ENGINE

454 CID (7.4L) / 502 CID (8.2L)
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*Note: 7.4L / 454 and 502 Multi-Port engines, Torque intake manifold fasteners to 25-30 Lb. Ft. (34-41 N·m).*
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### KENT-MOORE SPECIAL TOOLS

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Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

UNIT OF MEASUREMENT
In. (mm)

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<td>4.46 (113.28)</td>
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Note 1: 7.4L / 454 and 502 Magnum Multi-Port engine is equipped with a cast aluminum intake manifold with brass inserts.

Note 2: 7.4L Bravo Three engines with engine code UB with serial number OF1589289 and lower will have forged pistons.
   XX with serial number OF159290 and higher will have cast pistons

Note 3: Serial numbers OD838819 thru OF800699 are equipped with cast aluminum intake manifolds.

CYLINDER BORE

IMPORTANT: 7.4L Bravo Three engines with engine code UB with serial number OF1589289 and lower have forged pistons. The piston specifications for the 454 Magnum must be used.

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<tr>
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<td>Production</td>
<td>.001 (0.025) Max</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.002 (0.05) Max</td>
<td></td>
</tr>
<tr>
<td>Taper</td>
<td>Production</td>
<td>Thrust Side</td>
<td>.0005 (0.0127) Max</td>
</tr>
<tr>
<td></td>
<td>Relief Side</td>
<td>.001 (0.0254) Max</td>
<td></td>
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<tr>
<td></td>
<td>Service</td>
<td>.001 (0.02) Over Production</td>
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PISTON

<table>
<thead>
<tr>
<th>CLEARANCE</th>
<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM / 8.2L</th>
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<tbody>
<tr>
<td>Production</td>
<td>.0030-.0042 (0.0762-0.1066)</td>
<td>.0025-.0037 (0.0635-0.0939)</td>
<td>.0040-.0057 (0.1016-0.1447)</td>
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<tr>
<td>Service</td>
<td>.005 (0.12) Max</td>
<td>.0075 (0.15) Max</td>
<td>.0065 (0.16)</td>
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</table>
## Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

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<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM 8.2L</th>
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<tbody>
<tr>
<td></td>
<td>Top</td>
<td>Top</td>
<td>Top</td>
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<tr>
<td>Groove Side</td>
<td>.0012-.0029 (0.0305-0.0737)</td>
<td>.0017-.0032 (0.044-0.081)</td>
<td>.0017-.0032 (0.044-0.081)</td>
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<tr>
<td>Compression</td>
<td>.0012-.0029 (0.0305-0.0737)</td>
<td>.0017-.0032 (0.044-0.081)</td>
<td>.0017-.0032 (0.044-0.081)</td>
</tr>
<tr>
<td>Service</td>
<td>High Production Limit + .010 (0.02) Max</td>
<td>High Limit Production + .001 (0.25) Max</td>
<td>High Limit Production + .005 (0.12) Max</td>
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<tr>
<td>Oil</td>
<td>Production</td>
<td>.0050-.0065 (0.127-0.165)</td>
<td>High Limit Production + .001 (0.25) Max</td>
</tr>
<tr>
<td>Gap</td>
<td>Production</td>
<td>.0050-.0065 (0.127-0.165)</td>
<td>High Limit Production + .001 (0.25) Max</td>
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<td>Service</td>
<td>High Limit Production + .001 (0.25) Max</td>
<td>High Limit Production + .005 (0.12) Max</td>
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<td>Production</td>
<td>.010-.018 (0.25-0.46)</td>
<td>.011-.021 (0.28-0.53)</td>
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<td>2nd</td>
<td>.016-.024 (0.41-0.61)</td>
<td>.016-.026 (0.41-0.66)</td>
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<td>Service</td>
<td>High Limit Production + .001 (0.25) Max</td>
<td>High Limit Production + .005 (0.12) Max</td>
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<tr>
<td></td>
<td>Production</td>
<td>.016-.024 (0.41-0.61)</td>
<td>.016-.026 (0.41-0.66)</td>
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<tr>
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<td>Service</td>
<td>High Limit Production + .001 (0.25) Max</td>
<td>High Limit Production + .005 (0.12) Max</td>
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### PISTON PIN

<table>
<thead>
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<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM 8.2L</th>
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<tbody>
<tr>
<td>Diameter</td>
<td>.9895-.9897 (25.132-25.1371)</td>
<td>.9895-.9898 (25.134-24.140)</td>
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</tr>
<tr>
<td>Clearance In Pin</td>
<td>Production</td>
<td>.0002-.0007 (0.0050-0.0177)</td>
<td>.00025-.00035 (0.0064-0.0088)</td>
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<td></td>
<td>Service</td>
<td>.001 (0.025) Max</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fit In Rod</td>
<td>.0021-.0031 (0.0533-0.0787)</td>
<td>.0008-.0016 (0.021-0.040)</td>
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</tbody>
</table>

**Unit of Measurement**

- In. (mm)
## Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

### CRANKSHAFT

<table>
<thead>
<tr>
<th></th>
<th>7.4L / 454 MAGNUM</th>
<th>502 MAGNUM / 8.2L</th>
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</thead>
<tbody>
<tr>
<td><strong>Main Journal</strong></td>
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<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>No.1,2,3,4,5</td>
<td>2.7482-2.7489 (69.8042-69.8220)</td>
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<tr>
<td>Taper</td>
<td>Production</td>
<td>.0002 (0.005) Max</td>
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<td>Service</td>
<td>.001 (0.02) Max</td>
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<tr>
<td>Out of Round</td>
<td>Production</td>
<td>.0002 (0.005) Max</td>
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<td></td>
<td>Service</td>
<td>.001 (0.005) Max</td>
</tr>
<tr>
<td><strong>Main Bearing Clearance</strong></td>
<td></td>
<td></td>
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<tr>
<td>Production</td>
<td>No.1,2,3,4</td>
<td>.0007-.0030 (0.043-0.076)</td>
</tr>
<tr>
<td></td>
<td>No.5</td>
<td>.0025-.0038 (0.063-0.096)</td>
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<tr>
<td>Service</td>
<td>No.1</td>
<td>.001-.003 (0.03-0.07)</td>
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<tr>
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<td>No.2,3,4</td>
<td>.001-.003 (0.03-0.07)</td>
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<tr>
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<td>No.5</td>
<td>.0025-.0040 (.0635-.1016)</td>
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<tr>
<td>Crankshaft End Play</td>
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<td>.006-.0010 (0.15-0.2)</td>
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<td><strong>Connecting Rod Journal</strong></td>
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<tr>
<td>Diameter</td>
<td></td>
<td>2.1990-2.1996 (55.8546-55.8698)</td>
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<tr>
<td>Taper</td>
<td>Production</td>
<td>.0005 (0.0127) Max</td>
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<tr>
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<td>Service</td>
<td>.001 (0.0254) Max</td>
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<tr>
<td>Out of Round</td>
<td>Production</td>
<td>.0005 (0.0127) Max</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td><strong>Rod Bearing Clearance</strong></td>
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<td></td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td>.0011-.0029 (0.028-0.074)</td>
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<tr>
<td>Service</td>
<td></td>
<td>.003 (0.076) Max</td>
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<tr>
<td><strong>Rod Side Clearance</strong></td>
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<tr>
<td></td>
<td></td>
<td>.013-.023 (0.35-0.58)</td>
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<tr>
<td><strong>Crankshaft Runout @ No.3 Main Bearing</strong></td>
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<tr>
<td></td>
<td></td>
<td>.0015 (0.038) Max</td>
</tr>
</tbody>
</table>

### Caution
- Wear protective gloves and eyewear when handling engine parts.
- Always use the correct tools and equipment for each task.
- Consult the vehicle owner's manual for further information.

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Index

3A-6 - 454 C.I.D. (7.4L) / 502 C.I.D. (8.2L)
# Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

## Unit of Measurement

<table>
<thead>
<tr>
<th>In. (mm)</th>
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</table>

## VALVE SYSTEM

<table>
<thead>
<tr>
<th>ENGINE MODEL</th>
<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM 8.2L</th>
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</thead>
<tbody>
<tr>
<td>Lifter</td>
<td></td>
<td>Hydraulic</td>
<td></td>
</tr>
<tr>
<td>Rocker Arm Ratio</td>
<td>1.70 to 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face Angle (Intake &amp; Exhaust)</td>
<td>45°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seat Angle (Intake &amp; Exhaust)</td>
<td>46°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seat Runout (Intake &amp; Exhaust)</td>
<td>.002(0.05) Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seat Width</td>
<td>Intake</td>
<td>1/32-1/16 [.03125-.0625] in. (0.79-1.58 mm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>1/16-3/32 [.0625-.09375] in. (1.58-2.38 mm)</td>
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</tr>
<tr>
<td>Stem Clearance Production</td>
<td>Intake</td>
<td>.0010-.0027 (0.025-0.069)</td>
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<tr>
<td></td>
<td>Exhaust</td>
<td>.0012-.0029 (0.0304-0.0736)</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>Intake</td>
<td>.001 (0.02)</td>
<td>.003 (0.07)</td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>.002 (0.05)</td>
<td>.004 (0.10)</td>
</tr>
<tr>
<td>Stem Diameter</td>
<td>Intake</td>
<td>.372 (9.45)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>.372 (9.45)</td>
<td></td>
</tr>
<tr>
<td>Valve Margin (Intake and Exhaust)</td>
<td>.0312 (0.79)</td>
<td></td>
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</tr>
<tr>
<td>Valve Lash (Intake and Exhaust)</td>
<td>Fixed Lash</td>
<td></td>
<td></td>
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</tbody>
</table>
### Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

#### Unit of Measurement
- **In. (mm)**

#### VALVE SPRING

<table>
<thead>
<tr>
<th>ENGINE MODEL</th>
<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM</th>
<th>8.2L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valve Spring (Note 1)</strong> (Note 2)</td>
<td>Free Length</td>
<td>2.12 (53.9)</td>
<td>2.15 (54.6)</td>
<td></td>
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<tr>
<td></td>
<td>Closed at 1.88 in. (47.8 mm)</td>
<td>Does Not Apply</td>
<td>110 Lbs. (489 N)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed at 1.80 in. (45.7 mm)</td>
<td>74-86 Lbs. (329-382 N)</td>
<td>Does Not Apply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open at 1.34 in. (35.1 mm)</td>
<td>Does Not Apply</td>
<td>316 Lbs. (1406 N)</td>
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</tr>
<tr>
<td></td>
<td>Open at 1.40 in. (35.6 mm)</td>
<td>195-215 Lbs. (867-956 N)</td>
<td>Does Not Apply</td>
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</tr>
<tr>
<td><strong>Damper or Damper Shield</strong></td>
<td>Installed Height</td>
<td>1.875 (47.6)</td>
<td>1.88 (47.7)</td>
<td></td>
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<tr>
<td></td>
<td>Free Length</td>
<td>Does Not Apply</td>
<td>1.86 (47.2)</td>
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<tr>
<td></td>
<td>Approximate Number Of Coils</td>
<td>Does Not Apply</td>
<td>4</td>
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<tr>
<td><strong>Damper or Damper Shield</strong></td>
<td>Valve Spring Fit in Damper Shield</td>
<td>.42-.094 (1.07-2.38)</td>
<td>Does Not Apply</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: 454/502/8.2L Models Only-Test spring pressure with inner and outer spring assembled.

Note 2: 7.4L Models Only Test spring pressure with damper shield installed.
## Gen V And Gen VI (Except 7.4L Gen VI) Engine Specifications

### Unit of Measurement

<table>
<thead>
<tr>
<th>In. (mm)</th>
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</table>

### HYDRAULIC FLAT TAPPET CAMSHAFT

<table>
<thead>
<tr>
<th>ENGINE MODEL</th>
<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM</th>
<th>8.2L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobe Lift ± .002 (0.051)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>.271 (6.883)</td>
<td>.300 (7.62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>.282 (7.163)</td>
<td>.300 (7.62)</td>
<td></td>
<td></td>
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<tr>
<td>Duration at .050 In. (1.27mm) Cam Lift</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Exhaust</td>
<td>234°</td>
<td>224°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>238°</td>
<td>224°</td>
<td></td>
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### ROLLER TAPPET CAMSHAFT

<table>
<thead>
<tr>
<th>ENGINE MODEL</th>
<th>7.4L</th>
<th>454 MAGNUM</th>
<th>502 MAGNUM</th>
<th>8.2L</th>
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</thead>
<tbody>
<tr>
<td>Lobe Lift ± .020 (0.051)</td>
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<tr>
<td>Exhaust</td>
<td>.284 (7.214)</td>
<td>.342 (8.687)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>.282 (7.163)</td>
<td>.342 (8.687)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration at .050 In. (1.27mm) Cam Lift</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>209°</td>
<td>227°</td>
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<tr>
<td>Intake</td>
<td>209°</td>
<td>211°</td>
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</tr>
<tr>
<td>Journal Diameter</td>
<td>1.9482-1.9492 (49.485-49.509)</td>
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</tr>
<tr>
<td>Journal Out Of Round</td>
<td></td>
<td>.001 (0.025) Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camshaft Runout</td>
<td></td>
<td>.002 (0.051) Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing Chain Deflection</td>
<td></td>
<td>.375 (9.5) from taut position [total .75 (19)]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FLYWHEEL

| Runout | .008 (0.203) Max |

### CYLINDER HEAD

| Gasket Surface Flatness | .007 (0.178) Overall Maximum |
| | .003 (0.076) within a 6 in. (152 mm) Span |
### 7.4L Gen VI Engine Specifications

<table>
<thead>
<tr>
<th>Unit of Measurement</th>
<th>In. (mm)</th>
</tr>
</thead>
<tbody>
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<td><strong>Displacement</strong></td>
<td>454 CID (7.4L)</td>
</tr>
<tr>
<td><strong>Bore</strong></td>
<td>4.25 (108)</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td>4.00 (101.6)</td>
</tr>
<tr>
<td><strong>Compression Ratio</strong></td>
<td>8.0:1</td>
</tr>
<tr>
<td><strong>Heads</strong></td>
<td>Cast Iron (Oval Port)</td>
</tr>
<tr>
<td><strong>Intake Manifold</strong></td>
<td>Cast Iron</td>
</tr>
<tr>
<td><strong>Block</strong></td>
<td>Cast Iron (4 Bolt Main Bearing Caps)</td>
</tr>
<tr>
<td><strong>Rods</strong></td>
<td>Forged Steel</td>
</tr>
<tr>
<td><strong>Pistons</strong></td>
<td>Cast Aluminum</td>
</tr>
<tr>
<td><strong>Crankshaft</strong></td>
<td>Cast Steel</td>
</tr>
<tr>
<td><strong>Camshaft</strong></td>
<td>Steel</td>
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#### CYLINDER BORE

<table>
<thead>
<tr>
<th></th>
<th>Diameter</th>
<th>4.2500-4.2507 (107.950-107.968)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Out of Round</strong></td>
<td>Production</td>
<td>.001 (0.025) Max</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.002 (0.051) Max</td>
</tr>
<tr>
<td><strong>Taper</strong></td>
<td>Production</td>
<td>.0005 (0.0120) Max</td>
</tr>
<tr>
<td></td>
<td>Relief Side</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Over Production</td>
</tr>
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#### PISTON

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>.0018-.0030 (0.0457-0.0762)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Service</td>
<td>.0018 (0.0457) Max</td>
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</table>
# 7.4L Gen VI Engine Specifications

## PISTON RING

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<th></th>
<th>Groove Side Clearance</th>
<th>Production</th>
<th>2nd</th>
<th>Service</th>
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</thead>
<tbody>
<tr>
<td><strong>Compression</strong></td>
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<tr>
<td><strong>Groove Side Clearance</strong></td>
<td></td>
<td>Production</td>
<td>2nd</td>
<td>High Production Limit + .010 (0.0254) Max</td>
</tr>
<tr>
<td><strong>Gap</strong></td>
<td></td>
<td>Top</td>
<td>.010-.018 (0.254-0.457)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>.016-.024 (0.406-0.6096)</td>
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<tr>
<td><strong>Oil</strong></td>
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<td>Production</td>
<td>.0050-.0065 (0.1270-0.1651)</td>
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<tr>
<td></td>
<td></td>
<td>Service</td>
<td>High Limit Production + .001 (0.254)</td>
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</tr>
<tr>
<td><strong>Gap</strong></td>
<td></td>
<td>Production</td>
<td>.010-.030 (0.254-0.762)</td>
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<tr>
<td></td>
<td></td>
<td>Service</td>
<td>High Limit Production + .001 (0.254)</td>
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## PISTON PIN

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>.9895-.9897 (25.132-25.1371)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diameter</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Clearance In Piston</strong></td>
<td>Production</td>
<td>.0002-.0007 (0.0051-0.0177)</td>
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<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td><strong>Fit In Rod</strong></td>
<td></td>
<td>.0031-.0021 (0.0180-0.0787) Interference</td>
</tr>
</tbody>
</table>
# 7.4L Gen VI Engine Specifications

## CRANKSHAFT

<table>
<thead>
<tr>
<th>Main Journal</th>
<th>Diameter</th>
<th>No. 1, 2, 3, 4, 5</th>
<th>2.7482-2.7489 (69.8040-69.8220)</th>
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</thead>
<tbody>
<tr>
<td>Taper</td>
<td>Production</td>
<td>.0004 (0.0102) Max</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
<td></td>
</tr>
<tr>
<td>Out of Round</td>
<td>Production</td>
<td>.0004 (0.0102) Max</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
<td></td>
</tr>
<tr>
<td>Main Bearing Clearance</td>
<td>Production No. 1</td>
<td>.0017-.0030 (0.043-0.076)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. 1, 2, 3, 4</td>
<td>.0011-.0024 (.0279-.0610)</td>
<td></td>
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<tr>
<td></td>
<td>Production No. 5</td>
<td>.0025-.0038 (0.0635-0.0965)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service No. 1, 2, 3, 4</td>
<td>.0010-.0030 (0.0254-0.0762)</td>
<td></td>
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<tr>
<td></td>
<td>Service No. 5</td>
<td>.0025-.0040 (.0635-.1016)</td>
<td></td>
</tr>
<tr>
<td>Crankshaft End Play</td>
<td></td>
<td>.005-.0011 (0.1270-0.2794)</td>
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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Taper</td>
<td>Production</td>
<td>.0005 (0.0127) Max</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td>Out of Round</td>
<td>Production</td>
<td>.0005 (0.0127) Max</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td>Rod Bearing Clearance</td>
<td>Production</td>
<td>.0011-.0029 (0.0279-0.0736)</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>.001 (0.0254) Max</td>
</tr>
<tr>
<td>Rod Side Clearance</td>
<td></td>
<td>.013-.023 (0.330-0.5842)</td>
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</tbody>
</table>
# 7.4L Gen VI Engine Specifications

<table>
<thead>
<tr>
<th>Unit of Measurement</th>
<th>In. (mm)</th>
</tr>
</thead>
</table>

## VALVE SYSTEM

<table>
<thead>
<tr>
<th>Feature</th>
<th>Lifter</th>
<th>Hydraulic Roller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocker Arm Ratio</td>
<td></td>
<td>1.70 to 1</td>
</tr>
<tr>
<td>Face Angle (Intake &amp; Exhaust)</td>
<td></td>
<td>45°</td>
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<tr>
<td>Seat Angle (Intake &amp; Exhaust)</td>
<td></td>
<td>46°</td>
</tr>
<tr>
<td>Seat Runout (Intake &amp; Exhaust)</td>
<td></td>
<td>.002 (0.05) Max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Intake</th>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seat Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>.0300-.0600 (0.7620-1.5240)</td>
<td>.0600-.0950 (1.5240-2.4130)</td>
</tr>
<tr>
<td>Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake</td>
<td>.0010-.0029 (0.0254-0.0737)</td>
<td>.0012-.0031 (0.0300-0.0787)</td>
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<tr>
<td>Exhaust</td>
<td>.0037 (0.0939)</td>
<td>.0049 (0.1244)</td>
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<table>
<thead>
<tr>
<th>Feature</th>
<th>Intake</th>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Lash (Intake and Exhaust)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Lash</td>
<td></td>
<td></td>
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## VALVE SPRING

<table>
<thead>
<tr>
<th>Feature</th>
<th>Free Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Spring</td>
<td>2.12 (53.9)</td>
</tr>
<tr>
<td>Free Length</td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
</tr>
<tr>
<td>Closed</td>
<td>1.838 in. (46.6850 mm) at 71-79 Lbs. (316-351 N)</td>
</tr>
<tr>
<td>Open</td>
<td>1.3470 in. (34.2130 mm) at 238-262 Lbs. (1059-1165N)</td>
</tr>
<tr>
<td>Installed Height</td>
<td>1.8380 (46.6850) ± .07937 (47.6)</td>
</tr>
</tbody>
</table>
### 7.4L Gen Gen VI Engine Specifications

<table>
<thead>
<tr>
<th>Unit of Measurement</th>
<th>In. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLYWHEEL</strong></td>
<td></td>
</tr>
<tr>
<td>Runout</td>
<td>.008 (0.203) Max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CYLINDER HEAD</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasket Surface Flatness</td>
<td>.004 (0.1016) Overall Maximum .003 (0.076) within a 6 in. (152mm) Span</td>
</tr>
<tr>
<td>Lobe Lift ± .020 (0.051)</td>
<td>Exhaust</td>
</tr>
<tr>
<td>Intake</td>
<td>.282 (7.163)</td>
</tr>
<tr>
<td>Duration at .050 In. (1.27mm) Cam Lift</td>
<td>Exhaust</td>
</tr>
<tr>
<td>Intake</td>
<td>209°</td>
</tr>
<tr>
<td>Journal Diameter</td>
<td>1.9482-1.9492 (49.485-49.509)</td>
</tr>
<tr>
<td>Journal Out Of Round</td>
<td>.001 (0.025) Max</td>
</tr>
<tr>
<td>Camshaft Runout</td>
<td>.002 (0.051) Max</td>
</tr>
<tr>
<td>Timing Chain Deflection</td>
<td>.375 (9.5) from taut position [total .75 (19)]</td>
</tr>
</tbody>
</table>
General

Some of the repairs in this section must be completed with engine removed from boat. Engine removal depends upon type of repair and boat design. Place engine on repair stand for major repairs.

When engine removal is not required, make certain that battery cables are disconnected at the battery prior to performing any on-board repair procedures.

Lubricate all moving parts (during reassembly) with engine oil. Apply Quicksilver Perfect Seal on threads of and under heads of cylinder head bolts, and on threads of all cylinder block external bolts, screws and studs.

Engine Identification

The MerCruiser Model can be determined by looking at the last two letters of the engine code stamped into the cylinder block. This code number is stamped on all MerCruiser power packages and replacement partial engines, but not replacement cylinder block assemblies.

If the engine serial number and/or model decals are missing, the engine code letters may help in determining the engine models. Following is a list of GM engines and their respective code letters.

<table>
<thead>
<tr>
<th>MCM (Stern Drive)</th>
<th>Code</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4L</td>
<td>XY</td>
<td>LH</td>
</tr>
<tr>
<td>7.4L Bravo Three</td>
<td>UW,UB,XX</td>
<td>LH</td>
</tr>
<tr>
<td>7.4LX EFI Bravo</td>
<td>UJ</td>
<td>LH</td>
</tr>
<tr>
<td>7.4LX MPI Bravo</td>
<td>UC</td>
<td>LH</td>
</tr>
<tr>
<td>454 Magnum</td>
<td>XA</td>
<td></td>
</tr>
<tr>
<td>454 Magnum MPI</td>
<td>UA</td>
<td></td>
</tr>
<tr>
<td>502 Magnum</td>
<td>FJ</td>
<td></td>
</tr>
<tr>
<td>502 Magnum MPI</td>
<td>FJ,HJ</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Engines with a 6 or 7 preceding the block code Gen VI engines. Example: 6XW would be a 7.4L Bravo.

Cylinder Head Identification

7.4L
Gen V and VI Cylinder heads are identified by their smaller and rounded intake ports.

454 MAGNUM / 502 MAGNUM / 8.2L
Mark IV cylinder heads are identified by “HI PERF” cast in the head under the rocker cover. Gen V and VI cylinder heads are by their large rectangular intake ports.
Engine Rotation

Engine rotation terminology at times has caused confusion. To clarify, engine rotation is determined by observing flywheel rotation from the rear (transmission or stern drive end) of the engine looking forward (water pump end).

PROPELLER ROTATION IS NOT NECESSARILY THE SAME as engine rotation.

When ordering replacement engines, short blocks or parts for engines, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.

Camshaft and Drive

Flat tappet camshafts made of cast iron and roller lifter camshaft are made of steel. All camshafts are driven at one-half crankshaft speed by a timing chain and sprockets, or by timing gears, and are supported by five main bearings, which are pressed into the block.

A helical gear on the aft end of the camshaft drives the distributor and oil pump.

On engines with cast iron camshaft and flat faced lifters, a taper on the lobes, coupled with a spherical foot on the hydraulic valve lifters, causes the valve lifters to rotate, thus reducing wear.

Cylinder Head

The cylinder heads are made of cast iron and have individual intake and exhaust ports for each cylinder. Stainless steel or graphite composition head gaskets are used to retard corrosion.

Valve Train

The valves and valve springs are of a heavy-duty design to withstand the high engine speeds encountered. Valve tips have been hardened to extend valve life. Exhaust valve rotators are used on some engines (7.4L only) to help extend valve life.

Hydraulic valve lifters ride directly on the camshaft lobes and transmit the thrust of the lobes to the push rods which in turn actuate the valves through the rocker arm.

In addition to transmitting thrust of the cam lobes, the hydraulic lifters also serve to remove any clearance (lash) from the valve train to keep all parts in constant contact.

The valve lifters also are used to lubricate the valve train bearing surfaces.

Crankshaft

The crankshaft is supported in the block by five insert type bearings. Crankshaft end thrust is controlled by flanges on the No. 5 bearing. A torsional damper on the forward end of the crankshaft serves to help dampen any engine torsional vibration.

Piston and Connecting Rods

Piston pins are offset slightly toward the thrust side of the pistons to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins have a floating fit in the piston and a press fit in the connecting rod (to hold them in place).

Connecting rods are made of forged steel and are connected to the crankshaft through insert type bearings.
Intake Manifold

CARBURETED AND THROTTLE BODY INJECTION
The manifold is of the double level design for efficient fuel distribution. The upper level of passages feeds cylinders 2, 3, 5 and 8 while the lower level passages feed cylinders 1, 4, 6 and 7. All passages are of approximately equal length to assure more even fuel-air mixture to the cylinders.

MULTI-PORT INJECTION
The manifold is a cross flow design, with equal length runners. Injectors are positioned directly above the intake ports of each cylinder.

Lubrication System
The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters, and is supplied under controlled volume to the push rods and rocker arms. All other moving parts are lubricated by gravity flow or splash.

A positive displacement gear-type oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor (which is driven by the camshaft). Oil from the bottom of the pump in the rear of the oil pan is drawn into the oil pump through an oil pickup screen and pipe assembly.

If the screen should become clogged, a relief valve in the screen will open and continue to allow oil to be drawn into the system. Once the oil reaches the pump, the pump forces the oil through the lubrication system. A spring-loaded relief valve in the pump limits the maximum pump output pressure.

After leaving the pump, the pressurized oil flows through a full-flow oil filter. On engines with an engine oil cooler, the oil also flows through the cooler before returning to the block. A bypass valve allows oil to bypass the filter and oil cooler should they become restricted.

Some of the oil, after leaving the oil cooler and/or filter, is routed to the No. 5 crankshaft main bearing. The remainder of the oil is routed to the valve lifter oil galleries and No. 1, 2, 3, and 4 crankshaft main bearings by means of individual oil passages which intersect with the annular grooves.

The camshaft bearings have holes which align with the oil passages or annular grooves in the block and allow oil to flow in-between the bearings and the camshaft journals. The oil that is forced out the front end of the No. 1 camshaft bearing drains down onto the camshaft drive and keeps it lubricated.

The oil which reaches the crankshaft main bearings is forced through a hole in the upper half of each bearing and flows in-between the bearings and the crankshaft journals. Some of the oil is then routed to the connecting rod bearings through grooves in the upper half of the crankshaft main bearings and oil passages in the crankshaft. Oil which is forced out the ends of the connecting rod bearings and crankshaft main bearings is splashed onto the camshaft, cylinder walls, pistons and piston pins, keeping them lubricated. Oil which is forced out the front end of the No. 1 crankshaft main bearing also assists in lubricating the camshaft drive. A baffle plate, mounted on the bottom of the main bearings or in the oil pan, prevents oil thrown from the crankshaft and connecting rods from aerating the oil in the oil pan.

Oil which reaches the valve lifter oil galleries is forced into each hydraulic valve lifter through holes in the side of the lifter. From here, the oil is forced through the metering valve in each of the lifters (which controls the volume of oil flow) and then up through the push rods to the rocker arms. A hole in each rocker arm push rod seat allows the oil to pass through the rocker arm and lubricate the valve train bearing surfaces. After lubricating the valve train, oil drains back to the oil pan through oil return holes in the cylinder head and block.

The distributor shaft and gear also is lubricated by the oil flowing through the right valve lifter oil gallery.
Bearing Failures

Scratched By Dirt
a - Scratches
b - Dirt Imbedded In Bearing Material

Radius Ride
a - Worn Area

Tapered Journal
a - Overlay Gone From Entire Surface

Improper Seating
a - Bright Or Polished Sections

Lack Of Oil
a - Overlay Worn Off

Fatigue Failure
a - Craters or Pockets

Index
Piston Failures

Pre-Ignition
Pre-ignition is abnormal fuel ignition, caused by combustion chamber hot spots. Control of the start of ignition is lost, as combustion pressure rises too early, causing power loss and rough running. The upward motion on the piston is opposed by the pressure rise. This can result in extensive damage to the internal parts from the high increase in combustion chamber temperature.

Pre-Ignition Damage

PRE-IGNITION CAUSES
1. Hot spots in the combustion chamber from glowing deposits (due in turn to the use of improper oils and/or fuels).
2. Overheated spark plug electrodes (improper heat range or defective plug).
3. Any other protuberance in the combustion chamber, such as an overhanging piece of gasket, an improperly seated valve or any other inadequately cooled section of material which can serve as a source.

Engine failures, which result from the foregoing conditions, are beyond the control of Mercury Marine; therefore, no warranty will apply to failures which occur under these conditions.

Detonation
Detonation, commonly called “fuel knock,” “spark knock” or “carbon knock,” is abnormal combustion of the fuel which causes the fuel to explode violently. The explosion, in turn, causes overheating or damage to the spark plugs, pistons, valves and, in severe cases, results in pre-ignition.

Use of low octane gasoline is one of the most common causes of detonation. Even with high octane gasoline, detonation could occur if engine maintenance is neglected.

OTHER CAUSES OF DETONATION

IMPORTANT: Use of improper fuels will cause engine damage and poor performance.
1. Over-advanced ignition timing.
2. Lean fuel mixture at or near full throttle (could be caused by carburetor or leaking intake manifold).
3. Cross-firing spark plugs.
4. Excess accumulation of deposits on piston and/or combustion chamber (results in higher compression ratio).
5. Inadequate cooling of engine by deterioration of cooling system.
**NOTE:** Engine failures, which result from the foregoing conditions, are beyond the control of MerCruiser; therefore, no warranty will apply to failures which occur under these conditions.

**Detonation Damage**

- **a** - Spark Occurs
- **b** - Combustion Begins
- **c** - Combustion Continues
- **d** - Detonation Occurs

**Engine Mounts**

**Front Mount - All MCM (Stern Drive) Models**

**Rear Mount/Flywheel Housing - All MCM (Stern Drive) Models**

*Index*

3A-20 - 454 C.I.D. (7.4L) / 502 C.I.D. (8.2L)
Engine Mounts (Continued)

Flywheel Housing - All MIE (Inboard) Models

Rear Mount Assembly - MIE 7.4L/8.2L with Borg-Warner In-Line Transmission

Front Mount Assembly - All MIE Models
a - Rubber Insert Cannot Be Removed
Rocker Arm Cover

Removal

On Engines with Center Exhaust Outlet Exhaust Manifolds: It may be necessary to remove exhaust manifold before removing rocker arm cover. Refer to Section 7B for removal. Also remove any component that will interfere with the removal of the manifold.

1. Disconnect crankcase ventilation hoses.
2. Remove any items that interfere with the removal of rocker arm covers.
3. Remove rocker arm cover.

Installation

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser.
2. Place new rocker arm cover gasket in position in rocker arm cover.
3. Install rocker arm cover. Torque bolts to 70 lb. in. (10 N·m).
4. Reinstall exhaust manifolds, if removed.
5. Reinstall any items which were removed to allow removal of rocker arm covers.
6. Connect crankcase ventilation hoses to rocker arm covers.
7. Start engine and check for oil leaks.

Intake Manifold

NOTICE
For repair procedures on Fuel Injection Engines, refer to Section 5C.

Removal

1. Drain engine cooling system.
2. Disconnect hoses from thermostat housing.
3. Disconnect intake manifold-to-circulating pump by-pass hose from circulating pump.
4. Disconnect electrical leads interfering with removal.
5. Disconnect crankcase ventilation hoses from rocker arm covers.
6. Disconnect throttle cable from carburetor. Remove fuel line and sight tube running between fuel pump and carburetor.
7. Remove distributor cap and mark position of rotor on distributor housing. Also, mark position of distributor housing on intake manifold. Remove distributor.

IMPORTANT: Do not crank engine over after distributor has been removed.
8. Remove other ignition components.
9. Disconnect any other miscellaneous items that will prevent removal of manifold.

IMPORTANT: It may be necessary to pry intake manifold away from cylinder heads and block, in next step. Use extreme care to prevent damage to sealing surfaces.
10. Remove intake manifold bolts, then remove intake manifold and carburetor assembly.

NOTE: If intake manifold requires replacement, transfer all remaining parts to new manifold.

Cleaning and Inspection

1. Clean gasket material from all mating surfaces.

IMPORTANT: When cleaning cylinder head mating surface, do not allow gasket material to enter engine crankcase or intake ports.
2. Inspect manifold for cracks or scratches. Machined surfaces must be clean and free of all marks and deep scratches or leaks may result.
3. Check intake passages for varnish buildup and other foreign material. Clean as necessary.

Installation

IMPORTANT: When installing intake manifold gaskets, in next step, be sure to do the following:

- Be sure to install gasket with marked side up. Both gaskets are identical.
- All MerCruiser V-8 GM engines that have “automatic” carburetor chokes must use an intake gasket that has an opening for the exhaust crossover port in the intake manifold. Without this opening the “automatic” carburetor choke will not operate properly. The choke will remain ON longer causing rough engine operation and wasted fuel.

1. Apply Quicksilver Perfect Seal to intake manifold gaskets around coolant passages (both sides).

2. Using Quicksilver Bellows Adhesive, glue neoprene gaskets to engine block between cylinder heads.
3. Apply a small amount of RTV Sealer on neoprene gasket ends.
4. Set intake manifold gaskets in place, aligning bolt holes.

5. Carefully install manifold assembly. On all engines except 7.4L / 454 / 502 Magnum Multi-Port Injection, torque bolts to 35 lb. ft. (48 N·m) in sequence as shown.

**WARNING**

Be sure to read and follow package label directions when using bellows adhesive.
6. Connect all electrical leads.
7. Connect hoses to thermostat housing.
8. Install fuel line and sight tube to carburetor and fuel pump.
9. Connect crankcase ventilation hoses to rocker arm covers. Reconnect throttle cable to carburetor.
10. Install distributor. Position rotor and housing to align with marks made during removal, then install distributor cap.
11. Install other ignition components and reconnect wires.
12. Connect any other items which were disconnected from manifold during removal.

Rocker Arm / Push Rod

Removal

**NOTE:** When servicing only one cylinder’s rocker arms, bring that cylinder’s piston up to TDC before removing rocker arms. When servicing all rocker arms, bring No. 1 piston up to TDC before removing rocker arms.

1. Remove rocker arm covers as outlined.
2. Remove rocker arm assemblies and push rods.

**IMPORTANT:** Place rocker arm assemblies and push rods in a rack for reassembly in their original locations.

Cleaning and Inspection

1. Clean parts with solvent and dry with compressed air.
2. Inspect all contact surfaces for wear. Replace all damaged parts.

Installation

**IMPORTANT:** When installing rocker arms and rocker arm balls, coat bearing surfaces of rocker arms and rocker arm balls with engine oil.

Valve Adjustment

No adjustment is required. Valve lash is automatically set when rocker arm bolts are torqued to 45 lb. ft. (61 N·m).

Hydraulic Valve Lifters (Flat and Roller Lifter)
Hydraulic valve lifters require little attention. Lifters are extremely simple in design. Normally, readjustments are not necessary and servicing requires only that care and cleanliness be exercised in the handling of parts.

**Locating Noisy Lifters**

Locate a noisy valve lifter by using a piece of garden hose approximately 4 ft. (1.2 m) in length. Place one end of hose near end of each intake and exhaust valve, with other end of hose to the ear. In this manner, sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on face of valve spring retainer. If lifter is not functioning properly, a distinct shock will be felt when valve returns to its seat.

General types of valve lifter noise are as follows:

1. Hard rapping noise - usually caused by plunger becoming tight in bore of lifter body so that return spring cannot push plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit, causing abnormal stickiness.
   b. Galling or “pickup” between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedged between plunger and lifter body.

2. Moderate rapping noise - probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.

3. General noise throughout valve train - this will, in most cases, be a definite indication of insufficient oil supply or improper adjustment.

4. Intermittent clicking - probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, ball itself may be out of round or have a flat spot.
   c. Improper adjustment.

In most cases, where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in solvent, reassembled and reinstalled in engine. If dirt, corrosion, carbon, etc., is shown to exist in one unit, it more likely exists in all the units; thus it would only be a matter of time before all lifters caused trouble.

**Removal**

**IMPORTANT:** Keep push rod and hydraulic valve lifter from each valve together as a matched set and mark them so they can be reinstalled in the same location later.

Remove as outlined:

1. Remove rocker arm covers.
2. Remove intake manifold.
3. Remove rocker arm assemblies and push rods.
4. Remove valve lifters.

**NOTE:** Gen VI engines with roller lifters have additional valve train components shown below.

![Diagram of Gen VI engine valve train components](72329)

- a - Lifter Restrictor Retainer
- b - Fasteners

![Diagram of roller lifter components](72340)

- a - Roller Lifter Restrictor
- b - Roller Lifter

5. Remove lifter restrictors on roller lifters models.
6. Remove valve lifters.
Installation

IMPORTANT: It is recommended that the engine oil be changed and a new oil filter be installed whenever servicing valve lifters or camshaft.

IMPORTANT: Before installing lifters, coat the bottom of the lifter with engine oil. If new lifters or a new camshaft have been installed, an additive containing EP lube (such as General Motors Cam and Lifter Pre-lube or equivalent) should be poured over camshaft lobes before installing lifters.

IMPORTANT: Before installation, coat entire valve lifter with engine oil.

IMPORTANT: DO NOT install used valve lifters if a new camshaft has been installed.
1. Install hydraulic valve lifters and components.
2. Install intake manifold.
3. Install push rods and rocker arms. Torque rocker arm bolts to specification.
4. Install rocker arm cover.
5. Start engine and check for leaks.

Valve Stem Oil Seal/Valve Spring

Removal - Head Installed
1. Remove:
   a. Rocker arm cover.
   b. Spark plug of affected cylinder.
   c. Rocker arm assembly.
2. Install air line adaptor tool (J-23590) in spark plug hole and apply compressed air to hold valves in place.

NOTE: If compressed air is not available, piston may be brought up to TDC and used to keep valves from falling out of valve guides.

IMPORTANT: Do not turn crankshaft while valve springs, retainers, and locks are removed or valves will fall into cylinder.

3. Using valve spring compressor as shown, compress valve spring and remove valve locks.


IMPORTANT: Keep air pressure in cylinder while springs, caps, and valve locks are removed or valves will fall into cylinder.
5. Remove oil shields from valve stems.
Valve Assembly (Exploded View)

7.4L Only
1 - Valve Lock
2 - Retainer
3 - Oil Shield Seal
4 - Oil Shield
5 - Outer Spring
6 - Damper Shield
7 - Rotator
8 - Intake Valve
9 - Exhaust Valve

454 Magnum / 502 Magnum / 8.2L
1 - Valve Lock
2 - Retainer
3 - Oil Shield
4 - Inner Spring
5 - Outer Spring
6 - Shim
7 - Intake Valve
8 - Exhaust Valve
Installation - Head Installed

7.4L

1. Place rotator or shim on valve spring seat.
2. Coat valve stem and new seal with engine oil. Install seal over valve stem.
3. If taken apart, reassemble damper and valve spring. Place on top of rotator or shim.
4. Set valve spring assembly and cap in position over valve stem.
5. Compress spring, using valve spring compressor, and install valve locks (grease may be used to hold valve locks in place). Slowly release tool, making sure valve locks seat properly in valve stem grooves.

454 MAGNUM / 502 MAGNUM / 8.2L

1. Place shim on valve spring seat.
2. If taken apart, reassemble damper and valve spring as shown. Make sure tighter wound coils of spring and damper are on the same end.

3. Place valve spring assembly in position with tighter wound coils against spring seat.

IMPORTANT: Valve seal and cap must be assembled as shown before installation.

5. Set cap and seal assembly on valve stem. Align valve stem with center of valve seal.
6. Compress valve spring, using valve spring compressor, and install valve locks (grease may be used to hold valve locks in place). Slowly release tool to prevent damaging seal. Make sure valve locks seat properly in valve stem grooves.
7. Install push rods and rocker arm assemblies. Torque to specifications.
8. Install rocker arm cover [torque to 90 in. ft. (10 N·m)] and spark plug [torque to 22 lb. ft. (30 N·m)].

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3A-28 - 454 C.I.D. (7.4L) / 502 C.I.D. (8.2L)  
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Cylinder Head

Removal
1. Drain engine cooling system.
2. Remove as outlined:
   a. Exhaust manifolds.
   b. Intake manifold.
   c. Rocker arm covers.
   d. Rocker arm assemblies and push rods (keep in order for reassembly in their original locations).
   e. Any components attached to front or rear of cylinder head.
   f. Spark plugs.
   g. Head bolts.

**CAUTION**
The head gasket may be holding cylinder head to block. Use care when prying off cylinder heads. DO NOT damage gasket surfaces. DO NOT drop cylinder heads.

3. Place cylinder head on wooden blocks to prevent damage to gasket surfaces.

Cleaning and Inspection
1. Clean gasket material and sealer from engine block and cylinder heads.
2. Inspect sealing surfaces for deep nicks and scratches.
3. Inspect for corrosion around cooling passages.
4. Clean head bolt threads and engine block bolt hole threads, making sure no dirt, old oil or coolant remain.

Installation

**CAUTION**
DO NOT use sealer on head gaskets.

1. Place head gasket in position over dowel pins.
2. Carefully set cylinder head in place over dowel pins.
3. Coat threads of head bolts with Quicksilver Perfect Seal and install finger-tight.
4. To insure gasket sealing, torque head bolts in three steps, following torque sequence for each step. Start first step at 20 lb. ft. (27 N·m), second step at 50 lb. ft. (68 N·m), and finish with a final torque of
   - 7.4L 85 lb. ft. (115 N·m)
   - 454/502 Magnum 92 lb. ft. (124 N·m)

   ![Cylinder Head Torque Sequence Diagram](72944)

5. Install push rods and rocker arm assemblies in their original positions. Coat threads on rocker arm bolt with Perfect Seal. Torque
   - 7.4L 40 lb. ft. (54 N·m)
   - 454/502 Magnum 45 lb. ft. (61 N·m)

6. Install as outlined:
   a. Intake manifold.
   b. Rocker arm covers.
   c. Exhaust manifolds.
   d. Spark plugs.
   e. Any components removed from front or rear of cylinder heads.
7. Follow procedures in Section 6A or 6B of this manual:

**Seawater Cooled Models:** Provide for adequate water supply to seawater pickup (see Section 6A).

**Closed Cooled Models:** Refill closed cooling section (see Section 6B), and provide adequate water supply to seawater pickup.

**CAUTION**

Ensure that cooling water supply is available before starting the engine.


**Cylinder Head and Valve Conditioning**

**Disassembly**


2. Remove all valve components.

3. Remove valves from cylinder head and place in a rack, in order, for reassembly in their original locations.

**Cleaning**

1. Clean push rods and rocker arm assemblies.

2. Clean carbon from valves using a wire wheel.

3. Clean gasket material from cylinder head mating surfaces.

4. Clean all carbon from combustion chambers and valve ports using carbon remover brush.

5. Thoroughly clean valve guides with valve guide cleaner.
**Inspection**

1. Inspect cylinder heads for cracks in exhaust ports, water jackets, and combustion chambers (especially around spark plug holes and valve seats). Replace heads if any cracks are found.

2. Inspect cylinder head gasket surface for burrs, nicks, or erosion or other damage. Also, check flatness of cylinder head gasket surface, using a machinist’s straight edge and feeler gauges as shown. Refer to “Specifications.”

**IMPORTANT:** Cylinder head-to-block gasket surface should be resurfaced if warped more than specified. When head resurfacing is required, cylinder head-to-intake manifold gasket surface on head must be milled to provide proper alignment between intake manifold and head.

3. Inspect valves for burned heads, cracked faces or damaged stems.

4. Inspect rocker arm bolts and push rod guides for wear and damage.

**IMPORTANT:** Excessive valve stem to bore clearance will cause excessive oil consumption and possible valve breakage. Insufficient clearance will result in noisy and sticky valves.

5. Measure valve stem clearance as follows:
   a. Attach a dial indicator to cylinder head, positioning it against the valve stem and close to the valve guide.

b. Holding valve head off seat about 1/16 in. (2 mm), move valve stem back and forth in direction shown. Compare stem clearance with specifications.

c. If clearance exceeds specifications, it will be necessary to ream valve guides for oversized valves, as outlined under “Valve Guide Bore Repair.”

**Valve Guide Bore Repair**

**IMPORTANT:** Be sure to measure valve stem diameter of both the intake and exhaust valve, as valve stem diameter may or may not be the same for both valves.

If .015 in. oversize valves are required, ream valve guide bores for oversize valves, as follows:
1. Measure valve stem diameter of old valve being replaced and select proper size valve guide reamer from chart below.

<table>
<thead>
<tr>
<th>Standard Valve Stem Diameter</th>
<th>Reamer Required For .015 In. Oversize Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>.372 In.</td>
<td>J-7049</td>
</tr>
</tbody>
</table>

2. Ream valve guide bores, as shown.

3. Remove the sharp corner created by reamer at top of valve guide.

Valve Springs - Checking Tension

**NOTE:** On 7.4L models, spring tension must be tested with damper removed. All other models require testing with dampers installed. Refer to “Specifications.”

**IMPORTANT:** Springs should be replaced if not within 10 lb. (44 N) of specified tension.

Valve Seat Repair

Valve seat reconditioning is very important, since seating of valves must be perfect for engine to deliver maximum power and performance.

Another important factor is valve head cooling. Good contact between each valve and its seat in head is important to ensure that heat in valve head will be properly dispersed.

Several different types of equipment are available for reseating valve seats. Equipment manufacturer’s recommendations should be followed carefully to attain proper results.

Typical “3 Angle” Valve Seat

- Top Angle (30°)
- Seat Angle (46°)
- Bottom Angle (60°)
- Seat Width
  - Intake - .060-.090 in (1.52-2.29 mm)
  - Exhaust - .060-.090 in (1.52-2.29 mm)

Regardless of type of equipment, however, it is essential that valve guide bores be free from carbon or dirt to achieve proper centering of pilot in valve guide, ensuring concentricity.

Measuring Valve Seat Concentricity

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Valve Grinding

Valves that are pitted must be refaced to the proper angle. Valve stems which show excessive wear, or valves that are warped excessively, must be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head, due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning, or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32 in. (0.8 mm) after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Reassembly

1. Lubricate valve guides and valve stems with engine oil.
2. Install each valve in the port from which it was removed or to which it was fitted.
3. Install valve rotators, shims, springs, seals, and caps as shown under “Valve Assembly (Exploded View)” for each particular engine.
4. Using valve spring compressor, compress valve spring and install valve locks (grease may be used to hold locks in place).

Exhaust

a - 372 In. (9.45 mm)
b - 1/32 [.031] In. (0.79 mm) Min.

Intake

a - 372 In. (9.45 mm)
b - 1/32 [.031] In. (0.79 mm) Min.
5. Slowly release tool, making sure valve locks seat properly in grooves of valve stem.

### 7.4L
1. Valve Lock
2. Retainer
3. Oil Shield
4. Oil Shield Seal
5. Outer Spring
6. Damper Shield
7. Rotator
8. Intake Valve
9. Exhaust Valve

### 454 Magnum / 502 Magnum / 8.2L
a. Valve Lock
b. Retainer
c. Oil Shield
d. Inner Spring
e. Outer Spring
f. Shim
g. Intake Valve
h. Exhaust Valve
6. Check installed height of valve springs using a narrow, thin scale cutaway as shown. Measure from spring seat to top of valve spring, as shown. If measurement exceeds specified height, install a valve spring shim and recheck. DO NOT shim valve springs to give an installed height less than the minimum specified.

Cutaway Scale
a - Cut Away This Portion (1/2 Inch)
b - Valve Spring Installed Height
Dipstick Specifications

All Engines

UNIT OF MEASUREMENT
In. (mm)

a - MCM Engines (805567)
b - MIE Velvet Drive In Line Transmissions (821503-3)
c - MIE All Transmissions Except Velvet Drive (821503-4)
# Oil Pan

## Removal

1. Drain crankcase oil.
2. Remove dipstick and tube, or tubes, if equipped with two. Note shape of port and starboard tubes as shown following to aid in reassembly. On High Output (H.O.) Engine only, disconnect outlet hose of seawater pump.

**IMPORTANT:** On Generation V engines DO NOT move or disturb the orientation of fitting on bottom of pan or incorrect oil level readings may be obtained.

## Installation

1. Clean sealing surfaces of engine block and oil pan.
2. Apply a small amount of Quicksilver RTV Sealer to joints of rear seal retainer and joints of front cover.

**IMPORTANT:** Quicksilver RTV Sealer sets up in about 15 minutes. Be sure to complete assembly promptly.

3. Install oil pan gasket in position as shown.

**NOTE:** A one-piece oil pan gasket may be re-used if it is still pliable and is not cracked, torn or otherwise damaged.

4. Install oil pan. Starting from the center and working outward in each direction, tighten 5/16-18 threaded fasteners to 165 lb. in. (19 N·m).

5. Install dipstick tube(s) and dipstick(s). Be certain, if equipped with two tubes, that they are fitted where they were removed, and positioned as shown following.

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**Generation V MIE Engine Oil Pan**

- a - Factory Positioned Fitting For Tubes (Do Not Move)
- b - Port Tube
- c - Starboard Tube

3. Remove oil pan.

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IMPORTANT: DO NOT move or disturb the orientation of fitting on bottom of pan or incorrect oil level readings may be obtained.

Generation V MIE Engine Oil Pan
a - Factory Positioned Fitting For Tubes (Do Not Move)
b - Port Tube
c - Starboard Tube

6. Fill crankcase with required quantity of oil of specified viscosity. See Section 1B - “Maintenance.”

The oil pump consists of two gears and a pressure regulator valve enclosed in a two-piece housing. Oil pump is driven by distributor shaft which is driven by a helical gear on camshaft.

Removal
1. Remove oil pan as outlined.
2. Remove gasket carefully as the one-piece gasket for the oil pan may be reused if still pliable and not cracked, torn, etc.
3. Remove baffle.

Disassembly
1. Remove pump cover.
   IMPORTANT: Mark gear teeth for reassembly with same teeth indexing.
2. Remove idler gear and drive gear from pump body.
3. Remove retaining pin, spring, and pressure regulator valve from pump cover.

Oil Pump Assembly
1 - Extension Shaft
2 - Shaft Coupling
3 - Pump Body
4 - Drive Gear and Shaft
5 - Idler Gear
6 - Pickup Screen and Pipe
7 - Pump Cover
8 - Pressure Regulator Valve
9 - Pressure Regulator Spring
10 - Retaining Pin
11 - Screws
Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage and excessive wear.
4. Check for loose drive gear shaft in pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past ends of gears.
6. Inspect pickup screen and pipe assembly for damage to screen and pipe.
7. Check pressure regulator valve for fit.

IMPORTANT: Oil pump is not serviceable. If any parts are worn or damaged, replacement of entire pump assembly and pickup tube is necessary.

Reassembly

IMPORTANT: Oil internal parts liberally before installation.
1. Install pressure regulator valve and related parts.
2. Install drive gear in pump body.
3. Install idler gear in pump body with smooth side of gear toward pump cover opening. Align marks made in disassembly.
4. Fill gear cavity with engine oil.
5. Install pump cover and torque attaching screws to 80 lb. in. (9 N·m).
6. Turn extension shaft by hand to check for smooth operation.

Installation

1. Install pump, with extension shaft, to rear main bearing, aligning extension shaft with distributor drive shaft.
2. Install baffle. Tighten baffle nuts to 25 lb. ft. (34 N·m). Tighten oil pump bolt to 70 lb. ft. (95 N·m).

Torsional Damper

Removal
1. Remove drive belts.
2. Remove drive pulley and water pump pulley, then remove torsional damper retaining bolt.
IMPORTANT: Do not use a universal claw type puller to remove torsional damper (in next step) as outside ring of torsional damper is bonded in rubber to the hub and use of claw type puller may break the bond.

3. Remove torsional damper with Torsional Damper Remover and Installer.

Installation

IMPORTANT: The inertia weight section of torsional damper is assembled to the hub with a rubber type material. The installation procedure (with proper tool) must be followed or movement of the inertia weight on the hub will destroy the tuning of the torsional damper.

1. Replace key in crankshaft if it is damaged.
2. Coat seal surface of torsional damper with engine oil.
3. Install torsional damper on crankshaft, using Torsional Damper Remover and Installer as follows:
   a. Install appropriate end of threaded rod into crankshaft.

   IMPORTANT: Be sure to install threaded rod in crankshaft at least 1/2 in. (13 mm) to prevent damage to threads.

   b. Install plate, thrust bearing, washer and nut on rod.
   c. Install torsional damper on crankshaft by turning nut until it bottoms out.
   d. Remove tool from crankshaft.
   e. To prevent oil leakage, apply Quicksilver RTV sealant to keyway.
   f. Install torsional damper bolt. Torque to 90 lb. ft. (122 N·m).

4. Install drive pulley and water pump pulley. Torque bolts to 35 lb. ft. (48 N·m).
5. Install and adjust drive belts.
Crankcase Front Cover/ Oil Seal

Oil Seal Replacement
(Without Removing Front Cover)

REMOVAL
1. Remove torsional damper.
2. Pry seal out of cover from the front with a large screwdriver, being careful not to distort front cover or damage crankshaft.

INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.

1. Apply Quicksilver Perfect Seal to seal retainer mating surface and apply grease to seal lips.
2. Install new seal with open end of seal inward (lip of seal toward inside of engine), using crankcase front cover seal installer. Drive seal in until it just bottoms out. Do not use excessive force.
3. Reinstall torsional damper as outlined.

Crankcase Front Cover

Removal
1. Remove engine from boat.
2. Remove torsional damper and oil pan.
3. Remove water circulating pump.
4. Remove crankcase front cover.
5. If damaged, drive oil seal out of front cover (from the rear) using a punch.

Cleaning and Inspection

IMPORTANT: The Gen VI front cover is cast aluminum that has a molded o-ring style gasket. This gasket is retained in a cast groove. It must be replaced if damaged.

1. Clean front cover in solvent and dry with compressed air.
2. Clean old gasket material and sealer from mating surfaces on cover and cylinder block.
3. Check gasket surface on front cover for distortion, and true if necessary. Surfaces must be clean and flat or oil leakage may result.

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**Installation**

1. Install oil seal in cover with lip of seal toward inside of engine, using crankcase front cover seal installer. Support cover around seal area with appropriate tool as shown.

2. Coat both sides of front cover gasket with Quicksilver Perfect Seal and place in position on engine.

3. Install front cover, making sure holes in cover align with dowel pins in block. Torque front cover attaching bolts to 120 lb. in. (14 N·m).

4. Install oil pan and torsional damper as outlined.

5. Install water circulating pump.

6. Reinstall engine in boat.

7. Fill crankcase with engine oil.

8. Follow procedures in Section 6A or 6B of this manual:
   - **Seawater Cooled Models**: Provide for adequate water supply to seawater pickup (see Section 6A).
   - **Closed Cooled Models**: Refill closed cooling section (see Section 6B), and provide adequate water supply to seawater pickup.

   `CAUTION`

   Ensure that cooling water supply is available before starting the engine.

9. Start engine and check for water and oil leaks.

**Flywheel**

**Removal**

1. Remove engine from boat.

2. Remove transmission, if so equipped.

3. Refer to “Flywheel Housing” description in this section and remove flywheel housing and related parts.

4. Remove MCM coupler or MIE drive plate.

5. Remove flywheel.
Drive Shaft Extension Coupler

Inspection
1. Inspect splines in drive plate or coupler for wear.
2. Check flywheel ring gear for worn and missing teeth.

Installation

**NOTE:**If crankshaft is to be replaced, but old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

1. Clean mating surfaces of flywheel and crankshaft. Remove any burrs. Mating surfaces must be clean bare metal.
2. Aligning dowel hole in flywheel with dowel in crankshaft, install flywheel. Torque bolts to 70 lb. ft. (95 N·m).
3. Check flywheel runout as follows:
   a. Attach a dial indicator to engine block.
   b. Take readings around outer edge of flywheel. Push in on flywheel to remove crankshaft end play.
   c. Maximum runout - .008 in. (0.203 mm).

4. Install drive coupler or drive plate. Torque bolts to 35 lb. ft. (48 N·m).
5. Install flywheel housing and related parts. Torque bolts to 30 lb. ft. (41 N·m).
6. Install flywheel housing cover. Torque bolts to 80 lb. in. (9 N·m).
7. Install transmission (MIE). Torque bolts to 50 lb. ft. (68 N·m).
8. Refer to Section 2 “Removal and Installation” and install engine.
Rear Main Oil Seal
The rear crankshaft oil seal can be replaced without removing the oil pan or rear main bearing cap from engine.

Removal
Remove seal by using a screwdriver to pry it out of engine block as shown.

Cleaning and Inspection
Clean crankshaft/seal running surface and seal retainer.

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.
Installation

1. Apply Quicksilver Perfect Seal to engine block/seal mating surface. Apply grease to seal lips.
2. Install seal using rear main seal installer or suitable device.

Main Bearings

IMPORTANT: Before removing main bearing caps or connecting rod caps, mark them for reassembly in their original locations.

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001 in., .002, .010 in. and .020 in. undersize.

Inspection

In general, the lower half of the bearing (except No. 1 bearing) shows a greater wear and the most distress from fatigue. If, upon inspection, the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearances

To obtain accurate measurements while using Plastigage, or its equivalent, engine must be out of the boat and upside down so crankshaft will rest on the upper bearings and total clearance can be measured between lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

IMPORTANT: Inspect bearing caps for orientation marks prior to removal. If no markings exist, make suitable marks before disassembly so that they can be reinstalled in their original locations.

1. With the oil pan and oil pump removed, make suitable marks, if required, on bearing cap(s) to be inspected. Remove bearing cap(s) as needed. Wipe oil from journal and bearing cap to be inspected.
2. Place a piece of gauging plastic the full width of the bearing (parallel to the crankshaft) on the journal as shown.

IMPORTANT: Do not rotate the crankshaft while the gauging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gauge.
4. Remove bearing cap. The flattened gauging plastic will be found adhering to either the bearing cap or journal.

5. On the edge of the gauging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gauging plastic, measure its compressed width (at the widest point) with the graduations on the gauging plastic envelope as shown.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.

7. A standard, or .001 in., undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag. When checking No. 1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gauge.

9. Measure crankshaft end play (see “Specifications”) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gauge as shown.

NOTE: Normally main bearing journals wear evenly and are not out of round. However, if a bearing is being fitted to an out-of-round journal (.001 in. max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter, and the journal is out of round .001 in., interference between the bearing and journal will result in rapid bearing failure. If the flattened gauging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gauging plastic indicates more than .001 in. difference.

Replacement

NOTE: Main bearings may be replaced with or without removing crankshaft.

Main Bearing Inserts
a - Lower Bearing Insert (Install In Cap)
b - Upper Bearing Insert (Install In Block)
c - Oil Groove
WITH CRANKSHAFT REMOVED
1. Remove and inspect the crankshaft as outlined.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

WITHOUT CRANKSHAFT REMOVED

IMPORTANT: Inspect bearing caps for orientation marks prior to removal. If no markings exist, make suitable marks before disassembly so that they can be reinstalled in their original locations.

1. With oil pan, oil pump and spark plugs removed, make suitable marks on cap and remove cap on main bearing requiring replacement. Remove bearing from cap.
2. Install main bearing remover/installer in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent, as shown, to do the job.

3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (no notched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with marks made on disassembly (or arrows, if present) pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE REAR MAIN CAP, to 110 lb. ft. (149 N-m). Torque rear main bearing cap to 10-12 lb. ft. (14-16 N-m); then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Torque rear main bearing cap to 110 lb. ft. (149 N-m).

Connecting Rod Bearings

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and .001 in. and .002 in. undersize for use with new and used standard size crankshafts, and in .010 in. and .020 in. undersize for use with reconditioned crankshafts.

Inspection and Replacement

IMPORTANT: Before you remove the connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.

1. With oil pan and oil pump removed, mark the side of the rod and cap with the cylinder number and remove the connecting rod cap and bearing.
2. Inspect the bearing for evidence of wear and damage. Do not reinstall a worn or damaged bearing.
3. Wipe both upper and lower bearing shells and crank pin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.

5. If within specifications, measure new or used bearing clearances with gauging plastic or its equivalent. If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter, and the crankpin is out of round .001 in., interference between the bearing and crankpin will result in rapid bearing failure.

   a. Place a piece of gauging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface as shown. Position the gauging plastic in the middle of the bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere.)

   b. Install the bearing in the connecting rod and cap.

   c. Install the bearing cap and evenly torque nuts. Refer to “Specifications”.

   d. Remove the bearing cap and using the scale on the gauging plastic envelope, measure the gauging plastic width at the widest point as shown.

6. If the clearance exceeds specifications, select a new, correct size bearing and measure the clearance.

   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.

7. Coat the bearing surface with oil, install the rod cap and torque nuts

   3/8 in. nuts 50 lb. ft. (68 N·m)
   7/16 in. nuts 73 lb. ft. (99 N·m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances (see “Specifications”) between connecting rod caps as shown.

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**Connecting Rod/Piston Assembly**

**Removal**

1. Remove as outlined:
   a. Oil pan and dipstick tube.
   b. Baffle and oil pump.
   c. Distributor and intake manifold.
   d. Cylinder heads.

2. Use a ridge reamer to remove any ridge and/or deposits from upper end of cylinder bore.

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**IMPORTANT:** Before ridge and/or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke, then remove cloth and cuttings.

3. Mark connecting rods and bearing caps (left bank 1, 3, 5 and 7; right bank 2, 4, 6 and 8 from front to rear on same side as piston thrust).

4. Remove connecting rod cap and install connecting rod bolt guide (3/8-24 or 7/16-20) on bolts. Push connecting rod and piston assembly out of top of cylinder block.

**NOTE:** It will be necessary to turn crankshaft slightly to disconnect and remove some connecting rod and piston assemblies.
Disassembly

Disassemble piston from connecting rod using piston pin remover as shown. Follow instructions supplied with kit.

Cleaning and Inspection

CONNECTING RODS

1. Wash connecting rods in cleaning solvent and dry with compressed air.
2. Check for twisted and bent rods and inspect for nicks and cracks. Replace damaged connecting rods.

PISTONS

NOTE: Cylinder bore and taper must be within specifications before pistons can be considered for re-use.

1. Clean varnish from piston skirts with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF PISTON. Clean ring grooves with a groove cleaner and make sure oil ring holes are clean.
2. Inspect piston for cracked ring lands, skirts and pin bosses, wavy worn ring lands, scuffed or damaged skirts, and eroded areas at top of piston. Replace pistons which are damaged or show signs of excessive wear.
3. Inspect grooves for nicks and burrs that might cause rings to hang up.
4. Measure piston skirt and check clearance as outlined under “Piston Selection.”

5. Slip outer surface of a new top and second compression ring into respective piston ring groove and roll ring entirely around the groove to make sure that ring is free as shown. If binding occurs at any point, determine cause. If caused by ring groove, remove by dressing with a fine cut file. If binding is caused by a distorted ring, recheck with another ring.

6. Proper clearance of piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, clearances between ring and groove surfaces should be measured. See “Specifications.”
PISTON PINS

1. Piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, piston and piston pin are a matched set and not serviced separately.

2. Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish and scuffing when measured. Measure piston pin with a micrometer and piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of the .001 in. (0.025 mm) wear limit, replace piston and piston pin assembly.

Reassembly

IMPORTANT: When reassembling pistons and connecting rods, the following must be kept in mind.

- Piston and pin are machine fitted to each other and must remain together as a matched set. Do not intermix pistons and pins.
- If original pistons and/or connecting rods are being used, be sure to assemble pistons and connecting rods so they can be reinstalled in same cylinder from which they were removed.
- Connecting rod bearing tangs are always toward outside of cylinder block.

• Notch or valve relief in piston must be positioned correctly for engine that is being repaired.
1. Assemble piston to connecting rod using piston pin remover as shown. Follow instructions supplied with kit.

2. Once assembled, check piston for freedom of movement (back-and-forth and up-and-down) on connecting rod. Piston should move freely in all directions. If it does not, piston pin bore is tight and piston/pin assembly must be replaced.

3. If a new connecting rod has been installed, mark connecting rod and cap (on side of rod and cap with slots for connecting rod bearing tangs) with cylinder number in which it will be installed.

PISTON RINGS

All compression rings are marked on upper side of ring. When installing compression rings, make sure that marked side is toward top of piston.

Oil control rings are a three-piece type, consisting of two rings and a spacer.

1. Select rings comparable in size to cylinder bore and piston size.

2. Slip compression ring in cylinder bore, then press ring down into cylinder bore about 1/4 in. (6 mm) (below ring travel). Be sure that ring is square with cylinder wall.

3. Measure gap between ends of ring with a feeler gauge as shown.

4. If gap between ends of ring is below specifications, remove ring and try another for fit.

5. Fit each compression ring to cylinder in which it is going to be used.

6. Clean and inspect pistons, if not previously done.

7. Install piston rings as follows:
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, removed by dressing groove with a fine cut file. If binding is caused by a distorted ring, use a new ring.

   IMPORTANT: Use piston ring expander (91-24697) for compression ring installation.
   e. Install lower compression ring with marked side up, using ring expander.
   f. Install top compression ring with marked side up, using ring expander.
Installation

IMPORTANT: Cylinder bores must be clean before piston installation. Clean with a light honing, as necessary. Then clean with hot water and detergent wash. After cleaning, swab bores several times with light engine oil and clean cloth, then wipe with a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.

IMPORTANT: Be sure ring gaps are properly positioned as shown.

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tangs toward outside of cylinder block. Use piston ring compressor to compress rings. Guide connecting rod into place on crankshaft journal with connecting rod bolt guide. Use a hammer handle with light blows to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

5. Remove connecting rod bolt guide.
6. Install bearing caps and evenly torque nuts. Refer to “Specifications”.
7. Check connecting rod side clearance as previously described.

NOTE: If bearing replacement is required, refer to “Connecting Rod Bearings.”

8. Install as previously outlined:
   a. Oil pump and baffle.
   b. Dipstick and oil pan.
   c. Cylinder heads.
   d. Intake manifold.
   e. Distributor.
9. Fill crankcase with oil. Refer to Section 1 - “Maintenance.”
Crankshaft

Removal
1. Remove engine from boat.
2. Drain crankcase oil.
3. Remove as outlined:
   a. Starter.
   b. Flywheel housing.
   c. Drive coupler/plate and flywheel.
   d. Belts.
   e. Water pump.
   f. Crankshaft pulley and torsional damper.
   g. Spark plugs.
   h. Oil pan and dipstick tube.
   i. Baffle and oil pump.
   j. Timing chain/gear cover.
4. Turn crankshaft to align timing mark with camshaft mark.
5. Remove camshaft sprocket or gear.
6. Remove rear main seal.

IMPORTANT: Inspect bearing caps for orientation marks prior to removal. If no markings exist, make suitable marks before disassembly so that they can be reinstalled in their original locations.
7. Make sure all bearing caps (main and connecting rods) are marked so they can be reinstalled in their original locations.
8. Remove connecting rod bearing caps, then push piston and rod assemblies toward heads.
9. Remove main bearing caps and carefully lift crankshaft out of cylinder block.
10. If new main and/or connecting rod bearings are to be installed, remove main bearing inserts from cylinder block and bearing caps, and/or connecting rod bearing inserts from connecting rod and caps. Install new bearings following procedures outlined.

Cleaning and Inspection
1. Wash crankshaft in solvent and dry with compressed air.
2. Measure main bearing journals and crankpin dimensions with a micrometer for out-of-round, taper or undersize (see “Specifications”).
3. Check crankshaft for runout (by supporting at front and rear main bearings journals in V-blocks) and check at front and rear intermediate journals with a dial indicator (see “Specifications”).
4. Replace or recondition crankshaft if not within specifications.

Installation
1. If a new crankshaft is being installed, proceed as follows:
   a. Remove timing sprocket or gear from old crankshaft and reinstall on new crankshaft as outlined.
   b. On models with drive shaft extension, if old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

IMPORTANT: Be sure that all bearings and crankshaft journals are clean.
2. Install main bearings in engine block as follows.

Main Bearing Inserts
a - Lower Bearing Insert (Install In Cap)
b - Upper Bearing Insert (Install In Block)
c - Oil Groove
3. Carefully lower crankshaft into place. Be careful not to damage bearing surface.

4. Check clearance of each main bearing, following procedure outlined under “Main Bearings.” If bearing clearances are satisfactory, apply engine oil to journals and bearings.

5. Install main bearing caps. Torque bolts to 110 lb. ft. (149 N·m). When tightening rear main bearing cap, follow procedure outlined under “Main Bearings.”

6. Check crankshaft end play as outlined.

7. Check clearance for each connecting rod bearing, following procedure under “Connecting Rod Bearings.” If bearing clearances are satisfactory, apply engine oil to journals and bearings.

8. Install rod caps and evenly torque nuts. Refer to “Specifications”.

9. Turn crankshaft so mark on timing sprocket or gear is facing camshaft.

10. Install as outlined:
   a. Timing chain and sprocket or gear on camshaft -align marks with crankshaft.
   b. Timing chain/gear cover.
   c. Oil pump and baffle.
   d. Dipstick tube and oil pan.
   e. Spark plugs.
   f. Torsional damper and crankshaft pulley.
   g. Water pump.
   h. Belts.
   i. Flywheel and drive coupler/plate.
   j. Flywheel housing.
   k. Starter.

11. Install new oil filter. Fill crankcase with oil.

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**Timing Chain and Sprocket**

**Removal**

1. Remove torsional damper, oil pan and crankcase front cover as outlined.

2. Turn crankshaft until timing marks on crankshaft and camshaft sprockets are in alignment as shown.

3. Remove camshaft sprocket and timing chain. (If sprocket does not come off easily, a light tap on the lower edge of the sprocket, using a plastic mallet, should dislodge it.)

4. If crankshaft sprocket requires replacement, remove as outlined.
Cleaning and Inspection
1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing chain for wear and damage.
3. Inspect sprockets for wear and damage.

Installation
1. If crankshaft sprocket was removed, install as outlined in “Crankshaft Sprocket.”
2. Install timing chain on camshaft sprocket. Hold sprocket vertical with chain hanging down. Align marks on camshaft and crankshaft sprockets.
3. Install sprocket on camshaft. Torque bolts to 25 lb. ft. (34 N·m).
4. Lubricate timing chain with engine oil. Install crankcase front cover and torsional damper as outlined.

Crankshaft Sprocket

Removal
1. Remove torsional damper and crankcase front cover as outlined.
2. Remove camshaft timing chain as outlined.
3. Remove crankshaft sprocket using crankshaft gear and sprocket puller (J-24420-B).

Checking Timing Chain Deflection
With timing chain and sprockets installed, check timing chain deflection, as follows:
1. Rotate camshaft (in either direction) to place tension on one side of the chain.
2. Establish a reference point on the block (on taut side of chain) and measure from this point to the chain.
3. Rotate camshaft in the opposite direction to slacken the chain, then force chain out with fingers and again measure the distance between reference point and timing chain.
4. The deflection is the difference between these two measurements. If the deflection exceeds 3/4 in. (19 mm), timing chain should be replaced.

5. Install torsional damper and crankcase front cover.

Camshaft

Measuring Lobe Lift

NOTE: Procedure is similar to checking valve timing. If improper valve operation is indicated, measure lift of each push rod in consecutive order and record readings.

1. Remove valve mechanism as outlined.

2. Adapt dial indicator to cylinder head by temporarily installing suitable stud in bolt hole. Position indicator with ball socket adaptor tool, from Lift Indicator Tool Kit, on push rod. Be sure that push rod is in lifter socket.

3. Rotate torsional damper slowly in direction of rotation until lifter is on heel of cam lobe. At this point, push rod will be in its lowest position.

4. Set dial indicator on zero, then rotate damper slowly (or attach an auxiliary starter switch and “bump” engine over) until push rod is in fully raised position.

5. Compare total lift, recorded from dial indicator, with “Specifications.”

6. Continue to rotate engine until indicator reads zero. This will be a check on accuracy of original indicator reading.

7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly and hardware.

8. Install and torque valve mechanism to specifications.
Removal
1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove camshaft as follows:
   a. Remove timing chain and sprocket or timing gears as outlined.
   b. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes and carefully remove camshaft as shown.

Inspection
Measure camshaft bearing journals with a micrometer for out-of-round condition. If journals exceed .001 in. (0.025 mm) out-of-round, camshaft should be replaced.

Also check camshaft for alignment with V-blocks and dial indicator which indicates exact amount camshaft is out of true. If out more than .002 in. (0.051 mm) (dial indicator reading) camshaft should be replaced.

Checking Camshaft Alignment

Installation
1. Install camshaft as follows:
   a. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil and install camshaft, being careful not to damage bearings.
   b. Lubricate camshaft lobes with General Motors Cam and Lifter Prelube or equivalent.
   c. Install timing chain or gears as outlined.
2. Install crankcase front cover and valve lifters as outlined.

Camshaft Bearings

Removal
Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly. To replace bearings without complete disassembly, remove camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft, fasten connecting rods against sides of engine so that they will not interfere while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

NOTE: This procedure is based on removal of bearings from center of engine first, thus requiring a minimum amount of turns to remove all bearings.
2. Using camshaft bearing remover and installer set (J-6098-01) (with nut and thrust washer installed to end of threads), position pilot in front camshaft bearing and install puller screw through pilot.

3. Install tool with shoulder toward bearing. Be sure a sufficient amount of threads are engaged.

4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove tool and bearing from puller screw.

5. Remove remaining bearings (except front and rear) in same manner. It will be necessary to position pilot in rear camshaft bearing to remove rear intermediate bearing.

6. Assemble driver on driver handle and remove front and rear camshaft bearings by driving toward center of cylinder block.

**Inspection**

Clean camshaft bearing bores in cylinder block with solvent and blow out with compressed air. Be sure grooves and drilled oil passages are clean.

**Installation**

Front and rear bearings must be installed last as pilot will not fit into bearing bores if bearings are installed.

Lubricate outer surface of new camshaft bearings with engine oil to ease installation.

**IMPORTANT:** All camshaft bearings are not the same. Be sure to install bearings in proper locations (Indicated by bearing manufacturer) and to position bearings as follows (directional references are in reference to engine in its normal operating position):

- Front bearing must be positioned so that oil holes are equal distance from 6 o’clock position in the block. Intermediate and center bearings must be positioned so that oil holes are at the 5 o’clock position (toward left side of block and at a position even with bottom of cylinder bore). Rear bearing must be positioned so that oil hole is at the 12 o’clock position.

1. Installing intermediate and center bearings:
   a. Install nut and thrust washer all the way onto puller screw, then position pilot in front camshaft bearing bore and insert screw through pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2 in. (13 mm) of threads are engaged.
   c. Using two wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.
   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.

2. Installing front and rear bearings:
   a. Install appropriate size remover and installer tool on drive handle.
b. Index front bearing (as explained in “Important” above), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.

c. Install rear bearing in same manner, being sure to index bearing correctly.

3. Install a new camshaft rear plug.

**IMPORTANT:** Plug must be installed flush to 1/32 in. (0.8 mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.

### Cylinder Block

#### Cleaning and Inspection

1. Remove all engine components as previously outlined.

2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.

3. Remove oil gallery plugs and clean all oil passages.

4. Remove expansion plugs.

**NOTE:** These plugs may be removed with a sharp punch, or they may be drilled and pried out.

5. Clean and inspect water passages in cylinder block.

6. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.

7. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.

#### Cylinder Measurement

a - Equal To Right Angle To Centerline Of Engine

b - Parallel to Centerline Of Engine "Out Of Round" Equals

The Difference Between A and B

At Top Of Cylinder Bore and A

Measurement At Bottom Of Cylinder Bore

#### Measuring Cylinder Bore
Measuring Cylinder Bore

8. Check cylinder head gasket surfaces for warpage with a machinist’s straight-edge and a feeler gauge, as shown. Take measurements diagonally across surfaces (both ways) and straight down center. If surfaces are warped more than .003 in. (0.07 mm) in a 6 in. area or .007 in. (0.2 mm) overall, block must be resurfaced by an automotive machine shop.

3. If cylinders have less than .005 in. (0.127 mm) taper or wear, they can be conditioned with a hone and fitted with high limit standard size piston. A cylinder bore of more than .005 in. wear or taper may not clean up entirely when fitted to a high limit piston. To entirely clean up the bore, it will be necessary to bore for an oversize piston. If more than .005 in. taper or wear, bore and hone to smallest oversize that will permit complete resurfacing of all cylinders.

4. When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, swab cylinder bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

CYLINDER BORING

1. Before using any type boring bar, file off top of cylinder block to remove dirt or burrs. This is very important to prevent boring bar tilt, with result that bored cylinder wall is not at right angles to crankshaft.

2. Measure piston to be fitted with a micrometer, measuring at center of piston skirt and at right angles to piston pin. Bore cylinder to same diameter as piston and hone to give specified clearance.

NOTE: Hone cylinders as outlined under “Cylinder Honing” and “Piston Selection,” following.

3. Carefully observe instructions furnished by manufacturer of equipment being used.

CYLINDER HONING

1. Follow hone manufacturer’s recommendations for use of hone and cleaning and lubrication during honing.

2. Occasionally, during the honing operation, thoroughly clean cylinder bore and check piston for correct fit in cylinder.

3. When finish-honing a cylinder bore to fit a piston, move hone up and down at a sufficient speed to obtain very fine uniform surface finish marks in a crosshatch pattern of approximately 30 degrees to cylinder bore. Finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.

4. Permanently mark piston (for cylinder to which it has been fitted) and proceed to hone cylinders and fit remaining pistons.
IMPORTANT: Handle pistons with care and do not attempt to force them through cylinder until cylinder is honed to correct size, as this type piston can be distorted by careless handling.

5. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any abrasive material remains in cylinder bores, it will rapidly wear new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. Swab bores several times with light engine oil on a clean cloth, then wipe with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

PISTON SELECTION
1. Check used piston to cylinder bore clearance as follows:
   a. Measure cylinder bore diameter with a telescope gauge 2-1/2 in. (64 mm) from top of cylinder bore as follows.
   b. Measure piston diameter at skirt across center line of piston pin as shown.
   c. Subtract piston diameter from cylinder bore diameter to determine piston-to-bore clearance.
   d. Determine if piston-to-bore clearance is in acceptable range shown in “Specifications.”

2. If used piston is not satisfactory, determine if a new piston can be selected to fit cylinder bore within acceptable range.

3. If cylinder bore must be reconditioned, measure new piston diameter (across centerline of piston pin), then hone cylinder bore to correct clearance (preferable range).

4. Mark piston to identify cylinder for which it was fitted.
Oil Filter By-Pass Valve and Adaptor

**CAUTION**

Any Gen V or Gen VI engine with front mounted vertical oil cooler **MUST** have a 30 PSI oil pressure relief valve installed. Severe engine damage or failure will occur if not installed.

**Inspection and/or Replacement**

Oil by-pass valve and adaptor should be inspected whenever engine is disassembled for major repair or whenever inadequate oil filtration is suspected.

Refer to “Engine Parts List” when ordering parts for oil filter by-pass valve, adaptor assembly or remote oil filter parts.

1. Remove oil hoses from adaptor.
2. Remove hose fitting and seal from adaptor.
3. Remove connector.
4. Clean parts in solvent and blow dry with compressed air.
5. Inspect fiber valves for cracks or other damage. Check that valves fit tightly against seats. Push each valve down and release it. Valves should return freely to their seats. If valve operation is questionable, by-pass valve should be replaced.
6. Wipe out valve chamber in cylinder block to remove any foreign material.
7. Install by-pass valve (if replaced) and connector. Torque adaptor nut to 20 lb. ft. (27 N·m).
8. Lubricate adaptor seal with engine oil. Install hose fitting and torque to specifications.
9. Apply Perfect Seal to hose threads. Install and tighten securely.

**Typical By-Pass Valve and Adaptor**

- Fiber Valves (Ensure That Valves Fit Tightly Against Their Seals)
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