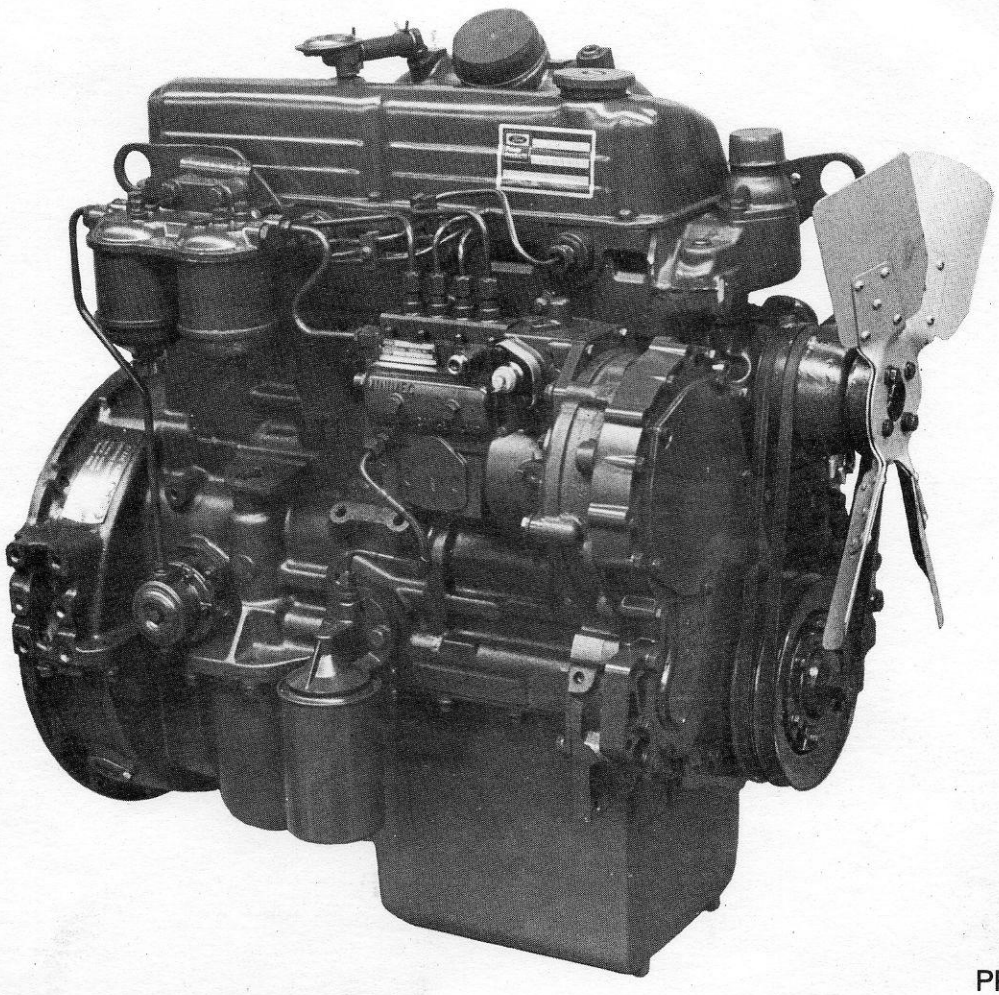
Ford

Power Products

DIESEL ENGINES

ESD-442
ESD-659
ESD-660T
ESD-662

SERVICE MANUAL



PPO 194-243
November, 1983

Introduction

This Service Manual provides the service technician with information for the proper servicing of the Dover Industrial Engine.

In general, this manual covers the servicing of the engine and associated standard equipment. In many cases, engines are supplied with accessories and equipment that are unique to the application. If service information is ever required on such unique accessories or equipment it is suggested that the Industrial Engine Operations of Ford Motor Company be contacted. The proper information will either be forwarded or the Service Technician will be advised where it can be obtained.

The information in this manual is grouped in sections according to the type of work being performed. The various sections are indicated in the index. In addition, each section is subdivided to include topics such as diagnosis and testing, cleaning and inspection, overhaul, removal and installation procedures, disassembly and assembly procedures, and service specifications.

Where the terms "Right" or "Left" occur in this publication, they refer to the respective sides of the engine when viewed from the rear or flywheel end.

Pistons and valves are numbered from the front or timing cover end of the engine commencing at Number 1.

Ford Parts and Service Division
Power Products Operations
3000 Schaefer Road
P.O. Box 6011
Dearborn, Michigan 48121

Note: The recommendations and suggestions contained in this publication are made to assist the distributor in improving his distributorship parts and/or service department operations. These recommendations and suggestions do not supersede or override the provisions of the Warranty and Policy Manual and in any cases where there may be a conflict, the provisions of the Warranty and Policy Manual shall govern.

IMPORTANT SAFETY NOTICE

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 the Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific operation. If you have a manual transmission, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) to the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts, when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind the head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.

PART I - Basic Engine

COMPONENT INDEX

IDENTIFICATION

An Identification Decal (Fig. 1) is affixed to the rocker cover of the engine. The decal contains the engine serial number which identifies the unit from all others. Next is the engine displacement which determines the engine specifications, then the model number and S.O. or special options which determines the parts or components required on the unit. Use all the numbers when seeking information or ordering replacement parts for your unit.

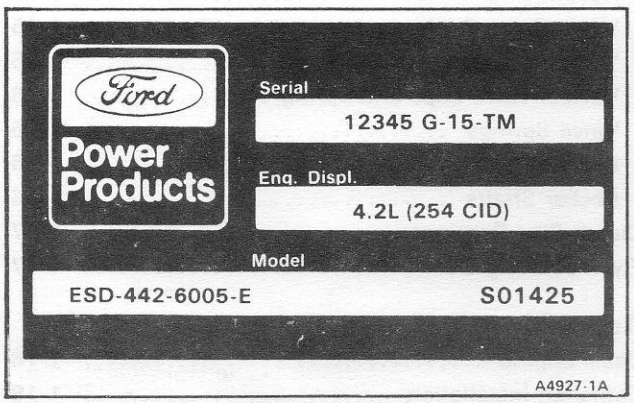


Fig. 1 - Identification Decal

Engine Identification

Identification of the cylinder block, and therefore of the basic engine type can be make by reference to the rised machined pad on the top edge of the cylinder block. As shown in Fig. 2 the identification points are on the fuel injection pump side of the engine.

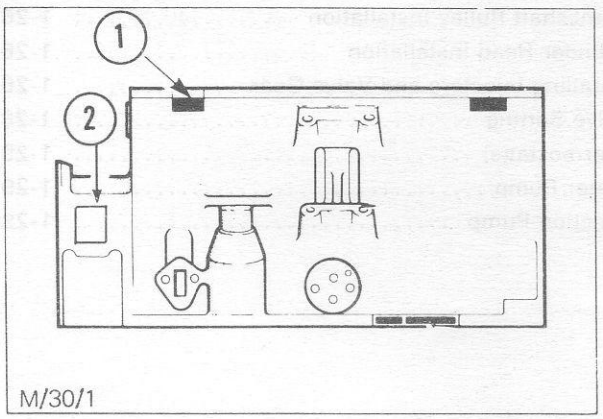


Fig. 2 - Cylinder Block Identification Codes

1. Engine Capacity
2. Engine Build Data Plate and Engine Build Date

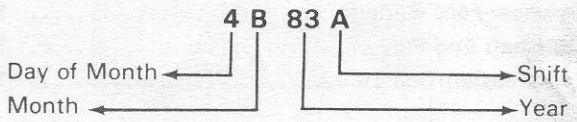
Engine Capacity

Code	Engine Capacity & Type
255	4.2 Litre (254 Cu. In.)
365NA	5.9 Litre (362 Cu. In.)
380NA	6,2 Litre (380 Cu. In.)
365TC	6,0 Litre (363 Cu. In.)

Note: NA - Naturally Aspirated
TC - Turbocharged

Engine Build Date

The engine build date is stamped in the right upper corner of the engine build data plate (Fig. 3).



A - Jan.	E - May	I - Sept.
B - Feb.	F - June	J - Oct.
C - March	G - July	K - Nov.
D - April	H - Aug.	L - Dec.

Orignial Engine Build Data Plate

During engine production, an original engine build data plate is installed on the right hand side of the cylinder block on the flywheel housing (Fig. 2). This plate identifies in millimeters the crankshaft main journal diameter (crank mains), main bearing cap/cylinder block inside diameter (block mains), and the crankshaft rod journal diameter (crank pins).

Four possible combinations of sizes may be encountered, and these are identified by the color of the plate and the dimensions on the plate (Fig. 3 A, B, C and D).

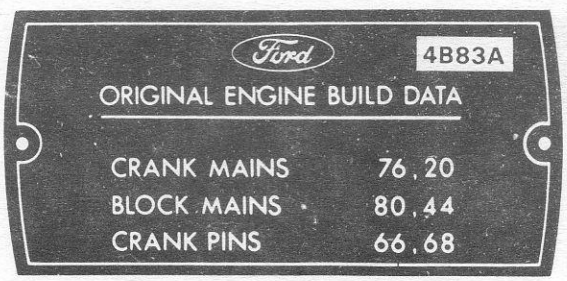


Fig. 3 A - Green

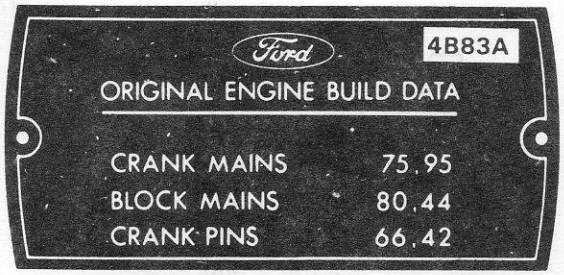


Fig. 3 B - Blue

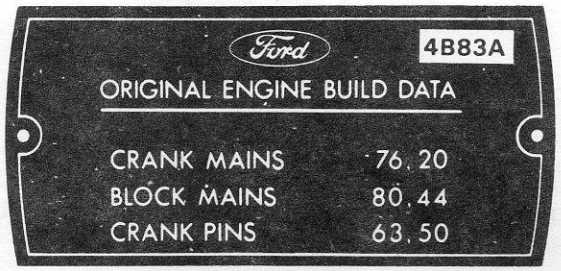


Fig. 3 C - Black

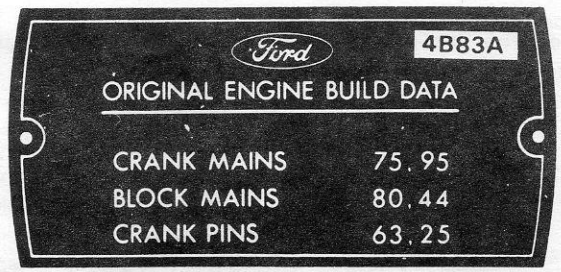


Fig. 3 D - Orange

Service Engines

Service engines are fitted with a service cylinder data plate, giving dimensions in millimeters of crank main bearing diameter, crank rod bearing diameter, block main bearing diameter, and block cam bearing diameter (Fig. 4).

The service cylinder data plate is fitted in place of the original engine build data plate.

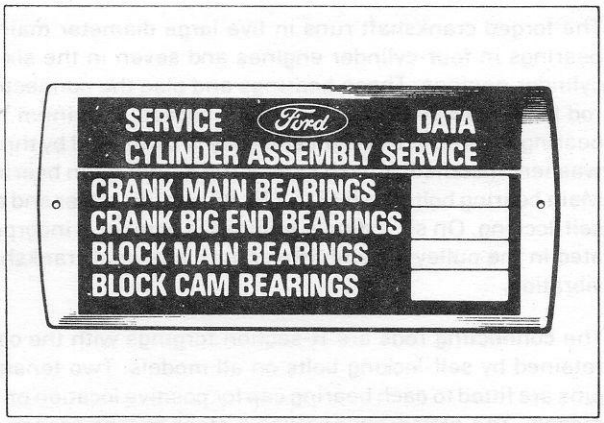


Fig. 4 - Service Cylinder Data Plate

DESCRIPTION

General

The Dover range of Ford Industrial Engines includes the following Models:

ESD-442	4 Cyl.	4.2 Liter (254 CID)
ESD-659	6 Cyl.	5.9 Liter (362 CID)
ESD-660T	6 Cyl.	6.0 Liter (363 CID) Turbo
ESD-662	6 Cyl.	6.2 Liter (380 CID)

Refer to Part 8, the Specifications section of this manual, for the bore, stroke and other details.

The engines are the direct injection type and operate on the four stroke cycle.

Overhead valves are mounted vertically in replaceable guides in the cast iron cylinder head and are operated by rockers, push rods and tappets from a camshaft located in the right-hand side of the cylinder block.

The camshaft is driven at half engine speed by a gear meshing directly with the crankshaft gear. Steel-backed bearing bushings support the camshaft.

The four-cylinder engine has four bearings and the six cylinder engine has six. The front bearing is bronze while the remainder are white metal.

A helical gear, machined integral with the camshaft drives the oil pump. An eccentric for the fuel pump is also incorporated on the camshaft.

Camshaft thrust is taken by a thrust plate bolted inside the timing case to the cylinder block front face. This thrust plate is located between thrust washers adjacent to a removable collar on the camshaft and the camshaft gear.

The forged crankshaft runs in five large diameter main bearings in four-cylinder engines and seven in the six-cylinder engines. These bearings and also the connecting rod bearings have removable steel-backed aluminum tin bearing inserts. Crankshaft end-play is controlled by thrust washers installed at each side of the center main bearing. Main bearing bolts are 5/8 in. (15.88 mm) diameter and are self-locking. On six-cylinder engines, a damper is incorporated in the pulley assembly to control torsional crankshaft vibration.

The connecting rods are H-section forgings with the caps retained by self-locking bolts on all models. Two tension pins are fitted to each bearing cap for positive location on all models. The piston pin end has a steel-backed bronze bushing.

Aluminum alloy solid skirt pistons with the combustion chamber machined in the piston crowns are used. The pistons of the naturally aspirated engine have two compression and one oil ring. In the turbocharged engine each piston has three compression and one oil control ring. The piston pins are full floating and are held in position by snap rings installed in grooves at each end of the piston pin bore.

The cylinder bores of the turbocharged engine have dry type, pre-sized, slip fit, hard faced cylinder liners. All other models have the piston in contact with the cylinder block. The cylinder block is cast iron and does not incorporate a tappet chamber. Push rods and drain holes are machined in the block.

The oil pans are aluminum castings and are located by dowels on the six-cylinder engines to ensure positive alignment of the rear face.

The fuel injection pump is an in-line type with a separate pumping element for each engine cylinder; it contains a mechanical governor to ensure that the selected engine speed remains constant despite variations in the driven load.

There is a provision for various combinations of power take-offs from the front and rear of the timing gear cover.

The aluminum alloy pan is cast integral with the lower half of the flywheel housing, and incorporates a dipstick housing.

The illustrations in Fig. 5 show the crankcase breathing systems.

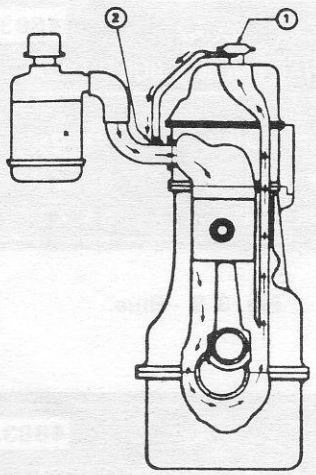


Fig. 5
1. Emission Control Valve
2. Fumes Pass Into Inlet Manifold

DIAGNOSIS AND TESTING

Camshaft Lobe Lift

Check the lift of each lobe in consecutive order and make a note of the readings:

1. Remove valve rocker arm cover.
2. If only one camshaft lobe is to be checked, loosen the valve rocker arm adjusting screw. Slide the rocker arm assembly serving the camshaft lobe to be checked to one side. Secure it in this position. Repeat this procedure on other lobes to be checked. Indicator is in the push rod socket and in the same plane as the push rod movement.
3. Make sure the push rod is in the valve lifter socket. Install a dial indicator so that the actuating point of the indicator is in the push rod socket and in the same plane as the push rod movement (Fig. 6).
4. Connect an auxiliary starter switch in the starting circuit. Crank the engine with the stop control in the "Stop" position. Bump the crankshaft over until the tappet or lifter is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.
5. Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position.
6. Compare the total lift recorded on the indicator with specifications.

7. To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. **If the lift on any lobe is below specified wear limits, the camshaft and the valve lifters operating on the worn lobe(s) must be replaced.**
8. Remove the dial indicator and auxiliary starter switch.
9. Install and adjust the rocker arms as detailed under Removal and Installation.
10. Install the valve rocker arm cover.

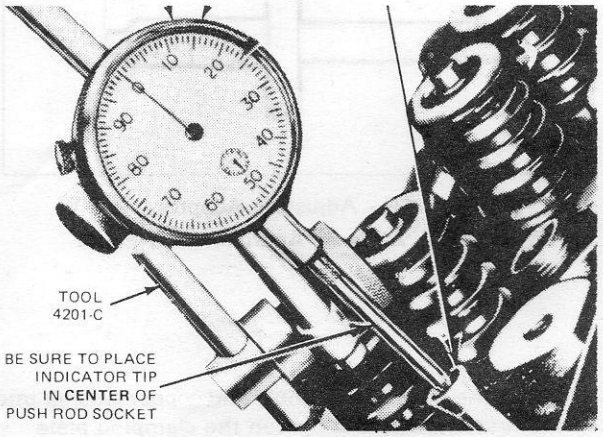


Fig. 6 - Testing Camshaft Lobe Lift - Typical

Crankshaft End Play

1. Force the crankshaft toward the rear of the engine.
2. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 7).
3. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.
4. If the end play exceeds the wear limit, replace the thrust washers. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt.

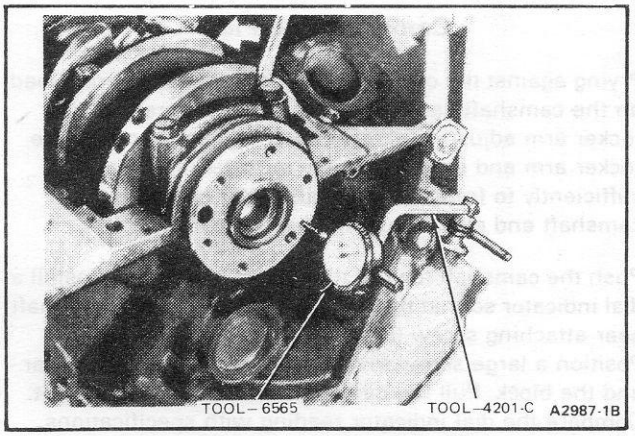


Fig. 7 - Checking Crankshaft End Play - Typical

Flywheel Face Runout

Using a dial gauge and magnetic base check that the flywheel run out is within the specified limits when measured at 140 mm (5,50 in.) radius (Fig. 8).

If the run out is excessive, remove the flywheel and check the flange and flywheel mating faces for burrs or filings. Lightly stone off any burrs and thoroughly clean off any dirt and/or filings. Reassemble and recheck the run out as before.

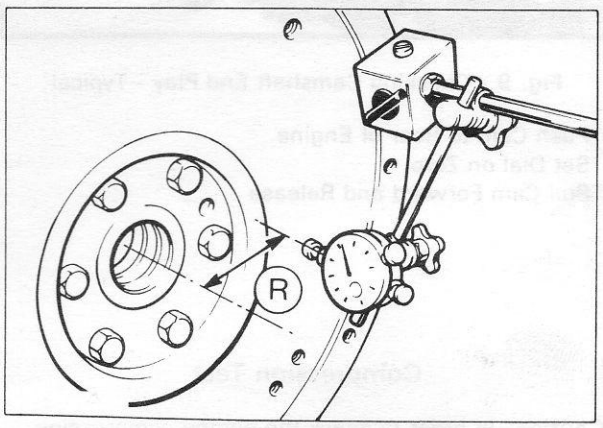


Fig. 8 - Checking Flywheel Run-Out
R = 140 mm (5,50 in.)

Camshaft End Play

Prying against the camshaft gear with the valve train load on the camshaft can damage the gear. Therefore, the rocker arm adjusting screws must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end play, adjust the valve clearance.

Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft gear attaching screw (Fig. 9). Zero the dial indicator. Position a large screwdriver between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications.

If the end play is excessive, check the plate for correct installation before it is removed. If the plate is correctly installed, replace the thrust plate.

Remove the dial indicator.

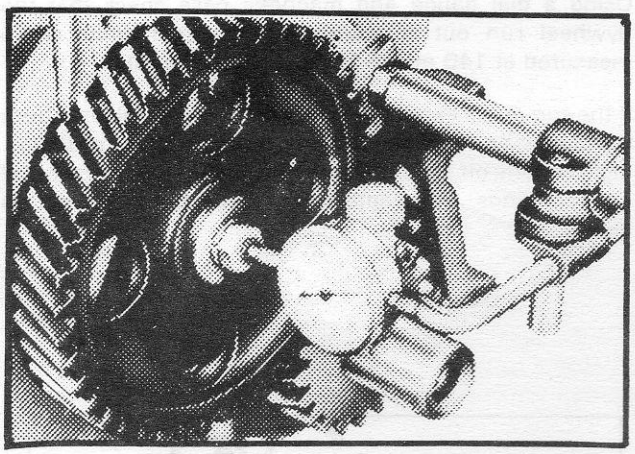


Fig. 9 - Checking Camshaft End Play - Typical

1. Push Cam to Rear of Engine
2. Set Dial on Zero
3. Pull Cam Forward and Release

Compression Test

Caution: In order to check the engine compression pressures, it is necessary to remove all the injectors. Fuel injection equipment is machined to extremely fine limits, and every precaution should be taken to avoid damage to the injectors when they are removed.

1. If the engine will start, run it and allow it to reach normal operating temperture. Be sure the battery is up to specification.
2. Stop the engine and remove all the injectors as detailed in Part 3.
3. Select a suitable cooper sealing washer for the adaptor. Adjust the adaptor so that the overall length of the assembly (from clamping plate to end of adaptor) is approximately the same as the injector body (Fig. 10).

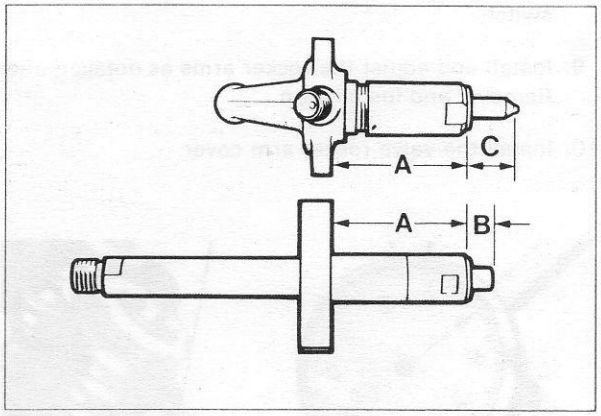


Fig. 10 - Adjusting Adaptor
Dimension "A" to be Approximately Equal

4. Install the adaptor assembly and copper washer into the first cylinder and tighten the clamping plate securely. Connect the pressure gauge assembly to the adaptor.
5. Secure the engine stop control lever on the injection pump in the "no delivery" position.
6. Crank the engine by the starter, and continue to "crank" until the pressure gauge is indicating a steady pressure. Note the pressure obtained.
7. Repeat the operation for the remaining cylinders.
8. Compare the pressure readings obtained from each cylinder with those specified. If the pressure variation is outside the specified limits, or if all cylinder pressures are low, engine damage or wear is indicated.

Note: Specified compression pressures are for normal atmospheric conditions at sea level. At altitudes considerably above sea level, proportionally lower compression pressures will be obtained.

9. Remove and dismantle the test equipment.
10. Check the injector seats to ensure that they are clean and free from any carbon deposits.
11. Install the injectors and bleed the system as detailed in Part 3 and install the valve cover.
12. Start the engine and allow it to run for a short period. Check for oil or fuel leaks. Rectify any leakage as necessary.

DISASSEMBLY

Basic Engine

1. If so equipped, disconnect and remove the turbocharger oil feed pipe and oil return pipe. Detach pipe connecting injection pump boost control and inlet manifold.
2. On the turbocharged industrial engine, loosen clamps securing hose between turbocharger and air inlet pipe, unscrew attaching bolts and remove the pipe.
3. Remove nuts attaching turbocharger to support plate and detach the exhaust outlet elbow. Discard gasket(s).

   Remove turbocharger support plate and bracket from cylinder block. Remove nuts attaching turbocharger to exhaust manifold and detach the turbocharger. Protect turbocharger from ingress of dirt and foreign bodies.
4. Remove inlet manifold and discard all gaskets.
5. Remove exhaust manifold and discard gaskets.
6. Remove starter motor.
7. Lift engine with a suitable hoist, using the cylinder head lifting brackets and mount the engine on the stand.
8. Remove dipstick and, in the case of a high level dipstick, remove the dipstick tube from the oil pan. Unscrew and discard the oil filter.
9. Remove low pressure fuel pipes connecting fuel lift pump, fuel filters and injection pump.
10. Remove fuel lift pump and (if so equipped) the pre-filter unit.
11. Remove fuel filters complete with mounting bracket.
12. Loosen or remove the high pressure fuel pipe clamps as necessary to enable the large oil seal nuts to be backed off.
13. Unscrew the nuts from the injectors and the injection pump and remove the high pressure fuel pipes.
14. Install plugs/caps to all injection equipment apertures, including pipe ends.
15. Remove oil feed pipe between oil filter head and injection pump. Remove filter head from cylinder block and discard gasket. Remove oil pressure sender unit.
16. Detach the lead connecting injection pump automatic excess fuel solenoid to temperature sensitive switch on the thermostat housing.
17. Unscrew the three retaining bolts and remove the injection pump.
18. Remove fan mounting bolts, fan and belt. On "Low Loss" Fan Drive System, also remove the bearing retainer outer plate which is retained by the fan attaching bolts.

    Note: On single belt drives, the pulley can be removed at the same time.
19. Remove water hose(s).
20. Remove water pump attaching bolts/nuts and remove pump from engine. Discard the gasket.
21. Remove alternator. Remove the water pump extension tube (if so equipped) together with the engine mounting bracket or spacers, as applicable.
22. Remove thermostat housing and lift out the thermostat(s).
23. Remove oil pan drain plug(s) and drain off the engine oil into a suitable receptacle.
24. Remove the rocker cover.
25. Loosen each rocker shaft pedestal retaining bolt approximately one turn at a time until all are loose, then remove them.
26. Tie the two end rockers in position to keep the complete assembly together, then lift off rocker shaft assembly complete.
27. Remove push rods in sequence and mark them to ensure that they are replaced in their original positions when assembling them later. Do not dislodge the valve stem caps.

Removing Injectors

28. Remove banjo bolts from leak-off line, then unscrew bolt and remove leak-off line from cylinder head.
29. Unscrew two retaining bolts and remove each injector. Discard "O" ring. Remove copper sealing washers from recesses in cylinder head and discard them (Fig. 11).