

## 1999-2000 ENGINES

## 2.5L V6

**ENGINE IDENTIFICATION****ENGINE IDENTIFICATION CODES**

Application	VIN
Grand Vitara	6

**ADJUSTMENTS****VALVE CLEARANCE ADJUSTMENT**

Hydraulic lifters are used, no valve adjustments are required.

**TROUBLE SHOOTING**

**NOTE:** To trouble shoot engine mechanical components, see appropriate table in **TROUBLE SHOOTING** article in **GENERAL INFORMATION**.

**REMOVAL & INSTALLATION**

**NOTE:** For repair procedures not covered in this article, see **ENGINE OVERHAUL PROCEDURES** article in **GENERAL INFORMATION**.

**NOTE:** For reassembly reference, label electrical connectors, vacuum hoses and fuel lines before removal. Place mating marks on engine hood and other major assemblies before removal.

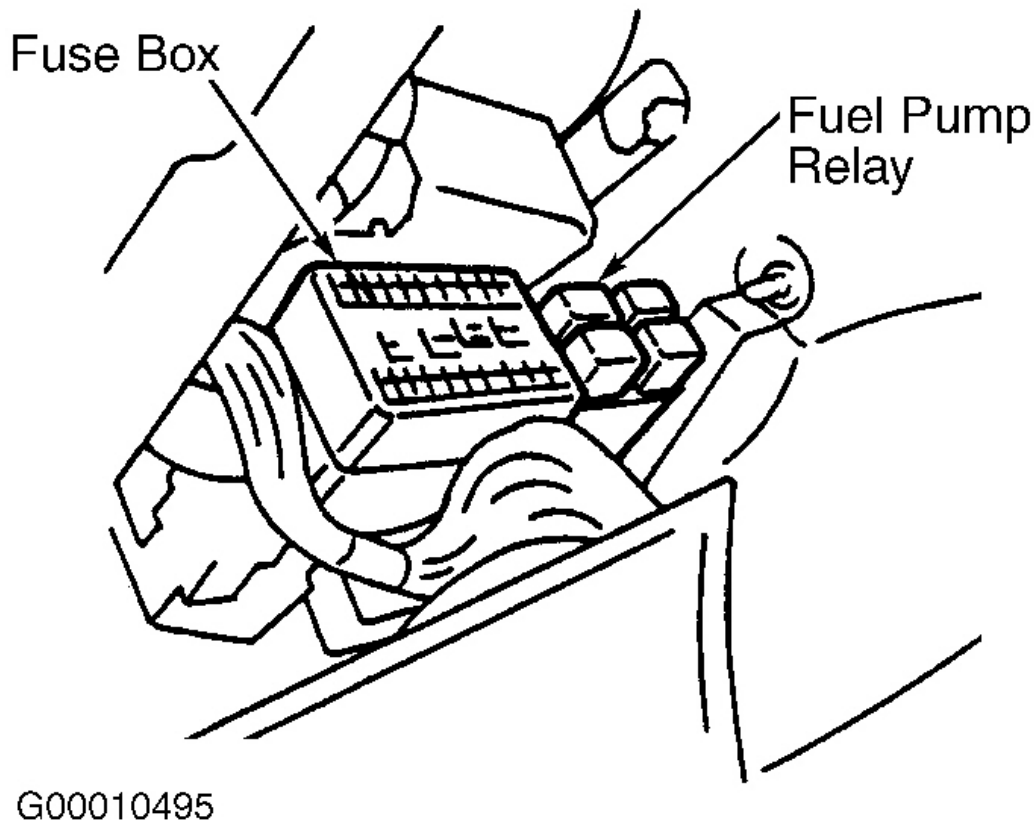
**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See appropriate **COMPUTER RELEARN PROCEDURES** article in **GENERAL INFORMATION** before disconnecting battery.

**FUEL PRESSURE RELEASE**

**CAUTION:** Fuel system is under pressure. Fuel pressure must be released before servicing any fuel system components. Allow engine to cool prior to releasing fuel pressure to avoid possible fire hazard and/or damage to catalyst..

1. Place transmission in Neutral (M/T) or Park (A/T). Set parking brake, and block drive wheels.

2. Disconnect fuel pump relay connector. Fuel pump relay box is located under driver-side dash, next to fuse box. See **Fig. 1**.
3. Remove fuel filler cap to release pressure. Reinstall fuel filler cap. Start engine and idle until engine stalls. Crank engine 2 or 3 times to ensure lines are empty. Turn ignition off. Upon completion of repairs, reconnect fuel pump relay connector.



**Fig. 1: Locating Fuel Pump Relay**  
Courtesy of SUZUKI OF AMERICA CORP.

## ENGINE

### Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** Disconnect battery cables. mark and remove hood. Remove strut tower crossbrace. Remove surge tank cover. Drain coolant and engine oil. Remove radiator hoses. Remove radiator, radiator fan shroud, cooling fan and radiator reservoir.
2. Disconnect accelerator cable and A/T throttle cable from throttle body. Remove air cleaner assembly, intake air pipe and surge tank.

3. Identify, mark and remove vacuum lines and hoses at engine. Label and disconnect electrical connectors, ground straps and wiring harness brackets attached to engine.
4. Remove power steering pump, A/C compressor and mounting brackets. Remove steering shaft lower assembly.
5. Raise and support vehicle. Remove front differential housing with differential from chassis. See appropriate DIFFERENTIALS article in DRIVE AXLES. Disconnect exhaust No.1 pipe bolts and remove exhaust pipe. Remove exhaust manifold stiffener, fluid hose clamps (A/T), clutch housing lower plate (M/T), starter motor and torque converter bolts (A/T).
6. Lower vehicle. Support transmission. On A/T models, DO NOT place jack under A/T oil pan to support transmission. Remove transmission-to-block nuts and bolts. Install engine lifting device. Remove remaining bolts, nuts and brackets from engine and transmission. Ensure all hoses, wire harnesses and cables which may interfere with engine removal have been disconnected. Slowly remove engine from engine compartment, while separating engine from transmission.

**Installation**

Install engine into engine compartment. Install engine mounting brackets. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure. Use NEW gaskets. Adjust all control cables. Fill crankcase and cooling system. Check for leaks after starting engine.

**INTAKE MANIFOLD****Removal**

1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect battery cables. Drain cooling system. Remove strut tower cross brace. Remove surge tank cover. Remove air intake hoses. Remove air cleaner assembly, intake air pipe and surge tank. Label and disconnect electrical connectors from intake manifold, injectors and throttle body. Disconnect accelerator cable and throttle cable (A/T) from throttle body.
2. Label and disconnect water, vacuum and fuel hoses from intake manifold. Label and disconnect ground straps and brackets from intake manifold. Remove EGR pipe.
3. Remove throttle body and intake collector from intake manifold. Remove intake manifold-to-cylinder head bolts and nuts. Remove intake manifold and gasket.

**Installation**

To install, reverse removal procedure. Install NEW intake manifold gasket to cylinder head. Tighten bolts and nuts to specifications. See **TORQUE SPECIFICATIONS**. Adjust all control cables and fill cooling system.

**EXHAUST MANIFOLD****Removal**

1. Disconnect negative battery cable. Remove air cleaner assembly, air intake pipe and EVAP canister (if required). Disconnect oxygen sensor connector and brackets. Disconnect EGR pipe from right (No. 2) bank exhaust manifold. Remove exhaust manifold covers.

2. Raise and support vehicle. On 4WD models, match mark joint flange and drive shaft. Disconnect drive shaft from front differential. On all models, remove No. 1 exhaust pipe bolts and nuts. Remove exhaust pipe. Remove exhaust manifold stiffener from transmission case. Remove exhaust manifolds and gaskets from cylinder head.

**Installation**

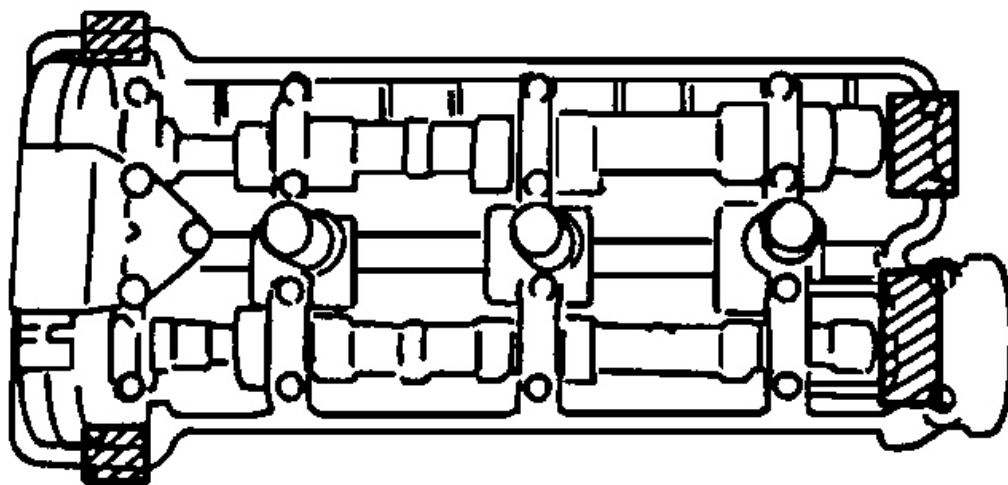
To install, reverse removal procedure. Install NEW gaskets to cylinder heads and exhaust No.1 pipe. Install exhaust manifolds. Tighten manifold nuts to specification. See **TORQUE SPECIFICATIONS**.

**VALVE COVERS****Removal**

Remove throttle body and intake manifold. See **INTAKE MANIFOLD**. Remove ignition coil covers, ignition coil connectors and ignition coils. Remove valve covers bolts. Remove valve covers.

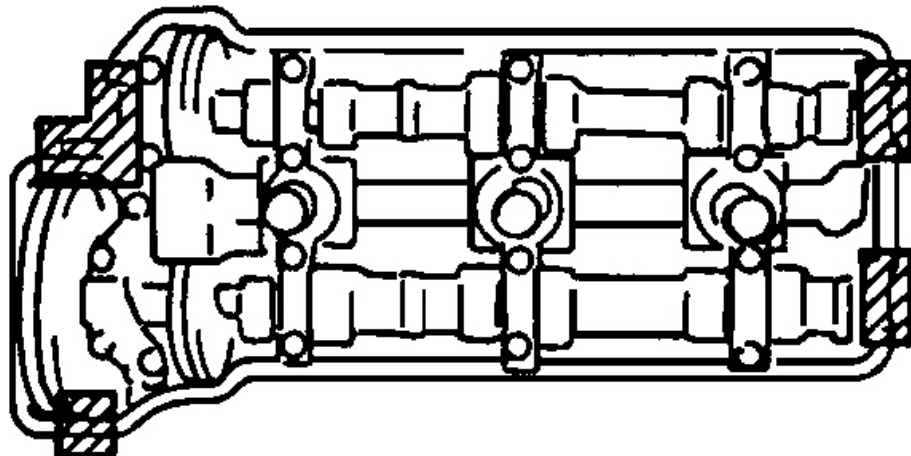
**Installation**

Clean gasket surfaces. Apply sealant to cylinder head. See **Fig. 2**. Install NEW gaskets. Install valve covers and tighten bolts to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.



LEFT SIDE (NO. 1) CYLINDER

 : Area To Apply Sealant "A"



RIGHT SIDE (NO. 2) CYLINDER

 : Area To Apply Sealant "A"

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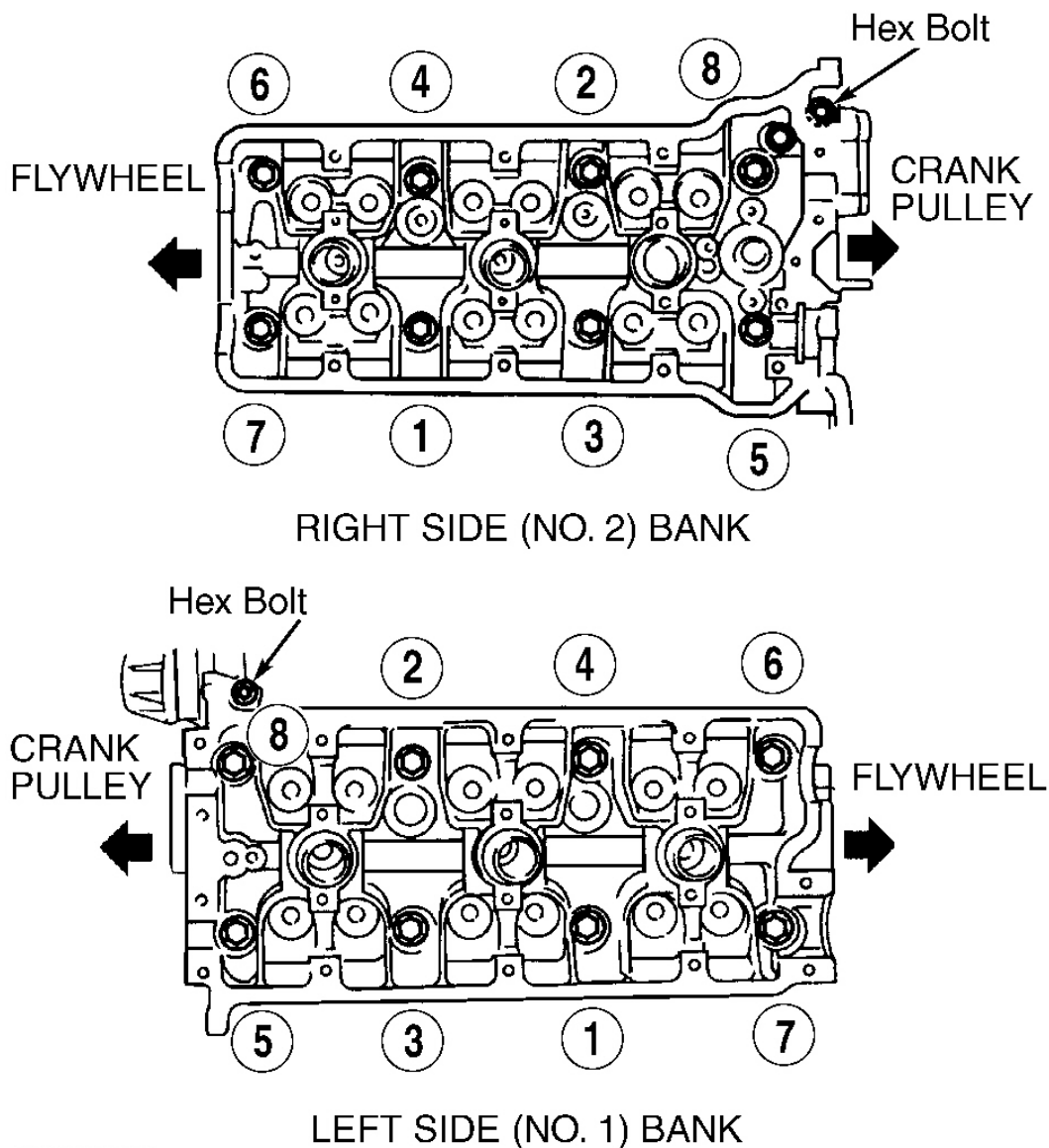
**Fig. 2: Applying Valve Cover Sealant**

Courtesy of SUZUKI OF AMERICA CORP.

## CYLINDER HEAD

### Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect negative battery cable. Drain engine oil. Drain cooling system and remove necessary coolant hoses from cylinder head. Remove intake manifold. See **INTAKE MANIFOLD**. Remove valve covers. See **VALVE COVERS**.
2. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Remove No. 1 and No. 2 timing chains and chain tensioners. See **RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER** and **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove camshaft position sensor. Remove camshaft and valve lash adjuster. See **CAMSHAFT AND VALVE LASH ADJUSTER**. Remove exhaust manifold. See **EXHAUST MANIFOLD**.
3. Loosen cylinder head bolts and 2 hex bolts in reverse order of tightening sequence. See **Fig. 3**. Loosen and remove head bolts in 2 or 3 steps to prevent cylinder head warpage. Remove cylinder heads.



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**Fig. 3: Cylinder Head Bolt Tightening Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Inspection

1. Check cylinder head for evidence of water leakage or damage. Remove carbon from combustion chambers. Check cylinder head for cracks in combustion chambers, head surface, intake and exhaust ports.
2. Check head warpage at 6 locations. If warpage exceeds specification, cylinder head should be machined or replaced. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.

3. Check intake and exhaust manifold seating faces on cylinder head for warpage. Warpage limit for manifold seating faces is .004" (.10 mm). If warpage exceeds specification, machine or replace cylinder head.

**Installation**

To install cylinder head, reverse removal procedure. Use NEW head and manifold gaskets. Loosely install cylinder head bolts. Tighten cylinder head bolts to specification in 3 steps using proper sequence. See **Fig. 3**. See **TORQUE SPECIFICATIONS**.

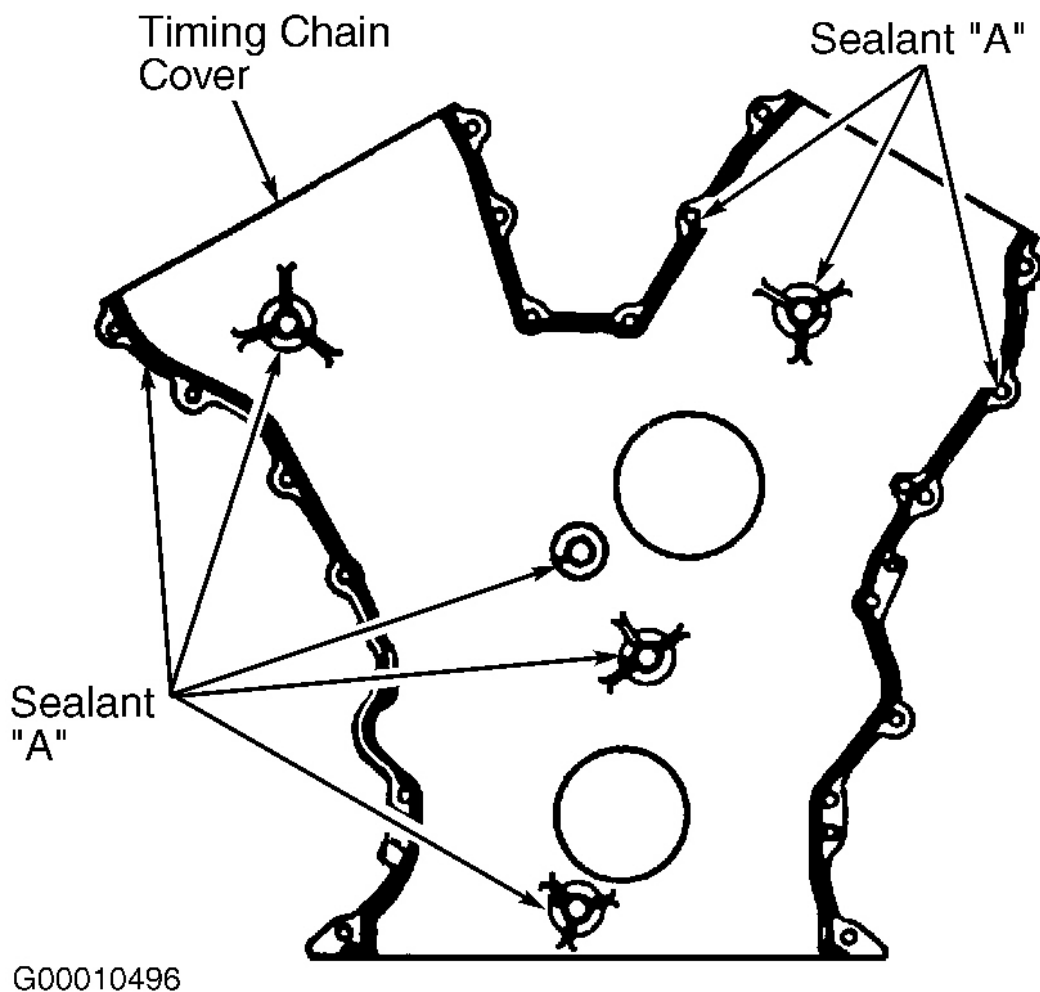
**TIMING CHAIN COVER & FRONT OIL SEAL****Removal**

1. Disconnect negative battery cable. Drain coolant and engine oil. Remove throttle body and intake manifold. See **INTAKE MANIFOLD**. Remove valve covers. See **VALVE COVERS**.
2. Remove cooling fan, fan shroud, fan belt, fan clutch and water pump pulley. Remove radiator hoses. Remove radiator. Remove thermostat housing. Remove power steering belt, pump and bracket.
3. Raise and support vehicle. Remove oil pan. See **OIL PAN**. Hold crankshaft pulley using Special Tool (09917-68221). Remove crankshaft pulley bolt. Using appropriate puller, remove crankshaft pulley.
4. Disconnect crankshaft position sensor connector, and remove sensor (if needed). Remove timing chain cover bolts and cover. Remove front oil seal using appropriate tool.

**Installation**

Install NEW front seal using Special Tool (09913-31150). Apply sealant to timing chain cover. See **Fig. 4**. Install timing chain cover. To complete installation, reverse removal procedure. Tighten bolts to specifications. See **TORQUE SPECIFICATIONS**.





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**Fig. 4: Applying Timing Chain Cover Sealant**  
 Courtesy of SUZUKI OF AMERICA CORP.

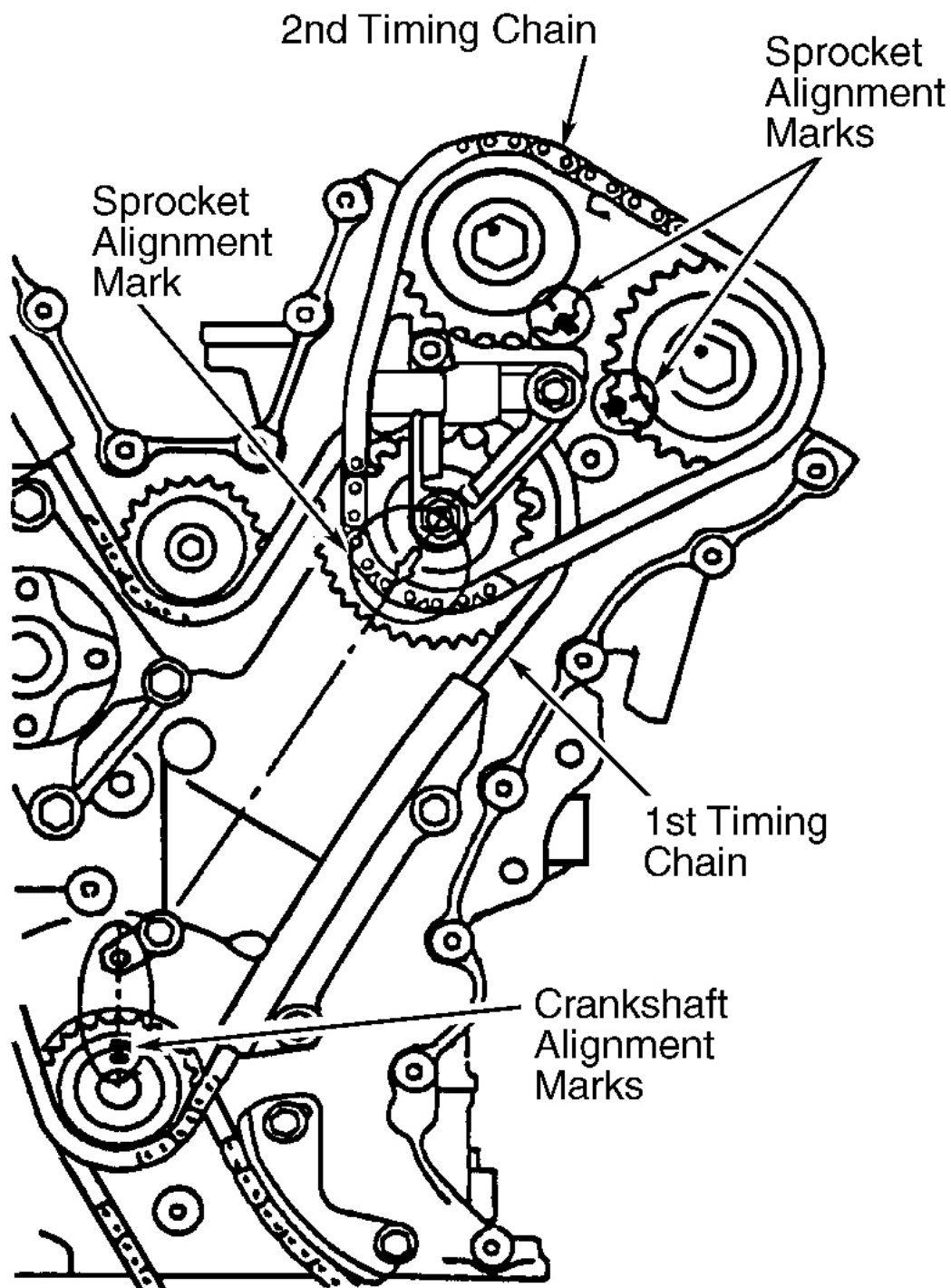
#### LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER

**NOTE:** Upper timing chain is 2nd timing chain.

#### Removal

1. Disconnect negative battery cable. Drain engine oil and coolant. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**.
2. Position crankshaft key mark to match mark on block. Position arrow mark on idler sprocket No. 2 so it points to crankshaft center. Align match marks on intake and exhaust camshafts to marks on cylinder head. See **Fig. 5**.

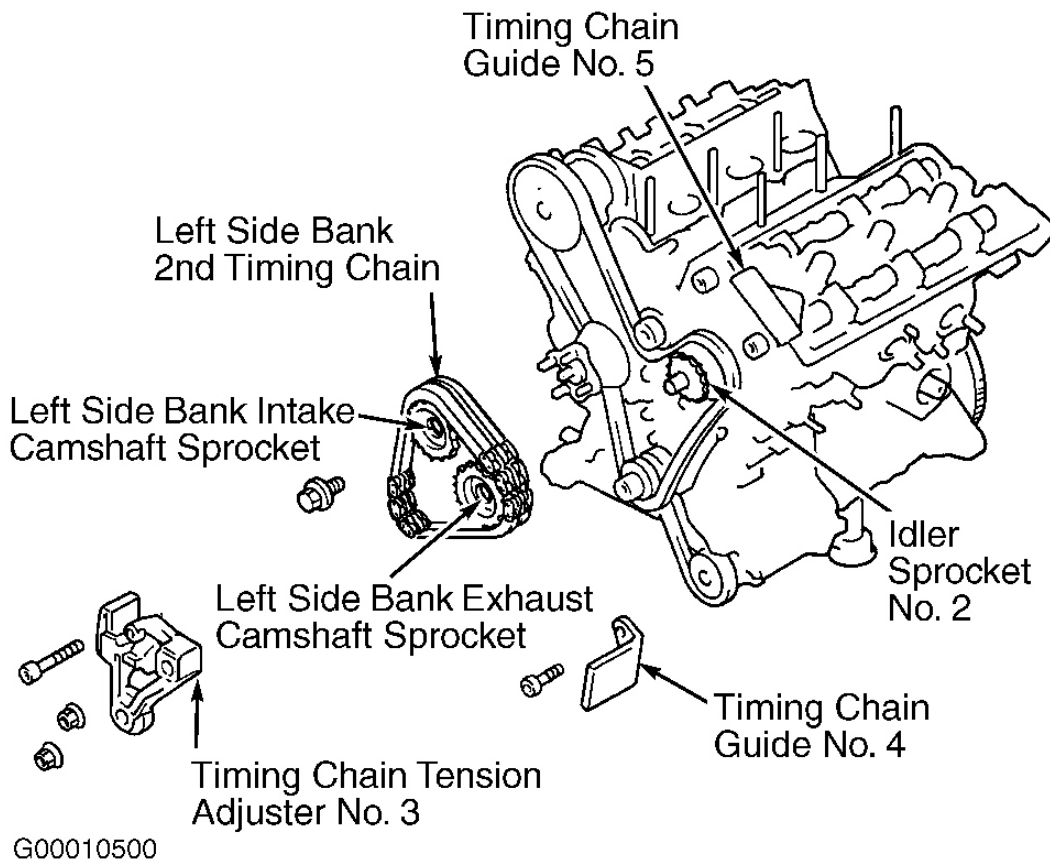
**CAUTION:** Removing sprockets from camshaft may cause camshaft to turn, resulting in damage to valve and piston. To prevent this, hold camshaft stationary by using a spanner at its hexagonal part, when removing sprocket.



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**Fig. 5: Aligning Marks For Left Bank 2nd Timing Chain**

Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 6: Removing Left Bank 2nd Timing Chain**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. Remove timing chain tensioner adjuster No. 3. Remove timing chain guides No. 4 and No. 5. Remove left bank intake and exhaust camshaft sprocket bolts. Remove intake and exhaust camshaft sprockets. Remove left bank 2nd timing chain. See **Fig. 6**.

### Inspection

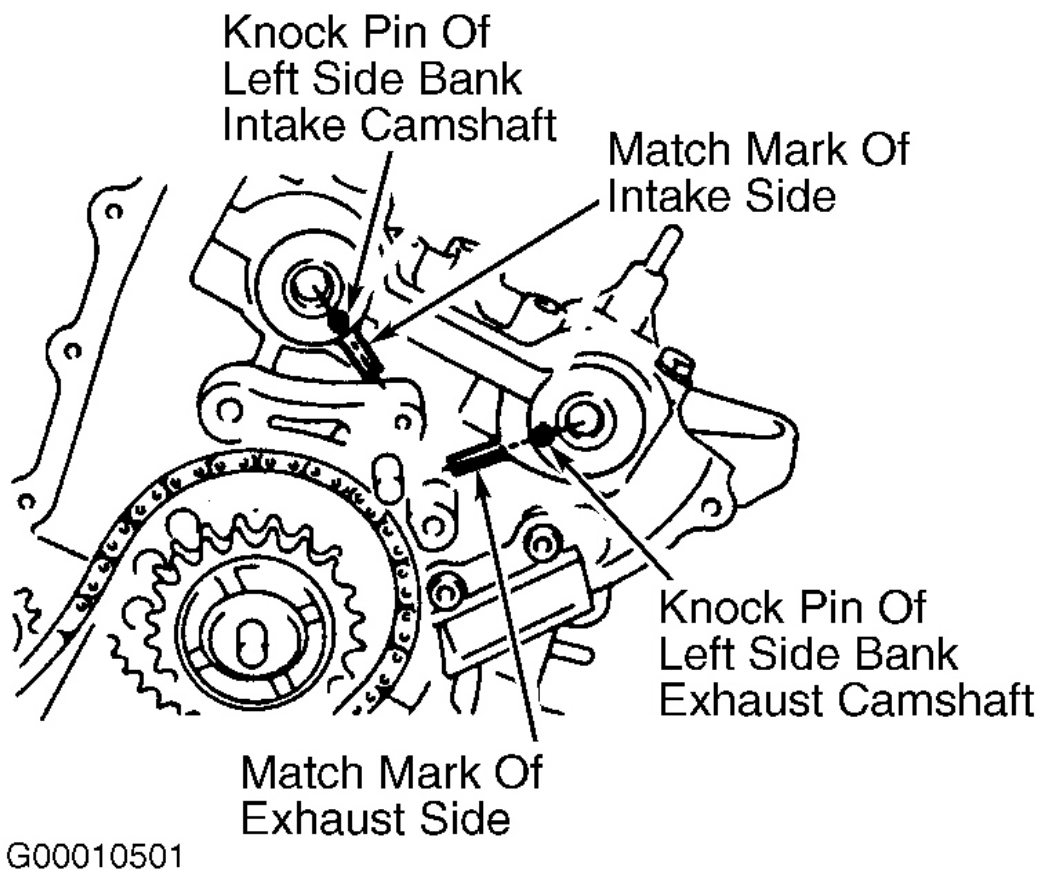
Inspect chain for wear or damage. Inspect sprocket teeth, and check guide and tensioner pads for wear or damage.

### Installation

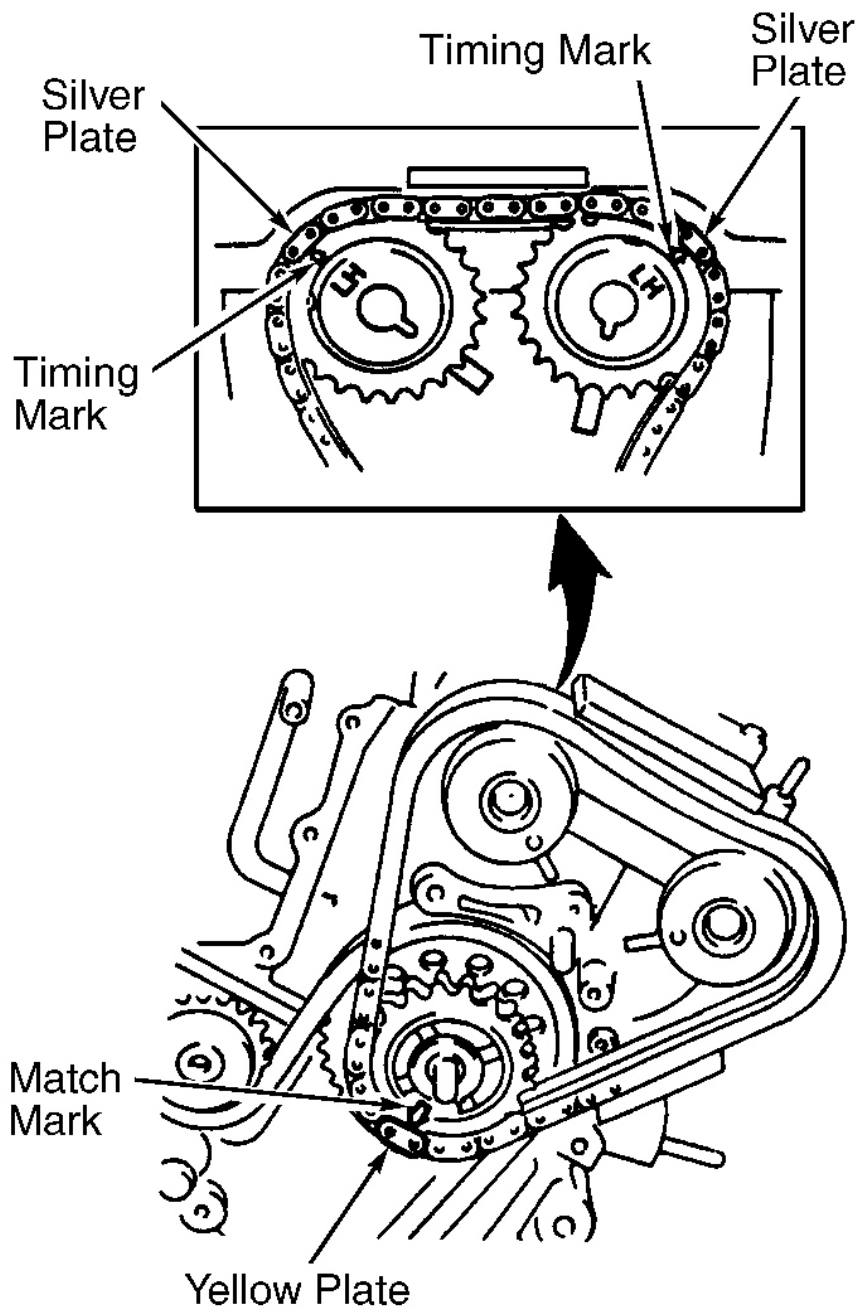
1. To install, ensure crankshaft sprocket and idler sprocket No. 2 match marks on block. See **Fig. 5**. Install timing chain guide No. 4. Ensure exhaust and intake camshaft knock pins are aligned with match marks on cylinder head. See **Fig. 7**. To install timing chain, align match marks on Yellow plate of left bank 2nd

timing chain and idler sprocket No. 2. See **Fig. 8**.

2. Install sprockets on intake and exhaust camshafts by aligning Silver plate of left bank 2nd timing chain. Match marks on intake sprocket and exhaust sprockets. See **Fig. 8**. Install intake and exhaust camshaft sprocket bolts. Place spanner on hexagonal part of camshaft to hold camshaft stationary. Tighten sprocket bolts to specification. See **TORQUE SPECIFICATIONS**.
3. Install timing chain guide No. 5. Push plunger of timing chain adjuster No. 3 into tensioner body. Install pin into set hole of tensioner. Install timing chain adjuster No. 3. Remove pin from tensioner set hole. Rotate crankshaft 2 rotations clockwise, then align timing mark on crankshaft and timing mark on cylinder block. Ensure all timing marks on sprockets align with match marks on block.



**Fig. 7: Aligning Left Bank Camshaft Knock Pins**  
Courtesy of SUZUKI OF AMERICA CORP.



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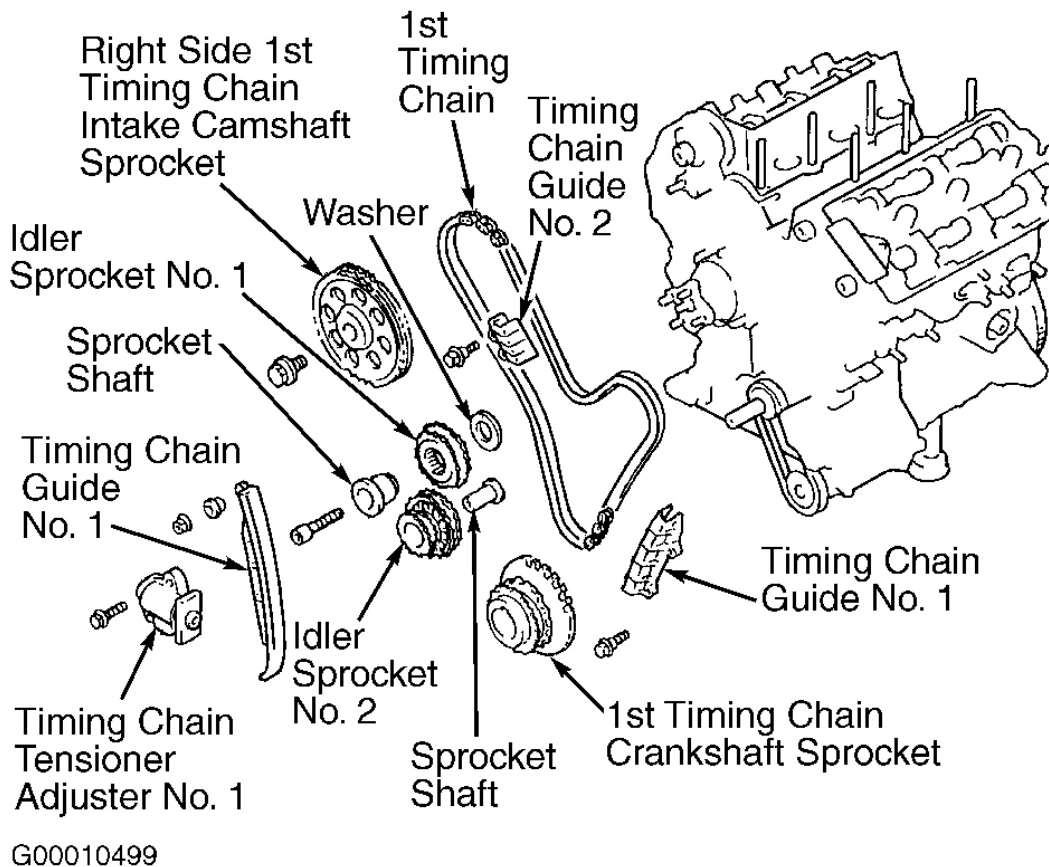
**Fig. 8: Locating Left Bank Camshaft Timing Chain Marks**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Coat timing chains, guide rail, sprockets and tensioner with clean engine oil. To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

## 1ST TIMING CHAIN & CHAIN TENSIONER

### Removal

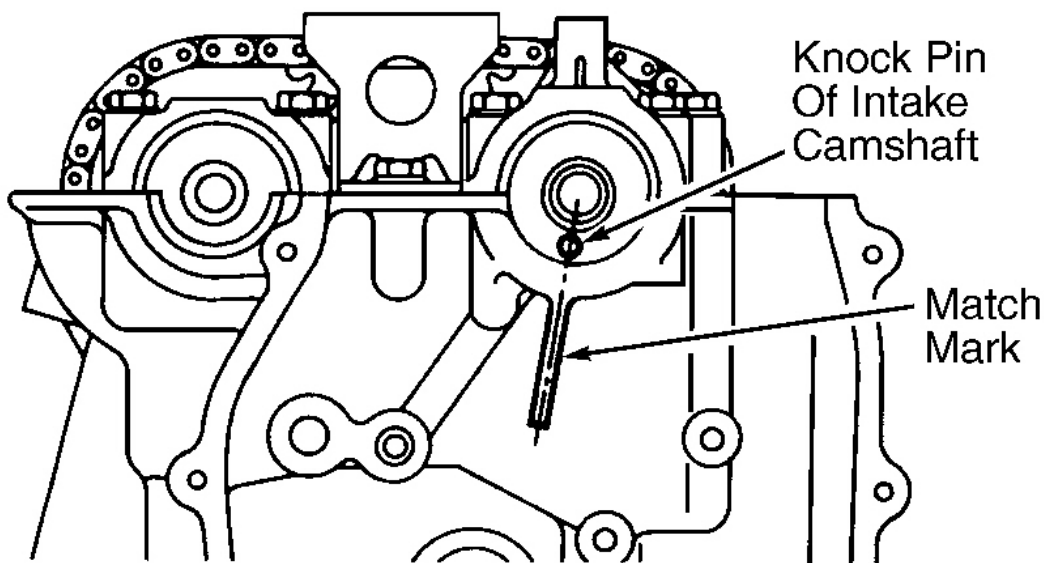
1. Disconnect negative battery cable. Drain engine oil and cooling system. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Align timing chain marks. See **Fig. 5**.
2. Remove left bank 2nd timing chain. See **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove timing chain guides No. 1 and No. 2. Remove timing chain tensioner adjuster No. 1. Remove idler sprocket No. 1 and 1st timing chain. Remove idler sprocket No. 2 and sprocket shaft. See **Fig. 9**.
3. Remove right bank 1st timing chain intake camshaft sprocket bolt. Hold camshaft stationary with spanner wrench at hexagonal part of camshaft. Remove right bank 1st timing chain intake camshaft sprocket. Remove 1st timing chain crankshaft sprocket.



**Fig. 9: Exploded View Of Right Bank Timing Chain Components**  
 Courtesy of SUZUKI OF AMERICA CORP.

### Installation

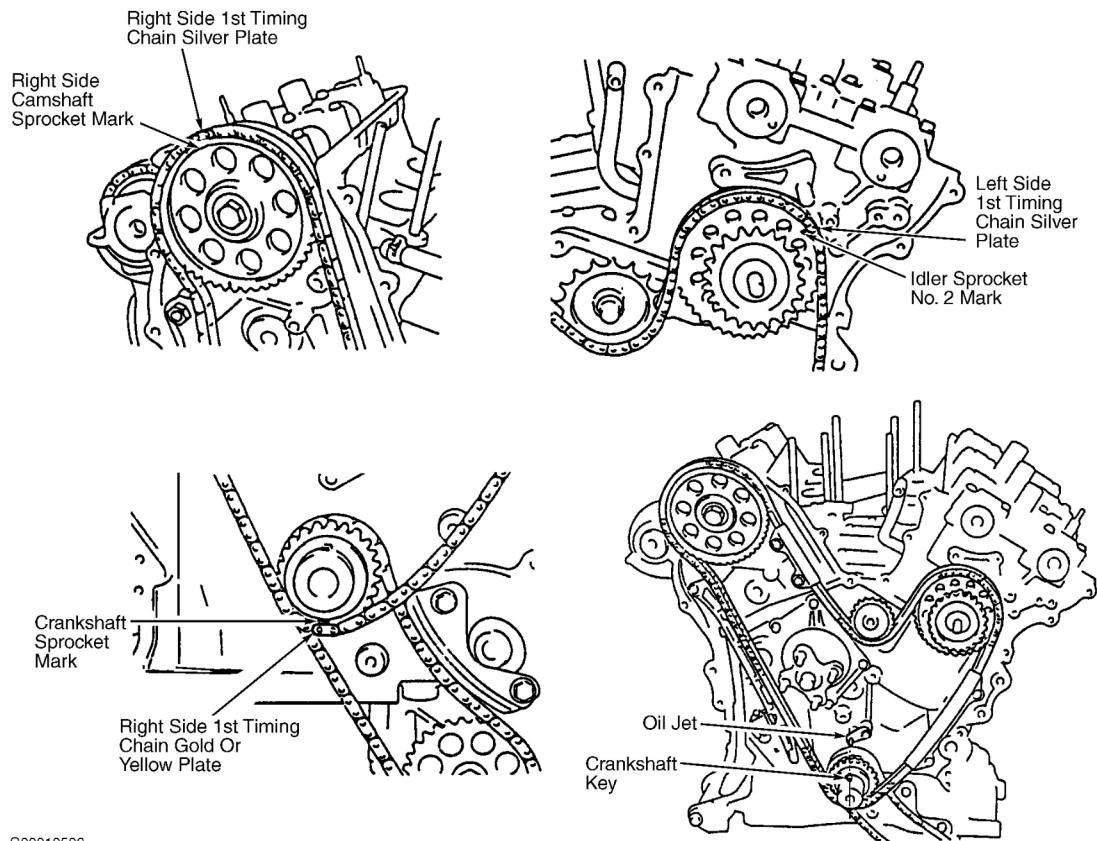
1. Install crankshaft sprocket. Ensure match mark on right bank intake camshaft aligns with mark on cylinder head. See **Fig. 10**. Install right bank 1st timing chain intake camshaft sprocket. Install timing chain tensioner. Install 1st timing chain. Ensure Silver plate on right 1st timing chain aligns with match marks on right bank 1st timing chain intake camshaft sprocket. See **Fig. 11**.
2. Install idler sprocket No.2 and sprocket shaft. Align Silver plate on left 1st timing chain with match marks on idler sprocket No.2. See **Fig. 11**.
3. Install 1st timing chain on crankshaft sprocket. Ensure Gold or Yellow plate of 1st timing chain aligns with mark on crankshaft sprocket. See **Fig. 11**.
4. Push plunger of tension adjuster No. 1 into tensioner body. Insert pin into tensioner set hole. Install timing chain tensioner adjuster No. 1. Remove pin from set hole. Install timing chain guides No. 1 and No. 2. Ensure sprocket and chain timing marks align. See **Fig. 11**.
5. Install left bank 2nd timing chain. See **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Coat timing chains, guide rail, sprockets and tensioner with clean engine oil. To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.



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**Fig. 10: Aligning Right Bank Intake Camshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.





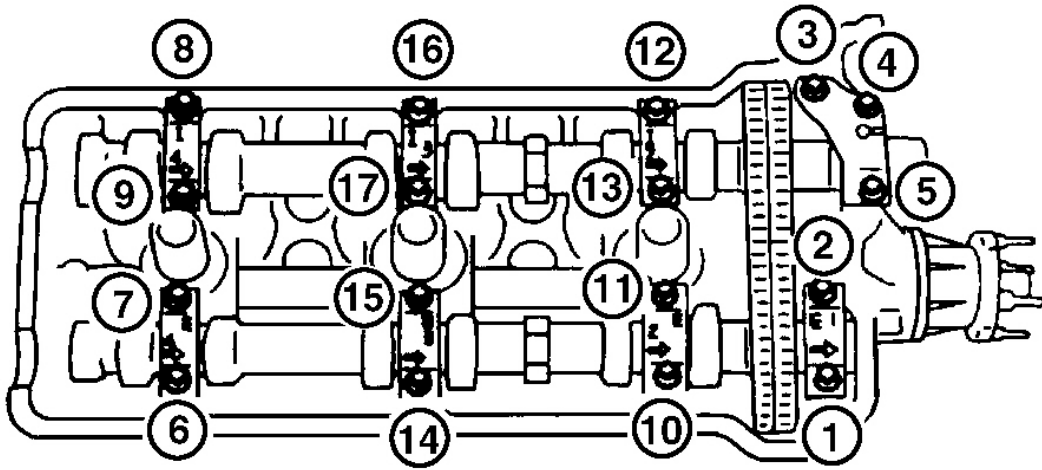
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**Fig. 11: Aligning Marks On Right 1st Timing Chain**  
 Courtesy of SUZUKI OF AMERICA CORP.

**RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**

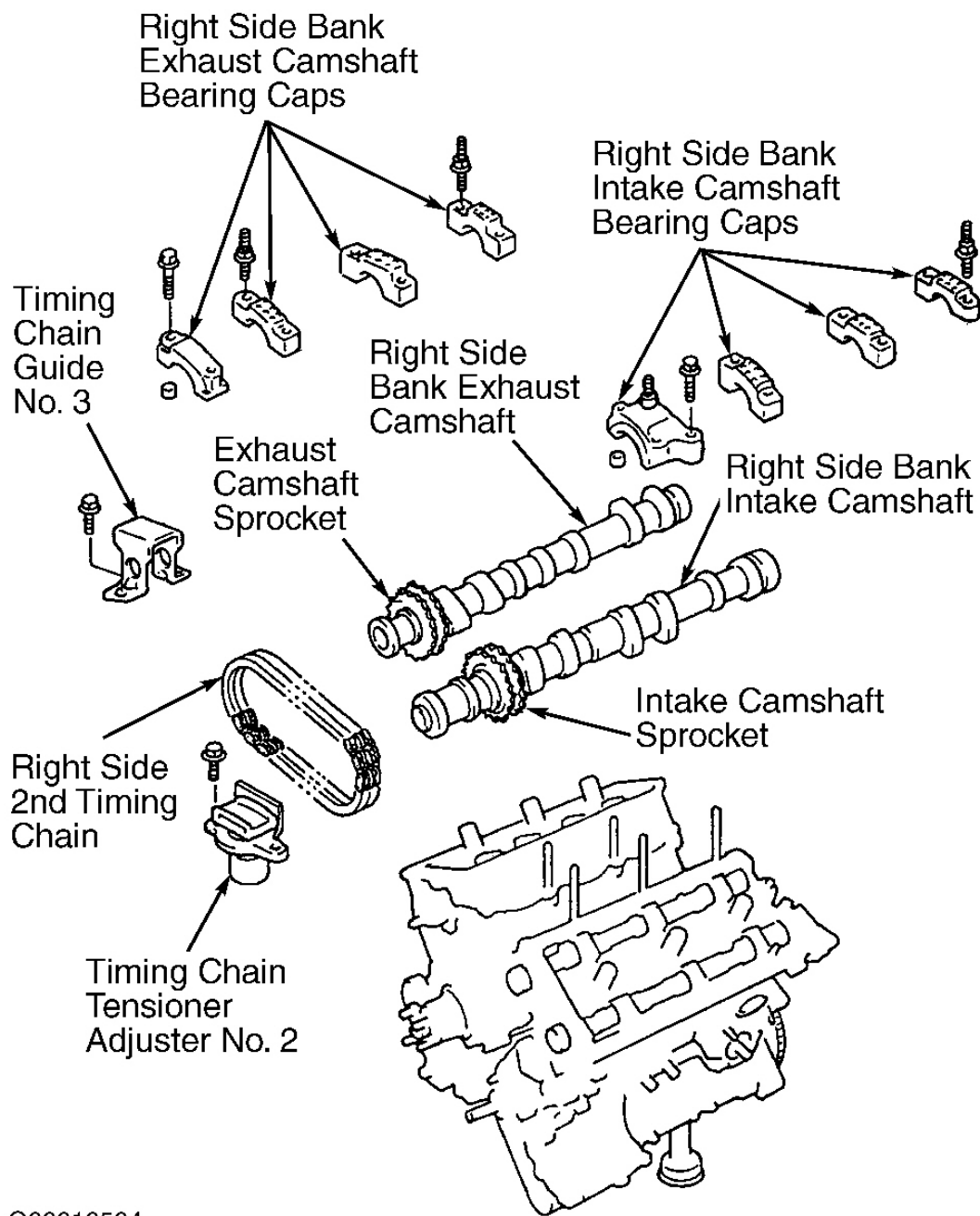
**Removal**

1. Remove left bank 2nd timing chain. See **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove 1st timing chain. See **1ST TIMING CHAIN & CHAIN TENSIONER**. Remove timing chain guide No.3.
2. Remove camshaft bearing cap bolts in sequence. See **Fig. 12**. Remove camshaft bearing caps. Remove right bank intake camshaft, exhaust camshaft and 2nd timing chain. Remove timing chain tensioner adjuster No. 2. See **Fig. 13**.



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**Fig. 12: Camshaft Bearing Cap Bolt Removal Sequence**  
Courtesy of SUZUKI OF AMERICA CORP.



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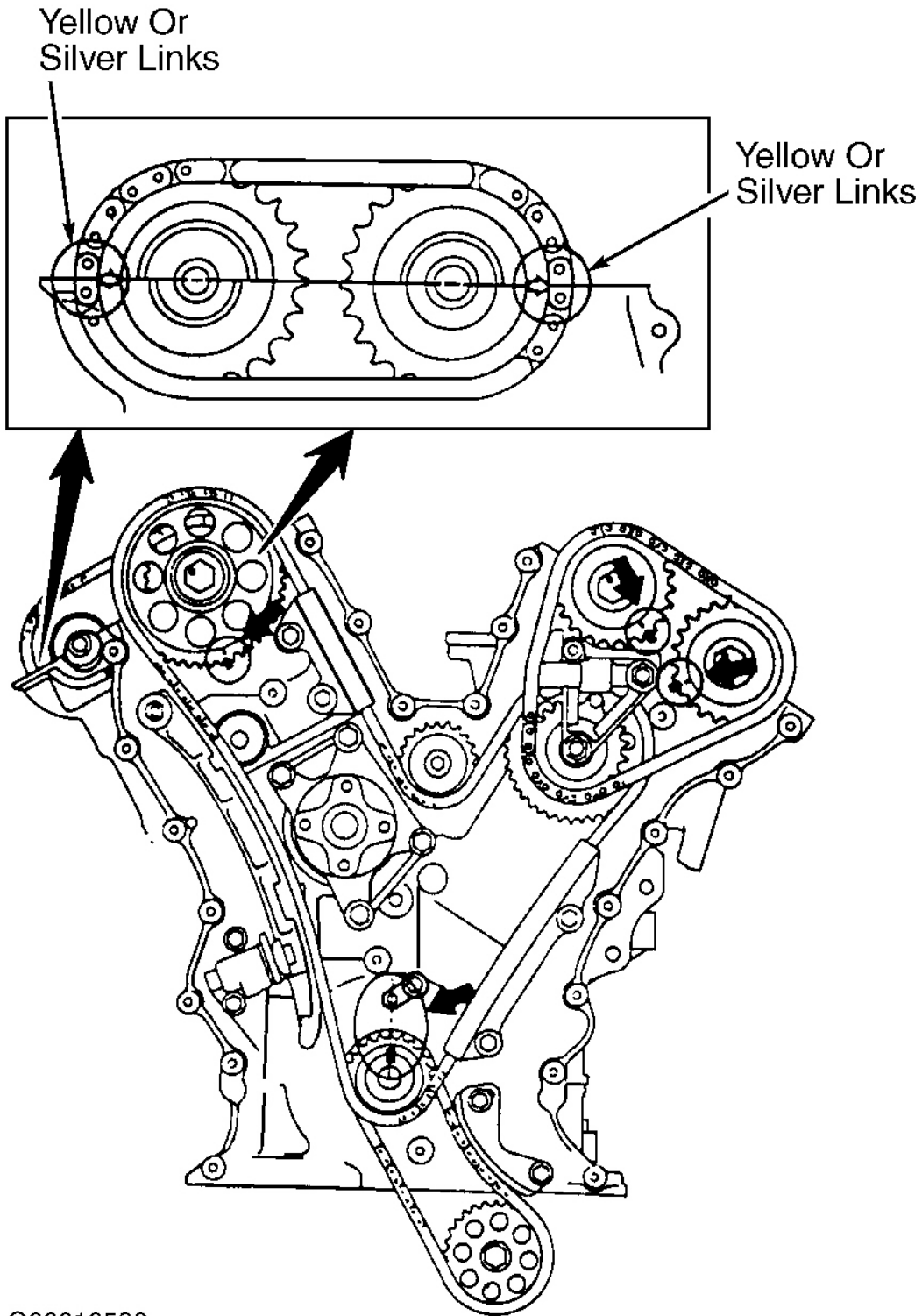
**Fig. 13: Exploded View Of Right Timing Chain & Camshafts**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Installation**

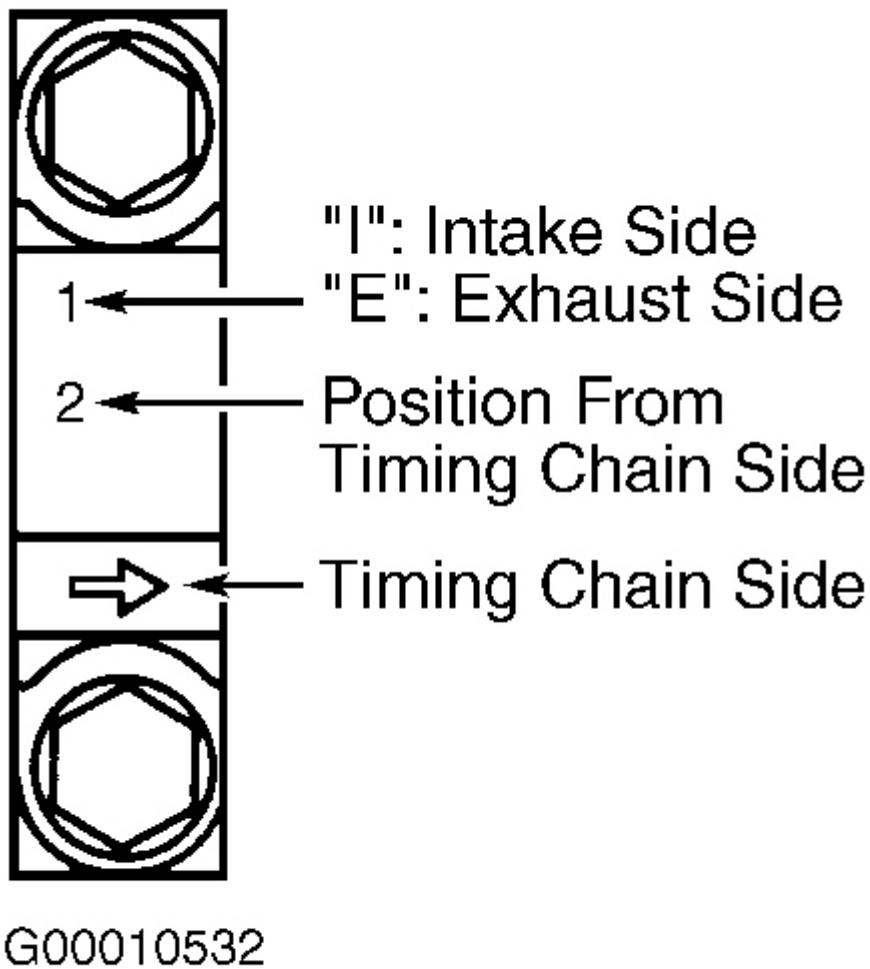
1. Align crankshaft timing mark. See **Fig. 5**. Install timing chain tensioner adjuster No. 2. Install right bank

intake and exhaust camshafts.

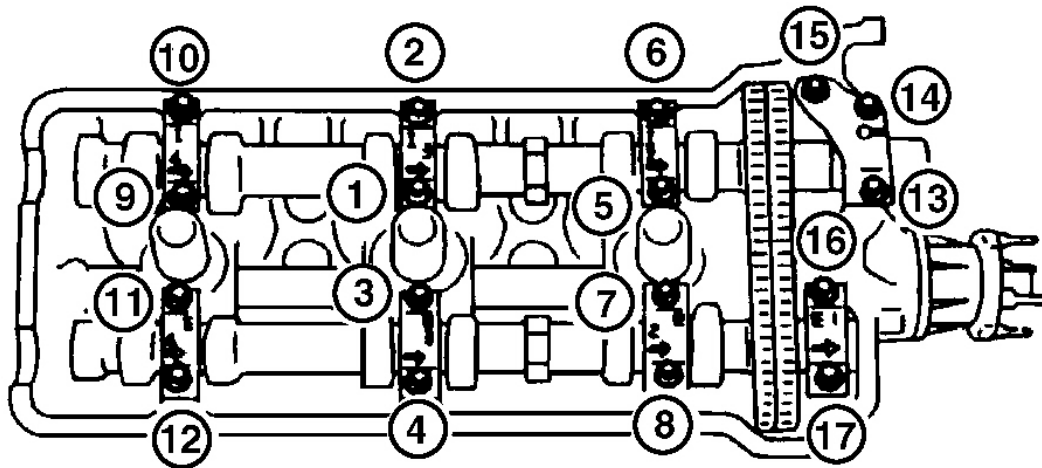
2. Install right 2nd timing chain. Ensure Yellow or Silver links of right bank 2nd timing chain aligns with match marks on right bank 2nd timing chain intake and exhaust camshaft sprockets. See **Fig. 14**.
3. Install camshaft bearing caps in proper direction. See **Fig. 15**. Tighten camshaft housing bolts in proper sequence. See **Fig. 16**. Tighten to specifications. See **TORQUE SPECIFICATIONS**.
4. Install timing chain guide No. 3. To complete installation, reverse removal procedure.



**Fig. 14: Aligning Right Bank Timing Chain & Camshaft Sprockets Marks**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 15: Installing Right Camshaft Bearing Caps**  
Courtesy of SUZUKI OF AMERICA CORP.



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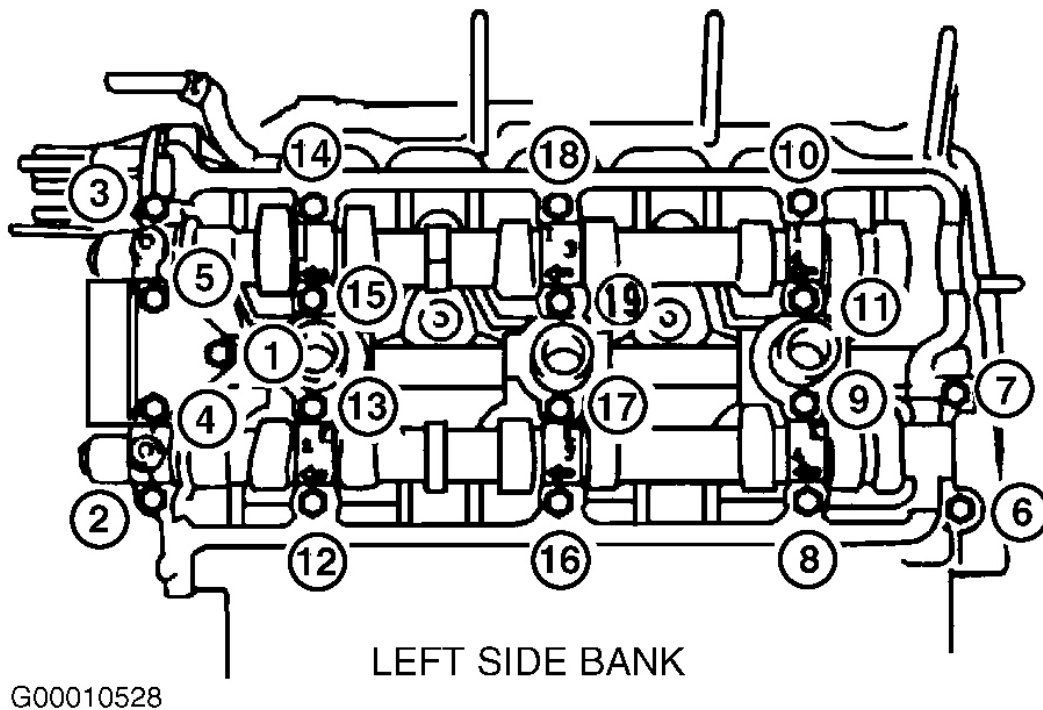
**Fig. 16: Right Camshaft Bearing Cap Tightening Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

## CAMSHAFT & VALVE LASH ADJUSTER

### Removal

1. Disconnect negative battery cable. Drain engine oil and coolant. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Remove left bank 2nd timing chain. See **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove right bank timing chain and camshafts. See **RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove right valve lash adjusters.
2. Remove camshaft position sensor. Remove left bank camshaft bearing cap bolts in sequence, using 2 or 3 steps. See **Fig. 17**. Remove left bank camshaft bearing caps. Remove left bank intake and exhaust camshafts. Remove valve lash adjusters.

**NOTE:** DO NOT disassemble hydraulic valve lash adjuster, or apply force to body.



**Fig. 17: Left Camshaft Bearing Cap Bolt Removal Sequence**  
Courtesy of SUZUKI OF AMERICA CORP.

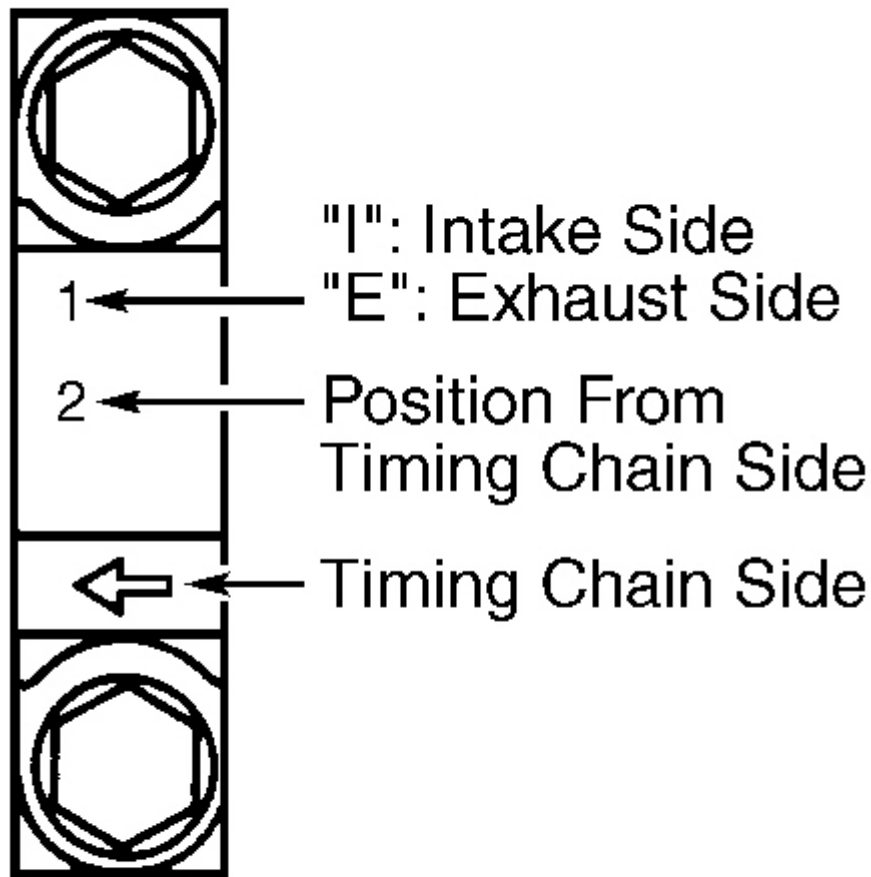
### Inspection

1. Check cam lobes and journals for wear and damage. Measure camshaft lobe height and journal diameter. If measurement exceeds specification, replace camshafts. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.
2. Using dial indicator and "V" blocks to measure camshaft runout at center of shaft. If wear exceeds specification, replace camshaft. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.
3. Inspect valve lash adjusters for damage, scratches or pitting. Measure valve lash adjuster diameter and adjuster-to-bore clearance in cylinder head. If measurements exceed specification, replace adjusters or cylinder head. See **VALVE LASH ADJUSTER** table under ENGINE SPECIFICATIONS.

### Installation

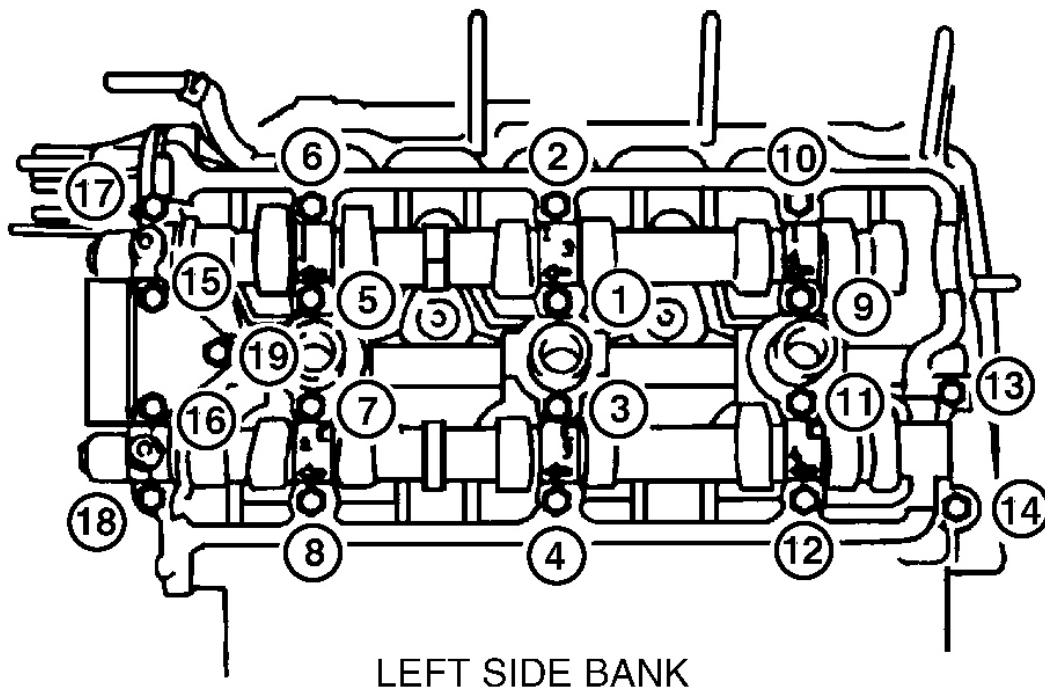
1. Apply engine oil to valve lash adjuster bore, journals and valve lash adjusters. Install valve lash adjuster in cylinder head bore. Rotate crankshaft and align crankshaft timing mark. See **Fig. 5**. Install right bank camshafts. See **RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**.
2. Install left bank camshafts. Align camshafts with match marks on cylinder head. See **Fig. 7**. Apply sealant to left exhaust camshaft bearing cap No. 5. Install camshaft bearing caps in proper direction. See **Fig. 18**. Tighten camshaft bearing cap bolts in sequence using several steps. See **Fig. 19**. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.





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**Fig. 18: Installing Left Camshaft Bearing Caps**  
Courtesy of SUZUKI OF AMERICA CORP.



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**Fig. 19: Left Camshaft Bearing Cap Tightening Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

## CRANKSHAFT REAR OIL SEAL

### Removal

Remove transmission from vehicle. For A/T, see appropriate TRANSMISSION REMOVAL & INSTALLATION article in TRANSMISSION SERVICING. For M/T, see appropriate article in CLUTCHES. Remove flywheel (M/T), or drive plate (A/T) from engine. Remove oil seal with suitable tool.

### Installation

Install oil seal using Special Tools (09911-97810 & 09911-97710). To complete installation, reverse removal procedure.

## THERMOSTAT

### Removal & Installation

Drain coolant and tighten drain plug. Remove fan shroud with cooling fan after disconnecting radiator inlet hose from radiator. Remove thermostat housing. Remove thermostat. When positioning thermostat on case, be sure to position so that air bleed valve comes at match mark and into recession of thermostat case. To install,

reverse removal procedure. Fill cooling system.

## **WATER PUMP**

### **Removal**

Disconnect negative battery cable. Drain engine oil and coolant. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Remove water pump assembly.

### **Installation**

Install NEW "O"rings into water pump. Install water pump to cylinder block. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure. Fill with coolant.

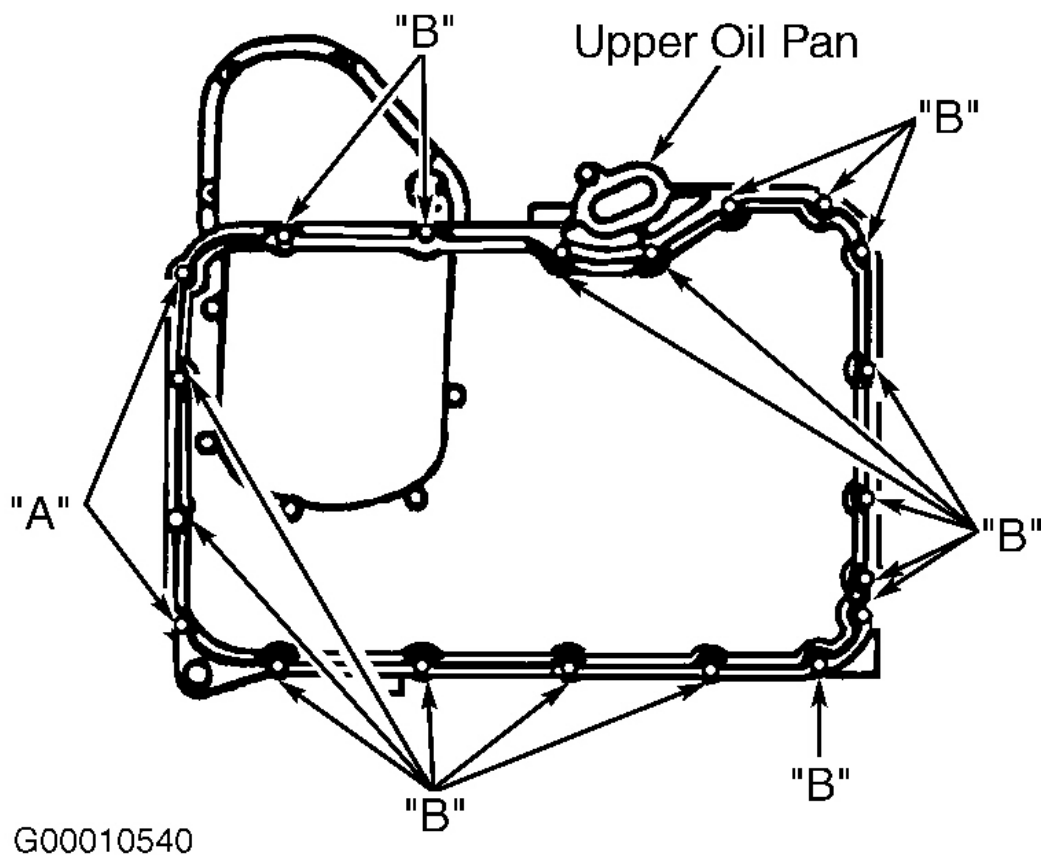
## **OIL PAN**

### **Removal**

1. Raise and support vehicle. Remove front wheels. Remove rack and pinion steering gear. See appropriate article in STEERING. Remove front differential housing with differential from chassis (if equipped). See appropriate DIFFERENTIALS article in DRIVE AXLES.
2. Drain engine oil. Remove lower oil pan bolts and separate lower oil pan from upper oil pan. Remove oil strainer bracket. Disconnect radiator outlet pipe from upper oil pan.
3. Remove bolts from upper oil pan. Rest oil pan on crossmember. Remove oil strainer bolts and oil strainer. Remove upper oil pan.

### **Installation**

1. Install NEW "O"rings to lower crankcase and oil pump strainer. Place upper oil pan on crossmember. Install oil pump strainer. Install upper oil pan to lower crankcase. See **Fig. 20**. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.
2. To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.



**Fig. 20: Installing Upper Oil Pan**  
 Courtesy of SUZUKI OF AMERICA CORP.

## OVERHAUL

### CYLINDER HEAD

#### Disassembly

1. Remove cylinder heads. See **CYLINDER HEAD** under REMOVAL & INSTALLATION. Remove camshaft and valve lash adjusters. See **CAMSHAFT & VALVE LASH ADJUSTER** under REMOVAL & INSTALLATION.
2. Using Valve Spring Compressor (09916-14510) and Adapters (09916-14910 & 09919-28610), compress valve springs. Using Valve Spring Retainer Remover (09916-84511) remove retainer locks. Remove valve spring retainers, springs, valve stem oil seals, spring seats and valves. Keep all components in order for reassembly reference.

#### Inspection

1. Check cylinder head for damage or water leakage. Check for cracks in combustion chamber, intake and exhaust ports. Measure cylinder head warpage. If warpage exceeds limit, resurface or replace cylinder head. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.
2. Measure intake and exhaust manifold seating surfaces. If warpage exceeds .004" (.10 mm) resurface or replace cylinder head.

### Reassembly

To reassemble, reverse disassembly procedure, using NEW oil seals. Ensure valve springs are installed with close coiled (small pitch) end facing valve spring seat.

### Valve Springs

Check valve springs for damage. Using a square and flat surface plate to check spring squareness. Using valve spring tester, check valve spring pre-load pressure. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS. Replace any weak or out-of-square springs.

### Valve Stem Oil Seals

**NOTE: DO NOT reuse old valve stem oil seals.**

Place new lubricated stem seal on valve guide Use Valve Stem Seal Installer Set (09917-98221 & 09916-58210). Press oil seal onto valve guide using hand pressure only. When installer bottoms on head, seal is properly positioned. DO NOT twist seals during installation.

### Valve Guides

1. Check valve guide-to-stem clearance. If clearance exceeds specification, replace guide with oversize guide. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.
2. Using Valve Guide Remover (09916-44910), drive out old guide toward valve spring side of head. Ream guide bore in cylinder head with 11-mm Reamer (09916-38210 or 09916-56011). Uniformly heat cylinder head to 176-212°F (80-100°C).
3. Using Valve Guide Installer Set (09916-58210 & 09917-87810, or 09916-56011 & 09916-58210), drive in new oversize valve guide until valve guide installer contacts cylinder head.
4. Valve guide installed height is .53" (13.5 mm). Ream valve guide with 6-mm Reamer (09916-37810).
5. Clean valve guide bore after reaming. Install valve and ensure valve stem oil clearance is correct. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Install new valve stem oil seals. See **VALVE STEM OIL SEALS**.

### Valve Seat

Inspect valve seats for damage, pitting or incorrect seat contact width. If valve seat rework is necessary, use seat cutters to obtain required seat angles. On intake valves, first cut should be 15 degrees. Second cut should be 45 degrees. On exhaust valve, first cut should be 15 degrees. Second cut should be 60 degrees. Third cut should be 45 degrees. After cutting valve seats to correct angles, lap valve seat.

## Valves

Remove carbon deposits. Inspect for wear, burns or distortion at face and stem. Replace as necessary. Measure valve head margin. Check valve stem end for pitting or wear. Valve may be reused if chamfer is still visible after resurfacing.

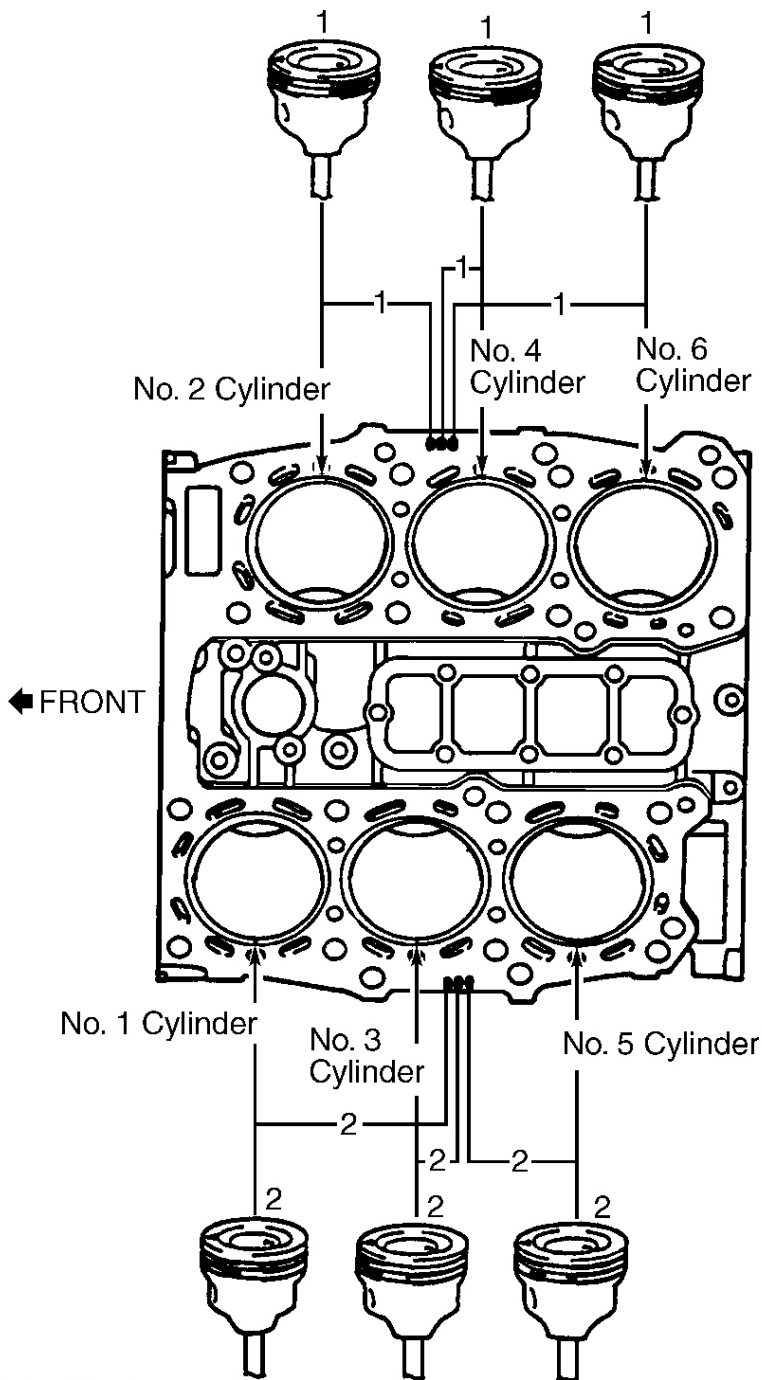
## CYLINDER BLOCK ASSEMBLY

### Piston & Rod Assembly

1. Remove cylinder heads. See **CYLINDER HEAD** under REMOVAL & INSTALLATION. Ensure pistons, connecting rods and rod caps are marked for reassembly reference. Remove carbon from top of cylinder bores. Remove connecting rod cap bolts and rod caps. Install protective hose over connecting rod bolts. Remove piston and connecting rod assembly through top of cylinder block. Mark cylinder number on piston crown. Remove rings from piston.
2. Using suitable tool, remove piston pin circlip, and push piston pin out. Check piston pin-to-bore fit. Pin should press in piston smoothly by hand at room temperature. Measure diameters of piston, piston pin and pin bore. **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.
3. When assembling, apply engine oil to outside of pin and to piston pin bore. Install piston pin circlip to one end of piston. Insert pin from other side of piston through rod small end until it contacts circlip. Install remaining circlip into piston. Position circlips with opening parallel to piston top and facing oil hole in connecting rod.

### Fitting Pistons

1. Check cylinder bore for damage, wear and taper. See **CYLINDER BLOCK ASSEMBLY**. Determine if block must be rebored. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS. Rebore if necessary.
2. Check outside diameter of piston. Measure at a point 1.04" (26.5 mm) from piston skirt end, in direction perpendicular to piston pin. Standard pistons are available in 2 sizes. Piston diameter is determined by numerical mark ("1" or "2") stamped on piston crown. See **Fig. 21**. Number represents outer diameter of piston. See **PISTON & CYLINDER DIAMETERS** table.
3. Cylinder bore diameter is determined by a number on cylinder block head surface. See **Fig. 21**. Stamped numbers on block should correspond to stamped numbers on piston crown. See **PISTON & CYLINDER DIAMETERS** table.



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**Fig. 21: Locating Stamped Numbers On Cylinder Block & Pistons**  
 Courtesy of SUZUKI OF AMERICA CORP.

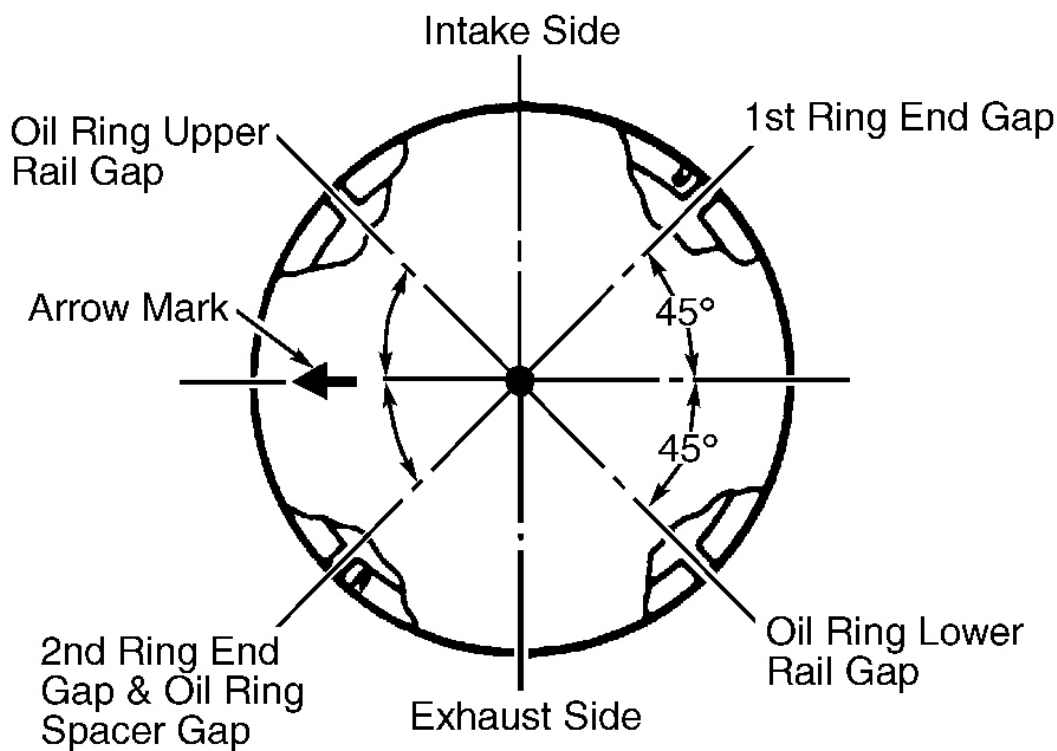
**PISTON & CYLINDER DIAMETERS**

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Piston Number At Top	Piston Outer Diameter - In. (mm)	Cylinder Block Number	Piston Bore Diameter - In. (mm)
1	3.3063-3.3066 (83.980-83.988)	1	3.3075-3.3078 (84.011-84.018)
2	3.3059-3.3062 (83.970-83.977)	2	3.3071-3.3074 (84.000-84.008)

**Piston Rings**

Ensure piston ring end gap and side clearance are within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS. Install rings with "R" or "RN" mark facing upward. Install oil ring spacer first, then rails. Position piston ring gaps in proper areas and with identification mark on piston ring toward top of piston. See **Fig. 22**.



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**Fig. 22: Positioning Piston Rings**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Rod Bearings**



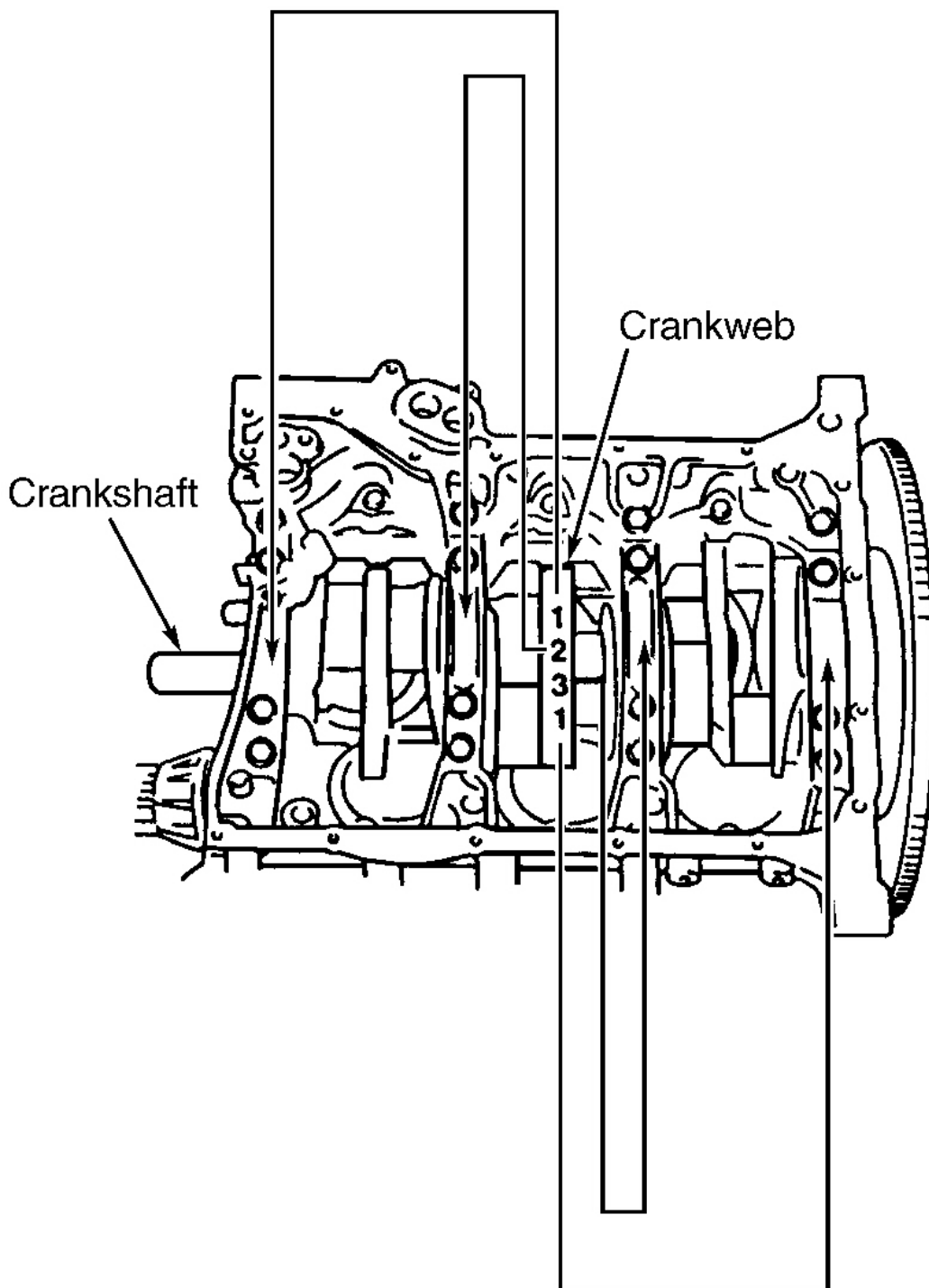
1. Inspect journals for wear, taper and out-of-round. If specifications are exceeded, grind journals to undersize, or replace crankshaft. Inspect rod bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Rod bearings are available in 2 sizes. See **ROD BEARING APPLICATION** table.
2. Check bearing clearance using Plastigage. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS. If clearance exceeds limit, install NEW standard bearing and measure clearance. If clearance still exceeds limit, use undersize bearing. Undersize bearing is identified by Red paint on bearing side and has thickness of .0632-.0635" (1.605-1.613 mm). Regrind crank pins to finished diameter. See **ROD BEARING APPLICATION** table.

### ROD BEARING APPLICATION

Connecting Rod Bearing Size	Crank Pin Diameter - In. (mm)
Standard	1.9678-1.9685 (49.982-49.999)
Undersize .0098" (.025 mm)	1.9580-1.9586 (49.733-49.748)

### Crankshaft & Main Bearings

1. Remove engine. See **ENGINE** under REMOVAL & INSTALLATION. Remove timing chain cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Remove No. 1 and No. 2 timing chains and chain tensioners. See **RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER** and **LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER**. Remove camshaft position sensor. Remove camshaft and valve lash adjuster. See **CAMSHAFT AND VALVE LASH ADJUSTER**. Remove exhaust manifold. See **EXHAUST MANIFOLD**. Remove flywheel and oil pan. Remove rear main oil seal. Remove connecting rod caps. Remove main bearing bolts. Remove lower crankcase. Remove crankshaft.
2. Inspect journals for wear, taper and out-of-round. If specifications are exceeded, grind journals to undersize or replace crankshaft. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS. Inspect bearings for pitting, scratches, wear and damage.
3. Main bearing journal diameter is determined by numerical mark ("1", "2" or "3") stamped on crank web. See **Fig. 23**. See **MAIN BEARING JOURNAL DIAMETER** table.
4. Bearing cap bore diameter is determined by letters stamped on lower crankcase. See **Fig. 24**. Letter represents bearing cap bore diameter. See **LOWER CRANKCASE BEARING CAP BORE DIAMETER** table.
5. Standard main bearings are color-coded. See **Fig. 25**. Color indicates thickness of bearing. See **COLOR CODE FOR STANDARD BEARING** table. Five standard main bearings are available.
6. From number stamped on crank web No. 2 and letters stamped on lower crankcase, determine new standard bearing to be installed to journal. See **STANDARD BEARING APPLICATION** table.

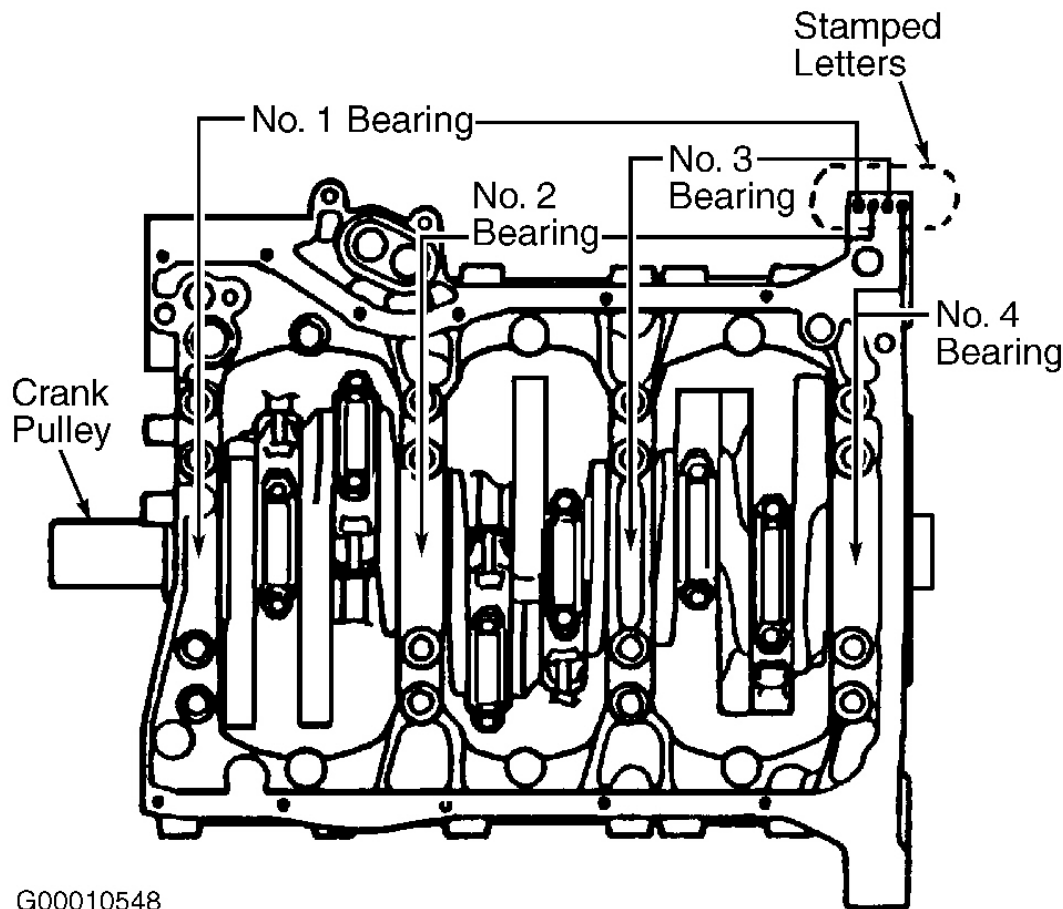


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**Fig. 23: Locating Main Bearing Marks**  
Courtesy of SUZUKI OF AMERICA CORP.

**MAIN BEARING JOURNAL DIAMETER**

Stamped Numbers	Journal Diameter - In. (mm)
"1"	2.5588-2.5590 (64.994-64.999)
"2"	2.5586-2.5588 (64.988-64.994)
"3"	2.5583-2.5586 (64.981-64.988)



**Fig. 24: Locating Lower Crankcase Diameter Marks**  
 Courtesy of SUZUKI OF AMERICA CORP.

**LOWER CRANKCASE BEARING CAP BORE DIAMETER**

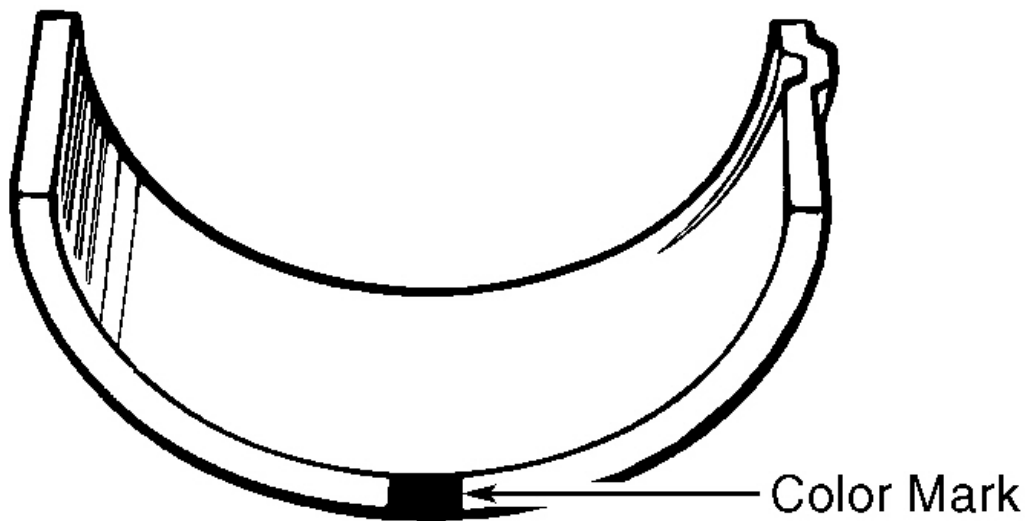
Stamped Letter	Diameter (Without Bearing) - In. (mm)
"A"	2.7559-2.7561 (69.999-70.005)
"B"	2.7561-2.7563 (70.005-70.010)
"C"	2.7563-2.7566 (70.010-70.018)

**COLOR CODE FOR STANDARD BEARING**

Paint Color	Bearing Thickness - In. (mm)
Green	.0982-.0983 (2.494-2.497)
Black	.0983-.0984 (2.497-2.499)
Colorless (No Paint)	.0984-.0985 (2.499-2.502)
Yellow	.0985-.0986 (2.502-2.504)
Blue	.0986-.0987 (2.504-2.507)

**STANDARD BEARING APPLICATION**

Letter Stamped On Lower Crankcase	Number 1 Stamped On Crank Web	Number 2 Stamped On Crank Web	Number 3 Stamped On Crank Web
A	Green	Black	Colorless
B	Black	Colorless	Yellow
C	Colorless	Yellow	Blue



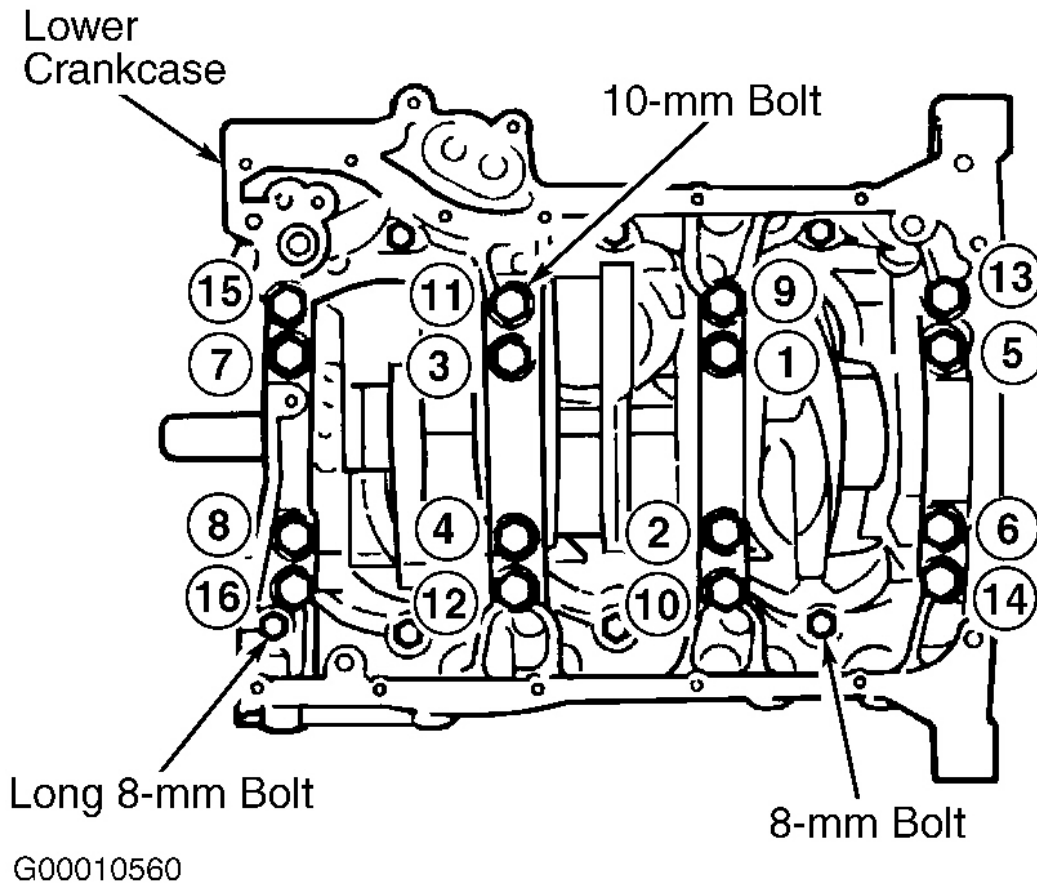
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**Fig. 25: Identifying Standard & Undersize Bearing Color Marks**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Installation**

Fit main bearings to cylinder block. Main bearing with oil groove goes toward block. Install "O" ring in

cylinder block. Install thrust bearings between No.2 and No.3 cylinders. Install crankshaft in cylinder block. Install lower crankcase to cylinder block. Coat crankcase bolts with oil. Tighten 10 mm bolts to specification in sequence, then tighten 8 mm bolts to specification in sequence. See **Fig. 26**. See **TORQUE SPECIFICATIONS**.



**Fig. 26: Lower Crankcase Bolts Tightening Sequence**  
Courtesy of SUZUKI OF AMERICA CORP.

#### Undersize Bearings

1. Bearings are available in .010" (.25 mm) undersize. Undersize bearing thickness is determined by color marks on bearing shell. See **Fig. 25** Five bearing sizes are available. See **COLOR CODE FOR UNDERSIZE BEARING** table.
2. Regrind crankshaft journal to finished diameters 2.5485-2.5492" (64.732-64.750 mm). Use journal finished diameter and letters stamped on lower crankcase, select undersize bearing. See **UNDERSIZE JOURNAL BEARING APPLICATION** table.
3. Install crankshaft. See **CRANKSHAFT & MAIN BEARINGS** under CYLINDER BLOCK

## ASSEMBLY.

**COLOR CODE FOR UNDERSIZE BEARINGS**

Paint Color	Bearing Thickness - In. (mm)
Green & Red	.1031-.1032 (2.619-2.621)
Black & Red	.1032-.1033 (2.621-2.624)
Red Only	.1033-.1034 (2.624-2.626)
Yellow & Red	.1034-.1035 (2.626-2.629)
Blue & Red	.1035-.1036 (2.629-2.631)

**UNDERSIZE JOURNAL BEARING APPLICATION**

Letters Stamped On Lower Crankcase	2.5489-2.5492 (64.742-64.750) Diameter Bearing Color	2.5487-2.5489 (64.737-64.742) Diameter Bearing Color	2.5485-2.5487 (64.732-64.737) Diameter Bearing Color
A	Green & Black	Black & Red	Red
B	Black & Red	Red	Yellow & Red
C	Red	Yellow & Red	Blue & Red

**Thrust Bearing**

1. With lower crankcase installed, check thrust clearance (end play) using dial indicator to measure thrust clearance in axial direction.
2. Standard thickness of thrust bearing is .0984" (2.50 mm). If clearance exceeds specification, replace thrust bearing with new standard one or oversize one to obtain standard thrust clearance. Thickness of oversize thrust bearing is .1009" (2.563 mm).

**Cylinder Block**

1. Inspect block for distortion of deck surface. Inspect block for cracks, scratches and other defects. Measure cylinder bores at 3 separate levels for wear, taper and out-of-round condition.
2. If bore wear, taper or out-of-round exceeds specification, rebore cylinders. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.

**ENGINE OILING****ENGINE LUBRICATION SYSTEM**

Oil pump is a trochoid type mounted under crankshaft. Force feed type lubrication system is used.

**Crankcase Capacity**

Oil crankcase capacity with oil filter change is 5.8 qts. (5.5L) with filter.

**Oil Pressure**

Oil pressure is 55-67 psi (3.9-4.7 kg/cm<sup>2</sup>) @ 4000 RPM.

## OIL PUMP

### Removal & Disassembly

Disconnect negative battery cable. Drain engine oil and coolant. Remove oil pan, oil pump strainer and timing chain cover. See **OIL PUMP** under REMOVAL & INSTALLATION. Loosen oil pump chain guide bolts. Remove oil pump from crankcase.

**NOTE: DO NOT remove oil pump sprocket or bolt.**

### Inspection

1. Disassemble oil pump. Inspect outer rotor, inner rotor and oil pump case for wear and damage. Using straightedge and feeler gauge, measure rotor end clearance. Check side clearance between rotor tooth and housing.
2. Check clearance between pressure regulator valve and bore. Measure free length and tension of oil relief spring. Replace components or entire assembly if not within specification. See **OIL PUMP SPECIFICATIONS** table.

## OIL PUMP SPECIFICATIONS

Application	Specification
Rotor	
Radial Clearance	.0059 (.150)
Side Clearance	.0043 (.109)
Relief Spring	
Free Length	2.5 (63.5)
Spring Preload	19 lbs. @ 2.05" (8.6 kg. @ 52.07 mm)

### Reassembly & Installation

Lubricate oil pump parts. Ensure pump rotors are assembled in same direction as originally installed. Install relief valve, spring and retainer. Check for smooth rotation of oil pump. Install oil pump to lower crankcase. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. To complete installation, install remaining parts in reverse order of removal.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS

Application	Lbs. (N.m)
Camshaft Sprocket Bolt	58 (79)
Connecting Rod Nuts	33 (45)
Crankshaft Pulley Bolt	109 (148)

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Cylinder Head Bolt <sup>(1)</sup>	
Step 1	39 (53)
Step 2	61 (83)
Step 3	Loosen All Bolts
Step 4	39 (53)
Step 5	76 (103)
Drive Plate (A/T) Bolt	51 (69)
Engine-To-Transmission Bolt	62 (84)
Exhaust Manifold Bolt	22 (30)
Exhaust Pipe Bolt	37 (50)
Flywheel (M/T) Bolt	51 (69)
Idler Sprocket No.1 Bolt	33 (45)
Intake Manifold Bolt	17 (23)
Lower Crankcase Bolts <sup>(2)</sup>	
8 mm	20 (27)
10 mm	44 (60)
Oil Drain Plug	26 (35)
Oil Pressure Switch	10 (14)
Oil Pump-To-Block Bolt	20 (27)
Timing Chain Tensioner No.3	
Bolt	18 (24)
Nuts	33 (45)
Torque Convertor Bolts	47 (64)
Universal Joint Flange Bolts	40 (54)
Upper Oil Pan Bolts <sup>(3)</sup>	
"A"	20 (27)
"B"	(4)
Water Pump Bolts	19.5 (27)
<b>INCH Lbs. (N.m)</b>	
Camshaft Housing Bolts <sup>(5)</sup>	106 (12)
Lower Oil Pan-To-Upper Oil Pan Bolts	97 (11)
Oil Pump Body Bolts	106 (12)
Oil Pump Chain Guide Bolts	97 (11)
Oil Pump Strainer Bolts	97 (11)
Throttle Body Bolts & Nuts	106 (12)
Timing Chain Cover Bolts	97 (11)
Timing Chain Guide Bolts	
No. 1 & No. 2	80 (9)
No. 3 & No. 4	97 (11)
Timing Chain Tensioner Adjuster Bolt	



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No. 1 & No. 2	97 (11)
Valve Cover Bolts	97 (11)
<p>(1) Tighten bolts to specification in sequence. See <b>Fig. 3</b>.</p> <p>(2) Tighten bolts to specification in sequence. See <b>Fig. 26</b>.</p> <p>(3) See <b>Fig. 20</b>.</p> <p>(4) Tighten bolts to 97 INCH lbs (11 Nm)</p> <p>(5) Tighten bolts to specification in reverse order of removal sequence. See <b>Fig. 12</b>.</p>	

## ENGINE SPECIFICATIONS

### GENERAL SPECIFICATIONS

#### GENERAL SPECIFICATIONS

Application	Specification
Displacement	153 Cu.In. (2.5L)
Bore	3.3071" (84 mm)
Stroke	(1)
Compression Ratio	(1)
Fuel System	SFI
(1) Information not available from manufacturer	

### CRANKSHAFT, MAIN BEARINGS & CONNECTING ROD BEARINGS SPECIFICATIONS

#### CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
<b>Crankshaft</b>	
End Play	
Standard	.0044-.0122 (.112-.310)
Limit	.0149 (.378)
Runout (Center Journal)	.0004 (.010)
<b>Thrust Bearing</b>	
Standard	.0984 (2.500)
Oversize	.1009 (2.563)
<b>Main Bearings</b>	
Journal Diameter	
Size Mark "1"	2.5588-2.5590 (64.994-65.999)
Size Mark "2"	2.5586-2.5588 (64.988-64.994)

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Size Mark "3"	2.5583-2.5586 (64.981-64.988)
Journal Out-Of-Round	.0004 (.010)
Journal Taper	.0004 (.010)
Oil Clearance	
Standard	.0010-.0018 (.025-.046)
Limit	.0023 (.058)
Bearing Cap Bore Diameter	
"A"	2.7559-2.7561 (69.999-70.005)
"B"	2.7561-2.7563 (70.005-70.010)
"C"	2.7563-2.7566 (70.010-70.018)
Connecting Rod Bearings	
Journal Diameter	
Standard	1.9678-1.9685 (49.982-49.999)
Undersize	1.9580-1.9586 (49.733-49.748)
Journal Out-Of-Round	.0004 (.010)
Journal Taper	.0004 (.010)
Oil Clearance	
Standard	.0018-.0025 (.046-.064)
Limit	.0031 (.079)

**CONNECTING RODS SPECIFICATIONS****CONNECTING RODS**

<b>Application</b>	<b>In. (mm)</b>
Bore Diameter	
Pin Bore	.8269-.8272 (21.003-21.011)
Maximum Bend	.0020 (.050)
Maximum Twist	.0039 (.099)
Side Play	
Standard	.0099-.0157 (.251-.399)
Limit	.0177 (.450)

**PISTONS, PISTON PINS & PISTON RINGS SPECIFICATIONS****PISTONS, PINS & RINGS**

<b>Application</b>	<b>In. (mm)</b>
Pistons	
Clearance	.0008-.0015 (.020-.038)
Diameter	3.3059-3.3067 (83.970-83.990)

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Pins	
Diameter	.8266-.8268 (20.996-21.001)
Piston Fit	Slip
Rod Fit	Slip
Rings	
No. 1	
End Gap	
Standard	.0079-.0137 (.201-.348)
Limit	.0276 (.701)
Side Clearance	.0012-.0027 (.030-.069)
No. 2	
End Gap	
Standard	.0138-.0196 (.351-.498)
Limit	.0276 (.701)
Side Clearance	.0008-.0023 (.020-.058)
No. 3 (Oil)	
End Gap	
Standard	.0079-.0275 (.201-.699)
Limit	.0709 (1.801)

**CYLINDER BLOCK SPECIFICATIONS****CYLINDER BLOCK**

Application	In. (mm)
Cylinder Bore Diameter <sup>(1)</sup>	
Size Mark "1"	3.3075-3.3078 (84.011-84.018)
Size Mark "2"	3.3071-3.3074 (84.000-84.008)
Maximum Limit	3.3090 (84.049)
Maximum Taper	.004 (.10)
Maximum Out-Of-Round	.004 (.10)
Maximum Deck Warpage	.0024 (.061)
(1) Cylinder bore diameter determined by number stamped on block head surface.	

**ENGINE VALVES & VALVE SPRINGS SPECIFICATIONS****VALVES & VALVE SPRINGS**

Application	In. (mm)
Intake Valves	
Face Angle	45 Degrees

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Head Thickness	
Standard	.039 (.99)
Limit	.023 (.58)
Face Width	.0433-.0512 (1.099-1.300)
Stem Diameter	.2348-.2354 (5.964-5.979)
Exhaust Valves	
Face Angle	45 Degrees
Head Thickness	
Standard	.047 (1.19)
Limit	.027 (.69)
Face Width	.0433-.0512 (1.099-1.300)
Stem Diameter	.2339-.2344 (5.941-5.954)
Valve Springs	
Free Length	
Inner	1.4204 (36.078)
Limit	1.3780 (35.001)
Outer	1.5921 (40.439)
Limit	1.5441 (39.220)
Out-Of-Square	
Inner	.063 (1.60)
Outer	.070 (1.78)
<b>Lbs. @ In. (kg @ mm)</b>	
Pressure	
Inner	15.2-17.4 @ 1.08 (6.9-7.9 @ 27.43)
Limit	13 @ 1.08 (5.9 @ 27.43)
Outer	33.9-39.2 @ 1.25 (15.4-17.8 @ 31.8)
Limit	30 @ 1.25 (13.3 @ 31.8)

### CYLINDER HEAD SPECIFICATIONS

#### CYLINDER HEAD

Application	In. (mm)
Maximum Warpage	
Head-To-Block	.002 (.05)
Manifold-To-Block	.004 (.10)
Valve Seats	
Seat Angle	45 Degrees
Seat Width	.0433-.0512 (1.099-1.300)
Valve Guides	
Valve Guide I.D.	.2362-.2367 (5.999-6.012)

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Valve Guide Installed Height	.53 (13.5)
Valve Stem-To-Guide Oil Clearance	
Intake Valve	
Standard	.0008-.0018 (.020-.046)
Limit	.0027 (.069)
Exhaust Valve	
Standard	.0018-.0028 (.046-.071)
Limit	.0035 (.089)

**CAMSHAFT SPECIFICATIONS****CAMSHAFT**

Application	In. (mm)
Bore Diameter	1.0236-1.0249 (25.999-26.032)
Journal Diameter	1.0220-1.0228 (25.959-25.979)
Journal Runout	.0039 (.099)
Lobe Height	
Intake	
Standard	1.5530-1.5593 (39.446-39.606)
Limit	1.5512 (39.400)
Exhaust	
Standard	1.5523-1.5586 (39.428-39.588)
Limit	1.5512 (39.400)
Oil Clearance	
Standard	.0008-.0029 (.020-.074)
Limit	.0047 (.119)

**VALVE LASH ADJUSTER SPECIFICATIONS****VALVE LASH ADJUSTER**

Application	In. (mm)
Bore Diameter	1.2205-1.2214 (31.00-31.023)
Lifter Diameter	1.2188-1.2194 (30.958-30.9723)
Oil Clearance	
Standard	.0010-.0025 (.025-.063)
Limit	.0059 (.150)