

David Brown*

Service Repair Manual

Three-Cylinder Diesel Engine

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Written In *Clear
And
Simple
English*

David Brown Tractors Ltd

A Tenneco Company

Affiliate of J I Case



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IDENTIFICATION OF THE ENGINE

There is a number on the right-hand side of the cylinder block. This number is used in the following way:

First number: Amount of cylinder.

Second and third numbers: These numbers show the capacity of ONE cylinder in cubic inches. When you multiply this amount by the first number, the result is the capacity of the engine.

Fourth number: Type of fuel used.

0 = diesel

1 = gasoline

Fifth number: Design series

0 = first series

1 = second series etc.

Sixth number: Type of clutch

1 = livedrive

2 = not livedrive

5 = twin plate

The next series of numbers are for the identification of a specific engine.

EXAMPLE:

No. 3 5 5 0 1 1/1 0 0 1

3 cylinders

55 cu in

Diesel

Design Series

Livedrive

This engine is a 3 cylinder, 165 cu.in capacity, diesel fuel, second series, livedrive model, serial number 1001.



This safety alert symbol indicates important safety messages in this manual.

When you see this symbol, carefully read the message that follows and be alert to the possibility of personal injury.

SPECIFICATIONS

TORQUES:

Connecting rod nuts	68 Nm	50 lb ft	6.9 kgm
Camshaft gear bolt	54 Nm	40 lb ft	5.5 kgm
Crankshaft balance weight bolts	54 Nm	40 lb ft	5.5 kgm
Cylinder head nuts	136 Nm	100 lb ft	13.8 kgm
Cylinder head studs	34 Nm	25 lb ft	3.5 kgm
Flywheel nuts	68 Nm	50 lb ft	7.0 kgm
Main bearing cap bolts	163 Nm	120 lb ft	16.6 kgm
Main frame to engine bolts	41 Nm	30 lb ft	4.2 kgm
Oil filter bowl bolt	14 Nm	10 lb ft	1.4 kgm
Sump to main frame bolts	27 Nm	20 lb ft	2.8 kgm
Sump to main frame bolts	27 Nm	20 lb ft	2.8 kgm
Valve rocker locking nuts	19 Nm	14 lb ft	1.9 kgm

For all other bolts and nuts with either UNC or UNF threads, use the following chart:

Thread Diameter	Torque		
$\frac{1}{4}$ in	9.5 Nm	7 lb ft	0.97 kgm
$\frac{5}{16}$ in	20 Nm	15 lb ft	2.1 kgm
$\frac{3}{8}$ in	34 Nm	25 lb ft	3.5 kgm
$\frac{7}{8}$ in	61 Nm	45 lb ft	6.2 kgm
$\frac{1}{2}$ in	88 Nm	65 lb ft	9.0 kgm
$\frac{3}{4}$ in	150 Nm	110 lb ft	15.2 kgm
$\frac{1}{2}$ in	190 Nm	140 lb ft	19.4 kgm

CAPACITIES

Cooling system	8.5 l	15 pt
Lubricating oil	6.25 l	11 pt
Air cleaner oil bath	0.7 l	1½ pt

DIMENSIONS:

Bore (see page 4)	100 mm	3½ in
Stroke	114.3 mm	4½ in
No. of cylinders	3	
Total capacity	2694 cm³	164.4 in³
Rated speed	1800 r/min	
Maximum full load speed	2200 r/min	
Maximum no load speed	2350 r/min	
Compression ratio	17 : 1	
Firing sequence	1, 2, 3	

VALVE CLEARANCES:

The correct clearance for all valves is 0.25 mm (0.010 in) when the engine is cold.

VALVE SPRINGS:

Length:

No load	50 mm	1.970 in
40 lb load	38.8 mm	1.530 in
80 lb load	28 mm	1.102 in
15 kg load	40.8 mm	1.608 in
30 kg load	31.5 mm	1.24 in

VALVE STEMS:

Diameters:

Normal	9.479 to 9.454 mm	0.3732 to 0.3722 in
Oversize 0.25 mm (0.010 in)	9.733 to 9.708 mm	0.3832 to 0.3822 in
Oversize 0.5 mm (0.020 in)	9.987 to 9.962 mm	0.3932 to 0.3922 in

SPECIFICATION

VALVE SEAT ANGLE:

45°

VALVE TIMING:

Inlet opens	8° before top dead centre
Inlet closes	38° after bottom dead centre
Exhaust opens	36° before bottom dead centre
Exhaust closes	10° after top dead centre

INJECTORS:

Operating pressure	2573 lb in ²	180 kg cm ²	175 Atm.
New injectors or injectors with new springs	2720 lb in ²	191 kg cm ²	185 Atm.

FUEL INJECTION PUMP

Distributor Type (CAV 3233000)

The static timing is 16° before top dead centre.

The pump flange and drive housing each have a mark and the timing is correct when the two marks are in alignment.

CONNECTING ROD ALIGNMENT:

Maximum out of parallel	0.0127 mm per cm	(0.0005 in per in)
Maximum twist	0.0127 mm per cm	(0.0005 in per in)
Maximum weight difference in set of three rods	7.1 g (0.25 oz)	

ROCKER SHAFT:

Diameter	18.99 to 19.02 mm	0.748 to 0.749 in
Bushes	19.05 to 19.06 mm	0.7500 to 0.705 in

CAMSHAFT JOURNALS:

Front	60.2869 to 60.2615 mm	2.3735 to 2.3725 in
No. 2	47.5488 to 47.5158 mm	1.8720 to 1.8707 in
No. 3	46.7919 to 46.7588 mm	1.8422 to 1.8409 in
No. 4	45.6032 to 45.5676 mm	1.7954 to 1.7940 in
No. 5	44.4195 to 44.3865 mm	1.7488 to 1.7475 in
End clearance	0.05 to 0.15mm	0.002 to 0.006 in

CRANKSHAFT

Main journal diameter		
Standard size	63.487—63.474 mm	2.4995—2.4990 in
Undersize 0.254 mm (0.010 in)	63.233—63.220 mm	2.4895—2.4890 in
Undersize 0.508 mm (0.020 in)	62.979—62.966 mm	2.4795—2.4790 in
Undersize 0.762 mm (0.030 in)	62.725—62.712 mm	2.4695—2.4690 in

BORE SIZES (New) AD 3/49 and AD 3/55

Standard	100.07—100.05 mm	3.9396—3.9388 in
Oversize 0.020 in	99.81—100.55 mm	3.9596—3.9588 in
Oversize 0.040 in	101.08—101.06 mm	3.9796—3.9788 in

AD 3/40 and AD 3/30

Sleeve diameter	96.86—96.84 mm	3.8135—3.8125 in
Taper—maximum	0.0127 mm	0.0005 in
Ovality—maximum	0.0127 mm	0.0005 in
Protrusion (excluding ridge)	0.058—0.0127 mm	0.002 —0.005 in

PISTONS

AD3/40, nominal diameter	96.8 mm	3 $\frac{1}{8}$ in
AD3/55, nominal diameter	100.0 mm	3 $\frac{1}{8}$ in
AD3/30, nominal diameter	96.8 mm	3 $\frac{1}{8}$ in
AD3/49, nominal diameter	100.0 mm	3 $\frac{1}{8}$ in
355011, nominal diameter	100.0 mm	3 $\frac{1}{8}$ in
AD3/40, skirt diameter	96.68—96.66 mm	3.8063—3.8055 in
AD3/55, skirt diameter	99.9—99.8 mm	3.9323—3.9315 in
AD3/30, skirt diameter	96.68—96.66 mm	3.8063—3.8055 in
AD3/49, skirt diameter	99.9—99.8 mm	3.9323—3.9315 in
355011, skirt diameter	99.9—99.8 mm	3.9323—3.9315 in
355011, skirt diameter	99.9—99.8 mm	3.9323—3.9315 in
AD3/40, height	101.6 mm	4 in
AD3/55, height	101.6 mm	4 in
AD3/30, height	114.3 mm	4 $\frac{1}{2}$ in
AD3/49, height	114.3 mm	4 $\frac{1}{2}$ in
355011, height	101.6 mm	4 in

PISTON RINGS AND GUDGEON PIN

Ring gap	0.28—0.406 mm	0.011—0.016 in
Compression ring, clearance in groove	0.057—0.078 mm	0.00225—0.00375 in
Scraper ring, clearance in groove	0.0508—0.0762 mm	0.002—0.003 in
Gudgeon pin diameter	31.750—31.745 mm	1.250—1.2495 in

(Push-fit in connecting rod bush, light-drive fit in piston)

OIL FILTER

Early Engines: Paper Element

Late Engines: Cartridge (Spin-on) Type

MAINTENANCE

AIR CLEANER

Air to the engine is first cleaned by a centrifugal filter or a paper filter element. The second part of the cleaning operation is an oil bath, and this is followed by a mesh screen.

IMPORTANT: Use only the correct grade of oil in the oil bath. If any other type of oil is used, the engine speed can get out of control and damage will be caused to the engine.

Service:

1. Remove the bowl, the screen mesh and the centrifugal filter. Clean them with fuel oil or kerosene.
2. Add new engine oil to the filter bowl up to the level shown inside the bowl.
3. Install the mesh screen, the bowl and the pre-cleaner. If a paper element is installed instead of a pre-cleaner, do the following.
4. Remove the centre bolt, the cover and the filter element.
5. Remove any dust or dirt from the element and look for damage. If there is any damage the element must be replaced.
6. Install the element, cover and centre bolt.

NOTE: A large amount of dirt in the bowl shows that the paper element is broken. An increase in the amount of black smoke from the exhaust shows that there is a restriction in the paper element.

FAN BELT:

The correct tension for the fan belt is as shown in Figure 1. To make the adjustment:

1. Loosen the bolts A and move the alternator until the tension is correct.
2. When the tension is correct, tighten the bolts.

NOTE. If you can not get the correct tension, replace the fan belt.

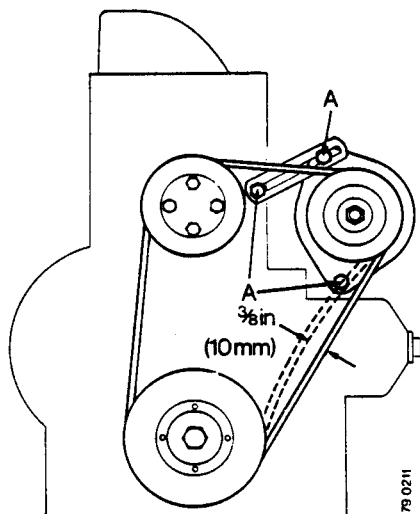


FIGURE 1 FAN BELT ADJUSTMENT

A. Securing Bolts

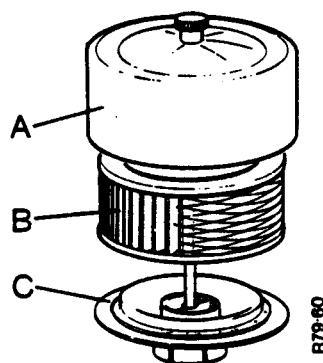


FIGURE 2 PRE-CLEANER

A. Cover B. Element C. Base

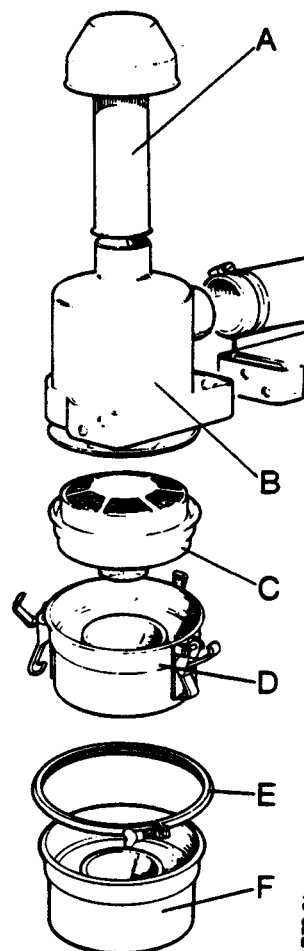


FIGURE 3 AIR CLEANER

A. Pre-Cleaner
B. Body
C. Element (Mesh)

D. Bowl with Clips
E. Clamp
F. Bowl } Early Engines

OIL FILTER:

It is a recommendation that the paper element is replaced every 250 hours. This is the maximum life of the element, and in some conditions the life can be much less. If you are not sure about the condition of the element, replace it. To replace the element do the following:

1. Clean the area around the filter.
2. Hold the filter case and remove the securing bolt.
3. Remove the case and the element.
4. Remove the sealing ring from the cylinder block.
5. Destroy the element and the sealing ring.
6. Clean the case with fuel oil using a brush. Clean the cylinder block and main frame.
7. Install a NEW sealing ring in the cylinder block.
8. Put the securing bolt in the case and a NEW element in position on the bolt.
9. Install the case with the element on the engine.
10. Tighten the securing bolt.

When you do this, make sure that the case is in the correct contact with the sealing ring.

11. Tighten the securing bolt to 13 Nm (10 lb ft).
12. Turn the engine with the starter for five seconds to fill the filter case with oil.
13. Check the level of oil with the dipstick and add oil if necessary.
14. Start the engine and check for leakage.

NOTE: Late model engines have a cartridge type filter. Installation instructions are as follows:

1. Use a strap wrench (K965917) to remove the old filter.
2. Clean the filter seat on the cylinder block and the area around it.
3. Check that the seal on the new filter cartridge is in good condition. Put a small amount of oil on the faces of the seal.
4. Install the cartridge on the screwed adaptor. Turn the cartridge until the seal is against the face of the block. Then tighten the cartridge $\frac{1}{4}$ to a turn more.
5. Start the engine and check for leaks. Stop the engine, check the oil level and add oil if necessary up to the correct level on the dipstick.

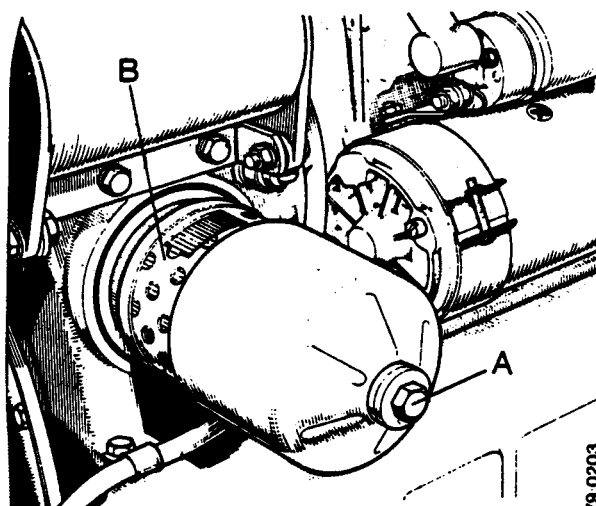


FIGURE 4 ENGINE OIL FILTER

A. Securing Bolt

B. Filter Element

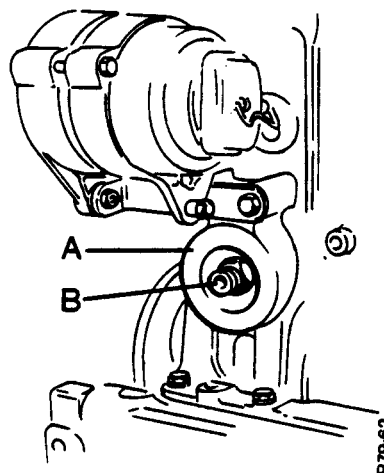


FIGURE 5 BLOCK WITH FILTER REMOVED

A. Filter seat

B. Screwed adaptor

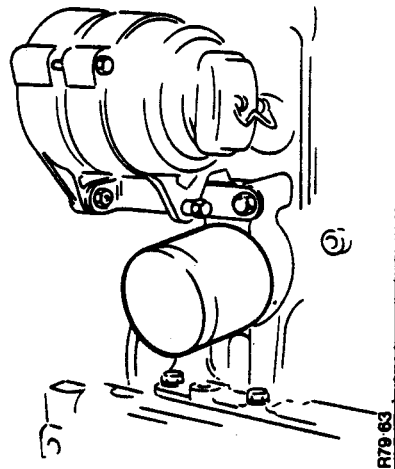


FIGURE 6 BLOCK WITH FILTER INSTALLED

CYLINDER HEAD TIGHTENING SEQUENCE:

The sequence for tightening the cylinder head nuts is shown in Figure 7. Do this job in the following steps:

First step: Tighten all the nuts to 41 Nm (30 lb ft) 4.15 kgm.

Second step: Tighten all the nuts to 81 Nm (60 lb ft) 8.3 kgm.

Third step: Tighten all the nuts to 122 Nm (90 lb ft) 12.4 kgm.

Fourth step: Tighten all the nuts to 136 Nm (100 lb ft) 13.8 kgm.

Fifth step: Check all the nuts at 136 Nm (100 lb ft) 13.8 kgm.

IMPORTANT: After tightening the cylinder head, you must check the valve clearances.

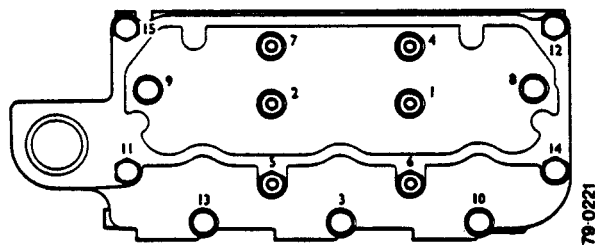


FIGURE 7 CYLINDER HEAD TIGHTENING SEQUENCE

CYLINDER HEAD NUTS

The five short nuts have now been replaced by nuts of a different type.

At the same time the torque specification was increased to 136 Nm (100 lb/ft).

This change was made to all engines after April 1976.

VALVE CLEARANCES:

The setting of the valve clearances must be done when the engine is cold. The correct clearance is 0.25 mm (0.010 in) for all the valves. Before making an adjustment, make sure that you measure the clearance when the tappet is on the base of the cam. The position of the valves in the cylinder head is as follows:

No. 1 Cylinder (Front)	No. 2 Cylinder (Centre)	No. 3 Cylinder (Rear)
---------------------------	----------------------------	--------------------------

Exhaust	Inlet	Exhaust	Inlet	Exhaust	Inlet
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To make the adjustment to the valve clearances do the following procedure:

1. Remove the cover from the cylinder head.
2. Turn the engine by hand in its normal direction of rotation and see which exhaust valve is closing. Turn the engine again until the inlet valve of the same cylinder starts to open. This position is the "valve rocking" position of that cylinder.
3. Measure the clearances of the valves shown in the chart and make any necessary adjustment.
4. Turn the engine until the next set of valves are in the "rocking" position.
Use the chart to find which valve clearances to measure.
5. Do the same procedure for the last set of valves.
6. Install the cover with a new gasket.

Rocking Position	Valves to Check
No. 1 Cylinder	No. 2 Inlet No. 3 exhaust
No. 2 Cylinder	No. 3 inlet No. 1 exhaust
No. 3 cylinder	No. 1 inlet No. 2 exhaust

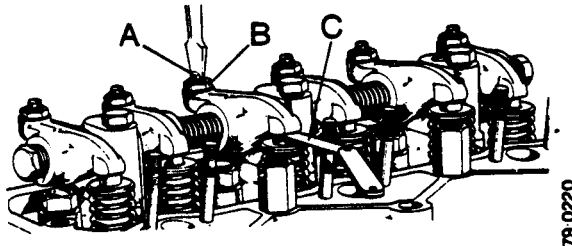


FIGURE 8 SETTING THE VALVE CLEARANCE

A. Adjusting Screw
B. Locknut

C. Feeler Gauge

FUEL SYSTEM:

Water Trap:

1. Remove the bowl and filter and clean them with diesel fuel oil.
2. Check the sealing ring for damage and replace if necessary.
3. Install the filter and bowl.

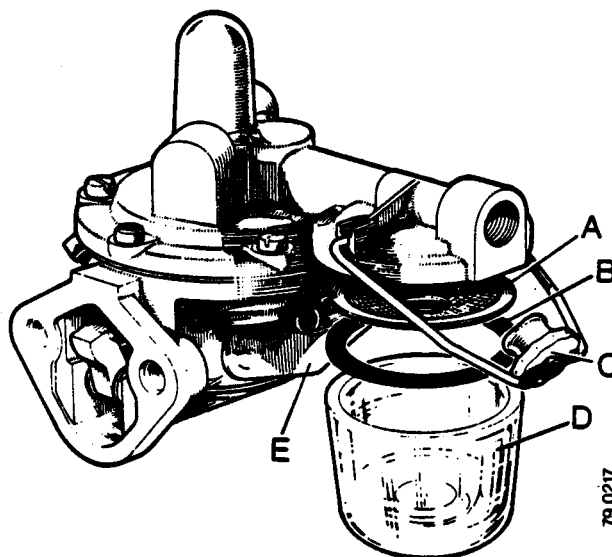


FIGURE 9 WATER TRAP AND SEDIMENT BOWL

- A. Filter
- B. Sealing ring
- C. Securing screw
- D. Bowl
- E. Fuel pump priming lever

Fuel Filters:

Two fuel filters are installed in series. The paper elements must be replaced at regular intervals. If clean fuel has been used all the time, the minimum life of an element is approximately 500 hours. Using dirty fuel, especially fuel with water in it, will decrease the life of an element to less than 100 hours.

IMPORTANT: The rust inhibitor mixed with the fuel for storage purposes can cause a restriction in the filter elements. Because of this, both the filter elements must be replaced at the 50 to 100 hour service.

To replace a filter element, do the following:

1. Clean the outside of the filter.
2. Hold the base and remove the securing bolt.
3. Remove the base with the filter element.
4. Destroy the element, the two element sealing rings, and the 'O' ring.
5. Clean the base. Install the new element on the base with a new sealing ring, 78 mm diameter.
6. Install a new 'O' ring in the centre of the element and a new sealing ring in the head of the filter. This ring has a blue stripe.
7. Hold the base and element in position and install the securing bolt.

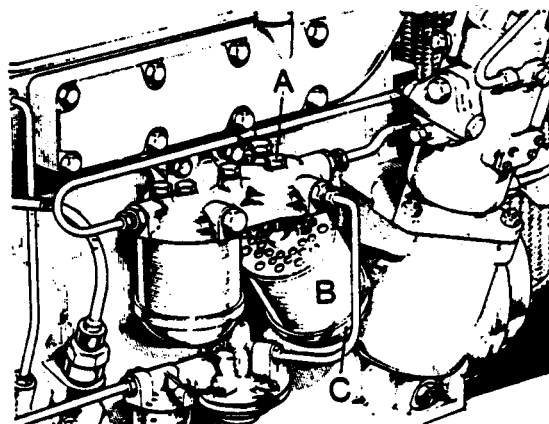


FIGURE 10 FUEL FILTERS

- A. Securing Bolt
- B. Filter Element
- C. Base

Fuel Injection Pump:

No maintenance is needed. The only adjustments are for the maximum and idling speed. These are adjusted before delivery of the tractor. DO NOT try to make any repairs or adjustments unless you have the correct equipment.

Removing Air from the System:

1. Make sure there is a minimum of 9 litres (2 gallons) of fuel in the tank.
2. Check the condition of the water trap and clean the bowl and filter if necessary.
3. Remove the plug G.
4. Operate the priming lever E until fuel flows from the plug hole.
5. Install and tighten the plug G.
6. Loosen plug J on the fuel injection pump. Operate the priming lever until fuel flows from the hole. Tighten the plug.
7. Do the same operation with plug K.
8. Loosen the connections from the high pressure pipes to the injectors.
9. Put the engine 'Stop' control in the 'Run' position and the throttle in the maximum speed position.
10. Turn the engine with the starter until fuel comes from the connections.
11. Tighten the connections.
12. Start the engine and check for fuel leakage.

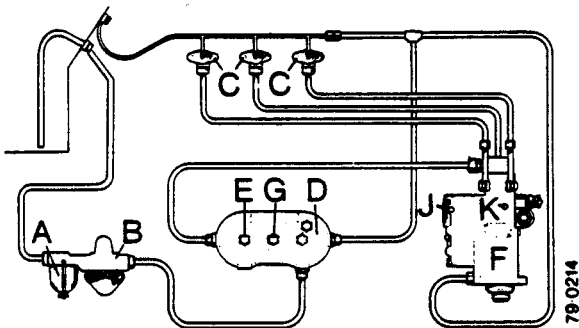


FIGURE 11 DIAGRAM OF FUEL SYSTEM

- | | |
|----------------------------|------------------------|
| A. Sediment Bowl | F. Fuel Injection Pump |
| B. Fuel Pump Priming Lever | G. Vent Plug |
| C. Injectors | J. Vent Plug |
| D. 1st Fuel Filter | K. Vent Plug |
| E. 2nd Fuel Filter | |

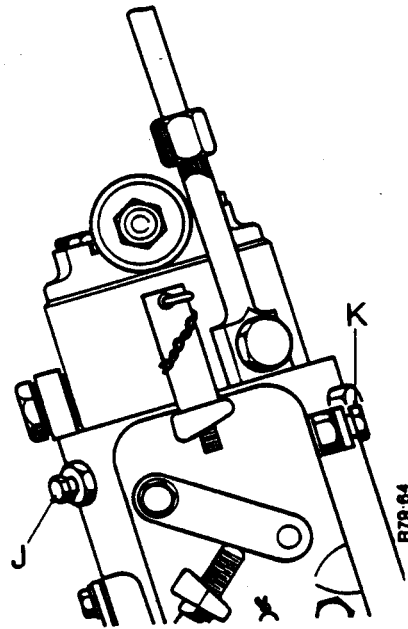


FIGURE 12 FUEL INJECTION PUMP VENT PLUGS

- J. Governor housing vent plug
K. Pump barrel vent plug.

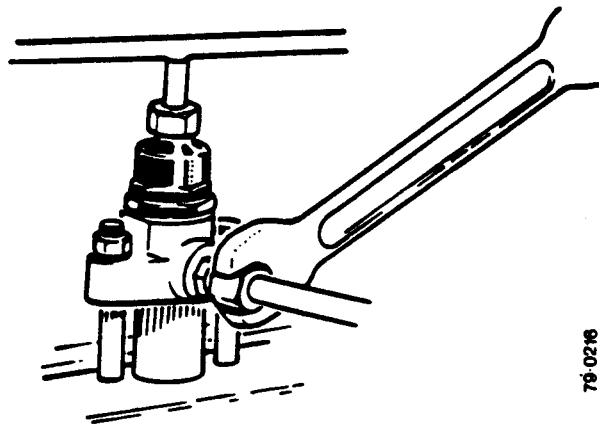


FIGURE 13 CONNECTIONS TO HIGH PRESSURE FUEL PIPES

INJECTORS:

The injectors are precision parts. Remove and install them carefully. When you have removed them, give the nozzles and the threads protection by using the correct caps. If caps are not available use paper and adhesive tape. It is a recommendation that the injectors are checked with an Injector Testing and Setting Outfit every 500 hours.

Removing the Injectors:

1. Clean the area around the injectors.
2. Remove the leak off pipe.
3. Disconnect the high pressure pipes at the injector end.
4. Loosen each nut a small amount at a time until the nuts can be removed by hand.
5. Remove the injectors carefully. If the injectors are held in position by carbon deposits, use a lever between the injector lugs and the cylinder head.
6. Use caps or tape to give protection to the nozzles and threads.
7. Remove the copper washers from the injector seats. Clean the injector seats and put plugs in position to prevent dirt getting in the engine.

Installing the Injectors:

1. Remove the plugs and install NEW copper washers.
2. Install the injectors and the nuts.
3. Tighten each nut a small amount at a time to a torque of 20 Nm (15 lb ft).
4. Install the leak off pipe.
5. Put the engine stop control in the "Run" position. Put the throttle control in the maximum engine speed position.
6. Use the starter to turn the engine until fuel flows from the high pressure pipes.
7. Connect and tighten the pipes to the injectors.
8. Start the engine. Check that the engine is running correctly and that there is no leakage.

Injector Pipes:

Engines made after August 1974, have smaller diameter injector pipes.

When a new olive is to be fitted to an injector pipe, the correct size must be used. Details of injector pipes and olives are as follows:-

Late Type:

External diameter of pipe 5.5 to 5.41 mm (0.219 to 0.217 in).

Internal diameter of olive 5.60 to 5.58 mm (0.2207 to 0.2192 in).

Early Type:

External diameter of pipe 5.82 to 5.76 mm (0.229 to 0.227 in).

Internal diameter of olive 5.86 to 5.82 mm (0.2307 to 0.2292 in).

Install an olive as shown in Figure 15.

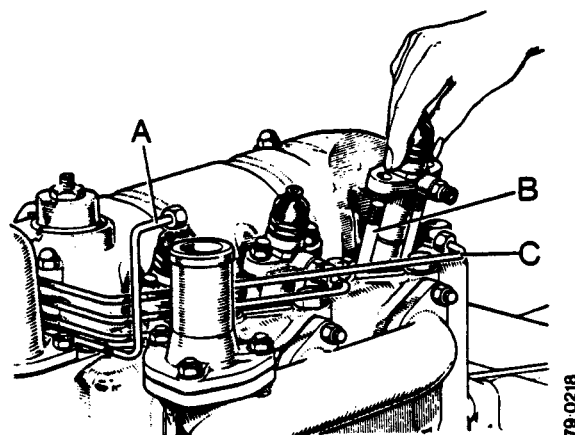


FIGURE 14 REMOVING INJECTORS

- A. Leak-off Pipe Connection
B. Securing Studs
C. High Pressure Fuel Pipe

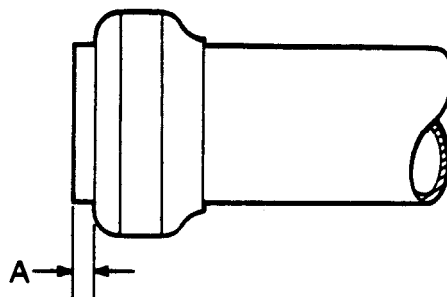


FIGURE 15 INSTALLING OLIVE

A. 0.80 mm (0.030 in)

REPAIR

FUEL FEED PUMP

The fuel feed pump is installed on the right-hand side of the cylinder block. It is operated by a push rod which makes contact with the camshaft.

Removing:

1. Disconnect the inlet and outlet fuel pipes from the body.
2. Remove the two setscrews which fasten the pump body to the cylinder block.
3. Remove the fuel pump.

Replacement of Diaphragm:

1. Clean the outside of the pump.
2. Put a mark on the pump so that the upper and lower housings can be installed in the same position.
3. Remove the six screws and remove the top part of the pump.
4. Hold the pump with one hand and with the fingers of the other hand turn the diaphragm in either direction 90 degrees.
5. Remove and destroy the old diaphragm.
6. Put the new diaphragm in the body with the tab in the position shown at A in Figure 16.
7. Push the centre of the diaphragm down until the end of the pull rod enters the slot in the connecting link.
8. Turn the diaphragm counterclockwise until the tab in position B in Figure 16.
9. Install the top part of the pump with the marks in alignment.
10. Install, but do not tighten the screws.
11. Lift the hand priming lever to put the spring in compression.
12. Keep the priming lever in this position while you tighten the screws.

Installing:

1. Put a new gasket in position on the cylinder block. Use a small amount of grease to keep the gasket in position.
2. Install new copper washers on the setscrews.
3. Put the fuel pump in position on the cylinder block. Make sure that the push rod is engaged correctly.
4. Install and tighten the setscrews to 20 Nm (15 lbs ft) 2.1 kgm.
5. Connect the inlet and outlet pipes to the body.
6. Remove any air from the system. See the operation Removing Air from the System.

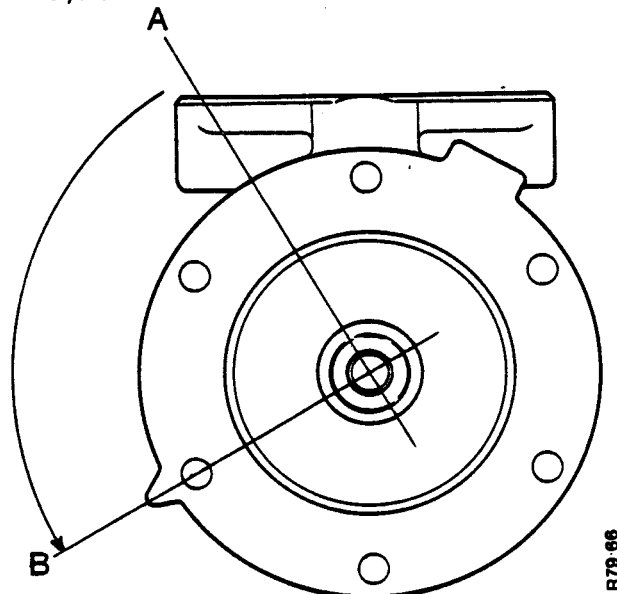


FIGURE 16 INSTALLING FEED PUMP DIAPHRAGM

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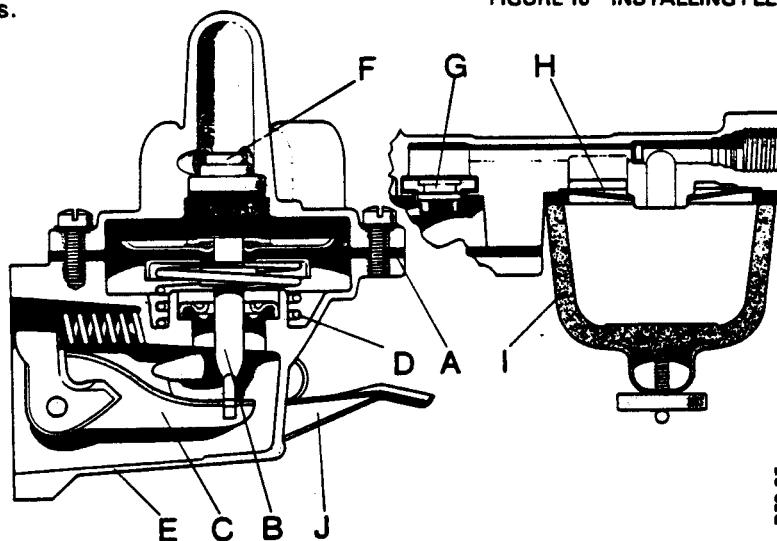


FIGURE 17 FUEL FEED PUMP

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- | | | |
|---------------------|-----------------------|--------------------|
| A. Diaphragm | B. Diaphragm push rod | C. Connecting link |
| D. Diaphragm spring | E. Body | F. Outlet valve |
| G. Inlet valve | H. Filter gauze | I. Sediment bowl |
| | J. Hand primer | |

INJECTORS

Tools and Equipment:

Special equipment is needed to make tests and repairs to injectors. Do not try to make repairs unless you have this equipment. Send any injectors that are not working correctly to your David Brown, Case or C.A.V. agent for repairs.



WARNING: Diesel fuel comes out of the nozzle at a very high pressure. It has enough force to go through the skin into the tissues. When you make tests or adjustments to fuel injectors, put a screen around the injector and do not put any part of your body near the nozzle. Failure to follow these rules can result in severe injury.

The design of the caps of the injectors was changed in December 1977.

The new type of cap has a female thread for the connection to the leak off pipe instead of a male thread. An adaptor is installed with a copper washer on the injector cap, which raises the leak off pipe 5mm ($\frac{1}{4}$ in).

IMPORTANT: If it is necessary to install new injectors, they must be replaced as a set. The cap is also the locknut for the pressure setting. If a cap is changed from one injector to another, the pressure setting of the injector must be checked and adjusted if necessary.

Pressure Test and Adjustment:

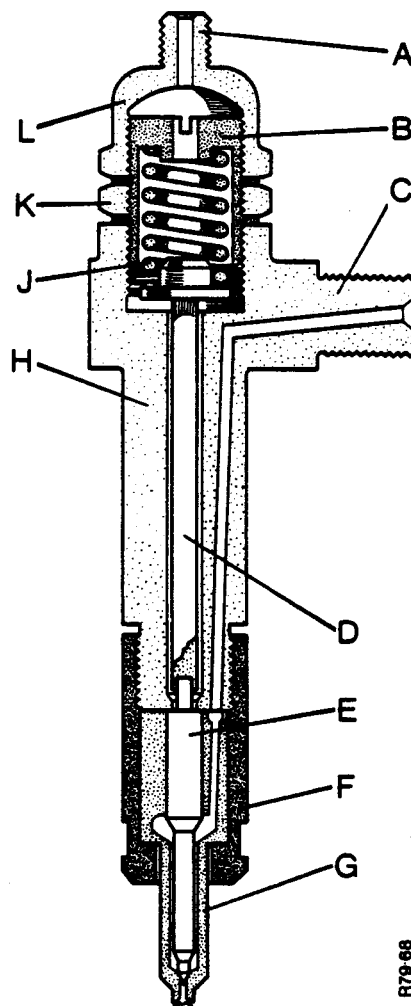
1. Install the injector on the test equipment.
2. Push down on the lever several times to remove any air.
3. Push down slowly on the lever and look at the pressure gauge. When the needle of the gauge makes a sudden movement, the pressure that is shown is the working pressure of the injector.

The correct working pressure is 185 atmospheres for new and 175 atmospheres for old injectors. To make an adjustment, do the following:

1. Remove the cap L and loosen the locknut K.
2. Put a large screwdriver in the slot in the adjusting screw B and turn the adjusting screw either clockwise to increase the pressure or counter-clockwise to decrease the pressure.
3. Tighten the locknut and check the working pressure again.
4. When the working pressure is correct, install and tighten the cap L.

Dry Seat Test:

1. Clean the nozzle.
2. Press down on the lever until the gauge shows a pressure of 165 atmospheres. Hold the lever in this position.
3. Check that the nozzle is dry and there is no leakage.



- | | |
|--------------------------|------------|
| A. Leak off connection | G. Nozzle |
| B. Adjusting screw | H. Holder |
| C. Fuel inlet connection | J. Spring |
| D. Plunger | K. Locknut |
| E. Needle | L. Cap |
| F. Nozzle nut | |

Cleaning:

If any of these tests show a defect, the injector must be disassembled and cleaned as follows:-

1. Remove the cap, loosen the locknut and the adjusting screw.
2. Remove the nozzle cap.
3. Remove the nozzle.
4. Remove the needle valve from the nozzle and check for wear and damage.

NOTE: The needle valve and the nozzle are made as a unit and must be kept together.

5. Check the colour of the needle valve. If the valve is blue, or you can see any wear or damage, replace the nozzle.
6. If there is no damage to the needle valve, clean the nozzle using the tools in the cleaning kit. Be careful when you clean the small holes in the nozzle and make sure that you use a wire of the correct size.
7. Reverse flush the nozzle with clean fuel oil.
8. Clean the needle valve with the brass brush.

Assembling:

1. Put the needle valve and the nozzle in clean fuel oil. Install the valve in the nozzle.
2. Put the nozzle in position on the holder G. Install and tighten the nozzle nut.
3. Do again the Pressure Test and Adjustment, the Leakage Test, the Atomizer Test and the Dry Seat Test. If any of these tests shows a defect, replace the injector nozzle.

Leakage Test:

1. Push down on the lever until the gauge shows a pressure of 170 atmospheres.
2. Release the lever.
3. Measure the time in seconds for the needle of the gauge to move from the 150 to the 100 atmosphere mark.
The time taken must be between 6 and 25 seconds.

Atomizer Test:

1. Close the valve to the pressure gauge.
2. Push down on the lever eight times with a rapid movement. At the same time look at the shape and condition of the fuel as it comes from the injector nozzle.
3. When an injector is working correctly, fuel leaves each of the four holes in the nozzle as a spray. The four sprays must be the same size and shape, and all the fuel must be in particles.

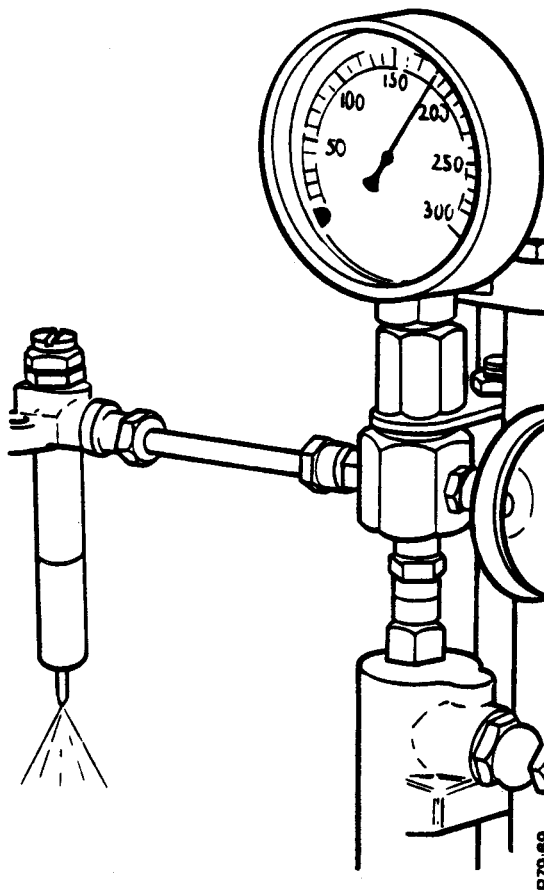


FIGURE 19 INJECTOR SPRAY PATTERN

NOTE: The spray guard has been removed to show the spray pattern clearly.



WARNING: When testing or adjusting injectors use a spray guard. DO NOT put any part of your body near the fuel spray. The spray has enough force to penetrate the skin and destroy tissue. If the fuel enters the blood stream it can cause poisoning.

FUEL INJECTION PUMP:

Removing:

1. Remove the cylinder head cover.
2. Turn the engine by hand until the inlet valve of No. 1 cylinder is closed.
3. Put the timing peg in the hole in the flywheel housing that has the mark SP.
4. Turn the engine slowly until the timing peg enters the hole in the flywheel.
5. Check that the timing marks on the injection pump and the housing can be easily seen.
If the mark on the housing is not clear, use a scribe to make a new mark on the housing in alignment with the mark on the pump.
6. Disconnect all the fuel pipes to and from the pump.
7. Disconnect the stop and throttle controls.
8. Remove the nuts and washers from the pump flange.
9. Lift the pump away from the housing.

Installing:

1. Before installing a fuel injection pump, make sure that the quill shaft is in the correct position. See Figure 21. If necessary, turn the engine to the No. 1 SP position as shown in Operation 2, 3 and 4, Removing.

Then pull the quill out of the housing and install it in the correct position as follows:

Engage the gear of the quill shaft with the camshaft gear at position A. As the quill shaft is pushed into the housing it will turn to position B. If the master spline cannot be aligned at the position shown, use the nearest position clockwise.

The master spline must not be counterclockwise of position B.

2. Install the thrust spring in the shaft of the pump.
3. Lower the pump into position on the housing.
4. Install the washers and nuts.
5. Turn the pump body until the marks are aligned.
6. Tighten the nuts.
7. Remove the timing peg.
8. Connect all the pipes to the pump.
9. Connect the stop and throttle controls.
10. Install the cylinder head cover.
11. Remove all air from the system. See Section: Removing Air from the System.

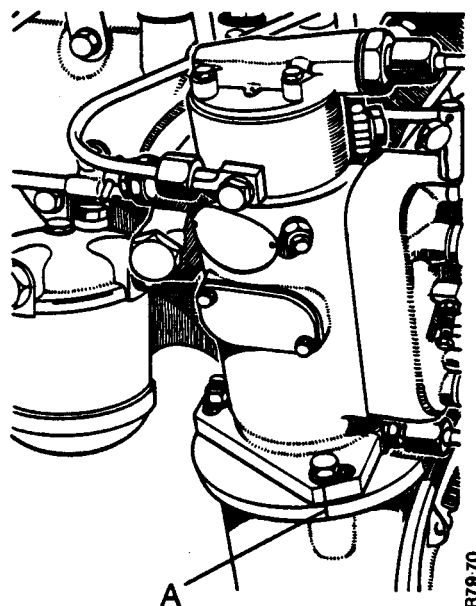


FIGURE 20 FUEL PUMP MARKS

A. Alignment Marks

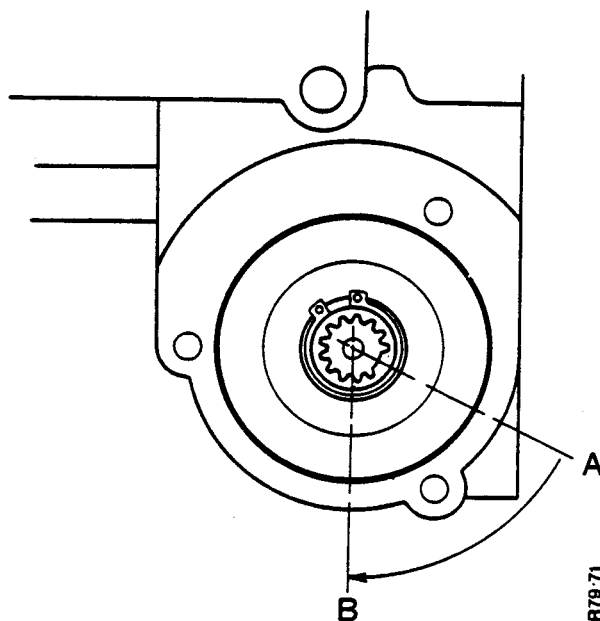


FIGURE 21 INSTALLING THE FUEL INJECTION PUMP QUILL SHAFT

A. Position to enter quill shaft

B. Correct position when fully engaged

TIMING THE FUEL INJECTION PUMP

The spill method of timing the pump to the engine is now to be used instead of the timing peg in the flywheel method.

The basis of this method is setting the pump so that injection of the fuel occurs at a specific amount of piston travel before Top Dead Centre. The timing information for the 3 cylinder engine is as follows:

Engine Type: 355011, Stroke: 114 mm ($4\frac{1}{2}$ in), Degrees before T.D.C.: 16° , Piston Travel before T.D.C.: 2.834 mm (0.1116 in).

Setting Procedure:

1. Remove No. 1 injector pipe from the injector and the pump.
2. Remove the hollow bolt which fastens the No. 1 connector to the pump. Install a standard hollow bolt which does not have an internal non-return valve.
3. Install the tubing on the No. 1 connector as shown in Figure 22.

NOTE: The diameter and length of glass capillary tube is very important and must be as given in Figure 22.

4. Start the engine to fill the capillary tube with fuel. When the fuel is just to the top of the capillary tube, stop the engine. Put the engine stop control in the "RUN" position.
5. Remove the cylinder head cover.
6. Turn the engine by hand to the top dead centre firing stroke on No. 1 cylinder.
7. Loosen the No. 1 inlet rocker adjusting screw and remove the push rod.
8. Remove the cotters from the No. 1 inlet valve. Remove the collar and spring.
9. Fasten a dial indicator gauge to the cylinder head so that vertical movement of the valve, which is against the top of the piston, can be measured.
10. Turn the engine slowly by hand a small amount in each direction until you can see by the gauge the top dead centre position of the piston.
11. With the piston in this position, make a note of the reading of the gauge.
12. Turn the engine counterclockwise so that the piston is approximately 12 mm ($\frac{1}{2}$ in) before top dead centre. Do not turn the engine more than this or the valve will go into the cylinder.
13. Carefully turn the engine in a clockwise direction and look at the capillary tube.
The fuel level in the capillary tube will first go down and then up.
The piston position when the fuel starts to go up the capillary tube must be 2.834 mm (0.1116 in) before top dead centre.
14. If the fuel level does not go up at the correct position of the piston, loosen the nuts which fasten the injection pump to the housing.

15. Then turn the pump either clockwise or counterclockwise until fuel goes up the tube at the correct position of the piston.

16. Tighten the nuts and check the timing again.

17. Remove the tubing and the standard hollow bolt.

18. Install the original hollow bolt which has an internal non-return valve.

19. Install the injector pipe.

20. Install the push rod, the valve spring, collar and the cotters.

Adjust the valve clearance.

NOTE: Turn the engine to the No. 1 top dead centre position before installing the valve cotters.

21. Install the cylinder head cover.

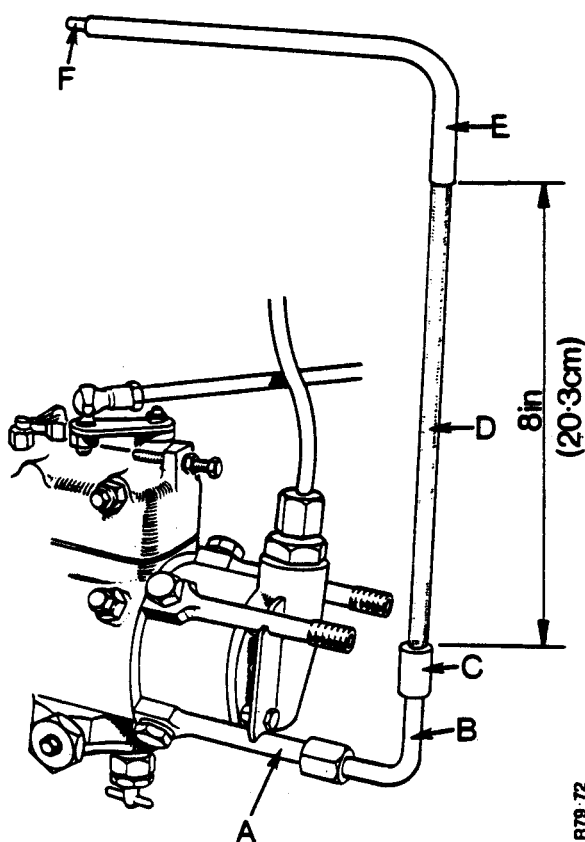


FIGURE 22 EQUIPMENT FOR SPILL TIMING

- A. No. 1 Injector pipe connection
- B. Piece of high pressure fuel pipe
- C. Plastic or rubber sleeve
- D. Glass capillary tube 8in (203mm) \times 1.5mm bore
- E. Plastic tube
- F. Plug

FUEL INJECTION PUMP:

Removing:

1. Check that the timing marks on the injection pump and the housing can be easily seen.
If the mark on the housing is not clear, use a scribe to make a new mark on the housing in alignment with the mark on the pump.
2. Disconnect all the fuel pipes to and from the pump.
3. Disconnect the stop and throttle controls.
4. Remove the nuts and washers from the pump flange.
5. Lift the pump away from the housing.

Installing: (See Figure 21).

If you are not sure that the engine timing is correct, check the position of the master spline in the injection pump drive housing as shown on page 45.

1. Install the thrust spring B in the driving shaft of the drive housing.
2. Turn the quill shaft of the fuel injection pump until the master spline is aligned with the master spline of the driving shaft.
3. Lower the fuel injection pump complete with the quill shaft into position.
4. Install the washers and nuts.
5. Turn the body of the fuel injection pump until the marks are aligned. See A. Figure 20.
6. Tighten the nuts.
7. Connect all the pipes to the fuel injection pump.
8. Connect the stop and throttle controls.
9. Remove all the air from the system. See the Section: Removing Air from the System.

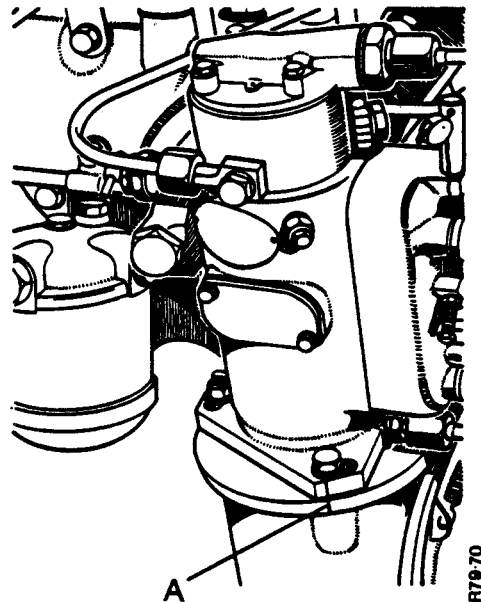
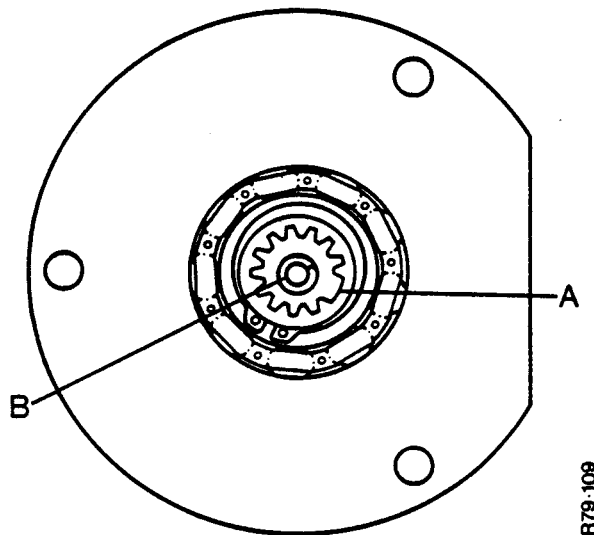


FIGURE 20 FUEL PUMP MARKS

A. Alignment Marks



† FIGURE 21 INSTALLING THE FUEL INJECTION PUMP

A. Master spline
B. Spring

TIMING THE FUEL INJECTION PUMP

The spill method of timing the pump to the engine is now to be used instead of the timing peg in the flywheel method.

The basis of this method is setting the pump so that injection of the fuel occurs at a specific amount of piston travel before Top Dead Centre. The timing information for the 3 cylinder engine is as follows:
Engine Type: 355011, Stroke: 114 mm (4½ in), Degrees before T.D.C.: 16°, Piston Travel before T.D.C.: 2.834 mm (0.1116 in).

Setting Procedure:

1. Remove No. 1 injector pipe from the injector and the pump.
2. Remove the hollow bolt which fastens the No. 1 connector to the pump. Install a standard hollow bolt which does not have an internal non-return valve.
3. Install the tubing on the No. 1 connector as shown in Figure 22.

NOTE: The diameter and length of glass capillary tube is very important and must be as given in Figure 22.

4. Start the engine to fill the capillary tube with fuel. When the fuel is just to the top of the capillary tube, stop the engine. Put the engine stop control in the "RUN" position.
5. Remove the cylinder head cover.
6. Turn the engine by hand to the top dead centre firing stroke on No. 1 cylinder.
7. Loosen the No. 1 inlet rocker adjusting screw and remove the push rod.
8. Remove the cotters from the No. 1 inlet valve. Remove the collar and spring.
9. Fasten a dial indicator gauge to the cylinder head so that vertical movement of the valve, which is against the top of the piston, can be measured.
10. Turn the engine slowly by hand a small amount in each direction until you can see by the gauge the top dead centre position of the piston.
11. With the piston in this position, make a note of the reading of the gauge.
12. Turn the engine counterclockwise so that the piston is approximately 12 mm (½ in) before top dead centre. Do not turn the engine more than this or the valve will go into the cylinder.
13. Carefully turn the engine in a clockwise direction and look at the capillary tube.
The fuel level in the capillary tube will first go down and then up.
The piston position when the fuel starts to go up the capillary tube must be 2.834 mm (0.1116 in) before top dead centre.
14. If the fuel level does not go up at the correct position of the piston, loosen the nuts which fasten the injection pump to the housing.

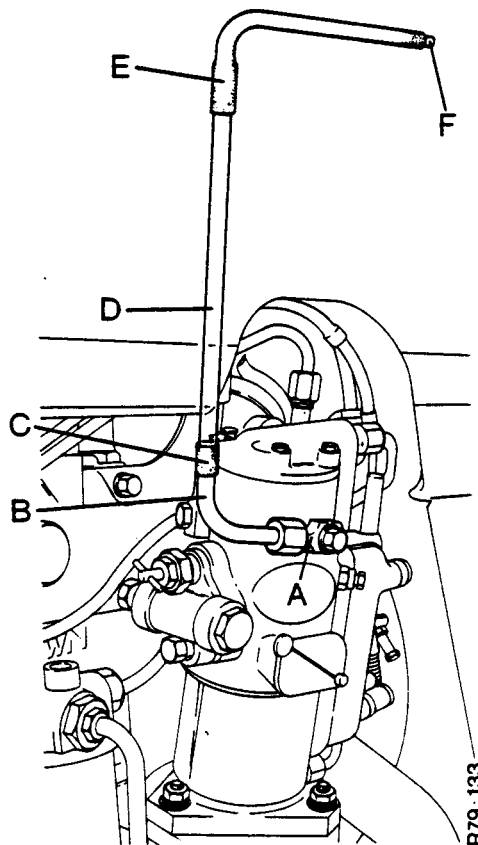
15. Then turn the pump either clockwise or counterclockwise until fuel goes up the tube at the correct position of the piston.

16. Tighten the nuts and check the timing again.
17. Remove the tubing and the standard hollow bolt.
18. Install the original hollow bolt which has an internal non-return valve.
19. Install the injector pipe.
20. Install the push rod, the valve spring, collar and the cotters.

Adjust the valve clearance.

NOTE: Turn the engine to the No. 1 top dead centre position before installing the valve cotters.

21. Install the cylinder head cover.



† FIGURE 22 EQUIPMENT FOR SPILL TIMING

- A. No. 1 Injector pipe connection
- B. Piece of high pressure fuel pipe
- C. Plastic or rubber sleeve
- D. Glass capillary tube 8in (203mm) × 1.5mm bore
- E. Plastic tube
- F. Plug

LUBRICATION SYSTEM:

Introduction:

When the engine is running, oil from the sump is sent under pressure to the oil filter. The clean oil then flows to the main oil gallery and through holes in the cylinder block to the main bearings and the camshaft bearings. There are holes in the crankshaft through which oil flows to the connecting rod bearings. The rear bearing of the camshaft has a hole through which oil flows to the rocker shaft and lubricates the valve gear before flowing back to the sump. The front bearing housing has a hole through which oil flows on to the drive gears for the fuel pump, and oil leakage from the front of the bearing lubricates the timing gears.

The oil filter is the full flow type and has a bypass valve installed. This valve opens if the difference in pressure between the inlet and outlet is more than 70 kPa (10 lb in²). This gives protection to the engine if there is a restriction in the oil filter.

OIL WARNING LAMP:

The oil warning lamp is operated by a pressure switch connected to the main oil gallery. The switch opens at 62 to 90 kPa (9 to 13 lb in²). There is no adjustment and if there is any defect, the switch must be replaced.

OIL PUMP:

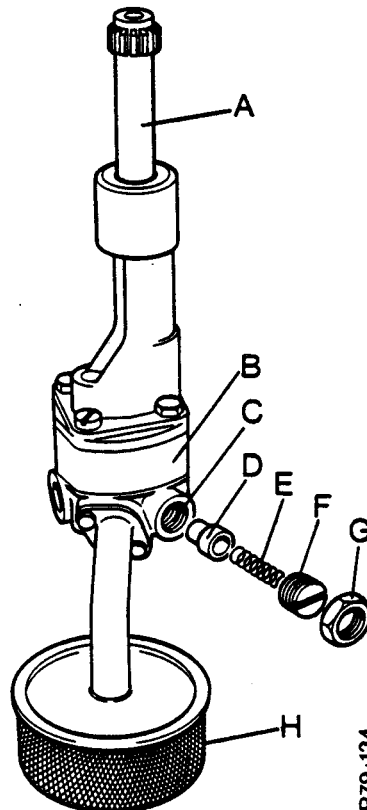
Removing:

1. Remove the engine oil.
2. Remove the sump.
3. Remove the pipe from the oil pump to the cylinder block.
4. Loosen the locknut and remove the locating screw.
5. Pull the pump down out of the housing. Be ready to hold the quill shaft which may come out of the housing when you remove the pump.

Installing:

If the quill shaft moved out of position when the oil pump was removed, it will be necessary to remove the fuel injection pump to install the quill shaft correctly. See the Sections: Removing the Fuel Injection Pump and Timing the Engine.

1. Push the oil pump into the housing.
2. Put a small amount of Wellseal or a similar joint compound on the locating screw. Install and tighten the locating screw. Install and tighten the locknut.
3. Install the pipe from the oil pump to the cylinder block and the suction pipe.



† FIGURE 23 OIL PUMP DRIVE

- | | |
|--------------------------|---------------------|
| A. Drive shaft | E. Spring |
| B. Pump body | F. Adjusting screw |
| C. Oil outlet connection | G. Locknut |
| D. Relief valve plunger | H. Oil inlet screen |

Disassembling:

1. Remove the two bolts and the two setscrews.
NOTE: The two setscrews keep the parts of the pump in position. Make sure that you know the holes to use when you assemble the pump.
2. Remove the cover with the inlet filter and the relief valve in position.
3. Measure the amount of backlash between the rotors. Make a note of this measurement.
4. Remove the driven rotor.
5. Push the driving shaft with the rotor out of the housing.
6. Use a puller to remove the driving rotor.
7. Remove the Woodruff key.
Remove the driving shaft.
8. Use a press and a piece of shaft to push the shaft for the driven rotor out of the housing.
9. Check the rotors, housing, driving shaft, driven shaft and the bush for wear or damage. Use the table below to find the permissible amount of wear.

NOTE: If there is any damage or wear to either of the rotors, BOTH rotors must be replaced.
From Engine 48270 on, both rotors are made of sintered iron and the driving shaft has been changed.

Backlash between rotors:

0.51 to 0.66 mm (0.020 to 0.026 in)

Rotor width:

30.14 to 30.11 mm (1.1865 to 1.1855 in)

Housing depth:

30.20 to 30.16 mm (1.189 to 1.1875 in)

Rotor end clearance:

0.025 to 0.089 mm (0.001 to 0.0035 in)

Bush inside diameter:

12.46 to 12.51 mm (0.4905 to 0.4925 in)

Shaft diameter:

12.43 to 12.45 mm (0.4895 to 0.490 in)

Clearance:

0.013 to 0.08 mm (0.0005 to 0.003 in)

Replacing the Bush: Figures 24 and 25.

1. Put the pilot bush through the slot in the rotor housing on to the old bush.
2. Put an old driving shaft through the bracket against the pilot bush.
3. Use a press to remove the bush.
4. Put the new bush in position on the bracket.
Make sure that the oil holes are in alignment.
5. Use the old bush to push the new bush in position.

Relief Valve:

Before you remove the relief valve for any purpose, make a note of the number of threads that are above the locknut for the adjusting screw. You can then install the adjusting screw to the same setting if test equipment is not available. An approximate setting is as follows:

Four threads above the locknut is 280 kPa (40 lb in²).

One turn of the adjusting screw is 42 kPa (6 lb in²).

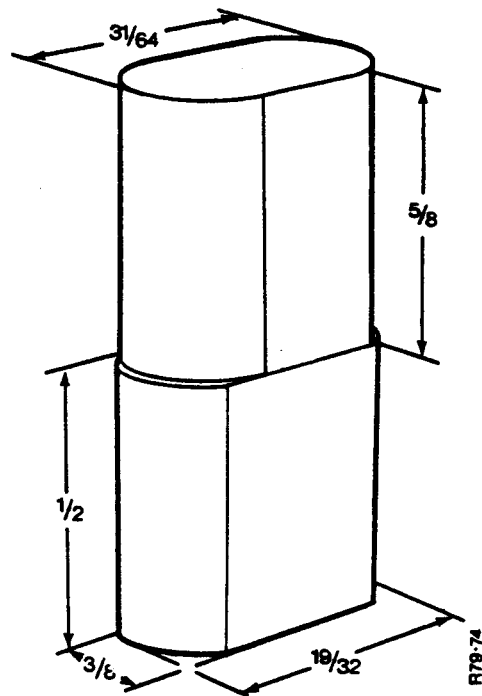


FIGURE 24 PILOT BUSH

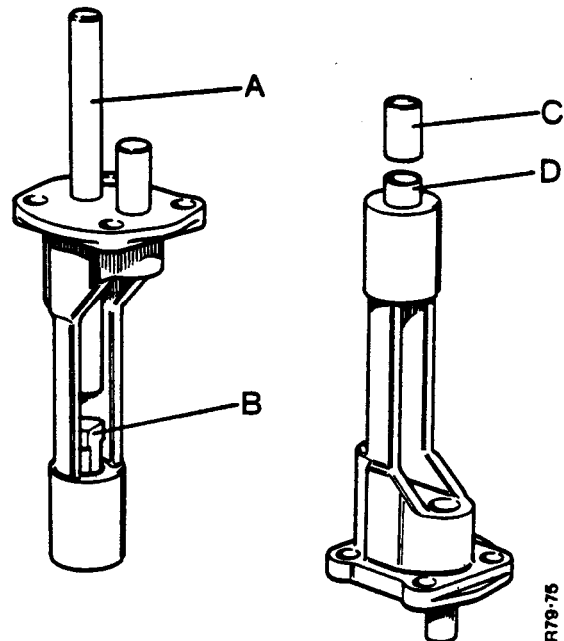


FIGURE 25 REPLACING OIL PUMP BRACKET BUSH

A. Old driving shaft
B. Pilot bush

C. Old bush
D. New bush

Assembling:

1. Use a press to install the shaft for the driven rotor.
2. Install the driving shaft.
Install the Woodruff key.
3. Use a press to install the driving rotor on the driving shaft.
4. Install the driven rotor.
5. Install the rotor housing.
6. Use a straight edge and feeler gauges to measure the end clearance between the faces of the rotors and the edge of the rotor housing.

NOTE: If there is too much end clearance on the rotors, the face of the housing can be machined. If there is not enough end clearance it is permitted to install a gasket of the correct thickness between the face of the housing and the cover.

6. Install the cover, the bolts and the setscrews.

Test Procedure:

If testing equipment is available, do the following procedure:

1. Use a 5W grade oil at a temperature of 20°C (68°F), or a 20W20 grade at a temperature of 46°C (115°F).
2. Adjust the relief valve to open at 280 kPa (40 lb in²).
3. Adjust the speed to 750 r/min or 330 r/min.
4. Check the flow using the information given below.

Oil Flow

Pressure	Speed	Minimum in 1 Min.
140 kPa (20 lb in ²)	750 r/min	10.9 litres (19.2 pt)
1.4 kgcm ²		
140 kPa (20 lb in ²)	330 r/min	4.7 litres (8.4 pt)
1.4 kgcm ²		

The oil flow in pt/ mins is:

$$\frac{480}{\text{time in seconds for one gallon}}$$

The oil flow in litre/ min is:

$$\frac{300}{\text{time in seconds for five litres}}$$

The maximum time for one gallon must be:

25 seconds at 750 r/min.

57 seconds at 330 r/min.

The maximum time for five litres must be:

28 seconds at 750 r/min.

63 seconds at 330 r/min.

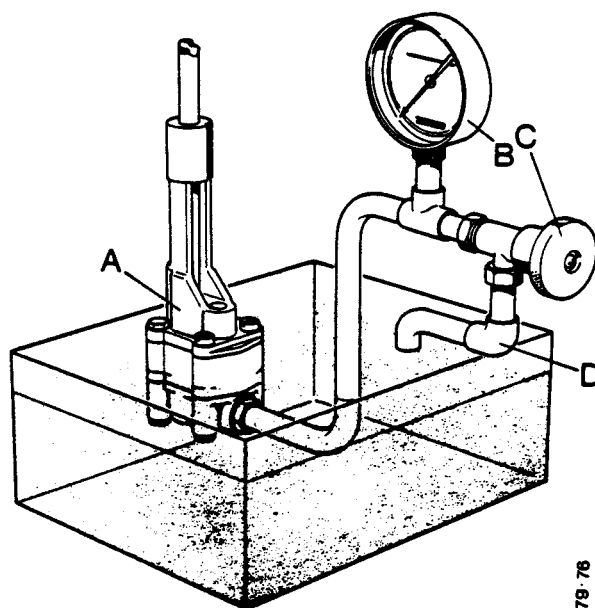


FIGURE 26 OIL PUMP TEST EQUIPMENT

- A. Oil pump
B. Pressure gauge
C. Valve
D. Outlet

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COOLING SYSTEM

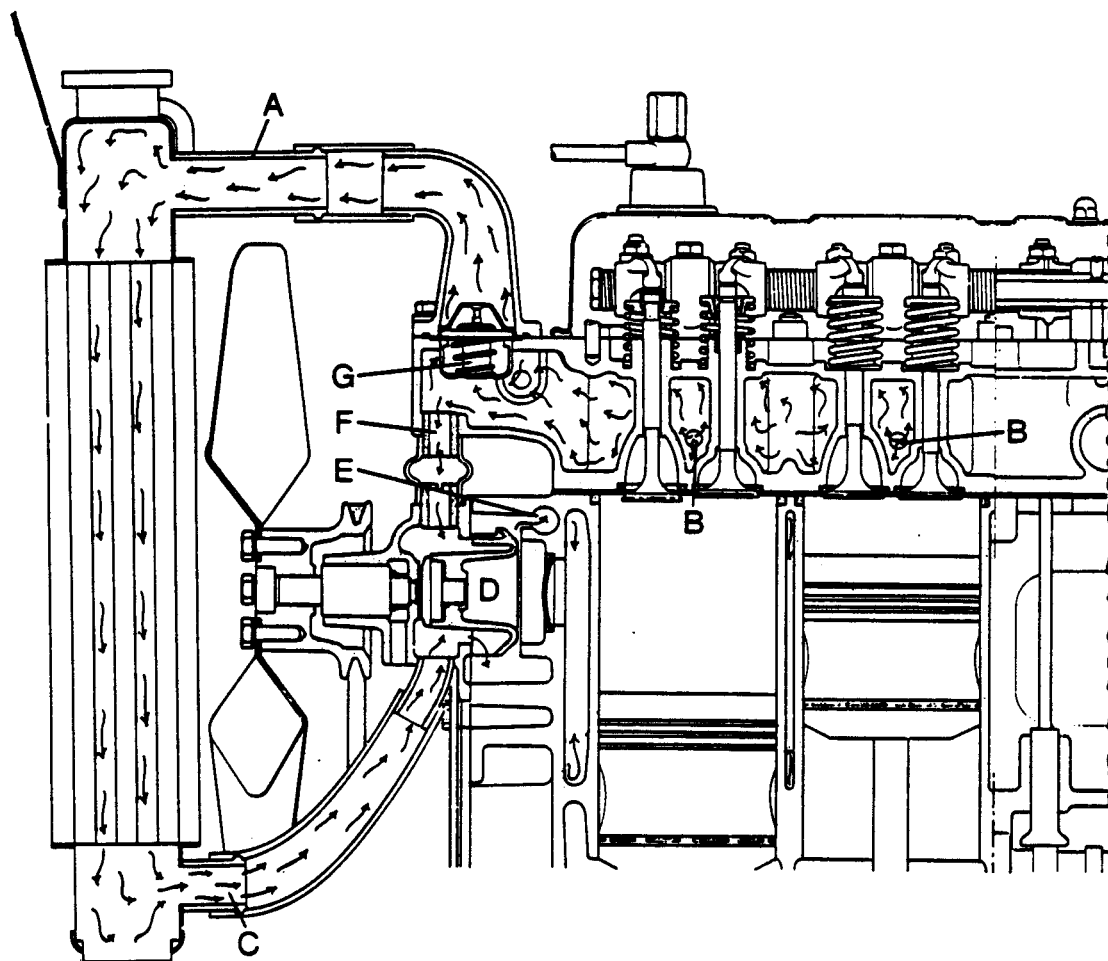
Introduction:

When the engine is running, the water pump causes cold water to flow from the bottom of the radiator through an opening in the cylinder block to the cylinder head. After coming in contact with the cooling surfaces of the fuel injectors and the valve guides, the water flows into the passages in the cylinder block. As the water get hot, it rises to the cylinder head and flows in the top of the radiator.

A thermostat valve is installed between the cylinder head and the top of the radiator. This prevents water from the cylinder head flowing to the radiator until the engine is at the correct running temperature.

The radiator has a pressure type radiator cap rated at 28 kPa (4 lb in²) 0.28 kg/cm².

A fan with seven blades is installed on the shaft of the water pump and turns at one and a half times the speed of the engine.



R179-77

FIGURE 27 DIAGRAM OF COOLING SYSTEM

A. Inlet to radiator
B. Jets to valve ports
C. Outlet to radiator

D. Water pump impeller
E. Port to cylinder head
F. Bypass seal

G. Thermostat

WATER PUMP

Removing:

1. Remove the coolant from the radiator and the cylinder block.
2. Remove the radiator.
3. Loosen the bolts which hold the alternator in position. Remove the fan belt.
4. Remove the setscrews which hold the fan on to the water pump shaft.
Remove the retainer and the fan.
5. Remove the five setscrews which hold the pump to the cylinder block.
6. Remove the pump.
Remove the seal which is installed between the pump and the cylinder head.
Remove the old gasket and clean the face of the cylinder block.

Installing:

1. Put a new gasket in position on the body of the water pump.
2. Put two or more setscrews through the body to keep the gasket in position.
3. Put a new rubber seal in the groove of the pump body.
4. Raise the water pump in position on the cylinder block.
5. Push the pump toward the cylinder head until the setscrews will enter the holes in the cylinder block.
6. Tighten the setscrews to 20 Nm (15 lb ft) 2.1 kgm.
7. Install the fan, the retainer and the setscrews.
Tighten the setscrews to 34 Nm (25 lb ft) 3.46 kgm.
8. Install the fan belt.
Adjust the fan belt to the correct tension.
See the Maintenance Section: Fan Belt.
9. Put the hose in position on the pump.
Tighten the hose clip.
10. Put the coolant in the radiator.
11. Start the engine and check for leakage.

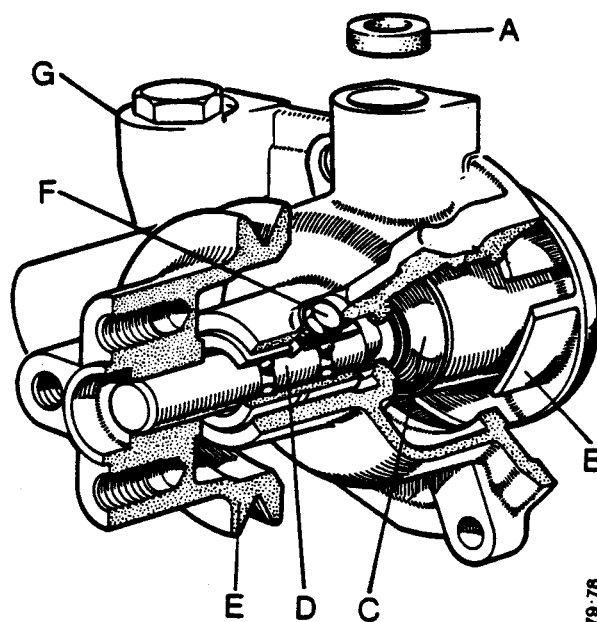


FIGURE 28 ARRANGEMENT OF WATER PUMP

- | | |
|----------------------|-------------------|
| A. Seal | E. Pulley |
| B. Impeller | F. Locating screw |
| C. Seal | G. Body |
| D. Bearing and shaft | |

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Types of Seal:

Two different methods of sealing the water pump have been used. On early model engines the seal was installed in the impeller and sealed against the pump body. On later models the seal is installed in the pump body and seals against the impeller. The seals, impeller and pump bodies of the two types are not interchangeable.

IMPORTANT: When a late type water pump is being reconditioned, measure the diameter of the seal housing, A in Figure 29. This measurement must be 29.97 mm (1.180 in). If the measurement is 30.22 mm (1.190 in) the pump body must be replaced. Then check the seal. If the seal has the number SCD927 on its circumference, replace it with the correct seal, K949550.

Replacing the Seal: Engines before No. 29639:

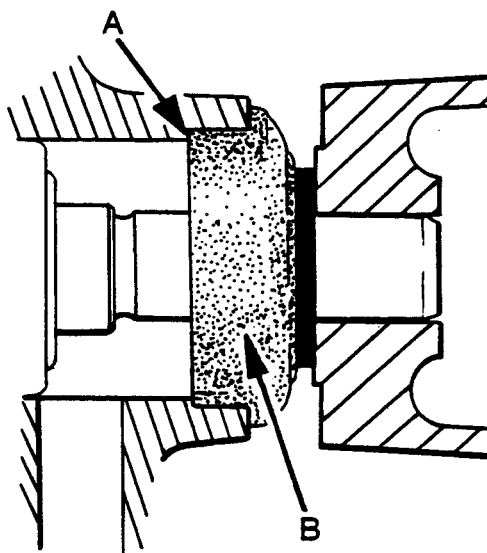
1. Remove the locating screw for the bearing.
2. Put the pump in position on a press with the impeller to the top.
3. Put a piece of shaft 12 mm ($\frac{1}{2}$ in) diameter and approximately 74 mm (3 in) long on the pump shaft. Use the press to push the shaft out of the impeller and the pump body.

NOTE: Impellers can be either cast iron or plastic.

4. Remove the impeller from the pump body. Use a tool similar to a screwdriver to remove the seal from its housing in the impeller.
5. Put the new seal assembly in position on the impeller. Use the press to push the seal into the housing until the shoulder of the seal contacts the end of the impeller.
6. Put a small amount of molybdenum base lubricant on the face of the seal.

Replacing the Seal: From Engine No. 29639:

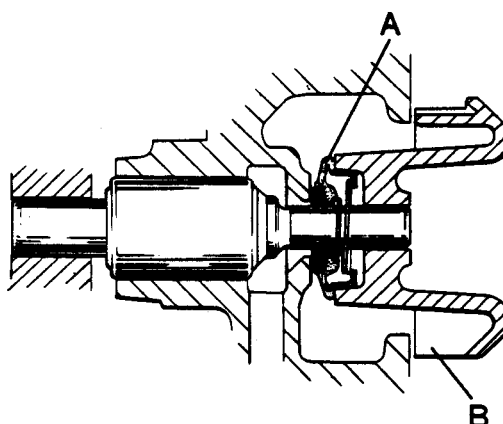
1. Remove the locating screw for the bearing.
2. Put the pump in position on a press with the impeller to the top.
3. Put a piece of shaft 12 mm ($\frac{1}{2}$ in) diameter and approximately 74 mm (3 in) long on the pump shaft. Use the press to push the shaft out of the impeller and the pump body.
4. Remove the impeller from the pump body. Use a screwdriver to remove the seal from the pump body.
5. Put the new seal in position on the pump body. Use the press to push the seal in the pump body until the shoulder of the seal is against the face of the body. Put a small amount of molybdenum base lubricant on the face of the seal.



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FIGURE 29 SEAL HOUSING

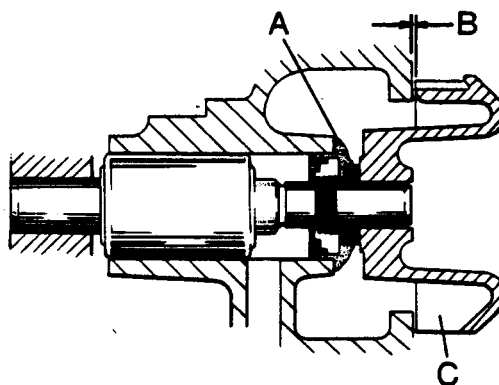
A. Housing diameter B. Seal



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FIGURE 30 SEAL: EARLY MODELS

A. Seal B. Impeller



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FIGURE 31 SEAL: LATER MODELS

A. Seal C. Impeller
B. Clearance, impeller to body, 0.13mm (0.005in)

Replacing the Bearing:

1. Use a press and the piece of shaft to push the bearing and shaft out of the fan pulley.
2. Use the press to push a new bearing and shaft in the fan pulley until the end of the shaft is level with the edge of the hole.

Assembling the Pump:

1. Align the hole in the bearing with the hole for the locating screw in the pump.
2. Use a press to push the shaft and bearing in the pump body until the hole in the bearing is in the centre of the hole for the locating screw.
3. Install the locating screw.
4. Use the piece of shaft as a support for the water pump shaft at the fan pulley end.
Put the pump body on a press with the fan pulley towards the bottom.
5. Put the impeller on the shaft.
Push the impeller on to the shaft until the end of the shaft is aligned with the face of the impeller.

Installing:

1. Put the thermostat in position in the cylinder head.
2. Install a NEW 'O' ring.
3. Install the outlet pipe and the two setscrews.
4. Move the radiator inlet hose into the correct position.
5. Tighten the hose clips.
6. Fill the radiator with coolant.
7. Check for leakage.

THERMOSTAT**Removing:**

1. Remove the coolant from the radiator.
2. Loosen the hose clips on the radiator inlet hose and move the hose toward the radiator.
3. Remove the two setscrews from the outlet pipe from the cylinder head and remove the pipe.
4. Remove the 'O' ring and the thermostat.

Test Procedure:

1. Put the thermostat in a small container full of cold water. Use wire as a support to prevent the thermostat coming in contact with the bottom of the container.
2. Heat the water and use a thermometer to measure the water temperature.
3. As the water gets hotter, make a note of the temperature at which the thermostat valve starts to open.
The correct temperature must be between 79° to 84°C (174° to 183°F).
4. Continue to heat the water until the thermostat valve is open the maximum amount.
The temperature in this position must be 94°C (200°F).

5. If there is any defect in the thermostat, replace it.
NOTE: There is a figure on the bottom of every thermostat.

This is the temperature at which the valve starts to open.

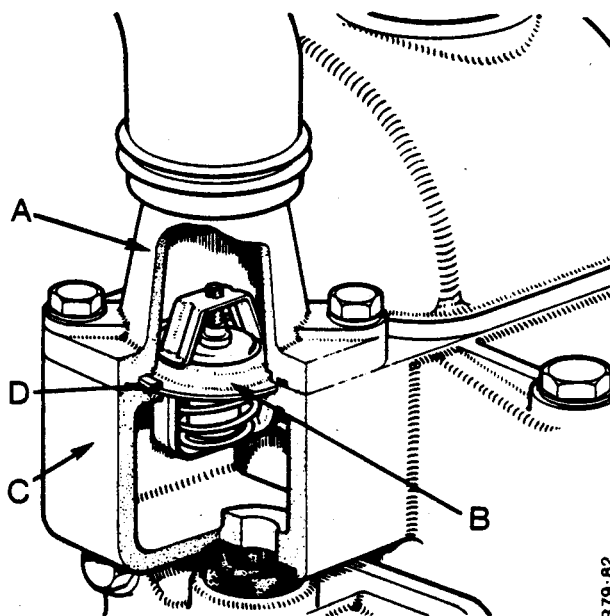


FIGURE 32 THERMOSTAT

A. Water outlet pipe
B. Thermostat

C. Cylinder head
D. 'O' ring

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COMPRESSION TESTING

1. Make sure that the battery has a maximum charge.
2. Remove all the injectors. See the Maintenance Section: Removing the Injectors.
3. Install a compression gauge that has a capacity of not less than 3200kPa (450 lb in²) in No. 1 injector hole.
4. Put the engine stop control in the STOP position.
5. Turn the engine with the starter and make a note of the pressure shown by the gauge.
Put the gauge needle to zero and do the test again to be sure of accuracy.
6. Do a similar test on the other cylinders.
7. Compare the results with the chart shown below.

Diagnosis of the Compression Test:

Pressure higher than normal is an indication of carbon deposits in the cylinder head. The necessary action is to remove the cylinder head and remove the carbon.

If the pressure is lower than normal, put 4 ml (1½ fl. oz) of engine oil into each cylinder and do the compression test again.

If the pressure increases to almost normal, there is wear in the piston rings or cylinders. If the pressure does not increase, the valves are not seating correctly.

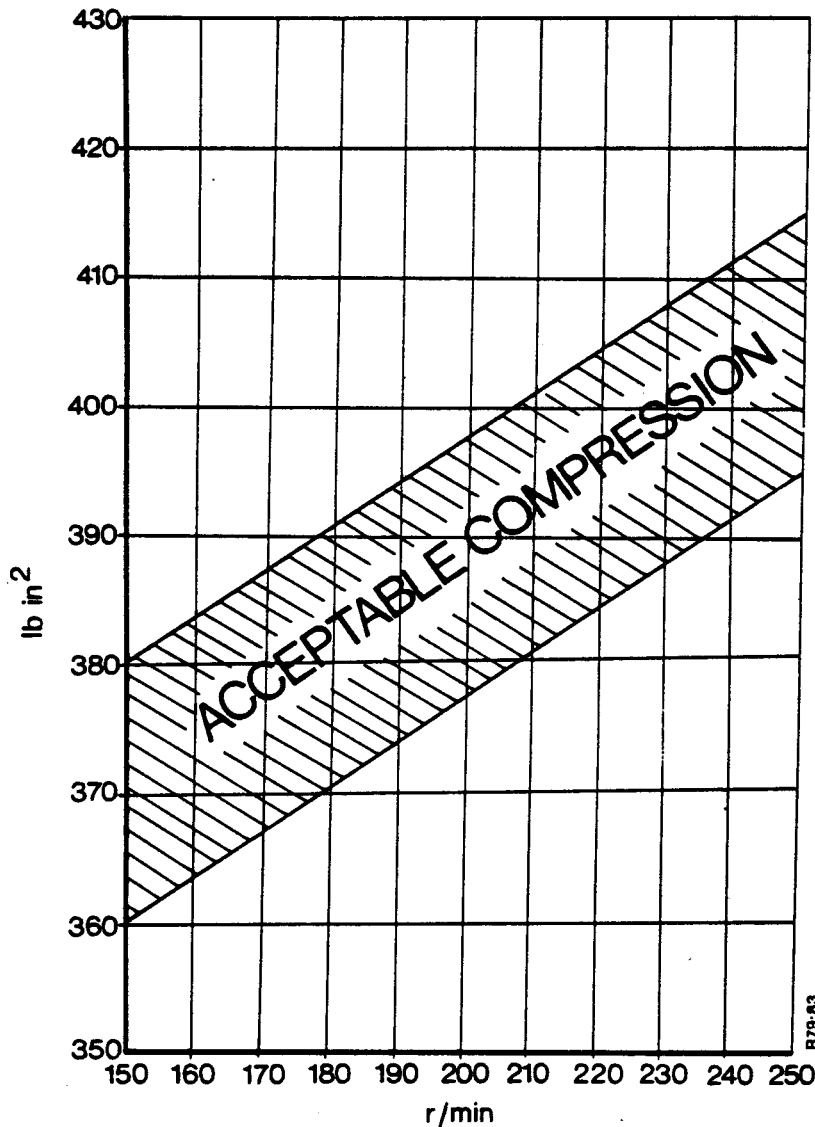


FIGURE 33 COMPRESSION PRESSURES

CYLINDER HEAD:

Removing:

1. Remove the coolant from the system.
2. Remove the top radiator hose.
3. Remove the coolant outlet pipe from the cylinder head.
Remove the thermostat.
4. Remove the injector leak off pipe and the pipe to the fuel tank.
5. Remove the fuel pipes from the injectors.
6. Remove the injectors and the copper washers from the injector ports.
7. Remove the pipe from the breather of the cylinder head cover.
8. Remove the four nuts which fasten the cover to the cylinder head.
Remove the cover and the gasket.
9. Remove the bolt from the inlet manifold which holds the pipe clip in position.
10. Remove the oil pipe between the cylinder block and the cylinder head.
11. Remove the rocker shaft and the push rods.
12. Remove the nine bolts and six nuts which fasten the cylinder head to the block.
13. Remove the cylinder head complete with manifolds.
14. Put a small amount of oil on the cylinder bores.
Put a cover over the block to prevent dirt getting into the cylinders.

Cylinder Head Gasket:

All the water flow holes in the top face of the cylinder block are now made 14.28 mm ($\frac{9}{16}$ in) diameter. This change was made after Engine No. 29525. To keep the same characteristics of water flow it was necessary to use a new type cylinder head gasket with two 9.13 mm ($\frac{3}{8}$ in) holes. The new type gasket, Part No. K949874, can be used on all 3 cylinder engines. The old type gasket, Part No. K942006, can only be used on engines made before this change.

Installing:

1. Clean the cylinder bores and the face of the cylinder block.
2. Put a new gasket in position on the cylinder block. Make sure that if there is a mark TOP on the gasket, this mark is toward the cylinder head.
3. Install a new rubber seal on the top face of the water pump.



WARNING: When you do the next job, make sure that you do not hold the cylinder head with your fingers under the head. Hold the inlet and exhaust manifolds to put the head in position. Failure to do this can result in serious injury.

4. Install the cylinder head, the bolts and the nuts.
5. Tighten the bolts and the nuts. See the Maintenance Section: Cylinder Head Nuts.
6. Install the push rods and the rocker shaft.
7. Install the bolts, washers and spring washers which fasten the rocker shaft to the cylinder head.
Tighten the bolts to 61 Nm (45 lb ft) 6.2 kgm.
8. Adjust the valve clearances. See the Maintenance Section: Valve Clearances.
9. Install the oil pipe between the cylinder block and the cylinder head.
10. Install the bolt in the inlet manifold which holds the pipe clip in position.
11. Install the thermostat and the coolant outlet pipe.
Install the top radiator hose.
12. Put a new cover gasket in position.
Install the cylinder cover.
Install the domed nuts.
13. Install the breather pipe.
14. Install the injectors. See the Maintenance Section: Installing the Injectors.
15. Install the injector leak off pipe and the pipe to the fuel tank.
16. Remove the air from the fuel system. See Maintenance Section.
17. Add coolant to the radiator up to 25 mm (1 in) from the bottom of the filler neck.

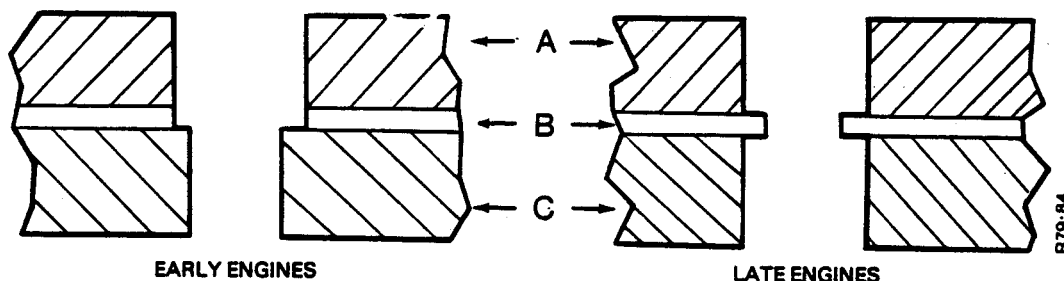


FIGURE 34 CYLINDER BLOCK AND CYLINDER HEAD GASKET

A. Cylinder head
B. Cylinder head gasket
C. Cylinder block

Disassembling:

1. Remove the inlet and exhaust manifolds.
2. Put a number, 1 to 6 on the head of each valve so that each valve can be installed in its original position.
3. Use an acceptable tool (Churchill 900200) to remove the valve cotters, collars, springs and valves.

Cleaning:

Use a soft metal tool, aluminium or brass, to clean the following:

1. Inside the exhaust manifold.
2. The combustion chambers and valve ports inside the cylinder head.
3. The injector ports.
4. The valves.

Exhaust Manifold Gaskets:

The material and thickness of the manifold gaskets was changed after March 1973.

IMPORTANT: The different types of gasket must only be installed as a set.

VALVE SEATS:

1. Check the seats for wear, damage, loose fitting and width of seat.
2. If the seats are in good condition, use grinding paste to seat the valves correctly. If the seats are in bad condition, use a seat cutting tool to put a new face of 45° on the inserts.
DO NOT remove more material than is necessary.
3. Check the width of the seats. This width must not be more than 1.65 mm (0.065 in). If necessary, use a cutting tool to decrease the width of the seat.

VALVE STEM BORES:

The valves work in the cylinder head and there are no separate valve guides.

1. Put a new valve in each bore and measure the clearance between the valve stem and the bore. If the clearance is more than 0.152 mm (0.006 in) it will be necessary to increase the size of the bore by 0.254 mm (0.010 in) or 0.508 mm (0.020 in).
Do the procedure as follows:
2. According to the amount of wear and the size of the bore, use reamer Part No. K960989 or reamer Part No. K961824.
Use a machine running at its slowest speed and lubricate the reamer with cutting fluid. Be careful and do not cause damage to the top edge of the exhaust bores.
3. After the bores have been machined it will be necessary to cut the valve seats. See the section: Valve Seats.

VALVE SPRINGS:

If equipment is available check the length of all valve springs under load. If equipment is not available, do the following procedure.

1. Take one spring from a set of NEW springs.
2. Make a comparison of the length of the old springs with the new spring.
Discard any spring which is 1.5 mm ($\frac{1}{16}$ in) shorter than the new spring.
3. Make a comparison of the length of each spring under load as shown in Figure 35.
4. Put a piece of shaft inside both springs to prevent the springs moving out of position. Put a washer between the end of the springs.
5. Tighten the vice until the new spring is at the length shown in the Data Section.
6. Measure the difference between the old springs and the new spring.

If any old springs are more than 1.5 mm ($\frac{1}{16}$ in) shorter than the new spring, discard them.

NOTE: If the record shows that the engine has run for a large number of hours, install a set of new springs.

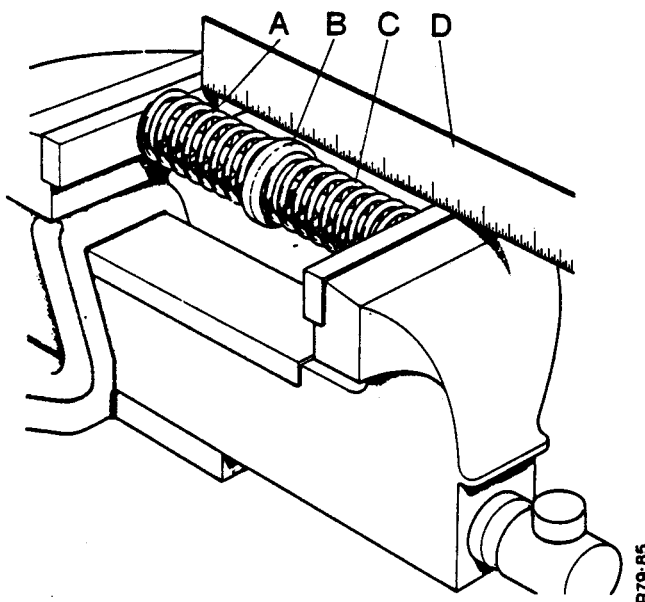


FIGURE 35 CHECKING VALVE SPRINGS

A. New spring
B. Spacer

C. Old spring
D. Rule

VALVES

The valves were changed at the following engine and serial numbers:

780 Tractor

Exhaust valve	Inlet valve	Serial number
928622	928622	6039 onwards
921434	921433	5584 to 6038
900417	914528	1001 to 5583

880 Tractor

Exhaust valve	Inlet valve	Serial number
928622	928622	25306 onward (Livedrive)
		2984 onward (non-Livedrive)
921434	921433	24645 to 25309 (Livedrive)
		2984 onwards (non-Livedrive)
900417	914528	1001 to 24644 (Livedrive)
		1001 to 2983 (non-Livedrive)

770 Tractor

Exhaust valve	Inlet valve	Serial number
921434	921433	9970 onwards (Livedrive)
		1879 onwards (non-Livedrive)
900417	914528	up to 9969 (Livedrive)
		up to 1878 (non-Livedrive)

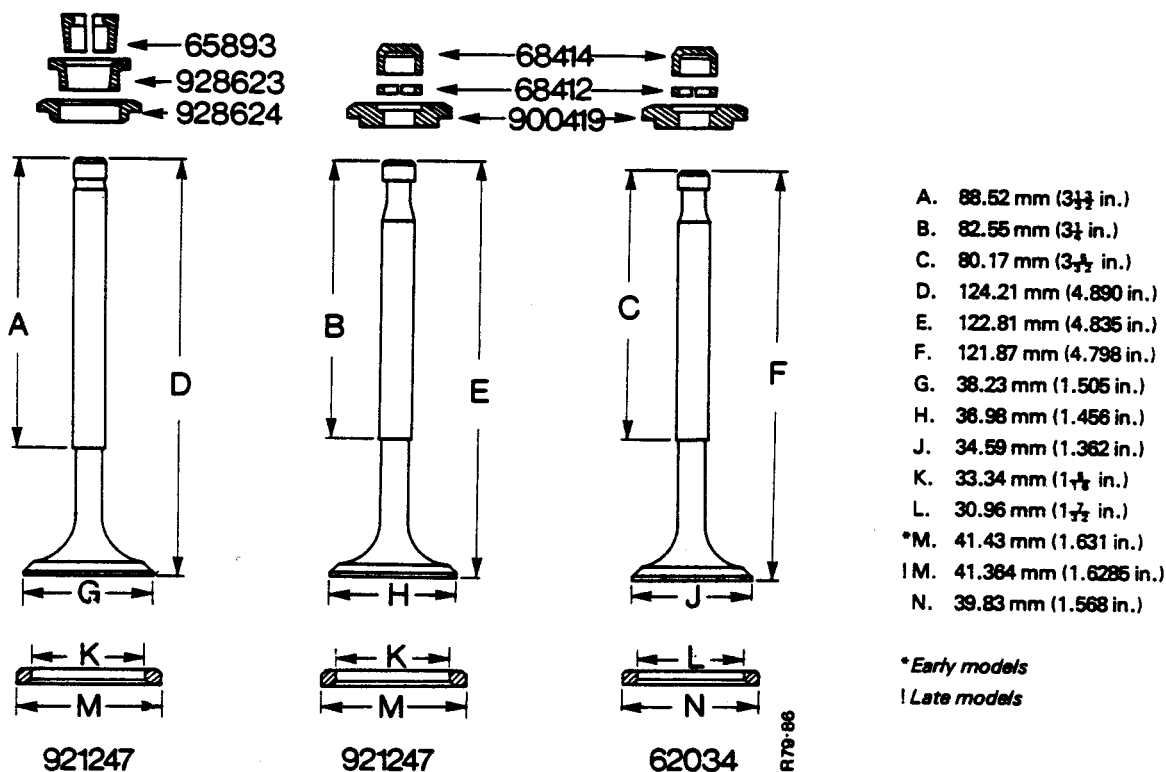


FIGURE 36 DETAILS OF EXHAUST VALVES

Oversize valves are available in two sizes, 0.254 mm (0.010 in) and 0.508 mm (0.020 in).

1. Check the valves for wear on the stems and in the cotter grooves. Discard any valves that show wear.
2. Check the valve seats for wear or damage.
3. If necessary, the valve seats can be machined to 45°.

When you do this, make sure that when the seat is correct, there is not a sharp edge on the circumference of the head of the valve. If there is a sharp edge, discard the valve.

INLET VALVE SEALS:

Seals are not installed on the inlet valves of engines after the following Model and Serial Numbers:

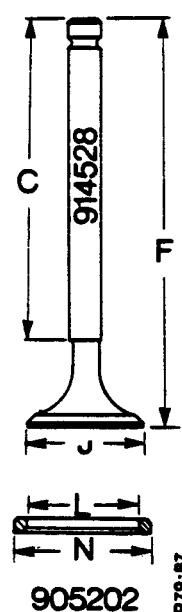
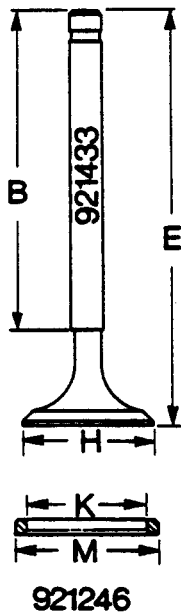
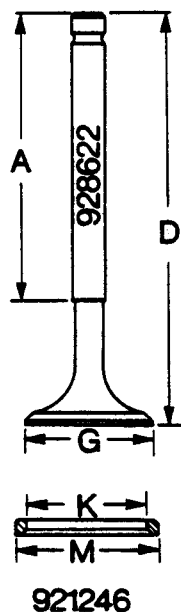
Model	Serial Number
355001	33361
355005	2019
355011	20198
355012	1049

Seals are available for early type engines from the parts Department.

FIGURE 37
INLET VALVES AND SEAT
INSERTS

- A. 88.52 mm (3 $\frac{1}{2}$ in.)
- B. 95.25 mm (3 $\frac{3}{4}$ in.)
- C. 96.84 mm (3 $\frac{7}{8}$ in.)
- D. 124.21 mm (4.890 in.)
- E. 123.44 mm (4.860 in.)
- F. 122.94 mm (4.840 in.)
- G. 38.23 mm (1.505 in.)
- H. 37.46 mm (1.475 in.)
- J. 35.05 mm (1.380 in.)
- K. 34.92 mm (1 $\frac{1}{2}$ in.)
- L. 35.54 mm (1 $\frac{3}{8}$ in.)
- *M. 41.43 mm (1.631 in.)
- !M. 41.364mm (1.6285 in.)
- N. 39.83 mm (1.568 in.)

*Early Models
! Late Models.



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FIGURE 37 DETAILS OF INLET VALVES

NOTE: Valve, Part No. K928622 is now used for both inlet and exhaust on AD3/55, AD3/49 and 355011 engines. This valve can be used to replace inlet valve K921443 and exhaust valve K921434. If it is used to replace exhaust valve K921434, the late type valve cotters must be used.

Valve, Part No. K928622 can not be used to replace inlet valve K914528 or exhaust valve K90047.

NOTE: When installing valve No. K928622 make sure that the width of seat is not less than 1.14mm (0.045in).

RECONDITIONING THE CYLINDER HEAD:**Cylinder Head Face:**

1. Clean the face of the cylinder head with a fine grade of emery cloth.
2. Use a surface plate and marking material, or a straight edge and feeler gauges to make sure that the cylinder head face is flat.
If the face is not flat, grinding will be necessary. Before this is done, the valve seats must be removed.

IMPORTANT: The amount of material removed must not be more than necessary to get a flat surface. The maximum amount that can be removed is 0.76 mm (0.030 in).

Removing the Valve Seat Inserts:

1. Hit the seat insert with a steel chisel and a hammer. Then remove the seat insert with a prybar or the jaw of an open end spanner.

Depth of Bore for the Valve Seat Insert:

1. Measure the depth of the bore with a vernier or micrometer depth gauge. If necessary the seat must be machined to the dimension shown in Figure 38.

NOTE: The seat of the bore must be at 90 degrees to the axis of the valve guide and must have a smooth surface.

Installing the Valve Seat Inserts:

Standard inserts are 41.364 to 41.338 (1.6285 to 1.6275 in) in diameter. They are an interference fit in the cylinder head of 0.0889 to 0.0381 mm (0.0035 to 0.0015 in).

There are two methods of installation:

1. Use dry ice to decrease the diameter of the inserts, or
2. Heat the cylinder head to increase the diameter of the bore.
3. Use the tool shown in Figure 39 and a hammer to install the valve seat inserts.

Do this job as quickly as possible.

NOTE: To make sure that the inserts have been installed correctly, check that the top face of the insert is 0.28 mm (0.010 in) below the face of the cylinder head. See Figure 41.

4. Use the tool shown in Figure 39 and a hammer to press the metal of the cylinder head over the edge of the insert. See Figure 42.

Valve Seat Dimension and Angle:

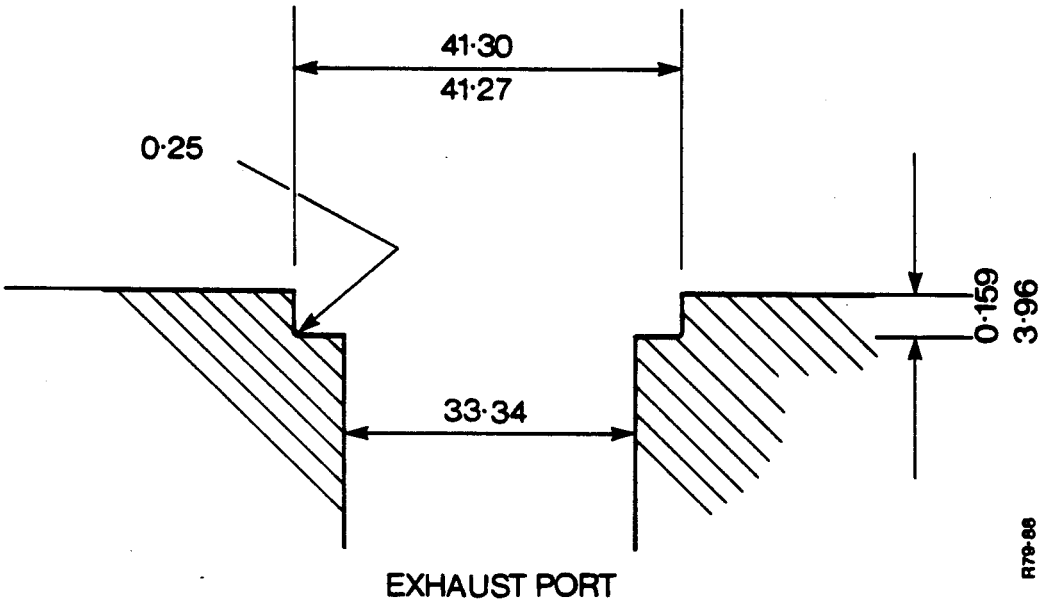
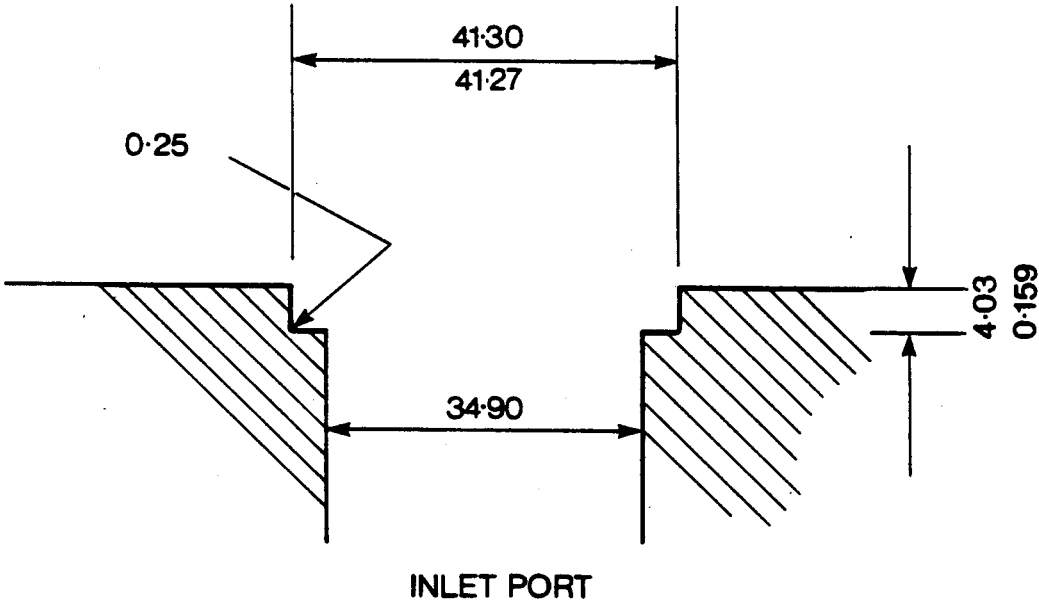
The valve seat inserts must be machined as shown in Figure 42.

Width of seat 1.78 to 1.52 mm (0.070 to 0.060 in).

Included angle of seat 87 degrees.

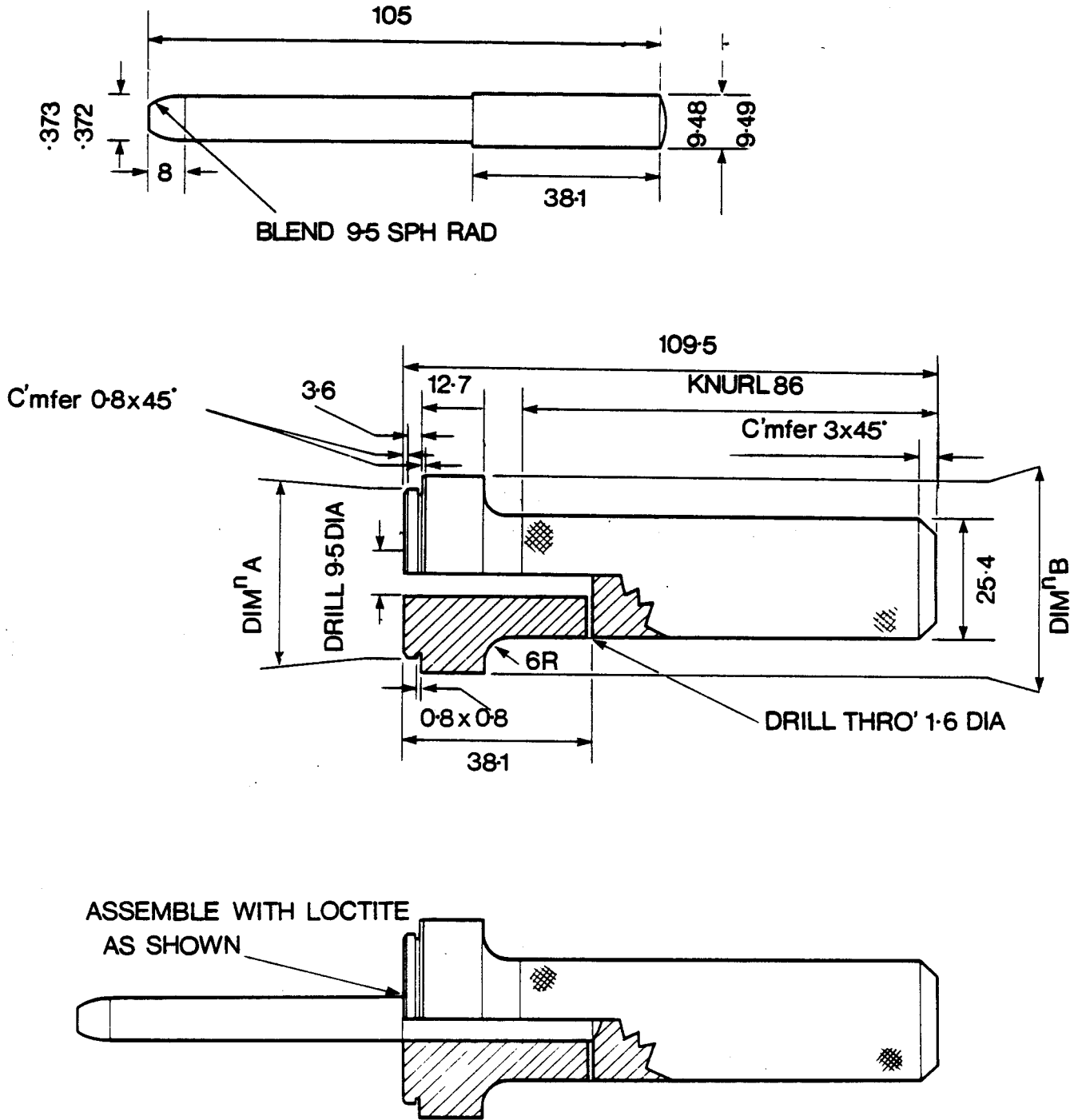
NOTES ON RECONDITIONING:

1. If there is wear in the valve guides and oversize valves are to be installed, the valve guides must be reamed to the correct size **BEFORE** the valve insert seats are machined.
2. After this has been done, or if the cylinder head has already had oversize valves installed, the pilot used with the tools shown must also be made to the same size as the valve guide.
That is either 0.254 mm (0.010 in) or 0.508 mm (0.020 in) oversize.
3. If the valve seat insert is broken or loose in the bore, an oversize valve seat insert must be made. When the bore is machined, the same interference fit of 0.0889 to 0.0281 mm (0.0035 to 0.0015 in) must be used.
The tool used to install the inserts must also be made to a similar oversize on the 42.862 mm (1 $\frac{7}{8}$ in) and the 40.479 mm (1 $\frac{5}{8}$ in) diameters.



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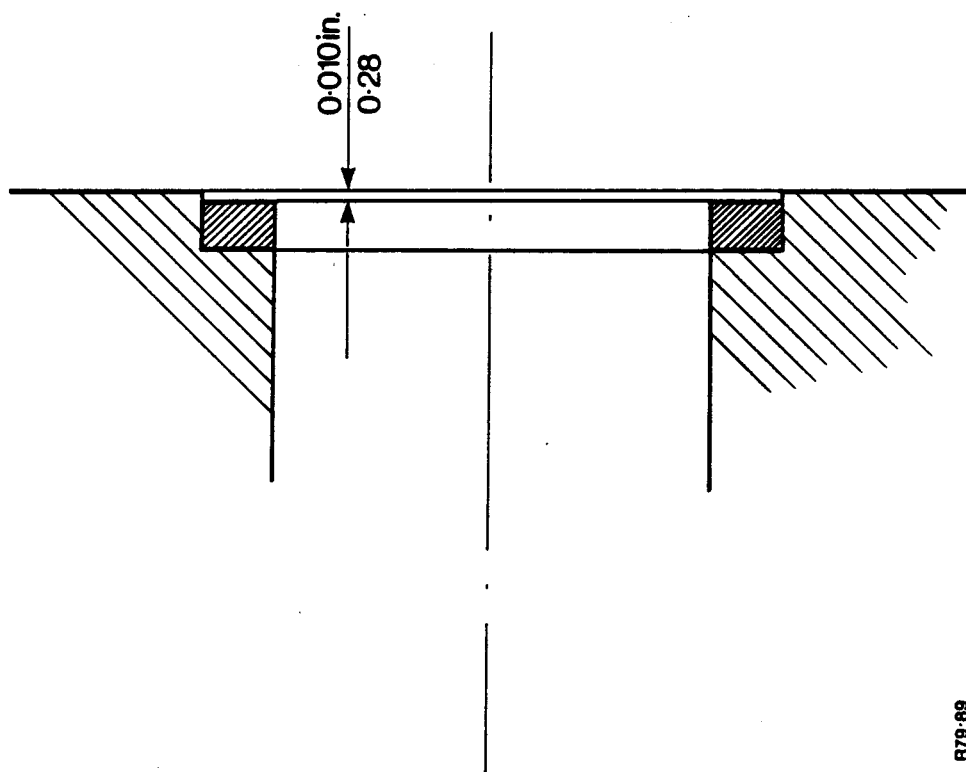
FIGURE 38 DIMENSIONS OF BORES FOR VALVE SEAT INSERTS



	DIMENSION A	DIMENSION B
INLET INSERT	34.67/ 34.65	41.28 DIA
EXHAUST IN'RT	33.08/ 33.06	41.28 DIA

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FIGURE 39 TOOL FOR INSTALLING VALVE SEAT INSERTS



R79-89

FIGURE 40 VALVE SEAT INSERT AFTER INSTALLATION

ITEM 2. MATERIAL: $3\frac{1}{2}\%$ Nickel Chrome Molybdenum Steel to BS 970 Part 3 1971 832 M13 (En 36c). Harden by oil quench from 780°C (Cherry Red). Temper at 300°C (Blue) for 1 hour. Alternative treatment using oxy-acetylene torch following the temperature colour guide. Make sure that the rate of heating is even.

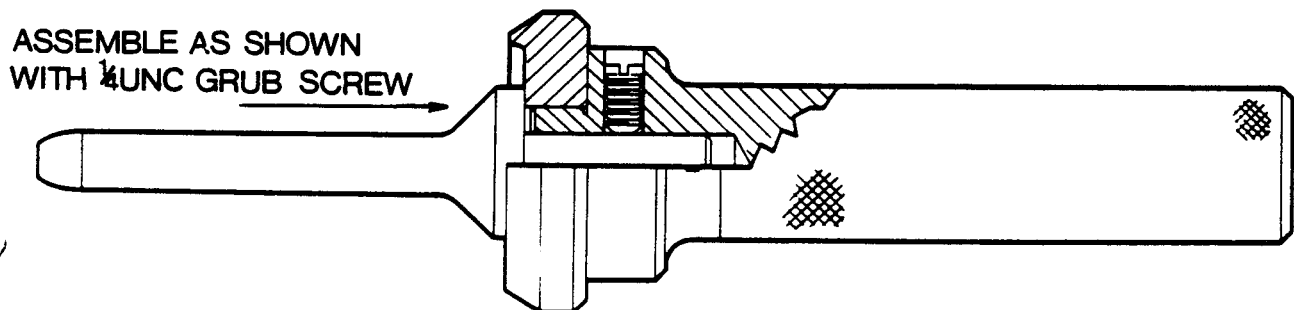
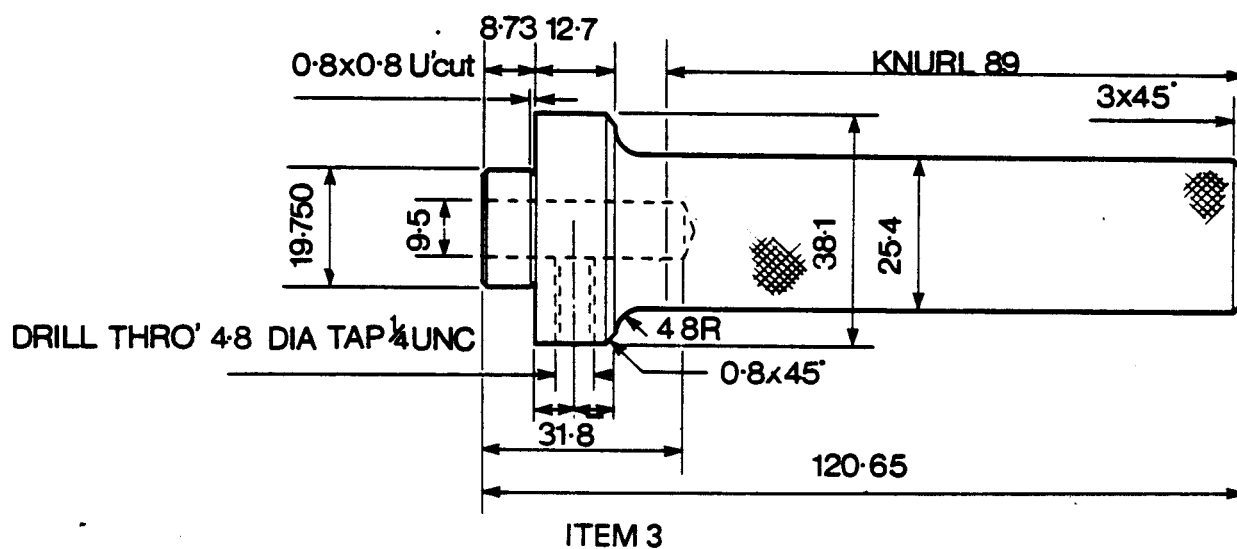
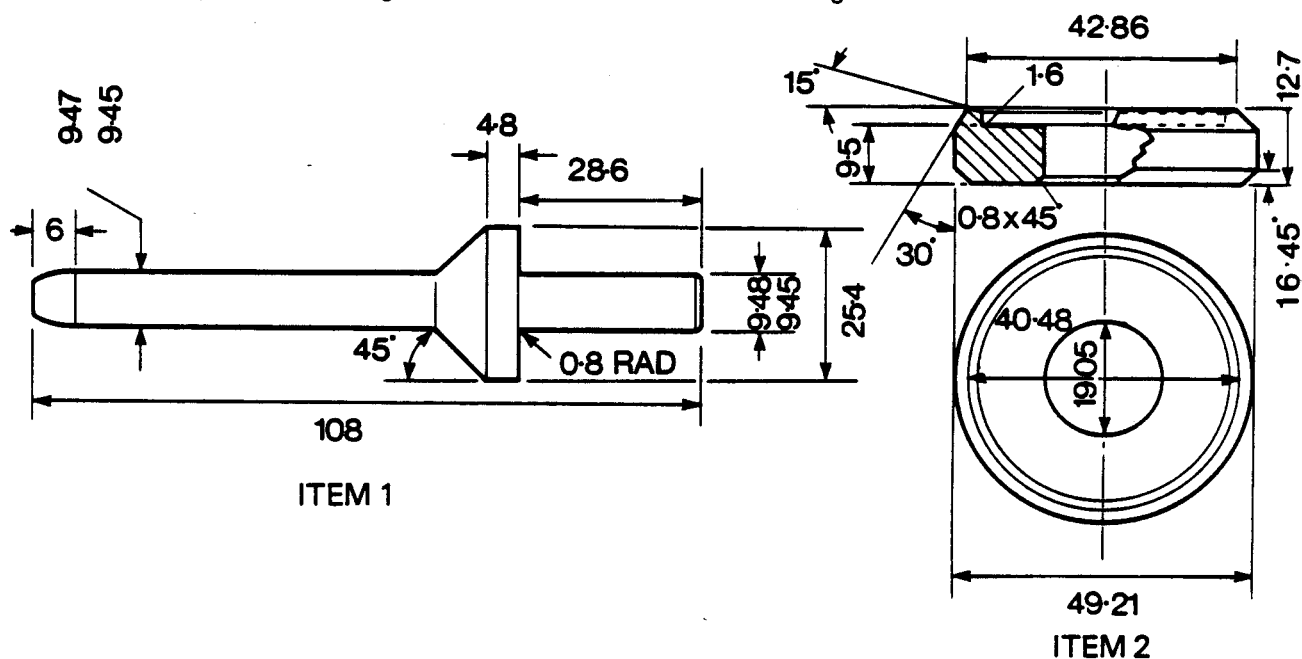
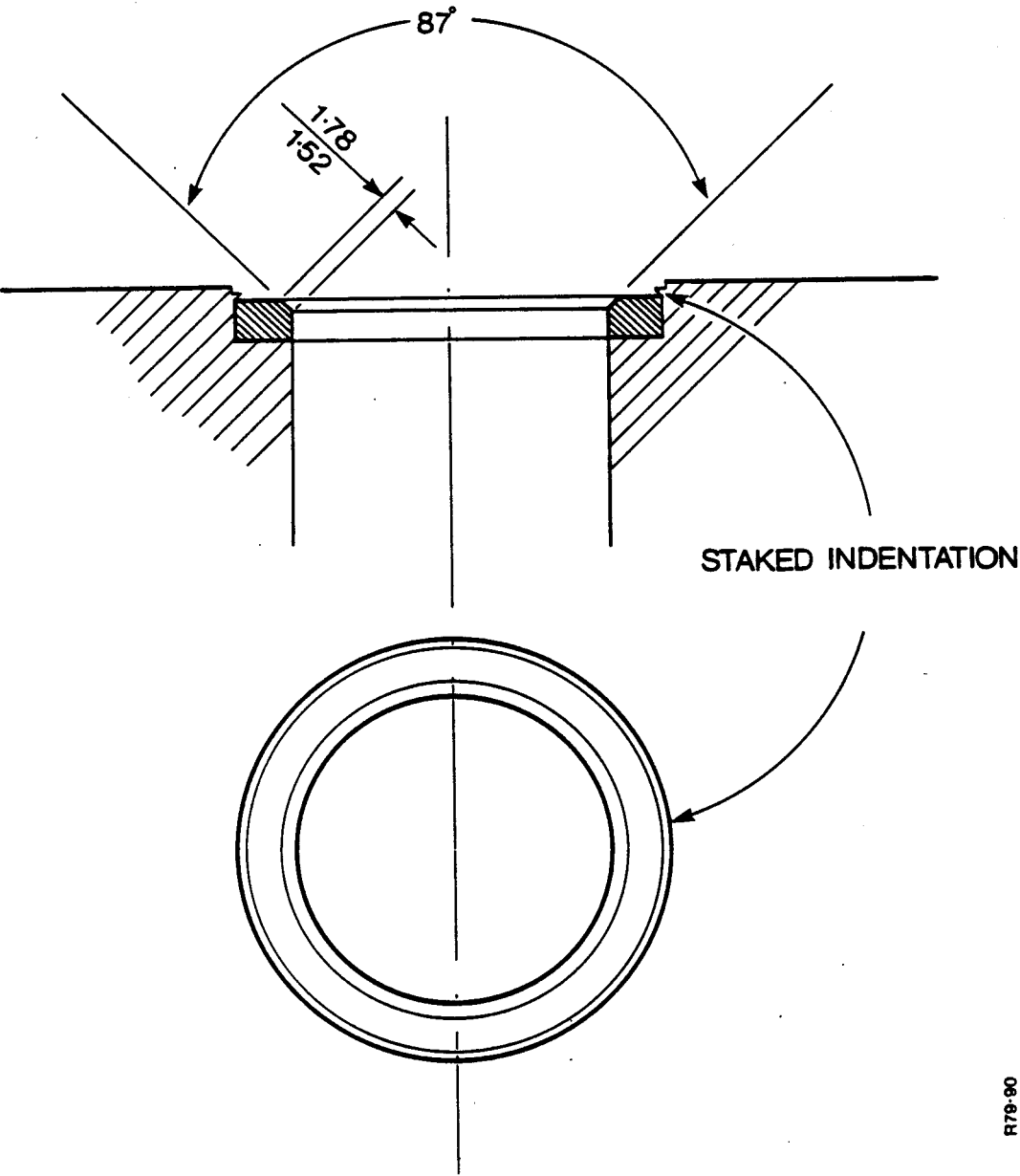


FIGURE 41 PEENING TOOL FOR CYLINDER HEAD



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FIGURE 42 MACHINING DIMENSIONS FOR VALVE SEAT INSERTS

VALVE ROCKERS AND SHAFT:

Disassembling:

1. Remove the plugs from both ends of the rocker shaft.
2. Remove the springs, valve rockers and brackets from the shaft.
3. Remove the locating screw from the rear bracket. Remove the rear bracket.

Inspection:

1. Check all the springs for wear or damage.
2. Check the shaft for wear.
3. Check the rocker ends and bushes for wear.

Replacing a Bush:

1. Use a press to remove the old bush.
2. Make sure that the oilholes in the new bush and the rocker are aligned.
Use a press to put the new bush in position.
3. Use an expanding type of reamer in the bush until the rocker can be turned easily on the shaft.

Assembling:

1. Install the shaft in the rear bracket.
Make sure that the hole in the bracket is aligned with the hole in the shaft.
2. Install and tighten the locating screw.
3. Install the brackets, springs, rockers and plugs.

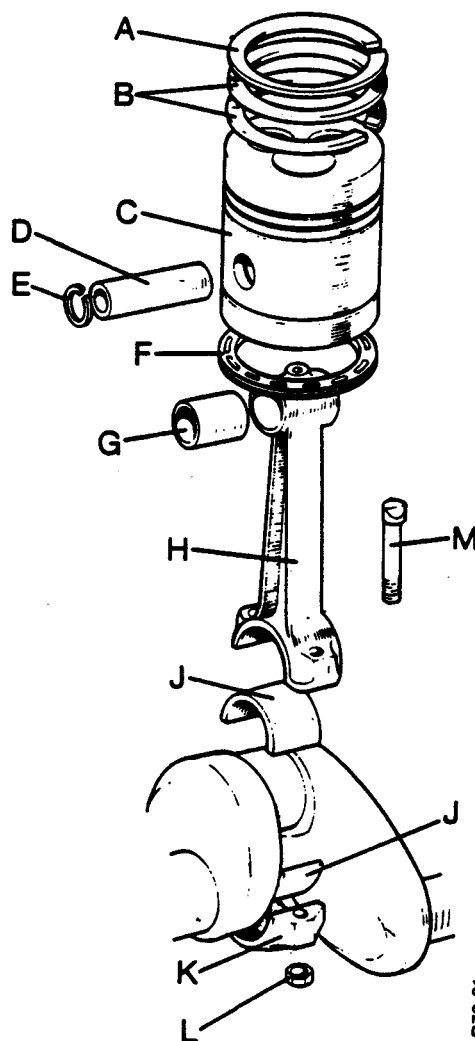


FIGURE 43. PISTON AND CONNECTING ROD

- A. Top compression ring
- B. Nos. 2 and 3 compression rings
- C. Piston
- D. Gudgeon pin
- E. Circlip
- F. Oil scraper ring
- G. Connecting rod bush
- H. Connecting rod
- J. Bearing shells
- K. Connecting rod cap
- L. Self locking nut
- M. Bolt

PISTONS:

The pistons in AD3/30 and AD3/40 engines are the same diameter but different heights.

The pistons in AD3/55, AD3/49 and 355011 engines are the same diameter but different heights.

For details of dimensions see the Specification Section.

Pistons installed in engines with high lift camshafts have a deeper recess for the valves.

High lift camshafts were used on all AD3/49, AD3/55 and 355011 engines. Also on AD3/40 engines from AD3/40A/3424 and AD3/40B/1495.

Make sure that the correct type of pistons are used or damage will be caused by the valves hitting the pistons.

Removing:

Before this operation can be done, the engine must be removed from the tractor.

1. Remove the cylinder head.
2. Put a mark, No. 1 to the front of the engine, on the pistons and connecting rod caps. You can then be sure that each piston and connecting rod can be installed in its correct cylinder.

NOTE: The connecting rods and caps have a mark to show correct assembly. These marks are on the camshaft side of the engine.

3. Remove the nuts from the bearing caps.
Remove each bearing cap.
Remove the bolts from the connecting rods to prevent damage to the cylinder bores.
4. Use a soft piece of wood to push each piston out of the cylinder head.
5. Use circlip pliers to remove the circlips from each side of the piston pin.
6. Put the piston in hot oil. 150°C (302°F) for two minutes.
7. Use gloves for this operation.
Remove the piston from the oil and push the pin out of the piston.

Installing:

NOTE: Before installing the pistons in the cylinders see the Sections: Glazed Cylinder Bores and Removing the Glaze.

NOTE: Gloves must be used for holding the hot piston.

1. Install a circlip in one side of the piston.
2. Put the piston in hot oil, 150°C (302°F) per two minutes.
3. Put the connecting rod in a vice that has soft metal or fibre jaws.
4. Remove the piston from the oil. Put it in position on the connecting rod with the valve recesses on the same side as the identification marks on the connecting rod.
5. Install the gudgeon pin through the bush until it is against the circlip in the piston.
Install the second circlip.
6. Turn the piston rings so that the ring gaps are evenly spaced around the piston.
7. Install the connecting rod and piston in the block. Make sure that the recesses in the piston are toward the camshaft side of the engine.
8. Use a clamp to put the piston rings in compression.
Use a soft piece of wood to push the piston into the cylinder.
9. Put a small amount of oil on the bearings.
10. Install the bolts, bearing cap and the nuts. Make sure that the marks on the bearing caps and the connecting rods are aligned.
11. Tighten the nuts to 68 Nm (50 lb ft) 6.9 kg/m.
12. Install the cylinder head.

PISTON RINGS:

Description:

There are three compression rings and one oil scraper ring on each piston.

The three compression rings are made with a taper face and the top ring has a chrome insert.

IMPORTANT: The compression rings must be installed with the word TOP toward the crown of the piston.

Checking for Wear:

1. Clean the tops of the bores where there is no wear.
2. Remove the rings from No. 1 piston.
3. Put each ring separately in the top of No. 1 bore, and measure the gap.
Repeat this operation with the rings from No. 2 and No. 3 pistons in their correct bores.
4. When any rings have a gap of more than 1.524mm (0.060 in), new rings must be installed.
5. Check the clearance of each ring in its correct groove of the piston with a feeler gauge. If this clearance is more than 0.127 mm (0.005 in), replace the piston.

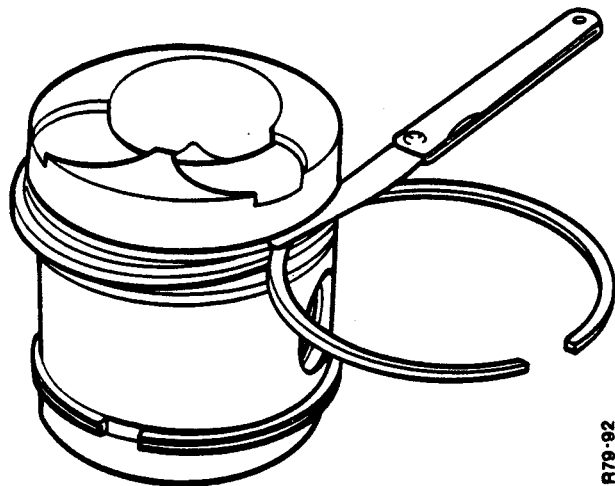


FIGURE 44 CHECKING PISTON RING GROOVE CLEARANCE

CYLINDER BORES:

Checking for wear:

1. Measure each bore at the top to find if the bores are standard or oversize.
2. Measure the maximum amount of wear in each bore.
3. Make an inspection of each bore for damage.

Reconditioning:

If the wear on any bore is more than 0.254 mm (0.010 in) or if there is damage to any bore, the cylinder block must be rebored to the next size and oversize pistons installed.

If the bores are already at the maximum oversize cylinders liners are available. See the Section: Cylinder Liners.

If there is less than 0.254 mm (0.010 in) of wear in the bores, oil control piston rings can be installed. See the Sections: Piston Rings and Glazed Cylinder Bores.

GLAZED CYLINDER BORES:

With use, the working surface of the cylinder bore becomes hard and similar to glass. This condition is known as glazed. Before new piston rings are installed this hard surface must be removed. If this is not done, the rings will not make a correct seal on the cylinder bores. The result will be that the engine will use more oil than normal and will not give its rated performance.

Removing the Glaze:

Tool Recommendation and Use:

It is a recommendation that you use the Flex Hone Type GB 4 $\frac{1}{2}$, 120 grit and do the following procedure.

1. Use tape or similar material to give protection to the crankshaft journals.
2. Put a small amount of 10W30 grade engine oil on the bores.
3. Fasten the Flex Hone in a drilling machine that has a capacity of 10 to 15 mm ($\frac{3}{8}$ to $\frac{1}{2}$ in) and a speed of 300 to 750 r/min.

IMPORTANT: Read all the following instructions before you do the next operation. Be careful when you do each operation.

4. Put the Flex Hone in position in contact with the top of the bore.
5. Start the machine and at the same time push the Flex Hone into the bore.
6. While the machine is running, move the Flex Hone up and down the length of the bore. Do this for 20 to 40 seconds at a rate of one second for each direction.
7. Remove the Flex Hone while the machine is running.
Stop the machine.

8. Clean the cylinder bore with a soap and water solution.

Make sure that the bore is clean by using white paper to remove the soap and water solution.

Continue to clean the bore until no dirt can be seen on the white paper.

9. Repeat this procedure with the remainder of the bores.

CYLINDER LINERS:

Cylinder liners are available and can be used when the bores are already at the maximum oversize or when there is damage to a bore. It is not necessary to install liners in all the cylinders, but when the overhaul is complete, all cylinders must be the same diameter.

Cylinder liners can be rebored in the same way as the original cylinder bore to 0.508 mm (0.020 in) oversize.

Sealing Rings:

A sealing ring is not installed in the top of the bore in engines made after August 1972. Because of this change the top of the bore is not machined to hold a sealing ring.

When reconditioning an early type 880 tractor with an engine type 3/40 that needs a replacement cylinder block, discard the cylinder liners and install pistons Part No. K943880. Cylinder Liners Part No. K912776 are available from the Parts Department if it is necessary to replace the liners only.

Installing Liners:

Use a boring bar and a honing machine to increase the cylinder bore to 104.99 to 105.00 mm (4.1334 to 4.1339 in).

NOTE: During this operation the boring tool may go into the water jacket. This is not important if the tool is kept correctly aligned.

2. Clean the bore and then wash the bore with a solution of soap and water.
 3. Put a small amount of Pressolene or a similar lubricant on the new liner.
 4. Put the liner in position on the bore with the chamfered end toward the bottom of the bore.
 5. Use an acceptable press to push the liner in the bore until the top of the liner is 0.13 to 0.25 mm (0.005 to 0.010 in) above the face of the cylinder block.
 6. Use a surface grinding machine to grind the liner level with the top face of the cylinder block. Do not remove metal from the block.
 7. Put a chamfer on the top of the liner of 0.76 mm (0.030 in) at an angle of 45°.
 8. Use a honing machine inside the bore to get a smooth surface, 20 to 40 micro inches CLA, and a diameter of 100.05 to 100.06 mm (3.9388 to 3.9396 in).
 9. Clean and wash the bore as in Operation 2.
- NOTE:** Correctly installed cylinder liners have an interference fit of 0.08 to 0.11 mm (0.0031 to 0.0046 in).

CONNECTING RODS:

Alignment:

It is recommended that all connecting rods are checked for distortion when they have been removed from the engine.

This is most important when the wear marks on the piston are not even.

Use an alignment tool as shown in the Service Tool Leaflet B5.

The following chart gives the permissible distortion. If any connecting rod has more distortion than shown, it must be replaced.

IMPORTANT: DO NOT try to make repairs to a connecting rod.

Maximum out of parallel: 0.005 mm per centimetre
0.0005 in per inch

Maximum twist: 0.005 mm per centimetre
0.0005 in per inch

Replacing the Bush:

1. Use a press and an acceptable piece of shaft to remove the old bush.
2. Put the new bush on the bore of the connecting rod and align the oil hole in the bush with the hole in the bore of the connecting rod.
3. Use a press to push the new bush in position.
4. Use a reamer that you can adjust to increase the bore of the bush until the gudgeon pin can be pushed in the bush using a small amount of hand pressure.

CONNECTING ROD BEARINGS:

The connecting rod bearings are of the steel shell type. The bearing material is aluminium and tin. After they have been installed, they must not be moved to a different position.

Each connecting rod and cap must be kept together as a unit. Do not use a file or scraper on the bearings, caps or connecting rods.

MAIN BEARINGS:

The main bearings are of the steel shell type. The bearing material is aluminium and tin.

Before removal, put a mark on each cap so that the caps can be installed in the same position. After they have been installed, they must not be moved to a different position.

When you install the caps, make sure that they are installed in their original positions.

Do not use a file or scraper on the bearings or the caps.

A range of bearings is available if reconditioning is necessary. For details of the sizes, see the Specification Section.

CRANKSHAFT RECONDITIONING:

If the crankshaft journals have wear or damage the crankshaft must be reconditioned and new bearings installed.

Permissible Wear:

The following recommendations are only to be used as guide to the maximum permissible amount of wear before reconditioning is necessary.

Connecting rod journals: 0.127 mm (0.005 in)

Main bearing journals: 0.127 mm (0.005 in)

End clearance: 0.38 mm (0.015 in)

Balance Weights:

Before any work is done on a crankshaft, the balance weights must be removed. The procedure for removing and installing the balance weights is as follows:

1. Put a mark on each balance weight so that it can be installed in the same position.
2. Bend the tabwashers away from the heads of the bolts.
3. Remove the bolts and the balance weights.
4. Before you install the balance weights, remove any sharp edges that will prevent the weights from making a good seat on the crankshaft.
5. Put the weights in position on the crankshaft. Install NEW bolts and NEW tabwashers. Tighten the bolts to 54 Nm (40 lb ft) 5.5 kgm.
6. Use a 0.05 mm (0.002 in) feeler gauge to make sure there is no gap between the faces of the balance weights and the crankshaft. This is important.
7. Bend the tabwashers against the heads of the bolts.

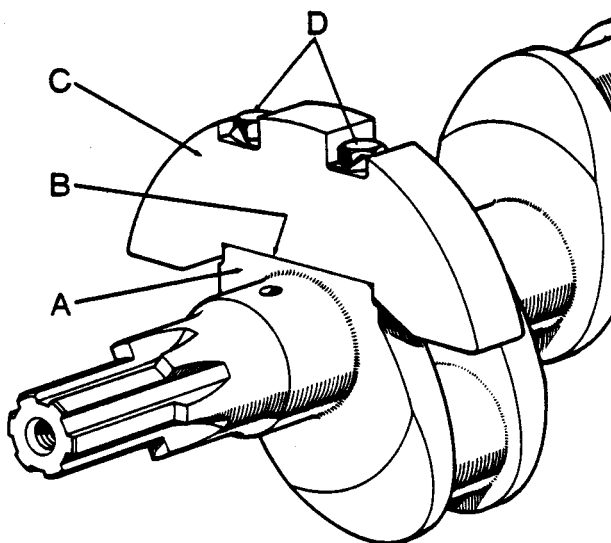


FIGURE 45 CHECKING BALANCE WEIGHTS AFTER INSTALLING

A. Crankshaft
B. Check gap here

C. Balance weight
D. Bolts

Grinding the Crankshaft:

The dimensions and tolerances are as shown below:

Main journal diameters:**Standard size**

63.487 to 63.474 mm (2.4995 to 2.4990 in)

Under size 0.254 mm (0.010 in)

63.233 to 63.220 mm (2.4895 to 2.4890 in)

Under size 0.508 mm (0.020 in)

62.979 to 62.966 mm (2.4795 to 2.4790 in)

Under size 0.762 mm (0.030 in)

62.725 to 62.712 mm (2.4695 to 2.4690 in)

Connecting rod journal diameters:**Standard size**

60.2869 to 60.2742 mm (2.3735 to 2.3730 in)

Under size 0.254 mm (0.010 in)

60.0329 to 60.0202 mm (2.3635 to 2.3630 in)

Under size 0.508 mm (0.020 in)

59.7789 to 59.7662 mm (2.3535 to 2.3530 in)

Under size 0.762 mm (0.030 in)

59.5249 to 59.5122 mm (2.3435 to 2.3430 in)

No. 3 main journal width:**Standard size**

41.3004 to 41.249 mm (1.626 to 1.624 in)

Oversize 0.254 mm (0.010 in)

41.5544 to 41.503 mm (1.636 to 1.634 in)

Oversize 1.016 mm (0.040 in)

42.3164 to 42.2656 mm (1.666 to 1.664 in)

Journal fillet radius:

All journals 4.06 to 3.81 mm (0.16 to 0.15 in)

IMPORTANT: When you recondition a crankshaft, make sure that you grind the radius of the journals correctly. They must be to the correct size and have a finish similar to the journal. There must be no steps between the journal and the radius.

If this operation is not done correctly, there will be a failure of the crankshaft.

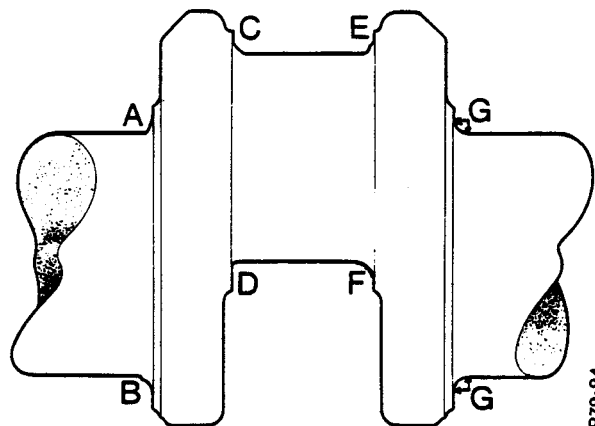


FIGURE 46 EXAMPLES OF REGROUND FILLET RADII

- | | |
|---------|------------------------------------|
| | A. No radius |
| | B. Radius not evenly finished |
| Wrong | C. Radius too large |
| | D. Radius too small |
| | E. Radius too small |
| | F. Radius roughly finished |
| Correct | G. Correct radius, evenly finished |

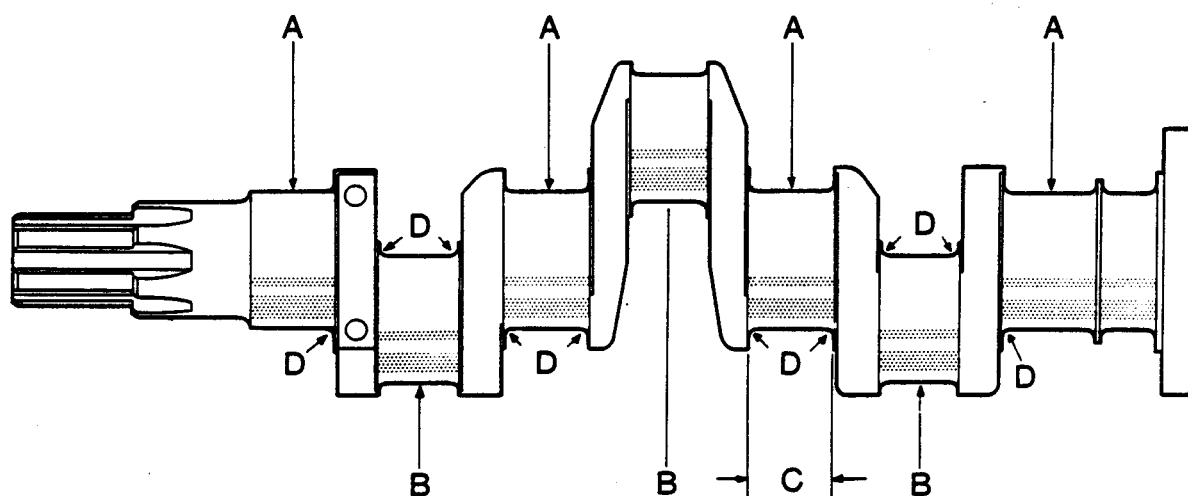


FIGURE 47 CRANKSHAFT DIMENSIONS

- | | |
|----|----------------------------|
| A. | Main journal diameters |
| B. | Big end journal diameter |
| C. | Number three journal width |
| D. | Fillet radius |

CRANKSHAFT REAR SEAL

Diagnosis of Oil Leaks:

It is very important that the exact location of an oil leak is found before removing the oil seal retainer from the engine.

An accurate diagnosis can be made using air pressure inside the engine crankcase after the flywheel has been removed.

Test Procedure:

1. Remove the flywheel.
2. Put a plug made of cloth into the breather pipe to prevent air leaking from the crankcase. Turbo-charged engines: Remove the breather body, cover and diaphragm and put the plug in the base of the breather.
3. Remove the dipstick.
4. Adjust the pressure in an air hose to 69 kPa (10 lb/in²) 0.7 Kg/cm². Hold the air hose on the dipstick sleeve so that air will flow into the engine crankcase.
5. While there is air pressure inside the crankcase move a piece of slow burning material (or a burning cigarette) around the oil seal retainer. Check for leaks as shown in Figure 48. If there are any faults, the air from the crankcase will come in contact with the burning material. When this occurs there will be an increase in the rate of burning which will show the exact position of any leakage.

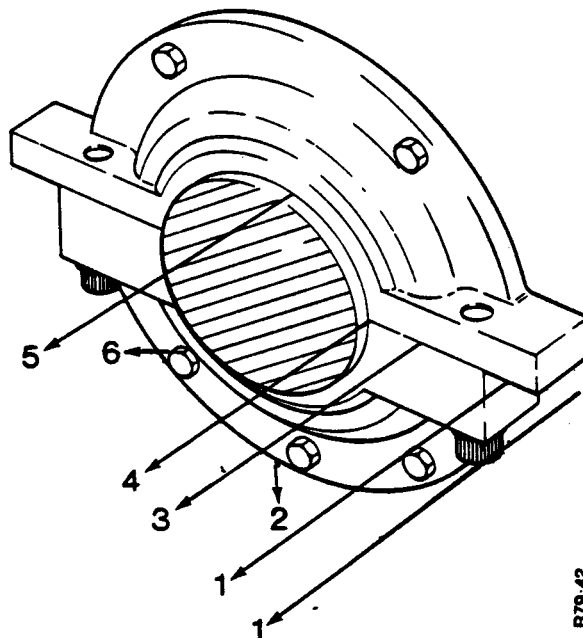


FIGURE 48 LEAK PATTERN: OIL RETAINER

Action:

1. *Leakage at Point 1 Figure 48:* Remove the engine and install new 'O' rings on the main bearing cap and new gaskets between the engine and the frame.

NOTE: This is not an oil retainer leak and installing a new oil retainer will not prevent leakage from this point.

2. *Leakage from Points 2 to 6. Figure 48.* Remove the oil retainer from the engine. Then carefully do the following procedure.

NOTE: If a new oil retainer is to be installed, also use the following procedure for checking the oil retainer and installing the packings.

Leakage from Point 2 Figure 48:

This is caused by the retainer not seating correctly on the cylinder block.

1. Check the retainer for the faults A, B, C and D Shown in Figure 49.
2. If necessary use a smooth file with chalk on the cutting edge to make the surface of the retainer flat.
3. Check that the seat of the socket head screw is parallel to the joint face of the retainer. See fault D, Figure 49. If the seats are not parallel, the retainer will bend when the screws are tightened. If necessary use a file as in Operation 2 to make the faces parallel.

NOTE: The latest type of oil retainers do not have a locating lip. These can be made flat using a sheet of smooth emery cloth and a similar size piece of plate glass.

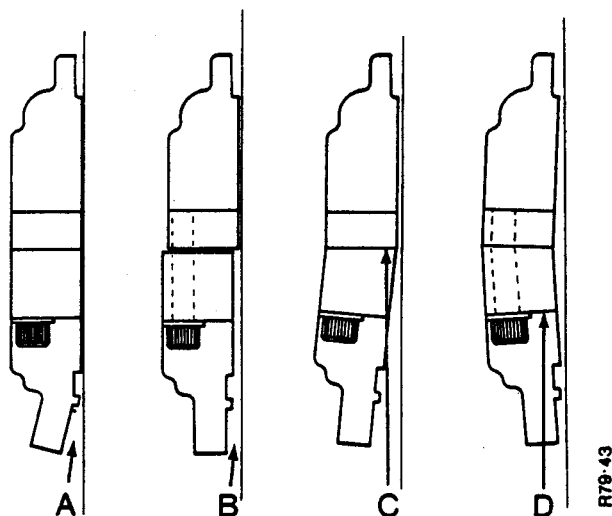


FIGURE 49 OIL RETAINER FAULTS

Leakage from Points 3 and 4 Figure 48:

This is caused by the following faults:

The two parts of the retainer are not parallel. See Figure 50. Loose ends of the packings are between the faces.

1. Remove the retainer from the cylinder block.
2. Remove the socket screws, separate the two parts and remove the packings.
3. Put the two parts of the retainer together. Install and tighten the socket screws.
4. Hold the retainer up to a good light and look at the joint faces.
5. If this check shows a gap between the joint faces, use a file as before to make the faces flat.
6. Put the two parts together. Install and tighten the socket screws.
7. Important: Check the face of the retainer that is fastened to the cylinder block.
8. If necessary, use a smooth file to make this face flat.

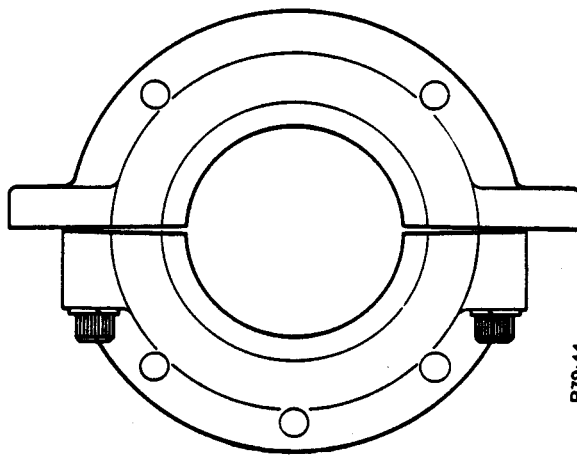


FIGURE 50 JOINT FACE FAULT

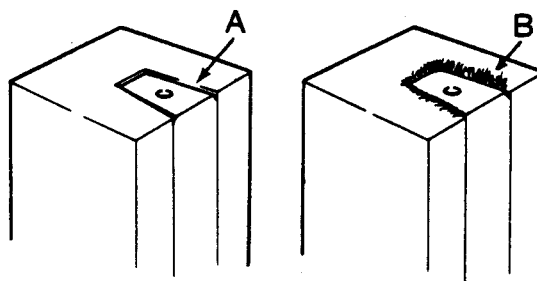


FIGURE 51 PACKING FAULT

Leakage from point 4. Figure 48:

This is caused by the ends of the packings not in correct contact and oil flowing through the gap.

1. Install new packings. See the Assembly Procedure.

Leakage from Point 5. Figure 48:

This is caused by the packings not sealing correctly on the crankshaft. Check the following:

1. Wear or damage to packings.
2. A restriction in the engine breather.

NOTE: On turbocharged engines there must be a hole in the breather body as shown in Figure 52.

3. Wear in piston rings which causes too much pressure in the crankcase.
4. Too much end movement on the crankshaft.
5. Wear on the main bearings.

Leakage from Point 6. Figure 48:

This is caused by oil flowing through the bolt threads.

1. Replace the spring washers with rolled copper washers, Part No. K15489.

Assembly Procedure

1. Clean the two parts of the oil retainer, remove the packings and clean the packing grooves. Make sure that all the old jointing material is removed.
2. Hold the top part of the oil retainer, packing groove up, in a vice that has soft jaws.
3. Put a small amount of Evostick impact adhesive in the bottom of the packing groove. This will keep the packing in its correct position when the engine is started.
4. Put a packing on the retainer and then push it into the groove with the smooth handle of a screwdriver. Push the handle down on the centre of the packing and slide the handle from the centre to each end of the packing. DO NOT roll the handle when pushing the packing into the groove. See Figure 53.
5. Use a screwdriver blade that is not sharp to push the ends of the packing below the joint face of the retainer. See Figure 54.

IMPORTANT: DO NOT cut the ends of the packings. These are made to the correct length and the seal will fail if the length is decreased.

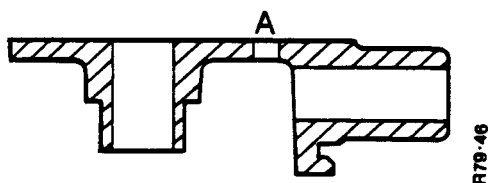


FIGURE 52 BREATHER HOLE POSITION

A. Breather hole

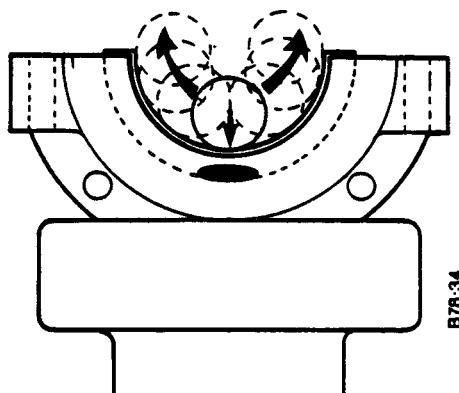


FIGURE 53 INSTALLING PACKING

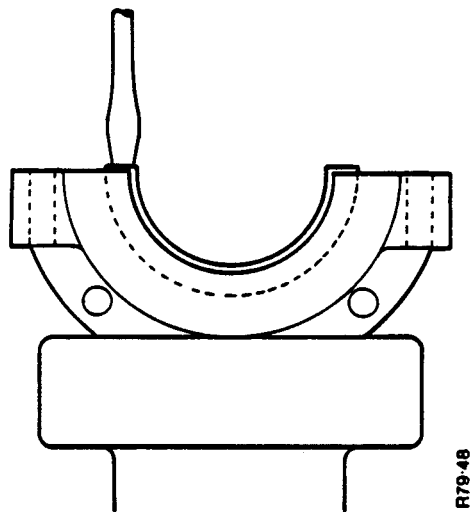


FIGURE 54 INSTALLING PACKING

6. Remove any loose fibres with a very sharp knife. See Figure 55.
7. Use the same method to install the packing in the bottom part of the retainer, BUT DO NOT use Evostik contact adhesive in the groove.
8. Put the two parts of the oil retainer around a smooth piece of shaft that has been machined to the following dimensions:
 Turbo-charged engines 66.50 mm (2.620 in)
 Other models 63.50 mm (2.500 in)
9. Install and tighten the socket screws. This will push the packings into the correct contact with the packing grooves and the correct diameter for installing in the crankshaft. See Figure 56.
10. Remove the socket screws. Carefully remove the two parts of the retainer from the shaft.
11. Check that the packings are seated correctly. If for any reason the seating is not correct, the retainer must be discarded and a new oil retainer assembly installed.

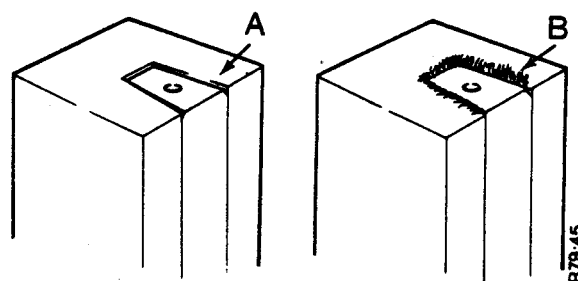


FIGURE 55 CUTTING THE PACKING

A. Correct B. Wrong

Before Installing the Oil Retainer:

1. Use worn 320 grade emery tape to remove any marks from the part of the crankshaft which is in contact with the packings.
2. Clean the face of the cylinder block. Use cleaning fluid if necessary and make sure that any old jointing material is removed.

Installing the Oil Retainer:**Method A: Using gaskets:**

1. Put a small amount of Evostik impact adhesive on the retainer faces which fit against the cylinder block. Put the gaskets in position on the retainer. Use a sharp knife to cut the ends of the gaskets level with the ends of the retainer faces.
2. Put an even layer of Wellseal joint compound on the face of the cylinder block.

IMPORTANT: Do not use a thick type of joint material as this will cause the retainer to bend when the bolts are tightened.

3. Put a thin strip of Loctite Superfast Flange Sealant 573, Part No. K965910 on each side of one part of the retainer. See Figure 57.

4. Replace the spring washers on the hexagon head bolts with copper washers. Part No. K15489.

5. Put a small amount of engine oil on the packings. Put the two parts of the retainer in position on the crankshaft and install the socket screws finger tight.

Install the hexagon head bolts.

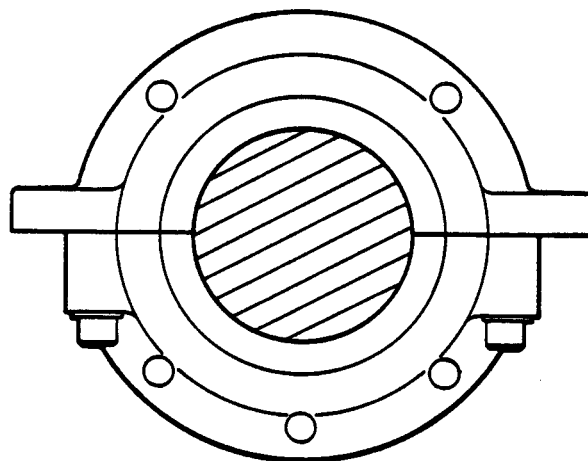


FIGURE 56 RETAINER INSTALLED ON SHAFT

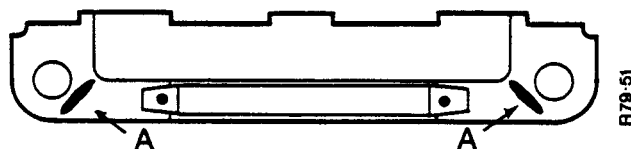


FIGURE 57 POSITION OF SEALANT

A. Loctite Superfast Flange Sealant 573

6. Tighten the bolts and socket screws in the following sequence.
 - i. Tighten the socket screws evenly, then loosen both socket screws one half turn.
 - ii. Tighten the hexagon head bolts.
 - iii. Tighten the socket screws.
 - iv. Loosen the hexagon head bolts one half turn. Wait for 30 seconds, then tighten the hexagon head bolts.

Do this procedure to make sure that there are no gaps between the two parts of the retainer and between the face of the retainer and cylinder block.

Method B: Not using gaskets:

NOTE: When Loctite Superfast Gasket Eliminator 504, Part No. K965909 is used instead of gaskets, all oil must be removed from the joint surfaces. Make sure there is no oil in bolt or drain holes which can get on to the joint surfaces before the seal material has become hard.

The strength and gap filling characteristics of this seal material will be increased if the joint surfaces are sprayed with Loctite Superclean Safety Solvent before the seal material is applied.

1. Put a thin strip of Loctite Superfast Flange Sealant 573 on each side of one part of the retainer. See Figure 57.
2. Put a thin strip of Loctite Superfast Gasket Eliminator 504 on the face of the retainer. See Figure 58.

Then follow the same procedure as in Method A, Operations 4, 5 and 6.

NOTE: On later engines the oil retainer is made without a lip. An extra hole is drilled at the bottom of the retainer as shown in Figure 56.

Oil retainer assembly, Part No. K964994 is available for earlier engines. This oil retainer has no lip but only four holes. When installing, use copper washers instead of spring washers on the bolts.

FRONT MAIN BEARING CAP:

When you install the front bearing cap use a sealant between the bearing cap and the cylinder block.

It is a recommendation that you put Wellseal on the front edges of the bearing cap. Wait five minutes for the Wellseal to harden before you install the bearing cap. See Figure 59.

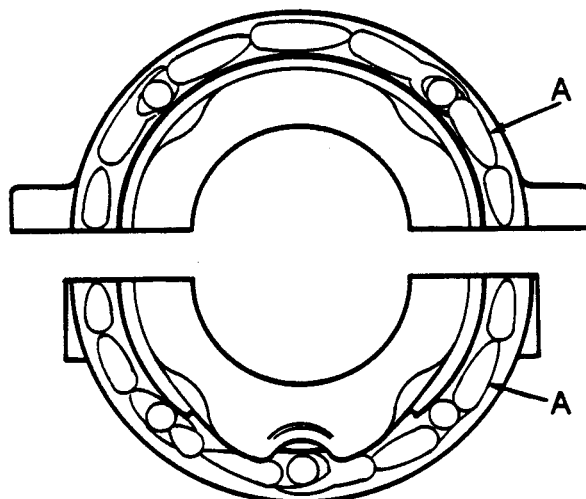


FIGURE 58 POSITION OF GASKET ELIMINATOR

A. Loctite Superfast Gasket Eliminator 504

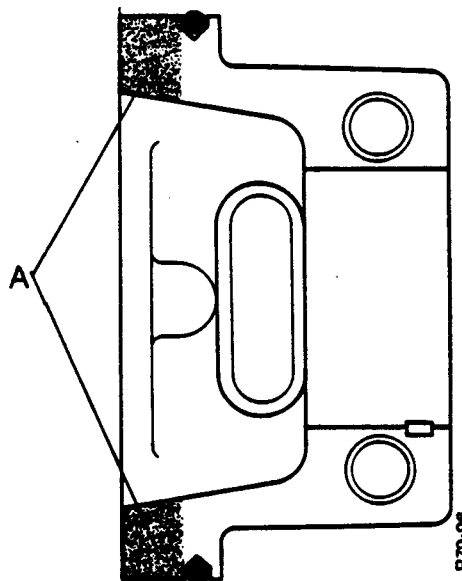


FIGURE 59 FRONT MAIN BEARING CAP

A. Wellseal joint material

TIMING COVER AND SEAL:

Removing:

1. Remove the setscrew from the front of the crankshaft.
Remove the flat washer.
2. Use a puller to remove the crankshaft pulley.
3. Remove the ten setscrews which fasten the timing cover to the cylinder block.
Remove the timing cover.
Remove the old gasket and clean the faces of the cover and the carrier plate.

Replacing the Oil Seal:

The dowels in the timing cover and the holes for the dowels in the cylinder block are not now used. If a timing cover has dowels, these must be removed before installing the timing cover.

1. Put the timing cover with the outside (front) on two pieces of wood.
Use a hammer and punch to remove the oil seal from its housing.
2. Put a new gasket in position on the carrier plate.
3. Put the timing cover in position and install the setscrews loosely.
4. Put Service Tool No. K962560 on the end of the crankshaft.
Push the tool along the crankshaft until it is inside the seal housing.
5. Tighten the setscrews evenly to 20.4 Nm (15 lb ft) 2.1 kg/m.
6. Remove the tool.
7. Put a new oil seal, seal lip toward the cylinder block, in position at the edge of the seal housing.
8. Use the spigot of the tool to push the seal in the housing.
Hit the end of the tool with a soft faced hammer to make sure the seal is in its correct position.
9. Install the crankshaft pulley 'O' ring, washer and setscrews.
10. Tighten the setscrew to 150 Nm (110 lb ft) kg/m.

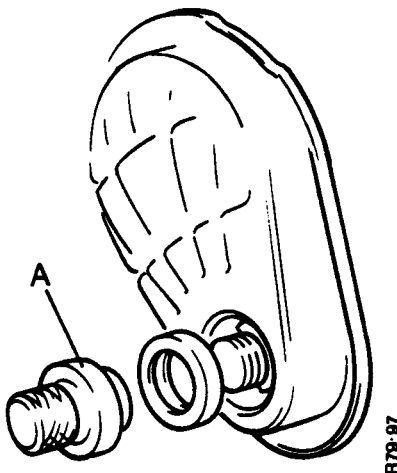


FIGURE 60 INSTALLING THE OIL SEAL

A. Special tool No. K962560

INJECTION PUMP DRIVE HOUSING:

Removing:

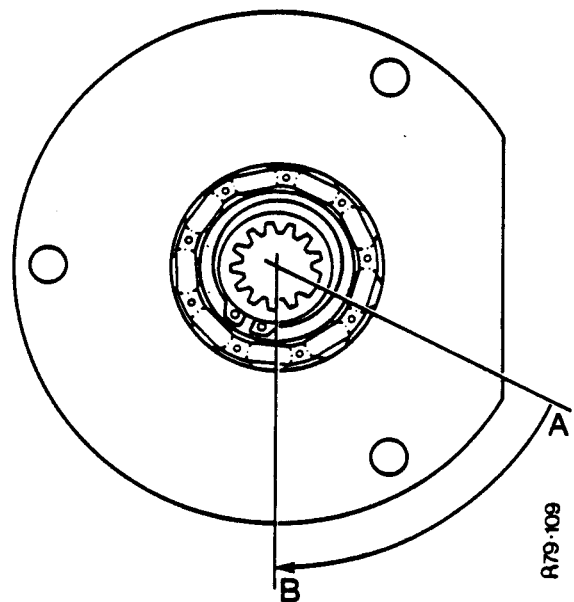
1. Remove the fuel injection pump.
2. Use a small lever to loosen the housing.
Pull the housing out of the cylinder block.

Installing:

1. Turn the engine in the normal direction of rotation until the No. 1 inlet valve is closing.
When the valve is in this position, stop turning.
2. Put the timing peg in the hole SP in the flywheel housing.
3. Continue to turn the engine slowly until the timing peg will go in to the hole in the engine flywheel.
4. Clean the faces of the cylinder block and the housing. Install a new gasket.
5. Put the master spline of the drive shaft in position A as shown in Figure 61.
6. Push the housing into the cylinder block.

NOTE: When the housing is in position, the master spline must be in position B as shown in Figure 61. If it is not possible to get the master spline exactly in this position, use a position after the one that is shown.

DO NOT install the drive shaft with the master spline in a position before the one that is shown.



† FIGURE 61 POSITION OF MASTER SPLINE

REPAIR

Pub. 9-38196

Disassembling:

1. Remove the circlip which holds the driven gear in position.
2. Use a soft metal punch and a hammer to remove the driven gear from the housing.
3. Carefully pull the needle roller bearing out of the housing.
4. Remove the bottom circlip.
Use a punch and a hammer to remove the ball bearing.

IMPORTANT: The needle roller bearing in the housing has been changed from an extra precision type to a precision type.

The bore of the housing has also been increased in diameter so that the new type bearing can be installed. It is most important to use the correct bearing for the type of housing. If the wrong bearing is installed it will fail rapidly.

Identification of the different bearings and housing is as follows:

Extra Precision Bearing: The outside diameter of the bearing case has a ground finish. The bearing has the marks GB 2812.

Precision Bearing: The outside diameter of the bearing case does not have a ground finish. The bearing has the marks B 2812.

Late Type Housing: The marks K948193 are on the housing.

Assembling:

1. Install the top circlip.
Install the ball bearing.
Install the bottom circlip.
2. Install the needle roller bearing using the special tool.
3. Carefully install the driven gear. Use a soft faced hammer to put the driven gear in position.
4. Install the circlip to hold the driven gear in position.

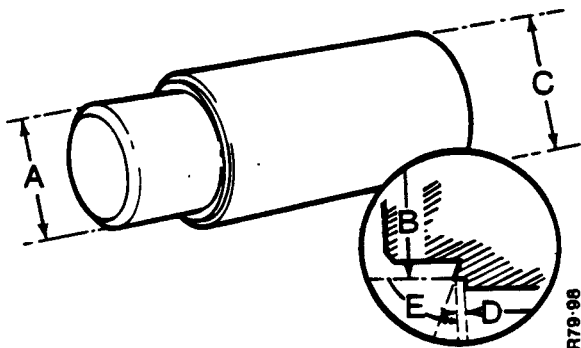
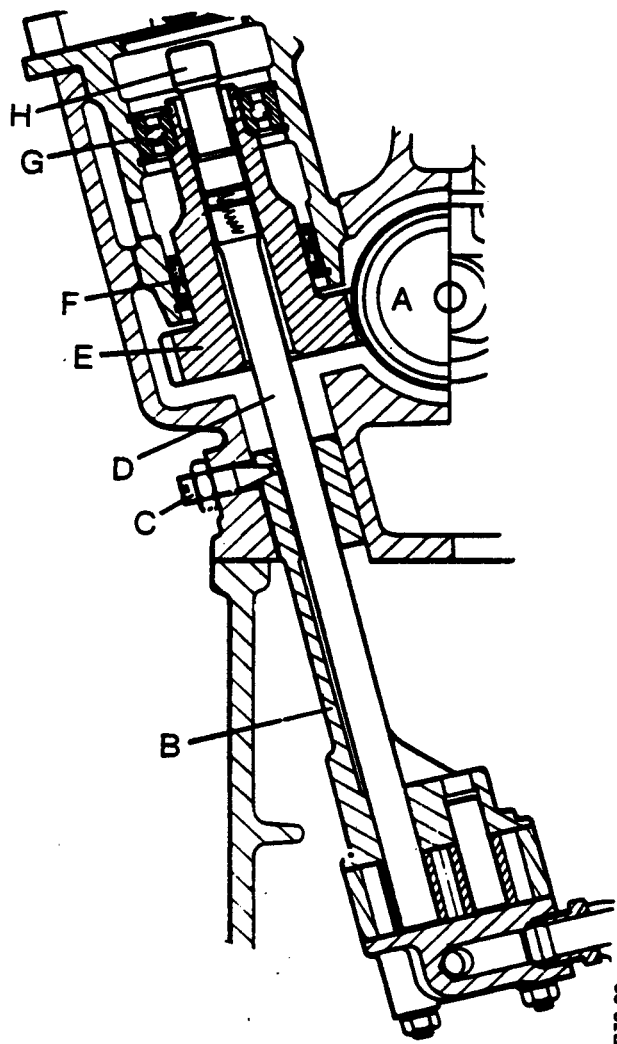


FIGURE 62 NEEDLE ROLLER BEARING TOOL

- A. Diameter 44.347 mm (1.746 in.)
- B. Diameter 53.772 mm (2.117 in.)
- C. 60.325 mm (2 3/8 in.)
- D. Recess 7.112 mm (0.280 in.)
- E. Chamfer 15°



† FIGURE 63 SECTION THROUGH INJECTION PUMP DRIVE

- | | |
|----------------------------|------------------------------|
| A. Camshaft skew gear | E. Driven gear |
| B. Oil pump bracket | F. Needle roller bearing |
| C. Oil pump locating screw | G. Ball bearing |
| D. Oil pump driveshaft | H. Injection pump driveshaft |

TRACTORMETER DRIVE:

Removing:

1. Remove the nut which connects the outer cable to the drive housing.
Pull the inner cable out of the spindle.
2. Loosen the locknut of the locating screw.
Remove the locating screw.
3. Carefully pull the housing out of the cylinder block.

Installing:

1. Install a new 'O' ring on the housing.
2. Carefully push the housing in the cylinder block.
3. Install and tighten the locating screw. Tighten the locknut.
4. Push the inner cable in the spindle.
5. Connect the outer cable to the housing with the nut.

Disassembling:

1. Hold the housing in a vice that has soft metal jaws.
2. Remove the adaptor from the top part of the housing.
3. Remove the spring pin which fastens the gear to the spindle.
4. Hit the spindle at the gear end with a soft metal punch until the spindle is away from the gear.
5. Remove the gear and spindle.

Assembling:

1. Install a NEW 'O' ring in the spindle housing.
2. Install the spindle.
3. Install the adaptor.
4. Align the holes in the gear with the hole in the spindle.
Install the gear and the spring pin.

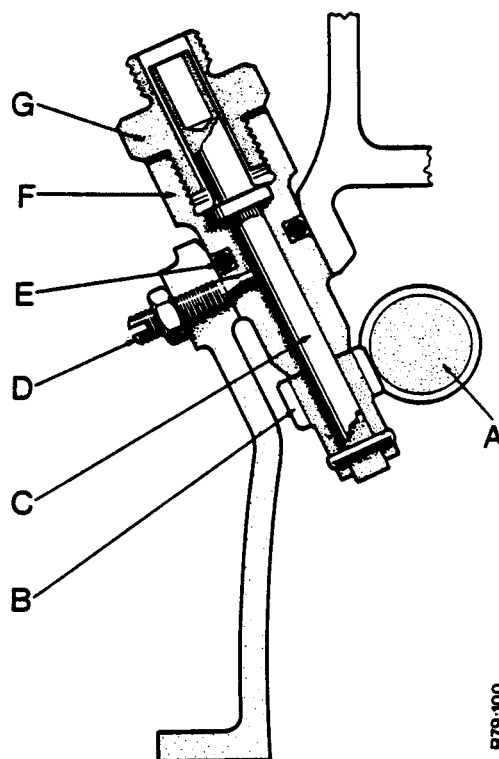


FIGURE 64 TRACTORMETER DRIVE

- | | |
|-------------|-------------------|
| A. Adaptor | D. Spindle |
| B. Camshaft | E. Locating screw |
| C. Gear | F. 'O' ring |
| | G. Body |

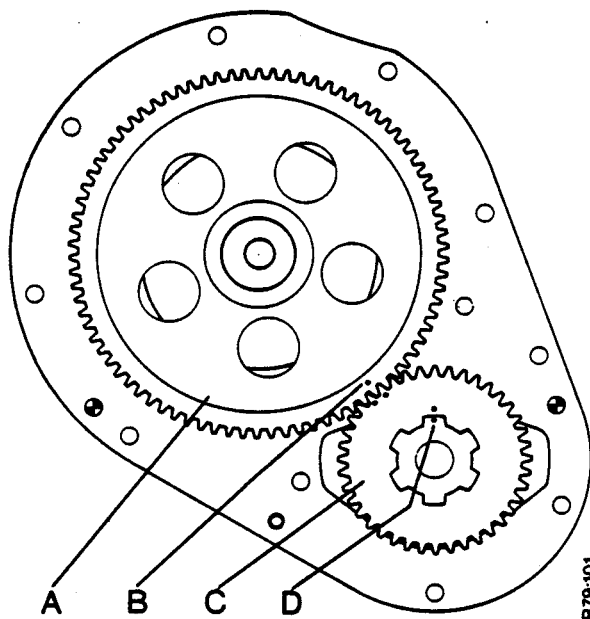


FIGURE 65 TIMING GEAR MARKING

- | | |
|-----------------------|--------------------|
| A. Camshaft gear | C. Crankshaft gear |
| B. Camshaft gear mark | D. Spline mark |

TIMING GEARS:

IMPORTANT: Before you remove either of the timing gears, turn the engine to the No. 1 top dead centre position. In this position the timing marks are aligned, which will make installation easier. **DO NOT** turn the crankshaft or the camshaft after the timing gears have been removed or damage will be caused to the valves and pistons.

Timing the Engine:

1. Check that the No. 1 piston is in the top dead centre position.
2. Install the camshaft gear on the camshaft. Move the camshaft if necessary so that the keyway is in the six o'clock position and the punch mark is toward the crankshaft.
3. Install the crankshaft gear so that the marks on the gear and the crankshaft are aligned.
4. Push the crankshaft gear on the crankshaft so that the marks on the circumference of the crankshaft gear and the camshaft gear are aligned.

See Figure 65.

CAMSHAFT:

Removing:

1. Remove the rocker shaft complete with the rockers, and the pushrods.
2. Remove the tappet covers.
3. Raise the tappets away from the camshaft. Use small 'O' rings, 12 mm ($\frac{1}{2}$ in) in diameter to keep the tappets in position.
4. Remove the fuel feed pump and the push rod.
5. Remove the timing cover.
6. Remove the injection pump drive housing.
7. Cut the lock wire and the bolt which fastens the gear to the camshaft. See the section Timing Gears before you remove the gear.
8. If the correct puller is available, remove the gear from the camshaft. DO NOT use levers to remove the gear as this will cause damage to the camshaft.
If the correct puller is not available see Operation No. 10, 11 and 12.
9. Remove the setscrews which fasten the locating housing to the cylinder block.
10. Pull the camshaft out of the cylinder block.
11. Turn the engine until a hole in the camshaft gear is aligned with one of the locating housing setscrews.
Remove the setscrew.
Turn the engine and remove the remainder of the setscrews in a similar way.
12. Pull the camshaft complete with the gear out of the engine.
13. Use a press to remove the gear from the camshaft.
Remove the locating housing.

Installing:

1. Put the camshaft in position in the cylinder block.
 2. Install the locating housing.
- NOTE: The housing can only be installed in one position.
3. Install the setscrews.
Tighten the setscrews to 20 Nm (15 lb ft) 2.1 kg/m.
 4. See the section Timing Gears before you install the camshaft gear.
Install the gear. Use a soft faced hammer to put the gear on the camshaft.
 5. Install the bolt and washer.
Tighten the bolt to 88 Nm (65 lb ft) 9 kg/m.
 6. Install a lock wire.
 7. Install the timing cover.
 8. Install the fuel pump and push rod.
 9. Install the injector pump drive housing.
 10. Remove the 'O' rings from the tappets.
 11. Install the tappet covers.
 12. Install the push rods and rocker shaft.
 13. Adjust the valve clearances.
 14. Install the fuel injection pump.
 15. Install the cylinder head cover.

EXHAUST FLANGE AND SILENCER:

A new type of silencer and exhaust flange was installed from Engine No. 43947. See Figure 66. The new type silencer, flange and studs can be installed on earlier engines if the hole in the bonnet is increased to 82.5mm ($3\frac{1}{4}$ in) diameter.

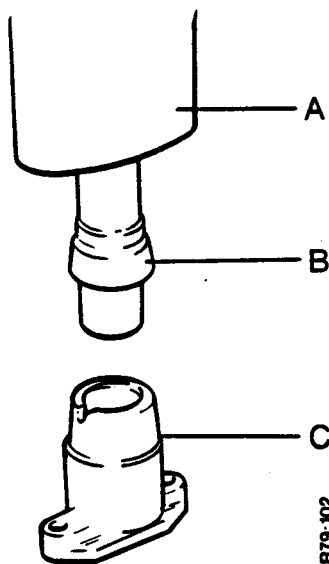


FIGURE 66 EXHAUST FLANGE AND SILENCER

- A. Silencer
- B. Shroud
- C. Flange

REMOVING THE ENGINE:

1. Remove the front cab mounting bolts. Loosen the rear cab mounting bolts.
2. Use jacks to raise the front of the cab approximately 25mm (1in).
Put pieces of wood between the cab floor and the gearbox cover to keep the cab in this position.
3. Remove the silencer and the bonnet.
4. Remove the starter motor.
5. Disconnect the tractormeter cable, the engine stop and throttle controls and the wiring from the instrument panel.
6. Remove the fuel from the fuel tank and remove the fuel tank complete with the instrument panel.
7. Disconnect the hydraulic pipes for the steering at the connectors near the flywheel housing.
8. Remove the coolant from the radiator and cylinder block.
9. Disconnect the hoses and remove the radiator.
10. Remove the oil from the engine sump.
11. Remove the sump cover.
12. Remove the two cylinder block bolts from inside the tractor frame on the right-hand side.
13. Remove the cylinder block bolt from inside the tractor frame below the fuel injection pump.

Using Special Tractor Support Tool:

14. Fasten the support wheels to the front part of the tractor.
15. Put wood blocks under the front and rear of each rear wheel to prevent any movement.
16. Remove the cover from under the flywheel housing.
17. Push a trolley type jack between the centre of the rear wheels until the lifting pad is just behind the rear frame joint.
Put a block of wood on the lifting pad and raise the jack until it is holding the weight of the rear of the tractor.
18. Remove the bolts which fasten the flywheel housing and the clutch housing to the main frame.
19. Remove the four internal frame bolts, two at each side, from inside the clutch housing.
20. Move the front part of the tractor forward to separate the two parts.
21. Check the alignment and if necessary raise or lower to rear part of the tractor.
22. Move the front part of the tractor forward until there is enough space to remove the clutch.
23. Remove the clutch, flywheel and clutch housing.
24. Remove the bolts from the flange of the cylinder block.
25. Fasten an acceptable lifting tool to the engine.
Use a hoist to lift the engine out of the frame.

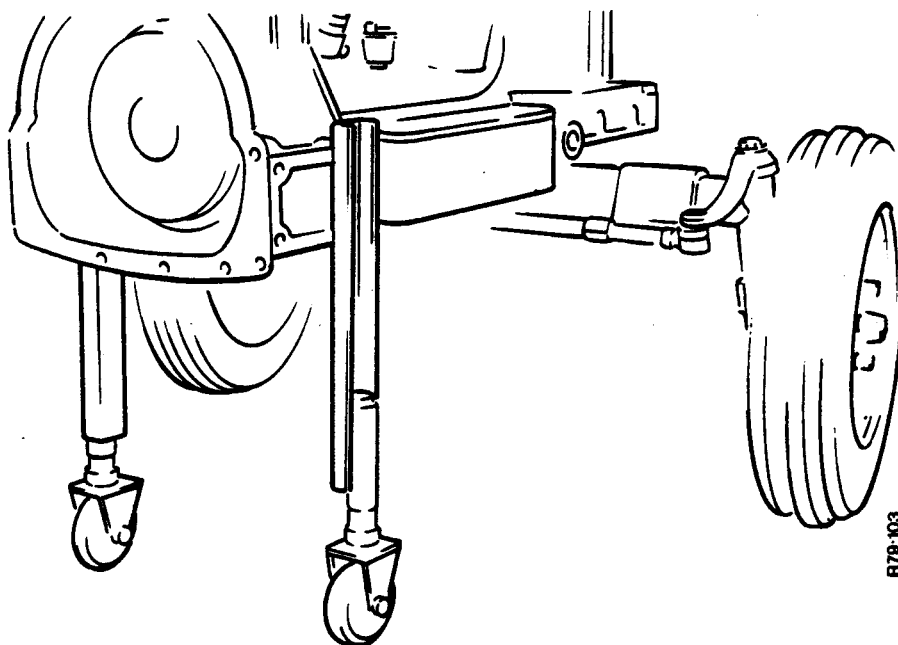


FIGURE 67 TRACTOR SEPARATED FOR ENGINE REMOVAL

Without Special Tractor Support Tool:

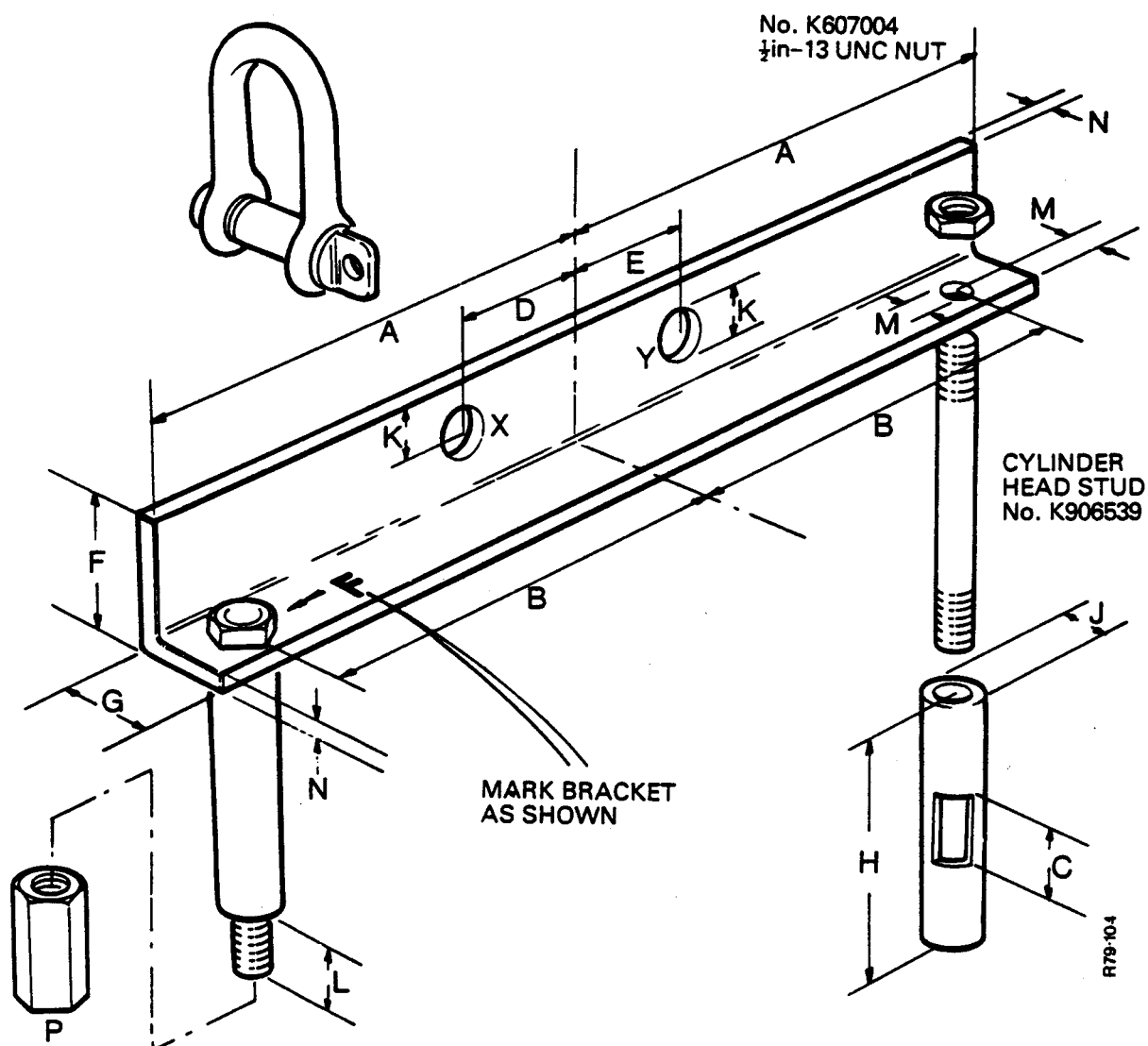
1. Do operations 1 to 13 as shown in Section: Removing the Engine.
2. Put wood wedges between both sides of the tractor frame and the front axle.
Put wood blocks under the front and rear of each rear wheel to prevent any movement.
3. Put supports under the rear half of the main frame to keep the frame in alignment.
4. Remove the cover from under the flywheel housing.
5. Push a trolley type of jack between the front wheels until the lifting pad is below the flywheel housing.
Put a block of wood on the lifting pad and raise the jack until it is holding the weight of the front of the tractor.
6. Remove the bolts which fasten the flywheel housing and the clutch housing to the main frame.
7. Move the trolley jack forward carefully to separate the two parts of the tractor.
8. Check the alignment of the two parts. If necessary, raise or lower the jack until the alignment is correct.
9. Move the front part of the tractor forward until there is enough space to remove the clutch.
10. Put supports between the frame and the ground.
Lower and remove the trolley jack.
11. Remove the clutch, flywheel and clutch housing.
12. Remove the bolts from the flange of the cylinder block.
13. Fasten an acceptable lifting tool to the engine.
Use a hoist to raise the engine out of the frame.

INSTALLING THE ENGINE:

1. Clean the faces of the main frame and the cylinder block.
Remove the old bearing cap seals.
Clean the grooves and the holes in the cylinder block.
2. Install new bearing cap seals. Put a small amount of Wellseal or a similar joint material on the faces of the main frame.
3. Put a small amount of Wellseal on both faces of the new gaskets.
Put the gaskets in position on the main frame.
4. Install one $\frac{3}{8}$ UNC stud on each side of the main frame. These studs will be guides for the cylinder block and will prevent the gaskets moving out of position.
5. Use a hoist to put the engine in position on the main frame.
6. Remove the studs and loosely install the bolts which fasten the cylinder block flange to the main frame.
7. Install the clutch housing.
Tighten the bolts to 34Nm (25 lb/ft) 3.46 kg/m.
8. Tighten the cylinder block to main frame bolts to 34Nm (25 lb/ft) 3.46 kg/m.
9. Install the flywheel. Install new tabwashers and tighten the nuts to 61Nm (45 lb/ft) 6.2 kg/m.

10. Install the clutch using a pilot shaft to align the clutch plates.
 11. Install a long $\frac{7}{8}$ UNC stud at each side of the front part of the main frame as a guide.
 12. Put the trolley jack in position with the lifting pad just behind the rear frame joint. Raise the jack and remove the supports.
 13. Push the front part of the tractor toward the rear part. Raise or lower the jack until the two parts are correctly aligned. In this position the guide studs will go in to the correct holes in the rear main frame.
 14. When the studs are in the holes, continue to push the front part toward the rear until the two parts are in contact.
- NOTE: During this operation it will be necessary to turn the engine by hand so that the gearbox driveshaft and the PTO cardan shaft engage in the splines of the clutch plates.
15. Remove the guide studs and install the bolts which fasten the two parts of the main frame together. Tighten the bolts to 61Nm (45 lb/ft) 6.2 kg/m.
 16. Remove the jack, the supports under the rear frame, the blocks from the wheels and the wedges from between the main frame and front axle.
 17. Install the bolts inside the main frame.
 18. Install the sump cover with a new gasket.
 19. Connect the hydraulic oil pipes.
 20. Install the radiator and connect the hoses.
 21. Install the fuel tank with the instrument panel.
 22. Install the starter motor.
 23. Connect the tractormeter cable.
 24. Connect the wiring.
 25. Use jacks to raise the cab.
Remove the wood from between the cab floor and the gearbox cover.
 26. Install and tighten the front cab mounting bolts.
Tighten the rear cab mounting bolts.
 27. Start the engine and check for leaks.

3-CYLINDER ENGINE LIFTING BRACKET



Nut and distance piece to be welded to stud allowing $\frac{1}{8}$ in. (0.158 cm) clearance between nut and angle bracket.

Position 'X' to be used for Engine only.

Position 'Y' to be used for Engine, Sump Frame, Flywheel and Flywheel Housing.

Dimension	A	B	C	D	E	F	G	H	J	K	L	M	N
mm	203	178	25	54	52	50	38	95	22	20	17	12	6
in	8	7	1	2 $\frac{1}{8}$	2 $\frac{1}{8}$	2	1 $\frac{1}{2}$	3 $\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{4}$	1 $\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{4}$

Shackle: — Screw Pin "D" Type: —
Shackle Diameter 12mm ($\frac{1}{2}$ in)
Pin Diameter 16mm ($\frac{5}{8}$ in)

For all engines built after September 1973 two special nuts, K906898 must be used. These nuts have been tested to lift the weight of a complete engine.

FIGURE 68 LIFTING BRACKET FOR ENGINE