

QUALITY DRIVEN® SERVICE



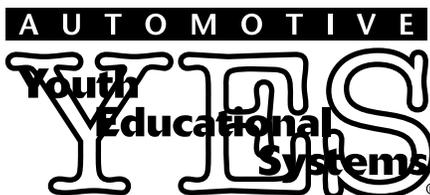
**SUBARU**®



# **Technician Reference Booklet**

## **6 Cylinder Boxer Engines Series**

**Module 104-H6**



December 2009

MSA5P0631C

**Technical Training**



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# 6 Cylinder Boxer Engines Series (104-H6)

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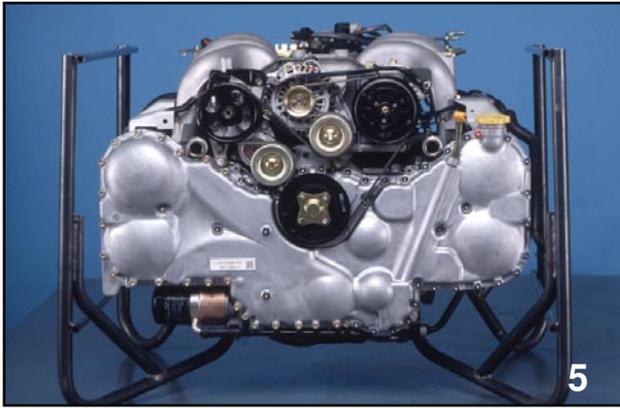
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## 3.0 Liter Engine



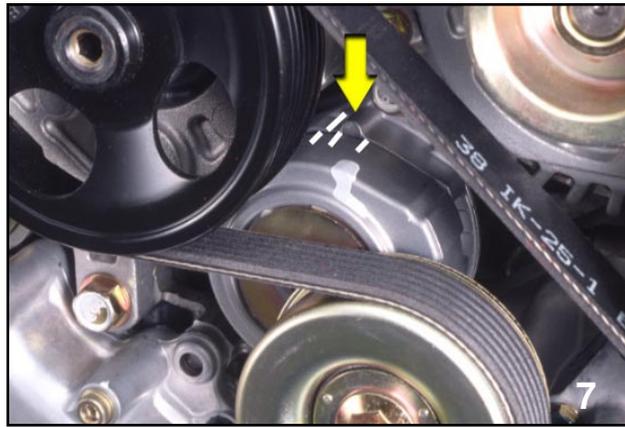
3.0 LITER ENGINE WITH STANDS

### General Information

The EZ-3.0 is the model name (Engine Designation) for the new 6-cylinder engine 2001-2009 model year Legacy. The design idea for this engine was to create a power plant that could utilize the current body style, provide more power and decreased exhaust emissions. Many of the features refined for the current 4 cylinder engine are employed on the EZ-3.0 however, new features such as Variable Intake Control and timing chain driven Camshafts give the new engine a look and operation all of its own.



SINGLE SERPENTINE BELT



BELT WEAR INDICATOR

### 3.0 Liter Engine Features

The front of the engine displays the large front timing chain cover. It is secured to the inner cover with 59 bolts. There are 4 different lengths used and is sealed to the inner cover with Three Bond (1280B). Special care must be used when servicing the timing chain covers to ensure the proper length bolt and sealing procedures are used. A single serpentine belt provides the power to turn all engine accessories.

Tension to the belt is controlled with an automatic tensioner.

Replace the serpentine belt when the indicator is at or beyond this line.

### 3.0 Specifications

Bore and stroke 89.2 x 80 millimeters (3.51 x 3.14 inches)

Length 465 millimeters (18.3 inches)

Height 635 millimeters (24.99)

Displacement 3.0 liters (183 cubic inches)

Compression Ratio 10.7 to 1

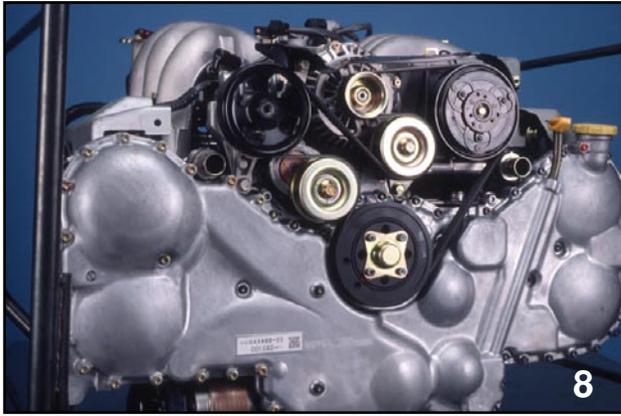
Gasoline for use Unleaded Premium

Fuel Injection Type DMPI

Maximum Horsepower 212 at 6,000 RPM

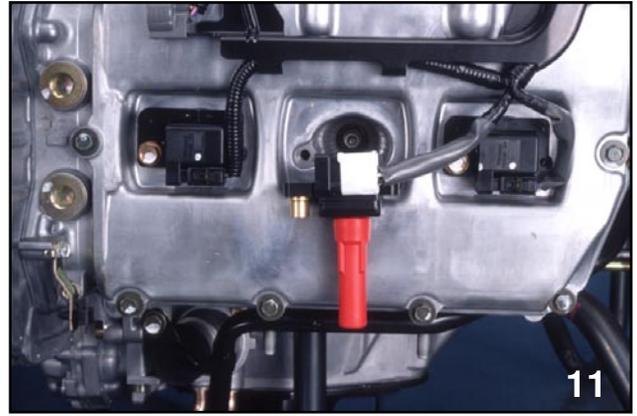
Maximum torque 210 at 4,400 RPM

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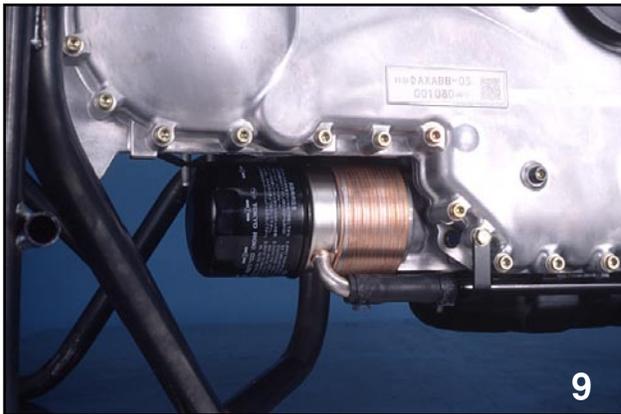
*UPPER RADIATOR HOSE CONNECTIONS*

Two radiator hose connections are located at the top of the engine block connecting to each of the cylinder heads.



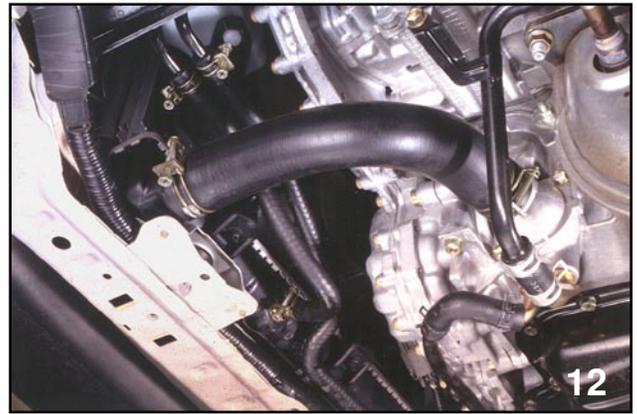
*COIL AND IGNITER ASSEMBLY*

The view of the left bank side shows the use of new direct ignition coils. The igniter and current control circuits are integrated.



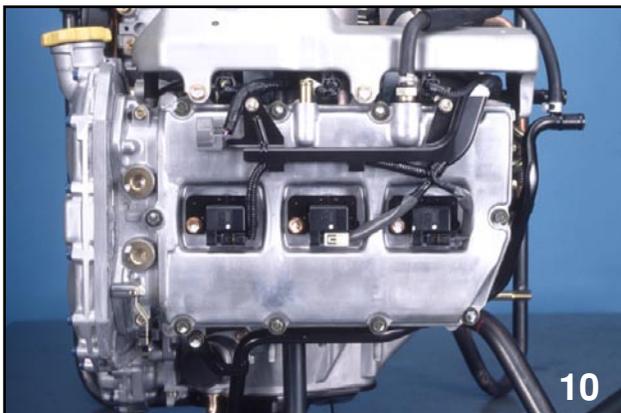
*OIL COOLER*

An oil cooler is used to assist with bringing the oil to operating temperature.



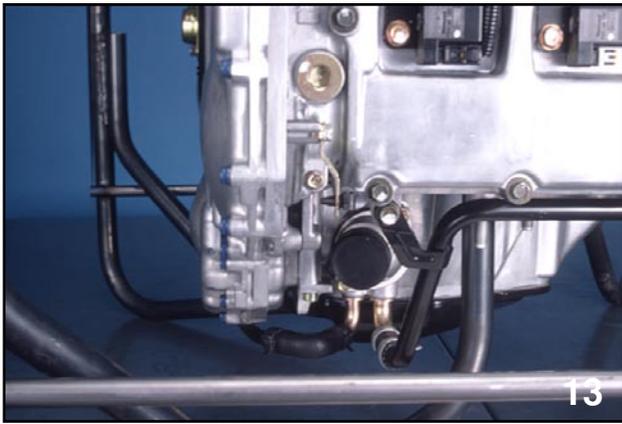
*LOWER RADIATOR HOSE*

The lower hose is located on the thermostat housing, connecting to the lower section of the radiator.



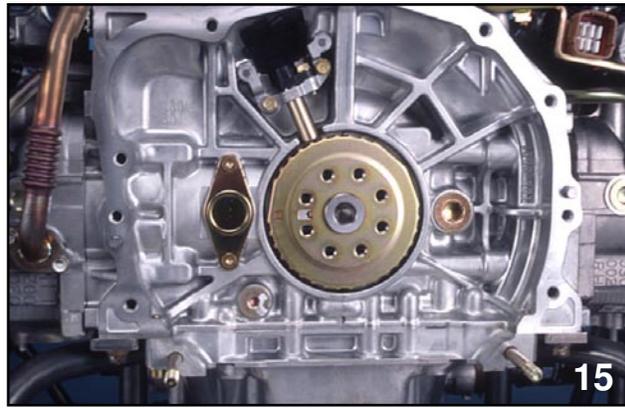
*INDIVIDUAL COILS*

# 6 Cylinder Boxer Engines Series (104-H6)



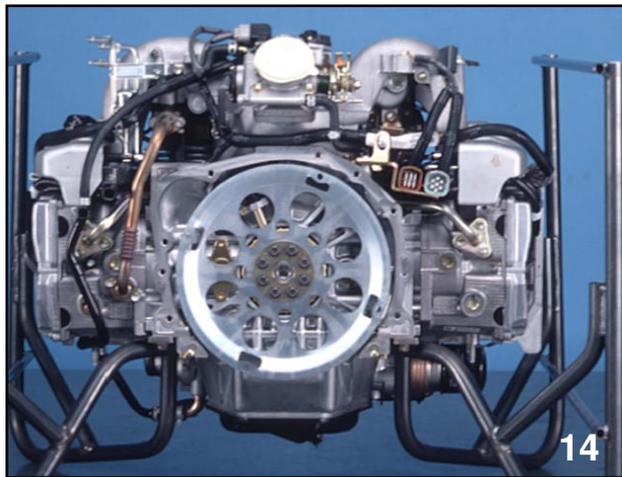
*OIL PAN AND EXTENSION CASE*

The thermostat is housed in the Oil Pan extension case. The Oil Pan itself is much smaller than previous model engines and contains a small magnet to collect metallic debris.



*CRANK ANGLE SENSOR WITH RELUCTOR*

The new crank angle sensor, reluctor, and EGR pipe. The crank angle sensor and reluctor have been moved to the rear of the crankshaft. The EGR pipe has a new design and is mounted on the left bank of the engine.

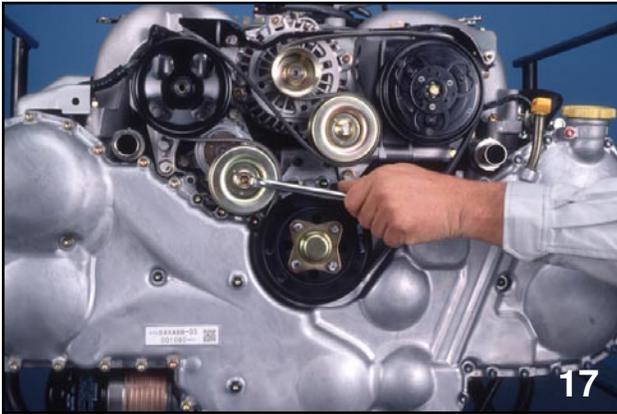


*CRANKCASE VENTILATION SYSTEM*

Connections for the crankcase ventilation system are located at the top of the valve cover. Pressure is equalized from the right bank with a cross over tube.

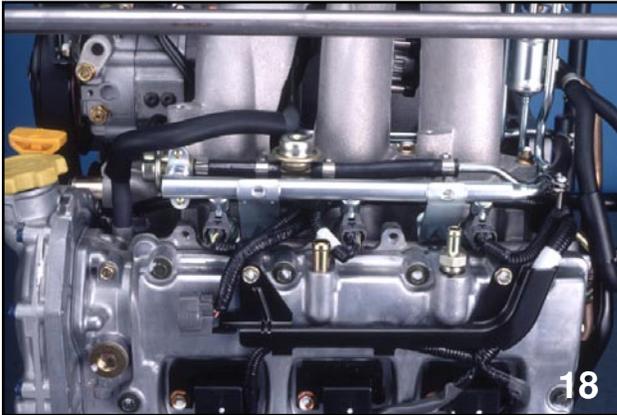
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## 3.0 Liter Engine Disassembly



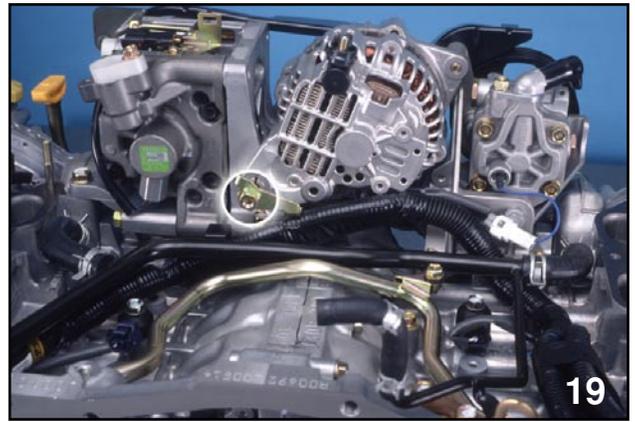
*UNLOADING TENSIONER*

Begin disassembly by unloading and removing the serpentine belt.



*FUEL RAIL ASSEMBLY*

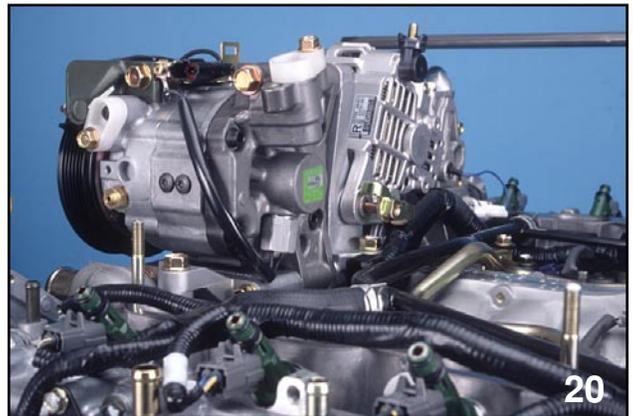
Remove the fuel rail protectors from both sides.



*LOWER ALTERNATOR BOLT*

The lower alternator bolt must be backed out before the manifold can be removed.

Remove the intake manifold.

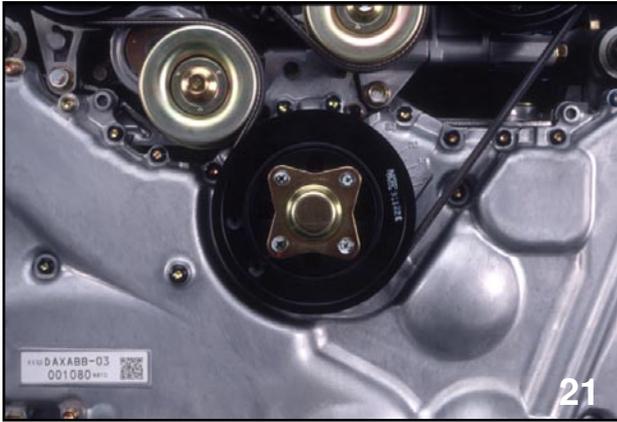


*REMOVE ACCESSORIES*

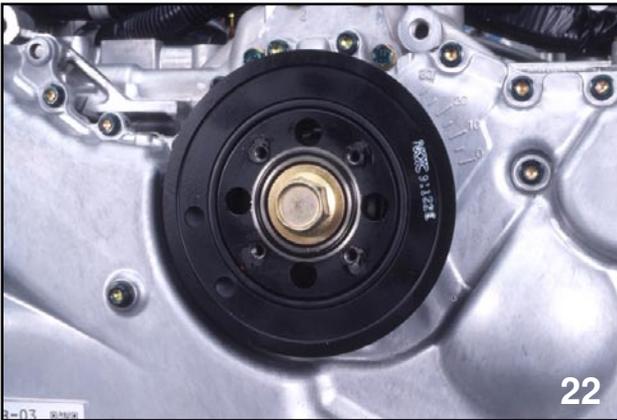
Remove the alternator, compressor and power steering pump.

**NOTE: THE COMPRESSOR IS EQUIPPED WITH A SPEED SENSOR THAT SENDS A SIGNAL TO THE ECM. IF THE COMPRESSOR SPEED DROPS MORE THAN 20% COMPARED TO THE ENGINE SPEED, THE ECM TURNS THE COMPRESSOR OFF THROUGH THE A/C RELAY. THE REFRIGERANT MUST BE EVACUATED BEFORE REMOVING THE SENSOR.**

# 6 Cylinder Boxer Engines Series (104-H6)



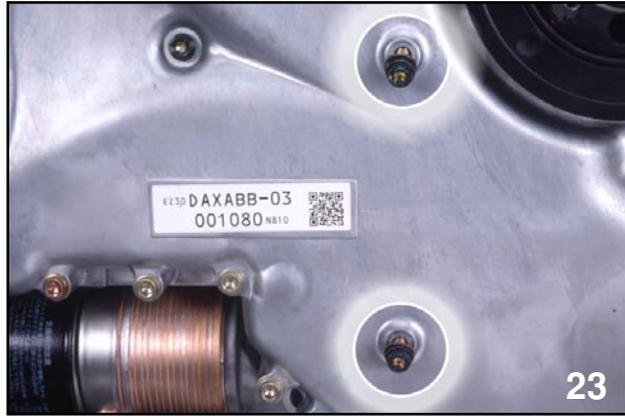
*CRANKSHAFT BOLT COVER*



*CRANKSHAFT BOLT SEAL*

Remove the crankshaft bolt cover, bolt and harmonic balancer. Do not lose the O-Ring that seals the crank shaft bolt cover to the harmonic balancer.

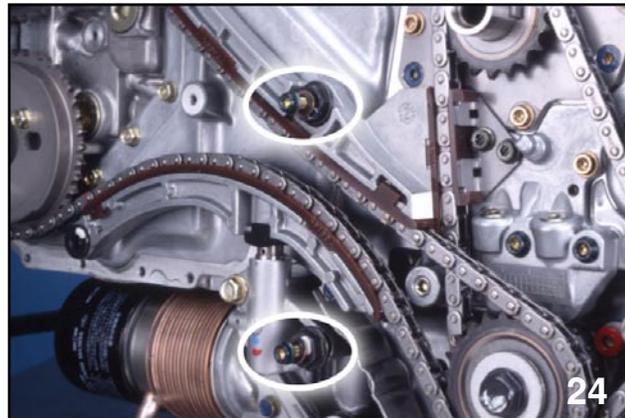
Begin removing the outer cover bolts. Keep them organized to ease reassembly. The bolts must be removed in the proper sequence to avoid warping the outer case.



*OUTER COVER SEALS*

These two bolts use sealing washers to prevent engine oil from leaking to the outside.

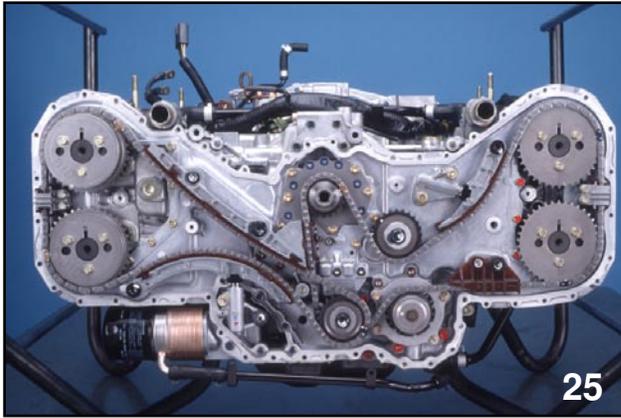
The seals are not reusable.



*OUTER COVER BOLTS*

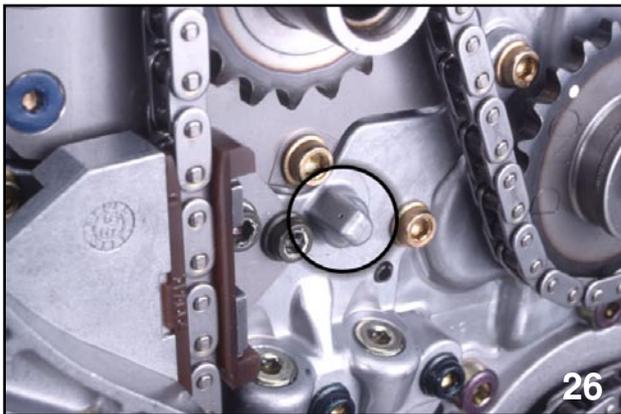
The bolts circled in the above picture secure the outer cover to special bolts that have internal threads. These bolts assist with supporting the outer chain cover along the middle where there is no support from the inner case.

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*TIMING CHAIN ROUTING*

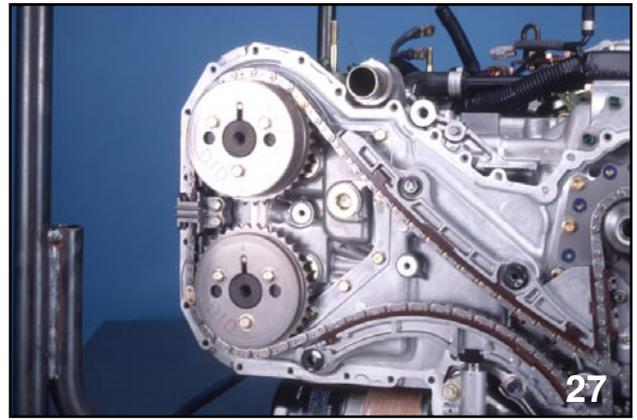
The timing chain on the EZ-3.0 is designed to last the life of the engine. Proper engine oil maintenance is necessary to ensure it lives up to its design. Two chains are used. Four (4) Camshaft sprockets, one (1) crankshaft sprocket, two (2) idler sprockets and the water pump complete the timing chain routing.



*TIMING CHAIN OIL JET*

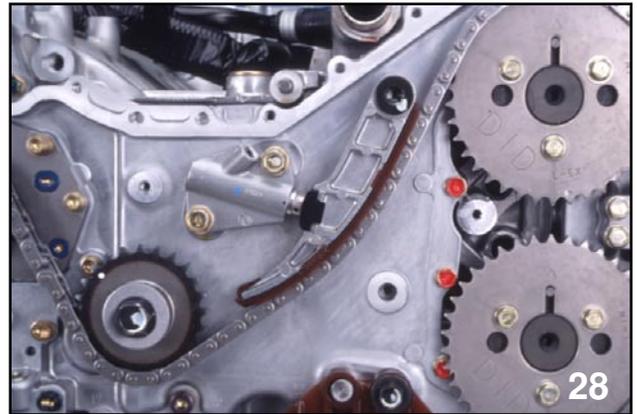
The timing chain is sprayed with oil from this jet located on the Oil Pump relief valve housing.

**CAUTION: THE SPROCKET TEETH ARE SHARP SO USE EXTREME CARE WHEN WORKING NEAR OR AROUND THEM.**



*RIGHT BANK CAMSHAFTS*

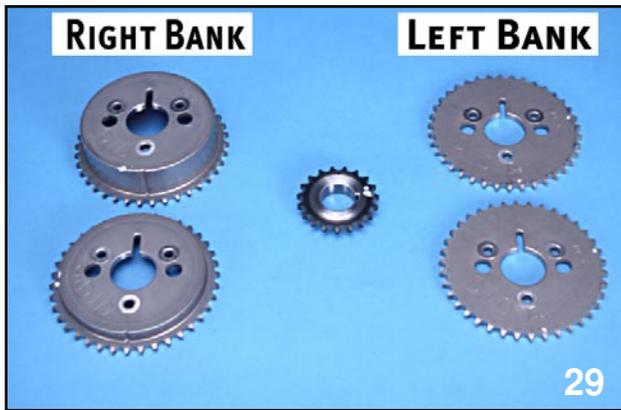
The right bank Camshafts are in a loaded state when the keyways are at 12:00. They must be unloaded in the proper way to prevent damage to the pistons and valves.



*LEFT BANK TIMING MARKS*

Timing marks are located on the Camshaft sprockets and the crankshaft sprocket. Marks and letters on the idlers are manufactures markings and are used only to establish which side faces outward. Do not use them to establish proper chain timing.

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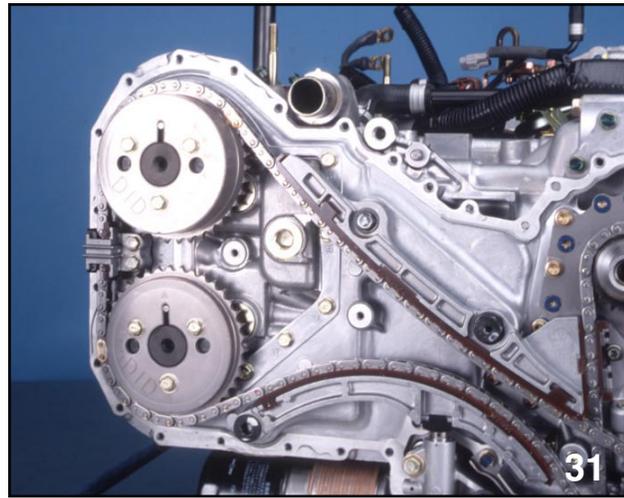
*CAMSHAFT SPROCKETS*

The left bank Camshaft sprockets are interchangeable when new. It is recommended they be returned to their original positions to maintain wear patterns after being used.



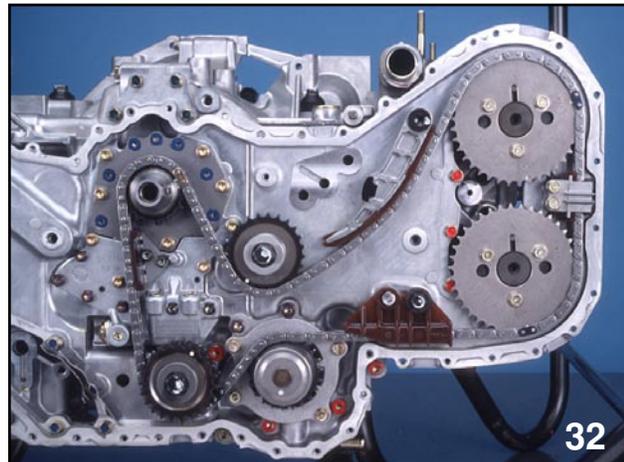
*TIMING CHAINS*

The left timing chain is the longer of the two with 148 links. The right chain has 134 links.



*REMOVAL OF RIGHT BANK TIMING CHAIN COMPONENTS*

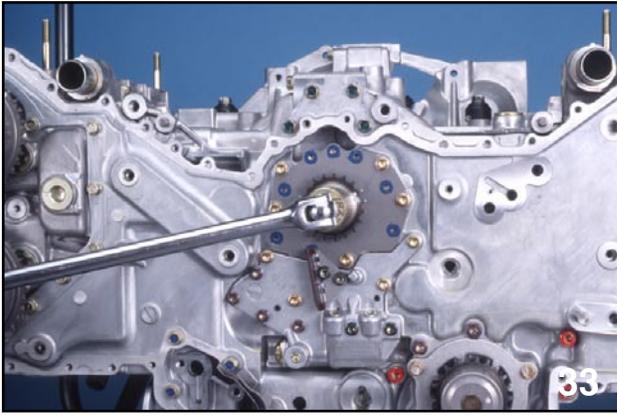
Turn engine clockwise to rotate it until the key ways of the cam sprockets are at the 12:00 position. Remove the right bank tensioner, chain and chain guides.



*REMOVAL OF LEFT BANK TIMING CHAIN COMPONENTS*

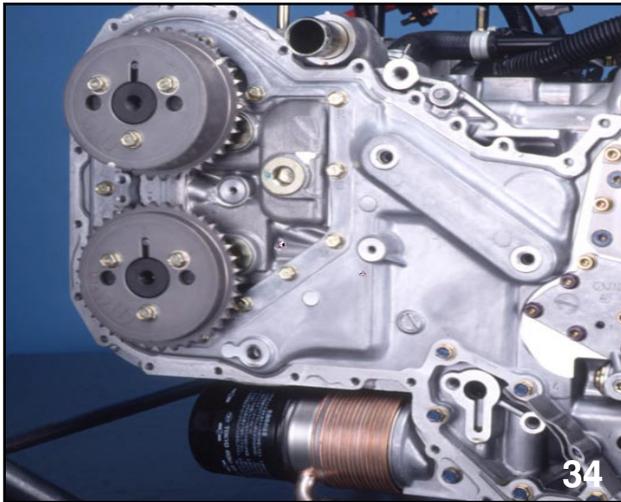
Remove the left bank tensioner, chain and chain guides.

# 6 Cylinder Boxer Engines Series (104-H6)



*TURN CRANKSHAFT TO PREVENT PISTON AND VALVE DAMAGE*

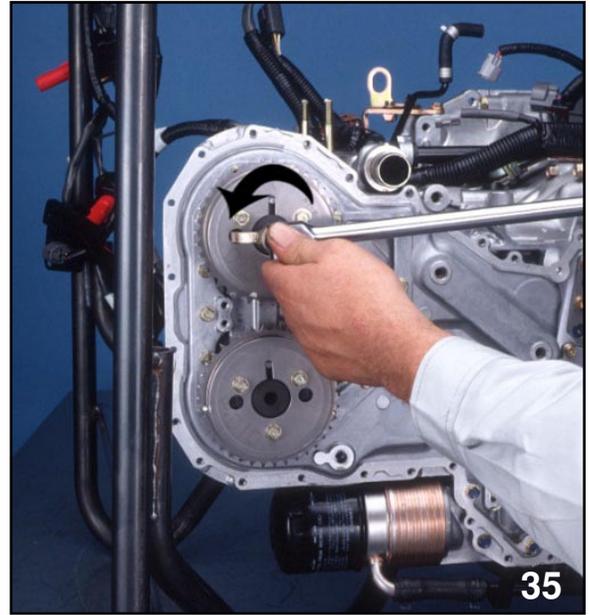
**NOTE: TURN THE CRANKSHAFT 90 DEGREES COUNTER CLOCKWISE TO REDUCE THE CHANCE OF ACCIDENTAL DAMAGE TO THE PISTONS AND VALVES IN THE EVENT THE CAMSHAFTS SUDDENLY UNLOAD.**



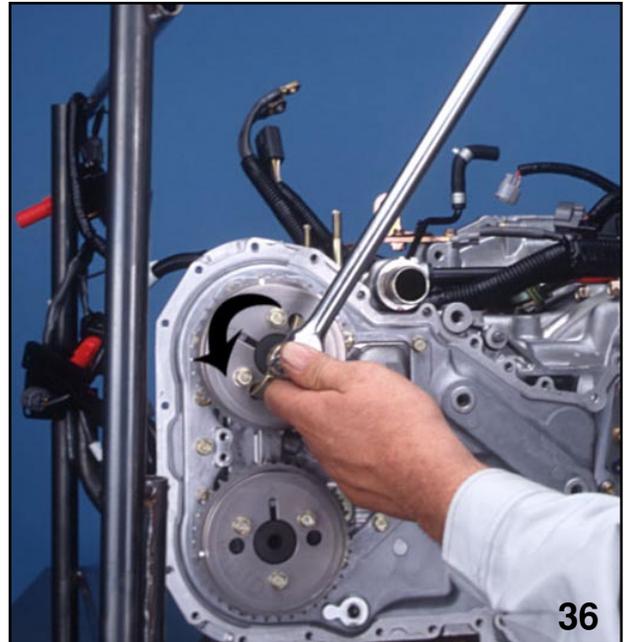
*RIGHT BANK CAMSHAFTS IN LOADED POSITION*

The left bank is currently unloaded. The right bank is loaded and must be unloaded using the procedure depicted on next page.

## Unloading Cam Sprockets



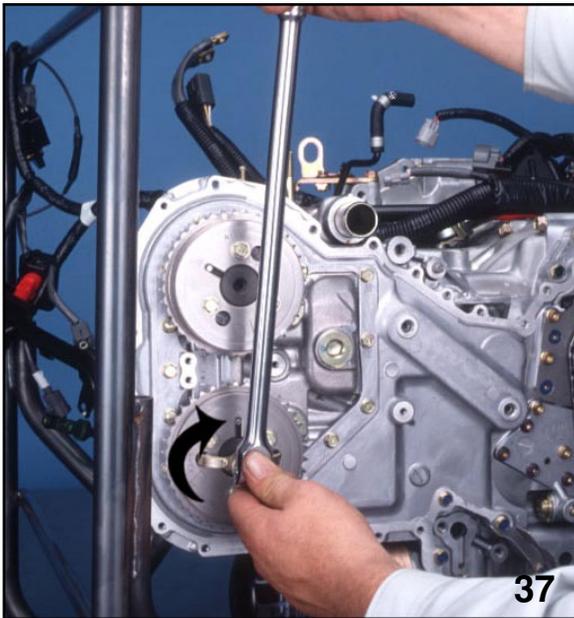
*UNLOADING INTAKE CAMSHAFT*



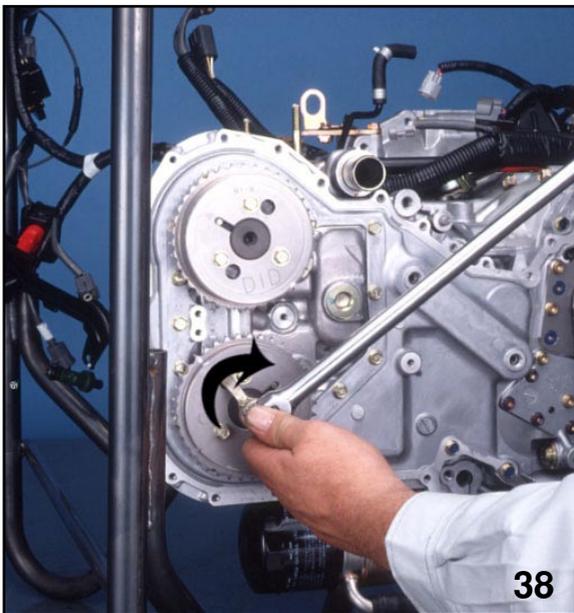
*UNLOADING INTAKE CAMSHAFT*

Position the Camshaft sprocket wrench on the right bank intake sprocket and turn 90 degrees counter clockwise.

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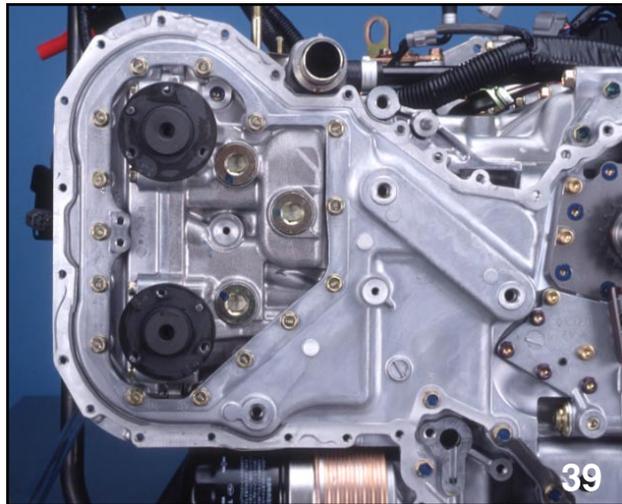


*UNLOADING EXHAUST CAMSHAFT*

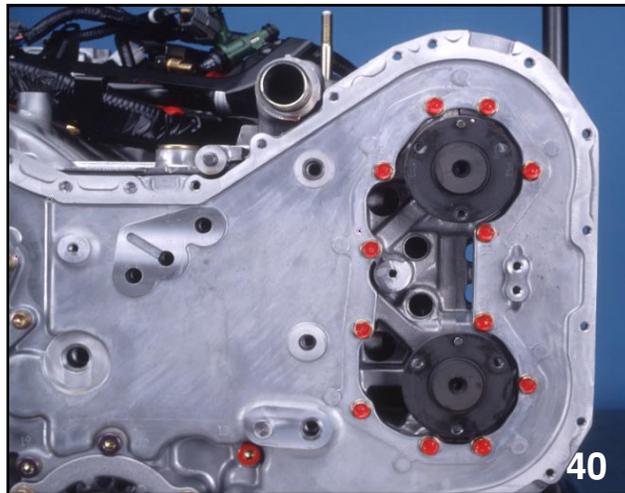


*UNLOADING EXHAUST CAMSHAFT*

Position the Camshaft sprocket wrench on the right bank exhaust sprocket and turn 90 degrees clockwise. Both Camshafts are now unloaded.



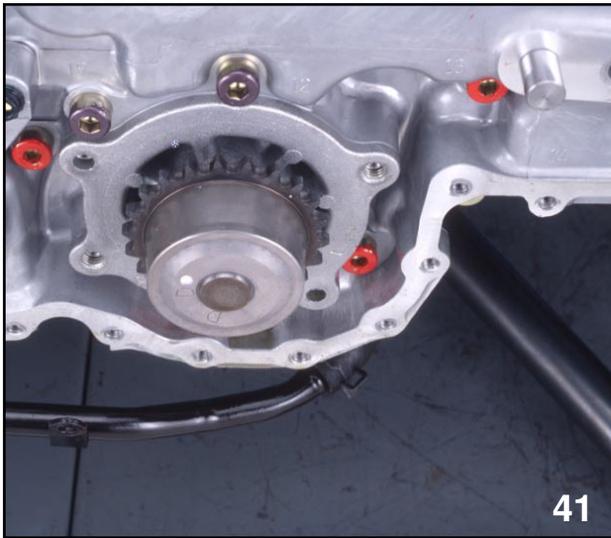
*REMOVE CAMSHAFT SPROCKETS (RIGHT BANK)*



*REMOVE CAMSHAFT SPROCKETS (LEFT BANK)*

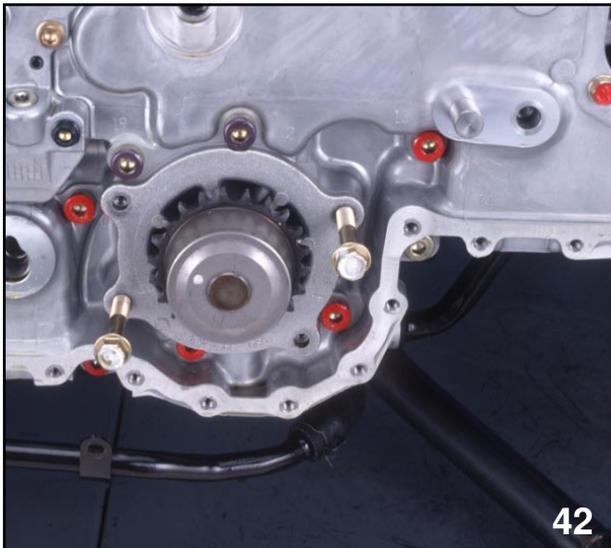
Remove both the intake and exhaust Camshaft sprockets on the left and right banks.

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*WATER PUMP ASSEMBLY*

Remove the bolts from the water pump.

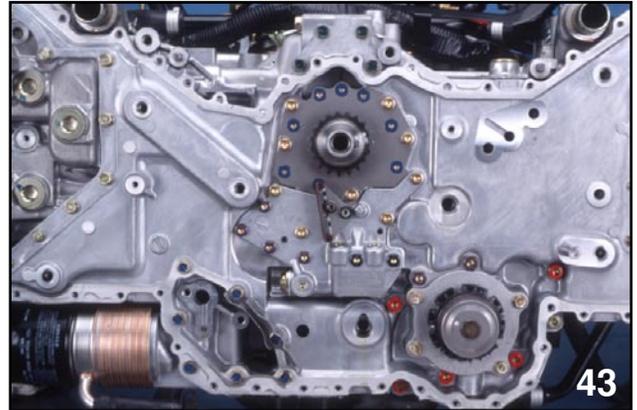


*INSERT BOLTS FOR PUMP REMOVAL*

Thread two eight millimeter bolts as shown and equally turn them in. This will assist with the removal of the pump.

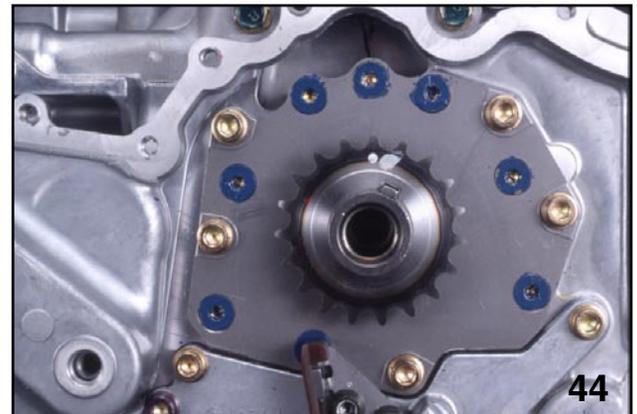
Remove the o-ring that seals the water pump to the inner cover.

## Removal of Oil Pump



*OIL PUMP COVER*

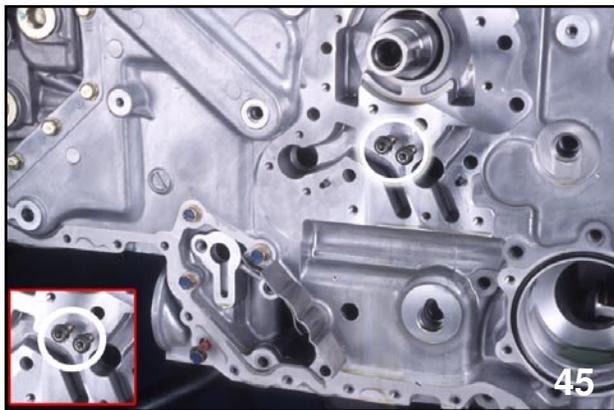
Remove the Oil Pump cover and Oil Pump gears.



*CHAIN GUIDE*

**NOTE: THE CHAIN GUIDE MUST BE REMOVED BEFORE REMOVING THE OIL PUMP COVER.**

# 6 Cylinder Boxer Engines Series (104-H6)



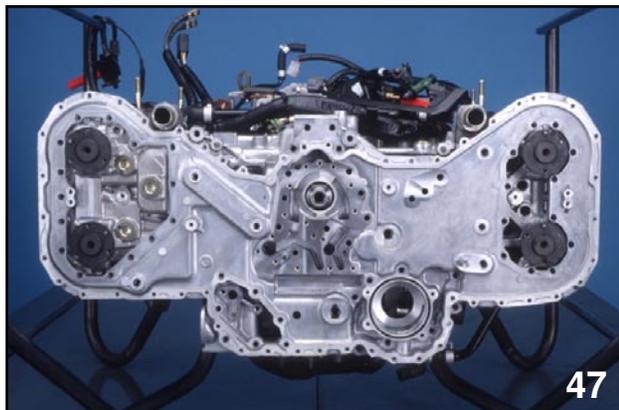
*CHAIN GUIDE BOLTS*

The two bolts that secure the chain guide at the crankshaft pulley are pretreated with Loctite. (See insert)



*OIL RELIEF VALVE HOUSING*

Remove the relief valve housing bolts and housing.



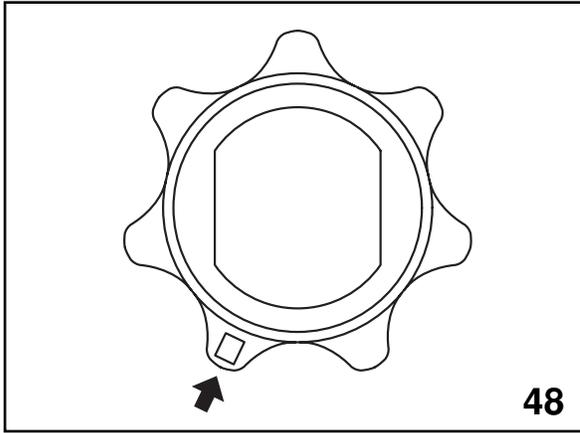
*INNER COVER*

**NOTE: PLEASE FOLLOW PROPER SEQUENCE.**

Remove the 46 bolts that secure the inner chain cover to the engine block. The numbers are embossed on the cover and must be removed in reverse order. (Start at bolt 46)

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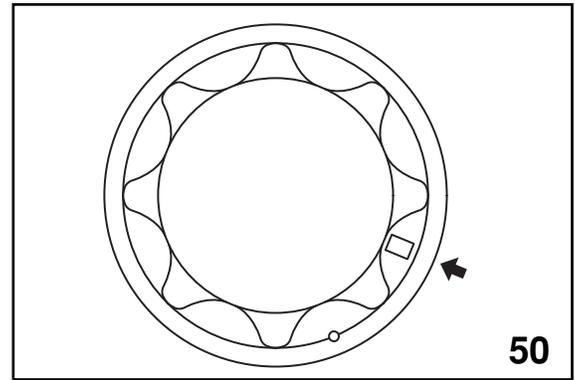
The Oil Pump inner and outer rotors are selective. The inner timing chain cover which serves as the Oil Pump housing, is also selective. When changing these selective parts due to wear or clearance conditions always use parts with the same identification mark.



INNER ROTOR

| Inner rotor    |            |  |
|----------------|------------|--|
| Classification | Parts      | Rotor thickness mm (in)                |
| A              | 15015AA250 | 12.993 - 13.006<br>(0.51153 - 0.51205) |
| None           | 15015AA300 | 12.980 - 12.993<br>(0.51102 - 0.51153) |
| C              | 15015AA310 | 12.967 - 12.980<br>(0.51051 - 0.51102) |

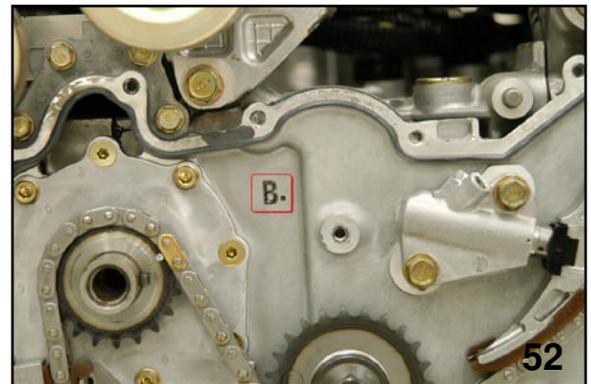
INNER ROTOR CHART



OUTER ROTOR

| Outer rotor    |            |  |
|----------------|------------|--|
| Classification | Parts      | Rotor thickness mm (in)                |
| A              | 15016AA250 | 12.993 - 13.006<br>(0.51153 - 0.51205) |
| None           | 15016AA300 | 12.980 - 12.993<br>(0.51102 - 0.51153) |
| C              | 15016AA310 | 12.967 - 12.980<br>(0.51051 - 0.51102) |

OUTER ROTOR CHART



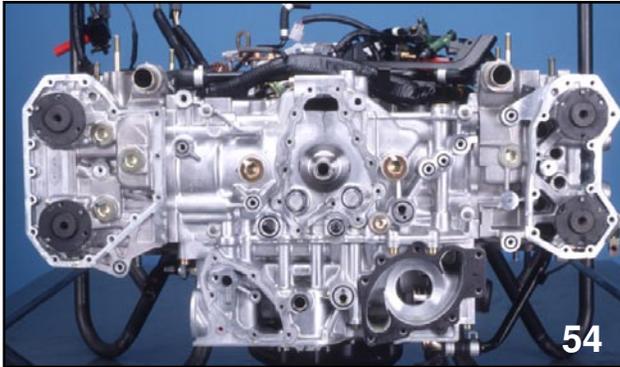
INNER TIMING CHAIN COVER

| Rear chain cover |            |  |
|------------------|------------|--|
| Classification   | Parts      | Rotor thickness mm (in)                |
| A                | 13119AA020 | 13.026 - 13.039<br>(0.51295 - 0.51335) |
| B                | 13119AA050 | 13.013 - 13.026<br>(0.51232 - 0.51284) |
| C                | 13119AA060 | 13.000 - 13.013<br>(0.51181 - 0.51232) |

REAR CHAIN COVER CHART

# 6 Cylinder Boxer Engines Series (104-H6)

## O-Ring Placement Inner Cover



*O-RING LOCATIONS*

Remove the inner cover and observe the location of the o-rings. There are fifteen (15) in total.

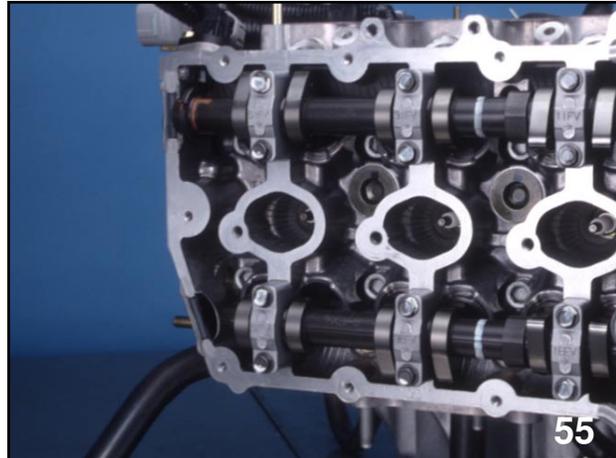
Care must be taken to ensure proper installation of all seals.

There are 6 different length bolts in this area so use care to keep them organized. Your 6 cylinder Service Manual Supplement illustrates correct order and size of the bolts.

**NOTE: COLOR OF RINGS ARE DIFFERENT FROM PREVIOUS MODELS OBSERVE PROPER PLACEMENT.**

**NOTE: THE PAPER-TYPE WATER PUMP GASKET.**

## Removal of Cylinder Head



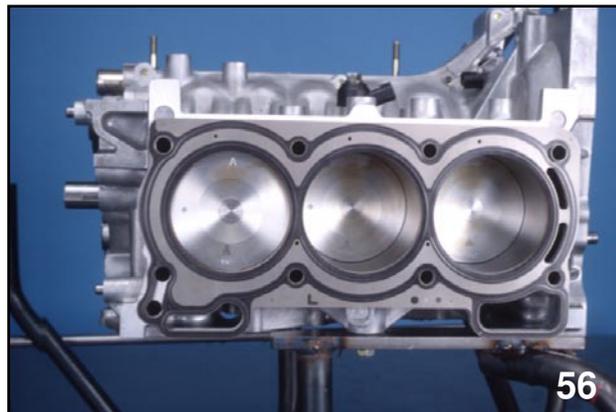
*VALVE TRAIN ASSEMBLY*

**NOTE: PLEASE FOLLOW THE PROPER SEQUENCE. ALSO NOTE THEY ARE HEX DESIGN BOLTS.**

Remove the cylinder head bolts. Use care to prevent rubbing the hex socket on the Camshafts during removal.

Remove the cylinder head and gasket.

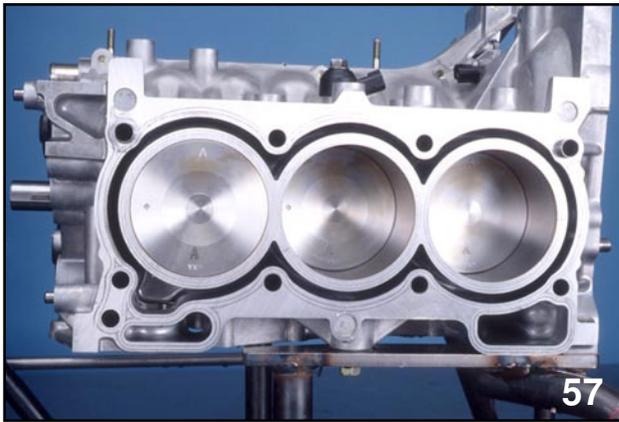
Repeat this procedure on the opposite side.



*CYLINDER BLOCK WITH HEAD GASKET*

The cylinder block is made from aluminum die casting with monoblock casting cast iron cylinder liners. Water jackets are independent for the RH and LH block halves.

# 6 Cylinder Boxer Engines Series (104-H6)



*OPEN DECK DESIGN*

The block utilizes open deck design.

## Removal of Oil Pan

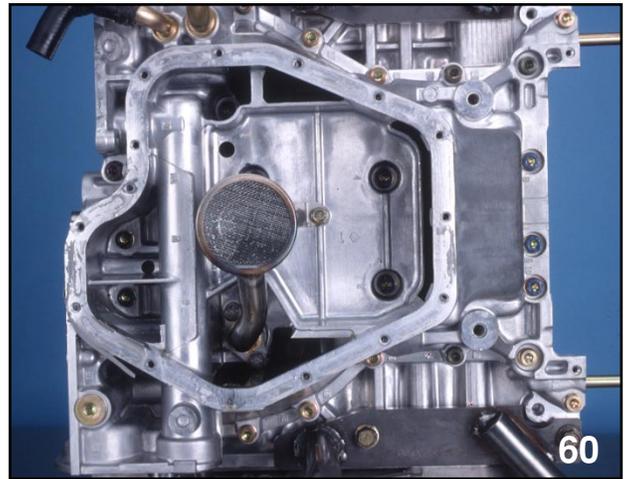


*OIL PAN (LOWER)*



*OIL PAN (UPPER)*

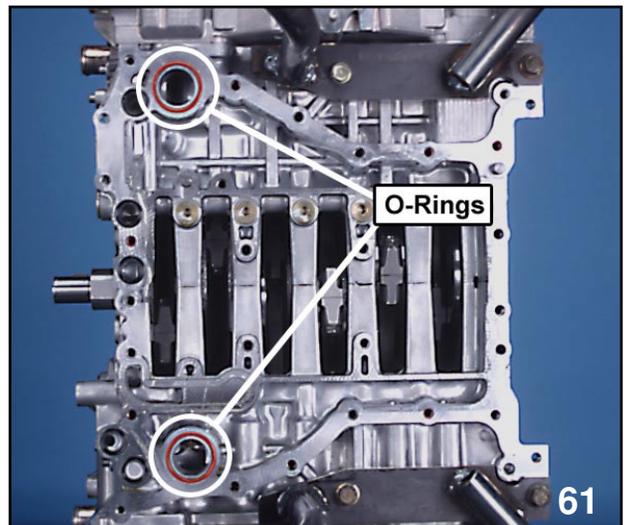
Remove the Oil Pan bolts and Oil Pan. Observe that the Oil Pan has a different design from 4 cylinder Subaru engines.



*OIL PAN BOLT LOCATIONS*

## NOTE: PLACEMENT OF BOLTS.

Remove the Oil Pan extension housing bolts. There are 28 bolts with five different lengths. Follow the proper sequence to prevent warping the case.

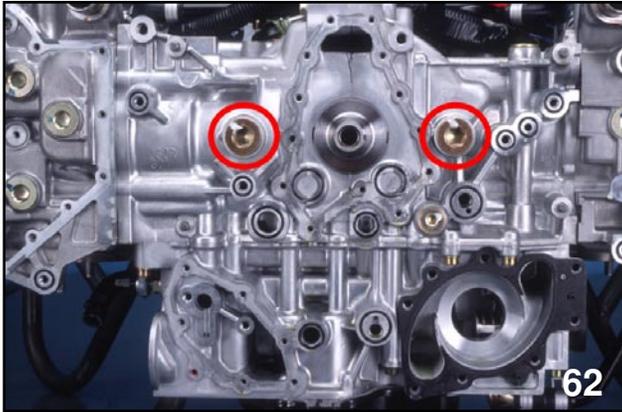


*BLOCK O-RING LOCATIONS*

## NOTE: CONFIRM PLACEMENT OF O-RINGS

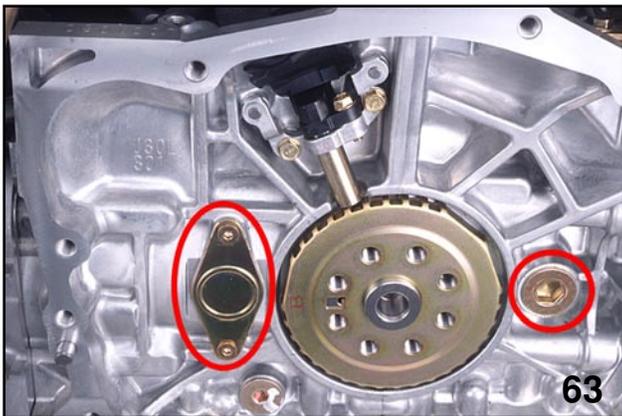
# 6 Cylinder Boxer Engines Series (104-H6)

## Piston Pin Access



*PISTON PIN ACCESS (FRONT VIEW)*

The piston pin access is gained from the front at these two positions.

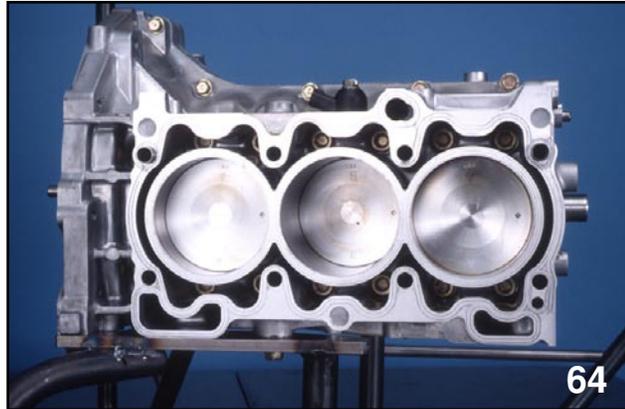


*PISTON PIN ACCESS (REAR VIEW)*

Rear piston pin access is gained at these two points.

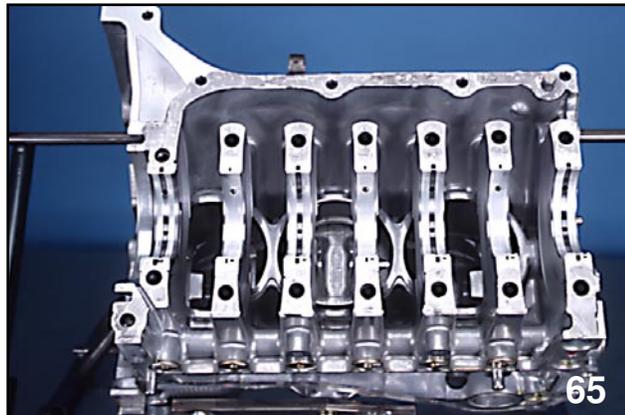
Remove the piston pins and organize them for assembly to their original positions.

## Splitting Block Halves

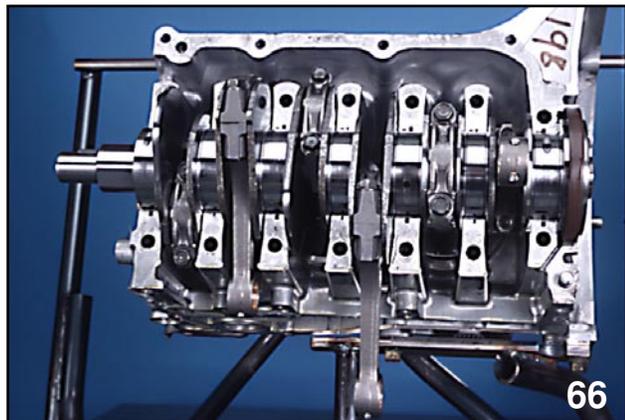


*ENGINE BLOCK ASSEMBLY BOLTS (RIGHT BANK)*

The engine block halves are bolted together with 19 bolts. They are all located on the right bank of the engine. Remove the bolts in the proper sequence and split the engine block.



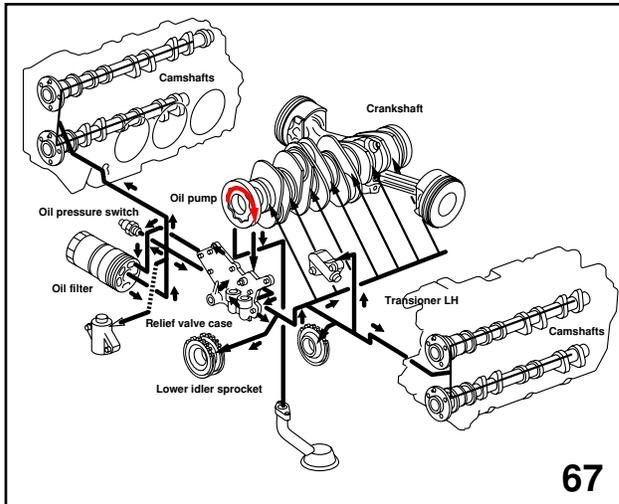
*MAIN BEARINGS*



*CRANKSHAFT AND CONNECTING RODS*

# 6 Cylinder Boxer Engines Series (104-H6)

## Lubrication System



### OIL FLOW

Oil is drawn from the Oil Pan to the trochoid Oil Pump and on to the following:

- Oil cooler and filter
- Relief valve case. (Oil pressure is regulated and oil is supplied to the oil jet that lubricates the timing chain)
- Right bank cylinder head
- Crank shaft
- Timing chain components
- Left bank cylinder head

**NOTE: FOR FURTHER INFORMATION CONSULT THE LUBRICATION (LU) SECTION OF THE 6 CYLINDER SUPPLEMENT.**



PUMP GEARS (FRONT SIDE)



PUMP GEARS (BACK SIDE)



RELIEF VALVE CASE (FRONT SIDE)



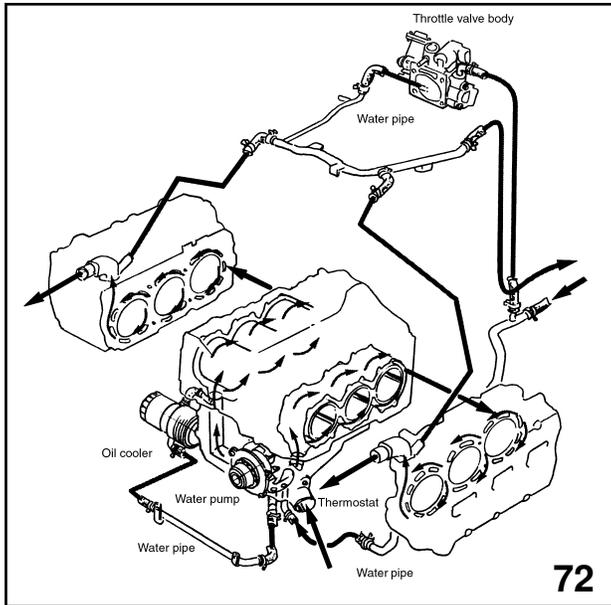
RELIEF VALVE CASE (BACK SIDE)

A new gasket must be used upon installation.

**NOTE: THE SCREEN OR FILTER IN GASKET. CONFIRM THAT IT IS NOT RESTRICTED.**

# 6 Cylinder Boxer Engines Series (104-H6)

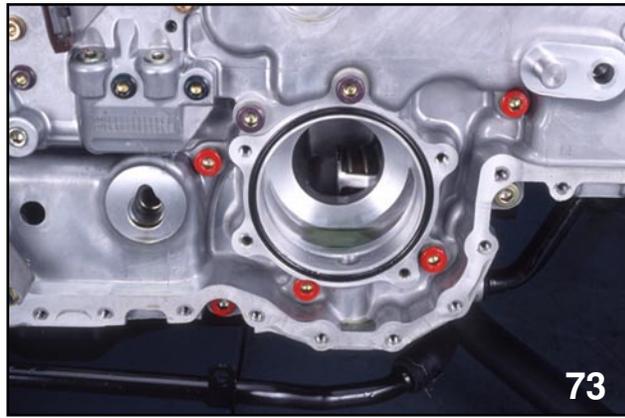
## Coolant System



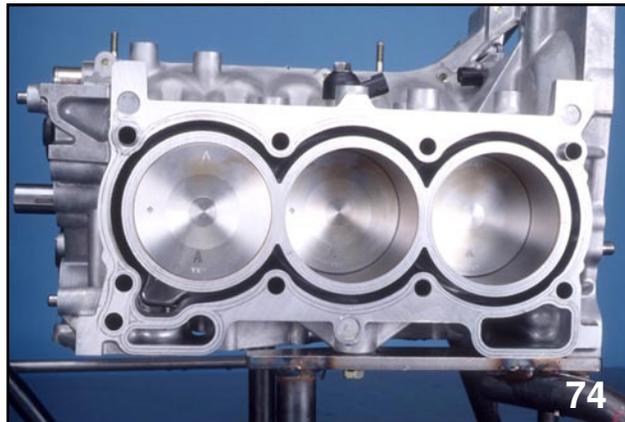
*COOLANT FLOW*

The coolant flow begins at the lower radiator hose and continues to the following:

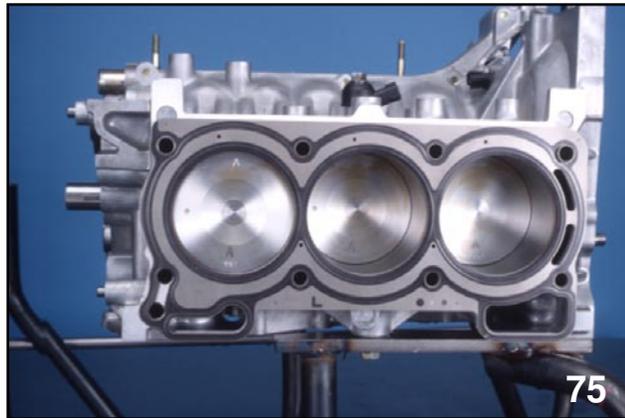
- Thermostat
- Water pump
- Internal block passages that carry coolant through the front of the block halves continuing on to the rear of the block halves.
- From around the rear cylinders of the block halves to the head gasket of the rear cylinders. A passage in the head gasket allows coolant to the cylinder heads.
- Around the cylinder heads to the upper radiator hose connections.



*WATER PUMP HOUSING*



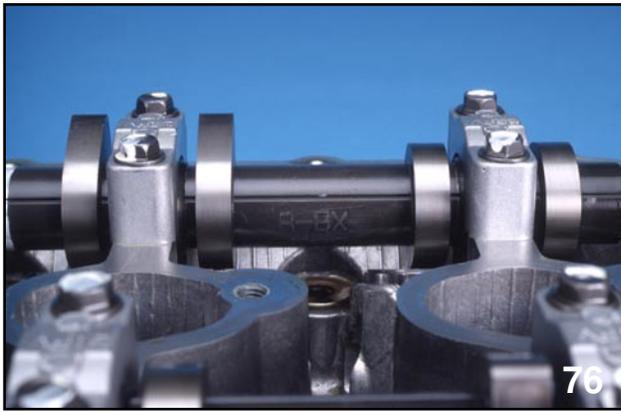
*WATER JACKETS (LEFT BANK)*



*HEAD GASKET COOLANT PASSAGES*

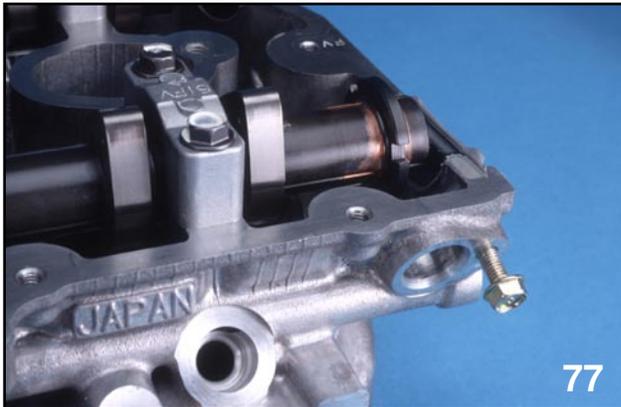
**NOTE: FOR FURTHER INFORMATION, CONSULT THE COOLING SECTION (CO) OF THE 2001 LEGACY AND OUTBACK 6 CYLINDER SUPPLEMENT.**

# 6 Cylinder Boxer Engines Series (104-H6)



*SINTERED CAMSHAFT LOBES*

The Camshafts are composed of carbon steel pipes with Sintered metal lobes. During construction, the lobes are positioned on the pipe using a sintered metal paste. The Camshafts are then baked until the paste is hardened. The lobes of the Camshafts are offset by 1 millimeter to rotate the Camshaft bucket and shim which will reduce wear.



*CAMSHAFT SENSOR RELUCTOR*

The right bank intake Camshaft has a reluctor built onto the end. The new Camshaft sensor uses this reluctor to help determine injection and ignition timing.

## Valve Adjustment



*VALVE ADJUSTMENT TOOL*

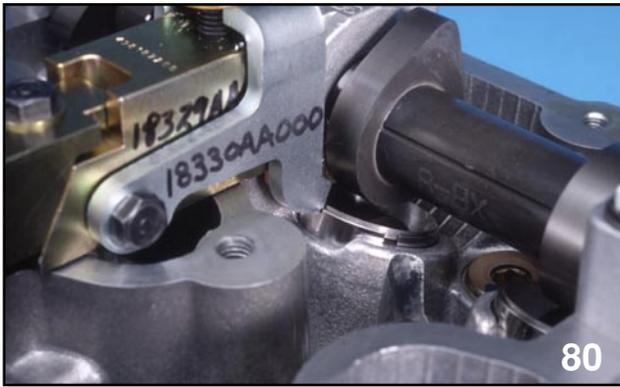
The valve adjustment procedure is the same as other DOHC Subaru engines however a new tool has been designed to work specifically on the EZ-3.0 Engine.



*VALVE ADJUSTMENT TOOL PLACEMENT*

The tool is wedge fitted into place over the two shims requiring removal.

# 6 Cylinder Boxer Engines Series (104-H6)



*ADJUSTING BUCKET DEPRESSION FINGER*

Some adjustment will be required to properly seat the bucket depression finger. Turning the top bolt pushes the fingers down allowing room for the shim to be removed.

## Chain Tensioners



*CHAIN TENSIONERS (LEFT AND RIGHT BANK)*

The chain tensioners are fed oil pressure from the engine oiling system. The supplied pressure combined with spring tension keeps the timing chains operating at the correct tension.

**NOTE: LEFT BANK AND RIGHT BANK TENSIONERS ARE NOT INTER-CHANGEABLE.**



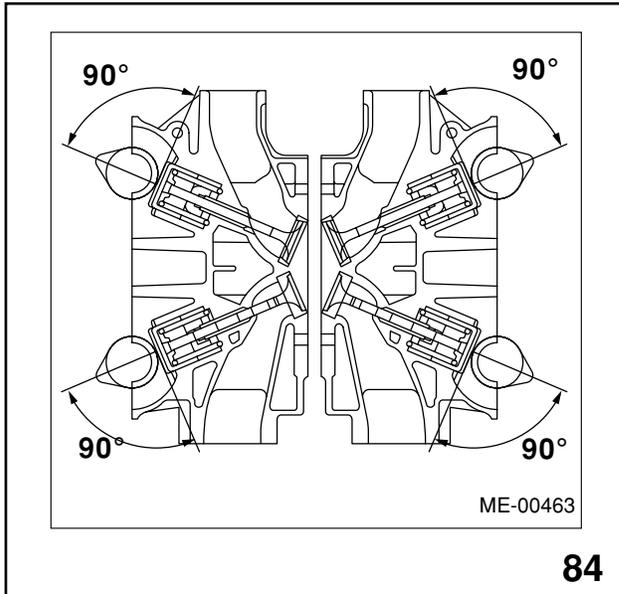
*WORM GEAR ASSEMBLY*

The worm gear assemble and spring tension keep tension on the chains with the engine off, eliminating any tension problems that could occur during engine start up.

The tensioners are turned in by hand for reassembly. Observe the order of the worm gear assemble. Make sure your hands are dry when depressing the tensioners. A rivet or large paper clip will hold tensioner in place. Do not use a press to depress tensioner.

# 6 Cylinder Boxer Engines Series (104-H6)

## 3.0 Liter Valve Clearance Adjustment- 2001~2004



VALVE ARRANGEMENT

1. Measure intake valve and exhaust valve clearances by using thickness gauge (A).

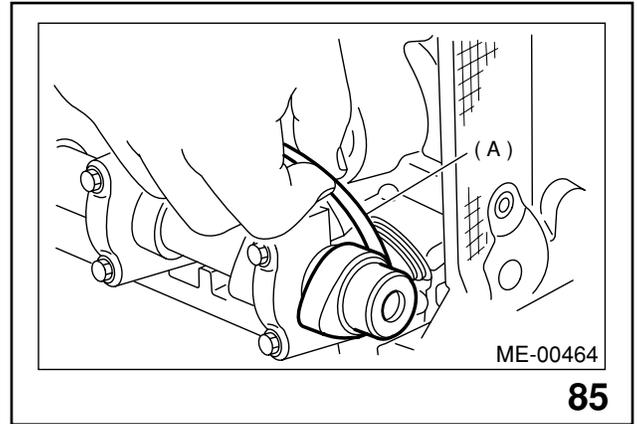
**CAUTION:** INSERT THE THICKNESS GAUGE IN AS HORIZONTAL A DIRECTION AS POSSIBLE WITH RESPECT TO THE SHIM.

### Valve clearance:

**INTAKE:** 0.20 +0.04/0.06 MM (0.0079 +0.0016/0.0024 IN)

**EXHAUST:** 0.25 0.05 MM (0.0098 0.0020 IN)

**NOTE:** IF THE MEASURED VALUE IS NOT WITHIN SPECIFICATION, TAKE NOTES OF THE VALUE IN ORDER TO ADJUST THE VALVE CLEARANCE LATER ON.



MEASURING VALVE CLEARANCE

2. If necessary, adjust the valve clearance. <Ref. to ME(H6DO), ADJUSTMENT, Valve Clearance.>
3. Further turn crankshaft pulley clockwise. Using the same procedure described previously, then measure valve clearances again.
4. After inspection, install the related parts in the reverse order of removal.

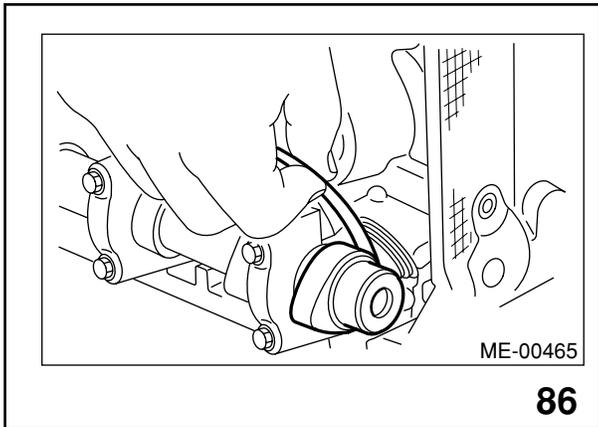
### Adjustment

**CAUTION:** ADJUSTMENT OF VALVE CLEARANCE SHOULD BE PERFORMED WHILE ENGINE IS COLD.

1. Measure all valve clearances. <Ref. to ME(H6D0), INSPECTION, Valve clearance.>

**NOTE:** RECORD EACH VALVE CLEARANCE AFTER IT HAS BEEN MEASURED.

# 6 Cylinder Boxer Engines Series (104-H6)



MEASURING VALVE CLEARANCE

2. Remove shim from valve lifter.

(1) Prepare the ST.

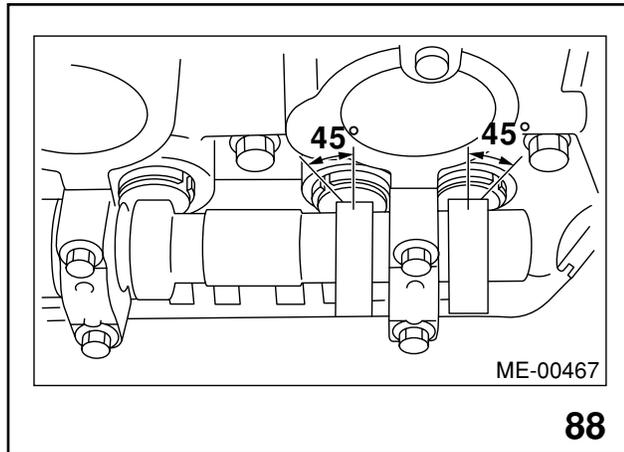
ST 18329AA000 SHIM REPLACER

<Ref. to ME(H6D0), PREPARATION  
TOOL, General Description.>



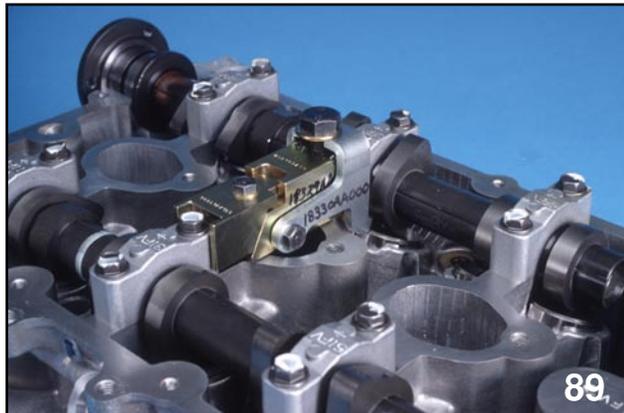
VALVE ADJUSTMENT TOOL

(2) Rotate the notch of the valve lifter  
outward by 45°.



SHIM REPLACER NOTCH

(3) Adjust SHIM REPLACER notch to  
valve lifter and set it.



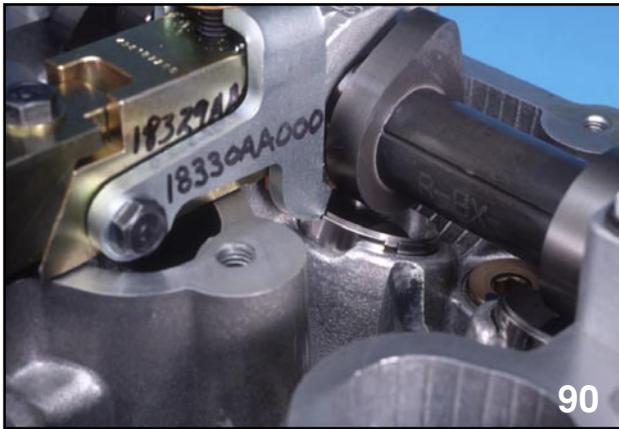
VALVE ADJUSTMENT TOOL PLACEMENT

**NOTE: WHEN SETTING, BE CAREFUL  
SHIM REPLACER EDGE DOES  
NOT TOUCH SHIM.**

(4) Tighten bolt (A) and install it to the  
cylinder head.

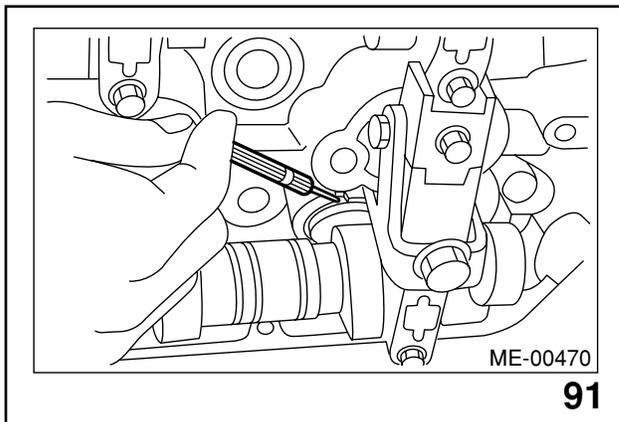
(5) Tighten bolt (B) and insert the valve  
lifter.

# 6 Cylinder Boxer Engines Series (104-H6)



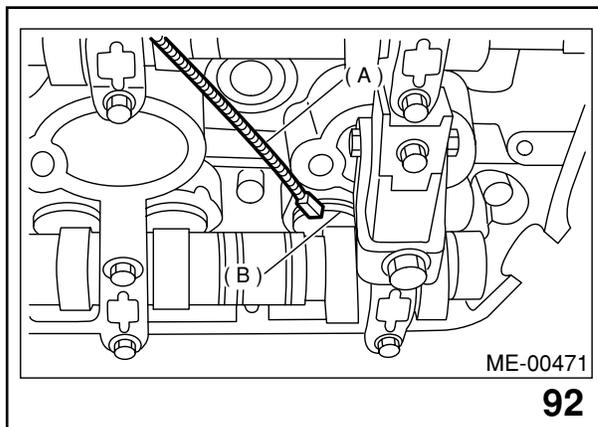
*ADJUSTING BUCKET DEPRESSION FINGER*

- (6) Insert tweezers into the notch of the valve lifter, and take the shim out.

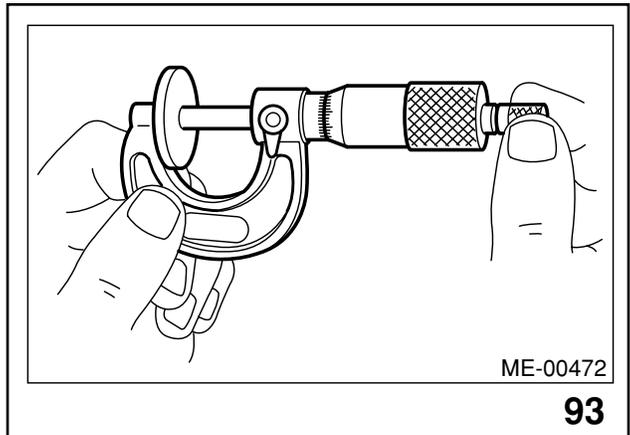


*USE OF MAGNET*

**NOTE: BY USING A MAGNET (A), THE SHIM (B) CAN BE TAKEN OUT WITHOUT DROPPING IT.**



*SHIM PLACEMENT*



*MICROMETER*

3. Measure thickness of shim with micrometer.
4. Select a shim of suitable thickness using measured valve clearance and shim thickness, by referring to the following table.
5. Set suitable shim selected in step 4 to valve lifter.

| Unit: mm                            |
|-------------------------------------|
| Intake valve: $S = (V + T) - 0.20$  |
| Exhaust valve: $S = (V + T) - 0.25$ |
| S: Shim thickness to be used        |
| V: Measured valve clearance         |
| T: Shim thickness required          |

# 6 Cylinder Boxer Engines Series (104-H6)

| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13218AK010 | 2.00 (0.0787)     |
| 13218AK020 | 2.02 (0.0795)     |
| 13218AK030 | 2.04 (0.0803)     |
| 13218AK040 | 2.06 (0.0811)     |
| 13218AK050 | 2.08 (0.0819)     |
| 13218AK060 | 2.10 (0.0827)     |
| 13218AK070 | 2.12 (0.0835)     |
| 13218AK080 | 2.14 (0.0843)     |
| 13218AK090 | 2.16 (0.0850)     |
| 13218AK100 | 2.18 (0.0858)     |
| 13218AK110 | 2.20 (0.0866)     |
| 13218AE710 | 2.22 (0.0874)     |
| 13218AE720 | 2.23 (0.0878)     |
| 13218AE730 | 2.24 (0.0882)     |
| 13218AE740 | 2.25 (0.0886)     |
| 13218AE750 | 2.26 (0.0890)     |
| 13218AE760 | 2.27 (0.0894)     |
| 13218AE770 | 2.28 (0.0898)     |
| 13218AE780 | 2.29 (0.0902)     |
| 13218AE790 | 2.30 (0.0906)     |
| 13218AE800 | 2.31 (0.0909)     |
| 13218AE810 | 2.32 (0.0913)     |
| 13218AE820 | 2.33 (0.0917)     |
| 13218AE830 | 2.34 (0.0921)     |
| 13218AE840 | 2.35 (0.0925)     |
| 13218AE850 | 2.36 (0.0929)     |
| 13218AE860 | 2.37 (0.0933)     |
| 13218AE870 | 2.38 (0.0937)     |
| 13218AE880 | 2.39 (0.0941)     |
| 13218AE890 | 2.40 (0.0945)     |
| 13218AE900 | 2.41 (0.0949)     |
| 13218AE910 | 2.42 (0.0953)     |
| 13218AE920 | 2.43 (0.0957)     |
| 13218AE930 | 2.44 (0.0961)     |
| 13218AE940 | 2.45 (0.0965)     |
| 13218AE950 | 2.46 (0.0969)     |
| 13218AE960 | 2.47 (0.0972)     |
| 13218AE970 | 2.48 (0.0976)     |

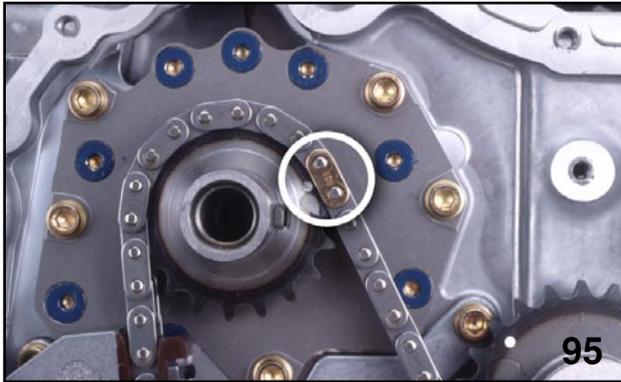
| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13218AE980 | 2.49 (0.0980)     |
| 13218AE990 | 2.50 (0.0984)     |
| 13218AF000 | 2.51 (0.0988)     |
| 13218AF010 | 2.52 (0.0992)     |
| 13218AF020 | 2.53 (0.0996)     |
| 13218AF030 | 2.54 (0.1000)     |
| 13218AF040 | 2.55 (0.1004)     |
| 13218AF050 | 2.56 (0.1008)     |
| 13218AF060 | 2.57 (0.1012)     |
| 13218AF070 | 2.58 (0.1016)     |
| 13218AF090 | 2.60 (0.1024)     |
| 13218AF100 | 2.61 (0.1028)     |
| 13218AF110 | 2.62 (0.1031)     |
| 13218AF120 | 2.63 (0.1035)     |
| 13218AF130 | 2.64 (0.1039)     |
| 13218AF140 | 2.65 (0.1043)     |
| 13218AF150 | 2.66 (0.1047)     |
| 13218AF160 | 2.67 (0.1051)     |
| 13218AF170 | 2.68 (0.1055)     |
| 13218AF180 | 2.69 (0.1059)     |
| 13218AF190 | 2.70 (0.1063)     |
| 13218AF200 | 2.71 (0.1067)     |
| 13218AF210 | 2.72 (0.1071)     |
| 13218AF220 | 2.73 (0.1075)     |
| 13218AF230 | 2.74 (0.1079)     |
| 13218AF240 | 2.75 (0.1083)     |
| 13218AF250 | 2.76 (0.1087)     |
| 13218AF260 | 2.77 (0.1091)     |
| 13218AF270 | 2.78 (0.1094)     |
| 13218AF280 | 2.79 (0.1098)     |
| 13218AF290 | 2.80 (0.1102)     |
| 13218AF300 | 2.81 (0.1106)     |

6. Inspect all valves for clearance again at this stage. If the valve clearance is not correct, repeat the procedure over again from the first step.

7. After inspection, install the related parts in the reverse order of removal.

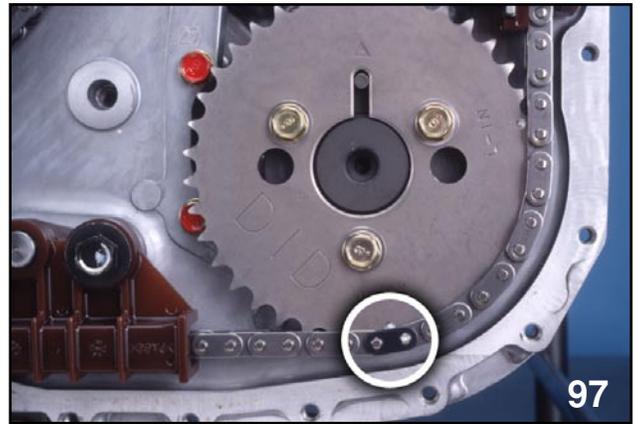
# 6 Cylinder Boxer Engines Series (104-H6)

## 3.0 Liter Engine Reassembly



*CRANKSHAFT TIMING MARK LOCATION*

Position the crankshaft sprocket to TDC. Indicated by the triangle mark. Place the chain over the water pump and lower idler sprocket.

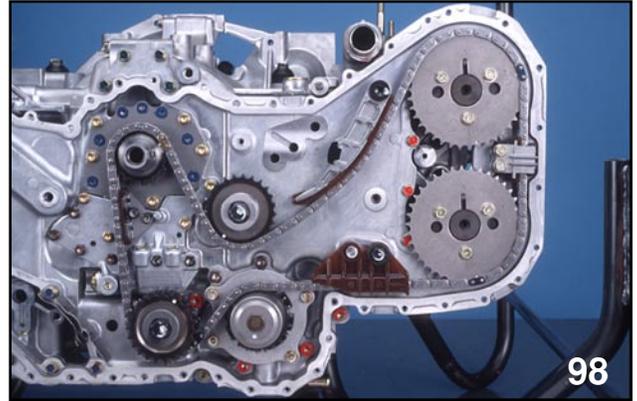


*LEFT BANK EXHAUST CAMSHAFT TIMING MARK*

Place the gold link over the small circular timing mark of the crankshaft sprocket. Ensure the keyways for the left bank Camshafts are at the 12:00 position.

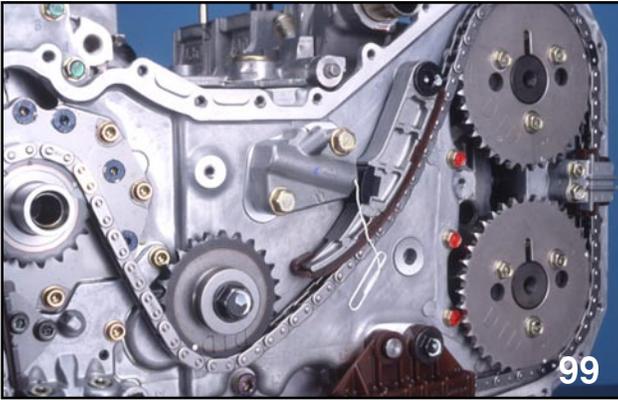


*LEFT BANK INTAKE CAMSHAFT TIMING MARK*



*MATCHING LINKS TO TIMING MARKS (LEFT BANK)*

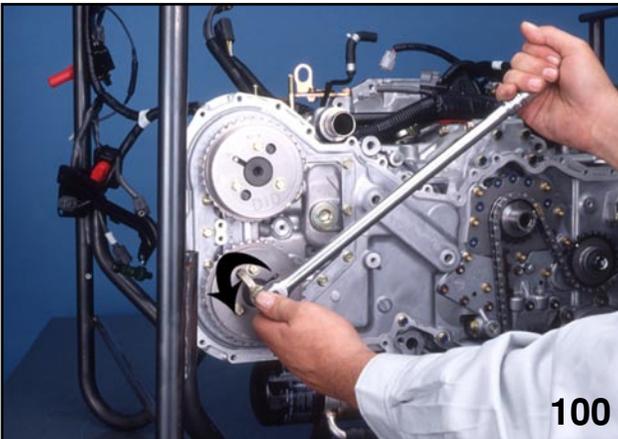
# 6 Cylinder Boxer Engines Series (104-H6)



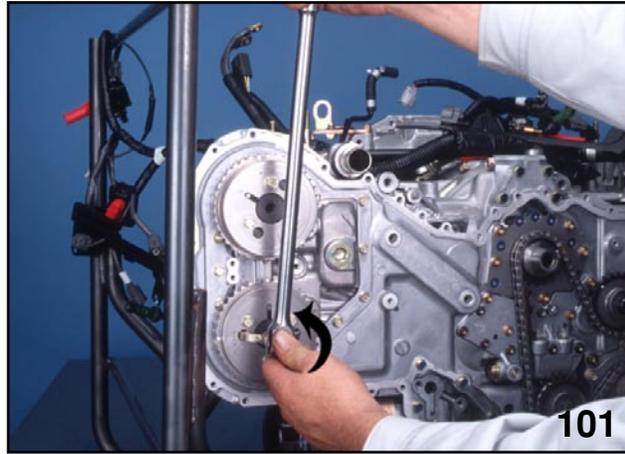
*INSTALLING GUIDES AND IDLERS (LEFT BANK)*

Place the black link over the circular timing mark of the intake sprocket and the other black link over the circular timing mark of the exhaust sprocket. Install the upper idler and chain guides. Install the chain tensioner but do not pull the pin. Confirm the timing marks once again and pull the pin.

Turn the crank shaft 90 degrees counter clockwise to prepare for installing the right bank timing chain.

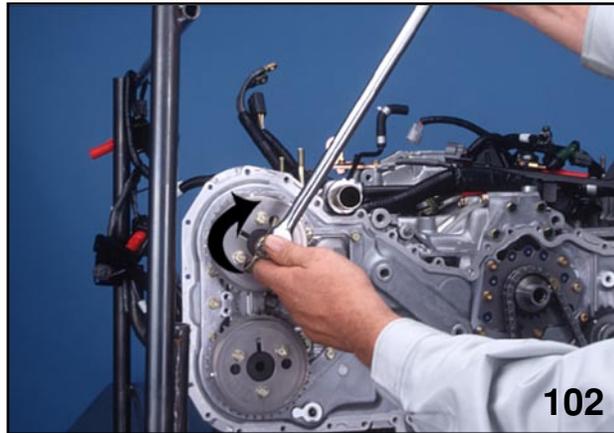


*LOADING EXHAUST CAMSHAFT (RIGHT BANK)*

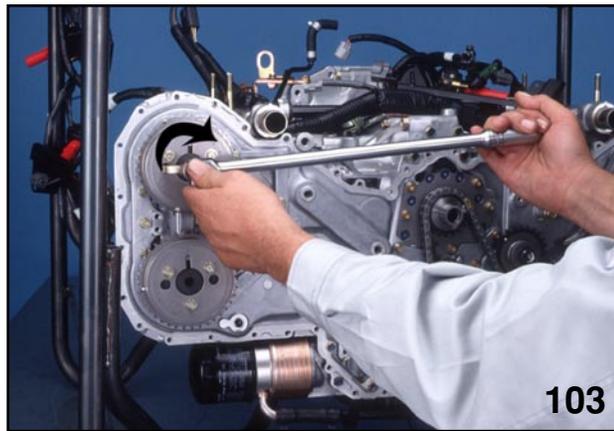


*LOADING EXHAUST CAMSHAFT (RIGHT BANK)*

Return the key way for the right bank exhaust Camshaft to 12:00 by turning the sprocket counter clockwise.



*LOADING INTAKE CAMSHAFT (RIGHT BANK)*



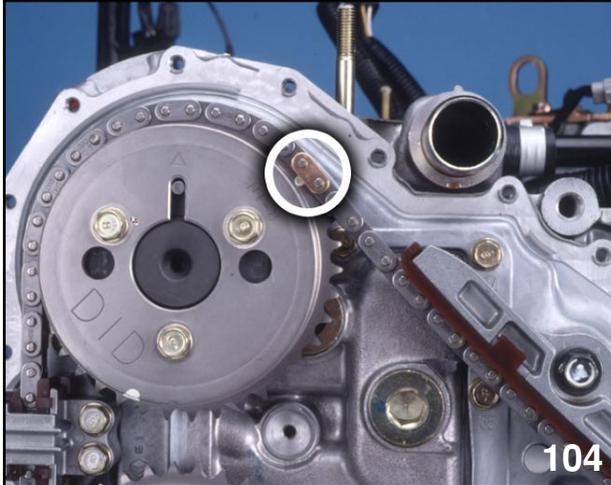
*LOADING INTAKE CAMSHAFT (RIGHT BANK)*

Return the key way for the right bank intake Camshaft to 12:00 by turning the sprocket clockwise.

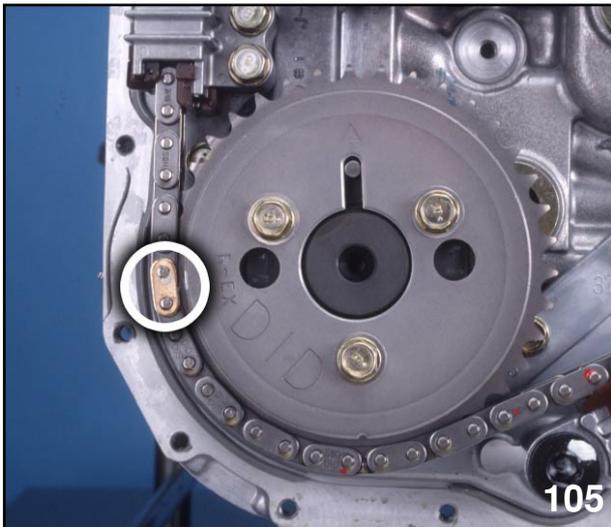
# 6 Cylinder Boxer Engines Series (104-H6)

Rotate the crankshaft 90° clockwise. This will position the left timing chain and the black link that will serve as the timing mark for the right timing chain.

Both right bank Camshaft sprockets should now be in the correct position for timing chain installation.



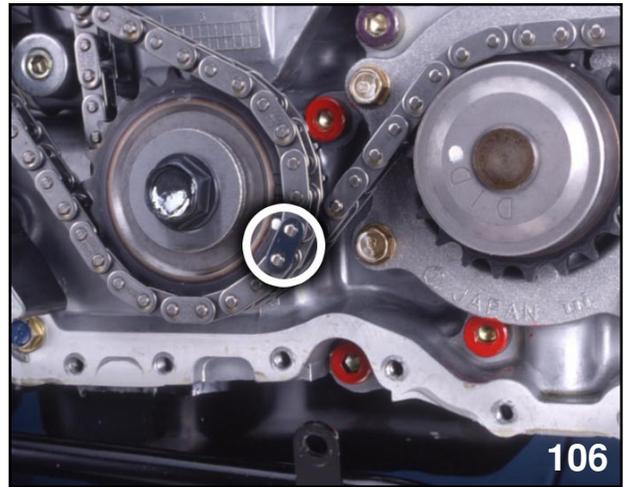
INTAKE CAMSHAFT TIMING MARKS (RIGHT BANK)



EXHAUST CAMSHAFT TIMING MARKS (RIGHT BANK)

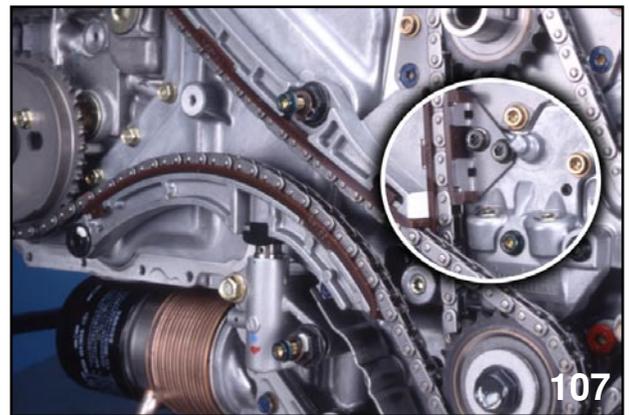
Place the lower gold link on the small circular mark of the exhaust cam sprocket and the upper gold link on the small circular timing mark of the intake Camshaft sprocket.

**NOTE: IT IS CRITICAL THAT TIMING MARKS ARE CONFIRMED TO BE CORRECT. IF THE MARKS ARE OFF MORE THAN 1 (ONE) TOOTH ON THE INTAKE OR 2 (TWO) TEETH ON THE EXHAUST, VALVE AND PISTON DAMAGE WILL OCCUR.**



LOWER IDLER TIMING MARKS

Place the black link of the right bank timing chain over the lower idler so that it indexes with the black link of the left bank chain.



CHAIN GUIDES AND IDLERS (RIGHT BANK)

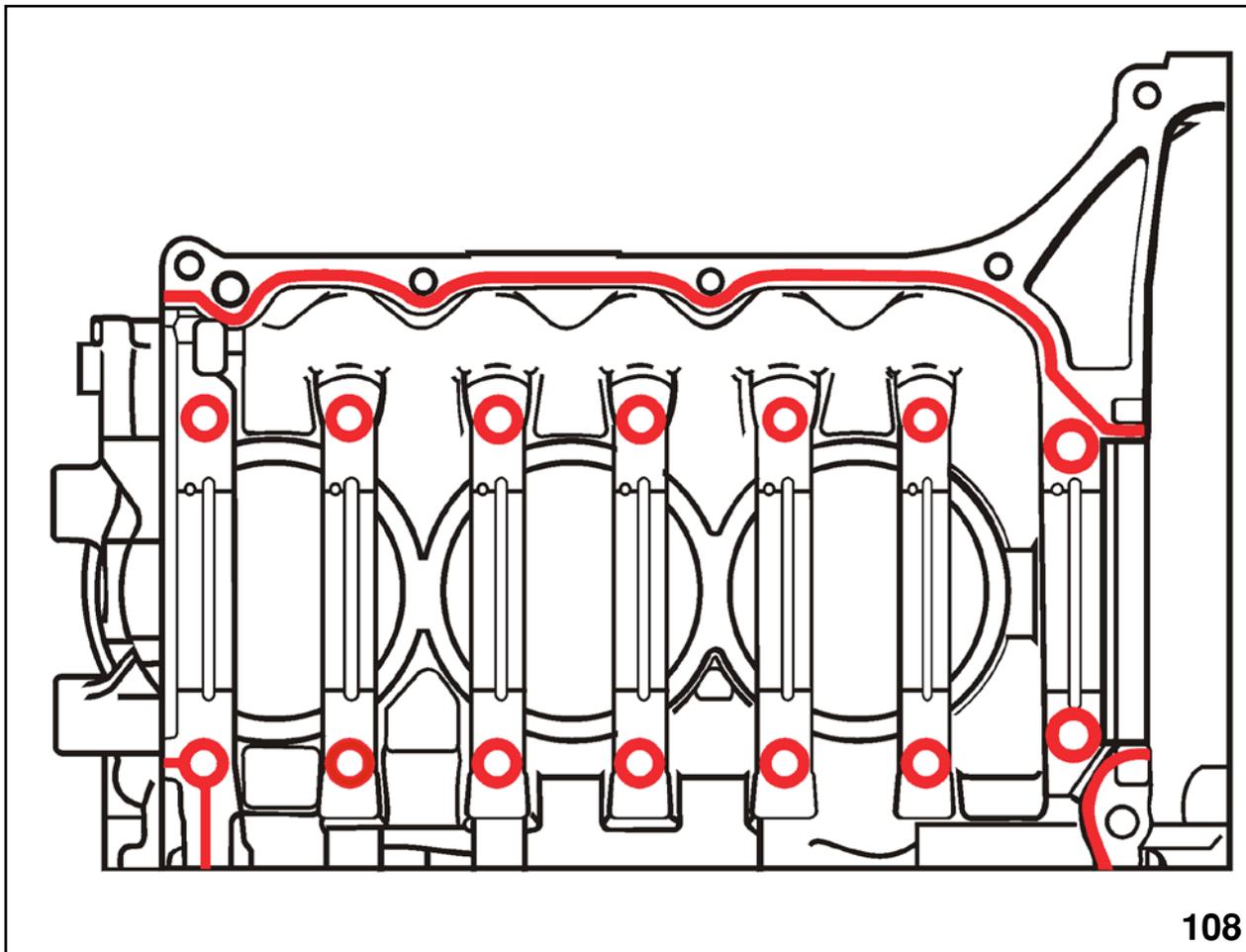
Install the timing chain guides and tensioner. Do not pull the pin. Confirm the timing marks once again and if correct pull the pin.

**NOTE: THE CHAIN GUIDE LOCATED ON THE OIL PRESSURE RELIEF HOUSING MUST BE ADJUSTED AS CIRCLED ABOVE.**

Follow procedures in the appropriate Subaru Service Manual on the STIS web site, during reassembly and for checking chain guide clearances.

# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE FOR BLOCK HALVES



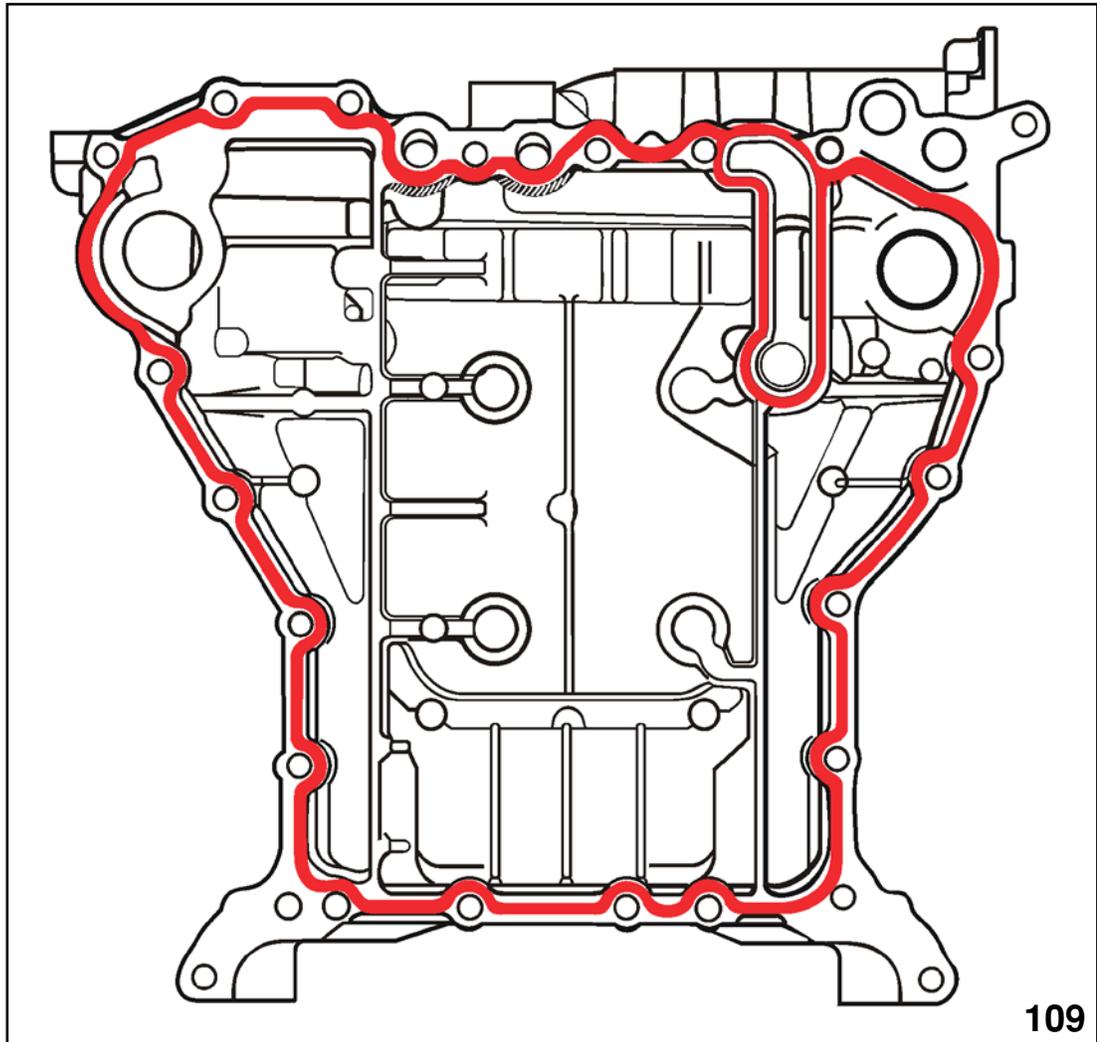
*CYLINDER BLOCK*

Refer to the Legacy and Outback 2001 Subaru Service Manual on the STIS web site 6 Cylinder Supplement.

ME (H6) 65 to 69 for proper sealing, bolt sizes and sequence. Torque to proper specifications.

# 6 Cylinder Boxer Engines Series (104-H6)

## OIL PAN EXTENSION HOUSING (UPPER OIL PAN)



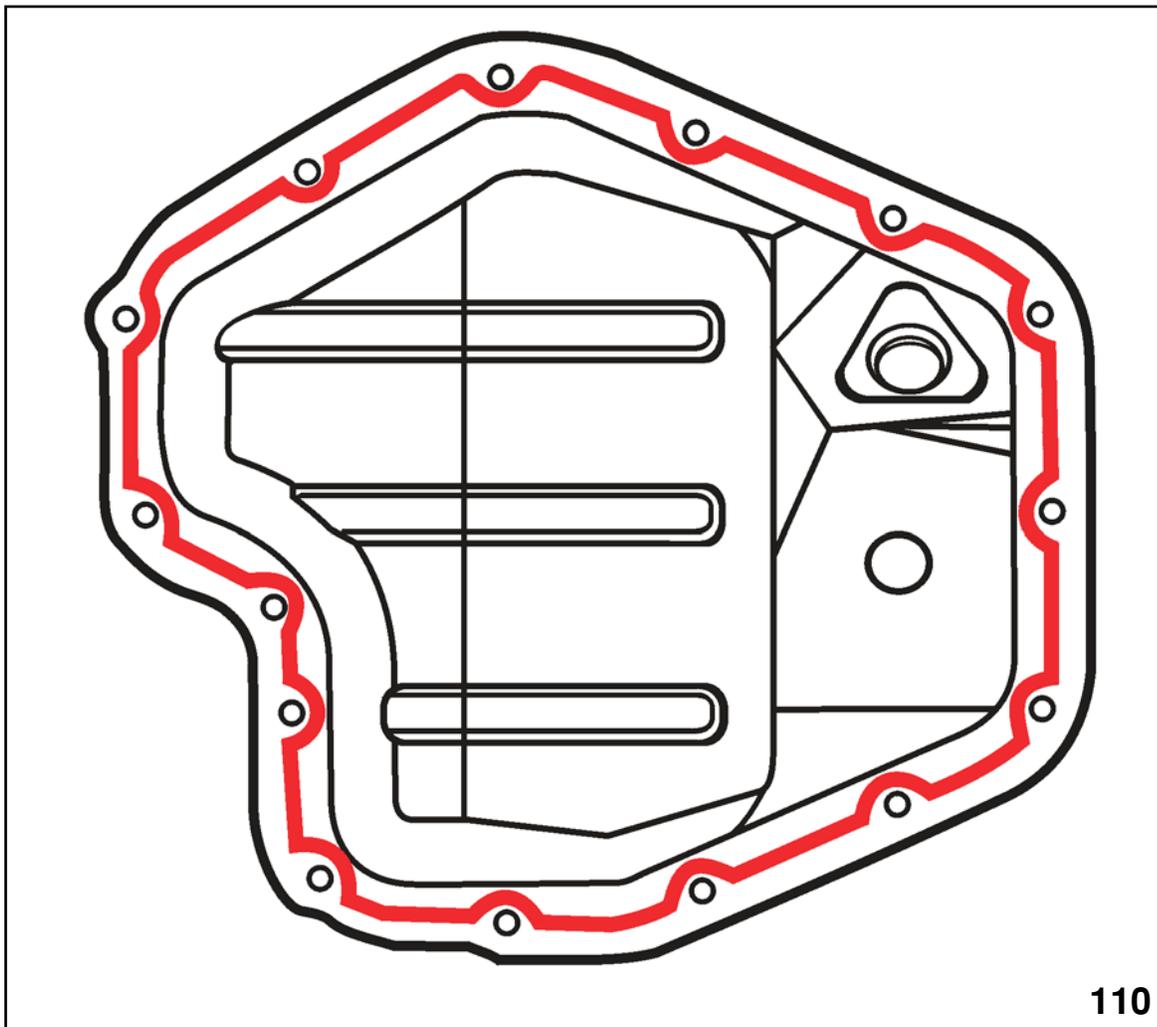
*LOWER CASE*

Refer to the Legacy and Outback 2001 Subaru Service Manual on the STIS web site 6 Cylinder Supplement.

ME (H6) 65 to 69 for proper sealing, bolt sizes and sequence. Torque to proper specifications.

# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE FOR OIL PAN (LOWER)



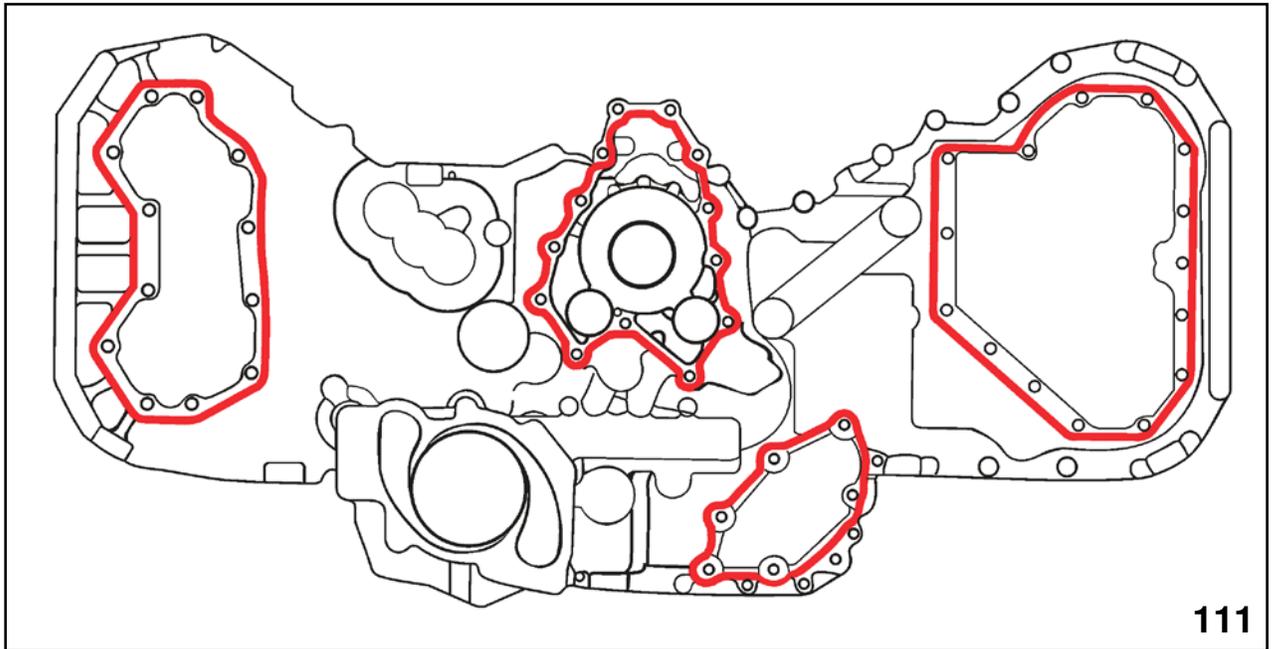
*OIL PAN*

Refer to the Legacy and Outback 2001 Subaru Service Manual on the STIS web site 6 Cylinder Supplement.

ME (H6) 65 to 69 for proper sealing, bolt sizes and sequence. Torque to proper specifications.

# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE FOR INNER COVER



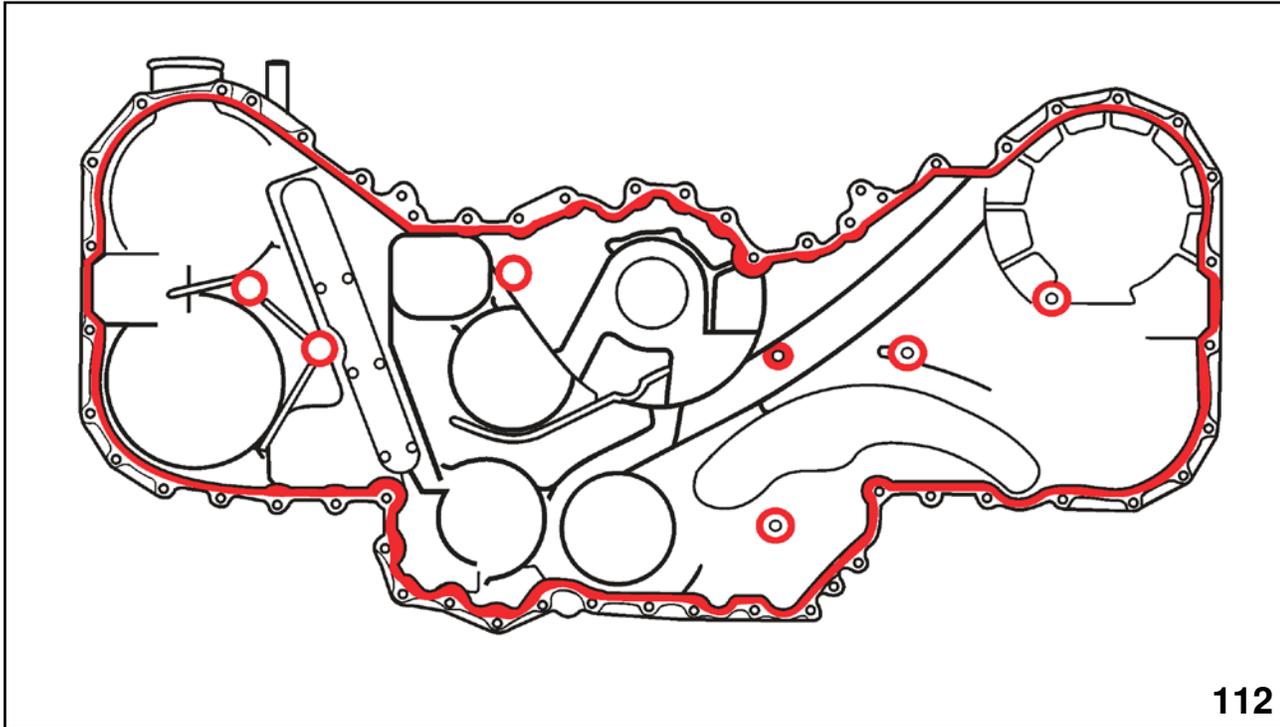
*REAR CHAIN*

Refer to the Legacy and Outback 2001 Subaru Service Manual on the STIS web site 6 Cylinder Supplement.

ME (H6) 52 for proper sealing, (including O-Ring placement) bolt sizes and sequence. Torque to proper specifications.

# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE FOR OUTER COVER (FRONT CHAIN COVER)



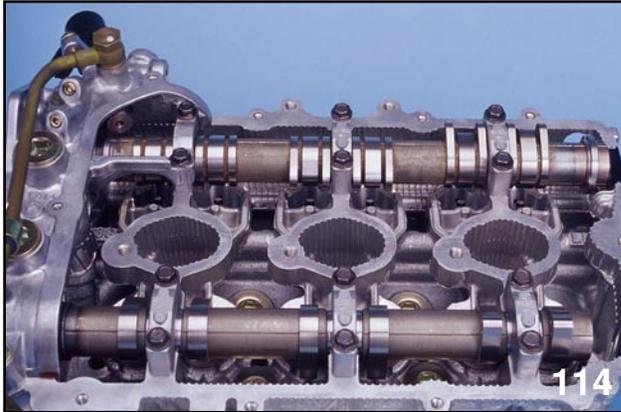
*FRONT CHAIN*

Refer to the Legacy and Outback 2001 Subaru Service Manual on the STIS web site 6 Cylinder Supplement.

ME (H6) 43 for proper sealing, bolt sizes and sequence. Torque to proper specifications.

# 6 Cylinder Boxer Engines Series (104-H6)

## 2005 Variable Valve Lift System

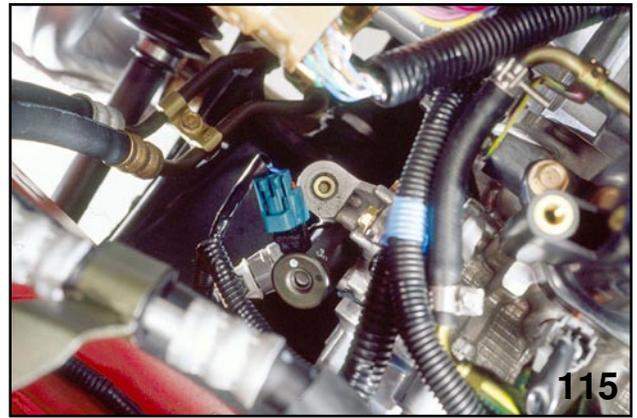


*CYLINDER HEAD*

The 3.0 Liter engine is equipped with Variable Valve Timing and Variable Valve Lift. The Variable intake control has been replaced with a high efficiency composite resin intake manifold with electronic throttle control. The variable valve timing performs and operates the same as the system that was introduced on the 2004 model year turbo vehicles. The Variable Valve Lift system is designed to provide fuel economy at lower engine speeds and higher engine power output at higher engine speeds. The variable valve lift system optimizes the intake valve lift by switching to the use of low lift cam lobes or high lift cam lobes in accordance with engine speed.

The Camshaft is machined with a split lobe for each intake valve. The center of the lobe is described as the low speed cam lobe. The outer cam lobes are described as the high speed cam lobe.

In response to the signals from the ECM, the oil switching solenoid valve operates to switch the valve lift.



*OIL SWITCHING VALVE*

At low engine speeds, the lift is reduced to increase intake air speed and to obtain effective combustion and higher torque output. The lift of the two valves are different from each other. By differentiating the intake air volume in this way, a swirl occurs in the combustion chamber and combustion is improved.

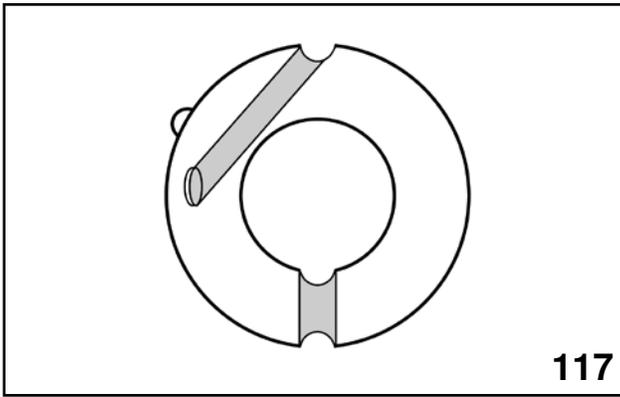
At high engine speeds, the lift is increased to reduce intake resistance and to obtain higher power.

To protect the engine, the system does not allow racing up the engine to high speeds in P or N range.



*TWO LIFTERS*

# 6 Cylinder Boxer Engines Series (104-H6)

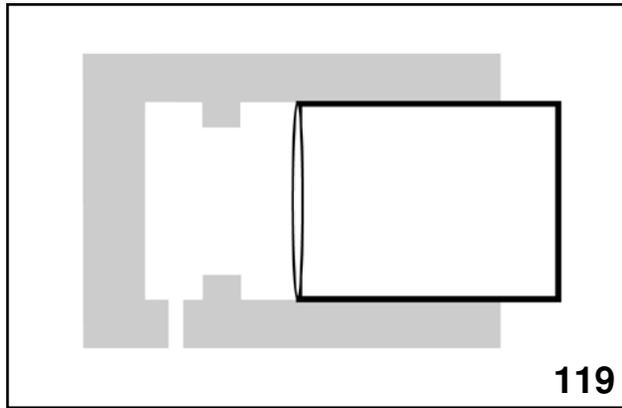


*TWO OIL PORTS (ARTWORK)*



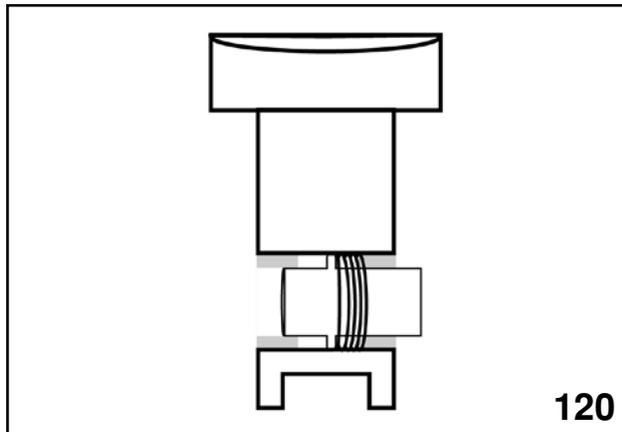
*OUTER AND INNER LIFTER*

The intake valve lifter is equipped with a location guide that ensures the lifter does not rotate in the lifter bore as it is operated. Two oil pressure ports are visible on the outside of the lifter. The oil port closest to the location guide is used to supply working pressure to the outer lifter locking pin. The other oil port is used to supply lubrication to the inner lifter. The straight sides of the inner lifter ensure the inner lifter does not rotate inside the outer lifter. The lifter is not serviceable and must be replaced as a unit.



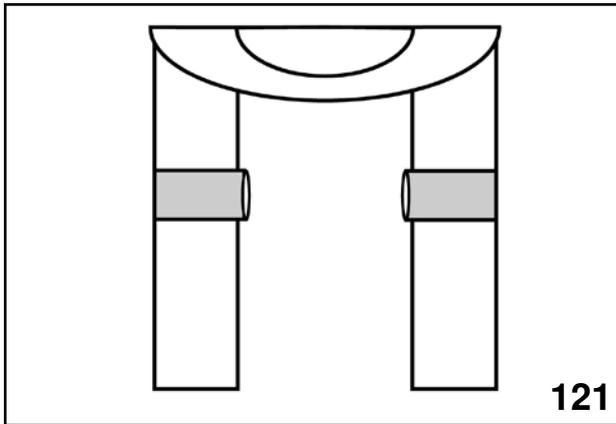
*OUTER LIFTER LOCKING PIN (ARTWORK)*

Oil pressure delivered into the outer lifter from the oil pressure port of the intake lifter bore pushes the outer lifter locking pin into the inner lifter locking pin. This locks the left side of the outer lifter into the left side of the inner lifter.



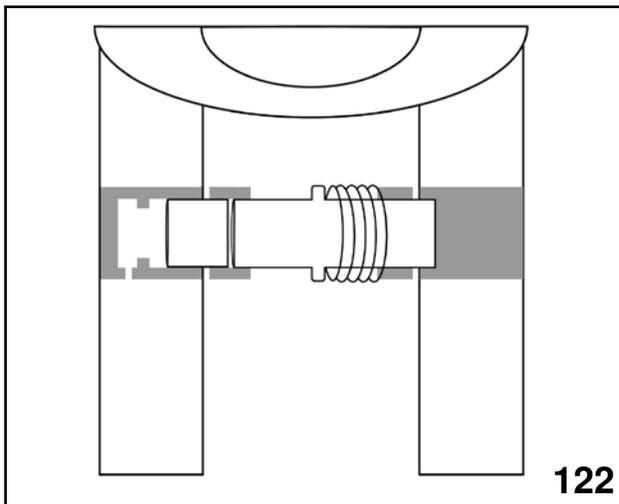
*INNER LIFTER LOCKING PIN (ARTWORK)*

# 6 Cylinder Boxer Engines Series (104-H6)



OUTER LIFTER (ARTWORK)

The force from this action compresses the return spring of the inner lifter locking pin and pushes the inner lifter locking pin to the right. This locks the right side of the inner lifter to the right side of the outer lifter.



(ARTWORK)

As the lifter is moved downward by the movement of the intake cam lobe the outer lifter moves away from the oil pressure port. However the mechanical force placed on the internal parts of the lifter keep it locked together until the intake valve is allowed to close.

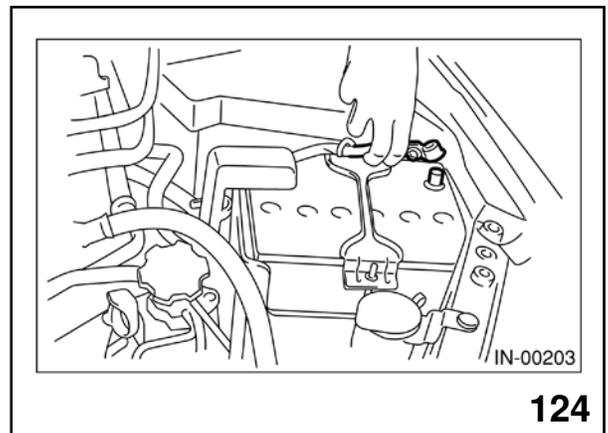
## Valve Clearance 3.0 H6

Valve clearance 3.0 H6 on 2005 and newer engines with Variable Valve Lift requires checking with a feeler gauge and then measuring with a micrometer the small lifter placed on top of the valve stem in order to obtain proper clearance.

### Inspection

Inspection and adjustment of valve clearance should be performed while engine is cold.

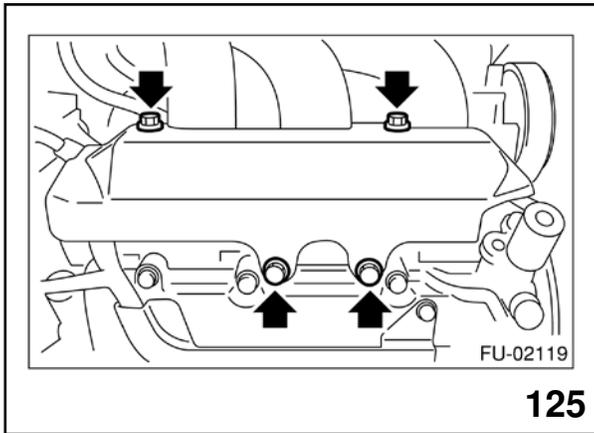
1. Set the vehicle on a lift.
2. Remove the collector cover.



DISCONNECTING THE BATTERY

3. Disconnect the ground cable from battery.
4. Lift-up the vehicle.
5. Remove the under cover.
6. Lower the vehicle.
7. When inspecting RH side cylinders:
  - (1) Remove the air intake duct and air cleaner case. <Ref. to IN(H6DO), REMOVAL, Air Intake Duct.> <Ref. to IN(H6DO), REMOVAL, Air Cleaner Case.>

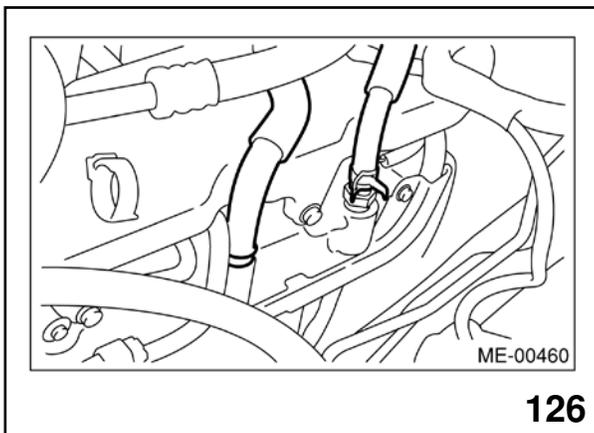
# 6 Cylinder Boxer Engines Series (104-H6)



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*FUEL TANK PROTECTOR (RH)*

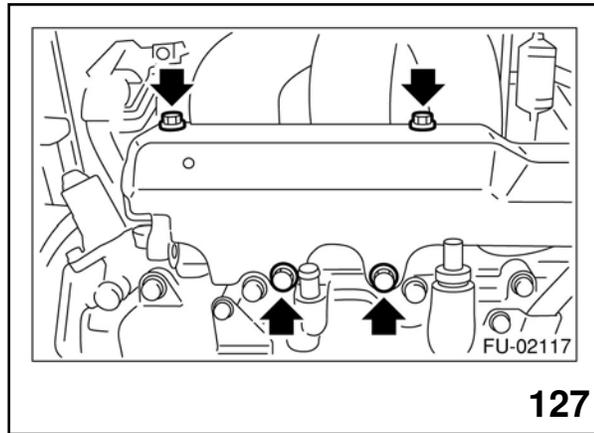
- (2) Remove the fuel tank protector (RH)
  - (3) Disconnect the connector of oil pressure switch.
  - (4) Remove the ignition coil. <Ref. to IG(H6D0), REMOVAL, Ignition Coil and Ignitor Assembly.>
  - (5) Remove the rocker cover (RH)
8. When inspecting LH side cylinders:
- (1) Disconnect the battery cable, and then remove the battery and battery carrier.



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*DISCONNECTING HOSES FROM ROCKER COVER*

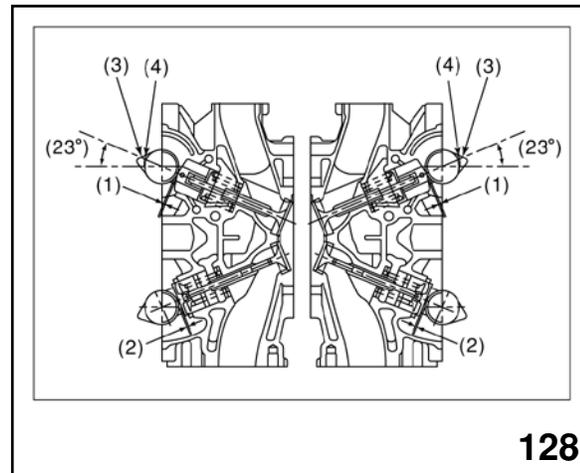
- (2) Disconnect the PCV hose and blowby hose from rocker cover (LH).



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*FUEL PIPE PROTECTOR (LH)*

- (3) Remove the fuel pipe protector (LH).
- (4) Remove the ignition coil. <Ref. to IG(H6D0)-7, REMOVAL, Ignition Coil and Ignitor Assembly.>
- (5) Remove the rocker cover (LH).



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*CAM SET TO POSITION*

9. Turn the crankshaft clockwise until the cam is set to position shown in the figure.
  - (1) Valve clearance (Intake side)
  - (2) Valve clearance (Exhaust side)
  - (3) High lift cam
  - (4) Low lift cam
10. Measure the clearance of intake valve and exhaust valve using thickness gauge (A).

# 6 Cylinder Boxer Engines Series (104-H6)

**NOTE: MEASURE VALVE CLEARANCE WITHIN THE RANGE OF  $\pm 30^\circ$  THAT SHOWN IN THE FIGURE.**

**MEASURE VALVE CLEARANCE ON LOW LIFT CAM FOR INTAKE SIDE.**

**INSERT THE THICKNESS GAUGE IN AS HORIZONTAL A DIRECTION AS POSSIBLE WITH RESPECT TO THE VALVE LIFTER.**

## Valve clearance

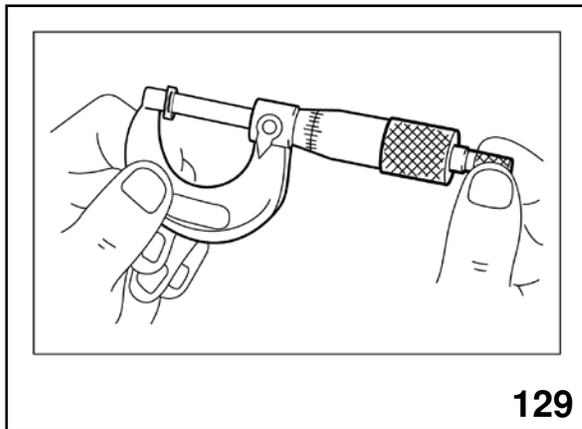
**Intake:**

**$0.20^{+0.04} -0.06$  mm ( $0.0079^{+0.0016} -0.00024$  in)**

**Exhaust:**

**$0.35 \pm 0.05$  mm ( $0.0138 \pm 0.0020$  in)**

- If the measured valve is not within specification, take notes of the value in order to adjust the valve clearance later on.



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*MEASURING VALVE CLEARANCE*

11. If necessary, adjust the valve clearance. <Ref. to ME(H6D0), ADJUSTMENT, Valve Clearance.>
12. Further turn the crank pulley clockwise and then measure the valve clearances again.
13. After inspection, install the related parts in the reverse order of removal.

## ADJUSTMENT

### INTAKE SIDE

**CAUTION: ADJUSTMENT OF VALVE CLEARANCE SHOULD BE PERFORMED WHILE ENGINE IS COLD.**

**DO NOT WEAR GLOVES DURING REMOVAL AND INSTALLATION OF VALVE LIFTER.**

**DO NOT USE A VALVE LIFTER WHICH RECEIVED HIGH IMPACT DUE TO DROP, ETC.**

**WHEN INSTALLING THE VALVE LIFTER, ALIGN THE ANTI-ROTATION OF VALVE LIFTER WITH GROOVE ON CYLINDER HEAD, AND THEN INSERT THE VALVE LIFTER.**

1. Measure all valve clearances.

<Ref. to ME(H6D0)-28, INSPECTION, Valve Clearance.>

**NOTE: RECORD EACH VALVE CLEARANCE AFTER IT HAS BEEN MEASURED.**

2. Remove the Camshaft. <Ref. to ME(H6D0)-53, REMOVAL, Camshaft.>
3. Remove the valve lifter.
4. Remove the adjustable shim (cap) from the top of the intake valve stem.
5. Check the thickness of the shim (cap) by stamped mark on the side of shim (cap) which is removed.
6. Select a shim (cap) of suitable thickness using measured valve clearance and shim (cap) thickness, by referring to the following table.

|   |
|---|
| Unit: (mm)  |
| $S = (V + T) - 0.20$  |
| S: Required shim (cap) thickness<br>V: Measured valve clearance<br>T: Shim (cap) thickness to be used |

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| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13218AK890 | 1.92 (0.0756)     |
| 13218AK900 | 1.94 (0.0764)     |
| 13218AK910 | 1.96 (0.0772)     |
| 13218AK920 | 1.98 (0.0780)     |
| 13218AK930 | 2.00 (0.0787)     |
| 13218AK940 | 2.02 (0.0795)     |
| 13218AK950 | 2.04 (0.0803)     |
| 13218AK960 | 2.06 (0.0811)     |
| 13218AK970 | 2.07 (0.0815)     |
| 13218AK980 | 2.08 (0.0819)     |
| 13218AK990 | 2.09 (0.0823)     |
| 13218AL000 | 2.10 (0.0827)     |
| 13218AL010 | 2.11 (0.0831)     |
| 13218AL020 | 2.12 (0.0835)     |
| 13218AL030 | 2.13 (0.0839)     |
| 13218AL040 | 2.14 (0.0843)     |
| 13218AL050 | 2.15 (0.0846)     |
| 13218AL060 | 2.16 (0.0850)     |
| 13218AL070 | 2.18 (0.0858)     |
| 13218AL080 | 2.18 (0.0858)     |
| 13218AL090 | 2.19 (0.0862)     |
| 13218AL100 | 2.20 (0.0866)     |
| 13218AL110 | 2.21 (0.0870)     |
| 13218AL120 | 2.22 (0.0874)     |
| 13218AL130 | 2.23 (0.0878)     |
| 13218AL140 | 2.24 (0.0882)     |
| 13218AL150 | 2.25 (0.0886)     |
| 13218AL160 | 2.26 (0.0890)     |
| 13218AL170 | 2.27 (0.0894)     |
| 13218AL180 | 2.28 (0.0898)     |
| 13218AL190 | 2.29 (0.0902)     |
| 13218AL200 | 2.30 (0.0906)     |
| 13218AL210 | 2.31 (0.0909)     |
| 13218AL220 | 2.32 (0.0913)     |
| 13218AL230 | 2.33 (0.0917)     |
| 13218AL400 | 2.34 (0.0921)     |
| 13218AL250 | 2.35 (0.0925)     |
| 13218AL260 | 2.36 (0.0929)     |

| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13218AL270 | 2.28 (0.0937)     |
| 13218AL280 | 2.38 (0.0937)     |
| 13218AL290 | 2.39 (0.0941)     |
| 13218AL300 | 2.41 (0.0945)     |
| 13218AL310 | 2.41 (0.0949)     |
| 13218AL320 | 2.42 (0.0953)     |
| 13218AL330 | 2.43 (0.0957)     |
| 13218AL340 | 2.44 (0.0961)     |
| 13218AL350 | 2.45 (0.0965)     |
| 13218AL360 | 2.46 (0.0969)     |
| 13218AL370 | 2.47 (0.0972)     |
| 13218AL380 | 2.48 (0.0976)     |
| 13218AL390 | 2.49 (0.0980)     |
| 13218AL400 | 2.50 (0.0984)     |
| 13218AL410 | 2.51 (0.0988)     |
| 13218AL420 | 2.52 (0.0992)     |
| 13218AL430 | 2.53 (0.0996)     |
| 13218AL440 | 2.54 (0.1000)     |
| 13218AL450 | 2.55 (0.1004)     |
| 13218AL460 | 2.56 (0.1008)     |
| 13218AL470 | 2.57 (0.1012)     |
| 13218AL480 | 2.58 (0.1016)     |
| 13218AL490 | 2.59 (0.1024)     |
| 13218AL500 | 2.60 (0.1024)     |
| 13218AL510 | 2.61 (0.1028)     |
| 13218AL520 | 2.62 (0.1032)     |
| 13218AL530 | 2.64 (0.1039)     |
| 13218AL540 | 2.66 (0.1047)     |
| 13218AL550 | 2.68 (0.1055)     |
| 13218AL560 | 2.70 (0.1063)     |
| 13218AL570 | 2.72 (0.1071)     |
| 13218AL580 | 2.74 (0.1079)     |
| 13218AL590 | 2.76 (0.1087)     |

# 6 Cylinder Boxer Engines Series (104-H6)

## EXHAUST SIDE

**CAUTION: ADJUSTMENT OF VALVE CLEARANCE SHOULD BE PERFORMED WHILE ENGINE IS COLD.**

**DO NOT WEAR GLOVES DURING REMOVAL AND INSTALLATION OF VALVE LIFTER.**

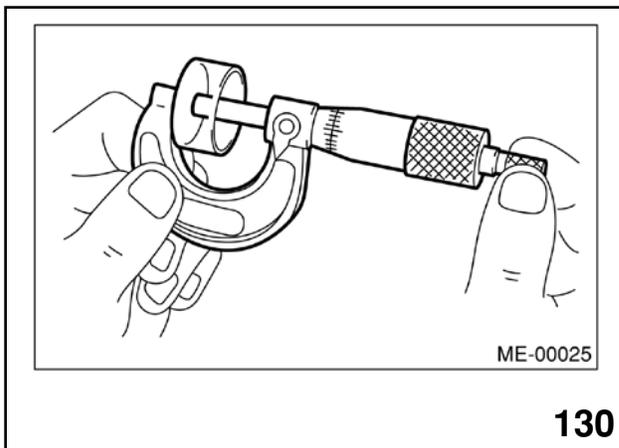
**DO NOT USE A VALVE LIFTER WHICH RECEIVED HIGH IMPACT DUE TO DROP, ETC.**

1. Measure all valve clearances. <Ref. to ME(H6DO), INSPECTION, Valve clearance.>

Note: Record each valve clearance after it has been measured.

2. Remove the Camshaft. <Ref. to ME(H6DO), REMOVAL, Camshaft.>

3. Remove the valve lifter.



MICROMETER MEASURING VALVE LIFTER

4. Measure the thickness of valve lifter with a micrometer.

5. Select a valve lifter of suitable thickness using measured valve clearance and valve lifter thickness, by referring to the following table.

|                                      |
|--------------------------------------|
| Unit: (mm)                           |
| $S = (V + T) - 0.35$                 |
| S: Valve lifter thickness required   |
| V: Measured valve clearance          |
| T: valve lifter thickness to be used |

| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13228AD180 | 4.32 (0.1701)     |
| 13228AD190 | 4.34 (0.1709)     |
| 13228AD200 | 4.36 (0.1717)     |
| 13228AD210 | 4.38 (0.1724)     |
| 13228AD220 | 4.40 (0.1748)     |
| 13228AD230 | 4.42 (0.1740)     |
| 13228AD240 | 4.44 (0.1748)     |
| 13228AD250 | 4.46 (0.1756)     |
| 13228AD260 | 4.48 (0.1764)     |
| 13228AD270 | 4.50 (0.1772)     |
| 13228AD280 | 4.52 (0.1780)     |
| 13228AD290 | 4.45 (0.1787)     |
| 13228AD300 | 4.56 (0.1795)     |
| 13228AD10  | 4.58 (0.1803)     |
| 13228AD320 | 4.60 (0.1881)     |
| 13228AC580 | 4.62 (0.1819)     |
| 13228AC590 | 4.63 (0.1823)     |
| 13228AC600 | 4.64 (0.1827)     |
| 13228AC610 | 4.65 (0.1831)     |
| 13228AC620 | 4.66 (0.1835)     |
| 13228AC630 | 4.67 (0.1839)     |
| 13228AC640 | 4.68 (0.1843)     |
| 13228AC650 | 4.69 (0.1846)     |
| 13228AC660 | 4.70 (0.1850)     |
| 13228AC670 | 4.71 (0.1854)     |
| 13228AC680 | 4.72 (0.1858)     |
| 13228AC690 | 4.73 (0.1862)     |
| 13228AC700 | 4.74 (0.1866)     |
| 13228AC710 | 4.75 (0.1870)     |
| 13228AC720 | 4.76 (0.1874)     |
| 13228AC730 | 4.77 (0.1878)     |
| 13228AC740 | 4.78 (0.1882)     |
| 13228AC750 | 4.79 (0.1886)     |
| 13228AC760 | 4.80 (0.1890)     |
| 13228AC770 | 4.81 (0.1894)     |
| 13228AC780 | 4.82 (0.1898)     |
| 13228AC790 | 4.83 (0.1902)     |
| 13228AC800 | 4.84 (0.1906)     |

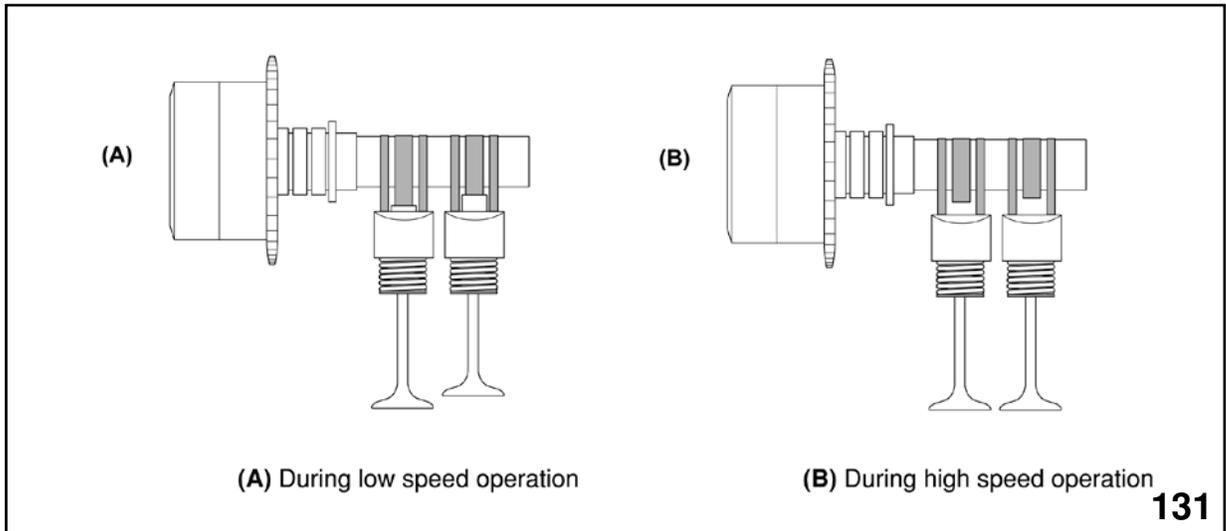
# 6 Cylinder Boxer Engines Series (104-H6)

| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13228AC810 | 4.85 (0.1909)     |
| 13228AC820 | 4.86 (0.1913)     |
| 13228AC830 | 4.87 (0.1917)     |
| 13228AC840 | 4.88 (0.1921)     |
| 13228AC850 | 4.89 (0.1925)     |
| 13228AC860 | 4.90 (0.1929)     |
| 13228AC870 | 4.91 (0.1933)     |
| 13228AC880 | 4.92 (0.1937)     |
| 13228AC890 | 4.93 (0.1941)     |
| 13228AC900 | 4.94 (0.1945)     |
| 13228AC910 | 4.95 (0.1949)     |
| 13228AC920 | 4.96 (0.1953)     |
| 13228AC930 | 4.97 (0.1957)     |
| 13228AC940 | 4.98 (0.1961)     |
| 13228AC950 | 4.99 (0.1965)     |
| 13228AC960 | 5.00 (0.1969)     |
| 13228AC970 | 5.01 (0.1972)     |
| 13228AC980 | 5.02 (0.1976)     |
| 13228AC990 | 5.03 (0.1980)     |
| 13228AD000 | 5.04 (0.1984)     |
| 13228AD010 | 5.05 (0.1988)     |
| 13228AD020 | 5.06 (0.1992)     |
| 13228AD030 | 5.07 (0.1996)     |
| 13228AD040 | 5.08 (0.2000)     |
| 13228AD050 | 5.09 (0.2004)     |
| 13228AD060 | 5.10 (0.2008)     |
| 13228AD070 | 5.11 (0.2012)     |
| 13228AD080 | 5.12 (0.2016)     |
| 13228AD090 | 5.13 (0.2020)     |
| 13228AD100 | 5.14 (0.2024)     |
| 13228AD110 | 5.15 (0.2028)     |
| 13228AD120 | 5.16 (0.2032)     |
| 13228AD130 | 5.17 (0.2035)     |
| 13228AD140 | 5.18 (0.2039)     |
| 13228AD150 | 5.19 (0.2043)     |
| 13228AD160 | 5.20 (0.2047)     |
| 13228AD170 | 5.21 (0.2051)     |
| 13228AD330 | 5.23 (0.2059)     |

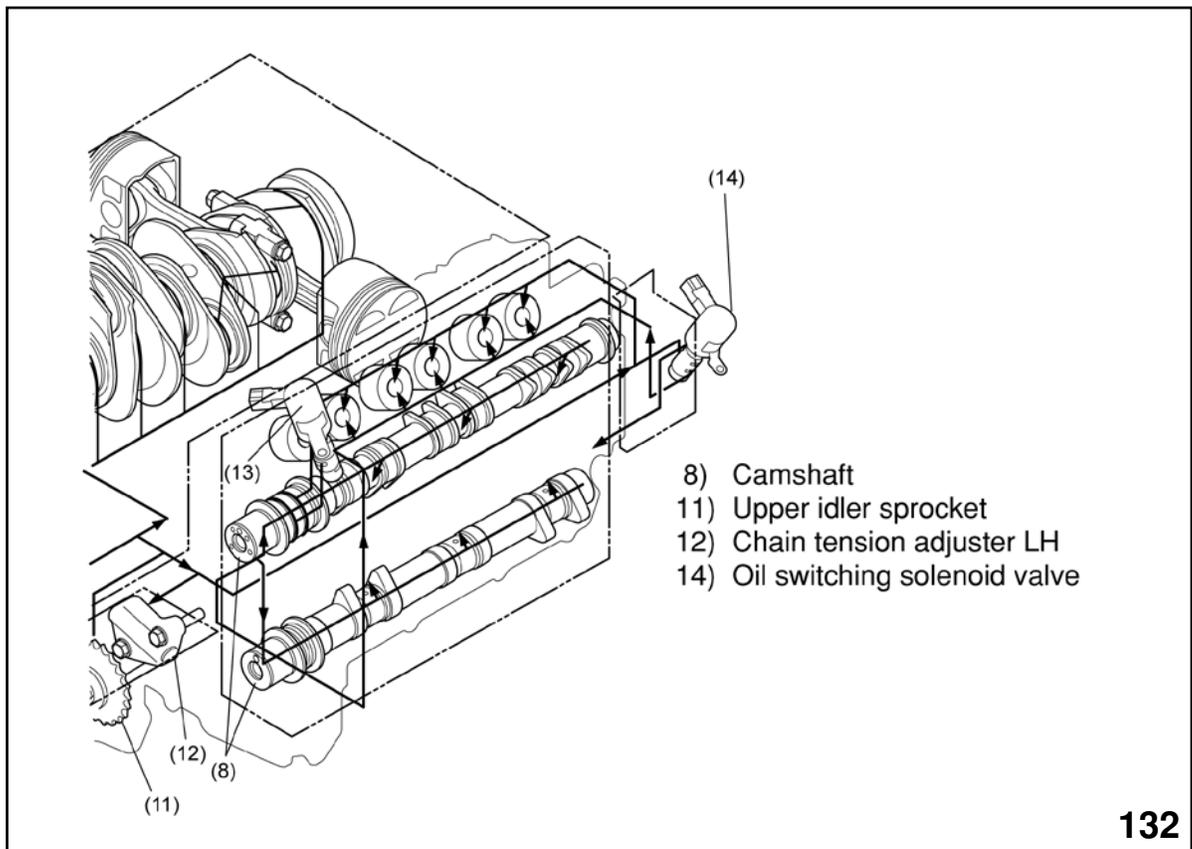
| Part No.   | Thickness mm (in) |
|------------|-------------------|
| 13228AD340 | 5.25 (0.2067)     |
| 13228AD350 | 5.27 (0.2075)     |
| 13228AD360 | 5.29 (0.2083)     |
| 13228AD370 | 5.31 (0.2091)     |
| 13228AD380 | 5.33 (0.2098)     |
| 13228AD390 | 5.35 (0.2106)     |
| 13228AD400 | 5.37 (0.2114)     |
| 13228AD410 | 5.39 (0.2122)     |
| 13228AD420 | 5.41 (0.2130)     |
| 13228AD430 | 5.43 (0.2138)     |
| 13228AD440 | 5.45 (0.2146)     |
| 13228AD450 | 5.47 (0.2154)     |
| 13228AD460 | 5.49 (0.2161)     |
| 13228AD470 | 5.51 (0.2169)     |
| 13228AD480 | 5.53 (0.2177)     |
| 13228AD490 | 5.55 (0.2185)     |
| 13228AD500 | 5.57 (0.2193)     |
| 13228AD510 | 5.59 (0.2201)     |

# 6 Cylinder Boxer Engines Series (104-H6)

When the oil pressure ports align the pressure is reapplied or released dependant on the duty ratio from the OSV. If the pressure is released the return spring of the inner lifter locking pin moves the inner lifter locking pin to the left. This action will move the outer lifter locking pin to the left resulting in the separation of the inner and outer lifter.

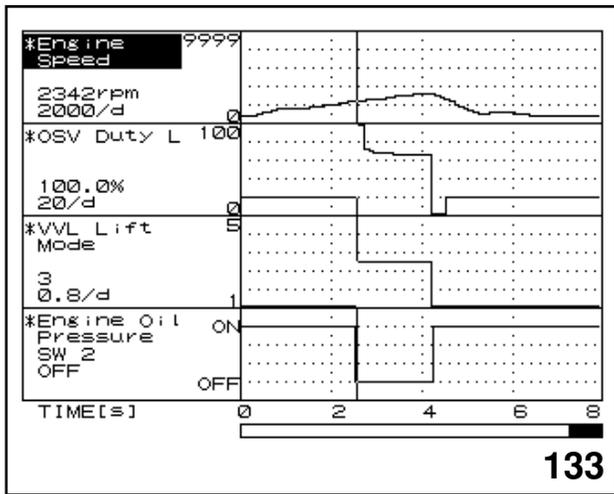


CAMSHAFTS

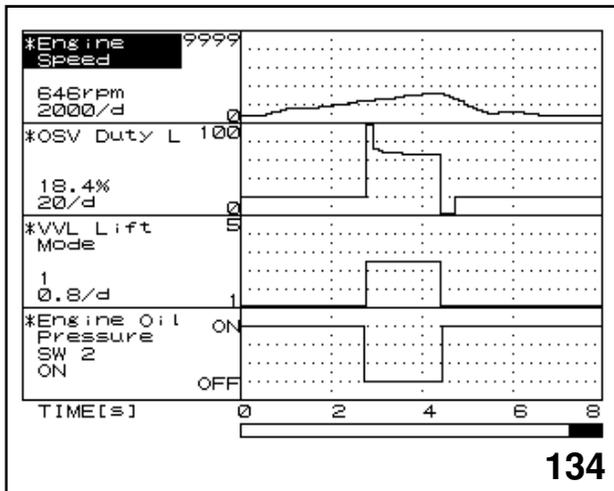


OIL PRESSURE SCHEMATIC

# 6 Cylinder Boxer Engines Series (104-H6)



NSM GRAPH 100% OSV DUTY



NSM GRAPH OSV DUTY RATIO 86%

The Variable Valve Lift (VVL) is controlled by a duty ratio signal from the ECM to the Oil Switching Valve (OSV). An OSV is located on each cylinder head to operate the VVL components on their respective sides of the engine. An oil pressure diagnosis switch is located on each OSV. The right side is “**Engine Oil Pressure SW 1**” and the left side is “**Engine Oil Pressure SW 2**” when viewing data on the Select Monitor. Both switches monitor the oil pressure in the application circuits of the OSVs. When the oil pressure in the application circuit is **low**, the oil pressure diagnosis switch is grounded and is displayed as “**On**” when viewing Select monitor data. When the pressure is **high**, the oil pressure switch is open and is displayed as “**Off**” when viewing Select Monitor data.

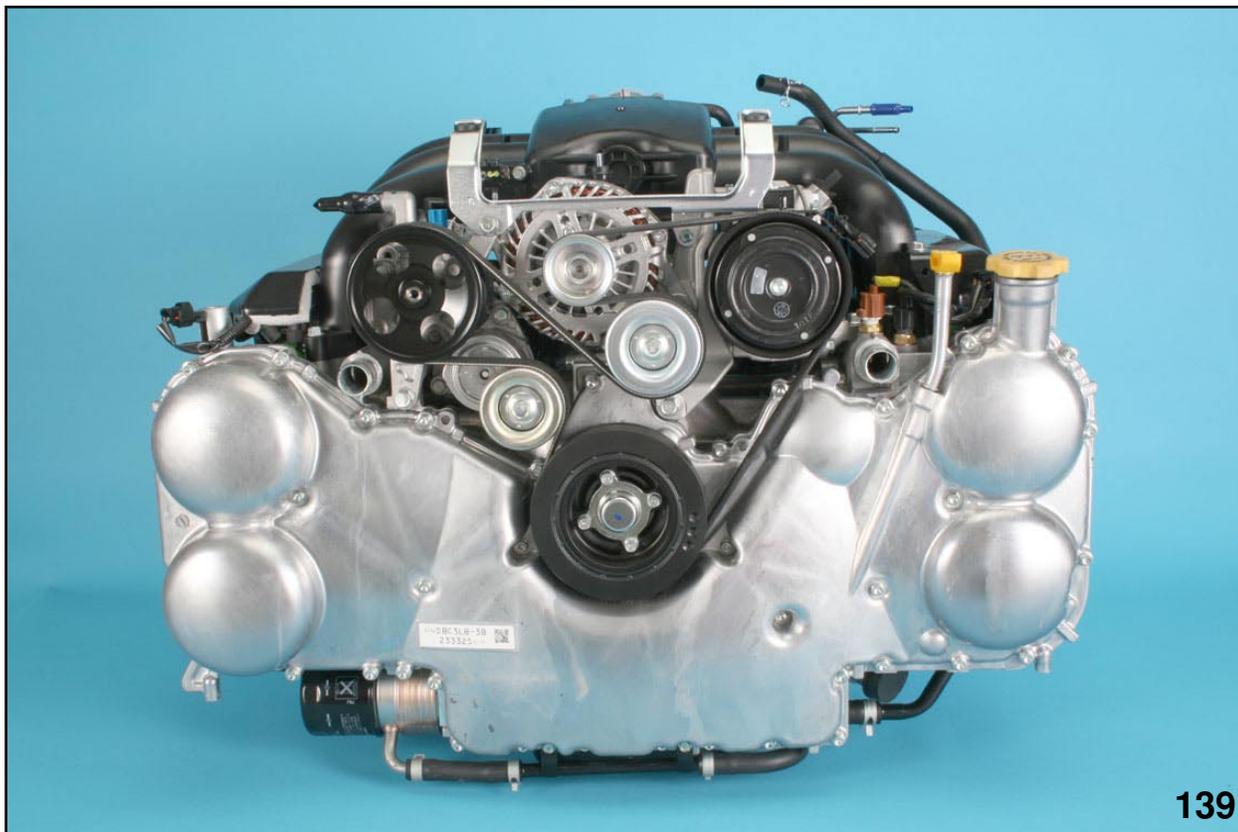
The OSV duty ratio at idle is approximately 18%. This short on time is allowing more oil pressure to drain rather than build up in the application circuit. The resulting pressure reaching the VVL lifters is not strong enough to overcome spring tension so the VVL lifter remains in a low speed operation mode, allowing the center lifter to work with the low speed cam lobes. The Select monitor will display this action as “**VVL Lift Mode 1**”.

The OSV duty ratio will initially increase to 100% when the ECM decides to change to high speed operation. After pressure has been established in the application circuit, the duty ratio will decrease to approximately 86%. This longer on time, as compared to the duty ratio at idle, will allow more oil pressure to build up in the application circuit rather than drain. The resulting pressure will be strong enough to overcome spring tension and lock the outer lifter to the inner lifter, allowing operation with the split high speed cam lobes. The Select monitor will display this action as “**VVL Lift Mode 3**”.



# 6 Cylinder Boxer Engines Series (104-H6)

## Introduction 3.6 Liter Engine



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### *3.6 Liter Engine*

The new 3.6 liter engine for the 2008 Tribeca produces 256 horse power at 6000 RPM and 247 foot pounds of torque at 4400 RPM. Designed to operate on regular fuel and with no changes to the external engine dimensions, this engine operates cleaner and provides more fuel efficiency than the 3.0 liter engine.

|                   | <b>3.6 ENGINE</b> | <b>3.0 ENGINE</b> |
|-------------------|-------------------|-------------------|
| BORE              | 92 mm             | 89.2 mm           |
| STROKE            | 91 mm             | 80 mm             |
| DISPLACEMENT      | 3,630 cc          | 2,999 cc          |
| WEIGHT            | 395 lbs.          | 397 lbs.          |
| FUEL              | 87 AKI            | 91 AKI            |
| COMPRESSION RATIO | 10.5:1            | 10.7:1            |

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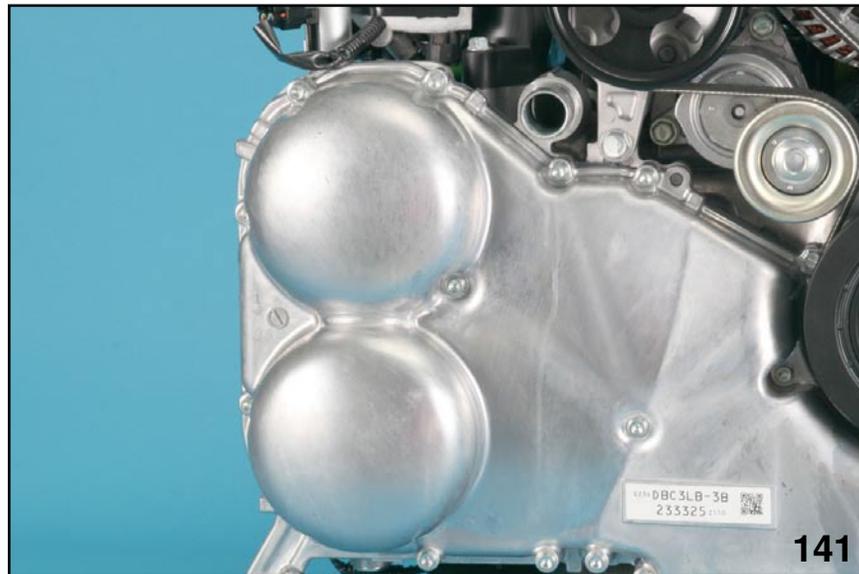
### *ENGINE CHART*

Engine designation is EZ 36.

# 6 Cylinder Boxer Engines Series (104-H6)

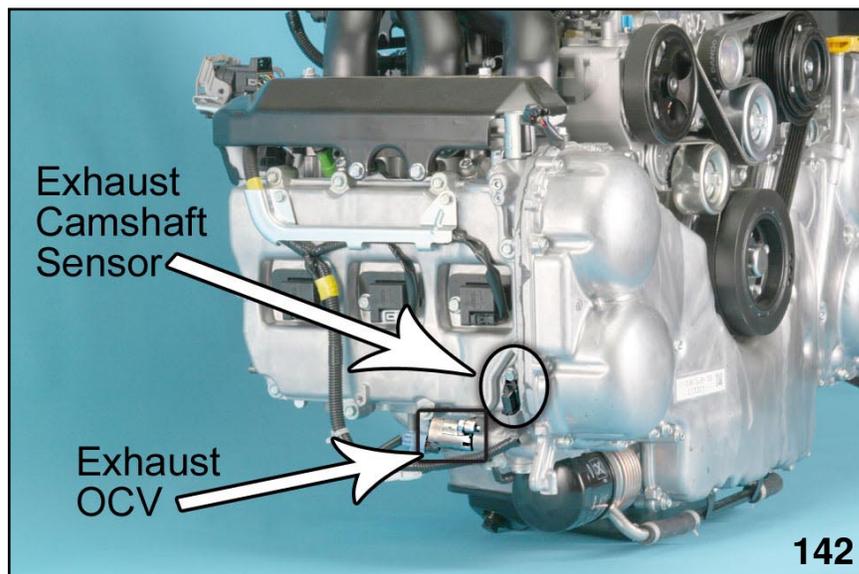
## Enhancements / Changes

- Introduction of the Dual Active Valve Timing System
- Deletion of the Variable Valve Lift System
- Cooling System design
- Timing Chain design



*TIMING CHAIN COVER*

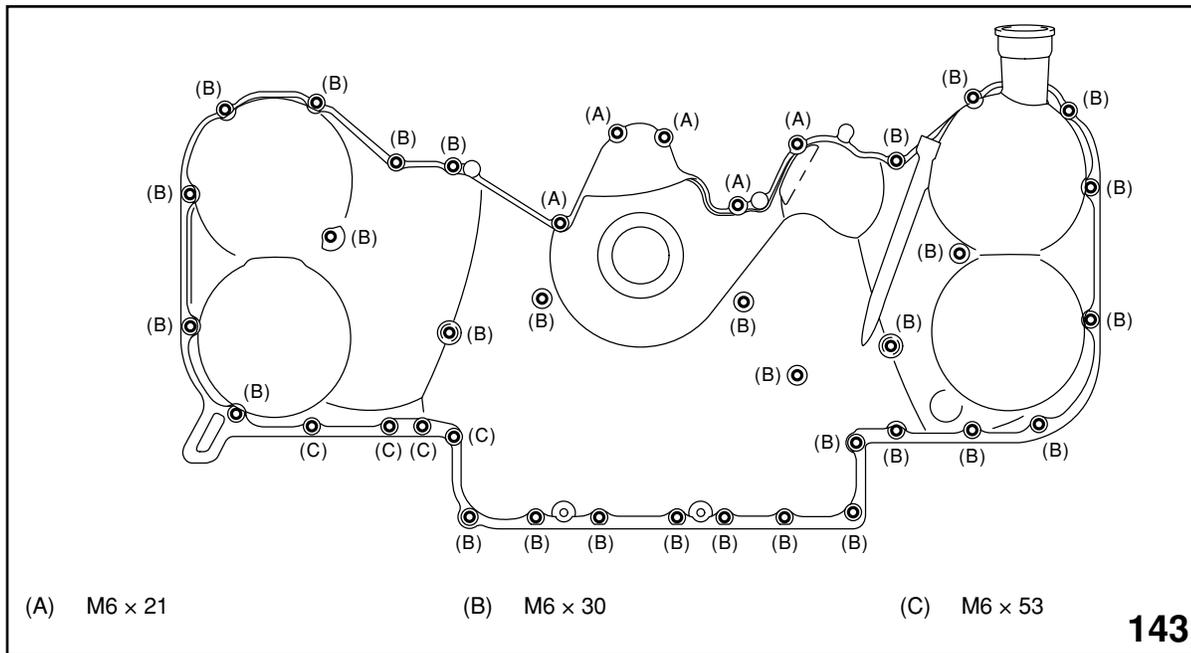
The dual active valve timing system requires additional space in the timing chain cover to allow room for the exhaust sprocket.



*EXHAUST CAMSHAFT SENSOR AND EXHAUST OCV*

The shape of the valve cover and the front Camshaft cap allows for the installation of the exhaust Oil Charge Valve (OCV) and the Exhaust Camshaft sensor.

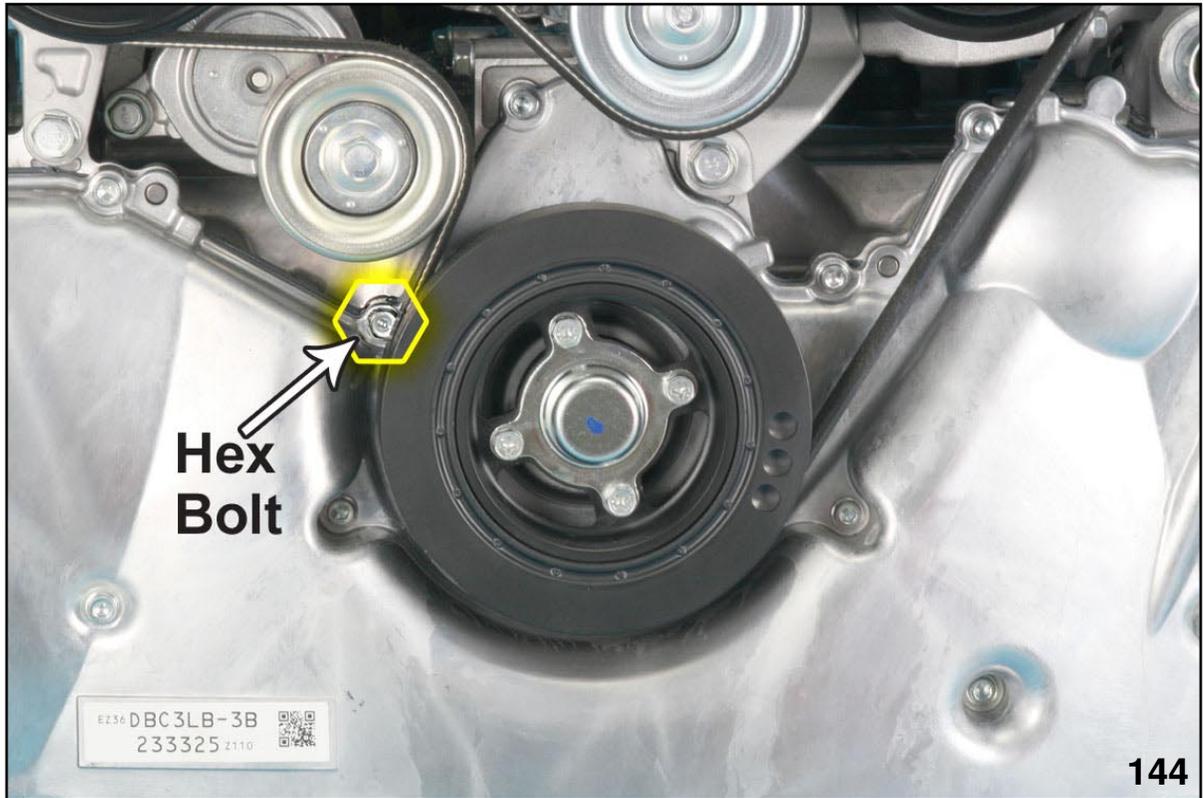
# 6 Cylinder Boxer Engines Series (104-H6)



*INNER TIMING CHAIN COVER*

The 3.6 liter engine is designed with the inner timing chain cover incorporated on the front surface of the engine block and cylinder heads while the outer timing chain cover is secured to the engine with 39 bolts and sealed with three bond.

# 6 Cylinder Boxer Engines Series (104-H6)

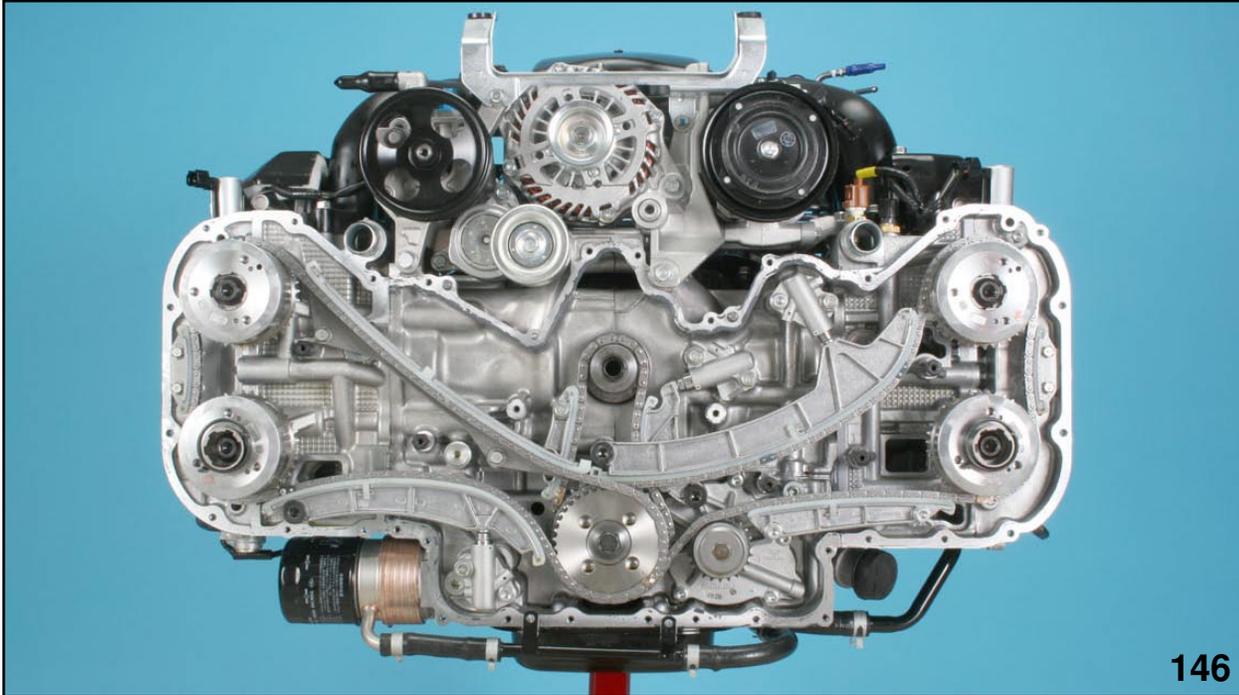


*PLACEMENT OF HEX BOLT*

Three different length bolts are used to secure the timing chain cover, all of which are 6mm Allen except one 6mm hex bolt located at the upper right side behind the Crankshaft pulley.

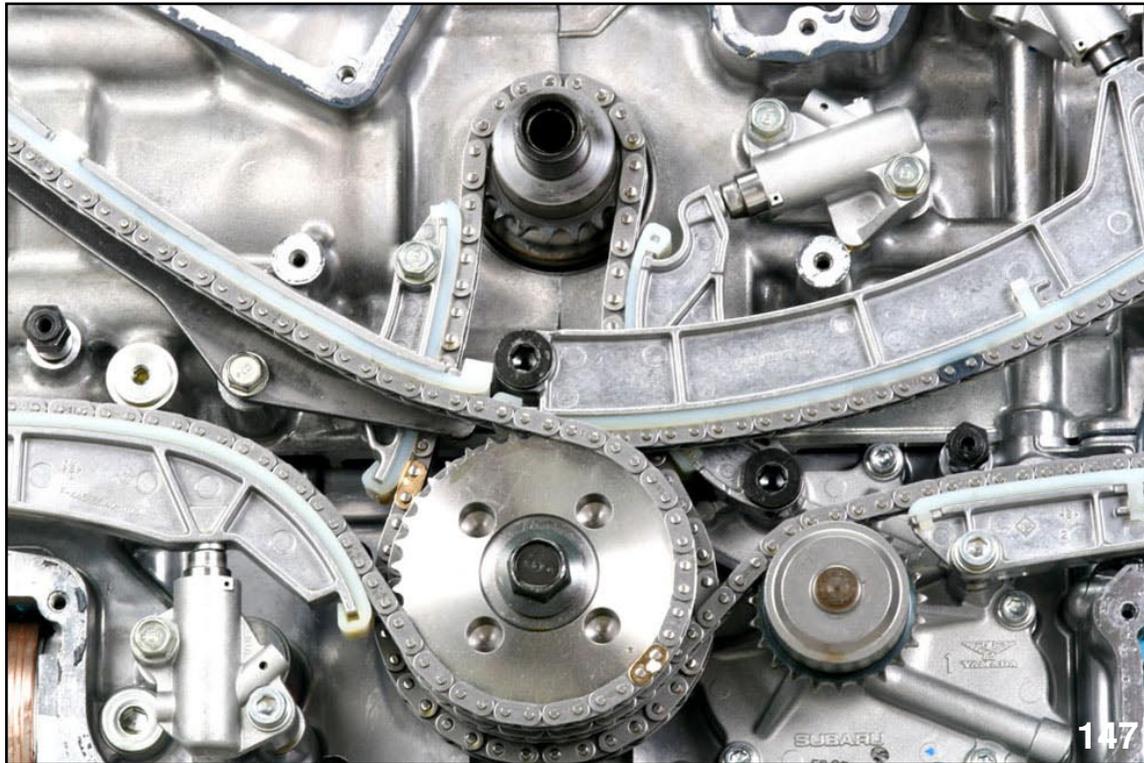
# 6 Cylinder Boxer Engines Series (104-H6)

## Timing Chains



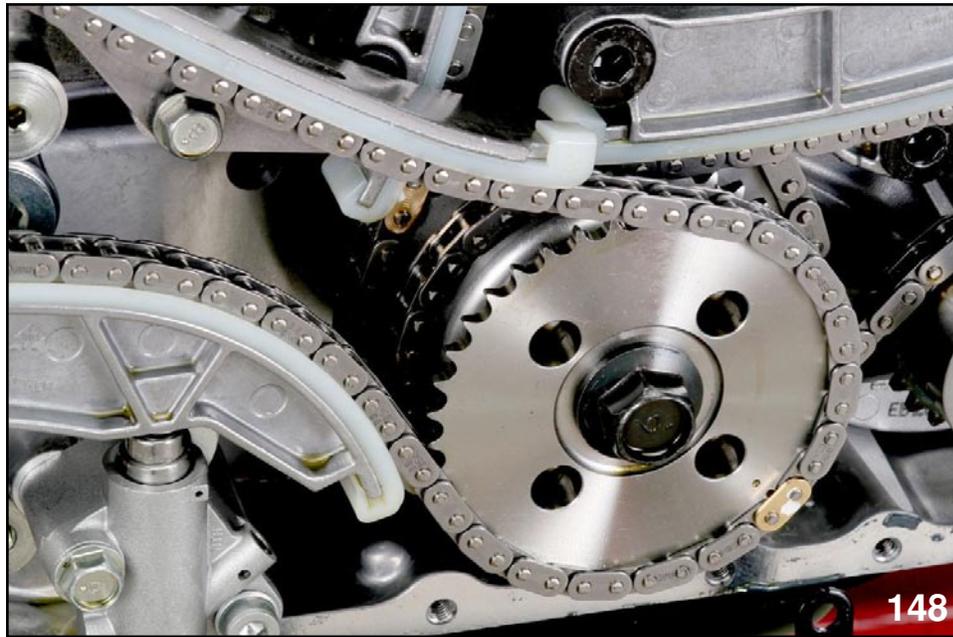
*3.6 LITER ENGINE SHOWING TIMING CHAINS*

This engine uses three (3) timing chains.



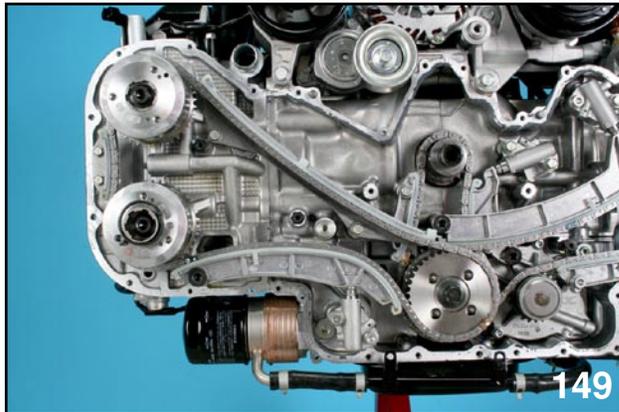
*CRANK GEAR AND IDLER GEAR*

# 6 Cylinder Boxer Engines Series (104-H6)

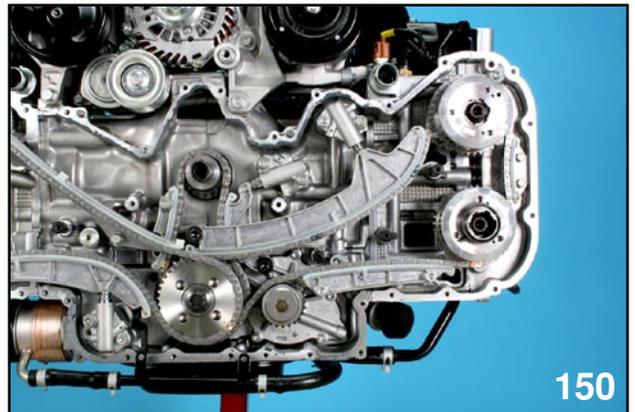


*IDLER SPROCKET*

A 10mm chain drives an idler from the Crankshaft sprocket and two 8mm chains driven from the idler operate the left and right bank Camshafts.



*RIGHT BANK CAMSHAFTS*



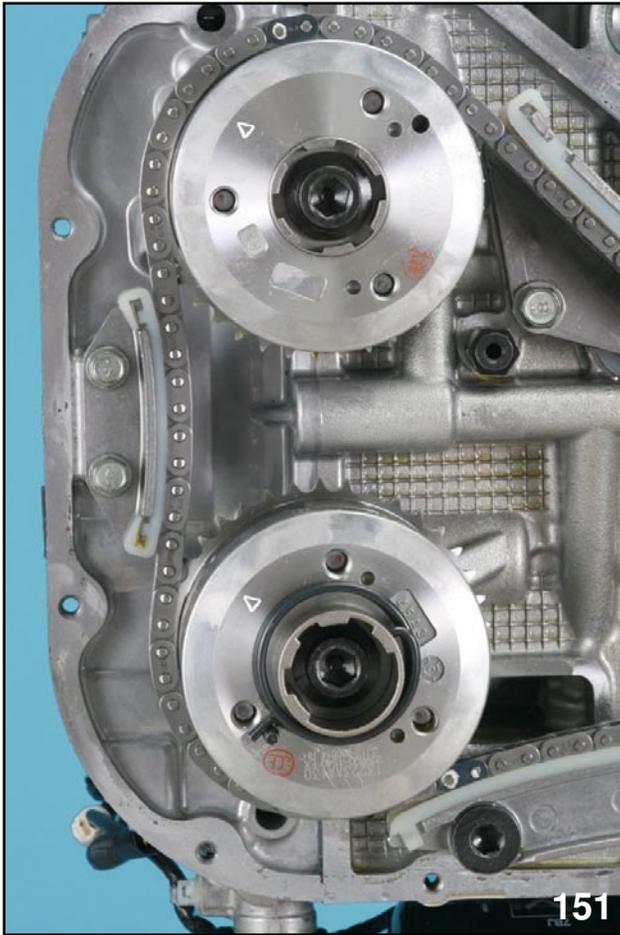
*LEFT BANK CAMSHAFTS*

The 3.6 liter engine is an interference type. Incorrect chain installation or turning of the Camshafts will result in valve to piston contact. Follow the correct procedures for working on the timing chain components.

The chain removal procedure in this TRB differs from the service manual and must be followed step by step to prevent personal injury and damage to the engine.

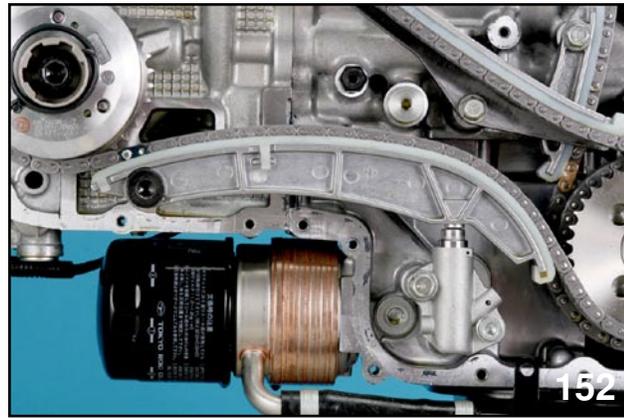
# 6 Cylinder Boxer Engines Series (104-H6)

## Timing Chain Removal Right Bank



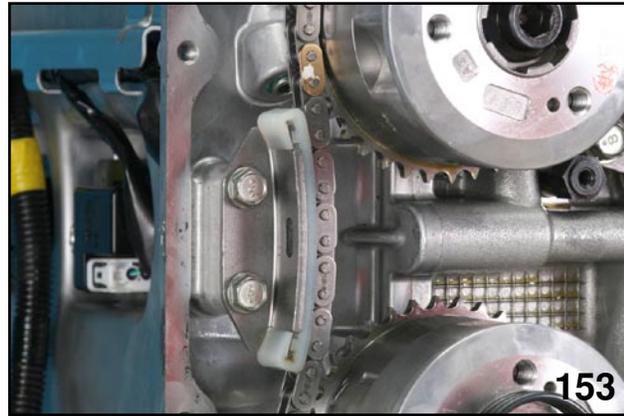
*RIGHT BANK INTAKE AND THE EXHAUST CAM SPROCKETS  
10:00 O'CLOCK POSITION*

1. Align the arrow marks of the Intake and the exhaust cam sprockets to 10:00 o'clock.
  - The timing mark of the Intake sprocket will be at 12:00 o'clock.
  - The timing mark of the Exhaust cam sprocket will be at 4:00 o'clock.
  - The timing mark of the crank sprocket will be at 9:00 o'clock.
  - The Key Way on the crank sprocket will be at 12:00 o'clock.
  - The timing mark on the idler will be at 4:00.
  - This will result in the right bank Camshafts resting in an unloaded state.



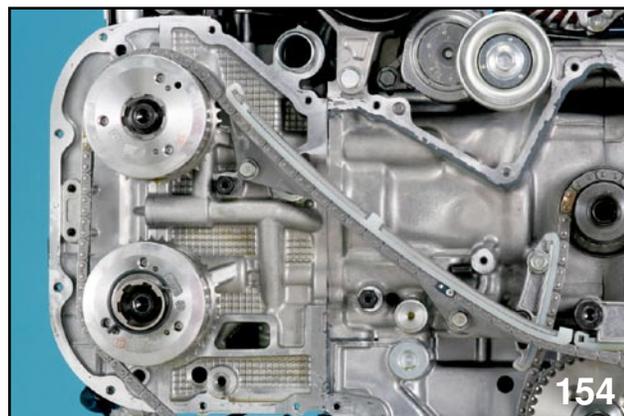
*RIGHT BANK CHAIN TENSIONER*

2. Remove the chain tensioner.
3. Remove the chain tensioner lever.



*RIGHT BANK SHORT CHAIN GUIDE*

4. Remove the short chain guide.

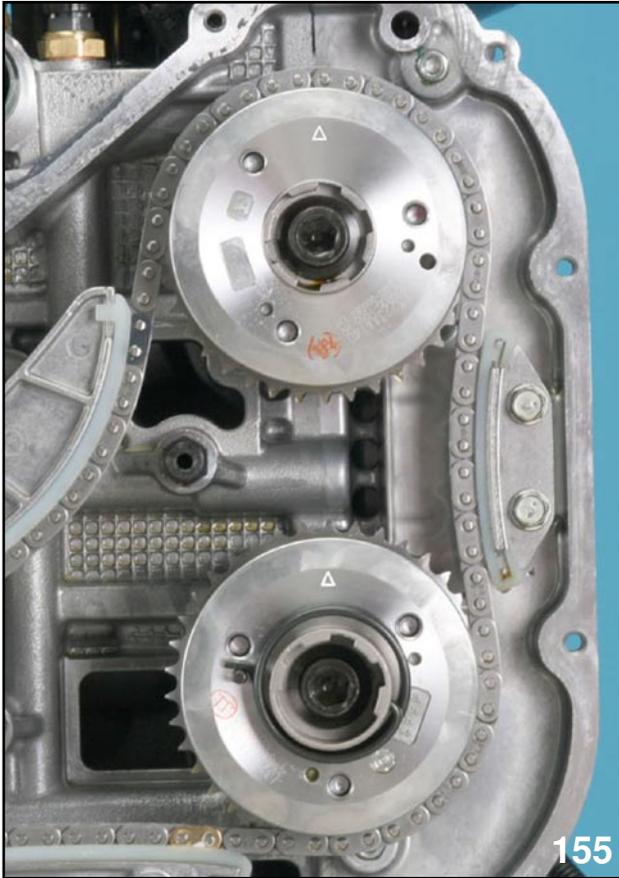


*RIGHT BANK LONG CHAIN GUIDE*

5. Remove the long chain guide.
6. Remove the chain.

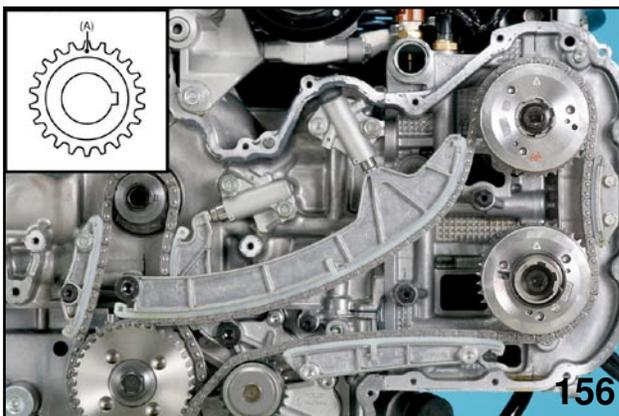
# 6 Cylinder Boxer Engines Series (104-H6)

## Left Bank



LEFT BANK CAMSHAFT AT 12:00 O'CLOCK POSITION

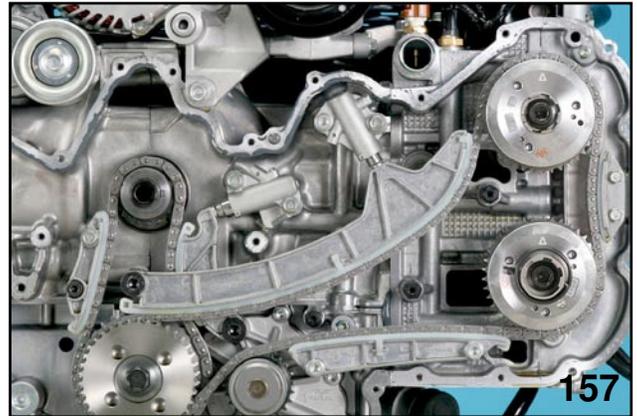
7. Rotate the Crankshaft 90 degrees.
  - The Crankshaft timing mark will be at 12:00 o'clock.



CRANKSHAFT KEY WAY AT 3:00 O'CLOCK

- The Crankshaft Key Way will be at 3:00.
- The arrow marks of the Intake and Exhaust cam sprockets will be at 12:00.

- The timing mark of the Intake sprocket will be at 3:00 o'clock.
- The timing mark of the exhaust cam sprocket will be at 3:00 o'clock.
- The timing mark on the idler will be at 6:00.
- This will result in the left bank Camshafts resting in an unloaded state.



LEFT BANK GUIDES

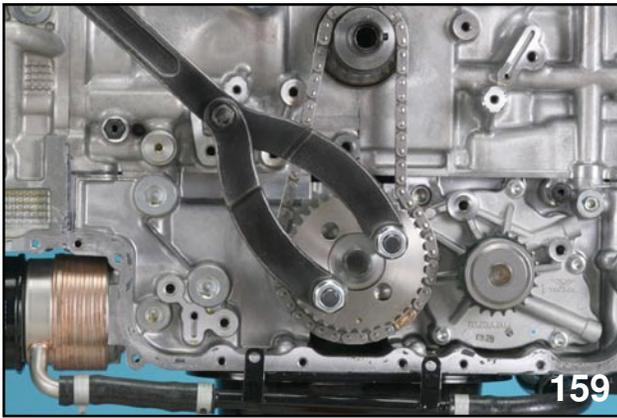
8. Remove the tensioner.
9. Remove the short chain guide.
10. Remove the chain tensioner lever.
11. Remove the long chain guide.
12. Remove the chain.



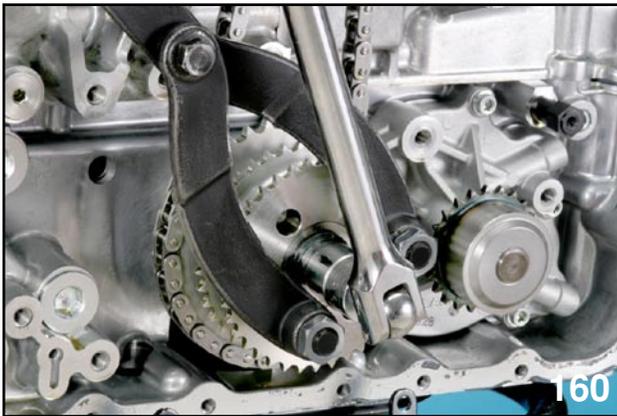
IDLER CHAIN

13. Remove the tensioner.
14. Remove the chain guide.
15. Remove the chain tensioner lever.

# 6 Cylinder Boxer Engines Series (104-H6)

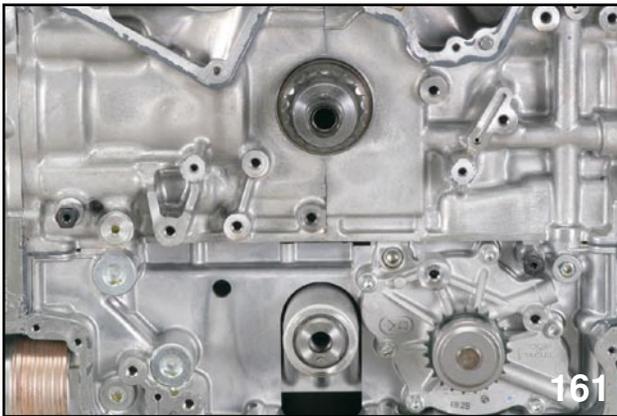


*ST18355AA000 PULLEY WRENCH AND  
ST18334AA000 PIN SET*



*BREAKER BAR AND SOCKET*

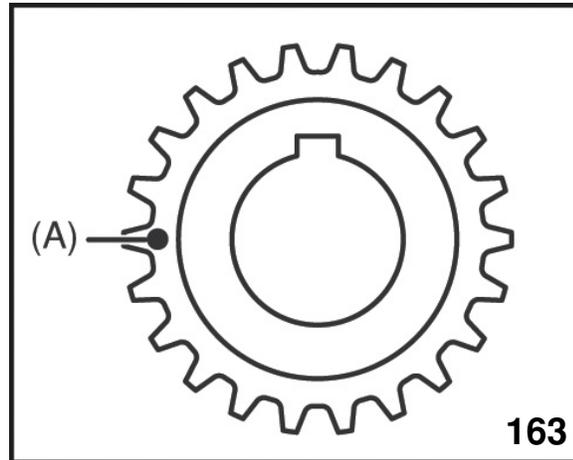
Use ST18355AA000 and ST18334AA000 to hold the idler stationary and remove the idler bolt. Remove the Crankshaft sprocket, chain and the idler together.



*IDLER SPROCKET AND OIL PUMP*

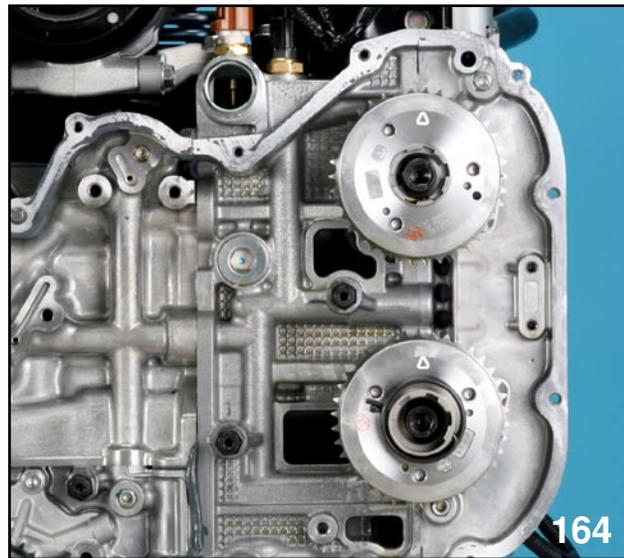
The idler sprocket also serves as the drive for the Oil Pump.

## Timing Chain Installation



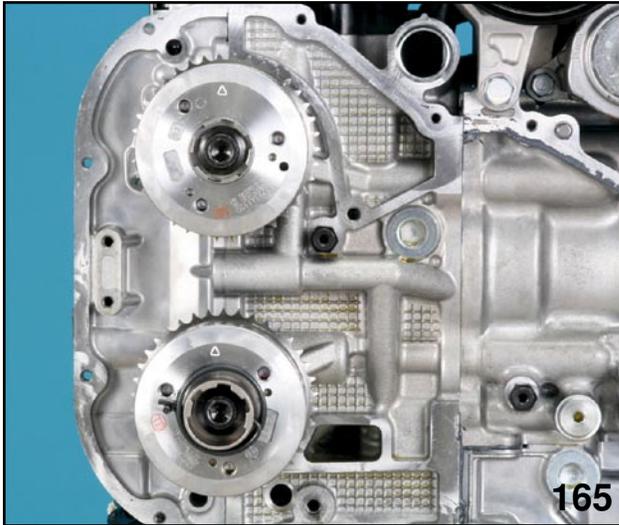
*CRANKSHAFT KEY WAY AT 12:00 O'CLOCK*

1. Position the Crankshaft Key Way at 12:00 o'clock (timing mark at 9:00 o'clock.)



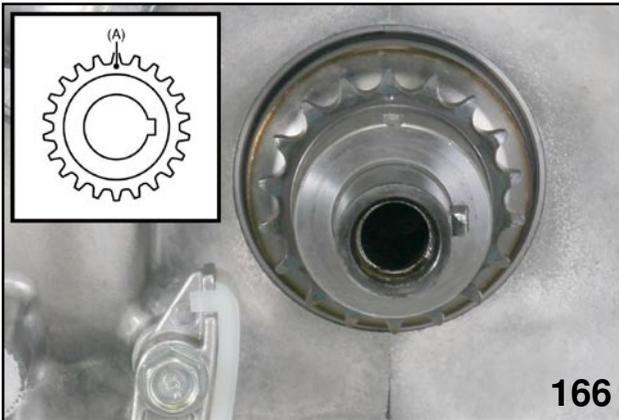
*INTAKE AND EXHAUST CAMSHAFT SPROCKETS ARROWS 12:00  
O'CLOCK*

# 6 Cylinder Boxer Engines Series (104-H6)



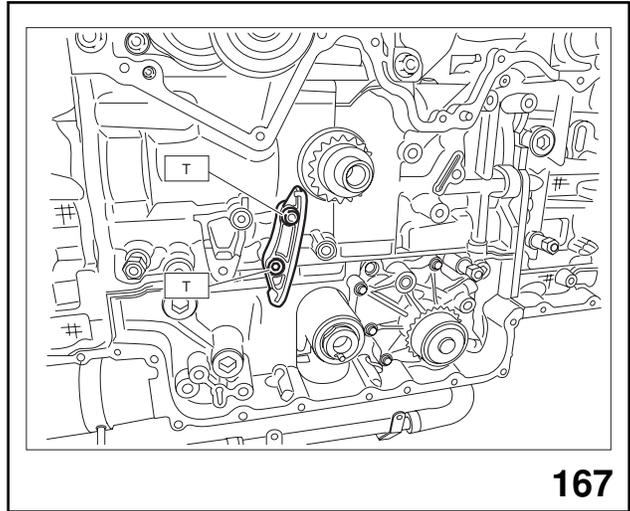
*INTAKE SPROCKET ARROWS 12:00 O'CLOCK*

2. Align the arrow marks of the intake and exhaust cam sprockets to 12:00 o'clock.



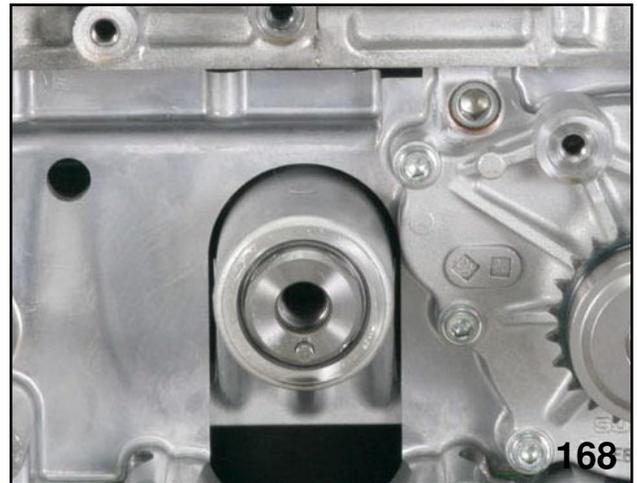
*CRANKSHAFT KEY WAY AT 3:00 O'CLOCK*

3. Position the Crankshaft Key Way to 3:00 o'clock (timing mark to 12:00 o'clock.)



*CHAIN GUIDE*

4. Install the chain guide.
5. Remove the Crankshaft Sprocket and assemble the timing chain, idler and Crankshaft Sprocket together. Position the parts on the Crankshaft and Oil Pump drive.



*OIL PUMP*

**NOTE: THE OIL PUMP DRIVE PIN MUST BE POSITIONED AT 6:00 O'CLOCK.**

# 6 Cylinder Boxer Engines Series (104-H6)



*CRANK TO IDLER*



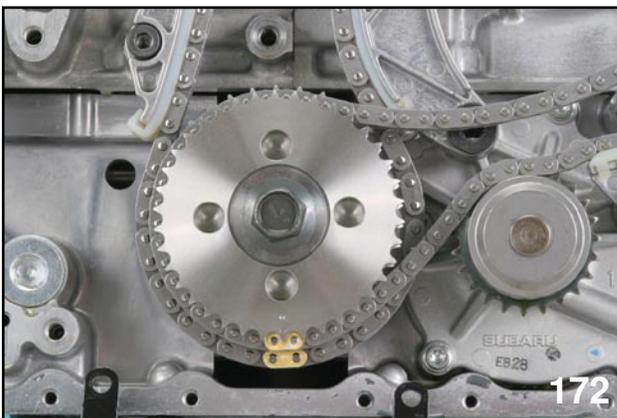
*CHAINS*

# 6 Cylinder Boxer Engines Series (104-H6)

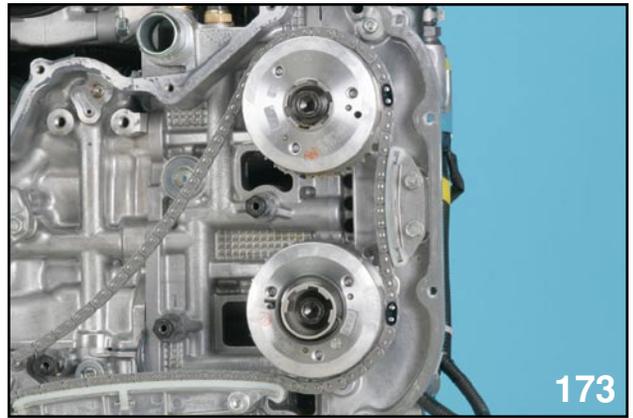


*IDLER CHAIN*

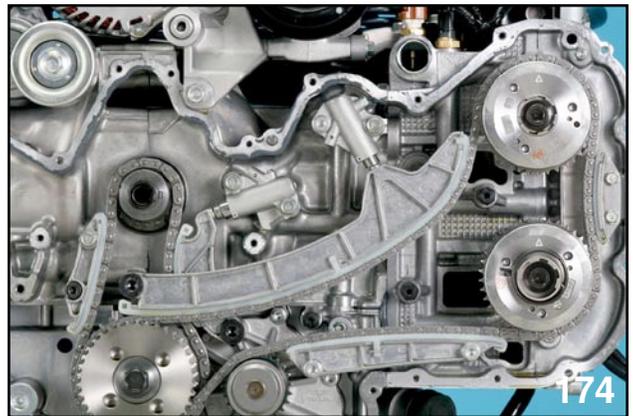
6. Install the chain tensioner lever and tensioner.  
Confirm the timing marks for the Crankshaft gear and idler are correctly positioned and release the captured tensioner.
7. Install the left bank long and short chain guides. Install the timing chain ensuring the timing marks on the idler gear and intake and Exhaust Camshaft sprockets are properly engaged with the timing chain.



*IDLER TIMING MARKS*

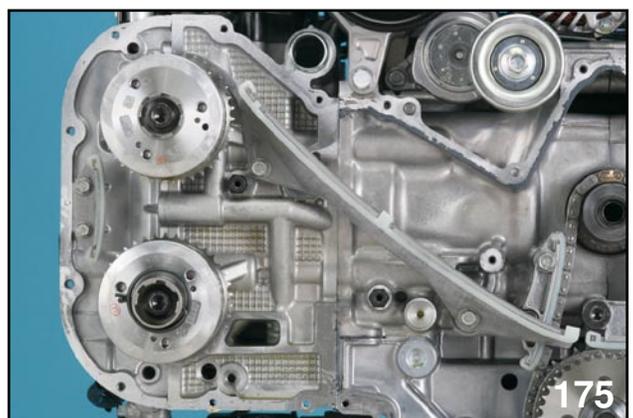


*CAMSHAFT SPROCKET TIMING MARKS*



*CHAIN TENSIONER LEVER AND TENSIONER*

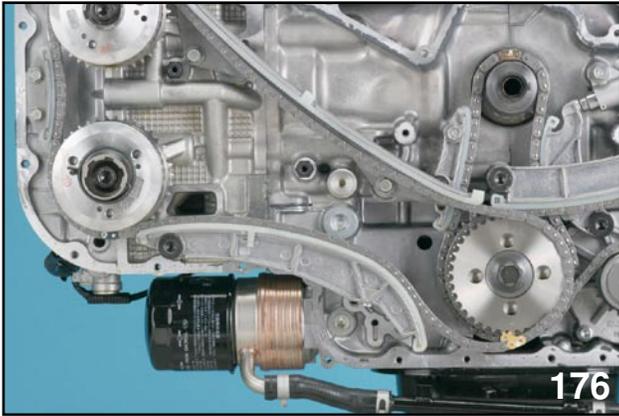
8. Install the chain tensioner lever and the tensioner. Release the captured tensioner.



*LONG AND SHORT CHAIN GUIDE*

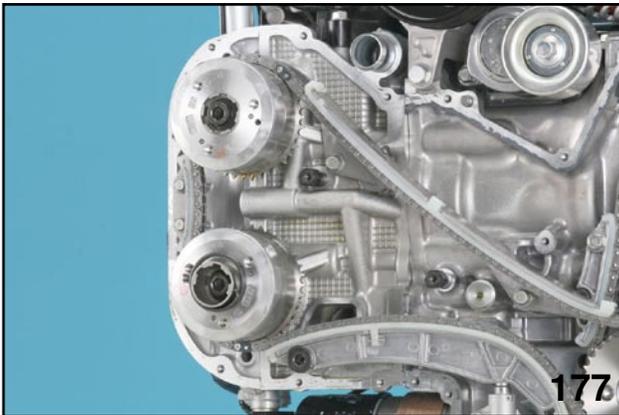
9. Install the right bank long and short chain guide.

# 6 Cylinder Boxer Engines Series (104-H6)



*RIGHT BANK CHAIN*

10. Install the timing chain ensuring the marks of the chain align with the marks on the intake and Exhaust Camshaft sprockets and idler. Install the chain tensioner lever and tensioner.



*CAMSHAFT SPROCKET TIMING MARKS*

11. Release the captured tensioner.

## The Dual Active Valve Timing System

The Dual Active Valve Timing System controls both the Intake and Exhaust Camshafts. The Intake Camshaft is advanced. The Exhaust Camshaft is retarded.



*INTAKE AND EXHAUST OCV*

Both Camshafts are operated by an Oil Charge Valve (OCV) that receives a duty ratio from the ECM. The higher the duty ratio, the higher the degree of operation.

The Intake Camshaft can advance up to 51 degrees ahead of its basic idle setting. When it advances it is rotated in the same direction as the engine operates (clockwise as viewed from the front of the engine).

The Exhaust Camshaft can retard up to 21 degrees behind its basic idle setting. When it retards it is rotated in the opposite direction of engine rotation (counter clockwise as viewed from the front of the engine).

# 6 Cylinder Boxer Engines Series (104-H6)

| Item   | Value | Unit | Maximum |
|--|-------|------|---------|
| <input checked="" type="checkbox"/> OCV Duty R             | 39.6  | %    | 46.7    |
| <input checked="" type="checkbox"/> VVT Adv. Ang. Amount R | 20    | deg  | 51      |
| <input checked="" type="checkbox"/> Exh OCV Duty R         | 47.8  | %    | 51.0    |
| <input checked="" type="checkbox"/> Exh. VVT Retard Ang. R | 12    | deg  | 21      |

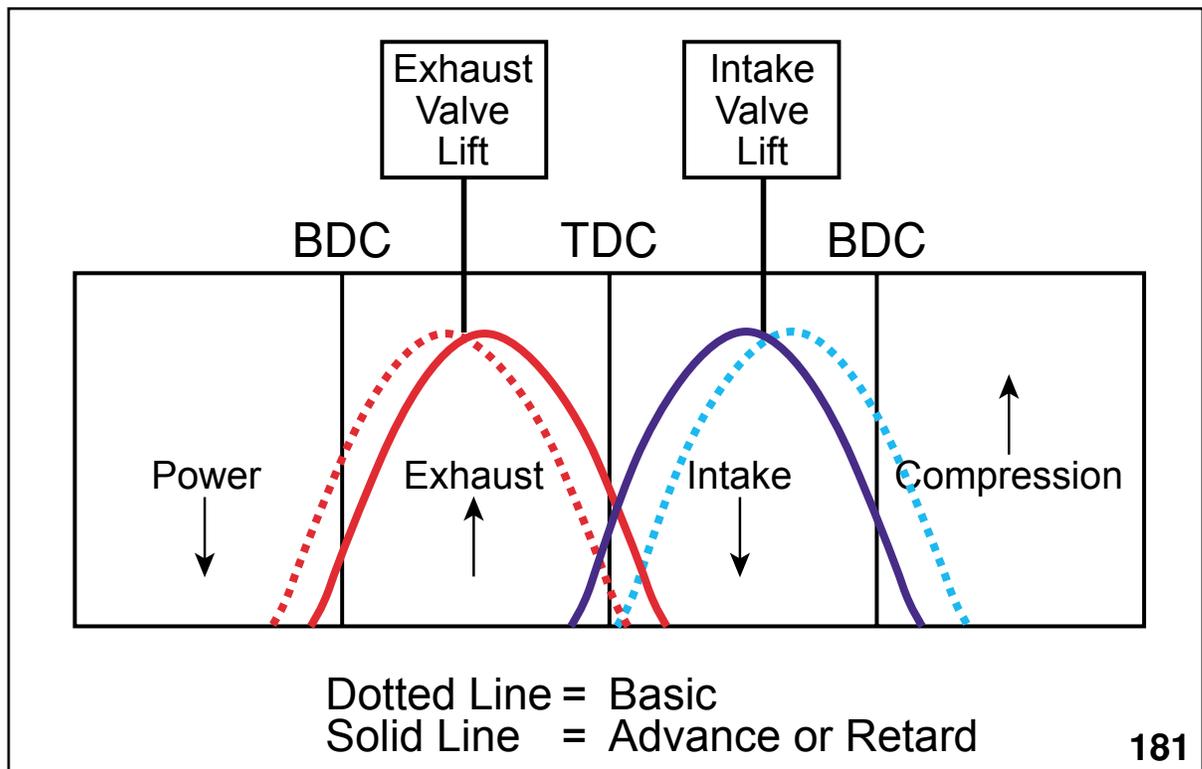
180

CHART

When the Intake Camshaft is advanced it allows more air and fuel to enter the cylinder and results in more power from combustion.

When the Exhaust Camshaft is retarded it allows the expanding gases of the power stroke to push on the piston for a longer period of time resulting in better fuel efficiency.

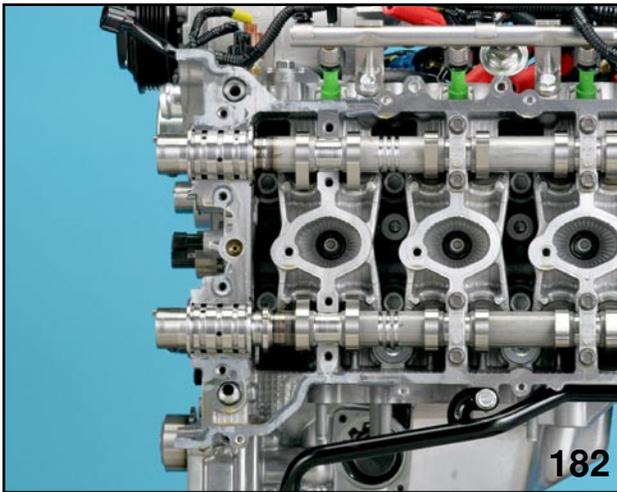
By combining the precise control of both Camshafts together a condition is created where the Intake and Exhaust valves work together to create better scavenging of the cylinders, reduced pumping loss and a better internal EGR affect.



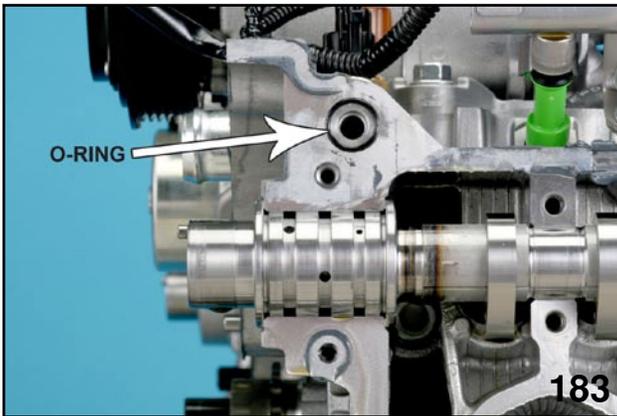
181

GRAPH

# 6 Cylinder Boxer Engines Series (104-H6)

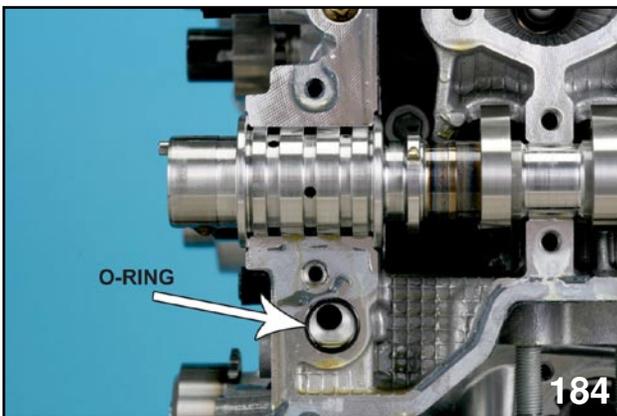


CAMSHAFT OCV OIL PORTS

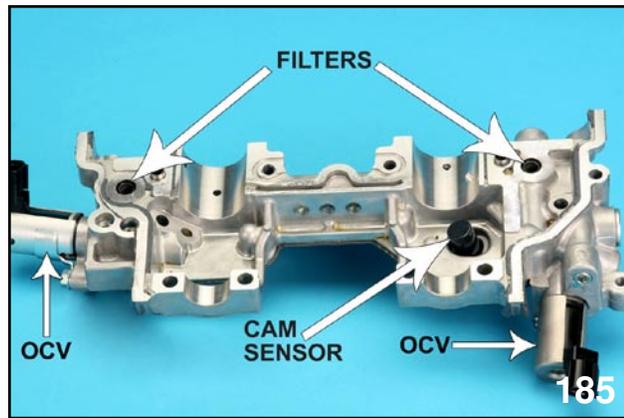


O-RING

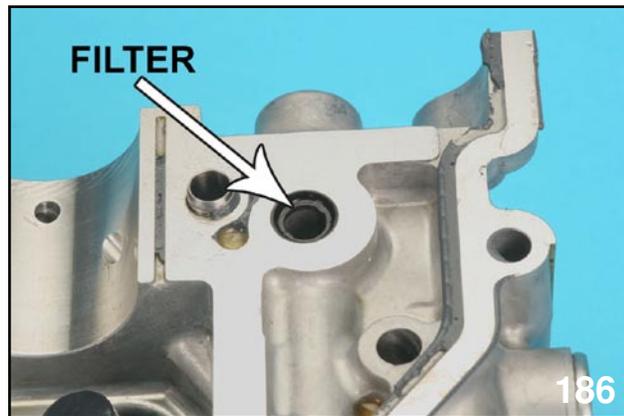
Oil pressure is delivered to the apply and release side of actuators of the intake and exhaust sprockets through oil ports made into the end of each Camshaft.



O-RING



PLACEMENTS OF FILTERS, OCV, CAM SENSOR ON CAMSHAFT CAP



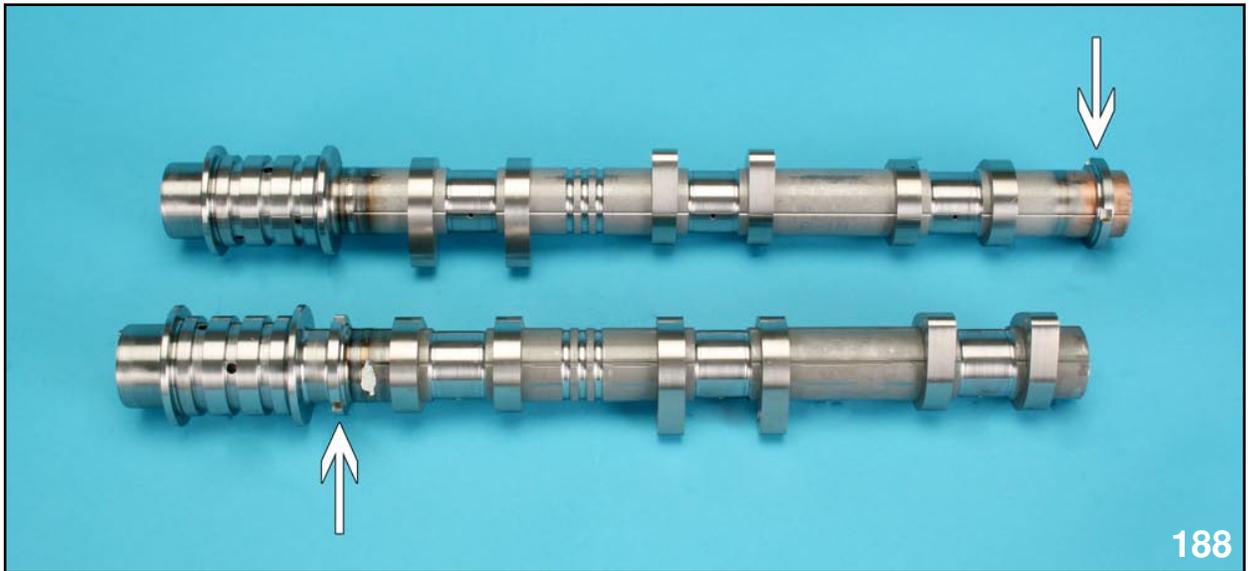
PLACEMENT OF OIL FILTER

The Camshaft cap houses the OCV of each Camshaft and a small oil filter is installed into the Camshaft cap that filters oil before entering the OCV.



OIL FILTER

# 6 Cylinder Boxer Engines Series (104-H6)



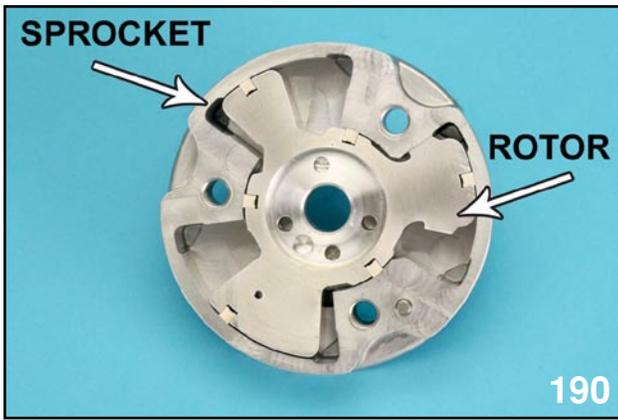
*CAMSHAFT SENSOR RELUCTORS*

The intake and Exhaust Camshafts both have a reluctor for the Camshaft sensors.



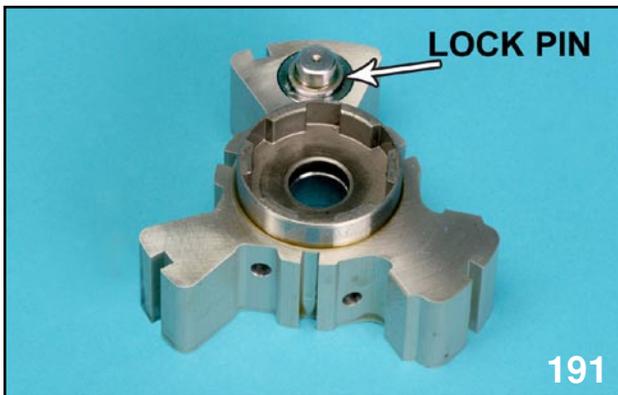
*INTAKE CAMSHAFT SPROCKET*

# 6 Cylinder Boxer Engines Series (104-H6)

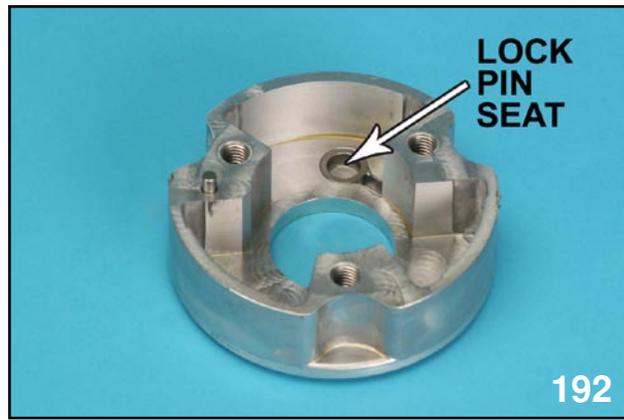


*SPROCKET AND ROTOR ATTACHED TO CAMSHAFT*

The variable valve timing is possible because of the ability of independent movement of the chain sprocket and the inner rotor which is attached to the Camshaft. As oil pressure is applied to one side or the other of the rotor the Camshaft will rotate, in or opposite engine rotation direction.



*INNER ROTOR BUILT IN LOCK PIN*



*LOCK PIN SEAT*

Each inner rotor has a built in lock pin which is spring loaded to keep the inner rotor locked to the chain sprocket. This is needed for engine start up and fail-safe operation. When the ECM decides to adjust the valve timing the lock pin is pushed into the rotor with oil pressure from the OCV and the lock pin is released from the chain sprocket.

The Intake Camshaft is always at a basic level (locked) or advanced (moving ahead of the chain sprocket). When fail-safe occurs the chain sprocket will catch up to the rotor and the lock pin will engage into the lock pin seat made on the chain sprocket.

# 6 Cylinder Boxer Engines Series (104-H6)

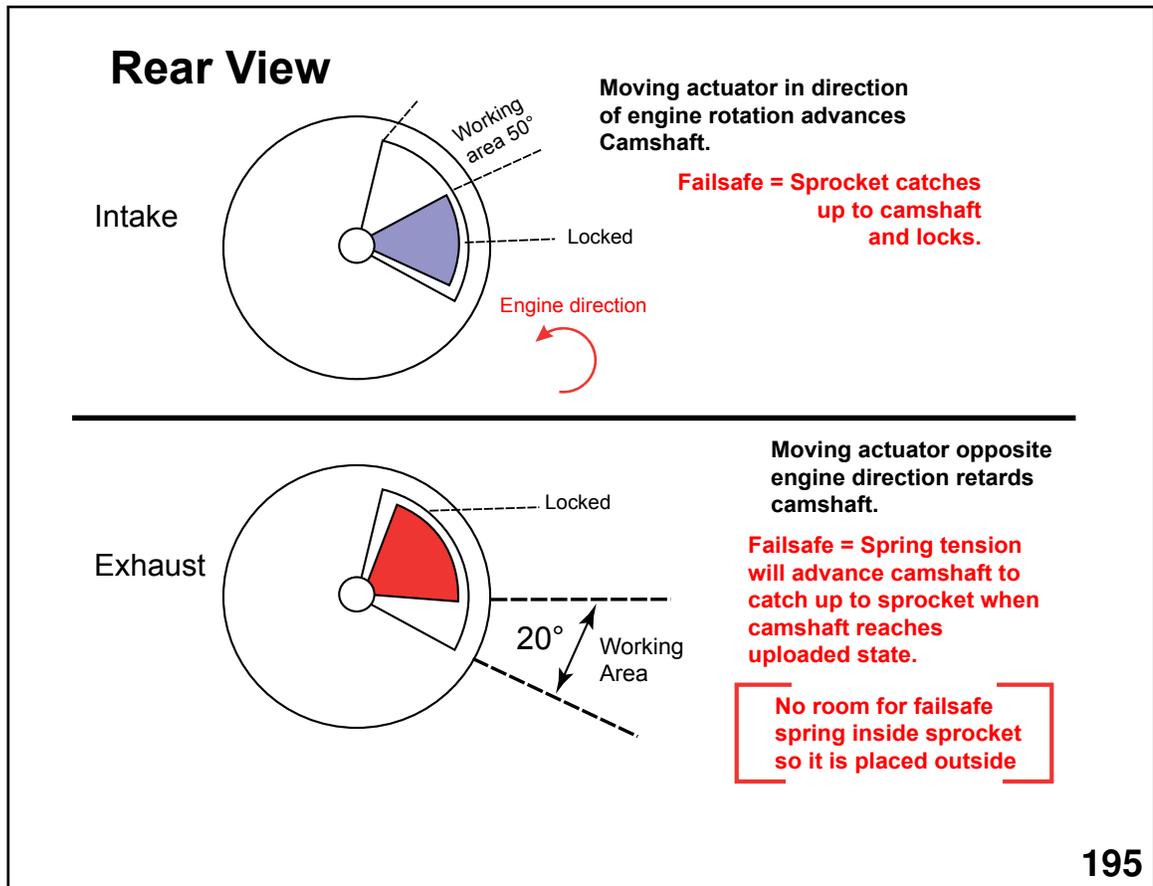


EXHAUST CAMSHAFT SPROCKET AND RETURN SPRING



SPROCKET AND ROTOR LOCATION

The Exhaust Camshaft is always at a basic level (locked) or retarded (moving opposite of the chain sprocket rotation). When fail-safe occurs it is necessary to use a return spring to move the Camshaft rotor in the direction of rotation of the chain sprocket. During deceleration or when the Camshaft reaches an unloaded state the force of the spring will move the rotor and Camshaft clockwise until the lock pin reaches the lock pin seat and the spring loaded lock pin will lock into the chain sprocket.



REAR VIEW CHART

# 6 Cylinder Boxer Engines Series (104-H6)

## New 2008 3.6 Liter Engine Trouble Codes

| DTC   | Item  | Reference   |
|-------|---|---|
| P0014 | Exhaust AVCS system 1 (range/performance)                     | <Ref. to EN (H6DO) (diag)-93, DTC P0014 EXHAUST AVCS SYSTEM 1 (RANGE/PERFORMANCE), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>                    |
| P0017 | Crank and Cam timing B system failure (Bank 1)                | <Ref. to EN(H6DO)(diag)-95, DTC P0017 CRANK AND CAM TIMING B SYSTEM FAILURE - (BANK 1), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>               |
| P0019 | Crank and Cam timing B system failure (Bank 2)                | <Ref. to EN(H6DO)(diag)-97, DTC P0019 CRANK AND CAM TIMING B SYSTEM FAILURE (BANK 2), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>                 |
| P0024 | Exhaust AVCS system 2 (range/performance)                     | <Ref. to EN(H6DO)(diag)-99, DTC P0024 EXHAUST AVCS SYSTEM 2 (RANGE/PERFORMANCE), Diagnostic Procedure with diagnostic Trouble Code (DTC).>                      |
| P0365 | Camshaft Position Sensor "B" Circuit (Bank 1)                 | <Ref. to EN(H6DO)(diag)-256, DTC P0365 Camshaft POSITION SENSOR "B" CIRCUIT (BANK 1), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>                 |
| P0390 | Camshaft Position Sensor "B" Circuit (Bank 2)                 | <Ref. to EN(H6DO)(diag)-258, DTC P0390 Camshaft POSITION SENSOR "B" CIRCUIT (BANK 2), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>                 |
| P0400 | Exhaust Gas Recirculation Flow                                | <Ref. to EN(H6DO)(diag)-260, DTC P0400 EXHAUST GAS RECIRCULATION FLOW. Diagnostic Procedure with Diagnostic Trouble Code (DTC).>                                |
| P1492 | EGR Solenoid Valve Signal #1 Circuit Malfunction (Low Input)  | <Ref. to EN(H6DO)(diag)-315, DTC P1492 EGR SOLENOID VALVE SIGNAL #1 CIRCUIT MALFUNCTION (LOW INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>  |
| P1493 | EGR Solenoid Valve Signal #1 Circuit Malfunction (High Input) | <Ref. to EN(H6DO)(diag)-315, DTC P1493 EGR SOLENOID VALVE SIGNAL #1 CIRCUIT MALFUNCTION (HIGH INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).> |
| P1494 | EGR Solenoid Valve Signal #2 Circuit Malfunction (Low Input)  | <Ref. to EN(H6DO)(diag)-315, DTC P1494 EGR SOLENOID VALVE SIGNAL #2 CIRCUIT MALFUNCTION (LOW INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>  |
| P1495 | EGR Solenoid Valve Signal #2 Circuit Malfunction (High Input) | <Ref. to EN(H6DO)(diag)-315, DTC P1495 EGR SOLENOID VALVE SIGNAL #2 CIRCUIT MALFUNCTION (HIGH INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).> |
| P1496 | EGR Solenoid Valve Signal #3 Circuit Malfunction (Low Input)  | <Ref. to EN(H6DO)(diag)-315, DTC P1496 EGR SOLENOID VALVE SIGNAL #3 CIRCUIT MALFUNCTION (LOW INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>  |

# 6 Cylinder Boxer Engines Series (104-H6)

| DTC   | Item   | Reference  |
|-------|--|--|
| P1497 | EGR Solenoid Valve Signal #3 Circuit Malfunction (High Input)    | <Ref. to EN(H6DO)(diag)-315, DTC P1497 EGR SOLENOID VALVE SIGNAL #3 CIRCUIT MALFUNCTION (HIGH INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>    |
| P1498 | EGR Solenoid Valve Signal #4 Circuit Malfunction (Low Input)     | <Ref. to EN(H6DO)(diag)-316, DTC P1498 EGR SOLENOID VALVE SIGNAL #4 CIRCUIT MALFUNCTION (LOW INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>     |
| P1499 | EGR Solenoid Valve Signal #4 Circuit Malfunction (High Input)    | <Ref. to EN(H6DO)(diag)-319, DTC P1499 EGR SOLENOID VALVE SIGNAL #4 CIRCUIT MALFUNCTION (HIGH INPUT), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>    |
| P2090 | Exhaust Camshaft Position Actuator Control Circuit Low (Bank 1)  | <Ref. to EN(H6DO)(diag)-338, DTC P2090 EXHAUST Camshaft POSITION ACTUATOR CONTROL CIRCUIT LOW (BANK 1), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>  |
| P2091 | Exhaust Camshaft Position Actuator Control Circuit High (Bank 1) | <Ref. to EN(H6DO)(diag)-340, DTC P2091 EXHAUST Camshaft POSITION ACTUATOR CONTROL CIRCUIT HIGH (BANK 1), Diagnostic Procedure with Diagnostic Trouble Code (DTC).> |
| P2094 | Exhaust Camshaft Position Actuator Control Circuit Low (Bank 2)  | <Ref. to EN(H6DO)(diag)-346, DTC P2094 EXHAUST Camshaft POSITION ACTUATOR CONTROL CIRCUIT LOW (BANK 2), Diagnostic Procedure with Diagnostic Trouble Code (DTC).>  |
| P2095 | Exhaust Camshaft Position Actuator Control Circuit High (Bank 2) | <Ref. to EN(H6DO)(diag)-348, DTC P2095 EXHAUST Camshaft POSITION ACTUATOR CONTROL CIRCUIT HIGH (BANK 2), Diagnostic Procedure with Diagnostic Trouble Code (DTC).> |

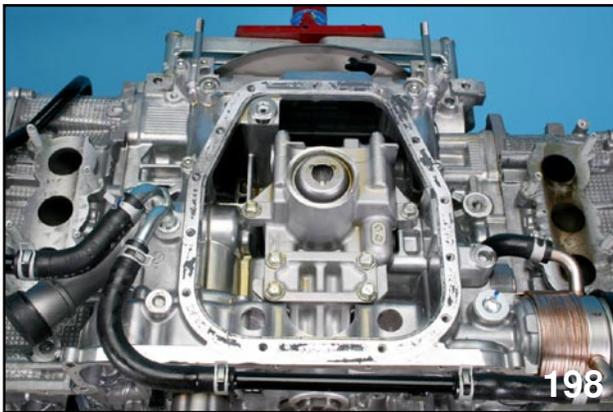
# 6 Cylinder Boxer Engines Series (104-H6)

## Oil Pump



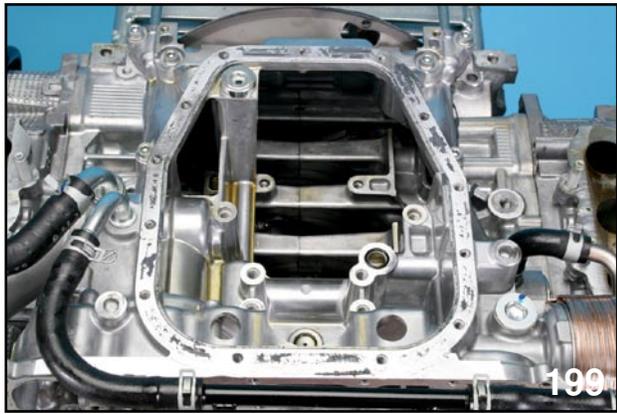
*LOWER OIL PAN*

The lower Oil Pan is attached to the upper Oil Pan with 13 bolts and sealed with liquid gasket.



*OIL PUMP*

Six (6) bolts secure the Oil Pump to the upper Oil Pan and 2 O-rings seal the Oil Pump to the upper Oil Pan.



*O-RINGS (2)*

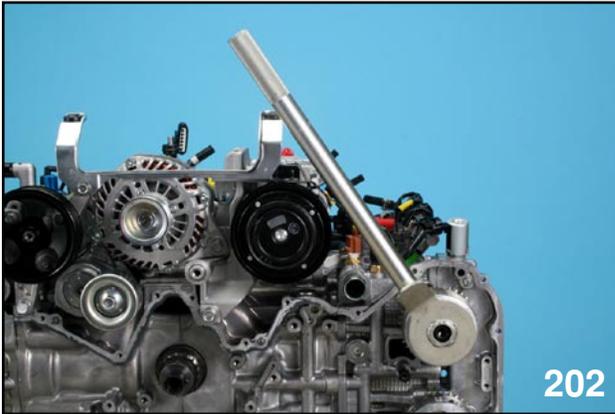


*OIL PUMP R & R IS AN IN CAR PROCEDURE*

Cylinder head removal is required to remove the upper Oil Pan.

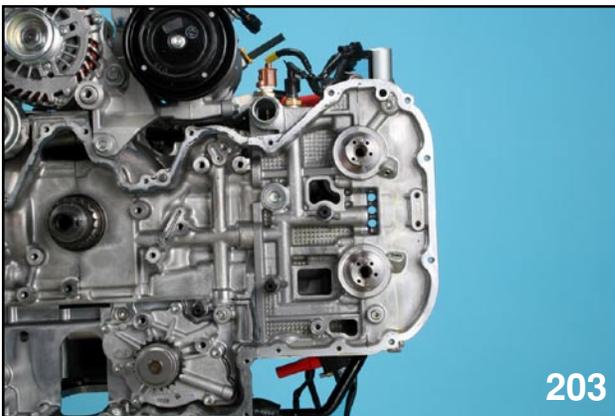
# 6 Cylinder Boxer Engines Series (104-H6)

## Cylinder Head Removal



*ST499977500*

Remove the Camshaft sprockets using ST499977500 and a 10 mm Allen Wrench.



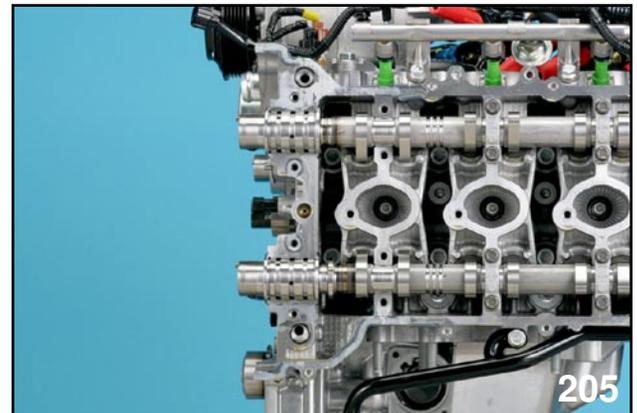
*CAMSHAFT SPROCKETS REMOVED*



*SHIM BUCKET*

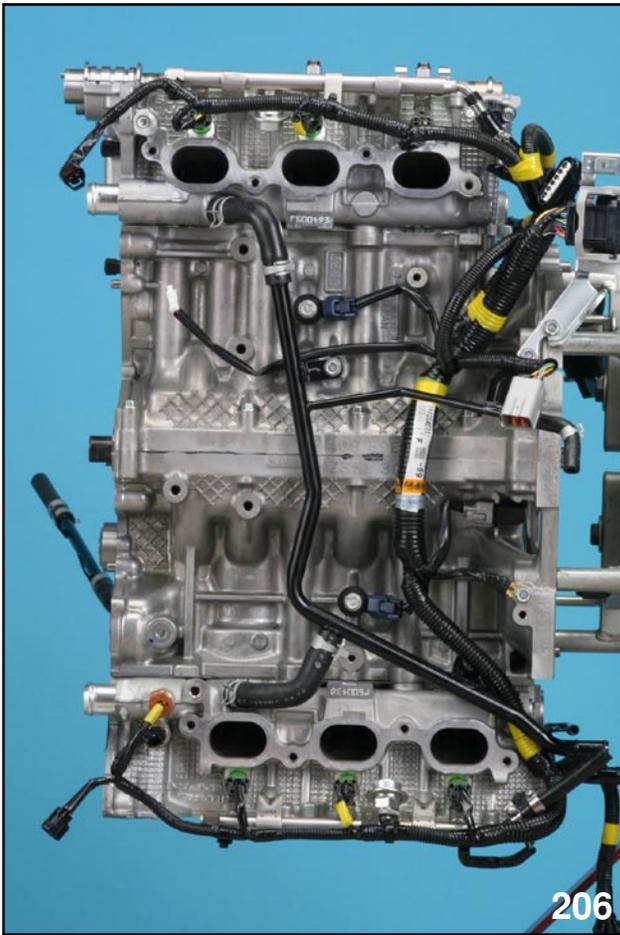
Remove the valve cover, Camshaft caps and Camshafts. (Valve Shim Buckets will fall when the Camshafts are removed. Carefully remove and maintain position for reassembly.)

Remove the cylinder head bolts and cylinder heads.



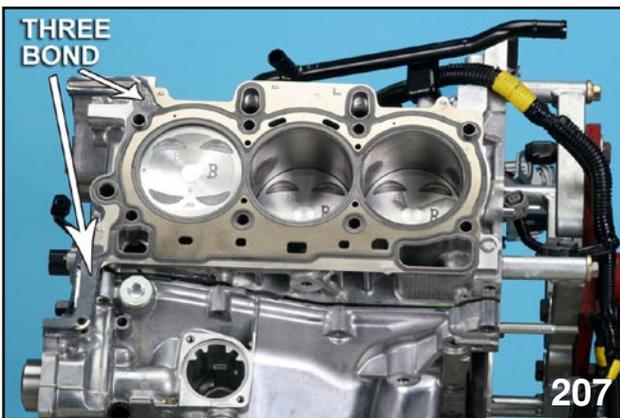
*CYLINDER HEAD BOLTS*

# 6 Cylinder Boxer Engines Series (104-H6)

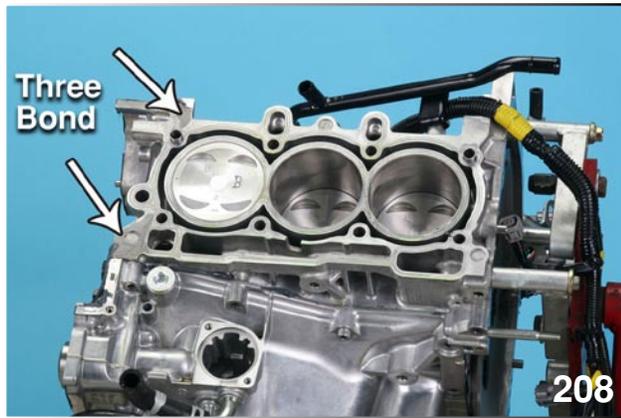


*WIRING HARNESSSES, COOLANT LINES AND HOSES ON CYLINDER HEADS*

Remove wiring harnesses, coolant lines and hoses from the cylinder heads.



*HEAD GASKETS UPPER*



*HEAD GASKETS LOWER*

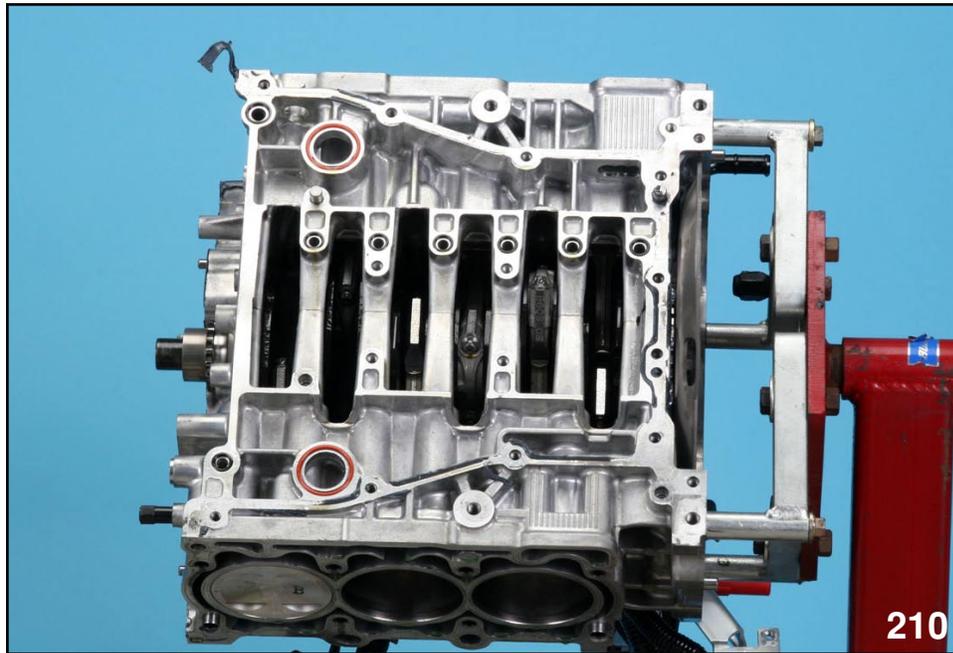
The head gaskets receive three bond on and below the head gasket at the indicated points.



*UPPER OIL PAN*

Remove the bolts from the upper Oil Pan and remove the upper Oil Pan from the cylinder block.

# 6 Cylinder Boxer Engines Series (104-H6)



*SHOWING O-RINGS*

There are 10 O-rings that seal the coolant and oil passages between the upper Oil Pan and the engine block.



*CONNECTING ROD*

The shape and design of the Connecting Rod provides strength and allows for the increase in stroke.



*CONNECTING ROD SIDE VIEW*

# 6 Cylinder Boxer Engines Series (104-H6)



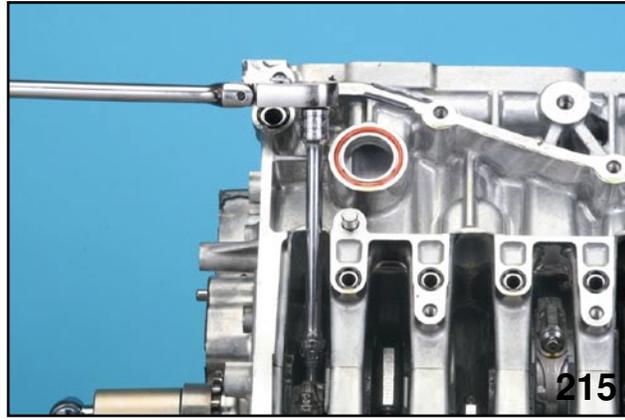
CONNECTING ROD CAP SEAM



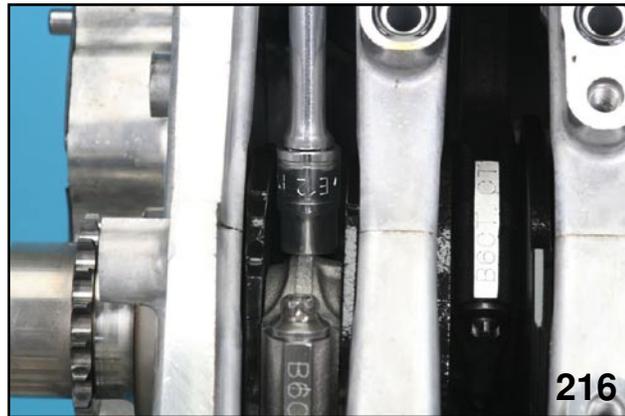
CONNECTING ROD CAP SEPARATED FROM ROD

The Connecting Rod cap is snapped from the Connecting Rod during construction which allows for a perfect fit to the Connecting Rod. This eliminates the need for dowel pins or other alignment devices.

The overall length of the Connecting Rod is shorter than the 3.0 liter but the Connecting Rod journal is 5.5 mm longer. The shape of the Connecting Rod ensures clearance between the Connecting Rod end cap and the bottom of the piston of a companion cylinder.



E 12 TORX® SOCKET ON CONNECTING ROD BOLT



REMOVAL OF CONNECTING ROD BOLT

The Connecting Rods are accessed from the bottom of the engine block. An E 12 Torx® socket is necessary to remove the Connecting Rod bolts.

Removal of the Connecting Rod caps and pistons should be performed in three stages. First, remove the # 1, # 4 Connecting Rod caps and pistons at the same time, then remove the # 2, # 5 Connecting Rod caps and pistons at the same time, then # 3, # 6 Connecting Rod caps and pistons at the same time.



# 6 Cylinder Boxer Engines Series (104-H6)



*SPLIT BLOCK CASE*

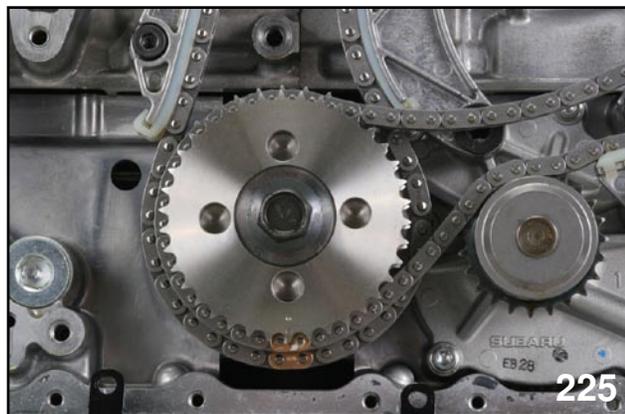
## Water Pump



*IMPELLER VIEW*



*DRIVE SPROCKET VIEW*

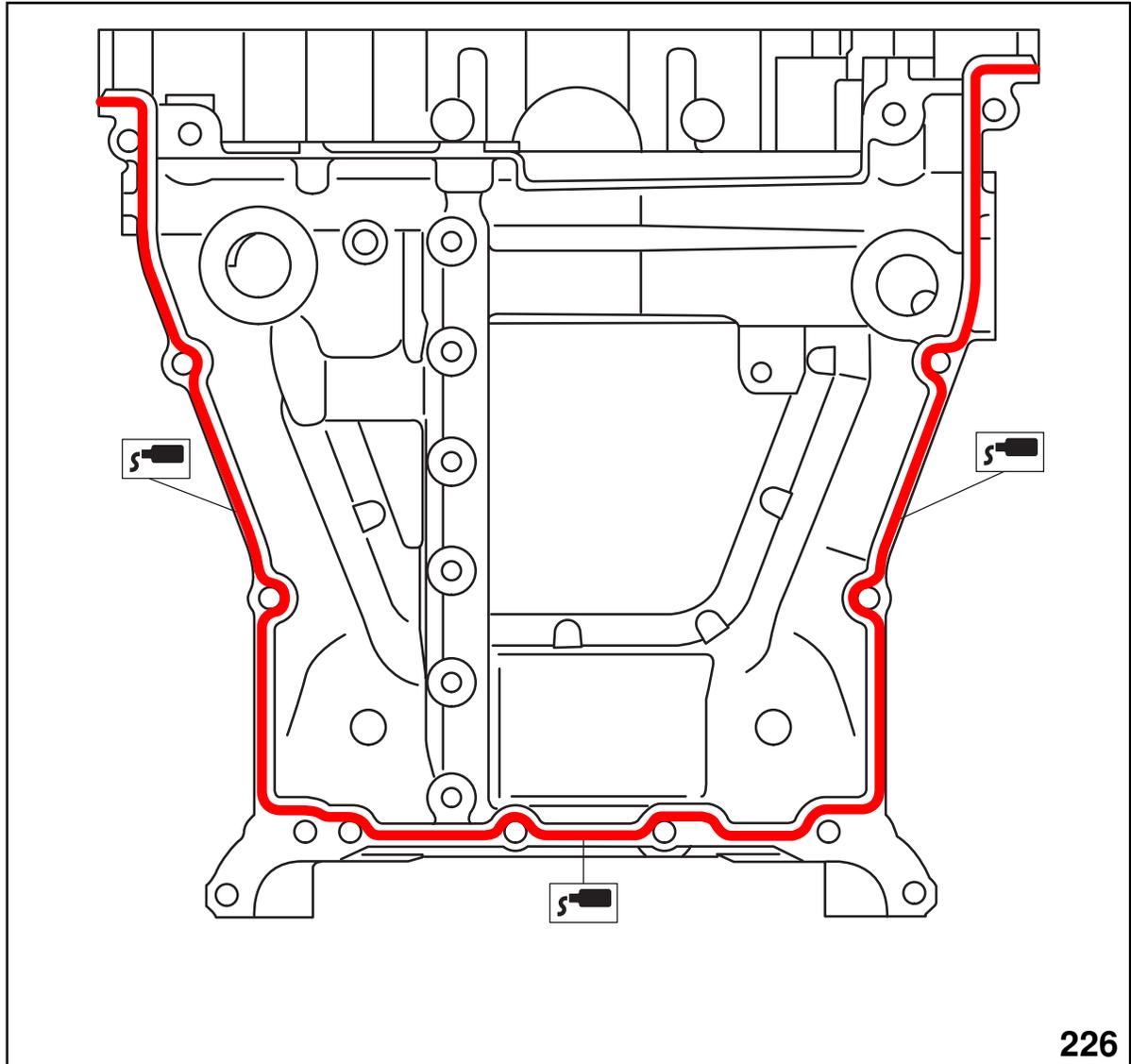


*CHAIN DRIVING WATER PUMP SPROCKET*

# 6 Cylinder Boxer Engines Series (104-H6)

Follow procedures in the appropriate Subaru Service Manual on STIS web site, during reassembly and for checking chain guide clearances.

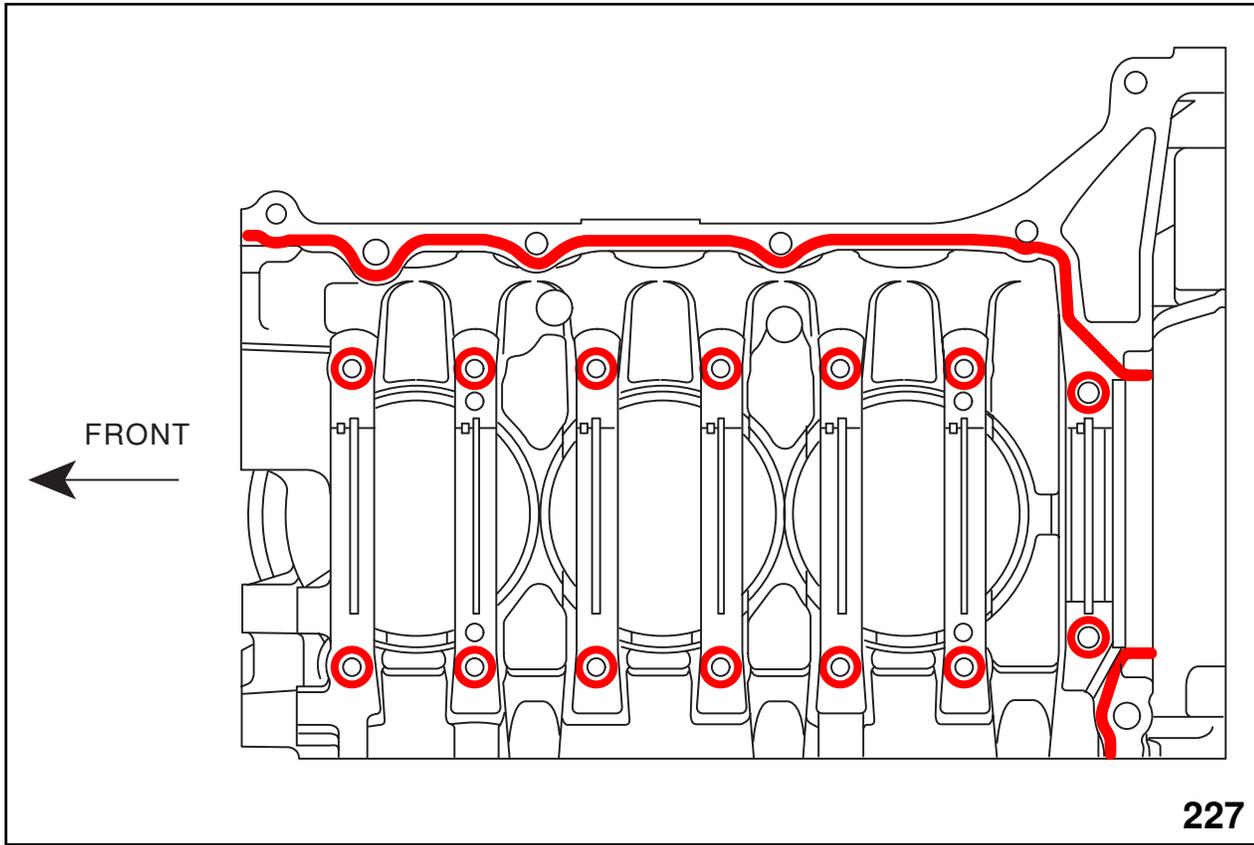
## FUJI BOND APPLICATION GUIDE FOR OIL PAN EXTENSION HOUSING (UPPER OIL PAN)



LOWER CASE

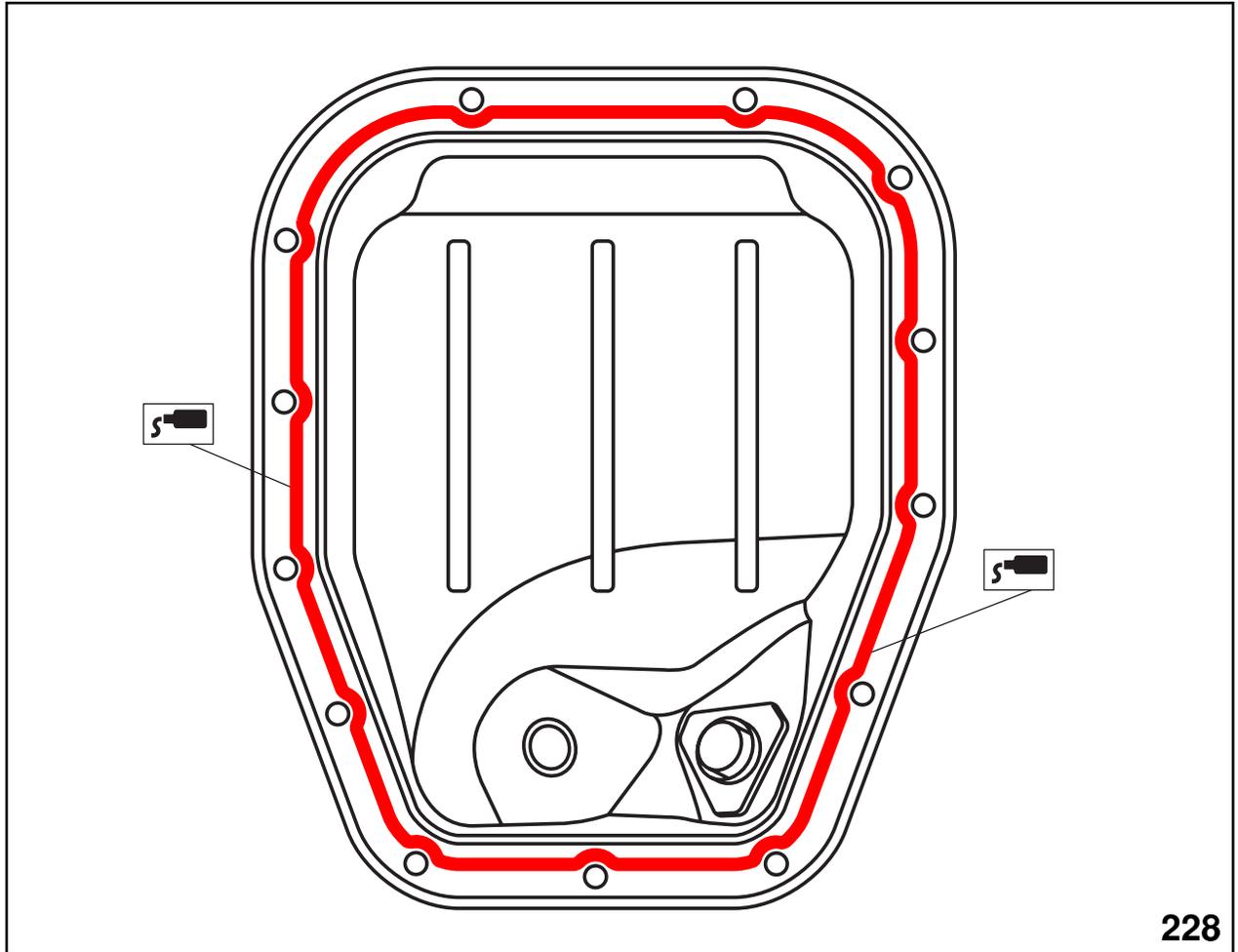
# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE FOR BLOCK HALVES



*BLOCK HALVES*

## FUJI BOND APPLICATION GUIDE FOR OIL PAN (LOWER)

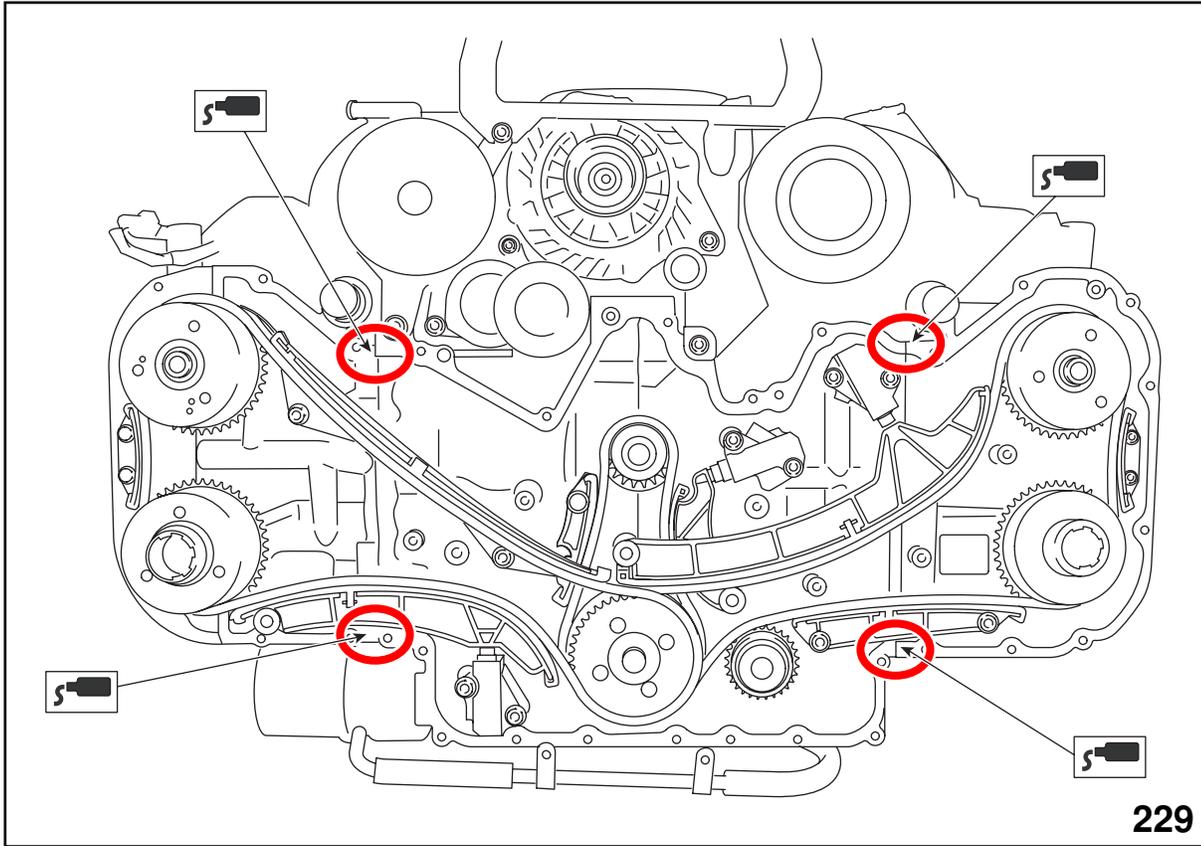


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*OIL PAN*

# 6 Cylinder Boxer Engines Series (104-H6)

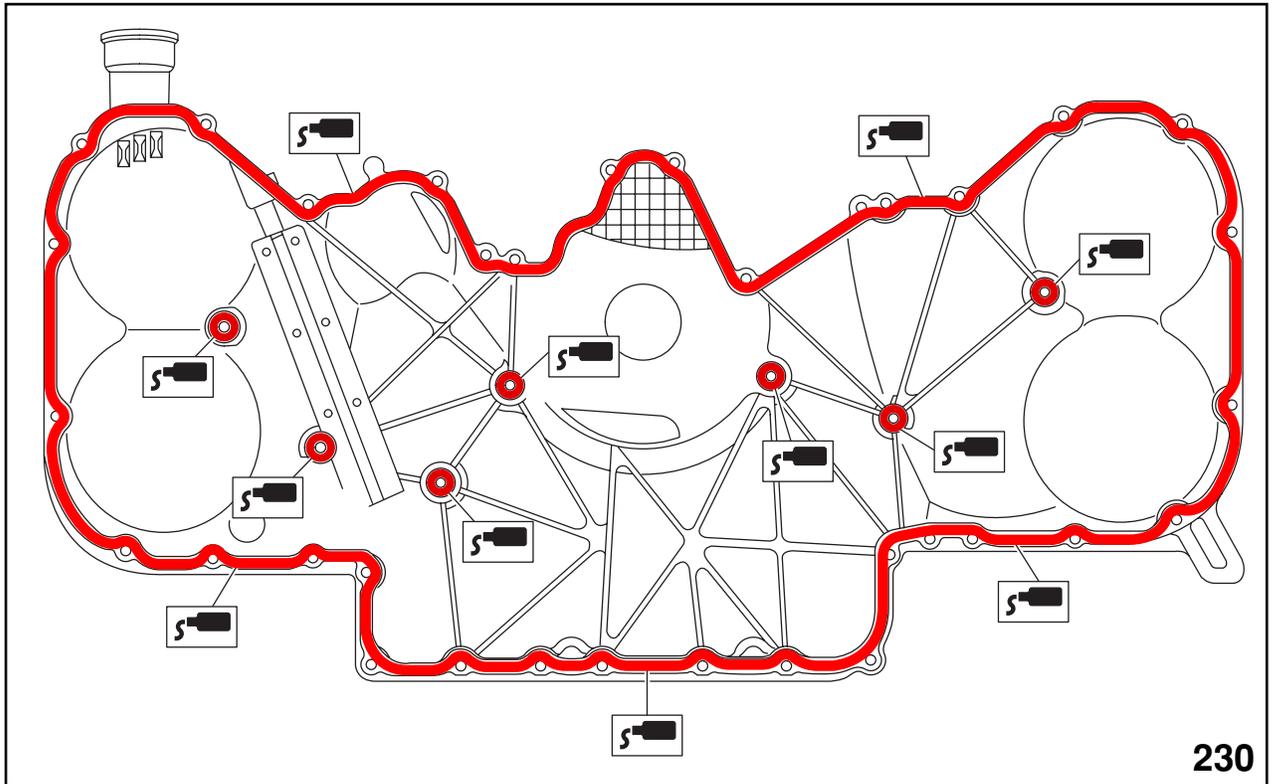
## FUJI BOND APPLICATION GUIDE CYLINDER BLOCK, CYLINDER HEAD AND OIL PAN UPPER



*CYLINDER BLOCK, CYLINDER HEAD AND OIL PAN UPPER*

# 6 Cylinder Boxer Engines Series (104-H6)

## FUJI BOND APPLICATION GUIDE CHAIN COVER

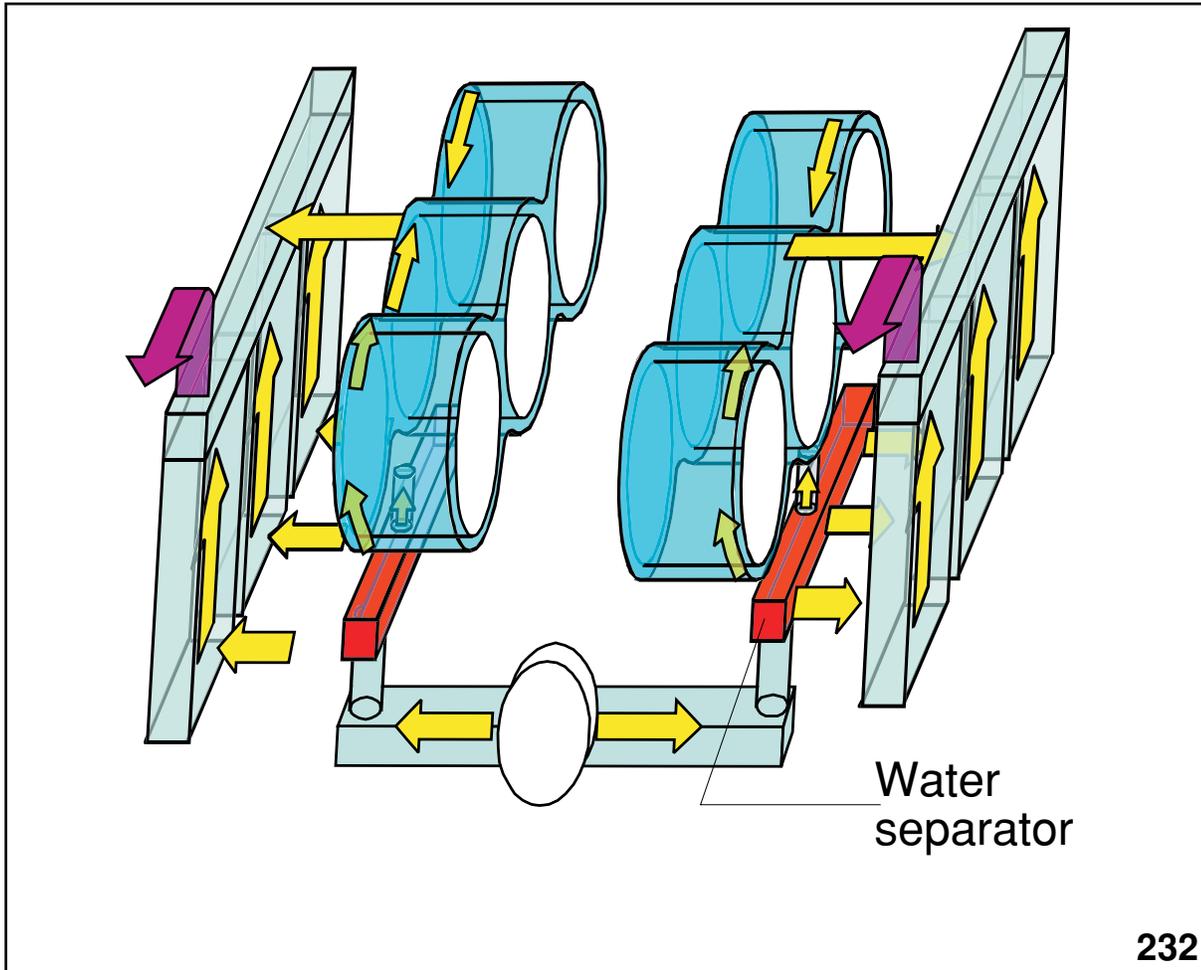


CHAIN COVER

# 6 Cylinder Boxer Engines Series (104-H6)

## Cooling System

The cooling system has been changed to a parallel flow. This design utilizes a water separation chamber in the engine block that allows coolant to flow to and across the cylinders and to and through the cylinder heads simultaneously. This produces a more even engine coolant temperature throughout the entire engine and assists with controlling engine knock. (Ignition timing can stay more advanced as cooler temperatures do not promote engine knock).



*PARALLEL FLOW COOLING SYSTEM*

# 6 Cylinder Boxer Engines Series (104-H6))

## Oil Pump



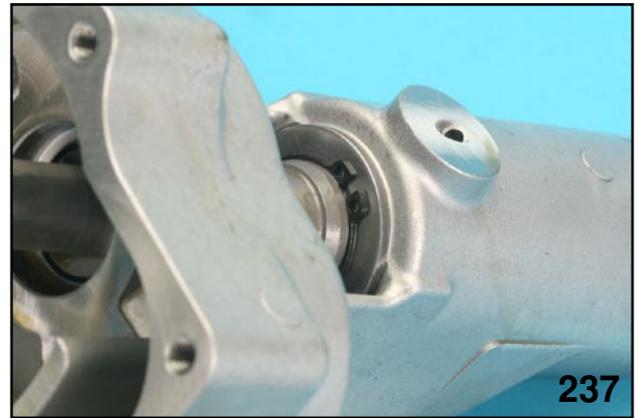
OIL PUMP FRONT VIEW



OIL PUMP CONSTRUCTION



OIL PUMP HOUSING



THRUST WASHER AND SNAP RING



IDLER SPROCKET

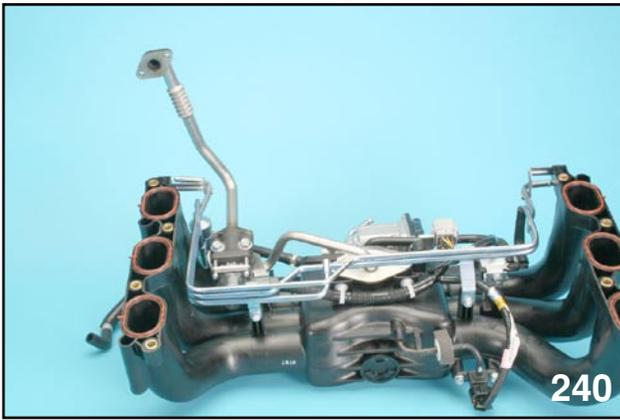
The 3.6 liter engine is equipped with EGR.



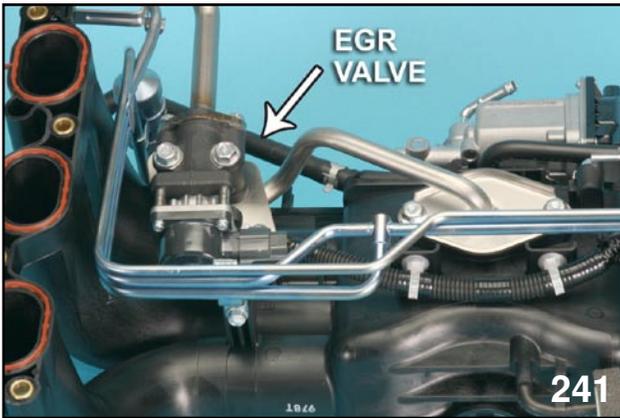
EGR PORT

An exhaust port located on the rear of the left bank cylinder head supplies the exhaust gas through a metal pipe to an electronic EGR valve.

# 6 Cylinder Boxer Engines Series (104-H6)



EGR PIPE



EGR VALVE

## Oil Level Sensor



UPPER OIL PAN

A new oil level sensor system has been added to all engines. This system will check the oil level at idle only. The light will illuminate when the oil level falls to the following levels:

6 cylinder engines 5.3 to 5.6 quarts

A float type sensor is utilized that is equipped with a small magnet. The magnet keeps a reed switch closed when the oil level is not low.

Once the light is ON the ECM memory must be cleared to extinguish the light, or allow the engine to operate until warm. There is no DTC when the light is illuminated. A PID on the SMIII engine menu will indicate "High" if the oil level is above the light on threshold and "Low" when it is at or below the threshold.

Oil level switch.ssm - SUBARU Select Monitor III - C:\Documents and Settings\mbre\Local Settings\Temporary Internet Files\OLK27\Oil level switch.ssm

File View Tool Help

F3 Graph1 F5 Select F7 Range F8 Print F9 Save F10 Non SI F11 Back F12 Exit

| Item   | Value      | Unit | Maximum | Minimum | Average |
|--|------------|------|---------|---------|---------|
| <input checked="" type="checkbox"/> Oil level switch | HIGH level |      | -       | -       | -       |

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PID OIL LEVEL SWITCH

# 6 Cylinder Boxer Engines Series (104-H6)



*REMOVAL*



*FLOAT*

When replacing the sensor the oil must be drained from the engine. During removal the sensor must be lifted slightly and then turned approx. 90 degrees towards the rear so that the float chamber will clear. The sensor has one wire leading to the ECM. The ground for the sensor is attached at the rear mounting bolt.

**NOTE: DO NOT APPLY A HIGH PRESSURE WASH DIRECTLY ONTO THE SENSOR AS DAMAGE MAY RESULT.**

# **6 Cylinder Boxer Engines Series (104-H6)**

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# 6 Cylinder Boxer Engines Series (104-H6)

## General hand tools and supplies

|                |                                     |
|----------------|-------------------------------------|
| Dial indicator | Rubber or Plastic Hammer            |
| Dye penetrant  | Fuji Bond 1105 or equivalent        |
| Feeler gauge   | Fuji Bond 1280B or equivalent       |
| Micrometers    | Fuji Bond 1107C or equivalent       |
| Plastigauge    | Fuji Bond 1215 or equivalent        |
| Press          | Torque wrench (ft-lb) and (in. lb.) |

## Reference Materials

Subaru Technical Information System (STIS)  
Technician Reference Booklets

## Special Tools

| SPECIAL TOOLS  | 2.0L | (97 TO 99)<br>(SOLID)<br>DOHC<br>(PHASE 1)<br>2.5L | (1999 &<br>LATER)<br>SOHC<br>(PHASE 2)<br>2.2 & 2.5L | 3.0 | (2004<br>&<br>LATER)<br>DOHC | 3.6L |
|--|------|--|--|-----|------------------------------|------|
| 498457000 Engine stand adapter RH                                  | X    | X  |  | X   |                              |      |
| 498457100 Engine stand adapter LH                                  | X    | X  |  | X   |                              |      |
| 498747100 Piston guide   |      | X  |  |     |                              |      |
| 498857100 Valve oil seal guide                                     | X    | X  | X  | X   |                              |      |
| 499017100 Piston pin guide   | X    | X  | X  |     | X                            |      |
| 499037100 Connecting rod bushing<br>remover & installer            | X    | X  | X  |     |                              |      |
| 499097500 Piston pin remover                                       |      | X  |  | X   |                              |      |
| 499207100 Camshaft sprocket wrench                                 |      | X  | X  |     | X                            |      |
| 499587100 Camshaft oil seal installer                              | X    | X  | X  | X   | X                            |      |
| 499587200 Crankshaft oil seal installer                            | X    | X  | X  | X   | X                            | X    |
| 499587300 Camshaft oil seal installer                              |      |  |  |     |                              |      |
| 499587400 Oil pump seal installer                                  |      |  |  |     |                              |      |
| 499597000 Camshaft oil seal guide                                  |      | X  | X  | X   |                              |      |
| 499718000 Valve spring remover                                     | X    | X  | X  | X   | X                            | X    |
| 499767000 Valve guide adjuster                                     | X    |  |  |     |                              |      |
| 499767200 Valve guide remove                                       | X    | X  | X  |     |                              |      |
| 499767400 Valve guide reamer                                       | X    | X  | X  |     |                              |      |
| 499817000 Engine stands (2)  | X    | X  |  |     |                              |      |
| 499977000 Crank pulley wrench                                      | X    | X  |  |     |                              |      |
| 898968600 Circlip pliers<br>(or SNAP-ON long<br>nose pliers 911CP) |      |  |  | X   |                              |      |

# 6 Cylinder Boxer Engines Series (104-H6)

| SPECIAL TOOLS |  | 2.0L | (97 TO 99)<br>(SOLID)<br>DOHC<br>(PHASE 1)<br>2.5L | (1999 &<br>LATER)<br>SOHC<br>(PHASE 2)<br>2.2 & 2.5L | 3.0 | (2004<br>&<br>LATER)<br>DOHC | 3.6L |
|---------------|--|------|--|--|-----|------------------------------|------|
| 499597100     | Crankshaft oil seal guide                  | X    |  | X  | X   |                              |      |
| 498747300     | Piston guide                               |      | X  | X  | X   | X                            |      |
| 499585500     | Valve oil seal guide                       |      |  |  |     |                              | X    |
| 499977500     | Cam sprocket wrench                        |      |  |  |     |                              | X    |
| 18252AA000    | Crankshaft socket                          |      |  |  | X   |                              | X    |
| 18251AA050    | Valve guide adjuster (Intake)              |      |  |  |     |                              | X    |
| 18251AA060    | Valve guide adjuster (Exhaust)             |      |  |  |     |                              | X    |
| 18332AA020    | Oil filter wrench                          |      |  |  |     |                              | X    |
| 18355AA000    | Pulley wrench                              |      |  |  |     |                              | X    |
| 18334AA000    | Pulley wrench pin set                      |      |  |  |     |                              | X    |
| 499585700     | Oil seal guide                             |      |  |  |     |                              | X    |
| 499207300     | Camshaft sprocket wrench                   |      |  |  |     |                              | X    |
| 498267600     | Cylinder head table                        | X    |  |  |     |                              |      |
| 498267700     | Valve guide adjuster                       | X    | X  |  |     |                              |      |
| 499987500     | Crankshaft socket                          |      |  | X  |     |                              |      |
| J-43979       | Shim remover tool                          |      | X  |  |     |                              |      |
| J-42908       | Camshaft sprocket holding tool             |      | X  |  |     |                              |      |
| 498497100     | Crankshaft stopper                         | X    | X  | X  | X   | X                            | X    |
| 18254AA00     | Piston guide                               |      |  |  | X   |                              |      |
| 18350AA000    | Connecting rod bushing remover & installer | X    |  | X  | X   |                              | X    |
| 499587700     | Camshaft oil seal installer                | X    |  | X  | X   |                              |      |
| 18251AA000    | Valve guide adjuster                       |      |  |  | X   |                              |      |
| 499765700     | Valve Guide remover                        |      |  |  | X   |                              | X    |
| 499765900     | Valve Guide reamer                         |      |  |  | X   |                              | X    |
| 499977100     | Crank pulley wrench                        |      |  | X  | X   | X                            |      |
| 18252AA00     | Crankshaft socket                          |      |  |  | X   |                              |      |
| 499587500     | Oil seal installer                         |      |  | X  | X   | X                            |      |
| 18329AA000    | Shim replacer assemble                     |      |  |  | X   |                              |      |
| 18233AA000    | Piston pin circlip pliers                  |      |  |  | X   |                              |      |
| 398744300     | Piston guide                               | X    |  |  |     |                              | X    |
| 499097700     | Piston pin remover assembly                | X    |  | X  |     |                              | X    |
| 499207400     | Camshaft sprocket wrench                   | X    |  | X  |     |                              |      |
| 499977300     | Crank pulley wrench                        | X    |  | X  |     |                              |      |
| 499987500     | Crankshaft socket                          | X    |  | X  |     |                              |      |

# 6 Cylinder Boxer Engines Series (104-H6)

| SPECIAL TOOLS |   | 2.0L | (97 TO 99)<br>(SOLID)<br>DOHC<br>(PHASE 1)<br>2.5L | (1999 &<br>LATER)<br>SOHC<br>(PHASE 2)<br>2.2 & 2.5L | 3.0 | (2004<br>&<br>LATER)<br>DOHC | 3.6L |
|---------------|---|------|--|--|-----|------------------------------|------|
| 499587600     | Oil seal guide                                  | X    |  |  |     | X                            |      |
| 499597200     | Oil seal guide                                  | X    |  |  |     | X                            |      |
| 498187200     | Shim replacer                                   | X    |  |  | X   |                              |      |
| 499767700     | Valve guide adjuster (intake)                   |      |  | X  |     |                              |      |
| 499767800     | Valve guide adjuster<br>(Exhaust)               |      |  | X  |     |                              |      |
| 499817100     | Engine stand (2)                                | X    |  | X  |     |                              |      |
| 49949700      | Torx plus                                       |      |  | X  |     |                              |      |
| 499097600     | Piston pin remover assembly                     |      | X  |  |     |                              |      |
| 498187100     | Shim replacer kit                               |      | X  |  |     |                              |      |
| 42099AE00     | Fuel line connection remover                    |      |  |  | X   | X                            | X    |
| 18232AA000    | Engine stand                                    |      |  |  | X   |                              | X    |
| 498277200     | Flywheel stopper                                | X    | X  | X  | X   | X                            | X    |
| 18354AA000    | Valve rocker holder<br>2006 phase two non-turbo |      |  |  |     |                              |      |
| 18258AA000    | Spring installer<br>2006 phase two non-turbo    |      |  |  |     |                              |      |
|               |   |      |  |  |     |                              |      |
|               |   |      |  |  |     |                              |      |
|               |   |      |  |  |     |                              |      |
|               |   |      |  |  |     |                              |      |

# 6 Cylinder Boxer Engines Series (104-H6)

## Service Bulletins

| No.        | Date     | Title  | Subject  |
|------------|----------|--|--|
| 02-90-94R  | 12/02/94 | 95MY Legacy with engine numbers between and including 003167 through 042715  | Engine oil pump leaks  |
| 01-143-96  | 12/23/96 | Recommended sealants and adhesives   |  |
| 02-92-03   | 11/28/03 | All Legacy H-6 Models  | Crankshaft pulley and cover Modification                                   |
| 02-93-04   | 11/05/04 | Legacy, Impreza and Forester Vehicles  | Modification of timing belt tensioner bracket                              |
| 02-94-05   | 02/02/05 | 1999~04MY Forester 2.5L SOHC N/A, 1999~04MY Impreza 2.5L SOHC N/A, 2000~04MY Legacy 2.5L SOHC N/A (Except 2004MY Legacy U5 specification vehicles) | Revised cylinder block specifications                                      |
| 02-95-05   | 03/25/05 | 1997~99 Legacy; 98MY Forester; 98MY Impreza with 2.5L DOHC engines   | Hybrid Engine Short Block Release  |
| 02-96-05   | 09/19/05 | Remanufactured SOHC short block release  | Various SOHC short block availability                                      |
| 02-95-05R  | 09/22/05 | 1997~99MY Legacy; 98MY Forester 98MY Impreza with 2.5L DOHC engine   | 2.5L Remanufactured DOHC short block release                               |
| 02-97-05   | 10/06/05 | 04MY Forester 2.5L turbo; 04MY Baja 2.5L turbo; 04MY Impreza STi 2.5L turbo  | Active valve control system (AVCS) union screw filter                      |
| 09-42-05   | 04/15/05 | All Models   | Cautions concerning engine coolant   |
| 09-39-04   | 05/07/05 | 2005MY Legacy & Outback vehicles   | Engine coolant system refilling  |
| 02-100-06R | 10/31/06 | All Models   | Cylinder Head Gasket (Residual carbon deposits and rubber coating removal) |
| 09-45-06   | 11/28/06 | All Models   | Radiator cap information   |
| 02-101-07  | 02/28/07 | All Turbo Equipped Models (4 cyl)  | Turbo vehicle operation & care   |
| 09-47-07   | 08/31/07 | All Models   | Coolant flushing machines and additives                                    |
| 02-103-07R | 10/29/07 | All Turbo Equipped Vehicles (4 cyl)  | Turbocharger oil supply mesh screen  |
| 11-85-07   | 10/15/07 | 2008 Legacy Outback & Forester NA PZEV   | PZEV Engine Noise  |



# 6 Cylinder Boxer Engines Series (104-H6)

## Warranty Bulletin

| <b>No.</b> | <b>Date</b> | <b>Applicability</b>  | <b>Subject</b>                            |
|------------|-------------|---|---|
| WXV-79     | 09/2000     | 2000MY Subaru Legacy and Outback and Outback Vehicles with Manual Transmission                              | Engine Control Module (ECM)               |
| WWF-89     | 04-2002     | 2000~01MY Subaru Legacy and Outback 4EAT<br>2000~02MY Impreza MT5 or 4EAT<br>2001~02MY Forester MT5 or 4EAT | Engine Control Module (ECM) Reprogramming |
| WWJ-93     | 09-2002     | Certain 2003MY Legacy, Outback and Baja Models  | Engine Water Pump                         |
| WWP-99     | 02-2004     | 2000~2002MY Subaru Legacy and Outback; 1999~2002MY Impreza; 1999~2002MY Forester                            | Engine Cooling System Conditioner         |
| WWU-05     | 10-2004     | 2004MY Turbo Subaru Forester, STi and Baja  | Engine Oil Control Valve Cover Bolts      |
| WWX-08     | 06-2006     | 2004MY California PZEV Spec. Subaru Legacy and Outback 2.5i NA  | Engine Control Module (ECM) Reprogramming |
| WWY-09     | 06-2006     | 2006MY Baja, Legacy, Outback and B9 Tribeca   | Engine Cooling System Flush and Refill    |
|            |             |   |   |
|            |             |   |   |
|            |             |   |   |
|            |             |   |   |

# 6 Cylinder Boxer Engines Series (104-H6)

## TECH TIPS

**Date Subject**

02/95 Idle quality complaints on '95 Legacy

02/95 Synthetic engine oil

04/95 Engine testing-back to basics

07/95 Synthetic lubricant usage - updated information

10/95 Oil viscosity change for 1996 Subaru vehicles

01/96 2.5 Liter motor engine knocking or tapping noise

09/96 1997MY engine noise

09/96 Legacy 2.2L and Impreza 1.8L, 2.2L engine oil filling

10/96 Welcome to shim city

04/97 New cam belt tensioner

08/97 Assembling 1997 and Newer engines

10/97 Molybdenum coating on pistons

11/97 Engine noise

11/97 2.5L engine cylinder head bolt tightening sequence

05/98 Legacy engine belt guides

09/98 1996 2.5L exhaust valves

10/98 2.2L front crankshaft oil seals

11/98 1999 Legacy short blocks

01/99 Leaking front crankshaft oil seals

03/99 SIA installed engine oil

04/00 2000MY spark plug application chart (revised 01-31-00)

08/00 Engine noise when cold

01/01 Oil pumps - replacement vs resealing

02/01 3.0L 6 cylinder engine valve train servicing

02/01 Engine noise when cold

05/01 Three Bond 1280B

06/01 2002MY WRX Turbo cool down procedure

03-04/02 Oil filters: H-4 versus H-6 engines

08/02 2.0L Camshaft cap torque correction

# 6 Cylinder Boxer Engines Series (104-H6)

## Tech TIPS

| Date | Subject |
|------|---------|
|------|---------|

|          |  |
|----------|--|
| 09-10/02 | DOHC Turbo valve specification                               |
| 01-02/03 | Radiator hose leakage  |
| 01-02/03 | SOA Replacement ignition wire set                            |
| 05/03    | Coolant seepage from water pump                              |
| 05/03    | 2004 Baja and Forester turbo engine oil filters              |
| 07/03    | Cam belt tensioner replacement                               |
| 07/03    | Vehicle Re-engineering/modifying                             |
| 11/03    | Head gasket repairs  |
| 11/03    | Oil filter application clarification                         |
| 12/03    | ISC valve cleaning   |
| 01/04    | Engine noise   |
| 04/04    | Cruise control cable retainer clip (WWQ-01 campaign)         |
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| 08/04    | Pressure washing of vehicle engine compartment- All models   |
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| 03/05    | Intercooler spray tank                                       |
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| 06/06    | H6 Oil Level explained (6 cyl.)                              |
| 02/07    | Turbocharger Oil Supply filter (4 cyl.)                      |
| 03/07    | Oil supply line filters (4 cyl.)                             |
| 05/07    | Engine oil specification information (All)                   |
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