SUBARU

QUALITY DRIVEN® SERVICE

CERTIFIED SUBARU TECHNICIAN

Technicians Reference Booklet

Boxer Engine Series Module

Module 104

AUTOMOTIVE Youth Educational Systems

March 2006

MSA5P0131C

Technical Training

Subaru of America, Inc. reserves the right at any time to make changes or modifications to systems, procedures, descriptions, and illustrations contained in this book without necessarily updating this document. Information contained herein is considered current as of March 2006.

This book is revised with material from New Model Updates 912 thru 915.

Table of Contents

Foreword

All Subaru of America, Inc. engines are of the four stroke, four cycle internal combustion design. The four strokes are the following: Intake, Compression, Power and Exhaust.

Subaru of America, Inc. vehicles are powered by boxer style opposed cylinder engines.

The engine horsepower has increased over the last several years at the same time as customer and governmental expectations for major component longevity and fuel mileage. This has meant better materials and engine design practices have been utilized. Higher quality piston and piston ring design as well as material construction have been used to obtain closer cylinder wall to piston clearance over more operating temperatures and longer mileage intervals. This has resulted in decreased "leak-down" for production engines. This "leak-down" percentage has decreased significantly over the last several years to where everyday street engines have cylinder sealing that once was the standard for racing applications.

Higher compression ratios have also been obtained. The compression ratio for all currently used Subaru engines that are naturally aspirated (non-turbocharged) are all over 10.1. This compression ratio was only previously seen in high performance and racing applications. Compression ratio is calculated by dividing the area in the cylinder head valve area for each cylinder by the distance in the combustion chamber at the bottom of the cylinder stroke. In the aforementioned 10.1 example, the cylinder head combustion area is 1/10 the size of the cylinder when the piston is in its lowest position in the cylinder.

New advances in computer design, fuel injection, ignition timing regulation, and air fuel swirl technology usage in the combustion chamber have greatly contributed to increased power output.

It is the desire of Subaru of America, Inc. that you derive the maximum possible knowledge from this engine course in order to do a complete diagnosis and repair of Subaru engines in order to achieve the utmost in customer satisfaction.

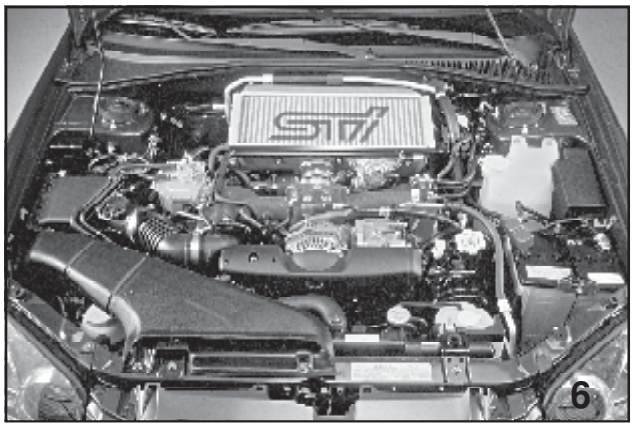
Introduction

This Technicians Reference Booklet is intended to introduce the 2.5 liter naturally aspirated (N/A), (Phase 1) and (Phase 2) engines, the 2.5 liter (DOHC) (Phase 1) and (Phase 2) engines, the 2.0 liter turbo engine and the 3.0 six cylinder engines.

This reference book reviews the mechanical features of these engines and the differences between existing engines. It also covers the procedures used in diagnosing and overhauling these engines. The text and slides also cover the new technologies and differences associated with variable valve lift and variable valve timing as well as active valve lift. The reference book text and illustrations are derived from and follow the classroom lectures and slide presentations. They are intended to supplement and reinforce classroom instruction and serve as an additional technical reference source. A list of applicable Service Bulletins, TechTips, Special Service Tools, pages for notes and cautions are included in this booklet.

Technician worksheets are to be completed during the hands on lab work segments of the engine series module.

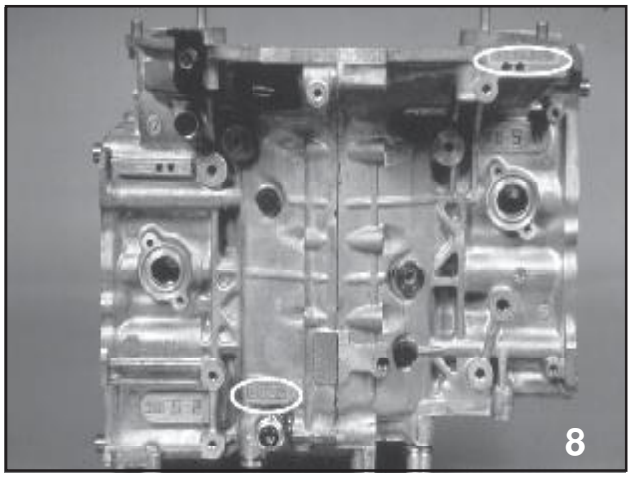
Always refer to the appropriate model year Subaru Service Manual and the applicable Subaru Service Bulletins on the STIS web site, for all specifications and detailed service procedures.



Engine

General Overview

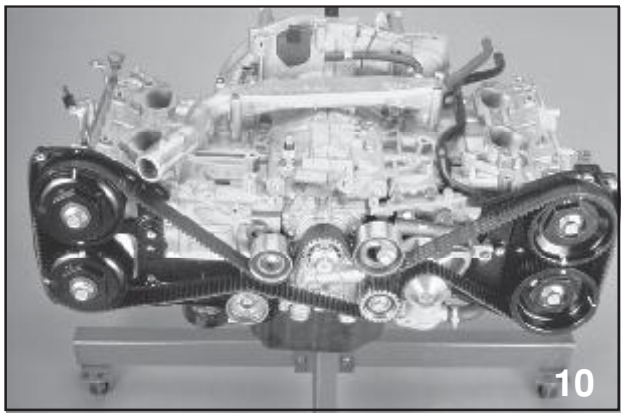
2.5 Engine Identification



Engine Serial and Designation Number

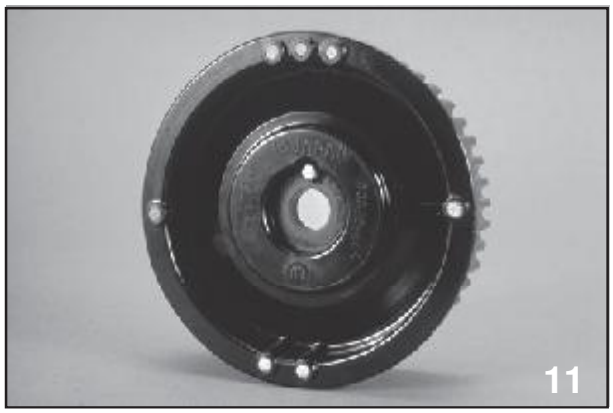
The engine serial number is located on the machined boss on the left side of the clutch housing. The 2.5 liter engine designation is EJ25.

2.5 Liter Engine Features Phase 1

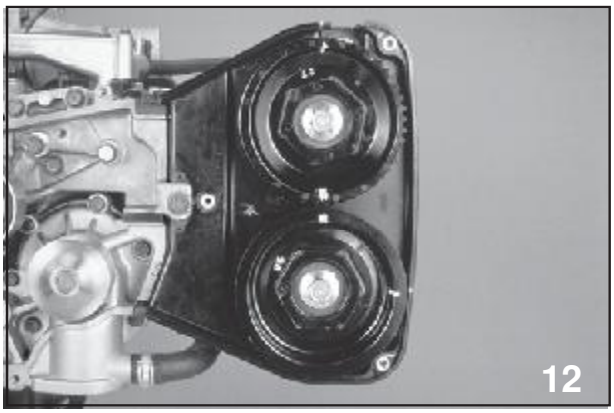


2.5 Liter Engine

The 2.5 liter engine uses double overhead camshafts that are belt driven. Belt tension is maintained through the use of the hydraulic tensioner.



Camshaft Sprocket (Left Bank) (Rear)



Camshaft Sprocket Timing Marks (Left Bank)

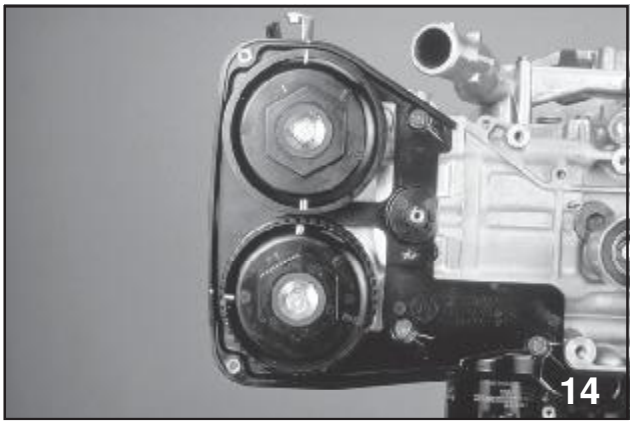
Camshaft sprockets are constructed from a resin type material with a metal key pressed into the sprocket for maintaining proper sprocket to shaft orientation.

The timing marks on the left bank intake camshaft sprocket are positioned at 12:00 o'clock and 6:00 o'clock. The 12:00 o'clock mark, which aligns with a timing mark on the timing belt housing, is used for camshaft to engine timing. The 6:00 o'clock mark is used for timing the intake camshaft to the exhaust camshaft, which has a timing mark at the 12:00 o'clock positions. The remaining timing mark on the exhaust camshaft sprocket, positioned at the 3:00 o'clock, ensures the exhaust camshaft sprocket is timed correctly to the engine. With all timing marks aligned, the intake and exhaust camshaft are in a loaded state. If the timing belt were removed, the camshafts would suddenly revolve from the force of the valve springs. To prevent this from occurring maintain the intake camshaft position and carefully unload the camshaft by allowing it to slowly rotate counterclockwise, (exhaust clockwise) while removing the belt.

NOTE: USE SPECIAL TOOL J-42908 FOR HOLDING CAMSHAFT SPROCKETS DURING BELT INSTALLATION. IT MAY ALSO BE USED FOR LOADING AS WELL AS UNLOADING THE CAMSHAFTS.

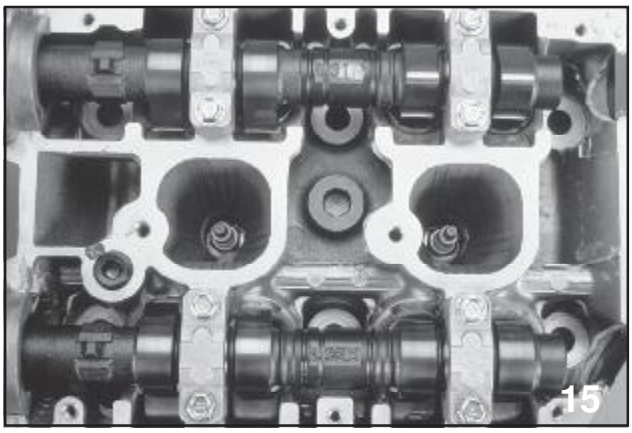
CAUTION: VALVE DAMAGE WILL OCCUR IF BOTH CAMSHAFTS ARE TURNED INCORRECTLY AFTER THE TIMING BELT HAS BEEN REMOVED.

Valve Interference



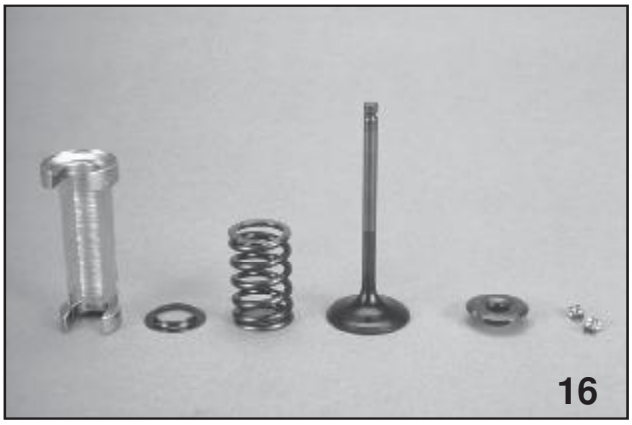
Camshaft Sprocket Timing Marks (Right Bank)

The right bank intake sprockets timing marks are similar in location and purpose as the left bank, however, the exhaust camshaft sprocket on the right bank uses a timing mark at the 9:00 o'clock position to ensure proper camshaft to engine timing.



Camshafts

To access the cylinder head bolts, the camshafts must be removed. Follow the procedure outlined in the on the STIS web site for performing this task. The camshafts are held to the cylinder head with bearing caps that are marked (right side) I1TD, I3TD, E1TD, E3TD.



Valve Spring Assembly

Valve servicing is accomplished by utilizing special tool **499718000** and a universal valve spring compressor. The single valve spring is color coded red and rests on a metal spring seat which is used to prevent cylinder head wear. A special tool (**498267700**) will be required to adjust valve guide height, if replacement is necessary. A valve guide reamer (**499767400**) and a valve guide remover (**499767200**) will also have to be used. The hydraulic lash adjuster is of the same type as the 3.3 and requires no servicing.

Spark plugs for the 2.5 liter engine will be platinum tipped, NGK PFR5B-11.

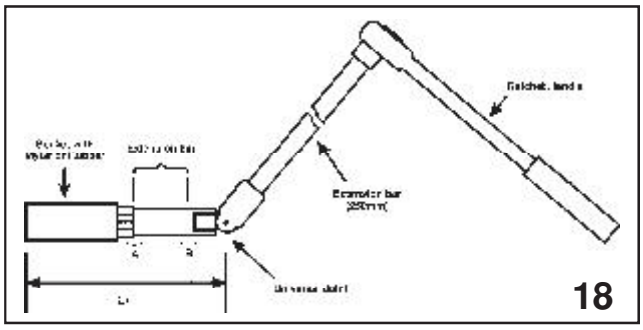
Direct Type HLA

Spark Plug Replacement Procedure for 2.5 Liter Engine

1. Remove battery, washer tank and air cleaner.
2. Remove high tension cords.
3. Cover ATF pipes and ABS pipes with cloth to prevent them from damage during replacement of spark plugs.
4. Remove spark plugs by using a general service tool with the special instruction described below.

Installation

1. Set the spark plug into the socket.
2. Tighten the spark plug in the cylinder head with the socket. It is necessary to support the end of the socket by a finger.
3. When the spark plug can be felt to be tightened with 2 or 3 rotations, remove the socket from the spark plug.



Spark Plug Removal

4. Confirm if the spark plug is screwed into the hole properly by touching it with a finger. If it is difficult to touch it by finger, confirm its condition by using mirror and so on.
5. Reset the socket on the plug then tighten it with the proper torque.
6. Install high tension cords.
7. Install battery, washer tank, and air cleaner.

Note:

1. Length L1 (100mm, 3.94") is most important for ease of removal and installation.
2. Wrap points A & B with tape to prevent them from separating during work.
3. An approximate 250mm long extension bar is recommended to be used between the ratchet and the universal joint.

1997 2.5 Engine DOHC (Phase 1) Changes

The double overhead camshaft engines have had internal and external changes that yield an approximately 10 % increase in power and 3% increase in fuel economy. Accomplishing this involves many factors, one of which is engine friction reduction.

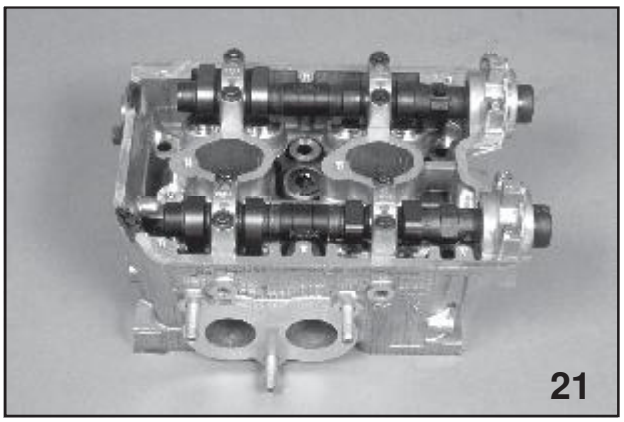
The piston, a major source of engine friction has been coated with a friction reducing agent called Molybendium. This thin coating not only allows a smoother travel through the cylinder but also reduces cylinder wall scuffing.

The skirt of the piston has been reshaped and the overall weight has reduced by approximately 100 grams. Compression ratio has been increased to 9.7 to 1 by reshaping the crown of the piston. This eliminates the clearance that was available between the piston at TDC and a fully opened valve. Piston pin offset has been changed to 0.5 mm. Piston to cylinder wall clearance has been reduced by increasing the piston diameter.

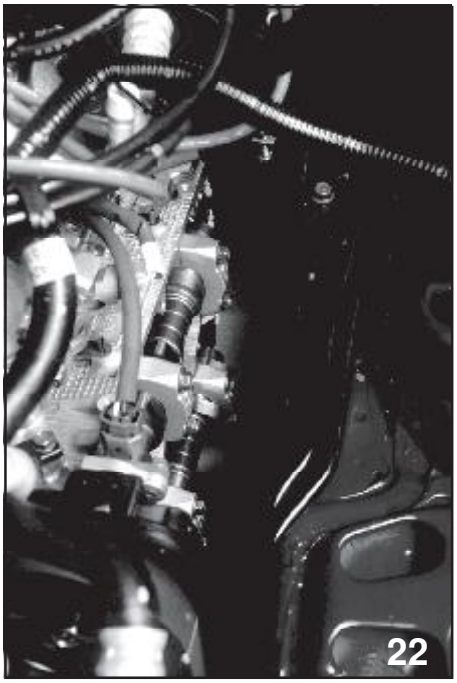
Redesigned 2.5 Liter Piston

Another source of high engine friction is the valve train. Hydraulic lash adjusters are always in contact with the camshaft or valve rockers. The hydraulic pressure of the lash adjuster must be overcome during operation and the most critical time of engine start. To overcome this situation and to contribute to the total reduction of friction loss the DOHC engines will have solid valve adjusters.

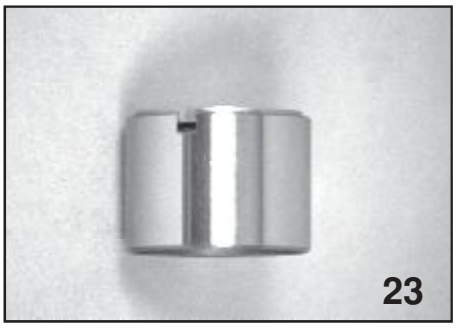
The scheduled service of these valve trains is set at 100,000 miles and is not required during the PDI. The DOHC engine uses an adjustment shim. There are 94 shim sizes.



2.5 Liter Valve Assembly



2.5 Liter Head on the car



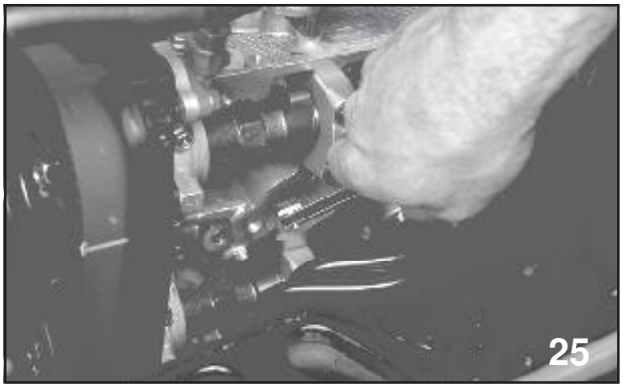
Bucket and Shim Assembly

NOTE: USE A THIN NONMAGNETIC TOOL PLACED IN THE NOTCH OF THE LASH ADJUSTER TO REMOVE SHIM. (SPECIAL TOOL J-43979)

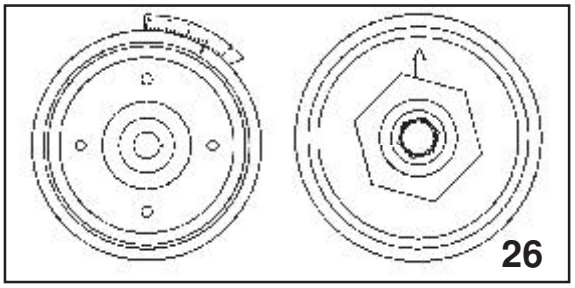
Identifying Shim Size

NOTE: THE PRINTED SIZE OF THE SHIM SHOULD BE INSTALLED AWAY FROM THE CAMSHAFT LOBE.

As you can see the space between the valve train and the frame rail of a DOHC is some what limited, however valve adjustment is possible by performing the following: Refer to the 1997 Legacy Subaru Service Manual on the STIS web site. Supplement.



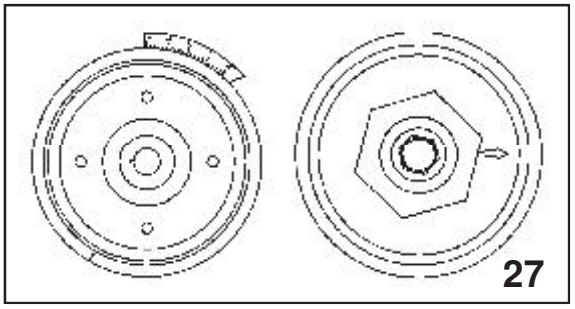
Checking Valve Clearance on the Car



Exhaust Valve Clearance on Cylinders 1 and 3

Step 1

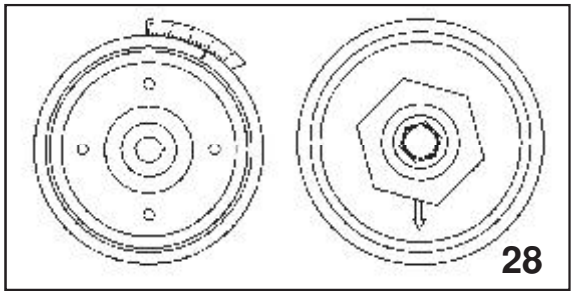
- Set the crankshaft sprocket at 0 degrees. (use crankshaft wrench)
- Set the left intake camshaft sprocket arrow at 12 o'clock (Please remember that the camshaft sprocket has an arrow and a mark used for belt timing. Make certain to use the arrow and not the mark for valve clearance check.)
- The engine is now set for allowing the clearance check of the exhaust valves on cylinders 1 and 3 only. (Please remember that the profile of a camshaft with solid lifters has a ramp that is used to gradually take up the clearance between the lift of the lobe and the lash adjuster.)
- Measure the clearance ensuring the thickness gauge is placed as shown on previous page.
- Record the measurement



Intake Valve Clearance on Cylinders 1 and 3

Step 2

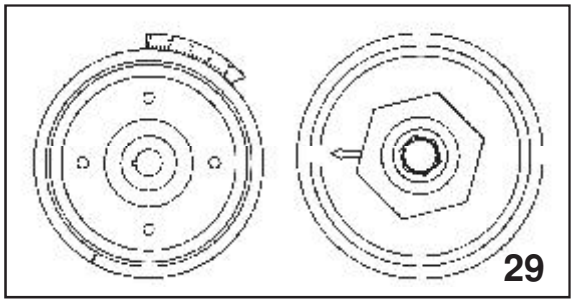
- Rotate the crankshaft 180 degrees
- The left intake camshaft arrow should now be at 3 o'clock (Figure 7).
- Check the clearance of the intake valves on cylinders 1 and 3 only.
- Record the measurement



Exhaust Valve Clearance on Cylinders 2 and 4

Step 3

- Rotate the crankshaft 180 degrees.
- The left intake camshaft arrow should now be at 6 o'clock.
- Check the clearance of the exhaust valves on cylinders 2 and 4 only.
- Record the measurement



Intake Valve Clearance on Cylinders 2 and 4

Step 4

- Rotate the crankshaft 180 degrees.
- The left intake camshaft sprocket arrow should now be at 9 o'clock.
- Check the clearance of the **intake valves on cylinders 2 and 4 only**.
- Record the measurement.

Step 5

- Use the formula below to choose the new shim:

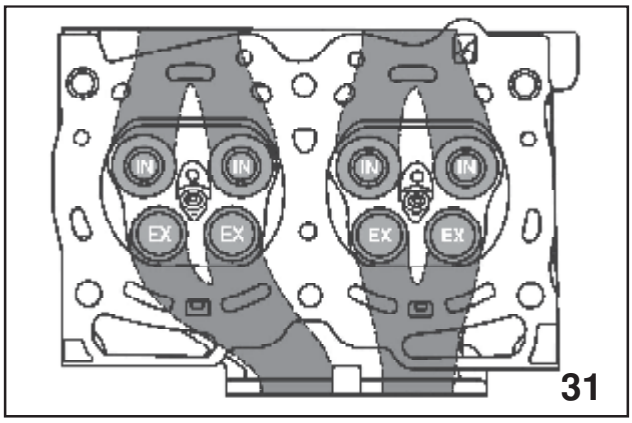
Intake valve S = V + T-.20
Exhaust valve S = V + T-.25
S = Shim thickness to be used
V = Measured valve clearance
T = Shim thickness in use

Standard valve clearance

(Intake valves 0.20 +/- 0.02 mm)
(Exhaust valves 0.25 +/- 0.02 mm)

1997 2.5 Liter Engine DOHC (Phase 1) Features

The 2.5 liter DOHC four valves per cylinder engine is an addition to the existing Subaru "Boxer" design. The horizontally opposed, 4 stroke, 4 cylinder, liquid cooled, gasoline engine has aluminum alloy block and heads. It uses a normally aspirated MPI system. The cylinder liners are of a cast iron dry type design.



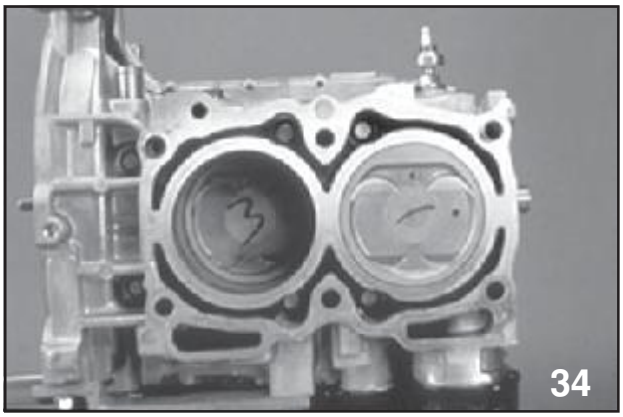
Cylinder Head Design

Crankshaft Assembly

The balanced forged crankshaft has fillet rolled micro-polished journals for increased strength and reduced friction. Due to the "Boxer" design, a counterbalance shaft is not required.

Connecting Rods

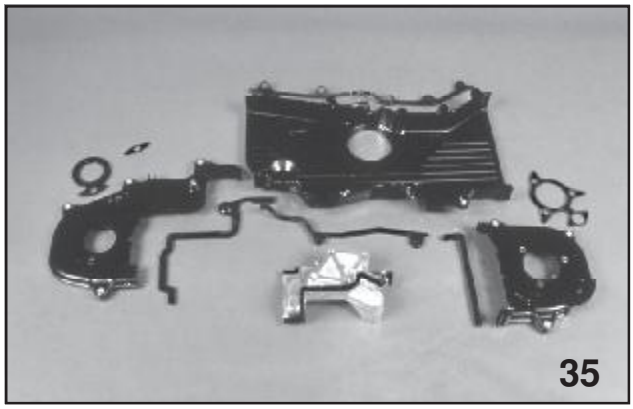
Due to increased material used to strengthen the large end of the rod, the rod bolts are pressed into the rod. An oiling notch is located on the large end of the rod below the FUJI symbol. This provides oil flow to the piston pin and the cylinder walls. The rods are not drilled.



N/A Pistons

The 2.5 liter pistons are cast aluminum alloy and feature a 2 mm offset piston pin. The pistons are directional for the left and the right side of the engine and are stamped with an "L" or "R". In addition, each piston is stamped with an arrow which must point to front of the engine. The valve reliefs for the intake and exhaust valves are different sizes to prevent valve contact with the piston should the cam belt break. The pistons use three rings, two compression and one oil.

A single belt is used to drive the camshafts and the water pump. This provides more precise valve timing. The cam belt width is 30 mm (1.18 inches) to increase cam belt life. The belt is constructed of wear resistant double canvas and heat resistant rubber materials with a wire core. A round tooth profile is used for quieter operation. The belt has an automatic cam belt tensioner which allows for thermal expansion and contraction. The cam belt path is from the crankshaft sprocket to the tensioner, to the left camshaft sprocket, to the water pump pulley, to the lower left idler to the lower right idler, to the right camshaft sprocket, to the upper right idler and back to the crankshaft sprocket. This has increased the belt life to 105,000 miles.



Cam Belt Covers

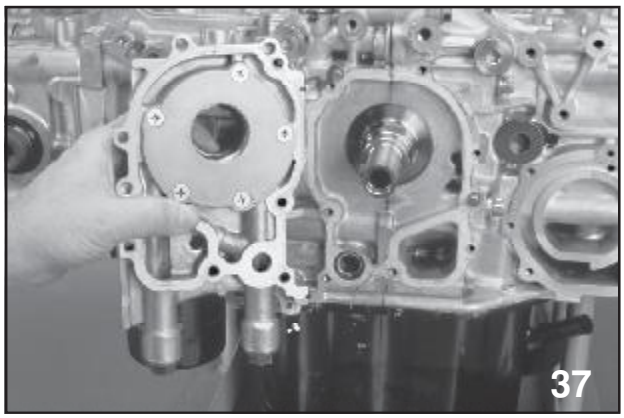
The cam belt covers and dust seals are resin molded and protect the timing belt from dust and water. There are additional dust seals on the left and right inner covers. These seals increase protection of the cam belt from dust and water and also improve cam belt noise isolation.

Water Pump Assembly-Cooling System

The water pump pulley is driven by the back side of the timing belt. The pump is mounted to the lower front of the engine. The thermostat is located in the lower part of the pump housing. This location provides even engine warm-up by improved metering of the coolant temperature. The thermostat senses the temperature of the crankcase and radiator coolant as it is mixed.

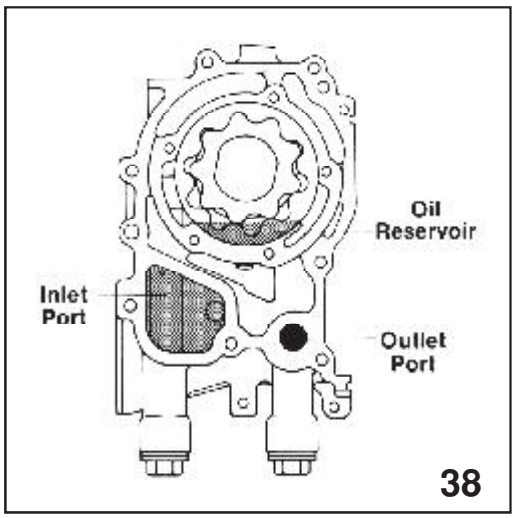
Because the thermostat housing is located on the lower front of the engine, all of the coolant must be drained to change the thermostat.

The heater core also serves as the bypass system.



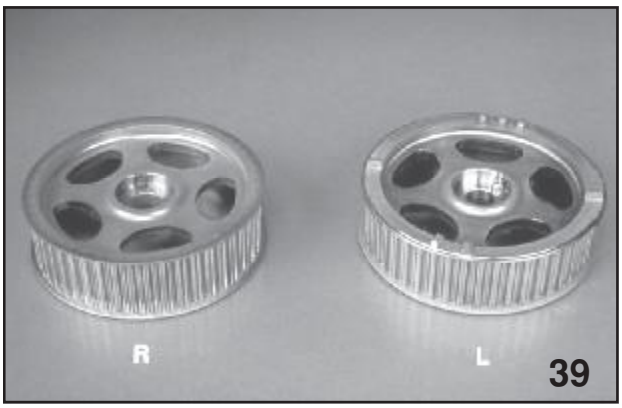
Oil Pump

The trichoid gear type oil pump is driven directly by the crankshaft. The pump is bolted to the front of the engine for serviceability. The relief valve located in the pump regulates oil pressure to 71 psi (5 kg-cm2). The filter bypass valve is located in the oil filter.



Oil Pump Cross Section

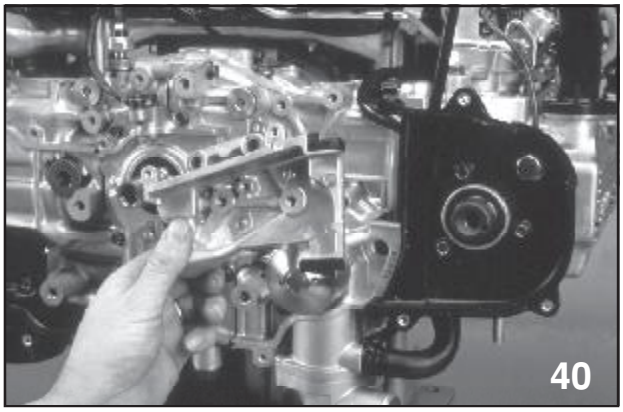
The oil pump has a reservoir which maintains oil for rotor lubrication. This is especially helpful when the engine has not been operated for extended periods of time. The reservoir also provides emergency oiling for the pump if there is temporary loss of oil supply.



Camshaft Sprockets

Notice the locating pin on back of the sprockets for reinstallation. Also locate the reluctors on the back of the left camshaft sprocket. These are the cam angle sensor reference triggers. Inspect the locating pin and reluctors for damage.

NOTE: THE LEFT CAMSHAFT SPROCKET MUST NOT BE INSTALLED ON THE RIGHT CAM SHAFT, AS DAMAGE TO THE INNER RIGHT CAM BELT COVER MAY OCCUR. A NO START CONDITION ALSO WILL RESULT.

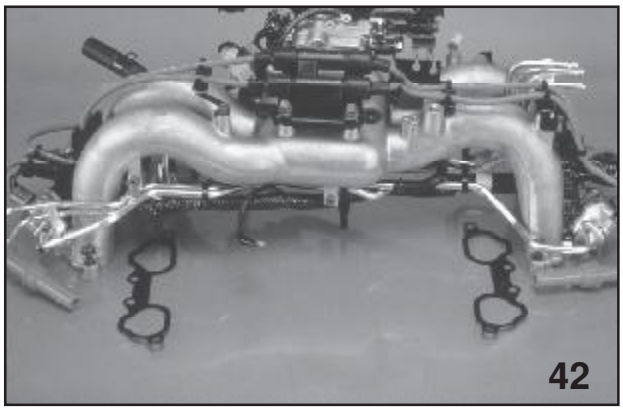


Tensioner Bracket Removal

Remove the mounting bolts and carefully remove the tensioner bracket to avoid damage to the friction-fit dust seals.

Inner Cam Belt Cover Removal

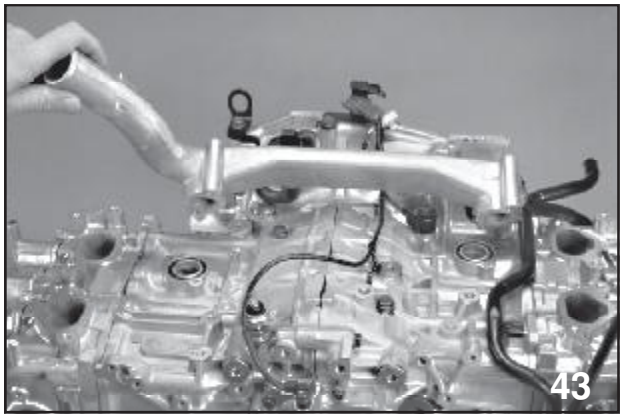
Remove the left and right inner cam belt covers. Note the location of the friction-fit dust seals.



Engine Accessory Removal

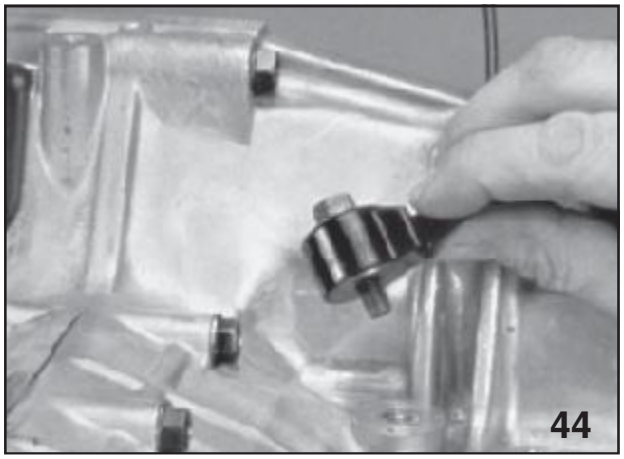
Remove the hoses, electrical connections, sensors, switches, intake manifold, and intake manifold gaskets.

NOTE: THE RUBBER COATED METAL GASKETS ARE ONE TIME USE ONLY.

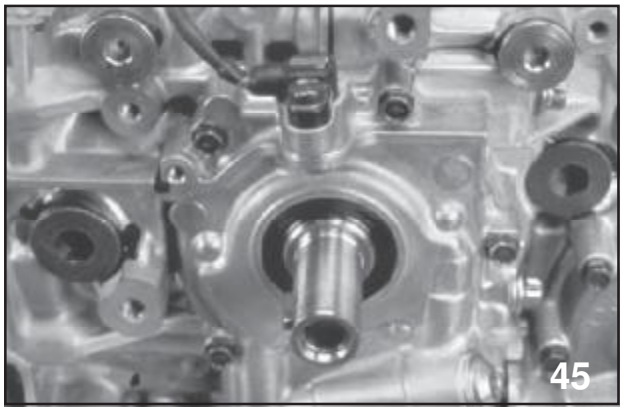


Remove the Water Transfer Pipe

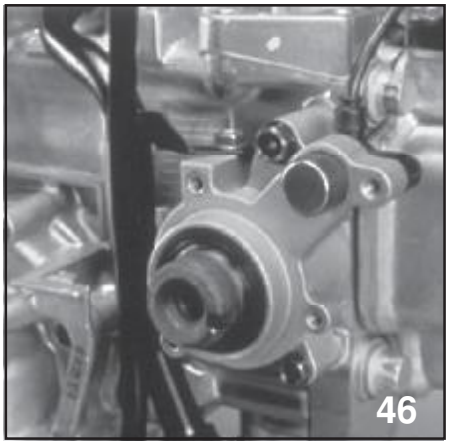
Remove the water transfer pipe and O-rings. New O-rings must be used at reinstallation.



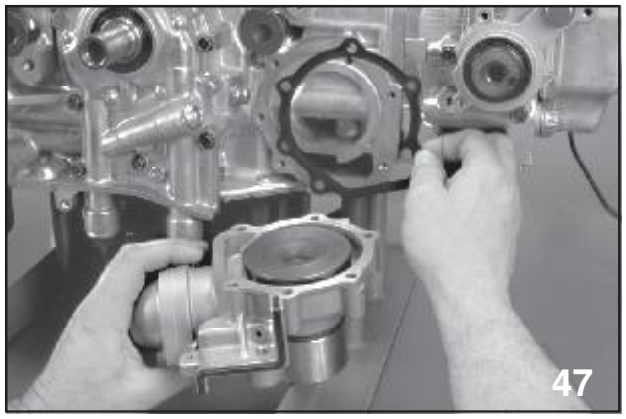
Remove Knock Sensor



Remove Crank Angle Sensor

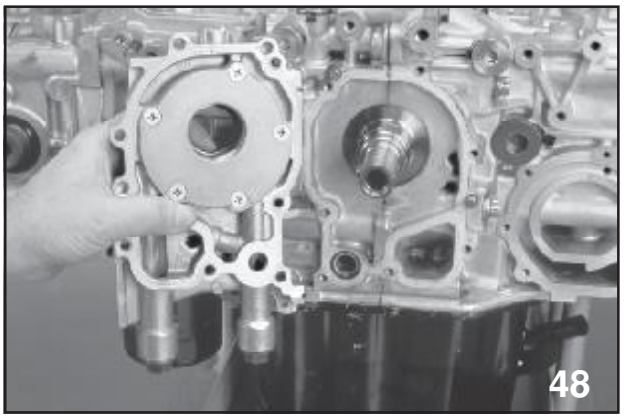


Remove Cam Angle Sensor



Remove Water Pump

Remove dip stick tube and then remove the water pump and rubber coated metal gasket. The gasket is onetime use only. Retain the dust seals for later reassembly.

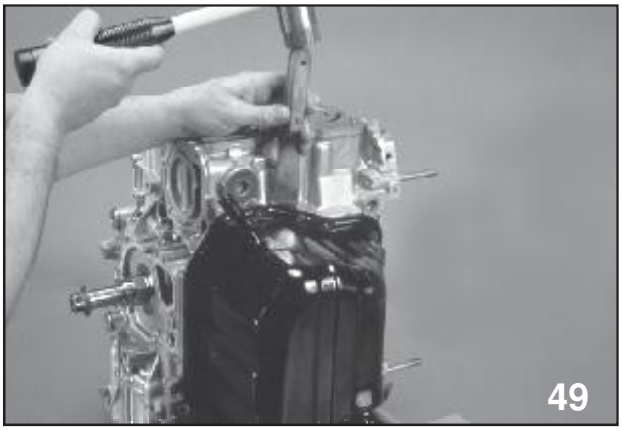


Remove Oil Pump

Remove the oil pump. Observe the condition and location of the O-ring seal and the dust seals. Retain the dust seals for later reassembly.

Loosen all head bolts in the reverse order of the tightening sequence, and then remove all of the cylinder head bolts except #1. Lightly tap the cylinder head with a rubber mallet to loosen the head from the gasket. Then remove #1 bolt and the cylinder head with the head gasket. Repeat the above steps for the other cylinder head.

NOTE: THE HEAD GASKETS ARE CARBON COMPOSITION WITH INTEGRATED O-RINGS. ALWAYS USE NEW GASKETS. CHECK FOR PROPER ORIENTATION.



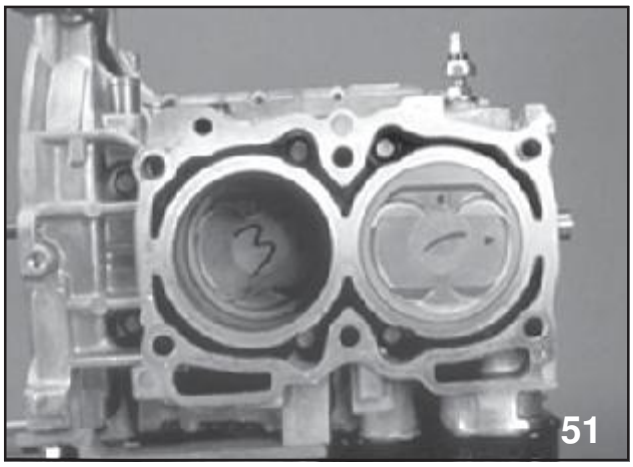
Remove Oil Pan

Remove the oil pan bolts. Use a thin gasket scraper/putty knife and a rubber mallet to loosen the oil pan. Remove the oil pan. Notice the location of the oil seal for the drain tube. Remove the oil pickup tube and also note the O-ring. Remove the oil pickup tube and also note the O-ring. Remove the oil pan baffle plate (windage tray).

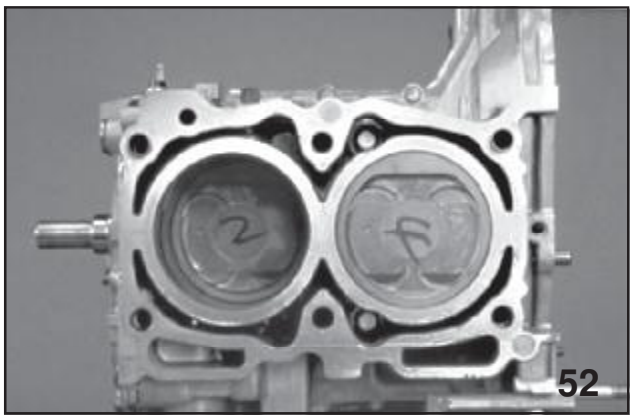
Piston Pin Removal

Use piston pin remover **499097300** or **499097500** to remove the piston pin. Insert the tool 3/4 of the way into the pin and pull the tool with the pin through the access hole. Repeat for the remaining pistons. Finally, rotate the crankshaft to position the pistons at the top of the cylinders. Repeat the procedure for the other cylinders.

NOTE: USE CAUTION WHILE ROTATING THE CRANKSHAFT TO PREVENT THE CONNECTING ROD LARGE ENDS FROM DAMAGING THE LOWER CYLINDER BORES.



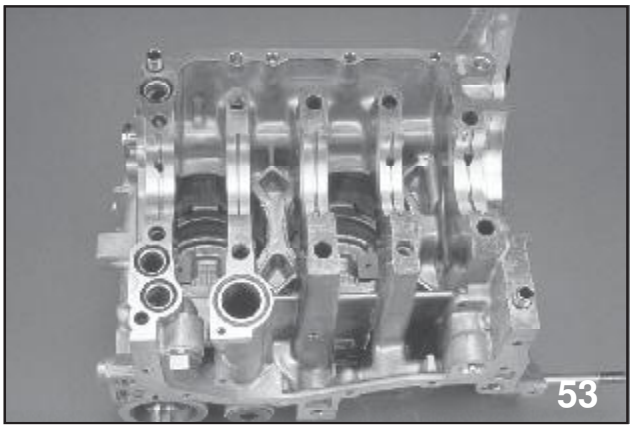
Crankcase Hidden Bolts (Right Bank)



Crankcase Hidden Bolts (Left Bank)

To split the crankcase remove **ALL 16** of the crankcase bolts. Six (6) of the bolts are hidden in the water passages, four in the RH case (1-3 side) and two in the LH case (2-4 side).

NOTE: ALL SIX (6) OF THE HIDDEN SHOULDERED CRANKCASE BOLTS HAVE SEALING WASHERS. THESE BOLTS ARE NOT INTERCHANGEABLE WITH THE OTHER CRANKCASE BOLTS. THE SEALING WASHERS ARE ONE TIME USE ONLY.

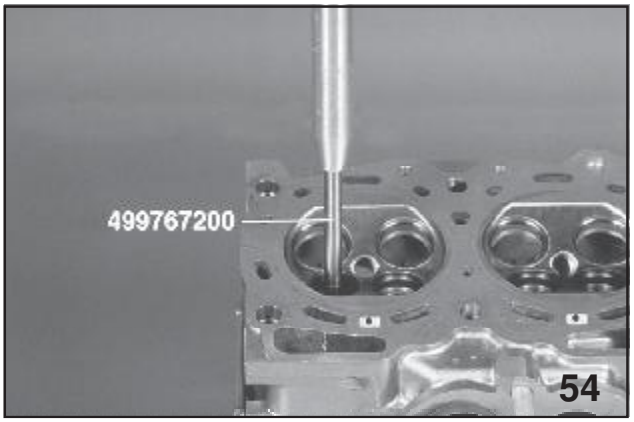


Crankcase Half with O-Rings

Carefully separate the crankcase halves.

NOTE: IDENTIFY THE LOCATION OF THE FOUR O-RINGS (THREE SMALL, ONE LARGE), IN THE MATING SURFACE OF THE RIGHT (1-3 SIDE) CRANKCASE. THE BLACK O-RINGS ARE FOR OIL PASSAGES, THE ORANGE O-RING IS FOR A COOLANT PASSAGE.

Finally, inspect the rocker arm cam contact surface. Replace the rocker arm(s) when they are scored or gouged.



Valve Guide Removal

Use a press, cylinder head table, **498267200**, and valve guide removal tool **499767200** to remove the valve guides.

Precautions

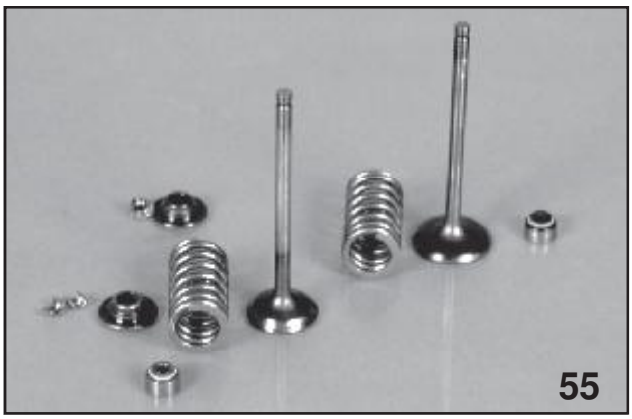
Follow the precautions listed below when inspecting and servicing engine components.

a. Clean all parts thoroughly.
b. Remove all gaskets and sealing material.

CAUTION: DO NOT DAMAGE ALUMINUM MATING SURFACES

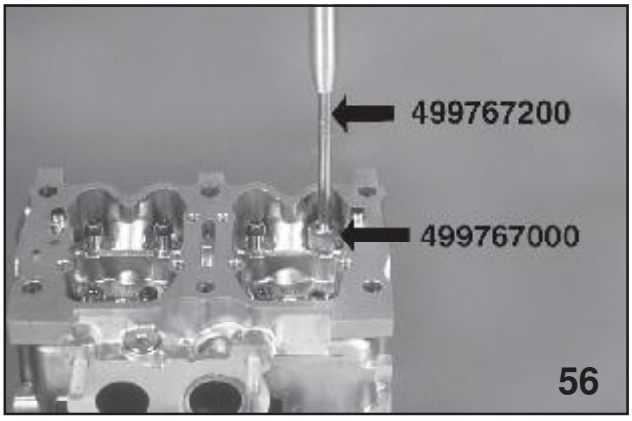
c. Use compressed air to insure clear oil and coolant passages.
d. Do not damage components when removing carbon.
e. Keep parts in order to ease reassembly.
f. Service all valves as a set.

Refer to the Subaru Service Manual on the STIS web site for the detailed step-by-step inspection and servicing steps. The following information addresses only the special steps which are distinctive to the 2.2L engine.



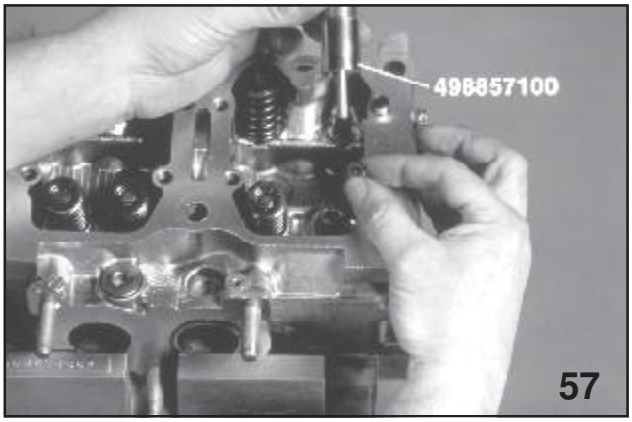
Valve Components

Use valve spring remover **499718000** to remove the valve springs. Then remove the valves and seals. The intake seals are black and the exhaust seals are brown.



Installing Valve Guides

Install the valve guides using a press, cylinder head table **498267200**, valve guide remover **499767200**, and valve guide adjuster **499767000**.

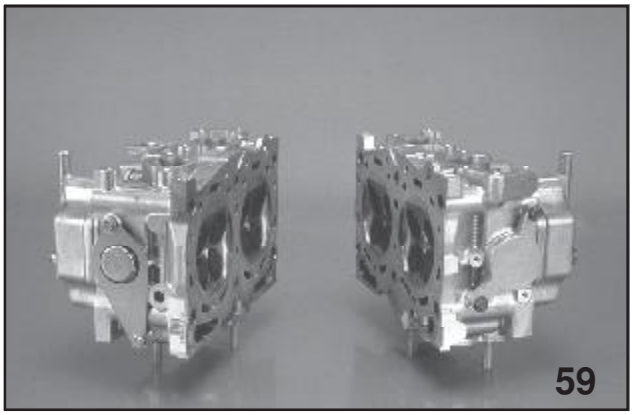


Installing Valve Guide Oil Seal

Use valve seal installer **498857100**, to install the valve guide seals (black for intake, brown for exhaust). Then use cylinder head table **498267200** and valve spring remover **499718000** to install the valve spring and retainer. Install the camshaft into the cylinder head bearing journals. Be careful to not damage or score the camshaft journals.

Installing the Oil Seal

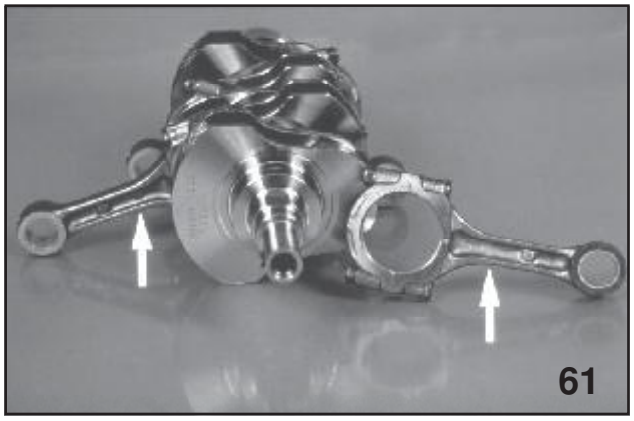
Install the left rear camshaft plug (oil seal). Then install the oil seal using oil seal installer **499587100**.



Storing Cylinder Heads

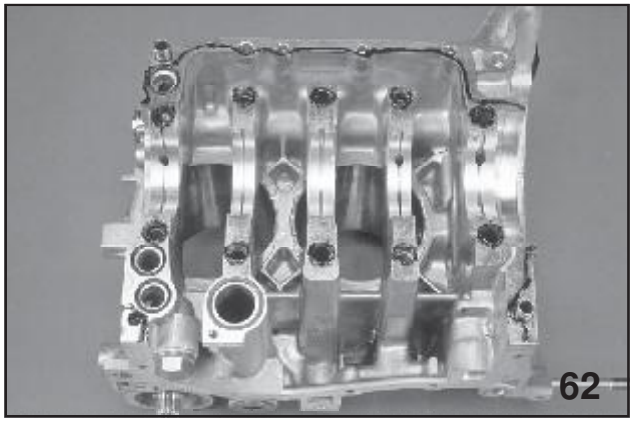
Temporarily store the cylinder head by standing it on the exhaust manifold studs. Repeat these steps for the other cylinder head.

Engine Reassembly



Assemble Crankshaft

Always refer to the applicable Subaru Service Manual on the STIS web site for the bearing size, oil clearance, and torque specifications. The "FUJI" symbol on the connecting rods must face the front of the engine.

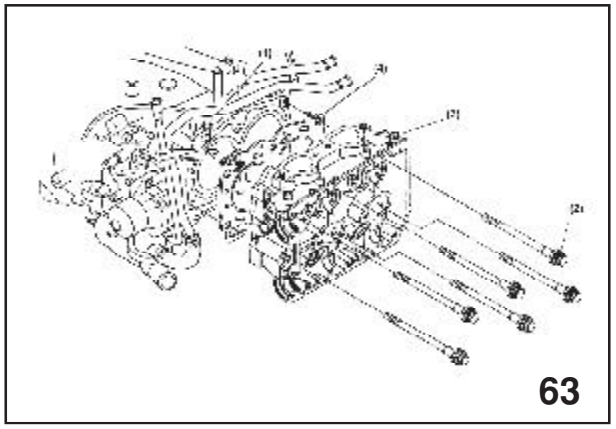


Crankcase Sealer and O-Rings

Apply sealant to the crankcase mating surface on the o-ring side of the crankcase. Do not allow the sealant to enter the O-ring grooves, oil passages, or bearing grooves. Install the crankshaft assembly. Align the connecting rods, and assemble the crankcase halves.

CAUTION: REMOVE ALL FLUIDS FROM THE THREADED PORTIONS OF THE CASE HALVES. THIS PREVENTS HYDROSTATIC LOCK AND POTENTIAL CRACKING OF THE CRANKCASE.

FOLLOW CORRECT SEQUENCE FROM THE SUBARU SERVICE MANUAL ON THE STIS WEB SITE.



Cylinder Head

(1) Bolt
(2) Cylinder head bolt
(3) Cylinder head
(4) Cylinder head gasket

1) Install cylinder head and gaskets on cylinder block.

CAUTION: USE NEW CYLINDER HEAD GASKETS.

2) Tighten cylinder head bolts per Subaru Service Manual specifications on STIS web site.

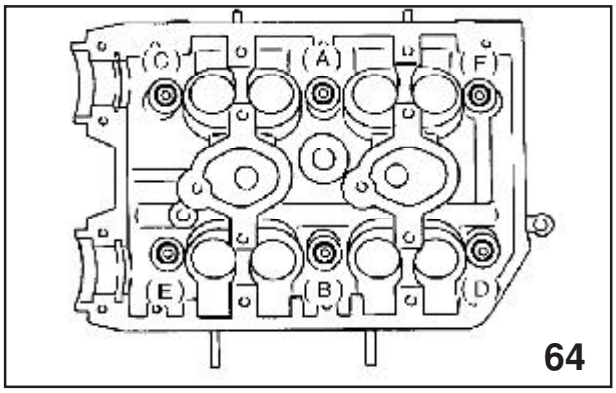
(1) Apply a coat of engine oil to washers and bolt threads.

(2) Tighten all bolts to 29 N•m (3.0 kg-m, 22 ft.-lb.) in alphabetical sequence.

Then tighten all bolts to 69 N•m (7.0 kg-m, 51 ft.-lb.) in alphabetical sequence.

(3) Back off all bolts by 180 first; back them off by 180 again.

(4) Tighten bolts (A) and (B) to 34 N•m (3.5 kg-m, 25 ft-lb).



Bolts

(5) Tighten bolts (C), (D), (E) and (F) to 15 N•m (1.5 kg-m, 11 ft-lb).

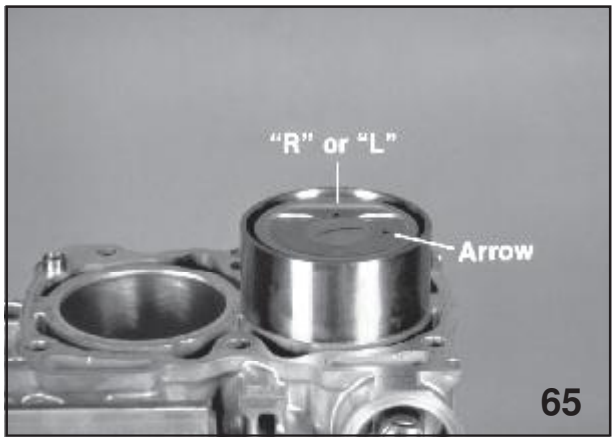
(6) Tighten all bolts by 80 to 90 in alphabetical sequence.

CAUTION: DO NOT TIGHTEN BOLTS MORE THAN 90.

(7) Further tighten all bolts by 80 to 90 in alphabetical sequence.

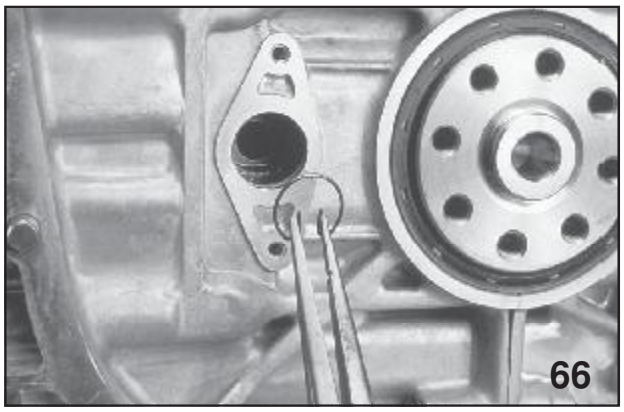
CAUTION: ENSURE THAT THE TOTAL "RE-TIGHTENING ANGLE" [IN THE TWO PREVIOUS STEPS] DO NOT EXCEED 180.

3) Install oil level gauge guide attaching bolt (LH side only).



Piston Installation

The pistons are directional and must be returned to the original cylinder locations. Use correct size piston guide to install the pistons. The pistons are marked with an "L" for the left side and an "R" for the right side. The arrow on the head of each piston must point to the front of the engine.

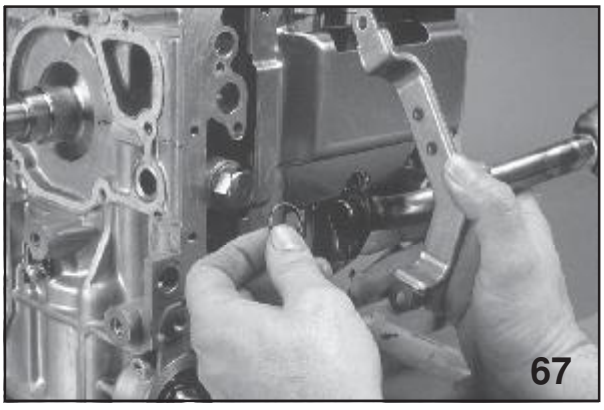


Circlip Removal

Rotate the crankshaft to position the connecting rod with the piston. Use piston pin guide **499017100** to align the piston and connecting rod. Then install the piston pin. Install the circlip. Note the proper direction of the circlip on early production models. The tangs must be tilted out. Repeat for the remaining pistons. Slowly rotate the crankshaft two (2) revolutions. This confirms the proper installation of the pins. Install the front piston pin access plugs. Use new aluminum sealing rings and sealer.

NOTE: DO NOT OVER TIGHTEN. CONSULT SUBARU SERVICE MANUAL ON THE STIS WEB SITE FOR SPECIFICATIONS.

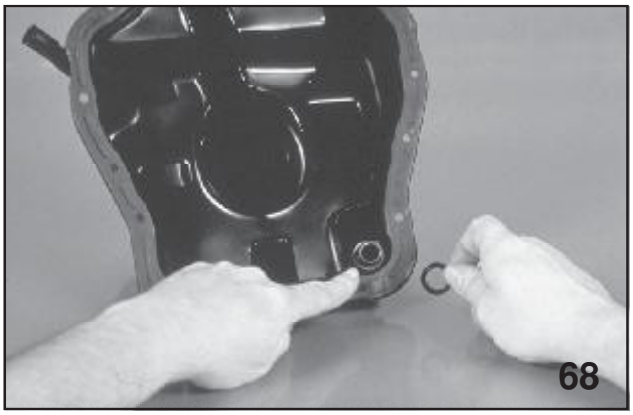
Install the left side access cover and new o-ring, PCV baffle plate, and piston pin plug using a new sealing ring and sealer.



Installing Oil Pick-Up Tube

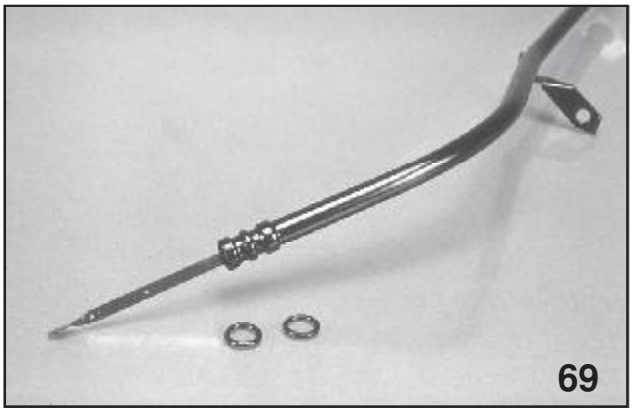
Install the oil pan baffle plate and oil pickup tube. Be sure to install a new O-ring to the oil pickup tube.

NOTE: DO NOT OVER TIGHTEN OR BOLT DAMAGE WILL OCCUR.



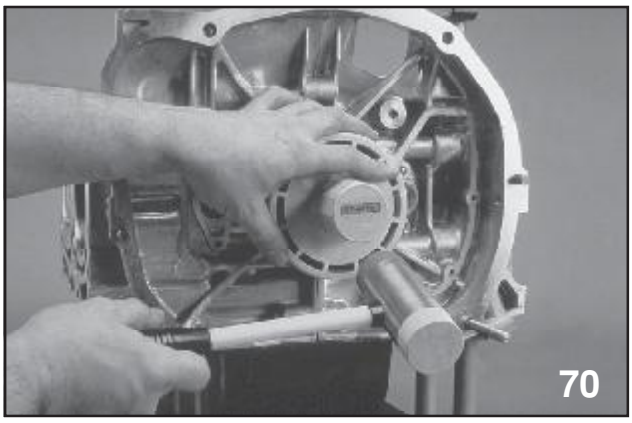
Oil Pan Drain Tube Seal

Install a new oil seal on the oil return tube. Apply liquid gasket sealer FUJI Bond 1207C or equivalent to the oil pan mating surface. Install the oil pan and oil pan retaining bolts. Diagonally torque the oil pan bolts on one pass to 0.5 Kg-m (3.6 ft lbs).



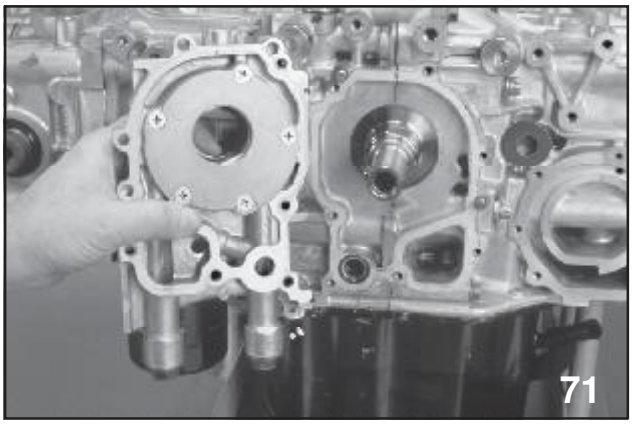
Dipstick Tube and Seals

Install the dipstick tube. Be sure to use two (2) new o-ring seals.



Installing Rear Crankshaft Oil Seal

Install the rear main oil seal using seal installer (**499587200**), oil seal guide (**499597100**) and a plastic hammer. Lubricate the seal with engine oil prior to installation.



Installing Oil Pump

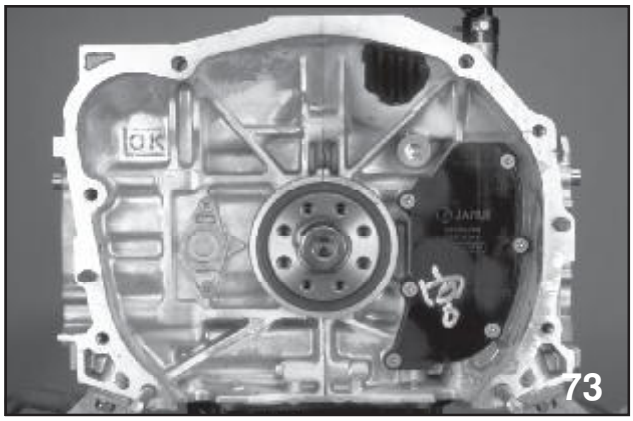
Install the oil pump. Refer to the 1995 Subaru Service Manual on the STIS web site section 2-4 [W1E0] for proper location of the sealer and O-ring. Apply FUJI Bond 1215 sealer or equivalent to the mating surface of the oil pump. Align the flats (2) on the oil pump with the flats (2) on the crankshaft and the mounting holes in the oil pump flange with the two (2) dowel pins. Install the mounting bolts and torque to specifications.

2.2 and 2.5 Engines 1999 Enhancements DOHC (Phase 1) and SOHC (Phase 2)

The engines for the 1999 Subaru line will be designated phase 1 and phase 2. 2.5 liter engines equipped on the Legacy will be phase 1 design while the Impreza and Forester will utilize phase 2 design 2.5 liter engines.

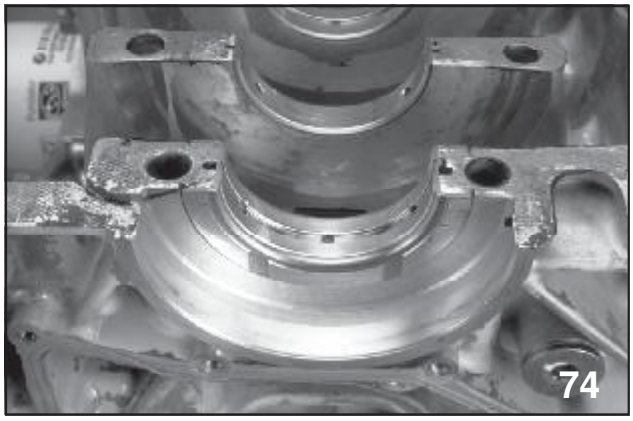
The 2.5 liter phase 2 engines are SOHC engine with a newly designed cylinder head. The (phase 1) 2.5 liter engine uses the same cylinder head configuration that it has used on prior year models with the crankcase and bell housing sharing the same characteristics of the new phase 2 engines.

Common Changes in the 2.5 liter (phase 1 and 2 engines.)



Engine to Transmission Mounting

The engine and the transmission are fastened with 6 bolts and 2 studs.



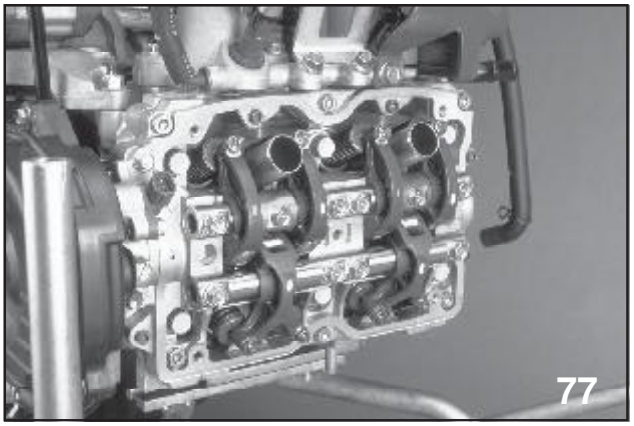
Thrust Bearing Location

The thrust bearing has been moved to the number 5 position.

Main Bearing Oil Grooves

Oil groove in the number 1 and 3 have been changed to supply additional lubrication to the crank journal.

New Features of the 2.2 and 2.5 Liter (Phase 2) SOHC Engine



2 Rocker Shaft Assembly

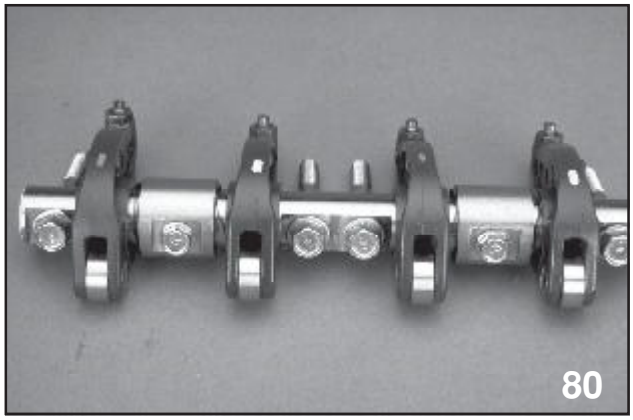
The cylinder head will be a 2-rocker shaft valve system.

The valves are positioned at a larger angle than previous model years. The intake valves are positioned 23 degrees off center with the exhaust valves positioned 20 degrees off center. Prior model year engines utilized a 15-degree positioning angle.

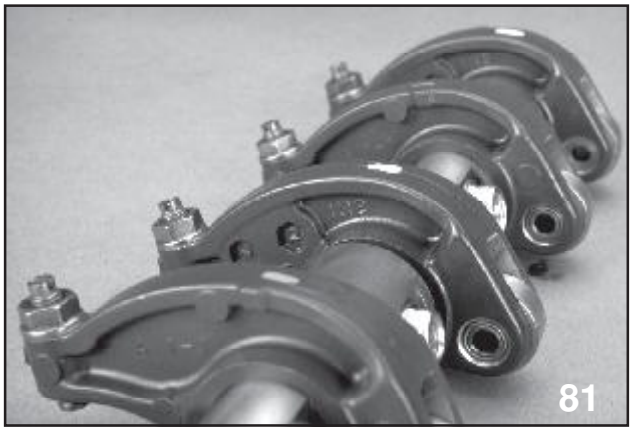
New Head Gasket Design

Head gasket thickness is 0.7 mm.

Rocker Arm Identification

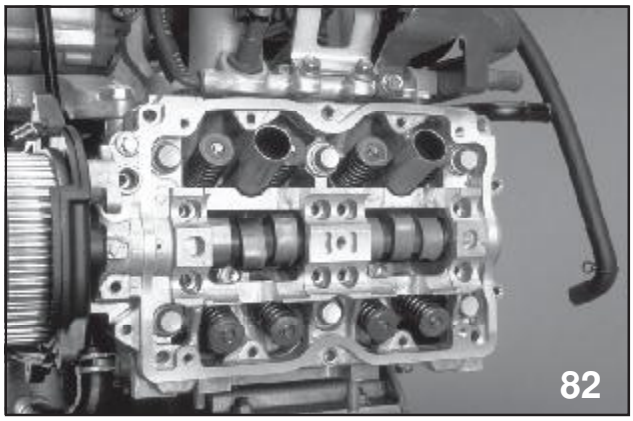


Roller Rockers and Wave Washers

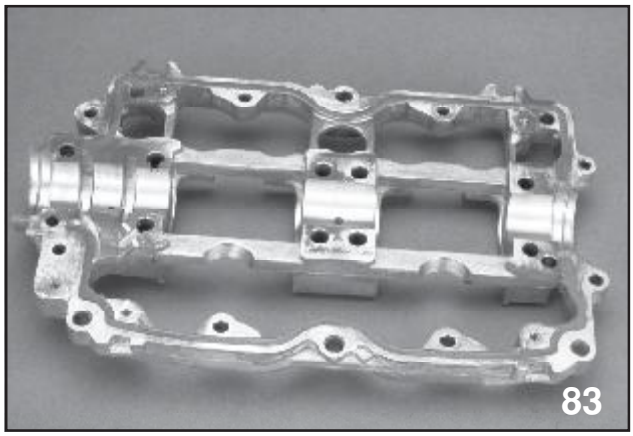


Adjustment Screw and Nut

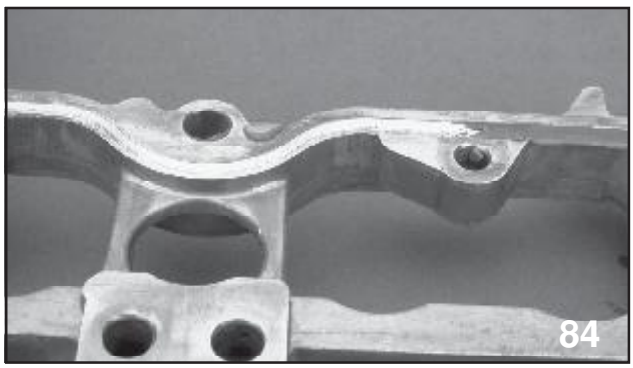
The intake rocker arms are marked so they are correctly placed on the rocker shaft when servicing. An IN1 or IN2 will be embossed on each rocker arm. As viewed from the front of the engine the Number 1 intake valve of each cylinder and the number 2 intake valve have an IN1 marked and IN2 marked rocker arm that mates with it. New IN1 rocker arms can also be identified by a Green painted mark on the top of the rocker arm. The IN2 rocker arms have a white mark. Proper positioning is maintained through the use of a wave washer located between the rocker shaft arm and rocker arm shaft support.



Camshaft Secured by Camcase



Camcase Sealing Points

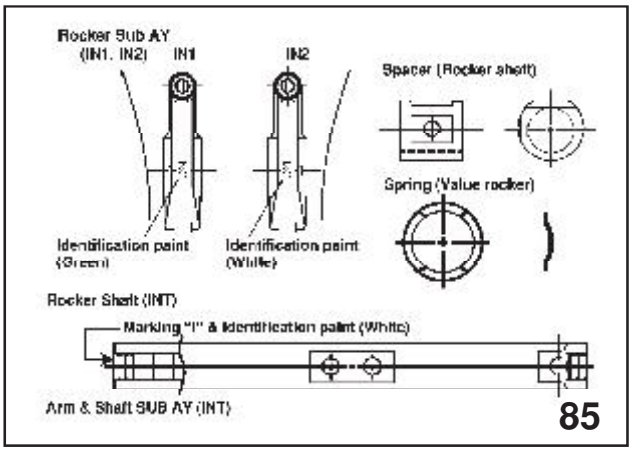


Sealing Groove

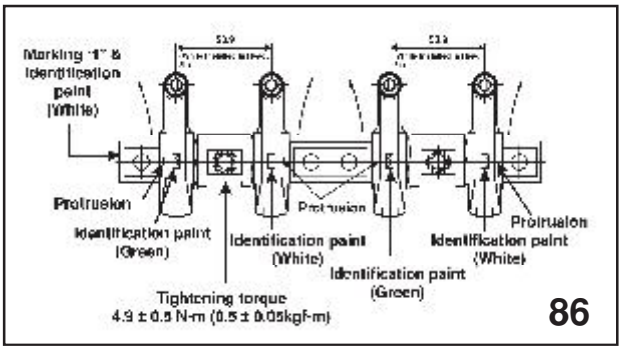
The camshaft is secured to the cylinder head with the camcase. An oil passage in the cylinder head provides the passageway in the camcase with oil that leads to the intake rocker shaft. Oil from the camshaft is collected on the opposite side of the passageway leading to the intake rocker shaft to provide oil to the exhaust rocker shaft.

Sealing of the camcase is accomplished by using a thin layer of three bond applied in the channel around the camcase edge. After the three bond (1280B) is applied, the camcase must be installed to the cylinder head and onto the engine before the three bond has time to cure. Failure to do this will result in oil leaks.

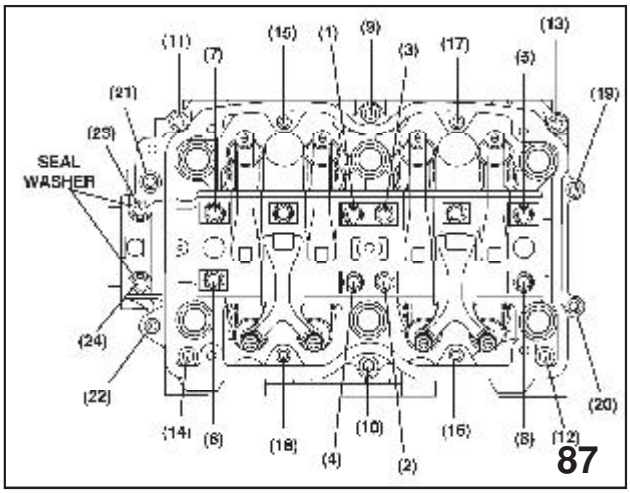
NOTE: CYLINDER HEAD AND CAMCASE MUST BE REPLACED TOGETHER. (LINE BORED)



Rocker Identification

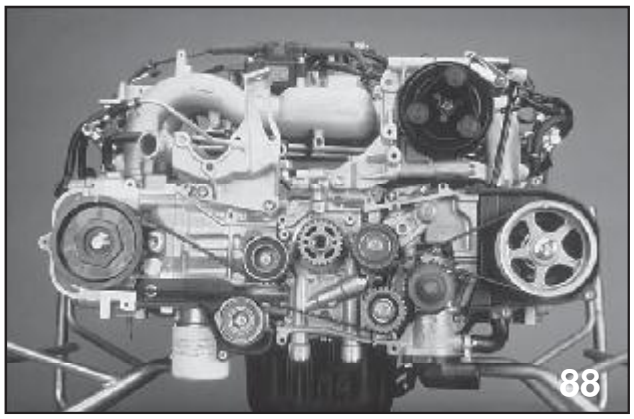


Rocker Arm Measurements



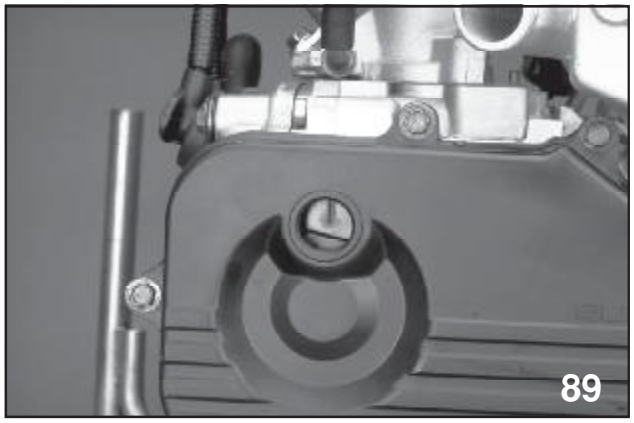
Camcase Tightening Sequence

The sparkplug pipe is pressed into the cylinder head and is not serviceable. If it becomes damaged the cylinder head must be replaced. The seals installed onto the ends of the sparkplug pipes seal against the valve covers and should be replaced when the valve cover is removed.



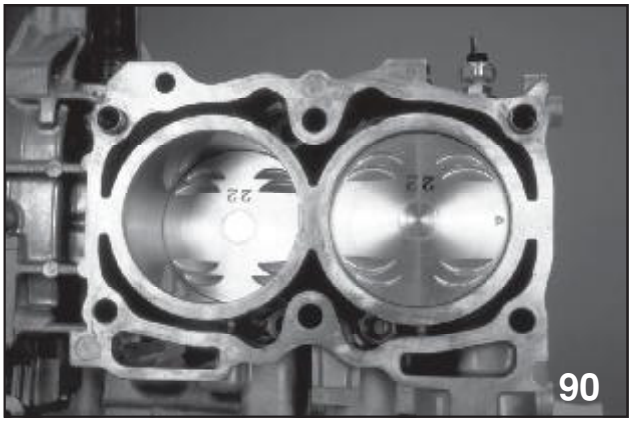
Timing Belt Marks

Timing belt marks on the left bank will be made onto the inner timing belt cover and the edge of the camshaft sprocket. The crank shaft timing mark remains on the reluctor with engine block mark just below the crank angle sensor. The right bank camshaft sprocket has a mark at the edge that is matched with the seam line formed by the meeting of the camcase and cylinder head. (12:00 o'clock position)



Right Bank Timing Mark Window

The right bank timing mark can be checked with outer cover in place using the provided window.

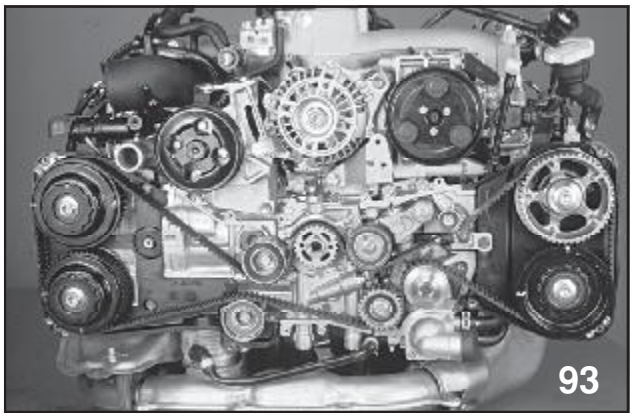


Open Deck Design

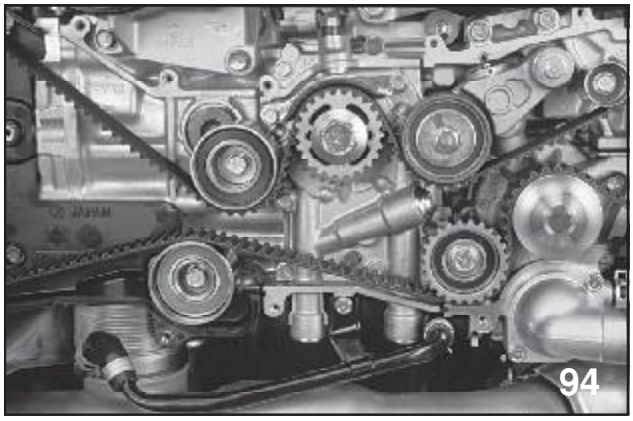
Piston With Valve Reliefs

Piston design on the 2.5 liter engine. The compression ratio is 10 to 1.

2.0 Liter Engine Features - WRX From 2002~2005



2.0 Liter Engine



Cam Belt and Idler Pulleys

The EJ-2.0 engine is a double over head camshaft, turbo charged engine. The timing belt procedure and routing is very similar to other Subaru DOHC, engines, however, the increased power output of the engine requires the use of an additional timing belt idler pulley. Manual transmission vehicles are equipped with additional belt guides that function during deceleration or fuel cut from high rpm running conditions.

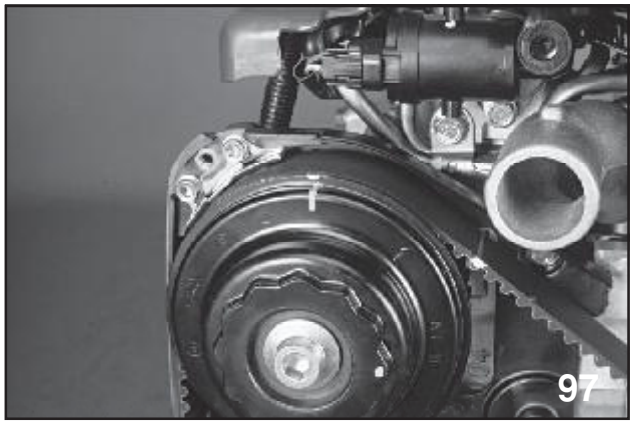
NOTE: WHEN SERVICING THE TIMING BELT RETURN ALL IDLER PULLEYS AND BELT GUIDES TO THEIR ORIGINAL POSITIONS.

Intake Camshaft Sprocket Timing Marks (Left Bank)

Exhaust Camshaft Sprocket Timing Marks (Left Bank)

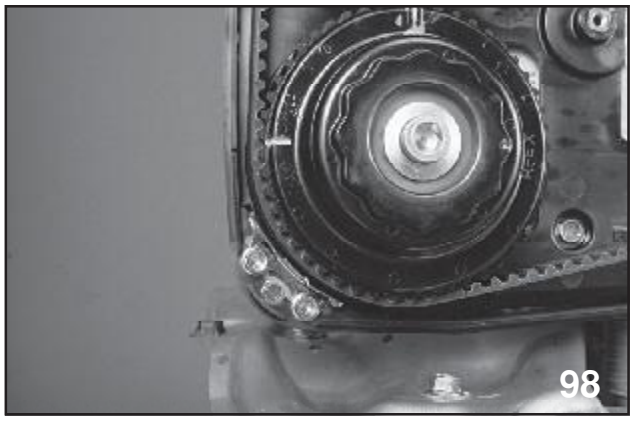
The left bank intake camshaft sprocket is metallic and the camshaft reluctor is made onto the backside. The timing marks for belt installation are at 12:00 (I) and 6:00 (III).

The left exhaust sprocket is made of a resin material with its timing marks during belt installation at 12:00 (II) and 3:00 (I). The exhaust 12:00 (II) mark lines up with 6:00 (II) of the intake sprocket. (A timing belt guide is located at the lower left side of the sprocket of manual transmission models.)



Intake Camshaft Sprocket Timing Marks (Right Bank)

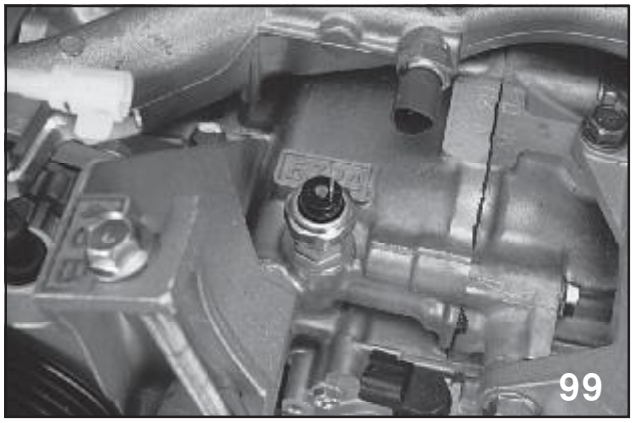
The right intake sprocket is also made of a resin material with its timing marks during belt installation at 12:00 (I) and 6:00 (III). (A timing belt guide is located at the upper left side of the sprocket of manual transmission models.)



Exhaust Camshaft Sprocket Timing Marks (Right Bank)

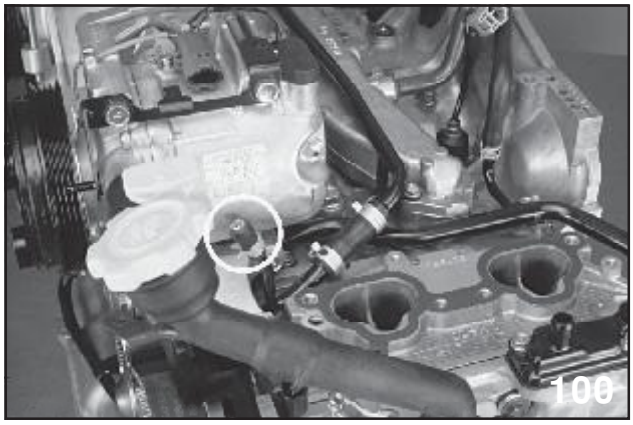
Finally, the right exhaust sprocket is made of a resin material with its timing marks during belt installation at 9:00 (I) and 12:00 (III). The exhaust 12:00 (II) mark lines up with 6:00 (II) of the intake sprocket. (A timing belt guide is located at the lower left of the sprocket of manual transmission models.)

NOTE: IT IS CRITICAL THAT ALL TIMING MARKS BE CONFIRMED TO THE CORRECT POSITION. INCORRECT POSITIONS WILL RESULT IN VALVE AND PISTON DAMAGE.



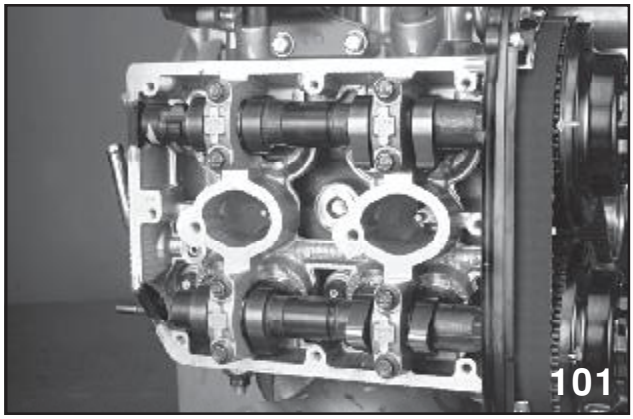
Engine Designation Number

The engine class number (Engine designation number) is located near the front of the engine behind the oil-sending unit and in front of the engine coolant temperature sensor.

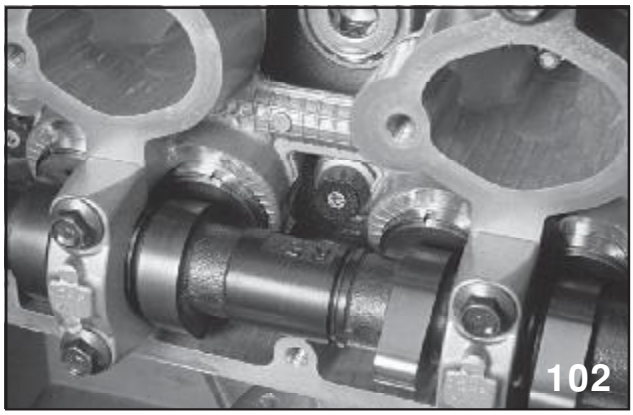


Factory Coolant Pipe Plug

A coolant pipe located on the left hand bank is sealed with a rubber plug at the factory. **Do not** remove the plug to service any part of the cooling system. When performing coolant pressure tests check plug for leaks.

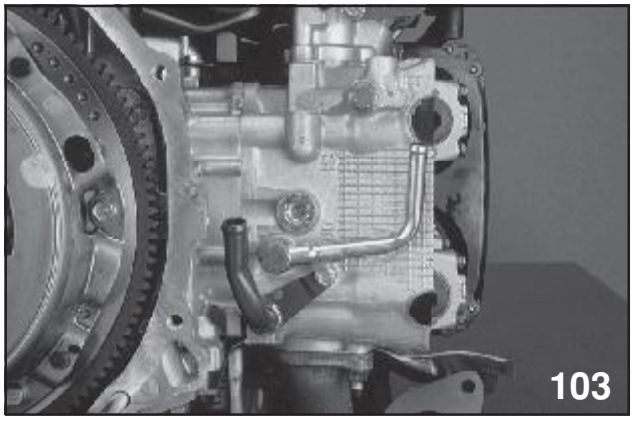


2.0 Liter Valve Train Assembly



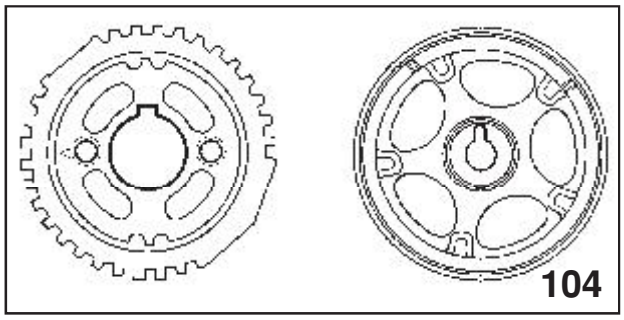
2.0 Liter Head Bolt Access

The valve train for the EJ 2.0 is the same design used on other DOHC engines. A new shim tool (2002 only) has been developed to allow valve adjustment without removing the camshafts. The camshaft inner cover, camshaft sprockets and camshafts must be removed to access the cylinder head bolts. 2003 and newer use select fit lifters to obtain correct valve clearance.



Turbo Oil and Coolant Passages (Right Bank)

The rear of the right bank cylinder head serves as the mounting for the oil and coolant passages for the Turbo Charger.

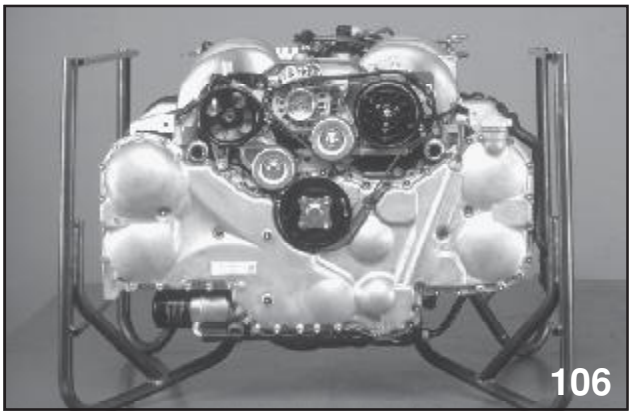


Crankshaft and Camshaft Sprockets for the 2.0 Turbo Engine

Piston pin design is strengthened with a near solid, non hollow design. Pin removal from pistons during disassembly requires a small diameter long thin punch of pliers to remove the pin.

Additional material is installed in the center of the piston pins in the 2.0 engine for strengthening.

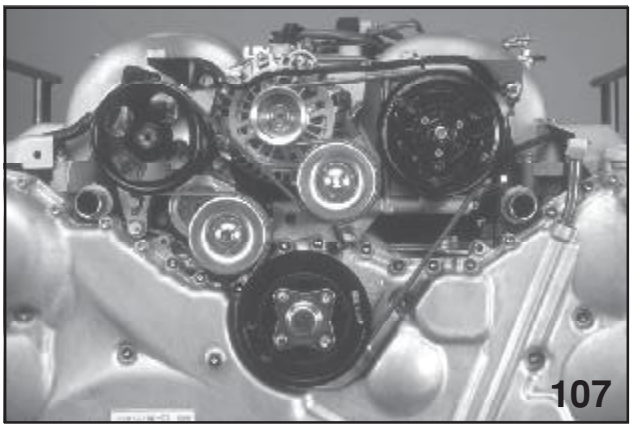
3.0 Liter Engine



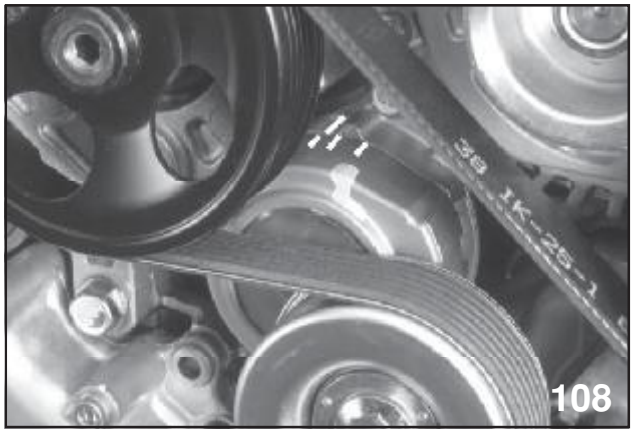
3.0 Liter Engine with Stands

General Information

The EZ-3.0 is the model name (Engine Designation) for the new 6-cylinder engine introduced for the 2001 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)

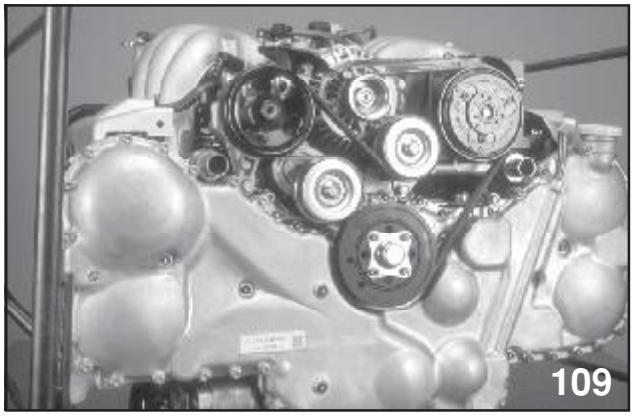
Compression Ratio 10.7 to 1

Gasoline for use Unleaded Premium

Fuel Injection Type DMPI

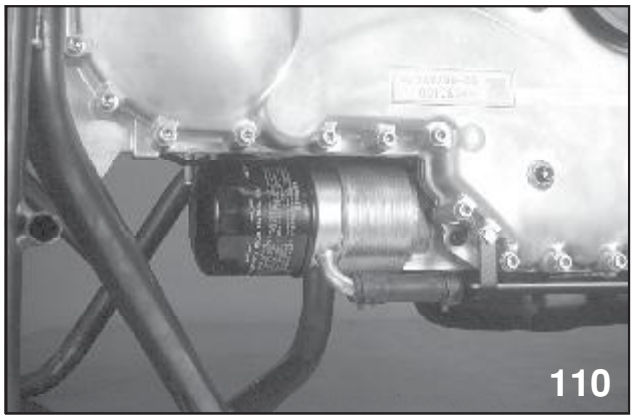
Maximum Horsepower 212 at 6,000 RPM

Maximum torque 210 at 4,400 RPM



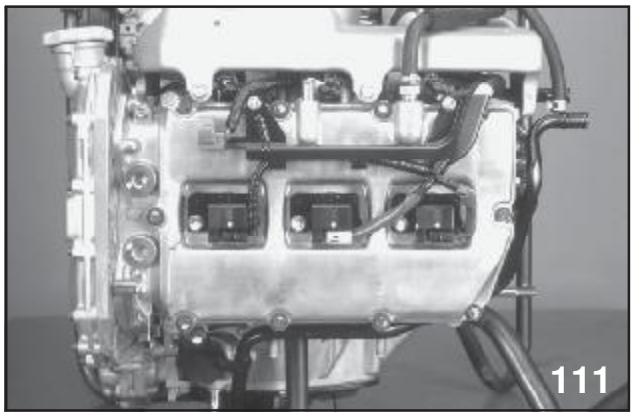
Upper Radiator Hose Connections

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

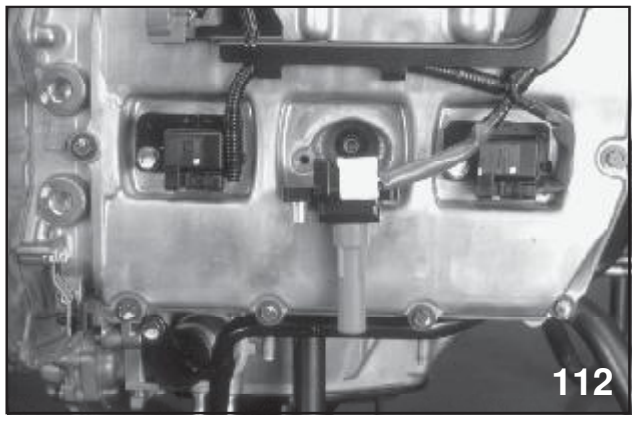


Oil Cooler

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

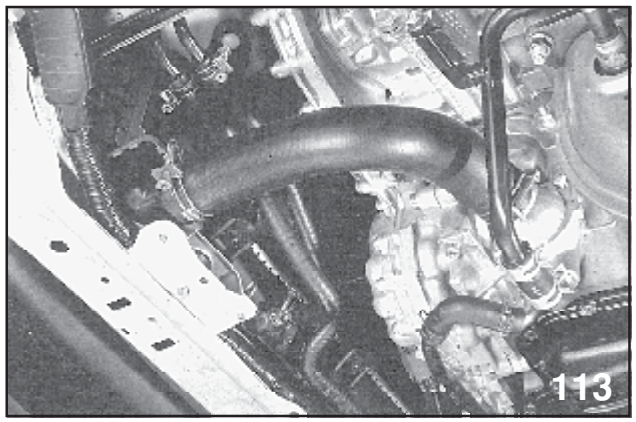


Individual Coils



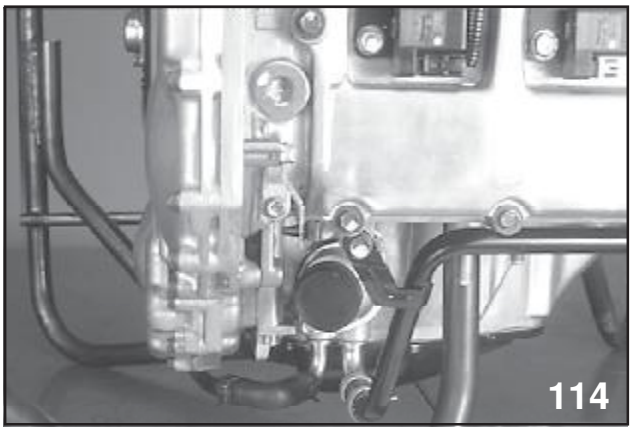
Coil and Igniter Assembly

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



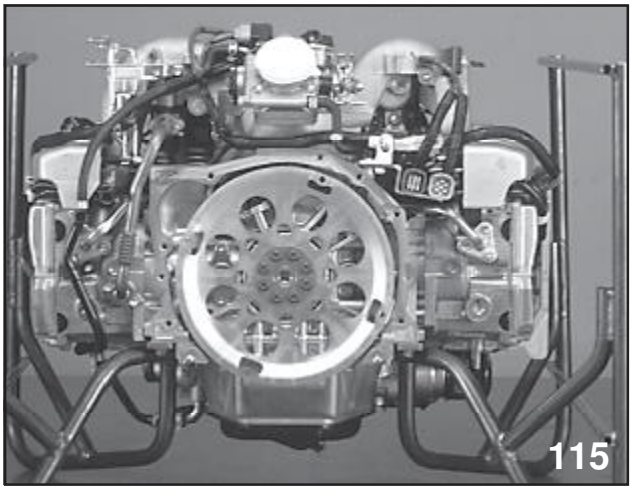
Lower Radiator Hose

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



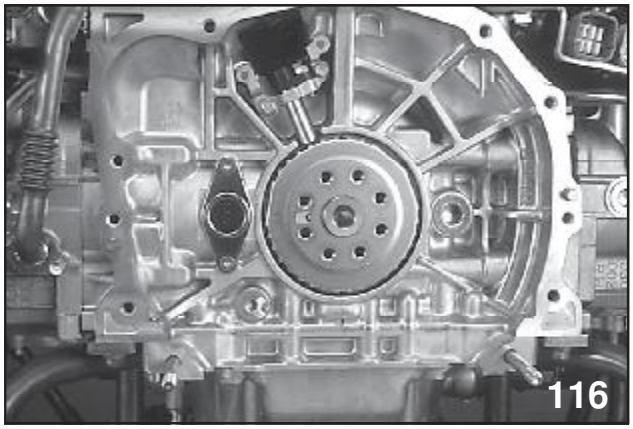
Oil Pan and Extension Case

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.



Crankcase Ventilation System

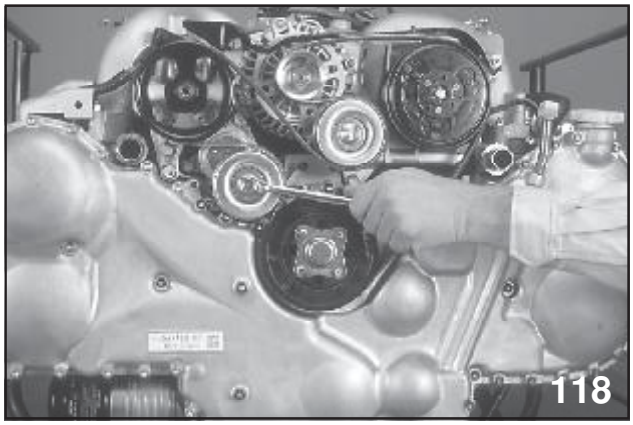
Connections for the crankcase ventilation system are located at the top of the valve cover. Pressure is equalized from the right bank with a cross over tube.



Crank Angle Sensor with Reluctor

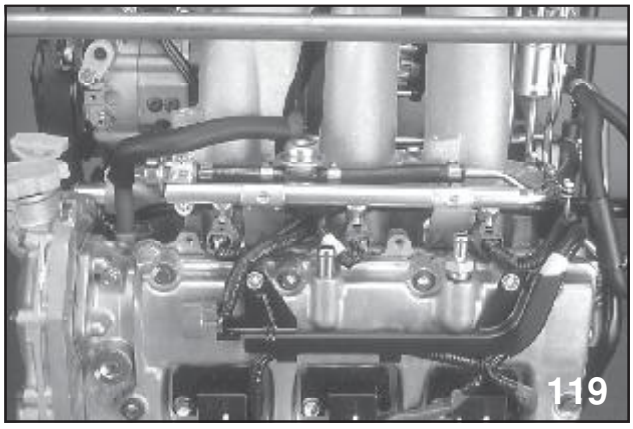
The new crank angle sensor, reluctor, and EGR pipe. The crank angle sensor and reluctor have been moved to the rear of the crankshaft. The EGR pipe has a new design and is mounted on the left bank of the engine.

3.0 Liter Engine Disassembly



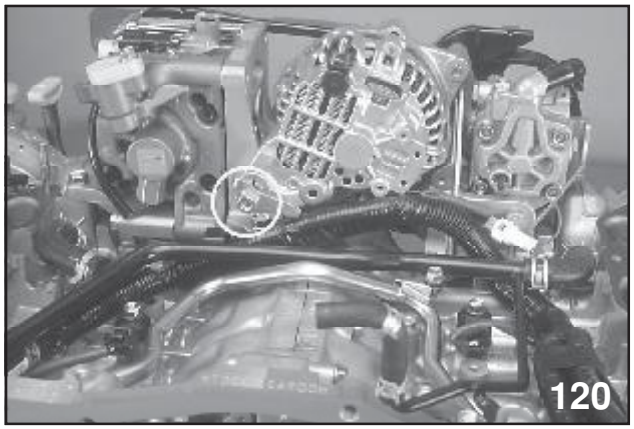
Unloading Tensioner

Begin disassembly by unloading and removing the serpentine belt.



Fuel Rail Assembly

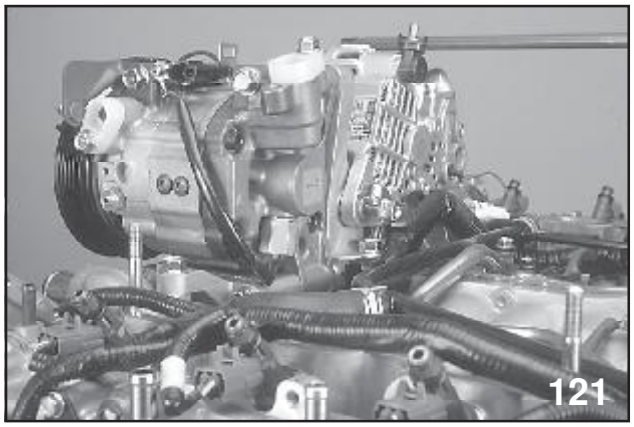
Remove the fuel rail protectors from both sides.



Lower Alternator Bolt

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

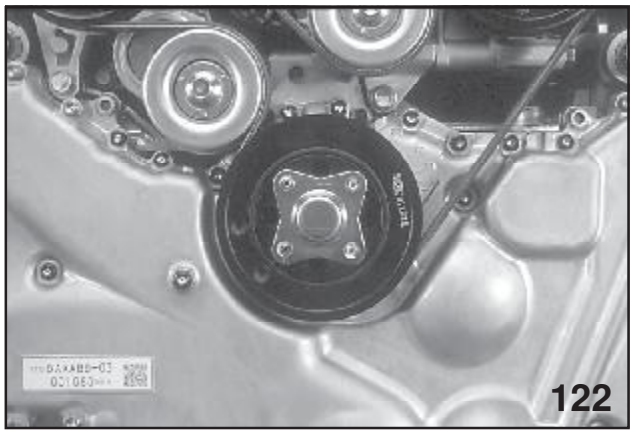
Remove the intake manifold.



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.

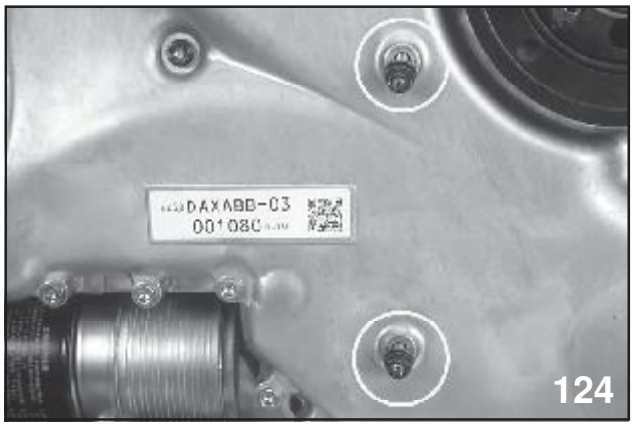


Crankshaft Bolt Cover

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.

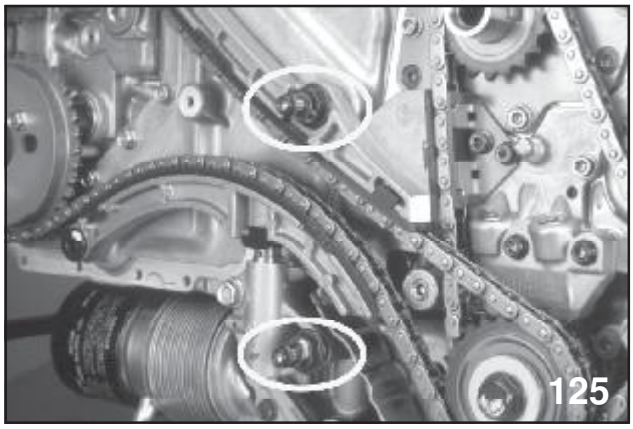
Begin removing the outer cover bolts. Keep them organized to ease reassembly. The bolts must be removed in the proper sequence to avoid warping the outer case.



Outer Cover Seals

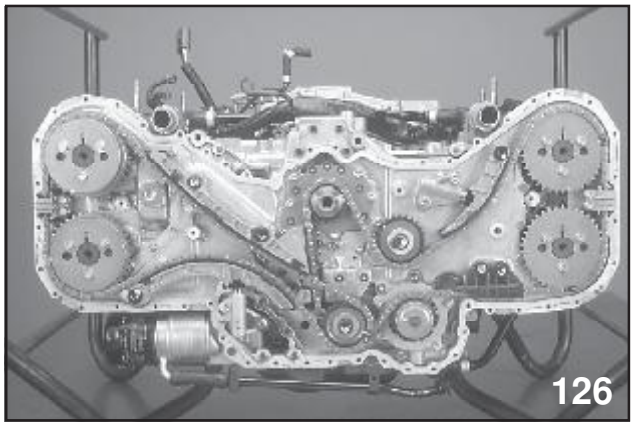
These two bolts use sealing washers to prevent engine oil from leaking to the outside.

The seals are not reusable.



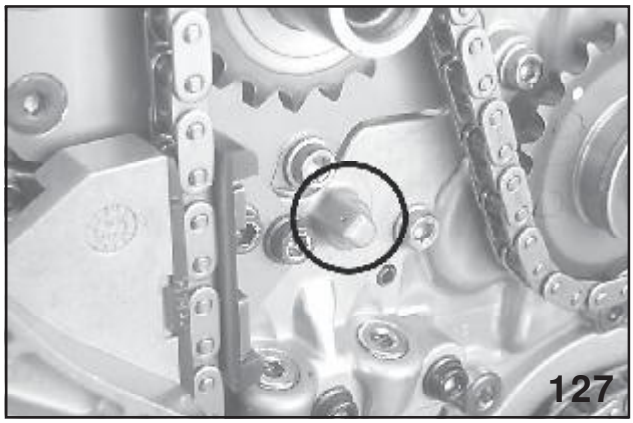
Outer Cover Bolts

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.



Timing Chain Routing

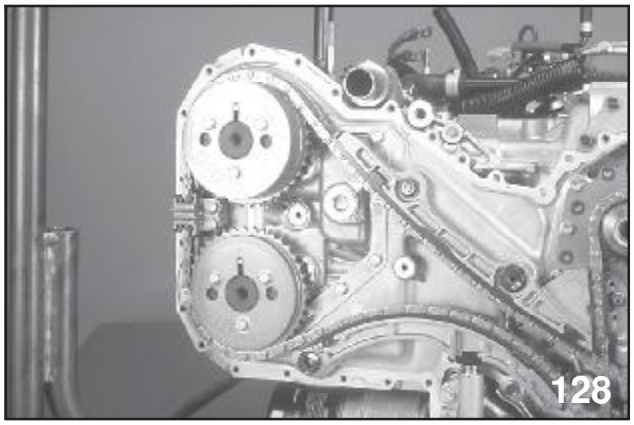
The timing chain on the EZ-3.0 is designed to last the life of the engine. Proper engine oil maintenance is necessary to ensure it lives up to its design. Two chains are used. Four (4) camshaft sprockets, one (1) crankshaft sprocket, two (2) idler sprockets and the water pump complete the timing chain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



Timing Chain Oil Jet

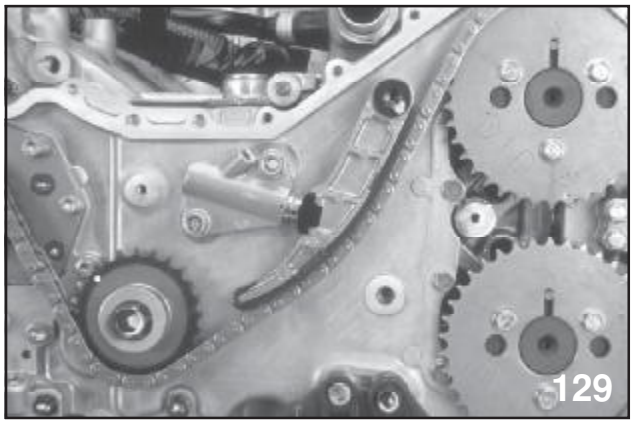
The timing chain is sprayed with oil from this jet located on the oil pump relief valve housing.

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



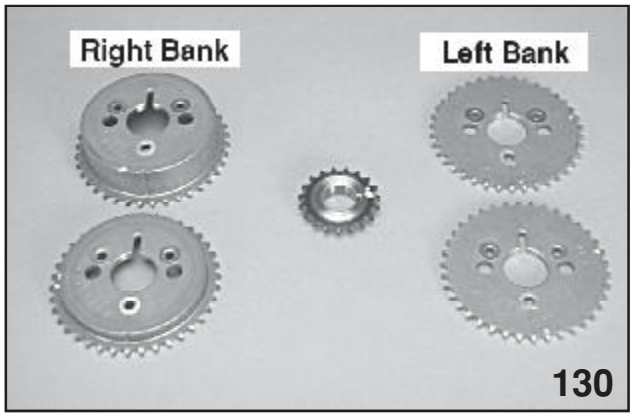
Right Bank Camshafts

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.



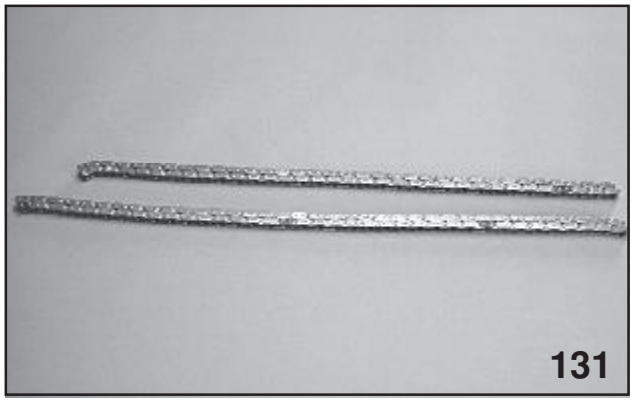
Left Bank Timing Marks

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*.



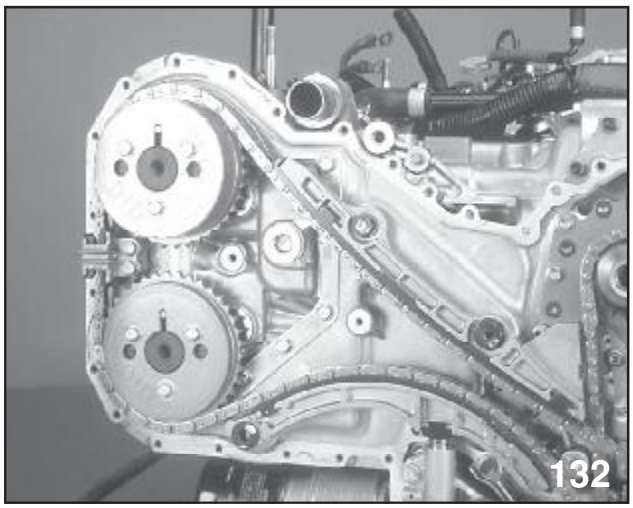
Camshaft Sprockets

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.



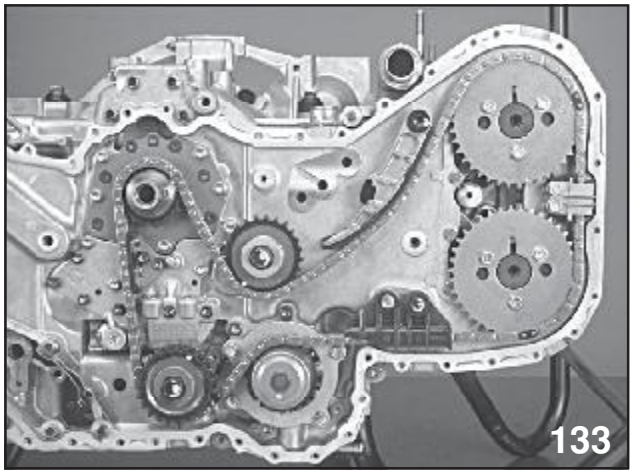
Timing Chains

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



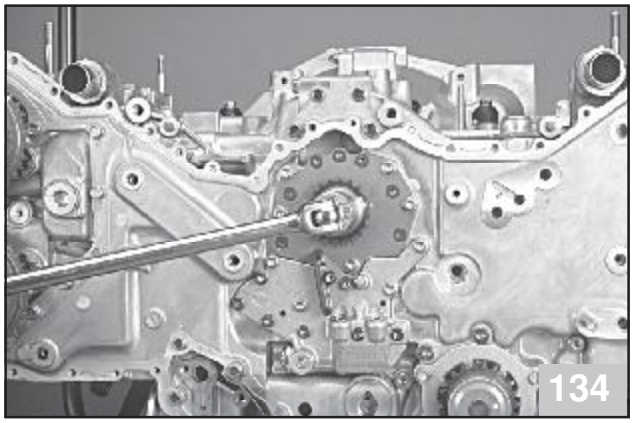
Removal of Right Bank Timing Chain Components

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.



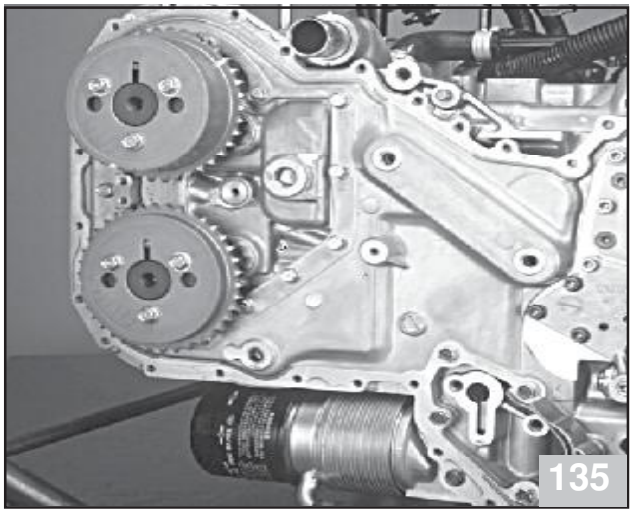
Removal of Left Bank Timing Chain Components

Remove the left bank tensioner, chain and chain guides.



Turn Crankshaft to Prevent Piston and Valve Damage

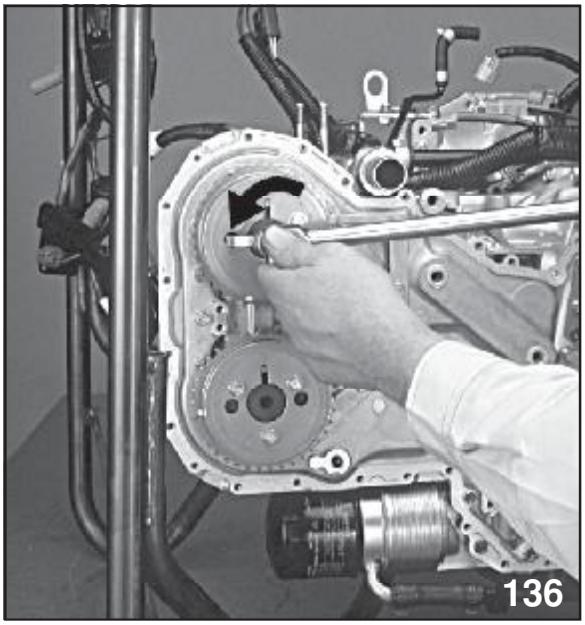
NOTE: TURN THE CRANKSHAFT 90 DEGREES COUNTER CLOCKWISE TO REDUCE THE CHANCE OF ACCIDENTAL DAMAGE TO THE PISTONS AND VALVES IN THE EVENT THE CAMSHAFTS SUDDENLY UNLOAD.



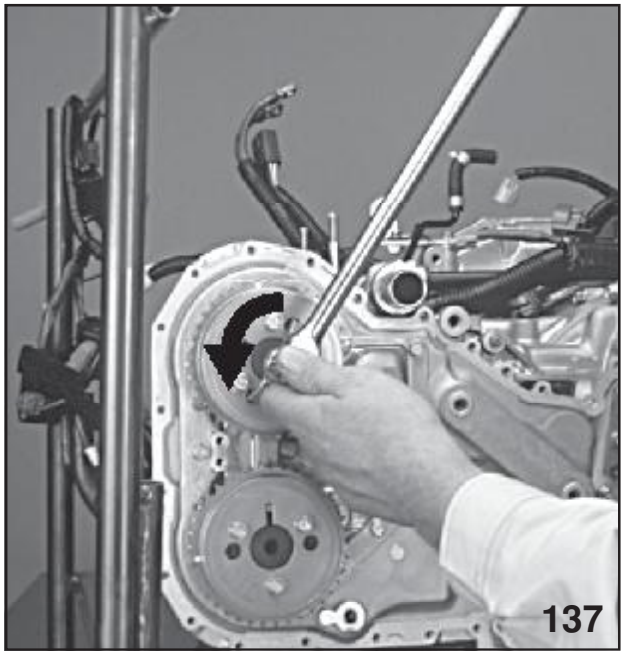
Right Bank Camshafts in Loaded Position

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

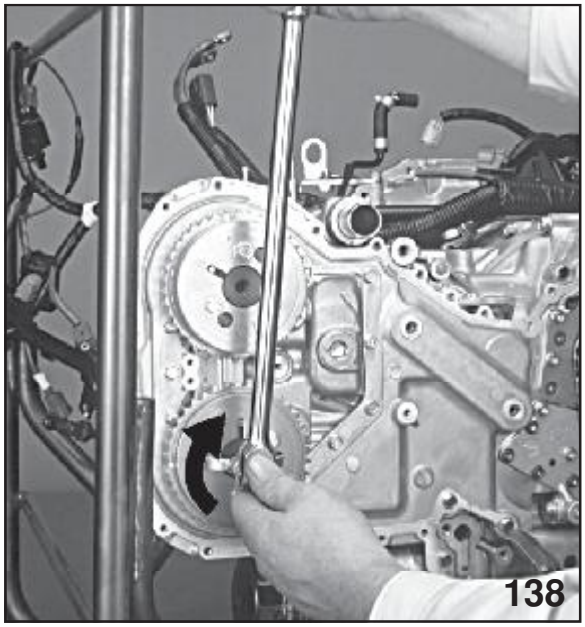


Unloading Intake Camshaft

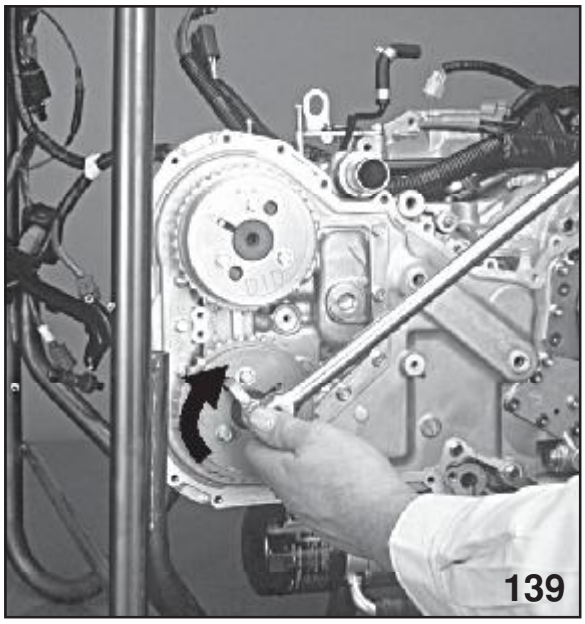


Unloading Intake Camshaft

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

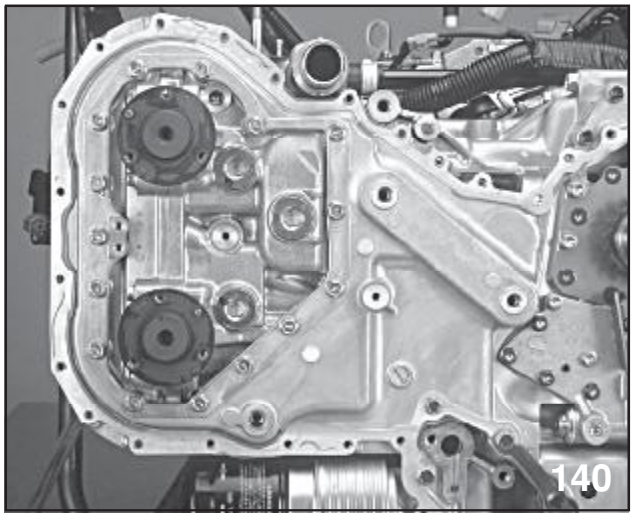


Unloading Exhaust Camshaft

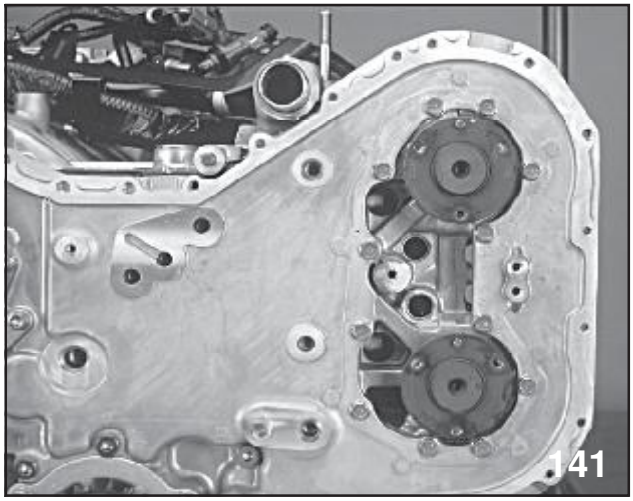


Unloading Exhaust Camshaft

Position the camshaft sprocket wrench on the **right bank exhaust** sprocket and turn 90 degrees **clockwise**. Both camshafts are now unloaded.

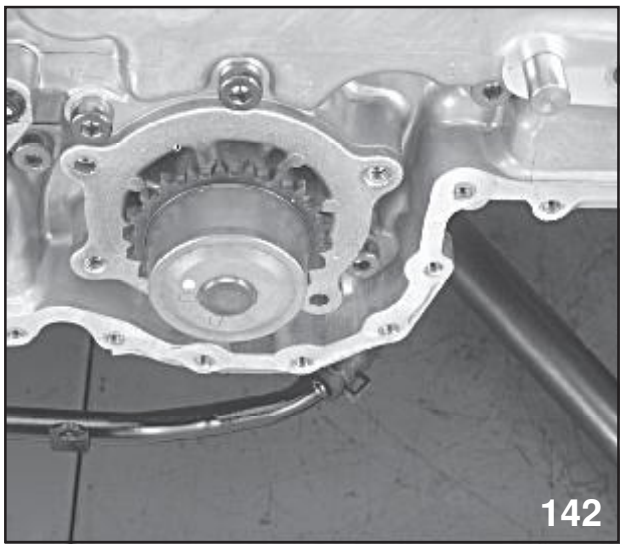


Remove Camshaft Sprockets (Right Bank)



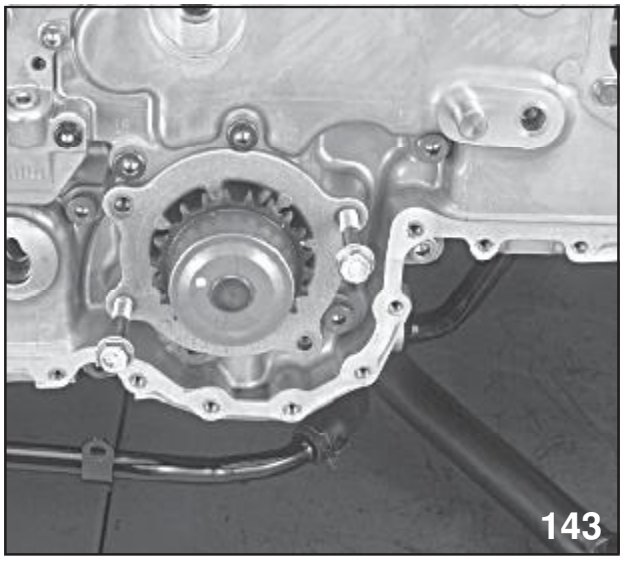
Remove Camshaft Sprockets (Left Bank)

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



Water Pump Assembly

Remove the bolts from the water pump.

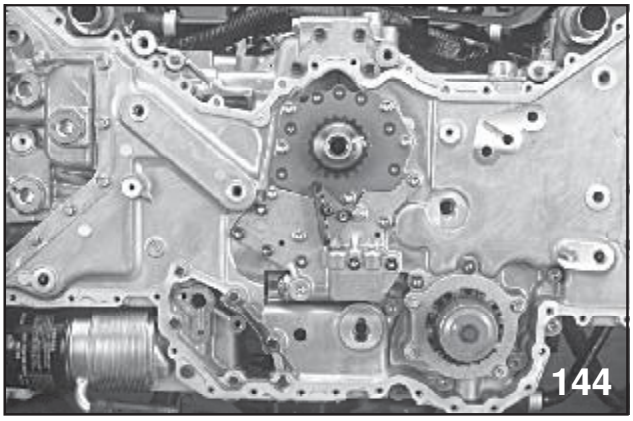


Insert Bolts for Pump Removal

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

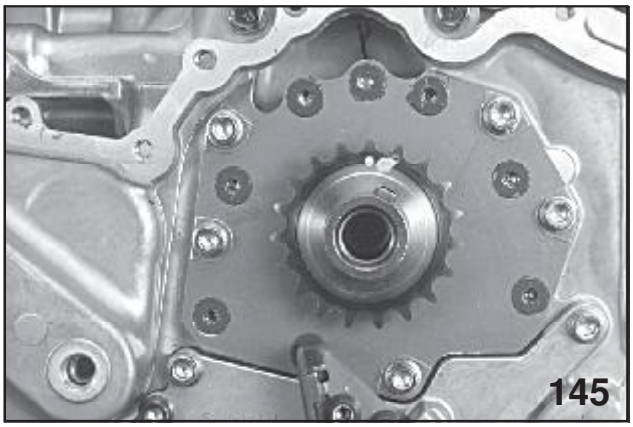
Remove the o-ring that seals the water pump to the inner cover.

Removal of Oil Pump



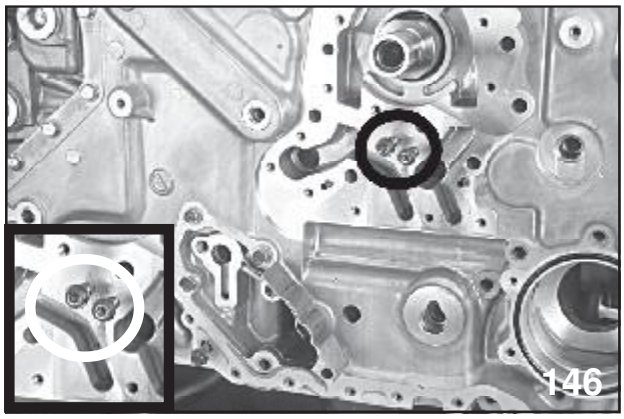
Oil Pump Cover

Remove the oil pump cover and oil pump gears.



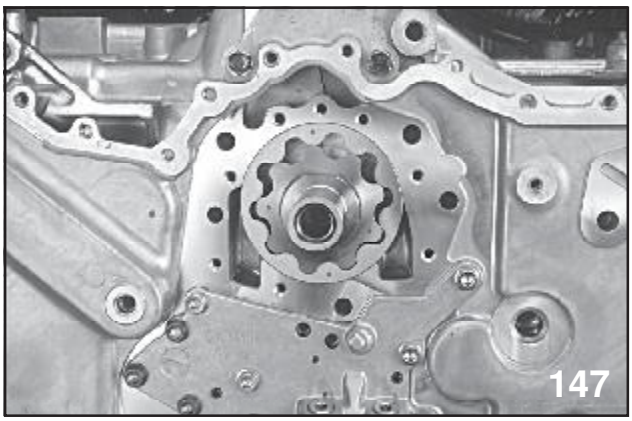
Chain Guide

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



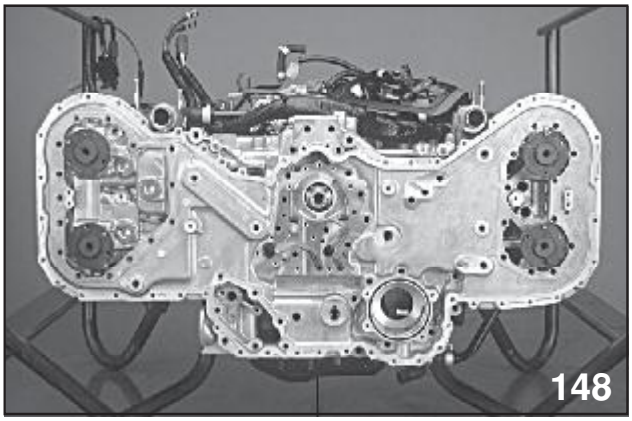
Chain Guide Bolts

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



Oil Relief Valve Housing

Remove the relief valve housing bolts and housing.

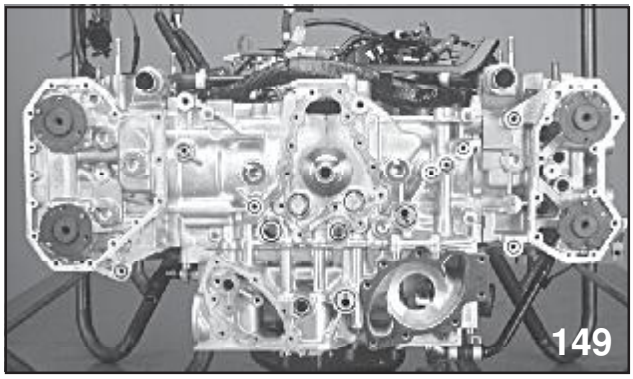


Inner Cover

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)

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.

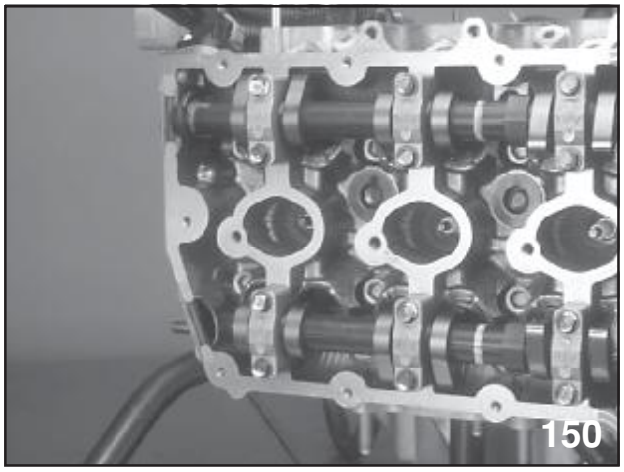
Care must be taken to ensure proper installation of all seals.

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



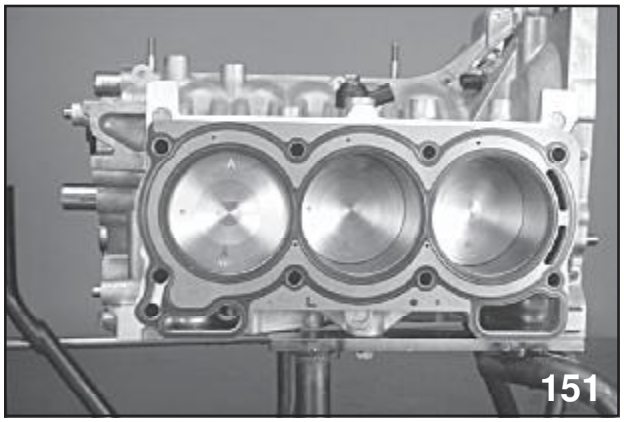
Valve Train Assembly

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.

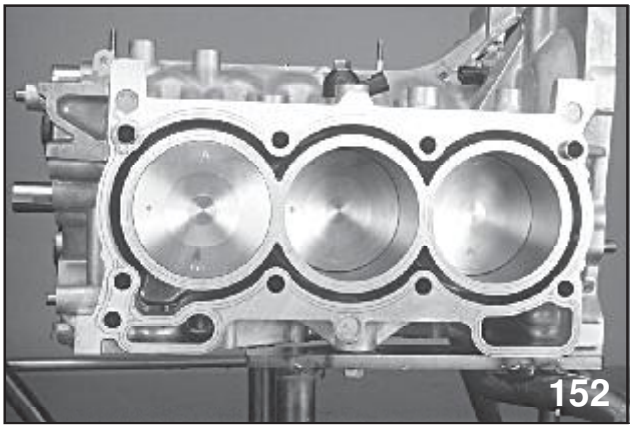
Remove the cylinder head and gasket.

Repeat this procedure on the opposite side.



Cylinder Block with Head Gasket

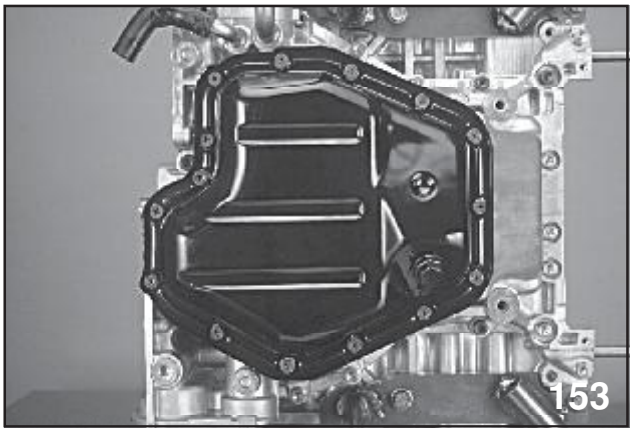
The cylinder block is made from aluminum die casting with monoblock casting cast iron cylinder liners. Water jackets are independent for the RH and LH block halves.



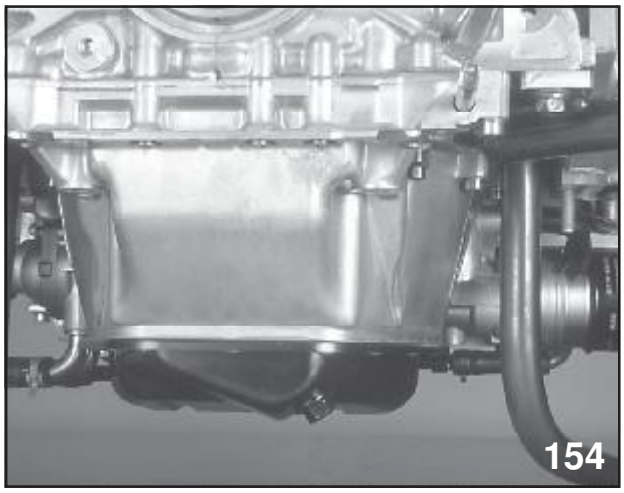
Open Deck Design

The block utilizes open deck design.

Removal of Oil Pan

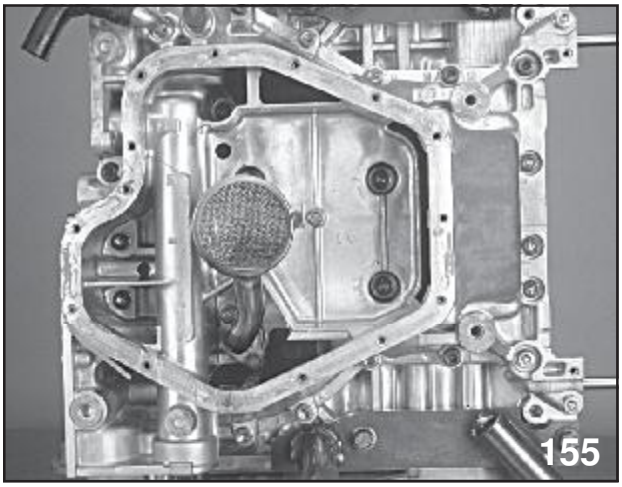


Oil Pan (Lower)



Oil Pan (Upper)

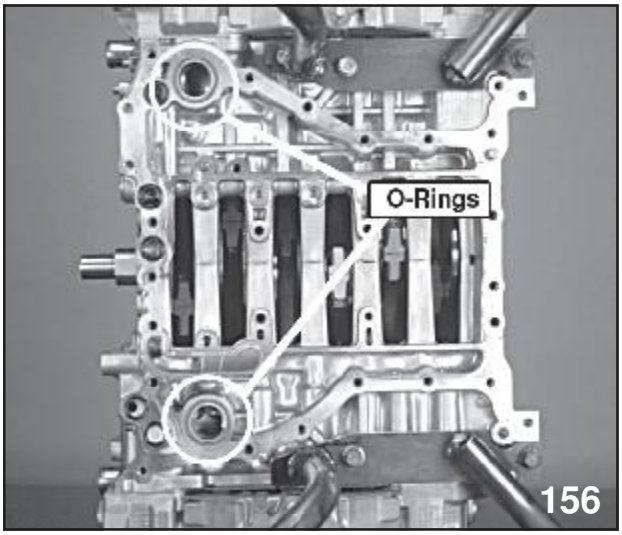
Remove the oil pan bolts and oil pan. Observe that the Oil Pan has a different design from 4 cylinder Subaru engines.



Oil Pan Bolt Locations

NOTE: PLACEMENT OF BOLTS.

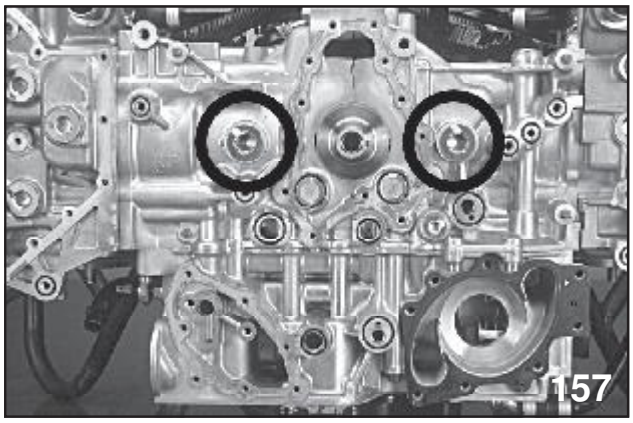
Remove the oil pan extension housing bolts. There are 28 bolts with five different lengths. Follow the proper sequence to prevent warping the case.



Block O-Ring Locations

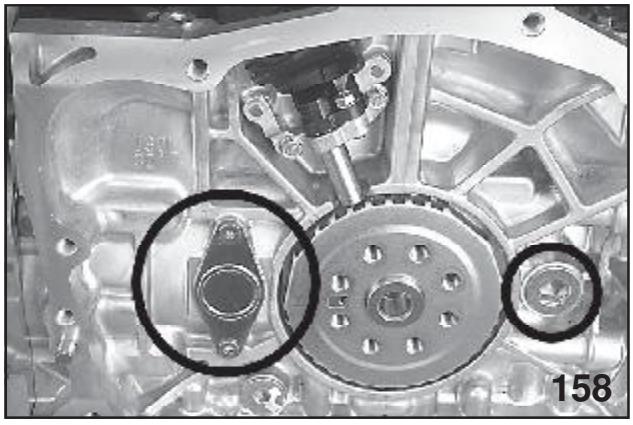
NOTE: CONFIRM PLACEMENT OF O-RINGS

Piston Pin Access



Piston Pin Access (Front View)

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

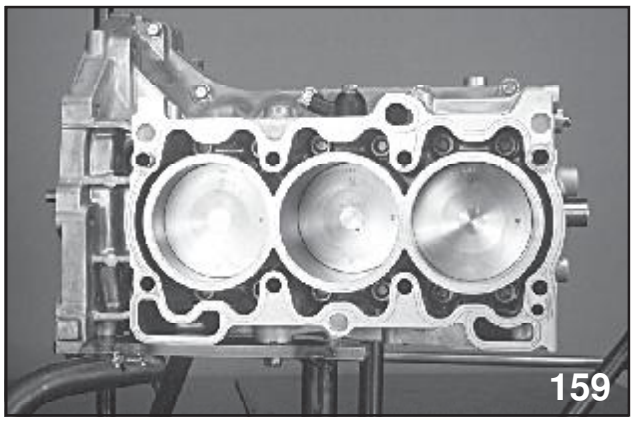


Piston Pin Access (Rear View)

Rear piston pin access is gained at these two points.

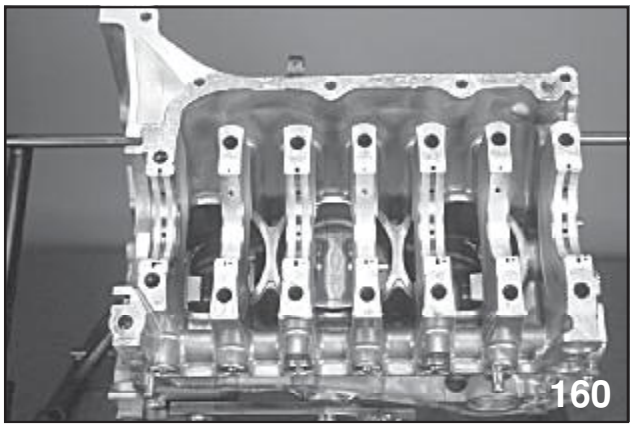
Remove the piston pins and organize them for assembly to their original positions.

Spliting Block Halves

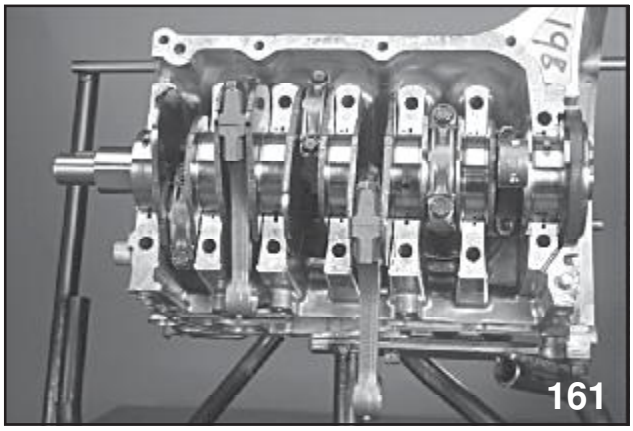


Engine Block Assembly Bolts (Right Bank)

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.

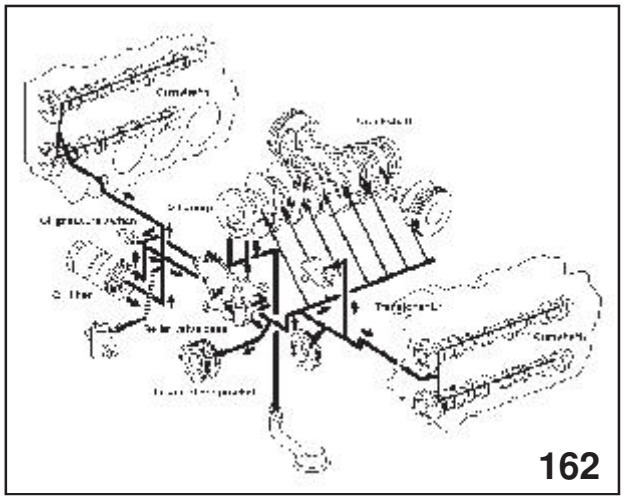


Main Bearings



Crankshaft and Connecting Rods

Lubrication System



Oil Flow

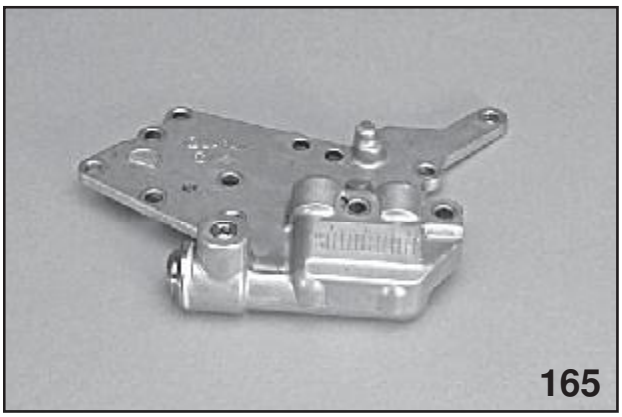
Oil is drawn from the oil pan to the trochoid oil pump and on to the following:

- 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

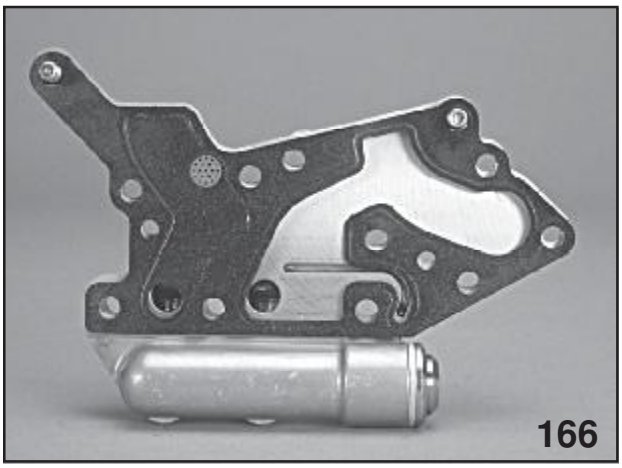
NOTE: FOR FURTHER INFORMATION CONSULT THE LUBRICATION (LU) SECTION OF THE 6 CYLINDER SUPPLEMENT.

Pump Gears (Front Side)

Pump Gears (Back Side)



Relief Valve Case (Front Side)

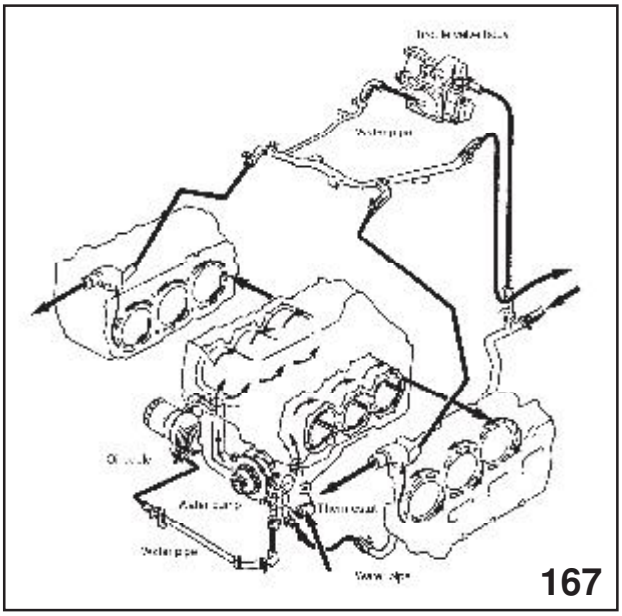


Relief Valve Case (Back Side)

A new gasket must be used upon installation.

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

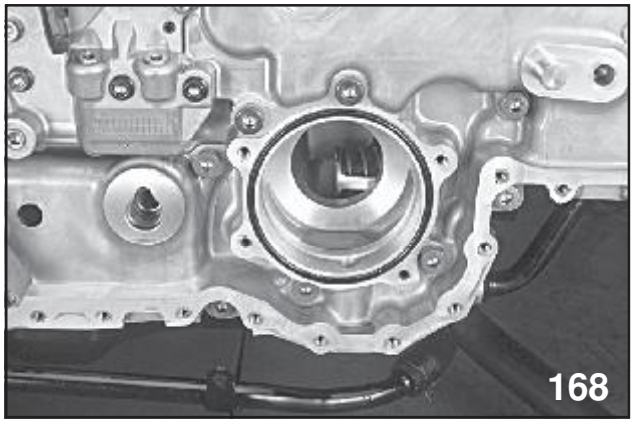
Coolant System



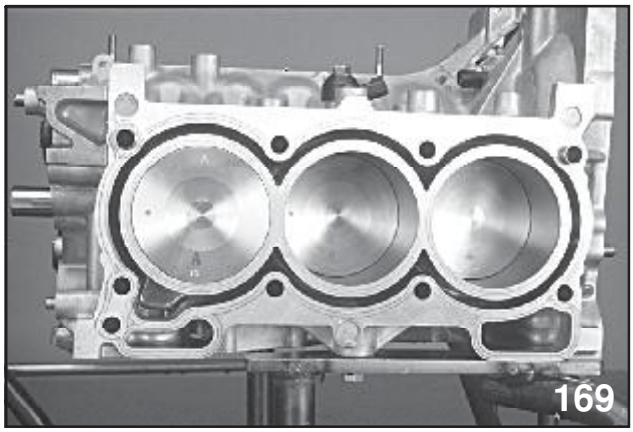
Coolant Flow

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

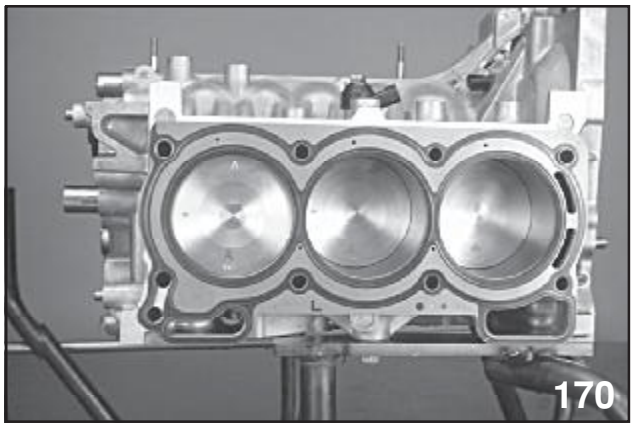
- Thermostat
- Water pump
- Internal block passages that carry coolant through the front of the block halves continuing on to the rear of the block halves.
- From around the rear cylinders of the block halves to the head gasket of the rear cylinders. A passage in the head gasket allows coolant to the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



Water Pump Housing

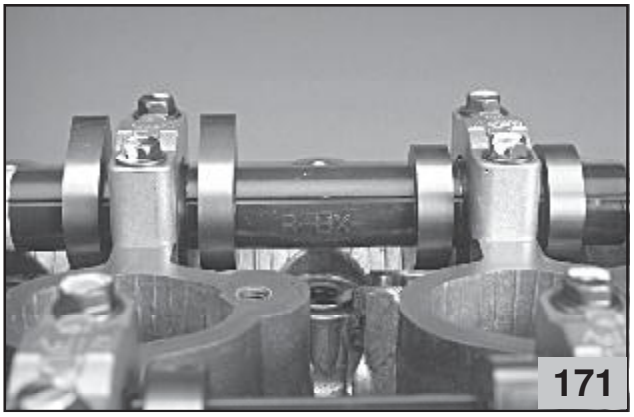


Water Jackets (Left Bank)



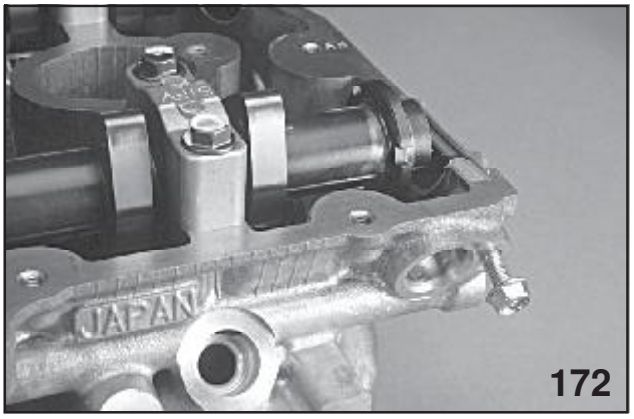
Head Gasket Coolant Passages

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



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.



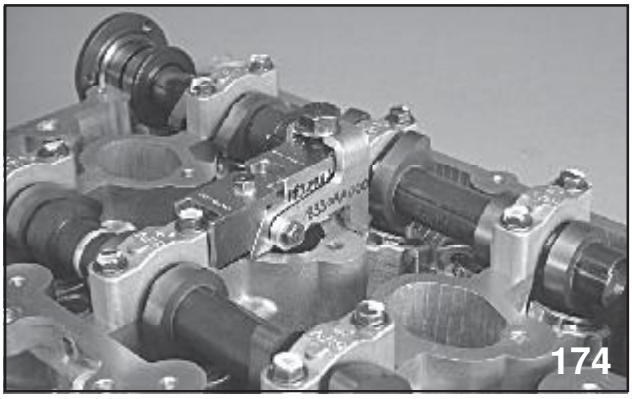
Camshaft Sensor Reluctor

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

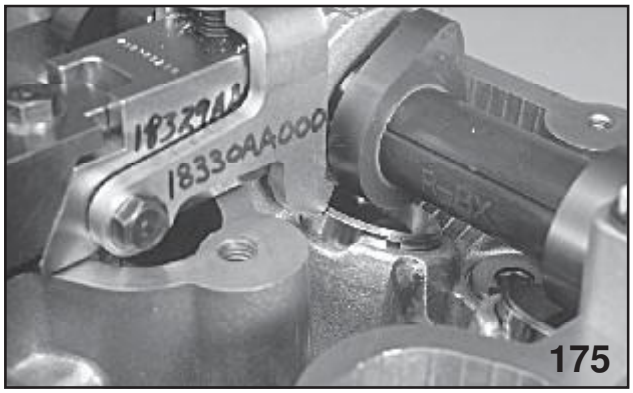
Valve Adjustment Tool

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

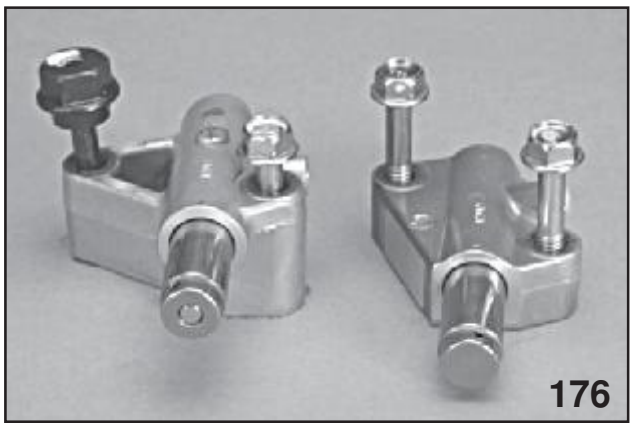
The tool is wedge fitted into place over the two shims requiring removal.



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.

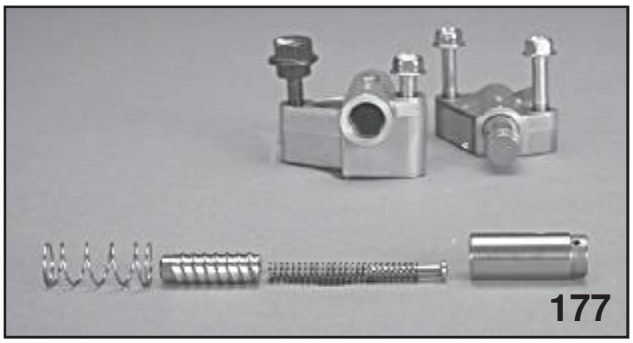
Chain Tensioners



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 INTERCHANGEABLE.

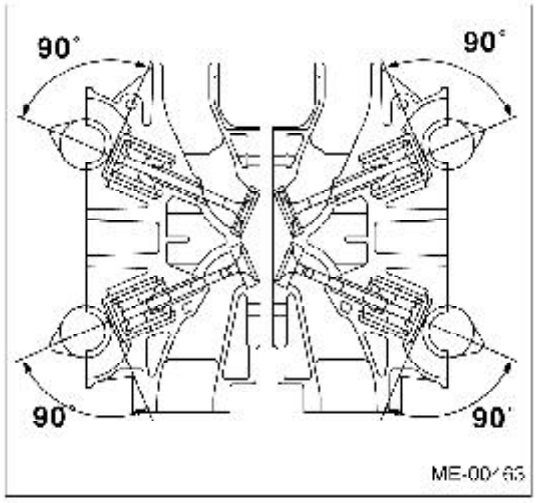


Worm Gear Assembly

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.

3.0 Liter Valve Clearance Adjustment- 2001~2004



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Valve Arrangement

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

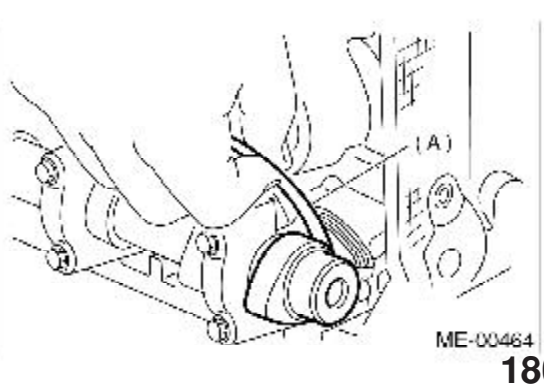
CAUTION: INSERT THE THICKNESS GAUGE IN AS HORIZONTAL A DIRECTION AS POSSIBLE WITH RESPECT TO THE SHIM.

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.



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Measuring Valve Clearance

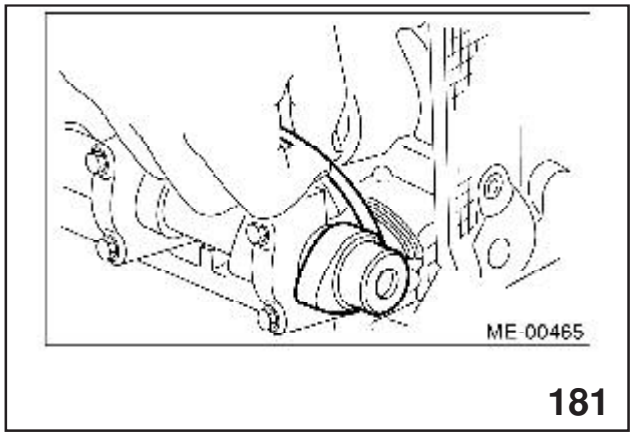
2. If necessary, adjust the valve clearance. <Ref. to ME(H6DO), ADJUSTMENT, Valve Clearance.>
3. Further turn crankshaft pulley clockwise. Using the same procedure described previously, then measure valve clearances again.
4. After inspection, install the related parts in the reverse order of removal.

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.



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Measuring Valve Clearance

2. Remove shim from valve lifter.

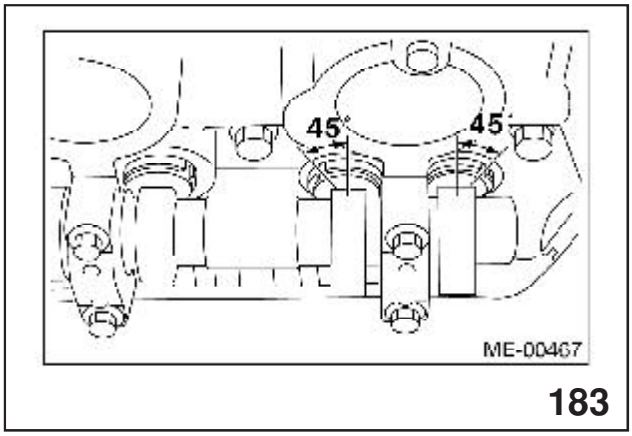
(1) Prepare the ST.

ST 18329AA000 SHIM REPLACER

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

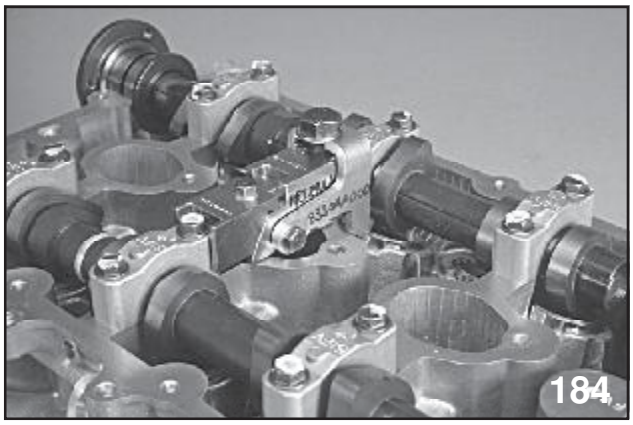
Valve Adjustment Tool

(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.

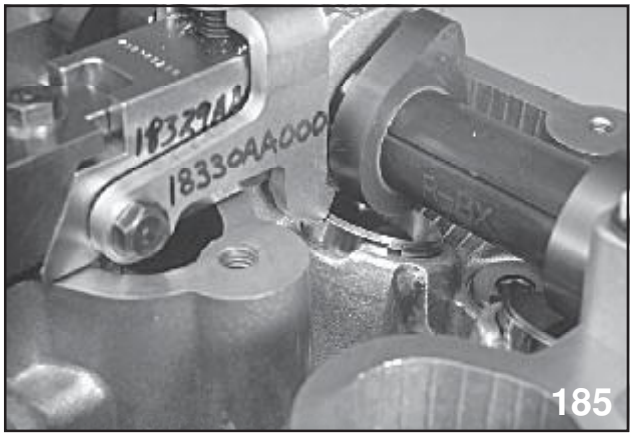


Valve Adjustment Tool Placement

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

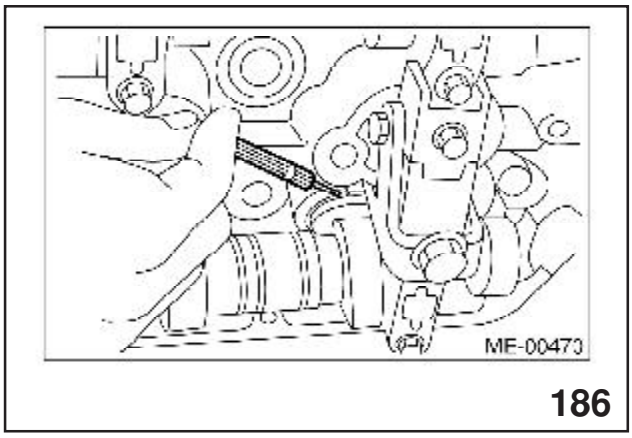
(4) Tighten bolt (A) and install it to the cylinder head.

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



Adjusting Bucket Depression Finger

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



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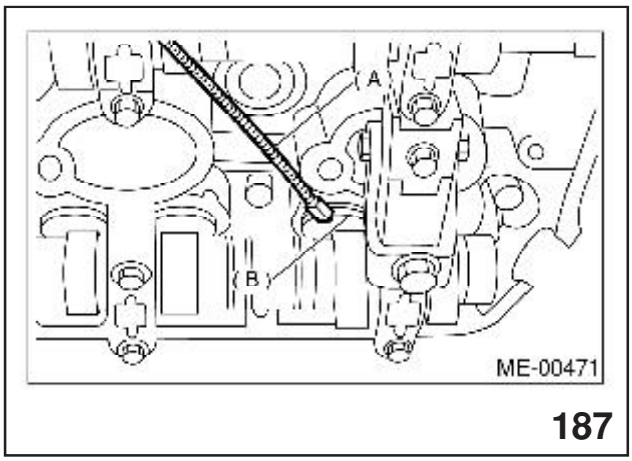
Use of Magnet

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



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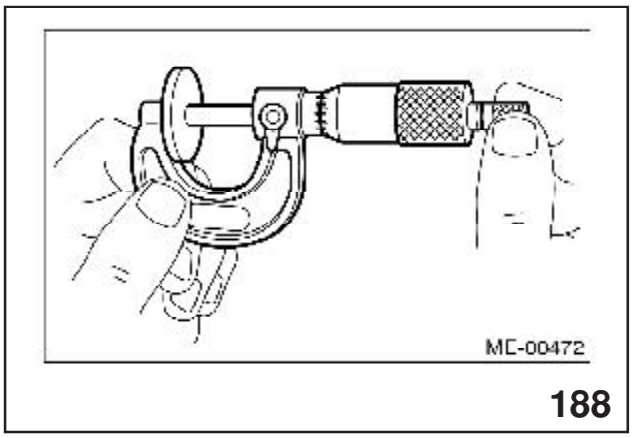
Shim Placement



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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.

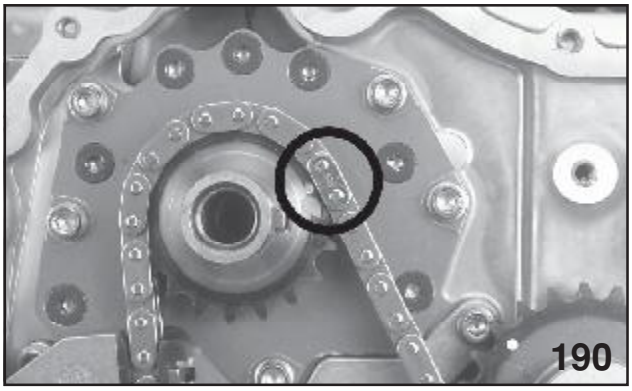
Unit: mm
Intake valve: S = (V + T) - 0.20 Exhaust valve: S = (V + T) - 0.25
S: Shim thickness to be used V: Measured valve clearance T: Shim thickness required

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

Part No.	Thickness mm (in)
13218 AE970	2.48 (0.0976)
13218 AE980	2.49 (0.0980)
13218 AE990	2.50 (0.0984)
13218 AF000	2.51 (0.0988)
13218 AF010	2.52 (0.0992)
13218 AF020	2.53 (0.0996)
13218 AF030	2.54 (0.1000)
13218 AF040	2.55 (0.1004)
13218 AF050	2.56 (0.1008)
13218 AF060	2.57 (0.1012)
13218 AF070	2.58 (0.1016)
13218 AF090	2.60 (0.1024)
13218 AF100	2.61 (0.1028)
13218 AF110	2.62 (0.1031)
13218 AF120	2.63 (0.1035)
13218 AF130	2.64 (0.1039)
13218 AF140	2.65 (0.1043)
13218 AF150	2.66 (0.1047)
13218 AF160	2.67 (0.1051)
13218 AF170	2.68 (0.1055)
13218 AF180	2.69 (0.1059)
13218 AF190	2.70 (0.1063)
13218 AF200	2.71 (0.1067)
13218 AF210	2.72 (0.1071)
13218 AF220	2.73 (0.1075)
13218 AF230	2.74 (0.1079)
13218 AF240	2.75 (0.1083)
13218 AF250	2.76 (0.1087)
13218 AF260	2.77 (0.1091)
13218 AF270	2.78 (0.1094)
13218 AF280	2.79 (0.1098)
13218 AF290	2.80 (0.1102)
13218 AF300	2.81 (0.1106)

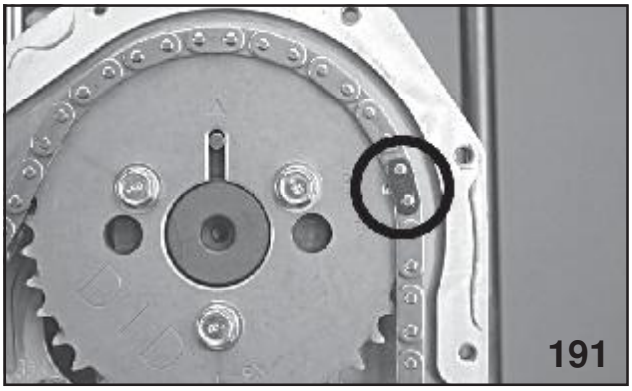
6. Inspect all valves for clearance again at this stage. If the valve clearance is not correct, repeat the procedure over again from the first step.
7. After inspection, install the related parts in the reverse order of removal.

3.0 Liter Engine Reassembly

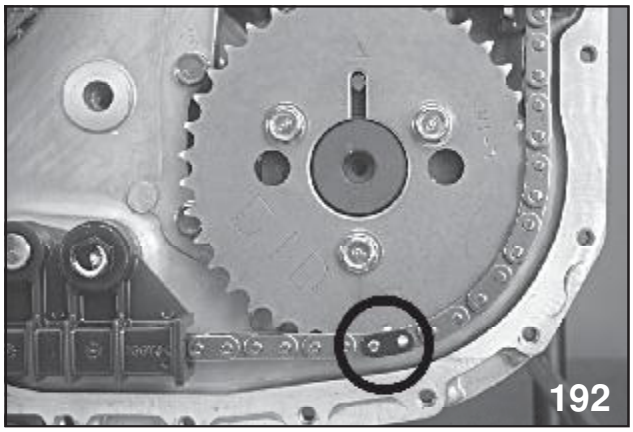


Crankshaft Timing Mark Location

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

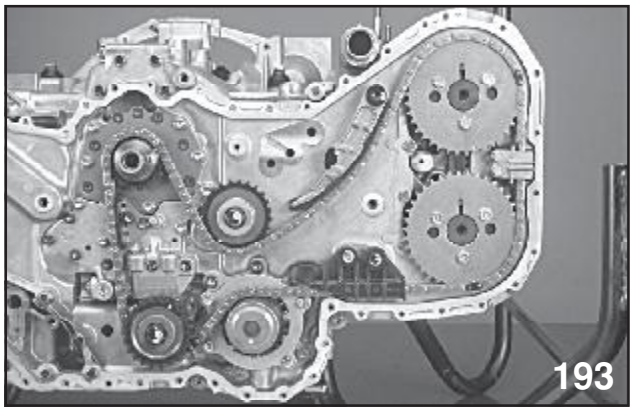


Left Bank Intake Camshaft Timing Mark

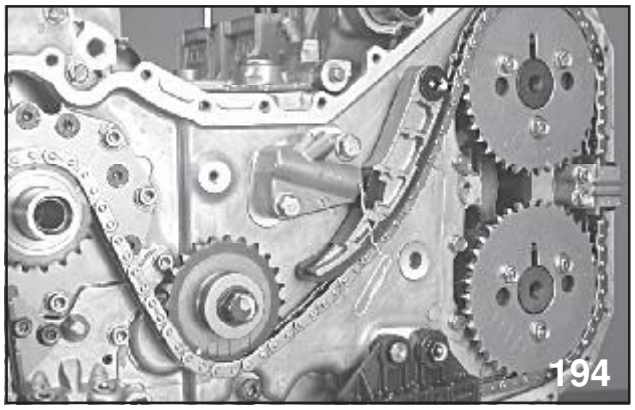


Left Bank Exhaust Camshaft Timing Mark

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.



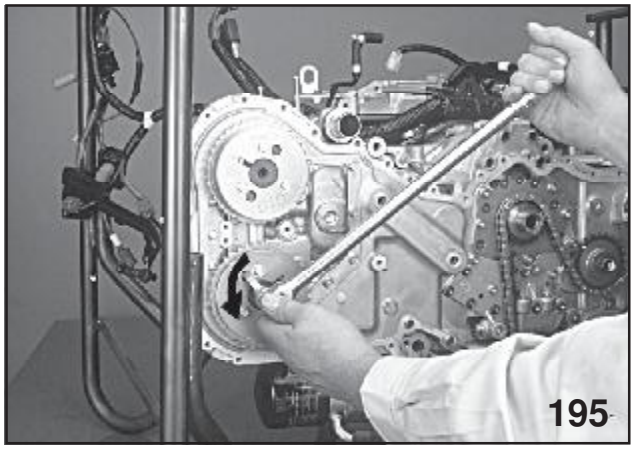
Matching Links to Timing Marks (Left Bank)



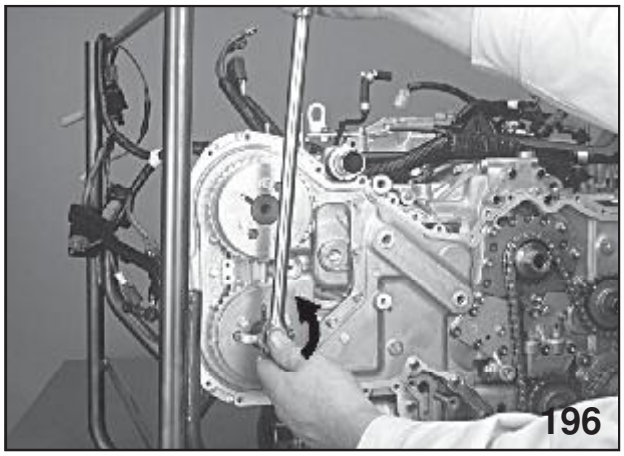
Installing Guides and Idlers (Left Bank)

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.

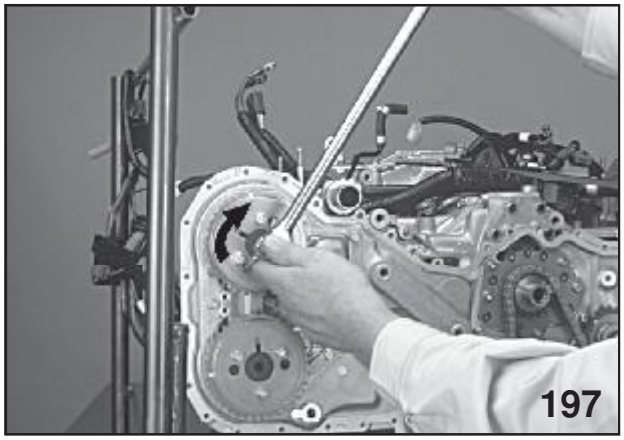


Loading Exhaust Camshaft (Right Bank)

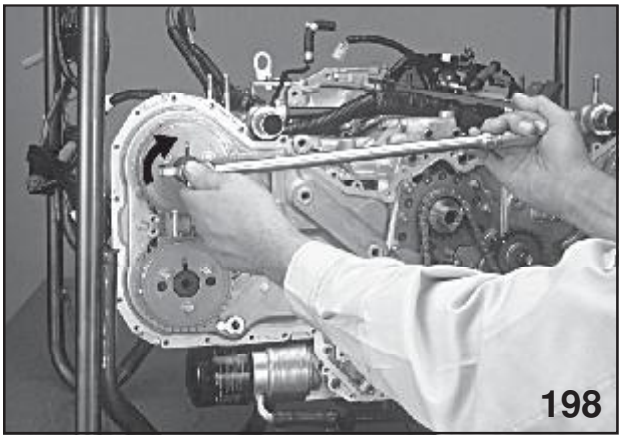


Loading Exhaust Camshaft (Right Bank)

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



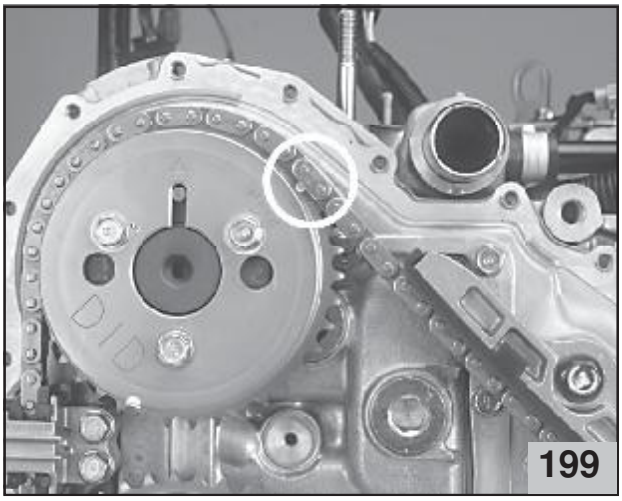
Loading Intake Camshaft (Right Bank)



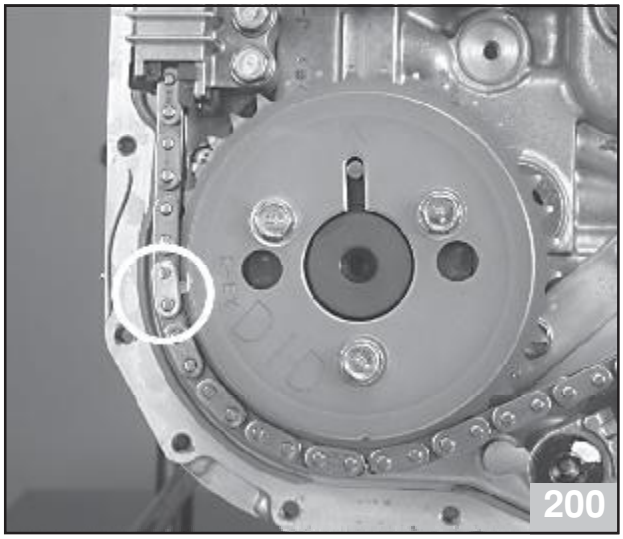
Loading Intake Camshaft (Right Bank)

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

Both right bank camshaft sprockets should now be in the correct position for timing chain installation. **Already done on image 191.**



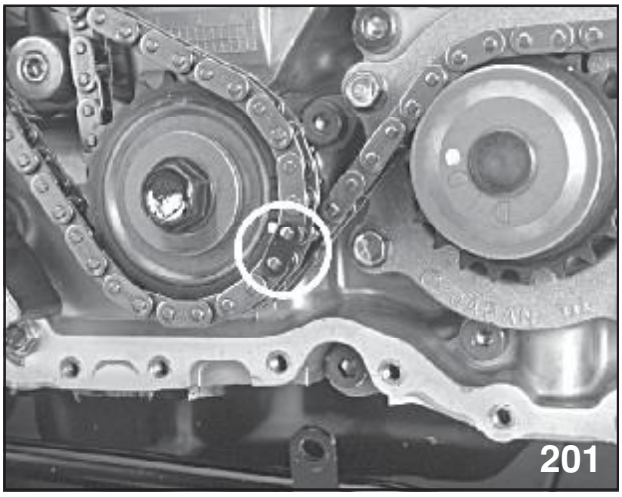
Intake Camshaft Timing Marks (Right Bank)



Exhaust Camshaft Timing Marks (Right Bank)

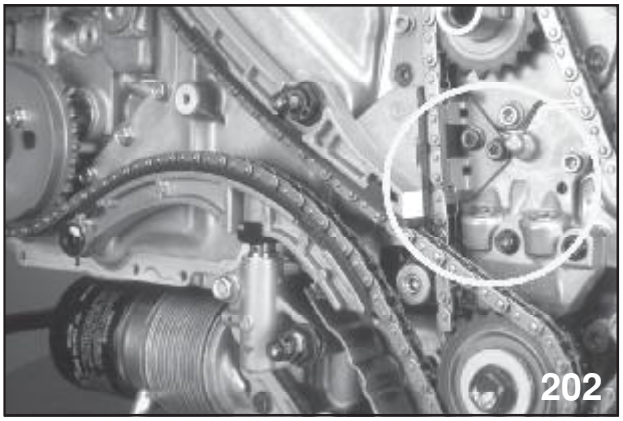
Place the lower gold link on the small circular mark of the exhaust cam sprocket and the upper gold link on the small circular timing mark of the intake camshaft sprocket.

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.



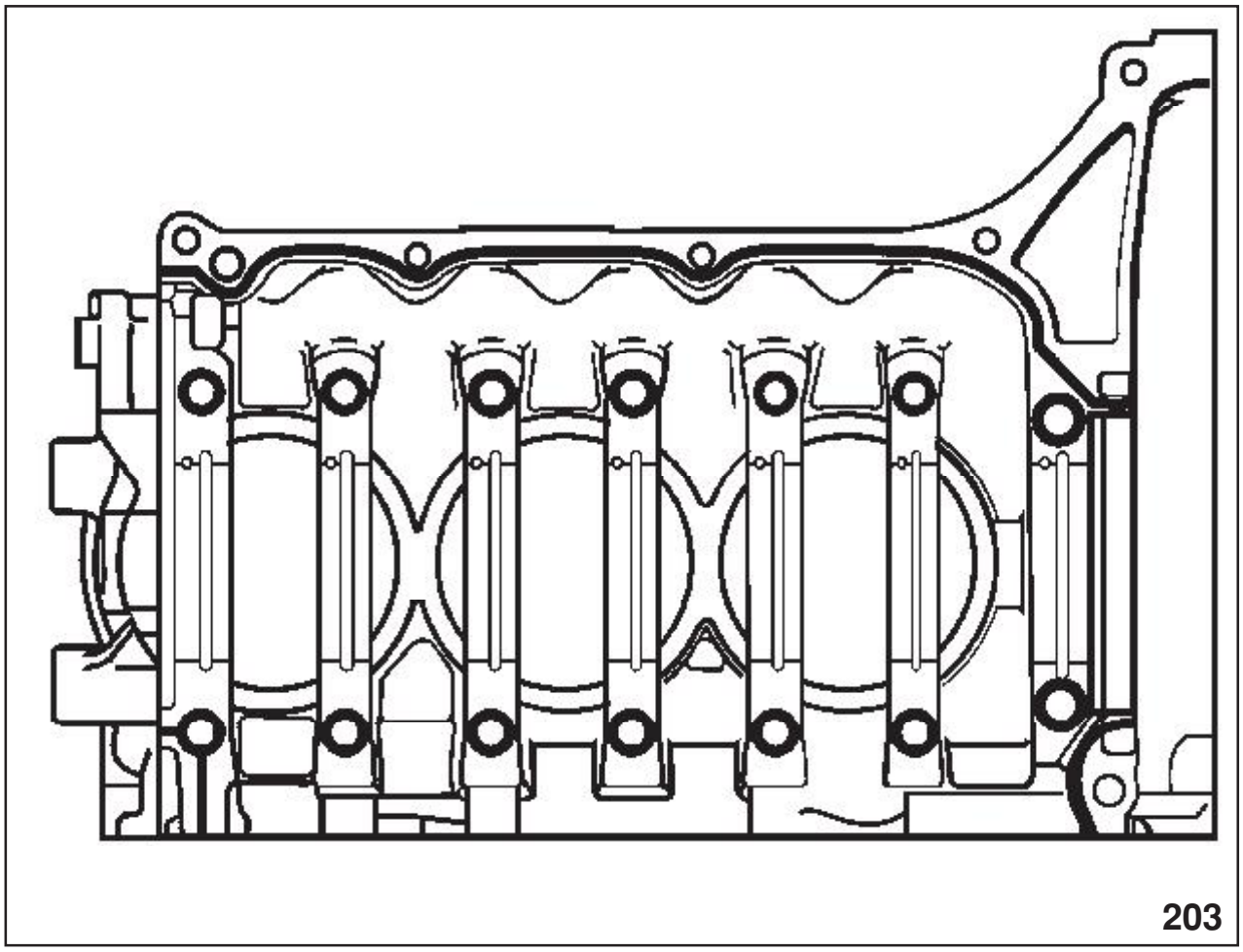
Chain Guides and Idlers (Right Bank)

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.

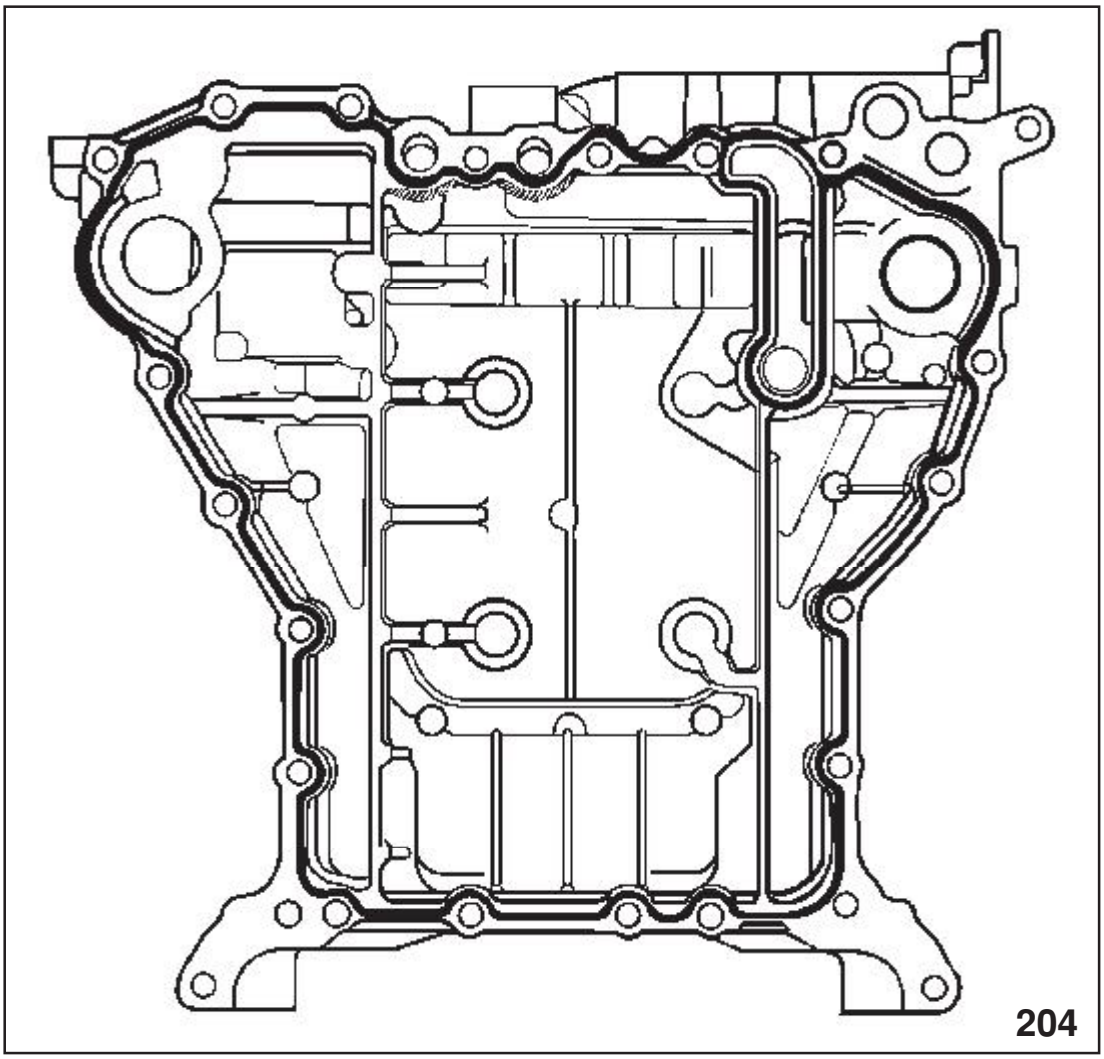
Fuji Bond Application Guide for Block Halves



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.

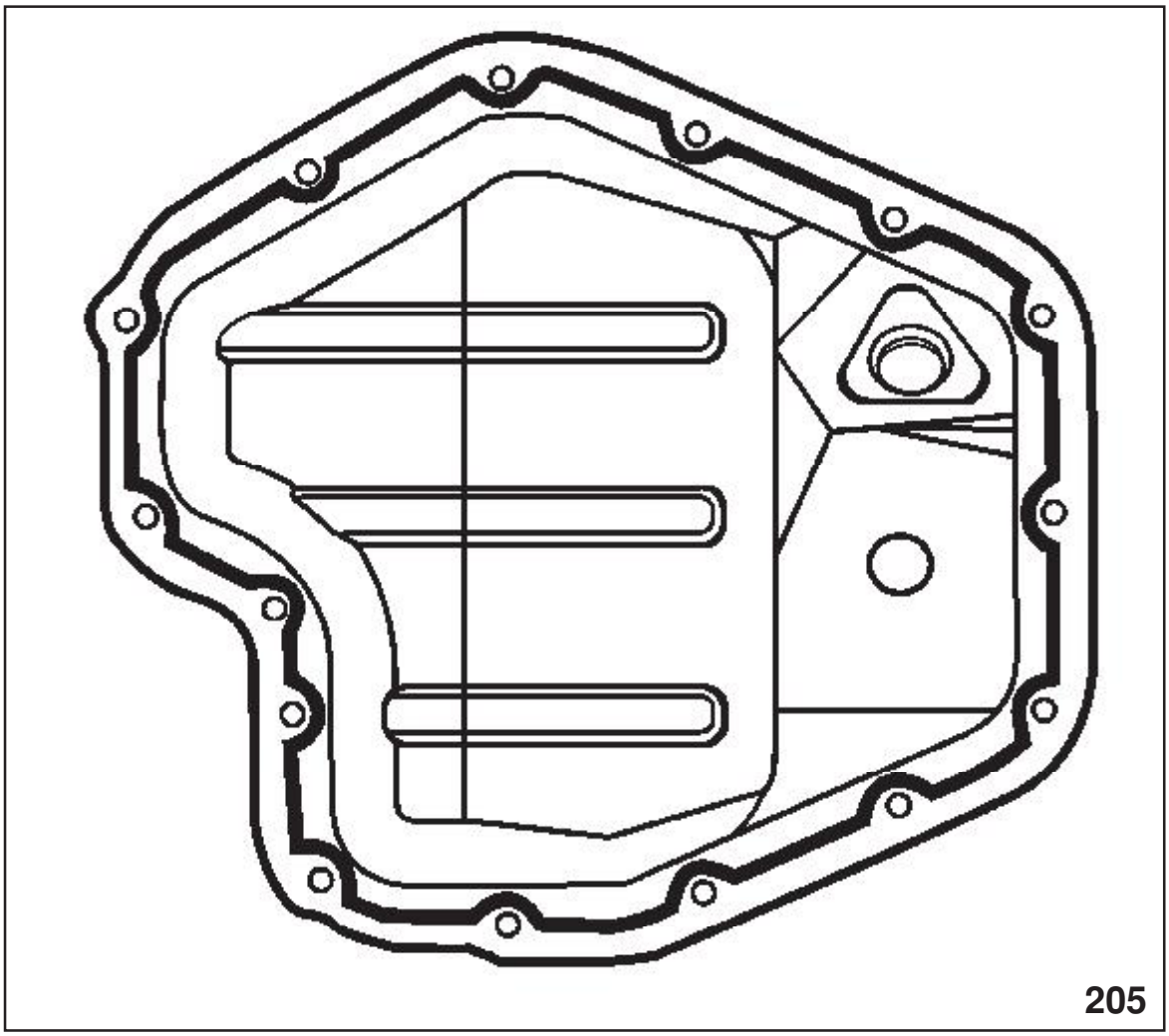
Oil Pan Extension Housing
(Upper Oil Pan)



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.

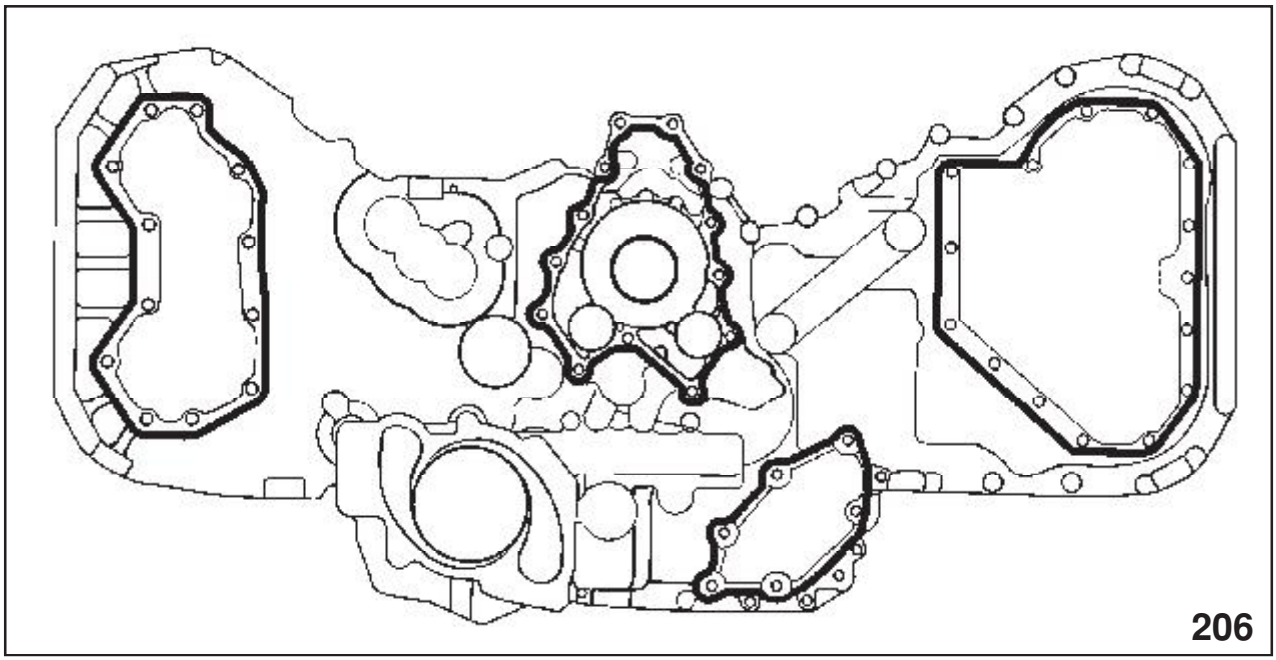
Fuji Bond Application Guide for Oil Pan (Lower)



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.

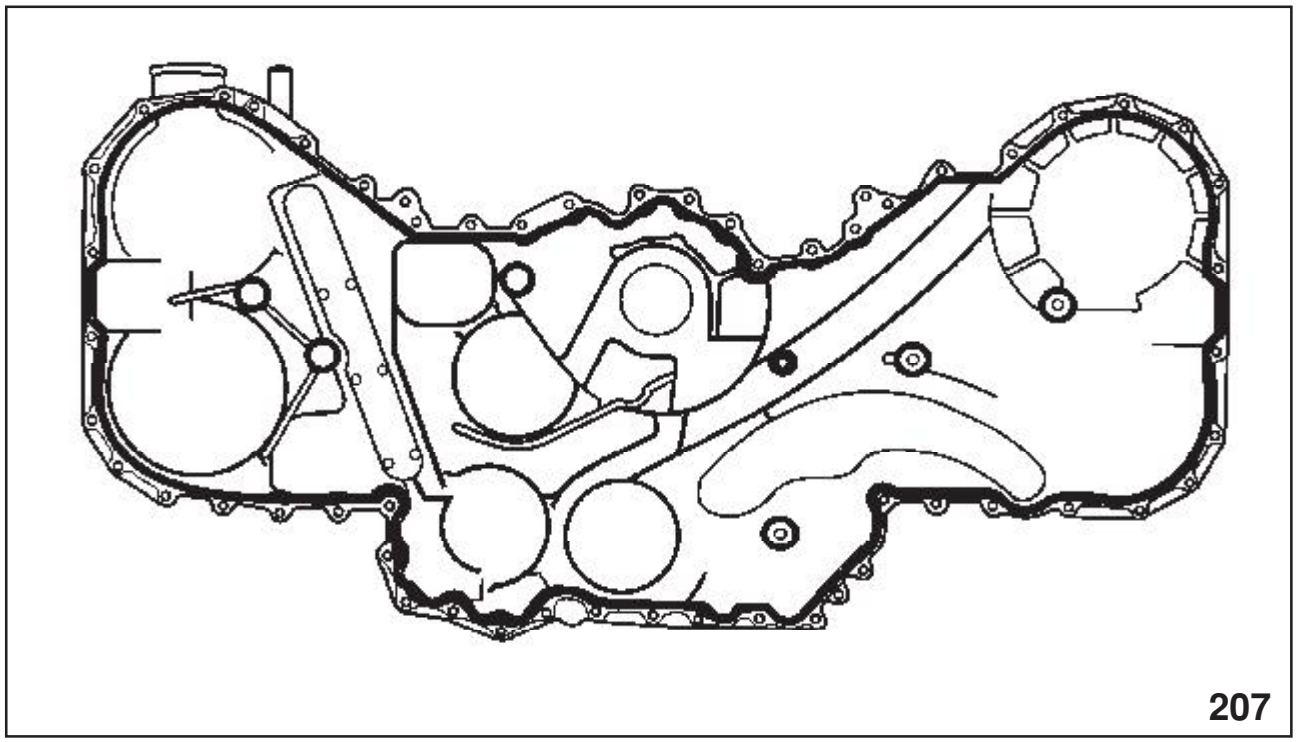
Fuji Bond Application Guide for Inner Cover



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.

Fuji Bond Application Guide for Outer Cover (Front Chain Cover)

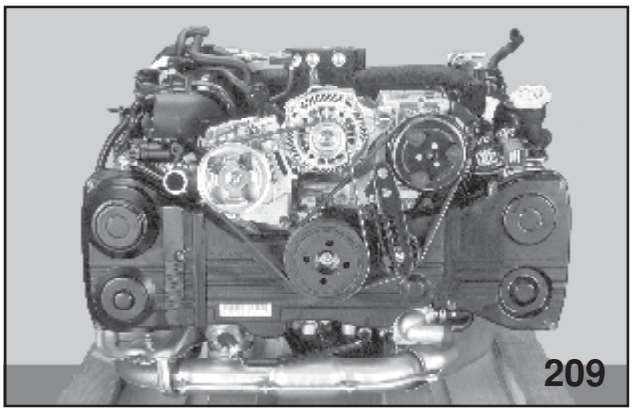


207

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

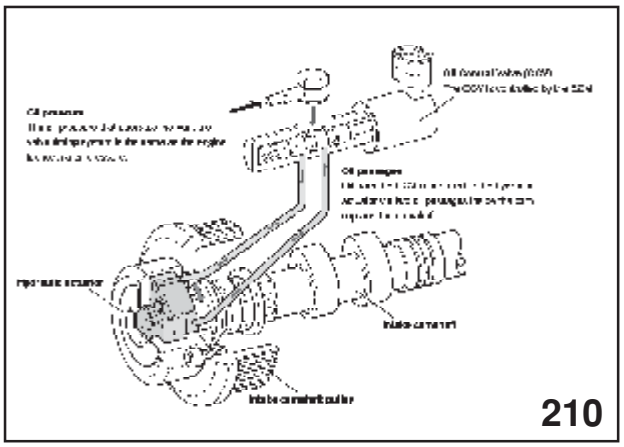
ME (H6) 43 for proper sealing, bolt sizes and sequence. Torque to proper specifications.

2004 Variable Valve Timing System (2.5 Liter Engine)



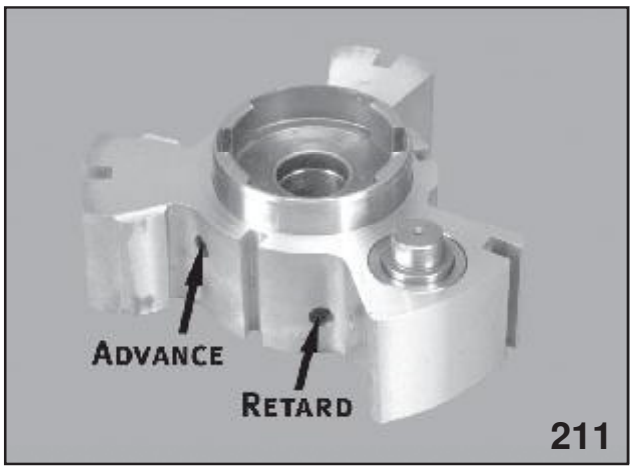
Engine

Variable valve timing functions to increase engine power output, improve fuel consumption and decrease exhaust emissions. These benefits are achieved by controlling the opening and closing time of the intake valves. The ECM monitors the engine operating condition and camshaft positions and controls the output duty ratio to oil control valves located on each cylinder head. The oil control valves in turn control the oil pressure to and from each intake camshaft sprocket. This allows the movement of the camshaft within the sprocket, controlling the opening and closing time of the intake valves.

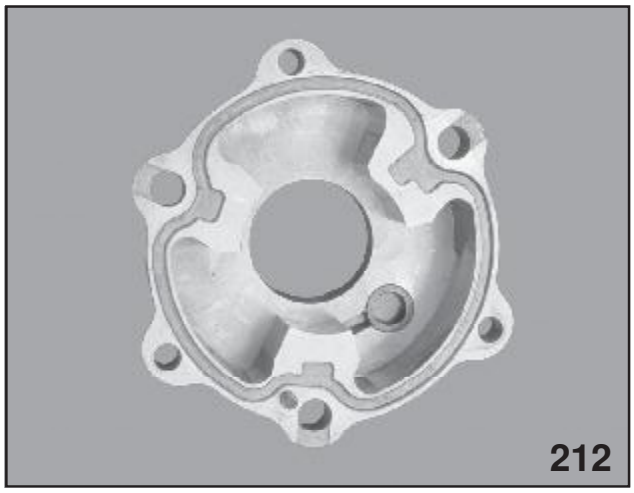


Camshaft (artwork)

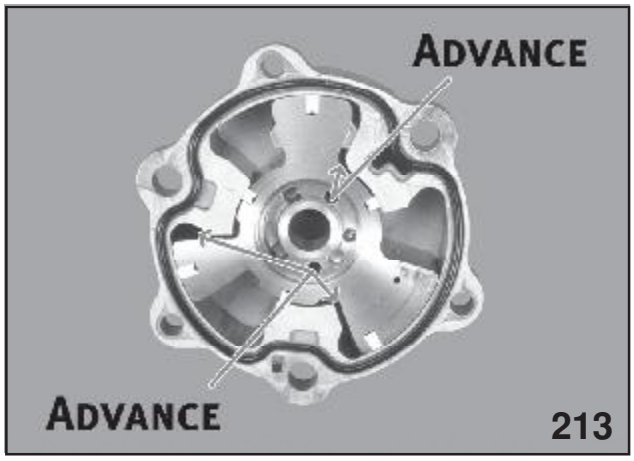
The intake camshaft sprocket is a non serviceable hydraulic actuator consisting of a set of sealing vanes, rotor and a fail-safe lock valve. The camshaft is secured to the rotor with a bolt. The position of the rotor within the camshaft sprocket forms advance and retard chambers. Changing the balance of oil pressure to these chambers moves the rotor to advance or retard the intake camshaft.



Camshaft Sprocket Rotor

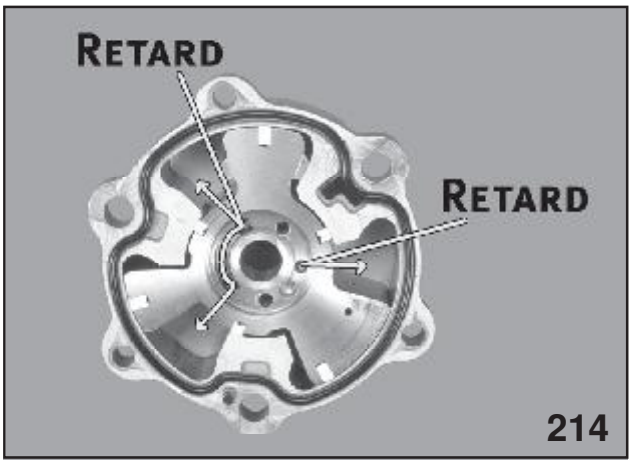


Sprocket Housing

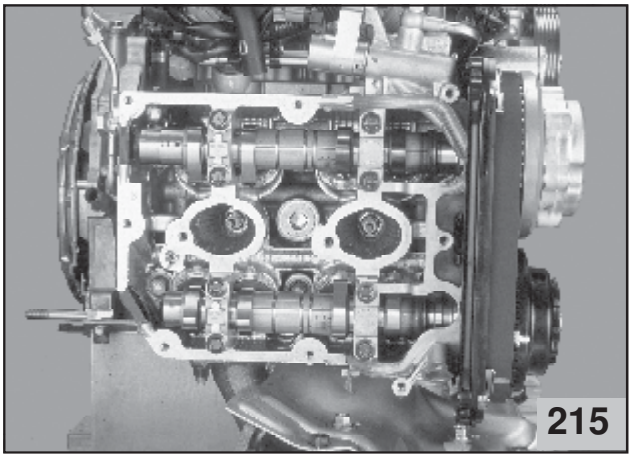


Advance Chambers

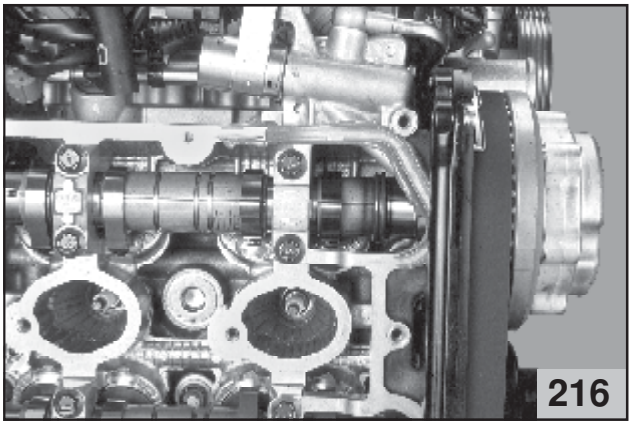
The fail-safe lock valve must operate to mechanically release the rotor from the sprocket before normal variable valve timing operation can begin. The fail-safe lock valve is unlocked by the oil pressure of the engine from the oil control valve when ever the camshaft is advanced and locked in place by the removal of pressure from the advance chamber and spring tension. The purpose of the valve is to allow the camshaft to operate in a preset fixed position in the event of a failure in the oil control valve or related hydraulic circuits. The camshaft position with the fail-safe lock valve seated is at full retard.



Retard Chambers



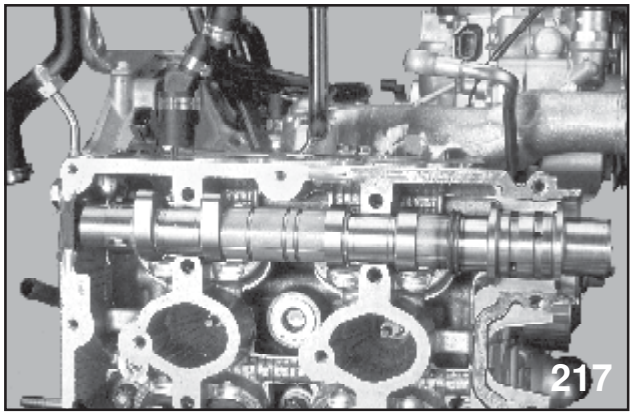
Cylinder Head



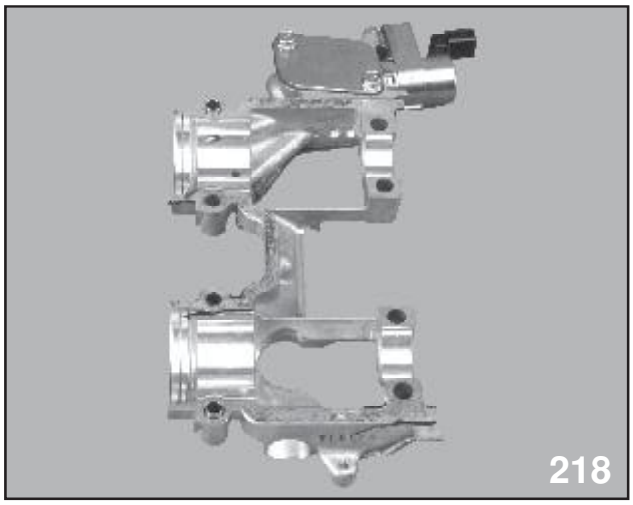
Saddle Cap

An oil control valve is located on each cylinder head, receiving a common duty ratio signal.

The oil control valve housing and the front camshaft saddle caps are incorporated into one unit.

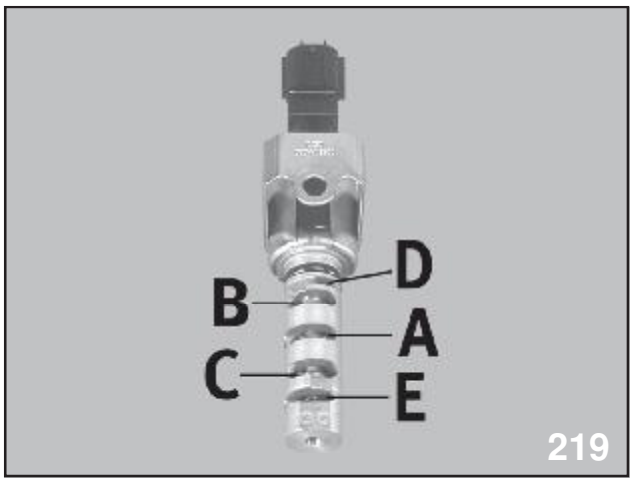


Camshaft

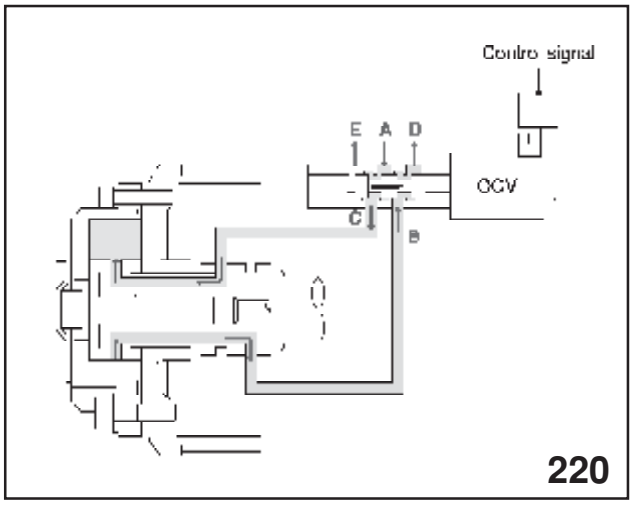


Oil Control Valve

Passageways in the oil control housing carry oil under pressure to and from the camshaft. The camshaft passageways then carry the oil to and from the camshaft sprocket. The forward passage way is for the advance chambers and the rear passage way is for the retard chambers.



OCV



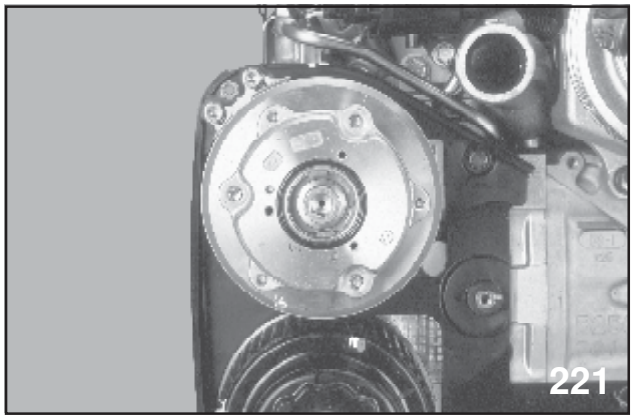
ABCD

The oil control valve chamber A is oil pressure into the valve. Chamber B provides a passage from the camshaft sprocket to drain D during advance.

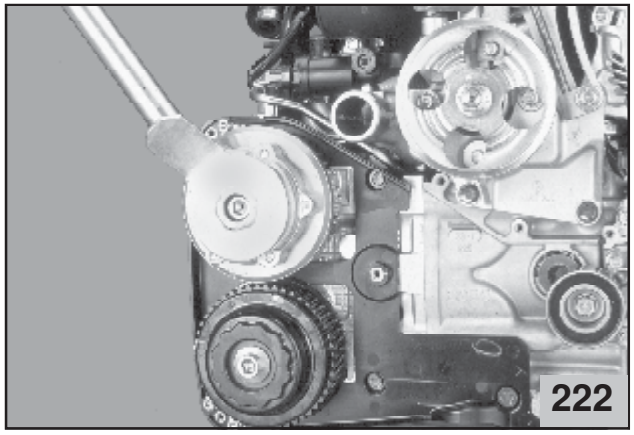
Chamber B also provides a passage way to the camshaft sprocket during retard.

Chamber C provides a passage way from the camshaft sprocket to drain E during retard.

Chamber C also provides a passage way to the camshaft sprocket during advance.



Intake Camshaft Sprocket

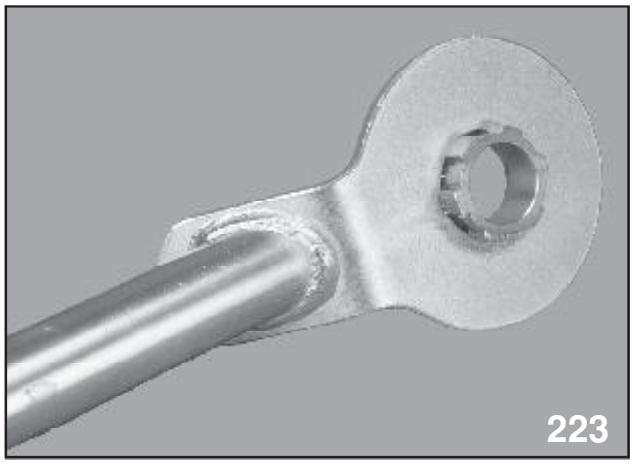


Special Tool Installed

Access to the intake camshaft bolt is obtained after removing the end cap. The bolt is hollow to allow oil to enter the front of the camshaft sprocket to lubricate the area where the rotor and the camshaft sprocket rotate against each other. Be certain to properly position the o-ring when reinstalling the end cap.

Make sure the special tool is positioned properly to avoid slippage as sprocket bolts are very tight.

Special tool 499977500 wrench is used to hold the camshaft sprocket while the bolt is being removed or installed.

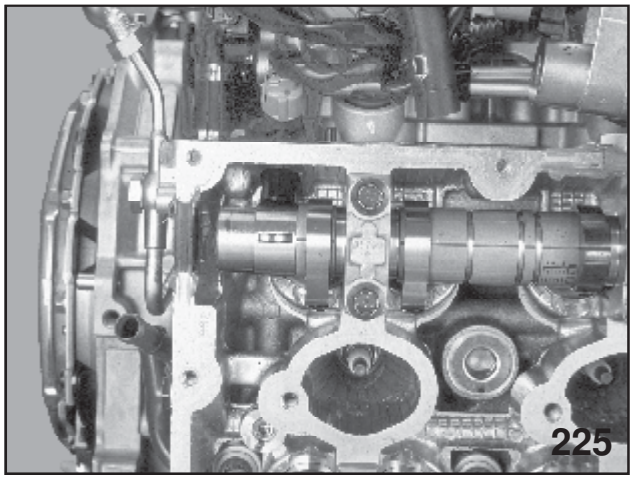


Wrench

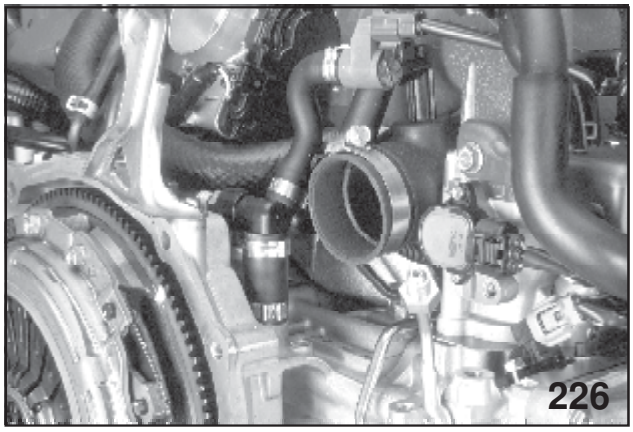
Camshaft Sprocket Bolt

The shape of the wrench is made to match the shape made into the sprocket.

The intake camshaft bolt on each intake camshaft is hollow. Exhaust camshaft bolts are solid. Do not mix them up as the intake sprocket will be damaged from lack of lubrication.



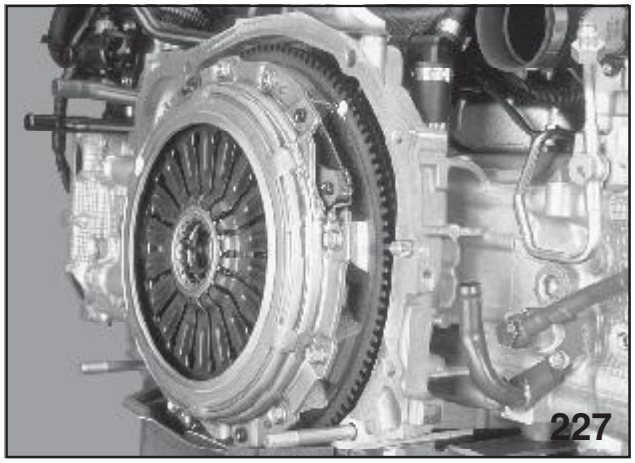
Hall Effect Sensor Over Camshaft



Sensor With Connector

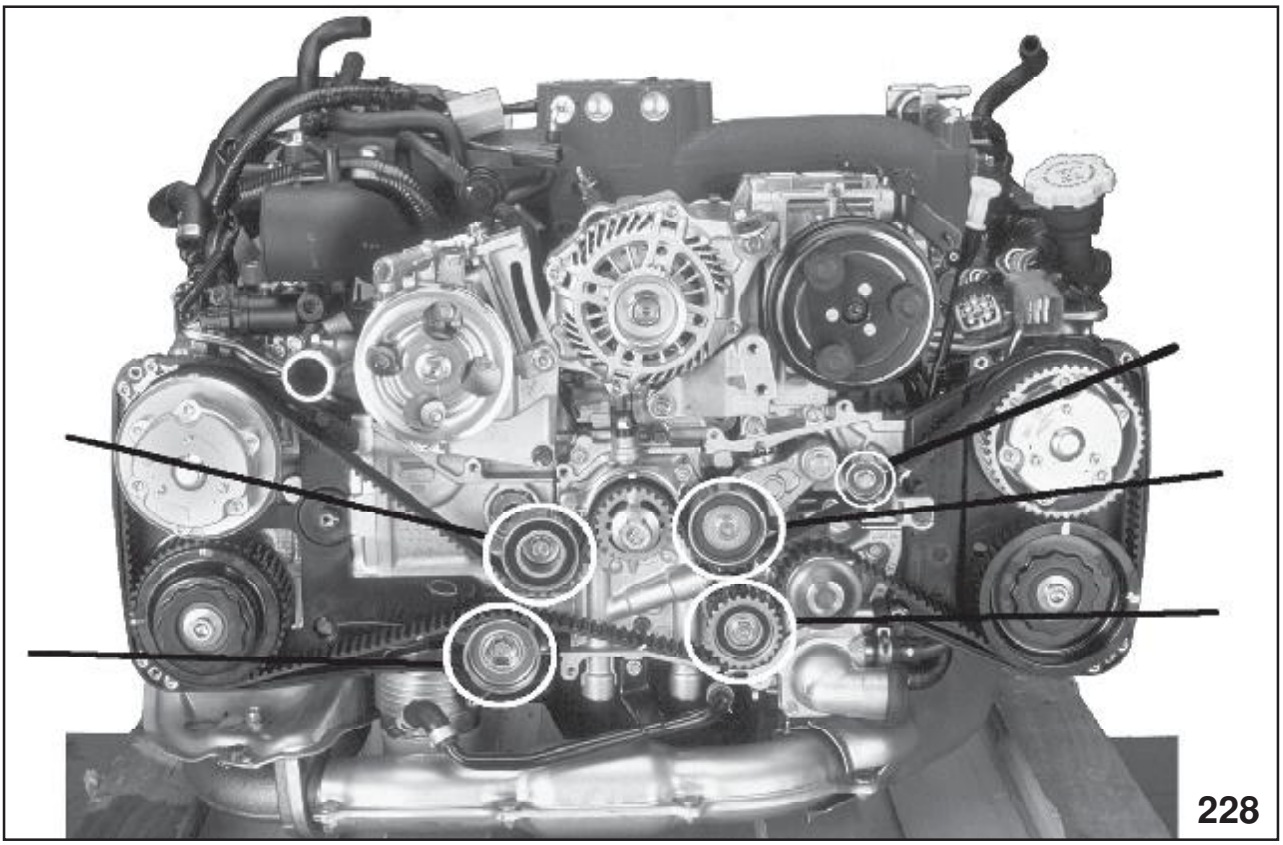
A Hall effect camshaft sensor is used on the rear of each camshaft. These sensors are used to control the variable valve timing and to also provide camshaft information for ignition and fuel control.

NOTE: SENSOR FOR PCV PRESSURE FOR OBD II.



Oil Pipes

The oil supply for the passenger side oil control valve is shared with the turbo charger. The driver side oil control valve receives oil from a pipe from the front of the cylinder head.

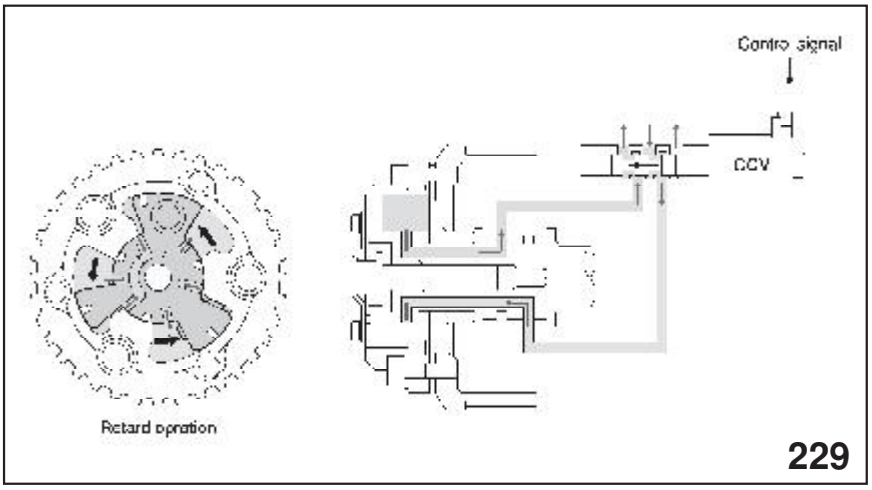


Engine Timing Belt Configuration And Bearing Identification

Proper timing belt configuration and pulley color identification.

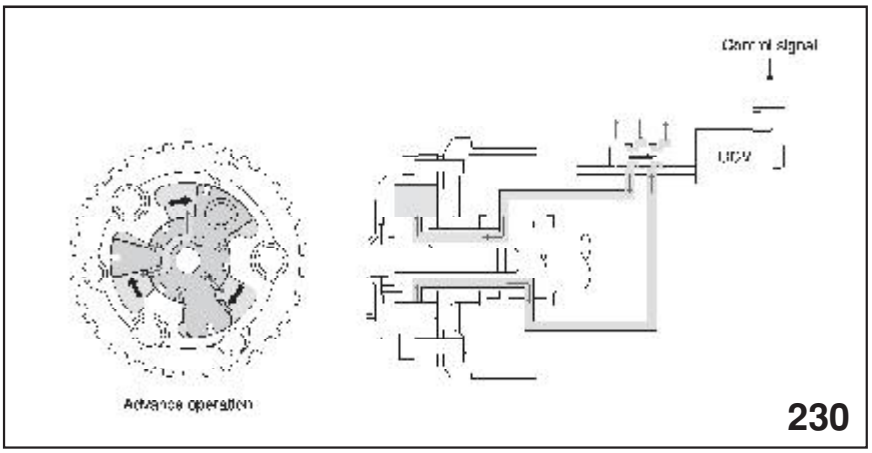
Operation

Variable Valve Timing



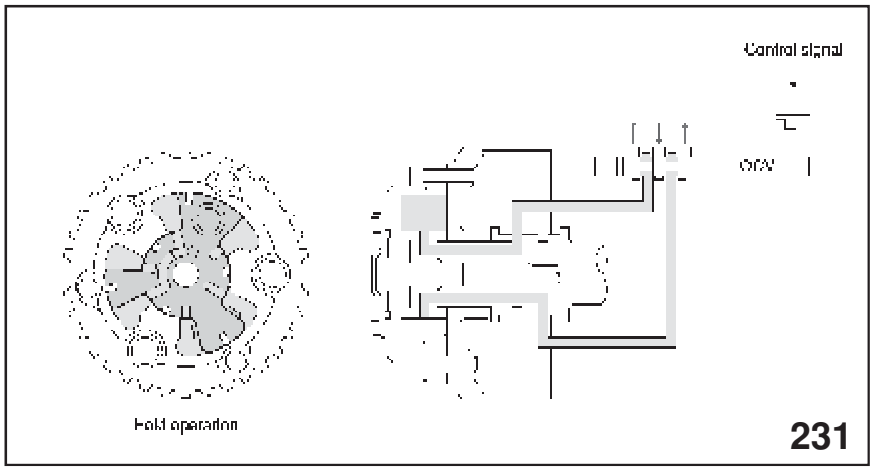
Retard Operation

The oil control valve duty ratio during the time the camshaft is being retarded is low. This will affect the balance of pressure against the rotor to move the rotor in the opposite direction of engine rotation. This will retard the opening and closing of the intake valves as compared to the exhaust valves and crankshaft position.



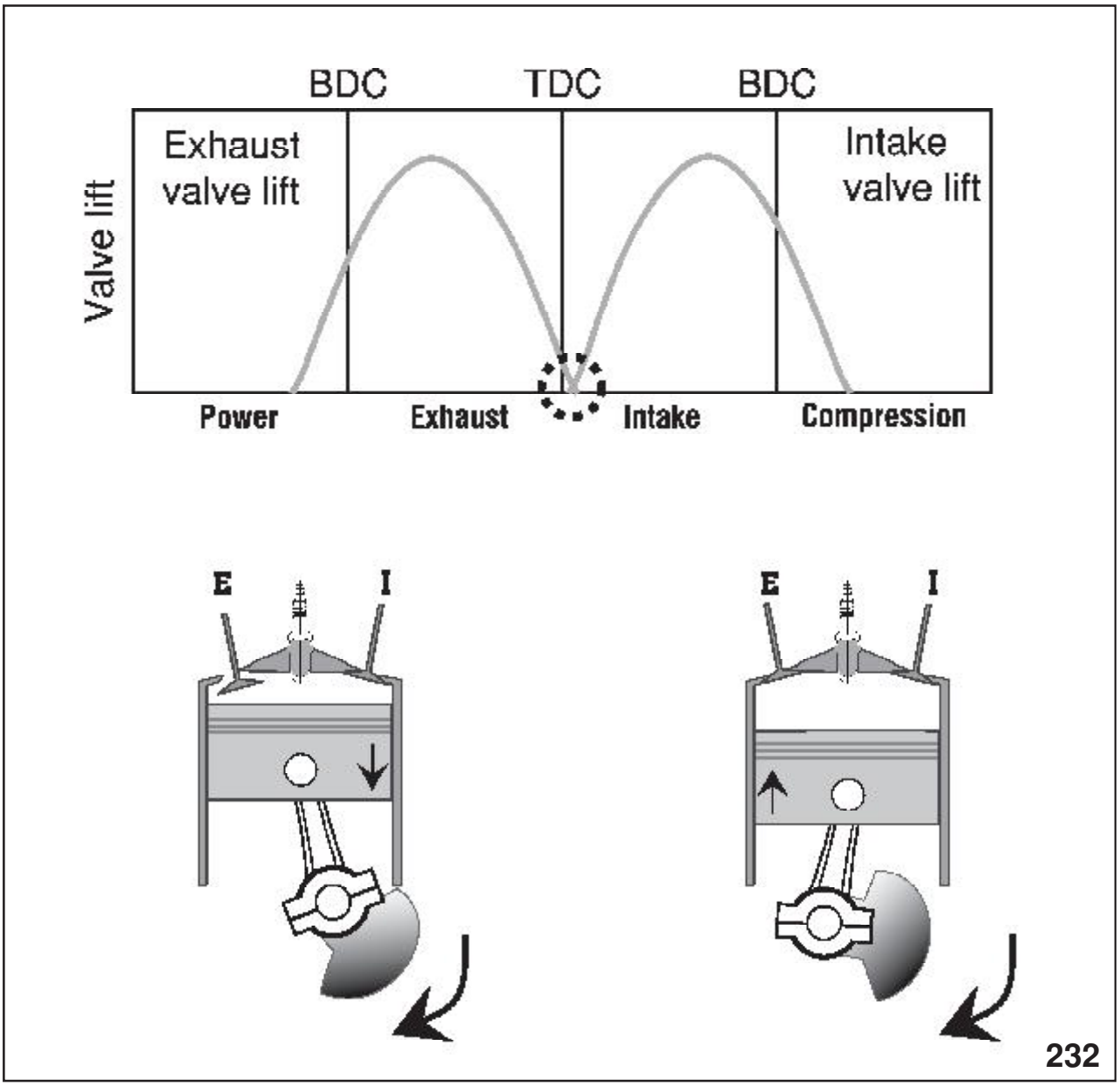
Advance Operation

The oil control valve duty ratio during the time the camshaft is being advanced is high. This will affect the balance of pressure against the rotor to rotate the rotor in the same direction of engine rotation. This will advance the opening and closing of the intake valves as compared to the exhaust valves and crankshaft position.



Hold Operation

The oil control valve duty ratio during the time the camshaft is being held is a certain valve. The two ports connected to the hydraulic actuator are closed by the valve, sealing the oil in the retard and advance chambers. This will maintain the balance of pressure against the rotor so that the camshaft is neither advanced or retarded as compared to the exhaust valves and crankshaft position.



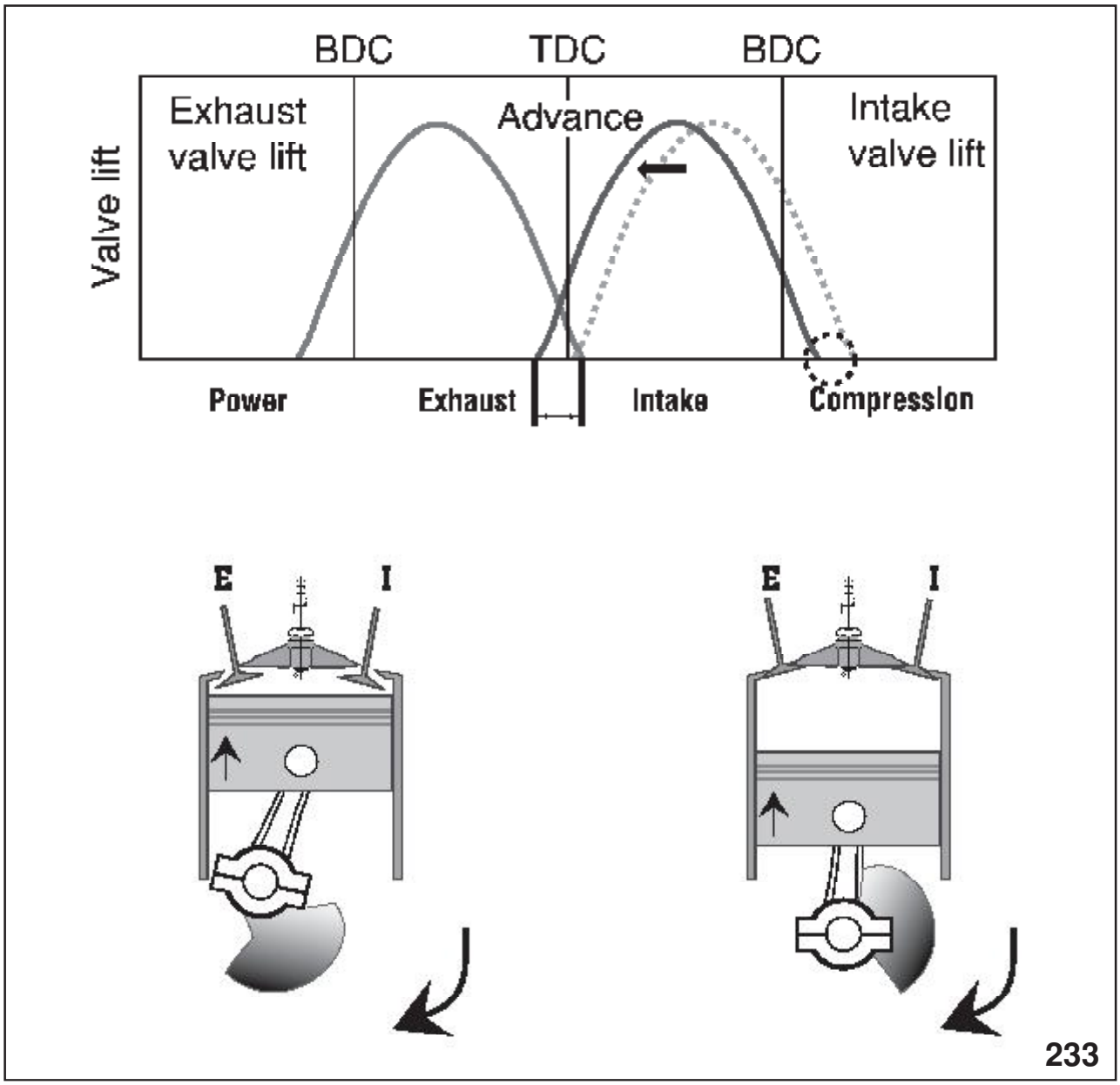
End of Exhaust Stroke
Beginning of Intake Stroke

Moving up on compression stroke

Light Engine Load

At idle the intake valves are timed to open a few degrees after TDC of the exhaust stroke. This takes advantage of the large volume of negative pressure created by the exhaust stroke and the positive pressure consisting of air/ fuel mixture now more efficiently fills the cylinder. The exhaust valves will remain open a few degrees down on the intake stroke.

Air/Fuel mixture will continue to fill the cylinder until a few degrees up on the compression stroke, Minimizing the air that goes back into the intake manifold.



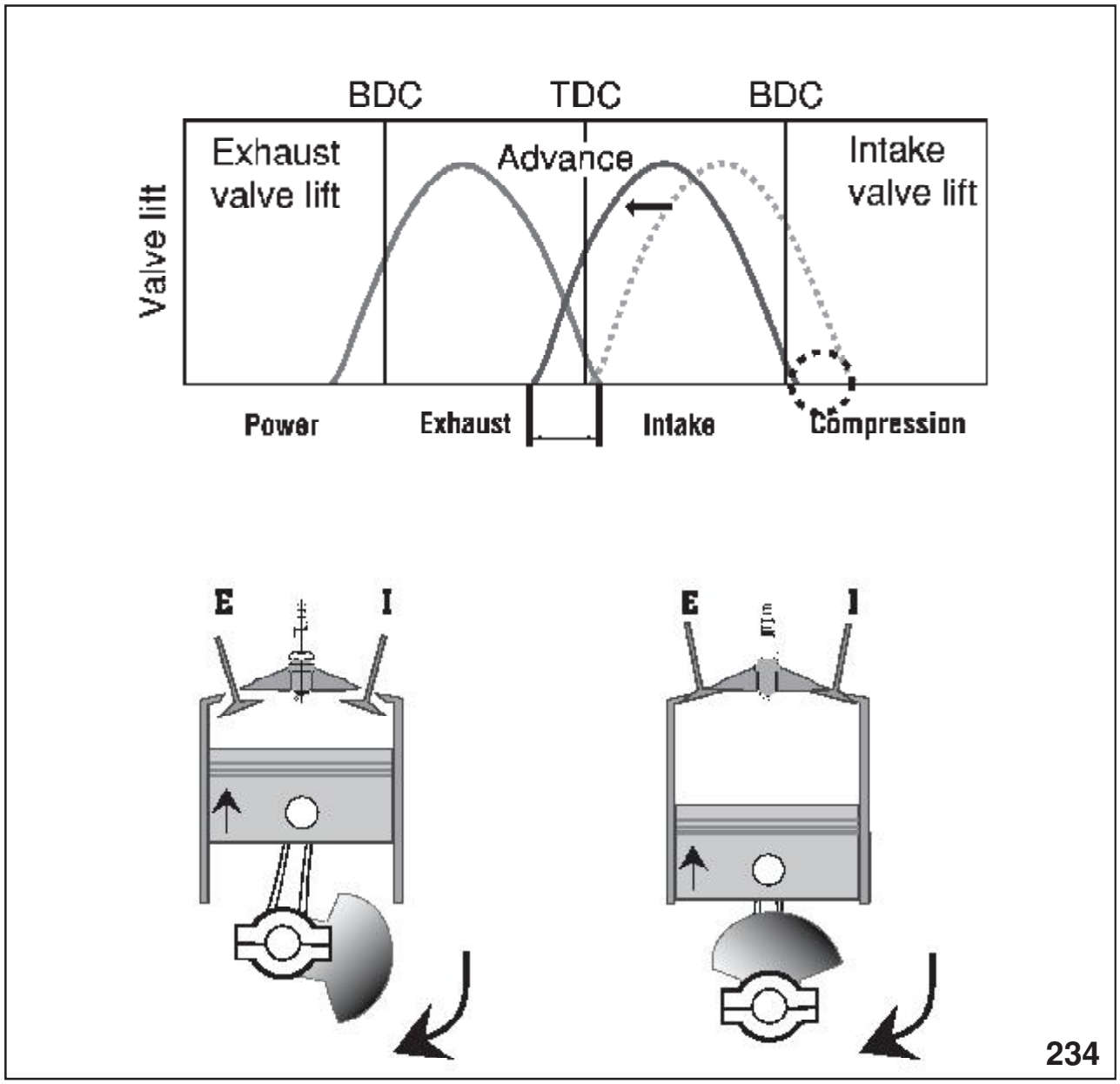
Near the end of exhaust *Moving up on compression stroke*

Medium Engine Load

During small to medium engine load operating conditions the intake valves are opened sooner. This advanced setting allows some of the pressure created during the exhaust stroke to flow back into the intake manifold, creating and EGR effect.

This helps reduce the creation of Nox. As the engine load increases the pressure inside the manifold becomes higher than that of the cylinder on exhaust stroke, eliminating the EGR affect.

The intake valves are closed sooner on the compression stroke improving volumetric efficiency.



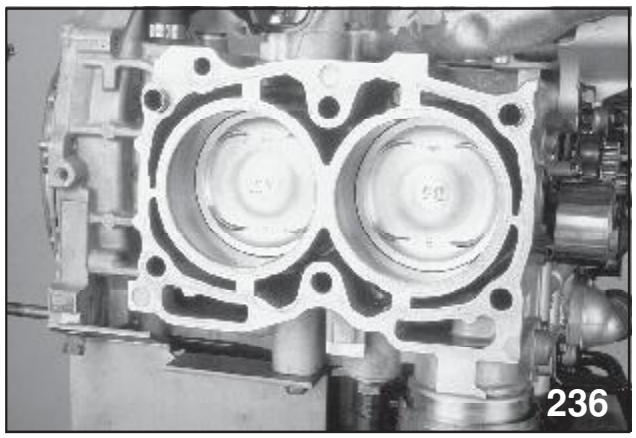
Moving Up On Exhaust Stroke *Near the beginning of compression stroke*

Heavy Engine Load

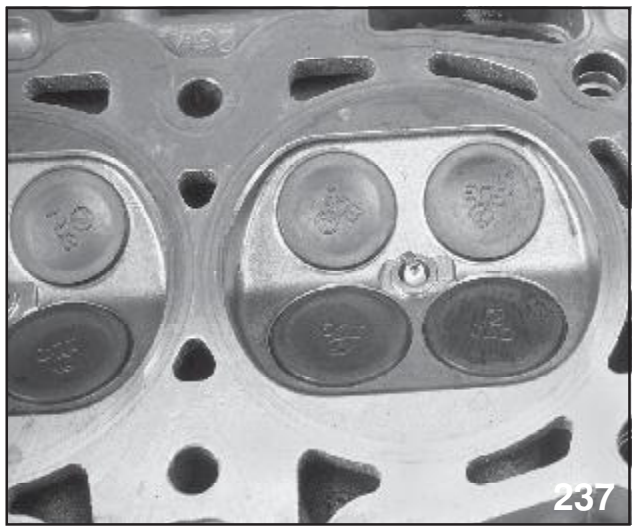
During heavy engine load operating conditions the intake valves are opened sooner. This produces a scavenging effect to clear the cylinder of exhaust gas.

Closing the intake valves sooner on the compression stroke further increases the volumetric efficiency and assists with generating high engine power output.

2004 2.5 Turbo Engine



Engine Block



Combustion Chamber

The 2.5 liter DOHC turbo engine for the WRX STi is designed with a semi-closed type cylinder block.

The 2004 2.5 engine was also used in the forester with less horsepower and torque due to changes in ht eturbocharger, intercooler, cylinder heads and camshafts.

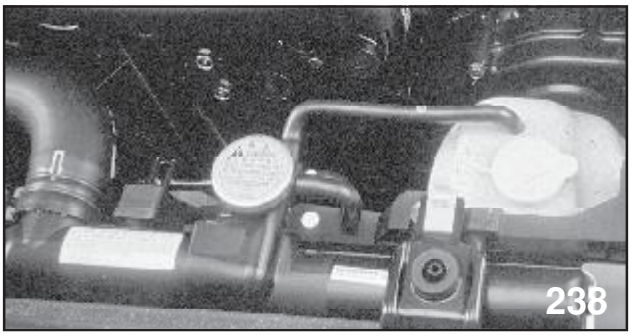
This provides stronger holding of the cylinder liners and improves the gas sealing characteristics between the cylinder block and cylinder head. The cylinder block itself has a cast in reinforcement above the number 5 main shaft journal that improves strength and noise control.

The exhaust valves are sodium filled to improve heat transfer. **Do not resurface exhaust valves. Dispose of discarded valves in accordance with regulations in your area.** The intake valve is hollow to reduce reciprocating weight.

Valve clearance is adjusted by replacing the selective shim less valve lifter.

Spark plugs are made with an Iridium center electrode to improve performance.

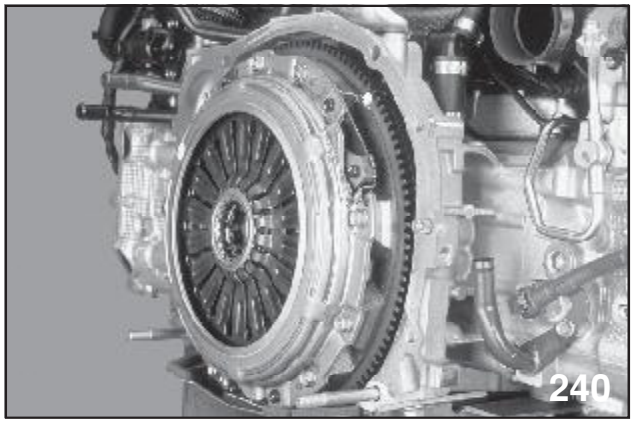
Additional changes include reshaping of the oil pan, to prevent aeration on turns, and the shape of the piston top to control compression ratio.



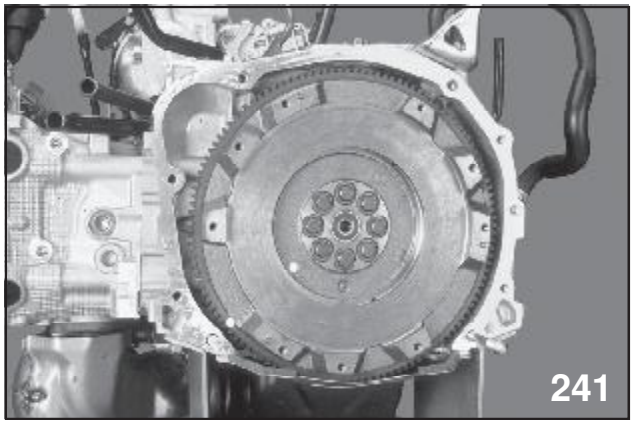
Lower Radiator Cap

Upper Coolant System Cap

The lower radiator cap contains only a pressure relief. The upper coolant system cap contains both a vacuum relief and a pressure relief. The lower radiator will open to pressure at 137+_14.7 kPa. The upper coolant system cap opens to pressure at 108+-15 kPa and under vacuum at -1.0 to - 4.9 kPa.



Pressure Plate

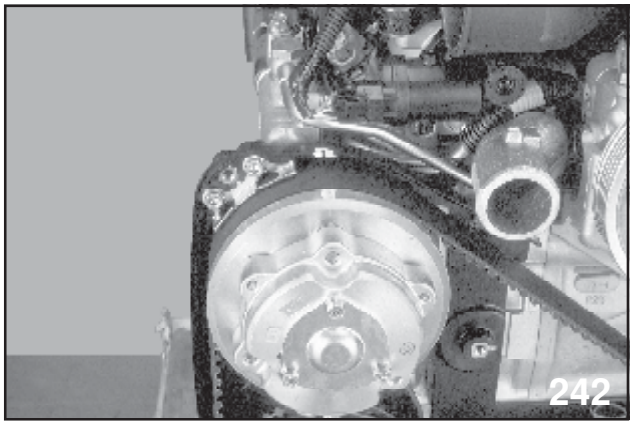


Flywheel

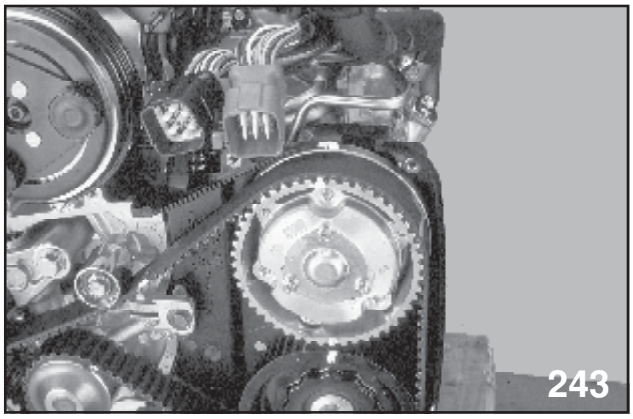
The flywheel is larger and lighter. The clutch is a hydraulic pull type with a clutch disc of 240 mm is longer than WRX.

Position the two heavy marks of the flywheel and pressure plate at least 120 degrees apart upon reassembly.

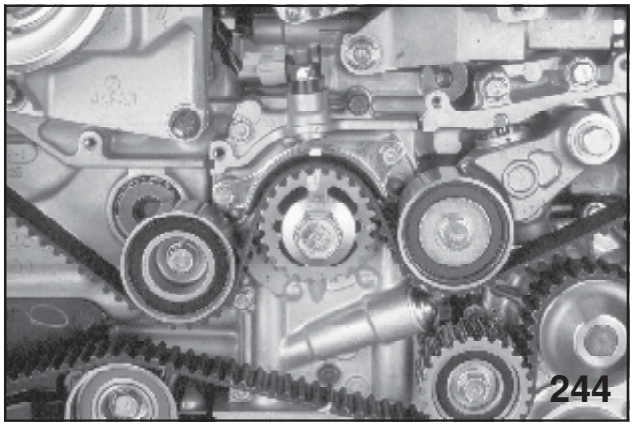
Timing Belt Timing Marks



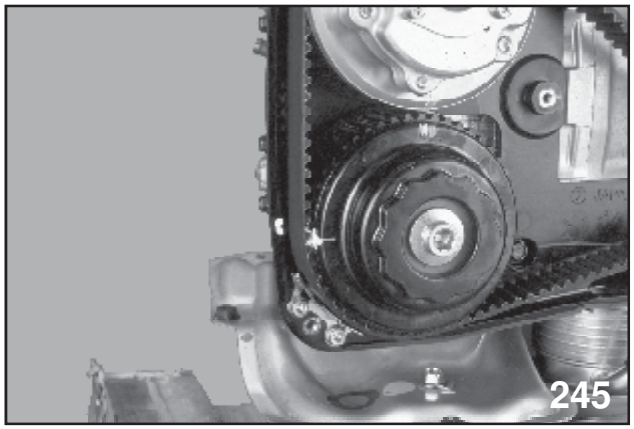
Intake Camshaft Passenger Side



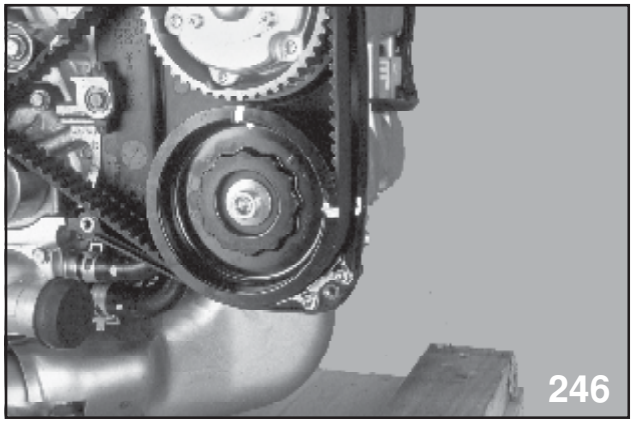
Driver Side Intake Camshaft



Crank Shaft



Passenger Side Exhaust Camshaft



Driver Side Exhaust Camshaft

NOTE: TIMING BELT RETAINERS MUST BE INSTALLED TO AVOID LOSING THE BELT ESPECIALLY ON HARD DECELERATION WHEN ENGINE IS TWISTING.

NOTES:

Engine

"LEGACY 2.5 i, OUTBACK 2.5 i and OUTBACK 2.5 i LIMITED:"
2.5L PHASE II

SOHC 16V HORIZONTALLY OPPOSED 4 CYLINDER
DISPLACEMENT: 2.5 LITERS (2457 CC / 150 CU INCHES)
BORE/STROKE: 99.5 x 79mm (3.92 x 3.11 INCHES.)
HORSEPOWER: 168 HP @ 5600: RPM
TORQUE: 166 LB-FT @ 4000 RPM
COMPRESSION RATIO: 10.0:1
ENGINE TYPE: EJ25

"LEGACY 2.5 GT, 2.5 GT LIMITED, OUTBACK 2.5 XT and OUTBACK 2.5 XT LIMITED:"
2.5L INTERCOOLED TURBO

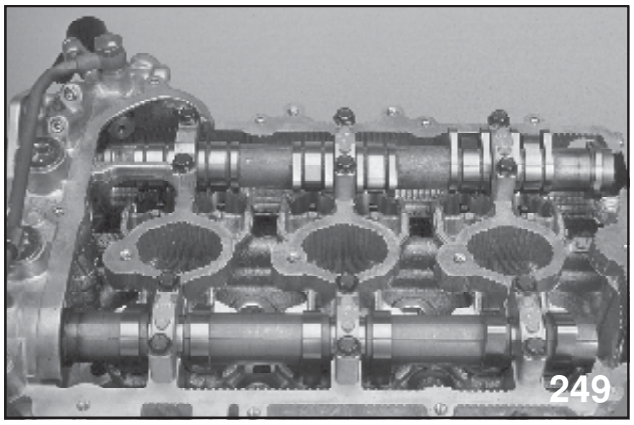
DOHC 16V HORIZONTALLY OPPOSED HIGH OUTPUT 4 CYLINDER
TURBOCHARGED
MAXIMUM BOOST PRESSURE: 700 mmHg (13.5 PSI)
INTERCOOLED
DISPLACEMENT: 2.5 LITERS (2457 CC / 150 CUBIC INCHES)
BORE/STROKE: 99.5 x 79mm (3.92 x 3.11 INCHES)
HORSEPOWER: 250 HP @ 6000 RPM
TORQUE: 250 LB-FT @ 3600 RPM
COMPRESSION RATIO: 8.2:1
ENGINE TYPE: EJ25
ACTIVE VALVE CONTROL SYSTEM (AVCS) VARIABLE VALVE TIMING

OUTBACK 3.0 R
3.0L

DOHC 24V HORIZONTALLY OPPOSED HIGH OUTPUT 6 CYLINDER
DISPLACEMENT: 3 LITERS (2,999 CC / 183 CU INCHES)
BORE/ STROKE: 89.2 x 80mm (3.51 x 3.15 INCHES.)
HORSEPOWER: 250 HP @ 6600 RPM
TORQUE: 219 LB-FT @ 4200 RPM
COMPRESSION RATIO:10.7:1
ENGINE TYPE: EZ30
ACTIVE VALVE CONTROL SYSTEM (AVCS) VARIABLE VALVE TIMING
ACTIVE VALVE LIFT SYSTEM (AVLS) VARIABLE VALVE LIFT **247**

Engine Types

2005 Variable Valve Lift System

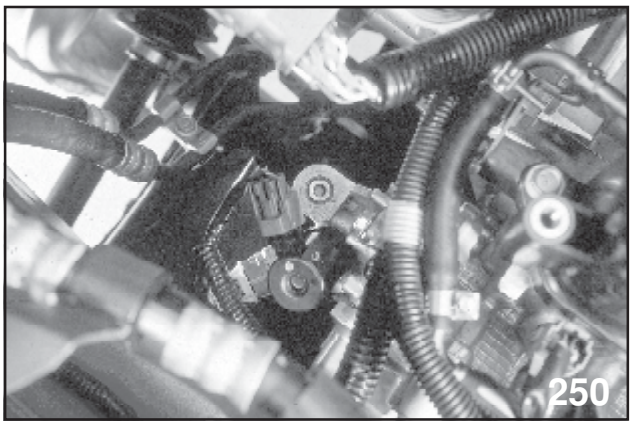


Cylinder Head

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.

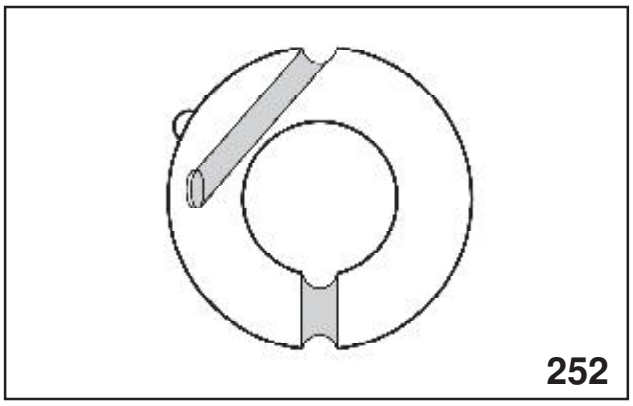


Oil Switching Valve

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.

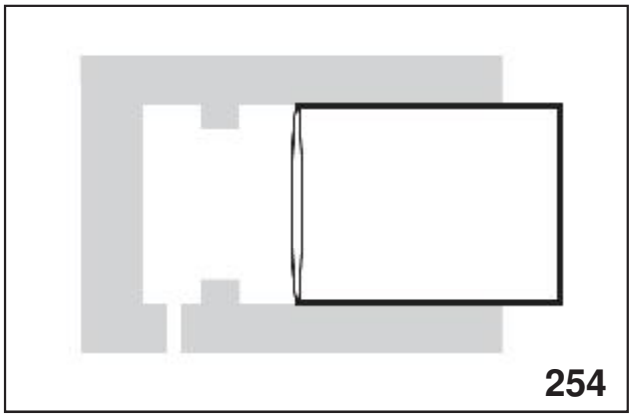
Two Lifters



Two Oil Ports (Artwork)

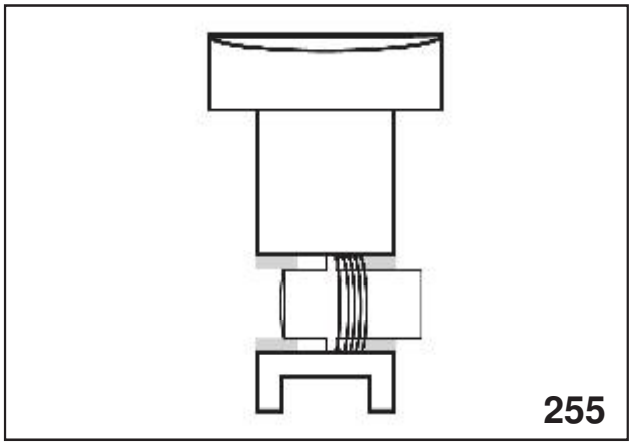
Outer and Inner Lifter

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.

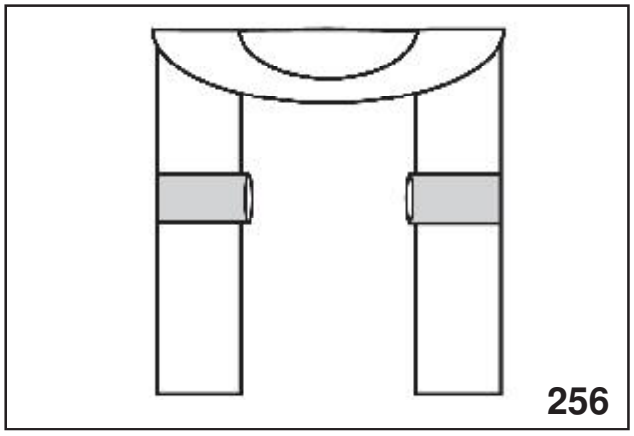


Outer Lifter Locking Pin (Artwork)

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.

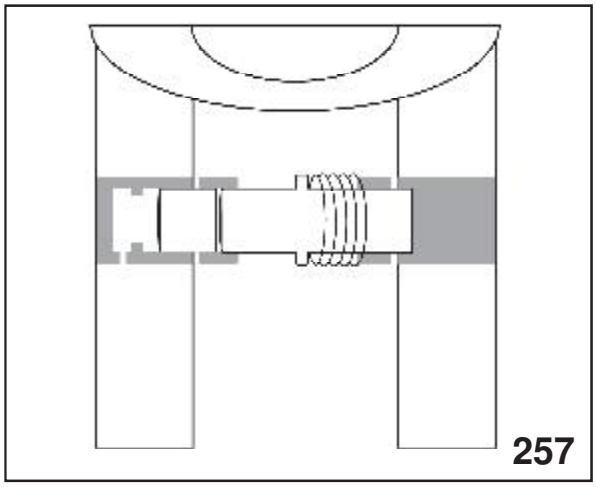


Inner Lifter Locking Pin (Artwork)



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.

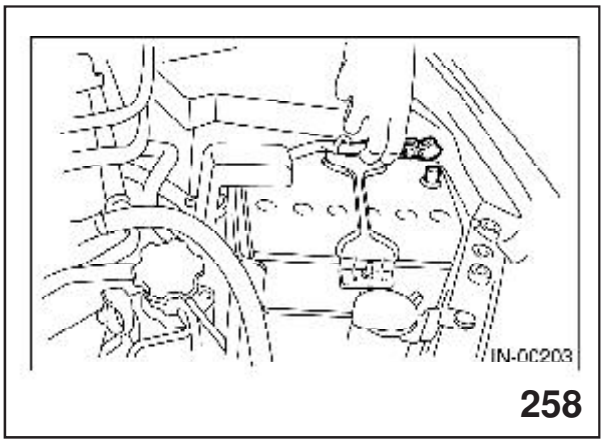
Valve Clearance 3.0 H6

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.

A: Inspection

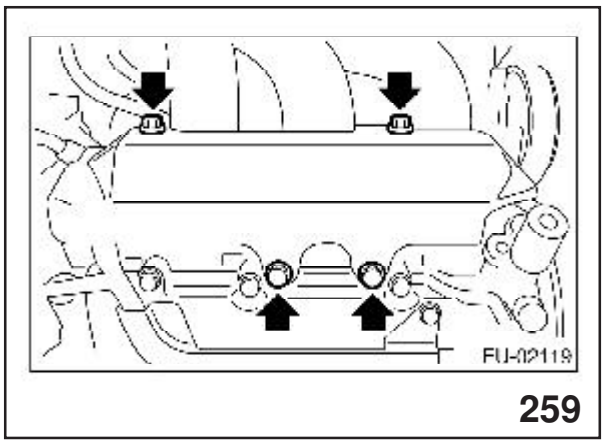
Inspection and adjustment of valve clearance should be performed while engine is cold.

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.>



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Fuel Tank Protector (RH)

(2) Remove the fuel tank protector (RH)

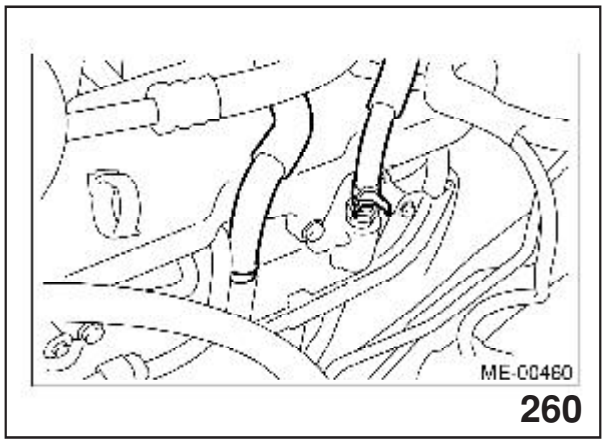
(3) Disconnect the connector of oil pressure switch.

(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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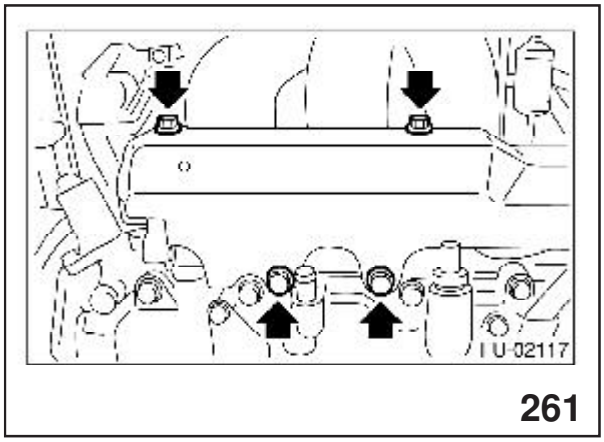
Disconnecting Hoses from Rocker Cover

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



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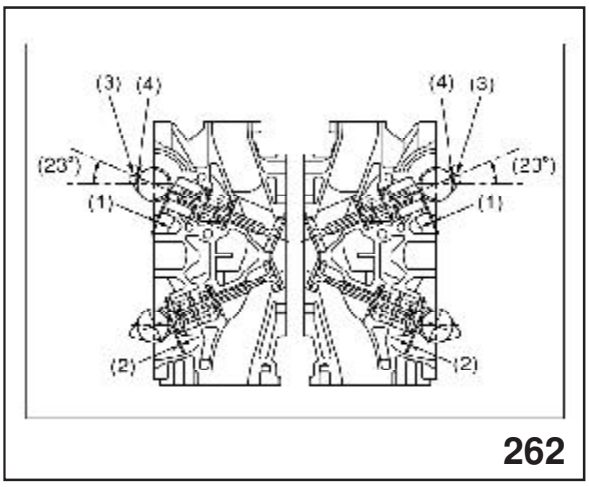
Fuel Pipe Protector (LH)

(3) Remove the fuel pipe protector (LH).

(4) Remove the ignition coil. <Ref. to IG(H6DO)-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).

NOTE: MEASURE VALVE CLEARANCE WITHIN THE RANGE OF ±30° 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

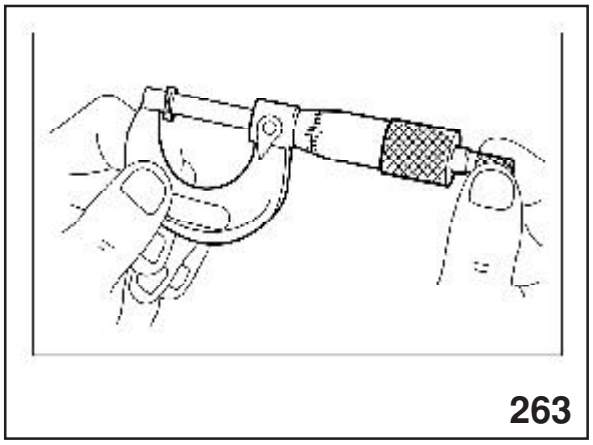
Intake:

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

Exhaust:

0.35 ±0.05 mm (0.0138 ±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.



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

1. 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(H6DO)-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 V: Measured valve clearance T: Shim (cap) thickness to be used

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)
13218AL40	2.34 (0.0921)
13218AL250	2.35 (0.0925)

Part No.	Thickness mm (in)
13218AL260	2.36 (0.0929)
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)

2. EXHAUST SIDE

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

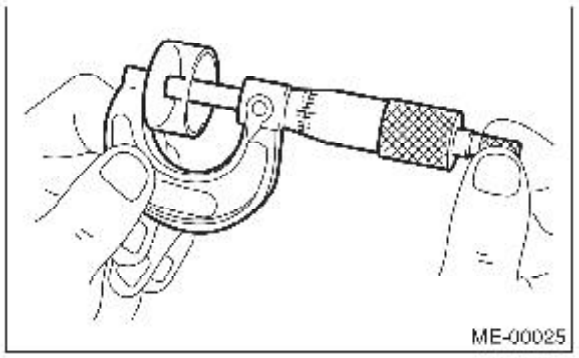
DO NOT WEAR GLOVES DURING REMOVAL AND INSTALLATION OF VALVE LIFTER.

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(H6D0), REMOVAL, Camshaft.>
3. Remove the valve lifter.



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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.

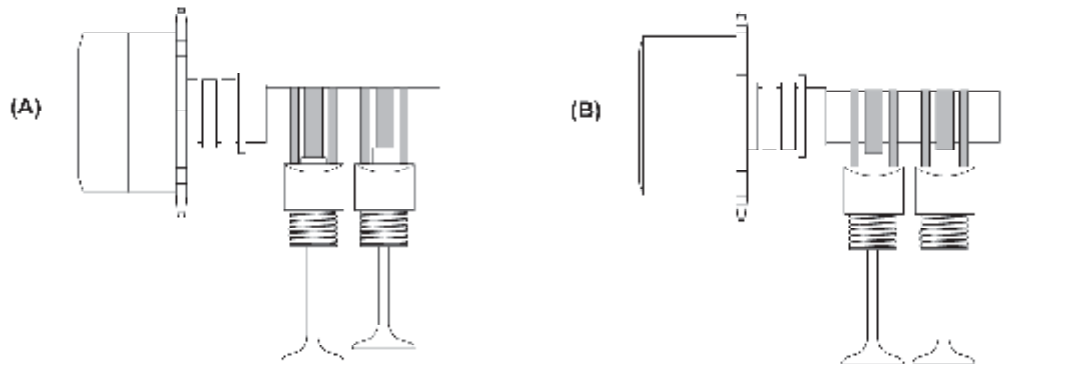
Unit: (mm)
S = (V + T) - 0.35
S: Valve lifter thickness required V: Measured valve clearance T: Valve lifter thickness to be used

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)

Part No.	Thickness mm (in)
13228AC800	4.84 (0.1906)
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)

Part No.	Thickness mm (in)
13228AD170	5.21 (0.2051)
13228AD330	5.23 (0.2059)
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 (02201)

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.



(A) During low speed operation

(B) During high speed operation

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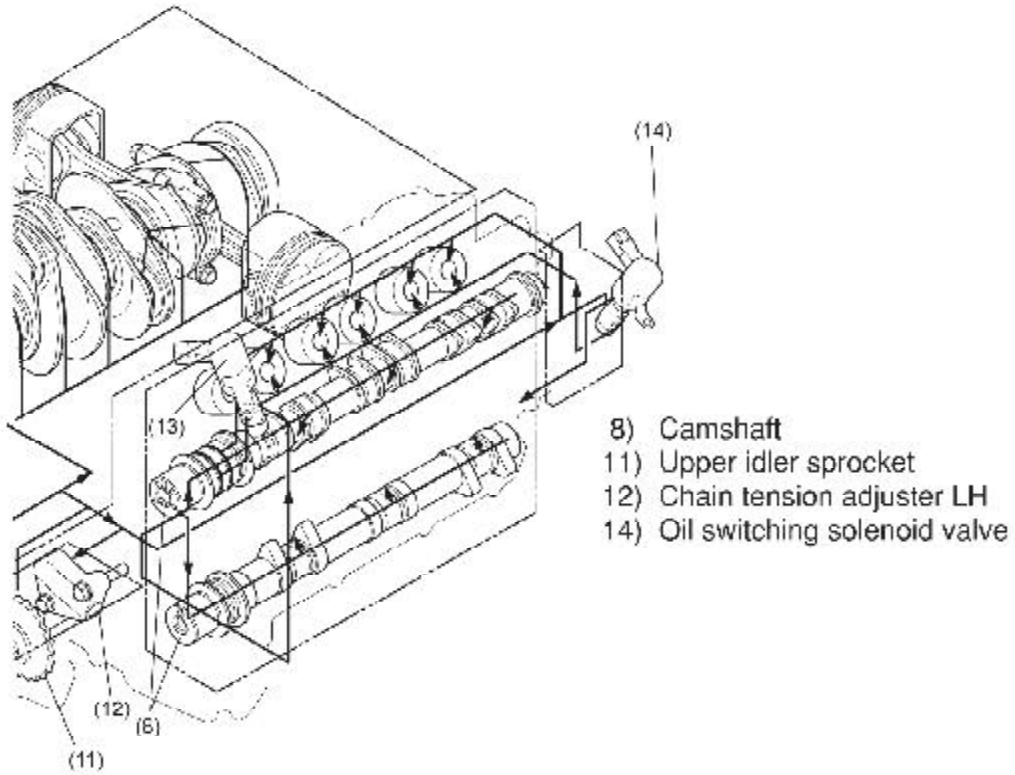
Camshafts



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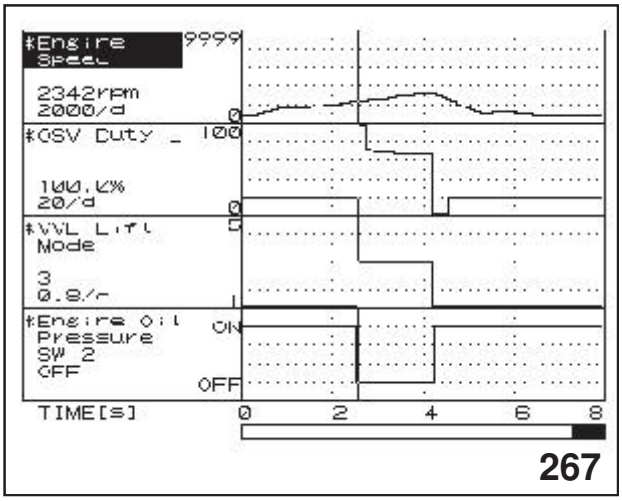
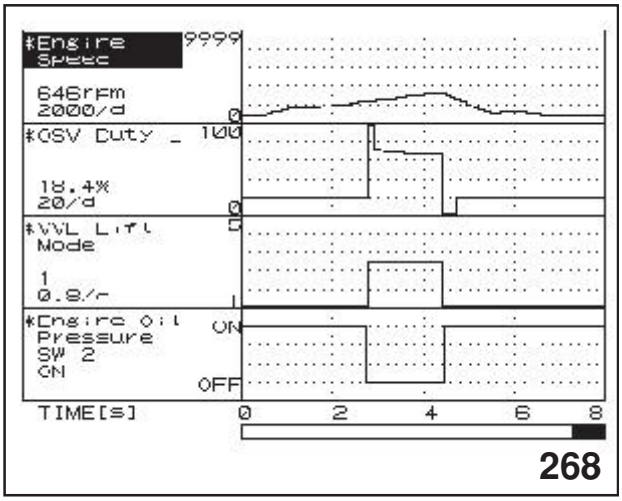
Oil Pressure Schematic



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.

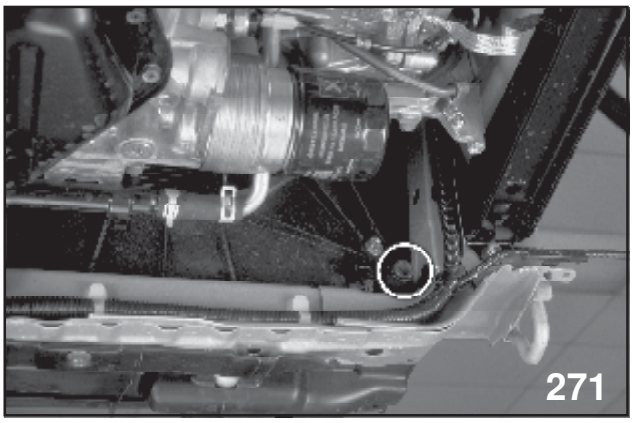
The OSV duty ratio at idle is approximately 18%. This short on time is allowing more oil pressure to drain rather than build up in the application circuit. The resulting pressure reaching the VVL lifters is not strong enough to overcome spring tension so the VVL lifter remains in a low speed operation 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**".

2006 Subaru B9 Tribeca Radiator Removal

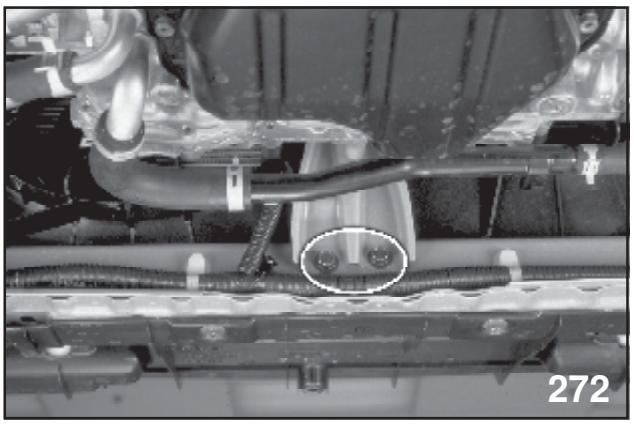
Engine Undercover

Remove the engine under cover.



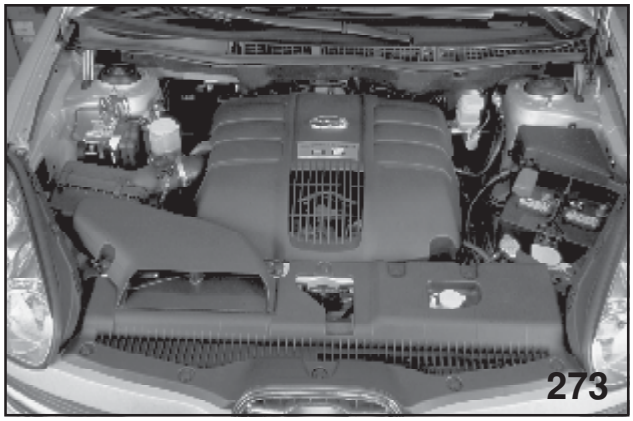
Circled Drain Plug

Loosen the radiator drain plug.



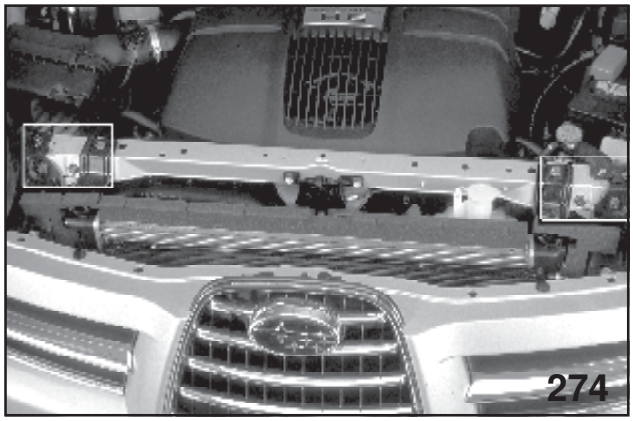
Circled Lower Radiator Support Bar Bolts

Remove the two lower radiator support bar bolts.



Engine Compartment

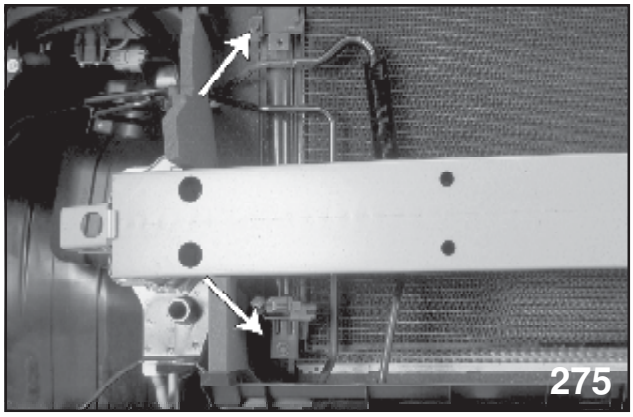
Remove the air intake duct and radiator trim.



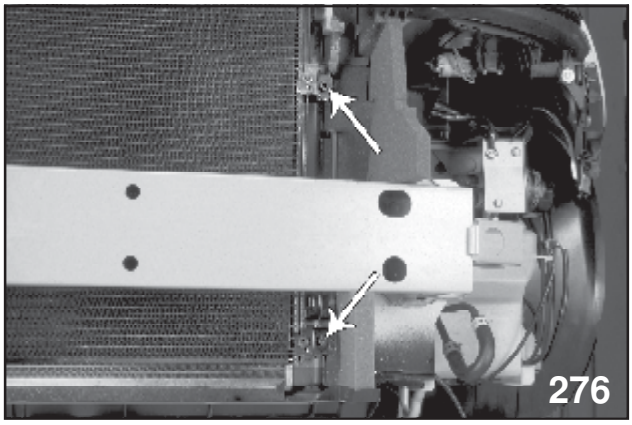
Highlighted Upper Radiator Support Bar Bolts

From the driver side of the radiator support bar, remove the three bolts securing the radiator support bar to the vehicle body. Remove the bolt securing the radiator filler neck to the radiator support bar. Remove the bolt and radiator mounting plate. From the passenger side remove the three bolts securing the radiator support bar to the vehicle body. Remove the three bolts securing the hood latch assembly to the radiator support bar. Remove the radiator support bar from the engine compartment. (Remove wiring tie wrap from radiator support bar.)

Elevate the vehicle and remove the lower radiator hose and lower ATF reservoir hoses.

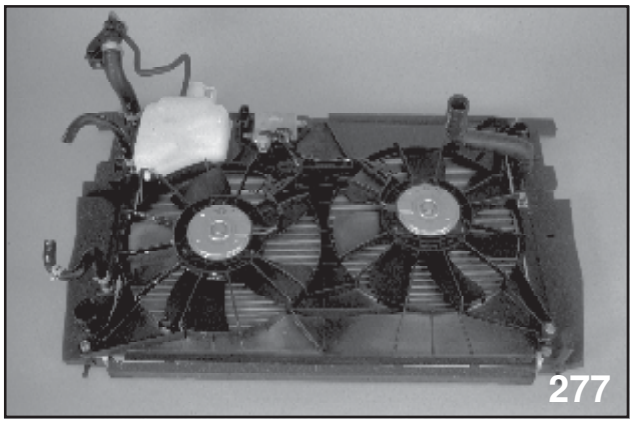


Passenger Side Bolts



Driver Side Bolts

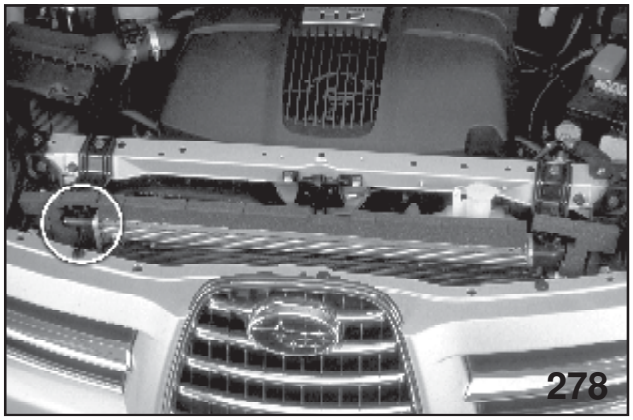
Reach through the front bumper cover and remove the two brackets from the driver and passenger side that connects the condenser to the radiator.



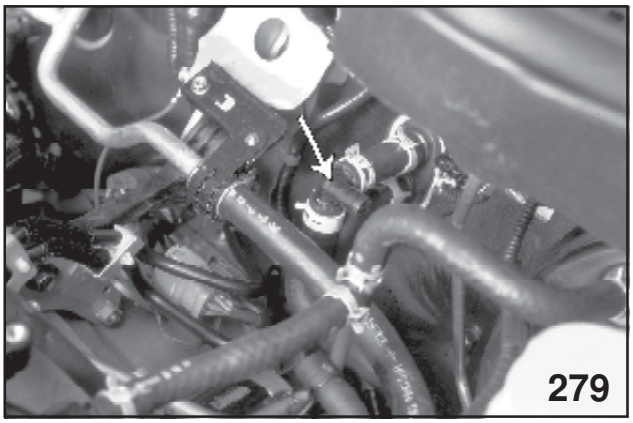
Radiator Assembly

Lower the vehicle and remove the two upper radiator hoses and the upper ATF reservoir hose. Disconnect the fan speed controller connector and remove the radiator from the vehicle.

The fan speed controller and individual fans are serviceable separately.



Circled Air Bleed

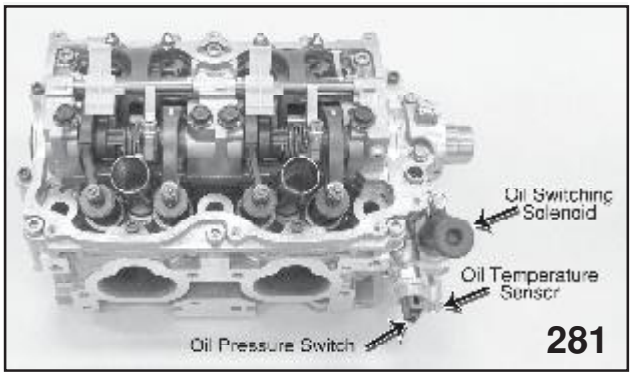


Arrow and Air Bleed

When refilling the coolant system, open the rear and forward air bleeds and continue to add coolant until coolant begins to flow from the air bleeds. Close the air bleeds. Run the engine until the fans cycle and add adequate coolant to the coolant reservoir that will ensure proper radiator coolant level as the coolant system cools.

2006 2.5 Naturally Aspirated Engine

The 2.5 naturally aspirated engine has increased in horsepower and torque over the previous model year. Horsepower is rated at 175 at 6,000 RPM and 169 ft. lbs. of Torque at 4,400 RPM.



Cylinder Head

NOTE: OIL TEMPERATURE SENSOR IS USED ONLY TO DETERMINE OIL TEMPERATURE FOR DIAGNOSIS. (MINIMUM TEMPERATURE 15°C OR 59° F)

Naturally aspirated models are equipped with i-Active Valve Lift System. The system operates similar to the variable valve lift system of 3.0 liter engine of the Legacy and Subaru B9 Tribeca vehicles.

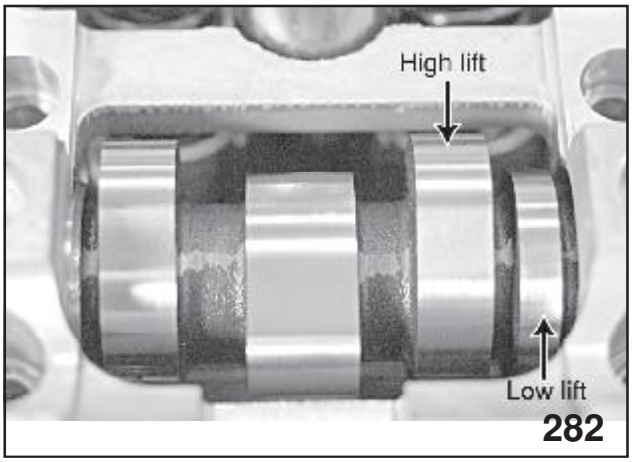
Operating one of two intake valves per cylinder, the i-Active Valve Lift System increases combustion chamber swirl at low engine speeds and increases air flow during high engine speeds.

NOTE: THE REASON FOR CHANGE INTERVALS ON PLATINUM SPARK PLUGS AND WHY SOME NEED TO BE CHANGED AT 30,000 MILES AND OTHERS AT 60,000 MILES.

THE REASON FOR THIS IS THE SPARK PLUGS ON 2.5L NA ENGINES, THE ELECTRODE SIDE OF THIS PLUG IS PLATINUM BUT THE PLUG CORE SIDE IS NOT PLATINUM. THEREFORE, IT IS A MAINTENANCE INTERVAL EVERY 30,000 MILES.

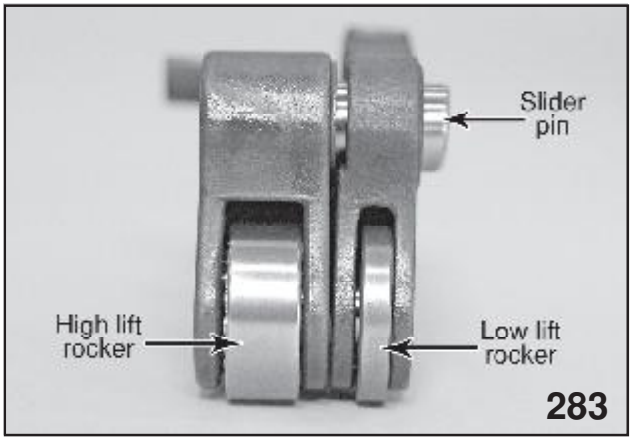
ON THE 2.5L TURBO AND 3.0L ENGINES, BOTH THE ELECTRODE SIDE AND THE PLUG CORE SIDE ARE PLATINUM.

THEREFORE, IT IS A MAINTENANCE INTERVAL EVERY 60,000 MILES.

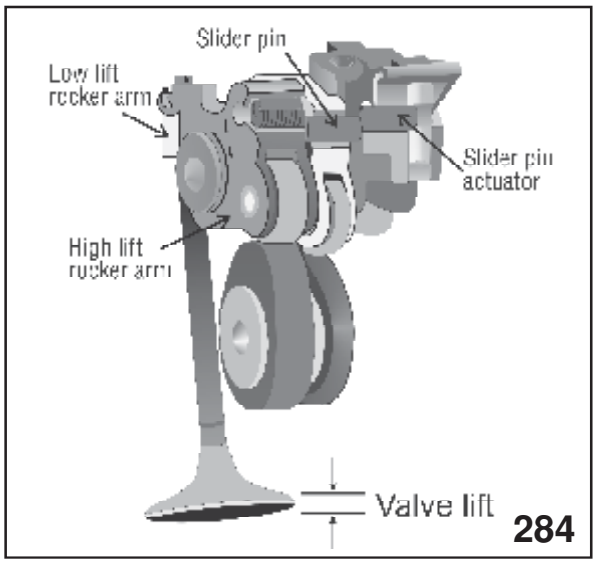


Camshaft

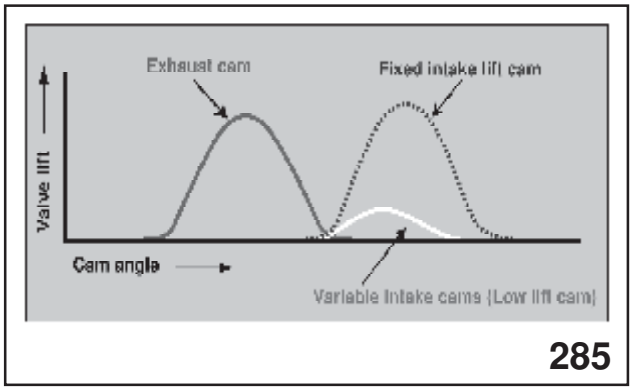
The inboard intake camshaft lobe of each cylinder is actually two lobes. The shorter lobe provides the lift for the low speed or mode 1 operation and the higher lobe provides the lift for high speed operation or mode 3.



Rocker Arm



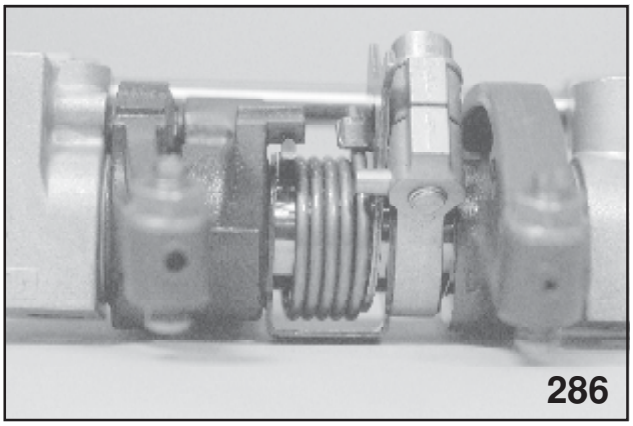
Valve and Rocker Arm (Low Lift)



Lift Graph

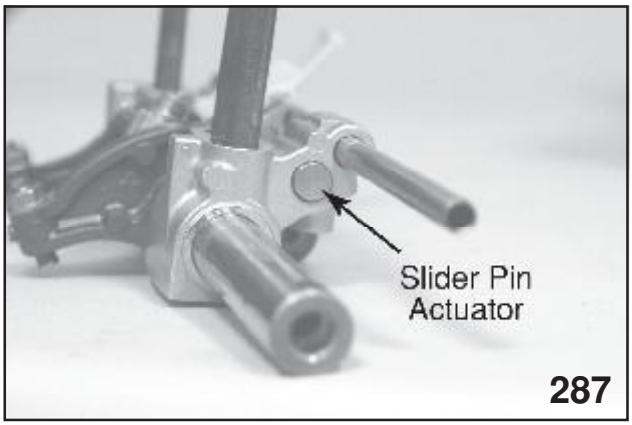
(Both rocker arms operate independently)

During low speed operation (mode 1) the low lift camshaft lobe transfers the lift and duration of the low speed camshaft lobe to the top of the intake valve.



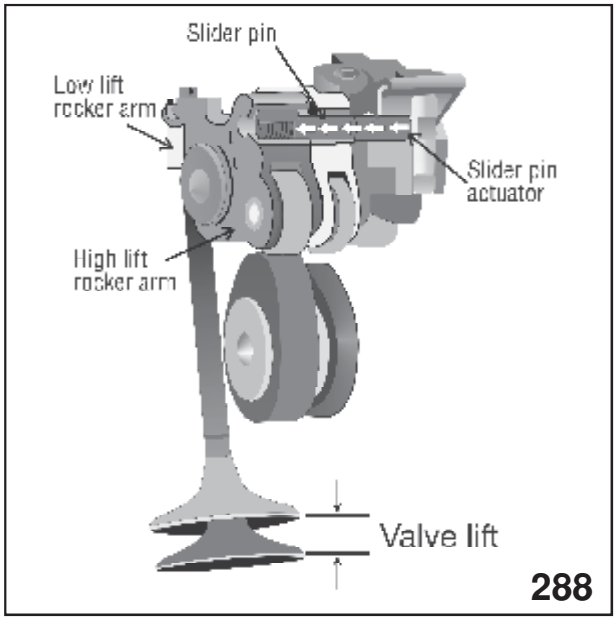
Tension Spring

The high lift rocker arm moves freely and has no affect on the intake valve. The high speed rocker arm utilizes a tension spring to maintain the correct positioning and to prevent noise as it has no load applied to it.

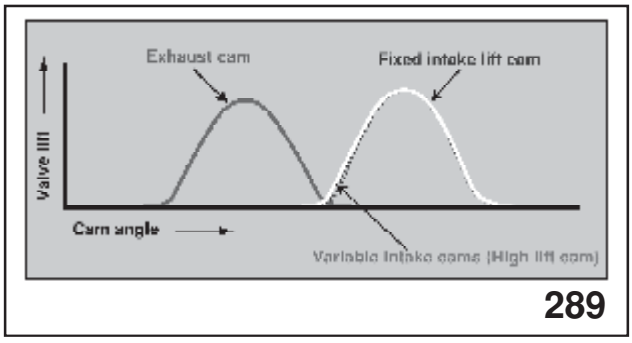


Slide Pin Actuator

A duty ratio signal sent to an Oil Switching Valve on the left and right side engine cylinder heads affects the build up of oil pressure behind a slider pin actuator of each cylinder. An increase in duty ratio closes the oil pressure release and the slider pin moves outward.



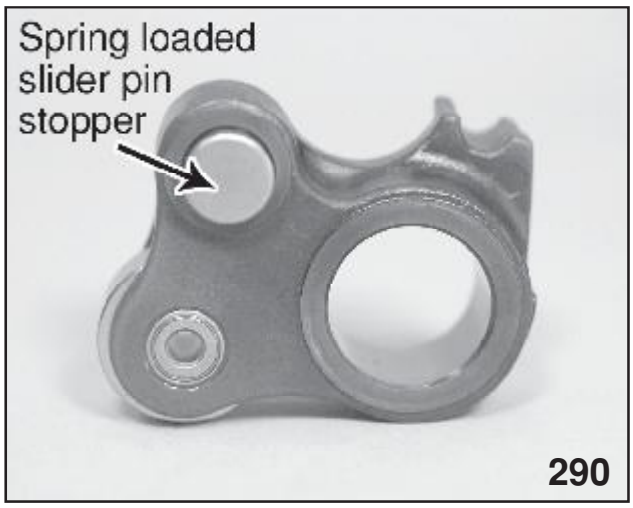
Valve and Rocker Arm (High Lift)



Lift Graph

(Both rocker arms locked together)

During high speed operation (mode 3) the slider pin actuator moves outward from the center rocker shaft support due to the increase in oil pressure behind the actuator. The actuator pushes the slider pin positioned in the low lift rocker arm into the slider pin stopper located in the high speed rocker arm. This action mechanically locks the two rocker arms together. The lift and duration of the high lift camshaft lobe is transferred from through the high lift rocker arm to the low lift rocker arm and then to the top of the intake valve.



Slider Pin Stopper

When the engine returns to mode 1, the oil pressure behind the slider pin actuator is drained away and the spring tension behind the slider pin stopper pushes the slider pin away from the high lift rocker arm and the low lift rocker arm functions from the low lift camshaft lobe only.

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Slide Sequence

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Slide Sequence

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General Hand Tools and Supplies

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

Special Tools

		2.0L	2.2L	(1996) (HLA's) DOHC (Phase 1) 2.5L	(97 to 99) (Solid) DOHC (Phase 1) 2.5L	(1999 & Later) SOHC (Phase 2) 2.2 & 2.5L	3.0	(2004 & Later) DOHC
498457000	Engine stand adapter RH	X	X		X		X	
498457100	Engine stand adapter LH	X	X		X		X	
498747100	Piston guide		X		X			
498857100	Valve oil seal guide	X	X		X	X	X	
499017100	Piston pin guide	X	X	X	X	X		X
499037100	Connecting rod bushing remover & installer	X	X		X	X		
499097500	Piston pin remover		X		X		X	
499207100	Camshaft sprocket wrench		X		X	X		X
499587100	Camshaft oil seal installer	X	X	X	X	X	X	X
499587200	Crankshaft oil seal installer	X	X	X	X	X	X	X
499587300	Camshaft oil seal installer							
499587400	Oil pump seal installer							
499597000	Camshaft oil seal guide		X	X	X	X	X	
499718000	Valve spring remover	X	X	X	X	X	X	
499718400	Valve spring compressor adapter		X					
499767000	Valve guide adjuster	X	X					
499767200	Valve guide remover	X	X		X	X		
499767400	Valve guide reamer	X	X		X	X		
499817000	Engine stands (2)	X	X	X	X			
499977000	Crank pulley wrench		X	x				
898968600	Circlip pliers (or SNAP-ON long nose pliers 911CP)		X	X				
499597100	Crankshaft oil seal guide	X	X	X		X	X	
498747300	Piston guide			X	X	X		X

		2.0L	2.2L	(1996) (HLA's) DOHC (Phase 1) 2.5L	(97 to 99) (Solid) DOHC (Phase 1) 2.5L	(1999 & Later) SOHC (Phase 2) 2.5L	3.0	(2004 & Later) DOHC
499207300	Camshaft sprocket wrench			X	X			
498267600	Cylinder head table	X		X	X			
498267700	Valve guide adjuster	X		X	X			
499987500	Crankshaft socket		X	X		X		
J-43979	Shim remover tool	X			X		X	
J-42908	Camshaft sprocket holding tool			X	X			
498497100	Crankshaft stopper	X			X	X	X	X
18254AA00	Piston guide						X	
18253AA000	Connecting rod bushing remover & installer						X	
18350AA000	Camshaft sprocket wrench						X	
499587700	Camshaft oil seal installer	X				X	X	
18251AA000	Valve guide adjuster						X	
499765700	Valve Guide remover						X	
499765900	Valve Guide reamer						X	
499977100	Crank pulley wrench				X	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						
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			
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 (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
18232AA000	Engine stand						X	
498277200	Flywheel stopper	X		X	X	X	X	X
18354AA000	Valve rocker holder 2006 phase two non-turbo							
18258AA000	Spring Installer 2006 phase two non-turbo							

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 specifictation vehicles)	Revised cylinder block spectifications
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 shrot 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

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 tighting 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
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	Cambelt tensioner replacement

Tech TIPS

Date	Subject
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)
04/04	H-6 Engine cover torque
08/04	Pressure washing of vehicle engine compartment- All models
09/04	ODS code 29
03/05	Intercooler spray tank
07/05	Oil classification change for 2006MY vehicles
08/05	Shortblocks replaced under warranty
09/05	LH cylinder head assembly /CHANGED PN 11063AB120
10/05	Safe handling of sodium filled valves
04/06	Platinum spark plug change intervals

NOTES


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