

1.6L 4-CYL - VIN [A] & 1.8L 4-CYL - VIN [A]

1993 Toyota Celica

1993 TOYOTA ENGINES
1.6L & 1.8L 4-Cylinder

Celica, Corolla

* PLEASE READ THIS FIRST *

NOTE: For engine repair procedures not covered in this article, see ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION article in the GENERAL INFORMATION section.

ENGINE IDENTIFICATION

Vehicle Identification Number (VIN) is located on top of dash panel, near lower left corner of windshield. Engine may be identified by the eighth character of VIN.

Engine identification serial number may be required when ordering replacement parts. Serial number is located on exhaust side cylinder block, near flywheel.

ENGINE IDENTIFICATION CODES TABLE

Application	Engine Code	VIN Code
Celica & Corolla		
1.6L 4-Cylinder PFI	4A-FE	A
1.8L 4-Cylinder PFI	7A-FE	A

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

NOTE: Adjust valve clearance with engine cold.

1) Disconnect negative battery cable. Disconnect all necessary control cables, hoses and electrical connections. Remove valve cover and gasket.

2) Rotate crankshaft so cylinder No. 1 is at TDC of compression stroke. Ensure timing mark on crankshaft pulley aligns with "0" mark on timing belt cover.

3) Using feeler gauge, check clearance between camshaft lobe and adjusting shim for the following: all valves on cylinder No. 1, intake valves on cylinder No. 2 and exhaust valves on cylinder No. 3. Record all readings.

4) Rotate crankshaft 360 degrees. Check clearance between camshaft lobe and adjusting shim for the following: all valves on cylinder No. 4, intake valves on cylinder No. 3 and exhaust valves on cylinder No. 2. If clearance is not within specification, adjust by replacing adjusting shim. See VALVE CLEARANCE SPECIFICATIONS table.

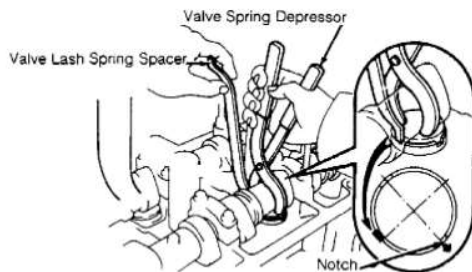
VALVE CLEARANCE SPECIFICATIONS TABLE

Application	Clearance In. (mm)
Exhaust	(1) .010-.014 (.25-.35)
Intake	(1) .006-.010 (.15-.25)

(1) - Adjust valve clearance with engine cold.

5) To adjust exhaust valves, rotate engine until camshaft lobe faces away from valve to be adjusted. Insert Valve Spring Depressor (09248-05011) between camshaft and adjusting shim. See Fig. 1.

6) Install Valve Lash Spring Spacer (09248-05021) between camshaft and valve lifter. Ensure bottom edge of valve lash spring spacer contacts valve lifter, NOT adjusting shim. Remove valve spring depressor. Using small screwdriver and magnet, remove adjusting shim from valve lifter.



93G82319

Fig. 1: Adjusting Valve Clearance
Courtesy of Toyota Motor Sales, U.S.A., Inc.

7) To adjust intake valves, manufacturer recommends removal of intake camshaft. See CAMSHAFTS under REMOVAL & INSTALLATION. Remove old adjusting shim and replace with shim of correct thickness.

8) To determine correct adjusting shim thickness for shim replacement, measure and record thickness of removed shim. Locate measured values of removed shim and valve clearance on appropriate adjusting shim selection chart to determine correct shim thickness. See Figs. 2 and 3.

9) Install correct shim thickness to obtain proper clearance. See VALVE CLEARANCE SPECIFICATIONS table. Repeat procedure as necessary. Before installing valve cover, apply Sealant (08826-00080) at valve cover-to-camshaft bearing cap and cylinder head surfaces. To complete installation, reverse removal procedure.

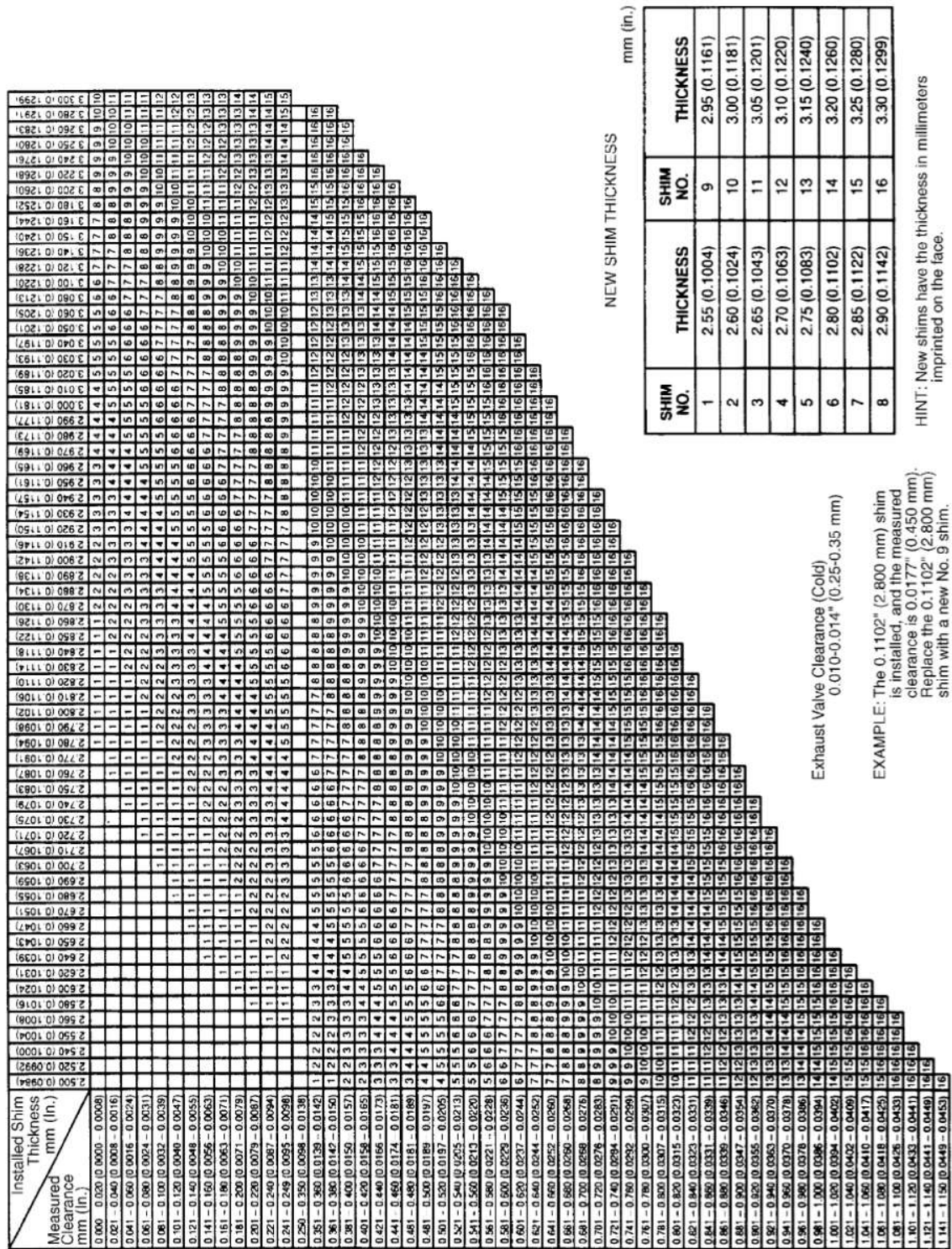


Fig. 2: Exhaust Valve Adjusting Shim Selection Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

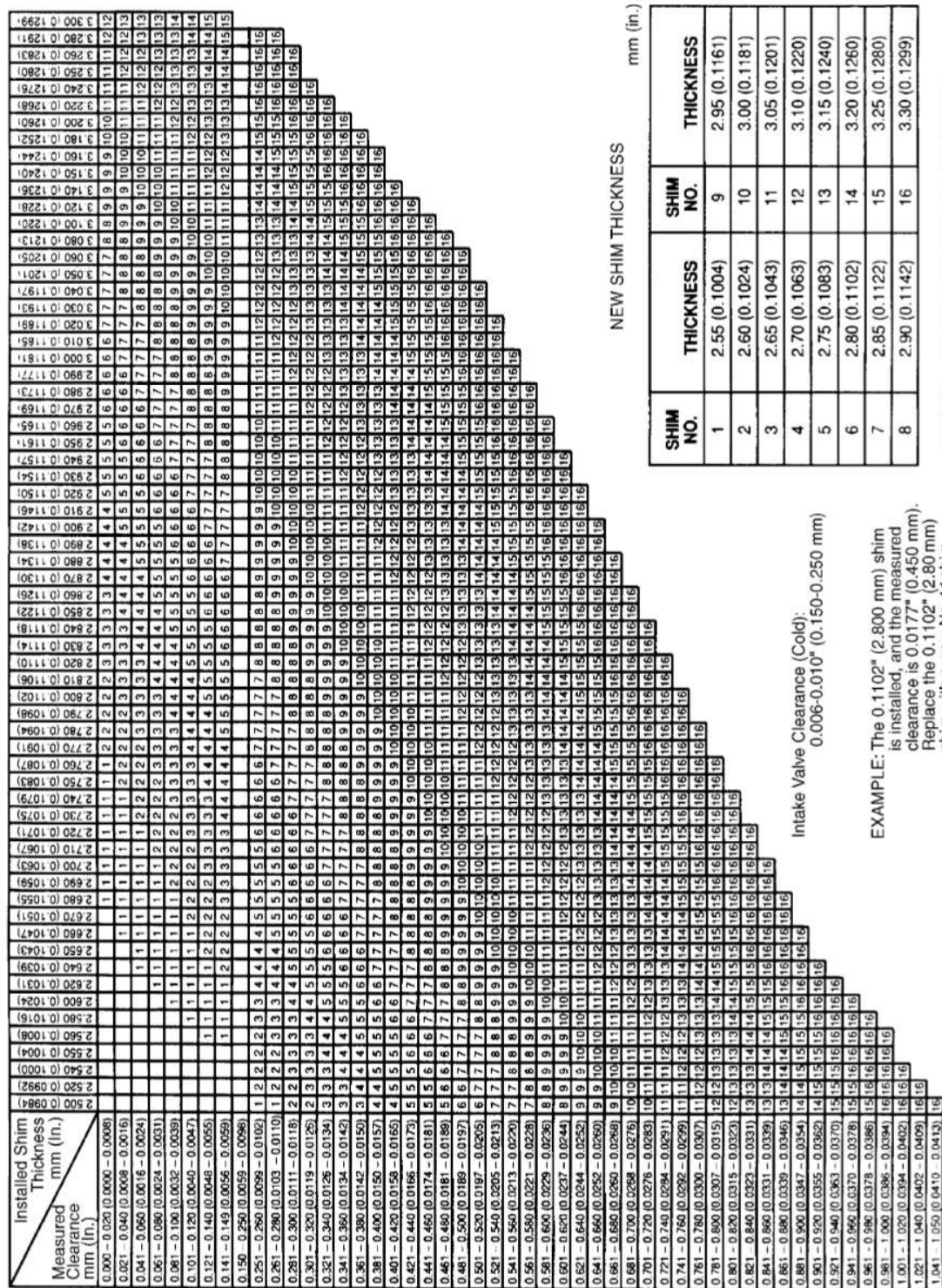


Fig. 3: Intake Valve Adjusting Shim Selection Chart
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REMOVAL & INSTALLATION

NOTE: For installation reference, label all electrical connectors, vacuum hoses and fuel lines before removing. Also place mating marks on engine hood and other major assemblies before removing.

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

FUEL PRESSURE RELEASE

Loosen fuel tank cap to release fuel tank pressure. Unplug circuit opening relay, located behind radio. Crank engine or start engine and allow to stall. Wrap fuel component or fitting with shop towel during removal. Disconnect component.

ENGINE

NOTE: Engine and transaxle are removed as an assembly.

Removal

1) Release fuel pressure. See FUEL PRESSURE RELEASE.

Disconnect battery cables, and remove battery. Remove hood.

2) Drain engine oil and cooling system. Disconnect necessary coolant hoses and fuel lines. Remove air intake duct and control cables from throttle body. Remove air cleaner.

3) Disconnect necessary vacuum hoses. Disconnect the following electrical connections: A/C SV valve, MAP sensor, data link connector, A/C triple switch and engine ground wires. Remove mounting bolts from engine relay box. Remove cruise control actuator (if equipped). On A/T models, disconnect shift cable and oil cooler lines from transaxle. On M/T models, disconnect clutch and shift control cables.

4) On all models, disconnect speedometer cable at transaxle. Remove coolant recovery bottle and bracket. Remove radiator and cooling fan. Remove power steering pump and A/C compressor (if equipped) with hoses attached and set aside.

5) Remove knee bolster, glove box and center console from vehicle. Remove radio. Remove one bolt and set aside left-side carpet bracket. Remove cruise control module mounting bolts and set aside. Disconnect PCM. From engine compartment side, pull wiring harness and grommet through firewall.

6) Raise and support vehicle. Remove lower engine covers. Drain transaxle fluid. Disconnect exhaust pipe at exhaust manifold. Disconnect oxygen sensor connector. Remove front wheels.

7) Remove tie rod nuts from left and right steering knuckle. Separate tie rods from steering knuckles. Remove lower ball joints from steering knuckles. Separate lower control arms from steering knuckles.

8) Using a pry bar or large screwdriver, pry axle shafts from transaxle case. Support engine with hoist. Remove bolt from engine mount near timing belt cover. Remove transaxle mount bolts. If necessary, remove crossmember located below transaxle. Remove engine and transaxle. Separate engine from transaxle.

Installation

1) To install, reverse removal procedure. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS.

2) Adjust all control cables. Adjust fluid levels. On A/T models, fill transaxle with Dexron-II. On M/T models, fill transaxle

with SAE 75W-90 GL-5 gear lubricant.

INTAKE MANIFOLD

Removal

1) Disconnect negative battery cable. Remove air intake ducting. Disconnect vacuum hoses from fuel pressure regulator, brake booster and A/C idle actuator.

2) Remove intake manifold brace. Disconnect fuel hose from fuel pressure regulator. Remove metal vacuum lines from intake manifold. Remove EGR valve and vacuum modulator.

3) Disconnect vacuum and electrical connections from throttle body. Remove throttle body from upper intake chamber. Remove fuel inlet hose. Remove upper intake chamber cover.

CAUTION: Do not drop fuel injectors when removing fuel rail. Damage to injectors may result.

4) Remove electrical connections from fuel injectors. Remove fuel rail mounting bolts and remove fuel rail with injectors. Remove 4 insulators and 2 spacers from intake manifold. Remove intake manifold mounting nuts and ground strap. Remove intake manifold from cylinder head.

Inspection

Check intake manifold surface for warpage. Replace intake manifold if warpage exceeds .008" (.20 mm).

Installation

1) Install new intake manifold gasket. Install new injector insulators in intake manifold. Install fuel rail with injectors, ensure injectors rotate freely. If injectors do not rotate freely "O" rings may not be properly installed.

2) To complete installation, reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS. Fill cooling system.

EXHAUST MANIFOLD

Removal

1) Disconnect negative battery cable. Remove heat shield from exhaust manifold. If necessary, disconnect oxygen sensor wiring connector. Remove exhaust manifold brace.

2) Remove warm up catalyst (California models). Disconnect exhaust pipe from exhaust manifold. Remove exhaust manifold bolts/nuts, exhaust manifold and gasket.

Inspection

Check exhaust manifold for cracks and warpage. Replace exhaust manifold if warpage exceeds .011" (.28 mm).

Installation

To install, reverse removal procedure. Tighten bolts/nuts to specification. See TORQUE SPECIFICATIONS.

CYLINDER HEAD

Removal

1) Remove intake and exhaust manifolds. See INTAKE MANIFOLD and EXHAUST MANIFOLD under REMOVAL & INSTALLATION.

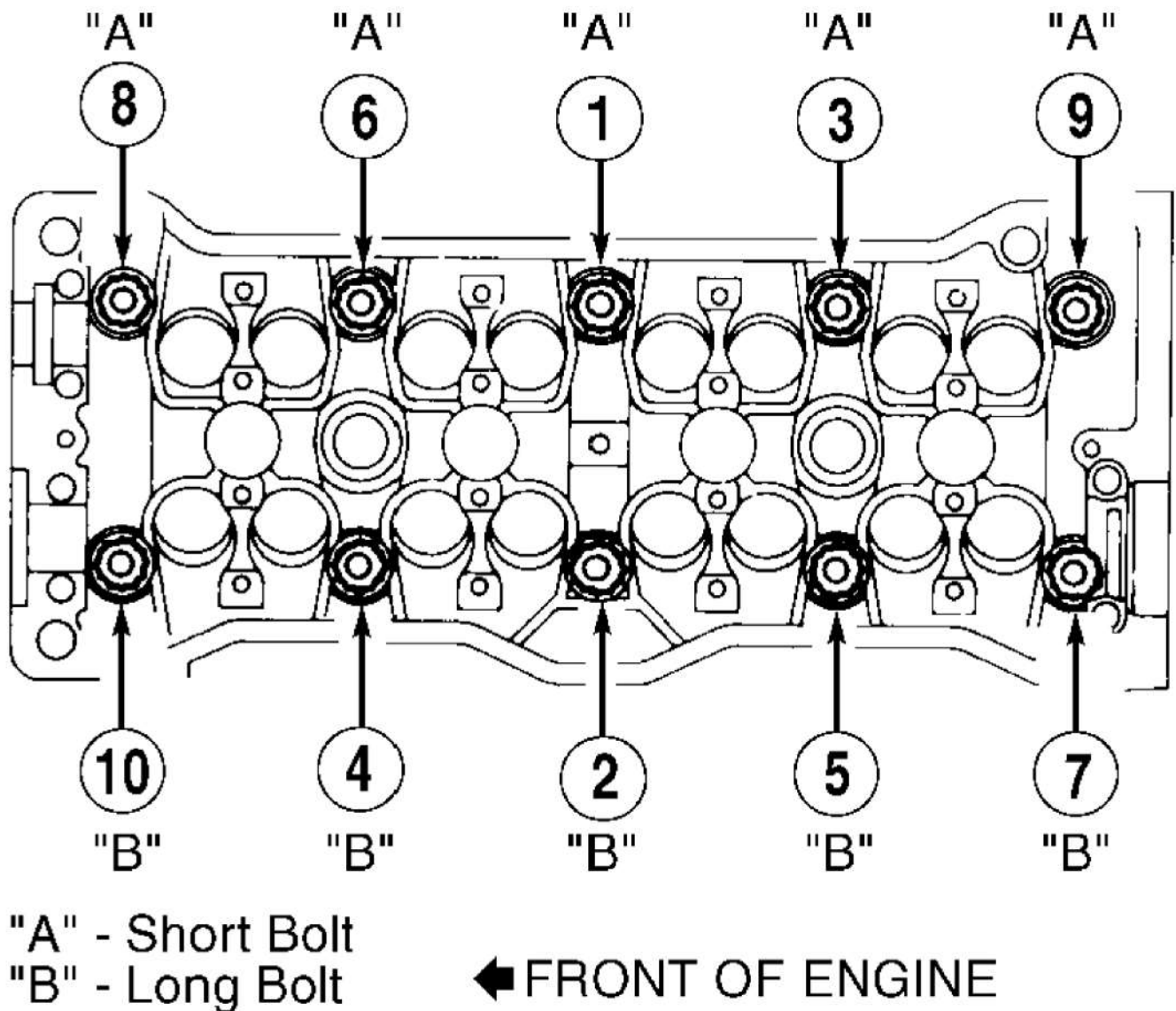
2) Disconnect necessary coolant hoses and vacuum lines. Remove coolant inlet and outlet housings. Remove EGR valve and lines.

3) Disconnect electrical connections at distributor. Remove

distributor cap. Mark rotor-to-distributor housing position and housing-to-cylinder head position. Remove retaining bolt, and remove distributor assembly.

4) Remove timing belt and camshafts. See TIMING BELT and CAMSHAFTS under REMOVAL & INSTALLATION.

5) Loosen cylinder head bolts in reverse of tightening sequence. See Fig. 4. Remove bolts, note location and length of cylinder head bolts for installation reference. Remove cylinder head and gasket.



93D02133

Fig. 4: Cylinder Head Bolt Removal & Installation Sequence
 Courtesy of General Motors Corp.

Inspection

Inspect cylinder head surface and manifold sealing areas (if manifolds are removed) for cracks and warpage. Replace cylinder head if warpage exceeds specification. Inspect cylinder block deck warpage.

Replace cylinder block if warpage exceeds specification. See CYLINDER HEAD and CYLINDER BLOCK tables under ENGINE SPECIFICATIONS at end of article.

Installation

1) If spark plug tubes were removed or NEW cylinder head is installed, spark plug tubes must be installed before head is installed on engine block. Use Adhesive (08833-00070) Three-Bond (1324) to coat bore of cylinder head for spark plug tube. Using Press, install each spark plug tube into bore until tube protrudes 1.843-1.874" (46.8-47.6 mm) from top horizontal surface of cylinder head. See Fig. 5.

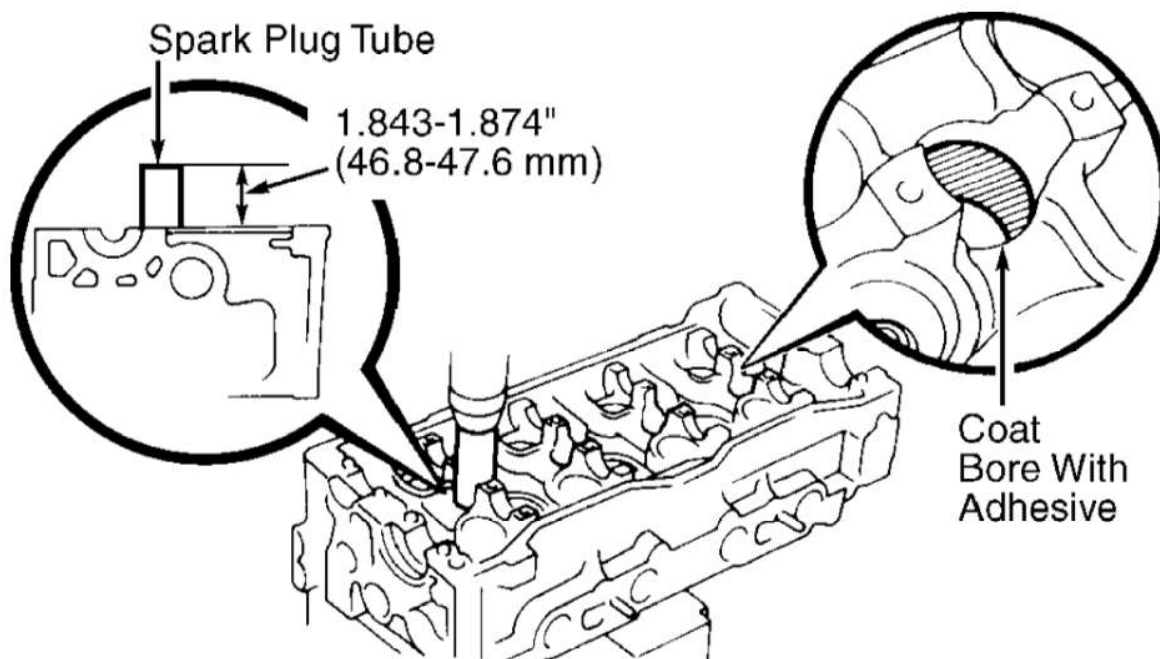
2) Before installing cylinder head bolts, apply light coat of engine oil to threads. Tighten cylinder head bolts in sequence. See Fig. 4. Tighten bolts in several steps to specification. See TORQUE SPECIFICATIONS.

3) If cylinder head components were serviced, check valve clearance. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS.

4) Ensure reference mark is aligned on distributor. If fuel injectors were removed from fuel rail, install NEW grommet and "O" ring on each fuel injector and insulators in intake manifold. Lubricate "O" ring with gasoline before installing fuel injector on fuel rail.

CAUTION: Ensure fuel injector rotates smoothly on fuel rail and intake manifold after installation. If fuel injector does not rotate smoothly, check for improper seal of fuel injector on fuel rail and intake manifold.

5) Before installing valve cover, apply Sealant (08826-00080) at valve cover-to-camshaft bearing cap surfaces on front and rear camshaft bearing caps. Fill cooling system.



93C01430

Fig. 5: Installing Spark Plug Tubes
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CRANKSHAFT FRONT SEAL

NOTE: Crankshaft front seal is mounted in oil pump housing.

Removal & Installation

1) Remove timing belt and crankshaft sprocket. See TIMING BELT under REMOVAL & INSTALLATION. Pry seal from oil pump housing. DO NOT damage sealing surfaces.

2) Using Seal Installer (09309-37010), install seal in oil pump housing. To install remaining components, reverse removal procedure.

TIMING BELT

CAUTION: Do not turn crankshaft or camshaft independently when timing belt is removed. Binding or damage to engine components could result.

Removal

1) Disconnect negative battery cable. Align crankshaft to cylinder No. 1 TDC. Raise and support vehicle. Remove right front wheel and engine undercover. Loosen water pump pulley bolts. Remove accessory drive belts.

2) Remove cruise control actuator. Remove windshield washer reservoir. Remove valve cover. Disconnect engine ground wire from right fender apron. Support engine with floor jack.

3) Remove through bolt at engine mount, located near timing belt cover. Raise engine slightly. Remove water pump pulley. Remove crankshaft pulley. If necessary, remove A/C compressor with hoses attached. Lower engine. Remove timing belt covers.

4) Remove timing belt guide. See Fig. 6. Loosen belt tensioner bolt. Move belt tensioner pulley away from timing belt, and temporarily tighten belt tensioner pulley bolt. Remove timing belt.

CAUTION: If timing belt is to be reused, mark direction of timing belt rotation, and place reference marks on timing belt and sprockets for installation reference.

5) Remove camshaft sprocket (if necessary) by removing retaining bolt while holding camshaft at hexagonal section with wrench. If crankshaft sprocket is to be removed, gently pry off sprocket using 2 flat-bladed screwdrivers.

Inspection

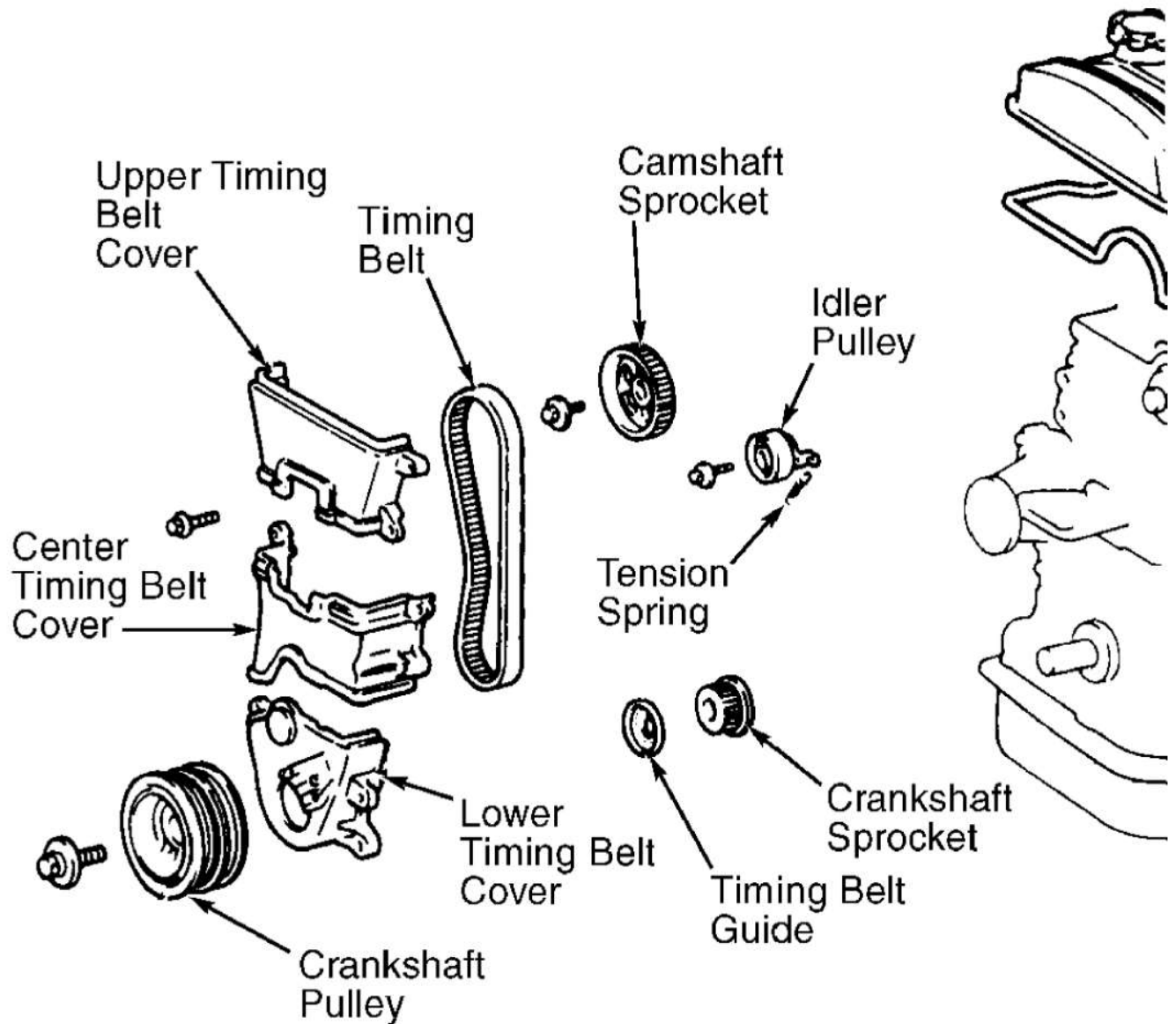
1) Inspect timing belt for cracks or damaged teeth. Ensure timing belt is not contaminated with oil. Check belt tensioner pulley for smooth rotation. Replace damaged components.

2) Check free length of belt tensioner spring. Free length is measured from inside end to inside end of spring (not coil area). Replace spring if free length is not 1.390" (35.3 mm) on 1.6L engine or 1.252 (31.8) on 1.8L engine.

Installation

1) Install crankshaft and camshaft sprockets (if removed). Tighten retaining bolt to specification. See TORQUE SPECIFICATIONS.

2) Ensure all timing marks are aligned. See Fig. 7. Install timing belt. If reusing old timing belt, ensure belt is installed in original rotating direction. Ensure marks on belt align with camshaft and crankshaft sprockets.



94H47362

Fig. 6: Exploded View Of Timing Belt & Components
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

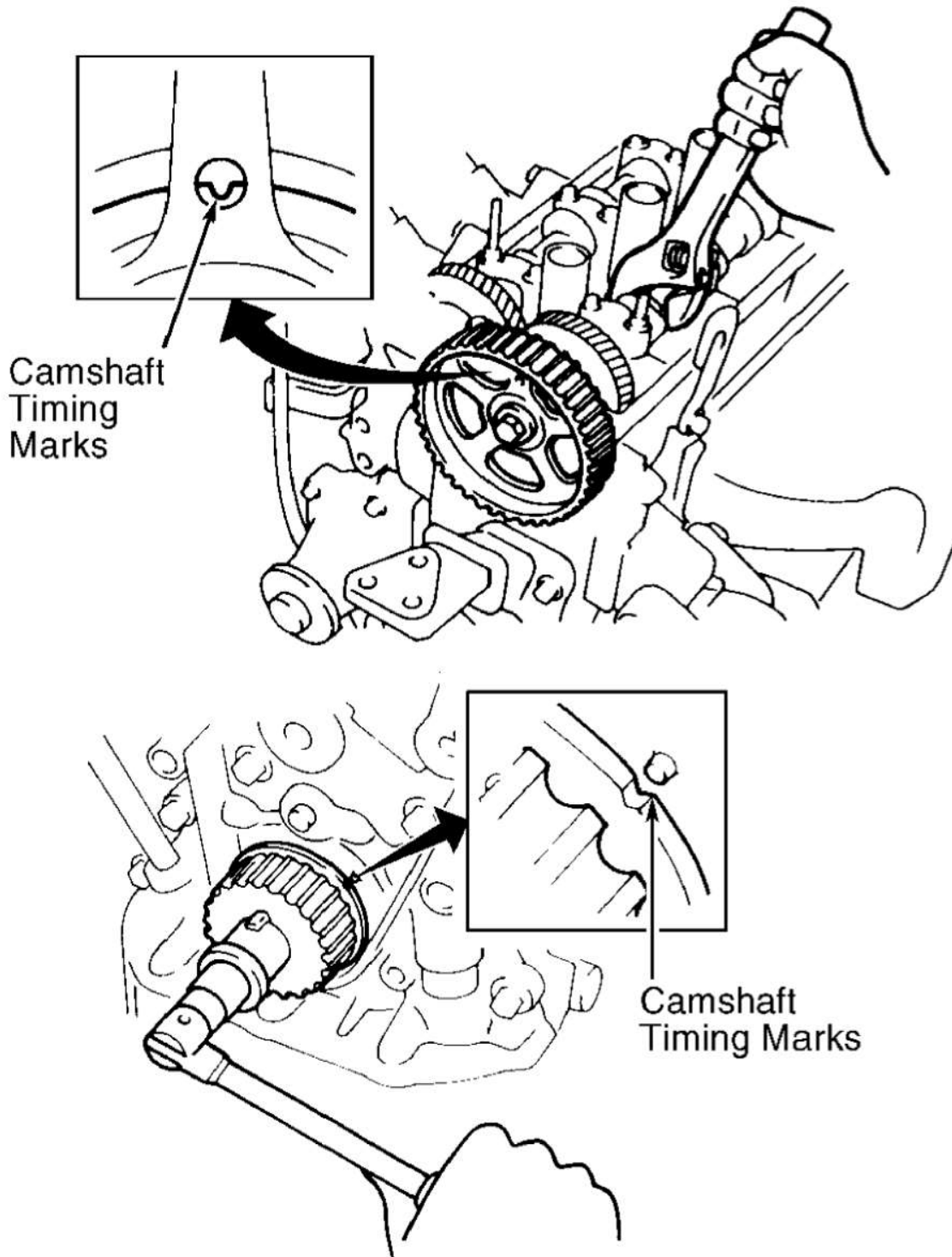
**93E82150**

Fig. 7: Aligning Timing Marks

Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Loosen belt tensioner bolt to allow tension to be applied on timing belt. Rotate crankshaft clockwise 2 revolutions. Ensure all

timing marks are aligned. Tighten timing belt idler pulley bolts to specification. See TORQUE SPECIFICATIONS.

4) Measure timing belt deflection halfway between camshaft and crankshaft sprockets. With 4.5 lbs. (2.0 kg) applied on timing belt, deflection should be .20-.24" (5-6 mm). If belt deflection is not within specification, repeat steps 3) and 4).

CAUTION: Ensure all timing marks are aligned once timing belt is adjusted.

5) To install remaining components, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Before installing valve cover, apply Sealant (1052942) at valve cover-to-cylinder head surfaces.

CAMSHAFTS

Removal

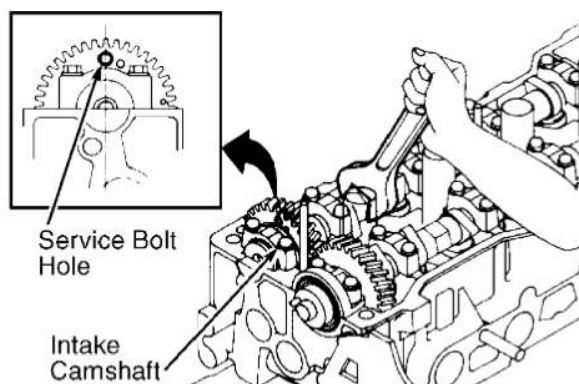
1) Remove timing belt, valve cover and camshaft sprocket. See TIMING BELT under REMOVAL & INSTALLATION. Using dial indicator, check camshaft end play before removing camshaft.

2) If end play is greater than specification, replace camshaft or cylinder head. See CAMSHAFT table under ENGINE SPECIFICATIONS at end of article.

NOTE: Camshaft bearing caps are marked either with an "I" for intake camshaft or an "E" for exhaust camshaft. Camshaft bearing caps are numbered starting with No. 1 at timing belt end of cylinder head. Ensure arrow on bearing cap points toward timing belt end of engine.

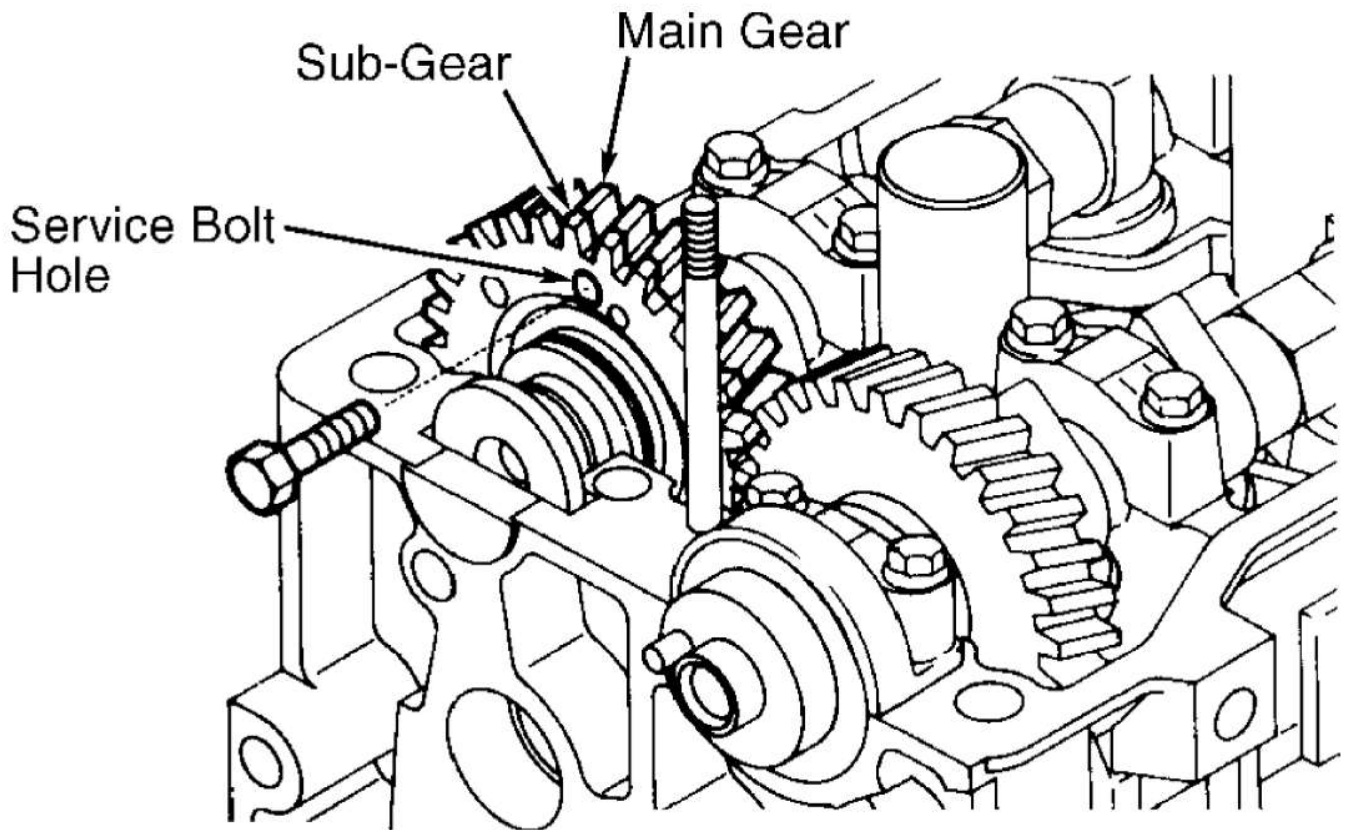
3) To remove intake camshaft, rotate camshafts so knock pin on exhaust camshaft is at 10 o'clock position and service bolt hole on intake camshaft is at 12 o'clock position. See Fig. 8. Remove No. 1 camshaft bearing cap bolts on exhaust and intake camshaft. Remove No. 1 bearing cap on intake camshaft. Install a 6.0 x 1.0 x 18-mm both in service bolt hole in intake camshaft gear. See Fig. 9.

4) Loosen remaining intake camshaft bearing caps evenly in sequence. See Fig. 10. Remove camshaft bearing caps and remove intake camshaft. Ensure camshaft remains level and parallel to cylinder head during removal.



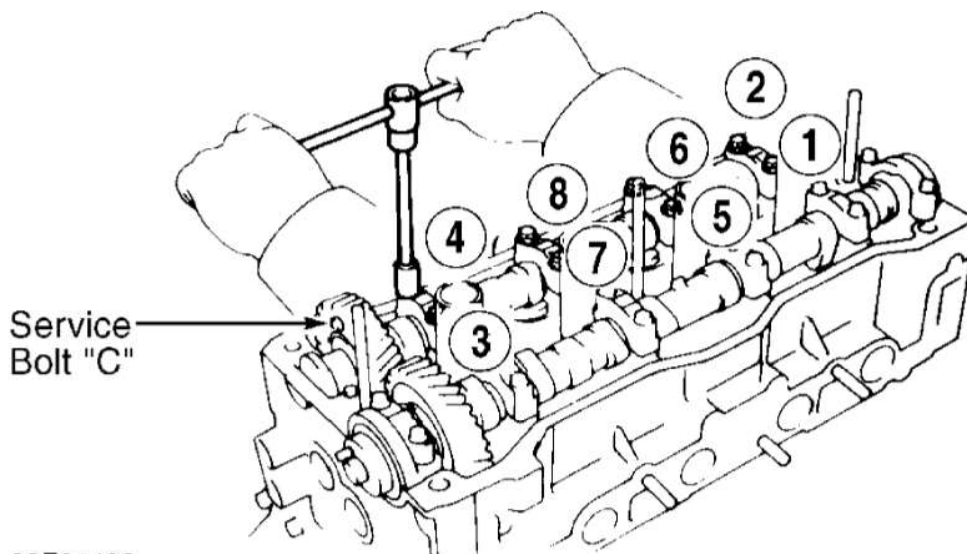
91E00418

Fig. 8: Positioning Intake Camshaft For Removal
Courtesy of Toyota Motor Sales, U.S.A., Inc.



91F00419

Fig. 9: Installing Service Bolt
 Courtesy of Toyota Motor Sales, U.S.A., Inc.



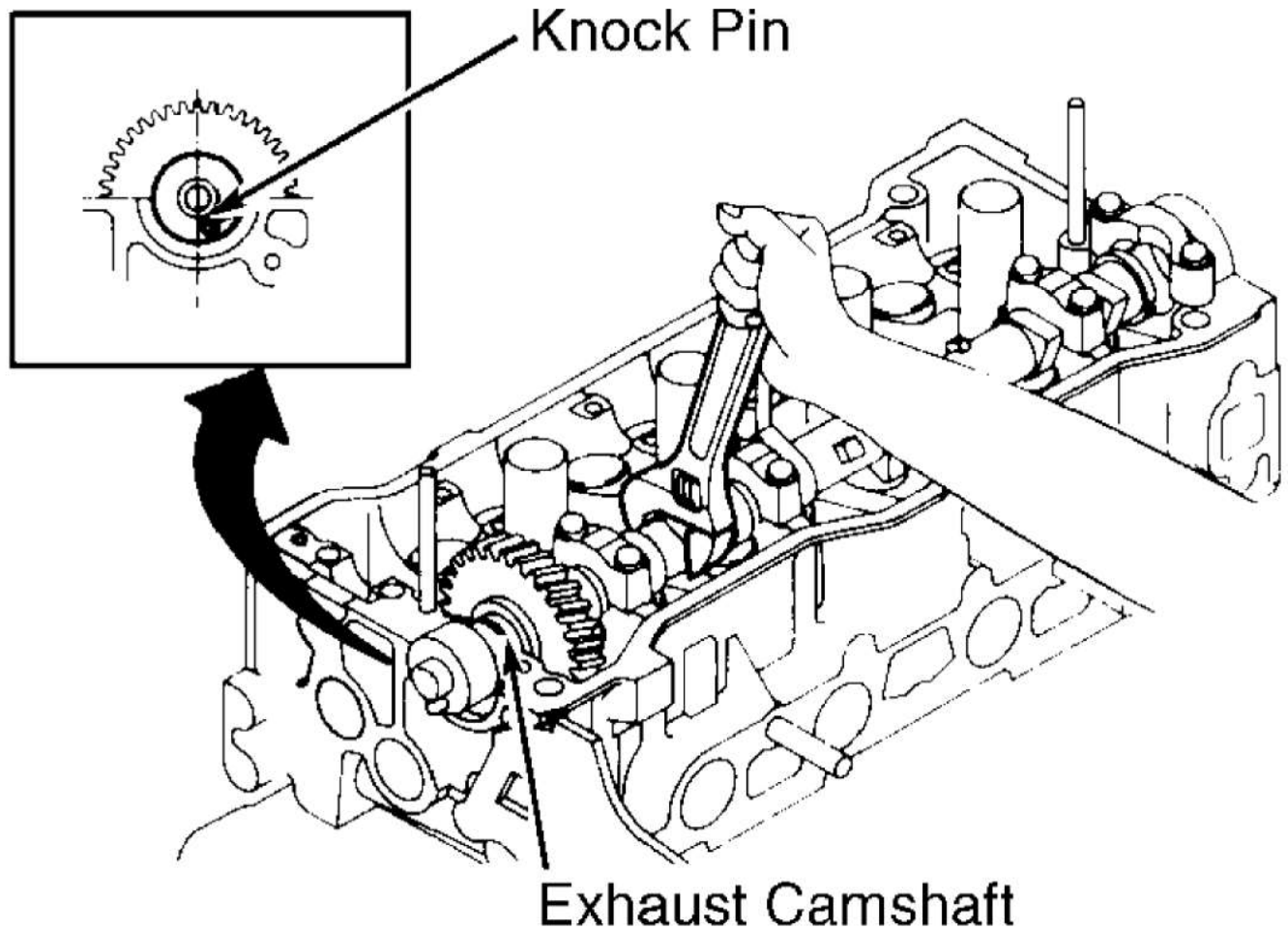
93E01426

Fig. 10: Intake Camshaft Bearing Cap Bolt Loosening Sequence
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

5) To remove exhaust camshaft, rotate camshaft so knock pin is positioned in 5 o'clock position. See Fig. 11. Note location and

direction of camshaft bearing caps.

6) Loosen exhaust camshaft bearing caps evenly in sequence. See Fig. 12. Remove camshaft bearing caps, camshaft and oil seal. If camshaft binds during removal procedure DO NOT force camshaft from cylinder head, retighten No. 3 camshaft bearing cap. Loosen bolts evenly while lifting camshaft. See Fig. 13.



91J00421

Fig. 11: Positioning Exhaust Camshaft For Removal
Courtesy of Toyota Motor Sales, U.S.A., Inc.

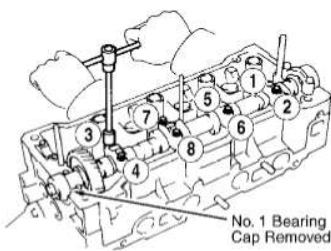
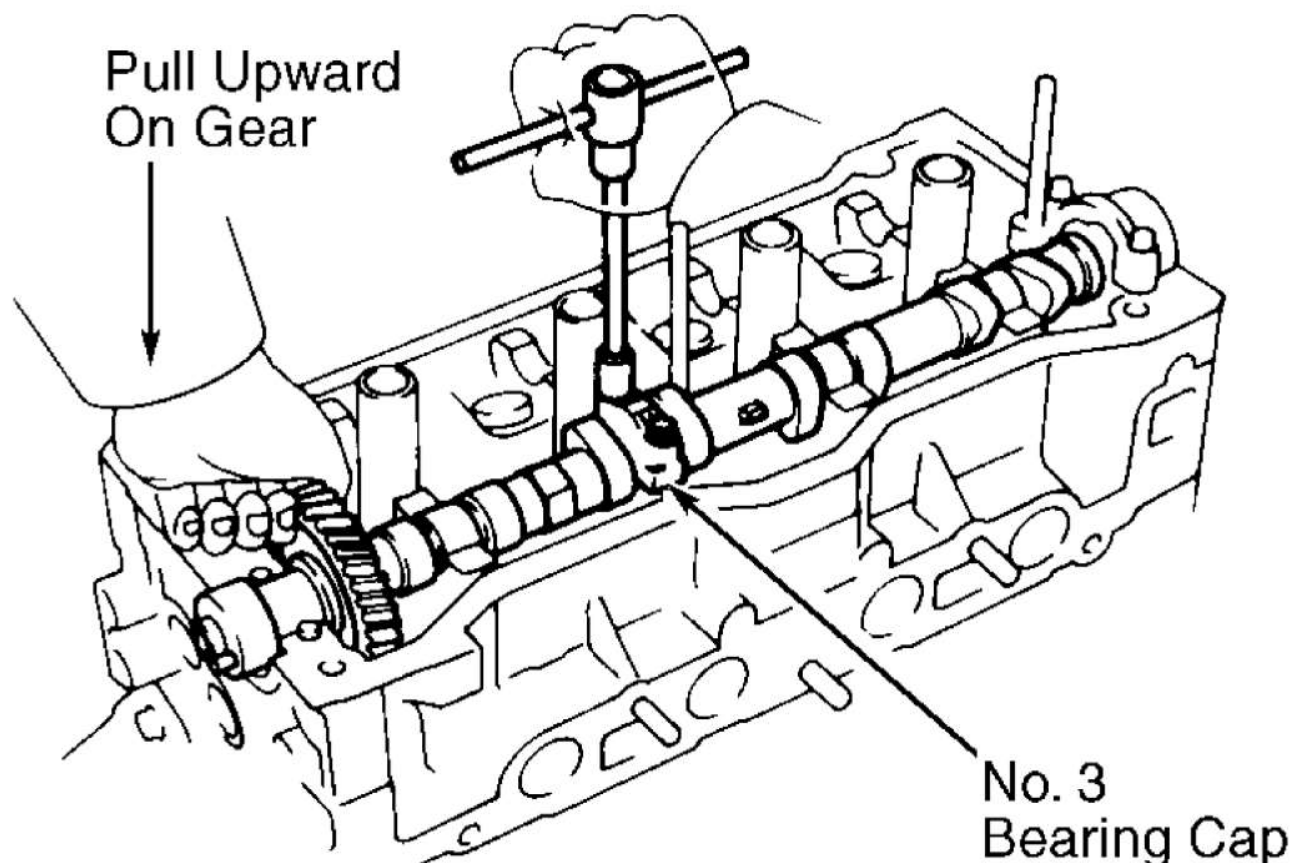


Fig. 12: Exhaust Camshaft Bearing Cap Bolt Loosening Sequence
Courtesy of Toyota Motor Sales, U.S.A., Inc.



93101428

Fig. 13: Removing Stuck Camshaft
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Disassembly & Inspection

1) To disassemble intake camshaft, mount camshaft in vise. Insert pins "A" and "B" in sub-gear holes. See Fig. 14. Using screwdriver, rotate sub-gear clockwise and remove service bolt. Remove pins. Remove snap ring, wave washer, sub-gear and gear spring. See Fig. 15.

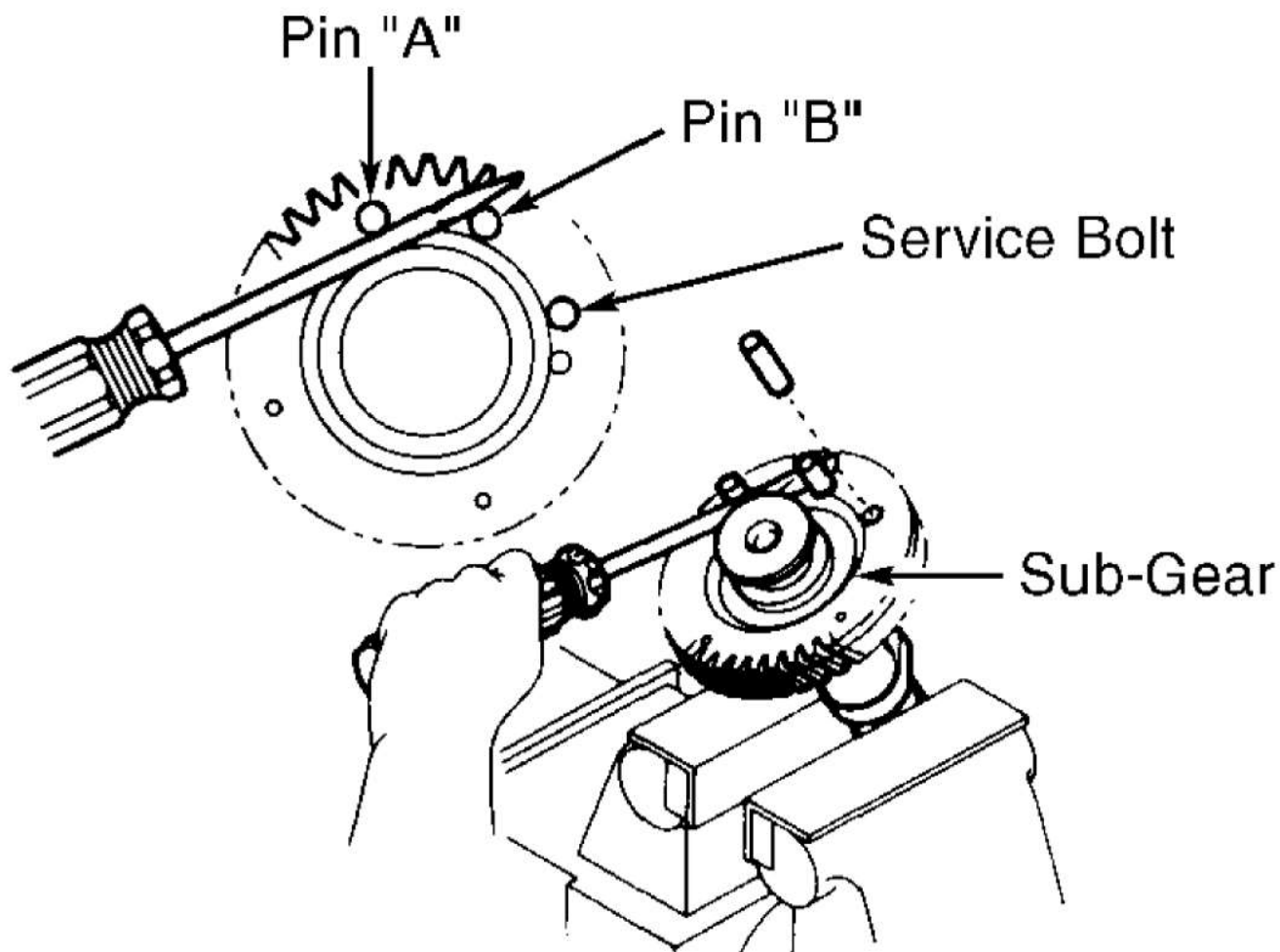
2) Inspect components for damage. Measure camshaft journal diameter, lobe height and journal runout. Replace camshaft if measurements are not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS at end of article.

3) Install camshaft in cylinder head without sub-gear. Using Plastigage, check camshaft oil clearance. Tighten camshaft bearing cap bolts to specification when checking oil clearance. See TORQUE SPECIFICATIONS. Replace camshaft and/or cylinder head if oil clearance is not within specification. See CAMSHAFT table.

4) Check camshaft end play with camshaft bearing cap bolts tightened to specification. Replace camshaft and/or cylinder head if end play is not within specification. See CAMSHAFT table under ENGINE SPECIFICATIONS at end of article.

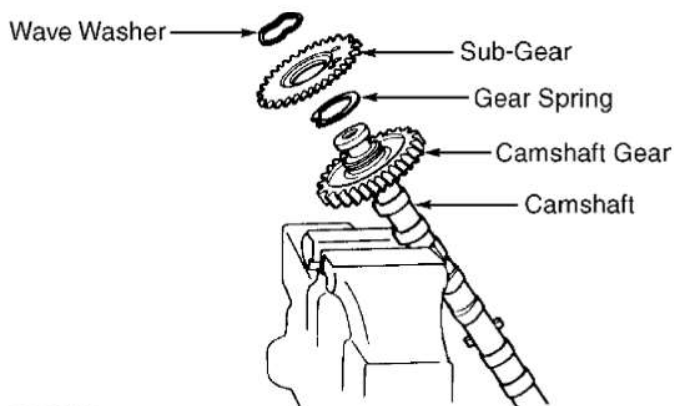
5) Use a dial indicator to check gear backlash between camshaft gears. Replace both camshafts if backlash exceeds specification. See CAMSHAFT table.

6) Measure distance between ends of gear spring. Replace gear spring if distance is not .669-.693" (17.0-17.6 mm).



93E82234

Fig. 14: Removing & Installing Sub-Gear
Courtesy of Toyota Motor Sales, U.S.A., Inc.



91B00423

Fig. 15: Exploded View Of Intake Camshaft & Components
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Reassembly & Installation

1) Install gear spring, sub-gear and wave washer. See

Fig. 15. Align pin on gear with gear spring ends. Install snap ring. Install pins "A" and "B" in sub-gear. See Fig. 14. Using screwdriver, rotate sub-gear clockwise and install service bolt and remove pins.

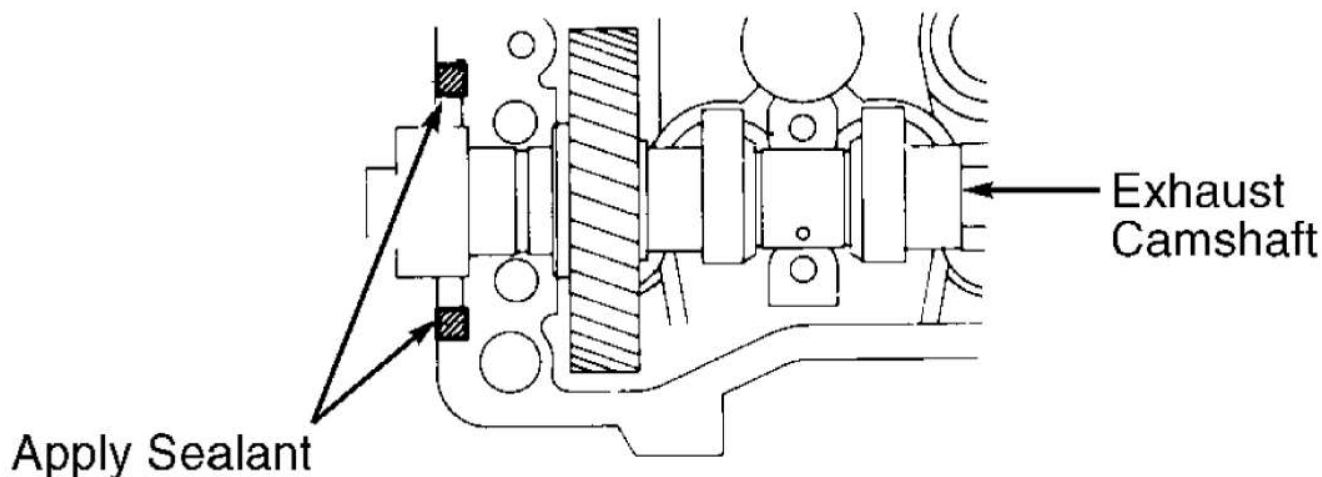
CAUTION: Keep camshaft level during installation, or camshaft binding and breakage may occur.

2) To install exhaust camshaft, lubricate thrust area of camshaft with multipurpose grease. Install exhaust camshaft so knock pin is in 5 o'clock position. This angle allows cylinders No. 1 and 3 cam lobes push on valve lifters evenly. Apply Sealer (08826-00080) to No 1 bearing cap. See Fig. 16. Install exhaust camshaft bearing caps on cylinder head.

CAUTION: Ensure arrow on camshaft bearing cap points toward timing belt end of engine. Install caps so numbers are in order.

3) Tighten bolts on exhaust camshaft bearing caps evenly in sequence. See Fig. 17. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

4) Apply multipurpose grease on camshaft oil seal. Using Seal Installer (09223-46011), install seal on exhaust camshaft.



93A02136

Fig. 16: Applying Sealant To No. 1 Bearing Cap
Courtesy of Toyota Motor Sales, U.S.A., Inc.

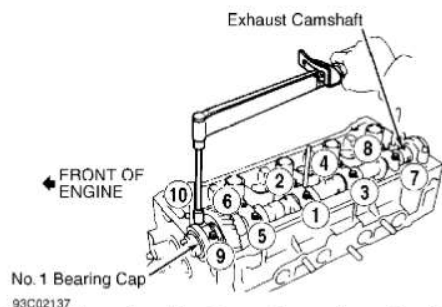


Fig. 17: Camshaft Bearing Cap Bolt Tightening Sequence
(Exhaust Camshaft Shown, Intake Camshaft Similar)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

CAUTION: DO NOT confuse TDC marks with camshaft aligning marks.

During camshaft installation, ensure installing marks, not TDC marks, are aligned.

5) To install intake camshaft, rotate exhaust camshaft so knock pin is at approximately 10 o'clock position. See Fig. 18. Lubricate thrust area of camshaft with multipurpose grease. Install intake camshaft so installing marks on camshaft gears are aligned.

6) Install all camshaft bearing caps, except No. 1, on cylinder head. Tighten both bolts on each camshaft bearing cap in sequence. See Figs. 16 & 17. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

CAUTION: Ensure arrow on camshaft bearing caps point toward timing belt end of engine. Install bearing caps so numbers are in order.

7) Remove bolt from service bolt hole. Install No. 1 bearing cap. If No. 1 camshaft bearing cap does not fit properly, push camshaft gear backward while installing camshaft bearing cap. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Rotate exhaust camshaft clockwise so knock pin is at 12 o'clock position.

8) Ensure TDC marks are together and at cylinder head surface. See Fig. 18. The installing marks should be at 12 o'clock position.

CAUTION: Check valve clearance if cylinder head or camshaft components were serviced or changed. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS.

9) To install remaining components, reverse removal procedure. Before installing valve cover, apply Sealant (08825-00080) at valve cover-to-camshaft bearing cap surfaces.

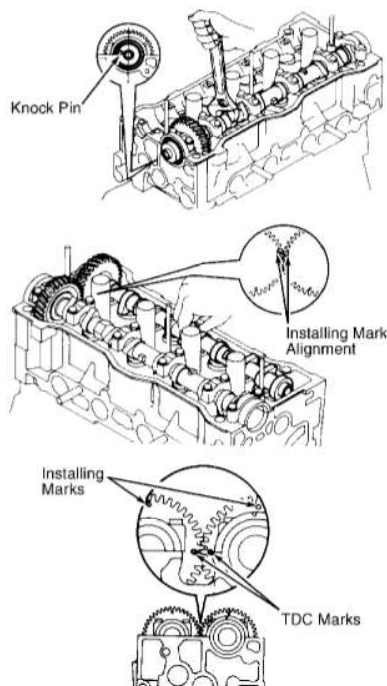


Fig. 18: Installing Intake Camshaft
Courtesy of Toyota Motor Sales, U.S.A., Inc.

VALVE LIFTER

Removal

Remove camshaft. See CAMSHAFTS under REMOVAL & INSTALLATION. Note location of adjusting shims and valve lifter for installation reference. Remove adjusting shim and valve lifter from cylinder head.

Inspection

Inspect valve lifter and bore for damage. Measure O.D. of valve lifter. Replace valve lifter if damaged, or O.D. is not within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS at end of article.

Installation

To install, reverse removal procedure. Ensure components are installed in original location. If camshaft, adjusting shims or valve lifter is replaced, check valve clearance. See VALVE CLEARANCE ADJUSTMENT under ADJUSTMENTS.

CRANKSHAFT REAR OIL SEAL

Removal

1) Remove transaxle. Place reference mark on crankshaft and flywheel/drive plate. Remove flywheel/drive plate.
2) Remove rear plate from cylinder block. Pry seal from seal retainer using care not to damage seal retainer.

Installation

1) Ensure all sealing surfaces are clean. Using Seal Installer (09223-41020), install seal flush with edge of seal retainer. Lubricate seal lip with grease.
2) Tighten bolts to specification. See TORQUE SPECIFICATIONS. To install remaining components, reverse removal procedure. Ensure reference mark on flywheel/drive plate aligns with mark on crankshaft.

WATER PUMP

Removal

1) Disconnect negative battery cable. Drain cooling system. Loosen bolts on water pump pulley and remove drive belts. Raise and support vehicle.
2) Support engine with floor jack. Remove right engine mount. Remove upper and center timing belt covers.
3) If equipped with power steering, Remove front transaxle mount, upper radiator hose and electric cooling fan. On all models, remove engine harness mounting bolt.
4) Remove coolant inlet pipe. Remove oil dipstick tube, and plug hole in oil pump housing (if necessary). Remove water pump retaining bolts, water pump and "O" ring from cylinder block.

Installation

Install NEW "O" ring on cylinder block and dipstick tube. Tighten bolts to specification. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Adjust drive belt tension, and fill cooling system.

OIL PAN

Removal & Installation

1) Drain engine oil. Raise and support vehicle. Remove lower engine covers. Disconnect oxygen sensor (if necessary) and remove exhaust pipe. Remove engine reinforcement bracket (if equipped).

Remove oil pan bolts and oil pan.

2) On 1.8L, remove oil pan baffle plate. Remove upper oil pan by removing 3 upper oil pan-to-transaxle bolts. Remove remaining upper oil pan bolts.

3) On all models, to install, reverse removal procedure.

Apply Sealant (08826-00080) to oil pan gasket(s) before installing.

Tighten bolts to specification. See TORQUE SPECIFICATIONS.

OVERHAUL

CYLINDER HEAD

Cylinder Head

Inspect cylinder head for cracks and warpage. Using a straightedge and feeler gauge check cylinder head at manifold and cylinder block surfaces for warpage. Replace cylinder head if warpage exceeds specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS at end of article.

Valve Springs

Using a valve spring tester, measure tension of valve springs at specified length. Ensure valve spring free length and out-of-square are within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS at end of article.

Valve Stem Oil Seals

Install oil seal using Seal Installer (09201-41020).

NOTE: Intake valve stem oil seal is Gray and exhaust valve oil seal is Black.

Valve Guides

1) To determine valve stem-to-guide clearance, measure and record valve stem diameter. Measure valve guide inside diameter and record. Subtract valve stem diameter from valve guide inside diameter. Ensure valve stem and guide are within specification and replace as necessary. See VALVES & VALVE SPRINGS table and CYLINDER HEAD table under ENGINE SPECIFICATIONS at end of article.

2) To remove valve guide, heat cylinder head to 176-212°F (80-100°C). Using hammer and Valve Guide Remover/Installer (09201-70010), drive valve guide from cylinder head.

3) Measure cylinder head valve guide bore I.D. If cylinder head valve guide bore I.D. is greater than .4341" (11.026 mm), use a reamer to machine cylinder head bore to .4350-.4361" (11.049-11.077 mm) for oversized valve guide. If valve guide bore I.D. is greater than .4361" (11.077 mm), replace cylinder head.

4) To install valve guide, heat cylinder head to 176-212°F (80-100°C). Using hammer and Valve Guide Remover/Installer (09201-70010), drive valve guide into cylinder head.

CAUTION: Install valve guide so installed height above cylinder head surface is .500-.516" (12.70-13.11 mm).

5) Using a sharp 6-mm reamer, ream valve guide to obtain correct valve stem oil clearance. See CYLINDER HEAD table.

Valve Seat

Information is not available from manufacturer.

Valves

Ensure valve stem diameter and valve margin are within specification. Check valve contact pattern and overall length. See

VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS at end of article.

Seat Correction Angles

To lower valve seat surface on valve, cut seat at 30 degrees and 45 degrees. To raise valve seat surface on valve, cut seat at 60 degrees and 45 degrees.

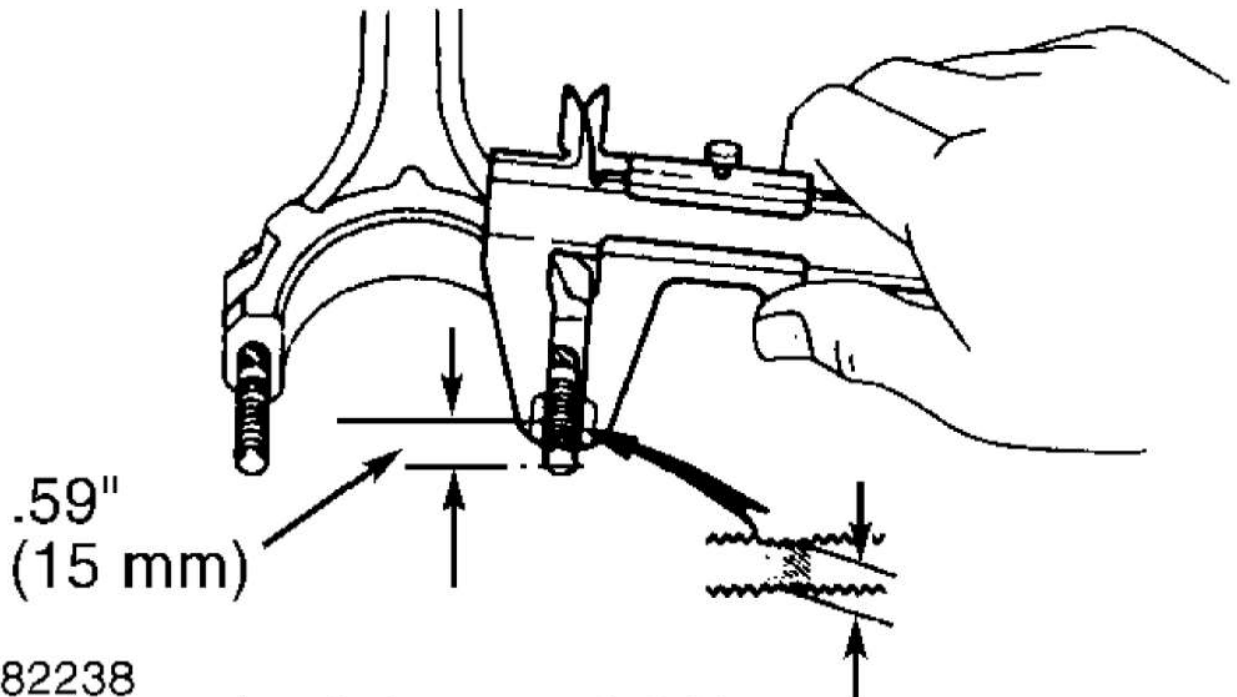
CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1) Note direction of connecting rod installation on piston before removing. Check rods for bend and twist. Replace rods if bend or twist exceeds specification. See CONNECTING RODS table under ENGINE SPECIFICATIONS at end of article.

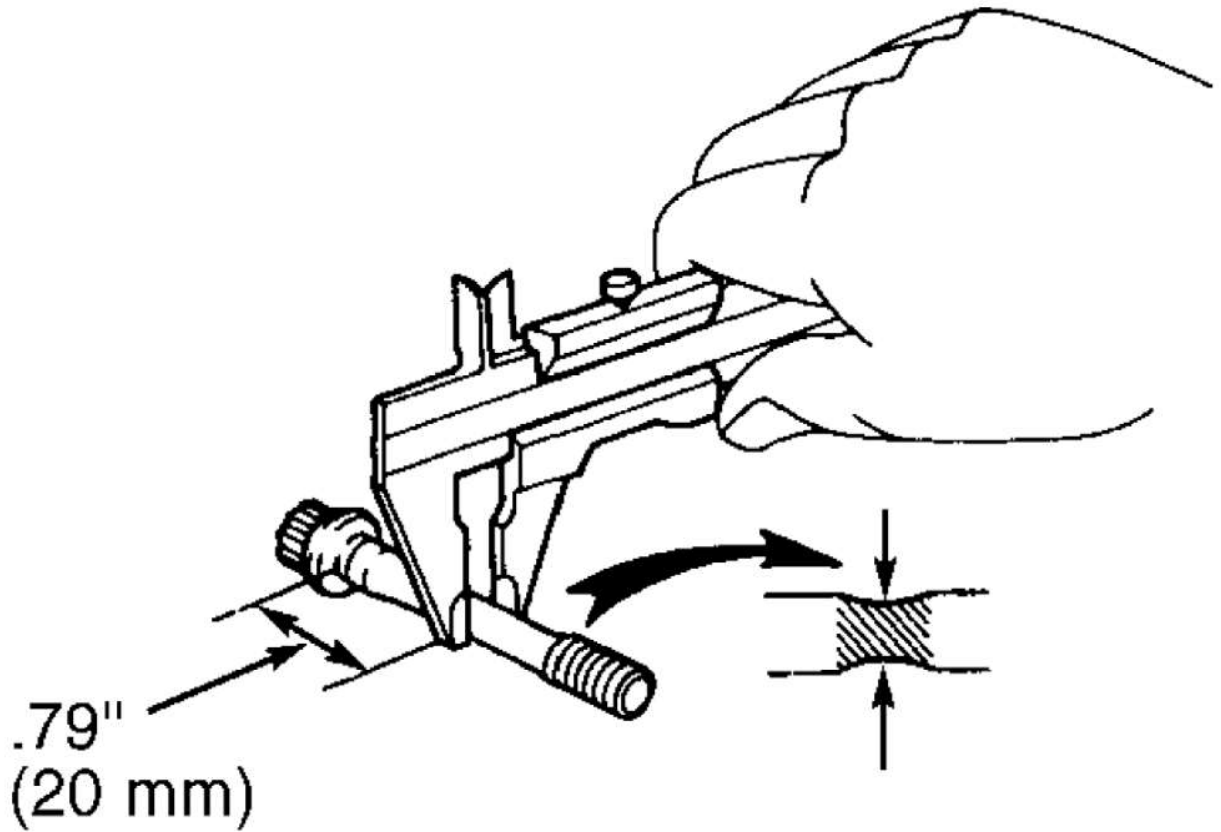
2) Measure connecting rod bolts for stretch. On 1.6L, measure rod bolt .59" (15 mm) from rod. See Fig. 19. Minimum diameter is .3386" (8.60 mm). On 1.8L, measure rod bolt .787" (20 mm) from head of bolt. See Fig. 19. Minimum diameter is .276" (7 mm). On all engines replace rod bolt and nut if less than minimum diameter.

3) Note mark at center of connecting rod, which must be aligned with front mark on top of piston. See Figs. 19 & 20. Install connecting rod in original direction. Install piston with front mark on piston top toward timing belt end of engine.



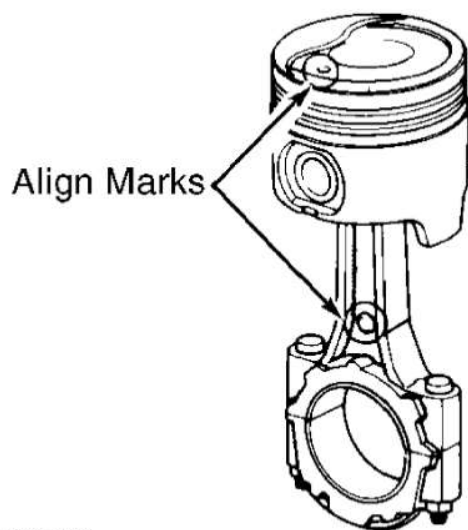
93182238

Fig. 19: Measuring Connecting Rod Bolts For Stretch (1.6L)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



93F82227

Fig. 20: Measuring Connecting Rod Bolts For Stretch (1.8L)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

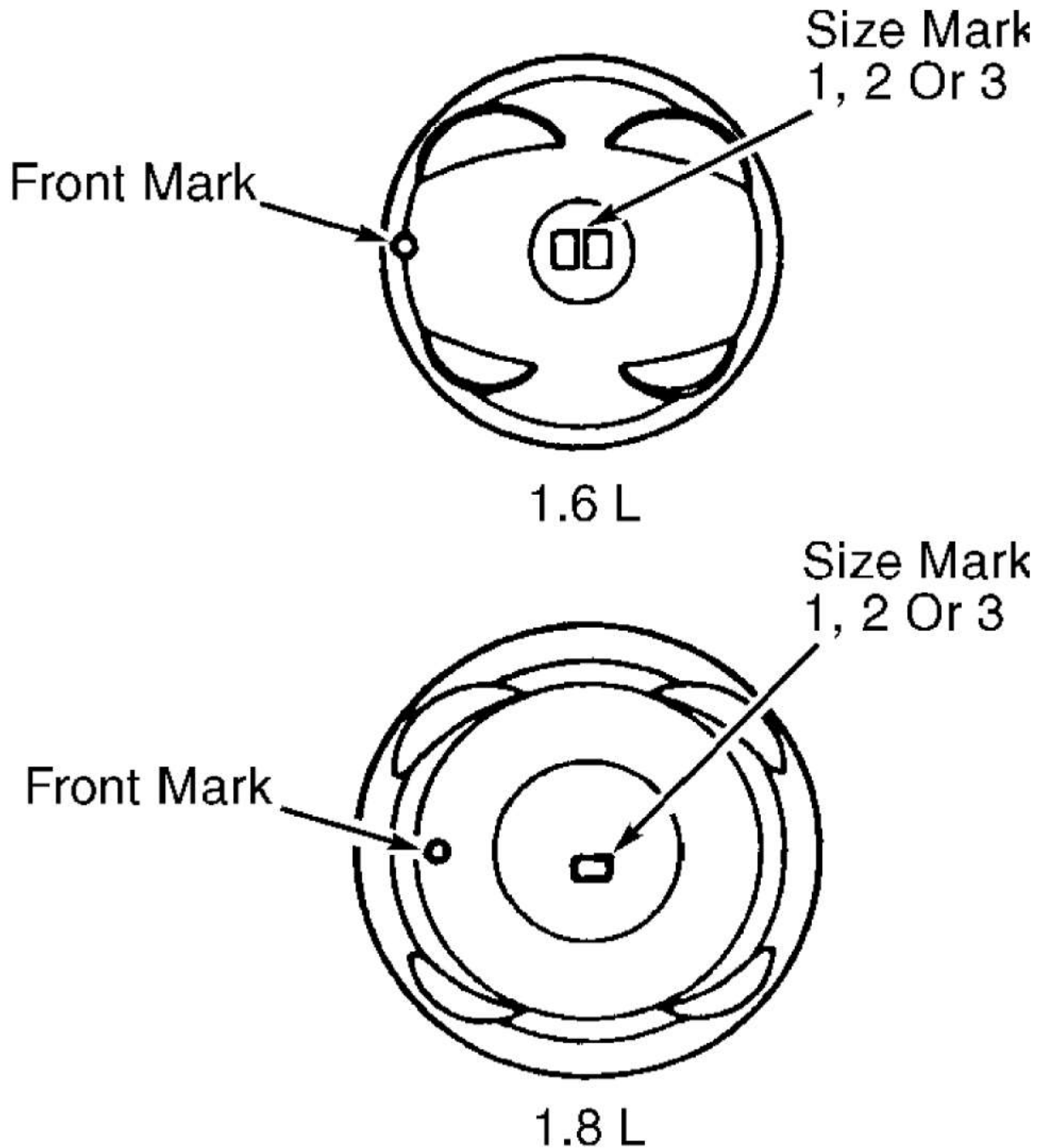


91F00427

Fig. 21: Aligning Piston & Connecting Rod (Typical)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: Three different standard sizes of piston and cylinder bore are used. Piston and cylinder bore sizes are identified by a

numerical size mark, "1", "2" or "3". Piston size is stamped on piston top and cylinder bore size is stamped on cylinder block deck surface. See Figs. 22 and 23.



93G82228

Fig. 22: Identifying Piston Front Mark & Size Mark
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fitting Pistons

- 1) To determine if piston-to-cylinder clearance is within

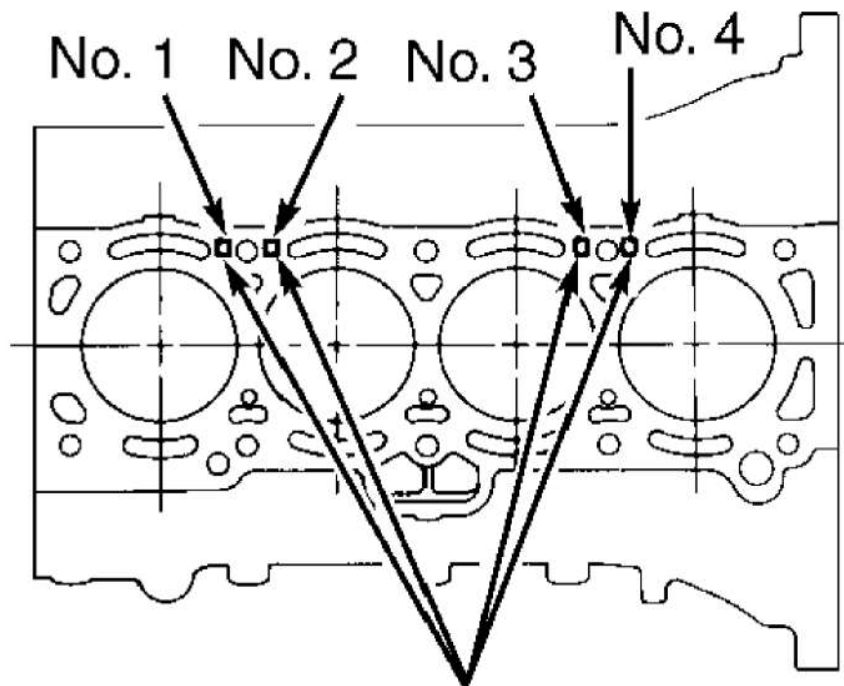
specification, measure piston skirt diameter at 90-degree angle to piston pin, .956" (24.5 mm) from top of piston.

2) Three standard piston sizes are used. Piston size is identified by a numerical size mark, "1", "2" or "3", stamped on top of piston. See Fig. 22. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS at end of article. Ensure piston diameter is within specification.

3) Three standard cylinder bore sizes are used. Cylinder bore size is identified by a numerical size mark, "1", "2" or "3", stamped on deck surface. See Fig. 23. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS at end of article. Cylinder bore diameter is measured .39" (10 mm) from top and bottom of bore, and at middle of bore. Make 2 measurements (front-to-rear and side-to-side) at top, middle and bottom of each cylinder to find taper and out-of-round.

4) To determine piston clearance, subtract piston diameter from cylinder bore diameter. If clearance exceeds specification, replace piston with standard piston if cylinder taper and out-of-round are within specification. If any cylinder measurement exceeds specification, bore all cylinders to uniform diameter and replace all pistons with oversize pistons to maintain balance. See PISTONS, PINS & RINGS table.

CYLINDER NUMBERS



Cylinder Bore Size Mark
"1", "2" OR "3"

91G00428

Fig. 23: Locating Cylinder Bore Size Marks
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Piston Rings

Ensure ring end gap and side clearance are within

specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS at end of article. Position piston ring gaps 90 degrees apart. Ensure ring end gaps are not aligned, and ensure ring gaps do not align with piston pin.

Rod Bearings

- 1) Note direction of connecting rod and cap before removal for reassembly reference. If bearings are to be reused, measure bearing oil clearance using Plastigage before removing pistons. Check connecting rod side play. See CONNECTING RODS and CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS tables under ENGINE SPECIFICATIONS at end of article.
- 2) Rod bearings are available in 3 standard sizes. Rod bearing size is indicated by a numerical identification mark, "1", "2" or "3", stamped on back side bearing shell and on connecting rod cap . Identification mark is used to determine bearing thickness. See CONNECTING ROD BEARING SPECIFICATIONS table.
- 3) Install piston and rod assembly. Check rod bearing clearance using Plastigage method. Tighten rod bolts in 2 steps to specification, then turn nut additional 90 degrees. If rod bearing clearance is excessive, measure crankpin journal diameter. If crankpin journal diameter is within specification, replace bearing with a standard bearing. If crankpin journal is less than minimum specification, a .0098" (.25 mm) undersize bearing is available. Regrind crankshaft to fit undersize bearing if necessary.

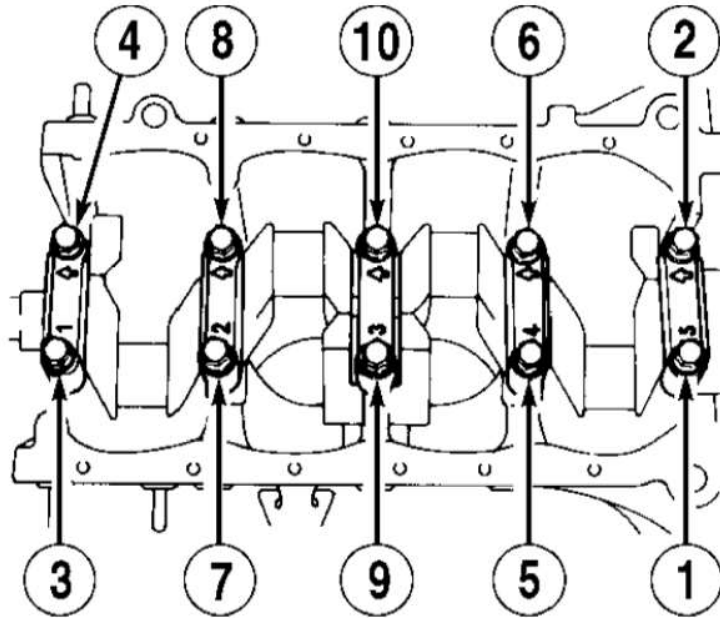
CONNECTING ROD BEARING SPECIFICATIONS TABLE

Bearing Identification Mark		Bearing Thickness	
		In.	(mm)
"1"	.....	.0585-.0587	(1.486-1.490)
"2"	.....	.0587-.0588	(1.490-1.494)
"3"	.....	.0588-.0590	(1.494-1.498)

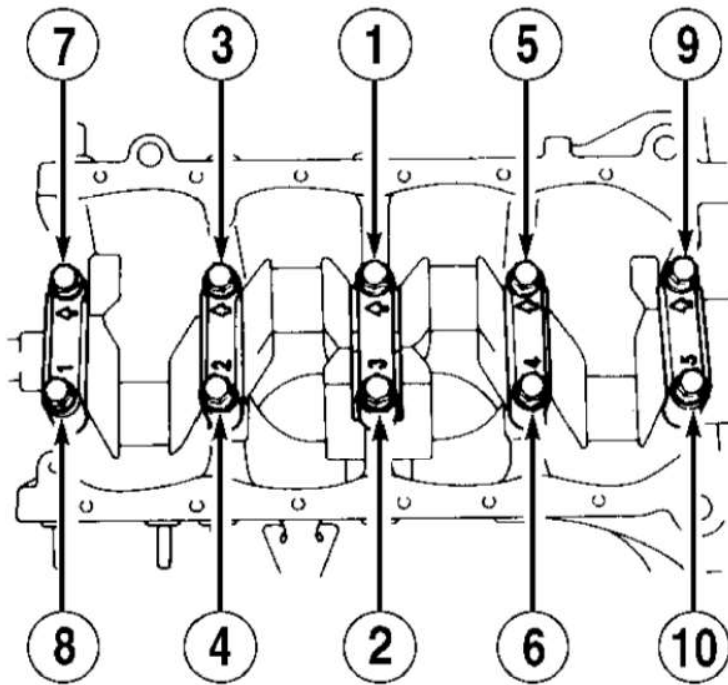
Crankshaft & Main Bearings

- 1) Ensure main bearing caps are numbered for location, and arrow on caps point toward timing belt end of crankshaft. Remove main bearing cap bolts in proper sequence. See Fig. 24.
- 2) Cylinder block main bearing bore size is indicated by a size mark number, "1", "2" or "3", stamped on cylinder block. See Fig. 25. Main bearing journal size is indicated by a size mark number, "0", "1" or "2", located near crankshaft counterweight.

TIMING BELT
SIDE OF ENGINE



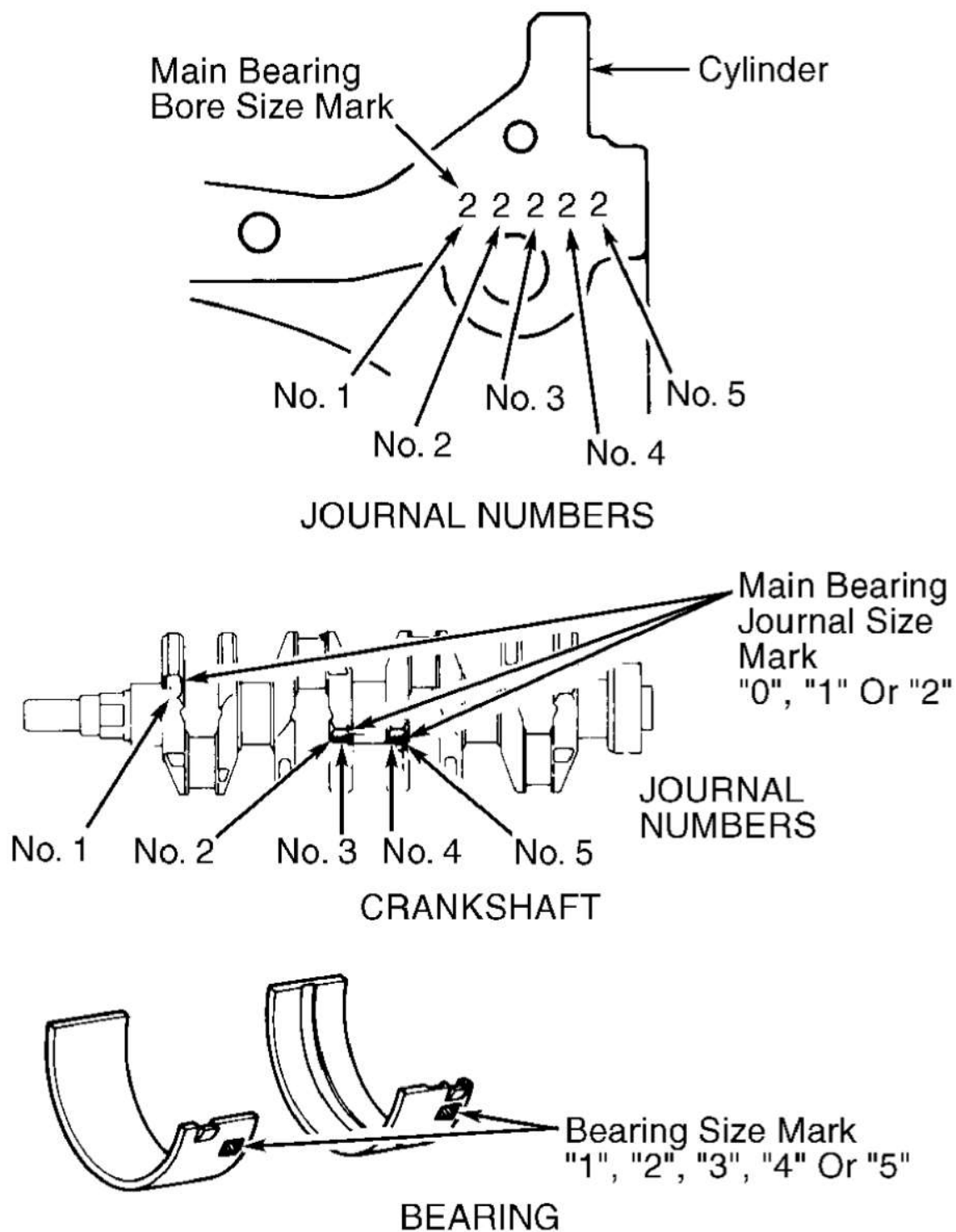
REMOVAL



INSTALLATION

91H00429

Fig. 24: Main Bearing Cap Bolt Removal & Installation Sequence
Courtesy of General Motors Corp.



91A00430

Fig. 25: Locating Main Bearing Bore, Main Bearing Journal & Bearing Size Marks

Courtesy of Toyota Motor Sales, U.S.A., Inc.

3) Measure main bearing clearance using Plastigage method.

Main bearing clearance should be .0006-.0013" (.015-.033 mm). Maximum wear tolerance is .004" (.10 mm). If bearing clearance is excessive, measure crankshaft main bearing journals. Measure journals at each end of journal and 90 degrees from first readings. Grind crankshaft to .0098" (.25 mm) undersize or replace crankshaft if journal minimum diameter, taper or out-of-round are not within specification.

4) When replacing worn bearings on a crankshaft that is within original specification, use size markings on bearings to identify replacement bearing. If bearing size mark on original bearing cannot be obtained, use number on cylinder block (main bearing bore size mark) and number on crankshaft (main bearing journal size mark) to determine bearing number. See MAIN BEARING SELECTION table.

MAIN BEARING SELECTION TABLE

Main Bearing Bore Size Mark	Main Bearing Journal Size Mark	Bearing Size Mark
"1"	"0"	"1"
"1"	"1"	"2"
"1"	"2"	"3"
"2"	"0"	"2"
"2"	"1"	"3"
"2"	"2"	"4"
"3"	"0"	"3"
"3"	"1"	"4"
"3"	"2"	"5"

5) When installing main bearing caps, ensure arrow on caps point toward timing belt end of crankshaft. Tighten bolts in sequence. See Fig. 24.

6) Tighten bolts to specification. See TORQUE SPECIFICATIONS. Ensure crankshaft end play is within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS at end of article.

Thrust Bearing

Install thrust bearing on main bearing, with grooves toward crankshaft, away from cylinder block. Replace thrust bearing if crankshaft end play is not within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS at end of article.

Cylinder Block

1) Using feeler gauge and straightedge, check cylinder block deck surface in 6 places for warpage. If warpage exceeds specification, replace cylinder block. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS at end of article.

2) Check cylinder bore wear and taper in 3 places. Cylinder block bore diameter is measured .39" (10 mm) from top and bottom of bore, and at middle of bore.

3) Various cylinder bore sizes are used. Cylinder bore size is identified by a numerical size mark, "1", "2" or "3", stamped on deck surface. See Fig. 23. Bore cylinder block if taper exceeds specification. See CYLINDER BLOCK table.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

The crankshaft-driven oil pump provides lubrication to the

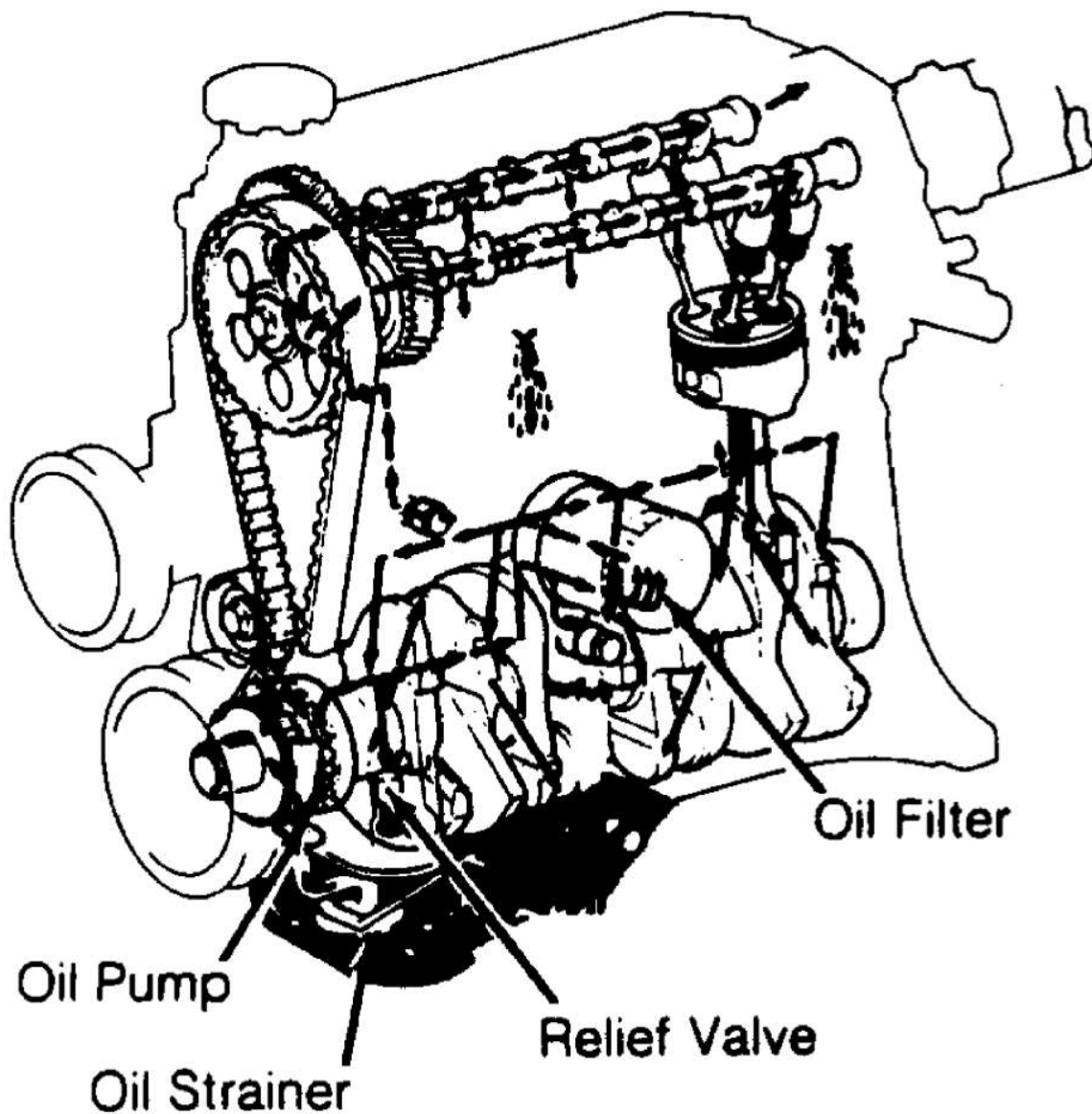
main gallery. See Fig. 26.

Crankcase Capacity

Crankcase capacity with oil filter change is 3.5 qts. (3.3L) for 1.6L and 3.9 qts. (3.7L) for 1.8L.

Oil Pressure

With engine at normal operating temperature, oil pressure should be greater than 4.3 psi (.3 kg/cm²) at idle and 36-71 psi (2.5-5.0 kg/cm²) at 3000 RPM.



50I01635

Fig. 26: Cross-Sectional View Of Engine Oil System
Courtesy of General Motors Corp.

OIL PUMP

Removal & Disassembly

1) Remove timing belt and crankshaft sprocket. See TIMING BELT under REMOVAL & INSTALLATION. Remove front exhaust pipe. Remove engine stiffener bracket (if equipped) and oil pan. See OIL PAN under REMOVAL & INSTALLATION.

2) Remove oil pump pickup. Remove dipstick from oil pump housing. Remove oil pump retaining bolts, and remove oil pump. Remove oil pump cover from rear of oil pump. Remove oil seal from oil pump housing. Remove snap ring, spring and relief valve from oil pump housing.

Inspection

1) Inspect components for damage. Ensure relief valve slides freely in bore. Using feeler gauge, measure clearance between driven gear (outer gear) and oil pump housing. Replace pump assembly if clearance exceeds specification. See OIL PUMP SPECIFICATIONS table.

2) Measure tip clearance between driven gear (outer gear) and drive gear (inner gear). Replace gear set if clearance exceeds specification.

3) With all gears in oil pump housing, place straightedge across oil pump housing. Measure gear end clearance between both gears and straightedge. Replace oil pump assembly if clearance exceeds specification. See OIL PUMP SPECIFICATIONS table.

OIL PUMP SPECIFICATIONS TABLE

Application	In. (mm)
Rotor Side Clearance	.0010-.0033 (.025-.085)
Rotor Tip Clearance	.0010-.0033 (.025-.085)
Maximum allowable	.014 (.35)
Rotor Clearance	.0031-.0071 (.080-.180)

Reassembly & Installation

1) To reassemble, reverse disassembly procedure. Install oil seal using seal installer. Coat seal lip with grease. Tighten oil pump cover bolts to specification. See TORQUE SPECIFICATIONS table.

2) To install, reverse removal procedure. Use new oil pump gaskets. Tighten all bolts to specification. See TORQUE SPECIFICATIONS table.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
A/C Compressor Bolt	18 (24)
Camshaft Sprocket Bolt	43 (58)
Center Transaxle Mount-To-Crossmember Nut	47 (64)
Connecting Rod Nut	
Step 1	21 (29)
Step 2	Turn Additional 90 Degrees
Crankshaft Pulley Bolt	87 (118)
Cylinder Head Bolt	
Step 1	(1) 22 (30)
Step 2	(1) Turn Additional 90 Degrees
Step 3	(1) Turn Additional 90 Degrees
Exhaust Manifold Bolt/Nut	25 (34)
Flywheel/Drive Plate Bolt	
A/T	47 (64)

M/T	58 (79)
Fuel Rail Bolt	11 (15)
Intake Manifold Bolt/Nut	14 (19)
Lower Ball Joint-To-Steering Knuckle Nut	94 (127)
Main Bearing Cap Bolt	(2) 44 (60)
Oil Pump Bolt	16 (22)
Power Steering Pump Bolt	29 (39)
Rear Transaxle Mount Through Bolt	64 (87)
Right Engine Mount (Timing Belt Side) Engine Mount Bracket Mounting Bolt	35 (47)
Through Bolt	64 (87)
Spark Plugs	13 (18)
Tie Rod End-To-Steering Knuckle Nut	36 (49)
Timing Belt Idler Pulley Bolt	27 (37)
Upper Oil Pan-To-transaxle Bolt	17 (23)
Upper Oil Pan-To-Engine (1.8L) Torx Bolt	11 (15)
Hex Bolts (1.8L)	12 (16)
Water Pump Bolt	11 (15)
Water Pump Pulley Bolt	17 (23)
Wheel Lug Nut	76 (103)

INCH Lbs. (N.m)

Camshaft Bearing Cap Bolt	(3) 115 (13)
Oil Pan Bolt	44 (5)
Oil Pump Cover Bolt	89 (10)
Oil Pump Pick-Up Tube Bolt	84 (9.5)
Rear Seal Retainer Bolt	79 (9)
Timing Belt Cover Bolt	62 (7)
Valve Cover Bolt	53 (6)

- (1) - Tighten bolts to specification in sequence.
See Fig. 4.
- (2) - Tighten bolts to specification in sequence.
See Fig. 24.
- (3) - Tighten bolt to specification in sequence.
See Fig. 17 & 18.

ENGINE SPECIFICATIONS

GENERAL ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS TABLE

Application	Specification
1.6L	
Displacement	97 Cu. In. (1.6L)
Bore	3.19" (81 mm)
Stroke	3.03" (77 mm)
Compression Ratio	9.5:1
Fuel System	PFI
Horsepower @ RPM	(1) 105 @ 5800
Torque Ft. Lbs. @ RPM	100 @ 4800
1.8L	
Displacement	108 Cu. In. (1.8L)
Bore	3.19" (81 mm)
Stroke	3.37" (85.5 mm)
Compression Ratio	9.5:1
Fuel System	PFI

Horsepower @ RPM (2) 115 @ 5600
 Torque Ft. Lbs. @ RPM 115 @ 2800

- (1) - Horsepower for California models is 100 @ 5800.
 (2) - Horsepower For California Model Is 110 @ 5600.

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS SPECIFICATIONS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS TABLE

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0008-.0087 (.020-.221)
Wear Limit	.0118 (.300)
Maximum Runout	.0002 (.005)
Main Bearings	
Journal Diameter	
Size Mark "0"	1.8895-1.8898 (47.994-48.000)
Size Mark "1"	1.8893-1.8895 (47.988-47.994)
Size Mark "2"	1.8891-1.8893 (47.982-47.988)
Journal Out-Of-Round	.0008 (.020)
Journal Taper	.0002 (.005)
Oil Clearance	.0006-.0013 (.015-.033)
Connecting Rod Bearings	
Journal Diameter	
1.6L	1.5742-1.5748 (39.985-39.999)
1.8L	1.8892-1.8898 (47.985-48.000)
Journal Out-Of-Round	.0002 (.005)
Journal Taper	.0002 (.005)
Oil Clearance	
Standard	.0008-.0020 (.020-.051)
Wear Limit	.0031 (.078)

CONNECTING RODS SPECIFICATIONS

CONNECTING RODS TABLE

Application	In. (mm)
Minimum Bolt Diameter	
(1.6L)	.3386 (8.60)
(1.8L)	.2760 (7.00)
Maximum Bend	.002 Per 3.94 (.050 Per 100.1)
Maximum Twist	.002 Per 3.94 (.050 Per 100.1)
Side Play	
Standard	.006-.010 (.015-.250)
Wear Limit	.0118 (.300)

PISTONS, PINS & RINGS SPECIFICATIONS

PISTONS, PINS & RINGS TABLE

Application	In. (mm)
Pistons	
Oil Clearance	
Standard	.0033-.0041 (.085-.105)

Maximum	.....	.0051 (.13)
Diameter (1)		
Size Mark "1"	.....	3.1852-3.1856 (80.905-80.915)
Size Mark "2"	.....	3.1856-3.1860 (80.915-80.925)
Size Mark "3"	.....	3.1860-3.1864 (80.925-80.935)
Pins		
Diameter	.....	Information Is Not Available
Rod Fit	.....	Information Is Not Available
Rings		
No. 1		
End Gap		
Standard	.....	.010-.018 (.25-.45)
Wear Limit	.....	.042 (1.07)
Side Clearance	.....	.0018-.0035 (.045-.090)
No. 2		
End Gap		
Standard	.....	.014-.020 (.35-.50)
Wear Limit	.....	.0472 (1.20)
Side Clearance	.....	.0012-.0028 (.030-.071)
No. 3 (Oil)		
End Gap		
Standard	.....	.006-.018 (.15-.45)
Wear Limit	.....	.041 (1.05)

(1) - Piston diameter is determined by numerical size mark on top of piston. See Fig. 22.

CYLINDER BLOCK SPECIFICATIONS

CYLINDER BLOCK TABLE

Application	In. (mm)
Cylinder Bore	
Standard Diameter (1)	
Size Mark "1"	 3.1890-3.1894 (81.001-81.010)
Size Mark "2"	 3.1894-3.1898 (81.010-81.020)
Size Mark "3"	 3.1898-3.1902 (81.020-81.030)
Cylinder Bore Limit	 3.2177 (81.73)
Maximum Taper & Out-Of-Round	004 (.101)
Maximum Deck Warpage	002 (.05)

(1) - Cylinder bore diameter is determined by numerical size mark on deck surface. See Fig. 23.

VALVES & VALVE SPRINGS SPECIFICATIONS

VALVES & VALVE SPRINGS TABLE

Application	Specification
Exhaust Valves	
Face Angle	 45 °
Minimum Margin	020" (.50 mm)
Overall Length (Min)	 3.4390 (87.35)
Stem Diameter	2348-.2354" (5.96-5.98 mm)
Intake Valves	
Face Angle	 45 °
Minimum Margin	020" (.50 mm)
Overall Length (Min)	 3.4232 (86.95)
Stem Diameter	2350-.2356" (5.969-5.985 mm)

Valve Springs	
Free Length	1.518" (38.57 mm)
Out-Of-Square	.079" (2.0 mm)
Lbs. @ In. (kg @ mm)	
Pressure	
Valve Closed	37.3 @ 1.25 (16.9 @ 31.7)
Valve Open	Information Is Not Available

CYLINDER HEAD SPECIFICATIONS

CYLINDER HEAD TABLE

Application	Specification
Maximum Warpage	
Cylinder Head Surface	.002" (.05 mm)
Manifold Surfaces	.004" (.10 mm)
Intake & Exhaust	
Cylinder Head Valve	
Guide Bore (Max)	(1) .4341" (11.026 mm)
Valve Seats	
Seat Angle	45°
Seat Contact Width	.039-.055" (1.0-1.4 mm)
Valve Guide I.D.	.2366-.2374" (6.010-6.029 mm)
Valve Guide Protrusion	.500-.516" (12.70-13.11 mm)
Intake	
Valve Stem-To-Guide Oil Clearance	
Standard	.0010-.0024" (.025-.061 mm)
Wear Limit	.003" (.08 mm)
Exhaust	
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026" (.030-.066 mm)
Wear Limit	.004" (.10 mm)
(1) - If diameter exceeds specification, cylinder head must be machined for oversized valve guide.	

CAMSHAFT SPECIFICATIONS

CAMSHAFT TABLE

Application	In. (mm)
Gear Backlash (Max.)	.0188 (.30)
Exhaust Camshaft	
End Play	
Standard	.0014-.0035 (.035-.090)
Wear Limit	.004 (.10)
Journal Diameter	
No. 1	.9822-.9829 (24.949-24.965)
Others	.9035-.9041 (22.949-22.965)
Journal Oil Clearance	
Standard	.0014-.0028 (.035-.072)
Wear Limit	.004 (.10)
Lobe Height	
Standard	1.6520-1.6560 (41.960-41.060)
Minimum	1.6358 (41.55)
Intake Camshaft	
End Play	
Standard	.0012-.0033 (.030-.084)

Wear Limit	.004 (.10)
Journal Diameter	
All	.9035-.9041 (22.949-22.965)
Journal Oil Clearance	
Standard	.0014-.0028 (.035-.072)
Wear Limit	.004 (.10)
Lobe Height	
Standard	1.6450-1.6539 (41.910-42.010)
Minimum	1.6338 (41.50)

VALVE LIFTERS SPECIFICATIONS

VALVE LIFTERS TABLE

Application	In. (mm)
Bore Diameter	1.2205-1.2215 (31.000-31.025)
Lifter Diameter	1.2191-1.2195 (30.966-30.976)
Oil Clearance	
Standard	.0009-.0023 (.024-.059)
Maximum	.003 (.07)