

**Sequence III G Engine Oil Certification Test
Engine Assembly Manual**

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Revision 04

December 15, 2003

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Section 0

Hardware usage guidelines

All materials used in this test must conform to acceptance guidelines as specified in the ASTM Sequence IIIG 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 / G 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 IIIG Engine Assembly Manual Update Revision Timeline

Latest Revision 4

Date 12/15/2003

Contact Person Mike Kasimirsky TMC 412-365-1033

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Date	Sec.	Sheet	Topic	Comments	Info Letter
4/28/03	1	5A	Cleaning instructions	Removal of NAT50 / PDN50 soap residue	
4/28/03	3	8	Ring Color Code	Addition of color code identification	
4/28/03	4	1	Front Cover usage	Change to OHT epoxy impregnated front cover part #.	
4/28/03	4	12	Pan Gasket	Change to 2003 gasket part #.	
4/28/03	6	9	MAF part #	Add new mass airflow sensor part #.	
6/23/03	6	9	MAF part #	Add remanufactured part # 88961007	
6/23/03	7	6	MAF part #	Add remanufactured part # 88961007	
9/10/03	3	8	Ring Gap	Correct typo for top ring gap (0.064 to 0.64)	
9/10/03	5	1	Valve Spring Calibration	Change +/- load from 22N to 44N (5lbf. To 10lbf.)	IIIG-03-2
12/15/03	1	1	Block part #	Change block part # from drawing # to 24502286	
12/15/03	1	5	Solvent specification	Update to mineral spirit	
12/15/03	1	5A	Solvent specification	Update to mineral spirit	
12/15/03	1	6	Fastener	Update fastener usage	
12/15/03	2	7	Honer	Update ratchet feed setting	
12/15/03	2	8	Honer	Update honing procedure	
12/15/03	2	9	Honer	Update revised loads and target sizing	
12/15/03	2	10	Honer	New page, honer calibration requirements	
12/15/03	2	11	Honer	New page, honer maintenance requirements	
12/15/03	2	12	Honer	New page, honer maintenance requirements	
12/15/03	3	5	Solvent specification	Update to mineral spirit	
12/15/03	3	6	Fastener	Update fastener usage	
12/15/03	3	8	Rings	Update paint removal and solvent usage	
12/15/03	3	11	Camshaft	Update solvent usage and lubrication requirements	
12/15/03	4	5	Sealer	Update approved sealer specification	
12/15/03	4	12	Sealer	Update approved sealer specification	
12/15/03	5	1	Solvent specification	Update to mineral spirit	
12/15/03	6	1	Solvent specification	Update to mineral spirit	
12/15/03	6	2	Solvent specification	Update to mineral spirit	
12/15/03	6	6	Sealer	Update approved sealer specification	

Sequence IIIG Engine Assembly Manual Update Revision Timeline

Latest Revision

4

Date 12/15/2003

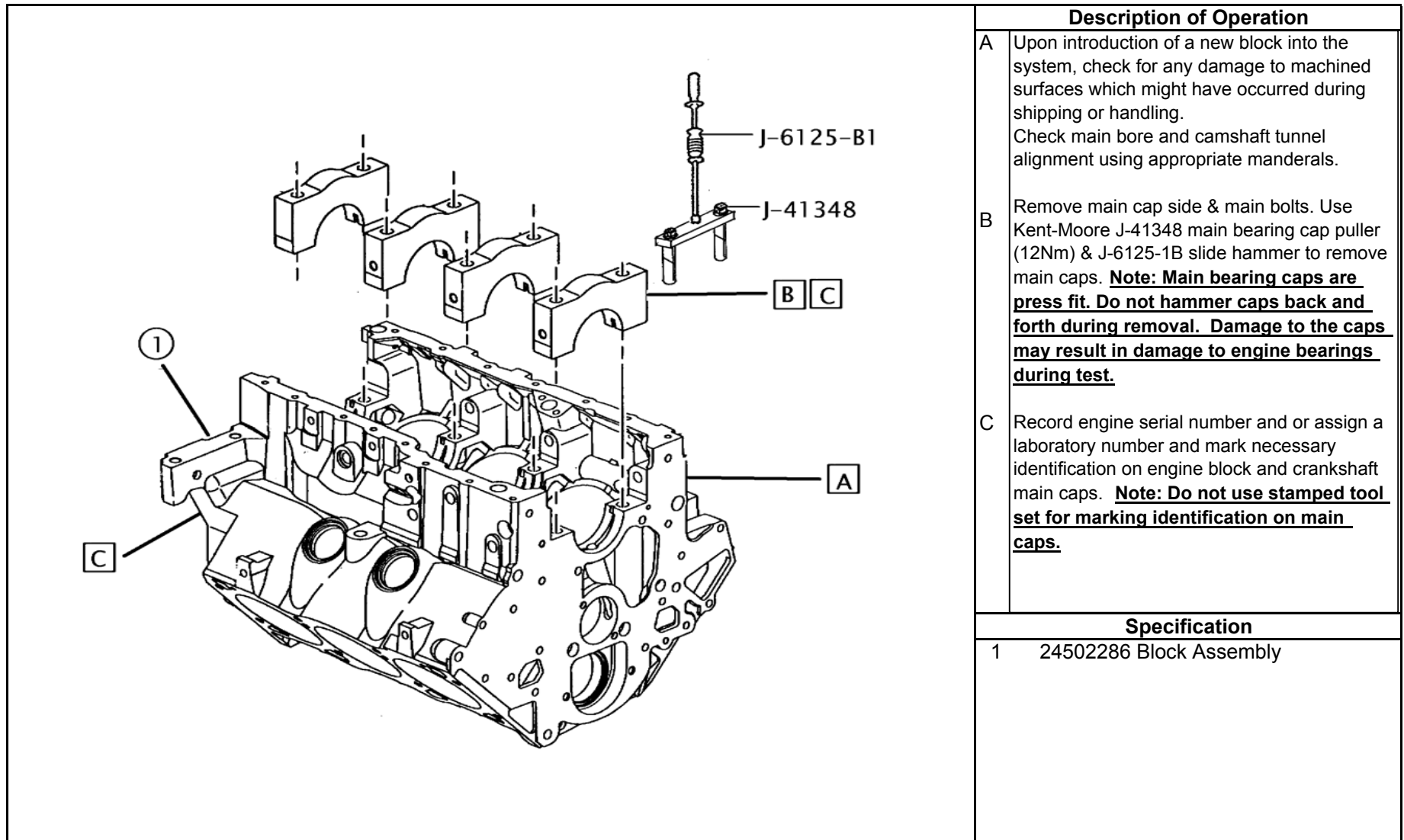
Contact Person Mike Kasimirsky TMC 412-365-1033

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Date	Sec.	Sheet	Topic	Comments	Info Letter
12/15/03	6	11	Text	Update text block (injector flow testing) reference procedure	
12/15/03	7	4	Part #	Add new shield 24508586	

Section 1

Cleaning and Pre Hone Preparation



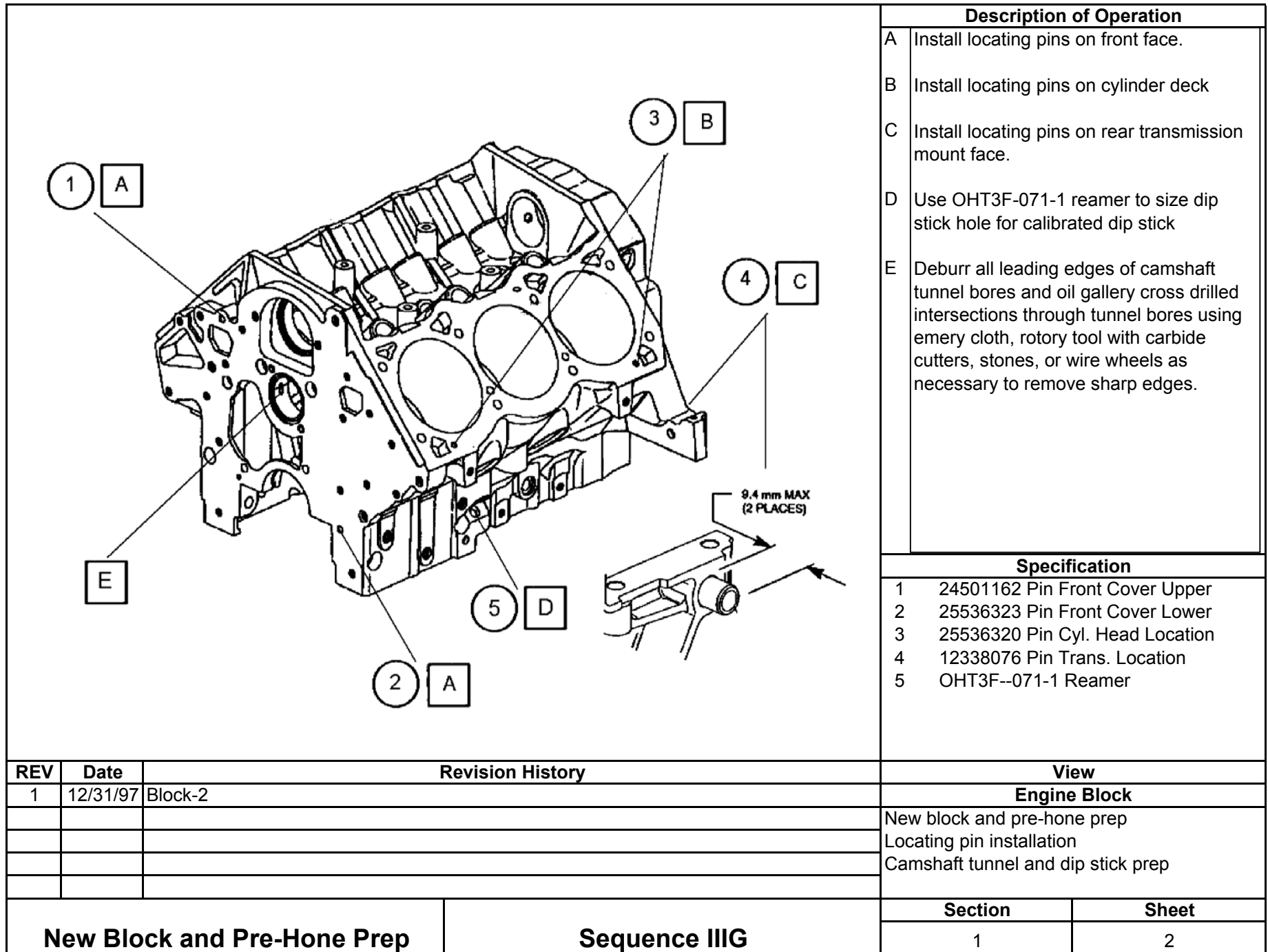
REV	Date	Revision History
1	12/31/97	Block-1
2	12/15/03	Change from engineering drawing part # (24506028) to actual part # 24502286

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. 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	24502286 Block Assembly

New Block and Pre-Hone Prep	Sequence III G
------------------------------------	-----------------------

View	
Engine Block	
New block and pre-hone prep Serial Number Locations	
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, rotary 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

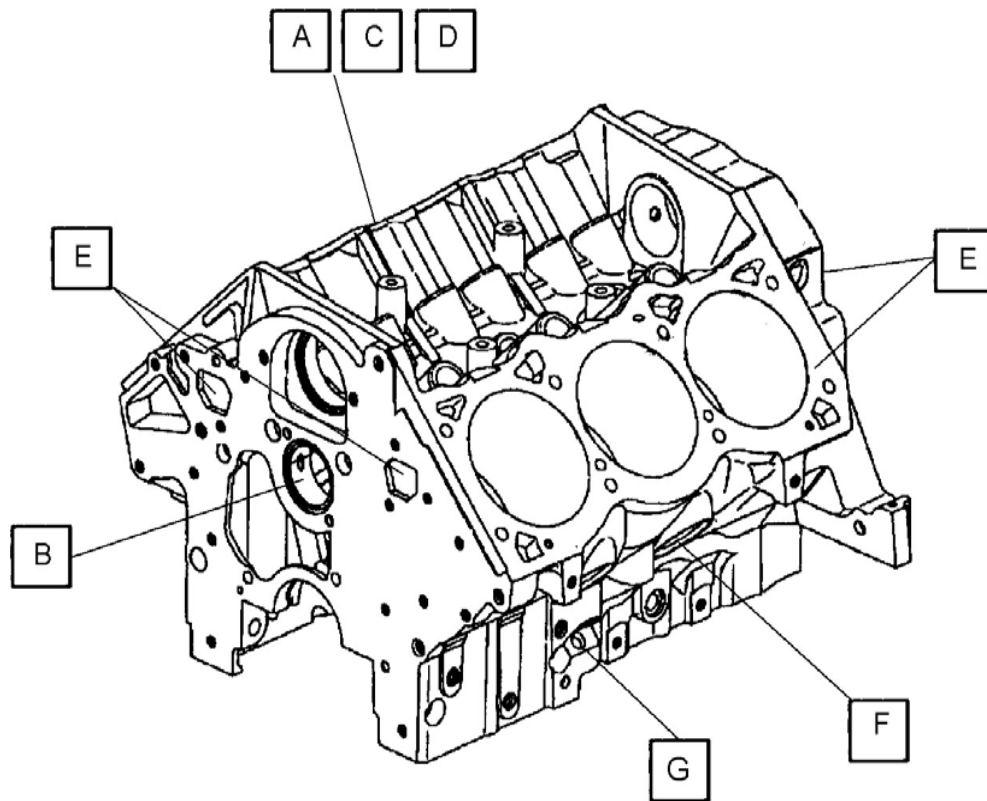
REV	Date	Revision History
1	12/31/97	Block-2

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

New Block and Pre-Hone Prep	Sequence III G

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.
			Note: This location is not to be used for temperature control or thermocoupled.	
			Specification	
			1	444777 Plug Auto Hex Socket
REV	Date	Revision History	View	
1	12/31/97	Block-3	Engine Block	
			New block and pre-hone prep	
			Plugged holes in front of engine	
New Block and Pre-Hone Prep			Sequence III G	
			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

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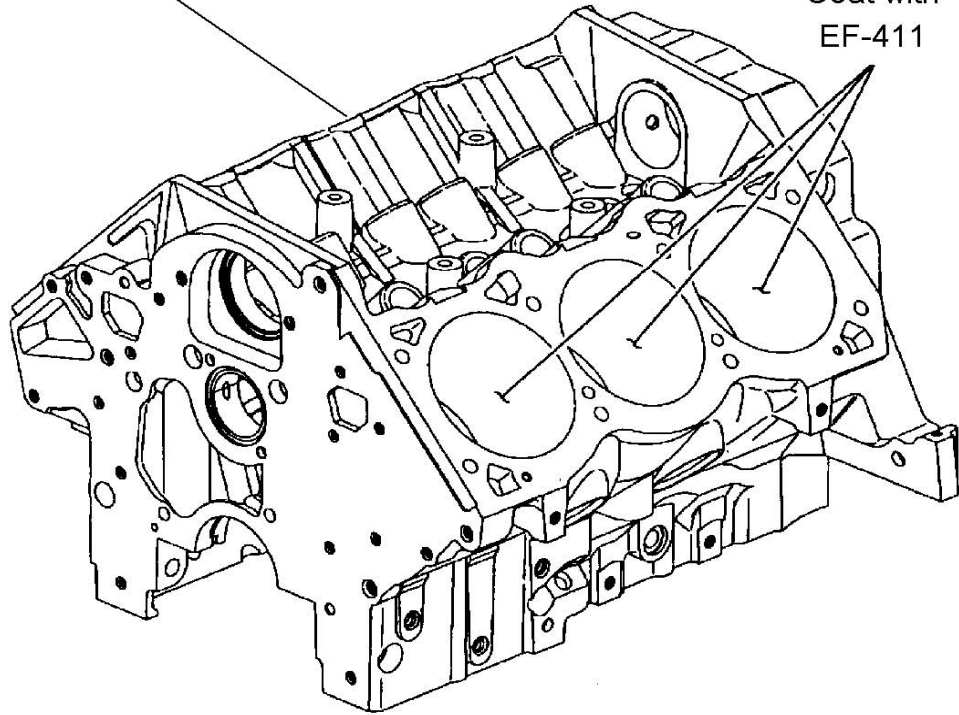
REV	Date	Revision History
1	12/31/97	Block-4

View
Engine Block
New block and pre-hone prep

New Block and Pre-Hone Prep	Sequence III G
------------------------------------	-----------------------

Section	Sheet
1	4

Spray engine with 50/50
Solution EF-411 / Mineral Spirits



Coat with
EF-411

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 mineral spirits to remove any detergent residue before honing.
- ? (Step Sec. 1 sheet 6)
Repeat step "A & B" after honing.
- Note: If this is the final cleaning after honing, spray the entire engine block using a 50/50 solution of EF-411 and mineral spirits. Air dry to remove excess solution.
- ? (Step Sec. 3 sheet 1)

Specification

View

Engine Block

Engine block cleaning

Section

Sheet

1

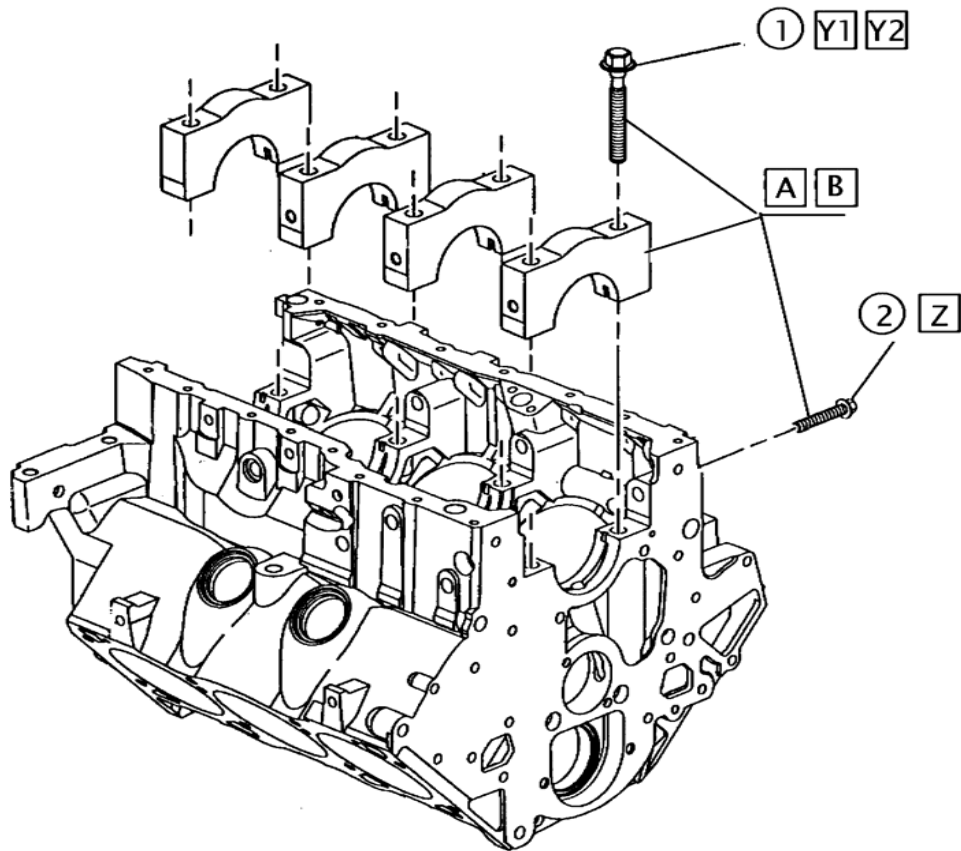
5

New Block and Pre-Hone Prep

Sequence III G

REV	Date	Revision History
1	12/31/97	Block-5
2	12/15/03	Update, change to mineral spirits

			Description of Operation	
<p>Automatic Parts Washer Procedure for IIIF Engine Blocks</p> <ol style="list-style-type: none"> 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 mineral spirits. 7) Wipe cylinder bores out with a lint free towel. 8) Spray engine block with a mixture of 50/50 EF-411 and mineral spirits. 				
			Specification	
REV	Date	Revision History	View	
1	9/5/00	Procedure for Better Engineering Jet Washer usage	Engine Block	
2	12/15/03	Update change to mineral spirits	Engine block cleaning procedure for automated type jet washers	
New Block and Pre-Hone Prep		Sequence III G	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
20Nm then 40Nm + 35°+35°+35° (repeat 40Nm + 35° 3 times from center out)(use used fasteners for honing)
- Z Torque & Angle 15Nm + 45°

Specification

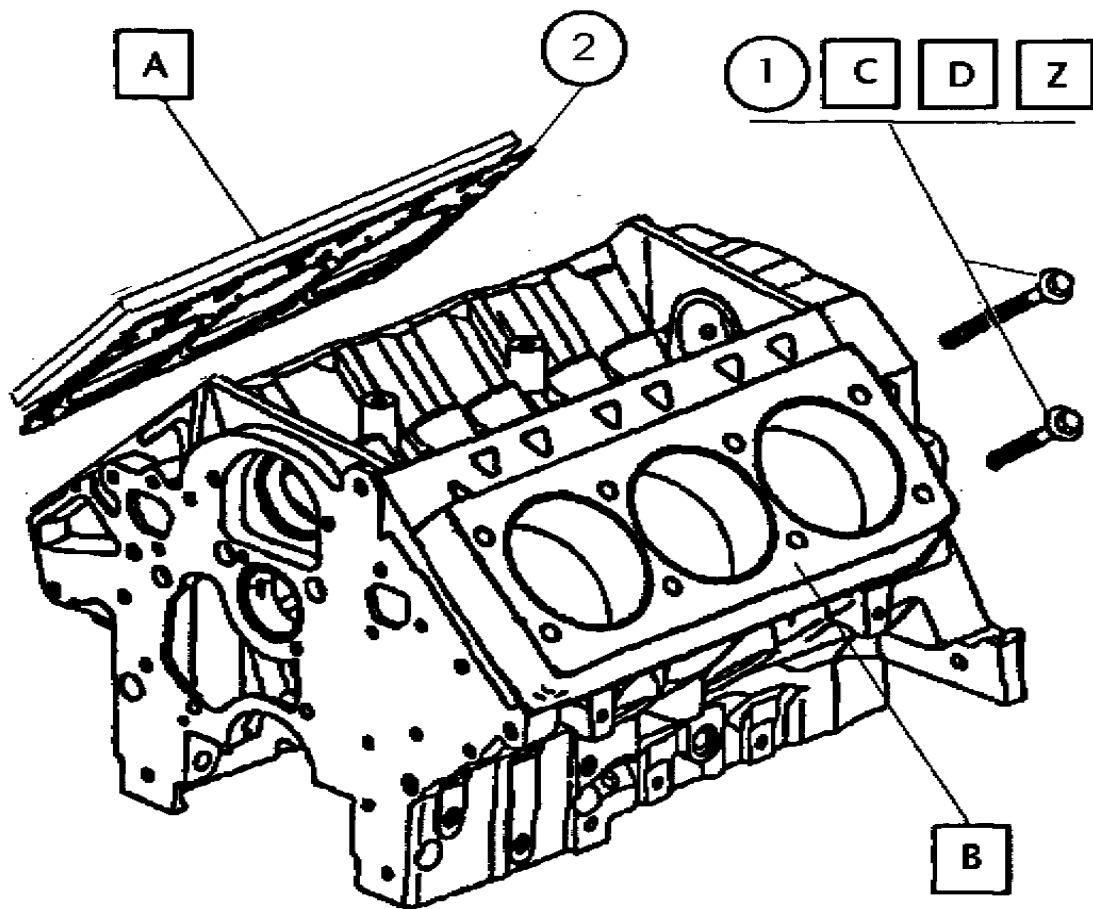
- 1 24503056 Bolt (8) see note Y (Tighten before Z)
- 2 24505576 Bolt (6) see note Z (Tighten after Y)

REV	Date	Revision History
1	1/10/98	Block-6
2	12/15/03	Clarification, add 40Nm + 35° 3 times... and (use used fasteners for honing) to Y2

View	
Engine Block	
Main cap installation	

New Block and Pre-Hone Prep	Sequence III G
------------------------------------	-----------------------

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)
See note Z
Use in upper and lower position with double hardened washers on lower row. Obtain washers from B-H-J.
- 2 24503801 Gasket RH.
24503802 Gasket LH.

View

Engine Block

B-H-J Torque Plate installation

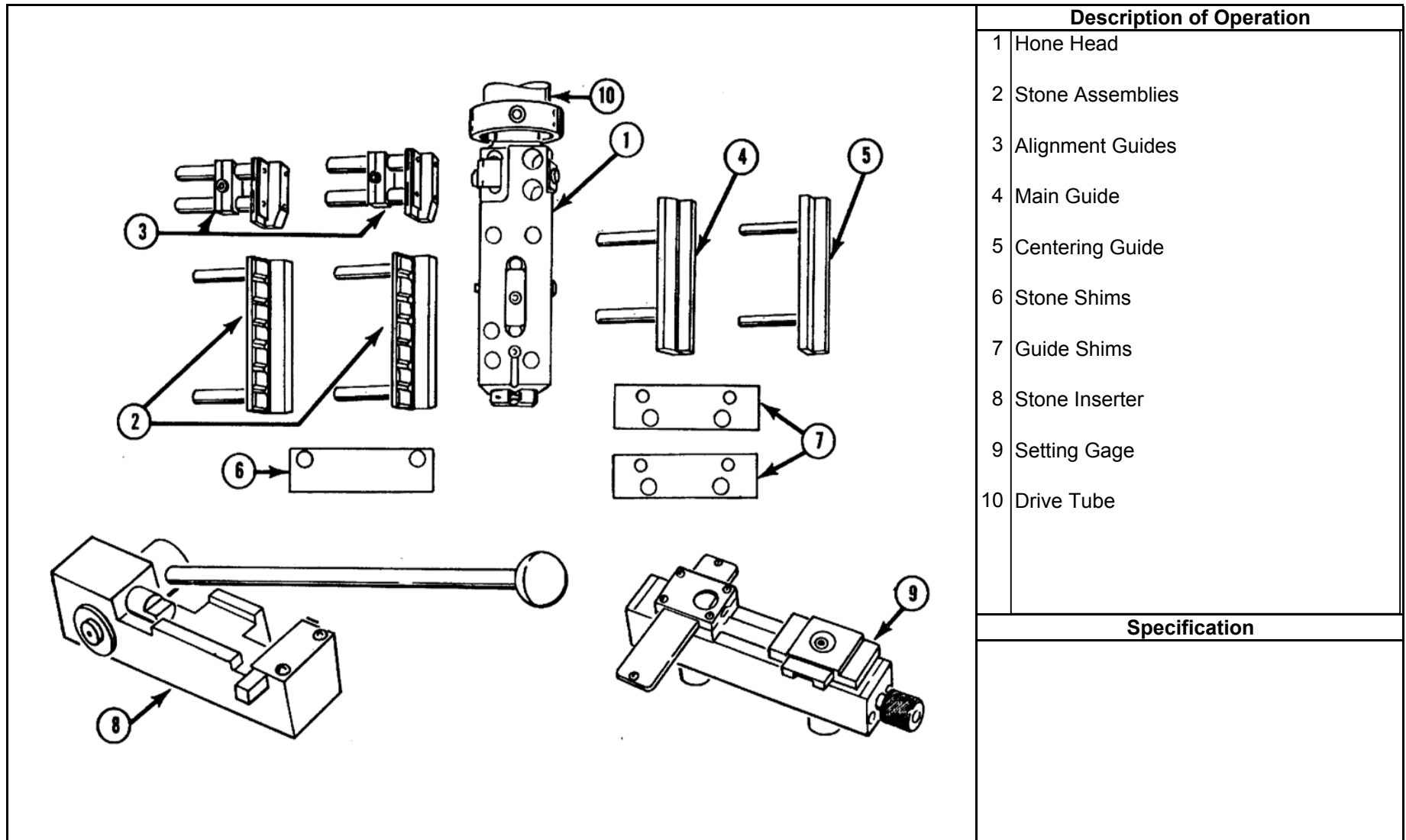
Section	Sheet
1	7

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

New Block and Pre-Hone Prep	Sequence III G
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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 III G
------------------------	-----------------------

Section	Sheet
2	1

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

View

Stones & Guides

Stone and guide adjustment

Section

2

Sheet

2

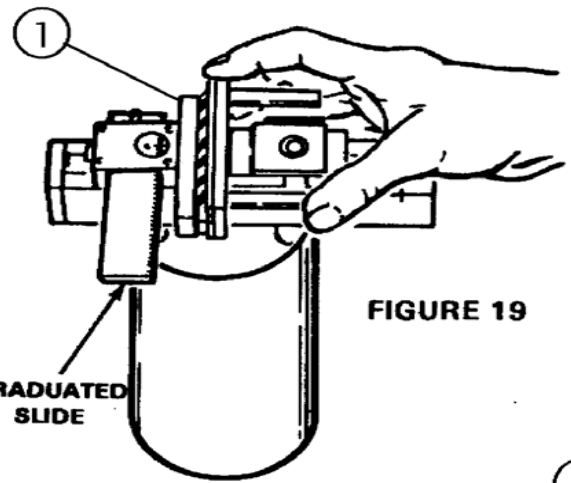


FIGURE 19

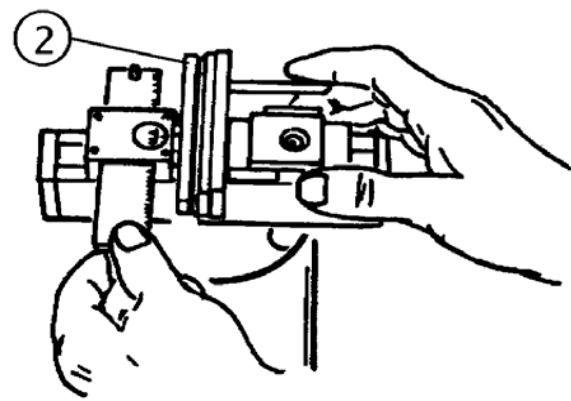
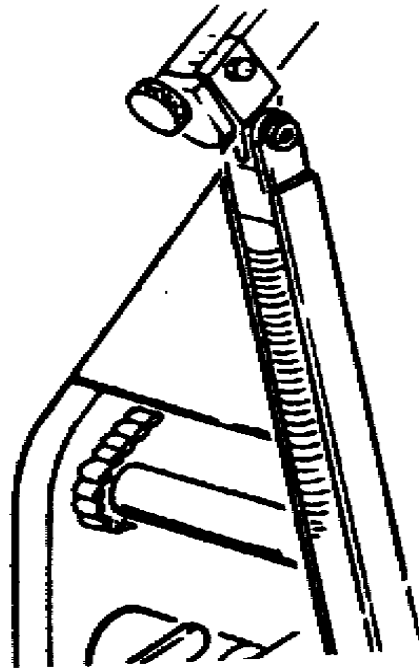
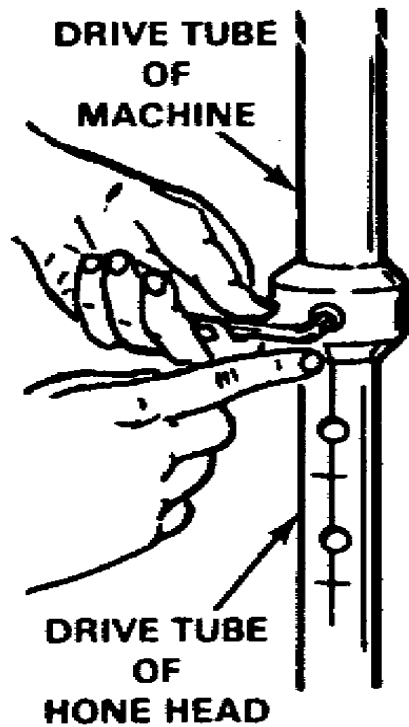


FIGURE 20

REV	Date	Revision History
1	1/7/98	Hone-3-1 & 3-2
Cylinder Honing		Sequence III G



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 III G

Section	Sheet
2	3

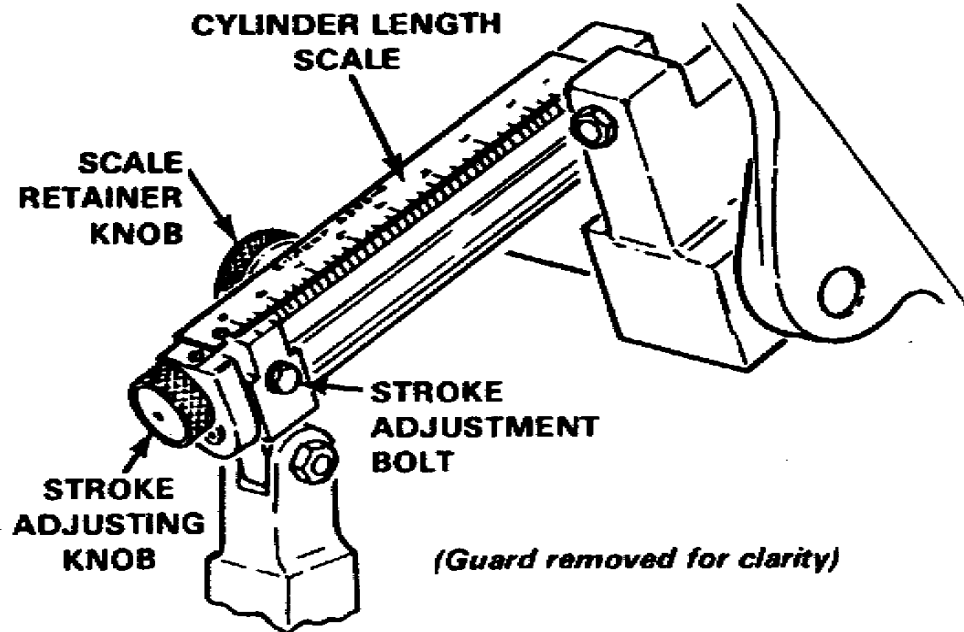


FIGURE 23

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

View

Stroke Length

Section

Sheet

2

4

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

Cylinder Honing

Sequence III G

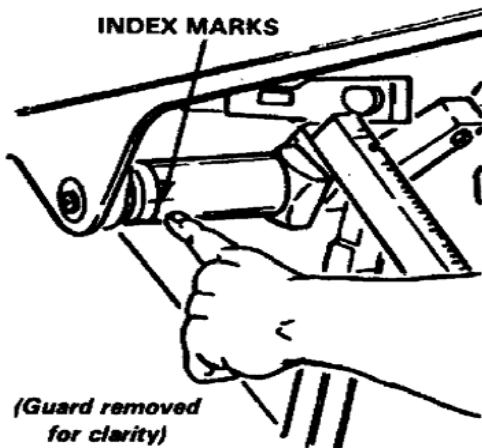


FIGURE 24

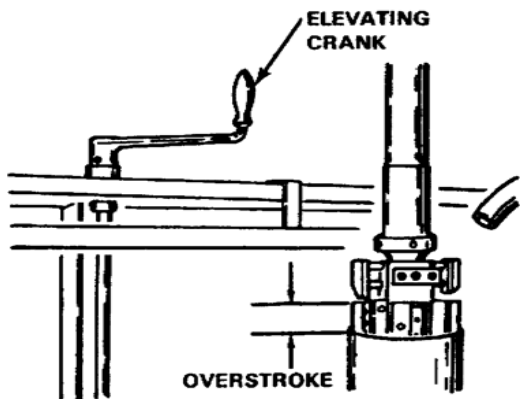


FIGURE 25

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

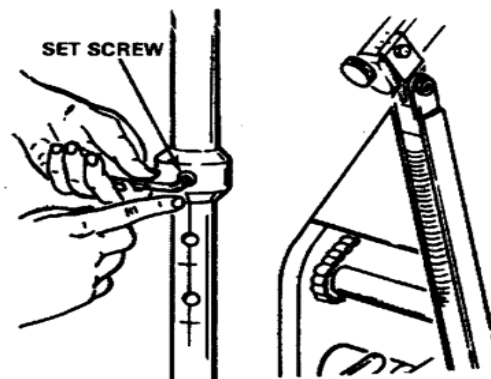


FIGURE 26

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

View

Overstroke

Overstroke adjustment

Section

2

Sheet

5

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

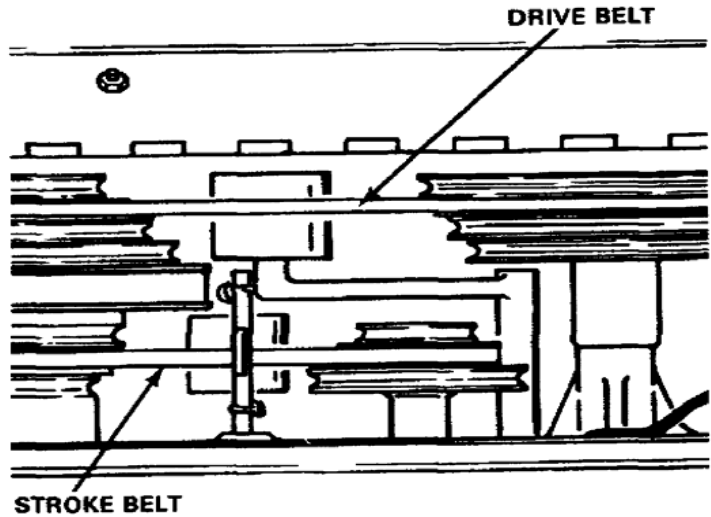
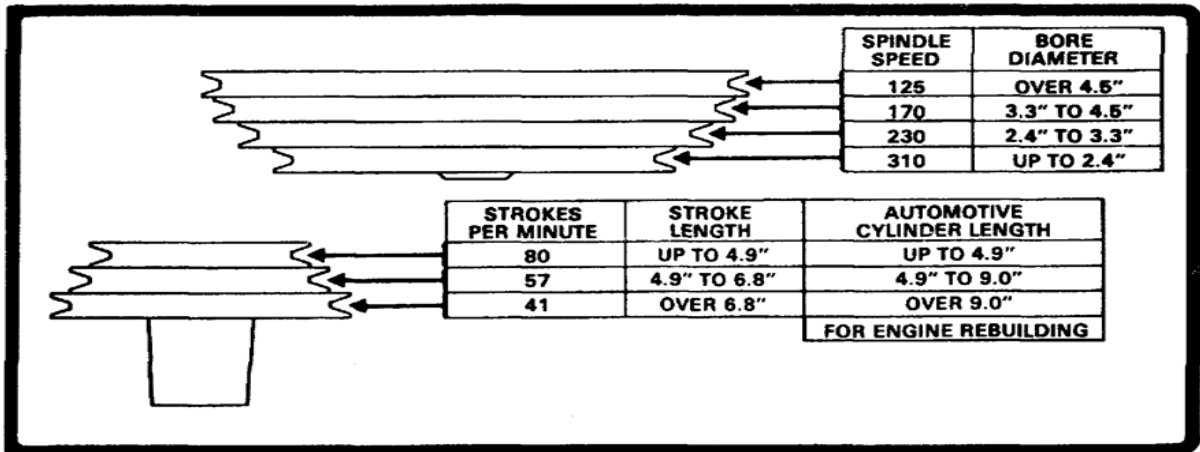


FIGURE 28

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

View

Speed & Stroke

Section

Sheet

2

6

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

Cylinder Honing

Sequence III G

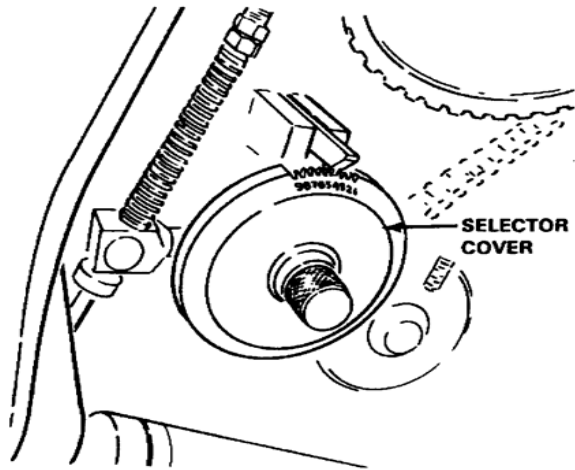


FIGURE 29

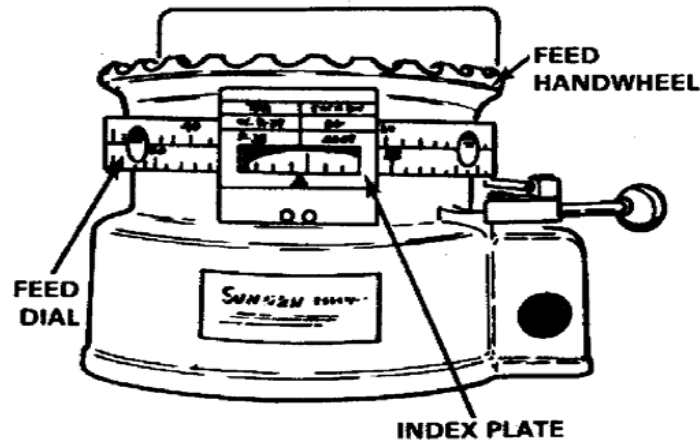


FIGURE 30

Description of Operation

Set the ratchet feed rate on the selector cover to 1 for the EHU 512 Stones. change the ratchet feed rate to 4 for the C30-PHT-731 Plateau Hone Brushes. 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
3	12/15/03	Update ratchet feed changes for stones and brushes

View	
Ratchet Feed & Index Plate	

Cylinder Honing

Sequence III G

Section	Sheet
2	7

Honing Operations Guide

EHU-512 Stones (Ratchet Feed Set to 1)

- 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 to a point where it will not shut off the honer over fifteen strokes
- 3 Set mode switch to timed mode and set controller to 15 seconds (15 seconds = 15 strokes)
- 4 Start the honer and adjust the load to 15 units, maintaining 15 units load by hand during honing. Apply no more than 15 strokes per cylinder at a time. (4 strokes minimum during final sizing) Switch stone positions in the hone head between each cylinder. Do not dwell machine when cylinder is within 0.01mm of target size.

- Note:1 Unit load will oscillate during normal operation. The intent is to hold 15 units as a minimum load during the honing process.
- Note:2 During final sizing, if less than 15 strokes are desired, set timer to desired seconds or operate in zero shut-off mode and never dwell machine or run less than 4 strokes / cylinder.
- 5 Follow recommended honing sequence (1,5,4,-3,2,6) do not hone adjacent cylinders
 - 6 Size cylinders, 15 strokes / cylinder maximum, switching stone positions in hone head between each cylinder. Do not chase taper (dwell machine) when cylinder size is within 0.01mm of target. Stop honing with the EHU-512 stones when cylinder size is within 0.005mm of target size.

C30-PHT-731 Plateau Honing Tool (Ratchet Feed Set to 4)

- 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 units and allow to run until system shuts off.

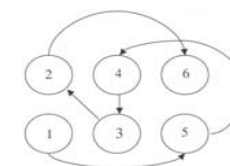
- Note:3 Proper ratchet feed setting is required to establish desired cylinder surface parameters using the C30-PHT-731 Plateau Hone Tool. After setting the initial load, the ratchet feed system will increase the load during the remaining time. Operators should not release load during this operation.

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.

See Section 2 Sheets 10 and 11 for honer calibration and maintenance requirements.

Honing Sequence



Note: When honing first run blocks, stroke limitations due not apply until cylinder size is within 0.0254mm (0.001in) of target size.

Specification

REV	Date	Revision History
1	1/7/98	
2	12/15/03	Update honing information according to Surveillance Panel direction 12/15/03

View

Fluid and Operations Guide

Section

2

Sheet

8

Cylinder Honing

Sequence III G

Honer Calibration

All CV-616 honers must be calibrated on-site by a qualified Sunnen Technician using the Hydraulic Pump and Reservoir Dynamometer. All CV-616 honers should be maintained according to the attached lubrication schedule each time the fluid and filters are changed.

Contact the Test Sponsor, ASTM Test Monitoring Center, Surveillance Panel Chairman, or Operations and Hardware Subpanel Leader for information on Sunnen calibration requirements.



Description of Operation

Specification

REV	Date	Revision History
1	1/1/98	Hone-10
2	12/15/03	Update honer calibration information

View

Honer Calibration

Cylinder Honing	Sequence III G
------------------------	-----------------------

Section	Sheet
2	10

Lubrication Point Table

1	Connecting Rod Needle Bearings	#2 Grease	2 Pumps
2	Stroke Rocker Arm (two points)	#2 Grease	2 Pumps
3	Lower Drive Arm to Carriage Connecting Strap Bearing	#2 Grease	2 Pumps
4	Upper Drive Arm to Carriage Connecting Strap Bearing	#2 Grease	Remove plug from bolt and fitting. 2 pumps, and replace plug.
5	Upper Rod-feed Universal Joint	SAE 20 Oil	Coat Universal
6	One Way Roller on Solenoid Energizer Switch	SAE 20 Oil	1 Sqirt
7	Electrical Limit Shaft Bearings	SAE 20 Oil	1 Sqirt
8	Solenoid Plunger Bushing	SAE 20 Oil	1 Sqirt
9	Top of Connecting Rod where the Stroke Release Pawl rides	#2 Grease	Brush on area
10	Connecting Rod Shaft	#2 Grease	Coat
11	Stroke Release Pawl Pivots (two points)	SAE 20 Oil	1 Sqirt
12	Stroke Release Block	#2 Grease	1 Pump
13	Gear Reducer	Gear Oil 140	Drain and refill
14	Carriage Traverse Shaft (both ends)	#2 Grease	2 Pumps each
15	Carriage Traverse Shaft (two points)	SAE 20 Oil	2 Sqirts
16	Handwheel Gears (not shown)	Lubriplate Low-Temp	Remove the handwheel and repack handwheel gears.
17	Feed Pawls	SAE 20 Oil	Fill Oiler
18	Idler Arm Shafts (three points)	#2 Grease	1 Pump each
19	Gear Reducer Pully Shaft	#2 Grease	1 Pump

Description of Operation

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

Perform recommended lubrication as outlined in lubrication table each time the fluid and filters are changed.

See Sheet 12 for lubrication guide.

Specification

View

Honer Maintenance

Section

Sheet

2

11

Cylinder Honing

Sequence III G

REV	Date	Revision History
1	12/15/03	New sheet, Honer maintenance

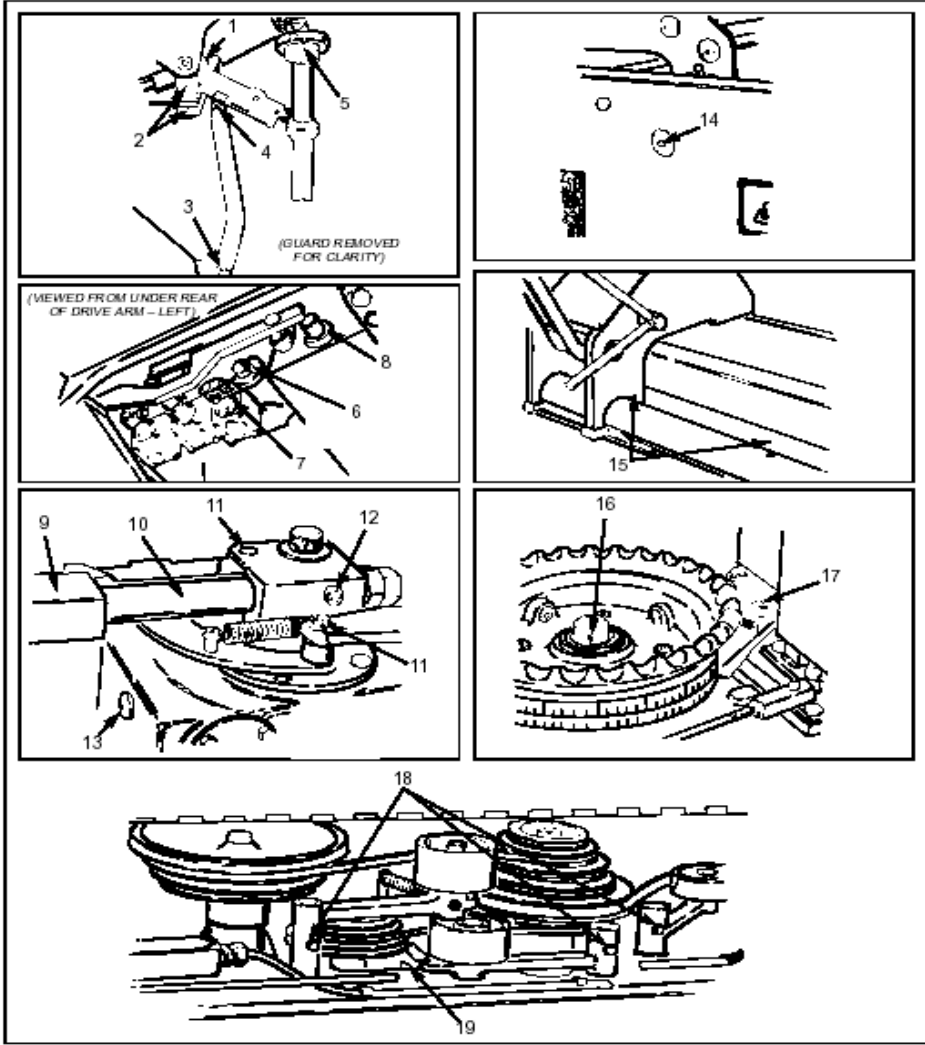


FIGURE 4-1, Lubrication

Description of Operation

Specification

View
Lubrication Guide

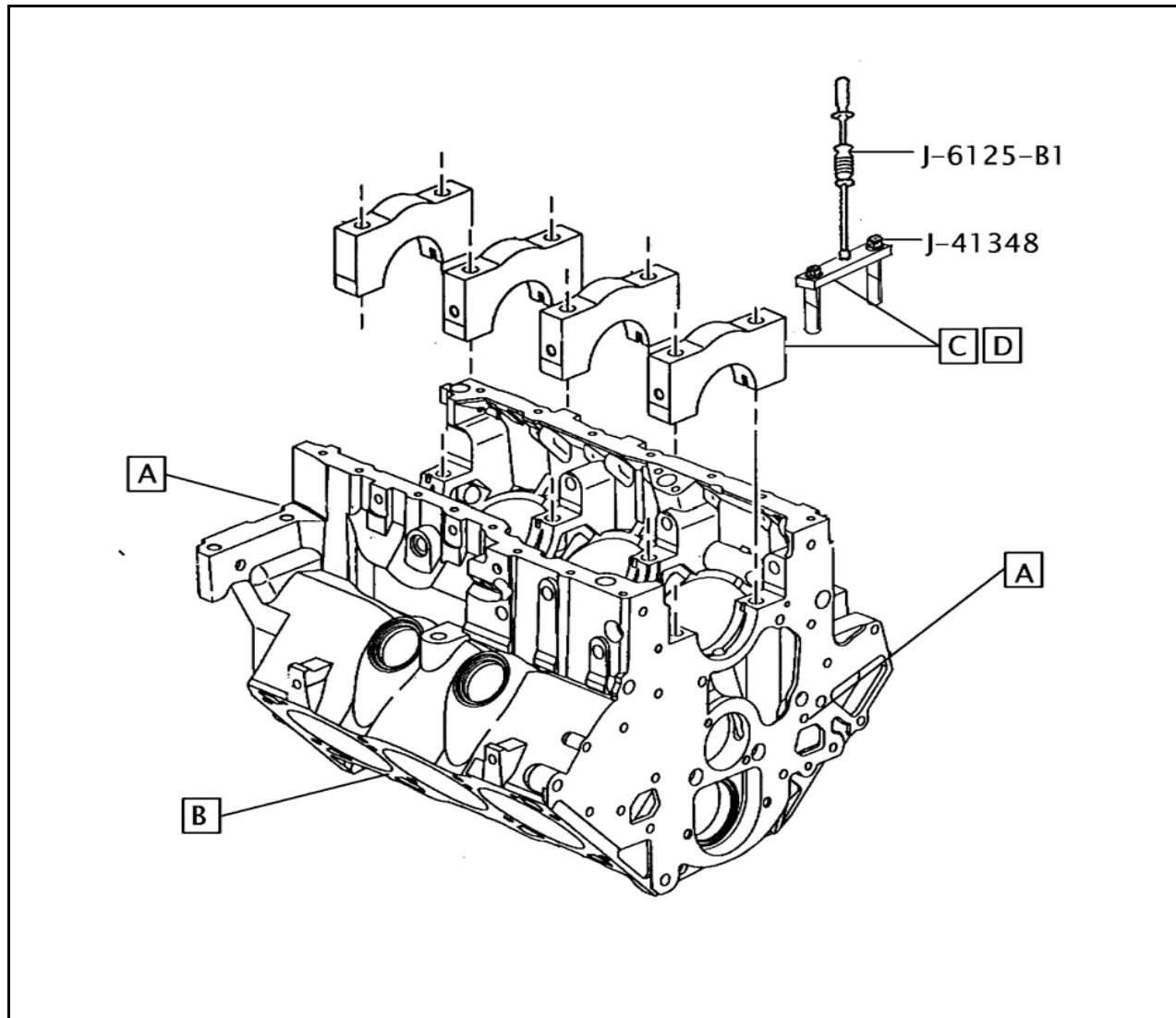
Section	Sheet
2	12

REV	Date	Revision History
1	12/15/03	New sheet, Lubrication points, visual guide

Cylinder Honing	Sequence III G
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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.
<p>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.</p>	

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 III G

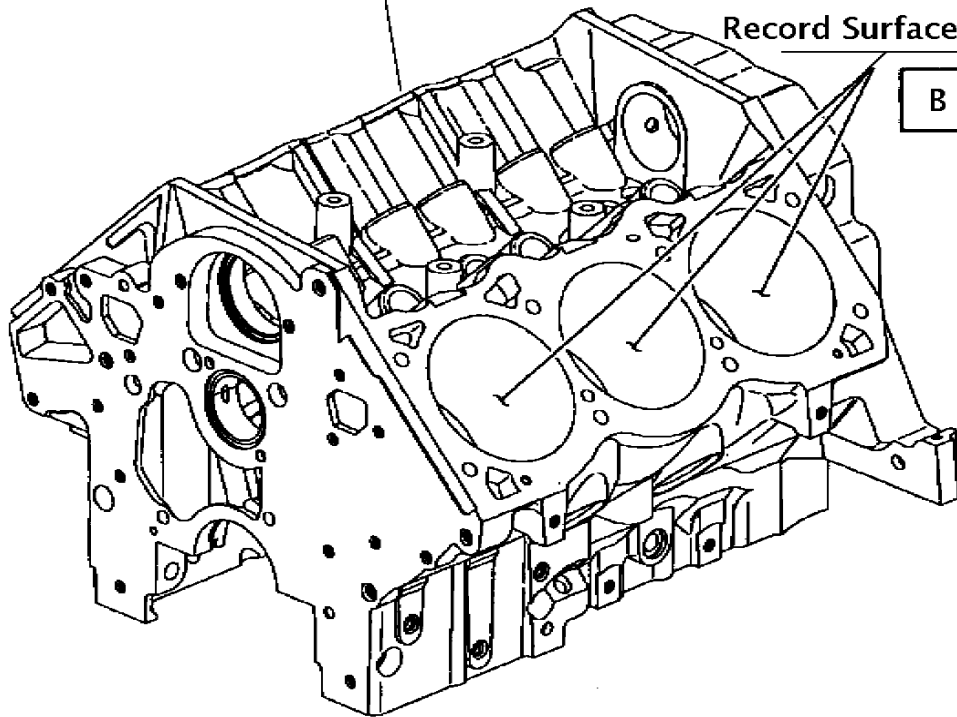
Section	Sheet
3	1

Check engine block for cleanliness

A

Record Surface Finish

B



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

View

Engine block cleanliness inspection and cylinder surface finish/size recording

Section

3

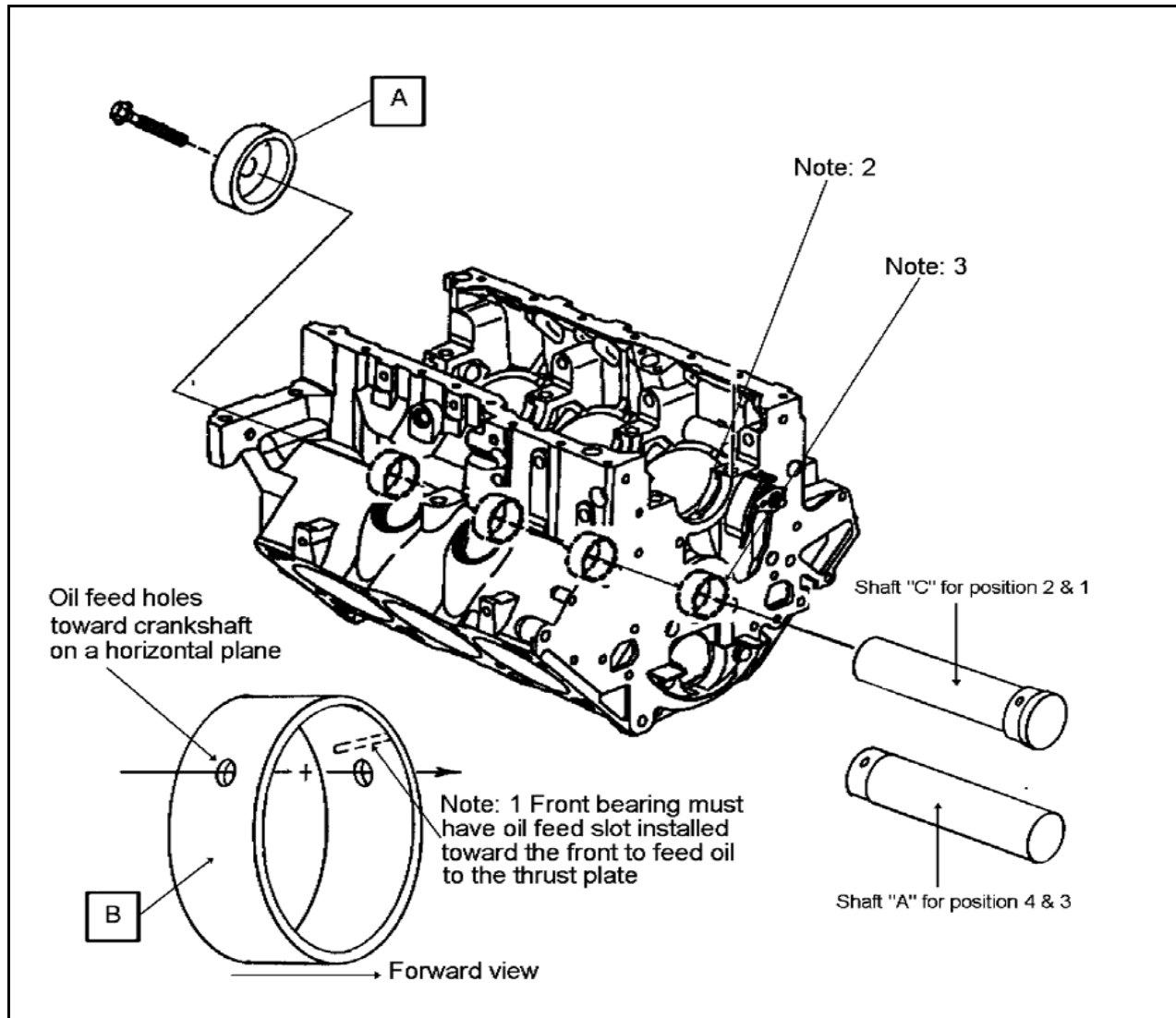
Sheet

2

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

Short Block Assembly

Sequence III G



Description of Operation

A Install camshaft bearings using OHT3F-019-1 camshaft bearing installation tool. Sections:
A for #4 rear & #3 intermediate
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. See view "B" and Note: 1

Note: 2
Use a pen light to check intersection of oil feed hole when viewed through main bearing oil gallery.

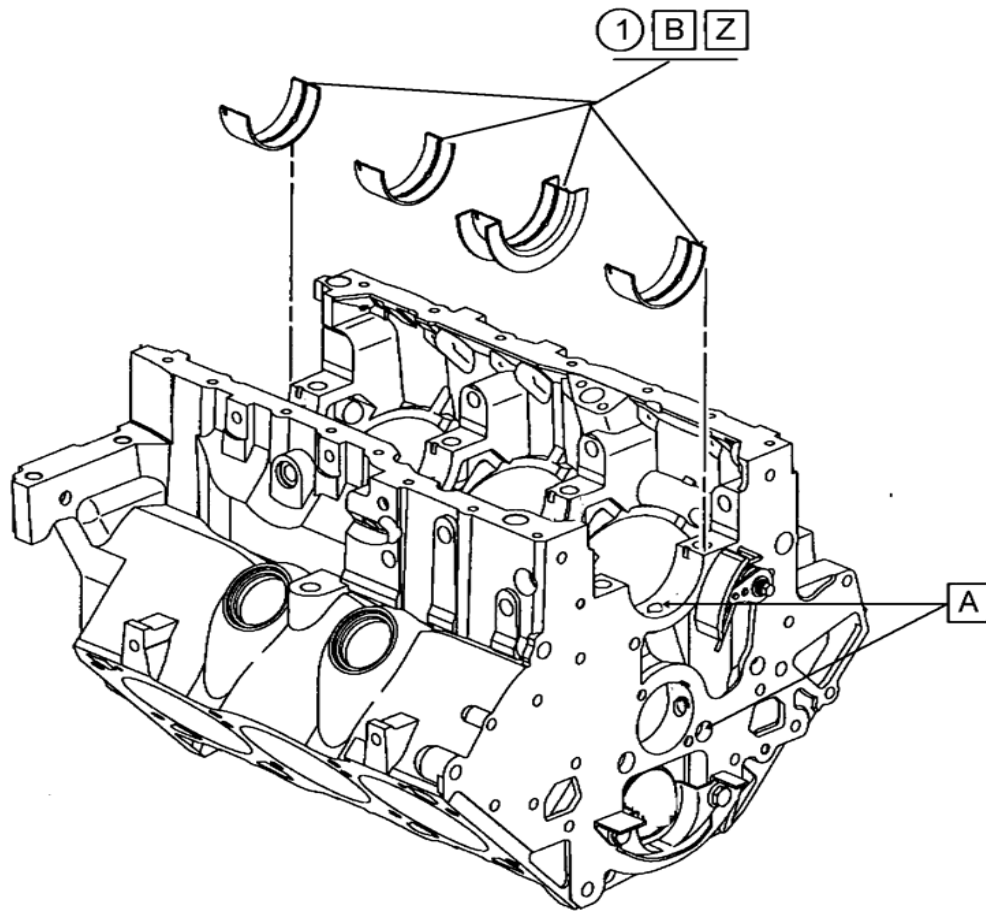
Note: 3
Check bearing bores to remove sharp edge or burrs in leading edge and/or bore before installation. See Sec.1 Sheet 2

Specification

1	Bearing camshaft #1 & #4 OHT3F-028-09
2	Bearing camshaft #2 & #3 OHT3F-028-10 Both bearings are included in OHT3F-042-2

REV	Date	Revision History
1	01/02/98	Block-10
Short Block Assembly		Sequence III G

View	
Short Block	
Camshaft bearing positioning and installation	
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

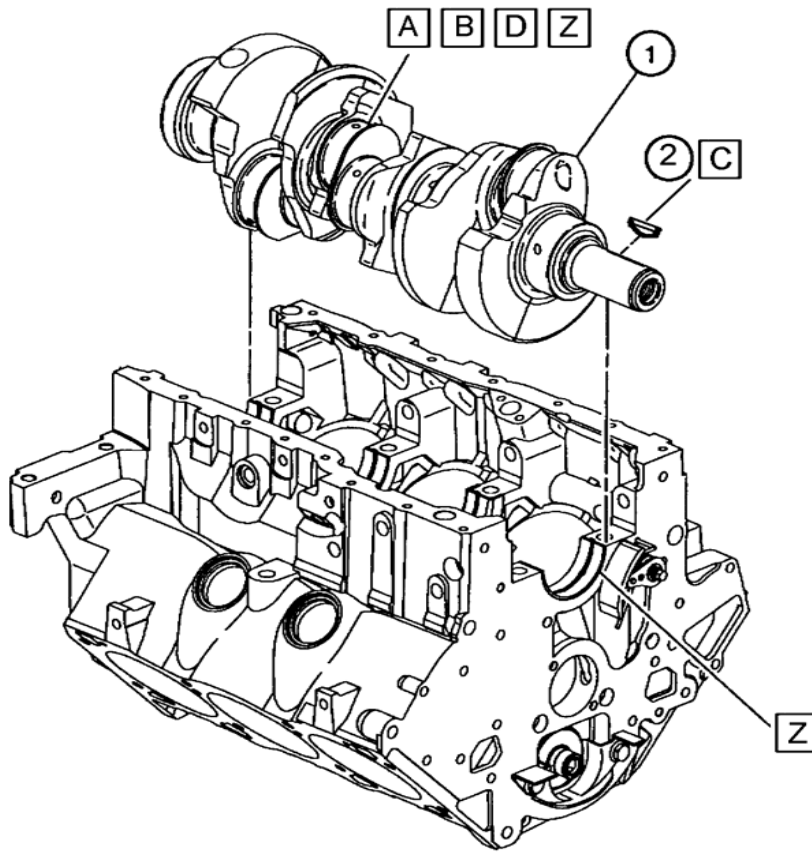
- 1 OHT3F-042-2
 OH-101 (1,3,4, Upper)
 OH-102 (1,3, Lower)
 OH-103 (4 Lower)
 OH-104 (2 Lower)
 OH-105 (2 Upper)

REV	Date	Revision History
1	01/03/98	Block-11

View
Short Block
Upper main bearing inspection and installation

Short Block Assembly	Sequence III G
-----------------------------	-----------------------

Section	Sheet
3	4



Description of Operation

- A Clean the crankshaft using an approved commercial cleaning agent followed by mineral spirits 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 mineral spirits and nylon bristle brushing of the oil galleries. Spray crankshaft with 50/50 solution and blow the excess off with compressed air.
- B Check journal diameters.
Mains 63.470 - 63.495mm
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

View

Short Block

Crankshaft cleaning, inspection, and installatio

Section

3

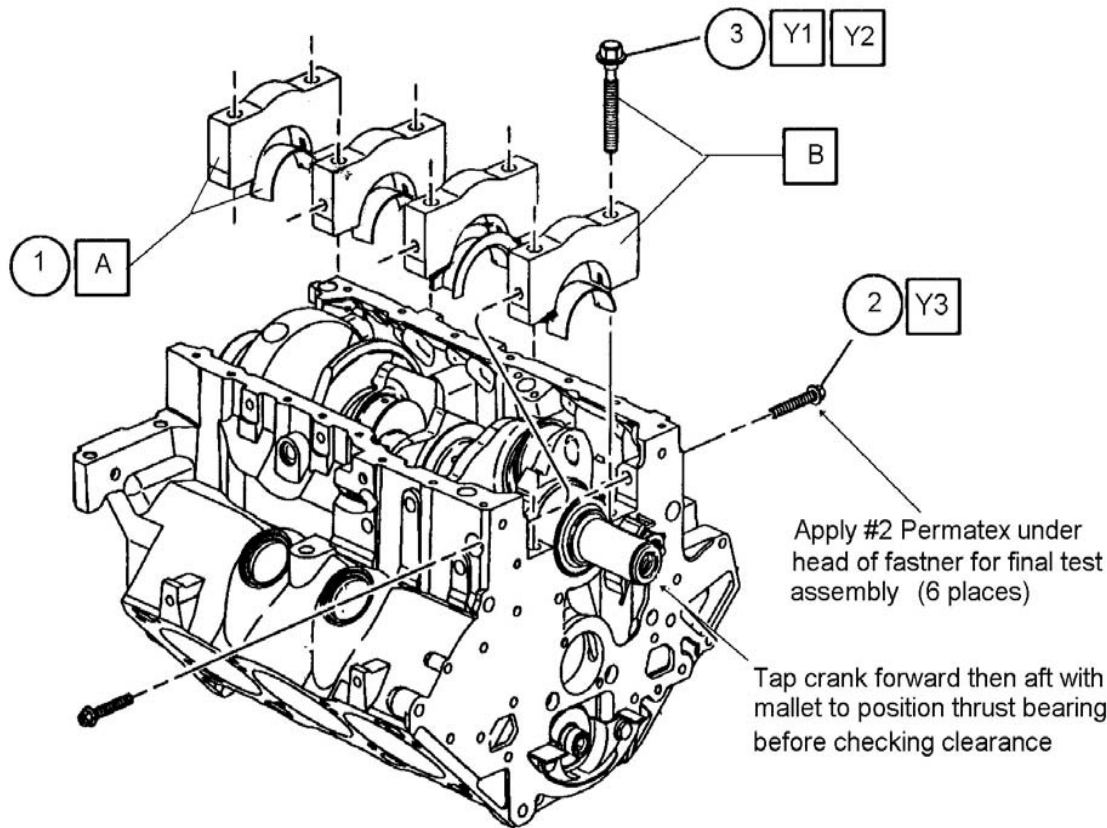
Sheet

5

REV	Date	Revision History
1	01/03/98	Block-12
2	12/15/03	Update text, change to mineral spirits

Short Block Assembly

Sequence III G



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. Use new bolts for each test
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 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) See note on sealer usage
3	24503056 Bolt main cap (8) Use new bolts for each test

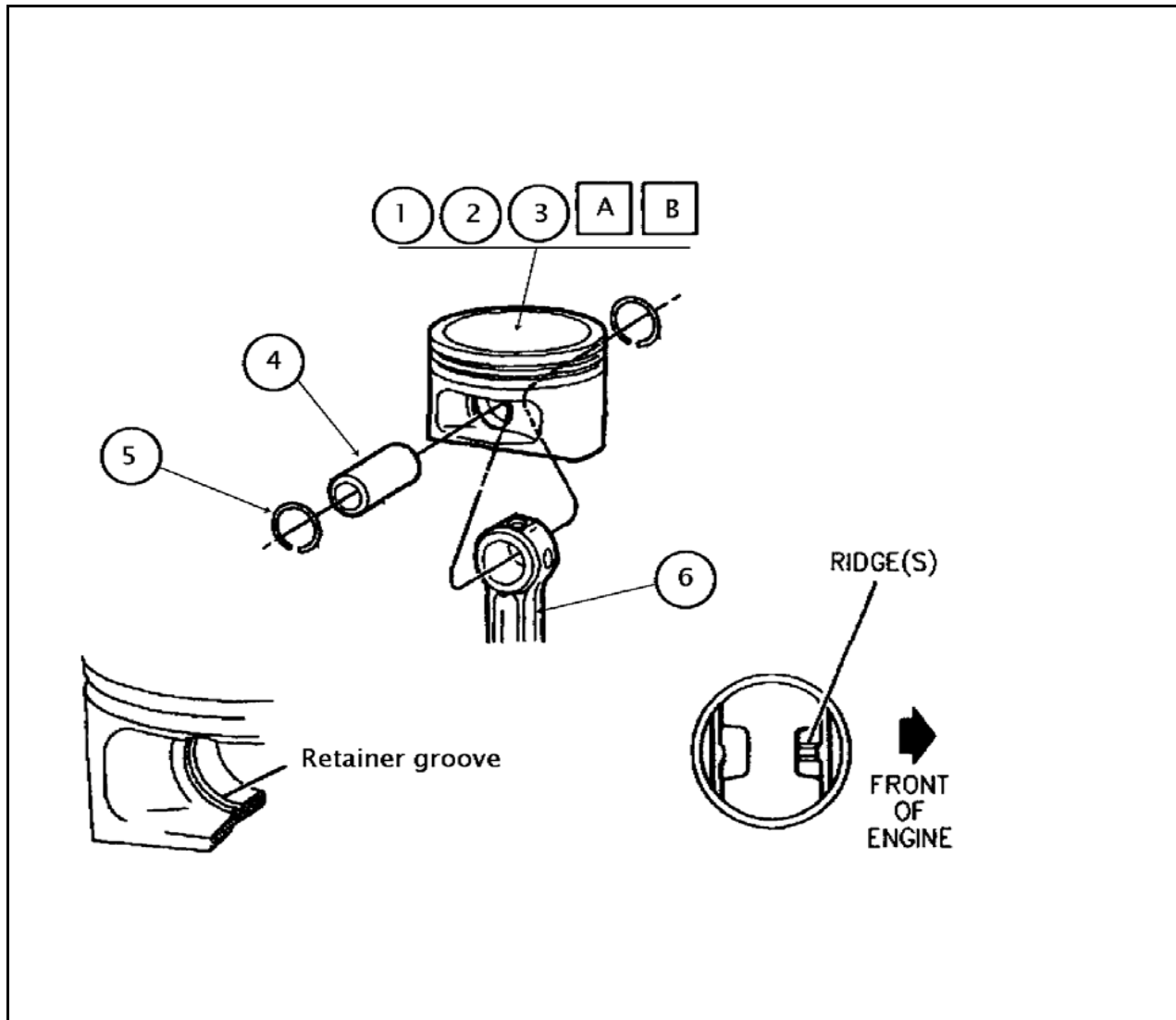
View	
Short Block	
Lower main bearing and crankshaft final test installation	

Section	Sheet
3	6

REV	Date	Revision History
1	01/10/98	Block-13
2	12/15/03	Update, use new bolts for each test

Short Block Assembly

Sequence IIIG



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 III G
-----------------------------	-----------------------

Section	Sheet
3	7

Hard Metric Piston & Ring Sizes

Grade/Run	Bore Size	Gage	+/-0.0254mm		Piston Size
			Target Ring Gap		
12/1st	96.52	96.53	Top 0.64	2nd 1.070	96.482 - 96.497
12/2nd	96.54	96.53	Top 0.64	2nd 1.070	96.482 - 96.497
34/3rd	96.56	96.57	Top 0.64	2nd 1.070	96.522 - 96.537
34/4th	96.58	96.57	Top 0.64	2nd 1.070	96.522 - 96.537
56/5th	96.60	96.61	Top 0.64	2nd 1.070	96.562 - 96.577
56/6th	96.62	96.61	Top 0.64	2nd 1.070	96.562 - 96.577

All gaps to be +/- 0.0254mm,

As measured in Ring Gage using Starrett Taper Gage # 270

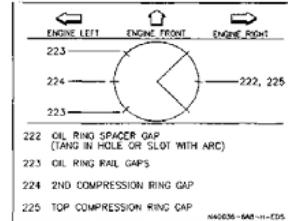
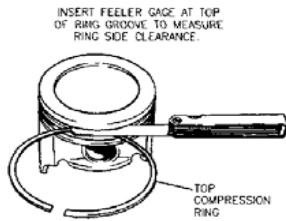


Figure 64 - Piston Ring Gap Location

RUN	OHT PART NUMBER	DESCRIPTION	COLOR	STRIPE(S)
1	3G050-TOP 1	TOP RING	PINK	ONE (1)
	3G050-SECOND 1	SECOND RING	YELLOW	ONE (1)
2	3G050-TOP 2	TOP RING	PINK	TWO (2)
	3G050-SECOND 2	SECOND RING	YELLOW	TWO (2)
3	3G051-TOP 3	TOP RING	PINK	THREE (3)
	3G051-SECOND 3	SECOND RING	YELLOW	THREE (3)
4	3G051-TOP 4	TOP RING	BROWN	ONE (1)
	3G051-SECOND 4	SECOND RING	GREEN	ONE (1)
5	3G052-TOP 5	TOP RING	BROWN	TWO (2)
	3G052-SECOND 5	SECOND RING	GREEN	TWO (2)
6	3G052-TOP 6	TOP RING	BROWN	THREE (3)
	3G052-SECOND 6	SECOND RING	GREEN	THREE (3)

NOTE: PAINT IDENTIFICATION MUST BE REMOVED FROM RING PRIOR TO GAP MEASUREMENT

Description of Operation

Clean paint identification marks from rings using acetone followed by wiping with a clean soft cloth and mineral spirits

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 OHT3G-050 run 1
- 2 OHT3G-050 run 2
- 3 OHT3G-051 run 3
- 4 OHT3G-051 run 4
- 5 OHT3G-052 run 5
- 6 OHT3G-052 run 6

REV	Date	Revision History
1	06/18/02	III G Block-15
2	04/28/03	Update color coding
3	09/10/03	Correct top ring gap typo from 0.064 to 0.64mm
4	12/15/03	Add ring paint mark removal information

View

Piston Ring

Piston ring installation and clearance

Section

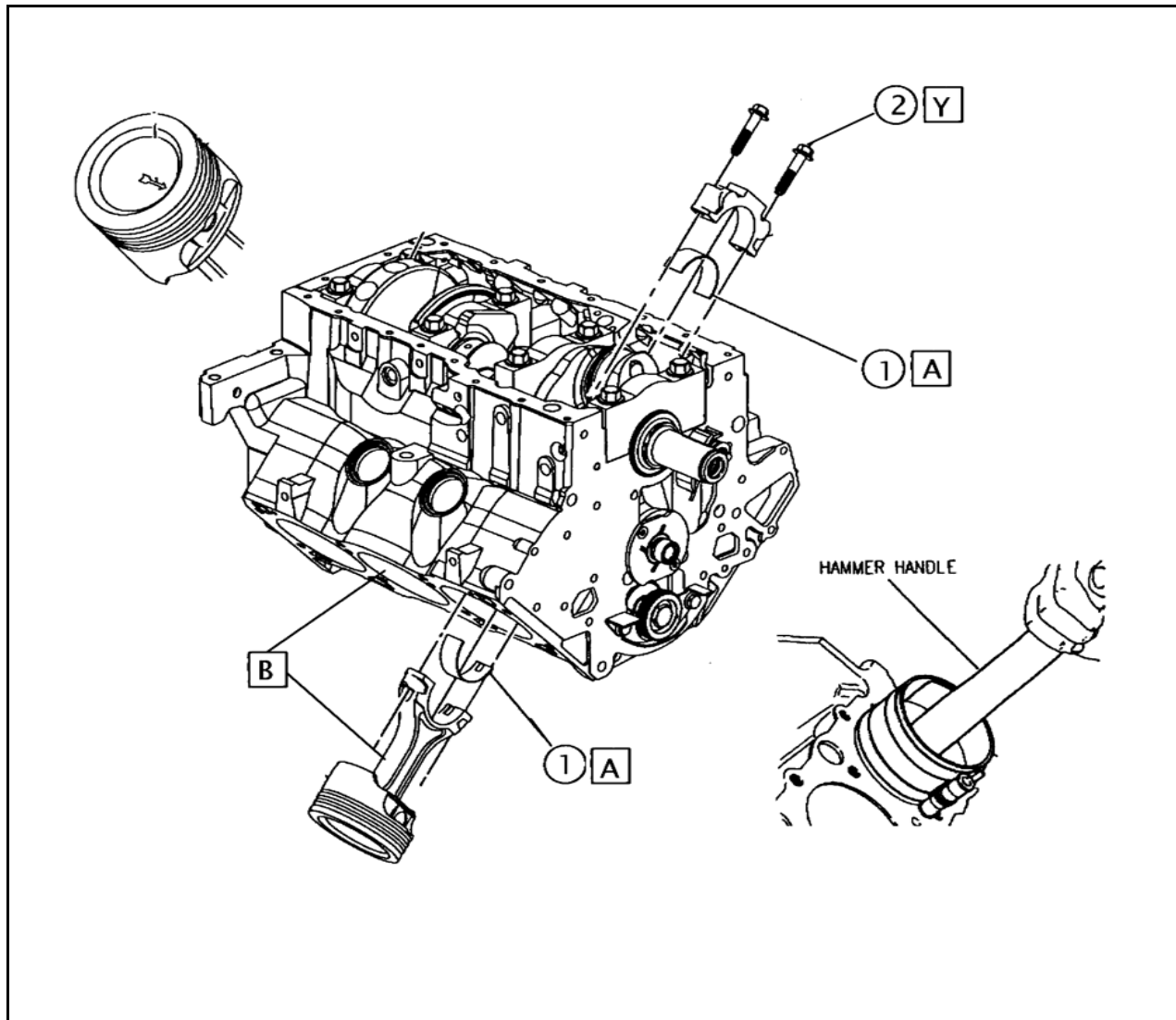
Sheet

3

8

Short Block Assembly

Sequence III G



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 27Nm + 50°
C	Check connecting rod side clearance 0.102 - 0.508mm

Specification	
1	OHT3F-042-2 Con rod bearing OH-106
2	25531956 Bolt con rod

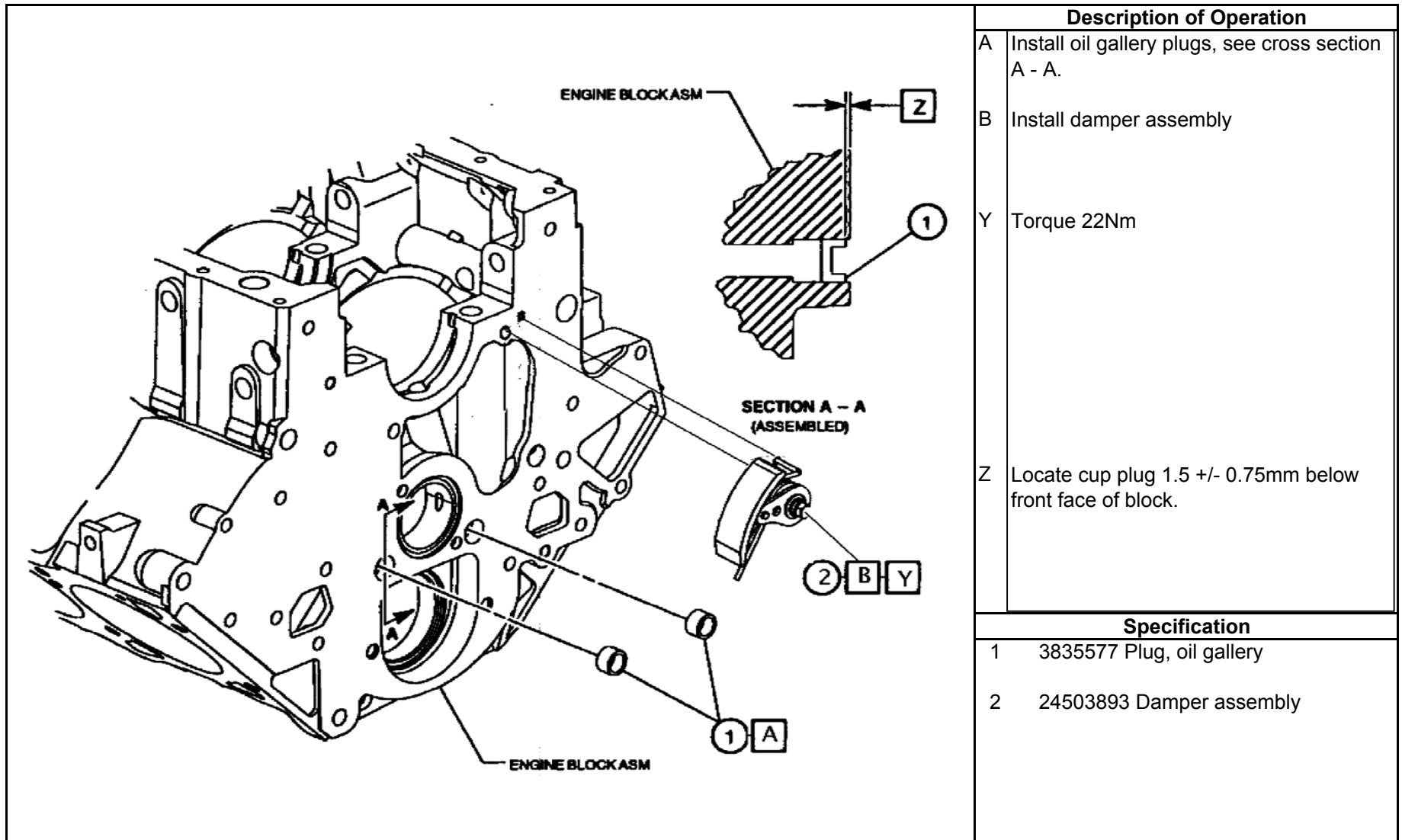
REV	Date	Revision History
1	1/3/98	Block-16

View
Short Block
Piston and rod assembly installation

Short Block Assembly

Sequence III G

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.

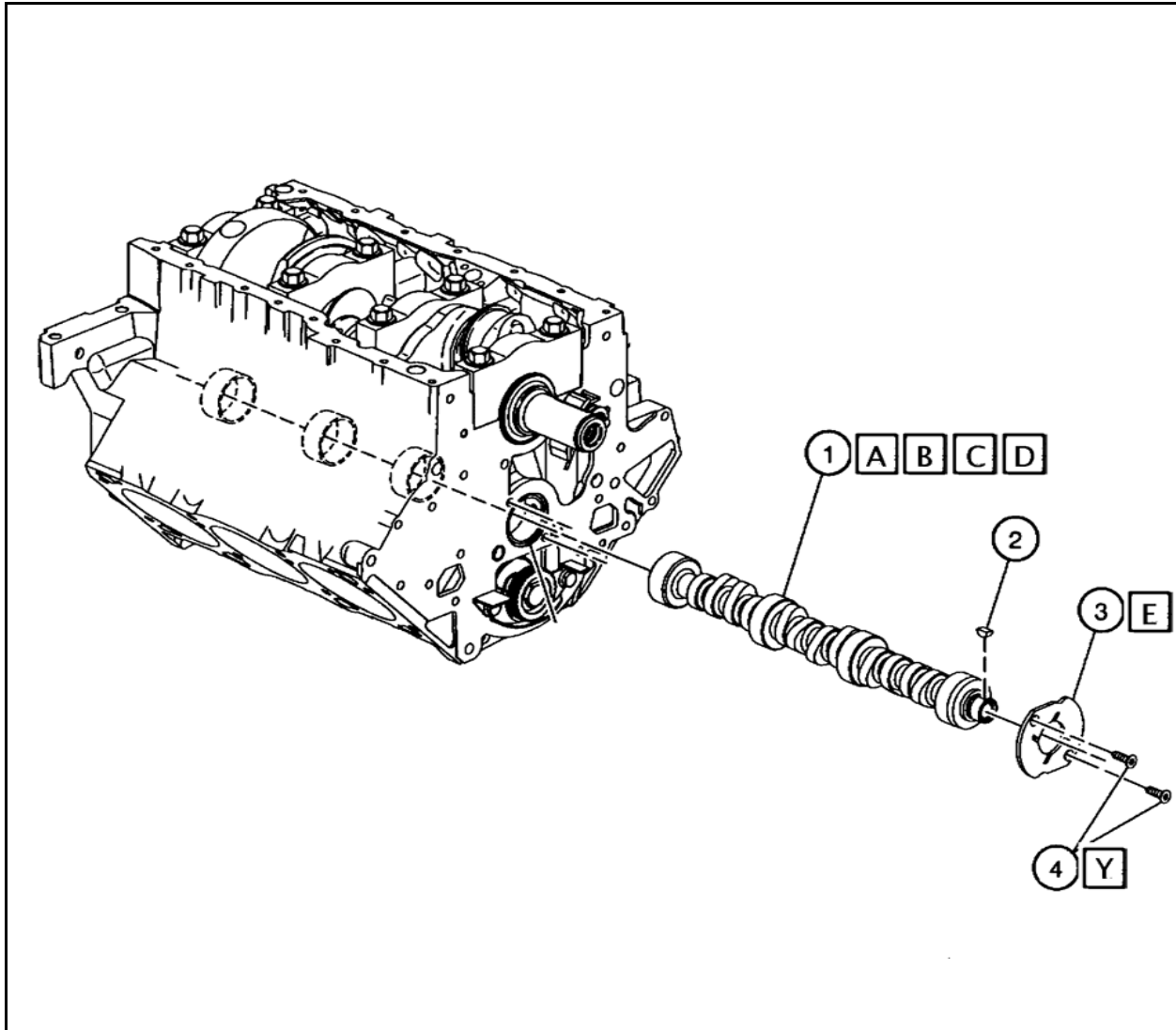
Specification	
1	3835577 Plug, oil gallery
2	24503893 Damper assembly

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

View	
Short Block	
Oil gallery plugs and timing chain damper	

Short Block Assembly	Sequence III G
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Section	Sheet
3	10



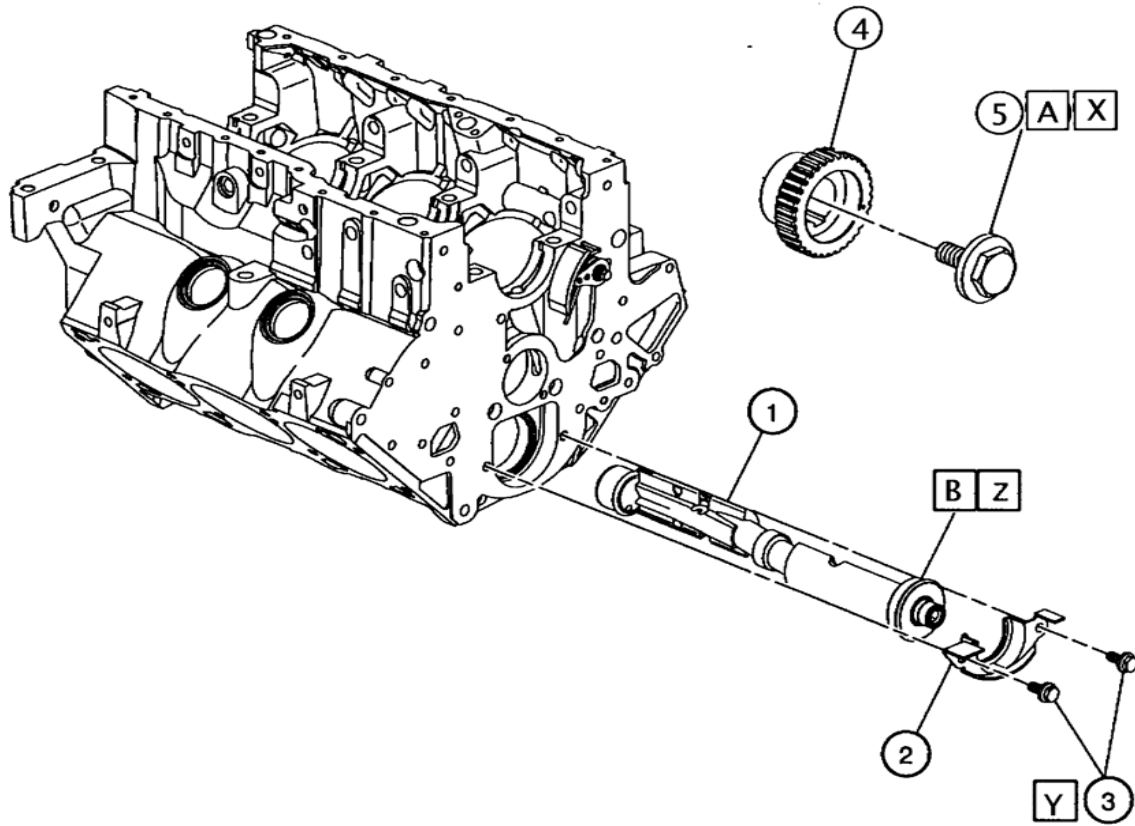
Description of Operation	
A	Check and de-burr if necessary, the front thrust surface of the camshaft.
B	Clean camshaft with mineral spirits and a very clean shop towel. Note: make sure all grinding residue is removed before continuing.
C	Make pre-test measurements at the rear side of each lobe and record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

Specification	
1	OHT3F-008-8 Phosphated Camshaft (For Use in IIIG Testing Only)
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	12/15/03	Update to mineral spirits and lubrication of camshaft with test oil during assembly

View	
Short Block	
Camshaft cleaning, measurement, and installation	

Short Block Assembly	Sequence IIIG	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

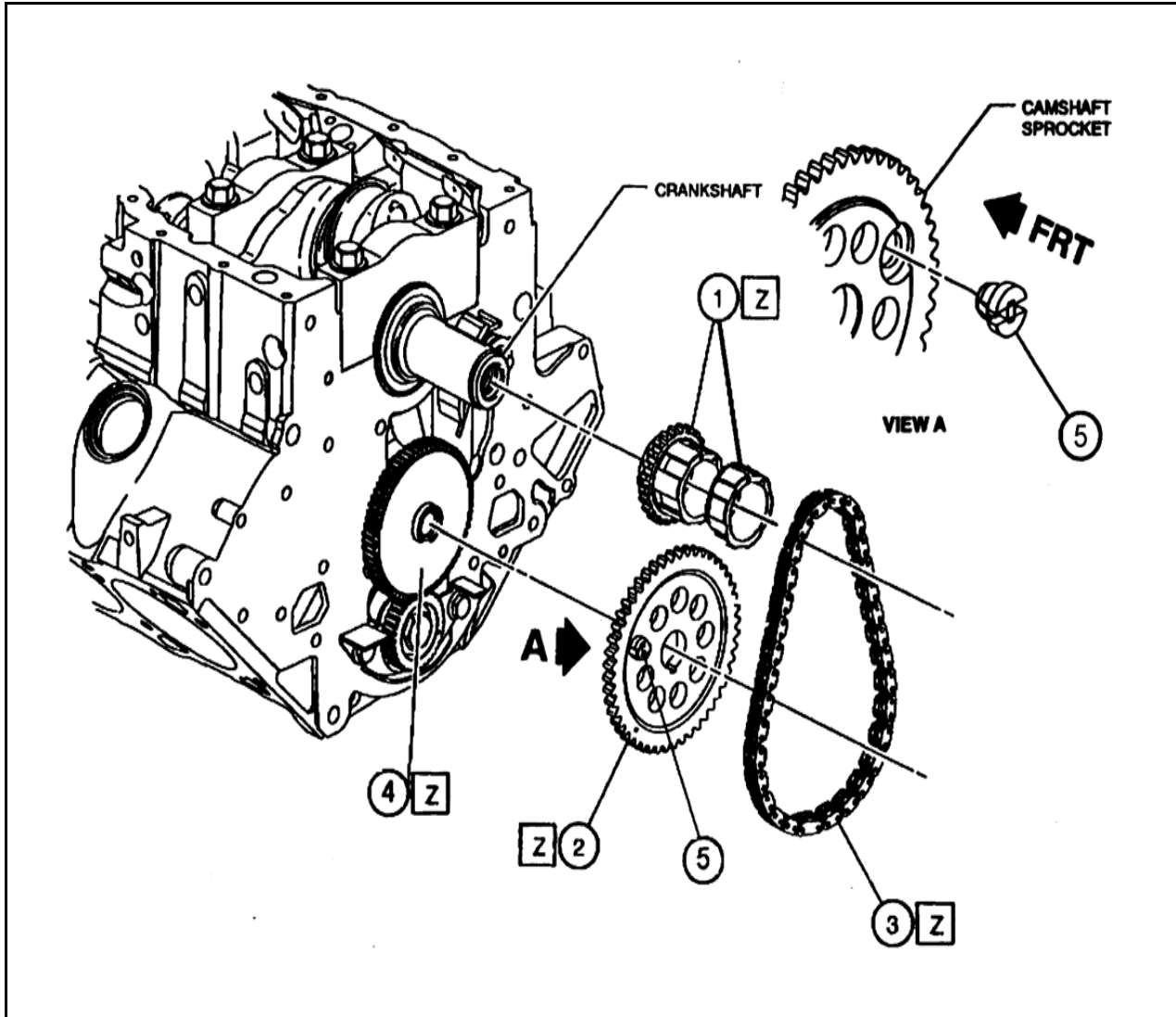
REV	Date	Revision History
1	1/5/98	Block-19

View
Short Block
Balance shaft inspect & install

Short Block Assembly

Sequence III G

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 gears 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

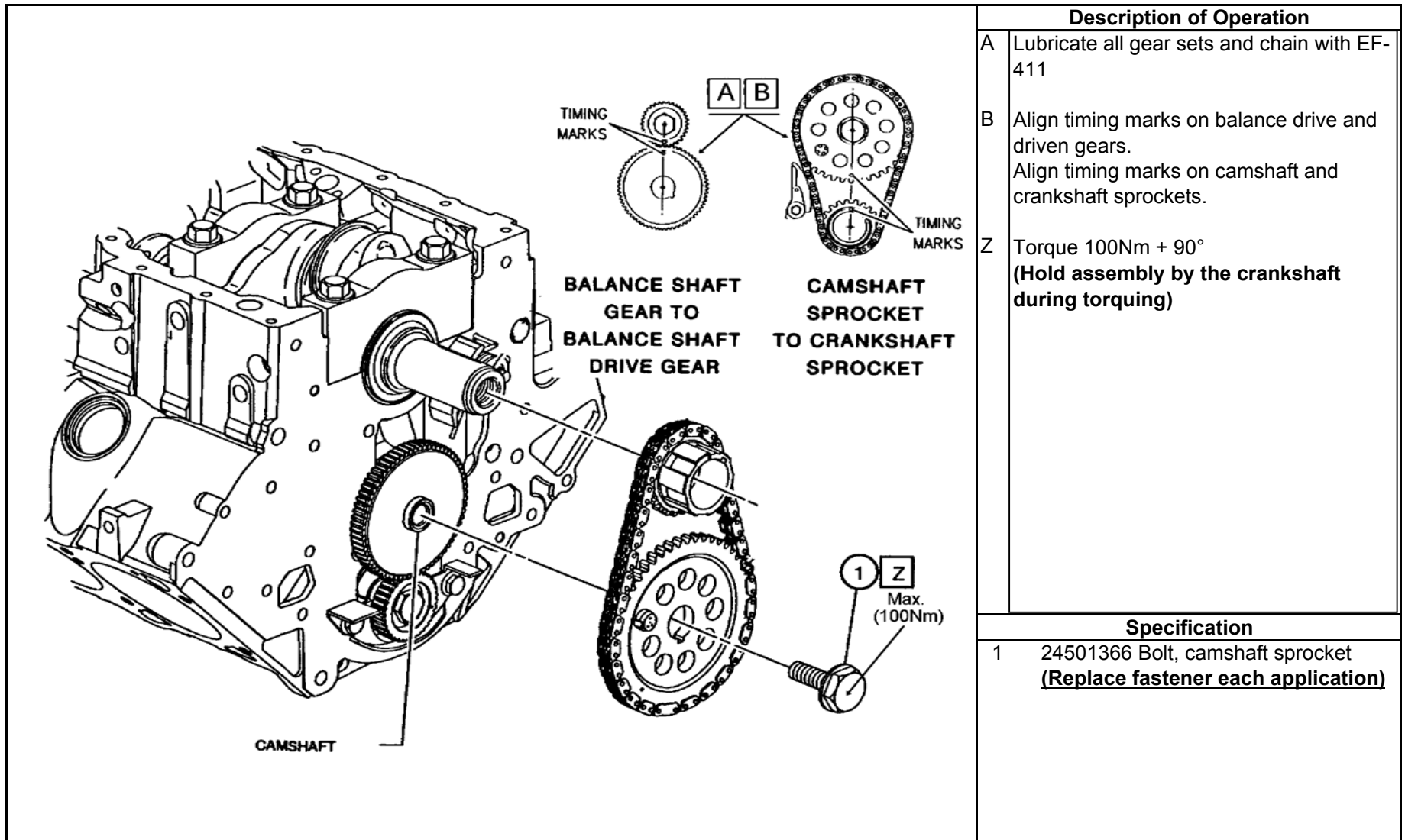
View

Short Block

Timing gear set

Short Block Assembly	Sequence III G
-----------------------------	-----------------------

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. Align timing marks on camshaft and crankshaft sprockets.
Z	Torque 100Nm + 90° (Hold assembly by the crankshaft during torquing)

Specification	
1	24501366 Bolt, camshaft sprocket <u>(Replace fastener each application)</u>

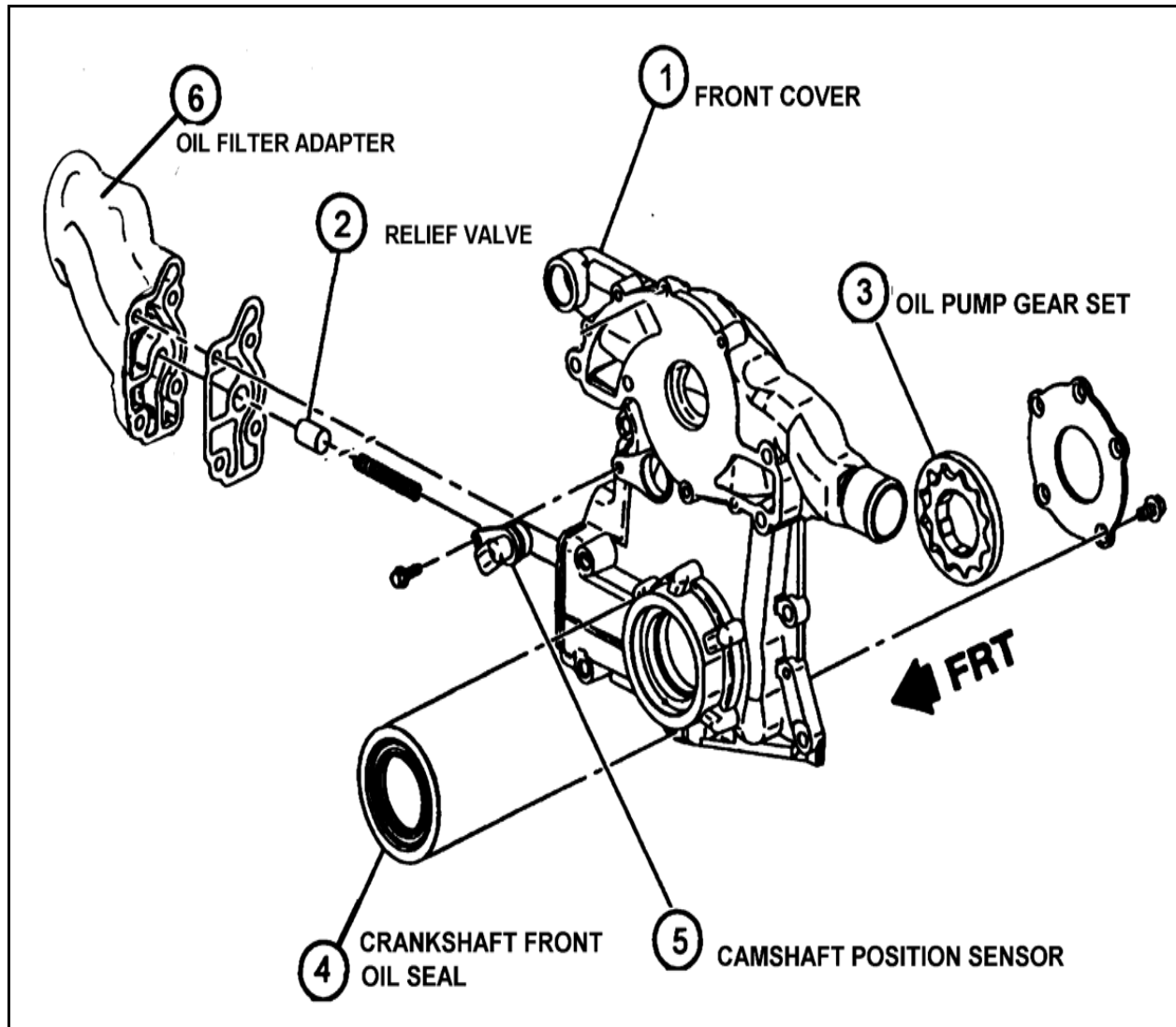
REV	Date	Revision History
1	1/5/98	Block-21

View	
Short Block	
Timing gear set alignment & torque	

Short Block Assembly	Sequence III G	Section	Sheet
		3	14

Section 4

Front Cover, Rear Cover, and Sump



Description of Operation

Assembly view

Specification

1	OHT3F-085-1 Front Cover
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	04/28/03	Change front cover over to OHT part number

View

Front Cover

Front cover assembly view

Front Cover, Rear Cover, & Sump

Sequence III G

Section	Sheet
4	1

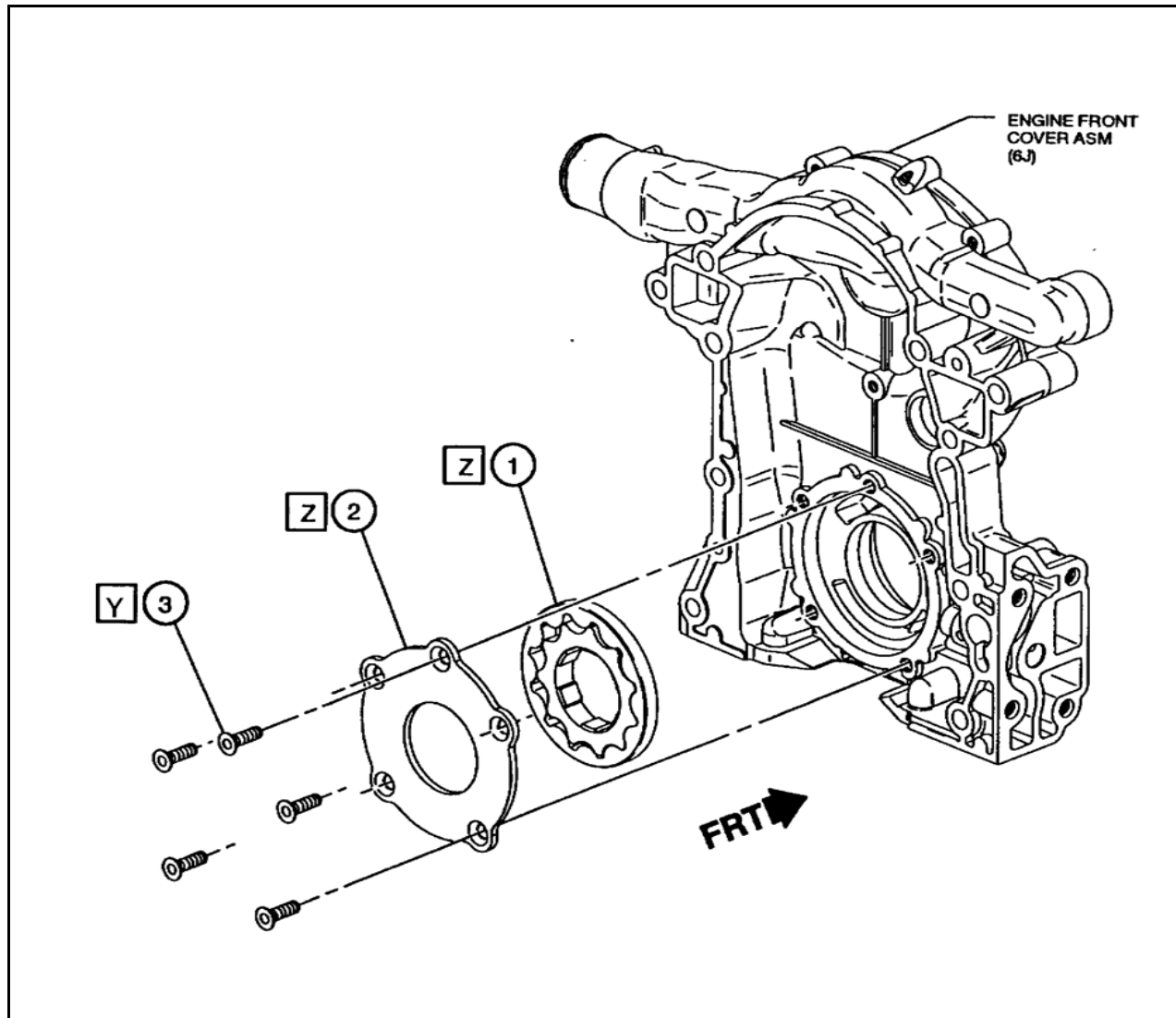
A
Measuring gear end clearance drop in housing

B
Measuring gear tip clearance

C
Measuring outer gear dia. clearance

Description of Operation	
A	Measure gear drop in housing 0.025 - 0.089mm
B	Measure gear tip clearance; 0.076 - 0.127mm (0.003 - 0.007in) as measured with gear teeth in mesh with opposite side.
C	Measure outer gear diameter clearance 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	View				
1	01/05/98	Block-23	Front Cover				
			Oil pump gear clearance				
Front Cover, Rear Cover, & Sump		Sequence III G	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Section</th> <th style="width: 50%;">Sheet</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> </tr> </tbody> </table>	Section	Sheet	4	2
Section	Sheet						
4	2						



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

Specification	
1	24505433 Gear set
2	OHT3F-085-1 Front Cover
3	25519242 Bolt

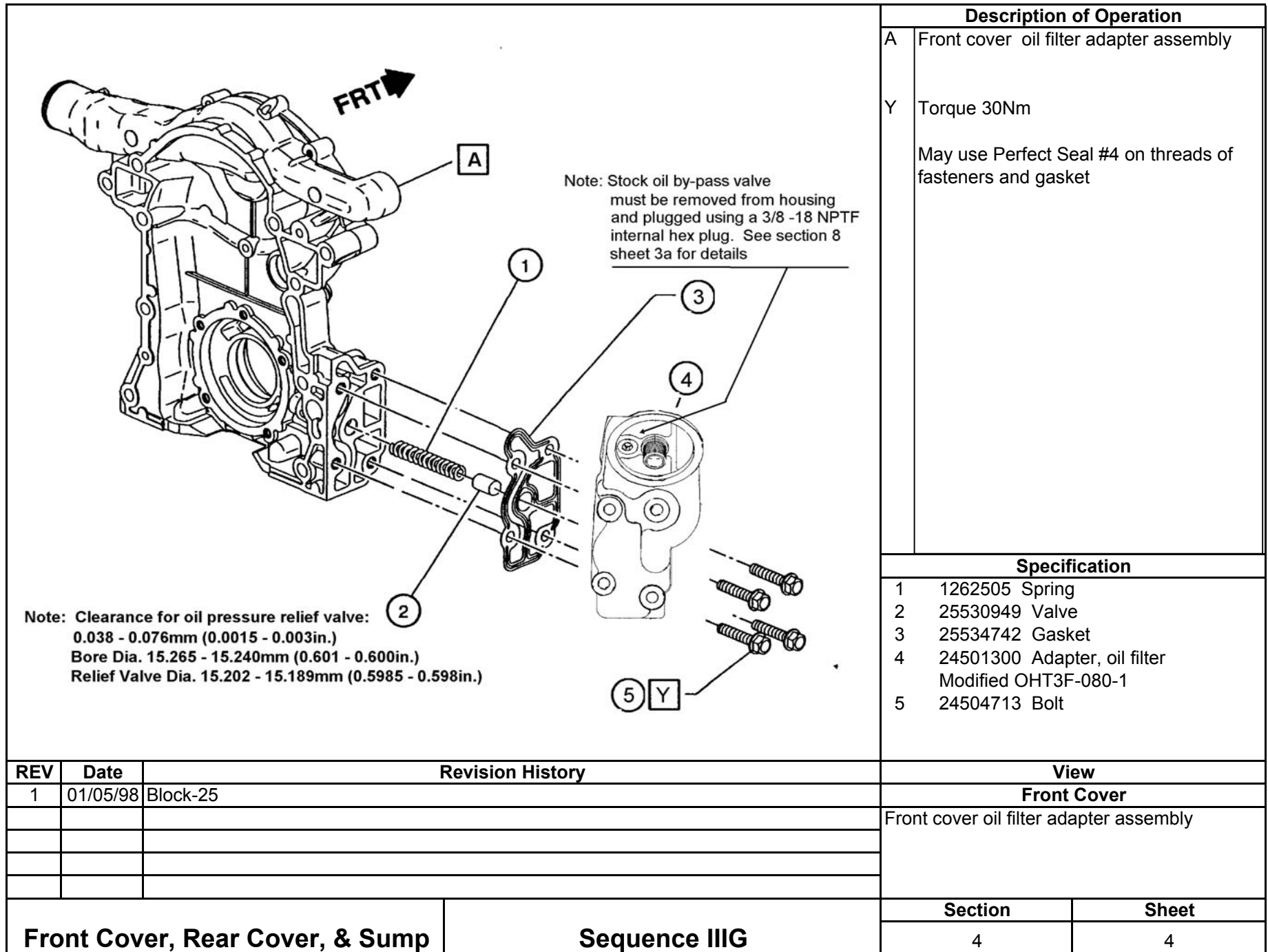
REV	Date	Revision History
1	01/05/98	Block-24
2	05/28/03	Change to OHT front cover

View	
Front Cover	
Front cover oil gear install	

Front Cover, Rear Cover, & Sump

Sequence III G

Section	Sheet
4	3



Description of Operation

A Front cover oil filter adapter assembly

Y Torque 30Nm

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 Modified OHT3F-080-1
- 5 24504713 Bolt

Revision History

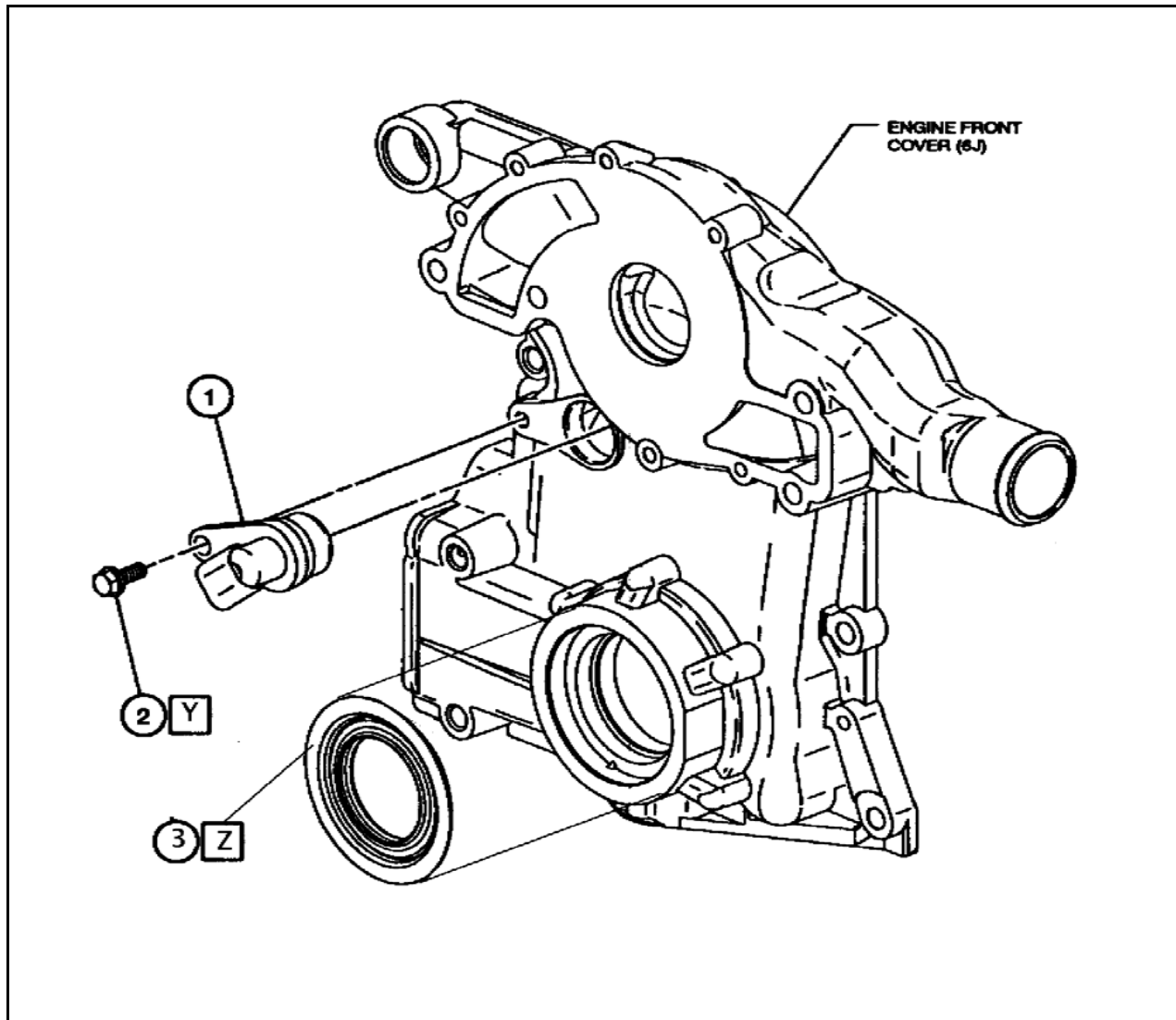
REV	Date	Revision History
1	01/05/98	Block-25

View

Front Cover

Front cover oil filter adapter assembly

Section	Sheet
4	4



Description of Operation	
Y	Torque 30Nm
Z	Use a light application of #4 Permatex or RTV, GM part number 12346193 or Dow Corning 3154 around the rear side of the seal where it contacts the front cover.

Specification	
1	10456148 Camshaft sensor
2	25526395 Bolt
3	24504098 Seal

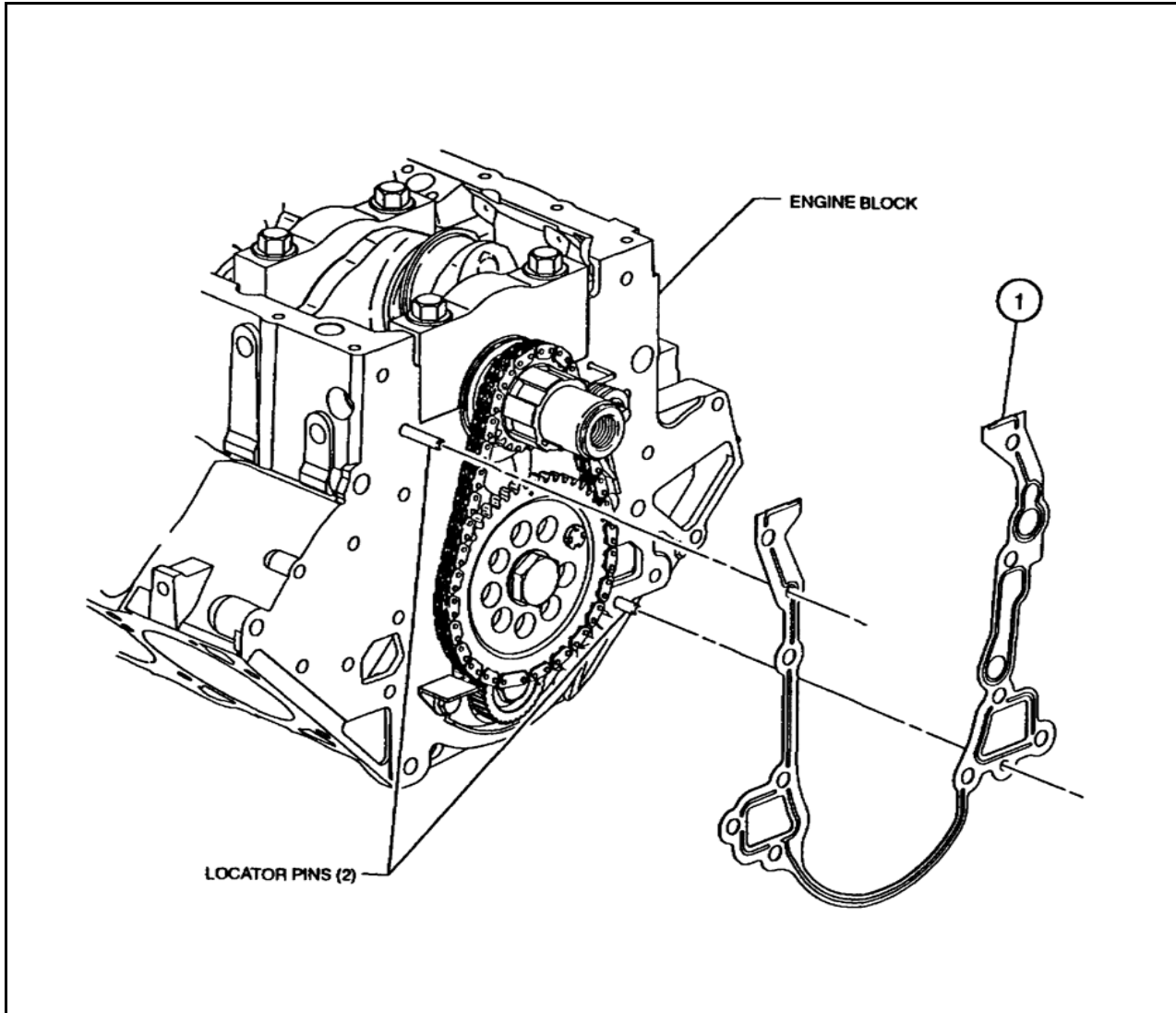
REV	Date	Revision History
1	01/05/98	Block-29
2	12/15/03	Add approved silicone sealers

View	
Front Cover	
Front cover camshaft sensor and seal install	

Front Cover, Rear Cover, & Sump

Sequence III G

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

View

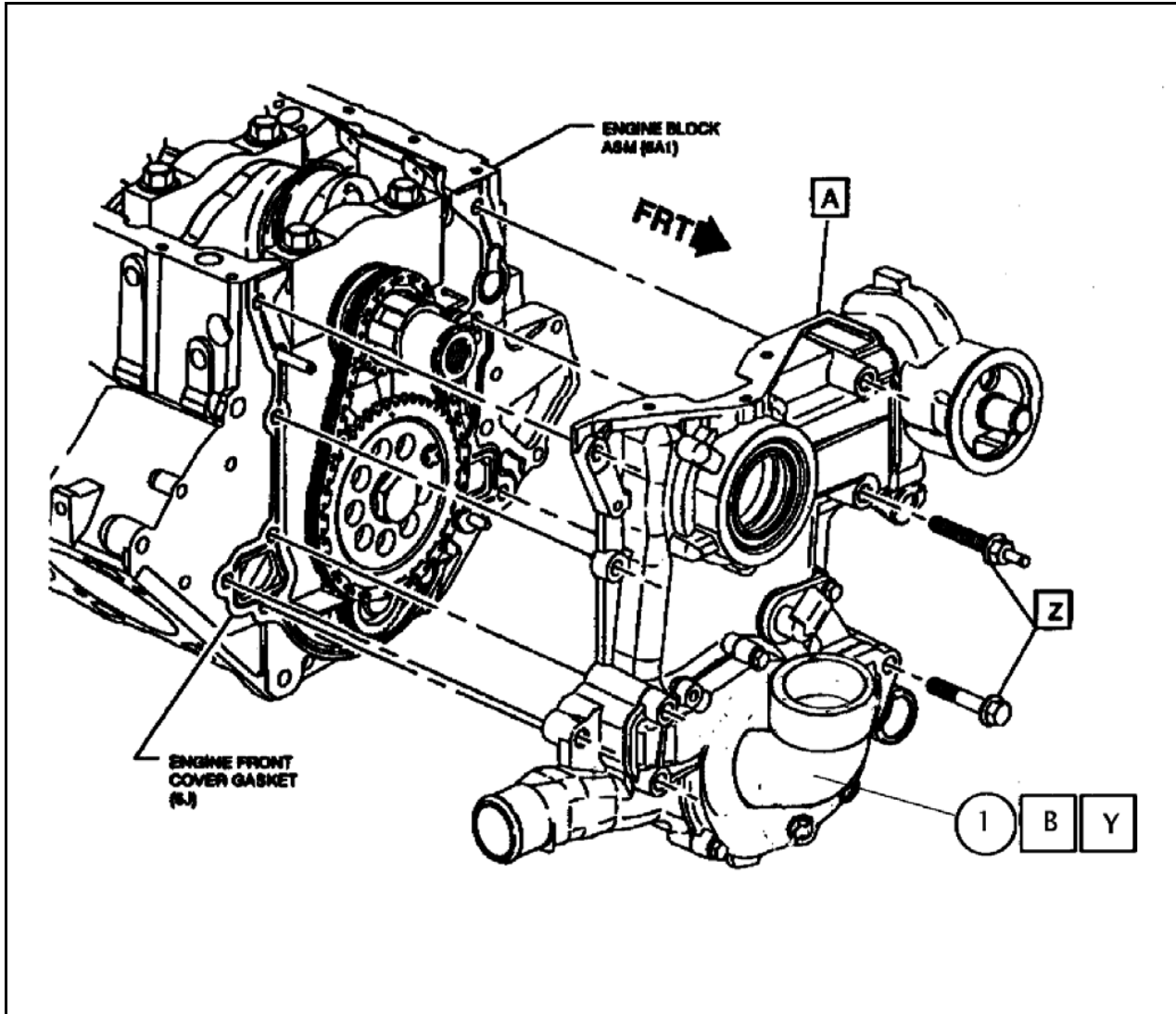
Front Cover

Front cover gasket install

Front Cover, Rear Cover, & Sump

Sequence III G

Section	Sheet
4	6



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

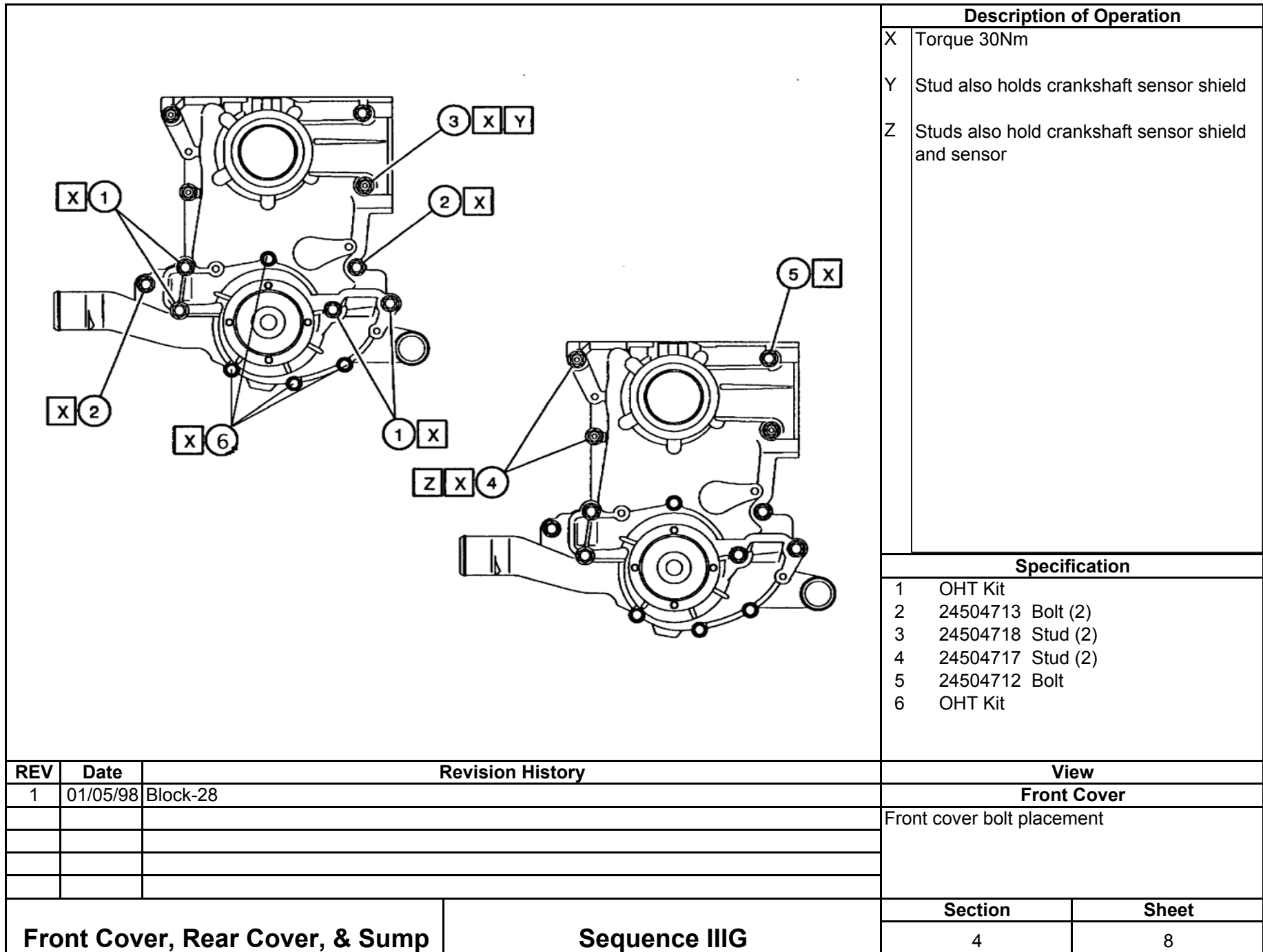
Specification	
1	OHT3F-031-3 Bolts included on print

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 III G
---------------------------------	----------------

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

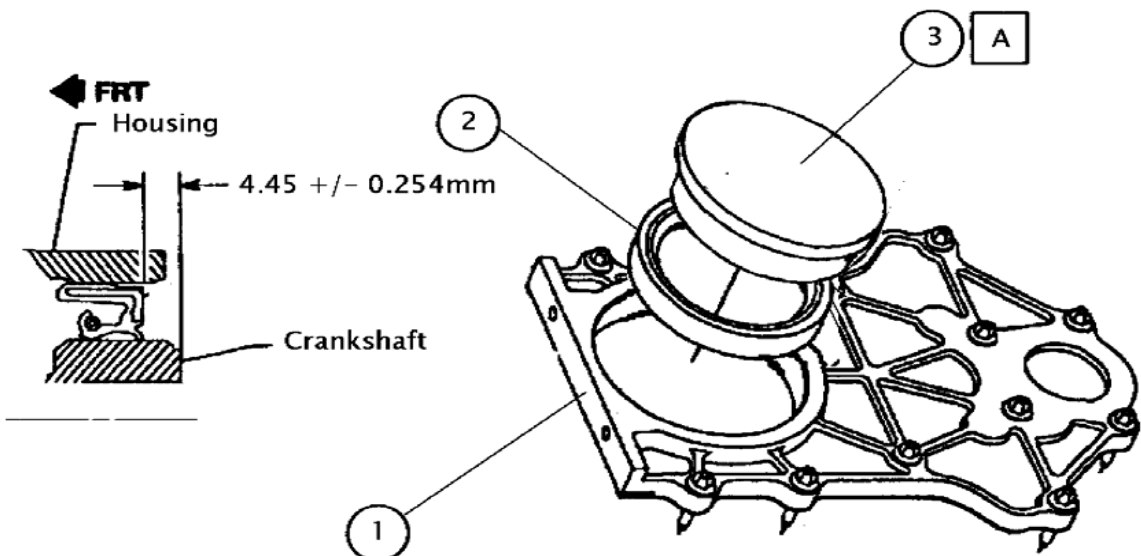
REV	Date	Revision History
1	01/05/98	Block-28

View	
Front Cover	
Front cover bolt placement	

Front Cover, Rear Cover, & Sump

Sequence III G

Section	Sheet
4	8



Description of Operation

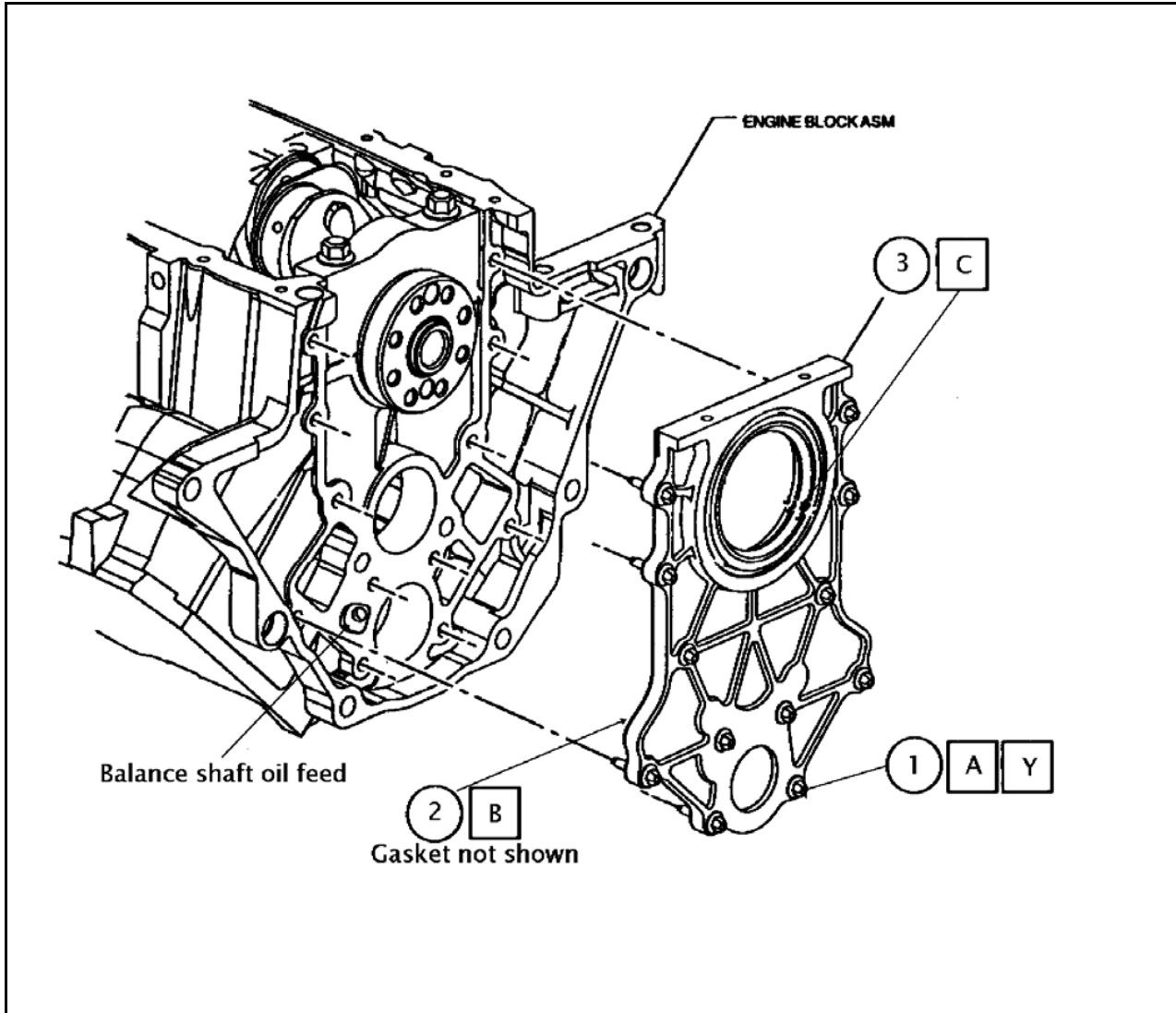
A Install rear main lip seal using GM R&D supplied installation tool and a light duty bench press until seal bottoms in housing.

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

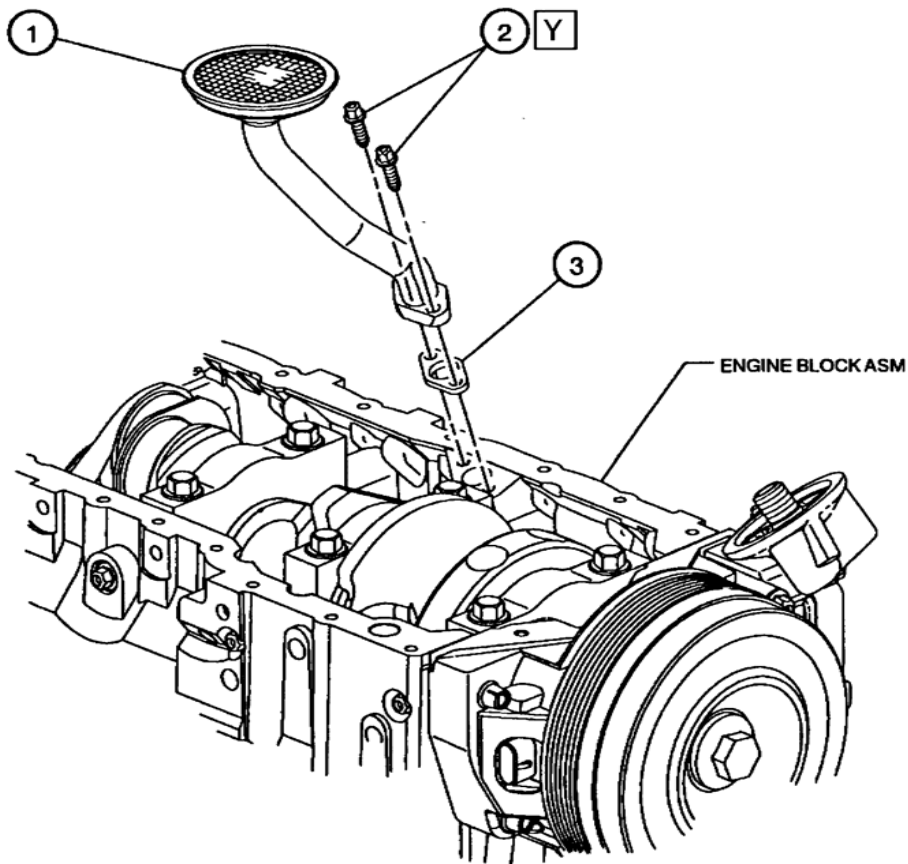


Description of Operation	
A	Install new bolts with nylon positioning collar for each run.
B	Install gasket (not shown in view) Note: Position rear cover plate gasket so that rear balance shaft oil feed is lined up with correct side of cover plate.
C	Lubricate rear lip seal with EF-411 and use extreme 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	



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

Section

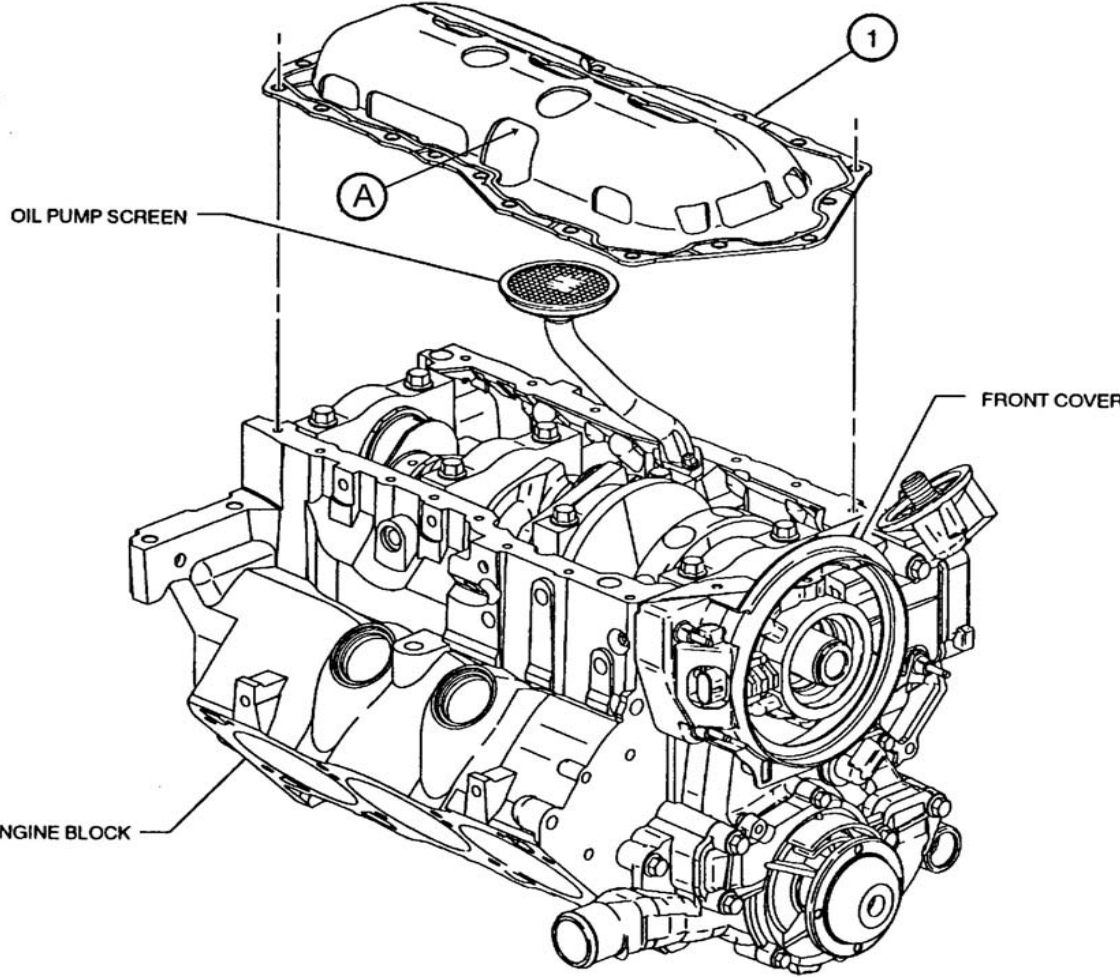
4

Sheet

11

Front Cover, Rear Cover, & Sump

Sequence III G



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 or Dow Corning 3154 may be used at corners of front and rear covers to aid in sealing.

Specification

1	12574776 Gasket
---	-----------------

REV	Date	Revision History
1	01/05/98	Block-34
2	04/28/03	Change part number from 24502397 to 12574776
3	12/15/03	Add approved silicone sealers

View Sump

Oil pan gasket install

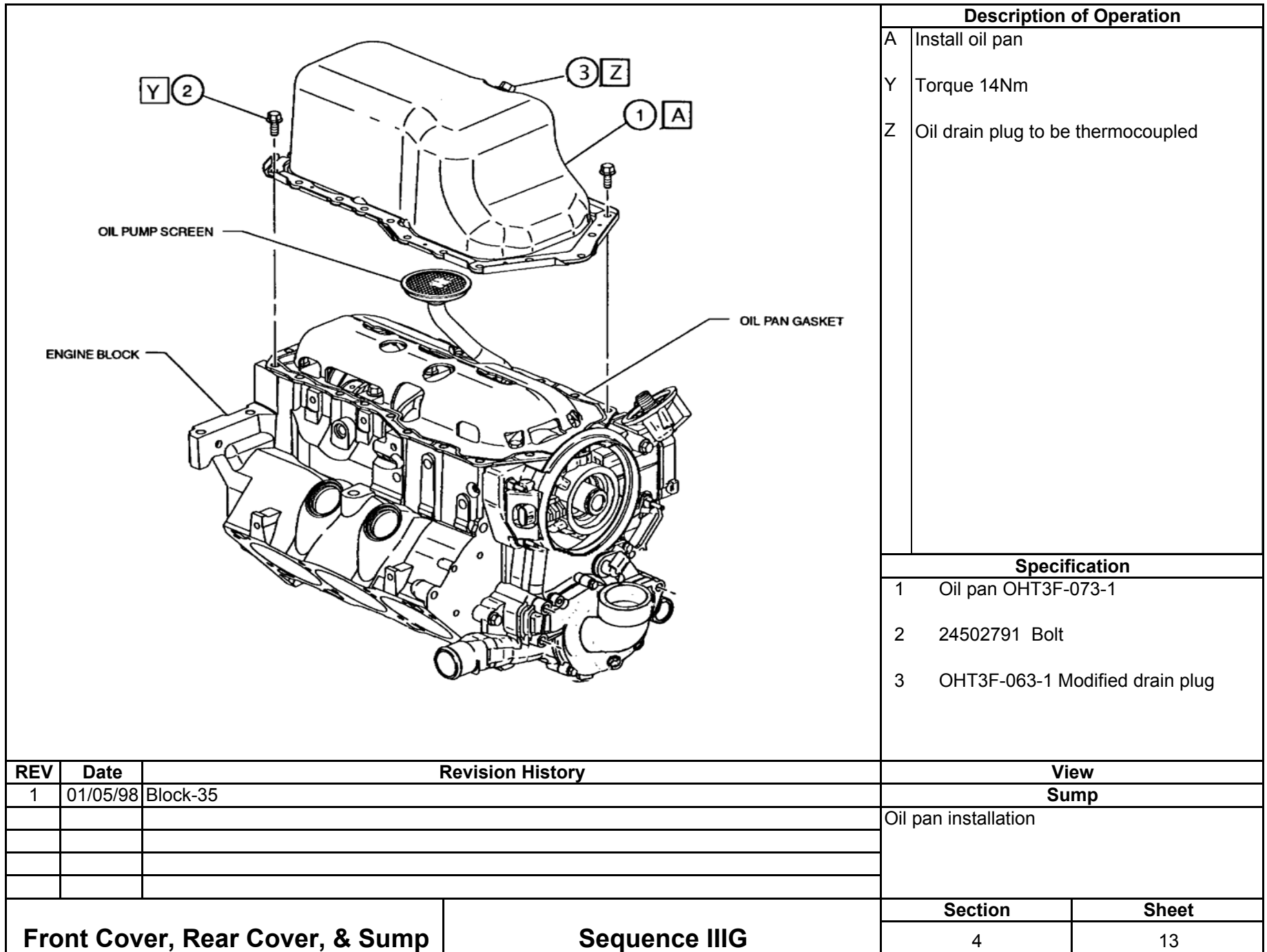
Front Cover, Rear Cover, & Sump	Sequence III G
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Section

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

View
Sump
Oil pan installation

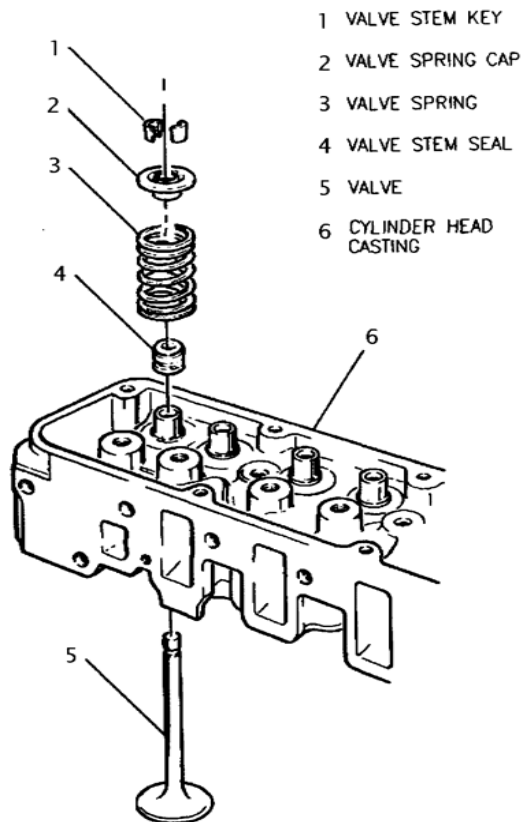
Front Cover, Rear Cover, & Sump

Sequence III G

Section	Sheet
4	13

Section 5

Cylinder Head and Valves



- 1 VALVE STEM KEY
- 2 VALVE SPRING CAP
- 3 VALVE SPRING
- 4 VALVE STEM SEAL
- 5 VALVE
- 6 CYLINDER HEAD CASTING

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 mineral spirits and spray with 50/50 solution of EF-411 and mineral spirits. 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.

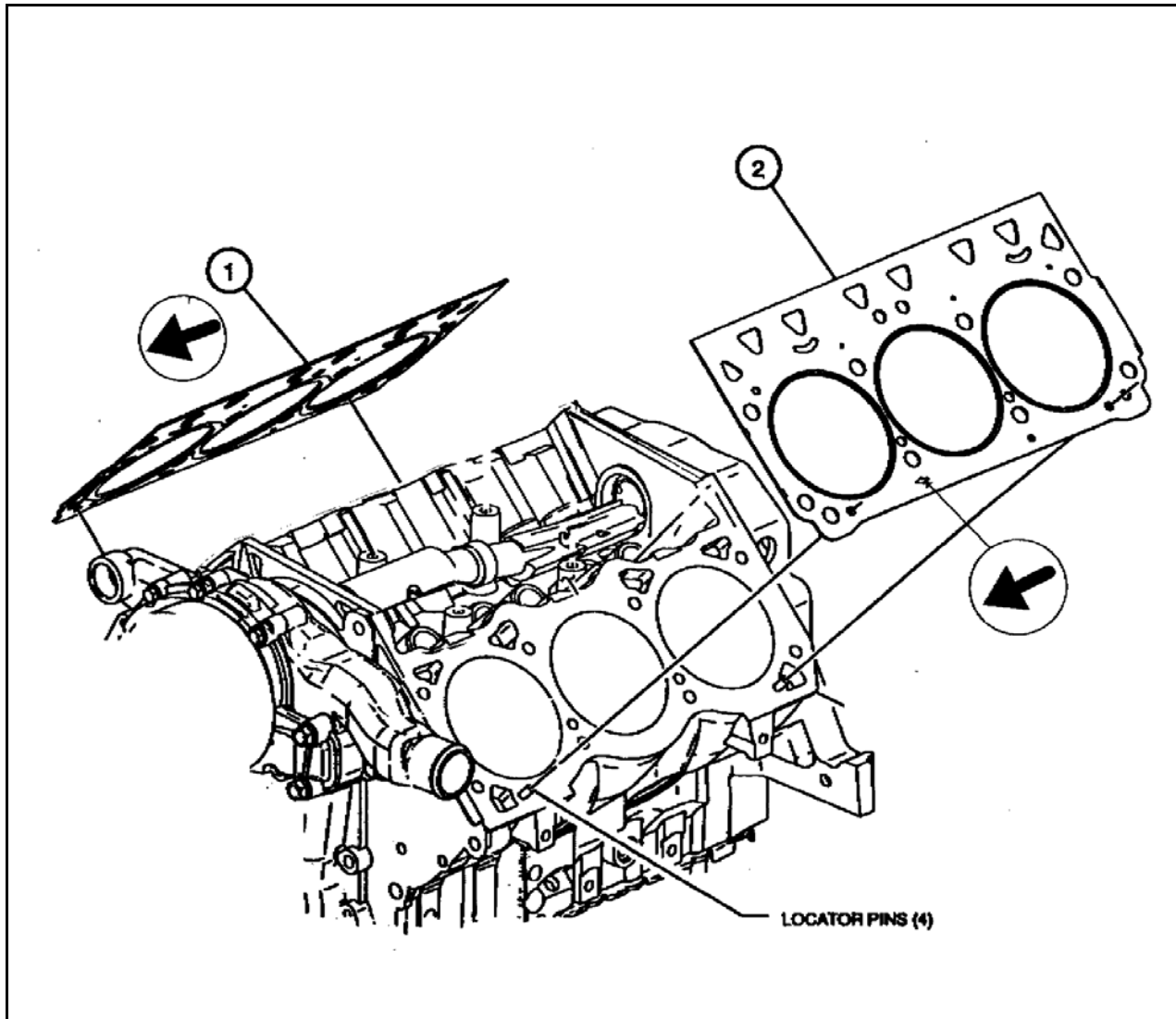
Calibrate the valve spring load to 912N +/- 22N @ 9.5mm (205lbf +/- 5lbf @ 0.375in.) travel.

Specification

- 1 1016634 Valve stem key
- 2 24502257 Valve spring cap
- 3 OHT3G-059-1 Valve spring (Pink)
- 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	12/15/03	Update, change to mineral spirits
Head Assembly		Sequence III G

View	
Head Assembly	
Valve & spring assembly	
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.

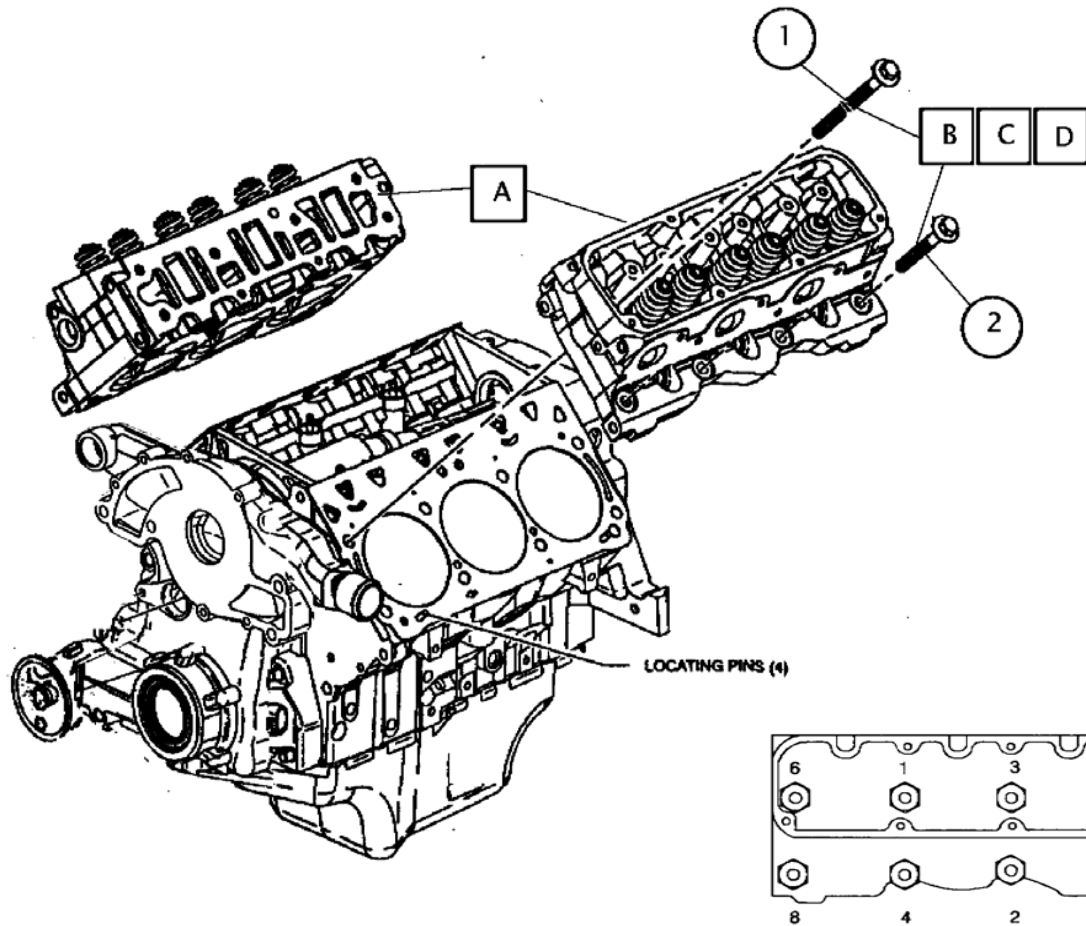
Install the head gasket with the arrow pointing toward the front of the engine.

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
Head Assembly		Sequence III G

View	
Head Gaskets	
Head gasket install	
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.
- 30Nm-50Nm-80Nm - JCS-TEL to yield.

Specification

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

View

Cylinder Head

Cylinder head installation

Section

5

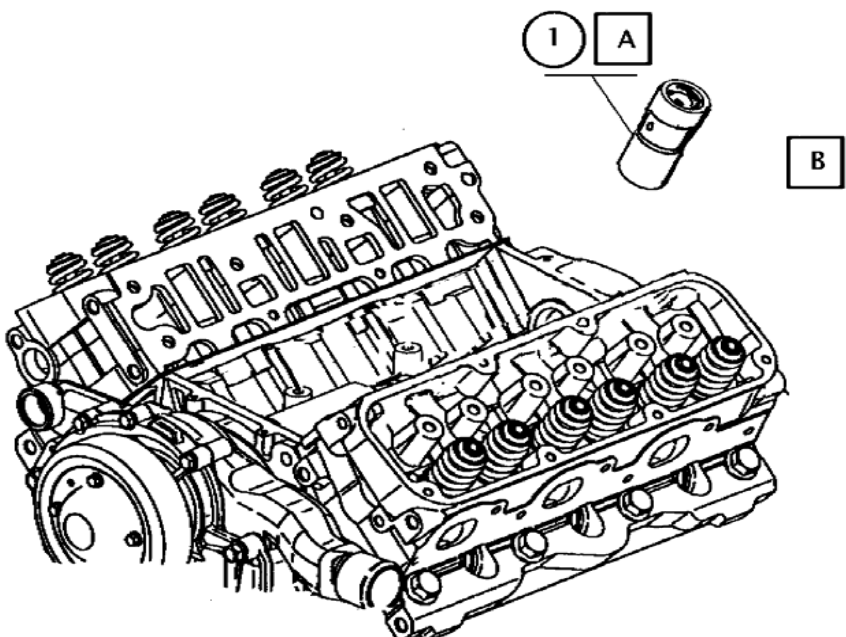
Sheet

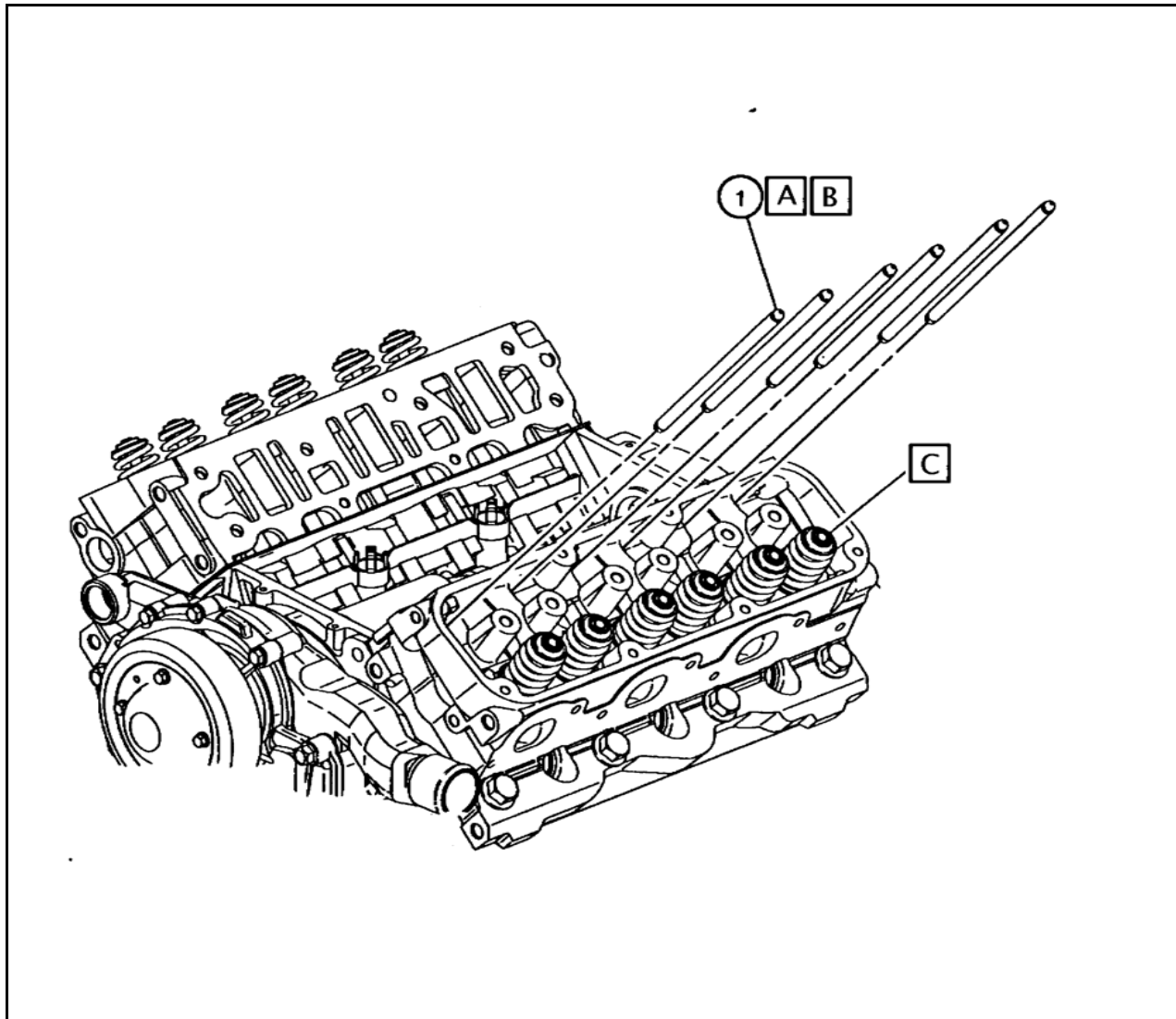
3

REV	Date	Revision History
1	01/06/98	Block-38 & 50
Head Assembly		Sequence III G

Section 6

Long Block Assembly

			Description of Operation		
			A	Measure and record pre-test lifter foot height to the nearest 0.001mm	
			B	<p>Installation:</p> <p>1) Clean each lifter using a lightly soaked cloth with mineral spirits (Do not disassemble, spray, or submerge the lifter in solvent).</p> <p>2) Dip each lifter foot in test oil and install the lifter set less pushrods.</p> <p>2) Rotate engine crankshaft 720° slowly with no load on lifters.</p> <p>3) Remove each lifter, one at a time, dip each foot in test oil, and re-install with the ground flat facing inboard.</p>	
			Specification		
			1	OHT3f-029-3 ACI Test Lifter (with flats)	
Revision History			View		
REV	Date		Lifter Installation		
1	1/6/98	Block-39	Lifter pre-oiling and installation		
2	12/15/03	Update, change to mineral spirits			
Long Block Assembly		Sequence III G		Section	Sheet
				6	1



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

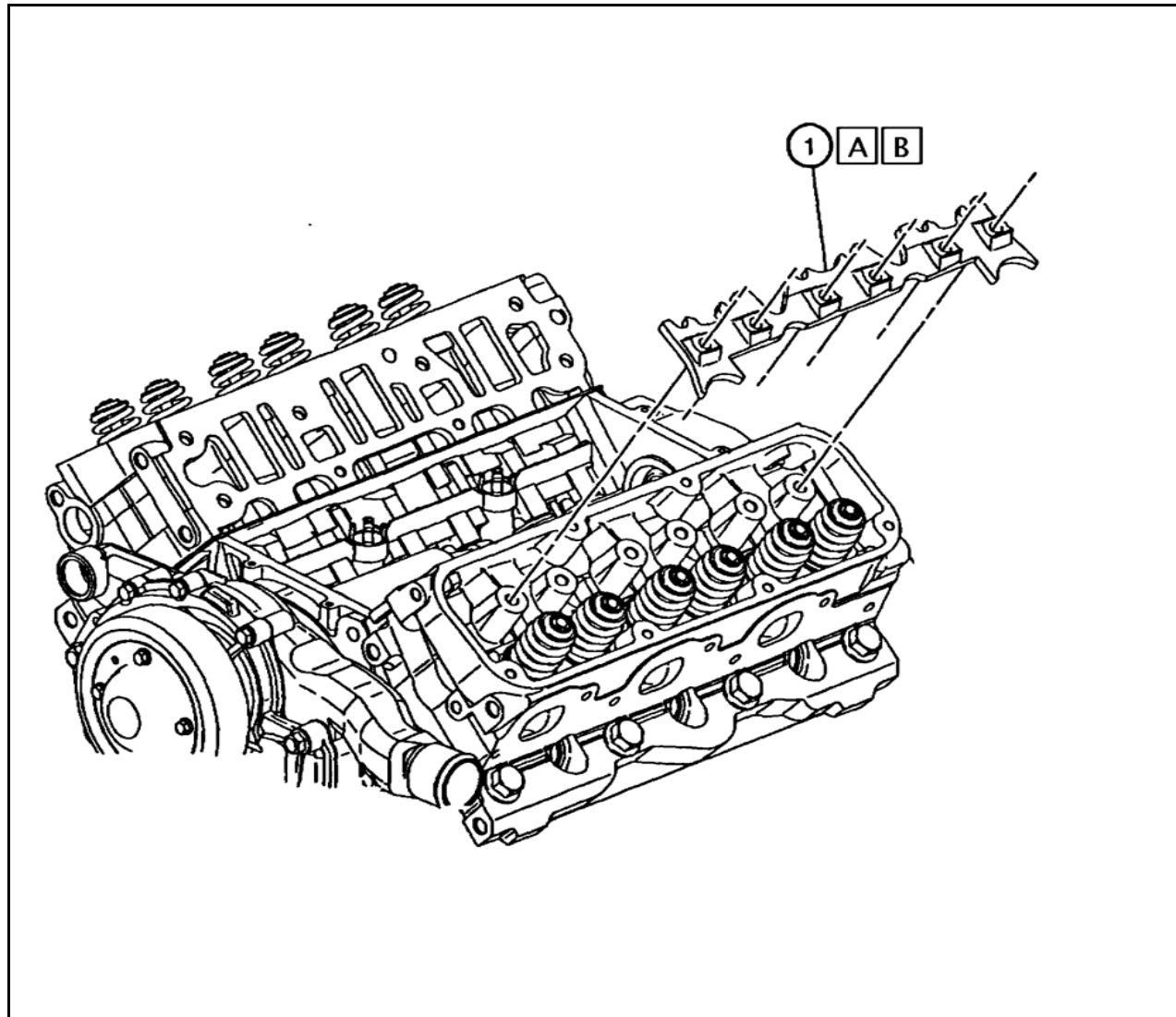
Specification	
1	OHT3F-007-1 Pushrod (Special Length)

REV	Date	Revision History
1	1/6/98	Block-40
2	12/15/03	Update, change to mineral spirits

View	
Pushrods	
Pushrod installation	

Long Block Assembly	Sequence III G
----------------------------	-----------------------

Section	Sheet
6	2



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

Specification	
1	24502278 Retainer

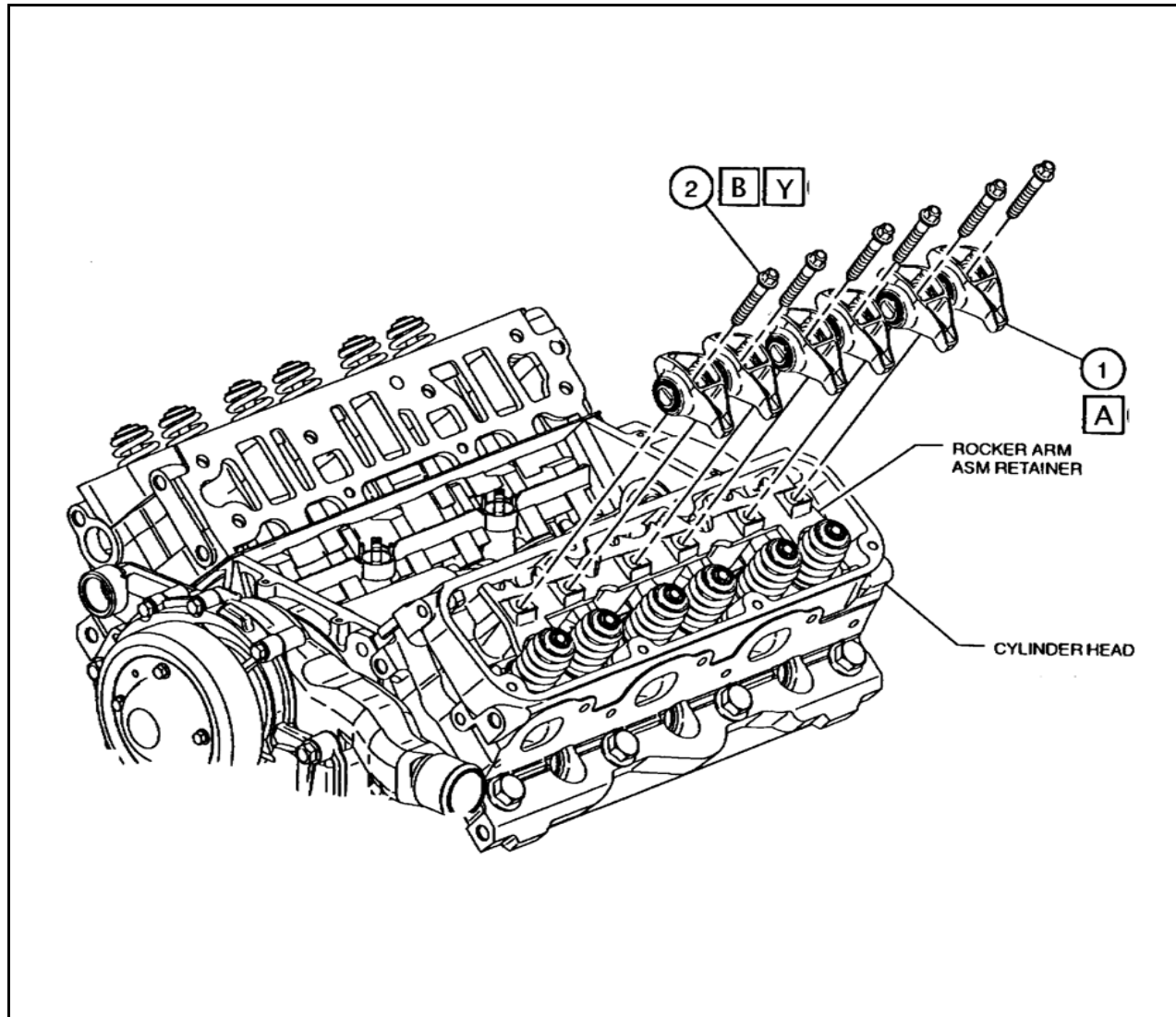
REV	Date	Revision History
1	1/6/98	Block-41

View
Retainer
Rocker bearing retainer installation

Long Block Assembly

Sequence III G

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 mineral spirits. Needle roller bearings will retain solvents.
B	Lubricate bolts with EF-411 and install.
Y	Torque & Angle 25Nm + 70°
	Note: Do not rotate engine after final valvetrain loading.

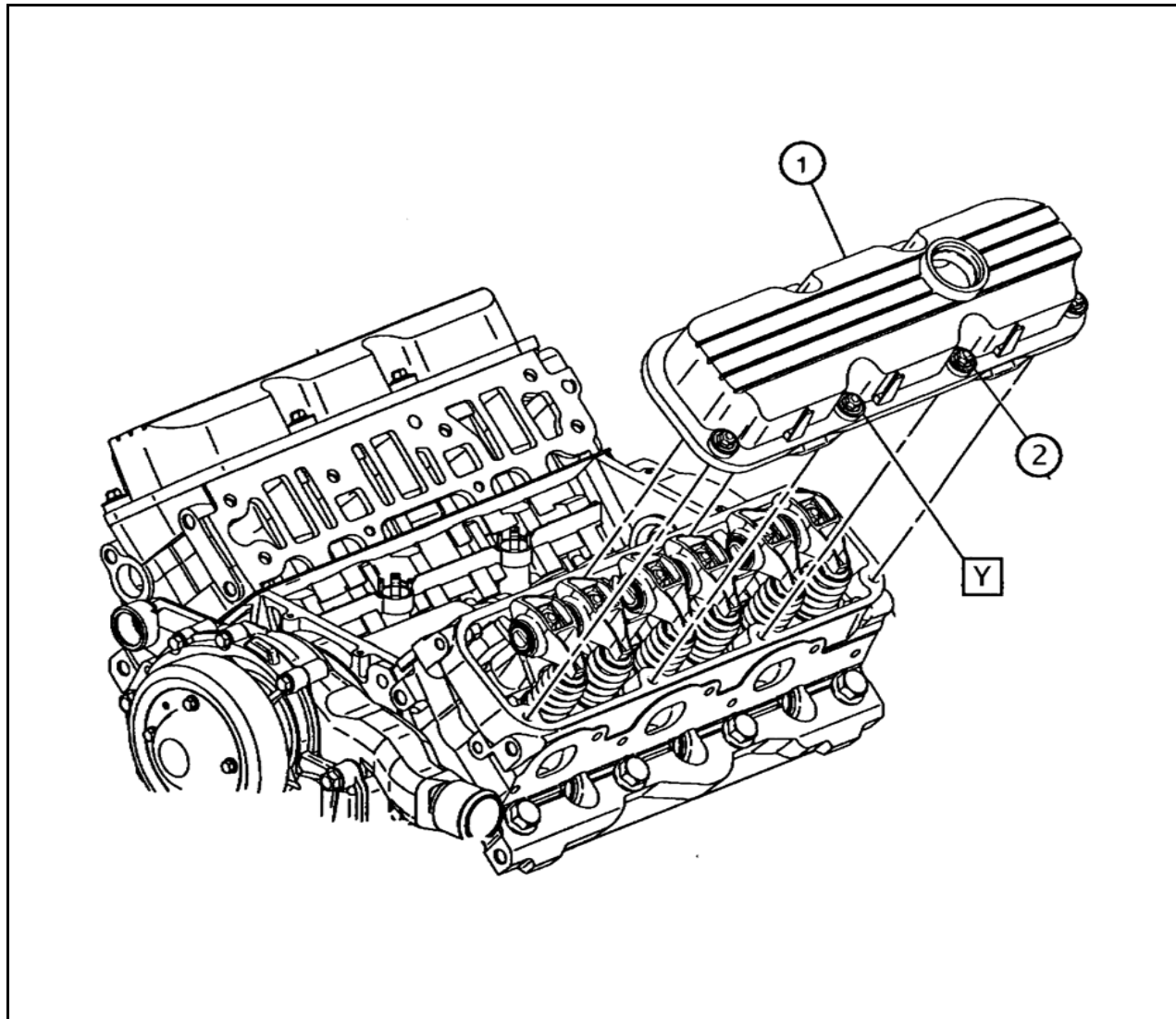
Specification	
1	OHT3F-058-1 Rocker Arm Assembly
2	Furnished less sealers with OHT Kit

REV	Date	Revision History
1	1/6/98	Block-42
2	12/15/03	Update, change to mineral spirits

View	
Rocker Arm	
Rocker arm installation	

Long Block Assembly	Sequence III G
----------------------------	-----------------------

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

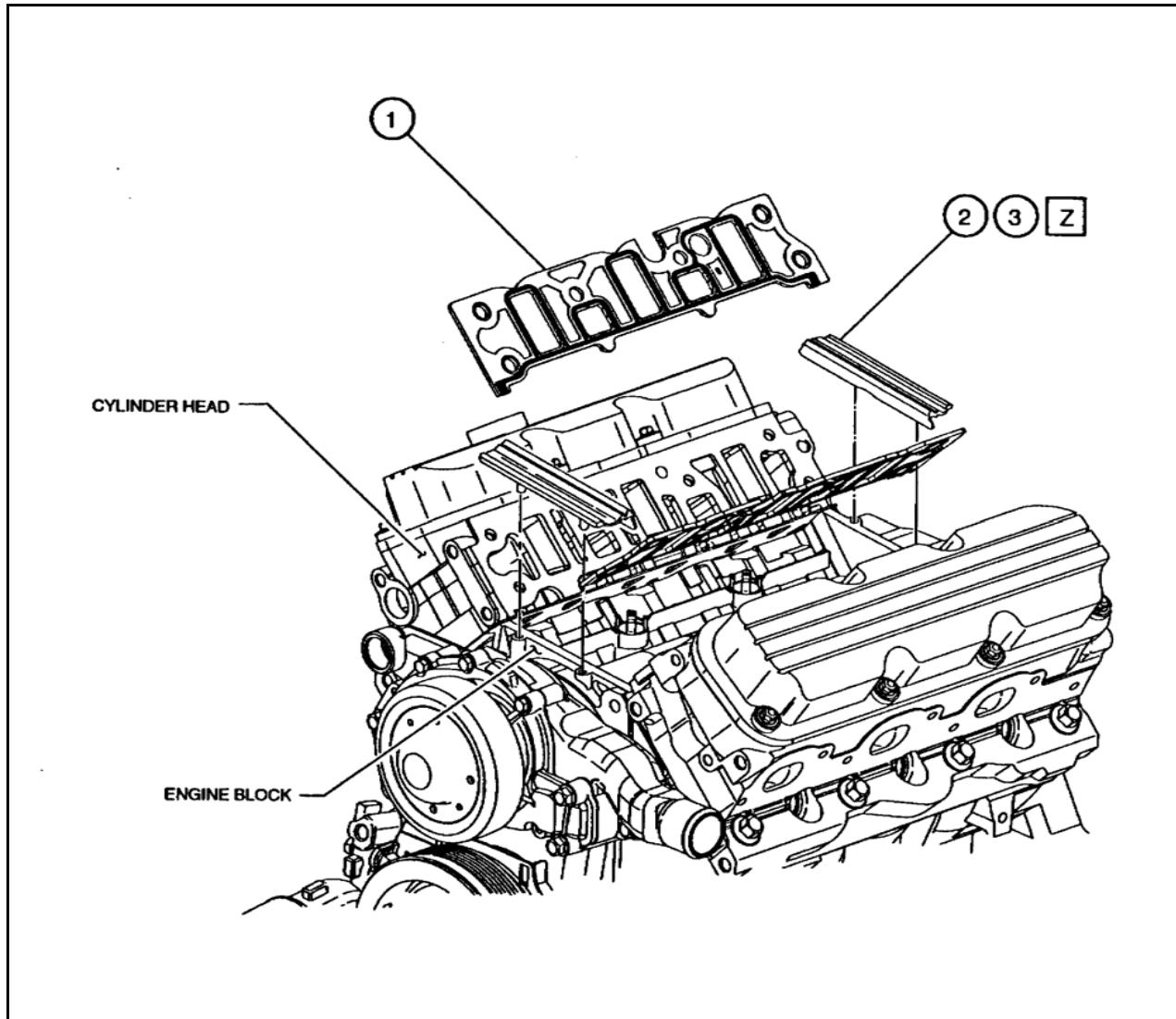
View	
Rocker Cover	
Rocker cover installation	

Long Block Assembly

Sequence III G

Section
6

Sheet
5



Description of Operation

2nd design gasket kit uses locating pins for front and rear seals

Z Apply RTV, GM 12346193 or Dow Corning 3154 sealer to both ends.

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	12/15/03	Update RTV sealer

View

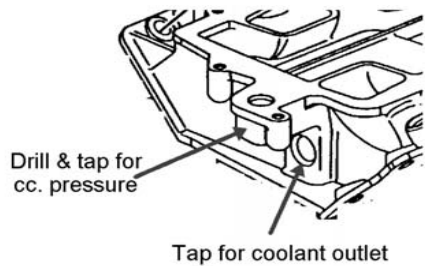
Intake Gaskets

Intake gasket installation

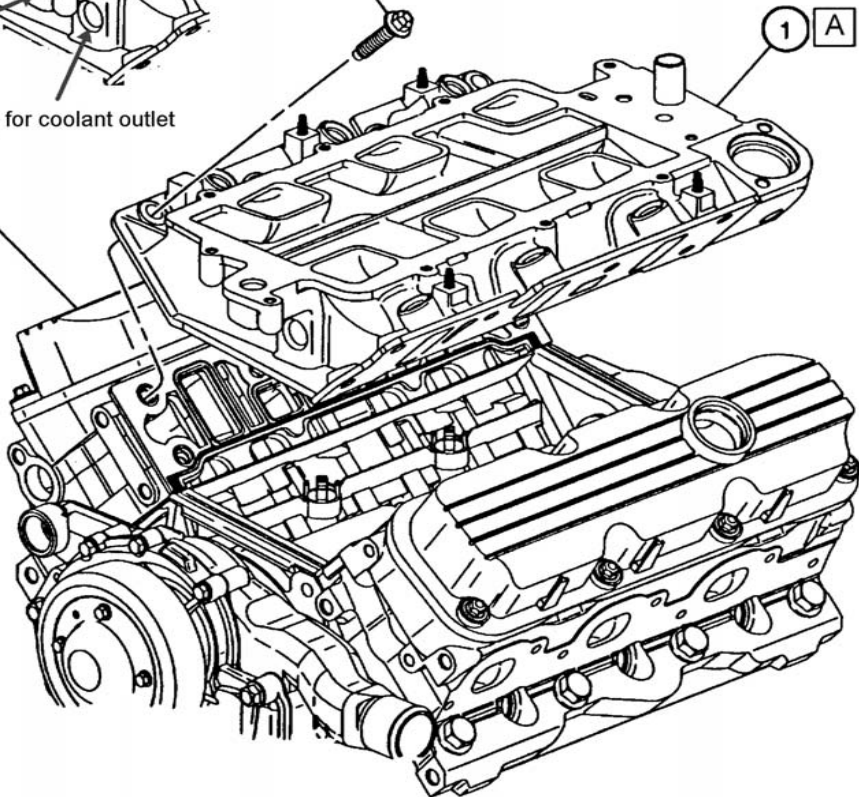
Long Block Assembly

Sequence III G

Section	Sheet
6	6



CYLINDER HEAD



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)

View

Lower Intake

Lower intake manifold installation

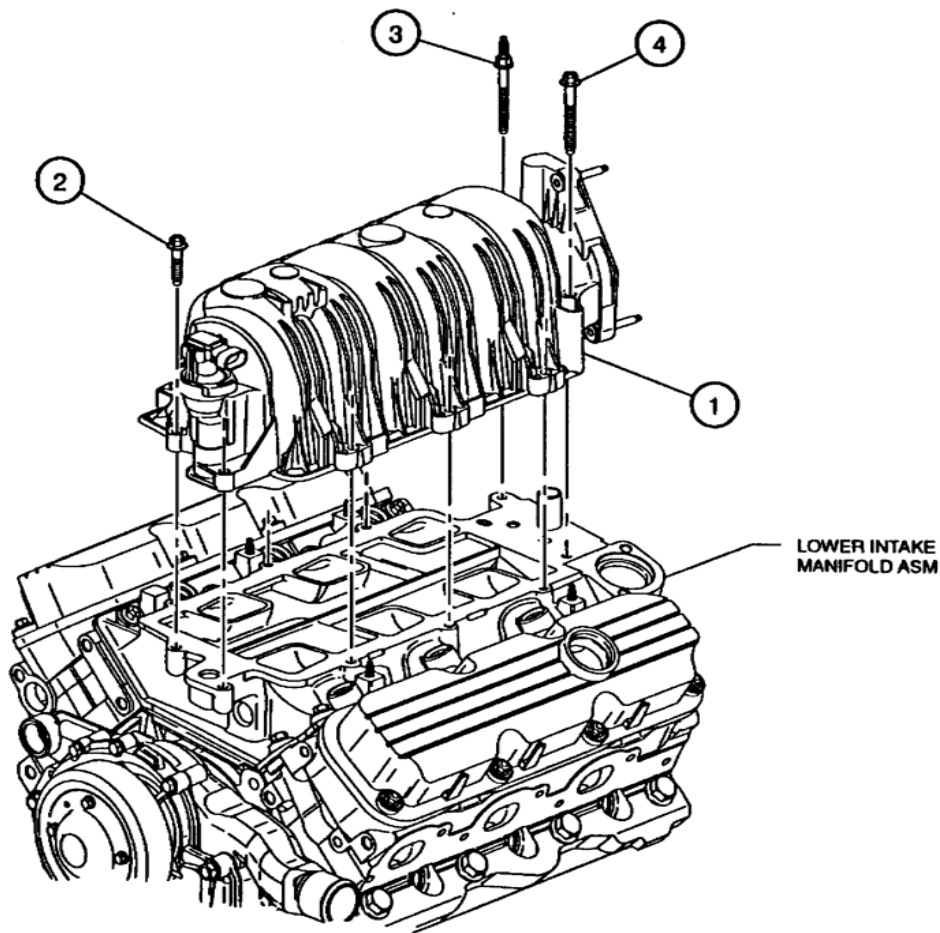
Section

6

Sheet

7

REV	Date	Revision History
1	1/6/98	Block-45
Long Block Assembly		Sequence III G



Description of Operation

Install upper intake and gasket assembly.

Torque 10Nm (Max. torque)

Y

Specification

- 1 17096162 Manifold assembly
17113137 Gasket Kit
- 2 24506498 Bolt (8)
- 3 24502453 Stud
- 4 24505205 Bolt

See note Y for torque

View

Upper Intake

Upper intake installation

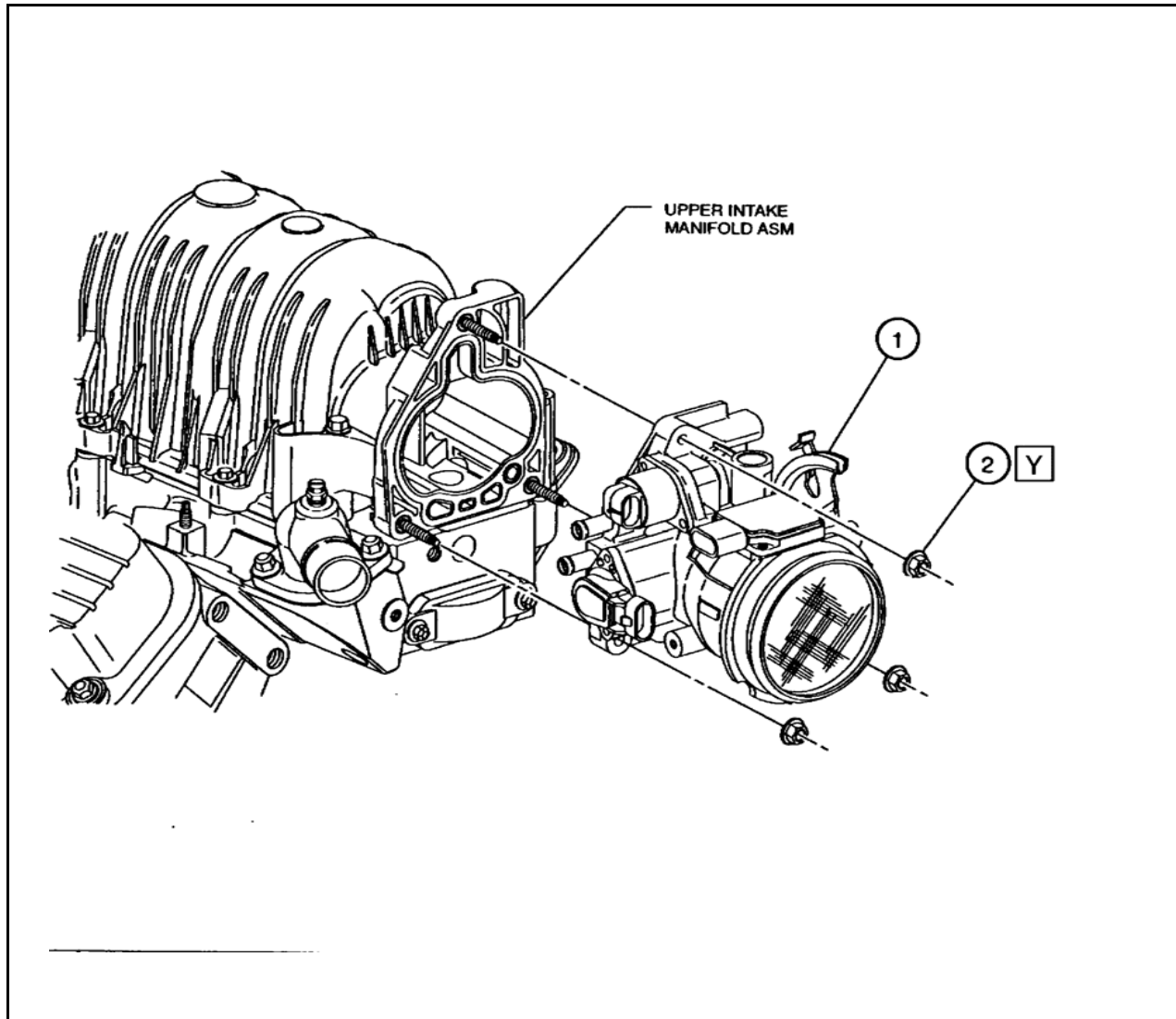
Section

Sheet

6

8

REV	Date	Revision History
1	1/6/98	Block-46
<p>Long Block Assembly</p>		<p>Sequence III G</p>



Description of Operation	
	Install modified throttle body
	Note: See section 7 sheet 5 for modifications
Y	Torque 10Nm

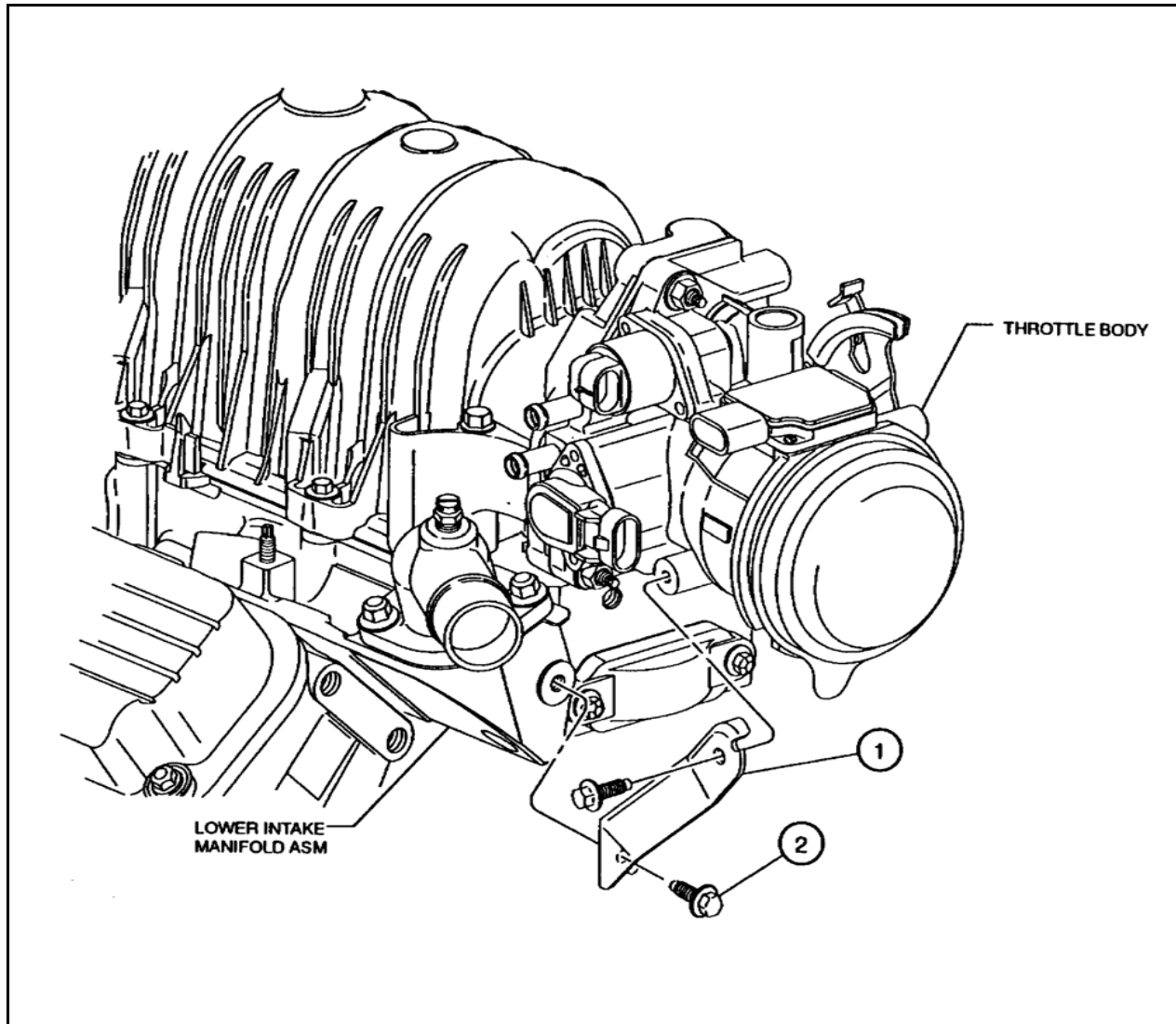
Specification	
1	24507235 Throttle Body (2 bolt Mass Air Flow Sensor) Use 12568877 or May be superseded with remanufactured part# 88961007
2	24506469 Nut

REV	Date	Revision History
1	1/6/98	Block-47
2	4/28/03	Add new mass airflow part number 12568877
3	6/23/03	Add 88961007 remanufactured from 12568877

View	
Throttle Body	
Throttle body installation	

Long Block Assembly	Sequence III G
----------------------------	-----------------------

Section	Sheet
6	9



Description of Operation	
	Install support bracket
Y	Torque 10Nm

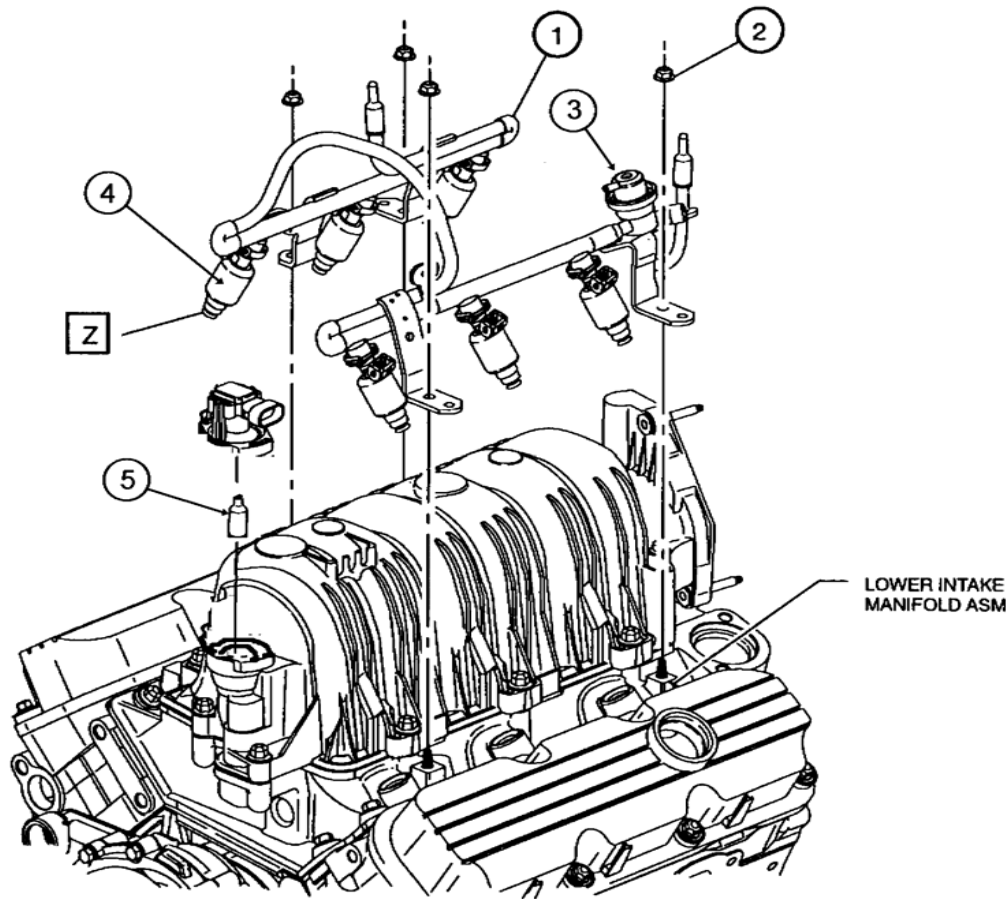
Specification	
1	24504697 Support
2	24503644 Bolt (2) See note Y for torque

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

View	
Throttle Body Support	
Throttle body support installation	

Long Block Assembly	Sequence III G
----------------------------	-----------------------

Section	Sheet
6	10



Description of Operation

Install injector assembly (See sec. 6.14.1 of the test procedure for injector flow testing requirements).

Torque 10Nm

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

View

Injector Assembly

Injector assembly installation

Section

6

Sheet

11

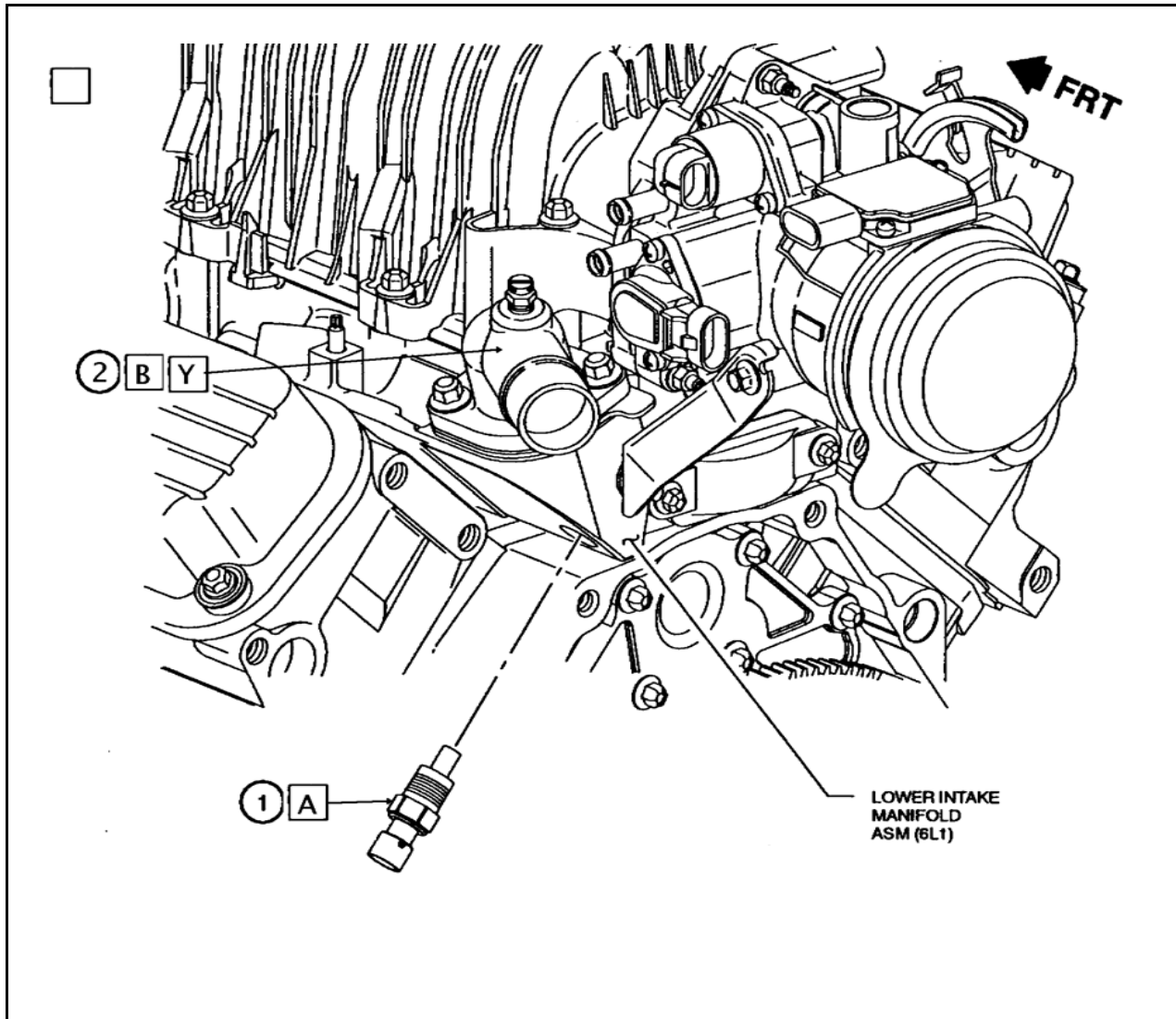
REV	Date	Revision History
1	1/6/98	Block-49
2	12/15/03	Update text on reference to procedure for injector flow testing requirements

Long Block Assembly

Sequence IIIG

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

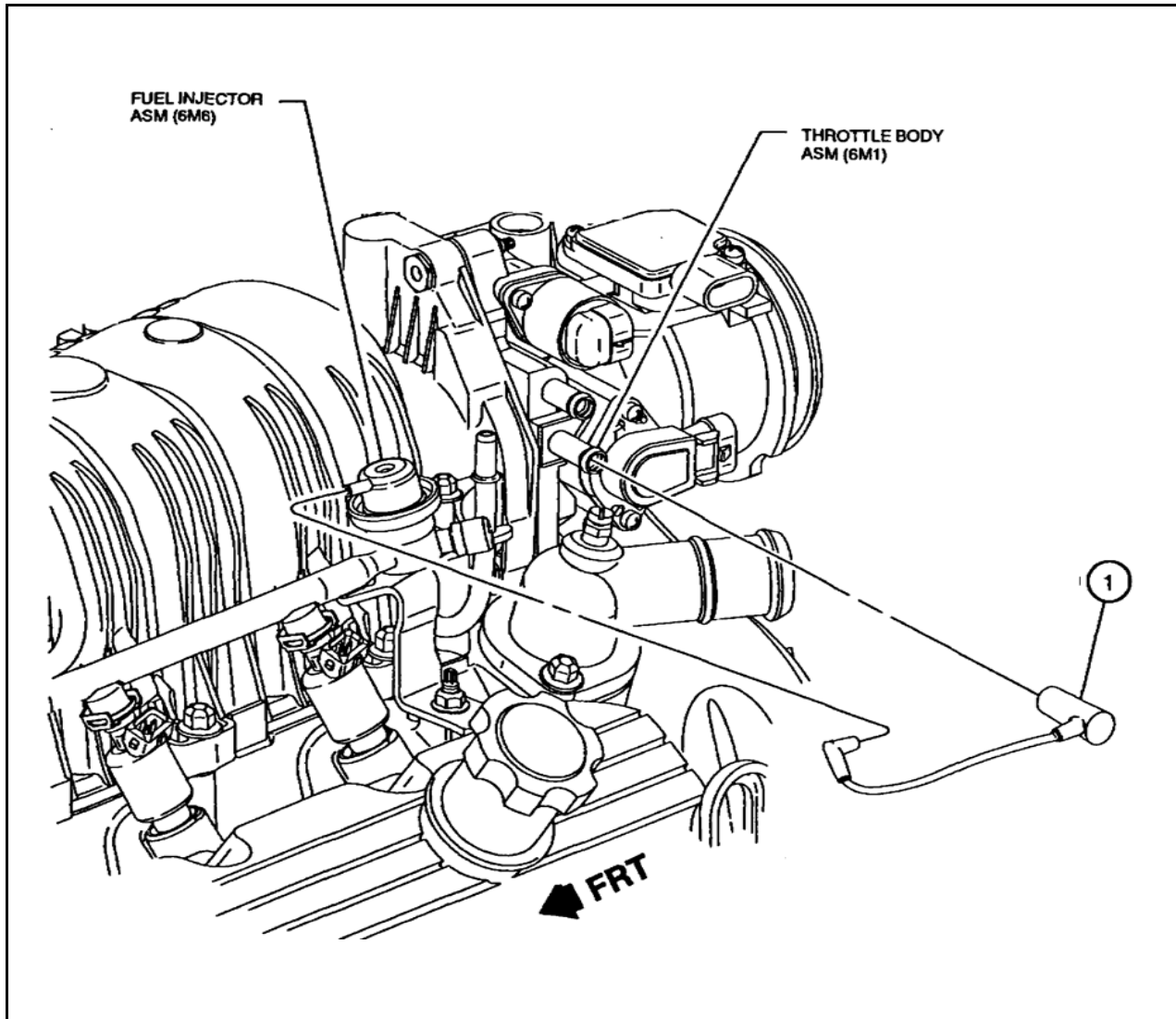
Specification	
1	10096181 Sensor (Used for plug only, disable connector)
2	OHT3F-034-1 Coolant Outlet (Not to detail on sheet)

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

View	
Coolant Out & Sensor	

Final Dress	Sequence III G
--------------------	-----------------------

Section	Sheet
7	1



Description of Operation

Specification	
1	24505671 Tube

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

View

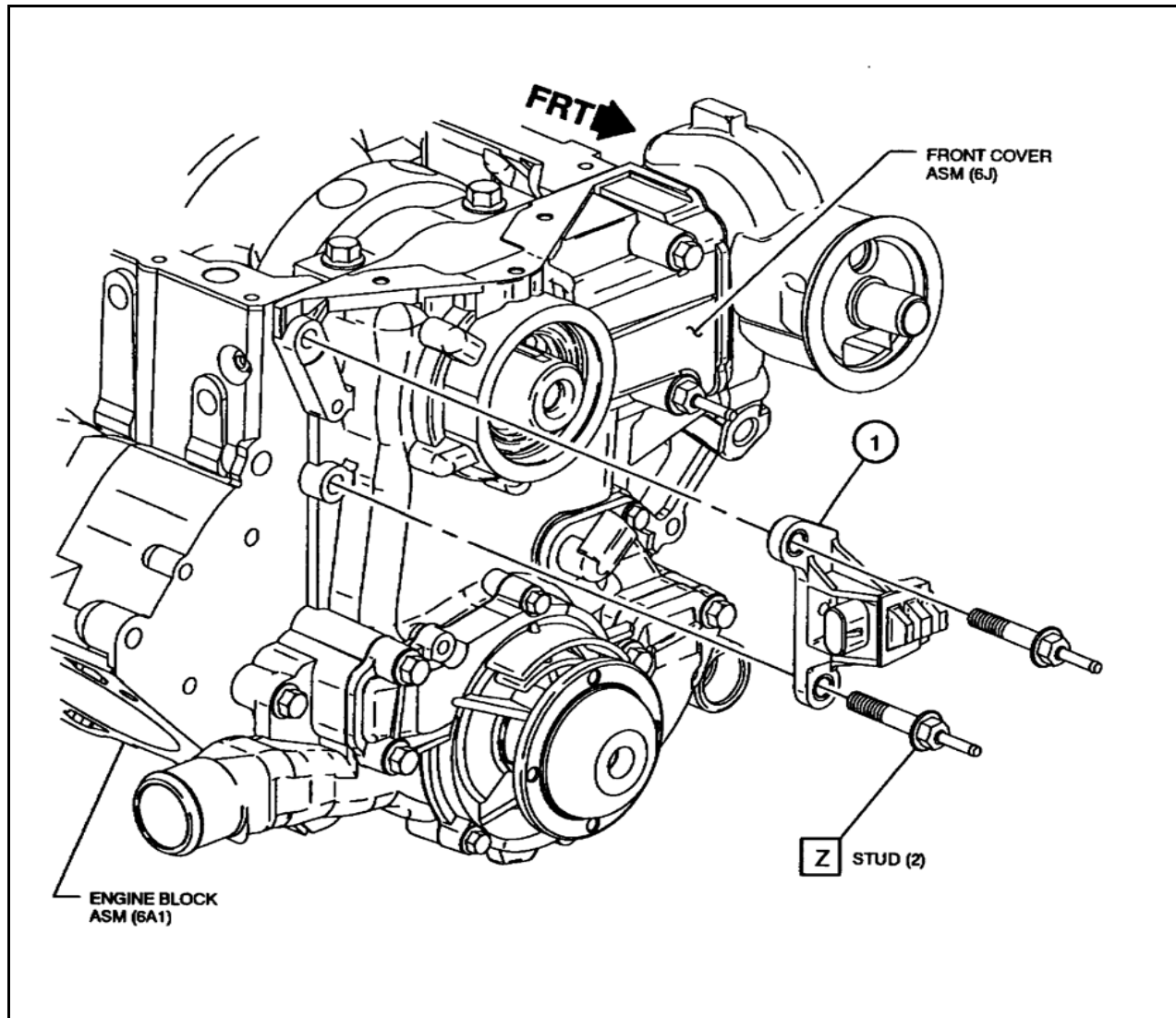
Vacuum Hose

Final Dress

Sequence III G

Section
7

Sheet
2



Description of Operation

Z See front cover section for bolt part numbers and torque.

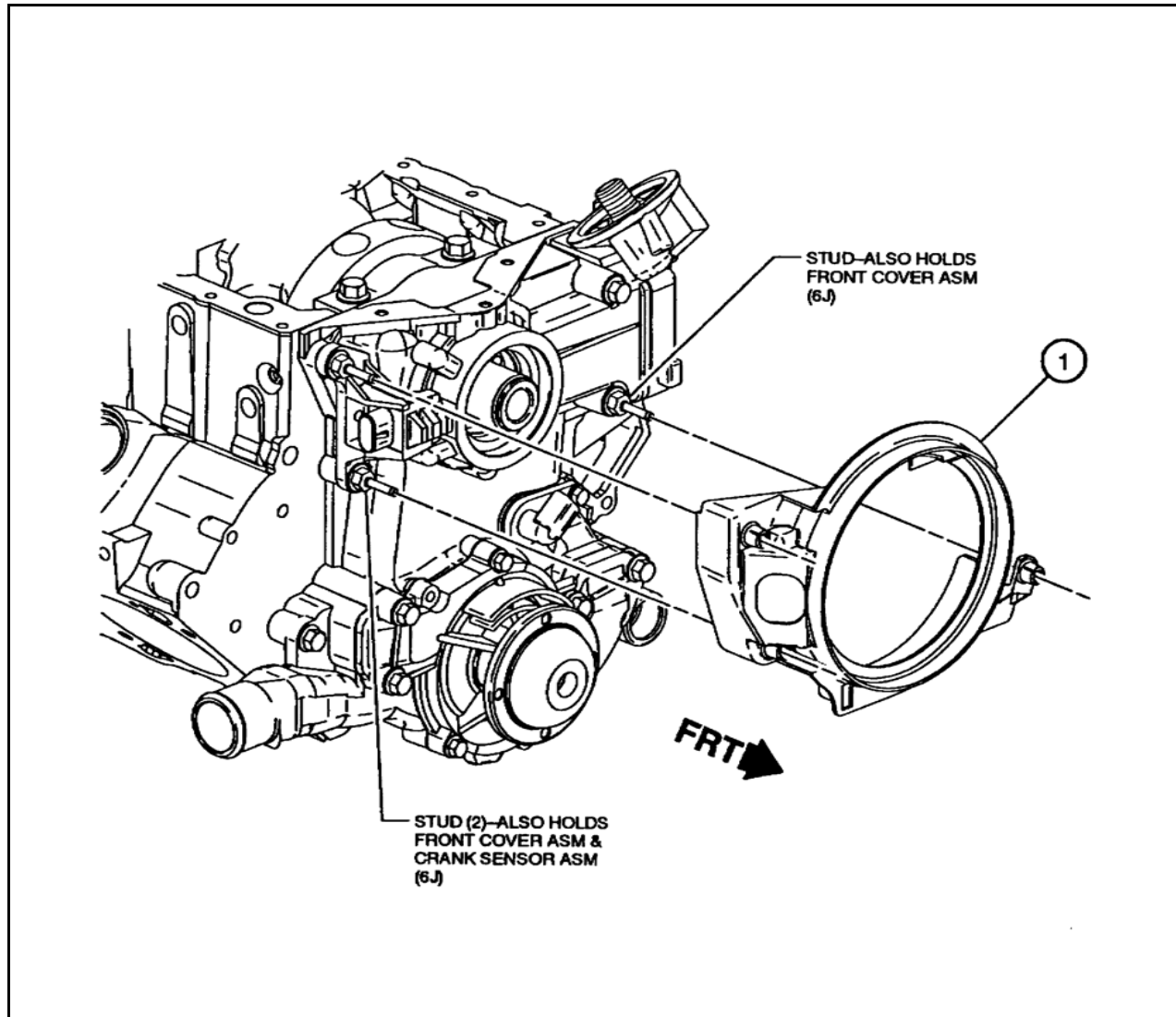
Specification	
1	10456161 Sensor

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

View
Crankshaft Sensor

Final Dress **Sequence III F**

Section	Sheet
7	3



Description of Operation

Specification

1 24506440 or 24508586 Shield

REV	Date	Revision History
1	1/10/98	Block-54
2	12/15/03	Add 24508586

View

Crankshaft Sensor Shield

Final Dress

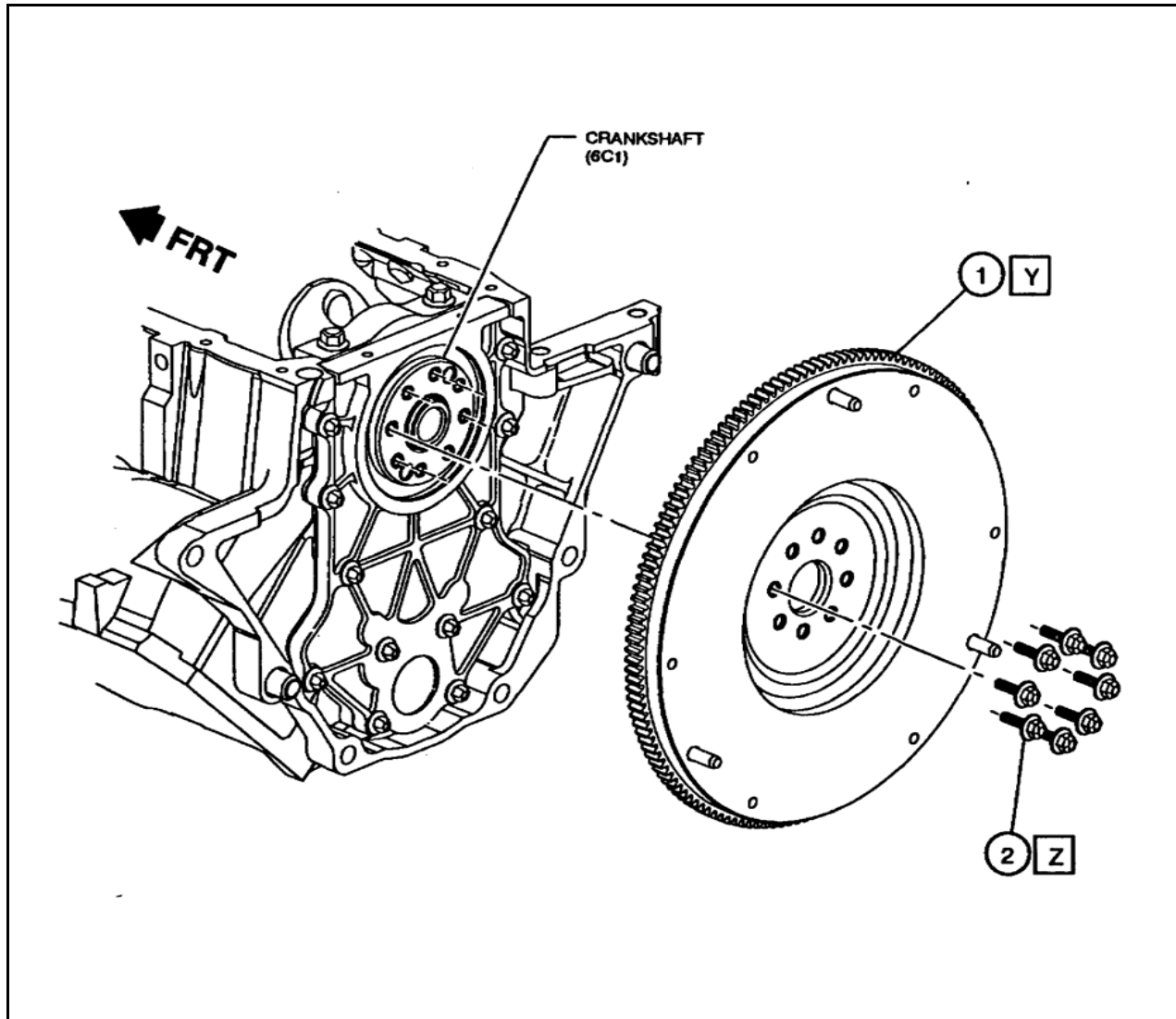
Sequence III G

Section

7

Sheet

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°

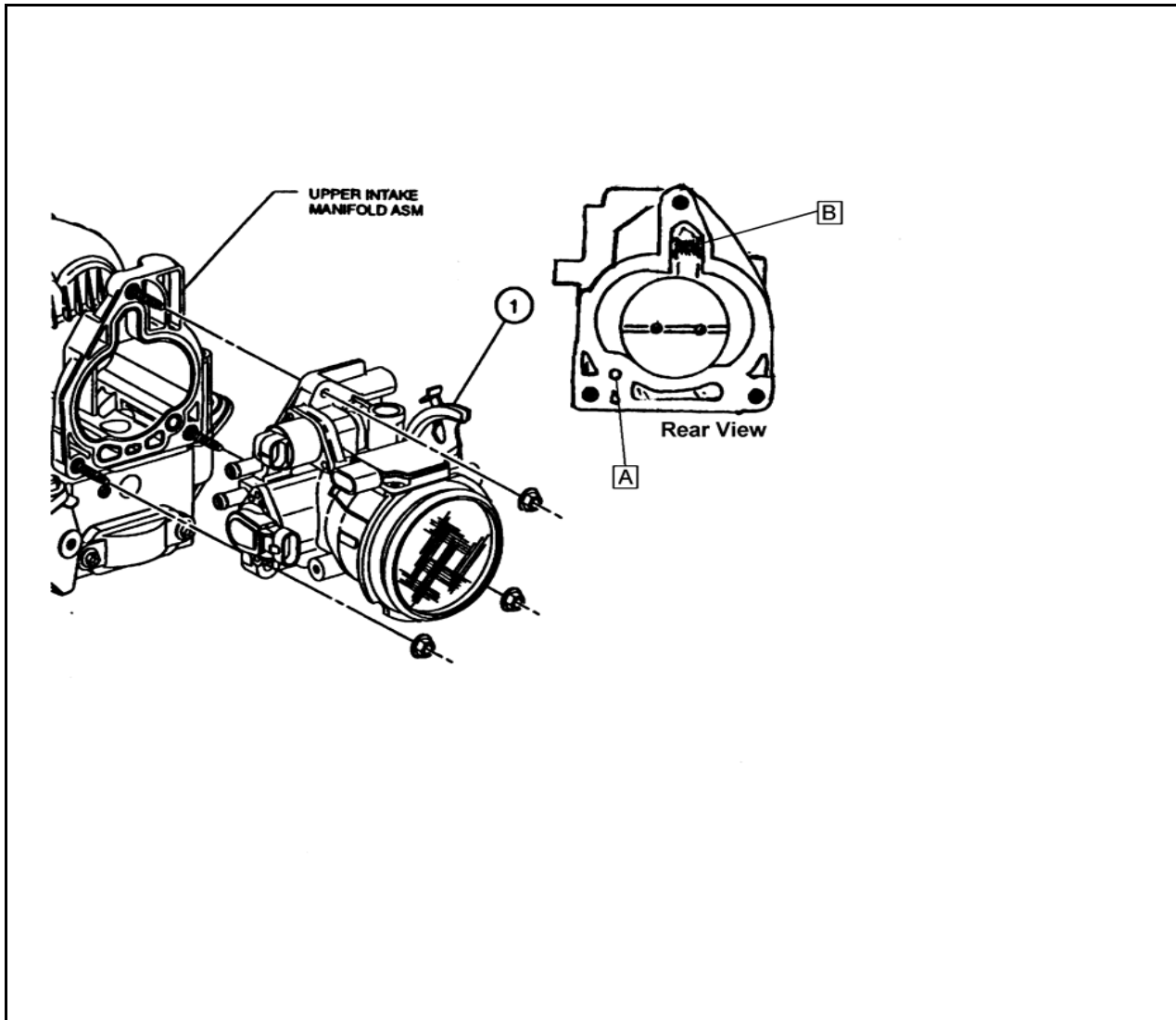
Specification	
1	OHT3F-020-2 Flywheel (Modified 24503285)
2	24505092 Bolt

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

View	
Flywheel	

Final Dress	Sequence III G
-------------	----------------

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 connector and adjust idle screw to obtain 800 RPM base idle.

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)
Use 12568877
or
May be superseded with
remanufactured part# 88961007

REV	Date	Revision History
1	11/13/99	Block-48
2	5/28/03	Add 12568877
3	6/23/03	Add 88961007 remanufactured from 12568877

View

Throttle Body Modification

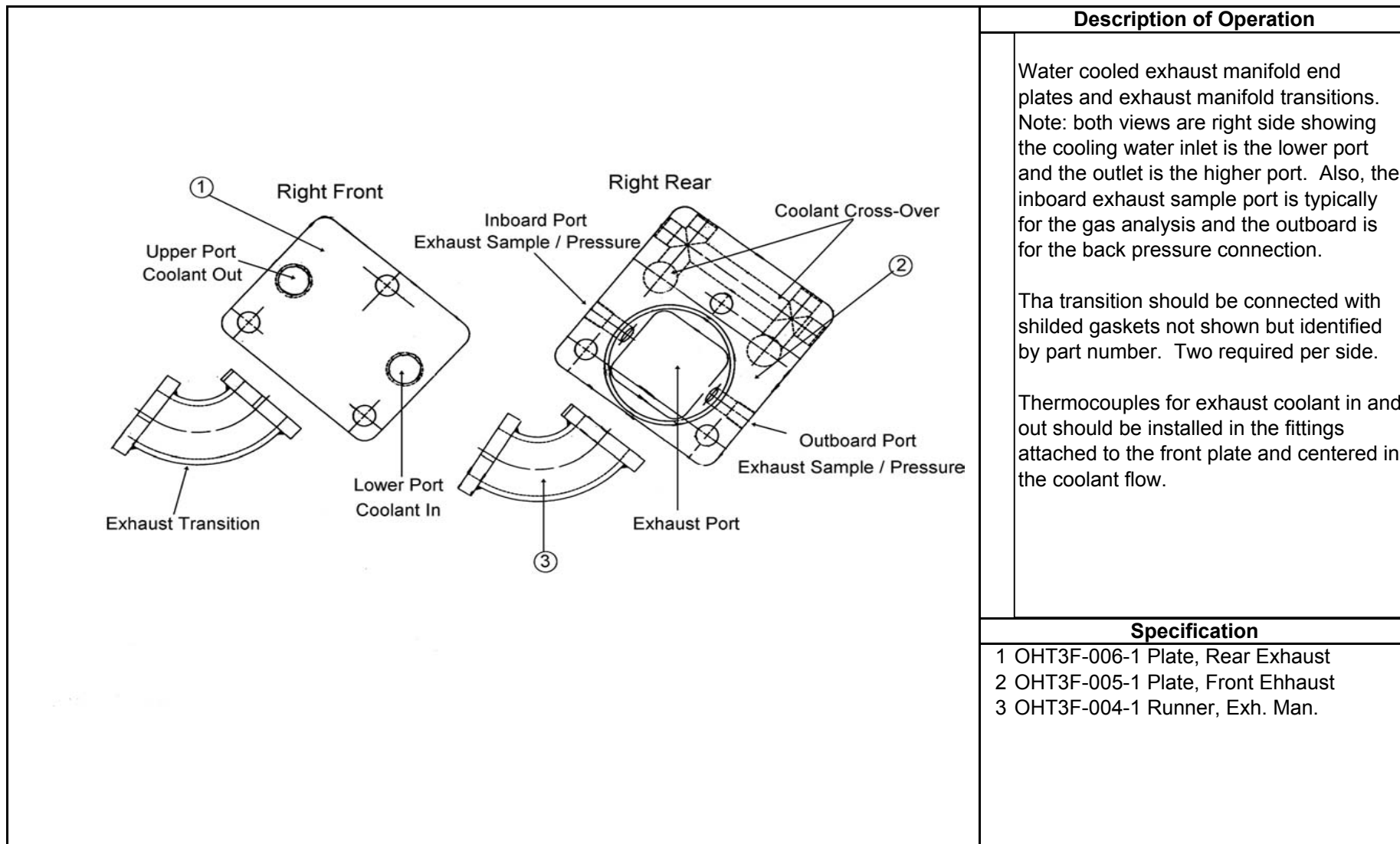
Final Dress

Sequence III G

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.

The transition should be connected with shielded 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.

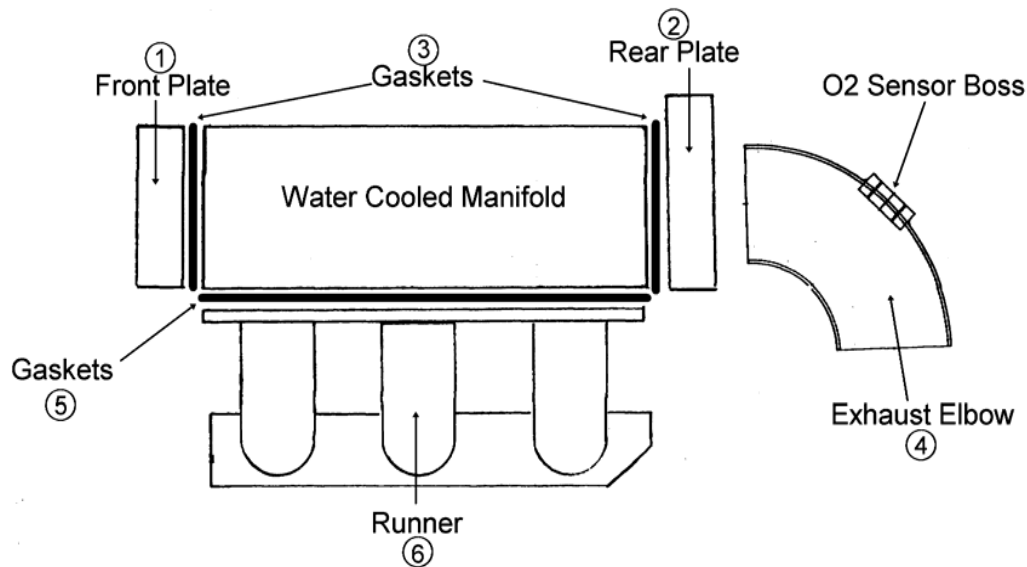
Specification

- 1 OHT3F-006-1 Plate, Rear Exhaust
- 2 OHT3F-005-1 Plate, Front Exhaust
- 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

OHT **Sequence III G**

View	
Water Cooled Exh. Man. End Plates	
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 Exhaust
- 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.

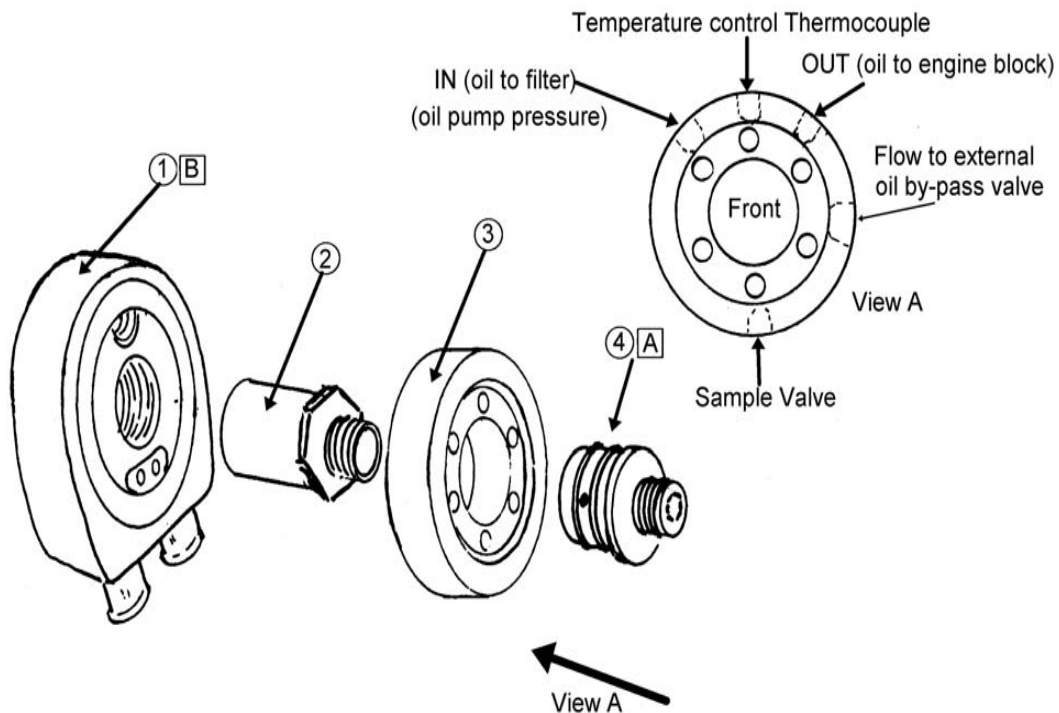
REV	Date	Revision History
1	11/13/99	Block-61
2	2/22/02	Update text, include warning on usage of RTV sealer

View

Water Cooled Exh. Man. & Elbow

OHT	Sequence III G
------------	-----------------------

Section	Sheet
8	2



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

Description of Operation

- A Replace "O"-rings every test.
- Note: View A
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

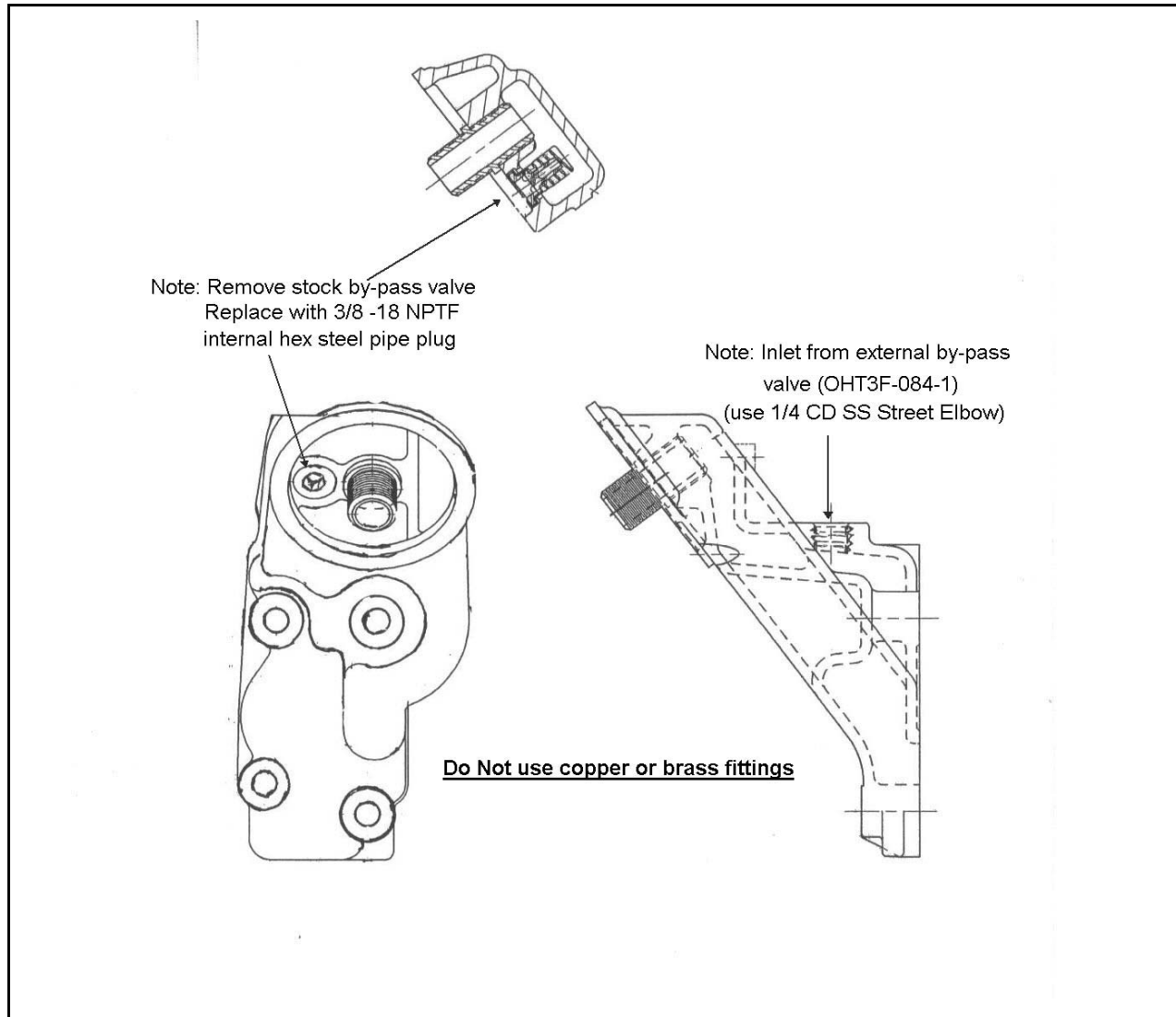
- 1 OHT3F-030-2 Cooler Nickel Plated
- 2 OHT3F-039-3 Connector Special Cut
- 3 OHT3F-035-2 Adapter, Oil Filter
- 4 OHT3F-043-2 Fitting, Oil Filter Adapter

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 III G
------------	-----------------------

Section	Sheet
8	3



Description of Operation

Special part modification information.

Modified 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

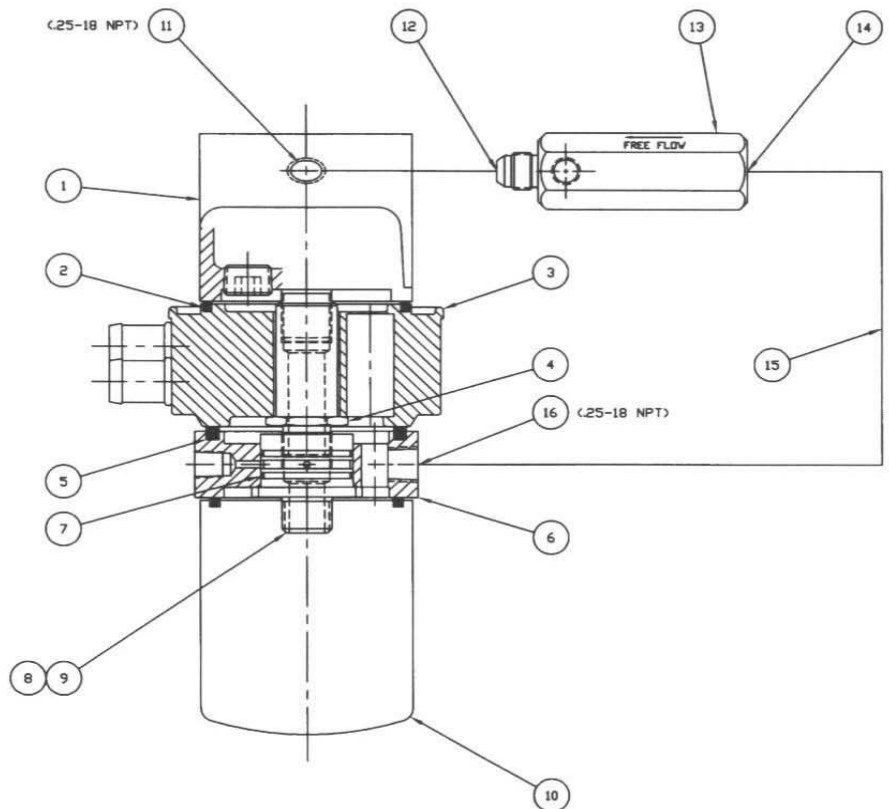
Oil Filter Adapter Modification

OHT

Sequence III G

Section
8

Sheet
3a



BILL OF MATERIAL		
ITEM	REQ'D	DESCRIPTION
1	1	BLOCK, OIL FILTER, MODIFIED W/BYPASS BLOCKED, DHT3F-080-1
2	1	SEAL, RECTANGULAR, DHT3F-074-1
3	1	COOLER, OIL, NICKEL PLATED, BYPASS CLOSED, DHT3F-030-2
4	1	CONNECTOR, MODIFIED, DHT3F-039-3
5	1	SEAL, RECTANGULAR, DHT3F-062-1
6	1	ADAPTER, OIL FILTER, DHT3F-035-2
7	2	SEAL, O-RING, #2-025-VITON PARKER
8	1	FITTING, OIL FILTER ADAPTER, .500" I.D., DHT3F-043-2
9	1	WRENCH, SPANNER, (FOR USE W/ITEM #8), DHT3F-083-1
10	1	FILTER, OIL (PF-47), DHT3F-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, DHT3F-084-1
14	1	CONNECTOR, MALE, #6-BFTX-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

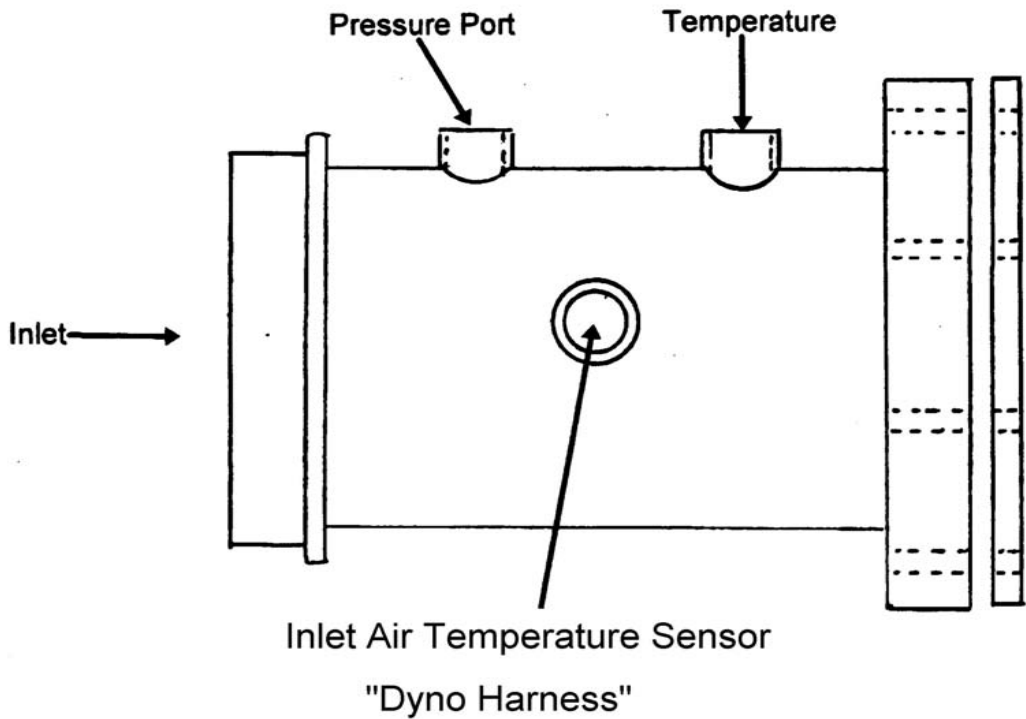
ASSEMBLE ALL SEALS WITH A LIGHT COATING OF #EF411 OIL

DIMENSIONS IN PARENTHESES ARE IN INCHES

METRIC		SYN	REVISES	DATE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS				
TOLERANCES UNLESS SPECIFIED	TITLE	ASS'Y, OIL FILTER, COOLER & BYPASS		
SECTION	MATERIAL	SEE B/M		
XX = .003	SCALE	FULL		
XXX = .010	DATE	6-6-02		
ANGULAR .1"	CHECKED BY	D.H.		
SURFACES 1/2	DRAWN BY	D.H.		
OH TECHNOLOGIES INC.		DVG. NO. DHT3G-XXX-1		
P.O. BOX 1007		MONTICELLO, TN 37138		

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REV	Date	Revision History	View	
1	6/17/02	OHT Print	OHT Oil Cooling & By-Pass	
			Printed by permission OH Technologies	
			Section	Sheet
			8	3b
		OHT	Sequence III G	



Description of Operation

Inlre 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

Section

8

Sheet

4

OHT

Sequence III G