

rearward. While holding in this position, tighten the cap bolts to specifications (Fig. 37).

7. Coat the sealing lip of a new crankshaft oil seal with SE-type engine oil. Slide seal over end of crankshaft and drive into position (Fig. 35). Be sure the seal bottoms in groove.
8. Using a flat tool such as a large blunt end screwdriver, push the two wedge-shaped seals between the cylinder block and rear main bearing cap. Position the seals with the round side facing the main bearing cap (Fig. 38).
9. Pull connecting rods up one at a time and install rod caps. Be sure to apply a liberal coating of SE-type oil to the bearing surfaces. Tighten cap nuts to specifications.
10. Install oil pump and pick up tube as an assembly.
11. Install front cover.
12. Install rear cover plate, flywheel housing and flywheel. Tighten flywheel bolts to specifications.
13. Install clutch disc and clutch pressure plate, if so equipped.
14. Install oil pan as described under Oil Pan—Installation. Be sure gaskets and seals are installed as directed.
15. Install the front cover and previously removed components.
16. Install the engine in the vehicle.

CAMSHAFT BEARING

The camshaft bearings are available pre-finished to size and require no reaming for standard and undersize journal diameters.

Removal

1. Remove the engine from the vehicle and place in a work stand. Remove the flywheel and the camshaft. Remove the rear bearing bore plug as detailed under Core Plugs in Part 21-01.
2. Remove the camshaft bearings with the tool shown in Fig. 45.
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel.

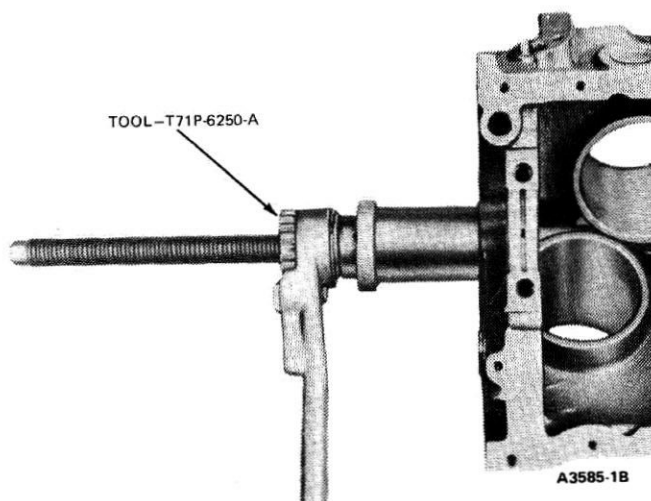


FIG. 45 Typical Camshaft Bearing Replacement

With the expanding collet collapsed, install the collet assembly in the camshaft bearing. Tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.

4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front and rear bearings, use the special adapter tube Tool T72C-6250.

Installation

1. Position the new bearings at the bearing bores, and press them in place with the tools shown in Fig. 45. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. Check oil hole alignment of Nos. 2 and 3 bearings with a welding rod of slightly smaller diameter than the oil holes. Insert the rod into the oil passage (Fig. 46). The rod will pass into the camshaft bore when the holes are properly aligned.

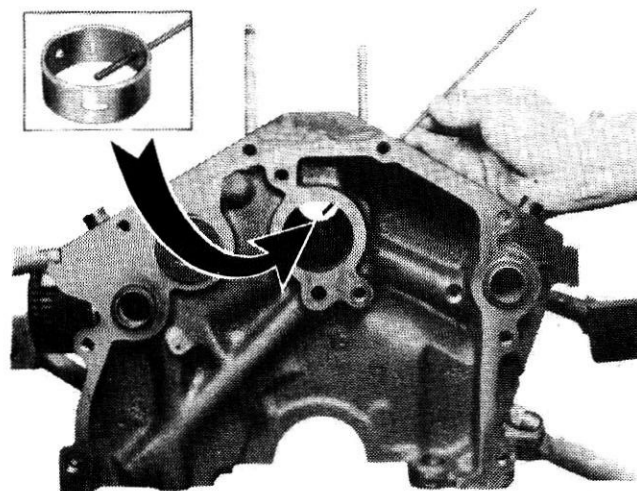


FIG. 46 Checking Oil Hole Alignment—Nos. 2 and 3 Camshaft Bearings

2. Install a new bearing bore plug. See Core Plugs in Part 21-01.
3. Install the camshaft, flywheel and related parts, following the appropriate procedures. Do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

OIL FILTER

Removal

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the filter adapter recess.

Installation

1. Coat the gasket on the replacement filter with oil. Position the filter on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary

repairs to correct the leakage. Check the oil level and fill the crankcase to the recommended level if necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to the Specification at the end of this Part for torque specifications), oil the threads with light weight (SE) engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer. Refer to Part 21-01 for cleaning and inspection procedures.**

VALVE ROCKER ARM ASSEMBLY

Refer to Fig. 47 for component parts.

Disassembly

1. Remove the spring washer and pin from each end of the valve rocker arm shaft.
2. Slide the rocker arms, springs and rocker arm shaft supports off the shaft. Be sure to mark the parts for re-assembly in the same locations.
3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end. Use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

Assembly

1. The oil holes in the rocker arm shaft must point down when the shaft is installed. This position of the shaft can be recognized by a notch on the front face of the shaft (Fig. 7).
2. If the plugs were removed from the shaft, use a blunt tool and install a plug, cup side out, in each end of the shaft.
3. Install a spring washer and pin on one end of the shaft, coat the rocker arm shaft with heavy SE engine oil and install the parts in the same sequence they were removed.

4. Install the remaining spring washer and pin.
5. Before installation on the engine, coat the rocker arm pads with Lubriplate or equivalent.

CYLINDER HEAD

Disassembly

1. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surfaces.**
2. Compress the valve springs. Remove the valve retainer locks and release the springs.
3. Remove the spring retainer, stem seal, and valve (Fig. 48). Discard the valve stem seals. Identify all valve parts for re-assembly. Remove the manifold assembly and spark plugs.

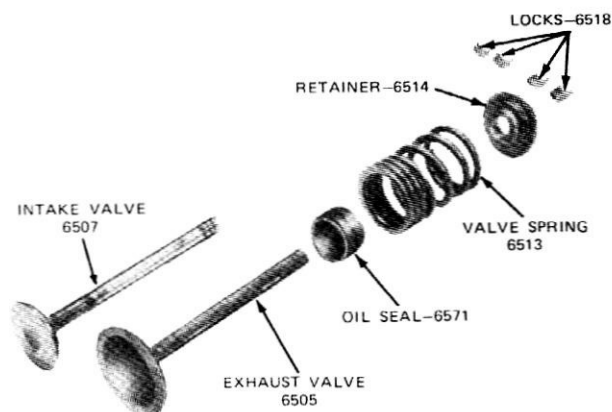


FIG. 48 Valve Assemblies

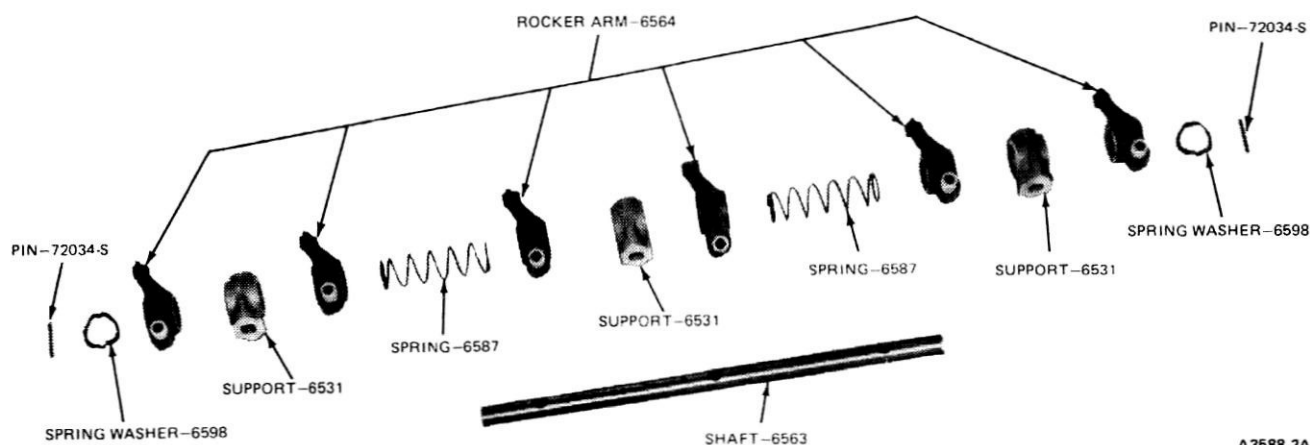
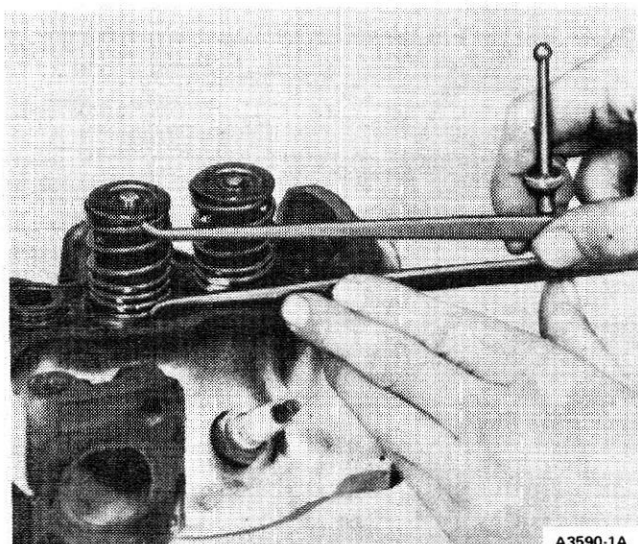


FIG. 47 Rocker Arm Shaft Assembly

Assembly

1. Clean, inspect and repair all parts before assembly. Install the manifold assembly and spark plugs. Torque the spark plugs and manifold attaching parts to specifications. Lubricate the valve guides and valve stems with engine oil. Apply Lubriplate or equivalent to the tips of the valve stems.
2. Install each valve in the valve guide from which it was removed or to which it was fitted. Install a new stem seal on the valve.
3. Install the valve spring assembly over the valve, close coils toward the cylinder head. Install the spring retainer.
4. Compress the spring and install the retainer locks (Fig. 48).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 49).



A3590-1A

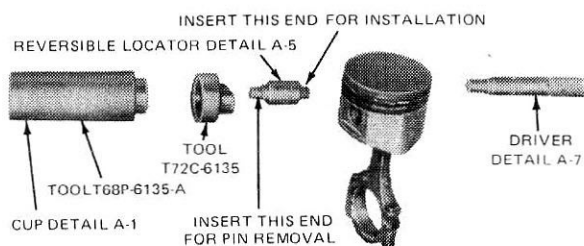
FIG. 49 Checking Valve Spring Assembled Height

6. Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of excess spacers will result in overstressing the valve springs and overloading the camshaft lobes which would lead to spring breakage and worn camshaft lobes.**

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Using an arbor press and the tool shown in Fig. 50 press the piston pin from the piston and connecting rod. Remove the piston rings.



A3592-1A

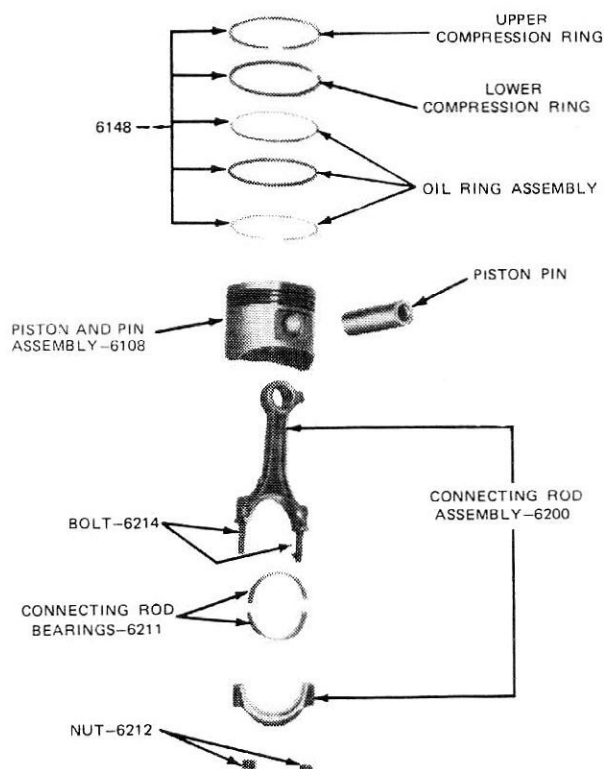
FIG. 50 Removing or Installing Piston Pin

Assembly

The piston, connecting rod and related parts are shown in Fig. 51. Clean and inspect the piston and connecting rod following procedures given in Part 21-01. Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications.

1. Apply a light coat of engine oil to all parts. **Assemble the piston and the connecting rod as shown in Fig. 42.**
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press, press the piston pin through the piston and connecting rod until the pin is centered in the piston (Fig. 50).
3. Check the end gap and spacing of all piston rings following instructions given in Part 21-01. They must be within specifications.



A3593-1C

FIG. 51 Piston, Connecting Rod and Related Parts

4. Follow the manufacturer's instructions (included with the piston ring package) and install the piston rings.
5. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and the lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
6. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY

Disassembly

1. Mount the old engine in a work stand and remove all parts not furnished with the new cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
2. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.

2. Position the new cylinder assembly in a work stand and transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Completely disassemble the old engine, following the procedures given in the Removal and Installation Section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.

Assembly

1. Clean the cylinder block following the instructions given in Part 21-01. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand and install all serviceable parts removed from the old cylinder block, following the procedures given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	2.8L (2800 cc)
NUMBER OF CYLINDERS	6
BORE AND STROKE	3.66 x 2.70
FIRING ORDER	1-4-2-5-3-6
OIL PRESSURE (Hot @ 2000 RPM)	40-60
DRIVE BELT TENSION	(1)
COMPRESSION PRESSURE	(2)
CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	42.8-44.3
VALVE GUIDE BORE DIAMETER	0.3174-0.3184
VALVE SEATS	
Width - Intake	0.060-0.079
Width - Exhaust	0.060-0.079
Angle	45°
Runout Limit (T. I. R. Max.)	0.0015
VALVE ARRANGEMENT (Front to Rear)	L H - I E E I E I R H - I E E I E I
GASKET SURFACE FLATNESS	0.003 in 6", 0.006" overall
GASKET SURFACE FINISH (RMS)	60-150
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.0008-0.0025
Exhaust	0.0018-0.0035
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	1.562-1.577
Exhaust	1.261-1.276
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std)	
Intake	0.3159-0.3167
Exhaust	0.3149-0.3156
(0.008 Oversize)	
Intake	0.3239-0.3245
Exhaust	0.3228-0.3235
(0.016 Oversize)	
Intake	0.3318-0.3324
Exhaust	0.3307-0.3314
(0.032 Oversize)	
Intake	0.3475-0.3481
Exhaust	0.3461-0.3468
VALVE SPRINGS	
Compression Pressure (Lb. @ Spec. Length)	60.0-68.0 @ 1.585 138.0-149.0 @ 1.222
Free Length (Approximate)	1.91
Assembled Height	1.37/64 - 1.39/64
Service Limit	(3)
Out-Of-Square	5/64 (0.078)
ROCKER ARM	
Shaft Diameter	0.7799-0.7811
Bore Diameter	0.7830-0.7842
Ratio	1.46:1
PUSH ROD RUNOUT (T. I. R. Max.)	0.020
VALVE TAPPET, LIFTER OR ADJUSTER	
Diameter (Std)	0.8736-0.8741
Clearance To Bore	0.0009-0.0024
Service Limit	0.005
VALVE LASH CLEARANCE (COLD)	
Intake	0.014
Exhaust	0.016
CAMSHAFT	
LOBE LIFT	
Intake	0.2555
Exhaust	0.2555
Allowable Lobe Lift Loss	0.005
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.3730
Exhaust	0.3730
END PLAY	0.0008-0.004
Service Limit	0.009
JOURNAL TO BEARING CLEARANCE	0.001-0.0026
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010
JOURNAL DIAMETER	
# 1	1.6497-1.6505
# 2	1.6347-1.6355

CAMSHAFT (Continued)	
# 3	1.6197-1.6205
# 4	1.6047-1.6055
Runout	0.005 Max. T. I. R.
Out-Of-Round	0.0003 Max. T. I. R.
BEARING INSIDE DIAMETER	
# 1	1.6515-1.6523
# 2	1.6305-1.6373
# 3	1.6215-1.6223
# 4	1.6065-1.6073
FRONT BEARING LOCATION	4 0.040-0.060

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	(5)
Finish (RMS)	60-150
CRANKSHAFT TO REAR FACE OF BLOCK RUNOUT (T. I. R. Max.)	0.005
CYLINDER BORE	
Diameter	3.6614-3.6630
Surface Finish (RMS)	18-38
Out-Of-Round	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPER BORE DIAMETER	0.8750-0.8760
MAIN BEARING BORE DIAMETER	2.3866-2.3874
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.4534-0.4549

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.2433-2.2441
Out-Of-Round	0.0006
Taper Limit	0.0006 per inch
Journal Runout	0.002 Max.
Surface Finish (RMS)	12
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	1.039-1.041
CONNECTING ROD JOURNAL	
Diameter	2.1252-2.1260
Out-Of-Round	0.0006
Taper Limit	0.0006 per inch
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish	20 Max.
Runout (T. I. R.)	0.001 Max.
FLYWHEEL CLUTCH FACE	
Runout	0.005
FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)	
Standard Transmission	0.025
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CONNECTING ROD BEARINGS	
Clearance To Crankshaft	- Desired 0.0006-0.0015 - Allowable 0.0005-0.0022
Bearing Wall Thickness (Std) (6)	Red - 0.0548-0.0552 Blue - 0.0552-0.0556
MAIN BEARING	
Clearance To Crankshaft	- Desired 0.0008-0.0015 - Allowable 0.0005-0.0019
Bearing Wall Thickness (Std) (6)	Red - 0.0707-0.0710 Blue - 0.0711-0.0714

Drive Belt Tension (Lbs.)			
Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-180 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.

(B) If less than 40 pounds, readjust to 40-60 pounds.

(C) If less than 90 pounds, readjust to 90-120 pounds.

(D) If less than 75 pounds, readjust to 90-120 pounds.

(2) PSI of lowest cylinder must be within 75% of highest (see part 21-01).

(3) 10% pressure loss @ specified Length.

(4) Distance in inches that front edge of bearing is installed below front face of cyl. block.

(5) 0.003 in any 6 inches - 0.006 overall.

(6) 0.002 undersize = add 0.001 to standard thickness.

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD

Piston Pin Bore Diameter	0.9450-0.9452
Crankshaft Bearing Bore Diameter	2.2370-2.2378
Out-Of-Round	0.0004
Taper	0.0004
Length (Center-to-Center)	5.1386-5.1413
Alignment (Bore-to-Bore Max. Diff.) ⑦	
Twist	0.006
Bend	0.002
Side Clearance (Assembled to Crank)	
Standard	0.004-0.011
Service Limit	0.014

PISTON

Diameter ⑧	
Coded Red	3.6605-3.6615
0.020 Oversize	3.6802-3.6812
Piston-To-Bore Clearance	0.0011-0.0019
Pin Bore Diameter	0.9450-0.9452
Ring Groove Width	
Compression (Top)	0.0803-0.0811
Compression (Bottom)	0.1197-0.1205
Oil	0.1579-0.1587

PISTON PIN

Length	2.835-2.866
Diameter	
Standard	0.9446-0.9450
Pin To Piston Clearance	0.0003-0.0006
Pin To Rod Clearance	Interference Fit

PISTON RINGS

Ring Width	
Compression (Top)	0.0778-0.0783
Compression (Bottom)	0.1172-0.1177
Side Clearance	
Compression (Top)	0.0020-0.0033
Compression (Bottom)	0.0020-0.0033
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.015-0.023
Compression (Bottom)	0.015-0.023
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP

Relief Valve Spring Tension (Lbs. at Spec. Length)	13.6-14.7 @ 1.39
Drive Shaft To Housing Bearing Clearance	0.0015-0.0030
Relief Valve To Bore Clearance	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race To Housing Clearance	0.001-0.013

OIL CAPACITY (Quarts U. S.) 4-1/2 ⑨

TORQUE SPECIFICATIONS - SPECIAL APPLICATIONS

ITEM	SIZE	TORQUE
CAMSHAFT GEAR BOLT	M-10	30-36
CAMSHAFT THRUST PLATE BOLT	M-8	12-15
CARBURETOR TO SPACER (Stud)		3-5
CARBURETOR ADAPTER TO MANIFOLD (STUD)		3-5
CARBURETOR TO SPACER (Nut)	M-8	4-18
CONNECTING ROD NUT	M-8	21-25
CRANKSHAFT DAMPER BOLT	M-12	92-103
CRANKCASE VENT VALVE		11-14
CYLINDER HEAD BOLT	M-12	65-80 ⑩
DECEL VALVE NUT		27-30
DECEL VALVE TO MANIFOLD ADAPTER		30-34
DISTRIBUTOR CLAMP BOLT	M-8	12-15
EGR TUBE FITTINGS		15-20
EGR VALVE TO SPACER BOLT	M-8	12-15
EXHAUST MANIFOLD TO EGR TUBE (CONN.)		25-35
EXHAUST MAN. TO CYLINDER HEAD (Bolt/Stud)	M-8	20-30
FLYWHEEL TO CRANKSHAFT (Bolt)	M-10	47-51
FRONT COVER TO CYLINDER BLOCK (Bolt)	M-8	12-15
FRONT PLATE TO CYLINDER BLOCK (Bolt)	M-8	12-15
FUEL PUMP TO CYLINDER BLOCK (Bolt)	M-8	12-15
INTAKE MAN. TO CYLINDER BLOCK (Bolt/Nut)	M-8	15-18 ⑪
INTAKE MAN. TO CYLINDER BLOCK (Stud)	M-8	10-12
MAIN BEARING CAP BOLT	M-12	65-75

TORQUE SPECIFICATIONS - SPECIAL APPLICATIONS (Continued)

ITEM	SIZE	TORQUE
TIMING POINTER TO FRONT COVER (Bolt)	M-6	5-7
OIL PUMP PICK-UP TUBE TO PUMP (Bolt)	M-6	7-9
OIL PUMP PICK-UP TUBE TO MAIN BEARING CAP (Bolt)	M-8	12-15
OIL PUMP COVER (Bolt)	M-6	7-9
OIL PAN DRAIN PLUG	M-14	15-20
OIL PAN TO CYLINDER BLOCK (Bolt)	M-6	5-7
OIL FILTER TO CYLINDER BLOCK (INSERT)		10-15
OIL FILTER		⑫
ROCKER ARM COVER BOLT	M-6	3-5
ROCKER ARM SHAFT SUPPORT BOLT	M-10	43-49
WATER JACKET DRAIN PLUG TO BLOCK		14-18
WATER OUTLET CONNECTION BOLT	M-8	12-15
WATER PUMP TO CYLINDER BLOCK (Bolt)	M-6	7-9
WATER TEMP SENDING UNIT		7-11
SPARK PLUG TO CYLINDER HEAD		10-15
FUEL FILTER TO CARBURETOR		80-100 in-lb.
ALT MOUNTIN BRKT TO CYLINDER HEAD (Bolt)	M-8	18-25
ALT MOUNTING BRKT TO CYLINDER BLOCK (Bolt)	M-10	28-40
ALT PIVOT BOLT		45-60
ALT ADJ ARM TO FRONT COVER (Bolt)	M-12	50-71
ALT ADJUSTING ARM TO ALTERNATOR		24-40
CRANKSHAFT PULLEY TO DAMPER (Bolt)	M-8	18-25
FAN TO WATER PUMP HUB (Bolt)	M-8	14-20
THERM PUMP MTG BRACKET TO CYLINDER BLOCK (Bolt)	M-10	28-40
THERM PUMP MTG BRACKET TO CYLINDER HEAD (Bolt)	M-8	18-25
THERMACTOR PUMP ADJUSTING ARM TO PUMP (Bolt)		22-32
THERMACTOR PUMP PIVOT BOLT		30-45

TORQUE SPECIFICATIONS - General Applications

U S THREAD SIZES	TORQUE
1/4-20	6-9
5/16-18	12-18
5/16-24	14-20
3/8-16	22-32
3/8-24	27-38
7/16-14	40-55
7/16-20	40-60
1/2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	12-18
3/8	22-33
1/2	25-35

- All values are in ft.-lb. unless otherwise noted
- NOTE: Oil threads with engine oil unless the threads require oil or water resistant sealer.

- ⑦ Pin and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at ends of an 8" bar, 4" on each side of rod centerline.
- ⑧ Measured at the piston pin bore centerline at 90° to the pin.
- ⑨ Add 1/2 quart with filter change.
- ⑩ In Sequence: Step 1 = 29-40; Step 2 = 40-51; Step 3 = 65-80;
- ⑪ In Sequence: Step 1 = 3-6; Step 2 = 6-11; Step 3 = 11-15; Step 4 = 15-18. After engine has been operating, retorque in sequence to 15-18 (hot).
- ⑫ 1/2 turn after gasket contacts sealing surface with oiled gasket.

5.0L/5.8L (302/351 "W" CID) V-8 Engines

PART
21-21

Mustang II, Fairmont, Zephyr, Granada, Monarch, LTD II, Cougar, Thunderbird, Ford, Mercury and Versailles

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Flywheel	21-18		

CA4262-2B

DESCRIPTION

ENGINE

The 5.0L (302 CID) and 5.8L (351 W CID) V-8 engines are shown in Figs. 1 and 2.

EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices

used on these engines are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

Both engines are equipped with a positive closed-type crankcase ventilation system re-cycling the crankcase vapors to the intake manifold.