FORD

Service Manual

Tractor-Loader-Backhoe
555A, 555B and 655A

Part 1 – Engine Systems
Part 2 – Fuel Systems
Part 3 – Electrical Systems
Part 4 – Clutches
Part 5 – Transmission Systems
Part 6 – Cab, Heating and Air Conditioning

Vol. 1

40055540A

Reprinted

FOREWORD

This manual provides information for the proper servicing and overhaul of the Ford Model 555A & B and 655A Tractor-Loader-Backhoe and is an essential publication for all service personnel carrying out repairs and maintenance procedures.

The model 555A designates three cylinder engine units produced from January 1984 through June 1985. The model 555B designates units produced from July 1985 and later.

The model 655A designates four cylinder engine units produced from June 1985 and later.

Special service instructions are identified by tractor model number or applicable production date code throughout the text.

The Manual is divided into twelve PARTS, each sub-divided into Chapters. Each Chapter contains information on general operating principles, detailed inspection and overhaul and, where applicable, trouble shooting, special tools and specifications.

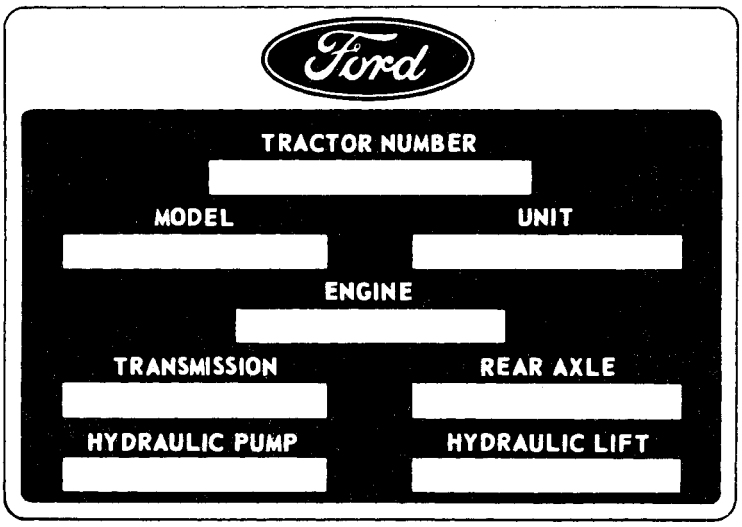
The material contained in this Manual was correct at the time of printing, but Ford policy is one of continuous improvement and the right to change prices, specifications, equipment or design at anytime without notice is reserved. All data in this Manual is subject to production variations, so overall dimensions and weights should be considered as approximate only and the illustrations do not necessarily depict the unit to standard build specification.

Ford New Holland, Inc.

CONTENTS

PRODUCTION DATE CODES AND SERIAL NUMBERS

A vehicle identification plate is located on the steering console on the left hand side. Whenever effecting repair or overhaul of the Ford Tractor, the relevant information should be noted and used when referring to service bulletins or ordering parts.



This plate is stamped with the following information:

- TRACTOR NUMBER — Serial number prefixed by the letter 'A', 'B' or 'C'.
- MODEL — Production model code.
- UNIT — Production unit date code.
- ENGINE — Engine production date code.
- TRANSMISSION — Transmission production date code.
- REAR AXLE — Rear axle production date code.

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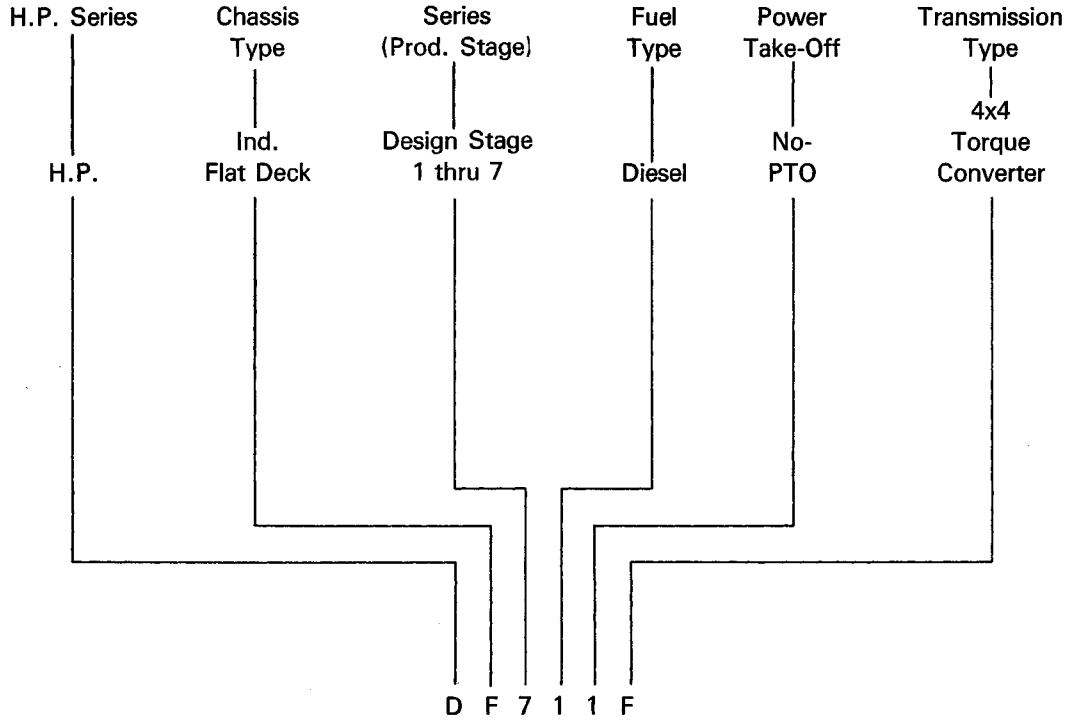
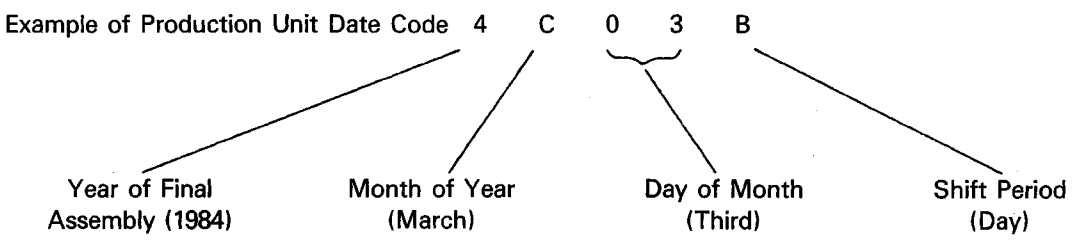
MODEL NUMBER — CODE



KEY TO PRODUCTION DATE CODES

First Number YEAR	First Letter MONTH	Second Number DAY OF MONTH	Second Letter PRODUCTION SHIFT
4 — 1984	A—Jan. H—Aug.	01-32	A—Midnight
5 — 1985	B—Feb. J—Sept.		B—Day
6 — 1986	C—March K—Oct.		C—Afternoon
7 — 1987	D—April L—Nov.		
8 — 1988	E—May M—Dec.		
9 — 1989	F—June		
0 — 1990	G—July		



SAFETY PRECAUTIONS

Practically all service work involves the need to drive the tractor. The Operator's Manual, supplied with each tractor, contains detailed safety precautions relating to driving, operating and servicing that tractor. These precautions are as applicable to the service technician as they are to the operator, and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or re-assembly operations, whether within a workshop facility or out "in the field," consideration should be given to factors that may have an effect upon safety, not only upon the mechanic carrying out the work, but also upon bystanders.

PERSONAL CONSIDERATIONS

- The wrong clothes or carelessness in dress can cause accidents. Check to see that you are suitably clothed.

  Some jobs require special protective equipment.

- **Skin Protection**
  Used engine oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and the length of time used oil remains on the skin.

- **Eye Protection**
  The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiselling, grinding, discing, welding, painting, etc.

- **Breathing Protection**
  Fumes, dust and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.

- **Hearing Protection**
  Loud noise may damage your hearing and the greater the exposure the worse the damage. If you feel the noise is excessive, wear ear protection.

- **Hand Protection**
  It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work clean your hands with soap and water. Solvents such as white spirit, paraffin, etc., may harm the skin.

- **Foot Protection**
  Substantial or protective footwear with reinforced toe-caps will protect your feet from falling objects. Additionally, oil-resistant soles will help to avoid slipping.

- **Special Clothing**
  For certain work it may be necessary to wear flame or acid-resistant clothing.

- Avoid injury through incorrect handling of components. Make sure you are capable of lifting the object. If in doubt get help.

EQUIPMENT CONSIDERATIONS

- **Machine Guards**
  Before using any machine, be sure the machine guards are in position and serviceable. These guards not only prevent body and clothing from coming in contact with the moving parts of the machine, but also ward off objects that might fly off the machine and cause injury.

- **Lifting Appliances**
  Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes are thoroughly checked before use. If in doubt, select stronger equipment than is necessary.

  Never stand under a suspended load or a raised implement.

- **Compressed Air**
  The pressure from a compressed air line is often as high as 100 psi (6.9 bar) 7 (kgf/cm^2). It is perfectly safe if used correctly. Any misuse may cause injury.

Never use compressed air to blow dust, filing, dirt, etc., away from your work area unless the correct type of nozzle is fitted.

Compressed air is not a cleaning agent, it will only move dust, etc., from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears or skin.

- **Hand Tools**
  Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job, as this generally leads either to some injury, or to a poor job.

  Never use

  — A hammer with a loose head or split handle.
  — Spanners or wrenches with splayed or worn jaws.
  — Spanners or files as hammers; or drills, clevis pins or bolts as punches.

  For removing or replacing hardened pins use a copper or brass drift rather than a hammer.

  For dismantling, overhaul and assembly of major and sub components, always use the Special Service Tools recommended. They will reduce effort, labor and repair cost.

  Always keep tools clean and in good working order.

- **Electricity**
  Electricity has become so familiar in day to day usage, that it s potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.

  Before using any electrical equipment — particularly portable applicances — make a visual check to make sure that the cable is not worn or frayed and that the plugs, sockets, etc., are intact. Make sure you know where the nearest isolating switch for your equipment is located.

GENERAL CONSIDERATIONS

- **Solvents**
  Use only cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components such as seals, etc., and can cause skin irritation. Use only solvents that are suitable for the cleaning of components and parts, and that do not affect the personal safety of the user.

- **Housekeeping**
  Many injuries result from tripping or slipping over, or on, objects or material left lying around by a careless worker. Prevent these accidents from occurring. If you notice a hazard, don't ignore it — remove it.

  A clean, hazard-free place of work improves the surroundings and daily environment for everybody.

- **Fire**
  Fire has no respect for persons or property. The destruction that a fire can cause is not always fully realized. Everyone must be constantly on guard.

  — Extinguish matches/cigars/cigarettes, etc., before throwing them away.
  — Work cleanly, disposing of waste material into proper containers.
  — Locate the fire extinguishers and find out how to operate them.
  — Do not panic — warn those near and raise the alarm.
  — Do not allow or use an open flame near the tractor fuel tank, battery or component parts.

- **First Aid**
  In the type of work that mechanics are engaged in, dirt, grease, fine dusts, etc., all settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may be found that a septic condition has formed within a short time. What appears at first to be trivial could become painful and injurious. It only takes a few minutes to have a fresh cut dressed, but it will take longer if you neglect it. Make sure you know where the First Aid box is located.

- **Cleanliness**
  Cleanliness of the tractor hydraulic system is essential for optimum performance. When carrying out service and repairs plug all hose ends and component connections to prevent dirt entry.

  Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacement. Use of a high pressure washer or steam cleaner is recommended.

OPERATIONAL CONSIDERATIONS

- Stop the engine, if at all possible, before performing any service.
- Place a warning sign on tractors which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.
- Do not attempt to start the engine while standing beside the tractor or attempt to by-pass the neutral start switch.
- Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.
- Never work beneath a tractor which is on soft ground. Always take the unit to an area which has a hard working surface — concrete for preference.
- If it is found necessary to raise the tractor for ease of servicing or repair, make sure that safe and stable supports are installed beneath axle housings, casings, etc., before commencing work.
- Certain repair or overhaul procedures may necessitate "separating the tractor," either at the engine/front transmission or front transmission/rear transmission locations. These operations are simplified by the use of the Tractor Splitting Kit/Stands. Should this equipment not be available, then every consideration must be given to stability, balance and weight of the components, especially if a cab is installed.
- Use footsteps or working platforms when servicing those areas of a tractor that are not within easy reach.
- Before loosening any hoses or tubes connecting implements to remote control valves, etc., switch off the engine, remove all pressure in the lines by operating levers several times. This will remove the danger of personal injury by oil pressure.
- Prior to pressure testing, make sure all hoses and connectors not only of the tractor, but also those of the test equipment, are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment, and to eliminate the possibility of personal injury.
- When equipment or implements are required to be attached to the hydraulic linkage, either for testing purposes or for transportation, then "position control" should be used.
- Always lower equipment to the ground when leaving the tractor.
- If high lift attachments are installed on a tractor beware of overhead power, electric or telephone cables when traveling. Drop attachment near to ground level to increase stability and minimize risks.
- Do not park or attempt to service a tractor on an incline. If unavoidable, take extra care and block all wheels.
- Escaping hydraulic/diesel fluid under pressure can penetrate the skin causing serious injury. Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Stop the engine and relieve the pressure before connecting or disconnecting oil lines. Tighten all connections before starting the engine or pressurizing the lines. If fluid is injected into the skin, obtain medical attention immediately or gangrene may result.

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- Observe recommended precautions as indicated in this Repair Manual when dismantling the air conditioning system as escaping refrigerant can cause frostbite.

- Prior to removing wheels and tires from a tractor, check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.

- When inflating tires beware of over inflation — constantly check the pressure. Overinflation can cause tires to burst and result in personal injury.

Safety precautions are very seldom the figment of someone's imagination. They are the result of sad experience, where most likely someone has paid dearly through personal injury.

Heed these precautions and you will protect yourself accordingly. Disregard them and you may duplicate the sad experience of others.

SERVICE TECHNIQUES

A. SERVICE SAFETY

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

B. SERVICE TECHNIQUES

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to 'O' rings and cause skin irritation. Use solvents that are suitable for cleaning components and do not risk the personal safety of the user.

Replace 'O' rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or 'O' rings, regardless of condition. Always lubricate new seals and 'O' rings with hydraulic oil before installation.

When replacing component parts use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the end connections are damaged.

When installing a new hose loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

The hoses are the arteries of the unit, be sure they are in good condition when carrying out repairs or maintenance, otherwise the machine's output and productivity will be affected.

After hose replacement to a moving component check the hose does not foul by moving the component through the complete range of travel.

Be sure any hose which has been installed is not kinked or twisted.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swaged position have failed, and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

BEARINGS

Bearings which are considered suitable for further service should be cleaned in a suitable solvent and immersed in clean lubricating oil until required.

Installation of a bearing can be classified in two ways: press fit on rotating parts such as shafts and gears, and push fit into static locations such as reduction gear housings. Where possible, always install the bearing onto the rotating component first.

Use the correct tools or a press to install a bearing or bushing. In the absence of the correct tools or press, heat the bearings and/or casing in hot oil to assist the installation of the bearing.

When bearings or bushings are removed always carefully check that the bearing is free from discoloration and signs of over-heating. Also check for mechanical damage such as excessive clearance, nicks and scuffing. If in doubt replace the bearings or bushings.

Bearings should never be removed unless absolutely necessary. Always use the recommended puller to reduce the risk of bearing or related component damage.

The reliability and durablity of a unit depends on the effective operation of the many types of bearings and bushings which are incorporated in the complete assembly.

These bearings and bushings are subjected, in normal operation, to high working loads and adverse conditions.

Be sure, during normal routine servicing, maintenance or repair that bearings are given the right attention and are installed with care.

PRESSURE TESTING

Prior to pressure testing be sure all hoses are in good condition and all connections tight. Pressure readings must be taken with gauges of specified pressure ratings.

The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibility of personal injury.

WARNING: *Service the engine compartment with the loader bucket on the ground in the dumped position or in the raised position with the loader lift cylinder "SAFETY BAR" installed (see Figure 1). Never work under or around a raised loader without the "SAFETY BAR INSTALLED."*

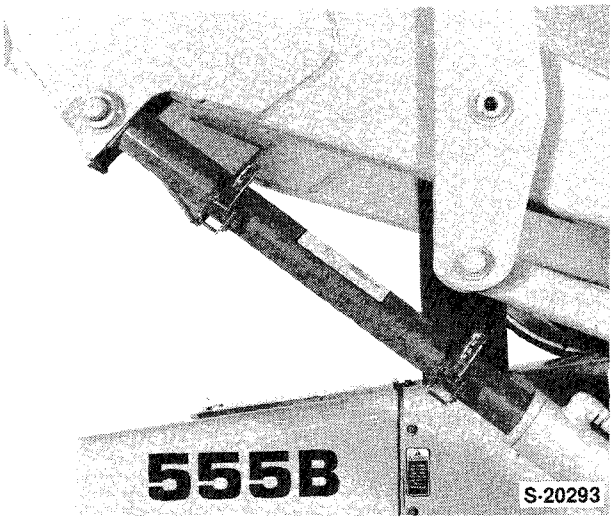

Figure 1
Loader Lift Cylinder "Safety Bar"
Installed in Raised Position

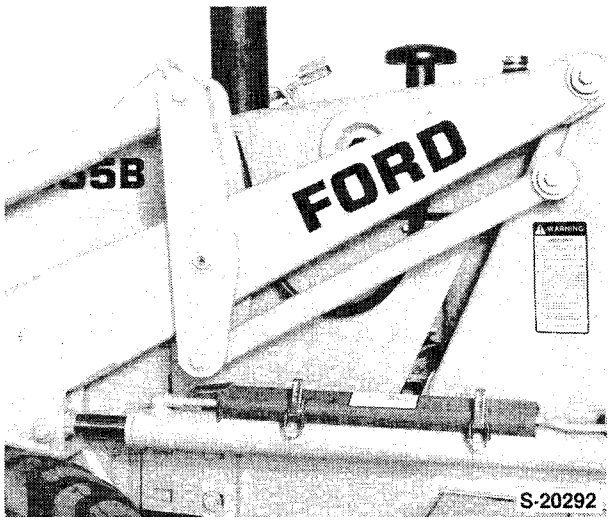

Figure 2
Loader Lift Cylinder "Safety Bar"
Installed in Storage Position

PART 1
ENGINE SYSTEMS

Chapter 1
ENGINES

Chapter 2
COOLING SYSTEM

Chapter 3
TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

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PART 1
ENGINE SYSTEMS

Chapter 1
ENGINES

A. DIESEL ENGINE — DESCRIPTION AND OPERATION

This chapter describes the overhaul and repair of the 3 and 4 cylinder Ford tractor direct injection diesel engines used in the 555A and B and 655A TLB model tractors.

The engines are of similiar design and service procedures are basically the same except as noted.

The major difference between the two engines is that the 3 cylinder engine, Figure 1, is equipped with a rotary type fuel injection pump and has a four main bearing crankshaft. The 4 cylinder engine, Figure 2, is equipped with a in-line fuel injection pump, a five main bearing crankshaft and a dynamic engine balancer.

The three and four cylinder diesel engines have a compression ratio of 16.3 to 1. The three cylinder engines use headland type pistons, Figure 3. The four cylinder engines use conventional type pistons. The headland type piston is a three ring piston having two compression rings and one oil control ring all located above the piston pin. The special design "L" shaped top compression ring is located at the top of the piston and provides a tight seal during the combustion stroke thereby reducing blow-by. As combustion dissipates, the ring releases its cylinder wall tension and rides almost friction free on a thin film of oil thus reducing power loss and cylinder wall wear.

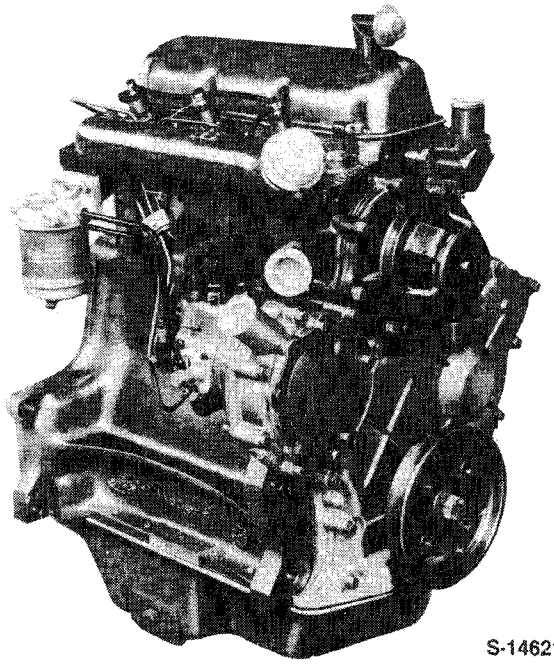

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Figure 1
3-Cylinder Diesel Engine with Rotary Type Fuel Injection Pump

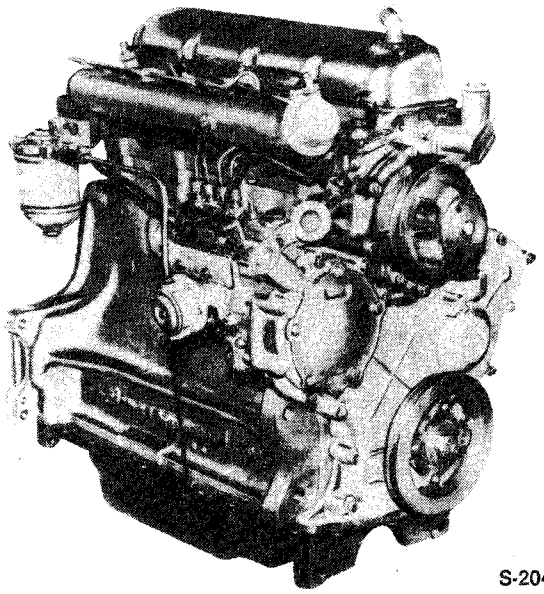

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Figure 2
4-Cylinder Diesel Engine with In-Line Type Fuel Injection Pump

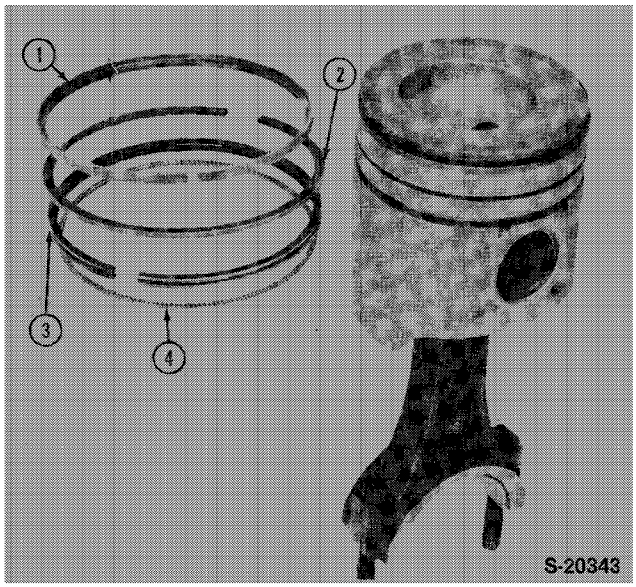


Figure 3
Headland Type Piston (3 Cyl.)

1. "L" Shape Compression Ring
2. Second Compression Ring
3. Oil Control Ring
4. Expander

The four cylinder engine piston has three compression rings and one oil control ring, all located above the piston pin.

The crankshaft is supported in the cylinder block by four main bearings for the 3-cylinder engine and five main bearings for the 4-cylinder engine. Crankshaft end thrust is suppressed by a thrust bearing located on the second main bearings of the 3-cylinder engine and the center (third) main bearing of the 4-cylinder engine.

Front and rear crankshaft oil sealing is effected by one piece, single lip type seals.

The crankshaft rear main bearing carrier block is sealed by two rubber type side seals and a gasket positioned between the block and the engine rear adaptor plate.

The crankshaft driven dynamic balancer, installed on the 4-cylinder engines, counteracts out-of-balance forces and thereby reduces engine vibration. The balancer housing is bolted to the bottom of the cylinder block and contains two meshing gears which are driven and timed from a gear machined on the crankshaft.

The engines feature cross flow cylinder heads with the inlet and exhaust manifolds on opposite sides of the head. The combustion chamber is formed in the crown of the piston.

The cylinder head assembly incorporates the valves, valve springs and spring retainers. Valve guides are an integral part of the cylinder head with replaceable valve seats pressed into the valve ports.

LUBRICATION SYSTEM

Lubrication of the engine is maintained by a rotor type oil pump mounted at the base of the engine block. The oil pump is driven from the camshaft and draws oil from the engine sump through a wire mesh screen.

A spring loaded relief valve in the pump body limits the pressure in the system by directing excess oil back to the intake side of the pump.

Oil passes from the pump to an external, throw-away, spin on type filter incorporating a relief valve which permits oil to be bypassed if filter blockage occurs, and so assures engine lubrication at all times.

Oil flows from the filter to the main oil gallery which runs the length of the cylinder block and intersects the camshaft follower chambers.

The main gallery also supplies oil to the crankshaft main bearings and to the connecting rod journals via drillings in the crankshaft. Drilled passages from each main bearing direct oil to the camshaft bearings.

The camshaft drive gear bushing is pressure lubricated through a drilled passage from the front main bearing. The gear has small oil passages machined on both sides which allow the oil to escape.

The timing gears are lubricated by oil from the cam follower chamber and the pressure lubricated camshaft drive gear bushing.

On the 4-cylinder engines, the dynamic balancer is lubricated through a drilled passage from the cylinder block intermediate thrust bearing web to the balancer housing. Oil flows through the balancer housing to the drilled balancer gear shafts and onto the bushings in the balancer gears.

Cylinder walls, pistons and piston pins are splash lubricated by the connecting rods and rotating crankshaft.

An intermittent flow of oil is directed to the valve rocker arm shaft assembly via a drilled passage in the cylinder block located vertically above the No. 1 camshaft bearing. This drilling aligns with a corresponding hole in the cylinder head. As the camshaft turns, holes in the camshaft and camshaft bearing align and a regulated stream of oil is directed to the cylinder head and on up the rocker arm shaft support bolt to the rocker shaft. The oil flows from the shaft through drilled holes in each rocker arm bushing to lubricate both ends of the arms. Excess oil flows down the push rods and assists in lubricating the cam followers before draining back into the sump through cored openings in the block.

B. DIESEL ENGINE — OVERHAUL

CYLINDER HEAD, VALVES AND RELATED PARTS

REMOVAL

Reference, Figure 4

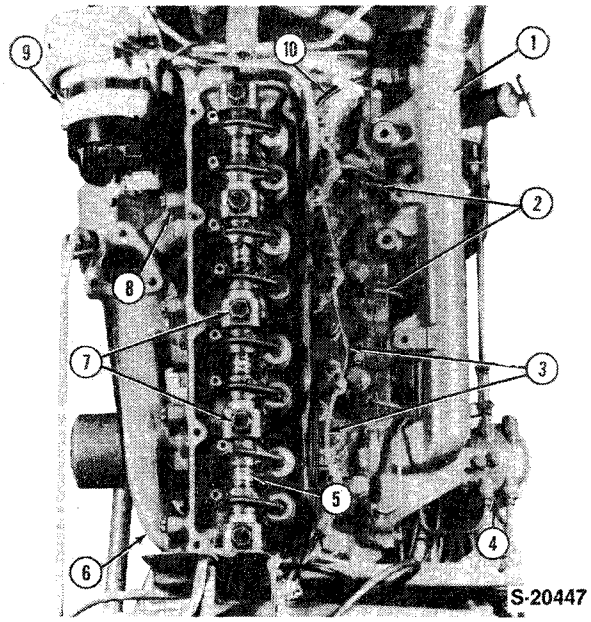


Figure 4
4-Cylinder Engine with Rocker Arm Cover Removed

1. Intake Manifold
2. Injection Tubes
3. Leak-Off Tubes
4. Fuel Filter
5. Rocker Shaft Assembly
6. Exhaust Manifold
7. Rocker Shaft Retaining Bolts
8. Tab Washer
9. Alternator
10. Cold Start Tube

NOTE: *The cylinder head can be removed with the engine installed in the tractor.*

1. Disconnect the battery.
2. Remove the vertical muffler
3. Drain the radiator and cylinder block
4. Shut off the heater hose taps then disconnect and plug the heater hose openings.
5. Remove the radiator top hose.
6. Shut off the main fuel tank tap.
7. Remove the hood panel assembly.
8. Disconnect the air inlet hose at the intake manifold.
9. Remove the vertical type exhaust pipe and bracket.
10. Bend the lock tabs back and remove the bolts, exhaust manifold and gasket.
11. Disconnect the cold start fuel lines at the fuel tank and thermostart unit. See Part 2, Chapter 1.
12. Remove the injection lines from the fuel injection pump and injectors. Cap the exposed openings in the pump, injectors and line ends.
13. Disconnect the fuel lines and remove the fuel filters from the inlet manifolds.
14. Remove the bolts and lockwashers and remove the inlet manifold and gasket.
15. Remove the rocker cover bolts, rocker arm cover and gasket from the cylinder heads.
16. Remove the fuel injector leak-off line. Clean the area surrounding the fuel injectors then remove the retaining nuts and carefully withdraw the fuel injectors and sealing washers from the head, Figure 5.
17. Check the push rods for straightness by rotating the rods with the valves closed and identify any bent rods.

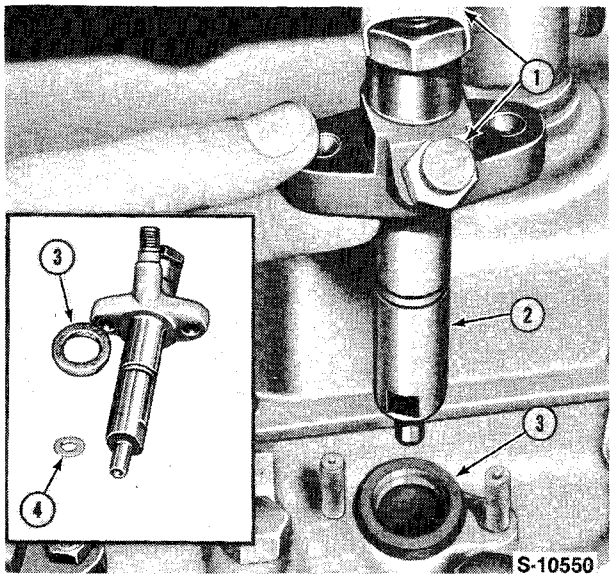


Figure 5
Fuel Injector Removed

1. Dust Caps
2. Injector
3. Dust Seal Washer
4. Injector Seal Washer

18. Loosen the rocker shaft retaining bolts, which also serve as cylinder head bolts, evenly and alternately. Remove the rocker shaft assembly.

    NOTE: *Leave the bolts in the rocker shaft support during removal as they retain the supports on the shaft.*

19. Remove the push rods and place in a numbered rack for ease of assembly in their original position.

20. Remove the remaining cylinder bolts and washers working inward from the ends to the center of the head.

21. Lift the cylinder head from the block. If necessary, lever the head off the block at the pads provided, taking care not to damage the cylinder head or block surfaces, Figure 6.

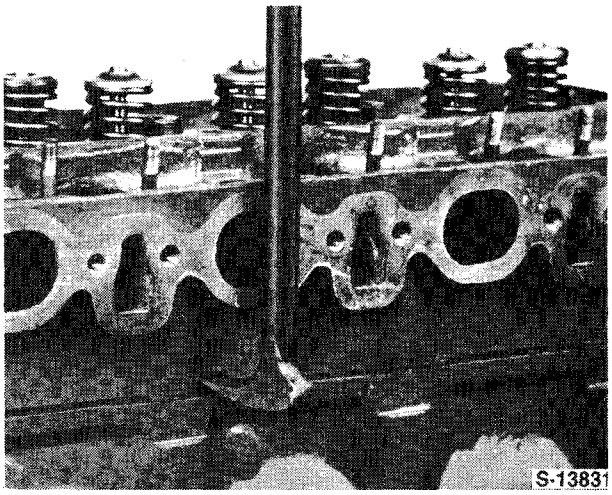


Figure 6
Cylinder Head Removal

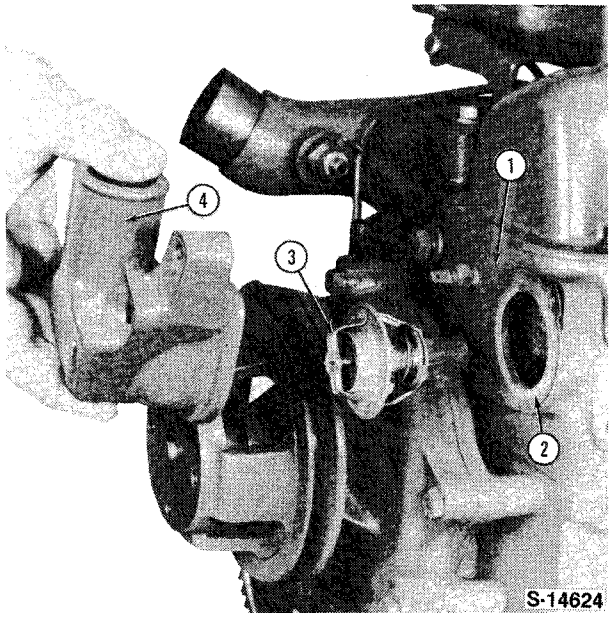


Figure 7
Coolant Outlet and Thermostat Removal

1. Cylinder Head
2. Gasket
3. Thermostat
4. Coolant Outlet Connection

DISASSEMBLY

THERMOSTAT:

1. Remove the coolant outlet connection and the thermostat and gasket, Figure 7.

CYLINDER HEAD:

2. Clean the head and remove carbon deposits from around the valve heads.

3. Using a valve spring compressor, Figure 8, remove the retainer locks, spring retainers/rotators, springs and seals from each valve, Figures 9 and 10.

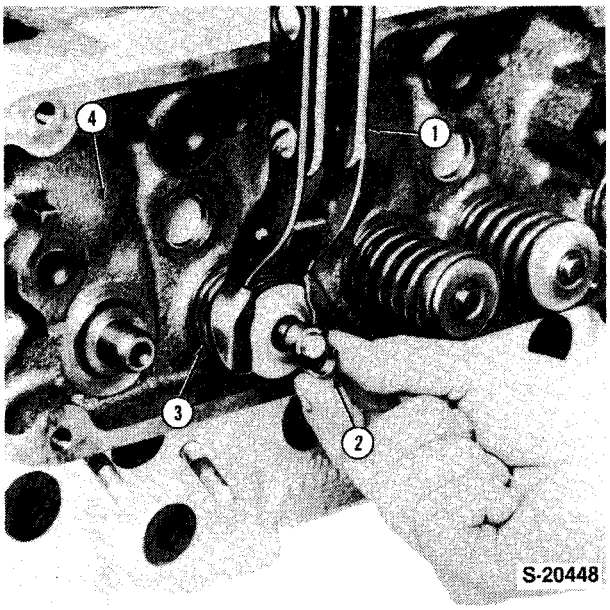


Figure 8
Valve Removal

1. Valve Spring Compressor
2. Retainer Locks
3. Valve Spring
4. Cylinder Head

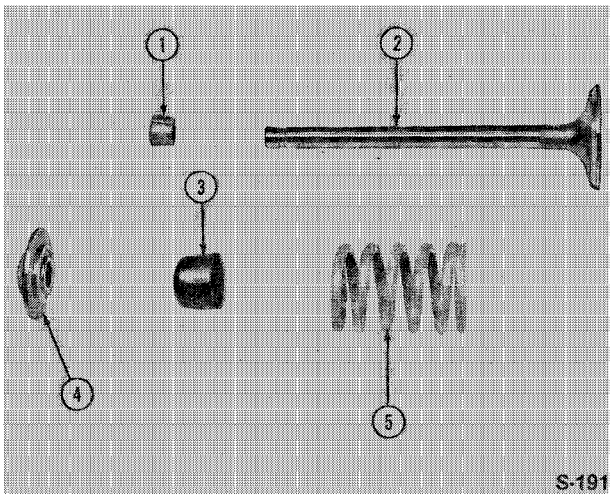


Figure 9
Intake Valve Assembly Components

1. Intake Valve Spring Retainer Lock
2. Intake Valve Spring Retainer
3. Intake Valve Seal
4. Intake Valve Spring
5. Intake Valve

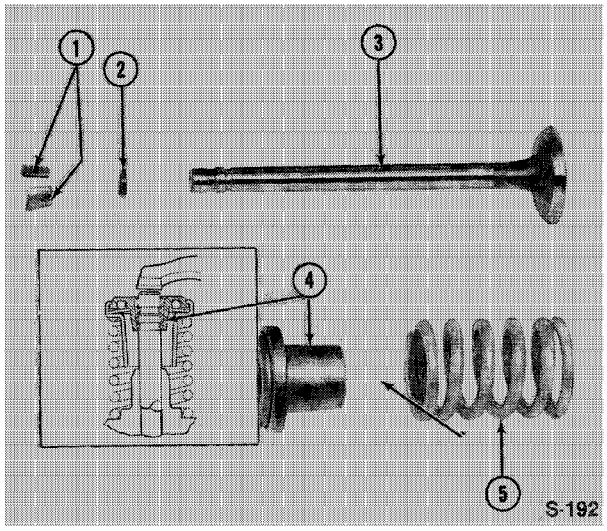


Figure 10
Exhaust Valve Assembly

1. Spring Retainer Locks
2. Seal
3. Exhaust Valve
4. Spring Retainer
5. Spring

4. Remove the valves and place in a numbered rack together with the valve rotators (where fitted).

ROCKER SHAFT ASSEMBLY:

5. Remove the cylinder head bolts which pass through the rocker shaft supports and slide the rocker shaft components from the shaft, Figure 11.

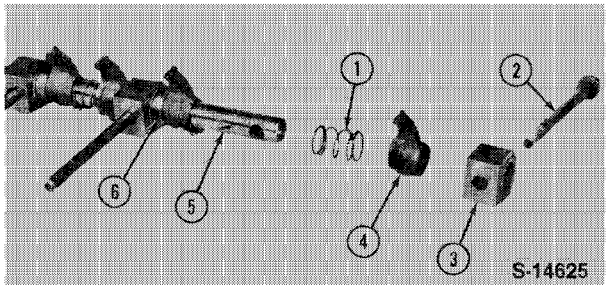


Figure 11
Rocker Shaft Disassembled

1. Spring
2. Retaining Bolt
3. Shaft Support
4. Rocker Arm
5. Shaft
6. Spacer

INSPECTION AND REPAIR

CYLINDER HEAD:

1. Scrape all gasket surfaces clean then wash the cylinder head in a suitable solvent and thoroughly dry with a lint free cloth or compressed air.

2. Inspect the cylinder head for damage and, if necessary, remove nicks and burrs from the gasket faces using a suitable abrasive. Be sure all traces of abrasive material are removed after repair.

3. Use a straight edge to check the flatness of the cylinder head in all directions, Figure 12. For flatness requirement see "Specifications" — Chapter 3.

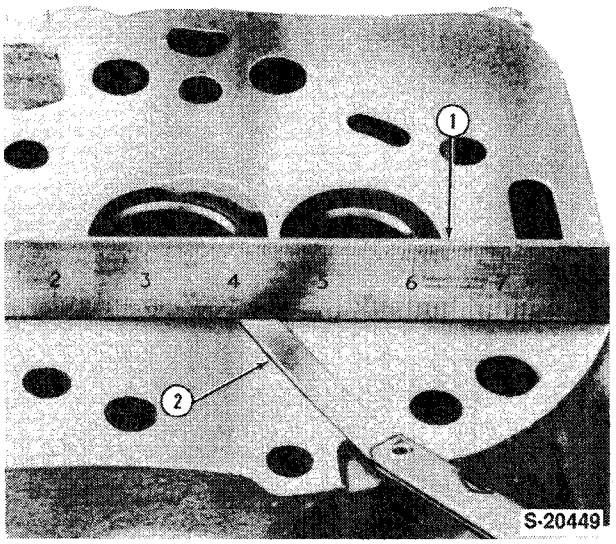


Figure 12
Measuring Cylinder Head Flatness
1. Straight Edge 2. Feeler Gauge

NOTE: *If the cylinder head exceeds the flatness specification it may be skimmed providing the depth from the lower face of the valve insert to the cylinder head face is not less than 0.064 in. (1.63 mm).*

4. After skimming the head, check whether any cylinder head bolts are bottoming by mounting the cylinder head on the block without a gasket and without any of the pistons at T.D.C. Install all the bolts finger tight and be sure the rocker shaft supports and flat washers are fitted with the long bolts. If a 0.010 in. (0.25 mm) feeler gauge can be inserted under the bolt head then the bolts are bottoming and the cylinder block thread must be increased in depth. Use a ½ in. x 13 UNC—2A thread tap.

VALVE SEATS:

5. Examine the valve seat inserts and reface if pitted but replace if damaged. If necessary, install an oversize insert by machining the seat counterbore in the cylinder head, see "Specifications"—Chapter 3. The insert must be chilled in dry-ice prior to installation.

NOTE: *Valve seat inserts of 0.010 in. (0.25 mm) and 0.020 in. (0.5 mm) oversize on diameter are sometimes installed in cylinder heads in production. Heads fitted with oversize inserts are stamped* $\frac{S010}{OS}$ *or* $\frac{S020}{OS}$ *on the exhaust manifold side in line with the valve seat concerned.*

When replacing exhaust valve seat inserts be sure the replacement inserts are of the correct type as the size and material specification varies for different engine types.

6. Check the width of the valve seat inserts and, if necessary, reface by grinding to the dimensions shown in Figure 13.

7. Grind the seat to:
intake 0.080"-0.102" (2.032-2.590 mm).
exhaust 0.84"-0.106" (2.133-2.692 mm).

Lower or raise the seat by removing material from the seat using the following stones.

To lower the seat use a 30 degree stone. To raise the seat use a 60 degree stone.

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

VALVES:

8. Examine the valve face and, if pitted, replace or reface by grinding to the dimension shown in Figure 14. Before refacing the valve, be sure the valve stem is not bent or worn and check the valve seat run-out, measured at right-angles to the seat,

does not exceed a total of 0.0015 in. (0.038 mm). Measure the valve head margin to assure sufficient margin remaining after refacing.

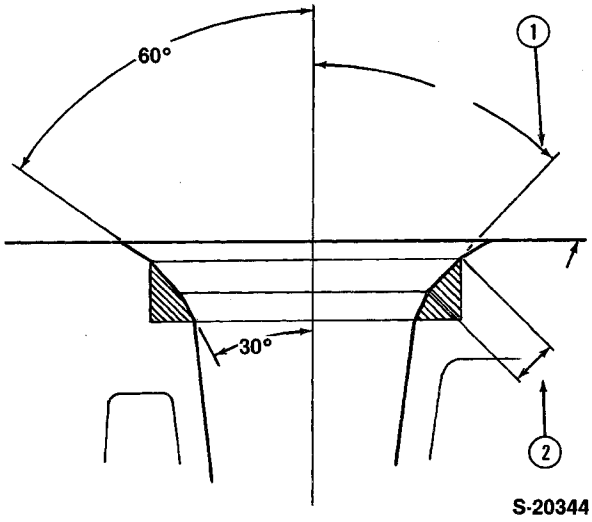


Figure 13
Valve Seat Dimensions

1. Valve Seat Angle: 45° 00′—45° 30′ for all Valve Seats
2. Valve Seat Width: Intake 0.080—0.102 in. (2.032—2.590 mm) Exhaust 0.084—0.106 in. (2.133—2.692 mm)

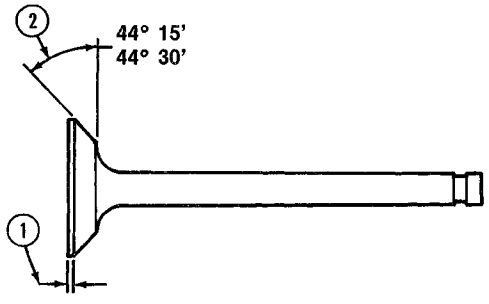


Figure 14
Intake and Exhaust Valves

1. Valve—Margin 0.031 in. (.787 mm) minimum
2. Valve—Face Angle

IMPORTANT: *The finished valve seat should contact the center of the valve face. Using the refaced or new valve, check the seat using Prussian Blue. Rotate the valve with a light pressure and if the blue is transferred to the middle of the valve face, the contact is correct, Figure 15.*

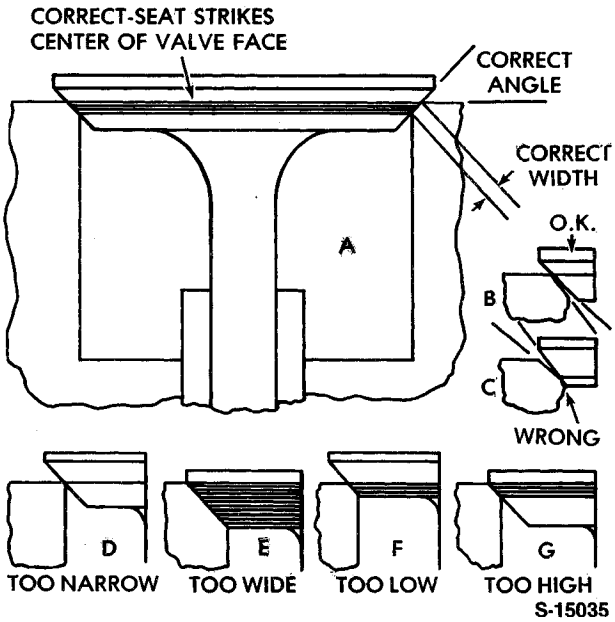


Figure 15
Valve Seating

VALVE GUIDES:

8. Using a telescopic gauge and micrometer, measure the valve to guide clearance, Figure 16. If the clearance exceeds the specified limits, see "Specifications"—Chapter 3. Ream the valve guide to fit the next oversize valve.

NOTE: *Production cylinder heads may have one or more 0.015 in. (0.38 mm) oversize valve guides and valves installed. Such cylinder heads have 15 or* $\frac{V015}{OS}$ *stamped on the exhaust manifold side of the head opposite the valve(s) concerned.*

9. Use Kit No. 2136 to ream out the valve guide to accept an oversize valve. The kit contains three reamer and pilot combinations as follows:

   - 0.003 in. (0.076 mm) Oversize Reamer and Standard Diameter Pilot.

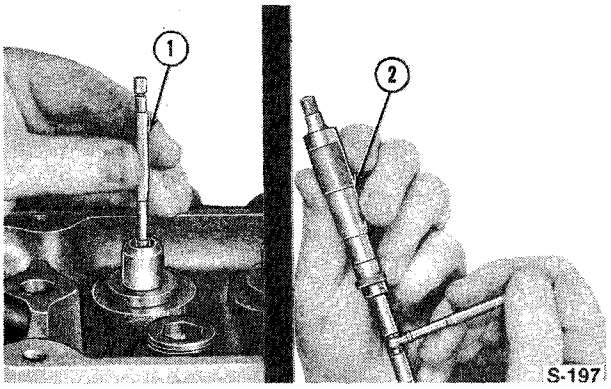


Figure 16
Measuring Valve Guide
1. Telescopic Gauge 2. Micrometer

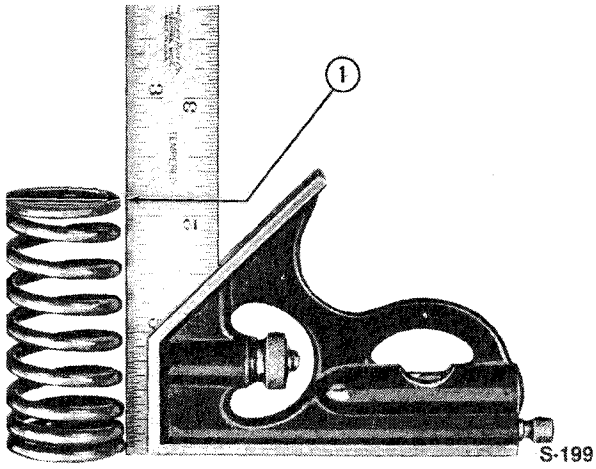


Figure 17
Checking Valve Spring Squareness
.1 Maximum Out-Of-Square 0.06 in. (1.5 mm)

- 0.015 in. (0.38 mm) Oversize Reamer and 0.003 in. (0.076 mm) Oversize Pilot.
- 0.030 in. (0.76 mm) Oversize Reamer and 0.015 in. (0.38 mm) Oversize Pilot.

When going from a standard valve stem to an oversize always use the reamers in sequence. After reaming a valve guide, always check the valve seating and reface if necessary.

VALVE SPRINGS:

10. Replace worn or damaged valve springs. Check for squareness and reject if out-of-squareness exceeds 0.06 in. (1.5 mm). Figure 17. Check the free length and loaded length of each valve spring, see "Specifications"—Chapter 3. Be sure the valve spring retainer locks are in good condition and the exhaust valve rotators are not binding or worn.

ROCKER SHAFT ASSEMBLY:

11. Examine the rocker arm for wear or damage. Check the adjusting screw threads and replace if damaged. Inspect the rocker arm locating springs and spacers for damage. Check the rocker arm-to-shaft clearances and replace if beyond specified limits, see "Specifications"—Chapter 3.

12. Clean the shaft in a suitable solvent and throughly dry with compressed air assuring the oil passages are free from obstruction.

THERMOSTAT:

13. For inspection and repair of the coolant outlet or thermostat, see "Cooling System"—Chapter 2.

ASSEMBLY

CYLINDER HEAD:

1. Insert each valve in the guide bore from which it was removed and lap in position to be sure of an even seat around the valve. Withdraw the valve and remove all traces of lapping compound.

2. Use a valve spring compressor to reassemble the valves, valve springs, retainers and retainer locks. For the exhaust valves install a new sealing ring in the second groove from the top of the valve stem.

THERMOSTAT:

3. Install the thermostat (spring end towards the head), coolant outlet and a new gasket, Figure 7.

ROCKER SHAFT ASSEMBLY:

4. Coat all components with engine oil and position the notch on the front of the rocker shaft upwards to correctly locate the oil holes, Figure 18.

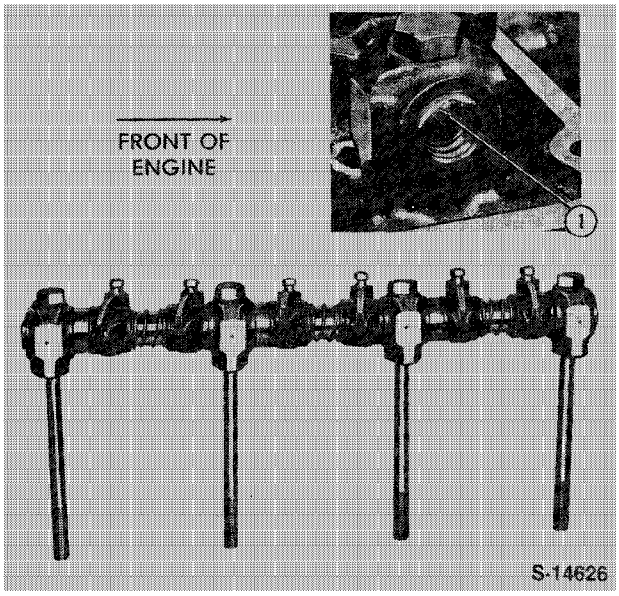


Figure 18
Rocker Shaft Assembly
1. Notch

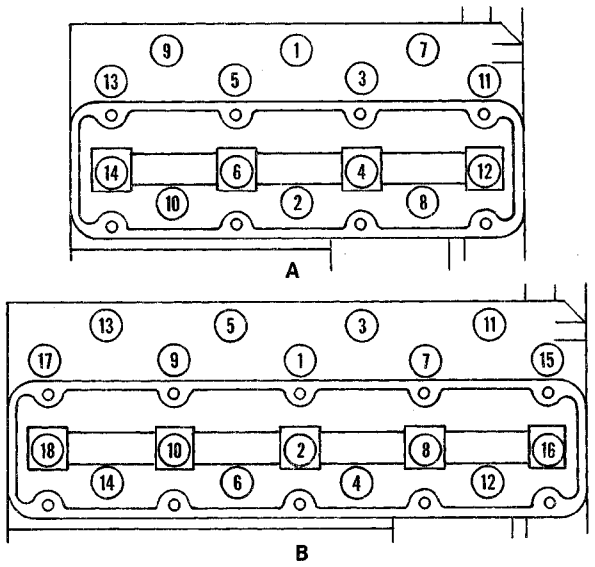


Figure 19
Cylinder Head Bolt Tightening Sequence
A. 3-Cylinder Engines B. 4-Cylinder Engines

5. Start the assembly from the shaft rear end by securing a rocker arm support with a long bolt. Be sure the notch on the support is positioned to the right of the shaft when looking forward. Proceed to install a spacer, rocker arm, spring, rocker arm and support. Repeat the procedure until complete.

INSTALLATION

Installation of the cylinder head and related components follows the removal procedure in reverse. On installation observe the following requirements:

- Install new cylinder head, intake and exhaust manifold gaskets.

- Be sure washers are installed under the heads of the cylinder head retaining bolts. Tighten the cylinder head bolts in the sequence shown in Figure 19, and progressively in three steps as follows:

  (i) Torque to 90 lbs. ft. (122 Nm)

  (ii) Torque to 100 lbs. ft. (135 Nm)

  (iii) Torque to 110 lbs. ft. (149 Nm)

NOTE: *The cylinder head bolts should be torqued only when the engine is cold.*

- Rotate the engine and set the valve lash, Figure 20. See "Specifications"—Chapter 3.

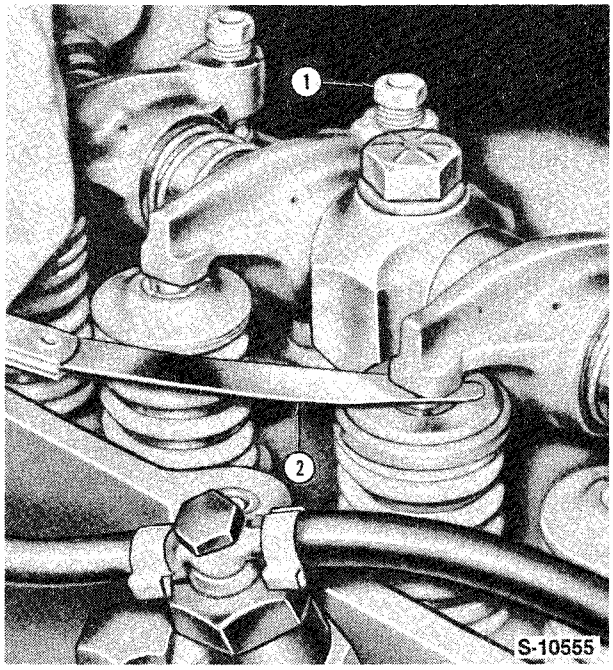


Figure 20
Setting Valve Lash
1. Adjuster Screw 2. Feeler Gauge

- Install the injectors with new seat washers and cork seals.
- Install the injector lines and leak-off pipe with new washers.

  NOTE: *Hold the leak-off plastic tube securely to prevent pivoting when tightening the banjo fitting bolts to the correct torque. See "Specifications"—Chapter 3.*

- Use new lock tabs for the exhaust manifold retaining bolts and bend the tabs to effect retention.
- Tighten all nuts and bolts to the specified torques. See "Specifications"—Chapter 3.

ENGINE FRONT COVER AND TIMING GEARS

REMOVAL

NOTE: *The engine front cover and timing gears can only be serviced after removing the radiator and front axle. See "SEPARATING THE TRACTOR"—Part 12.*

1. Drain the engine oil and remove the oil pan.
2. Remove the fan drive belt and withdraw the bolt and washer from the center of the crankshaft pulley.
3. Using Puller No. 9539 and Shaft Protector No. 9212, remove the crankshaft pulley, Figure 21.
4. Remove the power steering pump, see "STEERING SYSTEMS"—Part 9.
5. Remove the front cover retaining bolts, front cover and gasket. Remove the oil slinger, Figure 22, from the crankshaft.
6. Before removing the timing gears, use a dial indicator or feeler gauges to measure the backlash between each set of mating gears, Figure 22. Rotate the gears and check the backlash at four equidistant points on the gears. Renew the gears if the backlash exceeds the specified limits, see "Specifications"—Chapter 3.
7. Pry the camshaft gear away from the thrust plate and using a dial indicator or feeler gauges, measure the clearance, Figure 23. Install a new camshaft thrust plate if the camshaft end play exceeds the specified limits. See "Specifications"—Chapter 3.

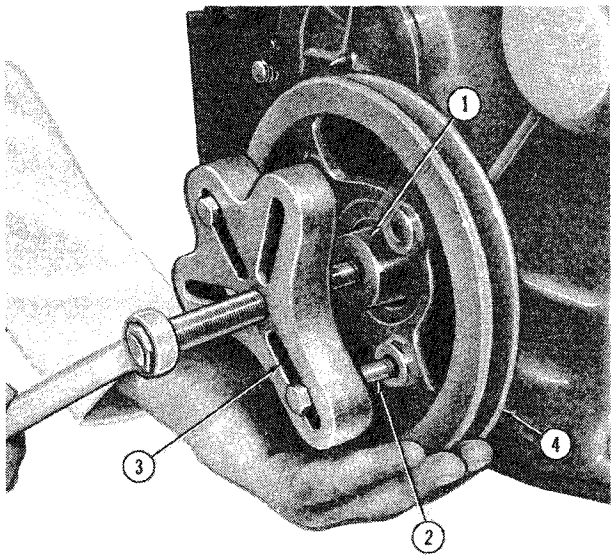


Figure 21
Crankshaft Pulley Removal

1. Shaft Protector No. 9212
2. 7/16 in. x 14 UNC Bolt
3. Puller No. 9539
4. Crankshaft Pulley

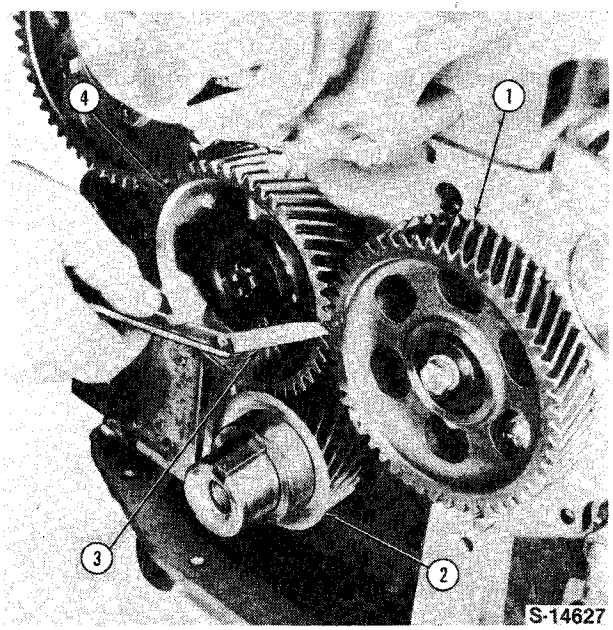


Figure 22
Measuring Timing Gear Backlash

1. Camshaft Gear
2. Oil Slinger (Reference Only)
3. Feeler Gauge
4. Camshaft Drive Gear

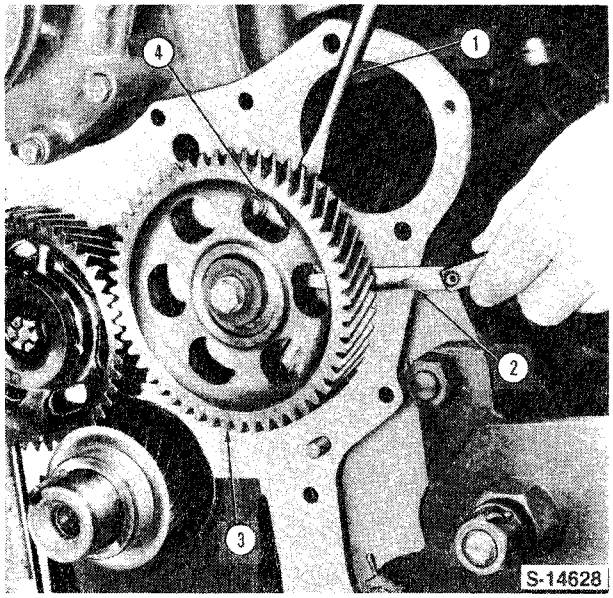


Figure 23
Measuring Camshaft End Play

1. Screwdriver
2. Feeler Gauge
3. Camshaft Gear
4. Thrust Plate

8. Remove the fuel injection pump drive gear, camshaft drive gear and adapter and the camshaft gear. Use Tool No. 2134 and 1237 to remove the crankshaft gear, Figure 24.

   NOTE: *The crankshaft gear should only be removed if it shows signs of wear.*

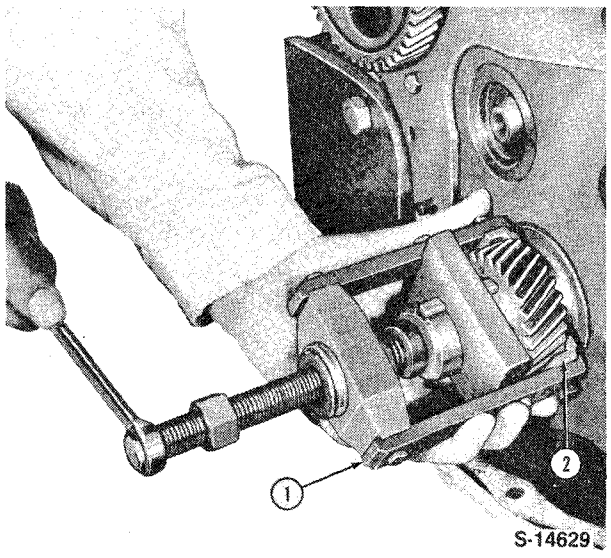


Figure 24
Crankshaft Gear Removal

1. Puller No. 2134
2. Insert No. 1237

INSPECTION AND REPAIR

1. Wash the gears and adapter in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Examine the gear teeth for wear, burrs or scratches. Any minor burrs or scratches may be removed with a fine abrasive; be sure all parts are throughly washed before reassembly.

3. Be sure the camshaft drive gear adapter oil passage is free from obstruction and the drive gear bushing is not damaged.

4. Check the key and keyway in the end of both the camshaft and crankshaft for damage. Replace the keys if necessary.

INSTALLATION

1. Install the spacer, key and the camshaft gear then recheck the camshaft end play.

2. Locate the key then use Tool No. 2134 and 1237 to install the crankshaft gear, Figure 25.

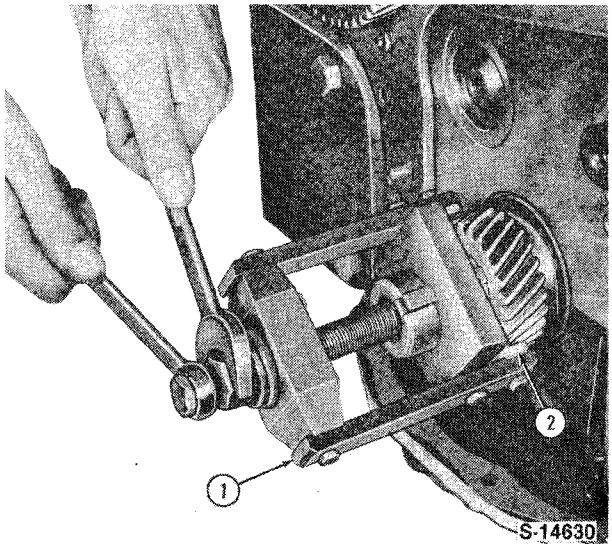


Figure 25
Installing Crankshaft Gear

1. Installer No. 2134
2. Insert No. 1237

3. Position No. 1 piston at top dead center and install the camshaft drive gear and adapter with the timing marks aligned with those of the other gears, as shown Figure 27.

Tighten the bolt to the specified torque and recheck the backlash between the gears.

4. Assemble the fuel injection pump to the engine front plate. Check No. 1 piston is at T.D.C. and install the injection pump drive gear with the timing mark aligned with that of the camshaft drive gear, Figure 26.

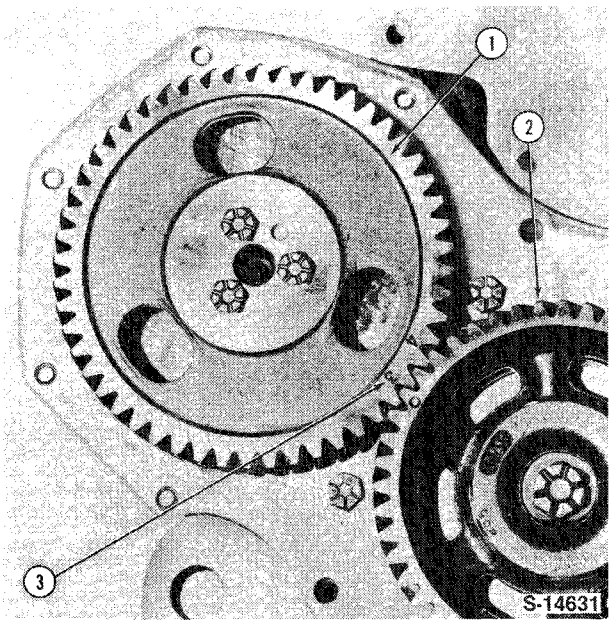


Figure 26
Injection Pump Drive Gear To Camshaft Drive Gear Timing

1. Pump Drive Gear
2. Camshaft Drive Gear
3. 3-Cylinder Timing Mark

NOTE: *All Ford engines with the rotary type fuel injection pump have a common fuel injection pump drive gear. This gear features two timing marks identified by numerals '3' and '4' for 3 and 4-cylinder engines respectively, Figure 27. When installing the pump drive gear, be sure the 3 cylinder timing mark aligns with the camshaft drive gear timing mark.*

5. Install a new dust seal in the front cover. Lubricate the oil seal with petroleum jelly and use adapter plate No. 9210 to press the seal into the front cover.

6. Locate the oil slinger onto the crankshaft with the dished side facing outward.

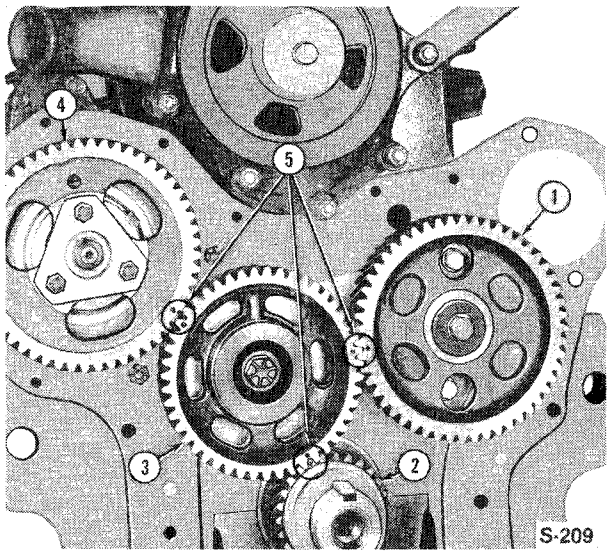


Figure 27
Aligning The Timing Gears

1. Camshaft Gear
2. Crankshaft Gear
3. Camshaft Drive Gear
4. Injection Pump Drive Gear
5. Timing Marks

7. Position a new gasket on the engine front plate and install the front cover. Be sure the cover aligns with the dowel pins. Tighten the bolts to the specified torque.

8. Lubricate the crankshaft pulley spacer and slide it over the key. Replace the pulley hub and tap onto the crankshaft. Tighten the securing bolt to the specified torque, see "Specifications" Chapter 3.

9. Install the oil pan using a new gasket and tighten the bolts to the specified torque, see "Specifications" Chapter 3.

10. Refill the engine with the correct grade and quantity of oil, see "Specifications" Chapter 3.

OIL PAN REMOVAL

NOTE: *The oil pan can be removed with the engine installed in the tractor.*

1. Drain the engine oil and remove the oil level indicator.

2. Support the front transmission.

3. Remove the hood.

4. Disconnect the radiator shell support, slacken the engine to front support bolts leaving the nuts flush or partly disengaged from the end of the bolts.

5. Ease the front support and radiator assembly forward to allow the front oil pan bolts and the pan to be removed.

NOTE: *Using this procedure it should not be necessary to disconnect the radiator hoses, power steering or hydraulic oil cooler tubes where fitted. However, care must be taken to be sure no components are unduly stressed.*

WARNING: *Due to the weight of the cast iron oil pan, exercise care on removal.*

INSPECTION AND REPAIR

1. Scrape all gasket material from the gasket surface then wash the oil pan in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Inspect the pan for cracks, damaged drain plug threads or distorted gasket surface.

INSTALLATION

Installation of the oil pan follows the removal procedure in reverse. On installation observe the following requirements.

- Be sure the gasket surfaces on the oil pan and block are clean.
- Install a new gasket and apply a thin film of sealer to the gasket, front cover and oil pan.
- Position the oil pan and install a bolt finger tight at each corner.
- Install the remaining bolts, tighten the rear bolts first, then tighten from the middle outward in each direction to the specified torque, see "Specifications" — Chapter 3.
- Fill the engine with the correct grade and quantity of oil, see 'Specifications" — Chapter 3.
- Operate the engine and check for oil leaks.

OIL PUMP

REMOVAL

1. Remove the oil pan as previously described in this Chapter.

2. Remove the oil pump with the filter screen, Figure 28. Withdraw the intermediate shaft.

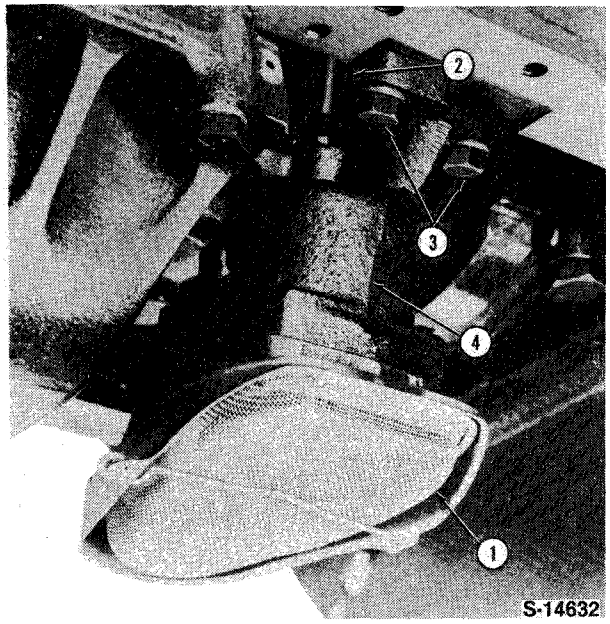


Figure 28
Oil Pump and Filter Screen

1. Filter Screen
2. Intermediate Shaft
3. Oil Pump Retaining Bolts
4. Oil Pump

3. Disconnect the proofmeter drive cable from the driveshaft adapter and remove the engine oil filter.

4. Slacken the retaining bolt then withdraw the driveshaft adapter assembly and the oil pump drive gear, Figure 29.

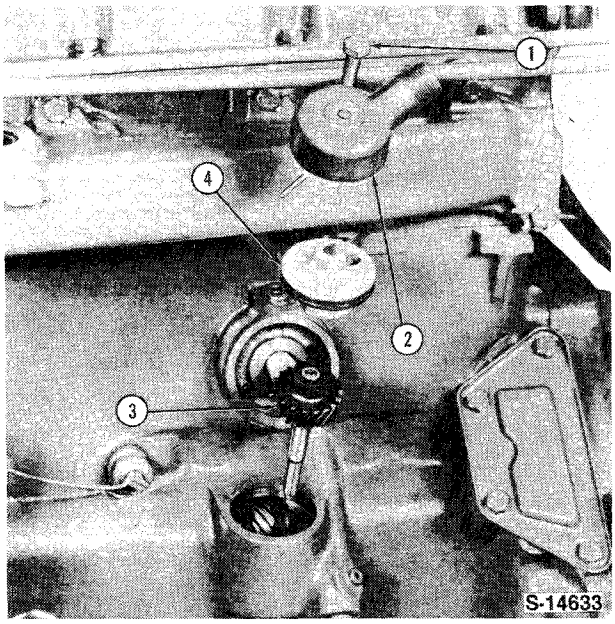


Figure 29
Oil Pump Drive Gear Removal

1. Retaining Bolt
2. Proofmeter Drive-shaft Adapter
3. Oil Pump Drive Shaft and Gear Assembly
4. Drive Shaft Adapter Mounting Base

DISASSEMBLY

Reference — Figure 30

1. Remove the pump screen.

2. Withdraw the retaining screw and washer assemblies then separate the inner and outer covers from the body and extract the rotor and shaft assembly.

3. Insert a self-tapping screw into the relief valve plug and pull the plug out of the body. Withdraw the relief valve and spring.

INSPECTION AND REPAIR

1. Wash all parts in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Inspect the inside of the pump cover and body for excessive wear.

3. Use a straight edge and feeler gauges to measure the endplay between the inner rotor and the pump body and measure the clearance between the outer rotor and the pump body, Figure 31.

4. Use feeler gauges to measure the clearance between the periphery of the outer rotor and the pump body, Figure 32.

   Replace the rotor assembly and/or pump body if beyond any of the specified limits, see "Specifications"—Chapter 3.

5. Check the relief valve spring tension, see "Specifications"—Chapter 3.

6. Inspect the relief valve for wear and check for freedom of movement within the bore. Inspect the valve bore for excess wear and scoring.

7. Examine the intermediate drive shaft socket ends for wear.

ASSEMBLY

Assembly of the oil pump components follows the disassembly procedure in reverse. On assembly observe the following requirements.

- Lubricate all the pump components with clean engine oil.

- The inner rotor and shaft assembly and the outer rotor are serviced as an assembly.

- Prior to installation, introduce clean engine oil into the inlet port and rotate the pump shaft by hand.

INSTALLATION

Installation of the oil pump follows the removal procedure in reverse. On installation observe the following requirements.

- Install a new gasket and tighten the bolts to the correct torque, see "Specifications"—Chapter 3.

- Cast the gasket on a new oil filter with a film of clean engine oil. Screw the filter into place until the seal contacts the block surface, then tighten the filter approximately ¾ of a turn by hand. Do not overtighten.

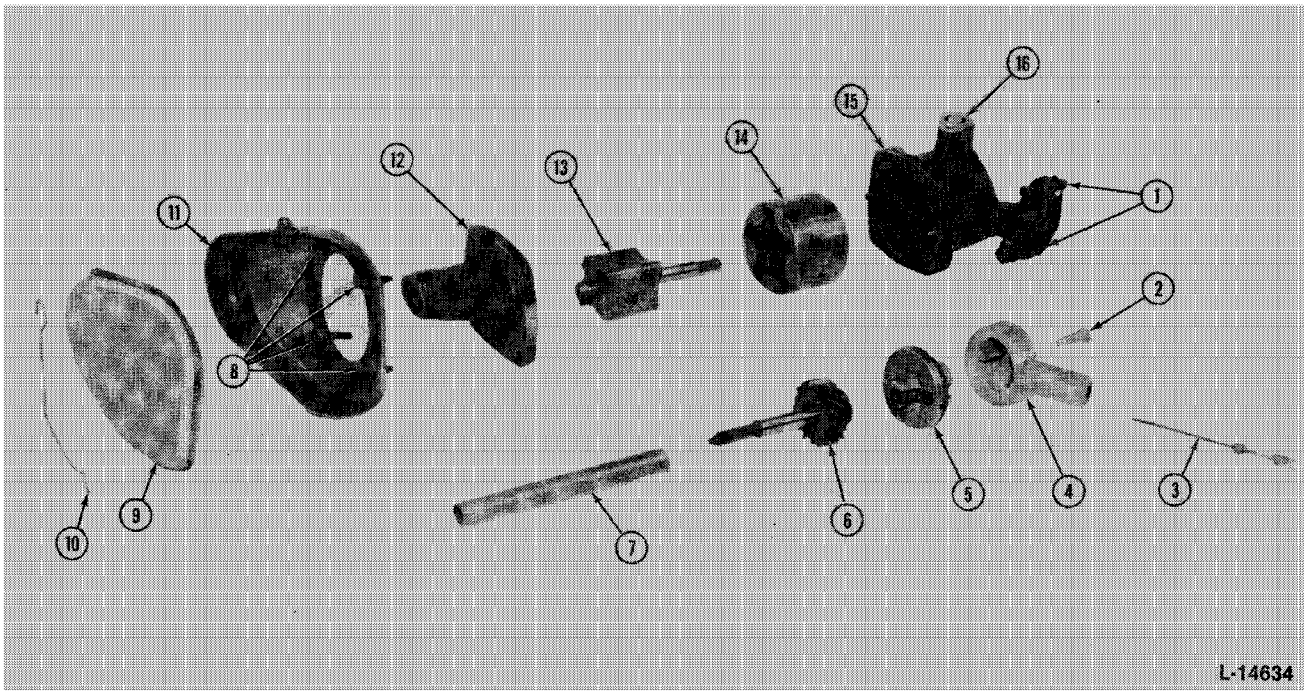


Figure 30
Oil Pump Assembly

1. Oil Pump Retaining Bolts
2. Adapter Retaining Bolt
3. Proofmeter Drive Shaft and Cable Assembly
4. Proofmeter Drive Shaft Adapter
5. Driveshaft Adapter Mounting Base
6. Oil Pump Drive Shaft and Gear Assembly
7. Intermediate Shaft
8. Screw and Washer Assemblies
9. Screen
10. Spring
11. Outer Cover
12. Inner Cover
13. Inner Rotor and Shaft Assembly
14. Outer Rotor
15. Body
16. Pressure Relief Valve Assembly

CONNECTING RODS, BEARINGS, PISTONS, RINGS AND CYLINDER BLOCK

REMOVAL

NOTE: *The connecting rods and pistons can be removed with the engine installed in the tractor after prior removal of the cylinder head, oil pan and oil pump assembly as described in this Chapter.*

1. If necessary, remove any ridge from the top of the cylinder bores with a cylinder ridge reamer or hand scraper, Figure 33. Do not cut down into the piston ring travel area.

2. With the piston at the bottom of its stroke, remove the nuts from the bearing cap bolts and remove the bearing cap and liner, Figure 34.

3. Use the handle end of a hammer to push the piston and rod assembly out of the top of the block. Remove the bearing liner from the connecting rod.

4. Turn the crankshaft to bring each piston to the bottom of its stroke and repeat this procedure. Keep the bearing caps and liners with their respective connecting rods.

CONNECTING ROD BEARINGS:

1. If the bearing liners are scored, have the flash overlay wiped out, show fatigue failure, or are badly scratched, as shown in Figure 35, install new bearing liners.

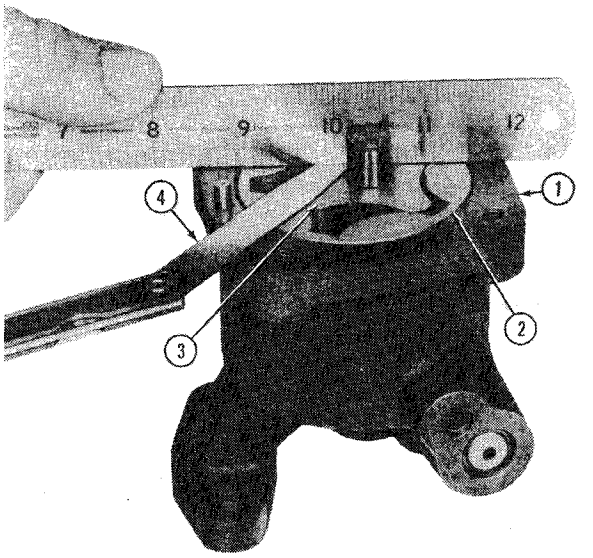


Figure 31
Measuring Oil Pump Clearance

1. Pump Body
2. Outer Rotor
3. Inner Rotor
4. Feeler Gauge

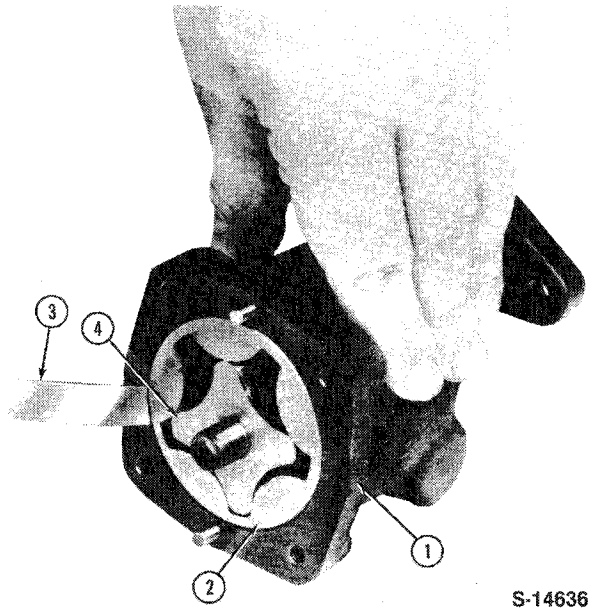


Figure 32
Measuring Outer Rotor to Pump Body Clearance

1. Pump Body
2. Outer Rotor
3. Feeler Gauge
4. Inner Rotor

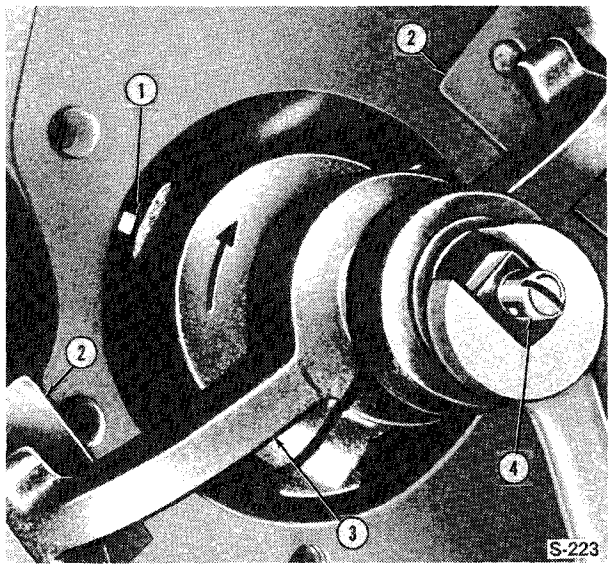


Figure 33
Removing Cylinder Ridge

1. Cutter Blade
2. Shoe
3. Reamer
4. Adjusting Screw

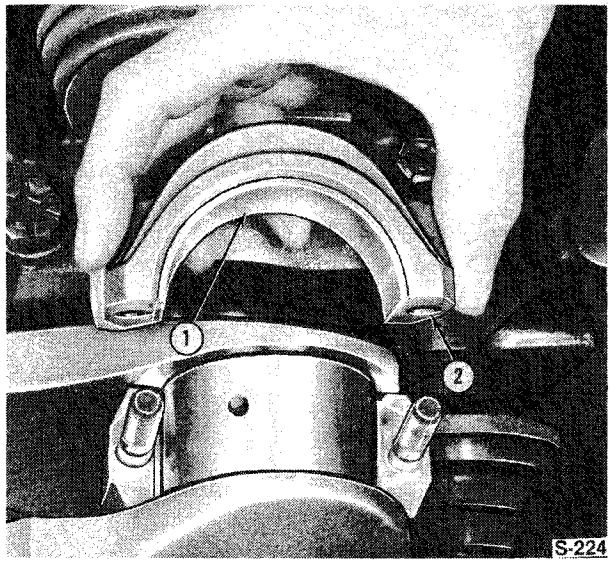


Figure 34
Connecting Rod Bearing Cap Removal

1. Bearing Liner
2. Bearing Cap

2. If the bearing liners appear to be serviceable, keep with their respective rods for reassembly in the engine. If the clearance exceeds the specified limits, new bearings must be installed. Undersize connecting rod bearings are available in 0.002 in. (0.0508 mm.), 0.010 in. (0.254 mm.), 0.020 in.

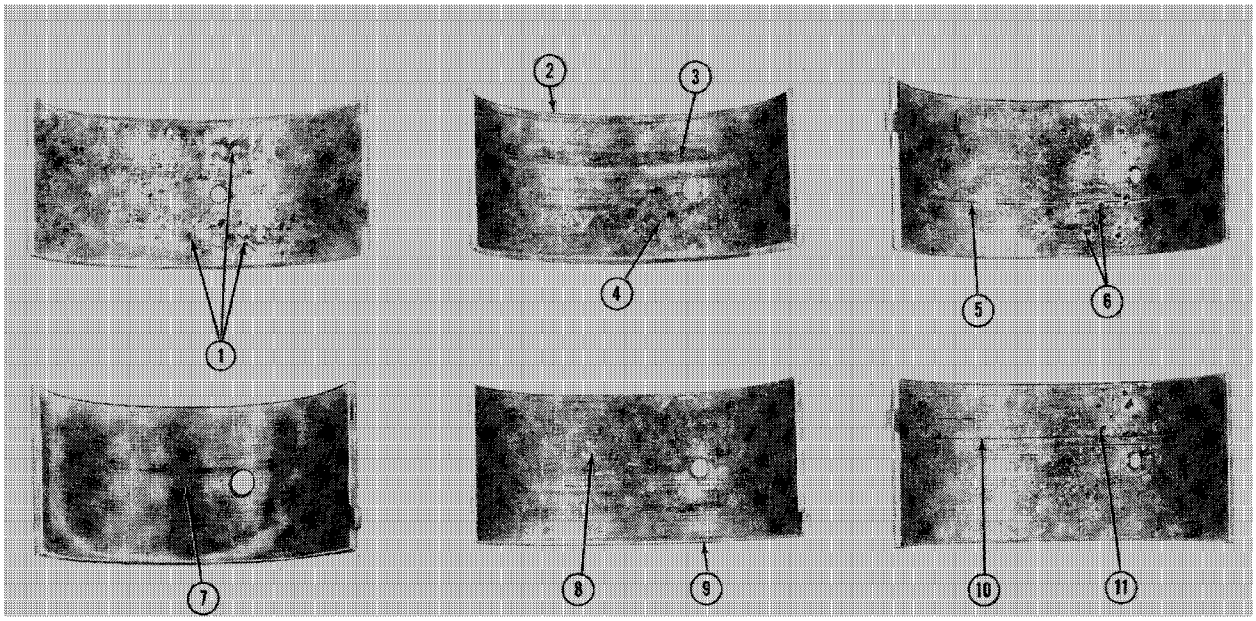


Figure 35
Typical Defective Bearing

(0.508 mm.), 0.030 in. (0.762 mm.) and 0.040 in. (1.016 mm.) for service. If new bearings are required follow the procedure covered in the crankshaft section of this chapter.

DISASSEMBLY

1. Remove the piston pin retainer (snap ring) from each side of the piston and remove the pin.
2. Use an expander to remove the piston rings, Figure 36.
3. Identify each piston and rod for reassembly, Figure 37.

INSPECTION AND REPAIR

Wash the piston and connecting rod assembly in a suitable solvent and dry with a clean lint free cloth or compressed air.

PISTON ASSEMBLY

The headland piston consists of a nickel-iron-alloy insert, Figure 38, chemically bonded to the otherwise aluminum piston. If the bond is fractured in any way at any point, the joint between the aluminum piston and the insert on the top face of the piston will not be totally flush. The pistons are machined after bonding on the top face to obtain a perfectly smooth, flat surface. A plastic cap is placed on top of the piston to protect the insert bond during handling and installation. **Do not remove this protective cap until after the piston is installed.**

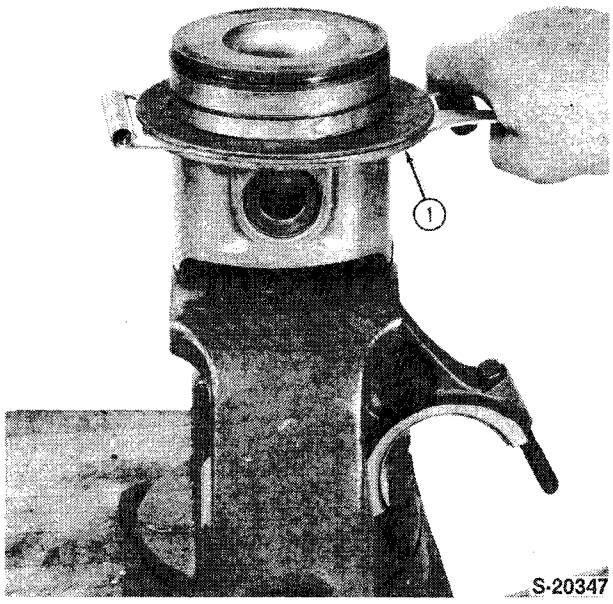


Figure 36
Piston Ring Removal
1. Piston Ring Expander Tool

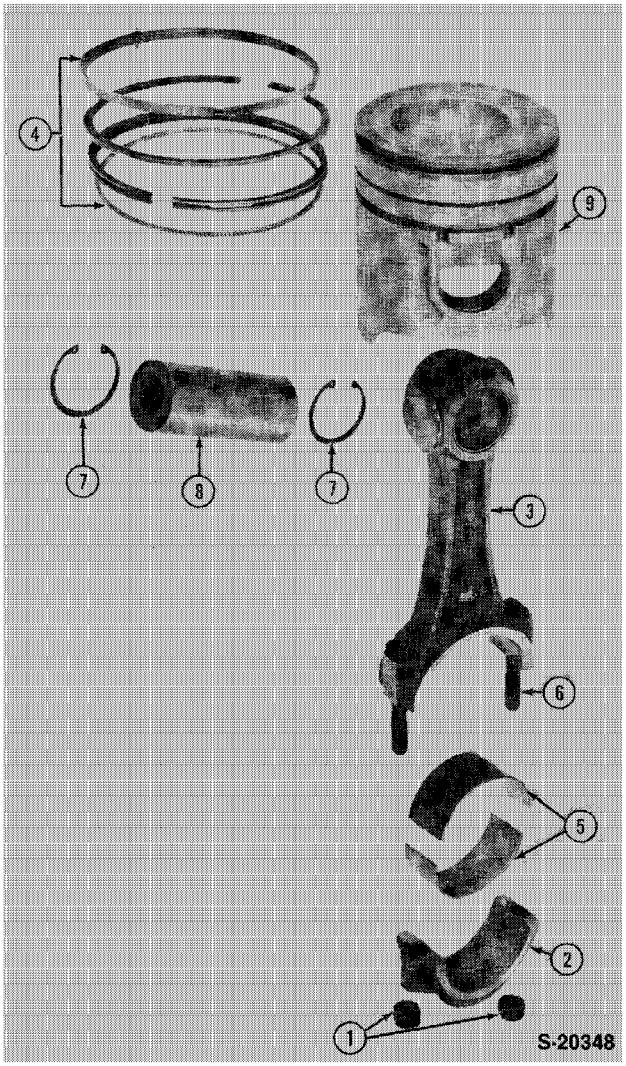


Figure 37
Piston and Connecting Rod
Disassembled

1. Retaining Nuts
2. Bearing Cap
3. Connecting Rod
4. Piston Rings
5. Bearing Liners
6. Bolt
7. Pin Retainers
8. Piston Pin
9. Piston

1. Visually inspect the piston ring lands, skirt and pin bosses for damage.

2. Clean the ring grooves and then using a new ring and feeler gauge, check the intermediate and lower ring grooves for side clearance wear, Figure 39. See "Specification" Chapter 3 for wear limits.

   NOTE: *Side clearance wear check is not applicable to the "L" shaped top compression ring groove.*

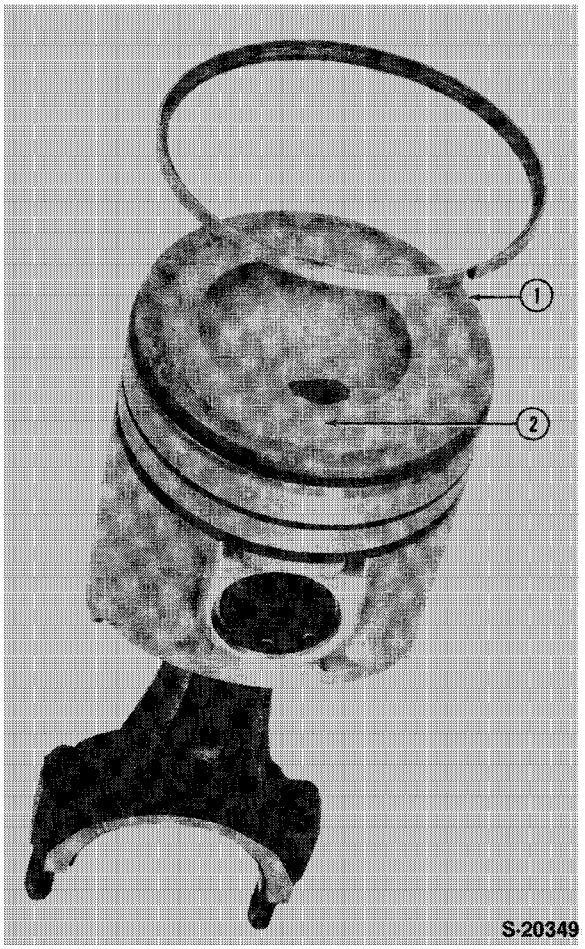


Figure 38
Headland Piston

1. Nickel - Iron Insert
2. Piston Dimple – Front

3. Check the piston to cylinder bore clearance as follows:

   - Measure the cylinder bore diameter as described below under "CYLINDER BOREWEAR CHECK."

   - Measure the piston skirt diameter at right angles to the piston pin just below the oil control ring groove.

   - Subtract the piston diameter from the cylinder bore diameter and the resultant figure should be within the specified clearance, see "Specifications" Chapter 3.

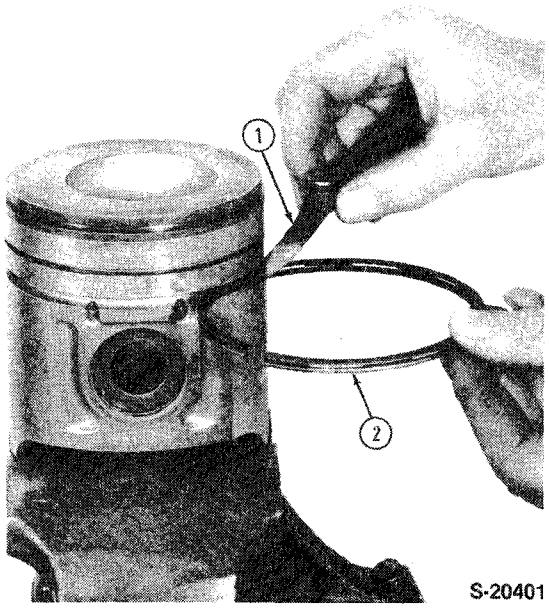


Figure 39
Checking Piston Ring Side Clearance
1. Feeler Gauge 2. New Piston Ring

- If the clearance is greater than specified, try a new piston. If the clearance still exceeds the specified limit, rebore the block to accept oversize pistons or install new cylinder sleeves as described below under "CYLINDER SLEEVE INSTALLATION."

- If the clearance is less than specified, hone the bore to obtain the desired clearance. See "PISTON CLEARANCE" Chapter 3.

NOTE: *Headland pistons are available in standard size only.*

PISTON RINGS

4. Check the piston ring for minimum end gap clearance prior to assembly, in the relevant cylinder, Figure 48.

   Using the head of a piston, push the ring down into the cylinder bore to the lower, unworn portion of the bore when measuring the ring end gap.

   See "End Gap Clearance" Chapter 3.

   - Check the ring side clearance as previously described in this section.

PISTON RING INSTALLATION

HEADLAND PISTON

Use the following instructions when installing rings to the headland type piston as used in the three cylinder engine.

1. Use an expander to install the piston rings, starting with the oil control ring in the bottom groove and working upwards. Refer to Figure 40 for identification of the rings.

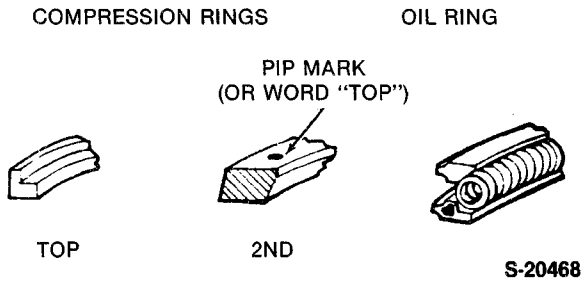


Figure 40
Piston Ring Identification
(Headland Piston)

2. Install the spiral spring wire expander, Figure 41, into the oil control ring groove in the piston. Position the coiled wire ends in line with the wrist pin hole. Insert the inner guide wire into the open ends of the coil. Close the coil until the ends meet.

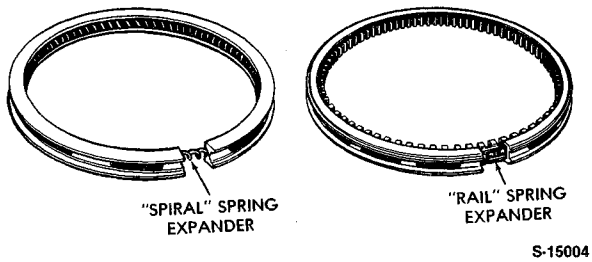


Figure 41
Oil Control Ring and Expander

3. Install the oil control rings, with either side up, in the oil control groove over the expander. Position the gap ends of this part opposite to those of the expander, Figure 42.

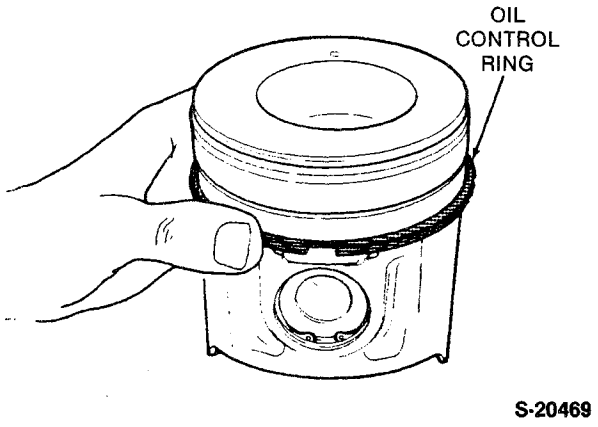


Figure 42
Oil Control Ring Installation
(All Pistons)

4. Install the 2nd compression ring with the word "Top" or the Pip Marking facing up. Position the gap of this part 180° away from the oil control ring gap, Figure 43.

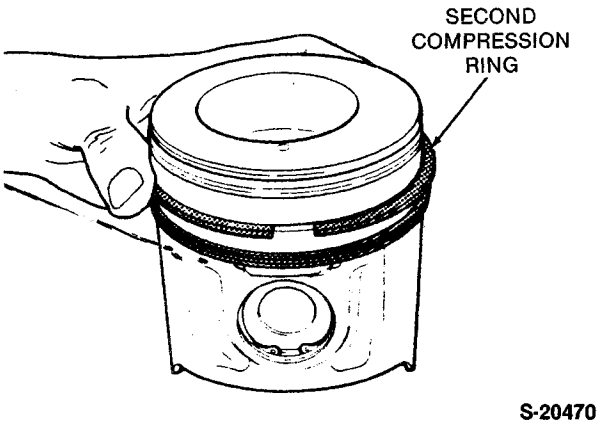


Figure 43
Second Compression Ring Installation
(Headland Piston)

5. Install the "L" shaped top compression ring with the top vertical face (bright chrome finish top) up. Position the gap of this part 180° away from the 2nd ring gap, Figure 44.

CONVENTIONAL TYPE PISTON

Use the following instructions when installing ring to the conventional type piston as used in the four cylinder engine.

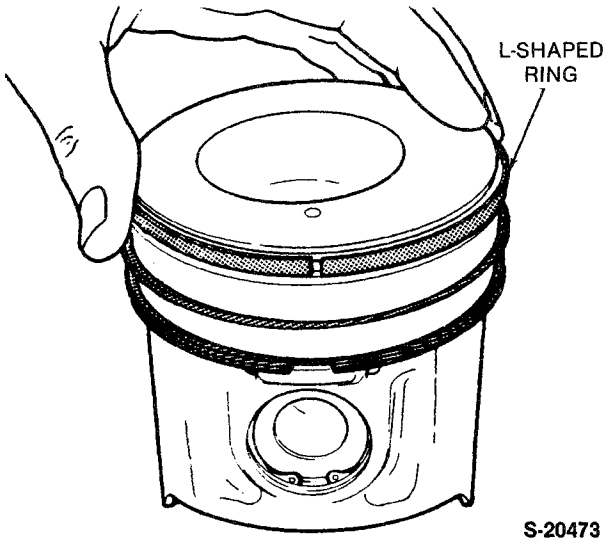


Figure 44
Top Ring Installation
(Headland Piston)

The service ring set comprises:

- A Wire Expander for Oil Control Ring, Figure 41.
- 1 Oil Control Ring.
- 3 Compression Rings.

Use an expander to install the piston rings, starting with the oil control ring in the bottom groove and working upwards.

Oil Control Ring

The oil control ring expander in the Service Ring Kit may be the spiral spring type or the rail spring type, Figure 41.

Install the expander in the piston's oil control ring groove. Position the ends in line with the wrist pin hole.

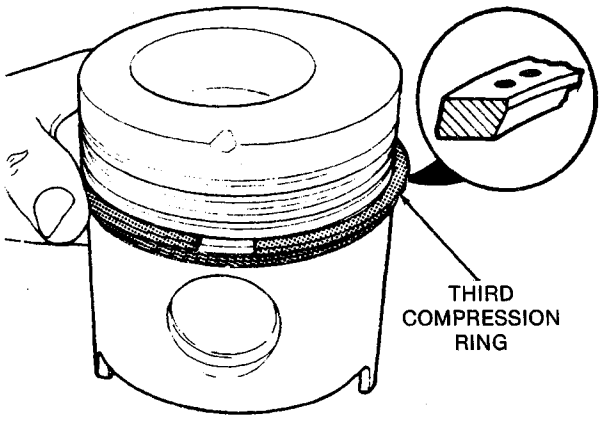
If the expander is the spiral spring type, insert the inner guide wire into the open ends of the coil. Close the coil until the ends meet.

If the expander is the rail spring type, make sure the ends of the expander do not overlap.

Install the cast iron oil ring (either side up) with the inside groove over the expander. Position the ring gap diametrically opposite the expander joint, Figure 42.

3rd Compression Ring

The 3rd compression ring has a dull finish and must be installed with the two pip marks facing up and the gap 180° away from that of the oil control ring. The third compression ring has an inside chamfer that distinguishes it from the two top compression rings, Figure 45.



S-20471

Figure 45
Third Compression Ring Installation
(Conventional Piston)

2nd Compression Ring

Install the second compression ring with the pip mark facing up and its end gap positioned 90° away from the lower compression ring end gap, Figure 46.

TOP COMPRESSION RING

The top compression ring has a bright chrome finish and has two pip marks. This ring can be installed with either side up. Its end gap should be positioned 180° away from the second compression ring's gap, Figure 47.

CONNECTING ROD

5. Measure the outside diameter of the piston pin and the inside diameter of the connecting rod bushing. If the clearance is not within the specified limits, see "Specifications"—Chapter 3. Press out the connecting rod bushing and install a new bushing using tool No. 9514 with a suitable adapter, Figure 49.

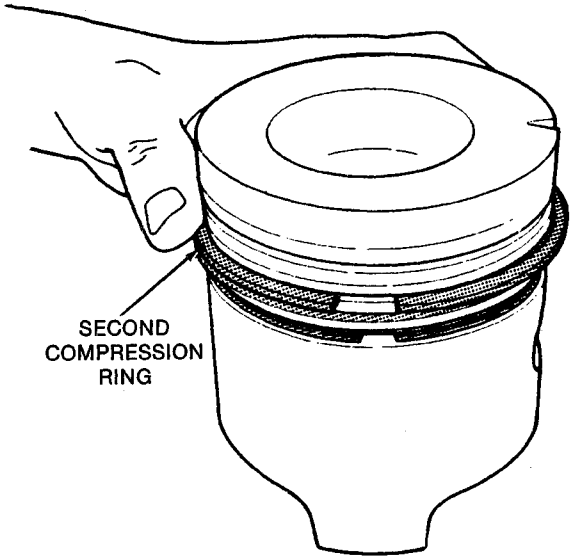


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Figure 46
Second Compression Ring Installation
(Conventional Piston)

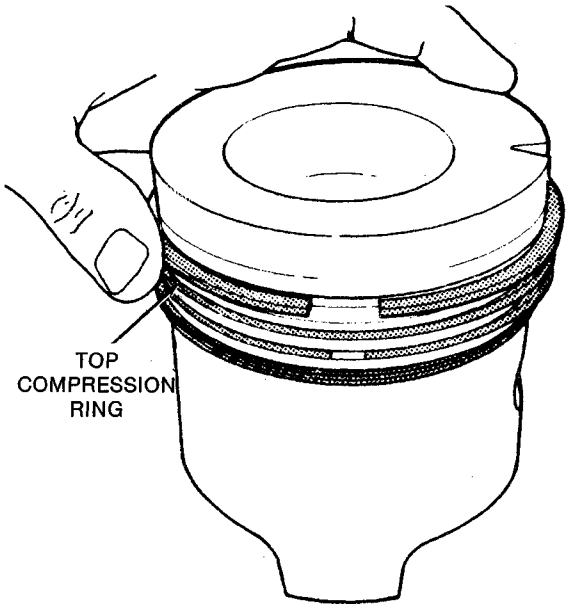

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Figure 47
Top Compression Ring Installation
(Conventional Piston)

6. After installation of a new connecting rod bushing, use the hole in the top of the rod as a guide and drill a 0.25 in. (6.4 mm) diameter hole through one wall of the bushing, Figure 50.

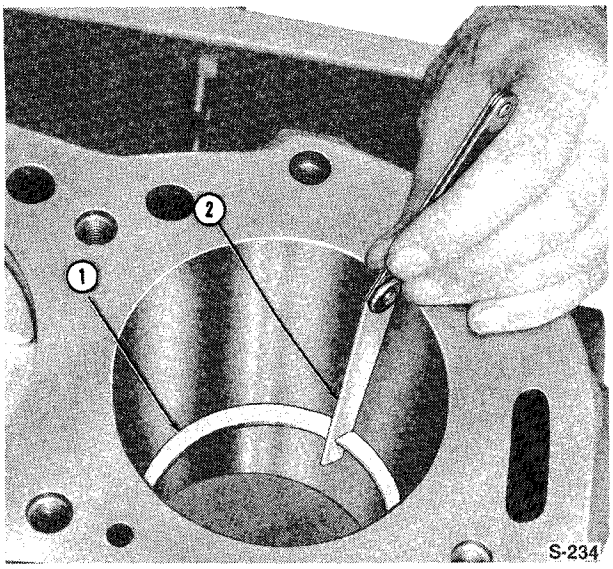

Figure 48
Measuring Piston Ring Gap
1. Piston Ring
2. Feeler Gauge

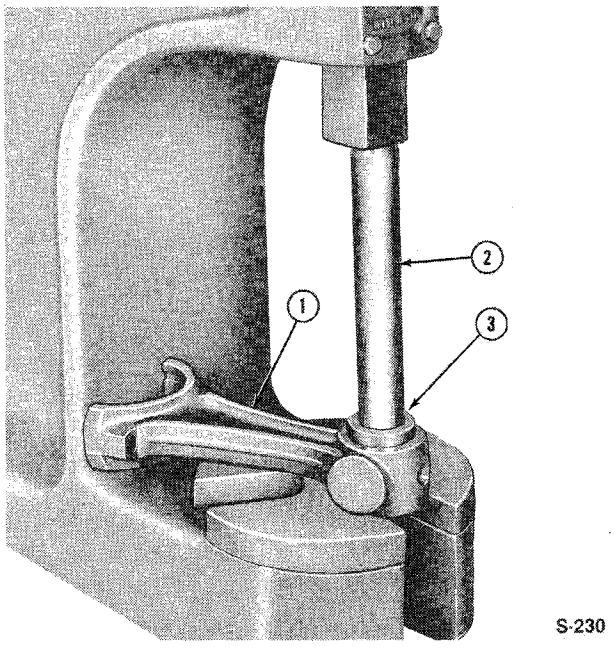

Figure 49
Connecting Rod Bushing Removal And Installation
1. Connecting Rod
2. Handle - Tool No. 9514
3. Adapter

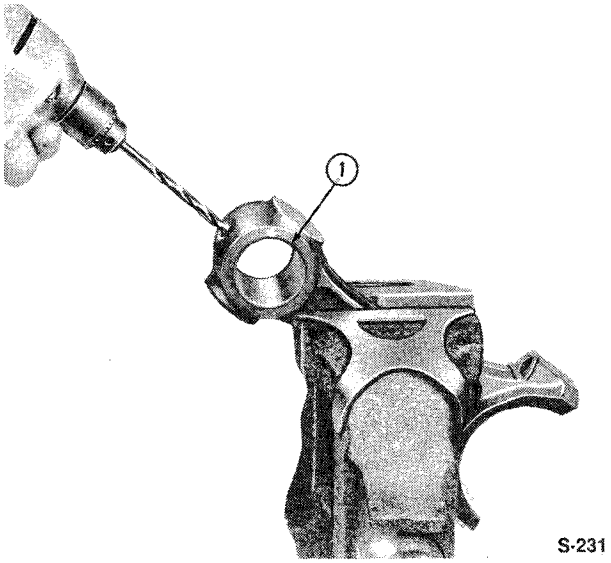

Figure 50
Connecting Rod Bushing Installed
1. Connecting Rod Bushing

7. Use an expansion reamer to ream the bushing to obtain the specified bushing-to-piston pin clearance.

8. Check the connecting rod and main bearing clearances as described in this Chapter. If the bearing clearances exceed the specified limits, see "Specifications"—Chapter 3, then install new bearings as described in the CRANKSHAFT section of this Chapter.

CYLINDER BLOCK

6. Clean and inspect the cylinder block. Rust around the core plugs indicates leakage and new plugs should be installed with suitable sealant.

7. Inspect and measure the cylinder bores for waviness, scratches, scuffing, out-of-round, wear and taper. A wavy cylinder wall has a series of parallel lines or rings worn around the cylinder, within the ring travel area. These irregularities can be felt by running a finger over the surface. A scuffed cylinder can be identified by discolored areas. Out-of-roundness, wear and taper can only be detected with a cylinder bore gauge. Measure lengthwise and crosswise to obtain dimensions 'A', 'B', 'C' and 'D', Figure 51. Dimension 'A' compared with 'B', and dimension 'C', compared with 'D', indicates taper while the

crosswise dimensions 'C' and 'D' compared to the lengthwise measurements 'A' and 'B' show if an out-of-round condition exists. See "Specifications"—Chapter 3.

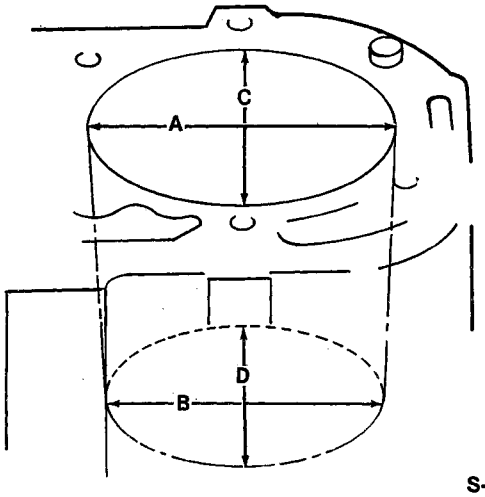

Figure 51
Cylinder Bore Measurements

If the cylinders are outside specification or the walls are damaged, the cylinder block must be bored and relined to accept the standard size headland pistons.

NOTE: Headland pistons are available in standard bore size only. When replacing headland pistons in an engine block with bore damage or wear, the cylinder block must be bored and relined to accept the standard size parts. Conventional oversize pistons are available for installation if relining is not desired.

8. Check the flatness of the cylinder block-to-head surface, see "Specifications"—Chapter 3. Minor surface imperfections may be removed by taking a light surface mill cut off the face of the block.

IMPORTANT: *The block cannot be milled so as to cause the piston to exceed the piston crown-to-block face dimension specification.*

Piston Crown-to-Block Face Dimensions:
0.011-0.023 in (0.279-0.584 mm) above.

NOTE: Headland pistons must never be milled to reduce the piston crown height.

CYLINDER SLEEVE INSTALLATION

- 4.4 in. (111.76 mm) Bore Thin Walled Lipped Sleeve:

(i) Measure the ouside diameter of the sleeve in four places and find the average diameter. Bore the block to 0.000-0.002 in. (0.00-0.05 mm) less than this average diameter.

(ii) Machine the counterbore to the dimensions shown in Figure 52. The counterbore depth is critical as the sleeve must be flush with the block surface when installed.

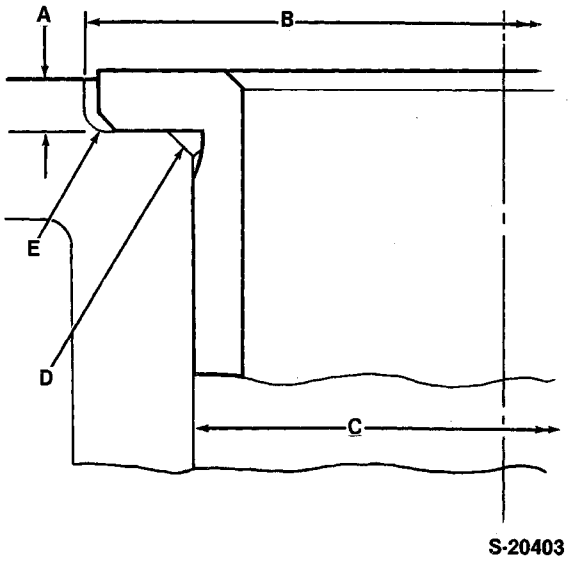

Figure 52
Dimensions for Machining Cylinder Bore For Thin Walled Sleeve

A. 0.095-0.099 in. (2.41-2.51 mm)
B. 4.746-4.753 in. (120.55-120.73 mm)
C. Bore Cylinder to Average Diameter of Sleeve less 0.000-0.002 in. (0.00-0.05 mm)
D. 0.020-0.030 in. (0.50-0.75 mm) x 45° Chamfer
E. 0.015 in. (0.381 mm) Radius Maximum

(iii) Install the liner and be sure the lip bottoms in the counterbore. If necessary the sleeve may be machined to bring it flush with the block face, or if necessary, the block face may be skimmed by up to 0.005 in. (0.13 mm) to achieve a flush condition. If the block is skimmed be sure the piston

to block height dimension is maintained within specification, Figure 53. See "Specifications" – Chapter 3.

(iv) Bore and hone the sleeve to the diameter required.

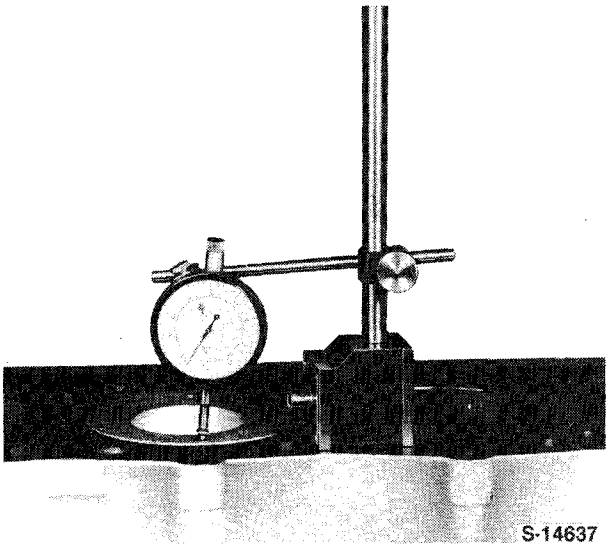

Figure 53
Measuring Piston To Block Height

ASSEMBLY

NOTE: *Prior to assembly, check the cylinder bores for taper and out-of-round previously described in this Chapter.*

1. Lubricate all components with clean engine oil then assemble the piston to the connecting rod with the dimple or notch on top of the piston facing forward and aligned with the pip on the connecting rod, Figure 55. Install the piston pin and retainer clips (snap rings).

2. Using an expander tool to install the rings, install the rings on the piston starting with the oil control ring in the bottom groove and working upwards.

INSTALLATION

NOTE: *Before installing a piston and new rings into a used cylinder bore, remove the high polish on the cylinder wall by passing a hone lightly through the cylinder or by making a figure eight pattern with very fine emery cloth dipped in a mixture of fuel and lubricating oil. After honing, thoroughly wash and dry the bores and coat the walls with oil.*

IMPORTANT: *Use care during assembly and installation to not drop, bump, or otherwise mishandle the headland piston as damage to the piston insert may occur. Do not apply any pressure on the insert during installation.*

1. Turn the crankshaft to position No. 1 crankpin at the bottom of the stoke. Lubricate the piston, rings, cylinder bore and bearing liners with clean engine oil. Using a ring compressor, install the piston into the cylinder, Figure 54. Be sure the dimple or notch on the top of the piston is towards the front of the engine, Figure 55.

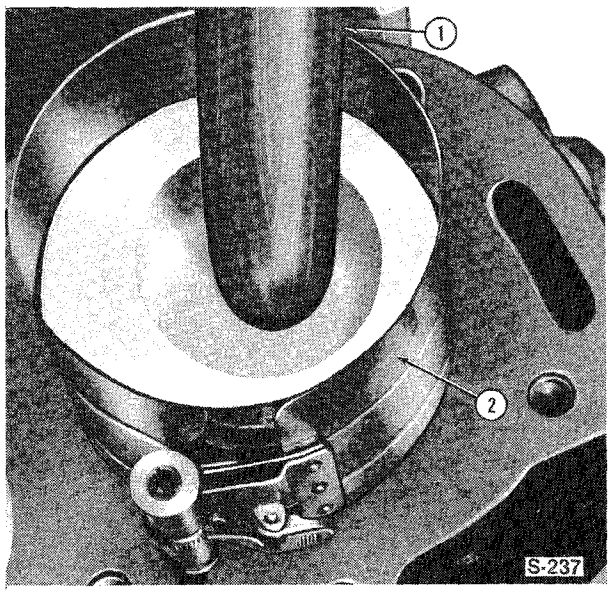

Figure 54
Piston and Connecting Rod Installation
1. Hammer Handle
2. Piston Ring Compressor

NOTE: *With headland pistons, do not remove the plastic cap until after the piston is installed. Be careful not to apply any pressure to the insert bond area, Figure 55.*

2. Push the piston into the bore until the connecting rod liner seats on the crankpin.

NOTE: *Select the correct bearing liners as described in the CRANKSHAFT section of this chapter.*

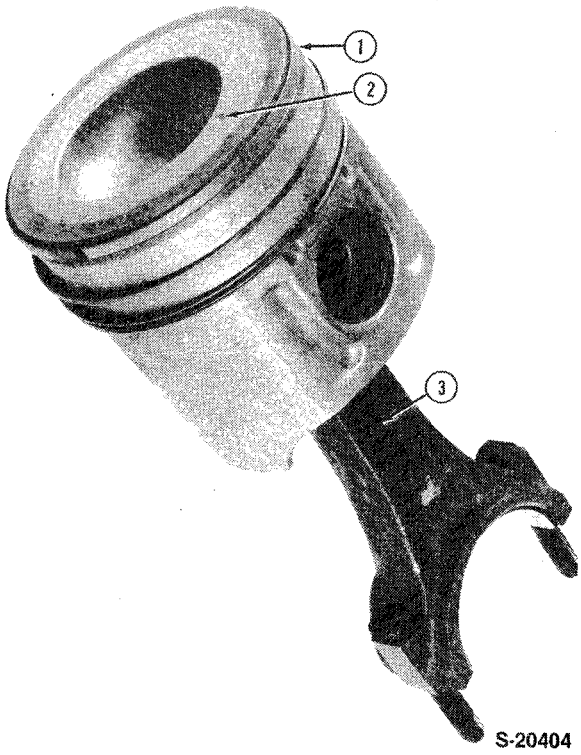

Figure 55
Headland Piston

1. Insert
2. Piston Crown Stamping - Front
3. Connecting Rod Pip

Install the connecting rod bearing cap with the number on the cap on the same side as the number stamped on the rod, Figure 56. Install new nuts and tighten to the specified torque, see "Specifications" Chapter 3.

With headland pistons, as or after the piston is installed, pull the plastic cap off the piston by holding it through the half-moon section, Figure 57.

IMPORTANT: *Do not attempt to remove any adhesive material that may stick to the top of the piston. This will evaporate during normal engine operation.*

3. Run your fingernail across the bond line on top of the piston at several points around the total circumference. See Figure 58. If you sense any irregularities or step between these surfaces at any point, it is likely that the piston bond has been fractured and the piston should be replaced.

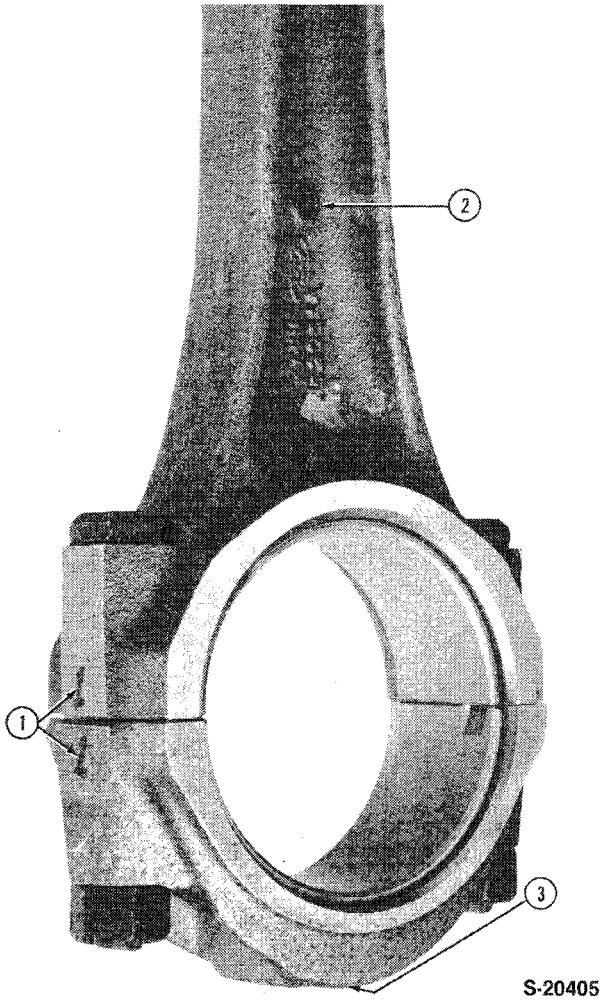

Figure 56
Piston To Connecting Rod Alignment

1. Notch To Front of Engine
2. Connecting Rod Pip
3. Cap Numbers

4. Use feeler gauges to check the side clearance of each connecting rod, Figure 59, see "Specifications" Chapter 3.

5. Install the remaining piston and rod assemblies in the same manner.

6. Install the oil pump, the oil pan and the cylinder head as previously described in this Chapter.

7. Fill the engine with the correct grade and quantity of oil and the radiator with coolant, see "Specifications"—Chapter 3.

8. Start the engine and check for leaks.

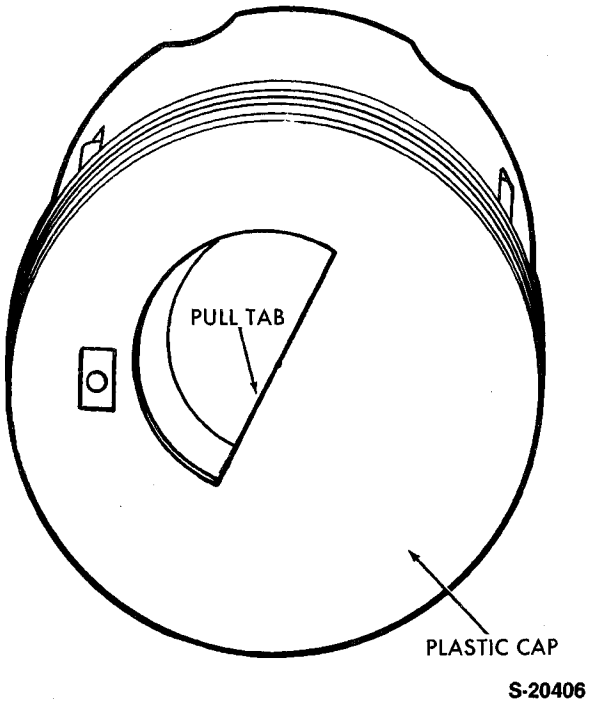

Figure 57
Plastic Cap

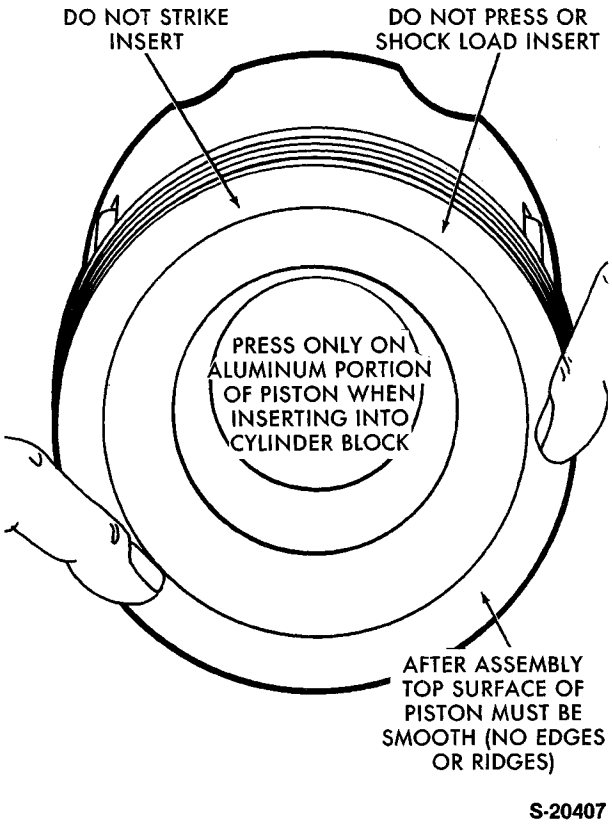

Figure 58
Headland Piston
(Plastic Cap Removed)

DYNAMIC BALANCER, MAIN BEARINGS, FLYWHEEL AND CRANKSHAFT

NOTE: *Replaceable bearing liners are installed in production to assure the correct crankshaft journal-to-bearing clearance can be maintained in Service. The main bearings and balancer can be overhauled with the engine installed in the tractor. However, if a new rear main bearing liner is to be installed, the engine will have to be separated from the tractor and the rear oil seal replaced as detailed in this Chapter. The crankshaft can only be serviced after removal of the engine from the tractor. To remove the flywheel, either remove the engine from the tractor or separate the tractor between the engine and the front transmission. See "SEPARATING THE TRACTOR"—Part 12.*

DYNAMIC BALANCER

REMOVAL

1. Remove the oil pan sump as previously described in this Chapter.
2. Use a dial indicator gauge to check the backlash between the crankshaft gear and the balancer drive gear, Figure 60. Position the dial plunger perpendicular to the face of one of the drive gear teeth, then rock the drive gear to measure the backlash. Take the backlash reading at 90° intervals around the drive gear. If the backlash exceeds the specified limits see "Specifications"—Chapter 3, install new balancer gears.
3. Withdraw the retaining bolts and remove the balancer assembly.

DISASSEMBLY

1. Drive out the roll pins securing the shafts to the housing, and disassemble the balancer components as shown in Figure 61.