2009 ENGINE

Engine Mechanical - XL7

PRECAUTIONS

TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE

CAUTION: A wrench must be used on the hex of the camshaft when loosening or tightening in order to prevent component damage. Failure to prevent the torque reaction against the timing drive chain can lead to timing drive chain failure.

VALVE LIFTER PRIMING CAUTION

CAUTION: Ensure each valve lifter is filled with clean engine oil and the valve lifter does not tip over (plunger down) before the installation of the valve lifters. The loss of oil in the valve lifter lower pressure chamber or the dry stroking/cycling of the valve lifter plunger will allow air to travel into the high pressure chamber of the valve lifter. Air in the high pressure chamber of the valve lifter may not be purged causing extensive engine component damage.

GENERAL DESCRIPTIONS

DRIVE BELT SYSTEM DESCRIPTION

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The drive belt idler pulley
- The crankshaft balancer pulley
- The accessory drive component mounting brackets
- The accessory drive components
  - The power steering pump, if belt driven
  - The generator
  - The A/C compressor, if equipped
  - The engine cooling fan, if belt driven
  - The water pump, if belt driven
  - The vacuum pump, if equipped
  - The air compressor, if equipped

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The drive belt system may use 1 belt or 2 belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. The drive belts are made of different types of rubbers, chloroprene or EPDM, and have different layers or plys containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

ENGINE COMPONENT DESCRIPTION

The High Feature V6 VIN Code 7 RPO LY7 is a 3.6L engine incorporating two intake and two exhaust valves per cylinder. Individual intake and exhaust camshafts (DOHC) with camshaft position actuators are mounted on each cylinder head. The cylinder bore is 94 mm (3.7008 in) and the piston stroke is 85.6 mm (3.3701 in). The cylinders are arranged in two banks of three with a 60 degree included angle. The right bank of cylinders are number 1-3-5 and the left bank of cylinders are 2-4-6. The engine firing order is 1-2-3-4-5-6.

Crankcase

The cylinder block is constructed of aluminum alloy by precision sand-casting with cast in place iron cylinder liners. Each copper-infiltrated sintered steel main bearing cap incorporates six bolts bolting the cap into the engine block. Along with two outer and two inner bolts, two side bolts are used in the deep skirt block. To prevent aeration, oil return from the valvetrain and cylinder heads is channeled away from the rotating and reciprocating components through oil drain back passages incorporated into the cylinder heads and engine block. Pressure-actuated piston oil cooling jets are mounted between opposing cylinders. A knock sensor is located on each side of the exterior of the engine block. The crankshaft position sensor is located on the right side of the exterior of the engine block.

Crankshaft

The crankshaft is a forged steel design with four main bearings. Crankshaft thrust is controlled by the number three main bearing. The crankshaft position reluctor wheel is pressed onto the rear of the crankshaft in front of the rear main journal. The crankshaft is internally balanced with an integral oil pump drive machined into the nose in front of the front main journal.

Connecting Rods and Pistons

The connecting rods are sinter forged steel and have full floating piston pins. The piston pins are a slip fit in the bronze bushed connecting rod. Round wire retainers are used to retain the piston pin into the piston. The cast aluminum pistons incorporate a polymer-coated skirt to reduce friction. The piston uses two low tension compression rings and one multi-piece oil control ring. The top compression ring is plasma sprayed. The second

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compression ring is cast iron napier. The oil control ring incorporates a steel expander and two chrome plated steel rails.

Camshaft Drive System

The camshaft drive system consists of one primary timing drive chain driven by the crankshaft sprocket. The primary timing drive chain drives two intermediate drive shaft sprockets. Each oil pressure fed intermediate drive shaft sprocket drives separate secondary timing drive chains. Each secondary timing drive chain drives the respective cylinder head's intake and exhaust camshaft position actuators.

The primary timing drive chain uses two stationary timing drive chain guides and an oil pressure hydraulically actuated tensioner with built-in shoe. The tensioner minimizes timing drive chain noise and provides accurate valve action by keeping slack out of the timing drive chains and continuously adjusting for timing drive chain wear. The tensioner incorporates a plunger that adjusts out with wear allowing only a minimal amount of backlash. The tensioner is equipped with an oiling jet to spray oil onto the timing components during engine operation. The secondary timing drive chains use a stationary timing drive chain guide and movable timing drive chain shoe. The secondary timing drive chain shoe is under tension from an oil pressure hydraulically actuated tensioner. All tensioners are sealed to the head or block using a rubber coated steel gasket. The gasket traps an adequate oil reserve to ensure quiet start-up.

From the initial production of the High Feature V6 there have been four timing drive systems. This application was built using the fourth design.

NOTE: The difference between the third design and the previous second design is a revised reluctor wheel on the camshaft position actuators. The reluctor wheels were revised due to revised camshaft position sensors.

The third design uses an inverted tooth (IT) timing drive chain on the primary timing drive components and roller timing drive components on the secondary components.

The third design primary timing drive chain uses an IT timing drive chain and a crankshaft sprocket with IT timing drive chain teeth. The primary timing drive chain connects the crankshaft sprocket with the left and right side intermediate drive shaft sprockets. The third design intermediate drive shaft sprockets incorporate IT primary timing drive chain sprocket teeth and roller timing drive chain secondary timing drive chain sprocket teeth. The third design actuators incorporate a new reluctor wheel and cannot be used on earlier designs.

NOTE: The pitch of the IT chain has changed therefore third and fourth primary IT components are not interchangeable.

The fourth design uses IT timing drive components on both the primary and secondary components. The two timing drive system's individual rotating components cannot be mixed. DO NOT mix third design timing drive chain rotating components with fourth design timing drive chain rotating components.

The following components are the ONLY components that are same between the third and fourth design:

- All timing drive tensioners
- Primary Guides

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- Secondary Shoes - Pivoting guides

Camshaft Position Actuator System

The engine incorporates a camshaft position actuator for each intake and exhaust camshaft. Camshaft phasing changes the inlet and exhaust valve timing within a range of 25 camshaft degrees as engine operating conditions vary. Dual camshaft phasing allows the further optimization of performance, fuel economy and emissions without compromising overall engine response and driveability. Variable valve timing also contributes to a reduction in exhaust emissions. It optimizes exhaust and inlet valve overlap and eliminates the need for an exhaust gas recirculation (EGR) system.

The camshaft position actuator is a hydraulic vane-type actuator that changes the camshaft lobe timing relative to the camshaft drive sprocket. Engine oil is directed by a camshaft position actuator oil control valve to the appropriate passages in the camshaft position actuator. Oil acting on the vane in the camshaft position actuator, rotates the camshaft relative to the sprocket. At idle, both camshafts are at the default or "home" position. At this position, the exhaust camshaft is fully advanced and the intake is fully retarded to minimize valve overlap for smooth idle. An internal lock pin locks the inner rotor to the outer camshaft position actuator housing at idle and maintains this position during start-up conditions. Under other engine operating conditions, the camshaft position actuator is controlled by the Engine Control Module (ECM) to deliver optimal intake and exhaust valve timing for performance, driveability and fuel economy. The camshaft position actuator incorporates an integral trigger wheel, which is sensed by the camshaft position sensor mounted in the front cover to accurately determine the position of each camshaft. Each camshaft position actuator has a specific timing drive mark for right or left bank application, as the camshaft position actuators are common bank to bank. The exhaust camshaft position actuator has a different internal configuration than the intake camshaft position actuator since the exhaust camshaft position actuator phases in the opposite direction relative to the inlet camshaft position actuator.

The camshaft position actuator oil control valve (OCV) directs oil from the oil feed in the head to the appropriate camshaft position actuator oil passages. There is one OCV for each camshaft position actuator. The OCV is sealed and mounted to the front cover. The ported end of the OCV is inserted into the cylinder head with a sliding fit. A filter screen protects each OCV oil port from any contamination in the oil supply.

The camshaft front journal has several drilled oil holes to allow camshaft position actuator control oil to transfer from the cylinder head to the camshaft position actuator. The center camshaft bolt hole is counterbored to allow oil to flow around the camshaft bolt and to the camshaft position actuator. Oil in this oil passage is used to move the camshaft position actuator to the default or home position. Radially outward from the center of the journal is a set of four drilled camshaft position actuator oil holes. Oil in this group of oil holes is used to move the camshaft from the default position to a specific set position as determined by the ECM. Seal rings are used at the front and rear of the front camshaft journal to prevent oil leakage from the camshaft position actuator hydraulic system. The seal is made from a plastic compound that resists wear and has a diagonal end gap to enhance sealing. The camshaft position actuator is mounted to the front end of the camshaft and the timing notch in the nose of the camshaft aligns with the dowel pin in the camshaft position actuator to ensure proper cam timing and camshaft position actuator oil hole alignment.

Cylinder Heads

The cylinder heads are semi permanent mold cast aluminum with powdered metal valve seat inserts and valve guides. Two 36.96 mm (1.4551 in) intake valves and two 30.60 mm (1.2047 in) exhaust valves are actuated by

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roller finger followers pivoting on a stationary hydraulic lash adjuster (SHLA). Separate exhaust and intake camshafts are supported by four bearings machined into the cylinder head. The front camshaft bearing cap is used as a thrust control surface for each camshaft. Each spark plug is shielded by a tube that is pressed into the cylinder head. Each spark plug ignition coil is also mounted through the spark plug tube. The engine coolant temperature (ECT) sensor is threaded into the left cylinder head.

Induction System

The intake manifold consists of two cast aluminum components. Two short bolts in the lower intake manifold and four long bolts, that pass through both manifolds, mount the intake manifold assembly to the cylinder heads. Additionally two bolts mount the upper intake manifold to the lower intake manifold. The throttle body, Evaporative Emissions (EVAP) solenoid and tubes, Positive Crankcase Ventilation (PCV) tubes, and brake booster hose are mounted to the upper intake manifold. The fuel injector wiring harness, fuel rail assembly, and fuel injectors are mounted to the lower intake manifold.

Right and Left Bank Designation

Right hand (RH) and left hand (LH) designation through the engine mechanical information are viewed from the rear of the engine or from inside the vehicle.

CLEANLINESS AND CARE

An automobile engine is a combination of many of the following surfaces:

- Machined
- Honed
- Polished
- Lapped

The tolerances of these surfaces are measured in the ten-thousandths of an inch. When you service any internal engine part, cleanliness and care are important. Apply a liberal coating of engine oil to the friction areas during assembly in order to protect and lubricate the surfaces on initial operation. Throughout this information, practice proper cleaning and protection procedures to the machined surfaces and to the friction areas.

CAUTION: Engine damage may result if an abrasive paper, pad, or motorized wire brush is used to clean any engine gasket surfaces.

Whenever you remove the valve train components, keep the components in order. Follow this procedure in order to install the components in the same locations and with the same mating surfaces as when removed.

WARNING: Refer to BATTERY DISCONNECT CAUTION .

Disconnect the negative battery cables before you perform any major work on the engine.

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SEPARATING PARTS

In addition to the room temperature vulcanizing (RTV) sealant's sealing capabilities, the RTV sealants may form an adhesive bond between the components. This may make the components difficult to remove or to separate. Pry points have been provided in the components that utilize RTV as the sealing system. Pry points are positioned so they can be used without damaging other vital engine components.

REPLACING ENGINE GASKETS

Gasket Reuse and Applying Sealant

- Do not reuse any gasket unless specified.
- Gaskets that can be reused will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless specified in the service procedure.

Separating Components

- Use incorporated pry points to separate components using an RTV sealing system.
- Do not try to separate RTV sealed components by prying against other engine components.
- Pry points are positioned so no other vital engine components are damaged when they are used.

Cleaning Gasket Surfaces

- Use care to avoid gouging or scraping the sealing surfaces.
- Use a plastic or wood scraper in order to remove all the sealant from the components.

  Do not use any other method or technique to remove the sealant or the gasket material from a part.

- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces.
  - These methods of cleaning can cause damage to the component sealing surfaces.
  - Abrasive pads also produce a fine grit that the oil filter cannot remove from the engine oil.

    This fine grit is an abrasive and can cause internal engine damage.

Assembling Components

- Assemble components using only the sealant, or equivalent, that is specified in the service procedure.
- Sealing surfaces must be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- Apply only the amount of sealant specified in the service procedure to a component.
- Do not allow the sealant to enter into any blind threaded holes, as the sealant may prevent the fastener from clamping properly or cause component damage when tightened.

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NOTE: Do not overtighten the fasteners.

- Tighten the fasteners to the proper specifications.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALANT

Sealant Types

NOTE: The correct sealant and amount of sealant must be used in the proper location to prevent oil leaks, coolant leaks, or the loosening of the fasteners. DO NOT interchange the sealants. Use only the sealant, or equivalent, as specified in the service procedure.

The following 2 major types of sealant are commonly used in engines:

- Anaerobic sealant room temperature vulcanizing (RTV)
- Anaerobic sealant, which include the following:
  - Gasket eliminator
  - Pipe
  - Threadlock

Anaerobic Type Room Temperature Vulcanizing (RTV) Sealant

Anaerobic type room temperature vulcanizing (RTV) sealant cures in the absence of air. This type of sealant is used where 2 components, such as the intake manifold and the engine block, are assembled together.

Use the following information when using RTV sealant:

- Do not use RTV sealant in areas where extreme temperatures are expected. These areas include:
  - The exhaust manifold
  - The head gasket
  - Any other surfaces where a different type of sealant is specified in the service procedure
- Always follow all the safety recommendations and the directions that are on the RTV sealant container.
- Use a plastic or wood scraper in order to remove all the RTV sealant from the components.

CAUTION: Do not allow the RTV sealant to enter any blind threaded hole. RTV sealant that is allowed to enter a blind threaded hole can cause hydraulic lock of the fastener when the fastener is tightened. Hydraulic lock of a fastener can lead to damage to the fastener and/or the components. Hydraulic lock of a fastener can also prevent the proper clamping loads to be obtained when the fastener is tightened. Improper clamping loads can prevent proper sealing of the components allowing leakage to occur. Preventing proper fastener tightening can allow the components to loosen or separate leading to

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extensive engine damage.

- The surfaces to be sealed must be clean and dry.
- Use a RTV sealant bead size as specified in the service procedure.
- Apply the RTV sealant bead to the inside of any bolt holes areas.

NOTE: Do not wait for the RTV sealant to skin over.

Assemble the components while the RTV sealant is still wet to the touch, within 3 minutes.

NOTE: Do not overtighten the fasteners.

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

Anaerobic Type Gasket Eliminator Sealant

Anaerobic type gasket eliminator sealant cures in the absence of air. This type of sealant is used where 2 rigid parts, such as castings, are assembled together. When 2 rigid parts are disassembled and no sealant or gasket is readily noticeable, then the 2 parts were probably assembled using an anaerobic type gasket eliminator sealant.

Use the following information when using gasket eliminator sealant:

- Always follow all the safety recommendations and directions that are on the gasket eliminator sealant container.
- Apply a continuous bead of gasket eliminator sealant to one flange.

The surfaces to be sealed must be clean and dry.

CAUTION: Do not allow the sealant to enter a blind hole. The sealant may prevent the fastener from achieving proper clamp load, cause component damage when the fastener is tightened, or lead to component failure.

NOTE:

- **Gasket eliminator sealed joint fasteners that are partially torqued and the gasket eliminator sealant allowed to cure more than 5 minutes, may result in incorrect shimming and sealing of the joint.**
- **Do not overtighten the fasteners.**
  - **Apply the gasket eliminator sealant evenly to get a uniform thickness of the gasket eliminator sealant on the sealing surface.**
  - **Tighten the fasteners in sequence, if specified, and to the proper torque specifications.**
  - **After properly tightening the fasteners, remove the excess gasket eliminator sealant from the outside of the joint.**

Anaerobic Type Threadlock Sealant

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Anaerobic type threadlock sealant cures in the absence of air. This type of sealant is used for threadlocking and sealing of bolts, fittings, nuts, and studs. This type of sealant cures only when confined between 2 close fitting metal surfaces.

Use the following information when using threadlock sealant:

- Always follow all safety recommendations and directions that are on the threadlock sealant container.
- The threaded surfaces to be sealed must be clean and dry.
- Apply the threadlock sealant as specified on the threadlock sealant container.

NOTE:
- **Fasteners that are partially torqued and then the threadlock sealant allowed to cure more than 5 minutes, may result in incorrect clamp load of assembled components.**
- **Do not overtighten the fasteners.**

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

Anaerobic Type Pipe Sealant

Anaerobic type pipe sealant cures in the absence of air and remains pliable when cured. This type of sealant is used where 2 parts are assembled together and require a leak proof joint.

Use the following information when using pipe sealant:

- Do not use pipe sealant in areas where extreme temperatures are expected. These areas include:
  - The exhaust manifold
  - The head gasket
  - Surfaces where a different sealant is specified
- Always follow all the safety recommendations and the directions that are on the pipe sealant container.
- The surfaces to be sealed must be clean and dry.
- Use a pipe sealant bead of the size or quantity as specified in the service procedure.

CAUTION: Do not allow the sealant to enter a blind hole. The sealant may prevent the fastener from achieving proper clamp load, cause component damage when the fastener is tightened, or lead to component failure.

- Apply the pipe sealant bead to the inside of any bolt hole areas.
- Apply a continuous bead of pipe sealant to one sealing surface.

NOTE: Do not overtighten the fasteners.

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

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SCHEMATIC AND ROUTING DIAGRAM

CAMSHAFT TIMING DRIVE DESIGN IDENTIFICATION

Fourth Design

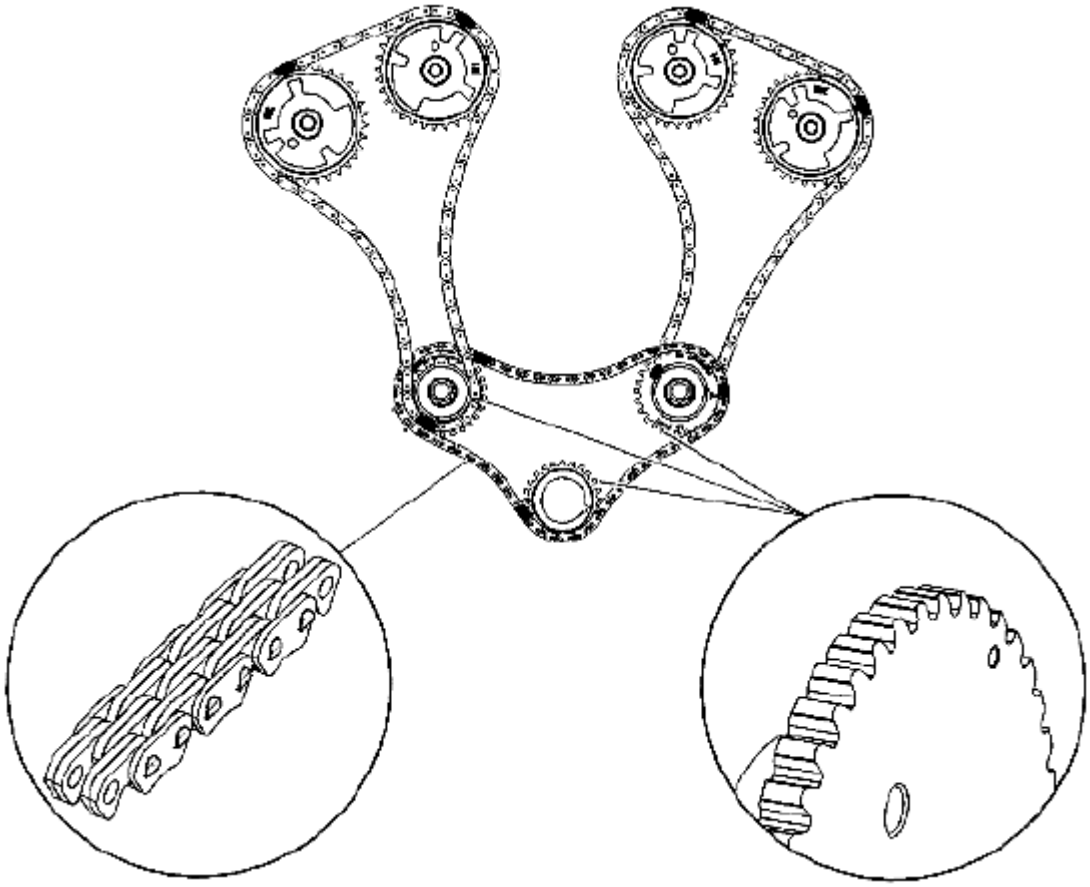


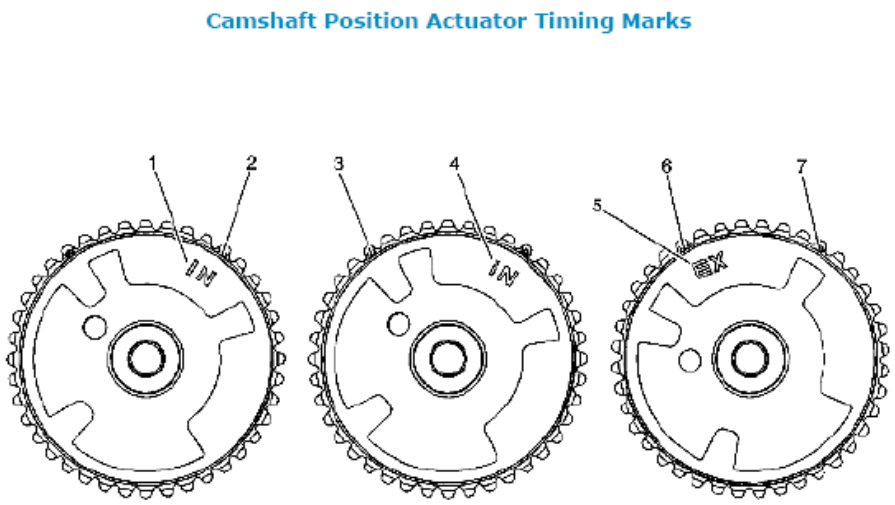
Fig. 1: Identifying Camshaft Timing Drive Design Identification - Fourth Design
Courtesy of SUZUKI OF AMERICA CORP.

- New secondary timing drive chains, inverted tooth (IT) design.
- The camshaft position actuators incorporate new sprockets that correspond with the use of IT chains on the secondary timing drive system.
- The intake camshaft position actuators are different for the left and right sides.
- The left and right secondary timing drive guides are new due to the use of IT chains on the secondary timing drive system.
- The intermediate timing drive sprockets are new due to the use of IT chains on the secondary timing drive system.
- New intake camshafts.
- New fourth design IT primary timing drive chain.
- New fourth design IT crankshaft sprocket.

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- Fourth design IT primary chain is not interchangeable with second and third design.

CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM

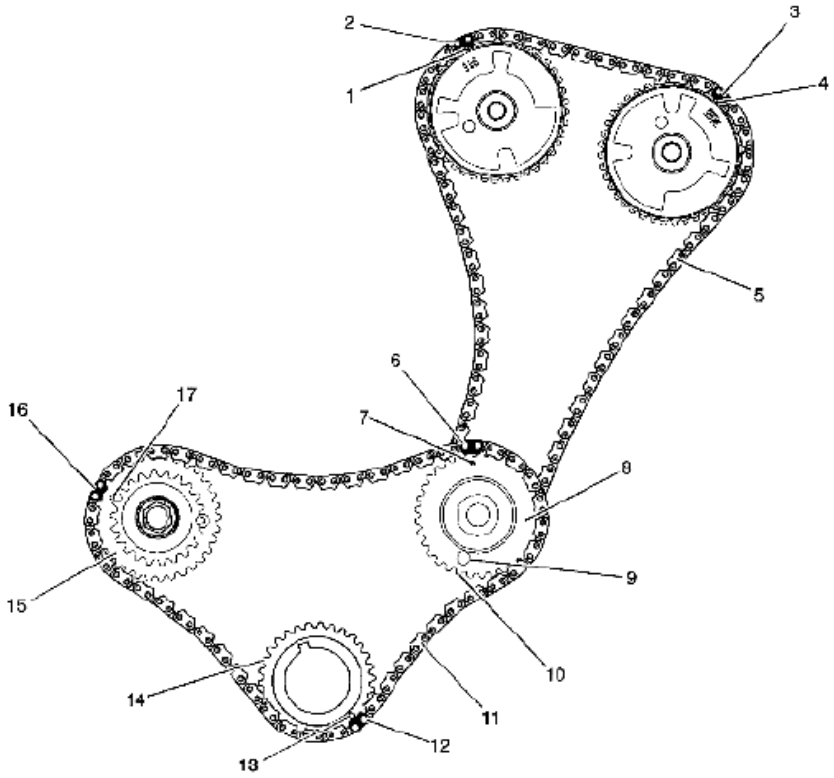


1.	Right Intake Camshaft Position Actuator Identifier	5.	Exhaust Camshaft Position Actuator Identifier
2.	Right Intake Camshaft Position Actuator Right Side Timing Mark – Triangle	6.	Exhaust Camshaft Position Actuator Right Side Timing Mark – Triangle
3.	Left Intake Camshaft Position Actuator Left Side Timing Mark – Circle	7.	Exhaust Camshaft Position Actuator Left Side Timing Mark – Circle
4.	Left Intake Camshaft Position Actuator Identifier		

Fig. 2: Camshaft Timing Drive Chain Alignment Diagram - Camshaft Position Actuator Timing Marks
Courtesy of SUZUKI OF AMERICA CORP.

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Stage One

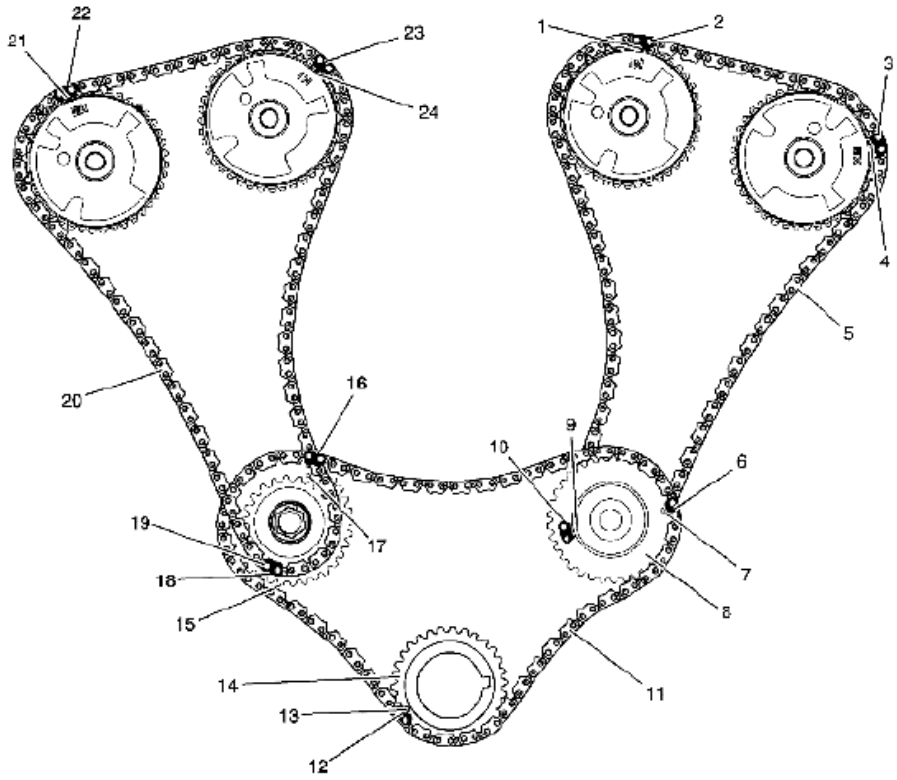


1. Left Intake Camshaft Position (CMP) Actuator Timing Mark – Circle	10. Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Window for the Left Secondary Camshaft Timing Drive Chain Timing Link
2. Left Intake Secondary Camshaft Timing Drive Chain Timing Link	11. Primary Camshaft Drive Chain
3. Left Exhaust Secondary Camshaft Timing Drive Chain Timing Link	12. Primary Camshaft Drive Chain Timing Link for the Crankshaft Sprocket
4. Left Exhaust Camshaft Position (CMP) Actuator Timing Mark – Circle	13. Crankshaft Sprocket Timing Mark
5. Left Secondary Camshaft Timing Drive Chain	14. Crankshaft Sprocket
6. Primary Camshaft Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket	15. Right Primary Camshaft Intermediate Drive Chain Sprocket
7. Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain	16. Primary Camshaft Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
8. Left Primary Camshaft Intermediate Drive Chain Sprocket	17. Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark
9. Left Secondary Camshaft Timing Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket	

Fig. 3: Camshaft Timing Drive Chain Alignment Diagram - Stage One
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Stage Two



1.	Left Intake Camshaft Position (CMP) Actuator Timing Mark – Circle	13.	Crankshaft Sprocket Timing Mark
2.	Left Intake Secondary Camshaft Timing Drive Chain Timing Link	14.	Crankshaft Sprocket
3.	Left Exhaust Secondary Camshaft Timing Drive Chain Timing Link	15.	Right Primary Camshaft Intermediate Drive Chain Sprocket
4.	Left Exhaust Camshaft Position (CMP) Actuator Timing Mark – Circle	16.	Primary Camshaft Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
5.	Left Secondary Camshaft Timing Drive Chain	17.	Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain
6.	Primary Camshaft Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket	18.	Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark/Window for the Right Secondary Camshaft Timing Drive Chain
7.	Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain	19.	Right Secondary Camshaft Timing Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
8.	Left Primary Camshaft Intermediate Drive Chain Sprocket	20.	Right Secondary Camshaft Timing Drive Chain
9.	Left Secondary Camshaft Timing Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket	21.	Right Exhaust Camshaft Position (CMP) Actuator Timing Mark – Triangle
10.	Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Window	22.	Right Exhaust Secondary Camshaft Timing Drive Chain Timing Link
11.	Primary Camshaft Drive Chain	23.	Right Intake Secondary Camshaft Timing Drive Chain Timing Link

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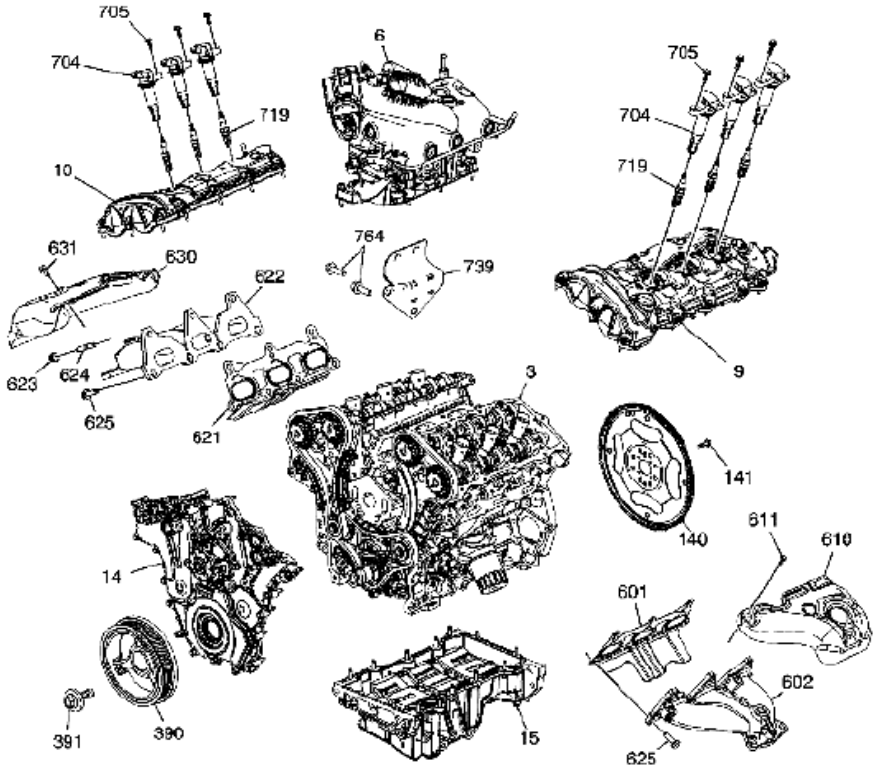
Fig. 4: Camshaft Timing Drive Chain Alignment Diagram - Stage Two
Courtesy of SUZUKI OF AMERICA CORP.

COMPONENT LOCATION

DISASSEMBLED VIEWS

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Engine Covers and Component Assemblies (1 of 2)

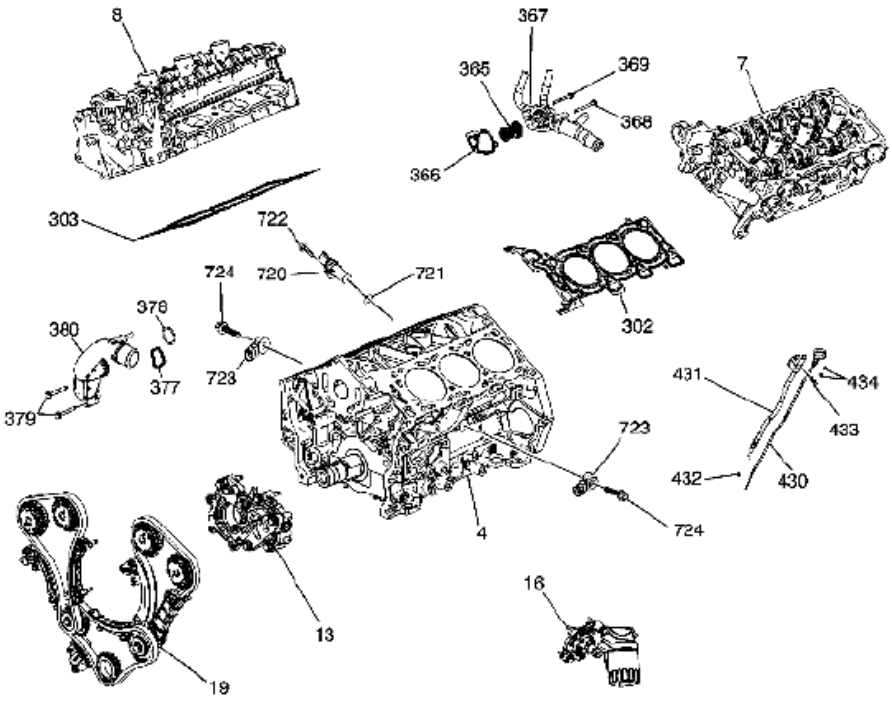


3.	Engine Assembly	611.	Exhaust Manifold Heat Shield Bolt
6.	Intake Manifold Assembly	621.	Right Exhaust Manifold Gasket
9.	Left Camshaft Cover Assembly	622.	Right Exhaust Manifold
10.	Right Camshaft Cover Assembly	623.	Exhaust Manifold Nut
14.	Engine Front Cover Assembly	624.	Exhaust Manifold Stud
15.	Oil Pan Assembly	625.	Cylinder Head Exhaust Manifold Bolt
140.	Engine Flywheel	630.	Right Exhaust Manifold Heat Shield
141.	Engine Flywheel Bolt	631.	Right Exhaust Manifold Heat Shield Bolt
390.	Crankshaft Balancer	704.	Ignition Coil
391.	Crankshaft Balancer Bolt	705.	Ignition Coil Bolt
601.	Left Exhaust Manifold Gasket	719.	Spark Plug
602.	Left Exhaust Manifold	739.	Crankshaft Position Sensor Heat Shield
610.	Left Exhaust Manifold Heat Shield	764.	Crankshaft Position Sensor Heat Shield Bolt - Large

Fig. 5: Disassembled Views - Engine Covers And Component Assemblies (1 Of 2)
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Engine Covers and Component Assemblies (2 of 2)

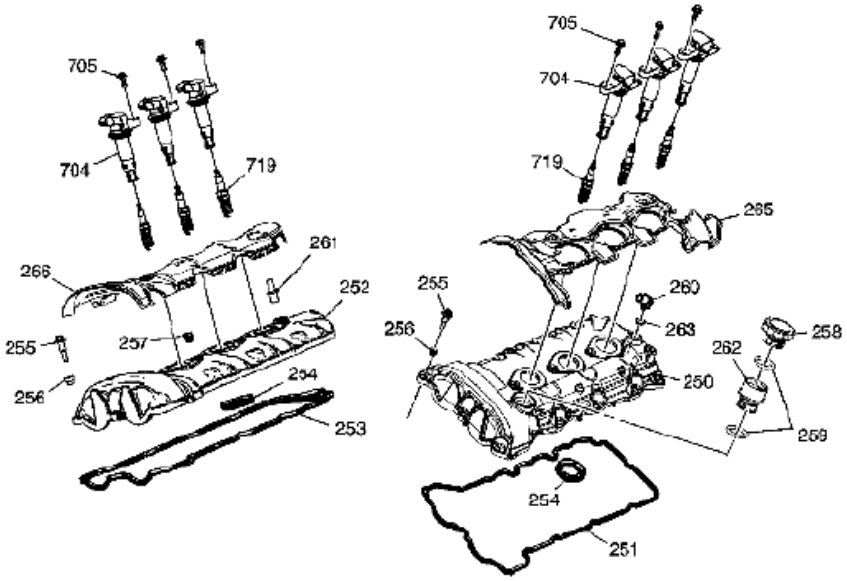


4. Engine Short Block Assembly	378. Water Outlet O-ring
7. Left Cylinder Head Assembly	379. Water Outlet Bolt
8. Right Cylinder Head Assembly	380. Water Outlet
13. Oil Pump Assembly	430. Oil Level Indicator
16. Oil Filter Adapter Assembly	431. Oil Level Indicator Tube
19. Timing Drive Assembly	432. Oil Level Indicator Tube O-ring
302. Left Cylinder Head Gasket	433. Oil Level Indicator Tube Bolt
303. Right Cylinder Head Gasket	434. Oil Level Indicator Handle O-ring
365. Engine Cooling Thermostat	720. Crankshaft Position Sensor
366. Engine Cooling Thermostat Gasket	721. Crankshaft Position Sensor O-ring
367. Engine Cooling Thermostat Housing	722. Crankshaft Position Sensor Bolt
368. Engine Cooling Thermostat Housing Bolt	723. Knock Sensor
369. Engine Cooling Thermostat Bolt - Short	724. Knock Sensor Bolt
377. Water Outlet Seal	

Fig. 6: Disassembled Views - Engine Covers And Component Assemblies (2 Of 2)
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Camshaft Cover Assembly

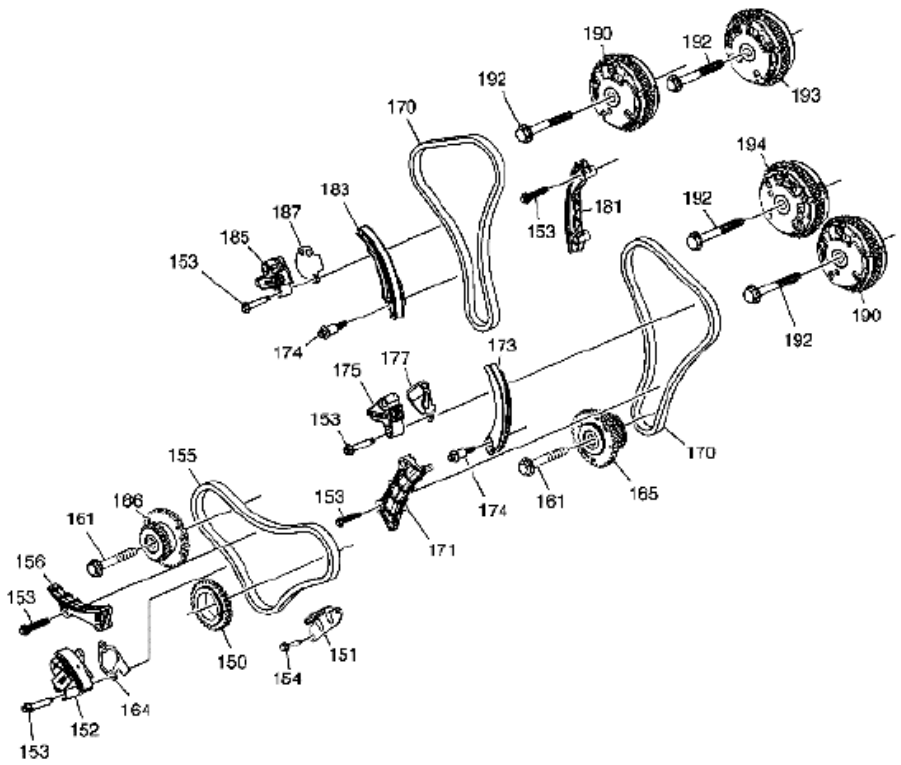


250.	Left Camshaft Cover	260.	Left Camshaft Cover PCV Fitting
251.	Left Camshaft Cover Gasket	261.	Right Camshaft Cover PCV Fitting Orifice
252.	Right Camshaft Cover	262.	Oil Fill Tube
253.	Right Camshaft Cover Gasket	263.	Left Camshaft Cover PCV Fitting O-ring
254.	Camshaft Cover Spark Plug Port Seal	265.	Left Camshaft Housing Cover Insulator
255.	Camshaft Cover Bolt	266.	Right Camshaft Housing Cover Insulator
256.	Camshaft Cover Bolt Insulator	704.	Ignition Coil
257.	Ignition Coil Bolt Thread Insert	705.	Ignition Coil Bolt
258.	Oil Fill Cap	719.	Spark Plug
259.	Oil Fill O-ring		

Fig. 7: Disassembled Views - Camshaft Cover Assembly
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Camshaft Timing Components – Fourth Design

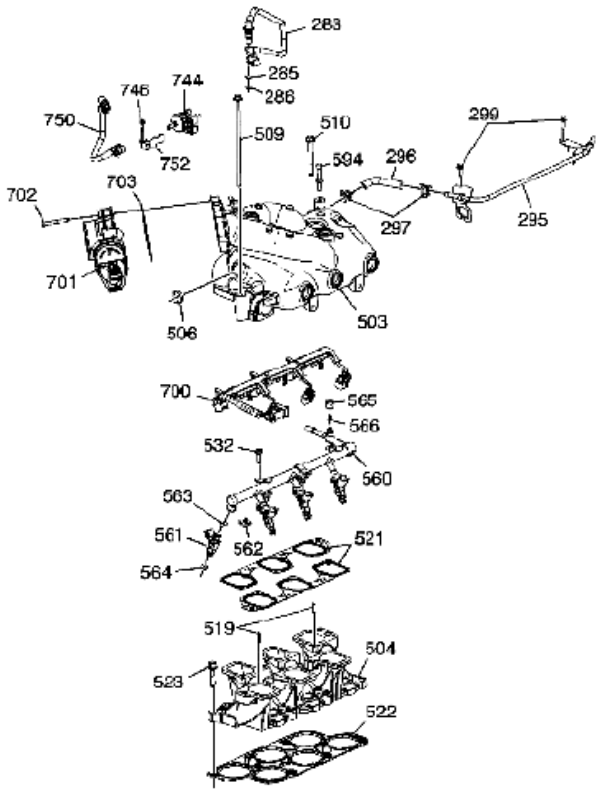


150.	Crankshaft Sprocket	173.	Left Secondary Timing Chain Shoe
151.	Lower Primary Timing Chain Guide	174.	Left Secondary Timing Chain Shoe Bolt
152.	Primary Timing Chain Tensioner	175.	Left Secondary Timing Chain Tensioner
153.	Primary Timing Chain Tensioner Bolt	177.	Left Secondary Timing Chain Tensioner Gasket
154.	Lower Primary Timing Chain Guide Bolt	181.	Right Secondary Timing Chain Guide
155.	Primary Timing Chain	183.	Right Secondary Timing Chain Shoe
156.	Upper Primary Timing Chain Guide	185.	Right Secondary Timing Chain Tensioner
161.	Camshaft Intermediate Drive Shaft Sprocket Bolt	187.	Right Secondary Timing Chain Tensioner Gasket
164.	Primary Timing Chain Tensioner Gasket	190.	Exhaust Camshaft Position Actuator
165.	Left Camshaft Intermediate Drive Shaft Sprocket	192.	Camshaft Position Actuator Bolt
166.	Right Camshaft Intermediate Drive Shaft Sprocket	193.	Intake Camshaft Position Actuator
170.	Secondary Timing Chain	194.	Intake Camshaft Position Actuator
171.	Left Secondary Timing Chain Guide		

Fig. 8: Disassembled Views - Camshaft Timing Components
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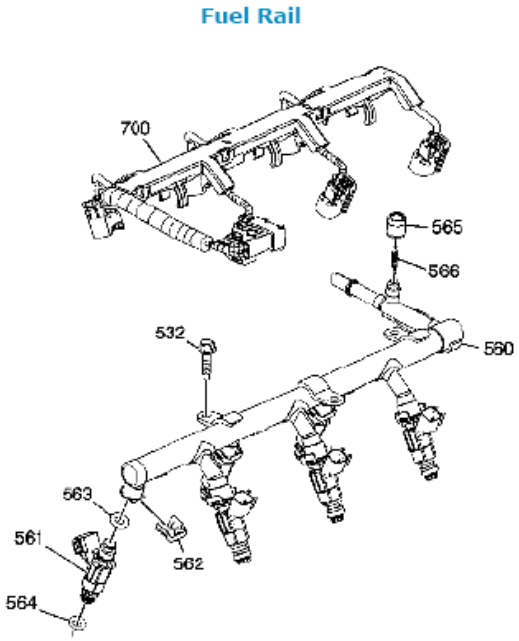
Intake Manifold



283.	Dirty PCV Hose	560.	Fuel Rail
285.	PCV Hose O-ring Outer/Larger	561.	Fuel Injector
286.	PCV Hose O-ring Inner/Smaller	562.	Fuel Injector Retainer
295.	Engine Coolant Air Bleed Pipe	563.	Fuel Injector Upper Seal
296.	Engine Coolant Air Bleed Hose	564.	Fuel Injector Lower Seal
297.	Engine Coolant Air Bleed Hose Clamp	565.	Fuel Pressure Service Valve Cap
299.	Engine Coolant Air Bleed Pipe Bolt	566.	Fuel Pressure Service Valve
503.	Upper Intake Manifold	594.	Fuel Injector Sight Shield Cover Ball Stud
504.	Lower Intake Manifold	700.	Fuel Injector Wiring Harness
506.	Expansion Plug	701.	Throttle Body
509.	Upper Intake Manifold Bolt - Long	702.	Throttle Body Bolt
510.	Upper Intake Manifold Bolt - Short	703.	Throttle Body Gasket
519.	Lower Intake Manifold to Upper Intake Manifold Dowel Pin	744.	EVAP Purge Solenoid
521.	Upper Intake Manifold Gasket	746.	EVAP Purge Solenoid Bolt
522.	Lower Intake Manifold Gasket	750.	EVAP Purge Solenoid Tube - Intake Manifold to EVAP Solenoid
523.	Lower Intake Manifold Bolt	752.	EVAP Purge Solenoid Bracket
532.	Fuel Rail Bolt		

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Fig. 9: Disassembled Views - Intake Manifold
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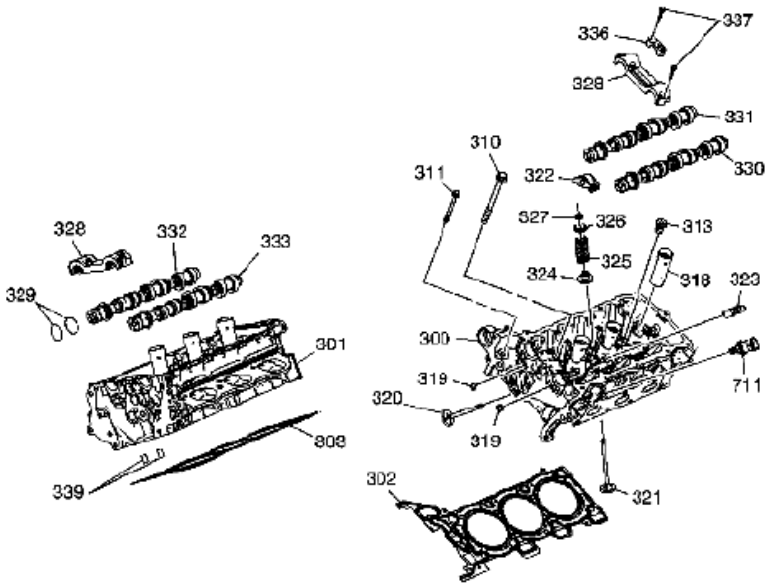


532. Fuel Rail Bolt	564. Fuel Injector Lower Seal
560. Fuel Rail	565. Fuel Pressure Service Valve Cap
561. Fuel Injector	566. Fuel Pressure Service Valve
562. Fuel Injector Retainer	700. Fuel Injector Wiring Harness
563. Fuel Injector Upper Seal	

Fig. 10: Disassembled Views - Fuel Rail
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Cylinder Head Assemblies

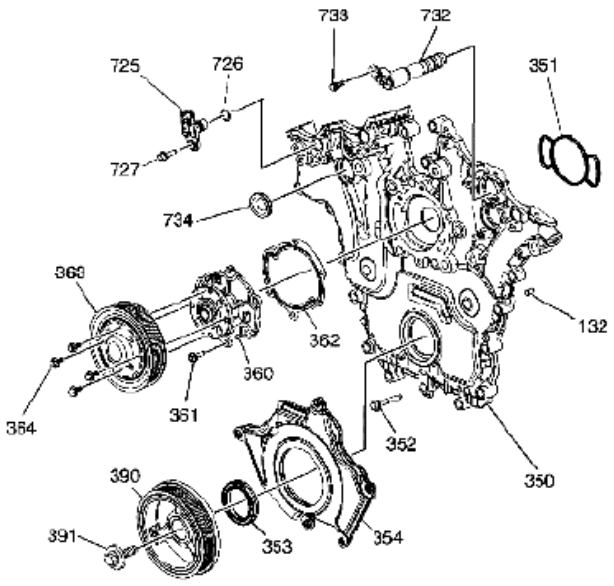


300. Left Cylinder Head	325. Valve Spring
301. Right Cylinder Head	326. Valve Spring Cap
302. Left Cylinder Head Gasket	327. Valve Stem Key
303. Right Cylinder Head Gasket	328. Cylinder Head Camshaft Front Thrust Bearing Cap
310. Cylinder Head Bolt	329. Camshaft Oil Seal Ring
311. Cylinder Head Front Bolt	330. Left Exhaust Camshaft
313. Cylinder Head Coolant Hole Threaded Plug	331. Left Intake Camshaft
318. Spark Plug Sleeve	332. Right Intake Camshaft
319. Cylinder Head Oil Gallery Expansion Plug – 14 mm	333. Right Exhaust Camshaft
320. Exhaust Valve	336. Cylinder Head Camshaft Cap – Intermediate
321. Intake Valve	337. Cylinder Head Camshaft Cap Bolt
322. Valve Rocker Arm Assembly	339. Cylinder Head Oil Gallery Check Valve
323. Hydraulic Valve Lash Adjuster Assembly	711. Engine Coolant Temperature Sensor
324. Valve Stem Oil Seal	

Fig. 11: Disassembled Views - Cylinder Head Assemblies
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Engine Front Cover

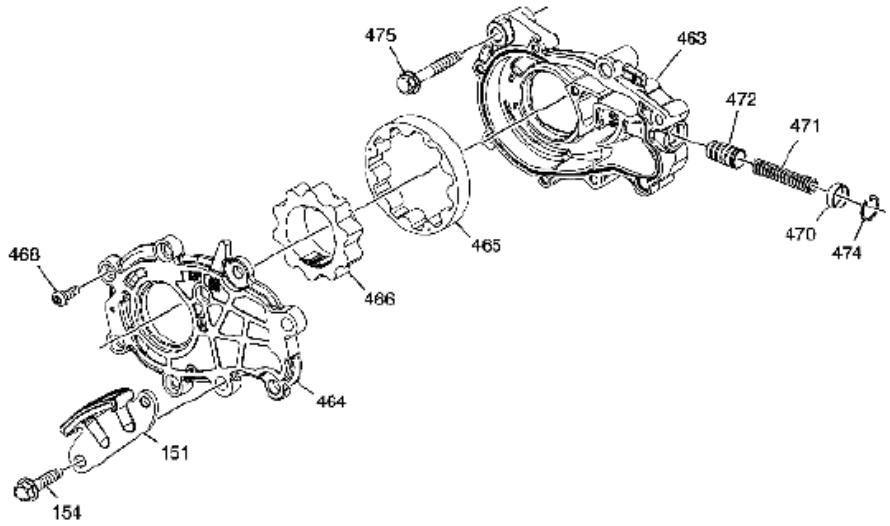


132.	Engine Front Cover Locating Pin	364.	Water Pump Pulley Bolt
350.	Engine Front Cover	390.	Crankshaft Balancer
351.	Engine Front Cover Gasket	391.	Crankshaft Balancer Bolt
352.	Engine Front Cover Bolt	725.	Camshaft Position Sensor
353.	Engine Front Cover Seal	726.	Camshaft Position Sensor O-ring
354.	Engine Front Cover Deadener	727.	Camshaft Position Sensor Bolt
360.	Water Pump Assembly	732.	Camshaft Position Actuator Solenoid Valve
361.	Water Pump Bolt	733.	Camshaft Position Actuator Solenoid Valve Bolt
362.	Water Pump Gasket	734.	Camshaft Position Actuator Solenoid Valve Seal
363.	Water Pump Pulley		

Fig. 12: Disassembled Views - Engine Front Cover
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Oil Pump – Second Design

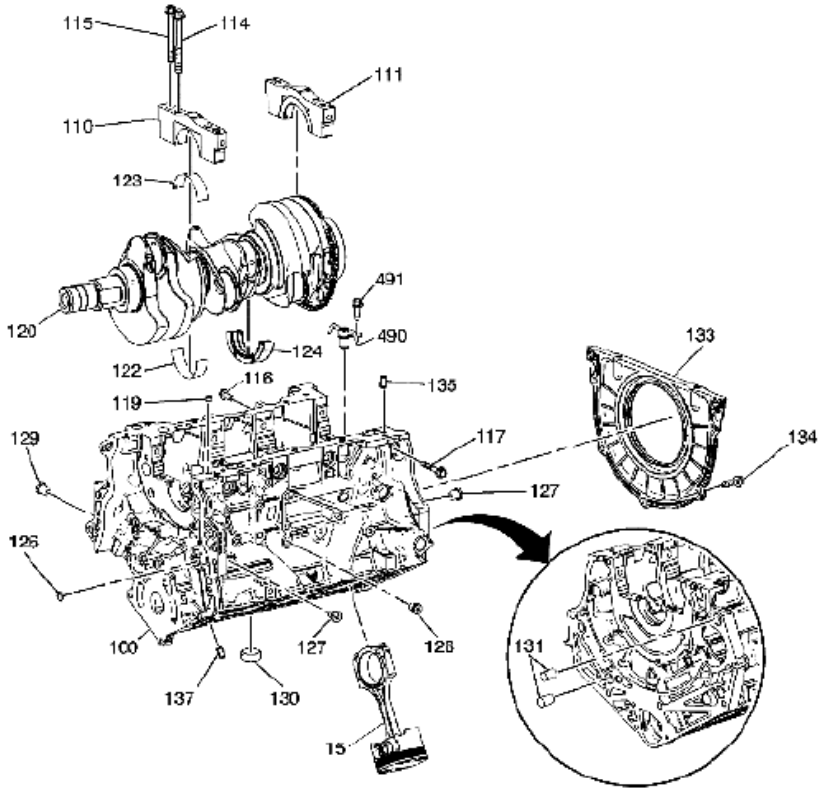


151.	Lower Primary Timing Chain Guide	468.	Oil Pump Cover Bolt
154.	Lower Primary Timing Chain Guide Bolt	470.	Oil Pressure Relief Valve Bore Plug
463.	Oil Pump Housing	471.	Oil Pressure Relief Valve Spring
464.	Oil Pump Cover	472.	Oil Pressure Relief Valve
465.	Oil Pump Driven Gear	474.	Oil Pressure Relief Valve Bore Plug Retainer Clip
466.	Oil Pump Drive Gear	475.	Oil Pump Bolt

Fig. 13: Disassembled Views - Oil Pump
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Engine Block Assembly

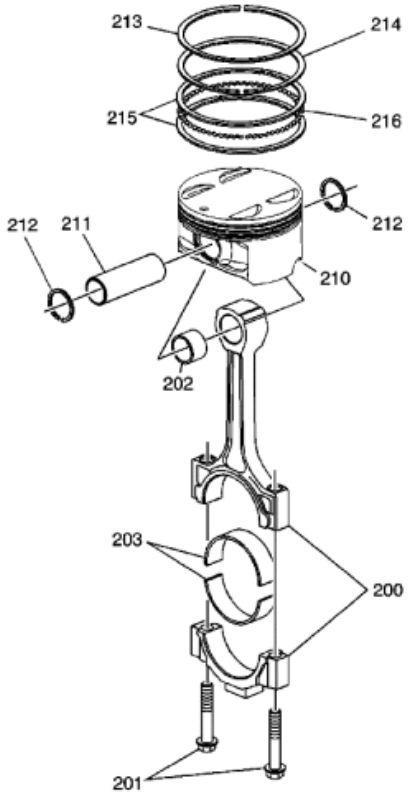


15.	Piston and Connecting Rod Assembly	126.	Engine Block Oil Gallery Expansion Plug - 14 mm
100.	Engine Block	127.	Engine Block Oil Gallery Threaded Plug - 14 mm
110.	Crankshaft Bearing Cap	128.	Engine Block Coolant Drain Threaded Plug - 14 mm
111.	Crankshaft Bearing Thrust Cap	129.	Engine Block Oil Gallery Threaded Plug - 20 mm
114.	Crankshaft Bearing Cap Inboard Bolt	130.	Engine Block Core Coolant Expansion Plug - 34.3 mm
115.	Crankshaft Bearing Cap Outboard Bolt	131.	Transaxle Locating Pin
116.	Crankshaft Bearing Cap Side Bolt - Short	133.	Crankshaft Rear Oil Seal Housing Assembly
117.	Crankshaft Bearing Cap Side Bolt - Long	134.	Crankshaft Rear Oil Seal Housing Assembly Bolt
119.	Engine Block Oil Gallery Expansion Plug - 10 mm	135.	Oil Pan Locating Pin
120.	Crankshaft	137.	Cylinder Head Locating Pin
122.	Crankshaft Upper Bearing	490.	Piston Oil Nozzle
123.	Crankshaft Lower Bearing	491.	Piston Oil Nozzle Bolt
124.	Crankshaft Upper Thrust Bearing #3		

Fig. 14: Disassembled Views - Engine Block Assembly
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Piston, Rings, Bearing and Connecting Rod

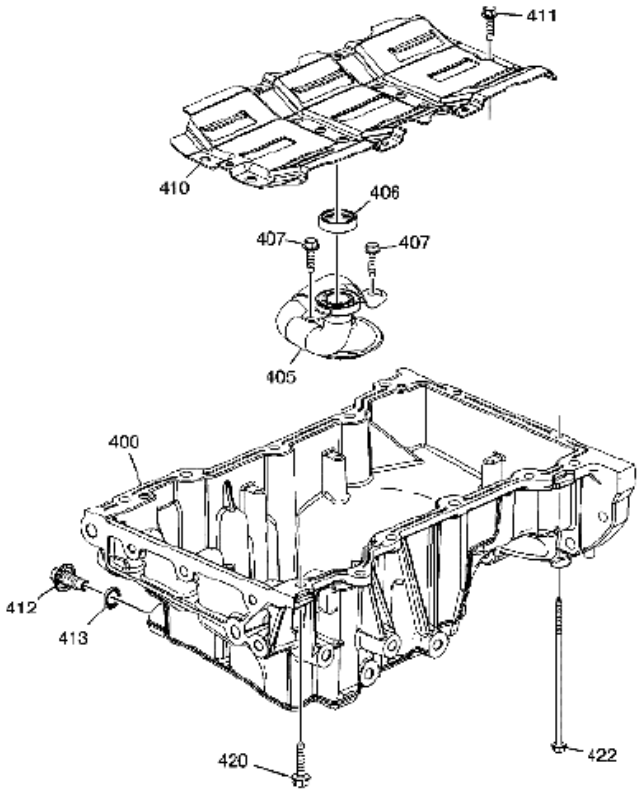


200.	Connecting Rod	212.	Piston Pin Retainer
201.	Connecting Rod Bolt	213.	Piston Upper Compression Ring
202.	Connecting Rod Bushing	214.	Piston Lower Compression Ring
203.	Connecting Rod Bearing	215.	Piston Oil Control Rail Ring
210.	Piston	216.	Piston Oil Control Ring Spacer
211.	Piston Pin		

Fig. 15: Disassembled Views - Piston, Rings, Bearing And Connecting Rod
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Oil Pan Assembly

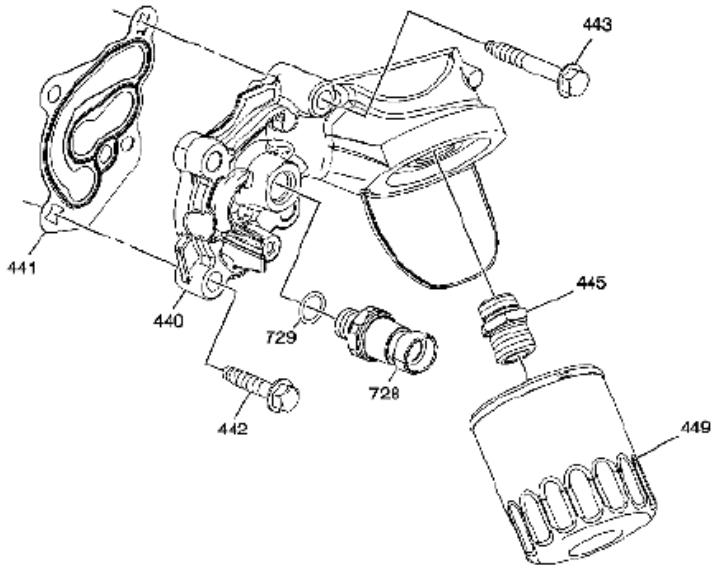


400. Oil Pan	411. Oil Pan Baffle Scraper Bolt
405. Oil Pump Suction Pipe	412. Oil Pan Drain Plug
406. Oil Pump Suction Pipe Gasket	413. Oil Pan Drain Plug O-ring
407. Oil Pump Suction Pipe Bolt	420. Oil Pan Bolt
410. Oil Pan Baffle Scraper	422. Oil Pan Bolt – Long

Fig. 16: Disassembled Views - Oil Pan Assembly
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Oil Filter Adapter



440.	Oil Filter Adapter	445.	Oil Filter Fitting
441.	Oil Filter Adapter Gasket	449.	Oil Filter
442.	Oil Filter Adapter Bolt	728.	Engine Oil Pressure Sensor
443.	Oil Filter Adapter Bolt - Long	729.	Engine Oil Pressure Sensor O-ring.

Fig. 17: Disassembled Views - Oil Filter Adapter
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DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE MECHANICAL

Begin the system diagnosis by reviewing the **DISASSEMBLED VIEWS**, **ENGINE COMPONENT DESCRIPTION**, **DRIVE BELT SYSTEM DESCRIPTION**, **LUBRICATION DESCRIPTION** . Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **SYMPTOMS - ENGINE MECHANICAL** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

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1. Perform a **DIAGNOSTIC SYSTEM CHECK - VEHICLE DIAGNOSTIC INFORMATION** before using the symptom tables, if applicable.
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **DISASSEMBLED VIEWS**, **ENGINE COMPONENT DESCRIPTION**, **DRIVE BELT SYSTEM DESCRIPTION**, **LUBRICATION DESCRIPTION** .

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system problem. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **STRATEGY BASED DIAGNOSIS** .

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Engine. Refer to **CHECKING AFTERMARKET ACCESSORIES** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Check for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES**
- **BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES**
- **BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE**
- **BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION**
- **BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION**
- **ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS**
- **UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED**
- **LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED**
- **ENGINE NOISE UNDER LOAD**
- **ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE**
- **ENGINE COMPRESSION TEST**

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- **OIL CONSUMPTION DIAGNOSIS**
- **OIL PRESSURE DIAGNOSIS AND TESTING**
- **OIL LEAK DIAGNOSIS**

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Cause	Correction
Abnormalities, severe cracking, bumps, or missing areas, in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout and may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required. Refer to **ENGINE FLYWHEEL REPLACEMENT** or **CRANKSHAFT BALANCER REPLACEMENT**.
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads, intake manifold and plenum duct, plenum duct and water crossover, water crossover and throttle body and/or pressure relief valve and intake manifold.	Replace the intake manifold, plenum duct, gaskets, cylinder heads, throttle body and/or pressure relief valve as required.
Improperly installed or damaged MAP sensor and/or seal The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor as required.
Improperly installed or damaged EVAP purge solenoid and/or O-ring seal	Repair or replace the EVAP purge solenoid as required.
Worn or loose followers, valve rocker arms The follower, valve rocker arm, roller bearing should be intact and in the proper position	Replace the followers, valve rocker arms, as required.
Stuck valves Carbon buildup on the valve stem can cause the valve	Repair or replace as required.

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not to close properly.	
Excessively worn or mis-aligned timing chain or chains	Replace the timing chain or chains and sprockets as required.
Worn camshaft lobes	Replace the camshaft or camshafts and SHLAs, valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump-up and loss of compression.	• Perform an oil pressure test. Refer to **OIL PRESSURE DIAGNOSIS AND TESTING** . • Repair or replace the oil pump as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **DIAGNOSTIC STARTING POINT - VEHICLE DIAGNOSTIC INFORMATION** . Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **SPARK PLUG INSPECTION** for the 3.6L engine. • Inspect the cylinder heads, engine block, and/or head gaskets. • Repair or replace as required.
Worn Piston Rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **SPARK PLUG INSPECTION** for the 3.6L engine. • Inspect the cylinders for a loss of compression. Refer to **ENGINE COMPRESSION TEST**. • Perform cylinder leak down and compression testing to identify the cause. • Repair or replace as required.
A damaged crankshaft reluctor wheel A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. • Systems with SEVERE reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position. • Systems with SLIGHT reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a P0300 DTC may be set.	Replace the crankshaft as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISE

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISE

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas, in	

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the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the engine flywheel and/or crankshaft balancer as required. Refer to **ENGINE FLYWHEEL REPLACEMENT** or **CRANKSHAFT BALANCER REPLACEMENT**.
Worn or Broken Piston Rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **SPARK PLUG INSPECTION** for the 3.6L engine. • Inspect the cylinders for a loss of compression. Refer to **ENGINE COMPRESSION TEST**. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.
Worn Crankshaft Thrust Bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Cause	Correction
Worn or loose followers, valve rocker arms The follower, valve rocker arm, roller bearing should be intact and in the proper position.	Replace the followers, valve rocker arms, as required.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain or chains	Replace the timing chain or chains and sprockets as required.
Worn camshaft lobes	Replace the camshaft or camshafts and SHLAs, valve lifters.
Sticking SHLAs, lifters	Replace the SHLAs as required.

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BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **DIAGNOSTIC STARTING POINT - VEHICLE DIAGNOSTIC INFORMATION** . Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **SPARK PLUG INSPECTION** for the 3.6L engine. • Perform a cylinder leak down test. • Inspect the cylinder heads and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	1. Inspect the spark plugs for oil deposits. Refer to **SPARK PLUG INSPECTION** . 2. Repair or replace as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. Refer to **SPARK PLUG INSPECTION** . 2. Inspect the cylinders for a loss of compression. Refer to **ENGINE COMPRESSION TEST**. 3. Perform cylinder leak down and compression testing to determine the cause. 4. Repair or replace as required.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

ENGINE NOISE ON START-UP, BUT ONLY LASTING FEW SECONDS

Cause	Correction
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	Drain the engine oil and replace with the correct viscosity oil.
High stationary hydraulic lash adjuster (SHLA), valve lifter, leak down rate	Replace the SHLAs, valve lifters, as required.
Worn crankshaft thrust bearing	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
	• Inspect the oil filter by-pass valve for

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Damaged or faulty oil filter by-pass valve	proper operation. • Repair or replace as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **OIL PRESSURE DIAGNOSIS AND TESTING** . 2. Repair or replace as required.
Loose and/or worn follower, valve rocker arm	1. Inspect the follower, valve rocker arm. 2. Repair or replace as required.
Improper lubrication to the followers, valve rocker arms	Inspect the following components, and repair or replace as required: • The follower, valve rocker arm • The SHLA, valve lifter • The oil filter bypass valve • The oil pump and pump screen • The cylinder head oil galleries • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn or dirty stationary hydraulic lash adjusters (SHLAs), valve lifters	Replace the SHLAs, valve lifters.
Stretched or broken timing chain or chains and/or damaged sprocket teeth	Replace the timing chain or chains and sprockets.
Worn timing chain tensioner or tensioners	Replace the timing chain tensioner or tensioners as required.
Worn timing chain shoe or shoes	Replace the timing chain shoe or shoes as required.
Worn timing chain guide or guides	Replace the timing chain guide or guides as required.
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft or camshafts and SHLAs, valve lifters, as required.
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides
• Stuck valves • Carbon on the valve stem or valve seat may cause the valve to stay open	Inspect the following components, and repair as required: • The valves • The valve guides

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LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **OIL PRESSURE DIAGNOSIS AND TESTING** . 2. Repair or replace damaged components as required.
• Worn accessory drive components • Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition controls system. Refer to **SYMPTOMS - ENGINE CONTROLS** .
Loose torque converter bolts	1. Inspect the torque converter bolts and engine flywheel. 2. Repair or replace as required.
Loose or damaged engine flywheel	Repair or replace the engine flywheel.
• Damaged oil pan, contacting the oil pump screen • An oil pan that has been damaged may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen. 3. Repair or replace as required.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin, and the connecting rod. 2. Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft • The crankshaft journals

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Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals
• Incorrect piston, piston pin and connecting rod installation • Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. 2. Repair as required.

ENGINE NOISE UNDER LOAD

ENGINE NOISE UNDER LOAD

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **OIL PRESSURE DIAGNOSIS AND TESTING** . 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition controls. Refer to **SYMPTOMS - ENGINE CONTROLS** .
Loose torque converter bolts	1. Inspect the torque converter bolts and engine flywheel. 2. Repair as required.
Cracked engine flywheel	1. Inspect the engine flywheel and bolts. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Cause	Correction
	1. Remove the accessory drive belt or belts.

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Seized accessory drive system component	2. Rotate the crankshaft by hand at the crankshaft balancer or the engine flywheel location. 3. Repair or replace as required.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove the spark plugs and check for fluid. 2. Inspect for broken head gasket or gaskets. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector. 5. Repair or replace as required.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate the crankshaft by hand at the crankshaft balancer or the engine flywheel location. 3. Repair or replace as required.
Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect the cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
Seized crankshaft or connecting rod bearings	1. Inspect the crankshaft and the connecting rod bearings. 2. Repair as required.
Bent or broken connecting rod	1. Inspect the connecting rods. 2. Repair as required.
Broken crankshaft	1. Inspect the crankshaft. 2. Repair as required.
Seized or broken camshaft	1. Inspect the camshaft or camshafts. 2. Inspect the cylinder head camshaft journals for damage. 3. Repair as required.
Seized or broken balance shaft	1. Inspect the balance shaft. 2. Inspect the block for damaged balance shaft bearings. 3. Repair as required.
Seized or broken camshaft timing components	1. Inspect the following sprockets: o The crankshaft sprocket o The exhaust sprockets o The intake sprockets 2. Inspect the following chains: o The primary camshaft drive chain o The secondary camshaft drive chains 3. Inspect the following guides:

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	○ The lower primary camshaft drive chain guide ○ The upper primary camshaft drive chain guides 4. Inspect the secondary camshaft drive chain shoe. 5. Inspect the following tensioners: ○ The primary camshaft drive chain tensioner ○ The secondary camshaft drive chain tensioners 6. Repair as required.
Seized or broken valve train components	1. Inspect the followers, rocker arms. 2. Inspect the lifters. 3. Inspect the valves. 4. Inspect the valve springs. 5. Repair as required.

COOLANT IN COMBUSTION CHAMBER

COOLANT IN COMBUSTION CHAMBER

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to **ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE**. 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a **CYLINDER LEAKAGE TEST**. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to **ENGINE COMPRESSION TEST**.	
Cracked intake manifold or failed gasket	Replace the components as required.
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** and **CYLINDER HEAD REPLACEMENT - LEFT SIDE** or **CYLINDER HEAD REPLACEMENT - RIGHT SIDE**.
Warped cylinder head	Machine the cylinder head to the proper flatness, if applicable and replace the cylinder head gasket. Refer to **CYLINDER HEAD CLEANING AND INSPECTION**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine	Replace the components as required.

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block	
Cylinder head or engine block porosity	Replace the components as required.

COOLANT IN ENGINE OIL

COOLANT IN ENGINE OIL

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil "overfill" condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to **LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED**. 2. Inspect by performing a **CYLINDER LEAKAGE TEST**. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block with low compression may indicate a failed cylinder head gasket. Refer to **ENGINE COMPRESSION TEST**.	
Faulty external engine oil cooler	Replace the components as required.
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** and **CYLINDER HEAD REPLACEMENT - LEFT SIDE** or **CYLINDER HEAD REPLACEMENT - RIGHT SIDE**.
Warped cylinder head	Machine the cylinder head to proper flatness, if applicable, and replace the cylinder head gasket. Refer to **CYLINDER HEAD CLEANING AND INSPECTION**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head, block, or manifold porosity	Replace the components as required.

ENGINE COMPRESSION TEST

Special Tool

J 39313 Spark Plug Port Adapter

A compression pressure test of the engine cylinders determines the condition of the rings, the valves and the

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head gasket.

1. Run the engine until it reaches normal operating temperature. The battery must be at or near full charge.
2. Turn the engine OFF.

NOTE: Remove the Powertrain Control Module (PCM) and the ignition fuse from the Instrument Panel (I/P) fuse block.

3. Disable the ignition.
4. Disable the fuel systems.
5. Remove the spark plugs from all cylinders.
6. Remove the air duct from the throttle body.
7. Block the throttle plate in open position.
8. Measure the engine compression, using the following procedure:
   a. Thread the J 39313 into the spark plug hole.
   b. Thread the compression gage into the J 39313.
   c. Have an assistant crank the engine through, at least 4 compression strokes, in the testing cylinder.
   d. Check and record the readings on the gage at each stroke.
   e. Remove the compression gage from the J 39313.
   f. Remove the J 39313 from the spark plug hole.
   g. Repeat the compression test for each cylinder.
9. Record the compression readings from all of the cylinders.
   - The lowest reading should not be less than 70 percent of the highest reading.
   - No cylinder reading should be less than 965 kPa (140 psi).
10. The following are examples of measurement problems:
    - When the compression measurement is normal, the compression builds up quickly and evenly to specified compression on each cylinder.
    - When low compression is caused by the piston rings, compression is low on the first stroke and tends to build up on the following strokes, but does not reach normal. Compression improves considerably with the addition of oil. Use approximately 3 squirts of oil from a plunger-type oiler.
    - When low compression is caused by the valves, the measurement is low on the first stroke and does not build up even with the addition of oil.
    - Leaking head gaskets will provide the same results as worn valves but engine coolant may be identified in the crankcase. In addition, a leaking head gasket will give low readings on paired cylinders.
11. Remove the block from the throttle plate.
12. Install the air duct to the throttle body.
13. Install the spark plugs.
14. Install the Powertrain Control Module (PCM).
15. Install the ignition fuses to the I/P fuse block.

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CYLINDER LEAKAGE TEST

Special Tool

J 35667-A Cylinder Head Leakdown Tester

J 39313 Spark Plug Port Adapter

NOTE: A leakage test may be performed in order to measure cylinder/combustion chamber leakage. High cylinder leakage may indicate one or more of the following:

- **Worn or burnt valves**
- **Broken valve springs**
- **Stuck valve lifters**
- **Incorrect valve lash/adjustment**
- **Damaged piston**
- **Worn piston rings**
- **Worn or scored cylinder bore**
- **Damaged cylinder head gasket**
- **Cracked or damaged cylinder head**
- **Cracked or damaged engine block**

WARNING: Refer to BATTERY DISCONNECT CAUTION .

1. Disconnect the battery ground negative cable.
2. Remove the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
3. Rotate the crankshaft to place the piston in the cylinder being tested at top dead center (TDC) of the compression stroke.
4. Thread the J 39313 into the spark plug hole.
5. Install the J 35667-A or equivalent.

NOTE: It may be necessary to hold the crankshaft balancer bolt to prevent the engine from rotating.

6. Apply shop air pressure to the J 35667-A and adjust according to the manufacturers instructions.
7. Record the cylinder leakage value. Cylinder leakage that exceeds 25 percent is considered excessive and may require component service. In excessive leakage situations, inspect for the following conditions:
   - Air leakage sounds at the throttle body or air inlet hose that may indicate a worn or burnt intake valve or a broken valve spring
   - Air leakage sounds at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve

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or a broken valve spring
    - Air leakage sounds from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head
    - Air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.
8. Perform the leakage test on the remaining cylinders and record the values.

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Crankcase Ventilation (CV) System Inspection

- Test for vacuum at the vacuum hose where it connects to the crankcase ventilation valve or the cylinder head cover. There should be manifold vacuum present at the hose. If there is no vacuum, inspect for a plugged hose, leaking hose or a plugged vent adapter.
- Plug the end of the vacuum hose while the engine is running. Inspect the hose for any areas that collapse when the end of the hose is blocked. Replace the hose if it collapses when blocked.
- If oil has accumulated in the intake air duct, inspect for the following conditions:
    - Plugged vacuum orifice in the crankcase ventilation housing
    - Plugged or restricted crankcase ventilation housing
    - Excessive crankcase pressure or blow-by, refer to **OIL CONSUMPTION DIAGNOSIS** .
- Additional items to inspect:
    - Plugged or leaking fresh air vent hose assembly or vent adapter
    - Plugged or restricted passages in the throttle body
    - Missing or damaged O-ring seals on the vent adapter
    - Inspect the cam covers, the oil pan gasket, and other sealing areas for leaks

Results of Incorrect Operation

A plugged crankcase ventilation housing or hose may contribute to the following conditions:

- A rough idle
- Stalling or a slow idle speed
- Oil leaks
- Oil accumulation in the intake air duct
- Sludge in the engine

A leaking housing or hose may contribute to the following conditions:

- A rough idle
- Stalling
- Unstable idle speed

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DRIVE BELT CHIRPING, SQUEAL, AND WHINE DIAGNOSIS

Diagnostic Aids

- A chirping or squeal noise may be intermittent due to moisture on the drive belts or the pulleys. It may be necessary to spray a small amount of water on the drive belts in order to duplicate the customers concern. If spraying water on the drive belt duplicates the symptom, cleaning the belt pulleys may be the probable solution.
- If the noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. An overcharged A/C system, power steering system with a pinched hose or wrong fluid, or a generator failing are suggested items to inspect.
- A chirping, squeal or whine noise may be caused by a loose or improper installation of a body or suspension component. Other items of the vehicle may also cause the noise.
- The drive belts will not cause a whine noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 . The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table.

3 . The noise may be an internal engine noise. Removing the drive belts one at a time and operating the engine for a brief period will verify the noise is related to the drive belt. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4 . Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills or it can be strings in the drive belt grooves from the accumulation of rubber dust.

6 . Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

10 . Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed.

12 . Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

14 . This test is to verify that the drive belt tensioner operates properly. If the drive belt tensioner is not operating properly, proper belt tension may not be achieved to keep the drive belt from slipping which could cause a squeal noise.

15 . This test is to verify that the drive belt is not too long, which would prevent the drive belt tensioner from working properly. Also if an incorrect length drive belt was installed, it may not be routed properly and may be turning an accessory drive component in the wrong direction.

16 . Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or

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outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

17 . This test is to verify that the pulleys are the correct diameter or width. Using a known good vehicle compare the pulley sizes.

19 . Replacing the drive belt when it is not damaged or there is not excessive pilling will only be a temporary repair.

DIAGNOSTIC CHART

Step	Action	Yes	No
CAUTION: **Refer to BELT DRESSING NOTICE .**			
DEFINITION: The following items are indications of chirping: • A high pitched noise that is heard once per revolution of the drive belt or a pulley. • Chirping may occur on cold damp start-ups and will subside once the vehicle reaches normal operating temp. DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belt. This is unusual for a drive belt with multiple ribs. • The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle, or slipping on a seized pulley or a faulty accessory drive component. DEFINITION: The following items are indications of drive belt whine: • A high pitched continuous noise. • The noise may be caused by an accessory drive component failed bearing.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to **SYMPTOMS - ENGINE MECHANICAL**
2	Verify that there is a chirping, squeal or whine noise. Does the engine make the chirping squeal or whine noise?	Go to Step 3	Go to **DIAGNOSTIC AIDS**
	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed.		

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3	2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the chirping, squeal or whine noise still exist?	Go to **SYMPTOMS - ENGINE MECHANICAL**	Go to Step 4
4	If diagnosing a chirping noise, inspect for severe pilling exceeding 1/3 of the belt groove depth. If diagnosing a squeal or whine noise, proceed to step 13. Do the belt grooves have pilling?	Go to Step 5	Go to Step 6
5	Clean the drive belt pulleys with a suitable wire brush. Did you complete the repair?	Go to Step 20	Go to Step 6
6	Inspect for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace or repair any misaligned pulleys. Did you complete the repair?	Go to Step 20	Go to Step 8
8	Inspect for bent or cracked brackets. Did you find any bent or cracked brackets?	Go to Step 9	Go to Step 10
9	Replace any bent or cracked brackets. Did you complete the repair?	Go to Step 20	Go to Step 10
10	Inspect for improper, loose or missing fasteners. Did you find the condition?	Go to Step 11	Go to Step 12
11	**CAUTION:** **Refer to FASTENER NOTICE .** 1. Tighten any loose fasteners. Refer to **FASTENER TIGHTENING SPECIFICATIONS - ENGINE MECHANICAL - 3.6L (LY7)**. 2. Replace any improper or missing fasteners. Did you complete the repair?	Go to Step 20	Go to Step 12
12	Inspect for a bent pulley. Did you find the condition?	Go to Step 18	Go to Step 19
13	Inspect for an accessory drive component seized bearing or a faulty accessory drive component. Did you find and correct the condition? If diagnosing a whine noise and the condition still exist, proceed to **DIAGNOSTIC AIDS**.	Go to Step 20	Go to Step 14
14	Test the drive belt tensioner for proper operation. Refer to **DRIVE BELT TENSIONER DIAGNOSIS**.	Go to Step 20	Go to Step 15

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	Did you find and correct the condition?		
15	Inspect for the correct drive belt length. Did you find and correct the condition?	Go to Step 20	Go to Step 16
16	Inspect for misalignment of a pulley. Did you find and correct the condition?	Go to Step 20	Go to Step 17
17	Inspect for the correct pulley size. Did you find and correct the condition?	Go to Step 20	Go to **DIAGNOSTIC AIDS**
18	Replace the bent pulley. Did you complete the repair?	Go to Step 20	Go to Step 19
19	Replace the drive belt. Refer to **DRIVE BELT REPLACEMENT**. Did you complete the repair?	Go to Step 20	Go to **DIAGNOSTIC AIDS**
20	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

DRIVE BELT RUMBLING AND VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components can have an affect on engine vibration. Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise.

Vibration can be caused by, but not limited to the A/C system over charged, the power steering system restricted or the incorrect fluid, or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

The drive belt may have a rumbling condition that can not be seen or felt. Sometimes replacing the drive belt may be the only repair for the symptom.

If replacing the drive belt, completing the diagnostic table, and the noise is only heard when the drive belts are installed, there might be an accessory drive component with a failure. Varying the load on the different accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 . This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.

3 . This test is to verify that one of the drive belts is causing the rumbling noise or vibration. Rumbling noise may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. When removing the drive belts the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4 . Inspecting the drive belts is to ensure that they are not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise. Belt separation is identified by the plys of the belt separating

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and may be seen at the edge of the belt our felt as a lump in the belt.

5 . Small amounts of pilling is normal condition and acceptable. When the pilling is severe the drive belt does not have a smooth surface for proper operation.

9 . Inspecting of the fasteners can eliminate the possibility that the wrong bolt, nut, spacer, or washer was installed.

11 . This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smooth operation and excessive play. Compare the water pump with a known good water pump.

12 . Accessory drive component brackets that are bent, cracked, or loose may put extra strain on that accessory component causing it to vibrate.

DIAGNOSTIC CHART

Step	Action	Yes	No
CAUTION: **Refer to BELT DRESSING NOTICE .**			
DEFINITION: The following items are indications of drive belt rumbling: • A low pitch tapping, knocking, or thumping noise heard at or just above idle. • Heard once per revolution of the drive belt or a pulley. • Rumbling may be caused from: o Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belt pulley groove o The separation of the drive belt o A damaged drive belt DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to **SYMPTOMS - ENGINE MECHANICAL**
2	Verify that there is a rumbling noise or that the vibration is engine related. Does the engine make the rumbling noise or vibration?	Go to Step 3	Go to **DIAGNOSTIC AIDS**
	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed.	Go to **SYMPTOMS -**	

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3	2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the rumbling or vibration still exist?	**ENGINE MECHANICAL** or Go to **VIBRATION ANALYSIS - ENGINE**	Go to Step 4
4	Inspect the drive belts for wear, damage, separation, sections of missing ribs, and debris build-up. Did you find any of these conditions?	Go to Step 7	Go to Step 5
5	Inspect for severe pilling of more than 1/3 of the drive belt pulley grooves. Did you find severe pilling?	Go to Step 6	Go to Step 7
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall the drive belts. Refer to **DRIVE BELT REPLACEMENT**. Did you correct the condition?	Go to Step 8	Go to Step 7
7	Install a new drive belt. Refer to **DRIVE BELT REPLACEMENT**. Did you complete the replacement?	Go to Step 8	Go to Step 9
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 9
9	Inspect for improper, loose or missing fasteners. Did you find any of these conditions?	Go to Step 10	Go to Step 11
10	**CAUTION:** **Refer to FASTENER NOTICE .** 1. Tighten any loose fasteners. Refer to **FASTENER TIGHTENING SPECIFICATIONS - ENGINE MECHANICAL - 3.6L (LY7)**. 2. Replace improper or missing fasteners. Did you complete the repair?	Go to Step 13	Go to Step 11
11	Inspect for a bent water pump shaft. Refer to **WATER PUMP REPLACEMENT** . Did you find and correct the condition?	Go to Step 13	Go to Step 12
12	Inspect for bent or cracked brackets.	Go to Step 13	Go to **DIAGNOSTIC**

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	Did you find and correct the condition?		**AIDS**
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

DRIVE BELT FALLS OFF AND EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

If the drive belt repeatedly falls off the drive belt pulleys, this is because of pulley misalignment. An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.

If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 . This inspection is to verify the condition of the drive belt. Damage may of occurred to the drive belt when the drive belt fell off. The drive belt may of been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing, or damaged belt plys.

4 . Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.

5 . Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

6 . Accessory drive component brackets that are bent or cracked will let the drive belt fall off.

7 . Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing. loose, or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

13 . The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mis-positioning the drive belt by one groove on a pulley.

14 . The installation of a drive belt that is two wide or two narrow will cause wear on the drive belt. The

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drive belt ribs should match all of the grooves on all of the pulleys.

15 . This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

DIAGNOSTIC CHART

Step	Action	Yes	No
CAUTION: **Refer to BELT DRESSING NOTICE .**			
DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys. DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to **SYMPTOMS - ENGINE MECHANICAL**
2	If diagnosing excessive wear, proceed to step 13. If diagnosing a drive belt that falls off, inspect for a damaged drive belt. Did you find the condition?	Go to Step 3	Go to Step 4
3	Install a new drive belt. Refer to **DRIVE BELT REPLACEMENT**. Does the drive belt continue to fall off?	Go to Step 4	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to Step 12	Go to Step 5
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to Step 12	Go to Step 6
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to Step 12	Go to Step 7
7	Inspect for improper, loose or missing fasteners. Did you find loose or missing fasteners?	Go to Step 8	Go to Step 9
8	**CAUTION:** **Refer to FASTENER NOTICE .** 1. Tighten any loose fasteners. Refer to **FASTENER TIGHTENING SPECIFICATIONS - ENGINE MECHANICAL - 3.6L (LY7)**. 2. Replace improper or missing fasteners. Does the drive belt continue to fall off?	Go to Step 9	System OK
9	Test the drive belt tensioner for operating correctly. Refer to **DRIVE BELT TENSIONER DIAGNOSIS**. Does the drive belt tensioner operate correctly?	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner. Refer to **DRIVE BELT TENSIONER REPLACEMENT**. Does the drive belt continue to fall off?	Go to Step 11	System OK

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11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to Step 12	Go to **DIAGNOSTIC AIDS**
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
13	Inspect the drive belt for the proper installation. Refer to **DRIVE BELT REPLACEMENT**. Did you find this condition?	Go to Step 16	Go to Step 14
14	Inspect for the proper drive belt. Did you find this condition?	Go to Step 16	Go to Step 15
15	Inspect for the drive belt rubbing against a bracket, hose, or wiring harness. Did you find and repair the condition?	Go to Step 17	Go to **DIAGNOSTIC AIDS**
16	Replace the drive belt. Refer to **DRIVE BELT REPLACEMENT**. Did you complete the replacement?	Go to Step 17	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

DRIVE BELT TENSIONER DIAGNOSIS

DIAGNOSTIC CHART

Step	Action	Yes	No
1	Remove the drive belt and inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to Step 4	Go to Step 2
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to Step 3	Go to Step 4
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the stop. Is the first torque reading within 10% of the second torque reading?	System OK	Go to Step 4
4	Replace the drive belt tensioner. Is the repair complete?	System OK	-

VIBRATION ANALYSIS - ENGINE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 . If powertrain related DTCs are present, there may be a powertrain performance condition present which could be a contributing cause to the customer's concern.

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5 . Making comparisons of the customer's vehicle with an equally equipped, same model year and type, KNOWN GOOD vehicle will help determine if certain disturbances may be characteristic of a vehicle design.

DIAGNOSTIC CHART

Step	Action	Yes	No
WARNING: **Refer to WORK STALL TEST CAUTION .**			
1	Has the Vibration Analysis - Road Testing table been completed?	Go to Step 2	Go to **VIBRATION ANALYSIS - ROAD TESTING**
2	Using a scan tool, determine if any DTCs are set. Were any DTCs set?	Go to **DIAGNOSTIC STARTING POINT - VIBRATION DIAGNOSIS AND CORRECTION**	Go to Step 3
3	1. Block the front wheels. 2. Apply BOTH the service brakes and the park brake. 3. With the scan tool and the J 38792-A, Electronic Vibration Analyzer (EVA) 2, if available, still installed, start the engine. 4. Place the transmission in NEUTRAL or PARK. 5. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 6. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 7. Place the transmission in DRIVE. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 10. If no frequency data was obtained, or if the J 38792-A, is	Go to Step 4	Go to **VIBRATION DIAGNOSTIC AIDS**

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	not available, place the transmission into REVERSE, then repeat steps 8 and 9. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Were you able to duplicate the customer's concern?		
4	Did the J 38792-A detect a dominant frequency, or was a significant vibration present?	Go to **VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION**	Go to Step 5
5	Compare the test results of the customer's vehicle to the results of the same tests run, at the same engine RPM, on an equally-equipped, same model year and type, KNOWN GOOD vehicle. Refer to **VEHICLE-TO-VEHICLE DIAGNOSTIC COMPARISON** . 1. Install a scan tool into the known good vehicle. 2. Install the J 38792-A, if available, into the known good vehicle; place the sensor in exactly the same location as it was placed in the customer's vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine. 6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency	Go to **VIBRATION DIAGNOSTIC AIDS**	Go to **VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION**

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	reading if obtained on the J 38792-A, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 12. If no frequency data was obtained, or if the J 38792-A, is not available, place the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Did both of the vehicles exhibit the same characteristics?		

VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5 . A loose, damaged, misaligned, or defective powertrain insulator and/or bracket may create a transfer path into the passenger compartment.

6 . A loose, damaged, misaligned, or defective exhaust system insulator and/or bracket may create a transfer path into the passenger compartment.

7 . Incorrectly seated and/or aligned powertrain components and/or exhaust system components may create a transfer path into the passenger compartment.

When loosening powertrain mounts in order to re-bed the powertrain observe the following:

Do not loosen the mount bracket-to-engine bolts/nuts, do not loosen the mount bracket-to-vehicle frame bolts/nuts if mount brackets are used.

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Loosen the mount-to-mount bracket bolts/nuts if mount brackets are used, or loosen the mount-to-slotted holes in vehicle frame bolts/nuts if a direct-mount design is used.

8 . Non-rotating engine driven accessory component systems can no longer produce a unique disturbance.

9 . Non-rotating engine driven accessory components can no longer produce a unique disturbance. If a disturbance is still present, but the characteristics have been altered, it is possible that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.

If a disturbance is still present, but the characteristics have NOT been altered, it is NOT likely that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.

10 . If the mark placed on the face of an engine driven accessory pulley seems to stand still while running this test, then that accessory system is either responding to an existing frequency, such as engine firing pulses, or creating a disturbance.

11 . A loose, damaged, misaligned, or defective engine driven accessory system insulator and/or bracket may create a transfer path into the passenger compartment.

12 . Removing the engine driven accessory and bracket, or brackets from the engine allows a thorough inspection to determine if any conditions are present that may create a transfer path into the passenger compartment.

DIAGNOSTIC CHART

Step	Action	Yes	No
WARNING: **Refer to WORK STALL TEST CAUTION .**			
1	Were you sent here from the Vibration Analysis - Engine table?	Go to Step 2	Go to **VIBRATION ANALYSIS - ENGINE**
2	Is the J 38792-A, Electronic Vibration Analyzer (EVA) 2, available?	Go to Step 3	Go to Step 5
3	1. Using the engine RPM and frequency data recorded for the customer's vehicle, determine the order of engine rotation to which the disturbance is related. 2. Determine the possible causes of the disturbance as it relates to a specific order of engine rotation. Refer to **ENGINE ORDER CLASSIFICATION**. Does the Engine Order Classification table indicate that the disturbance is of the same order as the engine firing frequency?	Go to Step 5	Go to Step 4
4	Does the Engine Order Classification table indicate that the disturbance is likely related to engine driven accessories?	Go to Step 8	Go to Step 5

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5	Inspect the powertrain mounts-engine, transmission, transfer case, and direct-mount drive axle, if equipped-and any powertrain braces for the following conditions: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets Realign or replace powertrain mounts as indicated by the inspection. Did you find and correct a condition?	Go to Step 13	Go to Step 6
6	Inspect the exhaust system components for the following: • Loose and/or missing fasteners o Heat Shields o Joints and/or couplings: Nuts, bolts, studs, clamps, straps o Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets Repair, replace, and/or realign exhaust system components as indicated by the inspection. Did you find and correct a condition?	Go to Step 13	Go to Step 7
	Perform the Powertrain Mount Balance Procedure if available or perform the following procedure to re-bed the powertrain: 1. Loosen, but do not remove, all powertrain mounts and exhaust system hangers.		

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7	2. Ensure that the exhaust flexible coupling, if equipped, moves freely. 3. Start the engine. 4. Settle the powertrain by shifting the transmission from DRIVE to REVERSE. 5. Place the transmission into NEUTRAL. 6. Turn OFF the ignition. 7. Tighten all of the loosened fasteners with the powertrain in a relaxed position. Did you complete the operation?	Go to Step 13	-
8	**CAUTION:** **Do not run the engine for longer than 60 seconds with the accessory drive belt, or belts removed, or overheating and/or damage may result.** 1. Remove the engine accessory drive belt, or belts. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the scan tool still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Increase the engine RPM to the level recorded during duplication of the disturbance. 7. Allow the engine to idle, then place the transmission in DRIVE. 8. Increase the engine RPM to the level recorded during duplication of the disturbance. 9. Turn OFF the ignition. 10. Install the engine accessory drive belt, or belts. Was the disturbance significantly reduced or eliminated?	Go to Step 10	Go to Step 9
9	Were the characteristics of the disturbance altered but still present?	Go to Step 11	Go to Step 15
	1. Mark the face of the suspected accessory pulleys, including any related idler pulleys, near the outer edge with a paint mark. 2. Install the J 38792-25, Inductive Pickup Timing Light to the J 38792-A. For information on the use of the EVA features, refer to **ELECTRONIC VIBRATION**		

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10	**ANALYZER (EVA) DESCRIPTION AND OPERATION** . 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. With the scan tool and the J 38792-A, still installed, start the engine. 6. Select the Smart Strobe feature on the J 38792-A. 7. Enter the recorded frequency of the disturbance as the initial frequency for strobe operation. 8. Have an assistant place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed. 10. Using the J 38792-25, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 11. Allow the engine to idle, then place the transmission in DRIVE. 12. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed closely. 13. Using the J 38792-25, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 14. Turn OFF the ignition. Did you identify an engine driven accessory system as being related to the frequency of the disturbance?	Go to Step 11	Go to **VIBRATION DIAGNOSTIC AIDS**
	Inspect the components of the engine driven accessory system for the following: • Loose and/or missing fasteners		

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11	○ Heat Shields, if equipped ○ Joints and/or couplings: Nuts, bolts, studs, clamps, straps ○ Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the accessory system both under a LOAD and NOT loaded • Improper alignment • Bent or damaged pulleys • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked component insulators • Stretched, twisted, broken, torn, and/or collapsed component insulators • Bent, twisted, cracked and/or deformed component brackets Repair, replace, and/or realign the engine driven accessory system components as indicated by the inspection. Did you find and correct a condition?	Go to Step 13	Go to Step 12
12	1. Remove the engine driven accessory and bracket, or brackets from the engine. 2. Thoroughly inspect the accessory bracket, or brackets, bolts/nuts/studs, and the accessory itself for signs of the following: Bent, twisted, cracked and/or deformed conditions 3. Replace any of the components found to exhibit any of these conditions. 4. Reinstall the components to the engine. Did you find and correct a condition?	Go to Step 13	Go to Step 17
	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install a scan tool into the customer's vehicle. 2. Install the J 38792-A, if available, into the		

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13	customer's vehicle; place the sensor in exactly the same location as it was originally placed in the vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine. 6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 12. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?	Go to Step 18	Go to Step 14
14	Have you investigated powertrain isolation as a possible cause of the disturbance?	Go to Step 15	Go to Step 5
15	Have you investigated engine driven accessories as a possible cause of the disturbance?	Go to **VIBRATION ANALYSIS - ENGINE BALANCE**	Go to Step 16
16	Is the J 38792-A available?	Go to Step 8	Go to **VIBRATION DIAGNOSTIC AIDS**
17	Replace the engine driven accessory component causing the disturbance. Did you complete the replacement?	Go to Step 18	-
	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing		

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18	table. Refer to **VIBRATION ANALYSIS - ROAD TESTING** . Is the disturbance still present?	Go to Step 2	System OK

VIBRATION ANALYSIS - ENGINE BALANCE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4 . If sufficient clearance exists to separate the transmission torque converter from the engine flywheel/flexplate, then further tests can be used to isolate the transmission from the engine.

5 . An engine flywheel/flexplate that has excessive lateral runout, when combined with the mass of the transmission torque converter, can produce a disturbance.

6 . An engine flywheel/flexplate that is loose at the engine crankshaft or that is cracked or damaged, when combined with the mass of the transmission torque converter, can produce a disturbance.

7 . This step is designed to isolate the transmission from the engine to determine if the disturbance is related to the engine ONLY.

9 . Re-indexing the transmission torque converter to the engine flywheel/flexplate alters the balance relationship between the torque converter and the rear of the engine.

11 . Placing the J 38792-A sensor onto the underside of the engine oil pan along the FRONT and the REAR edge allows for a determination to be made, which will help to narrow down the cause of the disturbance.

13 . An engine flywheel that has excessive lateral runout, when combined with the extra mass of the clutch pressure plate and clutch driven plate, can produce a disturbance.

14 . The clutch pressure plate and the engine flywheel are marked for proper indexing of the heavy-spot of one to the light-spot of the other. Improper indexing of the pressure plate to the flywheel can produce a disturbance.

15 . An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

16 . An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

17 . Re-indexing the pressure plate to the engine flywheel alters the balance relationship between the pressure plate/flywheel assembly and the rear of the engine.

18 . An engine flywheel/flexplate that is damaged, misaligned, and/or unbalanced, can produce a disturbance.

19 . An engine crankshaft balancer that is damaged, misaligned, and/or unbalanced, can produce a disturbance.

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DIAGNOSTIC CHART

Step	Action	Yes	No
WARNING: **Refer to WORK STALL TEST CAUTION .**			
1	Were you sent here from the Vibration Analysis - Engine/Accessory Isolation table?	Go to Step 2	Go to **VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION**
2	Is the J 38792-A, Electronic Vibration Analyzer (EVA) 2, available?	Go to Step 3	Go to **VIBRATION DIAGNOSTIC AIDS**
3	Is the vehicle equipped with a manual transmission?	Go to Step 11	Go to Step 4
4	1. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** . 2. Remove the flywheel/flexplate-to-torque converter bolts access cover, if equipped. 3. Determine if sufficient clearance exists to separate the transmission torque converter away from the engine flywheel/flexplate and safely secure the torque converter from accidentally engaging with the flywheel/flexplate. Is there sufficient clearance to separate and safely secure the transmission torque converter away from the engine flywheel/flexplate?	Go to Step 5	Go to Step 11
5	1. With the flywheel/flexplate-to-torque converter access cover still removed, and with the vehicle still raised, mark the position of the transmission torque converter in relation to the engine flywheel/flexplate. 2. Disconnect the torque converter and move it away from the flywheel/flexplate. 3. Secure the transmission torque converter away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate. 4. Lower the vehicle, start the engine and allow the engine to idle. 5. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE**	Go to Step 8	Go to Step 6

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	VEHICLE . 6. Visually inspect the flywheel/flexplate for excessive lateral runout. 7. Lower the vehicle. 8. Turn OFF the ignition. Did the flywheel/flexplate exhibit excessive lateral runout?		
6	1. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** . 2. Inspect the flywheel/flexplate for the following: o Looseness at the engine crankshaft o Cracks and/or damage o Missing balance weights Did the flywheel/flexplate exhibit any of the conditions listed?	Go to Step 8	Go to Step 7
7	1. With the transmission torque converter still secured away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate, lower the vehicle. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the scan tool and the J 38792-A still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 7. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A. 8. Turn OFF the ignition. Has the disturbance been significantly reduced or	Go to Step 9	Go to Step 11

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	eliminated?		
8	1. If the flywheel/flexplate is loose at the engine crankshaft, tighten the flywheel/flexplate mounting bolts in sequence and to specification. 2. If the flywheel/flexplate is cracked, damaged, and/or has missing balance weights, replace the damaged flywheel/flexplate. Did you complete the tightening or replacement?	Go to Step 20	-
9	1. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** . 2. Re-index the transmission torque converter to the engine flywheel/flexplate, 120 degrees from its original position. 3. Reconnect the transmission torque converter to the engine flywheel/flexplate. 4. Lower the vehicle. 5. Block the front wheels. 6. Apply BOTH the service brakes and the park brake. 7. With the scan tool and the J 38792-A still installed, start the engine. 8. Place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 10. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A. 11. If the disturbance is still noticeable, re-index the torque converter again to obtain the least amount of disturbance. Has the disturbance been significantly reduced or eliminated?	Go to Step 20	Go to Step 10
10	Replace the out-of-balance transmission torque converter. Did you complete the replacement?	Go to Step 20	-

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11	1. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** . 2. Position the J 38792-A sensor onto the underside of the engine oil pan, along the FRONT edge. 3. Lower the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. With the scan tool and the J 38792-A, still installed, start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A from the underside of the engine oil pan. 10. Repeat steps 1 through 9, placing the J 38792-A sensor onto the underside of the engine oil pan, along the REAR edge. Is the disturbance greater along the FRONT of the engine?	Go to Step 19	Go to Step 12
12	Is the vehicle equipped with an automatic transmission?	Go to Step 18	Go to Step 13
13	1. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** . 2. Remove the flywheel inspection cover. 3. Start the engine. Allow the engine to idle. 4. Visually inspect the engine flywheel clutch surface for excessive lateral runout. Does the engine flywheel clutch surface exhibit excessive lateral runout?	Go to Step 18	Go to Step 14
14	Inspect the clutch pressure plate to engine flywheel mounting for proper factory indexing.	Go to Step 16	Go to Step 15

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	Is the clutch pressure plate properly indexed to the engine flywheel?		
15	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: o Looseness at the engine crankshaft o Cracks, warpage and/or damage o Missing balance weights 3. Inspect the clutch pressure plate and clutch driven plate for the following: o Loose and/or damaged clutch driven plate damper springs o Loose and/or damaged clutch pressure plate diaphragm springs o Cracks, warpage and/or damage o Missing balance weights Do any of the above conditions exist?	Go to Step 18	Go to Step 17
16	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: o Looseness at the engine crankshaft o Cracks, warpage and/or damage o Missing balance weights 3. Inspect the clutch pressure plate and clutch driven plate for the following: o Loose and/or damaged clutch driven plate damper springs o Loose and/or damaged clutch pressure plate diaphragm springs o Cracks, warpage and/or damage o Missing balance weights Do any of the above conditions exist?	Go to Step 18	Go to **VIBRATION DIAGNOSTIC AIDS**
17	Re-index the pressure plate to the engine flywheel.	Go to Step 20	-

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	Did you complete the re-indexing?		
18	Replace the engine flywheel/flexplate. Did you complete the replacement?	Go to Step 20	-
19	Replace the engine crankshaft balancer. Did you complete the replacement?	Go to Step 20	-
20	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install or connect any components that were removed or disconnected during diagnosis. 2. Install a scan tool into the customer's vehicle. 3. Install the J 38792-A, if available, into the customer's vehicle; place the sensor in exactly the same location as it was originally placed in the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. Start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 10. Place the transmission in DRIVE. 11. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 12. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the J 38792-A, if available. 13. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 11 and 12. Reverse-loading of the powertrain may	Go to Step 21	Go to **VIBRATION DIAGNOSTIC AIDS**

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	increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?		
21	Perform the Vibration Analysis - Road Testing table. Refer to **VIBRATION ANALYSIS - ROAD TESTING** . Is the disturbance still present?	Go to **VIBRATION DIAGNOSTIC AIDS**	System OK

ENGINE ORDER CLASSIFICATION

Engine First Order Classification

1. Convert the engine speed in revolutions per minute (RPM), recorded during duplication of the disturbance into Hertz, revolutions per second (RPS), by dividing the RPM by 60 seconds. Refer to the following example:

   1,200 RPM divided by 60 = 20 Hz (or RPS)

2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine speed just converted into Hz, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, ARE related, then an engine FIRST ORDER related disturbance is present. Engine first order disturbances are usually related to an unbalanced component. Refer to the **ENGINE ORDER RELATED DISTURBANCES TABLE**.
4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, are NOT related, then determine if the disturbance is related to the engine's firing frequency. Proceed to **ENGINE FIRING FREQUENCY CLASSIFICATION**.

Engine Firing Frequency Classification

Engine firing frequency is a term used to describe the number of firing pulses (one firing pulse = one cylinder firing) that occur during ONE complete revolution of the crankshaft, multiplied by the number of crankshaft revolutions per second, Hz.

1. Calculate the engine firing frequency.
   - To determine the firing frequency of a 4-stroke engine during ONE complete revolution of the crankshaft, multiply the engine speed, converted into Hz, by HALF of the total number of cylinders in the engine.
   - For example: The engine speed, converted into Hz, was 20 Hz; if the vehicle was equipped with a V8 engine, 4 of the 8 cylinders would actually fire during ONE complete revolution of the crankshaft.
     - Multiply the converted engine speed (20 Hz) by 4 cylinders firing. 20 Hz X 4 = 80 Hz
     - The engine firing frequency for a V8 engine at the original engine speed of 1,200 RPM,

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recorded during duplication of the disturbance, would be 80 Hz.

- In like manner, a 6-cylinder engine would have a firing frequency of 60 Hz at the same engine speed of 1,200 RPM. 20 Hz X 3 = 60 Hz

2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine firing frequency in Hz, just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated ARE related, then an engine FIRING FREQUENCY related disturbance is present. Engine firing frequency disturbances are usually related to improper isolation of a component. Refer to the **ENGINE ORDER RELATED DISTURBANCES TABLE**.
4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated are NOT related, then determine if the disturbance is related to another engine order classification. Proceed to **OTHER ENGINE ORDER CLASSIFICATION**.

Other Engine Order Classification

1. Multiply the engine speed, converted into Hz, recorded during duplication of the disturbance by different possible order-numbers, other than 1 (first order) or the number used to determine the firing frequency of the engine.
2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the other possible engine orders just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and one of the other engine order frequencies in Hz, just calculated ARE related, then an engine related disturbance of that order is present. If an engine related disturbance is present that is NOT related to first order or firing frequency, then it could be related to an engine driven accessory system. Proceed to **ENGINE DRIVEN ACCESSORIES RELATED TO ENGINE ORDER**.

Engine Driven Accessories Related to Engine Order

Engine driven accessory systems can be related to specific engine orders depending upon the relationship of the accessory pulley diameter to the crankshaft pulley diameter. For example:

- If the crankshaft pulley measured 20 cm (8 in) in diameter and one of the engine driven accessory pulleys measured 10 cm (4 in) in diameter, then that accessory pulley would rotate 2 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 2nd order engine related disturbance.
- In like manner, if an engine driven accessory pulley measured 5 cm (2 in) in diameter, then that accessory pulley would rotate 4 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 4th order engine related disturbance.

Engine driven accessories that contribute to, are excited by, or are the sole cause of a disturbance are usually doing so because of improper isolation that causes a transfer path into the passenger compartment or to another major component of the vehicle body.

Using the J 38792-VS, Vibrate Software, accurately measuring the diameters of the accessory pulleys and the crankshaft pulley, and performing the appropriate diagnostic procedures completely will lead to the specific

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accessory system which is either contributing to, or causing the customer's concern.

ENGINE ORDER RELATED DISTURBANCES

Engine Order	Engine Arrangement						
	L4 W/O Balance Shaft	L4 With Balance Shaft	L5	L6	60 Degree V6	90 Degree V6 With Balance Shaft	90 Degre
1/2 Order Torque Sensitive	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnorm Likely Si Cylind Misfi
1st Order	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnorm Likel Compor Imbala
11/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance Possible Engine Driven Accessory Related	Possib Engine D Access Relate
2nd Order Non Torque Sensitive	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Possib Engine D Access Relate
2nd Order Torque Sensitive	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnorm Likely Ba Bank EGR/F Varian Possib Engine D Access Relate
			Characteristic				

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2 1/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	- ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Related Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possib Engine D Access
3rd Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possib Engine D Access Relate
4th Order Torque Sensitive	Characteristic - Minimal Amount - of Engine Arrangement - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - Minimal Amount - of Engine Arrangement - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characte - ENGI FIRIN FREQUE - Possil Powertr Isolati Relate Possib Engine D Access Relate

REPAIR INSTRUCTIONS

AIR CLEANER OUTLET DUCT REPLACEMENT

Removal Procedure

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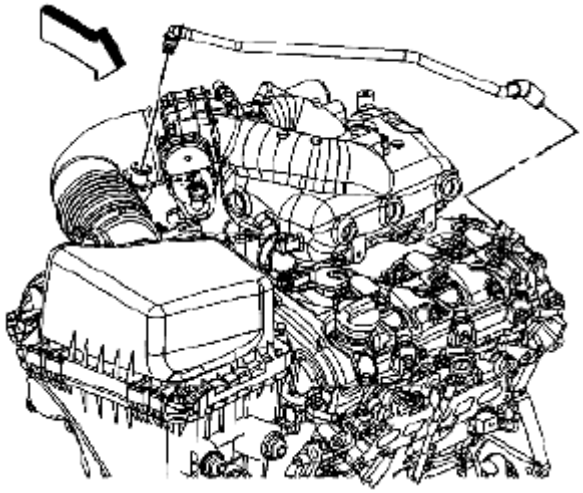


Fig. 18: Identifying Positive Crankcase Ventilation Tube
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the fuel injector sight shield. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
2. Remove the Positive Crankcase Ventilation (PCV) tube from the air cleaner outlet duct.

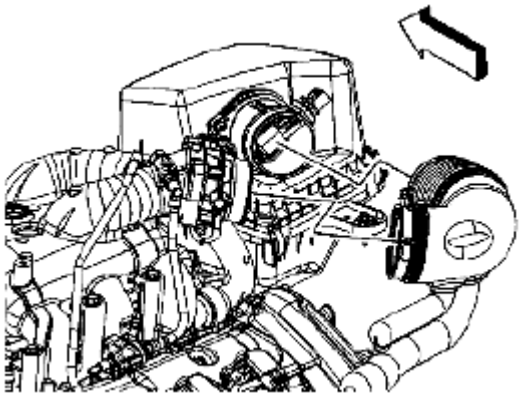


Fig. 19: Identifying Air Cleaner Outlet Duct Clamps, Mass Air Flow And Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

3. Loosen the air cleaner outlet duct clamps at the throttle body and the Mass Air Flow (MAF)/Intake Air Temperature (IAT) sensor.
4. Remove the air cleaner intake duct from the MAF/IAT sensor and the throttle body.

Installation Procedure

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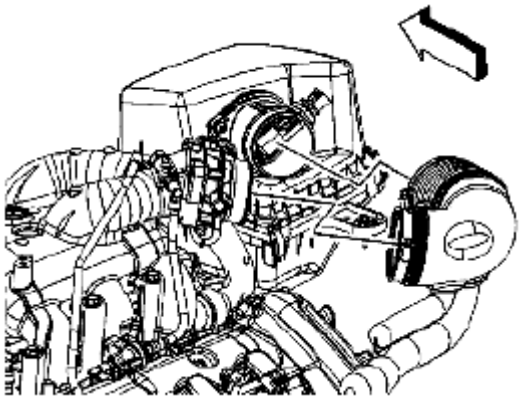


Fig. 20: Identifying Air Cleaner Outlet Duct Clamps, Mass Air Flow And Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the air cleaner intake duct to the MAF/IAT sensor and the throttle body.

   CAUTION: Refer to FASTENER NOTICE .

2. Tighten the air cleaner outlet duct clamps at the throttle body and the MAF/IAT sensor.

   Tightening torque

   Tighten the clamps to 4 N.m (35 lb in) .

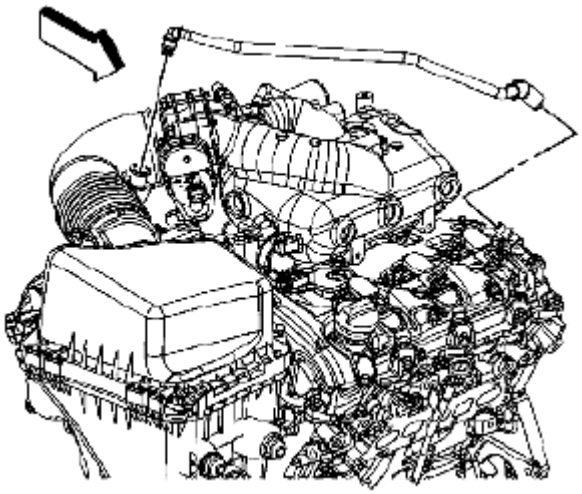


Fig. 21: Identifying Positive Crankcase Ventilation Tube
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the PCV tube to the air cleaner outlet duct.
4. Install the fuel injector sight shield. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.

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AIR CLEANER ELEMENT REPLACEMENT

Removal Procedure

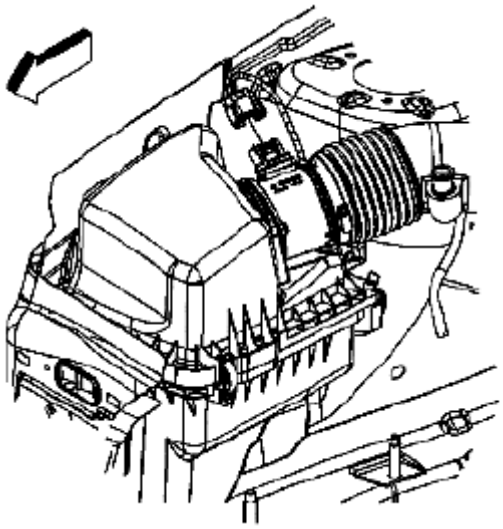


Fig. 22: Identifying Engine Wiring Harness Electrical Connector Of Mass Air Flow/Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.
2. Disconnect the engine wiring harness electrical connector from the mass air flow (MAF)/intake air temperature (IAT) sensor.

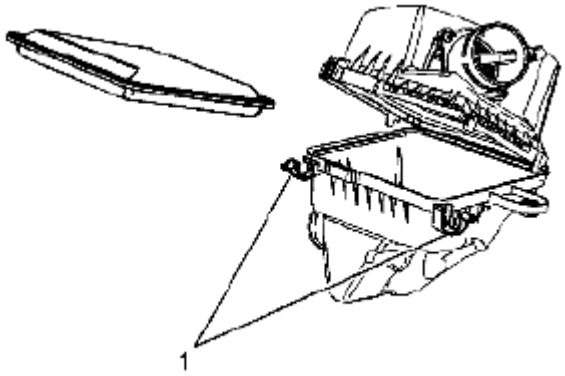


Fig. 23: Identifying Air Cleaner Lower Half Clips
Courtesy of SUZUKI OF AMERICA CORP.

3. Release the clips (1) on the air cleaner lower half.
4. Open and rotate the air cleaner upper half.
5. Remove the air cleaner element.

Installation Procedure

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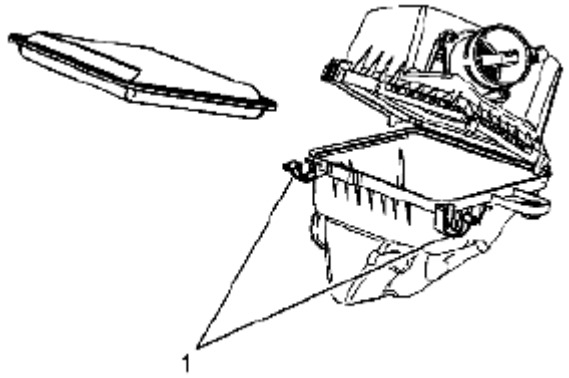


Fig. 24: Identifying Air Cleaner Lower Half Clips
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the air cleaner element.
2. Rotate and close the air cleaner upper half.
3. Secure the clips (1) on the air cleaner lower half.

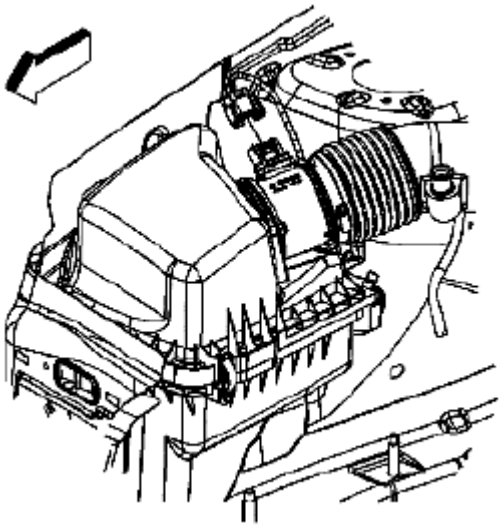


Fig. 25: Identifying Engine Wiring Harness Electrical Connector Of Mass Air Flow/Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

4. Connect the engine wiring harness electrical connector to the MAF/IAT sensor.
5. Install the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.

AIR CLEANER ASSEMBLY REPLACEMENT

Removal Procedure

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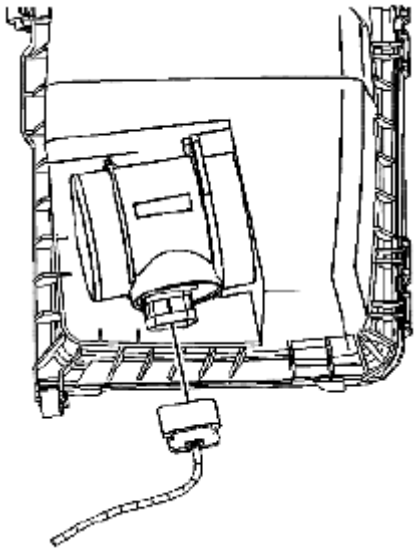


Fig. 26: Identifying Engine Wiring Harness Electrical Connector Of Mass Air Flow/Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.
2. Disconnect the engine wiring harness electrical connector from the Mass Air Flow (MAF)/Intake Air Temperature (IAT) sensor.

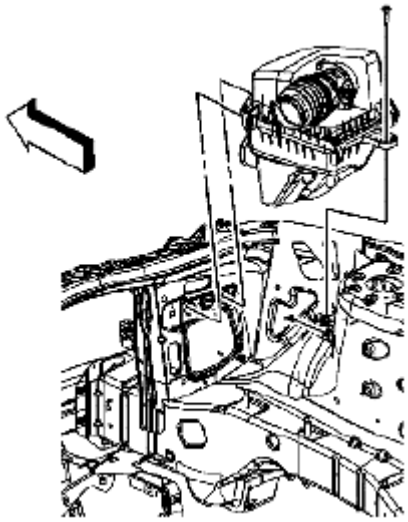


Fig. 27: Identifying Air Cleaner Assembly
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the air cleaner bolt.
4. Disengage the air cleaner pins from the front panel and remove the air cleaner assembly.
5. If replacing the air cleaner assembly, remove the MAF/IAT sensor. Refer to **MASS AIRFLOW SENSOR/INTAKE AIR TEMPERATURE SENSOR REPLACEMENT** .

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Installation Procedure

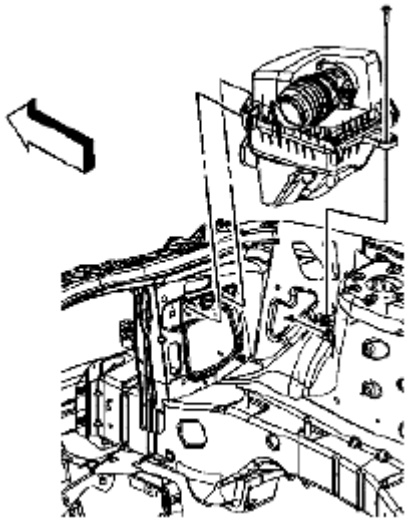


Fig. 28: Identifying Air Cleaner Assembly
Courtesy of SUZUKI OF AMERICA CORP.

1. If the air cleaner assembly was replaced, install the MAF/IAT sensor. Refer to **MASS AIRFLOW SENSOR/INTAKE AIR TEMPERATURE SENSOR REPLACEMENT** .
2. Install the air cleaner assembly by inserting the two pins into the front panel.

   CAUTION: Refer to FASTENER NOTICE .

3. Install the air cleaner bolt.

   Tightening torque

   Tighten the bolt to 10 N.m (89 lb in) .

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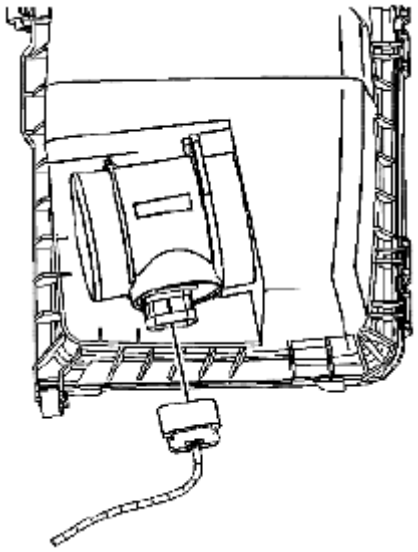


Fig. 29: Identifying Engine Wiring Harness Electrical Connector Of Mass Air Flow/Intake Air Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

4. Connect the engine wiring harness electrical connector to the MAF/IAT sensor.
5. Install the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.

THROTTLE BODY ASSEMBLY REPLACEMENT

Removal Procedure

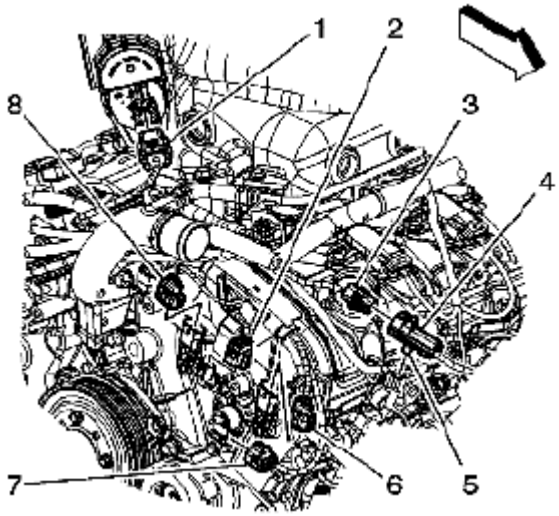


Fig. 30: Identifying Engine Wiring Harness Electrical Connector Of Throttle Actuator Control Module
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.
2. Disconnect the engine wiring harness electrical connector (1) from the Throttle Actuator Control (TAC)

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module.

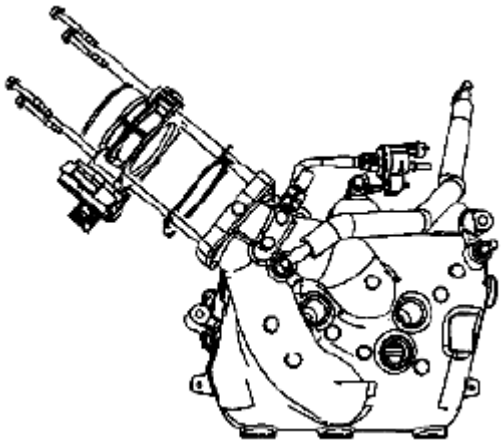


Fig. 31: Identifying Throttle Body, Bolts, And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the throttle body bolts.
4. Remove the throttle body and gasket. Discard the gasket.

Installation Procedure

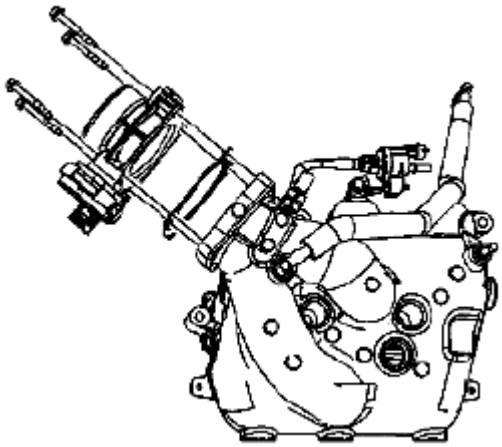


Fig. 32: Identifying Throttle Body, Bolts, And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

1. Position a NEW throttle body gasket to the upper intake manifold.
2. Position the throttle body to the upper intake manifold.

CAUTION: Refer to FASTENER NOTICE .

3. Install the throttle body bolts.

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Tightening torque

Tighten the bolts to 10 N.m (89 lb in) .

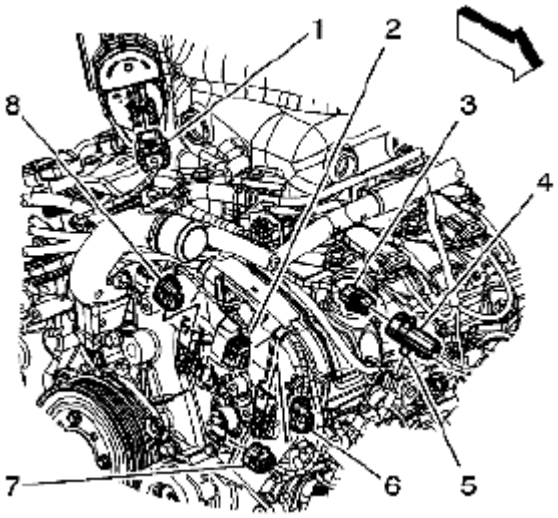


Fig. 33: Identifying Engine Wiring Harness Electrical Connector Of Throttle Actuator Control Module
Courtesy of SUZUKI OF AMERICA CORP.

4. Connect the engine wiring harness electrical connector (1) to the TAC module.
5. Install the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.

THROTTLE BODY INSPECTION AND CLEANING

NOTE: Over extended time and mileage, deposits may accumulate on the back of the throttle valve plate. The source of the deposit is Exhaust Gas Recirculation (EGR) gas. Typically these deposits pose no problem. Occasionally the deposit may accumulate to a point where perceived pedal effort or throttle valve movement is effected. This procedure should not be performed on vehicles with mileage under 80 450 km (50,000 mi).

1. Remove the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

CAUTION: Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

2. Inspect the throttle body bore and the throttle valve plate for deposits. You will need to open the throttle

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valve in order to inspect all surfaces.

CAUTION: Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

3. Clean the throttle body bore and the throttle valve plate using a clean shop towel with GM top engine cleaner, GM P/N 1052626 (Canadian P/N 993026) or AC-Delco Carburetor Tune-Up Conditioner, P/N X66-P, or an equivalent product.
4. Install the air cleaner outlet duct. Refer to **AIR CLEANER OUTLET DUCT REPLACEMENT**.

DRIVE BELT REPLACEMENT

Removal Procedure

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Install the engine support fixture. Refer to **ENGINE SUPPORT FIXTURE**.
3. Remove the engine mount strut bracket. Refer to **ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT SIDE**.
4. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** .
5. Remove the engine splash shield. Refer to **ENGINE SPLASH SHIELD REPLACEMENT - RIGHT SIDE** .
6. Remove the right side engine mount bracket. Refer to **ENGINE MOUNT BRACKET REPLACEMENT - RIGHT SIDE**.
7. Lower the vehicle.

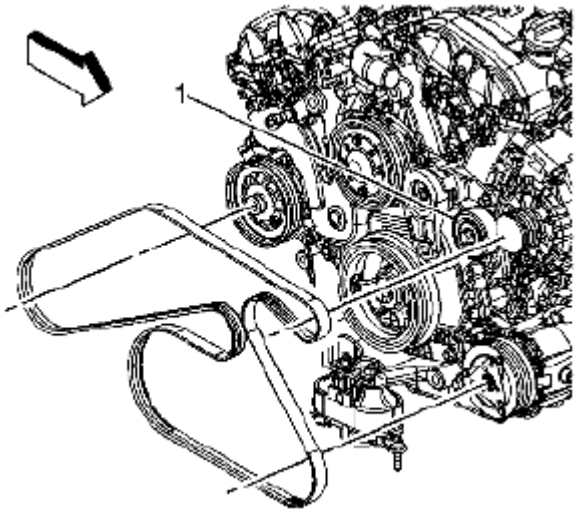


Fig. 34: Identifying Drive Belt And Belt Idler Pulley
Courtesy of SUZUKI OF AMERICA CORP.

8. Rotate the drive belt tensioner clockwise to release the drive belt tension.
9. Slide the drive belt off of the belt idler pulley (1).

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10. Slowly release the drive belt tensioner.
11. Remove the drive belt from the accessory drive pulleys.

Installation Procedure

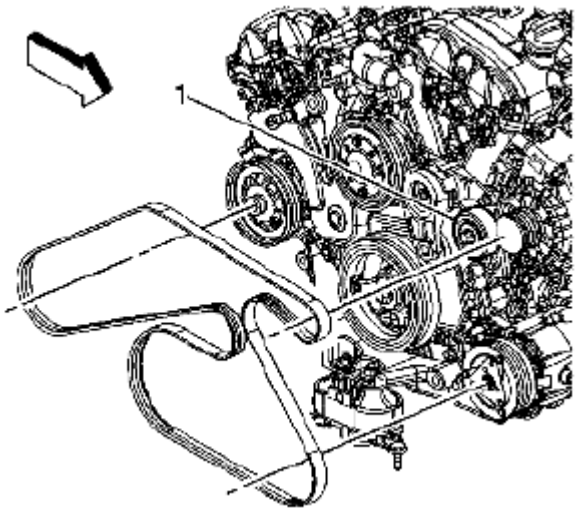


Fig. 35: Identifying Drive Belt And Belt Idler Pulley
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the drive belt to the crankshaft pulley, the tensioner and the generator.
2. Rotate the drive belt tensioner clockwise.
3. Install the drive belt to the idler pulley (1).

NOTE: Ensure the drive belt is properly aligned and seated into the grooves of the accessory drive pulleys.

4. Slowly release the drive belt tensioner.
5. Raise the vehicle.
6. Install the right side engine mount bracket. Refer to **ENGINE MOUNT BRACKET REPLACEMENT - RIGHT SIDE**.
7. Install the engine splash shield. Refer to **ENGINE SPLASH SHIELD REPLACEMENT - RIGHT SIDE** .
8. Lower the vehicle.
9. Install the engine mount strut bracket. Refer to **ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT SIDE**.
10. Remove the engine support fixture. Refer to **ENGINE SUPPORT FIXTURE**.
11. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

DRIVE BELT TENSIONER REPLACEMENT

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Removal Procedure

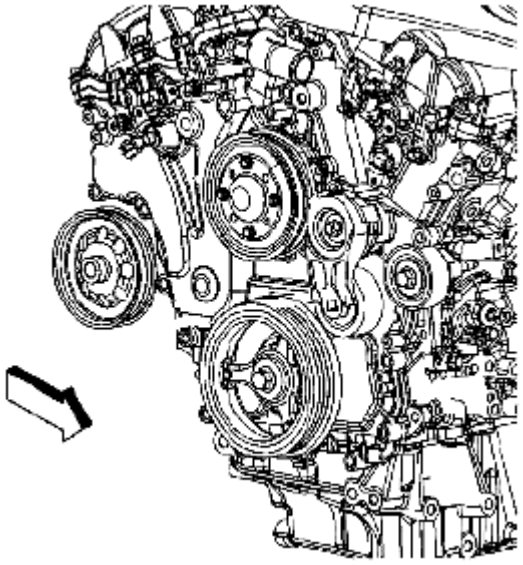


Fig. 36: Identifying Drive Belt Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
2. Loosen the idler pulley.
3. Remove the tensioner bolts.
4. Remove the tensioner.

Installation Procedure

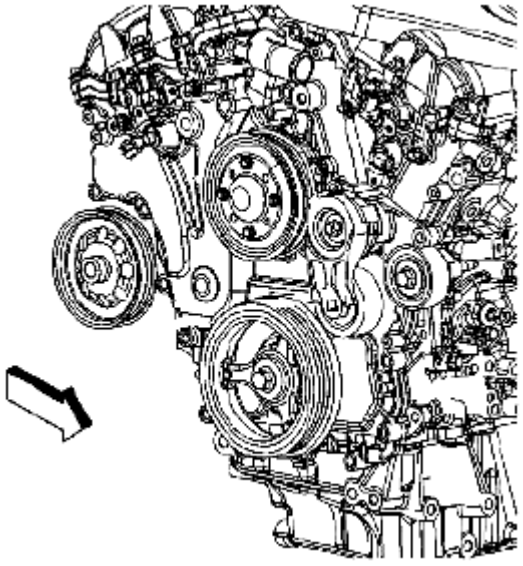


Fig. 37: Identifying Drive Belt Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

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1. Position the tensioner and install the tensioner bolts.
2. Tighten the idler pulley.
3. Install the drive belt. Refer to **DRIVE BELT REPLACEMENT**.

DRIVE BELT IDLER PULLEY REPLACEMENT

Removal Procedure

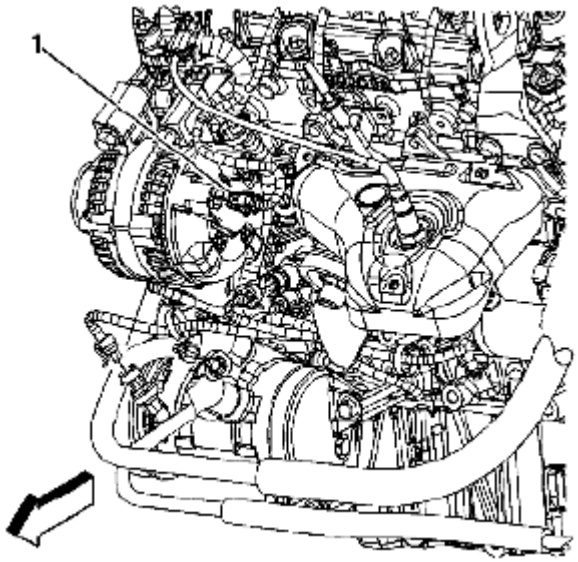


Fig. 38: Identifying Generator Electrical Connector
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
2. Completely loosen the idler pulley bolt.
3. Disconnect the negative battery cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION** .
4. Disconnect the generator electrical connector (1).

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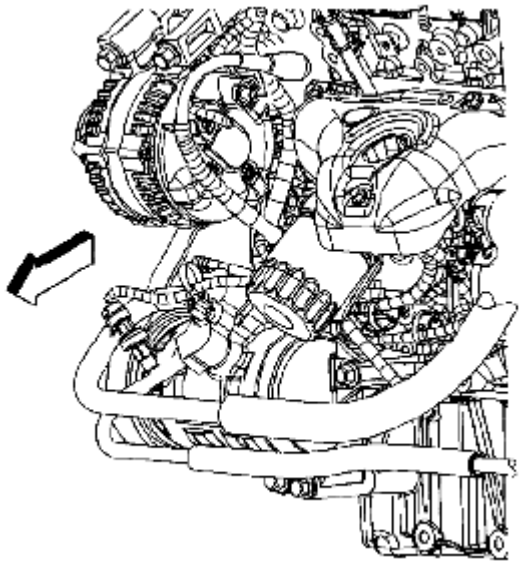


Fig. 39: Identifying Generator Battery Cable
Courtesy of SUZUKI OF AMERICA CORP.

5. Reposition the battery cable boot then disconnect the battery cable from the generator.
6. Remove the generator bolts and position generator aside.

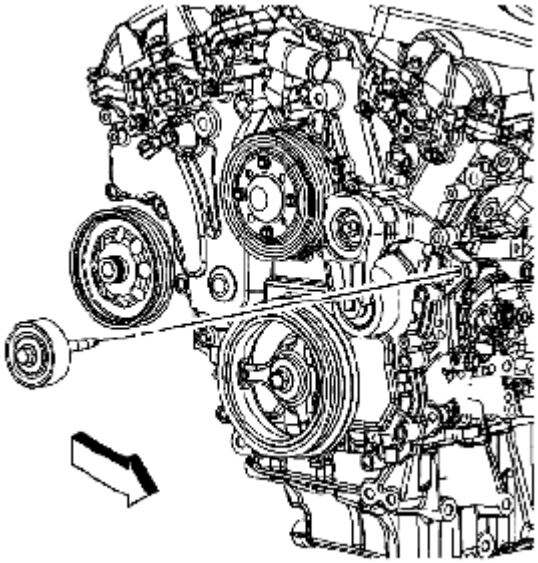


Fig. 40: Identifying Drive Belt Idler Pulley
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the drive belt idler pulley.

Installation Procedure

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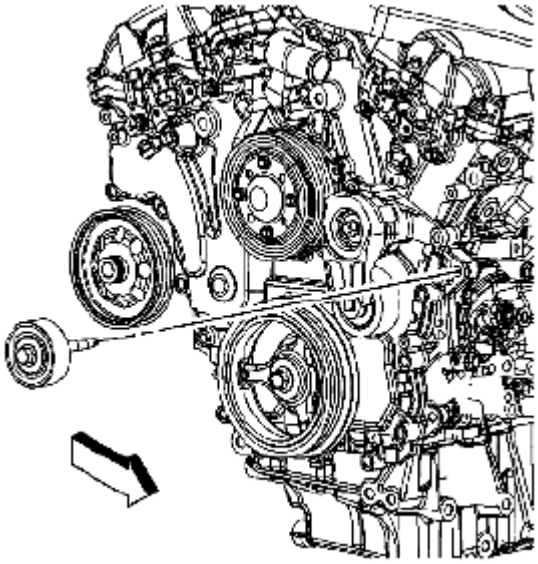


Fig. 41: Identifying Drive Belt Idler Pulley
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the drive belt idler pulley.
2. Position generator in place then install the generator bolts.

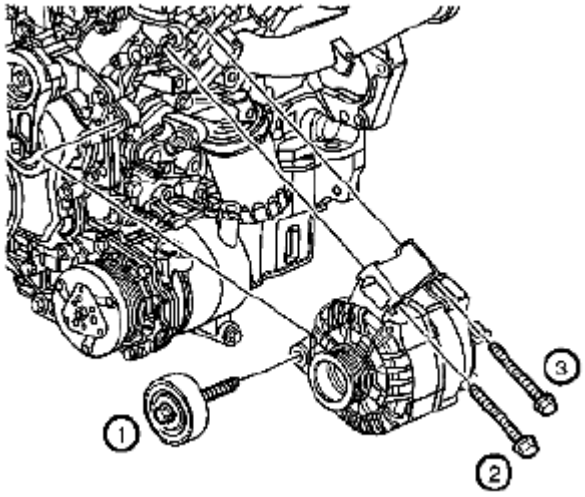


Fig. 42: Identifying Generator And Idler Pulley Bolt Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Tighten the generator and idler pulley bolt in sequence shown.

Tightening torque

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Tighten the generator and drive belt idler pulley bolts to 50 N.m (37 lb ft) .

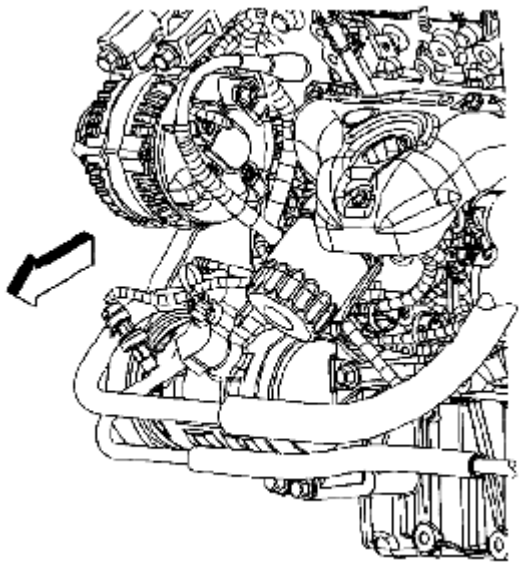


Fig. 43: Identifying Generator Battery Cable
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the battery cable.
5. Install the battery cable boot.

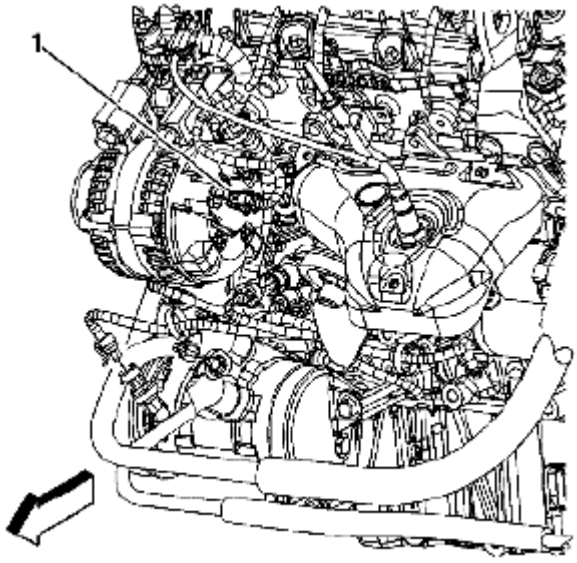


Fig. 44: Identifying Generator Electrical Connector
Courtesy of SUZUKI OF AMERICA CORP.

6. Connect the generator electrical connector (1).
7. Install the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
8. Connect the negative battery cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECTION**

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AND CONNECTION .

ENGINE MOUNT INSPECTION

NOTE: Before replacing any engine mount due to suspected fluid loss, verify that the source of the fluid is the engine mount, not the engine or accessories.

1. Install the engine support fixture. Refer to **ENGINE SUPPORT FIXTURE**.
2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
   - The hard rubber is covered with heat check cracks.
   - The rubber is separated from the metal plate of the engine mount.
   - The rubber is split through the center of the engine mount.
   - The engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to **ENGINE MOUNT REPLACEMENT - RIGHT SIDE**. Also see TRANSMISSION REAR MOUNT REPLACEMENT (FWD), TRANSMISSION REAR MOUNT REPLACEMENT (AWD), TRANSMISSION FRONT MOUNT REPLACEMENT, and TRANSMISSION MOUNT REPLACEMENT - LEFT SIDE in the Automatic Transmission article.

ENGINE REAR MOUNT REPLACEMENT

Removal Procedure

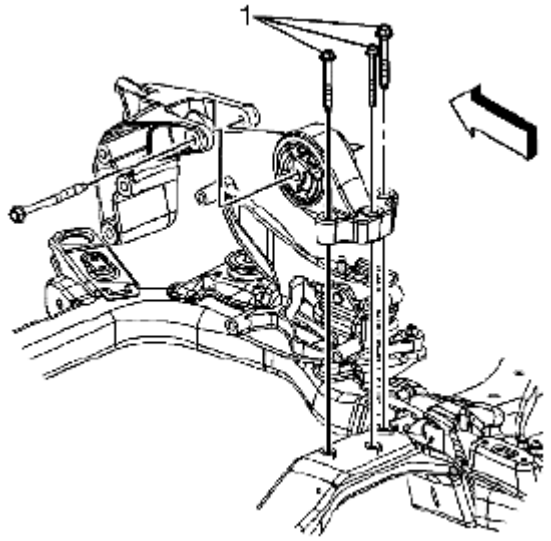


Fig. 45: Identifying Engine Mount Bracket And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Support the engine. Refer to **ENGINE SUPPORT FIXTURE**.

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3. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** .
4. Remove three engine mount bracket bolts (1).
5. Remove engine mount bracket to engine mount bolt.
6. Remove engine mount from vehicle.

Installation Procedure

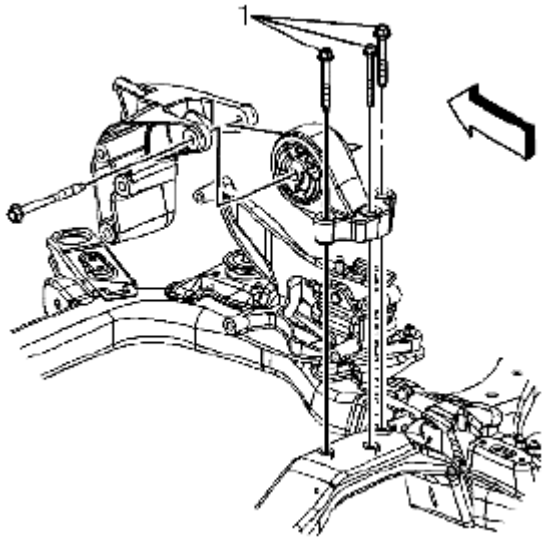


Fig. 46: Identifying Engine Mount Bracket And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

1. Position engine mount in place and install engine mount bracket to engine mount bolt.

   Tightening torque

   Tighten the bolt to 50 N.m (37 lb ft) .

2. Install the engine mount to frame bolts (1).

   Tightening torque

   Tighten the engine mount bolts to 50 N.m (37 lb ft) .

3. Lower the vehicle.
4. Remove the engine support. Refer to **ENGINE SUPPORT FIXTURE**.
5. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

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ENGINE MOUNT REPLACEMENT - RIGHT SIDE

Removal Procedure

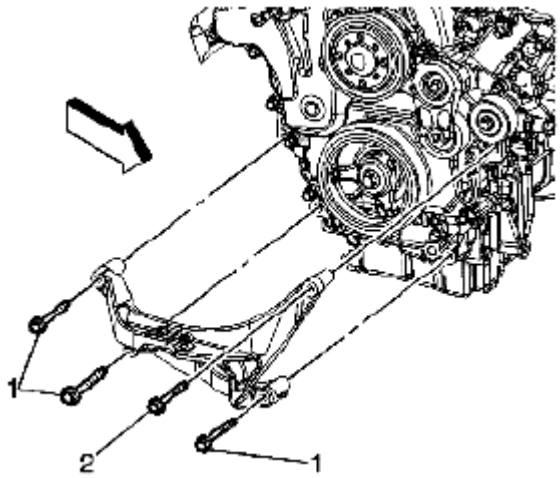


Fig. 47: Identifying Upper Engine Mount Bracket Bolts And Right Upper Front Engine Mount Bracket Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Remove the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
3. Support the engine. Refer to **ENGINE SUPPORT FIXTURE**.
4. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** .
5. Remove three upper engine mount bracket bolts (1).
6. Loosen right upper front engine mount bracket bolt (2).

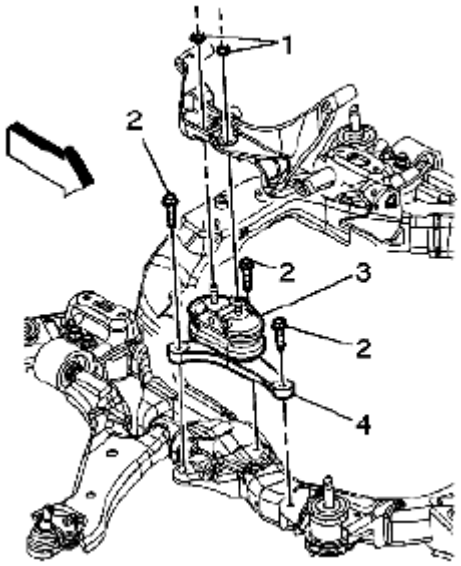


Fig. 48: Identifying Upper Engine Mount Bracket Nuts And Lower Bracket Bolts

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Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the upper engine mount bracket nuts (1).
8. Remove the lower bracket bolts (2).
9. Remove the ABS connector clip from the frame.
10. Remove the mount (3) and the lower bracket (4) from the vehicle.

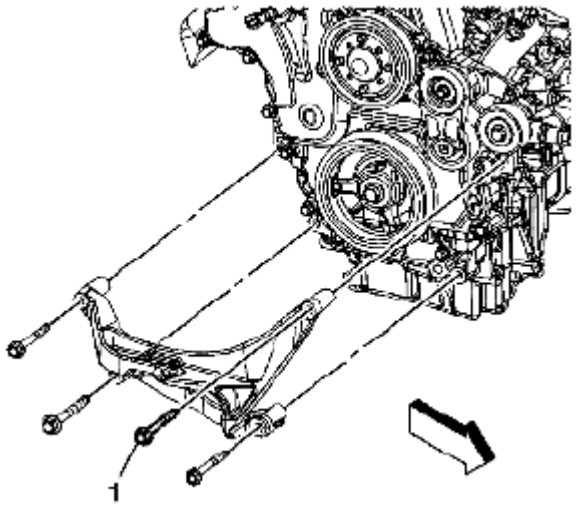


Fig. 49: Identifying Upper Bracket Bolt
Courtesy of SUZUKI OF AMERICA CORP.

11. Remove the upper bracket bolt (1) from the bracket.
12. Remove the upper bracket.

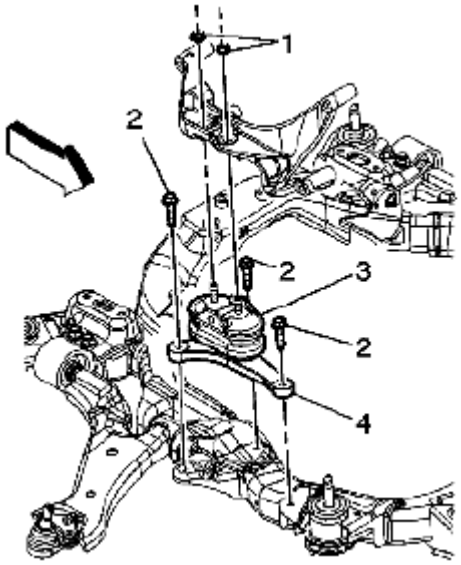


Fig. 50: Identifying Engine Mount And Lower Bracket
Courtesy of SUZUKI OF AMERICA CORP.

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13. Remove the engine mount (3) from the lower bracket (4).

Installation Procedure

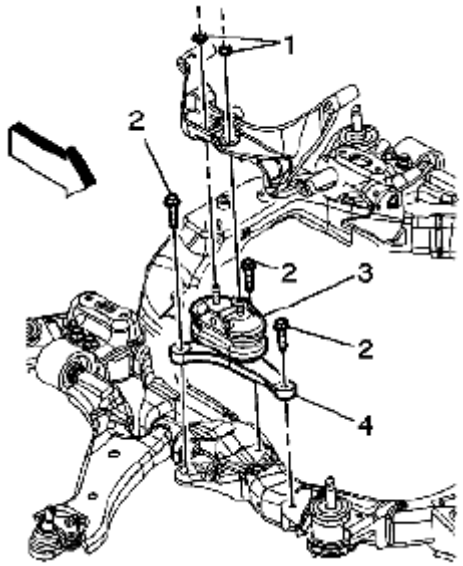


Fig. 51: Identifying Engine Mount And Lower Bracket
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the engine mount (3) to the lower bracket (4).

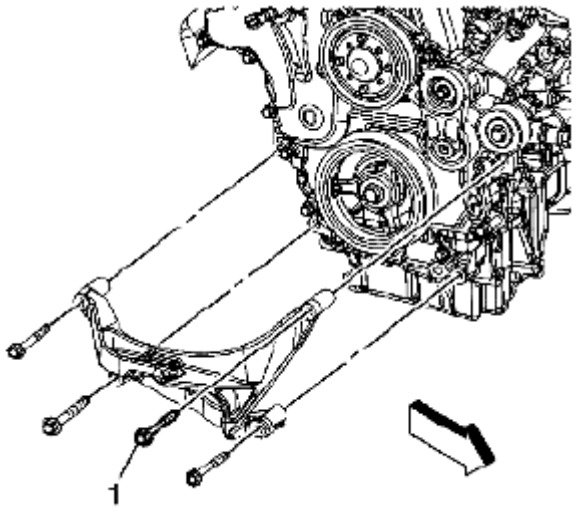


Fig. 52: Identifying Engine Mount Upper Bracket And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the engine mount upper bracket and bolt (1) to the engine. Do not tighten the bolt.
3. Install the ABS connector clip to the bracket.

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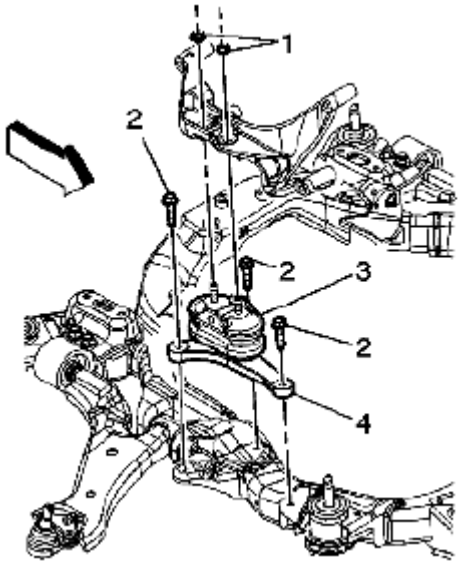


Fig. 53: Identifying Lower Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

4. Install the lower bracket bolts (2).

   Tightening torque

   Tighten the lower bracket bolts to 50 N.m (37 lb ft) .

5. Tighten the upper engine mount bracket nuts (1).

   Tightening torque

   Tighten the upper engine mount bracket nuts to 50 N.m (37 lb ft) .

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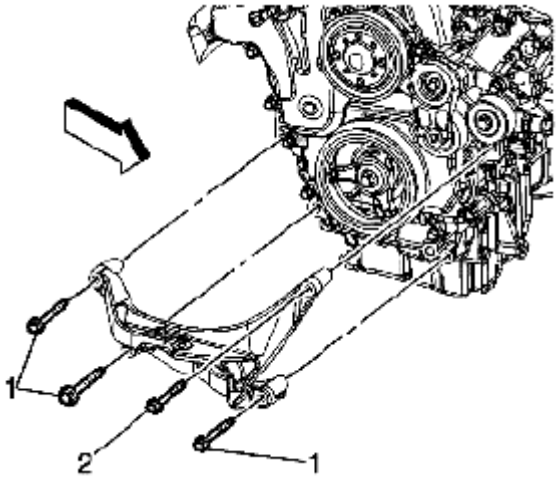


Fig. 54: Identifying Upper Engine Mount Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the upper engine mount bracket bolts (1).

   Tightening torque

   Tighten the upper engine mount bracket bolts to 50 N.m (37 lb ft) .

7. Tighten the right upper engine mount bracket bolt (2).

   Tightening torque

   Tighten the right upper engine mount bracket bolt to 110 N.m (81 lb ft) .

8. Lower the vehicle.
9. Remove the engine support. Refer to **ENGINE SUPPORT FIXTURE**.
10. Install the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
11. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

ENGINE MOUNT BRACKET REPLACEMENT - RIGHT SIDE

Removal Procedure

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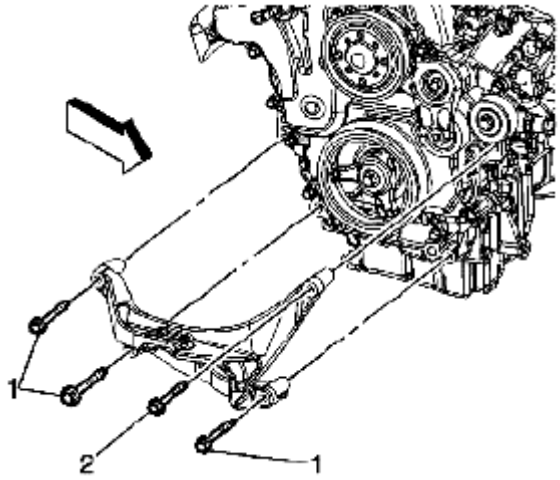


Fig. 55: Identifying Upper Engine Mount Bracket Bolts And Right Upper Front Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Support the engine. Refer to **ENGINE SUPPORT FIXTURE**.
3. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** .
4. Remove 3 upper engine mount bracket bolts (1).
5. Loosen right upper front bolt (2).

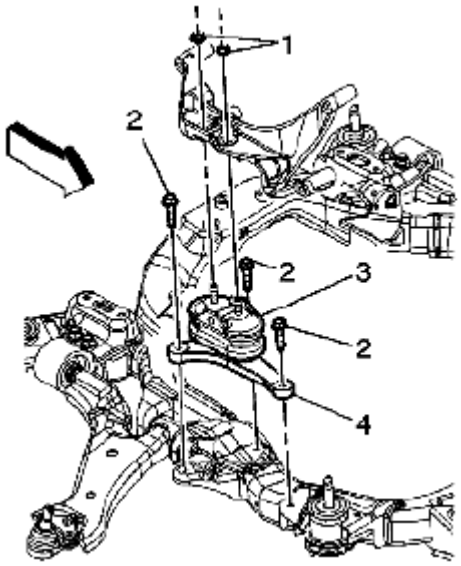


Fig. 56: Identifying Upper Engine Mount Bracket Nuts And Lower Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove the ABS connector clip from the frame.
7. Remove the upper engine mount bracket nuts (1).
8. Remove the lower bracket bolts (2).

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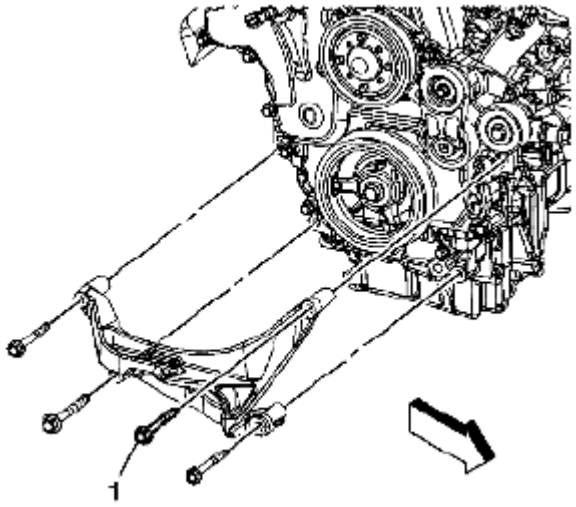


Fig. 57: Identifying Upper Bracket Bolt
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the upper bracket bolt (1) from the bracket.

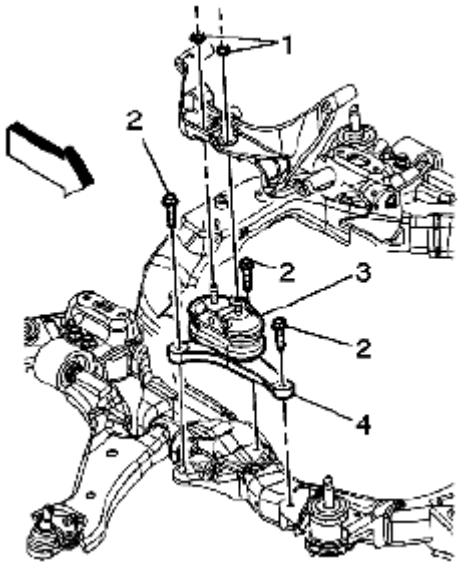


Fig. 58: Identifying Mount And Lower Bracket
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the mount (3) and the lower bracket (4) from the vehicle.
11. Remove the upper bracket.

Installation Procedure

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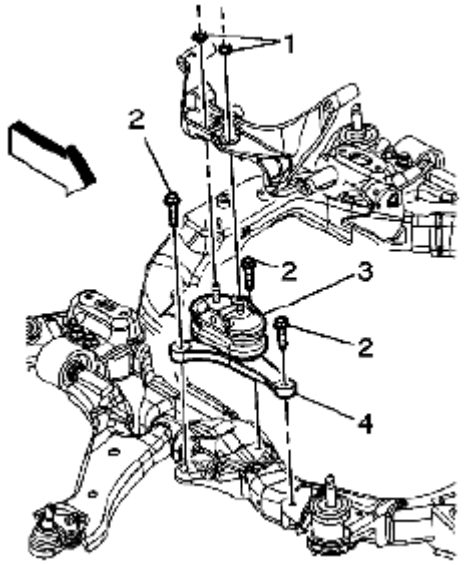


Fig. 59: Identifying Engine Mount And Lower Bracket
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

1. Install the engine mount (3) and the lower bracket (4) to the vehicle.

   Tightening torque

   Tighten the lower bracket bolts to 50 N.m (37 lb ft) .

2. Install the ABS connector clip to the frame.
3. Install the upper engine mount bracket nuts (1).

   Tightening torque

   Tighten the upper engine mount bracket nuts to 50 N.m (37 lb ft) .

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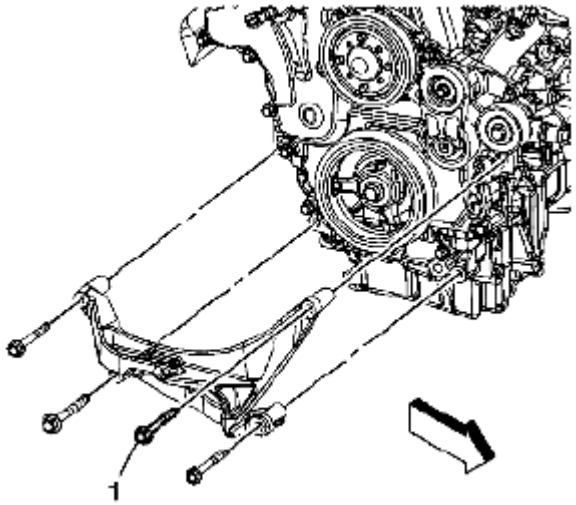


Fig. 60: Identifying Engine Mount Upper Bracket And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the engine mount upper bracket and bolt (1) to the engine. Do not tighten the bolt.

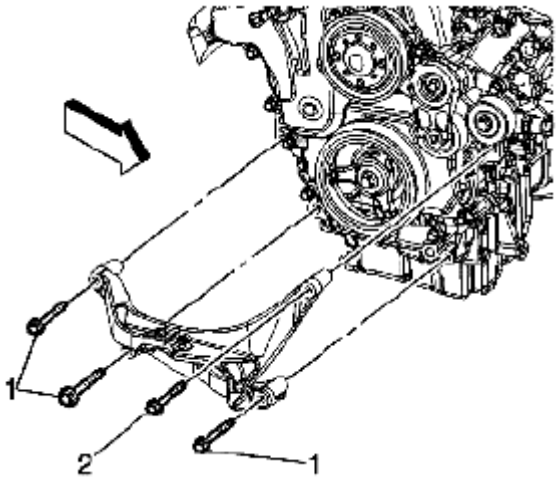


Fig. 61: Identifying Right Upper Engine Mount Bracket Bolt
Courtesy of SUZUKI OF AMERICA CORP.

5. Tighten the right upper engine mount bracket bolt (2).

   Tightening torque

   Tighten the right upper engine mount bracket bolt to 50 N.m (37 lb ft) .

6. Install the upper engine mount bracket bolts (1).

   Tightening torque

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Tighten the upper engine mount bracket bolts to 110 N.m (81 lb ft) .

7. Lower the vehicle.
8. Remove the engine support. Refer to **ENGINE SUPPORT FIXTURE**.
9. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

ENGINE MOUNT STRUT REPLACEMENT - RIGHT SIDE

Removal Procedure

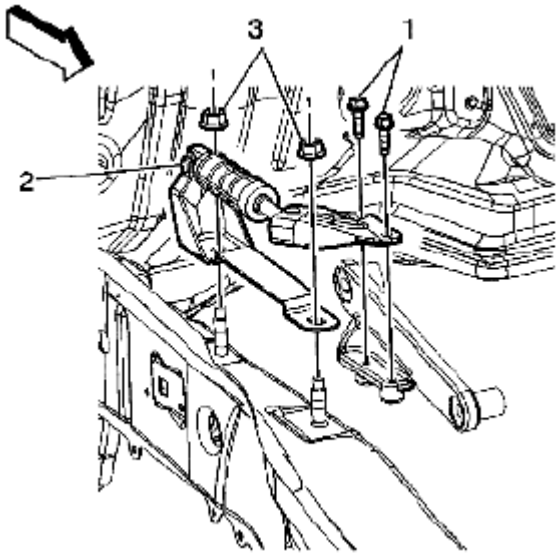


Fig. 62: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Remove the engine mount strut to bracket bolts (1).
3. Rotate strut (2) vertical then remove engine mount strut to side rail nuts (3).
4. Remove the strut from vehicle.

Installation Procedure

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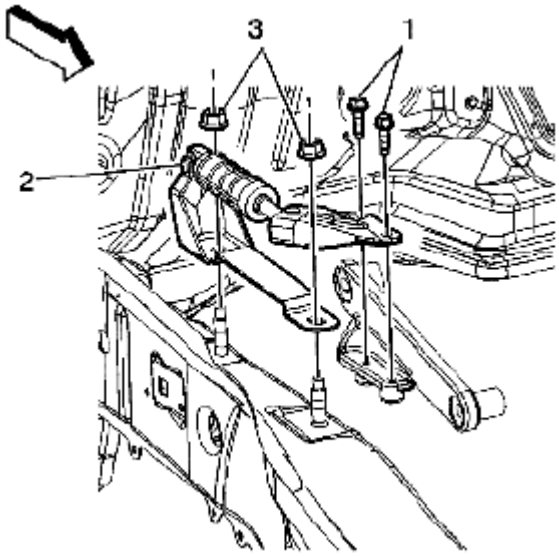


Fig. 63: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

1. Position the strut (2) to the side rail, then install the strut to side rail nuts (3).

   Tightening torque

   Tighten the nuts to 110 N.m (81 lb ft) .

2. Install the engine mount strut to bracket bolts (1).

   Tightening torque

   Tighten the bolts to 25 N.m (18 lb ft) .

3. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT SIDE

Removal Procedure

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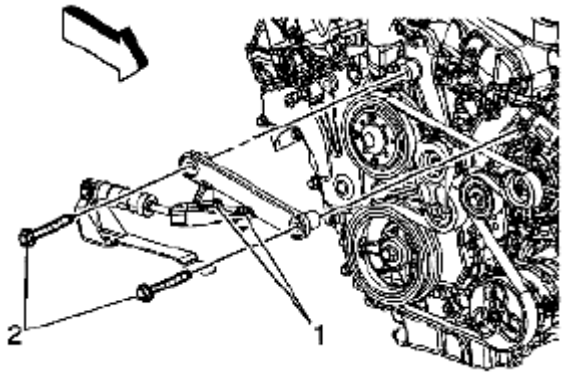


Fig. 64: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
2. Remove the engine mount strut to bracket bolts (1).
3. Rotate the strut vertical.
4. Remove the engine mount strut bracket to cylinder head bolts (2).

Installation Procedure

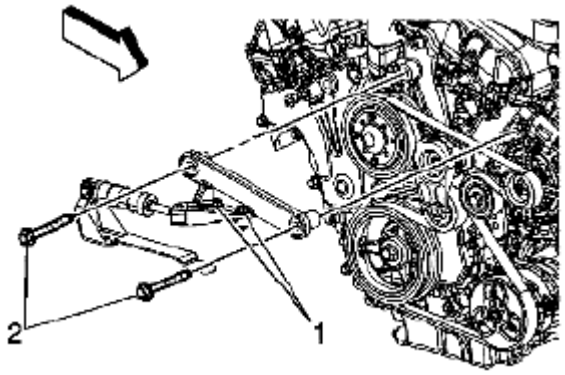


Fig. 65: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

1. Position the engine mount strut bracket.
2. Install the engine mount strut bracket to cylinder head bolts (2).

Tightening torque

Tighten the nuts to 110 N.m (81 lb ft) .

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3. Install the engine mount strut bracket bolts (1).

   Tightening torque

   Tighten the bolts to 25 N.m (18 lb ft) .

4. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

FUEL INJECTOR SIGHT SHIELD REPLACEMENT

Removal Procedure

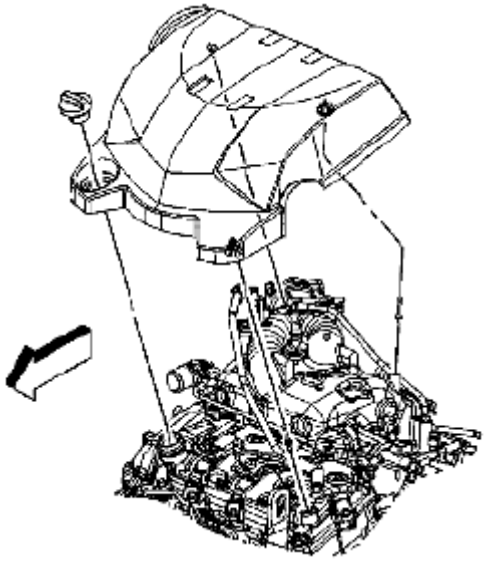


Fig. 66: Identifying Engine Cover
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the oil fill cap.
2. Lift upward and remove cover from ballstuds.

Installation Procedure

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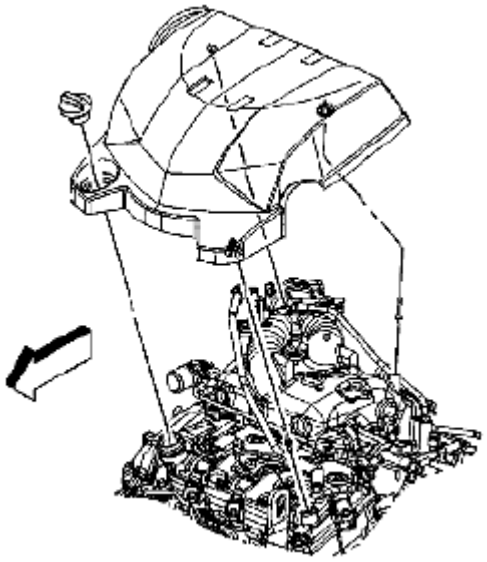


Fig. 67: Identifying Engine Cover
Courtesy of SUZUKI OF AMERICA CORP.

1. Push downward on cover and lock into place on ballstuds.
2. Install the oil fill cap.

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (FRONT)

Removal Procedure

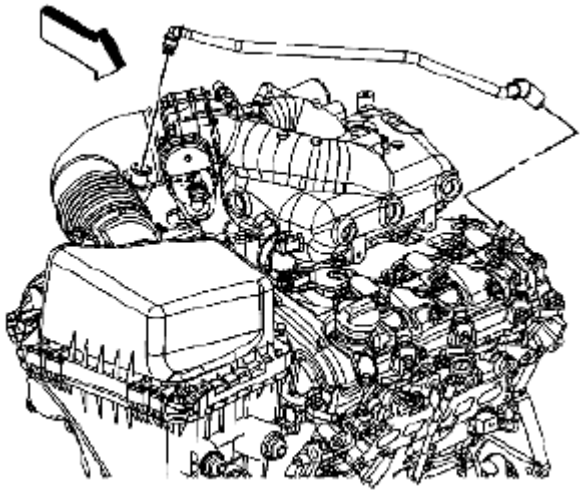


Fig. 68: Identifying Positive Crankcase Ventilation Tube (Front)
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
2. Disconnect the Positive Crankcase Ventilation (PCV) fresh air pipe from the air cleaner duct.
3. Disconnect the PCV air pipe from the valve cover.

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Installation Procedure

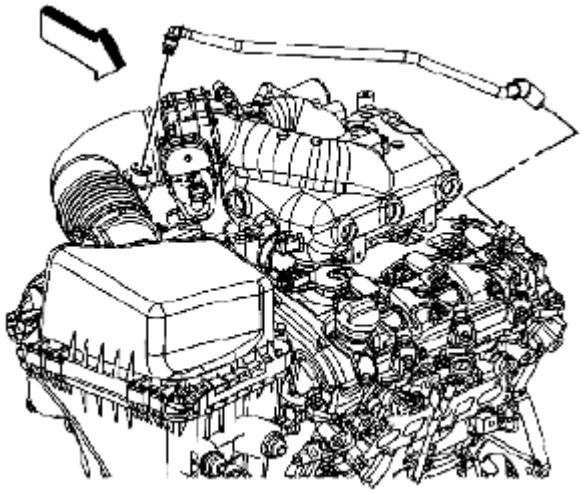


Fig. 69: Identifying Positive Crankcase Ventilation Tube (Front)
Courtesy of SUZUKI OF AMERICA CORP.

1. Connect the PCV air pipe to the valve cover valve.
2. Connect the PCV fresh air pipe to the air cleaner duct.
3. Install the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (REAR)

Removal Procedure

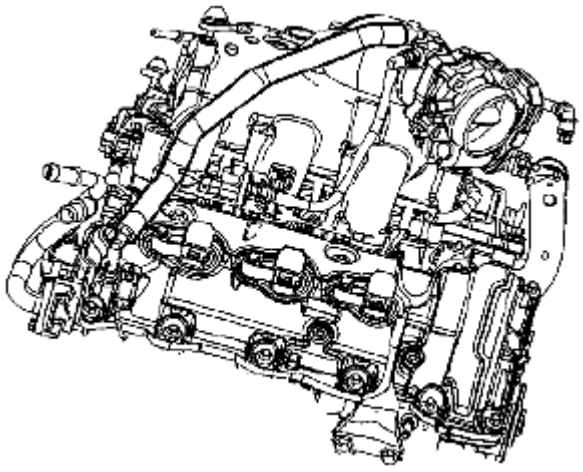


Fig. 70: Identifying Positive Crankcase Ventilation Tube (Rear)
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
2. Disconnect the Positive Crankcase Ventilation (PCV) fresh air pipe from the upper intake manifold.

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3. Disconnect the PCV foul air pipe from the PCV valve.

Installation Procedure

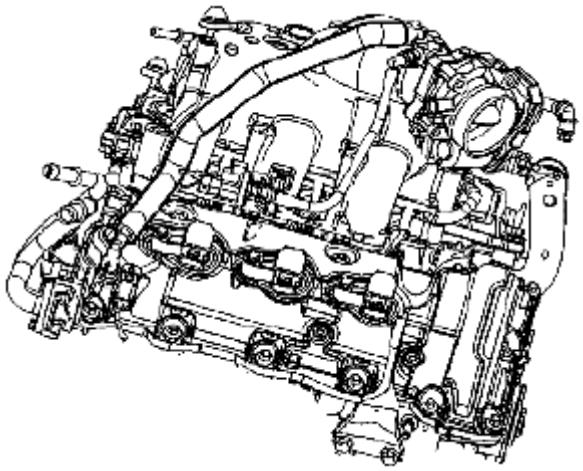


Fig. 71: Identifying Positive Crankcase Ventilation Tube (Rear)
Courtesy of SUZUKI OF AMERICA CORP.

1. Connect the PCV foul air pipe to the PCV valve.
2. Connect the PCV fresh air pipe to the upper intake manifold.
3. Install the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.

UPPER INTAKE MANIFOLD REPLACEMENT

Removal Procedure

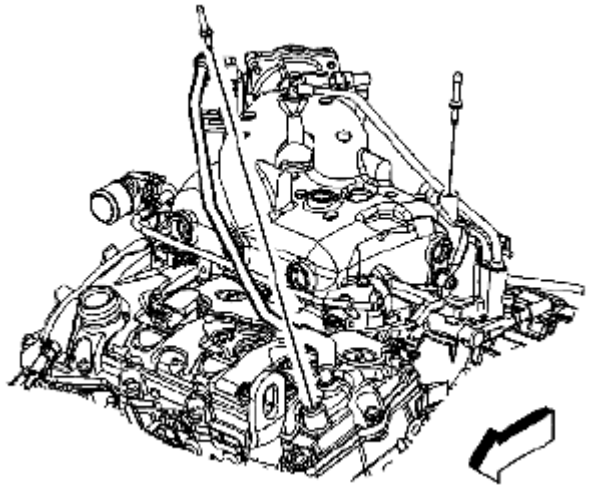


Fig. 72: Identifying Fresh Air Positive Crankcase Ventilation Line
Courtesy of SUZUKI OF AMERICA CORP.

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1. Remove the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
2. Remove the air cleaner outlet duct.
3. Reposition the fresh air Positive Crankcase Ventilation (PCV) line from the air cleaner inlet tube.

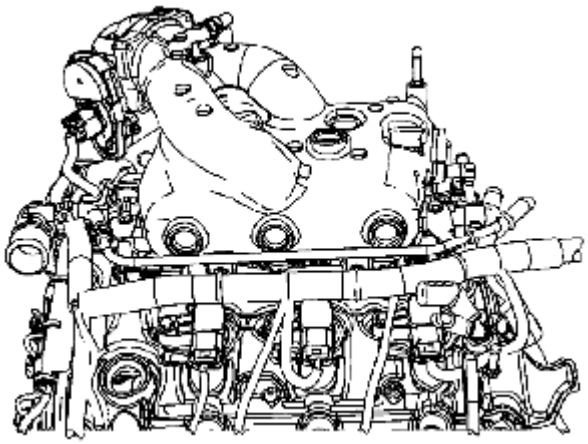


Fig. 73: Identifying Electronic Throttle Control Electrical Connector
Courtesy of SUZUKI OF AMERICA CORP.

4. Disconnect the Electronic Throttle Control (ETC) electrical connector.

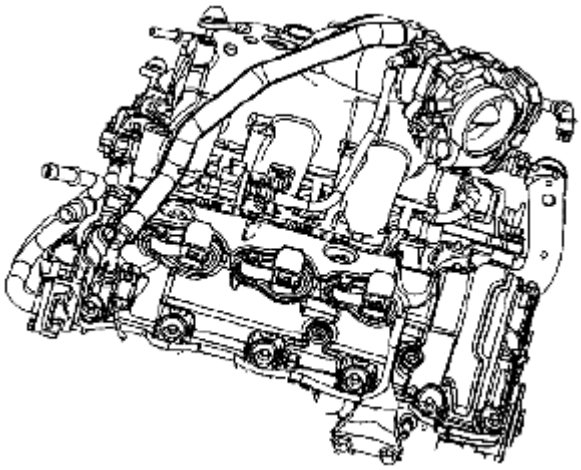


Fig. 74: Identifying PCV Line On Top Of Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

5. Disconnect the PCV line from the top of the intake manifold and reposition aside.

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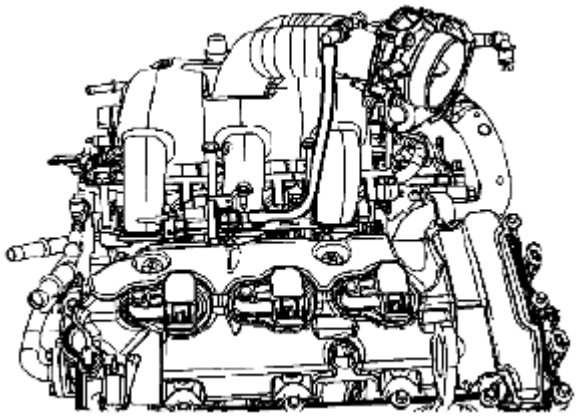


Fig. 75: Identifying Evaporative Emissions Canister Purge Line
Courtesy of SUZUKI OF AMERICA CORP.

6. Disconnect the Evaporative Emissions (EVAP) canister purge line and reposition aside.

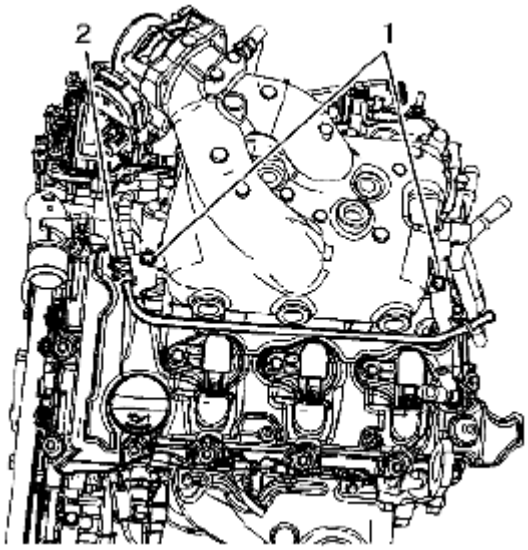


Fig. 76: Identifying Bleed Pipe Bolts And Hose Clamp
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the bleed pipe bolts (1).
8. Remove the bleed pipe hose clamp (2).
9. Reposition the bleed pipe.
10. Remove the brake booster vacuum hose from the intake manifold.

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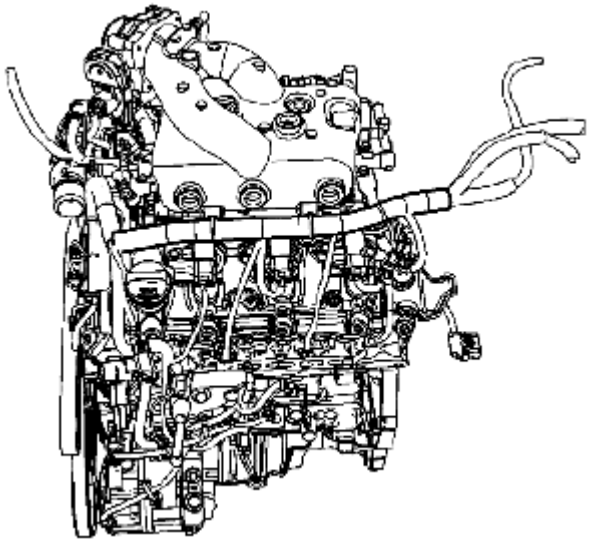


Fig. 77: Identifying Engine Harness Retaining Clips
Courtesy of SUZUKI OF AMERICA CORP.

11. Remove the engine harness retaining clips.

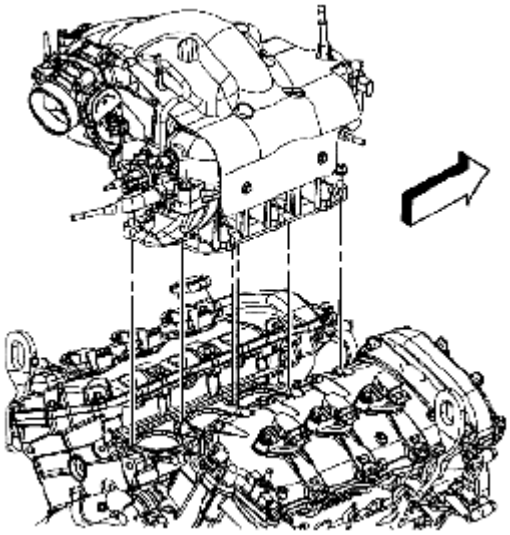


Fig. 78: Identifying Upper Intake Manifold And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove the upper intake retaining bolts.
13. Remove the upper intake manifold and gasket. Discard gasket.
14. If replacing the upper intake manifold complete the following steps:
    a. Remove the evaporative emissions (EVAP) purge solenoid valve. Refer to **EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT** .
    b. Remove the throttle body. Refer to **THROTTLE BODY ASSEMBLY REPLACEMENT**.

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Installation Procedure

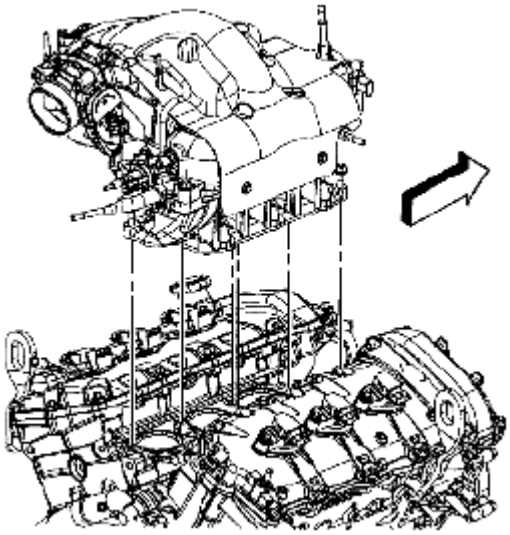


Fig. 79: Identifying Upper Intake Manifold And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the upper intake manifold gaskets to the lower intake manifold and install the fir tree retainers to retain the upper intake manifold gasket position.
2. Install the upper intake manifold.

CAUTION: Refer to FASTENER NOTICE .

3. Apply threadlock to the bolt threads. Refer to **SEALERS, ADHESIVES, AND LUBRICANTS**.

   Tightening torque

   Tighten the bolts to 25 N.m (18 lb ft) .

4. Install the upper intake manifold bolts.
5. If the upper manifold was replaced, complete the following steps:
   a. Install the throttle body. Refer to **THROTTLE BODY ASSEMBLY REPLACEMENT**.
   b. Install the EVAP purge solenoid valve. Refer to **EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT** .

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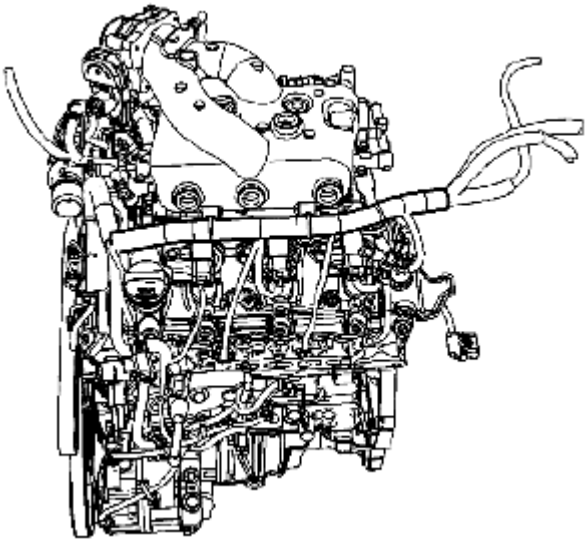


Fig. 80: Identifying Engine Harness Retaining Clips
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the engine harness retaining clips.
7. Install the brake booster vacuum hose to the intake manifold.
8. Install the brake booster vacuum hose to the intake manifold.

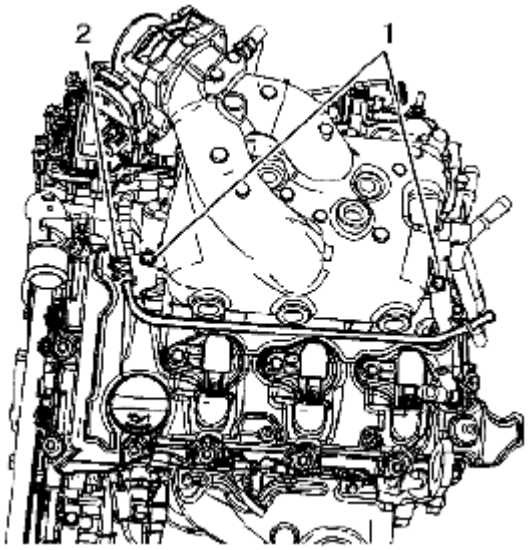


Fig. 81: Identifying Bleed Pipe Bolts And Hose Clamp
Courtesy of SUZUKI OF AMERICA CORP.

9. Position the bleed pipe.
10. Install the bleed pipe hose clamp (2).
11. Install the bleed pipe bolts (1).

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Tightening torque

Tighten the nut to 10 N.m (89 lb in) .

12. Connect the coolant hose bleed pipe.

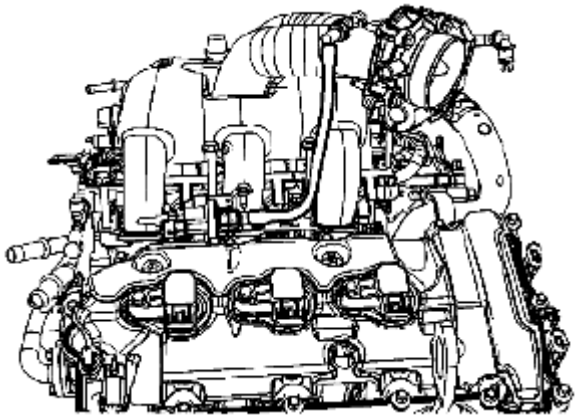


Fig. 82: Identifying EVAP Canister Purge Line
Courtesy of SUZUKI OF AMERICA CORP.

13. Connect the EVAP canister purge line.

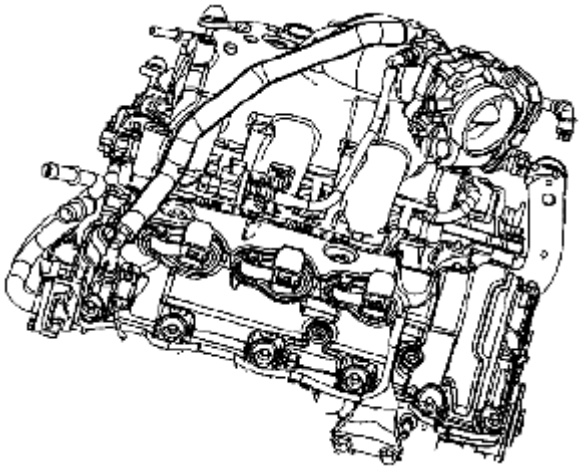


Fig. 83: Identifying PCV Line On Top Of Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

14. Connect the PCV line to the top of the intake manifold.

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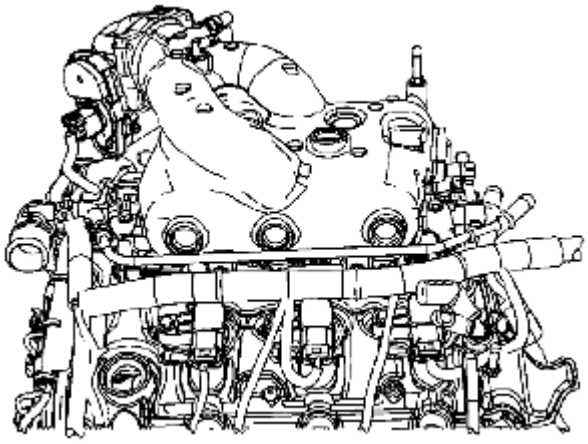


Fig. 84: Identifying ETC Electrical Connector
Courtesy of SUZUKI OF AMERICA CORP.

15. Connect the ETC electrical connector.
16. Install the air cleaner outlet duct.

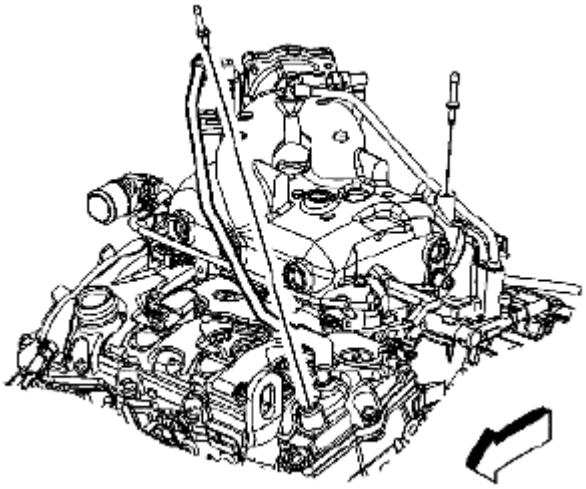


Fig. 85: Identifying Fresh Air PCV Line On Air Cleaner Inlet Duct
Courtesy of SUZUKI OF AMERICA CORP.

17. Install the fresh air PCV line to the air cleaner inlet duct.
18. Install the engine cover. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.

LOWER INTAKE MANIFOLD REPLACEMENT

Removal Procedure

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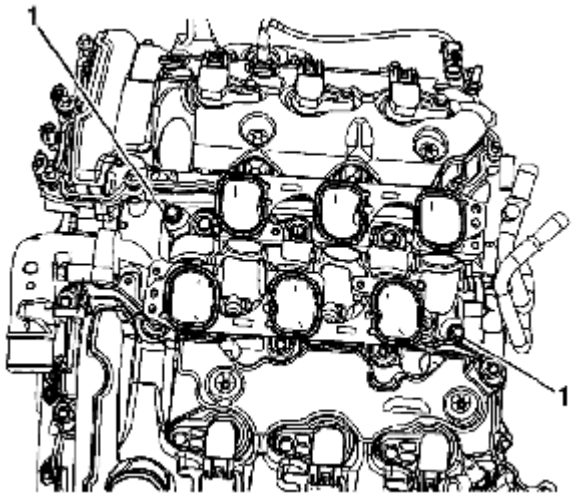


Fig. 86: Identifying Lower Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the fuel injectors and fuel rail. Refer to **FUEL INJECTOR AND FUEL RAIL REPLACEMENT** .
2. Remove the lower intake manifold bolts (1).
3. Remove the lower intake manifold and gasket from engine. Discard the gasket.
4. Clean and inspect the intake manifold and the sealing surfaces. Refer to **INTAKE MANIFOLD CLEANING AND INSPECTION**.

Installation Procedure

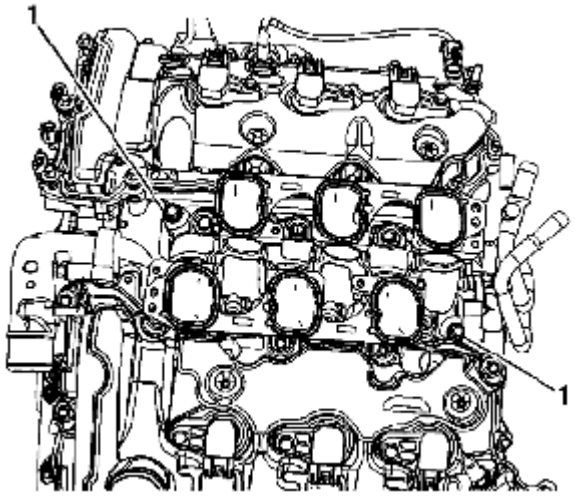


Fig. 87: Identifying Lower Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the lower intake manifold gasket.
2. Install the lower intake manifold bolts (1).

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CAUTION: Refer to FASTENER NOTICE .

3. Install the fuel injectors and fuel rail. Refer to **FUEL INJECTOR AND FUEL RAIL REPLACEMENT** .

   Tightening torque

   Tighten the bolts to 23 N.m (17 lb ft) .

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

- EN 46106 Flywheel Holding Tool
- J 38416-2 Crankshaft Button
- J 41816 Crankshaft Balancer Remover
- J 45059 Angle Meter

Removal Procedure

1. Remove the drive belt. Refer to **DRIVE BELT REPLACEMENT**.
2. Install the engine support fixture. Refer to **ENGINE SUPPORT FIXTURE**.
3. Remove the engine mount. Refer to **ENGINE MOUNT REPLACEMENT - RIGHT SIDE**.
4. Remove the starter. Refer to **STARTER MOTOR REPLACEMENT** .

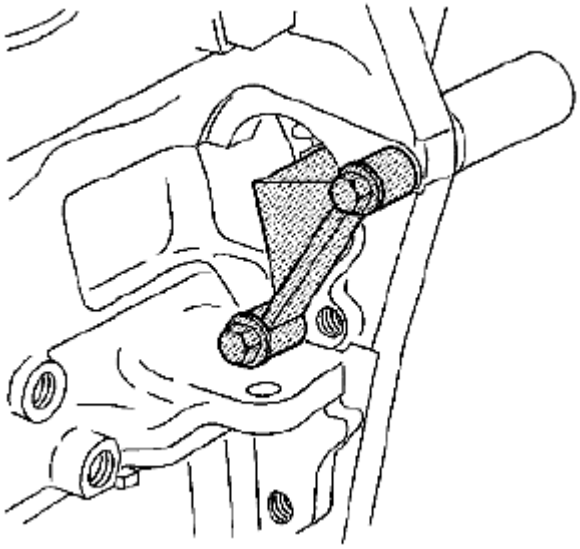


Fig. 88: Identifying EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

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5. Install the EN 46106 through the starter mounting hole.

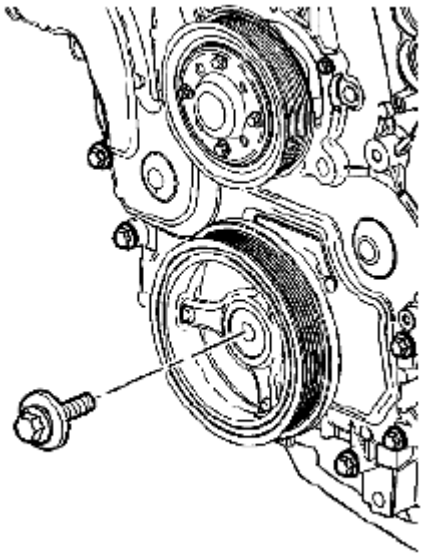


Fig. 89: Identifying Crankshaft Balancer Bolt
Courtesy of SUZUKI OF AMERICA CORP.

6. Using engine support fixture, lower engine approximately two inches.
7. Remove the crankshaft balancer bolt.

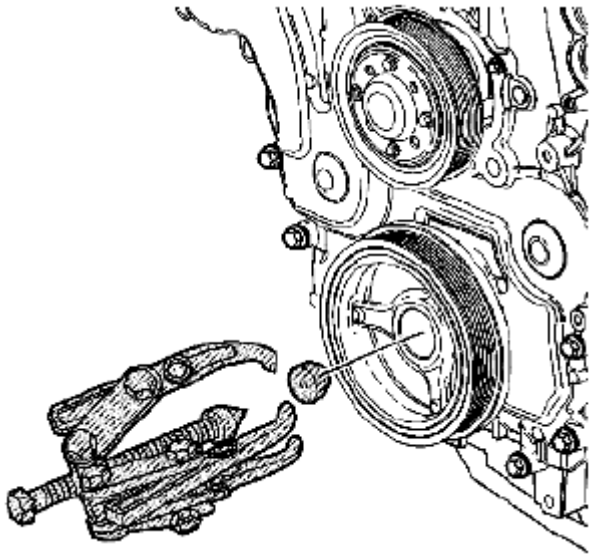


Fig. 90: Identifying Special Tools J 38416-2 And J 41816
Courtesy of SUZUKI OF AMERICA CORP.

8. Install the J 38416-2 in the nose of the crankshaft.
9. Install the J 41816 in order to remove the crankshaft balancer.
10. Tighten the center bolt of the J 41816 in order to pull the crankshaft balancer off of the crankshaft.

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11. Remove the J 41816 from the crankshaft balancer.

Installation Procedure

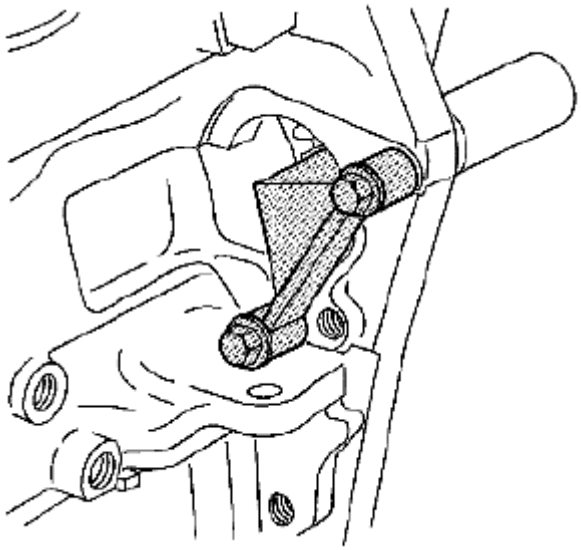


Fig. 91: Identifying Special Tools EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

1. The EN 46106 must be installed onto the flywheel.
2. Use the J 41998-B, nut, bearing and washer to install the crankshaft balancer.

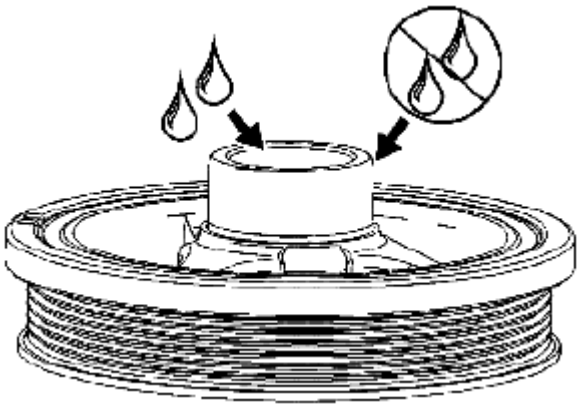


Fig. 92: Applying Lubricant To Inside Of Crankshaft Balancer Hub Bore
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

3. Apply lubricant to the inside of the crankshaft balancer hub bore.

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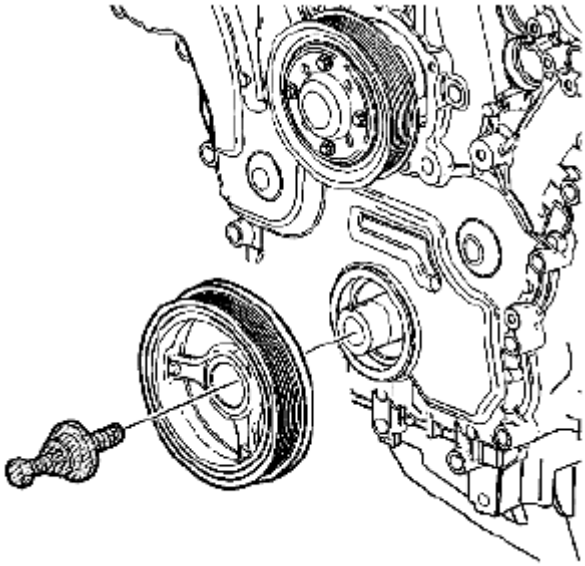


Fig. 93: Identifying Special Tool J 41998-B
Courtesy of SUZUKI OF AMERICA CORP.

4. Place the crankshaft balancer in position on the crankshaft.
5. Thread the J 41998-B in the crankshaft. Ensure you engage at least 10 threads of the J 41998-B before pressing the crankshaft balancer in place.
6. Push the crankshaft balancer into position by tightening the nut on the J 41998-B until the large washer bottoms out on the crankshaft end.
7. Remove the J 41998-B.

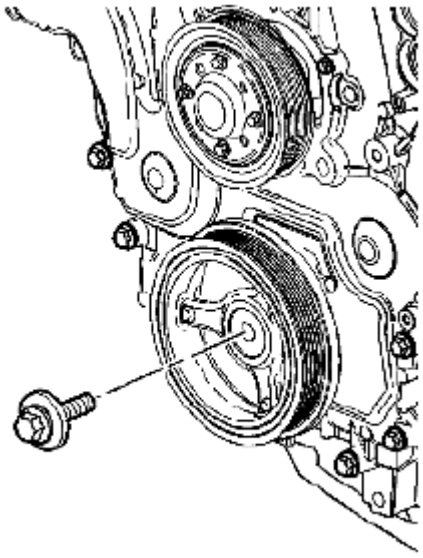


Fig. 94: Identifying Crankshaft Balancer Bolt
Courtesy of SUZUKI OF AMERICA CORP.

8. Install the crankshaft balancer bolt.

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CAUTION: Refer to FASTENER NOTICE .

9. Tighten the crankshaft balancer bolt.

   Tightening torque

   1. **Tighten the crankshaft balancer bolt to 100 N.m (74 lb ft)** .
   2. **Tighten the crankshaft balancer bolt an additional 150 degrees using the J 45059** .

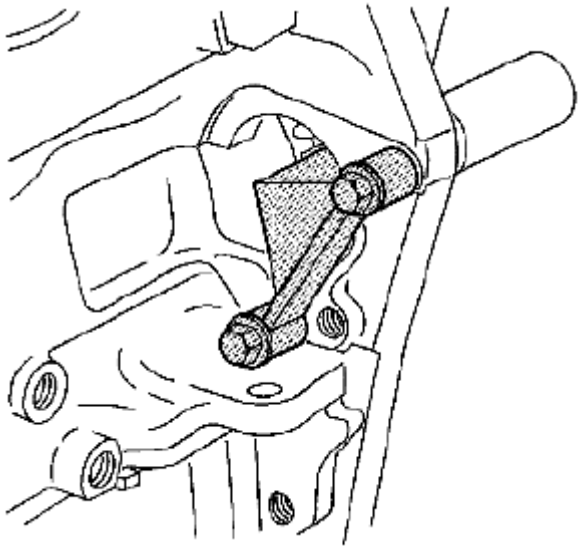


Fig. 95: Identifying Special Tool EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the EN 46106.
11. Install the starter. Refer to **STARTER MOTOR REPLACEMENT** .
12. Using engine support fixture, raise the engine into position.
13. Install the engine mount. Refer to **ENGINE MOUNT REPLACEMENT - RIGHT SIDE**.
14. Install the drive belt. Refer to **DRIVE BELT REPLACEMENT**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tool

J 29184 Oil Seal Installer

Removal Procedure

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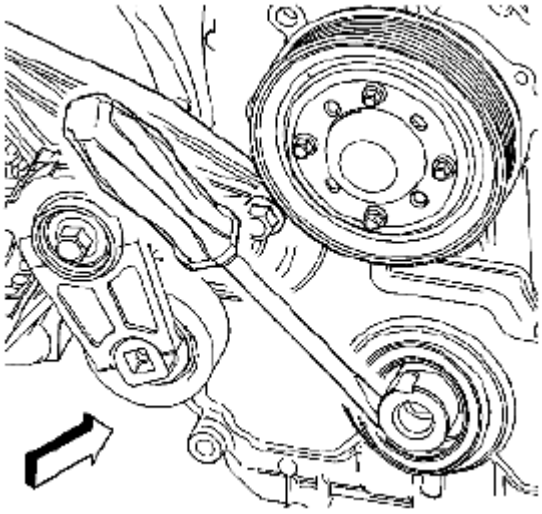


Fig. 96: Removing Crankshaft Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REPLACEMENT**.
2. Use a flat-bladed tool in order to remove the crankshaft oil seal. Use care not to damage the engine front cover or the crankshaft.

Installation Procedure

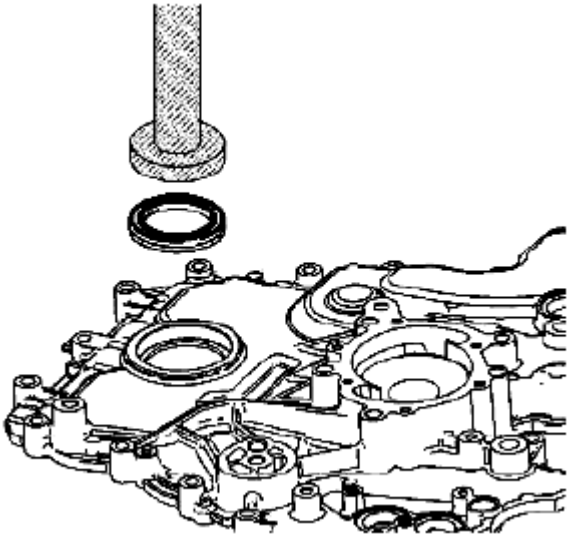


Fig. 97: Identifying Special Tool J 29184 And Crankshaft Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not lubricate the crankshaft front oil seal or the crankshaft balancer sealing surfaces.

1. Use the J 29184 or equivalent to install the crankshaft front oil seal.

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2. Install the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REPLACEMENT**.

CAMSHAFT COVER REPLACEMENT - LEFT SIDE

Special Tool

EN 46101 Spark Plug Tube Seal Guide

Removal Procedure

1. Remove the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the left side ignition coils. Refer to **IGNITION COIL REPLACEMENT - BANK 2** .
3. Unclip and reposition wire harness from camshaft cover.

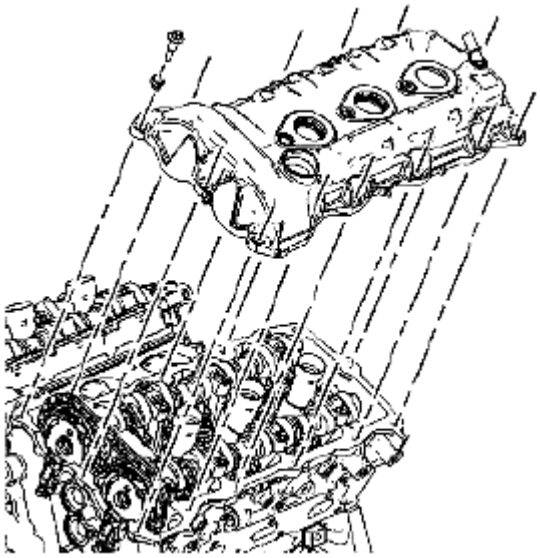


Fig. 98: Identifying Left Camshaft Cover And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the left camshaft cover bolts.
5. Remove the left camshaft cover from the left cylinder head.
6. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **CAMSHAFT COVER CLEANING AND INSPECTION**.

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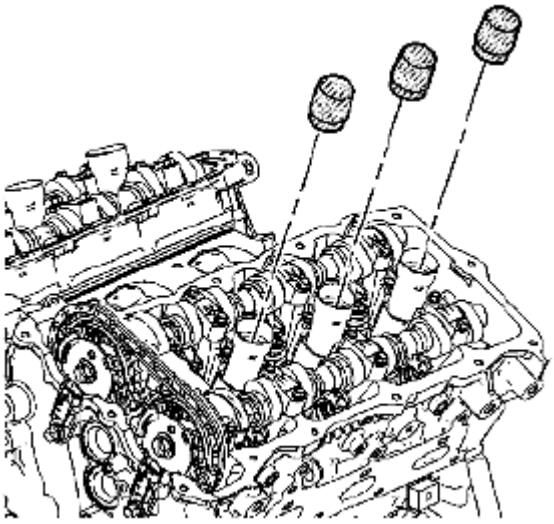


Fig. 99: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the EN 46101 onto the spark plug tubes of the left cylinder head.

Installation Procedure

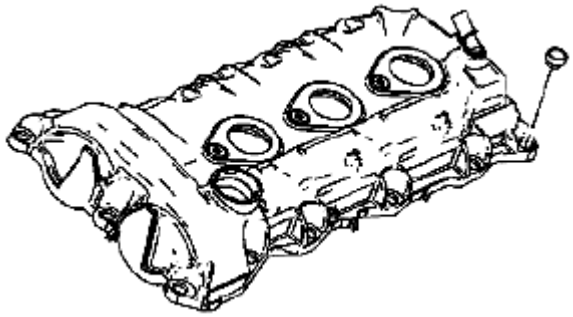


Fig. 100: Identifying Camshaft Cover Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.

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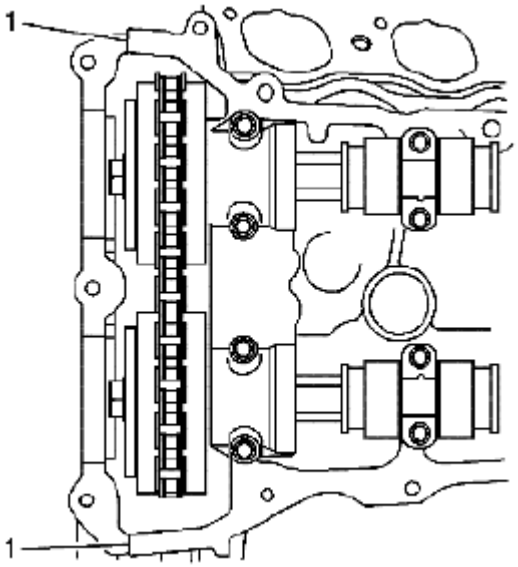


Fig. 101: Identifying Engine Front Cover Split Lines
Courtesy of SUZUKI OF AMERICA CORP.

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

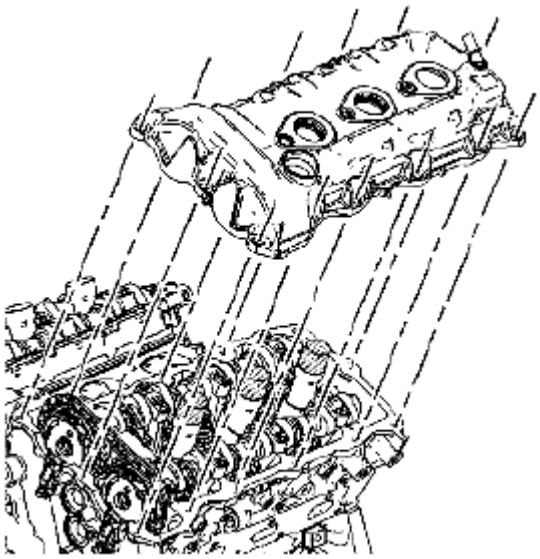


Fig. 102: Identifying Left Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Place the left camshaft cover into position onto the left cylinder head.

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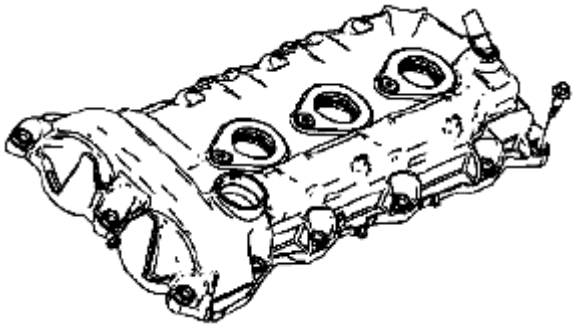


Fig. 103: Identifying Left Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

4. Loosely install the left camshaft cover bolts.

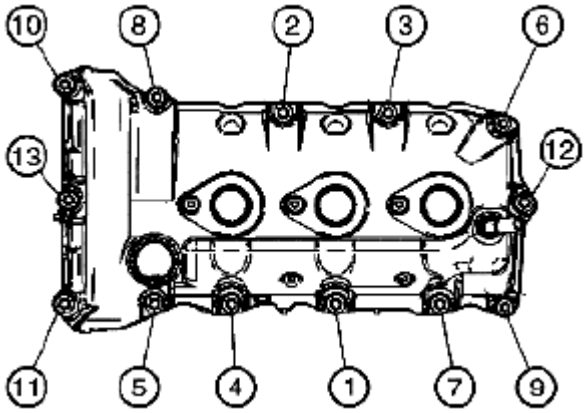


Fig. 104: Identifying Left Camshaft Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

5. Tighten the left camshaft cover bolts in the sequence shown.

Tightening torque

Tighten the left camshaft cover bolts in the sequence to 10 N.m (89 lb in) .

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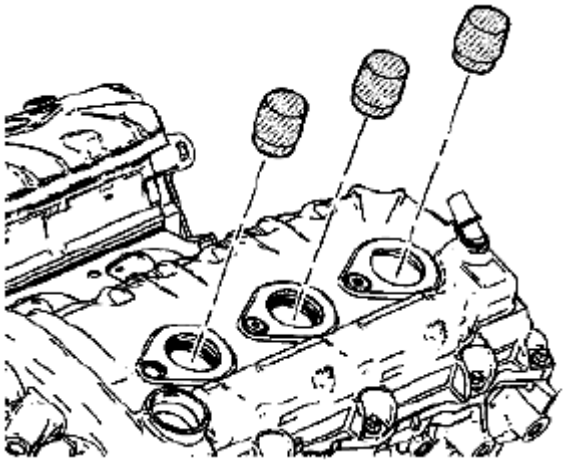


Fig. 105: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove the EN 46101 from the spark plug tubes of the left cylinder head.
7. Position wire harness and clip to camshaft cover.
8. Remove the left side ignition coils. Refer to **IGNITION COIL REPLACEMENT - BANK 2** .
9. Remove the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD REPLACEMENT**.

CAMSHAFT COVER REPLACEMENT - RIGHT SIDE

Special Tool

EN 46101 Spark Plug Tube Seal Guide

Removal Procedure

1. Remove the right bank spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
2. Unbolt the power steering reservoir and position aside. Refer to **REMOTE POWER STEERING FLUID RESERVOIR REPLACEMENT** .

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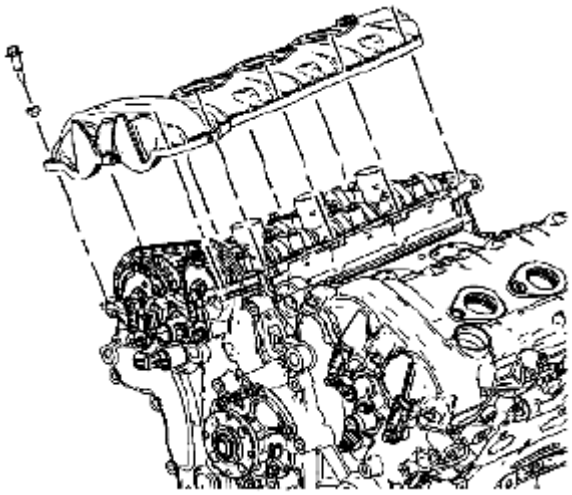


Fig. 106: Identifying Right Camshaft Cover And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the right camshaft cover bolts.
4. Remove the right camshaft cover from the right cylinder head.
5. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **CAMSHAFT COVER CLEANING AND INSPECTION**.

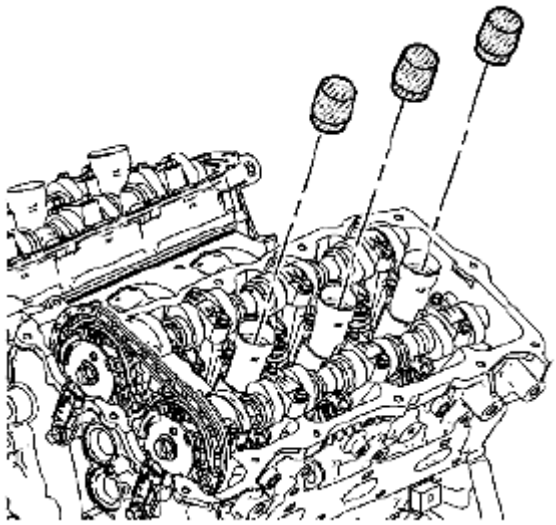


Fig. 107: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the EN 46101 onto the spark plug tubes of the left cylinder head.

Installation Procedure

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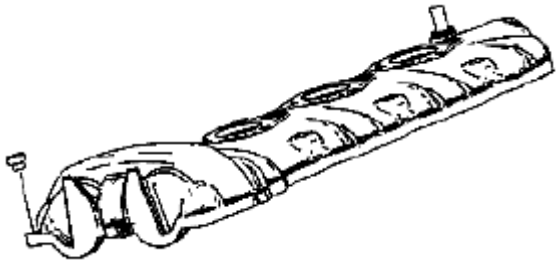


Fig. 108: Identifying Camshaft Cover Bolt Grommets
Courtesy of SUZUKI OF AMERICA CORP.

1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.

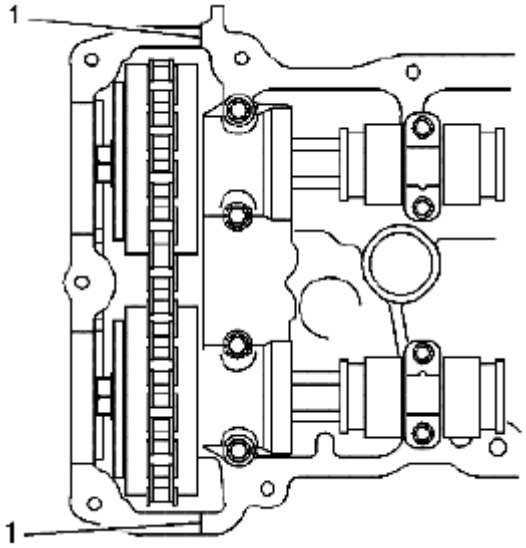


Fig. 109: Identifying Engine Front Cover Split Lines
Courtesy of SUZUKI OF AMERICA CORP.

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

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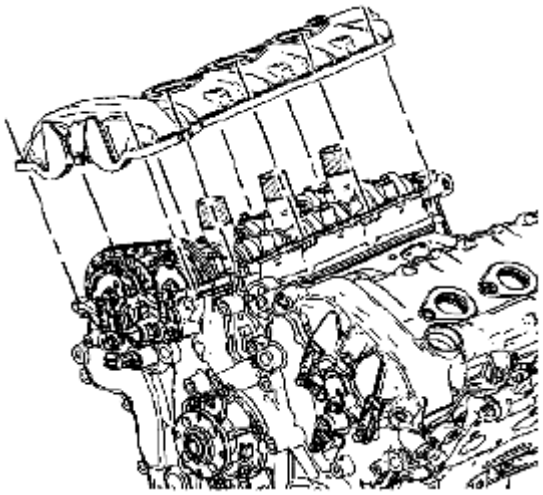


Fig. 110: Identifying Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Place the right camshaft cover into position onto the right cylinder head.

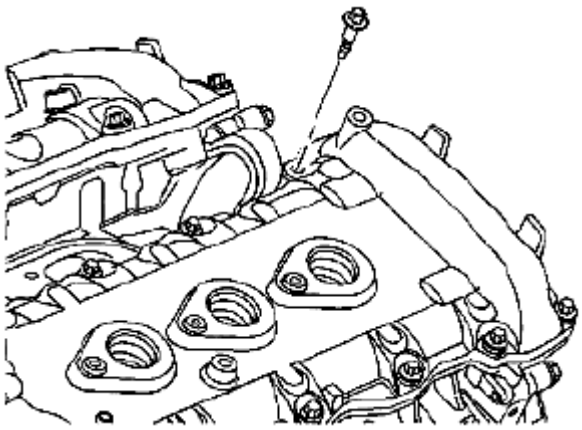


Fig. 111: Identifying Right Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

4. Loosely install the right camshaft cover bolts.

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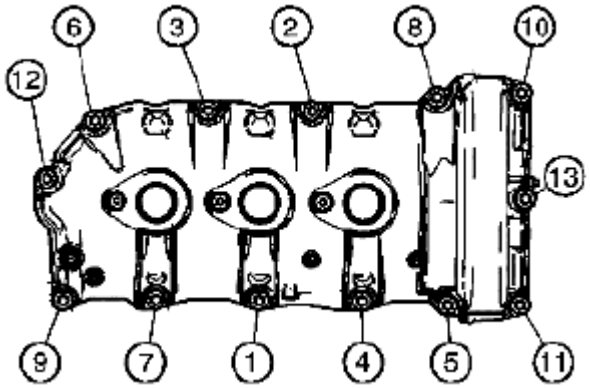


Fig. 112: Identifying Right Camshaft Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

5. Tighten the right camshaft cover bolts in the sequence shown.

   Tightening torque

   Tighten the left camshaft cover bolts in the sequence to 10 N.m (89 lb in) .

6. Install the power steering reservoir. Refer to **REMOTE POWER STEERING FLUID RESERVOIR REPLACEMENT** .

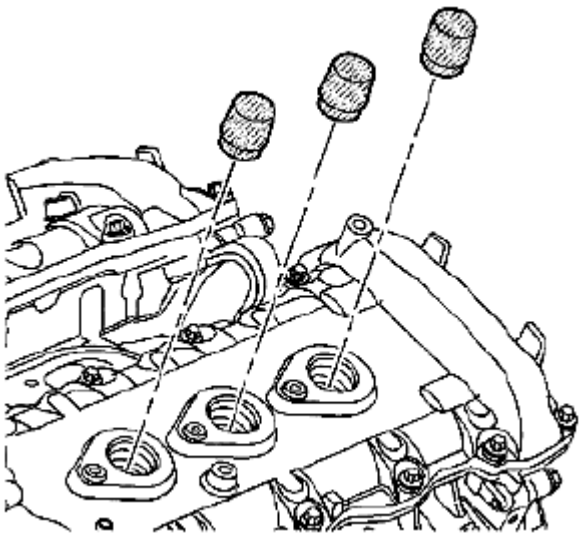


Fig. 113: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the EN 46101 from the spark plug tubes of the right cylinder head.

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8. Install NEW spark plugs into the right cylinder head. Refer to **SPARK PLUG REPLACEMENT** .

ENGINE FRONT COVER REPLACEMENT

Special Tool

EN 46105 Camshaft Locking Tool

EN 46111 Crankshaft Rotational Socket

EN 46109 Guide Pin Set

Removal Procedure

1. Remove the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the camshaft covers. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE** and **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
3. Drain the engine coolant. Refer to **COOLING SYSTEM DRAINING AND FILLING (LY7 GE 47716 FILL)** or **COOLING SYSTEM DRAINING AND FILLING (LY7 STATIC FILL)** .
4. Remove the water outlet housing assembly. Refer to **WATER OUTLET HOUSING REPLACEMENT** .
5. Remove the drive belt tensioner. Refer to **DRIVE BELT TENSIONER REPLACEMENT**.
6. Remove the water pump. Refer to **WATER PUMP REPLACEMENT** .
7. Remove the power steering pump. Refer to **POWER STEERING PUMP REPLACEMENT** .
8. Remove the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REPLACEMENT**.
9. Remove the camshaft position actuator valves from the front cover. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** , **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** , **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
10. Remove the camshaft position actuator solenoid valves from the front cover. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** , **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** , **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** , and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
11. Remove the generator. Refer to **GENERATOR REPLACEMENT** .

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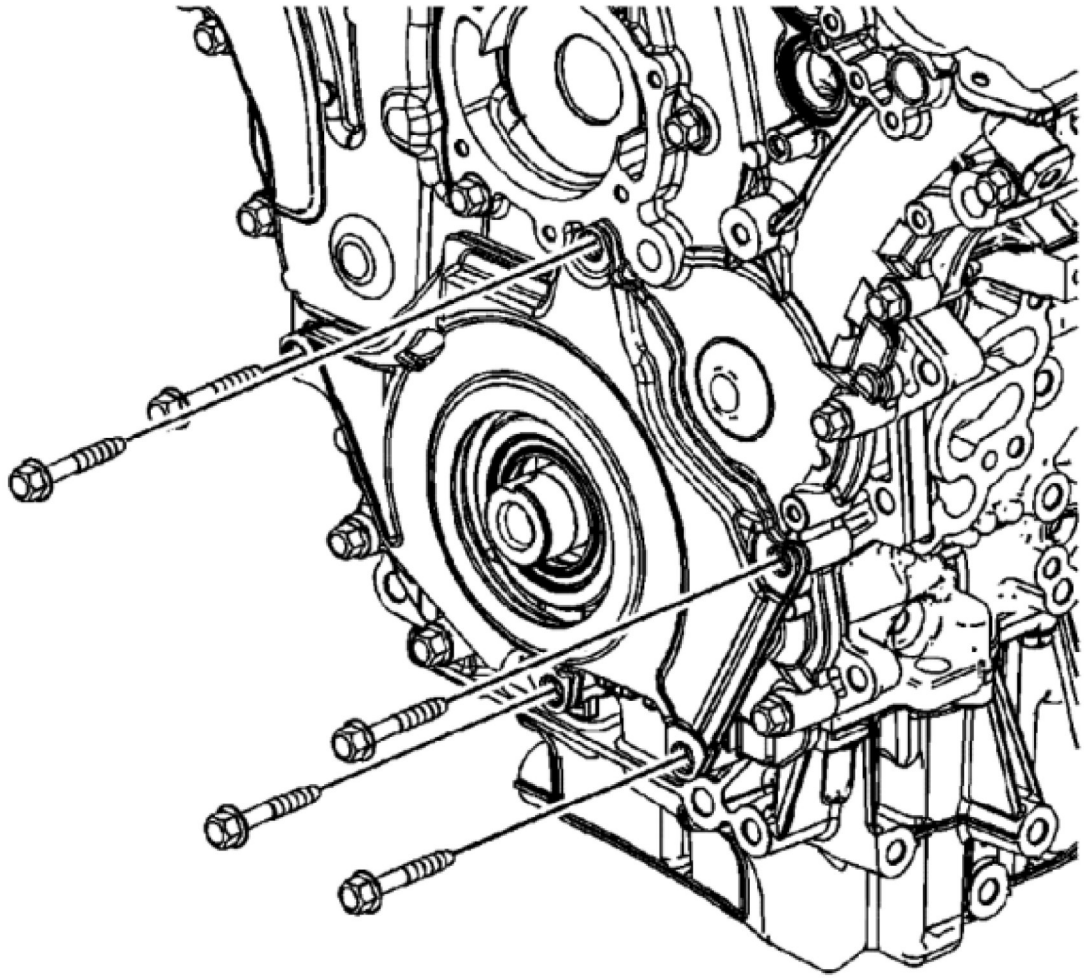


Fig. 114: Identifying Engine Front Cover Bolts For Engine Front Cover Deadener
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove the engine front cover bolts that hold the engine front cover deadener into position.

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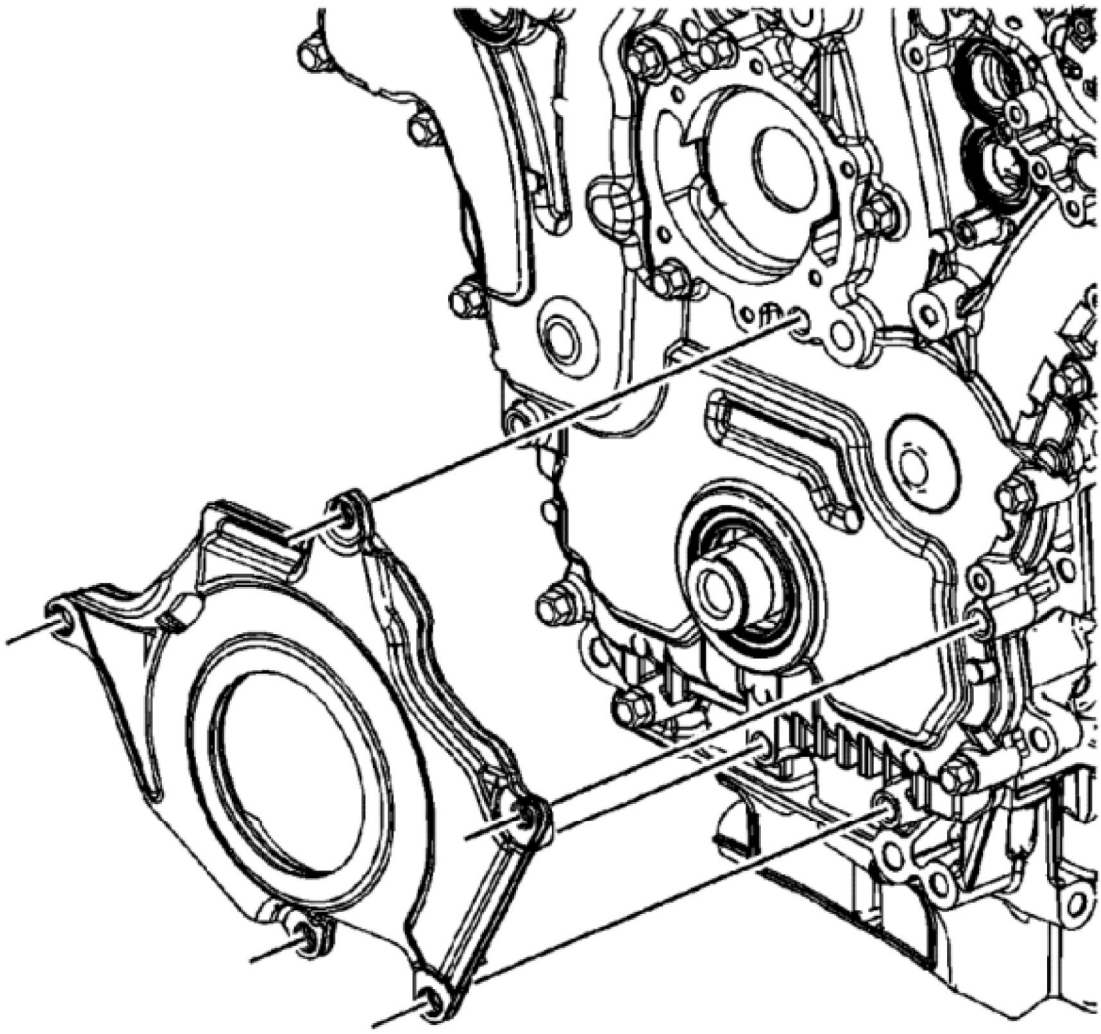


Fig. 115: Identifying Engine Front Cover Deadener
Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the engine front cover deadener.

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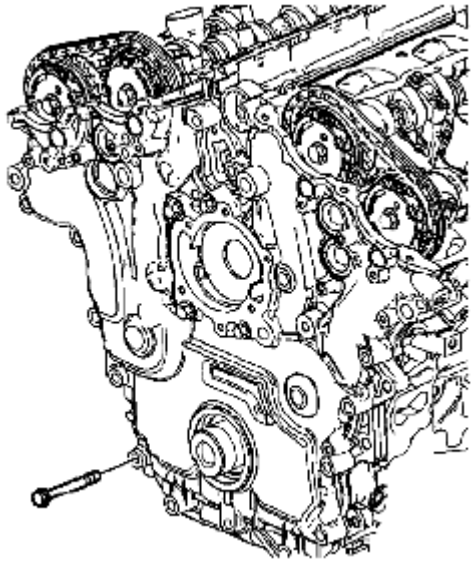


Fig. 116: Identifying Engine Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

14. Remove the remaining engine front cover bolts.

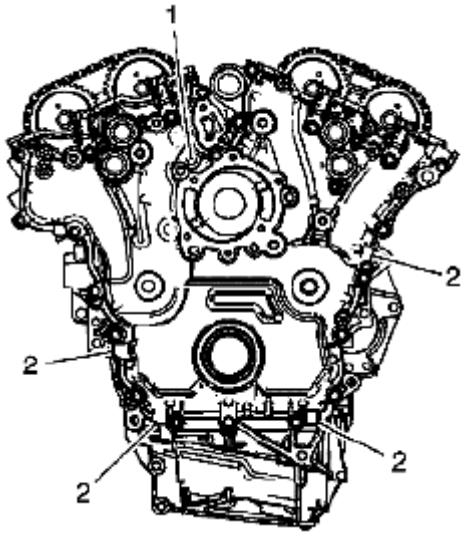


Fig. 117: Identifying Jackscrew Hole
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not pry between the engine front cover and the camshaft position sensors or the camshaft position actuators in order to separate the RTV. Use the pry points and a bolt in the jackscrew hole in order to remove the engine front cover. Damage to the camshaft position sensors or the camshaft position actuators may occur if the camshaft position sensors or the camshaft position actuators are used to pry against in order to remove the engine front cover.

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15. Loosely install a 10 x 1.5 mm bolt in the "jackscrew" hole (1).
16. Using the pry points (2) located at the edge of the front cover and the "jackscrew", shear the RTV sealant.

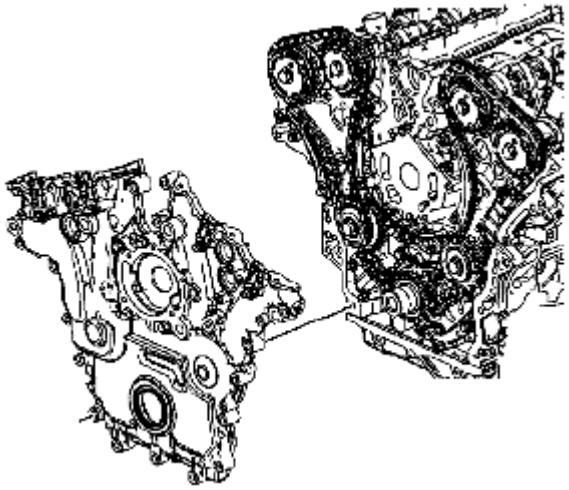


Fig. 118: Identifying Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

17. Remove the engine front cover.

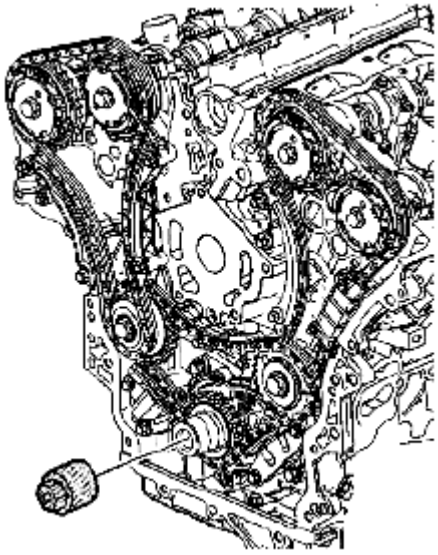


Fig. 119: Identifying Special Tool EN 46111
Courtesy of SUZUKI OF AMERICA CORP.

18. Using the EN 46111, rotate the crankshaft until the left cylinder head camshafts align with the EN 46105-2 and the right cylinder head camshafts align with the EN 46105-1.

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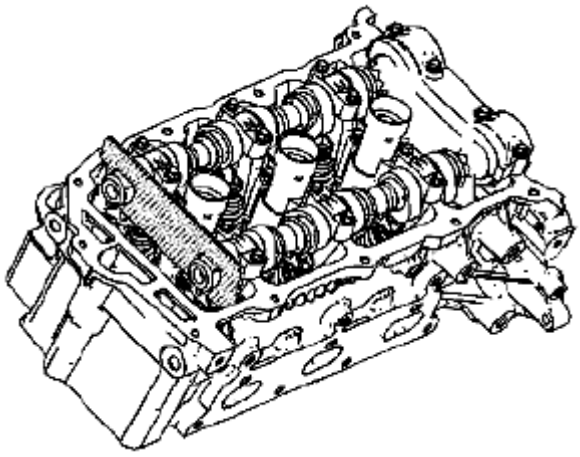


Fig. 120: Identifying Special Tool EN 46105-1
Courtesy of SUZUKI OF AMERICA CORP.

19. Install the EN 46105-1 to the right camshafts.

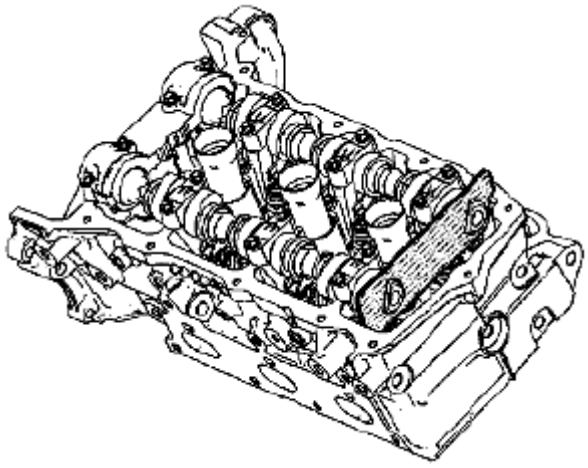


Fig. 121: Identifying Special Tool EN 46105-2
Courtesy of SUZUKI OF AMERICA CORP.

20. Install the EN 46105-2 to the left camshafts.

Installation Procedure

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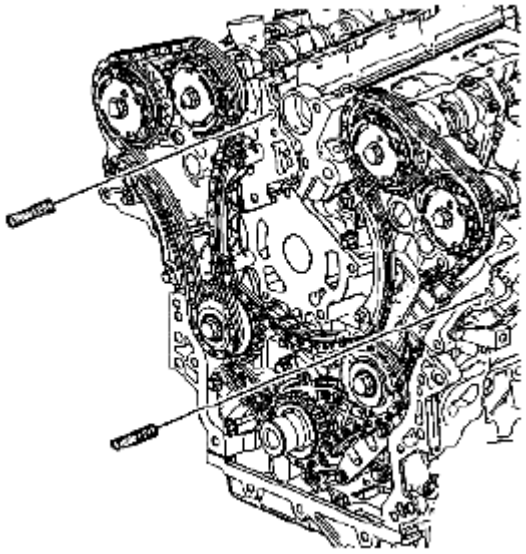


Fig. 122: Identifying 8 mm (0.315 in) Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the 8 mm (0.315 in) guide from the EN 46109 into the cylinder block positions as shown.

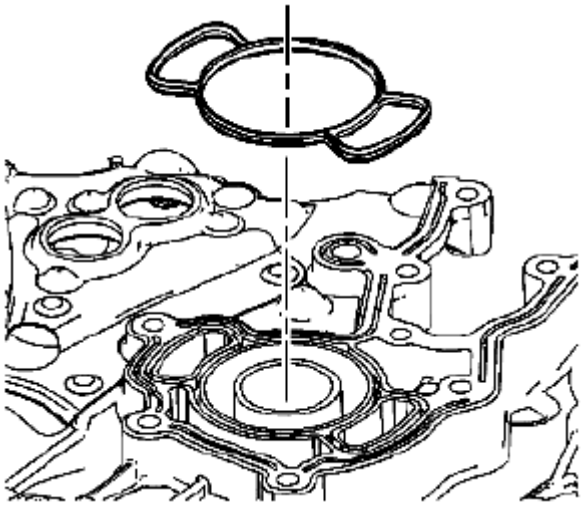


Fig. 123: Identifying Cylinder Block Seal
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the engine front cover to cylinder block seal.

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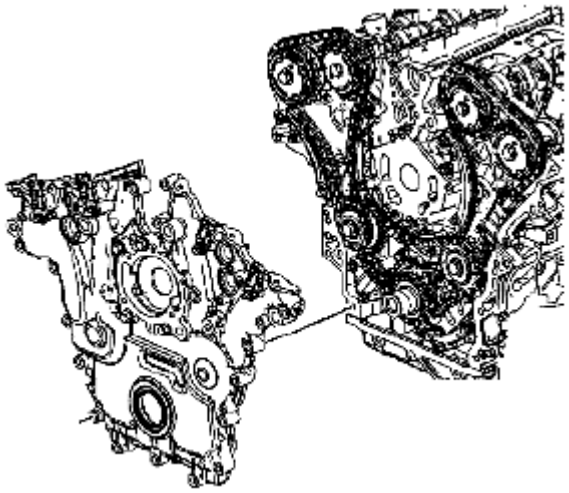


Fig. 124: Identifying Special Tool EN 46109
Courtesy of SUZUKI OF AMERICA CORP.

3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine.
4. Place the engine front cover onto the EN 46109 and slide into position.
5. Remove the EN 46109 from the cylinder block.

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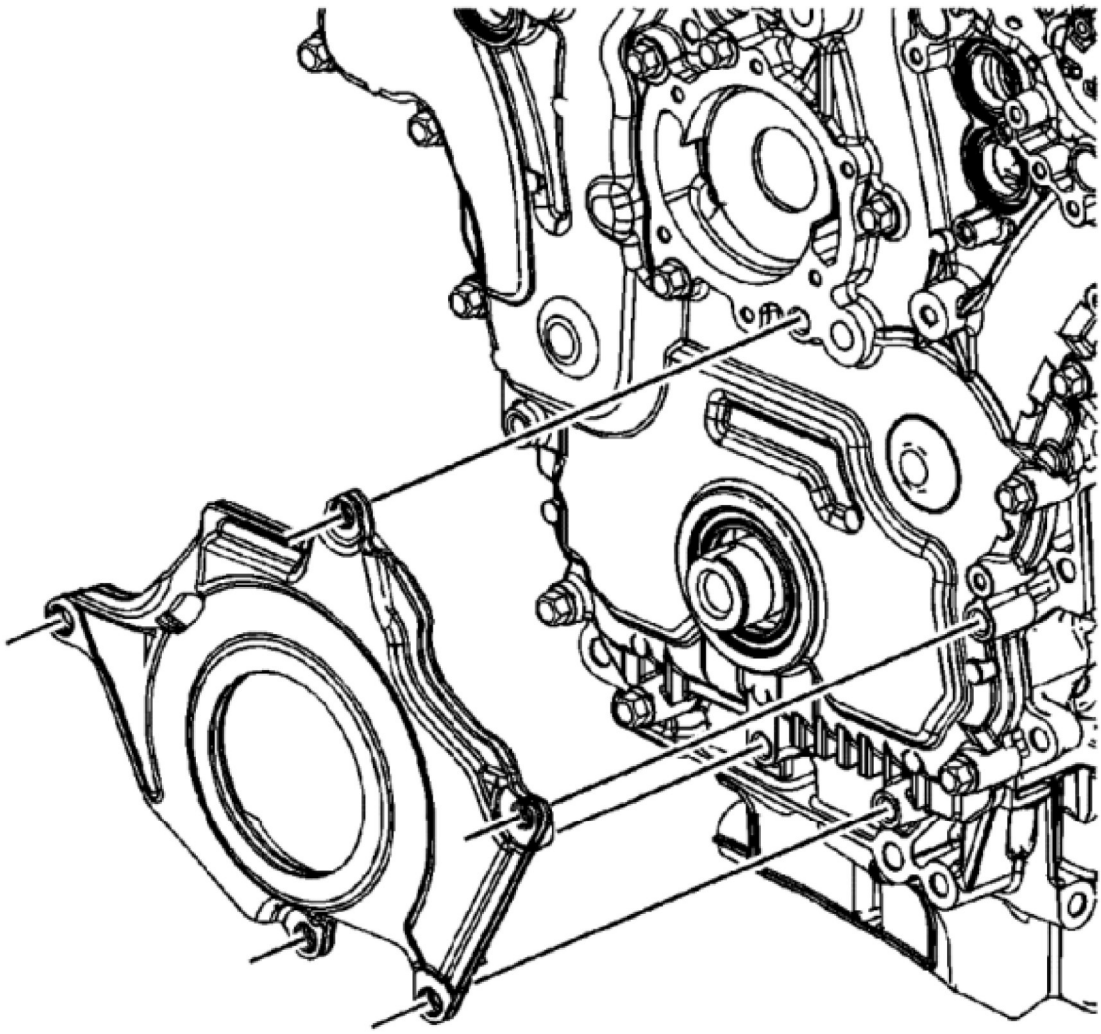


Fig. 125: Identifying Engine Front Cover Deadener
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the engine front cover deadener.

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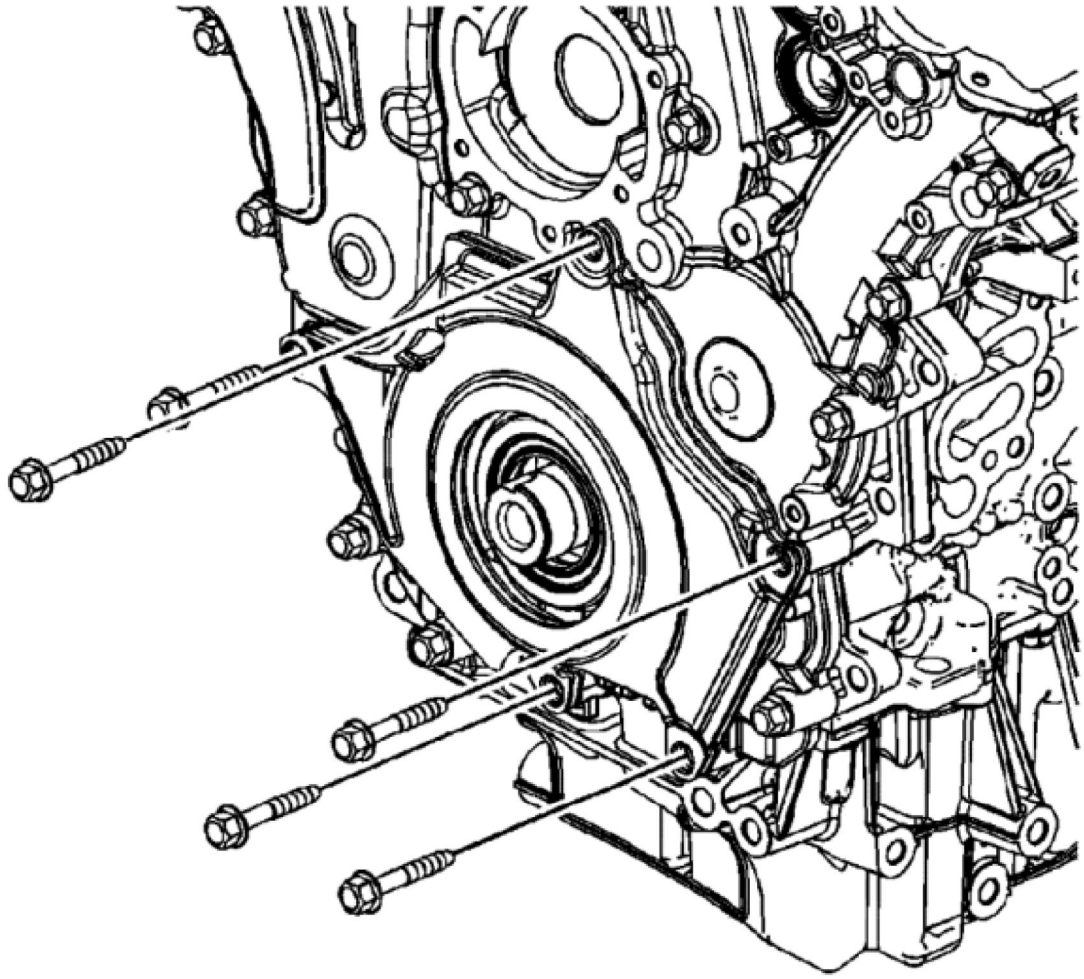


Fig. 126: Identifying Engine Front Cover Bolts For Engine Front Cover Deadener
Courtesy of SUZUKI OF AMERICA CORP.

7. Loosely install the engine front cover bolts to hold the engine front cover deadener into position.

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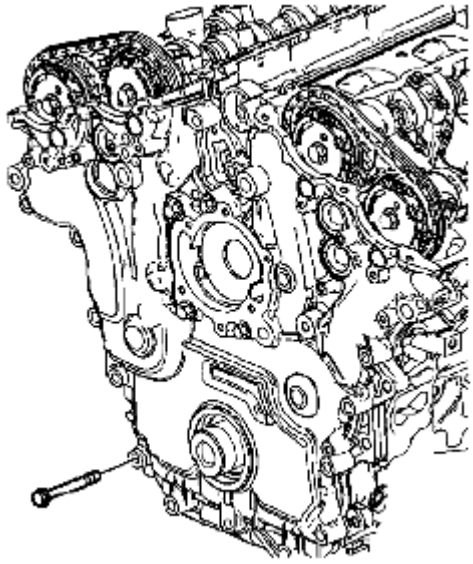


Fig. 127: Identifying Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

8. Loosely install the remaining front cover bolts.

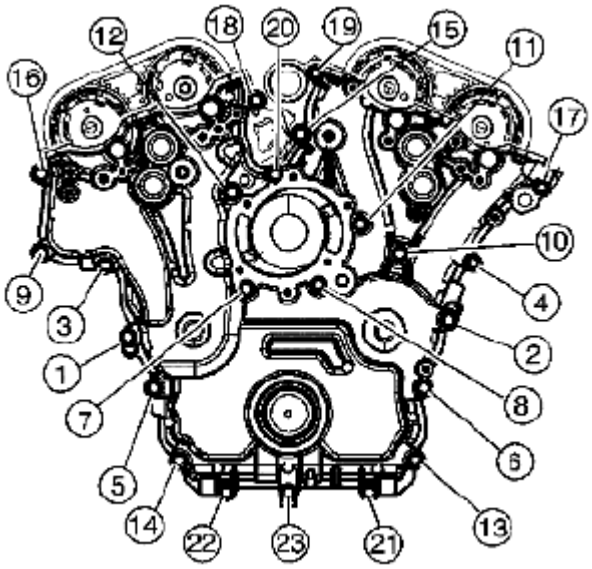


Fig. 128: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

9. Tighten the engine front cover bolts in the sequence shown.

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Tightening torque

Tighten the engine front cover bolts in sequence to 23 N.m (17 lb ft) .

10. Install the generator. Refer to **GENERATOR REPLACEMENT** .
11. Install the camshaft position actuator solenoid valves from the front cover. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** , **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** , **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** , and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
12. Install the camshaft position actuator valves from the front cover. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** , **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** , **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
13. Install the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REPLACEMENT**.
14. Install the power steering pump. Refer to **FASTENER NOTICE** .
15. Install the water pump. Refer to **WATER PUMP REPLACEMENT** .
16. Install the water outlet housing assembly. Refer to **WATER OUTLET HOUSING REPLACEMENT** .
17. Install the drive belt tensioner. Refer to **DRIVE BELT TENSIONER REPLACEMENT**.
18. Install the camshaft covers. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE** and **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
19. Install the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
20. Refill the engine coolant. Refer to **COOLING SYSTEM DRAINING AND FILLING (LY7 GE 47716 FILL)** or **COOLING SYSTEM DRAINING AND FILLING (LY7 STATIC FILL)** .

SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**.
4. Remove the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**.
5. Remove the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**.
6. Remove the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**.
7. Remove the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING DRIVE CHAIN**

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GUIDE REMOVAL - UPPER.

8. Remove the primary camshaft drive chain. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REMOVAL**.
9. Remove the right bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT SIDE**.
10. Remove the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**.
11. Remove the left bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT SIDE**.
12. Remove the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE**.
13. Remove the left bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT SIDE**.

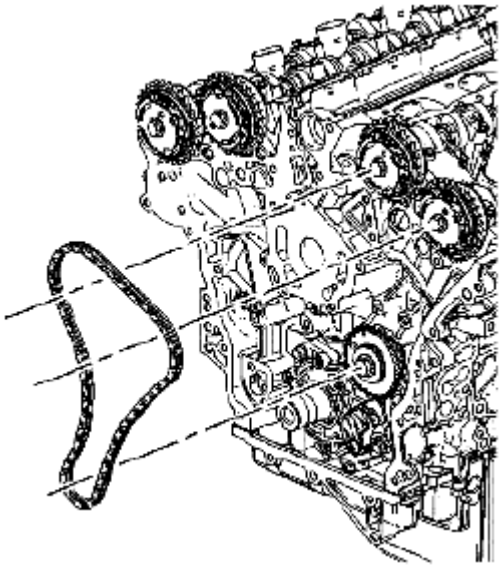


Fig. 129: Identifying Left Bank Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

14. Remove the left bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT SIDE**.
15. Clean and inspect all of the camshaft timing drive components. Refer to **CAMSHAFT TIMING DRIVE COMPONENTS CLEANING AND INSPECTION**. Replace components as necessary.

Installation Procedure

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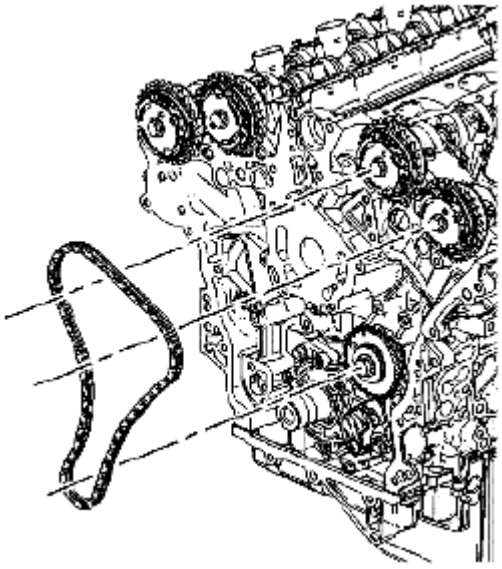


Fig. 130: Identifying Left Bank Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the left bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT SIDE (LY7 OR LP1)**.
2. Install the left bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - LEFT SIDE**.
3. Install the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE**.
4. Install the left bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE**.
5. Install the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.
6. Install the right bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT SIDE**.
7. Install the primary camshaft drive chain. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION**.
8. Install the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER**.
9. Install the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
10. Install the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE**.
11. Install the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**.
12. Install the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**.
13. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT**

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DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE.

14. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**.
5. Remove the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**.

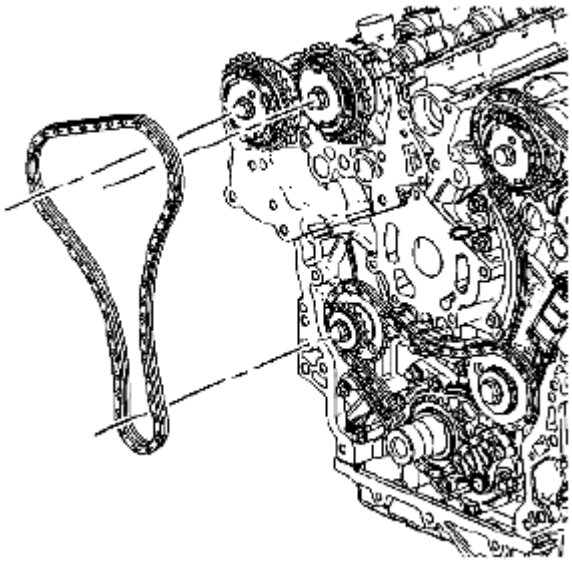


Fig. 131: Identifying Right Bank Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**.

Installation Procedure

1. Ensure the stage 1 camshaft timing is correct. Refer to **SETTING CAMSHAFT TIMING**.

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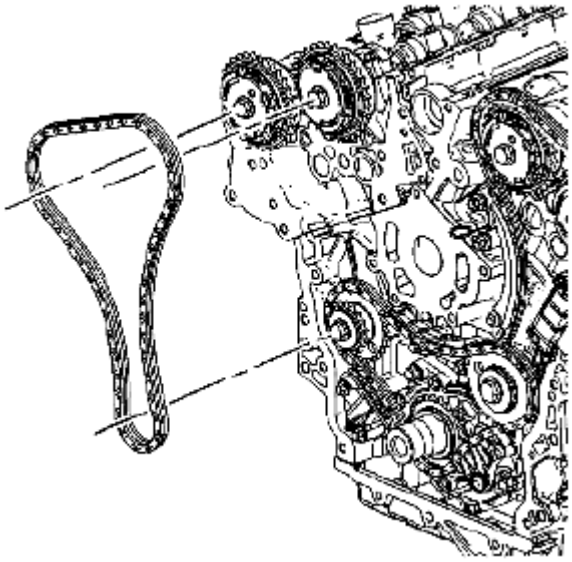


Fig. 132: Identifying Right Bank Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE**.
3. Install the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**.
4. Install the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**.
5. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
6. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
7. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .

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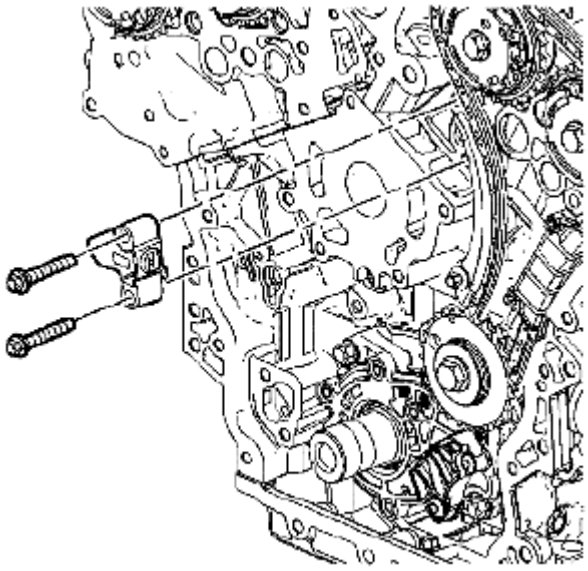


Fig. 133: Identifying Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**.

Installation Procedure

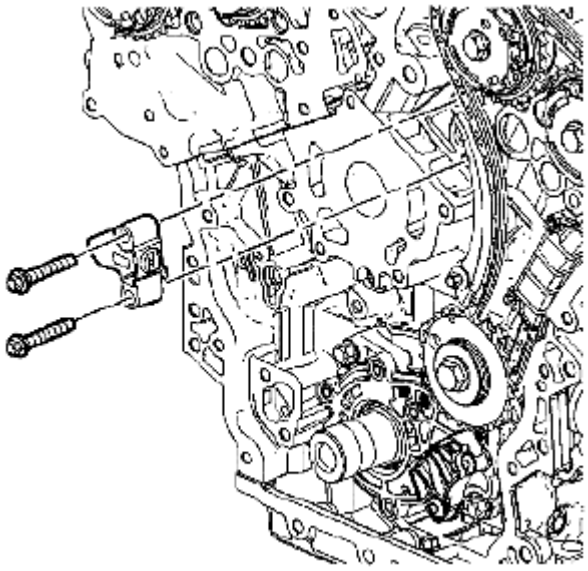


Fig. 134: Identifying Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.
2. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .

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3. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .

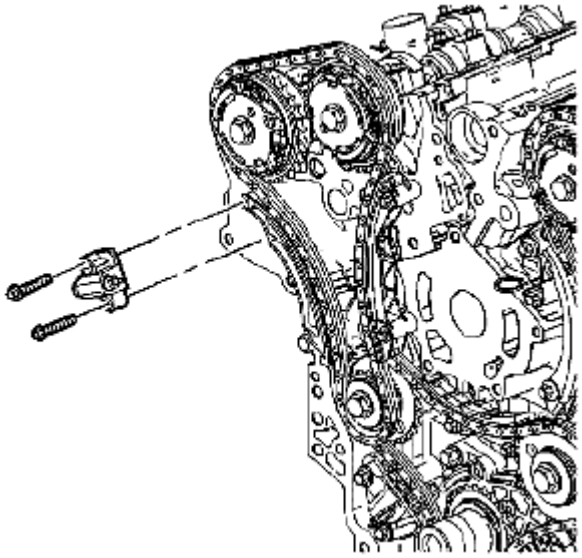


Fig. 135: Identifying Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.

Installation Procedure

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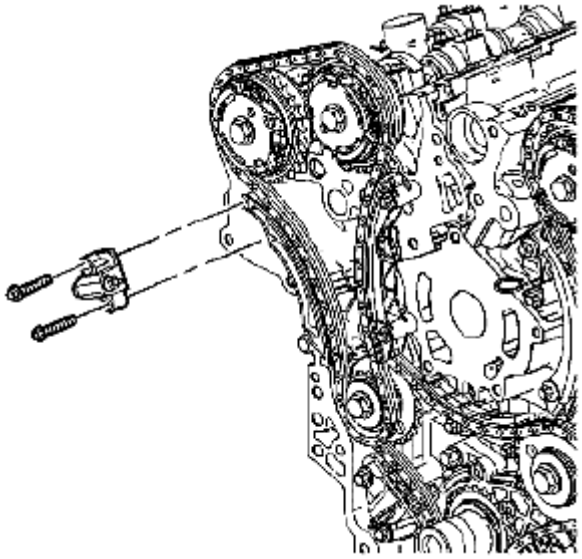


Fig. 136: Identifying Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
2. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
3. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**.

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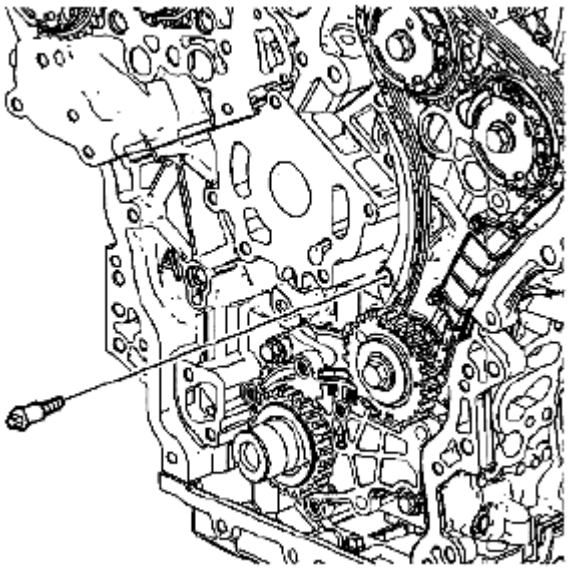


Fig. 137: Identifying Left Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the left secondary camshaft drive chain shoe bolt.

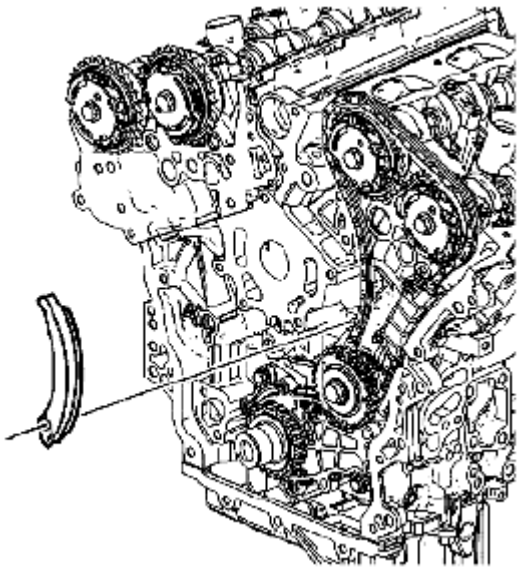


Fig. 138: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the left secondary camshaft drive chain shoe.

Installation Procedure

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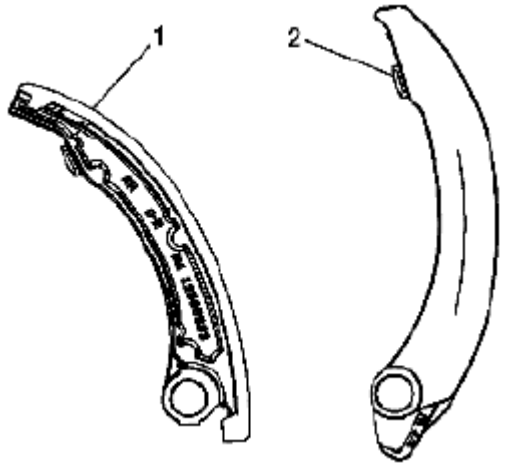


Fig. 139: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the left secondary camshaft drive chain shoe (2) is being installed.

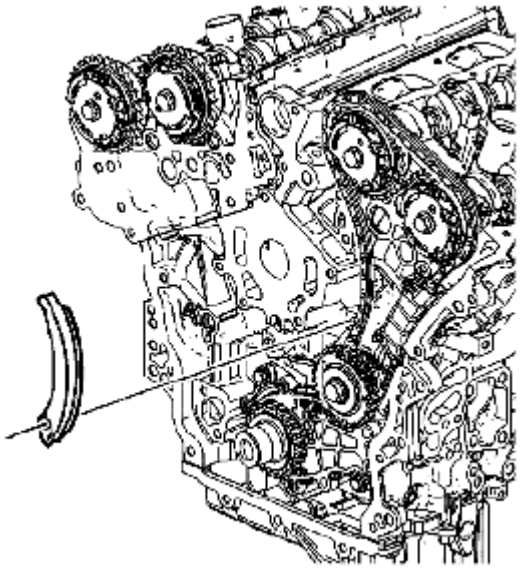


Fig. 140: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

2. Position the left secondary camshaft drive chain shoe.

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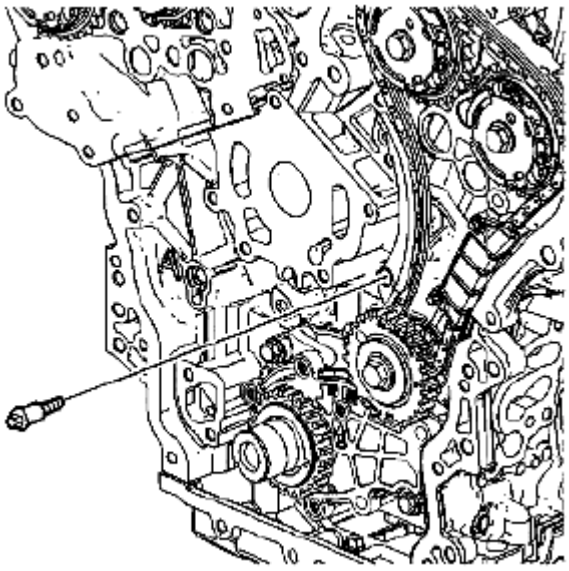


Fig. 141: Identifying Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Install the secondary camshaft drive chain shoe bolt.

   Tightening torque

   Tighten the secondary camshaft drive chain shoe bolt to 23 N.m (17 lb ft) .

4. Install the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.
5. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
6. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REPLACEMENT - RIGHT SIDE

Removal Procedure

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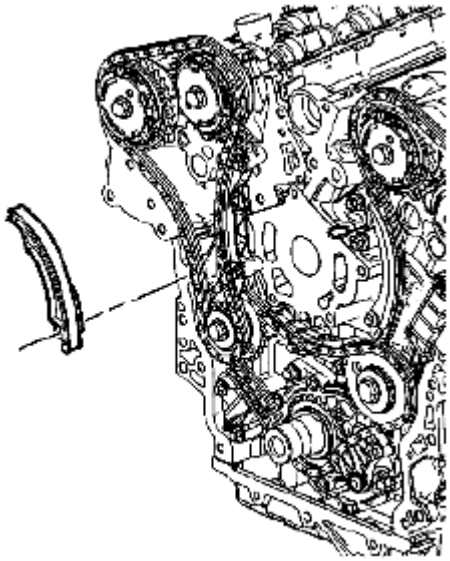


Fig. 142: Identifying Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**.

Installation Procedure

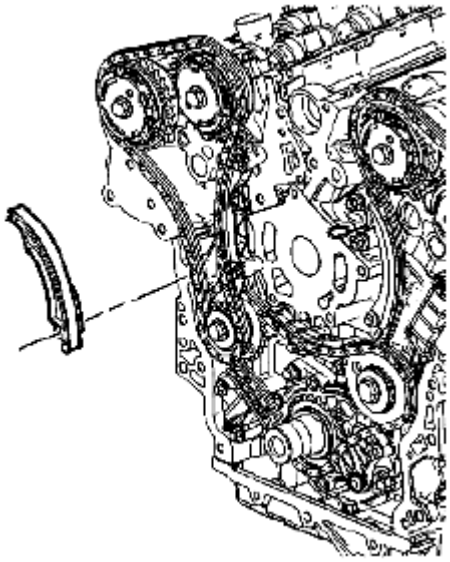


Fig. 143: Identifying Right Bank Secondary Camshaft Drive Chain Tensioner

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Courtesy of SUZUKI OF AMERICA CORP.

1. Install the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**.
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
3. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
4. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**.

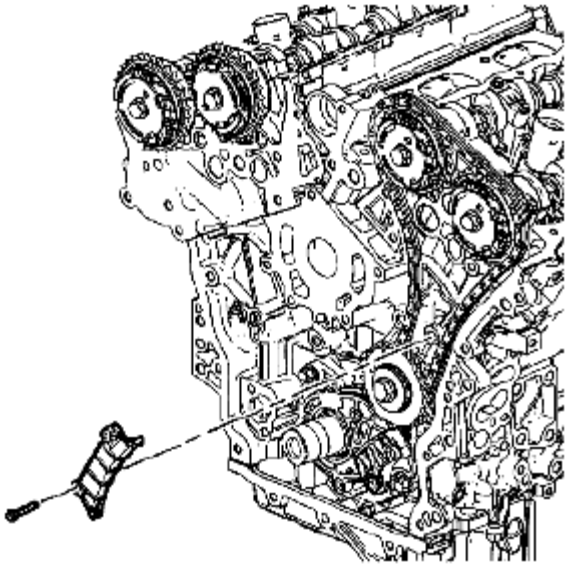


Fig. 144: Identifying Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE**.

Installation Procedure

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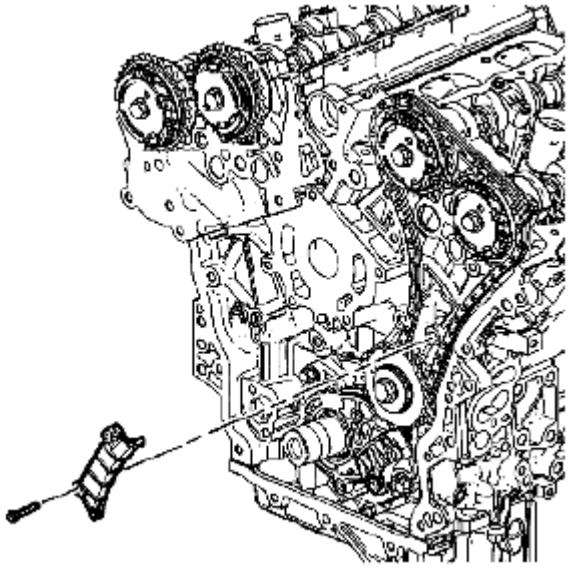


Fig. 145: Identifying Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE**.
2. Install the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.
3. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
4. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.

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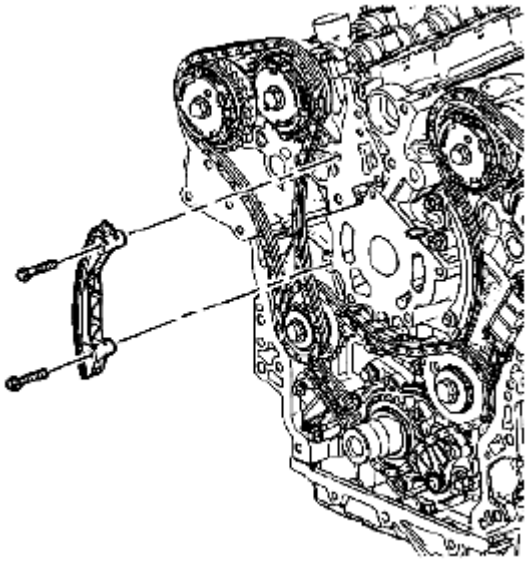


Fig. 146: Identifying Right Bank Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**.

Installation Procedure

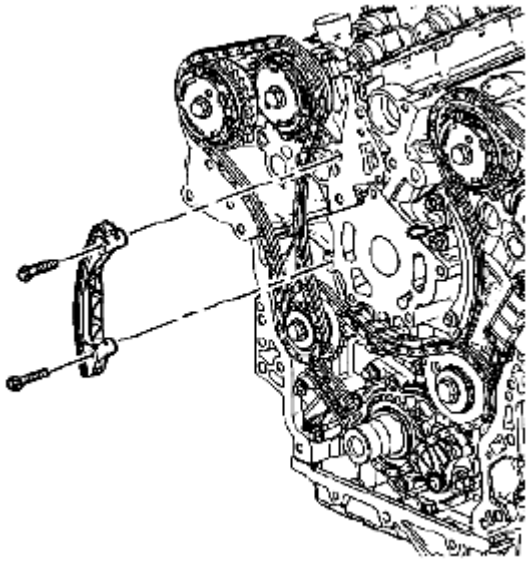


Fig. 147: Identifying Right Bank Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**.
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT**

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DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE.

3. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
4. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .

PRIMARY CAMSHAFT DRIVE CHAIN AND SPROCKETS REPLACEMENT

Special Tool

EN 46111 Crankshaft Rotation Socket

Removal Procedure

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**.
5. Remove the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**.
6. Remove the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**.
7. Remove the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**.
8. Remove the primary camshaft drive chain upper guide. Refer to **PRIMARY TIMING DRIVE CHAIN GUIDE REMOVAL - UPPER**.

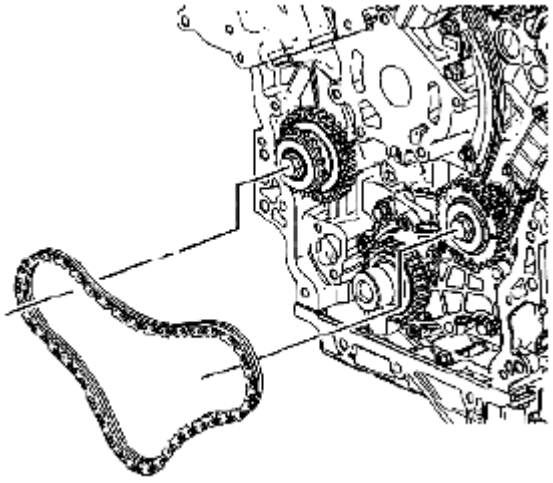


Fig. 148: Identifying Primary Camshaft Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

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9. Remove the primary camshaft timing chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**.

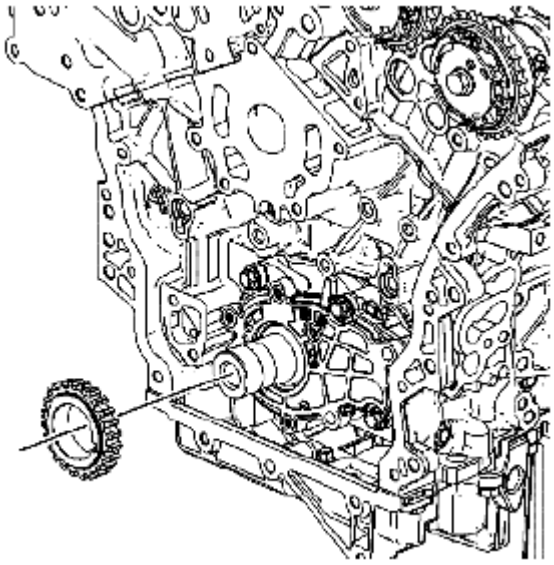


Fig. 149: Identifying Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the crankshaft sprocket from the nose of the crankshaft.

Installation Procedure

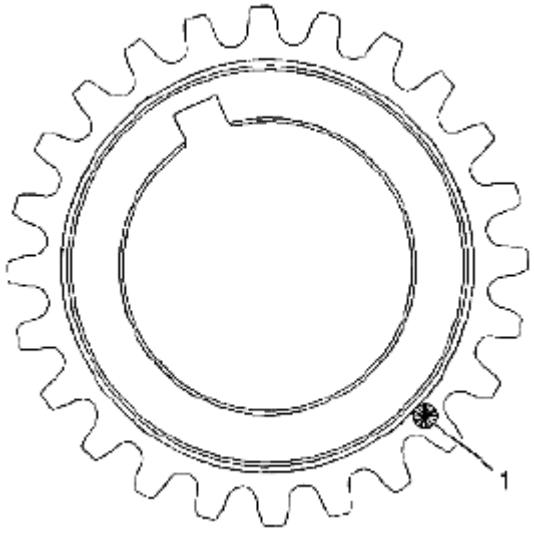


Fig. 150: Identifying Crankshaft Sprocket Timing Mark
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the crankshaft sprocket is installed with the timing mark (1) visible.

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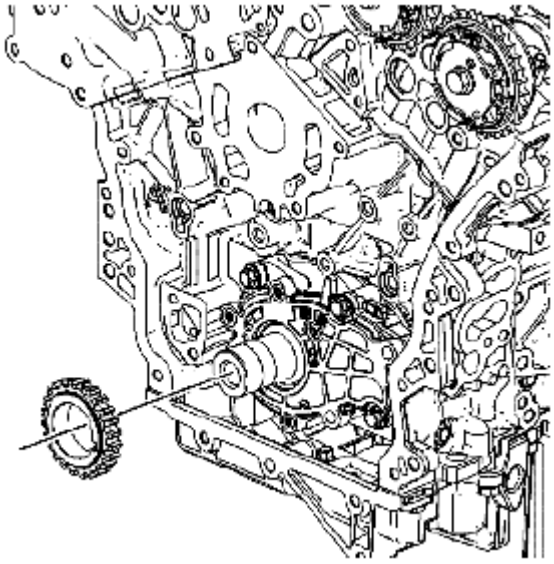


Fig. 151: Identifying Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the crankshaft sprocket on to the nose of the crankshaft.
3. Align the notch in the crankshaft sprocket with the pin in the crankshaft.
4. Slide the crankshaft sprocket on the crankshaft nose until the crankshaft sprocket contacts the step in the crankshaft.

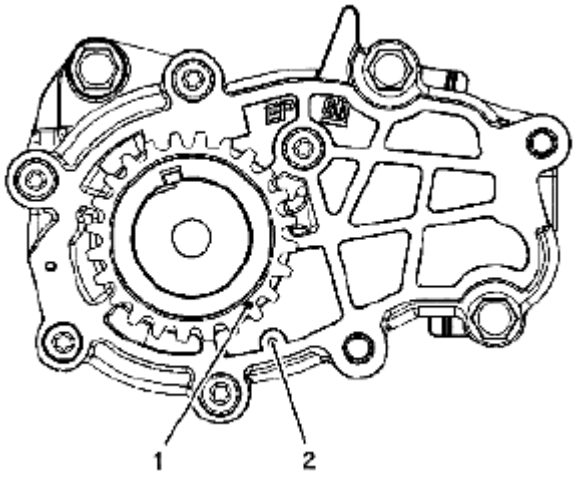


Fig. 152: Identifying Crankshaft Sprocket Timing Mark And Stage One Timing Mark On Oil Pump Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the EN 46111. Refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage One.

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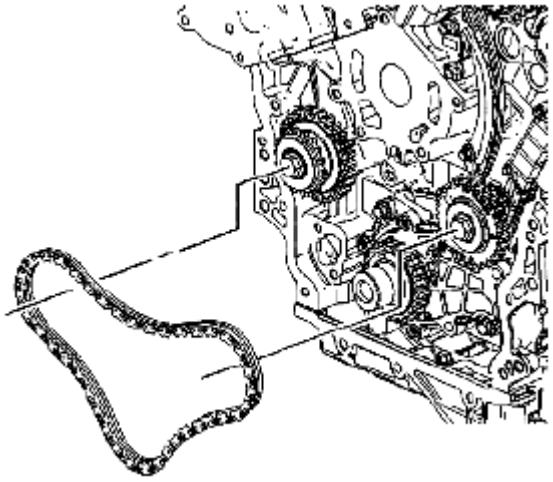


Fig. 153: Identifying Primary Camshaft Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the primary camshaft timing chain. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION**.
7. Install the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER**.
8. Install the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
9. Install the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE**.
10. Install the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**.
11. Install the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**.
12. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
13. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
14. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

TIMING CHAIN IDLER SPROCKET REPLACEMENT - LEFT SIDE

Removal Procedure

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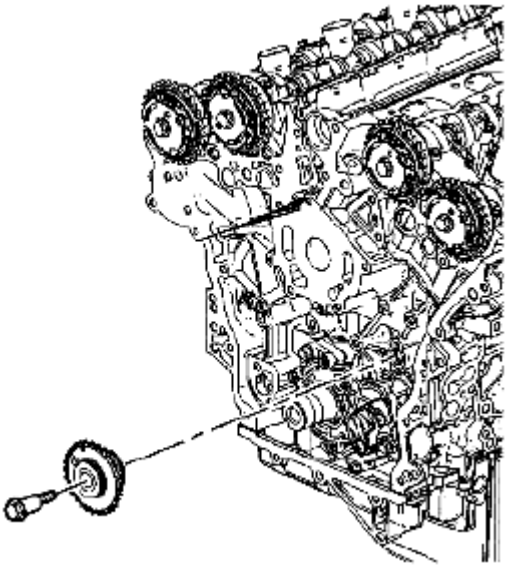


Fig. 154: Identifying Right Bank Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**.
5. Remove the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**.
6. Remove the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**.
7. Remove the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**.
8. Remove the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING DRIVE CHAIN GUIDE REMOVAL - UPPER**.
9. Remove the primary camshaft drive chain. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REMOVAL**.
10. Remove the right bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT SIDE**.

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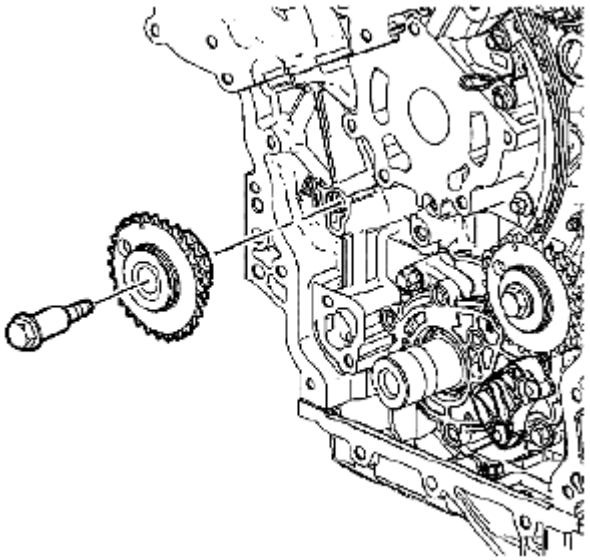


Fig. 155: Identifying Left Bank Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

11. If you are servicing the left bank camshaft intermediate drive chain idler, perform the following steps:
    a. Remove the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**.
    b. Remove the left bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT SIDE**.
    c. Remove the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE**.
    d. Remove the left bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT SIDE**.
    e. Remove the left bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT SIDE**.

Installation Procedure

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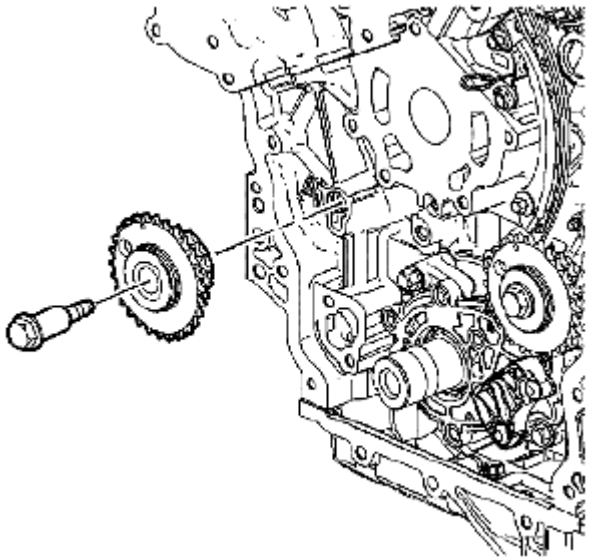


Fig. 156: Identifying Left Bank Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

1. If you are servicing the left bank idler sprocket, perform the following steps:
   a. Install the left bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - LEFT SIDE**.
   b. Install the left bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT SIDE (LY7 OR LP1)**.
   c. Install the left bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE**.
   d. Install the left bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE**.
   e. Install the left bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.

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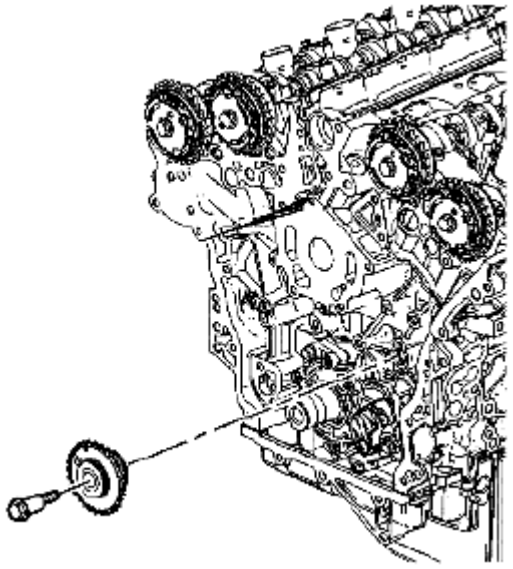


Fig. 157: Identifying Right Bank Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the right bank camshaft intermediate drive chain idler. Refer to **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT SIDE**.
3. Install the primary camshaft drive chain. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION**.
4. Install the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER**.
5. Install the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
6. Install the right bank secondary camshaft drive chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE**.
7. Install the right bank secondary camshaft drive chain guide. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**.
8. Install the right bank secondary camshaft drive chain shoe. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**.
9. Install the right bank secondary camshaft drive chain tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
10. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
11. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT

Removal Procedure

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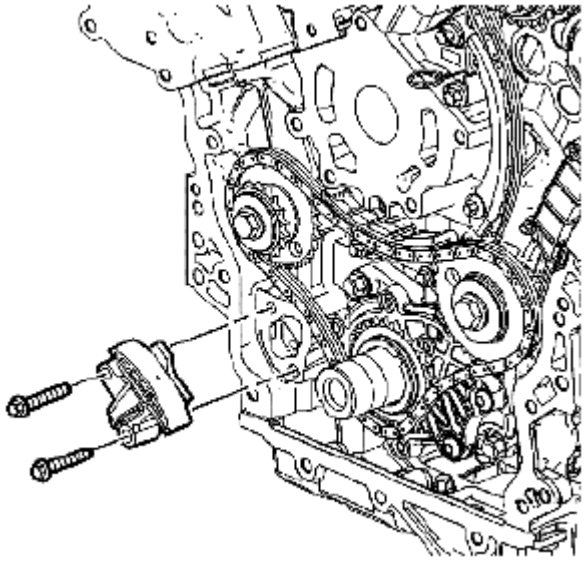


Fig. 158: Identifying Primary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .

NOTE: If the entire camshaft timing system is not in Stage 2 (CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM), mark the timing chain and sprockets in order to ensure proper reassembly.

3. Remove the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**.

Installation Procedure

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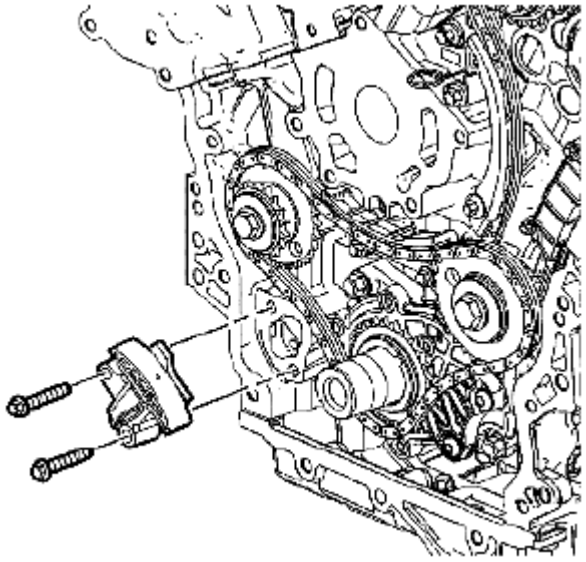


Fig. 159: Identifying Primary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
2. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
3. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - LOWER

The primary camshaft drive chain guide is not serviceable separately. If the guide is worn or damaged, the guide must be replaced with the oil pump.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - UPPER

Removal Procedure

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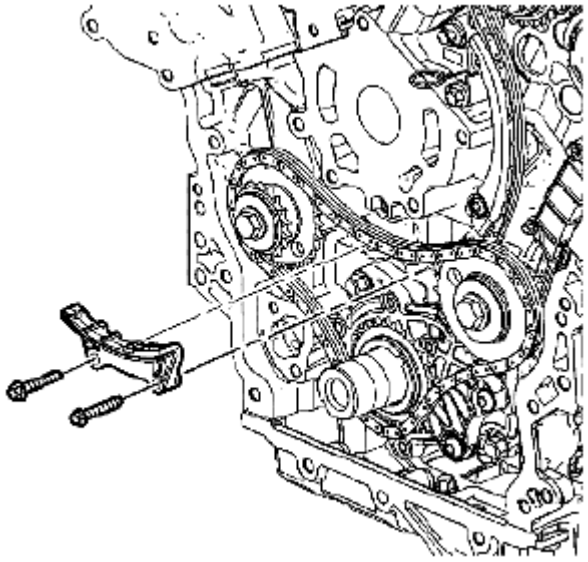


Fig. 160: Identifying Primary Upper Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **SPARK PLUG REPLACEMENT** .
2. Remove the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
3. Remove the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**.
4. Remove the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING DRIVE CHAIN GUIDE REMOVAL - UPPER**.

Installation Procedure

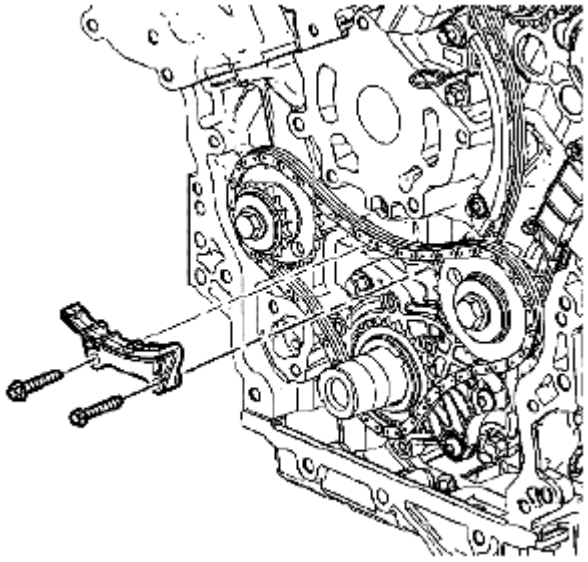


Fig. 161: Identifying Primary Upper Camshaft Drive Chain Guide

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Courtesy of SUZUKI OF AMERICA CORP.

1. Install the primary upper camshaft drive chain guide. Refer to **PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER**.
2. Install the primary camshaft drive chain tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
3. Install the engine front cover. Refer to **ENGINE FRONT COVER REPLACEMENT**.
4. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST

Special Tools

EN-48313 Timing Chain Retention Tool

Removal Procedure

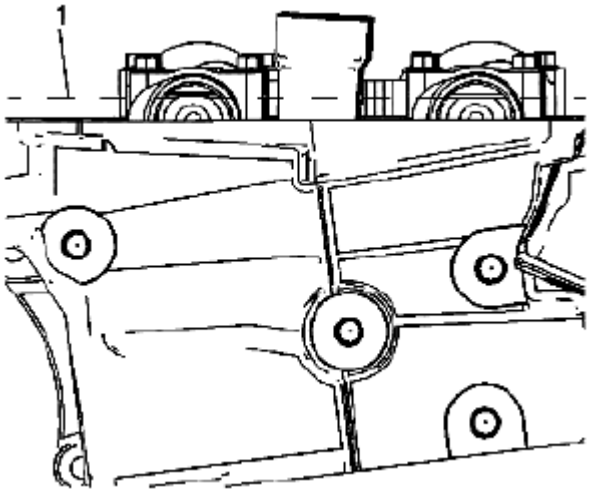


Fig. 162: Identifying Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the left camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE**.
3. Remove the left intake and exhaust camshaft position sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
4. Remove the left intake and exhaust camshaft position actuator solenoid. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .

NOTE: Rotate the crankshaft balancer bolt in a clockwise direction ONLY.

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5. Rotate the crankshaft balancer using the balancer bolt until the camshafts are in a neutral (low tension) position. The camshafts will be parallel with the camshaft cover rail (1).

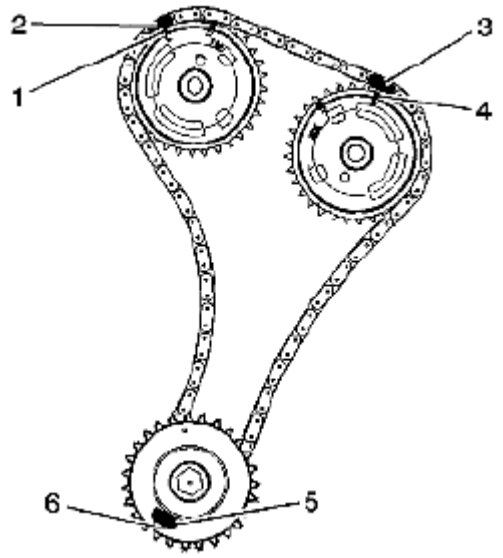


Fig. 163: Identifying Alignment Mark On One Of Timing Chain Links And Adjacent Tooth On Exhaust Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

6. Use a paint stick to create an alignment mark on one of the timing chain links (2) and the adjacent tooth on the exhaust camshaft position actuator (1).
7. Use a paint stick to create an alignment mark on one of the timing chain links (3) and the adjacent tooth on the intake camshaft position actuator (4).

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

8. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

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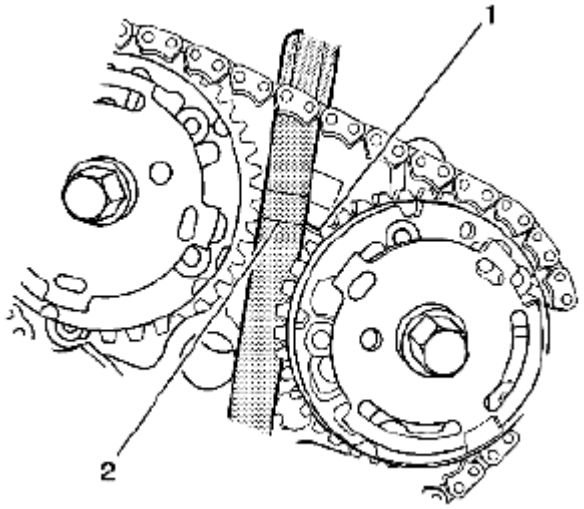


Fig. 164: Identifying Special Tool EN-48313 And Top Surface Of Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

9. Unscrew the EN-48313 so that the legs of the tool are retracted.
10. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This is the approximate installed position.

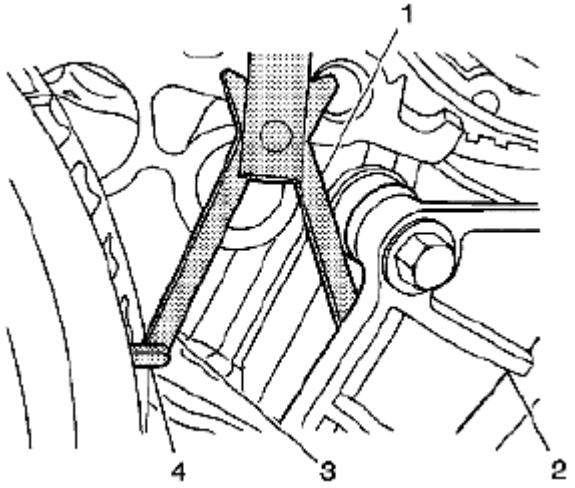


Fig. 165: Identifying Special Tool EN-48313 Legs Contact Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The engine front cover is removed for clarity in the following graphics, but NOT required to perform the procedure.

11. Ensure that the feet (4) on the legs of the tool are facing the front of the engine.
12. Partially expand the legs (1, 3) of the EN-48313 by turning the T-shaped handle clockwise.
13. Insert the leg of the tool (1) behind the timing chain guide (2).

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14. Continue expanding the EN-48313 until the legs (1, 3) contact the timing chain. Do not tighten at this time.

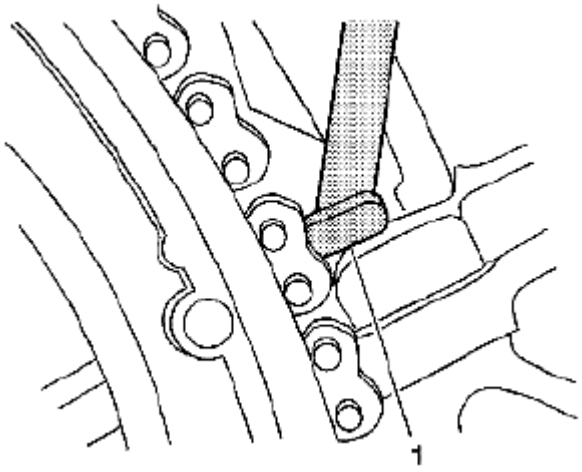


Fig. 166: Identifying Foot Of EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the foot (1) of the EN-48313 is engaged into one of the link pockets to prevent tool slippage during tightening of the EN-48313.

15. Hand tighten the EN-48313.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

16. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

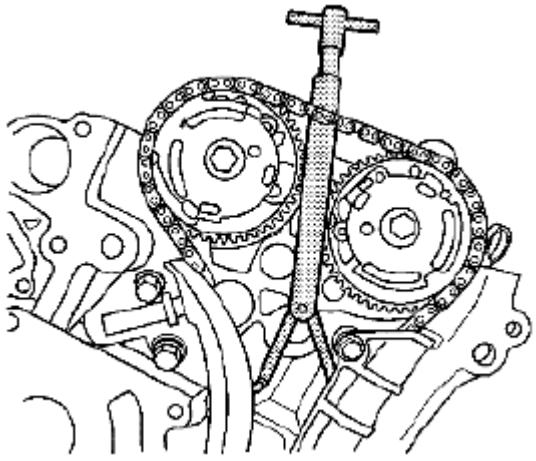


Fig. 167: Identifying Special Tool EN-48313

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Courtesy of SUZUKI OF AMERICA CORP.

17. The EN-48313 is now properly installed to hold the timing chain in position.

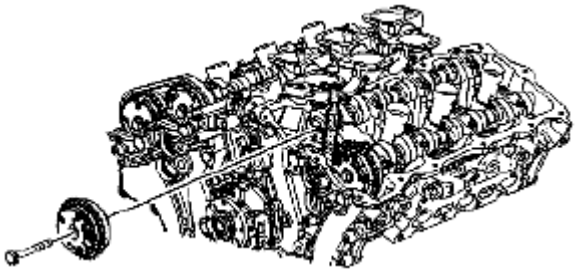
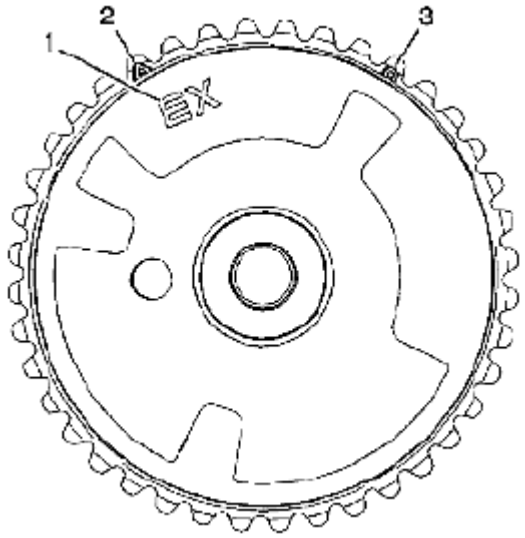


Fig. 168: Identifying Left Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

18. Use an open end wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
19. Remove the left exhaust camshaft position actuator bolt.
20. Remove the left exhaust camshaft position actuator. When removing the actuator, place the chain on the engine cover side of the actuators.
21. Rotate the actuator in order to align the opening in the actuator reluctor wheel with the cam sensor boss in the front cover, to allow actuator removal.
22. If removing both the exhaust and intake camshaft actuators, the timing chain can be draped over the EN-48313 once the actuators have been removed.

Installation Procedure



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Fig. 169: Identifying Outer Ring Of Camshaft Position Actuator For Circle Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the EX marking (1).

   The marking is for an exhaust camshaft position actuator,

2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (3).

   The marking is for alignment to the highlighted timing chain link on the left side of the engine.

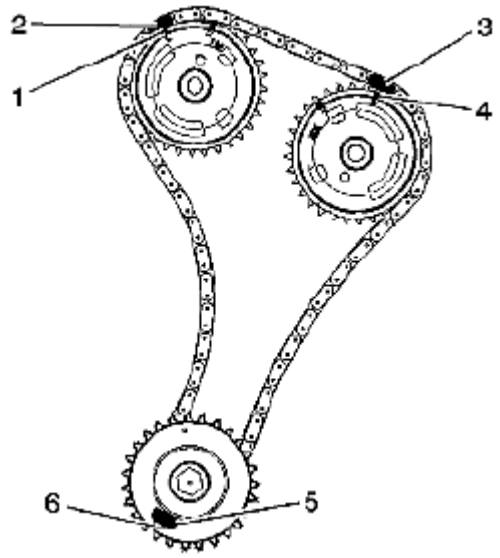


Fig. 170: Aligning Exhaust Camshaft Actuator Alignment Mark To Timing Chain Alignment Mark
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

3. Align the exhaust camshaft actuator alignment mark (1) to the timing chain alignment mark (2) made during disassembly.
4. Ensure that the intake camshaft actuator alignment mark (4) and the timing chain alignment mark (3) are also aligned.
5. Position the exhaust camshaft actuator to the camshaft and install the actuator bolt hand tight.
6. Remove the EN-48313.

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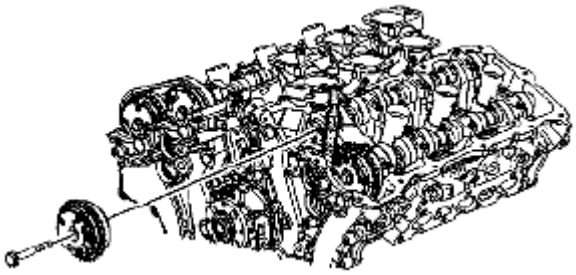


Fig. 171: Identifying Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

7. Tighten the exhaust camshaft position actuator bolt.

   Tightening torque

   Tighten the bolt to 58 N.m (43 lb ft) .

8. Install the left intake and exhaust camshaft position actuator solenoids. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
9. Install the left intake and exhaust camshaft position sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
10. Install the left camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE**.
11. Install the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST

Special Tools

EN-48313 Timing Chain Retention Tool

Removal Procedure

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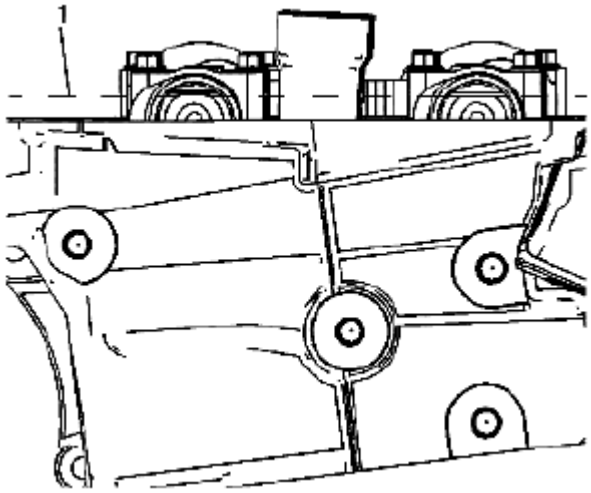


Fig. 172: Identifying Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the right camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
3. Remove the right intake and exhaust camshaft position sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** .
4. Remove the right intake and exhaust camshaft position actuator solenoids. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** .

NOTE: Rotate the crankshaft balancer bolt in a clockwise direction ONLY.

5. Rotate the crankshaft balancer using the balancer bolt until the camshafts are in a neutral (low tension) position. The camshafts will be parallel with the camshaft cover rail (1).

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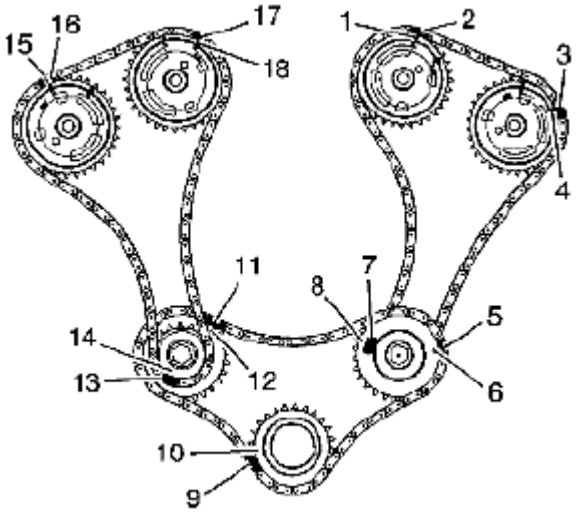


Fig. 173: Identifying Alignment Mark On Timing Chain Links And Adjacent Tooth On Exhaust Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

6. Use a paint stick to create an alignment mark (17) on one of the timing chain links and the adjacent tooth on the exhaust camshaft position actuator (18).
7. Use a paint stick to create an alignment mark (16) on one of the timing chain links and the adjacent tooth on the intake camshaft position actuator (15).

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

8. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

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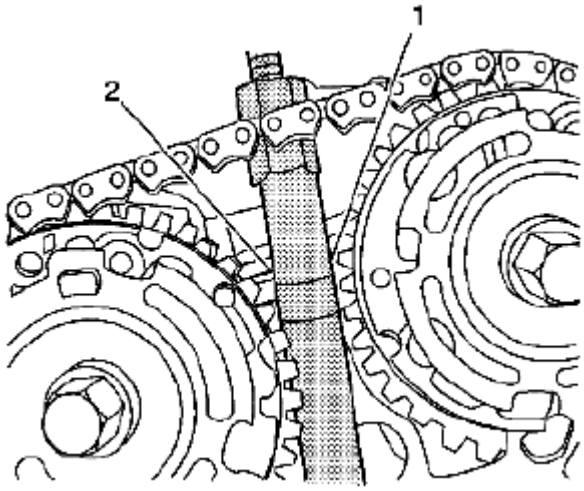


Fig. 174: Identifying Special Tool EN-48313 And Camshaft Actuators
Courtesy of SUZUKI OF AMERICA CORP.

9. Unscrew the EN-48313 so that the legs of the tool are retracted.
10. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.

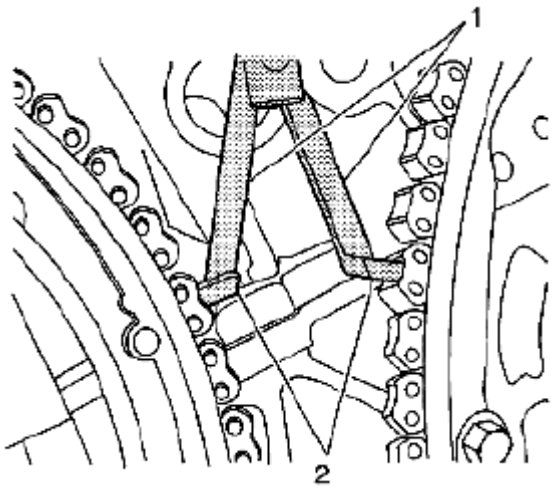


Fig. 175: Identifying Special Tool EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The engine front cover is removed for clarity in the following graphics, but NOT required to perform the procedure.

11. Ensure that the feet (2) on the legs of the tool are facing the front of the engine.
12. Partially expand the legs (1) of the EN-48313 by turning the T-shaped handle clockwise.
13. Continue expanding the EN-48313 until the feet (2) contact the timing chain. Do not tighten at this time.

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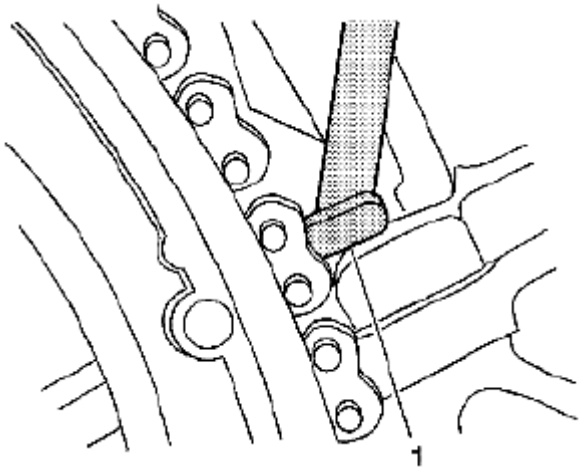


Fig. 176: Identifying Special Tool EN-48313 Foot
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Ensure that the foot (1) of the EN-48313 is engaged into one of the link pockets to prevent chain slippage during tightening of the EN-48313.**
- **Do not allow the body of the EN-48313 to rotate when tightening the T-handle.**

14. Hand tighten the EN-48313.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

15. Use an open end wrench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

16. Use an open end wrench on the hex cast into the right intake and exhaust camshafts and rotate the camshafts towards each other in order to create slack in the chain between the actuators.

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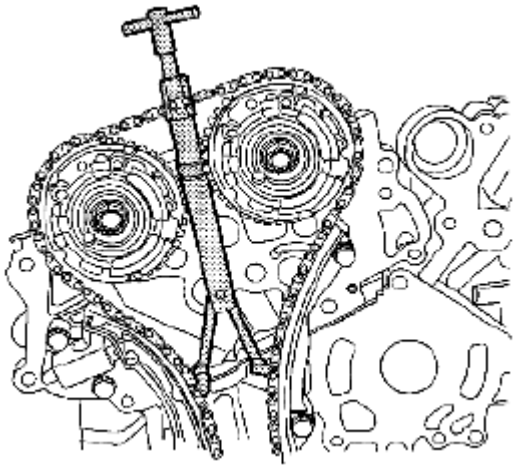


Fig. 177: Identifying Special Tool EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

17. The EN-48313 is now properly installed to hold the timing chain in position.

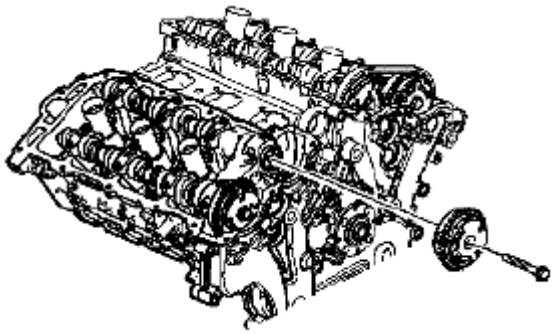


Fig. 178: Identifying Right Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

18. Use an open end wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
19. Remove the right exhaust camshaft position actuator bolt.
20. Remove the right exhaust camshaft position actuator. When removing the actuator, place the chain on the engine cover side of the actuators.
21. Rotate the actuator in order to align the opening in the actuator reluctor wheel with the cam sensor boss in the front cover, to allow actuator removal.
22. If removing both the exhaust and intake camshaft actuators, the timing chain can be draped over the EN-48313 once the actuators have been removed.

Installation Procedure

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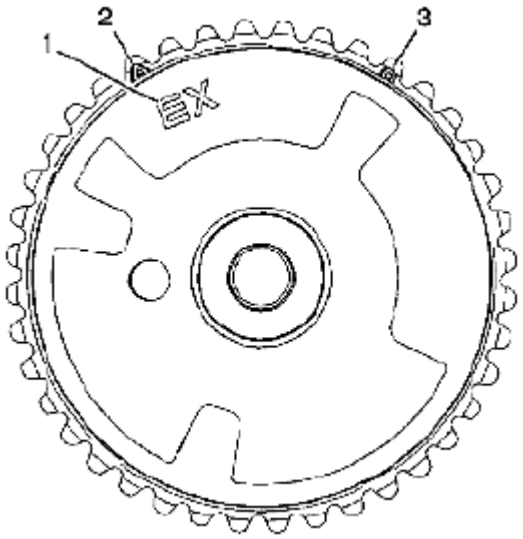


Fig. 179: Identifying Outer Ring Of Camshaft Position Actuator For Triangle Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the EX marking (1).

   The marking is for an exhaust camshaft position actuator,

2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2).

   The marking is for alignment to the highlighted timing chain link on the right side of the engine,

   CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

3. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

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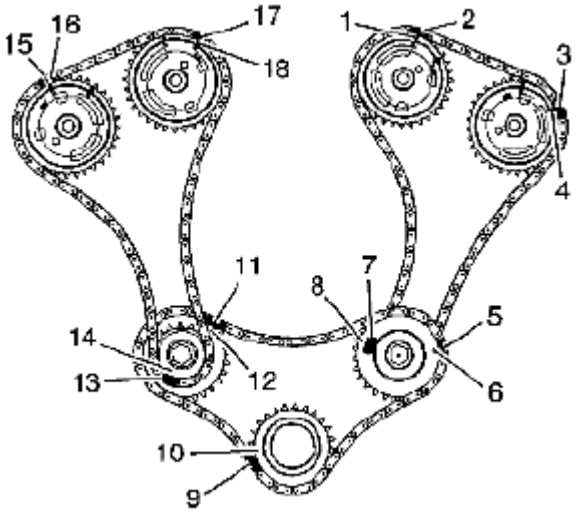


Fig. 180: Identifying Alignment Mark On Timing Chain Links And Adjacent Tooth On Exhaust Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

4. Align the exhaust camshaft actuator alignment mark (18) to the timing chain alignment mark (17) made during disassembly.
5. Ensure that the intake camshaft actuator alignment mark (15) and the timing chain alignment mark (16) are also aligned.
6. Position the exhaust camshaft actuator to the camshaft and install the actuator bolt hand tight.
7. Remove the EN-48313.

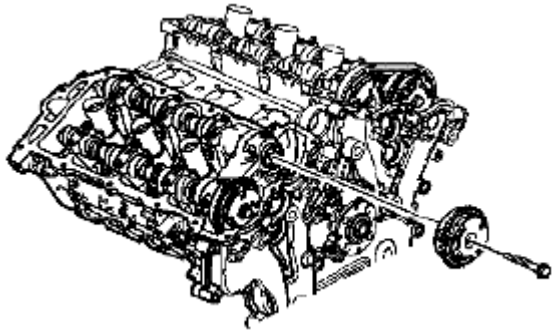


Fig. 181: Identifying Right Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

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8. Tighten the right exhaust camshaft position actuator bolt.

   Tightening torque

   Tighten the bolt to 58 N.m (43 lb ft) .

9. Install the right intake and exhaust camshaft position actuator solenoids. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** .
10. Install the right intake and exhaust camshaft position sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** .
11. Install the right camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
12. Install the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE

Removal Procedure

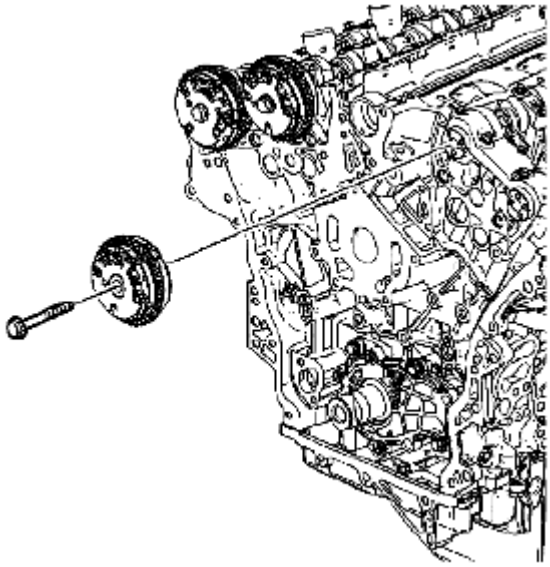


Fig. 182: Identifying Left Intake Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the left exhaust camshaft actuator. Refer to **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST**.
2. Remove the intake camshaft position actuator bolt.
3. Remove the left intake camshaft position actuator.

Installation Procedure

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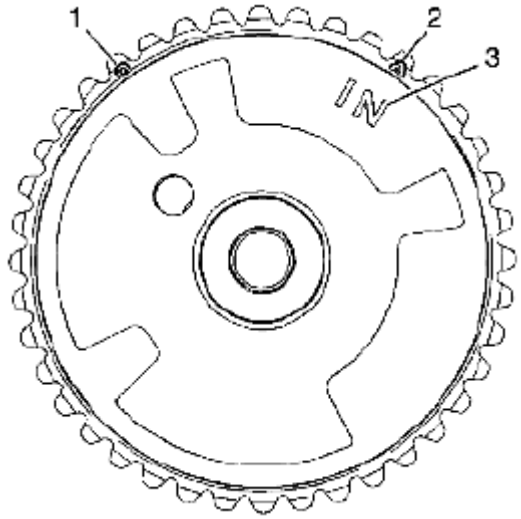


Fig. 183: Identifying Body Of Camshaft Position Actuator For IN Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the IN marking (3).

   The marking is for an intake camshaft position actuator,

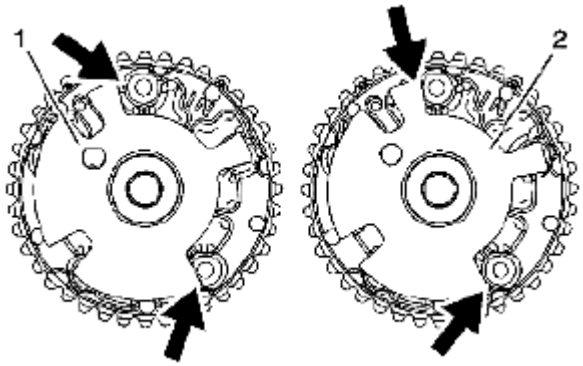


Fig. 184: Identifying Reluctor Wheel On Right And Left Intake Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Ensure the proper camshaft position actuator is installed in the correct position.
Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).

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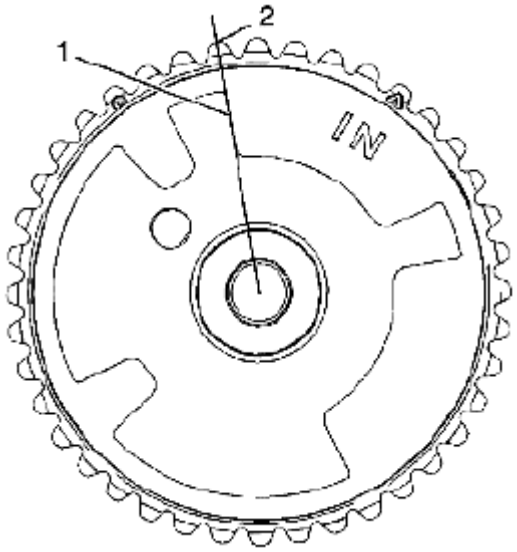


Fig. 185: Identifying Left Intake Camshaft Actuator Edge Of Reluctor Wheel Lines Up With Peak Of Sprocket Tooth
Courtesy of SUZUKI OF AMERICA CORP.

3. On the left intake camshaft actuator the edge of the reluctor wheel (1) lines up with the peak (2) of the sprocket tooth.

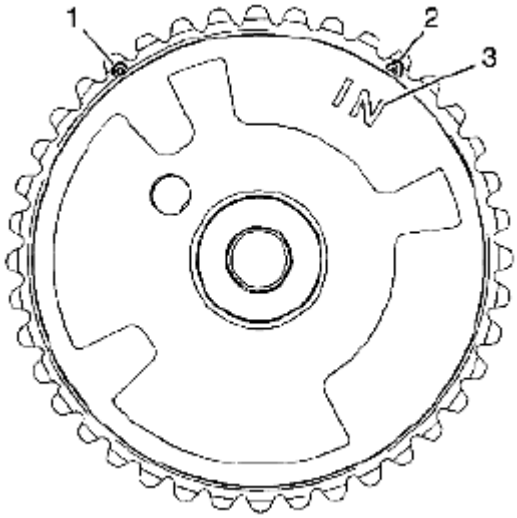


Fig. 186: Identifying Outer Ring Of Camshaft Position Actuator For Circle Marking
Courtesy of SUZUKI OF AMERICA CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (1).

   The circle marking is for alignment to the highlighted timing chain link on the left side of the engine.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN

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NOTICE.

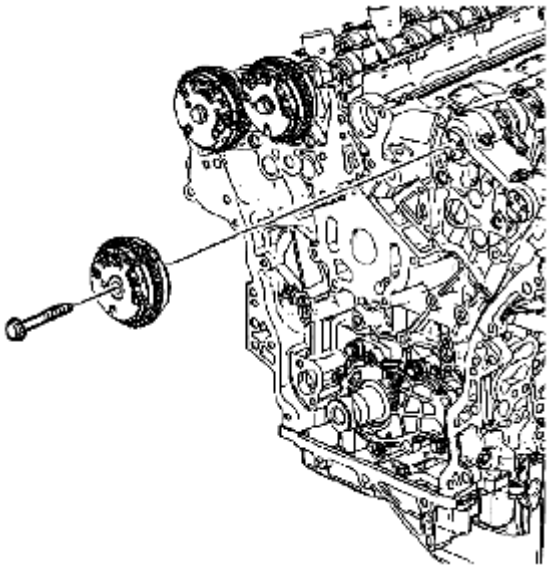


Fig. 187: Identifying Intake Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

5. Locate the intake camshaft position actuator to the camshaft and loosely install the bolt.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

NOTE: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Tighten the camshaft position actuator bolt. Refer to **CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE**.
7. Install the left exhaust camshaft actuator. Refer to **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST**.

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE

Removal Procedure

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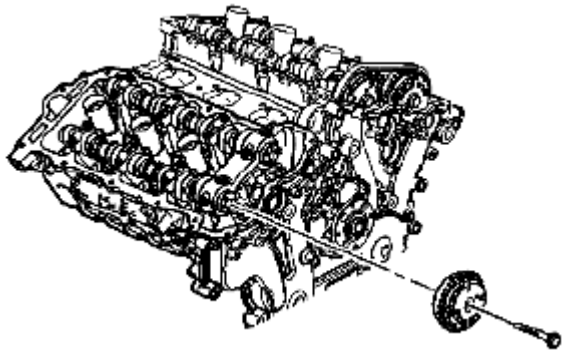


Fig. 188: Identifying Right Intake Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the right exhaust camshaft actuator. Refer to **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST**.
2. Remove the intake camshaft position actuator bolt.
3. Remove the right intake camshaft position actuator.

Installation Procedure

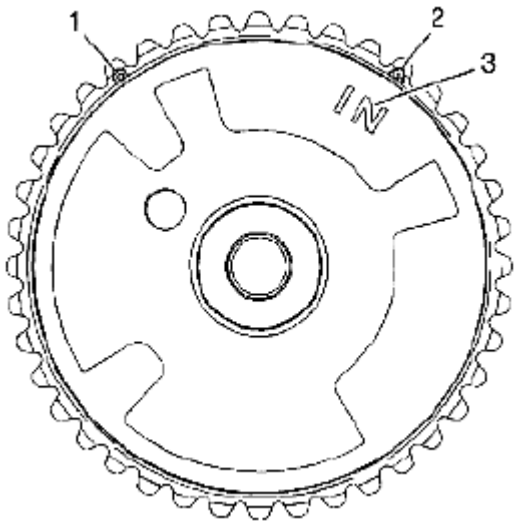


Fig. 189: Identifying Body Of Camshaft Position Actuator For IN Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the IN marking (3).

   The marking is for an exhaust camshaft position actuator.

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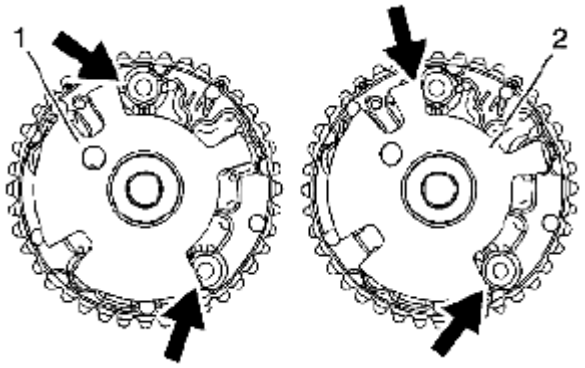


Fig. 190: Locating Reluctor Wheel On Right And Left Intake Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Ensure the proper camshaft position actuator is installed in the correct position.
Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).

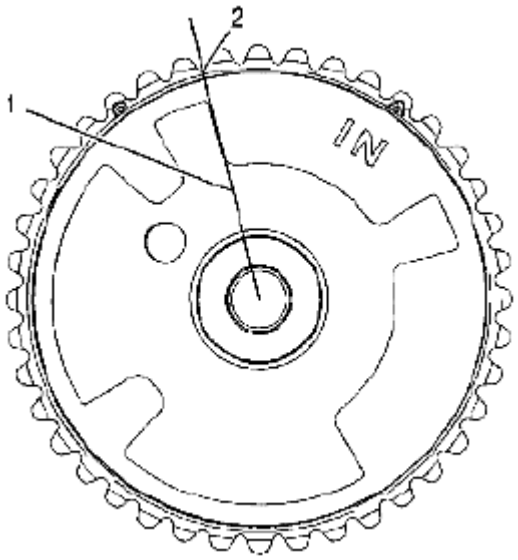


Fig. 191: Identifying Right Intake Camshaft Actuator Edge Of Reluctor Wheel Lines Up With Valley Of Sprocket Tooth
Courtesy of SUZUKI OF AMERICA CORP.

3. On the right intake camshaft actuator the edge of the reluctor wheel (1) lines up with the valley (2) of the sprocket tooth.

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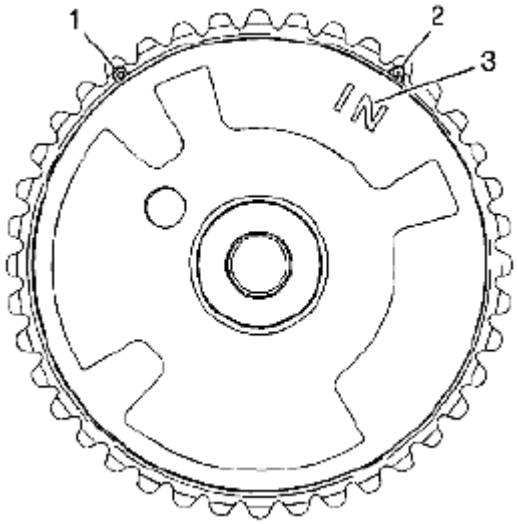


Fig. 192: Identifying Outer Ring Of Camshaft Position Actuator For Triangle Marking
Courtesy of SUZUKI OF AMERICA CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2).

   The triangle marking is for alignment to the highlighted timing chain link on the right side of the engine.

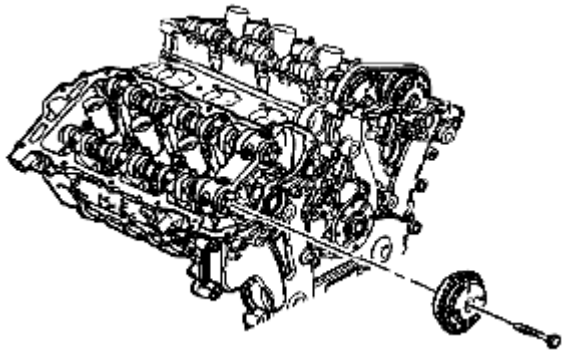


Fig. 193: Identifying Intake Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

5. Locate the intake camshaft position actuator to the camshaft and loosely install the bolt.

   CAUTION: Refer to FASTENER NOTICE .

   NOTE: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Tighten the camshaft position actuator bolt. Refer to **CAMSHAFT POSITION ACTUATOR**

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INSTALLATION - RIGHT SIDE INTAKE.

7. Install the right exhaust camshaft actuator. Refer to **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST**.

SETTING CAMSHAFT TIMING

NOTE: Setting the camshaft timing is necessary whenever the camshaft drive system has been disturbed such that the relationship between any chain and sprocket has been lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.

Follow the left bank secondary camshaft drive chain replacement procedures to reset the camshaft timing. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - LEFT SIDE**.

CAMSHAFT REPLACEMENT - LEFT SIDE

Special Tools

- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

Removal Procedure

1. Remove the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the left bank camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE**.
3. Remove the camshaft sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** .
4. Remove the camshaft position actuator solenoid. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** .
5. Remove the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REMOVAL**.

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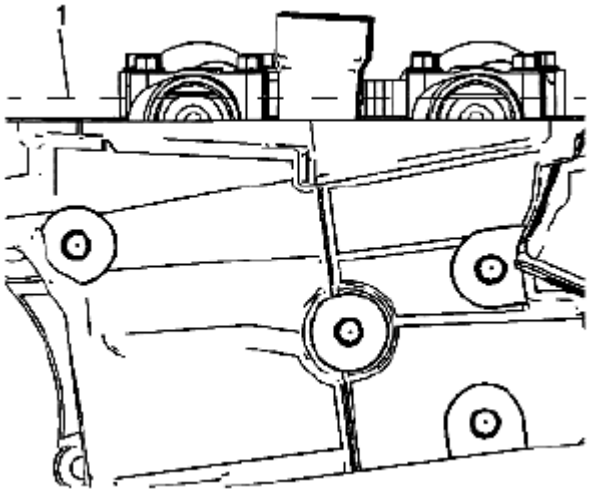


Fig. 194: Identifying Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

6. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

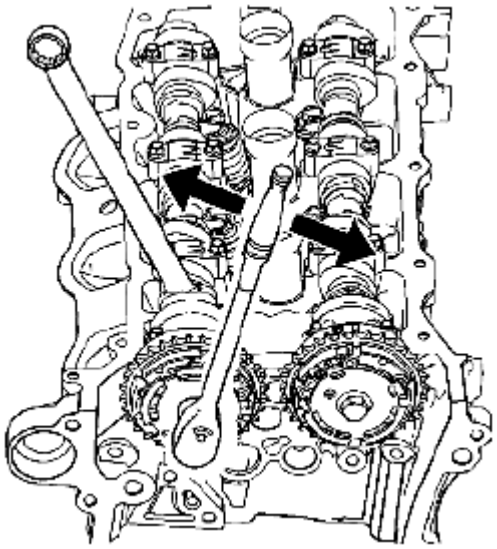


Fig. 195: Loosening Camshaft Position Actuator Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

NOTE:

- **Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.**
- **DO NOT remove the camshaft position actuator bolt at this time.**

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7. Loosen the camshaft position actuator bolt.

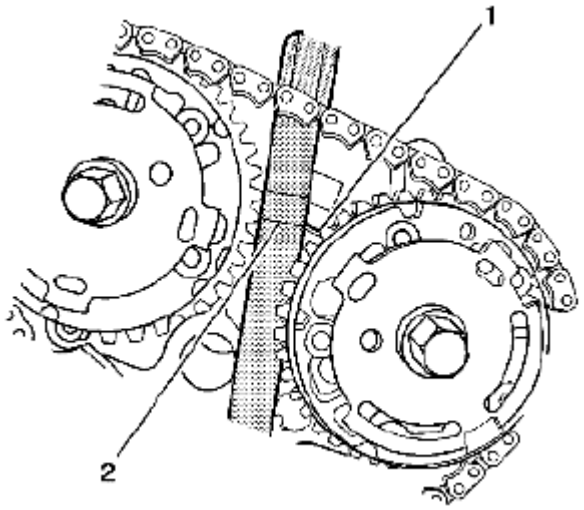


Fig. 196: Identifying Special Tool EN-48313 And Camshaft Actuators
Courtesy of SUZUKI OF AMERICA CORP.

8. Unscrew the EN-48313 so that the legs of the tool are retracted.
9. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This is the approximate installed position.

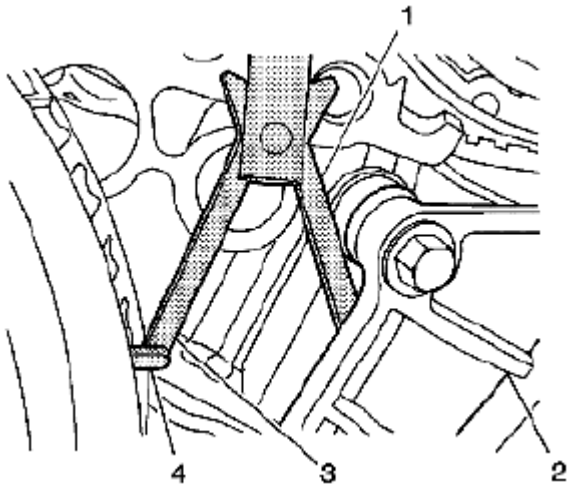


Fig. 197: Identifying Special Tool EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The engine front cover is removed for clarity in the following graphics, but NOT required to perform the procedure.

10. Ensure that the feet (4) on the legs of the tool are facing the front of the engine.

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11. Partially expand the legs (1, 3) of the EN-48313 by turning the T-shaped handle clockwise.
12. Insert the leg of the tool (1) behind the timing chain guide (2).
13. Continue expanding the EN-48313 until the legs (1, 3) contact the timing chain. Do not tighten at this time.

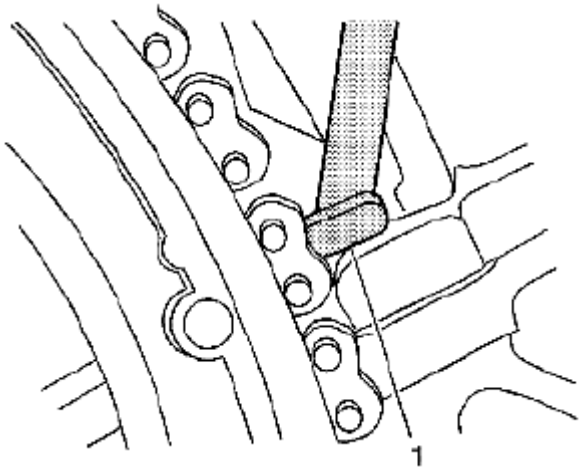


Fig. 198: Identifying Special Tool EN-48313 Foot
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the foot (1) of the EN-48313 is engaged into one of the link pockets to prevent tool slippage during tightening of the EN-48313.

14. Hand tighten the EN-48313.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

15. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

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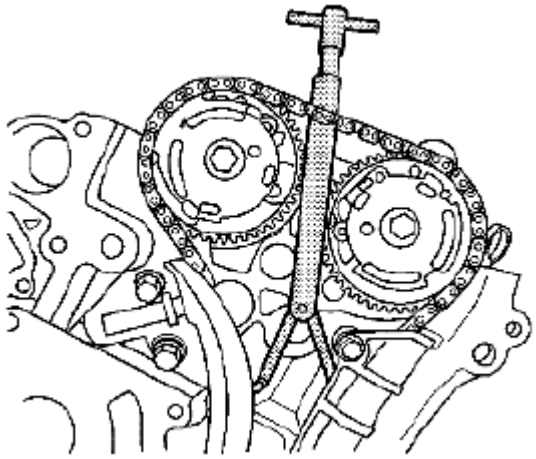


Fig. 199: Identifying Special Tool EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

16. The EN-48313 is now properly installed to hold the timing chain in position.

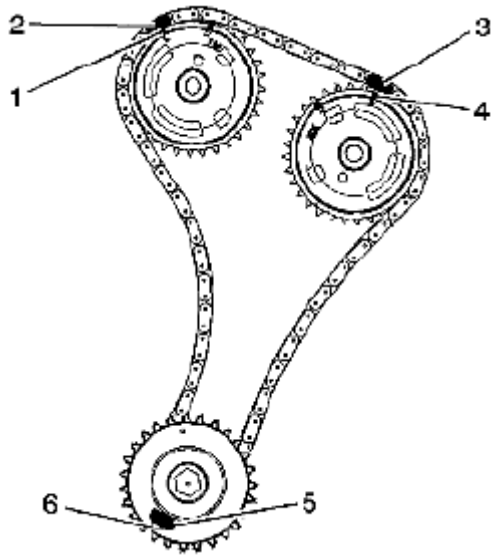


Fig. 200: Identifying Marks On Timing Chain And Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

17. Mark the timing chain and the respective locations on the camshaft position actuators (1-4).
18. Remove the camshaft position actuator bolt.
19. Remove the camshafts. Refer to **CAMSHAFT REMOVAL - LEFT SIDE**.

Installation Procedure

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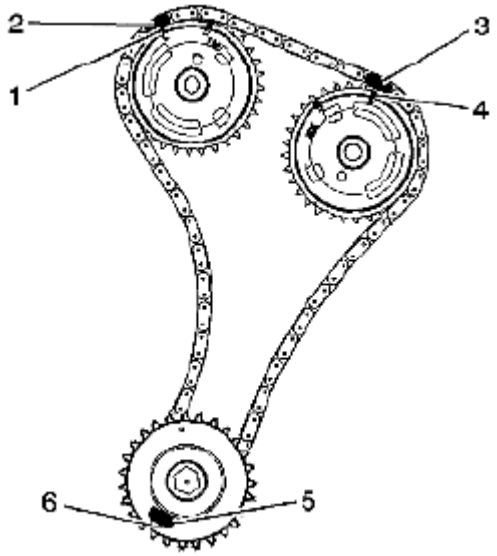


Fig. 201: Identifying Marks On Timing Chain And Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Ensure that the marks on the camshaft position actuator and the timing chain (1-4) are aligned.**
- **DO NOT tighten the camshaft position actuator bolt at this time.**

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **CAMSHAFT INSTALLATION - LEFT SIDE**.
3. Remove the EN-48313.

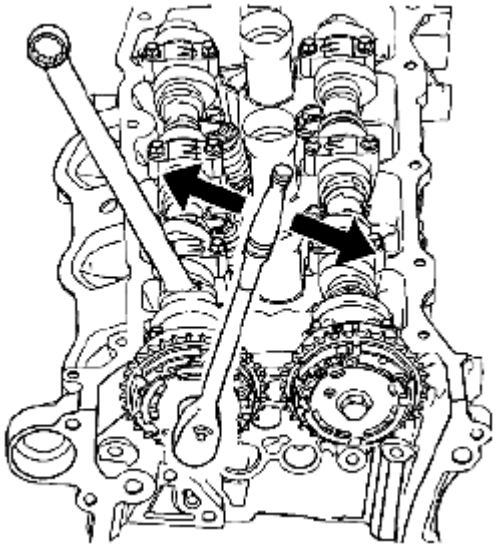


Fig. 202: Tightening Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

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CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

NOTE: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

4. Install and tighten the camshaft position actuators. Refer to **CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE** and **CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE EXHAUST**.
5. Install the intake camshaft position actuator solenoid. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** .
6. Install the camshaft sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** .
7. Install the crankshaft balancer. Refer to **CRANKSHAFT BALANCER INSTALLATION**.
8. Install the camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - LEFT SIDE**.
9. Install the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.

CAMSHAFT REPLACEMENT - RIGHT SIDE

Special Tools

- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

Removal Procedure

1. Remove the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.
2. Remove the camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
3. Remove the camshaft sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
4. Remove the intake camshaft position actuator solenoid. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
5. Remove the crankshaft balancer. Refer to **CRANKSHAFT BALANCER REMOVAL**.

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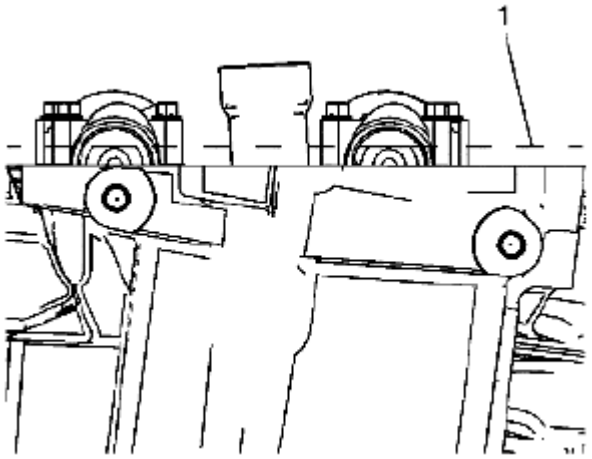


Fig. 203: Identifying Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

6. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

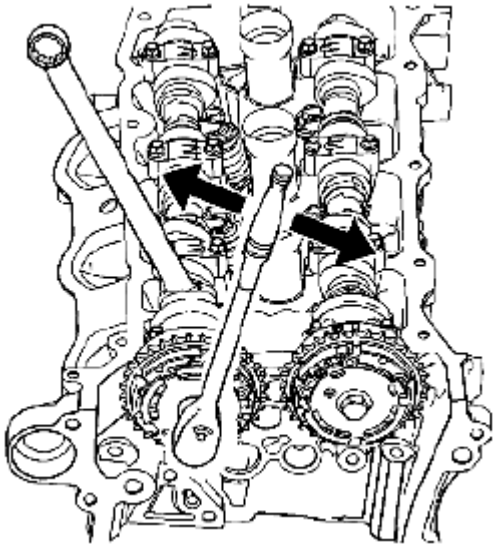


Fig. 204: Loosening Camshaft Position Actuator Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

NOTE:

- **Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.**
- **DO NOT remove the camshaft position actuator bolt at this time.**

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7. Loosen the camshaft position actuator bolt.

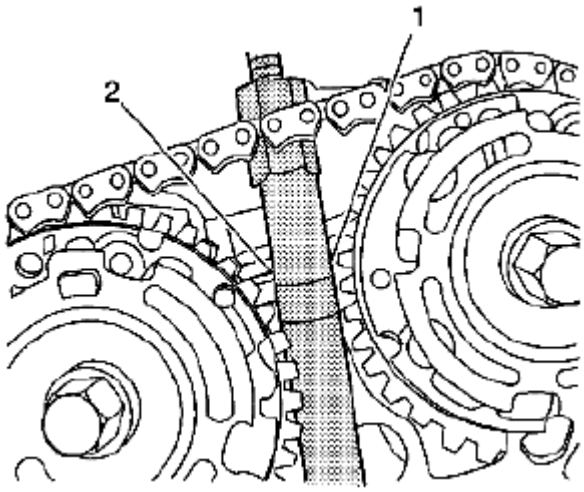


Fig. 205: Identifying Special Tool EN-48313 And Camshaft Actuators
Courtesy of SUZUKI OF AMERICA CORP.

8. Unscrew the EN-48313 so the legs of the tool are retracted.
9. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.

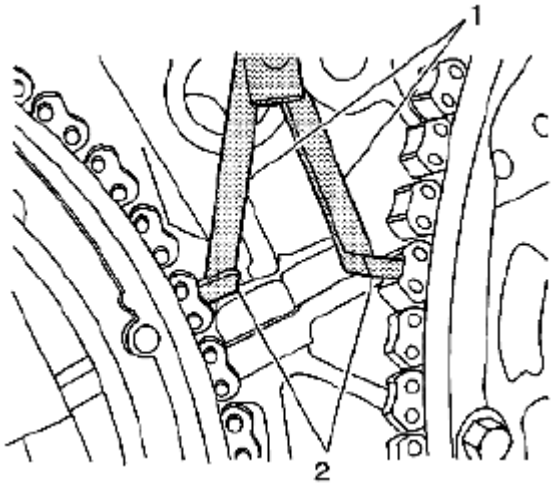


Fig. 206: Identifying EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The engine front cover is removed for clarity in the following graphics, but NOT required to perform the procedure.

10. Ensure that the feet (2) on the legs of the tool are facing the front of the engine.

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11. Partially expand the legs (1) of the EN-48313 by turning the T-shaped handle clockwise.
12. Continue expanding the EN-48313 until the feet (2) contact the timing chain. Do not tighten at this time.

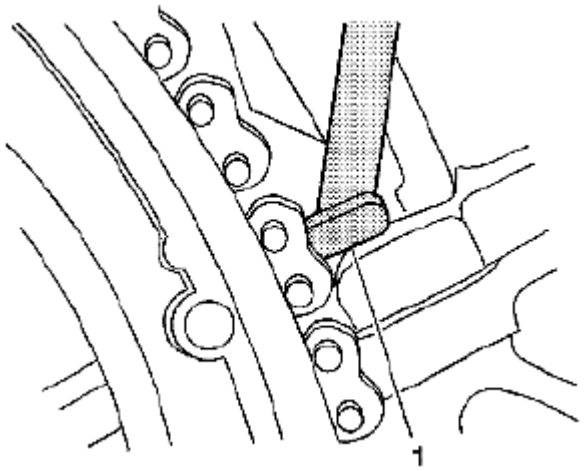


Fig. 207: Identifying Special Tool EN-48313 Foot
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Ensure that the foot (1) of the EN-48313 is engaged into one of the link pockets to prevent chain slippage during tightening of the EN-48313.**
- **Do not allow the body of the EN-48313 to rotate when tightening the T-handle.**

13. Hand tighten the EN-48313.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

14. Use an open end wrench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

15. Use an open end wrench on the hex cast into the right intake and exhaust camshafts and rotate the camshafts towards each other in order to create slack in the chain between the actuators.

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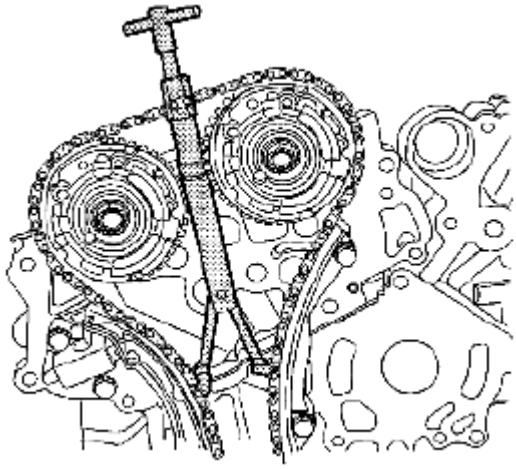


Fig. 208: Identifying Special Tool EN-48313
Courtesy of SUZUKI OF AMERICA CORP.

16. The EN-48313 is now properly installed to hold the timing chain in position.

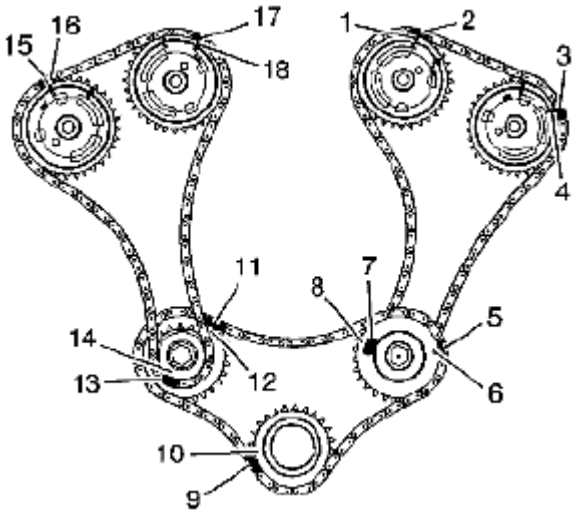


Fig. 209: Identifying Mark On Timing Chain And Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

17. Mark the timing chain and the respective locations on camshaft position actuators (15-18).
18. Remove the camshaft position actuator bolt.
19. Remove the camshaft bearing caps and the camshaft. Refer to **CAMSHAFT REMOVAL - RIGHT SIDE**.

Installation Procedure

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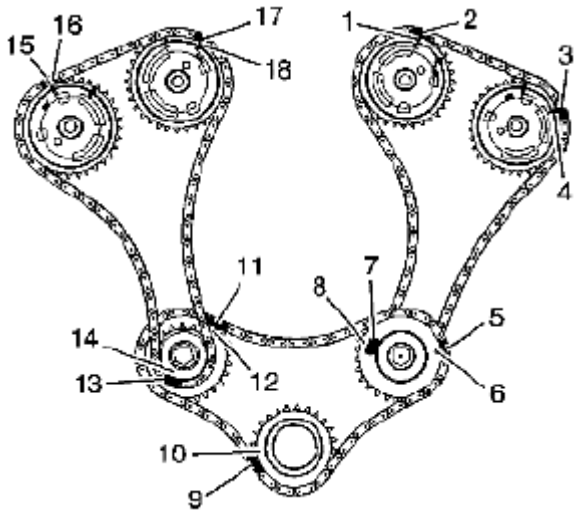


Fig. 210: Identifying Mark On Timing Chain And Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Ensure that the marks on the camshaft position actuators and the timing chain (15-18) are aligned.**
- **DO NOT tighten the camshaft position actuator bolt at this time.**

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **CAMSHAFT INSTALLATION - RIGHT SIDE**.
3. Remove the EN-48313.
4. Install the crankshaft balancer. Refer to **CRANKSHAFT BALANCER INSTALLATION**.

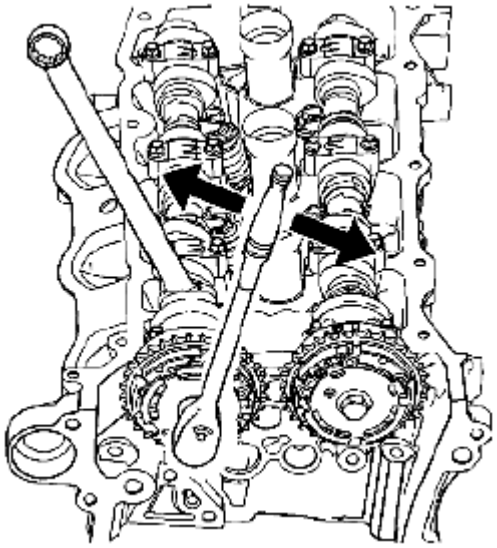


Fig. 211: Tightening Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

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CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

NOTE: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

5. Install and tighten the camshaft position actuators. Refer to **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE** and **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE EXHAUST**.
6. Install the intake camshaft position actuator solenoid. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
7. Install the camshaft sensors. Refer to **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) EXHAUST** and **CAMSHAFT POSITION SENSOR REPLACEMENT - BANK 1 (RIGHT SIDE) INTAKE** .
8. Install the camshaft cover. Refer to **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**.
9. Install the lower intake manifold. Refer to **LOWER INTAKE MANIFOLD REPLACEMENT**.

VALVE ROCKER ARM REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.

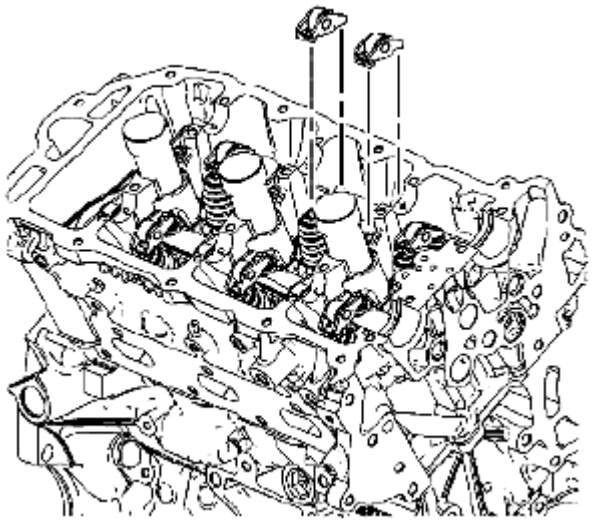


Fig. 212: Identifying Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the rocker arms. Refer to **VALVE ROCKER ARM REMOVAL - LEFT SIDE**.
3. Clean and inspect the camshaft(s) and the rocker arm(s). Repair or replace as necessary. Refer to **CAMSHAFT CLEANING AND INSPECTION** and **VALVE ROCKER ARMS CLEANING AND INSPECTION**.

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Installation Procedure

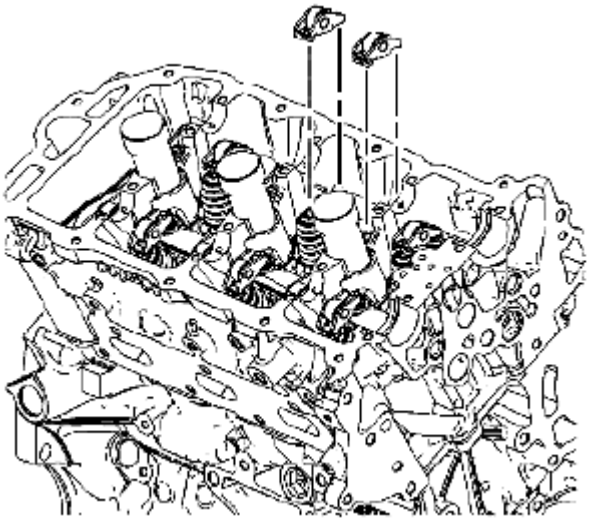


Fig. 213: Identifying Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the rocker arms. Refer to **VALVE ROCKER ARM INSTALLATION - LEFT SIDE**.
2. Install the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.

VALVE ROCKER ARM REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.

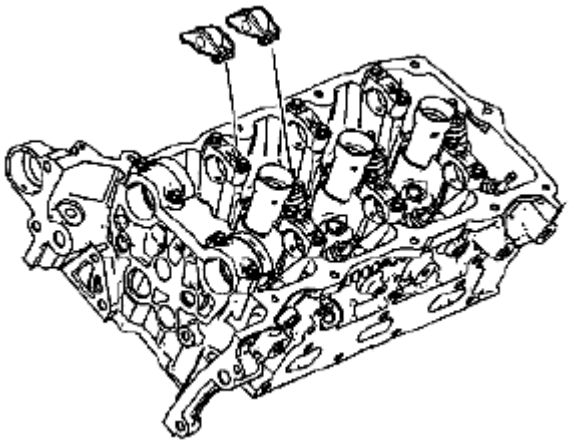


Fig. 214: Identifying Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the rocker arms. Refer to **VALVE ROCKER ARM REMOVAL - RIGHT SIDE**.

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3. Clean and inspect the camshaft(s) and the rocker arm(s). Repair or replace as necessary. Refer to **CAMSHAFT CLEANING AND INSPECTION** and **VALVE ROCKER ARMS CLEANING AND INSPECTION**.

Installation Procedure

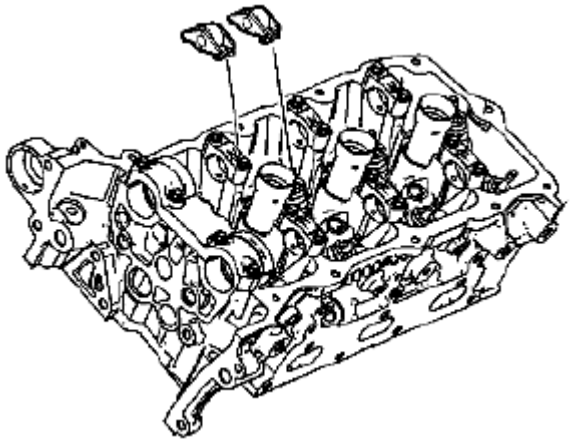


Fig. 215: Identifying Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the rocker arms.
2. Install the applicable camshaft(s). Refer to **VALVE ROCKER ARM INSTALLATION - RIGHT SIDE**.

VALVE LIFTER REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.
2. Remove the rocker arms. Refer to **VALVE ROCKER ARM REMOVAL - LEFT SIDE**.

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Fig. 216: Identifying Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the lifters. Refer to **VALVE LIFTER REMOVAL - LEFT SIDE**.
4. Clean and inspect the camshaft(s), rocker arm(s) and lifter(s). Repair or replace as necessary. Refer to **CAMSHAFT CLEANING AND INSPECTION**, **VALVE LIFTERS CLEANING AND INSPECTION** and **VALVE ROCKER ARMS CLEANING AND INSPECTION**.

Installation Procedure

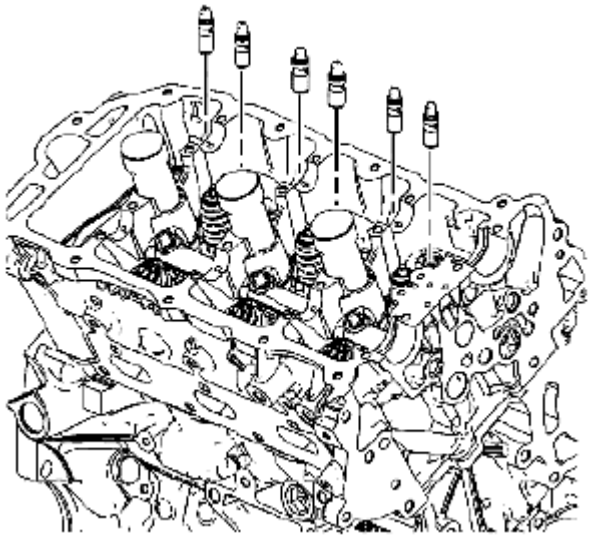


Fig. 217: Identifying Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the lifters. Refer to **VALVE LIFTER INSTALLATION - LEFT SIDE**.
2. Install the rocker arms. Refer to **VALVE ROCKER ARM INSTALLATION - LEFT SIDE**.

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3. Install the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.

VALVE LIFTER REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - RIGHT SIDE**.
2. Remove the rocker arms. Refer to **VALVE ROCKER ARM REMOVAL - RIGHT SIDE**.

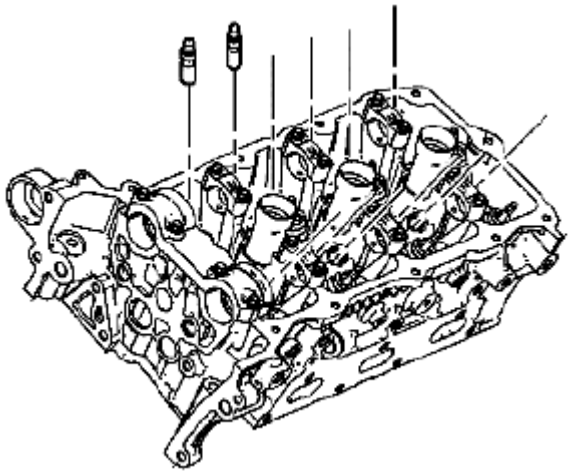
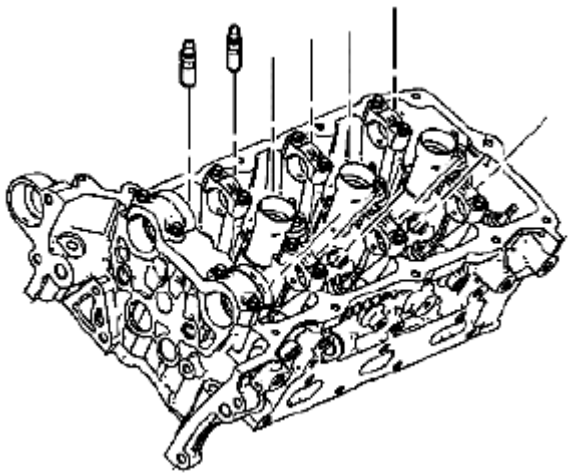


Fig. 218: Identifying Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the lifters. Refer to **VALVE LIFTER REMOVAL - LEFT SIDE**.
4. Clean and inspect the camshaft(s), rocker arm(s) and lifter(s). Repair or replace as necessary. Refer to **CAMSHAFT CLEANING AND INSPECTION**, **VALVE LIFTERS CLEANING AND INSPECTION** and **VALVE ROCKER ARMS CLEANING AND INSPECTION**.

Installation Procedure



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Fig. 219: Identifying Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the lifters. Refer to **VALVE LIFTER INSTALLATION - RIGHT SIDE**.
2. Install the rocker arms. Refer to **VALVE ROCKER ARM INSTALLATION - RIGHT SIDE**.
3. Install the applicable camshaft(s). Refer to **CAMSHAFT REPLACEMENT - RIGHT SIDE**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - LEFT SIDE

Special Tools

- EN 46106 Flywheel Holding Tool
- EN 46110 On-Vehicle Valve Spring Compressor
- EN 46116 Valve Stem Seal Remover/Installer
- J 39313 Spark Plug Port Adapter

Removal Procedure

1. Remove the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .

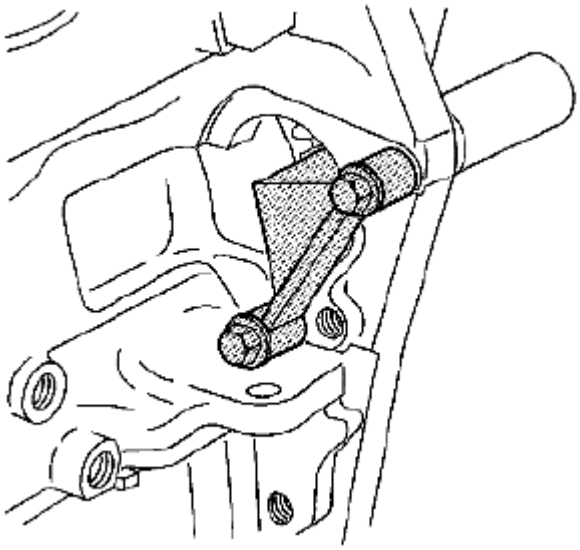


Fig. 220: Identifying Special Tool EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the EN 46106 is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the EN 46106 in order to prevent crankshaft rotation.
3. Remove the camshafts and rocker arms. Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.

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4. Remove the spark plug from the applicable cylinder. Refer to **SPARK PLUG REPLACEMENT** .
5. Remove Rocker arms. refer to **VALVE ROCKER ARM REPLACEMENT - LEFT SIDE**.
6. Install the J 39313 to the applicable cylinder.
7. Connect the J 39313 to a compressed air source.

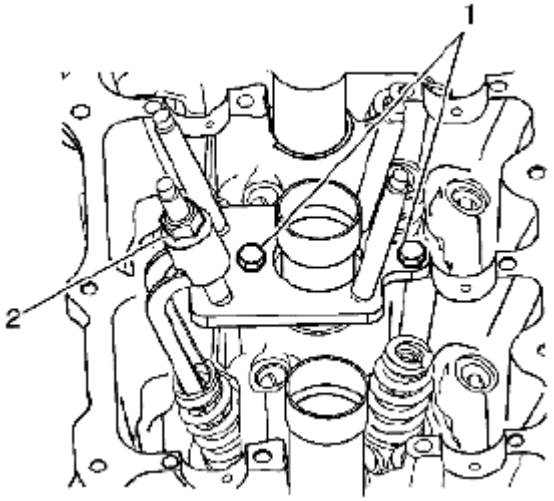


Fig. 221: Identifying Special Tool EN 46110
Courtesy of SUZUKI OF AMERICA CORP.

8. Install the EN 46110 above the applicable cylinder as shown.
9. Tighten the EN 46110 valve spring compressor nut (2).

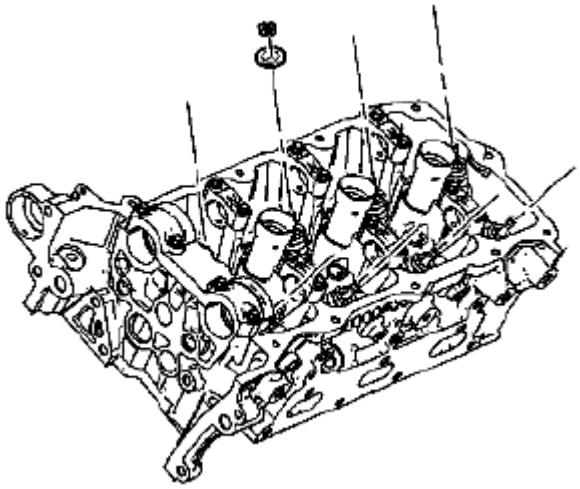


Fig. 222: Identifying Valve Keepers And Valve Spring Retainer
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the valve keepers.
11. Loosen the EN 46110 valve spring compressor nut.

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12. Remove the valve spring retainer.

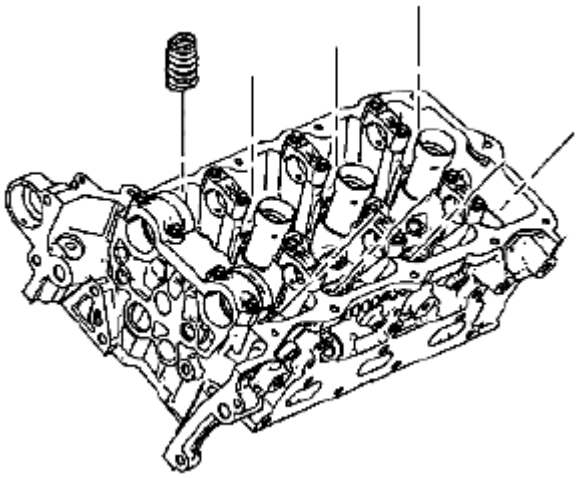


Fig. 223: Identifying Valve Spring
Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the valve spring.

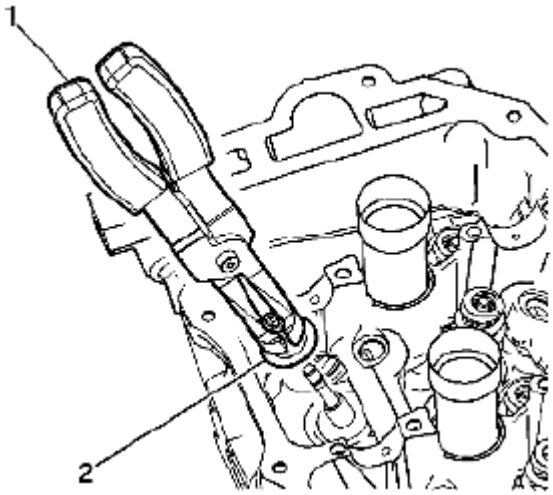


Fig. 224: Identifying Special Tool EN 46110 And Valve Stem Seal
Courtesy of SUZUKI OF AMERICA CORP.

14. Use the EN 46116 (1) in order to remove the valve stem seal (2).

Installation Procedure

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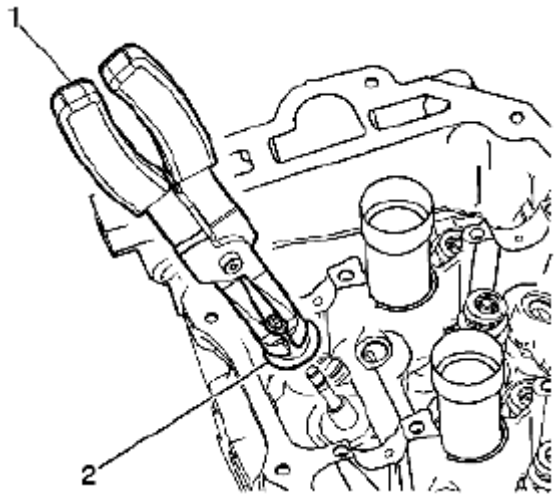


Fig. 225: Identifying Special Tool EN 46110 And Valve Stem Seal
Courtesy of SUZUKI OF AMERICA CORP.

1. Use the EN 46116 (1) in order to install the valve stem seal (2).

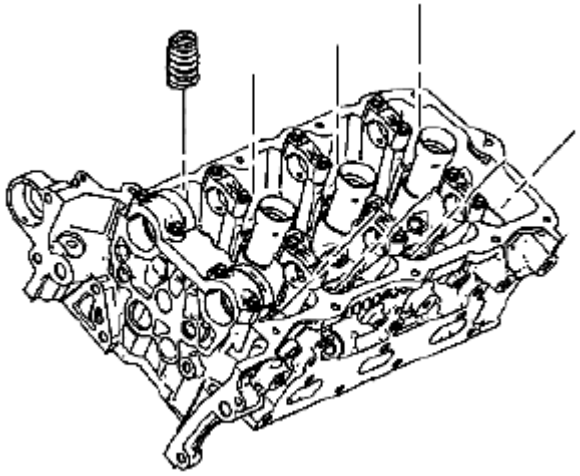


Fig. 226: Identifying Valve Spring
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the valve spring.
3. Install the valve spring retainer.

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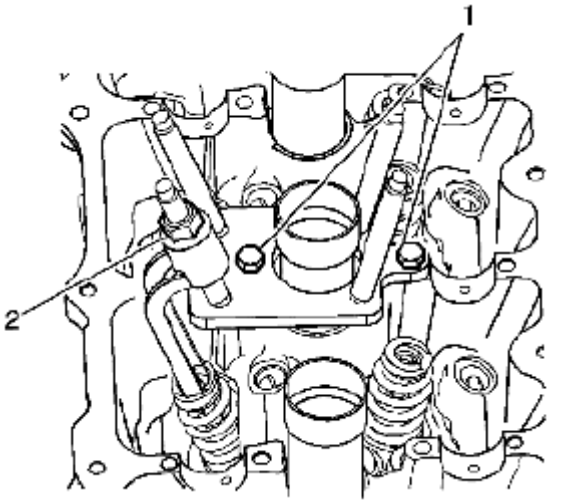


Fig. 227: Identifying Special Tool EN 46110
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the EN 46110 above the applicable valve spring as shown.

   Tighten the EN 46110 valve spring compressor nut (2).

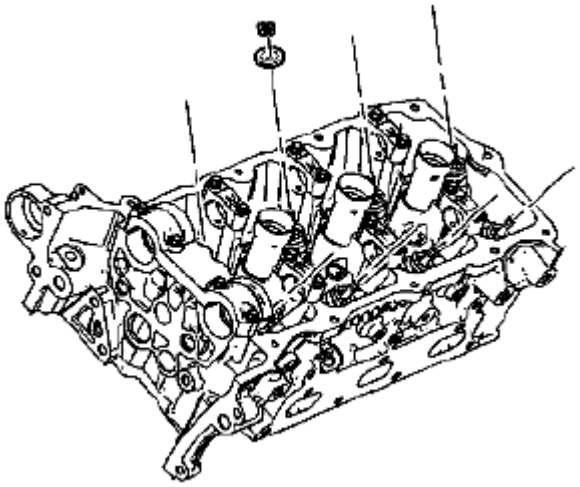


Fig. 228: Identifying Valve Spring Keepers
Courtesy of SUZUKI OF AMERICA CORP.

5. Install the valve spring keepers.
6. Remove the EN 46110.
7. Disconnect the J 39313 from the compressed air source.
8. Remove the J 39313.
9. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
10. Install the rocker arms and camshafts. Refer to **CAMSHAFT REPLACEMENT - LEFT SIDE**.
11. Remove the EN 46106 in order to prevent crankshaft rotation.

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12. Install the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - RIGHT SIDE

Special Tools

- EN 46106 Flywheel Holding Tool
- EN 46110 On-Vehicle Valve Spring Compressor
- EN 46116 Valve Stem Seal Remover/Installer
- J 39313 Spark Plug Port Adapter

Removal Procedure

1. Remove the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .

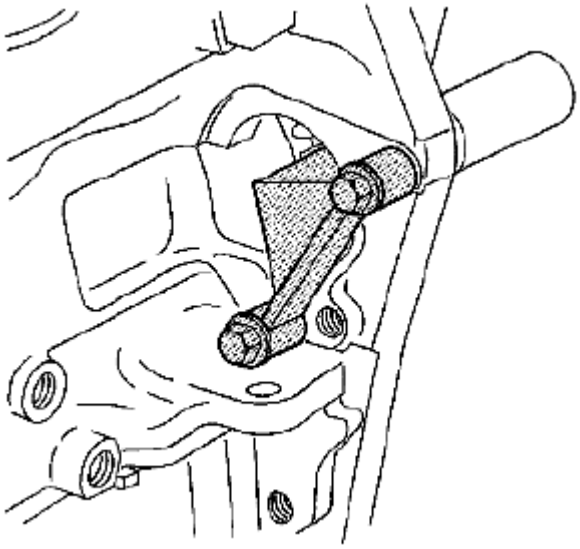


Fig. 229: Identifying Special Tool EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the EN 46106 is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the EN 46106 in order to prevent crankshaft rotation.
3. Remove the camshafts and rocker arms. Refer to **CAMSHAFT REPLACEMENT - RIGHT SIDE** and **VALVE ROCKER ARM REPLACEMENT - RIGHT SIDE**.
4. Remove the spark plug from the applicable cylinder. Refer to **SPARK PLUG REPLACEMENT** .
5. Install the J 39313 to the applicable cylinder.
6. Connect the J 39313 to a compressed air source.

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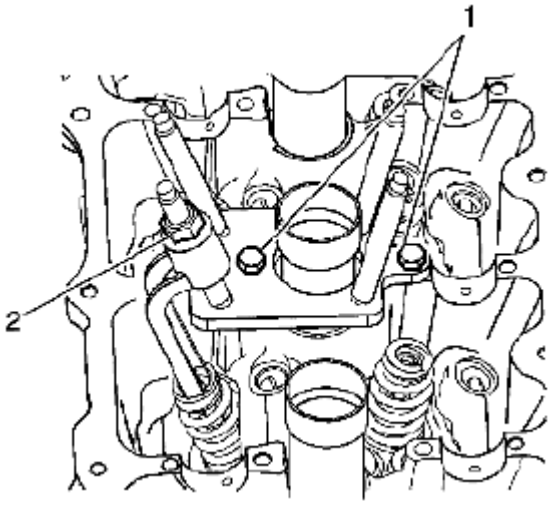


Fig. 230: Identifying Special Tool EN 46110
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the EN 46110 above the applicable cylinder as shown.
8. Tighten the EN 46110 valve spring compressor nut (2).

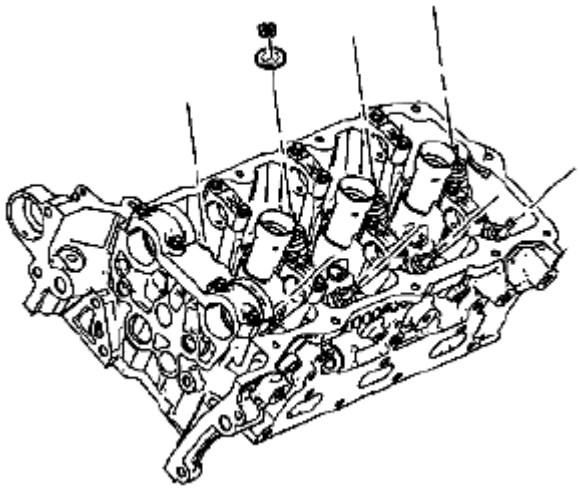


Fig. 231: Identifying Valve Keepers
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the valve keepers.
10. Loosen the EN 46110 valve spring compressor nut.
11. Remove the valve spring retainer.

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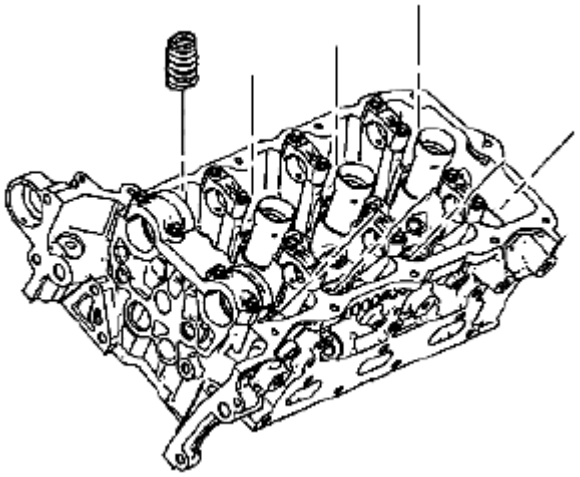


Fig. 232: Identifying Valve Springs
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove the valve springs.

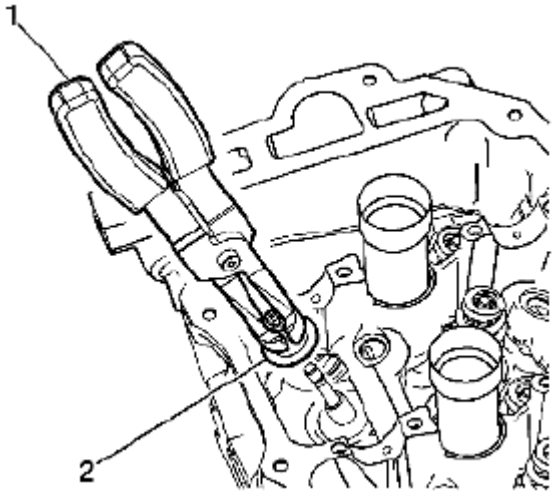


Fig. 233: Identifying Special Tool EN 46116 And Valve Stem Seal
Courtesy of SUZUKI OF AMERICA CORP.

13. Use the EN 46116 (1) in order to remove the valve stem seal (2).

Installation Procedure

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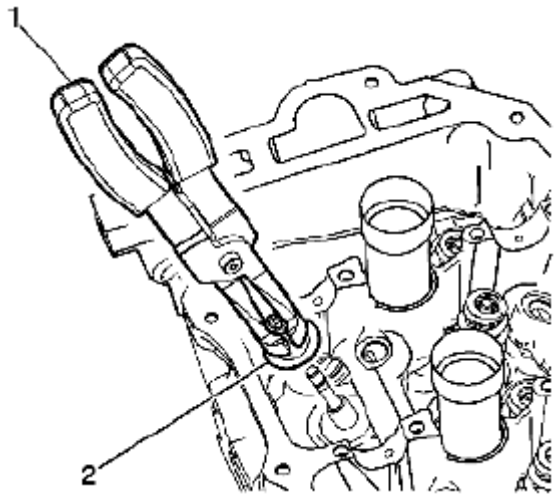


Fig. 234: Identifying Special Tool EN 46116 And Valve Stem Seal
Courtesy of SUZUKI OF AMERICA CORP.

1. Use the EN 46116 (1) in order to install the valve stem seals (2).

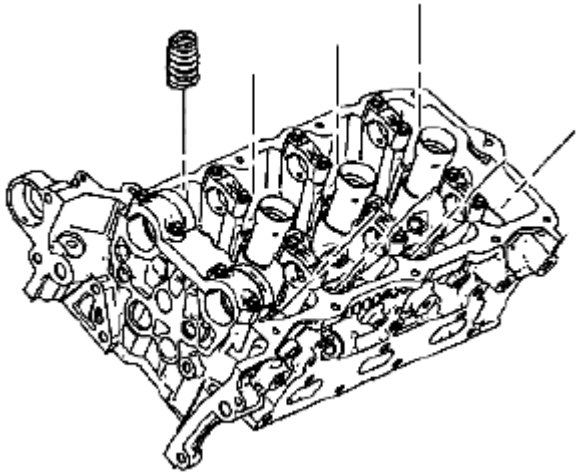


Fig. 235: Identifying Valve Spring
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the valve spring.
3. Install the valve spring retainer.

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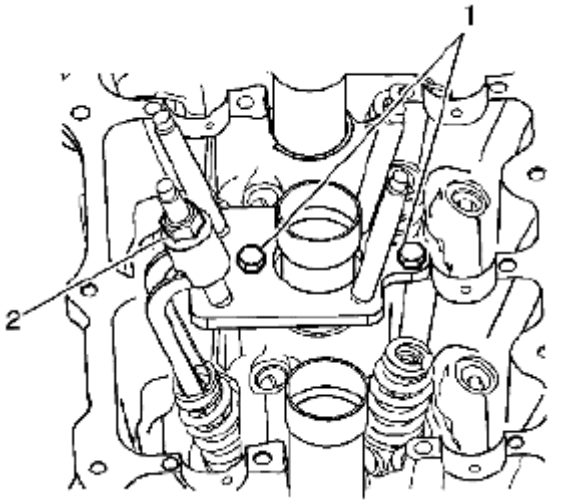


Fig. 236: Identifying Special Tool EN 46110
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the EN 46110 above the applicable valve spring as shown.

   Tighten the EN 46110 valve spring compressor nut (2).

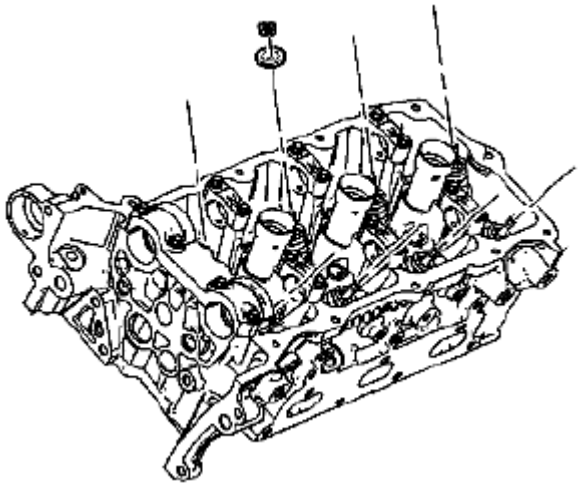


Fig. 237: Identifying Valve Spring Keepers
Courtesy of SUZUKI OF AMERICA CORP.

5. Install the valve spring keepers.
6. Remove the EN 46110.
7. Disconnect the J 39313 from the compressed air source.
8. Remove the J 39313.
9. Install the spark plugs. Refer to **SPARK PLUG REPLACEMENT** .
10. Install the rocker arms and camshafts. Refer to **CAMSHAFT REPLACEMENT - RIGHT SIDE**.
11. Remove the EN 46106.

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12. Install the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .

CYLINDER HEAD REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the left bank secondary timing chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - LEFT SIDE**.
2. Remove the oil level indicator. Refer to **OIL LEVEL INDICATOR AND TUBE REPLACEMENT** .
3. Disconnect the coolant temperature sensor electrical connector.

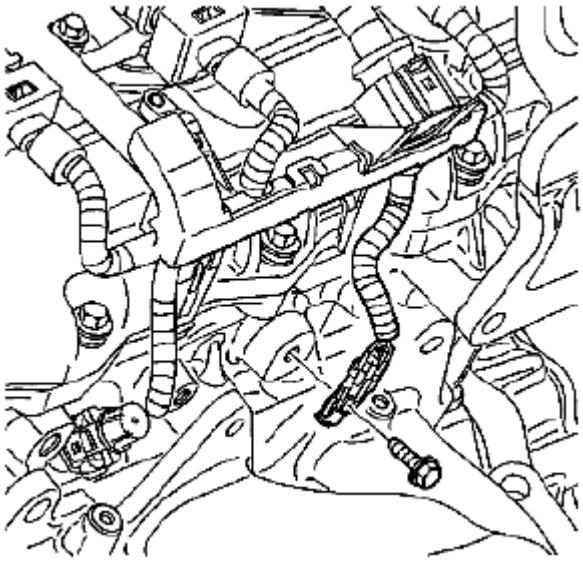


Fig. 238: Identifying Cylinder Head Wiring Harness Ground
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the wiring harness ground from the cylinder head.
5. Remove the catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE** .
6. Remove the camshaft position actuator solenoid valve. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .

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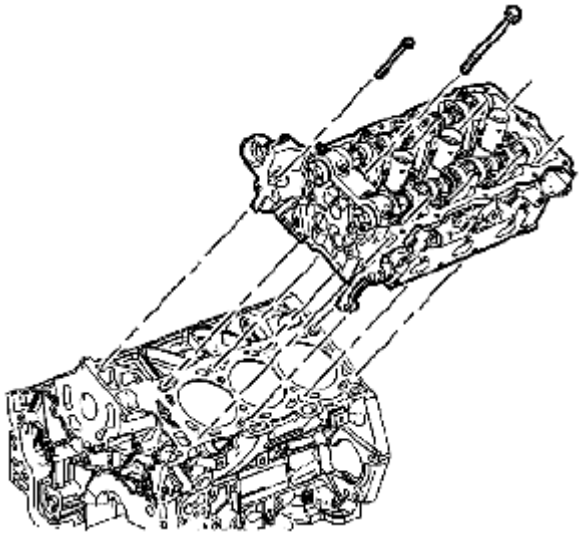


Fig. 239: Identifying Cylinder Head With Exhaust Manifold
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the cylinder head with the exhaust manifold. Refer to **CYLINDER HEAD REMOVAL - LEFT SIDE**.

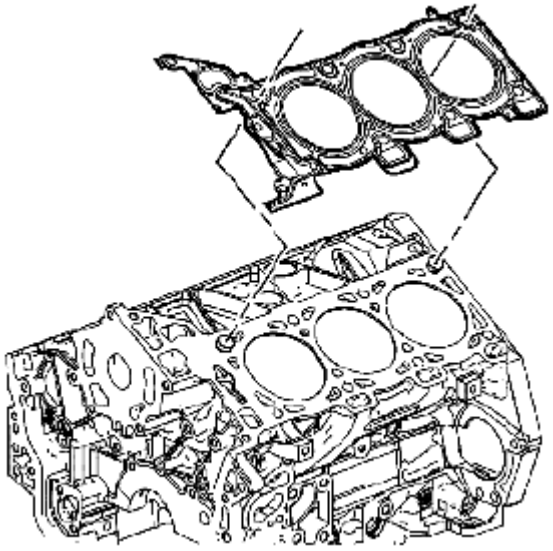


Fig. 240: Identifying Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove and discard the cylinder head gasket.
9. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** and **ENGINE BLOCK CLEANING AND INSPECTION**.
10. If necessary, perform the following steps:
    - Remove the exhaust manifold from the cylinder head. Refer to **EXHAUST MANIFOLD REMOVAL - LEFT SIDE** .

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- Remove the camshaft. Refer to **CAMSHAFT REMOVAL - LEFT SIDE**.
- Disassemble the cylinder head. Refer to **CYLINDER HEAD DISASSEMBLE**.
- Remove the coolant sensor. Refer to **ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT** .

Installation Procedure

1. If necessary, perform the following steps:
   - Install the coolant sensor. Refer to **ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT** .
   - Assemble the cylinder head. Refer to **CYLINDER HEAD ASSEMBLE**.
   - Install the camshaft. Refer to **CAMSHAFT INSTALLATION - LEFT SIDE**.
   - Install the exhaust manifold to the cylinder head. Refer to **EXHAUST MANIFOLD INSTALLATION - LEFT SIDE** .

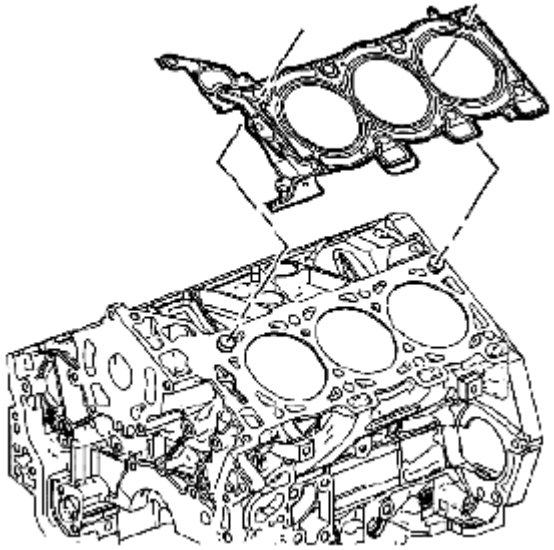


Fig. 241: Identifying Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install a NEW cylinder head gasket.

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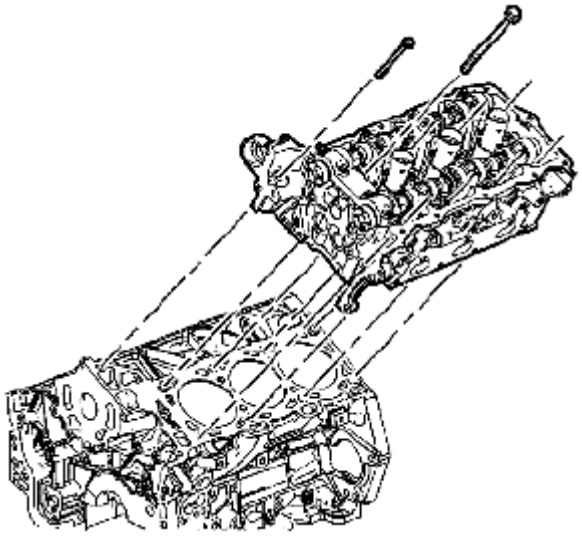


Fig. 242: Identifying Cylinder Head With Exhaust Manifold
Courtesy of SUZUKI OF AMERICA CORP.

3. Carefully install the cylinder head with the exhaust manifold to the engine. Refer to **CYLINDER HEAD INSTALLATION - LEFT SIDE**.
4. Install the camshaft position actuator solenoid valve. Refer to **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE** and **CAMSHAFT POSITION ACTUATOR SOLENOID VALVE SOLENOID REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST** .
5. Install the catalytic converter to the exhaust manifold. Refer to **CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE** .
6. Connect the wiring harness electrical connector located at the side of the cylinder head.

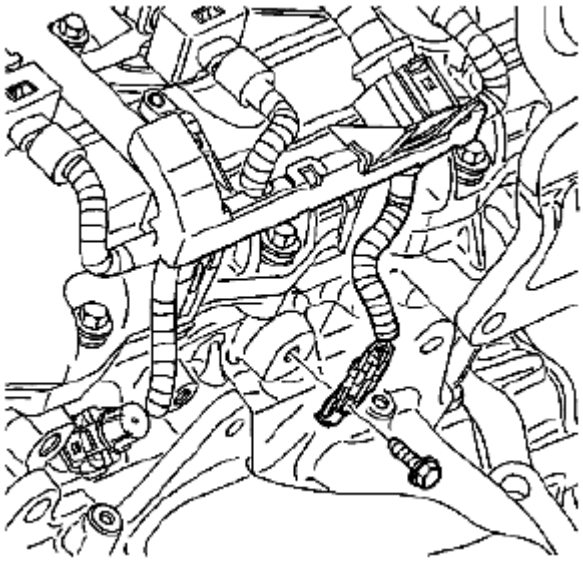


Fig. 243: Identifying Cylinder Head Wiring Harness Ground
Courtesy of SUZUKI OF AMERICA CORP.

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CAUTION: Refer to FASTENER NOTICE .

7. Install the wiring harness ground to the cylinder head.

   Tightening torque

   Tighten the wiring harness ground bolt to 10 N.m (89 lb in) .

8. Install the coolant temperature sensor electrical connector.
9. Install the oil level indicator. Refer to **OIL LEVEL INDICATOR AND TUBE REPLACEMENT** .
10. Install the left bank secondary timing chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - LEFT SIDE**.

CYLINDER HEAD REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the right bank secondary timing chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - RIGHT SIDE**.
2. Remove the right side catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE** .
3. Remove the ground wires from the cylinder head.
4. Disconnect and unclip the Heated Oxygen Sensor (HO2) wiring harness.
5. Unbolt the power steering hose retainer.

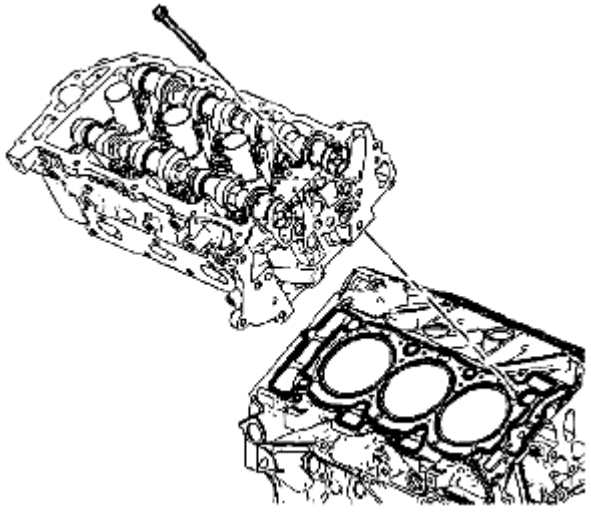


Fig. 244: Identifying Cylinder Head And Exhaust Manifold
Courtesy of SUZUKI OF AMERICA CORP.

6. Using the aid of an assistant, remove the cylinder head with the exhaust manifold. Refer to **CYLINDER**

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HEAD REMOVAL - RIGHT SIDE.

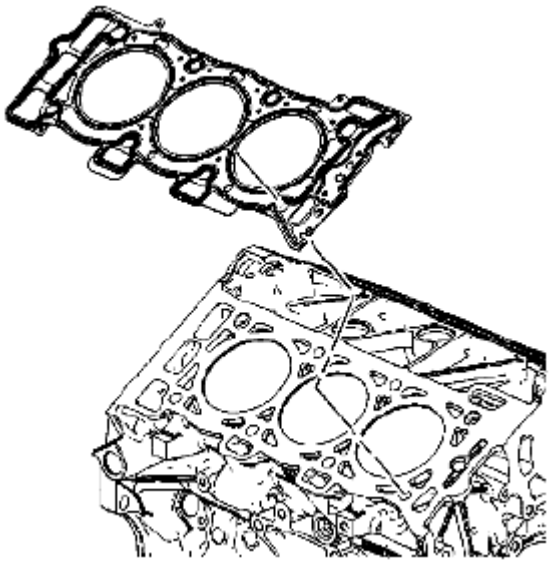


Fig. 245: Identifying Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove and discard the cylinder head gasket.
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** and **ENGINE BLOCK CLEANING AND INSPECTION**.
9. If necessary, perform the following steps:
    a. Remove the exhaust manifold from the cylinder head. Refer to **EXHAUST MANIFOLD REMOVAL - RIGHT SIDE** .
    b. Remove the camshaft. Refer to **CAMSHAFT REMOVAL - RIGHT SIDE**.
    c. Disassemble the cylinder head. Refer to **CYLINDER HEAD DISASSEMBLE**.

Installation Procedure

1. If necessary, perform the following steps:
    a. Assemble the cylinder head. Refer to **CYLINDER HEAD ASSEMBLE**.
    b. Install the camshaft. Refer to **CAMSHAFT INSTALLATION - RIGHT SIDE**.
    c. Install the exhaust manifold to the cylinder head. Refer to **EXHAUST MANIFOLD INSTALLATION - RIGHT SIDE** .

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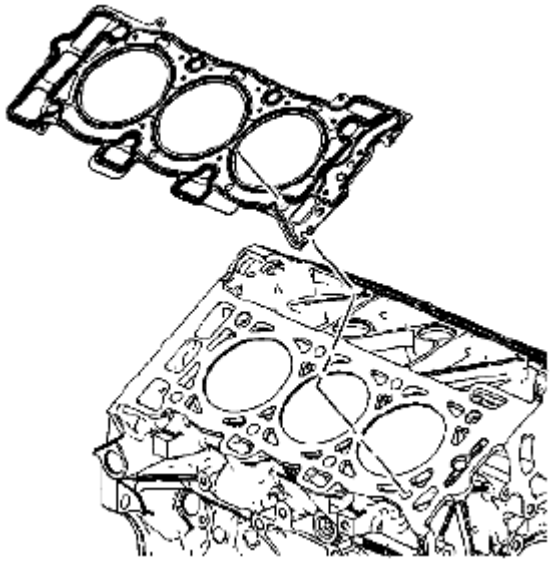


Fig. 246: Identifying Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install a NEW cylinder head gasket.

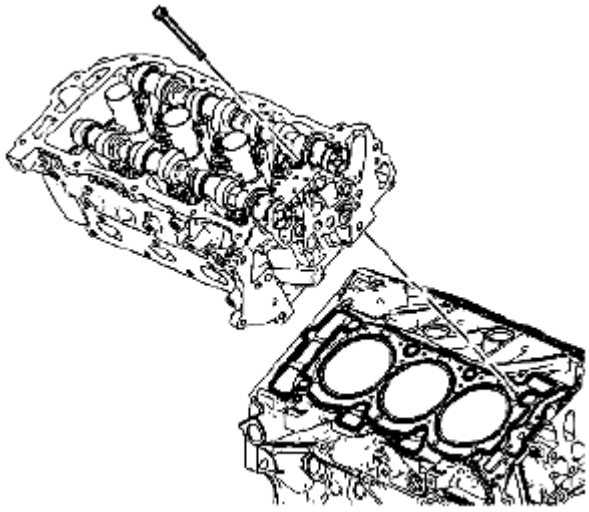


Fig. 247: Identifying Cylinder Head With Exhaust Manifold
Courtesy of SUZUKI OF AMERICA CORP.

3. Using the aid of an assistant, carefully install the cylinder head with the exhaust manifold to the engine. Refer to **CYLINDER HEAD INSTALLATION - RIGHT SIDE**.
4. Install the power steering hose retainer.
5. Connect and clip the HO2 sensor wiring harness.
6. Install the ground wires to the cylinder head.
7. Install the right side catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE** .

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8. Install the right bank secondary timing chain. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - RIGHT SIDE**.

ENGINE FLYWHEEL REPLACEMENT

Removal Procedure

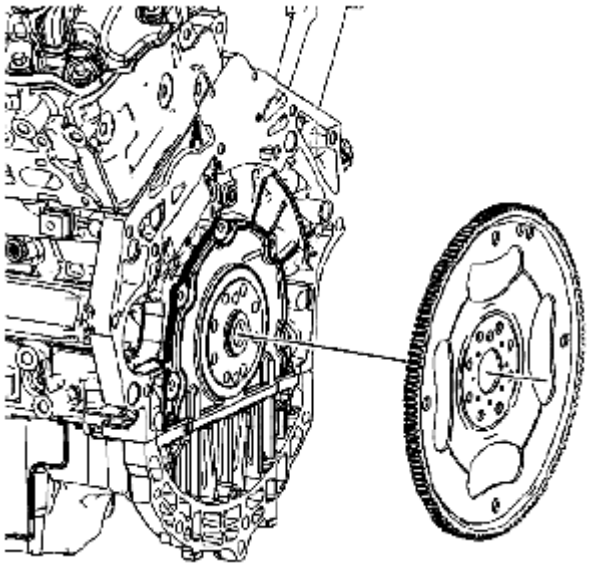


Fig. 248: Identifying Engine Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the transmission. Refer to TRANSMISSION REPLACEMENT in Automatic Transmission .
2. Remove the engine flywheel bolts and flywheel. Refer to **ENGINE FLYWHEEL REMOVAL**.
3. Clean and inspect the flywheel. Refer to **ENGINE FLYWHEEL CLEANING AND INSPECTION**. If the flywheel teeth are damaged, inspect the starter for proper operation. Replace the starter if you find excessive wear or damage to the starter drive. Refer to **STARTER MOTOR REPLACEMENT** .

Installation Procedure

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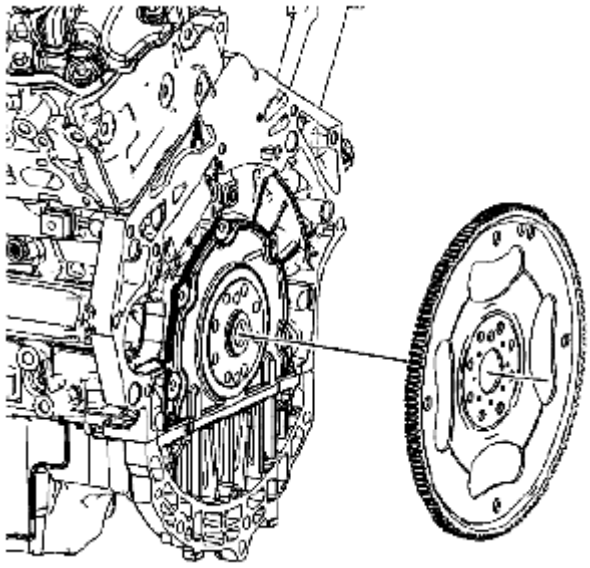


Fig. 249: Identifying Engine Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the engine flywheel and bolts. Refer to **ENGINE FLYWHEEL INSTALLATION**.
2. Install the transmission. Refer to TRANSMISSION REPLACEMENT in Automatic Transmission .

CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

Removal Procedure

1. Remove the oil pan. Refer to **OIL PAN REPLACEMENT** .
2. Remove the engine flywheel. Refer to **ENGINE FLYWHEEL REPLACEMENT**.

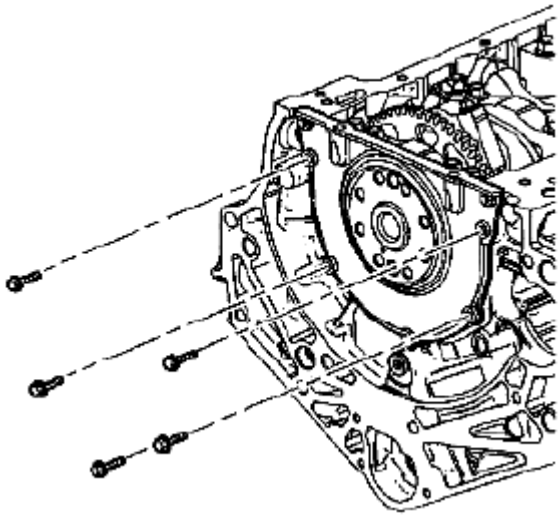


Fig. 250: Crankshaft Rear Oil Seal, Housing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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3. Remove the crankshaft rear oil seal and housing. Refer to **CRANKSHAFT REAR OIL SEAL AND HOUSING REMOVAL**.

Installation Procedure

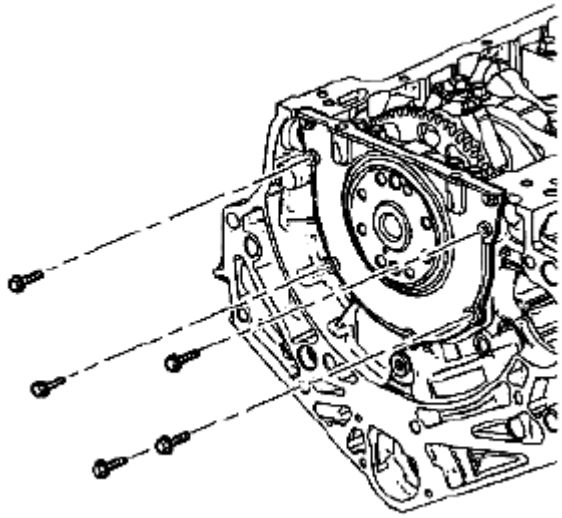


Fig. 251: Crankshaft Rear Oil Seal, Housing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the crankshaft rear oil seal and housing. Refer to **CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION**.
2. Install the engine flywheel. Refer to **ENGINE FLYWHEEL REPLACEMENT**.
3. Install the oil pan. Refer to **OIL PAN REPLACEMENT** .

ENGINE REPLACEMENT

Removal Procedure

1. Remove the battery box and carefully set the engine control module (ECM) on top of the engine. Refer to **BATTERY BOX REPLACEMENT** .
2. Disconnect the ECM connector from the under-hood fuse block.
3. Disconnect ground wire from frame, near battery box.
4. Remove the fuel injector sight shield. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
5. Release the clamp from the brake booster vacuum hose connection.
6. Disconnect the brake booster vacuum hose from the intake manifold.
7. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.
8. Discharge the fuel system. Refer to **FUEL PRESSURE RELIEF (WITH J 34730-1A)** or **FUEL PRESSURE RELIEF (WITHOUT J 34730-1A)** .
9. Disconnect the Evaporative Emission (EVAP) hose/pipe from the EVAP canister purge solenoid valve.

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Refer to **PLASTIC COLLAR QUICK CONNECT FITTING SERVICE** .

10. Disconnect the engine fuel hose/pipe from the chassis fuel hose/pipe. Refer to **METAL COLLAR QUICK CONNECT FITTING SERVICE** .
11. Discharge the air conditioning (A/C) system. Refer to **REFRIGERANT RECOVERY AND RECHARGING** .
12. Remove the A/C compressor hose assembly from the compressor. Cap or plug the hoses and compressor to prevent contamination. Refer to **COMPRESSOR HOSE ASSEMBLY REPLACEMENT** .
13. Disconnect the transaxle shift control cable from the transaxle. Refer to SHIFT CONTROL CABLE REPLACEMENT in Automatic transmission .
14. Drain the engine coolant from the cooling system. Refer to **COOLING SYSTEM DRAINING AND FILLING (LY7 GE 47716 FILL)** or **COOLING SYSTEM DRAINING AND FILLING (LY7 STATIC FILL)** .
15. Tie the radiator, A/C condenser, and fan module assembly to the upper radiator support to keep the assembly with the vehicle when the frame and drivetrain is removed.
16. Disconnect the heater hoses from the engine. Refer to **HEATER OUTLET HOSE REPLACEMENT** .
17. Remove the radiator inlet hose. Refer to **RADIATOR INLET HOSE REPLACEMENT** .
18. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** .
19. Remove the radiator outlet hose. Refer to **RADIATOR OUTLET HOSE REPLACEMENT** .

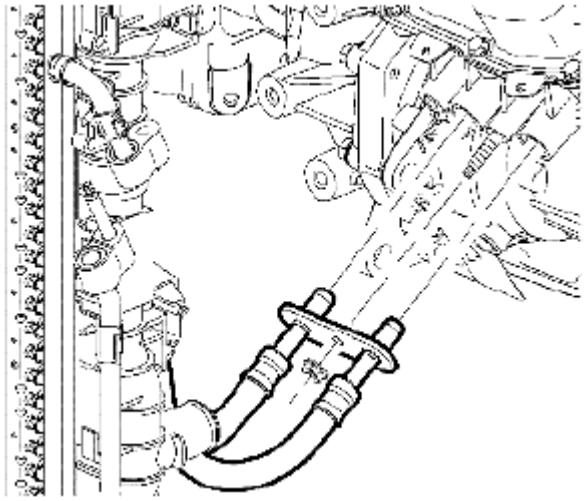


Fig. 252: Identifying Transaxle Oil Cooler Lines
Courtesy of SUZUKI OF AMERICA CORP.

20. Disconnect the transaxle oil cooler lines from the transaxle and remove the seals. Refer to FLUID COOLER PIPE SEAL REPLACEMENT in Automatic Transmission .
21. Cap the transaxle oil cooler lines and plug the transaxle oil cooler line fittings to prevent loss of transmission fluid.
22. Remove the catalytic converters and secure the rear half of the exhaust system to the vehicle underbody. Refer to **CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE** and **CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE** .

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23. Remove the front tires. Refer to **TIRE AND WHEEL REMOVAL AND INSTALLATION** .
24. Remove the right and left engine splash shields. Refer to **ENGINE SPLASH SHIELD REPLACEMENT - LEFT SIDE** and **ENGINE SPLASH SHIELD REPLACEMENT - RIGHT SIDE** .

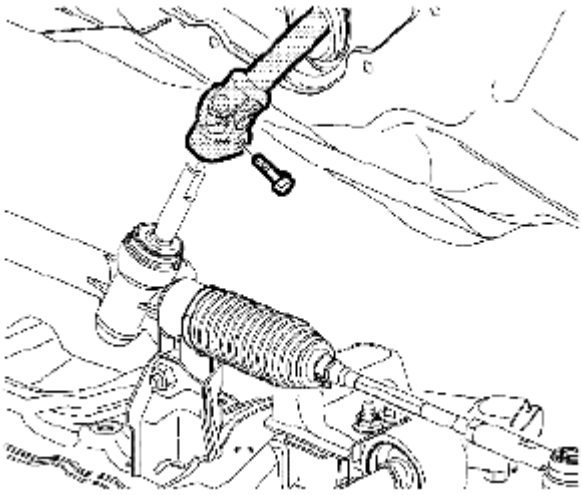


Fig. 253: Identifying Steering Intermediate Shaft And Pinch Bolt
Courtesy of SUZUKI OF AMERICA CORP.

25. Remove the steering intermediate shaft pinch bolt and discard the bolt.
26. Disconnect the steering intermediate shaft from the steering gear.

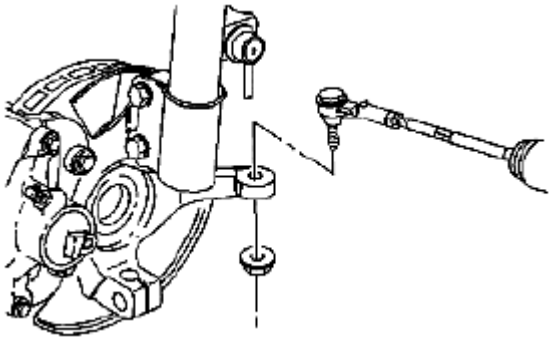


Fig. 254: Identifying Outer Tie Rod Ends And Steering Knuckles
Courtesy of SUZUKI OF AMERICA CORP.

27. Remove the right and left outer tie rod ends from the steering knuckles. Refer to **RACK AND PINION OUTER TIE ROD END REPLACEMENT** .

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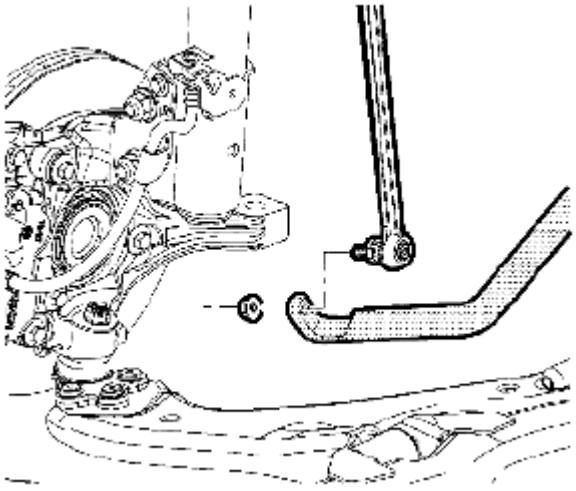


Fig. 255: Identifying Stabilizer Shaft Links And Stabilizer Shaft
Courtesy of SUZUKI OF AMERICA CORP.

28. Remove the right and left stabilizer shaft links from the stabilizer shaft. Refer to **STABILIZER SHAFT LINK REPLACEMENT** .

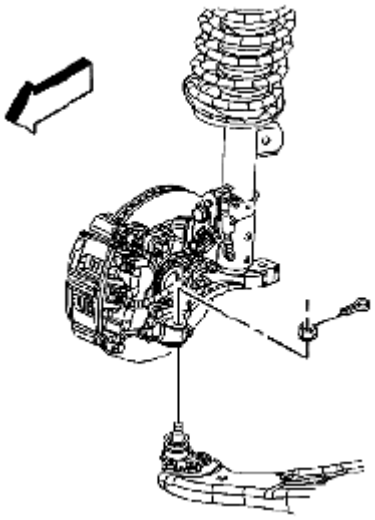


Fig. 256: Identifying Lower Ball Joints And Steering Knuckles
Courtesy of SUZUKI OF AMERICA CORP.

29. Remove the right and left lower ball joints from the steering knuckles. Refer to **LOWER CONTROL ARM REPLACEMENT** .
30. On front wheel drive (FWD) models, place a drain pan under the transaxle then separate the right and left front wheel drive shafts from the transaxle. Refer to **FRONT WHEEL DRIVE SHAFT REPLACEMENT** .
31. On all wheel drive (AWD) models, remove the rear wheel driveshaft. Refer to **REAR WHEEL DRIVE SHAFT REPLACEMENT** .

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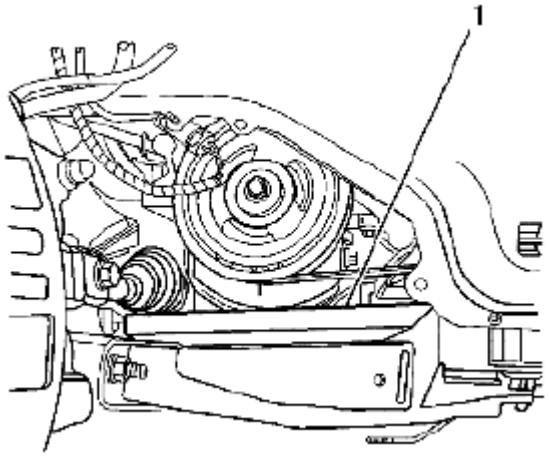


Fig. 257: Identifying Block Of Wood Between Frame And Engine Oil Pan
Courtesy of SUZUKI OF AMERICA CORP.

32. On all models, place a block of wood (1) between the frame and the engine oil pan in order to support the engine once the bolts are removed from the right engine mount.

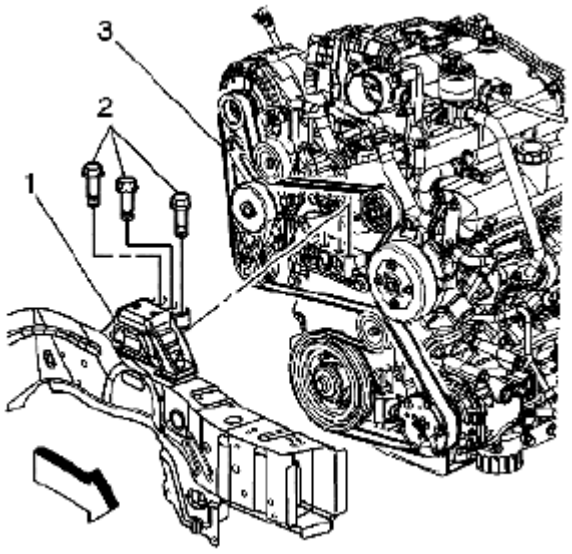


Fig. 258: Identifying Right Engine Mount And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

33. Lower the vehicle.
34. Remove the bolts (2) that secure the right engine mount (1) to the engine (3).

NOTE: Engine has a right lower mount attached to frame, does not need to be removed at this time.

35. Remove right strut mount.
36. Place a universal frame support fixture or jackstands under the frame.

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37. Lower the vehicle until the frame contacts the frame support fixture or jackstands.
38. Disconnect the wiring harness retaining clips near the right and left shock towers.
39. Remove the drivetrain and front suspension frame reinforcement. Refer to **DRIVETRAIN AND FRONT SUSPENSION FRAME REINFORCEMENT REPLACEMENT** .

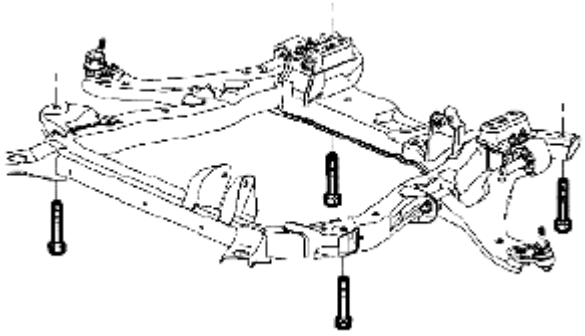


Fig. 259: Identifying Frame-To-Body Bolts
Courtesy of SUZUKI OF AMERICA CORP.

40. Remove the frame-to-body bolts. Discard the bolts.

NOTE: Inspect for areas of body to powertrain contact or entanglement of wires and hoses while separating the vehicle body and powertrain.

41. Carefully raise the vehicle body up away from the powertrain.

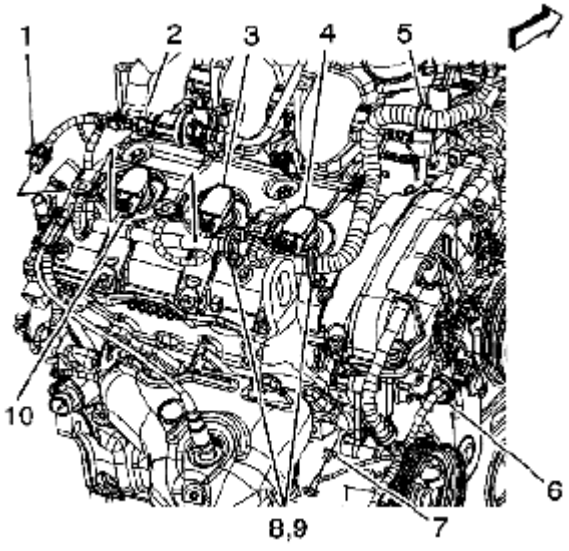


Fig. 260: Identifying Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

42. Disconnect the engine electrical wiring harness from the following components:
    - Oxygen sensor (1)

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- EVAP purge solenoid (2)
- Ignition coils (3, 4, 10)
- Ground leads (7, 11)
- Remove wire harness from retainers (5, 6, 8, 9)

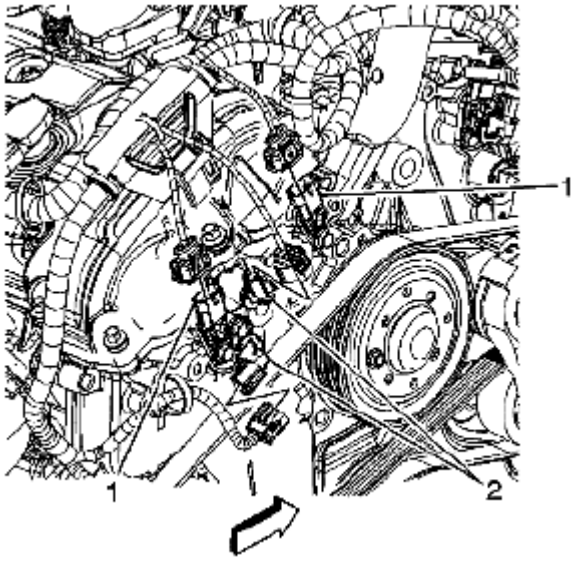
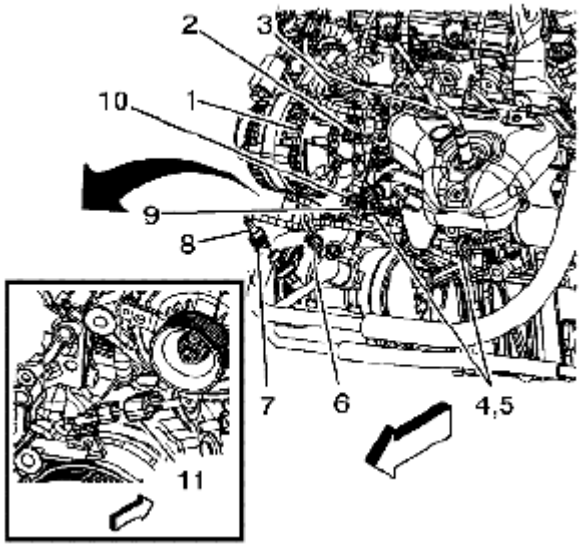


Fig. 261: Identifying Cylinder Head Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

43. Disconnect the left and right cylinder head engine electrical wiring harness from the following components:
    - Camshaft position sensors (1)
    - Camshaft position actuators (2)



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Fig. 262: Identifying Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

44. Disconnect the engine electrical wiring harness from the following components:
    - Generator (1)
    - Retainer clips (2, 3, 4, 5, 6, 7, 9)
    - A/C compressor hose (8)
    - Oil pressure switch (10)
    - A/C compressor (8)

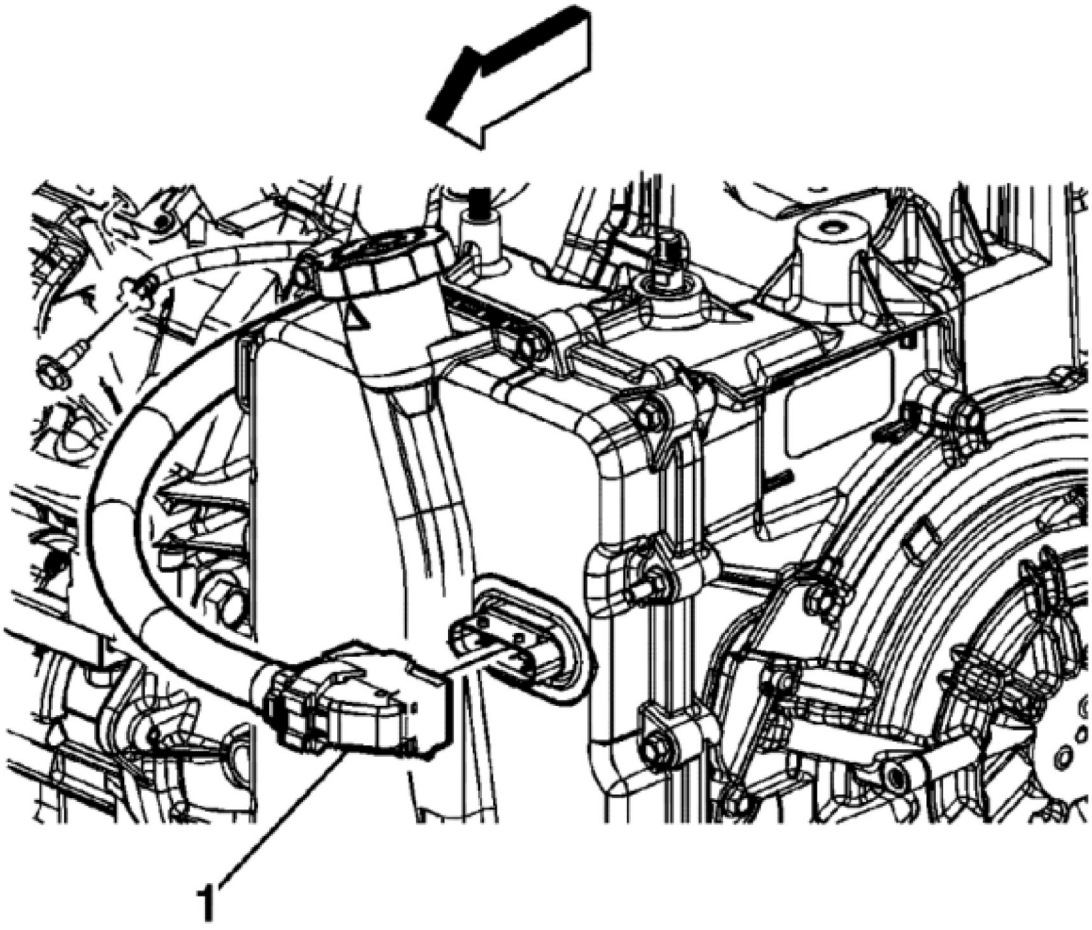


Fig. 263: Identifying Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

45. Disconnect the engine electrical wiring harness from the following components:
    - Battery cable
    - Retainer clips
    - Transmission electrical connector (1)

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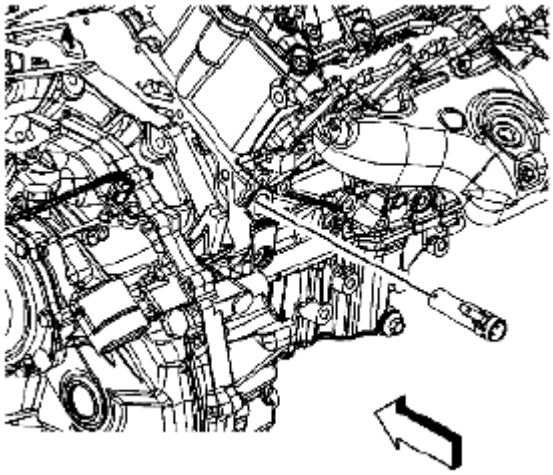


Fig. 264: Identifying Coolant Heater Cord
Courtesy of SUZUKI OF AMERICA CORP.

46. If equipped with an engine coolant heater, disconnect the coolant heater cord.
47. Remove the throttle body assembly. Refer to **THROTTLE BODY ASSEMBLY REPLACEMENT**.
48. Remove the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .

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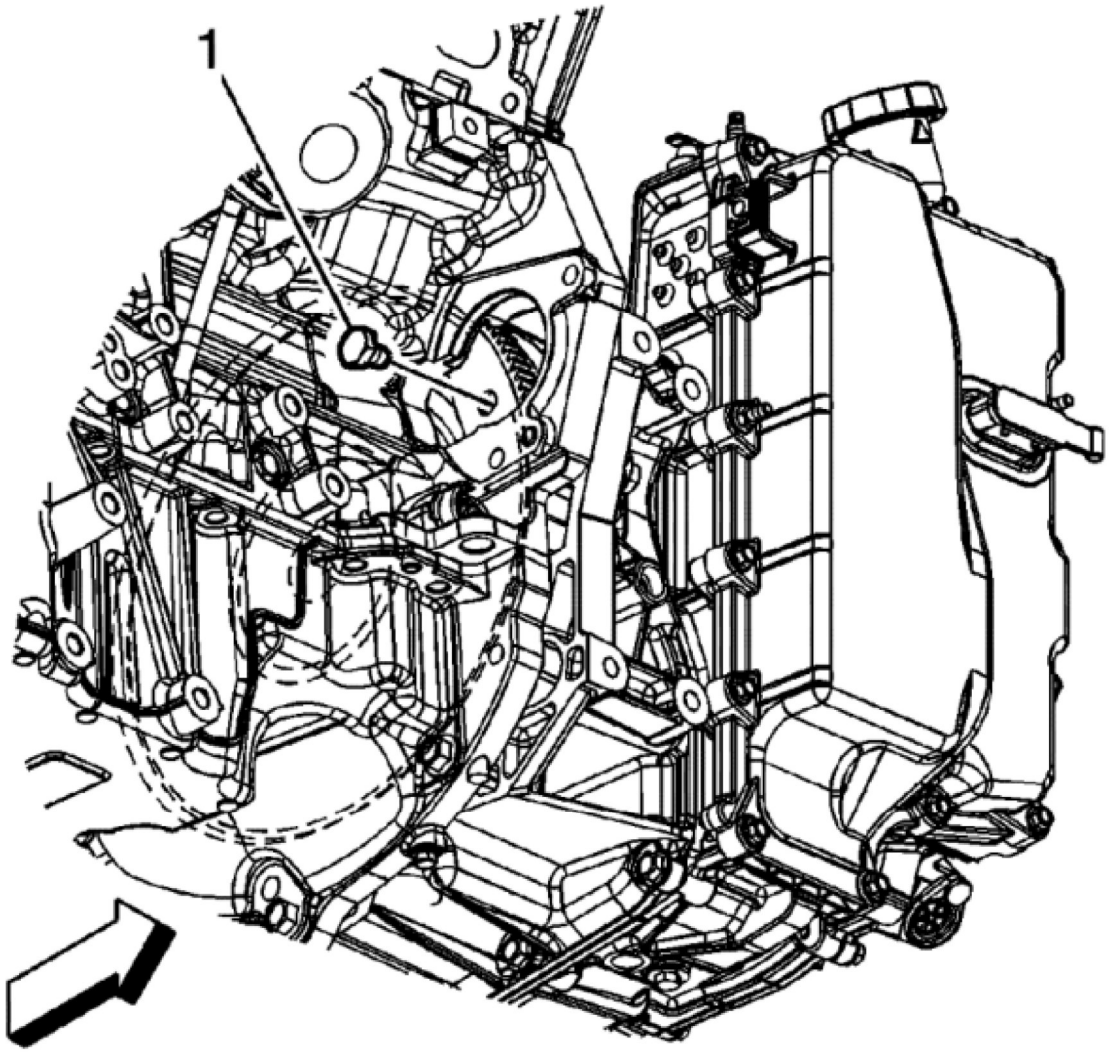


Fig. 265: Identifying Torque Converter Bolts
Courtesy of SUZUKI OF AMERICA CORP.

49. Remove the torque converter bolts.
50. Install the engine support adapters to the engine. Refer to **ENGINE SUPPORT FIXTURE**.
51. Support the engine weight with an engine hoist.

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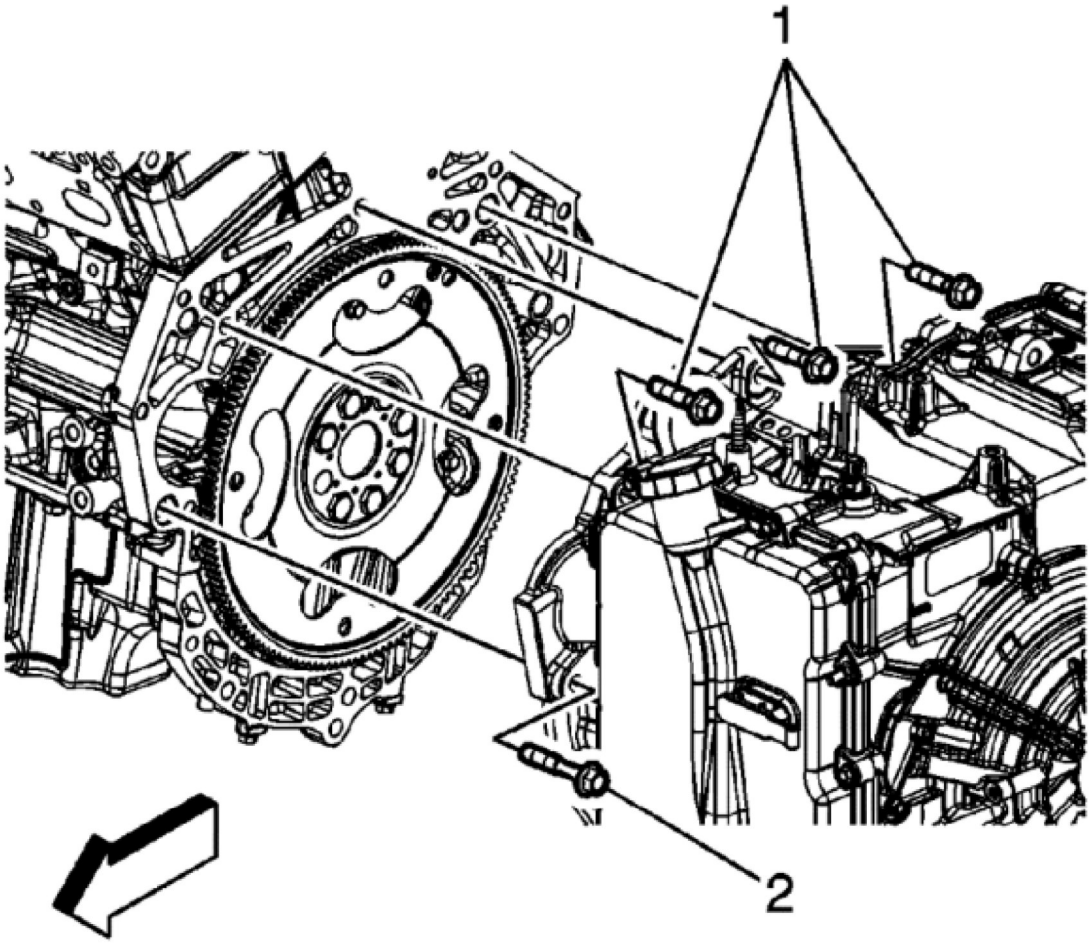


Fig. 266: Identifying Upper Automatic Transaxle Bolts
Courtesy of SUZUKI OF AMERICA CORP.

52. Remove the upper automatic transaxle bolts.

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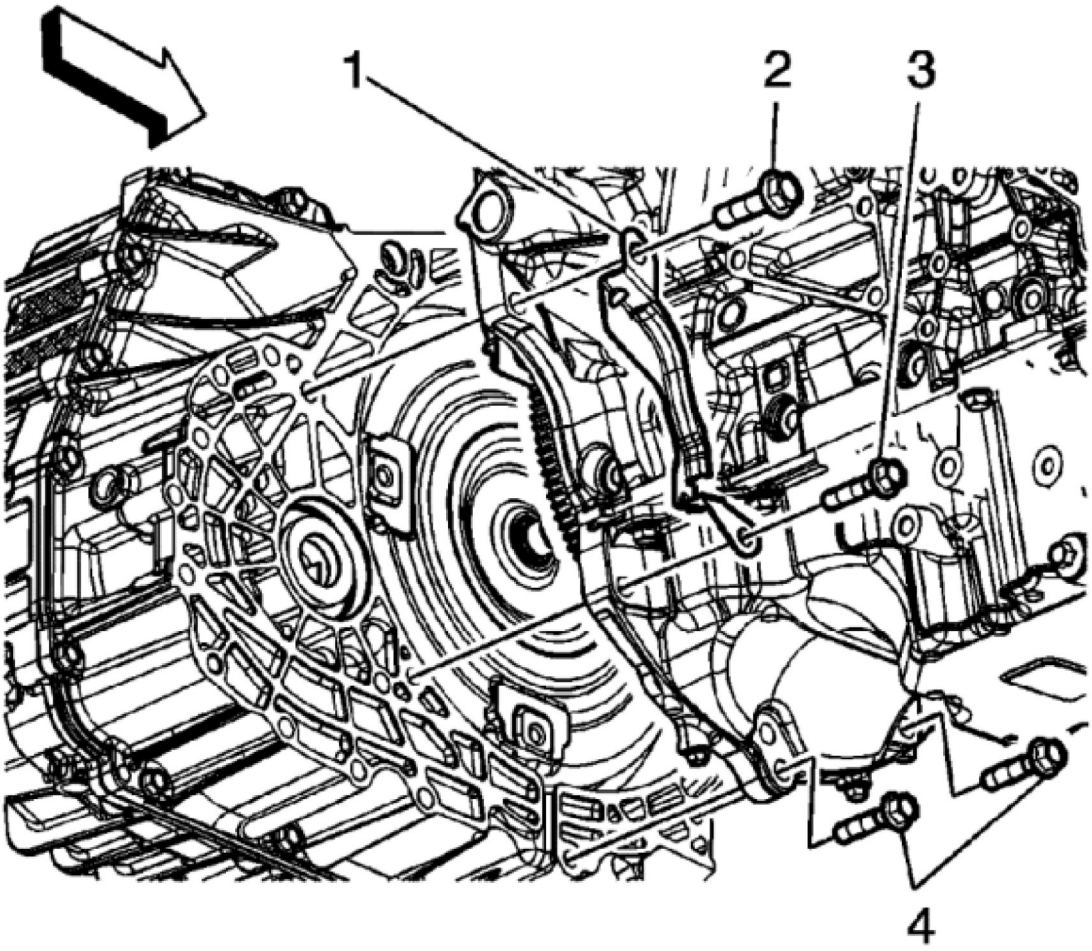


Fig. 267: Identifying Automatic Lower Automatic Transaxle Bolts
Courtesy of SUZUKI OF AMERICA CORP.

53. Remove the lower automatic transaxle bolts.
54. Separate the automatic transaxle from the engine.
55. Lift the engine away from the frame and the automatic transaxle.
56. Secure the engine to an engine stand.
57. Remove any additional engine components as necessary. Refer to appropriate component information if needed.

Installation Procedure

1. Remove the engine from the engine stand.

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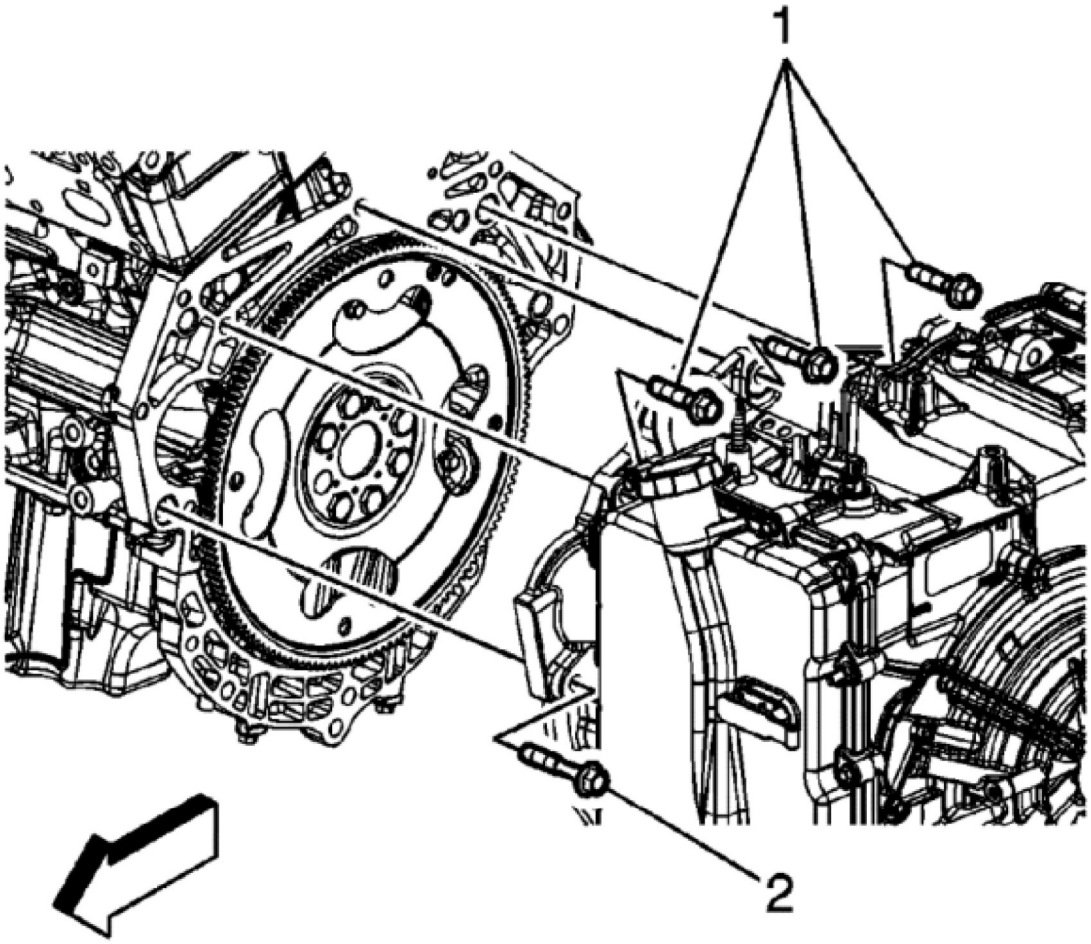


Fig. 268: Identifying Upper Automatic Transaxle Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Align the engine to the frame and automatic transaxle.

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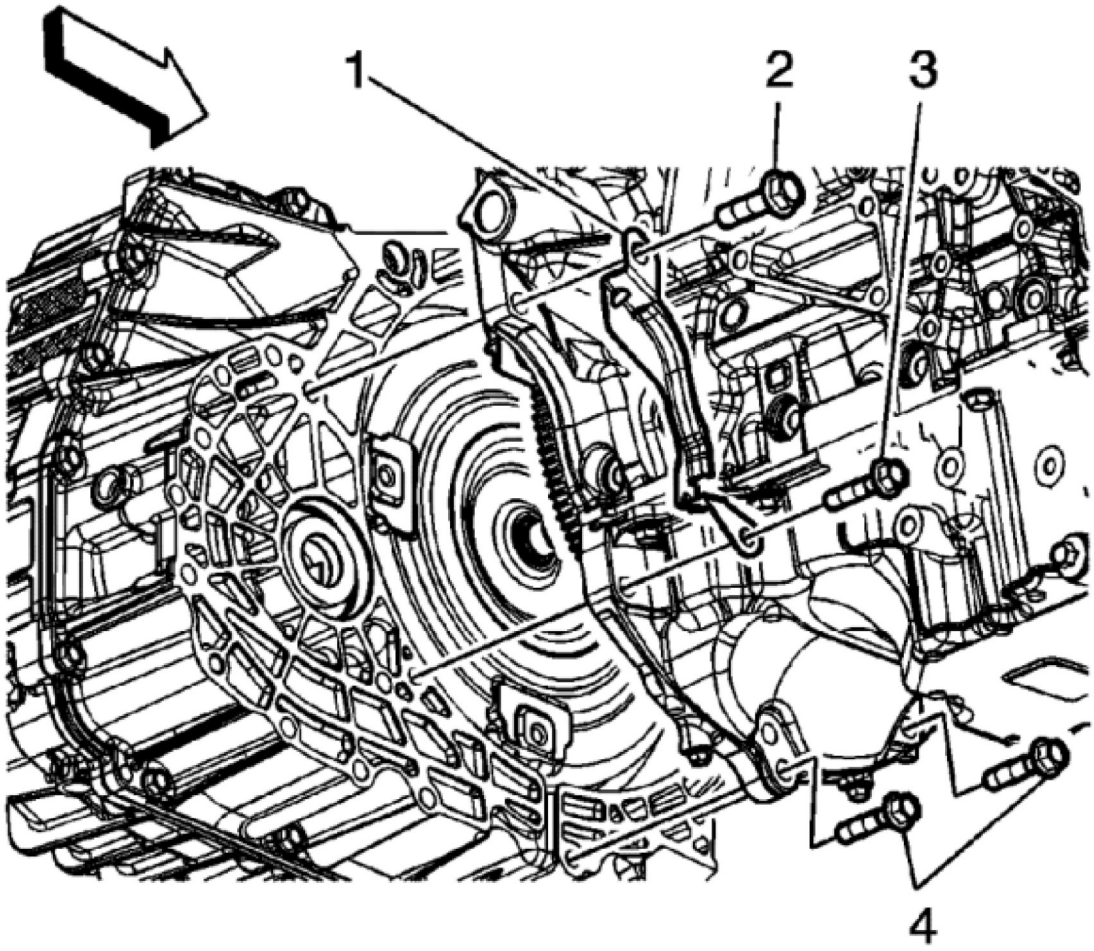


Fig. 269: Identifying Automatic Lower Automatic Transaxle Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Install and tighten the automatic transaxle bolts.

   Tightening torque

   Tighten the bolts to 75 N.m (55 lb ft) .

4. Place a block of wood between the frame and the engine oil pan in order to support the engine on the frame once the engine hoist is removed.
5. Remove the engine hoist and lift chain.
6. Remove the engine support adapters from the engine. Refer to **ENGINE SUPPORT FIXTURE**.

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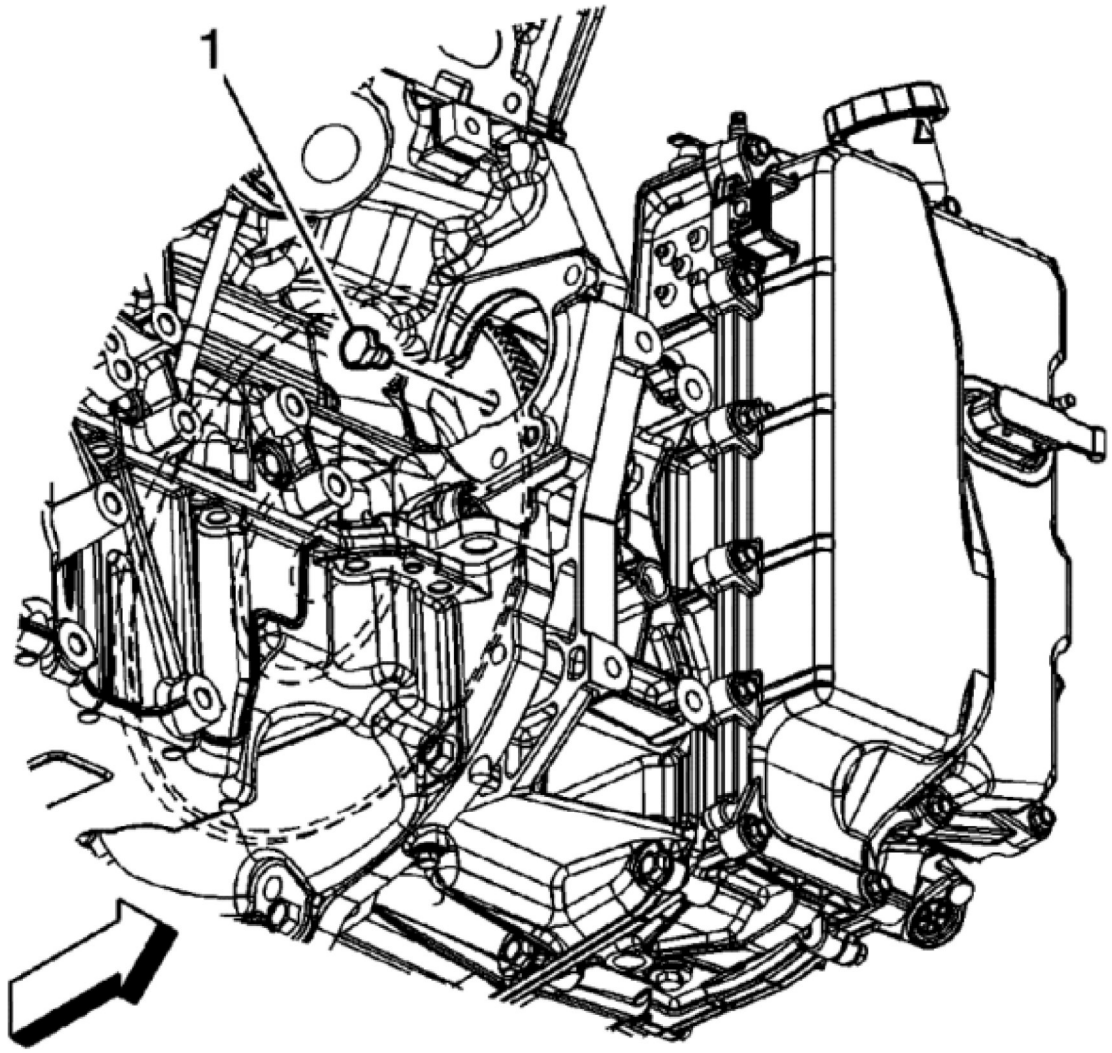


Fig. 270: Identifying Torque Converter Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the torque converter bolts.

   Tightening torque

   Tighten the bolts to 60 N.m (44 lb ft) .

8. Install the starter motor. Refer to **STARTER MOTOR REPLACEMENT** .
9. Install the throttle body assembly. Refer to **THROTTLE BODY ASSEMBLY REPLACEMENT**.

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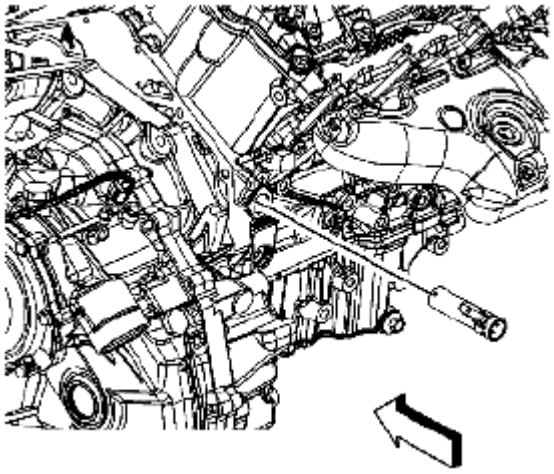


Fig. 271: Identifying Coolant Heater Cord
Courtesy of SUZUKI OF AMERICA CORP.

10. If equipped with an engine coolant heater, connect the coolant heater cord.

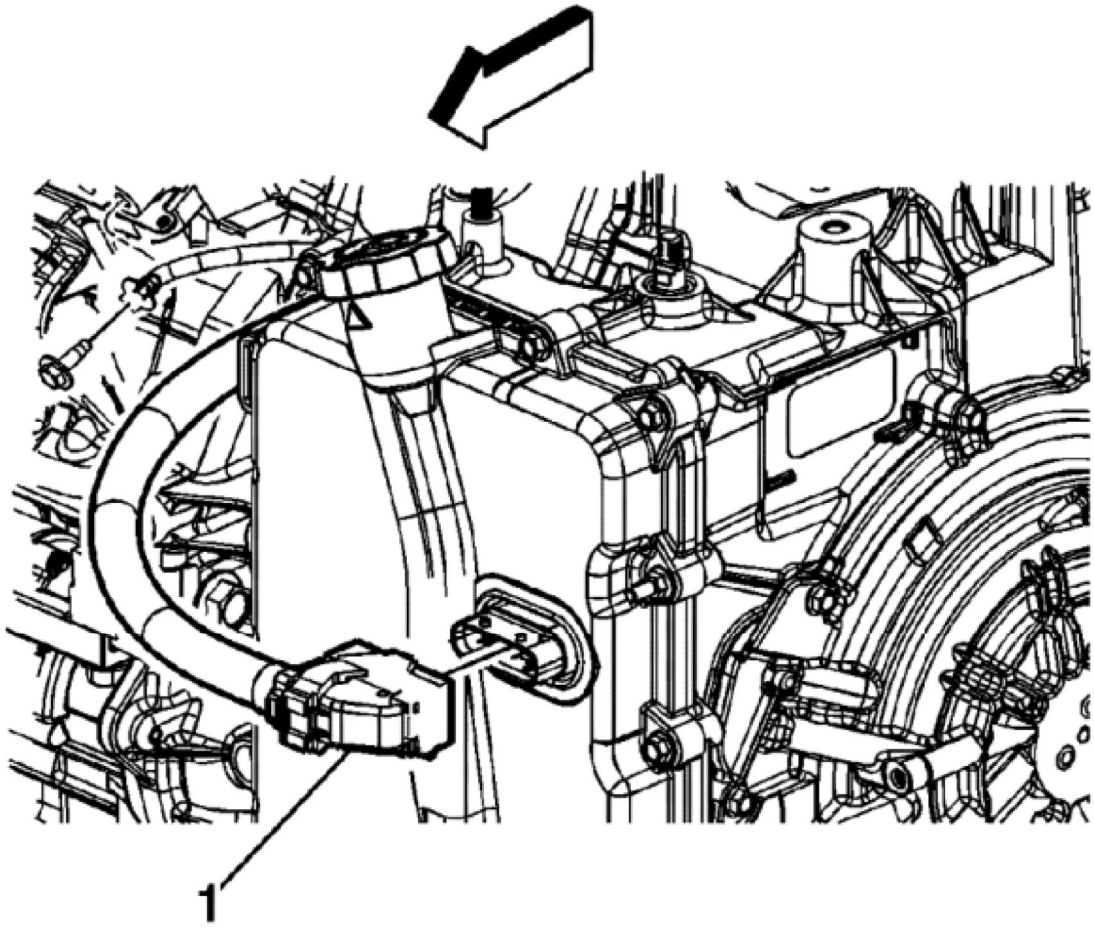


Fig. 272: Identifying Engine Electrical Wiring Harness Connector

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Courtesy of SUZUKI OF AMERICA CORP.

11. Connect the engine electrical wiring harness to the following components:
    - Transmission electrical connector (1)
    - Retainer clips
    - Battery cable

    Tightening torque

    Tighten the bolt to 25 N.m (18 lb ft) .

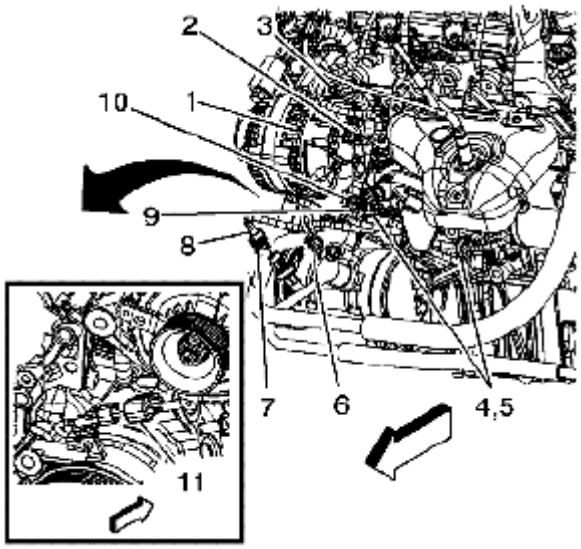


Fig. 273: Identifying Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

12. Connect the engine electrical wiring harness to the following components:
    - A/C compressor (8)
    - Oil pressure switch (10)
    - A/C compressor hose (8)
    - Retainer clips (2, 3, 4, 5, 6, 7, 9)
    - Generator (1)

    Tightening torque

    Tighten the nut to 13 N.m (115 lb in) .

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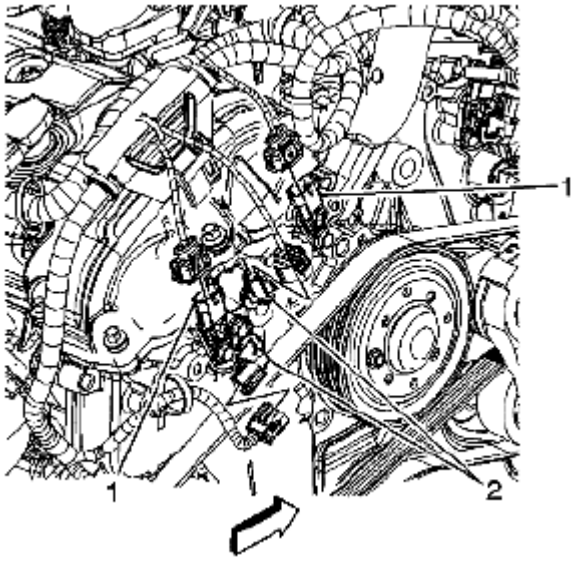


Fig. 274: Identifying Camshaft Position Actuators And Camshaft Position Sensors
Courtesy of SUZUKI OF AMERICA CORP.

13. Connect the left and right cylinder head engine electrical wiring harness to the following components:
    - Camshaft position actuators (2)
    - Camshaft position sensors (1)

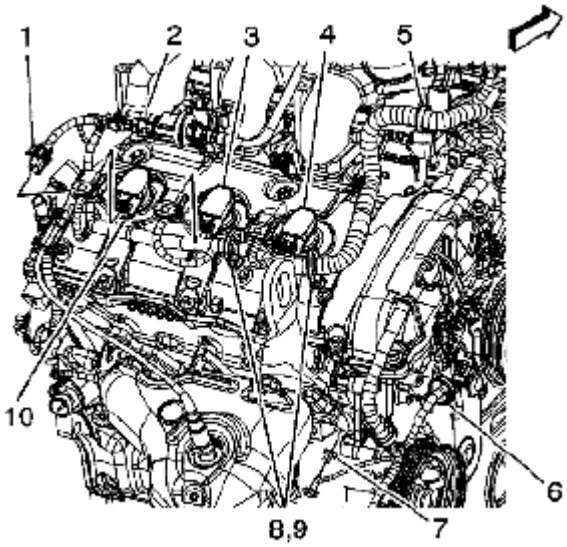


Fig. 275: Identifying Engine Electrical Wiring Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

14. Connect the engine electrical wiring harness to the following components:
    - Install wire harness to retainers (5, 6, 8, 9)
    - Ground leads (7, 11)
    - Ignition coils (3, 4, 10)

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- EVAP purge solenoid (2)
- Oxygen sensor (1)

15. Connect the wiring harness retaining clips near the right and left shock towers.

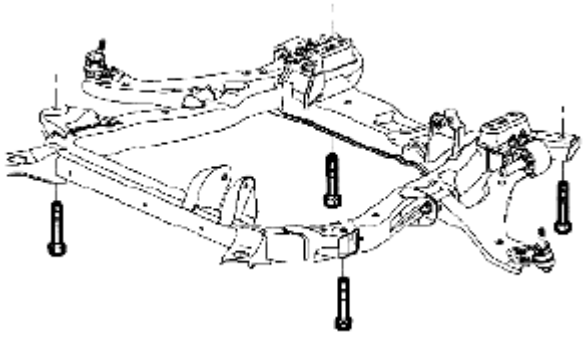


Fig. 276: Identifying Frame-To-Body Bolts
Courtesy of SUZUKI OF AMERICA CORP.

16. Install NEW frame-to-body bolts.

    Tightening torque

    Tighten the bolts to 155 N.m (114 lb ft) .

17. Install the drivetrain and front suspension frame reinforcement. Refer to **DRIVETRAIN AND FRONT SUSPENSION FRAME REINFORCEMENT REPLACEMENT** .
18. Raise the vehicle up away from the frame support fixture or jackstands and remove the support fixture or jackstands from under the vehicle.
19. Lower the vehicle.

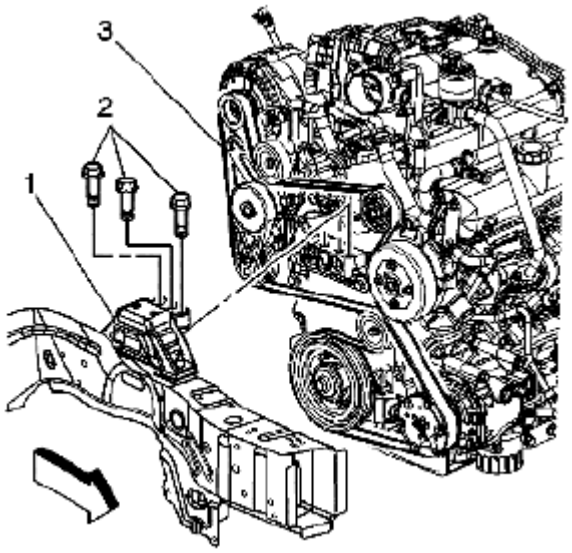


Fig. 277: Identifying Bolts That Secure Right Engine Mount To Engine

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Courtesy of SUZUKI OF AMERICA CORP.

20. Install the bolts (2) that secure the right engine mount (1) to the engine (3).

    Tightening torque

    Tighten the bolts to 50 N.m (37 lb ft) .

21. Raise the vehicle.

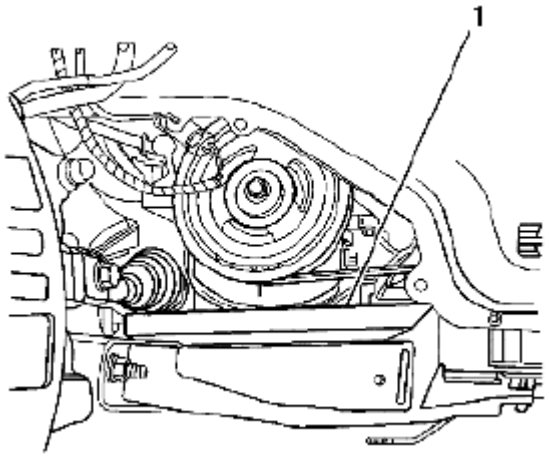


Fig. 278: Identifying Block Of Wood Between Frame And Engine Oil Pan
Courtesy of SUZUKI OF AMERICA CORP.

22. Remove the block of wood (1) between the frame and the engine oil pan used to support the engine while the bolts were removed from the right engine mount.
23. On all wheel drive (AWD) models, install the rear wheel driveshaft. Refer to **REAR WHEEL DRIVE SHAFT REPLACEMENT** .
24. On front wheel drive models, install the right and left front wheel drive shafts into the transaxle. Refer to **FRONT WHEEL DRIVE SHAFT REPLACEMENT** .

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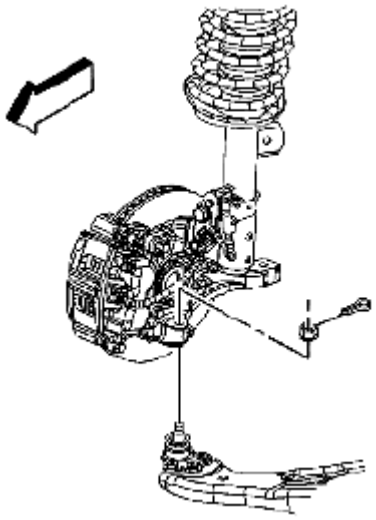


Fig. 279: Identifying Lower Ball Joints And Steering Knuckles
Courtesy of SUZUKI OF AMERICA CORP.

25. On all models, install the right and left lower ball joints to the steering knuckles. Refer to **LOWER CONTROL ARM REPLACEMENT** .

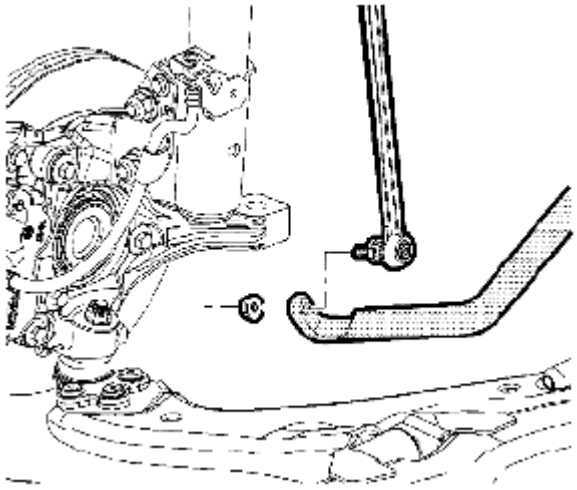


Fig. 280: Identifying Stabilizer Shaft Links And Stabilizer Shaft
Courtesy of SUZUKI OF AMERICA CORP.

26. Install the right and left stabilizer shaft links to the stabilizer shaft. Refer to **STABILIZER SHAFT LINK REPLACEMENT** .

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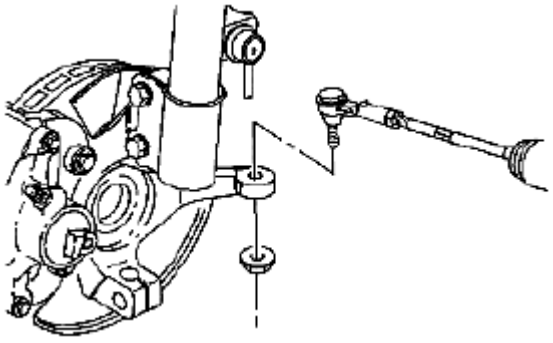


Fig. 281: Identifying Tie Rod Ends And Steering Knuckles
Courtesy of SUZUKI OF AMERICA CORP.

27. Install the right and left tie rod ends to the steering knuckles. Refer to **STEERING LINKAGE OUTER TIE ROD REPLACEMENT** .

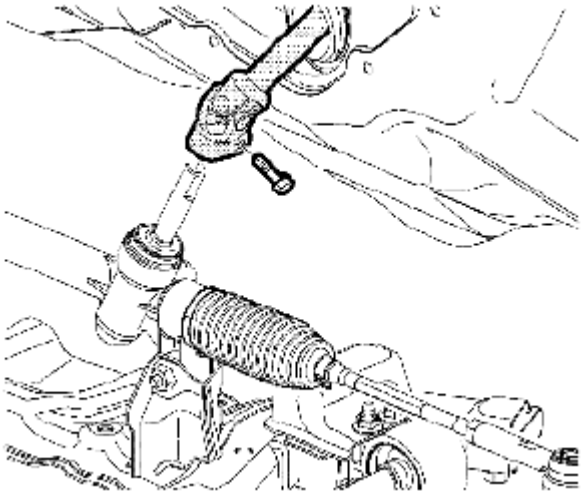


Fig. 282: Identifying Pinch Bolt And Steering Intermediate Shaft
Courtesy of SUZUKI OF AMERICA CORP.

28. Connect the steering intermediate shaft to the steering gear.
29. Install a NEW pinch bolt to the steering intermediate shaft.

Tightening torque

Tighten the bolt to 34 N.m (25 lb ft) .

30. Install the right and left engine splash shields. Refer to **ENGINE SPLASH SHIELD REPLACEMENT - LEFT SIDE** and **ENGINE SPLASH SHIELD REPLACEMENT - RIGHT SIDE** .
31. Install the front tires. Refer to **TIRE AND WHEEL REMOVAL AND INSTALLATION** .
32. Install the catalytic converters. Refer to **CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE** and **CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE** .

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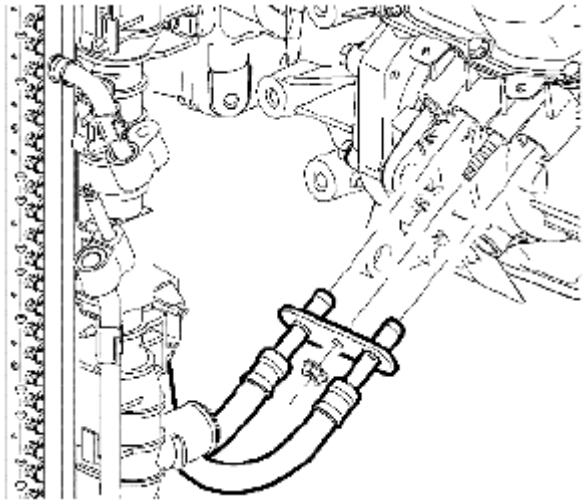
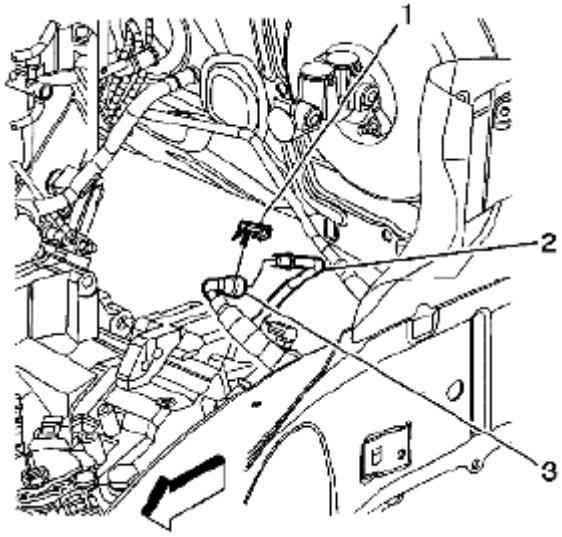


Fig. 283: Identifying Transaxle Oil Cooler Lines
Courtesy of SUZUKI OF AMERICA CORP.

33. Install new seals and connect the transaxle oil cooler lines to the transaxle. Refer to FLUID COOLER PIPE SEAL REPLACEMENT in Automatic Transmission .
34. Install the radiator outlet hose. Refer to **RADIATOR OUTLET HOSE REPLACEMENT** .
35. Lower the vehicle.
36. Install the radiator inlet hose. Refer to **RADIATOR INLET HOSE REPLACEMENT** .
37. Connect the heater hoses to the engine. Refer to **HEATER OUTLET HOSE REPLACEMENT** .
38. Untie the radiator, AC condenser, and fan module assembly from the upper radiator support.
39. Connect the transaxle shift control cable to the transaxle. Refer to SHIFT CONTROL CABLE REPLACEMENT in Automatic Transmission .
40. Install the AC compressor hose assembly to the compressor. Refer to **COMPRESSOR HOSE ASSEMBLY REPLACEMENT** .



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Fig. 284: Identifying Engine Fuel Hose/Pipe And Chassis Fuel Hose/Pipe
Courtesy of SUZUKI OF AMERICA CORP.

41. Connect the engine fuel hose/pipe (3) to the chassis fuel hose/pipe (2). Refer to **METAL COLLAR QUICK CONNECT FITTING SERVICE** .
42. Connect the EVAP hose/pipe to the EVAP canister purge solenoid valve. Refer to **PLASTIC COLLAR QUICK CONNECT FITTING SERVICE** .
43. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY REPLACEMENT**.

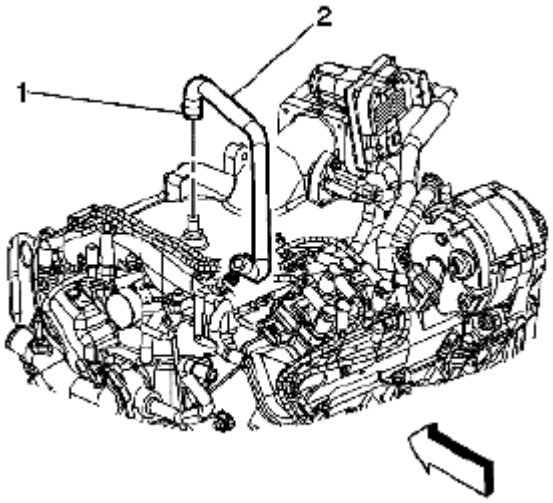


Fig. 285: Identifying Brake Booster Vacuum Hose
Courtesy of SUZUKI OF AMERICA CORP.

44. Connect the brake booster vacuum hose (2) to the intake manifold.
45. Position the clamp (1) on the brake booster vacuum hose connection.
46. Connect ground wire from frame, near battery box.
47. Connect the ECM connector to the under-hood fuse block.
48. Install the fuel injector sight shield. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
49. Install the battery box, battery and ECM. Refer to **BATTERY BOX REPLACEMENT** .
50. Fill the engine with engine oil. Refer to **APPROXIMATE FLUID CAPACITIES** , **FLUID AND LUBRICANT RECOMMENDATIONS** , and **MAINTENANCE SCHEDULE (NORTH AMERICAN EMISSIONS)** .
51. Fill the engine with coolant. Refer to **COOLING SYSTEM DRAINING AND FILLING (LY7 GE 47716 FILL)** or **COOLING SYSTEM DRAINING AND FILLING (LY7 STATIC FILL)** .
52. Check the transaxle fluid level. Refer to TRANSMISSION FLUID CHECK in the Automatic Transmission article.
53. Charge the AC system. Refer to **REFRIGERANT RECOVERY AND RECHARGING** .
54. Prime the fuel system.
    a. Cycle the ignition ON for 5 seconds then OFF for 10 seconds. Repeat cycling twice.
    b. Crank the engine until it starts. The maximum starter motor cranking time is 20 seconds.

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c. If the engine does not start, repeat the steps.

DRIVE BELT TENSIONER REMOVAL

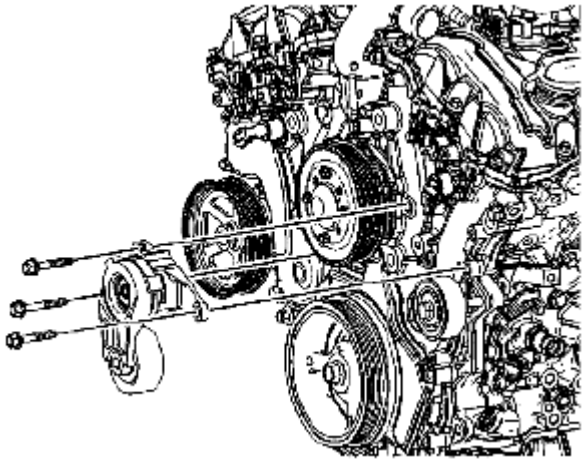


Fig. 286: Identifying Drive Belt Tensioner Bracket Bolts And Tensioner Assembly
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the drive belt tensioner bracket bolts.
2. Remove the drive belt tensioner assembly.

DRIVE BELT IDLER PULLEY REMOVAL

Reference: **DRIVE BELT TENSIONER REMOVAL**

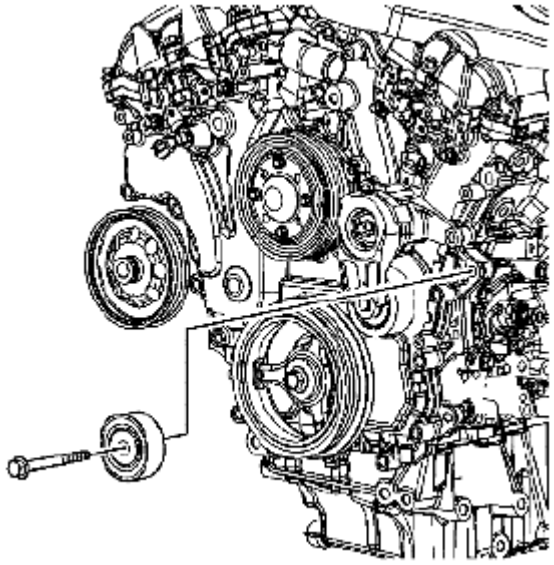


Fig. 287: Identifying Drive Belt Idler Pulley And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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1. Remove the drive belt idler pulley bolt.
2. Remove the drive belt idler pulley.

INTAKE MANIFOLD REMOVAL

Reference: **EXHAUST MANIFOLD REMOVAL - RIGHT SIDE**

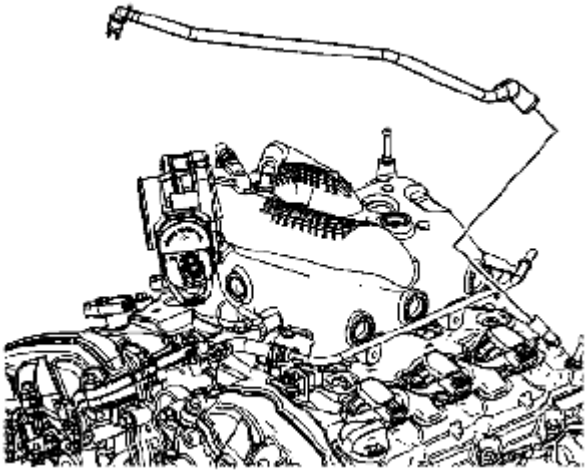


Fig. 288: Identifying Fresh Air Positive Crankcase Ventilation Hose
Courtesy of SUZUKI OF AMERICA CORP.

1. Disconnect and remove the fresh air Positive Crankcase Ventilation (PCV) hose from the left camshaft cover fitting.

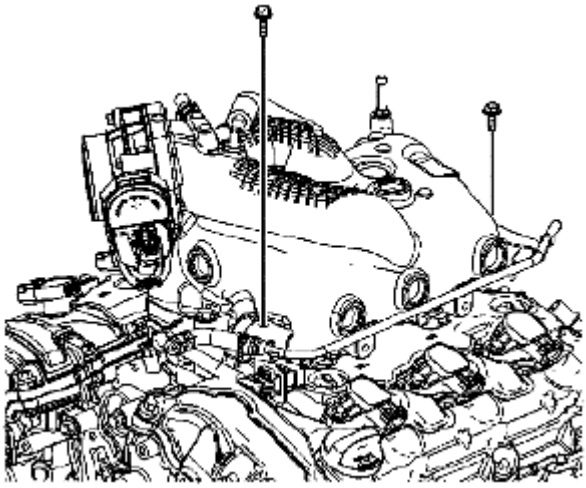


Fig. 289: Identifying Engine Coolant Air Bleed Pipe And Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the engine coolant air bleed pipe bracket bolts from the upper intake manifold.

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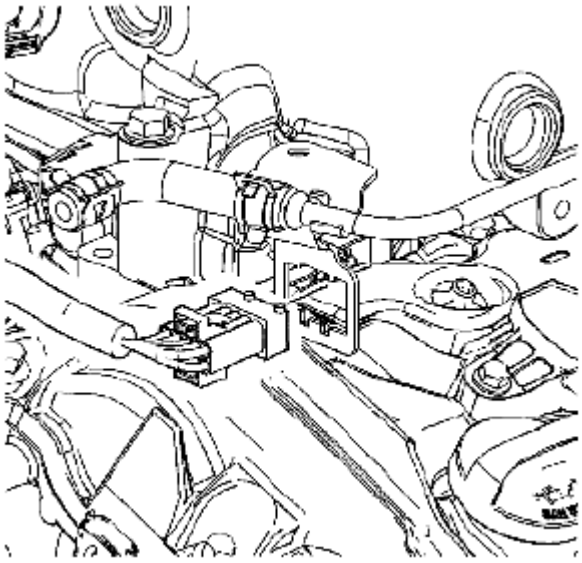


Fig. 290: Identifying Fuel Injector Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the fuel injector harness connector from the engine coolant air bleed pipe bracket.

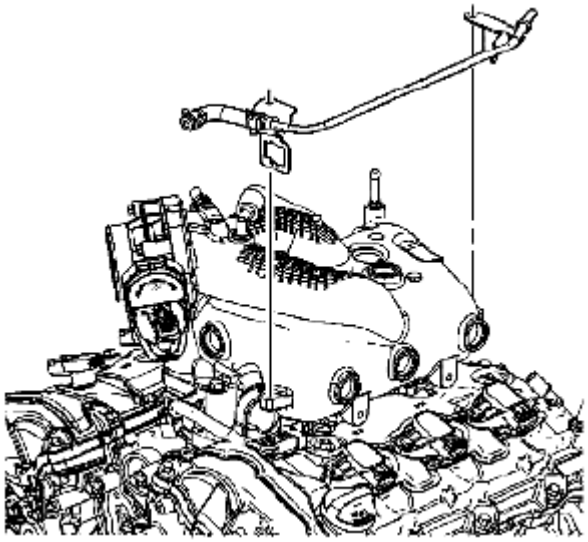


Fig. 291: Identifying Engine Coolant Air Bleed Pipe
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the engine coolant air bleed pipe.

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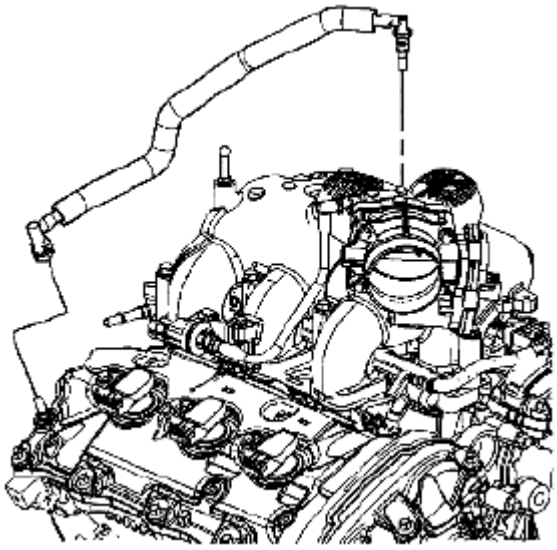


Fig. 292: Identifying Dirty Air PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

5. Disconnect and remove the dirty air PCV hose from the intake manifold and the right camshaft cover fitting.

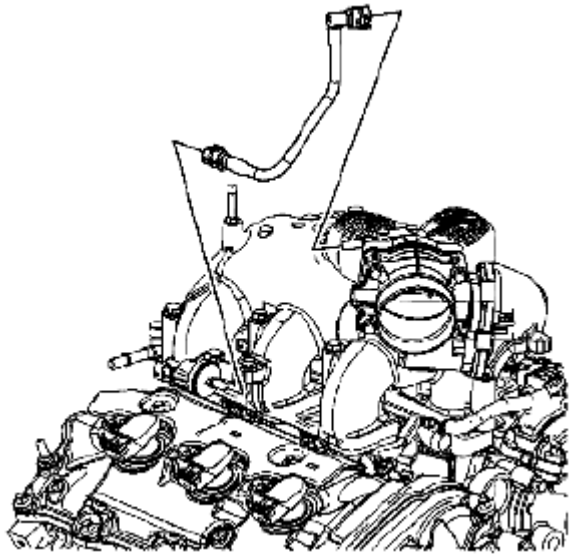


Fig. 293: Identifying Intake Manifold-To-Solenoid Evaporative Emissions Hose
Courtesy of SUZUKI OF AMERICA CORP.

6. Disconnect and remove the intake manifold-to-solenoid Evaporative Emissions (EVAP) hose from the intake manifold and from the EVAP solenoid.

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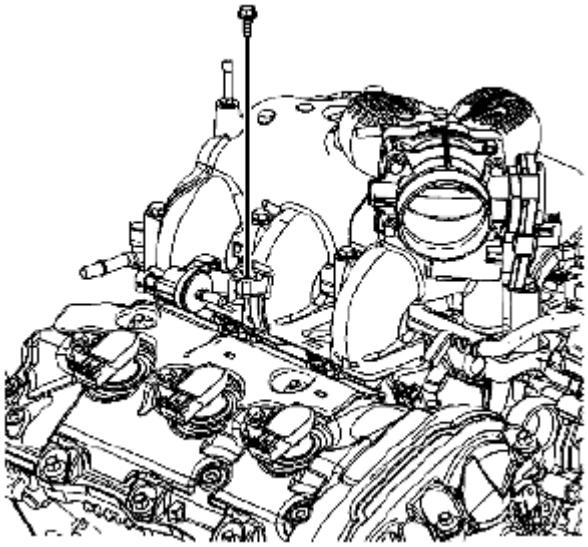


Fig. 294: Identifying EVAP Solenoid Bolt
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the EVAP solenoid bolt.

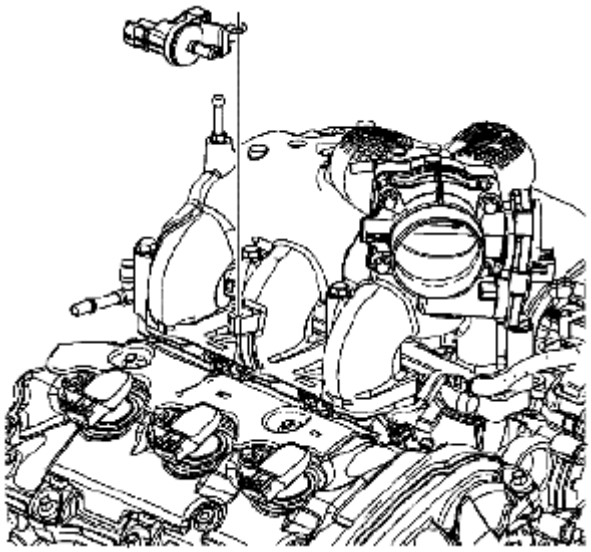


Fig. 295: Identifying EVAP Solenoid
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EVAP solenoid.

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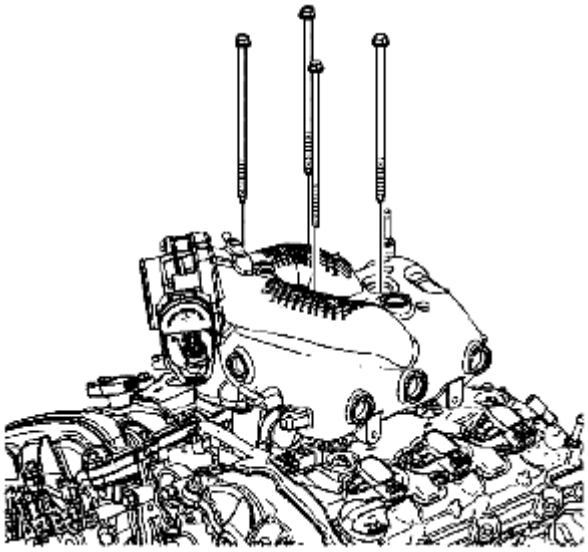


Fig. 296: Identifying Long Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the long intake manifold bolts.

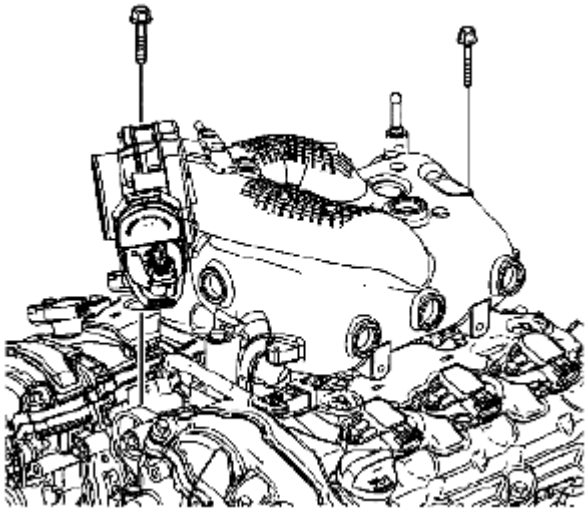


Fig. 297: Identifying Short Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the short intake manifold bolts.

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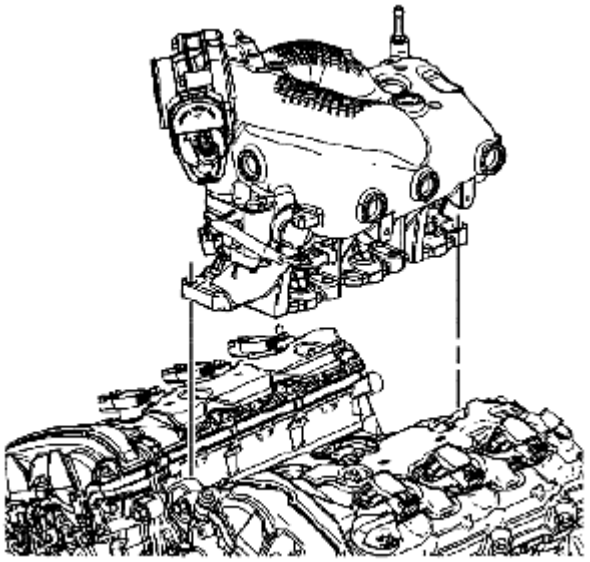


Fig. 298: Identifying Intake Manifold Assembly
Courtesy of SUZUKI OF AMERICA CORP.

11. Remove the intake manifold assembly.

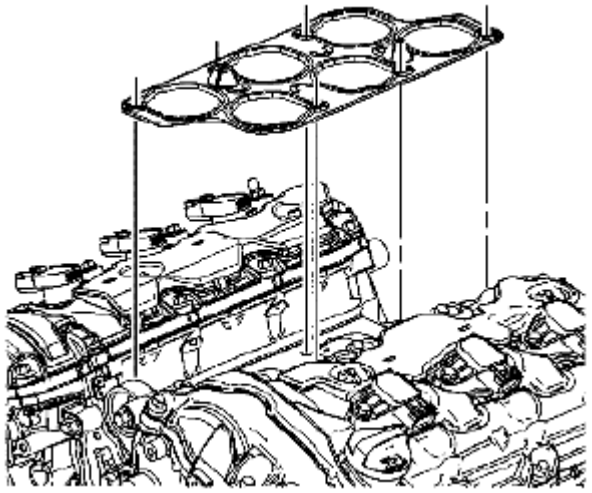


Fig. 299: Identifying Lower Intake Manifold Gasket
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove and discard the lower intake manifold gasket.

Reference: **INTAKE MANIFOLD DISASSEMBLE**

CRANKSHAFT BALANCER REMOVAL

Reference: **ENGINE COOLANT THERMOSTAT HOUSING REMOVAL**

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Special Tool

EN 46106 Flywheel Holding Tool

J 38416-2 Crankshaft Button

J 41816 Crankshaft Balancer Remover

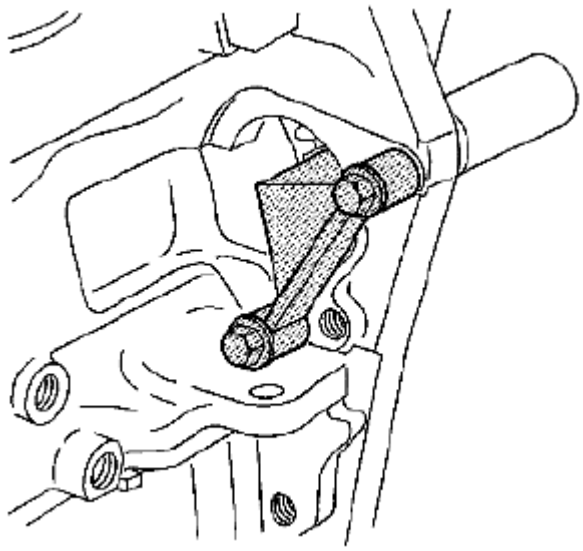


Fig. 300: Identifying EN 46106 Flywheel Holding Tool
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the EN 46106 through the starter mounting hole.

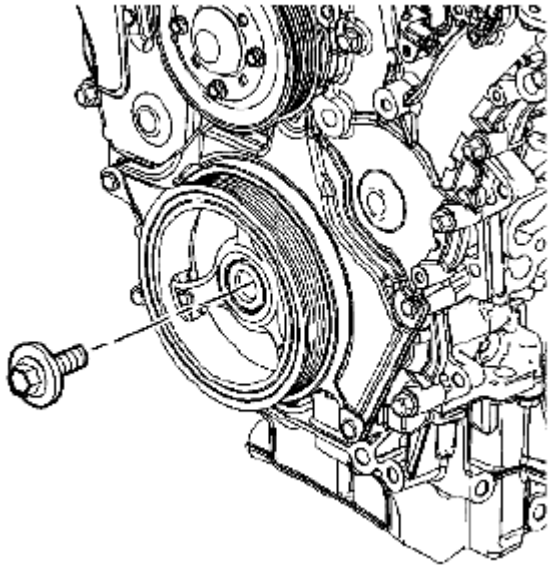


Fig. 301: Identifying Crankshaft Balancer Bolt

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Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the crankshaft balancer bolt.

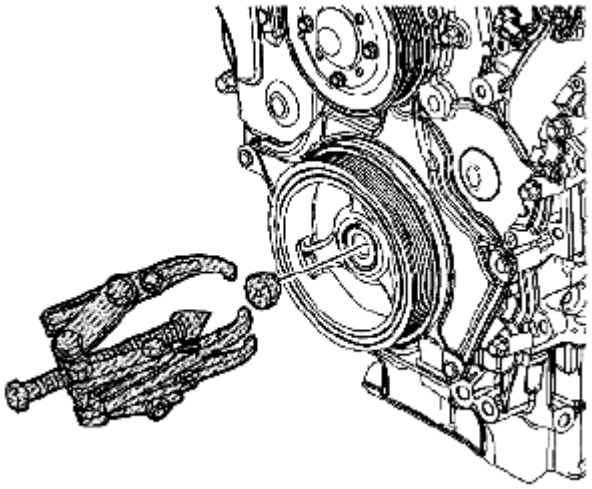


Fig. 302: Identifying Special Tools J 38416-2 And J 38416
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the J 38416-2 in the nose of the crankshaft.
4. Install the J 41816 in order to remove the crankshaft balancer.
5. Tighten the center bolt of the J 41816 in order to pull the crankshaft balancer off of the crankshaft.
6. Remove the J 41816 from the crankshaft balancer.

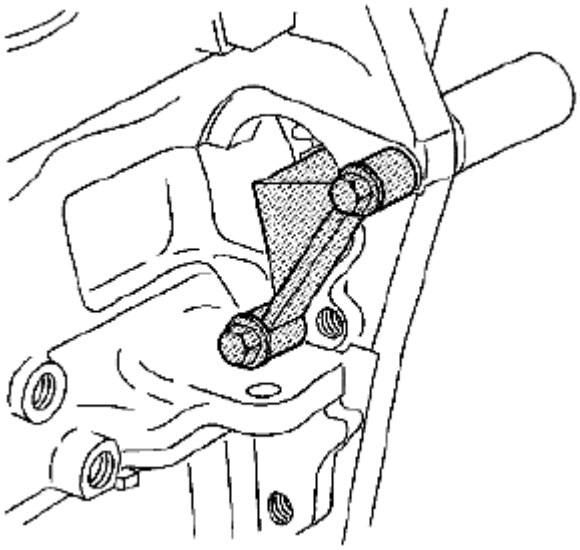


Fig. 303: Identifying EN 46106 Flywheel Holding Tool
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the EN 46106.

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Reference: **CRANKSHAFT BALANCER CLEANING AND INSPECTION**

ENGINE FLYWHEEL REMOVAL

Reference: **CRANKSHAFT BALANCER REMOVAL**

Special Tool

EN 46106 Flywheel Holding Tool

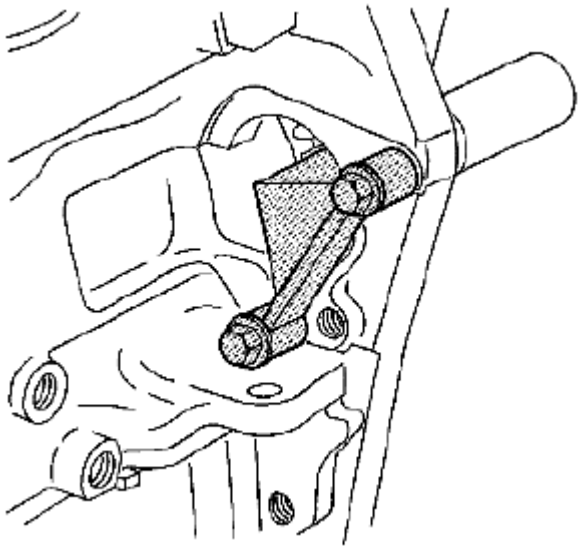
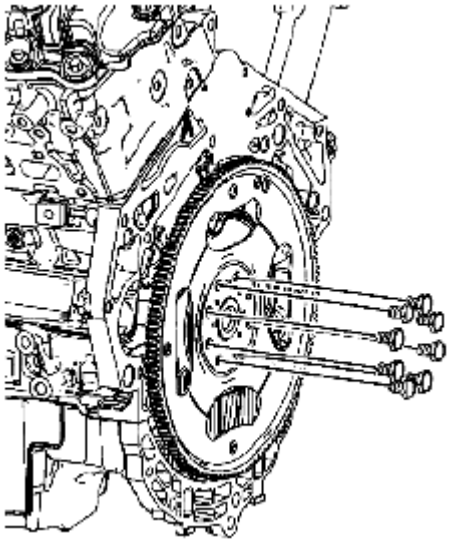


Fig. 304: Identifying EN 46106 Flywheel Holding Tool
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the EN 46106 through the starter mounting hole.



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Fig. 305: Identifying Engine Flywheel Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the engine flywheel bolts and discard.

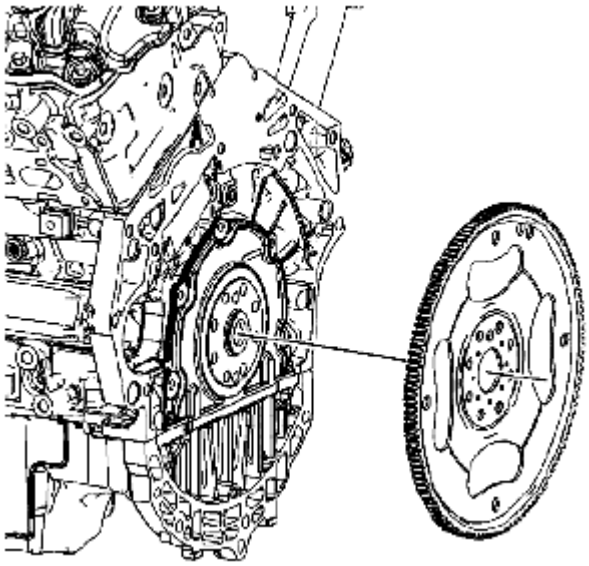


Fig. 306: Identifying Engine Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the engine flywheel from the crankshaft.

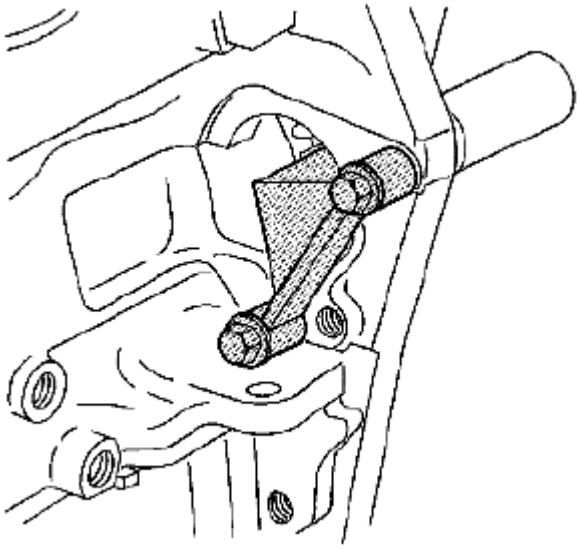


Fig. 307: Identifying EN 46106 Flywheel Holding Tool
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the EN 46106.

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Reference: **ENGINE FLYWHEEL CLEANING AND INSPECTION**

CAMSHAFT COVER REMOVAL - LEFT SIDE

Reference: **ENGINE FLYWHEEL REMOVAL**

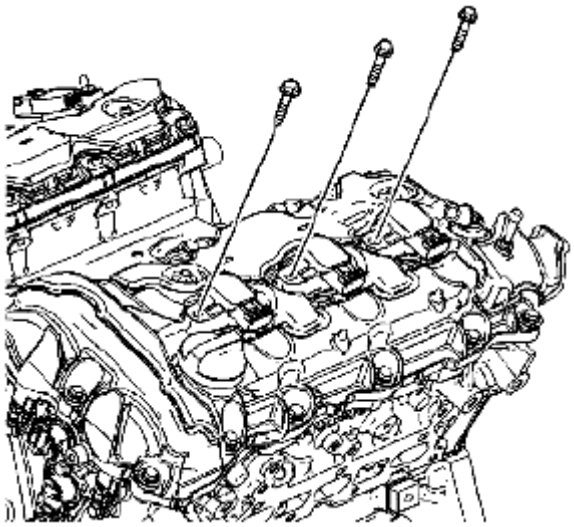


Fig. 308: Identifying Ignition Coil Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the ignition coil bolts.

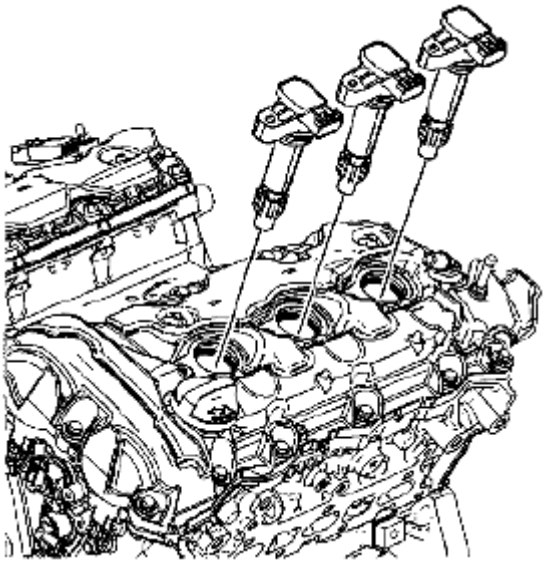


Fig. 309: Identifying Ignition Coil
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the ignition coils.

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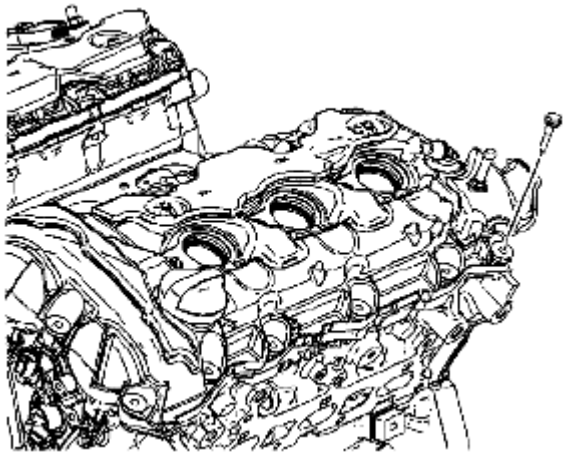


Fig. 310: Identifying Left Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the left camshaft cover bolts.
4. Remove and discard the camshaft cover grommets and camshaft cover bolts if they are serviced with the grommet.

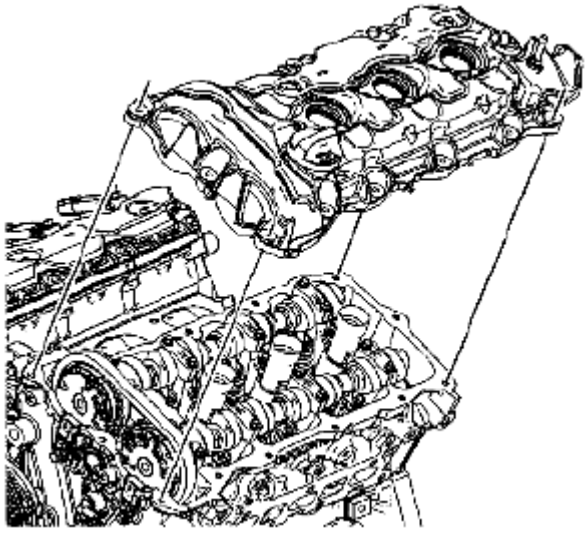


Fig. 311: Identifying Left Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the left camshaft cover from the left cylinder head.

   Reference: **CAMSHAFT COVER DISASSEMBLE**

CAMSHAFT COVER REMOVAL - RIGHT SIDE

Reference: **CAMSHAFT COVER REMOVAL - LEFT SIDE**

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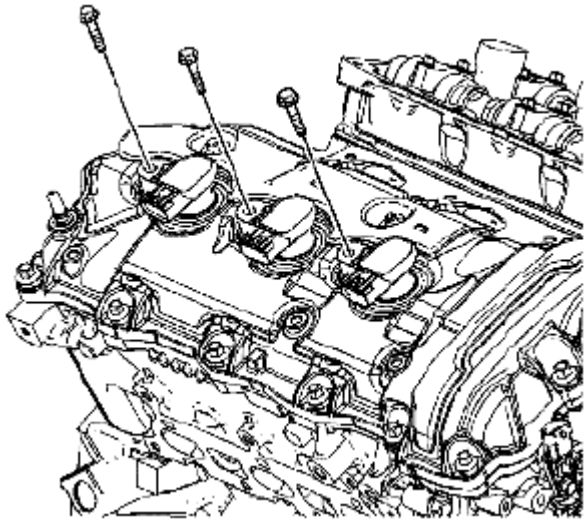


Fig. 312: Identifying Ignition Coil Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the ignition coil bolts.

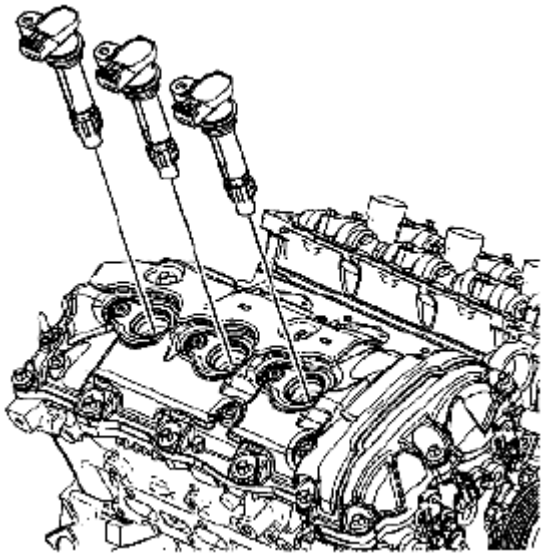


Fig. 313: Identifying Ignition Coil
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the ignition coils.

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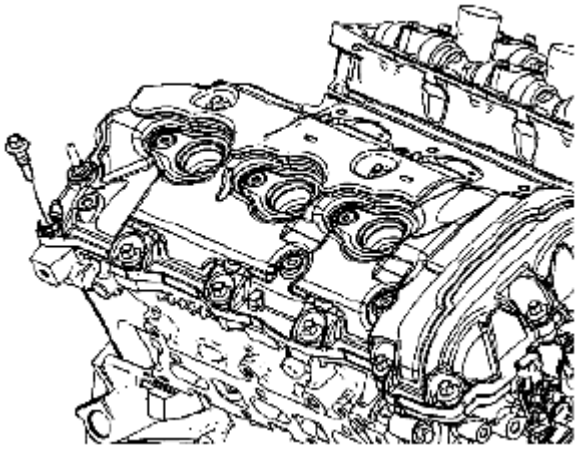


Fig. 314: Identifying Right Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the right camshaft cover bolts.
4. Remove and discard the camshaft cover grommets and camshaft cover bolts if they are serviced with the grommet.

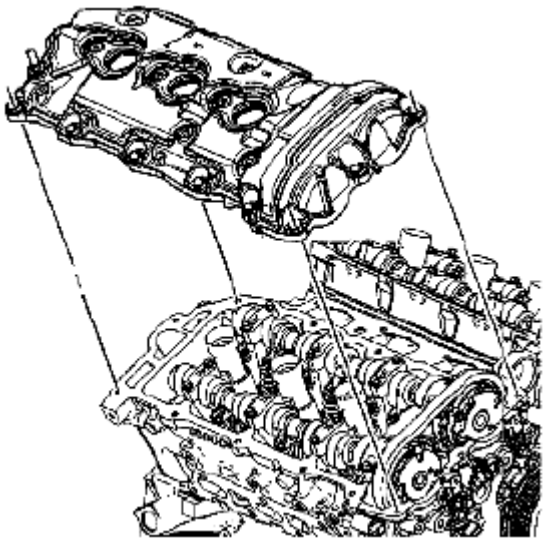


Fig. 315: Identifying Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the right camshaft cover from the right cylinder head.

   Reference: **CAMSHAFT COVER DISASSEMBLE**

ENGINE FRONT COVER REMOVAL

Reference: **WATER PUMP REMOVAL**

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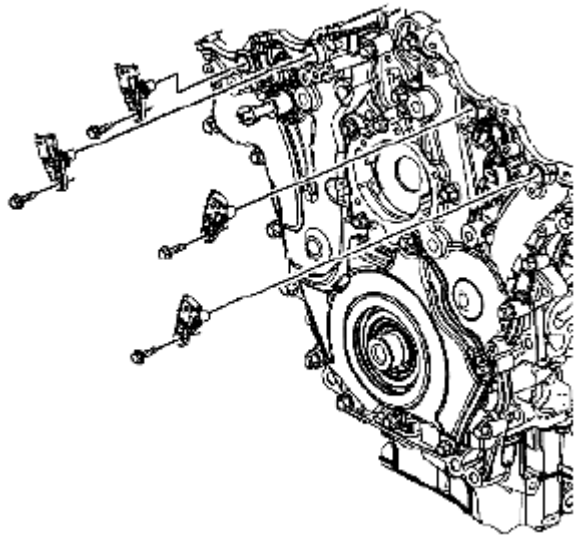


Fig. 316: Identifying Camshaft Position Sensors And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the camshaft position sensor bolts.
2. Remove the camshaft position sensors.

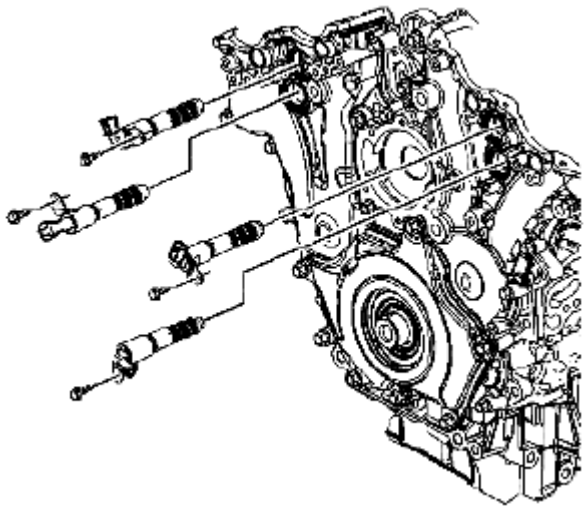


Fig. 317: Identifying Camshaft Position Actuator Valve And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the camshaft position actuator valve bolts.

CAUTION: The camshaft position actuator valves must be removed from the front cover prior to front cover removal or damage to the valves may occur.

4. Remove the camshaft position actuator valves from the front cover.

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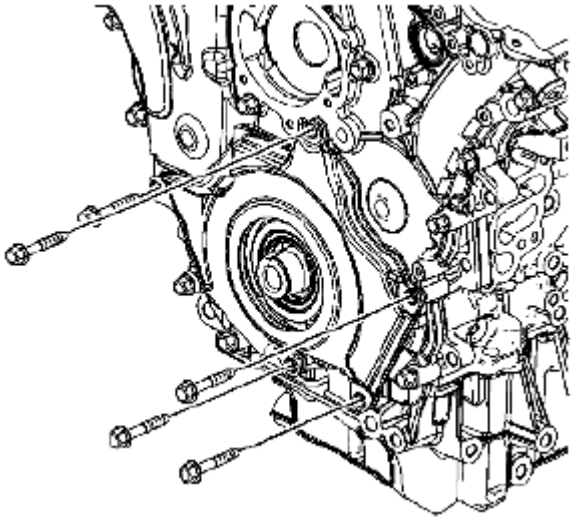


Fig. 318: Identifying Engine Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the engine front cover bolts that hold the engine front cover deadener into position.

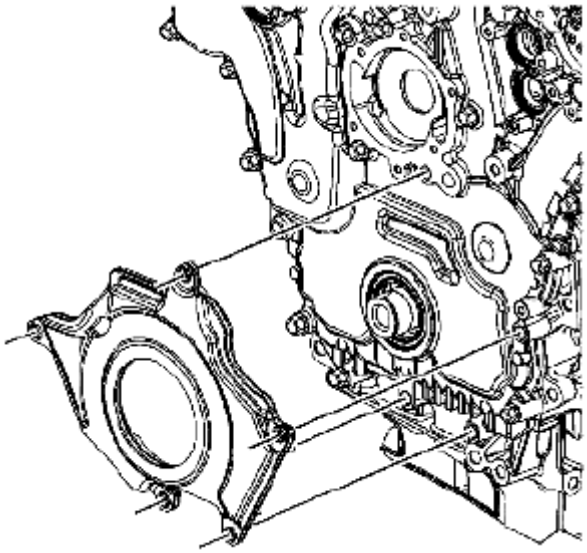


Fig. 319: Identifying Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove the engine front cover deadener.

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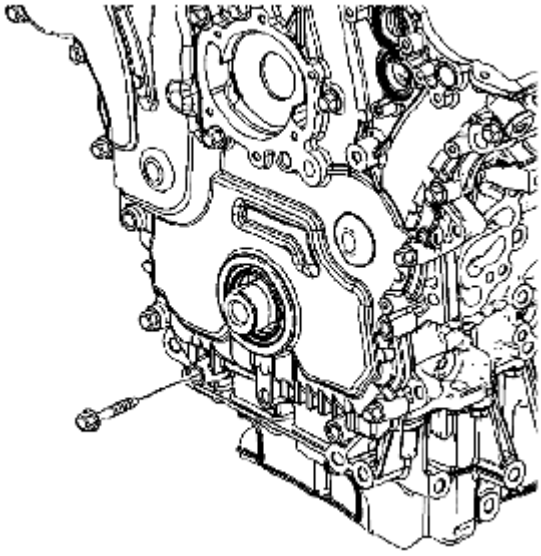


Fig. 320: Identifying Engine Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the remaining engine front cover bolts.

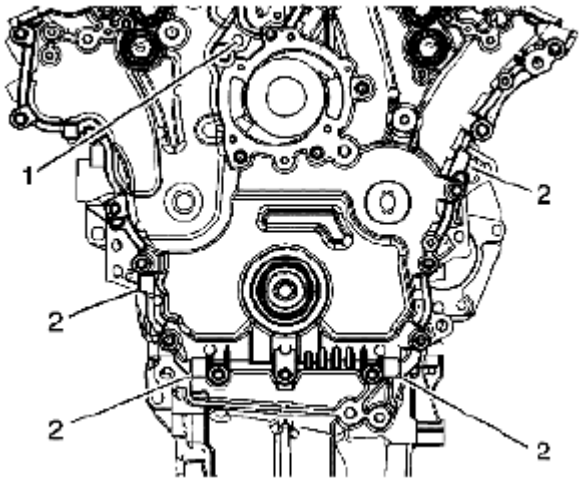


Fig. 321: Identifying Jackscrew Hole
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not pry between the engine front cover and the camshaft position sensors or the camshaft position actuators in order to separate the RTV. Use the pry points and a bolt in the jackscrew hole in order to remove the engine front cover. Damage to the camshaft position sensors or the camshaft position actuators may occur if the camshaft position sensors or the camshaft position actuators are used to pry against in order to remove the engine front cover.

8. Loosely install a 10 x 1.5 mm bolt in the jackscrew hole (1).

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9. Using the pry points (2) located at the edge of the front cover and the jackscrew, separate the room temperature vulcanizing (RTV) sealant.

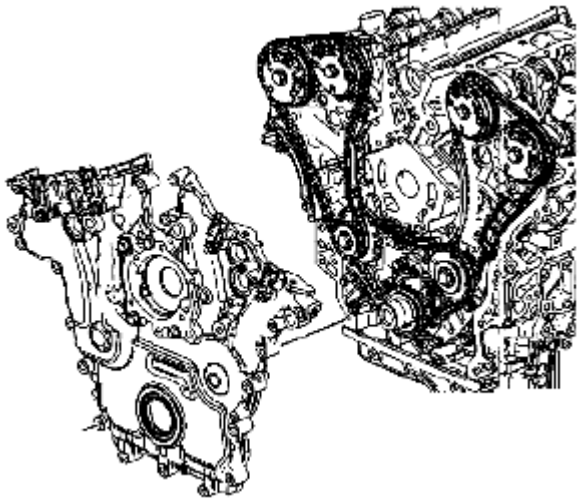


Fig. 322: Identifying Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the engine front cover.

    Reference: **ENGINE FRONT COVER DISASSEMBLE**

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE

Reference: **ENGINE FRONT COVER REMOVAL**

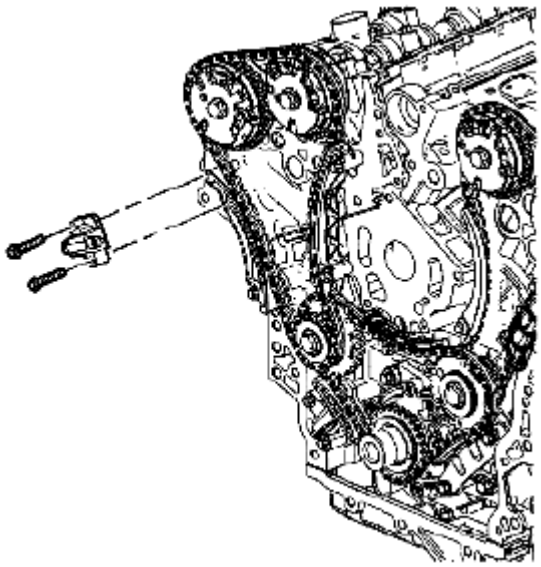


Fig. 323: Identifying Right Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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1. Remove the right secondary camshaft drive chain tensioner bolts.
2. Remove the right secondary camshaft drive chain tensioner.

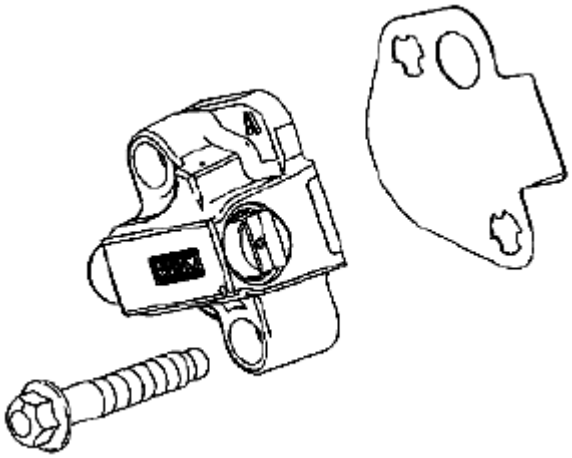


Fig. 324: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the right secondary camshaft drive chain tensioner gasket.
4. Inspect the right secondary camshaft drive chain tensioner mounting surface on the right cylinder head for burrs or any defects that would degrade the sealing of the NEW right secondary camshaft drive chain tensioner gasket.

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE**

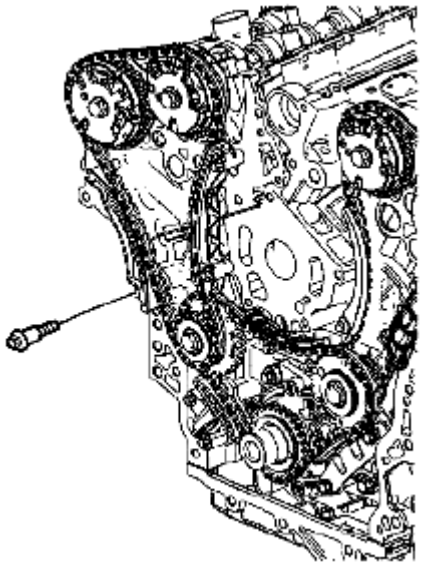


Fig. 325: Identifying Right Secondary Camshaft Drive Chain Shoe Bolt

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Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the right secondary camshaft drive chain shoe bolt.

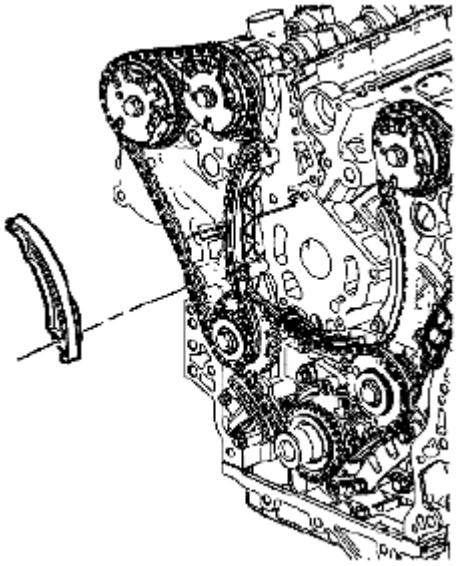


Fig. 326: Identifying Right Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the right secondary camshaft drive chain shoe.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT SIDE**

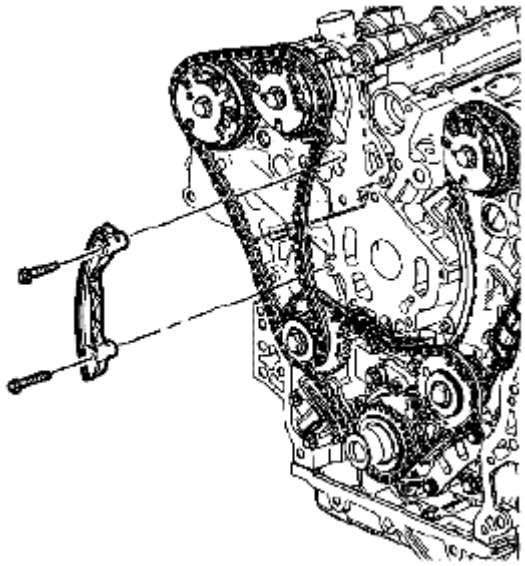


Fig. 327: Identifying Right Secondary Camshaft Drive Chain Guide And Bolts

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Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the right secondary camshaft drive chain guide bolts.
2. Remove the right secondary camshaft drive chain guide.

SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE**

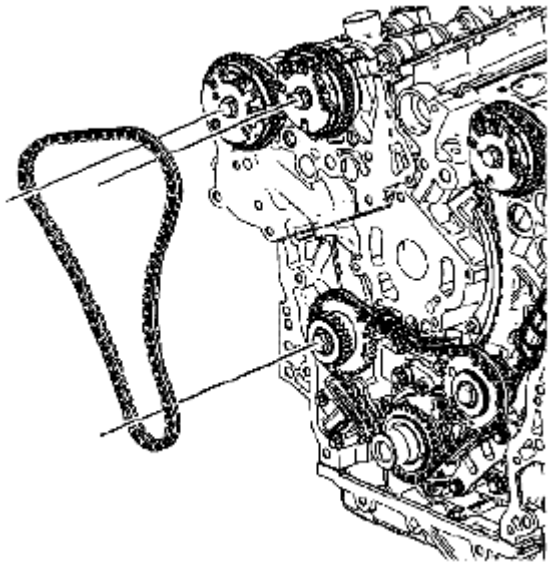


Fig. 328: Identifying Right Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

Remove the right secondary camshaft drive chain from the right camshaft position actuators and the right camshaft intermediate drive chain idler sprocket.

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE**

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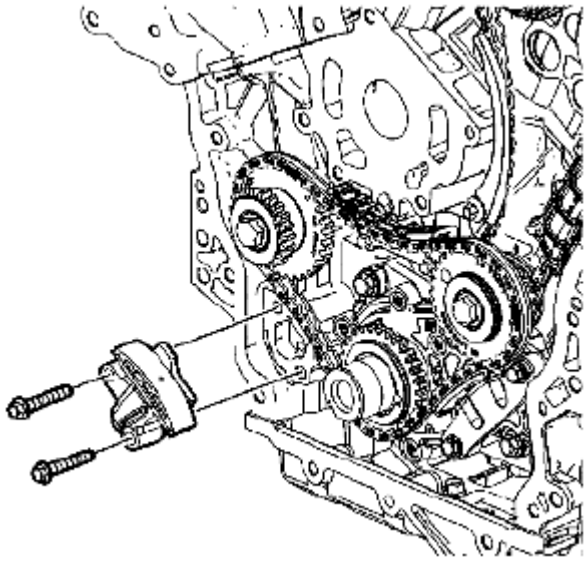


Fig. 329: Identifying Primary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the primary camshaft drive chain tensioner bolts.
2. Remove the primary camshaft drive chain tensioner.

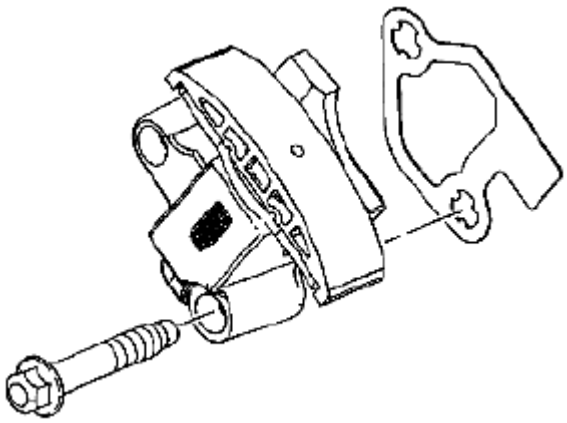


Fig. 330: Identifying Primary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the primary camshaft drive chain tensioner gasket.
4. Inspect the primary camshaft drive chain tensioner mounting surface on the engine block for burrs or any defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.

PRIMARY TIMING DRIVE CHAIN GUIDE REMOVAL - UPPER

Reference: **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REMOVAL**

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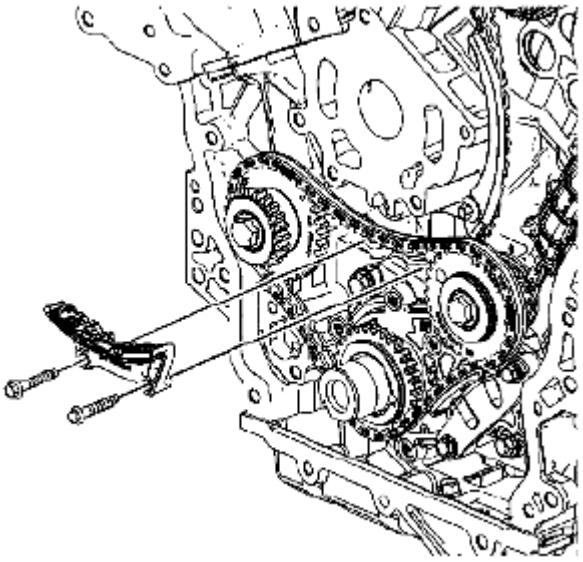


Fig. 331: Identifying Primary Camshaft Drive Chain Upper Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the primary camshaft drive chain upper guide bolts.
2. Remove the primary camshaft drive chain upper guides.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LOWER

Reference: **PRIMARY TIMING DRIVE CHAIN GUIDE REMOVAL - UPPER**

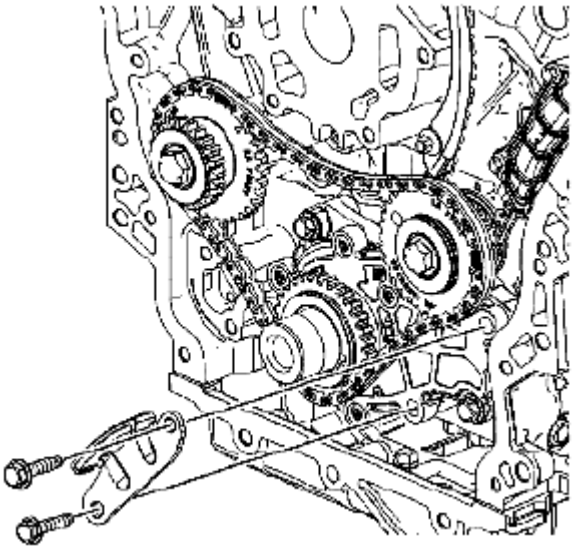


Fig. 332: Identifying Primary Camshaft Drive Chain Lower Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the primary camshaft drive chain lower guide bolts.

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2. Remove the primary camshaft drive chain lower guide.

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REMOVAL

Reference: **PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LOWER**

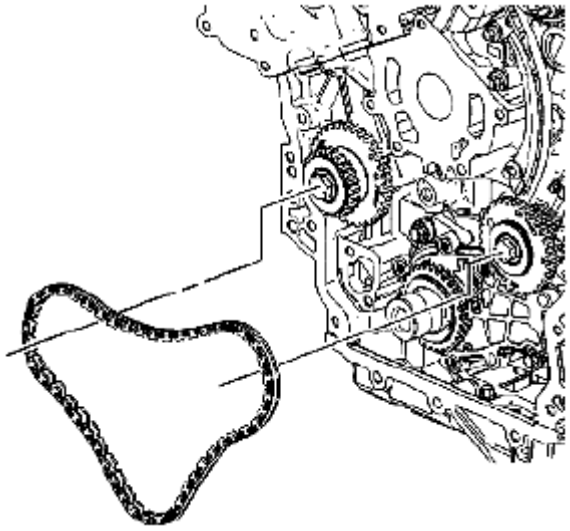
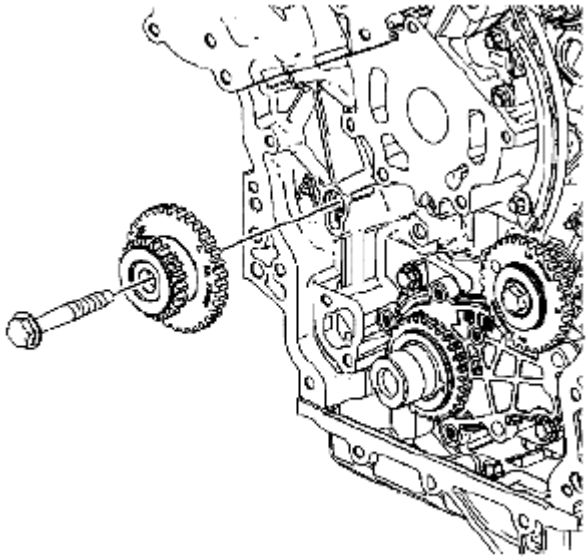


Fig. 333: Identifying Primary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

Remove the primary camshaft drive chain.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT SIDE

Reference: **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REMOVAL**



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Fig. 334: Identifying Right Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the right camshaft intermediate drive chain idler bolt.
2. Remove the right camshaft intermediate drive chain idler.

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE

Reference: **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT SIDE**

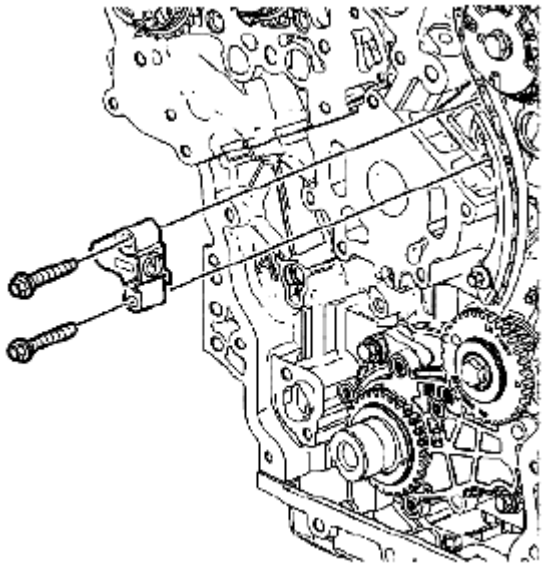
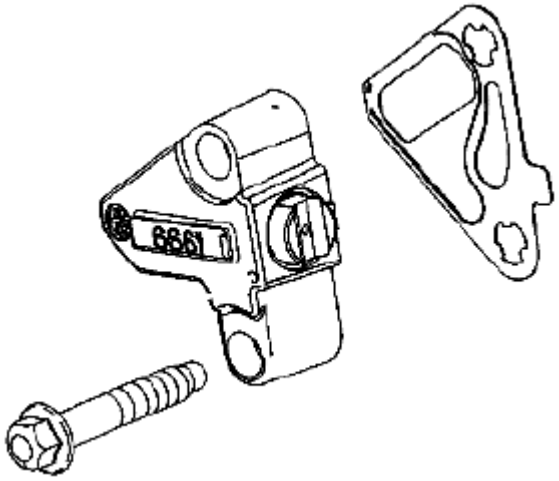


Fig. 335: Identifying Left Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the left secondary camshaft drive chain tensioner bolts.
2. Remove the left secondary camshaft drive chain tensioner.



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Fig. 336: Identifying Left Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the left secondary camshaft drive chain tensioner gasket.
4. Inspect the left secondary camshaft drive chain tensioner mounting surface on the left cylinder head for burrs or any defects that would degrade the sealing of the NEW left secondary camshaft drive chain tensioner gasket.

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE**

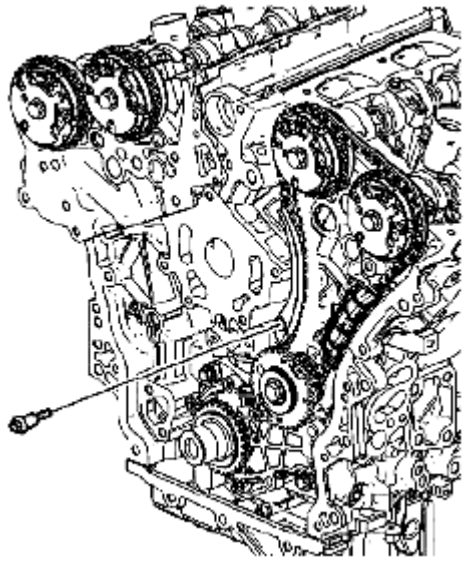


Fig. 337: Identifying Left Secondary Camshaft Drive Chain Shoe And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the left secondary camshaft drive chain shoe bolt.

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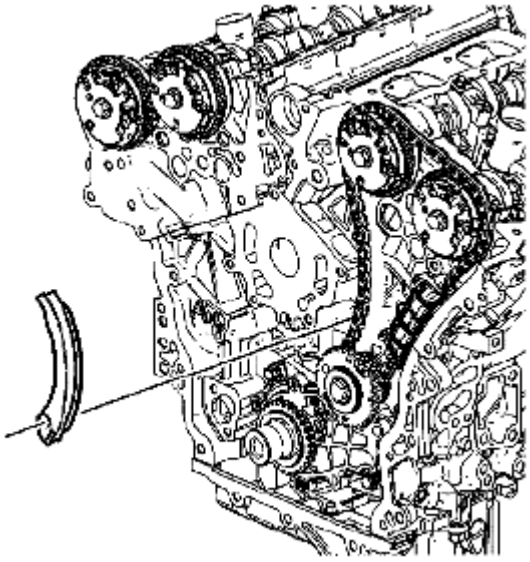


Fig. 338: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the left secondary camshaft drive chain shoe.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT SIDE**

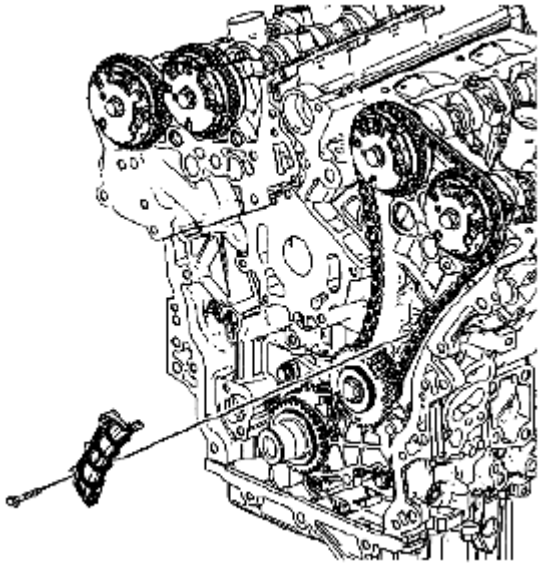


Fig. 339: Identifying Left Secondary Camshaft Drive Chain Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the left secondary camshaft drive chain guide bolts.
2. Remove the left secondary camshaft drive chain guide.

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SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE**

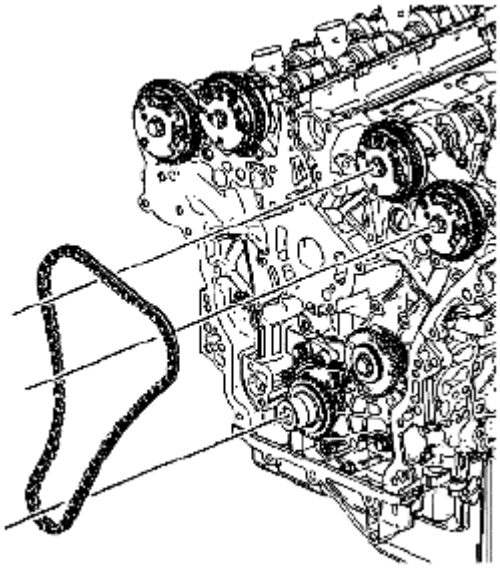
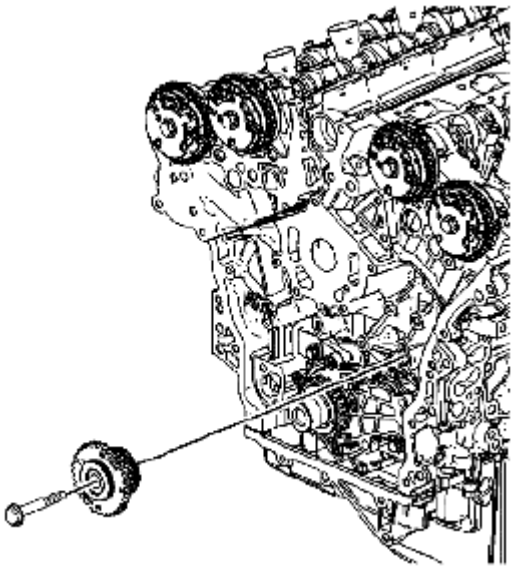


Fig. 340: Identifying Left Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

Remove the left secondary camshaft drive chain from the left camshaft position actuators and the left camshaft intermediate drive chain idler sprocket.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT SIDE

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT SIDE**



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Fig. 341: Identifying Left Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the left camshaft intermediate drive chain idler bolt.
2. Remove the left camshaft intermediate drive chain idler.

CRANKSHAFT SPROCKET REMOVAL

Reference: **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT SIDE**

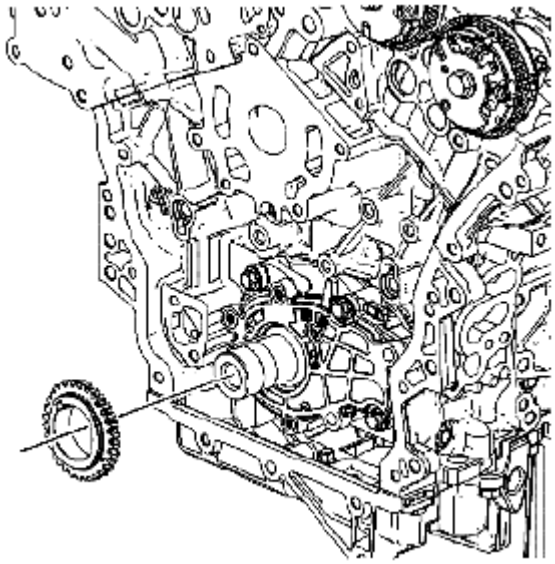


Fig. 342: Identifying Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

Remove the crankshaft sprocket from the nose of the crankshaft.

CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE EXHAUST

Reference: **CRANKSHAFT SPROCKET REMOVAL**

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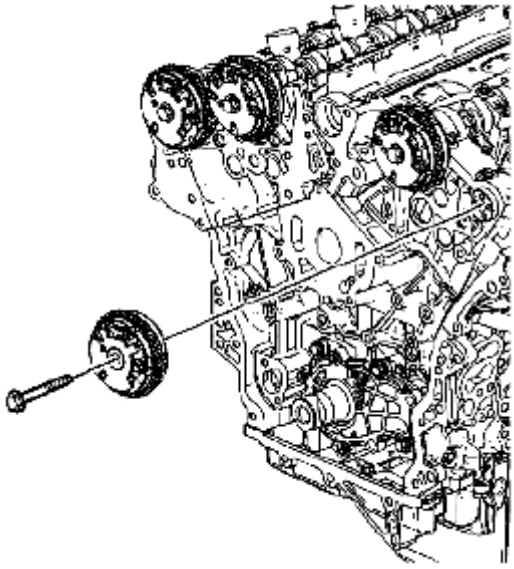


Fig. 343: Identifying Left Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the left exhaust camshaft position actuator bolt.
3. Remove the left exhaust camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE INTAKE

Reference: **CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE EXHAUST**

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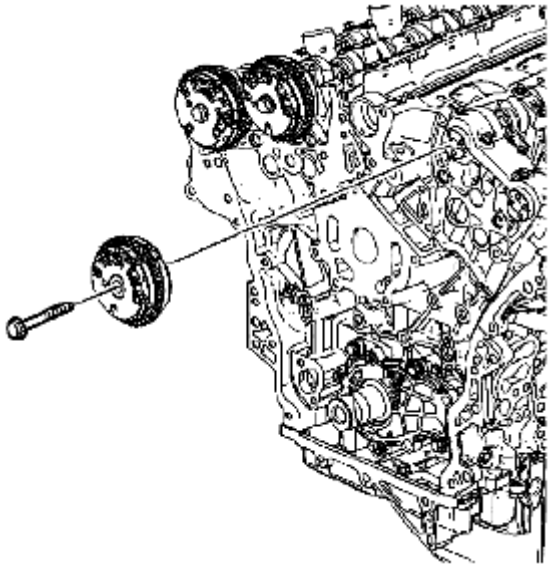


Fig. 344: Identifying Left Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the left intake camshaft position actuator bolt.
3. Remove the left intake camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE EXHAUST

Reference: **CRANKSHAFT SPROCKET REMOVAL**

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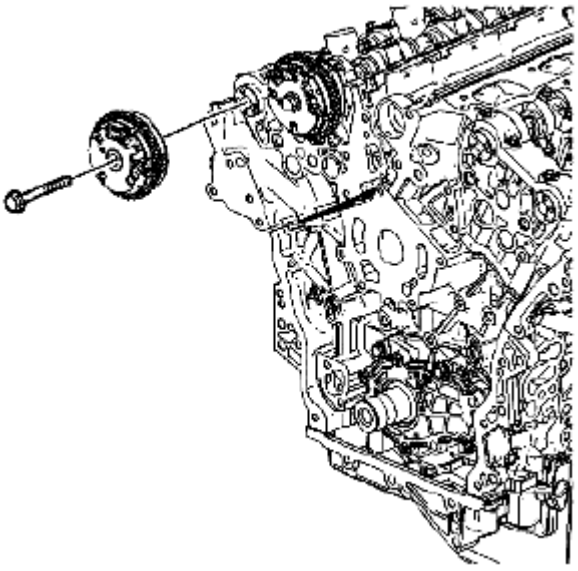


Fig. 345: Identifying Right Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the right exhaust camshaft position actuator bolt.
3. Remove the right exhaust camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE INTAKE

Reference: **CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE EXHAUST**

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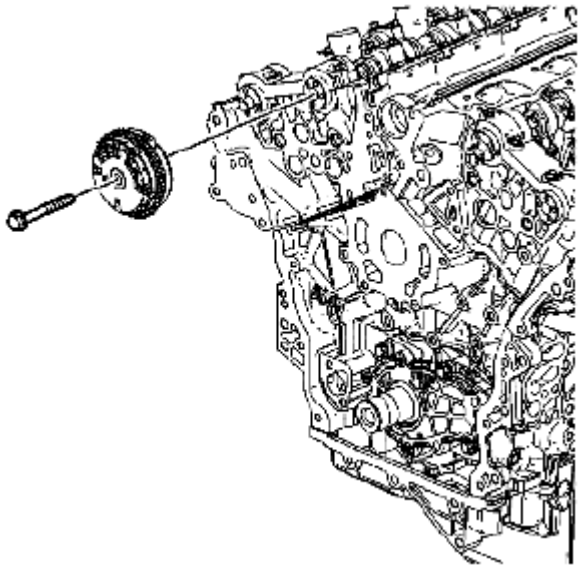


Fig. 346: Identifying Right Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the right intake camshaft position actuator bolt.
3. Remove the right intake camshaft position actuator.

Reference: **CAMSHAFT TIMING DRIVE COMPONENTS CLEANING AND INSPECTION**

CAMSHAFT REMOVAL - LEFT SIDE

Reference: **CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE INTAKE**

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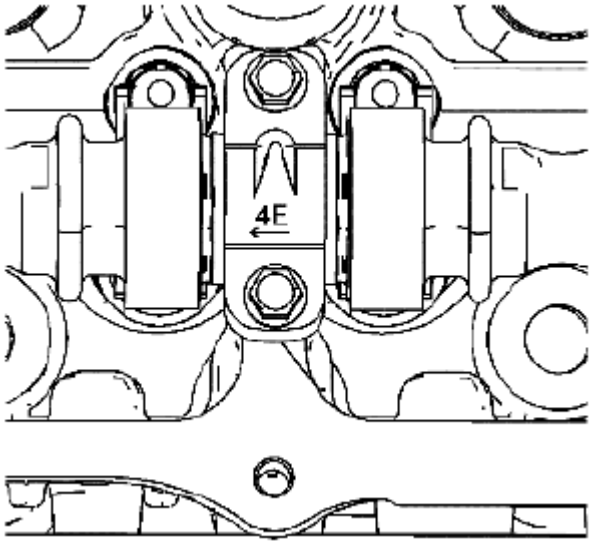


Fig. 347: Identifying Markings On Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

1. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
    - The raised feature must always be oriented toward the center of the cylinder head.
    - The I indicates the intake camshaft.
    - The E indicates the exhaust camshaft.
    - The number indicates the journal position from the front of the engine.

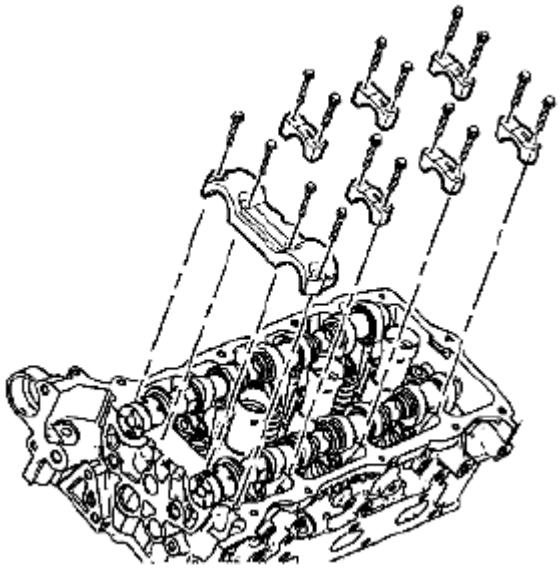


Fig. 348: Identifying Camshaft Bearing Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the camshaft bearing cap bolts.

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3. Remove the camshaft bearing caps.

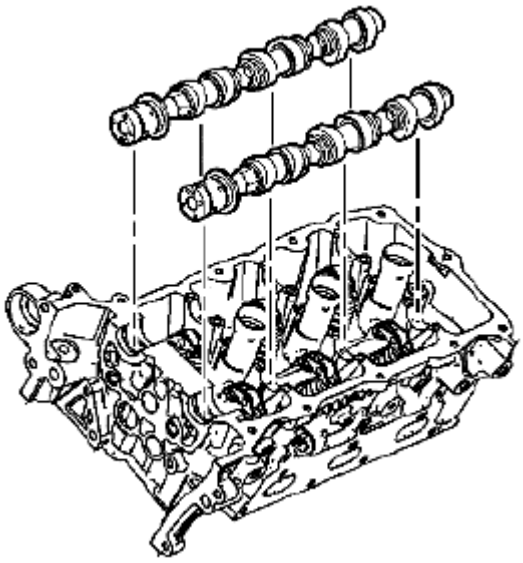


Fig. 349: Identifying Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the camshafts.
5. Replace the camshaft bearing caps and bolts.

Reference: **CAMSHAFT CLEANING AND INSPECTION**

VALVE ROCKER ARM REMOVAL - LEFT SIDE

Reference: **CAMSHAFT REMOVAL - LEFT SIDE**

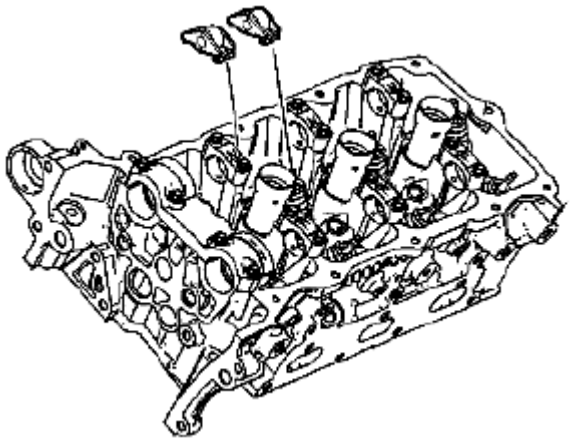


Fig. 350: Identifying Valve Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

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Remove the valve rocker arms, camshaft followers, from the left cylinder head.

Reference: **VALVE ROCKER ARMS CLEANING AND INSPECTION**

VALVE LIFTER REMOVAL - LEFT SIDE

Reference: **VALVE ROCKER ARM REMOVAL - LEFT SIDE**

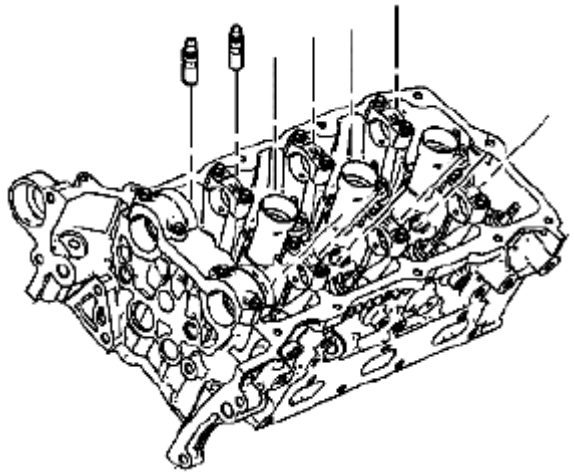


Fig. 351: Identifying Valve Lifters
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.**
- **Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.**

Remove the valve lifters, stationary hydraulic lash adjuster, (SHLAs) from the left cylinder head.

Reference: **VALVE LIFTERS CLEANING AND INSPECTION**

CYLINDER HEAD REMOVAL - LEFT SIDE

Reference: **VALVE LIFTER REMOVAL - LEFT SIDE**

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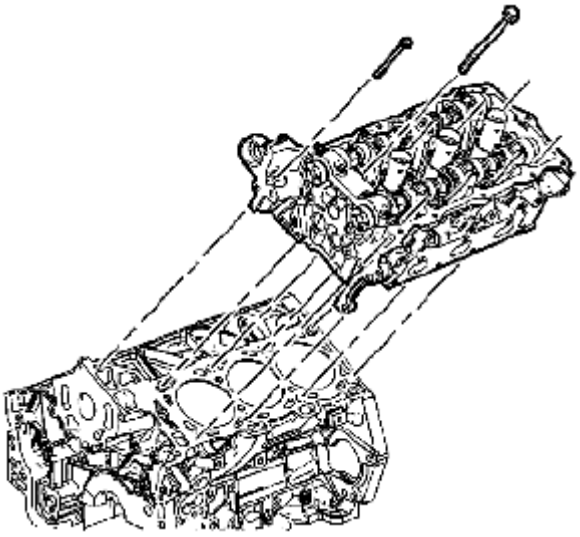


Fig. 352: Identifying Left Cylinder Head Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the two front M8 left cylinder head bolts.
2. Remove the left cylinder head bolts.
3. Remove the left cylinder head.

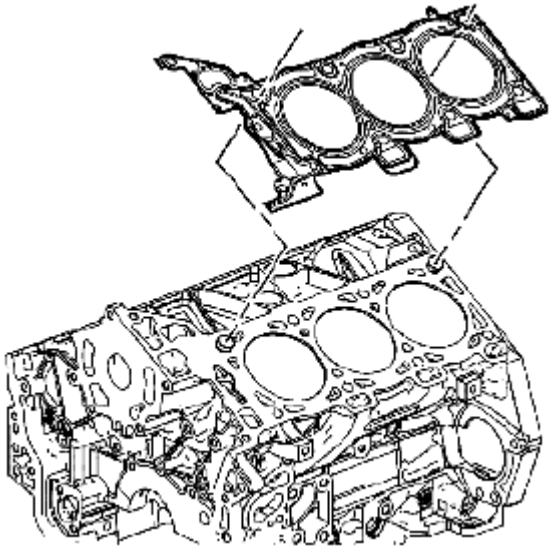


Fig. 353: Identifying Left Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove and discard the left cylinder head gasket.

Reference: **CYLINDER HEAD DISASSEMBLE**

CAMSHAFT REMOVAL - RIGHT SIDE

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Reference: **CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE INTAKE**

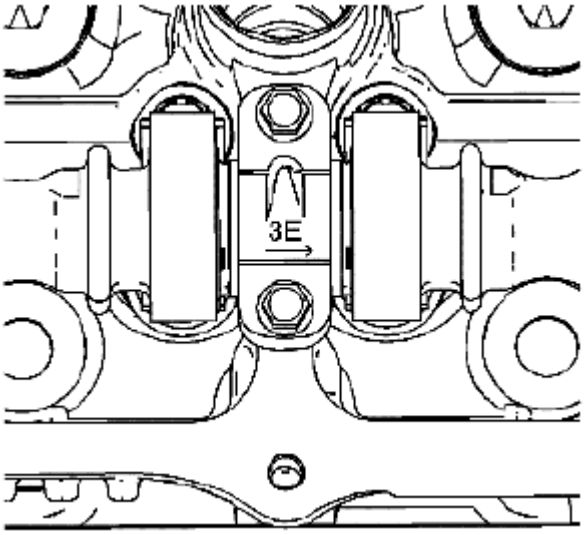


Fig. 354: Identifying Markings On Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

1. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
    - The raised feature must always be oriented toward the center of the cylinder head.
    - The I indicates the intake camshaft.
    - The E indicates the exhaust camshaft.
    - The number indicates the journal position from the front of the engine.

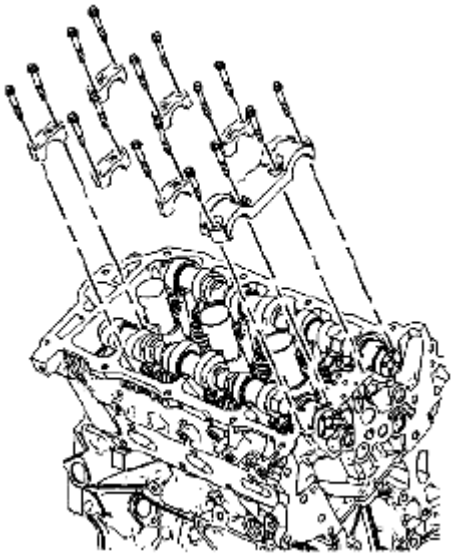


Fig. 355: Identifying Camshaft Bearing Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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2. Remove the camshaft bearing cap bolts.
3. Remove the camshaft bearing caps.

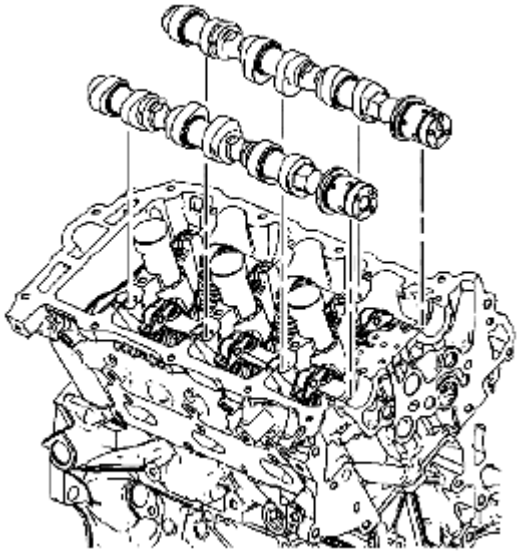


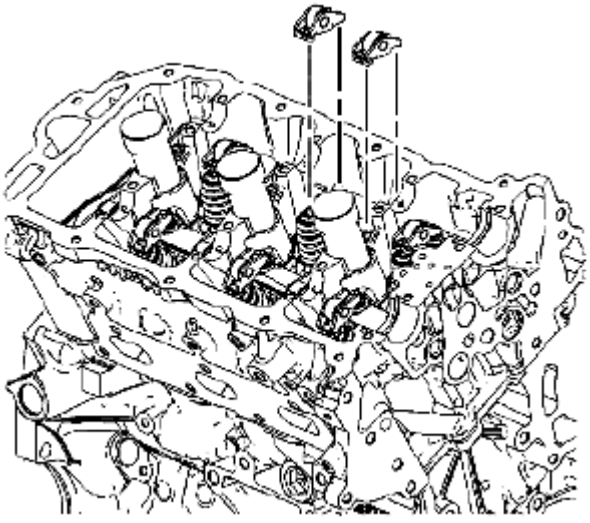
Fig. 356: Identifying Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the camshafts.
5. Replace the camshaft bearing caps and bolts.

Reference: **CAMSHAFT CLEANING AND INSPECTION**

VALVE ROCKER ARM REMOVAL - RIGHT SIDE

Reference: **CAMSHAFT REMOVAL - RIGHT SIDE**



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Fig. 357: Identifying Valve Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

Remove the valve rocker arms from the cylinder head. If the rocker arms are to be reused, keep in order so they can be reinstalled in the same position.

Reference: **VALVE ROCKER ARMS CLEANING AND INSPECTION**

VALVE LIFTER REMOVAL - RIGHT SIDE

Reference: **VALVE ROCKER ARM REMOVAL - RIGHT SIDE**

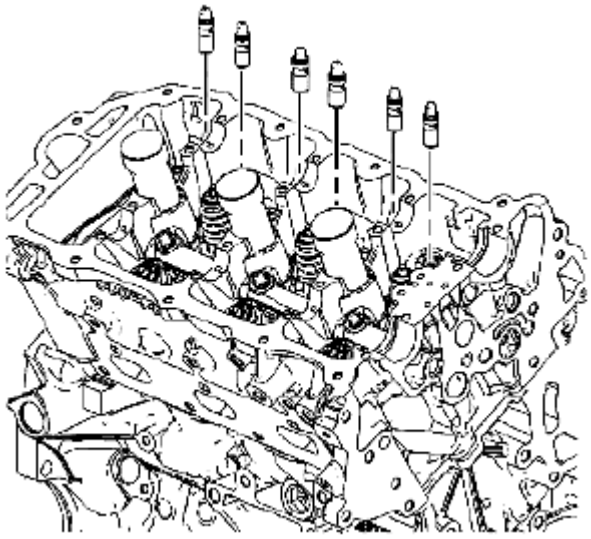


Fig. 358: Identifying Valve Lifters
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.**
- **Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.**

Remove the valve lifters, stationary hydraulic lash adjuster, (SHLAs) from the right cylinder head. If the lifters are to be reused, keep in order so they can be reinstalled in the same position.

Reference: **VALVE LIFTERS CLEANING AND INSPECTION**

CYLINDER HEAD REMOVAL - RIGHT SIDE

Reference: **VALVE LIFTER REMOVAL - RIGHT SIDE**

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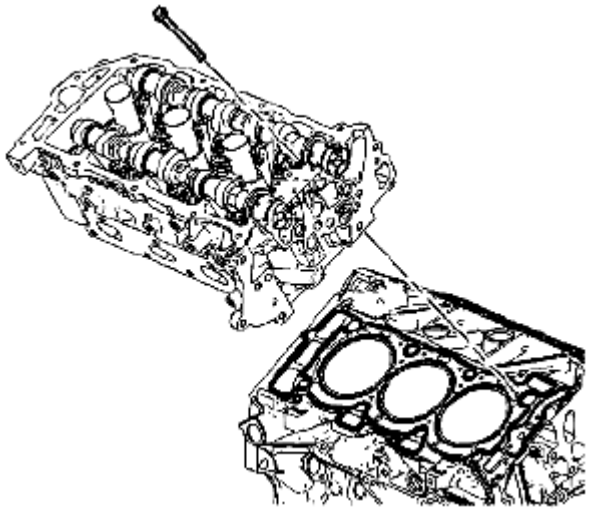


Fig. 359: Identifying Right Cylinder Head And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the right cylinder head bolts.
2. Remove the right cylinder head.

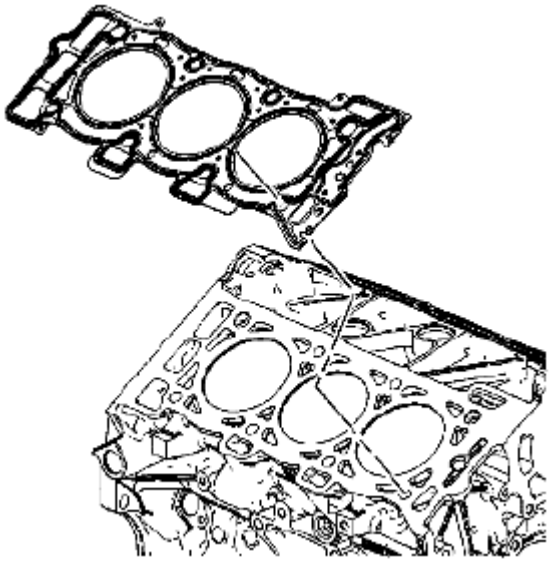


Fig. 360: Identifying Right Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the right cylinder head gasket.

Reference: **CYLINDER HEAD DISASSEMBLE**

CRANKSHAFT REAR OIL SEAL AND HOUSING REMOVAL

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Reference: **OIL PUMP REMOVAL**

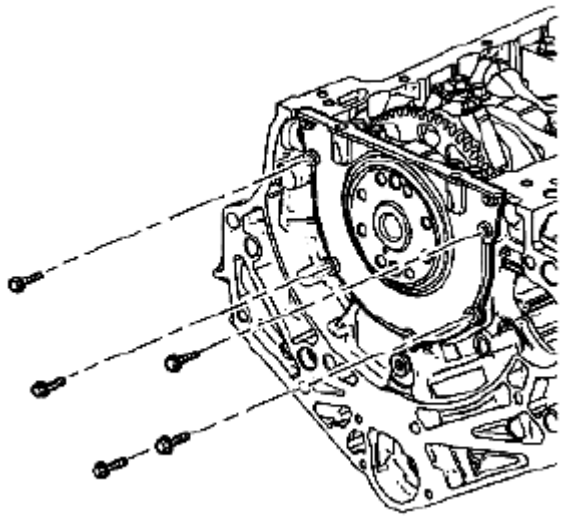


Fig. 361: Identifying Crankshaft Rear Oil Seal Housing Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the crankshaft rear oil seal housing bolts.

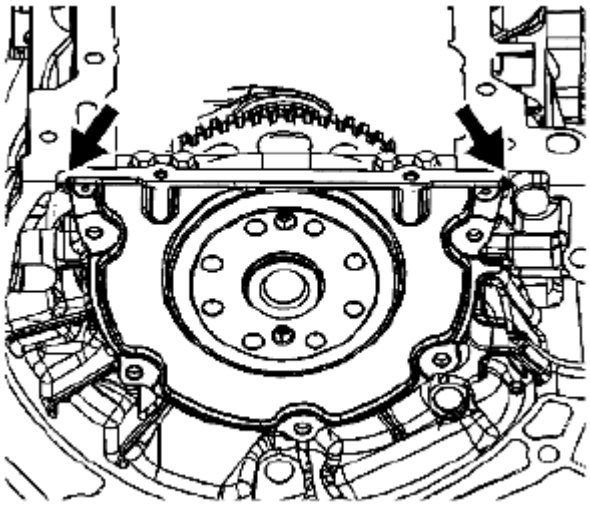


Fig. 362: Locating Pry Points At Edge Of Crankshaft Rear Oil Seal Housing
Courtesy of SUZUKI OF AMERICA CORP.

2. Use the pry points located at the edge of the crankshaft rear oil seal housing to separate the RTV sealant.

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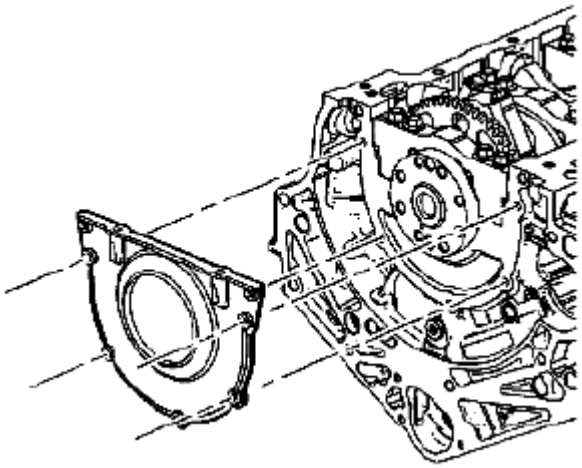


Fig. 363: Identifying Crankshaft Rear Oil Seal Housing
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the crankshaft rear oil seal housing.

PISTON, CONNECTING ROD, AND BEARING REMOVAL

Reference: **CRANKSHAFT REAR OIL SEAL AND HOUSING REMOVAL**

Special Tool

EN 46121 Connecting Rod Guide Pin Set

NOTE:

- **An arrow/dot showing proper piston orientation is located on the top of the piston.**
- **If the connecting rod bearings have been used in a running engine, you must replace them with NEW connecting rod bearings for reassembly.**

1. Before removing the connecting rods, check the connecting rod side clearance using the following procedure:
   a. Tap the connecting rod to one end of the crankshaft journal with a dead-blow or wooden hammer.
   b. Using feeler gages, measure the clearance between the crankshaft counterweight and the connecting rod.
   c. The connecting rod side clearance should not exceed specifications. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
   d. If the end play exceeds the specified limits, measure the width of the crankpin end of the connecting rod. Refer to **PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION**.
   e. If the connecting rod width is significantly smaller than specified and severe wear is present on the side of the connecting rod, replace the connecting rod.
   f. If the connecting rod width is within specification and excessive scoring is present on the

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crankshaft journals, replace the crankshaft.

2. Using a marker, number each piston face. Draw an arrow along the centerline of the piston pointing toward the front of the engine.

CAUTION: Do not use a stamp, punch or any other method that may distort or stress the connecting rod or connecting rod cap. Extensive engine damage may result from a connecting rod that is distorted or stressed.

3. Mark the cylinder number on the connecting rod and the connecting rod cap with a scribe, paint stick or permanent marker.

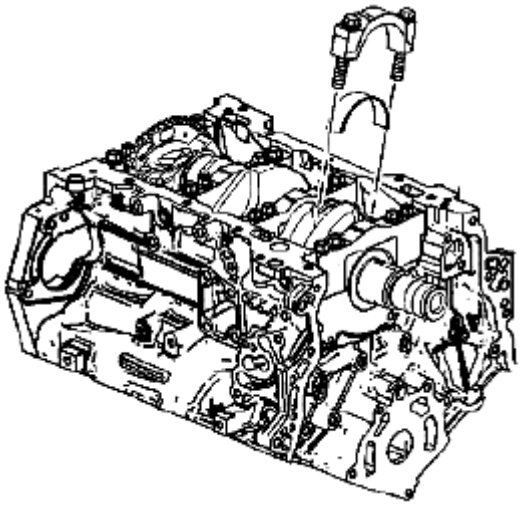


Fig. 364: Identifying Connecting Rod Cap
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Powdered metal connecting rods have rod bolts which yield when torqued. If the rod bolts are loosened or removed the rod bolts must be replaced. Rod bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

4. Remove the connecting rod bolts.

NOTE: The connecting rod caps must remain with the original connecting rod.

5. Remove the connecting rod cap.

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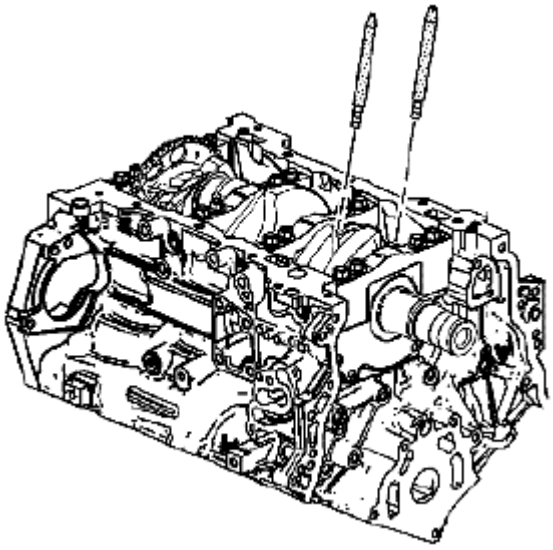


Fig. 365: Identifying Special Tool EN 46121
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the EN 46121 into the connecting rod bolt holes.

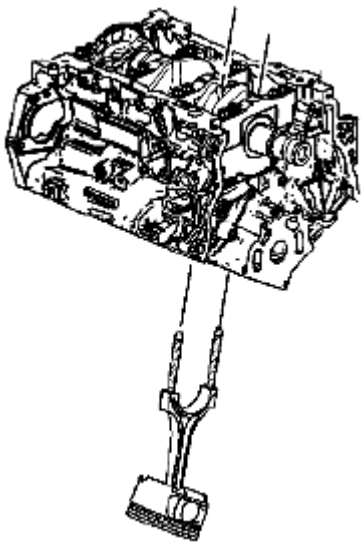


Fig. 366: Identifying Connecting Rod And Piston Assembly
Courtesy of SUZUKI OF AMERICA CORP.

7. Using the EN 46121, push the connecting rod and piston assembly through the top of the cylinder.

   DO NOT scratch the crankshaft journal or cylinder wall and DO NOT damage the oil jets when removing the connecting rod and piston assembly.

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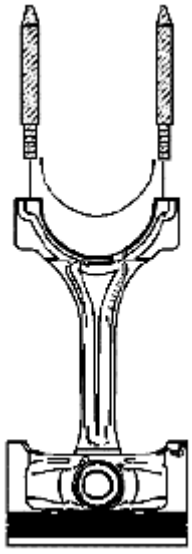


Fig. 367: Identifying Special Tool EN 46121
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EN 46121 from the connecting rod bolt holes.
9. Remove the upper connecting rod bearing from the connecting rod.

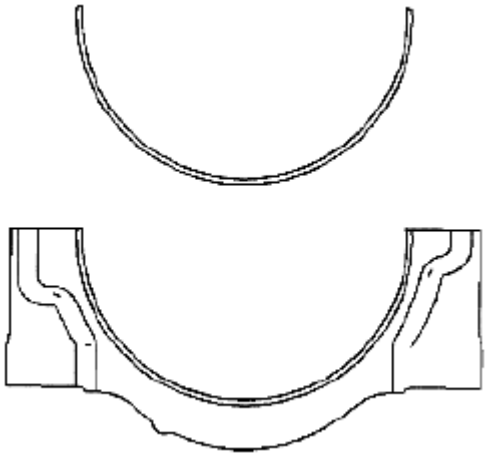


Fig. 368: Identifying Lower Connecting Rod Bearing And Connecting Rod Cap
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the lower connecting rod bearing from the connecting rod cap.

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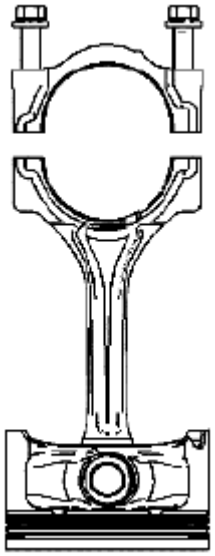


Fig. 369: Identifying Connecting Rod Cap
Courtesy of SUZUKI OF AMERICA CORP.

11. Reattach the connecting rod cap to the connecting rod to prevent damage to their mating surfaces.

    The cap and rod are a matched set and must be kept together.

Reference: **PISTON AND CONNECTING ROD DISASSEMBLE**

CRANKSHAFT AND BEARING REMOVAL

Reference: **PISTON, CONNECTING ROD, AND BEARING REMOVAL**

Special Tool

J 6125-1B Slide Hammer Adapter

J 41818 Crankshaft Bearing Cap Remover

Crankshaft End Play Measurement

1. Place a dial indicator at the crankshaft nose.
2. Gently force the crankshaft to the extreme front and rear positions with a pry tool while monitoring the movement of the dial indicator.
3. The crankshaft end play should not exceed specifications. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
4. If the specifications are exceeded inspect the thrust bearing thrust OD and the crankshaft thrust wall for wear and/or excessive runout. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
5. Replace the thrust bearing or crankshaft as necessary.

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Crankshaft Removal

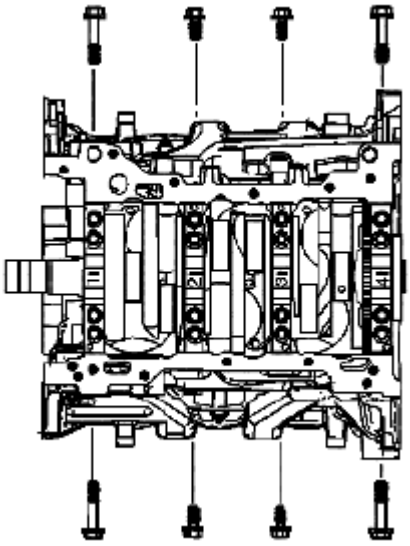


Fig. 370: Identifying Crankshaft Bearing Cap Side Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the crankshaft bearing cap side bolts.
2. Remove the crankshaft bearing cap outer bolts.
3. Remove the crankshaft bearing cap inner bolts.

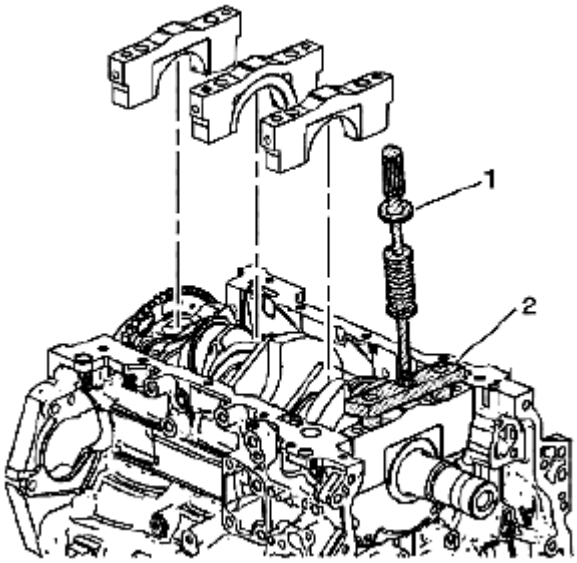


Fig. 371: Identifying Crankshaft Bearing Caps, J 6125-1B And J 41818
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the crankshaft bearing caps using the J 6125-1B (1) and J 41818 (2).

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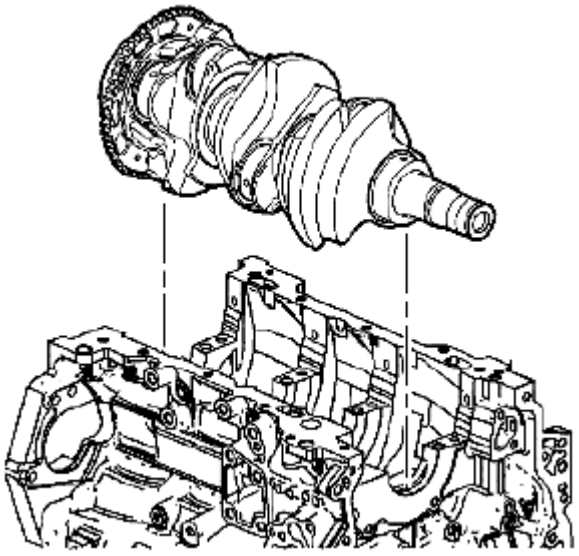


Fig. 372: Identifying Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

5. Using two hands, lift the crankshaft straight up from the engine block.
6. Place the crankshaft in a secure place.

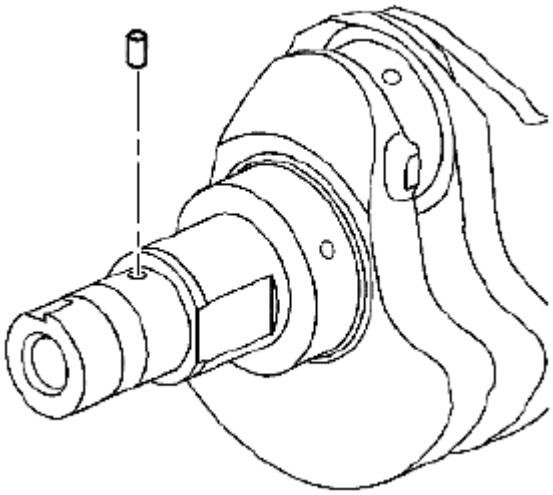


Fig. 373: Identifying Crankshaft Sprocket Drive Pin
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the crankshaft sprocket drive pin from the nose of the crankshaft, if damaged.

Crankshaft Bearing Removal

1. Prepare a piece of cardboard or equivalent, numbered 1-4 for bearing identification. Main bearing journals are numbered from the front of the engine.

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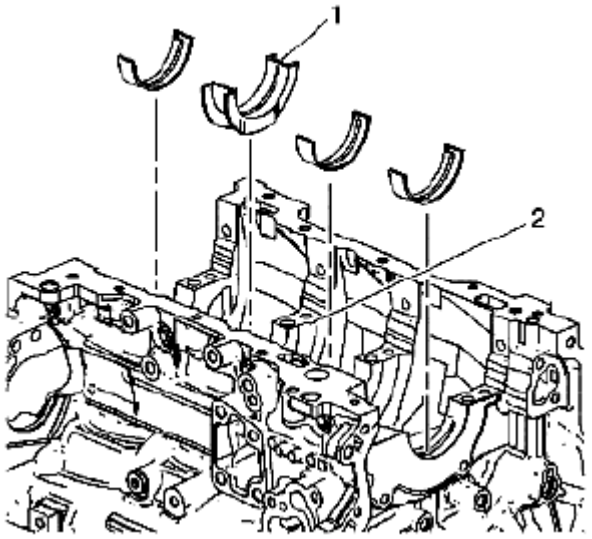


Fig. 374: Identifying Thrust Bearing And Journal
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the crankshaft upper bearing halves from the cylinder block. Note the position of the thrust bearing (1) at the number 3 journal (2).
3. Place the crankshaft upper bearing halves on the cardboard in the correct positions. Note that the number 3 bearing is the thrust bearing.

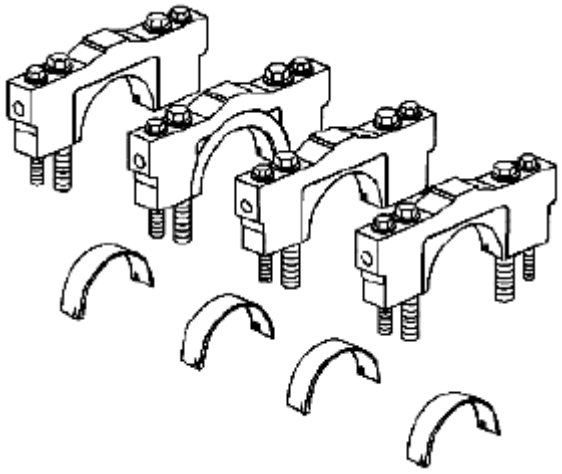


Fig. 375: Identifying Crankshaft Lower Bearing Halves And Crankshaft Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the crankshaft lower bearing halves from the crankshaft bearing caps.
5. Place the crankshaft lower bearing halves in the correct positions on the cardboard.

Reference: **CRANKSHAFT AND BEARING CLEANING AND INSPECTION**

ENGINE BLOCK DISASSEMBLE

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Reference: **CRANKSHAFT AND BEARING REMOVAL**

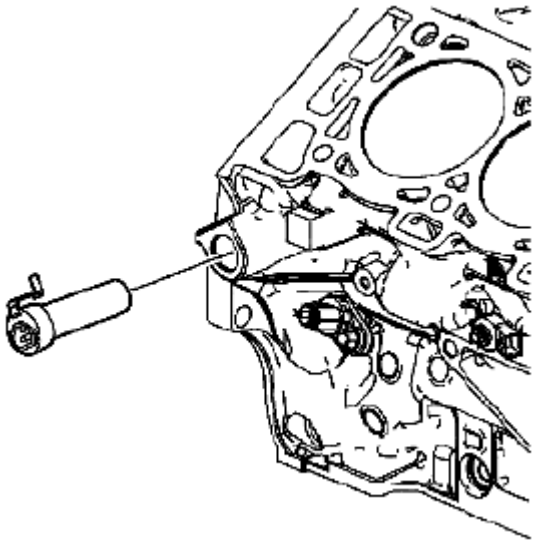


Fig. 376: Identifying Block Heater Cartridge
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the block heater cartridge.

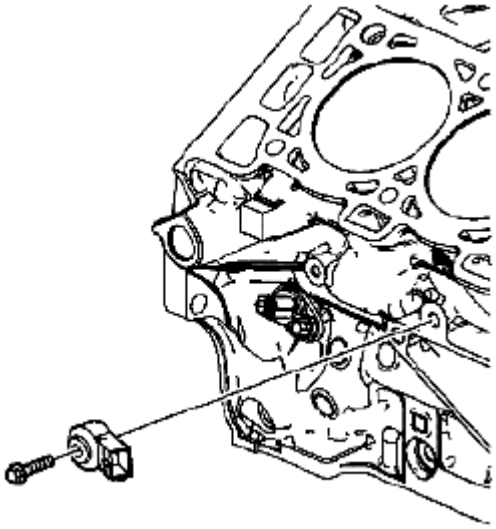


Fig. 377: Identifying Right Knock Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the right knock sensor bolt.
3. Remove the right knock sensor.

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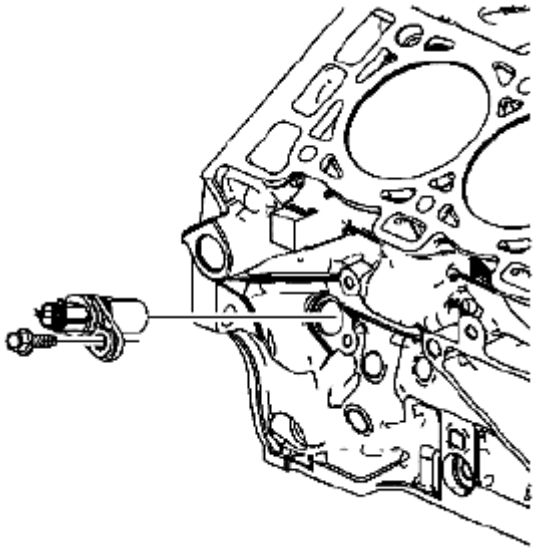


Fig. 378: Identifying Crankshaft Position Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the crankshaft position sensor bolt.
5. Remove the crankshaft position sensor.

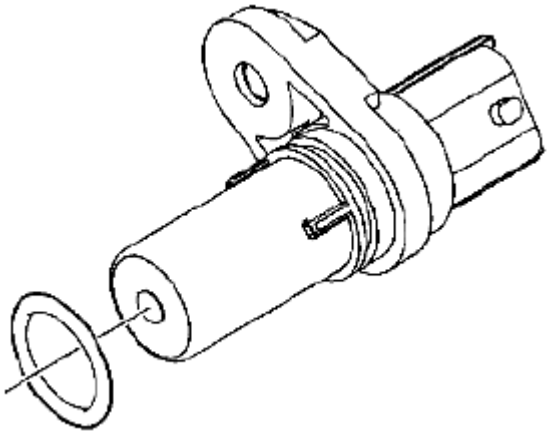


Fig. 379: Identifying Crankshaft Position Sensor O-Ring
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove and discard the crankshaft position sensor O-ring, if damaged.

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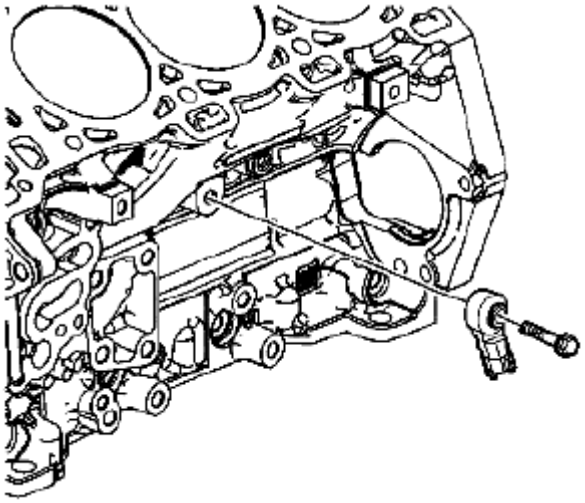


Fig. 380: Identifying Left Knock Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the left knock sensor bolt.
8. Remove the left knock sensor.

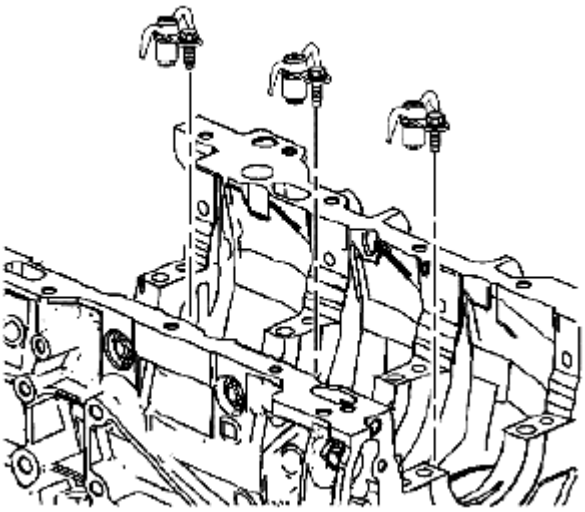


Fig. 381: Identifying Oil Jet And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the oil jet bolts.
10. Remove the oil jets.

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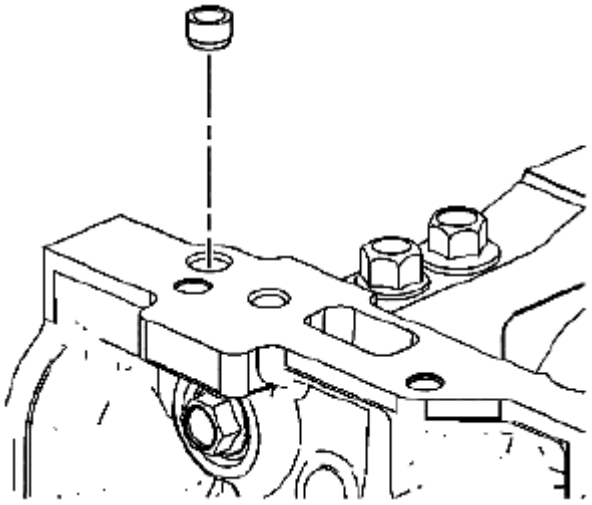


Fig. 382: Identifying Right Front Oil Pan Rail Oil Gallery Expansion Plug
Courtesy of SUZUKI OF AMERICA CORP.

11. Remove the right front oil pan rail oil gallery expansion plug.

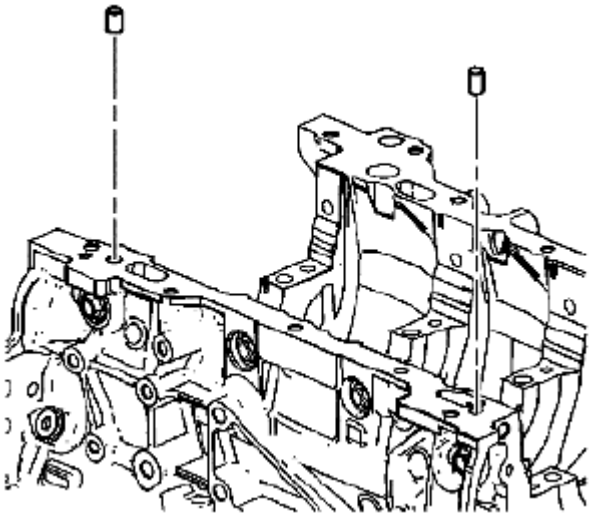


Fig. 383: Identifying Cylinder Block-To-Oil Pan Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove the cylinder block-to-oil pan alignment dowels.

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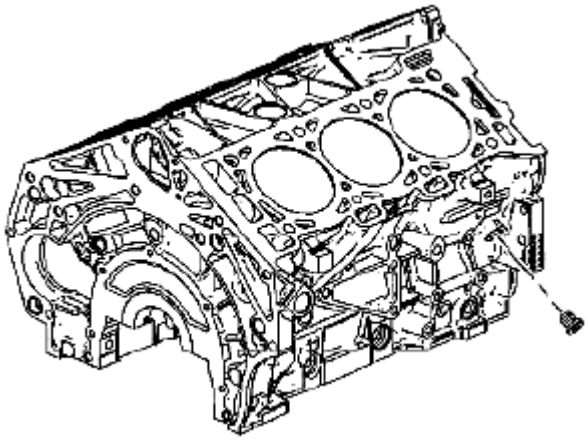


Fig. 384: Identifying M14 Right Side Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the M14 right side oil gallery threaded plug.

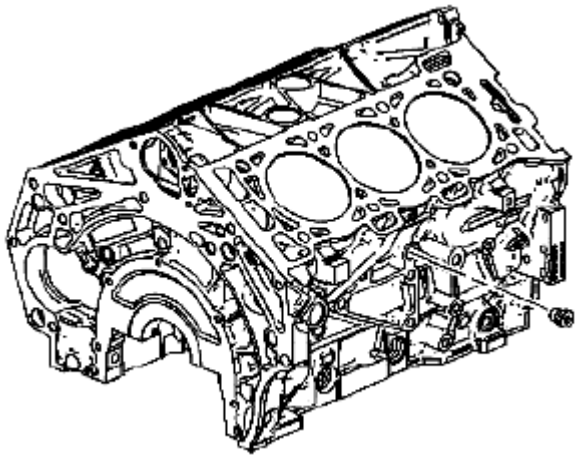


Fig. 385: Identifying M14 Right Side Coolant Drain Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

14. Remove the M14 right side coolant drain threaded plug.

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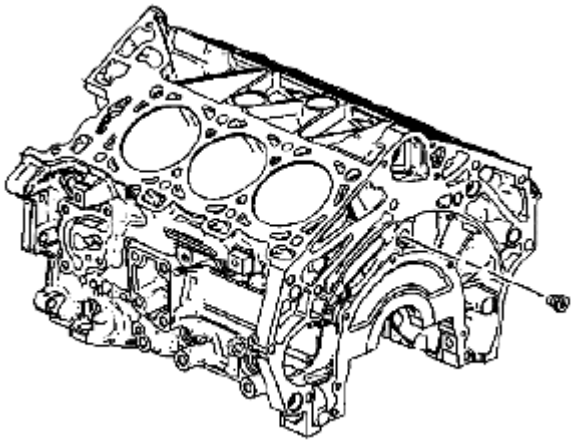


Fig. 386: Identifying M14 Rear Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

15. Remove the M14 rear oil gallery threaded plug.

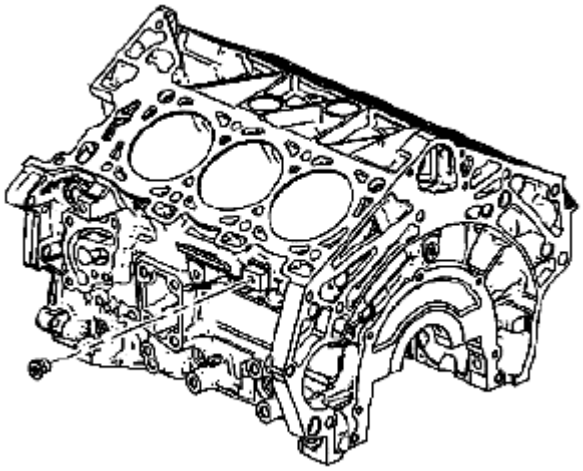


Fig. 387: Identifying M14 Left Side Coolant Drain Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

16. Remove the M14 left side coolant drain threaded plug.

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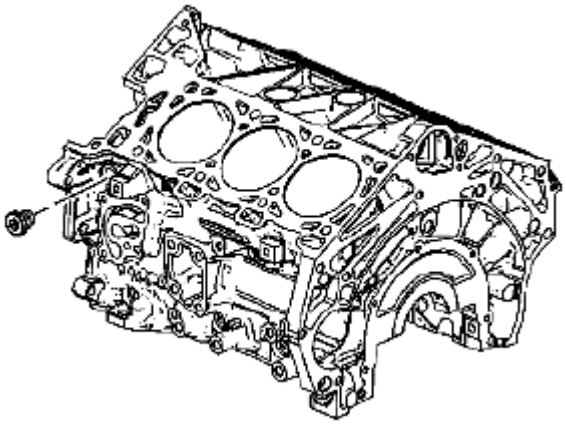


Fig. 388: Identifying M20 Left Side Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

17. Remove the M20 left side oil gallery threaded plug.

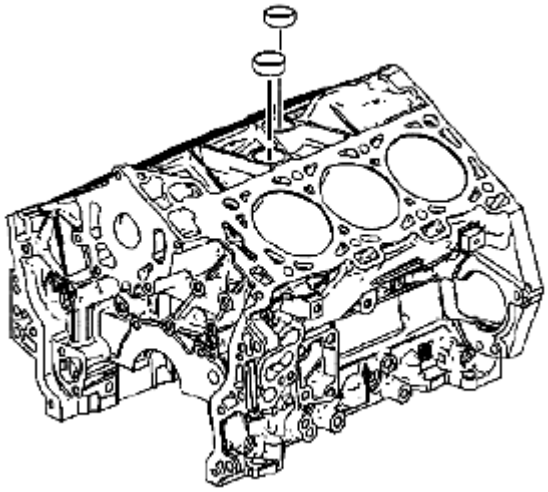


Fig. 389: Identifying Coolant Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

18. Remove the coolant expansion plugs.

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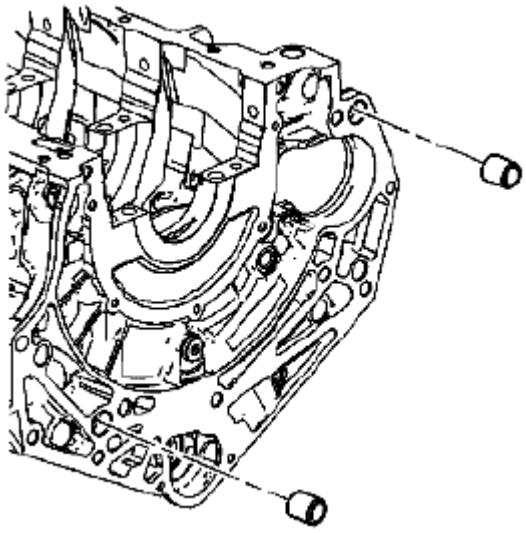


Fig. 390: Identifying Cylinder Block-To-Transmission Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

19. Remove the cylinder block-to-transmission alignment dowels.

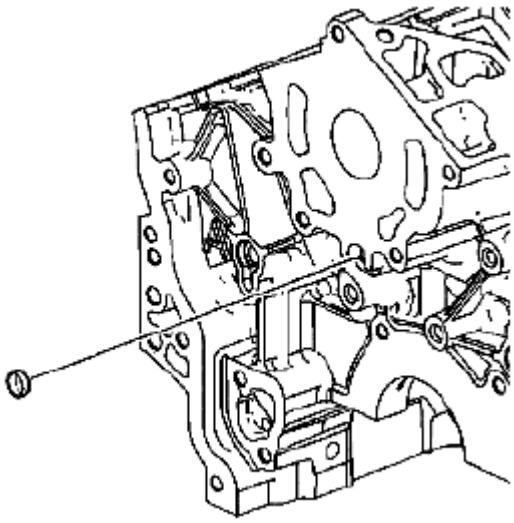


Fig. 391: Identifying Front Oil Gallery Expansion Plug
Courtesy of SUZUKI OF AMERICA CORP.

20. Remove the front oil gallery expansion plug.

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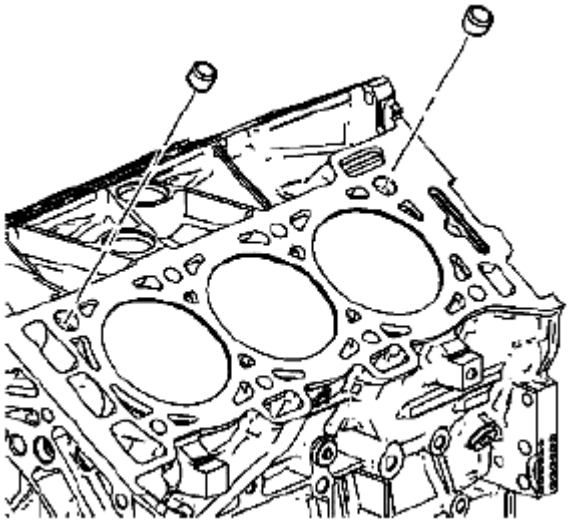


Fig. 392: Identifying Cylinder Block-To-Cylinder Head Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

21. Remove the cylinder block-to-cylinder head alignment dowels.

Reference: **ENGINE BLOCK CLEANING AND INSPECTION**

ENGINE BLOCK CLEANING AND INSPECTION

Reference: **ENGINE BLOCK DISASSEMBLE**

Special Tool

J 8087 Cylinder Bore Gage

J 28410 Gasket Remover

Cleaning Procedure

1. Remove any old thread sealant, gasket material or sealant using J 28410.
2. Clean all the following areas with solvent:
   - Sealing surfaces
   - Cooling passages
   - Oil passages
   - Bearing journals
3. Clean all threaded and through holes with solvent.

WARNING: Refer to SAFETY GLASSES CAUTION .

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4. Dry the engine block with compressed air.

Visual Inspection

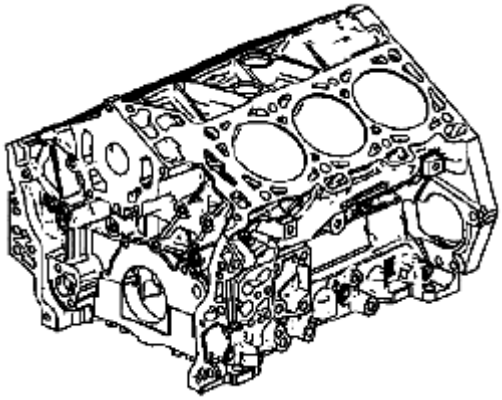


Fig. 393: Inspecting Engine Block
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the crankshaft bearings journals for damage or spun bearings. The crankshaft bearing journals are not repairable, if the crankshaft bearing journals are damaged the cylinder block assembly must be replaced.
2. Inspect the primary camshaft drive chain tensioner mounting surface on the engine block for burrs or any defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.
3. Inspect all sealing and mating surfaces for damage, repair or replace the cylinder block assembly if necessary.
4. Inspect all threaded and through holes for damage or excessive debris.
5. Inspect all bolts for damage, if damaged replace with NEW bolts only.
6. Inspect the cylinder walls for cracks or damage. The cylinder sleeves are not serviced separately, if the cylinders are damaged the cylinder block assembly must be replaced.
7. Inspect the engine block for cracks. Do not repair any cracks. If cracks are found, the cylinder block assembly must be replaced.
8. Repair any damaged threaded holes. Refer to **THREAD REPAIR SPECIFICATIONS** and **THREAD REPAIR**.

Measuring Cylinder Bore Diameter

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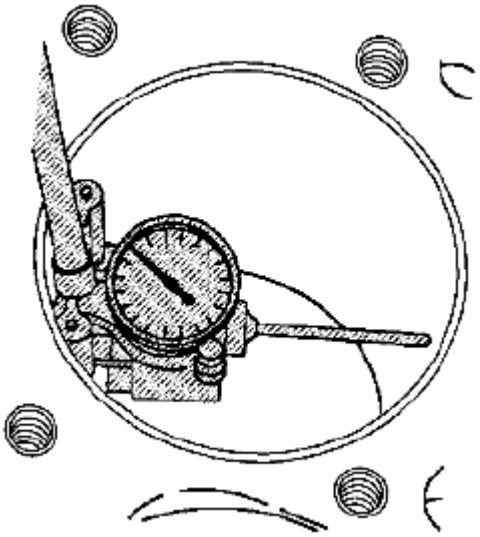


Fig. 394: Measuring Cylinder Bore Diameter 37 mm (1.457 in) From Deck Face Using J 8087
Courtesy of SUZUKI OF AMERICA CORP.

Measure the cylinder bore diameter 37 mm (1.457 in) from the deck face using the J 8087.

Compare your results with the **ENGINE MECHANICAL SPECIFICATIONS**. If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Measuring Cylinder Bore Taper

1. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centerline, at 10 mm (0.397 in) below the deck surface and record your measurement.
2. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centerline, at 100 mm (3.976 in) below the deck surface and record your measurement.
3. Calculate the difference between the 2 measurements. The result will be the cylinder taper.
4. Compare your results with the **ENGINE MECHANICAL SPECIFICATIONS**. If the cylinders exceed the specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Measuring Cylinder Bore Out-of-Round

1. Measure both the thrust and non-thrust cylinder diameter at 10 mm (0.397 in) below the deck. Record your measurements.
2. Calculate the difference between the 2 measurements. The result will indicate out-of-round at the upper end of the cylinder.
3. Measure both the thrust and non-thrust cylinder diameter at 100 mm (3.976 in) below the deck surface. Record your measurements.
4. Calculate the difference between the 2 measurements. The result will indicate out-of-round at the lower end of the cylinder.

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5. Compare your results with the **ENGINE MECHANICAL SPECIFICATIONS**. If the cylinders exceed these specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Deck Flatness Inspection

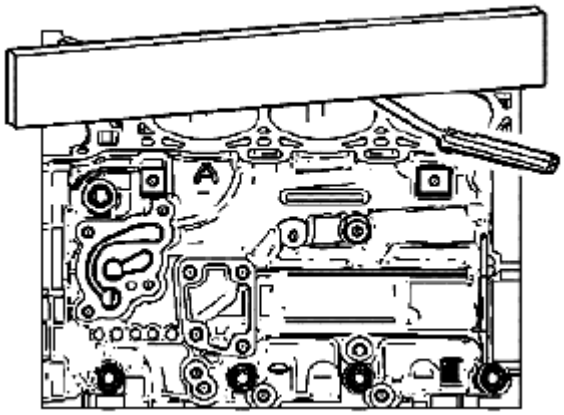


Fig. 395: Inspecting Deck Flatness
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the engine block decks are clean and free of gasket material.
2. Inspect the surface for any imperfections or scratches that could inhibit proper cylinder head gasket sealing.
3. Place a straight-edge diagonally across the cylinder block deck face surface.
4. Measure the clearance between the straight-edge and the cylinder block deck face using a feeler gage at 4 points along the straight-edge.
5. If the warpage is less than 0.05 mm (0.002 in), the cylinder block deck surface does not require resurfacing.
6. If the warpage is between 0.05-0.20 mm (0.002-0.008 in) or any imperfections or scratches that could inhibit proper cylinder head gasket sealing are present, the cylinder block deck surface requires resurfacing.
7. If resurfacing is required the maximum amount that can be removed is 0.25 mm (0.010 in).
8. If the cylinder block deck surface requires more than 0.25 mm (0.010 in) material removal the block must be replaced.

Reference: **ENGINE BLOCK ASSEMBLE**

CRANKSHAFT AND BEARING CLEANING AND INSPECTION

Reference: **CRANKSHAFT AND BEARING REMOVAL**

Cleaning Procedure

1. Clean the following components in solvent:

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- Crankshaft bearings
- Connecting rod bearings
- Crankshaft journals
- Crankpin journals
- Crankshaft oil passages
- Crankshaft threaded holes

WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the following components with compressed air:
   - Crankshaft bearings
   - Connecting rod bearings
   - Crankshaft journals
   - Crankpin journals
   - Crankshaft oil passages
   - Crankshaft threaded holes

Visual Inspection

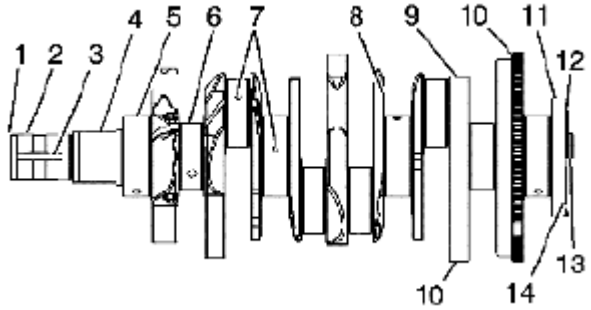


Fig. 396: Inspecting Crankshaft And Bearing
Courtesy of SUZUKI OF AMERICA CORP.

1. Perform the following visual inspections:
   - Inspect the crankshaft balancer bolt hole (1) for thread damage.
   - Inspect the crankshaft balancer mounting area (2) for damage.
   - Inspect the crankshaft keyway (3) for damage.
   - Inspect the oil pump drive flats (4) for damage.
   - Inspect the crankshaft main journals (5) for damage.
   - Inspect the crankshaft connecting rod journals (6) for damage.
   - Inspect the crankshaft oil passages (7) for obstructions.
   - Inspect the crankshaft main bearing thrust wall surfaces (8) for damage.

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- Inspect the crankshaft counterweights (9) for damage.
- Inspect the crankshaft reluctor ring teeth (10) for damage.
- Inspect the crankshaft rear main oil seal surface (11) for damage.
- Inspect the crankshaft engine flywheel mounting surface (12) for damage.
- Inspect the crankshaft pilot hole (13) for damage.
- Inspect the crankshaft engine flywheel bolt holes (14) for thread damage.

2. Repair or replace the crankshaft as necessary.

Crankshaft Bearing Inspection

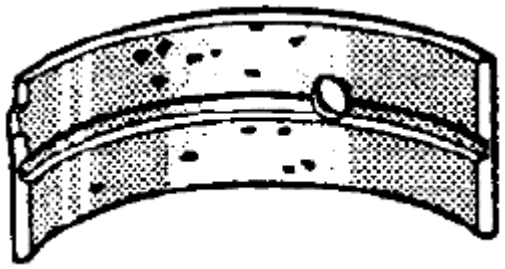


Fig. 397: Inspecting For Fatigue Indicated By Craters Or Pockets
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **All connecting rod and main journal bearings that have been used in a running engine must be replaced. Never re-use the crankshaft or connecting rod bearings.**
- **The following bearing wear conditions should be used to diagnose engine operating conditions or root cause of a condition.**

1. Inspect for fatigue indicated by craters or pockets. Flattened sections on the bearing halves also indicate fatigue.

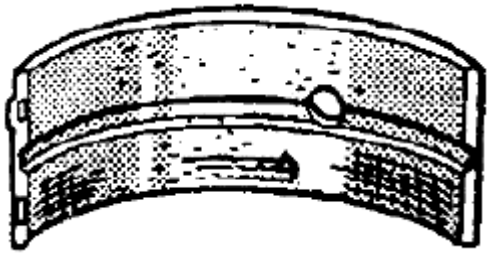


Fig. 398: Inspecting For Excessive Scoring Or Discoloration On Both Front And Back Of Bearing Halves
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect for excessive scoring or discoloration on both front and back of the bearing halves.
3. Inspect the main bearings for dirt embedded into the bearing material.

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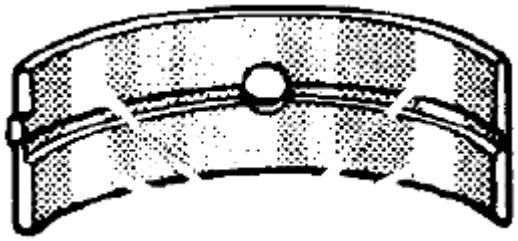


Fig. 399: Inspecting For Improper Seating Indicated By Bright, Polished Sections
Courtesy of SUZUKI OF AMERICA CORP.

4. Inspect for improper seating indicated by bright, polished sections.

Crankshaft Measurement

Special Tool

J 7872 Magnetic Base Dial Indicator

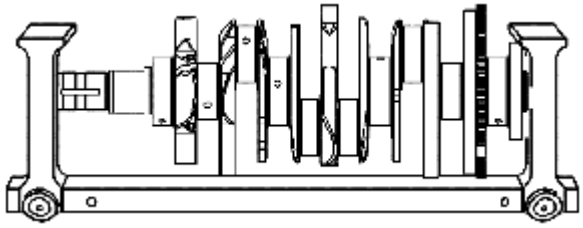


Fig. 400: Identifying Crankshaft Support Fixture
Courtesy of SUZUKI OF AMERICA CORP.

1. Using a suitable fixture, support the crankshaft.

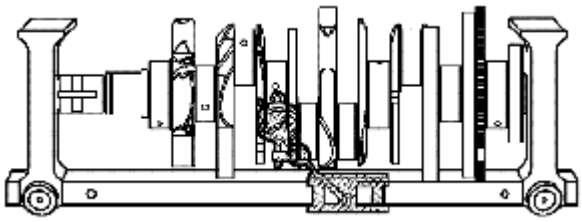


Fig. 401: Identifying Special Tool J 7872
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the J 7872.
3. Measure the crankshaft runout using the J 7872. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.

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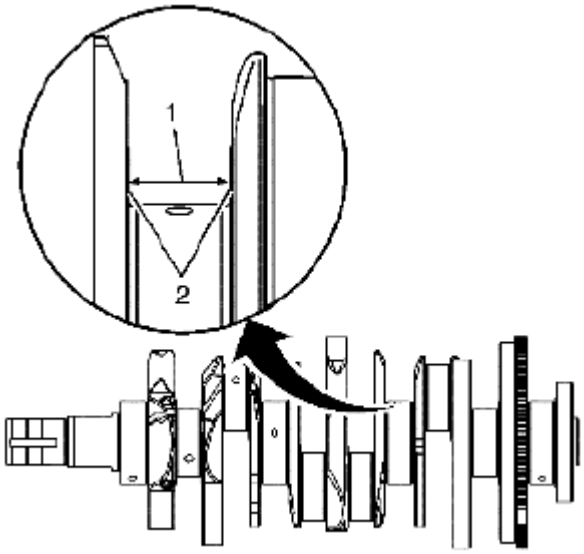


Fig. 402: Identifying Crankshaft Thrust Wall Width And Surface
Courtesy of SUZUKI OF AMERICA CORP.

4. Measure the crankshaft thrust wall width (1) for wear using an inside micrometer. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
5. Measure the crankshaft thrust wall surface (2) for runout using the J 7872. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
6. If the crankshaft journals are damaged or worn beyond specifications, the crankshaft may be ground 0.25 mm (0.010 in). There is only 1 size of oversized main bearings available for service.

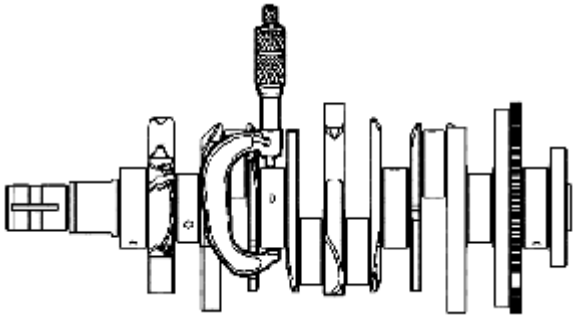


Fig. 403: Inspecting Crankshaft Main Journals For Undersize
Courtesy of SUZUKI OF AMERICA CORP.

7. Inspect the crankshaft main journals for undersize, using an outside micrometer.

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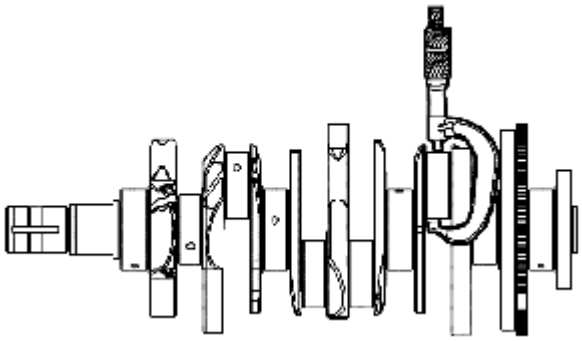


Fig. 404: Inspecting Crankpins For Undersize Using Outside Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

8. Inspect the crankpins for undersize using an outside micrometer.
9. Compare your measurements with those listed in the **ENGINE MECHANICAL SPECIFICATIONS**. If the crankpin journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm (0.010 in). There is only 1 size of oversized connecting rod bearings available for service.

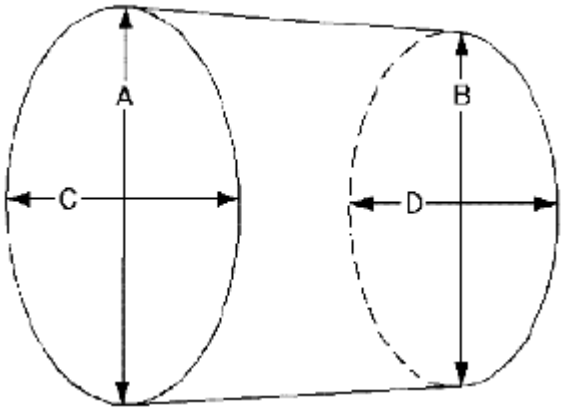


Fig. 405: Identifying Main Bearing And Crankpin Journals Out-Of-Round Points
Courtesy of SUZUKI OF AMERICA CORP.

10. Measure the main bearing and crankpin journals for out-of-round using the following procedure:
    a. Using an outside micrometer, measure the journal at the extreme front and rear locations on the journal. Call these points A and B.
    b. Measure the journal in 2 new locations exactly 90 degrees from the first points. Call these points C and D.
    c. Subtract A from C and B from D. The differences will indicate journal out-of-round.
    d. The out-of-round should not exceed 0.004 mm (0.00016 in) maximum.
    e. If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm (0.010 in). There is only 1 size of oversized crankshaft and connecting rod bearings available for service.
11. Measure the main bearing and crankpin journals for taper using the following procedure:
    a. Using an outside micrometer, measure the journal at the extreme front (A) and rear (B) of the journal parallel to the crankshaft centerline.

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b. Subtract the smallest from the largest measurement. The result will be the journal taper.
c. If the main bearing journal taper exceeds 0.004 mm (0.00016 in), replace the crankshaft.
d. If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm (0.010 in). There is only 1 size of oversized crankshaft and connecting rod bearings available for service.

CRANKSHAFT BALANCER CLEANING AND INSPECTION

Reference: **CRANKSHAFT BALANCER REMOVAL**

Cleaning Procedure

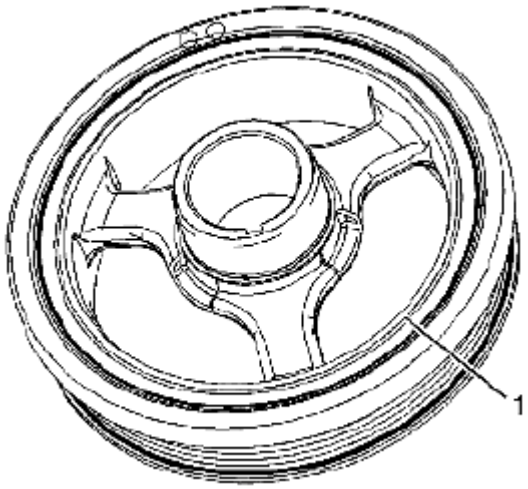


Fig. 406: Identifying Crankshaft Balancer Compatible With Rubber
Courtesy of SUZUKI OF AMERICA CORP.

1. Clean the crankshaft balancer in solvent that is compatible with the rubber (1).

WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the crankshaft balancer with compressed air.

Inspection Procedure

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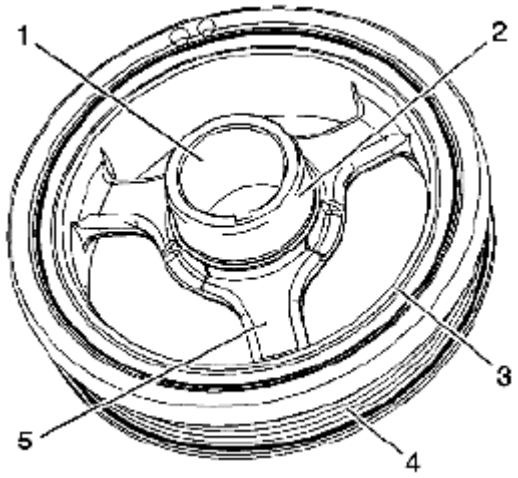


Fig. 407: Inspecting Crankshaft Balancer
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the crankshaft balancer for the following:
   - Worn or damaged hub-to-crankshaft surface (1)
   - Worn, grooved or damaged hub seal surface (2)

     A crankshaft balancer hub seal surface with excessive scoring, grooves, rust or other damage must be replaced.

   - Worn, chunking or deteriorated rubber between the hub and pulley (3)
   - Damaged drive belt ribs (4)
   - Damaged webs (5)
2. Repair or replace the crankshaft balancer as necessary.

Reference: **CRANKSHAFT BALANCER INSTALLATION**

ENGINE FLYWHEEL CLEANING AND INSPECTION

Reference: **ENGINE FLYWHEEL REMOVAL**

Cleaning Procedure

NOTE: In order to maintain the proper component balance, contact surface taper and heat transfer, manual transmission flywheels are NOT to be machined.

1. Clean the engine flywheel in solvent.

   WARNING: Refer to SAFETY GLASSES CAUTION .

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2. Dry the engine flywheel with compressed air.

Inspection Procedure

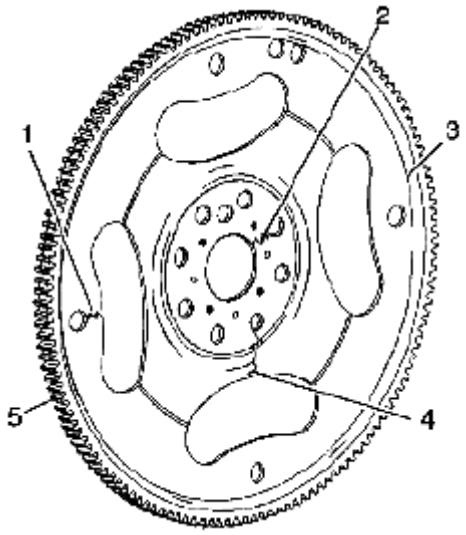


Fig. 408: Inspecting Engine Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the engine flywheel for the following conditions:
   - Stress cracks around the engine flywheel-to-torque converter mounting bolt hole locations (1) and/or engine flywheel-to-crankshaft (2, 4)

     NOTE: Do not attempt to repair the welded areas that retain the ring gear to the engine flywheel plate. Install a new engine flywheel.

   - Cracks at welded areas that retain the ring gear onto the engine flywheel (3)
   - Damaged or missing ring gear teeth (5)
2. Replace the engine flywheel as necessary.

   Reference: **ENGINE FLYWHEEL INSTALLATION**

PISTON AND CONNECTING ROD DISASSEMBLE

Reference: **PISTON, CONNECTING ROD, AND BEARING REMOVAL**

Special Tool

EN-46745 Piston Pin Clip Remover/Installer

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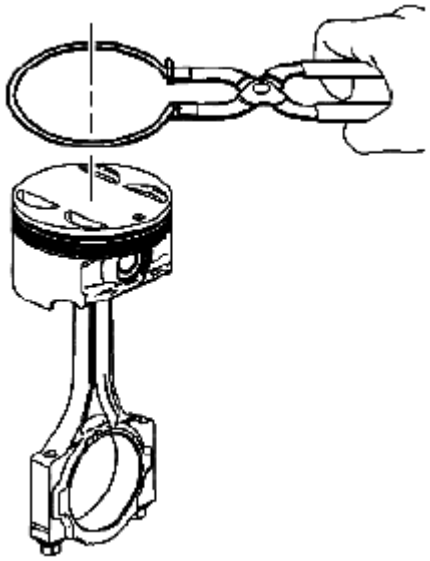


Fig. 409: Removing Piston Rings Using Piston Ring Expander
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: You must use a piston ring expander to remove and install the piston rings. Only expand the rings far enough to fit over the piston lands. If the rings are overexpanded, the top ring will shatter and the others will distort.

1. Remove the piston rings using a piston ring expander. Place each ring in a clean shop towel for storage.

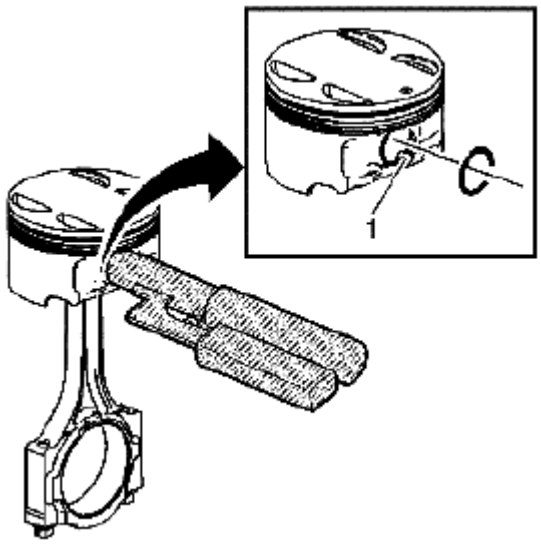


Fig. 410: Removing Piston Pin Retainers By Using Removal Access Notch In Side Of Piston
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **The connecting rod is non-directional and may be assembled/reassembled to the piston in either direction.**

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- **DO NOT reuse the piston pin retainers.**

2. Using the EN-46745, remove the piston pin retainers by using the removal access notch (1) in the side of the piston. Discard the piston pin retainers.

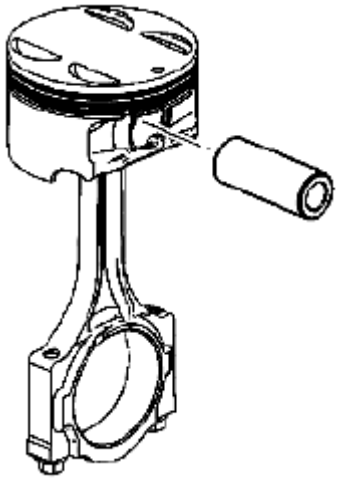


Fig. 411: Identifying Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

3. Slide the piston pin out of the piston. The piston will disconnect from the connecting rod.

Reference: **PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION**

PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION

Reference: **PISTON AND CONNECTING ROD DISASSEMBLE**

Cleaning Procedure

NOTE: DO NOT wire brush any part of the piston.

1. Clean the piston skirts and the pins with a cleaning solvent.
2. Clean the piston ring grooves with a groove cleaner. Ensure that the oil ring holes and slots are clean.

WARNING: Refer to SAFETY GLASSES CAUTION .

3. Dry the piston with compressed air.

Piston Inspection Procedure

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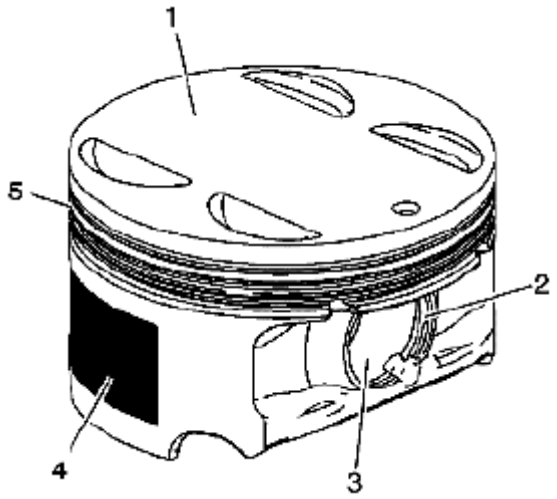


Fig. 412: Inspecting Piston
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the pistons for the following conditions:
    - Cracked ring lands, skirts or pin bosses
    - Ring grooves for nicks, burrs that may cause binding (5)
    - Warped or worn ring lands (5)
    - Piston pin retainer grooves for burrs (2)
    - Eroded areas at the top of the piston (1)
    - Scuffed or damaged skirt coating (4)
    - Worn piston pin bores or worn piston pins (3)
2. Replace pistons that show any signs of damage or excessive wear.

Piston Measurement Procedure

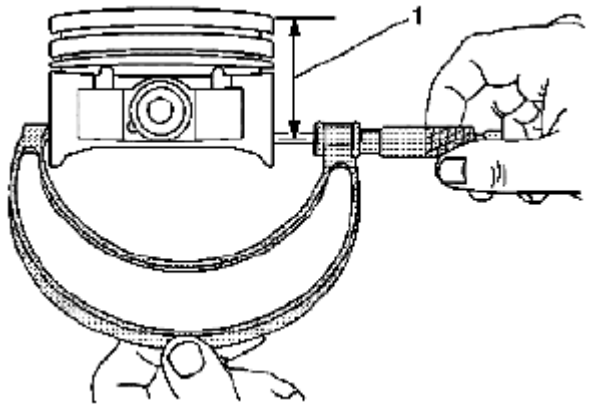


Fig. 413: Measuring Piston Width
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure piston width using the following procedure:

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a. Using an outside micrometer, measure the width of the piston at 30 mm (1.181 in) below the crown, top (1), at the thrust surfaces of the piston, perpendicular to the piston pin centerline.
b. Compare the measurement of the piston to its original cylinder by subtracting the piston width from the cylinder diameter.
c. Check your measurements with the **ENGINE MECHANICAL SPECIFICATIONS**.
d. If the clearance obtained through measurement is greater than the provided specifications and the cylinder bores are within specification, replace the piston.

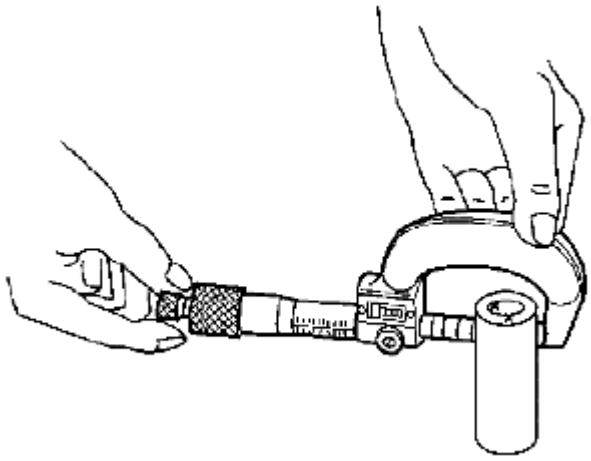


Fig. 414: Measuring Piston Pin Bore To Piston Pin Clearances
Courtesy of SUZUKI OF AMERICA CORP.

2. Measure the piston pin bore to piston pin clearances using the following procedure:
   a. Piston pin bores and pins must be free of varnish or scuffing.
   b. Use an outside micrometer to measure the piston pin in the piston contact areas.

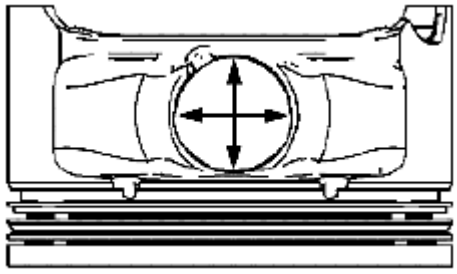


Fig. 415: Measuring Piston Pin Bore
Courtesy of SUZUKI OF AMERICA CORP.

3. Using an inside micrometer, measure the piston pin bore. Compare your result with the piston pin diameter and piston pin to piston pin bore clearance listed in the **ENGINE MECHANICAL SPECIFICATIONS**.
4. If the clearance is excessive, determine which piece is out of specification and replace as necessary.
5. You must replace the piston if any of its dimensions are out of specification.

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6. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Piston Ring Measurement Procedure

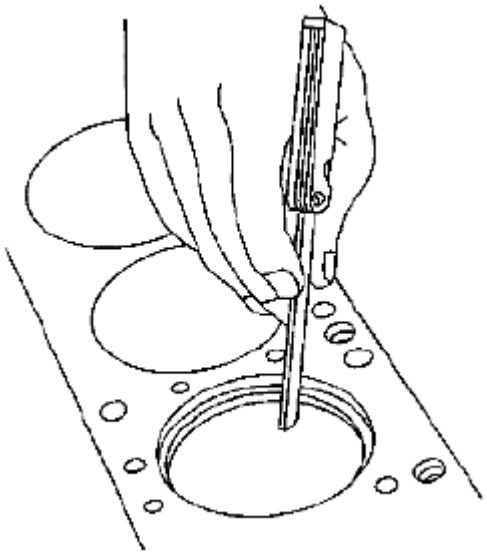


Fig. 416: Measuring Piston Ring End Gap
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure the piston ring end gap using the following procedure:
   a. Place the piston ring in the area of the bore where the piston ring will travel approximately 25 mm (1 in) down from the deck surface. Ensure that the ring is square with the cylinder bore by positioning the ring with the piston head.
   b. Measure the end gap of the piston ring with feeler gages. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
   c. If the clearance exceeds the provided specifications, the piston rings must be replaced.
   d. Repeat the procedure for all the piston rings.

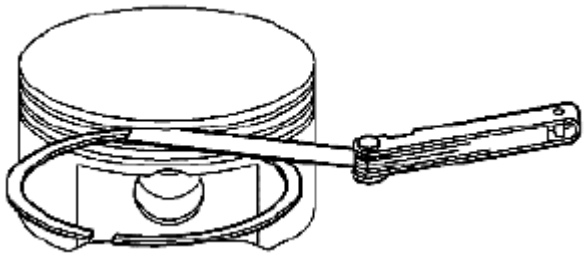


Fig. 417: Measuring Piston Ring Side Clearance
Courtesy of SUZUKI OF AMERICA CORP.

2. Measure the piston ring side clearance using the following procedure:
   a. Roll the piston ring entirely around the piston ring groove. If any binding is caused by the ring

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groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring, replace the ring.

b. With the piston ring on the piston, use feeler gages to check clearance at multiple locations.
c. Compare the measurements with piston ring side clearance listed in the **ENGINE MECHANICAL SPECIFICATIONS**.
d. If the clearance is greater than specifications, replace the piston rings.

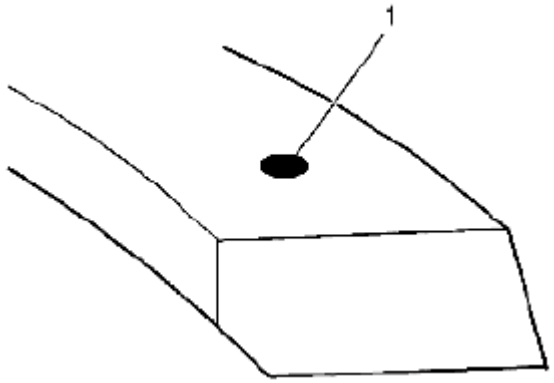


Fig. 418: Locating Dimple On Compression Rings Near End For Identification
Courtesy of SUZUKI OF AMERICA CORP.

3. There is a locating dimple (1) on the compression rings near the end for identification. Install the compression rings with the dimple facing up.
4. If the new ring does not reduce the clearance to the proper specification, install a new piston.
5. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Connecting Rod Cleaning Procedure

1. Clean the connecting rods in solvent.

WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the connecting rod using compressed air.
3. Remove the connecting rod cap and clean the threads.
4. Remove the connecting rod bearing and discard. Never reuse a connecting rod bearing used in a running engine.

Connecting Rod Visual Inspection Procedure

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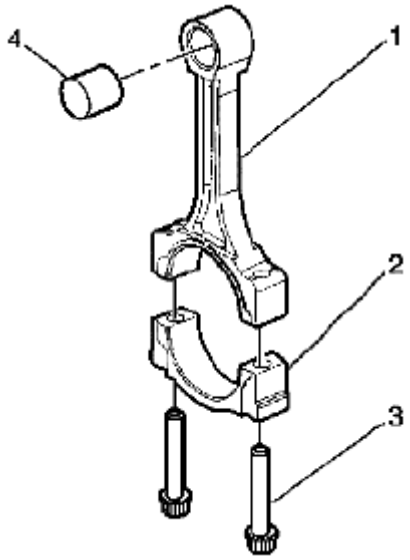


Fig. 419: Inspecting Connecting Rod
Courtesy of SUZUKI OF AMERICA CORP.

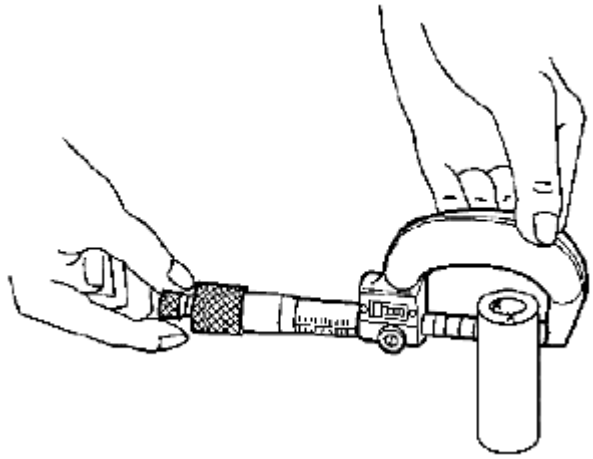
1. Inspect the piston pin bushing (4) for scoring or damage.
2. Inspect the connecting rod beam (1) for twisting or bending.
3. Inspect the rod cap (2) for any nicks or damage caused by possible interference.
4. Inspect for scratches or abrasion on the rod bearing seating surface.

NOTE: DO NOT scrape the rod or rod cap.

5. If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper.

Connecting Rod Measurement Procedure

Piston Pin End



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Fig. 420: Measuring Piston Pin In Area Of Connecting Rod Contact
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Measurements of all components should be taken with the components at normal room temperature.

1. Using an outside micrometer, take 2 measurements of the piston pin in the area of the connecting rod contact.

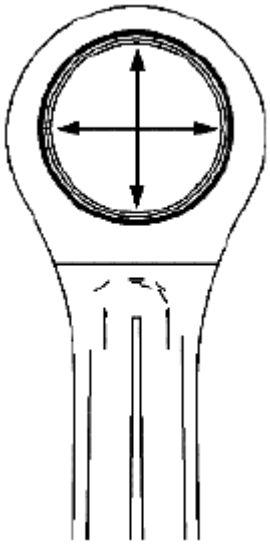


Fig. 421: Measuring Connecting Rod Piston Pin Bore
Courtesy of SUZUKI OF AMERICA CORP.

2. Using an inside micrometer, measure the connecting rod piston pin bore.
3. Subtract the piston pin diameter from the piston pin bore.
4. Compare the clearance measurements with the **ENGINE MECHANICAL SPECIFICATIONS**.
5. If the clearance is excessive, replace the piston pin. If a new pin does not resolve the clearance problem, replace the connecting rod.

Connecting Rod Crankshaft Bearing End

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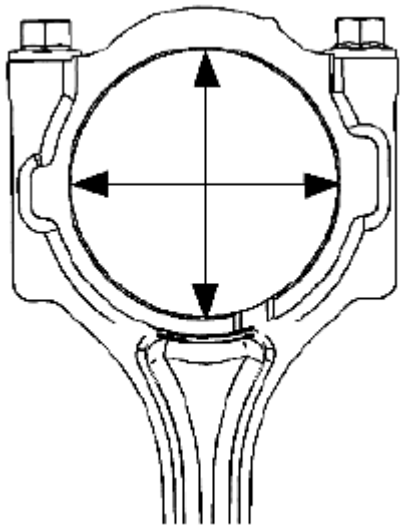


Fig. 422: Measuring Connecting Rod Crankshaft Bearing Bore
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Measurements of all components should be taken with the components at normal room temperature.

1. Using an inside micrometer, measure the connecting rod crankshaft bearing bore.
2. Compare the bore measurements with the **ENGINE MECHANICAL SPECIFICATIONS**.
3. Replace the connecting rod if the bore is out of specifications. DO NOT recondition the connecting rod.

   Reference: **PISTON AND CONNECTING ROD ASSEMBLE**

PISTON AND CONNECTING ROD ASSEMBLE

Reference: **PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION**

Special Tool

EN 46121 Connecting Rod Guide Pin Set

EN-46745 Piston Pin Clip Remover/Installer

Piston and Piston Pin Installation Procedure

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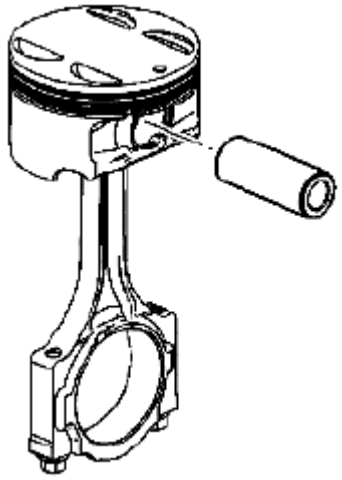


Fig. 423: Identifying Piston And Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **The arrow located on top of the piston must point toward the front of the engine.**
- **The connecting rod is non-directional and may be assembled/reassembled to the piston in either direction.**

1. Lubricate the piston pin bores in the piston and the connecting rod with GM prelube lubricant GM P/N 1052367 (Canadian P/N 992869) or equivalent.
2. Assemble the piston and piston pin to the connecting rod. Properly orient the piston when reusing a marked connecting rod.
3. Align the piston pin bore with the connecting rod pin bore.
4. Slide the piston pin into the piston and the connecting rod.

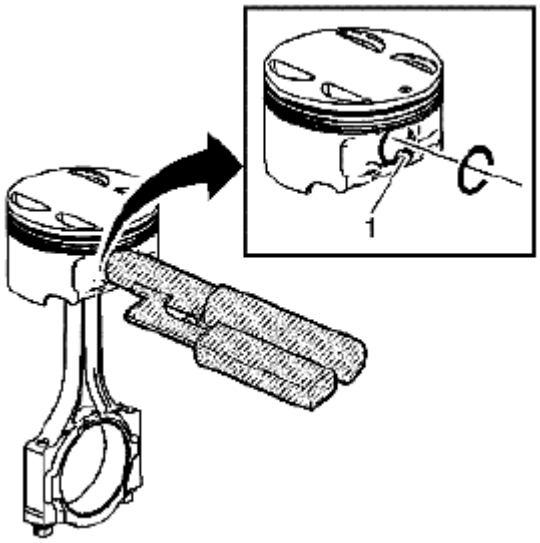


Fig. 424: Installing Piston Pin Retainers Using EN-46745

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Courtesy of SUZUKI OF AMERICA CORP.

NOTE: New piston pin retainers must be used. Never reuse the piston pin retainers.

5. Install NEW piston pin retainers using the EN-46745. Align the EN-46745 to the notch (1) in the piston.
6. Ensure that the piston pin retainers are fully seated in their grooves.
7. Repeat these procedures for the remaining pistons.

Piston Ring Installation Procedure

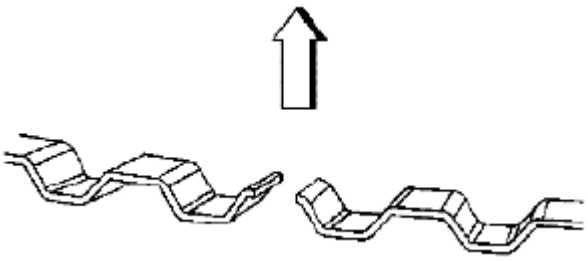


Fig. 425: Identifying Oil Control Ring Expander
Courtesy of SUZUKI OF AMERICA CORP.

1. Properly orient the oil control ring expander as shown before installation. The ends of the expander must be facing toward the top of the piston.

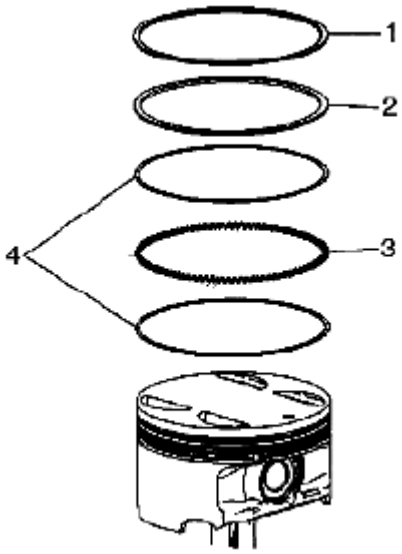


Fig. 426: Identifying Oil Control Rings
Courtesy of SUZUKI OF AMERICA CORP.

2. Using a piston ring expander, install the oil control ring assembly using the following procedure:
   a. Install the expander ring (3).

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b. Install the 2 oil scraper rings (4). Expand the rings only enough to clear the piston diameter. Overexpanding the piston rings will distort or crack the rings.

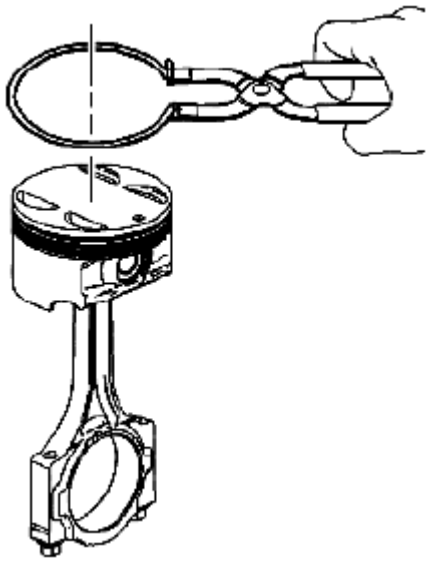


Fig. 427: Installing Second And Top Piston Rings Using Ring Expander
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the second and top piston rings using the ring expander. Ensure that you do not overexpand the rings.

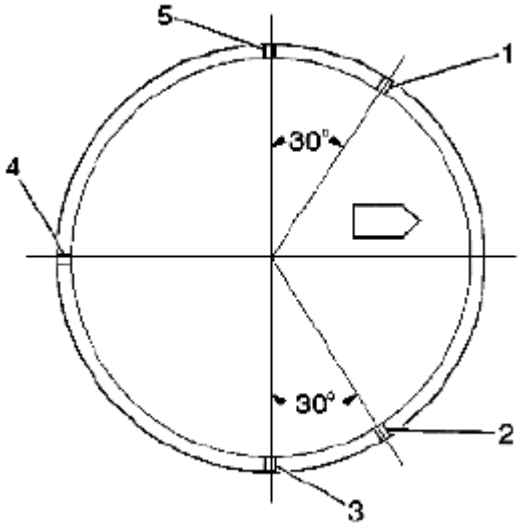


Fig. 428: Identifying Ring Gaps
Courtesy of SUZUKI OF AMERICA CORP.

4. Once the rings are installed, set the ring gaps for the oil control, second and top ring as follows. Use the piston location arrow for reference.
   a. Lower oil control ring - position 1

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b. Upper oil control ring - position 2
c. Top Ring - position 3
d. Oil control ring expander - position 4
e. Second ring - position 5

Connecting Rod Bearing Installation Procedure

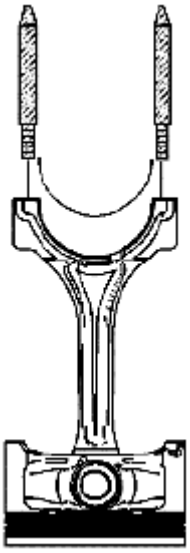


Fig. 429: Identifying Special Tool EN 46121
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the connecting rod bearings have been used in a running engine, you must replace them with NEW connecting rod bearings for reassembly.

1. Clean the connecting rod and the connecting rod cap bearing bore with a lint-free cloth.
2. Clean all the oil from behind the connecting rod bearing halves.
3. Install new upper connecting rod bearings into position. Roll the bearing into position so that the lock tang engages the alignment slot. The bearing must fit flush in the connecting rod.
4. Install the EN 46121 into the connecting rod bolt holes.

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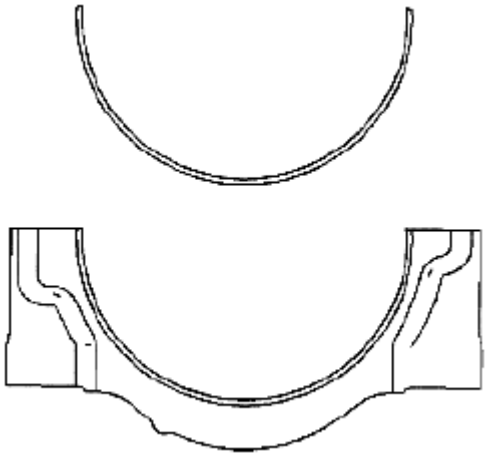


Fig. 430: Identifying Lower Connecting Rod Bearings And Connecting Rod Cap
Courtesy of SUZUKI OF AMERICA CORP.

5. Install new lower connecting rod bearings into position in the connecting rod cap. Roll the bearing into position so that the lock tang engages the alignment slot. The bearings must fit flush with the connecting rod cap.

   Reference: **PISTON, CONNECTING ROD, AND BEARING INSTALLATION**

CYLINDER HEAD DISASSEMBLE

Reference: **CYLINDER HEAD REMOVAL - LEFT SIDE**

Reference: **CYLINDER HEAD REMOVAL - RIGHT SIDE**

Special Tool

EN 46116 Valve Stem Seal Remover/Installer

EN 46117 Valve Stem Key Remover/Installer

EN 46119 Off-Vehicle Valve Spring Compressor Adapter

J 8062 Valve Spring Compressor - Head Off

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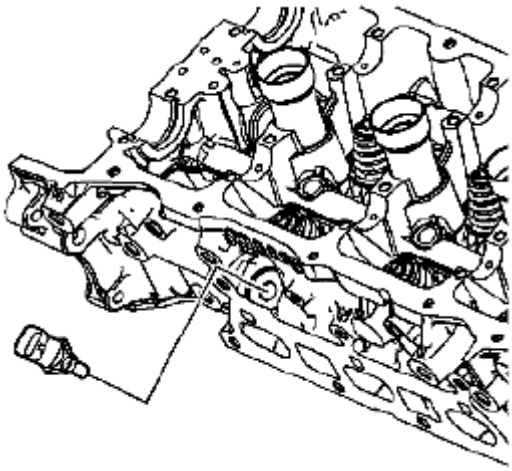


Fig. 431: Identifying Engine Coolant Temperature Sensor
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the Engine Coolant Temperature (ECT) sensor.

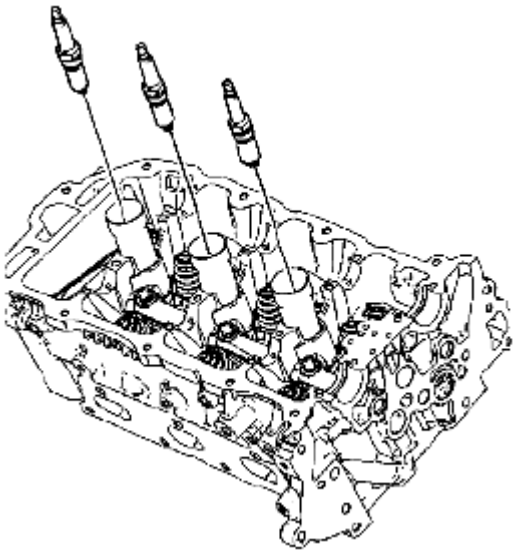


Fig. 432: Identifying Spark Plugs
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the spark plugs.

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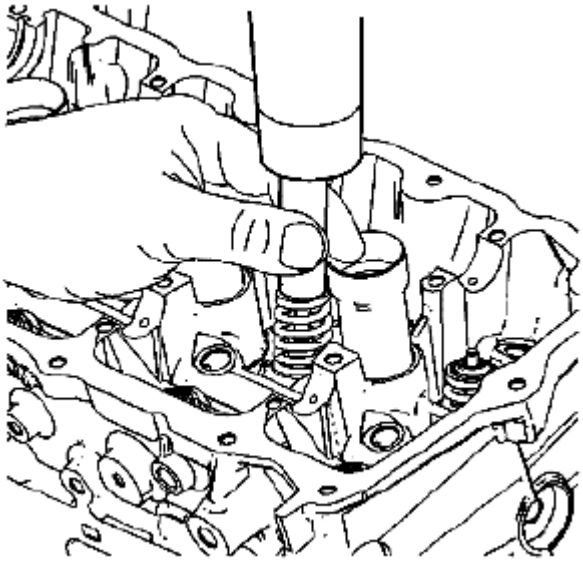


Fig. 433: Tapping On Valve Spring Retainer To Loosen Valve Keepers
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure valve heads will not contact anything during the following step in order to avoid bending or damage.

3. Using an appropriately sized deep socket and a plastic hammer, lightly tap on the valve spring retainer to loosen the valve keepers.

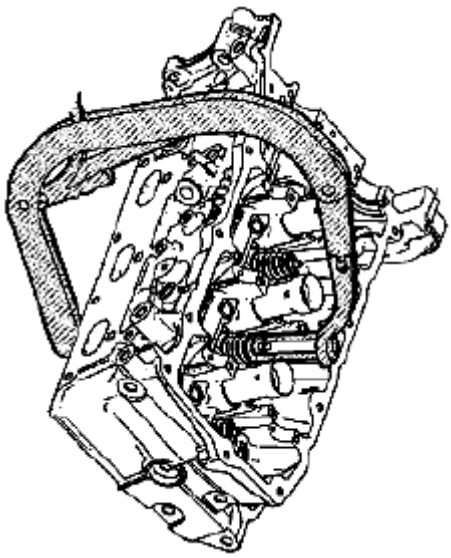


Fig. 434: Compressing Valve Spring Using J 8062 And EN 46119
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed

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by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs less than 24.0 mm (0.943 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

4. Compress the valve spring using the J 8062 and the EN 46119.

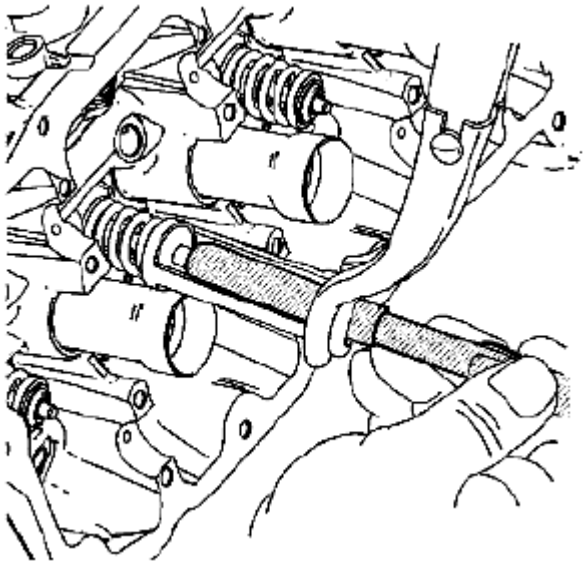


Fig. 435: Removing Valve Keepers Use Magnet Of EN 46117
Courtesy of SUZUKI OF AMERICA CORP.

5. Use the magnet of the EN 46117 in order to remove the valve keepers.
6. Remove the valve spring compressor and the adapter.

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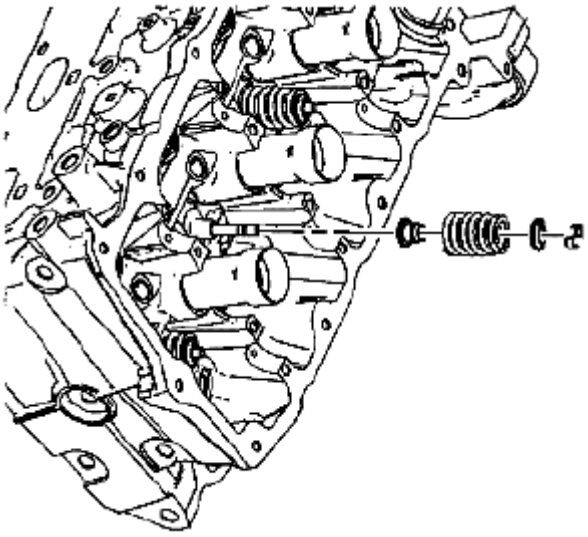


Fig. 436: Identifying Valve Spring And Retainer
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the valve spring retainer.
8. Remove the valve spring.

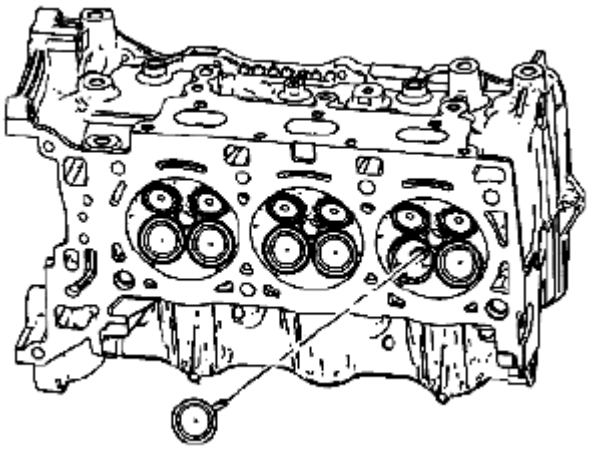


Fig. 437: Identifying Valve
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the valve.

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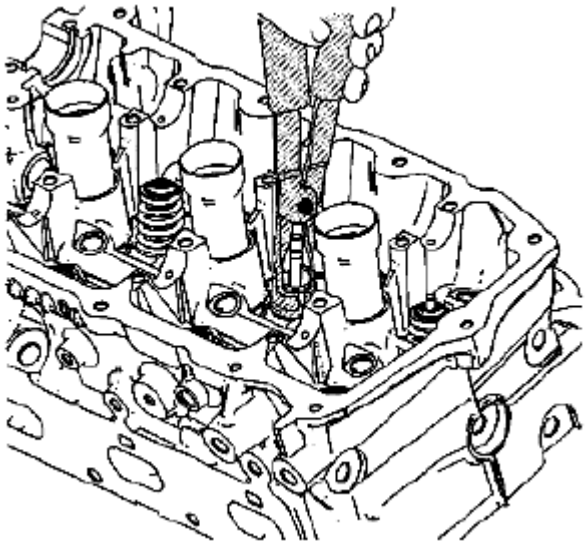


Fig. 438: Removing Valve Stem Oil Seal Using EN 46116
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: NEVER reuse a valve stem oil seal.

10. Remove the valve stem oil seal using the EN 46116 and discard.
11. Repeat these procedures for the remaining valves.

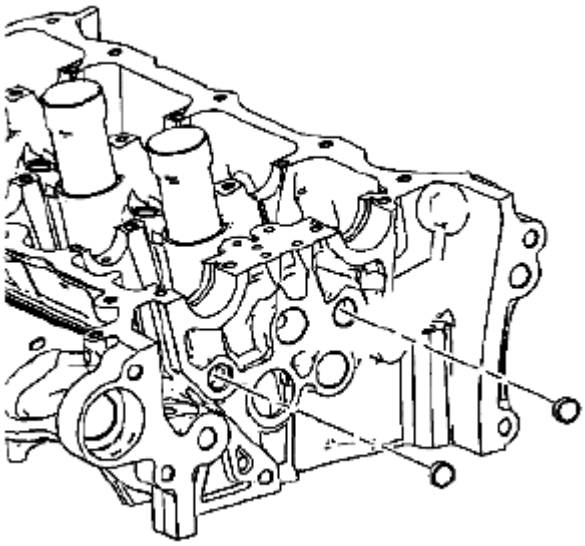


Fig. 439: Identifying Cylinder Head Oil Gallery Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove the cylinder head oil gallery expansion plugs.

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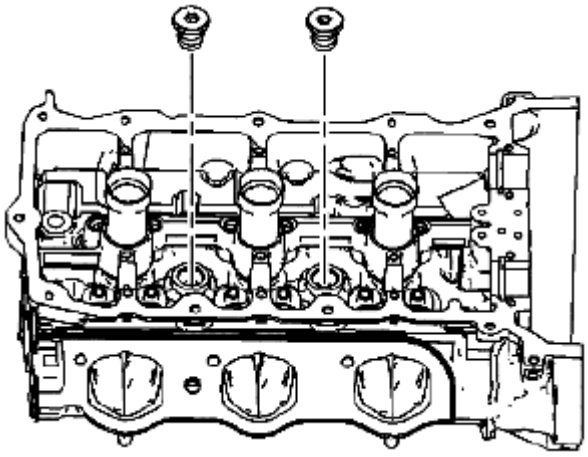


Fig. 440: Identifying Cylinder Head Coolant Threaded Plugs
Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the cylinder head coolant threaded plugs.

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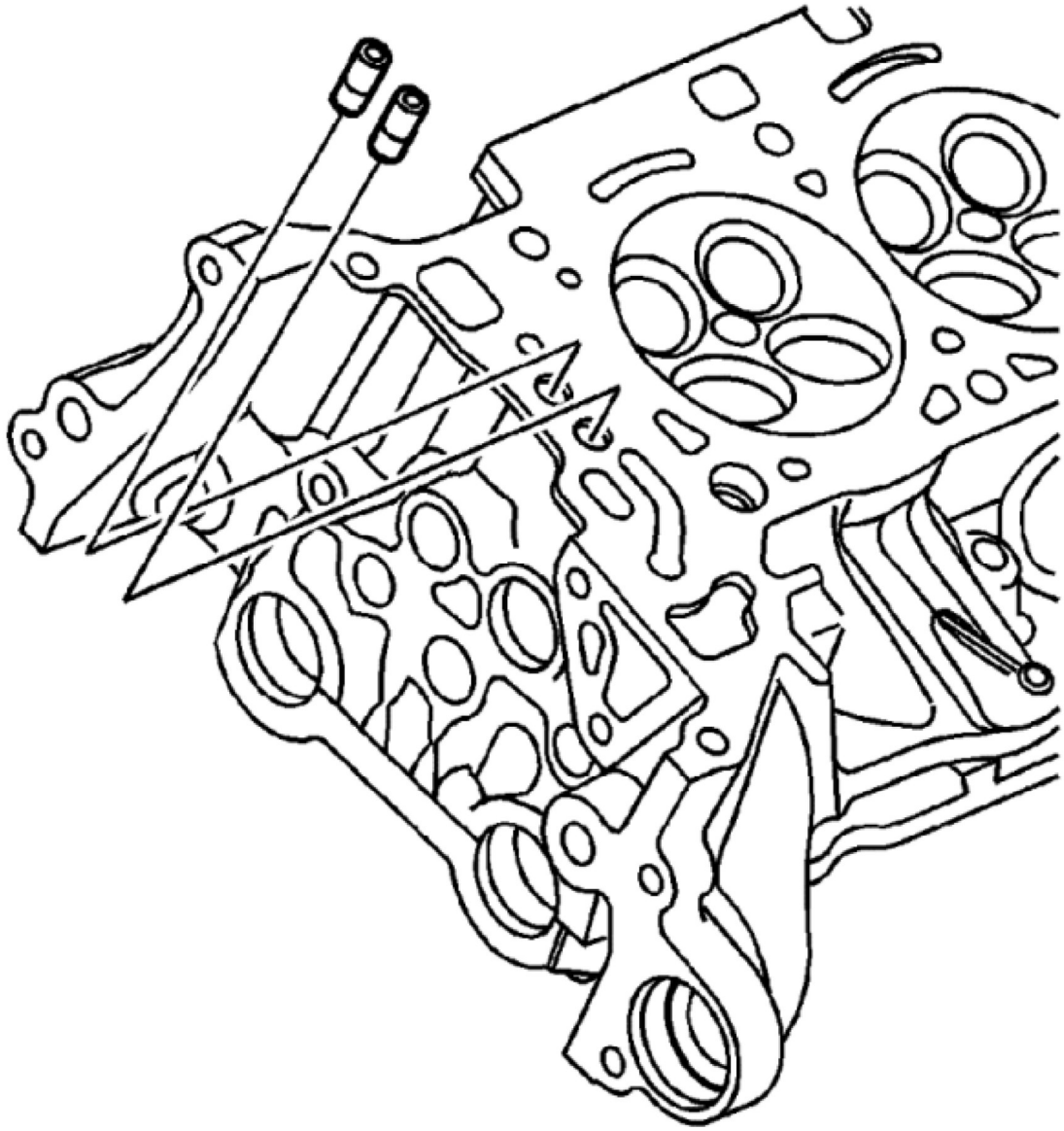


Fig. 441: Identifying Camshaft Position Actuator Oil Feed Check Valves
Courtesy of SUZUKI OF AMERICA CORP.

14. Inspect the camshaft position actuator oil feed check valves. Damaged, restricted or clogged check valves must be replaced.

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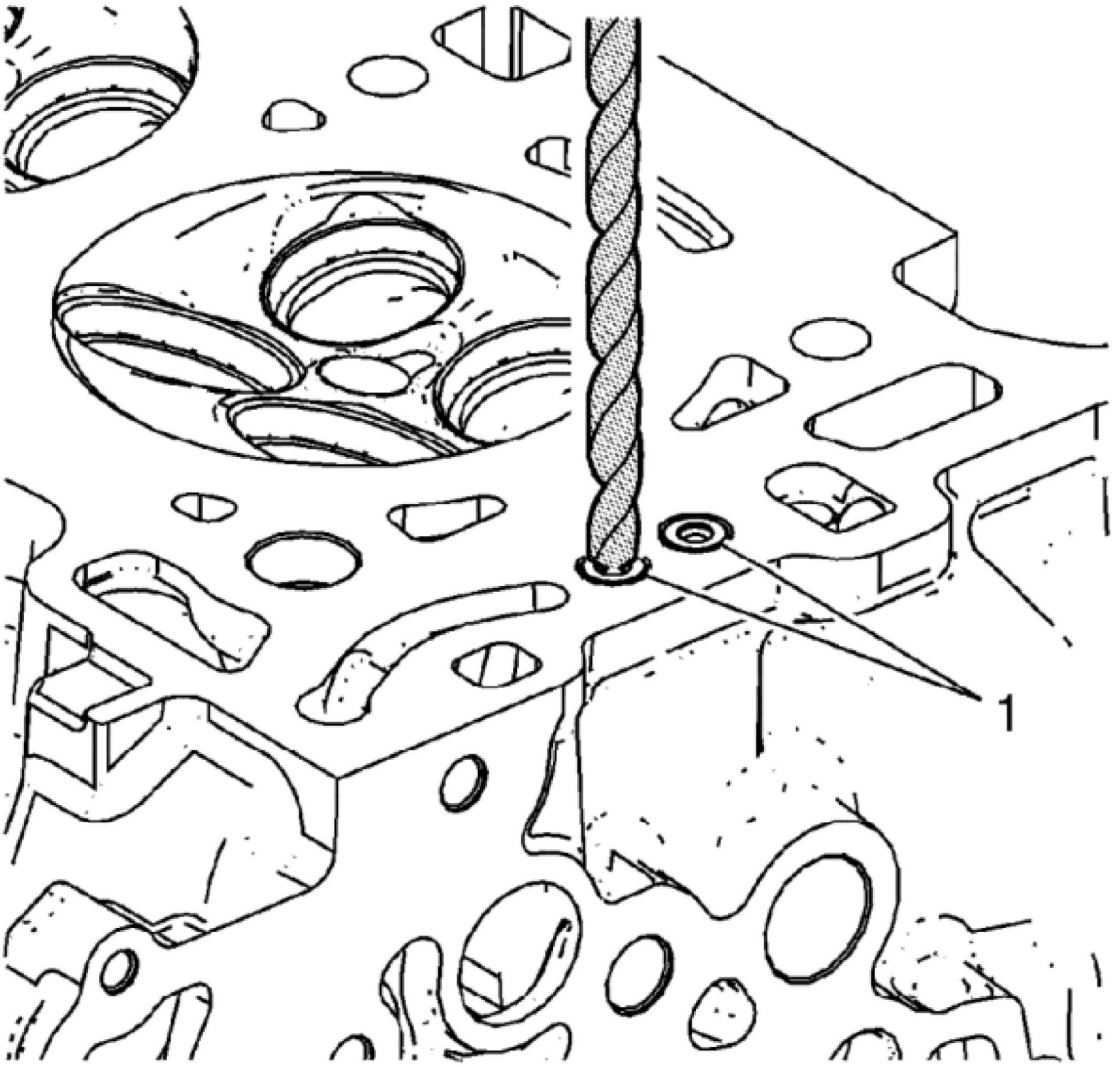


Fig. 442: Identifying Drill Bit EN-46122-3 And Check Valves (1)
Courtesy of SUZUKI OF AMERICA CORP.

15. Place cylinder head on firm surface with check valves (1) facing up. Protect all cylinder head components and machined surfaces.
16. Using drill bit EN-46122-3, drill out top portion of check valve to expose internal check ball.

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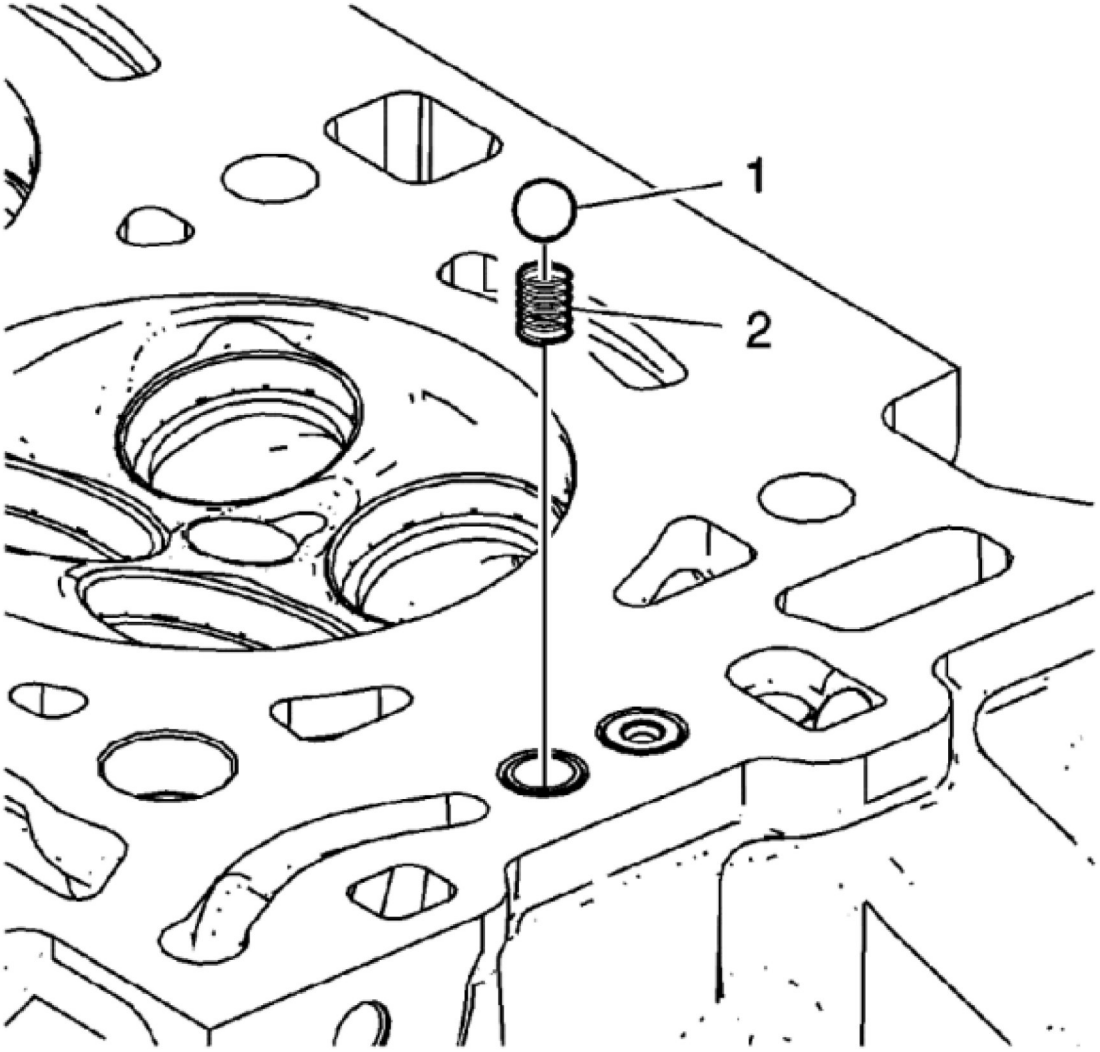


Fig. 443: Identifying Check Ball (1) And Check Ball Spring (2)
Courtesy of SUZUKI OF AMERICA CORP.

17. Remove check ball (1) and check ball spring (2) from inside of check valve.

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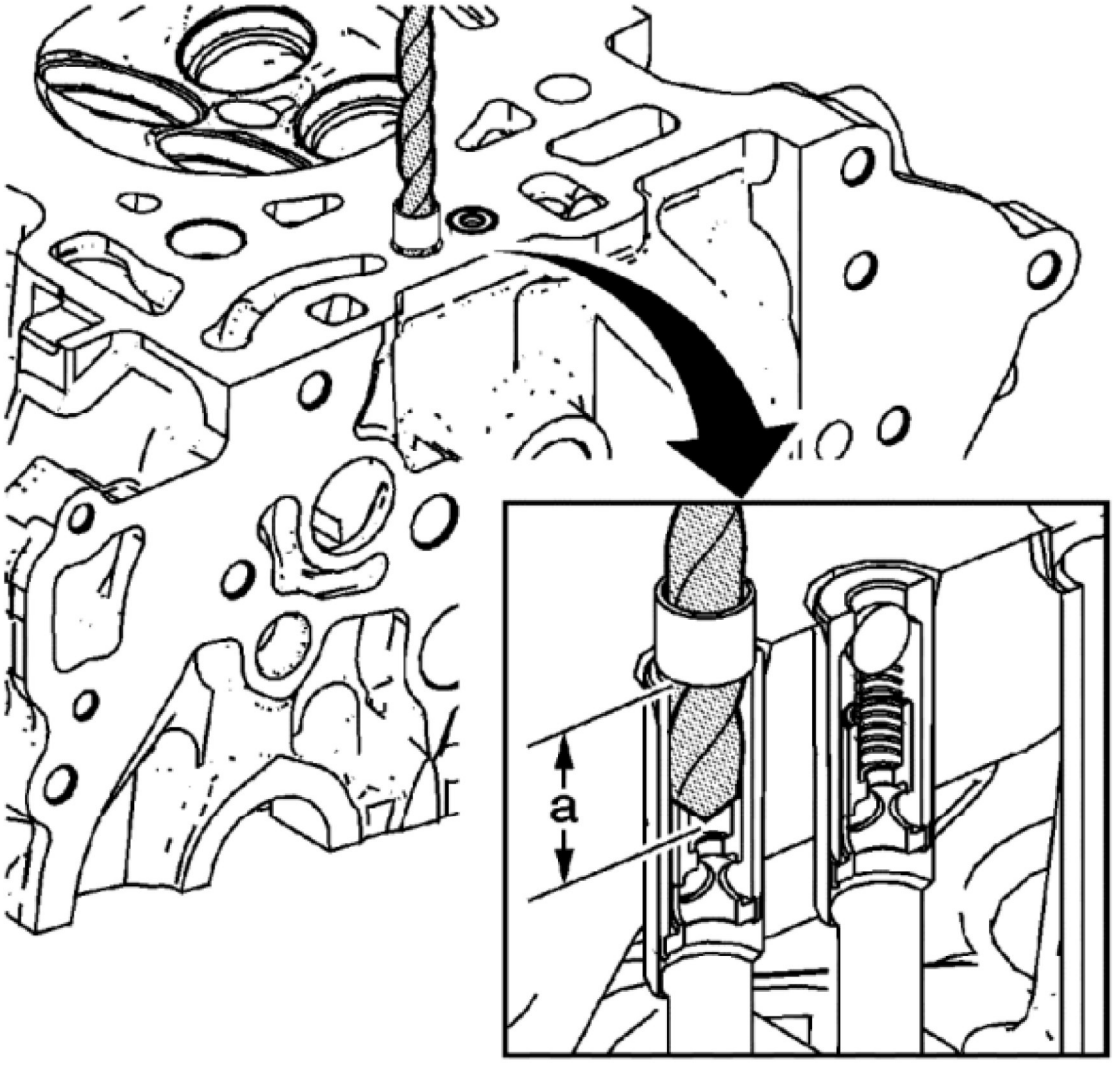


Fig. 444: Identifying Tape On Drill Bit As Depth Gauge
Courtesy of SUZUKI OF AMERICA CORP.

18. Continue drilling remainder of check valve sleeve to a depth of approximately 19 mm (0.75 in) (a) by placing tape on drill bit as a depth gauge. It is not necessary or desirable to drill completely through the bottom of the check valve.

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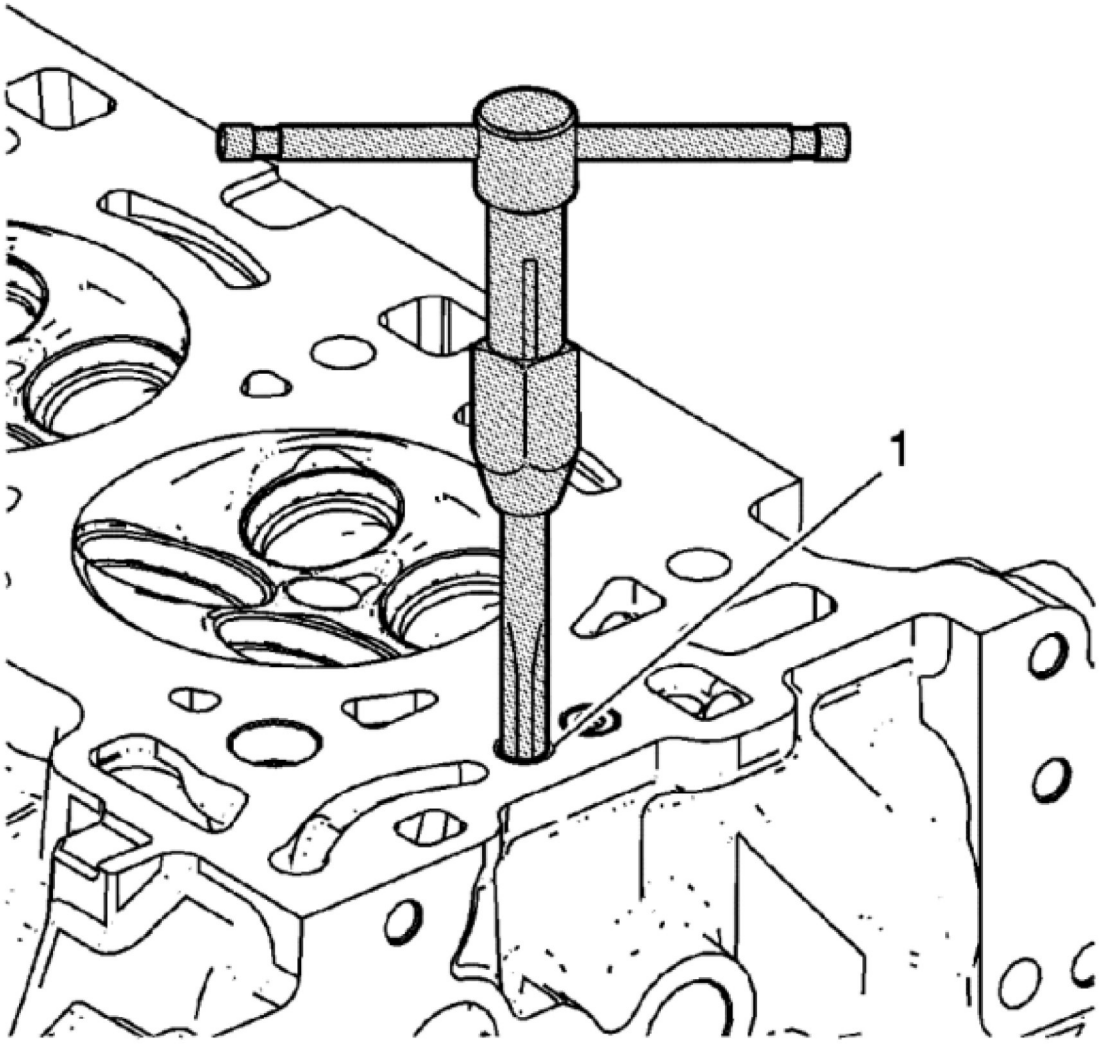


Fig. 445: Identifying Tap EN-46122-4
Courtesy of SUZUKI OF AMERICA CORP.

19. Lubricate tap EN-46122-4 with lubricant included in EN-46122 remover/installer. Tap drilled out portion of check valve (1) remaining in cylinder head. Tap to full depth possible until tap bottoms out in head.

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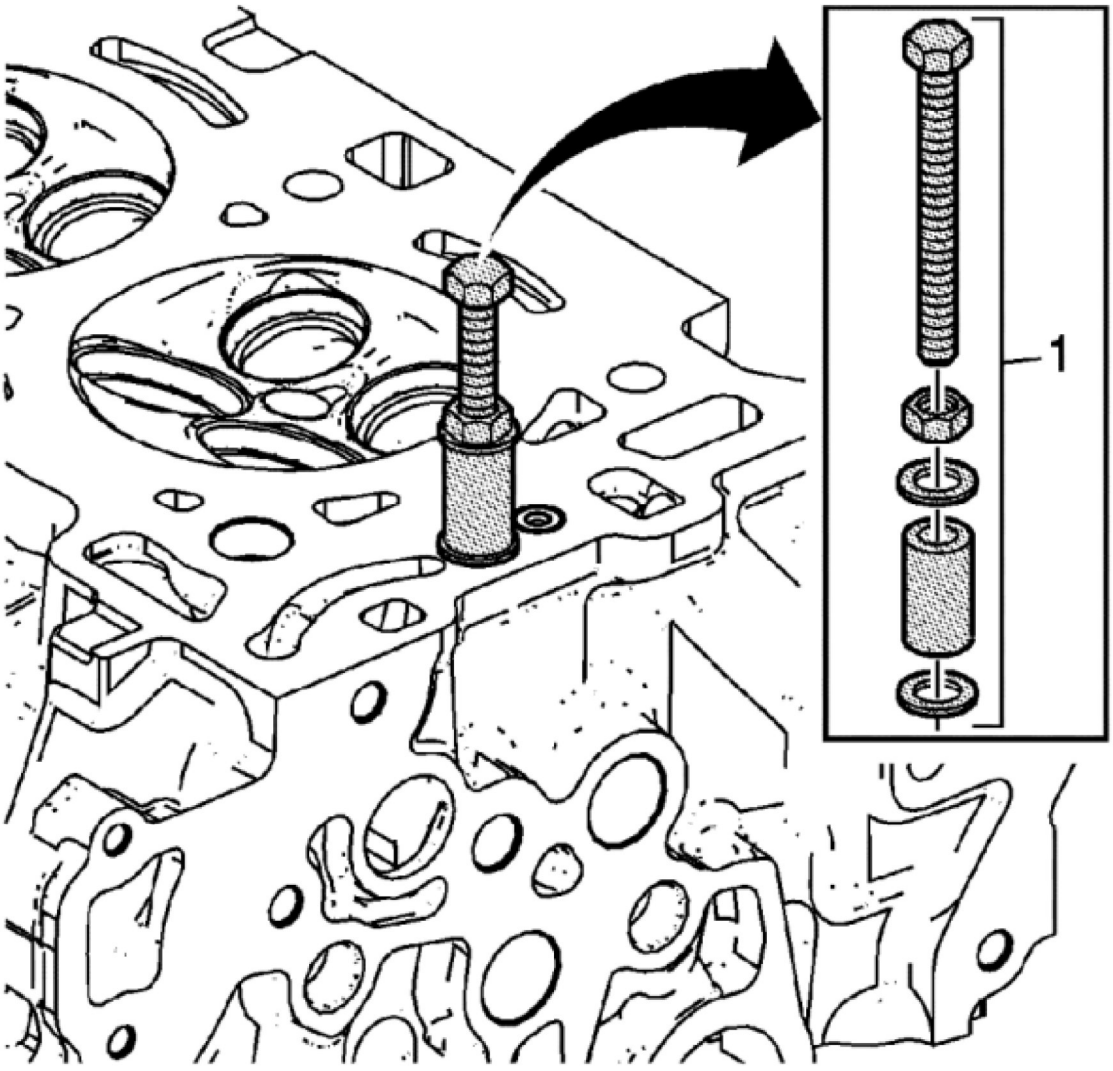


Fig. 446: Identifying Bolt, Nut, Washers, And Collar EN-46122-2 (1)
Courtesy of SUZUKI OF AMERICA CORP.

20. Assemble bolt, nut, washers, and collar EN-46122-2 (1) as shown. Position collar with slightly-larger inside diameter DOWN toward the cylinder head.
21. Screw bolt by hand fully down into threaded check valve sleeve, then lightly tighten nut against washer.

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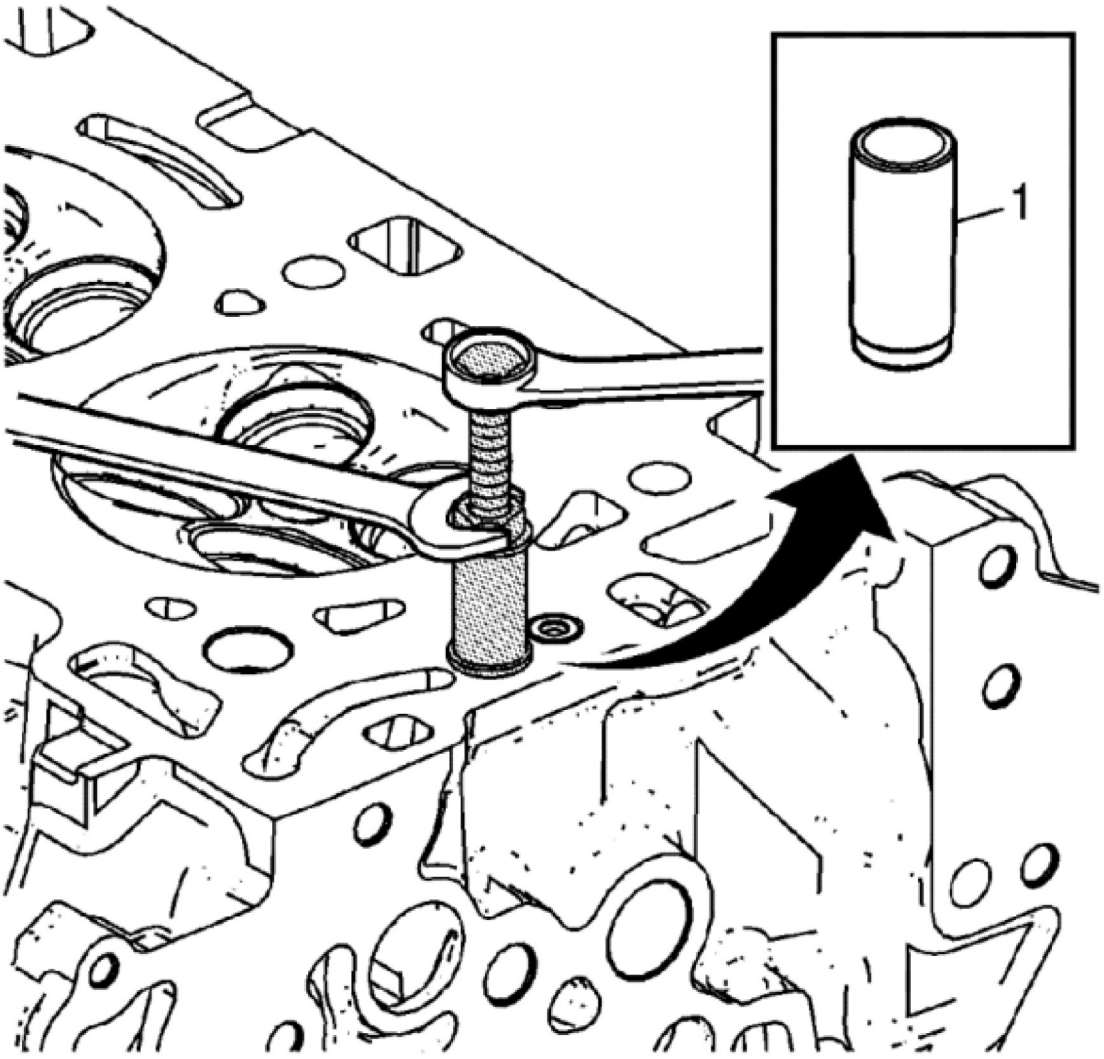


Fig. 447: Identifying Wrench And Check Valve Sleeve
Courtesy of SUZUKI OF AMERICA CORP.

22. Hold bolt with one wrench, and use another to tighten the nut until the check valve sleeve (1) is removed from the cylinder head.
23. Clean check valve bore and related passages thoroughly to remove any drilling chips or other debris.

Reference: **CYLINDER HEAD CLEANING AND INSPECTION**

Reference: **VALVE SPRING INSPECTION AND MEASUREMENT**

Reference: **VALVE AND SEAT GRINDING**

CYLINDER HEAD CLEANING AND INSPECTION

Reference: **CYLINDER HEAD DISASSEMBLE**

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Special Tool

J 8001 Dial Indicator Set

J 8358 Carbon Removal Brush

J 28410 Gasket Remover

J 42096 Valve Guide Reamer

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

Cleaning Procedure

1. Remove any old thread sealant, gasket material or sealant using J 28410.
2. Clean all cylinder head surfaces with non-corrosive solvent.

WARNING: Refer to SAFETY GLASSES CAUTION .

3. Blow out all the oil galleries using compressed air.
4. Remove any carbon deposits from the combustion chambers using the J 8358.
5. Clean any debris or build-up from the lifter pockets.

Visual Inspection

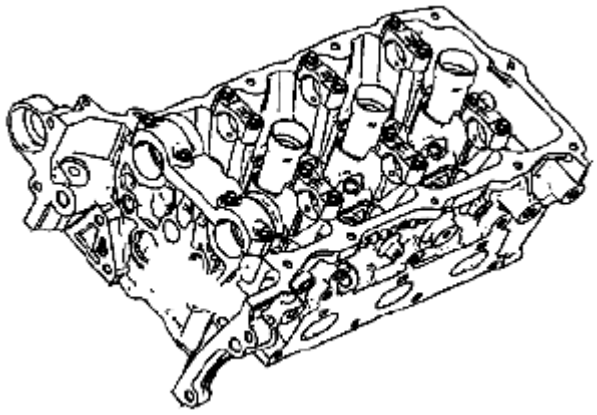


Fig. 448: Inspecting Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the cylinder head camshaft bearing surfaces for the following conditions:
   - Excessive scoring or pitting
   - Discoloration from overheating
   - Deformation from excessive wear

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- If the camshaft bearing journals appear to be scored or damaged, you must replace the cylinder head. DO NOT machine the camshaft bearing journals.

2. If any of the above conditions exist on the camshaft bearing surfaces, replace the cylinder head.
3. Inspect the cylinder head for the following:
   - Cracks, damage or pitting in the combustion chambers
   - Debris in the oil galleries - Continue to clean the galleries until all debris is removed.
   - Coolant leaks or damage to the deck face sealing surface - If coolant leaks are present, measure the surface warpage as described under Cylinder Head Measurement - Deck Flatness Inspection.
   - Burrs or any defects that would degrade the sealing of the NEW secondary camshaft drive chain tensioner gasket
   - Damage to any gasket surfaces
   - Damage to any threaded bolt holes
   - Burnt or eroded areas in the combustion chamber
   - Cracks in the exhaust ports and combustion chambers
   - External cracks in the water passages
   - Restrictions in the intake or exhaust passages
   - Restrictions in the cooling system passages
   - Rusted, damaged or leaking core plugs
4. If the cylinder head is cracked or damaged, it must be replaced. No welding or patching of the cylinder head is recommended.

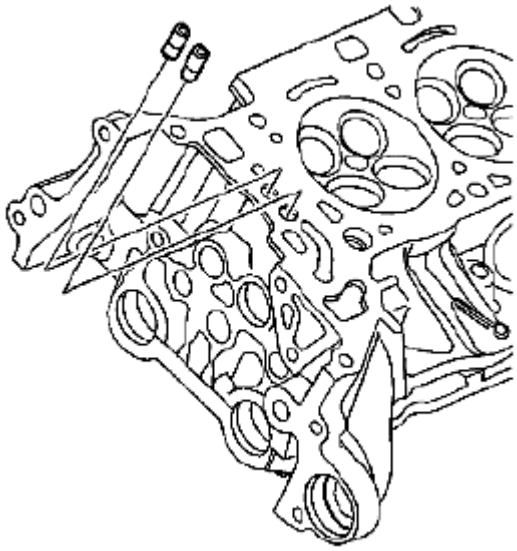


Fig. 449: Identifying Check Valves
Courtesy of SUZUKI OF AMERICA CORP.

5. Inspect the camshaft position actuator oil feed check valves. Damaged, restricted or clogged check valves must be replaced. Refer to **CYLINDER HEAD DISASSEMBLE**.

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Cylinder Head Measurement

Camshaft Journal Clearance

1. Install the camshaft bearing cap in the cylinder head without the camshaft.

CAUTION: Refer to FASTENER NOTICE .

2. Install the camshaft cap bolts.

Tightening torque

Tighten the camshaft cap bolts to 10 N.m (89 lb in) .

3. Measure the camshaft bearings using an inside micrometer.
4. Subtract the camshaft journal diameter from the camshaft bearing diameter. This will provide the running clearance. If the running clearance exceeds specifications and the camshaft journals are within specification, replace the cylinder head. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.

Camshaft Journal Alignment

1. Ensure the camshafts are serviceable.
2. Inspect the cylinder head camshaft bearing surfaces for any imperfections or scratches that could inhibit proper camshaft clearances. Repair minor imperfections or scratches.
3. Install the camshafts in the cylinder head.
4. Install the camshaft bearing caps.
5. Install the camshaft cap bolts.

Tightening torque

Tighten the camshaft cap bolts to 10 N.m (89 lb in) .

6. Ensure the camshafts spin freely in the cylinder head. If the camshaft does not run freely, replace the cylinder head.

Deck Flatness Inspection

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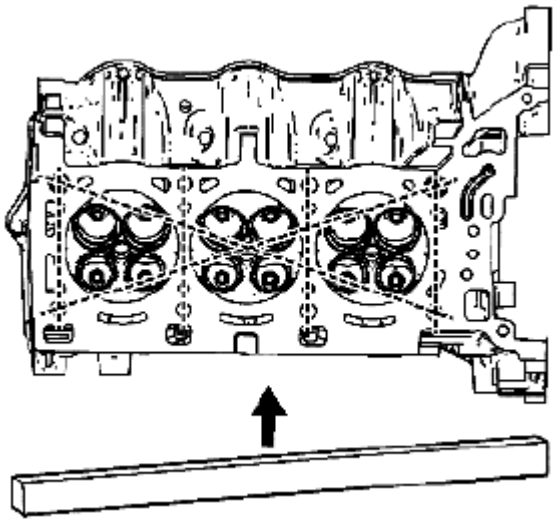


Fig. 450: Inspecting Deck Flatness
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the cylinder head decks are clean and free of gasket material.
2. Inspect the surface for any imperfections or scratches that could inhibit proper cylinder head gasket sealing.
3. Place a straight-edge diagonally across the cylinder head deck face surface.
4. Measure the clearance between the straight-edge and the cylinder head deck face using a feeler gage at 4 points along the straight-edge.
5. If the warpage is less than 0.05 mm (0.002 in), the cylinder head deck surface does not require resurfacing.
6. If the warpage is between 0.05-0.20 mm (0.002-0.008 in) or any imperfections or scratches that could inhibit proper cylinder head gasket sealing are present, the cylinder head deck surface requires resurfacing.
7. If resurfacing is required the maximum amount that can be removed is 0.25 mm (0.010 in).
8. If the cylinder head deck surface requires more than 0.25 mm (0.010 in) material removal the head must be replaced.

Valve Guide Measurement

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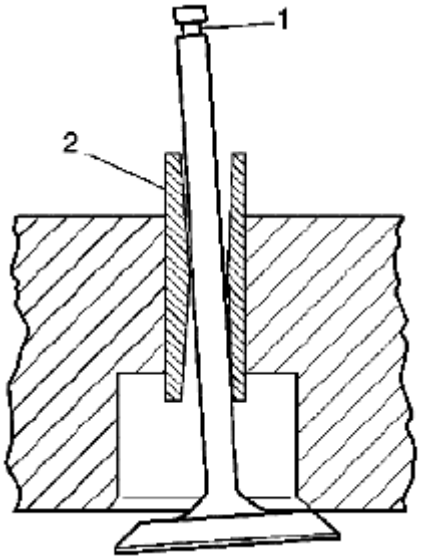


Fig. 451: Inspecting Valve Stem-To-Guide Clearance
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure the valve stem (1)-to-guide (2) clearance. Excessive valve stem-to-guide clearance may cause an excessive oil consumption and may also cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of the valve and will disturb the engine assembly smoothness.
2. Clamp the J 8001 to the cylinder head at the camshaft cover rail.
3. Locate the dial indicator so that the movement of the valve stem from side to side, crossways to the cylinder head, will cause a direct movement of the indicator stem. The dial indicator stem must contact the side of the valve stem just above the valve guide.
4. Drop the valve head about 0.064 mm (0.0025 in) off the valve seat.
5. Use light pressure when moving the valve stem from side to side in order to obtain a clearance reading. Refer to **ENGINE MECHANICAL SPECIFICATIONS** for proper clearance.
    - If the clearance for the valve is greater than specifications and a new standard diameter valve stem will not bring the clearance within specifications, the valve guide may be oversized by 0.075 mm (0.003 in) using the J 42096. There is 1 size of oversized valve stem available for service.
    - Valve guide wear at the bottom 10 mm (0.390 in) of the valve guide is not significant to normal operation.
    - If oversizing the guide does not bring the clearance within specifications, replace the cylinder head.

Reference: **CYLINDER HEAD ASSEMBLE**

VALVE SPRING INSPECTION AND MEASUREMENT

Reference: **CYLINDER HEAD DISASSEMBLE**

Special Tool

J 22738-B Valve Spring Tester

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For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

Inspection Procedure

1. Clean the valve springs in solvent.

   WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the valve springs with compressed air.
3. Inspect the valve springs for broken coils or coil ends.

Measurement Procedure

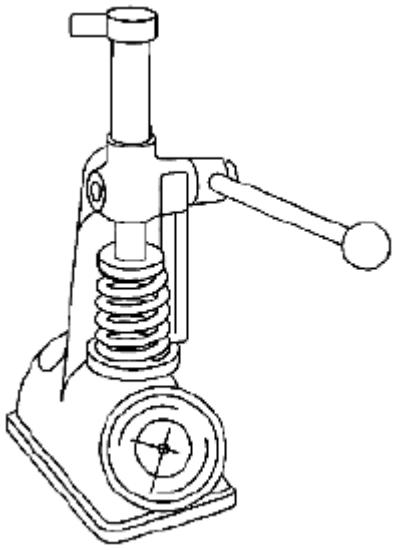


Fig. 452: Measuring Valve Spring Tension
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure the valve spring tension using the J 22738-B. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
2. If low valve spring load is found, replace the valve springs. DO NOT use shims to increase spring load. The use of shims can cause the valve spring to bottom out before the camshaft lobe is at peak lift.

   Reference: **CYLINDER HEAD ASSEMBLE**

VALVE AND SEAT GRINDING

Reference: **CYLINDER HEAD DISASSEMBLE**

Valve Cleaning Procedure

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1. Use soft bristle wire brush to clean any carbon build-up from the valve head. DO NOT use a wire brush on any part of the valve stem. The valve stem is chrome plated to provide enhanced wear characteristics. Wire brushing the stem could remove the chrome plating.
2. Thoroughly clean the valve with solvent and wipe dry.

Valve Visual Inspection Procedure

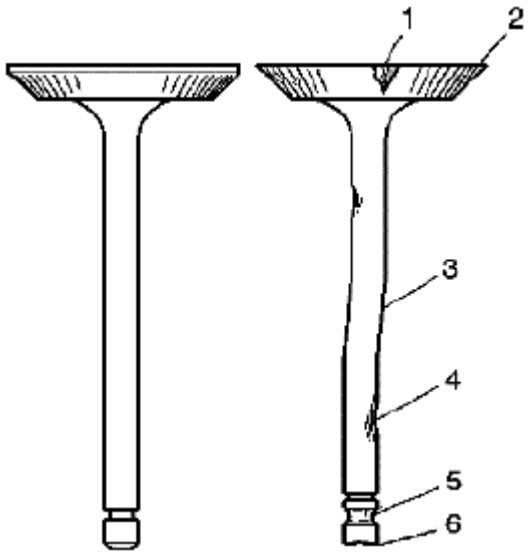


Fig. 453: Inspecting Valve
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the valve for damage from the head to tip for the following conditions:
   - Pitting in the valve seat area (1)
   - Lack of valve margin (2)
   - Bending in the valve stem (3)
   - Pitting or excessive wear in the stem (4)
   - Worn valve key grooves (5)
   - Worn valve tip (6)
2. Replace the valve if any of these conditions exist.

Valve Measurement and Reconditioning Overview

NOTE:

- **Proper valve service is critical to engine performance. Therefore, all detailed measurement procedures must be followed to identify components that are out of specification.**
- **If the measurement procedures reveal that the valve or valve seat must be reconditioned, it is critical to perform the measurement procedures after reconditioning.**

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Valve Seat Width Measurement Procedure

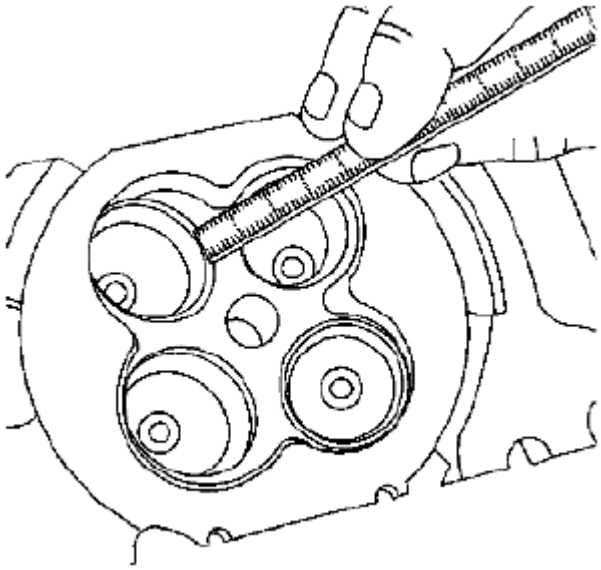


Fig. 454: Measuring Valve Seat Width In Cylinder Head Using Proper Scale
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure the valve seat width in the cylinder head using a proper scale.

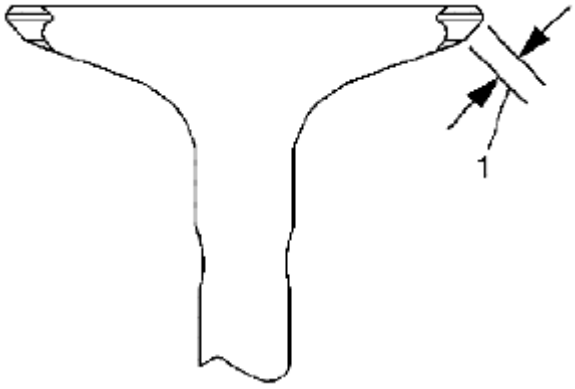


Fig. 455: Measuring Seat Width On Valve Face Using Proper Scale
Courtesy of SUZUKI OF AMERICA CORP.

2. Measure the seat width on the valve face (1) using a proper scale.

NOTE: **The seat contact area must be at least 0.5 mm (0.020 in) from the outer diameter (margin) of the valve. If the contact area is too close to the margins, the seat must be reconditioned to move the contact area away from the margin.**

3. Compare your measurements with the specifications listed in **ENGINE MECHANICAL SPECIFICATIONS**.

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4. If the seat widths are acceptable, check the valve seat roundness using the **VALVE SEAT ROUNDNESS MEASUREMENT PROCEDURE**.
5. If the seat width is not acceptable, you must grind the valve seat using the **VALVE AND SEAT RECONDITIONING PROCEDURE** to bring the width back into specification. Proper valve seat width is critical to providing the correct amount of valve heat dissipation.

Valve Seat Roundness Measurement Procedure

1. Measure the valve seat roundness using a dial indicator attached to a tapered pilot installed in the guide. The pilot should have a slight bind when installed in the guide.

CAUTION: The correct size pilot must be used. Do not use adjustable diameter pilots. Adjustable pilots may damage the valve guides.

2. Compare your measurements with the specifications listed in **ENGINE MECHANICAL SPECIFICATIONS**.
3. If the valve seat exceeds the roundness specification, you must grind the valve and valve seat using the **VALVE AND SEAT RECONDITIONING PROCEDURE**.
4. If new valves are being used, the valve seat roundness must be within 0.05 mm (0.002 in).

Valve Margin Measurement Procedure

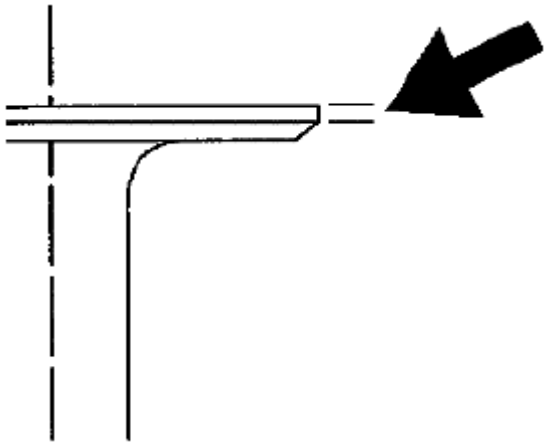


Fig. 456: Measuring Valve Margin
Courtesy of SUZUKI OF AMERICA CORP.

1. Measure the valve margin using an appropriate scale.
2. Reference the specifications in this information for minimum valve margin and compare them to your measurements.
3. If the valve margins are beyond specification, replace the valves.
4. If the valve margins are within specification and do not require refacing, test the valve for seat concentricity using the **VALVE-TO-SEAT CONCENTRICITY MEASUREMENT PROCEDURE**.

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Valve-to-Seat Concentricity Measurement Procedure

NOTE:

- **Checking the valve-to-seat concentricity determines whether the valve and seat are sealing properly.**
- **You must measure the valve face and the valve seat to ensure proper valve sealing.**

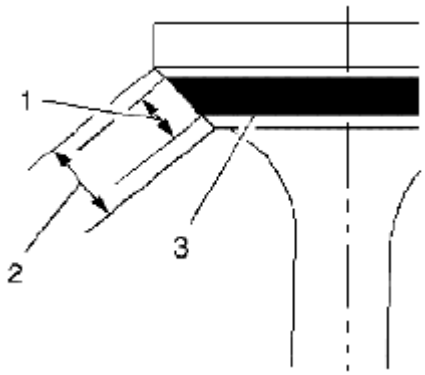


Fig. 457: Checking Valve-To-Seat Concentricity
Courtesy of SUZUKI OF AMERICA CORP.

1. Coat the valve face lightly with blue dye (3).
2. Install the valve in the cylinder head.
3. Turn the valve against the seat with enough pressure to wear off the dye.
4. Remove the valve from the cylinder head.
5. Inspect the valve face.
    - If the valve face is concentric, providing a proper seal, with the valve stem, a continuous mark will be made around the entire face (1).

      NOTE: The wear mark MUST be at least 0.5 mm (0.020 in) from the outer diameter, the margin, of the valve. If the wear mark is too close to the margin, the seat must be reconditioned to move the contact area away from the margin.

    - If the face is not concentric with the stem, the mark will NOT be continuous around the valve face. The valve should be refaced or replaced and the seat must be reconditioned using the **VALVE AND SEAT RECONDITIONING PROCEDURE**.

Valve and Seat Reconditioning Procedure

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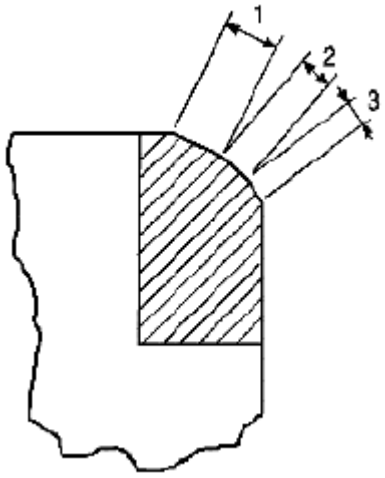


Fig. 458: Identifying Valve And Seat Reconditioning
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **If the valve seat width, roundness or concentricity is beyond specifications, you must grind the seats in order to ensure proper heat dissipation and prevent the build up of carbon on the seats.**
- **It is necessary to reface the valve if seat reconditioning is required unless a new valve is used.**

1. Grind the valve seats (2) to the proper angle specification listed in **ENGINE MECHANICAL SPECIFICATIONS**.
2. Using the proper angle specification listed in **ENGINE MECHANICAL SPECIFICATIONS**, grind, relieve, the valve seats (1) to correctly position the valve seating surface (2) to the valve.
3. Using the proper angle specification listed in **ENGINE MECHANICAL SPECIFICATIONS**, grind, undercut, the valve seats (3) to narrow the valve seat widths to the specifications listed in **ENGINE MECHANICAL SPECIFICATIONS**.
4. If the original valve is being used, grind the valve to the specifications listed in **ENGINE MECHANICAL SPECIFICATIONS**. Measure the valve margin again after grinding using the **VALVE MARGIN MEASUREMENT PROCEDURE**. Replace the valve if the margin is out of specification. New valves do not require grinding.
5. When grinding the valves and seats, grind off as little material as possible. Cutting valve seat results in lowering the valve spring pressure.
6. Install the valve in the cylinder head.
    - If you are using refaced valves, lap the valves into the seats with a fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that minimal lapping is required. Excessive lapping will groove the valve face and prevent a good seat when hot.

NOTE: **Be sure to clean any remaining lapping compound from the valve and seat with solvent and compressed air prior to final assembly.**

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- If you are using new valves, do not lap the valves under any condition.

7. After obtaining the proper valve seat width in the cylinder head, you must re-measure the valve stem height using the **VALVE STEM HEIGHT MEASUREMENT PROCEDURE**.
8. If the valve stem height is acceptable, test the seats for concentricity using the **VALVE-TO-SEAT CONCENTRICITY MEASUREMENT PROCEDURE**.

Valve Stem Height Measurement Procedure

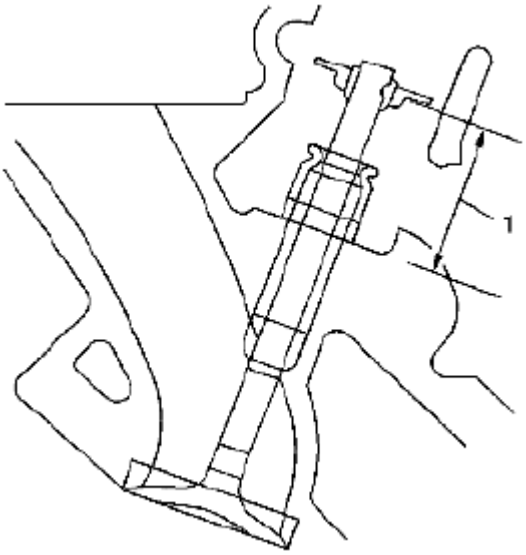


Fig. 459: Measuring Distance Between Cylinder Head To Bottom Of Valve Spring Retainer
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: To determine the valve stem height measurement, measure from the valve spring seat to the valve spring retainer.

1. Install the valve into the valve guide.
2. Ensure the valve is seated to the cylinder head valve seat.
3. Install the valve stem oil seal.
4. Install the valve spring retainer and valve stem locks.
5. Measure the distance (1) between the cylinder head to the bottom of the valve spring retainer. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
6. If the maximum height specification is exceeded, a new valve should be installed and the valve stem height re-measured.

CAUTION: DO NOT grind the valve stem tip. The tip of the valve is hardened and grinding the tip will eliminate the hardened surface causing premature wear and possible engine damage.

CAUTION: DO NOT use shims in order to adjust valve stem height. The use of

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shims will cause the valve spring to bottom out before the camshaft lobe is at peak lift and engine damage could result.

7. If the valve stem height still exceeds the maximum height specification, the cylinder head must be replaced.

   Reference: **CYLINDER HEAD ASSEMBLE**

CYLINDER HEAD ASSEMBLE

Reference: **CYLINDER HEAD CLEANING AND INSPECTION**

Reference: **VALVE SPRING INSPECTION AND MEASUREMENT**

Reference: **VALVE AND SEAT GRINDING**

Special Tool

EN 46116 Valve Stem Seal Remover/Installer

EN 46117 Valve Stem Key Remover/Installer

EN 46119 Off-Vehicle Valve Spring Compressor Adapter

EN-46122 Camshaft Position Actuator Check-Ball Valve Remover/Installer

J 8062 Valve Spring Compressor - Head Off

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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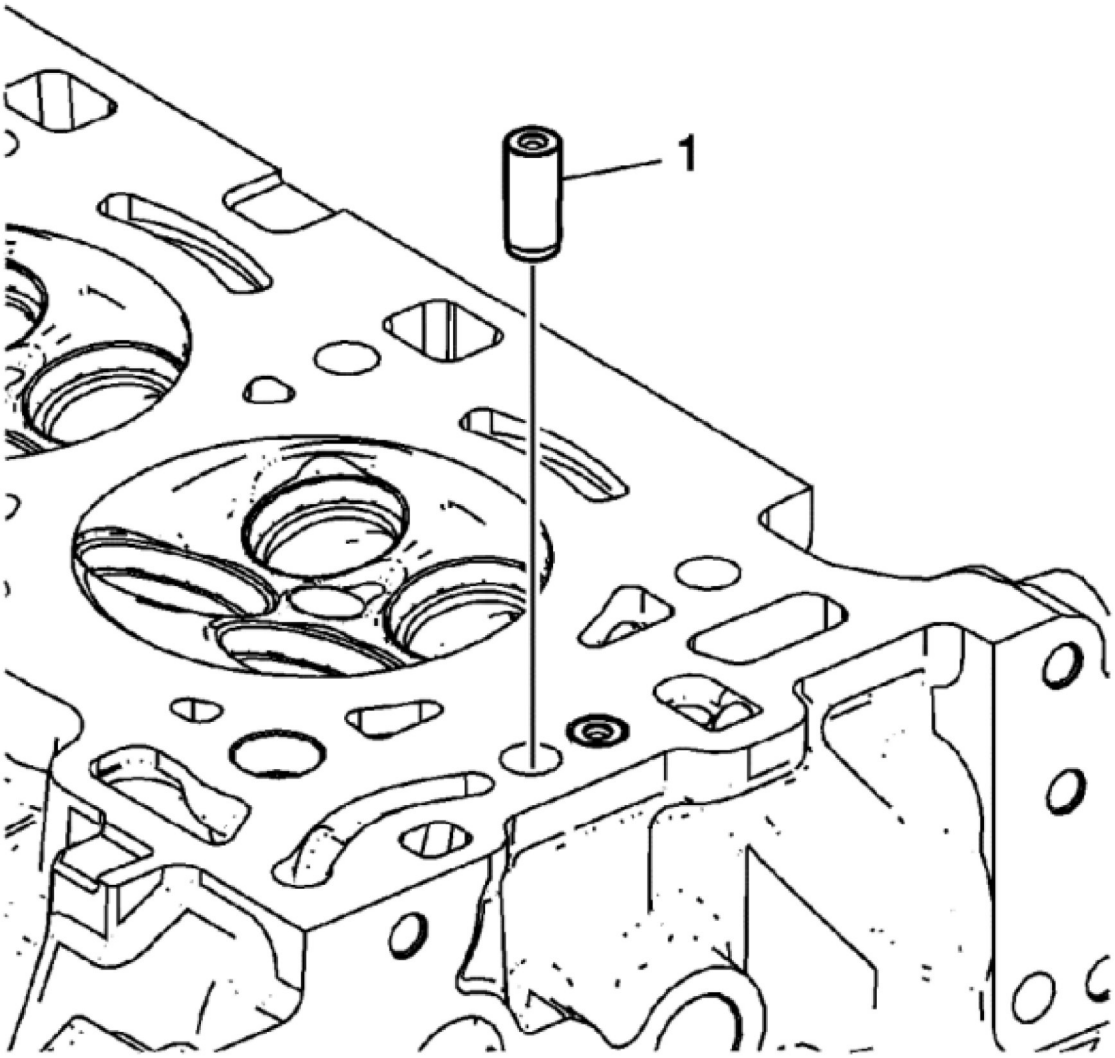


Fig. 460: Identifying Check Valve
Courtesy of SUZUKI OF AMERICA CORP.

1. Use lubricant included with EN-46122 remover/installer to lubricate outside of new check valve (1).
2. With the check ball end of the check valve facing UP, away from the head, insert the NEW check valve into the check valve bore in the cylinder head.

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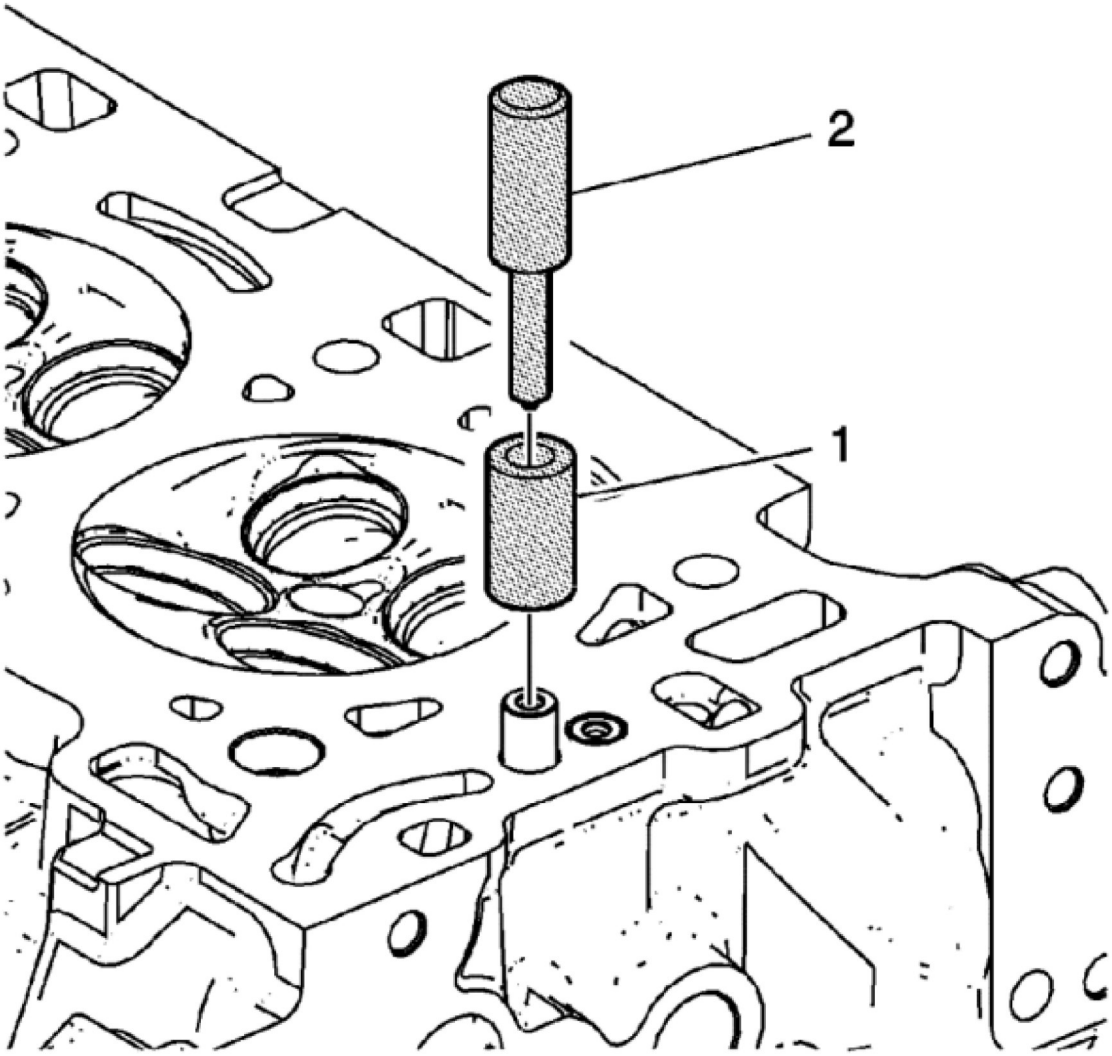


Fig. 461: Identifying Special Tool EN-46122
Courtesy of SUZUKI OF AMERICA CORP.

3. Place collar EN-46122-2 (1) over the new check valve with the slightly-larger inside diameter of the collar DOWN toward the cylinder head.
4. Using the driver EN-46122-1 (2), lightly tap the new check valve into place until the driver stops against the top of the collar.

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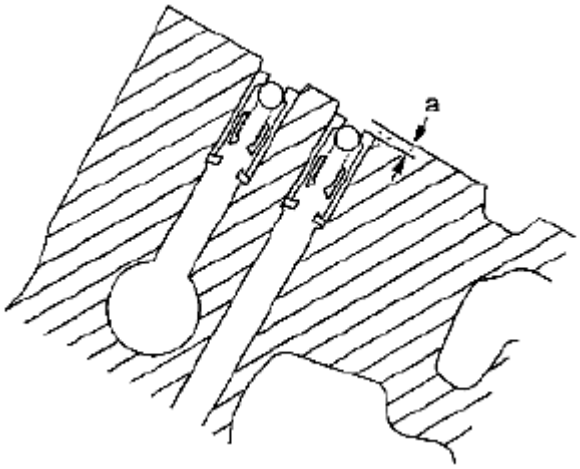


Fig. 462: Identifying Proper Camshaft Position Actuator Oil Feed Check Valves Installation
Courtesy of SUZUKI OF AMERICA CORP.

5. Inspect the camshaft position actuator oil feed check valves in order to ensure they are properly installed in the cylinder head. The camshaft position actuator oil feed check valve should be flush to 2 mm (0.0787 in) below the cylinder head deck surface (a).

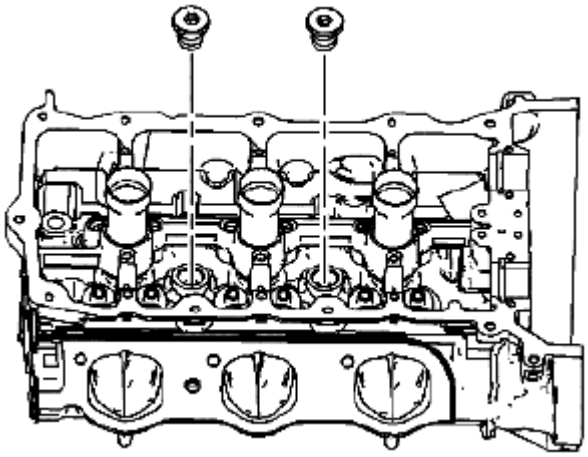


Fig. 463: Identifying Cylinder Head Coolant Threaded Plugs
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

6. Install the cylinder head coolant threaded plugs.

Tightening torque

Tighten the cylinder head coolant threaded plug to 31 N.m (23 lb ft) .

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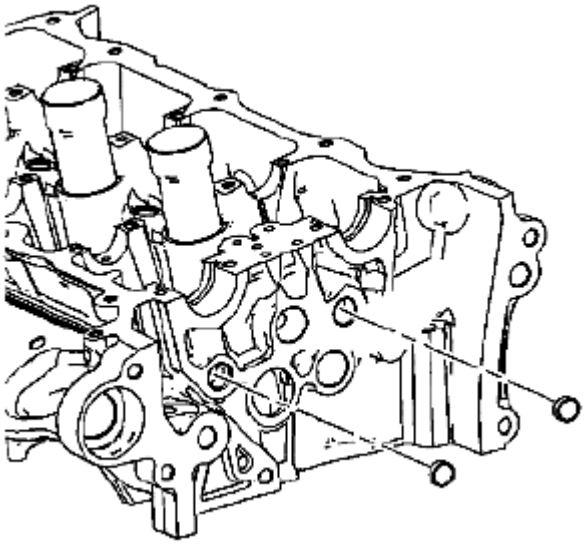


Fig. 464: Identifying Cylinder Head Oil Gallery Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the NEW cylinder head oil gallery expansion plugs.

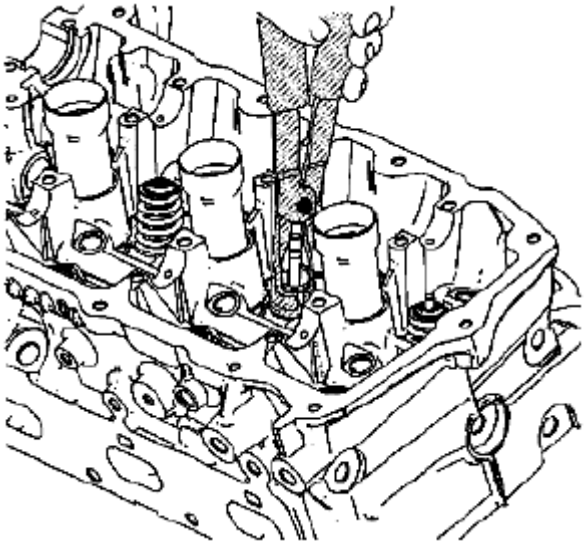


Fig. 465: Installing Valve Stem Oil Seals Onto Guides
Courtesy of SUZUKI OF AMERICA CORP.

8. Place the valve stem oil seals onto the guides.

NOTE: NEVER reuse a valve stem oil seal. Always use new seals when assembling the cylinder head.

9. Mount a new valve stem oil seal using the EN 46116 seal remover/installer.

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NOTE: Force should only be applied to the valve spring contact area of the new valve stem oil seal during installation.

10. Push and twist the valve stem oil seal into position on the valve guide until the seal positively locks on the guide using the EN 46116 seal remover/installer.
11. Lubricate the valve stem and valve guide ID with clean engine oil GM P/N 12345501 (Canadian P/N 992704) or equivalent.

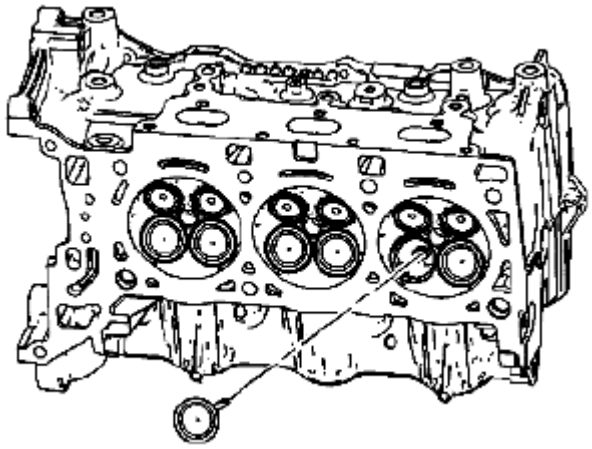


Fig. 466: Identifying Valve
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The valve stem oil seal must not come loose from the valve guide when the valve is installed.

12. Insert the valve into the valve guide until it bottoms on the valve seat.

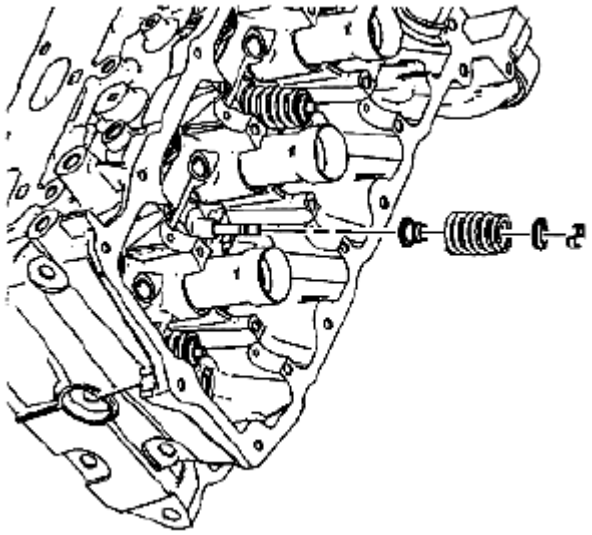


Fig. 467: Identifying Valve Spring And Retainer

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Courtesy of SUZUKI OF AMERICA CORP.

13. Position the valve spring on the spring seat.
14. Place the valve spring retainer onto the valve spring.

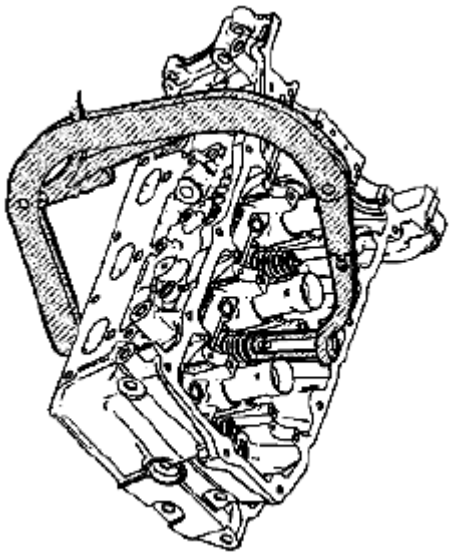


Fig. 468: Compressing Valve Spring Using J 8062 And EN 46119
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs less than 24.0 mm (0.943 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

15. Compress the valve spring using the J 8062 and the EN 46119.

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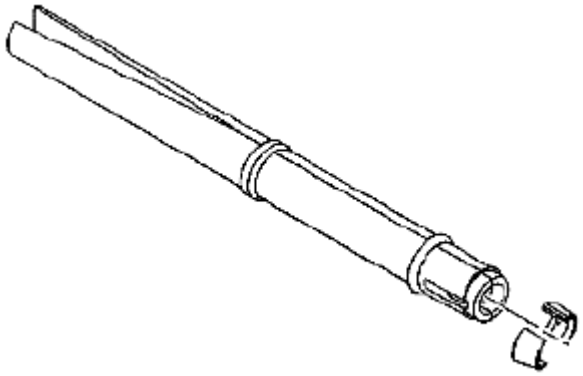


Fig. 469: Identifying Valve Keepers And Special Tool EN 46117
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure proper directional placement of valve keepers in the EN 46117. The valve keepers must be installed with the tapered end towards the valve stem seal.

16. With the spring compressed, install the valve keepers into the EN 46117.

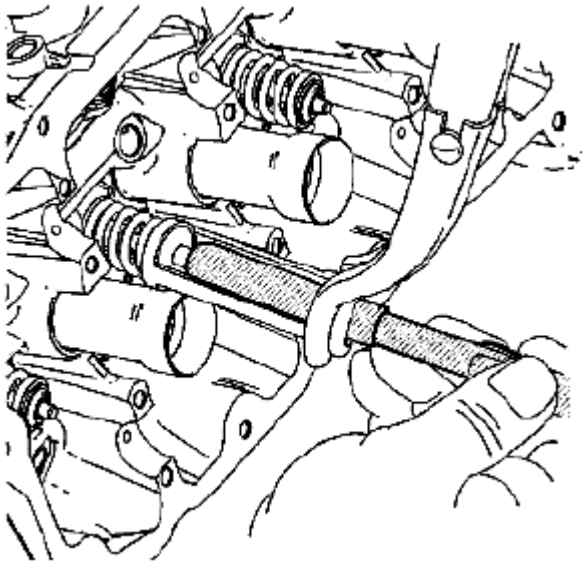


Fig. 470: Installing Valve Keepers
Courtesy of SUZUKI OF AMERICA CORP.

17. Place the keepers into position by pushing the tool downward and releasing tension on the EN 46119 and the J 8062 compressor - head off.
18. Verify that the valve keepers are installed by placing a rag over the valve tip and tapping with a dead-blow hammer. The valve keepers and the spring should remain in place.

Reference: **CYLINDER HEAD INSTALLATION - RIGHT SIDE**

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Reference: **CYLINDER HEAD INSTALLATION - LEFT SIDE**

CAMSHAFT CLEANING AND INSPECTION

Reference: **CAMSHAFT REMOVAL - LEFT SIDE**

Reference: **CAMSHAFT REMOVAL - RIGHT SIDE**

Special Tool

J 7872 Magnetic Base Dial Indicator

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

Cleaning Procedure

1. Clean the camshaft in solvent.

   WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the camshaft with compressed air.

Visual Inspection

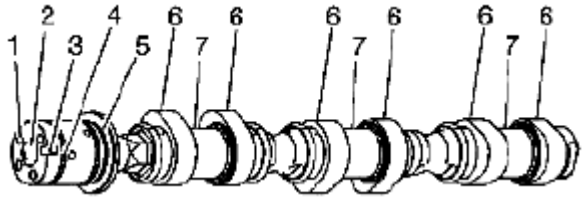


Fig. 471: Inspecting Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the camshaft oil feed holes (1) to the camshaft position actuator for dirt, debris or blockage.
2. Inspect the threaded hole (2) for damage.
3. Inspect the camshaft position actuator locating notch (3) for damage or wear.
4. Inspect the camshaft sealing grooves (4) for damage.
5. Inspect the camshaft thrust surface (5) for damage.
6. Inspect the camshaft lobes (6) and journals (7) for the following conditions:
   - Excessive scoring or pitting
   - Discoloration from overheating
   - Deformation from excessive wear, especially the camshaft lobes
7. If any of the above conditions exist on the camshaft, replace the camshaft.

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Camshaft Measurement

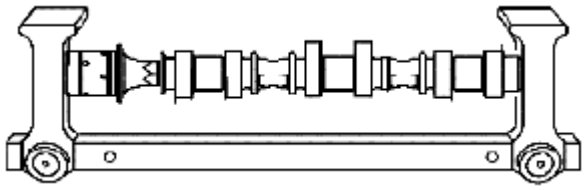


Fig. 472: Fixing Camshaft In Suitable Fixture
Courtesy of SUZUKI OF AMERICA CORP.

1. With the camshaft in a suitable fixture, measure the camshaft for wear.

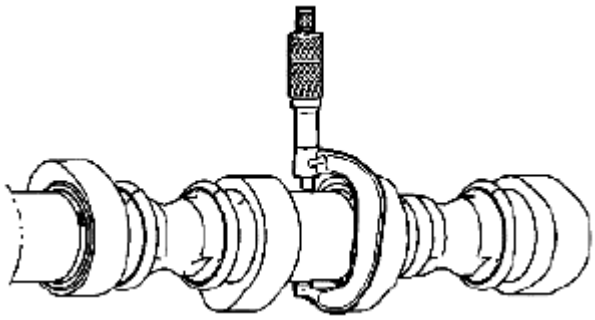


Fig. 473: Measuring Camshaft Journals For Diameter And Out-Of-Round Using Outside Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

2. Measure the camshaft journals for diameter and out-of-round using an outside micrometer. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
    - If the diameter is smaller than specifications, replace the camshaft.
    - If the out-of-round exceeds specifications, replace the camshaft.

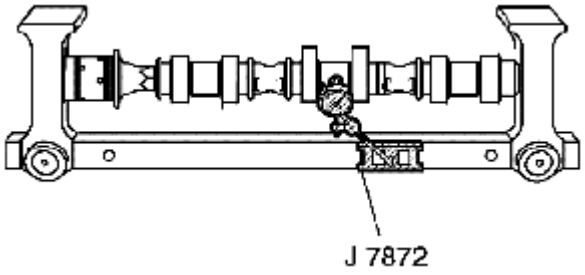


Fig. 474: Measuring Camshaft Runout Using J 7872
Courtesy of SUZUKI OF AMERICA CORP.

3. Measure the camshaft runout using the J 7872. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.

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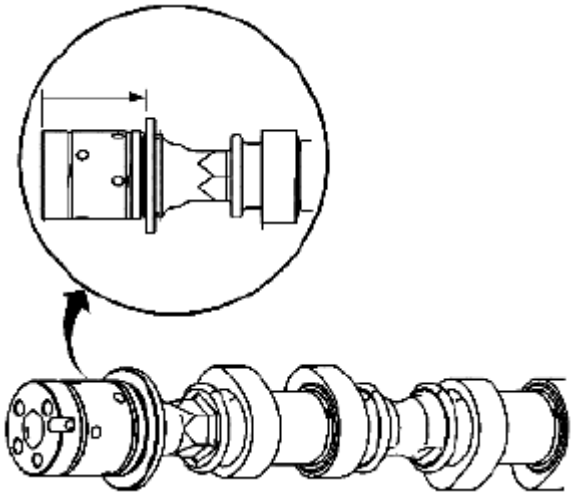


Fig. 475: Identifying Camshaft Thrust Width
Courtesy of SUZUKI OF AMERICA CORP.

4. Measure the camshaft thrust width for wear using a depth micrometer. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.

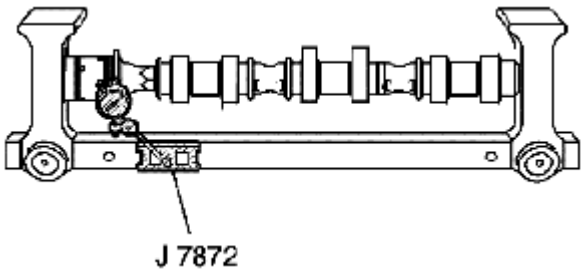


Fig. 476: Measuring Camshaft Thrust Wall Surface For Runout Using J 7872
Courtesy of SUZUKI OF AMERICA CORP.

5. Measure the camshaft thrust wall surface for runout using J 7872. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
6. If the camshaft is damaged or worn beyond specifications, replace the camshaft. No machining of the camshaft is allowed.

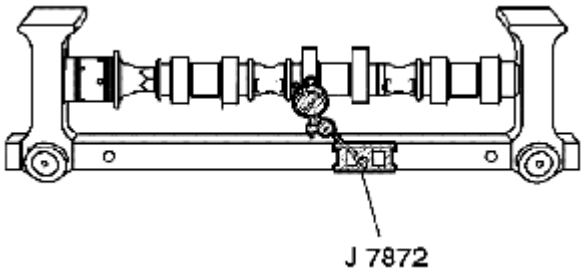


Fig. 477: Measuring Camshaft Lobes For Wear Using J 7872
Courtesy of SUZUKI OF AMERICA CORP.

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7. Measure the camshaft lobes for wear using the J 7872.

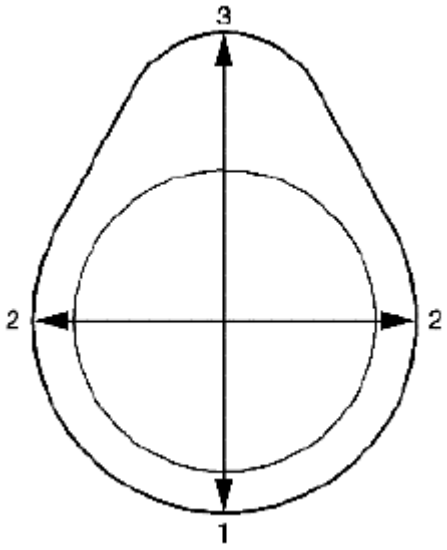


Fig. 478: Identifying Base Circle Of Camshaft Lobe
Courtesy of SUZUKI OF AMERICA CORP.

8. Place the J 7872 with the indicator tip on the base circle (1) of the camshaft lobe.
   a. Place the J 7872 at zero.
   b. Rotate the camshaft until the indicator tip is at the highest point (3) on the lobe. This reading is the lift of the camshaft lobe. Refer to **ENGINE MECHANICAL SPECIFICATIONS**.
   c. If the indicated measurement is significantly lower than these specifications, replace the camshaft or engine performance will be reduced.

Reference: **CAMSHAFT INSTALLATION - RIGHT SIDE**

Reference: **CAMSHAFT INSTALLATION - LEFT SIDE**

VALVE LIFTERS CLEANING AND INSPECTION

Reference: **VALVE LIFTER REMOVAL - LEFT SIDE**

Reference: **VALVE LIFTER REMOVAL - RIGHT SIDE**

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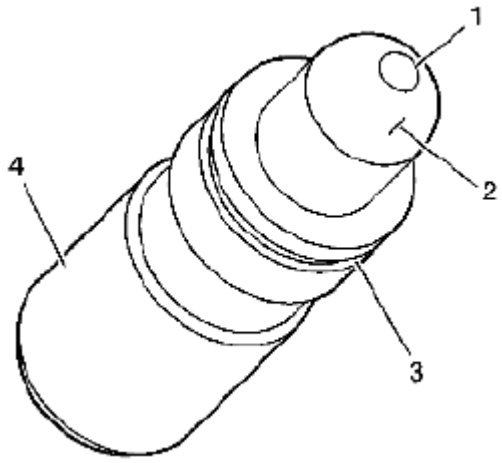


Fig. 479: Inspecting Stationary Hydraulic Lash Adjuster
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to Valve Lifter Priming Notice.

1. Inspect the stationary hydraulic lash adjuster (SHLA) in the following areas:
   - A plugged oil passage (1)
   - A scored or worn camshaft follower pivot area (2)
   - A damaged or broken retainer (3), some applications
   - A severely scuffed or worn SHLA body (4)
2. Replace the SHLA or SHLAs as necessary.

   Reference: **VALVE LIFTER INSTALLATION - RIGHT SIDE**

   Reference: **VALVE LIFTER INSTALLATION - LEFT SIDE**

VALVE ROCKER ARMS CLEANING AND INSPECTION

Reference: **VALVE ROCKER ARM REMOVAL - LEFT SIDE**

Reference: **VALVE ROCKER ARM REMOVAL - RIGHT SIDE**

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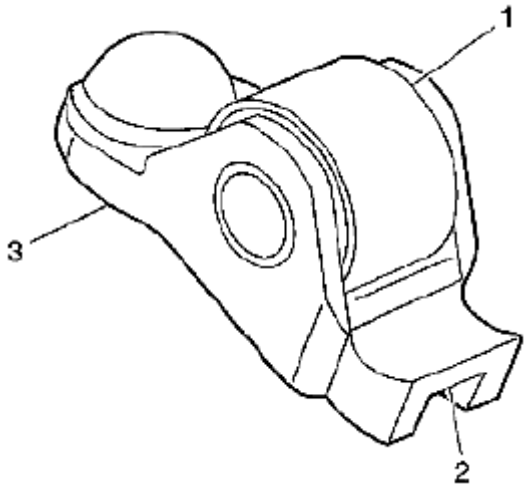


Fig. 480: Inspecting Valve Rocker Arms
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the camshaft follower roller (1) for the following:
    - Flat spots
    - Excessive scoring and pitting
    - Ensure the roller spins freely
2. Inspect the camshaft follower valve tip area (2).
3. Inspect the camshaft follower stationary hydraulic lash adjuster (SHLA) pivot area (3).
4. Replace the camshaft follower or followers as necessary.

    Reference: **VALVE ROCKER ARM INSTALLATION - RIGHT SIDE**

    Reference: **VALVE ROCKER ARM INSTALLATION - LEFT SIDE**

CAMSHAFT TIMING DRIVE COMPONENTS CLEANING AND INSPECTION

Reference: **CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE INTAKE**

Cleaning Procedure

1. Clean all the following components with solvent:
    - Crankshaft sprocket
    - Primary timing drive chain
    - Primary timing drive chain shoe
    - Primary timing drive chain guides
    - Primary timing drive chain tensioner
    - Secondary timing drive chains
    - Secondary timing drive chain shoes

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- Secondary timing drive chain guides
- Secondary timing drive chain tensioners
- Timing component fastening bolts

2. Clean each camshaft position actuator's exterior with solvent.

WARNING: Refer to SAFETY GLASSES CAUTION .

3. Dry the timing components with compressed air.

Visual Inspection

Camshaft Position Actuators

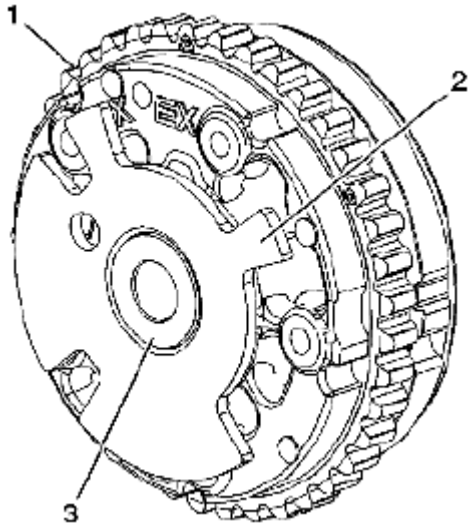


Fig. 481: Identifying Front Of Exhaust Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the front of the exhaust camshaft position actuators for the following:
   - Sprocket damage (1)
   - Reluctor/sensor wheel damage (2)
   - Camshaft position actuator bolt seating/sealing inner hub flange damage (3)

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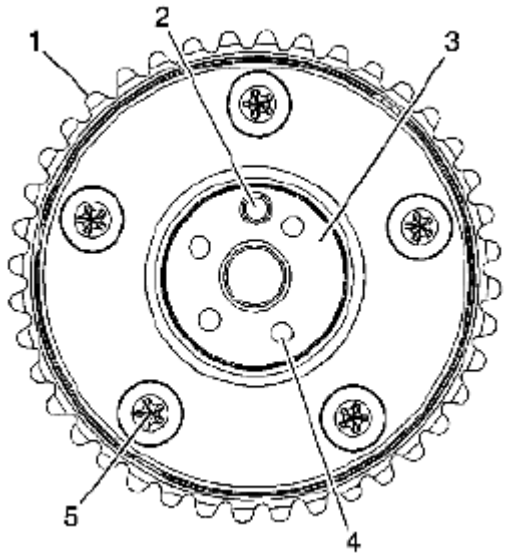


Fig. 482: Identifying Back Of Exhaust Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the back of the exhaust camshaft position actuators for the following:
   - Sprocket damage (1)
   - Camshaft locating pin damage (2)
   - Camshaft seating/sealing inner hub flange damage (3)
   - Blockage to the oil passages (4)
   - Loose or missing housing bolts (5)

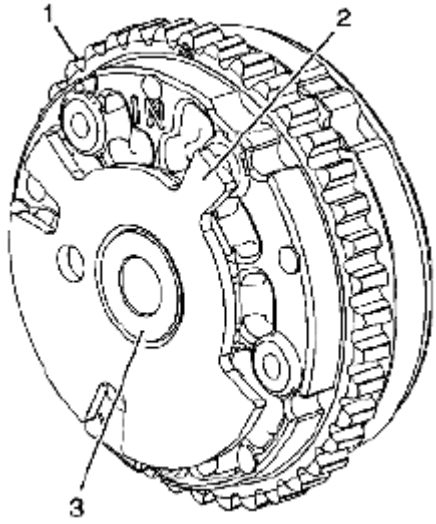


Fig. 483: Identifying Front Of Left Intake Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

3. Inspect the front of the left intake camshaft position actuators for the following:

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- Sprocket damage (1)
- Reluctor/sensor wheel damage (2)
- Camshaft position actuator oil control valve bolt seating/sealing inner hub flange damage (3)

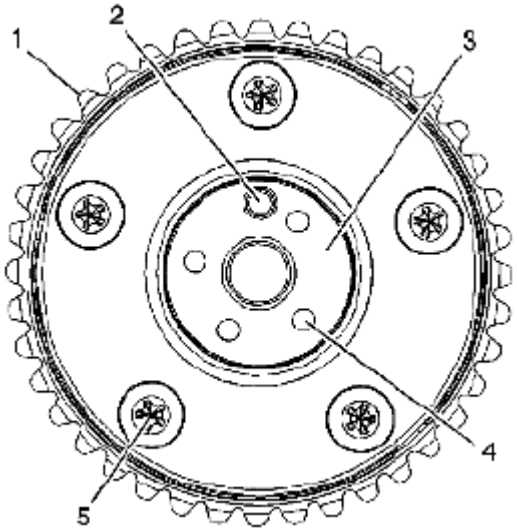
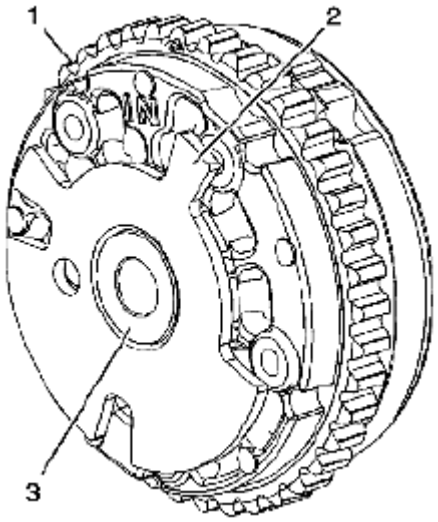


Fig. 484: Identifying Back Of Left Intake Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

4. Inspect the back of the left intake camshaft position actuators for the following:
   - Sprocket damage (1)
   - Camshaft locating pin damage (2)
   - Camshaft seating/sealing inner hub flange damage (3)
   - Blockage to the oil passages (4)
   - Loose or missing housing bolts (5)



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Fig. 485: Identifying Front Of Right Intake Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

5. Inspect the front of the right intake camshaft position actuators for the following:
   - Sprocket damage (1)
   - Reluctor/sensor wheel damage (2)
   - Camshaft position actuator oil control valve bolt seating/sealing inner hub flange damage (3)

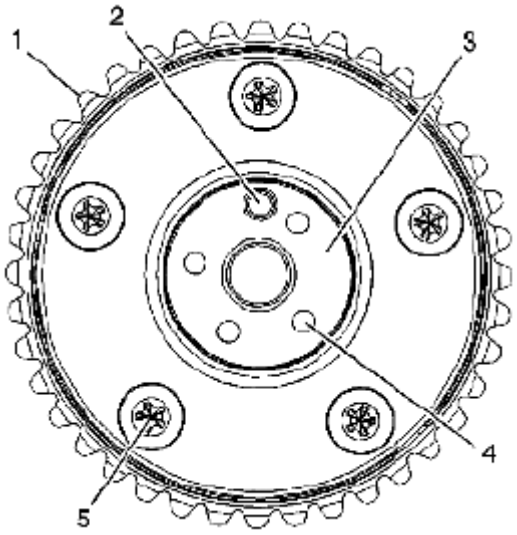


Fig. 486: Identifying Back Of Right Intake Camshaft Position Actuators
Courtesy of SUZUKI OF AMERICA CORP.

6. Inspect the back of the right intake camshaft position actuators for the following:
   - Sprocket damage (1)
   - Camshaft locating pin damage (2)
   - Camshaft seating/sealing inner hub flange damage (3)
   - Blockage to the oil passages (4)
   - Loose or missing housing bolts (5)
7. Replace a damaged camshaft position actuator.

Camshaft Position Actuator Oil Control Valves

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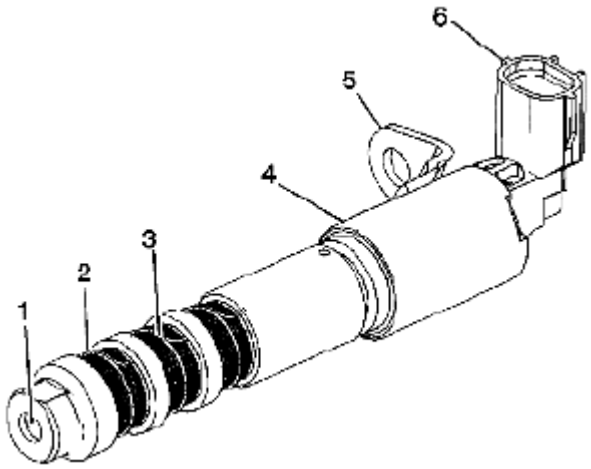


Fig. 487: Identifying Camshaft Position Actuator Oil Control Valves
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the camshaft position actuator oil control valves for the following:
   - Blockage to the oil passage (1)
   - Missing or damaged oil screen clip (2)
   - Blockage or damage to the oil screen (3)
   - Damage to the sealing surface for the camshaft position actuator oil control valve solenoid oil seal (4)
   - Damage to the bracket (5)
   - Damage to the wiring harness connection and/or terminals (6)
2. Replace a damaged camshaft position actuator oil control valve.

Left Intermediate Sprocket with Primary and Secondary Inverted Tooth (IT) Chain

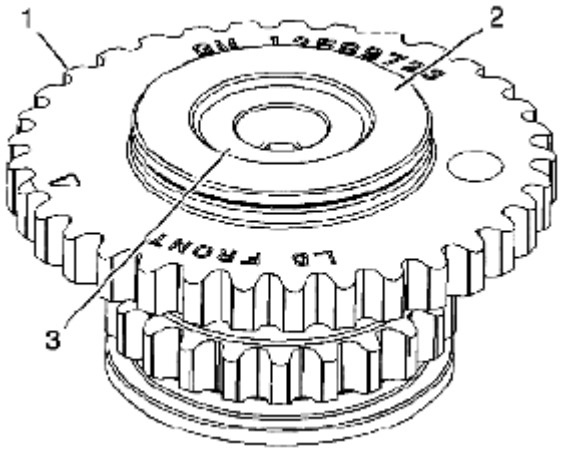


Fig. 488: Identifying Front Of Left Intermediate Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the front of the left intermediate sprocket for the following:

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- Damage to the primary camshaft drive chain sprocket (1)
- Damage to the hub bearing (2) - Ensure the hub bearing spins freely. If the hub bearing wobbles, is noisy, or feels rough when rotated, replace the intermediate sprocket.
- Damage to the bolt flange seating/sealing surface (3)

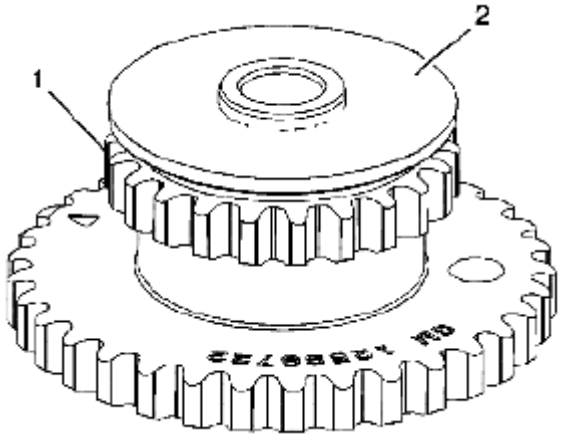


Fig. 489: Identifying Back Of Left Intermediate Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the back of the left intermediate sprocket for the following:
   - Damage to the left secondary camshaft drive chain sprocket (1)
   - Damage to the bearing hub-to-engine block sealing surface (2)
3. Replace a damaged left intermediate sprocket.

Right Intermediate Sprocket with Primary and Secondary Inverted Tooth (IT) Chain

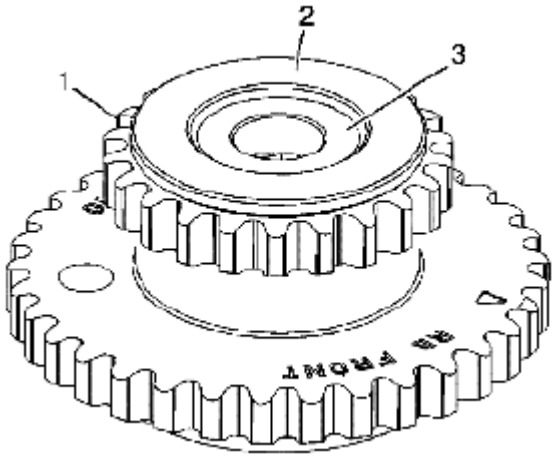


Fig. 490: Identifying Front Of Right Intermediate Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the front of the right intermediate sprocket for the following:

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- Damage to the right secondary camshaft drive chain sprocket (1)
- Damage to the hub bearing (2) - Ensure the hub bearing spins freely. If the hub bearing wobbles, is noisy, or feels rough when rotated, replace the intermediate sprocket.
- Damage to the bolt flange seating/sealing surface (3)

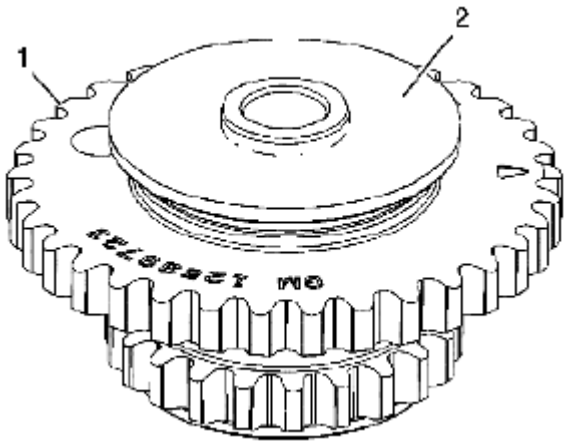


Fig. 491: Identifying Back Of Right Intermediate Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the back of the right intermediate sprocket for the following:
   - Damage to the primary camshaft drive chain sprocket (1)
   - Damage to the bearing hub-to-engine block sealing surface (2)
3. Replace a damaged right intermediate sprocket.

Crankshaft Sprocket with Second Version Primary Inverted Tooth (IT) Chain

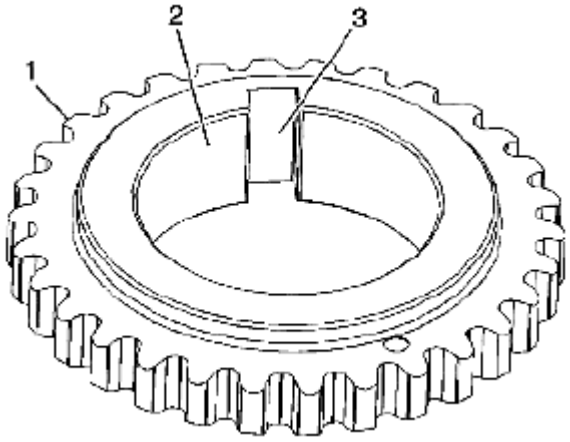


Fig. 492: Identifying Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the crankshaft sprocket for the following:

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- Sprocket damage (1)
- Bore damage (2)
- Keyway damage (3)

2. Replace a damaged crankshaft sprocket.

Secondary Timing Chains with Inverted Tooth (IT) Chain

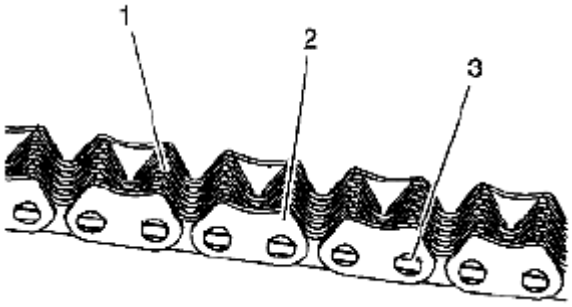


Fig. 493: Identifying Secondary Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the secondary timing chain for the following:
   - Binding or worn links (1)
   - Loose links (2)
   - Loose pins (3)
2. Replace a damaged secondary timing chain.

Primary Timing Chain with Inverted Tooth (IT) Chain

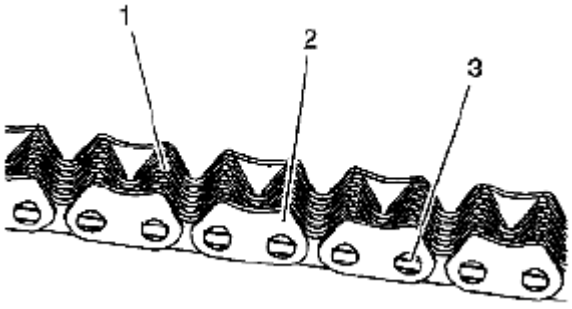


Fig. 494: Identifying Primary Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the primary timing chain for the following:
   - Binding or worn links (1)
   - Loose links (2)
   - Loose pins (3)
2. Replace a damaged primary timing chain.

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Primary Timing Chain Upper Guide

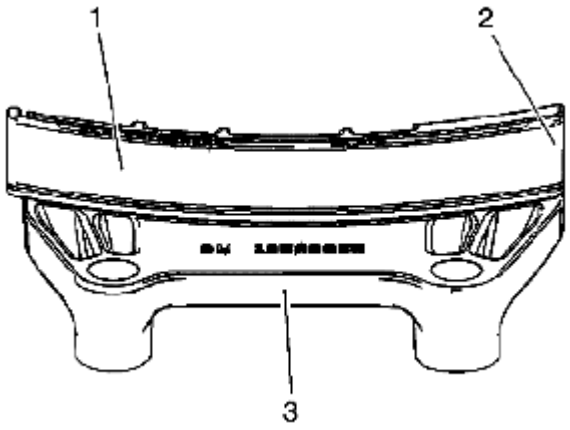


Fig. 495: Identifying Primary Timing Chain Upper Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the primary timing chain upper guide for the following:
   - Worn guide surface (1)
   - Cracked or broken guide surface (2)
   - Cracked or damaged guide base (3)
2. Replace a damaged primary timing chain upper guide.

Primary Timing Chain Lower Guide

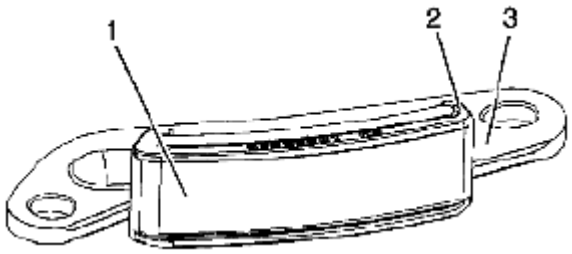


Fig. 496: Identifying Primary Timing Chain Lower Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the primary timing chain lower guide for the following:
   - Worn guide surface (1)
   - Cracked or broken guide surface (2)
   - Cracked or damaged guide base (3)
2. Replace a damaged primary timing chain lower guide.

Left Secondary Timing Chain Guide

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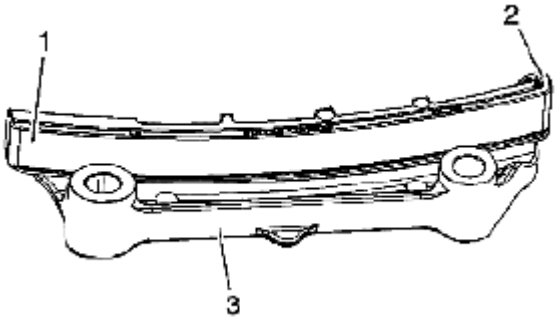


Fig. 497: Identifying Left Secondary Timing Chain Guides
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the left secondary timing chain guides for the following:
    - Worn guide surface (1)
    - Cracked or broken guide surface (2)
    - Cracked or damaged guide base (3)
2. Replace a damaged left secondary timing chain guide.

Right Secondary Timing Chain Guide

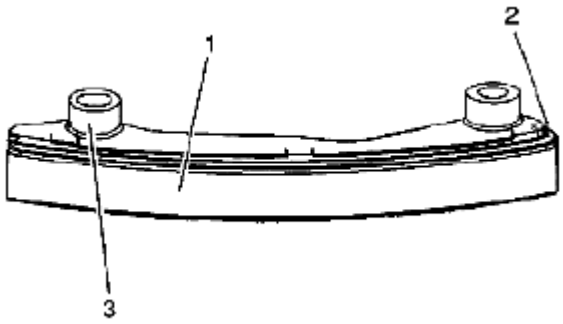


Fig. 498: Identifying Right Secondary Timing Chain Guides
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the right secondary timing chain guides for the following:
    - Worn guide surface (1)
    - Cracked or broken guide surface (2)
    - Cracked or damaged guide base (3)
2. Replace a damaged right secondary timing chain guide.

Left Secondary Timing Chain Shoe

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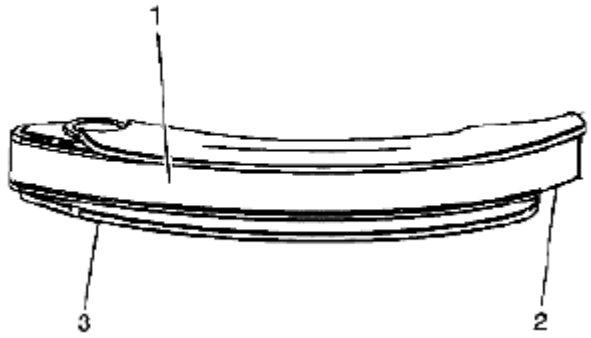


Fig. 499: Identifying Left Secondary Timing Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the front of the left secondary timing chain shoe for the following:
   - Worn shoe surface (1)
   - Cracked or broken shoe surface (2)
   - Cracked or damaged shoe (3)

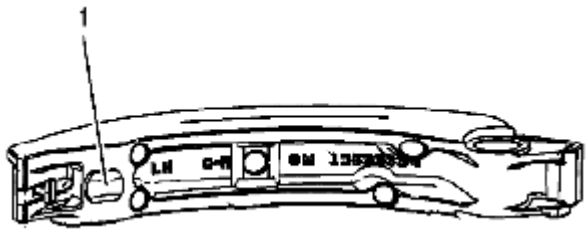


Fig. 500: Identifying Left Secondary Timing Chain Tensioner Contact Pad
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the back of the left secondary timing chain shoe for a damaged, worn, or missing left secondary timing chain tensioner contact pad (1).
3. Replace a damaged left secondary timing chain shoe.

Right Secondary Timing Chain Shoe

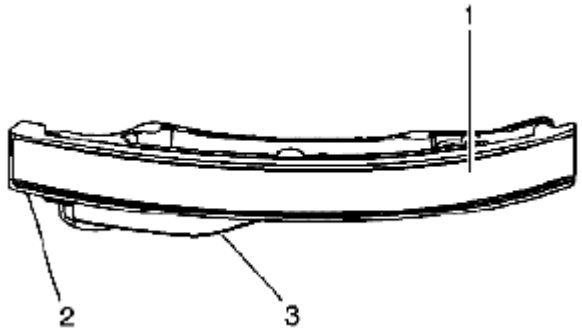


Fig. 501: Identifying Right Secondary Timing Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

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1. Inspect the front of the right secondary timing chain shoe for the following:
   - Worn shoe surface (1)
   - Cracked or broken shoe surface (2)
   - Cracked or damaged shoe (3)

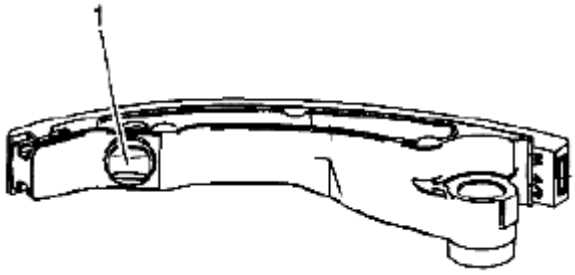


Fig. 502: Identifying Right Secondary Timing Chain Tensioner Contact Pad
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the back of the right secondary timing chain shoe for a damaged, worn, or missing right secondary timing chain tensioner contact pad (1).
3. Replace a damaged right secondary timing chain shoe.

Primary Timing Chain Tensioner

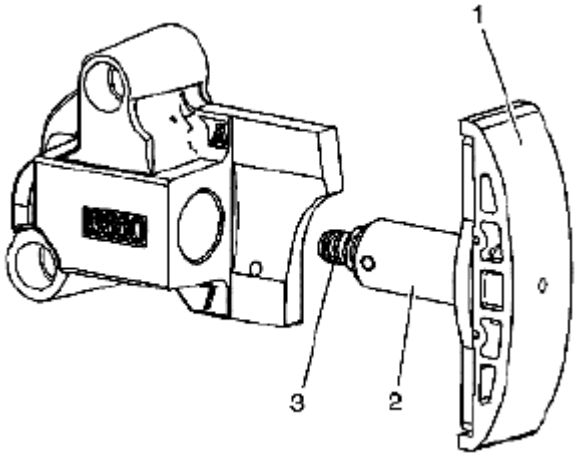


Fig. 503: Inspecting Primary Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the primary timing chain tensioner for worn primary timing chain tensioner shoe surface (1).
2. Inspect the primary timing chain tensioner for locked or binding timing chain tensioner. Reset the plunger (3) and ensure the plunger moves freely (2) in and out of the body of the tensioner. Refer to **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**.
3. Replace a damaged primary timing chain tensioner.

Left Secondary Timing Chain Tensioner

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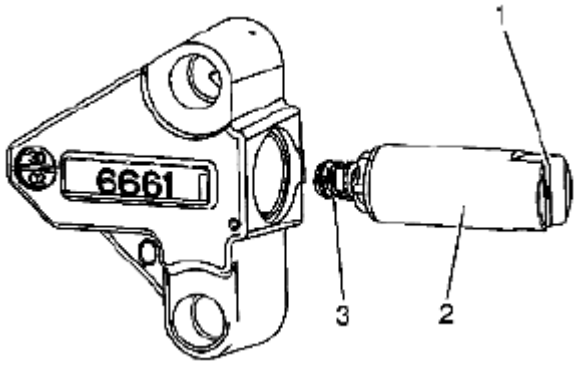


Fig. 504: Inspecting Left Secondary Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the left secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1).
2. Inspect the left secondary timing chain tensioner for locked or binding timing chain tensioner. Reset the plunger (3) and ensure the plunger moves freely (2) in and out of the body of the tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**.
3. Replace a damaged left secondary timing chain tensioner.

Right Secondary Timing Chain Tensioner

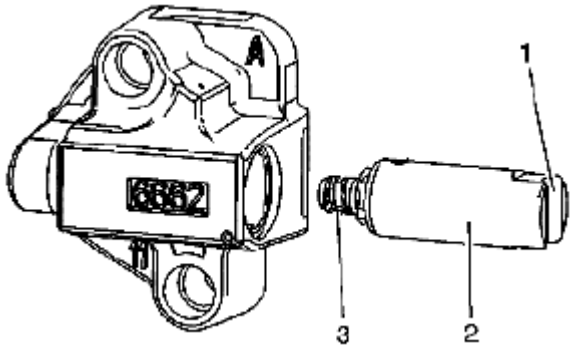


Fig. 505: Inspecting Right Secondary Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the right secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1).
2. Inspect the right secondary timing chain tensioner for locked or binding timing chain tensioner. Reset the plunger (3) and ensure the plunger moves freely (2) in and out of the body of the tensioner. Refer to **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**.
3. Replace a damaged right secondary timing chain tensioner.

Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE**

ENGINE FRONT COVER DISASSEMBLE

Reference: **ENGINE FRONT COVER REMOVAL**

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Special Tool

J 45000 Seal Remover

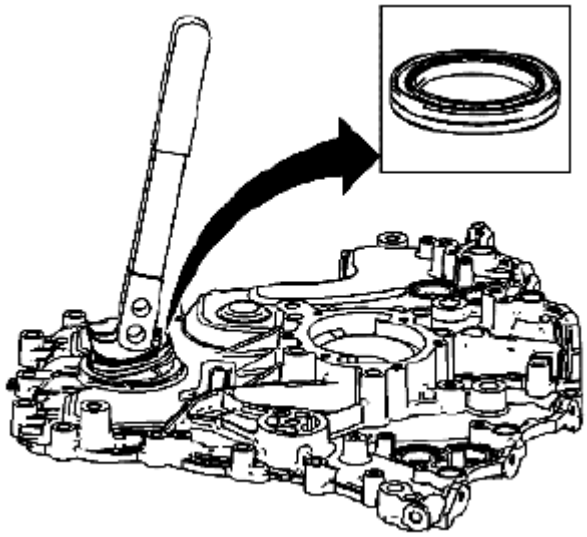


Fig. 506: Identifying Crankshaft Front Oil Seal And Special Tool J 45000
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the crankshaft front oil seal from the engine front cover using the J 45000.

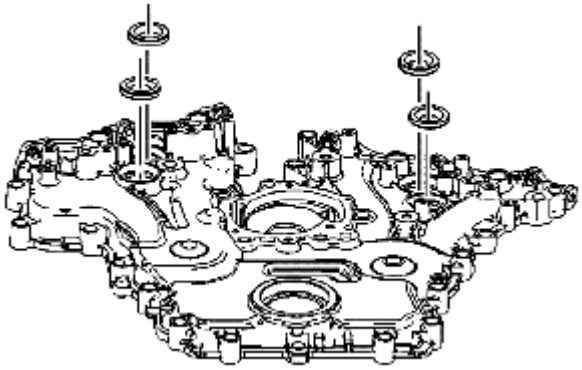


Fig. 507: Identifying Camshaft Position Actuator Valve Oil Seals
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the camshaft position actuator valve oil seals from the engine front cover.

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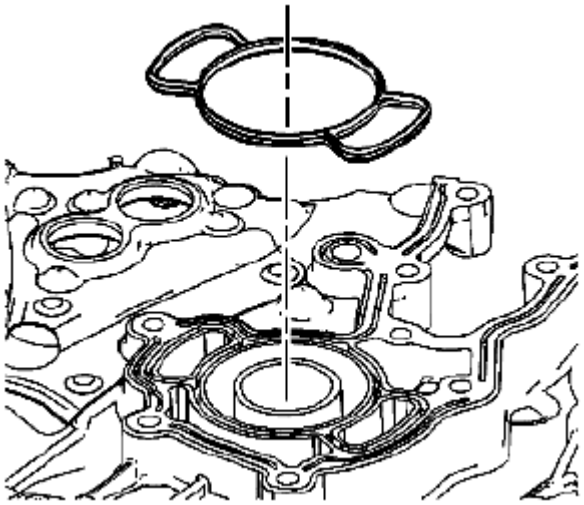


Fig. 508: Identifying Water Pump Seal
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the water pump seal from the engine front cover.
4. Discard the water pump seal.

Reference: **ENGINE FRONT COVER CLEANING AND INSPECTION**

ENGINE FRONT COVER CLEANING AND INSPECTION

Reference: **ENGINE FRONT COVER DISASSEMBLE**

Special Tool

J 28410 Gasket Remover

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

Cleaning Procedure

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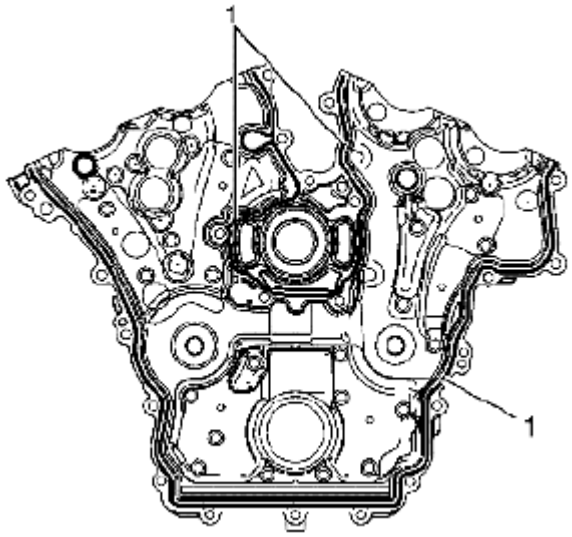


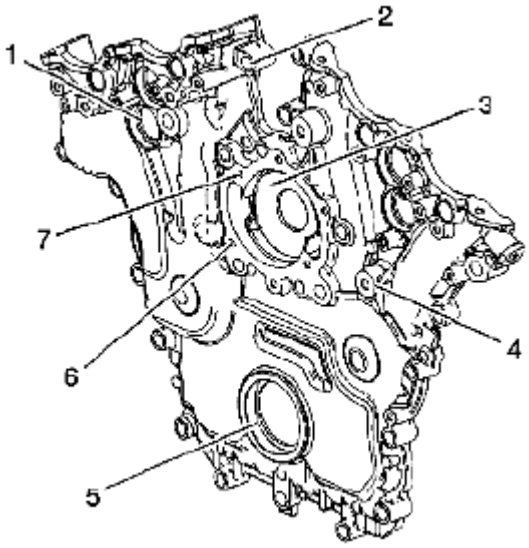
Fig. 509: Locating RTV Sealant On Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove any RTV sealant (1) from the engine front cover using J 28410.
2. Clean out debris from the bolt holes.
3. Clean the engine front cover in solvent.

WARNING: Refer to SAFETY GLASSES CAUTION .

4. Dry the engine front cover with compressed air.

Inspection Procedure



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Fig. 510: Inspecting Exterior Of Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the exterior of the engine front cover for the following conditions:
   - Damage to the camshaft position actuator valve oil seal bores (1)
   - Damage to the engine front cover bolt holes (2)
   - Damage and/or corrosion to the engine coolant passage (3)
   - Dents or damage to the exterior (4)
   - Damage to the crankshaft front oil seal bore (5)
   - Gouges or damage to the water pump sealing surfaces (6)
   - Damage to the water pump bolt hole threads (7)

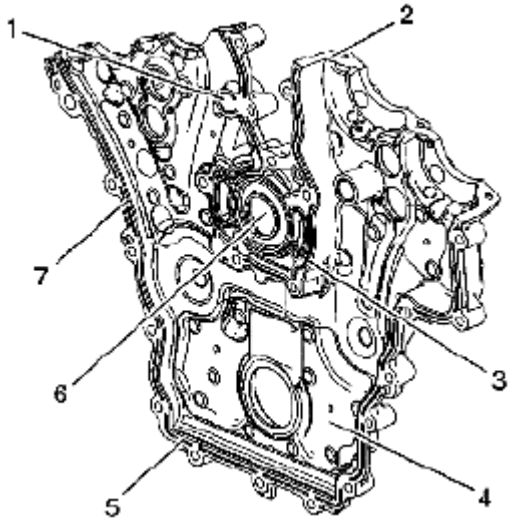


Fig. 511: Inspecting Interior Of Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the interior of the engine front cover for the following conditions:
   - Damage to the engine front cover bolt holes (1)
   - Gouges or damage to the engine front cover sealing surfaces to the engine block (7), oil pan (5), and/or camshaft covers (2)
   - Gouges or damage to the water pump seal area (3)
   - Loose or damaged deadener plates (4)
   - Damage and/or corrosion to the engine coolant passage (6)
   - Damage to the crankshaft front oil seal bore
   - Gouges or damage to the O-ring sealing areas
3. Repair or replace the engine front cover as necessary.

Reference: **ENGINE FRONT COVER ASSEMBLE**

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ENGINE FRONT COVER ASSEMBLE

Reference: **ENGINE FRONT COVER CLEANING AND INSPECTION**

Special Tool

EN-46103 Camshaft Actuator Valve Seal Remover/Installer

J 29184 Output Shaft Seal Installer

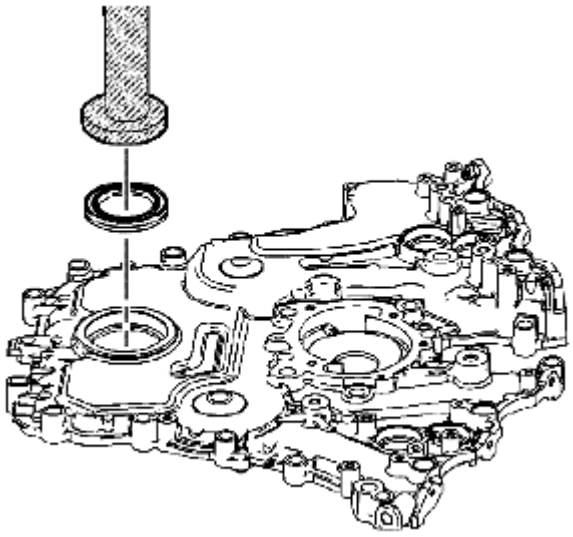
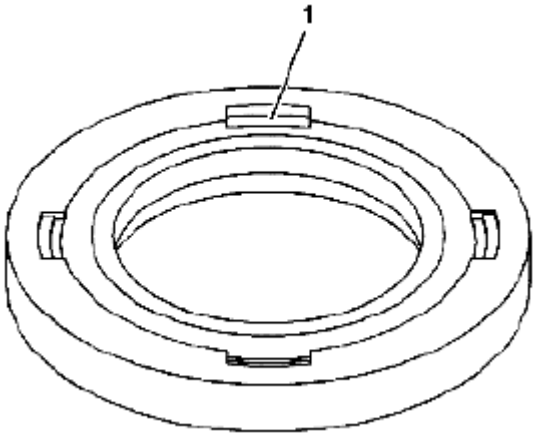


Fig. 512: Installing Crankshaft Front Oil Seal Into Engine Front Cover Using J 29184
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

1. Install the NEW crankshaft front oil seal into the engine front cover using the J 29184.



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Fig. 513: Placing Seal Into Position With Notches In Seal Down
Courtesy of SUZUKI OF AMERICA CORP.

2. Place the seal into position with the notches (1) in the seal down. The notches (1) will face in board when properly installed.

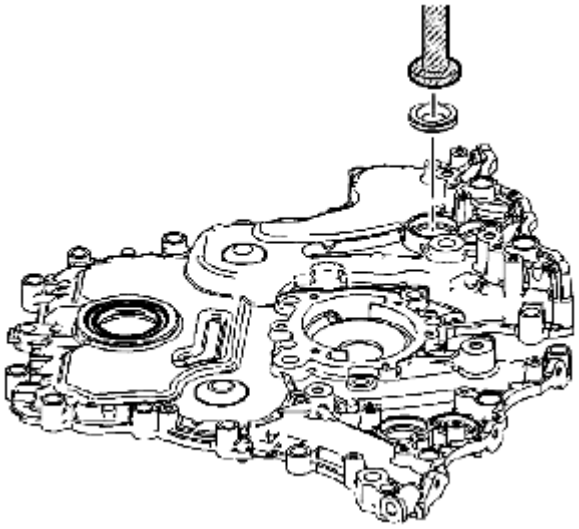


Fig. 514: Installing Camshaft Position Actuator Valve Oil Seals Into Engine Front Cover Using EN-46103
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the NEW camshaft position actuator valve oil seals into the engine front cover using the EN-46103.

   Reference: **ENGINE FRONT COVER INSTALLATION**

CAMSHAFT COVER DISASSEMBLE

Reference: **CAMSHAFT COVER REMOVAL - LEFT SIDE**

Reference: **CAMSHAFT COVER REMOVAL - RIGHT SIDE**

Left Camshaft Cover

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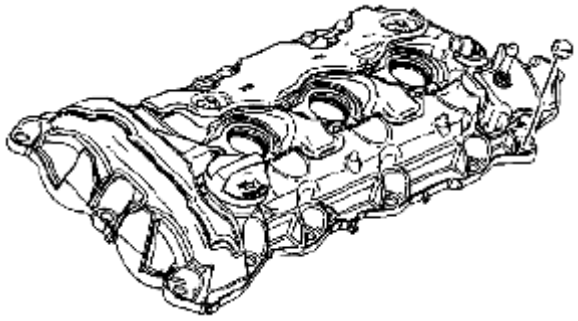


Fig. 515: Identifying Left Camshaft Cover Bolt Insulators
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove and discard the left camshaft cover bolt insulators.

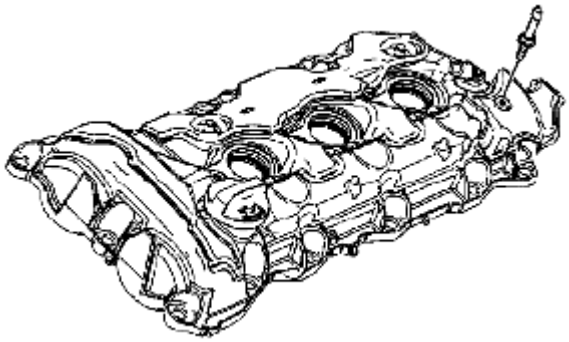


Fig. 516: Identifying Fuel Injector Sight Shield Ballstud
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the fuel injector sight shield ballstud.

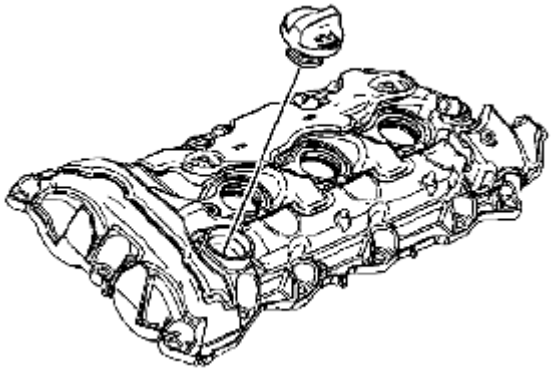


Fig. 517: Identifying Oil Fill Cap
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the oil fill cap.

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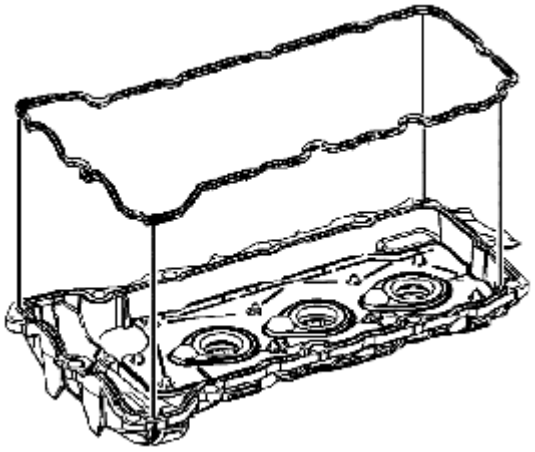


Fig. 518: Identifying Left Camshaft Cover Gasket
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not reuse the camshaft cover gasket and spark plug shield tube seals.

4. Remove and discard the left camshaft cover gasket.

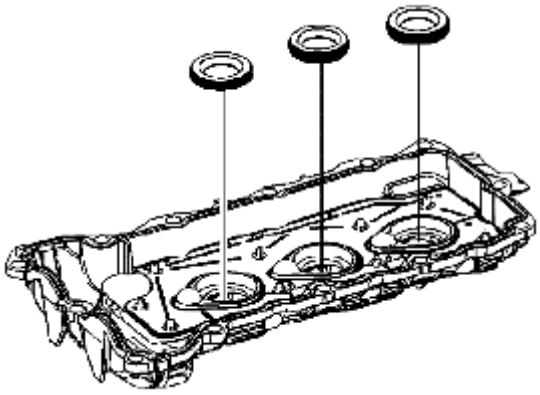


Fig. 519: Identifying Left Spark Plug Shield Tube Seals
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove and discard the left spark plug shield tube seals.

Right Camshaft Cover

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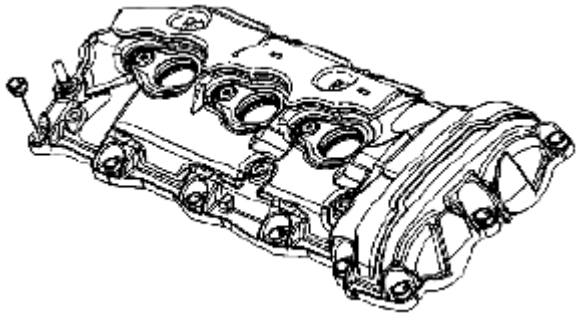


Fig. 520: Identifying Right Camshaft Cover Bolt Insulators
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove and discard the right camshaft cover bolt insulators.

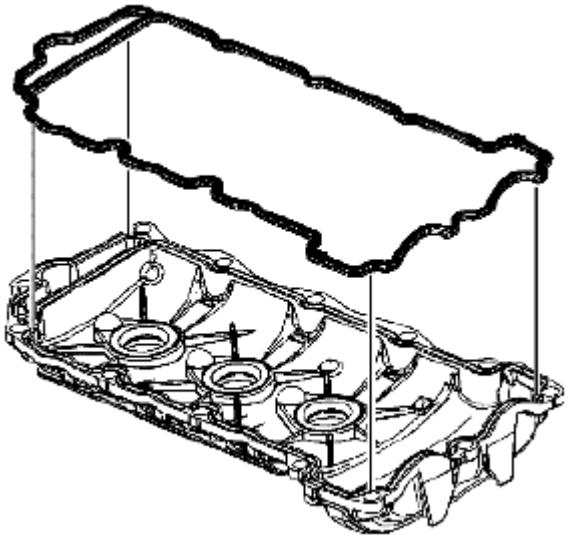


Fig. 521: Identifying Right Camshaft Cover Gasket
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not reuse the camshaft cover gasket and spark plug shield tube seals.

2. Remove and discard the right camshaft cover gasket.

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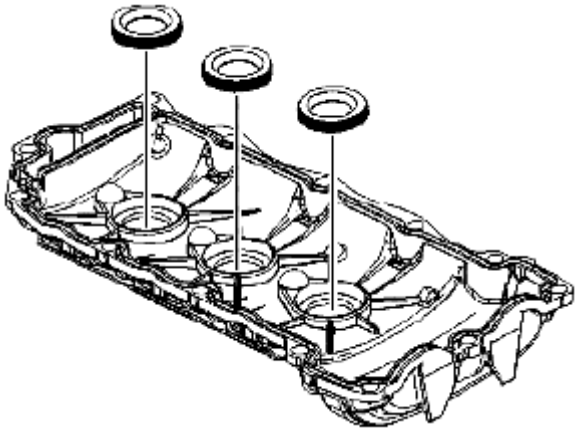


Fig. 522: Identifying Right Spark Plug Shield Tube Seals
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the right spark plug shield tube seals.

   Reference: **CAMSHAFT COVER CLEANING AND INSPECTION**

CAMSHAFT COVER CLEANING AND INSPECTION

Reference: **CAMSHAFT COVER DISASSEMBLE**

Cleaning Procedure

1. Clean the camshaft covers in solvent.

   WARNING: Refer to SAFETY GLASSES CAUTION .

2. Dry the camshaft covers with compressed air.

Inspection Procedure

1. Inspect each camshaft cover for the dents or damage to the exterior. A dented or damaged camshaft cover may:
   - Leak engine oil
   - Effect crankcase ventilation
   - Interfere with the camshafts
   - Interfere with the ignition coil sealing
   - Allow water or condensation to enter the engine

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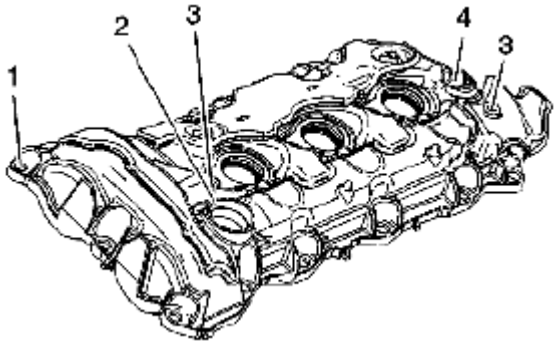


Fig. 523: Inspecting Exterior Of Left Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the exterior of the left camshaft cover for the following conditions:
   - Damage to the camshaft cover bolt holes (1)
   - Damage to the oil fill hole (2)
   - Damage to the mounting holes (3) for the ignition coil assembly and fuel injector sight shield ballstud.
   - Damage to the positive crankcase ventilation (PCV) hose connector (4) - A damaged PCV hose connector is replaceable.

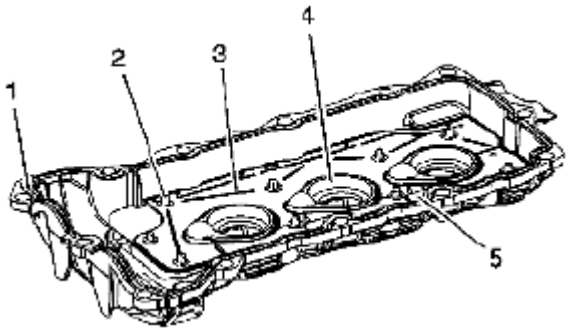


Fig. 524: Inspecting Interior Of Left Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Inspect the interior of the left camshaft cover for the following conditions:
   - Gouges or damage to the camshaft cover sealing groove (1)
   - Damaged, loose or missing baffle fasteners (2)
   - Damaged, loose or missing baffle (3)
   - Gouges or damage to the spark plug shield seal bore (4)
   - Restrictions to the ventilation system (5)

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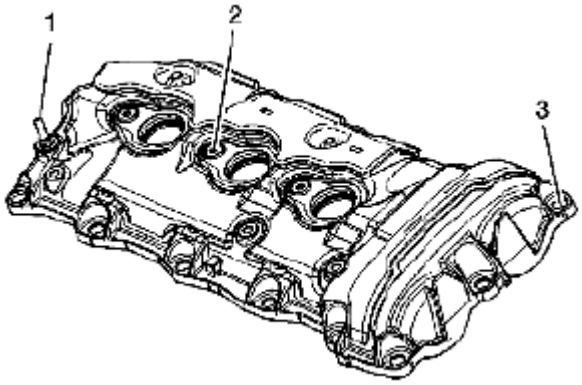


Fig. 525: Inspecting Exterior Of Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

4. Inspect the exterior of the right camshaft cover for the following conditions:
   - Damage to the PCV orifice (1) - A damaged PCV orifice can be replaced. Refer to **PCV ORIFICE REPLACEMENT**.
   - Damage to the mounting holes (2) for the ignition coil assembly
   - Damage to the camshaft cover bolt holes (3)

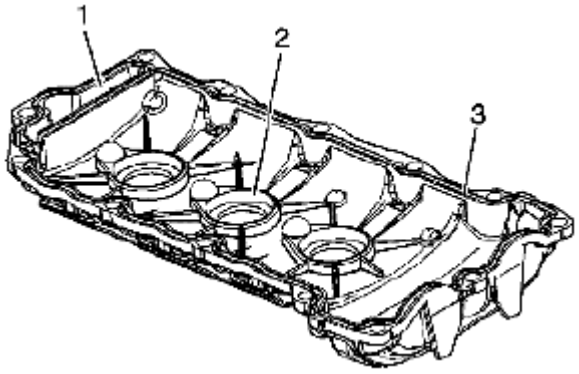


Fig. 526: Inspecting Interior Of Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Inspect the interior of the right camshaft cover for the following conditions:
   - Restrictions to the ventilation system (1)
   - Gouges or damage to the spark plug shield seal bore (2)
   - Gouges or damage to the camshaft cover sealing groove (3)
6. Repair or replace the camshaft cover or covers as necessary.

PCV Orifice Replacement

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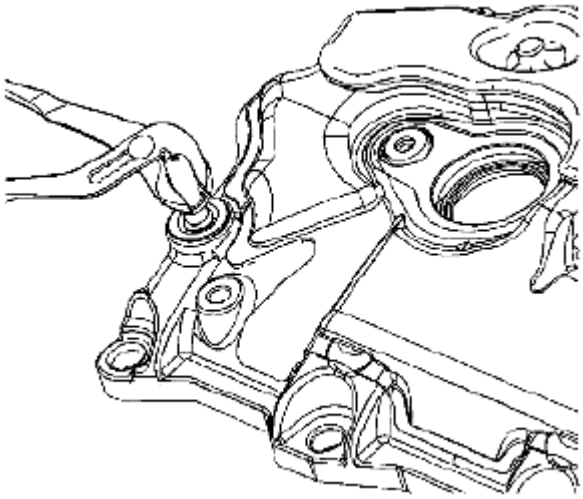


Fig. 527: Removing PCV Orifice
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the PCV orifice is damaged or plugged and cannot be cleaned out, the PCV orifice can be replaced.

1. Remove the old PCV orifice by griping the neck of the orifice with pliers and twisting and pulling out of the right camshaft cover.

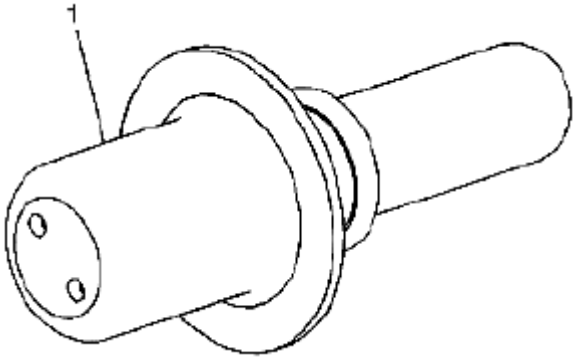


Fig. 528: Identifying PCV Orifice
Courtesy of SUZUKI OF AMERICA CORP.

2. Apply sealant GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the NEW PCV orifice (1).

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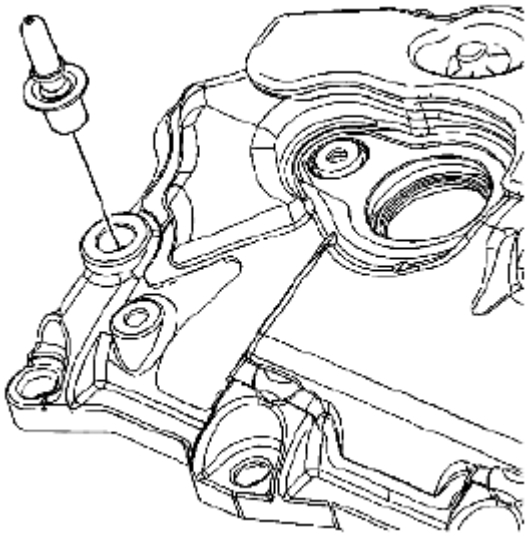


Fig. 529: Identifying PCV Orifice And Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the NEW PCV orifice into the right camshaft cover. After insertion, twist the PCV orifice in order to eliminate any vertical leak paths in the sealant.

PCV Fitting Replacement

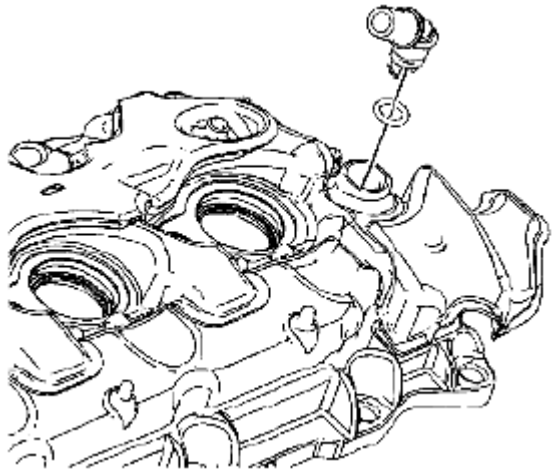


Fig. 530: Identifying PCV Fitting
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the PCV fitting is damaged or plugged and cannot be cleaned out, the PCV fitting can be replaced.

1. Remove the old PCV fitting.
2. Install the new PCV fitting with a NEW O-ring.

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Reference: **CAMSHAFT COVER ASSEMBLE**

CAMSHAFT COVER ASSEMBLE

Reference: **CAMSHAFT COVER CLEANING AND INSPECTION**

Special Tool

J 5590 Bearing and Seal Driver

J-25254-A Oil Seal Installer

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

Left Camshaft Cover

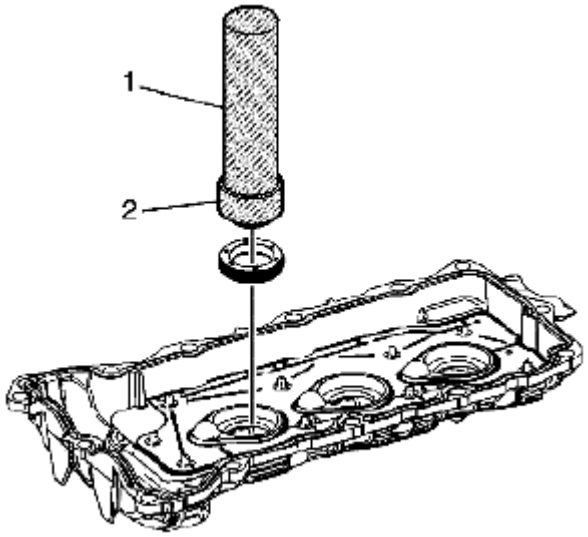


Fig. 531: Identifying Left Spark Plug Shield Tube Seals, Special Tools J 5590, And J-25254-A
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the NEW left spark plug shield tube seals using the J 5590 (1) and J-25254-A (2).

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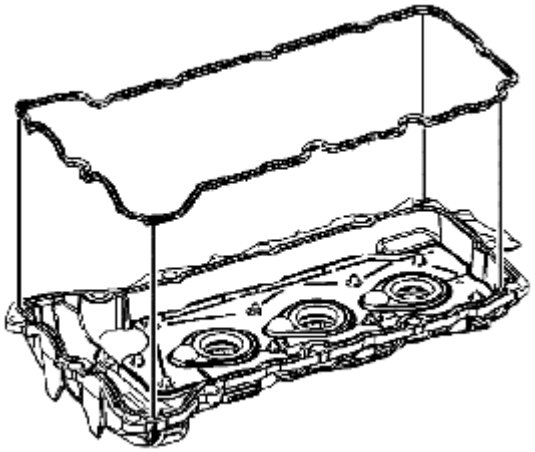


Fig. 532: Identifying Left Camshaft Cover Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the NEW left camshaft cover gasket.

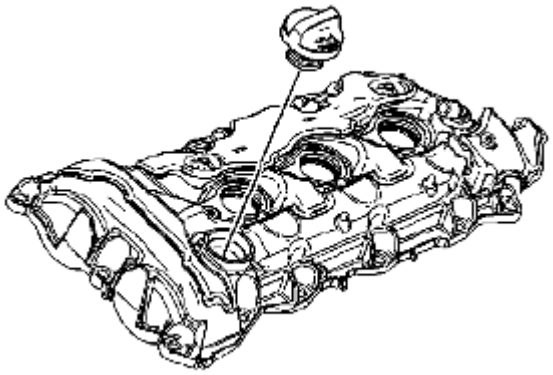


Fig. 533: Identifying Oil Fill Cap
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the oil fill cap.

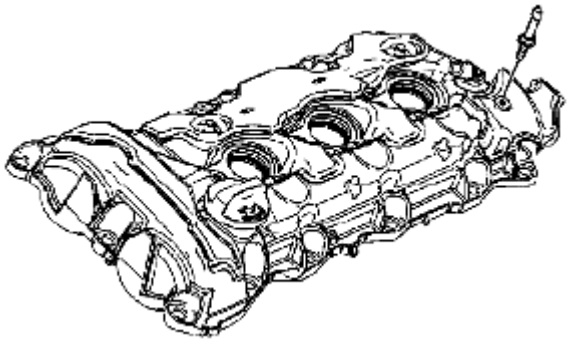


Fig. 534: Identifying Fuel Injector Sight Shield Cover Ballstud
Courtesy of SUZUKI OF AMERICA CORP.

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CAUTION: Refer to FASTENER NOTICE .

4. Install the fuel injector sight shield cover ballstud.

   Tightening torque

   Tighten the fuel injector sight shield cover ball stud to 10 N.m (89 lb in) .

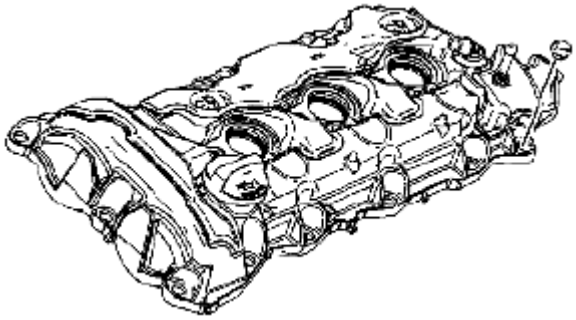


Fig. 535: Identifying Left Camshaft Cover Bolt Grommets
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The camshaft cover bolt grommet must be installed into the camshaft cover bolt hole before installing the camshaft cover bolt.

5. Install the NEW left camshaft cover bolt grommets.

Right Camshaft Cover

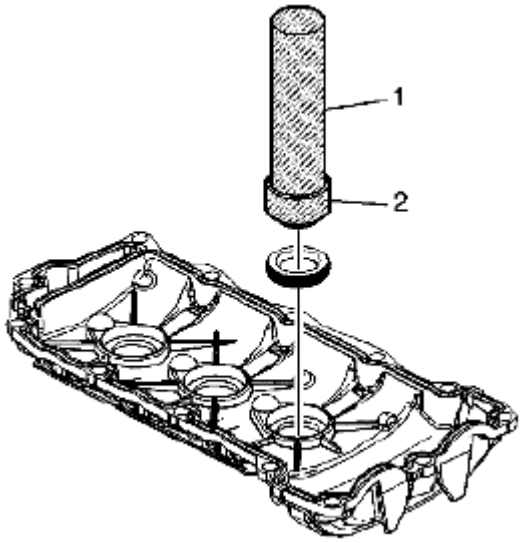


Fig. 536: Identifying Right Spark Plug Shield Tube Coil Seals, Special Tools J 5590, And J-25254-A
Courtesy of SUZUKI OF AMERICA CORP.

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1. Install the NEW right spark plug shield tube coil seals using the J 5590 (1) and J-25254-A (2).

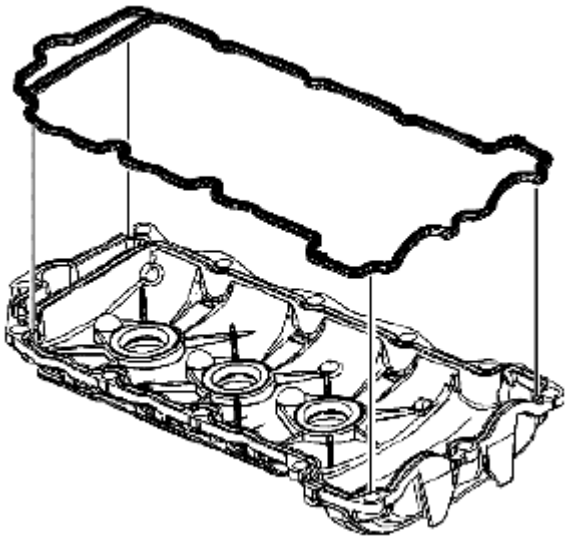


Fig. 537: Identifying Right Camshaft Cover Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the NEW right camshaft cover gasket.

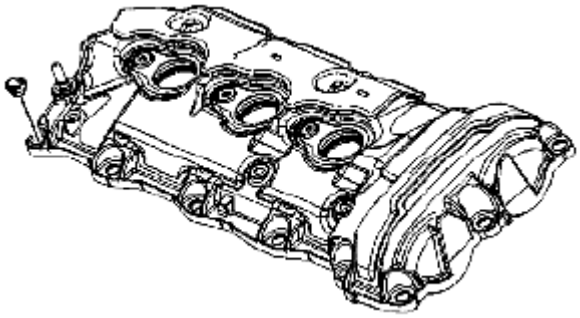


Fig. 538: Identifying Right Camshaft Cover Bolt Grommets
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The camshaft cover bolt grommet must be installed into the camshaft cover bolt hole before installing the camshaft cover bolt.

3. Install the NEW right camshaft cover bolt grommets.

Reference: **CAMSHAFT COVER INSTALLATION - LEFT SIDE**

Reference: **CAMSHAFT COVER INSTALLATION - RIGHT SIDE**

INTAKE MANIFOLD DISASSEMBLE

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Reference: **INTAKE MANIFOLD REMOVAL**

Upper to Lower Intake Manifold Disassemble Procedure

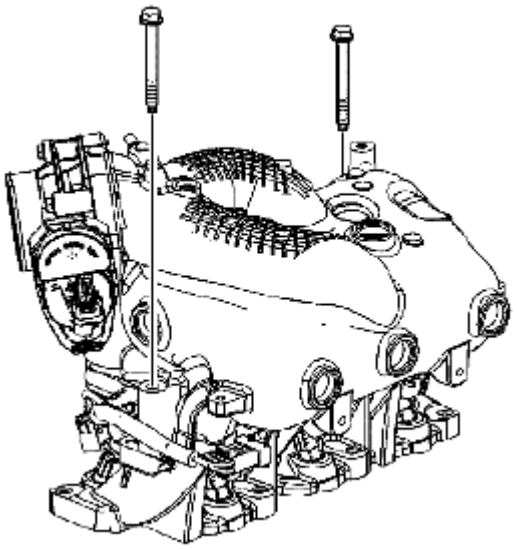


Fig. 539: Identifying Upper-To-Lower Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not reuse the upper-to-lower intake manifold gasket and the intake manifold-to-cylinder head sealing gaskets.

1. Remove the upper-to-lower intake manifold bolts.

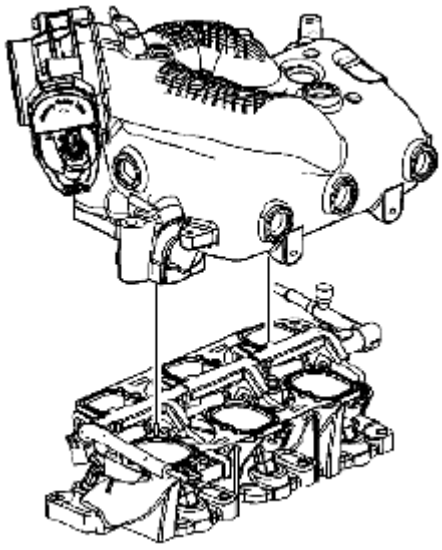


Fig. 540: Identifying Upper Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

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2. Remove the upper intake manifold from the lower intake manifold.

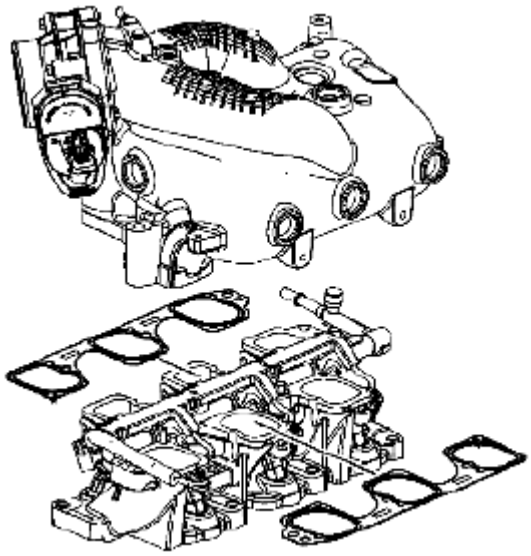


Fig. 541: Identifying Upper-To-Lower Intake Manifold Gaskets
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the upper-to-lower intake manifold gaskets.

Upper Intake Manifold Disassemble Procedure

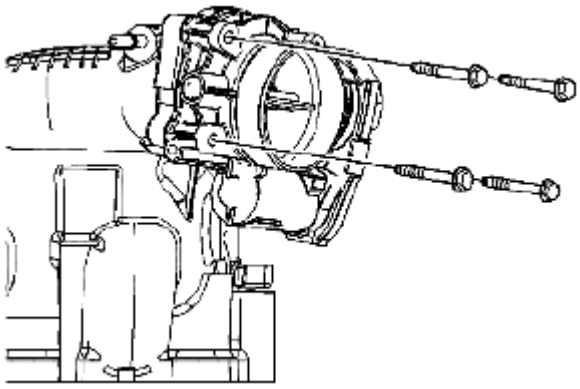


Fig. 542: Identifying Throttle Body Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the throttle body bolts.

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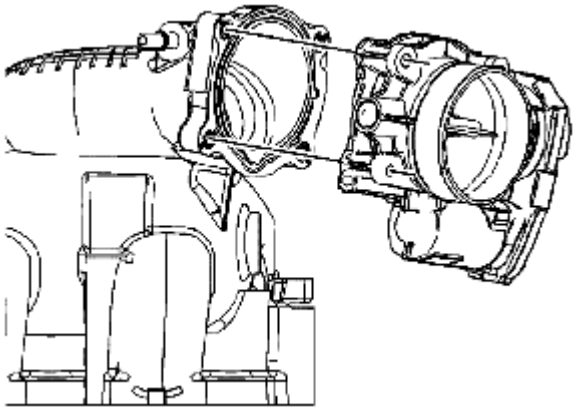


Fig. 543: Identifying Throttle Body
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the throttle body.

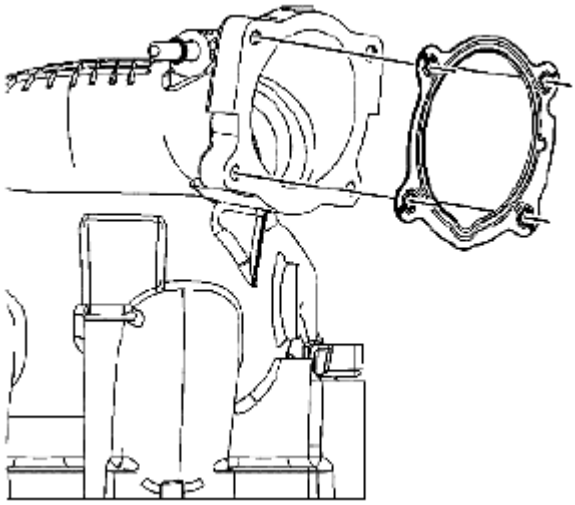


Fig. 544: Identifying Throttle Body Gasket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove and discard the throttle body gasket.

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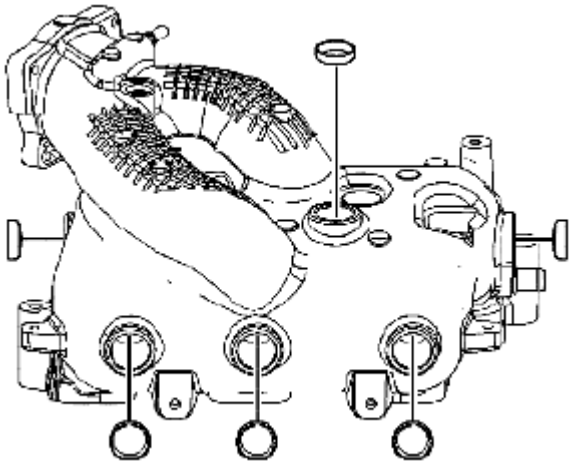


Fig. 545: Identifying Upper Intake Manifold Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove and discard the upper intake manifold expansion plugs, if required.

Lower Intake Manifold Disassemble Procedure

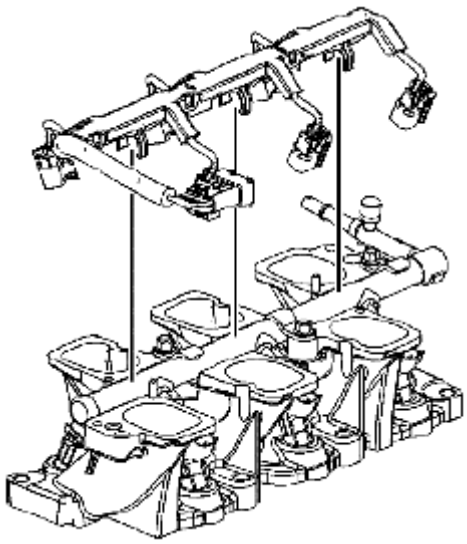


Fig. 546: Identifying Fuel Injector Wiring Harness Connectors
Courtesy of SUZUKI OF AMERICA CORP.

1. Disconnect the fuel injector wiring harness connectors and remove the fuel injector wiring harness.

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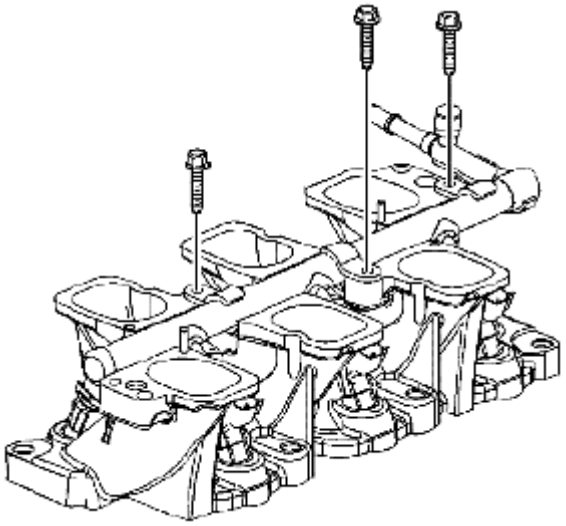


Fig. 547: Identifying Fuel Injector Rail Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove the fuel injector rail bolts.

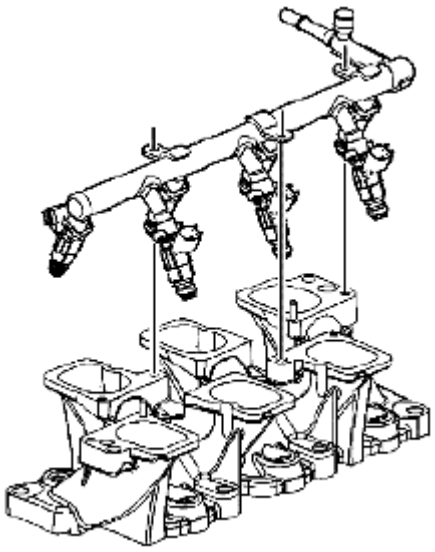


Fig. 548: Identifying Fuel Injector Rail
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the fuel injector rail.

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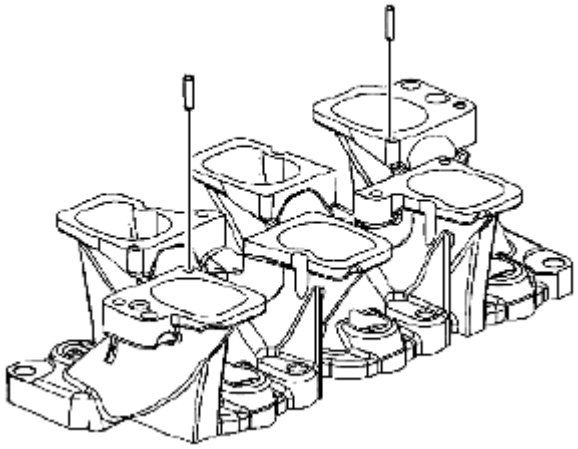


Fig. 549: Identifying Upper-To-Lower Intake Manifold Alignment Pins
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove the upper-to-lower intake manifold alignment pins.

   Reference: **INTAKE MANIFOLD CLEANING AND INSPECTION**

INTAKE MANIFOLD CLEANING AND INSPECTION

Reference: **INTAKE MANIFOLD DISASSEMBLE**

Upper Intake Manifold Cleaning Procedure

1. Remove any remaining gasket and/or gasket material from the following:
   - Throttle body
   - Intake manifold
2. Clean the following intake manifold areas in solvent.
   - Intake manifold gasket sealing areas
   - Intake manifold passages
   - Brake booster hose passage
   - Evaporative Emission (EVAP) solenoid passage
   - Positive Crankcase Ventilation (PCV) vacuum hose passages

WARNING: Refer to SAFETY GLASSES CAUTION .

3. Dry the upper intake manifold and throttle body with compressed air.

Inspection Procedure

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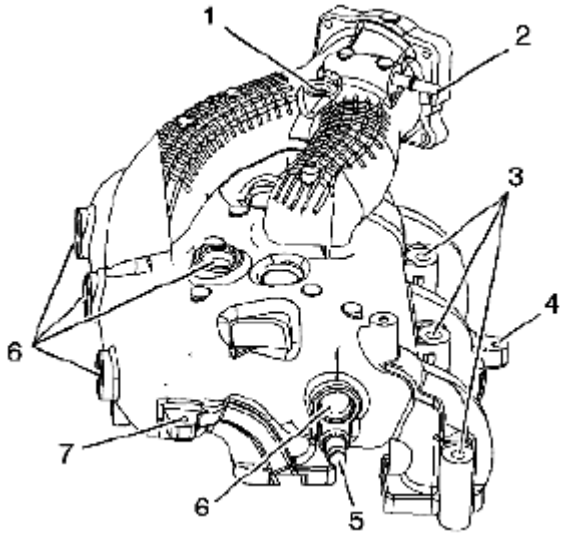


Fig. 550: Inspecting Upper Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the upper intake manifold for the following conditions:
    - Damage, debris or restrictions to the PCV system hose port (1)
    - Damage, debris or restrictions to the EVAP purge solenoid port (2)
    - Damage to the intake manifold bolt bosses (3)
    - Damage to the EVAP purge solenoid mounting boss (4)
    - Damage, debris or restrictions to the brake vacuum booster hose port (5)
    - Damage or corrosion to the intake manifold expansion plugs (6)
    - Damage to the engine coolant air bleed pipe bracket mounting boss (7)

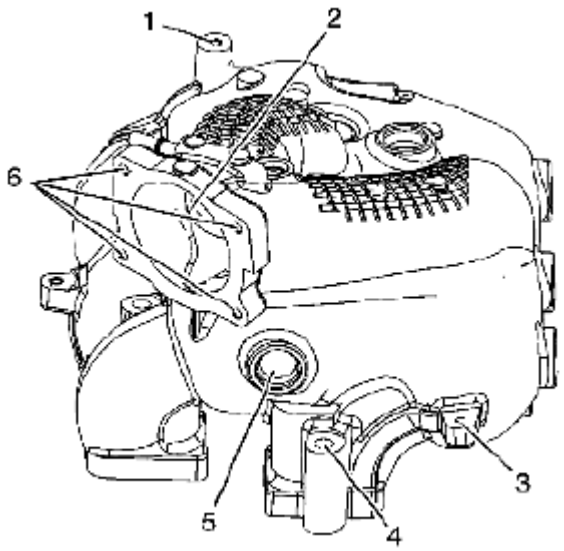


Fig. 551: Inspecting Upper Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

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2. Inspect the upper intake manifold for the following conditions:
    - Damage to the threads and boss for the fuel injector sight shield ball stud (1)
    - Damage, debris or restrictions within the intake manifold passages (2)
    - Damage to the engine coolant air bleed pipe bracket mounting boss (3)
    - Damage to the intake manifold bolt bosses (4)
    - Damage or corrosion to the intake manifold expansion plug (5)
    - Damage to the throttle body bolt holes (6)

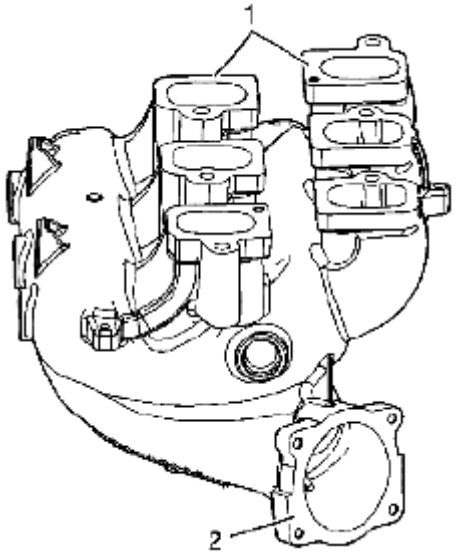


Fig. 552: Inspecting Upper Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

3. Inspect the upper intake manifold for the following conditions:
    - Gouges or damage to the upper intake manifold sealing surfaces (1)
    - Damage to the gasket sealing surface (2) for the throttle body

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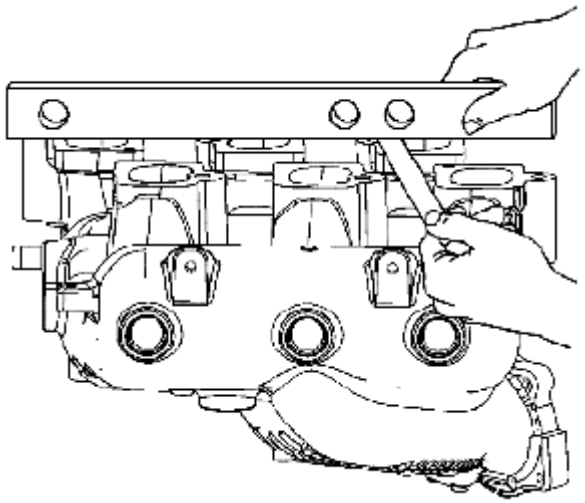


Fig. 553: Inspecting Upper Intake Manifold Sealing Surface For Warpage
Courtesy of SUZUKI OF AMERICA CORP.

4. Inspect the upper intake manifold sealing surface for warpage.
    a. Locate a straight edge across the upper-to-lower intake manifold sealing surface.
    b. Insert a feeler gage between the upper intake manifold and the straight edge. An upper intake manifold with warpage in excess of 0.50 mm (0.020 in) must be replaced.
5. Repair or replace the upper intake manifold as necessary.

Lower Intake Manifold Cleaning Procedure

1. Remove any remaining gasket and/or gasket material from the following:
    - Upper-to-lower intake manifold sealing surface
    - Cylinder head-to-lower intake manifold sealing surface
2. Clean the following intake manifold areas in solvent.
    - Intake manifold gasket sealing surfaces
    - Intake manifold passages

WARNING: Refer to SAFETY GLASSES CAUTION .

3. Dry the intake manifold with compressed air.

Inspection Procedure

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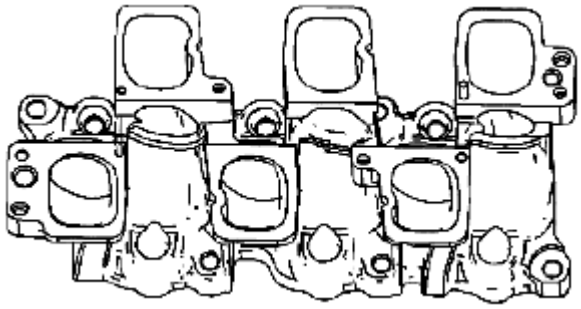


Fig. 554: Inspecting Lower Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

1. Inspect the lower intake manifold for the following conditions:
   - Damage, debris or restrictions to the lower intake manifold ports
   - Damage to the fuel rail mounting bolt holes
   - Damage to the fuel rail

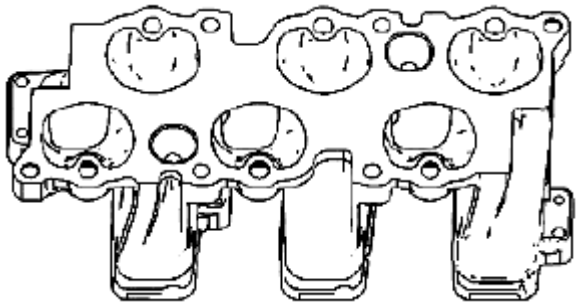


Fig. 555: Inspecting Lower Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

2. Inspect the lower intake manifold for the following conditions:
   - Gouges or damage to the intake manifold sealing surfaces
   - Damage to the lower intake manifold bolt bosses
   - Damage to the fuel injector ports

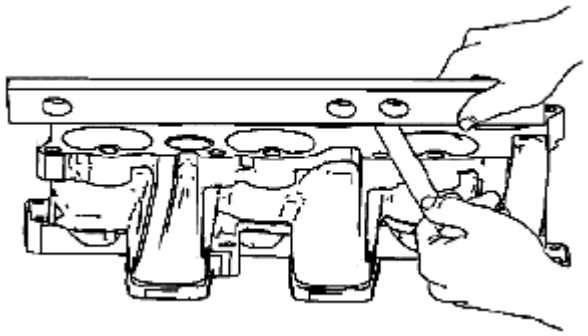


Fig. 556: Inspecting Lower Intake Manifold Sealing Surfaces For Warpage

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Courtesy of SUZUKI OF AMERICA CORP.

3. Inspect the lower intake manifold sealing surfaces for warpage.
   - Locate a straight edge across the lower intake manifold sealing surfaces.
   - Insert a feeler gage between the lower intake manifold and the straight edge. A lower intake manifold with warpage in excess of 0.5 mm (0.020 in) must be replaced.
4. Repair or replace the lower intake manifold as necessary.

Reference: **INTAKE MANIFOLD ASSEMBLE**

INTAKE MANIFOLD ASSEMBLE

Reference: **INTAKE MANIFOLD CLEANING AND INSPECTION**

Lower Intake Manifold Assemble Procedure

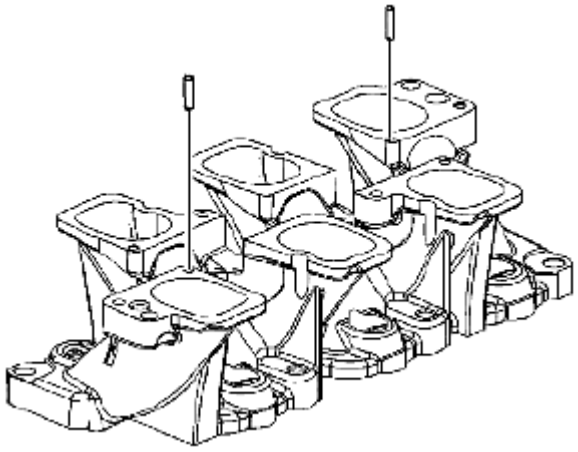


Fig. 557: Identifying Upper-To-Lower Intake Manifold Alignment Pins
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the upper-to-lower intake manifold alignment pins.

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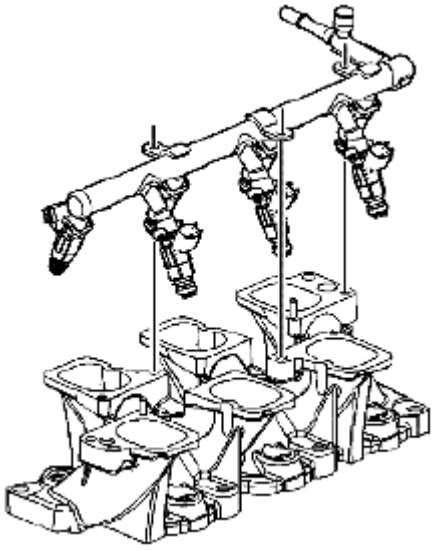


Fig. 558: Identifying Fuel Injector Rail
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the fuel injector rail.

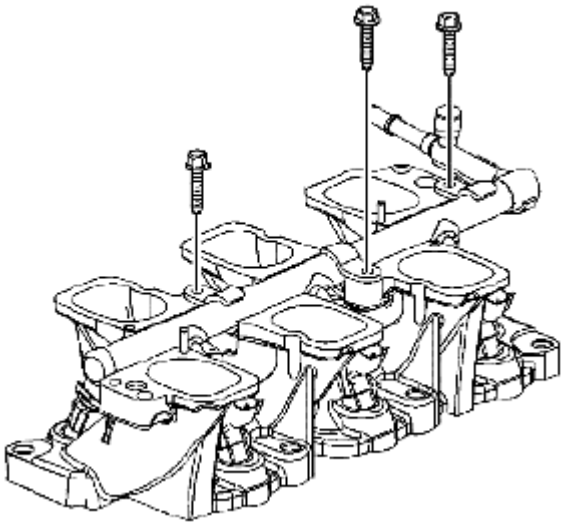


Fig. 559: Identifying Fuel Injector Rail Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Install the fuel injector rail bolts.

Tightening torque

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Tighten the fuel injector rail bolts to 10 N.m (89 lb in) .

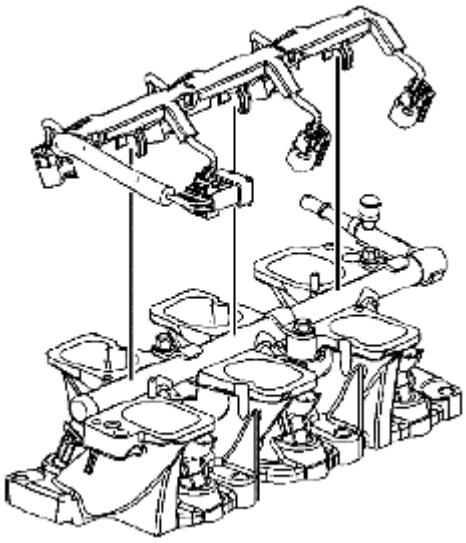


Fig. 560: Identifying Fuel Injector Wiring Harness And Connectors
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the fuel injector wiring harness and connect the fuel injector wiring harness connectors.

Upper Intake Manifold Assemble Procedure

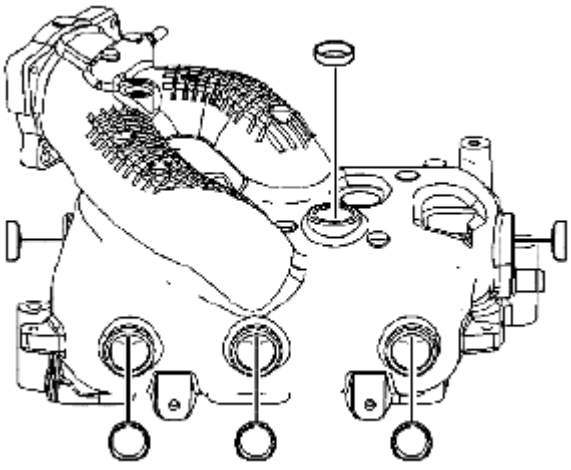


Fig. 561: Identifying Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

1. If removed, install the NEW expansion plugs into the upper intake manifold.

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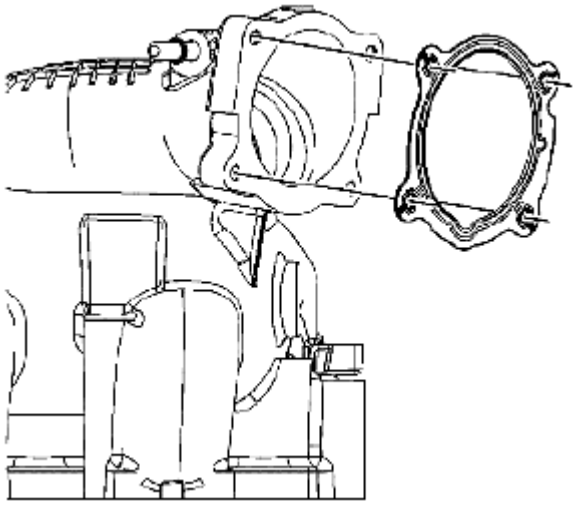


Fig. 562: Identifying Throttle Body Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the NEW throttle body gasket.

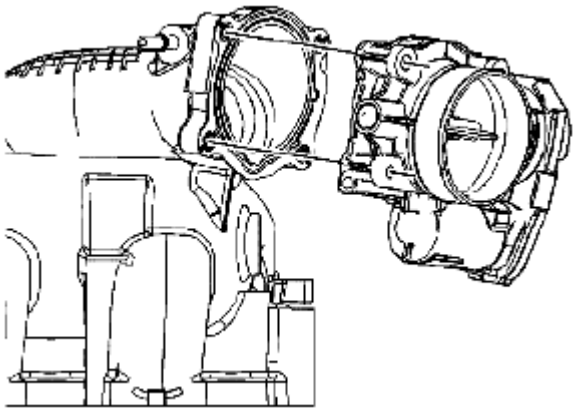


Fig. 563: Identifying Throttle Body
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the throttle body.

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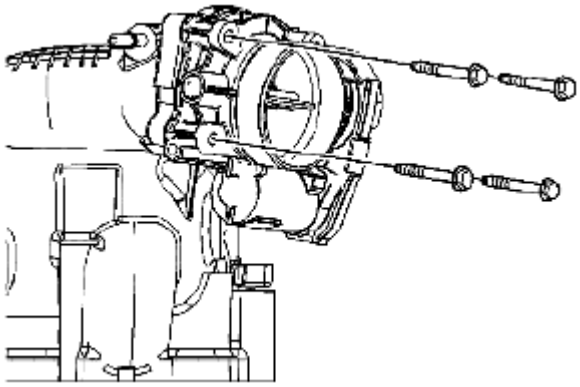


Fig. 564: Identifying Throttle Body Bolts
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the throttle body bolts.

   Tightening torque

   Tighten the throttle body bolts to 10 N.m (89 lb in) .

Upper to Lower Intake Manifold Assemble Procedure

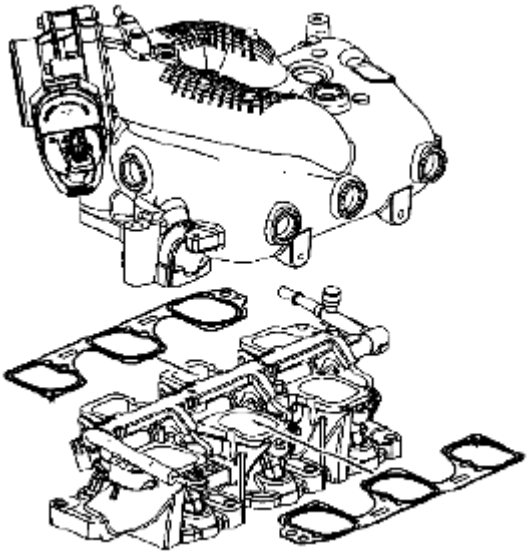


Fig. 565: Identifying Upper-To-Lower Intake Manifold Gaskets
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not reuse the upper-to-lower intake manifold gasket and the intake manifold-to-cylinder head sealing gaskets.

1. Install the NEW upper-to-lower intake manifold gaskets.

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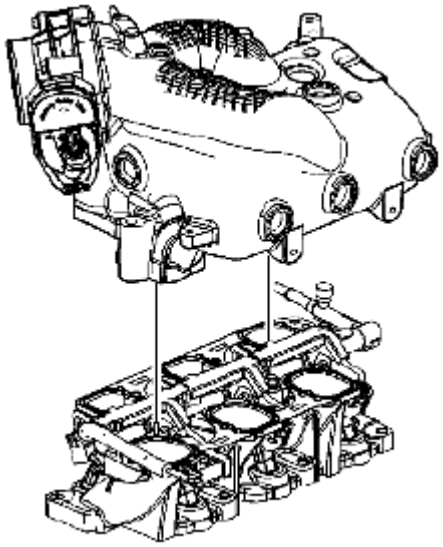


Fig. 566: Identifying Upper Intake Manifold And Lower Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the upper intake manifold to the lower intake manifold.

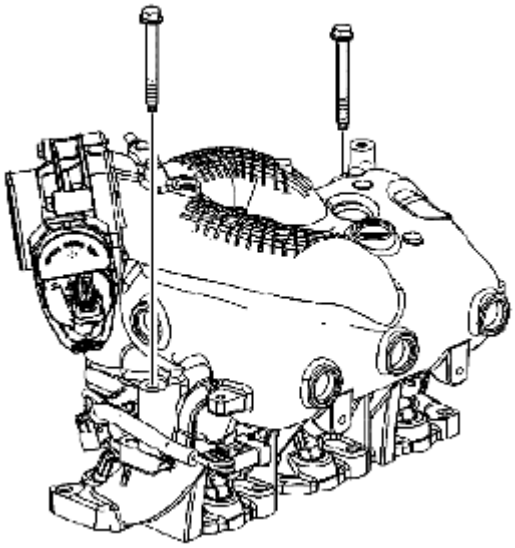


Fig. 567: Identifying Upper-To-Lower Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the upper-to-lower intake manifold bolts.

   Tightening torque

   Tighten the upper-to-lower intake manifold bolts to 23 N.m (17 lb ft) .

   Reference: **INTAKE MANIFOLD INSTALLATION**

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THREAD REPAIR

Special Tool

J 42385-700 High Feature Thread Repair Kit

J 42385-2000 Thread Insert Kit

J 43965 Thread Repair Extension Kit

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert. During the insert installation process, the installation driver tool cold-rolls the bottom internal threads and expands the bottom external threads of the insert into the base material. This action mechanically locks the insert into place.

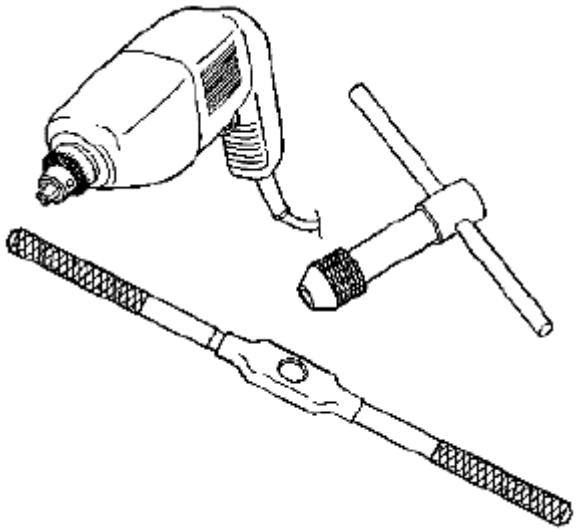


Fig. 568: Identifying Special Tools J 42385-700 And J 42385-2000
Courtesy of SUZUKI OF AMERICA CORP.

The drill bit and counter bore tool from the tool kit J 42385-700 and J 42385-2000 is designed for use with either a suitable tap wrench or drill motor. Limited access and larger hole repair may process better using a tap wrench. An extension from kit J 43965 may also be necessary to drive the thread repair tooling dependent on access to the hole being repaired. Use only a tap wrench when tapping the hole and during installation of the insert.

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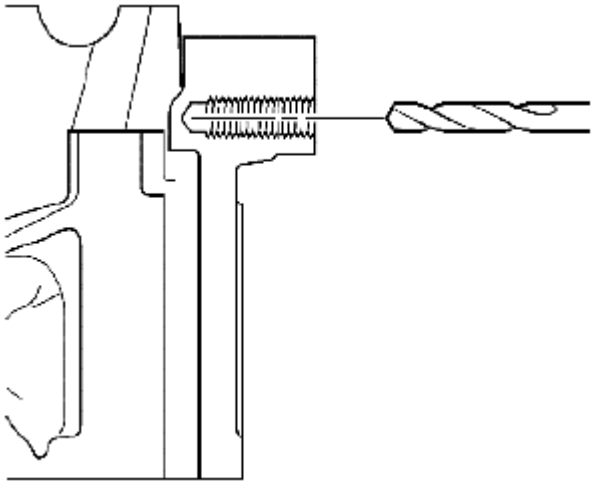


Fig. 569: Identifying Drilling, Counterboring And Tapping Of Hole To Same Centerline As Original Hole
Courtesy of SUZUKI OF AMERICA CORP.

It is critical that the drilling, counterboring and tapping of the hole to be repaired follows the same centerline as the original hole.

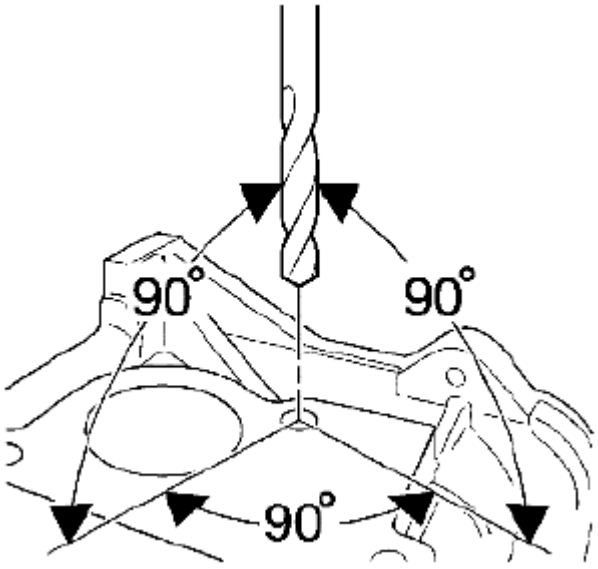


Fig. 570: Identifying Hole Tooling Is Consistently Machining Perpendicular To Surface Of Base Material
Courtesy of SUZUKI OF AMERICA CORP.

During the drilling and tapping of the hole being repaired ensure the tooling is consistently machining perpendicular to the surface of the base material.

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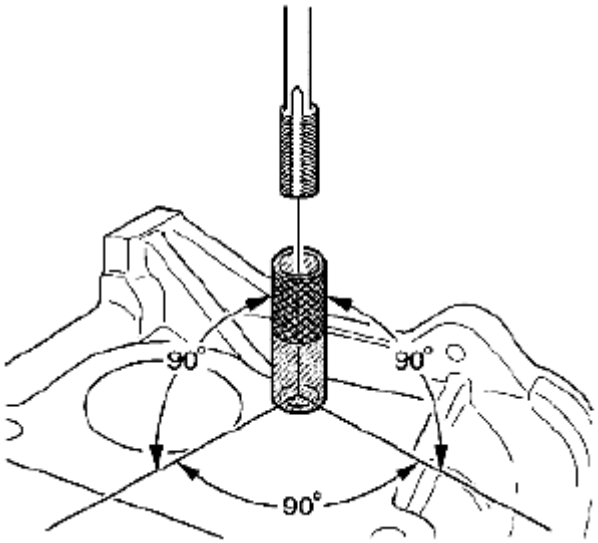


Fig. 571: Identifying Threaded Hole Of Base Surface Perpendicular To Hole Centerline
Courtesy of SUZUKI OF AMERICA CORP.

If the threaded hole being repaired has a base surface perpendicular to the hole centerline, tapping guides are available to aid in tapping the hole.

TAPPING GUIDES REFERENCE

Tap Size	Tap Guide	Tape Size	Tape Guide	Tap Size	Tape Guide
-	J 42385-	-	J 42385-	-	J 42385-
6 x 1.0	729	10 x 1.5	731	14 x 1.5	736
8 x 1.25	730	12 x 1.5	732	20 x 1.5	737

Standard Thread Repair - Flush Hole

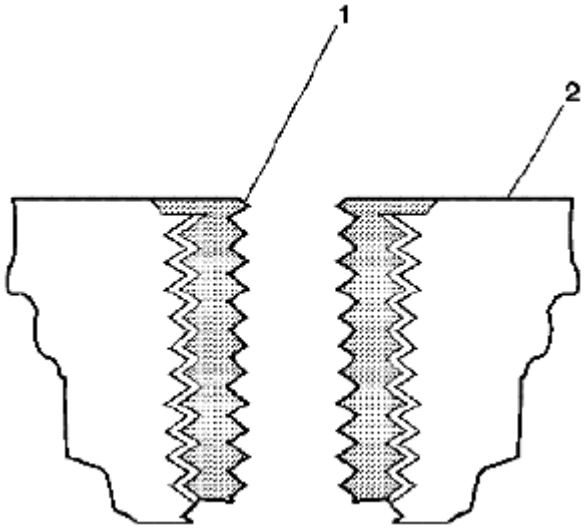


Fig. 572: Identifying Flange Of Insert And Surface Of Base Material

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Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE: The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.

When installed to the proper depth, the flange (1) of the insert will be seated against the counterbore of the drilled/tapped hole and just below the surface (2) of the base material.

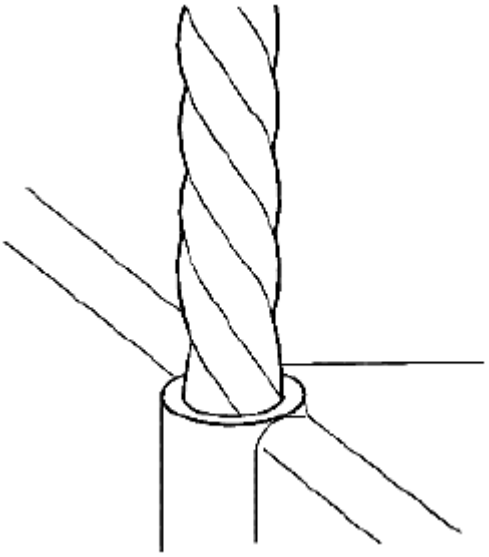


Fig. 573: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.**
- **Do NOT drill any further than the original hole depth.**

1. Drill out the threads of the damaged hole.

   Specifications

   - **M6 inserts require a minimum drill depth of 15 mm (0.59 in)** .
   - **M8 inserts require a minimum drill depth of 20 mm (0.79 in)** .
   - **M10 inserts require a minimum drill depth of 23.5 mm (0.93 in)** .

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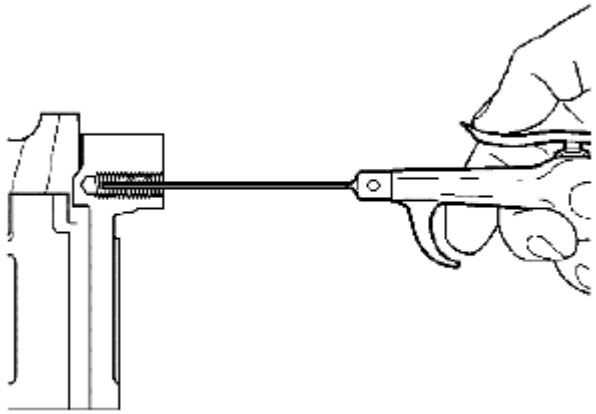


Fig. 574: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

2. Using compressed air, clean out any chips.

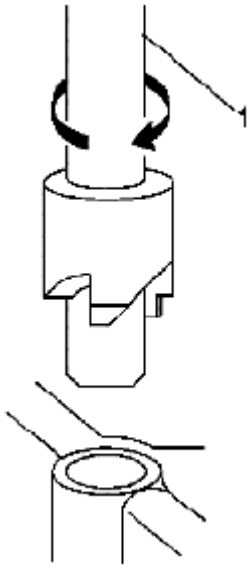


Fig. 575: Identifying Counterbore Tool
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: A properly counterbored hole will show a slight burnishing on the surface of the base material for 360 degrees around the drilled hole.

3. Counterbore the drilled hole to the full depth permitted by the tool (1).

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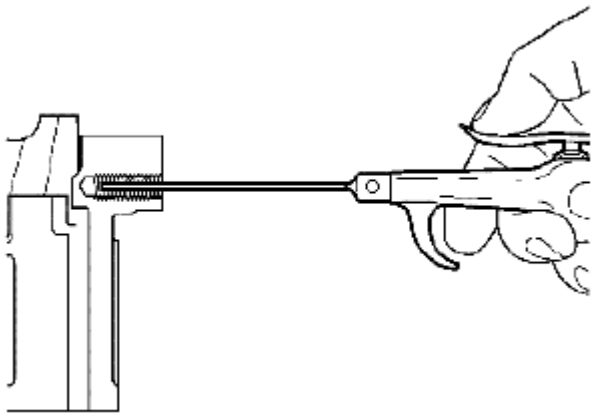


Fig. 576: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

4. Using compressed air, clean out any chips.

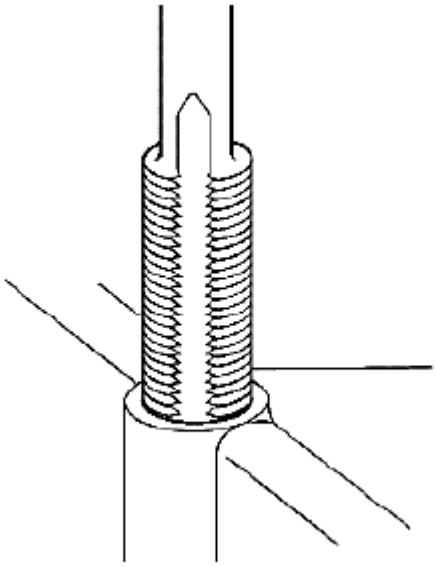


Fig. 577: Tapping Threads Of Drilled Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.**
- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

5. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

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Specifications

- **M6 inserts require a minimum tap depth of 15 mm (0.59 in)** .
- **M8 inserts require a minimum tap depth of 20 mm (0.79 in)** .
- **M10 inserts require a minimum tap depth of 23.5 mm (0.93 in)** .

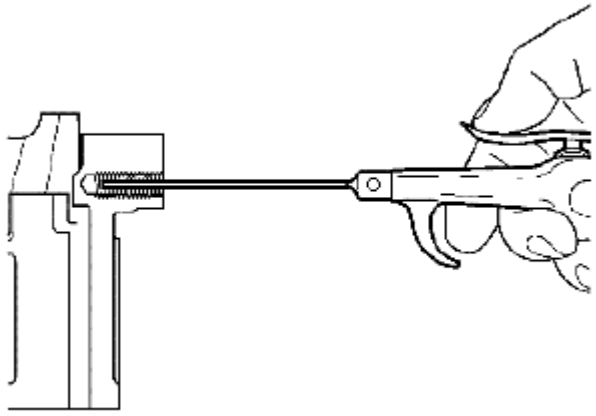


Fig. 578: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

6. Using compressed air, clean out any chips.

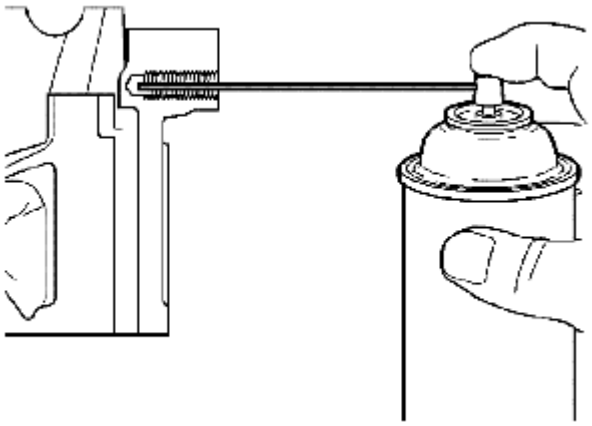


Fig. 579: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) Or Equivalent Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

7. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

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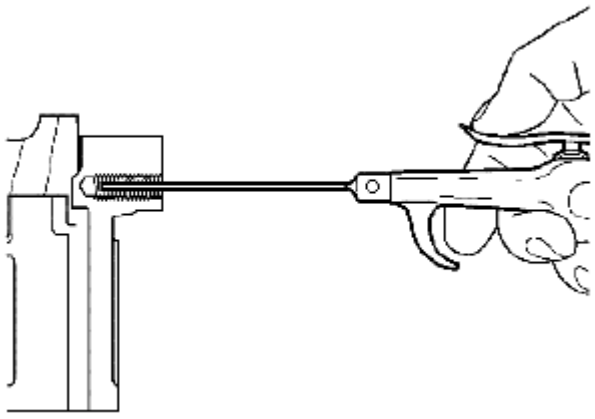


Fig. 580: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

8. Using compressed air, clean out any chips.

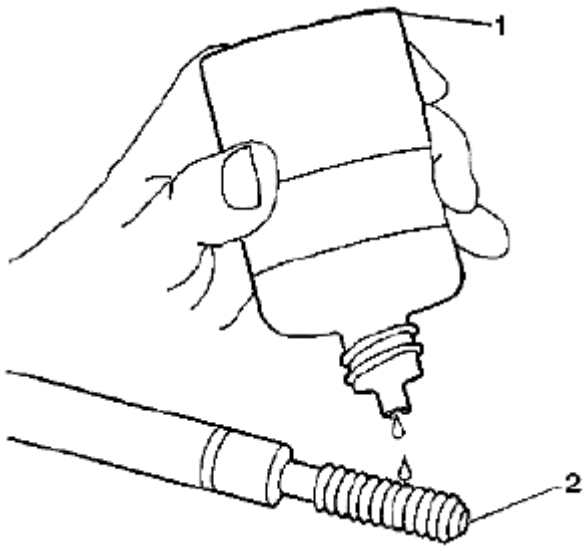


Fig. 581: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

9. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

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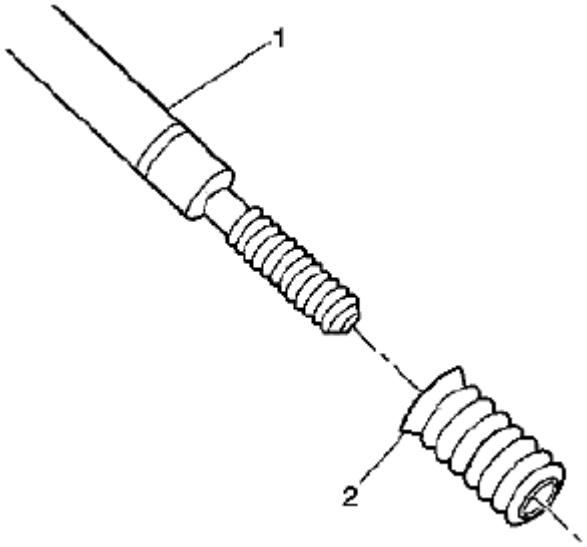


Fig. 582: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

10. Install the insert (2) onto the driver installation tool (1).

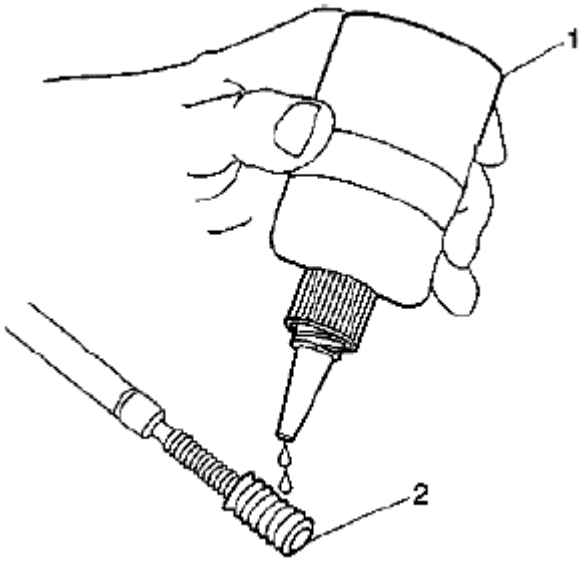


Fig. 583: Applying Threadlock Sealant GM P/N 12345493, J 42385-109, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

11. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

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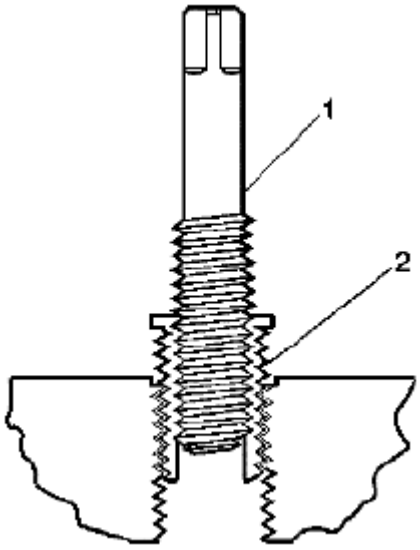


Fig. 584: Installing Insert Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

12. Install the insert (2) into the tapped hole by hand only.

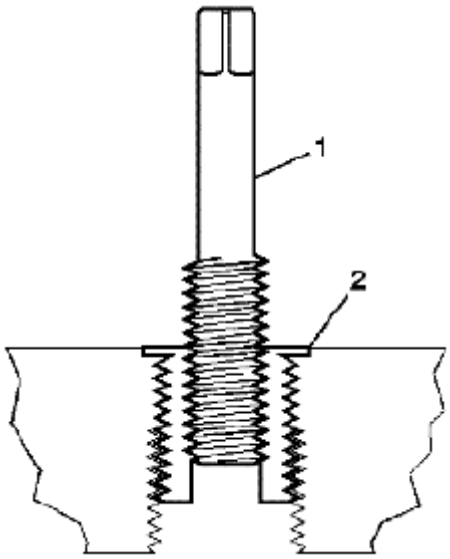


Fig. 585: Installing Insert Until Flange Of Insert Contacts Counterbored Surface
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the insert will not thread down until the flange contacts the counterbored surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

13. Install the insert until the flange (2) of the insert contacts the counterbored surface.

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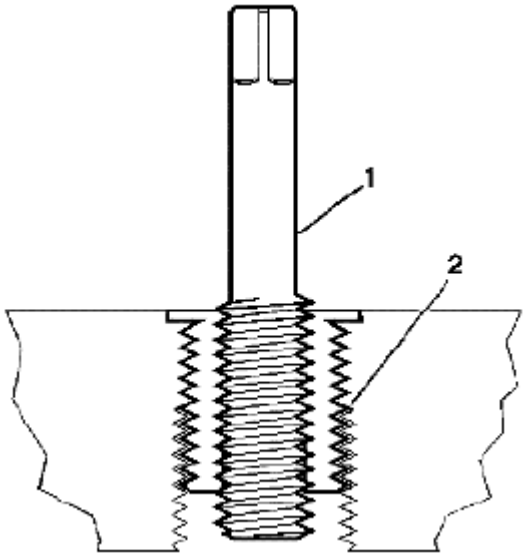


Fig. 586: Rotating Driver Installation Tool Through Insert
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

14. Continue to rotate the driver installation tool (1) through the insert (2).

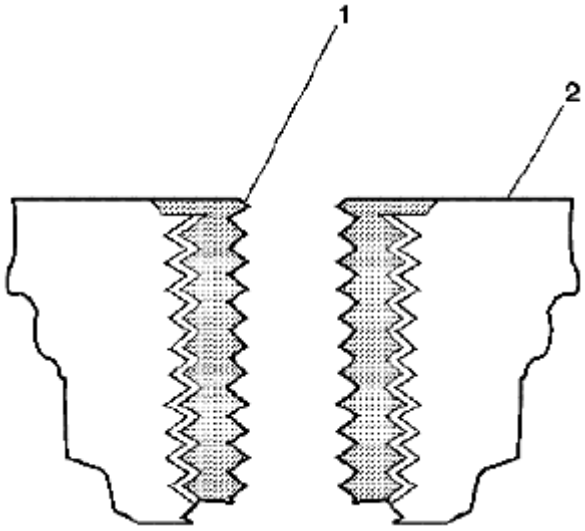


Fig. 587: Inspecting Insert For Proper Installation Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

15. Inspect the insert for proper installation into the tapped hole. A properly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

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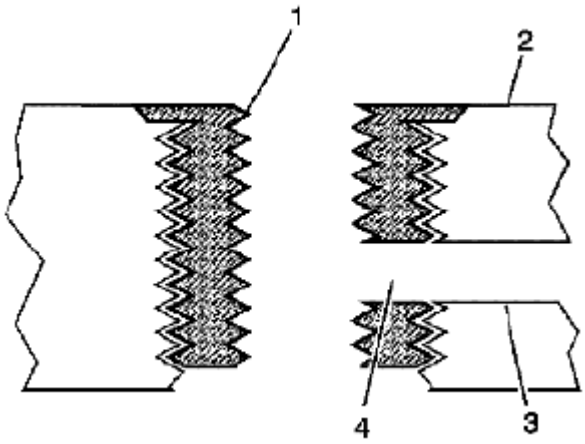


Fig. 588: Identifying Insert That Restricts Or Blocks An Oil Or Engine Coolant Passage
Courtesy of SUZUKI OF AMERICA CORP.

16. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

Recessed Thread Repair

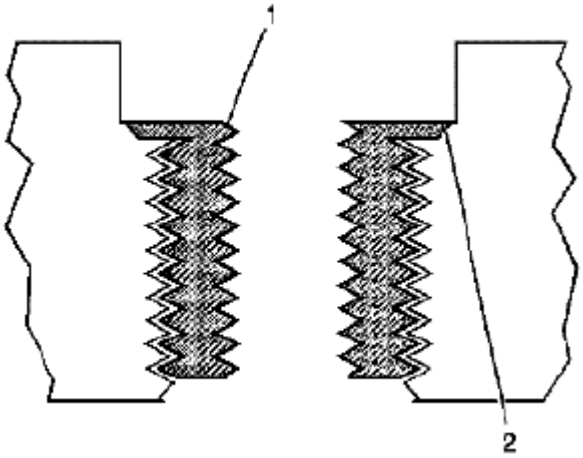


Fig. 589: Identifying Flange Of Insert And Counterbore Of Drilled/Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE:

- **The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

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- **Do NOT remove the original stop collar from a counterbore drill.**

When installed to the proper depth, the flange of the insert (1) will be seated against the counterbore (2) of the drilled/tapped hole.

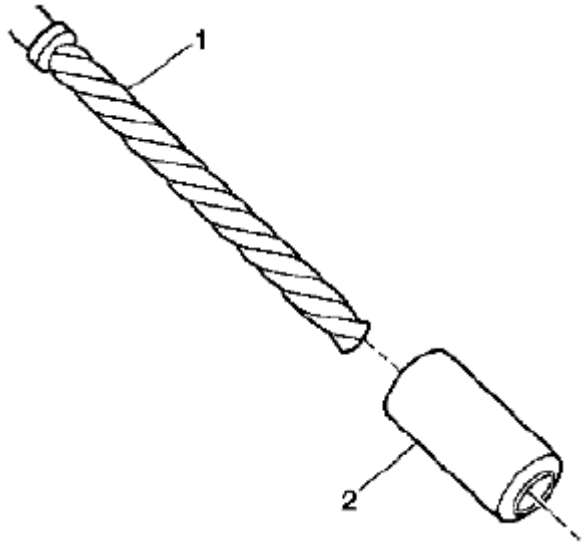


Fig. 590: Identifying Stop Collar And Counterbore Drill
Courtesy of SUZUKI OF AMERICA CORP.

1. Install a stop collar (2) on the counterbore drill (1), if required.

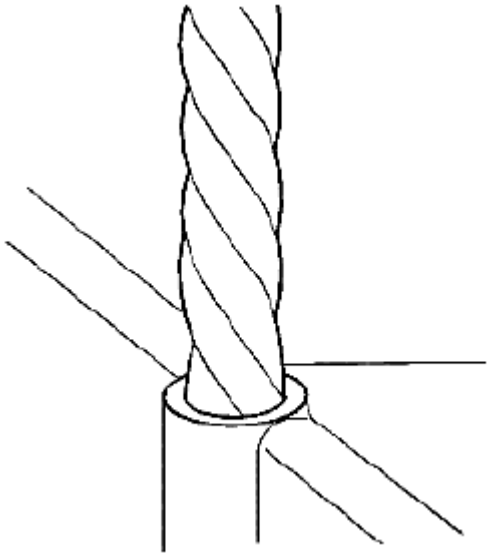


Fig. 591: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:
- **During the drilling process, it is necessary to repeatedly remove the**

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drill and clean chips from the hole and the flutes of the drill.

- **Drill the hole until the stop collar contacts the surface of the base material.**

2. Drill out the threads of the damaged hole.

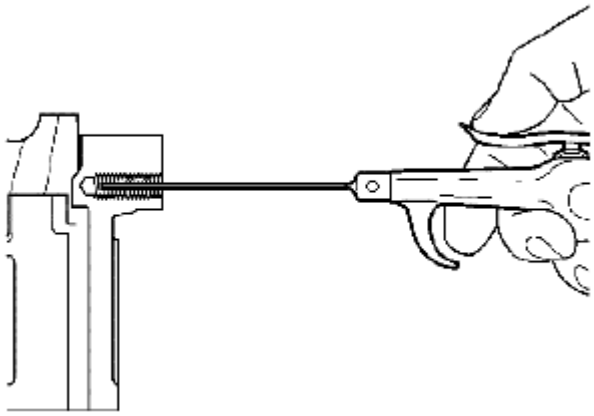


Fig. 592: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

3. Using compressed air, clean out any chips.

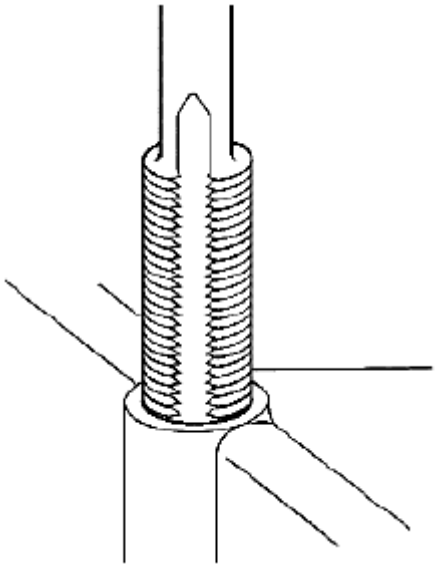


Fig. 593: Tapping Threads Of Drilled Hole Using Suitable Tapping Wrench
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **During the tapping process, it is necessary to repeatedly remove the**

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tap and clean chips from the hole and the flutes of the tap.

- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

4. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

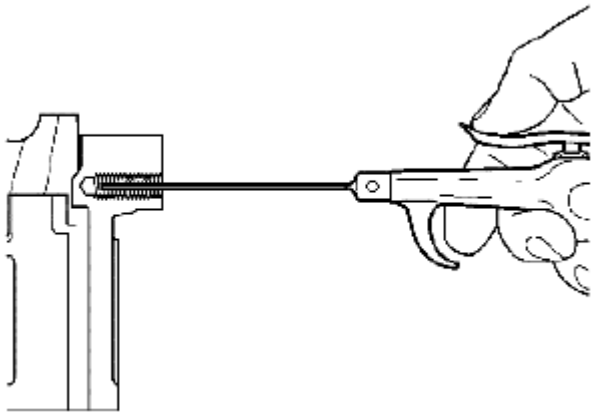


Fig. 594: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

5. Using compressed air, clean out any chips.

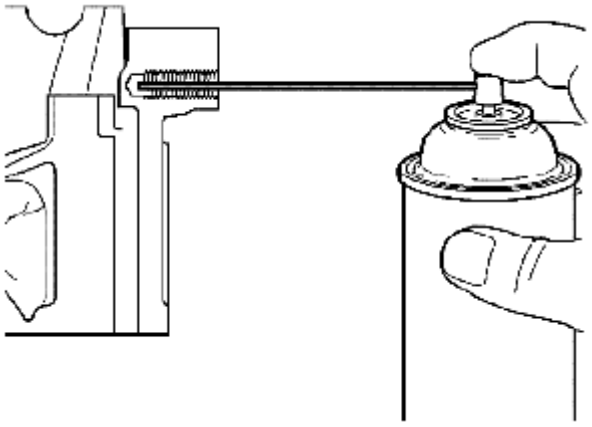


Fig. 595: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

6. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

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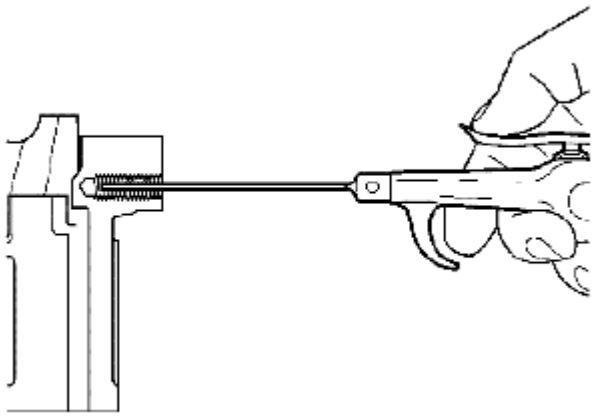


Fig. 596: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

7. Using compressed air, clean out any chips.

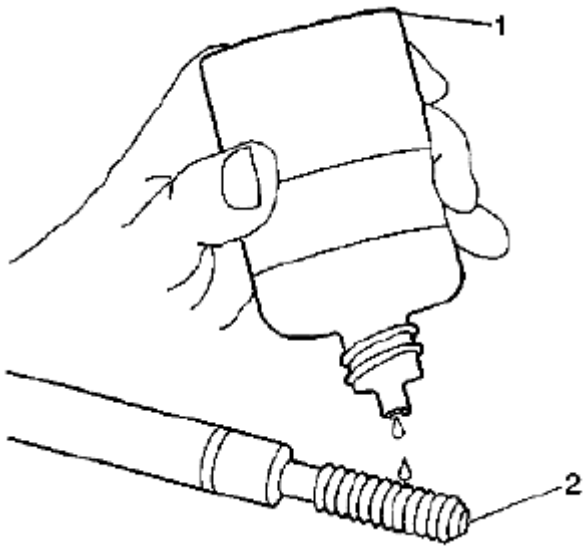


Fig. 597: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

8. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

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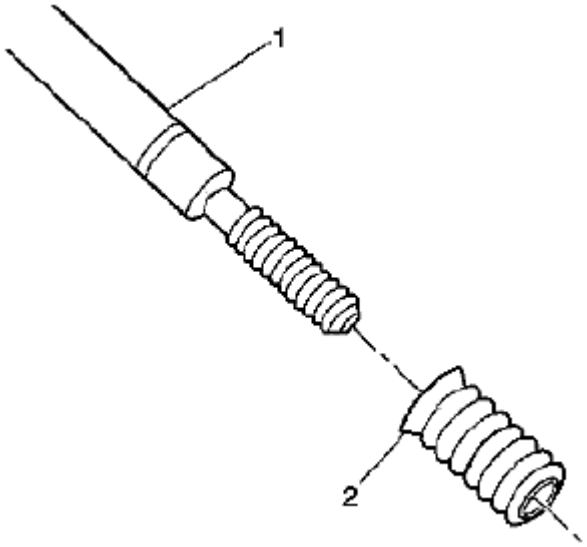


Fig. 598: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

9. Install the insert (2) onto the driver installation tool (1).

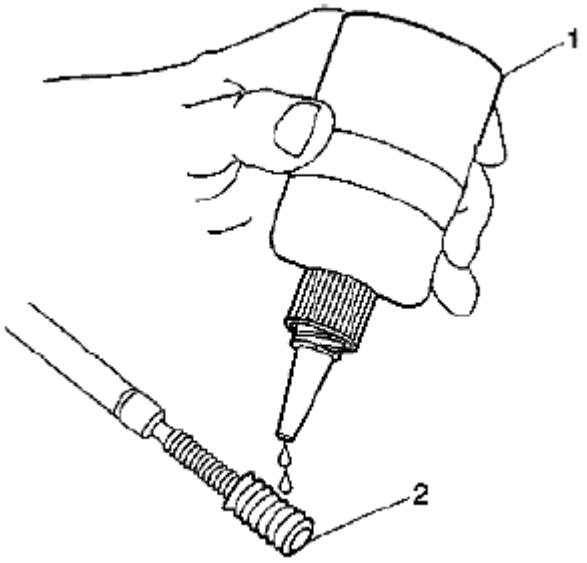


Fig. 599: Applying Threadlock Sealant GM P/N 12345493, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

10. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

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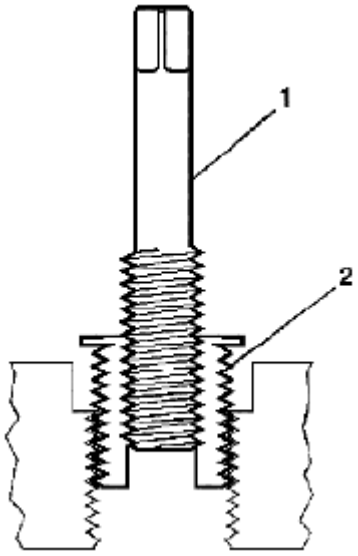


Fig. 600: Identifying Insert And Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the insert (2) into the tapped hole by hand only.

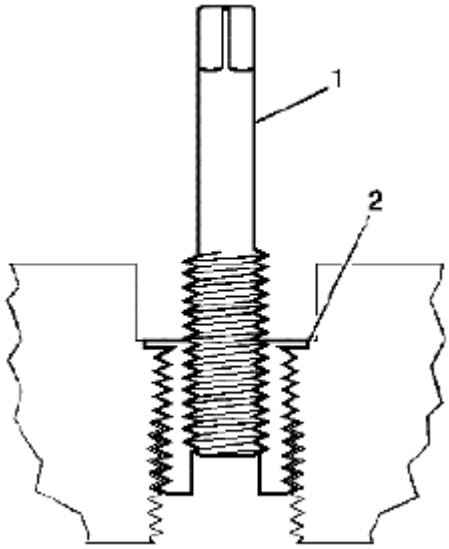


Fig. 601: Identifying Flange Of Insert Contacts Counterbored Surface
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

12. Install the insert until the flange (2) of the insert contacts the counterbored surface.

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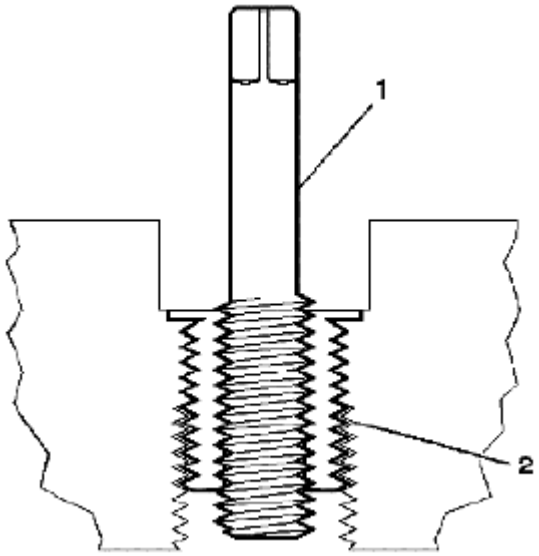


Fig. 602: Identifying Driver Installation Tool And Insert
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

13. Continue to rotate the driver installation tool (1) through the insert (2).

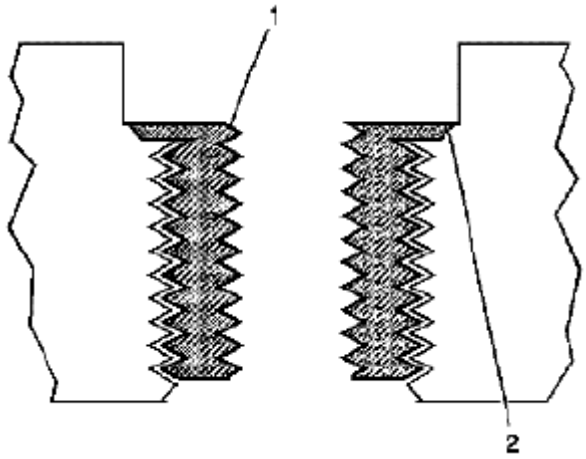


Fig. 603: Inspecting Insert For Proper Installation Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

14. Inspect the insert (1) for proper installation (2) into the tapped hole.

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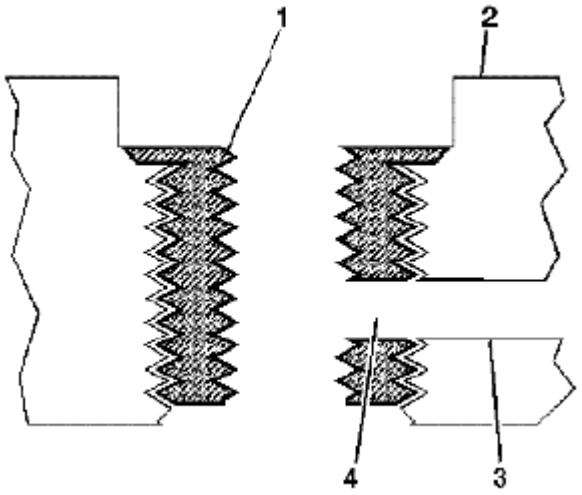


Fig. 604: Identifying Oil Or Engine Coolant Passage
Courtesy of SUZUKI OF AMERICA CORP.

15. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

Tapered Pipe Thread Repair

The thread repair insert for tapered pipe threads is coated with a clear silver zinc coating.

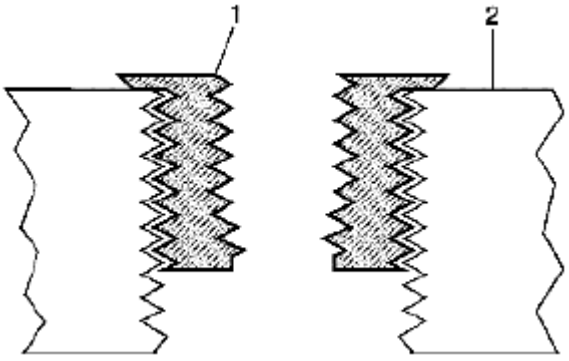


Fig. 605: Identifying Flange Of Insert And Surface Of Base Material Of Drilled/Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE: The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.

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When installed to the proper depth, the flange (1) of the insert will be seated against surface (2) of the base material of the drilled/tapped hole.

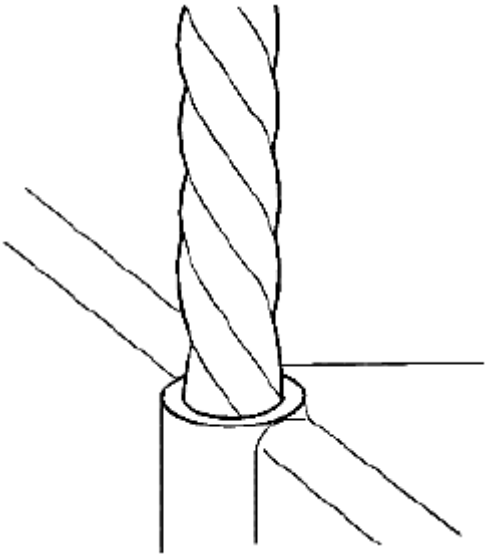


Fig. 606: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:
- **During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.**
- **Drill the hole until the stop collar contacts the surface of the base material.**

1. Drill out the threads of the damaged hole.

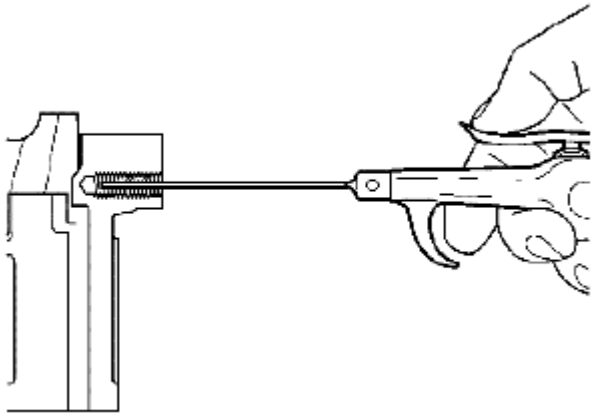


Fig. 607: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

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2. Using compressed air, clean out any chips.

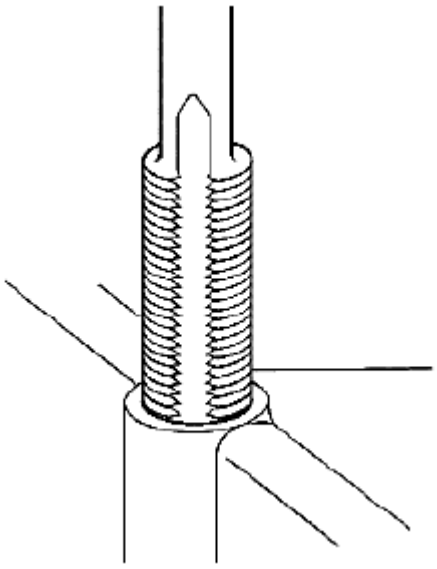


Fig. 608: Tapping Threads Of Drilled Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.**
- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

3. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

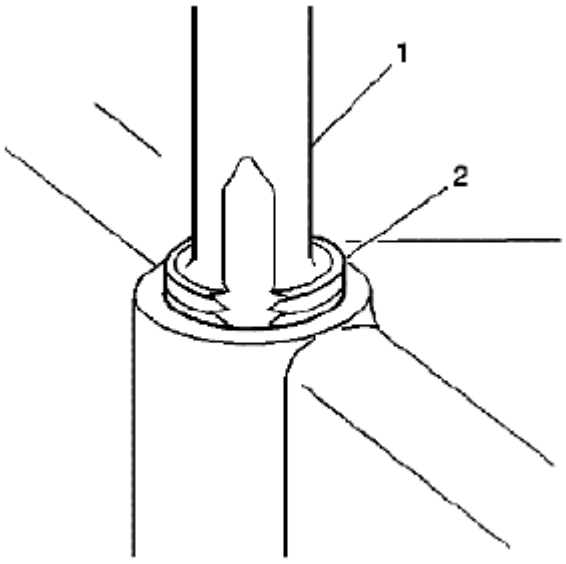


Fig. 609: Tapping Drilled Hole Until Threads At Top Of Tap Are Down To Surface Of Base

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Material
Courtesy of SUZUKI OF AMERICA CORP.

4. Tap the drilled hole until the threads at the top of the tap (2) are down to the surface of the base material.

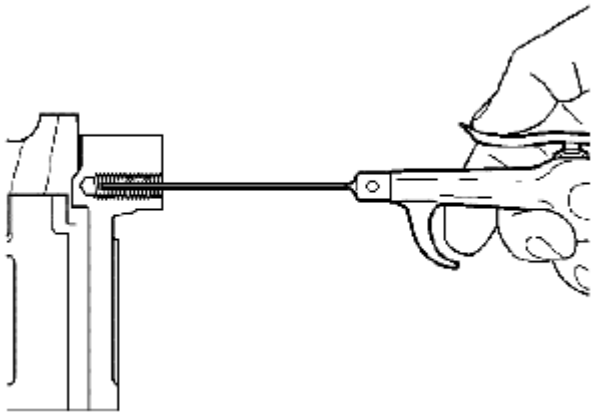


Fig. 610: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

5. Using compressed air, clean out any chips.

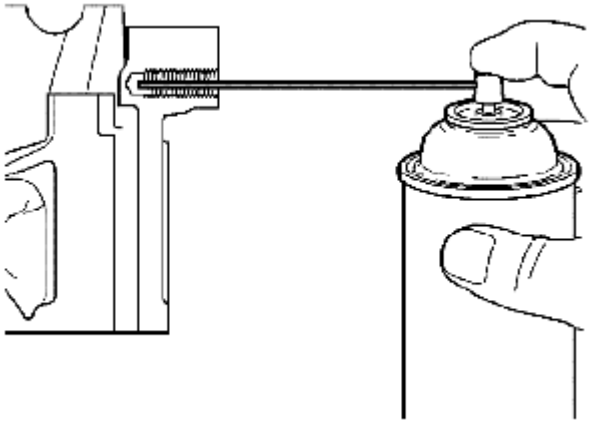


Fig. 611: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

6. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

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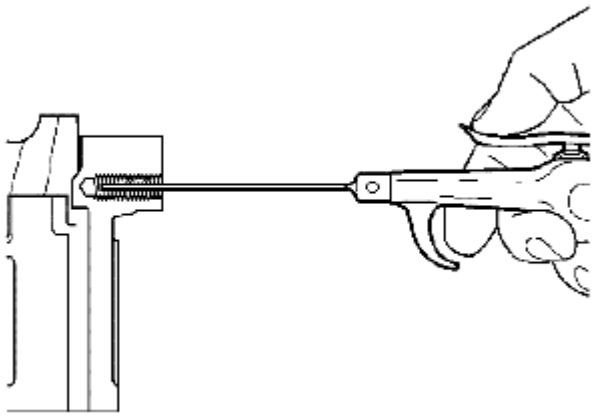


Fig. 612: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

7. Using compressed air, clean out any chips.

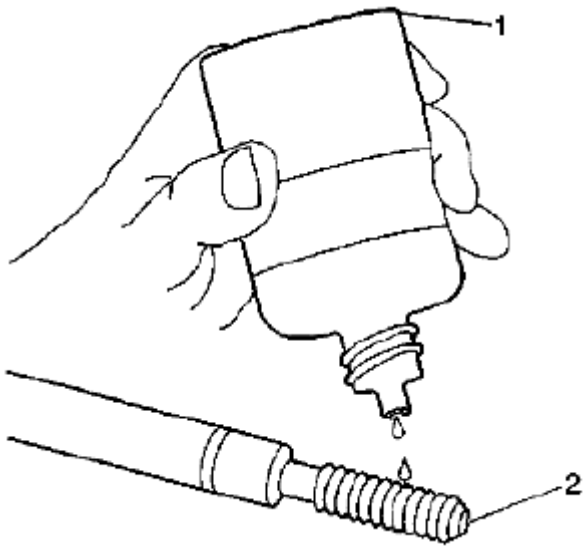


Fig. 613: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

8. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

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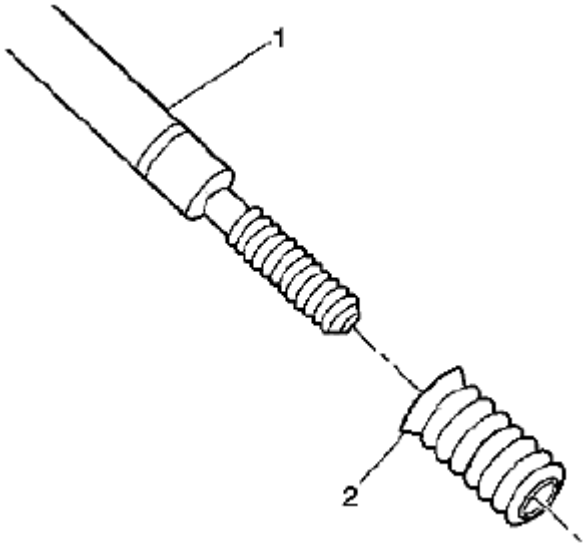


Fig. 614: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

9. Install the insert (2) onto the driver installation tool (1).

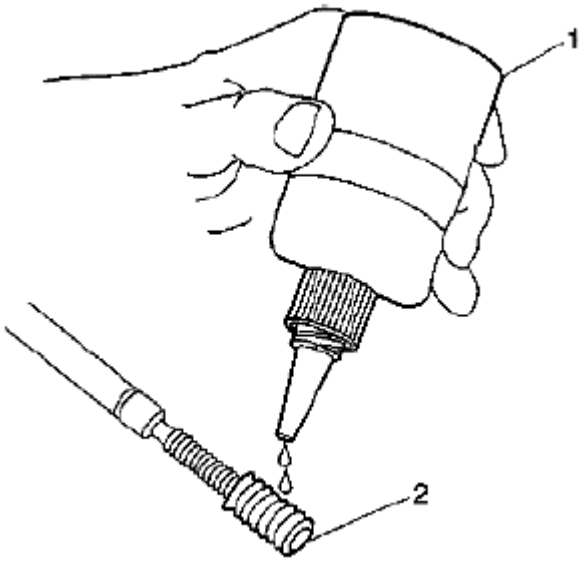


Fig. 615: Applying Threadlock Sealant GM P/N 12345493, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

10. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

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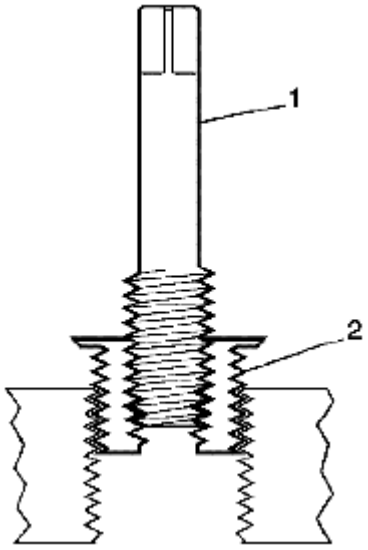


Fig. 616: Identifying Insert
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the insert (2) into the tapped hole by hand only.

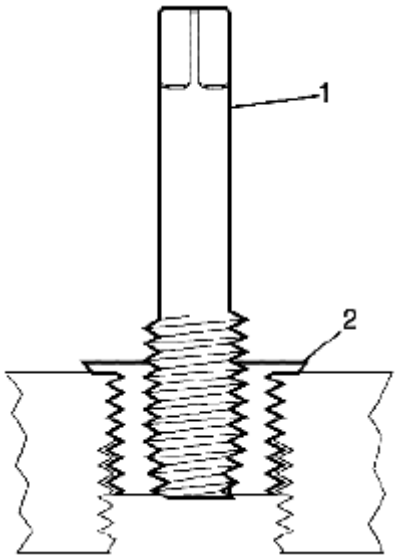


Fig. 617: Identifying Flange Of Insert Contacts Surface Of Base Material
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the insert will not thread down until the flange contacts the surface of the base material remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

12. Install the insert until the flange (2) of the insert contacts the surface of the base material.

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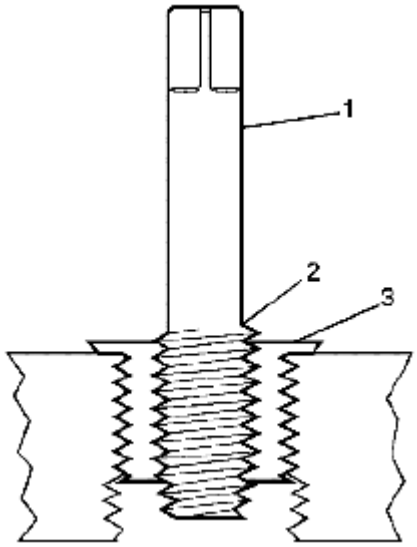


Fig. 618: Identifying Driver Installation Tool, Top Of Threaded Section And Top Of Insert
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

13. Continue to rotate the driver installation tool (1) until the top of the threaded section (2) is level with the top of the insert (3).

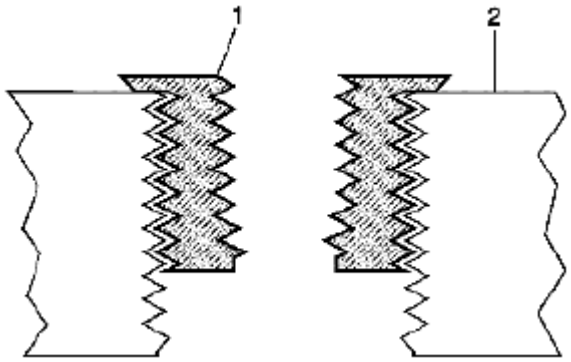


Fig. 619: Inspecting Insert For Proper Installation Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

14. Inspect the insert (1) for proper installation (2) into the tapped hole.

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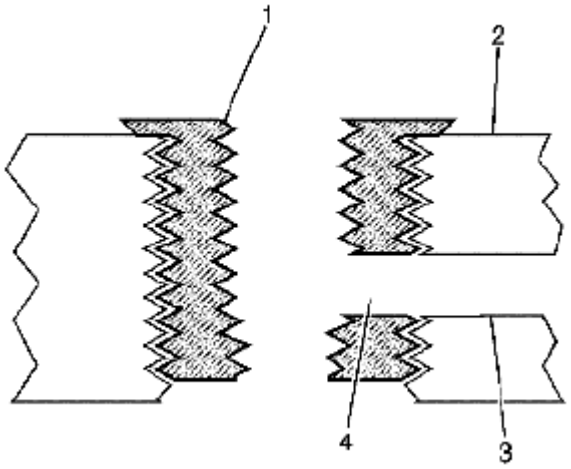


Fig. 620: Identifying Oil Or Engine Coolant Passage
Courtesy of SUZUKI OF AMERICA CORP.

15. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

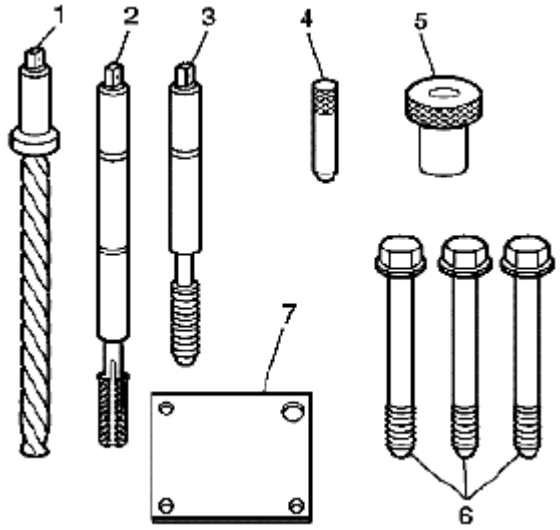
Cylinder Head Bolt Hole Thread Repair

Special Tool

J 42385-700 High Feature Thread Repair Kit

J 42385-2000 Thread Insert Kit

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.



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Fig. 621: Identifying Cylinder Head Bolt Hole Thread Repair Tool Kit
Courtesy of SUZUKI OF AMERICA CORP.

The cylinder head bolt hole thread repair tooling are in the kits J 42385-2000 and J 42385-700. The cylinder head bolt hole thread repair components consist of the following:

- J 42385-723 Drill (1)
- J 42385-724 Tap (2)
- J 42385-725 Installation driver (3)
- J 42385-303 Alignment pin (4)
- J 42385-302 Bushing (5)
- J 42385-733 Bolts (6)
- J 42385-401 Fixture plate (7)

WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE:

- **Remove the fixture plate prior to installing the insert with the installer tool.**
- **The use of a cutting type fluid GM P/N 1052864 (Canadian P/N 992881) WD 40®; or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

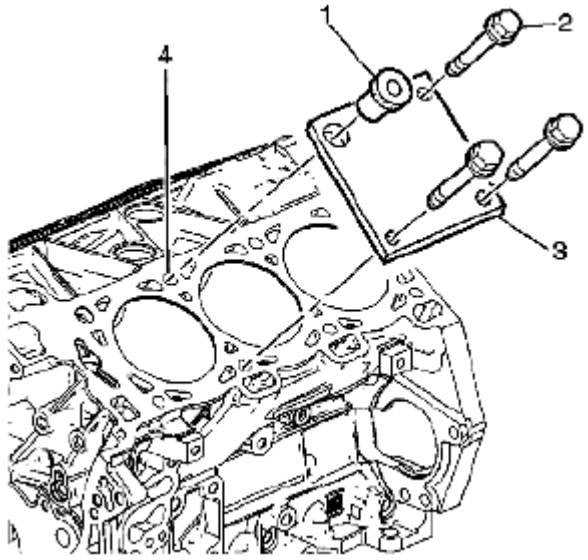


Fig. 622: Positioning Fixture Plate With Bushing Installed Over Cylinder Head Bolt Hole
Courtesy of SUZUKI OF AMERICA CORP.

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1. Position the fixture plate (3) with the bushing (1) installed over the cylinder head bolt hole to be repaired (4).
2. Loosely install the fixture plate bolts (2) into the remaining cylinder head bolt holes.

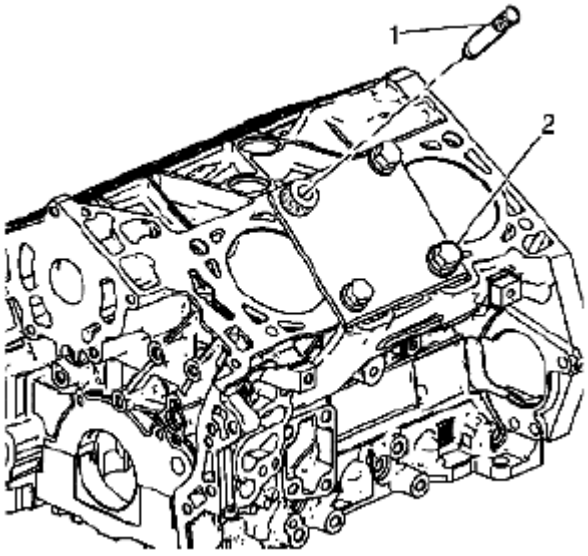


Fig. 623: Identifying Alignment Pin And Fixture Retaining Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Position the alignment pin (1) through the bushing and into the cylinder head bolt hole.
4. With the alignment pin in the desired cylinder head bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the cylinder head bolt hole.

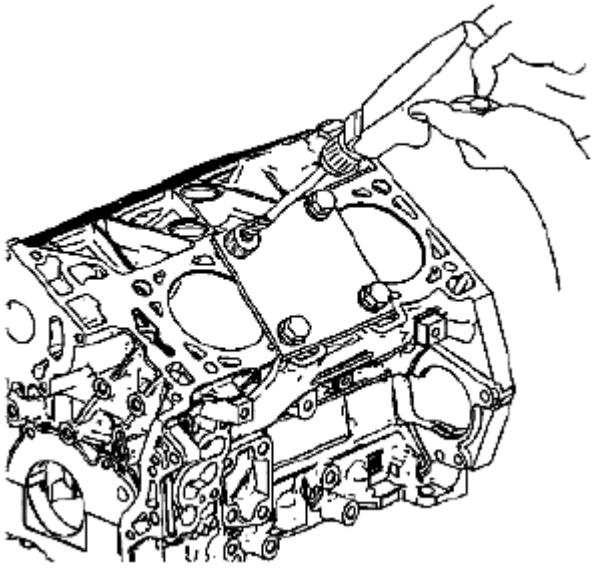


Fig. 624: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

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NOTE:

- **During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.**
- **Drill the hole until the stop collar contacts the top of the drill bushing.**

6. Drill out the threads of the damaged hole.

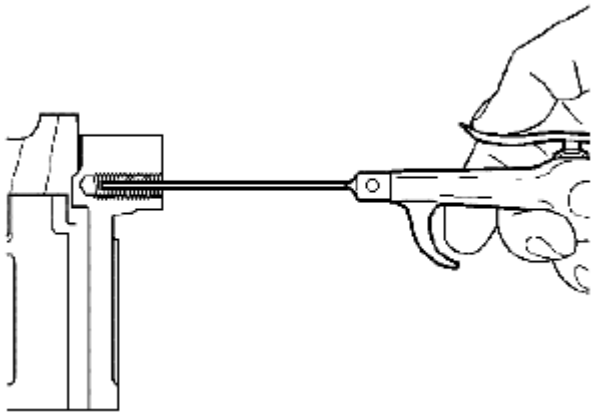


Fig. 625: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

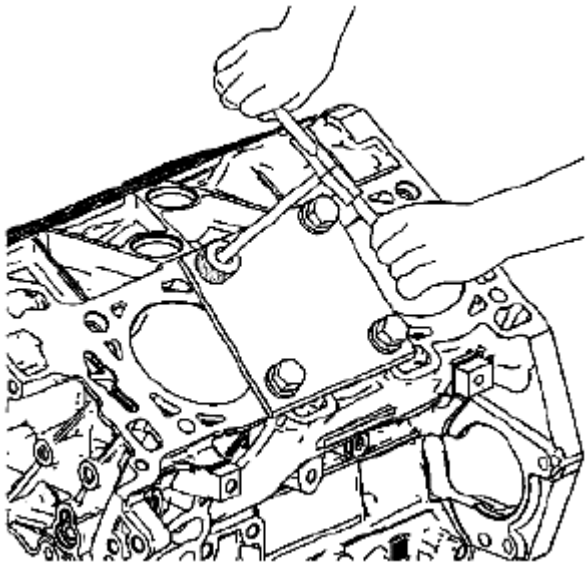


Fig. 626: Tapping Threads Of Drilled Hole By Hand Only
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

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- **During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.**
- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

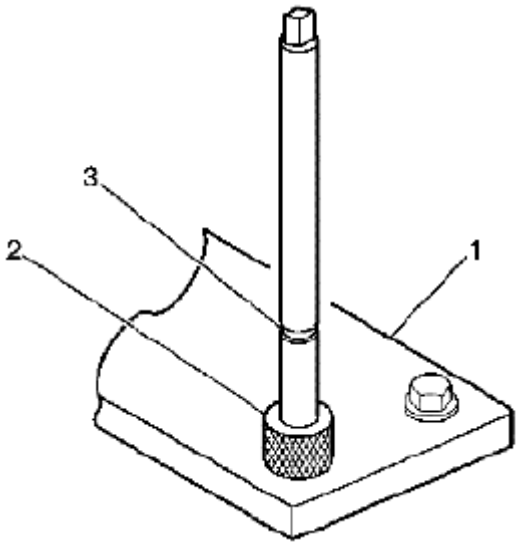


Fig. 627: Identifying Mark On Tap And Drill Bushing
Courtesy of SUZUKI OF AMERICA CORP.

9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the cylinder head bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

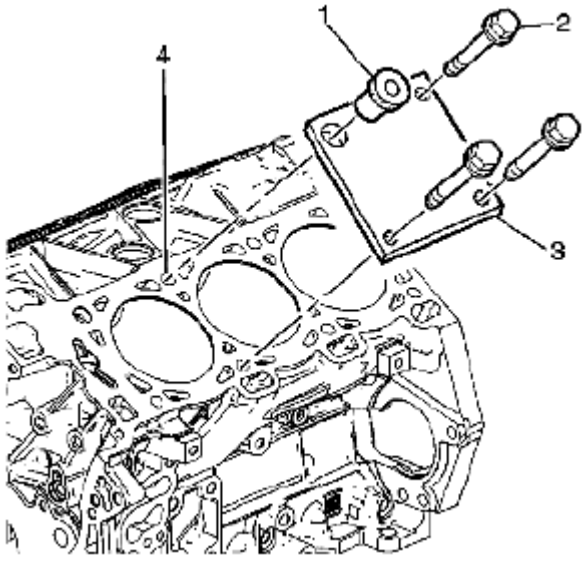


Fig. 628: Identifying Fixture Plate, Bolts And Bushing

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Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Remove the fixture plate prior to installing the insert with the installer tool.

10. Remove the fixture plate bolts (2).
11. Remove the fixture plate (3) and bushing (1).

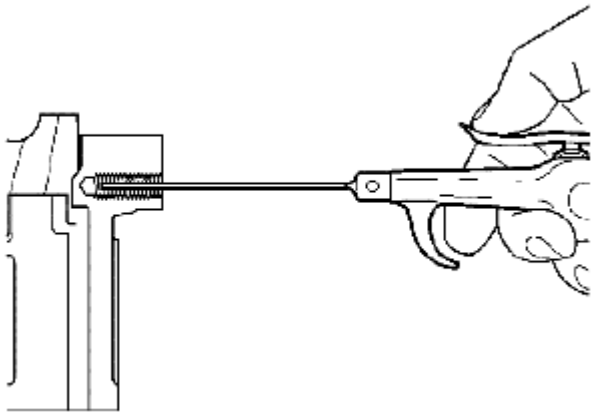


Fig. 629: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

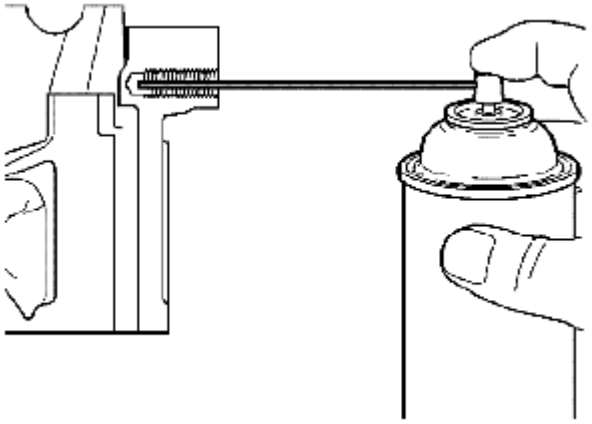


Fig. 630: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

13. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

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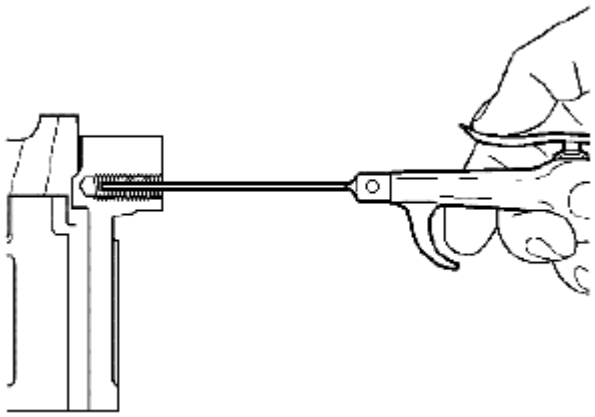


Fig. 631: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

14. Using compressed air, clean out any chips.

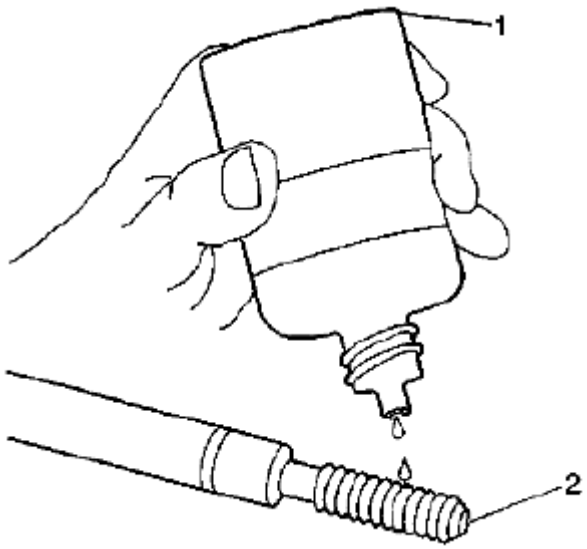


Fig. 632: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

15. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

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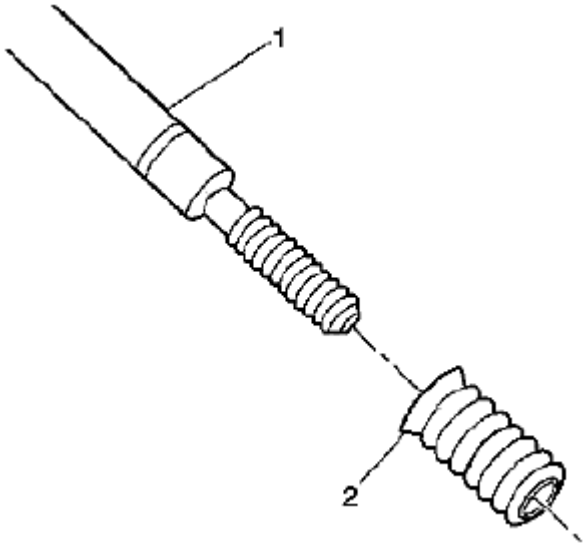


Fig. 633: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

16. Install the insert (2) onto the driver installation tool (1).

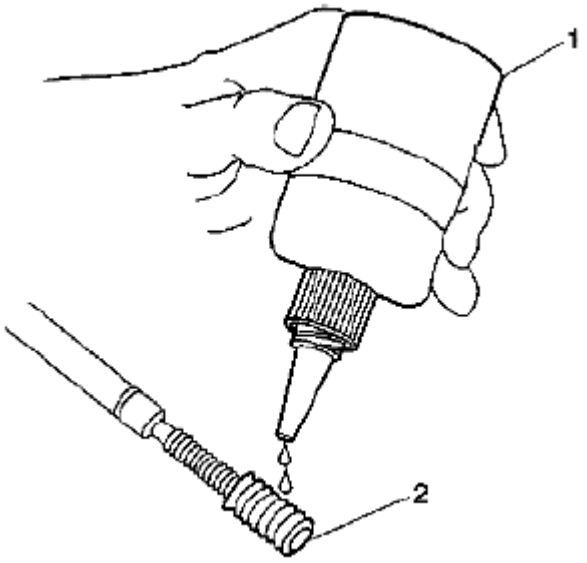


Fig. 634: Applying Threadlock Sealant GM P/N 12345493, J 42385-109, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

17. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®; or equivalent (1) to the insert OD threads (2).

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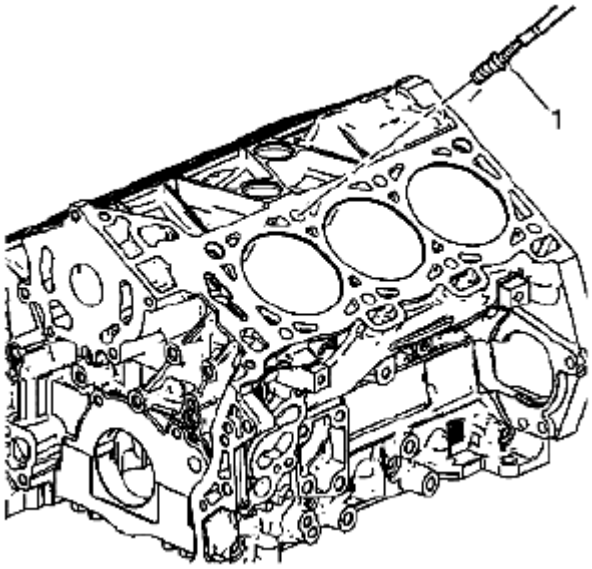


Fig. 635: Identifying Insert And Installation Driver
Courtesy of SUZUKI OF AMERICA CORP.

18. Install the insert and installation driver (1) into the tapped hole by hand only.
19. Start the insert into the threaded hole.

NOTE: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

20. Install the insert until the flange of the insert contacts the counterbored surface.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

21. Continue to rotate the driver installation tool through the insert.

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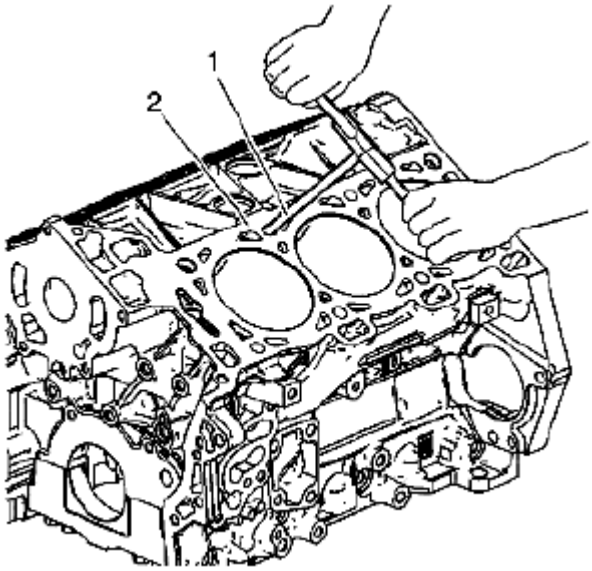


Fig. 636: Rotating Driver Installation Tool Through Insert Until Mark On Driver Installation Tool Aligns With Surface Of Engine Block Deck
Courtesy of SUZUKI OF AMERICA CORP.

22. In order to completely form the new threads in the insert, rotate the driver installation tool through the insert until the mark (1) on the driver installation tool aligns with the surface of the engine block deck (2).
23. Inspect the insert for proper installation into the tapped hole.

Crankshaft Main Bolt Hole Thread Repair

Special Tool

J 42385-700 High Feature Thread Repair Kit

J 42385-2000 Thread Insert Kit

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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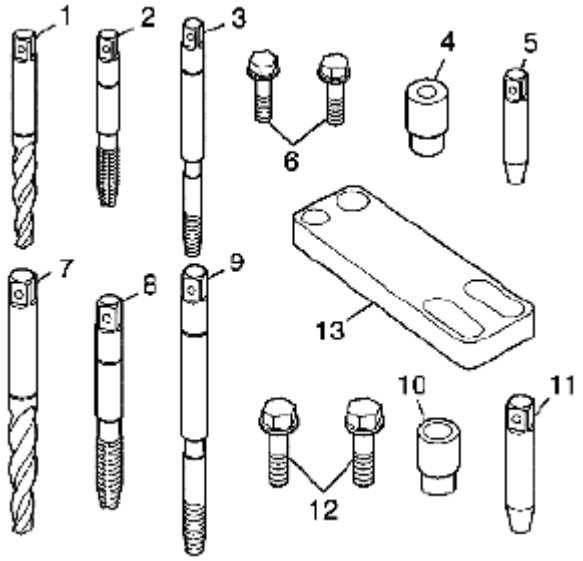


Fig. 637: Identifying Crankshaft Main Bearing Bolt Hole Thread Repair Tool Kits
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **In order to repair some crankshaft main bolt holes it will be necessary to mount the fixture plate upside down.**
- **Do NOT remove the fixture plate prior to installing the insert with the installation driver. The fixture plate remains in position throughout the thread repair process.**

The crankshaft main bearing bolt hole thread repair tooling are in the kits J 42385-2000 and J 42385-700. The crankshaft main bearing bolt hole thread repair components consist of the following:

- J 42385-702 Drill (1) for outboard holes
- J 42385-703 Tap (2) for outboard holes
- J 42385-704 Installation driver (3) for outboard holes
- J 42385-726 Bushing (4) for outboard holes
- J 42385-727 Alignment pin (5) for outboard holes
- J 42385-728 Bolts (6) for outboard holes
- J 42385-720 Drill (7) for inboard holes
- J 42385-721 Tap (8) for inboard holes
- J 42385-722 Installation driver (9) for inboard holes
- J 42385-713 Bushing (10)
- J 42385-308 Alignment pin (11)
- J 42385-734 Bolts (12)
- J 42385-712 Fixture plate (13)

Outboard Bolt Holes

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WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE:

- **Ensure the fixture plate is installed during the machining and installation processes of the insert.**
- **The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

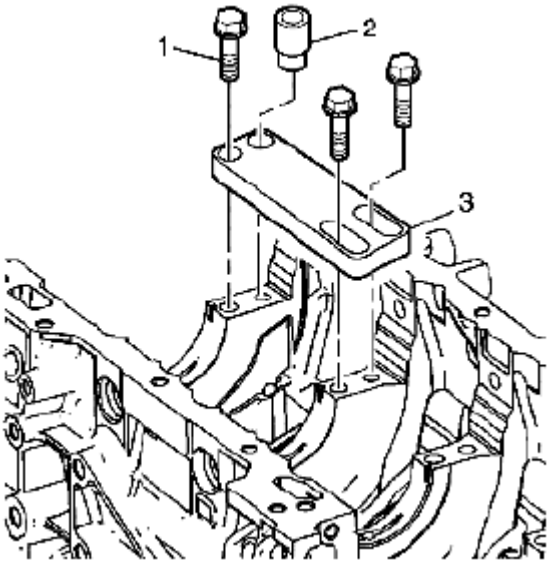


Fig. 638: Identifying Fixture Plate, Bushing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Position the fixture plate (3) with the bushing (2) installed over the crankshaft main cap bolt hole to be repaired.
2. Loosely install the fixture plate bolts (1) into the remaining crankshaft main cap bolt holes.

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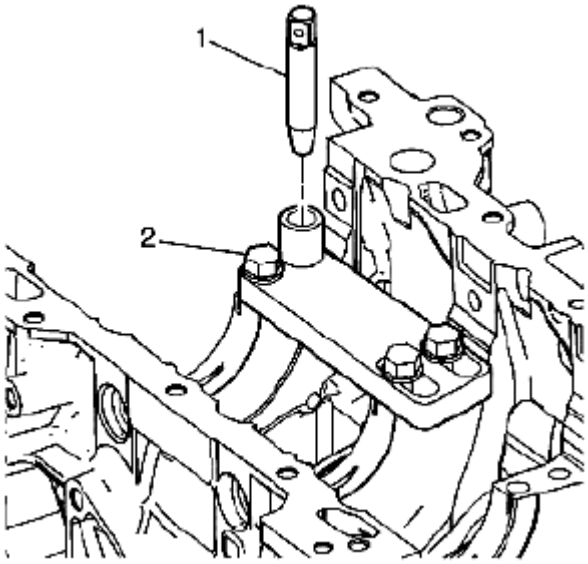


Fig. 639: Identifying Alignment Pin And Fixture Retaining Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.
4. With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the crankshaft main cap bolt hole.

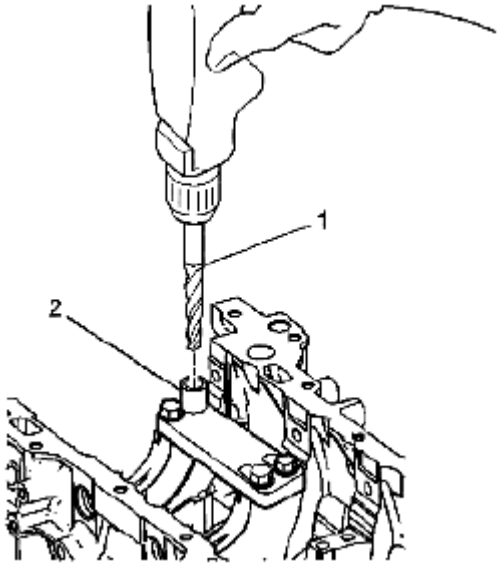


Fig. 640: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.**
- **Drill the crankshaft main bolt hole until the mark (1) on the drill aligns**

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with the top of the drill bushing (2).

6. Drill out the threads of the damaged hole.

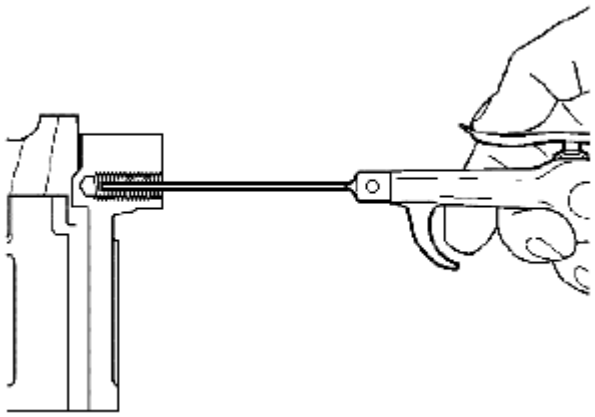


Fig. 641: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

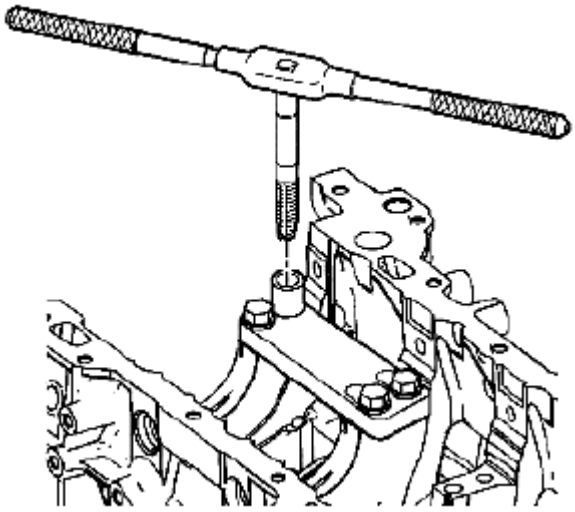


Fig. 642: Identifying Tapping Wrench
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not remove the fixture plate, ensure the fixture plate is installed during the machining and installation processes of the insert.**
- **During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.**

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- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

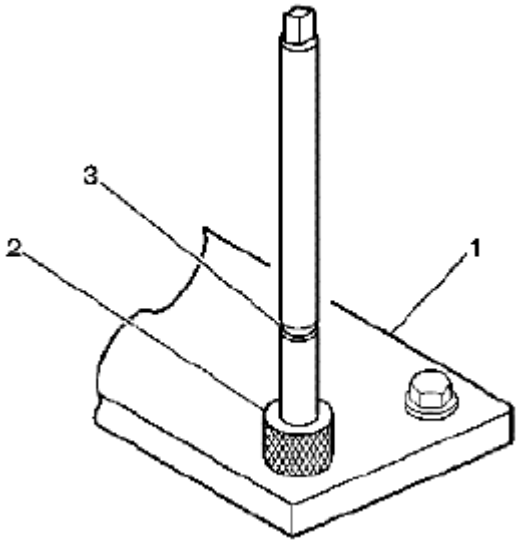


Fig. 643: Identifying Tap Mark And Drill Bushing
Courtesy of SUZUKI OF AMERICA CORP.

9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the crankshaft main cap bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

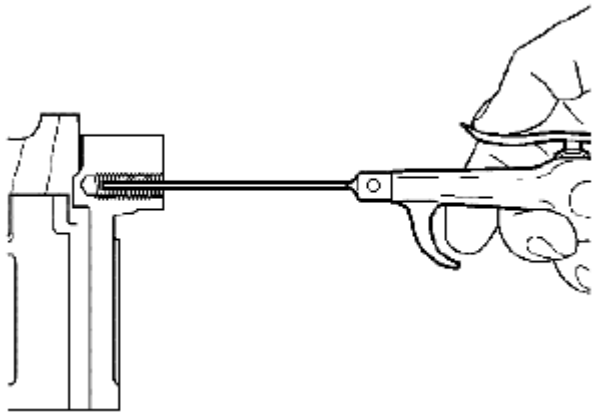


Fig. 644: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

10. Using compressed air, clean out any chips.

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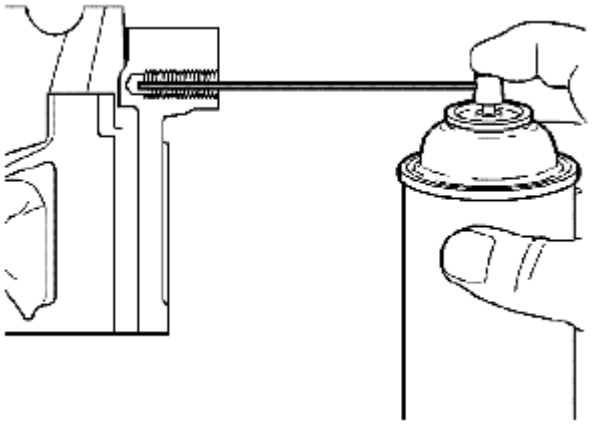


Fig. 645: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

11. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

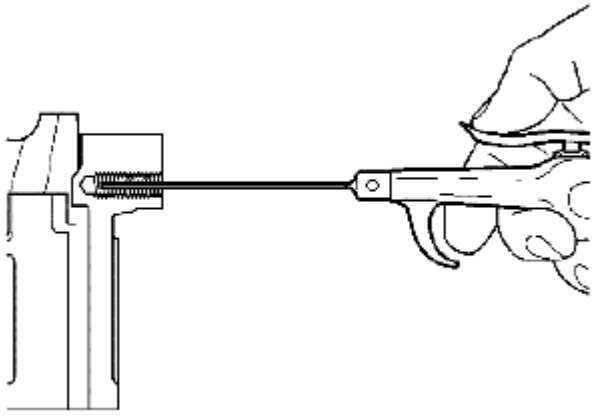


Fig. 646: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

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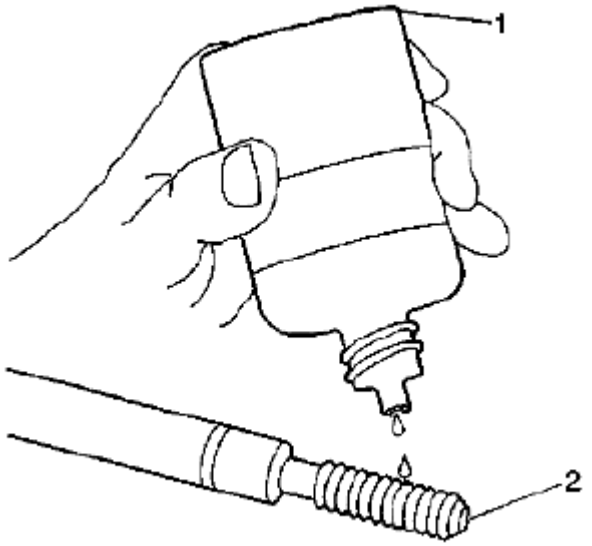


Fig. 647: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.**
- **Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.**

13. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

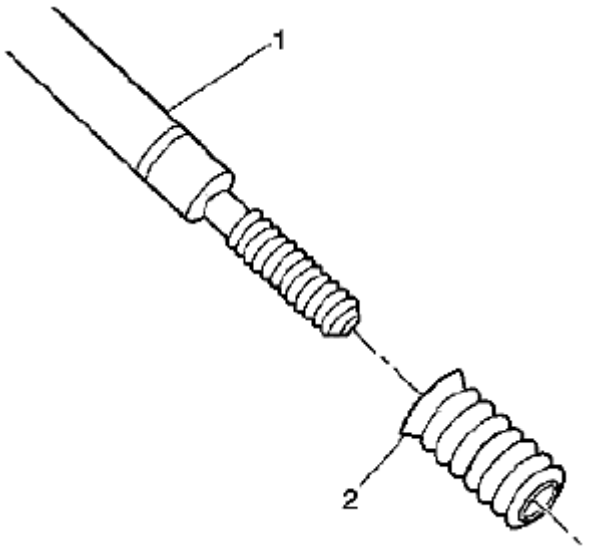


Fig. 648: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

14. Install the insert (2) onto the driver installation tool (1).

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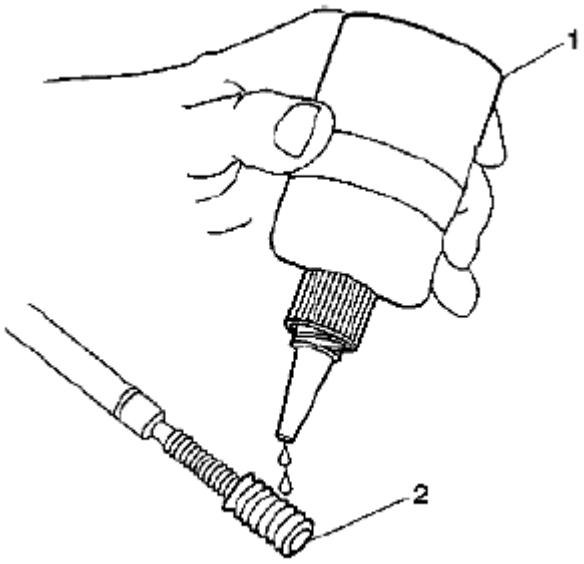


Fig. 649: Applying Threadlock Sealant GM P/N 12345493, J 42385-109, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

15. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®, or equivalent (1) to the insert OD threads (2).

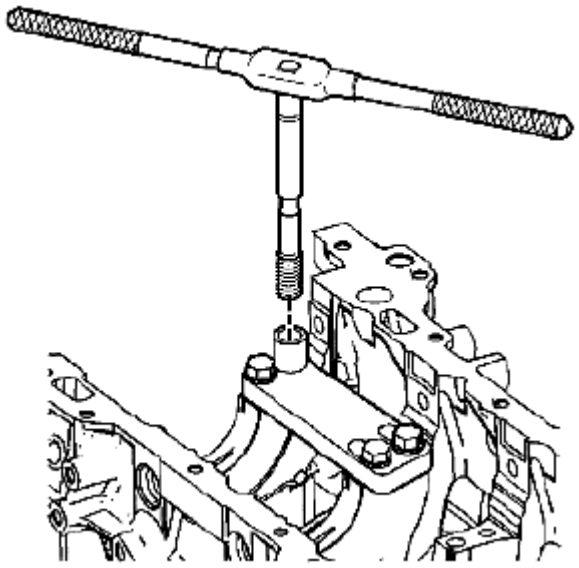


Fig. 650: Installing Insert And Installation Driver Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

16. Install the insert and installation driver into the tapped hole by hand only.
17. Start the insert into the threaded hole.

NOTE: If the insert will not thread down until the flange contacts the counterbored

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surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

18. Install the insert until the flange of the insert contacts the counterbored surface.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19. Continue to rotate the driver installation tool through the insert.

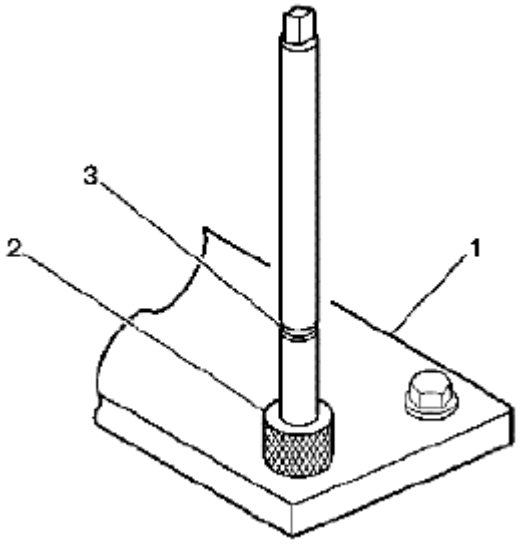


Fig. 651: Identifying Mark On Driver Installation Tool And Drill Bushing
Courtesy of SUZUKI OF AMERICA CORP.

20. Rotate the driver installation tool until the mark (3) on the driver installation tool aligns with the top of the drill bushing (2).
21. Inspect the insert for proper installation into the tapped hole.

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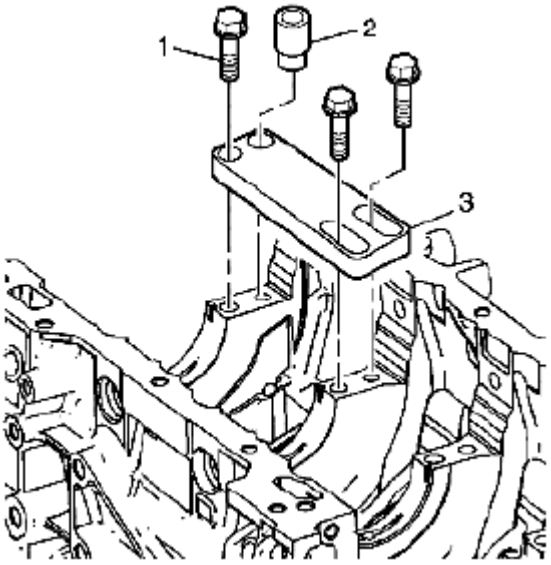


Fig. 652: Identifying Fixture Plate, Bushing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

22. Remove the fixture plate bolts (1).
23. Remove the fixture plate (3) and bushing (2).

Inboard Bolt Holes

WARNING: Refer to SAFETY GLASSES CAUTION .

NOTE:

- **Ensure the fixture plate is installed during the machining and installation processes of the insert.**
- **The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

  When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

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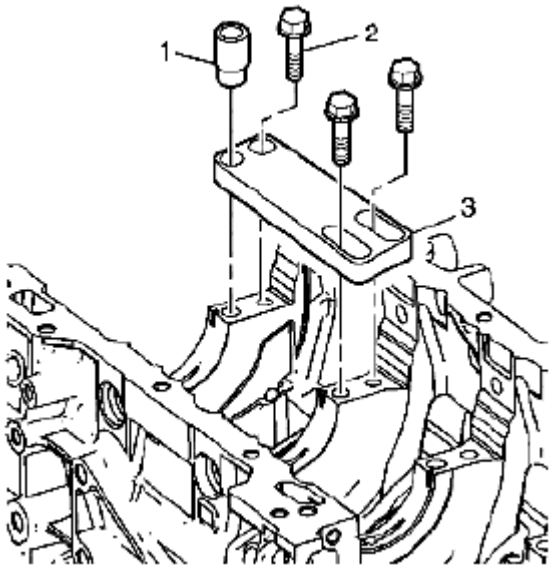


Fig. 653: Identifying Fixture Plate, Bushing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Position the fixture plate (3) with the bushing (1) installed over the crankshaft main cap bolt hole to be repaired.
2. Loosely install the fixture plate bolts (2) into the remaining crankshaft main cap bolt holes.

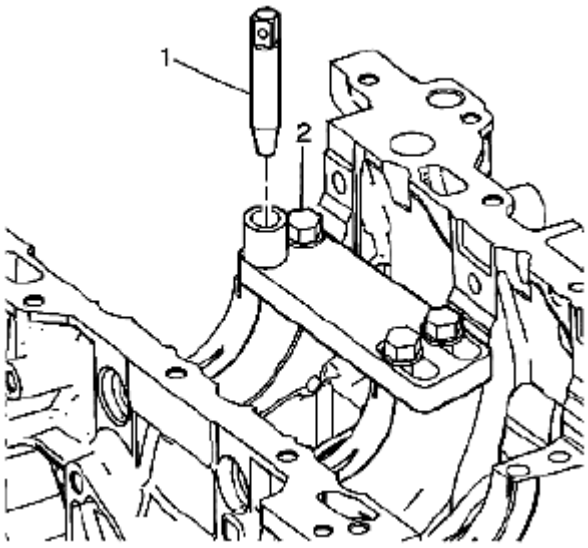


Fig. 654: Identifying Alignment Pin And Fixture Retaining Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.
4. With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the crankshaft main cap bolt hole.

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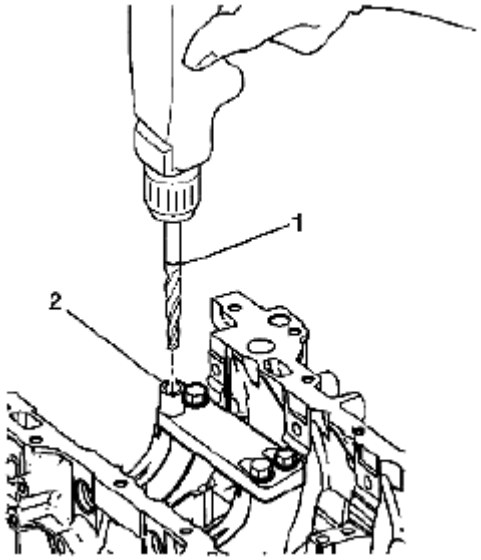


Fig. 655: Drilling Out Threads Of Damaged Hole
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:
- **During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.**
- **Drill the crankshaft main bolt hole until the mark (1) on the drill aligns with the top of the drill bushing (2).**

6. Drill out the threads of the damaged hole.

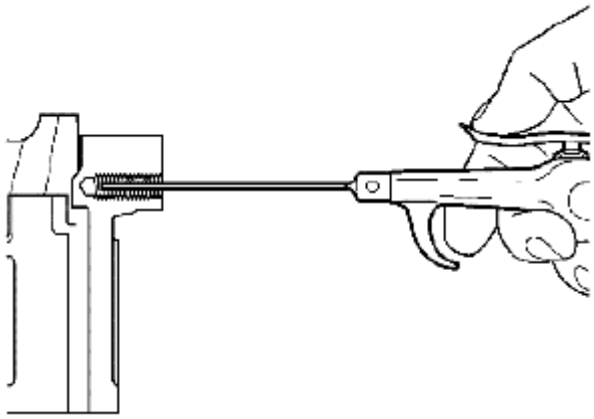


Fig. 656: Cleaning Out Chips From Drilled Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

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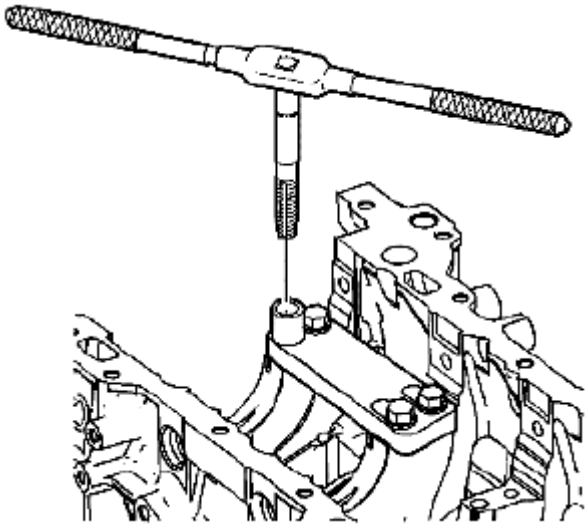


Fig. 657: Identifying Tapping Wrench
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not remove the fixture plate, ensure the fixture plate is installed during the machining and installation processes of the insert.**
- **During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.**
- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

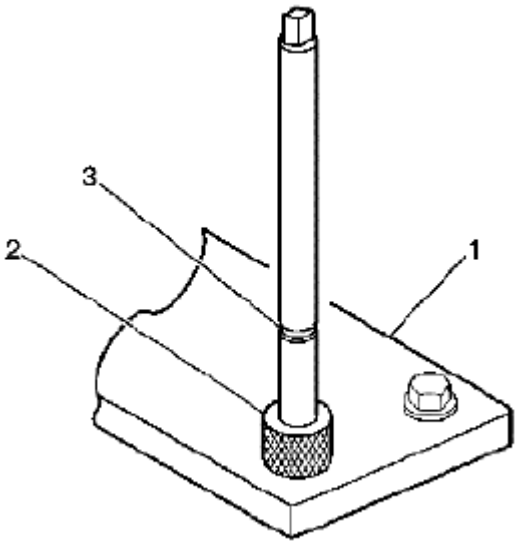


Fig. 658: Identifying Mark On Tap And Drill Bushing
Courtesy of SUZUKI OF AMERICA CORP.

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9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the crankshaft main cap bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

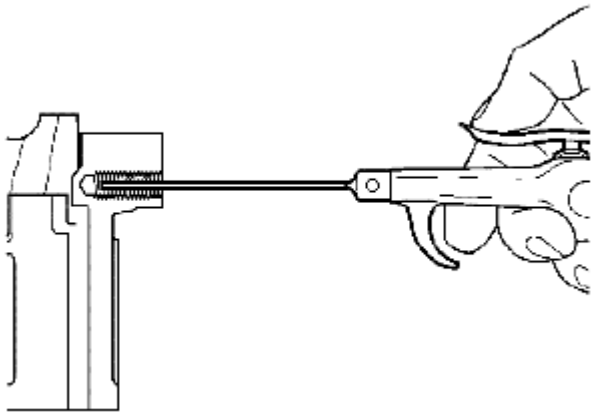


Fig. 659: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

10. Using compressed air, clean out any chips.

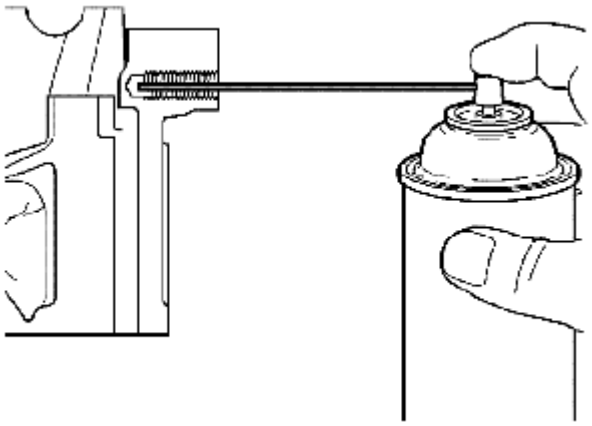


Fig. 660: Spraying Cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) Into Tapped Hole
Courtesy of SUZUKI OF AMERICA CORP.

11. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

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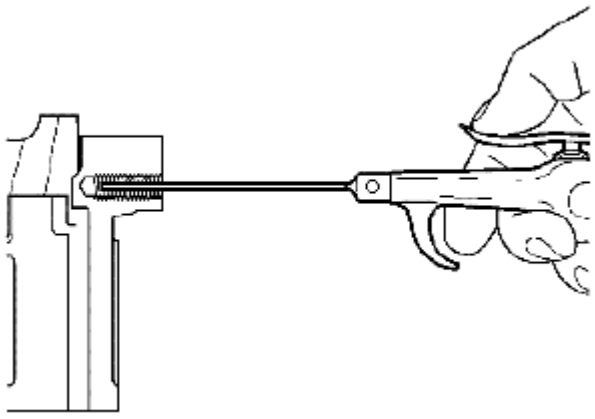


Fig. 661: Cleaning Out Chips From Tapped Hole Using Compressed Air
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

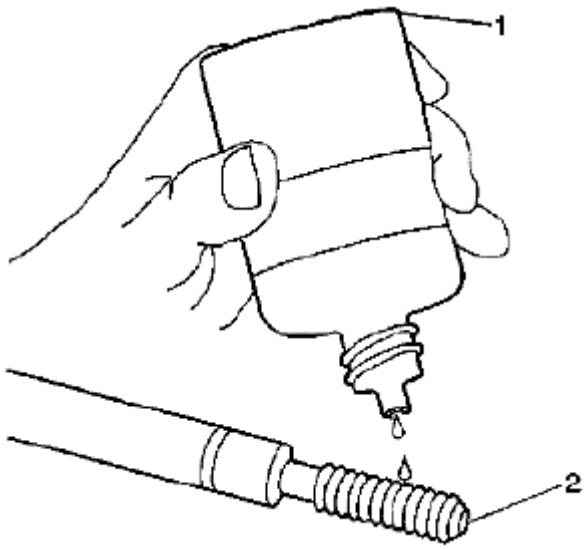


Fig. 662: Lubricating Threads Of Driver Installation Tool With J 42385-110
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.**
- **Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.**

13. Lubricate the threads of the driver installation tool (2) with the J 42385-110 (1).

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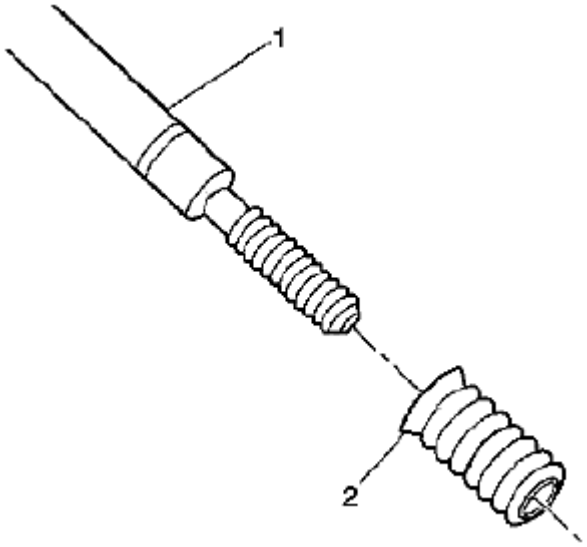


Fig. 663: Identifying Insert And Driver Installation Tool
Courtesy of SUZUKI OF AMERICA CORP.

14. Install the insert (2) onto the driver installation tool (1).

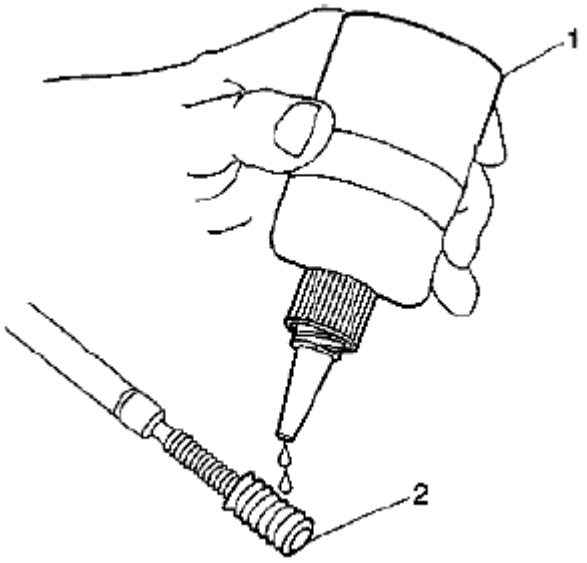


Fig. 664: Applying Threadlock Sealant GM P/N 12345493, J 42385-109, LOCTITE 277® To Insert OD Threads
Courtesy of SUZUKI OF AMERICA CORP.

15. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®, or equivalent (1) to the insert OD threads (2).

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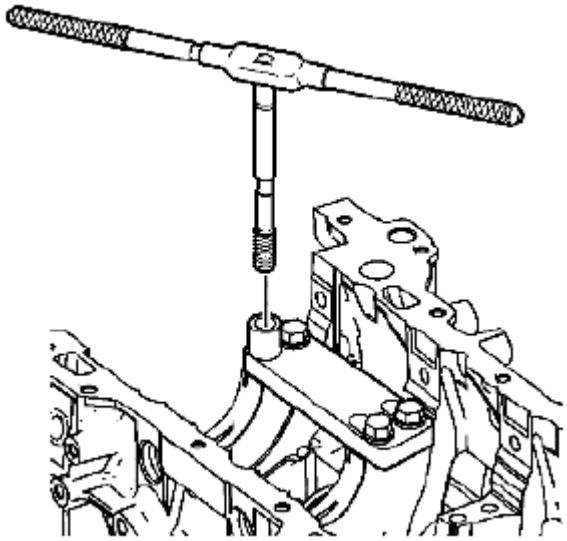


Fig. 665: Identifying Insert And Installation Driver
Courtesy of SUZUKI OF AMERICA CORP.

16. Install the insert and installation driver into the tapped hole by hand only.
17. Start the insert into the threaded hole.

NOTE: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

18. Install the insert until the flange of the insert contacts the counterbored surface.

NOTE: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19. Continue to rotate the driver installation tool through the insert.

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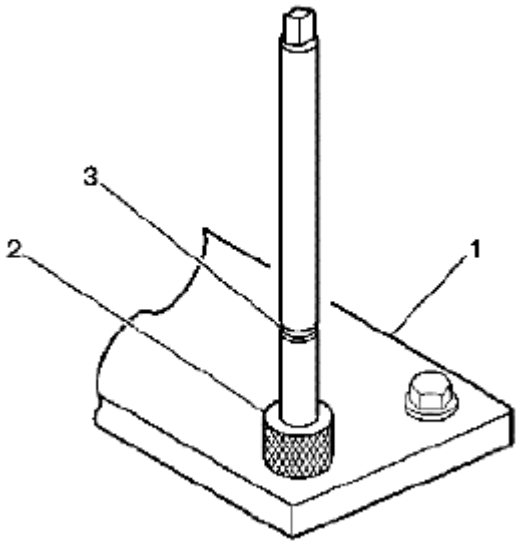


Fig. 666: Identifying Mark On Driver Installation Tool And Drill Bushing
Courtesy of SUZUKI OF AMERICA CORP.

20. Rotate the driver installation tool until the mark (3) on the driver installation tool aligns with the top of the drill bushing (2).
21. Inspect the insert for proper installation into the tapped hole.

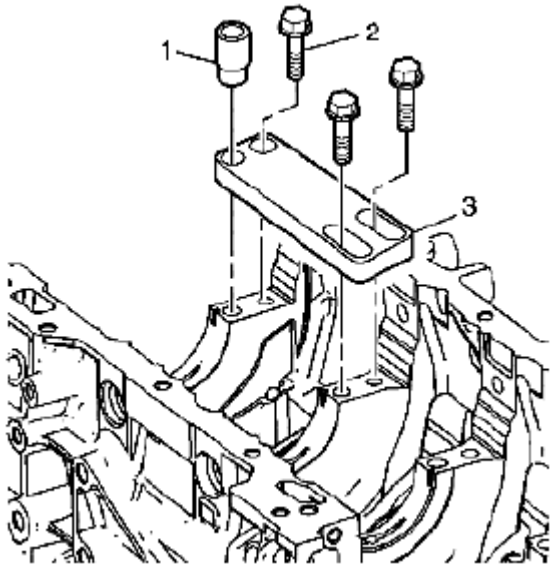


Fig. 667: Identifying Fixture Plate, Bushing And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

22. Remove the fixture plate bolts (2).
23. Remove the fixture plate (3) and bushing (1).

SERVICE PRIOR TO ASSEMBLY

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- Dirt will cause premature wear of the rebuilt engine. Clean all the components.
- Use the proper tools to measure the components when checking for excessive wear. Components not within the manufacturer's specification must be repaired or replaced.
- When the components are reinstalled into an engine, return the components to their original location, position, and direction.
- During assembly, lubricate all the moving parts with clean engine oil (unless otherwise specified). This will provide initial lubrication when the engine is first started.

Reference: **ENGINE BLOCK ASSEMBLE**

ENGINE BLOCK ASSEMBLE

Reference: **ENGINE BLOCK CLEANING AND INSPECTION**

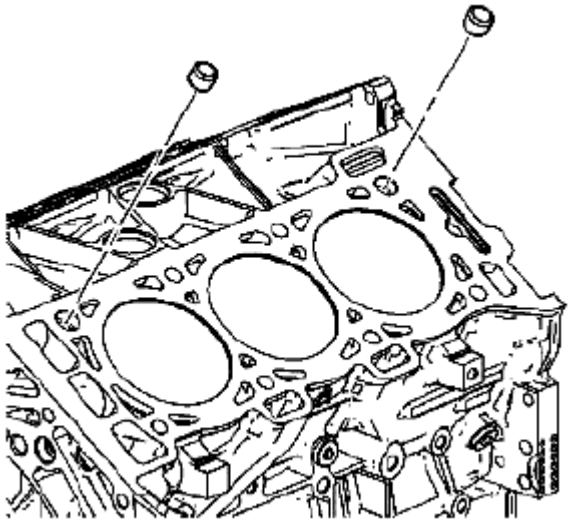


Fig. 668: Identifying Cylinder Block-To-Cylinder Head Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the cylinder block-to-cylinder head alignment dowels.

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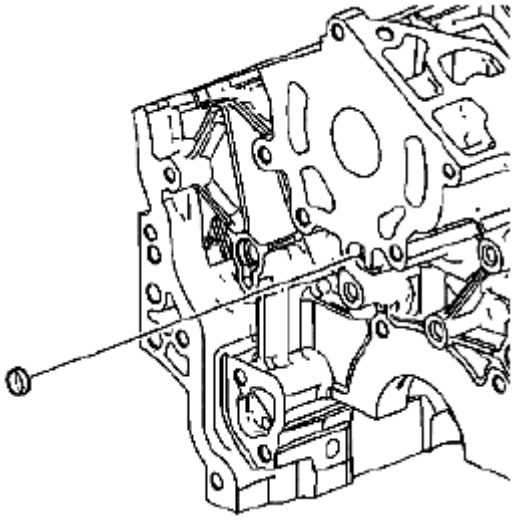


Fig. 669: Identifying Front Oil Gallery Expansion Plug
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the NEW front oil gallery expansion plug.
3. Ensure the NEW front oil gallery expansion plug is installed to the proper depth.

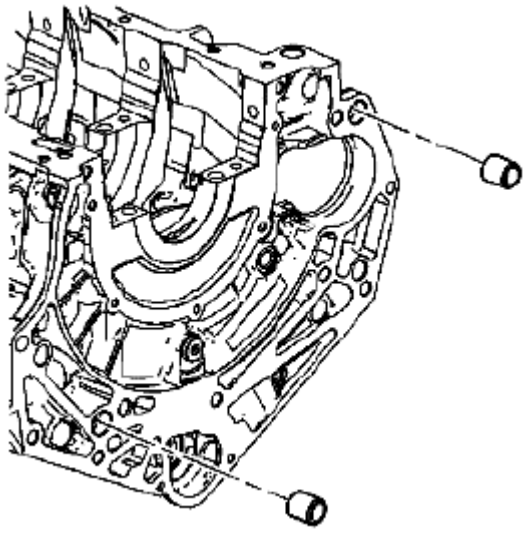


Fig. 670: Identifying Cylinder Block-To-Transmission Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the cylinder block-to-transmission alignment dowels.

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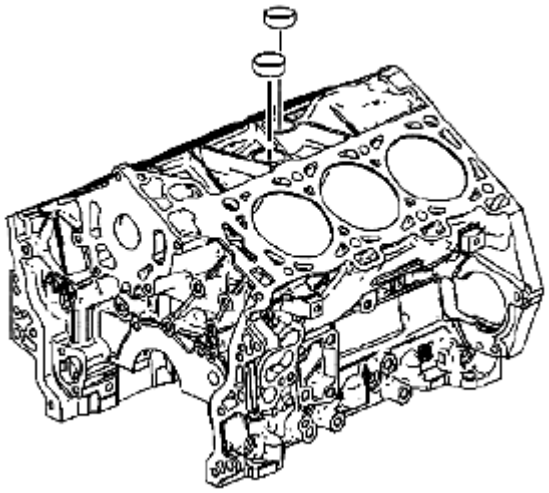


Fig. 671: Identifying Coolant Expansion Plugs
Courtesy of SUZUKI OF AMERICA CORP.

5. Apply the RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent on the NEW coolant expansion plugs.
6. Install the NEW coolant expansion plugs.
7. Ensure the NEW coolant expansion plugs are installed to the proper depth.

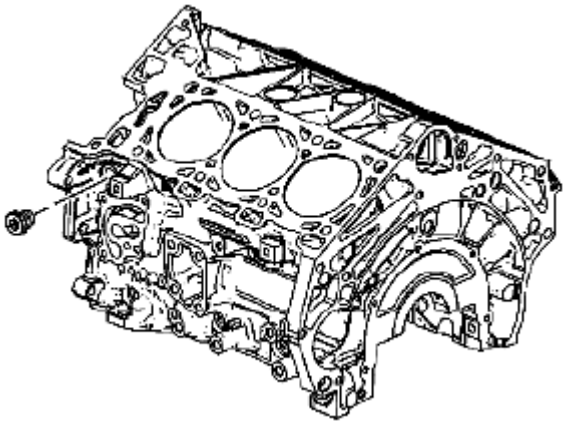


Fig. 672: Identifying M20 Left Side Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

8. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M20 left side oil gallery threaded plug.

CAUTION: Refer to FASTENER NOTICE .

9. Install the M20 left side oil gallery threaded plug.

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Tightening torque

Tighten the M20 left side oil gallery threaded plug to 31 N.m (23 lb ft) .

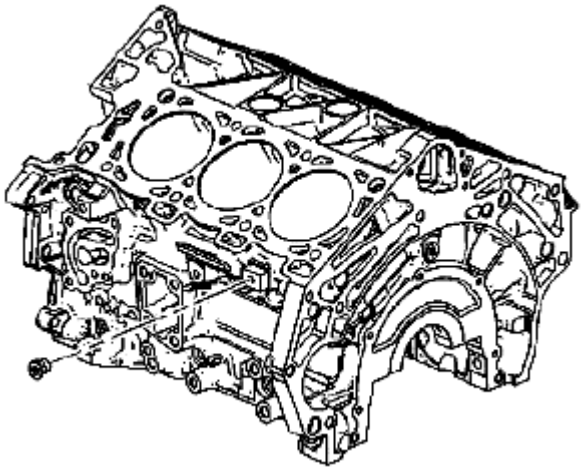


Fig. 673: Identifying M14 Left Side Coolant Drain Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

10. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 left side coolant drain threaded plug.
11. Install the M14 left side coolant drain threaded plug.

Tightening torque

Tighten the M14 left side coolant drain threaded plug to 31 N.m (23 lb ft) .

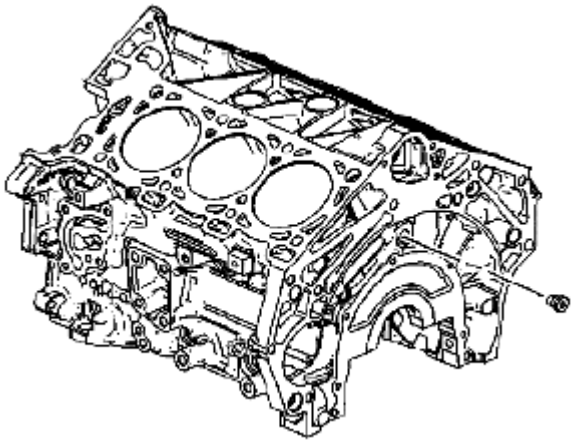


Fig. 674: Identifying M14 Rear Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

12. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 rear oil gallery threaded plug.

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13. Install the M14 rear oil gallery threaded plug.

    Tightening torque

    Tighten the M14 rear oil gallery threaded plug to 31 N.m (23 lb ft) .

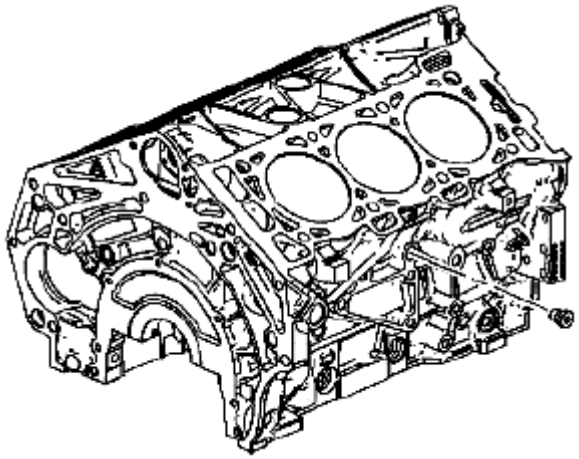


Fig. 675: Identifying M14 Right Side Coolant Drain Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

14. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 right side coolant drain threaded plug.
15. Install the M14 right side coolant drain threaded plug.

    Tightening torque

    Tighten the M14 right side coolant drain threaded plug to 31 N.m (23 lb ft) .

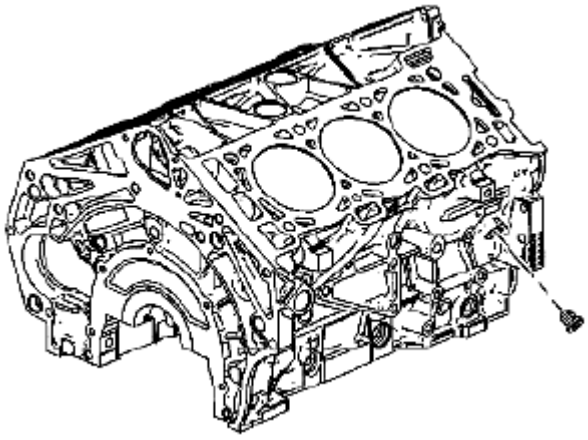


Fig. 676: Identifying M14 Right Side Oil Gallery Threaded Plug
Courtesy of SUZUKI OF AMERICA CORP.

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16. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 right side oil gallery threaded plug.
17. Install the M14 right side oil gallery threaded plug.

    Tightening torque

    Tighten the M14 right side oil gallery threaded plug to 31 N.m (23 lb ft) .

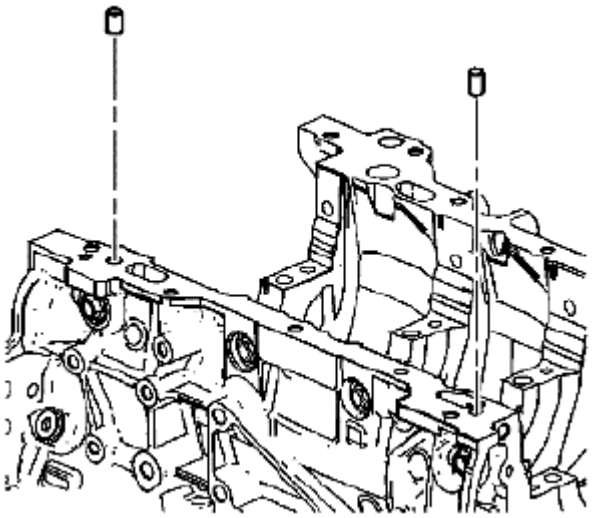


Fig. 677: Identifying Cylinder Block-To-Oil Pan Alignment Dowels
Courtesy of SUZUKI OF AMERICA CORP.

18. Install the cylinder block-to-oil pan alignment dowels.

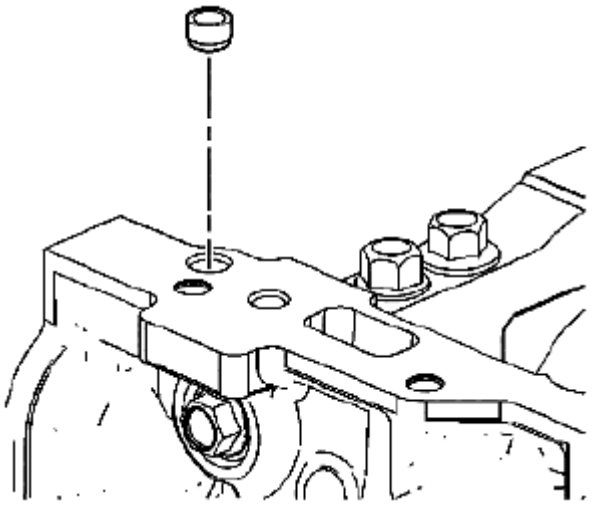


Fig. 678: Identifying Right Front Oil Pan Rail Oil Gallery Expansion Plug
Courtesy of SUZUKI OF AMERICA CORP.

19. Install the NEW right front oil pan rail oil gallery expansion plug.

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20. Ensure the NEW right front oil pan rail oil gallery expansion plug is installed to the proper depth.

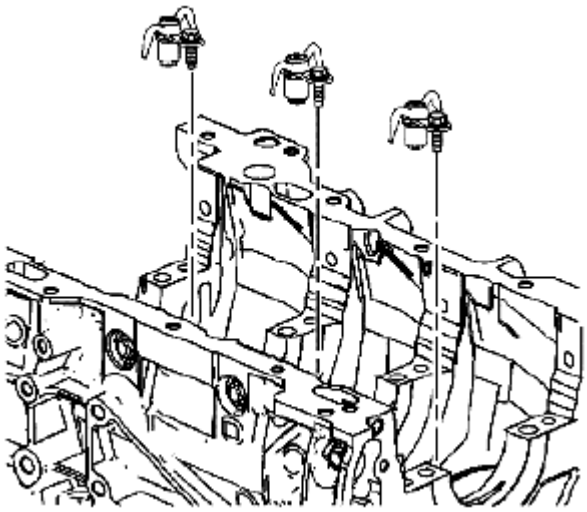


Fig. 679: Identifying Oil Jet And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

21. Install the oil jets.
22. Install the oil jet bolts.

Tightening torque

Tighten the oil jet bolts to 10 N.m (89 lb in) .

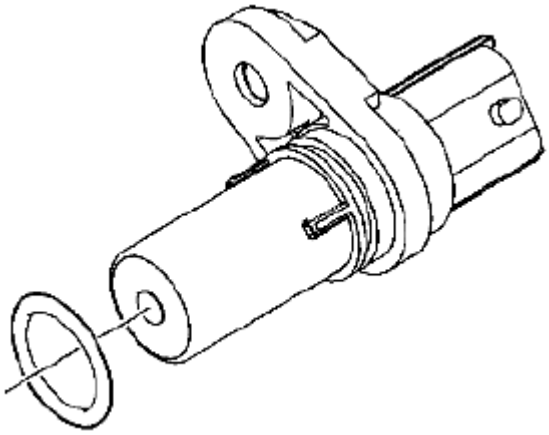


Fig. 680: Identifying Crankshaft Position Sensor O-Ring
Courtesy of SUZUKI OF AMERICA CORP.

23. Install the NEW crankshaft position sensor O-ring, if damaged.

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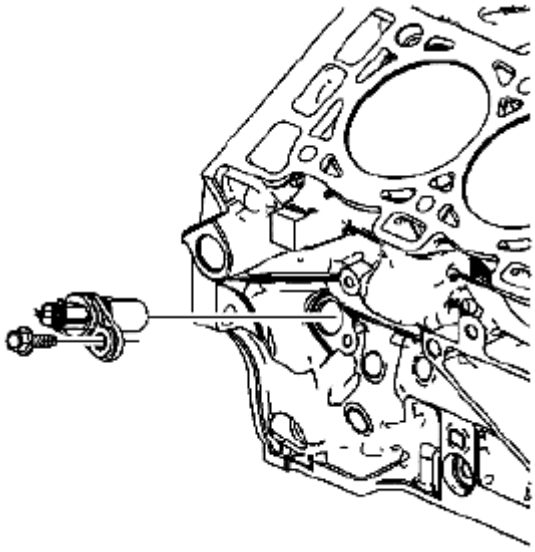


Fig. 681: Identifying Crankshaft Position Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

24. Install the crankshaft position sensor.

CAUTION: Refer to FASTENER NOTICE .

25. Install the crankshaft position sensor bolt.

Tightening torque

Tighten the crankshaft position sensor bolt to 10 N.m (89 lb in) .

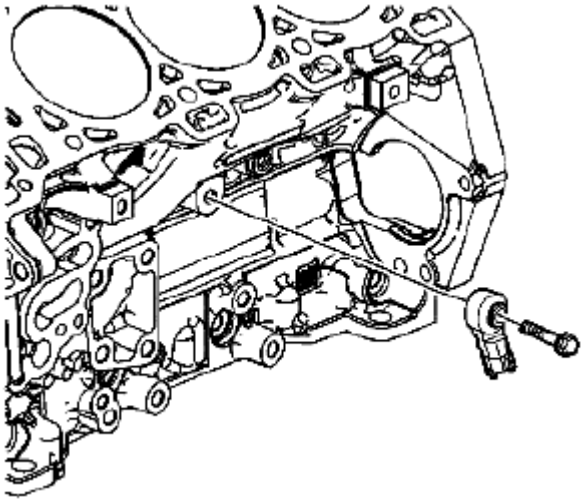


Fig. 682: Identifying Left Knock Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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26. Install the left knock sensor to the cylinder block, as shown.
27. Install the left knock sensor bolt.

    Tightening torque

    Tighten the left knock sensor bolt to 23 N.m (17 lb ft) .

28. Ensure proper sensor orientation.

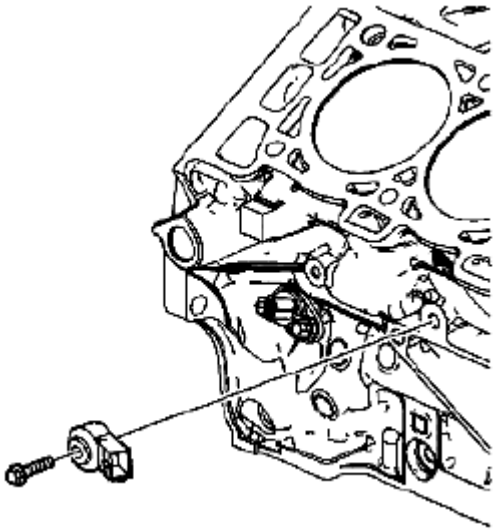


Fig. 683: Identifying Right Knock Sensor And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

29. Install the right knock sensor to the cylinder block, as shown.
30. Install the right knock sensor bolt.

    Tightening torque

    Tighten the right knock sensor bolt to 23 N.m (17 lb ft) .

31. Ensure proper sensor orientation.

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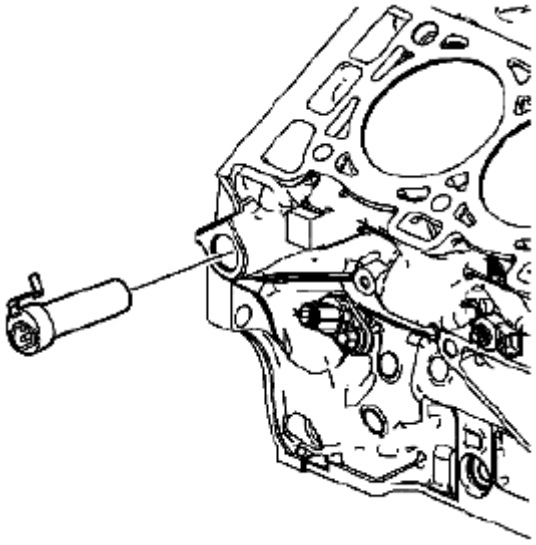


Fig. 684: Identifying Block Heater Cartridge
Courtesy of SUZUKI OF AMERICA CORP.

32. Install the block heater cartridge, if equipped.

    Reference: **CRANKSHAFT AND BEARING INSTALLATION**

CRANKSHAFT AND BEARING INSTALLATION

Reference: **CRANKSHAFT AND BEARING CLEANING AND INSPECTION**

Crankshaft Bearing Installation Procedure

NOTE: If the crankshaft bearings have been used in a running engine, you must replace them with NEW crankshaft bearings for reassembly.

1. Clean the crankcase crank bore with a lint-free cloth.
2. Clean all the oil from the backside of new bearing halves.

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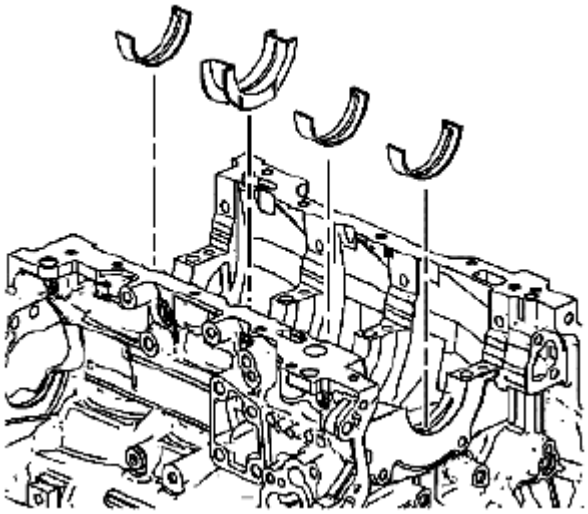


Fig. 685: Identifying Upper Crankshaft Bearings And Thrust Bearing
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the new upper crankshaft bearings into position. The thrust bearing belongs in the number 3 journal. Ensure that the upper bearing insert contains the oil transfer hole and groove. Roll the bearing into position so that the lock tang engages the crank slot. The bearing must fit flush with the upper crankcase.

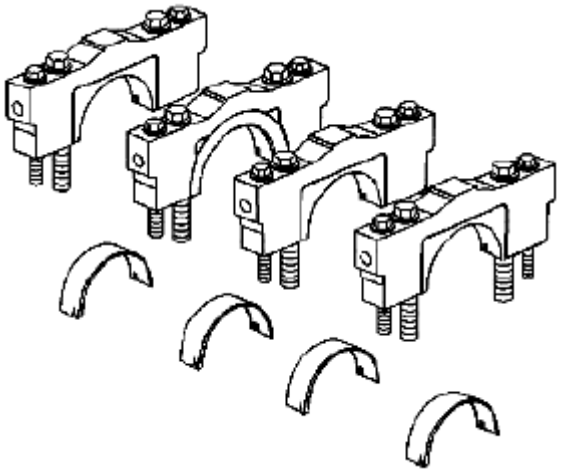


Fig. 686: Identifying Lower Crankshaft Bearings And Main Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the new lower crankshaft bearings into position in the main bearing caps. The lower crankshaft bearings are identified by NO grooves or holes. The bearings must fit flush with the crankshaft bearing caps.

Crankshaft Installation Procedure

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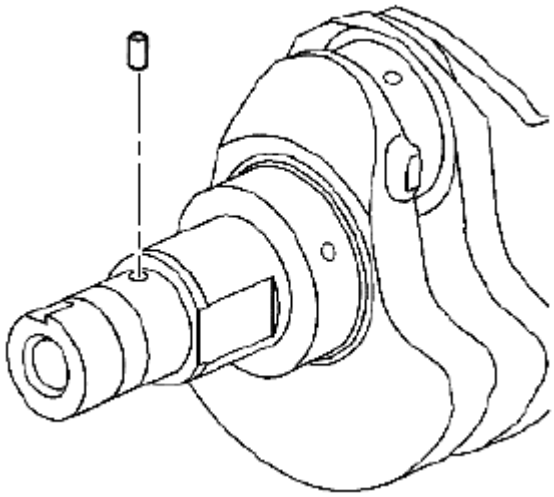


Fig. 687: Identifying Crankshaft Sprocket Drive Pin
Courtesy of SUZUKI OF AMERICA CORP.

1. If removed, install the crankshaft sprocket drive pin. Lightly tap the pin in place with a small soft face, bronze/plastic, hammer until it bottoms in the keyway.

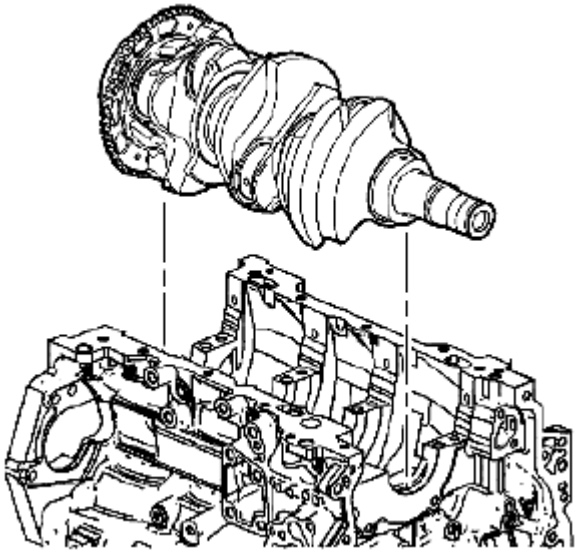


Fig. 688: Identifying Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

2. Gently lower the crankshaft into position in the cylinder block.

Crankshaft Bearing Clearance Measurement Procedure

Special Tool

J 6125-1B Slide Hammer Adapter

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J 41818 Crankshaft Bearing Cap Remover

J 45059 Angle Meter

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

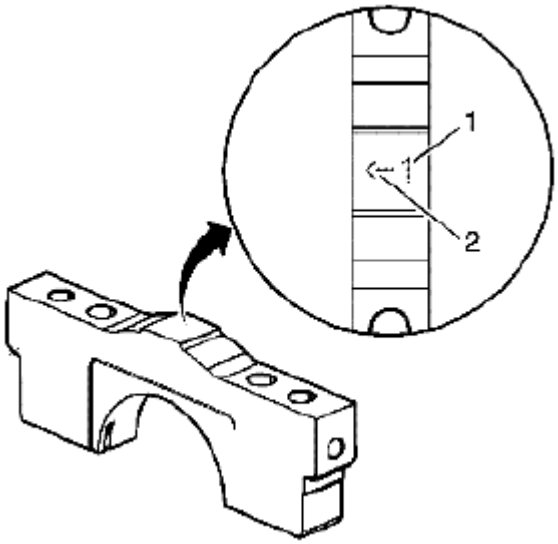
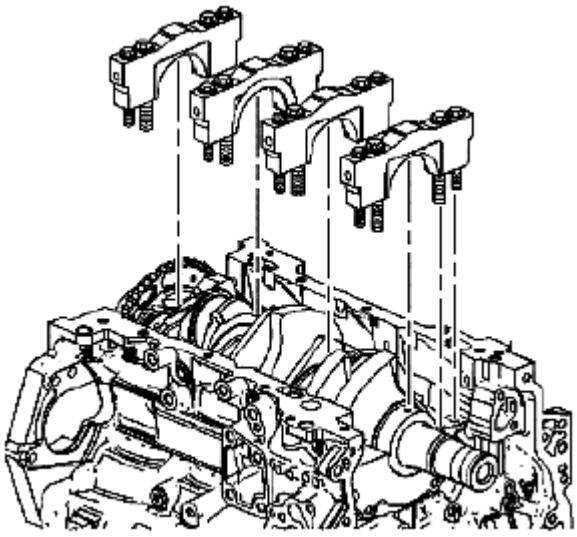


Fig. 689: Identifying Main Bearing Cap Mark
Courtesy of SUZUKI OF AMERICA CORP.

1. Place a length of fresh, room temperature plastic gaging material all the way across all the crankshaft bearing journals.
2. Identify the proper order of the main bearing caps. The main bearing caps are numbered 1 (1) through 4, with the front main bearing cap marked with the number 1. The arrow (2) is to be oriented to the front of the engine.



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Fig. 690: Identifying Crankshaft Main Bearing Caps And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the crankshaft main bearing caps.
4. Loosely install the original inner main cap bolts.
5. Loosely install the original outer main cap bolts.

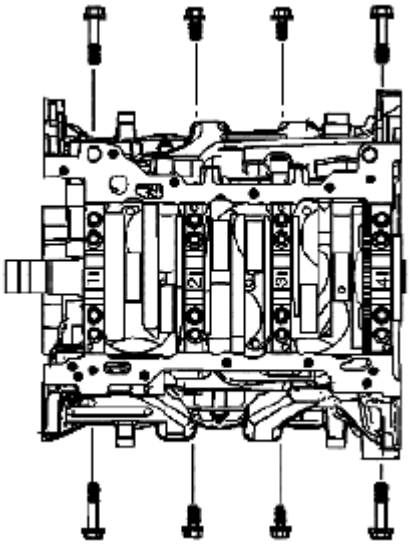


Fig. 691: Identifying Original Short/Inner Side Main Cap Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Loosely install the original short/inner side main cap bolts.
7. Loosely install the original long/outer side main cap bolts.

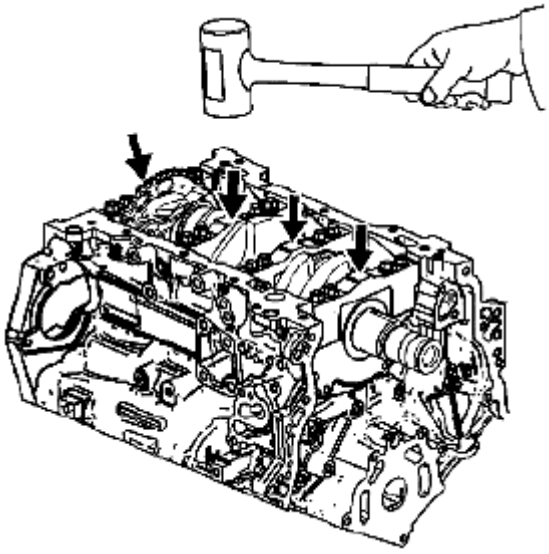


Fig. 692: Tapping Crankshaft Main Bearing Caps With Soft-Faced Hammer

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Courtesy of SUZUKI OF AMERICA CORP.

8. Tap the crankshaft main bearing caps with a soft-faced hammer.
9. Tighten the main caps bolts using the J 45059 in the following sequence:

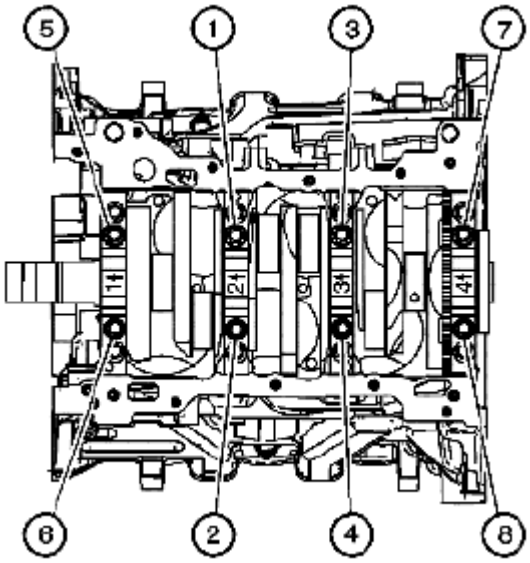


Fig. 693: Identifying Inboard Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

10. Tighten the inboard bolts (1-8).

Tightening torque

Tighten the inboard bolts to 20 N.m (15 lb ft) plus 80 degrees .

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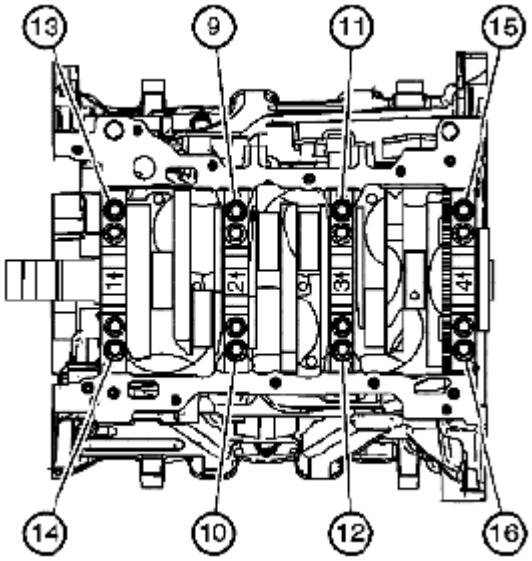


Fig. 694: Identifying Outboard Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

11. Tighten the outboard bolts (9-16).

    Tightening torque

    Tighten the outboard bolts to 15 N.m (11 lb ft) plus 110 degrees .

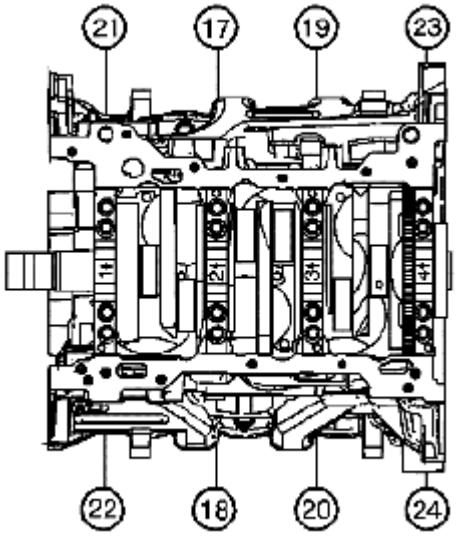


Fig. 695: Identifying Short/Inner Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

12. Tighten the short/inner bolts (17-20).

    Tightening torque

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Tighten the short/inner bolts to 30 N.m (22 lb ft) plus 60 degrees .

13. Tighten the long/outer bolts (21-24).

    Tightening torque

    Tighten the long/outer bolts to 30 N.m (22 lb ft) plus 60 degrees .

    NOTE: Do not rotate the crankshaft.

14. After reaching final torque, allow the assembly to sit for 2 minutes.

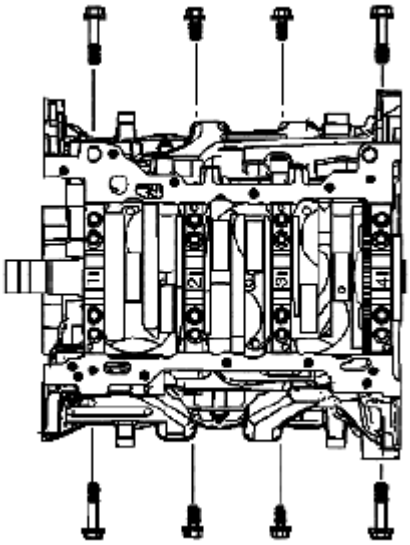


Fig. 696: Identifying Crankshaft Bearing Cap Side Bolts
Courtesy of SUZUKI OF AMERICA CORP.

15. Remove the crankshaft bearing cap side bolts.

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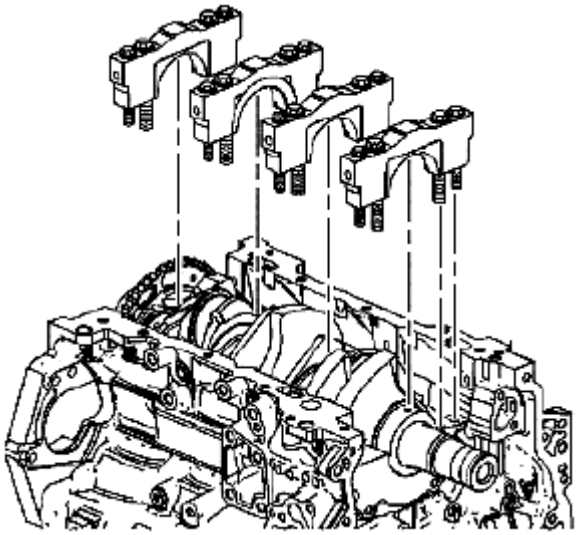


Fig. 697: Identifying Crankshaft Bearing Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

16. Remove the crankshaft bearing cap outer bolts.
17. Remove the crankshaft bearing cap inner bolts.
18. Remove the crankshaft bearing caps using the J 6125-1B and J 41818.

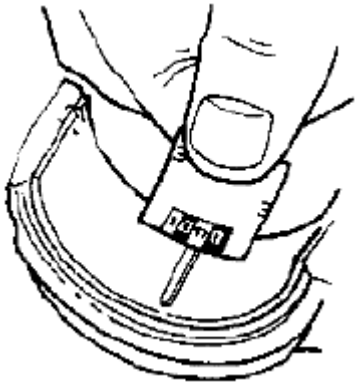


Fig. 698: Comparing Width Of Flattened Plastic Gaging Material At Its Widest Point With Graduation On Gaging Material Container
Courtesy of SUZUKI OF AMERICA CORP.

19. Determine the crankshaft bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the gaging material container.

NOTE: The crankshaft bearings CAN be reused after checking the clearance if the bearings have never been used in a running engine.

20. Compare your measurements with the **ENGINE MECHANICAL SPECIFICATIONS**. If the new bearings do not provide the proper crankshaft to bearing clearance, inspect the following:

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a. Re-measure the crankshaft journals for the correct specified size and ensure the proper new bearings are being installed. If the crankshaft journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.
b. Re-measure the engine block crankshaft bearing bore diameter to ensure proper size. The engine block crankshaft bearing bore is not machinable and the block must be replaced if out of specification.

21. Clean the plastic gaging material from the crankshaft bearing journals with a soft, lint-free cloth.

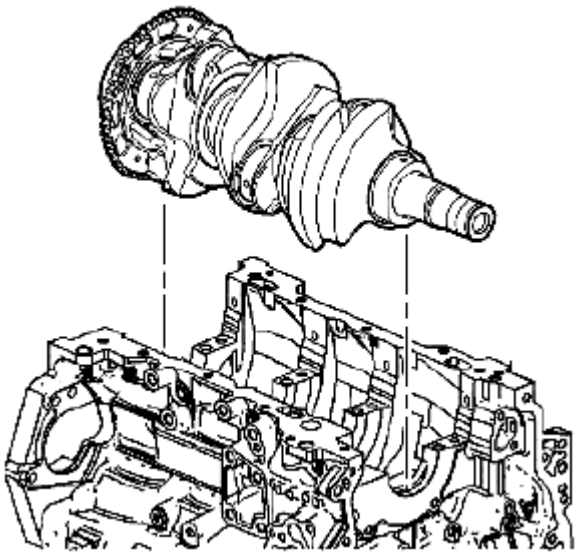


Fig. 699: Identifying Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

22. Lift the crankshaft out of the cylinder block.

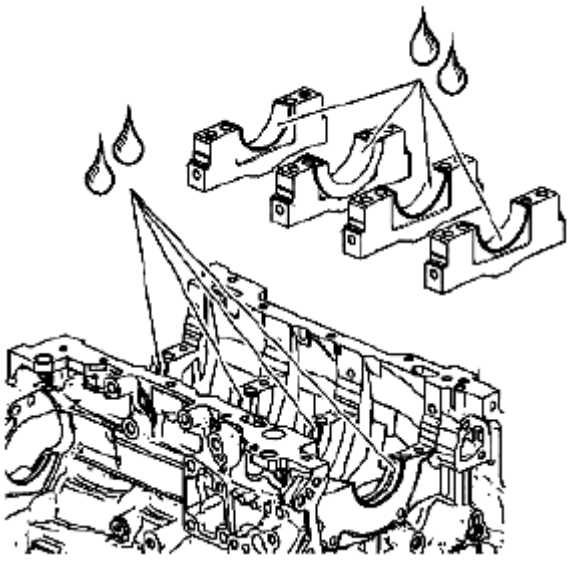


Fig. 700: Applying Crankshaft Prelube GM P/N 1052367 (Canadian P/N 992869) To Upper And

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Lower Bearing Surfaces
Courtesy of SUZUKI OF AMERICA CORP.

23. Apply a liberal amount of crankshaft prelube GM P/N 1052367 (Canadian P/N 992869) or clean engine oil GM P/N 12345501 (Canadian P/N 992704) to the upper and lower bearing surfaces.

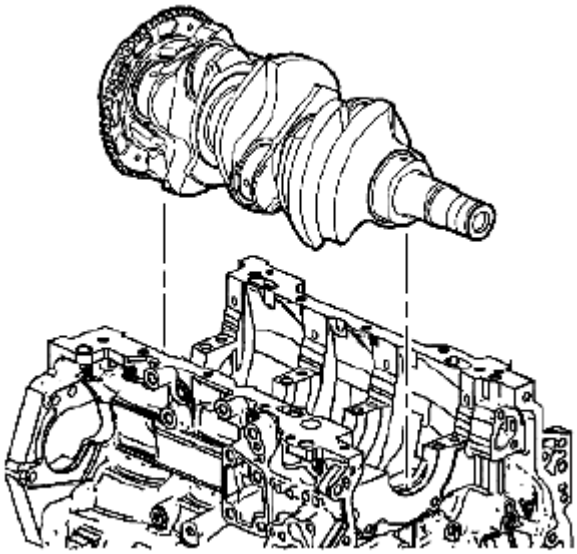


Fig. 701: Identifying Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

24. Gently lower the crankshaft into position in the cylinder block.

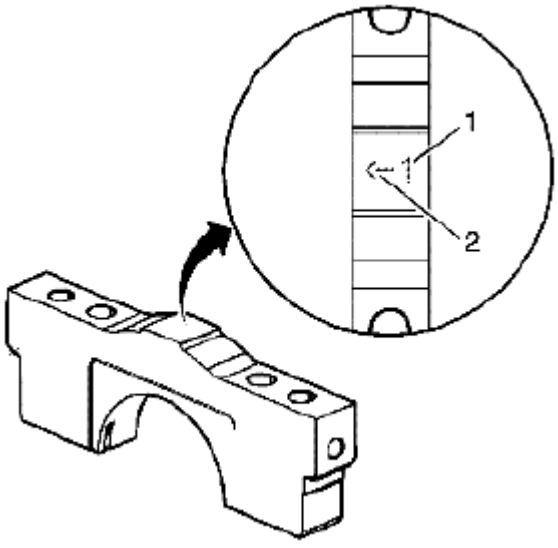


Fig. 702: Identifying Front Main Bearing Cap Mark And Number 1
Courtesy of SUZUKI OF AMERICA CORP.

25. Identify the proper order of the main bearing caps. The main bearing caps are numbered 1 (1) through 4,

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with the front main bearing cap marked with the number 1. The arrow (2) is to be oriented to the front of the engine.

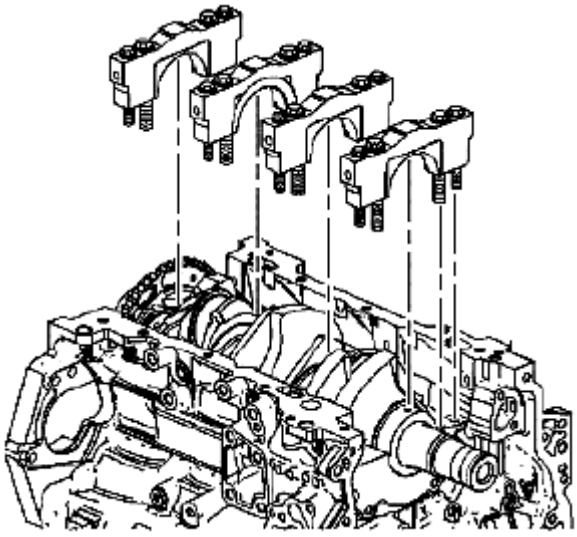


Fig. 703: Identifying Crankshaft Main Bearing Caps And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

26. Install the crankshaft main bearing caps.
27. Loosely install the original inner main cap bolts.
28. Loosely install the NEW outer main cap bolts.

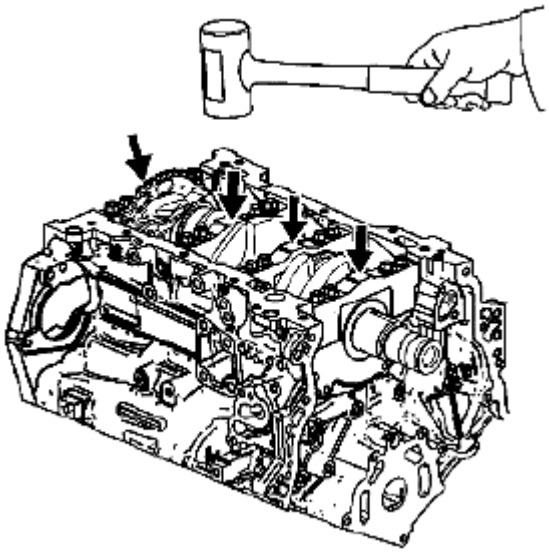


Fig. 704: Tapping Crankshaft Main Bearing Caps With Soft-Faced Hammer
Courtesy of SUZUKI OF AMERICA CORP.

29. Tap the crankshaft main bearing caps with a soft-faced hammer.

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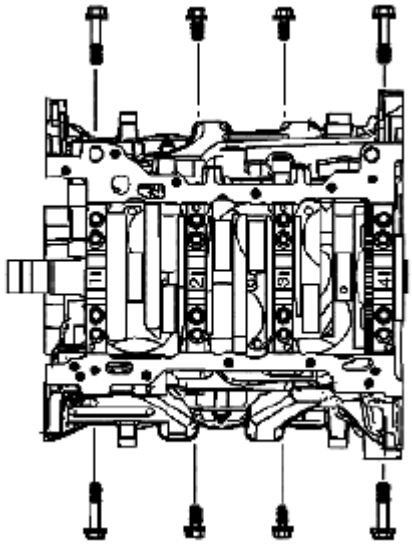


Fig. 705: Identifying Short/Inner Side Main Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The side main cap bolts originally have a sealant on the flange of the bolt head. NEW bolts must be used. If NEW bolts are not used, oil can leak from the crankcase past the bolts.

30. Loosely install the NEW short/inner side main cap bolts.
31. Loosely install the NEW long/outer side main cap bolts.
32. Tighten the main cap bolts using the J 45059 in the following sequence:

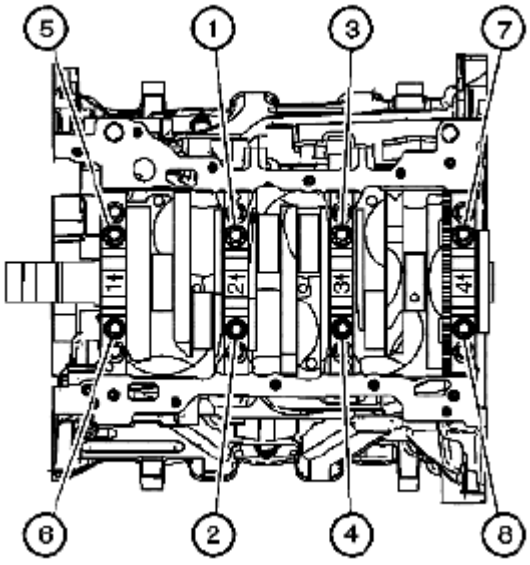


Fig. 706: Identifying Inboard Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

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Tighten the inboard bolts (1-8).

Tightening torque

Tighten the inboard bolts to 20 N.m (15 lb ft) plus 80 degrees .

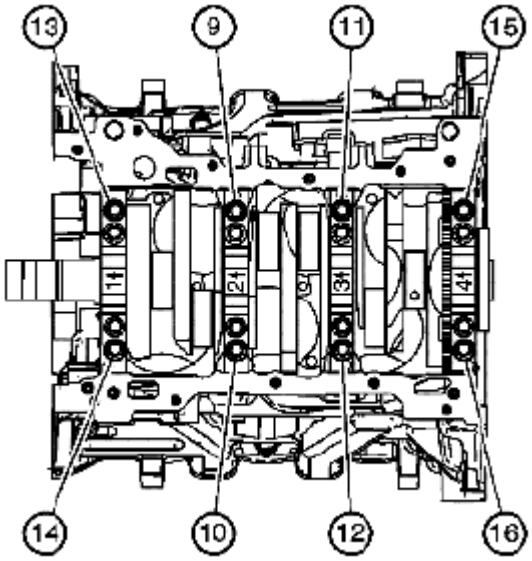
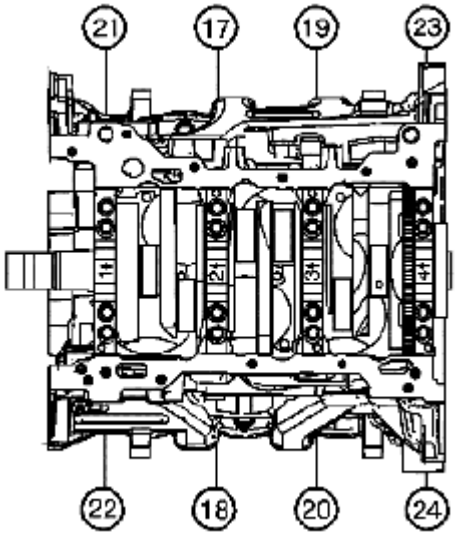


Fig. 707: Identifying Outboard Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

33. Tighten the outboard bolts (9-16).

Tightening torque

Tighten the outboard bolts to 15 N.m (11 lb ft) plus 110 degrees .



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Fig. 708: Identifying Short/Inner Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

34. Tighten the short/inner bolts (17-20).

    Tightening torque

    Tighten the short/inner bolts to 30 N.m (22 lb ft) plus 60 degrees .

35. Tighten the long/outer bolts (21-24).

    Tightening torque

    Tighten the long/outer bolts to 30 N.m (22 lb ft) plus 60 degrees .

36. Ensure that the crankshaft turns without binding or noise.

    Reference: **PISTON, CONNECTING ROD, AND BEARING INSTALLATION**

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Reference: **PISTON AND CONNECTING ROD ASSEMBLE**

Special Tool

EN 46111 Crankshaft Rotation Socket

EN 46121 Connecting Rod Guide Pin Set

J 8037 Ring Compressor

J 43690 Rod Bearing Clearance Checking Tool

J 43690-100 Rod Bearing Clearance Checking Tool - Adapter Kit

J 45059 Angle Meter

Piston and Connecting Rod Assembly Procedure

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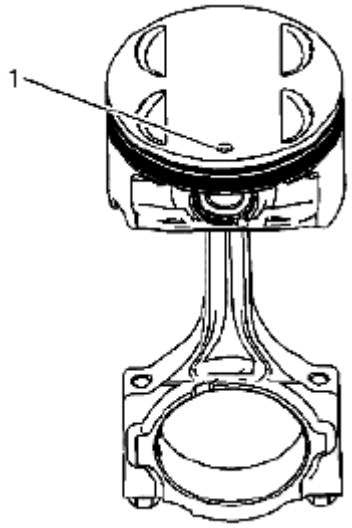


Fig. 709: Locating Dot On Top Of Piston
Courtesy of SUZUKI OF AMERICA CORP.

1. Liberally lubricate the cylinder walls, piston rings and piston skirts with engine oil.

NOTE: The piston is directional and must be installed in the engine block in the proper direction.

2. Select the correctly numbered piston/connecting rod assembly for the cylinder. A dot (1) showing proper piston orientation is located on the top of the piston.

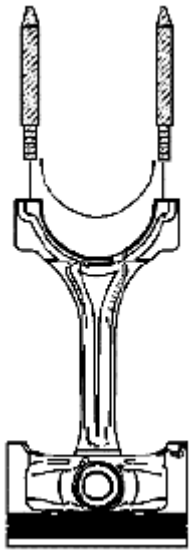


Fig. 710: Identifying Special Tool EN 46121
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: If the connecting rod bearings have been used in a running engine, you

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must replace them with NEW connecting rod bearings for reassembly.

3. Install the connecting rod bearing into the connecting rod.
4. Install the EN 46121 into the connecting rod bolt holes.
5. Compress the piston rings using the J 8037 or equivalent.

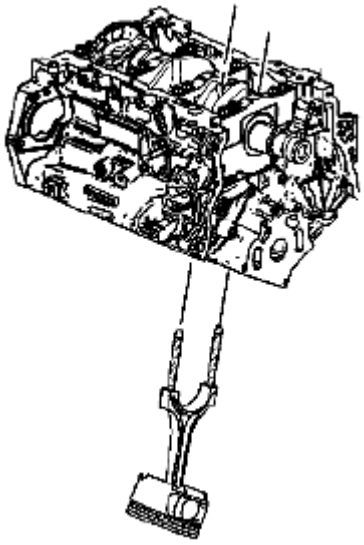


Fig. 711: Identifying Piston And Connecting Rod
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Extreme care must be used when installing the piston and connecting rod in order to be sure the rod does not scrape or nick the cylinder bore, the oil jets, or the crankshaft surfaces.

6. Using both hands, slowly guide the piston and connecting rod assembly into the cylinder from the top and bottom of the cylinder. DO NOT allow the connecting rod to contact the cylinder wall.
7. When the J 8037 contacts the deck surface, gently tap the piston into the cylinder using the handle end of a dead-blow hammer. Guide the connecting rod onto the crankshaft bearing journal using the EN 46121 while gently tapping the piston into the cylinder with a soft-blow hammer.

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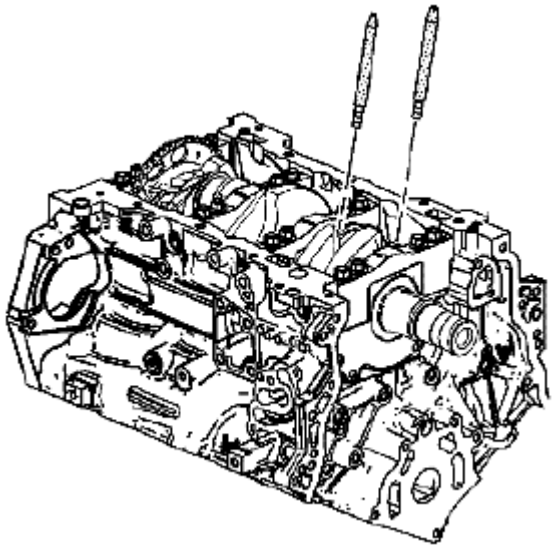


Fig. 712: Identifying Special Tool EN 46121
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EN 46121 from the connecting rod bolt holes.

Connecting Rod Bearing Clearance Measurement Procedure - Using Plastic Gaging

NOTE: Connecting rod bearings that have been run in an engine should NEVER be reused. Before final assembly it is important to check the clearance of the new connecting rod bearings.

1. Place a length of fresh, room temperature plastic gaging material all the way across the connecting rod bearing journal.
2. Install the connecting rod bearing into the connecting rod cap.

NOTE: The connecting rod is non-directional therefore the connecting rod bearing lock tangs can face inboard or outboard.

3. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

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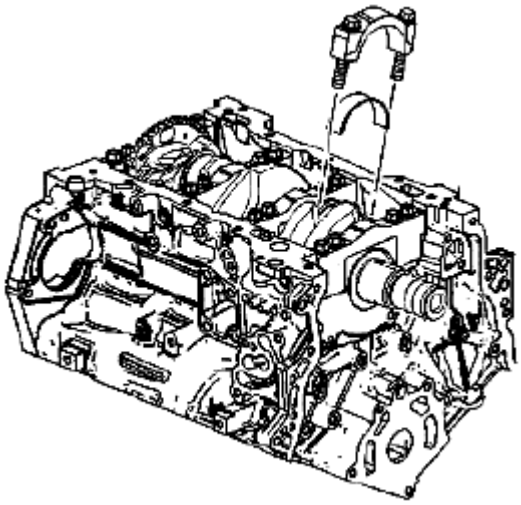


Fig. 713: Identifying Connecting Rod Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

CAUTION: Do not lubricate the NEW connecting rod bolts. The NEW bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

NOTE: Reuse the old connecting rod bolts ONLY for measuring the connecting rod bearing clearance.

4. Install the connecting rod bolts into the connecting rod cap.

   Tightening torque

   Tighten the connecting rod bolts to 30 N.m (22 lb ft) .

5. Loosen the connecting rod bolts until the torque reading is zero.
6. Re-tighten the connecting rod bolts.
   a. First Pass

      Tightening torque

      Tighten the connecting rod bolts to 25 N.m (18 lb ft) .

   b. Final Pass

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Tightening torque

Tighten the connecting rod bolts an additional 110 degrees using the J 45059 .

7. Allow the assembly to sit for at least 2 minutes.
8. Remove the connecting rod cap bolts.
9. Remove the connecting rod cap.

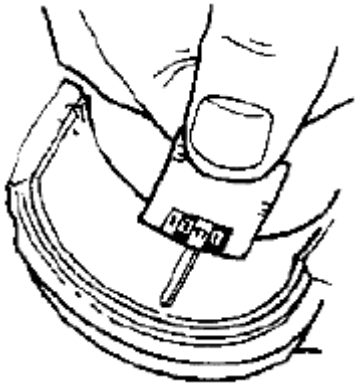


Fig. 714: Comparing Width Of Flattened Plastic Gaging Material At Its Widest Point With Graduation On Gaging Material Container
Courtesy of SUZUKI OF AMERICA CORP.

10. Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the gaging material container.
11. Compare your measurements with the engine mechanical specifications. If the new bearings do not provide the proper crankshaft to connecting rod bearing clearance, inspect the following:
    a. Re-measure the crankshaft connecting rod journals for the correct specified size and ensure the proper new bearings are being installed. If the crankshaft connecting rod journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.
    b. Re-measure the connecting rod bearing bore diameter to ensure proper size. The connecting rod is not machinable and the connecting rod must be replaced if out of specification.
12. Clean the plastic gaging material from the connecting rod bearing journals using a soft lint-free cloth.

Connecting Rod Bearing Clearance Measurement Procedure - Using J 43690 and J 43690-100

The J 43690 and the J 43690-100 have been developed as a more accurate method to measure connecting rod bearing clearances. The instructions below provide an overview of tool set-up and usage. For more detailed information, refer to the tool instruction sheets as supplied by the tool manufacturer.

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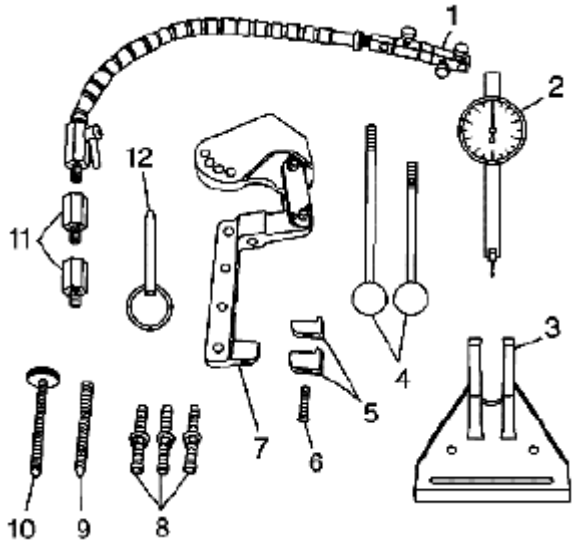


Fig. 715: Identifying J 43690 Rod Bearing Clearance Checking Tool
Courtesy of SUZUKI OF AMERICA CORP.

J 43690 Rod Bearing Clearance Checking Tool

- J 43690-20 Swivel Base (1)
- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5, -6 Handle (4)
- J 43690-10, -11 Foot (5)
- 280307 Screw (6)
- J 43690-1 Pivot Arm Assembly (7)
- J 43690-3, -7, -8 Screws (8)
- 280319 Screw (9)
- 280311 Screw (10)
- J 43690-17, -18 Adapter (11)
- 280310 Pin (12)

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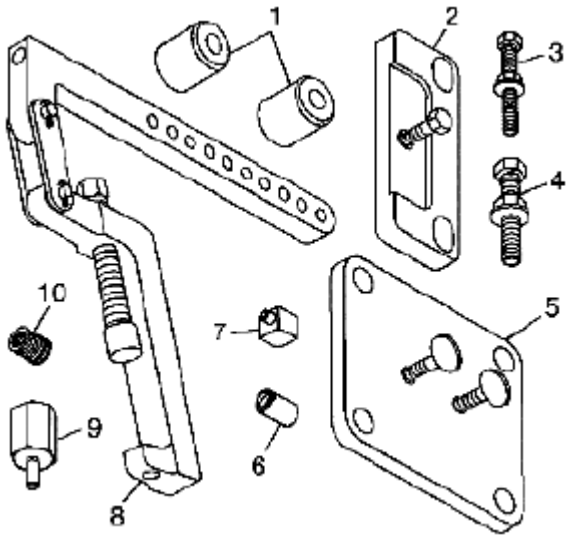


Fig. 716: Identifying J 43690-100 Rod Bearing Clearance Tool - Adapter Kit
Courtesy of SUZUKI OF AMERICA CORP.

J 43690-100 Rod Bearing Clearance Tool - Adapter Kit

- J 43690-104 Spacer (1)
- J 43690-105 Retainer Plate (2)
- 505478 Bolt (3)
- 511341 Bolt (4)
- J 43690-106 Retainer Plate (5)
- J 43690-107 Cap (6)
- J 43690-102 Foot (7)
- J 43690-101 Pivot Arm Assembly (8)
- J 43690-103 Adapter (9)
- 505439 Adapter (10)

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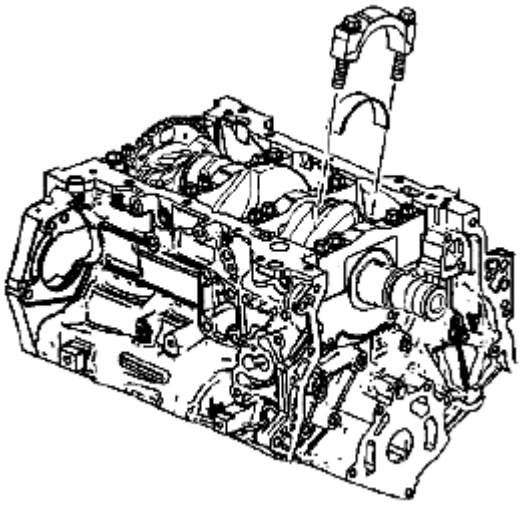


Fig. 717: Identifying Connecting Rod Bearing And Connecting Rod Cap
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Connecting rod bearings that have been run in an engine should NEVER be reused. Before final assembly it is important to check the clearance of the new connecting rod bearings.

1. Install the connecting rod bearing into the connecting rod cap.

NOTE: The connecting rod is non-directional therefore the connecting rod bearing lock tangs can face inboard or outboard.

2. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

CAUTION: Refer to FASTENER NOTICE .

CAUTION: Do not lubricate the NEW connecting rod bolts. The NEW bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

NOTE: Reuse the old connecting rod bolts ONLY for measuring the connecting rod bearing clearance.

3. Install the connecting rod bolts into the connecting rod cap.

Tightening torque

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Tighten the connecting rod bolts to 30 N.m (22 lb ft) .

4. Loosen the connecting rod bolts until the torque reading is zero.
5. Re-tighten the connecting rod bolts.
   a. First Pass

      Tightening torque

      Tighten the connecting rod bolts to 25 N.m (18 lb ft) .

   b. Final Pass

      Tightening torque

      Tighten the connecting rod bolts an additional 110 degrees using the J 45059 .

6. Rotate the crankshaft until the crankshaft journal and the connecting rod to be measured is in the 12 o'clock position.

   NOTE: The crankshaft must be secure with no movement or rotation in order to obtain an accurate reading.

7. Remove the crankshaft main bolts required to install the retainer plate J 43690-105.

   NOTE: Do not allow the J 43690-105 retainer plate screw to contact the reluctor ring.

8. Install the J 43690-105 and crankshaft main bolts.
9. Loosen the connecting rod bolts until the torque reading is zero.
10. Re-tighten the connecting rod bolts.
    a. First Pass

       Tightening torque

       Tighten the connecting rod bolts to 25 N.m (18 lb ft) .

    b. Final Pass

       Tightening torque

       Tighten the connecting rod bolts an additional 110 degrees using the J 45059 .

11. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.
12. Repeat these procedures for the remaining piston/connecting rod assemblies using the EN 46111 in order

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to rotate the crankshaft.

Connecting Rod Final Assembly Procedure

1. Guide the connecting rod away from the crankshaft connecting rod journal in order to lubricate the crankshaft connecting rod bearing journal.
2. Apply a liberal amount of crankshaft prelube GM P/N 1052367 (Canadian P/N 992869) or clean engine oil GM P/N 12345501 (Canadian P/N 992704) to the crankshaft connecting rod bearing journal.
3. Guide the connecting rod to the crankshaft connecting rod journal.
4. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

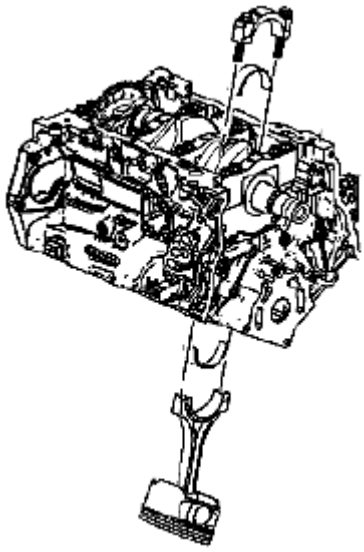


Fig. 718: Identifying Connecting Rod Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not lubricate the NEW connecting rod bolts. The NEW bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

NOTE: DO NOT reuse the old connecting rod bolts.

5. Install the NEW connecting rod bolts into the connecting rod cap.

   Tightening torque

   Tighten the NEW connecting rod bolts to 30 N.m (22 lb ft) .

6. Loosen the connecting rod bolts until the torque reading is zero.

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7. Re-tighten the connecting rod bolts.
   a. First Pass

      Tightening torque

      Tighten the connecting rod bolts to 25 N.m (18 lb ft) .

   b. Final Pass

      Tightening torque

      Tighten the connecting rod bolts an additional 110 degrees using the J 45059 .

8. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.
9. Repeat these procedures for the remaining piston/connecting rod assemblies using the EN 46111 in order to rotate the crankshaft.

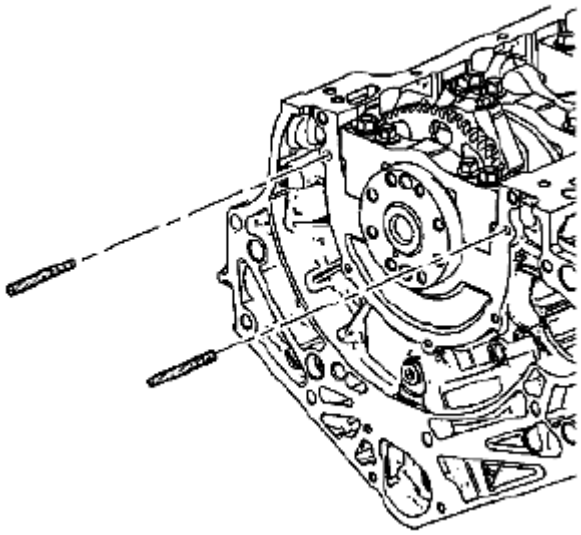
   Reference: **CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION**

CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION

Special Tools

- EN 46109 Guide Pin Set
- EN-47839 Crankshaft Rear Oil Seal Installation Tool
- J 42183 Handle

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.



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Fig. 719: Identifying 6 mm (0.236 in) Guides
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the 6 mm (0.236 in) guides from the EN 46109 into the 2 crankshaft rear oil seal housing corner bolt holes of the engine block.

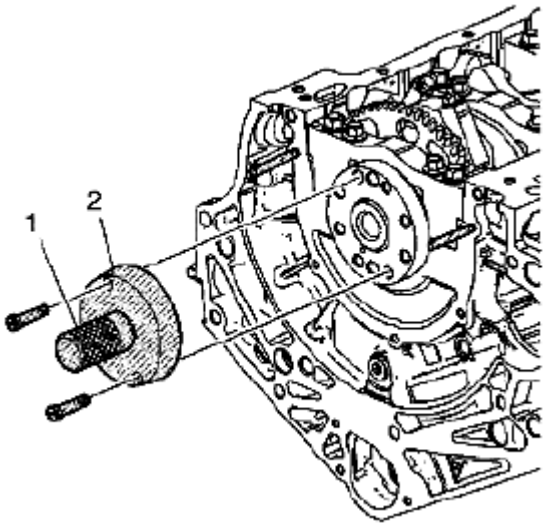


Fig. 720: Identifying Special Tool EN-47839 With J 42183
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the EN-47839 with the J 42183 (1, 2) onto the rear of the crankshaft flange.

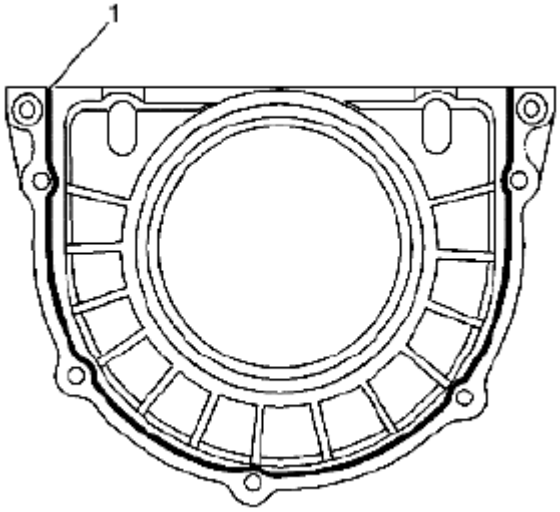


Fig. 721: Identifying Bead On Crankshaft Rear Oil Seal Housing
Courtesy of SUZUKI OF AMERICA CORP.

3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, to the NEW crankshaft rear oil seal housing as shown (1).

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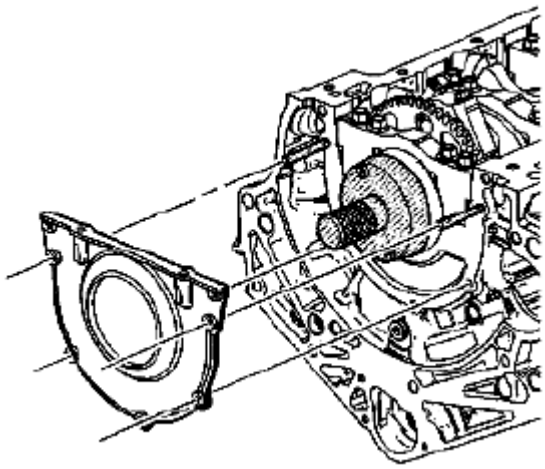


Fig. 722: Identifying Crankshaft Rear Oil Seal Housing
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: DO NOT allow any engine oil on the area where the crankshaft rear oil seal housing is to be installed.

4. Install the crankshaft rear oil seal housing to the engine block.

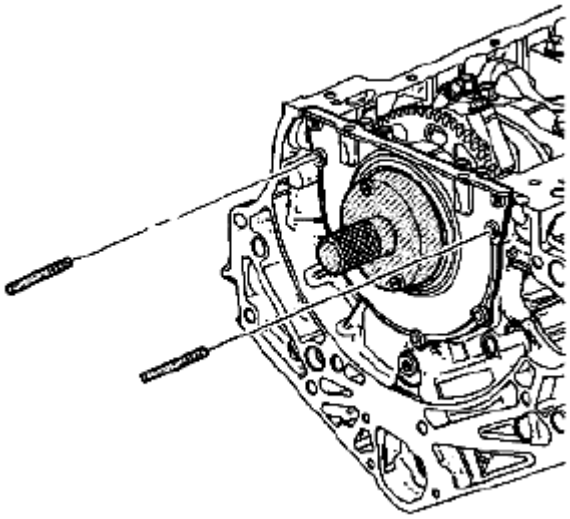


Fig. 723: Identifying EN 46109 6 mm (0.236 in) Guides
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the EN 46109 6 mm (0.236 in) guides from the engine block.

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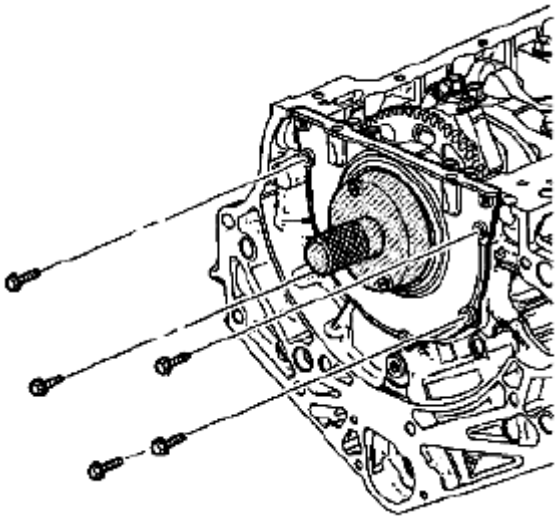


Fig. 724: Identifying Crankshaft Rear Oil Seal Housing Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the crankshaft rear oil seal housing bolts.

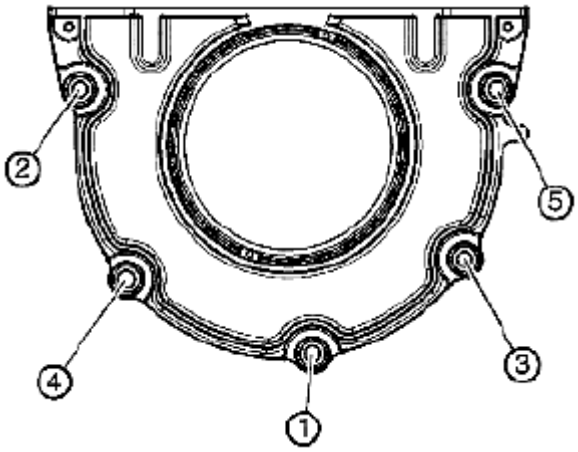


Fig. 725: Identifying Crankshaft Rear Oil Seal Housing Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

7. Tighten the crankshaft rear oil seal housing bolts in sequence shown.

Tightening torque

Tighten the crankshaft rear oil seal housing bolts to 10 N.m (89 lb in) .

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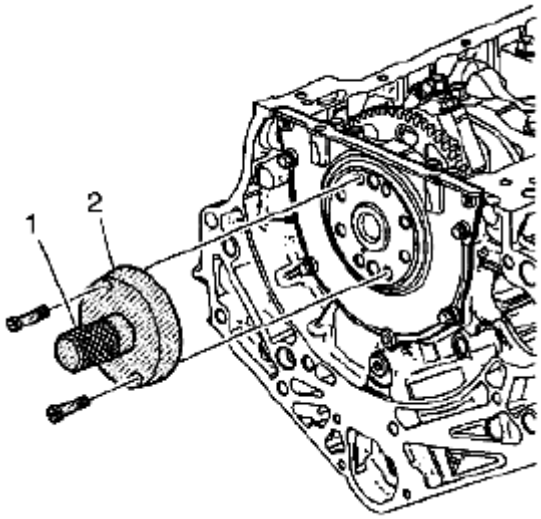


Fig. 726: Identifying EN-47839 And J 42183
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EN-47839 and J 42183 (1, 2) from the crankshaft flange.

   Reference: **OIL PUMP INSTALLATION**

CYLINDER HEAD INSTALLATION - RIGHT SIDE

Reference: **CYLINDER HEAD ASSEMBLE**

Special Tools

J 45059 Angle Meter

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.

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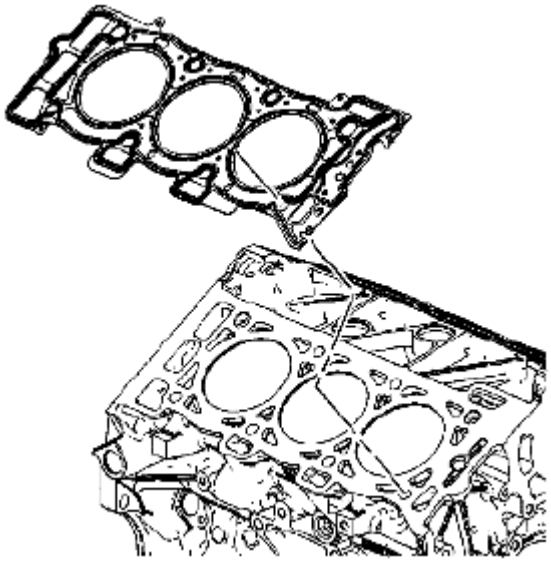


Fig. 727: Identifying Right Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install a NEW right cylinder head gasket using the deck face locating pins for retention.

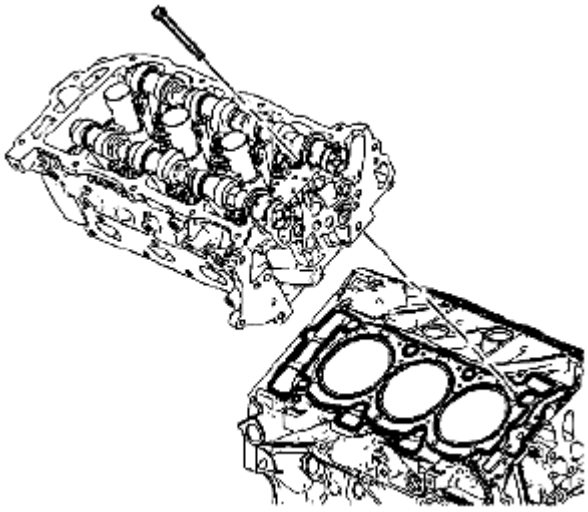


Fig. 728: Aligning Right Cylinder Head With Deck Face Locating Pins
Courtesy of SUZUKI OF AMERICA CORP.

3. Align the right cylinder head with the deck face locating pins.
4. Place the right cylinder head in position on the deck face.

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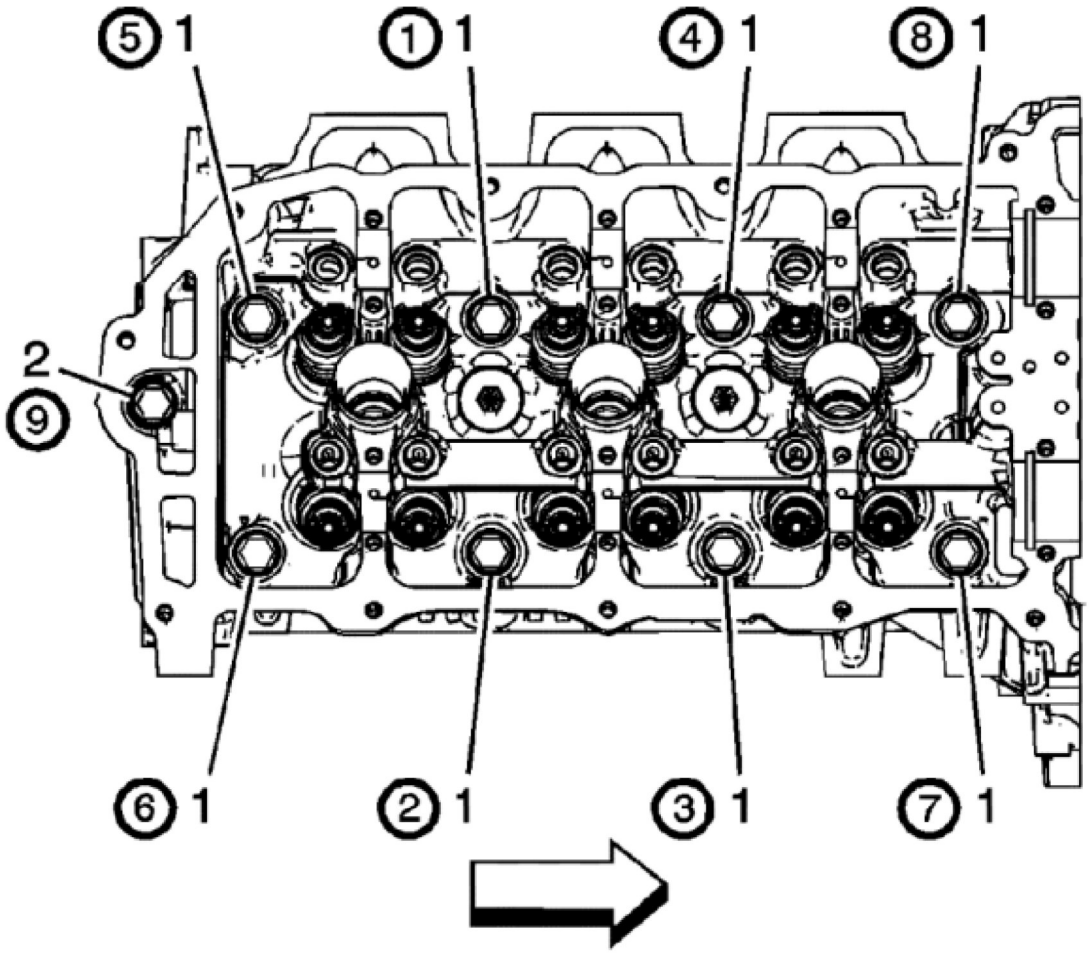


Fig. 729: Identifying Cylinder Head Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

NOTE: DO NOT allow oil on the cylinder head bolt bosses.

NOTE: DO NOT reuse the old cylinder head bolts.

5. Install the NEW M11 cylinder head bolts (1).

   Tightening torque

   a. **Tighten the M11 cylinder head bolts a first pass in sequence to 30 N.m (22 lb ft)** .
   b. **Tighten the M11 cylinder head bolts a second pass in sequence an additional 150 degrees using the J 45059 meter.** .
6. Install the NEW M8 cylinder head bolt (2).

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Tightening torque

a. **Tighten the M8 cylinder head bolt a first pass to 15 N.m (11 lb ft)** .
b. **Tighten the M8 cylinder head bolt a second pass an additional 75 degrees using the J 45059 meter.** .

Reference: **VALVE LIFTER INSTALLATION - RIGHT SIDE**

VALVE LIFTER INSTALLATION - RIGHT SIDE

Reference: **VALVE LIFTERS CLEANING AND INSPECTION**

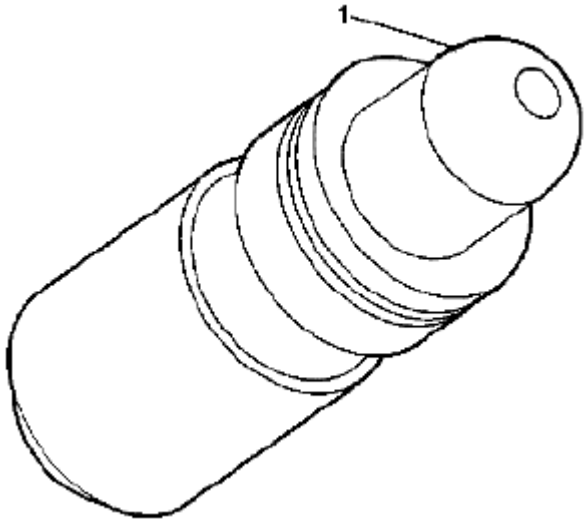


Fig. 730: Identifying Pivot Sphere Area Of SHLA
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.

NOTE: Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent.

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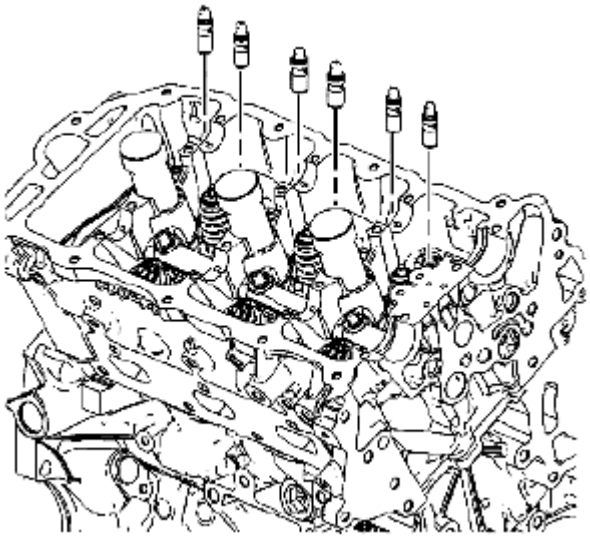


Fig. 731: Identifying SHLA
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the SHLAs in the cylinder head.
4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the SHLA pivot spheres.

Reference: **VALVE ROCKER ARM INSTALLATION - RIGHT SIDE**

VALVE ROCKER ARM INSTALLATION - RIGHT SIDE

Reference: **VALVE ROCKER ARMS CLEANING AND INSPECTION**

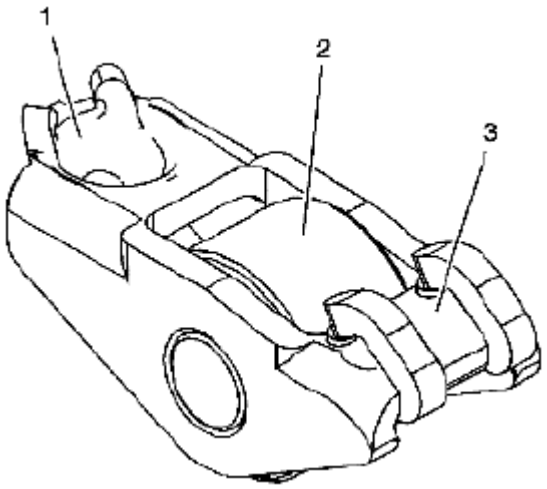


Fig. 732: Identifying Pivot Pocket, Roller And Valve Slot Areas Of Camshaft Followers
Courtesy of SUZUKI OF AMERICA CORP.

1. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the pivot

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pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

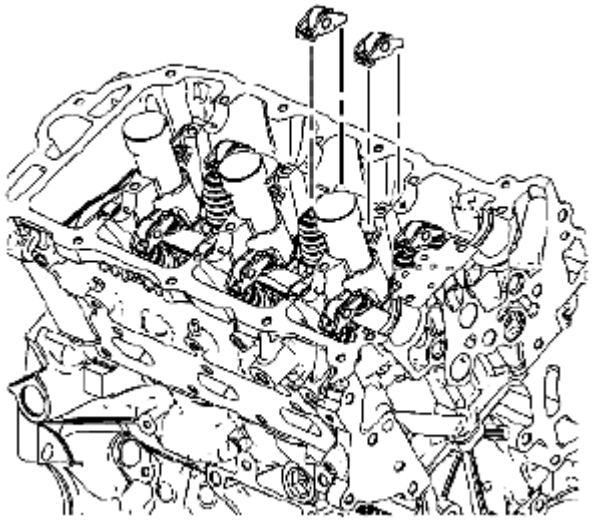


Fig. 733: Identifying Valve Rocker Arm
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2. Place the camshaft followers in position on the valve tip and stationary hydraulic lash adjuster (SHLA).
3. The rounded head end of the follower goes on the SHLA while the flat end goes on the valve tip.
4. Clean the camshaft journals and carriers with a clean, lint-free cloth.

Reference: **CAMSHAFT INSTALLATION - RIGHT SIDE**

CAMSHAFT INSTALLATION - RIGHT SIDE

Reference: **CAMSHAFT CLEANING AND INSPECTION**

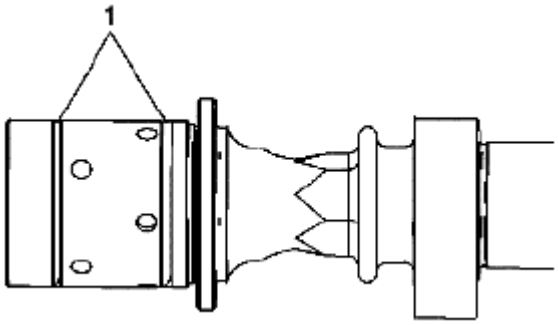


Fig. 734: Identifying Camshaft Sealing Rings

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Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the cylinder head and the camshaft caps.

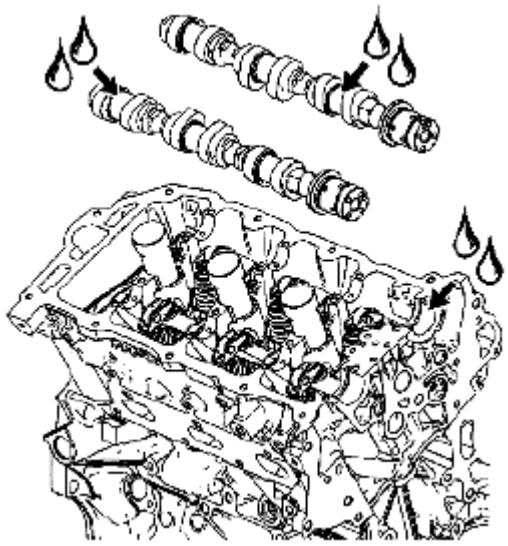


Fig. 735: Applying Lubricant GM P/N 12345501 (Canadian P/N 992704) To Camshaft Journals And Right Cylinder Head Camshaft Carriers
Courtesy of SUZUKI OF AMERICA CORP.

2. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft journals and the right cylinder head camshaft carriers.

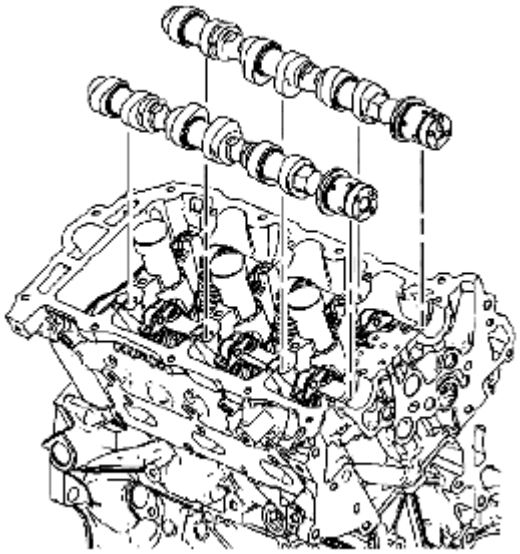


Fig. 736: Identifying Right Intake And Right Exhaust Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

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3. Place the right intake and right exhaust camshafts in position in the right cylinder head.

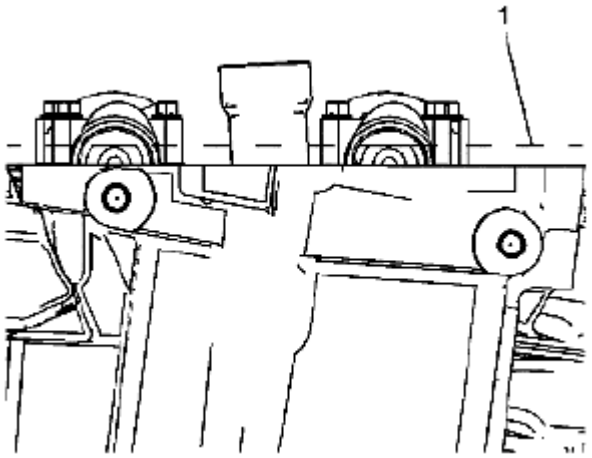


Fig. 737: Positioning Camshaft Lobes In Neutral Position With Flats On Back Of Camshafts Up And Parallel With Right Cylinder Head Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

4. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the right cylinder head camshaft cover rail.

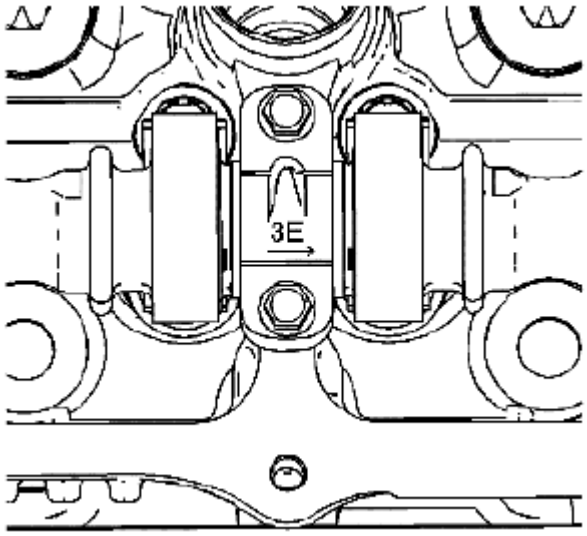


Fig. 738: Identifying Markings On Right Cylinder Head Camshaft Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

5. Observe the markings on the right cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
   - The raised feature must always be oriented toward the center of the cylinder head.
   - The I indicates the intake camshaft.
   - The E indicates the exhaust camshaft.

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- The number 1, 3, 5 indicates the cylinder position from the front of the engine.

6. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

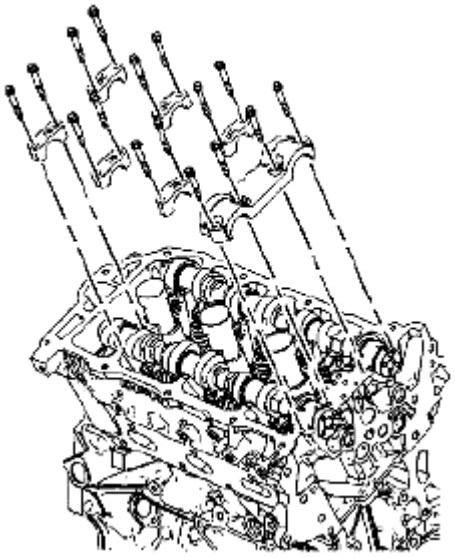


Fig. 739: Identifying Camshaft Bearing Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the camshaft bearing thrust caps in the first journal of the right cylinder head.
8. Install the remaining bearing caps with their orientation mark toward the center of the cylinder head.
9. Hand start all the camshaft bearing cap bolts.

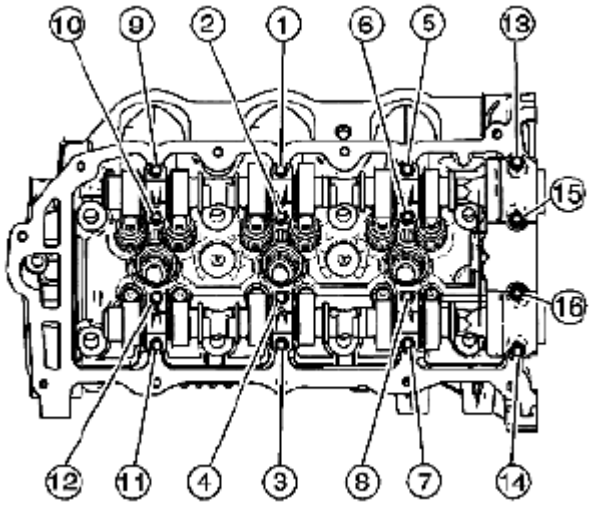


Fig. 740: Identifying Camshaft Bearing Cap Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

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10. Tighten the camshaft bearing cap bolts in the sequence shown.

    Tightening torque

    Tighten the camshaft bearing cap bolts in sequence to 10 N.m (89 lb in) .

11. Loosen the center intake camshaft bearing cap bolts (1, 2) and the center exhaust camshaft bearing cap bolts (3, 4).
12. Retighten the center camshaft bearing cap bolts (1, 2, 3, 4).

    Tightening torque

    Retighten the camshaft bearing cap bolts to 10 N.m (89 lb in) .

    Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE**

CYLINDER HEAD INSTALLATION - LEFT SIDE

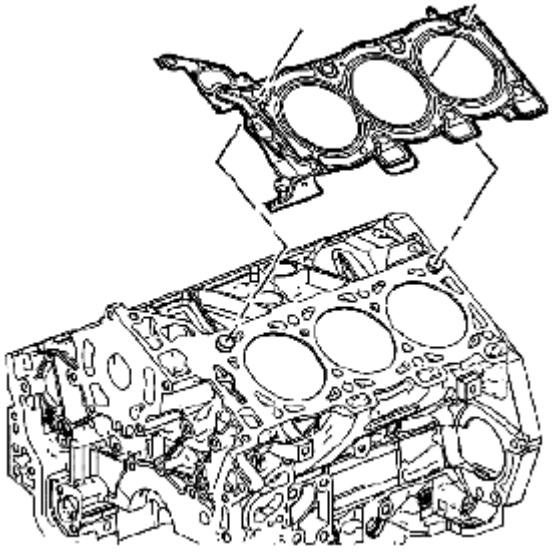
Reference: **CYLINDER HEAD ASSEMBLE**

Special Tools

J 45059 Angle Meter

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.



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Fig. 741: Identifying Left Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install a NEW left cylinder head gasket using the deck face locating pins for retention.

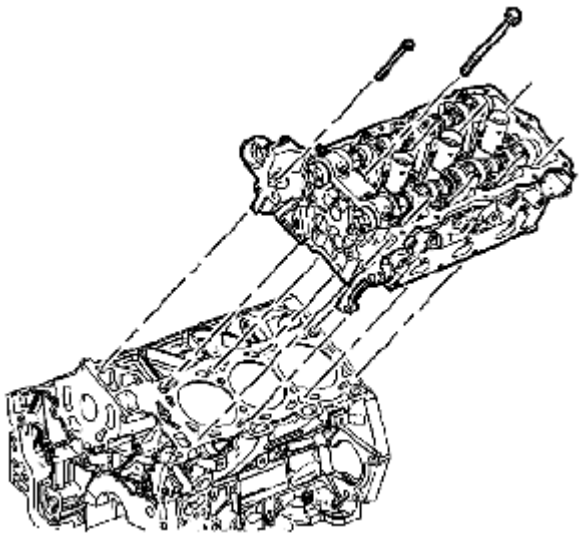


Fig. 742: Aligning Left Cylinder Head With Deck Face Locating Pins
Courtesy of SUZUKI OF AMERICA CORP.

3. Align the left cylinder head with the deck face locating pins.
4. Place the left cylinder head in position on the deck face.

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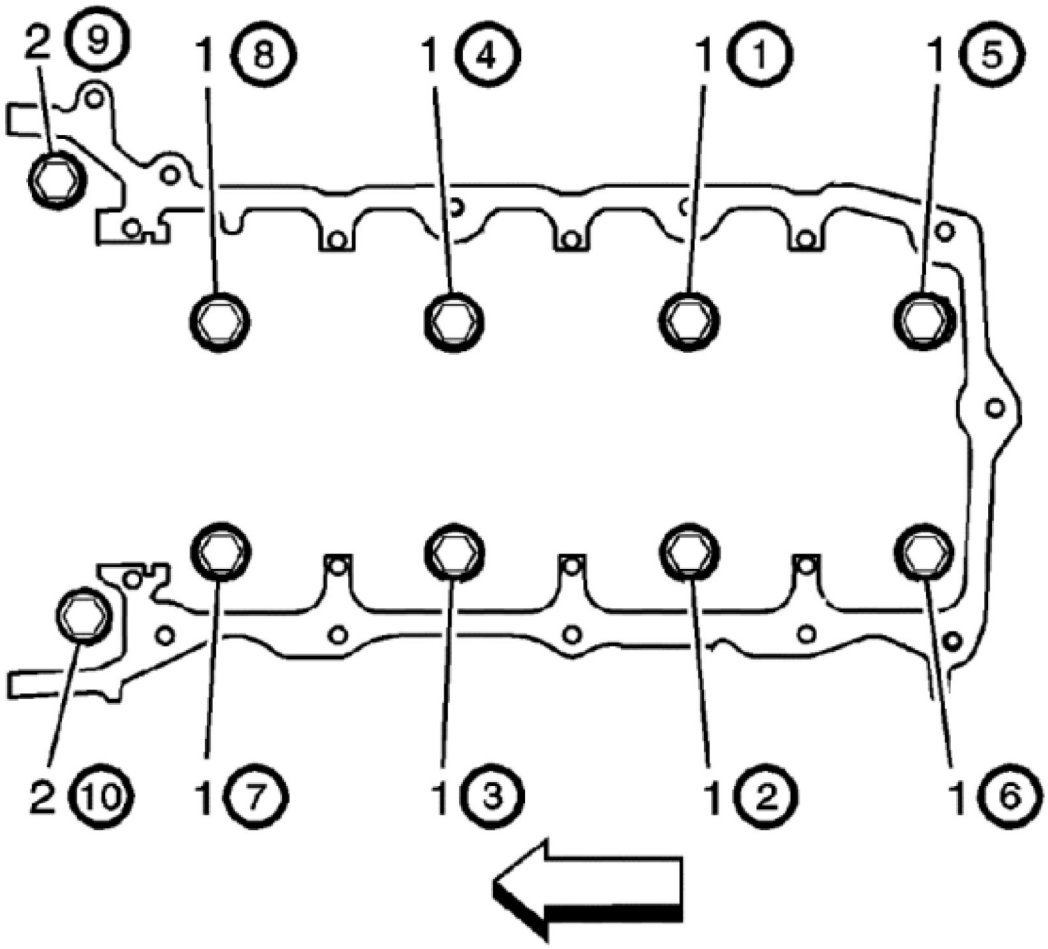


Fig. 743: Identifying Cylinder Head Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

NOTE: DO NOT allow oil on the cylinder head bolt bosses.

NOTE: DO NOT reuse the old cylinder head bolts.

5. Install new M11 cylinder head bolts.

   Tightening torque

   a. **Tighten the M11 cylinder head bolts a first pass in sequence to 30 N.m (22 lb ft)** .
   b. **Tighten the M11 cylinder head bolts a second pass in sequence an additional 150 degrees using the J 45059** .
6. Install the 2 front M8 left cylinder head bolts.

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Tightening torque

a. **Tighten the M8 cylinder head bolts a first pass to 15 N.m (11 lb ft)** .
b. **Tighten the M8 cylinder head bolts a second pass in sequence an additional 75 degrees using the J 45059** .

Reference: **VALVE LIFTER INSTALLATION - LEFT SIDE**

VALVE LIFTER INSTALLATION - LEFT SIDE

Reference: **VALVE LIFTERS CLEANING AND INSPECTION**

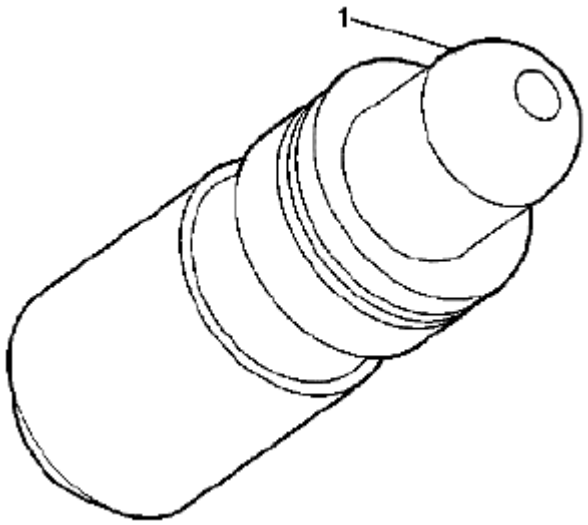


Fig. 744: Identifying Pivot Sphere Area Of SHLA
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.

NOTE: Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent.

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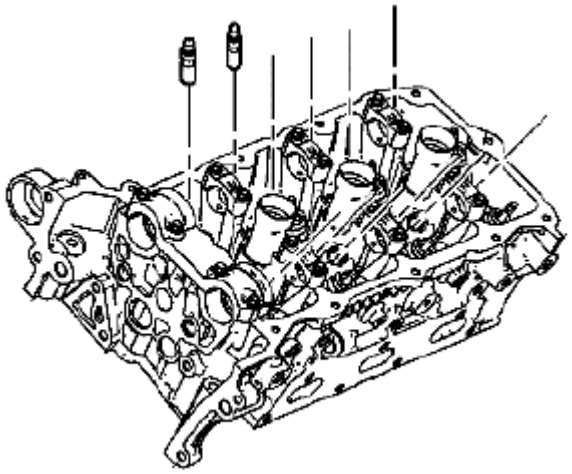


Fig. 745: Identifying SHLA
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the SHLAs in the cylinder head.
4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the SHLA pivot spheres.

   Reference: **VALVE ROCKER ARM INSTALLATION - LEFT SIDE**

VALVE ROCKER ARM INSTALLATION - LEFT SIDE

Reference: **VALVE ROCKER ARMS CLEANING AND INSPECTION**

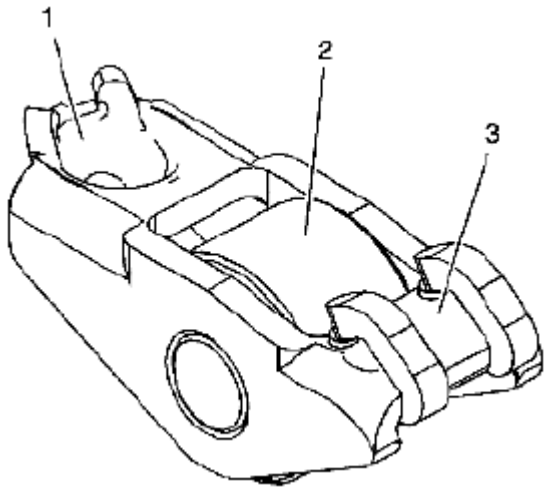


Fig. 746: Identifying Pivot Pocket, Roller And Valve Slot Areas Of Camshaft Followers
Courtesy of SUZUKI OF AMERICA CORP.

1. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the pivot pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

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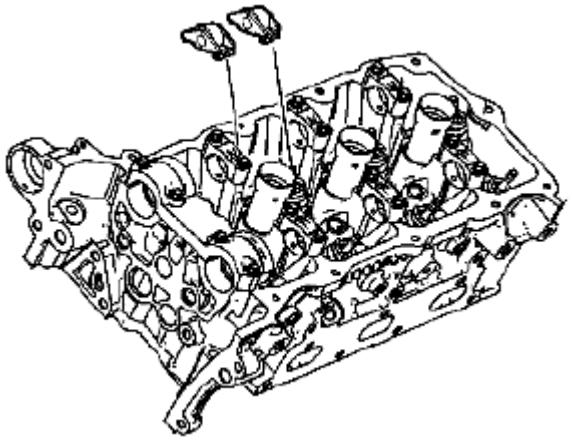


Fig. 747: Identifying Valve Rocker Arm
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2. Place the camshaft followers in position on the valve tip and stationary hydraulic lash adjuster (SHLA).
3. The rounded head end of the follower goes on the SHLA while the flat end goes on the valve tip.
4. Clean the camshaft journals and carriers with a clean, lint-free cloth.

Reference: **CAMSHAFT INSTALLATION - LEFT SIDE**

CAMSHAFT INSTALLATION - LEFT SIDE

Reference: **CAMSHAFT CLEANING AND INSPECTION**

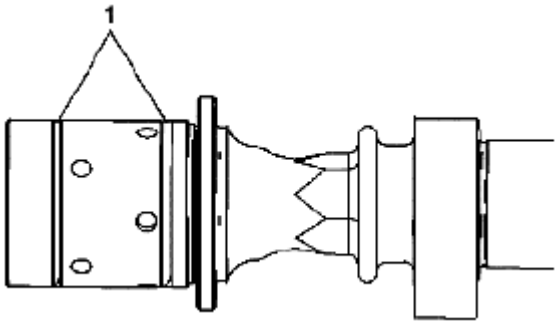


Fig. 748: Identifying Camshaft Sealing Rings
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the

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cylinder head and the camshaft caps.



Fig. 749: Applying Lubricant GM P/N 12345501 (Canadian P/N 992704) To Camshaft Journals And Left Cylinder Head Camshaft Carriers
Courtesy of SUZUKI OF AMERICA CORP.

2. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft journals and the left cylinder head camshaft carriers.

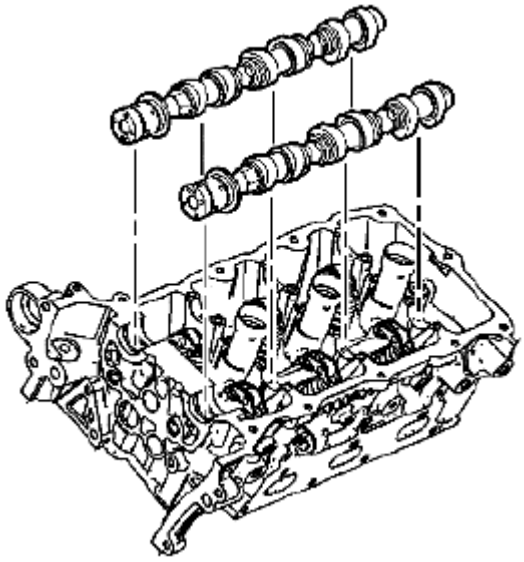


Fig. 750: Identifying Left Intake And Left Exhaust Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

3. Place the left intake and left exhaust camshafts in position in the left cylinder head.

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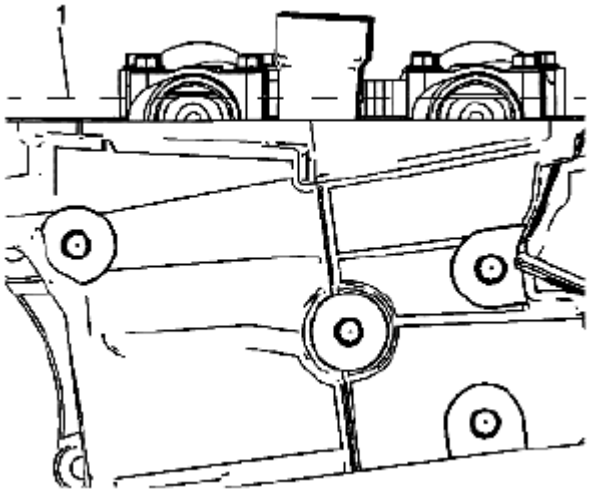


Fig. 751: Positioning Camshaft Lobes In Neutral Position With Flats On Back Of Camshafts Up And Parallel With Left Cylinder Head Camshaft Cover Rail
Courtesy of SUZUKI OF AMERICA CORP.

4. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the left cylinder head camshaft cover rail.

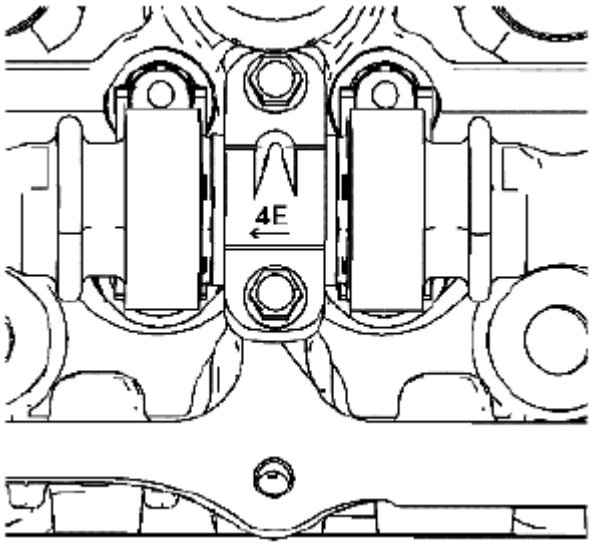


Fig. 752: Identifying Markings On Left Cylinder Head Camshaft Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

5. Observe the markings on the left cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
   - The raised feature must always be oriented toward the center of the cylinder head.
   - The I indicates the intake camshaft.
   - The E indicates the exhaust camshaft.
   - The number 2, 4, 6 indicates the cylinder position from the front of the engine.

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6. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

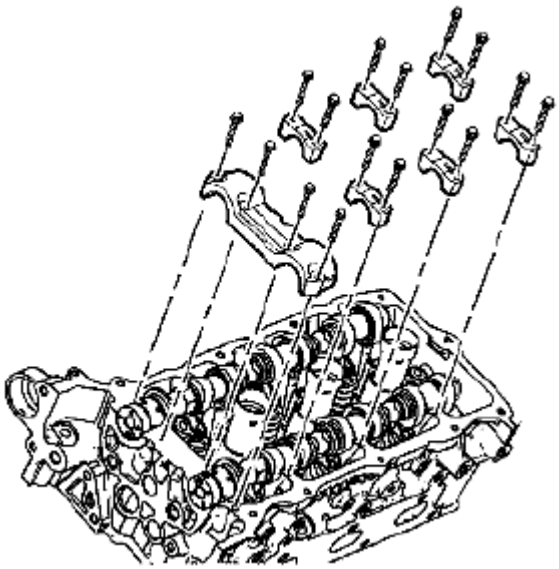


Fig. 753: Identifying Camshaft Bearing Cap And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Install the camshaft bearing thrust cap in the first journal of the left cylinder head.
8. Install the remaining bearing caps with their orientation mark toward the center of the cylinder head.
9. Hand start all the camshaft bearing cap bolts.

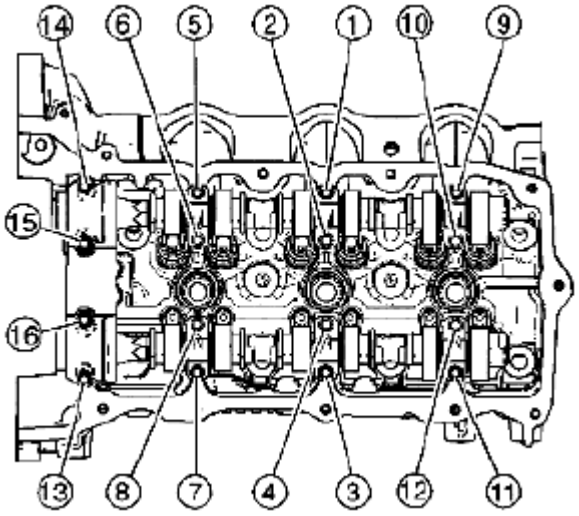


Fig. 754: Identifying Camshaft Bearing Cap Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

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10. Tighten the camshaft bearing cap bolts in the sequence shown.

    Tightening torque

    Tighten the camshaft bearing cap bolts in sequence to 10 N.m (89 lb in) .

11. Loosen the center intake camshaft bearing cap bolts 1, 2 and the center exhaust camshaft bearing cap bolts 3, 4.
12. Retighten the center camshaft bearing cap bolts 1, 2, 3, 4.

    Tightening torque

    Retighten the camshaft bearing cap bolts to 10 N.m (89 lb in) .

    Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE**

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE

Reference: **CAMSHAFT TIMING DRIVE COMPONENTS CLEANING AND INSPECTION**

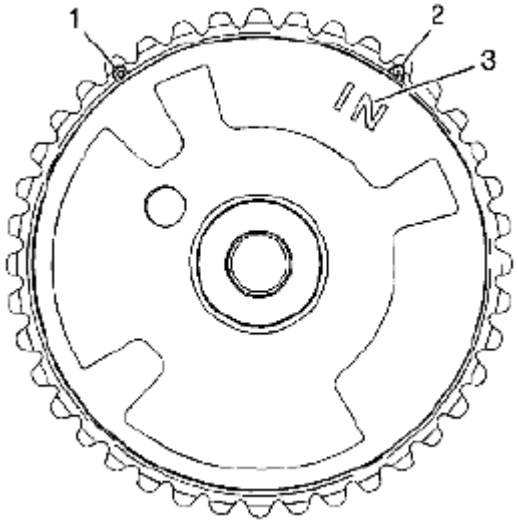


Fig. 755: Identifying Body Of Camshaft Position Actuator For "IN" Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (3). The marking is for an intake camshaft position actuator.

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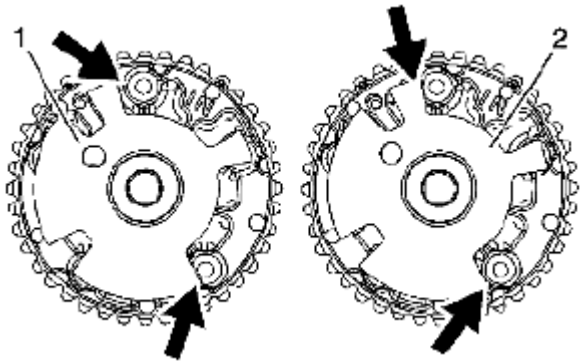


Fig. 756: Locating Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the 4th design right intake camshaft position actuator (1) is indexed in a different position compared to the 4th design left intake camshaft position actuator (2).

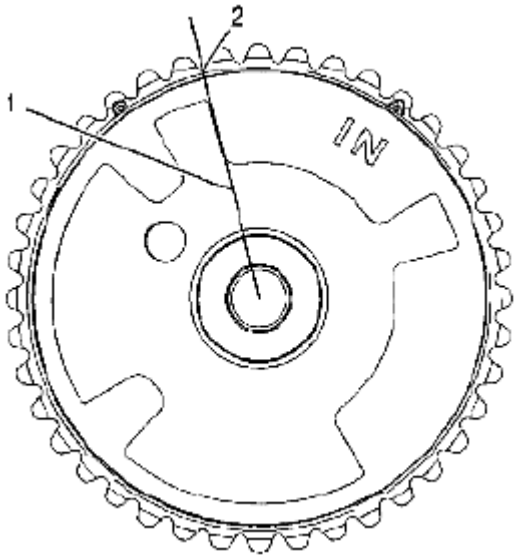


Fig. 757: Identifying Right Intake Camshaft Actuator Edge Of Reluctor Wheel Lines Up With Valley Of Sprocket Tooth
Courtesy of SUZUKI OF AMERICA CORP.

3. On the right intake camshaft actuator the edge of the reluctor wheel (1) lines up with the valley (2) of the sprocket tooth.

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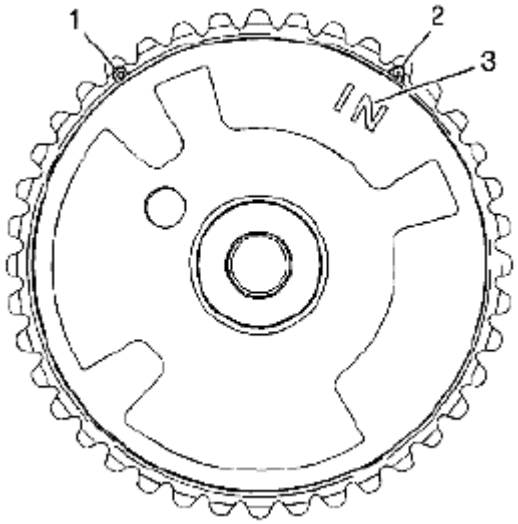


Fig. 758: Identifying Outer Ring Of Camshaft Position Actuator For Triangle Marking
Courtesy of SUZUKI OF AMERICA CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2). The triangle marking is for alignment to the highlighted timing chain link on the right side of the engine.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

5. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

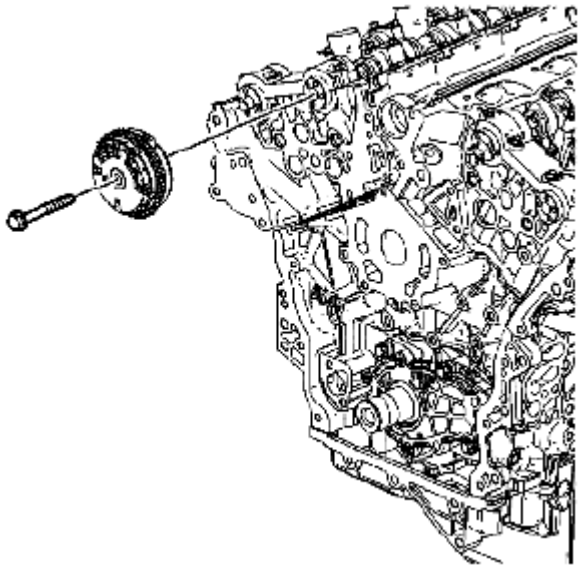


Fig. 759: Identifying Right Intake Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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6. Install the right intake camshaft position actuator.

CAUTION: Refer to FASTENER NOTICE .

7. Install the camshaft position actuator bolt.

Tightening torque

Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft) .

Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE EXHAUST**

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE EXHAUST

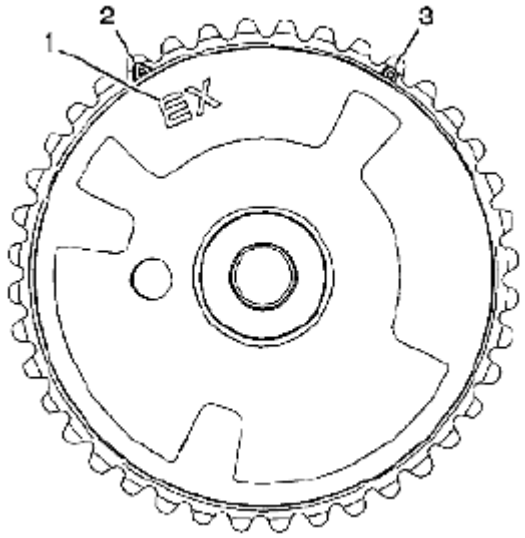


Fig. 760: Identifying Body Of Camshaft Position Actuator For "EX" Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2). The marking is for alignment to the highlighted timing chain link on the right side of the engine.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

3. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

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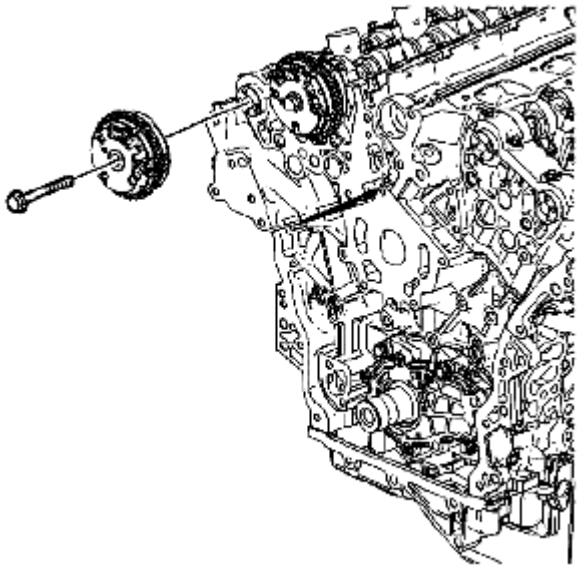


Fig. 761: Identifying Right Exhaust Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the right exhaust camshaft position actuator.

CAUTION: Refer to FASTENER NOTICE .

5. Install the camshaft position actuator bolt.

Tightening torque

Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft) .

Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE**

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE

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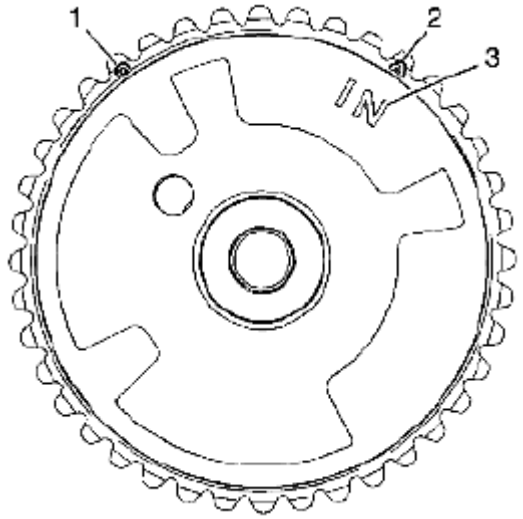


Fig. 762: Identifying Body Of Camshaft Position Actuator For "IN" Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (3). The marking is for an intake camshaft position actuator.

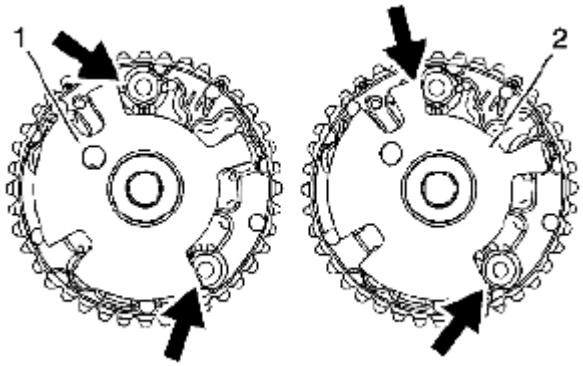


Fig. 763: Locating Camshaft Position Actuator
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the 4th design right intake camshaft position actuator (1) is indexed in a different position compared to the 4th design left intake camshaft position actuator (2).

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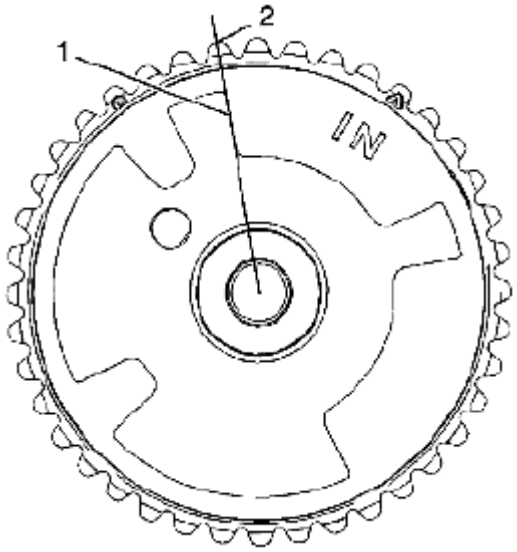


Fig. 764: Identifying Left Intake Camshaft Actuator Edge Of Reluctor Wheel Lines Up With Peak Of Sprocket Tooth
Courtesy of SUZUKI OF AMERICA CORP.

3. On the left intake camshaft actuator the edge of the reluctor wheel (1) lines up with the peak (2) of the sprocket tooth.

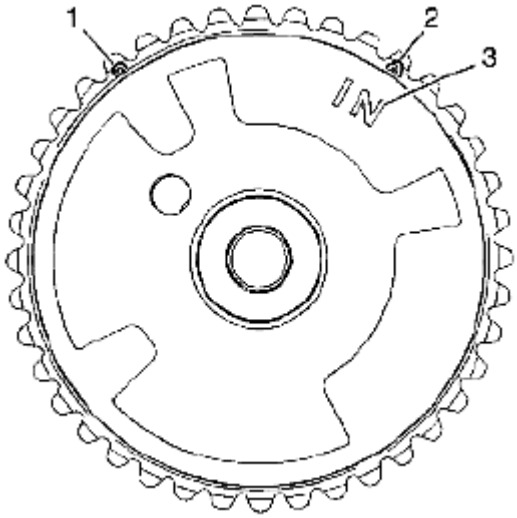


Fig. 765: Identifying Outer Ring Of Camshaft Position Actuator For Circle Marking
Courtesy of SUZUKI OF AMERICA CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (1). The circle marking is for alignment to the highlighted timing chain link on the left side of the engine.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

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5. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

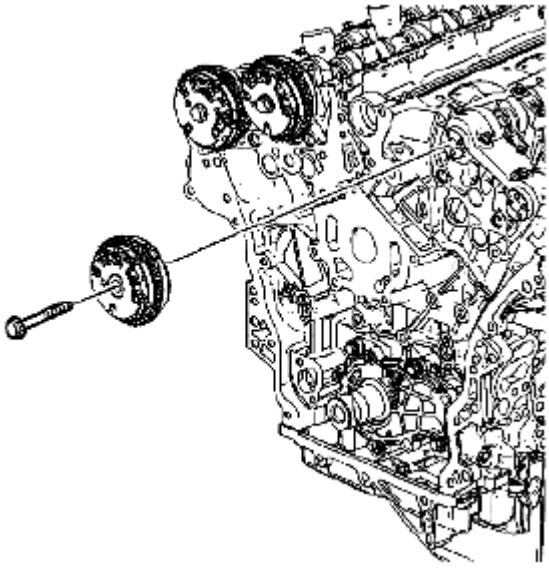


Fig. 766: Identifying Left Intake Camshaft Position Actuator And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the left intake camshaft position actuator.

CAUTION: Refer to FASTENER NOTICE .

7. Install the camshaft position actuator bolt.

Tightening torque

Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft) .

Reference: **CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE EXHAUST**

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE EXHAUST

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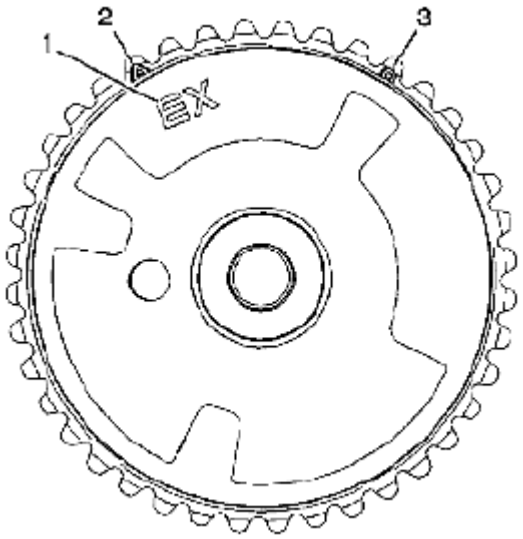


Fig. 767: Identifying Body Of Camshaft Position Actuator For "EX" Marking
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (3). The marking is for alignment to the highlighted timing chain link on the left side of the engine.

CAUTION: Refer to TORQUE REACTION AGAINST TIMING DRIVE CHAIN NOTICE.

3. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

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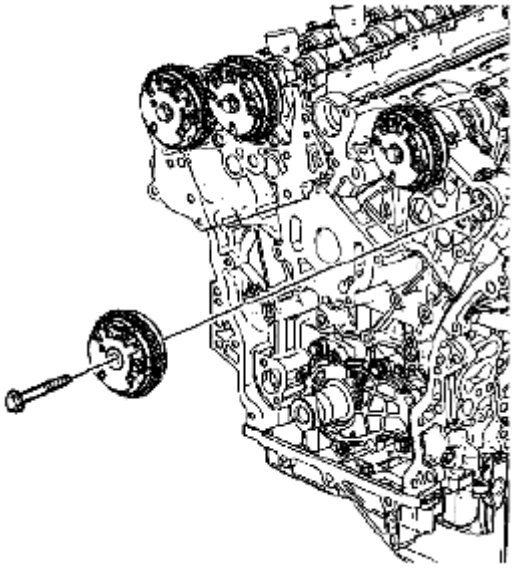


Fig. 768: Identifying Left Exhaust Camshaft Position Actuator And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the left exhaust camshaft position actuator.

CAUTION: Refer to FASTENER NOTICE .

5. Install the camshaft position actuator bolt.

Tightening torque

Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft) .

Reference: **CRANKSHAFT SPROCKET INSTALLATION**

CRANKSHAFT SPROCKET INSTALLATION

Special Tool

EN 46111 Crankshaft Rotation Socket

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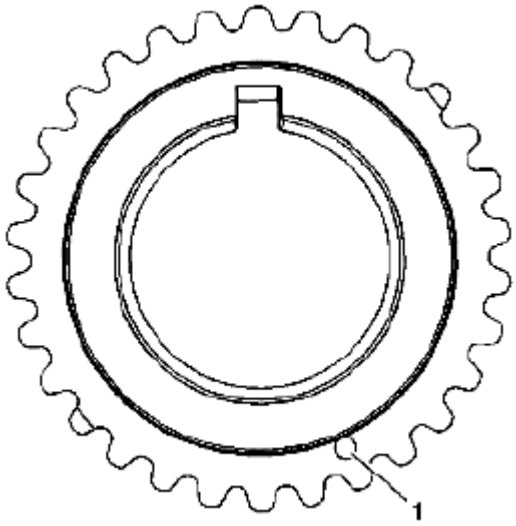


Fig. 769: Identifying Crankshaft Sprocket Timing Mark
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the crankshaft sprocket is installed with the timing mark (1) visible.

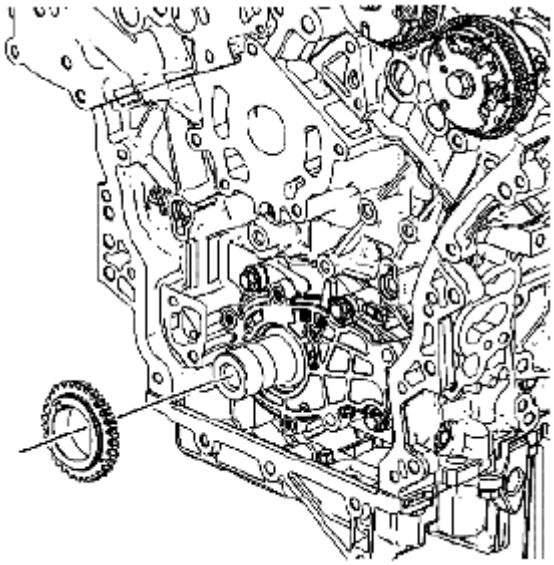


Fig. 770: Identifying Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the crankshaft sprocket on to the nose of the crankshaft.
3. Align the notch in the crankshaft sprocket with the pin in the crankshaft.
4. Slide the crankshaft sprocket on the crankshaft nose until the crankshaft sprocket contacts the step in the crankshaft.

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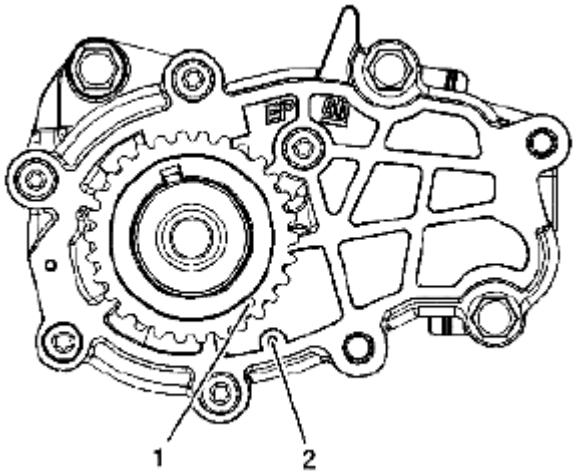


Fig. 771: Aligning Crankshaft Sprocket Timing Mark To Stage One Timing Mark On Oil Pump Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the EN 46111. Refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage One.

   Reference: **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - LEFT SIDE**

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - LEFT SIDE

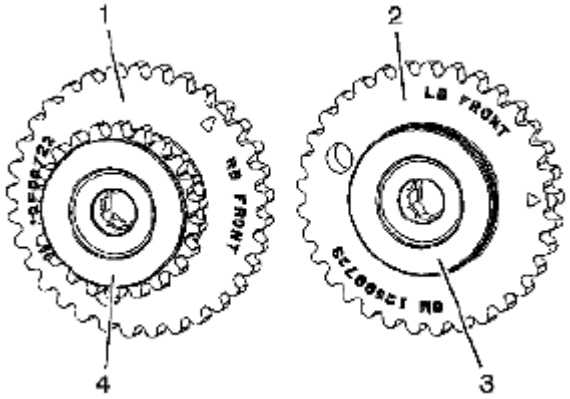


Fig. 772: Identifying Left Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the left camshaft intermediate drive chain idler (2) is being installed. The recessed hub (3) and the larger sprocket of the left camshaft intermediate drive chain idler is installed outward. The raised hub and the smaller sprocket of the left camshaft intermediate drive chain idler is installed towards the block.

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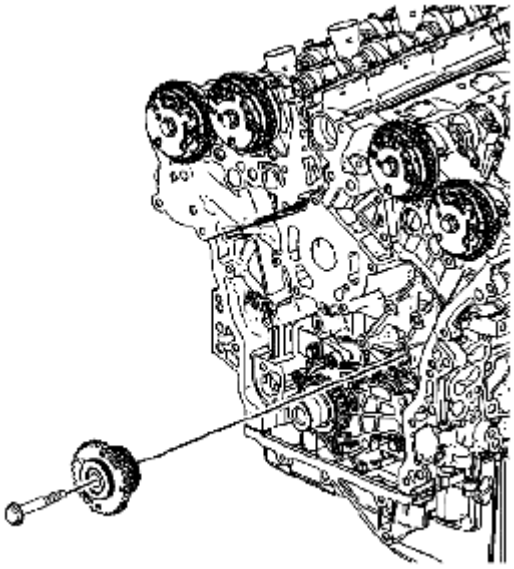


Fig. 773: Identifying Left Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

2. Place the left camshaft intermediate drive chain idler to the cylinder block.

CAUTION: Refer to FASTENER NOTICE .

3. Install the camshaft intermediate drive chain idler bolt.

Tightening torque

Tighten the camshaft intermediate drive chain idler bolt to 58 N.m (43 lb ft) .

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT SIDE (LY7 OR LP1)**

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT SIDE (LY7 OR LP1)

Special Tool

EN 46111 Crankshaft Rotation Socket

EN 48383 Camshaft Retaining Tools

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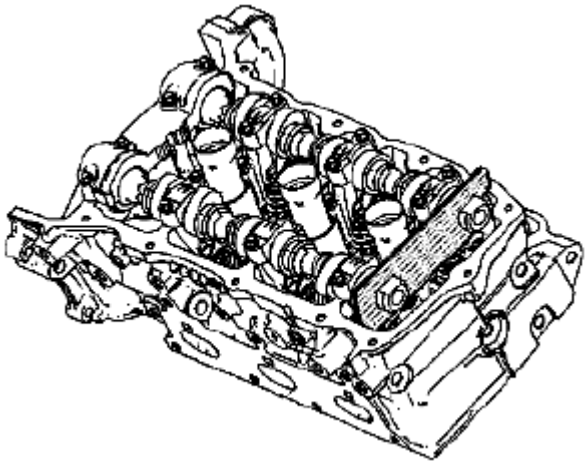


Fig. 774: Identifying Special Tool EN 48383-1
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: There should be no need to rotate the camshaft more than 10 degrees. Using the hex cast into the camshaft rotate the camshaft in order to install the EN 48383.

1. Install the EN 48383-1 onto the rear of the left camshafts.

NOTE: All camshafts must be locked in place before installation of any camshaft drive chains.

2. Ensure that the EN 48383-1 is fully seated onto the camshafts.

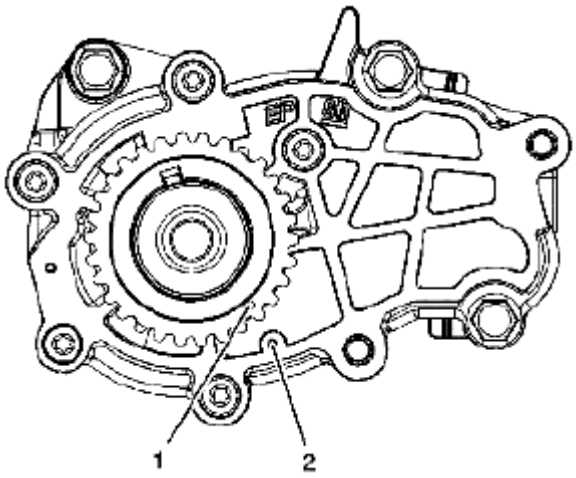


Fig. 775: Aligning Crankshaft Sprocket Timing Mark To Stage One Timing Mark On Oil Pump Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1)

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aligned to the stage one timing mark on the oil pump cover (2) using the EN 46111. Refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage One.

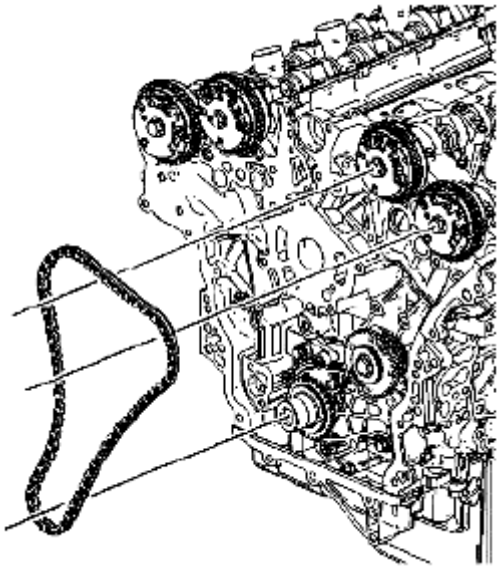


Fig. 776: Identifying Left Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the left secondary camshaft drive chain.

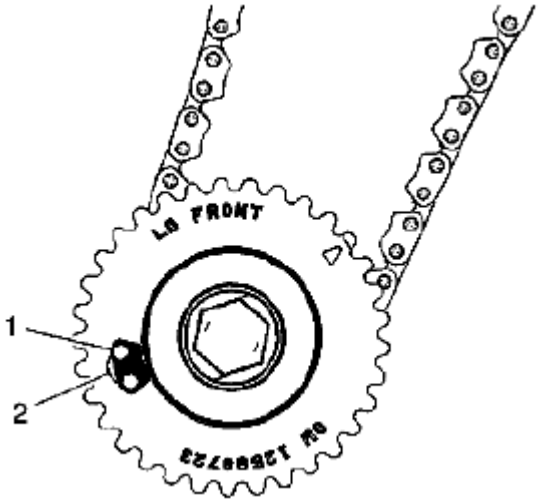


Fig. 777: Aligning Timing Camshaft Drive Chain Link To Alignment Access Hole
Courtesy of SUZUKI OF AMERICA CORP.

5. Place the left secondary camshaft drive chain around the inner sprocket of the left camshaft intermediate drive chain idler with the timing camshaft drive chain link (1) aligned to the alignment access hole (2) made in the left camshaft intermediate drive chain idler outer sprocket.

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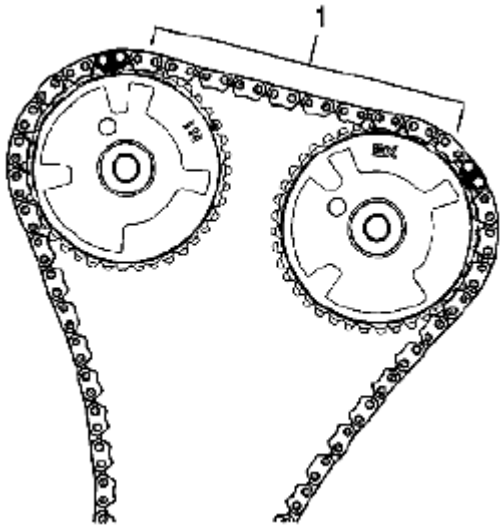


Fig. 778: Identifying 10 Links Between Timing Camshaft Drive Chain Links For Camshaft Position Actuator Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

6. Wrap the secondary camshaft drive chain around both left actuator drive sprockets.
7. Ensure there are 10 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

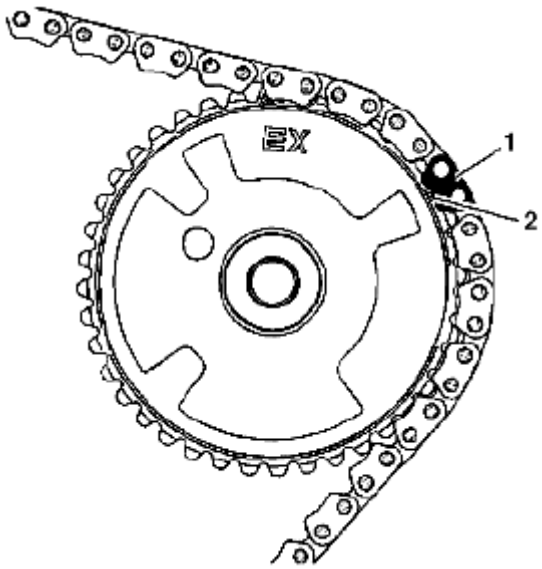


Fig. 779: Aligning Left Exhaust Camshaft Position Actuator Sprocket Alignment Circle Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

8. Align the left exhaust camshaft position actuator sprocket alignment circle mark (2) with the timing camshaft drive chain link (1).

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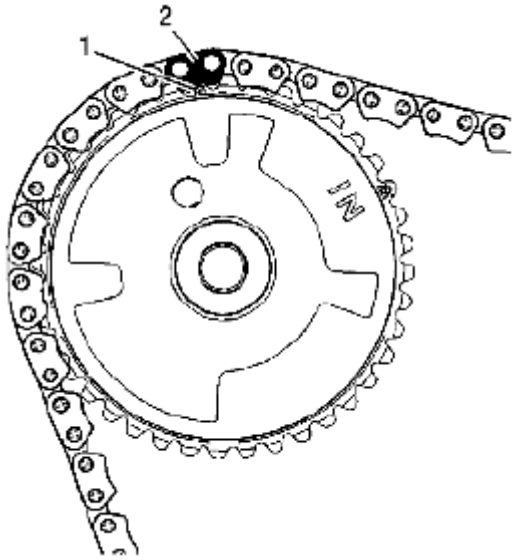


Fig. 780: Aligning Left Intake Camshaft Position Actuator Sprocket Alignment Circle Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

9. Align the left intake camshaft position actuator sprocket alignment circle mark (1) with the timing camshaft drive chain link (2).

   Reference: **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE

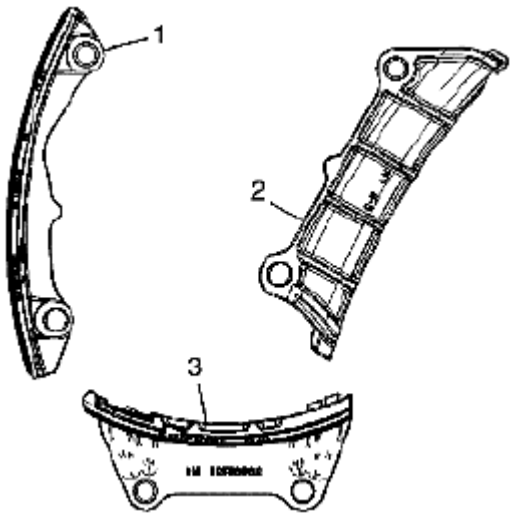


Fig. 781: Identifying Left Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the left secondary camshaft drive chain guide (2) is being installed.

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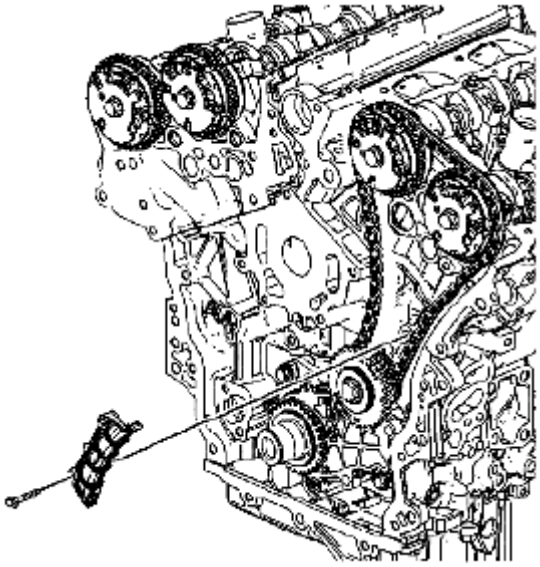


Fig. 782: Identifying Left Secondary Camshaft Drive Chain Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Position the left secondary camshaft drive chain guide.

CAUTION: Refer to FASTENER NOTICE .

3. Install the secondary camshaft drive chain guide bolts.

Tightening torque

Tighten the secondary camshaft drive chain guide bolts to 23 N.m (17 lb ft) .

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE

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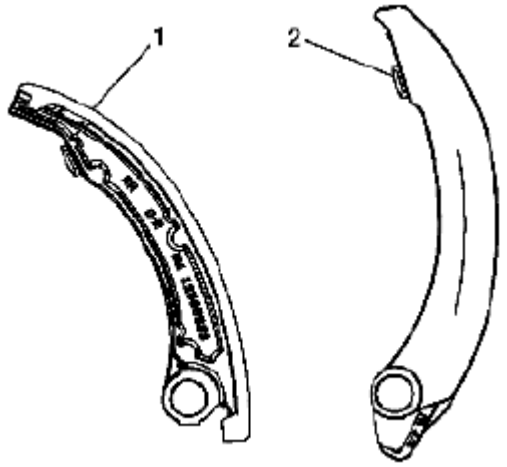


Fig. 783: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the left secondary camshaft drive chain shoe (2) is being installed.

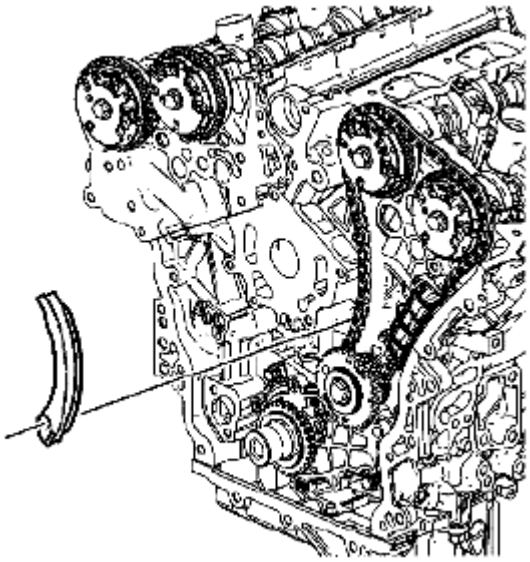


Fig. 784: Identifying Left Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

2. Position the left secondary camshaft drive chain shoe.

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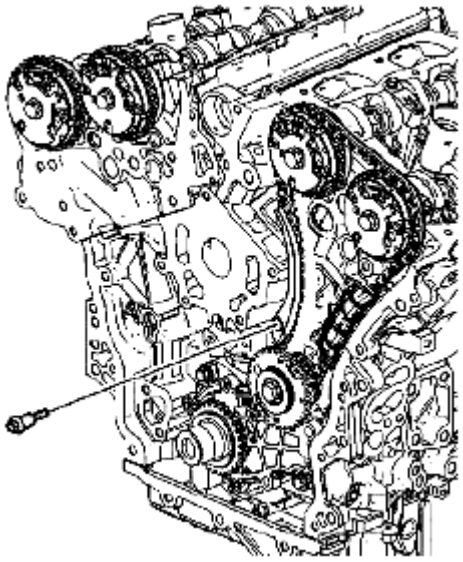


Fig. 785: Identifying Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Install the secondary camshaft drive chain shoe bolt.

   Tightening torque

   Tighten the secondary camshaft drive chain shoe bolt to 23 N.m (17 lb ft) .

   Reference: **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE

Special Tool

EN 46112 Tensioner Retraction Pins

J 45027 Tensioner Tool

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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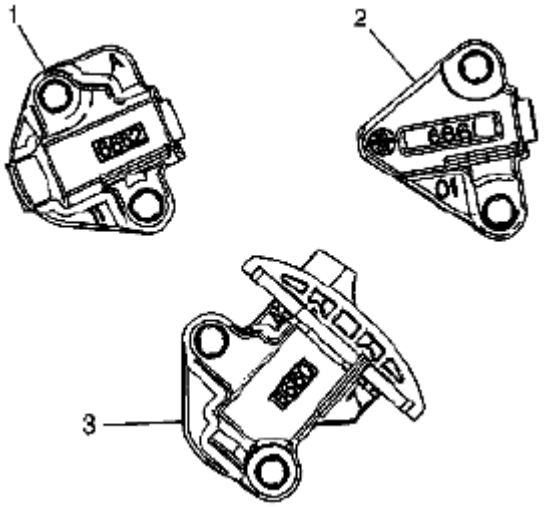


Fig. 786: Identifying Left Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the left secondary camshaft drive chain tensioner (2) is being installed.

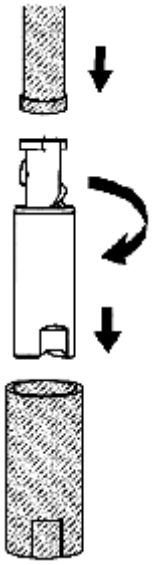


Fig. 787: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of SUZUKI OF AMERICA CORP.

2. Using the J 45027, reset the left secondary camshaft drive chain tensioner plunger.

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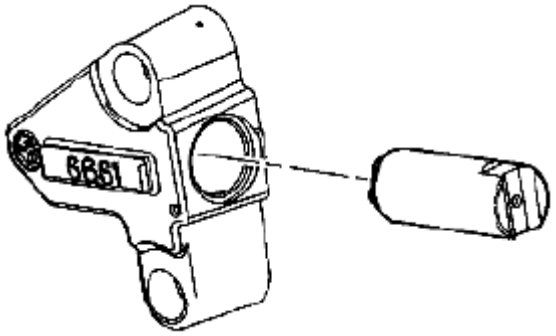


Fig. 788: Identifying Left Secondary Camshaft Drive Chain Tensioner Body Plunger
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the plunger into the left secondary camshaft drive chain tensioner body.

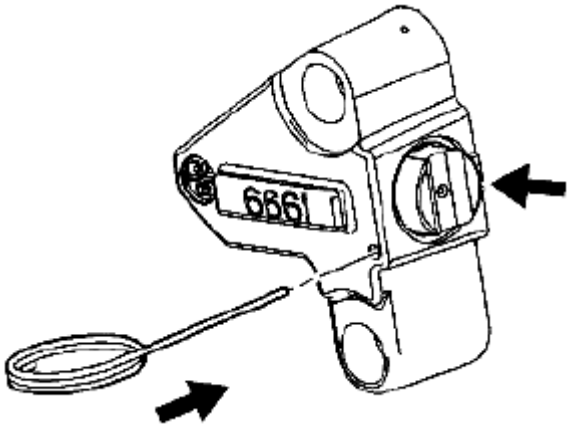


Fig. 789: Compressing Plunger Into Body And Lock Left Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

4. Compress the plunger into the body and lock the left secondary camshaft drive chain tensioner by inserting the EN 46112 into the access hole in the side of the left secondary camshaft drive chain tensioner body.
5. Slowly release pressure on the left secondary camshaft drive chain tensioner. The left secondary camshaft drive chain tensioner should remain compressed.

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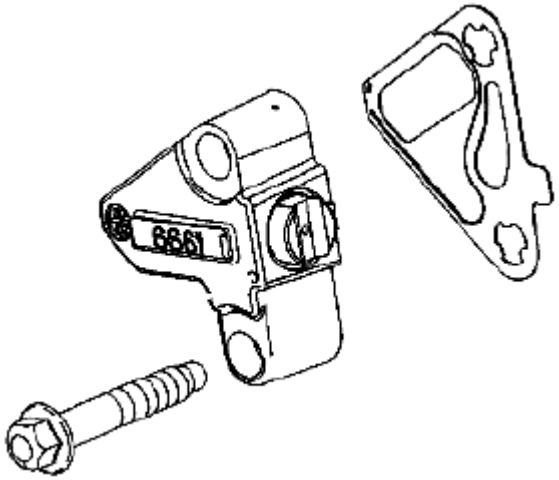


Fig. 790: Identifying Left Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

6. Install a NEW left secondary camshaft drive chain tensioner gasket to the left secondary camshaft drive chain tensioner.
7. Install the left secondary camshaft drive chain tensioner bolts through the left secondary camshaft drive chain tensioner and gasket.
8. Ensure the left secondary camshaft drive chain tensioner mounting surface on the left cylinder head does not have any burrs or defects that would degrade the sealing of the NEW left secondary camshaft drive chain tensioner gasket.

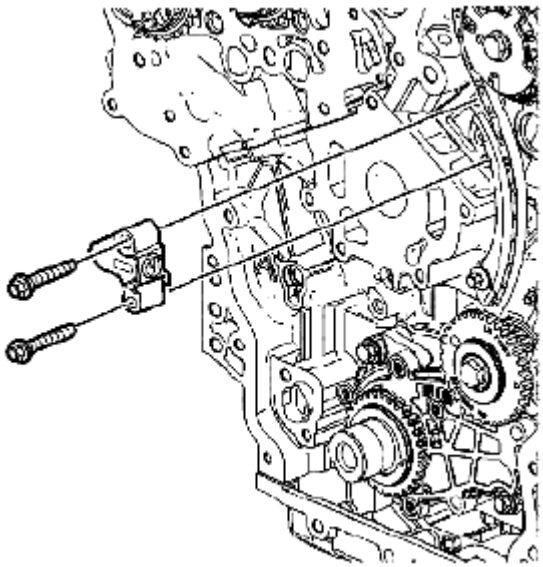


Fig. 791: Identifying Left Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

9. Place the left secondary camshaft drive chain tensioner into position and loosely install the bolts to the block.

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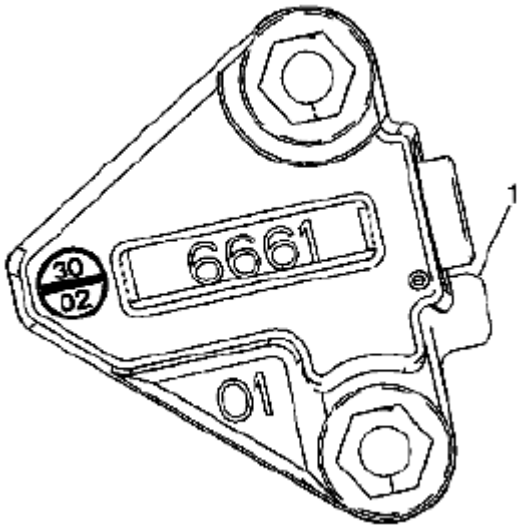


Fig. 792: Identifying Proper Placement Of Left Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

10. Verify the proper placement of the left secondary camshaft drive chain tensioner gasket tab (1).
    a. First Pass

       Tightening torque

       Tighten the left secondary camshaft drive chain tensioner bolts to 5 N.m (44 lb in) .

    b. Final Pass

       Tightening torque

       Tighten the left secondary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft) .

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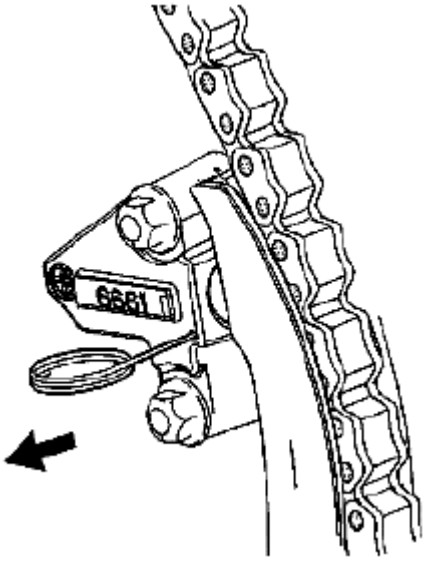


Fig. 793: Releasing Left Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

11. Release the left secondary camshaft drive chain tensioner by pulling out the EN 46112 and unlocking the tensioner plunger.

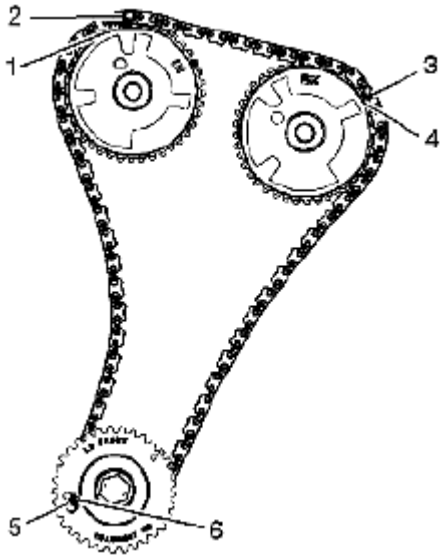


Fig. 794: Identifying Left Secondary Camshaft Drive Chain Timing Mark Alignments
Courtesy of SUZUKI OF AMERICA CORP.

12. Verify the left secondary camshaft drive chain timing mark alignments (1-6). Also refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage One. Reference: **CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT SIDE**

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT SIDE

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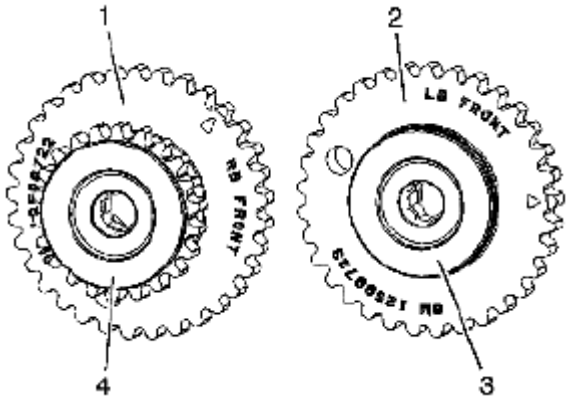


Fig. 795: Identifying Right Camshaft Intermediate Drive Chain Idler
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the right camshaft intermediate drive chain idler (1) is being installed. The recessed hub (4) and the smaller sprocket of the right camshaft intermediate drive chain idler is installed outward. The raised hub and the larger sprocket of the right camshaft intermediate drive chain idler is installed towards the block.

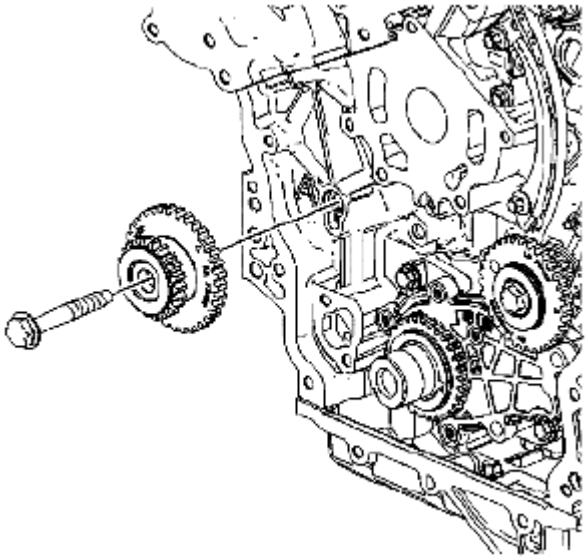


Fig. 796: Identifying Right Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the right camshaft intermediate drive chain idler.

CAUTION: Refer to FASTENER NOTICE .

3. Install the camshaft intermediate drive chain idler bolt.

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Tightening torque

Tighten the camshaft intermediate drive chain idler bolt to 58 N.m (43 lb ft) .

Reference: **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION**

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION

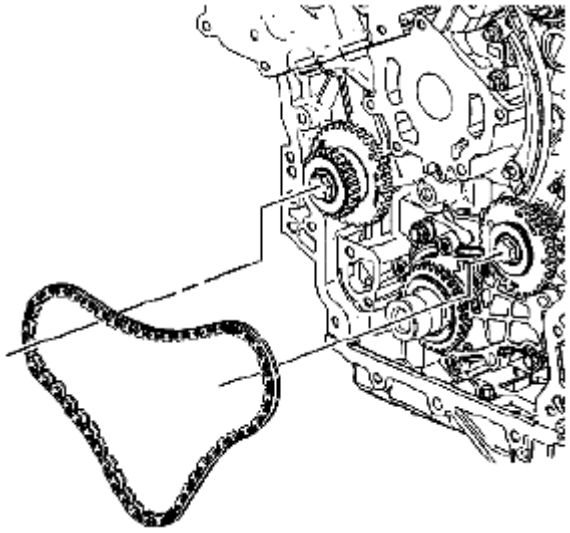


Fig. 797: Identifying Primary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure that the crankshaft is in the stage one timing drive assembly position.

1. Install the primary camshaft drive chain.

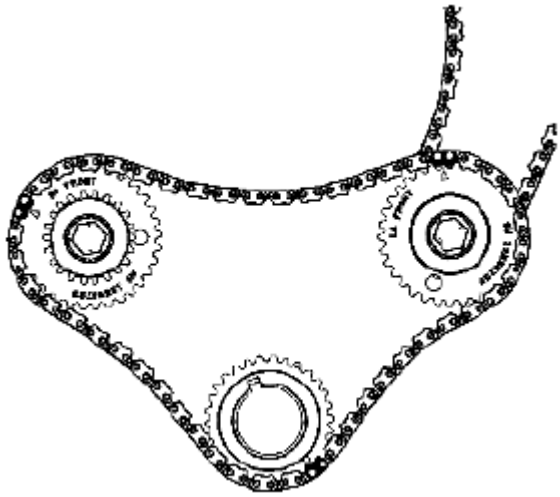


Fig. 798: Identifying Primary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

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2. Wrap the primary camshaft drive chain around the large sprockets of each camshaft intermediate drive chain idler and the crankshaft sprocket.

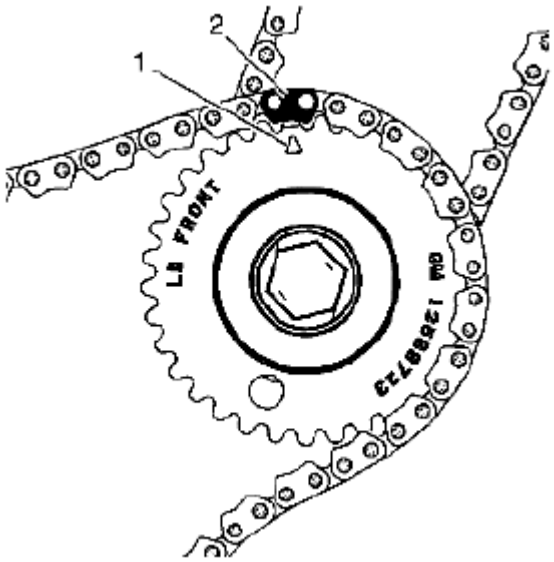


Fig. 799: Aligning Left Camshaft Intermediate Drive Chain Idler Timing Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

3. The left camshaft intermediate drive chain idler timing mark (1) will align with a timing camshaft drive chain link (2).

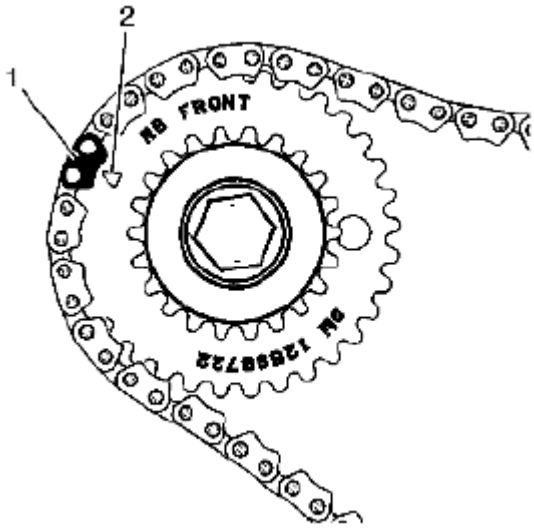


Fig. 800: Aligning Right Camshaft Intermediate Drive Chain Idler Timing Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

4. The right camshaft intermediate drive chain idler timing mark (2) will align with a timing camshaft drive

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chain link (1).

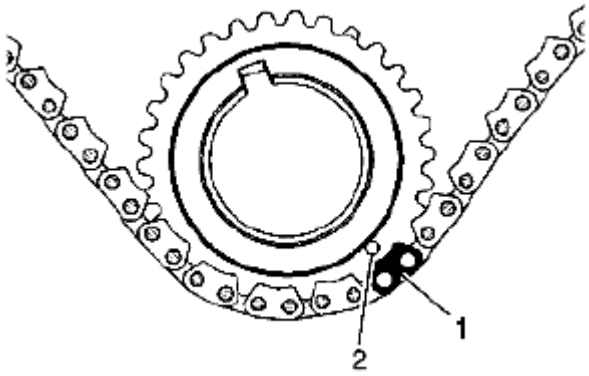


Fig. 801: Aligning Crankshaft Sprocket Timing Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

5. The crankshaft sprocket timing mark (2) will align with a timing camshaft drive chain link (1).

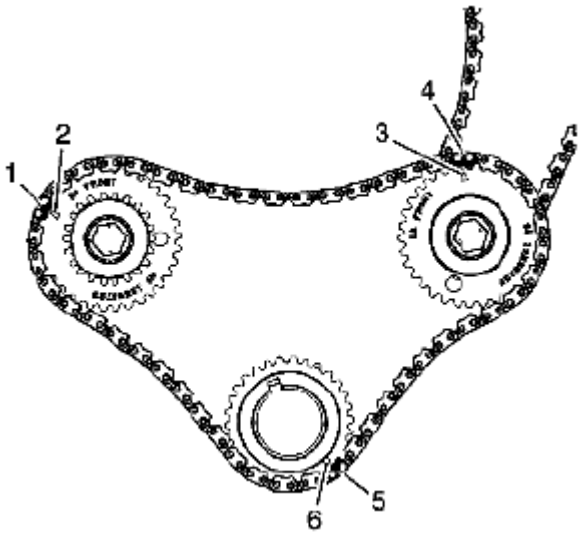


Fig. 802: Aligning Timing Marks With Timing Camshaft Drive Chain Links
Courtesy of SUZUKI OF AMERICA CORP.

6. Ensure all the timing marks (2, 3, 6) are properly aligned with the timing camshaft drive chain links (1, 4, 5).

Reference: **PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LOWER**

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LOWER

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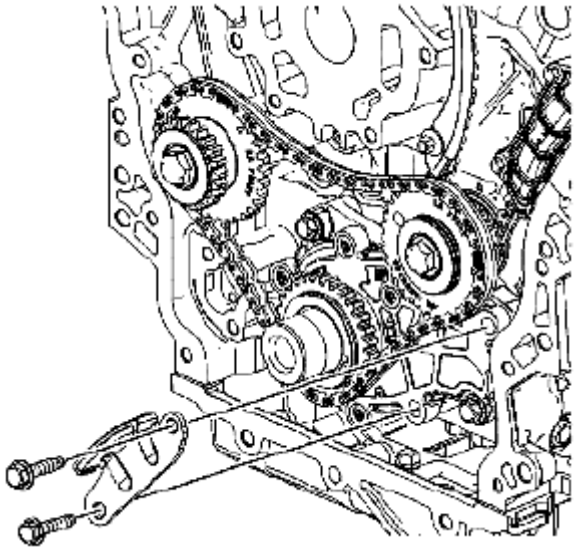


Fig. 803: Identifying Primary Camshaft Drive Chain Lower Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Position the primary camshaft drive chain lower guide to the oil pump.

   CAUTION: Refer to FASTENER NOTICE .

2. Install the primary camshaft drive chain lower guide bolts.

   Tightening torque

   Tighten the primary camshaft drive chain lower guide bolts to 23 N.m (17 lb ft) .

   Reference: **PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER**

PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER

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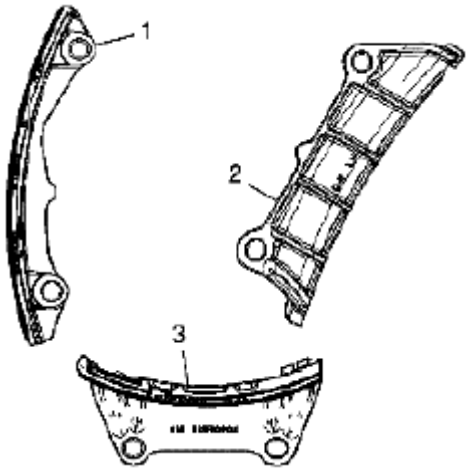


Fig. 804: Identifying Upper Primary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure the upper primary camshaft drive chain guide (3) is being installed.

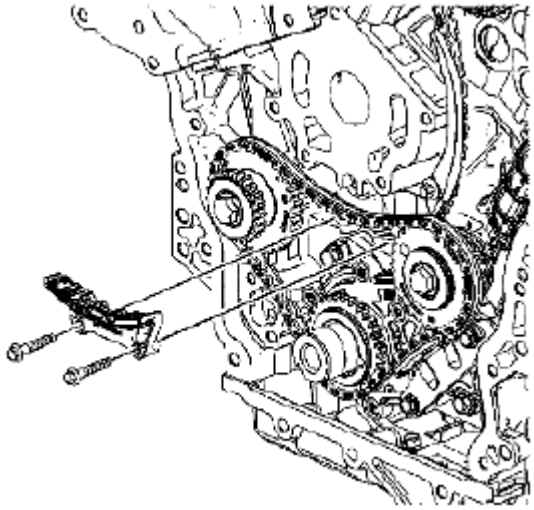


Fig. 805: Identifying Upper Primary Camshaft Drive Chain Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the upper primary camshaft drive chain guides.

CAUTION: Refer to FASTENER NOTICE .

3. Install the upper primary camshaft drive chain guide bolts.

Tightening torque

Tighten the upper primary camshaft drive chain guide bolts to 23 N.m (17 lb ft) .

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Reference: **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION**

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION

Special Tool

EN 46111 Crankshaft Rotation Socket

EN 46112 Tensioner Retraction Pins

EN-48383 Camshaft Retaining Tools

J 45027 Tensioner Tool

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

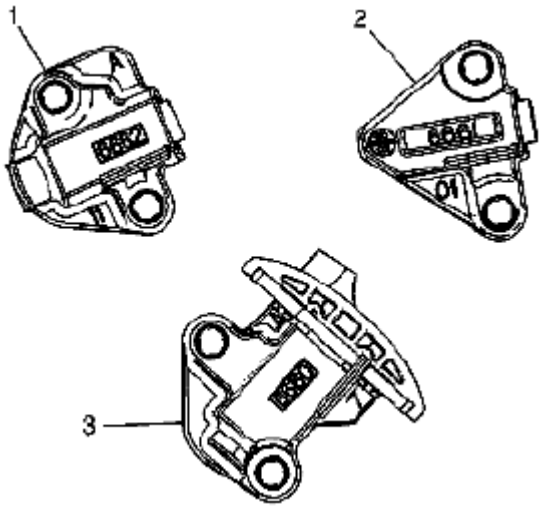


Fig. 806: Identifying Primary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the primary camshaft drive chain tensioner (3) is being installed.

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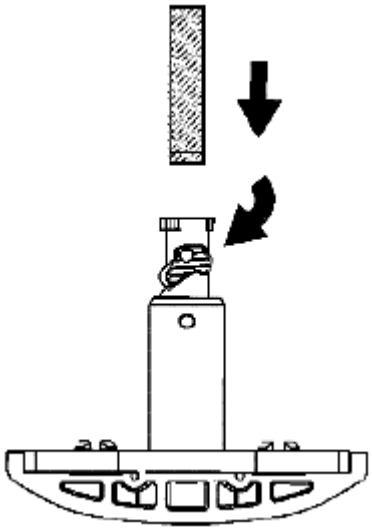


Fig. 807: Resetting Primary Camshaft Drive Chain Tensioner Plunger
Courtesy of SUZUKI OF AMERICA CORP.

2. Using the J 45027, reset the primary camshaft drive chain tensioner plunger.

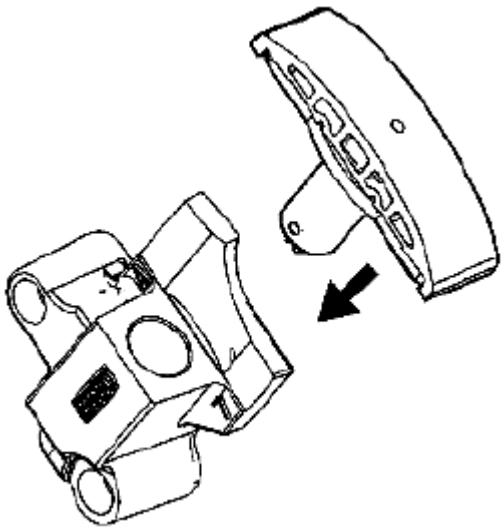


Fig. 808: Installing Plunger Into Primary Camshaft Drive Chain Tensioner Body
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the plunger into the primary camshaft drive chain tensioner body.

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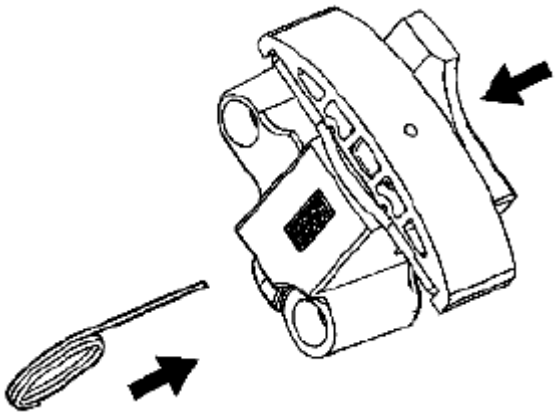


Fig. 809: Locking Primary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

4. Compress the plunger into the body and lock the primary camshaft drive chain tensioner by inserting the EN 46112 into the access hole in the side of the primary camshaft drive chain tensioner body.
5. Slowly release pressure on the primary camshaft drive chain tensioner. The primary camshaft drive chain tensioner should remain compressed.

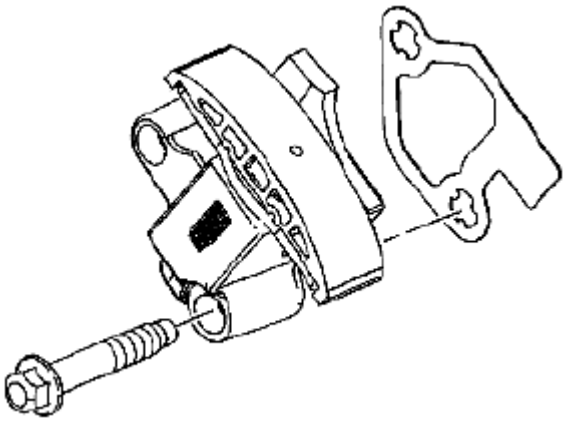


Fig. 810: Identifying Primary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

6. Install a NEW primary camshaft drive chain tensioner gasket to the primary camshaft drive chain tensioner.
7. Install the primary camshaft drive chain tensioner bolts through the primary camshaft drive chain tensioner and gasket.
8. Ensure the primary camshaft drive chain tensioner mounting surface on the engine block does not have any burrs or defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.

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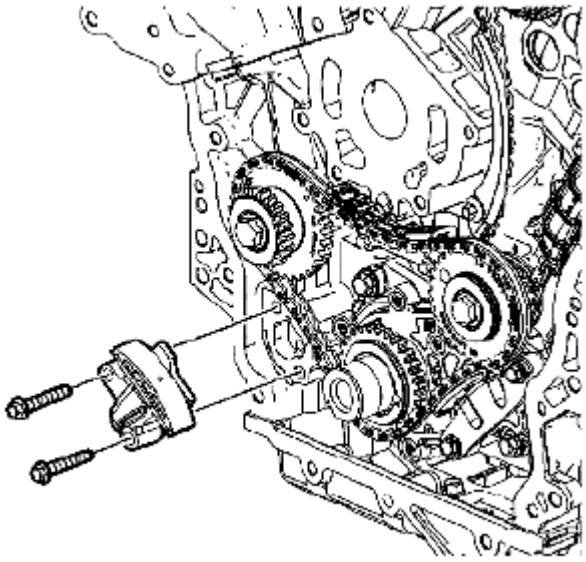


Fig. 811: Identifying Primary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

9. Place the primary camshaft drive chain tensioner into position and loosely install the bolts to the block.

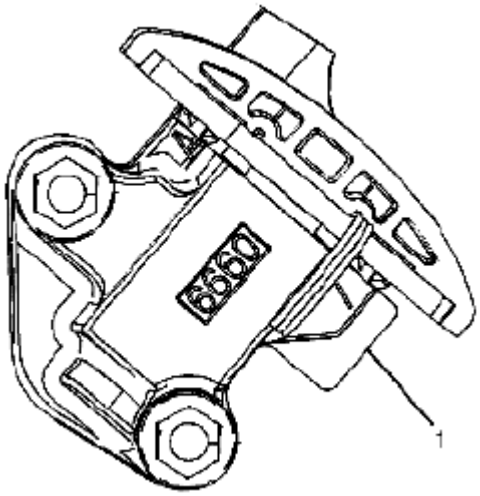


Fig. 812: Identifying Proper Placement Of Primary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

10. Verify the proper placement of the primary camshaft drive chain tensioner gasket tab (1).
    a. First Pass

Tightening torque

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Tighten the primary camshaft drive chain tensioner bolts to 5 N.m (44 lb in) .

b. Final Pass

Tightening torque

Tighten the primary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft) .

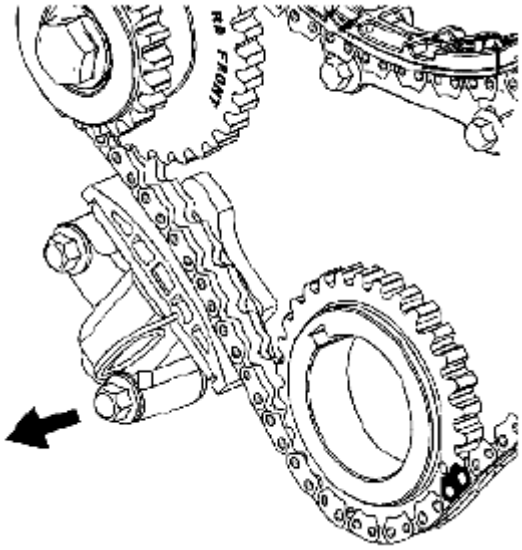


Fig. 813: Unlocking Tensioner Plunger
Courtesy of SUZUKI OF AMERICA CORP.

11. Release the primary camshaft drive chain tensioner by pulling out the EN 46112 and unlocking the tensioner plunger.

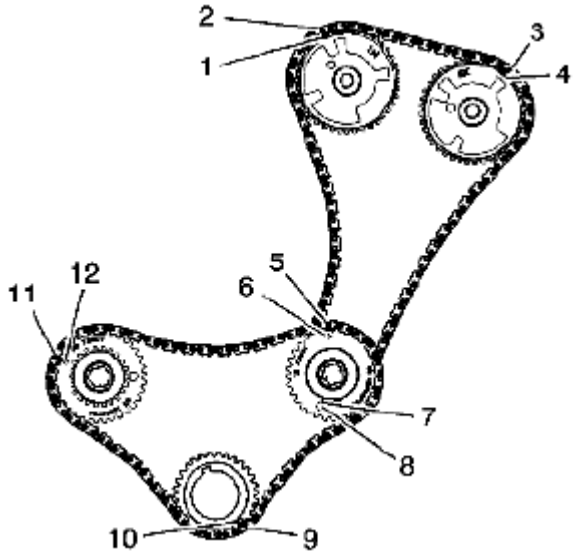


Fig. 814: Identifying Primary And Left Secondary Camshaft Drive Chain Timing Mark

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Alignments
Courtesy of SUZUKI OF AMERICA CORP.

12. Verify the primary and left secondary camshaft drive chain timing mark alignments (1-12). Also refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage One.

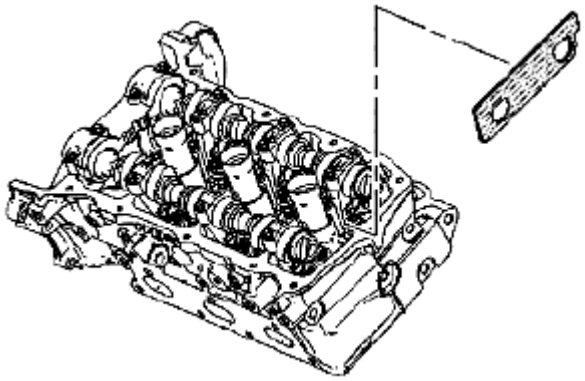


Fig. 815: Identifying Special Tool EN 48383-1
Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the EN 48383-1 from the rear of the left camshafts.

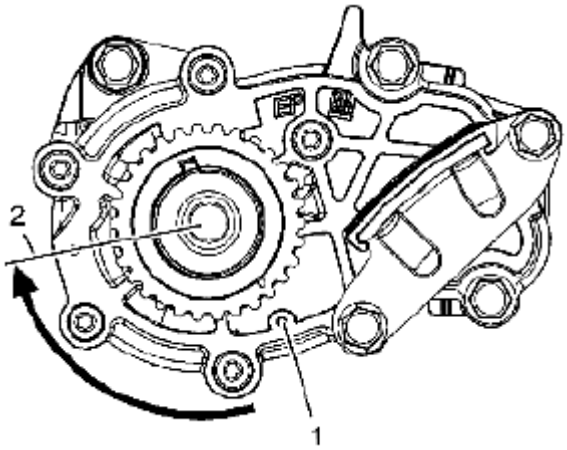


Fig. 816: Rotating Crankshaft And Crankshaft Sprocket From Stage 1 Alignment Position To Stage 2 Alignment Position
Courtesy of SUZUKI OF AMERICA CORP.

14. Using the EN 46111, rotate the crankshaft and crankshaft sprocket from the stage 1 alignment position (1) to the stage 2 alignment position (2), 115 crankshaft degrees, in order to install the right secondary camshaft drive chain components.

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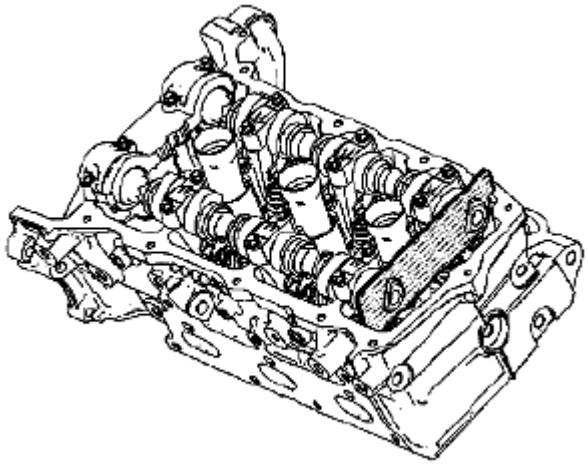


Fig. 817: Identifying Special Tool EN 48383-2
Courtesy of SUZUKI OF AMERICA CORP.

15. Install the EN 48383-2 onto the rear of the left camshafts.

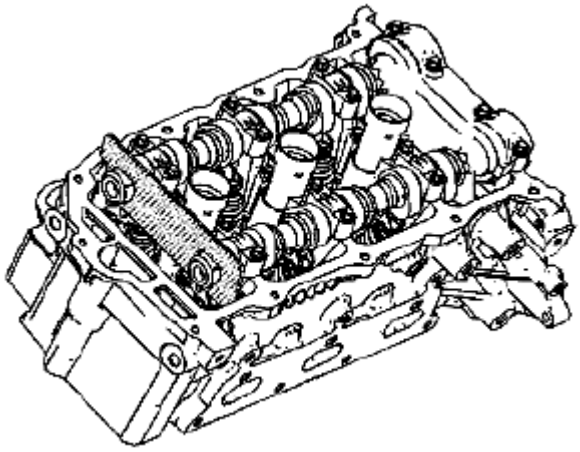


Fig. 818: Identifying Special Tool EN 48383-3
Courtesy of SUZUKI OF AMERICA CORP.

16. Install the EN 48383-3 onto the rear of the right camshafts.

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE

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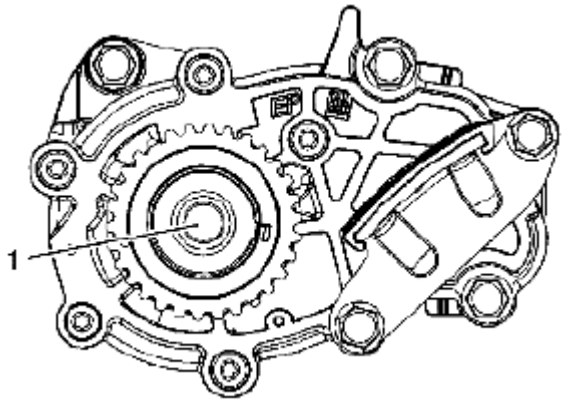


Fig. 819: Locating Stage 2 Timing Drive Assembly Position
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the crankshaft is in the stage 2 timing drive assembly position (1).

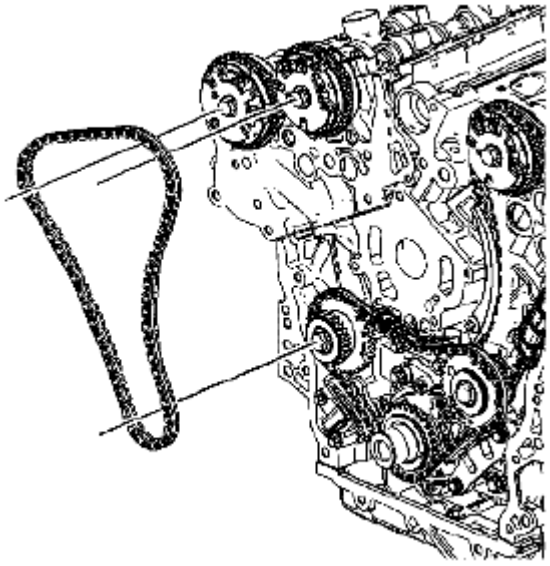


Fig. 820: Identifying Right Secondary Camshaft Drive Chain
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the right secondary camshaft drive chain.

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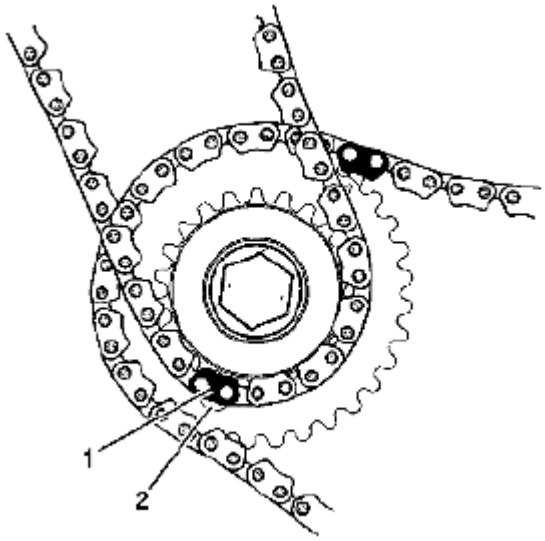


Fig. 821: Aligning Timing Camshaft Drive Chain Link With Alignment Access Hole
Courtesy of SUZUKI OF AMERICA CORP.

3. Place the secondary camshaft drive chain around the right camshaft intermediate drive chain idler outer sprocket, aligning the timing camshaft drive chain link (1) with the alignment access hole (2) made in the right camshaft intermediate drive chain idler inner sprocket.

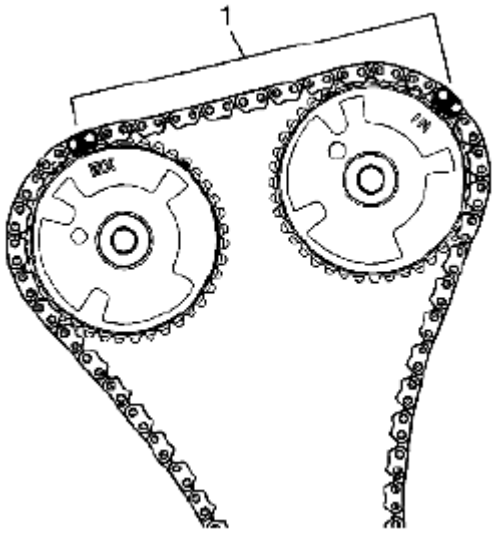


Fig. 822: Identifying 10 Links Between Timing Camshaft Drive Chain Links For Camshaft Position Actuator Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

4. Wrap the secondary camshaft drive chain around both right actuator drive sprockets.
5. Ensure there are 10 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

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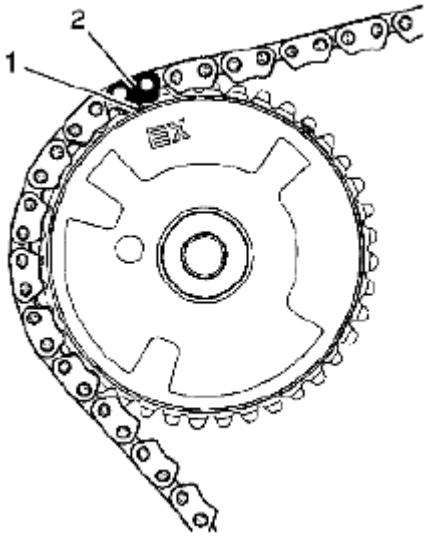


Fig. 823: Aligning Right Exhaust Camshaft Position Actuator Sprocket Alignment Triangle Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

6. Align the right exhaust camshaft position actuator sprocket alignment triangle mark (1) with the timing camshaft drive chain link (2).

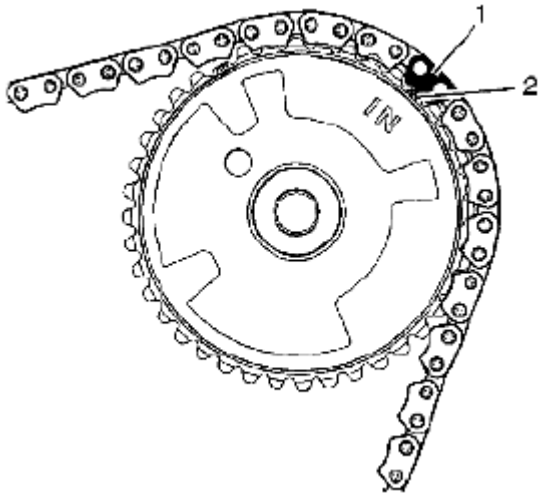


Fig. 824: Aligning Right Intake Camshaft Position Actuator Sprocket Alignment Triangle Mark With Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

7. Align the right intake camshaft position actuator sprocket alignment triangle mark (2) with the timing camshaft drive chain link (1).

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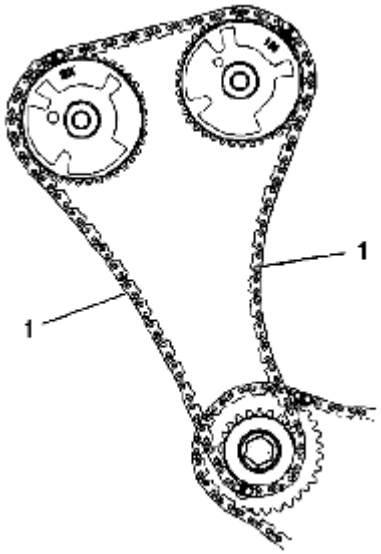


Fig. 825: Identifying 22 Links Between Right Camshaft Intermediate Drive Chain Idler Timing Camshaft Drive Chain Link
Courtesy of SUZUKI OF AMERICA CORP.

8. There will be 22 links (1) between the right camshaft intermediate drive chain idler timing camshaft drive chain link and each right camshaft position actuator sprocket timing camshaft drive chain link.

   Reference: **SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE

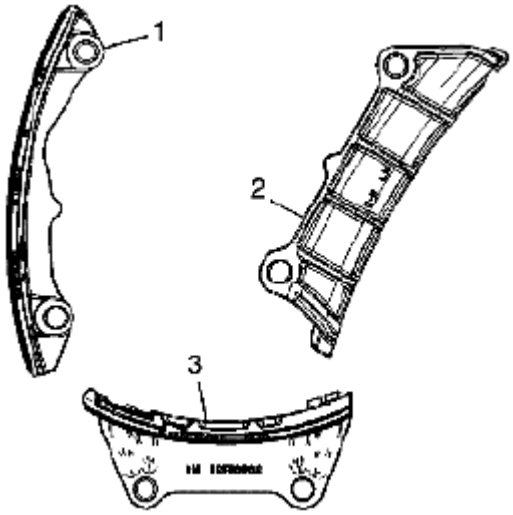


Fig. 826: Identifying Right Secondary Camshaft Drive Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the right secondary camshaft drive chain guide (1) is being installed.

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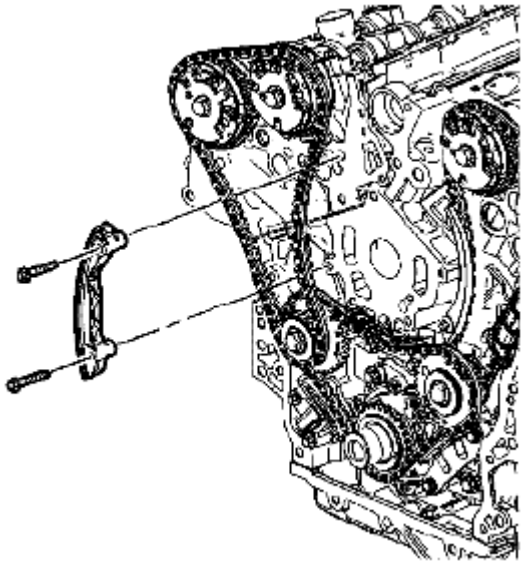


Fig. 827: Identifying Right Secondary Camshaft Drive Chain Guide And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Position the right secondary camshaft drive chain guide.

CAUTION: Refer to FASTENER NOTICE .

3. Install the secondary camshaft drive chain guide bolts.

Tightening torque

Tighten the secondary camshaft drive chain guide bolts to 23 N.m (17 lb ft) .

Reference: **SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE

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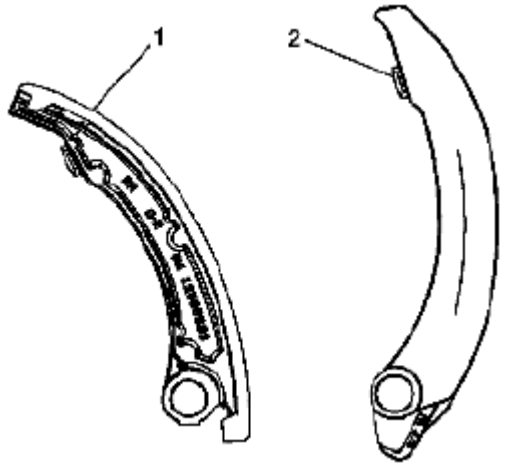


Fig. 828: Identifying Right Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the right secondary camshaft drive chain shoe (1) is being installed.

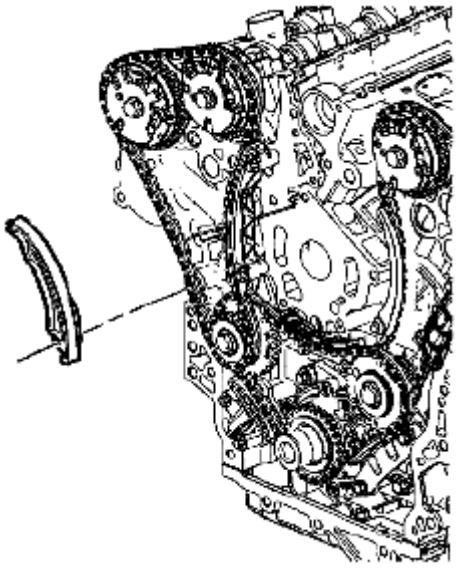


Fig. 829: Identifying Right Secondary Camshaft Drive Chain Shoe
Courtesy of SUZUKI OF AMERICA CORP.

2. Position the right secondary camshaft drive chain shoe.

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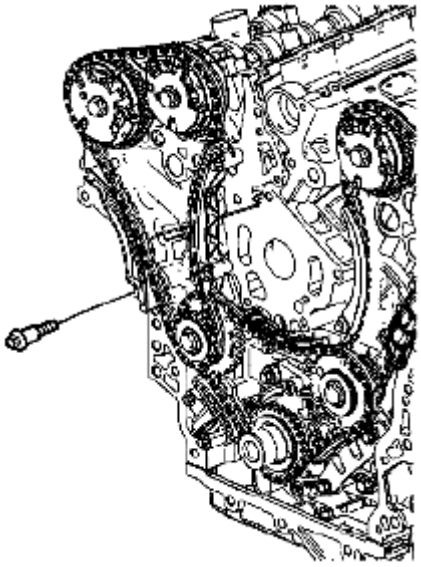


Fig. 830: Identifying Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Install the secondary camshaft drive chain shoe bolt.

   Tightening torque

   Tighten the secondary camshaft drive chain shoe bolt to 23 N.m (17 lb ft) .

   Reference: **SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE**

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE

Special Tool

EN 46112 Tensioner Retraction Pins

J 45027 Tensioner Tool

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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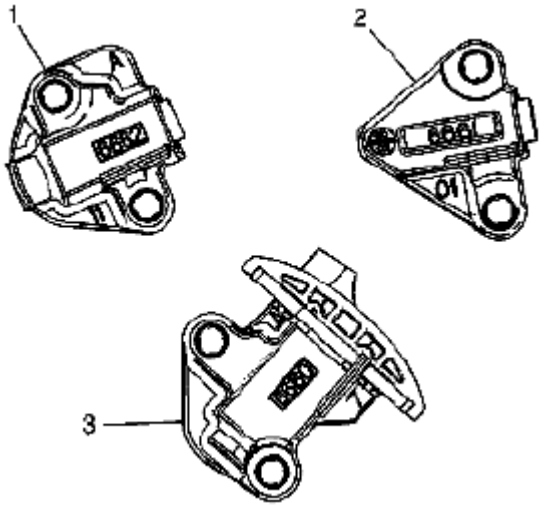


Fig. 831: Identifying Right Secondary Camshaft Drive Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

1. Ensure that the right secondary camshaft drive chain tensioner (1) is being installed.

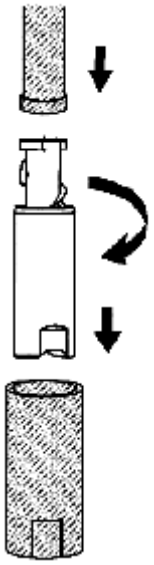


Fig. 832: Resetting Right Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of SUZUKI OF AMERICA CORP.

2. Using the J 45027, reset the right secondary camshaft drive chain tensioner plunger.

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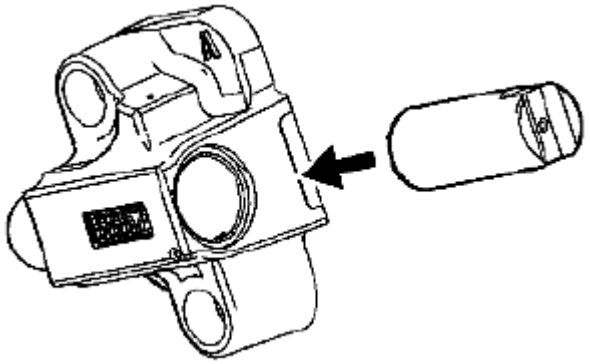


Fig. 833: Installing Plunger Into Right Secondary Camshaft Drive Chain Tensioner Body
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the plunger into the right secondary camshaft drive chain tensioner body.

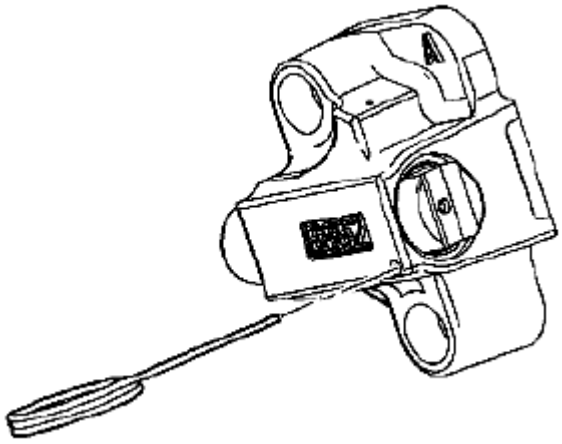


Fig. 834: Inserting EN 46112 Into Access Hole In Side Of Right Secondary Camshaft Drive Chain Tensioner Body
Courtesy of SUZUKI OF AMERICA CORP.

4. Compress the plunger into the body and lock the right secondary camshaft drive chain tensioner by inserting the EN 46112 into the access hole in the side of the right secondary camshaft drive chain tensioner body.
5. Slowly release pressure on the right secondary camshaft drive chain tensioner. The right secondary camshaft drive chain tensioner should remain compressed.

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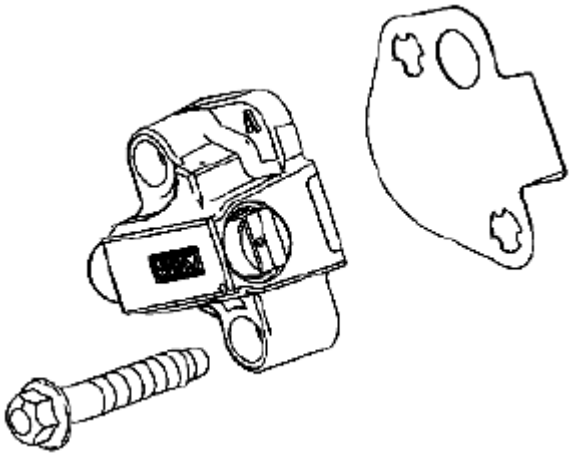


Fig. 835: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of SUZUKI OF AMERICA CORP.

6. Install a NEW right secondary camshaft drive chain tensioner gasket to the right secondary camshaft drive chain tensioner.
7. Install the right secondary camshaft drive chain tensioner bolts through the right secondary camshaft drive chain tensioner and gasket.
8. Ensure the right secondary camshaft drive chain tensioner mounting surface on the right cylinder head does not have any burrs or defects that would degrade the sealing of the NEW right secondary camshaft drive chain tensioner gasket.

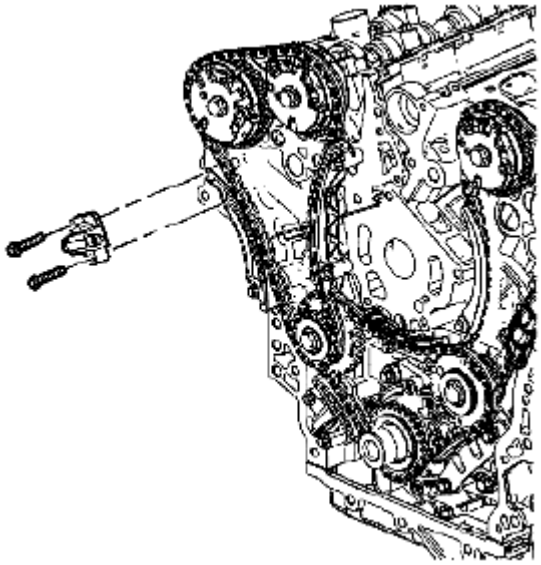


Fig. 836: Identifying Right Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

9. Place the right secondary camshaft drive chain tensioner into position and loosely install the bolts to the block.

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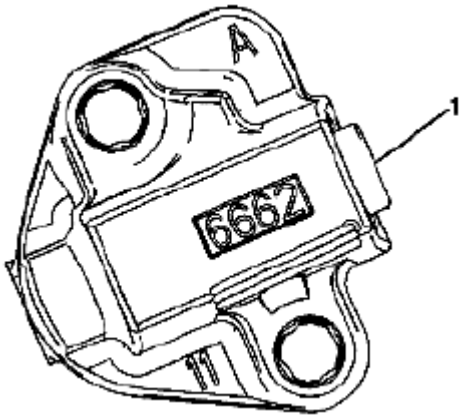


Fig. 837: Identifying Proper Placement Of Right Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

10. Verify the proper placement of the right secondary camshaft drive chain tensioner gasket tab (1).
    a. First Pass

       Tightening torque

       Tighten the right secondary camshaft drive chain tensioner bolts to 5 N.m (44 lb in) .

    b. Final Pass

       Tightening torque

       Tighten the right secondary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft) .

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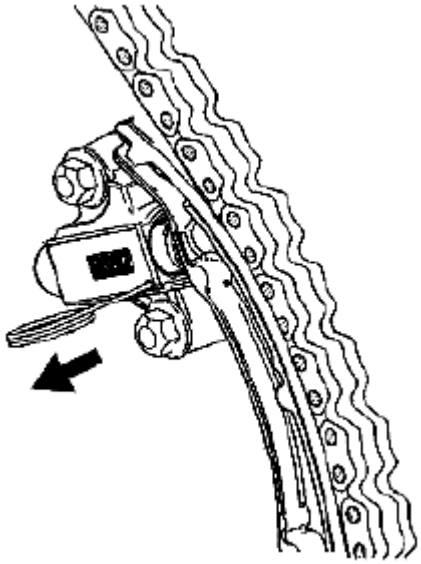


Fig. 838: Pulling Out EN 46112
Courtesy of SUZUKI OF AMERICA CORP.

11. Release the right camshaft drive chain tensioner by pulling out the EN 46112 and unlocking the tensioner plunger.

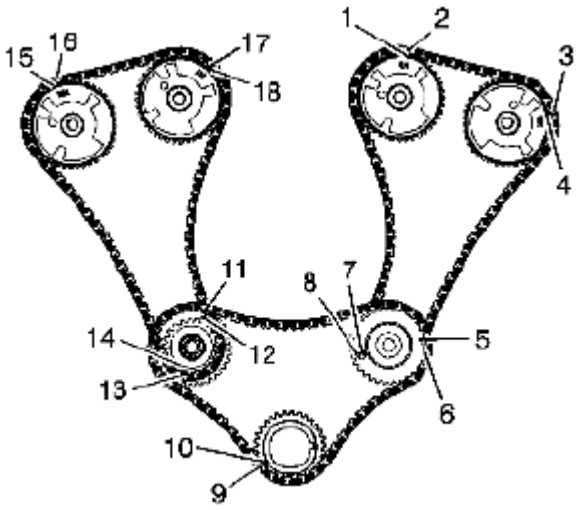


Fig. 839: Identifying Primary And Secondary Camshaft Drive Chain Timing Mark Alignments
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Ensure that all timing chain tensioners are completely released. A timing chain tensioner that is not properly released can lead to serious engine damage.

12. Verify all primary and secondary camshaft drive chain timing mark alignments (1-18). Also refer to **CAMSHAFT TIMING DRIVE CHAIN ALIGNMENT DIAGRAM** - Stage Two.

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13. Remove EN 48383 camshaft tools from both sets of camshafts.

    Reference: **ENGINE FRONT COVER INSTALLATION**

ENGINE FRONT COVER INSTALLATION

Reference: **ENGINE FRONT COVER ASSEMBLE**

Special Tools

EN 46109 Guide Pins

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

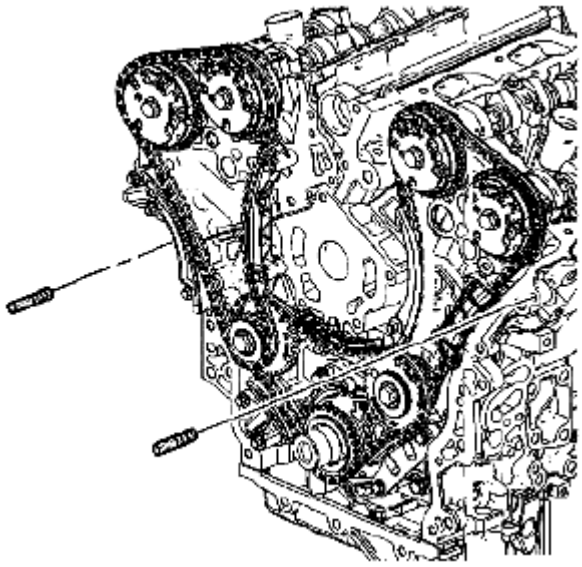


Fig. 840: Identifying 8 mm (0.315 in) Guide
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the 8 mm (0.315 in) guide from the EN 46109 into the cylinder block positions as shown.

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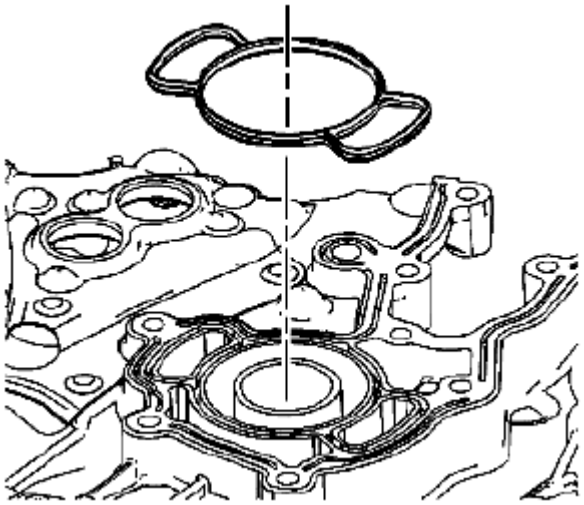


Fig. 841: Identifying Cylinder Block Seal
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the NEW engine front cover to cylinder block seal.

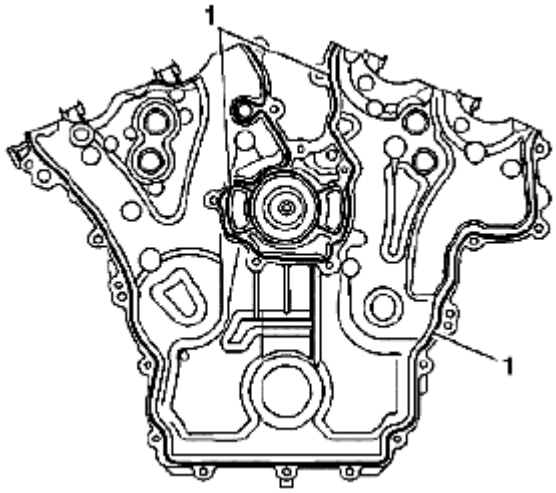


Fig. 842: Identifying Bead On Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover as shown (1).

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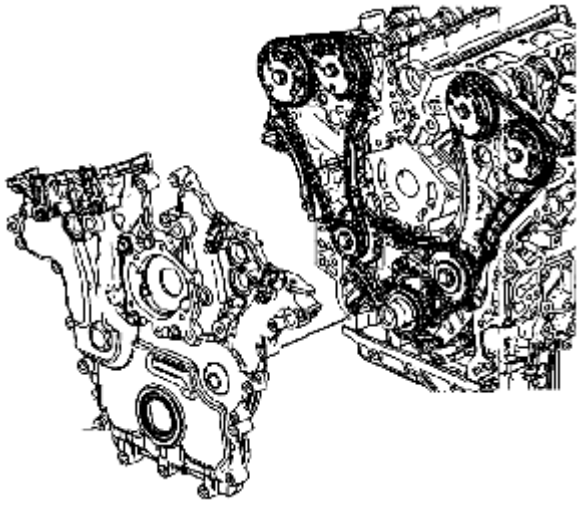


Fig. 843: Identifying Engine Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

4. Place the engine front cover onto the EN 46109 and slide into position.
5. Remove the EN 46109 from the cylinder block.

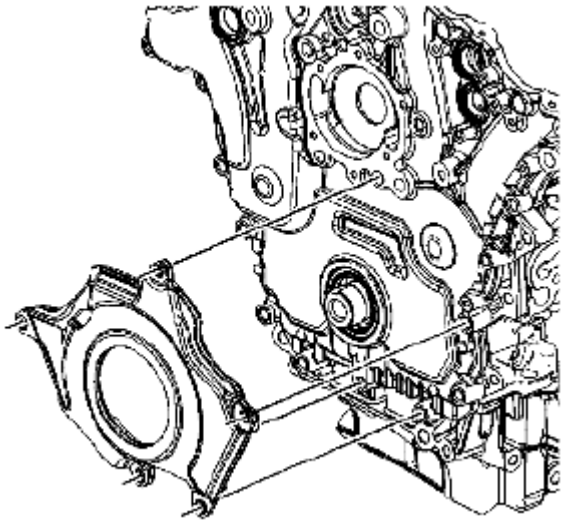


Fig. 844: Identifying Engine Front Cover Deadener
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the engine front cover deadener.

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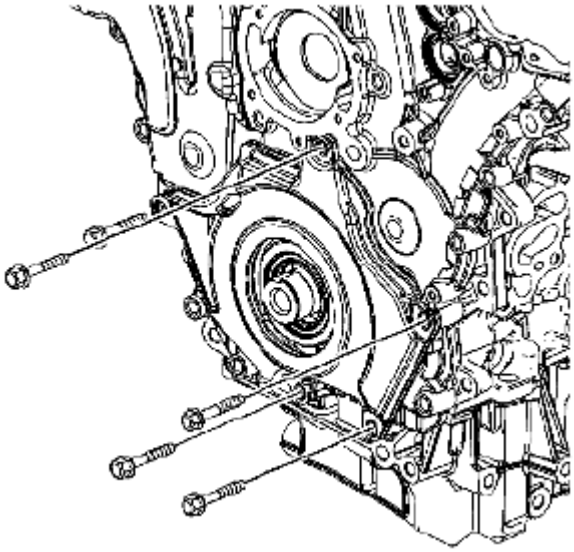


Fig. 845: Identifying Engine Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Loosely install the engine front cover bolts to hold the engine front cover deadener into position.

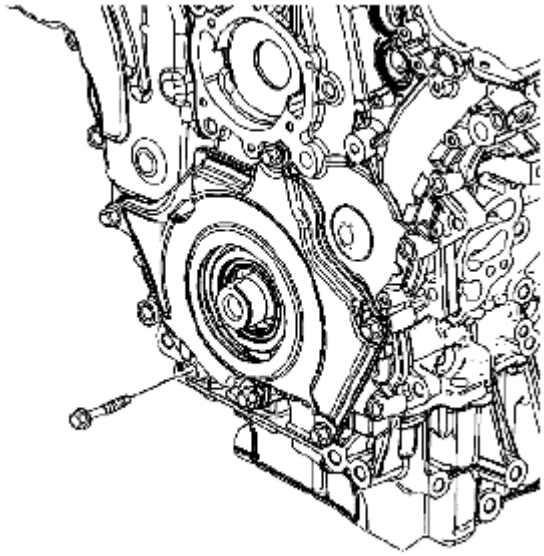


Fig. 846: Identifying Remaining Engine Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

8. Loosely install the remaining engine front cover bolts.

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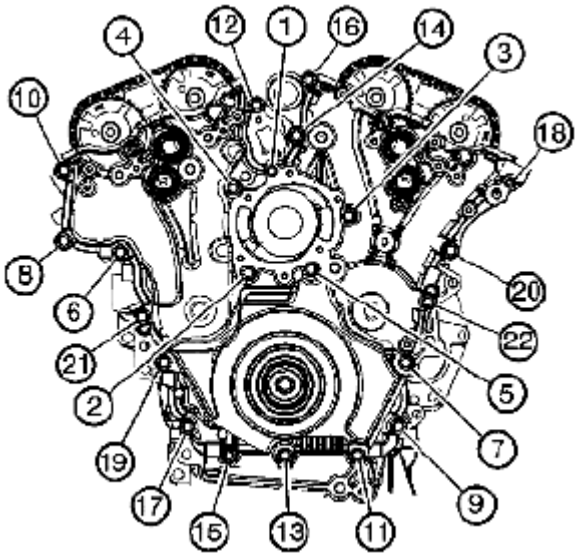


Fig. 847: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE

9. Tighten the engine front cover bolts in the sequence shown (1-22).

   Tightening torque

   1. **Tighten the engine front cover bolts a first pass in sequence to 23 N.m (17 lb ft)** .
   2. **Tighten the engine front cover bolts a second pass in sequence an additional 60 degrees** .

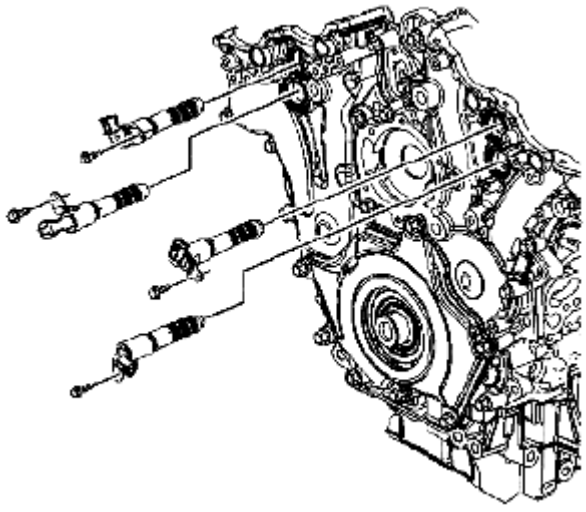


Fig. 848: Identifying Camshaft Position Actuator Valve And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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10. Place the camshaft position actuator valves in position on the front cover.
11. Install the camshaft position actuator valve bolts.

Tightening torque

Tighten the camshaft position actuator valve bolts to 10 N.m (89 lb in) .

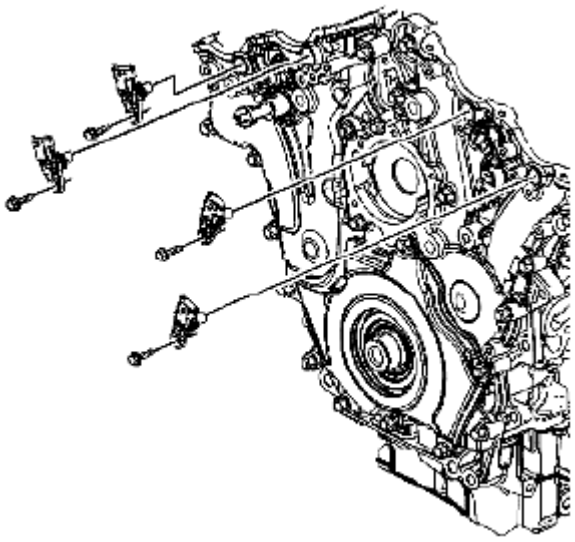


Fig. 849: Identifying Camshaft Position Sensor Bolts
Courtesy of SUZUKI OF AMERICA CORP.

12. Install NEW O-rings on the camshaft position sensor.
13. Place the camshaft position sensors in position on the front cover.
14. Install the camshaft position sensor bolts.

Tightening torque

Tighten the camshaft position sensor bolts to 10 N.m (89 lb in) .

Reference: **WATER PUMP INSTALLATION**

CAMSHAFT COVER INSTALLATION - LEFT SIDE

Reference: **CAMSHAFT COVER ASSEMBLE**

Special Tool

EN 46101 Spark Plug Tube Seal Guide

EN 46105 Camshaft Locking Tool

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For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

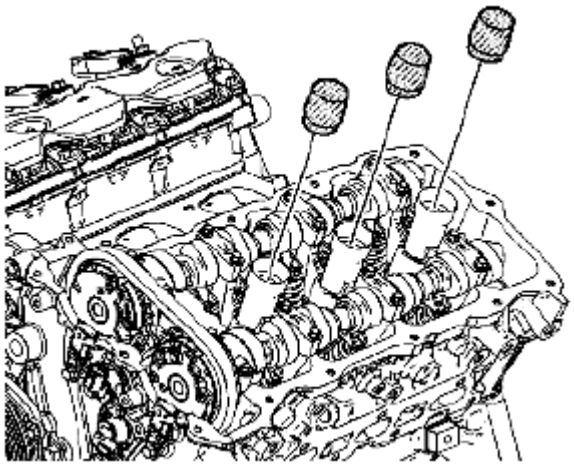


Fig. 850: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the EN 46101 onto the spark plug tubes of the left cylinder head.

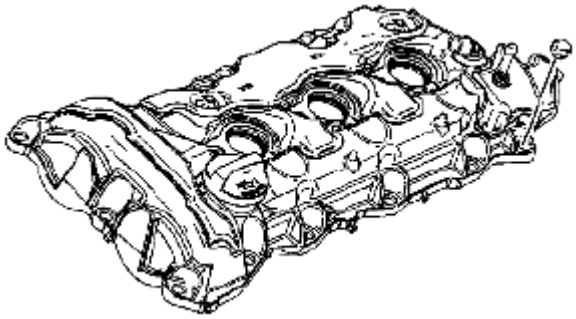


Fig. 851: Identifying Camshaft Cover Bolt Grommets
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the camshaft cover bolt grommets prior to installing the camshaft cover bolts.
3. Wipe the camshaft cover sealing surface on the left cylinder head with a clean, lint-free cloth.

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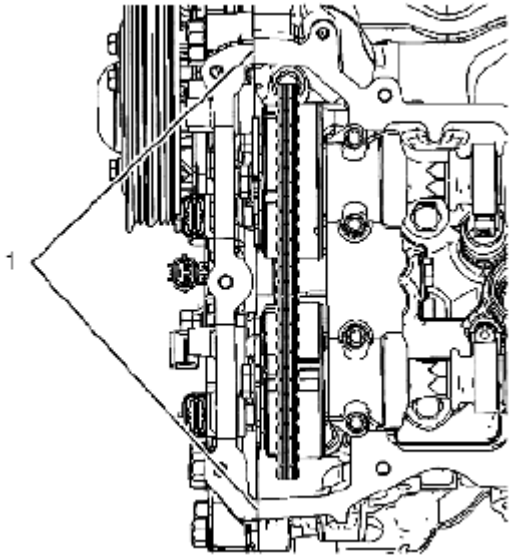


Fig. 852: Identifying Engine Front Cover Split Lines
Courtesy of SUZUKI OF AMERICA CORP.

4. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

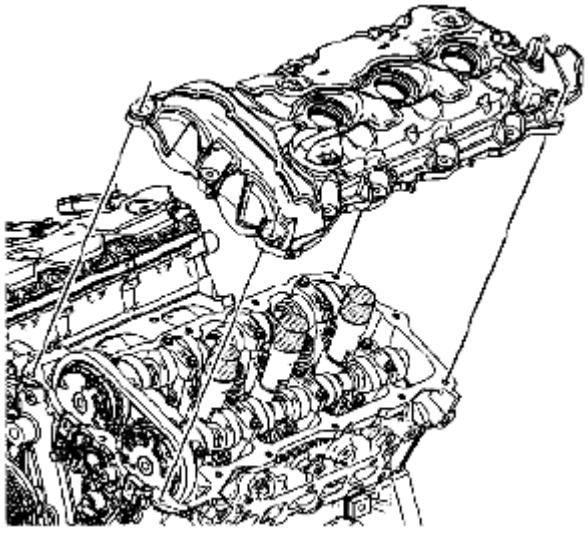


Fig. 853: Identifying Left Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Place the left camshaft cover into position onto the left cylinder head.

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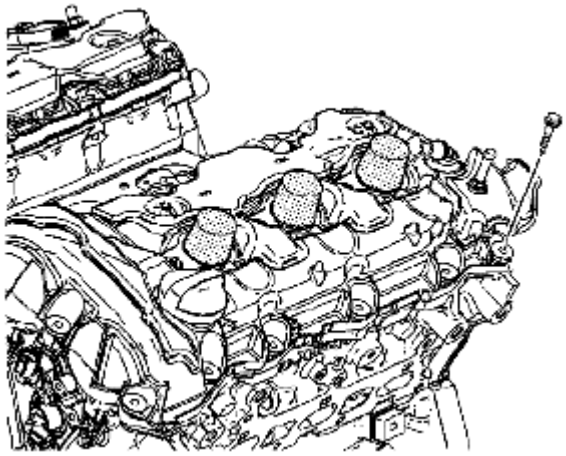


Fig. 854: Identifying Left Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Loosely install the left camshaft cover bolts.

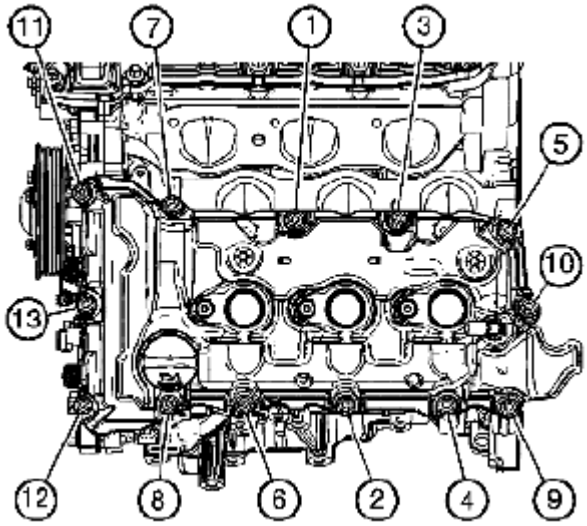


Fig. 855: Identifying Left Camshaft Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

7. Tighten the left camshaft cover bolts in the sequence shown.

Tightening torque

- **Tighten the left camshaft cover bolts in the sequence to 10 N.m (89 lb in)** .
- **Tighten the left camshaft cover bolts a second pass in the sequence to 10 N.m (89 lb in)** .

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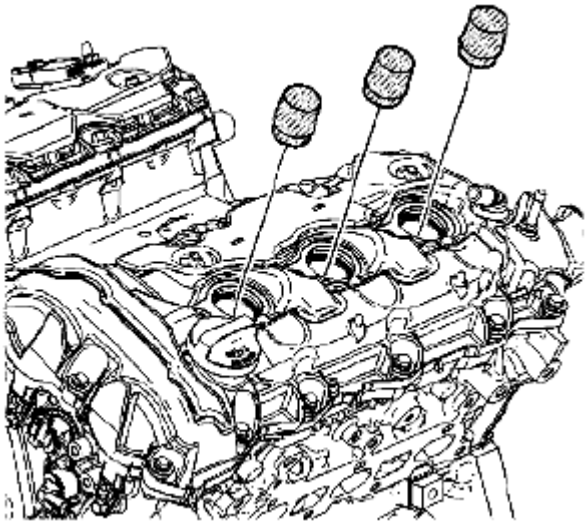


Fig. 856: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EN 46101 from the spark plug tubes of the left cylinder head.

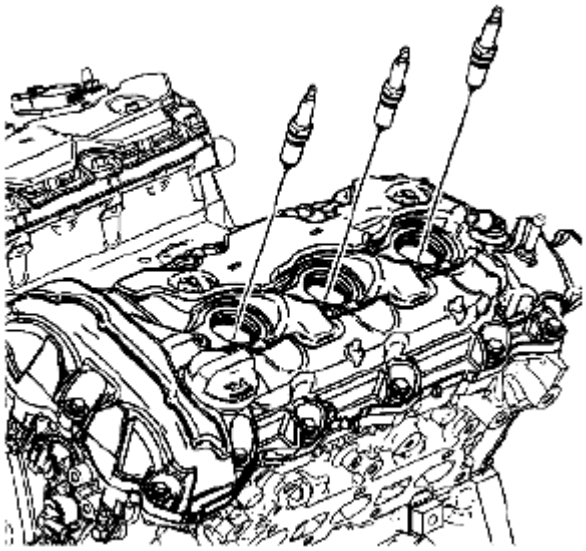


Fig. 857: Identifying Spark Plugs
Courtesy of SUZUKI OF AMERICA CORP.

9. Install the NEW spark plugs into the left cylinder head.

   Tightening torque

   Tighten the spark plugs to 20 N.m (15 lb ft) .

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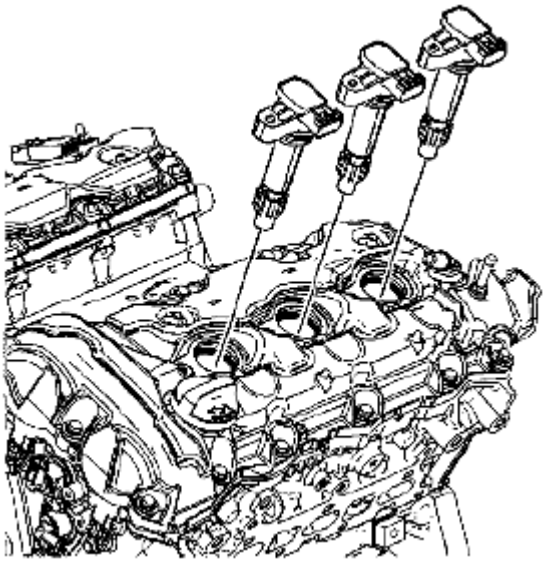


Fig. 858: Identifying Ignition Coils
Courtesy of SUZUKI OF AMERICA CORP.

10. Install the ignition coils.

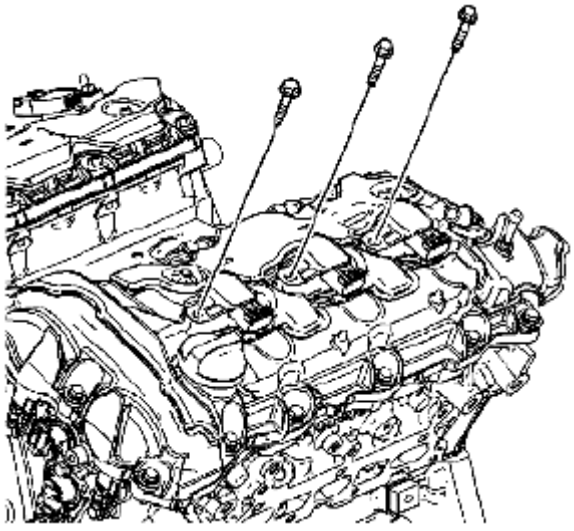


Fig. 859: Identifying Ignition Coil Bolts
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the ignition coil bolts.

Tightening torque

Tighten the ignition coil bolts to 10 N.m (89 lb in) .

Reference: **CAMSHAFT COVER INSTALLATION - RIGHT SIDE**

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CAMSHAFT COVER INSTALLATION - RIGHT SIDE

Reference: **CAMSHAFT COVER ASSEMBLE**

Special Tools

- EN 46101 Spark Plug Tube Seal Guide
- EN-48383 Camshaft Retaining Tools

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

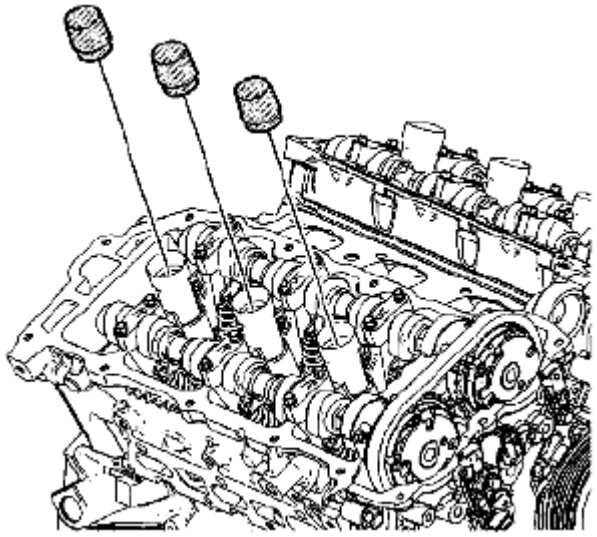


Fig. 860: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the EN 46101 onto the spark plug tubes of the right cylinder head.

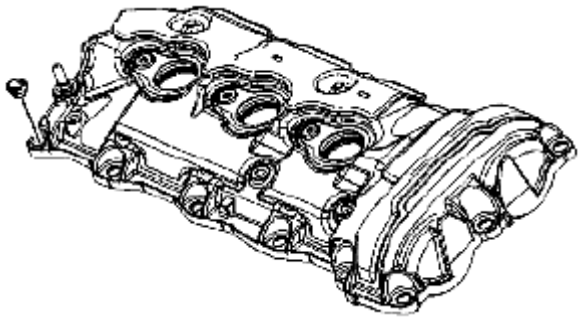


Fig. 861: Identifying Camshaft Cover Bolt Insulators
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the camshaft cover bolt insulators prior to installing the camshaft cover bolts.
3. Wipe the camshaft cover sealing surface on the right cylinder head with a clean, lint-free cloth.

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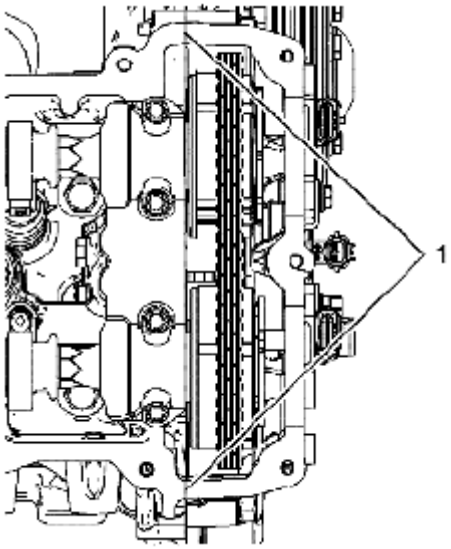


Fig. 862: Identifying Engine Front Cover Split Lines
Courtesy of SUZUKI OF AMERICA CORP.

4. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

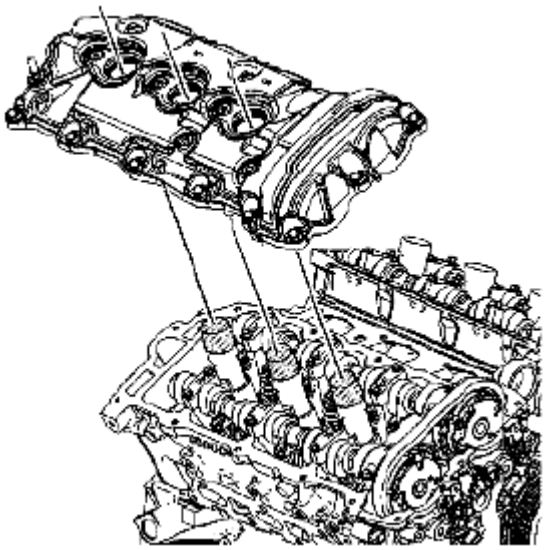


Fig. 863: Identifying Right Camshaft Cover
Courtesy of SUZUKI OF AMERICA CORP.

5. Place the right camshaft cover into position onto the right cylinder head.

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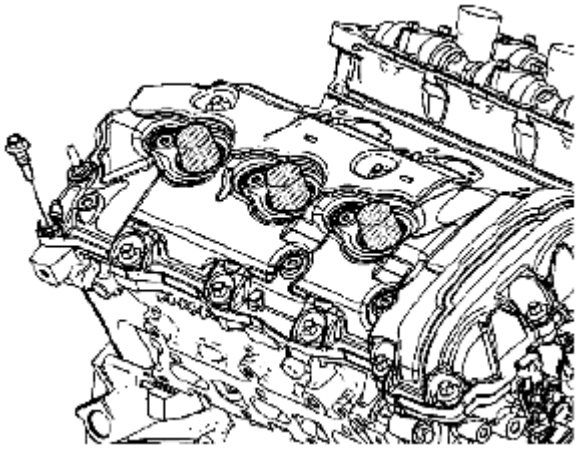


Fig. 864: Identifying Right Camshaft Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

6. Loosely install the right camshaft cover bolts.

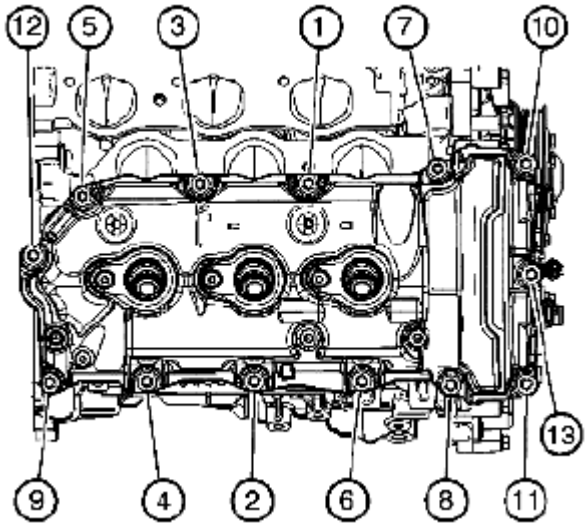


Fig. 865: Identifying Right Camshaft Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

7. Tighten the right camshaft cover bolts in the sequence shown.

Tightening torque

1. **Tighten the right camshaft cover bolts in the sequence to 10 N.m (89 lb in)** .
2. **Tighten the right camshaft cover bolts a second pass in the sequence to 10 N.m (89 lb in)** .

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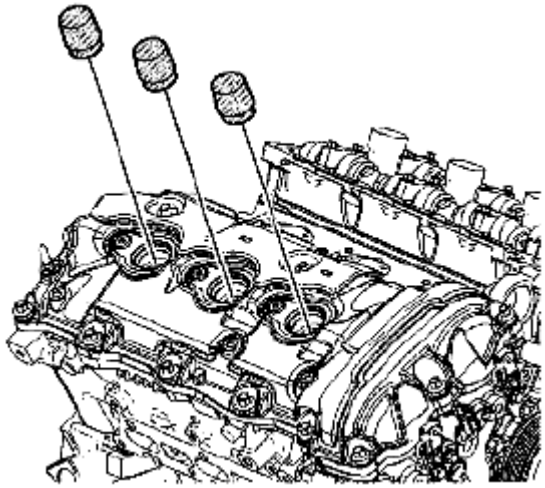


Fig. 866: Identifying Special Tool EN 46101
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the EN 46101 from the spark plug tubes of the right cylinder head.

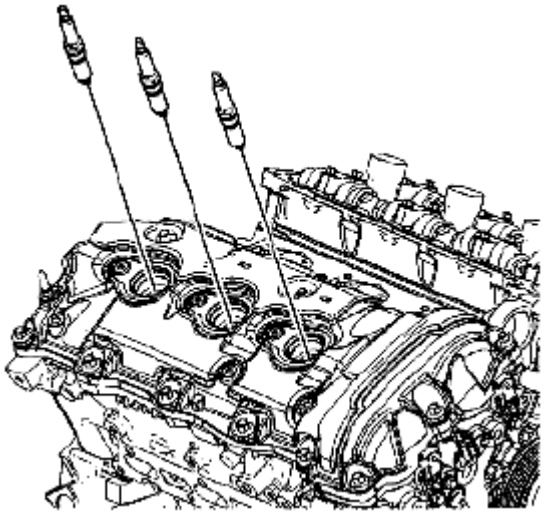


Fig. 867: Identifying Spark Plugs
Courtesy of SUZUKI OF AMERICA CORP.

9. Install the NEW spark plugs into the right cylinder head.

   Tightening torque

   Tighten the spark plugs to 20 N.m (15 lb ft) .

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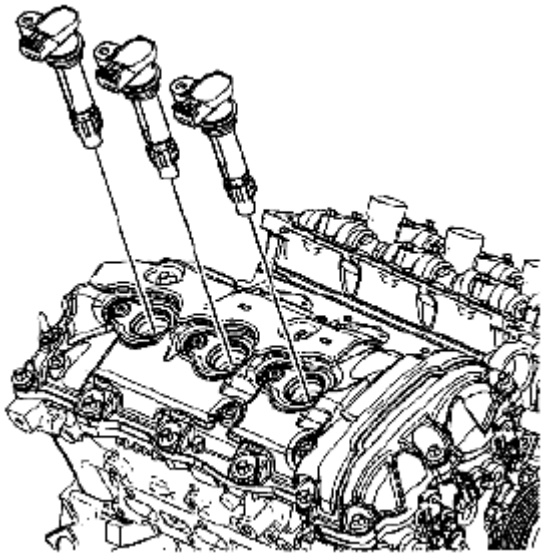


Fig. 868: Identifying Ignition Coils
Courtesy of SUZUKI OF AMERICA CORP.

10. Install the ignition coils.

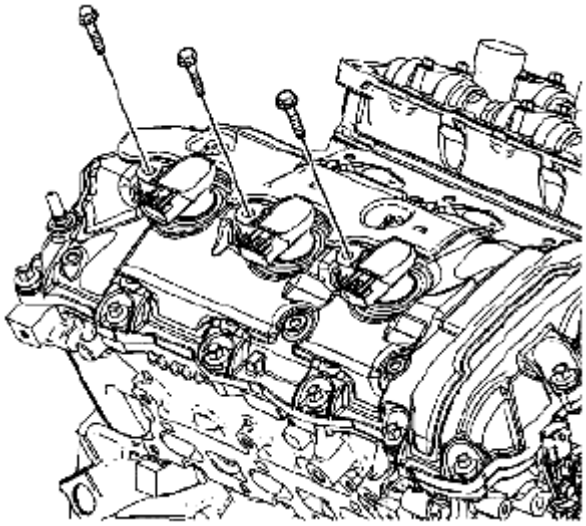


Fig. 869: Identifying Ignition Coil Bolts
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the ignition coil bolts.

    Tightening torque

    Tighten the ignition coil bolt to 10 N.m (89 lb in) .

    Reference: **INTAKE MANIFOLD INSTALLATION**

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INTAKE MANIFOLD INSTALLATION

Reference: **INTAKE MANIFOLD ASSEMBLE**

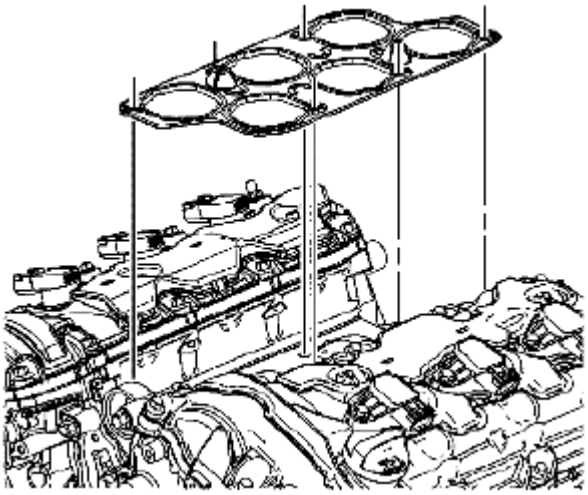


Fig. 870: Identifying Lower Intake Manifold Gasket
Courtesy of SUZUKI OF AMERICA CORP.

1. Install the NEW lower intake manifold gasket.

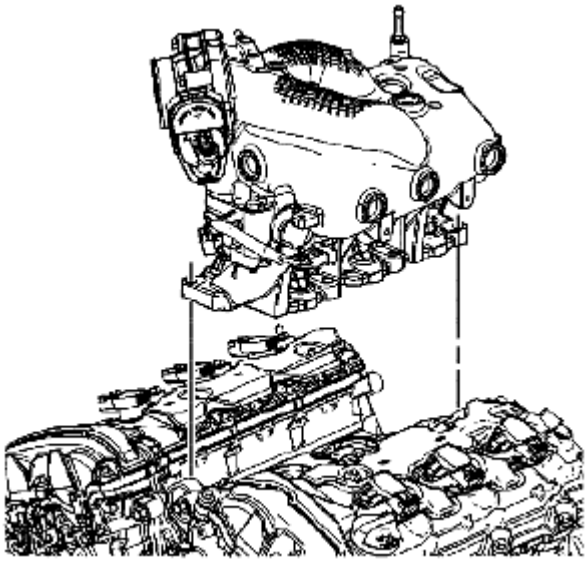


Fig. 871: Identifying Intake Manifold Assembly
Courtesy of SUZUKI OF AMERICA CORP.

2. Install the intake manifold assembly.

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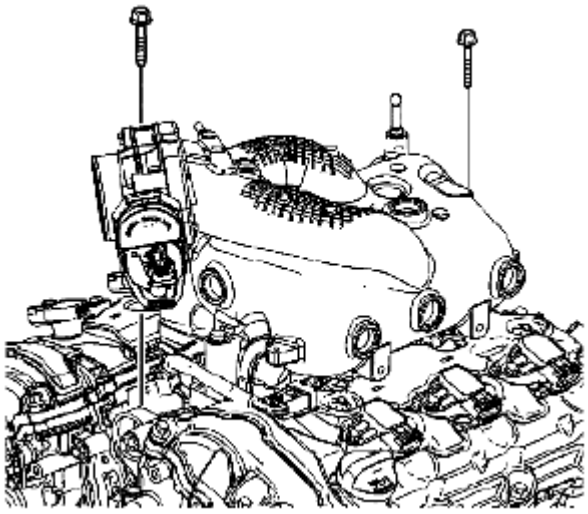


Fig. 872: Identifying Short Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

3. Loosely install the short intake manifold bolts.

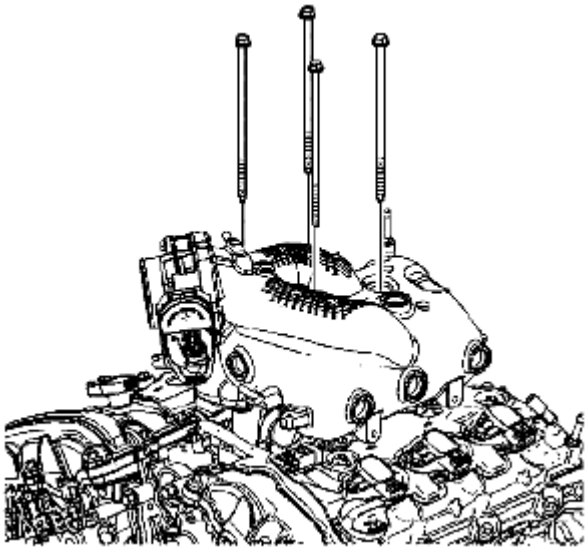


Fig. 873: Identifying Long Intake Manifold Bolts
Courtesy of SUZUKI OF AMERICA CORP.

4. Loosely install the long intake manifold bolts.

Tightening torque

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Tighten all of the intake manifold bolts to 23 N.m (17 lb ft) .

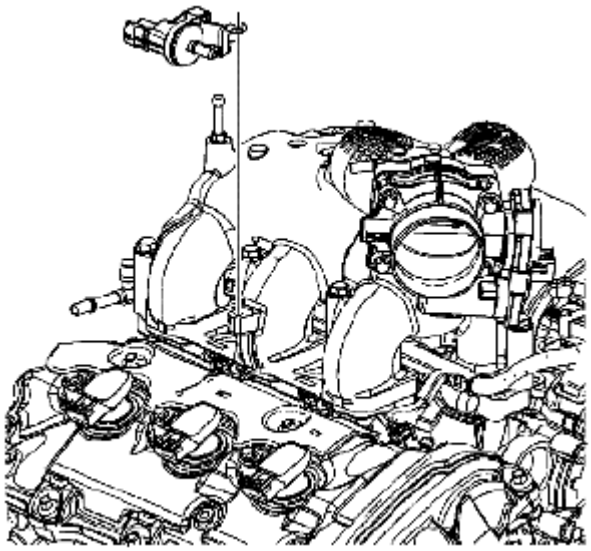


Fig. 874: Identifying Evaporative Emissions Solenoid
Courtesy of SUZUKI OF AMERICA CORP.

5. Install the evaporative emissions (EVAP) solenoid.

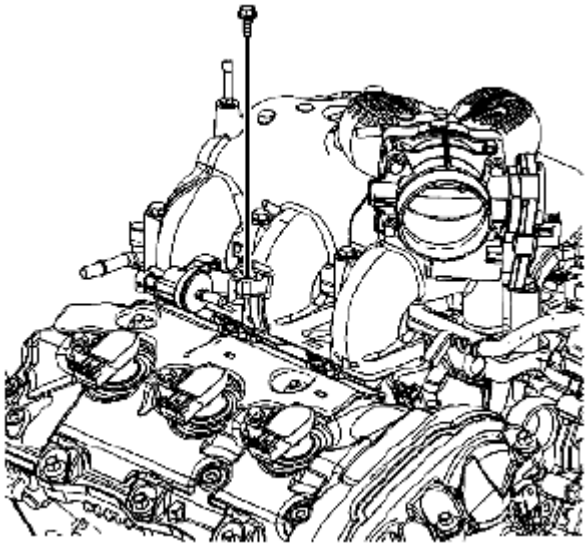


Fig. 875: Identifying EVAP Solenoid Bolt
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the EVAP solenoid bolt

Tightening torque

Tighten the EVAP solenoid bolt to 10 N.m (89 lb in) .

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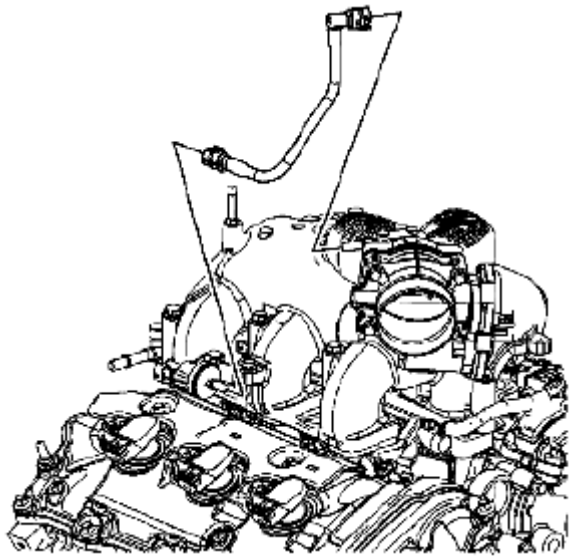


Fig. 876: Identifying Intake Manifold-To-Solenoid EVAP Hose
Courtesy of SUZUKI OF AMERICA CORP.

7. Install and connect the intake manifold-to-solenoid EVAP hose to the intake manifold and to the EVAP solenoid.

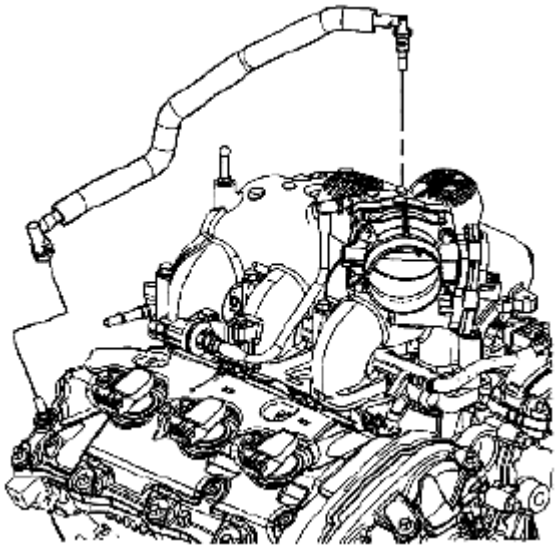


Fig. 877: Identifying Dirty Air Positive Crankcase Ventilation Hose
Courtesy of SUZUKI OF AMERICA CORP.

8. Install and connect the dirty air Positive Crankcase Ventilation (PCV) hose to the intake manifold and to the right camshaft cover fitting.

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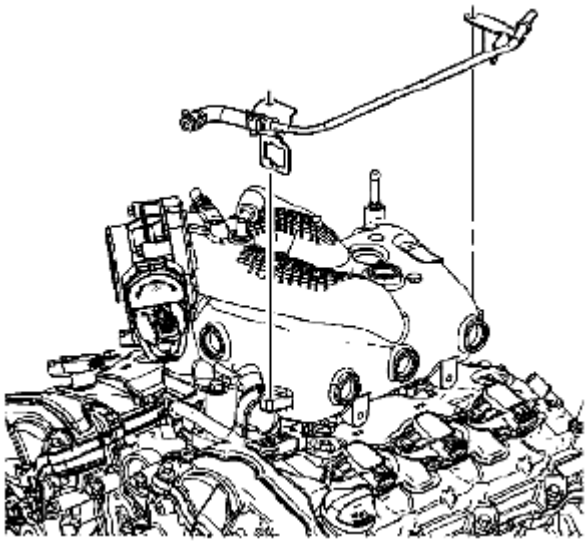


Fig. 878: Identifying Engine Coolant Air Bleed Pipe
Courtesy of SUZUKI OF AMERICA CORP.

9. Install the engine coolant air bleed pipe.

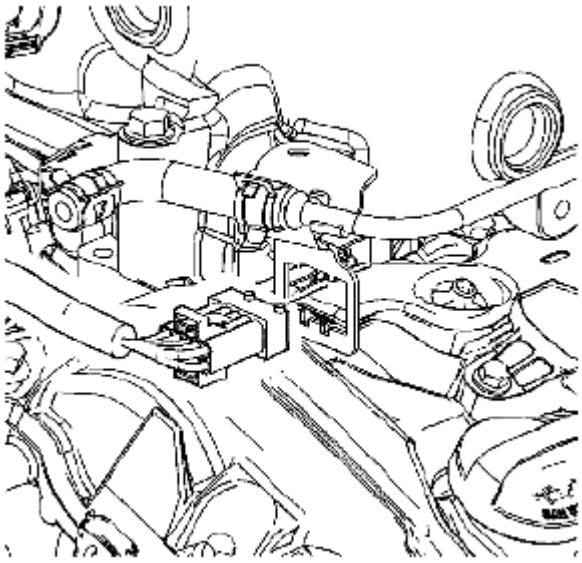


Fig. 879: Identifying Fuel Injector Harness Connector
Courtesy of SUZUKI OF AMERICA CORP.

10. Install the fuel injector harness connector to the engine coolant air bleed pipe bracket.

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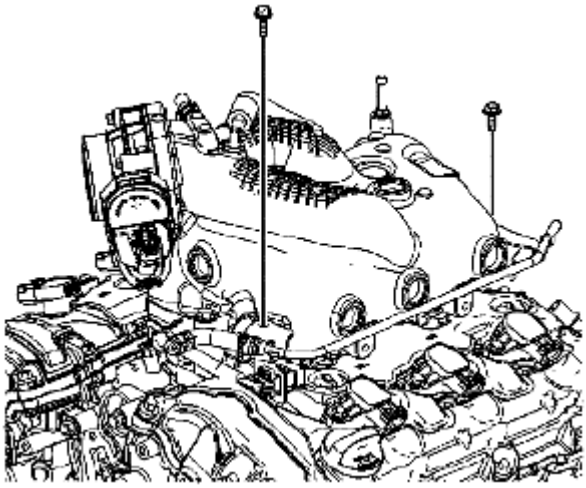


Fig. 880: Identifying Engine Coolant Air Bleed Pipe Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the engine coolant air bleed pipe bracket bolts to the upper intake manifold.

    Tightening torque

    Tighten the engine coolant air bleed pipe bracket bolts to 10 N.m (89 lb in) .

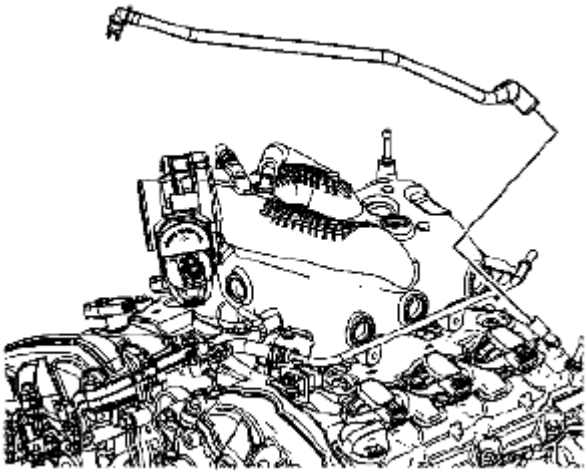


Fig. 881: Identifying Fresh Air PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

12. Install and connect the fresh air PCV hose to the left camshaft cover fitting.

    Reference: **ENGINE FLYWHEEL INSTALLATION**

ENGINE FLYWHEEL INSTALLATION

Reference: **ENGINE FLYWHEEL CLEANING AND INSPECTION**

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Special Tool

EN 46106 Engine Flywheel Holding Tool

J 45059 Angle Meter

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

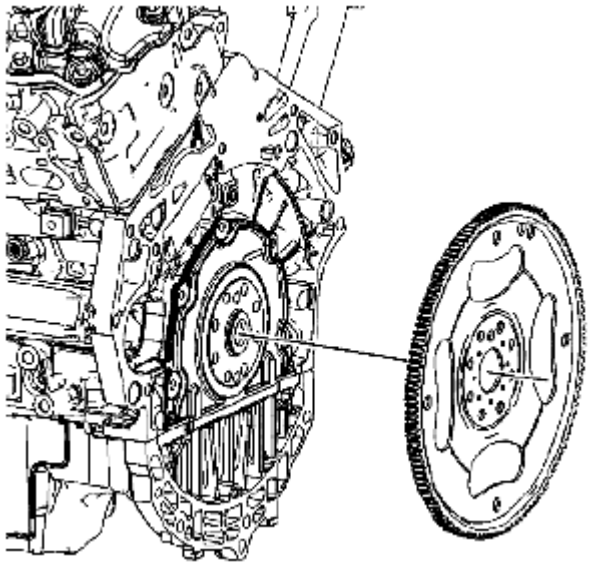


Fig. 882: Identifying Engine Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

1. Place the engine flywheel in position on the crankshaft.

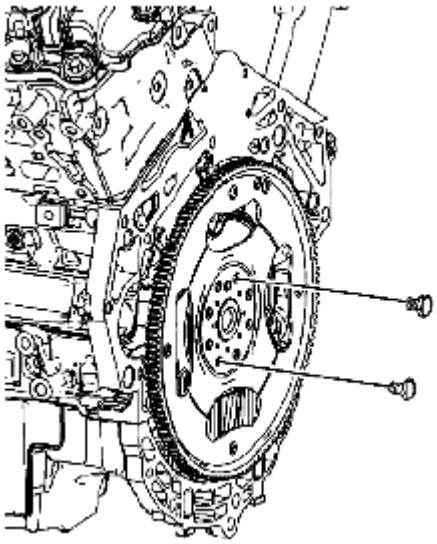


Fig. 883: Identifying Engine Flywheel Bolts Install Pattern
Courtesy of SUZUKI OF AMERICA CORP.

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2. Install 2 NEW bolts in location at the top and bottom of the engine flywheel bolt pattern allowing the engine flywheel to hang in position.

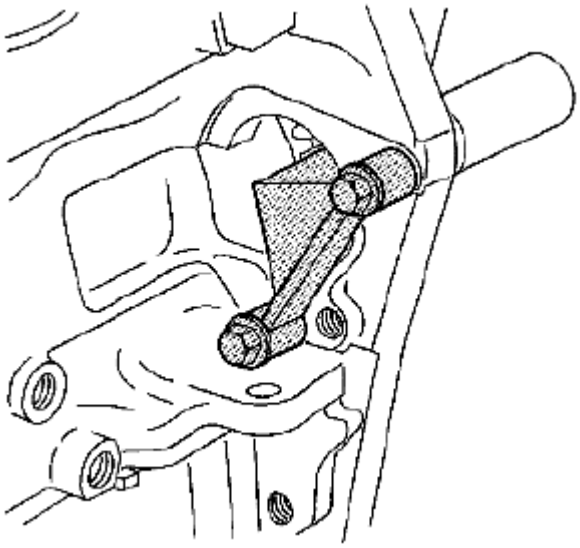


Fig. 884: Identifying Special Tools EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the EN 46106.

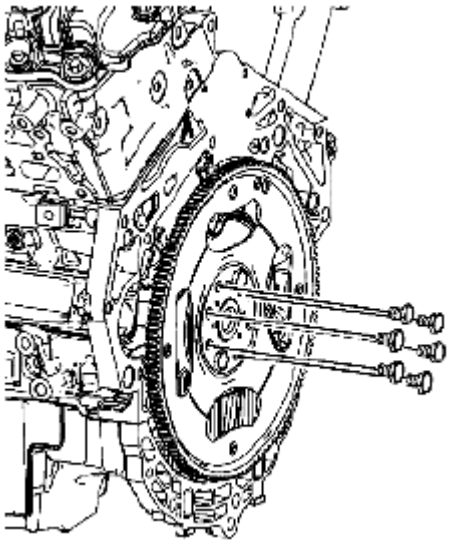


Fig. 885: Identifying Engine Flywheel Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

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4. Install the remaining NEW engine flywheel bolts.

   Tightening torque

   1. **Tighten the NEW engine flywheel bolts to 30 N.m (22 lb ft)** .
   2. **Tighten the NEW engine flywheel bolts an additional 45 degrees using the J 45059** .

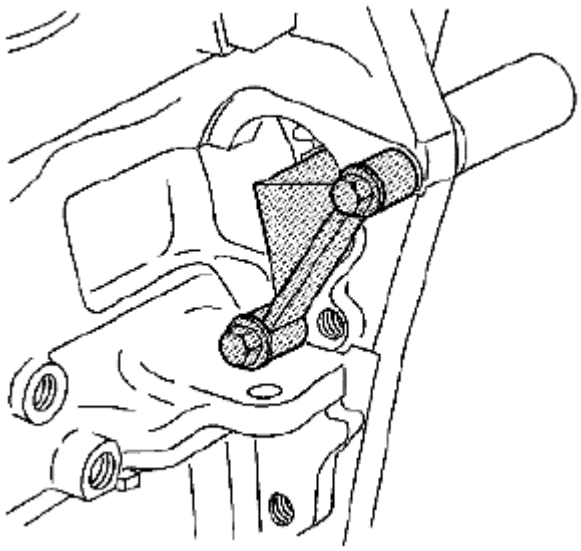


Fig. 886: Identifying Special Tools EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove the EN 46106.

   Reference: **CRANKSHAFT BALANCER INSTALLATION**

CRANKSHAFT BALANCER INSTALLATION

Reference: **CRANKSHAFT BALANCER CLEANING AND INSPECTION**

Special Tool

EN 46106 Engine Flywheel Holding Tool

J 41998-B Crankshaft Balancer Installer

J 45059 Angle Meter

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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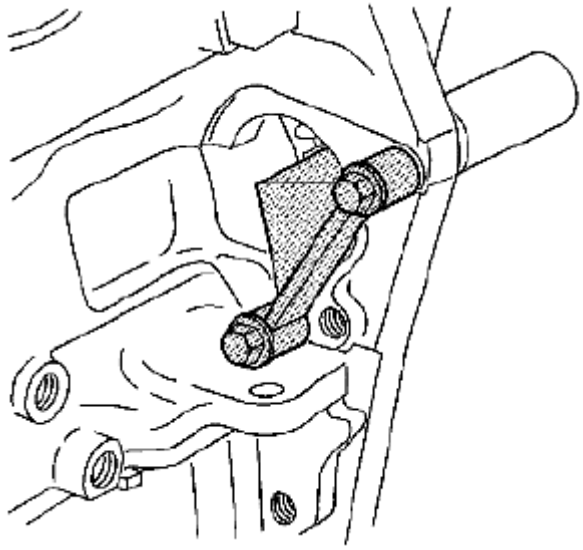


Fig. 887: Identifying Special Tools EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

1. The EN 46106 must be installed onto the flywheel.
2. Use the J 41998-B, nut, bearing and washer to install the crankshaft balancer.

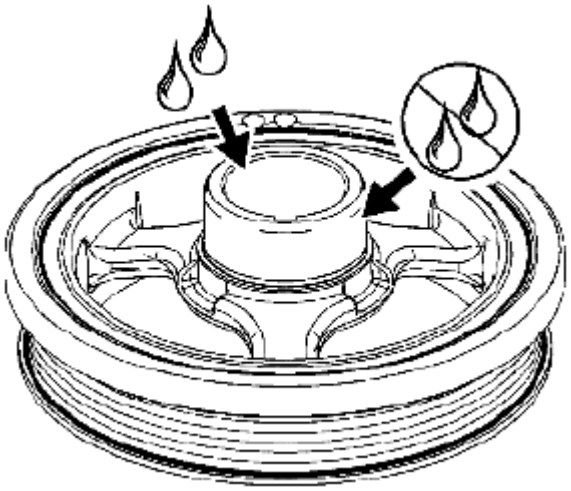


Fig. 888: Applying Lubricant To Inside Of Crankshaft Balancer Hub Bore
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

3. Apply lubricant to the inside of the crankshaft balancer hub bore.

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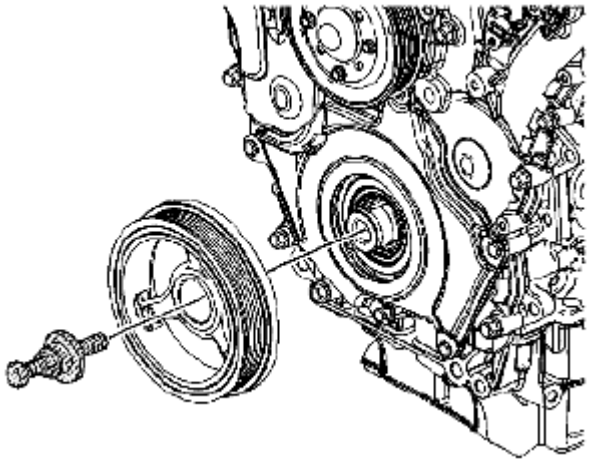


Fig. 889: Identifying Special Tools J 41998-B
Courtesy of SUZUKI OF AMERICA CORP.

4. Place the crankshaft balancer in position on the crankshaft.
5. Thread the J 41998-B in the crankshaft. Ensure you engage at least 10 threads of the J 41998-B before pressing the crankshaft balancer in place.
6. Push the crankshaft balancer into position by tightening the nut on the J 41998-B until the large washer bottoms out on the crankshaft end.
7. Remove the J 41998-B.

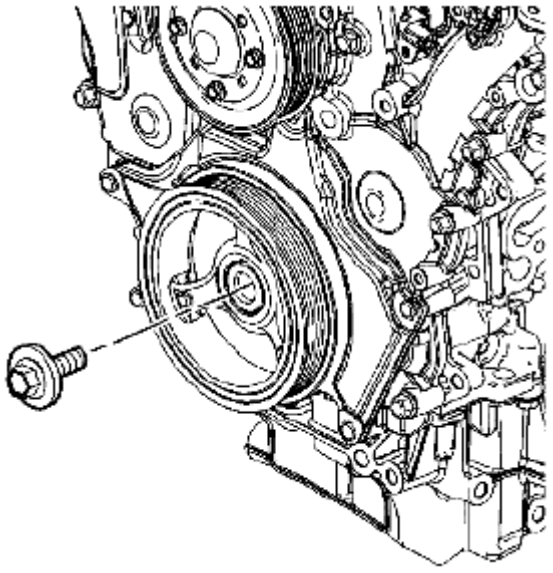


Fig. 890: Identifying Crankshaft Balancer Bolt
Courtesy of SUZUKI OF AMERICA CORP.

8. Install the crankshaft balancer bolt.

CAUTION: Refer to FASTENER NOTICE .

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9. Tighten the crankshaft balancer bolt.

   Tightening torque

   1. **Tighten the crankshaft balancer bolt to 100 N.m (74 lb ft)** .
   2. **Tighten the crankshaft balancer bolt an additional 150 degrees using the J 45059** .

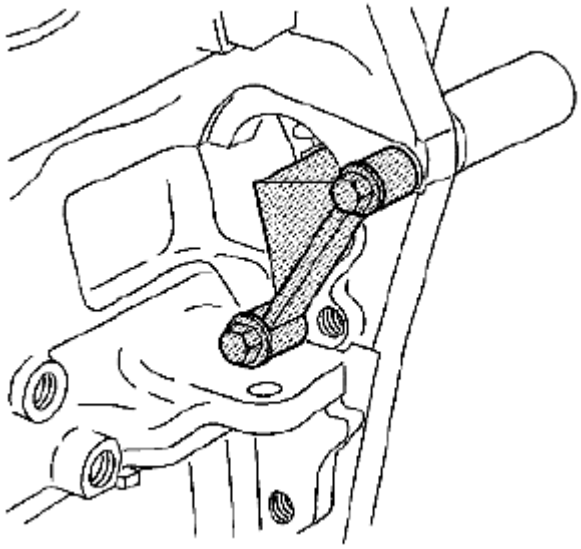


Fig. 891: Identifying Special Tools EN 46106
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the EN 46106.

    Reference: **EXHAUST MANIFOLD INSTALLATION - LEFT SIDE**

DRIVE BELT IDLER PULLEY INSTALLATION

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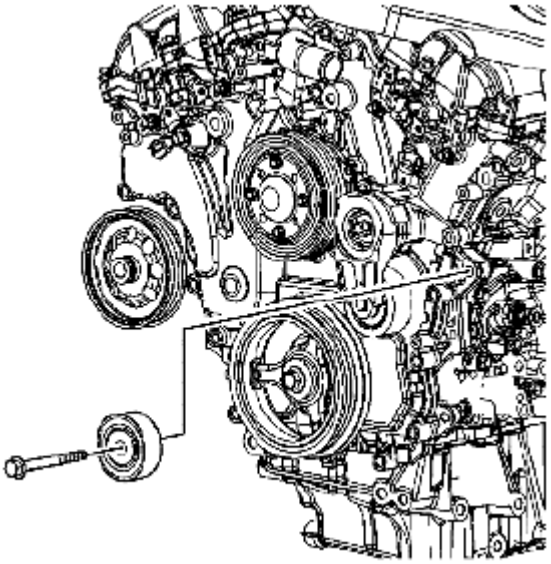


Fig. 892: Identifying Drive Belt Idler Pulley And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

1. Place the drive belt idler pulley and bolt in position through the generator mounting hole and into the engine front cover.

   CAUTION: Refer to FASTENER NOTICE .

2. Install the drive belt idler pulley bolt.

   Tightening torque

   Tighten the drive belt idler pulley bolt to 50 N.m (37 lb ft) .

3. Tighten the generator bolts.

   Tightening torque

   Tighten the generator bolts to 50 N.m (37 lb ft) .

   Reference: **DRIVE BELT TENSIONER INSTALLATION**

DRIVE BELT TENSIONER INSTALLATION

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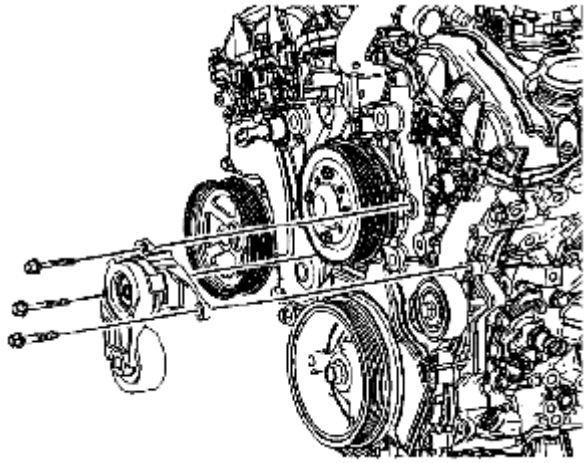


Fig. 893: Identifying Left Drive Belt Tensioner Bracket And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

1. Place the left drive belt tensioner assembly in position to the engine front cover.

   CAUTION: Refer to FASTENER NOTICE .

2. Install the left drive belt tensioner bracket bolts.

   Tightening torque

   Tighten the left drive belt tensioner bracket bolts to 23 N.m (17 lb ft) .

ENGINE PRELUBING

Special Tools

- EN-47971 Oil Pressure Gage Adapter
- J 45299 Engine Preluber

For equivalent regional tools, refer to **SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)**.

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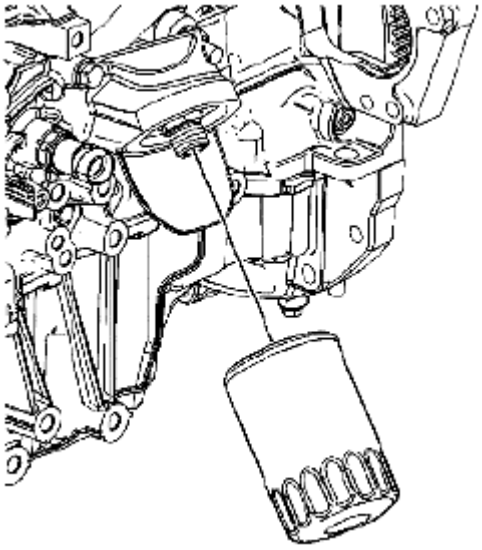


Fig. 894: Identifying Engine Oil Filter
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Ensure the oil cooler lines are disconnected and the oil filter adapter oil cooler line ports are blocked in order to direct the oil from the engine preluber into the engine.

1. Remove the engine oil filter.

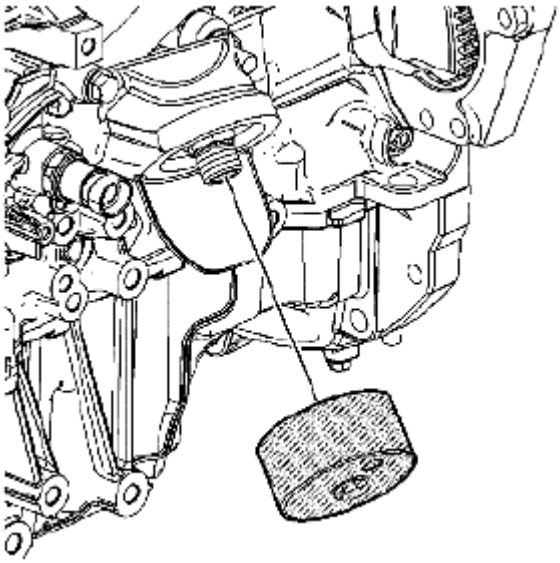


Fig. 895: Identifying Special Tools EN 47971
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Special new tool EN 47971 must be used. Due to the special size and thread pitch of the oil filter adapter fitting ensure the proper tool is

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used or component damage will result.

2. Install the EN-47971 onto the oil filter adapter.

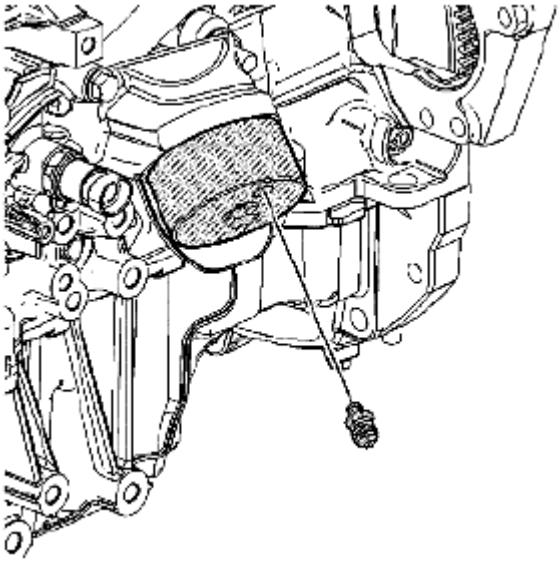


Fig. 896: Identifying 1/8 NPT Fitting
Courtesy of SUZUKI OF AMERICA CORP.

3. Install the 1/8 NPT fitting from the J 45299 into the port on the EN-47971.

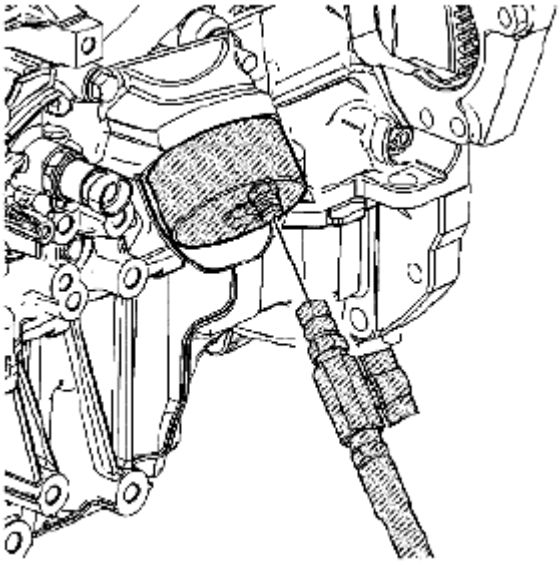


Fig. 897: Identifying J 45299 Flexible Hose
Courtesy of SUZUKI OF AMERICA CORP.

4. Install the J 45299 flexible hose to the fitting.

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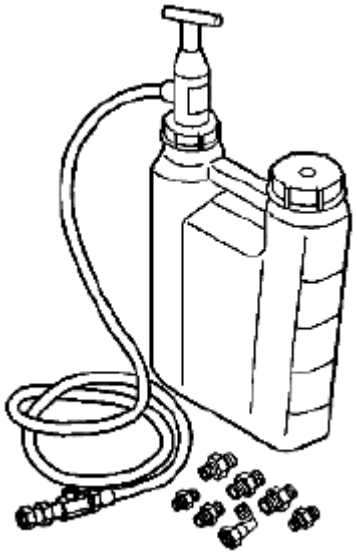


Fig. 898: Identifying Special Tools J 45299
Courtesy of SUZUKI OF AMERICA CORP.

5. Open the valve of the J 45299.

NOTE: A constant and continuous flow of clean engine oil is required in order to properly prime the engine. Use the approved engine oil as specified in the owner's manual.

6. Pump the handle of the J 45299 in order to flow a minimum of 1-1.9 liters (1-2 quarts) of fresh clean engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
7. Close the valve of the J 45299.

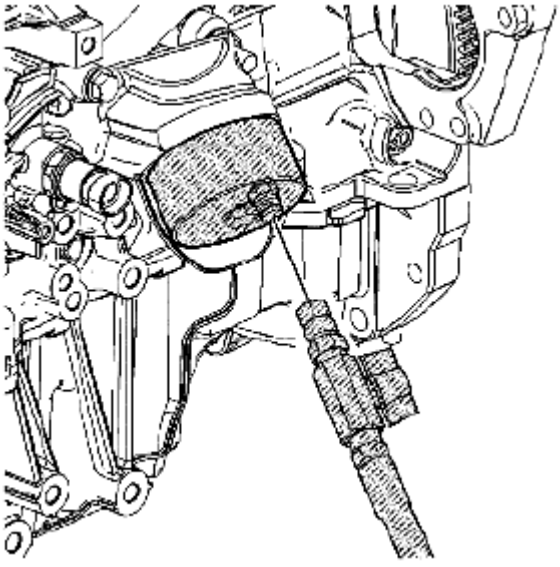


Fig. 899: Identifying J 45299 Flexible Hose

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Courtesy of SUZUKI OF AMERICA CORP.

8. Remove the J 45299 flexible hose.

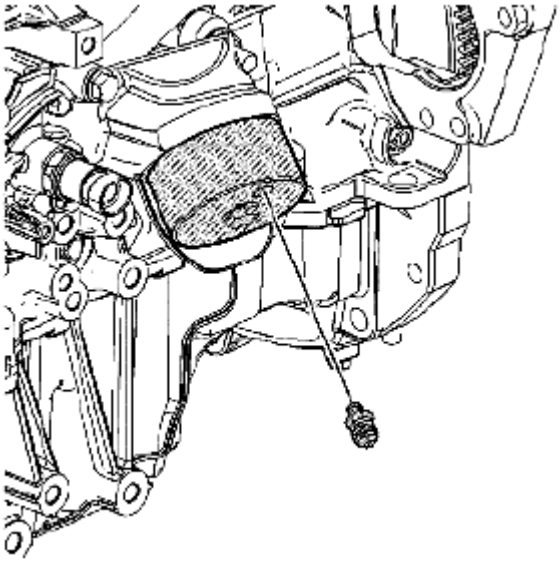


Fig. 900: Identifying Fitting
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove the fitting from the EN-47971.

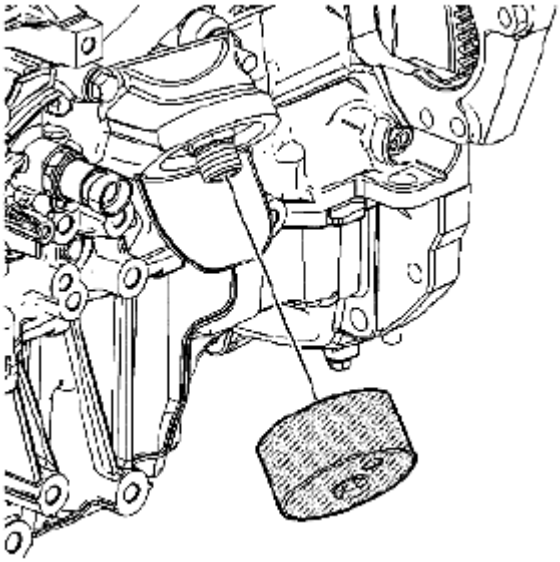


Fig. 901: Identifying Special Tools EN-47971
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove the EN-47971 from the oil filter adapter.

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CAUTION: This engine uses a special high performance oil filter. Use of any other filter may lead to filter failure and/or severe engine damage.

11. Ensure the NEW oil filter is filled with clean fresh engine oil.

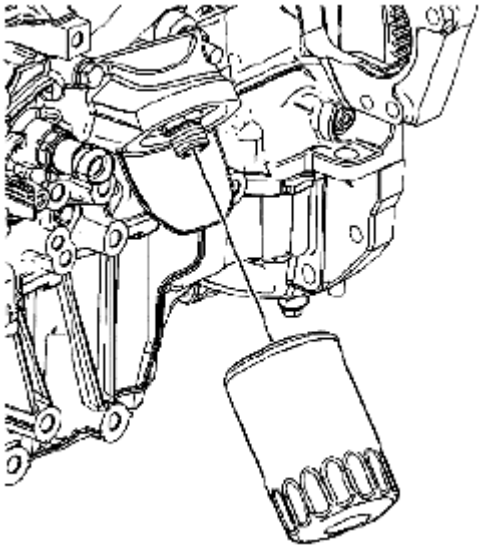


Fig. 902: Identifying Oil Filter
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Refer to FASTENER NOTICE .

12. Install the NEW oil filter.

Tightening torque

Tighten the oil filter to 30 N.m (22 lb ft) .

SPECIFICATION

FASTENER TIGHTENING SPECIFICATIONS - ENGINE MECHANICAL - 3.6L (LY7)

FASTENER TIGHTENING SPECIFICATIONS - ENGINE MECHANICAL - 3.6L (LY7)

Application	Specification	
	Metric	English
Camshaft Position Actuator		
Camshaft Bolt	58 N.m	43 lb ft
Oil Control Valve Bolt	10 N.m	89 lb in
Camshaft Cap Bolt	10 N.m	89 lb in
Camshaft Cover Bolt	10 N.m	89 lb in

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Camshaft Intermediate Drive Sprocket Bolt - Idler Sprocket	58 N.m	43 lb ft
Camshaft Position Sensor Bolt	10 N.m	89 lb in
Connecting Rod Bolt		
First Pass	30 N.m	22 lb ft
Second Pass - Counterclockwise	Back Off to Zero	
Third Pass	25 N.m	18 lb ft
Final Pass	110 Degrees	
Coolant Pipe Bolt	10 N.m	89 lb in
Crankshaft Balancer Bolt		
First Pass	100 N.m	74 lb ft
Final Pass	150 Degrees	
Crankshaft Main Bearing Bolt		
Inner		
First Pass	20 N.m	15 lb ft
Final Pass	80 degrees	
Outer		
First Pass	15 N.m	10 lb ft
Final Pass	110 Degrees	
Side		
First Pass	30 N.m	22 lb ft
Final Pass	60 Degrees	
Crankshaft Position Sensor Bolt	10 N.m	89 lb in
Crankshaft Position Sensor/Right Exhaust Manifold Lower Heat Shield		
Bolt	50 N.m	37 lb ft
Crankshaft Rear Oil Seal Housing Bolt	10 N.m	89 lb in
Cylinder Head Bolt - M8		
First Pass	15 N.m	10 lb ft
Final Pass	75 Degrees	
Cylinder Head Bolt - M11		
First Pass	30 N.m	22 lb ft
Final Pass	150 degrees	
Cylinder Head Core Hole Plug	75 N.m	55 lb ft
Drive Belt		
Idler Pulley Bolt	50 N.m	37 lb ft
Tensioner Bracket Bolt	23 N.m	17 lb ft
Engine Coolant Air Bleed Pipe Bracket Bolt	10 N.m	89 lb in
Engine Coolant Temperature (ECT) Sensor	22 N.m	16 lb ft
Engine Flywheel Bolt		

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First Pass	30 N.m	22 lb ft
Final Pass	45 Degrees	
Engine Front Cover Bolt		
First Pass	20 N.m	14 lb ft
Final Pass	60 Degrees	
Engine Mount Bolt	50 N.m	37 lb ft
Engine Mount Bracket Bolt - Upper Right	110 N.m	81 lb ft
Engine Mount Bracket Bolts	50 N.m	37 lb ft
Engine Mount Bracket Nuts	50 N.m	37 lb ft
Engine Mount Strut Bolts	25 N.m	18 lb ft
Engine Mount Strut Bracket Bolts	25 N.m	18 lb ft
Engine Mount Strut Bracket Nuts	110 N.m	81 lb ft
Engine Mount Strut Nuts	110 N.m	81 lb ft
Engine Wiring Harness Bracket		
Bolt	25 N.m	18 lb ft
Nut	13 N.m	115 lb in
Evaporative (EVAP) Purge Valve Bolt	10 N.m	89 lb in
Frame-to-Body Bolt	155 N.m	114 lb ft
Fuel Injector Sight Shield Cover Ball Stud	10 N.m	89 lb in
Fuel Rail Bolt	10 N.m	89 lb in
Ignition Coil Bolt	10 N.m	89 lb in
Intake Manifold		
Upper-to-Cylinder Head Bolt - Long	23 N.m	17 lb ft
Upper-to-Cylinder Head Bolt - Short	23 N.m	17 lb ft
Upper-to-Lower Intake Manifold Bolt	23 N.m	17 lb ft
Knock Sensor Bolt	23 N.m	17 lb ft
M14 Left Side Coolant Drain Threaded Plug	31 N.m	23 lb ft
Oil Filter	30 N.m	22 lb ft
Oil Gallery Plug	31 N.m	23 lb ft
Piston Oil Cooling Nozzle Bolt	10 N.m	89 lb in
Primary Camshaft Drive Chain		
Left Lower Guide Bolt - Oil Pump - Second Design	23 N.m	17 lb ft
Tensioner Bolt	23 N.m	17 lb ft
Upper Guide Bolt	23 N.m	17 lb ft

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Rear Engine Mount Bolts	50 N.m	37 lb ft
Secondary Camshaft Drive Chain		
Guide Bolt	23 N.m	17 lb ft
Shoe Bolt	23 N.m	17 lb ft
Tensioner Bolt	23 N.m	17 lb ft
Spark Plug	20 N.m	15 lb ft
Steering Intermediate Shaft Pinch Bolt	34 N.m	25 lb ft
Throttle Body Bolt	10 N.m	89 lb in
Torque Converter Bolt	60 N.m	44 lb ft
Transmission		
Brace Bolt	50 N.m	37 lb ft
To Engine Bolt	75 N.m	55 lb ft
Upper Intake Manifold Bolts	25 N.m	18 lb ft
Wiring Harness Ground to Cylinder Head Bolt	10 N.m	89 lb in

FASTENER TIGHTENING SPECIFICATIONS - ENGINE CONTROLS - 3.6L (LY7)

FASTENER TIGHTENING SPECIFICATIONS - ENGINE CONTROLS - 3.6L (LY7)

Application	Specification	
	Metric	English
Air Cleaner Bolt	10 N.m	89 lb in
Air Cleaner Outlet Duct Clamp	4 N.m	35 lb in
Knock Sensor Bolt	23 N.m	17 lb ft
Throttle Body Bolt	10 N.m	89 lb in

ENGINE MECHANICAL SPECIFICATIONS

ENGINE MECHANICAL SPECIFICATIONS

Application	Specification	
	Metric	English
General		
Engine Type	V-6	
Displacement	3.6 Liter	217 cu in
RPO	LY7	
VIN	7	
Bore	94 mm	3.7008 in
Stroke	85.6 mm	3.37 in
Compression Ratio	10.2:1	
Cranking RPM - at 40 °C (104 °F)	80 RPM	
Idle Speed	600 A/C Off - 700 A/C On	

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Firing Order	1-2-3-4-5-6	
Spark Plug Gap	1.1 mm	0.0433 in
Block		
Crankshaft Main Bearing Bore Diameter	72.867-72.881 mm	2.8688-2.8693 in
Cylinder Bore Diameter	93.992-94.008 mm	3.7005-3.7011 in
Cylinder Bore Out-of-Round - Production Max.	0.013 mm	0.0005 in
Camshaft		
Camshaft Bearing Inside Diameter - Front Number 1	35.000-35.020 mm	1.3779-1.3787 in
Camshaft Bearing Inside Diameter - Middle and Rear Number 2-4	27.000-27.020 mm	1.0630-1.0638 in
Camshaft End Play	0.045-0.215 mm	0.0018-0.0085 in
Camshaft Journal Diameter - Front Number 1	34.936-34.960 mm	1.3754-1.3764 in
Camshaft Journal Diameter - Middle and Rear Number 2-4	26.936-26.960 mm	1.0605-1.0614 in
Camshaft Journal Out-of-Round	0.006 mm	0.0002 in
Camshaft Journal to Bore Clearance	0.040-0.084 mm	0.0016-0.0033 in
Camshaft Lobe Duration - Exhaust @ 0.150 mm (0.0059 in) Lift	238 degrees	
Camshaft Lobe Duration - Intake @ 0.150 mm (0.0059 in) Lift	237 degrees	
Camshaft Lobe Lift - Exhaust	42.425-42.725 mm	1.6703-1.6821 in
Camshaft Lobe Lift - Intake	42.385-42.685 mm	1.6687-1.6805 in
Camshaft Lobe Overlap @ 0.150 mm (0.0059 in) Lift	0 degrees	
Camshaft Runout - Front and Rear Number 1 and 4	0.025 mm	0.0010 in
Camshaft Runout - Middle 2 and 3	0.050 mm	0.0020 in
Camshaft Timing @ 0.15 mm (0.0059 in) Lift		
Valve Opens - Exhaust	-229 degrees BTDC	
Valve Opens - Intake	14 degrees BTDC	
Centerline - Exhaust	111 degrees BTDC	
Centerline - Intake	132 degrees ATDC	
Valve Closes - Exhaust	9 degrees ATDC	
Valve Closes - Intake	251 degrees ATDC	
Valve Lift - Exhaust	10.8 mm	0.4252 in
Valve Lift - Intake	10.8 mm	0.4252 in
Cooling System		
Thermostat Full Open Temperature	95 °C	203 °F
Connecting Rod		
Connecting Rod Bearing Clearance	0.010-0.070 mm	0.0004-0.0028 in
Connecting Rod Bore Diameter - Bearing End	59.620-59.636 mm	2.3472-2.3479 in
Connecting Rod Bore Diameter - Pin End	24.007-24.021 mm	0.9452-0.9457 in
Connecting Rod Length - Center to Center	150.400 mm	5.9212 in
Connecting Rod Side Clearance	0.095-0.355 mm	0.0374-0.0140 in
Connecting Rod Width - Bearing End		
Production	21.775 mm	0.8573 in
Service	21.725-21.825 mm	0.8553-0.8593 in
Connecting Rod Width - Pin End		

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Production	21.775 mm	0.8573 in
Service	21.725-21.825 mm	0.8553-0.8593 in
Crankshaft		
Connecting Rod Journal Diameter	55.992-56.008 mm	2.2044-2.2050 in
Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
Connecting Rod Journal Taper	0.005 mm	0.0002 in
Connecting Rod Journal Width		
Production	22.000 mm	0.8661 in
Service	21.920-22.080 mm	0.8630-0.8693 in
Crankshaft End Play	0.100-0.330 mm	0.0039-0.0130 in
Crankshaft Main Bearing Clearance	0.010-0.060 mm	0.0004-0.0024 in
Crankshaft Main Journal Diameter	67.992-68.008 mm	2.6768-2.6775 in
Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
Crankshaft Main Journal Taper	0.005 mm	0.0002 in
Crankshaft Main Journal Thrust Wall		
Runout	0.000-0.040 mm	0.0000-0.0016 in
Square	0.000-0.010 mm	0.0000-0.0004 in
Crankshaft Main Journal Width, #2, 4		
Production	24.000 mm	0.9449 in
Service	23.900-24.100 mm	0.9409-0.9488 in
Crankshaft Main Journal Width, #3		
Production	24.400 mm	0.9606 in
Service	24.360-24.440 mm	0.9591-0.9622 in
Crankshaft Pilot Bearing Bore Diameter	20.965-20.995 mm	0.8254-0.8266 in
Crankshaft Rear Flange Runout	0.025 mm	0.0010 in
Crankshaft Reluctor Ring Runout - Maximum	1.500 mm	0.0591 in
Crankshaft Runout	0.030 mm	0.0012 in
Crankshaft Thrust Bearing Clearance	0.076-0.305 mm	0.0030-0.0120 in
Crankshaft Thrust Surface - Height Diameter	95.000 mm	3.7401 in
Crankshaft Thrust Surface Runout	0.040 mm	0.0016 in
Cylinder Head		
Combustion Chamber Volume	53.407 cc	3.259 cu in
Valve Guide Bore - Exhaust	6.000-6.020 mm	0.2362-0.2370 in
Valve Guide Bore - Intake	6.000-6.020 mm	0.2362-0.2370 in
Valve Guide Installed Height	14.050-14.550 mm	0.5531-0.5728 in
Valve Lifter Bore Diameter	12.008-12.030 mm	0.4728-0.4736 in
Lubrication System		
Oil Capacity - with New Dry Oil Filter	5.2 Liters	5.5 Quarts
Oil Capacity - without Oil Filter Change	4.8 Liters	5.2 Quarts
Oil Pressure - Minimum @ Idle	69 kPa	10 psi
Oil Pressure - Minimum @ 2,000 RPM	138 kPa	20 psi

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	1.7-2.3 bar	25-33 psi
Oil Pump		
Gear Diameter - Outer	87.095-87.175 mm	3.4289-3.4321 in
Gear Pocket - Depth	15.565-15.600 mm	0.6128-0.6142 in
Gear Pocket - Diameter	87.275-87.325 mm	3.4360-3.4380 in
Gear Thickness - Drive/Driven	15.511-15.536 mm	0.6107-0.6117 in
Gear-to-Cover Clearance - Drive/Driven	0.030-0.085 mm	0.0012-0.0033 in
Gear-to-Housing Clearance - Drive/Driven	0.100-0.230 mm	0.0039-0.0091 in
Inner Gear Tip Clearance	0.075-0.180 mm	0.0030-0.0071 in
Crankshaft Clearance to Housing	0.040-0.130 mm	0.0016-0.0051 in
Inner Gerotor Hub Diameter	53.310-53.335 mm	2.0988-2.0998 in
Housing Hub Diameter	53.380-53.420 mm	2.1016-2.1031 in
Inner Gerotor Hub Clearance to Housing	0.045-0.110 mm	0.0018-0.0043 in
Piston Rings		
Piston Ring End Gap		
First Compression Ring	0.150-0.300 mm	0.0059-0.0118 in
Second Compression Ring	0.280-0.480 mm	0.0110-0.0189 in
Oil Control Ring	0.150-0.600 mm	0.0059-0.0236 in
Piston Ring to Groove Clearance		
First Compression Ring	0.030-0.065 mm	0.0012-0.0026 in
Second Compression Ring	0.015-0.060 mm	0.0006-0.0024 in
Oil Control Ring	0.030-0.170 mm	0.0012-0.0067 in
Piston Ring Thickness		
First Compression Ring	1.175-1.190 mm	0.0463-0.0469 in
Second Compression Ring	1.470-1.495 mm	0.0579-0.0589 in
Oil Control Ring	2.360-2.480 mm	0.0929-0.0976 in
Pistons and Pins		
Piston		
Piston Diameter	93.956-93.974 mm	3.6990-3.6998 in
Piston Pin Bore Diameter	24.004-24.009 mm	0.9450-0.9452 in
Piston Ring Groove Width - First Compression Ring	1.220-1.240 mm	0.0480-0.0488 in
Piston Ring Groove Width - Second Compression Ring	1.510-1.530 mm	0.0595-0.0602 in
Piston Ring Groove Width - Oil Control Ring	2.510-2.530 mm	0.0988-0.0996 in
Piston to Bore Clearance	0.026-0.052 mm	0.0010-0.0021 in
Pin		
Piston Pin Clearance to Connecting Rod Bore	0.007-0.024 mm	0.0003-0.0010 in
Piston Pin Clearance to Piston Pin Bore	0.004-0.012 mm	0.0002-0.0005 in
Piston Pin Diameter	23.997-24.000 mm	0.9448-0.9449 in
Piston Pin Length	60.600-61.100 mm	2.3858-2.4055 in
Valve System		
Valves		

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	44.25 degrees	
Valve Face Runout	0.038 mm	0.0015 in
Valve Face Width - Exhaust	2.750 mm	0.1083 in
Valve Face Width - Intake	2.180 mm	0.0858 in
Valve Head Diameter - Exhaust	30.470-30.730 mm	1.1996-1.2098 in
Valve Head Diameter - Intake	36.830-37.090 mm	1.4500-1.4602 in
Valve Installed Height	35.23-36.69 mm	1.3870-1.4445 in
Valve Length - Exhaust	97.110 mm	3.8232 in
Valve Length - Intake	101.230 mm	3.9854 in
Valve Seat Angle - Seating Surface	45 degrees	
Valve Seat Angle - Relief Surface	30 degrees	
Valve Seat Angle - Undercut Surface	60 degrees	
Valve Seat Runout - Maximum	0.050 mm	0.0020 in
Valve Seat Width - Exhaust Seating Surface	1.400-1.800 mm	0.0551-0.0709 in
Valve Seat Width - Exhaust Relief Surface	0.700-0.900 mm	0.0276-0.0354 in
Valve Seat Width - Intake Seating Surface	1.000-1.400 mm	0.0394-0.0551 in
Valve Seat Width - Intake Relief Surface	0.500-0.700 mm	0.0197-0.0276 in
Valve Stem Diameter - Exhaust	5.945-5.965 mm	0.2341-0.2348 in
Valve Stem Diameter - Intake	5.955-5.975 mm	0.2344-0.2352 in
Valve Stem-to-Guide Clearance - Exhaust	0.035-0.075 mm	0.0014-0.0030 in
Valve Stem-to-Guide Clearance - Intake	0.025-0.065 mm	0.0010-0.0026 in
Valve Lifters		
Valve Lifter Diameter	11.489-12.000 mm	0.4523-0.4724 in
Valve Lifter-to-Bore Clearance	0.037-0.041 mm	0.0015-0.0016 in
Rocker Arms		
Valve Rocker Arm Ratio	1.68 to 1	
Valve Rocker Arm Roller Diameter	17.750-17.800 mm	0.6988-0.7008 in
Valve Springs		
Valve Spring Coil Thickness	3.250 x 3.900 mm	0.1280 x 0.1535 in
Valve Spring Diameter - Inside Top	12.090-12.590 mm	0.4760-0.4957 in
Valve Spring Diameter - Outside Top	20.140 mm	0.7929 in
Valve Spring Diameter - Inside Bottom	17.950-18.450 mm	0.7067-0.7264 in
Valve Spring Diameter - Outside Bottom	26.000 mm	1.0236 in
Valve Spring Free Length	42.050-44.850 mm	1.6555-1.7657 in
Valve Spring Installed Height - Closed	35.000 mm	1.3779 in
Valve Spring Installed Height - Open	24.000 mm	0.9449 in
Valve Spring Load - Closed	247-273 N	56-61 lb
Valve Spring Load - Open	598-662 N	134-149 lb
Valve Spring Total Number of Coils	7.1	

SEALERS, ADHESIVES, AND LUBRICANTS

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SEALERS, ADHESIVES, AND LUBRICANTS

Application	Type of Material	GM Part Number	
		United States	Canada
Camshaft Prelube	Lubricant	12345501	993362
Coolant and Oil Plug Threads	Sealant	12346004	10953480
Crankshaft Prelube	Lubricant	1052367	992869
Engine Oil	5W-30 Oil	12345610	993193
Oil Pan, Engine Front Cover, Crankshaft Rear Oil Seal Housing, Expansion Plugs	Sealant	12378521	88901148

THREAD REPAIR SPECIFICATIONS

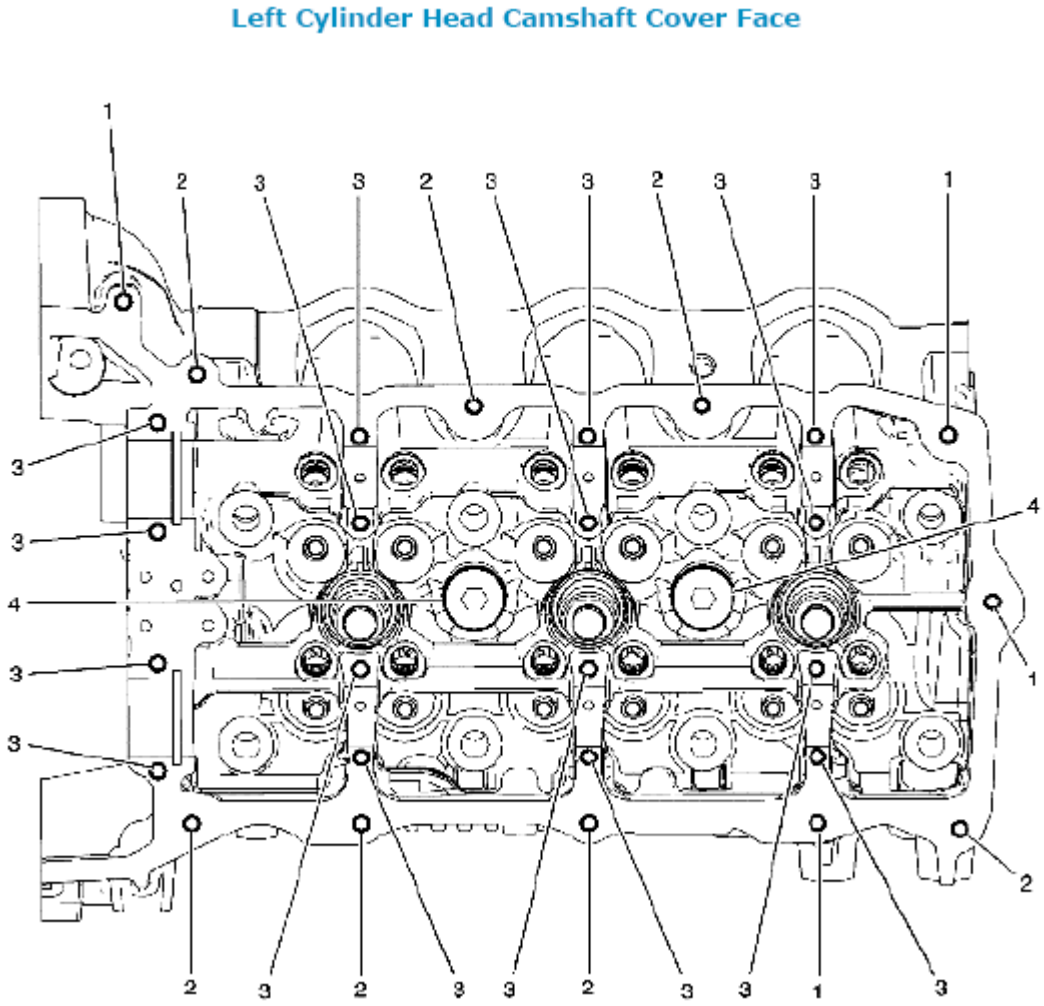


Fig. 903: Left Cylinder Head Camshaft Cover Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Left Cylinder Head Camshaft Cover Face

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LEFT CYLINDER HEAD CAMSHAFT COVER FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.7087
2	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
3	M6 x 1.0	701	N/A	N/A	203	204	205	28.5	1.1220	24.0	0.9449
4	M20 x 1.5	715	716	N/A	717	718	719	25.0	0.9842	17.0	0.6693

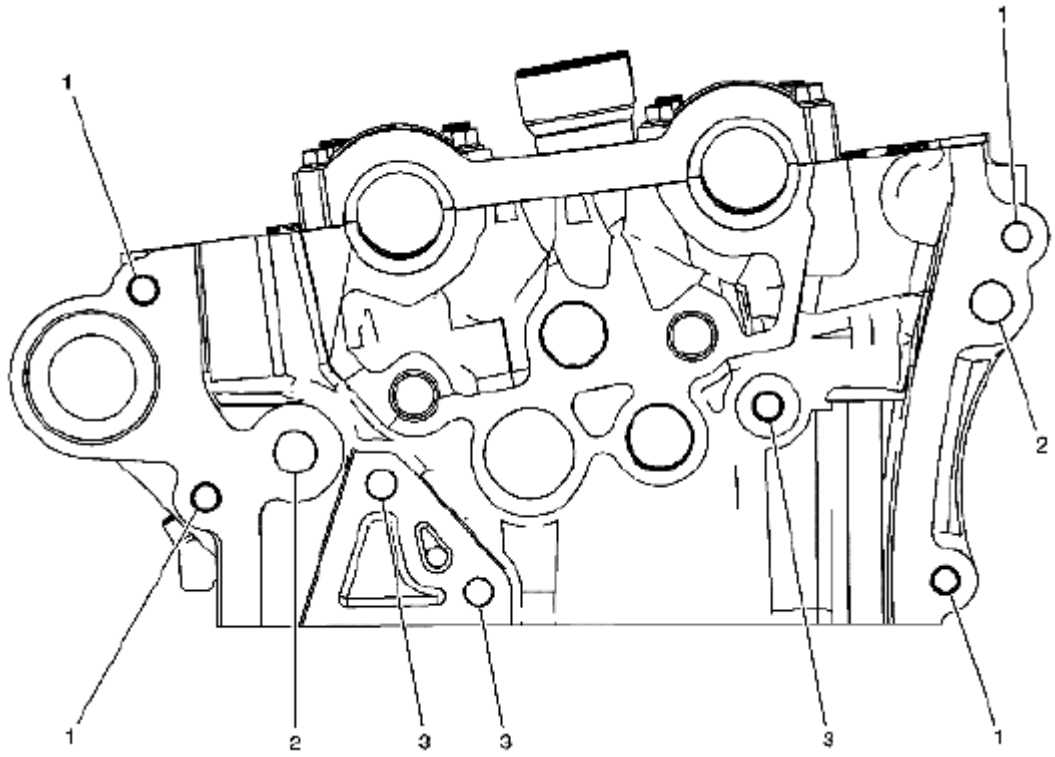


Fig. 904: Left Cylinder Head Front Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Left Cylinder Head Front Face

LEFT CYLINDER HEAD FRONT FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	THRU		THRU	
2	M12 x 1.75	856	857	N/A	858	859	416	40.0	1.5748	32.5	1.2795
	M8 x										

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3	1.25	206	207	N/A	208	209	210	18.0	0.7087	22.5	0.8858

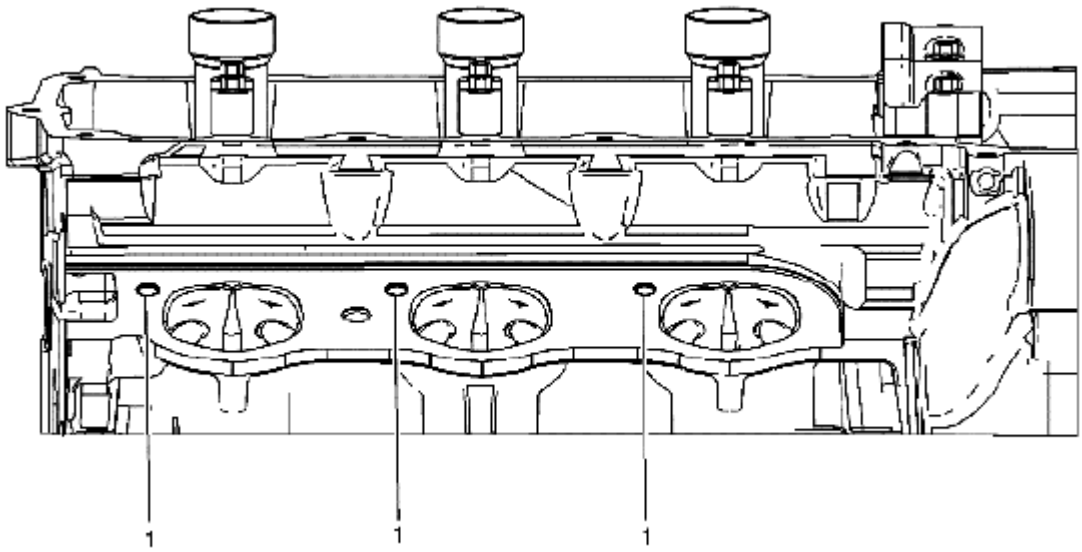


Fig. 905: Left Cylinder Head Intake Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Left Cylinder Head Intake Face

LEFT CYLINDER HEAD INTAKE FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055

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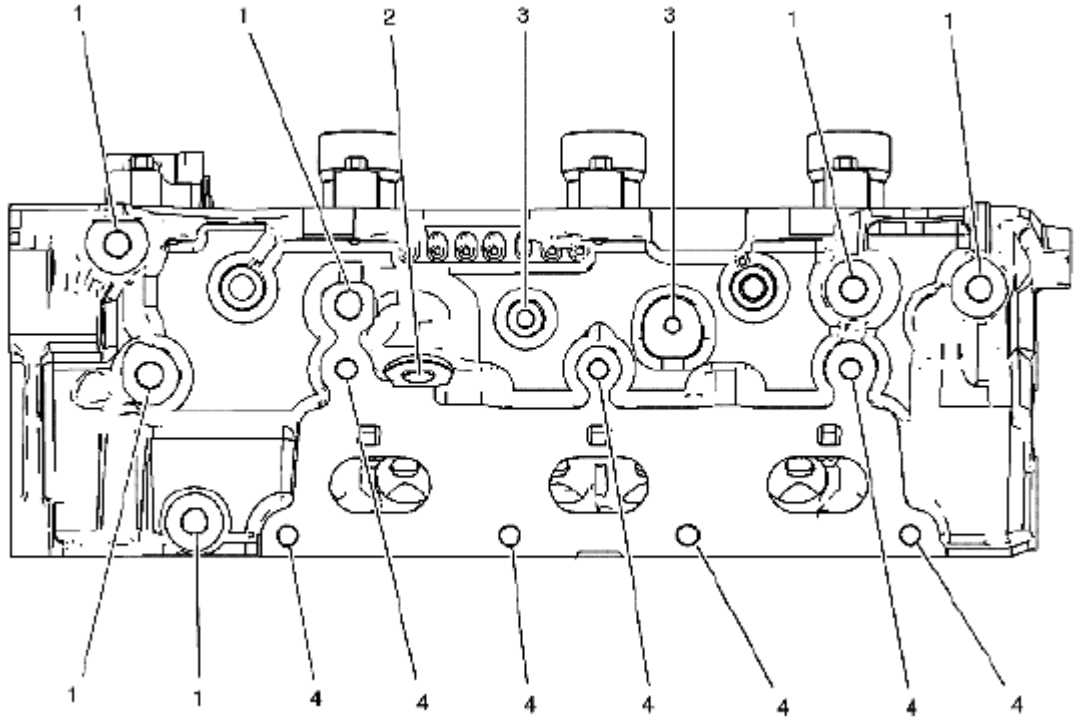


Fig. 906: Left Cylinder Head Exhaust Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Left Cylinder Head Exhaust Face

LEFT CYLINDER HEAD EXHAUST FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3189	27.0	1.0630
2	M12 x 1.5	705	706	N/A	707	708	709	27.5	1.0827	13.0	0.5118
3	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.0000
4	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055

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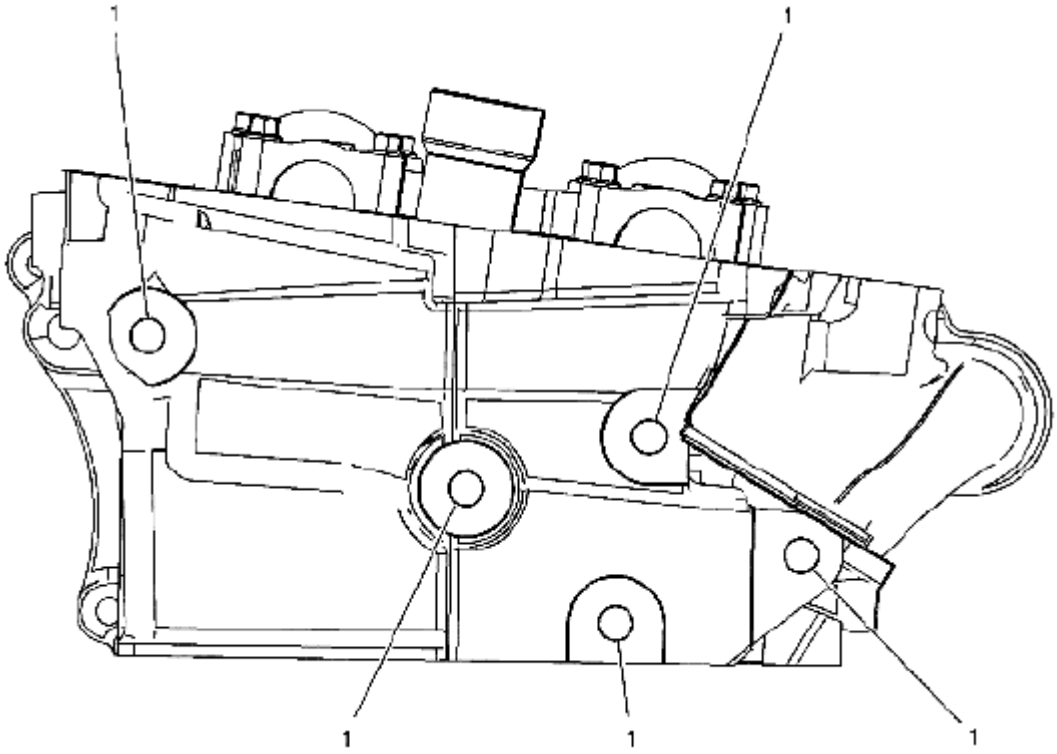


Fig. 907: Left Cylinder Head Rear Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Left Cylinder Head Rear Face

LEFT CYLINDER HEAD REAR FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3189	27.0	1.0630

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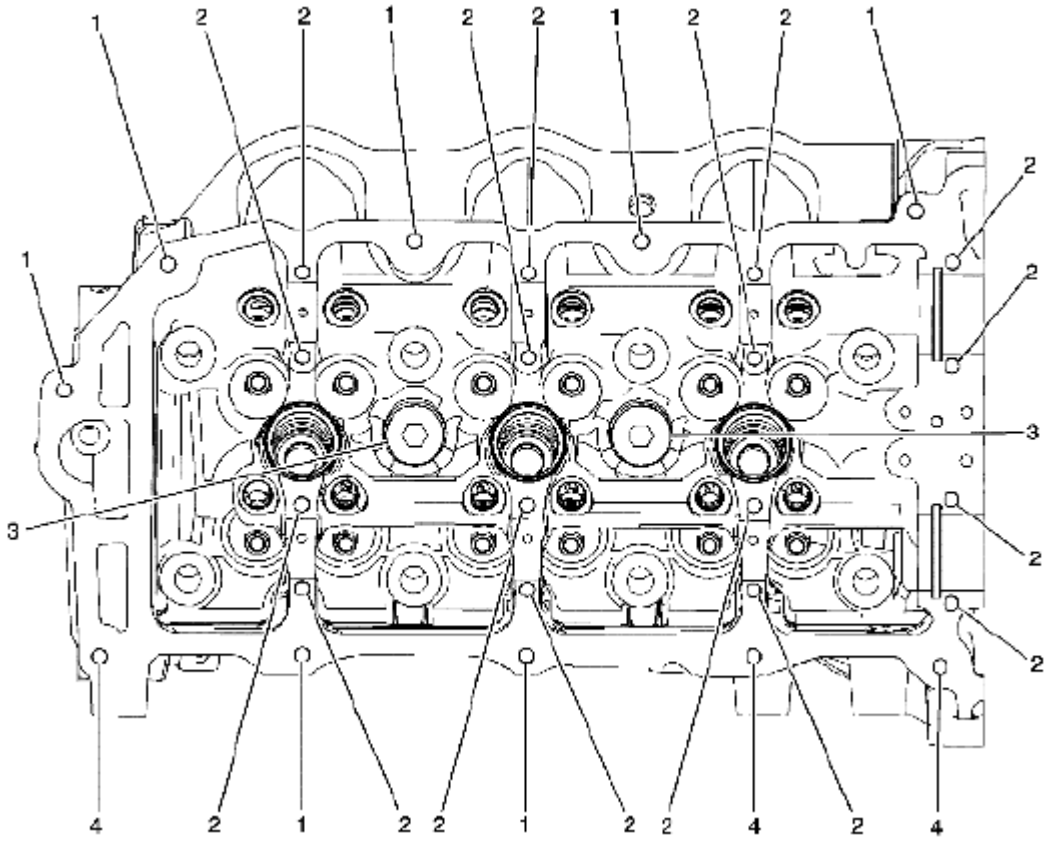


Fig. 908: Right Cylinder Head Camshaft Cover Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Right Cylinder Head Camshaft Cover Face

RIGHT CYLINDER HEAD CAMSHAFT COVER FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
2	M6 x 1.0	701	N/A	N/A	203	204	205	28.5	1.1220	24.0	0.9449
3	M20 x 1.5	715	716	N/A	717	718	719	25.0	0.9842	17.0	0.6693
4	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.7087

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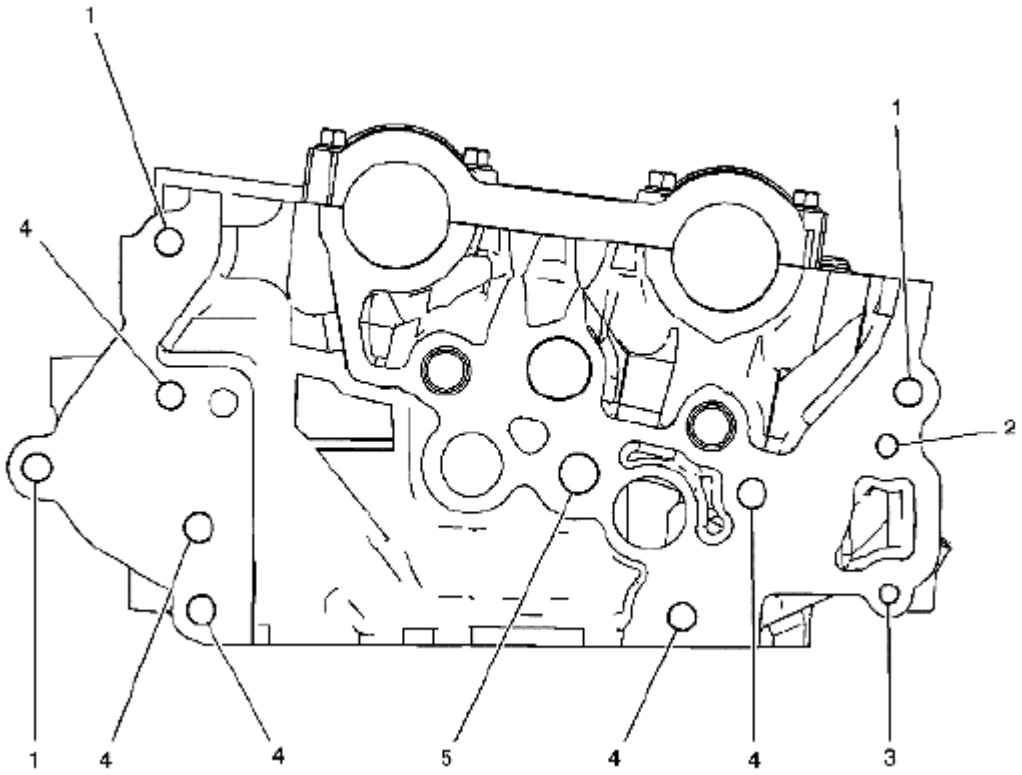


Fig. 909: Right Cylinder Head Front Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Right Cylinder Head Front Face

RIGHT CYLINDER HEAD FRONT FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	THRU		THRU	
2	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8880	18.0	0.7087
3	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
4	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
5	M12 x 1.75	856	857	N/A	858	859	416	40.0	1.5748	32.5	1.2795

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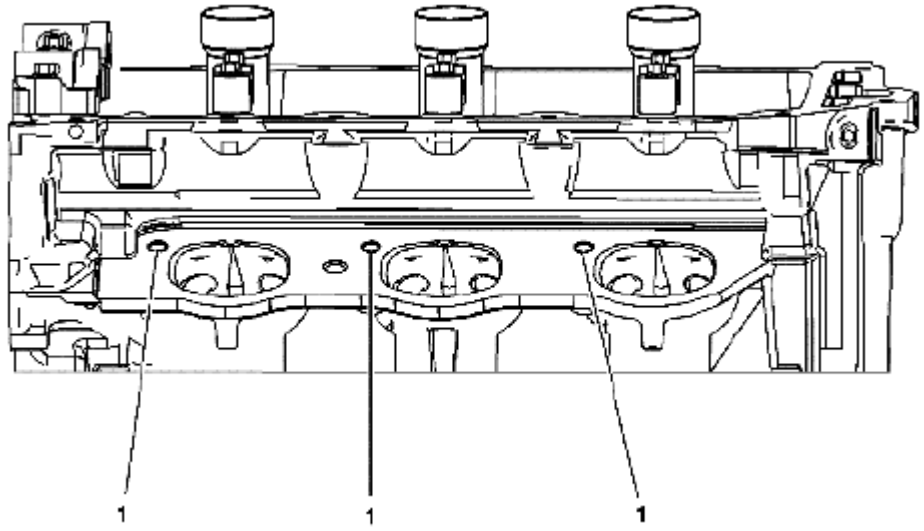


Fig. 910: Right Cylinder Head Intake Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Right Cylinder Head Intake Face

RIGHT CYLINDER HEAD INTAKE FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055

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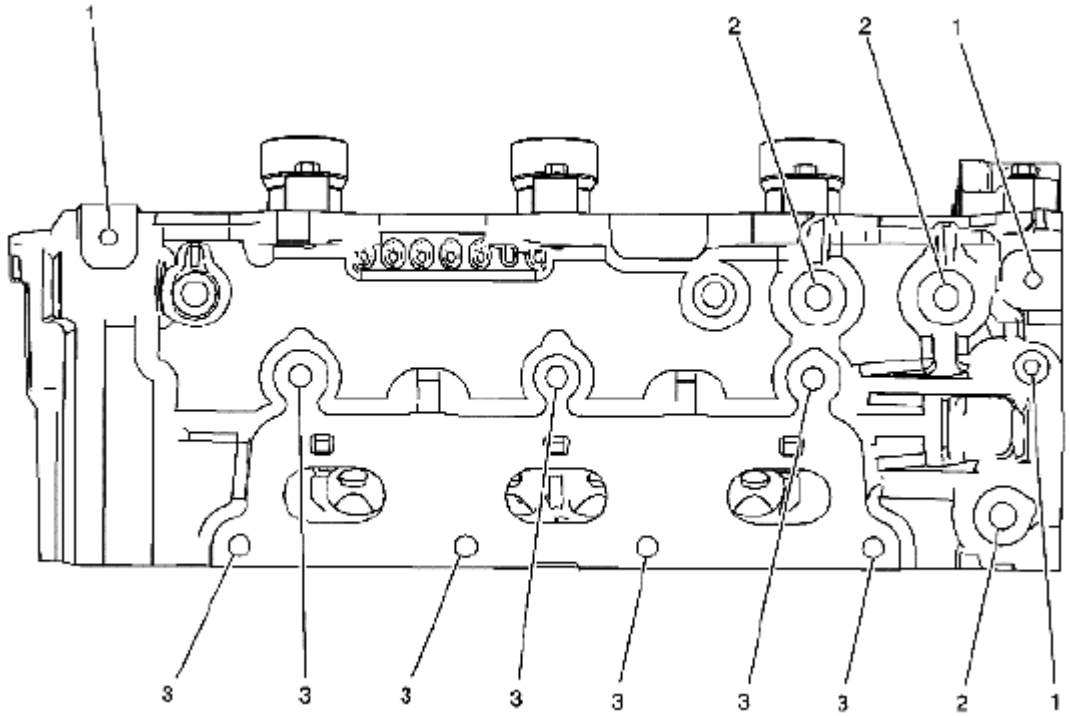


Fig. 911: Right Cylinder Head Exhaust Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Right Cylinder Head Exhaust Face

RIGHT CYLINDER HEAD EXHAUST FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.0000
2	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3189	27.0	1.0630
3	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055

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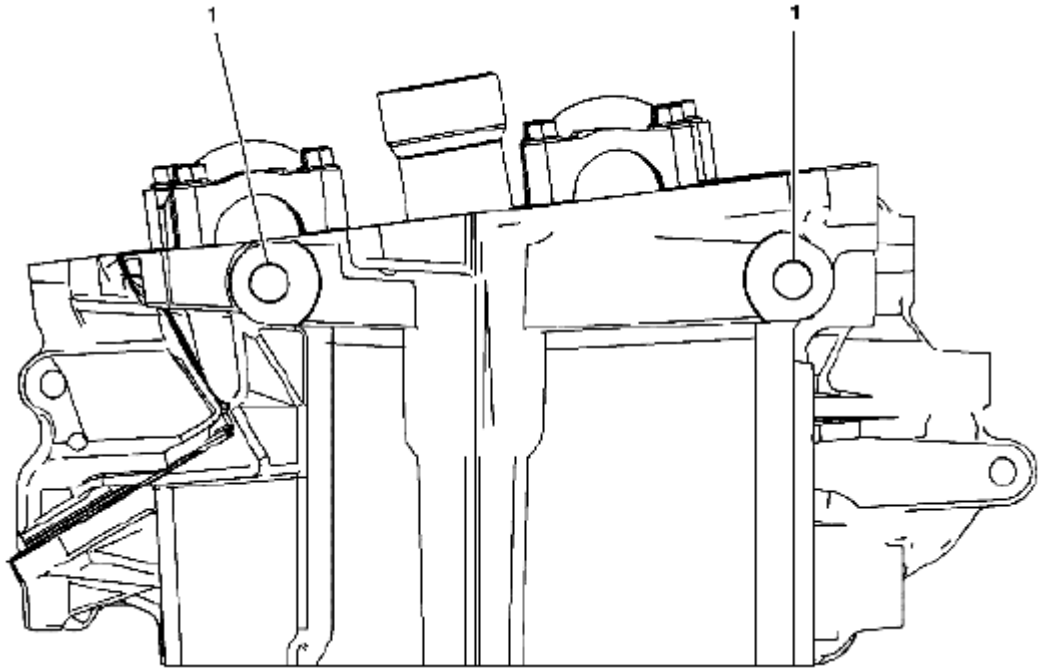


Fig. 912: Right Cylinder Head Rear Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Right Cylinder Head Rear Face

RIGHT CYLINDER HEAD REAR FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3189	27.0	1.0630

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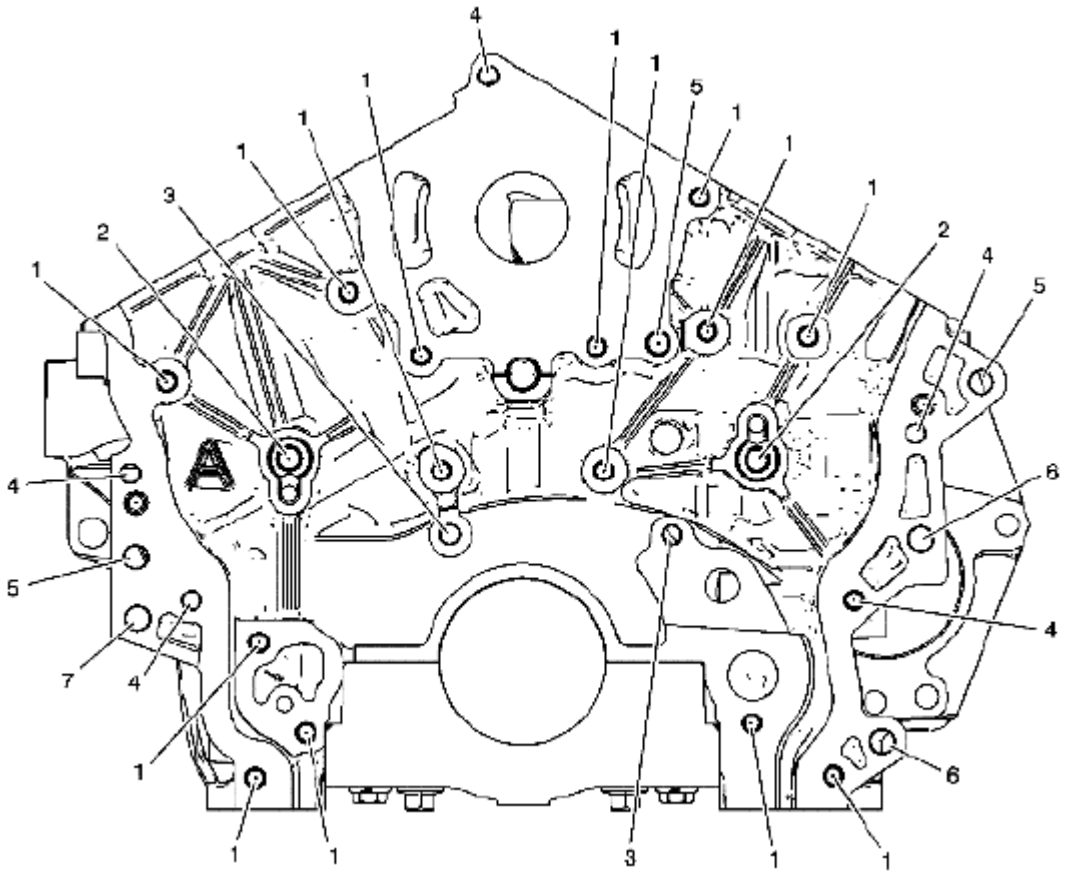


Fig. 913: Engine Block Front - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Front

ENGINE BLOCK FRONT - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
2	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3189	27.0	1.0630
3	M8 x 1.25	206	207	N/A	208	209	210	THRU		23.0	0.9055
4	M8 x 1.25	206	207	N/A	208	209	210	THRU		THRU	
5	M10 x 1.5	211	212	N/A	213	214	215	28.0	1.1024	28.0	1.1024
6	M10 x 1.5	211	212	N/A	213	214	215	THRU		20.0	0.7874

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7	M10 x 1.5	211	212	N/A	213	214	215	THRU	28.0	1.1024

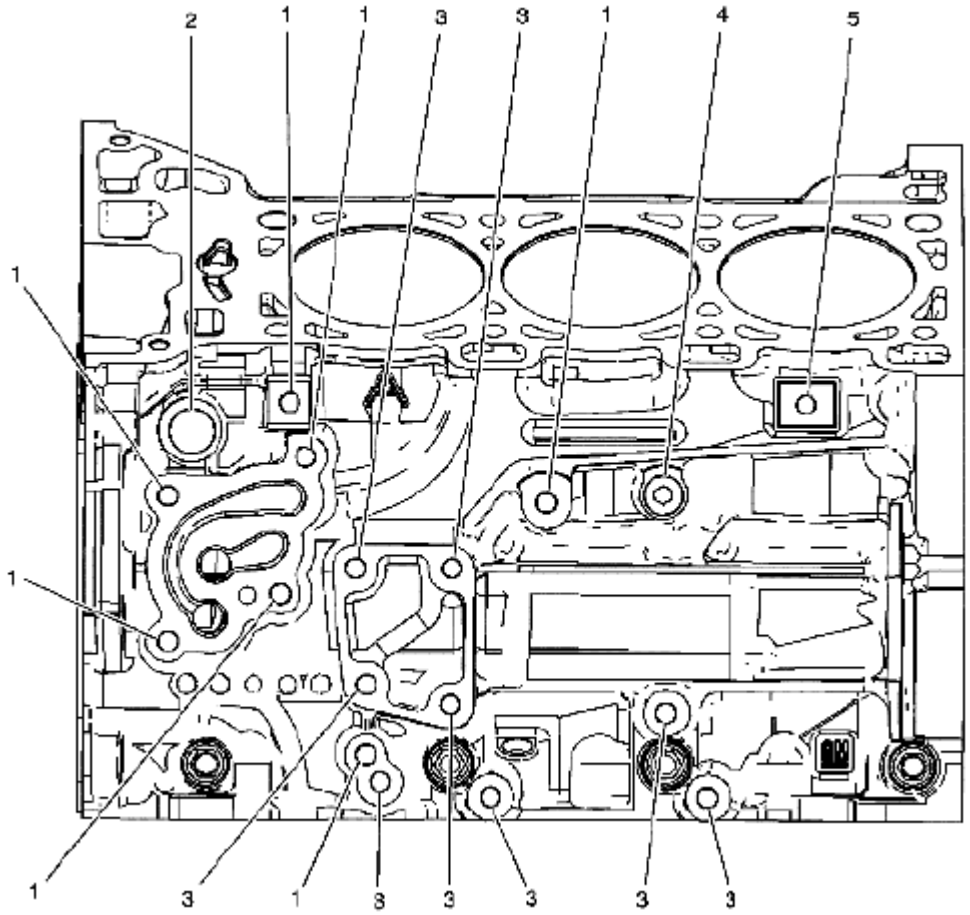


Fig. 914: Engine Block Left Side - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Left Side

ENGINE BLOCK LEFT SIDE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
2	M20 x 1.5	715	716	N/A	717	718	719	30.0	1.1810	20.0	0.7874
3	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3190	27.0	1.0630
4	M14 x 1.5	409	410	N/A	411	412	735	THRU		15.0	0.5905

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5	M8 x 1.25	206	207	N/A	208	209	415	16.5	0.6496	11.0	0.4331

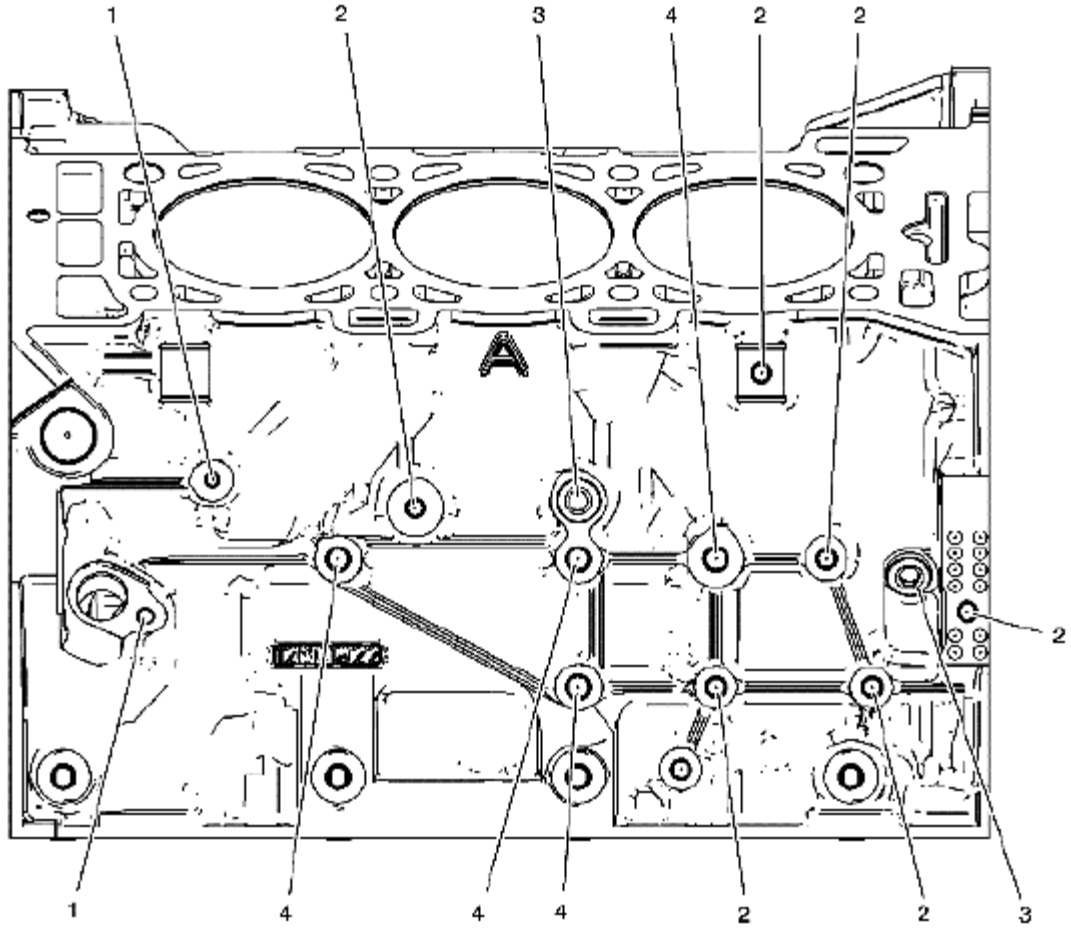


Fig. 915: Engine Block Right Side - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Right Side

ENGINE BLOCK RIGHT SIDE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.7087
2	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
3	M14 x 1.5	409	410	N/A	411	412	735	THRU		15.0	0.5905
4	M10 x 1.5	211	212	N/A	213	214	215	33.5	1.3190	27.0	1.0630

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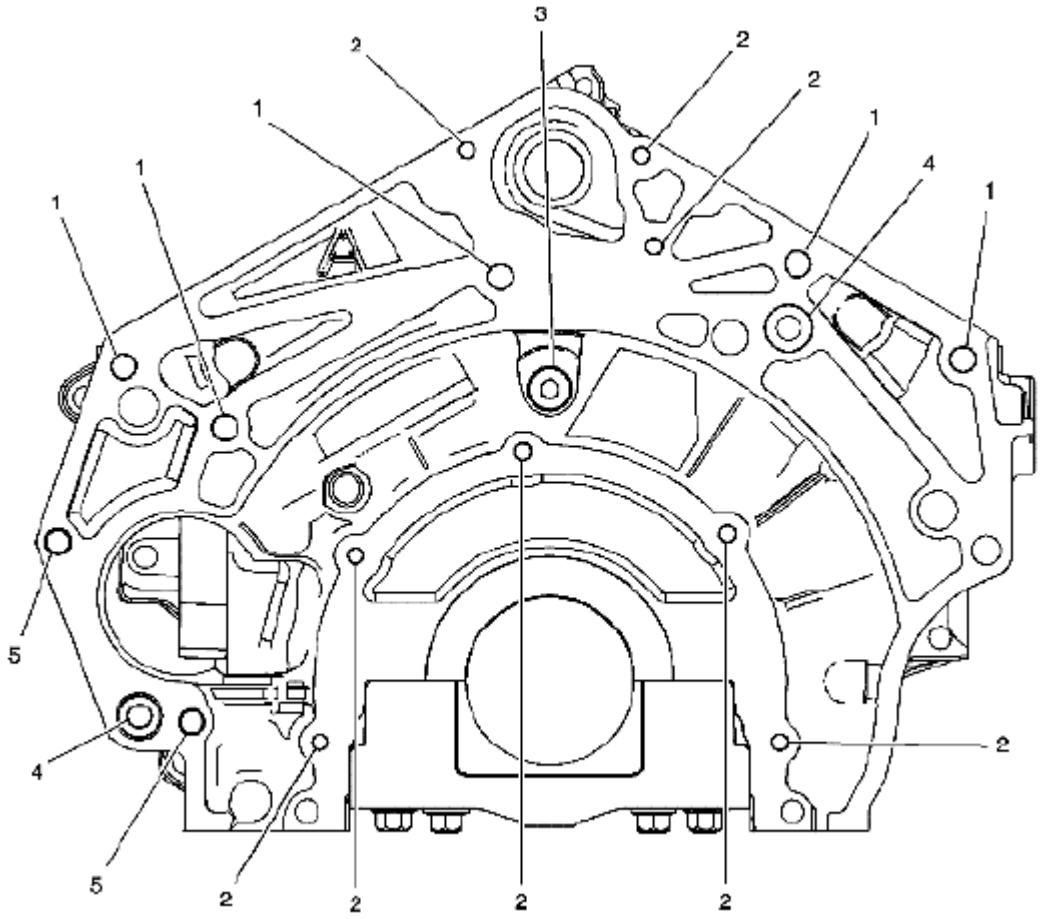


Fig. 916: Engine Block Rear - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Rear

ENGINE BLOCK REAR - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3190	27.0	1.0630
2	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.7087
3	M14 x 1.5	409	410	N/A	411	412	735	THRU		15.0	0.5905
4	M10 x 1.5	211	212	N/A	213	214	216	39.5	1.5551	33.0	1.2992
5	M10 x 1.5	211	212	N/A	213	214	420	THRU		THRU	

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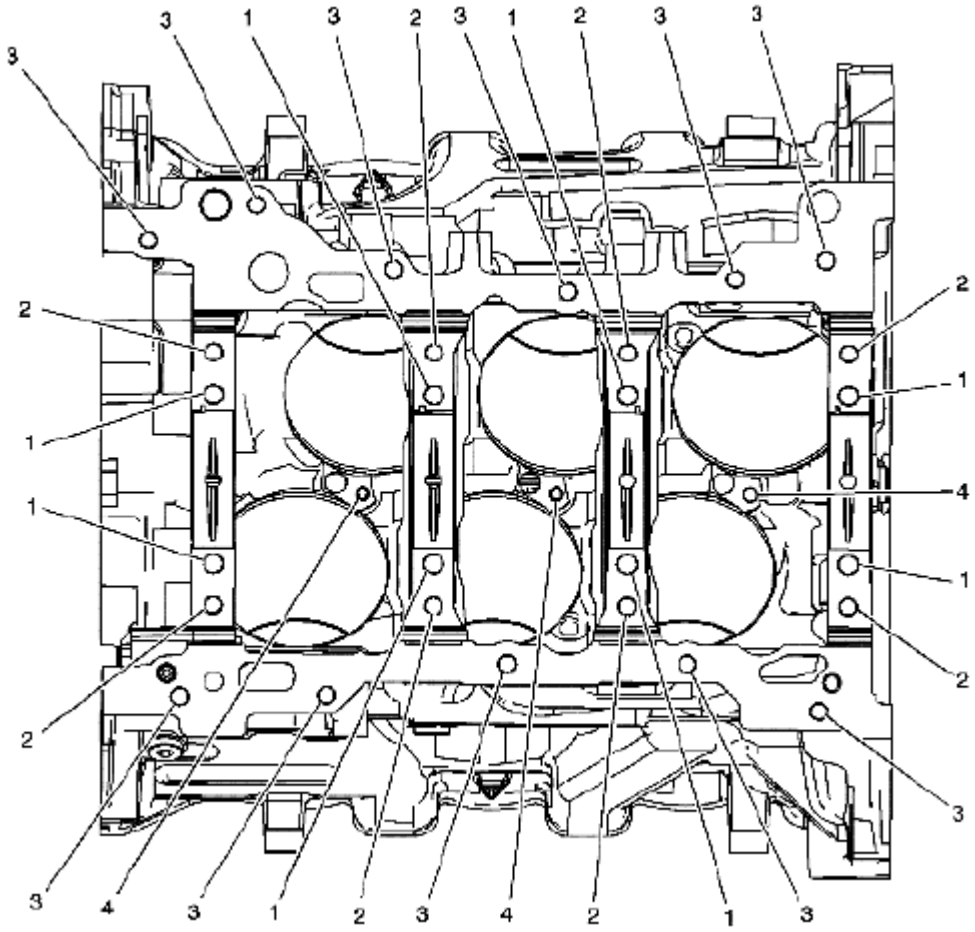


Fig. 917: Engine Block Bottom - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Bottom

ENGINE BLOCK BOTTOM - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 2.0	720	N/A	N/A	721	722	104	56.0	2.2047	49.0	1.9291
2	M8 x 1.25	702	N/A	N/A	703	704	620	46.0	1.8110	40.5	1.5945
3	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
4	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	

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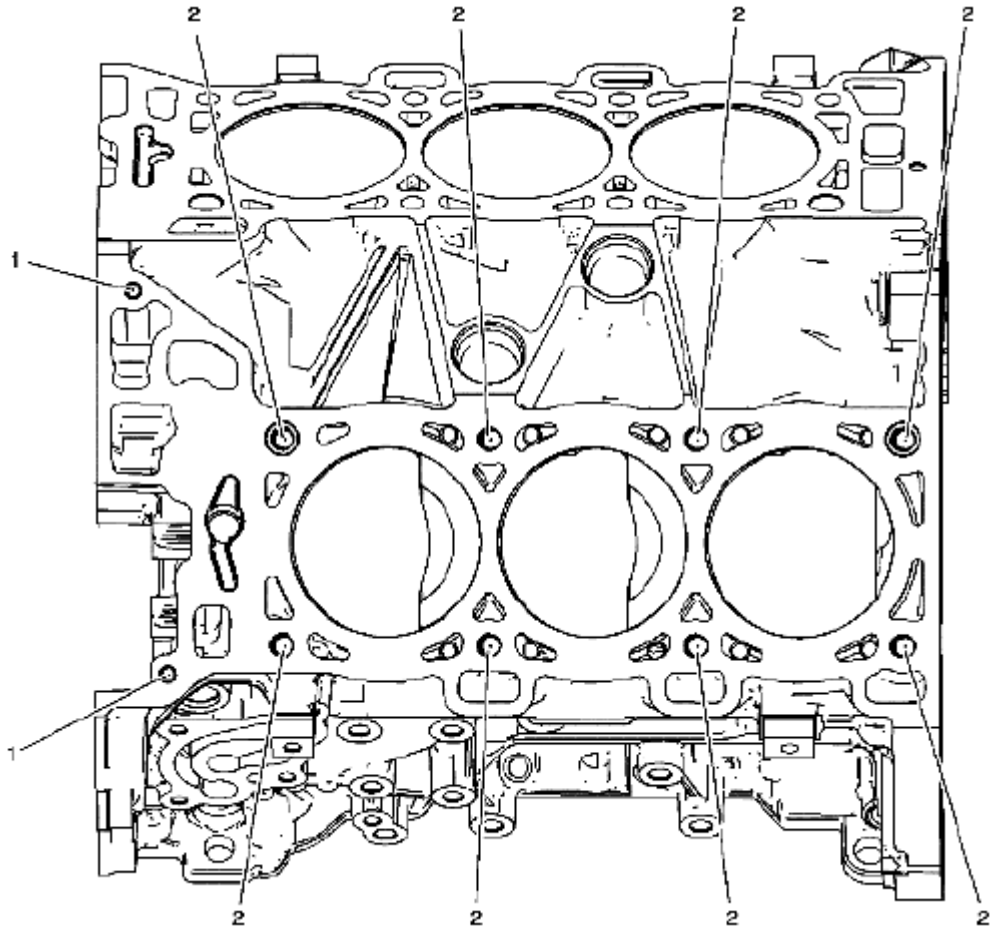


Fig. 918: Engine Block Left Deck Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Left Deck Face

ENGINE BLOCK LEFT DECK FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
2	M11 x 2.0	723	N/A	N/A	724	725	108	102.5	4.0354	94.0	3.7008

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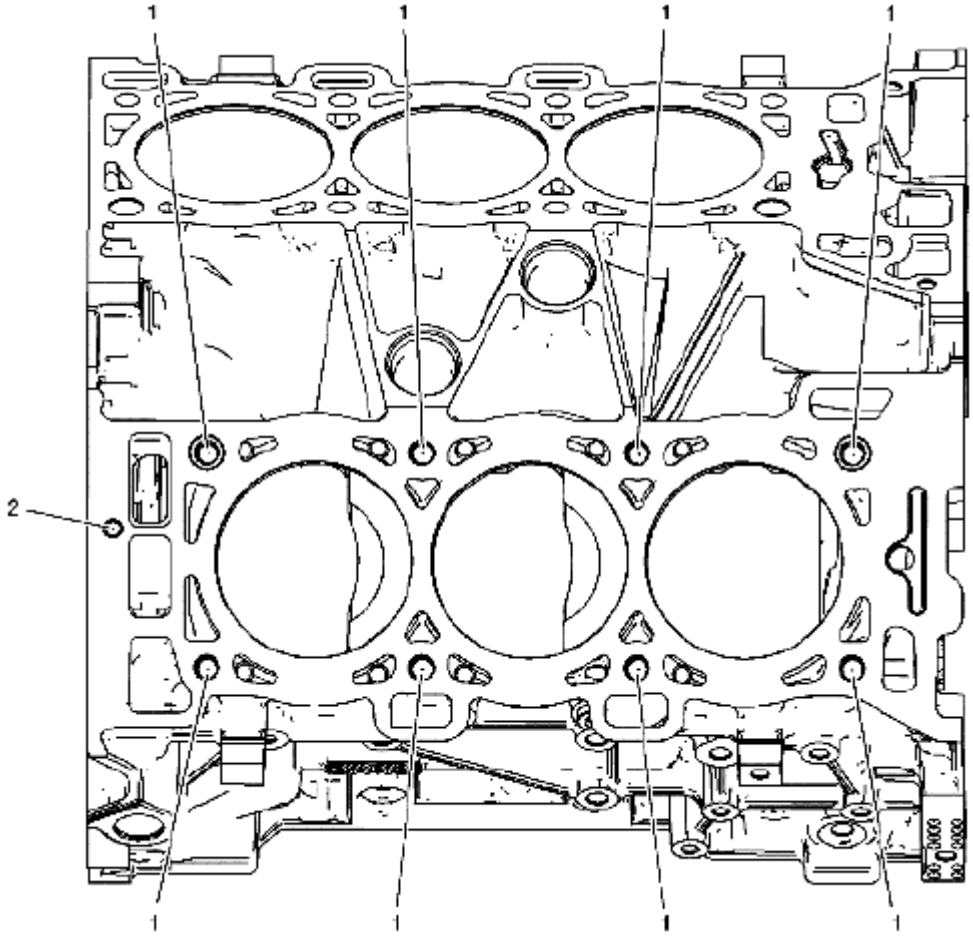


Fig. 919: Engine Block Right Deck Face - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Block Right Deck Face

ENGINE BLOCK RIGHT DECK FACE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M11 x 2.0	723	N/A	N/A	724	725	108	102.5	4.0354	94.0	3.7008
2	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055

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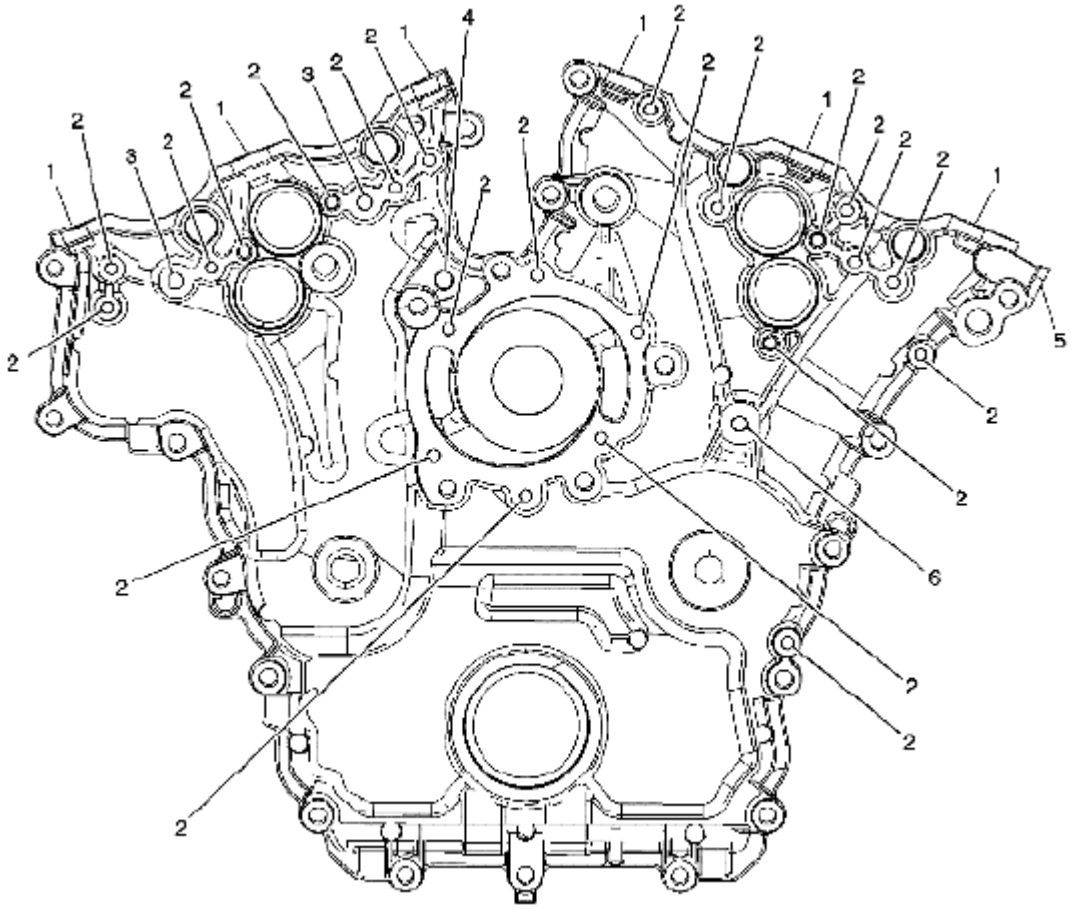


Fig. 920: Engine Front Cover - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Engine Front Cover

ENGINE FRONT COVER - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
2	M6 x 1.0	201	202	N/A	203	204	205	21.5	0.8465	18.0	0.7087
3	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
4	M10 x 1.5	211	212	N/A	213	214	420	THRU		THRU	
5	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3189	27.0	1.0630
6	M8 x 1.25	206	207	N/A	208	209	210	27.5	1.0827	23.0	0.9055

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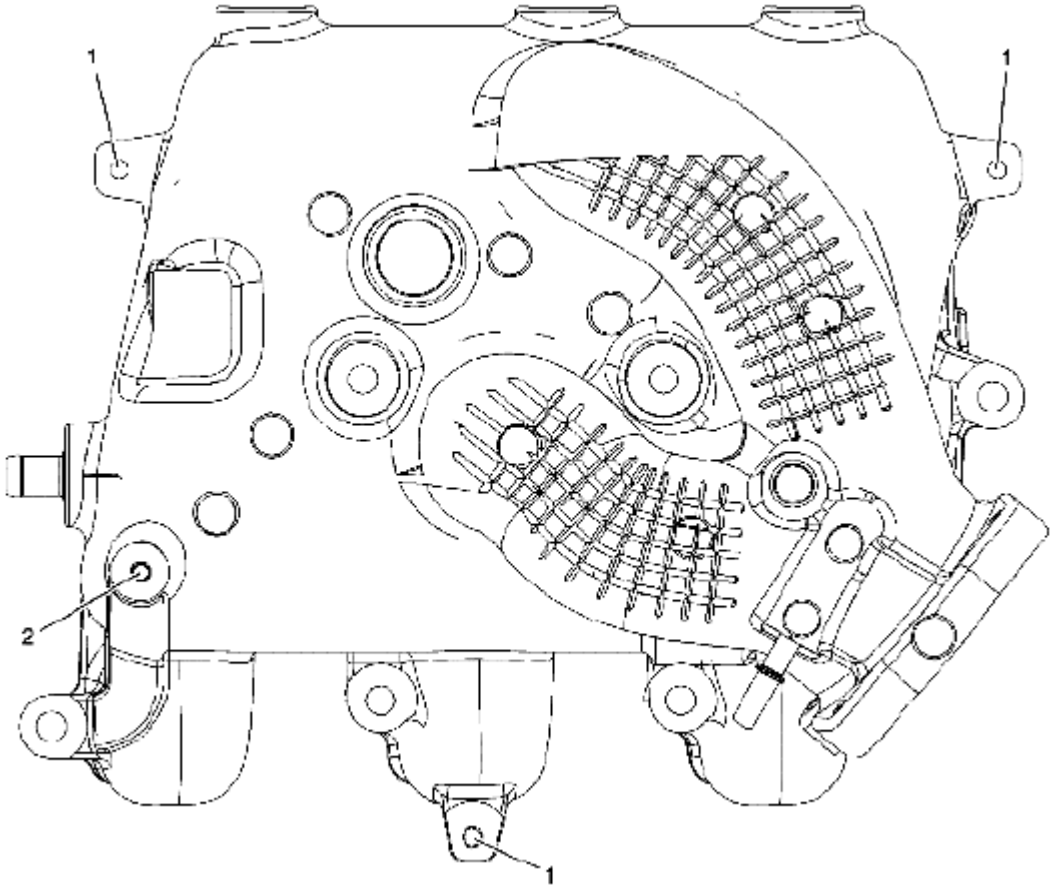


Fig. 921: Upper Intake Manifold (Top) - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Upper Intake Manifold - Top

UPPER INTAKE MANIFOLD (TOP) - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
2	M6 x 1.0	201	202	N/A	203	204	205	22.5	0.8858	18.0	0.7087

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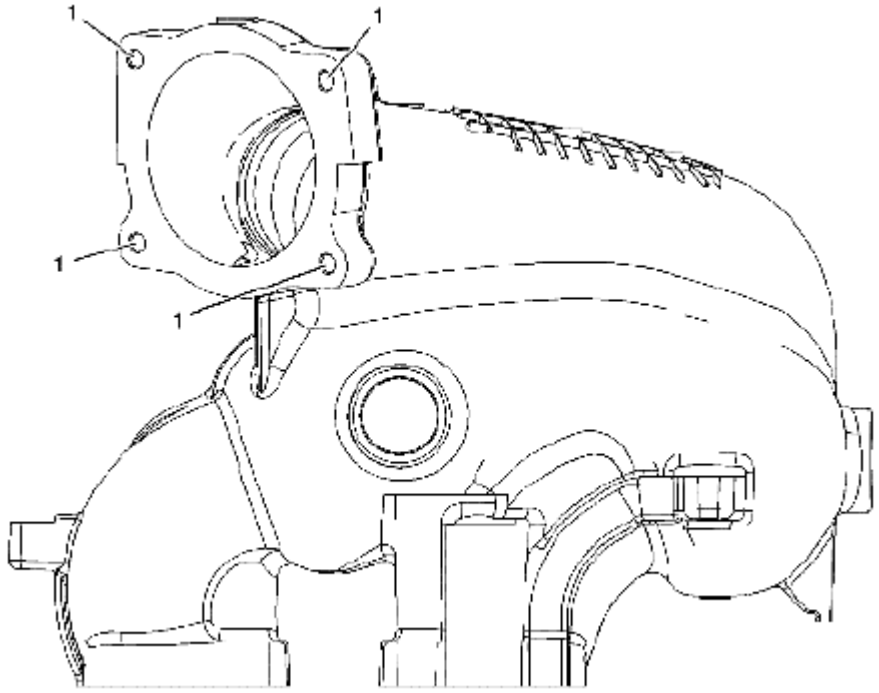


Fig. 922: Upper Intake Manifold (Front) - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Upper Intake Manifold - Front

UPPER INTAKE MANIFOLD (FRONT) - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	

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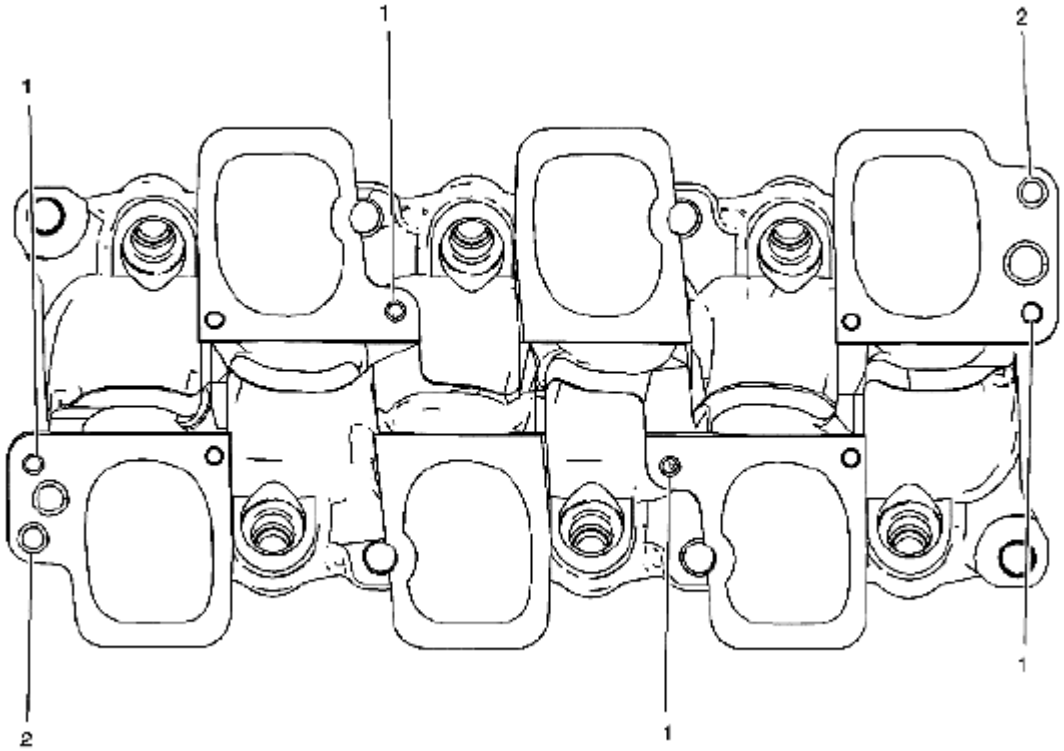


Fig. 923: Lower Intake Manifold (Top) - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Lower Intake Manifold - Top

LOWER INTAKE MANIFOLD (TOP) - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	201	202	N/A	203	204	205	THRU		THRU	
2	M8 x 1.25	206	207	N/A	208	209	210	THRU		THRU	

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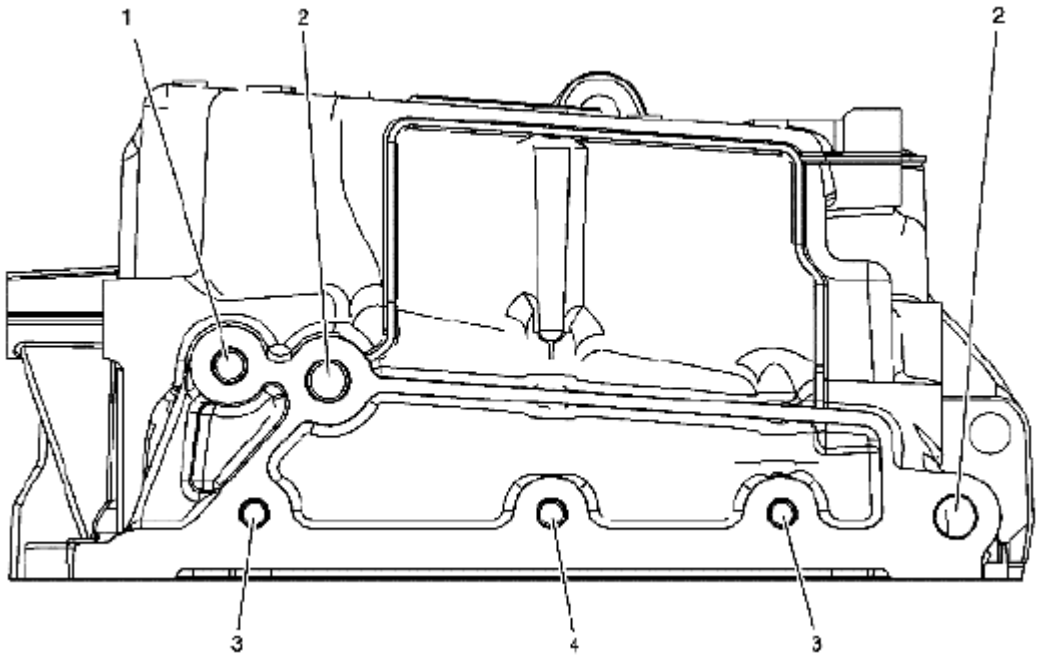


Fig. 924: Oil Pan Front - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pan Front

OIL PAN FRONT - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3189	27.0	1.0630
2	M12 x 1.75	856	857	N/A	858	859	416	39.5	1.5551	32.0	1.2598
3	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
4	M8 x 1.25	610	N/A	N/A	208	209	620	37.5	1.4764	32.0	1.2598

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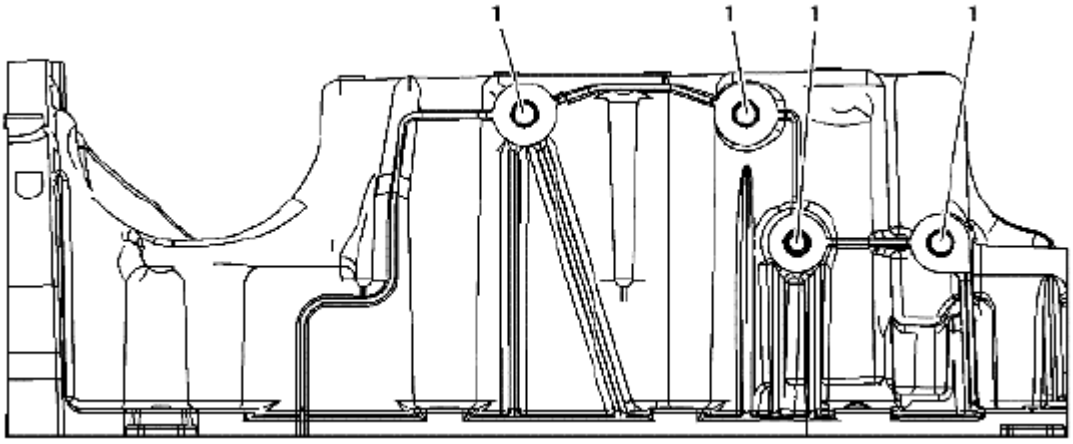


Fig. 925: Oil Pan Left Side - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pan Left Side

OIL PAN LEFT SIDE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3189	27.0	1.0630

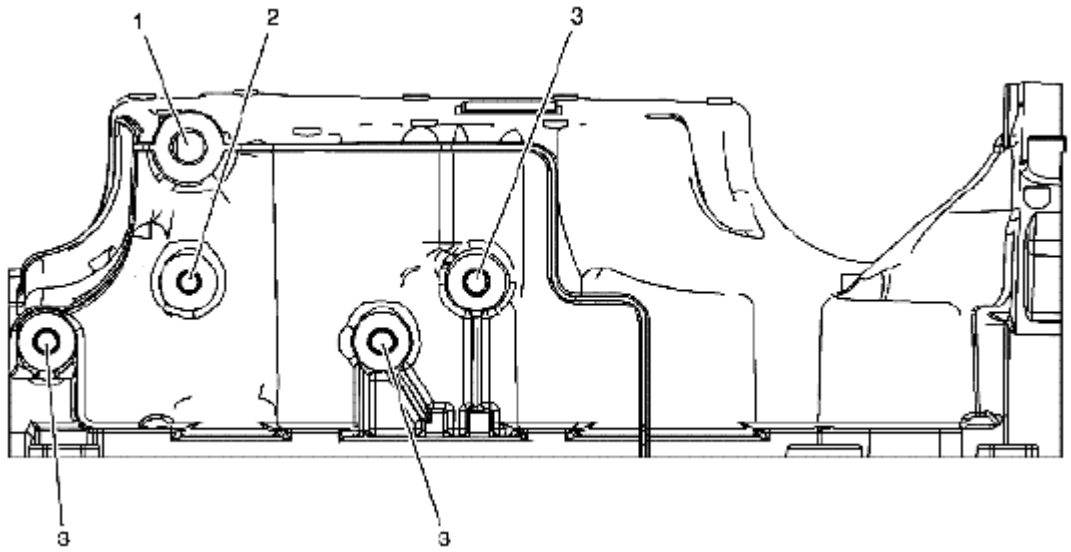


Fig. 926: Oil Pan Right Side - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pan Right Side

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OIL PAN RIGHT SIDE - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M12 x 1.75	856	857	N/A	858	859	416	THRU		THRU	
2	M8 x 1.25	206	207	N/A	208	209	210	28.5	1.1220	23.0	0.9055
3	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3189	27.0	1.0630

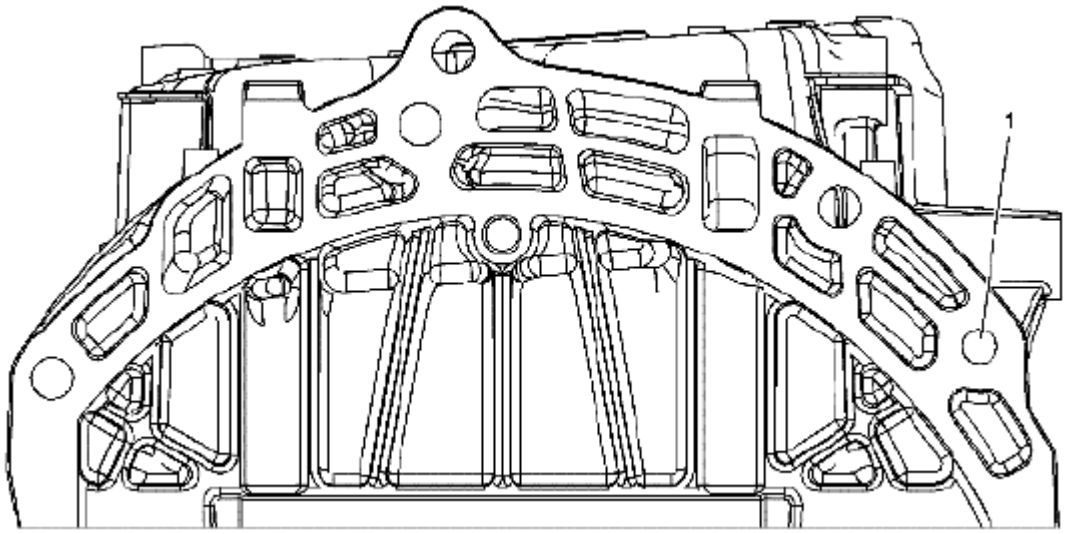


Fig. 927: Oil Pan Rear - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pan Rear

OIL PAN REAR - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M10 x 1.5	211	212	N/A	213	214	420	33.5	1.3189	27.0	1.0630

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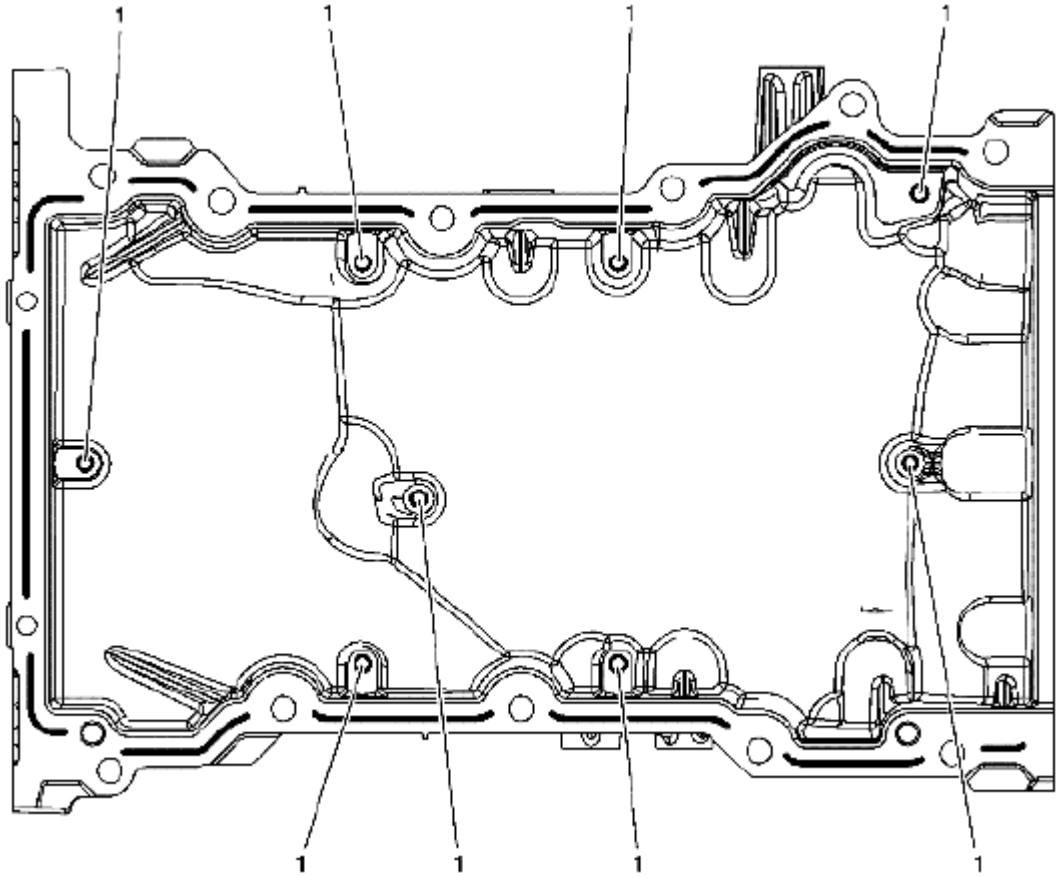


Fig. 928: Oil Pan Top - Thread Repair Specifications Chart
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pan Top

OIL PAN TOP - THREAD REPAIR SPECIFICATIONS

Hole Location	Thread Size	Drill	Counter Bore Tool	Stop Collar	Tap	Driver	Insert	Drill Depth (Maximum)		Tap Depth (Minimum)	
		J 42385-						MM	(IN)	MM	(IN)
1	M6 x 1.0	701	N/A	N/A	203	204	205	28.0	1.1024	23.5	0.9252

SPECIAL TOOLS AND EQUIPMENT

ENGINE SUPPORT FIXTURE

Installation Procedure

Special Tool

J 28467-B Universal Engine Support Fixture

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J-28467-13 Engine Support Fixture Adapters

J 42451-1 Engine Support Adapter

J 36462-A Engine Support Adapter Leg Set

J 28467-7A Bolt Hook

J 28467-34 Lift Hook Wing Nut & Washer

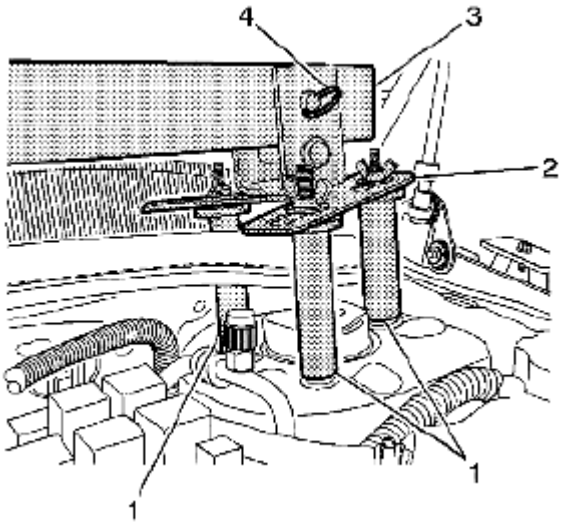


Fig. 929: Identifying Engine Support Fixture
Courtesy of SUZUKI OF AMERICA CORP.

1. Remove the fuel injector sight shield. Refer to **FUEL INJECTOR SIGHT SHIELD REPLACEMENT**.
2. Pull each end of the hood rear seal away from the cowl panel flange near both strut towers.
3. Install three J-28467-13 (1) and two J 28467-5 strut tower adapters (2) to the top of the left and right strut tower.
4. Install a 127 cm (50 in) engine support fixture cross bar J-28467-B (3) transversely across the vehicle between both J 28467-5 strut tower adapters (2).
5. Insert safety pins J-28467-10 (4) through the J 28467-5 strut tower adapters (2) and the cross bar (3) to prevent movement.

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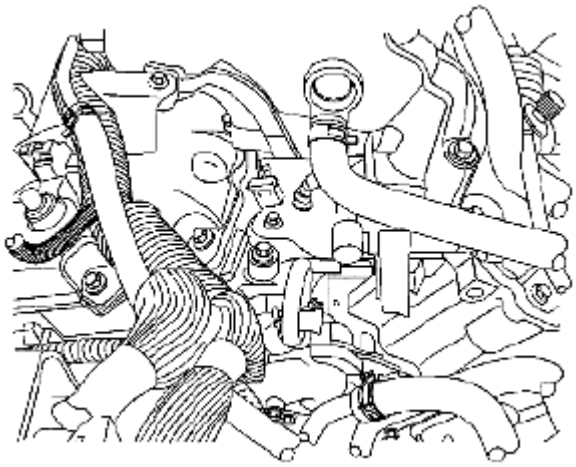


Fig. 930: Identifying Engine Support Bracket J 42451-1
Courtesy of SUZUKI OF AMERICA CORP.

6. Install the engine support bracket J 42451-1 to the engine.

CAUTION: Refer to FASTENER NOTICE .

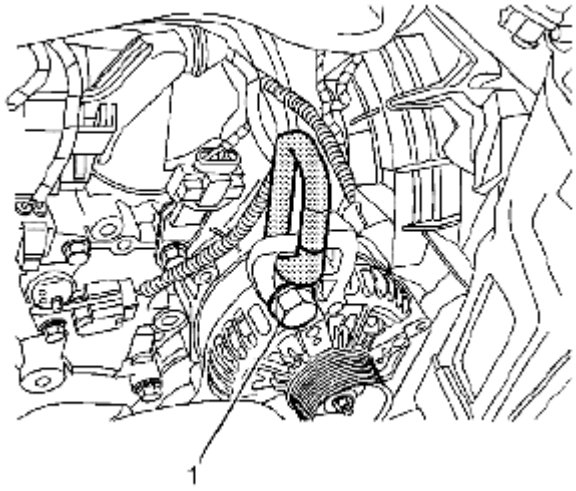


Fig. 931: Identifying Alternator Bolt
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the alternator bolt (1), then install the alternator bolt with the engine support bracket J 42451-1 to the engine.

Tightening torque

Tighten the bolts to 50 N.m (37 lb ft) .

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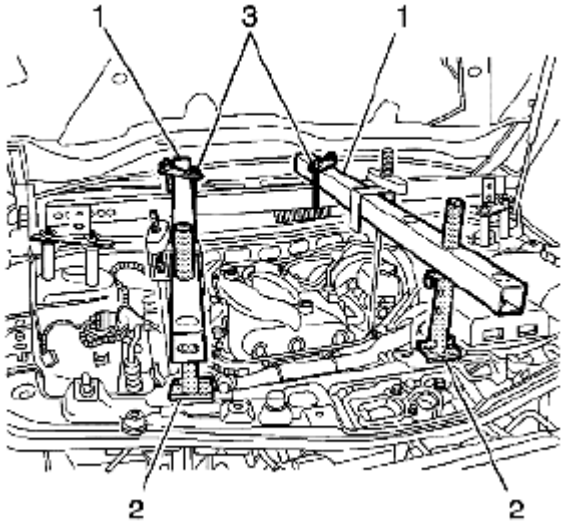


Fig. 932: Identifying 58 cm (23 in) Engine Support Fixture Cross Bars And J 36462-A Leg Assembly
Courtesy of SUZUKI OF AMERICA CORP.

8. Position two 58 cm (23 in) engine support fixture cross bars (1) longitudinally with two J 36462-A leg assembly (2).
9. Install two J 28467-1A clamp (3) to secure the longitudinal mounted cross bar to the transverse mounted cross bar.

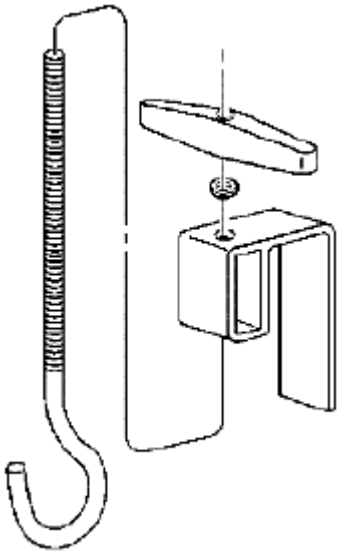


Fig. 933: Identifying Lift Hook Wing Nut J-28467-34 And Lift Hook Bracket J-28467-6A
Courtesy of SUZUKI OF AMERICA CORP.

10. Assemble the lift hook wing nut J-28467-34 and the lift hook bracket J-28467-6A to the lift hook J-28467-7A.

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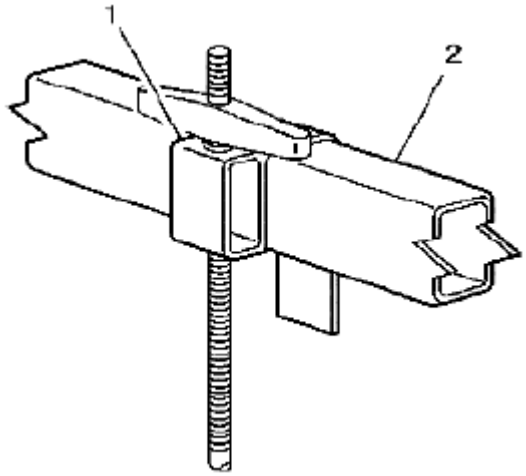


Fig. 934: Identifying Bracket Assembly And Longitudinal Mounted Cross Bar
Courtesy of SUZUKI OF AMERICA CORP.

11. Install the lift hook and bracket assembly (1) to the longitudinal mounted cross bar (2).

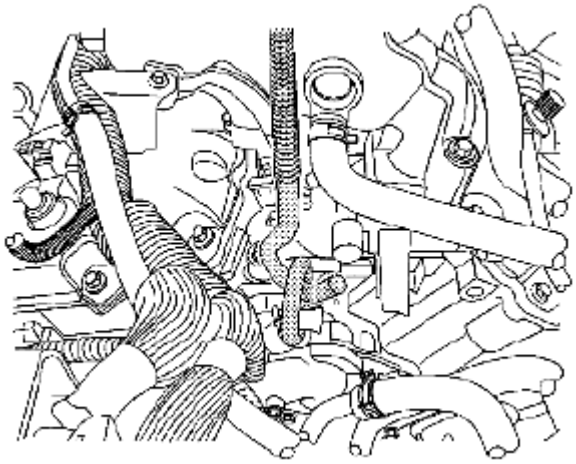


Fig. 935: Identifying J 28467-7A Lift Hook And Rear Engine Lift Bracket J-42451-1
Courtesy of SUZUKI OF AMERICA CORP.

12. Position the J 28467-7A lift hook to the rear engine lift bracket J-42451-1 (2).

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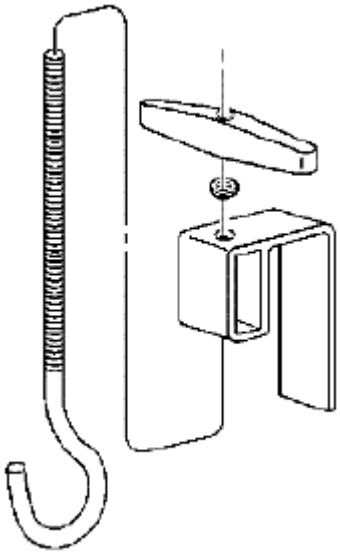


Fig. 936: Identifying Lift Hook Wing Nut J-28467-34, Lift Hook Bracket J-28467-6A And Lift Hook J-28467-7A
Courtesy of SUZUKI OF AMERICA CORP.

13. Assemble the lift hook wing nut J-28467-34 and the lift hook bracket J-28467-6A to the lift hook J-28467-7A.

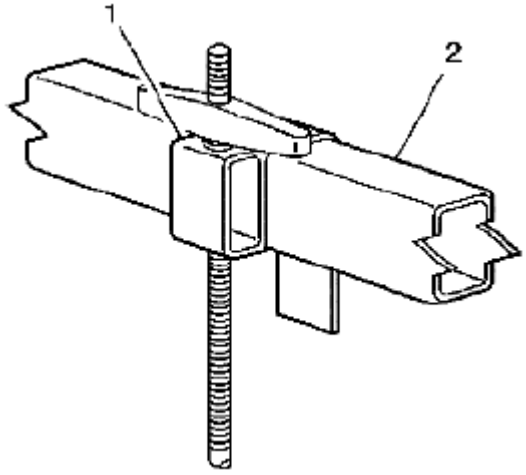


Fig. 937: Identifying Lift Hook And Bracket Assembly And Longitudinal Mounted Cross Bar
Courtesy of SUZUKI OF AMERICA CORP.

14. Install the lift hook and bracket assembly (1) to the longitudinal mounted cross bar (2).

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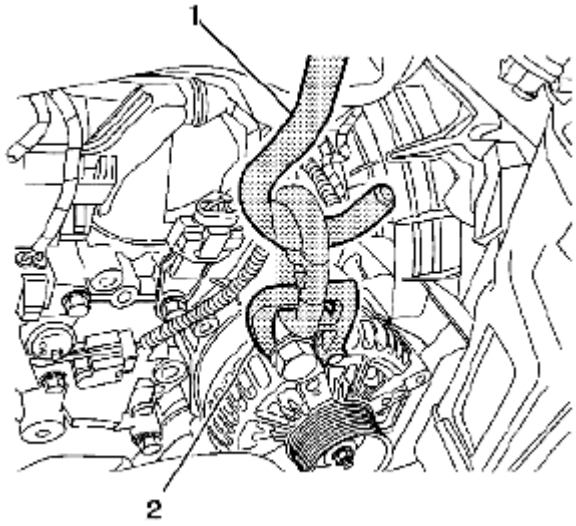


Fig. 938: Identifying J 28467-7A Bolt Hook And Front Engine Lift Bracket J-42451-1
Courtesy of SUZUKI OF AMERICA CORP.

15. Position the J 28467-7A bolt hook (1) to the front engine lift bracket J-42451-1 (2).

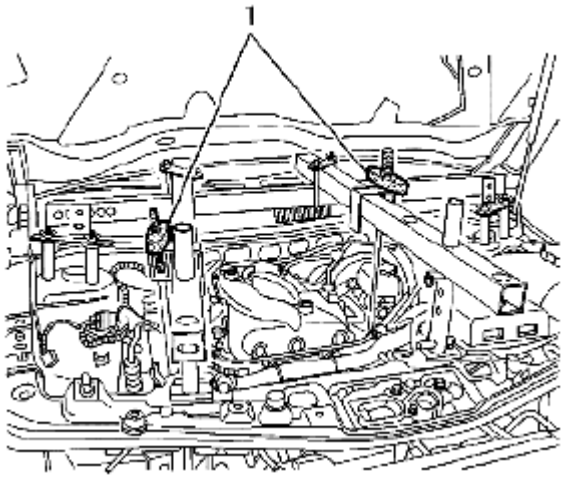


Fig. 939: Identifying Wing Nuts J-28467-34
Courtesy of SUZUKI OF AMERICA CORP.

16. Evenly tighten both wing nuts J-28467-34 (1) until the engine weight is supported by the engine support fixture and no longer carried by the engine mounts.

TOOLS AND EQUIPMENT

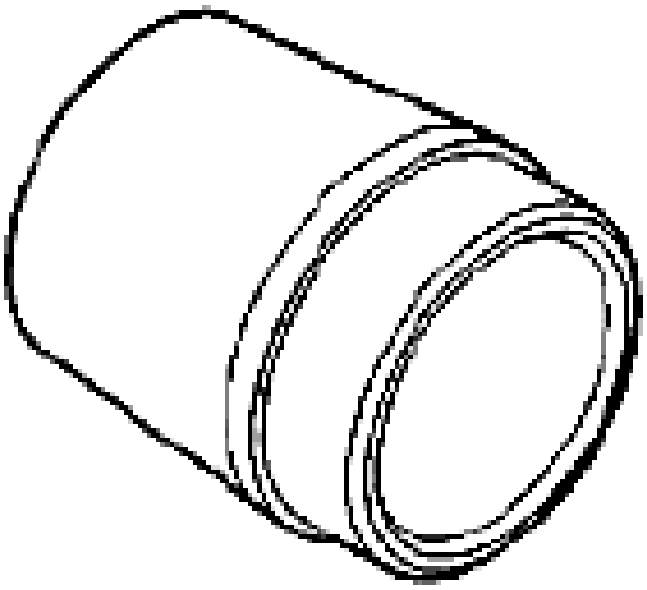
- Special tools are listed and illustrated throughout this information, with a complete listing at the end of the article. These tools, or their equivalents, are designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools also minimize possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. Torque wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

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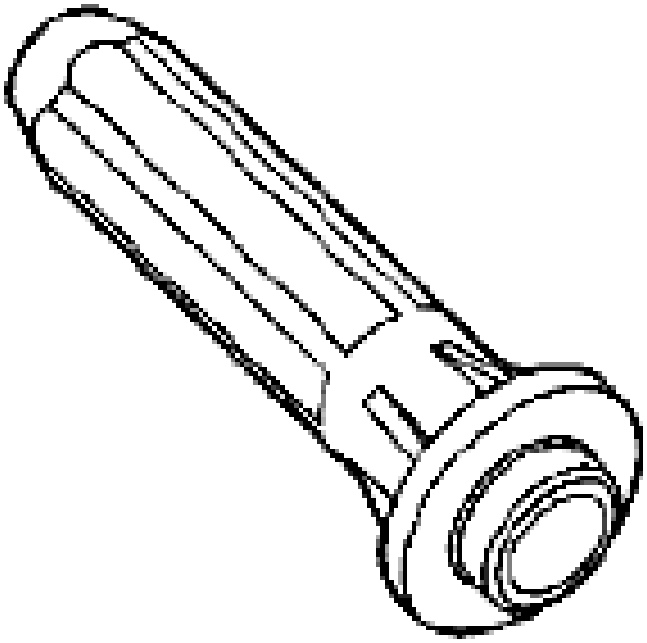
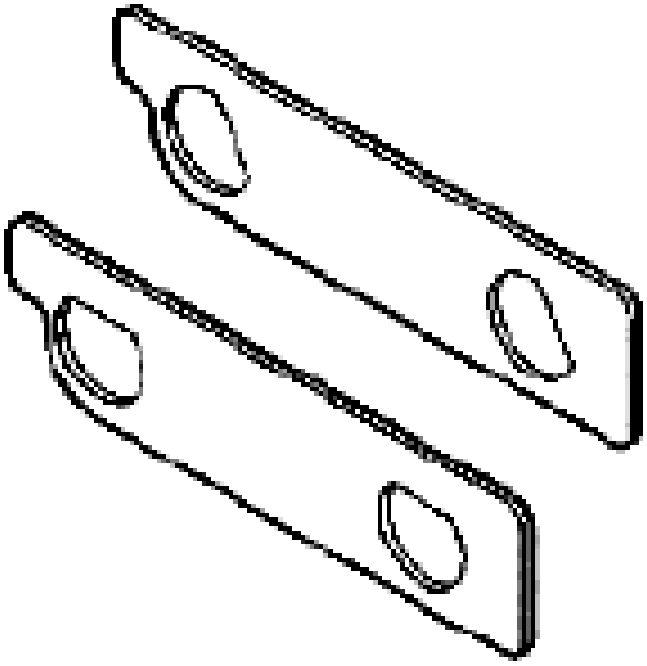
- To properly service the engine assembly, the following items should be readily available:
  - Approved eye protection and safety gloves
  - A clean, well-lit, work area
  - A suitable component cleaning tank
  - A compressed air supply
  - Trays or storage containers to keep components and fasteners organized
  - An adequate set of hand tools
  - Approved engine repair stand
  - An approved engine lifting device that adequately supports the weight of the components

SPECIAL TOOLS - ENGINE MECHANICAL - 3.6L (LY7)

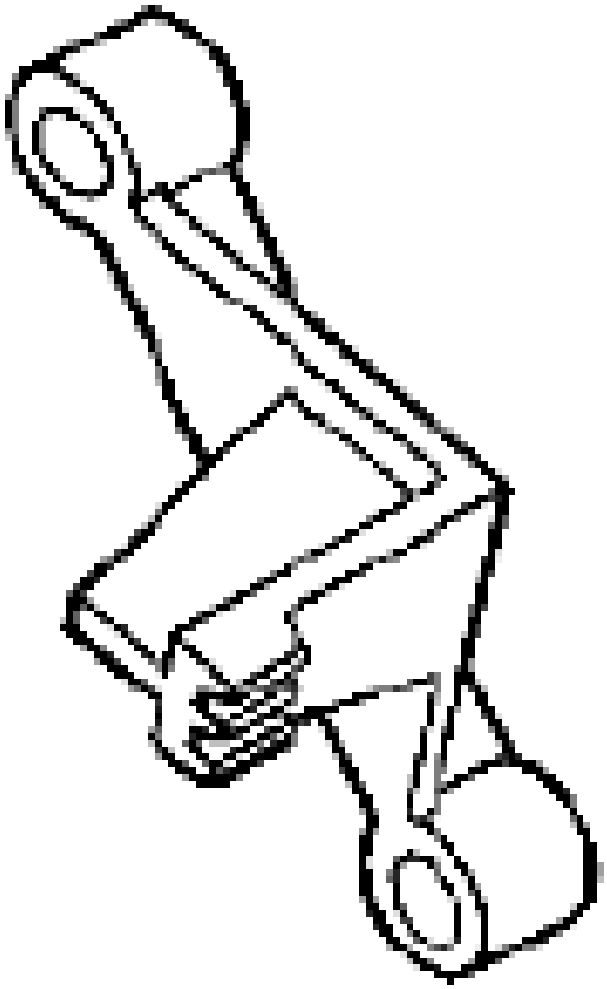
SPECIAL TOOLS - ENGINE MECHANICAL 3.6L (LY7)

Illustration	Tool Number/Description
	EN 46101 Spark Plug Tube Seal Guide
	EN 46103 Camshaft Actuator Valve Seal Remover/Installer

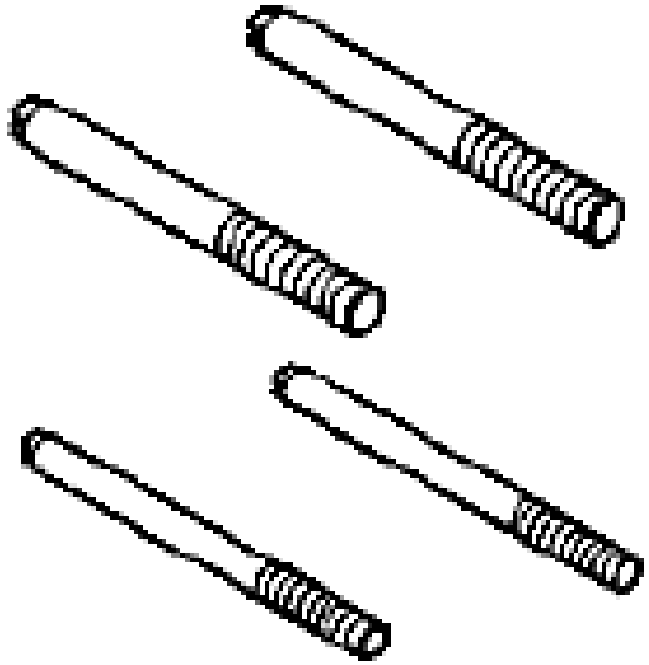
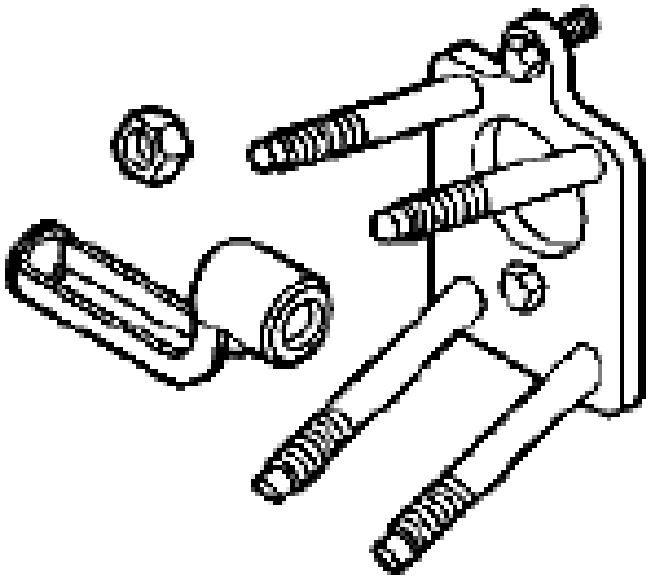
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	EN 46105 Camshaft Locking Tool

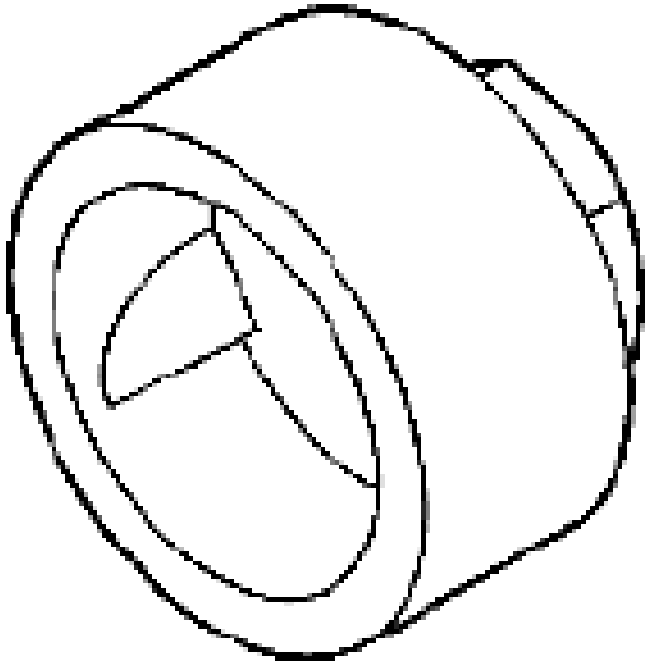
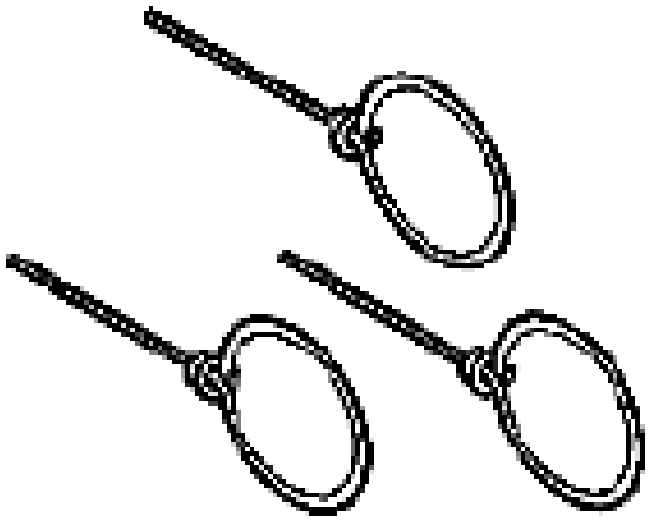
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	EN 46106 Flywheel Holding Tool
	EN 46109 Engine Front Cover Installation Guide Pins

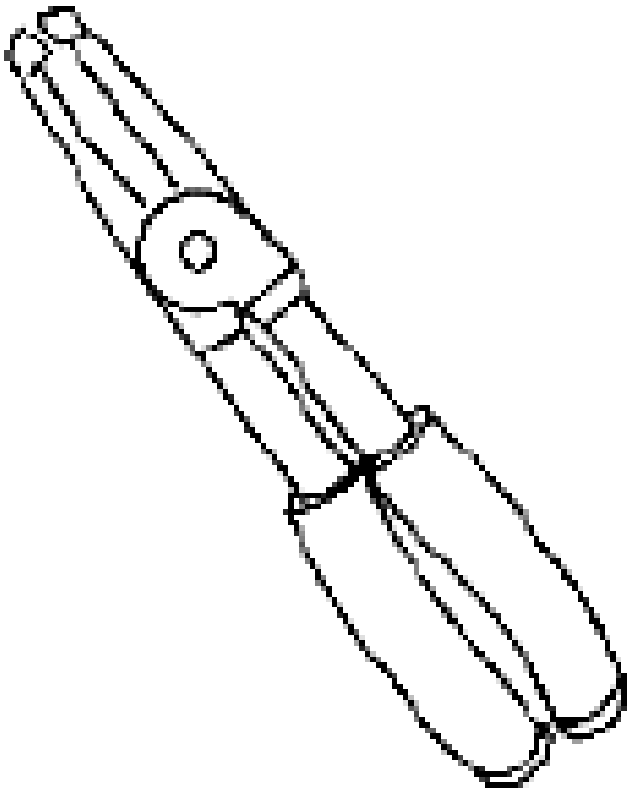
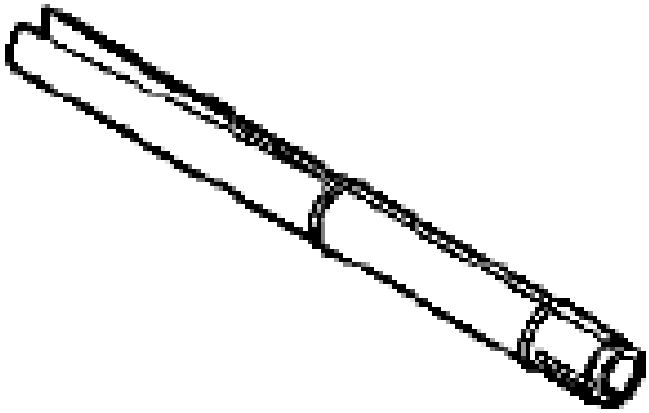
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	EN 46110 On-Vehicle Valve Spring Compressor

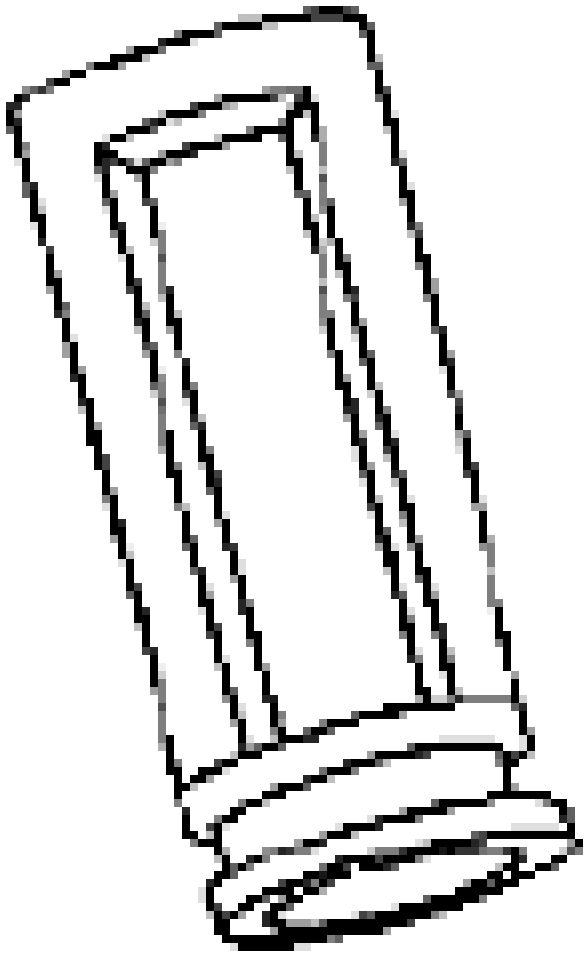
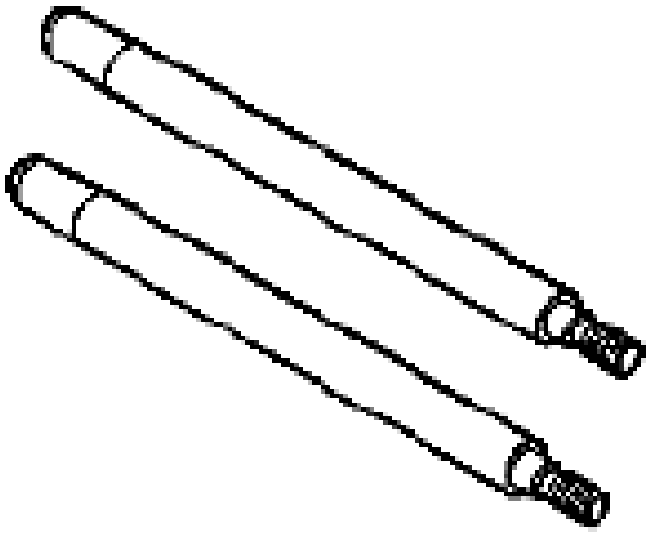
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	EN 46111 Crankshaft Rotation Socket
	EN 46112 Tensioner Retraction Pins

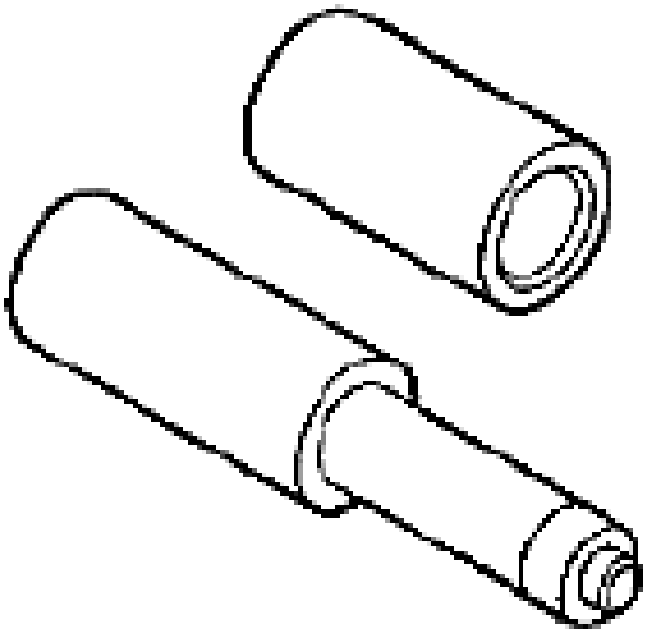
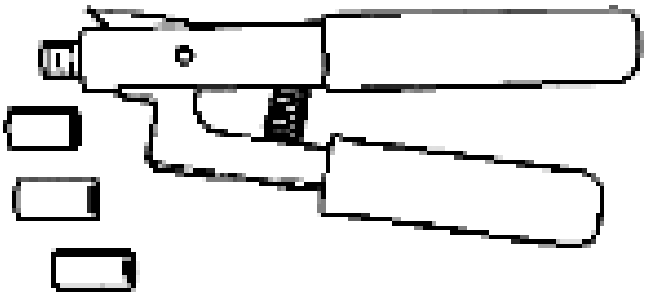
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	EN 46116 Valve Stem Seal Remover/Installer
	EN 46117 Valve Stem Key Remover/Installer

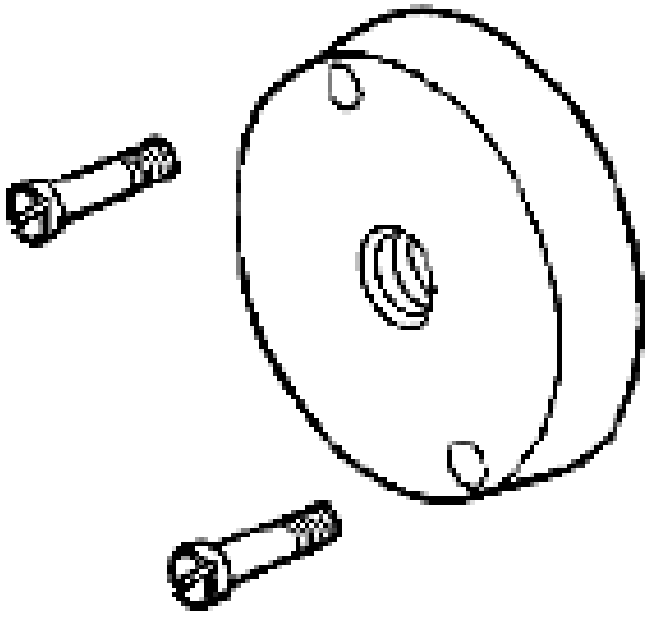
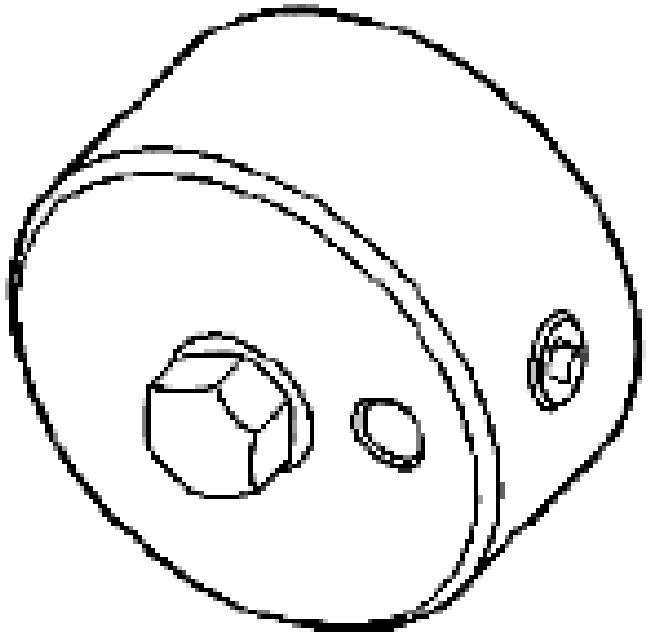
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	EN 46119 Off-Vehicle Valve Spring Compressor Adapter
	EN 46121 Connecting Rod Guide Pin Set

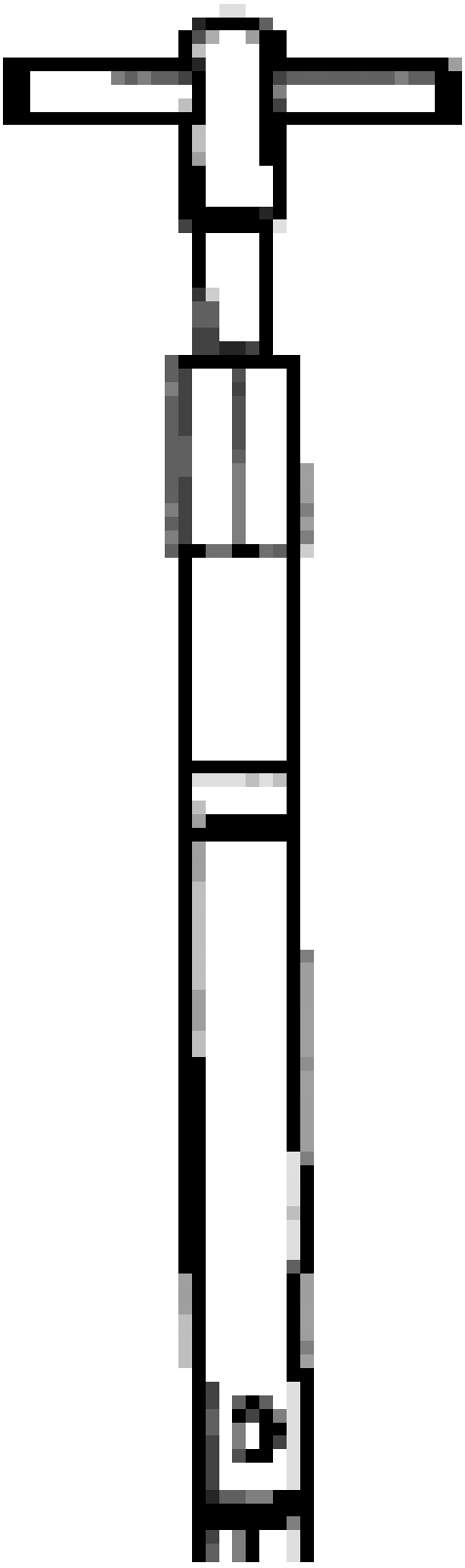
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	EN 46122 Camshaft Position Actuator Check-Ball Valve Remover/Installer
	EN 46745 Piston Pin Clip Remover/Installer
	EN 47839 Crankshaft Rear Oil Seal Installation Tool

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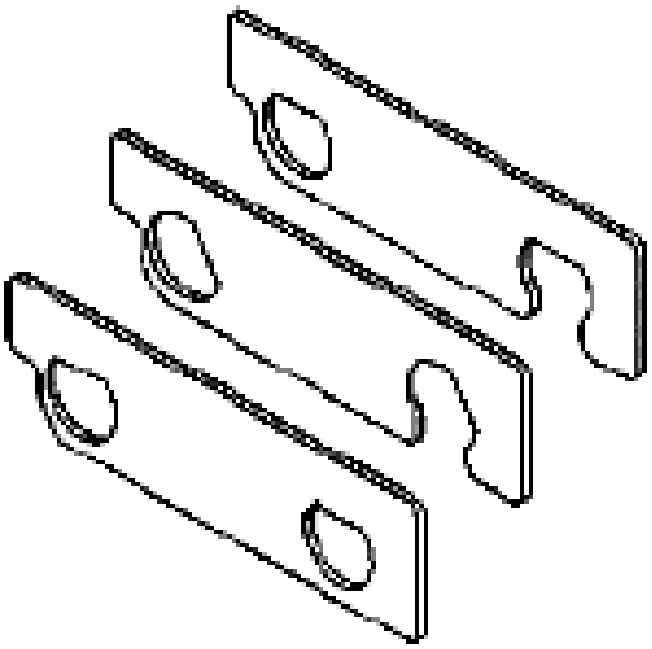
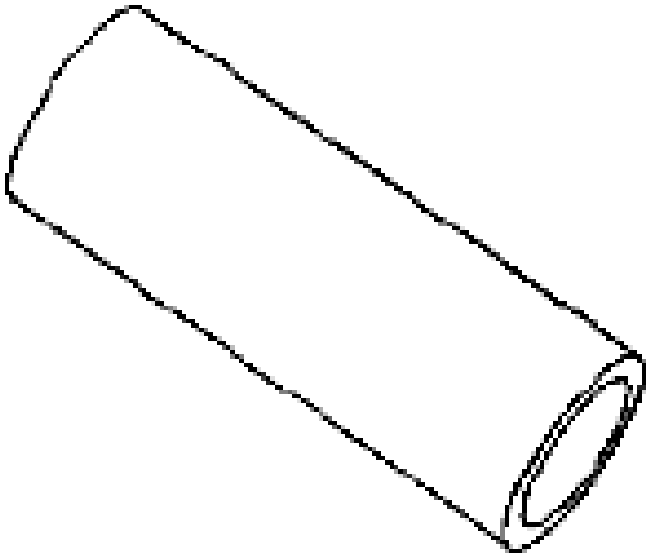
	
	EN 47971 Oil Pressure Gage Adapter

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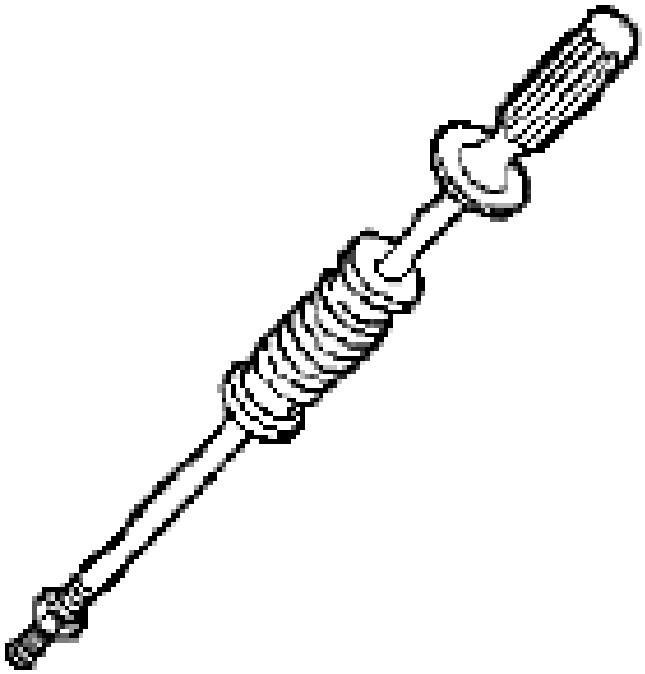
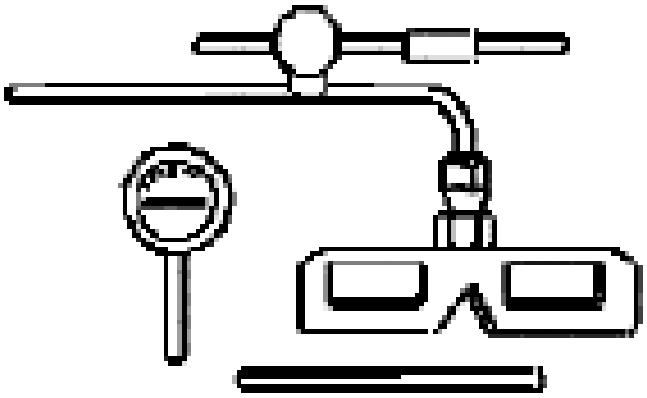


EN 48313
Timing Chain Retention Tool

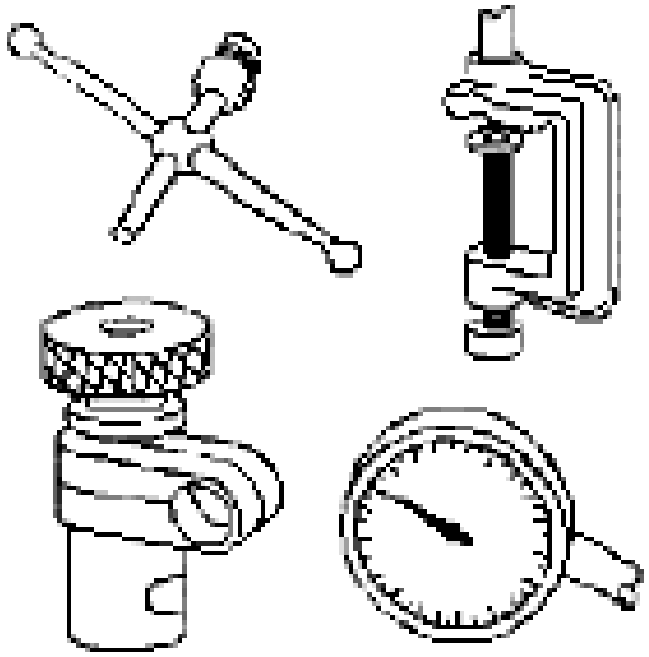
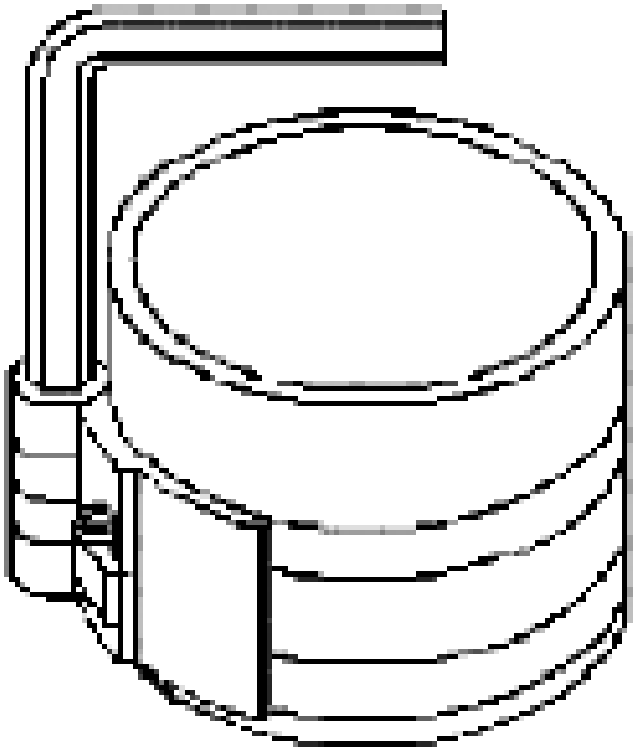
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	EN 48383 Camshaft Retaining Tools
	J 5590 Bearing and Seal Driver

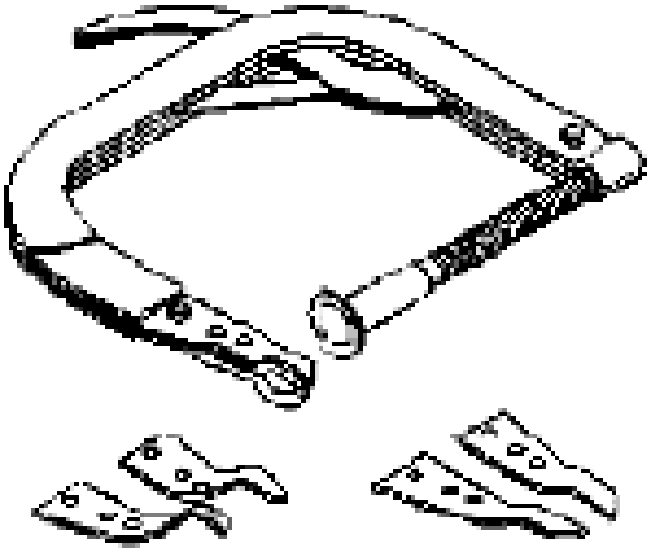
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	J 6125-1B Slide Hammer Adapter
	J 7872 Magnetic Base Dial Indicator
	J 8001 Dial Indicator Set

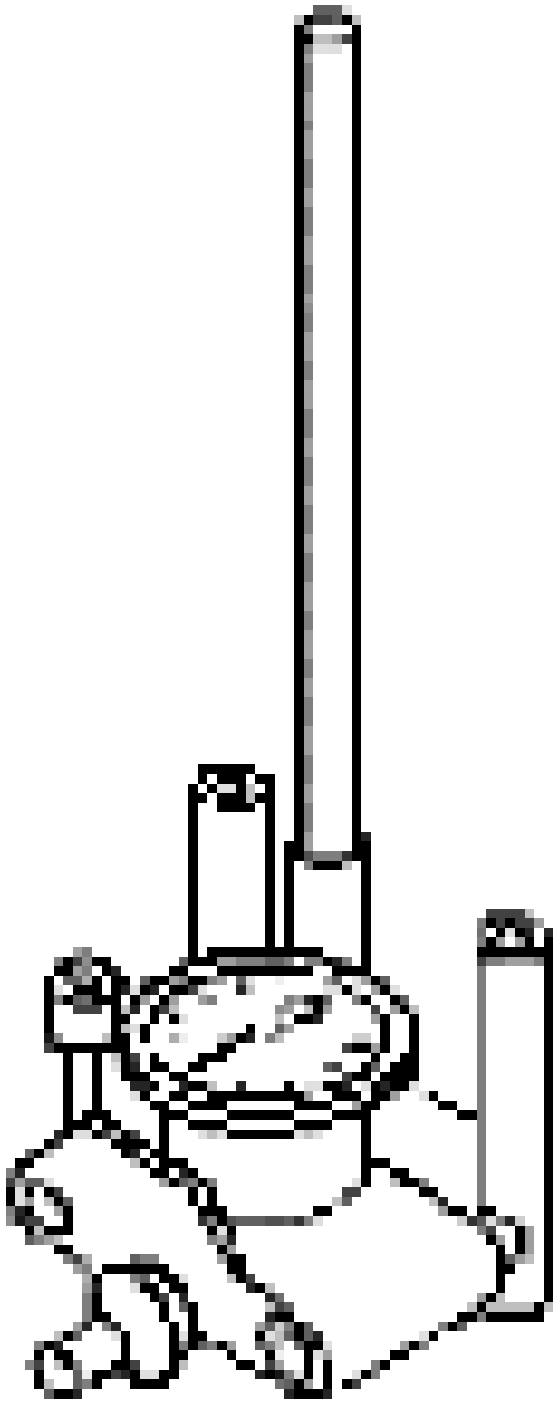
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	J 8037 Ring Compressor

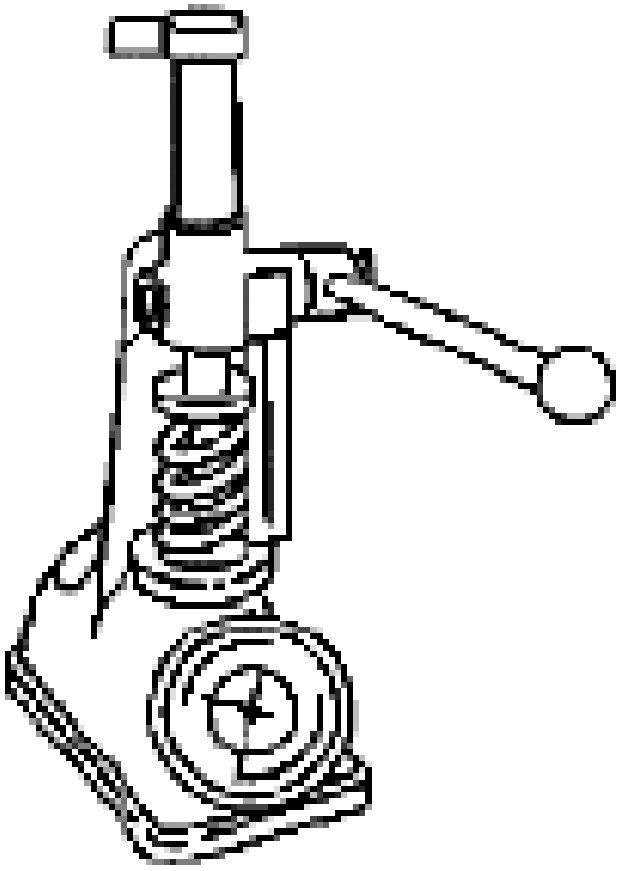
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	J 8062 Valve Spring Compressor - Head Off
	J 8087 Cylinder Bore Gage

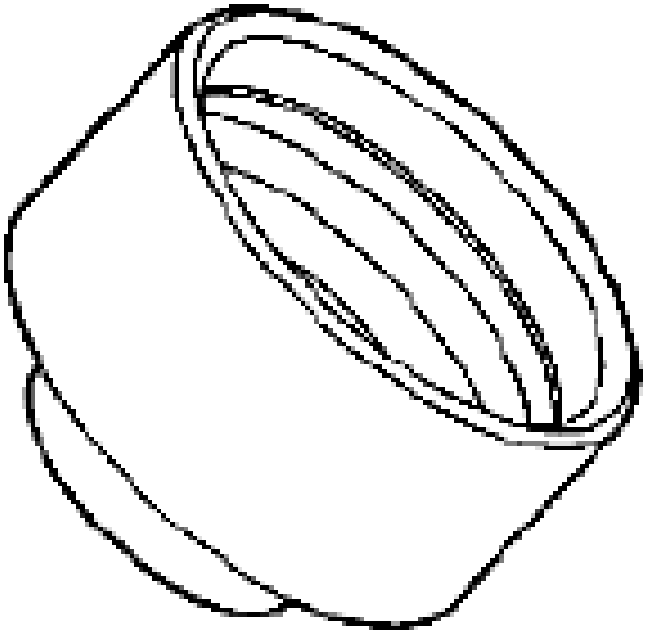
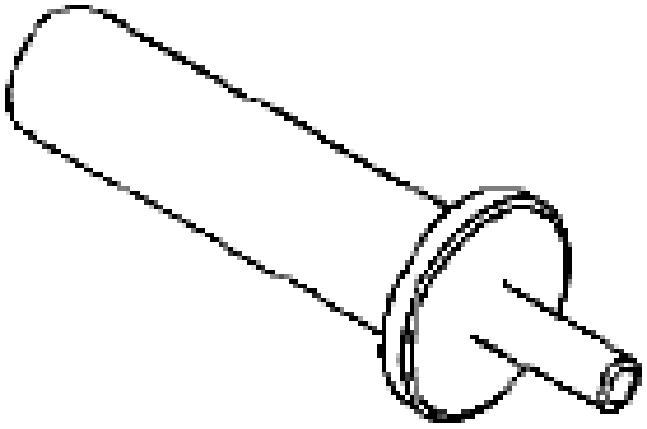
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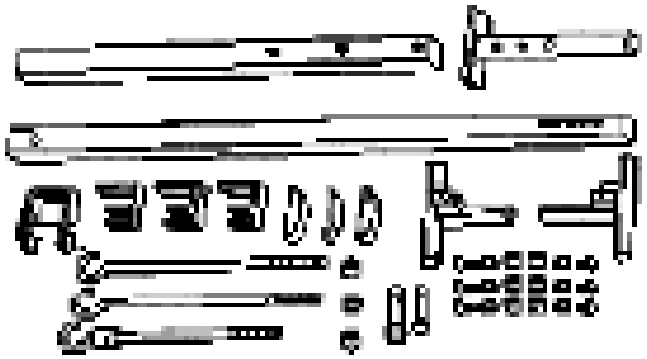
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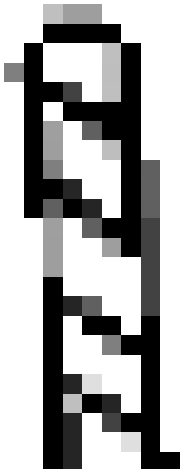
	J 8358 Carbon Removal Brush
	J 22738-B Valve Spring Tester
	J 25254-A Oil Seal Installer

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	J 28410 Gasket Remover
	J 28467 Engine Support Fixture Adapter
	J 28467-B Universal Engine Support Fixture

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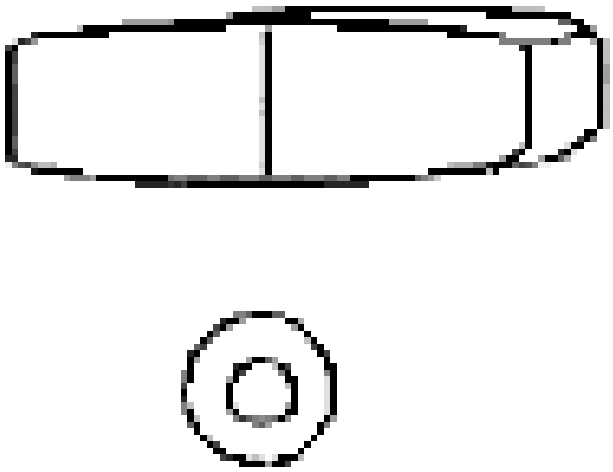
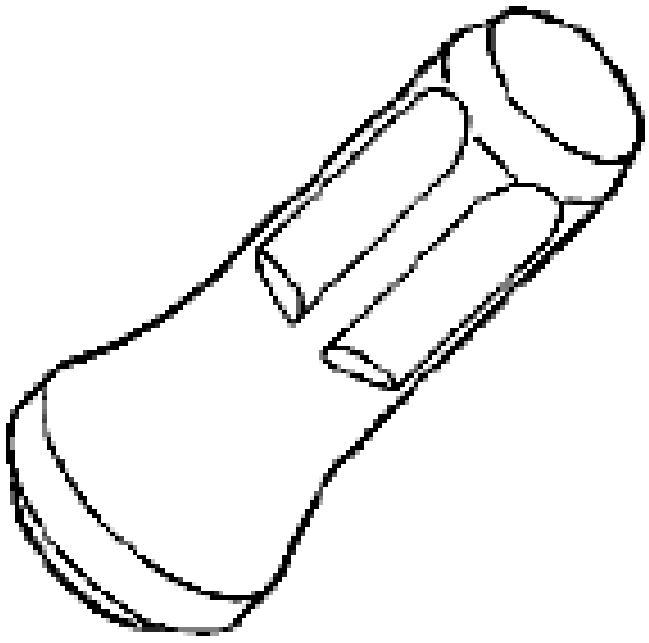




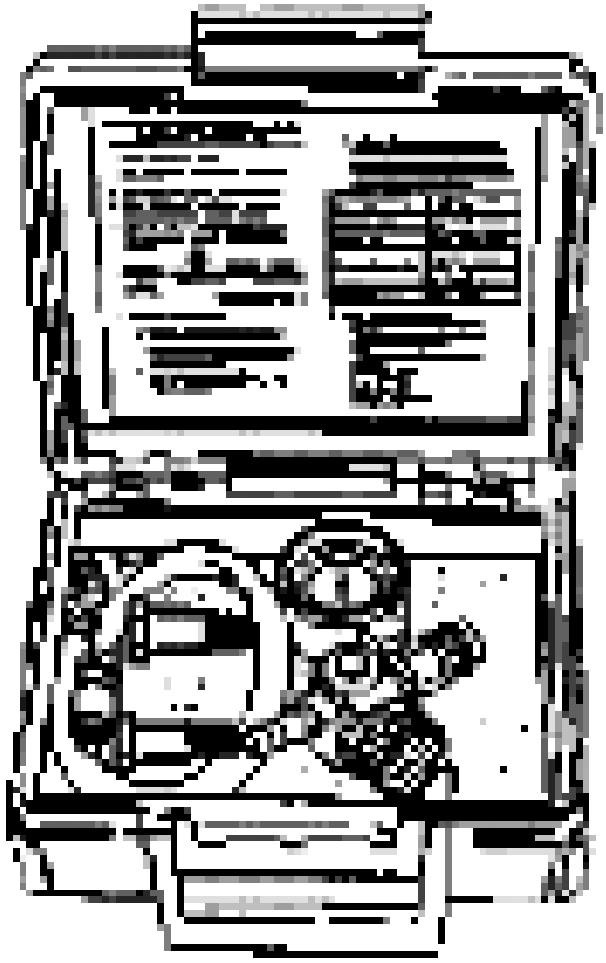
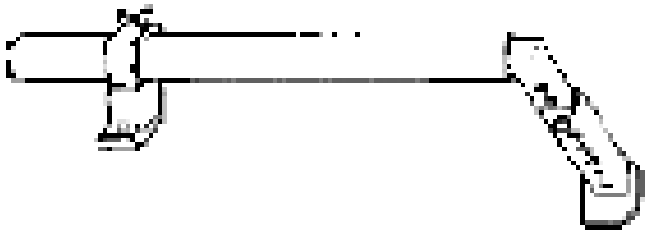
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	J 28467-7A Bolt Hook

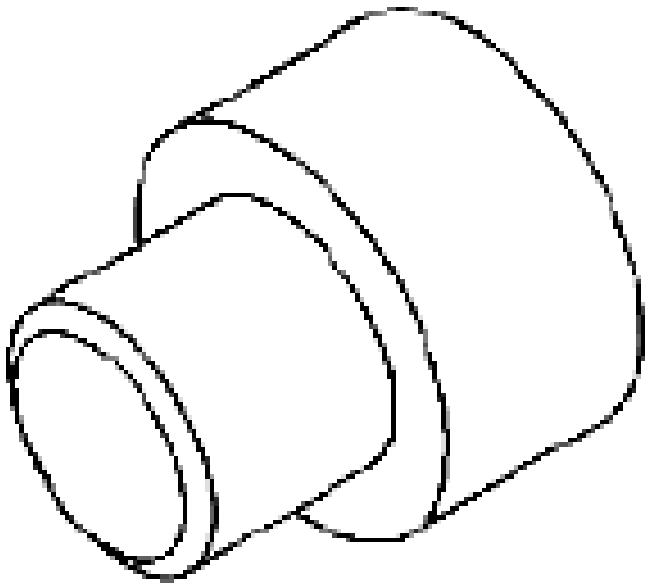
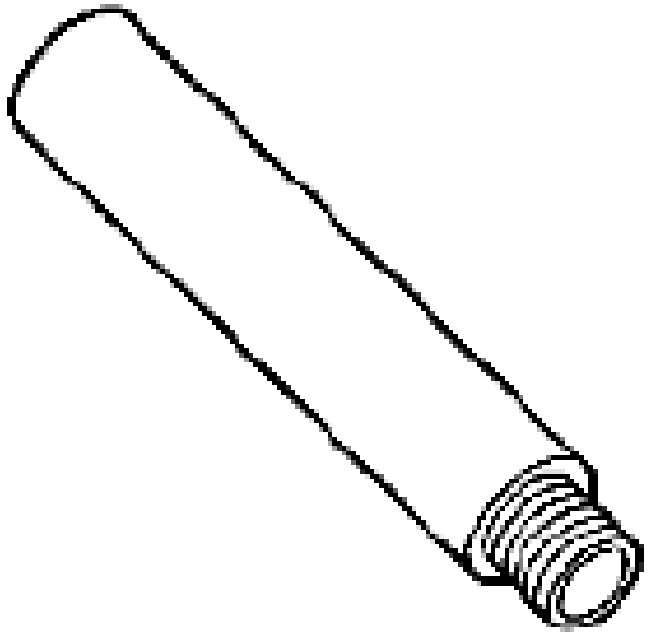
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	J 28467-34 Lift Hook Wing Nut and Washer
	J 29184 Oil Seal Installer

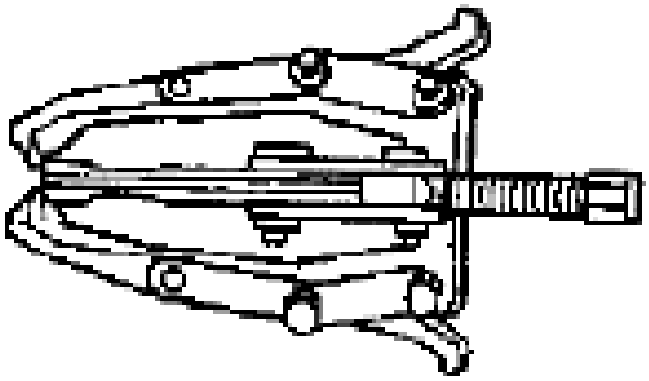
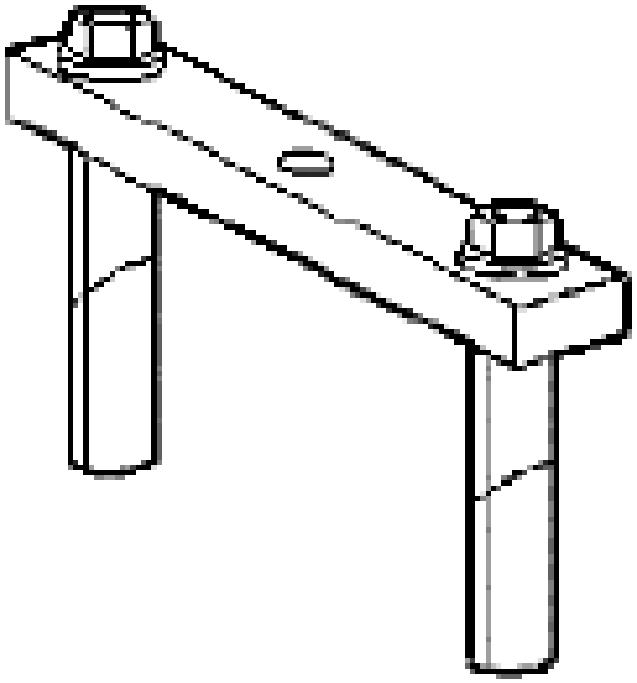
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	J 35667-A Cylinder Head Leakdown Tester
	J 36462-A Engine Support Adapter Leg Set

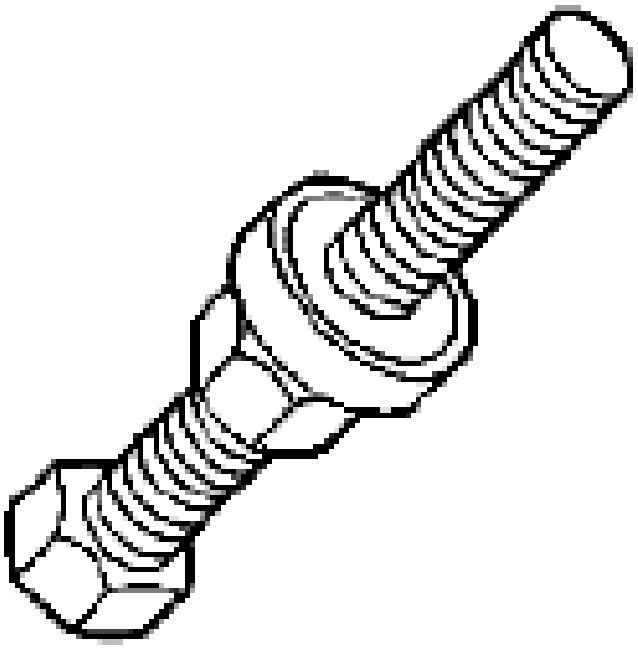
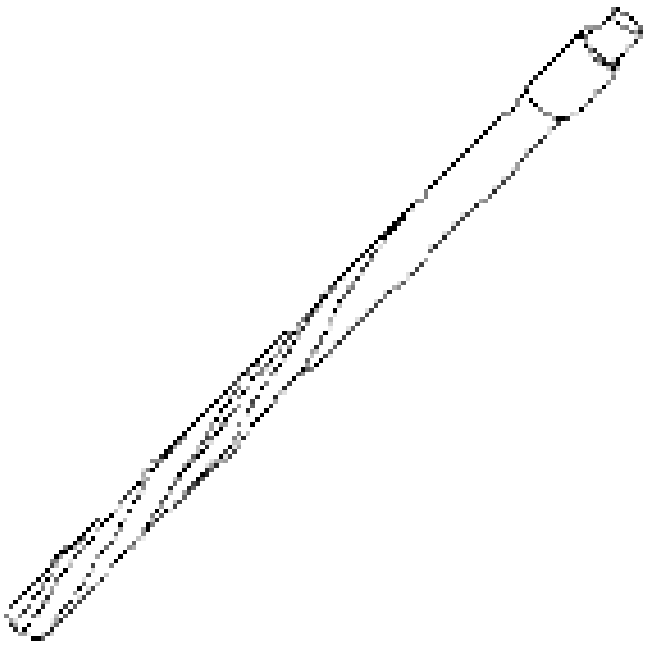
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	J 38416-2 Crankshaft Button
	J 39313 Spark Plug Port Adapter
	J 41816 Crankshaft Balancer Remover

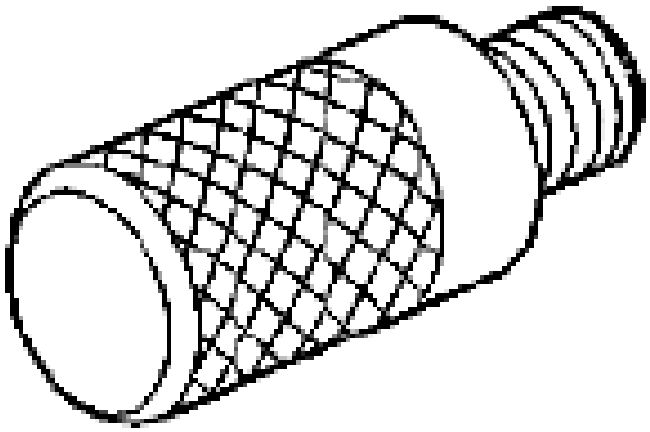
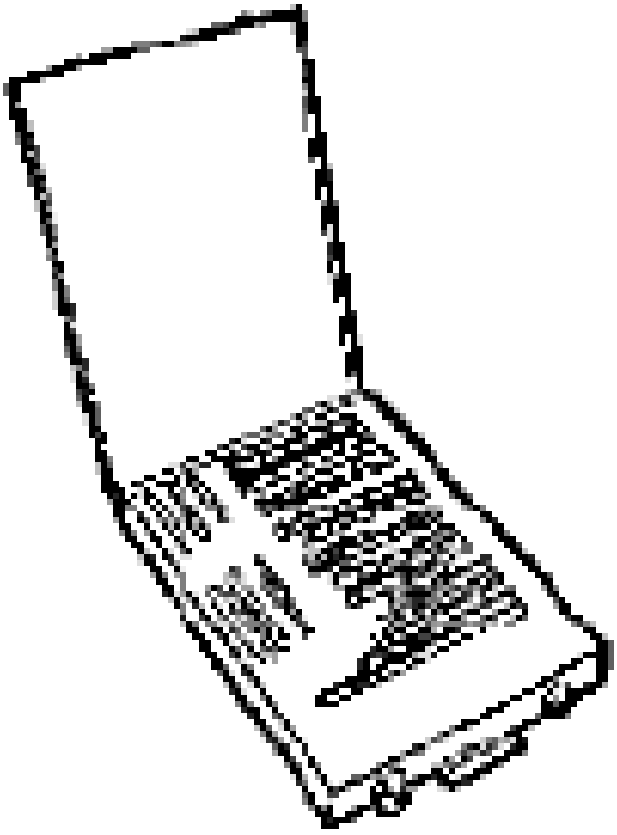
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	J 41818 Crankshaft Bearing Cap Remover
	J 41998-B Crankshaft Balancer Installer

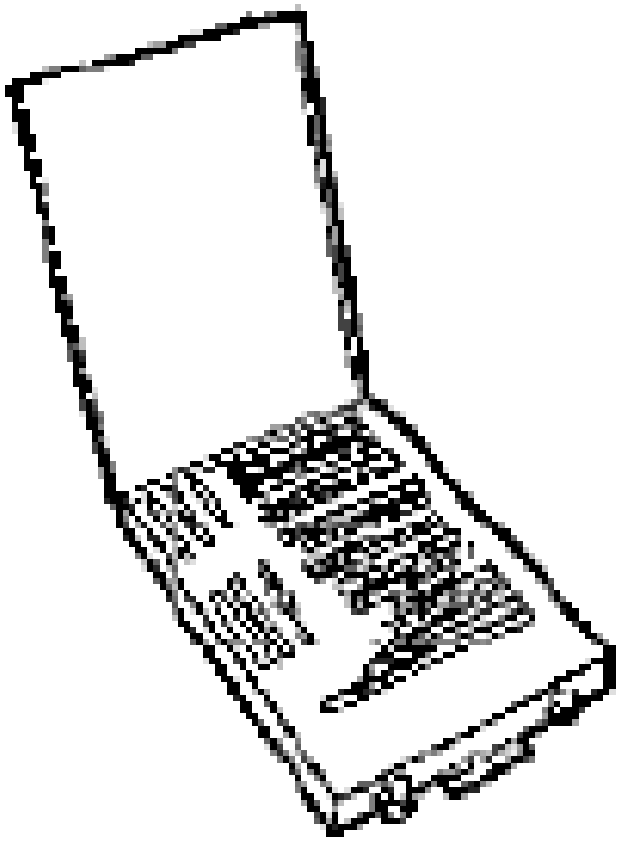
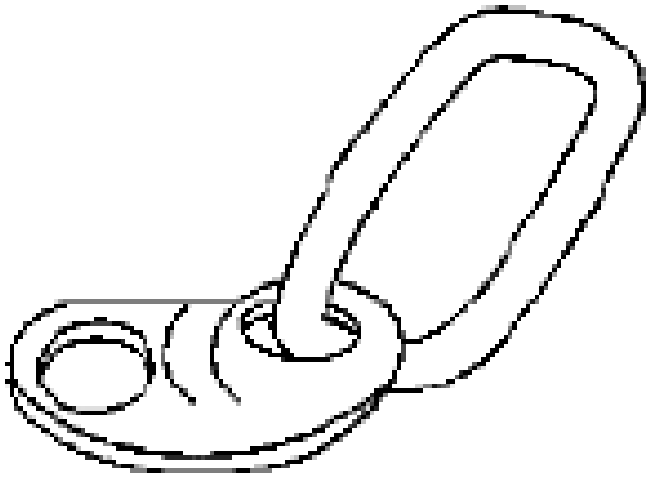
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	J 42096 Valve Guide Reamer
	J 42183

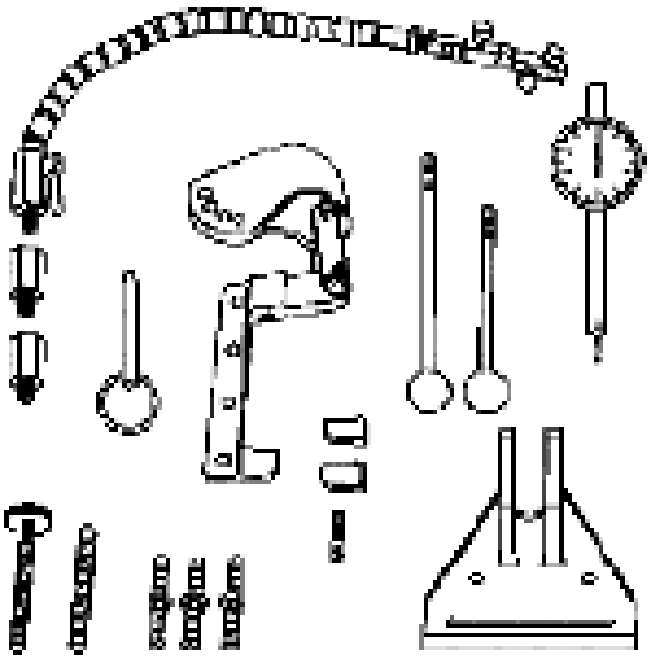
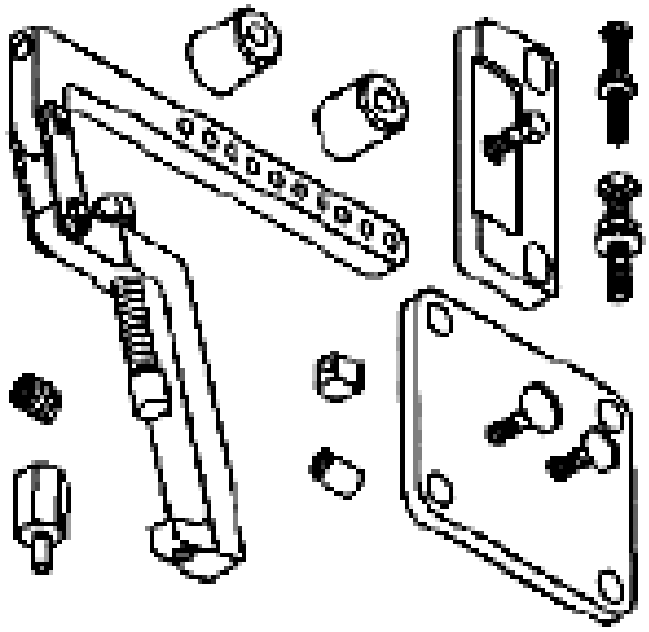
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	Handle
	J 42385-700 High Feature Thread Repair Kit

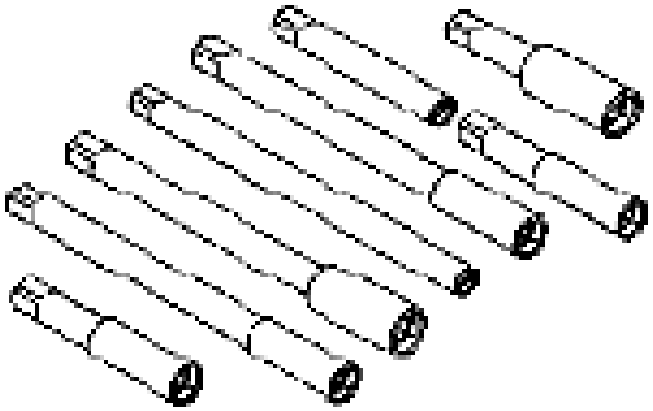
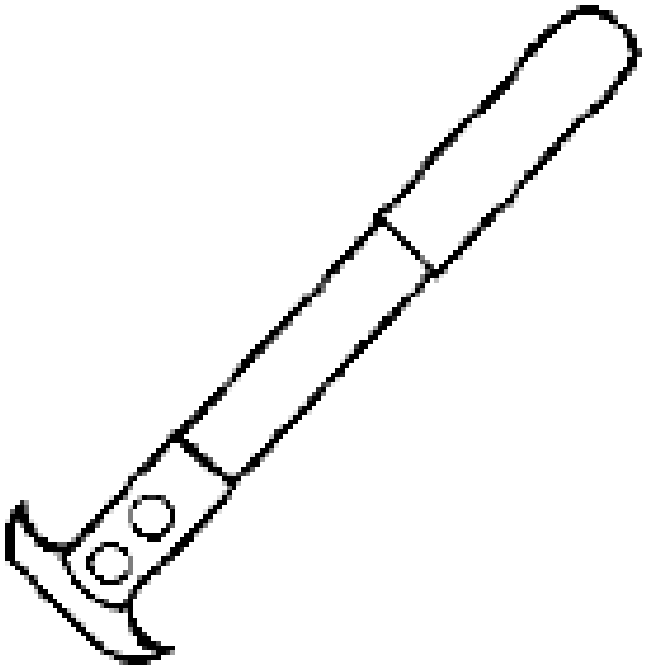
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	J 42385-2000 Thread Insert Kit
	J 42451-1 Engine Support Fixture

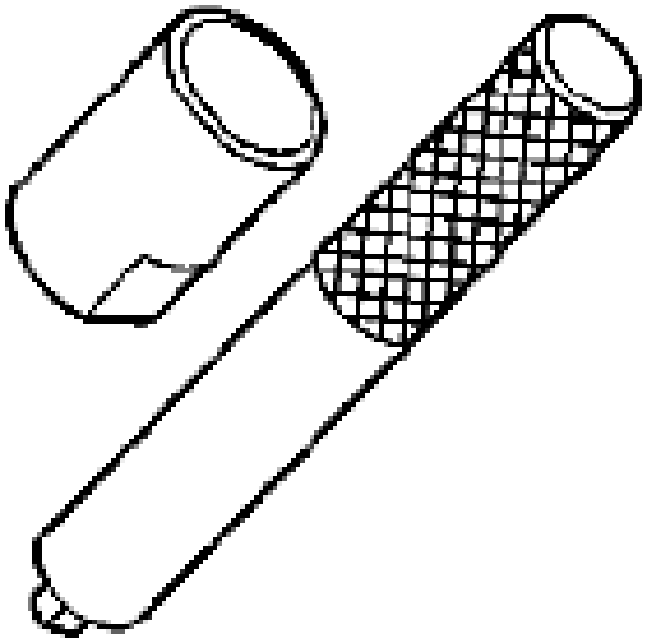
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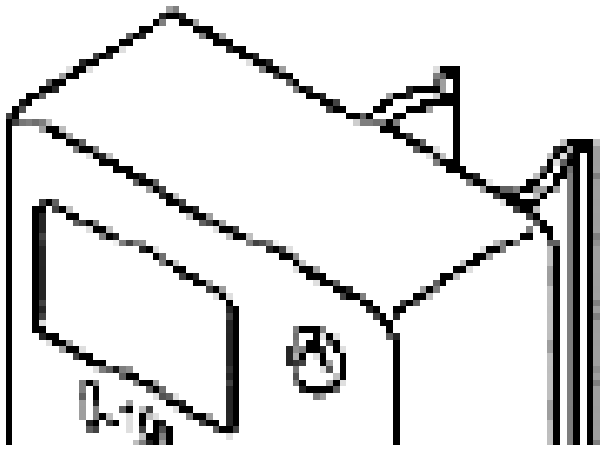
	J 43690 Rod Bearing Clearance Checking Tool
	J 43690-100 Rod Bearing Clearance Checking Tool - Adapter Kit
	J 43965 Thread Repair Extension Kit

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	J 45000 Seal Remover
	J 45027 Tensioner Tool

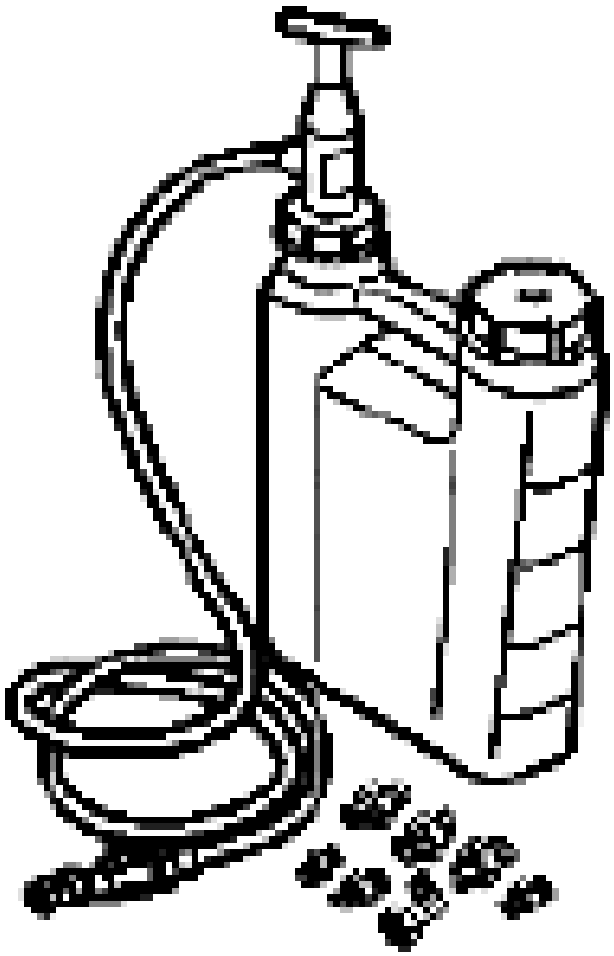
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J 45059
Angle Meter

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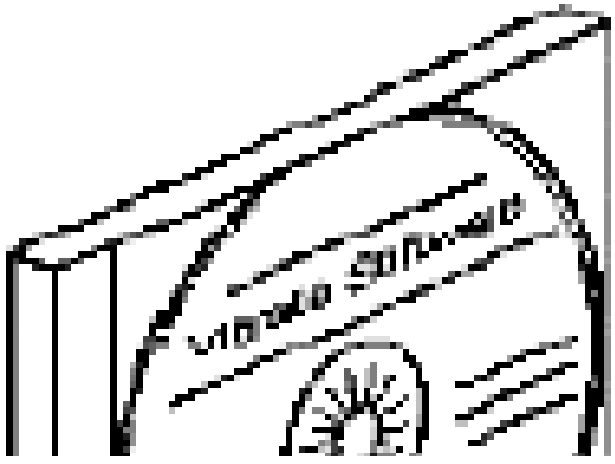
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SPECIAL TOOLS - VIBRATION DIAGNOSIS AND CORRECTION

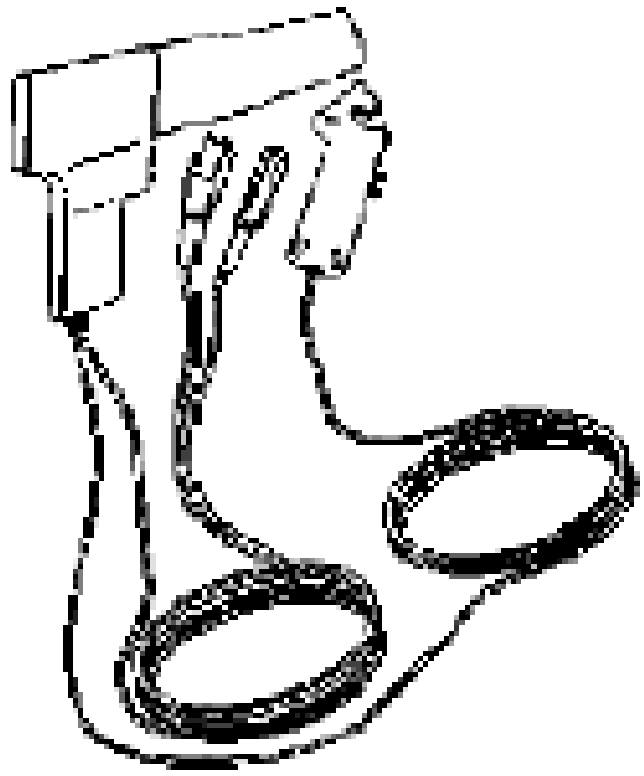
SPECIAL TOOLS - VIBRATION DIAGNOSIS AND CORRECTION

Illustration	Tool Number/Description
	J 38792-A Electronic Vibration Analyzer 2

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	J 38792-VS Vibrate Software

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	J 38792-25 Inductive Pickup Timing Light

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