurement taken at points “A” and “B” on a journal.

   NOTE: The smallest reading taken at any point indicates the size of the journal. See the Table below for wear limits and repair recommendations.

5. Mount the crankshaft in a set of V-blocks and measure the amount of run out using a dial indicator, at points 1 and 2.
6. Straighten or replace crankshafts when run out exceeds 0.06 mm (0.002 in.).

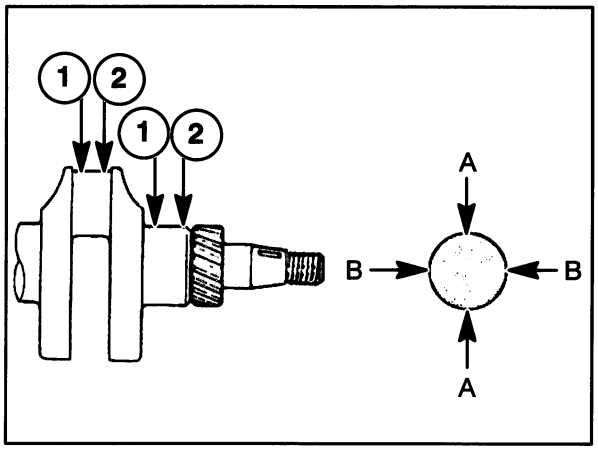

Figure 1-64

1. Taper Readings: 1 vs 2
2. Out-of-Round Readings: A vs B

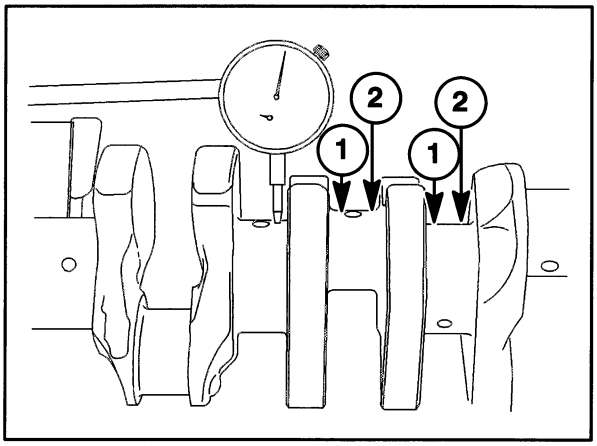

Figure 1-65

CRANKSHAFT JOURNAL WEAR LIMIT AND BEARING USAGE

Description	Wear Limit	Remarks
Taper	0.025 mm (0.002 in.)	Regrind to 0.25 or 0.50 mm (0.01 or 0.020 in.) undersize
Out-of-Round	0.25 mm (0.002 in.)	Regrind to 0.25 or 0.50 mm (0.01 or 0.020 in.) undersize
Journal Diameter - Main Bearing	Less than 45.9 mm (1.807 in.) Less than 45.65 mm (1.797 in.) Less than 45.4 (1.787 in.)	Use 0.25 mm (0.010 in.) Undersize Bearings Use 0.50 mm (0.020 in.) Undersize Bearings Replace Crankshaft
Journal Diameter - Connecting Rod	Less than 38.9 mm (1.53 in.) Less than 38.65 mm (1.522 in.) Less than 38.4 mm (1.512 in.)	Use 0.25 mm (0.010 in.) Undersize Bearings Use 0.50 mm (0.020 in.) Undersize Bearings Replace Crankshaft