# Sequence IIIF Engine Oil Certification Test
# Engine Assembly Manual

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**Revision 3 Last Update 6/18/02**

Table of Contents

# Section 0

## Hardware usage guidelines

All materials used in this test must conform to acceptance guidelines as specified in the ASTM Sequence IIIF Test Procedure accompanied by the direction and information contained in this Assembly Manual.

Any changes in procedures or substitutions of qualified parts or materials, must be approved by the Sequence IIIF Surveillance Panel prior to their use in non-reference and reference oil tests.

Any parts or materials specified in this document that are found to be unacceptable for testing, both pre and post test, must be reported to the Test Sponsor, the appropriate Critical Parts Distributor, and the ASTM Test Monitoring Center.

Unless otherwise directed, all parts and materials required for testing should be stored and used on a first in – first out basis following the guidelines outlined in the ASTM Test Monitoring Center Sequence IID and IIIE Information Letter #60 June 21, 1991.

# Section 01

# Revision Update Timeline

Sequence IIIF Engine Assembly Manual Update Revision Timeline

Latest Revision 3

Date 6/18/2002

Contact Person Mike Kasimirsky TMC 412-365-1033
Sid Clark GM 586-986-1929

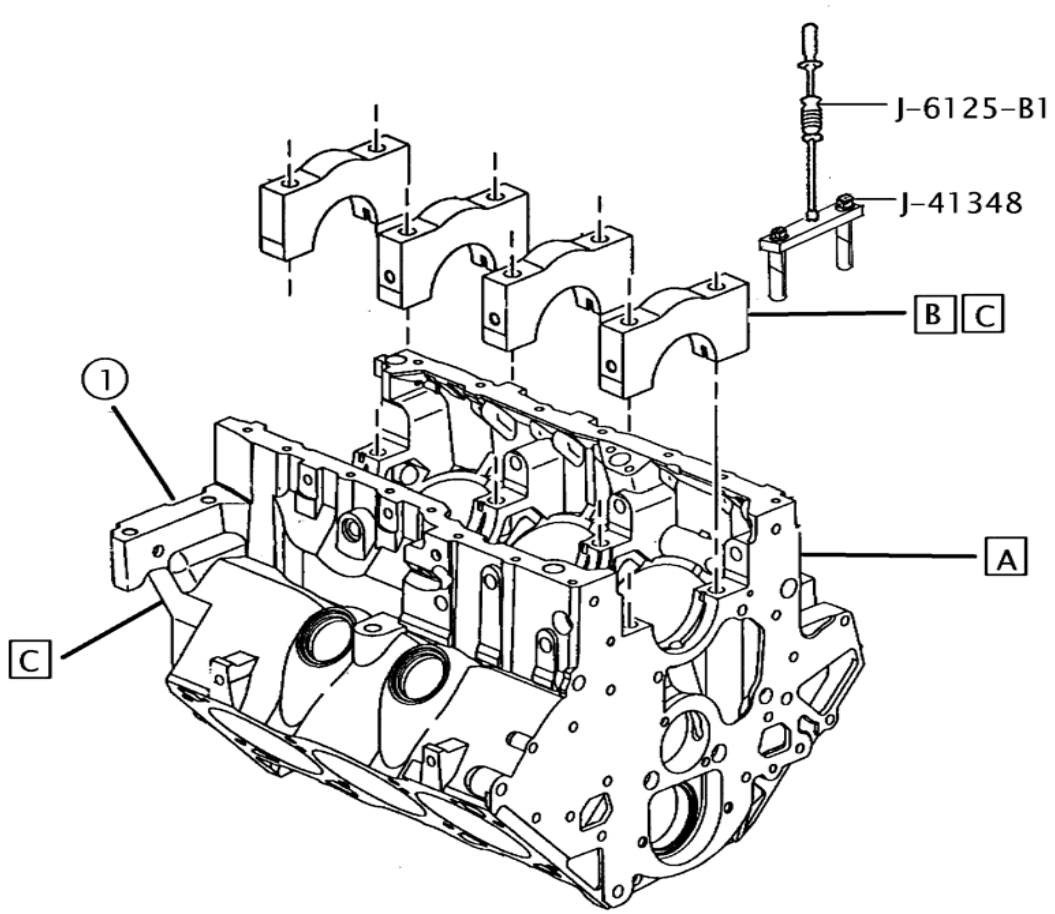
| Date | Sec. | Sheet | Topic | Comments | Info Letter |
|---|---|---|---|---|---|
| 2/4/2002 | 1 | 1 | New Block and Pre-Hone Prep | Check main bore and cam tunnel alignment | |
| 11/6/99 | 1 | 2 | New Block and Pre-Hone Prep | Dip stick reamer, cam tunnel prep | |
| 6/17/02 | 1 | 2 | New Block and Pre-Hone Prep | Add Rotory Tool Information | |
| 11/6/99 | 1 | 3 | New Block and Pre-Hone Prep | Update drawing, indicated fastener locations | |
| 6/17/02 | 1 | 3 | New Block and Pre-Hone Prep | Change sealer to Perfect Seal #4 | |
| 2/1/02 | 1 | 4 | New Block and Pre-Hone Prep | Update etxt, Class 2B Tap & Reamer | |
| 11/6/99 | 1 | 5 | New Block and Pre-Hone Prep | Update drawing | |
| 9/5/00 | 1 | 5A | New Block and Pre-Hone Prep | Jet Washer parts cleaning procedure | |
| 2/1/02 | 1 | 5A | New Block and Pre-Hone Prep | Add PDN 50 Soap | |
| 2/1/02 | 1 | 6 | New Block and Pre-Hone Prep | Update text "Add line C" "Main cap side bolts" | |
| 11/6/99 | 1 | 7 | New Block and Pre-Hone Prep | Add head gasket part numbers | |
| 12/1/99 | 2 | 7 | Cylinder Honing | Change note from 0.0005" to 0.005" | |
| 10/12/98 | 3 | 3 | Short Block Assembly | Update 2nd design block & part numbers | |
| 11/7/99 | 3 | 3 | Short Block Assembly | Update part numbers and note 3 (can tunnel de-burring) | |
| 6/22/00 | 3 | 3 | Short Block Assembly | Update part numbers (cam bearings) | |
| 11/7/99 | 3 | 4 | Short Block Assembly | Update oil gallery cleaning | |
| 9/7/00 | 3 | 4 | Short Block Assembly | Update part numbers (engine bearings) | |
| 11/6/99 | 3 | 5 | Short Block Assembly | Update crankshaft cleaning (Mylar Tape Polishing) | |
| 6/17/02 | 3 | 5 | Short Block Assembly | Update "A" polishing of crankshaft | |
| 9/5/00 | 3 | 5 | Short Block Assembly | Update crankshaft cleaning (Mylar Tape Polishing) | |
| 9/7/00 | 3 | 6 | Short Block Assembly | Update part number (engine bearing) | |
| 2/1/02 | 3 | 6 | Short Block Assembly | Update description, Add C, change Z to Y3" | |
| 11/13/99 | 3 | 8 | Short Block Assembly | Update ring gap dimensions | |
| 6/20/00 | 3 | 8 | Short Block Assembly | Update ring gap dimensions | |
| 9/7/00 | 3 | 8 | Short Block Assembly | Update ring gap instructions and part numbers | |
| 2/1/02 | 3 | 8 | Short Block Assembly | Add Starrett Taper Gage | |
| 11/7/99 | 3 | 9 | Short Block Assembly | Update part number (engine bearing) | |
| 11/13/99 | 3 | 11 | Short Block Assembly | Add De-burring operation | |
| 6/22/00 | 3 | 11 | Short Block Assembly | Update part number ( 0.153" thrust plate) | |
| 10/18/00 | 3 | 11 | Short Block Assembly | Update operation (thrust face de-burring) | |

| Date | Sec. | Sheet | Topic | Comments | Letter |
|---|---|---|---|---|---|
| 2/1/02 | 3 | 11 | Short Block Assembly | Add note item #2, 0.152" Thrust Plate & Camshaft Prt. No. | |
| 11/7/99 | 3 | 13 | Short Block Assembly | Update view "A" | |
| 6/17/02 | 3 | 13 | Short Block Assembly | Add inspection of balance shaft drive gear | |
| 11/7/99 | 3 | 14 | Short Block Assembly | Update view "A,B,Z" | |
| 2/1/02 | 3 | 14 | Short Block Assembly | Update torque and replace each test, camshaft bolt | |
| 11/6/99 | 4 | 1 | Front Cover, Rear Cover & Sump | Update view, add adaptor | |
| 10/18/00 | 4 | 2 | Front Cover, Rear Cover & Sump | Update oil pump gear clearance | |
| 02/114/02 | 4 | 2 | Front Cover, Rear Cover & Sump | Add clearance specification | |
| 6/17/02 | 4 | 2 | Front Cover, Rear Cover & Sump | Add inspection of oil gear housing in front cover | |
| 12/1/99 | 4 | 4 | Front Cover, Rear Cover & Sump | Add sealer usage | |
| 2/14/02 | 4 | 4 | Front Cover, Rear Cover & Sump | Add clearance specification | |
| 6/17/02 | 4 | 4 | Front Cover, Rear Cover & Sump | Update view, add info on by-pass valve with reference | |
| 12/1/99 | 4 | 6 | Front Cover, Rear Cover & Sump | Add sealer usage | |
| 12/1/99 | 4 | 7 | Front Cover, Rear Cover & Sump | Add thermocouple information | |
| 12/1/99 | 4 | 10 | Front Cover, Rear Cover & Sump | Add sealer usage | |
| 12/1/99 | 4 | 12 | Front Cover, Rear Cover & Sump | Add sealer usage | |
| 2/14/02 | 4 | 12 | Front Cover, Rear Cover & Sump | Add clearance check | |
| 6/22/00 | 4 | 13 | Front Cover, Rear Cover & Sump | Add new oil pan part number | |
| 11/13/99 | 5 | 1 | Head Assembly | Update part number (valve spring) | |
| 12/1/99 | 5 | 1 | Head Assembly | Update velve spring calibration | |
| 2/22/02 | 5 | 1 | Head Assembly | Update valve spring calibration | |
| 11/13/99 | 6 | 1 | Long Block Assembly | Update lifter part number and installation instructions | |
| 6/22/00 | 6 | 1 | Long Block Assembly | Add ACI test lifter | |
| 2/22/02 | 6 | 1 | Long Block Assembly | Update test lifter part number | |
| 6/18/02 | 6 | 2 | Long Block Assembly | Add oiling of pushrod ball ends | |
| 11/13/99 | 6 | 4 | Long Block Assembly | Remove SPO part number for rocker arm bolts | |
| 12/1/99 | 6 | 4 | Long Block Assembly | Add note on engine rotation | |
| 12/1/99 | 6 | 6 | Long Block Assembly | Update part number (RTV sealer) | |
| 2/22/02 | 6 | 6 | Long Block Assembly | Delete first design intake gasket | |
| 11/30/99 | 6 | 7 | Long Block Assembly | Add exploded view | |
| 6/22/00 | 6 | 7 | Long Block Assembly | Update coolant return line description | |
| 2/22/02 | 6 | 7 | Long Block Assembly | Add Perfect Seal #4 | |
| 6/17/02 | 6 | 7 | Long Block Assembly | Change to Permatex #2 | |
| 6/17/02 | 6 | 8 | Long Block Assembly | Add "Max. torque" | |
| 11/13/99 | 6 | 9 | Long Block Assembly | Update part number and modification information | |
| 2/22/02 | 6 | 9 | Long Block Assembly | Update throttle body part numbers | |

| Date | Sec. | Sheet | Topic | Comments | Letter |
|---|---|---|---|---|---|
| 6/17/02 | 6 | 9 | Long Block Assembly | Change part number 2 bolt Mass Air Flow Sensor | |
| 11/13/99 | 6 | 11 | Long Block Assembly | Update part number and view | |
| 2/22/01 | 6 | 11 | Long Block Assembly | Update description, "Procedure Reference" | |
| 9/5/00 | 6 | 11A | Long Block Assembly | Add injector flow procedure | |
| 2/22/02 | 6 | 11A | Long Block Assembly | Delete Sheet | |
| 2/22/02 | 7 | 6 | Final Dress | Update throttle body part numbers | |
| 2/22/02 | 8 | 1 | OHT | Update view "Add exhaust sample / pressure" | |
| 2/22/02 | 8 | 2 | OHT | Add warning on RTV Sealer | |
| 6/17/02 | 8 | 3 | OHT | Update view & part numbers | |
| 6/17/02 | 8 | 3a | OHT | Add Sheet | |
| 6/18/02 | 9 | 3b | OHT | Add Sheet | |
| 2/22/02 | 8 | 4 | OHT | Change view "inlet air temperature sensor" | |

# Section 1

# Cleaning and Pre Hone Preparation



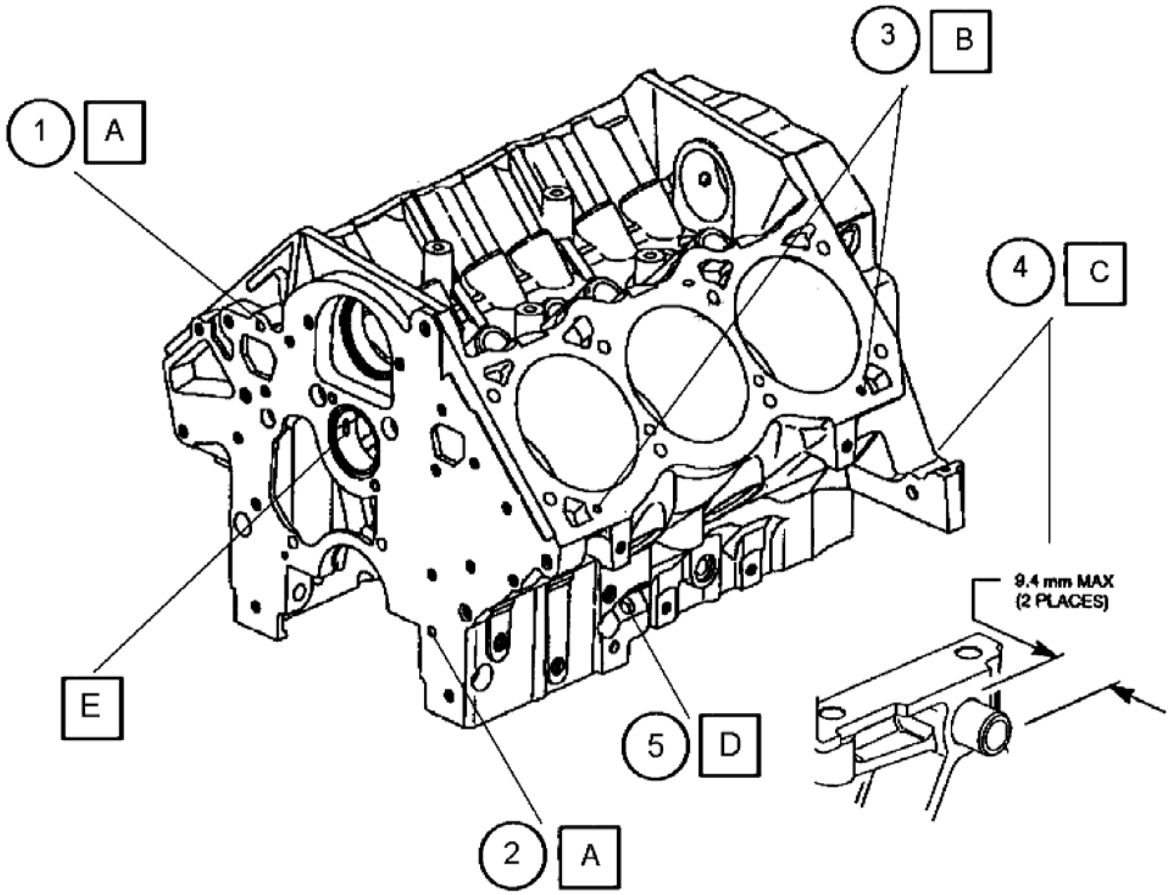

| Description of Operation | |
|---|---|
| A | Upon introduction of a new block into the system, check for any damage to machined surfaces which might have occurred during shipping or handling.<br>Check main bore and camshaft tunnel alignment using appropriate manderals. |
| B | Remove main cap side & main bolts. Use Kent-Moore J-41348 main bearing cap puller (12Nm) & J-6125-1B slide hammer to remove main caps. **Note: Main bearing caps are press fit. Do not hammer caps back and forth during removal. Damage to the caps may result in damage to engine bearings during test.** |
| C | Record engine serial number and or assign a laboratory number and mark necessary identification on engine block and crankshaft main caps. **Note: Do not use stamped tool set for marking identification on main caps.** |

| Specification | |
|---|---|
| 1 | 24506028 Block Assembly |

| REV | Date | Revision History |
|---|---|---|
| 1 | 12/31/97 | Block-1 |
| 2 | 02/04/02 | Update "A" (check main bore and camshaft tunnel alignment) |
| | | |
| | | |
| | | |

| View |
|---|
| Engine Block |
| New block and pre-hone prep<br>Serial Number Locations |

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 1 |



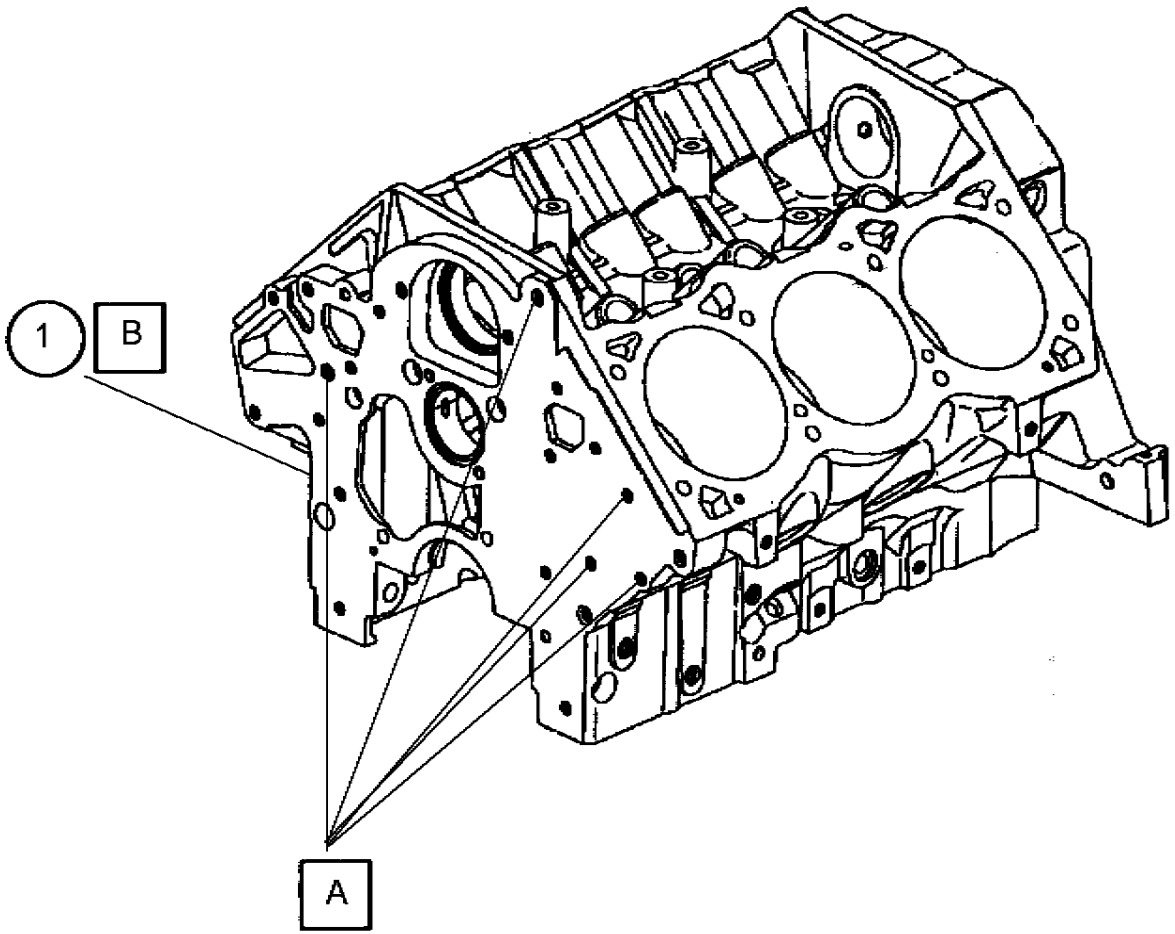

| Description of Operation | |
|---|---|
| A | Install locating pins on front face. |
| B | Install locating pins on cylinder deck |
| C | Install locating pins on rear transmission mount face. |
| D | Use OHT3F-071-1 reamer to size dip stick hole for calibrated dip stick |
| E | Deburr all leading edges of camshaft tunnel bores and oil gallery cross drilled intersections through tunnel bores using emery cloth, rotory tool with carbide cutters, stones, or wire wheels as necessary to remove sharp edges. |

| Specification | |
|---|---|
| 1 | 24501162 Pin Front Cover Upper |
| 2 | 25536323 Pin Front Cover Lower |
| 3 | 25536320 Pin Cyl. Head Location |
| 4 | 12338076 Pin Trans. Location |
| 5 | OHT3F--071-1 Reamer |

| REV | Date | Revision History |
|---|---|---|
| 1 | 12/31/97 | Block-2 |
| 2 | 11/6/99 | Add Operation "D" & "E" and OHT3F-071 |
| 3 | 6/17/02 | Revise operation "E" include rotory tool and accessories |
| | | |
| | | |

| View |
|---|
| Engine Block |
| New block and pre-hone prep<br>Locating pin installation<br>Camshaft tunnel and dip stick prep |

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 2 |



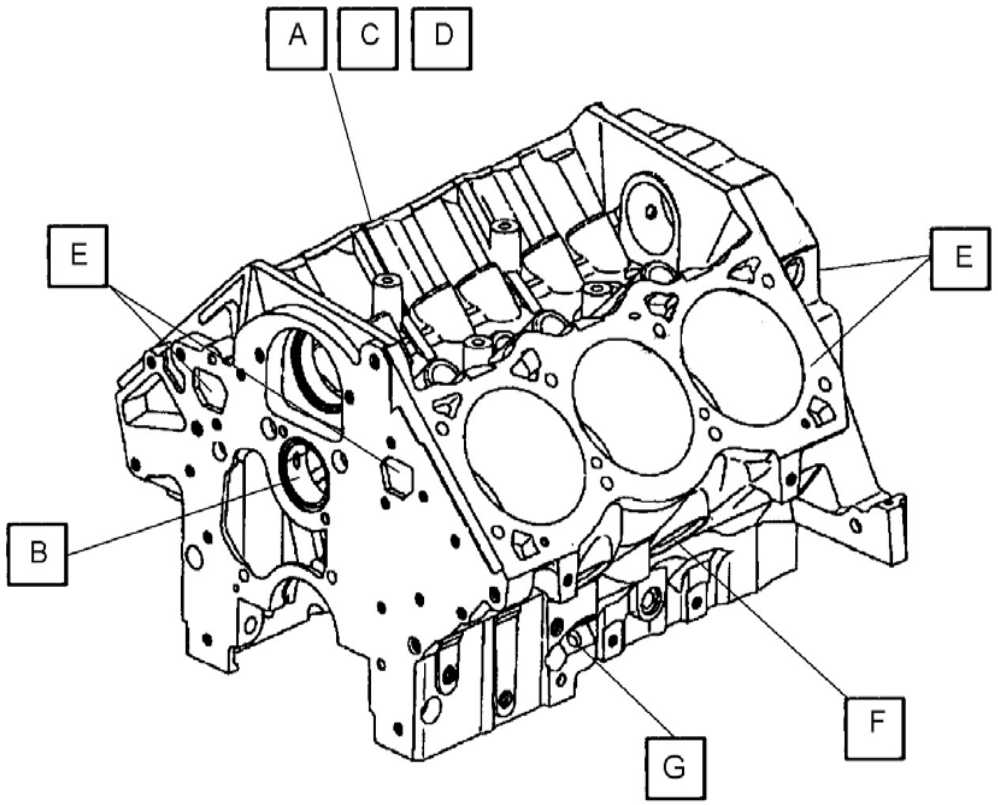

| Description of Operation | |
|---|---|
| A | Install threaded fasteners with #2 Non-Hardening Permatex or Perfect Seal #4 in locations identified in view. |
| B | Install 1/4NPT plug in main oil gallery on the right front side of engine block.<br><br>Note: This location is not to be used for temperature control or thermocoupled. |

| Specification | |
|---|---|
| 1 | 444777 Plug Auto Hex Socket |

| REV | Date | Revision History |
|---|---|---|
| 1 | 12/31/97 | Block-3 |
| 2 | 11/6/99 | Change location in group "A" |
| 3 | 6/17/02 | Add Perfect Seal to "A" |
| | | |
| | | |

| View |
|---|
| Engine Block |
| New block and pre-hone prep<br>Plugged holes in front of engine |

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 3 |




| Description of Operation | |
|---|---|
| A | Remove all casting slag and core sand deposits from the coolant passages on new blocks and check for core sand deposits on used blocks |
| B | Remove all camshaft bearings and oil gallery plugs. |
| C | Clean all gasket surfaces. |
| D | Chase all threaded holes for the main caps and cylinder head fasteners using a Class 2B Tap. |
| E | Install block-off plates over the coolant passages on the front face, rear face, and cylinder deck. (Fabricate in-house) |
| F | Install coolant Welch plugs. |
| G | Ream dip stick hole using OHT3F-071-1 reamer for calibrated dip stick. |

**Specification**

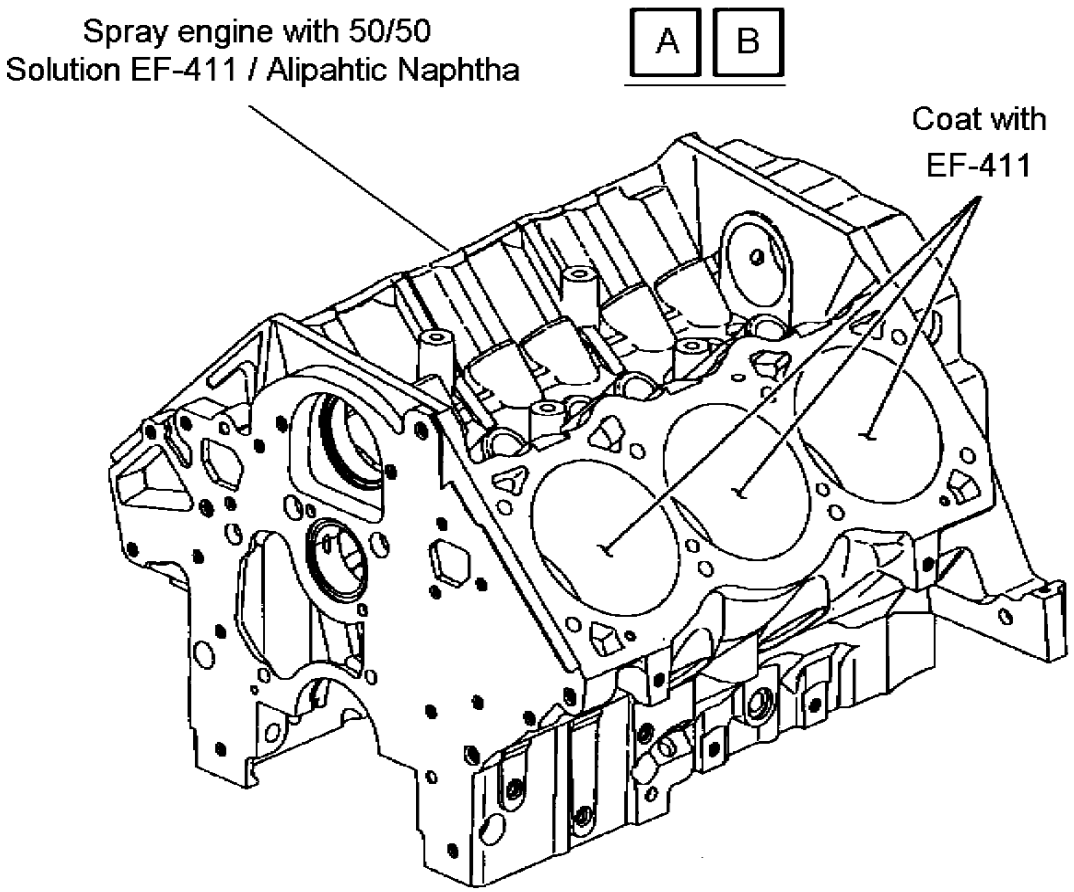
| REV | Date | Revision History |
|---|---|---|
| 1 | 12/31/97 | Block-4 |
| 2 | 2/1/02 | Update text "D" Add Class 2B Tap "G" Add reamer operation |
| | | |
| | | |
| | | |

**View**

**Engine Block**

New block and pre-hone prep

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 4 |




| Description of Operation | |
|---|---|
| A | The engine may be cleaned using an automated washing device, however, caution should be used to prevent oxidation flash over of the ferrous surfaces. Note: Do not use caustic chemicals or acid type baths. See 5A |
| B | The block must be thoroughly cleaned using brushes through the oil galleries, camshaft tunnel, and cylinder bores with aliphatic naphtha to remove any detergent residue before honing. |
| ? | (Step Sec. 1 sheet 6)<br>Repeat step "A & B" after honing.<br><br>Note: If this is the final cleaning after honing, spray the entire engine block using a 50/50 solution of EF-411 and aliphatic naphtha. Air dry to remove excess solution. |
| ? | (Step Sec. 3 sheet 1) |

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 12/31/97 | Block-5 |
| 2 | 11/6/99 | View update |
| | | |
| | | |
| | | |

**View**

**Engine Block**

Engine block cleaning

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 5 |

Automatic Parts Washer Procedure for IIIF Engine Blocks

1) Use only NAT-50-S or PDN-50 soap at a concentration of 16 pounds of soap per 100 gallons of water.

2) Set the temperature of the water to 140 degrees F.

3) Do not pre-condition the water that is being used in any way.

4) Prior to installing the engine in the parts washer, ensure that all coolant passages are blocked off to prevent cleaning solutions from entering the passages.

5) Allow the block to run through the cleaning cycle for a period of 30 to 40 minutes.

6) After the cycle is complete, immediately remove the block from the washer and spray it down with stoddard solvent.

7) Wipe cylinder bores out with a lint free towel.

8) Spray engine block with a mixture of 50/50 EF-411 and stoddard solvent.

**Description of Operation**

**Specification**

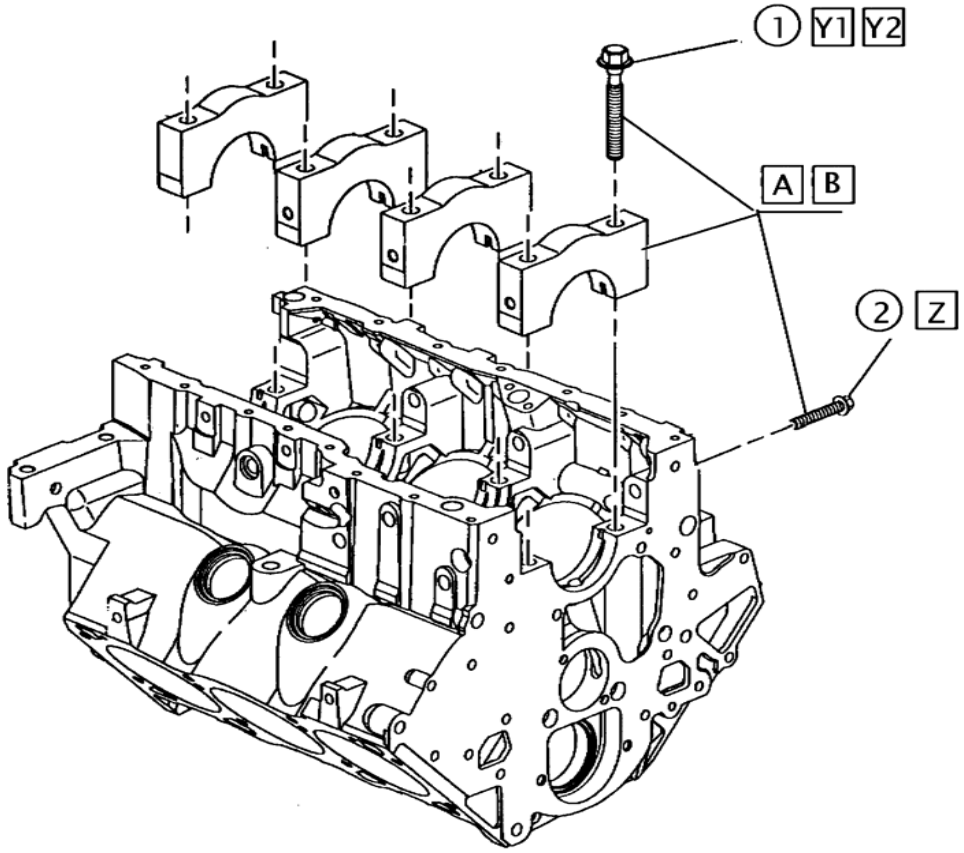
| REV | Date | Revision History |
|---|---|---|
| 1 | 9/5/00 | Procedure for Better Engineering Jet Washer usage |
| 2 | 2/1/02 | Update line item 1. "Add PDN-50 soap" |
| | | |
| | | |
| | | |

**View**

**Engine Block**

Engine block cleaning procedure for automated type jet washers

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 5A |



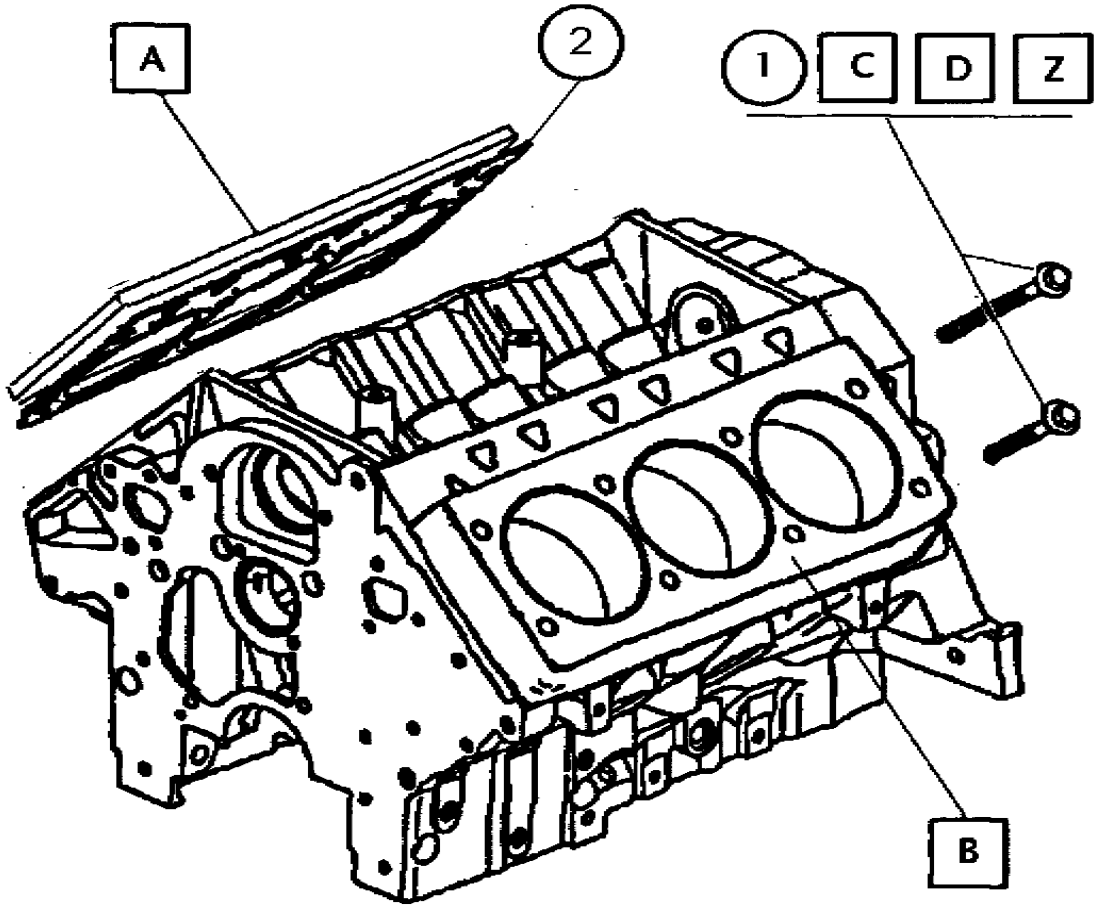

| Description of Operation | |
|---|---|
| A | Clean and oil all main cap bolts (EF-411) and install main caps.Note: Do not use air tools to run main caps down. |
| B | Install main cap with fasteners as guides and tap into position with plastic mallet or use very light pressure by hand with speed handle and socket in crisscross pattern to draw the main cap down. |
| C | Install main cap side bolts |
| Y1 | Tighten all main bolts to 70 Nm to fully seat main caps and then loosen the bolts 360° counterclockwise. |
| Y2 | Torque & Angle<br>20Nm then 40Nm + 35°+35°+35° (repeat 3 times from center out) |
| Z | Torque & Angle 15Nm + 45° |

| Specification | |
|---|---|
| 1 | 24503056 Bolt (8) see note Y<br>(Tighten before Z) |
| 2 | 24505576 Bolt (6) see note Z<br>(Tighten after Y) |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-6 |
| 2 | 2/1/02 | Update text, "Add line C" |
| | | |
| | | |
| | | |

| View |
|---|
| Engine Block |
| Main cap installation |

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 6 |




| Description of Operation | |
|---|---|
| A | Remove cylinder deck block off plates. |
| B | Install B-H-J Torque Plates w/gaskets (GM-3.8/3E-R-S-T-HT) |
| C | Note: When installing torque plates, 1) move the bottom row of fasteners to the top, 2) discard the top row of fasteners, 3) use the post test fasteners from the last teardown in the bottom row on the torque plates. |
| D | Use the Torque Sensor 1 wrench set on soft joint for gasketed applications. |
| Z | 30Nm-50Nm-80Nm - JCS-TEL to yield. |
| | (Step Sec.2 sheet 1) |

| Specification | |
|---|---|
| 1 | 25527831 Bolt Cyl. Head (8)(Long)<br>See note Z<br>Use in upper and lower position with double hardened washers on lower row. Obtain washers from B-H-J. |
| 2 | 24503801 Gasket RH.<br>24503802 Gasket LH. |

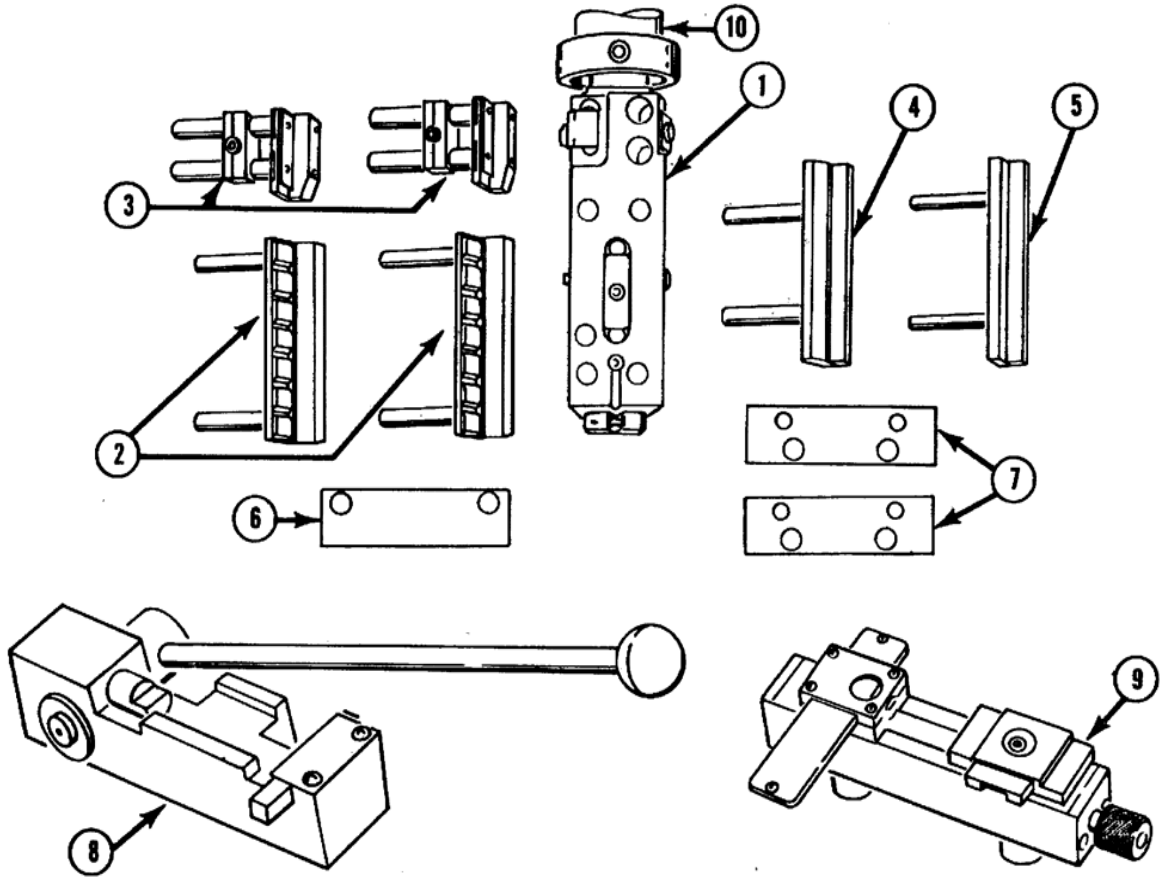
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/1/98 | Block-7 |
| 2 | 11/6/99 | Add head gasket part numbers |
| | | |
| | | |
| | | |

| View |
|---|
| Engine Block |
| B-H-J Torque Plate installation |

| New Block and Pre-Hone Prep | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 1 | 7 |

# Section 2

# Cylinder Block Honing




| Description of Operation | |
|---|---|
| 1 | Hone Head |
| 2 | Stone Assemblies |
| 3 | Alignment Guides |
| 4 | Main Guide |
| 5 | Centering Guide |
| 6 | Stone Shims |
| 7 | Guide Shims |
| 8 | Stone Inserter |
| 9 | Setting Gage |
| 10 | Drive Tube |

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-1-1 |
| | | |
| | | |
| | | |
| | | |

**View**

**Hone Unit Details**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 1 |

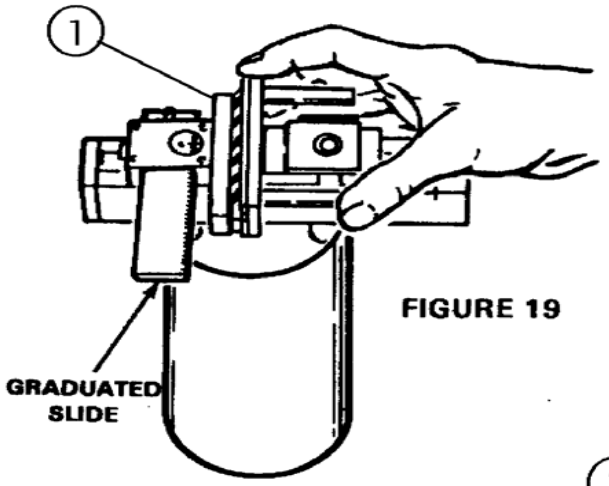



FIGURE 19

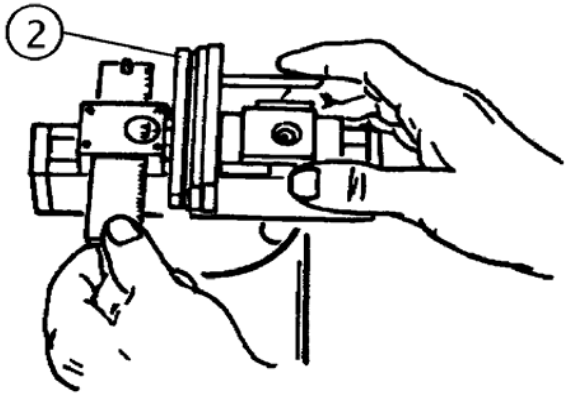



FIGURE 20

**Description of Operation**

Set the turret block to the standard position and adjust the setting block snugly in the cylinder bore.

19 Place the stone assembly in the setting gage with the slide scale set at "0". Add shims as necessary to adjust to 1 - 2 on the slide scale for the stone and guide assemblies.

20 Place the plateau honing tool in the setting gage with the slide scale set at "0". Add shims as necessary to adjust to 3 - 4 on the slide scale.

Note: The alignment guides are not used during honing of IIIF blocks.

**Specification**

1 EHU 512 Stone

2 C30-PHT-731 Plateau Honing Tool

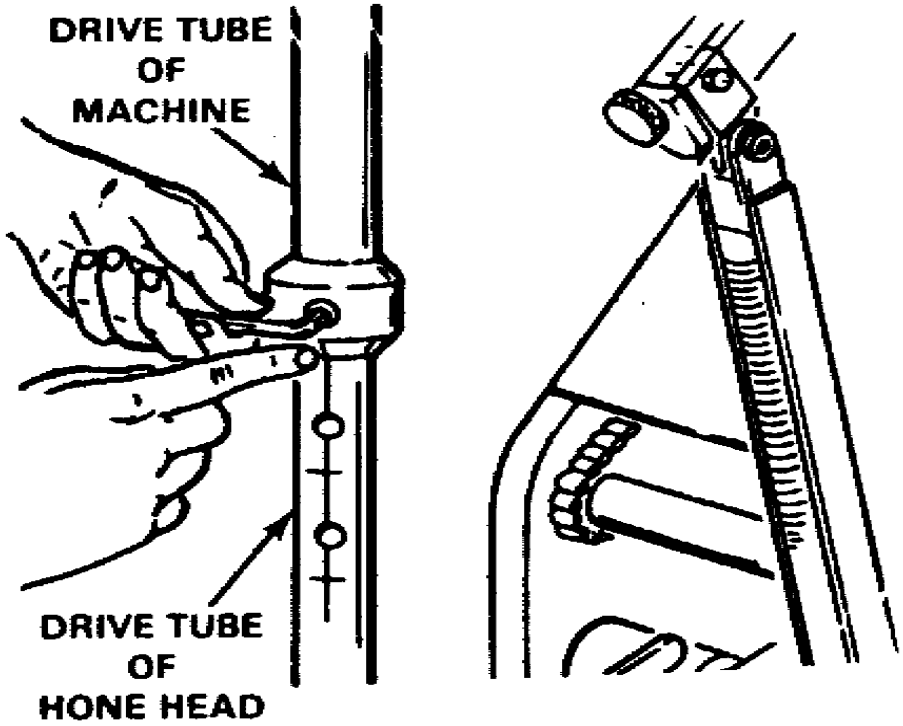
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-3-1 & 3-2 |
| | | |
| | | |
| | | |
| | | |

**View**

**Stones & Guides**

Stone and guide adjustment

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 2 |




**Description of Operation**

Slip the Drive Tube of the Hone Head into the Drive Tube of the CV-616-46 and tighten the set screw with the first set of index marks in line.

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-2-2 |
| | | |
| | | |
| | | |
| | | |

**View**

**Drive Tube**

Drive tube adjustment

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 3 |

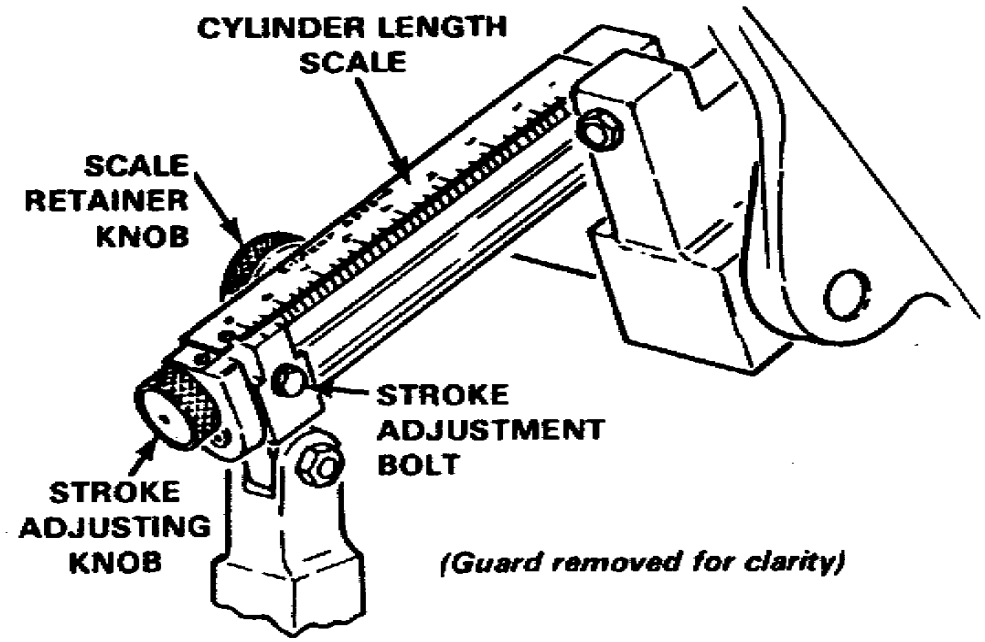



FIGURE 23

**Description of Operation**

Loosen stroke adjustment bolt and set stroke length at 5 3/8"

Note; to change the Stroke Scale to Metric, order PNP 1275M.

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-4 |
| | | |
| | | |
| | | |
| | | |

**View**

**Stroke Length**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 4 |

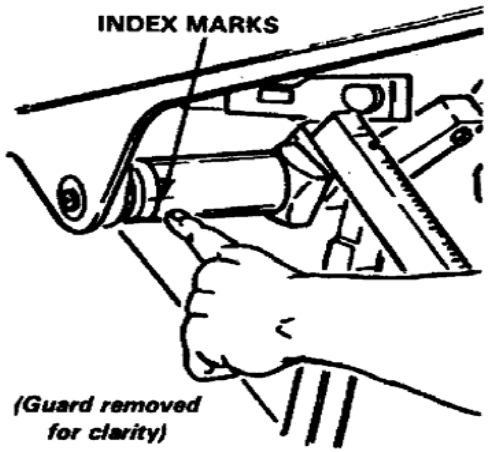



FIGURE 24

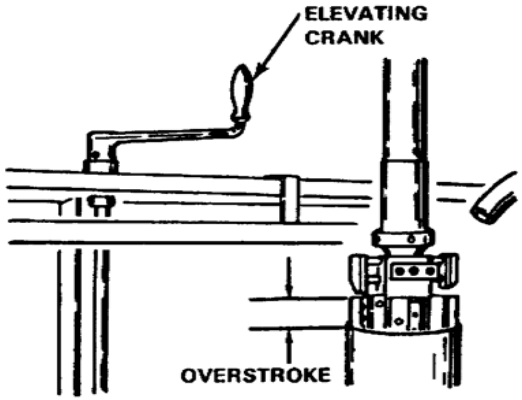



FIGURE 25

| Stone Length | | Top Overstroke Setting | |
|---|---|---|---|
| Inches | mm | Inches | mm |
| 2-3/4'' | 70 mm | 3/8'' | 9,5 mm |
| 3-1/2'' | 89 mm | 5/8'' | 16 mm |
| 4-1/2'' | 115 mm | 13/16'' | 21 mm |
| 6'' | 152 mm | 1-1/16'' | 27 mm |

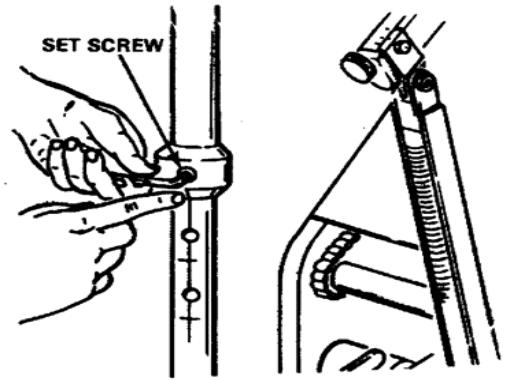



FIGURE 26

**Description of Operation**

With the hone head in the cylinder and the index marks lined up as shown in figure 24, use the elevating crank to adjust the overstroke length to 3/8" as indicated in figure 26 for 2 3/4" stone length.

Note: Drive tube should be set at first set of index marks.

**Specification**

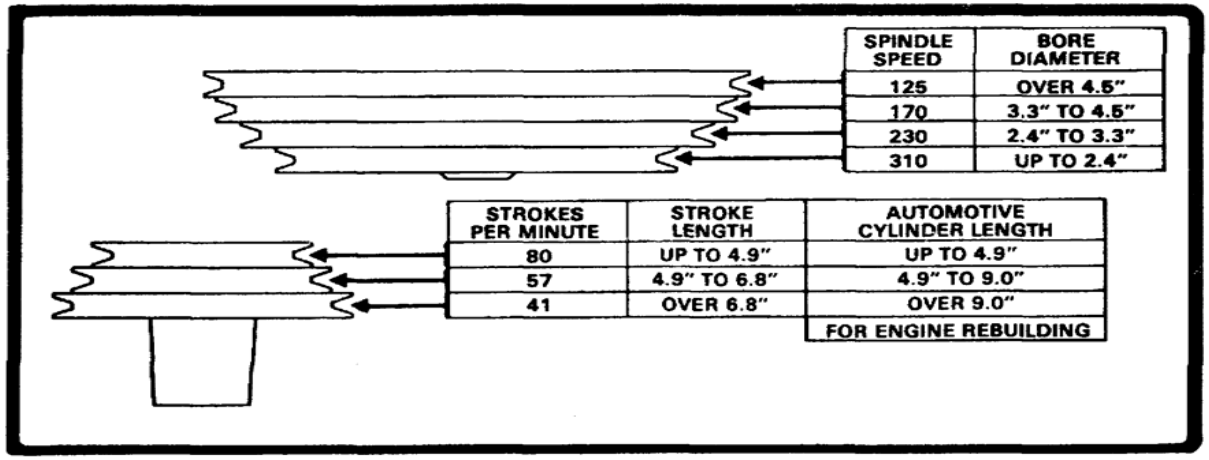
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone 4 & 5 |
| | | |
| | | |
| | | |
| | | |

**View**

**Overstroke**

Overstroke adjustment

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 5 |



| SPINDLE SPEED | BORE DIAMETER |
|---|---|
| 125 | OVER 4.5" |
| 170 | 3.3" TO 4.5" |
| 230 | 2.4" TO 3.3" |
| 310 | UP TO 2.4" |

| STROKES PER MINUTE | STROKE LENGTH | AUTOMOTIVE CYLINDER LENGTH |
|---|---|---|
| 80 | UP TO 4.9" | UP TO 4.9" |
| 57 | 4.9" TO 6.8" | 4.9" TO 9.0" |
| 41 | OVER 6.8" | OVER 9.0" |
| | | FOR ENGINE REBUILDING |

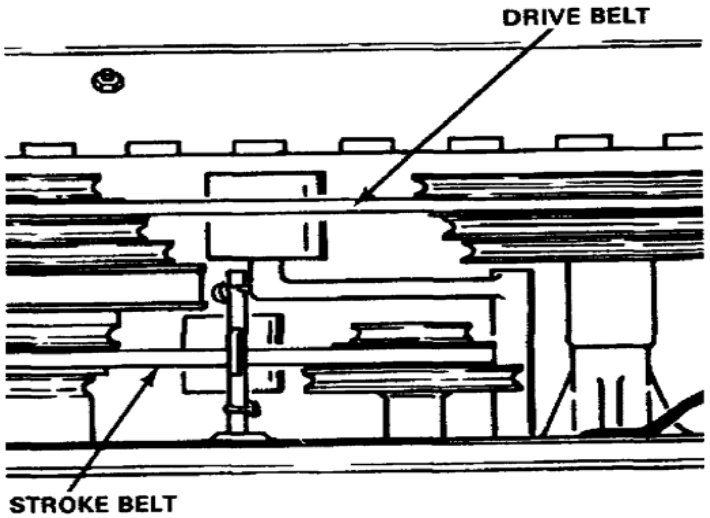



FIGURE 28

**Description of Operation**

Open the left side of the belt cover and set the spindle speed at 170 and the strokes per minute at 57.

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-6 |
| | | |
| | | |
| | | |
| | | |

**View**

**Speed & Stroke**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 6 |

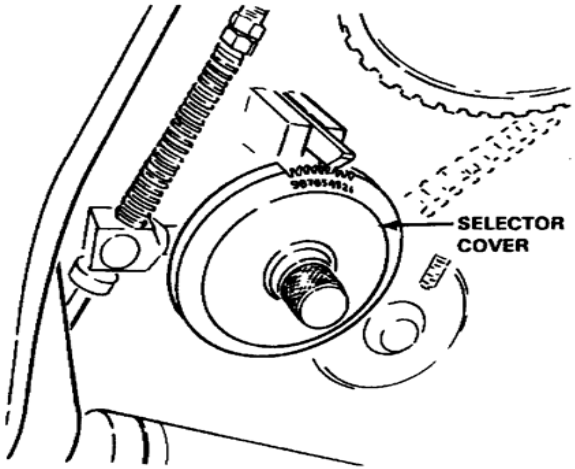



FIGURE 29

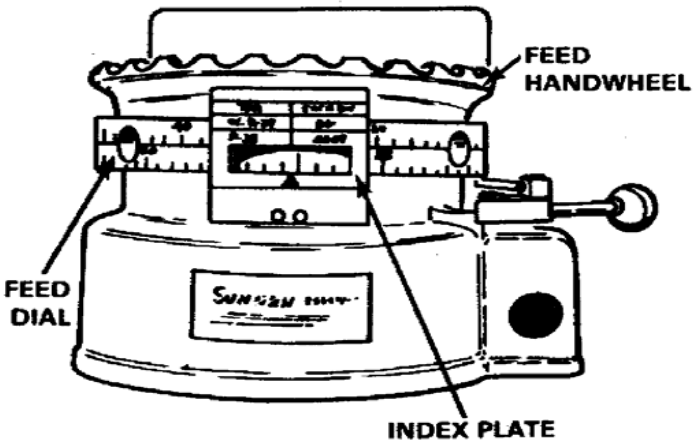



FIGURE 30

**Description of Operation**

Set the ratchet feed rate on the selector cover to 4. See figure 29

Use the index plate for the lower scale identified as P28 .005 per division.

Note: to change the Hand Wheel Assembly and Stroke Plate to Metric, order CV-215MA.

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | Hone-7 |
| 2 | 12/1/99 | Change note from .0005 to .005 |
| | | |
| | | |
| | | |

**View**

**Ratchet Feed & Index Plate**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 7 |

**Honing Operations Guide**

Rough Cut to Size (EHU-512 Stones)

1 Insert hone head into cylinder and rotate feed handle to the left while shaking the hone head until a slight resistance is felt.

2 Adjust the feed dial for the amount of stock to be removed. (See supplemental section IV.C. honing to size.

3 Set mode switch to zero shutoff.

4 Start honer and watch control panel for unit load and taper indication.
Unit load should be between 20 and 30 units during operation.
Adjust table for overstroke or dwell as necessary to eliminate taper.

Plateau or Finish Hone (C30-PHT-731 Plateau Honing Tool)

1 Insert hone head into cylinder and rotate feed handle to the left while shaking the hone head until a slight resistance is felt.

2 Adjust feed dial so it will not shut the machine off before the control panel timer.

3 Set mode switch to timed mode and set controller to 45 seconds.

4 Start honer and increase unit load to 20 to 30 units and allow to run until system shuts off.

**SEE SUPPLEMENTAL SECTION IV. HOW TO HONE**

**Description of Operation**

Use LP8X-55 Chlorine free fluid set at 7L/min. flow rate. Use dual canister filtration system with honing mats CV-1100. Change filters, fluid, and mats every 15 hours of operation.

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/7/98 | |
| | | |
| | | |
| | | |
| | | |

**View**

**Fluid and Operations Guide**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 8 |

## Cylinder Sizing Specifications

| | Metric mm | Inch |
|---|---|---|
| First Run Target Bore Size | 96.52 | 3.8000 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.515 | 3.7998 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.52 | 3.8000 |
| Second run Target Bore Size | 96.54 | 3.8008 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.535 | 3.8006 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.54 | 3.8008 |
| Third Run Target Bore Size | 96.56 | 3.8016 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.555 | 3.8014 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.56 | 3.8016 |
| Fourth Run Target Bore Size | 96.58 | 3.8024 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.575 | 3.8022 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.58 | 3.8024 |
| Fifth Run Target Bore Size | 96.60 | 3.8031 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.595 | 3.8030 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.60 | 3.8031 |
| Sixth Run Target Bore Size | 96.62 | 3.8039 |
| Hone with EHU-512 @ 20 to 30 units load to | 96.615 | 3.8037 |
| Hone with C30-PHT-731 @ 20 to 30 units load for 45 sec. | 96.62 | 3.8039 |

**Description of Operation**

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/8/98 | Cylinder sizing chart |
| | | |
| | | |
| | | |
| | | |

**View**

**Cylinder Size**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 9 |

## Honer Calibration

1 Setup the hone head and stroke length according to steps 1 through 7.
2 Insert the hone head into the cylinder and tighten the feed handwheel while shaking the drive tube until resistance is encountered.
3 Back off the handwheel until hone head is free and can be turned easily be hand in the cylinder.
4 Open the control panel to gain excess to the adjustment pots, i.e., zero & gain.
5 Start the honer and engage the hone head.
6 Adjust the load meter to read 10 units load using the gain adjustment.
7 The load unit watt meter is now ready for IIIF operations.

**Description of Operation**

**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/1/98 | Hone-10 |
| | | |
| | | |
| | | |
| | | |

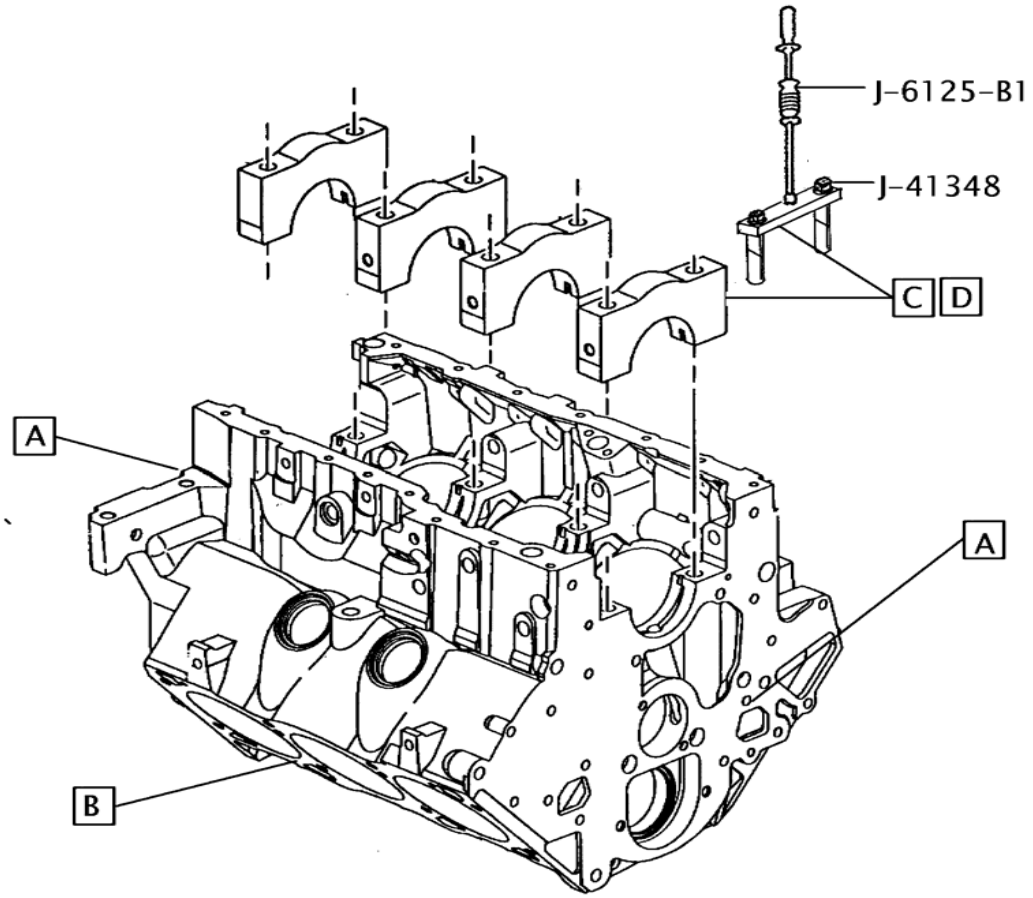
**View**

**Honer Calibration**

| Cylinder Honing | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 2 | 10 |

# Section 3

# Short Block Assembly




| Description of Operation | |
|---|---|
| A | Remove all block off plates |
| B | Remove torque plates |
| C | Remove main cap side & main bolts. |
| D | Use Kent-Moore J-41348 main bearing cap puller & J-6125-1B slide hammer to remove main caps.<br><br>Note: Main bearing caps are press fit. Do not hammer caps back and forth during removal. Damage to the caps may result in damage to engine bearings during test. |

**Specification**

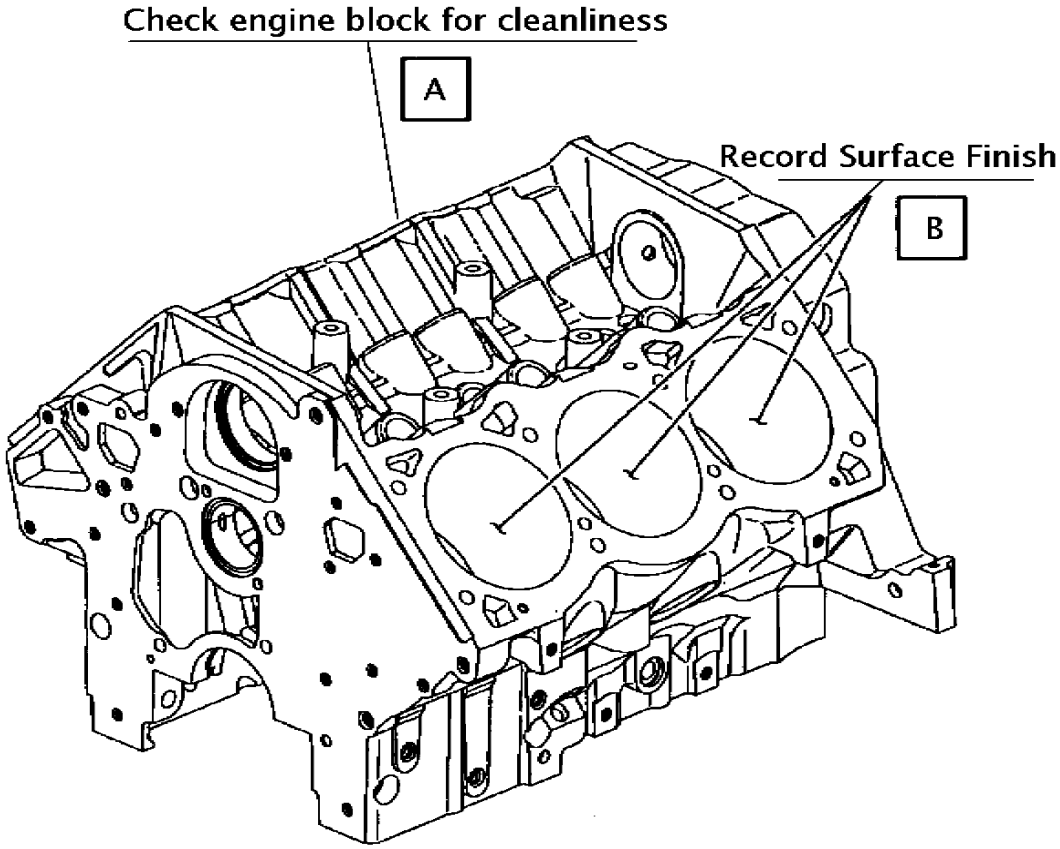
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/01/98 | Block-8 |
| | | |
| | | |
| | | |
| | | |

**View**

**Short Block**

Block off plate, torque plate and main cap removal

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 1 |




| Description of Operation | |
|---|---|
| A | Check engine block, camshaft tunnel, lifter bores, oil galleries, gasket surfaces, and cylinder bores for cleanliness. |
| B | Check and record cylinder bore surface finish Ra and confirm bore diameters / run number. |

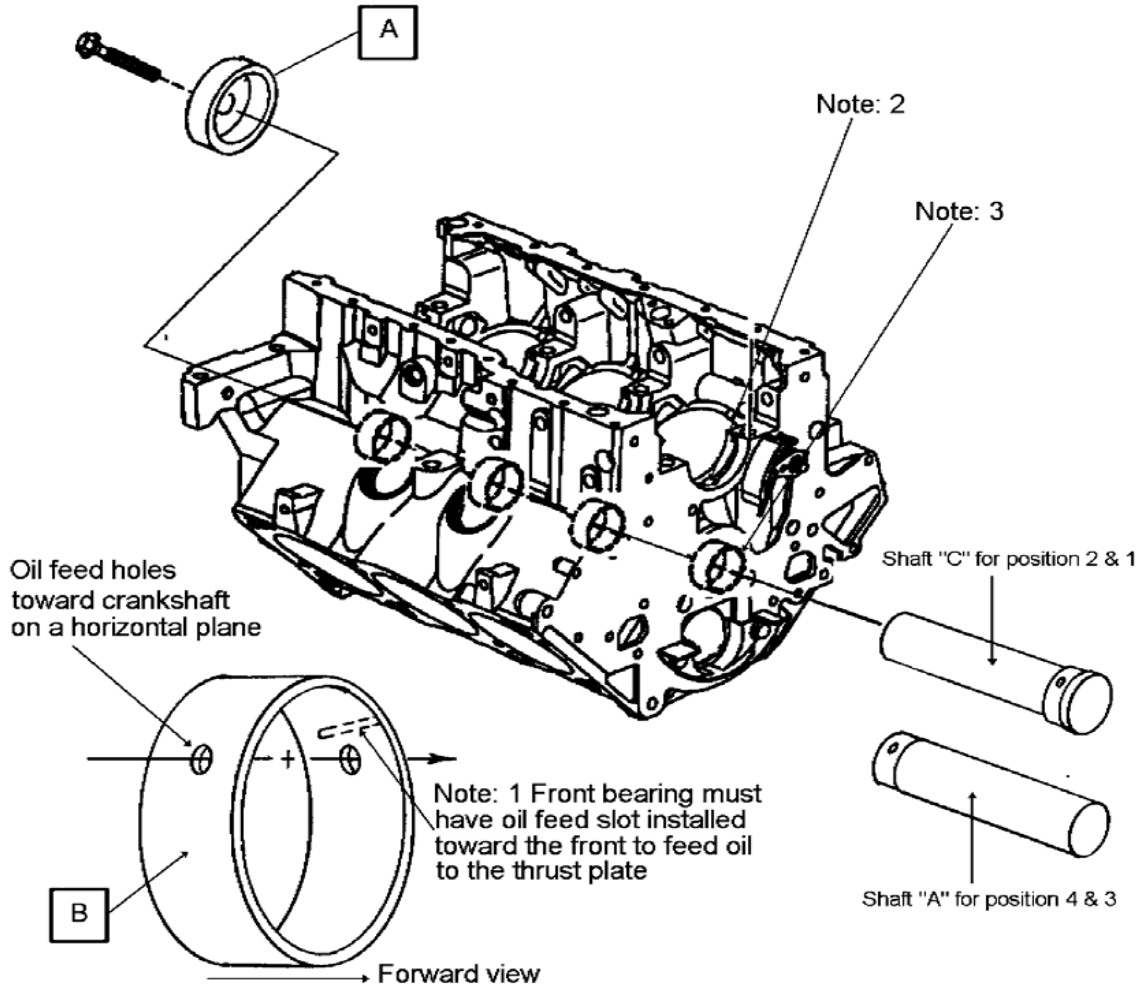
**Specification**

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/02/98 | Block-9 |
| | | |
| | | |
| | | |
| | | |

**View**

Engine block cleanliness inspection and cylinder surface finish/size recording

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 2 |



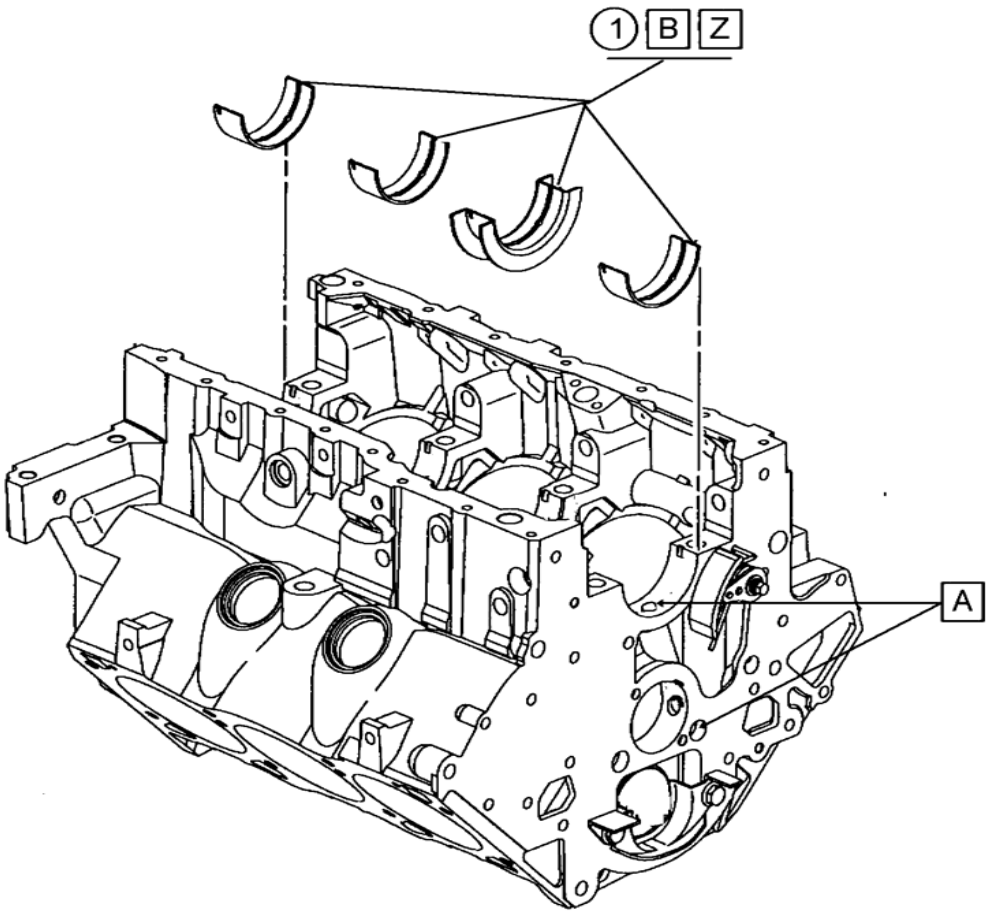

| Description of Operation | |
|---|---|
| A | Install camshaft bearings using OHT3F-019-1 camshaft bearing installation tool.<br>Sections:<br>A for #4 rear & #3 intermediate<br>C for #2 intermediate and #1 front |
| B | Lubricate bearing bore and bearing OD. with EF-411. Install bearings with the oil feed holes positioned toward the crankshaft on a horizontal plane.<br>See view "B" and Note: 1<br><br>Note: 2<br>Use a pen light to check intersection of oil feed hole when viewed through main bearing oil gallery.<br><br>Note: 3<br>Check bearing bores to remove sharp edge or burrs in leading edge and/or bore before installation. See Sec.1 Sheet 2 |

| Specification | |
|---|---|
| 1 | Bearing camshaft #1 & #4<br>OHT3F-028-09 |
| 2 | Bearing camshaft #2 & #3<br>OHT3F-028-10<br>Both bearings are included in<br>OHT3F-042-2 |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/02/98 | Block-10 |
| 2 | 10/12/98 | Update 2nd design block requires bearings 19581 & 19582 |
| 3 | 11/07/99 | Update part numbers and note 3 |
| 4 | 06/22/00 | Update part numbers |
| | | |

| View |
|---|
| **Short Block** |
| Camshaft bearing positioning and installation |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 3 |




| Description of Operation | |
|---|---|
| A | Using compressed air, blow through each oil gallery feed from the main bearing support through the camshaft bearings to dislodge any babbit material that might have come off the camshaft bearings during installation. Use an inspection light to ensure proper alignment of the camshaft bearings and that all debris has been removed from the main and lifter oil galleries. |
| B | Check the upper main bearing bores for cleanliness and install the upper main bearings in the engine block. |
| Z | Lubricate with EF-411 |

**Specification**

1 OHT3F-042-2
OH-101 (1,3,4, Upper)
OH-102 (1,3, Lower)
OH-103 (4 Lower)
OH-104 (2 Lower)
OH-105 (2 Upper)

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/03/98 | Block-11 |
| 2 | 11/07/99 | Revise drawing, add to "A" |
| 3 | 09/07/00 | Revise OHT3F-042-2 |
| | | |
| | | |

**View**

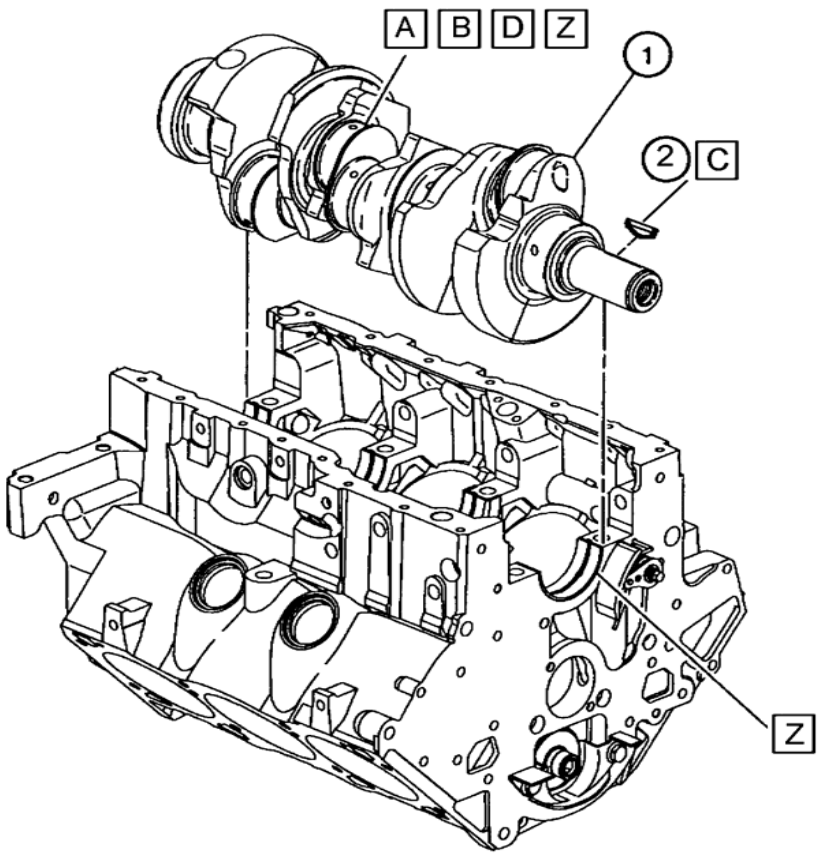
**Short Block**

Upper main bearing inspection and installation

## Short Block Assembly

## Sequence IIIF

| Section | Sheet |
|---|---|
| 3 | 4 |



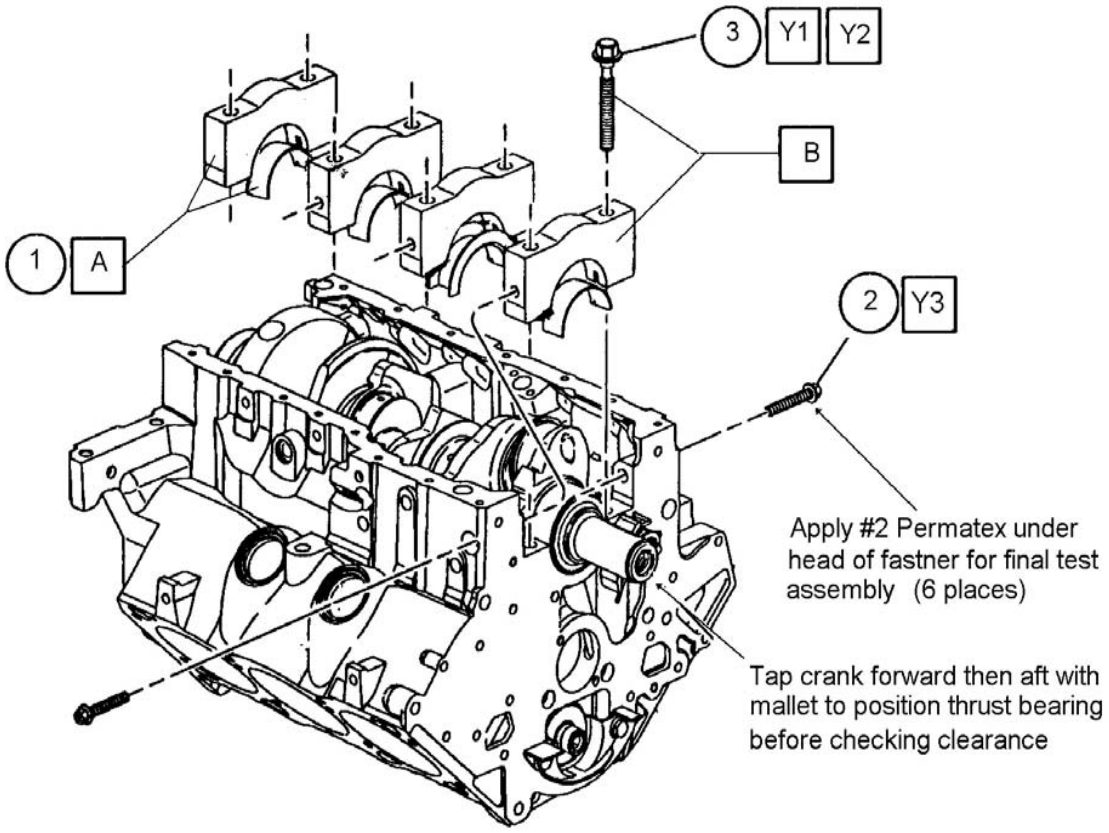

| Description of Operation | |
|---|---|
| A | Clean the crankshaft using an approved commercial cleaning agent followed by alipahtic naphtha and Mylar strip polishing cloth (use Mylar polishing cloth only if journals are nicked or oxidized, Do Not use to remove varnish). The final step should be aliphatic naphtha and nylon bristle brushing of the oil galleries. Spray crankshaft with 50/50 solution and blow excess with compressed air. |
| B | Check journal diameters.<br>Mains 63.470 - 63.495mm<br>Rods 57.1170 - 57.1475mm |
| C | Install key |
| D | Install crankshaft in engine block using care to not move the upper main bearings. |
| Z | Lubricate with EF-411 |

| Specification | |
|---|---|
| 1 | 24502168 Crankshaft |
| 2 | 25534912 Key |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/03/98 | Block-12 |
| 2 | 11/06/99 | Update for polishing with mylar tape and add key |
| 3 | 09/05/00 | Update Mylar tape polishing only if nicked or oxidized |
| 4 | 06/17/02 | Update "A" "Do Not use to remove varnish" |
| | | |

| View |
|---|
| Short Block |
| Crankshaft cleaning, inspection, and installatic |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 5 |



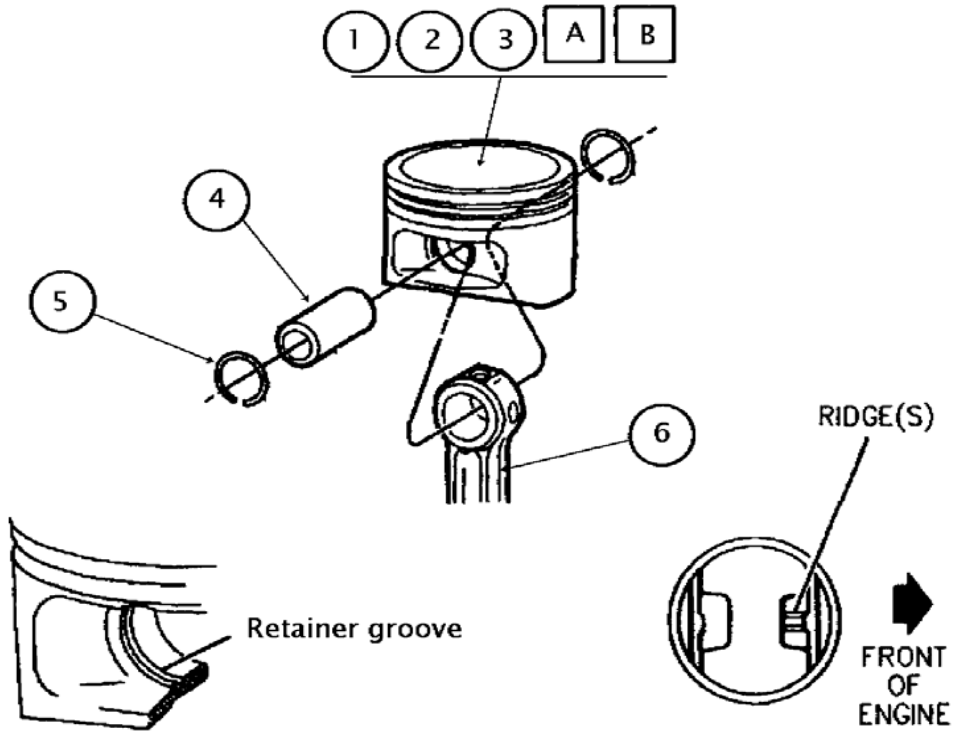

| Description of Operation | |
|---|---|
| A | Install lower main bearings into main caps. Clean and oil all main cap bolts (EF-411) and install main caps. Note: Do not use air tools to run main caps down. |
| B | Install main cap with fasteners as guides and tap into position with plastic mallet or use very light pressure by hand with speed handle and socket in crisscross pattern to draw the main cap down. |
| C | Install main cap side bolts |
| Y1 | Tighten all main bolts to 70 Nm to fully seat main caps and then loosen the bolts 360° counterclockwise. Check crankshaft end play 0.076 - 0.276mm |
| Y2 | Torque & Angle<br>20Nm then 40Nm + 35°+35°+35° (repeat 3 times from center out) |
| Y3 | Torque & Angle 15Nm + 45° (See note on sealer usage) |

| Specification | |
|---|---|
| 1 | OHT3F-042-2 Bearing kit |
| 2 | 24505576 Bolt side (6)<br>See note on sealer usage |
| 3 | 24503056 Bolt main cap (8) |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/10/98 | Block-13 |
| 2 | 09/07/00 | Revise part number OHT3F-042-2 |
| 3 | 02/01/02 | Update Description add "C" change "Z to Y3" |
| | | |
| | | |

| View |
|---|
| **Short Block** |
| Lower main bearing and crankshaft final test installation |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 6 |




| Description of Operation | |
|---|---|
| A | Confirm run number and proper grade piston selections. |
| B | Lubricate piston pin and connecting rod with EF-411. Install one piston pin retainer clip into the retaining groove. Install the con rod with the dimple to the rear and piston pin. Install the second retainer clip. Make sure both retainer clips are properly seated in their grooves. |

| Specification | |
|---|---|
| 1 | OHT3F-053-1 Grade 12 test piston set |
| 2 | OHT3F-054-1 Grade 34 test piston set |
| 3 | OHT3F-055-1 Grade 56 test piston set |
| 4 | OHT3F-014-1Piston pin set |
| 5 | OHT3F-012-1 Retainer clip set |
| 6 | 24501696 Connecting rod |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/03/98 | Block-14 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Piston, Pin and Connecting Rod |
| Piston pin and Connecting Rod assembly |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 7 |

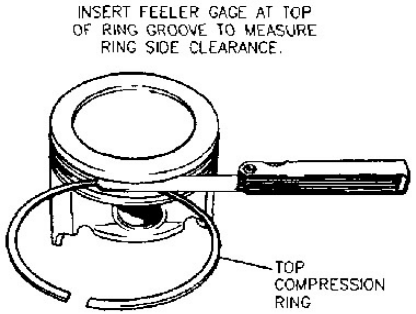
## Hard Metric Piston & Ring Sizes

+/-0.0254mm

| Grade/Run | Bore Size | Gage | Target Ring Gap | Piston Size |
|---|---|---|---|---|
| 12/1st | 96.52 | 96.53 | Top 1.067 2nd 0.965 | 96.482 - 96.497 |
| 12/2nd | 96.54 | 96.53 | Top 1.067 2nd 0.965 | 96.482 - 96.497 |
| 34/3rd | 96.56 | 96.57 | Top 1.067 2nd 0.965 | 96.522 - 96.537 |
| 34/4th | 96.58 | 96.57 | Top 1.067 2nd 0.965 | 96.522 - 96.537 |
| 56/5th | 96.60 | 96.61 | Top 1.067 2nd 0.965 | 96.562 - 96.577 |
| 56/6th | 96.62 | 96.61 | Top 1.067 2nd 0.965 | 96.562 - 96.577 |

All gaps to be +/- 0.0254mm,

**As measured in Ring Gage using Starrett Taper Gage # 270**



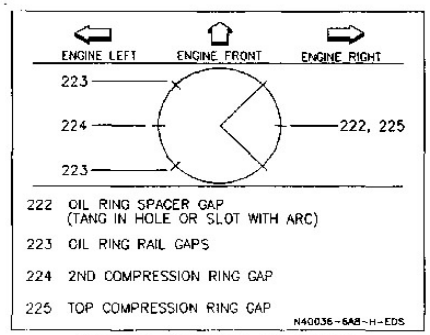




Figure 64 - Piston Ring Gap Location

### Description of Operation

Confirm correct ring grade and gaps for the engine run / piston grade. No piston ring gap adjustments are allowed.

Check for proper ring side clearance.
Top & 2nd. 0.033 - 0.079mm
Oil control 0.023 - 0.201mm

Position rings on piston according to ring stagger chart.

Lubricate assembly with EF-411

To check ring gap, use OHT3F - 050, 051, and 052 Ring Gage with Starrett Taper Gage #270

### Specification

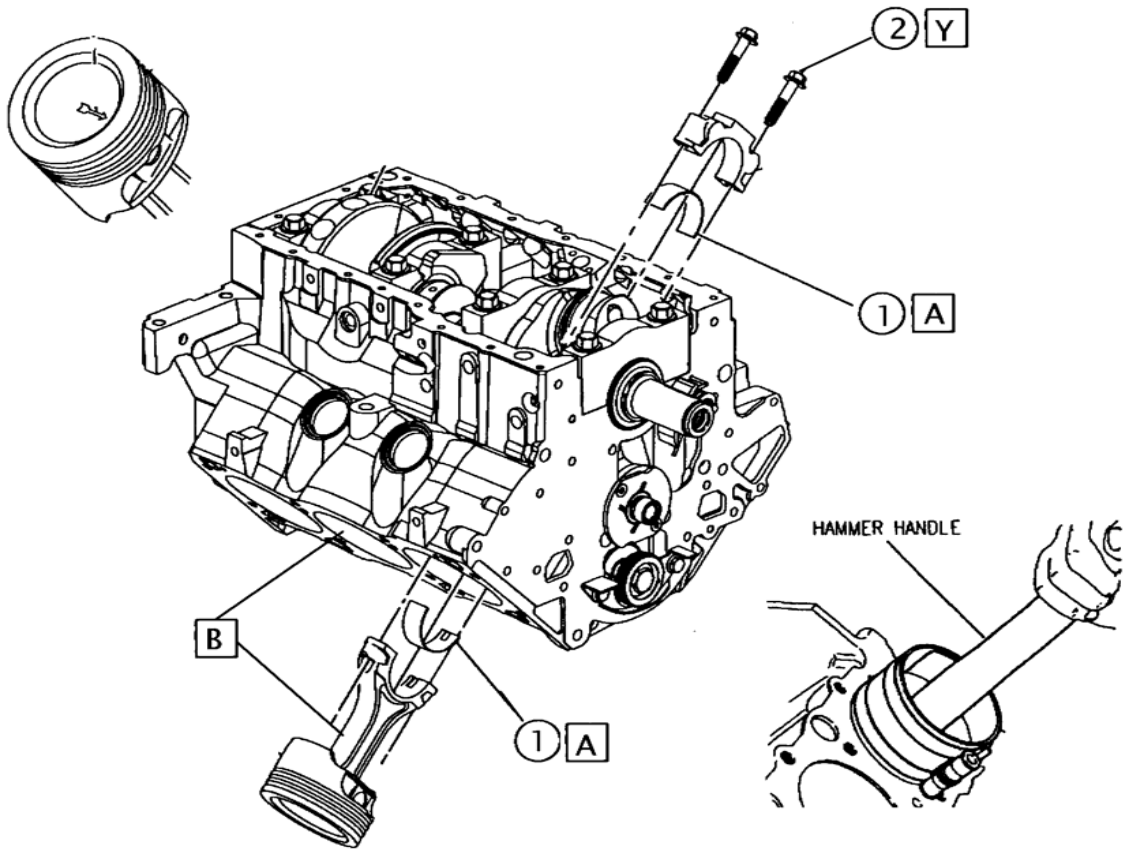
| | |
|---|---|
| 1 | OHT3F-050 Ring set run 1 |
| 2 | OHT3F-050 Ring set run 2 |
| 3 | OHT3F-051 Ring set run 3 |
| 4 | OHT3F-051 Ring set run 4 |
| 5 | OHT3F-052 Ring set run 5 |
| 6 | OHT3F-052 Ring set run 6 |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/03/98 | Block-15 |
| 2 | 11/13/99 | Update reverse ring gap dimensions |
| 3 | 06/20/00 | Update reverse ring gap dimensions |
| 4 | 09/07/00 | Update text box (Ring Gap Instructions & Part Numbers) |
| 5 | 02/01/02 | Update picture to include Starrett Taper Gage |

### View

**Piston Ring**

Piston ring installation and clearance



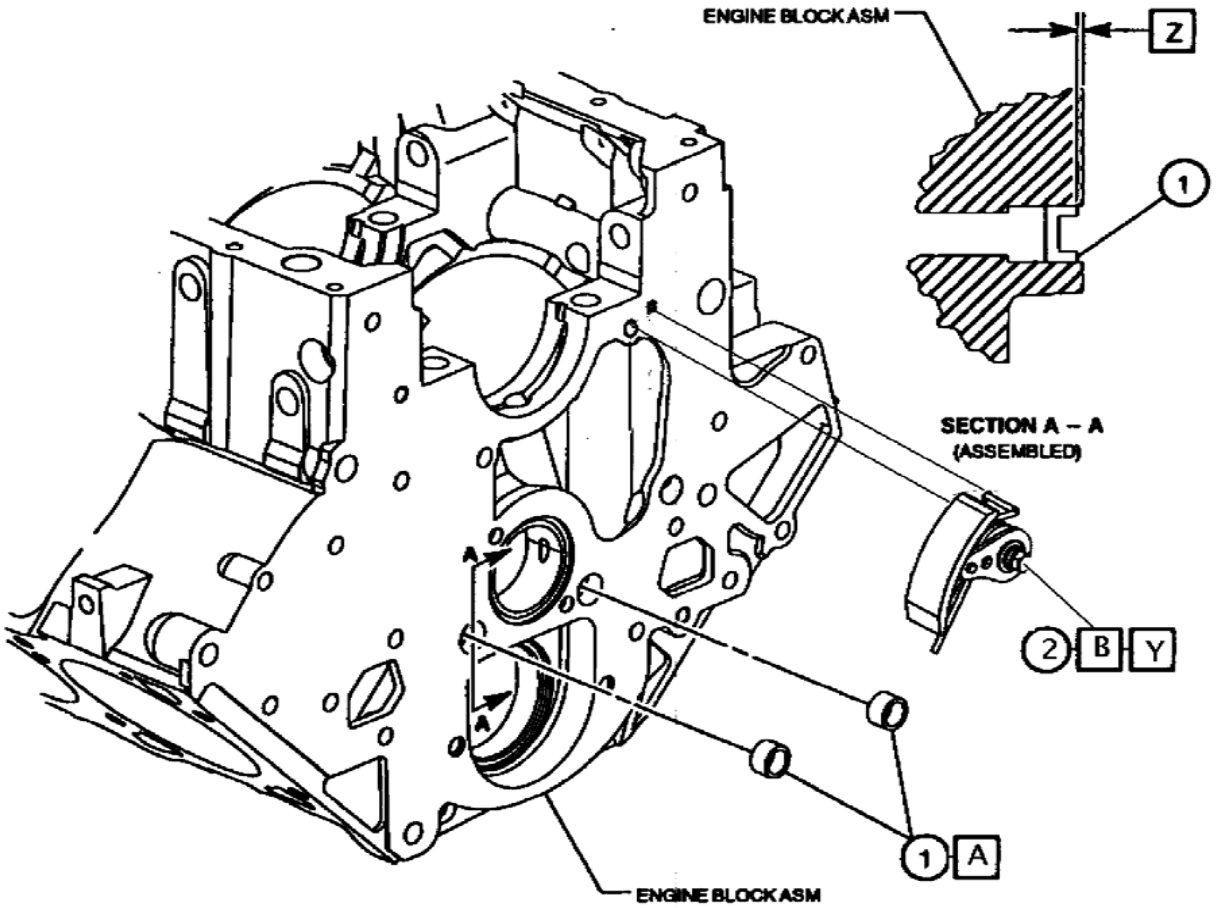

| Description of Operation | |
|---|---|
| A | Install connecting rod bearings and lubricate assembly with EF-411. |
| B | Clean cylinder bores and lubricate with EF-411. Install piston assembly using suitable piston ring compressor and soft ended installation tool. |
| Y | Torque & Angle<br>27Nm + 50° |
| C | Check connecting rod side clearance<br>0.102 - 0.508mm |

| Specification | |
|---|---|
| 1 | OHT3F-042-2 Con rod bearing<br>OH-106 |
| 2 | 25531956 Bolt con rod |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/3/98 | Block-16 |
| 2 | 11/7/99 | Update OHT part number |
| | | |
| | | |
| | | |

| View |
|---|
| Short Block |
| Piston and rod assembly installation |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 9 |



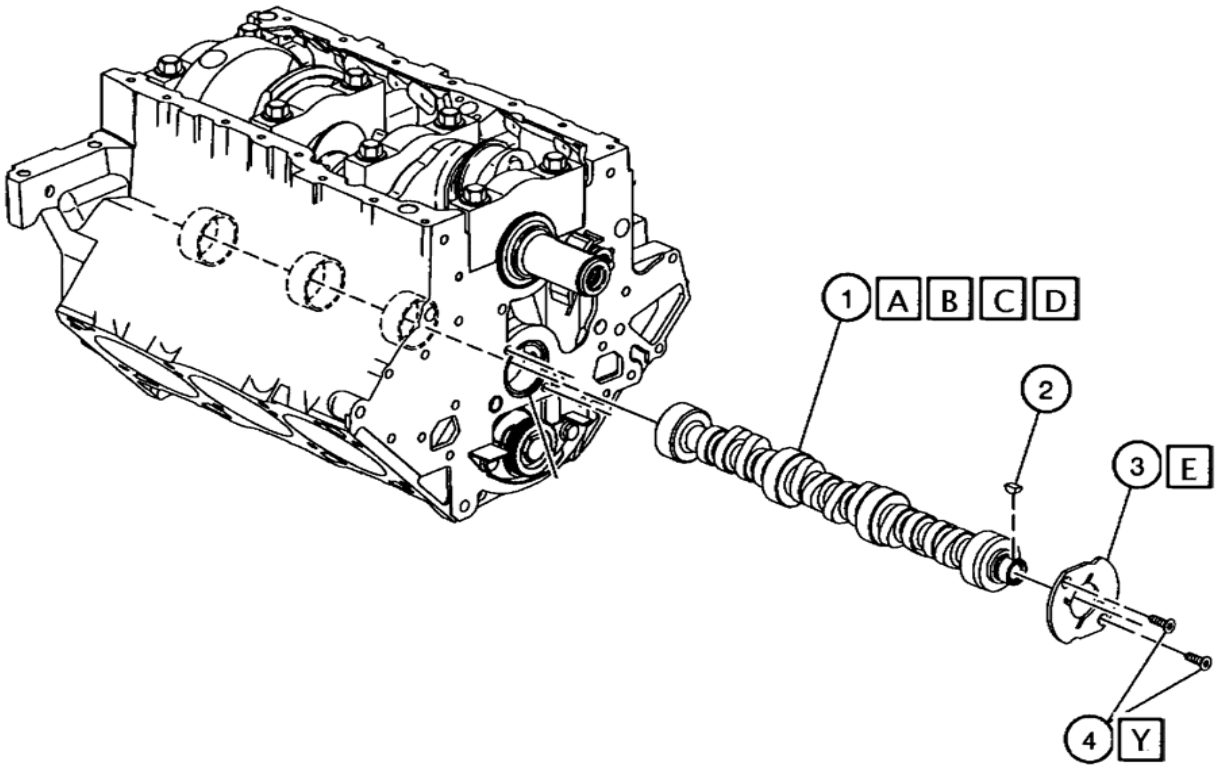

| Description of Operation | |
|---|---|
| A | Install oil gallery plugs, see cross section A - A. |
| B | Install damper assembly |
| Y | Torque 22Nm |
| Z | Locate cup plug 1.5 +/- 0.75mm below front face of block. |

| Specification | |
|---|---|
| 1 | 3835577 Plug, oil gallery |
| 2 | 24503893 Damper assembly |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/3/98 | Block-17 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Short Block |
| Oil gallery plugs and timing chain damper |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 10 |



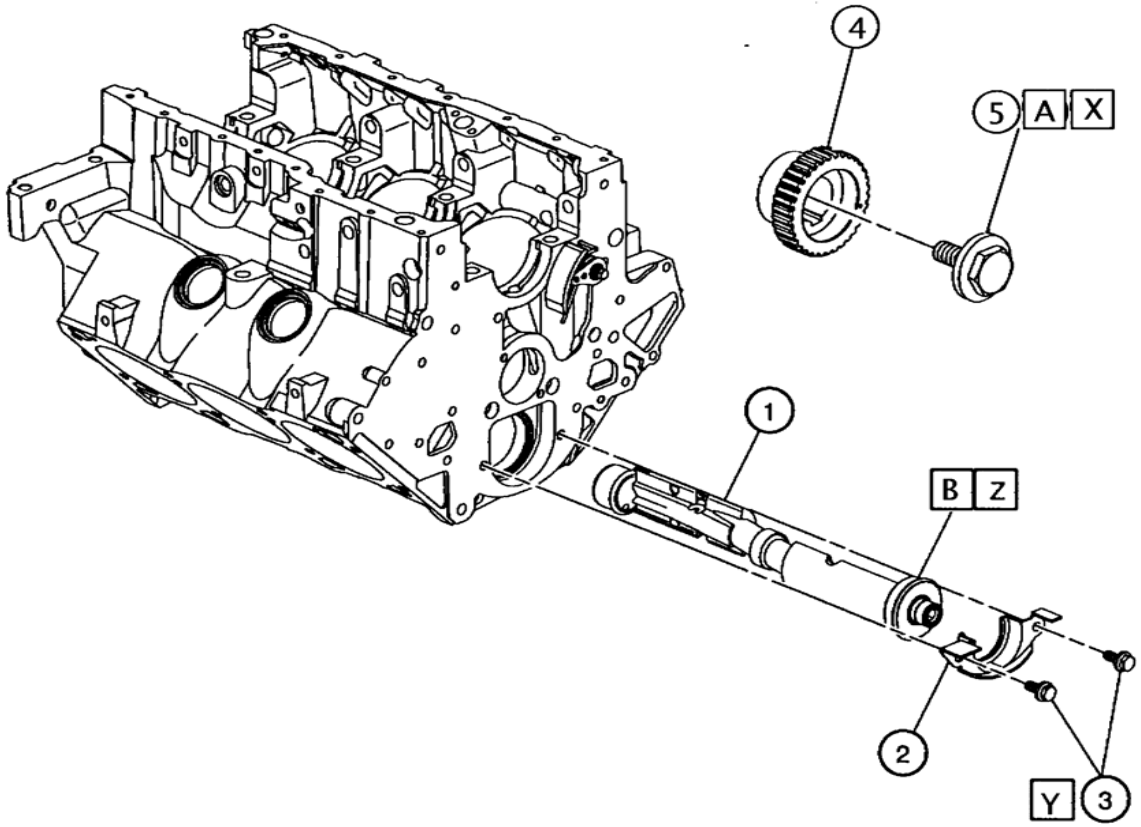

| Description of Operation | |
|---|---|
| A | Check and de-burr if necessary, the front thrust surface of the camshaft. |
| B | Clean camshaft with alipahtic naphtha and very clean shop towel. Note: make sure all grinding residue is removed before continuing. |
| C | Make pre-test measurements at the rear side of each lobe and record to the nearest 0.001mm. |
| D | Lubricate the camshaft journals and lobes with EF-411 and install. |
| E | Lubricate thrust plate and install |
| Y | Torque 15Nm |

| Specification | |
|---|---|
| 1 | OHT3F-008-6 Camshaft |
| 2 | 24500618 Key (Replace each test) |
| 3 | OHT3F-011-2 Thrust plate (0.152") |
| 4 | 25519242 Bolt/screw |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/13/98 | Block-18 |
| 2 | 11/13/99 | Add De-burring operation |
| 3 | 6/22/00 | Change part number for 0.153" Thrust Plate |
| 4 | 10/18/00 | Update Description of Operation |
| 5 | 2/1/02 | Add note item #2 (replace each test) #3 (0.152") & OHT3F-008-6 |

| View |
|---|
| **Short Block** |
| Camshaft cleaning, measurement, and installation |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 11 |




| Description of Operation | |
|---|---|
| A | Secure balance shaft in a smooth jawed vice and install drive gear and bolt. |
| B | Inspect balance shaft and roller bearing for cleanliness and install. |
| X | Torque & Angle 22Nm + 70° |
| Y | Torque 30Nm |
| Z | Lubricate with EF-411 |

**Specification**

| | | |
|---|---|---|
| 1 | 24502388 | Shaft Assembly |
| 2 | 24500374 | Retainer |
| 3 | 24500055 | Bolt |
| 4 | 24503524 | Gear |
| 5 | 24501367 | Bolt |

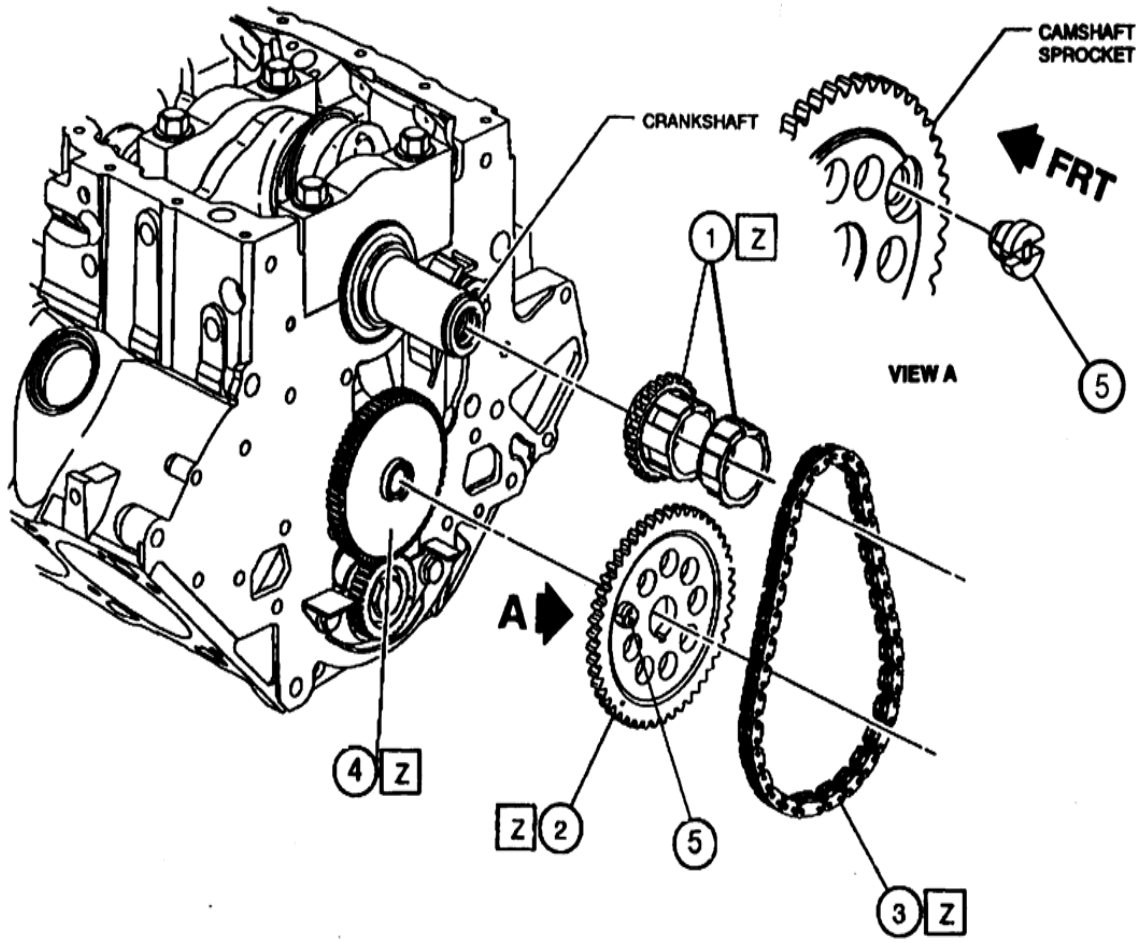
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/5/98 | Block-19 |
| | | |
| | | |
| | | |
| | | |

**View**

**Short Block**

Balance shaft inspect & install

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 12 |



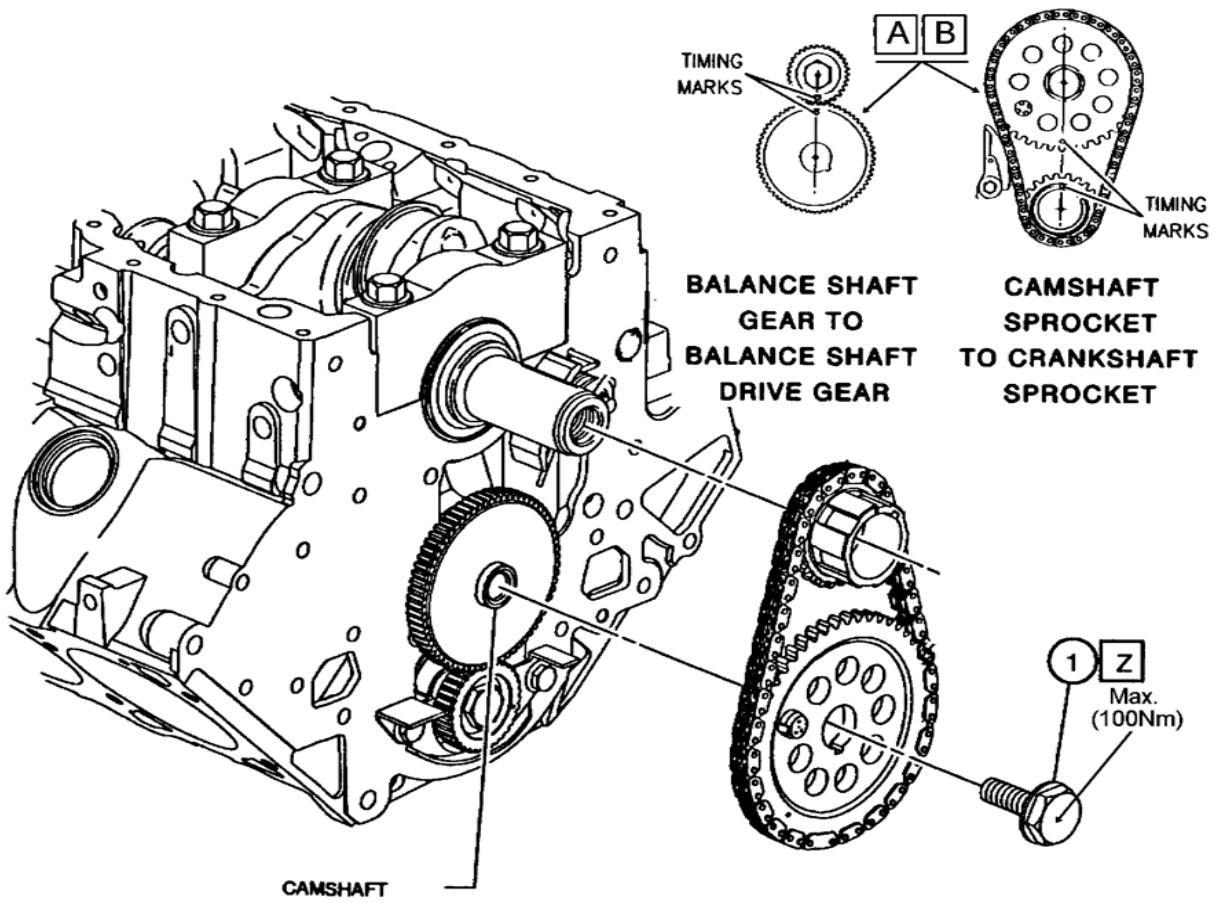

| Description of Operation | |
|---|---|
| | Timing gear set. See part number information. |
| A | Install magnet See view "A" |
| Z | Lubricate with EF-411 |
| | Note: Inspect balance shaft and replace as necessary if damage to gear teeth and / or thrust surface is evident. |

| Specification | |
|---|---|
| 1 | OHT3F-036-1 Sprocket, 2pc. |
| 2 | 24505306 Sprocket, camshaft |
| 3 | 24504668 Chain |
| 4 | 24504792 Gear |
| 5 | 10456195 Magnet |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/5/98 | Block-20 |
| 2 | 11/7/99 | Update view "A" |
| 3 | 6/17/02 | Add note to description about inspecting balance shaft drive gear. |
| | | |
| | | |

| View |
|---|
| Short Block |
| Timing gear set |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 13 |




| Description of Operation | |
|---|---|
| A | Lubricate all gear sets and chain with EF-411 |
| B | Align timing marks on balance drive and driven gears.<br>Align timing marks on camshaft and crankshaft sprockets. |
| Z | Torque 100Nm + 90°<br>**(Hold assembly by the crankshaft during torquing)** |

| Specification | |
|---|---|
| 1 | 24501366 Bolt, camshaft sprocket<br>**(Replace fastener each application)** |

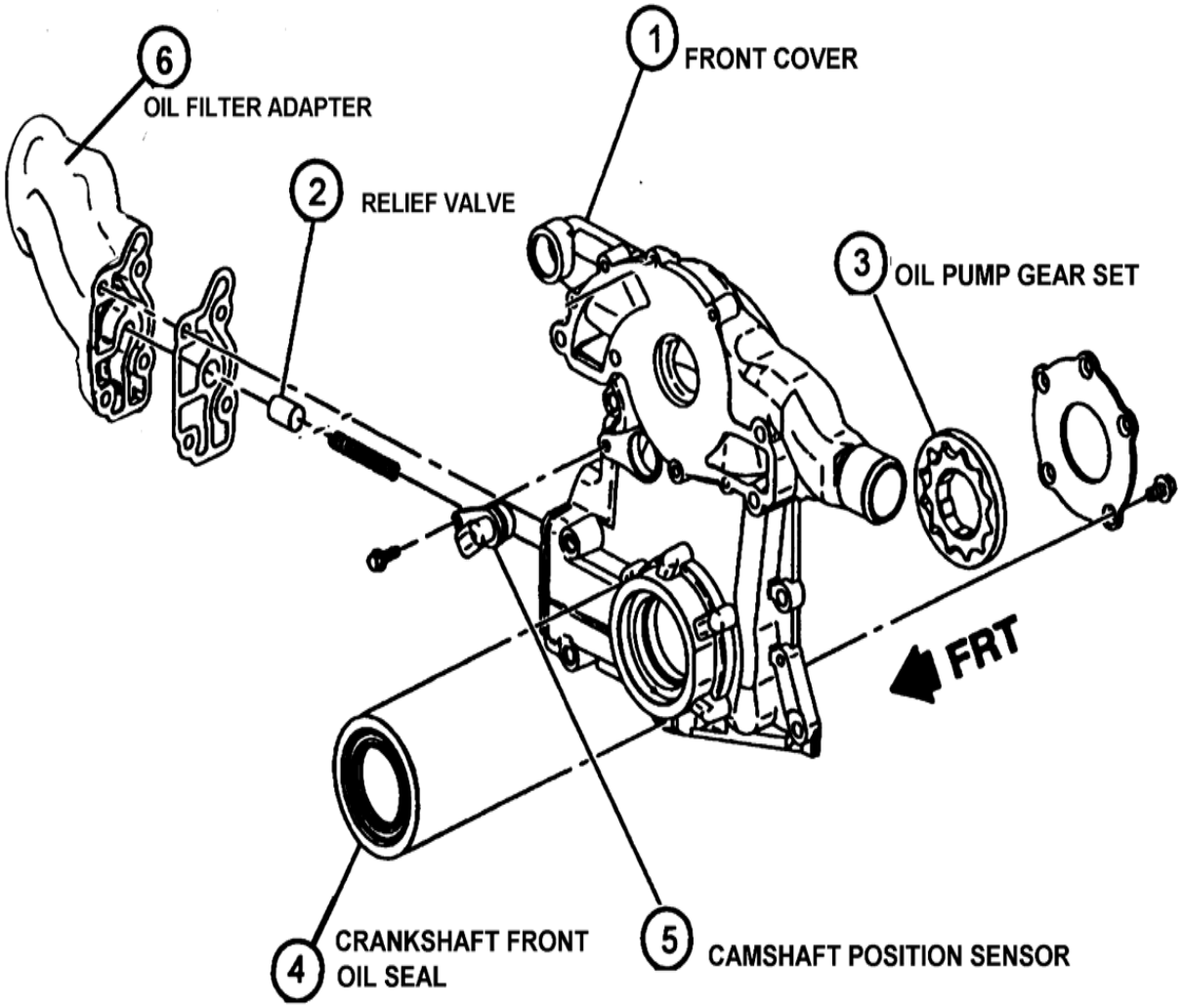
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/5/98 | Block-21 |
| 2 | 11/7/99 | Update view "A,B,Z" |
| 3 | 2/1/02 | Update "Z" torque and #1 "Replace fastener each application" |
| | | |
| | | |

| View |
|---|
| **Short Block** |
| Timing gear set alignment & torque |

| Short Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 3 | 14 |

# Section 4

# Front Cover, Rear Cover, and Sump



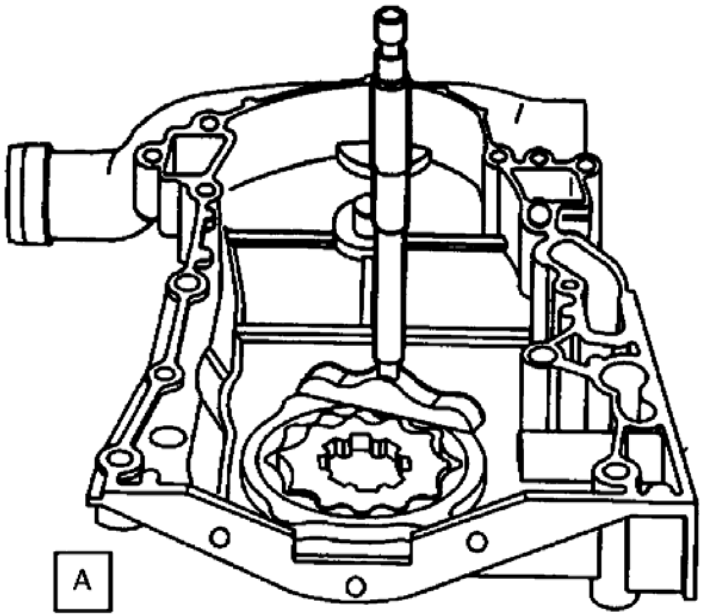

| Description of Operation |
|---|
| Assembly view |

| Specification | |
|---|---|
| 1 | 24502241 Cover assembly |
| 2 | 25530949 Valve, oil pressure relief |
| 3 | 24505433 Oil pump gear set |
| 4 | 24504098 Seal |
| 5 | 10456148 Camshaft position sensor |
| 6 | 24501300 Adapter, oil filter |

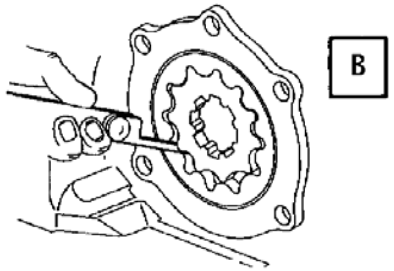
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-22 |
| 2 | 11/06/99 | Update view, add 24501300 Adapter |
| | | |
| | | |
| | | |

| View |
|---|
| **Front Cover** |
| Front cover assembly view |

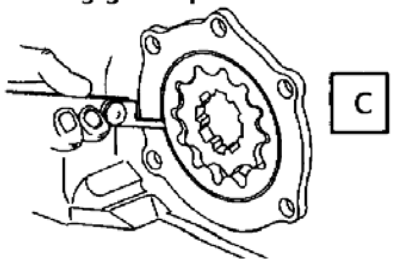
| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 1 |




Measuring gear end clearance drop in housing




Measuring gear tip clearance




Measuring outer gear dia. clearance

| Description of Operation | |
|---|---|
| A | Measure gear drop in housing<br>0.025 - 0.089mm |
| B | Measure gear tip clearance;<br>0.076 - 0.127mm (0.003 - 0.007in) as measured with gear teeth in mesh with opposite side. |
| C | Measure outer gear diameter clearance<br>0.025 - 0.127mm (0.001 - 0.005in) |
| | Note: Inspect front cover oil gear housing for evidence of wear from previous test. Replace as necessary if wear is evident. |

**Specification**

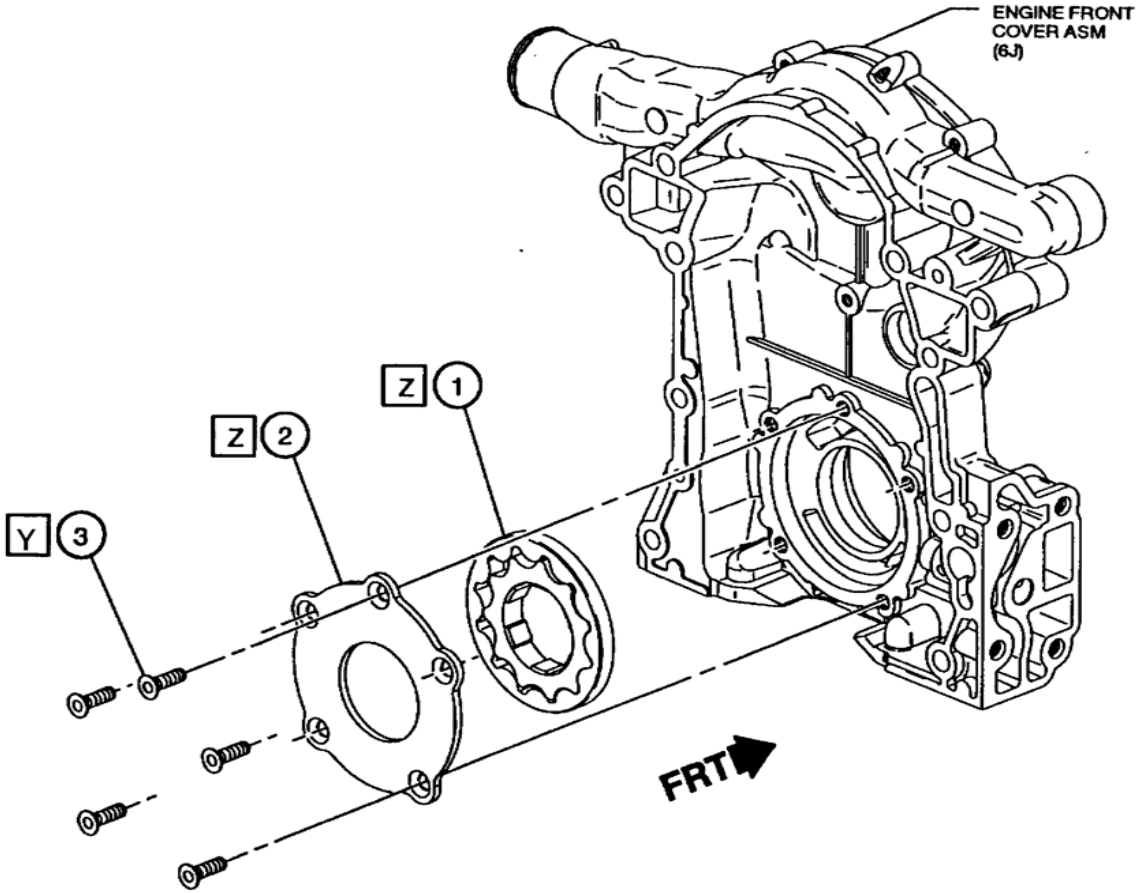
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-23 |
| 2 | 10/18/00 | Update outer gear diameter clearance specification |
| 3 | 02/14/02 | Add "B" clearance specification |
| 4 | 06/17/02 | Add note to description to inspect oil gear housing for evidence of wear |
| | | |

**View**

**Front Cover**

Oil pump gear clearance

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 2 |




| Description of Operation | |
|---|---|
| Y | Torque 11Nm |
| Z | Lubricate with EF-411 |

| Specification | | |
|---|---|---|
| 1 | 24505433 | Gear set |
| 2 | 25521935 | Cover |
| 3 | 25519242 | Bolt |

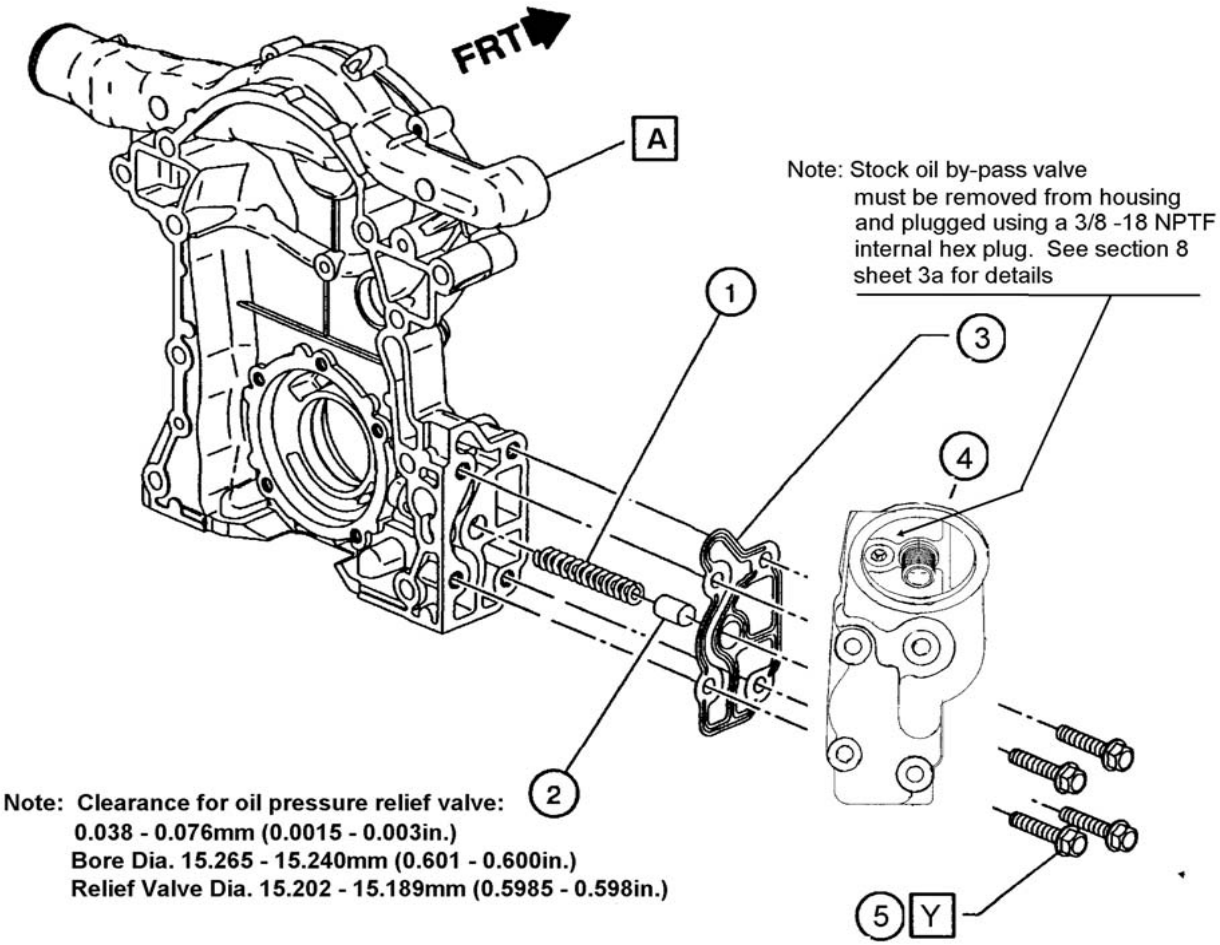
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-24 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Front Cover |
| Front cover oil gear install |

# Front Cover, Rear Cover, & Sump

## Sequence IIIF

| Section | Sheet |
|---|---|
| 4 | 3 |



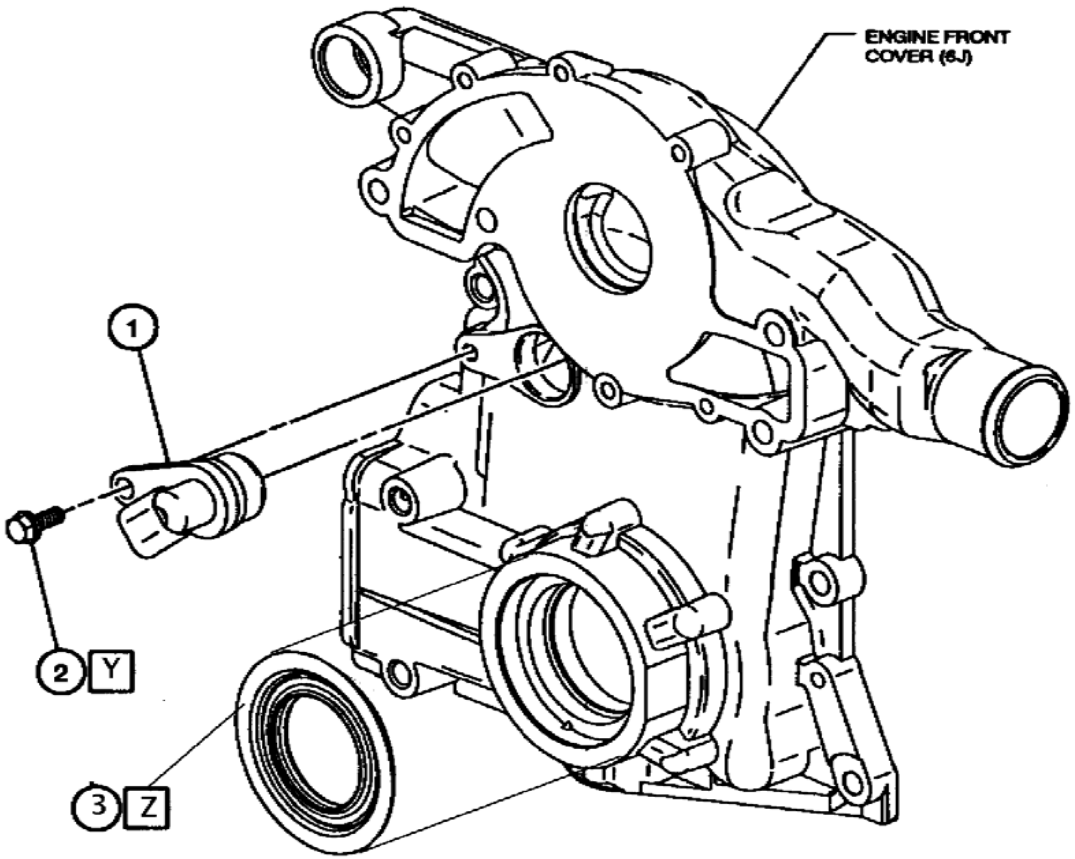

| Description of Operation | |
|---|---|
| A | Front cover oil filter adapter assembly |
| Y | Torque 30Nm<br><br>May use Perfect Seal #4 on threads of fasteners and gasket |

| Specification | |
|---|---|
| 1 | 1262505 Spring |
| 2 | 25530949 Valve |
| 3 | 25534742 Gasket |
| 4 | 24501300 Adapter, oil filter<br>Modified OHT3F-080-1 |
| 5 | 24504713 Bolt |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-25 |
| 2 | 12/01/99 | Add sealer usage |
| 3 | 02/04/02 | Add clearance note in drawing for pressure relief valve |
| 4 | 06/17/02 | Add note to replace stock by-pass valve with 3/8 -18 NPTF internal hex plug |
| | | |

| View |
|---|
| Front Cover |
| Front cover oil filter adapter assembly |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 4 |



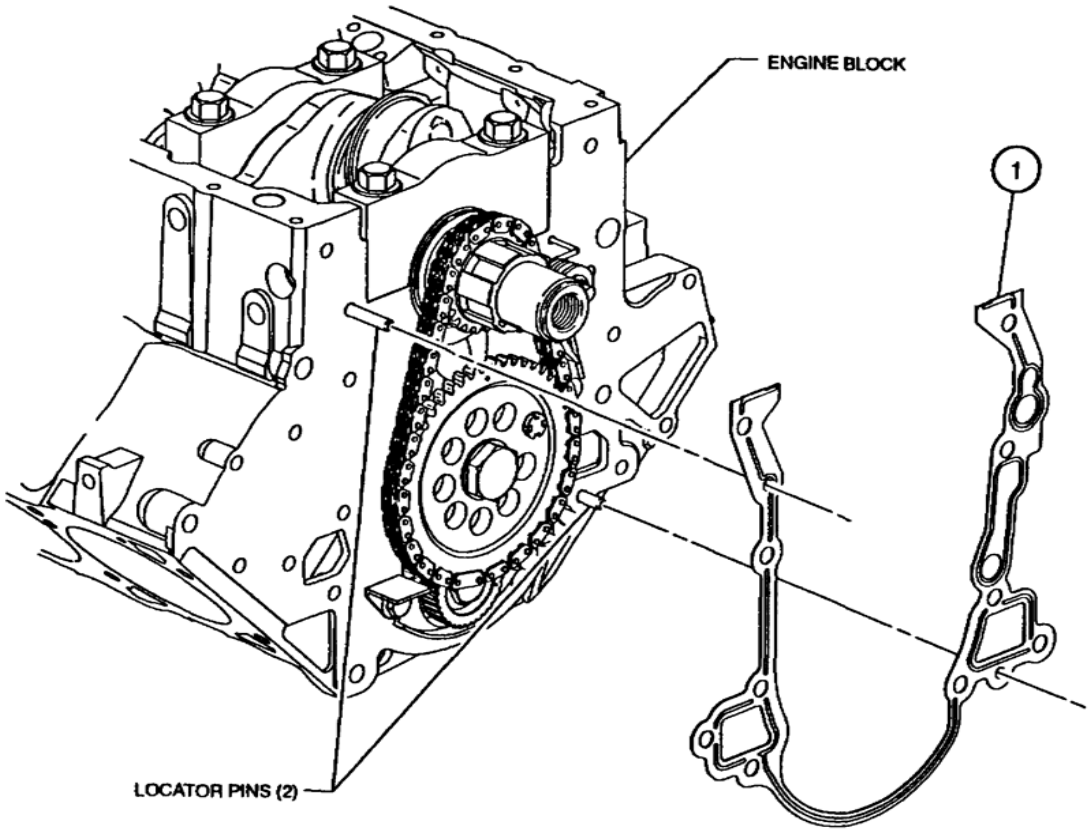

| Description of Operation | |
|---|---|
| Y | Torque 30Nm |
| Z | Use a light application of #4 Permatex around the rear side of the seal where it contacts the front cover. |

| Specification | | |
|---|---|---|
| 1 | 10456148 | Camshaft sensor |
| 2 | 25526395 | Bolt |
| 3 | 24504098 | Seal |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-29 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Front Cover |
| Front cover camshaft sensor and seal install |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 5 |




**Description of Operation**

Note:
Perfect seal #4 may be used around coolant passages on gasket.

**Specification**

| | | |
|---|---|---|
| 1 | 24502252 | Gasket |

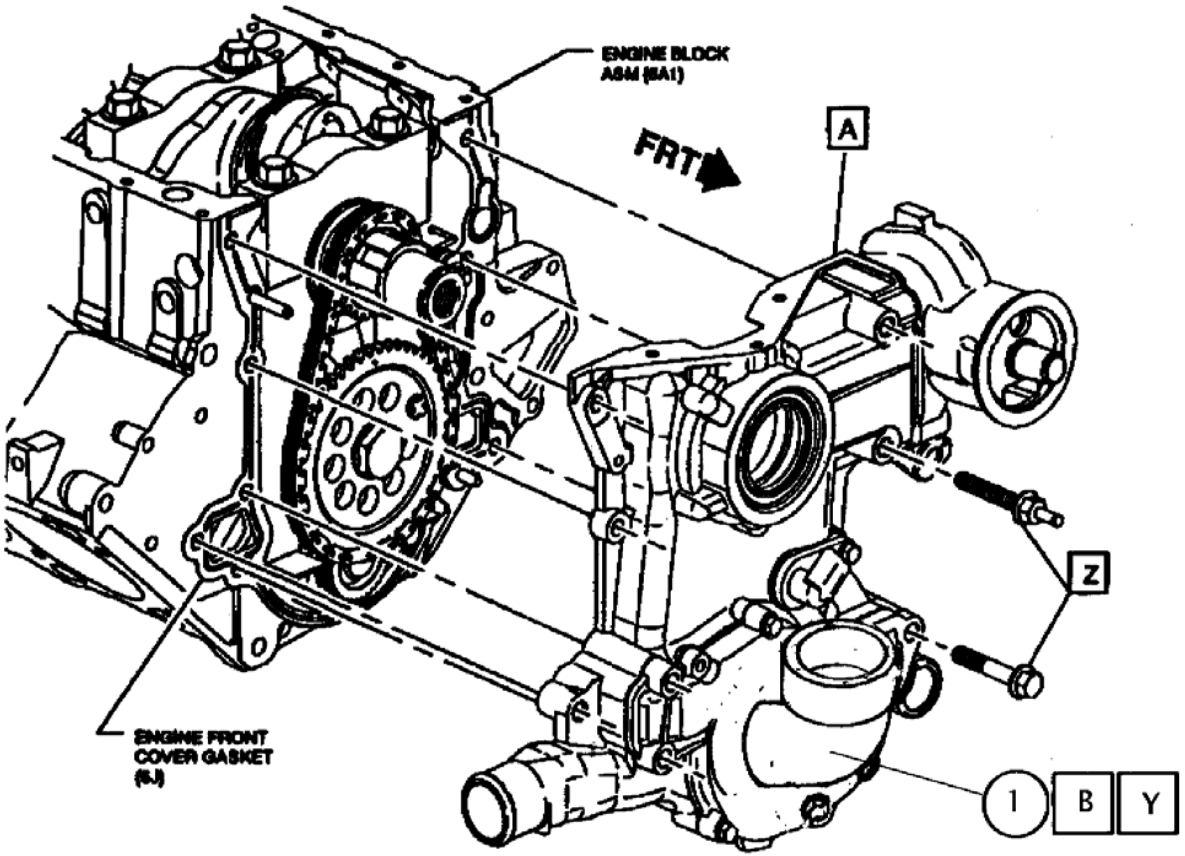
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-26 |
| 2 | 12/01/99 | Add Note on Perfect seal |
| | | |
| | | |
| | | |

**View**

**Front Cover**

Front cover gasket install

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 6 |



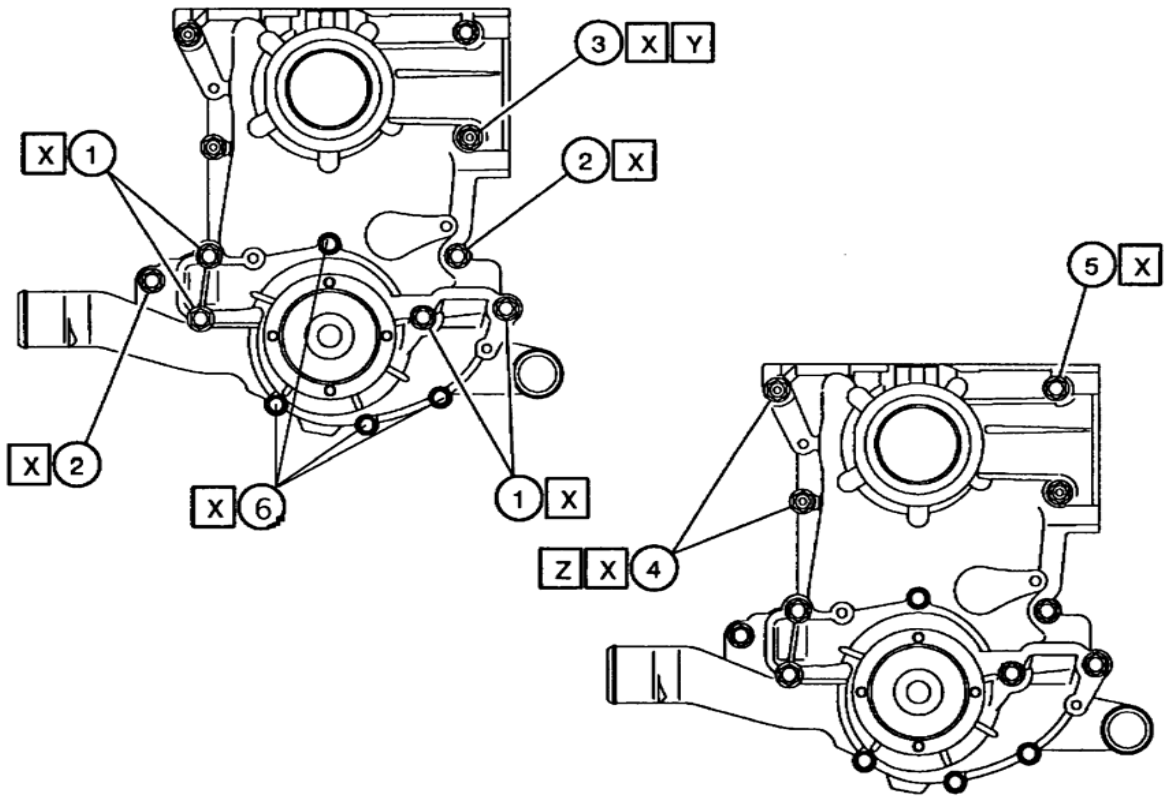

| Description of Operation | |
|---|---|
| A | Front cover assembly |
| B | Install coolant inlet adapter with front cover |
| Y | Torque 30Nm<br><br>Install thermocouple in OHT3F-031 with sensing tip centered in flow. |

| Specification | |
|---|---|
| 1 | OHT3F-031-3<br>Bolts included on print |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-30 |
| 2 | 12/01/99 | Add thermocouple information |
| | | |
| | | |
| | | |

| View |
|---|
| **Front Cover** |
| Front cover install |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 7 |




| Description of Operation | |
|---|---|
| X | Torque 30Nm |
| Y | Stud also holds crankshaft sensor shield |
| Z | Studs also hold crankshaft sensor shield and sensor |

| Specification | |
|---|---|
| 1 | OHT Kit |
| 2 | 24504713 Bolt (2) |
| 3 | 24504718 Stud (2) |
| 4 | 24504717 Stud (2) |
| 5 | 24504712 Bolt |
| 6 | OHT Kit |

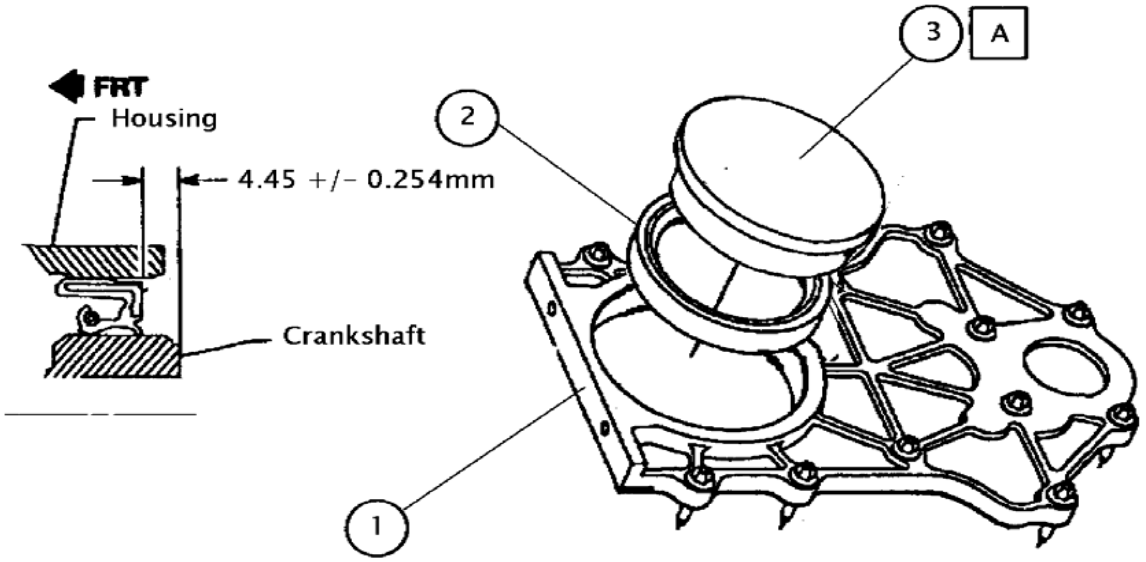
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-28 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Front Cover |
| Front cover bolt placement |

# Front Cover, Rear Cover, & Sump

## Sequence IIIF

| Section | Sheet |
|---|---|
| 4 | 8 |



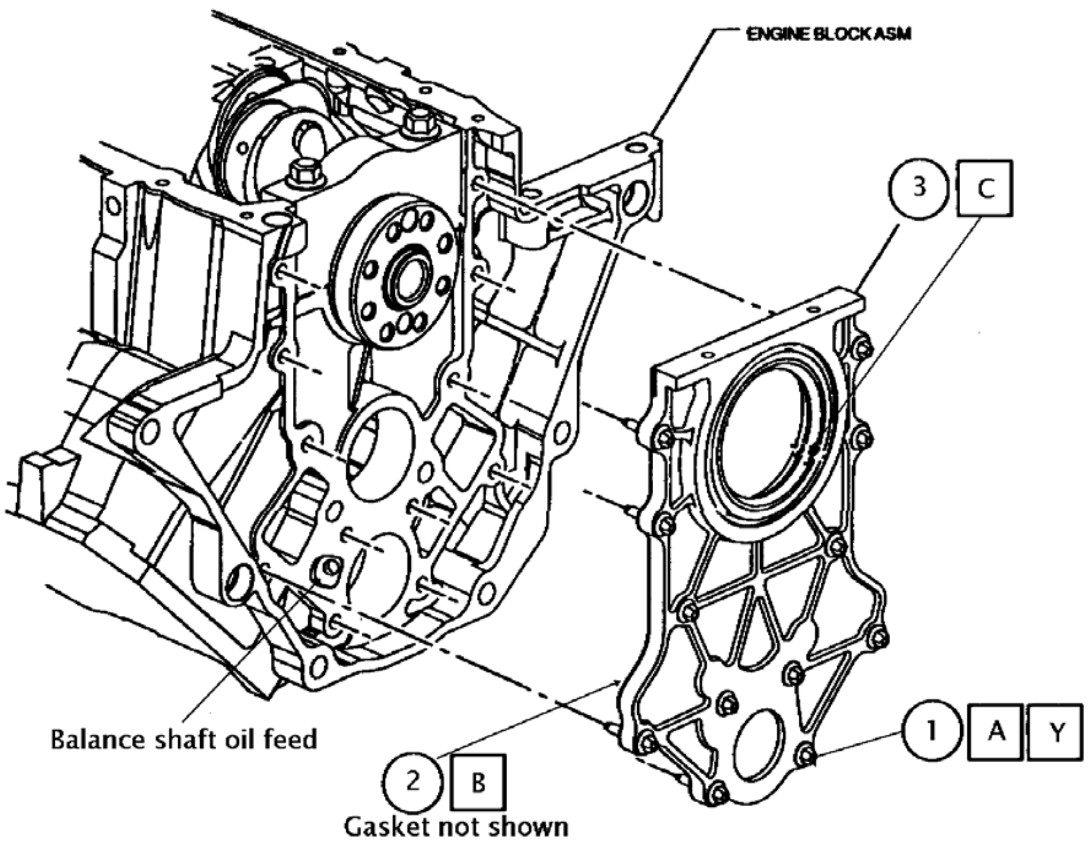

| Description of Operation | |
|---|---|
| A | Install rear main lip seal using GM R&D supplied installation tool and a light duty bench press until seal bottoms in housing. |

| Specification | |
|---|---|
| 1 | 24502297 Rear cover housing |
| 2 | 25534760 Seal |
| 3 | GM R&D Seal Installation Tool |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-31 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Rear Cover |
| Rear seal installation |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 9 |



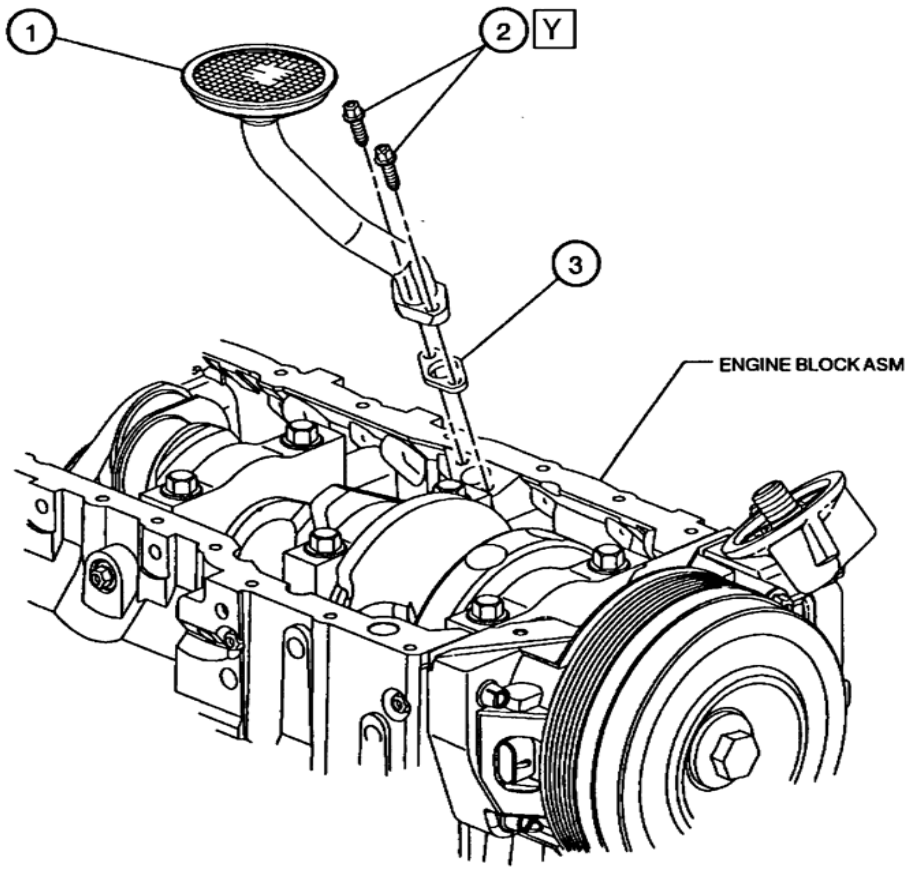

| Description of Operation | |
|---|---|
| A | Install new bolts with nylon positioning collar for each run. |
| B | Install gasket (not shown in view) **Note: Position rear cover plate gasket so that rear balance shaft oil feed is lined up with correct side of cover plate.** |
| C | Lubricate rear lip seal with EF-411and use extreme care not to damage rear lip seal during rear cover plate installation. |
| Y | Torque & Angle 15Nm + 50° |
| | Note: Perfect Seal #4 sealer may be used around coolant passages on gasket. |

| Specification | | |
|---|---|---|
| 1 | 24503970 | Bolt |
| 2 | 24506644 | Gasket |
| 3 | 24502297 | Housing assembly |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-32 |
| 2 | 12/01/99 | Add Perfect seal note. |
| | | |
| | | |
| | | |

| View |
|---|
| **Rear Cover** |
| Rear cover installation |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 10 |



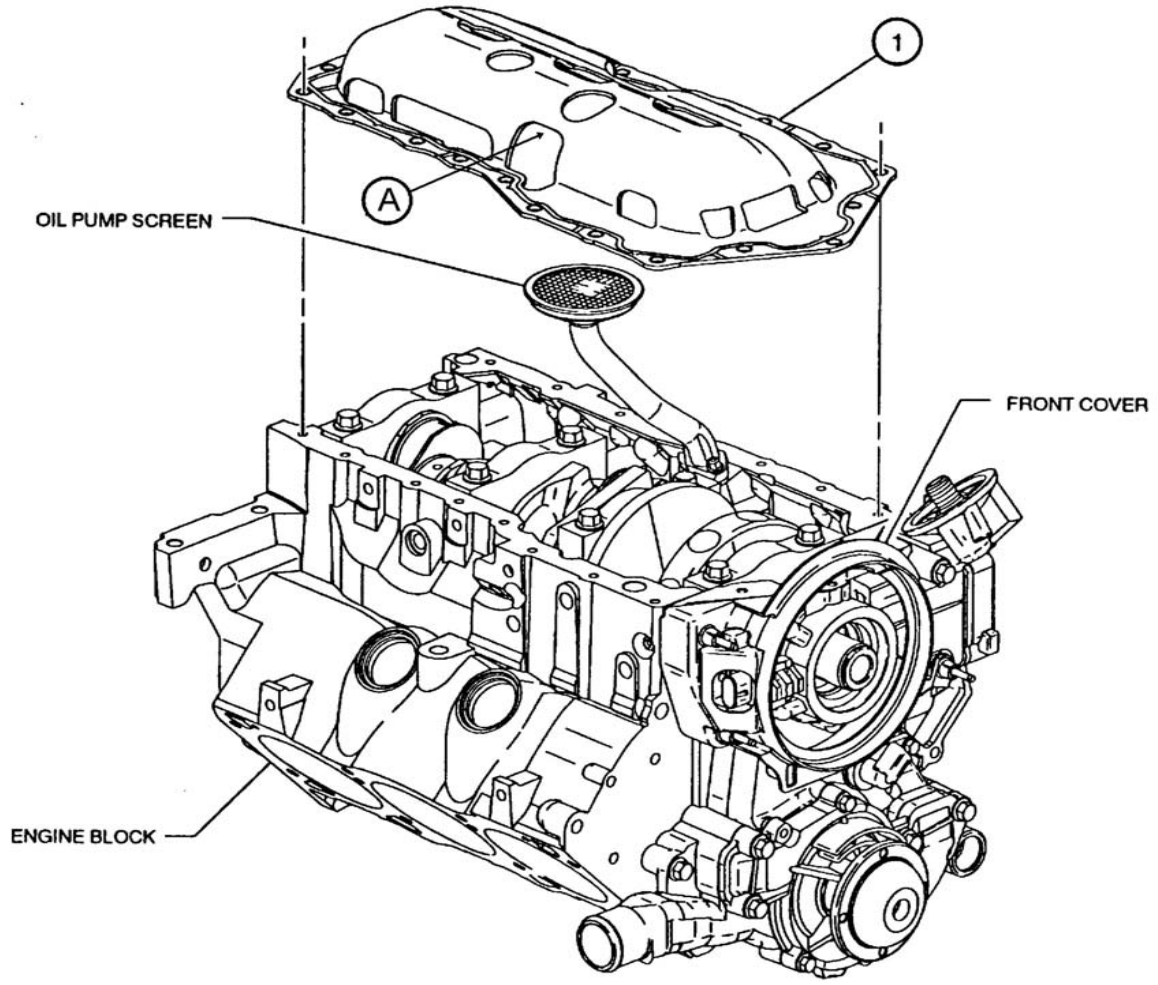

| Description of Operation | |
|---|---|
| | Install oil screen assembly |
| Y | Torque 15Nm |

| Specification | | |
|---|---|---|
| 1 | 24505569 | Screen assembly |
| 2 | 24505570 | Bolt |
| 3 | 24501259 | Gasket |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-33 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Sump |
| Oil pickup tube |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 11 |



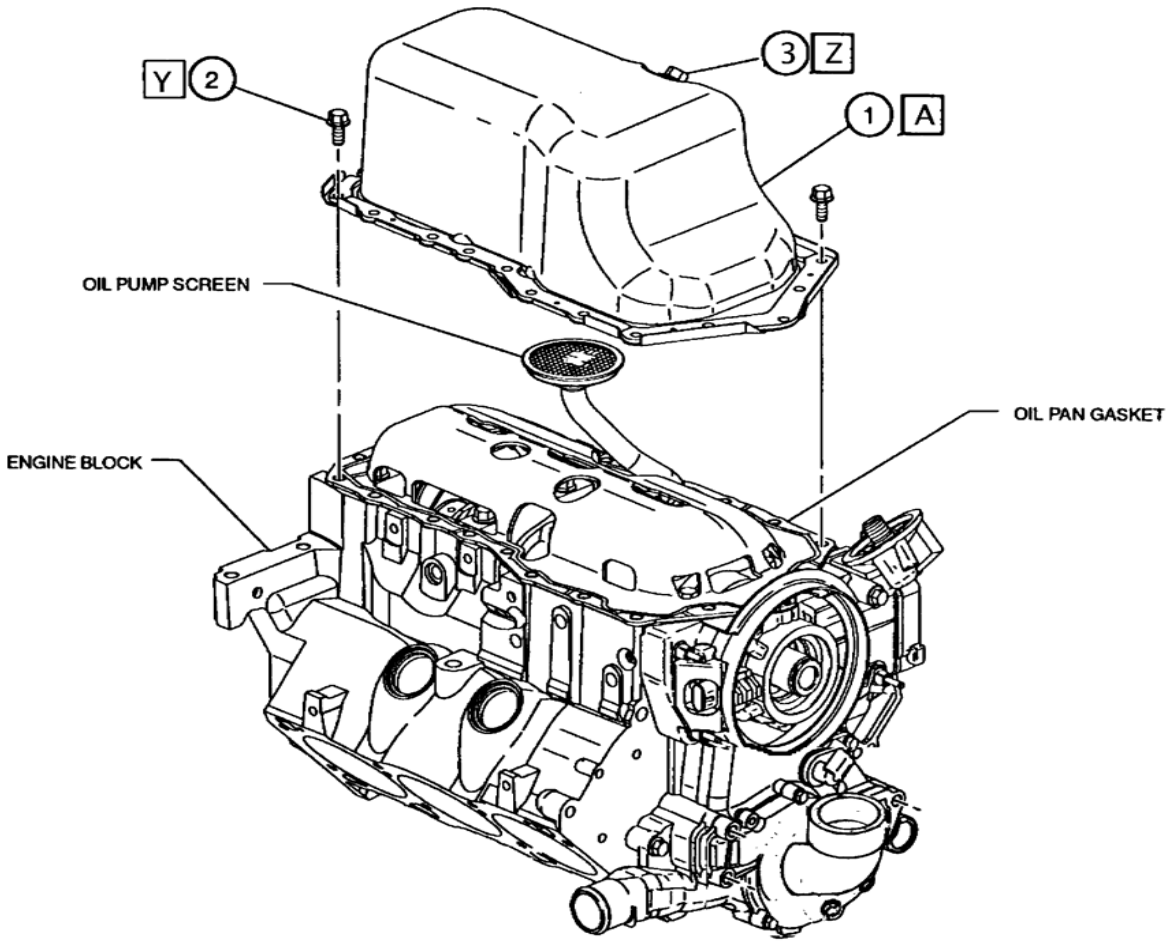

| Description of Operation | |
|---|---|
| | Install oil pan gasket |
| A | Insure that calibrated oil level dipstick clears windage tray before final assembly |
| | Note: RTV GM part number 12346193 may be used at corners of front and rear covers to aid in sealing. |

| Specification | |
|---|---|
| 1 | 24502397 Gasket |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-34 |
| 2 | 12/01/99 | Revise description, allow use of RTV |
| 3 | 02/14/02 | Add "A" dipstick clearance check |
| | | |
| | | |

| View |
|---|
| Sump |
| Oil pan gasket install |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 12 |




| Description of Operation | |
|---|---|
| A | Install oil pan |
| Y | Torque 14Nm |
| Z | Oil drain plug to be thermocoupled |

| Specification | |
|---|---|
| 1 | Oil pan OHT3F-073-1 |
| 2 | 24502791 Bolt |
| 3 | OHT3F-063-1 Modified drain plug |

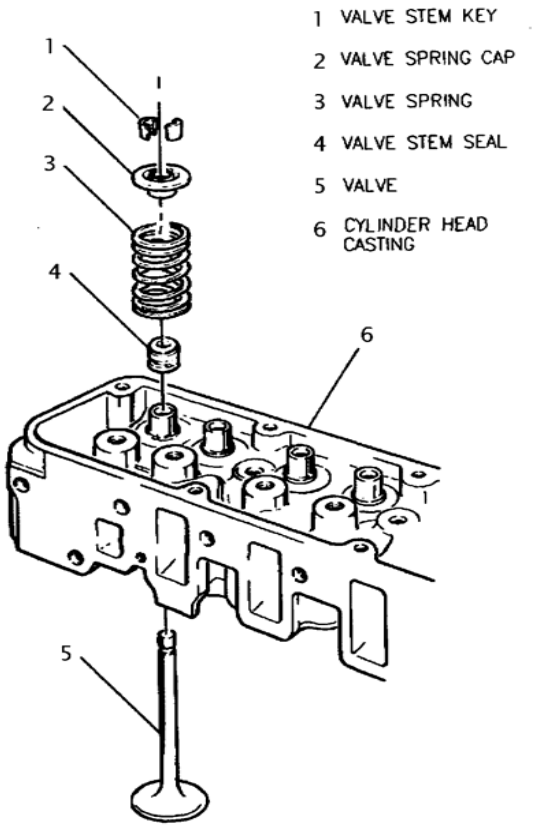
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/05/98 | Block-35 |
| 2 | 06/22/00 | Add OHT Special Nickel Plated Oil Pan |
| | | |
| | | |
| | | |

| View |
|---|
| Sump |
| Oil pan installation |

| Front Cover, Rear Cover, & Sump | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 4 | 13 |

# Section 5

# Cylinder Head and Valves




During calibration, use OHT3F-070-1 Sleeve to protect seals from being cut and OHT3F-072, 006", 010", 015", & 020" shims to assist in obtaining proper load.

**Description of Operation**

Clean cylinder head with aliphatic naphtha and spray with 50/50 solution of EF-411 and aliphatic naphtha. Remove excess solution using compressed air.

Lubricate valve stems and guides with EF-411 during assembly. Ensure valve stem moves freely in guide before installing valve seal. Use a protective sheath over the valve stem that extends downward past the keeper grooves when installing the valve stem seals.

Install the valve springs, retainers, and keepers.

Calibrate the valve spring load to 801N +/- 22N @ 9.5mm (180lbf +/- 5lbf @ 0.375in.) travel.

**Specification**

| | |
|---|---|
| 1 | 1016634 Valve stem key |
| 2 | 24502257 Valve spring cap |
| 3 | OHT3F-059-5 Valve spring (Yellow) |
| 4 | OHT3F-060-1 Seal int. |
| | OHT3F-061-1 Seal exh. White stripe |
| 5 | 24502254 Valve int.(STD) |
| | 24504195 Valve exh.(STD) |
| 6 | 24502259 Head, GM Raceshop |

| REV | Date | Revision History |
|---|---|---|
| 1 | 01/06/98 | Block-36 |
| 2 | 11/13/99 | Update valve spring part number |
| 3 | 12/01/99 | Update valve spring calibration |
| 4 | 02/22/02 | Update valve spring calibration |
| | | |

**View**

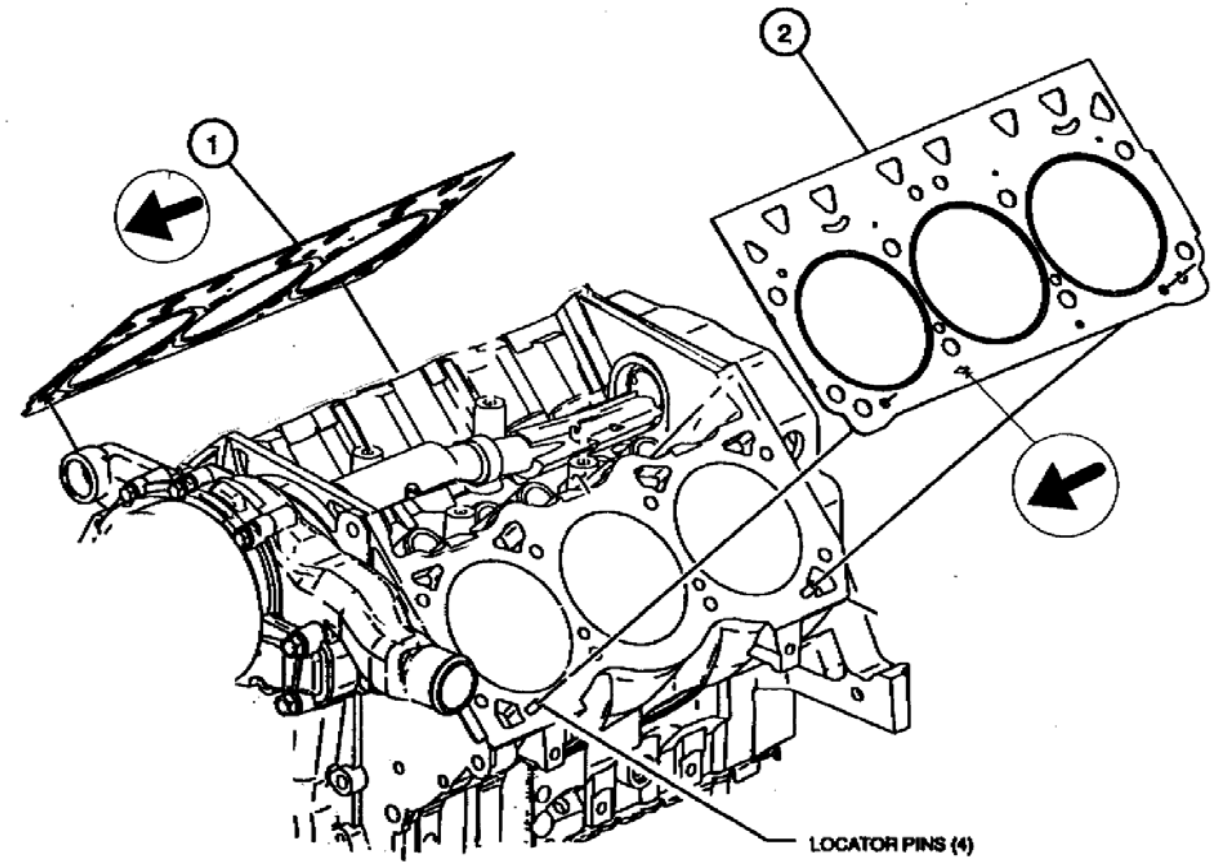
**Head Assembly**

Valve & spring assembly

## Head Assembly

## Sequence IIIF

| Section | Sheet |
|---|---|
| 5 | 1 |




**Description of Operation**

Head gaskets are not interchangeable. Installing the head gasket with the arrow pointing to the rear will cause gasket failure and possible engine failure.

Install the head gasket with the arrow pointing toward the front of the engine.

Do not use any sealers on the head gaskets.

**Specification**

| | | |
|---|---|---|
| 1 | 24503801 | Gasket RH |
| 2 | 24503802 | Gasket LH |

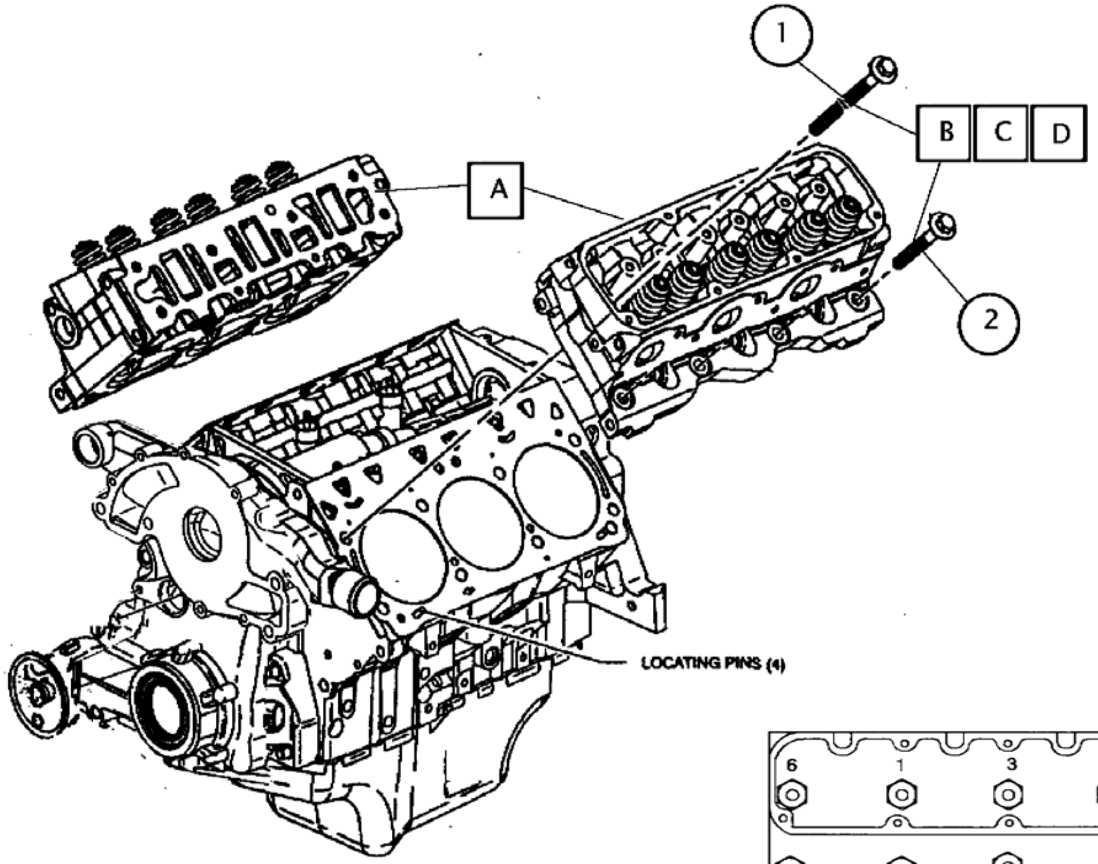
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/06/98 | Block-37 |
| | | |
| | | |
| | | |
| | | |

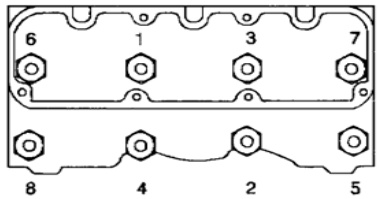
**View**

**Head Gaskets**

Head gasket install

| Head Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 5 | 2 |




| Description of Operation | |
|---|---|
| A | Carefully install cylinder heads. |
| B | Clean all Teflon type sealer from new bolt threads and underside of head. |
| C | Install #2 Permatex on threads and underside of fastener head. |
| D | Torque fasteners from center out using a crisscross pattern with the Torque Sensor 1 wrench set on soft joint for gasketed applications.<br><br>30Nm-50Nm-80Nm - JCS-TEL to yield. |

| Specification | |
|---|---|
| 1 | 25527831 Bolt Cyl. Head (8) Long |
| 2 | 25533811 Bolt Cyl. Head (8) Short |

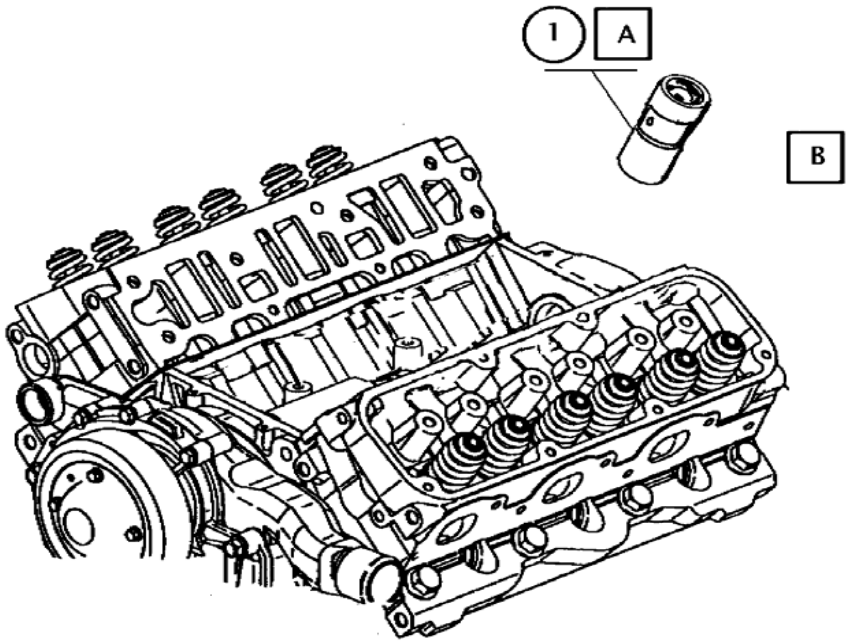
| REV | Date | Revision History |
|---|---|---|
| 1 | 01/06/98 | Block-38 & 50 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Cylinder Head |
| Cylinder head installation |

| Head Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 5 | 3 |

# Section 6

# Long Block Assembly



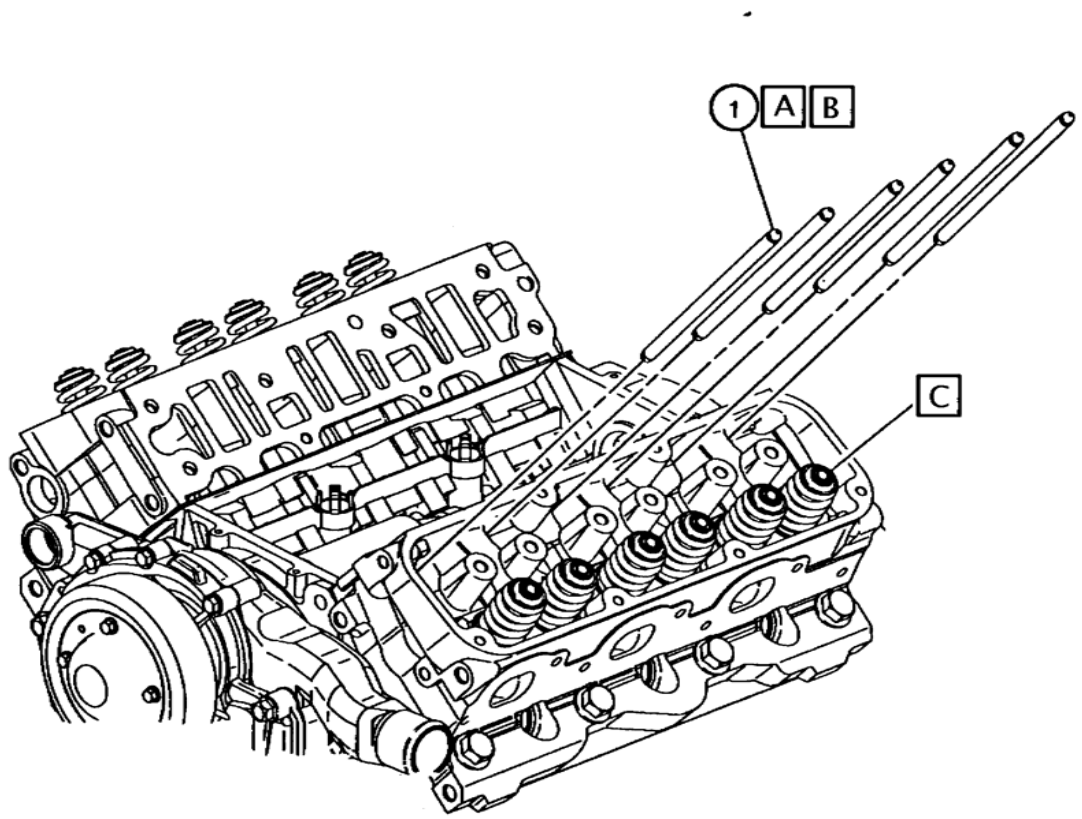

| Description of Operation | |
|---|---|
| A | Measure and record pre-test lifter foot height to the nearest 0.001mm |
| B | Installation:<br>1) Clean each lifter using a lightly soaked cloth with aliphatic naphtha (Do not disassemble, spray, or submerse the lifter in solvent).<br><br>2) Dip each lifter foot in test oil and install the lifter set less pushrods.<br><br>2) Rotate engine crankshaft 720° slowly with no load on lifters.<br><br>3) Remove each lifter, one at a time, dip each foot in test oil, and re-install with the ground flat facing inboard. |

| Specification | |
|---|---|
| 1 | OHT3f-029-3 ACI Test Lifter (with flats ) |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-39 |
| 2 | 11/13/99 | Update lifter part number, description, and installation instructions |
| 3 | 6/22/00 | Add OHT part number for ACI test lifter |
| 4 | 2/22/02 | Remove OHT3F-029-2 52100 wear test Lifter |
| | | |

| View |
|---|
| Lifter Installation |
| Lifter pre-oiling and installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 1 |




| Description of Operation | |
|---|---|
| A | Clean all pushrods with aliphatic naphtha and spray with a 50/50 solution of EF-411 and aliphatic naphtha. Remove excess with compressed air. Lubricate each pushrod end, pushrod seat, and rocker arm ball socket with EF-411 prior to installation. |
| B | Install pushrods |
| C | Lubricate each valve stem seal and tip with EF-411. |

| Specification | |
|---|---|
| 1 | OHT3F-007-1 Pushrod (Special Length) |

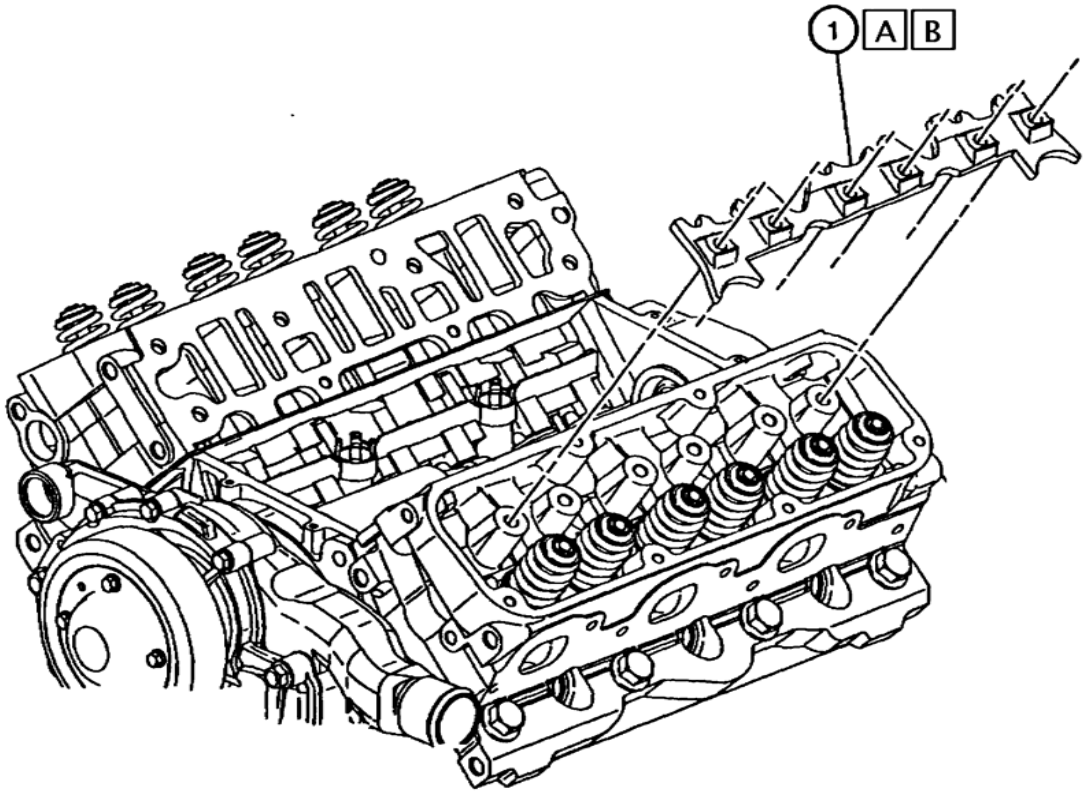
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-40 |
| 2 | 6/18/02 | Add lubrication of pushrod ball ends "A" |
| | | |
| | | |
| | | |

| View |
|---|
| **Pushrods** |
| Pushrod installation |

# Long Block Assembly

## Sequence IIIF

| Section | Sheet |
|---|---|
| 6 | 2 |



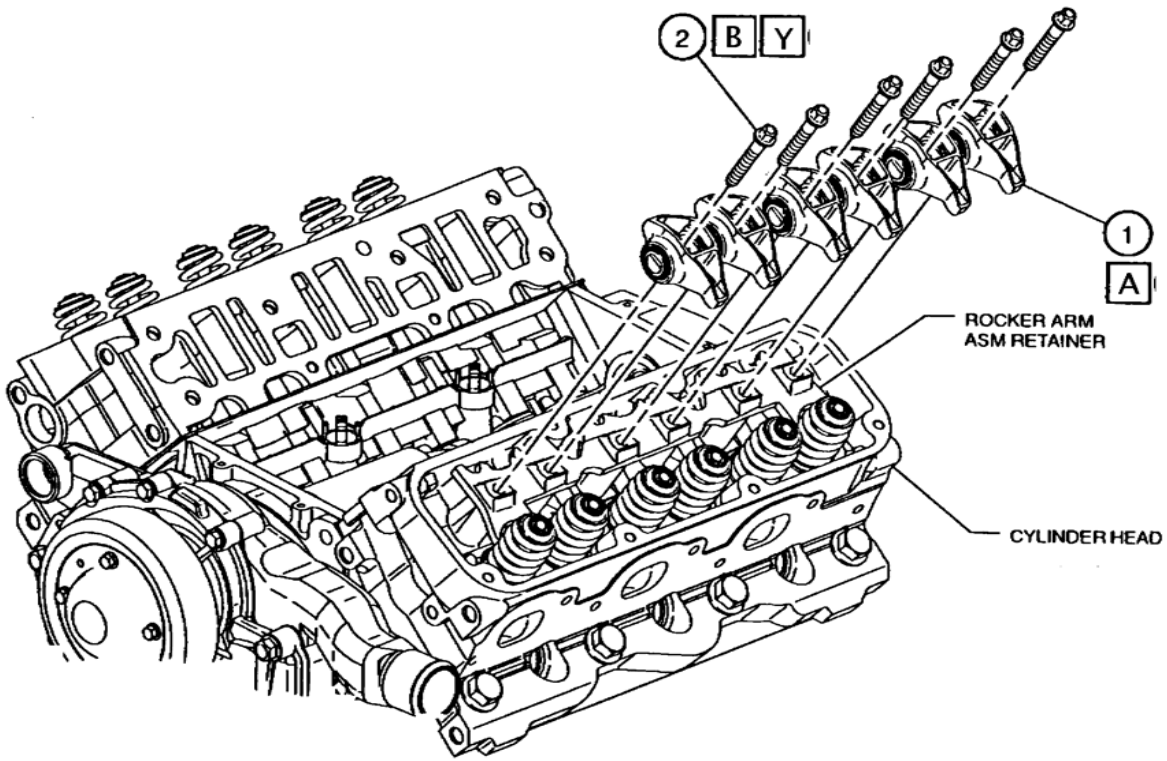

| Description of Operation | |
|---|---|
| A | Clean and inspect for wear. |
| B | Install pushrod guide / rocker bearing retainer. |

| Specification | | |
|---|---|---|
| 1 | 24502278 | Retainer |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-41 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Retainer |
| Rocker bearing retainer installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 3 |



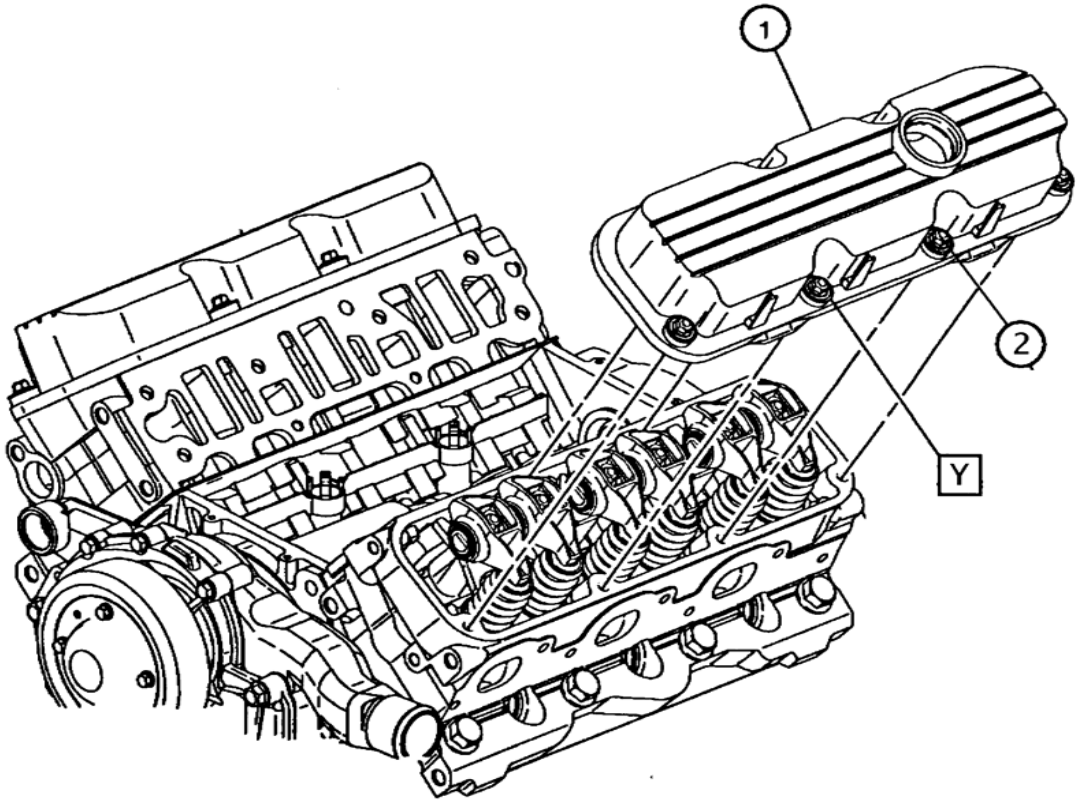

| Description of Operation | |
|---|---|
| A | Lubricate rocker arms with EF-411 and install. **Note: Rocker arm assemblies are replaced every test. Do not dip or spray with aliphatic naphtha. Needle roller bearings will retain solvents.** |
| B | Lubricate bolts with EF-411 and install. |
| Y | Torque & Angle<br>25Nm + 70°<br><br>Note: Do not rotate engine after final valvetrain loading. |

| Specification | |
|---|---|
| 1 | OHT3F-058-1 Rocker Arm Assembly |
| 2 | Furnished less sealers with OHT Kit |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-42 |
| 2 | 11/13/99 | Remove SPO part number for furnished rocker arm bolts |
| 3 | 12/1/99 | Add note on rotation |
| | | |
| | | |

| View |
|---|
| **Rocker Arm** |
| Rocker arm installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 4 |



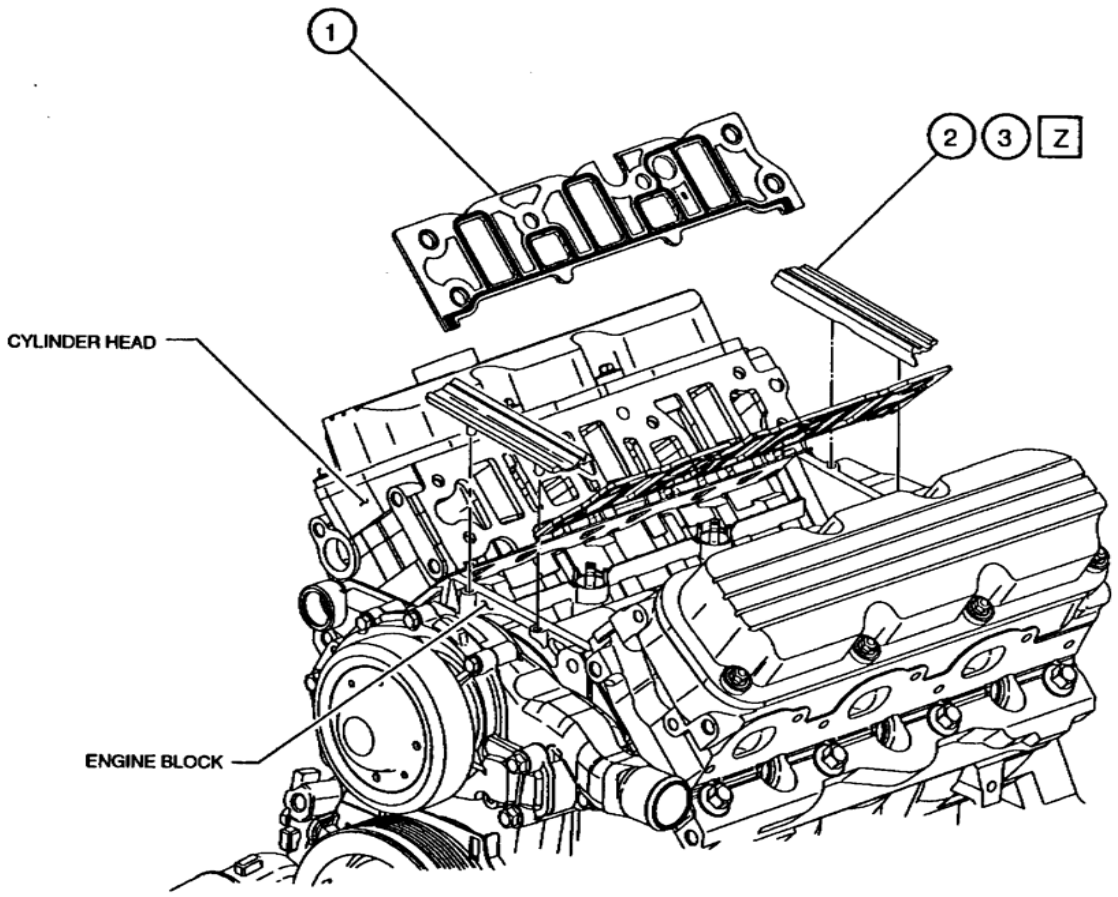

| Description of Operation | |
|---|---|
| | Install rocker covers |
| Y | Torque 10Nm |

| Specification | | |
|---|---|---|
| 1 | 25534751 | Cover, Valve Lt (2) |
| 2 | 24502164 | Bolt |
| | 25534748 | Bolt w/washer |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-43 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Rocker Cover |
| Rocker cover installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 5 |



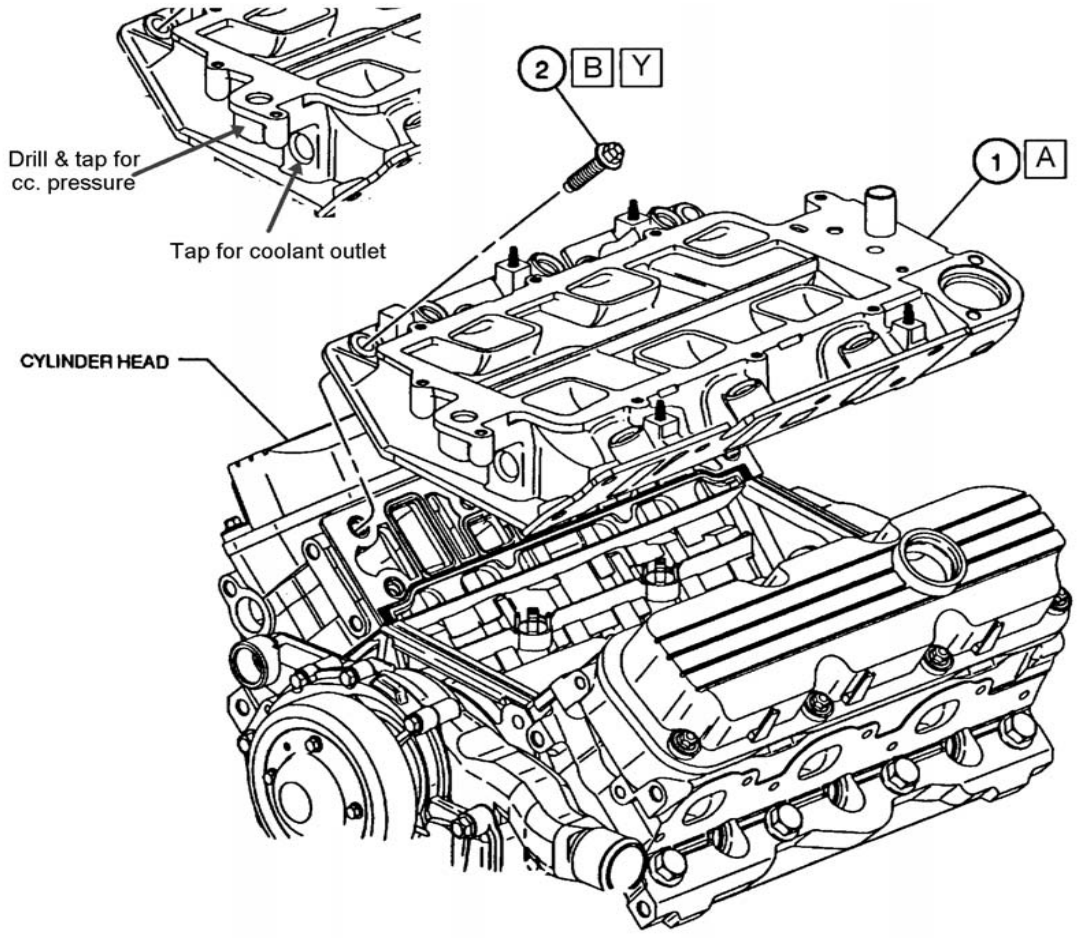

| Description of Operation | |
|---|---|
| | 2nd design gasket kit uses locating pins for front and rear seals |
| Z | Apply GM RTV Sealer at both ends part # 12346193 |

| Specification | |
|---|---|
| 1 | 12539093 Gskt. Kit 2nd design |
| 2 | Seal / part of kit |
| 3 | Sealant (see note Z) |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-44 |
| 2 | 12/1/99 | Add sealant part number |
| 3 | 2/22/02 | Delete first design intake gasket |
| | | |
| | | |

| View |
|---|
| Intake Gaskets |
| Intake gasket installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 6 |



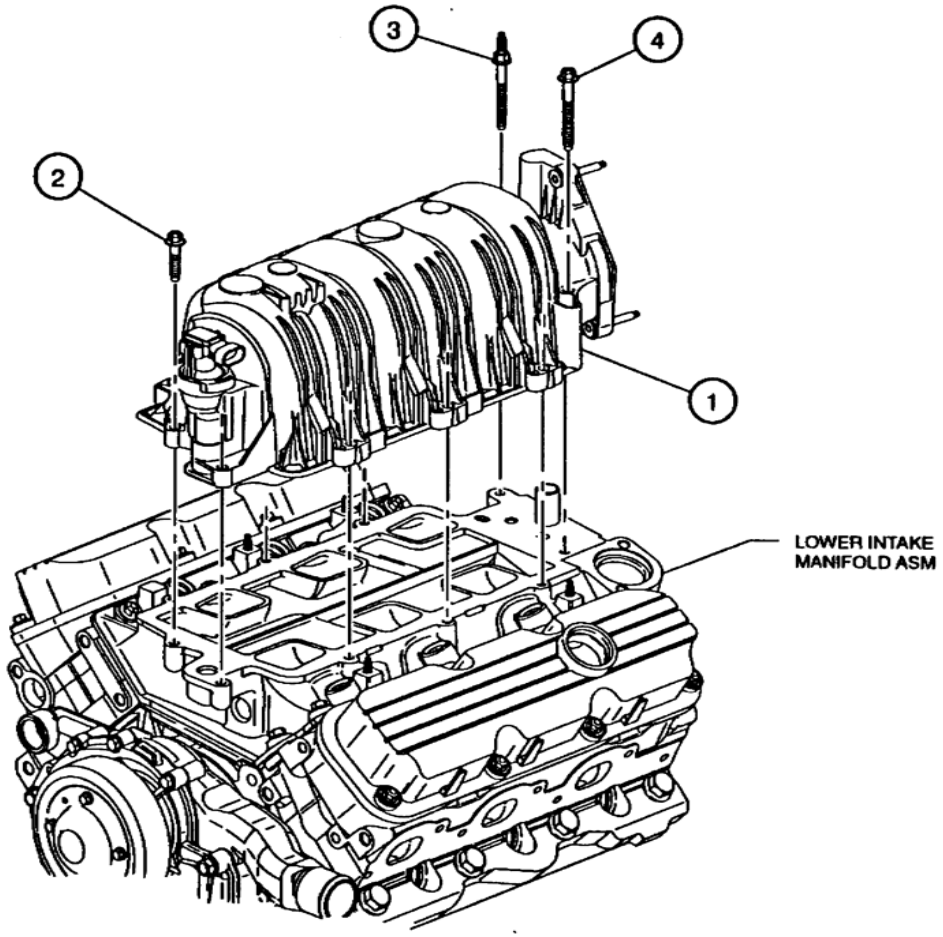

| Description of Operation | |
|---|---|
| A | Install modified intake manifold |
| B | Clean and lubricate bolts with Permatex #2 and install. |
| Y | Torque 15Nm |
| | Drill and tap as indicated for the crankcase pressure line . Also tap coolant outlet port for coolant return line to process controller. Use a 3/4" I.D. unrestricted line for the return. Do not install shut off valves in the return line. |

| Specification | | |
|---|---|---|
| 1 | 24505728 | Manifold assembly |
| 2 | 24504090 | Bolt (12) |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-45 |
| 2 | 11/30/99 | Add exploded view for c.c. and coolant lines. |
| 3 | 6/22/00 | Update coolant return line description |
| 4 | 2/22/02 | Add Perfect Seal #4 |
| 5 | 6/17/02 | Change "B" from Perfect Seal #4 to Permatex #2 |

| View |
|---|
| **Lower Intake** |
| Lower intake manifold installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 7 |



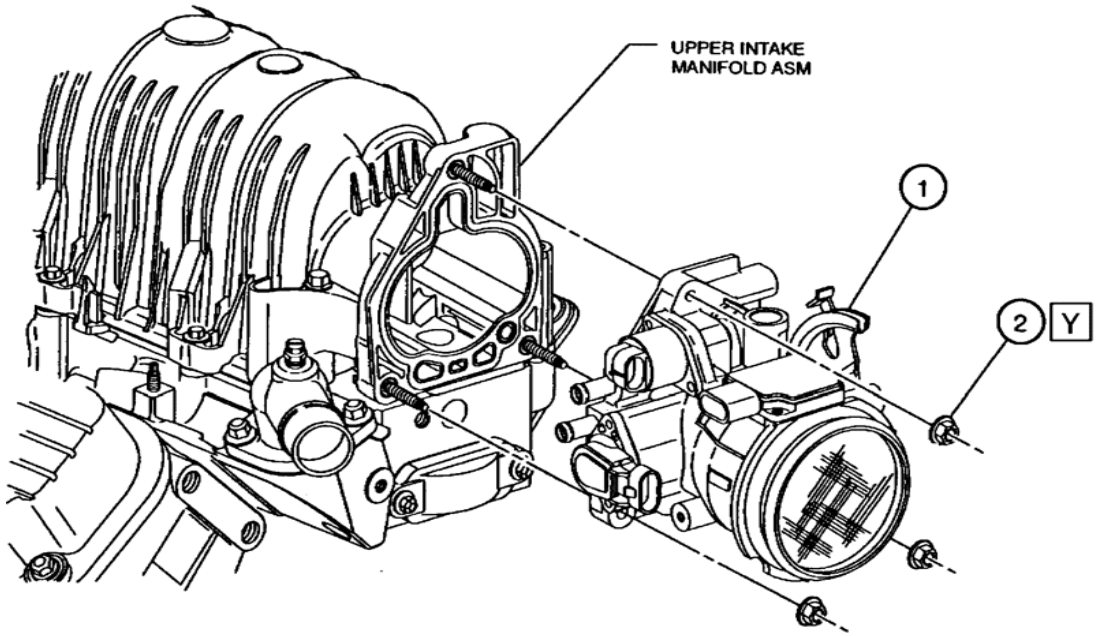

| Description of Operation | |
|---|---|
| | Install upper intake and gasket assembly. |
| Y | Torque 10Nm (Max. torque) |

| Specification | |
|---|---|
| 1 | 17096162 Manifold assembly<br>17113137 Gasket Kit |
| 2 | 24506498 Bolt (8) |
| 3 | 24502453 Stud |
| 4 | 24505205 Bolt |
| | See note Y for torque |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-46 |
| 2 | 6/17/02 | Add "Max. torque" to "Y" |
| | | |
| | | |
| | | |

| View |
|---|
| Upper Intake |
| Upper intake installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 8 |




| | Description of Operation |
|---|---|
| | Install modified throttle body<br><br>**Note: See section 7 sheet 5 for modifications** |
| Y | Torque 10Nm |

**Specification**

1 24507235 Throttle Body
(2 bolt Mass Air Flow Sensor 24508238)
or
24507230 Throttle Body
(3 bolt Mass Air Flow Sensor 24504302)

2 24506469 Nut

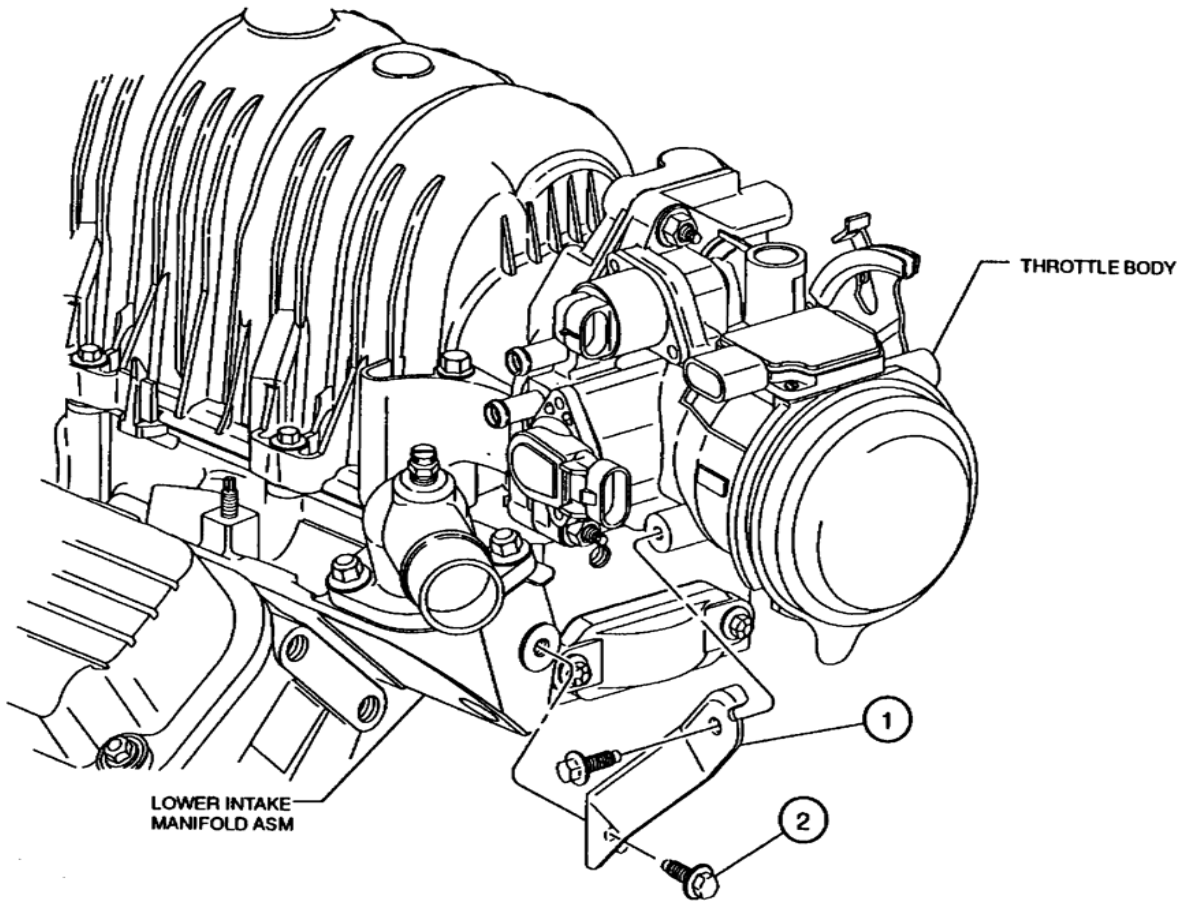
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-47 |
| 2 | 11/13/99 | Update part number and add note for modification see section 7 sheet 5 |
| 3 | 2/22/02 | Update Throttle Body Part Numbers |
| 4 | 6/17/02 | Update 2 bolt Mass Air Flow Sensor Part Number |
| | | |

**View**

**Throttle Body**

Throttle body installation

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 9 |



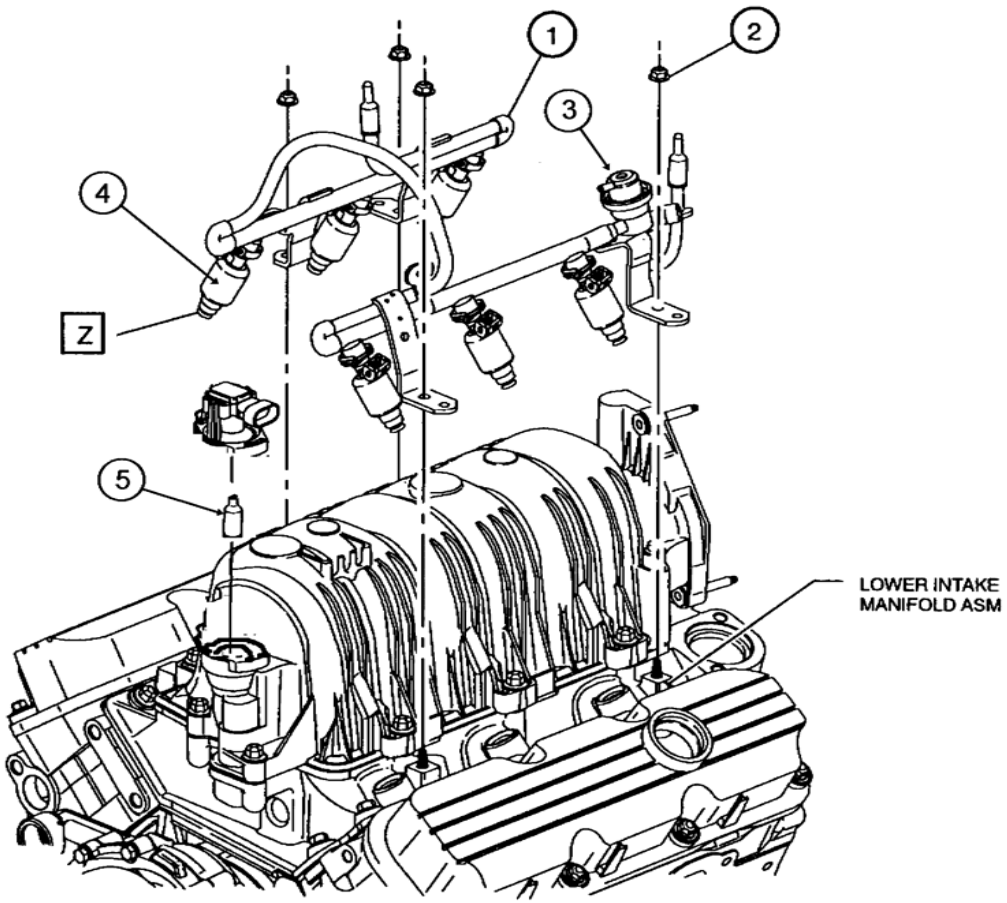

| Description of Operation | |
|---|---|
| | Install support bracket |
| Y | Torque 10Nm |

| Specification | |
|---|---|
| 1 | 24504697 Support |
| 2 | 24503644 Bolt (2)<br>See note Y for torque |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-48 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Throttle Body Support |
| Throttle body support installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 10 |




| Description of Operation | |
|---|---|
| | Install injector assembly (See sec. 6.14.1 of Sequence IIIF Test Procedure) |
| Y | Torque 10Nm |
| Z | Lubricate O-ring with EF-411 |

| Specification | |
|---|---|
| 1 | 17098211 Fuel Rail |
| 2 | 24506469 Nut |
| 3 | 17113346 Regulator |
| 4 | 17120601 Injector |
| 5 | OHT3F-002-1 PCV Dummy |

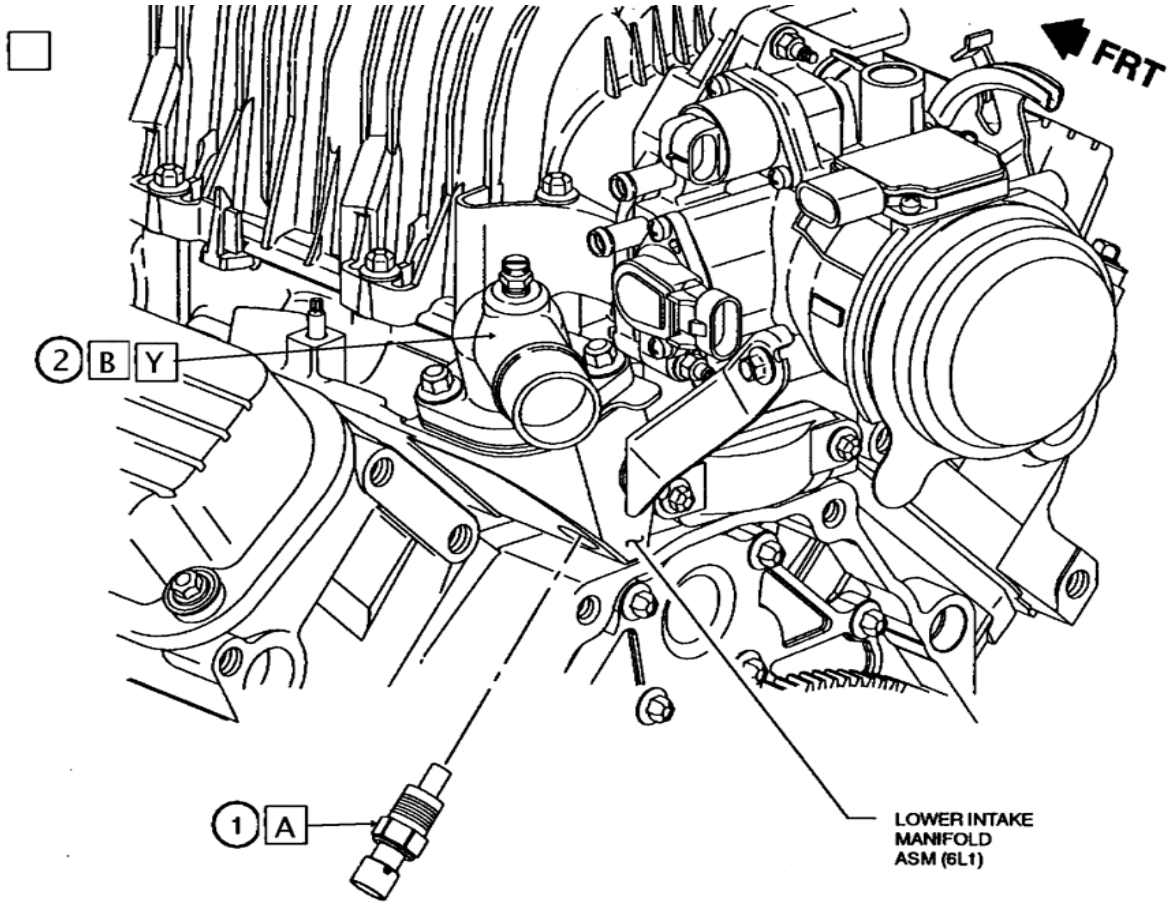
| REV | Date | Revision History |
|---|---|---|
| 1 | 1/6/98 | Block-49 |
| 2 | 11/13/99 | Update part numbers and view |
| 3 | 2/22/02 | Update Text Box (Procedure Reference) |
| | | |
| | | |

| View |
|---|
| **Injector Assembly** |
| Injector assembly installation |

| Long Block Assembly | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 6 | 11 |

# Section 7

# Final Dress




| Description of Operation | |
|---|---|
| A | Install production sensor as a plug only. **Do not use for connection to harness. Disable connector.** |
| B | Install coolant outlet |
| Y | Torque 27Nm |

**Specification**

1 10096181 Sensor
(Used for plug only, disable connector)

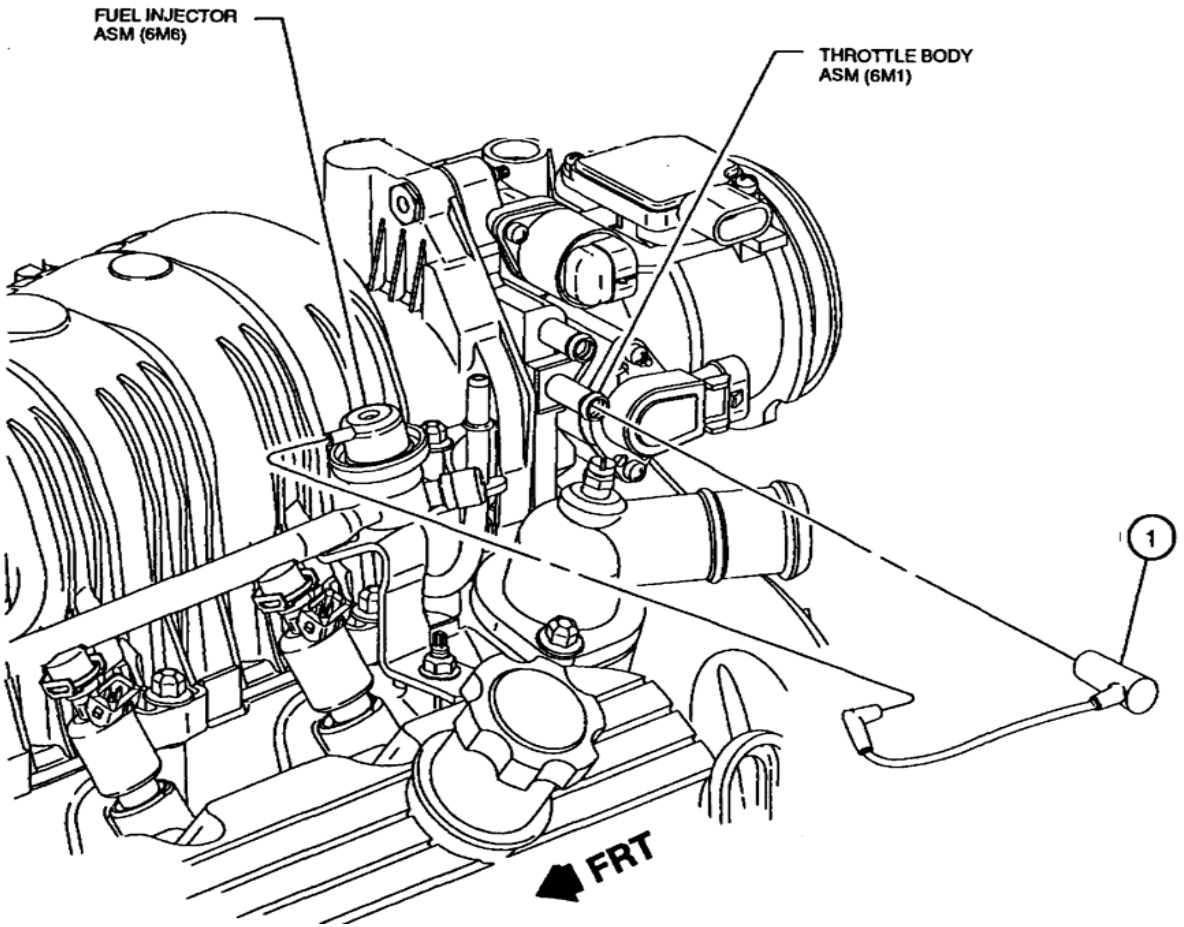
2 OHT3F-034-1 Coolant Outlet
(Not to detail on sheet)

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-51 |
| | | |
| | | |
| | | |
| | | |

**View**

**Coolant Out & Sensor**

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 1 |




**Description of Operation**

**Specification**

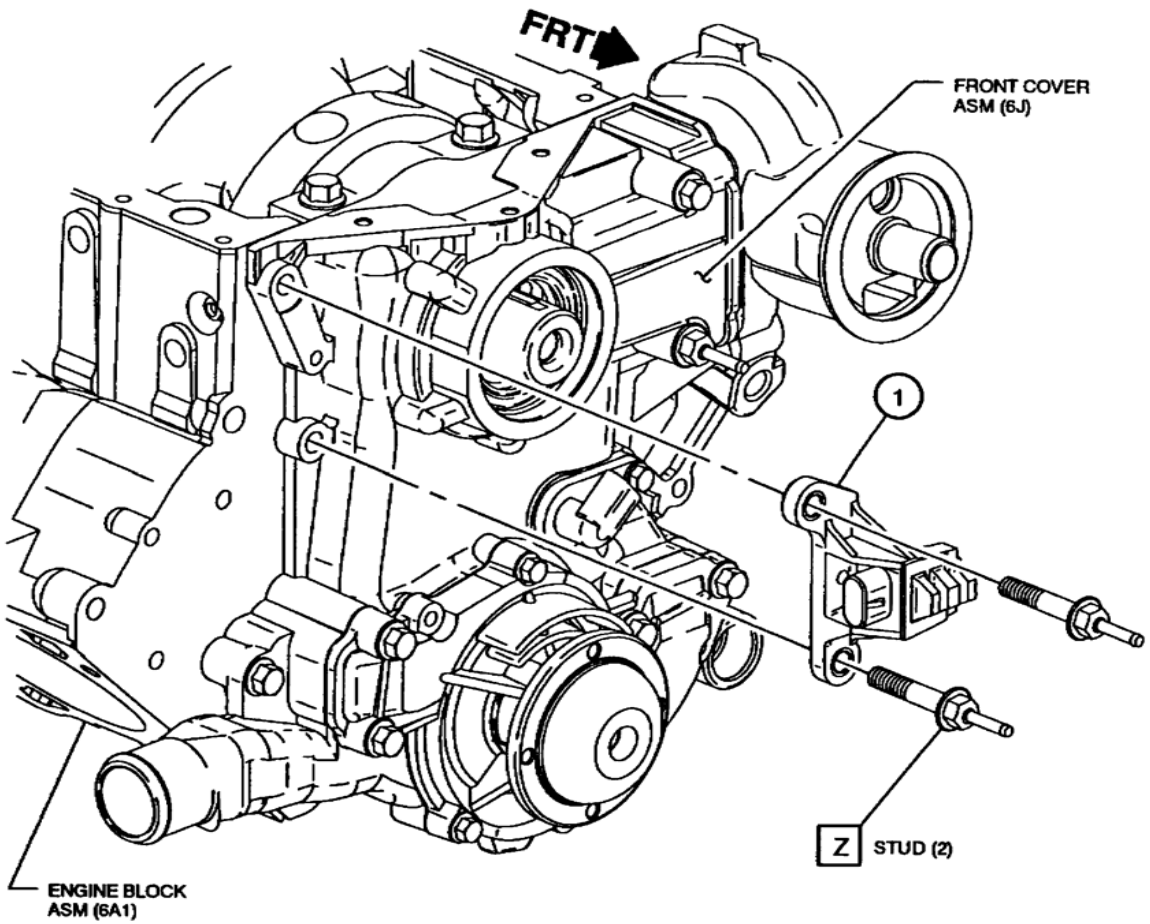
1 24505671 Tube

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-52 |
| | | |
| | | |
| | | |
| | | |

**View**

**Vacuum Hose**

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 2 |



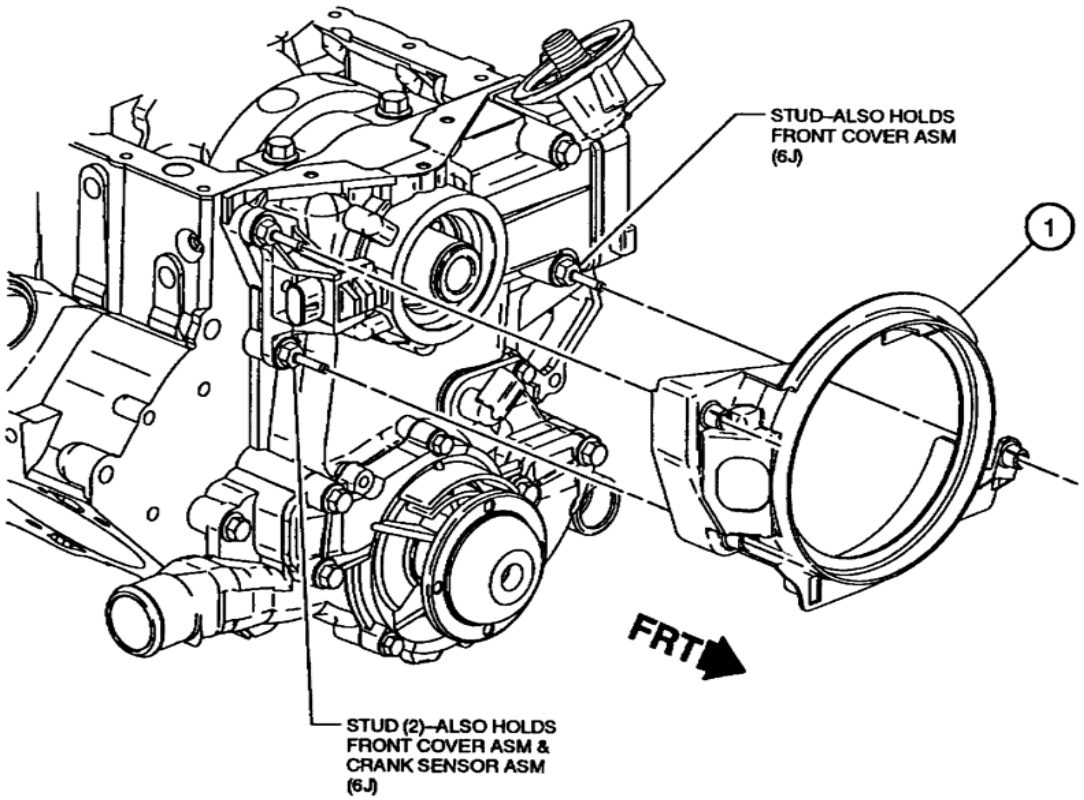

| Description of Operation | |
|---|---|
| Z | See front cover section for bolt part numbers and torque. |

| Specification | | |
|---|---|---|
| 1 | 10456161 | Sensor |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-53 |
| | | |
| | | |
| | | |
| | | |

| View |
|---|
| Crankshaft Sensor |

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 3 |




**Description of Operation**

**Specification**

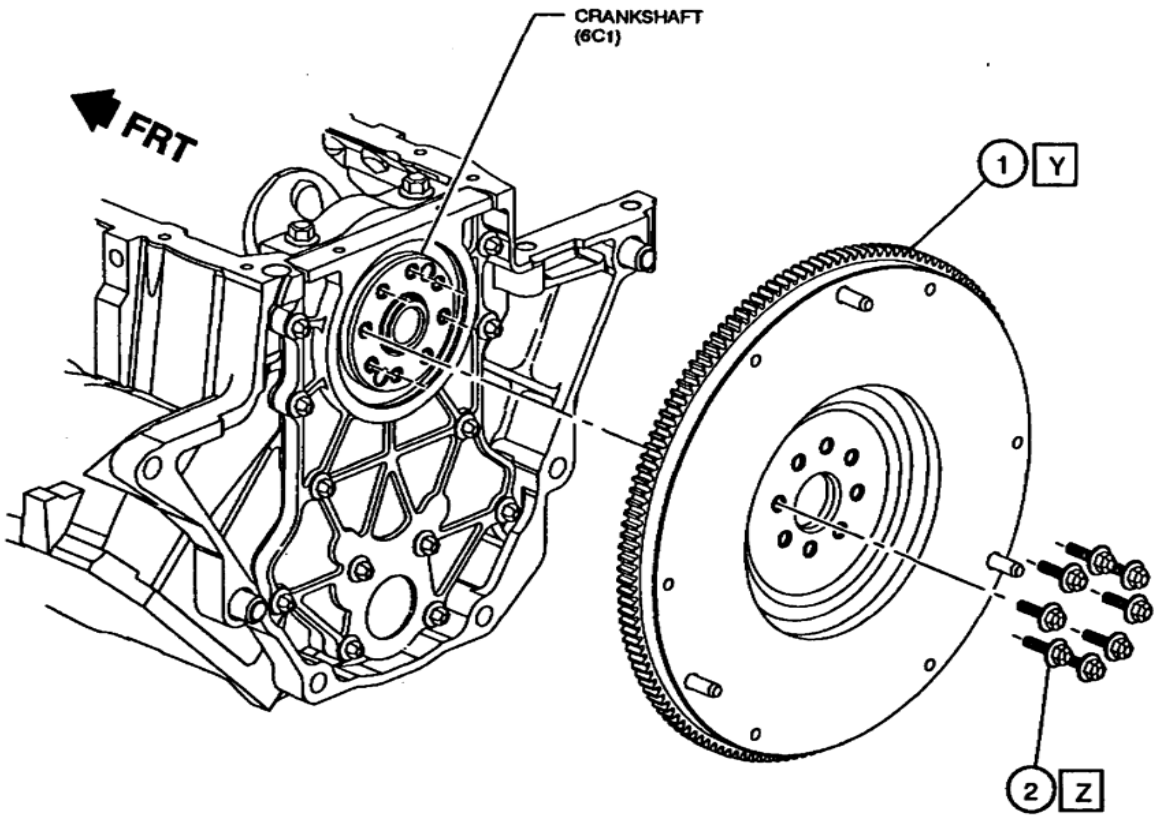
| | | |
|---|---|---|
| 1 | 24506440 | Shield |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-54 |
| | | |
| | | |
| | | |
| | | |

**View**

**Crankshaft Sensor Shield**

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 4 |




| Description of Operation | |
|---|---|
| Y | OHT-020-2 modified to fit offset balance and adapter plate for Dana 1550 four bolt yoke. |
| Z | Torque & Angle 15Nm + 50° |

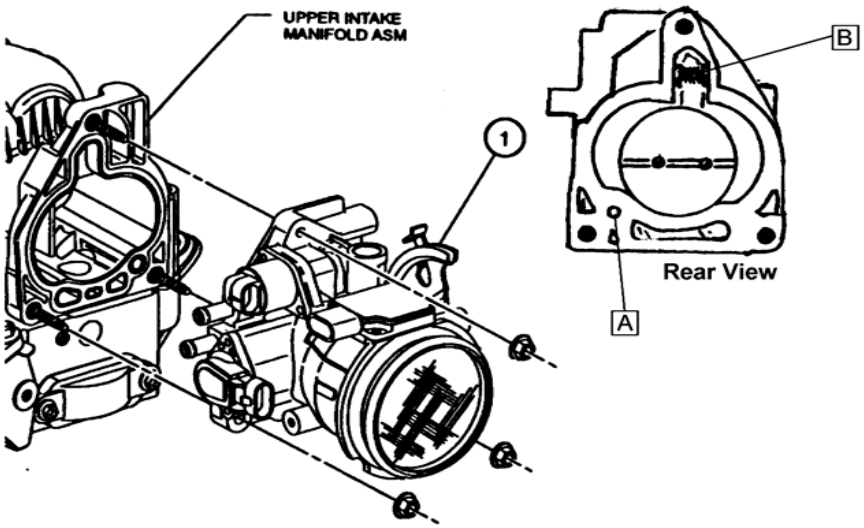
| Specification | |
|---|---|
| 1 | OHT3F-020-2 Flywheel (Modified 24503285) |
| 2 | 24505092 Bolt |

| REV | Date | Revision History |
|---|---|---|
| 1 | 1/10/98 | Block-55 |
| | | |
| | | |
| | | |
| | | |

**View**

**Flywheel**

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 5 |




| Description of Operation | |
|---|---|
| A | Drill and tap to receive a hex head plug |
| B | Use power to PCM with engine not running and throttle blade open to drive Idle Air Control motor closed. Disconnect harness connecter and adjust idle screw to obtain 800 RPM base idle.<br><br>As an alternative, the IAC may be removed and both ports plugged using epoxy and welch type plugs. |

**Specification**

1 24507235 Throttle Body
(2 bolt Mass Air Flow Sensor 24503983)
or
24507230 Throtle Body
(3 bolt Mass Air Flow Sensor 24504302)

| REV | Date | Revision History |
|---|---|---|
| 1 | 11/13/99 | Block-48 |
| 2 | 2/22/02 | Update Throttle Body Part Numbers |
| | | |
| | | |
| | | |

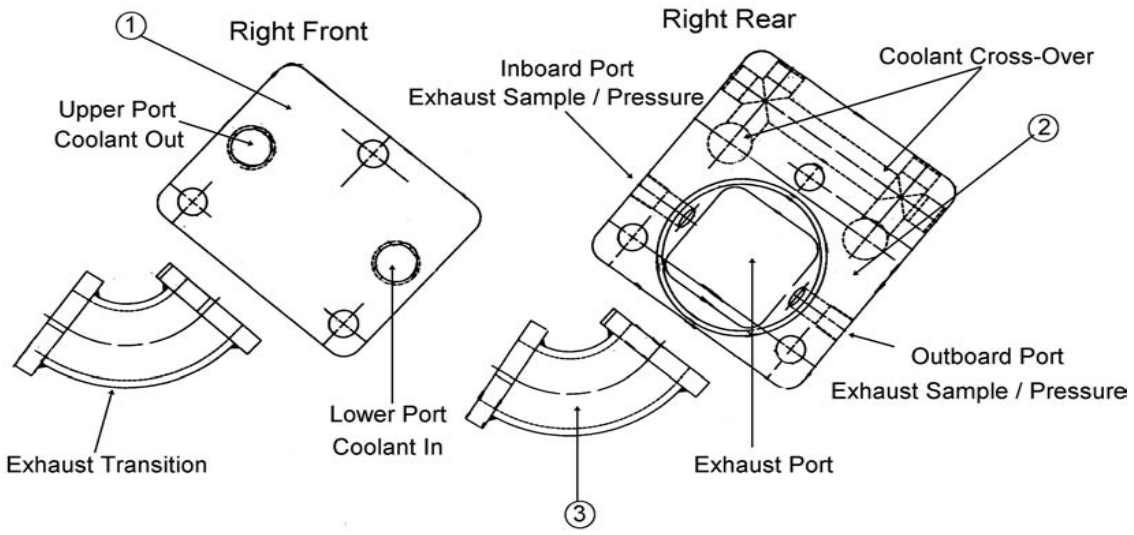
**View**

**Throttle Body Modification**

| Final Dress | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 7 | 6 |

# Section 8

# OH Technologies Special Engine Dress




## Description of Operation

Water cooled exhaust manifold end plates and exhaust manifold transitions. Note: both views are right side showing the cooling water inlet is the lower port and the outlet is the higher port. Also, the inboard exhaust sample port is typically for the gas analysis and the outboard is for the back pressure connection.

Tha transition should be connected with shilded gaskets not shown but identified by part number. Two required per side.

Thermocouples for exhaust coolant in and out should be installed in the fittings attached to the front plate and centered in the coolant flow.

## Specification

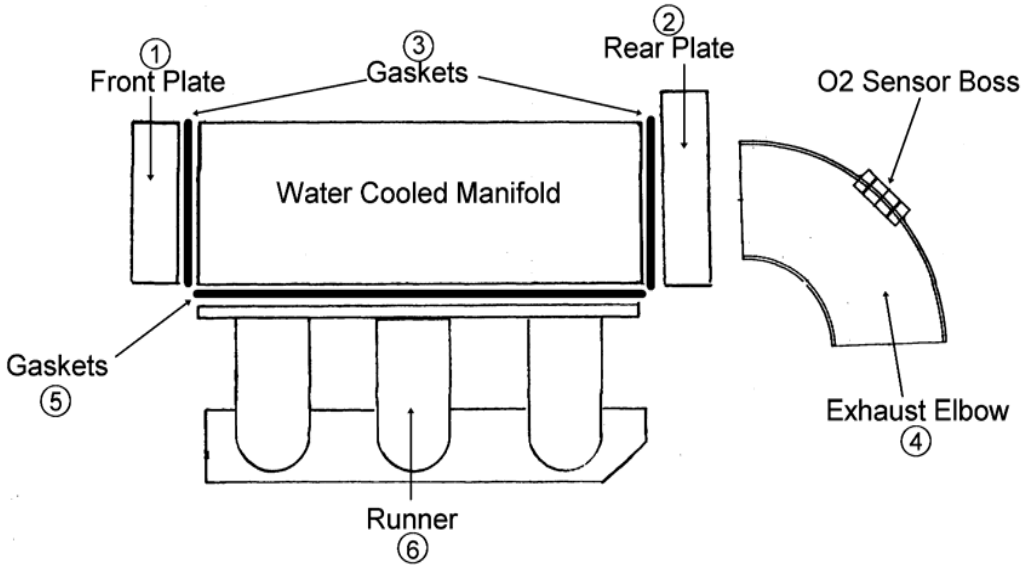
1 OHT3F-006-1 Plate, Rear Exhaust
2 OHT3F-005-1 Plate, Front Ehhaust
3 OHT3F-004-1 Runner, Exh. Man.

| REV | Date | Revision History |
|---|---|---|
| 1 | 11/13/99 | Block-60 |
| 2 | 2/22/02 | Update View Exhaust sample / pressure locations |
| | | |
| | | |
| | | |

**View**

**Water Cooled Exh. Man. End Plates**

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 1 |




**Description of Operation**

Water cooled exhaust manifold

Not to scale

**Note: Do Not Use RTV Sealer on O2 sensor or other exhaust system components upstream of O2 sensor.**

**Specification**

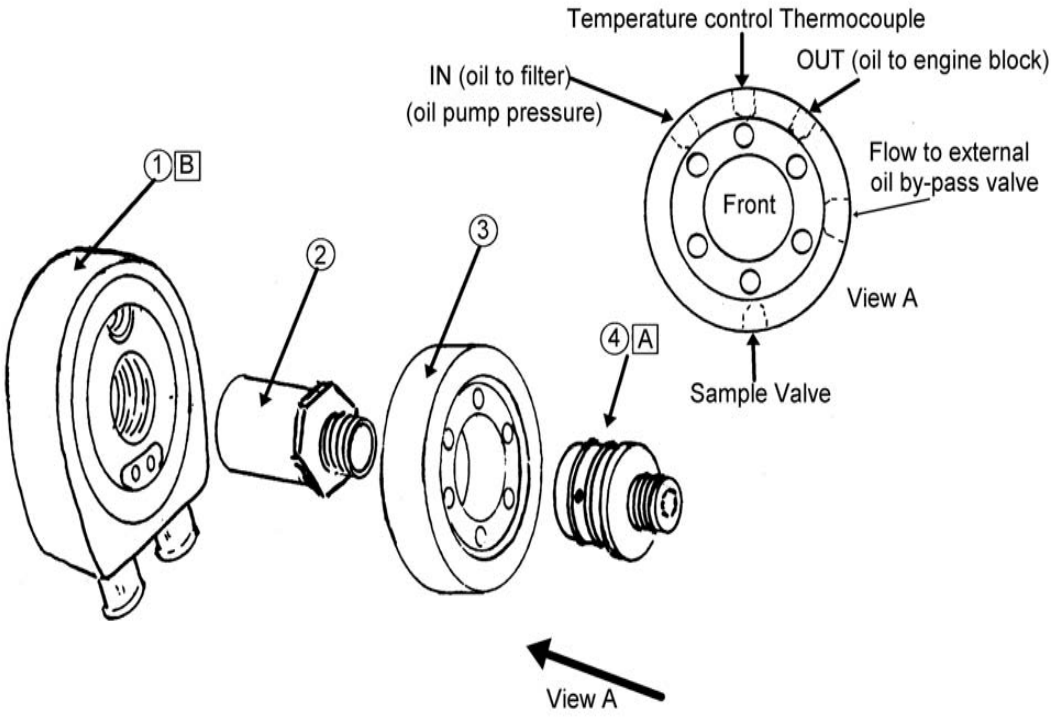
1 OHT3F-005-1 Plate, Front Ehhaust
2 OHT3F-006-1 Plate, Rear Exhaust
3 OHT3F-009-1 Gasket, End Plate
4 OHT3F-005A-1 Elbow, Exh. Modified
5 OHT3F-018-1 Gasket Flange, Metal
6 OHT3F-004-1 Runner, Exh. Man.

| REV | Date | Revision History |
|---|---|---|
| 1 | 11/13/99 | Block-61 |
| 2 | 2/22/02 | Update text, include warning on usage of RTV sealer |
| | | |
| | | |
| | | |

**View**

**Water Cooled Exh. Man. & Elbow**

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 2 |




Note: See section 8 sheet 3a & 3b for additional information

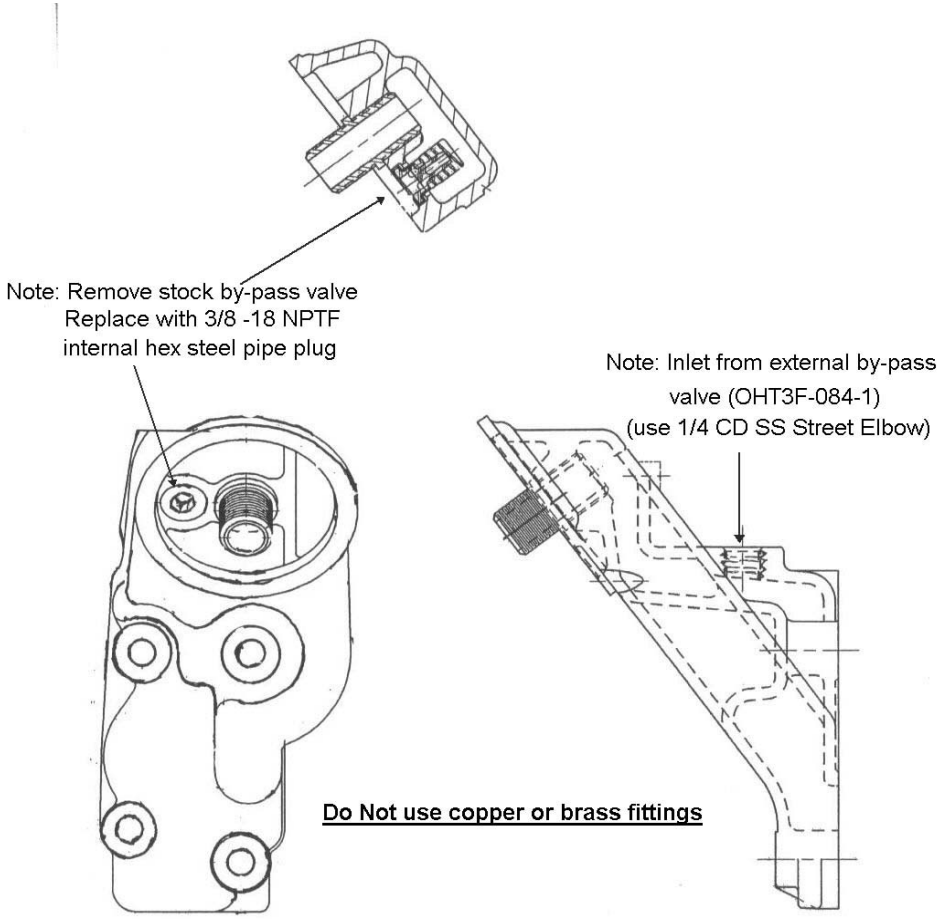
| Description of Operation | |
|---|---|
| A | Replace "O"-rings every test.<br><br>Note: View A<br>Viewed from front or oil filter side, passages are, IN (oil pump pressure to filter), center port for temperature control thermocouple, OUT (oil flow out of filter in to engine block), Side outlet to external oil by-pass valve, and lower port is for oil sample valve. |
| B | Replace oil cooler every test |

| Specification |
|---|
| 1 OHT3F-030-2 Cooler Nickel Plated |
| 2 OHT3F-039-3 Connecter Special Cut |
| 3 OHT3F-035-2 Adapter, Oil Filter |
| 4 OHT3F-043-2 Fitting, Oil Filter Adapter |

| REV | Date | Revision History |
|---|---|---|
| 1 | 11/30/99 | Block 62 |
| 2 | 6/17/02 | Add notes, new part numbers and update view. See next sheet for further details |
| | | |
| | | |
| | | |

| View |
|---|
| Oil Cooler Assembly |

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 3 |




**Description of Operation**

Special part modification information.

Modofied part may be purchased direct from OHT (OHT3F-080-1)

**Specification**

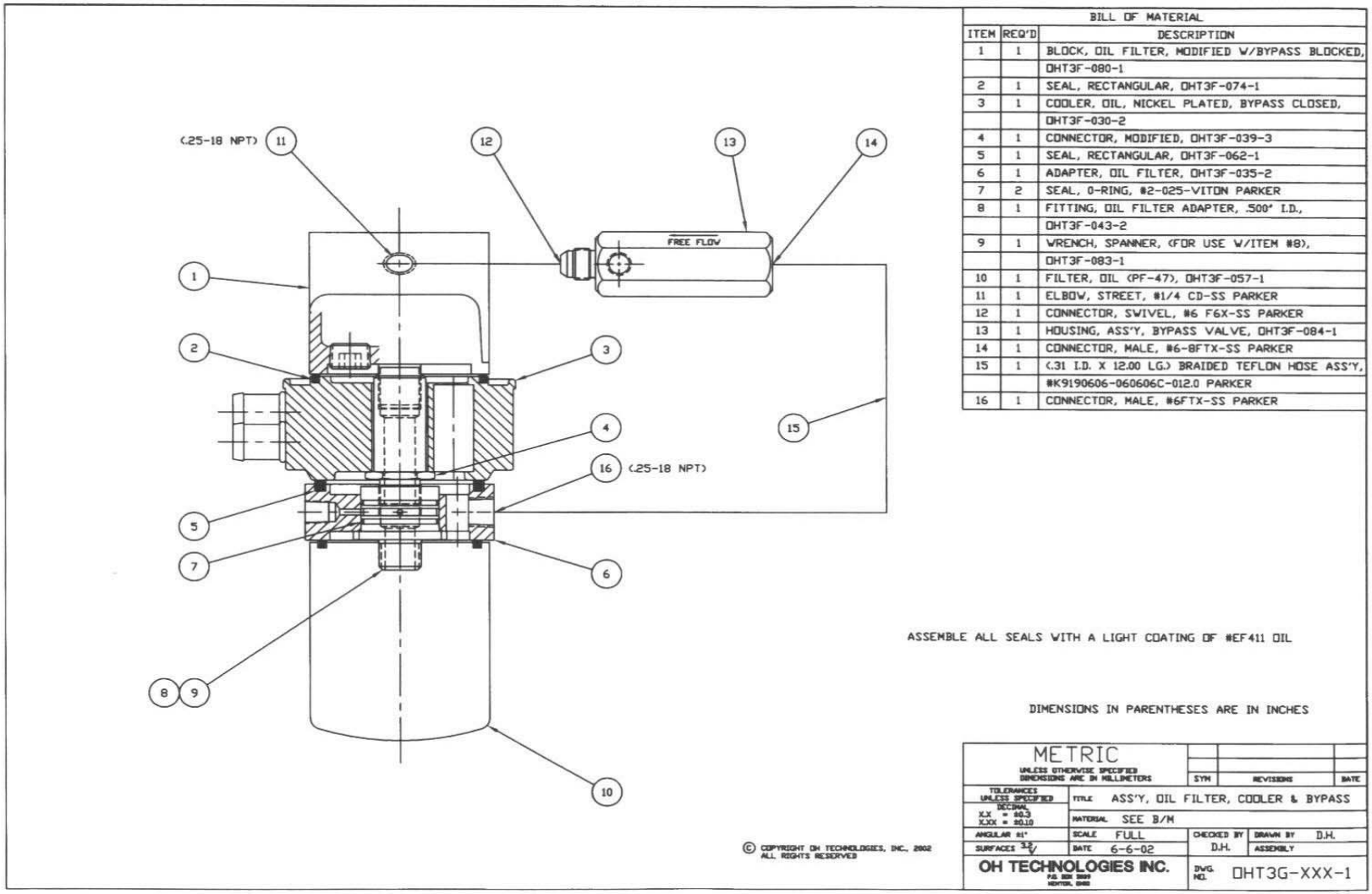
1 24501300 Adapter, oil filter
OHT3F-080-1 Modified

| REV | Date | Revision History |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**View**

**Oil Filter Adapter Modification**

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 3A |

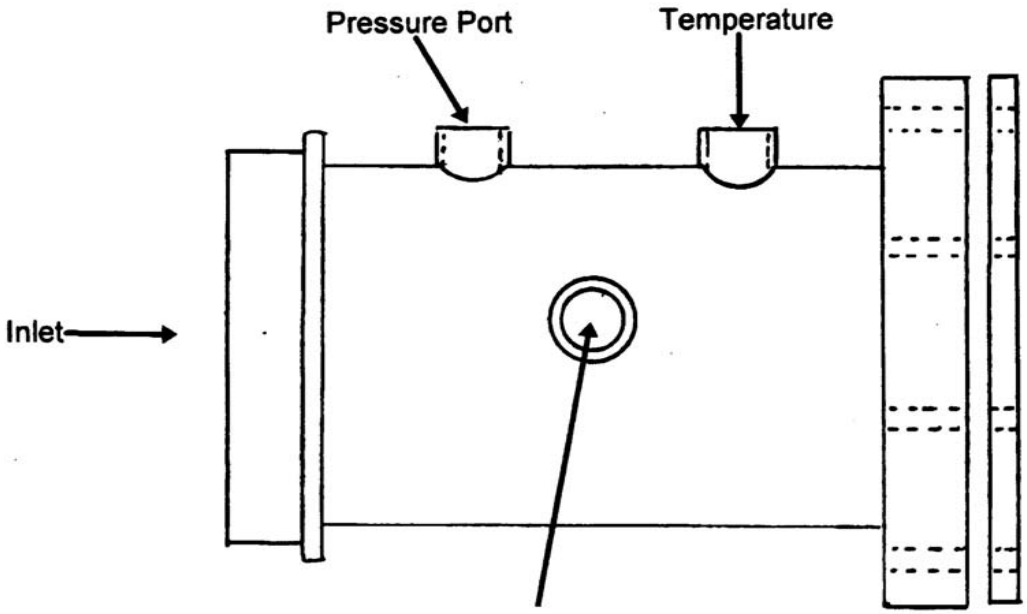



BILL OF MATERIAL

| ITEM | REQ'D | DESCRIPTION |
|---|---|---|
| 1 | 1 | BLOCK, OIL FILTER, MODIFIED W/BYPASS BLOCKED, |
| | | OHT3F-080-1 |
| 2 | 1 | SEAL, RECTANGULAR, OHT3F-074-1 |
| 3 | 1 | COOLER, OIL, NICKEL PLATED, BYPASS CLOSED, |
| | | OHT3F-030-2 |
| 4 | 1 | CONNECTOR, MODIFIED, OHT3F-039-3 |
| 5 | 1 | SEAL, RECTANGULAR, OHT3F-062-1 |
| 6 | 1 | ADAPTER, OIL FILTER, OHT3F-035-2 |
| 7 | 2 | SEAL, O-RING, #2-025-VITON PARKER |
| 8 | 1 | FITTING, OIL FILTER ADAPTER, .500" I.D., |
| | | OHT3F-043-2 |
| 9 | 1 | WRENCH, SPANNER, (FOR USE W/ITEM #8), |
| | | OHT3F-083-1 |
| 10 | 1 | FILTER, OIL (PF-47), OHT3F-057-1 |
| 11 | 1 | ELBOW, STREET, #1/4 CD-SS PARKER |
| 12 | 1 | CONNECTOR, SWIVEL, #6 F6X-SS PARKER |
| 13 | 1 | HOUSING, ASS'Y, BYPASS VALVE, OHT3F-084-1 |
| 14 | 1 | CONNECTOR, MALE, #6-8FTX-SS PARKER |
| 15 | 1 | (.31 I.D. X 12.00 LG.) BRAIDED TEFLON HOSE ASS'Y, |
| | | #K9190606-060606C-012.0 PARKER |
| 16 | 1 | CONNECTOR, MALE, #6FTX-SS PARKER |

| REV | Date | Revision History | View |
|---|---|---|---|
| 1 | 6/17/02 | OHT Print | **OHT Oil Cooling & By-Pass** |
| | | | Printed by permission OH Technologies |
| | | | |
| | | | |
| | | | |

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 3b |




Inlet Air Temperature Sensor

"Dyno Harness"

**Description of Operation**

Inlte air adapter

Use pressure port for hookup to transducer, temperature for thermocouple (centered in flow), and inlet air pressure sensor port for Dyno Harness sensor.

**Specification**

OHT3F-001-2 Adapter, Throttle Body

| REV | Date | Revision History |
|---|---|---|
| 1 | 11/30/99 | Block-63 |
| 2 | 2/22/02 | Update View, Inlet Air Temp. Sensor |
| | | |
| | | |
| | | |

**View**

**Adapter, Throttle Body**

| OHT | Sequence IIIF | Section | Sheet |
|---|---|---|---|
| | | 8 | 4 |