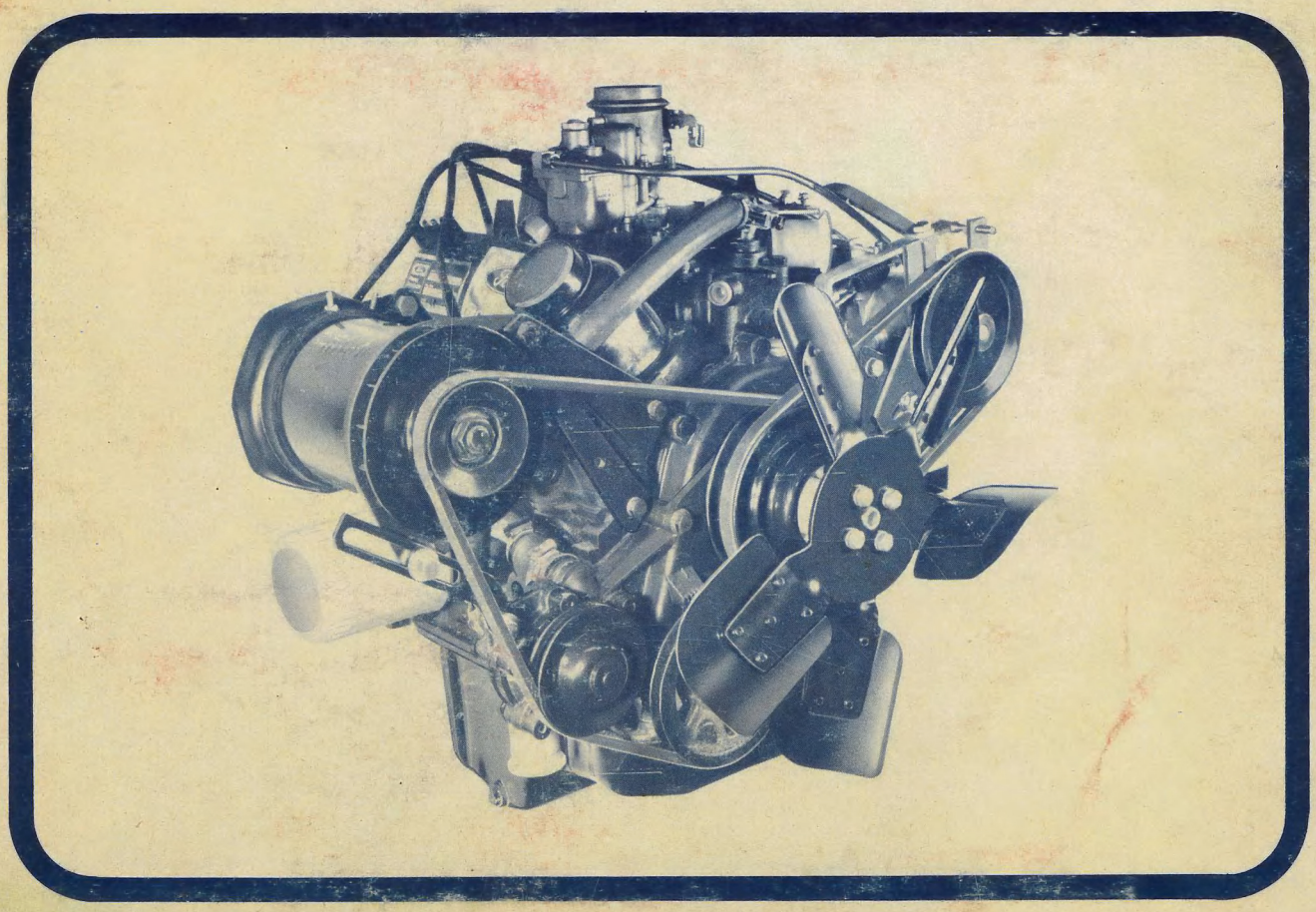
Ford

Power Products

SERVICE FEATURES FOR GASOLINE ENGINE FORD 104 C.I.D. V-4



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IEO
APR 74 194-187

TABLE OF CONTENTS

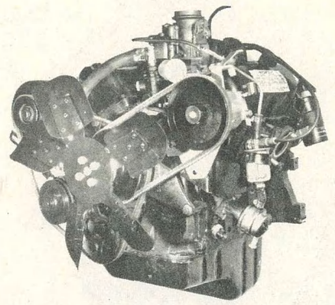
INTRODUCTION

This training handbook is intended as a ready reference for the service features on the Ford 104 CID V-4 gasoline engine. Although similar in many ways to the older model 104 CID V-4 produced by Ford, this version of the V-4 has some unique differences, which will be covered in this book.

Note that hardware sizes on this engine are metric and as such require special tools for maintenance. Refer to the service manual for these tools and for millimeters to inches/inches to millimeters conversion tables. These conversion tables, which are quite important to you for working on the V-4 and are easy to use, are included in the back of this book. To use a table, simply read the value in one column, then read the conversion value in the next column.

This engine is presently being used successfully in a number of applications. Among them are forklifts, front-end loaders, air compressors, asphalt paving machines, and farm sprayer equipment.

NOTE: The numbers shown in the lower right hand corner of the pictures coincide with the numbers on the slides for your easy reference.

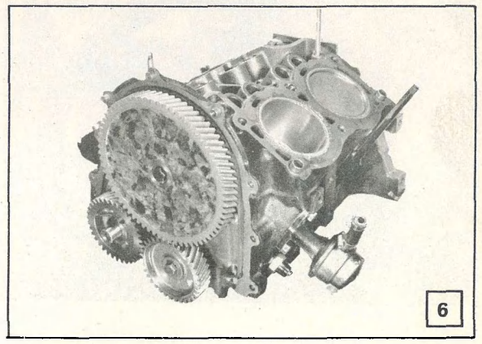


FORKLIFTS
FRONT END LOADERS
AIR COMPRESSORS
ASPHALT PAVING MACHINES
FARM SPRAYER EQUIPMENT

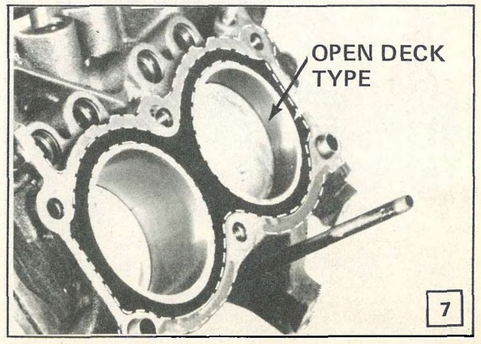
3

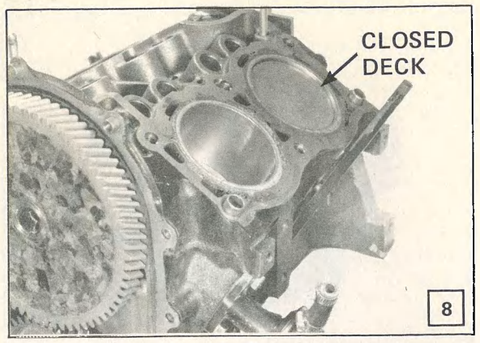
PART I — CYLINDER BLOCK, MAIN BEARINGS, CRANKSHAFT, AND BALANCE SHAFT ASSEMBLY

The cast-iron cylinder block has a 60-degree V-angle to provide a more compact configuration. One of the unique differences between this V-4 engine and the older V-4 model is this block.

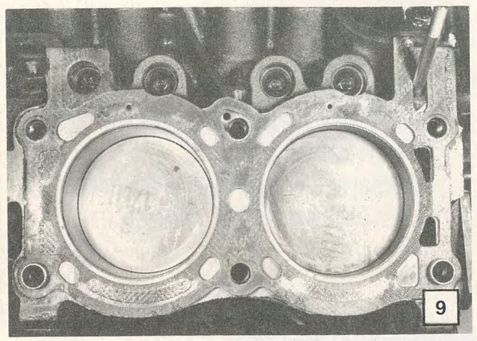


The older V-4 block was an open-deck type.

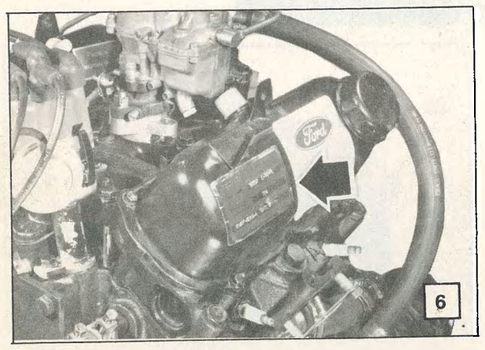




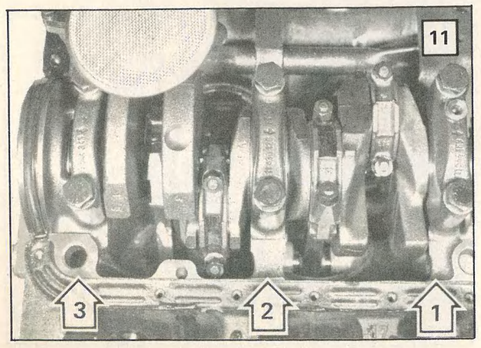
This block is a solid closed-deck type.



It is important to recognize this difference since parts, such as the cylinder head gasket shown here, for this engine are different from the older one. When ordering replacement parts, be sure to specify the correct engine model.

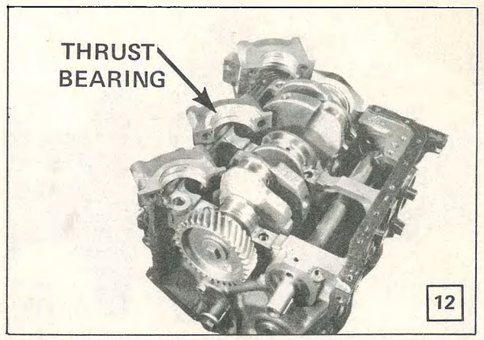


Since it may be difficult to tell the difference between a newer and older V-4 without removing the cylinder head, check the color of the block. The color of the closed-deck block, as supplied by Ford, is blue. The open-deck block was silver grey.



The precision-molded cast-iron crankshaft is supported by three replaceable, copper alloy main bearings. Two are the end bearings and one is the thrust bearing in the middle of the crankshaft.

Make sure you note that the thrust bearing is positioned on the center of the crankshaft. Knowing this location is very important if the bearing is going to be removed and either replaced or reinstalled on the crankshaft.

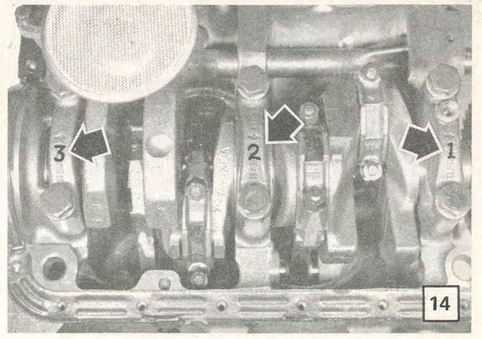


Since the service procedures are the same for main and connecting rod bearings, we'll cover both of them at the same time.

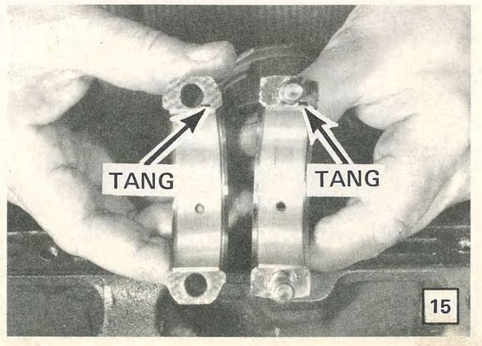
SERVICING MAIN AND CONNECTING ROD BEARINGS

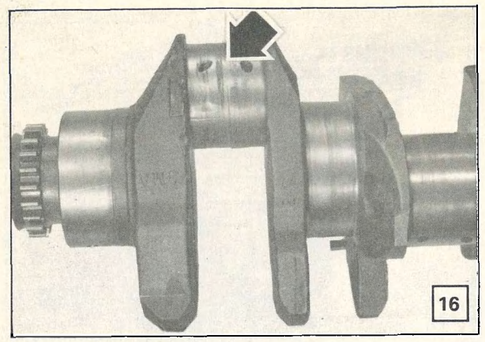
13

During removal of main bearings, make sure all bearing caps are marked so you can reinstall them in their original location.



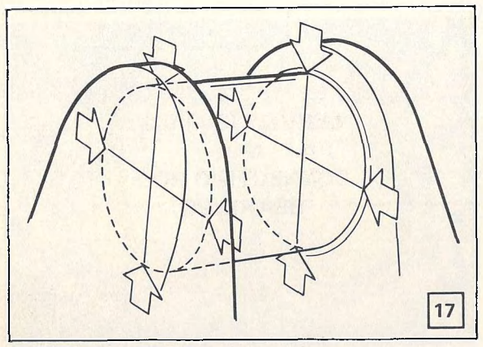
Check if the connecting rods and caps are already identified. If they're not, mark each one of them. Note that each bearing assembly has the block and cap tangs located on the same side.





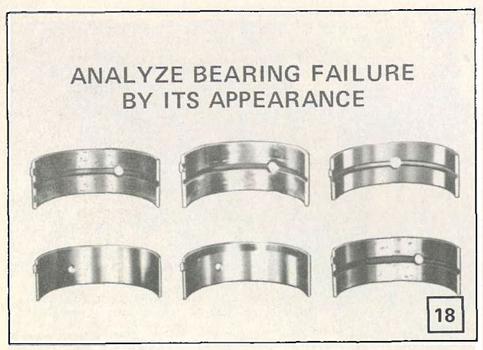
16

Inspect the main and connecting rod journals for scratches, grooves, or scores. If any of these conditions are present, turn the journal to the next undersize. If the next undersize exceeds minimum requirements, replace the crankshaft.



17

Also measure the diameter of each journal in at least four places to determine if the journal is out-of-round, tapered, or undersize.



18

Replace main and connecting rod bearings during any major overhaul. However, it is important to inspect the bearings since some types of bearing damage will clearly indicate other engine conditions that must be corrected to prevent engine failure. You can usually analyze the cause of a bearing failure by its appearance.

LACK OF OIL
DIRTY OIL
FATIGUE
IMPROPER SEATING
RADII RIDE
TAPERED JOURNAL

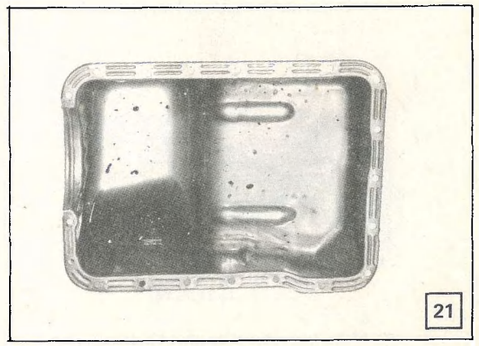
19

Bearing failures are usually caused by a lack of oil, dirty oil, fatique, improper seating, radii ride, or a tapered crankshaft journal.

A lack of oil causes actual metal-to-metal contact. This results in the bearing overheating and the metal melting or being wiped out of the bearing shell.

20

Dirty oil is one of the major causes not only of bearing failure, but of many other engine problems. The importance of changing oil to rid the engine of dirt particles, acid, water, and other harmful substances cannot be over-emphasized.

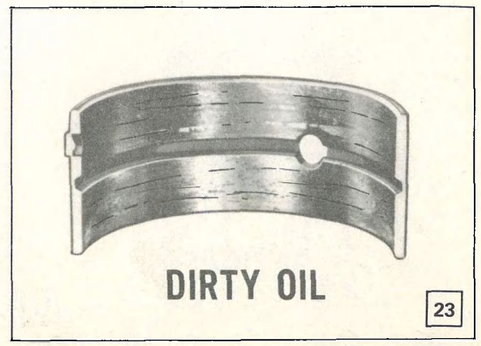


21

Bearings have the capability of protecting themselves by allowing dirt particles to embed so they won't gouge out bearing material or scratch the rotating crankshaft journal. Shown here is what happens when a dirt particle embeds . . . the metal is pushed up around the particle, reducing oil clearance in this area. Usually the metal will flow outward enough to restore adequate oil clearance.

22

If, however, the dirt particles are too large, they won't embed completely and are carried with the rotating journal, gouging out scratches in the bearing. If the oil is excessively dirty, the bearing becomes overloaded with dirt particles and bearing failure will soon occur. Again, it cannot be stressed too much . . . get rid of that dirty oil.



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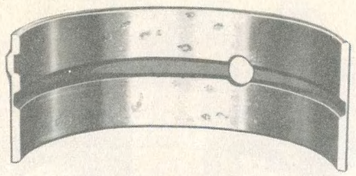
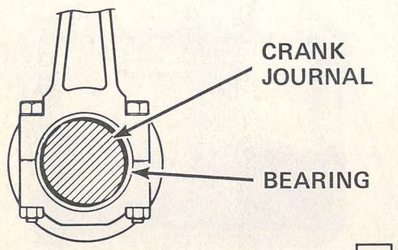


FATIGUE

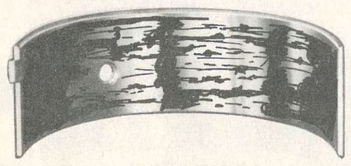
24

Metal fatique will occur if abnormal loads are constantly applied on a bearing. The bearing metal will start to crack or flake out and craters or pockets will form in the bearing as shown here.



25

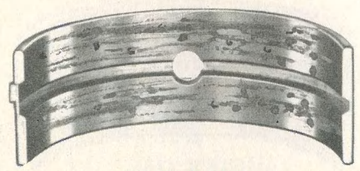
Even though fatique failure seldom occurs under average operating conditions, it does occur under certain special conditions. A journal worn out-of-round will cause the bearing to be overstressed with each crankshaft revolution.



FATIGUE

26

Prolonged operation at low speeds and maximum torque with wide open throttle . . . that is . . . if the engine is lugged, will cause the upper bearing insert to fatique out, as shown here.

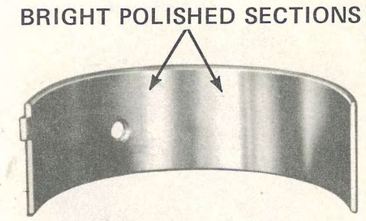


FATIGUE

27

Excessive or prolonged high-speed operation tends to cause fatique failure of the lower bearing insert. Note the marks on the lower bearing insert shown.

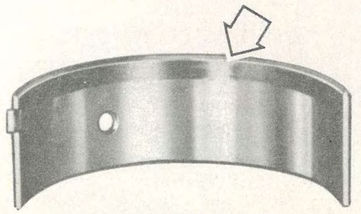
Improper seating of the bearing inserts can cause high spots, resulting in insufficient oil clearance. Improper seating is usually caused by dirt particles being left under the bearing insert during installation.



IMPROPER SEATING

28

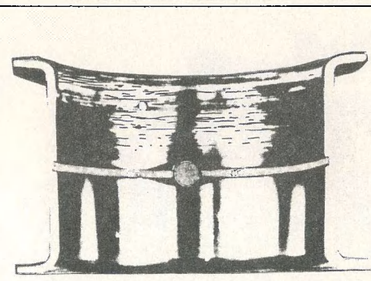
Radii ride is usually the result of improper crankshaft grinding. If the crankshaft journal-to-crank check radius isn't cut away sufficiently during grinding, it will cause the bearing to ride on the radius, resulting in cramming of the bearing, possible poor seating, rapid fatique, and early bearing failure. During crankshaft grinding, it is important to maintain the specified radius on the side of the crankshaft journal.



RADII RIDE

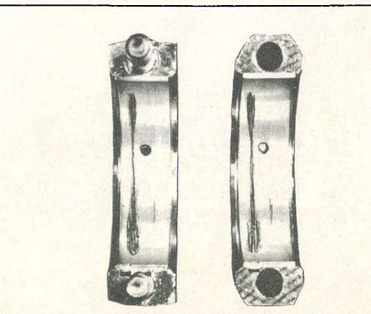
29

If a crankshaft journal is tapered, one side of each bearing insert will carry most of the load, causing that side to wear prematurely. Both bearing inserts will then eventually fail.



30

On connecting rod bearings, it's easy to confuse a tapered journal failure with a failure from a bent connecting rod. However, with a bent rod, failure occurs on opposite sides, not on the same side as for a tapered journal.



31

STANDARD INSERTS
RED-GREATER CLEARANCE
BLUE-LESS CLEARANCE

32

Main and connecting rod bearing inserts are available for service in two standard sizes and four undersizes. Standard size bearings are color-coded, either red or blue. Red inserts are thinner and provide greater clearance, while blue inserts are thicker and provide less clearance.

UNDERSIZE INSERTS
AVAILABLE

.25 mm
.50 mm
.75 mm
1.00 mm

33

Undersize bearings are available in millimeter sizes of .25, .50, .75, and 1.00. These undersize bearings are primarily for use on crankshaft journals that have been reground.

RED OR BLUE
RED AND BLUE
RED AND RED
BLUE AND BLUE

34

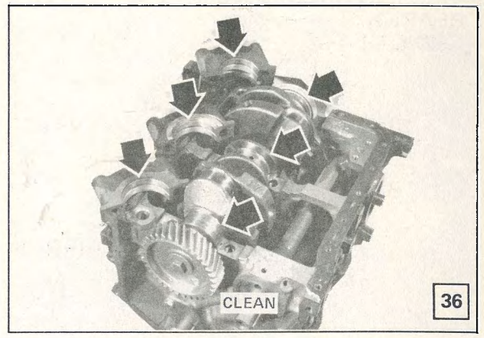
When fitting bearing inserts, it may be necessary to use red inserts, blue inserts, or a combination of red and blue on the same journal to obtain the proper clearance. If using two blue inserts results in too large a clearance, it will be necessary to grind the crankshaft journal and use undersized bearing inserts.

DO NOT MIX
BEARING INSERTS
OF DIFFERENT
MATERIAL ON THE
SAME JOURNAL

35

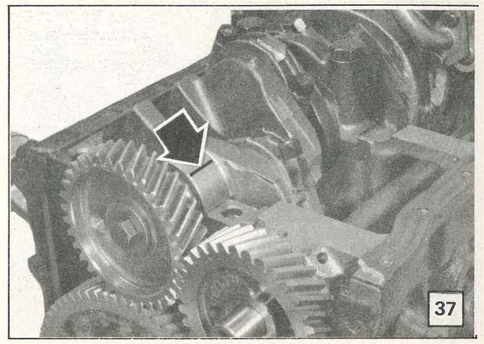
If inserts of different material are used on the same engine, make sure the top and bottom inserts of any one bearing are of the same material.

To determine bearing clearance, the easiest and most accurate method is by using Plastigage. Before using the Plastigage, clean the bearing bores in the block and caps, the crankshaft journals, and the bearing inserts on both sides. Make sure these surfaces are dry and oil-free.



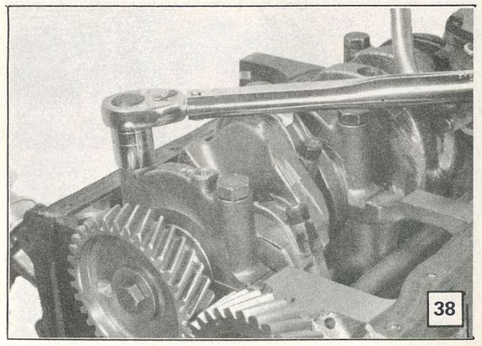
36

Assemble the bearing inserts in the block and caps, and carefully lower the crankshaft into place. Then, checking the clearance of each bearing one at a time, place a piece of Plastigage full-width on the crankshaft journal and about 1/4-inch off center.



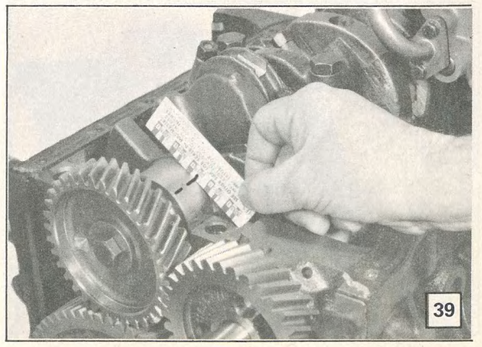
37

Carefully install the main bearing cap over the journal and tighten the cap retaining bolts to 72 foot-pounds. Be careful not to turn the crankshaft while the Plastigage is in place.



38

Remove the main bearing bolts and carefully lift the cap so you don't disturb the flattened Plastigage. Use the scale on the Plastigage package to measure the width of the Plastigage. The measurement corresponds to the bearing clearance. If necessary, change the bearing inserts until you obtain the specified clearance.



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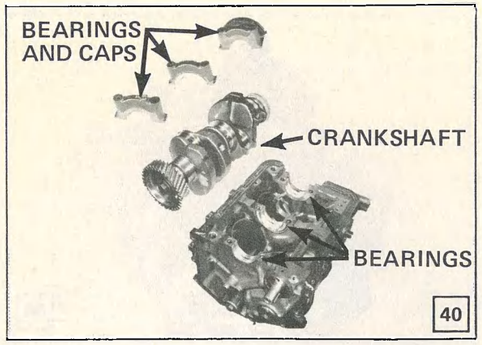
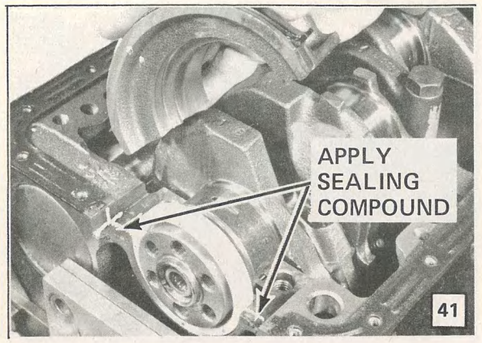
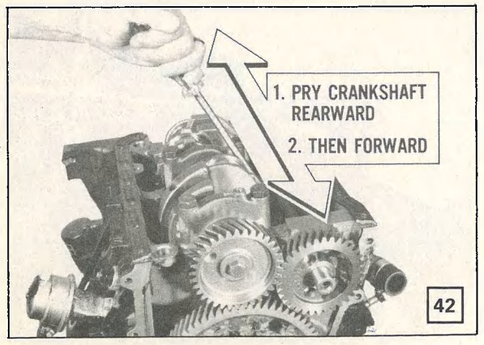


After the specified clearances are obtained, install the crankshaft and bearings according to the standard installation procedures in the service manual. It will be necessary to check the crankshaft timing marks for correct positioning. The timing marks are discussed under Timing Gears.



To seal the mating surfaces of the block and rear main bearing cap, apply a light coat of oil-resistant sealing compound to the rear main bearing cap and block mating surfaces, as shown.



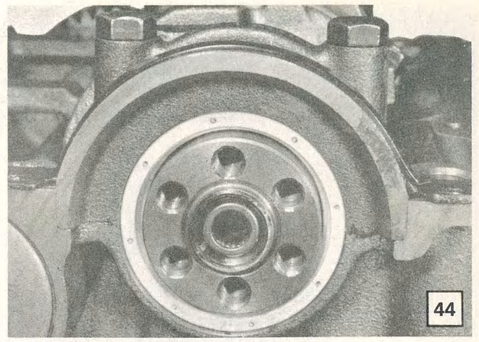
Check the crankshaft end play check to see whether the thrust bearing is within wear limits. End play will become excessive if the thrust bearings are worn. This produces a noticeable sharp and irregular knock, caused by sudden endwise movement of the crankshaft. To check the end play, mount a dial indicator so that it will measure for-and-aft movement of the crankshaft in the engine. Pry the crankshaft fully to the rear of the engine with a screwdriver and set the dial to zero, then pry the crankshaft fully forward and read the end play on the indicator dial.

CRANKSHAFT END PLAY
.12 mm to .35 mm

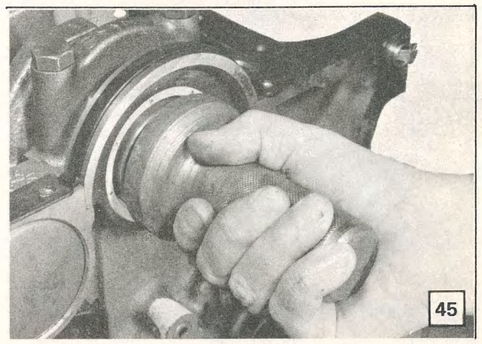
43

The end play should read from .12 to .35 millimeters. (See the back of this book for inches to millimeter conversion.) If the reading is greater than .35 millimeters, replace the thrust bearing. If it is less than .12 millimeters, check for dirt or burrs on the thrust surfaces.

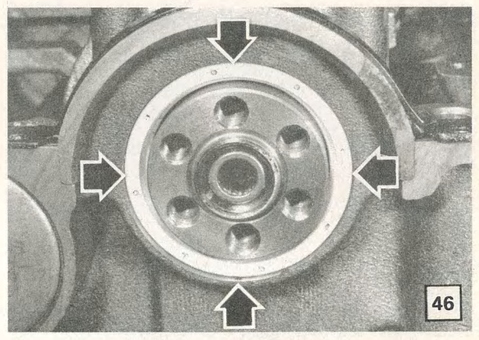
Be very careful while installing the crankshaft rear oil seal. An improperly installed seal will leak.



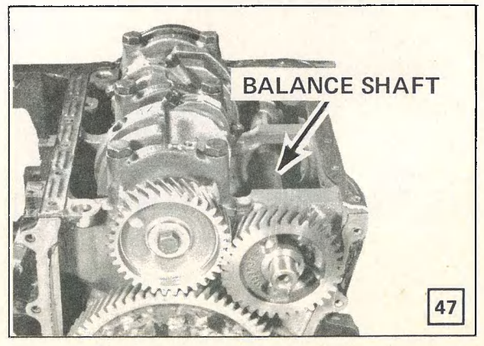
To install the oil seal, lightly coat the outside of the seal with nonhardening sealer and the inner sealing lip with engine oil. Slide the seal over the end of the crankshaft with the hollow face of the seal facing forward and drive it into position with the special tool recommended in the service manual.



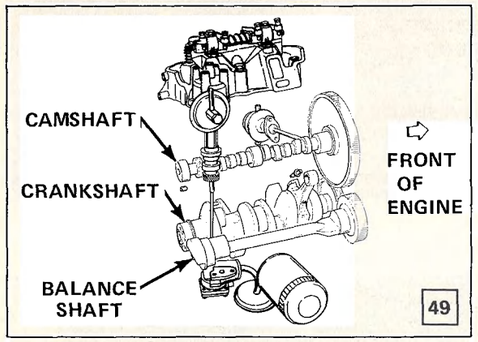
Be very careful not to cock the seal while installing it. Once the seal is installed, check that it is properly sealed all around in the groove.



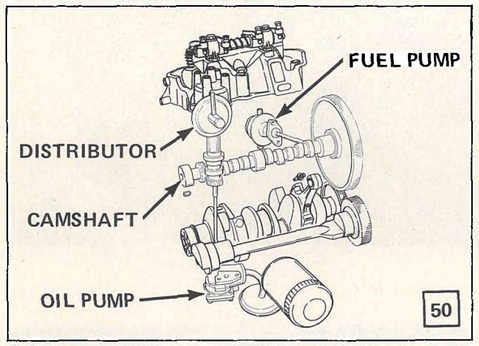
One last item we should cover in this part is the internal balance shaft that is gear driven at crankshaft speed by the crankshaft. The purpose of this balance shaft is to reduce vibration at all speeds and provide a smoother flow of power. We'll look again at the balance shaft when we cover timing.



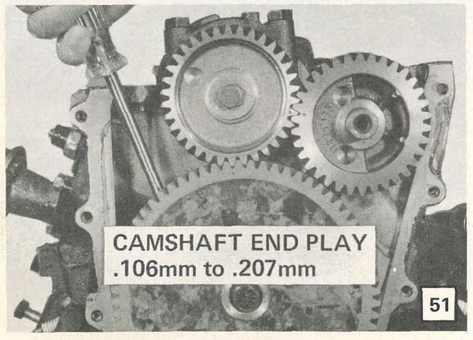
PART II—CAMSHAFT, TIMING GEARS, PISTON ASSEMBLIES, AND CYLINDER HEAD ASSEMBLY



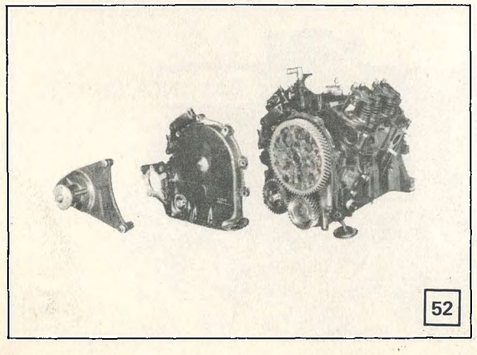
The camshaft for this engine is supported by bearings pressed into the block, and is driven by the crankshaft through helical gears. Note the relationship of the camshaft to other components in the engine as shown here.



The distributor and oil pump are driven by a gear at the rear of the camshaft, while the fuel pump is driven by an eccentric at the front of the camshaft. Service procedures for these components are as specified in the service manual.

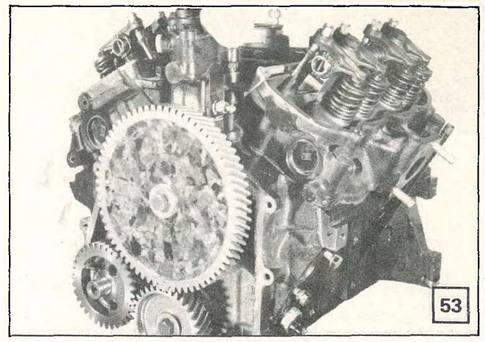


Whenever removing the camshaft, first check the camshaft end play to see if the thrust plate needs replacement. To check end play, push the camshaft to the rear of the engine and mount and zero a dial indicator against the front of the camshaft drive gear, then pry the camshaft forward and measure the end play. The end play should read from .106 to .207 millimeters. (See the back of this book for inches to millimeter conversion.) If the clearance exceeds the limit, install a new thrust plate.

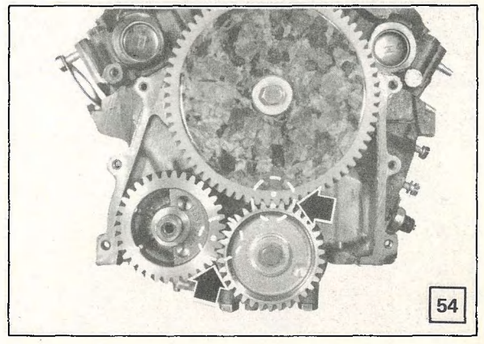


To gain access to the timing gears, you'll first have to remove the front cover. Note that the front cover, shown here, is different from the cover on older V-4 models. This cover has a separate fan bracket bolted to it.

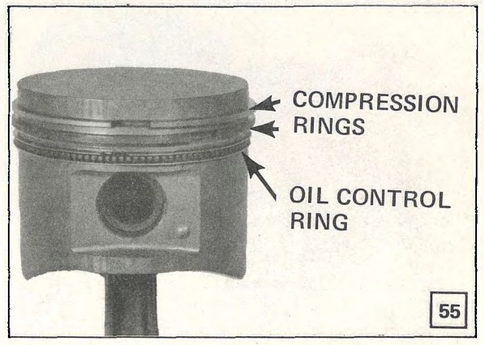
A unique feature about this engine is that there are three rather than two gears which have to be aligned for timing. Each of the three gears, camshaft, crankshaft, and balance shaft, have to be timed with each other.



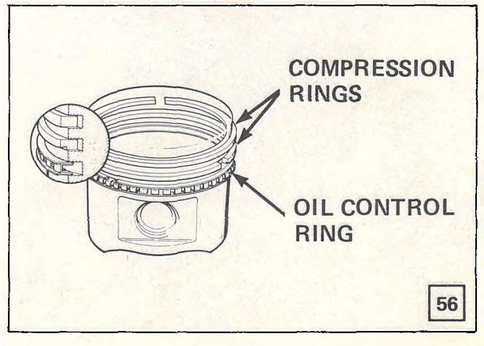
Note the position of the two marks on the crankshaft gear. One mark has to be aligned with the camshaft gear, the other with the balance shaft gear, as shown.

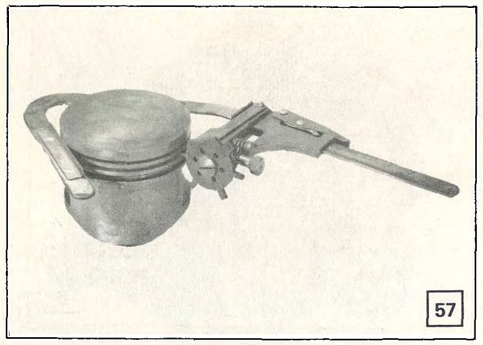


The pistons for this engine are made of aluminum and have three rings – two compression and one oil control. The top compression ring is chrome plated. The oil control ring consists of a rail expander spacer and two chrome-plated steel rails.

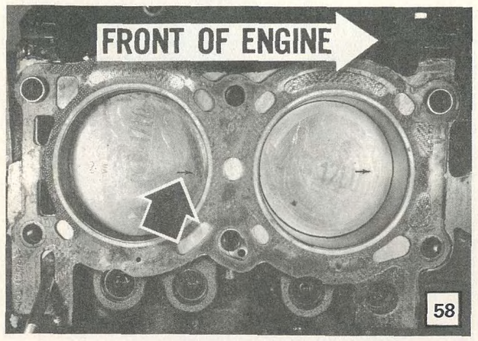


When replacing piston rings, make sure they are correctly positioned. The top compression ring and the oil control ring may be installed either side up. The second compression ring must be installed as shown.

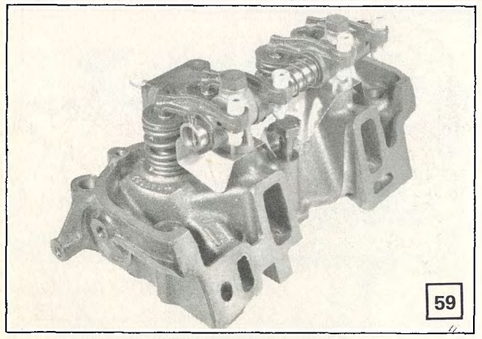




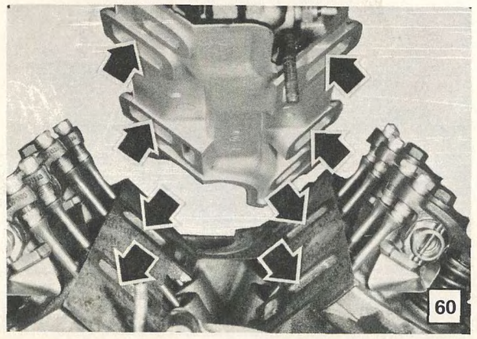
Check for carbon build-up on the rings and ring grooves. Remove the carbon with a cutting tool, as shown.



When assembling the piston to the connecting rod, make sure the arrow on the dome of the piston points toward the front of the engine. Always use new piston pin retainers and be sure they are fully seated.

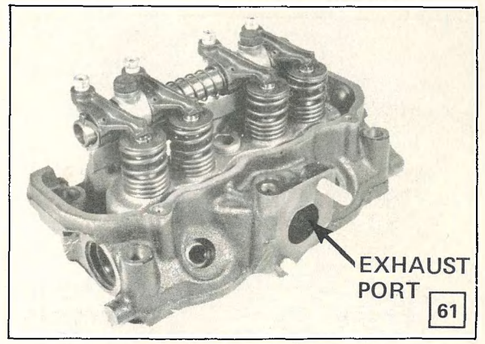


Next, let's look at a cylinder head assembly.

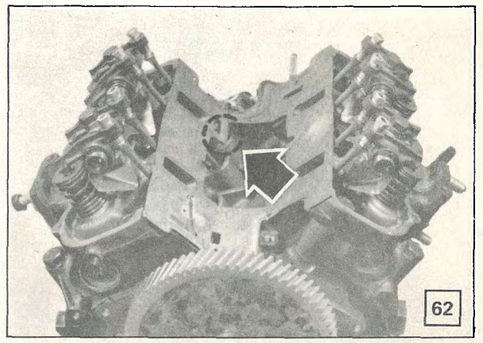


Note the relationship between the intake manifold, which is a separate casting, and the intake ports in each cylinder head.

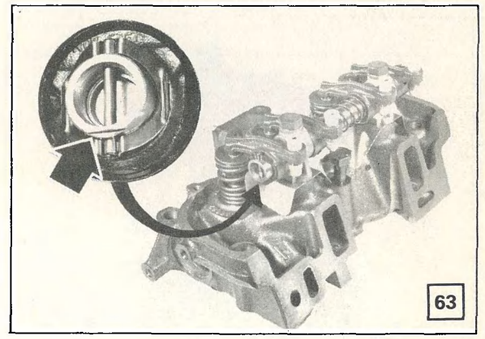
Shown here is one of the exhaust manifolds, which is a part of the casting in each cylinder head.



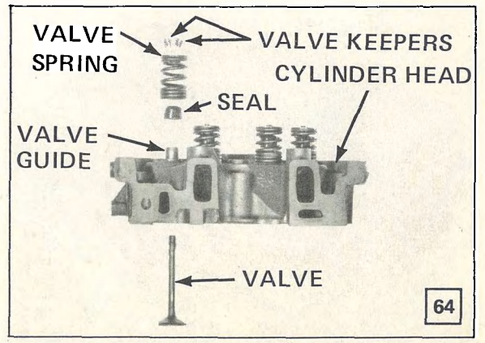
Make sure when installing an intake manifold that the tab on the right bank cylinder head gasket fits into the cutout of the manifold gasket. As long as you follow this step, you will be assured the gasket is correctly positioned.

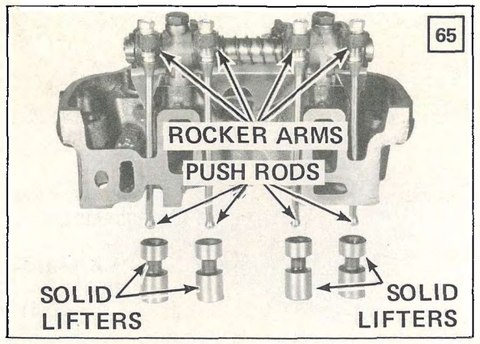


The rocker shaft assembly consists of the rocker arms, springs, spacers, and supports. Make sure when installing the rocker arm shaft that the oil holes in the rocker arm point down. This position can be recognized by a notch at the end of the rocker arm shaft.

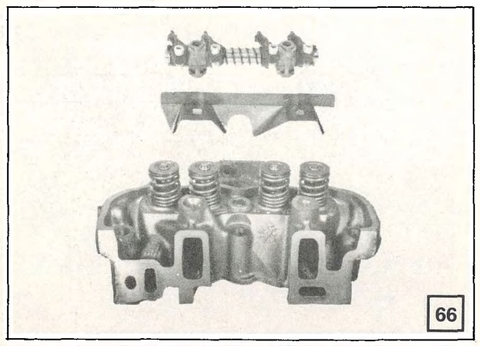


The valve guides are an integral part of the head and are not replaceable.

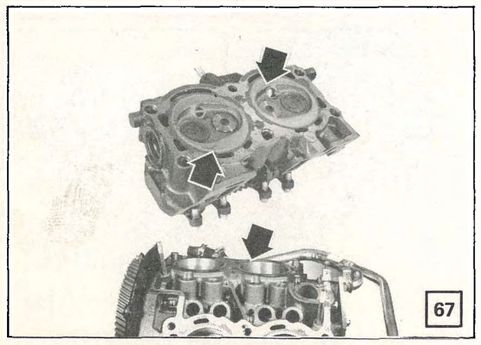




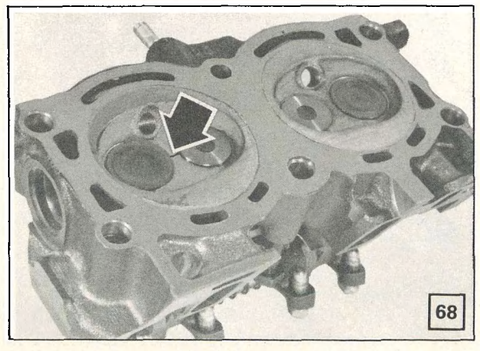
The valves are actuated through solid lifters, steel push rods, and individual rocker arms.



The baffles, which are the deflectors on top of each cylinder head, provide proper oil distribution for the valves.

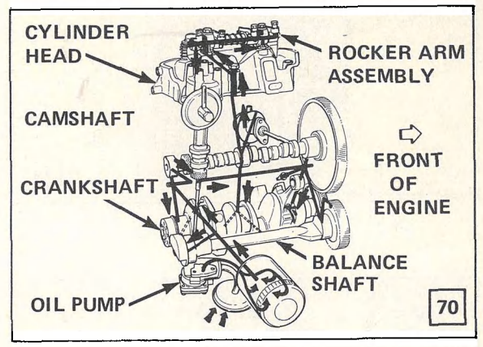


If a cylinder head has to be removed, as in the case of a blown gasket, carefully and thoroughly clean carbon and gasket material off the machined areas.

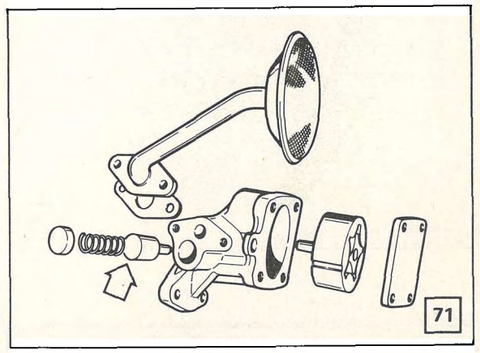


It's also good practice to check the cylinder heads and block for cracks. Be sure to use new cylinder head gaskets. Refer to the service manual for cylinder head installation procedures.

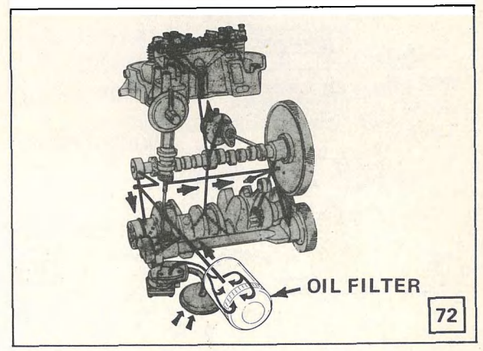
PART III — LUBRICATION SYSTEM, COOLING SYSTEM, FUEL SYSTEM, GOVERNOR, AND ELECTRICAL SYSTEM



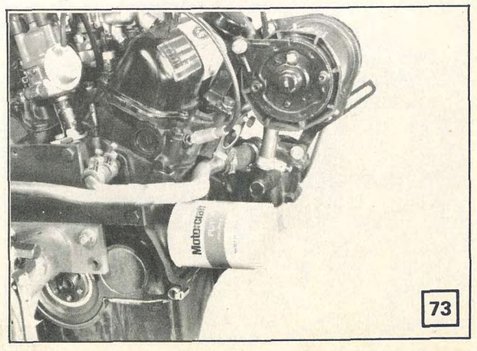
Looking at the pressure-type lubrication system, we can follow the oil flow as it is fed by a rotor-type oil pump mounted at the rear of the crankcase.



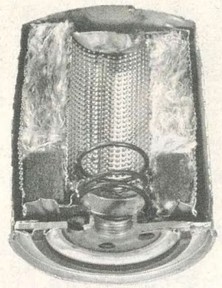
A nonadjustable spring-loaded relief valve in the pump limits maximum system pressure to approximately 50 psi.



A full-flow oil filter located on the right cylinder bank filters the entire output of the pump before the oil enters the engine.



It is recommended that you use a Ford Motorcraft oil filter whenever you replace a filter.



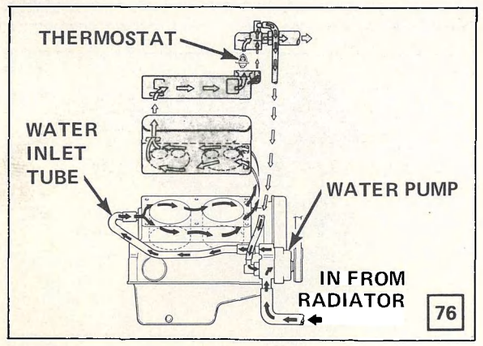
74

Since this filter has the advantage of being one of the few that has a two-stage filtering element, we feel it is superior to the average filter and will provide better protection for your engine.

CHANGE OIL AND FILTER-EVERY 100 HOURS

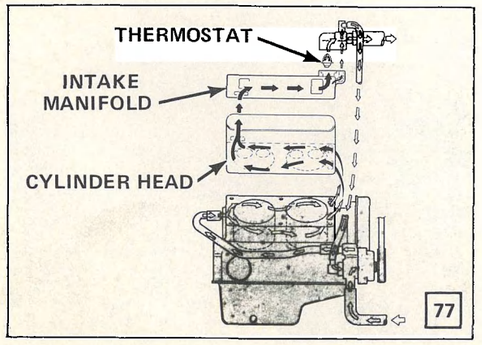
75

For the V-4 engine, change the oil and the filter every 100 hours, or more often if the type of use so dictates.



76

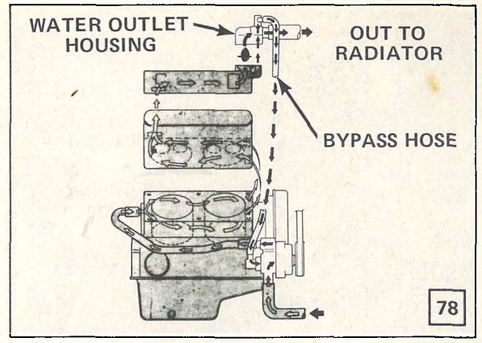
This cooling system on the V-4 is a single-stage type with one water pump and one thermostat. A centrifugal-type water pump draws the coolant from the bottom of the radiator and delivers it through tubes to both sides of the cylinder block at the rear.



77

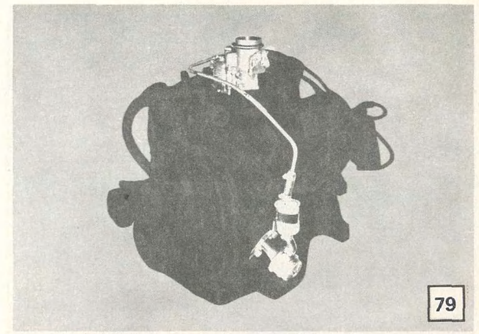
The coolant flows from the cylinder block into the cylinder heads and the intake manifold. A thermostat at the front of the manifold controls the discharge of coolant to the radiator.

All the coolant passing through the engine flows from the intake manifold through the water outlet housing, and is discharged through a connection at the front. When the thermostat is in the closed position, the bypass system is operational and provides continuous circulation through the block.



78

A conventional fuel system, incorporating a single-barrel carburetor and an in-line disposable filter unit, is used for the V-4, as shown here. Only two adjustments are required for this single-barrel carburetor—idle fuel mixture and idle speed.



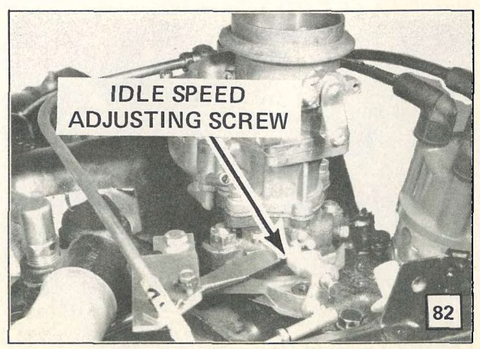
79

To make these two adjustments, first install a tachometer. Then start and bring the engine up to normal operating temperature, disengage any load on the engine, and set the throttle at minimum speed. Make sure the throttle linkage doesn't control the idle speed. The idle speed adjustment screw must contact the throttle lever.

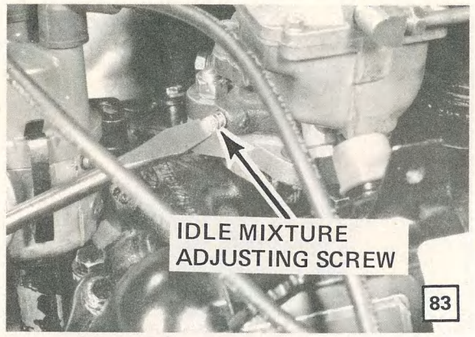
1. INSTALL TACHOMETER
2. BRING ENGINE UP TO NORMAL OPERATING TEMPERATURE
3. DISENGAGE ANY LOAD ON THE ENGINE
4. SET THROTTLE AT MINIMUM SPEED

81

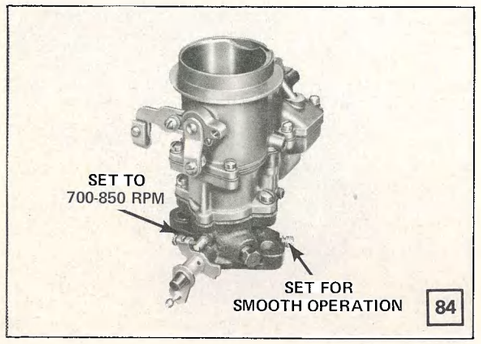
Turn the idle speed adjusting screw either in or out to obtain 700 rpm.



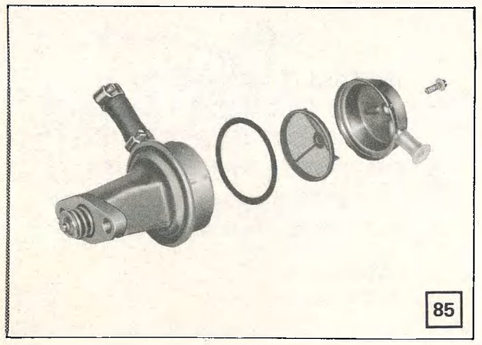
82



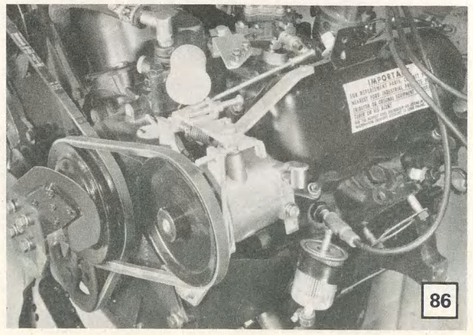
Turn the idle mixture adjustment screw inward until engine speed begins to drop because of a lean mixture. Next, turn the screw outward until the engine speed begins to drop because of a too rich mixture. Then turn the screw inward to a point between the two extremes to obtain maximum engine smoothness and rpm.



Reset the idle speed to the smoothest point within a range of 700 to 850 rpm. Recheck the idle mixture adjustment and reset if necessary.

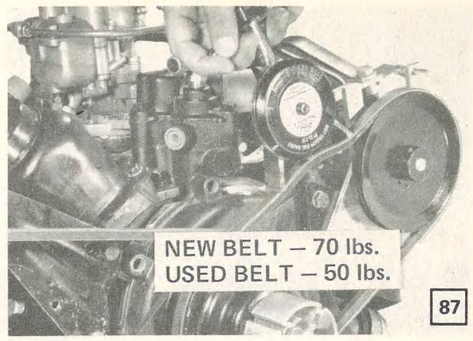


The fuel pump has a filter screen which can be cleaned when necessary. If the screen shows signs of corrosion, it must be replaced. The remainder of the fuel pump is a sealed unit and is replaced as a unit.

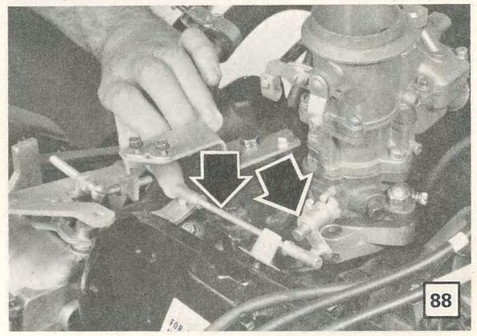


Moving into another area affecting engine operation, let's look at the governor, which has some of the most important adjustments you can make to prevent engine operating problems. There are five different adjustments, each of which will affect engine operation.

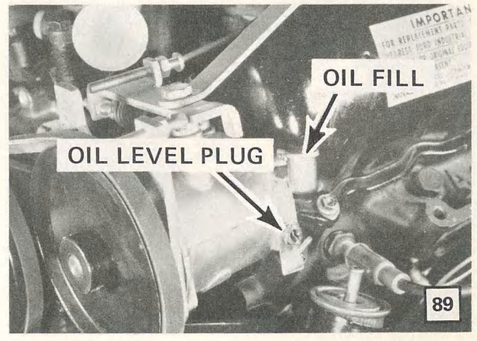
However, before making any governor adjustments, first check the governor drive belt tension. Perform the check on a cold engine since the specified belt tension limits (actual lbs. strand tension) will not apply after the engine has been operated. Use a Ford belt tension gage, tool number T63L-8620-A. Position the gage on the belt as shown, making sure the gage doesn't touch any pulleys. For a new belt, the gage should read from 70 lbs. For a used belt being reset because of a repair or replacement of associated components, the gage should read from 50 lbs. Any belt run 10 minutes or more is considered a used belt.



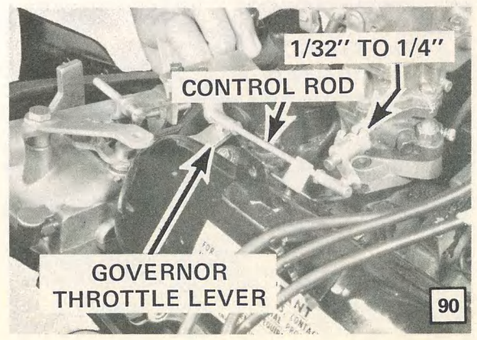
Next, check the control rod length and adjust if necessary. Also check that all governor and carburetor linkage is free of binds and without play, and that the oil level is correct.

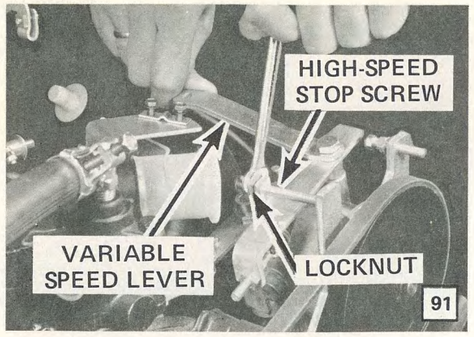


To check the oil level, slowly remove the oil level plug. If oil drips out, the oil level is full. If oil doesn't drip out, slowly add 10W30, or 10W40 engine oil into the oil fill. As soon as it begins dripping out, insert the oil level plug.



The first adjustment is the governor-to-carburetor control rod adjustment. With the control rod connected, manually move the governor throttle lever to the maximum open throttle position, as shown. Check that the carburetor throttle shaft lever is set from 1/32 to 1/4-inch from its maximum open position. If necessary, adjust length of the control rod to obtain this setting.





To perform a high-speed adjustment, first attach a tachometer to the engine, then run the engine until it reaches normal operating temperature.

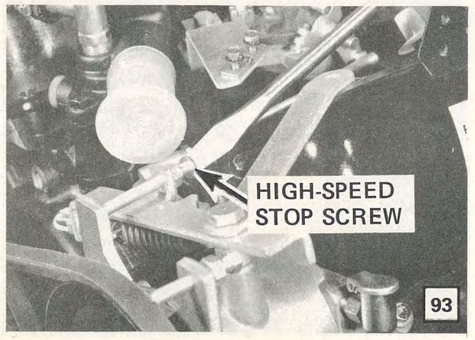
1- loosen the locknut on the high speed stop screw
2- disengage engine load
3- slowly pull the throttle to desired maximum engine speed
4- adjust the high speed stop screw on the governor to attain the desired maximum engine speed
5- tighten the locknut

TOO SMALL RPM SPREAD=
GOVERNOR HUNTING
AND SURGING

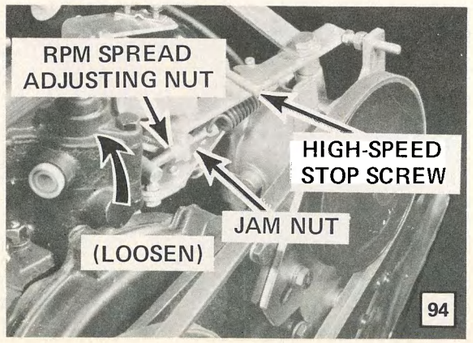
TOO LARGE RPM SPREAD=
GOVERNOR LOW
RESPONSE

92

The third adjustment is for spread. Proper governor operation requires a difference between full-load and no-load governed speed. Too small an rpm spread between the two speeds will cause governor hunting and surging. Too large a spread will cause low response. For this governor, normal rpm spread is 5 to 10 percent.

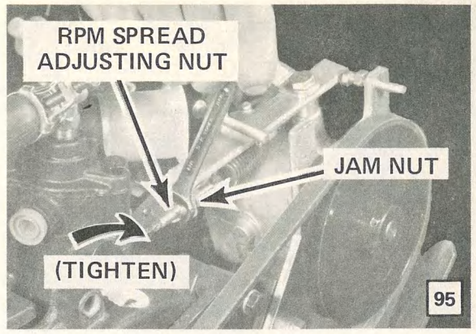


To increase rpm spread and decrease sensitivity, first bring the engine up to normal operating temperature. With the load disconnected, adjust the high-speed stop screw for the hand throttle, or governor variable speed lever until maximum desired governed speed is obtained.

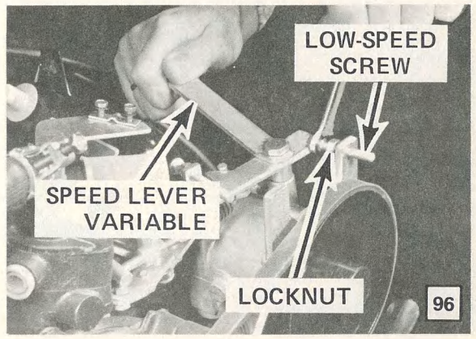


Loosen the rpm spread adjusting nut and decrease spring tension until engine speed decreases 150 rpm; then tighten the jam nut. Recheck governor operation under full-load and no-load conditions to determine if operation is stabilized and sensitivity is satisfactory. You might also have to readjust the governor high-speed stop screw to maintain the correct high-speed setting under load.

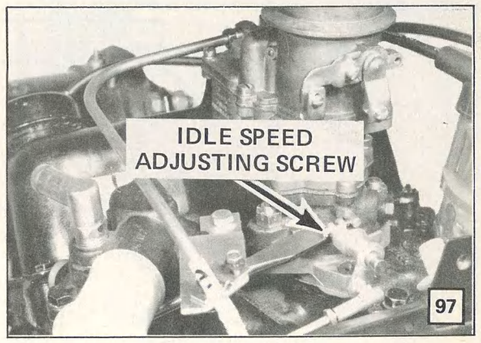
To decrease rpm spread, run the engine under no-load at maximum governed speed and tighten the rpm spread adjusting nut and increase spring tension until engine speed increases 150 rpm. Recheck governor operation under load and no-load conditions.



To perform a low-speed adjustment, attach a tachometer and run the engine until normal operating temperature is reached. Move the hand throttle, or variable speed lever, to the closed position and loosen locknut on governor low-speed screw. Turn stop screw in or out until you can maintain the desired speed.



To obtain the absolute minimum idle speed, adjust the governor stop screw in until there isn't any further decrease in engine speed. Then adjust the idle speed adjustment screw on the carburetor to maintain an engine speed of 700-750 rpm.

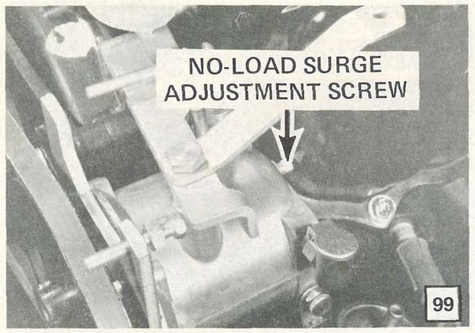


The no-load surge adjustment is set at the factory and rarely requires adjustment. If necessary, this adjustment can be used to prevent hunting and surging at no-load speeds, provided the rpm spread adjustment is set properly.

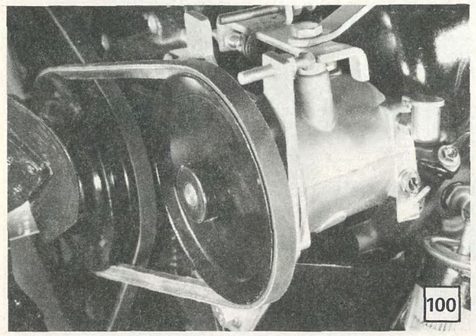
NO-LOAD SURGE

NORMALLY-FACTORY ADJUSTED

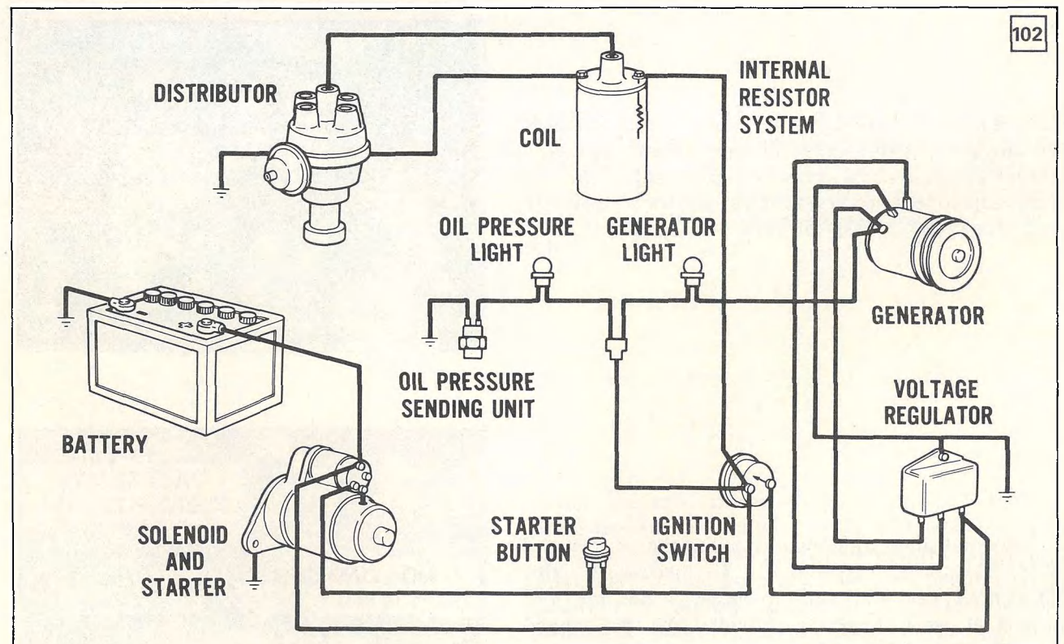
98



Make this adjustment with the tachometer installed. Increase the engine speed with the hand throttle to 75 rpm lower than the maximum no-load desired control rpm. Then loosen the no-load surge adjustment screw locknut and turn the screw inward until the rpm increases to the desired control rpm. Do not turn the screw in all the way. It will interfere with proper governor operation and prevent the governor from returning the engine to idle speed.

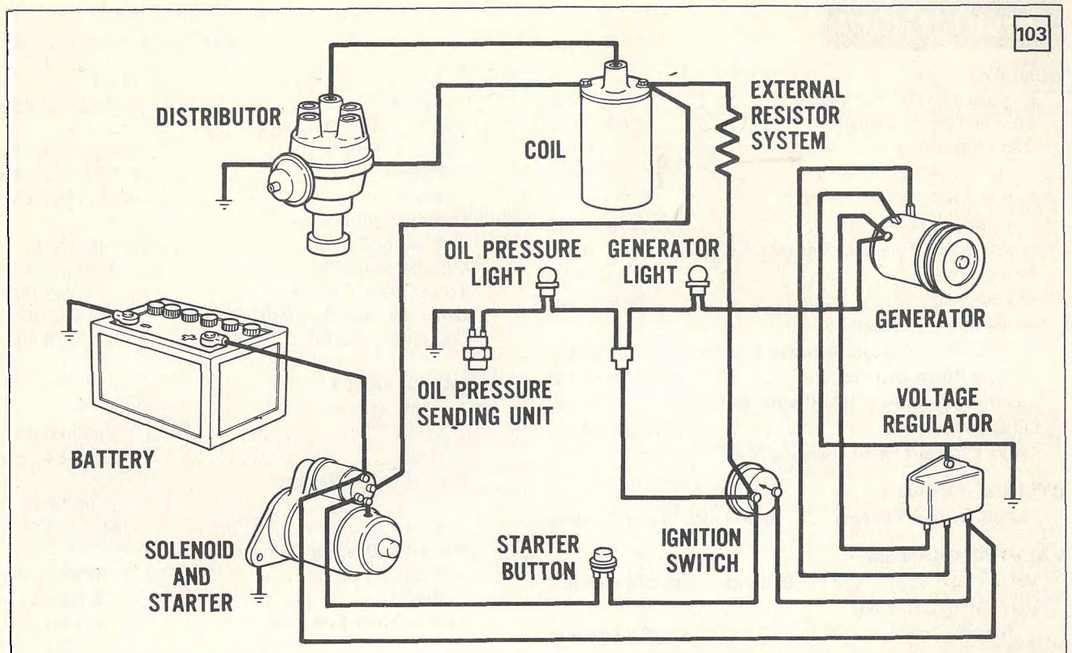


If all adjustments are complete and the governor isn't operating properly, check that the governor is equipped with the proper drive belt and pulley arrangement.



STANDARD ELECTRICAL SYSTEM
INTERNAL RESISTOR

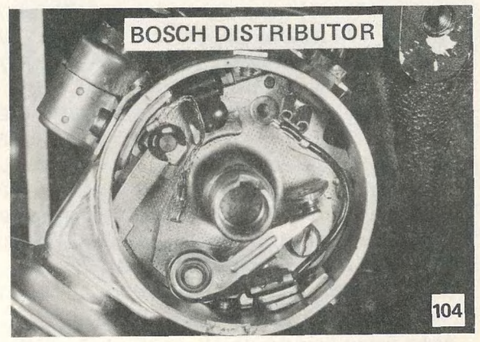
A 12-volt negative ground ignition system is used on this engine. Either of two types of ignition coils may be used on the engine. One is an internal resistor system, as shown here.



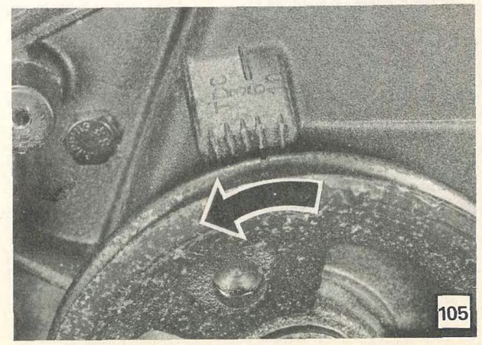
STANDARD ELECTRICAL SYSTEM
EXTERNAL RESISTOR

The other type, shown here, is an external resistor system.

Shown here is a Bosch distributor, which is standard on this engine. Refer to the service manual for all distributor adjustment procedures.



The ignition timing marks are located on the balance shaft pulley. On this engine, the pulley rotates counterclockwise as you face the front of the engine.



SPECIFICATIONS

GENERAL

Displacement (Cubic Inches)	104
Bore and Stroke (Inches)	3.54 x 2.63
Compression Ratio	9 to 1 Nominal
	7.5 to 1 Nominal
Compression Pressure — PSI	
At Cranking Speed	128 - 142
Allowable Tolerance Between Cylinders	20 psi
Firing Order	1-3-4-2
Idle Speed	700-850 rpm
Initial Spark Advance	
With Ford Vacuum Advance Distributor	10° BTDC
With Bosch Distributor	6° ± 1 BTDC
Manifold Vacuum at Idle (Inches of Mercury)	17
Oil Capacity	3 qts.

*Add 1/2 quart when changing filter.

CYLINDER HEAD

Gasket Surface Flatness	0.003 inch in any 6 inches

VALVE MECHANISM

Valve Lash	.018 inch cold; .016 inch hot
Valve Stem Diameter	
Intake — Std.	8.025-8.043 mm
— 0.2 Oversize	8.225-8.243 mm
— 0.4 Oversize	8.425-8.443 mm
— 0.6 Oversize	8.625-8.643 mm
— 0.8 Oversize	8.825-8.843 mm
Exhaust — Std.	7.999-8.017 mm
— 0.2 Oversize	8.199-8.217 mm
— 0.4 Oversize	8.399-8.417 mm
— 0.6 Oversize	8.599-8.617 mm
— 0.8 Oversize	8.799-8.817 mm
Valve Guide Bore Diameter	
Intake and Exhaust — Std.	8.063-8.088 mm
Intake and Exhaust — Oversize	8.463-8.488 mm
Valve Stem to Guide Clearance	
Intake	0.020-0.063 mm
Exhaust	0.046-0.089 mm
Valve Seat Width	1.5-2.0 mm
Valve Face Angle	45°
Valve Seat Max. Runout	.0015 in.
Valve Travel	9.7 mm
Valve Spring Free Length	45.2 mm
Valve Tappet Diameter	22.190-22.202 mm
Valve Tappet to Tappet	
Bore Clearance	0.023-0.060 mm

CAMSHAFT

Journal Diameter	
No. 1 (Front)	41.522-41.542 mm
No. 2	41.141-41.161 mm
No. 3	40.760-40.780 mm
Bearings Inner Diameter	
No. 1 (Front)	41.567-41.587 mm
No. 2	41.186-41.206 mm
No. 3	40.805-40.825 mm
Camshaft Journal to	
Bearing Clearance	0.025-0.077 mm
Camshaft End Play	0.106-0.207 mm
Thrust Plate Thickness	4.05-4.09 mm
Camshaft Gear Backlash	0.051-0.102 mm
Camshaft Lobe Lift	6.49 mm

BALANCE SHAFT

Journal Diameter	
Front	50.80-50.83 mm
Rear	53.98-54.00 mm
Bearing Inner Diameter	
Front	50.85-50.88 mm
Rear	54.03-54.05 mm
Journal to Bearing Clearance	
Front	0.02-0.08 mm
Rear	0.03-0.07 mm
Balance Shaft End Play	0.18-0.38 mm

CRANKSHAFT

Main Bearing Journal Diameter	
Color Coded Red	56.990-57.000 mm
Color Coded Blue	56.980-56.990 mm
0.25 Undersize	56.736-56.746 mm
0.50 Undersize	56.482-56.492 mm
0.75 Undersize	56.228-56.238 mm
1.00 Undersize	55.974-55.984 mm
Thrust Bearing Journal Length	26.390-26.440 mm
Connecting Rod Journal Diameter	
Color Coded Red	53.990-54.000 mm
Color Coded Blue	53.980-53.990 mm
0.25 Undersize	53.736-53.746 mm
0.50 Undersize	53.482-53.492 mm
0.75 Undersize	53.228-53.238 mm
1.00 Undersize	52.974-52.984 mm
Crankshaft Free End Play	0.12-0.35 mm

MAIN BEARINGS

Inner Diameter (Assembled)	
Color Coded Red	54.014-57.038 mm
Color Coded Blue	57.004-57.028 mm
0.25 Undersize	57.760-56.794 mm
0.50 Undersize	56.506-56.530 mm
0.75 Undersize	56.252-56.276 mm
1.00 Undersize	55.998-56.022 mm
Crankshaft to Main Bearing Clearance	
Standard Bearings	0.012-0.048 mm

SPECIFICATIONS

Undersize Bearings	0.014-0.058 mm
Thrust Bearing Width	26.240-26.290 mm

CONNECTING ROD

Piston Pin Bushing I.D.	22.963-23.974 mm
Bearing Bore Diameter	
Color Coded Red	56.820-56.830 mm
Color Coded Blue	56.830-56.840 mm
Length — Center to Center	130.52-130.59 mm

CONNECTING ROD BEARINGS

Inner Diameter (Assembled)	
Color Coded Red	54.014-54.044 mm
Color Coded Blue	54.004-54.034 mm
0.05 Undersize	53.943-53.983 mm
0.25 Undersize	53.760-53.800 mm
0.50 Undersize	53.506-53.546 mm
0.75 Undersize	53.252-53.292 mm
1.00 Undersize	52.998-53.038 mm
Crankshaft to Connecting	
Rod Clearance	
Standard Bearings	0.014-0.054 mm
Undersize Bearings	0.014-0.064 mm

PISTON

Diameter	
Std.	89.978-90.002 mm
0.5 Oversize	90.478-90.502 mm
1.0 Oversize	90.978-91.002 mm
Piston to Cylinder Bore Clearance	0.028-0.248 mm
Piston Pin Bore Diameter	
Color Coded Red	24.002-24.005 mm
Color Coded Blue	24.005-24.008 mm
Color Coded Yellow	24.008-24.011 mm
Ring Groove Width	
Top	2.030-2.055 mm
Middle	3.030-3.056 mm
Lower	5.017-5.042 mm

PISTON PINS

Length	69.800-70.000 mm
Diameter	
Color Coded Red	23.994-23.997 mm
Color Coded Blue	23.997-24.000 mm
Color Coded Yellow	24.000-24.003 mm
Piston Pin to Piston Clearance	0.005-0.011 mm

PISTON RINGS

Width	
Top	1.978-1.990 mm
Middle	2.978-2.990 mm
Lower (Total)	4.839-4.991 mm
Side Clearance	
Top	0.040-0.070 mm
Middle	0.040-0.078 mm
Lower	0.026-0.203 mm
Ring Gap Width	
Top	0.38-0.58 mm
Middle	0.38-0.58 mm
Lower (Segments)	0.38-1.40 mm

CYLINDER BLOCK

Cylinder Bore Diameter	
Class 1	90.010-90.020 mm
Class 2	90.020-90.030 mm
Class 3	90.030-90.040 mm
Class 4	90.040-90.050 mm
Oversize Class A	90.510-90.520 mm
Oversize Class B	90.520-90.530 mm
Oversize Class C	90.530-90.540 mm
Bores for Main Bearing	
(Caps Assembly)	
Color Coded Red	60.620-60.630 mm
Color Coded Blue	60.630-60.640 mm
Bores for Camshaft Bearings —	
No. 1 (Front)	41.567-41.593 mm
No. 2	41.186-41.212 mm
No. 3	40.805-40.831 mm
Bores for Balance Shaft Bearings	
Front	50.850-50.880 mm
Rear	54.030-54.050 mm

OIL PUMP

Relief Valve Pressure	44.9-53.7 psi
Housing to Rotor Clearance	0.3 mm max.
Rotor End Play	0.1 mm max.

See Page 30 for millimeter to inch conversion table.

CONVERSION TABLE 1

Millimeter to Inches

1 Millimeter (mm) = 0.039370 (")

mm	ins	mm	ins	mm	ins	mm	ins	mm	ins
.01	.000 394	.51	.020 079	1	.039 370	51	2.007 870	105	4.133 848
.02	.000 787	.52	.020 472	2	.078 740	52	2.047 240	110	4.330 700
.03	.001 181	.53	.020 866	3	.118 110	53	2.086 610	115	4.527 550
.04	.001 575	.54	.021 260	4	.157 480	54	2.125 980	120	4.724 400
.05	.001 969	.55	.021 654	5	.196 850	55	2.165 350	125	4.921 250
.06	.002 362	.56	.022 047	6	.236 220	56	2.204 720	130	5.118 100
.07	.002 756	.57	.022 441	7	.275 590	57	2.244 090	135	5.314 950
.08	.003 150	.58	.022 835	8	.314 960	58	2.283 460	140	5.511 800
.09	.003 543	.59	.023 228	9	.354 330	59	2.322 830	145	5.708 650
.10	.003 937	.60	.023 622	10	.393 700	60	2.362 200	150	5.905 500
.11	.004 331	.61	.024 016	11	.433 070	61	2.401 570	155	6.102 350
.12	.004 724	.62	.024 409	12	.472 440	62	2.440 940	160	6.299 200
.13	.005 118	.63	.024 803	13	.511 810	63	2.480 310	165	6.496 050
.14	.005 512	.64	.025 197	14	.551 180	64	2.519 680	170	6.692 900
.15	.005 906	.65	.025 591	15	.590 550	65	2.559 050	175	6.889 750
.16	.006 299	.66	.025 984	16	.629 920	66	2.598 420	180	7.086 600
.17	.006 693	.67	.026 378	17	.669 290	67	2.637 790	185	7.283 450
.18	.007 087	.68	.026 772	18	.708 660	68	2.677 160	190	7.480 300
.19	.007 480	.69	.027 165	19	.748 030	69	2.716 530	195	7.677 150
.20	.007 874	.70	.027 559	20	.787 400	70	2.755 900	200	7.874 000
.21	.008 268	.71	.027 953	21	.826 770	71	2.795 270	210	8.267 700
.22	.008 661	.72	.028 346	22	.866 140	72	2.834 640	220	8.661 400
.23	.009 055	.73	.028 740	23	.905 510	73	2.874 010	230	9.055 100
.24	.009 449	.74	.029 134	24	.944 880	74	2.913 380	240	9.448 800
.25	.009 843	.75	.029 528	25	.984 250	75	2.952 750	250	9.842 500
.26	.010 236	.76	.029 921	26	1.023 620	76	2.992 120	260	10.236 200
.27	.010 630	.77	.030 315	27	1.062 990	77	3.031 490	270	10.629 900
.28	.011 024	.78	.030 709	28	1.102 360	78	3.070 860	280	11.032 600
.29	.011 417	.79	.031 102	29	1.141 730	79	3.110 230	290	11.417 300
.30	.011 811	.80	.031 496	30	1.181 100	80	3.149 600	300	11.811 000
.31	.012 205	.81	.031 890	31	1.220 470	81	3.188 970	310	12.204 700
.32	.012 598	.82	.032 283	32	1.259 840	82	3.228 340	320	12.598 400
.33	.012 992	.83	.032 677	33	1.299 210	83	3.267 710	330	12.992 100
.34	.013 386	.84	.033 071	34	1.338 580	84	3.307 080	340	13.385 800
.35	.013 780	.85	.033 465	35	1.377 949	85	3.346 450	350	13.779 500
.36	.014 173	.86	.033 858	36	1.417 319	86	3.385 820	360	14.173 200
.37	.014 567	.87	.034 252	37	1.456 689	87	3.425 190	370	14.566 900
.38	.014 961	.88	.034 646	38	1.496 050	88	3.464 560	380	14.960 600
.39	.015 354	.89	.035 039	39	1.535 430	89	3.503 930	390	15.354 300
.40	.015 748	.90	.035 433	40	1.574 800	90	3.543 300	400	15.748 000
.41	.016 142	.91	.035 827	41	1.614 170	91	3.582 670	500	19.685 000
.42	.016 535	.92	.036 220	42	1.653 540	92	3.622 040	600	23.622 000
.43	.016 929	.93	.036 614	42	1.692 910	93	3.661 410	700	27.559 000
.44	.017 323	.94	.037 008	44	1.732 280	94	3.700 780	800	31.496 000
.45	.017 717	.95	.037 402	45	1.771 650	95	3.740 150	900	35.433 000
.46	.018 110	.96	.037 795	46	1.811 020	96	3.779 520	1000	39.370 000
.47	.018 504	.97	.038 189	47	1.850 390	97	3.818 890	2000	78.740 000
.48	.018 898	.98	.038 583	48	1.889 760	98	3.858 260	3000	118.110 000
.49	.019 291	.99	.038 976	49	1.929 130	99	3.897 630	4000	157.480 000
.50	.019 685	1 mm	.039 370	50	1.968 500	100	3.937 000	5000	196.850 000

CONVERSION TABLE 2

Inches to Millimeters

Inch (") = 25.4 Millimeters (mm)

ins	mm	ins	mm	ins	mm
1/64	.015 625	.396 875	.0001	.002 540	.40	10.160 020
1/32	.031 250	.793 752	.0002	.005 080	.41	10.414 020
3/64	.046 875	1.190 627	.0003	.007 620	.42	10.668 021
1/16	.062 500	1.587 503	.0004	.010 160	.43	10.922 021
5/64	.078 125	1.984 379	.0005	.012 700	.44	11.176 022
3/32	.093 750	2.381 255	.0006	.015 240	.45	11.430 022
7/64	.109 375	2.778 131	.0007	.017 780	.46	11.684 023
1/8	.125 000	3.175 006	.0008	.020 320	.47	11.938 023
9/64	.140 625	3.571 882	.0009	.022 860	.48	12.192 024
5/32	.156 250	3.968 958			.49	12.446 024
11/64	.171 875	4.365 634	.001	.025 400		
3/16	.187 500	4.762 510	.002	.050 800	.50	12.700 025
13/64	.203 125	5.159 385	.003	.076 200	.51	12.954 025
7/32	.218 750	5.556 261	.004	.101 600	.52	13.208 026
15/64	.234 375	5.953 137	.005	.127 000	.53	13.462 026
1/4	.250 000	6.350 013	.006	.152 400	.54	13.716 027
17/64	.265 625	6.746 889	.007	.177 800	.55	13.970 027
9/32	.281 250	7.143 764	.008	.203 200	.56	14.224 028
19/64	.296 875	7.540 640	.009	.228 600	.57	14.478 028
5/16	.312 500	7.937 516			.58	14.732 029
21/64	.328 125	8.334 392			.59	14.986 029
11/32	.343 750	8.731 268	.01	.254 000		
23/64	.359 375	9.128 143	.02	.508 001	.60	15.240 030
3/8	.375 000	9.525 019	.03	.762 001	.61	15.494 030
25/64	.390 625	9.921 895	.04	1.016 002	.62	15 748 031
13/32	.406 250	10.318 771	.05	1.270 002	.63	16.002 032
27/64	.421 875	10.715 647	.06	1.524 003	.64	16.256 032
7/16	.437 500	11.112 522	.07	1.778 003	.65	16.510 033
29/64	.453 125	11.509 398	.08	2.032 004	.66	16.764 033
15/32	.468 750	11.906 274	.09	2.286 004	.67	17.018 034
31/64	.484 375	12.303 150			.68	17.272 034
1/2	.500 000	12.700 025	.10	2.540 005	.69	17.526 035
33/64	.515 625	13.096 901	.11	2.794 005	.70	17.780 035
17/32	.531 250	13.493 777	.12	3.048 006	.71	18.034 036
35/64	.546 875	13.890 653	.13	3.302 006	.72	18.288 036
9/16	.562 500	14.287 529	.14	3.556 007	.73	18.542 037
37/64	.578 125	14.684 405	.15	3.810 007	.74	18.796 037
19/32	.593 750	15.081 280	.16	4.064 008	.75	19.050 038
39/64	.609 375	15.478 156	.17	4.318 008	.76	19.304 038
5/8	.625 000	15.875 032	.18	4.572 009	.77	19.558 039
41/64	.640 625	16.271 908	.19	4.826 009	.78	19.812 039
21/32	.656 250	16.668 784			.79	20.066 040
43/64	.671 875	17.065 659				
11/16	.687 500	17.462 535	.20	5.080 010	.80	20.320 040
45/64	.703 125	17.859 411	.21	5.334 010	.81	20.574 041
23/32	.718 750	18.256 287	.22	5.588 011	.82	20.828 041
47/64	.734 375	18.653 163	.23	5.842 012	.83	21.082 042
3/4	.750 000	19.050 038	.24	6.096 012	.84	21.336 042
49/64	.765 675	19.446 914	.25	6.350 012	.85	21.590 043
25/32	.781 250	19.843 790	.26	6.604 013	.86	21.844 043
51/64	.796 875	20.240 666	.27	6.858 013	.87	22.098 044
13/16	.812 500	20.637 541	.28	7.112 014	.88	22.352 044
53/64	.828 125	21.034 417	.29	7.366 014	.89	22.606 045
27/32	.843 750	21.431 293				
55/64	.859 375	21.828 169	.30	7.620 015	.90	22.860 045
7/8	.875 000	22.225 045	.31	7.874 015	.91	23.114 046
57/64	.890 625	22.621 921	.32	8.128 016	.92	23.368 046
29/32	.906 250	23.018 796	.33	8.382 016	.93	23.622 047
59/64	.921 875	23.415 672	.34	8.636 017	.94	23.876 047
15/16	.937 500	23.812 548	.35	8.890 017	.95	24.130 048
61/64	.953 125	24.209 424	.36	9.144 018	.96	24.384 048
31/32	.968 750	24.606 300	.37	9.398 018	.97	24.638 049
63/64	.984 375	25.003 175	.38	9.652 019	.98	24.892 049
1	1.000 000	25.400 050	.39	9.906 019	.99	25.146 050